TACAN (GROUND)
TRANSPONDER AN/GRN-9D

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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Ministry of Defence

FOR USE IN THE

ROYAL AIR FORCE

Prepared by the Procurement Executive, Ministry of Defence

PREFACE

This 2nd Edition of AP 116C-0701-1A6A supersedes the original (1st) Edition. (The latter was originally NAVSHIPS 93881(A)).

This publication refers to those models of the GRN-9D manufactured by ITT, and the associated special-to-type test equipment housed in the Power Supply Rack - OA1537/GRN-9A. A further model of the GRN-9D manufactured by the National Radio Company differs from the ITT version in that it has a non-temperature-controlled spectrum filter in the Control Duplexer C-2226A/GRN-9, (and other minor variations), and the original special-to-type test equipment has been superseded by the Test Monitor Control Rack, MM-TMC-212A. This publication has been amended to include details of these modifications, and later equipments.

Between June 1973 and Jan 1977, further changes were introduced or are scheduled for general incorporation. These include (1) rationalization of individual drawer units for complete interchangeability between URN-3A and GRN-9D, and (2) incorporation of a non-temperature-controlled single-section dual-mode cavity in place of the previous twin-cavity spectrum filter in the Control Duplexer C-2226/GRN-9, and (3) phasing out of service of the Mechanical Keyer Sub-assembly in the Coder Indicator KY-382/GRN-9D, and its replacement by a solid-state Keyer Unit. These changes are dealt with in the new Section 8 to this work.

Where a fully updated equipment is being serviced, reference to Section 8 should be made. The new section is issued as Amendment List No.1. to the main publication.

LIST OF ASSOCIATED PUBLICATIONS

AP 116C-0701-1B6B	TACAN (Ground) Transponder AN/GRN-9D
AP 116C-0702-1A6A Series	TACAN (Ground) Test Monitor Control Group
AP 116C-0707-16	TACAN (Surface) Aerial and Control System
AP 116C-0709-1, 10	TACAN Ground Systems
AP 116C-0712-16,10	Telotel

LETHAL WARNING

HIGH VOLTAGE HIGH VOLTAGE

HIGH VOLTAGES EXIST IN THIS EQUIPMENT AND DUE PRECAUTIONS SHOULD BE TAKEN. SEE ALSO SECTION 8, CHAP 2, PARA 22 REGARDING THE UPDATED TRANSPONDER INDICATOR DRAWER.

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MODIFICATIONS SUMMARY
(completely revised)

These modifications are included in Section 8. The information given in Section 8 supplements and updates earlier sections of this book during the period of transition, when transponders in various states of modification may exist together. Modifications with no electrical significance are omitted here but can be found in the topic 2 publication.

Mod No.	Leaflet No.	Strike-off No.	Brief Description	Unit or Sub-unit affected.
A3375	B9	3	E.H.T. Protection Monitor point.	HV Power Supply
A3825	B11	3	GRN-9D/URN-3A Interchangeability. Fitting of R.F. Cable.	Amp-Mod drawer
A4295	B15	3	TMC/Non-TMC switch S1109.	Control Duplexer
A4299	B16	3	TMC/Non-TMC switch S1602	LV Power Supply
A3831	B22	2	GRN-9D/URN-3A Interchangeability	Coder-Indicator
A4838 A4837	B25) B27)	4	New cavity (High or Low-band)	Control Duplexer
A4620	B28	3	Protection resistor R1475	Freq.Mult.Osc.
A6364	B31	4	Electronic Keyer Unit	Coder-Indicator
A6368	B32	4	Installation of VORTAC switching cables.	Cabinet,Receiver CY-3163/GRN-9D
A6726	B33	5	Resistor R1919 Increased rating	HV Power Supply
A7031	B34	3	Change of valve types	Freq.Mult.Osc. Osc. Sub. Assy. HB/LB
B0790	B35	4	Klystron filament supply resistor.	Amp-Mod drawer

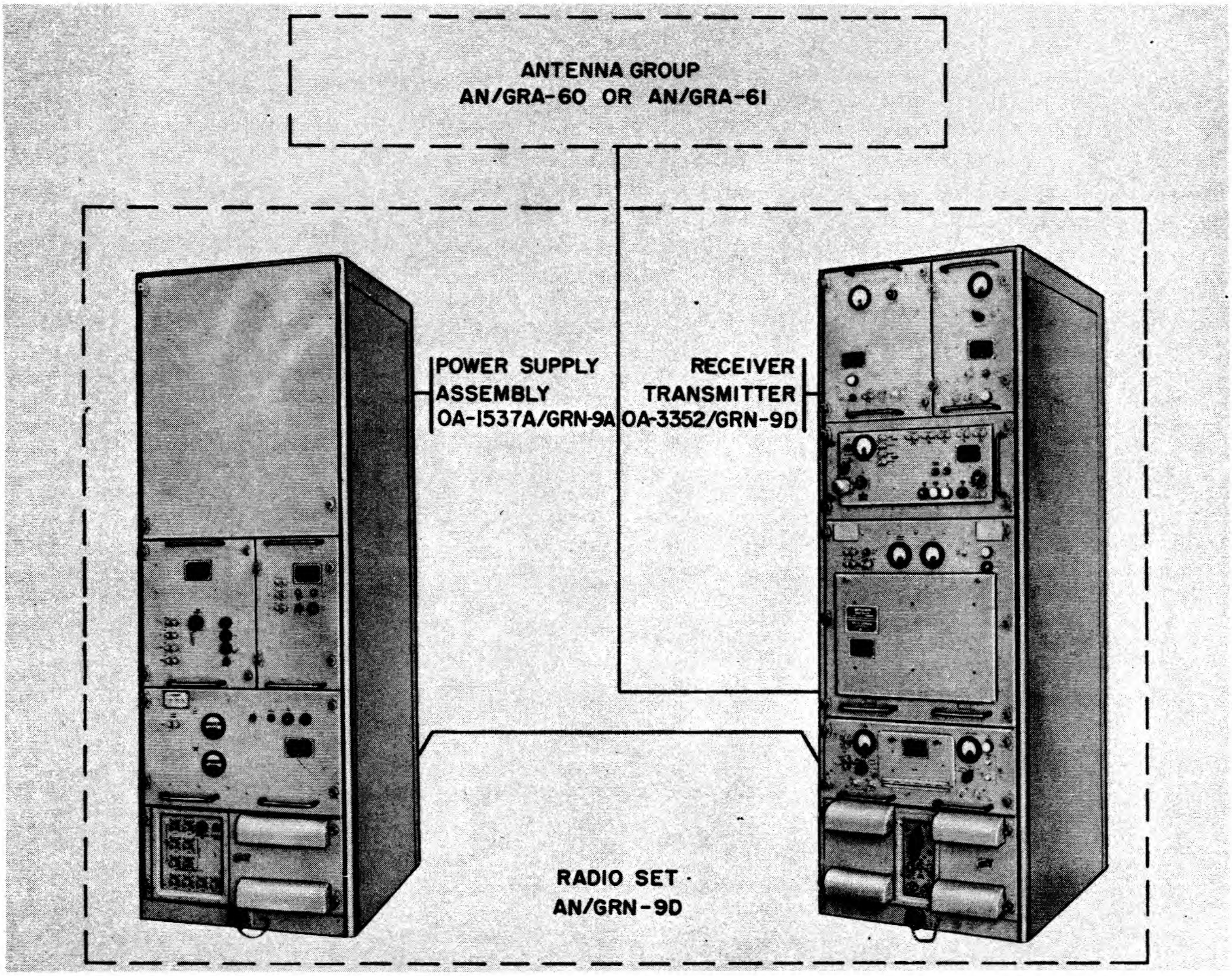


Figure 1-1. Radio Beacon, Using Radio Set AN/GRN-9D and Antenna Group AN/GRA-60 or AN/GRA-61

SECTION 1

GENERAL INFORMATION

1-1 INTRODUCTION.

This technical manual provides the general description, theory of operation, and instructions for the installation, operation, and maintenance of Radio Set AN/GRN-9D (see figure 1-1 and table 1-1) constituting a portion of the shore-based installation of a tactical air communication and navigation (TACAN) system.

1-2. FUNCTIONAL DESCRIPTION

Radio Set AN/GRN-9D is a shore-based radio set intended for use with Antenna Group AN/GRA-60 or AN/GRA-61. The radio set and the antenna group together function as a radio beacon that provides navigational information for aircraft within a 200-mile radius of the radio beacon. The radio beacon is part of TACAN. Each beacon installation consists of a receiver-transmitter group, a power supply assembly, and an antenna group.

The signals transmitted by the radio beacon provide aircraft equipped with Radio Set AN/ARN-21 with the distance and bearing information needed to determine their positions.

The AN/ARN-21 transmitter in the aircraft requests distance information by sending out interrogation signals with a repetition pattern peculiar to that transmitter. Reception of these distance interrogations at the radio beacon causes the transmission of a series of replies having the same pattern. The aircraft receives these replies along with other replies emitted by the beacon in response to interrogations from other aircraft. The AN/ARN-21 then picks out its own reply by comparing the reply pulse patterns with that of its own transmitter. Distance is determined by measuring the total time elapsed between the initial transmission of the distance interrogation pulse pair and receipt of the corresponding radio beacon reply pulse pair, and translating this time into miles.

The radio beacon transmits bearing information by rotating a lobed antenna radiation pattern through 360 degrees and then transmitting omni-directional bursts of reference pulse pairs at the instant that the antenna radiation pattern is in certain reference positions. The aircraft obtains its bearing by noting the position of the antenna pattern, as determined by the relative signal strength at the time of the reference burst.

Each of the information elements supplied by the radio beacon is analyzed briefly in the following paragraphs.

a. BEACON IDENTIFICATION.–Every 37.5 seconds, the radio beacon transmits its identifying call in International Morse Code; this enables the aircraft to determine the radio beacon with which it is in contact. The identification signal originates as a 1350-cps tone signal and is then converted into a series of coded pulses that are inserted into the radio beacon output pulse train. These pulses are received by the airborne radio set and converted back into a coded 1350-cps tone signal that is audible to the pilot. Because it is essential that the average output pulse rate of the radio beacon be maintained during transmission of all signal elements, the identification signal is transmitted at the rate of 2700 pulse pairs per second. Each cycle of the 1350-cps tone signal initiates a pair of pulses spaced 100 microseconds apart. Each pulse of these pairs is then further encoded into pulse pairs having 12-microsecond spacing between pulses. A mechanical keying device in the radio beacon keys the identification tone pulses in and out of the output pulse train. For each dot, the identification tone pulses are transmitted for 0.125 second; for each dash, the identification pulses are transmitted for 0.375 second. During transmission of these dots and dashes, the transmission of distance information is interrupted, but the reception of distance information by the aircraft is not adversely affected. Bearing reference bursts, which are transmitted 135 times per second as a short group of coded pulses, interrupt the identification tone pulses in the output pulse train; because of their short duration however, they do not interrupt the audible signal received by the pilot.

b. DISTANCE INFORMATION.–Distance information originates in the aircraft as a series of randomly spaced pulse pairs. These pulse pairs are transmitted by the aircraft and are called the distance interrogation signal. Because the pulse pairs of this signal are randomly spaced, the distance interrogation signal from each aircraft will be different. The radio beacon receives distance interrogation signals from up to 100 aircraft and, after a delay of 50 microseconds, transmits all of these interrogation signals as part of the r-f output pulse train. The distance measuring circuits in each aircraft are capable of extracting from the series of pulses received those reply pulses that have the same random spacing as the pulses in the distance interrogation signal it transmitted. The time interval between transmission of interrogation pulses and reception of reply pulses is measured. After subtracting the 50-microsecond delay inserted by the radio beacon, the time required for the radio signals to travel from the aircraft to the radio beacon and back again is converted into distance (nautical miles). Distance information appears as a direct-reading meter indication to the pilot.

c. BEARING INFORMATION. —The bearing information supplied by the radio beacon is originated in the antenna system of the radio beacon. Bearing information consists of four components, each of which is described in this section and more thoroughly described in Section 4.

(1) 15-CPS AMPLITUDE MODULATION. —The r-f output of the transmitter portion of the radio beacon consists of a series of pulse pairs that have an average repetition rate of 3600 pulse pairs per second. The amplitude of these pulses is constant at the output of the transmitter. Therefore, the average carrier level of the r-f signal fed to the central array of the antenna is constant. A parasitic element is mounted on a rotatable cylinder that has the central array at its center of rotation. By rotating the parasitic element about the central array at the rate of 15 rps, the signal is modulated in amplitude at the rate of 15 cps. The phase of the 15-cps amplitude-modulation signal, with respect to reference burst received by each aircraft, depends on the bearing of the aircraft relative to the beacon.

(2) 15-CPS REFERENCE BURSTS. —A burst of 12 pulse pairs spaced 30 microseconds apart is transmitted 15 times per second. This pulse group is known as the 15-cps reference burst or north reference burst. It serves as a timing point from which the phase of the 15-cps amplitude-modulation of the output pulse train may be measured by the airborne radio set. The 15-cps modulation and 15-cps reference burst provide sufficient information to determine the bearing of an aircraft relative to the radio beacon within a 40-degree sector. The timing of the 15-cps reference burst is determined by trigger pulses initiated by the antenna. When the main lobe of the 15-cps modulation signal is directed due east, a 15-cps reference burst is transmitted.

(3) 135-CPS AMPLITUDE MODULATION. — Nine parasitic elements are mounted on a rotatable cylinder that has the central array at its center of rotation. As this cylinder is rotated about the central array, the amplitude of the r-f signal is modulated at a rate of 135 cps. The cylinder containing the 135-cps modulating element rotates as a unit with the cylinder containing the 15-cps modulating element. Therefore, the phase of the 15-cps modulation and the phase of the 135-cps modulation are locked relative to each other. The phase of the 135-cps signal with respect to the 135-cps reference burst received by an aircraft is dependent on the bearing of the aircraft relative to the beacon.

(4) 135-CPS REFERENCE BURSTS. —A burst of six pulse pairs spaced 24 microseconds apart is transmitted 120 times per second. This pulse group is known as the 135-cps reference burst or auxiliary reference burst. One 135-cps reference burst occurs for each 40 degrees of antenna cylinder rotation except for that 40-degree point which coincides with the transmission of the 15-cps reference burst. Therefore, eight 135-cps reference bursts are transmitted for each rotation of the antenna cylinder. The 135-cps reference bursts serve as a timing point from which the airborne radio set measures the phase of the 135-cps amplitude modulation of the received signal. After the bearing of the aircraft has been determined to be within a certain 40-degree sector by means of the 15-cps modulation and 15-cps reference bursts, the 135-cps modulation and 135-cps reference bursts provide sufficient information to localize the bearing of the aircraft to within plus or ± 1 degree.

1-3. FACTORY OR FIELD CHANGES.

All units of the AN/GRN-9D are supplied, on initial delivery, without factory or field changes.

1-4. QUICK REFERENCE DATA.

a. NOMENCLATURE. – The official nomenclature for units of Radio Set AN/GRN-9D is as follows:

(1) Receiver-Transmitter OA-3352/GRN-9D contains the following units:

(a) Coder-Indicator KY-382/GRN-9D

(b) Radio Receiver R-824/URN

c. CONTRACTORS. – (i) ITT Federal Laboratories formerly ITT Federal Division, a division of International Telephone and Telegraph Corporation, New Jersey and (ii) National Company Incorporated Melrose, Mass. For the purpose of this manual, the models of the individual manufacturers will be designated ITT and National respectively.

(d) Amplifier-Modulator AM-1701 URN

(e) Frequency Multiplier-Oscillator CV-1171/GRN-9D

(f) Cabinet CY-3163/GRN-9D

(2) Power Supply Assembly OA-1537A/GRN-9A contains the following units:

(a) Low Voltage Power Supply PP-1766 URN

(b) Medium Voltage Power Supply PP-1765 URN

(c) High Voltage Power Supply PP-1763 URN

(d) Cabinet CY-3164 GRN-9D

b. CONTRACT NUMBER. – The contract number is NObsr 81170, dated 26 April 1960.

c. CONTRACTOR. – ITT Federal Laboratories, formerly ITT Federal Division, a division of International Telephone and Corporation. Clifton, New Jersey is the contractor.

d. COGNIZANT NAVAL INSPECTOR. – The cognizant Naval Inspector is: Inspector of Naval Material, Newark, New Jersey.

e. NUMBER OF PACKAGES INVOLVED. – Eighteen packages are involved, including equipment spares.

f. TOTAL CUBIC CONTENTS.

(1) Crated: approximately 460 cubic feet. including equipment spares.

(2) Uncrated: approximately 250 cubic feet, not including equipment spares.

g. TOTAL WEIGHT.

(1) Crated: approximately 6500 pounds, including equipment spares.

(2) Uncrated: approximately 4000 pounds, not including equipment spares.

h. RADIO BEACON DUTY CYCLE. —The term duty cycle is expressed here as percentage of actual transmitting time per second.

(1) The useful signal pulse-pair contents, per second of operation of the radio beacon, is variable, consisting of:

(a) 180 north reference burst pulse pairs per second (12 pulse pairs occurring 15 times per second).

(b) 720 auxiliary (135 cps) reference burst pulse pairs per second (6 pulse pairs occurring 120 times per second).

(c) Identify tone pulses occurring at a rate of 2700 pulse pairs per second when keyed. The actual number of code pulse pairs present depends, however, on the particular code assigned to the radio beacon.

(d) Distance measuring interrogation pulse pairs, the number of which depends on the number of aircraft interrogating the radio beacon at any particular time. The maximum, for 100 aircraft interrogating the beacon simultaneously, is 2700 pulse pairs per second.

(2) To sustain the sine-wave modulation envelope of the transmitted r-f energy, it is necessary to maintain the total number of pulse pairs transmitted during each second constant. The radio beacon maintains a constant duty cycle by introducing noise pulses into the signal train in a number sufficient to bring the total number of pulse pairs in the signal pulse train to 3600 pulse pairs per second. The noise pulses thus introduced into the signal are referred to as squitter. Obviously, since the burst pulse pairs occur at a constant rate, and the identification code pulse pairs also occur at a constant rate, the number of squitter pulses in the signal train varies inversely with the number of aircraft interrogating the radio beacon at any given time. Thus, the number of squitter pulses is maximum when no aircraft is interrogating the beacon, and is minimum when the maximum number of 100 aircraft are interrogating the radio beacon at any one time. When the number of aircraft interrogating the radio beacon exceeds 100 (that is, when the total number of distance measuring interrogation pulse pairs exceeds the 2700 for which time is available), the excess number of pulse pairs is suppressed.

i. CHARACTERISTIC OF RADIO BEACON SIGNALS.

(1) All signals transmitted by the radio beacon are characterized by the fact that they consist of pulse pairs, with 12-microsecond spacing between the two pulses of the pair. The number of pulse pairs per second and the spacings between pulse pairs (the spacing between the leading edge of the first pulse of one pair and the leading edge of the first pulse of the next pair) depend on the particular signal element and are characteristic of that particular signal element. However, it is the spacing of 12 microseconds between the pulses of a pair that provides the AN/ARN-21 of the aircraft with the means for distinguishing between the signal pulses from the radio beacon and other pulses present on the received radio frequency.

(2) The characteristics of the signal elements as transmitted by the radio beacon are as follows:

(a) NORTH REFERENCE BURST. —The north reference burst consists of 12 pulse pairs. There is 12-microsecond spacing between pulses of a pair and a 30-microsecond spacing between pulse pairs, occurring 15 times per second.

(b) AUXILIARY REFERENCE BURST. —The auxiliary reference burst consists of six pulse pairs. There is 12-microsecond spacing between pulses of a pair and 24 microseconds between pulse pairs occurring 120 times per second at the rate of 135 cps.

(c) IDENTIFICATION CODE. —The identification code consists of a train of 2700 pulse pairs per second. There is 12-microsecond spacing between pulses of a pair occurring at 1350-cps double-pulsed rate (100 microseconds between double-pulsed pairs), keyed by a coding wheel built into the beacon. The tone pulses are synchronized to the reference bursts.

(d) DISTANCE MEASURING INTERROGATIONS. —The distance measuring interrogations consist of pulse pairs with 12-microsecond spacing between pulses of the pair; spacing between pulse pairs depending on the pulse-repetition rate peculiar to the interrogating aircraft.

(e) SQUITTER PULSES. —Squitter pulses consist of pulse pairs with 12-microsecond spacing between pulses of the pair. The number of pulse pairs per second depends on the number of interrogations being received by the beacon, with a minimum spacing of 40 microseconds between pulse pairs.

j. HIGH-BAND AND LOW-BAND RADIO BEACON FREQUENCY ALLOCATION.

(1) The radio beacon operates in the frequency range between 962 and 1213 mc. This frequency range is divided into two transmitting bands and one receiving band as follows:

(a) The band between 962 and 1024 mc (low band) is used for transmission from the radio beacon.

(b) The band between 1025 and 1150 mc (low and high band) is used for reception by the radio beacon.

(c) The band between 1151 and 1213 mc (high band) is also used for transmission from the radio beacon.

(2) In any one radio beacon, the receiver and transmitter operate at frequencies 63 mc apart; thus, a beacon transmitting at 962 mc receives at 1025 mc. Similarly, a beacon transmitting at 1024 megacycles receives at 1087 megacycles, and a transmitter operating at 1151 megacycles receives at 1088 mc. Finally, a transmitter operating at 1213 mc receives at 1150 mc. These frequencies serve to illustrate how the end frequencies for each band are used and show how the total frequency range of the radio beacon is divided into low band and high band. Thus:

(a) A radio beacon operating in the low band transmits at a frequency between 962 and 1024 mc and receives at a frequency 63 mc above the transmitter frequency. This receiver frequency falls in the band of 1025 and 1087 mc.

(b) Similarly, a radio beacon transmitting in the high band between 1151 and 1213 mc receives at a frequency 63 mc below the transmitter frequency. In this case, the receiver frequency falls in the band between 1088 and 1150 mc.

(3) Radio beacons are provided to operate either in the high band or in the low band, depending on the antenna used. The high-band and the low-band antennas differ in size, but are otherwise basically similar.

k. FREQUENCY STABILITY.

(1) Transmitter frequency stability is ±25 kc (over the operating range).

(2) Receiver frequency stability is ±50 kc (over the operating range).

l. RECEIVER SELECTIVITY. —The receiver rejects properly coded interrogations on adjacent channels 80 db above the threshold level of a properly coded interrogation in the pass band. Signals arriving at intermediate frequency are suppressed 80 db. All other spurious responses within the 960- to 1215-mc band are suppressed 75 db. Low-pass filters are provided for the suppression of radar interference from 1650 to 10,500 mc. The suppression will be at least 60 db.

m. RECEIVER BANDWIDTH. —The receiver bandwidth is such that the triggering level does not deteriorate by more than 3 db when its total frequency drift is added directly to an incoming frequency drift of ±70 kc.

n. TRIGGERING LEVEL. —Receiver triggering level (triggering level is the sensitivity level of the receiver at which a signal will cause the transmitter to fire 60 percent of the time in the absence of reference and identity pulses) is properly coded interrogation 125 db below 1 watt measured at the input connector on the receiver chassis; it is sufficient to trigger the transmitter under a condition of no load. A properly coded interrogation 124 db below 1 watt measured at the same point is sufficient to trigger the transmitter under a condition of full load. The total number of pulses out of the receiver is 2700 ±90 pulses for conditions of normal loading or for a 50-percent overload.

o. RECEIVER ECHO SUPPRESSION. —Properly spaced pulse pairs do not trigger the transmitter more than 20 percent of the time for any signal 70 db below 1 watt or stronger if the amplitude of the second pulse of the pair is at least 25 db below the amplitude of the first pulse.

p. RECEIVER RECOVERY TIME. —After the second pulse of a correctly coded interrogation which results in decoding, the receiver becomes deactivated. Provisions are made for adjusting the dead time which follows decoding from 20 to 65 microseconds.

q. RECEIVER INTERMEDIATE FREQUENCY. — The receiver intermediate frequency is 63 mc.

r. RESPONSE DELAY. —The radio beacon response delay is 50 ±0.25 microseconds measured from the leading edge of the second incoming pulse to the leading edge of the second reply pulse measured at a standard signal strength of 50 db above threshold.

s. INTERROGATION PULSE REPETITION FREQUENCY (PRF). —The average prf of the pulse pairs which this equipment receives shall be 24 cps from each of 95 interrogating sources. In addition, the equipment receives interrogations at a prf of 150 cps from each of five other sources. The equipment shall be considered to be operating at full load when receiving interrogations from both prf sources simultaneously. Under full load conditions and in absence of identification keying, the transmitter shall reply to at least 78 percent of the interrogation.

t. TRAFFIC CAPACITY. —The maximum traffic capacity is 100 aircraft.

u. TRANSMITTER PULSE COUNT LIMITING.— From zero to full load, pulse count limiting is effective to maintain the average number of transmitter pulses constant to within ±2.5 percent of its nominal value.

v. CRYSTAL FREQUENCIES. —The equipment is adjustable to any one of 126 crystal controlled frequencies in the range listed in paragraph 1-4j.

w. CHANNEL FREQUENCY SEPARATION. — There is a channel frequency separation of 63 mc between nominal interrogation frequency and nominal reply frequency for all operating channels. There is a channel frequency spacing of 1 mc.

x. MODULATION. —The modulation depth in the horizon for each modulation frequency is 21±9 percent at the respective frequency bands. The modulation frequencies produced by the antenna are 15 cps and 135 cps (the ninth harmonic of 15 cps). The horizontal antenna pattern is a scalloped cardioid. Pulse type transmission at a rate of 3600 pulse pairs per second (includes reference groups and distance replies).

y. TRANSMITTER IDENTIFICATION.—Identification is provided by switching the transmitter from pulse pairs of random spacing to pulse pairs which occur at a fixed frequency rate of 1350 cps during the keydown position. The first pulse of the identity occurs 740 ±50 microseconds after the first pulse of each auxiliary reference group.

z. TRANSMITTER REFERENCE PULSES (FOR BEARING INFORMATION).—A total of 120 code groups are transmitted at a rate of 135 cps. Each code group consists of six pulse pairs spaced 24 microseconds apart. Fifteen code groups per second are transmitted at a rate of 15 cps. Each of these code groups consist of 12 pulse pairs spaced 30 microseconds apart.

aa. SQUITTER RATE.—Squitter rate is the rate of random firing of the transmitter in the absence of interrogations. The total number of pulses out of the receiver is 2700 ±90 for normal operation.

ab. TRANSMITTER POWER OUTPUT.—The power output of the transmitter is 7 kw minimum.

ac. TRANSMITTER R-F DUTY CYCLE.—Under normal operation at 3600 pulse pairs per second, the transmitter r-f duty cycle is ±2.5 percent.

ad. PULSE SPECTRUM.—The energy level contained in an 0.5-megacycle bandwidth, centered about a frequency ±0.8 mc from the nominal frequency, is 60 db below the energy level contained in an 0.5-mc bandwidth centered about the nominal frequency. The energy level contained in an 0.5-mc bandwidth centered about a frequency ±2.0 mc from the nominal frequency is more than 65 db below the energy level contained in an 0.5-mc bandwidth centered about the nominal frequency.

ae. POWER INPUT REQUIREMENTS.—All incoming primary power is brought to the input terminals of Receiver-Transmitter OA-3352/GRN-9D and is used either within the receiver-transmitter group or redistributed to Power Supply Assembly OA-1537/GRN-9A, associated antenna group, and the convenience outlets on each of these units.

The receiver-transmitter group and the power supply assembly (less convenience outlets) have a 208-volt, 4-wire, 3-phase, 60-cps, 6.8 kw, 7.2-kva power consumption with an 0.9 power factor and a maximum current of 25 amperes per phase.

1-5. EQUIPMENT LISTS

a. EQUIPMENT SUPPLIED.

The major components of the radio set are contained in two main groups, the receiver-transmitter group and the power supply assembly. The complete equipment supplied by the manufacturer is listed in table 1-1, and illustrated in figures 1-2 and 1-3.

NOTE

Space is provided in the power supply assembly of the radio set for the test equipment listed in table 1-2 Switch-Test Adapter SA-420/URN-3 is mounted external to the radio set. The test equipment, referred to as built-in test equipment, is to be installed by the using activity after delivery of the beacon power supply assembly from the manufacturer.

b. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED.—Additional equipment required for the operation of the radio set, but not supplied by the manufacturer under this contract, is listed in table 1-2.

c. SHIPPING DATA.—The dimensions, volumes, and weights of the equipment, packed and ready for shipment, are listed in table 1-3.

d. EQUIPMENT SIMILARITIES.—The Radio Set AN/GRN-9D, produced by the National Co. Inc., is similar to both the AN/GRN-9A and AN/GRN-9D manufactured by ITT Federal Laboratories. There are, however, certain differences between the models; mainly in the transmitter output power, the type of antenna group used, the primary power supply requirements and the power distribution circuits. Where differences occur between the ITT and National models, reference is made to them in the text, schematics and wiring diagrams.

(1) RECEIVER-TRANSMITTER OA-3352/GRN-9D SIMILARITIES.—The radio receiver and the amplifier-modulator in the AN/GRN-9D are identical to those in the AN/GRN-9A.

(2) RECEIVER-TRANSMITTER OA-3352/GRN-9D DIFFERENCES

(a) The coder-indicator in AN/GRN-9D is similar to that in the AN/GRN-9A, except that the magnetic variation unit, the METER SELECTOR switch, the ANTENNA POSITION SELECTOR switch, and the SET TO MAGNETIC VARIATION dial, have been deleted. Also, the identification tone keyer assembly, has been slightly modified. The wiring of the unit has been changed to incorporate these modifications.

(b) The differences which occur between the various models of Control Duplexer are:

1. ITT Federal Laboratories - The Control Duplexer in the AN/GRN-9D is similar to that in AN/GRN-9A with the following exceptions. The high-and low-band filters in AN/GRN-9D are of the sealed, gas-filled, temperature-stabilized type. The desiccant chamber and flexible tubing have been deleted. Temperature stability of the filters in the AN/GRN-9D is achieved by use of a thermostatically-controlled heating element housed in the filter assembly. A CAVITY HEATER ON lamp is provided on the front panel and indicates the operation of the heater element.

2. National Co. Inc. - The filters of the AN/GRN-9D Control Duplexer of this model are not temperature-stabilized although they are sealed and, as with the AN/GRN-9A (ITT), a desiccant chamber has been incorporated.

TABLE 1-1. RADIO SET AN/GRN-9D, EQUIPMENT SUPPLIED

QTY PER EQUIP.	QTY PER GROUP	NOMENCLATURE		OVERALL DIMENSIONS[1]			VOLUME[1]	WEIGHT[1]
		NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1		Receiver-Transmitter	OA-3352/GRN-9D	72	25	34-1/8	35.5	1126
	1	Coder-Indicator	KY-382/GRN-9D					
	1	Radio Receiver	R-824/URN					
	1	Control-Duplexer	C-2226A/GRN-9					
	1	Amplifier-Modulator	AM-1701/URN					
	1	Frequency Multiplier-Oscillator	CV-1171/GRN-9D					
	1	Cabinet	CY-3163/GRN-9D					
1		Power Supply Assembly	OA-1537A/GRN-9A	72	25	34-1/8	35.5	986
	1	High Voltage Power Supply	PP-1763/URN					
	1	Medium Voltage Power Supply	PP-1765/URN					
	1	Low Voltage Power Supply	PP-1766/URN					
	1	Cabinet	CY-3164/GRN-9D					
	1	Test Equipment Cable Harness						
2		Technical Manual	NAVSHIPS 93881(A)					
1		Performance Standards Sheet	NAVSHIPS 93881.32					
1		Maintenance Standards	NAVSHIPS 93881.42					

[1]Dimensions in inches, volume in cubic feet, and weight in pounds, unless otherwise stated.

3. The wiring of the units has been adjusted to suit the various differences.

(c) The frequency multiplier-oscillator in the AN/GRN-9D is similar to that in the AN/GRN-9A with the following exceptions:

1. Additional r-f shielding is incorporated in order to reduce the radiation of superfluous r-f energy.

2. The crystal oven assemblies used in the high-band and low-band r-f chassis have been slightly modified. The adjustable coil provided in the AN/GRN-9A crystal oven assembly has been deleted.

3. The wiring of this unit has been changed to incorporate these modifications.

(d) The cabinet in the AN/GRN-9D is similar to that in the AN/GRN-9A except that relay K902 and

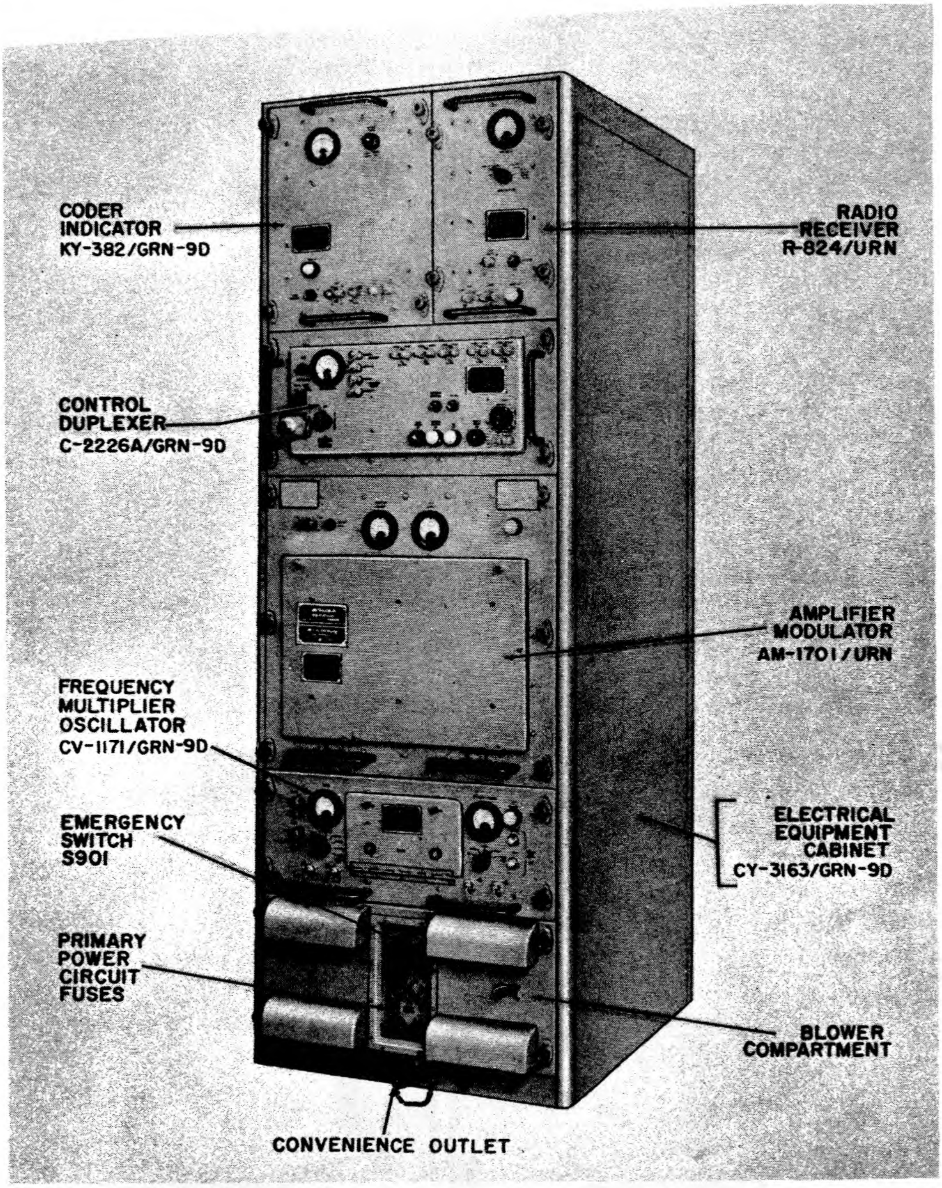


Figure 1-2. Receiver-Transmitter OA-3352/GRN-9D, Overall View

terminal board TB906 have been deleted, and the wiring has been extensively changed to incorporate the modifications in the receiver-transmitter group.

(3) POWER SUPPLY ASSEMBLY OA-1537A/GRN-9D SIMILARITIES. —The high voltage power supply, the medium voltage power supply, and the low voltage power supply in the AN/GRN-9D are identical to their counterparts in the AN/GRN-9A.

(4) POWER SUPPLY ASSEMBLY OA-1537A/GRN-9D DIFFERENCES. —The cabinet in the AN/GRN-9D is similar to that in the AN/GRN-9A except that the AN/GRN-9D cabinet has a switch to reduce the high voltage applied to the klystron during the performance of aging the klystron. The wiring of the AN/GRN-9D cabinet has been changed to reflect this modification.

e. ELECTRON TUBE COMPLEMENT. —The full complement of electron tubes used in the equipment is broken down in table 1-4 to show the number of each type used in each of the component units and also the total number of each type used in the equipment.

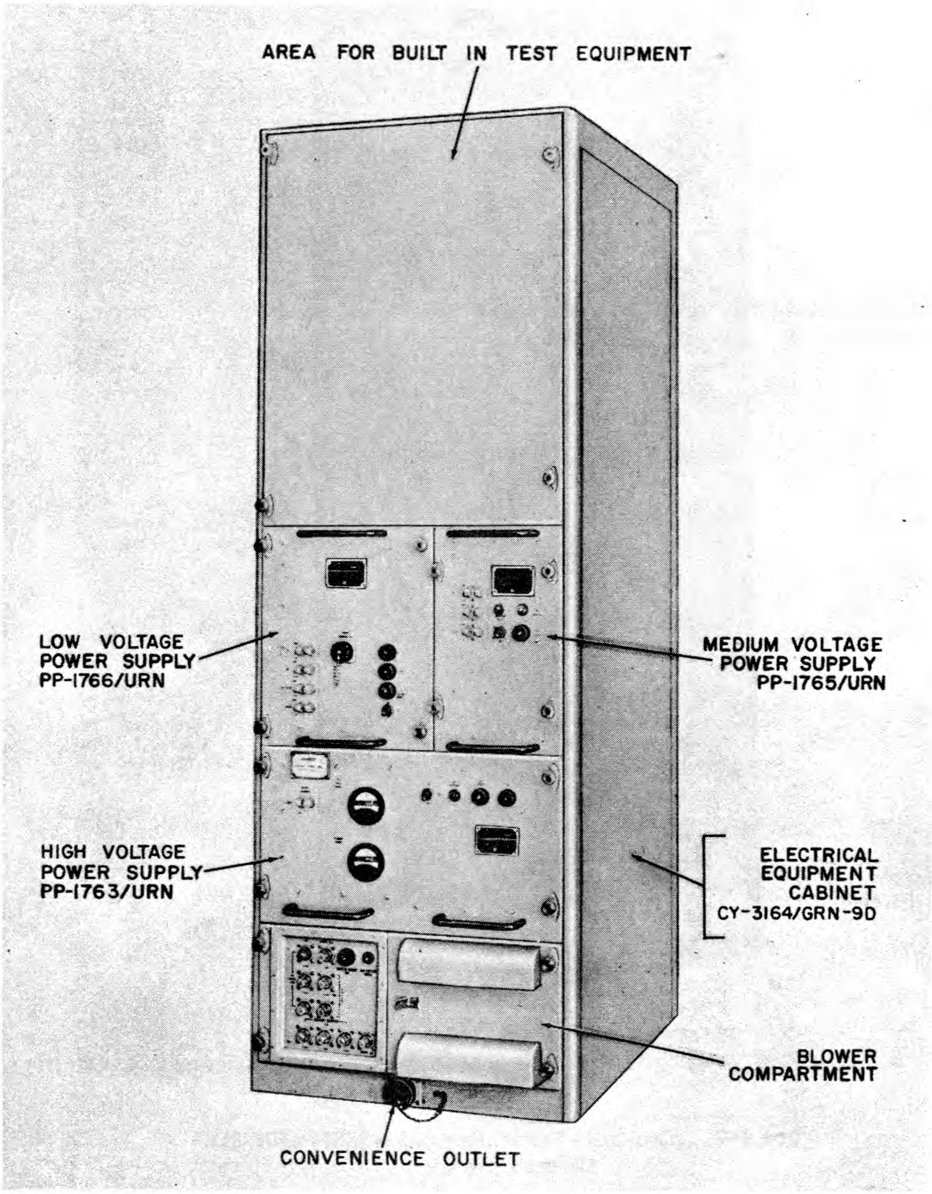


Figure 1-3. Power Supply Assembly OA-1537/GRN-9A, Overall View

TABLE 1-2. RADIO SET AN/GRN-9D, EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QTY PER EQUIP.	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
1	Power Meter-Pulse Counter	TS-891/URN-3	Performs power measurements, counts radio beacon squitter output pulses, and determines reply rate. Also checks receiver sensitivity.	Provides variable d-c source used to bias a diode in switch-test adapter and provides facilities for counting pulses.
1	Switch-Test Adapter	SA-420/URN-3	Performs power measurements.	Provides means of transferring radio beacon transmitter output power from antenna to dummy load and supplies detected signal to test equipment.
	Technical Manual	NAVSHIPS 92809		
1	Oscilloscope	OS-54/URN-3	Measures signal waveform amplitude and pulse width.	Provides timing markers and calibrating voltage to permit accurate measurements.
	Technical Manual	NAVSHIPS 92778		
1	Pulse Analyzer-Signal Generator	TS-890A/URN-3 or TS-890B/URN-3	Tests operation of radio beacon and analyzes radio beacon output signal.	Provides r-f carrier source and calibrated receiver for spectrum analysis of a signal.
	Technical Manual	NAVSHIPS 93231		
1	Pulse Sweep Generator	SG-121A/URN-3	Simulates pulse output of one or more airborne Radio Sets AN/ARN-21.	Provides facilities for generating pulsed pairs at controlled variable rate.
	Technical Manual	NAVSHIPS 92745		

TABLE 1-2. RADIO SET AN/GRN-9D, EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (cont)

QTY PER EQUIP.	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
1	Antenna Group	AN/GRA-60 or AN/GRA-61 or equivalent	Transmits r-f output signal of radio set, receive distance interrogation signals from aircraft, and modulates radio beacon r-f output. Provides facilities for transmitting r-f output of the radio set, modulating radio set r-f output so that envelope of r-f signal is modulated in amplitude at 15-cps and 135-cps rates, generating trigger pulses that time generation by radio set of bearing reference pulse groups, and receiving distance interrogation signals from aircraft equipped with AN/ARN-21 or equivalent.	Frequency range transmission: 962 to 1024 mc (low-band operation) or 1151 to 1213 mc (high-band operation) Frequency range reception: 1025 to 1087 mc (low-band operation) or 1088 to 1150 mc (high-band operation) Vswr: not more than 2 to 1 over the specified transmission band R-f power: 20-kw peak power with a duty cycle of 2 percent Antenna impedance: 50 ohms Polarization: vertical Horizontal pattern: scalloped cardioid rotated at 15 cps (900 rpm) Vertical pattern: maximum carrier energy is radiated above a plane perpendicular to axis of antenna
	Technical Manual	NAVSHIPS 94118		

TABLE 1-2a. RADIO SET AN/GRN-9D. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (AN/GRA-34)		
Qty per Equip.	NOMENCLATURE	EQUIPMENT CHARACTERISTICS
1	Antenna Transfer Switching Unit SA-544/GRA-34 Technical Manual: NAVSHIPS 93121(A)	In response to alarm or proper dialling signals, provides automatic switching of either of the TACAN transmitters r.f. output to one antenna group input; also provides a facility for manual switching. The unit incorporates dummy load facilities to permit maintenance tests to be performed on either or both transmitters under load conditions. The chassis also provides for manual switching of the antenna azimuth leads from either of the two transmitters. The unit incorporates, and supplants the SA-420/URN-3 Switch Test Adapter listed in TABLE 1-2.
1	Radio Set Transfer Control C2233/GRA-34 Technical Manual: NAVSHIPS 93121(A)	Provides for manual and automatic control, alarm indication, telephone facilities and simulation testing; also provides power for the entire transfer control chassis.
2	Radio Frequency Monitor MX-2229/GRA-34 Technical Manual: NAVSHIPS 92975(A)	Provides a continuous and complete check of all TACAN functions and provides an alarm signal, after a suitable delay, in the event of system malfunction.
1	Electrical Equipment Cabinet CY-2200/GRA-34 Technical Manual: NAVSHIPS 93121(A)	The four above-mentioned major components plus a fan are housed in this cabinet which provides interconnections between the components and facilities for interconnection to related units.
1	Remote Switching Control C2234/GRA-34 Technical Manual: NAVSHIPS 93121(A)	This unit contains alarm indicators, a standard navy telephone for communication with the local station and a telephone dial which effects the same functions as the telephone dial of the Radio Set Transfer Control Unit at the local station.

	TABLE 1-2b. RADIO SET AN/GRN-9D: EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (MM-TMC-212A) (This equipment supersedes that listed in TABLES 1-2 and 1-2a)	
Qty Per Equip.	NOMENCLATURE	EQUIPMENT CHARACTERISTICS
1	TACAN Transfer and Switching Unit MM-1602 Technical Manual: AP 116C-0702-1D6D	In response to an external command, the unit provides automatic transfer of TACAN beacons between antenna and dummy load and between beacon and test equipment. The unit also provides facilities for sampling the transmitter output signals and injection of interrogation signals. Manual switching is also provided in the event of automatic transfer failure.
1	Spectrum Analyzer/Test Generator MM-705 Technical Manual: AP 116C-0702-1H6H	The unit tests the operation of the radio beacon and analyzes the radio beacon output. The spectrum analyzer section provides the facility to measure the transmitted energy in each of six bands adjacent to the transponder transmitting frequency, as well as the on-channel energy. The test generator section provides (a) a suitable signal to use for aligning the IF stages of the beacon receiver and (b) the r.f. energy (at beacon receiver frequency) for testing and maintenance purposes.
1	Oscilloscope MM-504 Technical Manuals: AP 116C-0702-1J6J AP 116C-0702-1K6K	This unit enables inspection and measurement of of the amplitudes and pulse-widths of all signals associated with the GRN-9D and its associated test equipment.
1	Power Meter - Pulse Counter - Marker Generator MM-109 Technical Manual: AP 116C-0702-1G6G	This unit enables the following functions to be performed by the MM-TMC-212A. (a) Power Meter - measures the peak r.f. power output of the GRN-9D and its test equipment in the frequency range 960 to 1215MHz. The unit is used in conjunction with the Transfer and Switching Unit which, in this instance of its use, provides the necessary facilities for sampling the transmitter output signal and the interrogation signals. (b) Pulse Counter - measures the average repetition rates of all the pulse sources in the GRN-9D and its test equipment. (c) Marker Generator - provides precision time marker pulses for modulating the Y and Z axis of the MM-504 Oscilloscope. The markers are used for measurements of pulse width, pulse spacing, time intervals and frequencies.

TABLE 1-2b. RADIO SET AN/GRN-9D. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED (MM-TMC-212A) (cont)
(This equipment supersedes that listed in TABLES 1-2 and 1-2a)

Qty Per Equip.	NOMENCLATURE	EQUIPMENT CHARACTERISTICS
1	Transfer and State Transmission Unit (TELOTEL) and associated logic interface. Technical Manual:* AP 116C-0702-1L6L *Note. This manual also contains details of the central information centre.	On receiving an alarm signal (confirmed by both Transponder Monitors) of a parameter failure, the unit sends a command signal to the Transfer and Switching Unit thereby initiating a transfer of beacons between antenna and dummy load. The unit is also capable of accepting specific failure data from the monitors and other non-electronic parts of the system (e.g. frequency converter) and transmitting an indication of such a failure to a remote indicator. Facilities are provided whereby the unit can automatically call a central station remote from the installation and pass such failure data as it has received.
2	TACAN Transponder Monitor MM-209 Technical Manuals: AP 116C-0702-1E6E AP 116C-0702-1F6F	These units automatically provide, every 4 seconds, a detailed analysis of 13 TACAN transponder parameters and in the event of a failure of any one of them will register, after a preset time delay, an alarm indication. The particular parameter malfunction is retained as a memory indication. The units are interconnected such that a failure must be registered by both units before an alarm condition is signalled.
1	Electrical Equipment Cabinet MM-TMC-212A Technical Manuals: AP 116C-0702-1A6A AP 116C-0702-1B6B AP 116C-0702-1C6C	The seven above-mentioned major components plus two ventilation fans are housed in this cabinet, which provides interconnections between the components and facilities for interconnection to related units. The technical manuals listed cover the following aspects of the Electrical Equipment Cabinet and its associated units: (a) 1A6A - Installation Instructions (b) 1B6B - Overall servicing manual (c) 1C6C - Beacon Performance testing.

TABLE 1-3. RADIO SET AN/GRN-9D, SHIPPING DATA

BOX NO.[2]	NOMENCLATURE		OVERALL DIMENSIONS[1]			VOLUME[1]	WEIGHT[1]
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
	Receiver-Transmitter	OA-3352 GRN-9D	90	44	46	105	1935
	Power Supply Assembly	OA-1537A GRN-9A	90	44	46	105	1655
	Tube, Klystron	SAL-89	30	20	20	7	78
	Equipment Spares						

[1]Dimensions in inches, volume in cubic feet, and weight in pounds, unless otherwise stated.

[2]Box numbers have not been assigned.

TABLE 1-4. RADIO SET AN/GRN-9D, ELECTRON TUBE AND GERMANIUM DIODE COMPLEMENT

UNIT	NUMBER OF TUBES AND GERMANIUM DIODES OF TYPES INDICATED																												TOTAL
	1N21C	1N25	1N69	1N126	1N256	2C39A	5R4WGB	6AH6	6J4WA	6X4W	6V3A	12AT7WA	SAL89	829B	836	5651WA	5654/6AK5W	5670	5687WA	5725/6AS6W	5726/6AL5W	5814A	6005/6AW5W	6080WA	6293	6626/OA2WA	6627/OB2WA	8020	
Radio Receiver R-824/URN	2			5			1		1	1		3					8	3		2	3		1	1			2		33
Coder-Indicator KY-382/GRN-9D			6				1	1		1		7						5	3					1			1		26
Amplifier-Modulator AM-1701/URN					2								1			1	1		1										6
Frequency Multiplier-Oscillator CV-1171/GRN-9D		2	2			6			2		1						2	2	4			1			5				27
Low Voltage Power Supply PP-1766/URN							3					2		3		2													10
Medium Voltage Power Supply PP-1765/URN												1		5	2											5			13
High Voltage Power Supply PP-1763/URN																												6	6
Total Number of Each Type	2	2[1]	8	5	2	6	5	1	3	2	1	13	1	8	2	3	11	10	8	2	3	1	1	2	5	5	3	6	121

[1] Crystal detector assembly E1152, one of which is supplied with each radio set, contains one 1N25 diode.

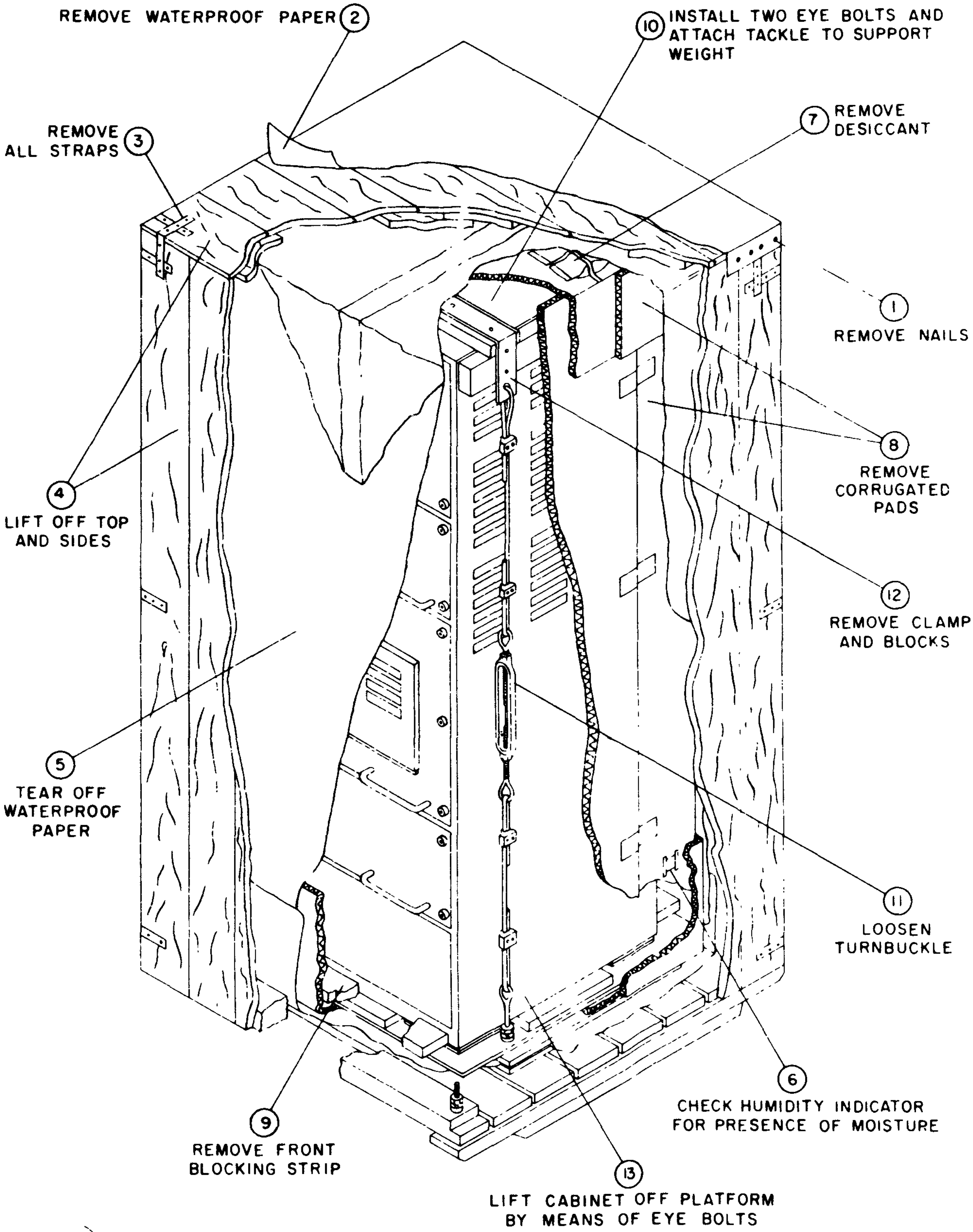


Figure 2-1. Receiver-Transmitter Group or Power Supply Assembly, Typical Unpacking Diagram

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

a. GENERAL. —The components and accessories of Radio Set AN/GRN-9D are packed in several crates. For a list of crates and packages constituting the complement of a radio set, refer to table 1-3. Before unpacking the equipment, determine the exact location for each major component; then bring the crate containing the component to the immediate vicinity of the location selected for it. Unpack the equipment, one component at a time, in the order in which the major components are to be installed.

b. TYPICAL UNPACKING PROCEDURE. —A typical component unpacking diagram is shown in figure 2-1. Unpack the equipment in accordance with the procedure outlined in the following steps:

Step 1. Use nail puller to remove all nails.

Step 2. Remove outer layer of waterproof paper.

Step 3. Remove all straps.

Step 4. Remove top and sides of wooden crate.

Step 5. Tear off inner layer of waterproof paper.

Step 6. Check humidity indicator for presence of moisture.

CAUTION

If humidity indicators show that moisture has penetrated to equipment, examine equipment carefully for signs of corrosion or fungus.

Step 7. Remove desiccant.

Step 8. Remove corrugated pads.

Step 9. Remove front blocking strip.

Step 10. Install two eyebolts and attach tackle to support weight.

Note

The consolidating parts box, which is included in shipment of radio beacon, contains two eyebolts that are used when lifting receiver-transmitter group and power supply-test set group. The consolidating parts box also contains electron tubes to be installed in these groups, as well as cable connectors, etc.

Step 11. Loosen turnbuckle.

Step 12. Remove clamp and blocks.

Step 13. Lift cabinet off platform by means of eyebolts.

Receiver-Transmitter OA-3352/GRN-9D and Power Supply Assembly OA-1537A/GRN-9A are now uncrated and ready for installation. Before connecting cables or applying power, make certain that the front-panel controls are set to the positions shown in table 2-1.

2-2. POWER REQUIREMENTS AND DISTRIBUTION.

The overall primary power distribution for the radio set is shown in figure 6-15. All incoming primary power is brought to the input terminals of the receiver-transmitter group, the associated antenna group, and the convenience outlets on each of these units.

The power requirements for the receiver-transmitter group and the power supply assembly are 208 volts, 4 wire, 3 phase, 60 cps, 6.8 kw, 7.2 kva, with an 0.9-power factor and a maximum current of 25 amperes per phase.

The power requirements for the convenience outlets are 120 volts, 1 phase, 60 cps, 15 amperes maximum, and 1.8 kva maximum obtained either from a 208-volt, 4-wire, 3-phase, 60-cps source or from an auxiliary 120-volt, 1-phase, 60-cps source.

2-3. INSTALLATION LAYOUT.

The receiver-transmitter group and power supply assembly should be placed as close together as practical (but a minimum of 15 inches apart) so as to be accessible for operation and maintenance. The maximum permissible distance between the cabinets is 5 feet. Figure 2-2 shows the placement of the components of a radio set for a typical installation and the dimensional data and mounting details.

2-4. INSTALLATION REQUIREMENTS.

a. CABLE FABRICATION. —For the multiconductor cables, a terminal lug-type connection is satisfactory. This connection is applicable to all cables shown except those with RG-18A/U and RG-10/U designations.

(1) REMOVING ARMOR. —The method of removing the armor is as follows:

Step 1. Form cable as it is to be run into stuffing tube; carefully estimate where cable should come

TABLE 2-1. INITIAL CONTROL SETTINGS PRIOR TO ENERGIZING

NAME OR PANEL MARKING	REFERENCE SYMBOL	LOCATION	INITIAL POSITION
EMERGENCY SWITCH	S901	Front panel of receiver-transmitter group blower compartment	OFF (arrow pointing left or right)
MASTER SWITCH	S1101	Panel of control-duplexer	OFF
CODER-INDICATOR	S601	Panel of coder-indicator	OFF
Receiver ON-OFF	S502	Panel of radio receiver	OFF
ANTENNA CONTROL	S1102	Panel of control-duplexer	OFF
FIL ON	S1108	Panel of control-duplexer	OFF
LV	S1601	Panel of low voltage power supply	OFF
MV	S1801	Panel of medium voltage power supply	OFF
HV	S1902	Panel of high voltage power supply	OFF
BATTLE SHORT	S1107	Panel of control-duplexer	NOR
HIGH VOLTAGE	S1006	Power supply assembly	BREAK IN

through tube. Mark this position with piece of friction tape.

Step 2. Cut armor with either a diagonal cutter or an armor stripper. If using diagonal cutter, be careful not to cut through insulation.

Step 3. Cut either in front of tape marker or within it. By cutting just in front of marker, cut can be closely observed. Frayed edges of armor can then be trimmed away. When cutting within tape marker, tape serves to hold frayed edges down, but care must be used to avoid cutting insulation.

CAUTION

Do not cut insulation when cutting armor, to prevent frayed armor edges from penetrating cable and causing grounding.

(2) STRIPPING INSULATION.—After armor has been removed, start to remove the insulation approximately 1/2 inch from where armor terminates. The following procedure is recommended in stripping insulation:

Step 1. Place one end of cable in vise or have another man hold cable.

Step 2. Put a bend in cable and carefully ring insulation, taking care to cut only insulating jacket and not into insulation of individual conductors.

Step 3. With knife blade at an angle, start cutting a strip lengthwise, approximately 1/2 inch wide and long enough to allow side cutters to get grip on insulation.

Step 4. Pull down on cut with side cutters; this action will form a 1/2-inch strip. After stripping approximately 4 inches, remainder of strip can usually be removed by hand.

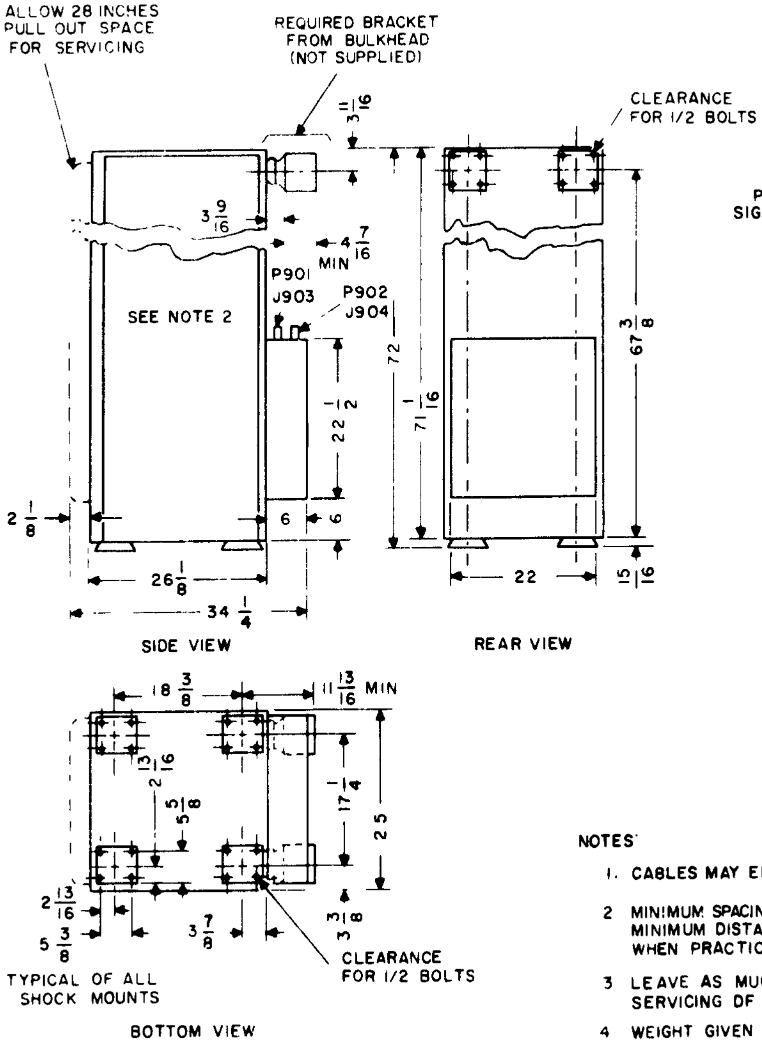
(3) APPLYING TERMINAL LUGS.—Remove just enough insulation so that the stripped conductor fits lug exactly. Always use lug large enough to fit over all strands of conductor. All lugs used must be soldered; however, solderless-type lugs may also be used to provide good mechanical and electrical connection by crimping before soldering (figure 2-3). A solder lug, type 20-14 (SNSN G17-L-14325) or equivalent, is connected to the cable conductors as follows:

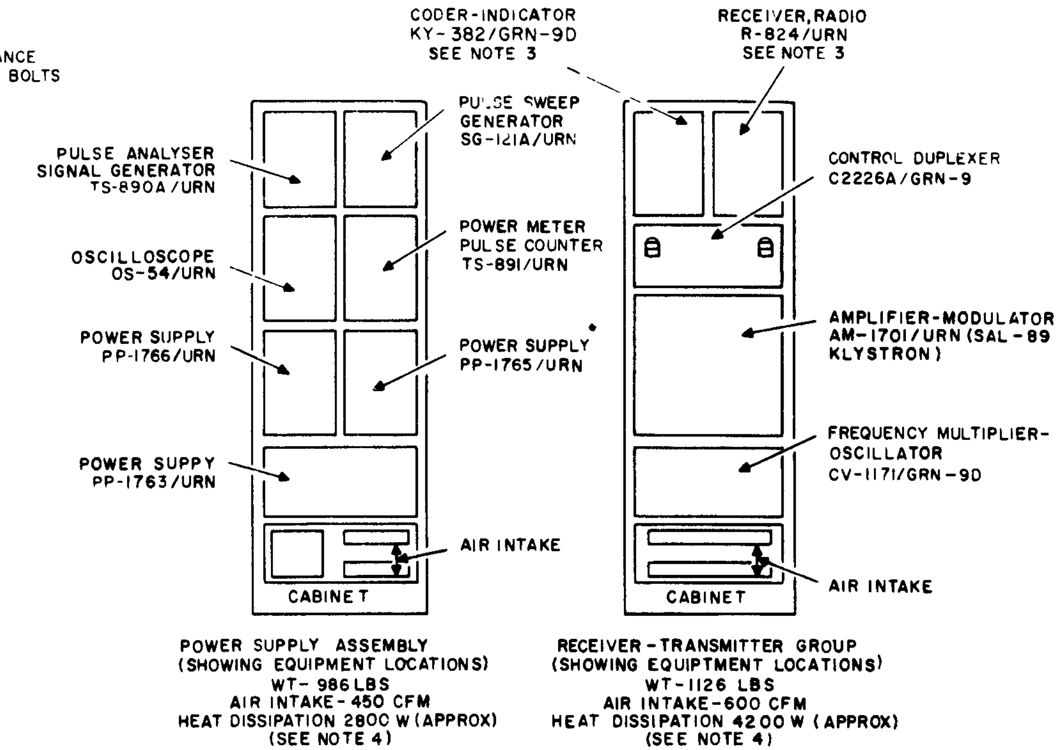
Note

Cables used in this installation have a waterproofing compound (silicone grease) which fills all voids even in individual conductors. This grease makes the soldering of terminal lugs very difficult. Individual strands must be cleaned with Decalene (deca-hydronapthalene).

Step 1. Slip lug over inner conductor and heat with soldering iron.

Step 2. As lug becomes warm, force it under insulation so that when it cools off it has added support of insulation (B, figure 2-3).





NOTES:

1. CABLES MAY ENTER THE CABLE ENTRANCE BOXES ON ANY OF FOUR SIDES.
2. MINIMUM SPACING ON SIDES OF CABINETS IS 15 INCHES FOR VENTILATION AND SERVICING. MINIMUM DISTANCE BETWEEN CABINETS IS 15 INCHES AND MAXIMUN IS 5 FEET; USE MINIMUN WHEN PRACTICAL.
3. LEAVE AS MUCH SPACE AS PRACTICAL ABOVE THE RECEIVER-TRANSMITTER GROUP FOR SERVICING OF THE TOP PULL-OUT UNITS, RADIO RECEIVER R-824/URN AND CODER-INDICATOR KY-382/GRN-9D
4. WEIGHT GIVEN FOR POWER SUPPLY ASSEMBLY DOES NOT INCLUDE TEST EQUIPMENT

Figure 2-2. Receiver-Transmitter Group and Power Supply Assembly, Typical Outline Drawing.

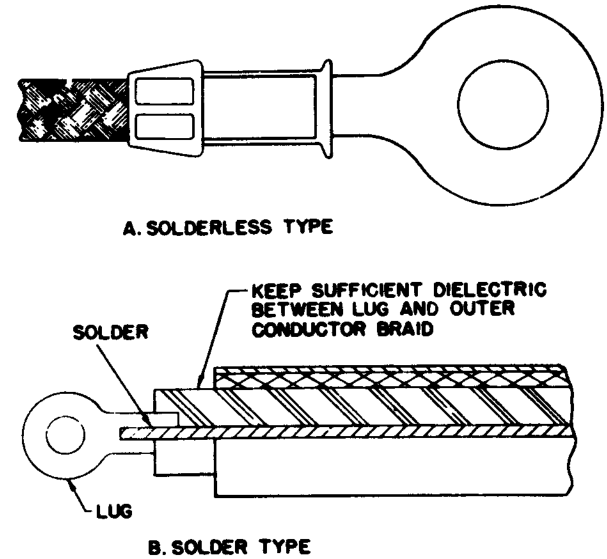


Figure 2-3. Method of Attaching Terminal Lugs

Step 3. Make sure that inner conductor is well bonded and secured to solder lug.

(4) ASSEMBLY OF CABLE RG-27/U. —Cable RG-27/U is connected between the receiver-transmitter group and power supply assembly. This cable has a standard lug-type termination, fastened by a nut to special standoff insulator binding posts E903 and E1001. Six inches of the armor should be removed from each end before the cable is inserted in the stuffing tubes.

The shielding at each end of the cable should be grounded. The two layers of shielding should be soldered together and then connected to the ground terminals on terminal board TB1002 in the power supply-test assembly entrance box and on binding post E999 in the receiver-transmitter cable entrance box.

CAUTION

At least 4 inches of the thin layer of conducting rubber over the inner insulation must be removed; otherwise the high voltage will cause a breakdown. If the inner insulation is cut even slightly during preparation, the high voltage will eventually cause a breakdown.

(5) ASSEMBLY OF CABLE RG-18A/U. —Cable RG-18A/U is connected between the antenna and the receiver-transmitter group. An r-f cable connector, UG-154A/U connects one end of this cable through adapter UG-216B/U to receiver-transmitter group jack J1155. Plug UG-1041-A/U connects the other end of this cable to antenna jack J3302, type 427B/U. Figure 2-4 provides complete instructions for assembly of a connector UG-154A/U to cable RG-18A/U.

Note

Before mating connector UG-154A/U into adapter, coat face of dielectric with dielectric compound ANA Specification AN-D-128.

(6) ASSEMBLY OF CABLE RG-10/U. —Cable RG-10/U is connected between the antenna and the receiver-transmitter groups. The r-f cable connectors UG-943A/U for the 135-cps and 15-cps reference pulse cables connect both ends of these cables to the equipment. Figure 2-5 provides complete instructions for this connector.

b. LAYOUT AND INSTALLATION OF CABLES.

(1) GENERAL. —After all cables have been prepared as described in paragraph 2-4a, they should be laid out and routed in accordance with a plan applicable to the specific installation. Since cable layout and routing details vary from installation to installation, layout details have been omitted in this manual. The general plan shown in figure 2-6 for a shore-based radio beacon should be adapted to fit specific requirements. Cables may be routed in trenches, ducts, or overhead cable racks. The objectives are to limit total cable lengths to the maximum lengths specified above, to bring cable terminations to within connecting distance of the components involved, and to secure cable runs with clamps or other suitable means, so as to prevent damage due to cable movements.

The cables intended for connection to the receiver-transmitter group and to the power supply assembly are brought into the equipment through cutouts provided in the cable entrance box. Cover plates are secured by means of hex bolts. The cutouts are intended to provide cable entrance to the interior of the box. To place the interconnecting cables into the equipment and to prepare for making the connections, proceed as follows:

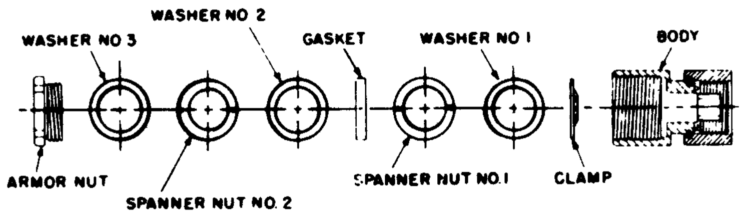
Step 1. Open amplifier-modulator and frequency multiplier-oscillator drawers of receiver-transmitter group and high-voltage power supply unit just above transformer and blower compartment of power supply assembly, as far as they will go.

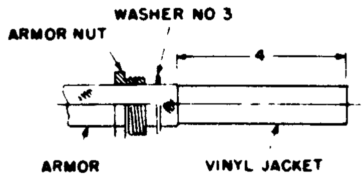
WARNING

Unless cabinet has been bolted in place, it may topple over if too many drawers are opened at one time.

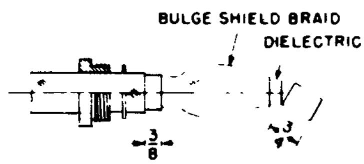
Step 2. Remove screws securing sides of cabinet to frame, and lift off sides of cabinet.

Step 3. In receiver-transmitter group only, release four knurled thumbscrews securing lower portion of ventilating duct inside cabinet. Push down on that section of duct to disengage it from retaining clamps, and move it aside to gain access to front of terminal boards in cable entrance box.

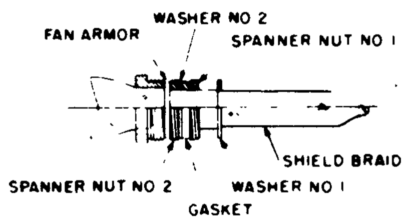




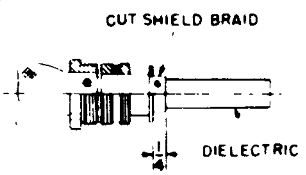
STEP 1. Slip armor nut and washer No. 3 over cable armor. Cut armor sharp and square at desired point allowing approximately 1/4 inch for fanning the armor and using connector body to determine first cut. This applies to cable which has been installed in run. Allow approximately 4 inches for making assembly. Cut off remaining cable end.



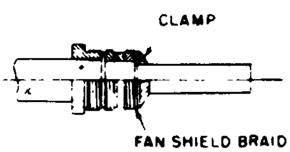
STEP 2. Cut cable jacket sharp and square with knife 3/8 inch from cut of armor. Do not damage conductor braid. Push back shield conductor braid and cut off approximately 3/4 inches of dielectric and inner conductor.



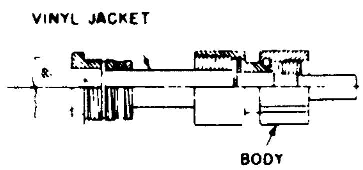
STEP 3. Pull braid forward and taper to a point. Fan 1/4 inches of armor against washer No. 3 and trim flush with washer. Slide spanner nut No. 2, wahser No. 2, gasket, and spanner nut No. 1 against fanned out armor, pushing armor back to allow parts to slide over jacket. Slide washer No. 1 over braid and against jacket.



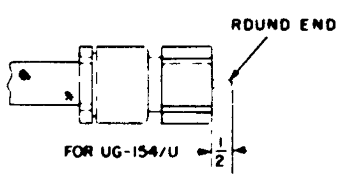
STEP 4. Cut off braid 1/4 inch from washer and fan against washer. Trim flush with outside diameter of washer.



STEP 5. Slide clamp against fanned out braid. Splitfingers on clamp should extend towards end of cable.



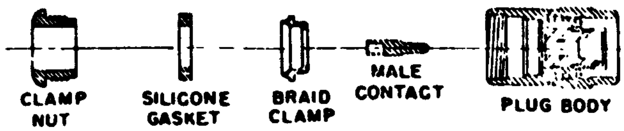
STEP 6. Push spanner nut No. 1 back to bulging armor, allowing approximately 2 inches for spanner wrench. Insert prepared end of cable into plug body.

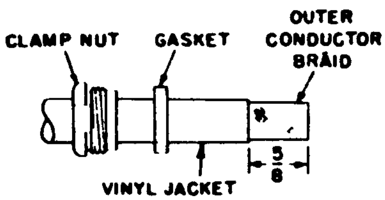


STEP 7. Apply a small amount of dielectric compound to spanner nut threads and gasket. Screw spanner nut No. 1 tightly into Body using wrench TL-323/U. Slide gasket and washer No. 2 into body. Screw spanner No. 2 tight against washer No. 2. Push armor and washer No. 3 into body by smoothing bulge in armor. Screw up armor nut tightly securing armor. Tap end of dielectric with hammer to allow braid and armor to set properly. Cut dielectric of cable flush with forward edge of coupling ring. Do not nick centre conductor. Remove dielectric with gas pliers. Cut centre conductor 1/2 inch from dielectric. Round off centre conductor with file. Using a file, cut a chamfer 1/16 " deep by 45° into the dielectric immediately surrounding the centre conductor. This will enable any excessive length of the associated female mating pin to be accommodated.

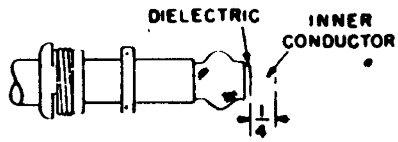
CAUTION Make sure no filings are left on dielectric.

Figure 2-4. Attaching Plug UG-154A/U to Cable RG-18/U, Assembly Details

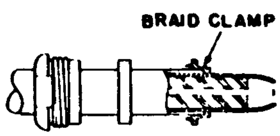




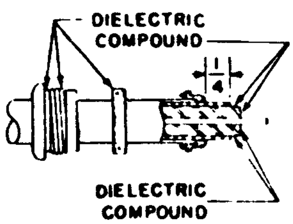
STEP 1. Cut cable to desired length. If cable is armored, push back armor approximately 2 inches and slide clamp nut and gasket over jacket. Be careful not to damage silicone gasket as it does not have the abrasive or elastic qualities of neoprene. Cut vinyl jacket sharply and squarely with knife allowing approximately 5/8 inch for making assembly. Do not damage outer conductor braid.



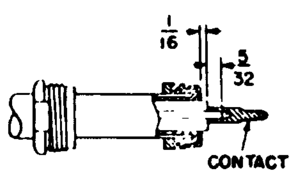
STEP 2. Push back outer conductor braid. Cut and remove approximately 1/4 inch of dielectric. Do not nick, bend, or otherwise damage inner conductor.



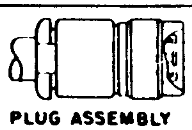
STEP 3. Pull braid forward and taper to a point. Slide braid clamp over braid and against jacket so that jacket fits snugly against internal shoulder of clamp.



STEP 4. Cut off braid 1/4 inch from braid clamp. Do not damage dielectric.



STEP 5. Unbraid ends of outer conductor and fan straight back onto tapered portion of clamp. Trim braid flush with flange portion of braid clamp so that no strands extend beyond outside diameter of flange. Braid strands should not cross each other. Cut off dielectric surface and square 1/16 inch from point where braid bends back over clamp. This dimension is critical. Be careful not to nick, bend, or otherwise damage the inner conductor. Cut off inner conductor 5/32 inch from end of dielectric.



STEP 6. Check to make sure contact fits over inner conductor and snugly against dielectric. Tin inner conductor with soft solder. Slide center contact over end of inner conductor and soft solder in place. Remove all excess solder and flux. Make certain contact is square and at right angles with dielectric. Apply a small amount of dielectric compound to end of dielectric, silicone gasket, and clamping nut threads. Push body over end of cable so that contact fits through center hole of insulator bead. Push body onto cable as far as it will go and tighten clamp nut. After assembly is complete, check contact pin to make sure that it is properly located.

Figure 2-5. Attaching Plug UG-943A/U to Cable RG-10/U, Assembly Details

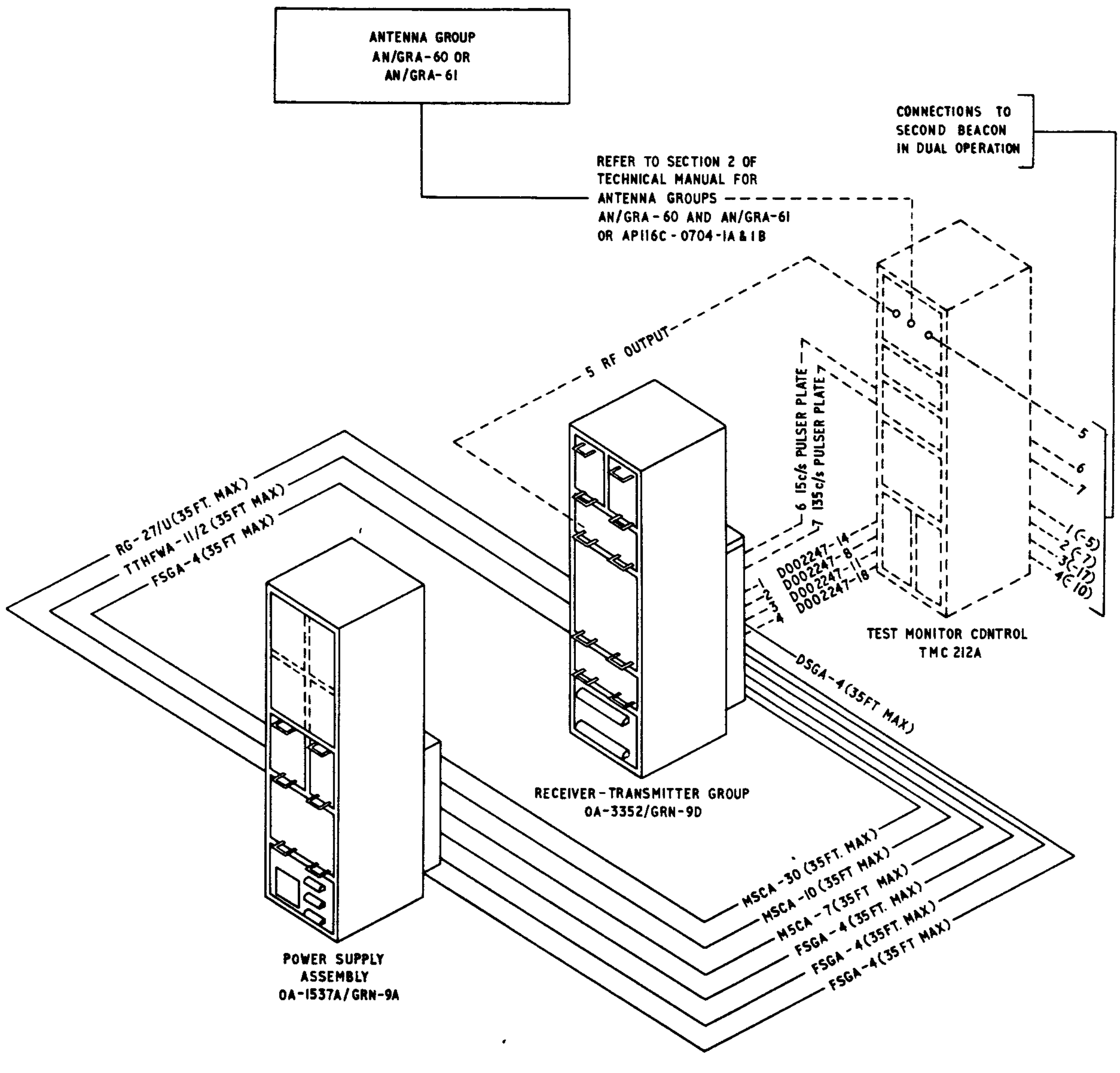


Figure 2-6. Shore Radio Beacon Cable, Location Diagram

Step 4. Use hex wrench to remove bolts securing cover plate over cutout selected to provide cable entrance. Remove cover plate. Fit cover plates with stuffing tubes, as required.

Step 5. Feed cables into stuffing tubes and then into equipment through cutout, guiding cables so that terminals appear inside cabinet frame near front of cable entrance box terminal boards. Fan out individual cables and leads as required for making connections to individual terminal boards. Restore cover plates.

CAUTION

Be careful not to damage any of the cables or components while doing work inside the cabinet.

(2) CABLE CONNECTIONS. —Detailed interconnection information for the radio set is given in table 2-2. Most of the connections are made to terminal boards with screw-type terminals. An r-f coaxial cable RG-18A/U, fitted with plug UG-154A/U on the transmitter end and plug UG-1041A/U on the antenna end, is connected between a coaxial connector

TABLE 2-2. WIRING LIST OF INTERCONNECTING CABLES FOR SHORE RADIO BEACON RADIO SET AN/GRN-9D

WIRE NO.	FUNCTION	VOLTS	AMPS	CONDUCTOR SIZE (CM)	COLOR CODE	FROM	TO
INCOMING CABLES TO RECEIVER-TRANSMITTER OA-3352/GRN-9D (FHFH-23: 35-foot maximum)							
1	3-phase input, phase A	208	31	22,800	Blk	Shore input	FL901
2	3-phase input, phase B	208	31	22,800	R	Shore input	FL902
3	3-phase input, phase C	208	31	22,800	Gn	Shore input	FL903
4	3-phase neutral	208	31	22,800	W	Shore input	FL906
(DSGA-4: 35-foot maximum)							
1	Auxiliary power input	117	15	4497	Blk	Shore input	FL904
2	Auxiliary power input	117	15	4497	W	Shore input	FL905
CABLES BETWEEN RECEIVER-TRANSMITTER OA-3352/GRN-9D AND POWER SUPPLY ASSEMBLY OA-1537A/GRN-9A (MSCA-30: 5-foot maximum distance between units; 35-foot maximum cabling)							
1	12-kv ground	Gnd		1779	Blk	TB1004(1)	TB903(1)
2	1-minute delay circuit	120	0.05	1779	W	TB1003(1)	TB908(19)
3	1-minute delay coil	120		1779	R	TB1004(12)	TB908(17)
4	5-minute delay coil	120		1779	Gn	TB1004(14)	TB908(14)
5	Remote ready indicator			1779	O	TB1004(12)	TB907(13)
6	Control circuit neutral	120	0.94	1779	Blu	TB1003(12)	TB907(3)
7	Chassis ground	Gnd		1779	W-Blk	TB1002(12)	E999(9)
8	Spare			1779	R-Blk		
9	Interlock circuit	120	0.32	1779	Gn-Blk	TB1003(15)	TB907(7)
10	Spare			1779	O-Blk		
11	Cabinet blower B1001. phase A	208	3.1	1779	Blu-Blk	TB1001(18)	TB908(8)
12	Interlock circuit	120	0.48	1779	Blk-W	TB1003(17)	TB907(10)
13	Spare			1779	R-W		
14	Spare			1779	Gn-W		
15	Cabinet air switch circuit	120	0.29	1779	Blu-W	TB1003(20)	TB907(12)
16	High-voltage interlock	120		1779	Blk-R	TB1002(6)	TB908 (15)
17	Spare			1779	W-R		
18	Spare			1779	O-R		
19	Automatic overload circuit	120	0.3	1779	Blu-R	TB1003(10)	TB907(4)
20	Spare			1779	R-Gn		
21	Spare			1779	O-Gn		
22	Control circuit	120	0.94	1779	Blk-W-R	TB1003(14)	TB907(5)
23	Interlock circuit	120	0.63	1779	W-Blk-R	TB1003(18)	TB907(9)
24	Cabinet blower B1001, phase B	208	3.1	1779	R-Blk-W	TB1001(17)	TB908(7)
25	Spare			1779	Gn-Blk-W		
26	Spare			1779	O-Blk-W		
27	Spare			1779	Blu-Blk-W		
28	Spare			1779	Blk-R-Gn		
29	Cabinet blower B1001, phase C	208	3.1	1779	W-R-Gn	TB1001(20)	TB908(10)
30	High-voltage indicator circuit	120	0.15	1779	R-Blk-Gn	TB1003(7)	TB908(18)

TABLE 2-2. WIRING LIST OF INTERCONNECTING CABLES FOR SHORE RADIO BEACON RADIO SET AN/GRN-9D (contd)

WIRE NO.	FUNCTION	VOLTS	AMPS	CONDUCTOR SIZE (CM)	COLOR CODE	FROM	TO
	CABLES BETWEEN RECEIVER-TRANSMITTER OA-3352/GRN-9D AND POWER SUPPLY ASSEMBLY OA-1537A/GRN-9A (MSCA-10: 5-foot maximum distance between units; 35-foot maximum cabling)						
1	+250-volt ground	Gnd	0.46	1779	Blk	TB1004(17)	E999(2)
2	+1000-volt regulated from medium voltage power supply	+1000	0.41	1779	W	E1011	E907
3	Spare			1779	R		
4	+250-volt regulated from low voltage power supply	+250	0.36	1779	Gn	TB1004(18)	TB903(11)
5	+1000-volt ground	Gnd	0.41	1779	O	TB1004(8)	E999(3)
6	+1000-volt regulated from medium voltage power supply	+1000	0.41	1779	Blu	E1011	E907
7	+100-volt ground	Gnd	0.41	1779	W-Blk	TB1004(8)	E999(3)
8	Spare			1779	R-Blk		
9	Spare			1779	Gn-Blk		
10	Spare			1779	O-Blk		
	MSCA-7: 5-foot maximum distance between units; 35-foot maximum cabling)						
1	Spare			1779	Blk		
2	-375-volt regulated from low voltage power supply	-375	0.14	1779	W	TB1004(11)	TB903(12)
3	-375-volt ground	Gnd	0.12	1779	R	TB1004(13)	E999(3)
4	Spare			1779	Gn		
5	Spare			1779	O		
6	Spare			1779	Blu		
7	Spare			1779	W-Blk		
	(FSGA-4: 5-foot maximum distance between units; 35-foot maximum cabling)						
1	12-kv plate trans-primary T1001, phase A	208	8.3	4497	Blk	TB1001(12)	TB901(2)
2	12-kv plate trans-primary T1001, phase B	208	8.3	4497	W	TB1001(11)	TB901(3)
3	12-kv plate trans-primary T1001, phase C	208	8.3	4497	R	TB1001(14)	TB901(4)
4	Plate trans-neutral	208	8	4497	G	TB1002(5)	TB904(13)
1	Cabinet convenience outlets	117	15	4497	Blk	TB1001(9)	TB904(9)
2	Cabinet convenience outlets	117	15	4497	W	TB1001(10)	TB904(10)
3	Cabinet convenience outlets	117	15	4497	R	TB1001(8)	TB904(4)
4	Cabinet convenience outlets	117	15	4497	G	TB1001(7)	TB904(6)

TABLE 2-2. WIRING LIST OF INTERCONNECTING CABLES FOR SHORE RADIO BEACON RADIO SET AN/GRN-9D (cont)

WIRE NO.	FUNCTION	VOLTS	AMPS	CONDUCTOR SIZE (CM)	COLOR CODE	FROM	TO
1	3-phase neutral	120	10	4497	Blk	TB1002(15)	TB901(8)
2	Test set input, 1-phase, phase C	120	3.4	4497	W	TB1002(14)	TB902(1)
3	Test set input, 1-phase, phase A	120	3.4	4497	R	TB1002(13)	TB902(3)
4	Test set input, 1-phase, phase B	120	3.4	4497	G	TB1002(16)	TB902(2)
1	Regulated filament bus	120	4.6	4497	Blk	TB1002(10)	TB904(19)
2	Low and medium voltage P1 transformer	120	3.4	4497	W	TB1002(3)	TB904(14)
3	Spare			4497	R		
4	Filament bus neutral	120	4.5	4497	G	TB1002(8)	TB904(20)
(TTHFWA-1-1/2: 5-foot maximum distance between units; 35-foot maximum cabling)							
1	Sound powered telephone	60 micro-volts	100 micro-amperes	704	Blk	TB903(8)	TB1004(19)
2	Sound powered telephone	60 micro-volts	100 micro-amperes	704	W	TB903(10)	TB1004(20)
3	Spare			704	R		
(RG-27/U: 5-foot maximum distance between units; 35-foot maximum cabling)							
1	12-kv high voltage output	12 kv	300 ma			E903	E1001

CABLES BETWEEN RECEIVER - TRANSMITTER OA - 3352/GRN-9D

AND TEST MONITOR CONTROL RACK TYPE MM - TMC - 212A

WIRE NO	FUNCTION	DESIGNATION	COLOR CODE	FROM	TO (TMC)
1.	Keyer Output to TMC	CABLE D002247-14-(5) RG 188/U	WHT/CENTRE SHORT SHIELD LONG SHIELD	TB903 (5) TB903 (3) TB903 (4)	TB8-7 (TB8-9)
2.	Pre - Trig	CABLE D002247-8-(7) RG 223/U	CENTRE SHIELD EXT. SHIELD	TB903 (6) TB903 (4) E999	J1 (J2)
3.	High Voltage Inter-lock to TMC	CABLE D002247-11-(17) (Min elec. DEF-10 No. 2C).*	WHT BLK	TB907 (11) TB907 (14)	TB3-4 IN (6) TB3-5 OUT (7)
4.	Mis - set cables to TMC	CABLE D002247-18-(10) (Min elec. DEF-10 No. 2C).* *Nato Stock No. 6145-99-910-0004	WHT BLK	TB907 (19) TB907 (13)	TB5-8 (10) TB5-7 (9)

NOTE: Suffixes shown in brackets in the 'DESIGNATION' and 'TO (TMC)' columns refer to alternative beacon in dual-operation installations.

on the antenna and a connector on the front panel of Control-Duplexer C-2226A/GRN-9. Two r-f coaxial cables RG-10/U, fitted with plug UG-943A/U at each end, are connected between the cable entrance box on the receiver-transmitter group cabinet and the antenna base. High-voltage power cable RG-27/U is connected between binding posts in the transmitter-receiver group and power supply assembly cable entrance boxes. To make the connections outlined above, proceed as follows:

CAUTION

Three-phase power connections are made to filters FL901, FL902, and FL903. Before connecting power, check the phase rotation of the line, so that after connection the antenna spin motor and the cooling blowers of the receiver-transmitter and power supply-test set groups rotate in the proper directions. The correct direction of rotation is indicated on an instruction plate on the spin motor.

(a) TERMINAL BOARD CONNECTIONS. — Connect the terminal lugs on the cables brought into the cable entrance boxes in accordance with procedures of paragraph 2-4a(3) to the terminals on the cable entrance box terminal boards in the receiver-transmitter group and power supply assembly. Similarly, connect the cable leads to the terminal boards on the other equipment components. For further details, refer to table 2-2.

(b) POWER CABLE CONNECTIONS. —Connect one end of high-voltage power cable RG-27/U to binding post E903 in the receiver-transmitter group cable entrance box. Connect the cable armor to ground at terminal 12 on binding post E999.

CAUTION

Make sure that the areas around binding posts E903 and E1001 are cleared of all other cable leads.

(c) COAXIAL CABLE CONNECTIONS. —R-f cable RG-18A/U is fitted with plug UG-1041A/U at the antenna end, and a plug UG-154A/U at the equipment end. Connect one end to jack J3302 on the (shore) antenna pedestal. Connect the other end of the cable to plug P1169, a UG-216B/U, right-angle fitting. Connect the fitting to RF OUTPUT jack J1155 on the front panel of the control-duplexer in the receiver-transmitter group. For further details, refer to table 2-2.

The two r-f cables RG-10/U have been fitted with plugs UG-943A/U at each end. One cable brings the 15-cps reference trigger and the other, the 135-cps reference trigger, to the receiver-transmitter group. Connect one of the cables between jack J904 on top of the receiver-transmitter group cable entrance box and J3303 on the antenna pedestal. This is the 15-cps reference trigger connection. Connect the other cable between jack J903 on top of the receiver-transmitter group cable entrance box and jack J3304 on the antenna pedestal. This is the 135-cps reference trigger connection.

c. ELECTRON TUBE INSTALLATION. —The electron tubes listed in table 2-3 should be installed after the receiver-transmitter group and power supply-test group have been fastened in place.

The klystron V1304 should be installed in accordance with the procedure outlined below (figures 2-7 and 2-8).

Note.
For those beacons incorporating the Test Monitor Control Rack MM - TMC - 212A, the main RF and pulser plate cables from the antenna to the beacon are routed via the TMC rack

TABLE 2-3. ELECTRON TUBE INSTALLATION

TUBE TYPE	UNIT	REFERENCE SYMBOL
836	Medium voltage Power supply	V1801 and V1802
8020	High voltage power supply	V1901 through V1906
Klystron SAL-89	Amplifier modulator	V1304

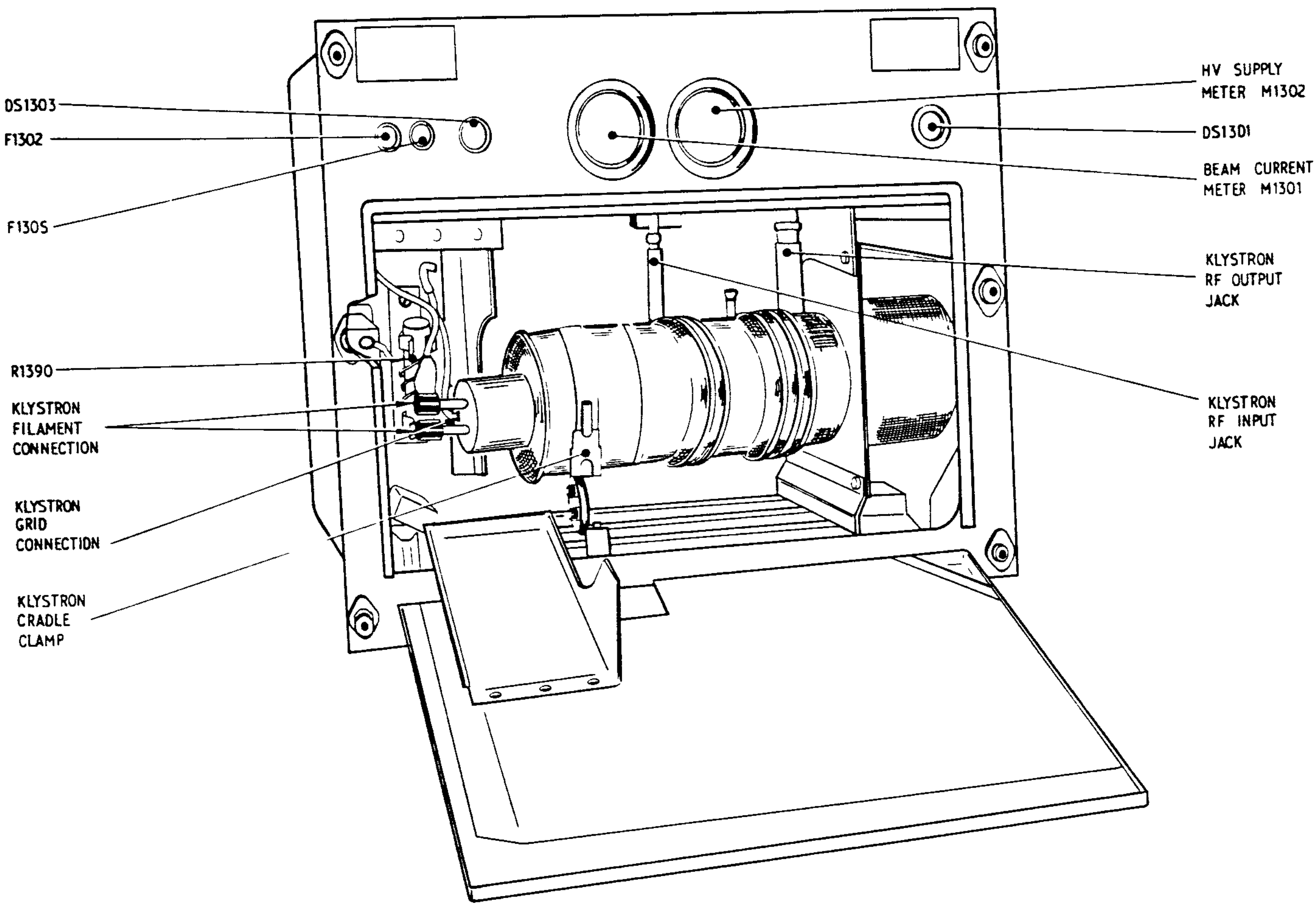


Figure 2-7. Amplifier Modulator AM-1701/URN, Front View with Klystron Access Door Open

Step 1. Before installing klystron, preset spacings of cavity rings to approximate required distance determined by assigned frequency. The spacing of cavity tuning rings is determined by special tuning chart provided with each klystron. A typical chart is shown in figure 2-9.

CAUTION

Do not use sample chart, figure 2-9 for presetting cavity ring spacing. Instead, use chart supplied with particular klystron being installed.

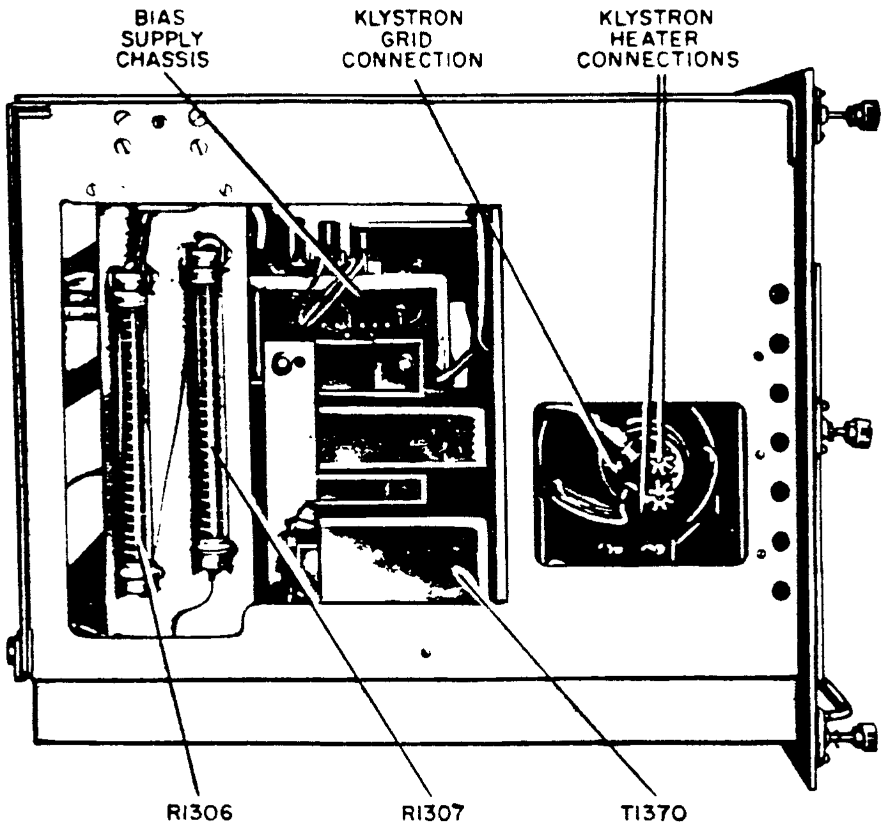


Figure 2.8. Amplifier-Modulator AM-1701/URN, Left Side View

Note

As shown in figure 2-9, the chart contains three curves, one for each of the three klystron cavities; these are klystron INPUT, MIDDLE, and OUTPUT cavities.

Step 2. Determine channel at which radio beacon is to operate and appropriate transmitter frequency. Using chart provided with klystron, determine spacing required for each of the three cavities. To determine spacing from calibration curve, use transmitter frequency as ordinate of curve; spacing (in thousandths of an inch) between inside surfaces of flanges is abscissa of curve.

Step 3. Using caliper micrometer, gauge spacing between cavity rings and adjust. Use adjusting wrench provided for this purpose. It is very important that flanges be moved parallel to each other while being tuned. Turn each adjusting nut by not more than one full turn before adjusting other nuts on flange by same amount. Repeat as necessary until required setting is obtained.

CAUTION

Some klystrons are shipped with flexible filament leads unattached. When attaching leads to terminals, take care not to crack filament rod seals (figure 2-10).

Step 4. Check that cup shield provided with klystron is over filament terminals. Remove two back screws but not two screws that face front when klystron is in amplifier-modulator. (The back screws are not accessible for removal when tube is installed).

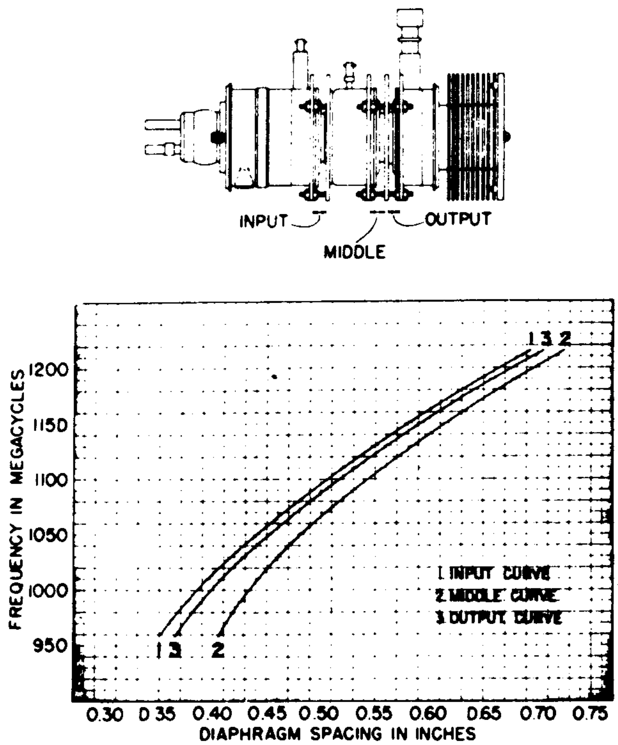


Figure 2-9. Klystron Characteristics, Sample Calibration Curve

Step 5. Pull amplifier-modulator out to fully extended position and be sure that the slides lock unit in this position. Open access door and hinged shield that covers klystron filament terminals.

Step 6. Loosen the four cradle bolts and tilt cradle forward, pushing band up and to rear of compartment. Loosen bolt holding cradle to chassis and push it completely to right.

Step 7. Place klystron into compartment, cathode end first. Position anode end on two anode supports and allow other end to rest on cradle.

Step 8. Insert and tighten the four bolts in anode plate. Secure grounding strap to anode.

Step 9. Position cradle directly under raised ring on input cavity and tighten band around klystron.

Step 10. Tighten bolt holding cradle to chassis; then tighten the four bolts on cradle.

Step 11. Attach r-f input and output cables.

CAUTION

Make sure, when attaching r-f output cable to klystron, that equal torque is maintained on the two pin wrenches (figure 2-10); this ensures that torque required to tighten connector is not applied to r-f output terminal. The bend in cable should be maintained so that transverse force is not applied to terminal.

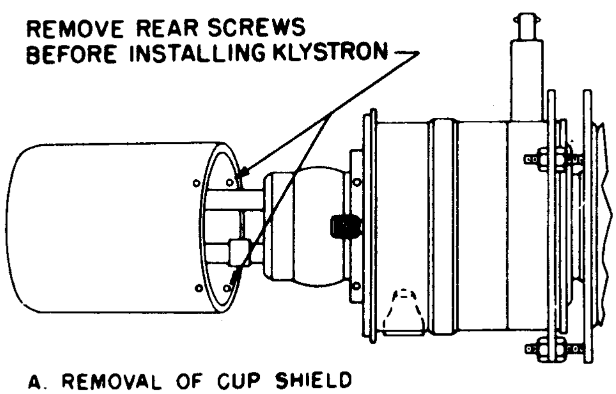
Step 12. Remove cup shield from filament end of klystron and attach flexible leads to terminals at insulating bushing at back of compartment. Make sure to connect lead from heater-cathode terminal (marked HK) to outer conductor of coaxial connector. Connect other heater terminal to inner conductor.

Step 13. Attach flexible grid lead to solid terminal on cathode end of klystron SAL-89.

d. BUILT-IN TEST EQUIPMENT INSTALLATION (Not MM - TMC - 212A).

—The power supply assembly is shipped with-out the built-in test equipment installed (figure 1-3). At the time of installation, the blank panel covering the upper half of the power supply assembly is removed, and the built-in test equipment is installed in its place.

The physical arrangement of the built-in test equipment in the power supply assembly cabinet is



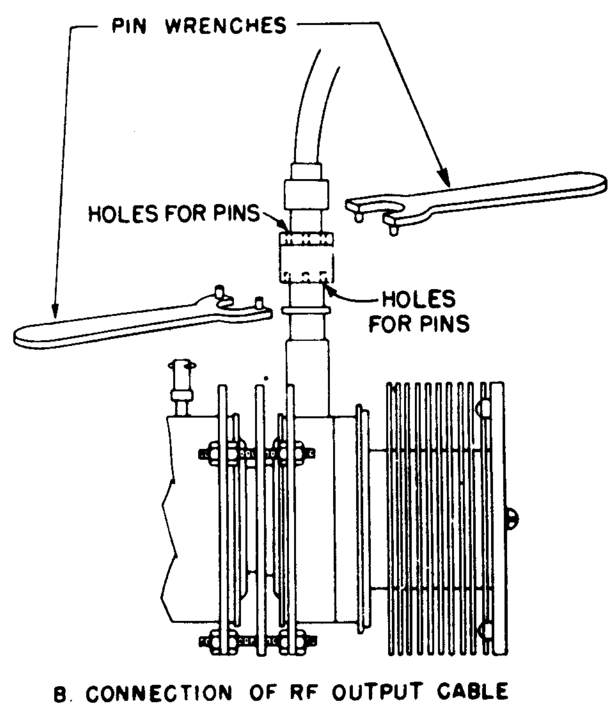


Figure 2-10. Klystron Installation Details

shown in figure 2-2. The test equipment interconnecting harness, shown schematically in figure 2-11, is added to the power supply assembly when the built-in test equipment is installed. Figure 3-13 shows the front panel connections needed to perform the standard tests listed in paragraph 2-5d. These connections are temporary, and are removed when testing is complete. The test equipment provided includes the following:

(1) Pulse-Sweep Generator SG-121A/URN-3 (Technical Manual NAVSHIPS 92745).

(2) Pulse Analyzer-Signal Generator TS-890A/URN-3 (Technical Manual NAVSHIPS 93231).

(3) Power Meter-Pulse Counter TS-891/URN-3 (Technical Manual NAVSHIPS 92809).

(4) Switch-Test Adapter SA-420/URN-3 (Technical Manual NAVSHIPS 92809).

(5) Oscilloscope OS-54/URN-3 (Technical Manual NAVSHIPS 92778).

e. BUILT-IN TEST EQUIPMENT INSTALLATION (MM-TMC-212A). - The MM-TMC-212A has been designed to replace the built-in test equipment described in para 2-4d and completely replaces the AN/GRA-34 Control Monitor Group. Minor modifications to the AN/GRN-9D are necessary in order to incorporate the TMC-212A and these are described in AP 116C-0702-1A6A which also includes complete installation details of the TMC-212A. The schematic and wiring diagrams in this manual incorporate the changes resulting from the introduction of the TMC-212A and a block diagram of the equipment is shown in Fig 2-11a whilst Fig 3-13a shows the front panel connections required to perform certain standard tests described in pargraph 3-6a(12). The TMC-212A rack comprises the following pieces of test equipment whose functions are briefly described in TABLE 1-2b.

(1) Transfer and Switching Unit MM-1602
Technical Manual: AP 116C-0702-1D6D.

(2) Spectrum Analyzer/Test Generator MM-705
Technical Manual: AP 116C-0702-1H6H

(3) Oscilloscope MM-504
Technical Manuals: AP 116C-0702-1J6J
AP 116C-0702-1K6K

(4) Power Meter - Pulse Counter - Marker Generator MM-109
Technical Manual: AP 116C-0702-1G6G

(5) Transfer and State Transmission Unit (TELOTEL)
Technical Manual: AP 116C-0702-1L6L

(6) Two. Transponder Monitors MM-209
Technical Manuals: AP 116C-0702-1E6E
AP 116C-0702-1F6F

2-5. INSPECTION AND ADJUSTMENTS.

Note

Details regarding the setting up of the TACAN beacon using MM-TMC-212A can be found in Paragraph 3-6a(12).

a. INITIAL CHECKS. —After the equipment has been installed and interconnected, and before proceeding with the initial adjustments outlined in paragraph 2-5b, proceed as follows:

(1) Check that all connections have been properly made.

(2) Check fuses, pilot lamps, and other removable items to be sure they are properly installed.

(3) Inspect cables, drawers, and panel-mounted components, particularly meters, to make sure that nothing was damaged during installation.

(4) Make certain that all panel screws are tight, so that interlocks function properly.

(5) Restore equipment cabinets to normal operating condition as follows:

(a) Replace the section of ventilating duct removed for connection of cables to cable entrance box terminal boards.

(b) Restore sides of each cabinet.

(c) Close equipment drawer units that were opened for interconnection of incoming cables.

Note

Safety interlock switches along equipment frames are held in closed position when drawers are fully closed and open when drawers are opened.

(6) Initially set switches listed in table 2-1 in positions indicated.

b. PRELIMINARY ADJUSTMENT (RADIO SET UNENERGIZED). —The equipment is shipped with a crystal in place in the frequency multiplier-oscillator. This crystal should not be replaced unless it is necessary to change the channel. If the channel frequency is changed, the equipment must be retuned (paragraph 2-5g).

c. INITIAL ENERGIZING. —Proceed as follows when energizing the radio beacon equipment, consisting of the radio set and associated antenna group, for the first time:

WARNING

Operation of this equipment involves use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the amplifier-modulator or high-voltage power supply chassis while high voltage power supply is on. Do not depend upon safety interlock switches for protection. Under certain conditions, dangerous potentials may exist in the circuit with power controls set OFF because of charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits before touching them. Never service or adjust the equipment without the presence or the assistance of another person capable of rendering first aid immediately.

CAUTION

Before energizing the equipment for the first time, set the controls in the initial positions listed in table 2-1.

Step 1. Turn EMERGENCY SWITCH S901, on bottom panel of receiver-transmitter group cabinet, right to ON (arrow pointing up or down). Check that OVEN lamp DS1403 and NORMAL lamp DS1402, on panel of frequency multiplier oscillator, are on.

Note

When crystal oven has reached proper operating temperature, NORMAL lamp will go out. Thereafter NORMAL lamp goes on and off as oven thermostat turns heater on and off to maintain oven temperature.

Step 2. Turn MASTER SWITCH S1101 on panel of control-duplexer to STANDBY. Check that blue MAIN POWER ON lamp DS1102 on control-duplexer goes on. Check that amber AIR SWITCH OPEN lamps DS1303 (on amplifier modulator panel). DS901 (on panel of blower compartment of receiver-transmitter cabinet), and DS1001 (on power supply-test set group bottom panel) are not on. When on, these lamps indicate that blowers operating air switches are not working properly.

CAUTION

If amber lamps are on, blowers may be rotating in wrong direction. Shut off equipment immediately and check wiring for possible phase reversal by comparing equipment wiring and interconnection with schematic and wiring diagrams in Section 6. Operating equipment while blowers rotate in wrong direction may cause serious damage because of overheating.

Step 2a. Remove the klystron access panel from the front of the Amplifier Modulator drawer, see figure 2-7.

Step 2b. Using a true rms reading voltmeter, HP3400A (6625-00-727-4706) or equivalent, measure the klystron filament voltage between terminals H and HK on the klystron. The voltage should be between 4.1V and 4.3V rms.

Note

Do not measure between the resistor clamps or between the R1390 resistor board flying leads.

Step 2c. If the filament voltage is within range, proceed to step 21.

Step 2d. If the filament voltage is low, the klystron or filament transformer may be faulty and should be investigated.

Step 2e. If the filament voltage is high, turn MASTER SWITCH S1101 to OFF.

Step 2f. Obtain R1390 Resistor Set for the Amplifier Modulator, see Table 7-3. Select a mid-range value resistor from the resistor set and fit it into the clips on the R1390 resistor board.

Step 2g. Turn MASTER SWITCH S1101 to STANDBY and wait for 5 minutes.

Step 2h. Repeat step 2b.

Step 2i. If the filament voltage is out of range, turn MASTER SWITCH S1101 to OFF.

Step 2j. (a) If the voltage is low, fit a higher value resistor.

(b) If the voltage is high, fit a lower value resistor.

Step 2k. Repeat steps 2g to 2j until the voltage is within range.

Step 2l. Allow the equipment to remain in STANDBY for a further 15 minutes and then check that the filament voltage is within range. If not, repeat steps 2i to 2k.

Step 3. Snap switch S502 on radio receiver panel, to ON. Check that white POWER ON lamp DS501 on radio receiver is on.

Step 4. Snap CODER-INDICATOR switch S601 on coder-indicator panel to ON. Check that white POWER ON lamp DS601 on panel of coder-indicator is on.

Note

Check that all switches on antenna control unit are at ON. These switches are intended for use during servicing, and are normally left at ON.

Step 5. Snap ANTENNA CONTROL switch S1102 on control-duplexer panel, to ON. Check that white ANTENNA CONTROL lamp DS1103 on control-duplexer panel, is on. Check that antenna is rotating in proper direction; correct direction of rotation is indicated on instruction plate on antenna spin motor.

CAUTION

If both antenna and ventilating blowers in equipment cabinets are rotating in wrong direction(air switches fail to operate), interchange power input leads to FL908 and FL909 in rear of receiver-transmitter group cable entrance box. If only antenna is rotating in wrong direction, stop equipment and reconnect antenna spin motor by interchanging wires installed on terminals 3 and 5 of test board TB3394 in antenna pedestal. If blowers alone are rotating in wrong direction (air switches fail to operate) check wiring from power input to terminal boards on blowers for possible reversal of phase. Check that ANTENNA CONTROL lamp DS602 on coder-indicator panel is on constantly; blinking of this lamp indicates trouble in antenna or antenna control circuits.

Step 6. Set FIL ON switch S1108 on control-duplexer panel to ON. Check that FIL ON lamp DS1101 on control-duplexer, FIL lamp DS1301 on amplifier-modulator, FILAMENT lamp DS1401 on frequency multiplier-oscillator go on. Check that blue LV-MV READY lamp DS1605 on low voltage power supply goes on after a 1- minute time delay.

Step 7. Read SUPPLY VOLTS meter M1101 on control-duplexer. If reading is 120V ac, proceed to next step. If reading is not 120V ac, open control-duplexer drawer, loosen locking screw on ADJUST FOR 120V knob (on left side of control-duplexer drawer), and adjust for reading of 120V ac on SUPPLY VOLTS meter.

Note

Use SUPPLY VOLTS meter to check control line voltage by holding spring-return REG FIL BUS-LINE switch S1106 at LINE. Line voltage, as read on meter should be 120 ±12V.

Step 8. Turn MASTER SWITCH S1101 to OFF and then immediately to ON. Check that there is a 1- minute delay before blue LV-MV READY lamp DS1605 on the panel of the low-voltage power supply goes on.

Step 9. When blue LV-MV READY lamp goes on, snap LV switch S1601 on low voltage power supply panel, to ON. Check that red LV lamp DS1602 and green -375V lamp DS1601 on panel of low

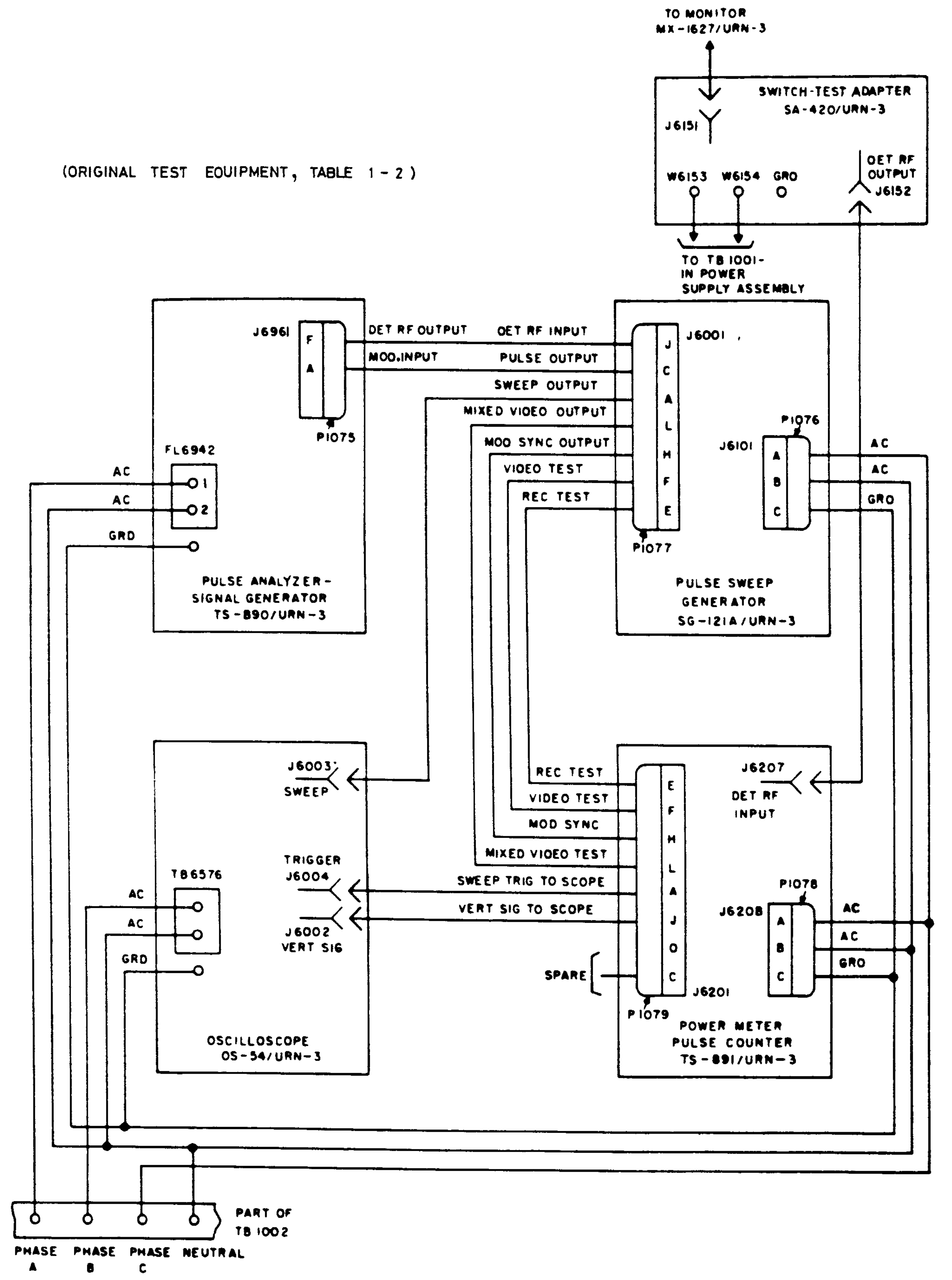


Fig. 2-11. Built-in Test Equipment Interconnection Harness, Schematic Diagram

voltage power supply are on. The green lamp indicates that low voltage power supply is delivering dc power to the other transmitter units of radio beacon.

Step 10. Check, and if necessary adjust, low voltage power supply output voltages. (Refer to paragraph 2-5e(1) for adjustment procedure.)

Step 11. Snap MV switch S1801, on medium voltage power supply panel to ON. Check that red +1000V lamp DS1801 on panel of medium voltage power supply is on. Check that amber MV OVERLOAD lamp DS1803 on medium voltage power supply panel does not go on. Check that lamp DS1802 inside the power supply unit is on. To make this check, open power supply drawer unit and temporarily lock interlock switch on cabinet frame behind panel.

WARNING

Dangerous voltages are present when lamp DS1802 is on.

Step 12. Check, and if necessary adjust, medium voltage power supply output voltage.

CAUTION

When starting radio set for the first time, or when starting a radio set containing a klystron that has not been in use for 3 months or more, age klystron (paragraph 2-5k) before applying full power to it.

Step 13. Turn MASTER SWITCH to OFF and then immediately to ON. Check that there is a 5-minute delay before blue HV READY lamp DS1902 on high voltage power supply panel goes on.

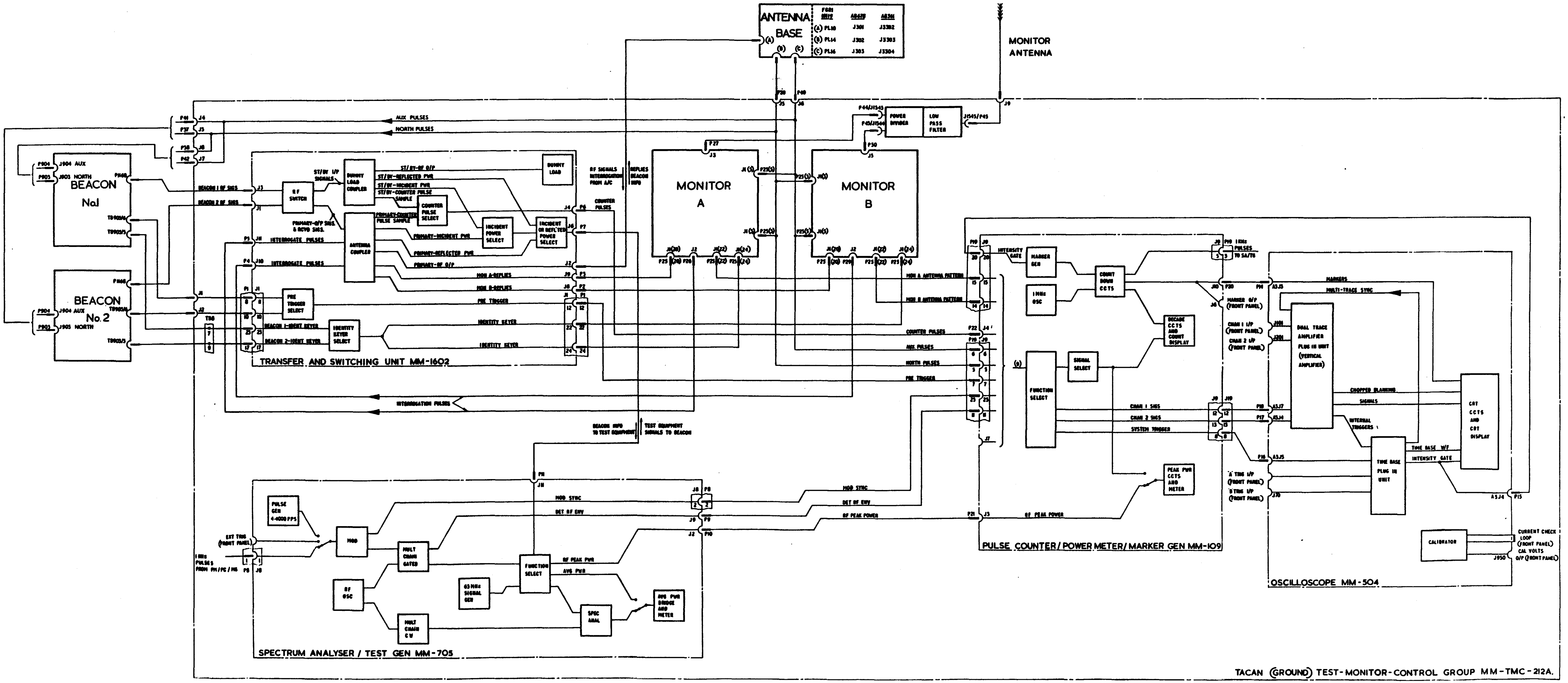


Figure 2-11a. TEST EQUIPMENT SIGNAL / CONTROL INTERCONNECTIONS. (SHEET 1 of 2)
REPLACEMENT TEST EQUIPMENT. (Table 1-2b)

Step 14. When HV READY lamp DS1902 goes on, set HV switch S1902 to ON. Check that red HV lamp DS1901, on high voltage power supply panel is on. Check that amber HV OVERLOAD lamp DS1903 on high voltage power supply panel is not on. Check that HV SUPPLY meter M1302 on amplifier-modulator panel reads approximately 12,000 volts.

Step 15. Check that ANTENNA SPEED ERROR meter reads in green portion of its scale; a reading in red portion of meter scale is an indication of trouble in antenna control circuits.

Note

Under normal operating conditions, the radio set is turned off and on by means of MASTER SWITCH on control-duplexer. All off-on switches, except those on built-in test equipment, are left in the on position. When MASTER SWITCH is turned to ON, the radio set will be energized with proper time delays applied to various power supplies. Whenever a radio set is being energized for the first time, or whenever tuning or troubleshooting operations are being performed on the radio set, it is best to perform the initial energizing procedure step by step.

d. ADJUSTMENT OF BUILT-IN TEST EQUIPMENT.

(1) GENERAL. –Internal adjustments to test equipment (before use) are given in the individual manuals supplied with the test equipment.

The units are interconnected internally through a cable harness and a built-in switching system permits rapid connection for standard test procedures.

(2) ORIGINAL TEST EQUIPMENT (TABLE 1-2).– The switching system for this equipment includes two four-position function switches located on the front panels of the Oscilloscope OS-54/URN-3 and Power Meter - Pulse Counter TS-891/URN-3, and a two-position coaxial r.f. switch located in the Switch Test Adapter SA-420/URN-3. If the front panel connections of Figure 3-13 are made it is only necessary to amnipulate the front panel controls to make the checks as listed. Note that the two function switches should be in the same position specified in TABLE 2-4 for any one of the tests.

Note

With the function switches in position 4, GENERAL TESTING, all internal inter-unit connections, except power connections, are effectively disconnected and the test equipments are operated as individual units. For checks and adjustments not listed in the table, set the function switches to position 4.

TABLE 2-4. FUNCTION SWITCH POSITION FOR TESTING

SWITCH POSITION	PANEL NAME	TEST
1	OPERATING TEST	R-f peak power, visual pulse shape, output pulse count, and transmitter spectrum
2	RECEIVER SENSITIVITY	Reference burst pulse count and squitter count
3	DELAY SYSTEM	Overall zero-distance time delay and video zero distance time delay.
4	GENERAL TEST	Maintenance testing

(3) PRELIMINARY SETTING OF FRONT PANEL CONTROLS ON PULSE ANALYZER-SIGNAL GENERATOR TS-890A/URN-3.–Before making any tests with the Pulse Analyzer/Signal Generator, set the POWER switch to ON (see fig 3-14), allow equipment to warm up for 10 minutes, and proceed as follows:

Step 1. Set INTERROGATE switch to OFF.

Step 2. Set INPUT ATTEN SELECTOR switch to maximum attenuation.

Step 3. Set BAND SHIFT switch to 0.

Step 4. Set MODULATION SELECTOR switch to CW.

Step 5. Set CHANNEL SELECTOR switch to applicable channel.

Note

If a built-in crystal oscillator is to be used as the frequency generating source, omit Steps 6, 7 and 8.

Step 6. Set MAIN TUNING control to applicable channel.

Step 7. Set the OSCILLATOR SELECTOR switch to VFO CALIBRATE.

Step 8. Adjust VFO CALIBRATE control until zero beat is heard in a telephone headset plugged into the VFO CALIBRATE jack.

Step 9. Set OSCILLATOR SELECTOR switch to either REF OSC, for crystal control or VFO depending on which oscillator is to be used as the generating source.

Step 10. Adjust ZERO SET control for 0 reading on OUTPUT LEVEL INDICATOR.

Step 11. Set INTERROGATE switch to ON.

Note

Before proceding with the next step, energize the Pulse Sweep Generator and allow it to warm up for at least two minutes.

Step 12. Adjust POWER SET control on TS-890A/URN-3 and PULSE AMPLITUDE control on SG-121A/URN-3 for mid-scale (100) reading on OUTPUT LEVEL INDICATOR. Retune CHANNEL control slightly and recheck setting of POWER SET control for mid-scale reading on OUTPUT LEVEL INDICATOR.

Step 13. Set MODULATOR SELECTION switch to PULSE.

Note

The TS-890A/URN-3 is now read for special tests. Upon completion of the tests, shut down the equipment by turning INTERROGATE and POWER switches to OFF.

(4) REPLACEMENT TEST EQUIPMENT (TABLE 1-2b).

Note

Due to an inherent characteristic in the Pulse Counter (part of the MM-109), the counter normally returns to '00001' and only returns to '00000' when reset by the CTR/RESET switch on the front panel of the unit.

Step 1. Turn the MM-TMC-212A on by turning the POWER ON switches of each unit to ON.

Step 2. Observe XPONDER ON ANT light on MM-1602 Transfer and Switching Unit. Number -1 indicator should be lit; if not, select position -1 on the ANTENNA XFER SEL switch to achieve this state.

Step 3. On the Spectrum Analyzer/Test Generator MM-705:-

a. Switch FUNCTION switch to RF PEAK PWR position.

b. Switch TEST METER to -12·6V position, and note meter indication. Meter reading should be approximately mid-scale.

c. Repeat Step b. for +12·6, +25·2 and +75 TEST METER positions. All readings should be approximately mid-scale.

d. Switch FUNCTION switch to RF AVG PWR position and repeat Steps b. and c.

e. Set ATTENUATOR to 0.

f. Place FUNCTION switch in PWR METER ZERO SET position and adjust SET ZERO control to position AVERAGE POWER meter indication over the ZERO SET position.

g. Switch FUNCTION switch to the IF SIG GEN position and repeat Steps b. and c.

h. Set IF SIG GEN FREQ control to approximately mid-range.

i. Adjust IF SIG GEN LEVEL control (increase or decrease) until POWER SET is obtained on the AVERAGE POWER meter. Note whether, or not, POWER SET can be obtained.

j. Switch FUNCTION switch to RF SIG GEN position and repeat Steps b. and c.

k. Switch RF SIG GEN MODE switch to OFF and adjust SET ZERO control for ZERO SET reading on the AVERAGE POWER meter.

l. Switch RF SIG GEN MODE switch to the CW position.

m. Switch RF SIG GEN FREQ SEL switch to ON CHAN position.

n. Adjust RF SIG GEN PWR SET control for POWER SET reading on the AVERAGE POWER meter. Note whether, or not, POWER SET reading can be obtained.

o. Repeat Step n. for RF SIG GEN +200, +900, -200 and -900 kHz FREQ SEL positions.

p. Switch RF SIG GEN MODE switch to PULSE position.

q. Switch RF SIG GEN FREQ SEL switch to ON CHAN position.

r. Switch MODULATOR PULSE SPACING switch to VAR and set variable control to mid-range.

s. Set PRR variable control to 10 and PRR switch to X400.

t. Observe linear detector output with the Oscilloscope MM-504, using the procedure for the normal transponder test set-up. (Refer to the receiver sensitivity tests in Paragraph 3-6a(12)).

u. Adjust the RF SIG CEN AMPL ADJ control and oscilloscope controls until a 2·0V Gaussian pulse pair is observed on the oscilloscope. The spacing between the pulses of the pulse pair should be either 12 ±3 μsec or 36 ±3 μsec; depending on the setting of the PULSE SPACING switch mounted internally on the Modulator Unit and normally set to the 12 μsec position.

v. Measure the pulse repetition rate on the oscilloscope (the spacing between pulse pairs). The spacing should be 250 ±25 μsec.

w. Switch MODULATOR PRR switch to X40 and repeat Step v. except that the spacing between pulse pairs should be 2·5 ±0·25 ms.

x. Switch MODULATOR PRR switch to X4 and repeat Step v. except that the spacing between pulse pairs should be 25 ±2·5 ms.

y. Switch FUNCTION switch to PWR METER ZERO SET and adjust the ZERO SET control to cause the AVERAGE POWER meter to indicate ZERO SET.

z. Switch the FUNCTION switch to SA and repeat Steps b. and c.

aa. Switch SPECTRUM ANALYZER BAND SHIFT switch to 0.

ab. Adjust the NOISE SET control for NOISE SET reading on the AVERAGE POWER meter. Note whether or not NOISE SET indication is obtained.

ac. Repeat Step ab. for SPECTRUM ANALYZER BAND SHIFT positions +0·8, +1·0, +2·0, -0·8, -1·0 and -2·0 MHz.

Step 4. On the Oscilloscope MM-504:

a. Set the B TRIG SOURCE switch to AC-

b. Set the HORIZ DISPLAY switch to A.

c. Set the combined TIME/CM AND DELAY TIME switch to 5 μsec.

d. Set the MODE switch to CH 1 and CH 1 INPUT switch to AC.

e. Set the CH 1 VOLTS/CM switch to 2.

On the Power Meter - Pulse Counter - Marker Generator MM-109, set the FUNCTION switch to GEN TEST and the COUNTER/MARKER SELECT switch to MARKERS 10. Connect a patch cable from the MARKER OUTPUT socket to CH 1 INPUT socket on the Oscilloscope. Adjust the oscilloscope controls for a suitable picture of the markers which should be displayed on the CRT.

f. Set the MODE switch to CH 2 and CH 2 INPUT switch to AC. Set the CH 2 VOLTS/CM switch to 2 and change the patch cable from the INPUT of CH 1 to that of CH 2. The markers now displayed are routed via channel 2.

g. Set the HORIZ DISPLAY switch to A INTEN BY B, adjust B TRIGGER LEVEL (red knob) and note that the intensity of the displayed markers varies. Disconnect the patch cable.

Step 5. On the MM-109:

a. Set the COUNTER/MARKER SELECT switch to SELF CHK.

b. Set the TIME INTERVAL switch to MANUAL and GATE OPEN/CLOSED switch to OPEN.

c. Set the FUNCTION switch to GEN TEST. The unit will begin to 'count'.

d. Set the TIME INTERVAL GATE switch to CLOSED. The counting action will stop.

e. Press the CTR/RESET switch and observe that the counter digits return to '0'. Switch the GATE switch to OPEN and the counting action will restart.

Step 6. On the MM-109:

a. Set the COUNTER INPUT COARSE switch to 1·0 and FINE control fully counter-clockwise.

b. Press the ZERO SET switch and whilst pressed, zero the meter by adjusting the SET ZERO control.

c. Set the FREQ STD switch to INT and connect the patch cable between the FREQ STD output socket and that of COUNTER INPUT.

d. Press the COUNTER INPUT READ switch and adjust the FINE control until the meter indicates in the green area. Disconnect the patch cable.

e. ADJUSTMENT OF POWER SUPPLIES.

(1) LOW VOLTAGE POWER SUPPLY PP-1766/URN.

Step 1. Turn meter selector switch S1402, under D. C. SUPPLY VOLTAGE meter M1402 on frequency multiplier-oscillator panel, to -375V and +250V. Check whether these voltages are within tolerance, or whether they require adjustment; permissible tolerance for each voltage is ±10 volts.

Note

When drawer unit is opened, the interlock switch located on cabinet frame behind panel will open and disconnect power to power supply unit. Operate this switch manually before making adjustments by pushing interlock pin gently to side and pulling it out until it catches. Ordinarily, the power supply assembly will be located near enough to the receiver-transmitter group so that meter M1402 on frequency multiplier-oscillator panel may be observed while making the adjustments of low voltage power supply. If this is not possible however, the adjustment adjustment must be made by two technicians. The sound-powered telephone (outlets provided on front of units) may be used for communication between the two groups, if necessary.

Step 2. The low voltage power supply adjustment potentiometers R1623 (+250V) and R1663 (-375V) are located inside drawer unit on side of chassis (figure 2-12) and are marked with voltages which they control. To make the adjustments, open drawer unit, loosen hex nut which locks potentiometer shaft in adjusted position, manually operate interlock and, using screwdriver, adjust potentiometer until proper volt-

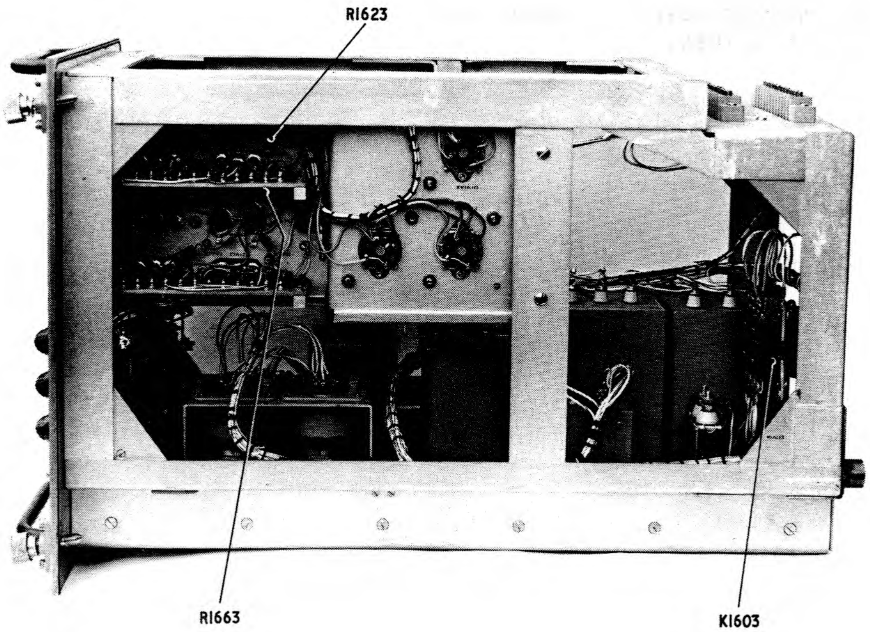


Figure 2-12. Low Voltage Power Supply PP-1766/URN, Right Side View

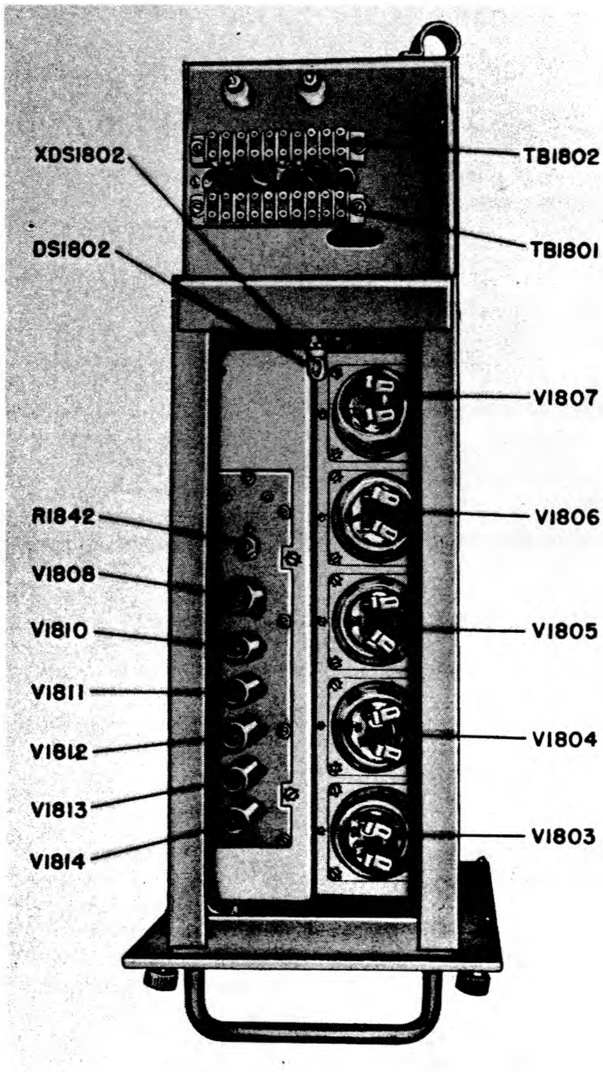


Figure 2-13. Medium Voltage Power Supply
PP-1765/URN, Top View

age reading is obtained on D. C. SUPPLY VOLTAGE meter on frequency multiplier-oscillator panel. Tighten the hex nut to secure potentiometer in adjusted position. Be careful not to change potentiometer setting while tightening locknut. After all adjustments have been made, close drawer unit. The interlock will be released automatically.

(2) MEDIUM VOLTAGE POWER SUPPLY PP-1765/URN.

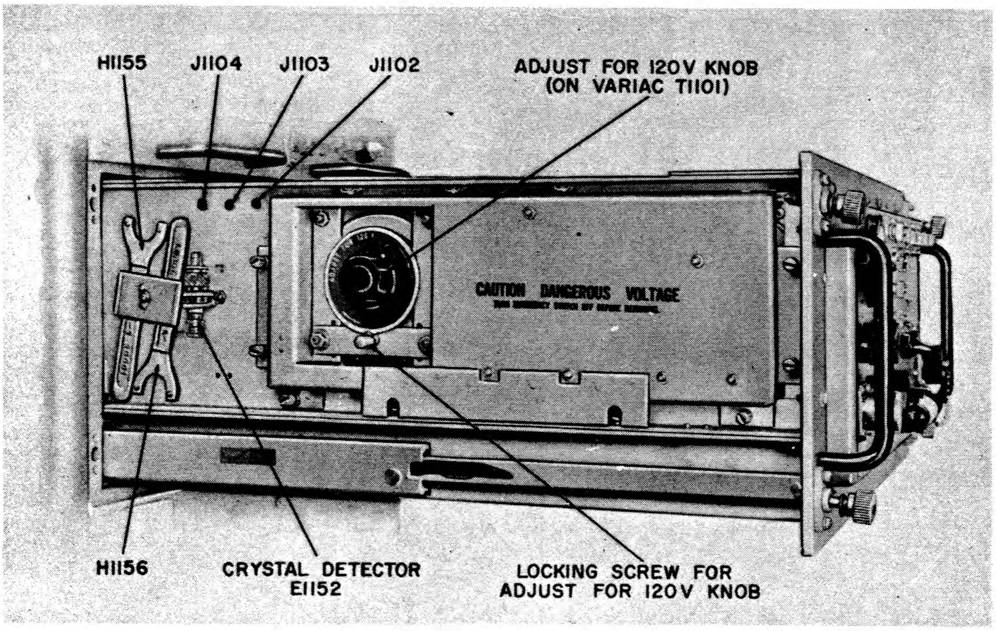
Step 1. Turn meter selector switch S1402, under D. C. SUPPLY VOLTAGE meter M1402 on panel of frequency multiplier-oscillator, to +1000V. Note which voltages are out of tolerance and will require adjustment; permissible tolerance is ±20 volts.

Step 2. Medium voltage power supply adjustment potentiometer R1842 +1000V is located inside power supply drawer unit on top of chassis (figure 2-13) and is marked with the voltage it controls. To make the adjustments, open drawer unit, loosen hex nut which locks potentiometer shaft in adjusted position, manually operate interlock switch (see notes preceding step 2 of paragraph 2-5e(1)), and, using screwdriver, adjust potentiometer until proper voltage reading is obtained on D. C. SUPPLY VOLTAGE meter located on frequency multiplier-oscillator panel. Tighten hex nut to secure potentiometer in adjusted position. Be careful not to change potentiometer setting while tightening nut. After both adjustments have been made, close drawer unit.

f. ADJUSTMENT OF CONTROL-DUPLEXER.

(1) ADJUSTMENT OF FILAMENT VOLTAGE. — The regulated filament voltage should be adjusted to exactly 120 volts. To perform this adjustment, proceed as follows:

Step 1. Open control-duplexer drawer unit.



Step 2. Locate ADJUST FOR 120V knob on left side toward rear of control-duplexer. (See figure 2-14.)

Step 3. Loosen locking screw under ADJUST FOR 120V knob.

Step 4. Turn ADJUST FOR 120V knob until 120 volts is read on D. C. SUPPLY VOLTS meter M1101.

Step 5. Tighten locking screw.

(2) ADJUSTMENT OF PRESELECTOR CAVITIES.—Open the control-duplexer drawer to gain access to cavity heads of preselector Z1153. Adjust micrometer heads according to data listed for the particular operating channel in table 2-5.

(3) ADJUSTMENT OF TRANSMISSION LINE FILTER.—The transmission line filter is adjusted in conjunction with the tuning of the klystron output stage. When tuning the cavities for the first time, or when tuning the radio set to a new channel, the cavities should be preset to the approximate adjustment according to the tuning curves shown in figure 2-15. The transmission line filter is illustrated in figure 2-16.

CAUTION

Do not use the sample chart in figure 2-15 for presetting the cavities. Use the chart supplied with the particular transmission line filter that is installed in the control-duplexer.

For touch-up tuning or when changing to an adjacent channel, it is not necessary to preset the cavities according to the tuning curves. All that is necessary is a slight adjustment for maximum output signal at the ANTENNA INCIDENT jack on the control-duplexer front panel. There is an interaction between the tuning of the klystron, double-slug tuner Z1303, and transmission line filter Z1156. Therefore, if an adjustment is made on any one of these units, the adjustment of the others must be checked. Refer to the tuning procedure of the transmitter output stages for a step-by-step method of tuning the transmission line filter and associated circuits.

g. CHANGING CRYSTALS.—It may be necessary to change the channel frequencies used by the radio beacon. There are 126 crystal frequencies available for use. Refer to table 2-5 for a list of channel numbers and corresponding crystal frequencies.

To change crystals, open the front panel tuning access door on the frequency multiplier-oscillator and insert a crystal oven assembly containing the crystal of the desired frequency in the crystal oven socket (figure 3-3). For channels 1 to 63, the low-band r-f chassis is used with the crystal oven assembly plugged into socket XY1501. For channels 64 and 126, the highband r-f chassis is used with the crystal oven assembly plugged into socket XY1502.

After changing crystals, retune the frequency multiplier-oscillator and output circuits as instructed.

TABLE 2-5. CHANNEL CRYSTAL FREQUENCIES AND PRESELECTOR MICROMETER CAVITY HEAD SETTINGS

CHANNEL NO.	CRYSTAL FREQUENCIES (mc)	RECEIVER FREQUENCY (mc)	TRANSMITTER FREQUENCY (mc)	MICROMETER CAVITY HEAD SETTING (mils)
1	40.083333	1025	962	087
2	40.125000	1026	963	090
3	40.166667	1027	964	093
4	40.208333	1028	965	096
5	40.250000	1029	966	099
6	40.291667	1030	967	102
7	40.333333	1031	968	105
8	40.375000	1032	969	108
9	40.416667	1033	970	111
10	40.458333	1034	971	114
11	40.500000	1035	972	117
12	40.541667	1036	973	120
13	40.583333	1037	974	123
14	40.625000	1038	975	126
15	40.666667	1039	976	129
16	40.708333	1040	977	132
17	40.750000	1041	978	135
18	40.791667	1042	979	138
19	40.833333	1043	980	141
20	40.875000	1044	981	144
21	40.916667	1045	982	147
22	40.958333	1046	983	150
23	41.000000	1047	984	153
24	41.041667	1048	985	156
25	41.083333	1049	986	159
26	41.125000	1050	987	162
27	41.166667	1051	988	164
28	41.208333	1052	989	167
29	41.250000	1053	990	170
30	41.291667	1054	991	173
31	41.333333	1055	992	176
32	41.375000	1056	993	179
33	41.416667	1057	994	182
34	41.458333	1058	995	185
35	41.500000	1059	996	188
36	41.541667	1060	997	190
37	41.583333	1061	998	194
38	41.625000	1062	999	197

TABLE 2-5. CHANNEL CRYSTAL FREQUENCIES AND PRESELECTOR MICROMETER CAVITY HEAD SETTINGS (cont)

CHANNEL NO.	CRYSTAL FREQUENCIES (mc)	RECEIVER FREQUENCY (mc)	TRANSMITTER FREQUENCY (mc)	MICROMETER CAVITY HEAD SETTING (mils)
39	41.666667	1063	1000	199
40	41.708333	1064	1001	202
41	41.750000	1065	1002	205
42	41.791667	1066	1003	209
43	41.833333	1067	1004	211
44	41.875000	1068	1005	214
45	41.916667	1069	1006	218
46	41.958333	1070	1007	220
47	42.000000	1071	1008	223
48	42.041667	1072	1009	226
49	42.083333	1073	1010	229
50	42.125000	1074	1011	232
51	42.166667	1075	1012	235
52	42.208333	1076	1013	238
53	42.250000	1077	1014	241
54	42.291667	1078	1015	244
55	42.333333	1079	1016	247
56	42.375000	1080	1017	251
57	42.416667	1081	1018	254
58	42.458333	1082	1019	257
59	42.500000	1083	1020	259
60	42.541667	1084	1021	262
61	42.583333	1085	1022	265
62	42.625000	1086	1023	268
63	42.666667	1087	1024	271
64	47.958333	1088	1151	274
65	48.000000	1089	1152	277
66	48.041667	1090	1153	279
67	48.083333	1091	1154	282
68	48.125000	1092	1155	285
69	48.166667	1093	1156	288
70	48.208333	1094	1157	291
71	48.250000	1095	1158	294
72	48.291667	1096	1159	296
73	48.333333	1097	1160	299
74	48.375000	1098	1161	302
75	48.416667	1099	1162	305
76	48.458333	1100	1163	307

TABLE 2-5. CHANNEL CRYSTAL FREQUENCIES AND PRESELECTOR MICROMETER CAVITY HEAD SETTINGS (cont)

CHANNEL NO.	CRYSTAL FREQUENCIES (mc)	RECEIVER FREQUENCY (mc)	TRANSMITTER FREQUENCY (mc)	MICROMETER CAVITY HEAD SETTING (mils)
77	48.500000	1101	1164	310
78	48.541667	1102	1165	312
79	48.583333	1103	1166	315
80	48.625000	1104	1167	318
81	48.666667	1105	1168	320
82	48.708333	1106	1169	323
83	48.750000	1107	1170	325
84	48.791667	1108	1171	328
85	48.833333	1109	1172	331
86	48.875000	1110	1173	333
87	48.916667	1111	1174	336
88	48.958333	1112	1175	338
89	49.000000	1113	1176	341
90	49.041667	1114	1177	343
91	49.083333	1115	1178	346
92	49.125000	1116	1179	349
93	49.166667	1117	1180	351
94	49.208333	1118	1181	354
95	49.250000	1119	1182	356
96	49.291667	1120	1183	359
97	49.333333	1121	1184	361
98	49.375000	1122	1185	364
99	49.416667	1123	1186	367
100	49.458333	1124	1187	369
101	49.500000	1125	1188	372
102	49.541667	1126	1189	374
103	49.583333	1127	1190	377
104	49.625000	1128	1191	379
105	49.666667	1129	1192	382
106	49.708333	1130	1193	385
107	49.750000	1131	1194	387
108	49.791667	1132	1195	390
109	49.833333	1133	1196	392
110	49.875000	1134	1197	395
111	49.916667	1135	1198	397
112	49.958333	1136	1199	400
113	50.000000	1137	1200	403
114	50.041666	1138	1201	405

TABLE 2-5. CHANNEL CRYSTAL FREQUENCIES AND PRESELECTOR MICROMETER CAVITY HEAD SETTINGS (cont)

CHANNEL NO.	CRYSTAL FREQUENCIES (mc)	RECEIVER FREQUENCY (mc)	TRANSMITTER FREQUENCY (mc)	MICROMETER CAVITY HEAD SETTING (mils)
115	50.083333	1139	1202	407
116	50.125000	1140	1203	410
117	50.166667	1141	1204	412
118	50.208333	1142	1305	415
119	50.250000	1143	1206	417
120	50.291667	1144	1207	419
121	50.333333	1145	1208	422
122	50.375000	1146	1209	424
123	50.416667	1147	1210	427
124	50.458333	1148	1211	429
125	50.500000	1149	1212	432
126	50.541667	1150	1213	435

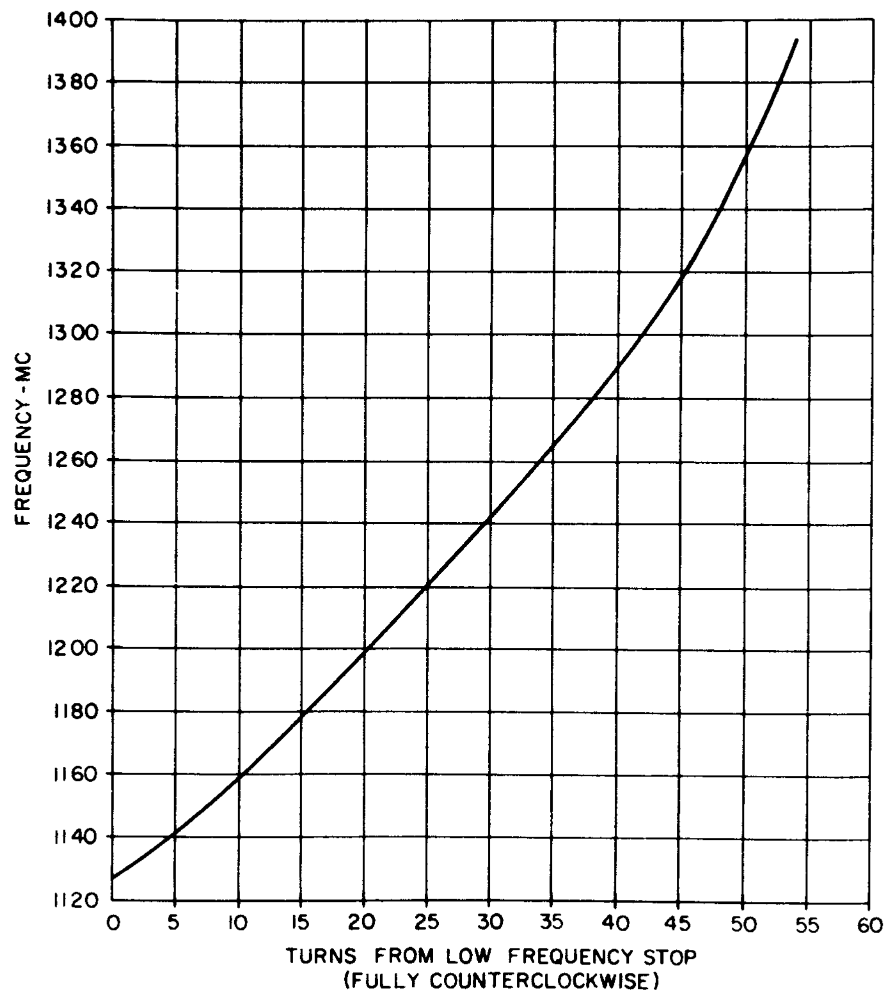


Figure 2-15. Transmission Line Filter Cavity, Tuning Curve

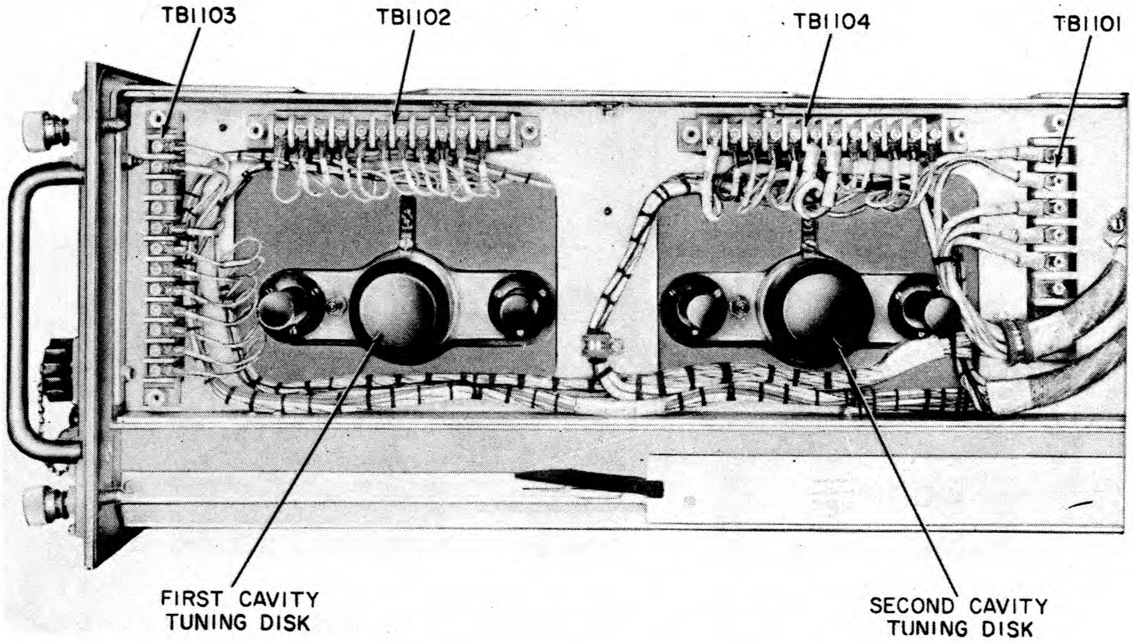


Figure 2-16. Control-Duplexer C-2226A/GRN-9, Right Side View
(There are slight differences between the models of the various manufacturers).

h. ADJUSTMENT OF FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D.

(1) GENERAL.–If the desired output frequency falls between 962 and 1024 mc, the low-band r-f chassis is used, power plug P1504 is connected to jack J1510, the receiver local oscillator signal plug P1514 on cable W1502 is connected to jack J1505, and plug P1513 on cable W1501 is connected to output jack J1506. If the desired output frequency falls between 1151 and 1213 mc, the high-band r-f chassis is used, power plug P1504 is connected to jack J1509, the receiver local oscillator signal plug P1514 is connected to jack J1502, and plug P1513 is connected to the output jack J1503 (figure 2-17).

(2) TUNING CARRIER FREQUENCY GENERATING CHAIN.

Note

With switch S1401 set at TRIPLER and AMPL., TUNING meter M1401 will show a reading, even though these stages are untuned. However, as the associated cavities are tuned through resonance, a definite peak will occur in the meter reading.

Step 1. Insert crystal oven containing crystal of desired frequency into crystal oven socket on frequency multiplier-oscillator r-f chassis. When crystal oven is installed, both OVEN and NORMAL lamps on frequency oscillator-multiplier front panel will go on. Wait until crystal oven reaches operating temperature (indicated when NORMAL lamp goes off) before proceeding with tuning. NORMAL lamp will turn on and off occasionally as crystal oven temperature cycles through its normal operating temperature range.

Step 2. Set switch S1401 to OSC, and adjust oscillator tuning coil L1502 (high band) or L1513 (low band) for maximum reading on TUNING meter M1401 (figures 2-17 and 2-18).

Step 3. Set switch S1401 to 1ST DOUBLER and adjust first doubler tuning coil L1503 (high band) or L1514 (low band for maximum reading on TUNING meter M1401.

Step 4. Set switch S1401 to 2ND DOUBLER and adjust second doubler tuning coil L1509 (high band) or L1519 (low band) for maximum reading on TUNING meter M1401.

Step 5. Set switch S1401 to 3RD DOUBLER and adjust third doubler tuning capacitors C1519 and C1522 (high band) or capacitors C1536 and C1537 (low band) for maximum reading on TUNING meter M1401.

Step 6. Set METER SELECTOR switch S501, located on front panel of radio receiver, to CR201 and adjust tuning screw on tripler cavity Z1501 (high band) or Z1504 (low band)(figure 2-18) for maximum reading on TEST METER M501. If reading on TEST METER M501 exceeds midscale (50 microamperes), open frequency multiplier-oscillator drawer and adjust receiver local oscillator output jack J1502 (high band) or J1505 (low band) by moving assembly in or out until TEST METER M501 reading is below midscale.

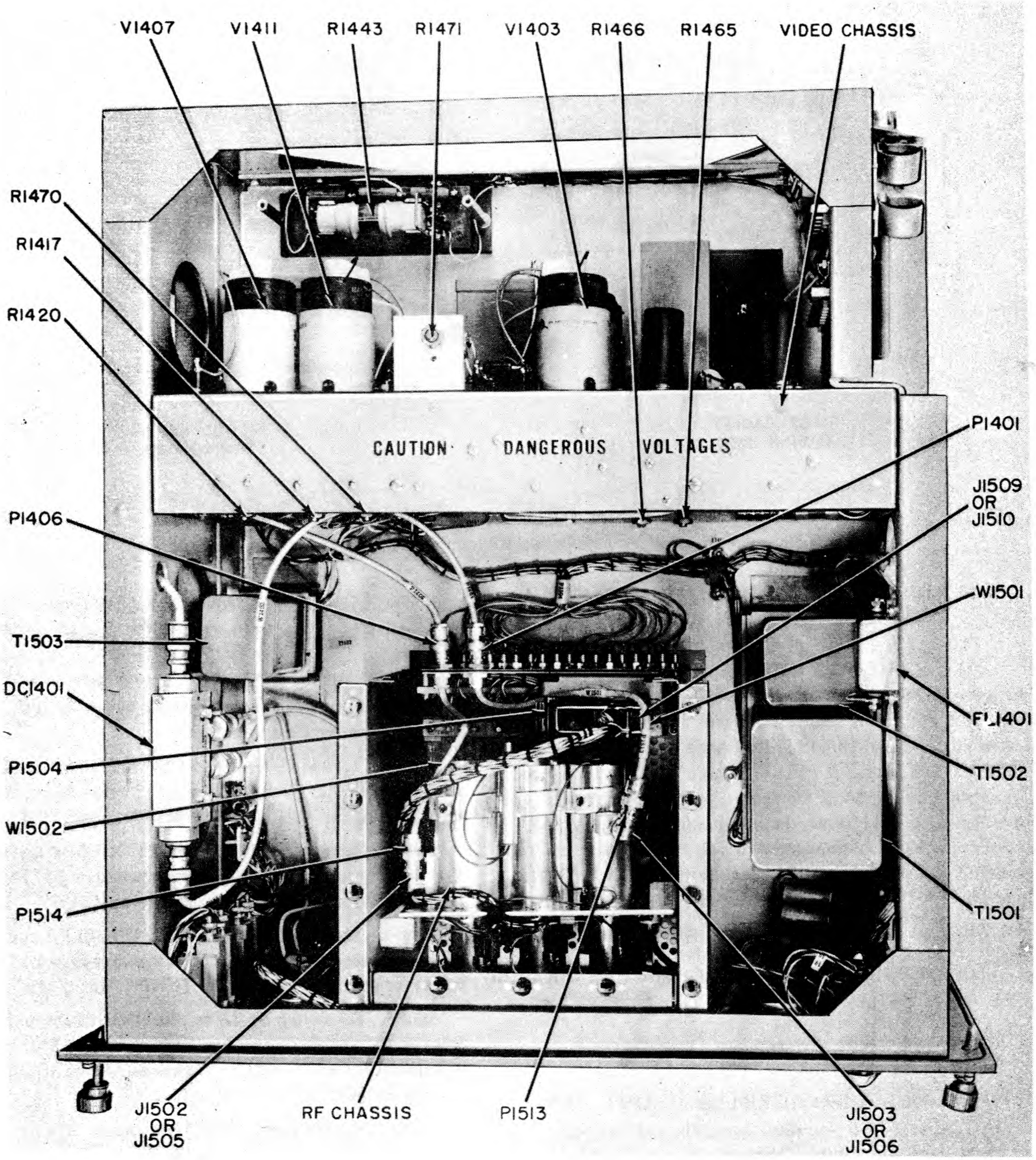


Figure 2-17. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Top View

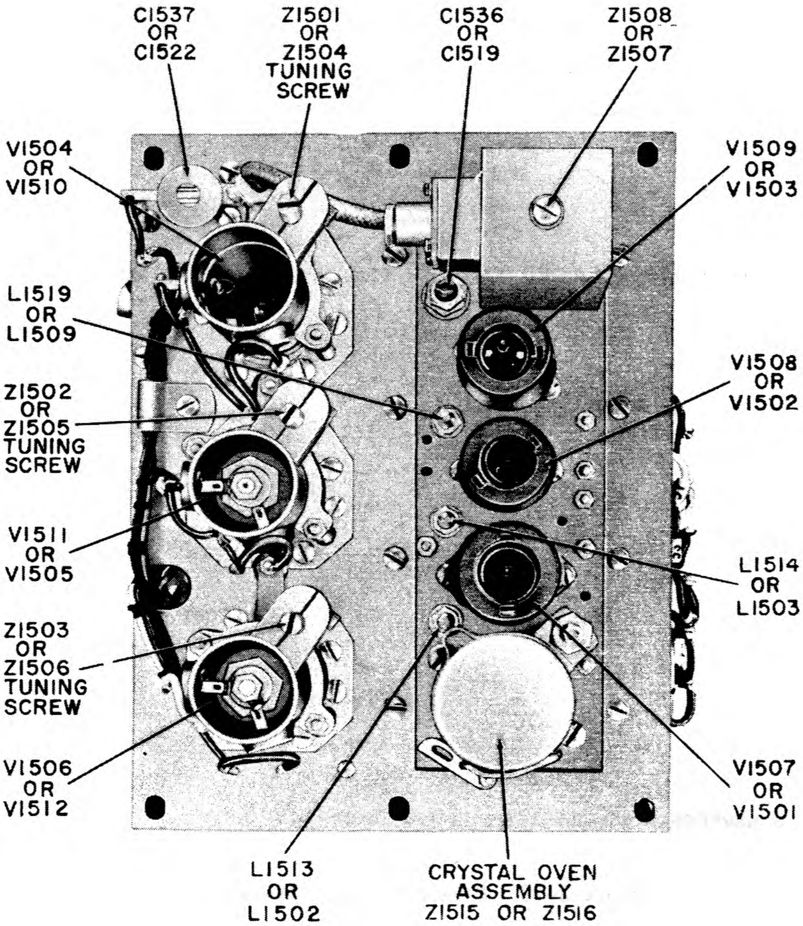


Figure 2-18. Frequency Multiplier-Oscillator CV-1171/GRN-9D,
R-F Chassis, Top View

Step 7. Repeat step 6 until maximum reading, which is below midscale, is obtained on TEST METER M501; then, adjust receiver local oscillator jack J1502 (high band) or J1505 (low band) to set TEST METER M501 reading between 0.6 and 1.0 ma (between 30 and 50 microamperes on meter scale) with METER SELECTOR switch S501 set to CR201 and CR202.

Step 8. Set switch S1401 to AMPL. and adjust tuning screw on first amplifier cavity Z1502 (high band) or Z1505 (low band) for maximum reading on TUNING meter M1401.

Step 9. Recheck current through crystals CR201 and CR202 as described in step 7.

Step 10. Set switch S1401 to INCID.-KLYSTRON INPUT and adjust tuning screw on second amplifier cavity Z1503 (high band) or Z1506 (low band) for maximum reading on TUNING meter M1401.

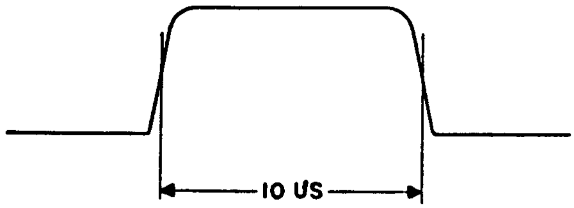
Step 11. Connect vertical input of Oscilloscope OS-54/URN-3 or equivalent to KLYSTRON INPUT-INCIDENT jack J1409, and peak the tuning adjustments of first and second r-f amplifiers described in three steps 8, 9, and 10 to obtain maximum pulse amplitude on oscilloscope screen.

Note

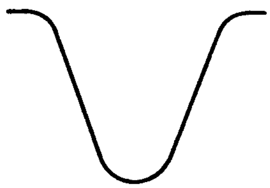
Since both the first and second amplifiers are pulsed, TUNING meter readings for these stages are rather broad. More definite indication of proper tuning is obtained by observing a rectified sample of output pulse on oscilloscope.

Step 12. When observing signal at KLYSTRON INPUT-INCIDENT jack, test lead to oscilloscope should be terminated in a 50- to 70-ohm resistance to prevent distortion of pulse. Pulse should appear as shown in waveform b of figure 2-19.

(3) VIDEO CHASSIS ADJUSTMENTS.—Adjustable components in the frequency multiplier-oscillator video chassis are preset at the factory. Under normal conditions it is not necessary to check these adjust-



a. WAVEFORM OBTAINED AT KLYSTRON INPUT INCIDENT JACK J1409



b. WAVEFORM AT KLYSTRON OUTPUT INCIDENT JACK J1157

Figure 2-19. Klystron Tuning Waveshapes

ments at the time of installation. Detailed instructions on video chassis adjustments are included in Section 6.

i. ADJUSTMENT OF RADIO RECEIVER R-824/URN. —The radio receiver should be adjusted after OFF-ON switch S502 on the radio receiver panel has been set to ON, and after POWER ON lamp DS501 on the receiver panel has been on for 10 minutes.

(1) POWER CHECKS.

Step 1. Set METER SELECTOR switch S501, located on front panel of radio receiver (figure 3-1) to B +200 VFS; meter reading should be 150 volts.

Note

200 VFS means 200 volts full-scale deflection; therefore, a meter reading of 75 represents 150 volts.

Step 2. If meter reading is not 150 volts, adjust potentiometer R507 (figure 6-3) to obtain a reading of 150 volts.

Step 3. Set METER SELECTOR switch to C -200 VFS; meter reading should be -105 ± 5 volts.

Note

-200 VFS represents -200 volts full-scale deflection; therefore, a meter reading of 52.5 represents -105 volts.

(2) SQUITTER CONTROL VOLTAGE CHECK.

Step 1. Turn METER SELECTOR switch S501 on radio receiver panel first to CR201 and then to CR202. In each case, meter reading should be about 1 ma (half-scale deflection).

Step 2. Turn METER SELECTOR switch to SQUITTER CONTROL -10 VFS; meter reading should be about 5 volts (half-scale deflection) when the local oscillator is normal; that is, when 1-ma reading is obtained for either CR201 or CR202 on METER SELECTOR switch.

Step 3. Disconnect local oscillator input at jack J201; meter reading should be no less than 4 volts. Reconnect local oscillator input at jack J201.

(3) SQUITTER RATE ADJUSTMENT.

Step 1. Turn FUNCTION SWITCH on power meter-pulse counter to position 2, RECEIVER SENSITIVITY. (See figure 3-17.)

Step 2. Set COUNTER SELECTOR switch on power meter-pulse counter to SQUITTER.

Step 3. Set RANGE SWITCH on power meter-pulse counter to X10.

Step 4. Squitter rate,as read on PULSE COUNT METER, should be 2700 ±90 pulses per second.

Step 5. If reading obtained in step 4 is not 2700 ±90 pulses per second, carefully adjust PULSE COUNT CONTROL potentiometer R427, located on the video chassis on the left side of the radio receiver drawer unit, until reading of 2700 ±90 pulses per second is obtained on PULSE COUNT METER.

j. ADJUSTMENT OF CODER-INDICATOR KY-382/GRN-9D.

(1) ADJUSTMENT OF 1350-CPS IDENTIFICATION TONE OSCILLATOR. - To adjust the 1350-cps identification tone oscillator (figures 6-6 and 6-7), proceed as follows:

Step 1. Turn on coder-indicator by turning CODER-INDICATOR ON-OFF switch S601 on coder-indicator panel to ON, and BATTLE SHORT switch on control-duplexer to INTLK SHORTED.

Step 2. Turn on antenna by turning ANTENNA CONTROL switch S1102 on control-duplexer panel to ON.

Step 3. Connect coaxial cable from TEST OUTPUT jack on coder-indicator to VERT SIG INPUT jack on oscilloscope.

Step 4. Connect coaxial test lead from SYNC OUTPUT jack on coder-indicator to EXT TRIG INPUT jack on oscilloscope.

Step 5. Open coder-indicator drawer and lower video chassis.

Step 6. Set switch S603,located on top of video chassis, to CONTINUOUS TONE.

Step 7. Lock in signal on oscilloscope with sweep speed set to 4000 microseconds per inch.

Step 8. Auxiliary reference bursts will apear as heavy pulses with tone pulse groups appearing as faint pulses, evenly spaced between auxiliary reference bursts (waveform 24E, figure 5-11). Count number of tone pulse groups which occur between auxiliary reference bursts. If 1350-cps identification tone oscillator is properly adjusted, nine tone pulse groups will appear between auxiliary reference bursts.

Step 9. If necessary, adjust coil L603 on coder-indicator video chassis until nine tone pulse groups appear between auxiliary reference bursts.

Step 10. Set oscilloscope sweep speed to 100 microseconds per inch and lock in two identification pulse pairs on oscilloscope screen.

Step 11. Adjust potentiometer R798 on coder-indicator video chassis until spacing between leading edges of first pulses in each pulse-pair is 100 ±10 microseconds.

(2) ADJUSTMENT OF NORTH AND AUXILIARY REFERENCE BURSTS. -To adjust the north and auxiliary reference bursts (figures 6-6 and 6-7), proceed as follows:

Step 1. Perform steps 1 through 5 of paragraph 2-5j(1).

Step 2. Remove plug P906 from jack J603 on coder-indicator video chassis.

Step 3. Lock in signal on oscilloscope with sweep speed set to 110 microseconds per inch. North reference burst will appear on oscilloscope screen as series of pulse pairs. When radio set is operating properly, north reference burst consists of 12 ±1 pulse pairs (waveform 24A, figure 5-11).

Step 4. Locate potentiometer R675 on coder-indicator video chassis. Loosen shaft locking nut and adjust to obtain 12 pulse pairs on oscilloscope screen.

Note

Turning shaft clockwise decreases the number of pulse pairs. Turning shaft counter-clockwise increases number of pulse pairs.

While observing north reference burst on oscilloscope, turn shaft of potentiometer R675 clockwise to obtain 11 pulse pairs; then turn shaft counterclockwise to obtain 13 pulse pairs. The correct setting of potentiometer R675 is midway between settings which provide 11 and 13 pulse pairs. After potentiometer R675 is set correctly, carefully tighten locking screw.

Step 5. Check spacing between leading edge of first pulse and leading edge of twenty-third pulse; this spacing should be 330 ±5 microseconds (3 inches on oscilloscope screen with sweep speed set at 110 microseconds per inch). If spacing is incorrect, adjust coil L601 on coder-indicator video chassis to obtain correct spacing.

Step 6. Replace plug P906 in jack J603 and remove plug P905 from jack J604.

Step 7. Lock in auxiliary reference burst with sweep speed set to 40 microseconds per inch. When radio set is operating properly, auxiliary reference burst should consist of 6 ±1 pulse pairs.

Step 8. Locate potentiometer R672 on coder-indicator video chassis. Loosen shaft locking nut and adjust potentiometer R672 while observing auxiliary reference burst on oscilloscope. Turn shaft clockwise until five pulse pairs are obtained; then turn shaft counterclockwise until seven pulse pairs are obtained. The correct setting for potentiometer R672 is midway between settings which give five and seven pulse pairs.

Step 9. Check spacing between leading edge of first pulse and leading edge of eleventh pulse; this spacing should be 120 ±2 microseconds (3 inches on oscilloscope with sweep speed set to 40 microseconds per inch). If spacing is incorrect, adjust coil L602 on coder-indicator chassis to obtain correct spacing. After completing this step, north and auxiliary bursts are properly adjusted. Replace plug P905 in jack J604 and close coder-indicator drawer.

(3) SETTING IDENTIFICATION CALL CODE. - For tactical reasons it may be necessary to change the identification call code. Whenever a new code is to be assigned to the radio beacon, reset the code as follows:

Note

If the radio beacon must provide bearing and distance information to aircraft during the time taken to set up the code, turn BATTLE SHORT switch on control-duplexer to INTLK SHORTED. The radio beacon will continue to transmit a signal normal in every way except for the absence of the identification call tone. After setting the code, turn BATTLE SHORT switch to NOR (normal operating). Shut off equipment if supplying bearing and distance information is not necessary.

Step 1. Loosen the four captive screws holding coder-indicator in place and slide drawer forward. The code wheel and coder switch will be exposed on right side of drawer (figure 6-7).

Step 2. Turn off coder switch S605 located below and to right of the center of the keying wheel.

Step 3. Remove hub nut from keying wheel shaft by rotating hub nut counterclockwise.

CAUTION

Be sure to lift keying switch S607 cam during removal of keying wheel, to prevent damaging cam.

Step 4. To remove keying wheel, pull it forward by handles provided.

Step 5. Starting with segment indicated by START CODE arrow and going in clockwise direction, set back first three segments before starting first code character.

Step 6. Set up first character of code, using one segment pulled out for each dot, three segments pulled out for each dash, and one segment set in for space between dots and dashes (figure 3-12).

Step 7. Continuing in clockwise direction, set three segments in, to provide one full space between characters.

Step 8. Set up remaining characters of code following procedure outlined in steps 6 and 7.

Step 9. Replace keying wheel and restore coder-indicator drawer to operating position by reversing procedure outlined in steps 1 to 4.

k. AGING THE KLYSTRON. - To age the klystron, proceed as follows (figures 2-7 and 2-8):

Note

A new klystron, or one that has not been energized within three months or more must be aged according to the following procedure before being used. When installing a klystron, or making more than a minor change in output frequency, the three cavities of the klystron should be pretuned mechanically to the approximate operating frequency by reference to the individual tuning chart provided with each klystron. This should be done while the klystron is out of the equipment to permit access to the three adjusting nuts on each cavity. Refer to paragraph 2-4c for this tuning procedure. Before aging a new klystron, check the filament voltage and, if necessary, adjust to be within the range 4.1V to 4.3V, see para. 2-5c.

Step 1. Set HV switch S1902 on high voltage power supply to OFF.

Step 2. Disconnect r-f drive at input BNC jack on klystron.

Step 3. Turn MASTER SWITCH S1101 on control-duplexer to OFF.

Step 4. Set BREAK IN-OPERATE switch S1006 behind power supply blower compartment front panel to BREAK-IN.

Step 5. Reduce grid drive voltage to zero by turning CODER-INDICATOR switch to OFF and potentiometer R1470 located on the frequency multiplier-oscillator video chassis, completely counterclockwise (figure 2-17).

WARNING

Make sure that HV switch S1902 on high voltage power supply is off and that high voltage is discharged.

Step 6. Connect multimeter (AN/PSM-4 or equivalent)across klystron grid to cathode (figure 2-8). Set multimeter to appropriate range to read approximately 125V dc negative on grid with reference to cathode.

Step 7. Turn MASTER SWITCH to ON.

Step 8. Reading from klystron grid to cathode should be -125V dc. If not, adjust potentiometer R1382 on bias supply chassis of amplifier modulator (figure 2-8) for -125V.

Step 9. Turn MASTER SWITCH to OFF and remove multimeter.

Step 10. Turn MASTER SWITCH to ON and operate klystron filament for 15 minutes.

Step 11. Set HV switch S1902 on high voltage power supply to ON. Allow a 15-minute warmup period before proceeding.

Step 12. Set CODER-INDICATOR switch to ON and adjust potentiometer R1470 until 10 ma of beam current is indicated on BEAM CURRENT meter M1301, located on front panel of amplifier-modulator. Allow a 15-minute period before proceeding.

Step 13. Every 5 minutes, for 15 minutes, advance potentiometer R1470 clockwise to provide incremental increase of 10 ma until 50 ma of beam current is reached. Operate at 50 ma beam current for 5 minutes.

Step 14. Set HV switch to OFF, turn potentiometer R1470 completely counterclockwise, and turn MASTER SWITCH to OFF.

Step 15. Set BREAK IN-OPERATE switch S1006 behind power supply blower compartment front panel to OPERATE.

Step 16. Turn MASTER SWITCH to ON.

Step 17. Set HV switch to ON and turn potentiometer R1470 clockwise until 60 ma of beam (HV) current is reached.

Step 18. Every 5 minutes during a 15-minute period, advance potentiometer R1470 clockwise to provide incremental increase of 10 ma until 90 ma is reached. Operate at 90 ma beam current for 5 minutes.

Step 19. Set MASTER SWITCH and HV switch to OFF and discharge high voltage.

Step 20. Reconnect r-f drive at input BNC jack on klystron.

Step 21. Klystron SAL-89 is now properly aged; check setting of potentiometer R1420 as follows:

a. Set HV switch and CODER-INDICATOR switch to OFF.

b. Connect multimeter (AN/PSM-4 or equivalent) across potentiometer R1425 in frequency multiplier-oscillator video chassis.

c. Set MASTER SWITCH to ON and adjust potentiometer R1420 to obtain reading of 8 volts dc.

l. TRANSMITTER OUTPUT CIRCUIT TUNING ADJUSTMENT.

(1) GENERAL INSTRUCTIONS.

(a) When installing a klystron, or making more than a minor change in output frequency, mechanically pretune the three cavities of the klystron to the approximate operating frequency. This should be done while the klystron is out of the equipment, to permit access to the three adjusting nuts on each cavity. To tune the three cavities, proceed as follows:

Step 1. Refer to special klystron chart provided with klystron; this chart shows a curve for each of the three cavities: INPUT, MIDDLE, and OUTPUT. (A typical klystron chart is shown in figure 2-9 for explanatory purposes only.) Transmitter frequency is represented in horizontal scale of the curve; spacing in thousandths of an inch between inside surface of flanges is represented in vertical scale of the curve.

Step 2. Choose proper transmitter frequency and record proper spacing for each cavity.

Step 3. Check, and if necessary, readjust each cavity to settings recorded, making use of wrench provided and an inside vernier caliper. Flanges must be kept parallel to each other; this is accomplished by not turning any one nut more than a full turn before turning the other nuts the same amount.

(b) If klystron is being energized for the first time, or has not been energized during the past 3 months, age it according to procedure outlined in paragraph 2-5k.

(c) To perform several of the steps listed in tuning procedure (paragraph 2-5l(2)), detect the r-f carrier signal and observe detected pulse on oscilloscope. To preserve pulse shape, terminate coaxial test lead from oscilloscope to test jacks on radio set in low impedance at oscilloscope end. To provide this termination, connect BNC T-connector UG-274/U to oscilloscope end of test lead, and connect a BNC 50-ohm termination MX-554/U to T-connector. (If MX-544/U termination is not available, connect 1/2-watt, 50- to 70-ohm resistor across side jack of T-connector.) This termination must be used when observing signal at KLYSTRON INPUT INCIDENT and REFLECTED jacks on frequency multiplier-oscillator front panel, and at KLYSTRON OUTPUT INCIDENT and REFLECTED jacks and ANTENNA INCIDENT and REFLECTED jacks on the control duplexer front panel.

(d) Before tuning transmitter output circuits, tune carrier frequency generating chain in frequency multiplier-oscillator drawer (paragraph 2-5h).

(e) When tuning the radio set for first time or when making a large change in output frequency, preset resonant cavities of transmission line filter according to tuning curves shown in figure 2-15. Rotate tuning disc (figure 2-16) fully counterclockwise and then clockwise by the number of turns specified on tuning curves. When tuning the radio set to an adjacent channel or making slight change in tuning, it is not necessary to preset the transmission line filter cavities.

(f) The proper tuning procedure for klystron SAL-89 includes three basic steps which if performed, prevent damage of the klystron output connector from high transmission line voltage and r-f arcing. To perform these three steps, proceed as follows:

Step 1. Create matched r-f transmission line while operating reduced klystron power levels (steps 1 through 19 of paragraph 2-51(2)).

Step 2. Apply rated klystron output power to this matched load by tuning klystron to deliver maximum power at rated operating voltage (steps 20 through 25, paragraph 2-51(2)).

CAUTION
(ITT Models only)

The transmission filter cavities must be allowed to reach operating temperature before any attempt is made to retune the klystron. Operating temperature has been reached when the OVEN lamp DS1105 on front panel of the control-duplexer begins to flash.

Step 3. Without retuning klystron output cavity, adjust double slug tuner, filter cavities, klystron input and middle cavity for best shape and spectrum with rated antenna power (step 26, paragraph 2-51(2)).

(2) TUNING ADJUSTMENTS. —To perform the tuning adjustments, proceed as follows:

Note

Refer to paragraph 2-51(1) before proceeding.

Step 1. Reduce grid drive to zero by turning potentiometers R1470 and R1471, located on the frequency multiplier-oscillator video chassis, completely counterclockwise (figure 2-17).

WARNING

Make sure HV switch S1902 on high voltage power supply is off and that high voltage is discharged.

Step 2. Connect multimeter (AN/PSM-4 or equivalent) across klystron grid and cathode connections (figure 2-8). Set multimeter to appropriate range to read approximately 125 volts dc negative on grid with reference to cathode.

Step 3. Turn MASTER SWITCH S1101 to ON.

Step 4. Reading from klystron grid to cathode should be -125-volt dc; if not, adjust potentiometer R1382 on bias supply chassis of amplifier-modulator (figure 2-8) for -125 volts.

Step 5. Turn MASTER SWITCH to OFF and remove multimeter.

Step 6. Set HV switch S1902 and CODER-INDICATOR switch S601 to OFF and connect multimeter (AN/PSM-4 or equivalent) across potentiometer R1425 on frequency multiplier-oscillator video chassis. Turn MASTER SWITCH S1101 to ON.

Step 7. Adjust potentiometer R1420 to obtain reading of 8 volts dc on multimeter and remove multimeter.

Step 8. Set HV switch S1902 and CODER-INDICATOR switch S601 to ON and check shaped pulse on oscilloscope.

Step 9. Turn MASTER SWITCH S1101 to OFF and remove multimeter.

Step 10. Turn MASTER SWITCH S1101 to ON.

Step 11. Adjust potentiometer R1470 (figure 2-17) to set beam current, as indicated by BEAM CURRENT meter M1301, to 30 ma. Set HV switch S1902 to OFF

Step 12. Connect oscilloscope input to SHAPED PULSE jack J1405 on frequency multiplier-oscillator front panel. Connect oscilloscope sync jack to VIDEO IN jack J1404 on frequency multiplier-oscillator front panel. Adjust oscilloscope sweep and position controls to position klystron grid drive pulse peaks on two easily remembered graticule lines.

Step 13. Connect oscilloscope to KLYSTRON INPUT INCIDENT jack J1409. Tune output cavity of the frequency multiplier-oscillator for maximum pulse amplitude at time of klystron grid drive pulse peaks by matching klystron input reflected pulse peaks to graticule lines selected in step 12.

Step 14. Connect oscilloscope to KLYSTRON INPUT REFLECTED jack J1408. Tune input cavity of klystron for minimum reflected signal at time of klystron grid drive pulse peaks.

Step 15. Repeat steps 13 and 14 until there is no further improvement, and the best symmetry about the peak of the klystron incident pulses is attained.

Note

To preserve the waveshape of the detected r-f pulse monitored at the center cavity of the klystron, klystron output, and antenna jacks, connect a 10-db pad between the jack to be monitored and crystal detector E1152. The crystal detector is stored within the control-duplexer drawer.

Step 16. Connect oscilloscope through crystal detector E1152 to klystron center cavity jack. Adjust center cavity for maximum output without pulse flattening or loss of symmetry.

Step 17. Connect oscilloscope through crystal detector E1152 to KLYSTRON OUTPUT INCIDENT jack J1157 and adjust output cavity of klystron and double slug tuner (figure 2-20) for maximum output without pulse flattening or loss of symmetry.

Step 18. Connect oscilloscope through crystal detector E1152 to KLYSTRON OUTPUT REFLECTED jack J1152 and tune first filter cavity for minimum at peak of pulse. The first filter cavity is on the left as

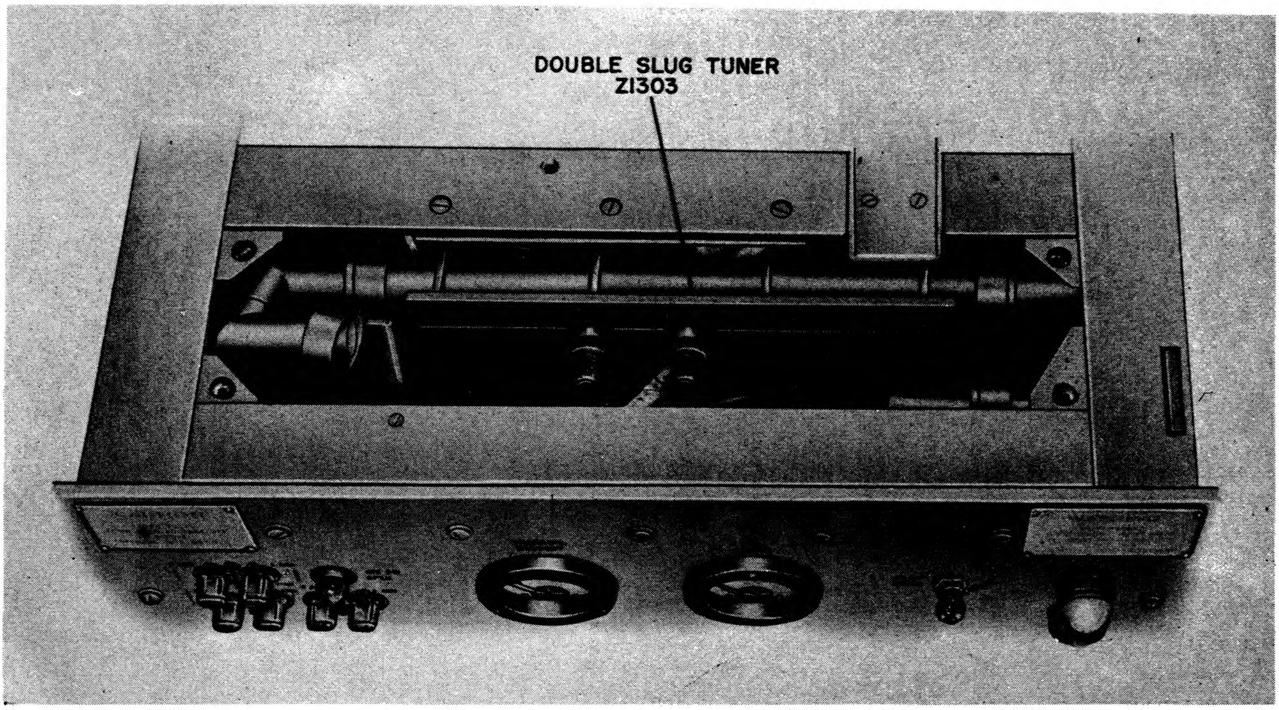


Figure 2-20. Amplifier Modulator AM-1701/URN, Top Front View Showing Double-Slug Tuner

seen when facing right side of fully opened control-duplexer drawer (figure 2-16).

Step 19. Leave oscilloscope connected as in step 11 and tune second filter cavity for minimum reflected signal.

Step 20. Set HV switch S1902 to ON.

Step 21. Connect oscilloscope through crystal detector E1152 to KLYSTRON OUTPUT INCIDENT jack J1157. Adjust potentiometer R1470 for maximum pulse amplitude possible without limiting. A limited shaped pulse is shown in figure 2-21.

Step 22. Detune center cavity of klystron toward high frequency side until klystron output incident pulse amplitude is halved.

Step 23. Alternately adjust the input cavity of klystron and output cavity of frequency multiplier-oscillator for maximum output.

Step 24. Alternately adjust klystron output cavity and double-slug tuner for maximum pulse amplitude without pulse flattening or loss of symmetry. Adjust klystron center cavity for maximum pulse amplitude without flattening or loss of symmetry.

Step 25. Connect oscilloscope through crystal detector E1152 to ANTENNA OUTPUT INCIDENT jack J1157. Make minor adjustments in klystron center and output cavities and double-slug tuner for best pulse shape for spectrum.

CAUTION

After this adjustment, the output cavity of the klystron must not be retuned.

Step 26. Connect oscilloscope through crystal detector E1152 to ANTENNA INCIDENT jack J1154. Tune first and second filter cavities and make minor adjustments in double-slug tuner and in klystron input and center cavities while viewing antenna incident signal for specified power and for best pulse shape for spectrum. Further pulse shape improvement can frequently be obtained by repeating step 21.

Step 27. With oscilloscope connected as directed in step 26, look at the auxiliary reference burst on oscilloscope screen. Check that amplitude of pulses remains constant throughout reference burst. If reference burst appears as shown in waveform c of figure 2-21, no further adjustment is necessary. If reference burst appears as shown in either waveform a or b of figure 2-21, adjust potentiometer R1471 on frequency multiplier-oscillator video chassis (figure 2-17) to obtain a constant amplitude for all pulses in reference burst, as shown in waveform. Adjustment of potentiometer R1470, as described in step 17, and the adjustment of potentiometer R1471 are interde-

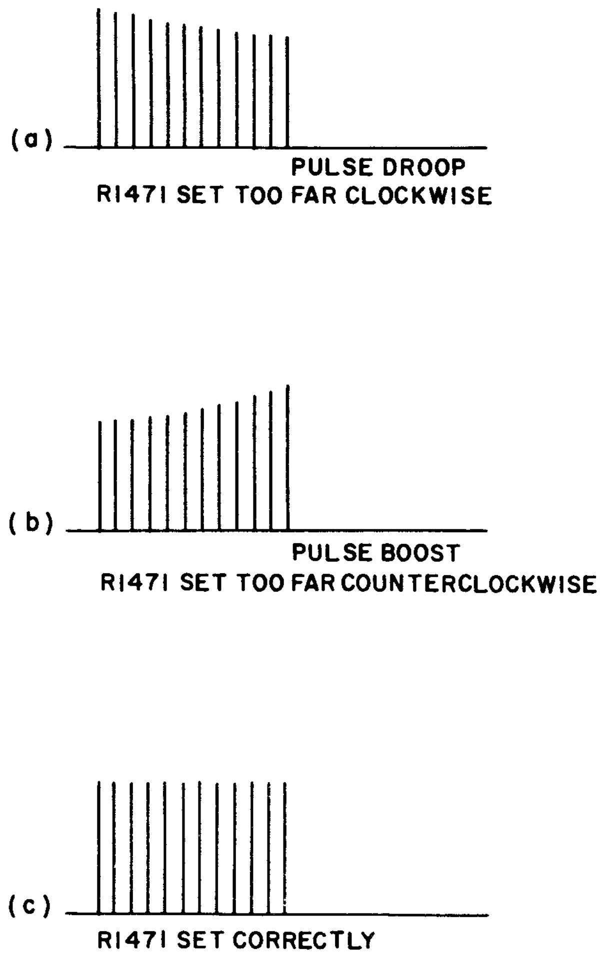


Figure 2-21. Frequency Multiplier-Oscillator, Adjustment of R1471 to Correct for Pulse Droop in Reference Bursts

pendent. If it is necessary to adjust potentiometer R1471 to minimize droop, recheck readjustment of potentiometer R1470 by observing a single pulse on oscilloscope and touching up adjustment of potentiometer R1470 to obtain maximum pulse amplitude possible without limiting.

m. RADIO BEACON PERFORMANCE CHECKS. — After the equipment has been checked, aligned, and adjusted as described in the preceding paragraphs, make the overall radio beacon performance checks described in paragraphs 3-6a(1) through 3-6a(11) of Section 3. Use the built-in test equipment for these checks. If all the requirements given for these checks are met, the radio beacon may be assumed to be in proper operating condition, and it is ready to be turned over to operating personnel.

Note

Detailed procedures for checking the performance of the radio beacon are also covered in the Performance Standards Handbook, NAVSHIPS 93881.32, furnished with the equipment.

2-6. PREPARATION FOR RESHIPMENT.

To prepare the equipment for reshipment, reverse the order of the procedure for installing the klystron and unpacking the equipment. Determine whether the shipment is domestic or overseas and pack accordingly. Mark the carton containing the technical manuals: TECHNICAL MANUALS INSIDE.

SECTION 3
OPERATOR'S SECTION

3-1. FUNCTIONAL OPERATION.

a. GENERAL. —Radio beacons installed at shore stations employ Radio Set AN/GRN-9D, and the associated antenna groups and accessories. The radio beacon installation consists of, a receiver-transmitter group (figure 1-2), a power supply assembly (figure 1-3), and an antenna group. The major units of radio beacon are identified in table 1-1 and shown in figure 1-1.

The signals transmitted by these radio beacons provide aircraft equipped with Radio Set AN/ARN-21 with the distance and bearing information needed to determine their positions.

The AN/ARN-21 transmitter in the aircraft requests distance information by sending out interrogation signals with a repetition pattern peculiar to that transmitter. Reception of these distance interrogations at the radio beacon causes the transmission of a series of replies having the same pattern. The aircraft receives these replies along with other replies emitted by the beacon in response to interrogations from other aircraft. The AN/ARN-21 then picks out its own reply by comparing the reply pulse patterns with that of its own transmitter. Distance is determined by measuring the total time elapsed between the initial transmission of the distance interrogation pulse pair and receipt of the corresponding radio beacon reply pulse pair, and translating this time into miles.

The radio beacon transmits bearing information by rotating a lobed antenna radiation pattern through 360 degrees, and then transmitting omnidirectional bursts of reference pulse pairs at the instant that the antenna radiation pattern is in certain reference positions. The aircraft obtains its bearing by noting the position of the antenna pattern, as determined by the relative signal strength at the time of the reference burst. A more detailed description of the operation of the radio beacon is given in Section 4.

b. CAPABILITIES AND LIMITATIONS.

(1) RADIO BEACON. —The radio beacon transmits on one of 126 channel frequencies one mc apart, in the ranges between 962 and 1024 mc and between 1151 and 1213 mc. It receives on one of 126 channel frequencies one mc apart, in the ranges between 1025 and 1150 mc.

The radio beacon can provide individual distance-measuring service to 100 interrogating aircraft simultaneously. The repetition frequency of the average distance interrogation pulse which the radio beacon receives is 24 cps, from as many as 95 interrogating aircraft. When receiving from 100 aircraft simultaneously, the radio beacon is operating at full load. The number of pulse pairs that the beacon transmits per second is 3600. Of these, 2700 are either random-noise pulses or replies to distance interrogations, and the remaining nine hundred are the reference burst pulses used to provide bearing information. Once every 37.5 seconds, the interrogation-reply and random-noise pulses are interrupted for the transmission of identification-tone pulses.

Peak power emitted from the AN/GRN-9D is 7.5 kw. Maximum range of the radio beacon is 200 miles for distance information. Bearing information may be received beyond 200 miles depending on the altitude of the aircraft. Aircraft flying in the cone of silence, approximately 55 degrees in any direction from the vertical extension of the antenna axis, will receive distance replies but not bearing information.

The 126 pairs of frequencies to which the radio beacon can be tuned fall into two groups of 63 pairs each. Since one of these groups requires a high-band antenna and the other a low-band antenna, operation of any given beacon is limited to one group of 63 channels.

(2) RADIO RECEIVER R-824/URN. —Radio Receiver R-824/URN (figure 3-1) receives and decodes pulse pairs in the frequency range of 1025 to 1087 mc when the low-band antenna is used, and 1088 to 1150 mc when the high-band antenna is used.

The radio receiver converts the received distance interrogation pulse pairs, along with random noise pulses, into an intermediate frequency of 63 mc, and amplifies and demodulates these signals. It also produces, by means of a coincidence-type decoding circuit, a single pulse for each pulse pair (interrogation or noise).

(3) CODER-INDICATOR KY-382/GRN-9D. — Coder-Indicator KY-382/GRN-9D (figure 3-2) receives distance information and noise pulses from the radio receiver. It also receives 15-cps trigger pulses and 135-cps trigger pulses from the reference pulse-generator in the antenna. The 15-cps trigger, the 135-cps trigger, and the pulses from the radio receiver are coded and mixed in proper sequence by the coder-indicator into pulses that are applied to the frequency multiplier-oscillator of the transmitter. To prevent the transponder from responding to its own transmitted output, the coder-indicator blanks the radio receiver while a pulse pair is being transmitted. The coder-indicator also generates an identification call signal which is applied to the frequency multiplier-oscillator.

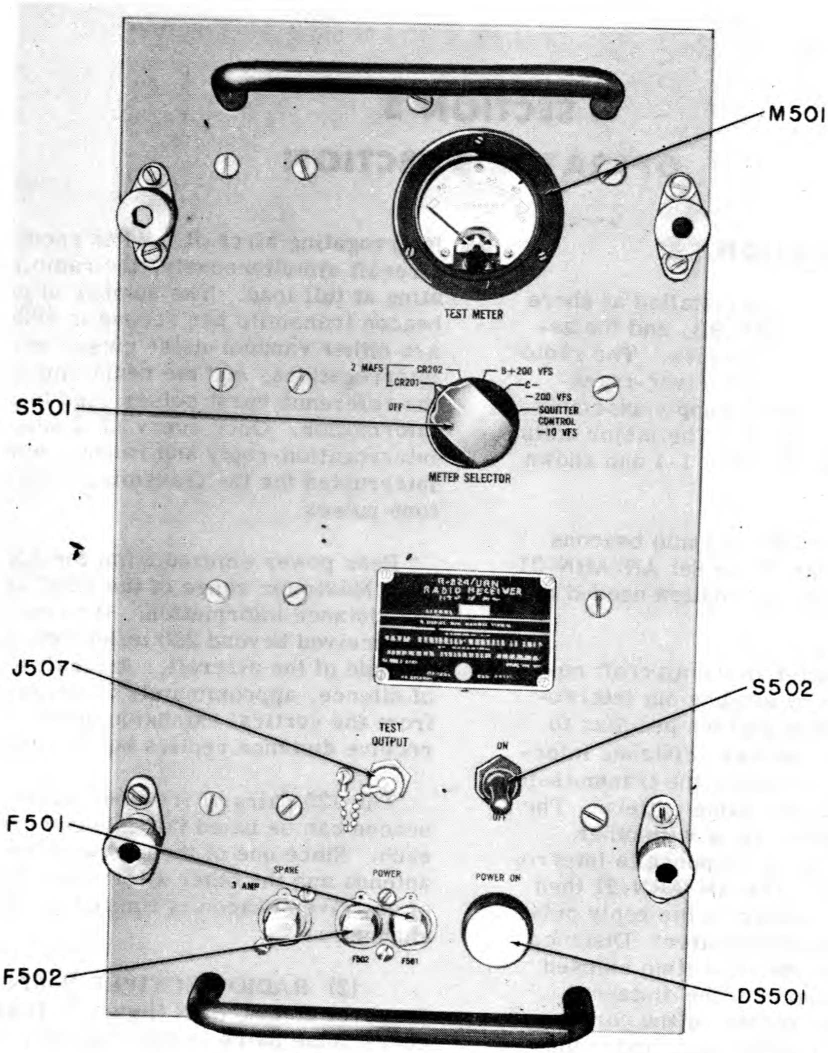


Figure 3-1. Radio Receiver R-824/URN, Front Panel View

(Models fitted for TMC have a 10 dB COUPLER socket).

(4) TRANSMITTER. —The radio transmitter includes the frequency multiplier-oscillator (figure 3-3), the amplifier-modulator (figure 3-4), and the duplexer in the control-duplexer (figure 3-5), and produces shaped r-f pulses spaced at proper time intervals, which are radiated from the antenna. It is capable of transmitting on any one of 126 channels in the frequency ranges of 962 to 1024 mc and 1151 to 1213 mc. The primary function of the duplexer is to permit simultaneous reception and transmission over a common antenna without interference. The receiver and transmitter carrier frequencies are always 63 mc apart.

(5) CONTROL CIRCUITS.—The control circuits of the radio beacon make it possible to automatically energize the units of the beacon in proper sequence so that no unit will be overloaded or damaged due to improper warmup. These circuits provide overload protection; the overload protective relays shut the system down for 3 seconds if an overload occurs, and then automatically re-energize it. They will do this a total of three times during a continued overload and then will shut down the system until the cause of the overload is removed, after which the overload circuits must be manually reset. Other circuits put the automatic overload circuit into operation if a power phase or a high-voltage rectifier tube fails.

3-2. OPERATING PROCEDURES.

a. GENERAL. —The radio beacon is started, monitored, and stopped by controls located on the front panels of the receiver-transmitter and the power supply assembly cabinets. With the exception of EMERGENCY SWITCH S901 on the bottom panel of the receiver-transmitter group, all controls for starting the radio beacon are on the front panels of the individual units. Meters and lamps on the units indicate the stages completed in energizing the radio

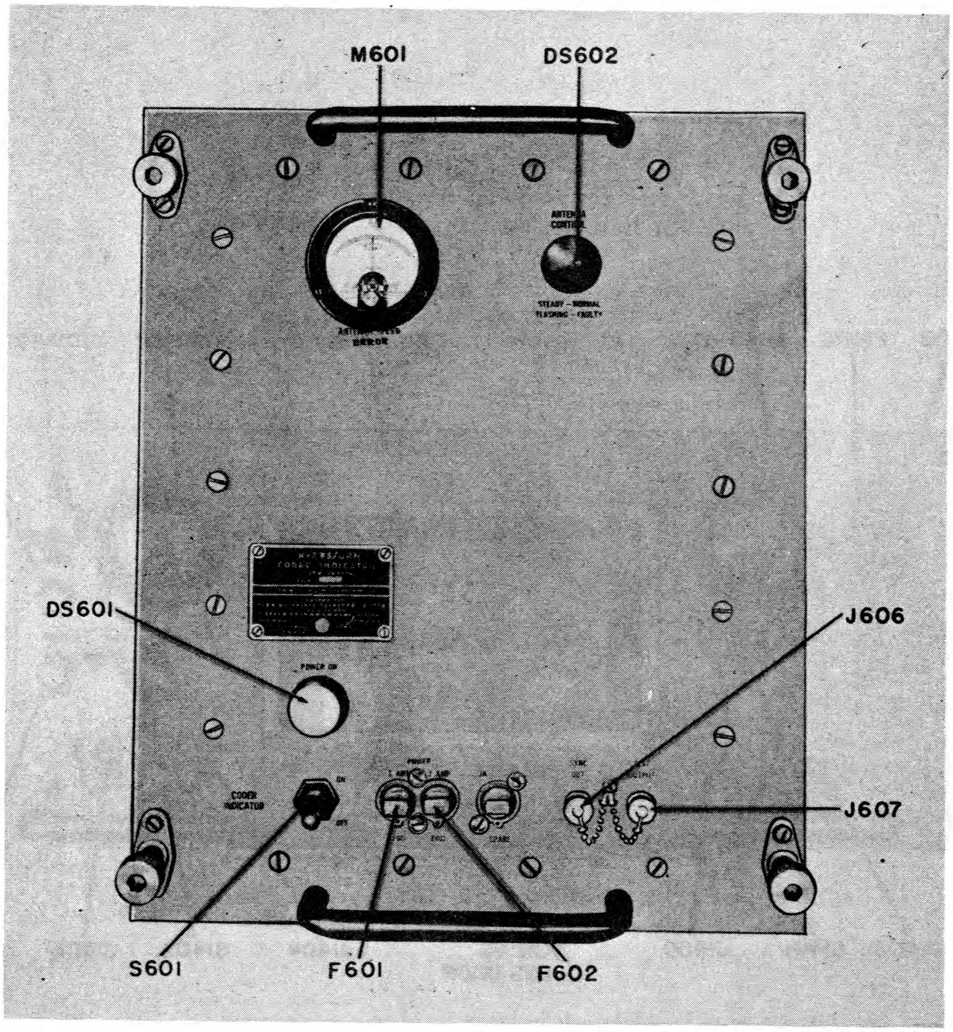


Figure 3-2. Coder-Indicator KY-382/GRN-9D, Front Panel View

beacon, but it is not necessary for the operator to consult them during normal operation of the equipment. Because the various units of the radio beacon should be energized in proper sequence, relay circuits are provided which prevent the turning on of any unit prematurely.

b. DESCRIPTION OF CONTROLS. —Radio Set AN/GRN-9D consists of two main groups, Receiver-Transmitter OA-3352/GRN-9D, and Power Supply Assembly OA-1537A/GRN-9A.

(1) RECEIVER-TRANSMITTER OA-3352/GRN-9D. —The receiver-transmitter group includes the following drawer units which are housed in Cabinet CY-3163/GRN-9D:

(a) Radio Receiver R-824/URN (figure 3-1).

(b) Coder-Indicator KY-382/GRN-9D (figure 3-2).

(c) Frequency Multiplier-Oscillator CV-1171/GRN-9D (figure 3-3).

(d) Amplifier-Modulator AM-1701/URN (figure 3-4).

(e) Control-Duplexer C-2226A/GRN-9 (figure 3-5).

A description of each control and indicator in the receiver-transmitter group is presented in table 3-1. The controls and indicators are listed according to their physical location on the individual drawer units and their location on the cabinet (figure 3-6). Illustrations which will aid in the location of the controls and indicators are listed in the table.

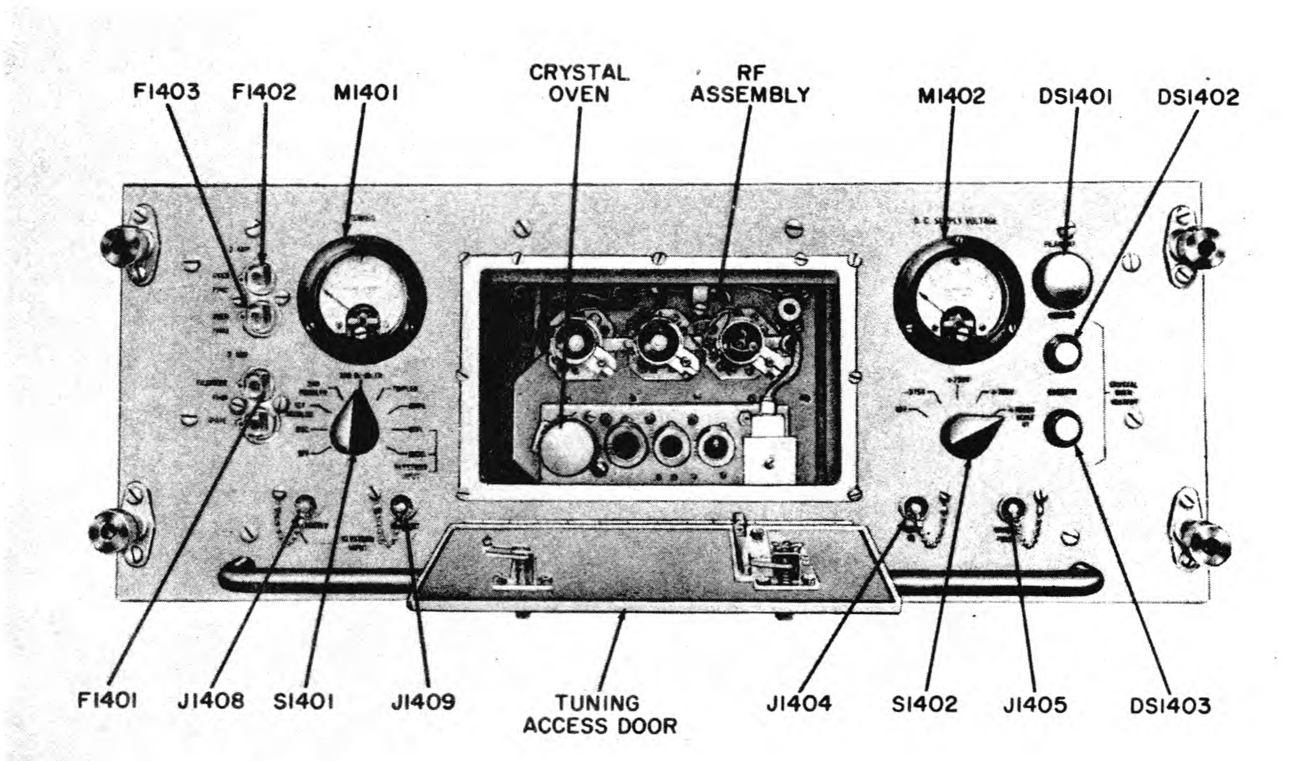


Figure 3-3. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Front Panel View

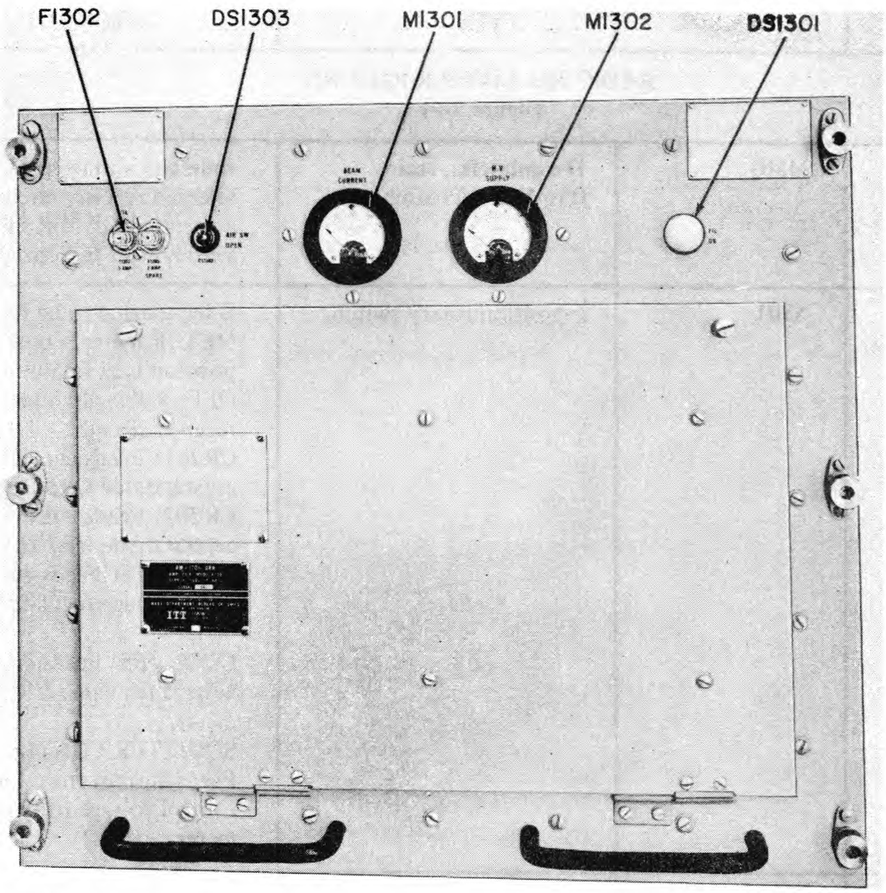
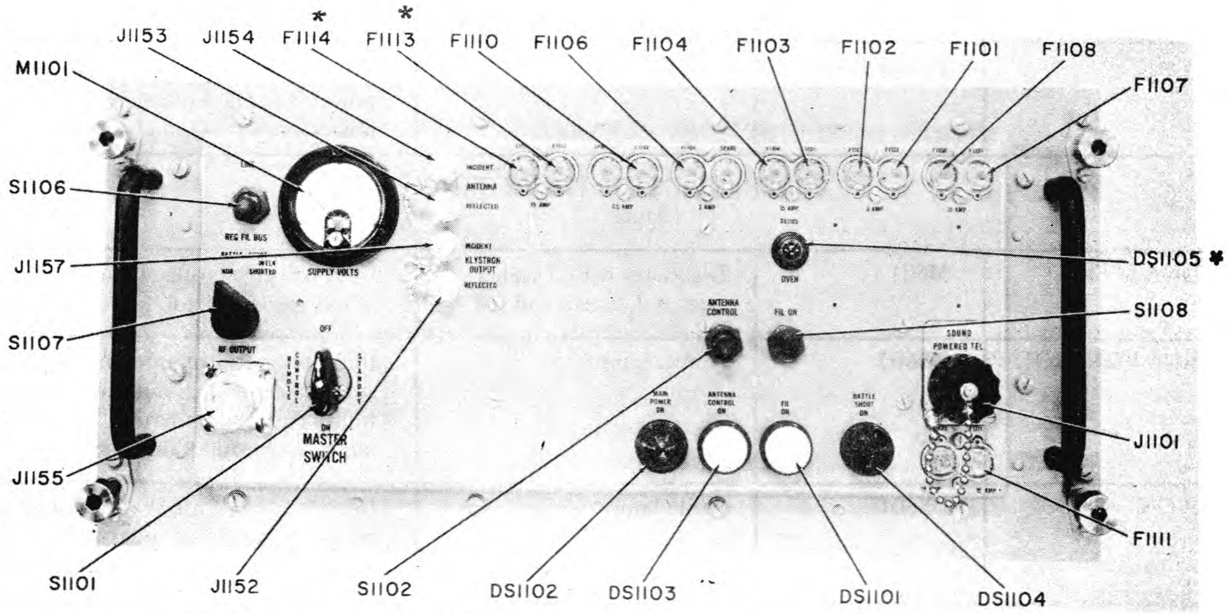


Figure 3-4. Amplifier-Modulator AM-1701/URN, Front Panel View



* (ITT. Models only)

Figure 3-5. Control-Duplexer C-2226A/GRN-9, Front Panel View

TABLE 3-1. RECEIVER-TRANSMITTER GROUP OA-3352/GRN-9D, CONTROLS AND INDICATORS

NAME OR PANEL MARKING	REFERENCE SYMBOL	TYPE	FUNCTION
RADIO RECEIVER R-824/URN (figure 3-1)			
TEST METER	M501	D-c ammeter, scale, 0 to 100 microamperes	Indicates voltage present in selected receiver circuit when associated METER SELECTOR switch is set to desired position.
METER SELECTOR	S501	6-position rotary switch	Selects signal to be fed to TEST METER meter. Function of each position is as follows: OFF: Meter disconnected from receiver circuits. CR201: Feeds current from crystal diode CR201 to meter. CR202: Feeds current from crystal diode CR202 to meter. B+200VFS: Feeds current from +150 voltage regulator VR503 to meter. C-200 VFS: Feeds current from voltage regulator VR503 to meter. SQUITTER CONTROL -10 VFS: Feeds current from squitter control voltage regulator to meter.
ON-OFF	S502	Toggle switch	Control for energizing or de-energizing receiver.
POWER	F501 and F502	Blown fuse indicating fuse holders	Fuse cap goes on, indicating corresponding primary power fuse has blown.
POWER ON	DS501	White lamp	Goes on to indicate that primary power is applied to receiver power supply.
CODER-INDICATOR KY-382 GRN-9D (figure 3-2)			
ANTENNA SPEED ERROR	M601	D-c meter with 3 scaled arcs: red, green, and red	Indicates error voltage present in the speed control.
ANTENNA CONTROL	DS602	Amber lamp	Indicates status of antenna and antenna control circuits. Intermittent illumination indicates malfunction.
POWER ON	DS601	White lamp	Goes on to indicate that primary power is applied to coder-indicator power supply.
CODER INDICATOR	S601	Toggle switch	Control for energizing or de-energizing coder-indicator.
POWER	F601 and F602	Blown-fuse indicating fuse holders	Fuse cap goes on indicating corresponding primary power fuse has blown.

TABLE 3-1. RECEIVER-TRANSMITTER GROUP OA-3352/GRN-9D, CONTROLS AND INDICATORS (cont)

NAME OR PANEL MARKING	REFERENCE SYMBOL	TYPE	FUNCTION
FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D (figure 3-3)			
OVEN	F1402 and F1403	Blown-fuse indicating fuse holders	Fuse cap goes on, indicating corresponding crystal oven power fuse has blown.
FILAMENT	F1401	Blown-fuse indicating fuse holder	Fuse cap goes on, indicating filament power fuse has blown.
TUNING	M1401	D-c ammeter, scaled at 0 to 100 microamperes	Tuning indicator. Indicates level of signal from selected circuit when associated meter selector switch is set to desired position.
Meter Selector	S1401	9-position rotary switch	Selects signal to be fed to TUNING meter. Function of each position is as follows: OFF - Meter disconnected from frequency multiplier-oscillator circuits. OSC. - Feeds crystal oscillator V1501A or V1507A grid current to meter. 1ST DOUBLER - Feeds signal from first doubler V1501B or V1507B to meter. 2ND DOUBLER - Feeds signal from second doubler V1502 or V1508 to meter. 3RD DOUBLER - Feeds signal from third doubler V1503 or V1509 to meter. TRIPLER - Feeds signal from tripler V1504 or V1510 to meter. AMPL. - Feeds signal from first amplifier V1505 or V1511 to meter. KLYSTRON INPUT REFL. - Feeds sample of klystron reflected signal to meter. KLYSTRON INPUT INCID. - Feeds sample of klystron incident signal to meter.
D. C. SUPPLY VOLTAGE	M1402	D-c voltmeter, scaled at 0 volt center, 1 kilovolt at both ends	Indicates dc supplied by either low voltage power supply or medium voltage power supply when associated meter selector switch is set to desired position.
Meter Selector	S1402	5-position rotary switch	Selects voltage to be fed to D. C. SUPPLY VOLTAGE meter. Function of each position is as follows: OFF - Meter disconnected from circuit. -375V - Feeds -375-volt d-c output of low voltage power supply to meter.

TABLE 3-2. POWER SUPPLY ASSEMBLY OA-15374A/GRN-9A, CONTROLS AND INDICATORS

NAME OR PANEL MARKING	REFERENCE SYMBOL	TYPE	FUNCTION
			+250V - Feeds +250-volt d-c output of low voltage power supply to meter +700V - Not used. +1000 SCALE X2 - Feeds +1000-volt d-c output of medium voltage power supply to meter.
FILAMENT	DS1401	White lamp	Goes on to indicate that filament voltage is applied to transformer T1501.
NORMAL	DS1402	White lamp	Indicates status of oven heating element: goes on and off as oven heating element goes on and off.
BOOSTER	DS1403	White lamp	Goes on to indicate proper operation of oven heating element.
AMPLIFIER MODULATOR AM-1701/URN (figure 3-4)			
FIL	F1302	Blown-fuse indicating fuse holder	Fuse cap goes on to indicate that fuse F1302 has blown.
AIR SW OPEN	DS1303	Neon lamp	Goes on to indicate that klystron is not receiving sufficient cooling air.
BEAM CURRENT	M1301	D-c ammeter, scaled at 0 to 200 milliamperes	Indicates amplitude of klystron V1304 beam current.
H.V. SUPPLY	M1302	D-c voltmeter, scaled at 0 to 15 kilovolts	Indicates amplitude of voltage supplied by high voltage power supply.
FIL ON	DS1301	White lamp	Goes on to indicate presence of filament voltages.
CONTROL-DUPLEXER C-2226A/GRN-9 (figure 3-5)			
LINE-REG FIL BUS	S1106	Toggle switch	Selects voltage to be fed to SUPPLY VOLTS meter. Function of each position is as follows: LINE - Feeds 120-volt ac (line voltage unregulated) to meter. REG FIL BUS - Feeds 120-volt as (regulated) to meter.
BATTLE SHORT	S1107	2-position rotary switch	Provides means of shorting interlocks.
SUPPLY VOLTS	M1101	A-c voltmeter, scaled at 0 to 150 volts	Indicates amplitude of voltage selected when switch S1106 is set to desired position.

TABLE 3-1. RECEIVER-TRANSMITTER GROUP OA-3352/GRN-9D, CONTROLS AND INDICATORS (cont)

NAME OR PANEL MARKING	REFERENCE SYMBOL	TYPE	FUNCTION
MASTER SWITCH	S1101	4-position rotary switch	Primary control for energizing or deenergizing radio beacon when EMERGENCY SWITCH is set to ON. Function of each position is as follows: OFF - Deenergizes radio beacon. STANDBY - Connects all filament voltages and disconnects all dc supplied to individual drawer units. ON - Energizes radio beacon. REMOTE CONTROL - Transfers OFF-ON control of radio beacon to remote location.
Blown fuse indicators	F1101 to F1114	Blown-fuse indicating fuse holder	Goes on to indicate that corresponding fuse has blown.
OVEN (ITT Models only)	DS1105	Neon lamp	Indicates status of cavity heating element; goes on and off as cavity heating element goes on and off.
ANTENNA CONTROL	S1102	Toggle switch	Control for energizing or de-energizing antenna control unit.
FIL ON	S1108	Toggle switch	Controls application of 120-volt ac (filament voltage) to variac.
MAIN POWER ON	DS1102	Blue lamp	Goes on to indicate that three-phase power is available.
ANTENNA CONTROL ON	DS1103	White lamp	Goes on to indicate that ANTENNA CONTROL switch is set to ON.
FIL ON	DS1101	White lamp	Goes on to indicate that FIL ON switch is set to ON.
BATTLE SHORT ON	DS1104	Red lamp	Goes on to indicate that BATTLE SHORT switch is set to INTLK SHORTED.
ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D (figure 3-6)			
EMERGENCY SWITCH	S901	Rotary switch	Primary control for energizing or de-energizing radio beacon.
AIR SW OPEN	DS901	Neon lamp	Goes on to indicate that cabinet is not receiving sufficient cooling air.
BLOWN FUSE INDICATORS	F901 to F903, F905 to F907	Blown-fuse indicating fuse holders	Fuse cap goes on, indicating corresponding fuse has blown.

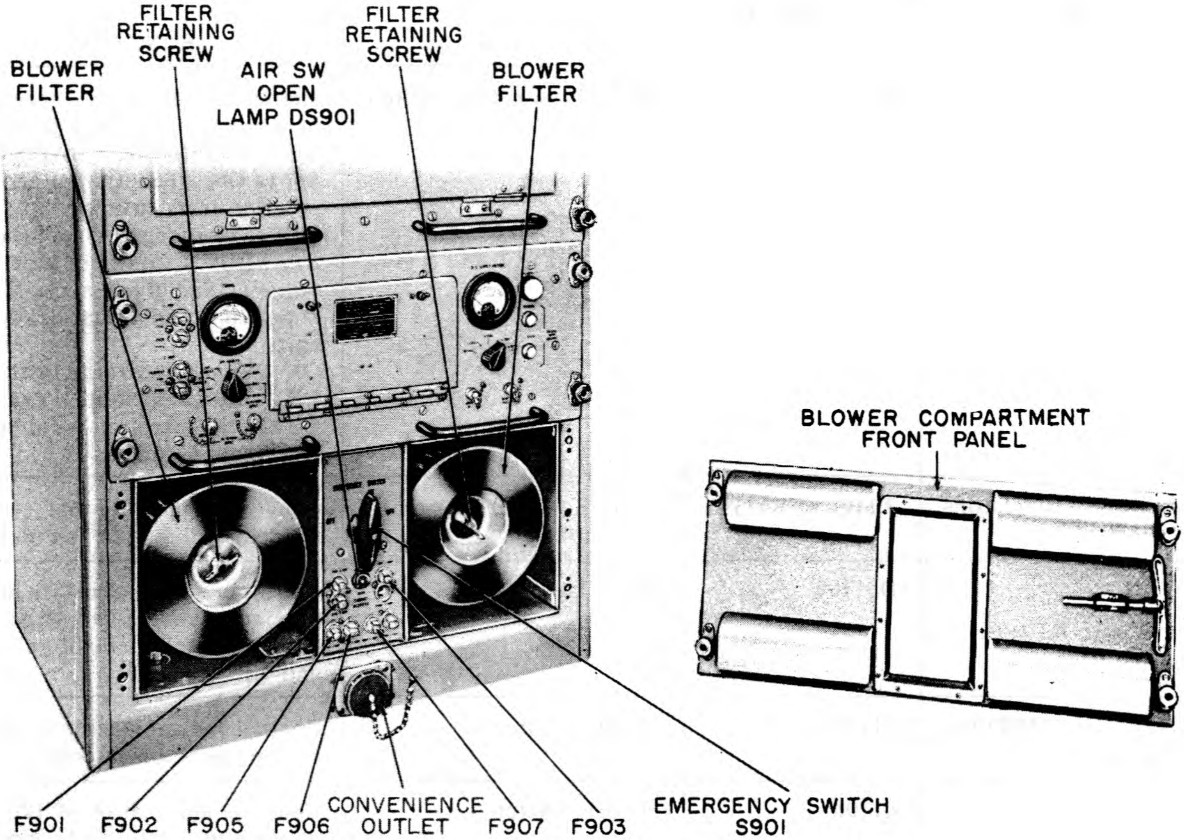


Figure 3-6. Cabinet CY-3163/GRN-9D, Blower Compartment

(2) POWER SUPPLY ASSEMBLY OA-1537/GRN-9A. —The power supply assembly includes the following drawer units, housed in Cabinet CY-3164/GRN-9D.

(a) Low Voltage Power Supply PP-1766/URN (figure 3-7).

(b) High Voltage Power Supply PP-1763/URN (figure 3-8).

(c) Medium Voltage Power Supply PP-1765/URN (figure 3-9).

A description of each control and indicator in the power supply assembly is presented in table 3-2. The controls and indicators are listed according to their physical location on the individual power supplies listed above and to their location on the cabinet (figure 3-10). Illustrations which will aid in the location of the controls and indicators are listed in the table.

The power supply assembly cabinet also houses built-in test equipment. For a description of the controls and indicators provided on the built-in test equipment, refer to the manuals specified in table 1-2.

c. SEQUENCE OF OPERATIONS.

(1) BEFORE USE. —After the equipment has been installed, interconnected, and adjusted as specified in Section 2, and before proceeding with the initial starting procedure outlined in paragraph 3-2 c (1) (a), proceed as follows:

Step 1. Check that the fuses, pilot lamps, and crystal oven assembly are properly installed.

Step 2. Check that all drawer units are fully closed and that all panel screws are tight, so that the interlocks function properly.

Step 3. Check that BATTLE SHORT switch, located on control-duplexer panel, is set to NOR.

(a) INITIAL STARTING. —Under certain conditions, it may be necessary for the operator to start the radio beacon after all switches have been turned off. To do this, proceed as follows:

Step 1. Place all switches on the control-duplexer to OFF (figure 3-5).

Step 2. Turn the switches on the antenna control unit to ON.

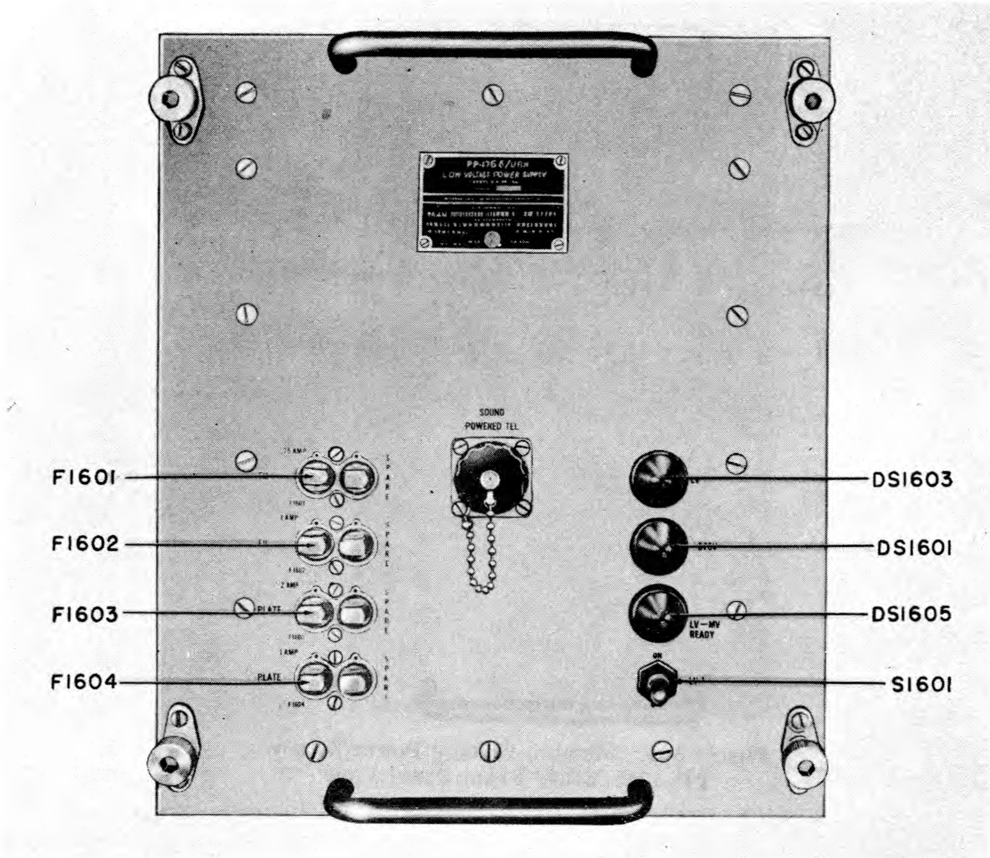


Figure 3-7. Low Voltage Power Supply PP-1766/URN, Front Panel View

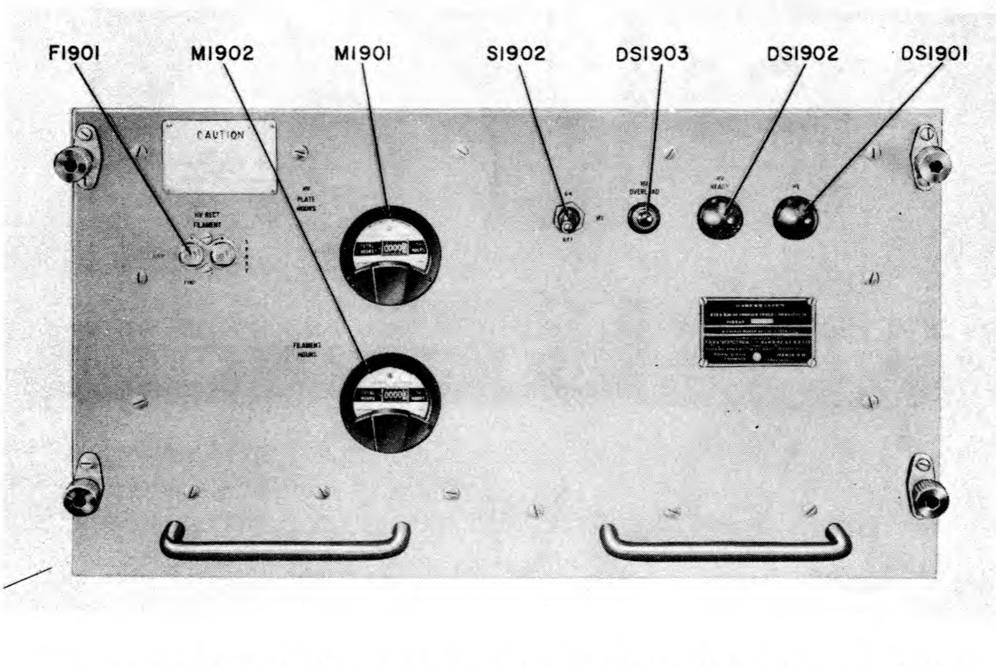


Figure 3-8. High Voltage Power Supply PP-1763/URN, Front Panel View

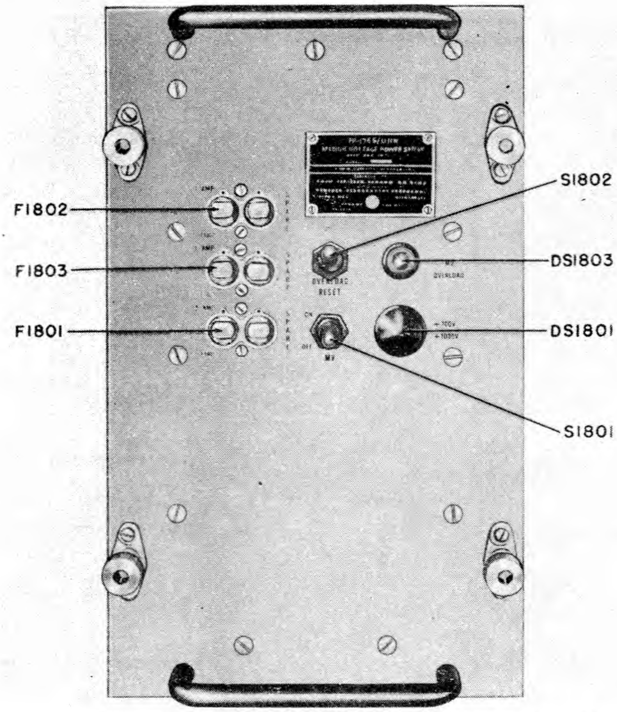


Figure 3-9. Medium Voltage Power Supply
PP-1765/URN, Front Panel View

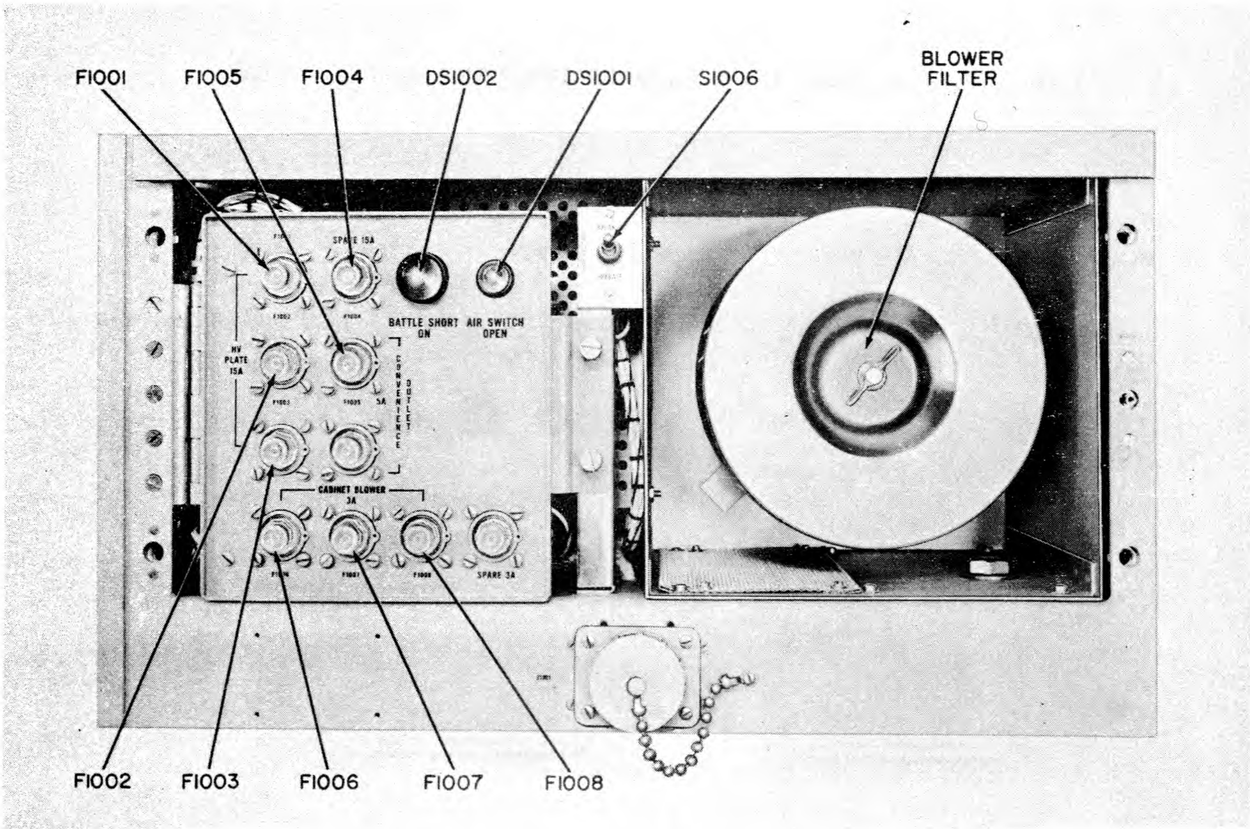


Figure 3-10. Cabinet CY-3164/GRN-9D, Blower Compartment

TABLE 3-2. POWER SUPPLY ASSEMBLY OA-1537A/GRN-9A, CONTROLS AND INDICATORS

NAME OR PANEL MARKING	REFERENCE SYMBOL	TYPE	FUNCTION
LOW VOLTAGE POWER SUPPLY PP-1766/URN (figure 3-7)			
FIL	F1601 and F1602	Blown-fuse indicating fuse holders	Fuse cap goes on to indicate that corresponding fuse has blown.
PLATE	F1603 and F1604	Blown-fuse indicating fuse holders	Fuse cap goes on to indicate that corresponding fuse has blown.
LV	DS1603	Red lamp	Goes on to indicate that low voltage power supply is energized.
-375V	DS1601	Green lamp	Goes on to indicate availability of -375-volt dc.
LV-MV READY	DS1605	Blue lamp	Goes on to indicate that status of power control circuits enables power supply to be energized.
LV	S1601	Toggle switch	Control for energizing or de-energizing low voltage power supply.
HIGH VOLTAGE POWER SUPPLY PP-1763/URN (figure 3-8)			
HV RECT FILAMENT	F1901	Blown-fuse indicating fuse holder	Fuse cap goes on to indicate that fuse F1901 has blown.
HV PLATE HOURS	M1901	Electric time totalizing meter	Indicates total number of hours that plate circuits have been energized.
FILAMENT HOURS	M1902	Electric time totalizing meter.	Indicates total number of hours that filament circuits have been energized.
HV	S1902	Toggle switch	Control for energizing or de-energizing high voltage power supply.
HV OVERLOAD	DS1903	Neon lamp	Goes on to indicate presence of overload condition (existence of trouble) in power supply.
HV READY	DS1902	Blue lamp	Goes on to indicate that status of power control circuits enables power supply to be energized.
HV	DS1901	Red lamp	Goes on to indicate availability of -12-kilovolt dc.
MEDIUM VOLTAGE POWER SUPPLY PP-1765/URN (figure 3-9)			
PLATE	F1801	Blown-fuse indicating fuse holders	Fuse cap goes on to indicate that corresponding fuse has blown.
FIL	F1802 and F1803	Blown-fuse indicating fuse holders	Fuse cap goes on to indicate that corresponding fuse has blown.

TABLE 3-2. POWER SUPPLY ASSEMBLY OA-1537A/GRN-9A, CONTROLS AND INDICATORS (cont)

NAME OR PANEL MARKING	REFERENCE SYMBOL	TYPE	FUNCTION
OVERLOAD RESET	S1802	Toggle switch	Provides capability for manually restoring power supply to energized state after cause of the overload condition has been removed.
MV	S1801	Toggle switch	Control for energizing or de-energizing high voltage power supply.
MV OVERLOAD	DS1803	Neon lamp	Goes on to indicate presence of overload condition in the power supply.
+700V - +1000V	DS1801	Red lamp	Goes on to indicate availability of +1000-volt dc.
CABINET CY-3164/GRN-9D (figure 3-10)			
AIR SWITCH OPEN	DS1001	Neon lamp	Goes on to indicate that cabinet is not receiving sufficient cooling air.
BATTLE SHORT ON	DS1002	Red lamp	Goes on to indicate that BATTLE SHORT switch, on control-duplexer, is set to BATTLE SHORTED.
HV PLATE 15A	F1001 to F1005	Blown-fuse indicating fuse holders	Fuse cap goes on to indicate that corresponding fuse has blown.
CABINET BLOWER 3A	F1006 to F1008	Blown-fuse indicating fuse holders	Fuse cap goes on to indicate that corresponding fuse has blown.
HIGH VOLTAGE	S1006	Toggle switch	Provides means of reducing plate power during performance of aging klystron.

Step 3. Turn the EMERGENCY SWITCH S901 (fig 3-6) to ON (arrow pointing up or down). When EMERGENCY SWITCH is set to ON, both OVEN and NORMAL lamps on the front panel of the Frequency Multiplier Oscillator will light. After the oven has reached its operating temperature, the NORMAL lamp will go out. Thereafter, the NORMAL lamp will go on and off as the heating element in the crystal oven goes on and off to maintain the correct oven temperature. In those beacons where the Control Duplexer filter cavities are fitted with heating elements, the CAVITY HEATER ON lamp DS1105, on the Control Duplexer front panel, will go on and off as the heating element goes on and off.

Step 4. Turn MASTER SWITCH S1101 on panel of control-duplexer (figure 3-5) to STANDBY.

Step 5. Set ON-OFF switch S502 on radio receiver panel (figure 3-1) to ON, CODER-INDICATOR switch S601 on coder-indicator panel to ON, and ANTENNA CONTROL S1102 and FIL ON switch S1108 on control-duplexer panel to ON.

Note

All on-off switches on test equipment should be left in off position, unless test equipment is to be used for checking operation of radio beacon.

Step 6. Turn MASTER SWITCH S1101 to ON. One minute will elapse from the time that MASTER SWITCH is moved to STANDBY before voltage is available for blue LV-MV READY light DS1605 on low voltage power supply panel. This lamp will light after this delay only if MASTER SWITCH and FIL ON switch S1108 are at ON.

Step 7. After LV-MV READY light DS1605 comes on, set LV switch S1601 on low voltage power supply panel (figure 3-7) to ON.

Step 8. Set MV switch S1801 on medium voltage power supply panel (figure 3-9) to ON. Five minutes will elapse from time that MASTER SWITCH is turned to STANDBY position before voltage is available for blue HV READY light DS1902 on high-voltage power supply panel. This lamp will light after 5-minute delay only if MASTER SWITCH, LV, and FIL ON switches are ON.

WARNING

Operation of this equipment involves use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high-voltage supply on. Do not depend upon safety interlock switches for protection. Under certain conditions dangerous potentials may exist in the circuits, with power controls in the off position, due to charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits prior to touching them. Never service or adjust equipment without the presence or assistance of another person capable of rendering aid.

CAUTION

If the equipment has not been used for a period of three months, it will be necessary to age the klystron prior to application to it of full beam voltage. (Refer to paragraph 2-5 of Section 2 if aging is necessary.)

Step 9. When HV READY DS1902 is on, place HV switch S1902 on high voltage power supply panel (figure 3-8) at ON. The equipment is now fully energized and operating. Make sure that red HV lamp DS1901 is on.

(b) NORMAL STARTING.—Ordinarily, when the radio beacon is functioning normally, EMERGENCY SWITCH S901 (figure 3-6) is left at ON; that is, with the arrow pointing either up or down. The power on-off switches on the various units are left on. Power to the entire radio beacon is then under the control of MASTER SWITCH S1101 on the control-duplexer panel (figure 3-5). The radio beacon may be turned on, off, or placed in standby condition by means of this switch. The power on-off switches for the test set components mounted in the power supply assembly are normally left off, and are set to on only when the test units are to be used.

Note

When starting the radio set for the first time, or after a shutdown period, refer to paragraph 3-2c(1)(a) of this section for the initial starting procedure.

To turn the radio beacon on by means of the MASTER SWITCH after the equipment has been shut off,turn MASTER SWITCH S1101 on the panel of the control-duplexer first to STANDBY, and then immedaitely to ON.

When the MASTER SWITCH is at ON and the radio beacon is functioning normally. the following lamps will go on: MAIN POWER ON lamp DS1102, FIL ON lamp DS1101, and ANTENNA CONTROL ON lamp DS1103 on the control-duplexer panel (figure 3-5), LV-MV READY lamp DS1103 after a 1-minute delay, on the low-voltage power supply (figure 3-7), and HV READY lamp DS1902, after a 5-minute delay, on the high voltage power supply (figure 3-8).

Note

OVEN lamp DS1105, on control-duplexer panel, will go on and off as the cavity heating element goes on and off.
(ITT Models only)

The following lamps should not go on: MV OVERLOAD lamp DS1803 on the medium voltage power supply panel (figure 3-9), HV OVERLOAD lamp DS1903 on the high voltage power supply panel (figure 3-8), and BATTLE SHORT ON lamp DS1104 on the control-duplexer panel (figure 3-5).

CAUTION

BATTLE SHORT switch S1107 (figure 3-5) should be at NORMAL. This switch is set to INTLK SHORTED only when one or more of the interlocks fail during an extreme emergency, such as battle conditions. The operator should not turn the switch to INTLK SHORTED unless told to do so by an authorized person, because opening the amplifier-modulator or high voltage power supply drawer units with the BATTLE SHORT switch at INTLK SHORTED would cause serious damage to the equipment.

The following lamps should also go on: POWER ON lamp DS501 on the radio receiver panel (figure 3-1), POWER ON lamp DS601 and ANTENNA CONTROL lamp DS602 on the coder-indicator panel (if the ANTENNA CONTROL lamp flashes, trouble in the antenna system is indicated), FILAMENT lamp DS1401 and OVEN lamp DS1403 on the frequency multiplier-oscillator panel (figure 3-3), FIL lamp DS1301 on the amplifier-modulator panel (figure 3-4), LV lamp DS1603 and -375 lamp DS1601 on the low voltage power supply panel (figure 3-7), HV lamp DS1901 on high voltage power supply panel (figure 3-8), and +1000V lamp DS1801 on the medium voltage power supply panel (figure 3-9).

Note

The NORMAL lamp on the front panel of the frequency multiplier-oscillator will turn on and off as the oven thermostat turns on and off to maintain the correct crystal oven temperature.

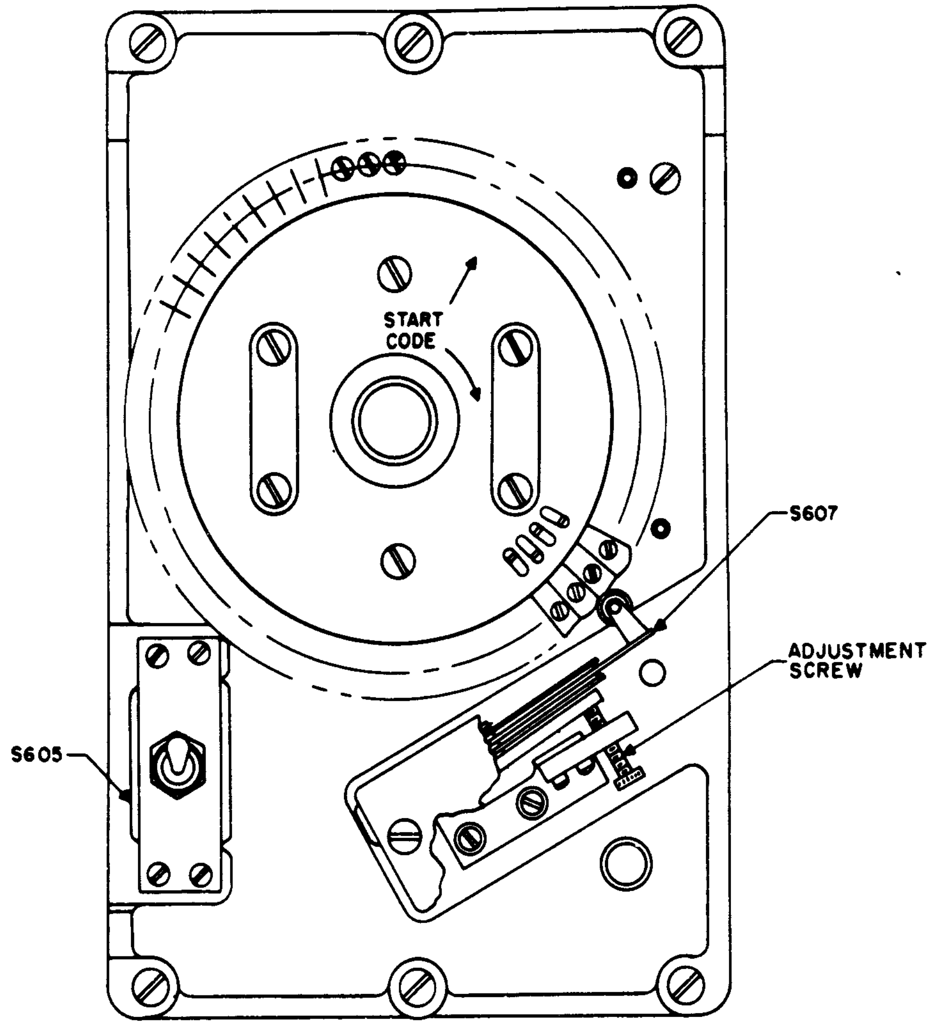


Figure 3-11. Coder-Indicator Tone Wheel Assembly

Note

Check that the AIR SW OPEN lamp DS1303 on the amplifier-modulator is not on.

(2) DURING USE.

(a) CHANGING CRYSTALS. —It may be necessary to change the channel frequencies used by the radio beacon: 126 crystal frequencies are available for use. Refer to table 2-5 for a list of channel numbers and corresponding crystal frequencies.

To change crystals, open the front panel tuning access door on the frequency multiplier-oscillator and insert a crystal oven assembly containing the crystal of the desired frequency in the crystal oven socket. For channels 1 to 63 the low-band r-f chassis is used with the crystal oven assembly plugged into socket XY1501. For channels 64 to 126 the high-band R-F chassis is used with the crystal oven assembly plugged into socket XY1502. After changing crystals, retune the frequency multiplier-oscillator and output circuits.

Note

Operators shall not perform any of the frequency multiplier-oscillator and output circuit adjustments without proper authorization. Detailed tuning and adjusting procedures are presented in Section 2, paragraph 2-5.

(b) CHANGING IDENTIFICATION CALL CODE. —If it is necessary to change the identification code proceed as follows (figures 3-11 and 3-12):

Note

If the radio beacon must provide bearing and distance information to aircraft during the time taken to set up the code, turn the BATTLE SHORT switch on the control-duplexer to INTLK SHORTED. The radio beacon will continue to transmit a signal normal in every way except for the absence of the identification call tone. After setting the code, turn the BATTLE SHORT switch to NOR (normal operating). Shut off the equipment if supplying bearing and distance information is not necessary.

Step 1. Loosen the four captive screws on coder-indicator panel and pull out unit.

Step 2. Snap code switch S605 to OFF.

Step 3. Remove the nut on the code wheel by rotating it counterclockwise.

Step 4. Remove the code wheel by pulling it forward with the handles provided.

CAUTION

During removal or replacement of code wheel, use care when lifting coding switch cam to prevent damage to switch S607.

Step 5. Change code on cam wheel by loosening screws in segments, pulling out or pushing back necessary cam segments, and then tightening screws. Always set up code by starting with cam segment marked START CODE. It is desirable to let three segments, including segment marked START CODE, remain pushed back before code is actually started. Therefore, unless code used more than 50 segments, the first segments should not be used and code should be set up starting with fourth segment. A dot consists of a single pulled out segment. A dash consists of three pulled out segments. To separate dots and a dash, two dots, or two dashes, push back three segments between characters of the code.

The code for USA is inserted in the following manner (figure 3-12): Push back the segment marked START CODE and the next two segments and pull out the fourth segment; this comprises the first dot of the character U. Push back the fifth segment, pull out the sixth (second dot of character U), push back the seventh, and pull out the next three; this completes the character U, "dot-dot-dash". Pull out three alternate segments, forming "dot-dot-dot", the character S; push these three segments back to separate the S from the next character, A. To form the character A, pull out the next segment, push back the following one, and pull out the three following segments; this forms the "dot-dash" of the A. The complete code, USA, has now been installed. Push back all other segments.

Step 6. Replace the coding wheel by engaging the two locating pins on wheel hub. Use caution during this procedure to avoid damaging coding switch. Replace hub nut and tighten securely by turning it in the clockwise direction. Manually turn switch S605 to ON. While code changes are made, as outlined in previous paragraph, no identification is being transmitted from radio beacon. However, bearing and distance information may continue uninterrupted during this interval.

(c) REMOTE OPERATION. —By means of a remote control unit, it is possible to place the radio beacon in off, on, or standby operating condition from a remote point. To operate the radio from a remote position, follow the normal starting procedure described in paragraph 3-2c(1)(b) and then set the MASTER SWITCH S1101 on the control-duplexer panel (figure 3-5) at REMOTE. With switch S1 on

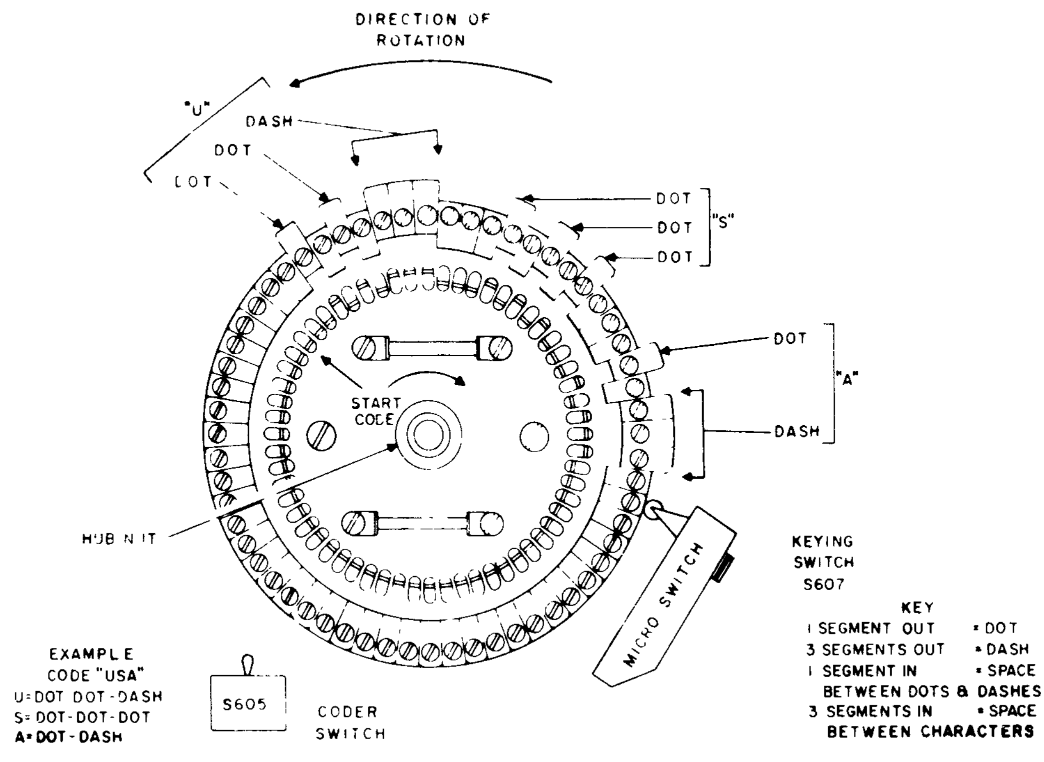


Figure 3-12. Setting the Code

the remote control unit set at OFF, the radio set will be off and all three pilot lights on the remote unit will be off. When switch S1 is set to STANDBY, filament voltages are switched on and white ON lamp DS1 on the remote control unit will go on. To turn the radio set on, turn switch S1 to ON. After a time delay of 1 minute, red READY lamp DS2 will go on, indicating that the low voltage and medium voltage power supples are ready for operation. Five minutes after the filaments are turned on the radio set will be completely energized, and red HV ON lamp DS3 on the remote control unit will go on.

(3) STANDBY OPERATION.–Standby operation provides a means of keeping the radio set ready for immediate operation when no r-f signal is being generated by the radio set. When the MASTER SWITCH is at STANDBY, all filament voltages are on and all d-c voltages are off. After the filament voltages have been on for 5 minutes, all time delays will have been completed, and the radio set can be fully energized immediately by switching the MASTER SWITCH from STANDBY to ON.

To operate the radio beacon in standby condition, follow the normal starting procedure described in paragraph 3-2c(1)(b) and then set the MASTER SWITCH to STANDBY.

(4) AFTER USE.–Turn MASTER SWITCH S1101 on the panel of the control-duplexer (figure 3-5) to OFF.

Note

Under ordinary conditions, the EMERGENCY SWITCH at the bottom of the receiver-transmitter cabinet (see figure 3-6) is left at ON, and all the on-off switches except those on the built-in test equipment are left on.

(5) STOPPING THE EQUIPMENT.–When the radio beacon is being completely shut down (that is, when all switches are being turned off) set MASTER SWITCH S1101 to OFF, wait at least 1 minute, and then turn off EMERGENCY SWITCH S901. This delay is necessary because the cooling blowers will continue to run for 1 minute after the MASTER SWITCH has been turned off but will stop immediately when the EMERGENCY SWITCH is turned off. If the blowers are turned off too soon, excessive residual heat may seriously damage the equipment.

d. INDICATOR PRESENTATIONS.–After the equipment has been started in accordance with the procedures outlined, the following observations should be made to determine whether the equipment is functioning properly. Compare the readings obtained in the following checks with those entered in the equipment log to make sure they are within 10 percent of logged readings.

Note

These observations do not constitute a complete operational check but are intended to give the operator reasonable assurance that the equipment is functioning normally. Refer to paragraph 3-6a for complete operator's check procedures.

(1) TUNING meter M1401, located on the front panel of frequency multiplier-oscillator (figure 3-3).

(2) BEAM CURRENT meter M1301, located on the front panel of the amplifier-modulator (figure 3-4).

(3) HV SUPPLY meter M1302, located on the front panel of the amplifier-modulator (figure 3-4).

(4) TEST METER M501, located on the front panel of the receiver (figure 3-1).

(a) The squitter-control voltage should read within 5 percent of the initial entry.

(b) The crystal rectifier CR201 and CR202 currents should read within 10 percent of the initial entry.

(5) ANTENNA SPEED ERROR meter M601, located on the front panel of the coder-indicator (figure 3-2), reads in the green portion of its scale; a reading in the red portion indicates trouble in the antenna control circuits.

3-3. SUMMARY OF OPERATING PROCEDURES.

After the radio beacon equipment has been inspected and adjusted as specified in Section 2, paragraphs 2-5a through 2-5l, the radio beacon may be operated. The following subparagraphs present step-by-step procedures for operating the equipment.

Note

The equipment is shipped with a crystal installed in the frequency multiplier-oscillator. The instructions outlined in Section 2, paragraph 2-5, pertain to all adjustments made prior to operating the equipment to ensure optimum performance.

a. STARTING PROCEDURE.–To energize the equipment for the first time, or after all power switches have been turned off, proceed as follows:

Note

Under normal operating conditions, the radio set is turned off and on by means of the MASTER SWITCH on the control-duplexer, and the EMERGENCY SWITCH is left at ON. All other power switches except those on the built-in test equipment are left at ON. When the MASTER SWITCH is turned to ON, the radio set will be energized with the proper time delays applied to the various power supplies.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the amplifier-modulator or the high voltage power supply chassis with the high voltage supply on. Do not depend upon safety interlock switches for protection. Under certain conditions, dangerous potentials may exist in the circuit with power controls off because of charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits before touching them. Never service or adjust the equipment without the presence or the assistance of another person capable of rendering first aid immediately.

Step 1. Turn switches on antenna control unit to ON.

Step 2. Turn EMERGENCY SWITCH S901, on blower compartment panel of receiver-transmitter group cabinet, (figure 3-6), to right until it checks into ON; that is, with arrow pointing up or down.

Step 3. Check that white crystal oven lamps OVEN lamp DS1403 and NORMAL lamp DS1402, on frequency multiplier-oscillator panel (figure 3-3), are on. Check that OVEN lamp DS1105, on control-duplexer panel goes on.

Note

After the crystal oven and the cavity compartment have reached proper operating temperatures, NORMAL lamp and OVEN lamp will go out. Thereafter, NORMAL lamps will turn on and off as their respective thermostats turn the respective heaters on and off to maintain the proper operating temperatures.

Step 4. Turn MASTER SWITCH S1101, on control-duplexer panel (figure 3-5) to STANDBY.

Step 5. Check that blue MAIN POWER lamp DS1102, on the control-duplexer, goes on.

Step 6. Check that amber AIR SWITCH OPEN lamps DS1303 (on amplifier-modulator panel), DS902 (on blower compartment panel of receiver-transmitter cabinet), and DS1001 (on bottom panel of power supply-test set group) are not on. When on, these lamps indicate that blowers which operate air switches are not working properly.

CAUTION

If amber lamps are on, blowers may be rotating in wrong direction. Shut off equipment immediately and check wiring for possible phase reversal by comparing equipment wiring and interconnection with schematic and wiring diagrams in Section 6. Operating equipment with blowers rotating in wrong direction may cause serious damage because of overheating.

Step 7. Set switch S502 on radio receiver panel (figure 3-1) to ON. Check that POWER ON white lamp DS501 on radio receiver is on.

Step 8. Set CODER-INDICATOR switch S601 on coder-indicator panel (figure 3-2) to ON. Check that white POWER ON lamp DS601 on coder-indicator panel is on.

Note

Check that all switches on antenna control unit are at ON. These switches are intended for use during servicing, and are normally left at ON.

Step 9. Set ANTENNA CONTROL switch S1102 on control-duplexer panel (figure 3-5) to ON. Check that white ANTENNA CONTROL lamp DS1103, on control-duplexer panel is on.

Step 10. Check that ANTENNA CONTROL lamp DS602 on coder-indicator panel (figure 3-2) is constantly on. If this lamp flashes, there is trouble in antenna or in antenna control circuits.

Step 11. Turn MASTER SWITCH S1101 to ON.

Step 12. Snap FIL ON switch S1108 on the control-duplexer panel to ON. Check that following white lamps go on:

FIL ON lamp DS1101 on control-duplexer.
FIL lamp DS1301 on amplifier-modulator.
FILAMENT lamp DS1401 on frequency multiplier-oscillator.
LV-MV READY lamp DS1605 on the low-voltage power supply (after 1-minute time delay).

Step 13. When blue LV-MV READY lamp goes on, set LV switch S1601 on panel of the low voltage power supply to ON. Check that red LV lamp DS1602 and green -375V lamp DS1601, both on panel of low voltage power supply, are on. Green lamp indicates that low voltage power supply is delivering d-c power to the other transmitter units of radio beacon.

Step 14. Set MV switch S1801 on the medium voltage power supply panel to ON. Check that red +1000V lamp DS1801 on medium voltage power supply panel is on. Check that amber MV OVERLOAD lamp DS1803 on the medium voltage power supply panel does not go on.

CAUTION

When starting radio set for first time, or when starting radio set containing klystron not in use for a period of 3 months or more, the klystron must be aged before applying full power to it. Refer to Section 2 for instructions on aging klystron.

Step 15. When the HV READY lamp DS1902 goes on, set HV switch S1902 to ON. Check that read HV lamp DS1901 on high voltage power supply panel is on. Check that amber HV OVERLOAD lamp DS1903 on high voltage power supply panel is not on.

b. TUNING AND ADJUSTING PROCEDURE.—For proper operation of the radio beacon equipment, perform the following adjustments:

Note

It is the duty of technical personnel to perform these adjustments; operators should not perform any of the adjustments without proper authorization. Detailed tuning and adjusting procedures are presented in Section 2, paragraph 2-5.

(1) Adjust regulated filament voltage.

(2) Adjust squitter control voltage.

(3) Adjust pre-selector cavities in control-duplexer.

(4) Tune crystal oscillator.

(5) Tune carrier frequency generating chain.

(6) Tune klystron and r-f output circuits.

c. CHANGING FREQUENCIES.—If it is necessary to change the channel frequency used by the radio beacon, proceed as follows:

Note

There are 126 crystal frequencies available for use. Refer to table 2-5 for a list of channel numbers and corresponding crystal frequencies. If the desired frequency falls within the range of 962 mc to 1024 mc, use the low-band r-f chassis. If the frequency falls within the 1151- to 1213-mc range, use the high-band r-f chassis.

Step 1. Select crystal oven assembly containing crystal of desired frequency.

Note

If desired frequency falls within frequency range associated with r-f chassis installed in frequency multiplier-oscillator, perform steps 2 through 4. If desired frequency falls outside frequency range associated with installed r-f chassis, perform steps 5 through 12.

Step 2. Open front panel tuning access door on frequency multiplier-oscillator panel (figure 3-3).

Step 3. Remove crystal oven assembly inserted in crystal oven socket and insert selected crystal oven assembly.

Step 4. Retune frequency multiplier-oscillator and transmitter output circuits.

Step 5. Open frequency multiplier-oscillator drawer to gain access to r-f chassis mounted on top of unit (figure 2-17).

Step 6. Loosen 11 captive screws securing cover to r-f chassis. Separate cover from chassis.

Note

Operators shall not perform adjustments specified in steps 7 and 10 without proper authorization. Detailed tuning and adjusting procedures are presented in Section 2, paragraph 2-5.

Step 7. Make following disconnections within r-f chassis:

a. Disconnect power plug P1514 from jack J1509 (high band) or jack J1510 (low band).

b. Disconnect plug P1514 from jack J1502 (high band) or jack J1505 (low band).

c. Disconnect plug P1513 from jack J1503 (high band) or jack J1506 (low band).

Step 8. Remove four screws (two screws per side) securing r-f chassis to frame assembly. Separate r-f chassis from frame assembly.

Step 9. Install r-f chassis associated with frequency range that covers desired frequency into frame assembly. Insert the four screws and tighten in order to secure r-f chassis to assembly.

Step 10. Make following connections within r-f chassis.

a. Connect plug P1514 to jack J1509 or jack J1510.

b. Connect plug P1514 to jack J1502 or jack J1505.

c. Connect plug P1513 to jack J1503 or jack J1506.

Step 11. Install cover on frame assembly by reversing procedure specified in step 6. Close frequency multiplier-oscillator drawer.

Step 12. Open front panel tuning access door on frequency multiplier-oscillator panel and insert selected crystal oven assembly into crystal oven socket.

Step 13. Perform step 4.

d. CHANGING IDENTIFICATION CALL CODE.- Whenever a new code is to be assigned to the radio beacon, reset the code wheel as follows:

Note

If the radio beacon must provide bearing and distance information to aircraft during the time taken to set up the code, turn BATTLE SHORT switch on control-duplexer to INTLK SHORTED. The radio beacon will continue to transmit a signal normal in every way except for the absence of the identification call tone. After setting the code, turn BATTLE SHORT switch to NOR (normal operating). Shut off the equipment if supplying bearing and distance information is not necessary.

Step 1. Loosen the four captive screws holding coder-indicator in place and slide drawer forward. Code wheel and coder switch will be exposed on right side of drawer.

Step 2. Turn off code switch S605 located below and to right of center of keying wheel.

Step 3. Remove hub nut from keying wheel shaft by rotating hub nut counterclockwise.

CAUTION

During removal of keying wheel, care should be taken to lift keying switch S607 cam to prevent damaging cam.

Step 4. Remove the keying wheel by pulling it forward with the handles provided.

Step 5. Starting with segment indicated by START CODI arrow and going in clockwise direction, set back first three segments before starting first code character.

Step 6. Set up first character of code, using one segment pulled out for each dot, three segments pulled out for each dash, and one segment set in for space between dots and dashes (figure 3-12).

Step 7. Continuing in clockwise direction, set three segments in to provide one full space between characters.

Step 8. Set up remaining characters of code, following procedure outlined in steps 6 and 7.

Step 9. Replace keying wheel and restore coder-indicator

e. SECURING THE EQUIPMENT

(1) TURNING OFF RADIO BEACON. Under normal operating conditions, all on-off switches except those located on the built-in test equipment are left on. To turn off the radio beacon, turn MASTER SWITCH S1101, located on the control duplexer panel to OFF.

Note

EMERGENCY SWITCH, located on the blower compartment panel of receiver-transmitter cabinet, is left at ON.

(2) SHUTTING DOWN RADIO BEACON. To completely shut down (de-energize) radio beacon, proceed as follows:

Step 1. Set HV switch S1902 on high voltage power supply panel to OFF.

Step 2. Set MV switch S1801 on medium voltage power supply panel to OFF.

Step 3. Set LV switch S1601 on low voltage power supply panel to OFF.

Step 4. Set FIL ON switch S1108 and ANTENNA CONTROL SWITCH S1102, both on control-duplexer panel, to OFF.

Step 5. Set CODER-INDICATOR switch S601 on coder-indicator panel to OFF.

Step 6. Set switch S502 on receiver panel to OFF.

Step 7. Set all switches on antenna control unit to OFF.

Step 8. Set MASTER SWITCH S1101 on control duplexer panel to OFF.

Step 9. At least 1 minute after setting MASTER SWITCH to OFF, set EMERGENCY SWITCH S901 to OFF.

CAUTION

The delay specified in step 9 is necessary in order to dissipate the residual heat remaining in the cabinets. The blowers will continue to run for 1 minute after MASTER SWITCH has been set to OFF, but they will stop immediately when EMERGENCY SWITCH is set to OFF. If blowers are turned off too soon, equipment may be seriously damaged.

3-4. EMERGENCY OPERATION

If the radio beacon must provide bearing and distance information to aircraft during the time taken to make certain operational changes (when changing crystal frequency or identification call code, for example) set BATTLE SHORT switch on control-duplexer panel to INTLK SHORTED.

Note

Operators should not set BATTLE SHORT switch to INTLK SHORTED without proper authorization.

3-5. TEST PROCEDURES (FOR TEST EQUIPMENT ONLY).

Test Equipment is provided to permit a rapid check of operating characteristics of the Radio Beacon.

a. ORIGINAL TEST EQUIPMENT (TABLE 1-2). - This test equipment includes the following five units:

(1) Pulse Sweep Generator SG-212A/URN-3.

(2) Pulse Analyzer/Signal Generator TS-890A/URN-3.

(3) Power Meter/Pulse Counter TS-891/URN-3.

(4) Oscilloscope OS-54/URN-3.

(5) Switch-Test Adapter SA-420/URN-3.

The first four units are mounted in the upper part of the Power Supply Cabinet. The location of the Switch-Test Adapter is optional. The functions of the test equipment and the principles upon which the various tests are made are included in Section 4.

Refer to Para 4-3a(7) for the functional description of the test equipment and to Para 4-3c for a description of the test principles.

Although the Control Monitor Group AN/GRA-34 and its associated Remote Switching Unit C-2234/GRA-34, are not regarded as part of the built-in test equipment they are used to provide monitoring facilities and unattended, and automatic, operation of one or two radio beacons.

b. REPLACEMENT TEST EQUIPMENT (TABLE 1-2b). - This equipment includes the following three units:

(1) Spectrum Analyzer/Test Generator MM-705.

(2) Oscilloscope MM-504.

(3) Power Meter - Pulse Counter - Marker Generator MM-109.

These units are mounted with a Transfer and Switching Unit, a Transfer and State Transmission Unit (TELOTEL), and its associated interface unit, and two Transponder Monitors in the Electrical Equipment Cabinet 212A and are interconnected through a cable harness and (for certain tests) two function switches, all of which permit rapid connection for standard test procedures. Refer to Para 4-3a(7)(f) for a functional description of the test equipment and to Para 3-6a(12) for a description of the test procedures.

3-6. OPERATOR'S MAINTENANCE.

Original Test Equipment (TABLE 1-2) Only.

a. OPERATING CHECKS AND ADJUSTMENTS. It is desirable to make sure that the radio beacon meets certain minimum performance requirements. The series of tests described in the following paragraphs serve to determine whether or not the radio beacon is operating properly, and whether or not optimum performance adjustments are required. The test procedures are based on using the built-in test equipments. The checks should be performed daily. It is not necessary to turn off the radio beacon to perform the checks.

The built-in test equipment must be interconnected as shown in figure 3-13 so that the special test described in this section may be performed.

Note

All references to the pulse analyzer-signal generator throughout this manual are for Pulse Analyzer-Signal Generator TS-890A/URN-3 or TS-890B/URN-3 unless otherwise noted.

(1) PRELIMINARY SETTINGS OF FRONT PANEL CONTROLS ON PULSE ANALYZER-SIGNAL GENERATOR TS-890A/URN-3. —Before making any tests with TS-890A/URN-3, set up the front panel controls as follows (figure 3-14):

Step 1. Set OUTPUT ATTENUATOR to 0 DBM.

Step 2. Set INPUT ATTENUATOR SELECTOR control to maximum attenuation.

Step 3. Set BAND SHIFT switch on 0.

Step 4. Set MODULATION SELECTOR to C.W.

Step 5. Set CHANNEL SELECTOR control to applicable channel.

Note

If built-in crystal oscillator is to be used as frequency generating source, omit steps 6, 7, and 8.

Step 6. Set MAIN TUNING control to applicable channel.

Step 7. Set OSCILLATOR SELECTOR to V. F. O. CALIBRATE.

Step 8. Adjust V. F. O. CALIBRATE control until zero beat is heard in headphone plugged into V. F. O. CALIBRATE JACK.

Step 9. Set OSCILLATOR SELECTOR switch to either REF. OSC. (for crystal control) or to V. F. O., depending on which oscillator is to be used as generating source.

Step 10. Adjust for a zero reading on OUTPUT LEVEL indicator, using its ZERO SET control.

Step 11. Set INTERROGATE switch to ON.

Note

Before performing step 12, energize the Pulse-Sweep Generator SG-121A/URN-3 (figure 3-15) and allow it to warm up for at least 2 minutes.

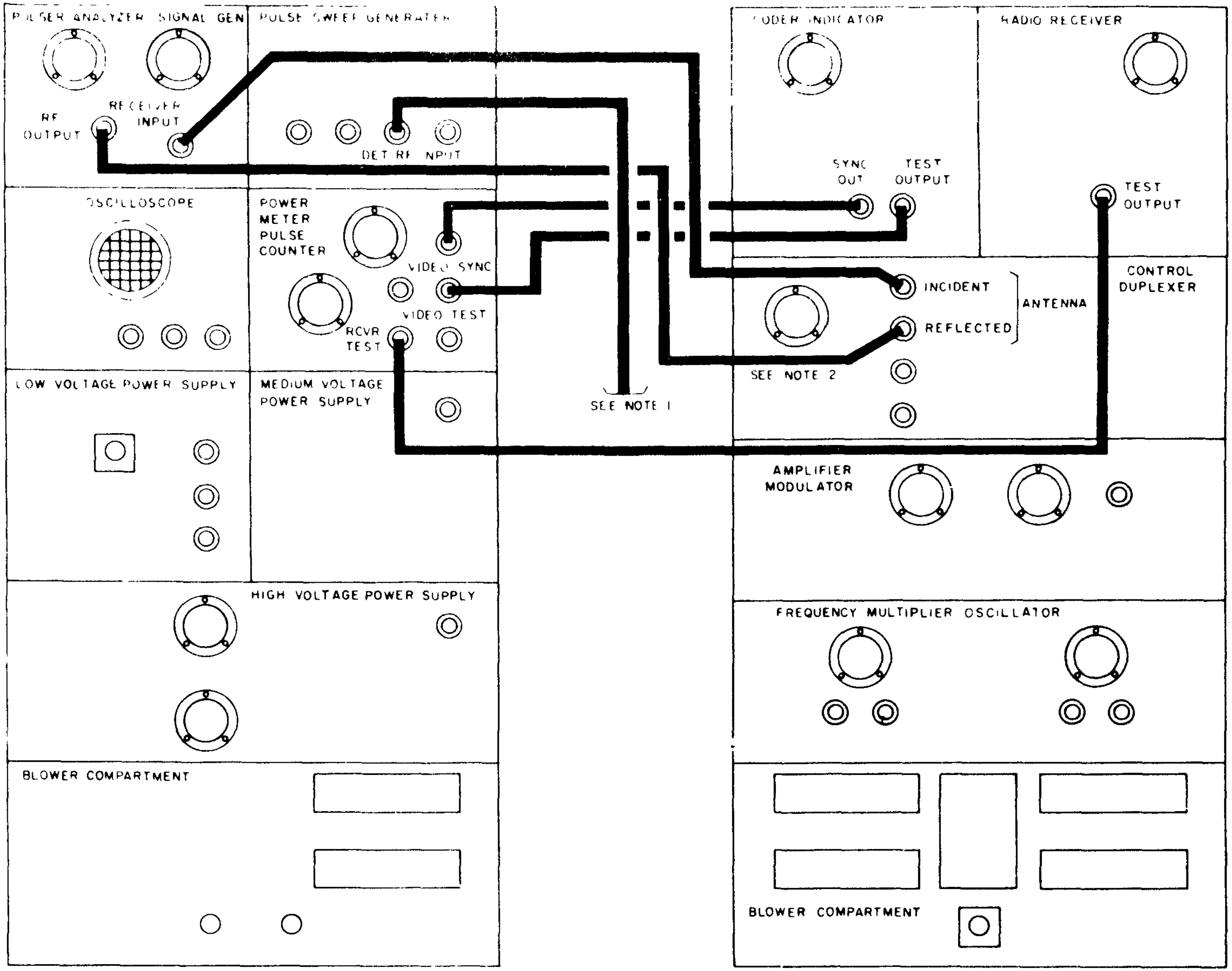
Step 12. Set POWER SET control to midscale.

Step 13. Adjust PULSE AMPLITUDE control, located on the SG-121A/URN-3 to obtain a midscale reading (100) on OUTPUT LEVEL INDICATOR (figure 3-15).

Step 14. Adjust CHANNEL SELECTOR slightly for a maximum reading on OUTPUT LEVEL INDICATOR.

Note

There is a time lag between the application of signal to OUTPUT LEVEL INDICATOR and indication of power level. When taking readings on this meter, allow time for stabilization of needle.



NOTE 1 WHEN CHECKING ZERO DISTANCE DELAY THIS LEAD MUST BE CONNECTED TO THE ANTENNA INCIDENT JACK IN PLACE OF THE LEAD SHOWN

NOTE 2 WHEN CHECKING RECEIVER SENSITIVITY THIS LEAD MUST BE CONNECTED TO THE ANTENNA INCIDENT JACK IN PLACE OF THE LEAD SHOWN

Figure 3-13. Test Equipment, Front Panel Interconnection Diagram

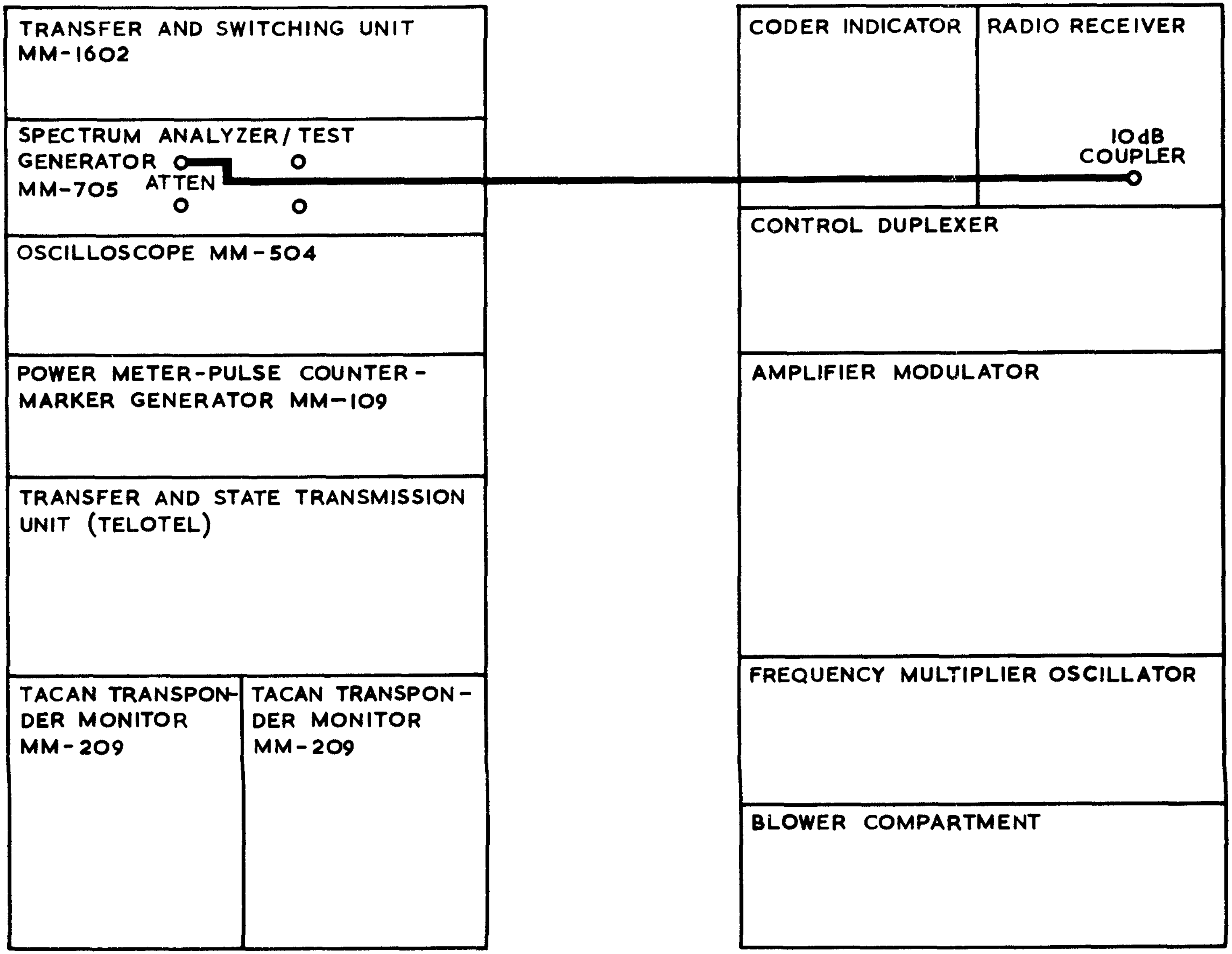


FIG. 3-13a FRONT PANEL INTERCONNECTION FOR RECEIVER SELECTIVITY TEST

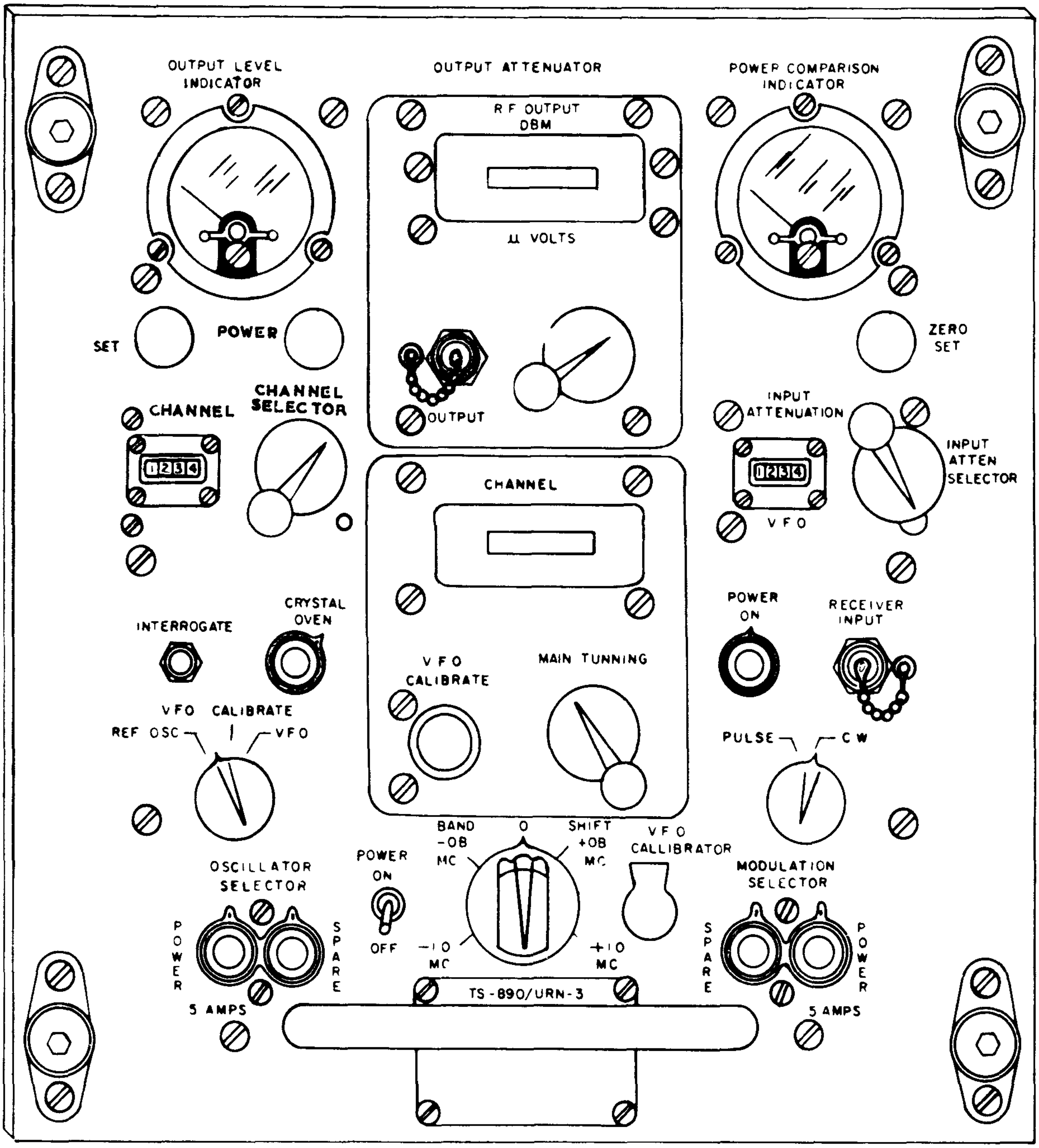


Figure 3-14. Pulse Analyzer-Signal Generator TS-890A/URN-3, Front Panel View

Step 15. Readjust PULSE AMPLITUDE control on SG-121A/URN-3 to obtain midscale reading (100) on OUTPUT LEVEL INDICATOR.

Step 16. Adjust ZERO SET control of POWER COMPARISON INDICATOR to obtain zero on POWER COMPARISON INDICATOR.

Step 17. Set MODULATION SELECTOR to PULSE.

Note

The TS-890A/URN-3 is now ready for use in making tests. Upon completion of tests, shut down equipment by turning INTERROGATE and POWER switches to OFF.

(2) PEAK POWER MEASUREMENTS.– Peak power delivered to the antenna must be 7.5 kw, or greater; to obtain this measurement, proceed as follows:

Step 1. Turn FUNCTION switches on Oscilloscope OS-54/URN-3 (figure 3-16) and power meter-pulse counter (figure 3-17) to OPERATING TEST.

Step 2. With radio set fully operative, observe transmitter r-f envelope on oscilloscope. It should appear as shown in figure 3-18. Note that gain, sweep speed, and trigger selection controls on oscilloscope are automatically set as required for this test by internal controls associated with position 1, OPERATING TEST, of FUNCTION switch. Adjust-

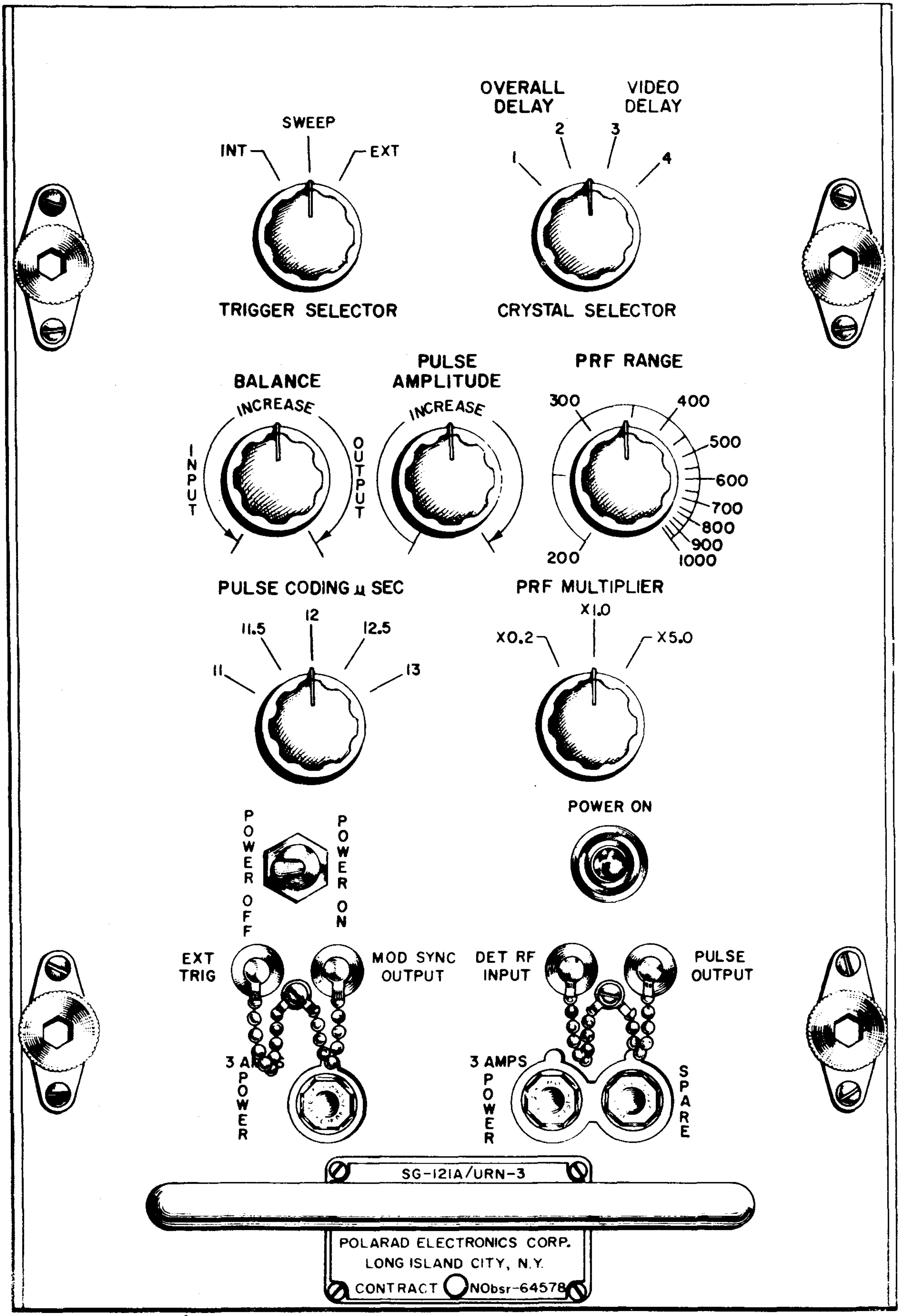


Figure 3-15. Pulse Sweep Generator SG-121A/URN-3, Front Panel View

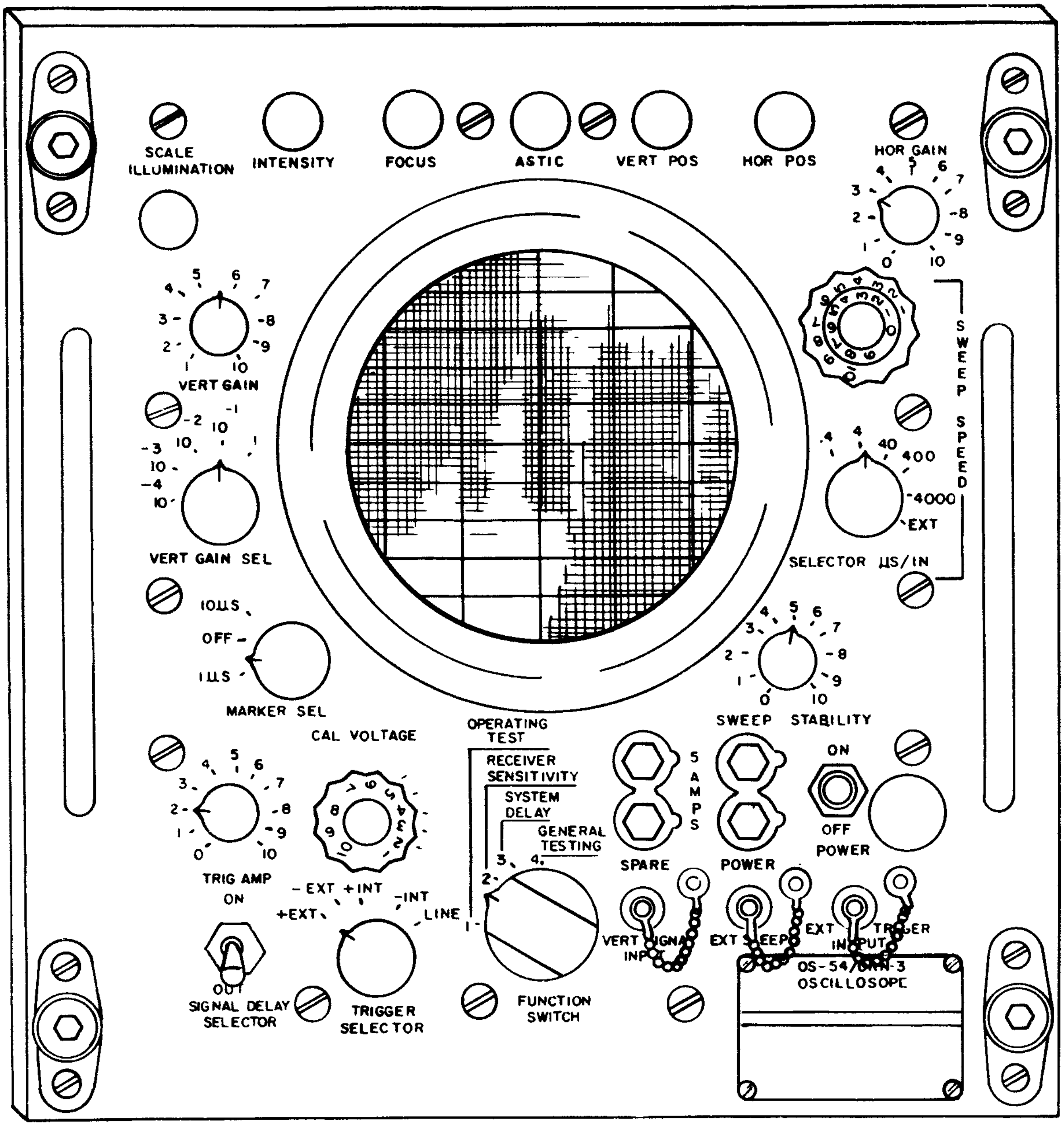


Figure 3-16. Oscilloscope, Front Panel View

ment procedures for these controls are described in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope. The SCALE ILLUMINATION, TRIG AMP. and SWEEP STABILITY controls, and the SIGNAL DELAY SELECTOR and MARKER SEL switches are the only other controls which remain effective. These should be set, respectively, to counterclockwise, 5, 5, OUT, and OFF. If a stable sweep is not achieved with these settings, adjust TRIG AMP and SWEEP STABILITY controls as required.

Step 3. Turn PEAK PWR VOLTAGE control on power meter-pulse counter completely counterclockwise to its minimum setting.

Step 4. Depress RF POWER switch on power meter-pulse counter and maintain it in that position while making measurement.

Step 5. While observing pulse envelope on oscilloscope (figure 3-18), turn PEAK PWR VOLTAGE control clockwise until negative pulses just touch baseline. At this point, stop advancing control and read r-f power directly in kilowatts on PEAK RF POWER meter. Release RF POWER switch. A reading of 7.0 kw or more is considered normal. If this requirement is not met, report trouble to technical personnel.

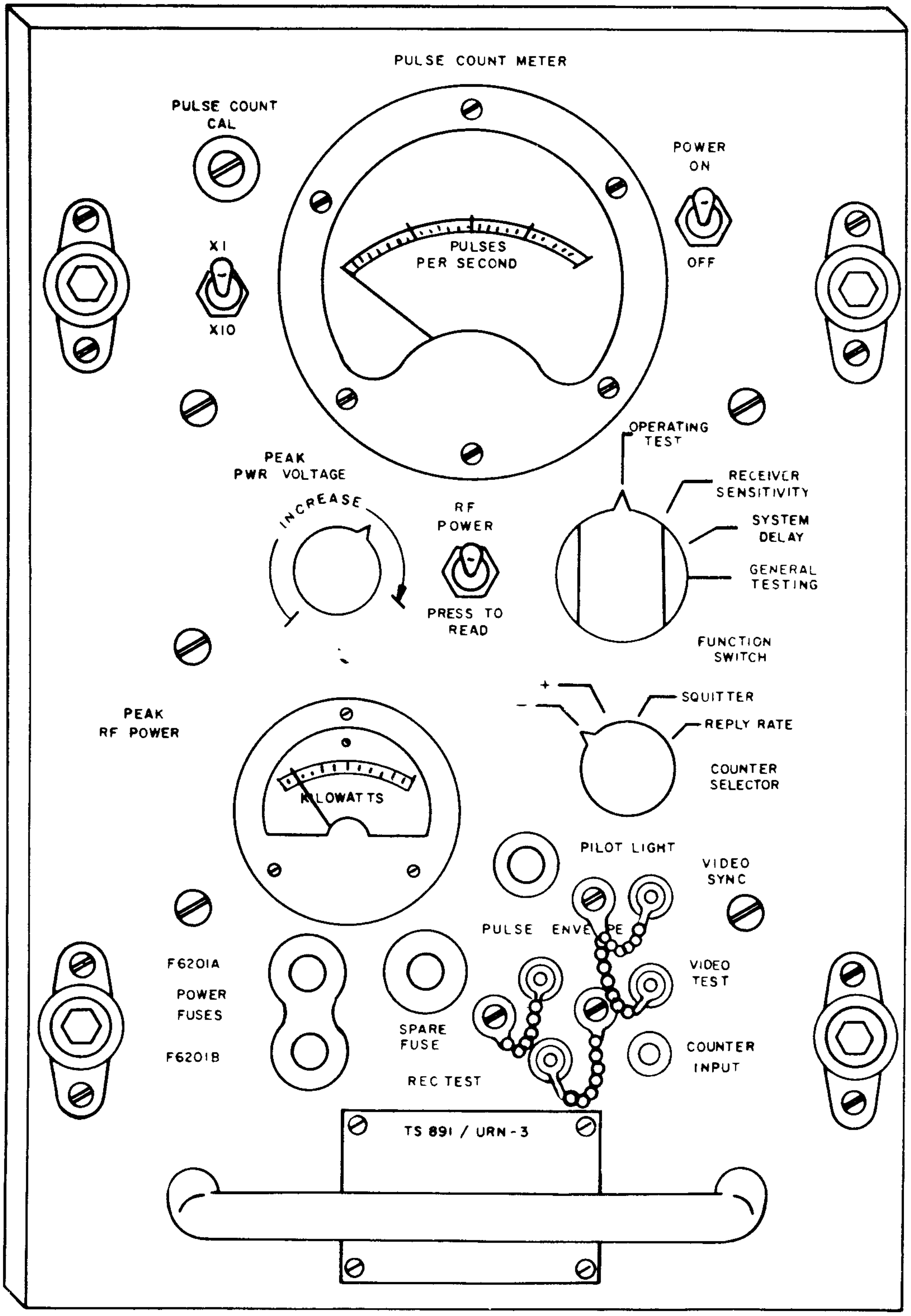


Figure 3-17. Power Meter-Pulse Counter TS-891/URN-3, Front Panel View

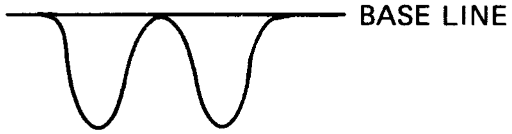


Figure 3-18. Transmitter Output R-F Envelope

(3) VISUAL PULSE SHAPE.

Step 1. Turn the FUNCTION SWITCH on the oscilloscope to position 1, OPERATING TEST.

Step 2. With the radio set fully operative, observe r-f envelope on oscilloscope; it should appear as shown in figure 3-18.

Step 3. Utilizing 1-microsecond MARKER SEL switch on oscilloscope, measure spacing between pulses; spacing should be 12 ± 0.5 microseconds.

Step 4. Measure pulse width at half-amplitude points. The correct pulse width is 3.5 ± 0.5 microseconds. If this requirement is not met, report trouble to technical personnel.

(4) OUTPUT PULSE COUNT.

Step 1. Turn FUNCTION SWITCH on power meter pulse counter to position 1, OPERATING TEST.

Step 2. Set COUNTER SELECTOR switch to +.

Step 3. Set RANGE SWITCH to X10. Output pulse count with radio set operating properly, should be 7200 ± 180 pulses per second (3600 pulse pairs). If rerequirement is not met, report trouble to technical personnel.

(5) OUTPUT PULSE SPECTRUM TEST.–The built-in test equipment includes a sharply tuned relative power meter (analyzer portion of TS-890A/URN-3) which is used to compare sideband energy with center frequency energy for an accurate check of pulse shape. The test equipment is highly specialized for this purpose. The test is made with the beacon operating under normal traffic conditions. Proceed as follows:

Step 1. Make preliminary setup of TS-890A/URN-3 as directed in paragraph 3-6a(1).

Step 2. Remove connection at RECEIVER INPUT jack of TS-890A/URN-3.

Step 3. Perform output pulse spectrum test in accordance with detailed procedure covered in Technical Manual for the TS-890A/URN-3 and TS-890B/URN-3 (NAVSHIPS 93231). The test procedure is in Section 3, paragraph 3-4a of the issue of this manual incorporating change number 2.

(6) SQUITTER COUNT.

Step 1. Turn FUNCTION SWITCH on TS-891/URN-3 to position 2, RECEIVER SENSITIVITY.

Step 2. Set COUNTER SELECTOR switch on TS-891/URN-3 to SQUITTER.

Step 3. Set RANGE SWITCH on TS-891/URN-3 to X10. The squitter rate, as read on PULSE COUNT METER, should be 2700 ± 90 pulses per second. If this requirement is not met, report trouble to technical personnel.

(7) REPLY COUNT (RECEIVER SENSITIVITY).

Step 1. Make preliminary setup of front panel controls of pulse analyzer-signal generator as directed in paragraph 3-6a(1).

Note

Before proceeding, check that setting of OUTPUT ATTENUATION SELECTOR on TS-890A/URN-3 is at maximum attenuation so as not to load the beacon and cause the squitter voltage to become positive.

Step 2. Set MODULATION SELECTOR switch on TS-890A/URN-3 to PULSE.

Step 3. Connect coaxial test lead from RF OUTPUT jack on TS-890A/URN-3 to ANTENNA INCIDENT jack on control-duplexer.

Step 4. Set FUNCTION SWITCH ON TS-890A/URN-3 to position 2, RECEIVER SENSITIVITY.

Step 5. Set COUNTER SELECTOR SWITCH on TS-891/URN-3 to REPLY RATE.

Step 6. Set RANGE SWITCH on TS-891/URN-3 to X10.

Step 7. Set PRF RANGE on SG-121A/URN-3 to 1000 and PRF MULTIPLIER to X1.

Step 8. Set PULSE CODING μSEC switch on SG-121A/URN-3 to 12.

Step 9. Advance OUTPUT ATTENUATOR on TS-890A/URN-3 until reply count is reduced to 600.

Step 10. Read RF OUTPUT DBM scale on OUTPUT ATTENUATOR. The RF OUTPUT DBM should be -53 dbm or more. If this requirement is not met, report trouble to technical personnel.

Note

Receiver sensitivity is defined as the signal level required to obtain 60 percent reply to an interrogating signal. With pulse-pair repetition rate set at 1000 pulse pairs per second, a reply rate of 600 will indicate 60 percent response. A properly coded signal having a level of -93 dbm will cause receiver to reply to at least 60 percent of interrogating pulses. Since directional coupler DC1156 through which test signal is fed has a coupling loss of 40 db, a test signal at a level of -53 dbm will cause receiver to respond to at least 60 percent of interrogating pulses. If the antenna were disconnected from RF OUTPUT jack on control-duplexer and the test signal fed into RF OUTPUT jack, receiver would then respond to 60 percent of interrogating pulses of test signal having level of -93 dbm or less.

Step 11. Test the 12-microsecond acceptance decoder of radio receiver to determine whether it is working properly; this is done by observing whether reply rate remains the same for the 11.5 μSEC and 12.5 μSEC positions of PULSE CODING switch. The number of replies should be reduced considerably for the 11 and 13 μSEC positions of switch. The radio receiver decoder is designed to pass all pulse pairs with a spacing of from 11.5 to 12.5 microseconds between pulses of a pair. Pulse pairs with spacings of 11 microseconds or less, and those of 13 microseconds or greater, will be either attenuated or decoupled.

Step 12. Repeat steps 7 through 9, changing PRF RANGE setting to 200 and PRF MULTIPLIER to X1. A minimum reply count of 120 at -53 dbm should be obtained.

Step 13. Repeat steps 7 through 9, changing PRF RANGE setting to 250 and PRF MULTIPLIER to X10. A minimum reply count of 1500 replies at -53 dbm should be obtained. If this requirement is not met, report trouble to technical personnel.

(8) CHECKING RECEIVER BLANKING TIME.

Step 1. Allow at least 10 minutes for receiver warmup time.

Step 2. Connect TEST OUTPUT jack on front panel of receiver to oscilloscope EXT TRIG INPUT (figure 3-16). Use positive sync on oscilloscope.

Step 3. Connect blanking pulse test point TP9 to vertical input of oscilloscope. Test point TP9 is located on radio receiver video chassis (figure 6-5). Make necessary adjustments on oscilloscope to synchronize blanking pulses. Total horizontal sweep should be between 50 and 100 microseconds.

Step 4. The blanking pulse should be 40 ± 2-microseconds wide. If necessary, adjust potentiometer R443 to set pulse duration at 40 ± 2 microseconds. BLANKING TIME ADJUST control R443 is located on the radio receiver video chassis (figure 6-3).

(9) CHECKING RECEIVER LOCAL OSCILLATOR SIGNAL. —Set METER SELECTOR SWITCH S501 on receiver front panel to CR201 and CR202. The METER should read halfscale deflection at each position. If necessary, local signal strength may be adjusted by moving pickup probe on electron tube V1504 tripler cavity in or out to obtain the optimum meter reading.

(10) REFERENCE BURST PULSE COUNT.

Step 1. Turn FUNCTION SWITCH on oscilloscope to position 2, RECEIVER SENSITIVITY.

Note

TRIGGER AMP and SWEEP STAB. controls of oscilloscope may have to be adjusted carefully to obtain waveform shown in figure 3-19.

Step 2. Check oscilloscope; the presentation shown in figure 3-19 should appear. Normal indication, as shown in figure 3-19, is six auxiliary reference burst pulse pairs (heavy pulses) and 12 north reference burst pulse pairs (light pulses). Five of the north reference pulse pairs will be superimposed on the auxiliary pulse pairs. A north pulse pair should be visible; one pulse of the pair to the left, and one pulse of the pair to the right of the fourth and ninth auxiliary pulses. Seven more north burst pulse pairs should be counted at the end of the auxiliary burst. If the requirement is not met, report the trouble to technical personnel.

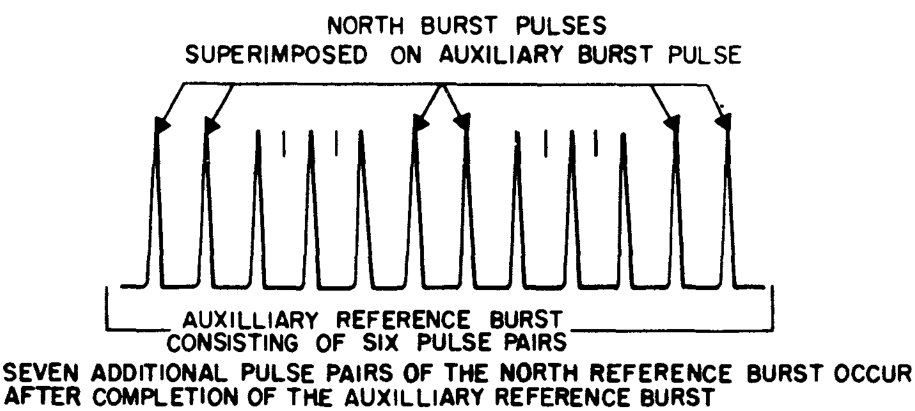


Figure 3-19. Composite Waveform, North and Auxiliary Reference Burst

Figure 3-20. Zero Distance Delay Measurement Waveforms

(11) ZERO DISTANCE CHECK.

Step 1. Set FUNCTION switches on oscilloscope and TS-891/URN-3 to position 3, SYSTEM DELAY.

Step 2. Set SG-121A/URN-3 INT-SWEEP-EXT switch to SWEEP and PULSE CODING μSEC switch to 12. Set OVERALL DELAY-VIDEO DELAY switch to 1.

Step 3. Adjust TS-890A/URN-3 to provide a modulated signal by following the preliminary setup procedure in paragraph 3. At completion of those steps, set MODULATION SELECTOR to PULSE and set RF OUTPUT attenuator to -35 DBM.

Step 4. Observe display on oscilloscope and, if necessary, adjust controls in top row for clear presentation. Note that there are two sets of pulses displayed; the radio beacon output pulse and a pair of reference pulses. Adjust SG-121A/URN-3 BALANCE control so that pulses from TS-890A/URN-3 are slightly larger in amplitude than pulses from ANTENNA INCIDENT jack.

Step 5. If pattern such as waveform in figure 3-20 is obtained (with radio beacon output pulse pair to left of reference pulse pair), overall delay is less than 50.2 microseconds and next step may be performed. If it is to right, zero delay is too great and must be adjusted. If requirement is not met, report trouble to technical personnel.

Step 6. Change switch setting on SG-121A/URN-3 to OVERALL DELAY 2. Observe that pattern is like waveform b of figure 3-20. If not (that is, if radio beacon output is to left of reference pulse pair), zero distance relay is less than 49.8 microseconds and must be adjusted. Ideally, output pulses should be as much to right of reference pulse (switch position 1) as they are to left (switch position 2).

Note

Delay error indicated by above check is magnified by type of presentation used. The check is intended as an accurate, readable go-no go gauge and should be so used.

TABLE 3-3. ROUTINE MAINTENANCE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	INDICATIONS AND CORRECTIVE ACTION
	DAILY CHECKS	
	POWER DISTRIBUTION AND CONTROL	
Panel fuses (table 3-4)	Inspect all indicating fuseholders on receiver-transmitter group cabinet and power supply cabinet.	A glowing fuseholder indicates a blown fuse. Replace fuse.
Cabinet blowers (figures 3-6 and 3-10)	Inspect amber AIR SW OPEN lamps on amplifier-modulator DS1303, blower compartment panel of the receiver-transmitter cabinet (DS901), and blower and transformer compartment of power supply cabinet (DS1001).	If one of the lights is on, a blower is not working properly. De-energize equipment and repair or replace blower. Blower filters should be cleaned in accordance with procedure in paragraph 3-6b (1)(b).

12. TEST PROCEDURES USING REPLACEMENT TEST EQUIPMENT (TABLE 1-2b) ONLY. - For easy reference the following abbreviations are used to denote specific pieces of test equipment:

XFER UNIT for Transfer and Switch Unit MM-1602
CTR Unit for Power Meter - Pulse Counter - Marker Generator MM-109
SA/TG for Spectrum Analyzer/Test Generator MM-705
CABLE for Calibrated Cable B002314

(a) SQUITTER RATE MEASUREMENT AND TOTAL PULSE COUNT. - If the operational beacon is to be tested, it must be removed from service before proceeding. To do this, inhibit both Transponder Monitors, turn the standby beacon MASTER SWITCH to ON and set the ANTENNA XFER SEL switch on the XFER UNIT to the standby position.

1. On the XFER UNIT and CTR unit, set the PRIMARY POWER switches to ON. Allow the test equipment five minutes to stabilize.

2. On the CTR Unit, confirm that the coaxial link is connected between the NON-CAL COUPLER and LIN DET INPUT jacks

3. a. Set the BATTLE SHORT switch to INTLK SHORTED.

b. Release the bolts securing the Coder Indicator and draw the unit fully forward.

4. a. Set the Coder switch S605 to OFF

b. At the rear of the beacon, remove the cables from the NORTH INPUT and AUXILIARY INPUT sockets. Mark/identify the cables to ensure correct reconnection.

5. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

6. On the CTR unit, set the controls as follows:

a. FUNCTION switch to TRANSPONDER TEST

b. MODE switch to FUNCTION TEST

c. Momentarily depress the COUNTER INPUT READ switch and adjust the COUNTER INPUT COARSE and FINE controls for a reading within the green zone of the PEAK RF POWER meter.

Note
Use the lowest setting of the COUNTER INPUT COARSE control that allows adjustment of the FINE control to give the green zone reading.

d. COUNTER/MARKER SELECT switch to any COUNT position.

e. TIME INTERVAL selector to 1·0 SECS. Set the DISPLAY TIME control as desired.

f. MARKERS switch to GATED

Squitter Rate

7. On the CTR unit, observe the Nixie readout. The count should be between 5220 and 5580 pulses per second (nominally 5400 pulses per second). If necessary, adjust the squitter rate as detailed in Paragraph 6-2h (1)

8. a Replace the NORTH and AUXILIARY cables at the rear of the beacon.

b. Set the Coder switch S605 to ON and return the Coder Indicator to the rack. Tighten and secure the bolts.

c. Set the BATTLE SHORT switch to NOR.

Total Pulse Count

9. On the CTR unit, observe the Nixie readout. The count should be between 7020 and 7380 pulses per second, (nominally 7200 pulses per second).

Note
During identity transmission, the total pulse count is reduced to approximately 6660 pulses per second for the duration of a tone transmission.

10. If the beacon was removed from service, return beacon and Monitors to normal operation.

(b) PULSE PAIR ANALYSIS. -

1. On the XFER UNIT, Oscilloscope and CTR unit, set the PRIMARY POWER switches to ON. Allow the test equipment approximately five minutes to stabilize.

2. On the CTR unit, confirm that the coaxial link is connected between the NON-CAL COUPLER and LIN DET INPUT jacks.

3. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

4. On the CTR unit, set the FUNCTION switch to TRANSPONDER TEST.

5. Set the Oscilloscope controls as follows:

a. MAG switch to OFF.

b. Vertical MODE switch to CH2.

c. Vertical TRIGGER switch to NORM

d. CH2 input selector to SYSTEM TEST AC.

e. A TRIG SOURCE selector to SYSTEM P.

f. A TRIGGER MODE selector to AUTO.

g. Depress the TRACE FINDER button and use the INTENSITY and POSITION controls to centralize the trace

6. Set the Oscilloscope timebase controls:

a. HORIZ DISPLAY switch to A.

b. A TIME/CM (outer control) to 5μ sec.

c. B TIME/CM (pull to unlock) to 1·0μ sec.

d. VARIABLE TIME/CM A and B fully clockwise.

7. Set the Oscilloscope CH2 VOLTS/CM and VARIABLE VOLTS/CM controls for a 6cm vertical deflection and inspect the displayed pulse

pairs for normal gaussian configuration. If a positive-going waveform is desired, pull the CH2 PULL TO INVERT knob and re-adjust the CH2 vertical POSITION control.

8. On the CTR unit, calibrate the markers as follows:

a. Turn the COUNTER/MARKER SELECT switch to the 0·5μ SEC position.

b. Set the MARKERS switch to FREE RUN and the MODE switch to FUNCTION TEST.

c. Set the TIME INTERVAL selector to 0·01 SECS, momentarily lift the CTR RESET switch and adjust the 2MC SET control for a Nixie readout of 20000 (disregard the decimal).

d. Set the MARKERS switch to GATED.

9. Use the MARKERS INTENSITY and POSITION controls on the CTR unit, also the oscilloscope INTENSITY control, to position one 0·5μsec marker (intensified) on the leading or trailing edge of the first pulse, at the half-amplitude point.

10. Set the Oscilloscope HORIZ DISPLAY switch to the left-hand B DLY'D BY A position.

Pulse Spacing

11. Using the DELAY TIME MULT control, count markers to measure the time interval to the same point on the second pulse. The pulse spacing should be between 11·75 and 12·25μ sec. (nominally 12μ sec).

Pulse Width

12. Carefully measure the pulse width at the half-amplitude point; the pulse width should be between 3·0 and 4·0μ sec, (nominally) 3·5μ sec).

Rise- and Fall-time

13. Use the 0·5μ sec markers to measure the pulse rise- and fall-time. These should be between 2·0 and 3·0μ sec between the 10% and 90% amplitude points. Three minor graticule divisions represents 10% of 6cm.

14. Repeat sub-clause (8) to determine marker accuracy; if the 2MC SET control requires adjustment, sub-clauses 9 to 13 must be repeated.

(c) REFERENCE BURST ANALYSIS.-

1. On the XFER UNIT, Oscilloscope and CTR unit, set the PRIMARY POWER switches to ON. Allow the test equipment five minutes to stabilize.

2. On the CTR unit, confirm that the coaxial link is connected between the NON-CAL COUPLER and LIN DET INPUT jacks.

3. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

4. On the CTR unit, set the REF MKR switch to NORTH and the FUNCTION switch to REF BURSTS/ANTENNA SPEED. Calibrate the markers as follows:

a. Turn the COUNTER/MARKER SELECT switch to 0·5μ sec

b. Set the MARKERS switch to FREE RUN and the MODE switch to FUNCTION TEST.

c. Set the TIME INTERVAL selector to 0·01 SECS, momentarily lift the CTR RESET switch and adjust the 2MC SET control for a readout of 20000 on the Nixie display (disregard the decimal).

d. Set the MARKERS switch to GATED.

5. On the CTR unit, set the COUNTER/MARKER SELECT switch to the 1·0μ SEC position.

6. Set the Oscilloscope controls as follows:

a. MAG switch to OFF.

b. Turn the VARIABLE TIME/CM A and B controls fully clockwise.

c. Vertical MODE switch to CH1.

d. Vertical TRIGGER switch to NORM.

e. CH1 input selector to SYSTEM TEST AC.

f CH1 VOLTS/CM selector to 0·5

g DELAY TIME MULT control fully-counterclockwise

h. A TRIG SOURCE selector to SYSTEM TEST P and the TRIGGER MODE switch to AUTO.

j. HORIZ DISPLAY switch to the left-hand side A INTEN BY B position:

k. Set the A TIME/CM and DELAY TIME combined or integral control (outer control) to the 50μ SEC position and the B TIME/CM AND DELAY TIME control (pull to unlock) to the 2μ SEC position.

l. Depress the TRACE FINDER button and use the DELAY TIME MULT control to place the intensified B timebase onto the first pulse-pair of the North burst. (See Figure 3-22).

7. On the oscilloscope, set the HORIZ DISPLAY switch to the left-hand side B DLY'D BY A position. Measure the average North Brust jitter in microseconds and record the jitter obtained. The average jitter should not exceed 6μ sec.

8. On the CTR unit, set the REF MKR switch to AUX.

9 Measure the average Auxiliary Burst jitter in microseconds and record the jitter obtained. The average jitter should not exceed 6μ sec.

10. On the CTR unit, set the REF MKR switch to NORTH and turn the INTENSITY control fully counter-clockwise.

11. Set the oscilloscope controls as follows:

a. HORIZ DISPLAY switch to the right-hand side A INTEN BY B position.

b. B TIME/CM to the 5μ sec position.

c. B TRIG SOURCE selector to -AC INT.

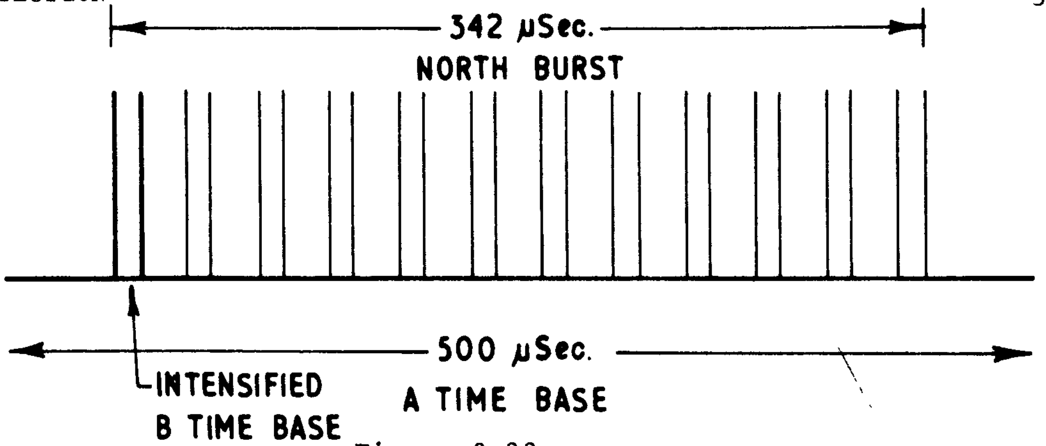


Figure 3-22

d. Adjust the DELAY TIME MULT and INTENSITY controls to centre the intensified B timebase about the first pulses of the North Burst. If the B timebase is not visible, adjust the B TRIGGER LEVEL control.

12. Set the oscilloscope HORIZ DISPLAY switch to the right-hand side B DLY'D BY A position and adjust the B TRIGGER LEVEL and INTENSITY controls to obtain a stable display.

13. Use the oscilloscope HORIZ POSITION control, 10μ sec and 1μ sec markers and (on the CTR unit) the marker INTENSITY and POSITION controls to measure the pulse-pair spacing. The spacing should be between 29·7 and 30·3μ sec. Record the spacing obtained.

14. Set the REF MKR switch to AUX, and in a similar manner, measure the pulse-pair spacing of an Auxiliary Burst. The spacing should be between 23·75 and 24·25μ sec. Record the spacing obtained. Recalibrate the markers as described in sub-clause 4.

15. Reset the oscilloscope controls to observe a complete Auxiliary Burst. Observe that there are six pulse-pairs and that there is no pulse mis-firing (intermittent base-line under pulse).

16. Set the CH1 VARIABLE VOLTS/CM control for an average vertical deflection of 6 cm on the graticule and measure the droop or boost of the Auxiliary burst. Droop of boost should not exceed one minor graticule division (3·2% of the average burst amplitude).

17. Set the REF MKR switch to NORTH Repeat the procedure described in sub-clauses 15 and 16; observe that the North Burst consists of twelve pulse-pairs.

18. If the above specifications are not met, set up as described in Paragraph 6-2h 5 and 6.

d. MEASUREMENT AND ADJUSTMENT OF IDENTITY AND EQUALIZING PULSE SPACING.--The beacon should operate into the dummy load in order to prevent transmission of continuous identity tone.

1. On the XFER UNIT, Oscilloscope and CTR unit, set the PRIMARY POWER switches to ON. Allow the test equipment five minutes to stabilize.

2. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

3. On the CTR unit, confirm that the coaxial link is connected between the NON-CAL COUPLER and LIN DET INPUT jacks.

4. On the Beacon:--

a. Set the BATTLE SHORT switch to INTLK SHORTED.

b. Withdraw the Coder Indicator to the fullest extent of its slides and set switch S603 to CONTINUOUS TONE.

5. On the CTR unit, calibrate the markers as follows:--

a. Turn the COUNTER/MARKER SELECT switch to 0·5μ sec.

b. Set the MARKERS switch to FREE RUN and the MODE switch to FUNCTION TEST.

c. Set the TIME INTERVAL selector to 0·01 SECS; momentarily lift the CTR RESET switch and adjust the 2MC SET control for a Nixie readout of 20000 (disregard the decimal).

d. Set the MARKERS switch to OFF.

6. Turn the FUNCTION switch to REF BURSTS/ANTENNA SPEED and set the REF MKR switch to AUX.

Identity Pulse Spacing

7. Set the oscilloscope controls as follows:--

a. Vertical MODE switch to CH2.

b. Vertical TRIGGER switch to NORM.

c. CH2 INPUT selector to SYSTEM TEST DC.

d. CH2 VOLTS/CM selector to 0·5 and the VARIABLE VOLTS/CM control fully clockwise.

e. HORIZ DISPLAY switch to the right-hand side A INTEN BY B position.

f. A TRIG SOURCE selector to SYSTEM TEST P and the B TRIG SOURCE selector to - DC INT.

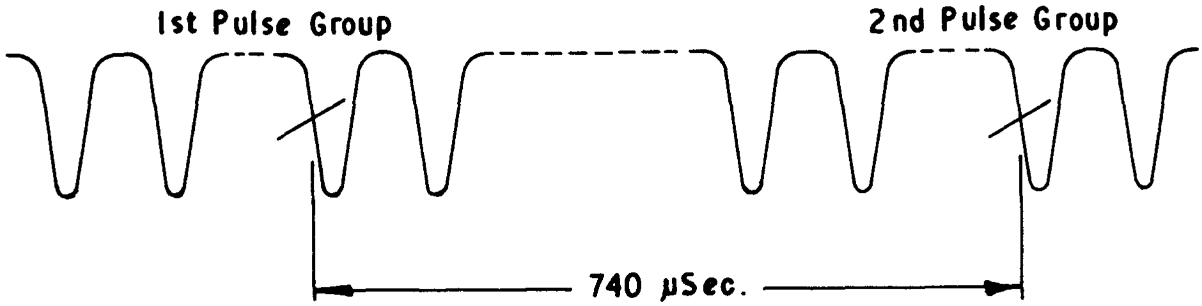


Figure 3-23

g. A TIME/CM control to 0·5 mSEC and the B TIME/CM control (pull to unlock) to 0·1 mSEC.

h. DELAY TIME MULT control to 3·00.

j. Adjust the TRIG LEVEL, INTENSITY and HORIZ POSITION controls to obtain a brightened section of the trace and set the DELAY TIME MULT control to observe two brightened pulse-pairs in the centre of the trace.

8. Set the HORIZ DISPLAY switch to B DLY'D BY A (right-hand side) and use the HORIZ POSITION control to place the second pulse-pair of the first group on the centre-line. Set the MAG switch to the X10 position.

9. On the CTR unit, set the COUNTER/MARKER SELECT switch to the 10µ SEC position and the MARKERS switch to GATED.

10. Adjust the MARKERS POSITION control on the CTR unit and the INTENSITY control on the oscilloscope to place a 100µ sec marker (intensified) on the half-amplitude point of the leading edge of the third pulse of the first pulse group. (See figure 3-23).

11 Using the Oscilloscope HORIZ POSITION and INTENSITY controls, measure the time interval from this point to the identical place in the second pulse group as shown in figure 3-23. The pulse spacing should be between 690 and 790µ sec (nominally 740µ sec). Record the spacing obtained. If the spacing is not between 690 and 790µ sec, set up as described in Paragraph 6-2h 4.

Equalizing Pulse Spacing

12. On the Oscilloscope, set the B TIME/CM control to the 0·2µ SEC position.

13. On the CTR unit, adjust the MARKERS POSITION control to place a marker on the half-amplitude point of the leading edge of the second pulse of the first pulse group (see figure 3-24).

14. Measure the time interval from this point to the identical place on the fourth pulse of the same group, as shown in figure 3-24. The pulse spacing should be between 95 and 105µ sec, nominally 100µ sec. Record the spacing obtained.

15. If necessary, set the spacing as described in Paragraph 6-2h 4

16. On the beacon:-

a. Set switch S603 to NORMAL KEYING

b. Return the Coder Indicator to the rack and tighten the securing bolts.

c. Set the BATTLE SHORT switch to NOR.

(e) REPLY DELAY MEASUREMENT. -

1. On the XFER UNIT, SA/TG, Oscilloscope and CTR units, set the PRIMARY POWER switches to ON. Allow five minutes for the test equipment to stabilize.

2. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

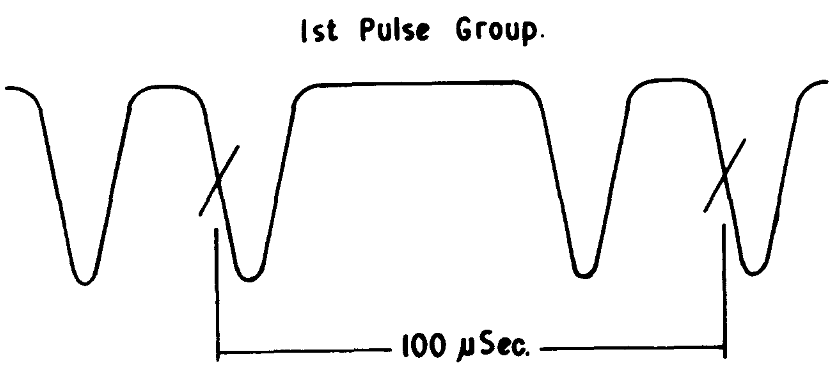


Figure 3-24

3. Confirm that the coaxial links are connected as follows:-

a On the XFER UNIT, between the SA/TG and SEL SW'S jacks.

b On the SA/TG unit, between the ATTEN and XFER UNIT jacks and between the PWR BRIDGE and FUNCTION SW jacks.

c On the CTR unit, between the NON-CAL COUPLER and LIN DET INPUT jacks.

4. On the CTR unit, set the FUNCTION switch to the DELAY/RCVR SENS position and the COUNTER/MARKER SELECT switch to any COUNT position.

5. Set the SA/TG unit controls as follows:-

a. ATTENUATOR to 100 dB, or higher.

b. PULSE SPACING switch to NON.

c. PRR selector to 1 KC.

d. RF SIG GEN MODE switch to OFF.

e. FREQ SEL selector to ON CHAN.

f. FUNCTION switch to RF SIG GEN.

g. Adjust the ZERO SET control for a ZERO SET reading on the AVERAGE POWER meter.

6. Set the oscilloscope controls as follows:-

a. Vertical MODE switch to CH2

b. Vertical TRIGGER switch to NORM

c. CH2 INPUT selector to SYSTEM TEST DC.

d CH2 VOLTS/CM selector to 0·2.

e HORIZ DISPLAY switch to the A position.

f. A TRIG SOURCE selector to SYSTEM TEST P.

g A TRIG MODE selector to AUTO.

h. MAG switch to OFF.

7. Set the oscilloscope TIME/CM AND DELAY TIME controls as follows:-

a. Time base A (outer control) to 10μ SEC.

b. Time base B (pull to unlock) to 1·0μ SEC.

c. Turn the VARIABLE A and B controls fully clockwise.

8. Depress the TRACE FINDER button and use the INTENSITY and POSITION controls to centralize the trace.

9. On the SA/TG unit, set the RF SIG GEN MODE selector to CW and adjust the PWR SET control for a red line reading on the AVERAGE POWER meter.

Note
The SA/TG signal generator is now adjusted to give an output power of 1·0 mW CW.

10. Set the oscilloscope CH2 Vertical POSITION and VARIABLE VOLTS/CM control to establish a DC reference for 1·0 mW CW.

11. On the SA/TG unit, set the RF SIG GEN MODE selector to PULSE and set the AMPL ADJ control to position the peaks of the pulse-pair on the DC reference level established in sub-clause 10.

Note
The SA/TG signal generator is now adjusted to give an output of 1·0 mW pulse power.

12. Adjust the oscilloscope ASTIG and FOCUS controls to obtain the best presentation of the displayed pulses. If necessary repeat sub-clause 11.

13. Set the oscilloscope MODE selector to ADDED and the CH1 and CH2 INPUT selectors to SYSTEM TEST DC.

14. On the SA/TG unit, set the ATTENUATOR to 30dB.

15. Observe the displayed waveform and confirm that both the interrogation and reply pulses appear on the same sweep. Adjust the CH2 VOLTS/CM and/or VARIABLE controls to obtain a 6 cm display of interrogation pulse-pairs and adjust the CH1 VOLTS/CM and/or VARIABLE controls for a 6 cm display of reply pulse-pairs.

16. On the CTR unit, calibrate the markers as follows:-

a. Set the COUNTER/MARKER SELECT switch to 0·5μ SEC.

b. Set the MARKERS switch to FREE RUN and the MODE switch to FUNCTION TEST.

c. Set the TIME INTERVAL switch to 0·01 SECS: momentarily lift the CTR RESET switch and adjust the 2MC SET control for a counter reading of 20000 (disregard the decimal).

d. Set the MARKERS switch to GATED.

17. Adjust the INTENSITY control on the oscilloscope and the MARKERS INTENSITY control on the CTR unit until the markers are clearly observed.

Note
The markers are spaced 0·5μ sec apart, every tenth one being intensified; although the first brightened marker appears after the ninth interval.

18. Set the HORIZ DISPLAY switch to the left-hand B DLY'D BY A position.

19. Adjust the oscilloscope DELAY TIME MULT control to position the second pulse of the interrogation pulse-pair near the centre of the trace.

20. On the CTR unit, set the COUNTER/MARKER SELECT switch to 1·0μ SEC and adjust the MARKERS POSITION control to superimpose a marker on the half-amplitude point of the leading (or trailing) edge of the second interrogation pulse.

21. Using the oscilloscope DELAY TIME MULT control, count the markers in the interval to the same point on the reply pulse pair. The time interval should be between 49·8 and 50·2μ sec. Record the reading obtained.

(f) RECEIVER SENSITIVITY MEASUREMENT AND PULSE PAIR DECODER EFFICIENCY.

Note

On the Amplifier Modulator, ensure that the HV SUPPLY and BEAM CURRENT meters indicate their normal readings.

1. On the XFER UNIT, SA/TG, Oscilloscope and CTR unit, set the PRIMARY POWER switches to ON. Allow five minutes for the test equipment to stabilize.

2. On the XFER UNIT set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

3. Confirm that the coaxial links are connected as follows:-

a. On the XFER UNIT, between the SA/TG and SEL SW'S jacks

b. On the SA/TG unit, between the ATTEN and XFER UNIT jacks and between the PWR BRIDGE and FUNCTION SW jacks.

c. On the CTR unit, between the NON-CAL COUPLER and LINE DET INPUT jacks.

Receiver Sensitivity

4. On the CTR unit, set the controls as follows:-

a. The FUNCTION switch to DELAY/RECVR SENS.

b. The COUNTER/MARKER SELECT switch to any COUNTS position.

c The TIME INTERVAL selector to 1·0 SEC.

d. The MODE switch to REPLY RATE

5. Set the SA/TG unit controls as follows:-

a. The PRR selector to 1 KC.

b. The PULSE SPACING selector to NOM (12μ sec.

c. The RF SIG GEN MODE switch to OFF.

d. The FREQ SEL selector to ON CHAN.

e. The ATTENUATOR to 100 dB, or higher.

f. The FUNCTION switch to RF SIG GEN.

g. Adjust the ZERO SET control for ZERO SET reading on the AVERAGE POWER meter.

6. Set the oscilloscope controls as follows:-

a. The vertical MODE switch to CH2.

b. The vertical TRIGGER switch to NORM.

c. The CH2 INPUT selector to SYSTEM TEST DC.

d. The CH2 VOLTS/CM selector to 0·2.

e. The HORIZ DISPLAY switch to the A position.

f. The A TRIG SOURCE selector to SYSTEM TEST P.

g. The A TRIG MODE selector to AUTO.

h. The MAG switch to OFF.

j. The A time base TIME/CM AND DELAY TIME control (outer knob) to the 2μ SEC position

k. Turn the VARIABLE VOLTS/CM A and B controls fully clockwise.

l. Depress the TRACE FINDER button and use the POSITION and INTENSITY controls to centre the trace.

7. On the SA/TG unit, set the RF SIG GEN MODE switch to CW and adjust the PWR SET control for a POWER SET (red line) reading on the AVERAGE POWER meter.

Note

The SA/TG unit signal generator is now adjusted to give an output power of 1·0 mW CW.

8. Adjust the oscilloscope CH2 vertical POSITION and VARIABLE VOLTS/CM controls to obtain a 5 cm deflection when switching the CH2 INPUT selector from GND to SYSTEM TEST DC. This establishes a DC reference level for 1·0 mW.

9. On the SA/TG unit:

a. Set the RF SIG GEN MODE switch to PULSE and set the AMPL ADJ control to position the peaks of the pulse-pair on the DC reference level established in sub-clause 8.

Note

The SA/TG signal generator is now adjusted to give an output of 1·0 mW pulse power.

b. Set the ATTENUATOR to 30 dB.

10. On the oscilloscope, set the CH2 INPUT selector to SYSTEM TEST AC. Adjust the ASTIG and FOCUS controls to obtain the best presentation of the displayed pulses. If necessary repeat sub-clause 9.

11. On the CTR unit, depress the COUNTER INPUT READ switch and adjust the COARSE and FINE controls for a reading within the green zone of the PEAK RF POWER meter.

Note

The CTR unit is counting the synchronous replies to the SA/TG signal generator, which is set to 1000 interrogations per second. Due to normal beacon action, it is not possible to obtain 1000 replies per second.

12. Set the DISPLAY TIME control for a minimum time of display and observe that the counter readout is approximately 700 to 800 synchronous replies per second.

13. Increase the SA/TG ATTENUATOR reading until the average counter readout is 600. Note the ATTENUATOR reading and add this to the system losses, to obtain the beacon receiver sensitivity, which should be between -91 and -97 dBm. Record the reading obtained.

Notes

1. A typical set of system losses is shown below, together with the resultant receiver sensitivity:

a. SA/TG ATTENUATOR reading (61·8 to 67·8 dB)	64·8 dB Typical
b. TMC RACK - Switch, cable and connector losses. (2·3 to 3·7 dB)	3·0 dB Typical
c. XFER UNIT - Precision directional coupler. (22·5 to 23·5 dB)	23·0 dB Typical
d. BEACON Preselector Loss. (1·0 to 3·0 dB)	1·5 dB Typical
e. Receiver, Duplexer transmission line, cable and connector losses. (1·0 to 2·0 dB)	1·7 dB Typical
f. Total dB below 1 mW at Receiver input	94·0 dB
g. Receiver sensitivity	-94·0 dBm

2. The beacon RF losses may be found by comparing the ATTENUATOR reading obtained in sub-clause 13 with that obtained in Paragraph 3-6a (12) (g) (14) a; subtract the CALIBRATED CABLE loss from the reading obtained in this paragraph and the difference between the two readings is now equal to the beacon RF loss, including the 10 dB coupler at the receiver input.

Receiver Decoder Test

Note

The receiver sensitivity for a pulse spacing of 12μ sec must be obtained before performing this test.

14. On the CTR unit, calibrate the markers as follows:

a. Turn the COUNTER/MARKER SELECT switch to 0·5μ sec.

b. Set the MARKERS switch to FREE RUN and the MODE switch to FUNCTION TEST.

c. Set the TIME INTERVAL switch to 0·01μ SEC. Momentarily lift the CTR RESET button and adjust the 2MC SET control for a readout of 20000 ± 1 on the Nixie display (disregard the decimal).

d. Set the MARKERS switch to GATED, taking care not to disturb the 2MC SET control.

15. On the CTR unit, use the markers POSITION and INTENSITY controls to observe the 0·5μ sec markers on the oscilloscope. Note that every tenth marker is intensified.

16. Measure the spacing between the half-amplitude points of the leading edges of the pulses. The pulse spacing should be 11·75 to 12·25μ sec. Record the spacing obtained.

17. On the SA/TG unit, set the PULSE SPACING switch to VAR and use the variable PULSE SPACING control to adjust the pulse spacing at the half-amplitude points to 12·5μ sec.

18. Measure the receiver sensitivity as detailed in sub-clauses 1 to 13 inclusive. The receiver sensitivity should not decrease by more than 3 dB from the value obtained in 13. Record the receiver sensitivity in -dBm.

19. Using the variable PULSE SPACING control, set the pulse spacing to 11·5μ sec at the half-amplitude points and repeat sub-clause 18.

20. Using the variable PULSE SPACING control, set the pulse spacing to 15·0μ sec at the half-amplitude points. Measure the receiver sensitivity as described in sub-clauses 1 to 13 inclusive and record the reading obtained, in -dBm. The receiver sensitivity should be reduced by at least 50 dB from the value obtained in sub-clause 13.

21. Using the variable PULSE SPACING control, set the pulse spacing to 9μ sec and repeat sub-clause 20.

(g) RECEIVER SELECTIVITY MEASUREMENT. -

1. On the SA/TG, Xfer Unit, Oscilloscope and CTR unit, set the PRIMARY POWER switches to ON.

2. On the XFER UNIT set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

3. Confirm that the coaxial links are connected as follows:-

a. On the SA/TG unit, between the PWR BRIDGE and FUNCTION SW jacks.

b. On the CTR unit, between the NON-CAL COUPLER and LIN DET INPUT jacks.

4. On the SA/TG unit:

a. Remove the link from between the ATTEN and XFER UNIT jacks

b. Connect the CALIBRATED TEST CABLE between the ATTEN jack and the 10 dB COUPLER jack on the beacon receiver front panel.

5. Set the controls on the CTR as follows:-

a. FUNCTION switch to DELAY/RCVR SENS.

b. COUNTER/MARKER SELECT switch to any COUNT position.

c. TIME INTERVAL selector to 1·0 SECS.

d. MODE switch to REPLY RATE.

6. On the SA/TG unit set the controls as follows:-

a. PRR selector to 1 KC.

b. PULSE SPACING selector to NOM (12μ sec).

c. RF SIG GEN MODE switch to OFF.

d. FREQ SEL selector to ON CHAN.

e. ATTENUATOR to 100 dB, or higher.

f. FUNCTION switch to RF SIG GEN.

g. Adjust the ZERO SET control for a ZERO SET reading on the AVERAGE POWER meter.

7. Set the Oscilloscope controls as follows:-

a. Vertical MODE switch to CH2.

b. Vertical TRIGGER switch to NORM.

c. CH2 INPUT selector to SYSTEM TEST DC.

d. CH2 VOLTS/CM selector to 0·2.

e. HORIZ DISPLAY switch to the A position.

f. A TRIG SOURCE selector to SYSTEM TEST P.

g. A TRIG MODE selector to AUTO.

h. A time base TIME/CM AND DELAY TIME control (outer knob) to the 5μ sec position.

j. Depress the TRACE FINDER button and adjust the INTENSITY and POSITION controls to centre the trace.

8. On the SA/TG unit, set the RF SIG GEN MODE switch to CW and adjust the PWR SET control for a POWER SET (red line) reading on the AVERAGE POWER meter.

Note

The SA/TG signal generator is now adjusted to give an output power of 1·0 mW CW.

9. Adjust the oscilloscope CH2 vertical POSITION and VARIABLE VOLTS/CM controls to obtain a 5 cm deflection when switching the CH2 INPUT selector from GND to SYSTEM TEST DC. This establishes a DC reference level for 1·0 mW CW.

10. On the SA/TG unit, set the RF SIG GEN MODE switch to PULSE and set the AMPL ADJ control to position the peaks of the pulse-pair on the DC reference level established in sub-clause 9.

Note

The SA/TG signal generator is now adjusted to give an output of 1·0 mW pulse power.

11. Adjust the oscilloscope ASTIG and FOCUS controls to obtain the best presentation of the displayed pulses. If necessary repeat sub-clause 10.

12. Set the SA/TG ATTENUATOR to approximately 30 dB. On the CTR unit, depress the COUNTER INPUT READ switch and adjust the COARSE and FINE controls for a reading within the green zone of the PEAK RF POWER meter.

Note

The CTR unit is counting the synchronous replies to the SA/TG signal generator, which is set to 1000 interrogations per second. Due to normal beacon action, it is not possible to obtain 1000 replies per second.

13. Set the DISPLAY TIME control for a minimum time of display and observe that the counter readout is approximately 700 to 800 synchronous replies per second.

14. Increase the SA/TG ATTENUATOR reading until the average counter readout is 600. Note the ATTENUATOR reading and add this to the system losses to obtain the beacon receiver sensitivity as measured at the 10 dB COUPLER jack. Calculate the receiver sensitivity in - dBm as follows:-

a.	SA/TG ATTENUATOR READING (80 to 86 dB)	83·0 dB Typical
b.	CALIBRATED CABLE LOSS (0·5 to 1·5 dB)	1·0 dB Typical
c.	PRECISION DIRECTIONAL COUPLER (9·5 to 10·5 dB)	10·0 dB Typical
d.	TOTAL dB BELOW 1 mW at receiver input	94·0 dB
e.	Receiver sensitivity	-94·0 dBm

Note the receiver sensitivity, which should be between -91 and -97 dBm.

15. On the SA/TG unit, set the FREQ SEL switch to +200 KC.

16. Adjust the ATTENUATOR to obtain an average counter readout equal to that obtained in sub-clause (14); the ATTENUATOR reading should not deviate by more than 3 dB from the reading obtained in that sub-clause. Record the deviation.

17. Set the FREQ SEL switch to -200 KC and repeat sub-clause (16).

18. Set the FREQ SEL switch to -900 KC.

19. Decrease the ATTENUATOR until the counter readout is equal to that obtained in sub-clause (14); the ATTENUATOR reading should decrease by at least 80 dB from the reading obtained in that sub-clause.

20. Return the ATTENUATOR to the reading obtained in 14 set the FREQ SEL switch to ON CHAN and confirm the counter readout obtained in 14.

21. Set the FREQ SEL switch to +900 and repeat 19 and 20.

22. Disconnect the CALIBRATED CABLE: reconnect the co-axial link between the ATTEN and XFER UNIT jacks.

(h) ANTENNA SPEED MEASUREMENT. –

1. On the CTR unit, set the controls as follows:–

a. PRIMARY POWER switch to ON.

b. FUNCTION switch to REF BURSTS/ANTENNA SPEED.

c. MODE switch to GEN TEST +

d. COUNTER/MARKER SELECT switch to INTV.

e. MARKERS switch to GATED.

f. REF MKR switch to NORTH.

Allow five minutes for the test equipment to stabilize.

2. Depress the COUNTER INPUT READ switch and adjust the COARSE and FINE controls for a reading within the green zone of the PEAK RF POWER meter. Use the lowest setting of the COARSE control that allows adjustment of the FINE control for a green zone reading.

3. Momentarily lift the CTR RESET switch. Observe the counter readout, which should be 6660 ± 134. This indicates an antenna speed of between 882 and 918 rpm.

4. Set the REF MKR switch to AUX and repeat 2 Momentarily lift the CTR RESET switch. The counter readout should be 7407 ± 15. Occasionally the readout will be 14815 ± 30.

(j) RADIATED ANTENNA PATTERN ACCURACY.

1. Confirm that :

a. A TACAN beacon is on and operating into the antenna.

b. Monitors A6 and A7 are both on and serviceable.

2. On the Oscilloscope and the CTR unit, set the PRIMARY POWER switches to ON. Allow five minutes for the test equipment to stabilize.

3. On the CTR unit, set the FUNCTION switch to ANT PATTERN MON A6 RCVR.

4. On the Oscilloscope set the controls as follows:–

a. Vertical MODE switch to CH1.

b. Vertical TRIGGER switch to NORM.

c. CH1 VOLTS/CM selector to 0·5.

d. CH1 INPUT selector to SYSTEM TEST AC.

e. HORIZ DISPLAY switch to the A position.

f. A TIME/CM AND DELAY TIME selector to 10 m SECS.

g. A TRIG SOURCE selector to SYSTEM TEST P and the TRIGGER MODE switch to AUTO.

h. Adjust the remaining controls for the best antenna pattern presentation.

5. Use the Oscilloscope time base controls and the REF MKR switch on the CTR unit to analyze the antenna pattern. Pay particular attention to the following points:–

a. 15 Hz and 135 Hz modulation.

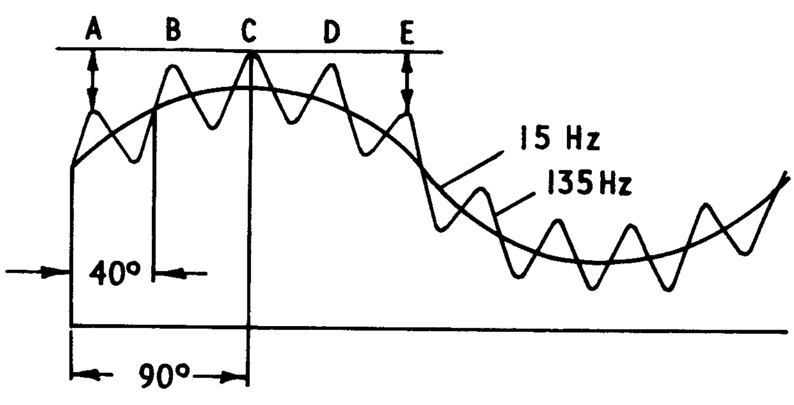
b. Phase relationships of the North and Auxiliary Bursts, relative to the 15 and 135 Hz amplitude modulation.

c. Examine the squitter texture and ensure that there is no abnormal pulse bunching.

d. Carefully compare the antenna pattern with the pattern obtained on initial installation, or with the pattern obtained on replacement of the TACAN antenna.

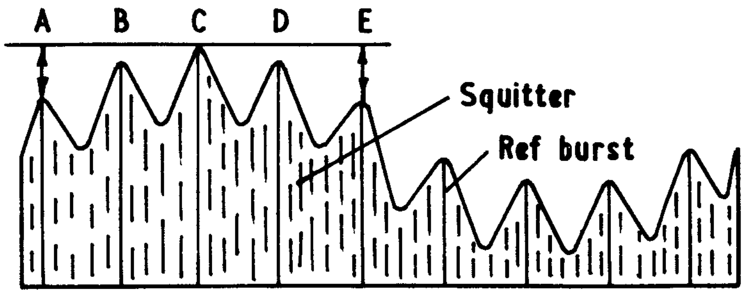
6. On the CTR unit, set the FUNCTION switch to the ANT PATTERN MON A7 RCVR position and repeat 5.

Note
The following illustrations show some of the correct and incorrect patterns which may be obtained.



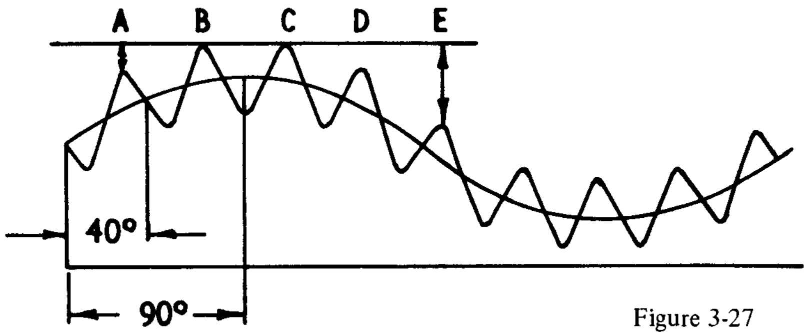
A = E : B = D
WAVEFORMS CORRECT
IN PHASE

Figure 3-25



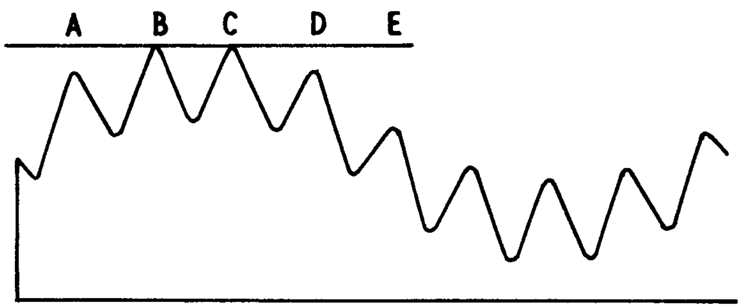
A = E : B = D
CORRECT PATTERN
WAVEFORMS IN PHASE

Figure 3-26



A = E : B = D
INCORRECT PATTERN
20° PHASE SHIFT

Figure 3-27



A = E : B = D
WAVEFORMS INCORRECT
20° PHASE SHIFT

Figure 3-28

(k) BLANKING TIME ADJUSTMENT.—Allow at least 10 minutes for the beacon receiver to warm up.

1. Connect the TEST OUTPUT jack on the front panel of the receiver to the Oscilloscope A time base TRIG IN jack.

2. Locate TP9 on the right-hand side of the receiver video chassis and connect a lead from TP9 to the Oscilloscope CH1 INPUT jack. Set up the oscilloscope to observe the blanking pulse as shown in figure 6-9a of Section 6.

3. Calibrate the markers and use them to measure the pulse width at the half-amplitude point.

4. Adjust R443, BLANKING TIME ADJUST, on the video chassis to obtain a pulse width of exactly 40μ sec.

(l) OUTPUT FREQUENCY SPECTRUM.—Ensure that the meter readings of the Amplifier Modulator HV SUPPLY and BEAM CURRENT meters are normal.

1. On the XFER UNIT and SA/TG unit, set the PRIMARY POWER switches to ON. Allow five minutes for the test equipment to stabilize.

2. Ensure that the coaxial links are connected as follows:—

a. On the XFER UNIT, between the SA/TG and SEL SW'S jacks.

b. On the SA/TG unit, between the ATTEN and XFER UNIT jacks and between the PWR BRIDGE and FUNCTION SW jacks.

3. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

4. On the SA/TG, set the controls as follows:-

a. ATTENUATOR to 100 dB.

b. BAND SHIFT selector to 0.

c. FREQ SEL switch to SA.

d. FUNCTION switch to PWR MTR ZERO SET.

e. Adjust the ZERO SET control for a ZERO SET reading on the AVERAGE POWER meter.

f. FUNCTION switch to SA.

g. Adjust the NOISE SET control for a NOISE SET reading on the AVERAGE POWER meter.

5. Set the ATTENUATOR to obtain a red line reading on the meter. Record the ATTENUATOR setting.

6. Set the BAND SHIFT selector to +0·8 MC.

7. Reduce the ATTENUATOR setting to obtain a red line reading on the meter. Record the ATTENUATOR setting; this should be at least 50 dB less than the setting obtained in (5).

CAUTION

The ATTENUATOR must be set to 100 dB, or higher, before turning the BAND SHIFT selector switch through the 0 position or meter may be damaged.

8. Set the ATTENUATOR to 100 dB, or higher, and turn the BAND SHIFT selector to -0·8 MC. Repeat the procedure outlined in (7).

9. Repeat the procedures outlined in (7) and 8. for BAND SHIFT selector settings of -2·0 MC and +2·0 MC. The ATTENUATOR settings obtained should be reduced by at least 60 dB from those obtained in (5).

Note

If the ATTENUATOR settings do not fall within the required specifications, tune the Amplifier Modulator and Control Duplexer as detailed in Paragraph 6-2h.

(m) BEACON PEAK POWER MEASUREMENT.-

1. Ensure that the coaxial links are connected as follows:-

a. On the XFER UNIT, between the SA/TG and SEL SW'S jacks.

b. On the SA/TG unit, between the ATTEN and XFER UNIT jacks and between the PWR BRIDGE and FUNCTION SW jacks.

2. On the XFER UNIT, CTR and SA/TG units, set the PRIMARY POWER switches to ON.

Note

Allow thirty minutes for the peak power diode oven in the CTR unit to stabilize.

3. On the XFER UNIT, set the XPONDER SEL switch to the beacon under test.

4. On the SA/TG unit, turn the FUNCTION switch to the PWR MTR ZERO SET position. Depress the ZERO SET switch on the CTR and adjust the SET ZERO control for zero reading on the PEAK RF POWER meter

5. On the SA/TG, set the FUNCTION switch to the RF PEAK POWER position.

6. On the SA/TG, set the ATTENUATOR to the reading established for the desired range of power. Approximate settings are:-

a. 13 dB for the 200W to 2kW range

b. 23 dB for the 2kW to 20 kW range.

7. On the CTR, read the peak power on the PEAK RF POWER meter. Multiply this reading by 10,000 if in the 2kW to 20kW range, or by 1000 if in the 200W to 2kW range. Record the reading obtained.

(n) BEACON RF AVERAGE POWER OUTPUT.-

1. On the XFER UNIT, SA/TG and CTR units, set the PRIMARY POWER switches to ON. Allow half an hour for the test equipment to stabilize.

2. On the Amplifier Modulator, ensure that the HV SUPPLY and BEAM CURRENT meters indicate their normal readings.

3. Confirm that the coaxial links are connected as follows:-

a. On the XFER UNIT, between the SA/TG and SEL SW'S jacks.

b. On the SA/TG unit, between the ATTEN and XFER UNIT jacks and between the PWR BRIDGE and FUNCTION SW jacks.

4. On the XFER UNIT, set the XPONDER SEL switch to PRIM or STBY. This selects the beacon to be tested.

5. On the SA/TG:-

a. Set the FUNCTION switch to the PWR METER ZERO SET position and adjust the ZERO SET control for a zero reading on the AVERAGE POWER meter.

b. Set the FUNCTION switch to the RF AVERAGE PWR position and adjust the ATTENUATOR for a red line reading on the meter. Note the ATTENUATOR reading.

6. Add the ATTENUATOR reading to the system losses to obtain the beacon average power in dB. A typical set of readings is given below:-

a.	Attenuator Reading:	19 dB
b.	Attenuation insertion loss:	5 dB (not greater than 6 dB)
c.	TMC switch, cable and connector loss:	3 dB
d.	XFER UNIT, directional coupler loss:	23 dB
e.	Total average beacon power:	+50 dBm
f.	Total average power in watts:	100 Watts.

(o) FREQUENCY MULTIPLIER OSCILLATOR - RF AVERAGE POWER OUTPUT.

Note

a. It is assumed that the transmitter circuits are correctly aligned.

b. Verify that the beacon total pulse count is within the specification in Paragraph 3-6a (12) (a)

1. On the SA/TG unit:-

a. Set the PRIMARY POWER switch to ON.

b. Remove the coaxial link from between the ATTEN and XFER UNIT jacks.

c. Confirm that the coaxial link is connected between the PWR BRIDGE and FUNCTION SW jacks.

2. Turn the FUNCTION switch to the PWR MTR ZERO SET position and adjust the ZERO SET control for zero reading on the AVERAGE POWER meter.

3. Set the ATTENUATOR to 100 dB, or higher.

4. On the beacon to be tested:

a. Set the BATTLE SHORT switch to INTLK SHORTED.

b. Release the bolts securing the Frequency Multiplier Oscillator (FMO) and draw the unit fully forward.

WARNING

The FMO employs high voltages. Exercise caution when proceeding with 5.

5. Remove the lead, complete with crystal detector, from the B socket of the directional coupler DC 1401 on the left-hand side of the FMO chassis. Connect the CALIBRATED TEST CABLE between the B socket of DC 1401 and the ATTEN socket on the SA/TG.

6. On the High Voltage Power Supply, set the HV ON/OFF switch to OFF.

7. Observing the AVERAGE POWER meter, reduce the ATTENUATOR setting to obtain a red line reading on the meter. Note the ATTENUATOR reading.

8. Set the HV ON/OFF switch to ON.

9. Determine the FMO average power output as follows:-

a.	ATTENUATOR reading:	8 dB Typical
b.	CALIBRATED CABLE loss:	1·2 dB Typical
c.	DC 1401 loss:	25 dB
d.	Total loss:	34·2 dB Typical
e.	RF average power:	2·6 watts Typical

10. a. Disconnect the CALIBRATED CABLE and reconnect the crystal detector to the B socket of directional coupler DC 1401.

b. Return the FMO to the rack and tighten the securing bolts. Set the BATTLE SHORT switch to NOR.

c. On the SA/TG unit, reconnect the coaxial link between the ATTEN and XFER UNIT jacks. Set the PRIMARY POWER switch to OFF.

b. ROUTINE CHECKS. — A general routine preventive-maintenance chart is shown in table 3-3. This table lists maintenance within scope of operator. Reference should be made to the Maintenance Standards Book, NAVSHIPS 93881.42, for a detailed list of routine checks within scope of operator.

For installations where the Test Monitor Control Rack 212A is incorporated, Paragraph 3-6a (12) should be consulted where specific tests are called for in TABLE 3-3.

TABLE 3-3. ROUTINE MAINTENANCE CHECK CHART (cont)

WHAT TO CHECK	HOW TO CHECK	INDICATIONS AND CORRECTIVE ACTION
	DAILY CHECKS (cont)	
	POWER DISTRIBUTION AND CONTROL (cont)	
Control-duplexer front panel	Inspect blue MAIN POWER ON lamp DS1102.	If lamp is not on, check for blown fuse. If blown fuse is not found, refer to trouble-shooting procedure in Section 5.
	Inspect white FIL ON and ANTENNA CONTROL ON lamps DS1101 and DS1103, respectively.	Both lamps should be on. If not, check to see that switches are on; if they are, de-energize equipment and refer to troubleshooting procedue in Section 5.
Regulated filament transformer voltage	Read SUPPLY VOLTS meter M1101 on front panel of control-duplexer.	Meter should read exactly 120 volts. If not, open control-duplexer unit, manually close interlock, loosen lock on the ADJUST FOR 120V knob, and adjust knob until voltage is correct; then tighten lock.
	Set LINE-REG FIL BUS switch to LINE	If line voltage is not 120V ±10 percent, check external power source.
	RADIO RECEIVER R-824/URN	
Panel lamps	Check white POWER ON lamp DS501	If light is not on, check receiver, switch on radio receiver panel; if switch is set to ON, refer to troubleshooting procedure in Section 5.
Voltages	Set METER SELECTOR switch to B+, 200 VFS.	Correct voltage is +150 ±5 volts. Full-scale deflection is equivalent to ±200 volts; therefore, TEST METER should read 75 ± 2.5 divisions on calibrated scale. If reading is incorrect, refer to troubleshooting procedure Section 5.
	Set METER SELECTOR switch to C-200 VFS	Correct voltage is -105 ± 2.5. The TEST METER should read 52.5 ± 2.5. If the reading is incorrect, refer to troubleshooting procedures in Section 5.
	After ten minutes warmup, set METER SELECTOR switch to SQUITTER CONTROL -10VFS.	Correct voltage is -5 ± 1.0 volts (rapid 0.1-volt fluctuation is normal). Full-scale deflection is equivalent to -10 volts; therefore, TEST METER should read 50 ± 10 divisions on calibrated scale; if not, refer to troubleshooting procedures in Section 5.

TABLE 3-3. ROUTINE MAINTENANCE CHECK CHART (cont)

WHAT TO CHECK	HOW TO CHECK	INDICATIONS AND CORRECTIVE ACTION
	DAILY CHECKS (cont)	
	CODER-INDICATOR KY-382/GRN-9D	
Power	Inspect white POWER ON lamp DS601.	If lamp is not on, check CODER-INDICATOR switch on coder-indicator panel; if switch is ON, refer to troubleshooting procedure in Section 5.
	Check amber ANTENNA CONTROL lamp DS602; it should burn steadily.	Blinking of lamp indicates trouble in antenna control unit or antenna. Refer to troubleshooting procedure in Section 5.
Speed, indicator reading	Check to see that speed error reading is not in red portion of ANTENNA SPEED ERROR meter scale.	Trouble is indicated by steady reading in red portion of meter scale. Refer to troubleshooting procedures in Section 5 for corrective measures. **Note** A temporary reading in red portion of scale while servo system is correcting is normal.
Identification keyer	Check to see that keyer motor and code wheel are rotating and that keyer switch is operating smoothly.	If operation is faulty, refer to Section 5 for troubleshooting and replacement procedures.
	POWER SUPPLIES	
Panel lamps	Inspect LV-MV READY and HV READY lamps on low and high voltage power supplies, respectively.	LV-MV READY lamp DS1601 should go on after 1 minute of operation. HV READY lamp DS1902 should go on after 5 minutes of operation. If lamps are not on after proper time interval, refer to troubleshooting procedure in Section 5.
	Inspect LV lamp DS1603 and -375V lamp DS1601 on low voltage power supply panel, +700V-+1000V lamp DS1801 on medium voltage power supply panel, and HV lamp DS1901 on high voltage supply panel.	The LV, -375V, and +700V-+1000V lamps should go on after 1 minute of operation, and the HV lamp should go on after 5 minutes of operation. If the lamps are not on after proper time interval, refer to troubleshooting procedures in Section 5.
	Inspect amber MV OVERLOAD lamp DS1803 on low voltage power supply panel, and HV OVERLOAD lamp DS1903 on high voltage power supply panel.	If one or both of these lamps are on, refer to troubleshooting procedures in Section 5.

TABLE 3-3. ROUTINE MAINTENANCE CHECK CHART (cont)

WHAT TO CHECK	HOW TO CHECK	INDICATIONS AND CORRECTIVE ACTION
DAILY CHECKS (cont)		
CODER-INDICATOR KY-382/GRN-9D (cont)		
Output voltages	Set meter selector switch under DC SUPPLY VOLTAGE meter on frequency multiplier-oscillator to each indicated voltage.	If meter does not read within 2 percent of what meter selector switch indicates it should read, refer to troubleshooting procedures in Section 5.
TRANSMITTER		
Frequency multiplier-oscillator lamps	Check white CRYSTAL OVEN HEATERS lamps.	Whenever EMERGENCY SWITCH S901 is at ON, OVEN lamp DS1403 should be on. NORMAL lamp DS1402 will go on when EMERGENCY SWITCH S901 is first turned to ON. After crystal oven reaches operating temperature, NORMAL lamp will switch off and on as oven heater goes off and on to maintain proper oven temperature.
Frequency multiplier-oscillator tuning meter	Read TUNING METER M1401 on frequency multiplier-oscillator front panel in each position of switch S1401.	Note any variation from values given in log showing daily readings of all switch positions on this meter. If any readings indicate variation from readings of more than 5 percent, refer to troubleshooting procedures in Section 5.
Amplifier-modulator lamps	Check that white FIL lamp DS1301 is on.	FIL lamp should come on as soon as amber airflow switch lamp goes out.
Klystron beam current	Read BEAM CURRENT meter M1301 on amplifier-modulator front panel.	Beam current should be between 80 and 100 ma.
High-voltage power supply	Read HV SUPPLY meter on amplifier-modulator front panel.	High voltage should be approximately 12,000 volts ±1000 volts. If reading is incorrect, refer to troubleshooting procedures in Section 5.
WEEKLY CHECKS		
RADIO RECEIVER R-824/URN		
Squitter count	Check squitter rate once a week or after replacing any tube or repairing receiver. Refer to paragraph 3-6a(6).	2700±90 pulses per second.

TABLE 3-3. ROUTINE MAINTENANCE CHECK CHART (cont)

WHAT TO CHECK	HOW TO CHECK	INDICATIONS AND CORRECTIVE ACTION
	WEEKLY CHECKS (cont)	
	RADIO RECEIVER R-824/URN (cont)	
Receiver sensitivity	Check the receiver sensitivity once a week or after replacing any tube or repairing receiver. Refer to paragraph 3-6a(7).	-53 dbm signal level for 60-percent reply to a properly coded interrogation signal.
	CODER-INDICATOR KY-382/GRN-9D	
Output pulse count	Refer to paragraph 3-6a(4) for method of checking output pulse count.	Output pulse count should be 7200±180 pulses per second. If pulse count is incorrect, refer to troubleshooting procedures in Section 5.
North reference burst pulse count and auxiliary reference burst pulse count	Refer to paragraph 3-6a(10) for method of checking reference bursts.	North reference burst should consist of 12±1 pulse pairs. Auxiliary reference burst should consist of 6±1 pulse pairs.
Identification code keyer	Connect a set of headphones to TEST OUTPUT jack on coder-indicator front panel and listen to identification code.	Identification code should be transmitted every 37-1/2 seconds.
	FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D	
Zero distance time	Refer to paragraph 3-6a(11).	Refer to paragraph 3-6a(11).
	AMPLIFIER-MODULATOR AM-1701/URN	
Output pulse shape	Refer to paragraph 3-6a(3).	See figure 3-18.
Peak power output	Refer to paragraph 3-6a(2).	Peak power output should be at least 7.5 kw.
	MONTHLY CHECKS	
Klystron output incident signal	Using Oscilloscope OS-54/URN-3, observe signal at KLYSTRON OUTPUT INCIDENT jack on control-duplexer front panel.	Compare amplitude of signal with previously logged readings (figure 3-18).
Klystron output reflected signal	Using oscilloscope, observe signal present at KLYSTRON OUTPUT REFLECTED jack.	Compare amplitude of signal with previously logged readings.
Antenna incident signal	Using oscilloscope, observe signal at ANTENNA INCIDENT jack on control-duplexer front panel.	Compare amplitude of signal with previously logged readings (figure 3-18).

TABLE 3-3. ROUTINE MAINTENANCE CHECK CHART (cont)

WHAT TO CHECK	HOW TO CHECK	INDICATIONS AND CORRECTIVE ACTION
MONTHLY CHECKS (cont)		
ELECTRICAL EQUIPMENT CABINETS		
Cabinet blower air filters 0901, 0902, and 01001	Open blower compartments at bottom of receiver transmitter cabinet and power supply cabinet and check blower filter (figures 3-6 and 3-10).	Clean filter if dirty in accordance with paragraph 3-6b(1)(b)
SEMIANNUAL CHECKS		
CODER-INDICATOR KY-382/GRN-9D		
Identification keyer	Check that keyer motor and code wheel are rotating and that keyer switches are operating smoothly. Lubricate according to paragraph 3-6b(3).	If contacts are worn, replace switches S604 and S607.

(1) CLEANING.

WARNING

Be sure to de-energize the equipment before proceeding with the steps outlined in the following paragraphs. Set the master power switch and the auxiliary power switch to OFF, and tag these switches to warn other personnel against turning them on while work is being performed on the equipment.

(a) GENERAL.--In addition to specific cleaning and inspection procedures outlined in foregoing paragraphs, service personnel are directed to inspect and clean all units listed in tables 1-1 and 1-2 at least twice yearly. General cleaning instructions are as follows:

Step 1. Using a vacuum cleaner or air hose (compressed air), remove all dirt and dust from the interior of each of the compartments. Excess dirt may be removed with a clean, dry cloth.

Step 2. Using drycleaning solvent 140-F (SNSN 51-S-4718-10 for 5-gallon drum) clean ceramic or glass surfaces, and high-voltage insulators. This solvent may also be used to clean or wash grease or oil from the transmitter-receiver and antenna components.

Step 3. With a clean, lint-free rag, remove all dust and dirt from the ventilating louvers of the cabinet enclosure.

WARNING

Dry-cleaning solvent is flammable and should not be used near an open flame. A fire extinguisher should be provided when cleaning solvents are used. Solvents evaporate rapidly and have a drying and cracking effect on the skin; occasionally they cause a milk irritation or inflammation. Use solvents only in well-ventilated places. The use of gasoline or benzene for cleaning is prohibited.

(b) CLEANING BLOWER FILTERS IN ELECTRICAL EQUIPMENT CABINETS.

Step 1. Shut off equipment and remove front panel blower compartment.

Step 2. Remove blower filter retaining screw (long threaded rod with wing head) holding filter in place (figures 3-6 and 3-10).

Step 3. Remove cylindrical filter. Clean filter with vacuum cleaner and wash with dishwashing compound SNSN-G-51-C-1576-100 in solution of water.

Step 4. Shake out excess water and let filter dry.

CAUTION

Do not oil filters

Step 5. Replace filter in cabinet.

(2) INSPECTION.–Each item must be externally inspected to see whether it is in good condition or

damaged beyond safe or serviceable limits. Inspect as follows:

Step 1. Inspect all lug and screw connections for tightness. Check that cables and leads are properly dressed to prevent short circuits or strains on wires and lugs.

Step 2. Inspect resistors, capacitors, coils and transformers for evidence of overheating. Carbonized or discolored surfaces as well as loss of potting compound are indications of overheating.

Step 3. Inspect front panel knobs and switches for looseness.

Step 4. Inspect vacuum tubes, making certain that all tubes are properly seated in their sockets.

Step 5. Inspect for rust and corrosion on metal surfaces. If rust or corrosion is detected, sand the area with emery cloth and touch up with varnish or paint. Do not use paint or varnish on or near switches or tube socket connections.

(3) LUBRICATION.–Lubrication of the identification-keyer assembly installed in the coder-indicator is required every 6 months. To lubricate the identification-keyer assembly, proceed as follows:

Note

Shut off the equipment if it is not needed to provide bearing and distance information.

Step 1. Loosen the four captive screws on panel of coder-indicator unit and pull out unit. The identification-keyer assembly is mounted on right side of unit.

Step 2. Fill gear box with grease, Military Specification MIL-G-3278. Using a grease gun, feed grease through grease fittings shown in figure 3-21. Fill oil cup with oil, Military Specification MIL-L-6085.

Step 3. Slide coder-indicator unit back into recessed position and tighten the four captive screws.

c. EMERGENCY MAINTENANCE.

Note

Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

(1) FUSE FAILURE.–All fuses used in the radio beacon are held in fuseholders that have neon lamps in their caps that go on when the fuse is blown. When any apparent improper functioning of the radio beacon occurs, the indicating fuses should be checked before proceeding with other tests. For fuse locations, refer to table 3-4.

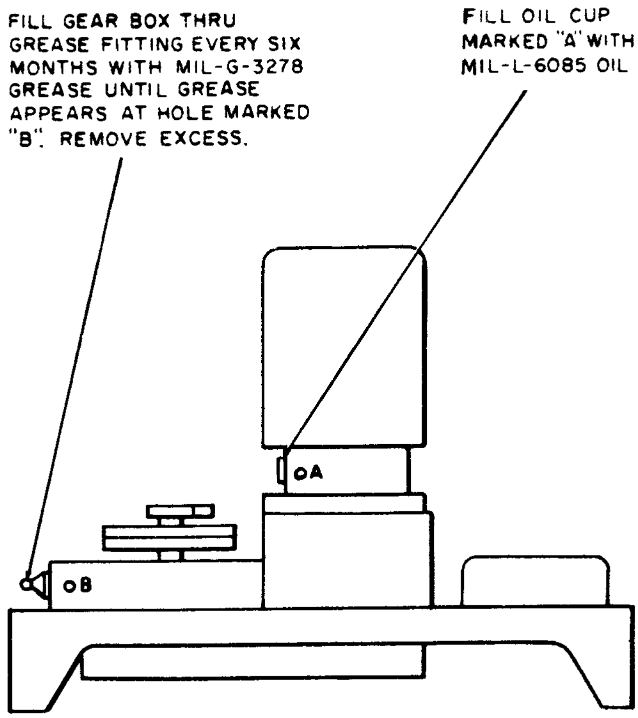


Figure 3-21. Coder-Indicator Identification Keyer, Lubrication Points

CAUTION

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. Use spare fuses located adjacent to the faulty fuse. If a fuse burns out immediately after replacement, do not replace it a second time until the cause of burnout has been corrected.

(2) TUBE FAILURE.–To replace defective electron tubes, loosen the captive screws holding the particular units in the cabinet and slide the units to its fully extended position. For tube locations, refer to table 3-5.

(a) REPLACING TRIPLER TUBE V1504 AND FINAL R-F AMPLIFIERS V1503 AND V1506 IN FREQUENCY MULTIPLIER-OSCILLATOR.–Whenever a tube is replaced in one of the r-f cavities, Z1501, Z1502 or Z1503, the cavities should be inspected and cleaned. Examine the cavity contacts to make sure that they have not been bent as a result of an improperly seated tube. It is possible that metal filings from the threads on the tube holder and anode clip have entered the cavity as a result of extensive tube replacement. The cavity should be cleaned with compressed air of moderate pressure to blow out any filings or dirt.

WARNING

Operation of this equipment involves the use of HIGH VOLTAGES which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes inside the frequency multiplier-oscillator with the MEDIUM VOLTAGE supply ON. Do not depend upon safety interlock switches for protection. Under certain conditions, dangerous potentials may exist in the circuit with power controls at OFF because of charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits before touching them. Never service the equipment without the presence or the assistance of another person capable of rendering first aid immediately.

To remove a type 2C39A tube from cavity Z1501, Z1502, or Z1503, proceed as follows:

Step 1. Disengage the spring clip on the cavity cover.

Step 2. Lift off the cavity cover.

Step 3. Remove the 2C39A by pulling straight out with a tube puller. If a tube puller is not available the tube may be removed by gently prying on opposite sides of the anode with two screw drivers.

Step 4. Replace the 2C39A by holding it in the center of the cavity and pressing straight in on the anode to seat the tube in the tube socket.

Step 5. Press the cavity cover in place making certain that the contact fingers around the edge of the cover are on the outside of the cavity.

Step 6. Engage the cavity cover spring clip on the lugs on either side of the cavity.

Step 7. After replacement of this tube, return the cavity and check overall tuning of the radio set.

(b) REPLACING KLYSTRON. —The procedure for installing a new klystron is described in Section 2, paragraph 2-4c. After the klystron is installed it should be aged according to the procedure described in Section 2, paragraph 2-5k.

TABLE 3-4. FUSE LOCATIONS

SYMBOL	LOCATION	PROTECTS	AMPS
F501	Radio receiver[1]	Main power bus	3
F502	Radio receiver[1]	Main power bus	3
F601	Coder-indicator[1]	Main power bus	3
F602	Coder-indicator[1]	Main power bus	3
F901	Front panel of blower compartment[1]	Cabinet blower B901	3
F902	Front panel of blower compartment[1]	Cabinet blower B901	3
F903	Front panel of blower compartment[1]	Cabinet blower B901	3
F905	Front panel of blower compartment[1]	Cabinet blower B902	2
F906	Front panel of blower compartment[1]	Cabinet blower B902	2
F907	Front panel of blower compartment[1]	Cabinet blower B902	2
F1001	Front panel of blower compartment[2]	HV plate supply	15
F1002	Front panel of blower compartment[2]	HV plate supply	15
F1003	Front panel of blower compartment[2]	HV plate supply	15
F1004	Front panel of blower compartment[2]	Convenience outlets	15
F1005	Front panel of blower compartment[2]	Convenience outlets	15
F1006	Front panel of blower compartment[2]	Cabinet blower B1001	3
F1007	Front panel of blower compartment[2]	Cabinet blower B1001	3
F1008	Front panel of blower compartment[2]	Cabinet blower B1001	3
F1101	Control-duplexer[1]	Control circuits	3
F1102	Control-duplexer[1]	Control circuits	3
F1103	Control-duplexer[1]	Antenna control units	15
F1104	Control-duplexer[1]	Antenna control unit	15
F1106	Control-duplexer[1]	Control circuits	3
F1107	Control-duplexer[1]	Regulated filament bus	15
F1108	Control-duplexer[1]	Regulated filament bus	15
F1110	Control-duplexer[1]	Meter M1101	0.50
F1111	Control-duplexer[1]	LV-MV plate supply neutral	15
F1113	Control-duplexer[1]		15
F1114	Control-duplexer[1]		15
F1302	Amplifier-modulator[1]	Filaments V1302 and V1303	3
F1401	Frequency multiplier-oscillator[1]	Filaments	2

TABLE 3-4. FUSE LOCATIONS (cont)

SYMBOL	LOCATION	PROTECTS	AMPS
F1402	Frequency multiplier-oscillator[1]	Crystal oven	2
F1403	Frequency multiplier-oscillator[1]	Crystal oven	2
F1601	Low voltage power supply[2]	Filaments	0.75
F1602	Low voltage power supply[2]	Filaments	1
F1603	Low voltage power supply[2]	Rectifier plates (+250V)	2
F1604	Low voltage power supply[2]	Rectifier plates (-375V)	1
F1801	Medium voltage power supply[2]	Rectifier plates	5
F1901	High voltage power supply[2]	Rectifier plates	3

[1]Receiver Transmitter OA-3352/GRN-9D

[2]Power Supply Assembly OA-1537A/GRN-9A

TABLE 3-5. TUBE LOCATION

LOCATION	SYMBOL	FUNCTION	TYPE
RADIO RECEIVER			
Preamplifier subassembly	V201	I-f amplifier	5654/6AK5W
	V202	I-f amplifier	6J4WA
	V203	I-f amplifier	5654/6AK5W
I-f amplifier subassembly	V301	I-f amplifier	5654/6AK5W
	V302	I-f amplifier	5654/6AK5W
	V303	I-f amplifier	5654/6AK5W
	V304	I-f amplifier	5654/6AK5W
	V305	I-f amplifier	5654/6AK5W
	V306	Discriminator	5654/6AK5W
	V307	Video amplifier	12AT7WA
	V308	Clamper	5726/6AL5W
Video amplifier subassembly	V401	Blanking gate	5725/6AS6W
	V402	Video amplifier	12AT7WA
	V403	Decoder	5725/6AS6W
	V404	Multivibrator	5670
	V405	Cathode follower	12AT7WA
	V406	Blanking multivibrator	5670
	V407	Phase inverter	5670
	V408	Pulse amplifier	6005/6AQ5W
Power supply subassembly	V501	Full-wave rectifier	5R4WGB
	V502	Full-wave rectifier	6X4W
	V503	Voltage regulator	6080WA
	V504	Amplifier	5654/6AK5W
	V505	Voltage reference	6627/OB2WA
	V506	Voltage reference	6627/OB2WA

TABLE 3-5. TUBE LOCATION (cont)

LOCATION	SYMBOL	FUNCTION	TYPE
CODER-INDICATOR			
Video amplifier subassembly	V601	15-cps amplifier	12AT7WA
	V602	15-cps gate generator	12AT7WA
	V603	Oscillator	5670
	V604	Amplifier	12AT7WA
	V605	Multivibrator	12AT7WA
	V606	Blocking oscillator	5687WA
	V607	Amplifier	5687WA
	V608	Tuning fork oscillator	12AT7WA
	V609	135-cps gate generator	12AT7WA
	V610	Oscillator	5670
	V611	Priority gate	12AT7WA
	V612	1350-cps tone oscillator	5670
	V613	Amplifier	5670
	V614	Multivibrator	5670
	V615	Multivibrator	5687WA
Power supply subassembly	V701	Plate supply rectifier	5R4WGR
	V702	Bias supply rectifier	6X4W
	V703	Series regulator	6080
	V704	Control tube	6AH6
	V705	Bias voltage regulator	6627/OB2WA
AMPLIFIER-MODULATOR			
Power amplifier	V1304	Power amplifier	SAL-89
Bias supply	V1370	Regulator amplifier	5654/6AK5WA
	V1371	Voltage reference	5651WA
	V1372	Series regulator	5687WA
FREQUENCY MULTIPLIER-OSCILLATOR			
Video subassembly	V1401	Multivibrator	5814A
	V1402	Multivibrator	5687WA
	V1403	Amplifier	6293
	V1404	Amplifier	6293
	V1405	Amplifier	6293
	V1406	Series diode	6V3A
	V1407	Cathode follower	6293
	V1408	Multivibrator	5687WA
	V1409	Cathode follower	5687WA
	V1410	Voltage regulator	5687WA
	V1411	Cathode follower	6293
R-f subassembly	V1501	Oscillator-first doubler	5670
	V1502	Second doubler	5654/6AK5W
	V1503	Third doubler	6J4WA
	V1504	Tripler	2C39A
	V1505	First amplifier	2C39A
	V1506	Second amplifier	2C39A
	V1507	Oscillator-first doubler	5670
	V1508	Second doubler	5654/6AK5W
	V1509	Third doubler	6J5WA

SECTION 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

Radio Set AN/GRN-9D is a shore-based radio set intended for use with Antenna Group AN/GRA-60 or AN/GRA-61. The radio set and the antenna group together function as a radio beacon that provides navigational information for aircraft within a 200-mile radius of the radio beacon. The radio beacon is part of the tactical air navigation system known as TACAN. An overall functional description of this system is presented in paragraph 4-2.

The radio beacon is divided into six major circuits: antenna circuits, control-duplexer circuits, receiving circuits, transmitting circuits, coder-indicator circuits, and power supply circuits. A detailed description of these circuits, with the exception of the antenna circuits, is presented in paragraph 4-3. Refer to Technical Manual for Shore Antenna Group (NAVSHIPS 94118) for a functional and detailed description of the antenna circuits.

4-2. OVERALL FUNCTIONAL DESCRIPTION.

a. GENERAL. —The TACAN System is designed to provide azimuth, identity, and distance information to aircraft equipped with the proper equipment. The airborne equipment consists of a receiver-transmitter unit (referred to as an interrogator) and visual bearing and distance indicators. The ground equipment (referred to as the radio beacon) consists of a radio set and associated antenna group and accessories. Because the system operates at high frequency, line-of-sight transmission is required between the aircraft and the radio beacon. Therefore, a number of radio beacons are necessary over large geographic areas. Each radio beacon is capable of receiving air-to-ground transmissions on one of the 126 assigned frequencies in the 1025- through 1150-mc band. The radio beacon can transmit on any one of 63 frequencies from 962 through 1024 mc (low band operation), or on any one of 63 frequencies from 1151 through 1213 mc (high band operation). Thus, the pilot selects a specific radio beacon in his area for navigation information. Signals from the radio beacon provide the pilot with meter indications, in nautical miles, of the aircraft distance and the bearing, in degrees, from the radio beacon. With the distance and bearing established from a specific location, the pilot can fix his position on a chart.

The basic elements of the radio beacon are shown in figure 4-1. The radio beacon consists of a radio set containing a receiver-transmitter group and a power supply group, and an antenna group. Essentially, the radio beacon is a transmitter-receiver combination (transponder) for the reception and transmission of information used in determining aircraft distance from the radio beacon. The addition of a rotating directional antenna permits the transmission of bearing information to the aircraft.

The radio beacon output consists of replies to distance interrogations from the aircraft interrogator, bearing information signals, radio beacon identification signals, and random pulses. Signals from both the ground station and the aircraft are transmitted in the form of coded pairs of 3.5-microsecond wide pulses having a 12-microsecond spacing between pulses of a pair. Each of the information elements supplied (in the order of the priority established for each within the radio beacon) is analyzed briefly in the following paragraphs.

b. BEARING INFORMATION.

(1) BEARING INFORMATION COMPONENTS.— The bearing information presented to the pilot is the direction of the beacon with respect to the aircraft, measured in degrees clockwise from magnetic north. This is the reciprocal (180 degrees removed) of the information obtained from the modulated antenna pattern, which actually shows the direction of the aircraft from the beacon. The bearing information supplied by the beacon is originated by the beacon, and consists of four components, discussed in the paragraphs (a) to (d) that follow.

(a) 15-CPS AMPLITUDE MODULATION. — A 15-cps amplitude-modulation component is imposed on the r-f energy radiated by the beacon antenna. Figure 4-2 shows how modulation is imposed on the field of r-f energy radiated by the antenna.

Waveshape A in figure 4-2 shows a conventional circular antenna pattern. Waveshape B in figure 4-2 shows the same antenna pattern as it is affected when a fixed reflector is placed in the field of energy radiated by the antenna. The pattern becomes a cardioid. The field of r-f energy is at its maximum in the direction (E) opposite to the reflector.

When the reflector is rotated about the radiating element of the antenna the effect is a cardioid pattern, similar to waveshape B, shown in figure 4-2, which rotates about the axis of the antenna at the same rate as the reflector. Waveshape C, shown in figure 4-2, shows five of the positions taken by the antenna pattern during the 360-degree rotation of the reflector. In the case of pattern No. 1, an aircraft located at a position due south of the beacon antenna would receive a half-amplitude signal. If the antenna were rotated through 90 degrees (pattern No. 2), the same aircraft would receive a signal at maximum amplitude. Rotating the antenna another 90 degrees (pattern No. 3) would cause the aircraft to receive a half-amplitude signal of diminishing strength. Still another 90-degree rotation of the antenna (pattern

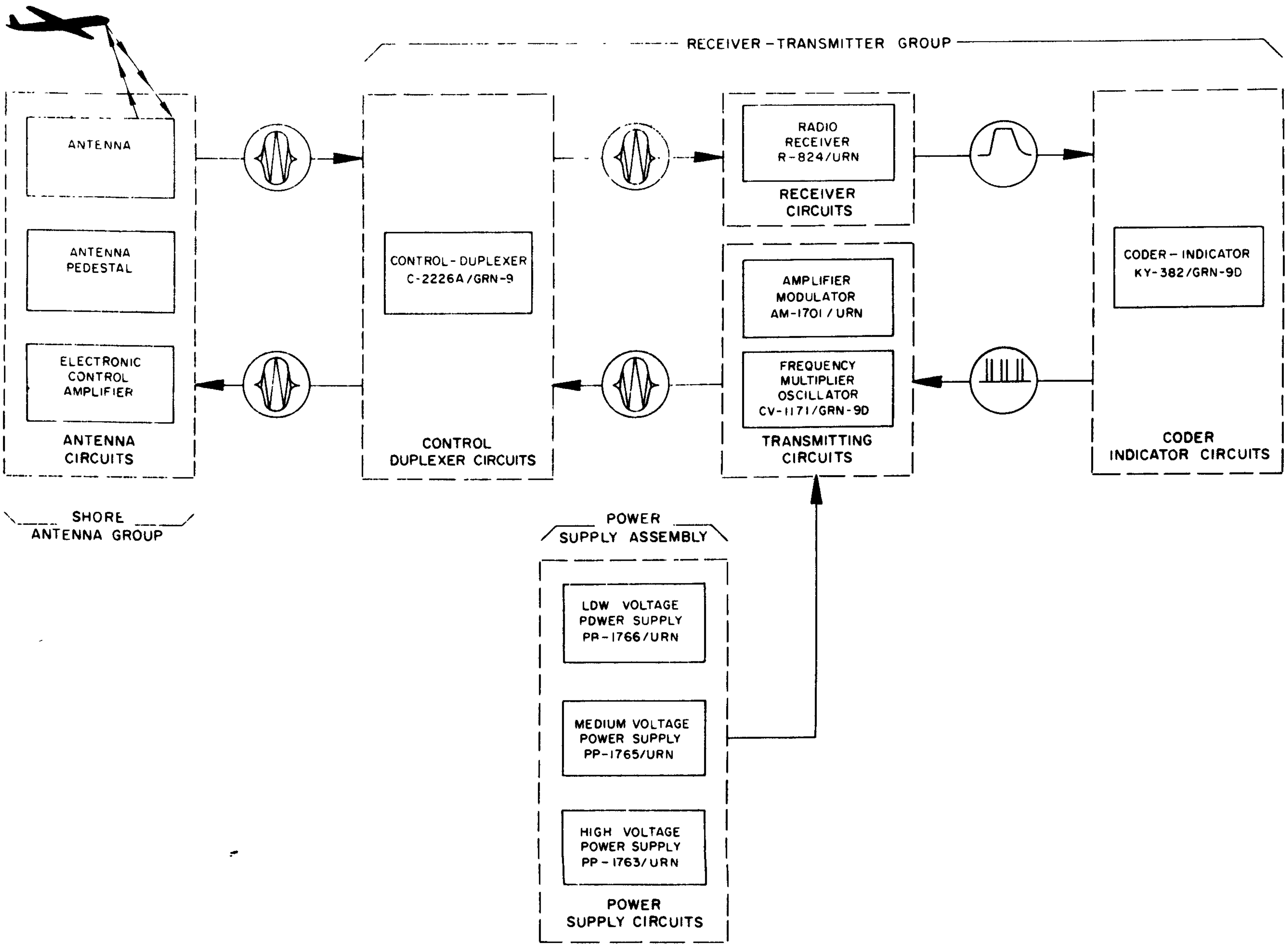


Figure 4-1. Radio Beacon Overall Functional Block Diagram

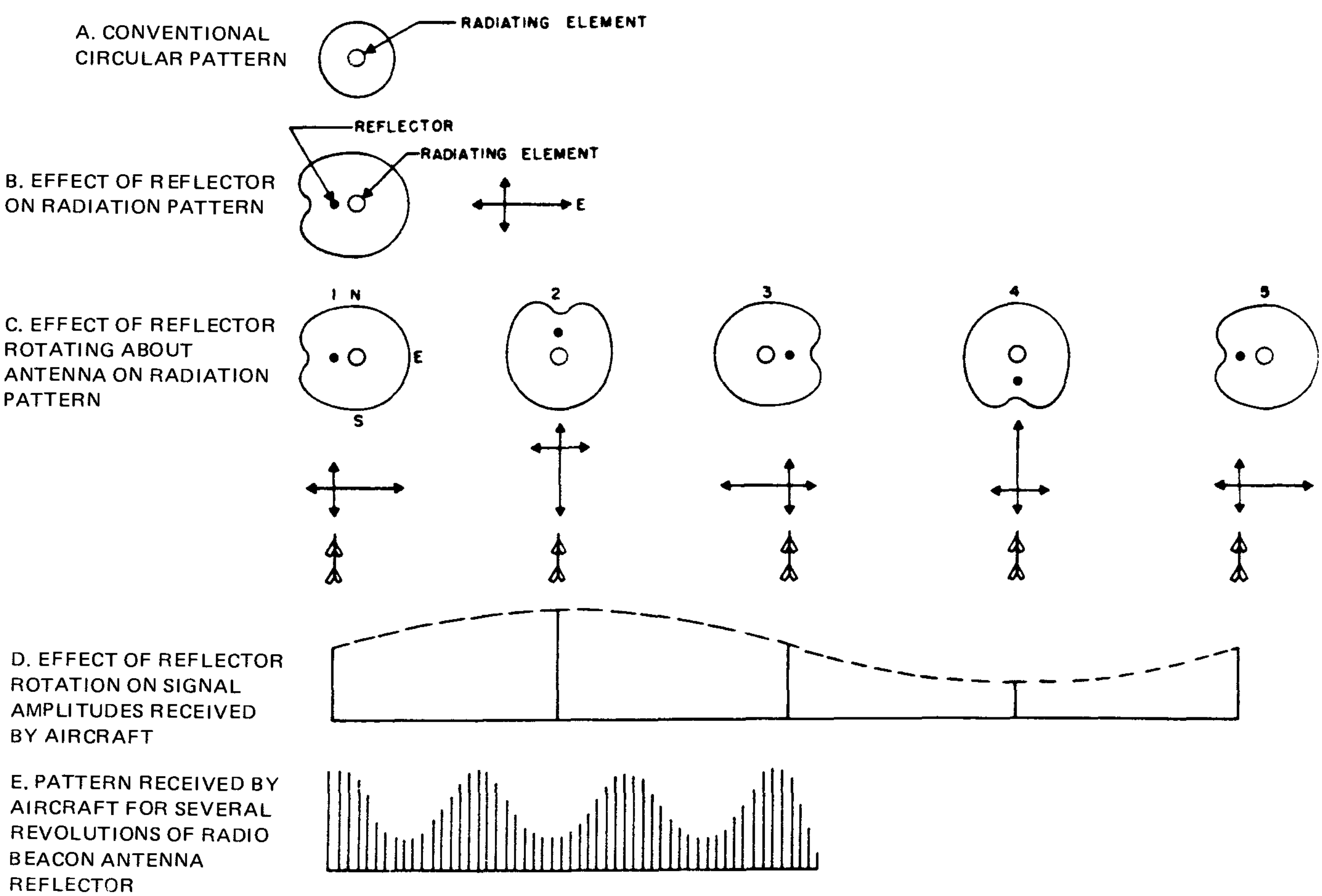


Figure 4-2. Development of Radio Beacon Radiation Pattern

No. 4) would cause the aircraft to receive a minimum-amplitude signal. Finally, completion of the 360-degree rotation of the antenna reflector (pattern No. 5) would return the signal received by the aircraft to half amplitude (increasing in strength).

The relative amplitudes of the signals received by the aircraft for one complete revolution of the antenna reflector are shown for comparison purposes in waveshape D of figure 4-2. Although the total beacon output is of constant amplitude through the full 360-degree rotation of the reflector, the signal received by an aircraft at any given point around the beacon will vary in amplitude, as explained above.

The amplitude variation of the envelope of the pulses received by the aircraft follows a sine-wave (approximate) pattern (waveshape E of figure 4-2), the frequency of which corresponds to the rate of rotation of the reflector around the antenna. Since the reflector rotates about the beacon antenna at a 15-cps rate, an aircraft at any given point in space within range of the beacon will detect the complete sine wave 15 times per second. Note that a 15-cps rate of rotation corresponds to 900 revolutions per minute (rpm).

(b) NORTH REFERENCE (15-CPS) BURST.– To orient the bearing information of the beacon with respect to magnetic north (figure 4-3), a group of coded pulses is introduced into the 15-cps amplitude-modulated field of energy radiated by the radio beacon antenna. This group of pulses (or coded burst) is generated once during each revolution of the reflector, and occurs every time the peak of the radiation lobe points due east (with respect to magnetic north). At that moment, a trigger pulse, generated by the antenna, is used by the radio beacon to initiate the formation of the burst.

Figure 4-3 shows the positions of the north reference burst on the 15-cps amplitude-modulated sine wave, as seen by four aircraft at four different points around the beacon. Waveshape A of figure 4-3 shows the position of the north reference burst on the 15-cps modulation as observed by an aircraft due south of the beacon, flying on bearing 000. As seen by the aircraft, this burst occurs at the positive going half-amplitude point, or 0-degree point, of the sine-wave modulation. Waveshape B of figure 4-3 shows the north reference burst as observed by an aircraft due west of the beacon, flying on bearing 90 degrees. This burst occurs at the minimum-amplitude, 270-degree point of the sine wave. Waveshape C of figure 4–3 shows the position of the burst for an aircraft due

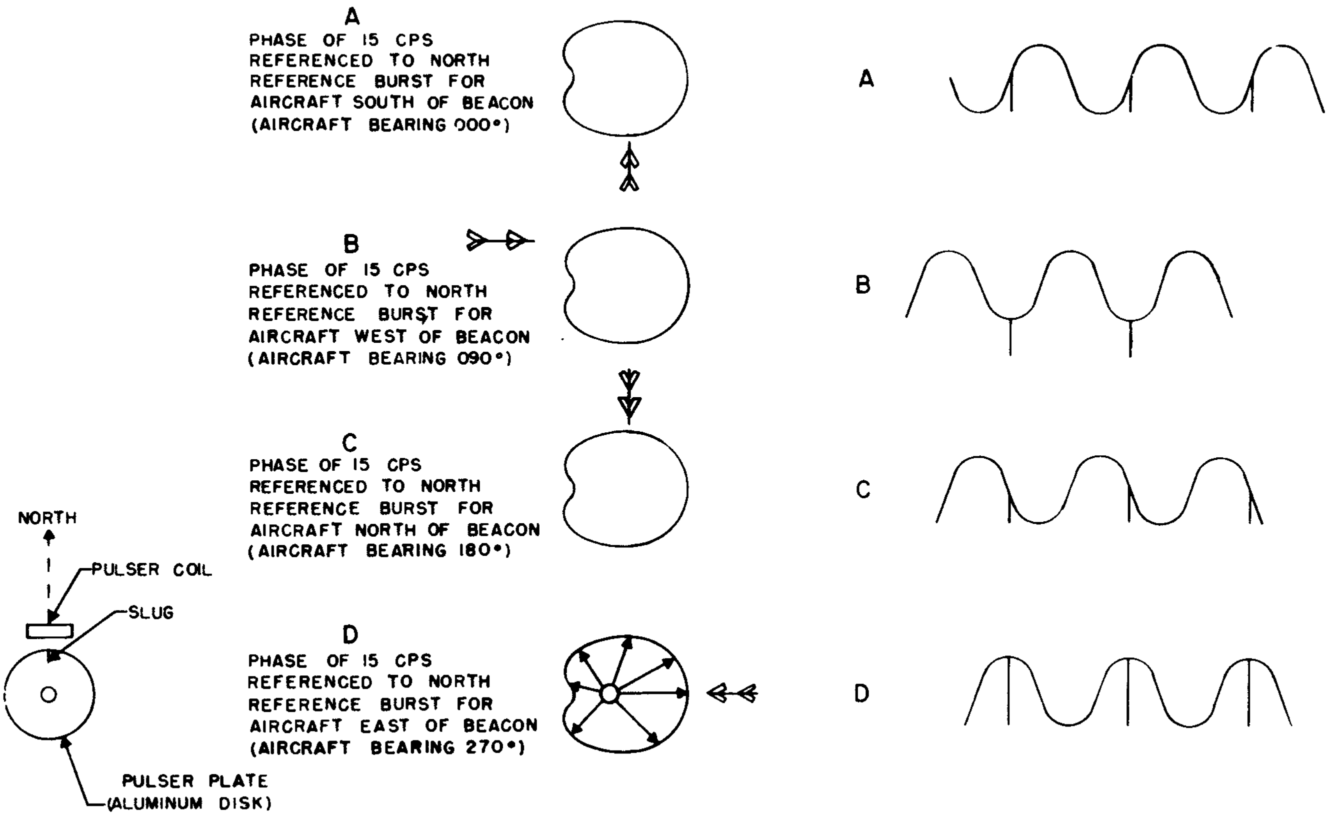


Figure 4-3. Employment of North Reference Burst to Mark Bearing of Aircraft Relative to Radio Beacon

north of the beacon, flying on bearing 180 degrees. Here, the burst occurs at the half-amplitude (going negative), or 180-degree point of the sine wave. Waveshape C of figure 4-3 shows the burst at the maximum-amplitude, 90-degree point of the 15-cps modulation (sine wave), as it would be observed by an aircraft to the east of the beacon, flying on bearing 270 degrees. This illustrates how the phase of the 15-cps modulation shifts with respect to the 15-cps north reference burst, as the aircraft moves on a 360-degree circle around the radio beacon.

This phase difference is detected by the aircraft receiver of Radio Set AN/ARN-21 and converted to a meter reading in degrees showing the bearing from the aircraft to the beacon with respect to magnetic north.

Figure 4-4 illustrates the signals received by four aircraft located at four different points around the radio beacon, as well as the corresponding meter readings (indicating their bearings) relative to the beacon. Note that all aircraft receive the north reference burst at the same instant of time, but at different phases of the 15-cps amplitude modulation.

(c) 135-CPS AMPLITUDE MODULATION. — A 135-cps amplitude-modulation component (figure 4-5) is also imposed on the r-f energy radiated by the radio beacon antenna. The 135-cps modulation is produced, in a manner similar to that described above, by directors spaced 40 degrees apart around the radiating element, and which rotate about it at a 15-cps rate.

This 135-cps component, acting alone, would shape the antenna pattern as shown in pattern No. 2 of figure 4-5. The resultant antenna pattern, caused by the combined effect of the 15-cps reflector and the 135-cps directors, is also shown in patterns No. 3 and No. 4 of figure 4-5. Note that 135-cps is the ninth harmonic of 15 cps.

(d) AUXILIARY REFERENCE (135-CPS) BURST. —Iron slugs passing through the field of a magnetic pickup coil initiate the formation of the 135-cps reference bursts, as in the case of the 15-cps reference bursts, but at 40- instead of 360-degree intervals. The 135-cps amplitude-modulated component and the 135-cps reference burst are used in a manner similar to that described in paragraph 4-2 b (1) (a) for the 15-cps signals.

(2) COMBINING BEARING INFORMATION COMPONENTS. —Figure 4-6 summarizes the steps involved in the development of the composite 15-cps and 135-cps signal elements into the total bearing information supplied by the radio beacon to the aircraft. The signals (including the 15-cps and 135-cps amplitude modulation and the 15-cps and 135-cps reference bursts) received by the aircraft in positions due east, south, west, and north, relative to the beacon, appear as shown. Again, the phase of the modulation relative to the bursts depends on the

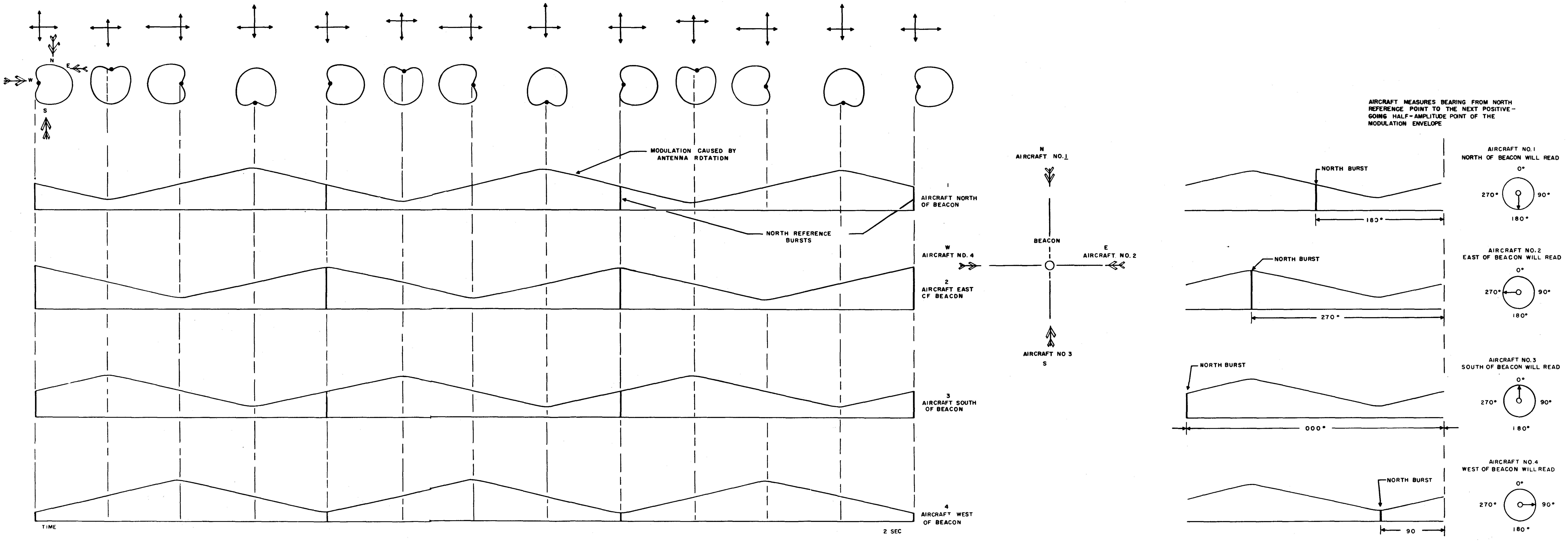


Figure 4-4. Comparison of Bearing Information by Aircraft in Different Geographical Positions Relative to Radio Beacon

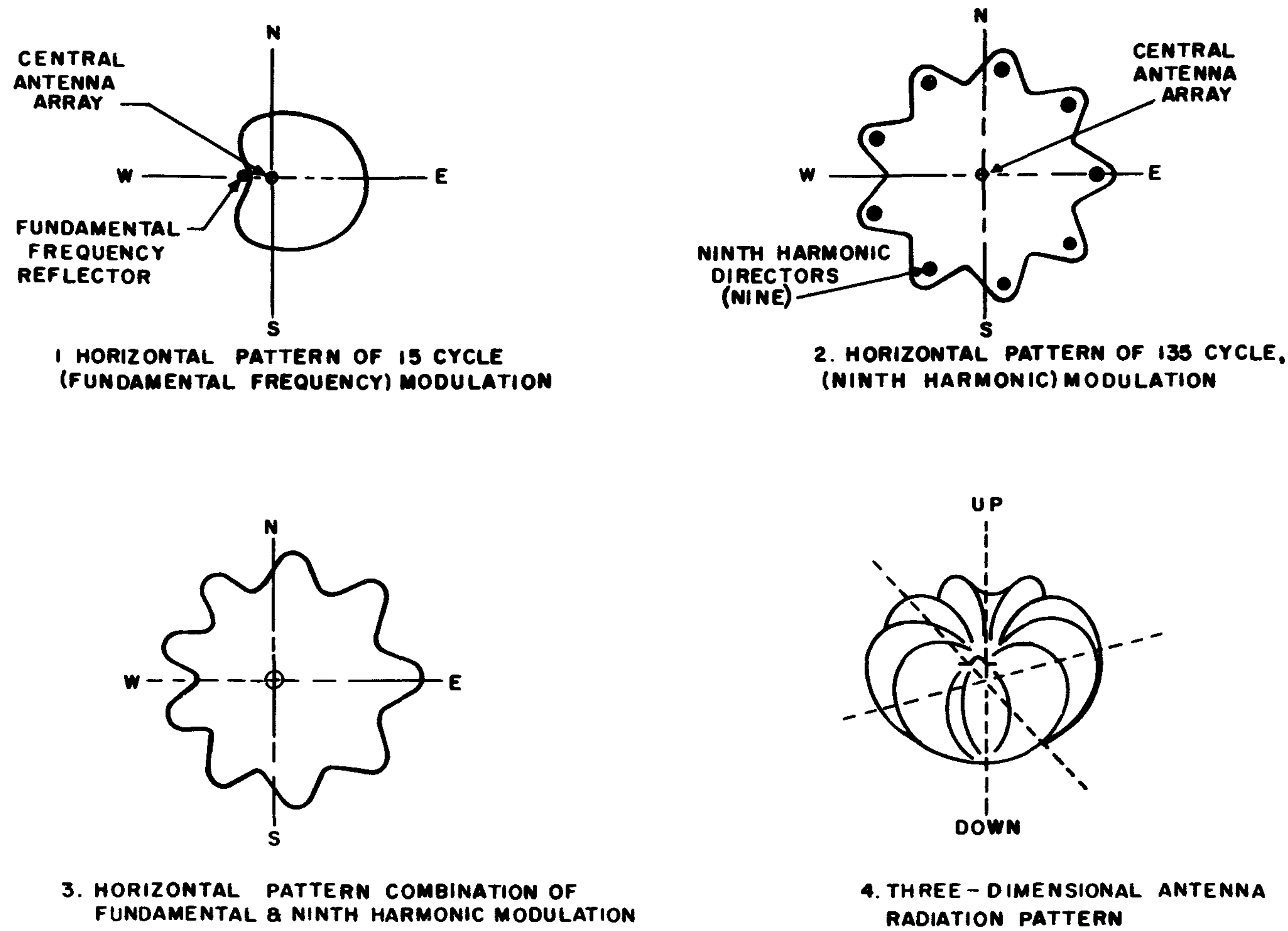


Figure 4-5. Development of Composite Radiation Pattern

position of the aircraft relative to the beacon. The 135-cps bursts have simply refined the measurement of angle relative to magnetic north.

c. DISTANCE INFORMATION. —Of all the signals transmitted by the radio beacon, distance measuring information alone is not originated within the beacon. Distance reply signals are supplied by the radio beacon only in response to interrogations from an airborne AN/ARN-21. Thus, such information is actually originated by the airborne portion of the TACAN system. Each AN/ARN-21 transmits, at the frequency of the radio beacon, a sequence of paired pulses with a random pulse-pair spacing peculiar to itself. This signal is received by the radio beacon receiver. The beacon adds a 50-microsecond delay to the received distance measuring interrogations, and retransmits them to the aircraft as replies at the transmitting frequency of the radio beacon and the coded pulse-pair spacing of the interrogating aircraft. The aircraft radio receiver selects the particular distance measuring reply from all other signals by comparing the repetition rate of the relay pulse pairs with the repetition rate of the originally transmitted interrogation pulse pairs. Then it subtracts the 50-microsecond zero distance delay time from the total time between transmission and reception of interrogation pulse pairs and converts the remaining round trip travel time of the signal into distance between the aircraft and the beacon. A continuous display indicator on the AN/ARN-21 displays this distance in nautical miles.

d. RADIO BEACON IDENTIFICATIONS. —The radio beacon periodically transmits its identifying call in International Morse Code, thus enabling the aircraft to determine which radio beacon it is in contact with. The characters of the code consist of a train of 1350 double pulses per second, keyed by a coding wheel built into the radio beacon. The aircraft receiver of the AN/ARN-21 decodes the pulses representing the identification call, and reproduces them as 1350-cps identification call signals.

e. INFORMATION ELEMENT PRIORITY IN RADIO BEACON. —The three elements of information (bearing, identification code, and distance measuring information) discussed in the preceding subparagraphs are transmitted by the radio beacon as a train of pulse pairs. To prevent interference between the three signal elements, the radio beacon is arranged to assign a sequence or priority in which each enters into the overall pulse train.

(1) The bearing reference bursts are first in the order of priority because they occur at a fixed rate and are of relatively short duration. Accordingly, reference bursts can break in on any other information element being transmitted by the radio beacon.

(2) Second in the order of priority are the identification-code signals, which also occur at a fixed rate. However, the duration of the identification-code signal is such that the utilization of the portion required for the insertion of bearing reference bursts does not materially affect the reception of intelligible identification code by the aircraft.

(3) Third in the order of priority are the distance interrogation signals. The interrogation pulses are not initiated within the beacon, and their arrival within the pulse train must therefore be controlled if their interfering with the other signal elements of the radio beacon is to be prevented. This is done by allowing the interrogation pulses to enter the pulse train only during a time interval not occupied by the reference bursts or identification-code signals. This is possible because the time occupied by the reference bursts is small in comparison with the time allowed for the total radio beacon signal cycle. In addition, a memory circuit built into the aircraft receiver of the AN/ARN-21 makes it possible to compensate for the time interval during which identity tone is transmitted, and no reply pulses are received because of the priority system within the beacon.

(4) Last in the order of priority are squitter pulses, which are used as fill-in signals when the maximum number of aircraft are not interrogating the beacon; this maintains the modulation pattern and permits constant duty-cycle operation of the radio beacon.

Note

The relative duration of the signal elements is such that effectively there is no interruption of bearing, identification call, or distance information received by the aircraft.

4-3. FUNCTIONAL DESCRIPTION

Radio Set AN/GRN-9D contains seven functional sections; a receiver, coder-indicator, transmitter, control-duplexer, power supplies, power distribution and control circuits, and built-in test equipment. Figure 4-7 shows in block diagram form the receiver-transmitter group circuits discussed by functional sections with associated power supplies, and government-furnished test equipment described in detail and illustrated separately.

a. BLOCK DIAGRAM ANALYSIS.

(1) RECEIVER. – Distance interrogation pulse pairs are received by the antenna and passed through the duplexer, and then pass through a low-pass filter to the mixer stage of the receiver. The low-pass filter rejects frequencies between 1650 and 10,000 mc to prevent interference from other pulse producing equipment operating in the band. To prevent interference from the transmitter portion of the radio set, a blanking pulse blanks out the receiver whenever the transmitter klystron is operating.

The receiver uses the output from the frequency multiplier-oscillator section of the transmitter as its local oscillator signal. The mixer and preamplifier consists of a balanced hybrid T-type mixer and a three-stage preamplifier. The local oscillator signal is fed into one arm of the mixer and the interrogation r-f pulses are fed into the other arm; the resultant intermediate frequency of 63 mc is amplified in the three-stage preamplifier.

The i-f amplifier receives the interrogation pulses and random noise pulses from the preamplifier at the intermediate frequency. These voltages are amplified to a level sufficient to operate the Ferris discriminator, which detects the interrogation and random noise pulses at 63 mc and effects adjacent and near-adjacent channel rejection. The video signal output of the Ferris discriminator is fed to the receiver video amplifiers. Echo-suppression circuits employed in the i-f amplifier permit operation in areas where large reflecting objects are present. Squitter-control voltage, fed into the i-f amplifier from the squitter-voltage generator, maintains the receiver output at 2700 ± 90 pulses per second.

The video amplifiers receive the i-f amplifier output (noise and interrogation pulses) and further amplify these video signals to a level that can operate the coincidence-type decoder. The decoder produces a single pulse for each input pulse pair having pulses separated by 12 microseconds. The decoding of each pulse pair is followed by a 40-microsecond blanking of the receiver to ensure that the 2700 pulses at the receiver output will be distributed over a period of 1 second. Although the squitter-control circuits set the pulse output of the receiver at 2700 ± 90 pulses per second, the entire pulse output for 1 second could occur during the first quarter-second; likewise, the entire pulse output for the following second could occur during the second quarter-second and a period of 1-1/2 seconds would be left during which there would be no output from the receiver. By introducing a blanking period of 40 microseconds after the decoding of each pulse pair, the minimum spacing between receiver output pulses is set at 65 microseconds, owing to the total effect of the 40-microsecond blanking period plus the coding time of 12 microseconds, and the 10-microsecond blanking of the receiver by the transmitter.

While the transmitter is transmitting output pulses, a sample of the 10-microsecond pulse generated in the frequency multiplier-oscillator video chassis is fed to the receiver blanking gate to disable the receiver. Disabling the receiver during the transmission of output pulses prevents the radio set from responding to its own transmitted signal. In addition, a pulse-counter circuit produces a squitter-control voltage which is fed back to the i-f amplifier and controls the gain of the i-f amplifier circuit. The

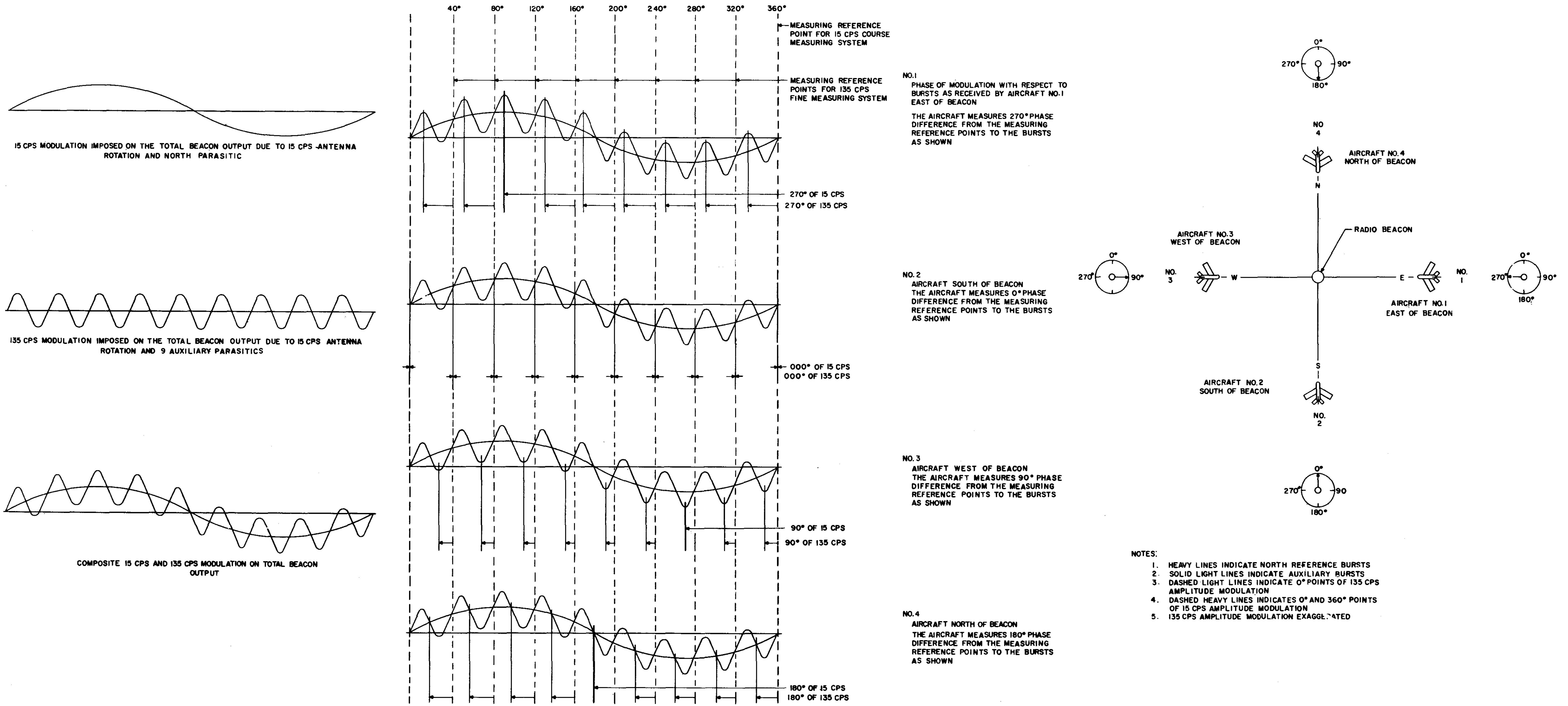


Figure 4-6. Compositing 15-CPS and 135-CPS Amplitude Modulation and Burst Signal Elements into Bearing Information

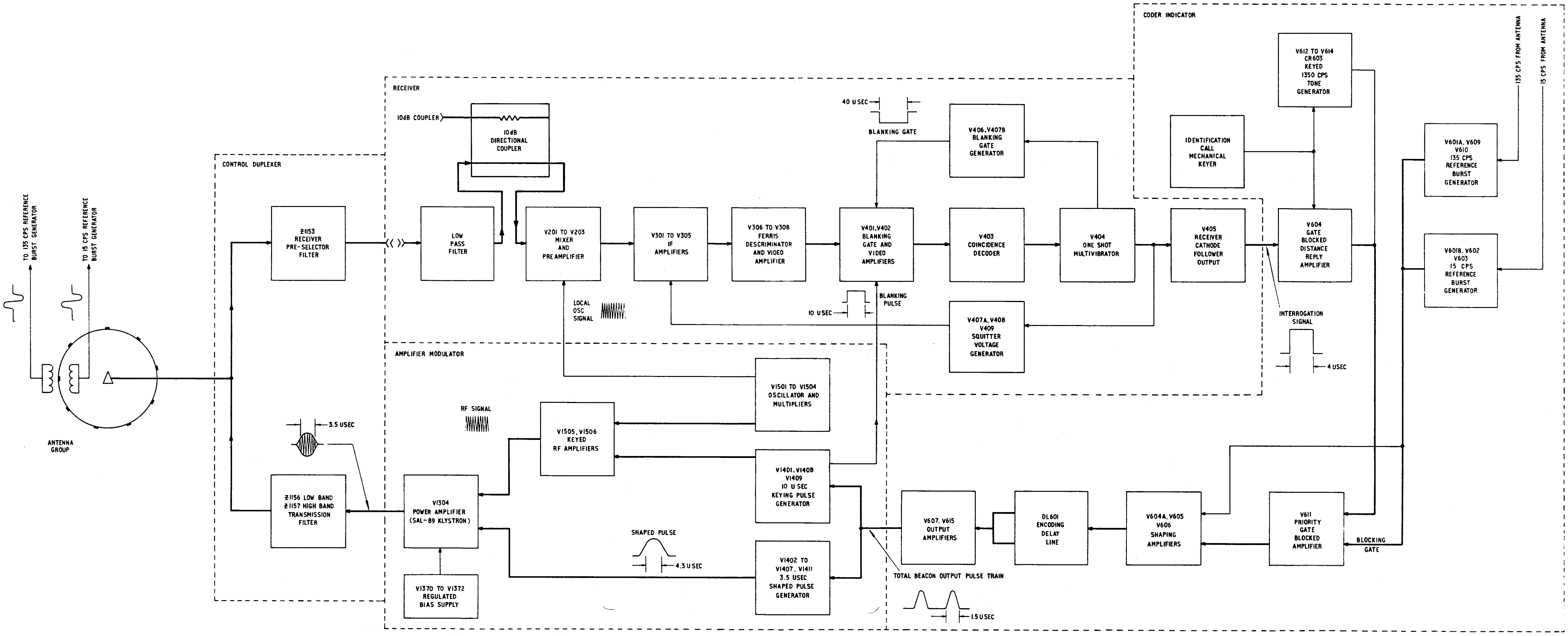


Figure 4-7. Radio Set AN/GRN-9D, Simplified Block Diagram

result is that decoding of 12-microsecond-interval pulse pairs (interrogations) and of random noise groups causes the desired output of 2700 pulses per second. When the rate of interrogation pulse pairs falls below 2700 pulse pairs per second, i-f amplification is increased until the number of random noise pulse pairs decoded is sufficient to maintain receiver output at the required rate. Under normal conditions, the maximum interrogation rate should not be above 2500 pulse pairs per second.

The pulse output of the decoder triggers a one-shot multivibrator having three outputs: one output initiates a blanking gate to the video amplifiers; the second output initiates the squitter-control voltage to the i-f amplifiers; and the third output drives the receiver output cathode-followers. The output of the cathode-followers is fed to the coder-indicator.

(2) CODER-INDICATOR. – The coder-indicator produces a multiplexed output signal consisting of three components: reference burst, distance reply pulses. Generation of the reference bursts component has priority over generation of all other output components.

For each revolution of the antenna, the 135-cps reference burst generator receives eight trigger pulses from the antenna and the 15-cps reference burst generator receives one 15-cps trigger pulse. The 135-cps trigger pulse applied to the 135-cps reference burst generator is approximately 12 volts peak-to-peak and 150 microseconds wide. Upon reception of the 135-cps trigger pulse, a reference burst generator produces six pulses spaced 24 microseconds apart.

The 15-cps reference pulses are generated in a similar manner in the 15-cps reference burst generator. The output of the 15-cps reference burst consists of 12 pulses, 30 microseconds apart. At the input to the shaping amplifier stage, the 15-cps and 135-cps reference pulse groups are mixed; from this point on, both pulse groups pass through the same stages. This action is possible because two reference pulse groups never occur simultaneously.

For each reference burst sent to the shaping amplifiers, a blocking gate is sent to the priority gate which blocks out the identification call and distance reply signals during transmission of reference bursts. This establishes the priority of reference burst over all other signals.

The output of the shaping amplifiers drives encoding delay line DL601, which is inductively tapped at 32-microsecond delay and at 44-microsecond delay. The encoding delay line introduces the major portion of the standard zero distance delay for distance reply pulses and provides a pulse pair having a 12-microsecond spacing for each pulse fed into the delay line.

The double-pulsed output of DL601 is coupled to the output amplifier stages. These stages provide gain in signal amplitude, improvement in waveshape and uniformity, of output, and impedance matching to the transmitter input.

The other coder-indicator output components are distance reply pulses and beacon identification code tone pulses. Selection of one or the other of these components is controlled by the mechanical switching action of the identification call mechanical keyer. The voltage on pin 10 of testboard TB604 is 0 volt with a -50-volt gate appearing whenever the code keying wheel indicates that a 1350-cps-tone dot or dash is to be sent.

During transmission of identification code characters, the -50-volt gate cuts off the gate-blocked distance-reply amplifier that normally passes distance reply pulses from the receiver to the priority gate. Simultaneously, the -50-volt gate keys on the normally cut off 1350-cps-tone signal and permits the 1350-cps-tone output to be sent to the priority gate. In this manner, the code keying wheel controls the selection of the code and establishes the priority of the 1350-cps-tone oscillator signal over the distance reply signals.

The priority gate passes identification code and distance reply signals to the shaping amplifiers. Whenever a reference burst is generated, a blocking gate is applied to the priority gate, cutting it off and establishing priority of the reference burst over the identification code and distance reply signals.

All signals from the priority gate to the shaping amplifiers are shaped, double-encoded, amplified, and sent to the transmitter as components of a multiplexed signal in the same manner as previously described for the reference bursts signals.

The antenna-synchronization, 1350-cps-oscillator is not dependent on the signal output of any other coder-indicator circuit. The frequency output of this oscillator is controlled by a 1350-cps tuning fork. The oscillator output is used in conjunction with the antenna tachometer output to obtain a Lissajous pattern for speed comparison.

(3) TRANSMITTER. – Each pulse from the coder-indicator initiates the formation of a 3.5-microsecond shaped pulse and a 10-microsecond keying pulse. The 3.5-microsecond shaped pulse is amplified in the video portion of the frequency multiplier-oscillator to a power level sufficient to key-on and grid-modulate the klystron beam current. Square pulses of 10-microsecond duration are applied to the cathodes of the keyed r-f amplifiers to key-on these stages that are normally cut off by a positive voltage applied to the cathodes. A sample of the 10-microsecond pulse is fed from the frequency multiplier-oscillator to the receiver to be used as a blanking pulse as previously described.

The output of the keyed r-f amplifiers consists of a 10-microsecond pulse of r-f energy which drives the klystron. While 10-microsecond pulses are being applied to the klystron r-f input jack, the 3.5-microsecond shaped pulse is applied to the klystron control grid. Klystron beam current, normally cut off by negative bias from the regulated bias supply in the amplifier modulator, is keyed on and grid modulated by the 3.5-microsecond shaped pulse. As the beam current passes through the first resonant cavity of the klystron, it is velocity modulated by the application of the 10-microsecond r-f pulse to the first cavity of the klystron. The combined effect of the above-mentioned grid modulation and velocity modulation of the klystron beam current results in a high-powered r-f pulse having an envelope which is controlled in shape to ensure that the radiated r-f power will occupy a minimum of frequency spectrum about the assigned carrier frequency.

(4) CONTROL-DUPLEXER. —The control-duplexer consists of a duplexer circuit and control circuits. The duplexer circuit permits feeding both the transmitter output signal and the receiver input signal through the same transmission line and antenna; the control circuits permit operating the radio set by means of switches on the front panel of the control-duplexer drawer. Also included in the control-duplexer drawer are two resonant cavity filters inserted in series with the transmission line to limit the overall spectrum of the transmitter output.

(5) POWER SUPPLIES. —The power supplies provide regulated voltages at the various output levels required for radio set operation. These power supplies include low, medium, and high voltage supplies for the transmitter, a coder-indicator power supply and a receiver power supply.

(6) POWER DISTRIBUTION AND CONTROL CIRCUITS. —The functioning of power distribution and control circuits is such that the various components of the equipment are energized in their proper sequence: the failure of one component will result in the de-energizing of other components that might be damaged by its failure. Safety interlocks, on component drawers and compartments in which high voltages are present, disconnect parts of the system when the drawers are pulled out or the compartments opened. The radio set receives 208-volt a-c, 60-cycle, three-phase, four-wire primary power. Rectifiers in the various d-c power supplies throughout the radio set convert a-c power to d-c power of the required voltage. Additional a-c power is supplied from the 117-volt, single-phase, 60-cycle lighting circuit to the convenience outlets on the radio set antenna control units and antenna base.

(7) BUILT-IN TEST EQUIPMENT. - Test equipment is provided to permit rapid check of the important operating characteristics of the Radio Beacon. In this paragraph the first five Sections (a) to (e) concern the original test equipment (TABLE 1-2) whilst Section (f) describes the facilities provided by the replacement test equipment (TABLE 1-2b).

Pulse-Sweep Generator SG-121A/URN-3 (Technical Manual NAVSHIPS 92745).

Pulse Analyzer-Signal Generator TS-890A/URN-3 (Technical Manual NAVSHIPS 93231).

Power Meter-Pulse Counter TS-891/URN-3 (Technical Manual NAVSHIPS 92809).

Oscilloscope OS-54/URN-3 (Technical Manual NAVSHIPS 92778).

Switch-Test Adapter SA-420/URN-3 (Technical Manual NAVSHIPS 92809).

The first four units are mounted in the upper half of the power supply assembly directly above the low and medium voltage power supplies. The location of the SA-420/URN-3 is optional. However, it should be located in such a way that the lengths of cable connecting it to the rest of the equipment are kept to a minimum.

The units are interconnected through a cable harness to permit rapid connection for standard test procedures, as selected by means of an integral switching system. The switching system includes two four-position function switches located on the front panels of the oscilloscope and the power meter-pulse counter and a two-position coaxial r-f switch on the switch-test adapter. Also, it is necessary to interconnect front panel jacks of the units by means of coaxial patch cords. The interconnection harness is shown in figure 2-11 and front panel connections are shown in figure 3-13.

The tests which may be made in each of the four positions of both function switches are listed in table 4-1.

Note

Both function switches should be in the same position during a specific test.

The following paragraphs include the theoretical principles upon which the tests listed in table 4-1 are based, a functional description of each of the units involved in these tests, and a brief circuit description of each of the equipments. These discussions are based on the block diagrams, figures 4-8 through 4-12. For more detailed information, reference should be made to the technical manuals for these equipments. Overall schematic diagrams of the test equipments are given in Section 6 of this handbook.

(a) PULSE-SWEEP GENERATOR SG-121A/URN-3. —The pulse-sweep generator (figure 4-8) provides pulsed pairs at a controlled variable rate to simulate the pulse output of one or more airborne AN/ARN-21. The pulse-sweep generator output is a video signal applied as modulation to Pulse Analyzer-Signal Generator TS-890A/URN-3 to provide the required pulsed r-f signal, which simulates the normal input to the radio beacon receiver.

The paired-pulse output of the pulse-sweep generator is carefully timed to facilitate measurement of the characteristics of the radio beacon. The spacing between pulses in the pair may be varied from 11 to 13 microseconds, in 0.5-microsecond steps, to permit checking that radio beacon output pulse-pair spacing is within the specified limit of 11.5 to 12.5 $\pm$ 0.2 microseconds and that the beacon will decode for retransmission only those pulse pairs

TABLE 4-1. FUNCTION SWITCH POSITIONS FOR TESTING

SWITCH POSITION	PANEL NAME	TEST
1	OPERATING TEST	R-f peak power Visual pulse shape Output pulse count AN/URN-3 transmitter spectrum
2	RECEIVER SENSITIVITY	Reference burst pulse count Squitter count
3	DELAY SYSTEM	Overall zero-distance time delay Video zero-distance time delay
4	GENERAL TEST	Maintenance testing

within the same limits. The pulse repetition rate is variable. Continuous variation over the range of 40 to 4000 pulse pairs per second permits interrogating the radio beacon at rates which simulate different numbers of AN/ARN-21 within the operating range. Fixed, crystal-controlled rates are also provided. Separate crystal timing frequencies produce sweep rates for checking the upper and lower tolerance limits of the overall zero distance delay, 50.2 and 49.8 microseconds, respectively.

Sweep voltage in the form of a sawtooth is provided at exactly one half of specified rates. A modulation trigger is also provided which is an exact multiple, at an interval of approximately 1000 microseconds, of the sweep rate, i.e., the modulation trigger times the output pulse pair; the reason for this arrangement is given in the discussion of test principles. A sync trigger is also provided; this trigger is developed from the modulation trigger, which times the pulse pair at the continuously variable or crystal-controlled rates.

(b) PULSE ANALYZER-SIGNAL GENERATOR TS-890A/URN-3 or TS-890B/URN-3

Note

The TS-890A/URN-3 and the TS-890B/URN-3 are similar except for r-f spectrum measuring capabilities. Either unit may be used for all tests requiring a pulse analyzer-signal generator except for the spectrum test. When checking r-f output spectrum, the TS-890A/URN-3 model must be used.

The TS-890A/URN-3 (figure 4-9) provides an r-f carrier for testing the beacon and a calibrated receiver for spectrum analysis of the beacon output signal. The pulse analyzer-signal generator is capable of supplying an r-f signal over the complete range of the beacon receiver and analyzing radio beacon output signals over the complete range of output frequencies.

The r-f signal provided by the signal generator portion of this unit is continuously variable over the range of 1023 to 1152 mc. Means are also provided for plugging in crystals corresponding to the frequency of any channel within this range, as a fixed frequency source. The amplitude of this signal may be varied over an accurately calibrated range of 0.1 microvolt to 0.5 volt. The specified voltages are for a 50-ohm output. This r-f signal may be either continuous wave or pulsed.

The receiver (analyzer) portion of this unit may be tuned to any frequency in the two bands of 962 to 1024 and 1151 to 1213 mc. Once tuned to a channel, the receiver may be detuned to a narrow band of frequencies 0.8 mc or 1 mc above or below the channel. An attenuator associated with this feature provides a particular discrete loss when tuned 0.8-mc off channel, and when tuned on channel. This arrangement varies receiver sensitivity in such a way that, if the radio beacon output signal has the correct spectral distribution, a meter in the receiver output circuit will read midscale for all five on-channel and off-channel conditions. A separate attenuator having a range of 30 db permits varying receiver output so that the meter may be set to mid-scale for the on-channel condition. Thus, any deviations from the specified spectral characteristics of the radio beacon output will be indicated by corresponding deviations of the meter reading.

(c) POWER METER-PULSE COUNTER TS-891/URN-3. – The power meter-pulse counter (figure 4-10) includes two functionally separate circuits in the one unit.

1. POWER METER CIRCUIT. – The power meter circuit is a metered variable d-c source used to bias the diode in Switch-Test Adapter SA-420/URN-3 for power measurement. Varying the bias changes the diode clipping level and causes less detected positive pulse to be passed on for display on the oscilloscope. By adjusting the bias to the point at which the detected pulse is just eliminated from the scope presentation, the d-c voltage is made equal to the peak amplitude of the pulse. Since the d-c voltage is a measured quantity, a direct indication of

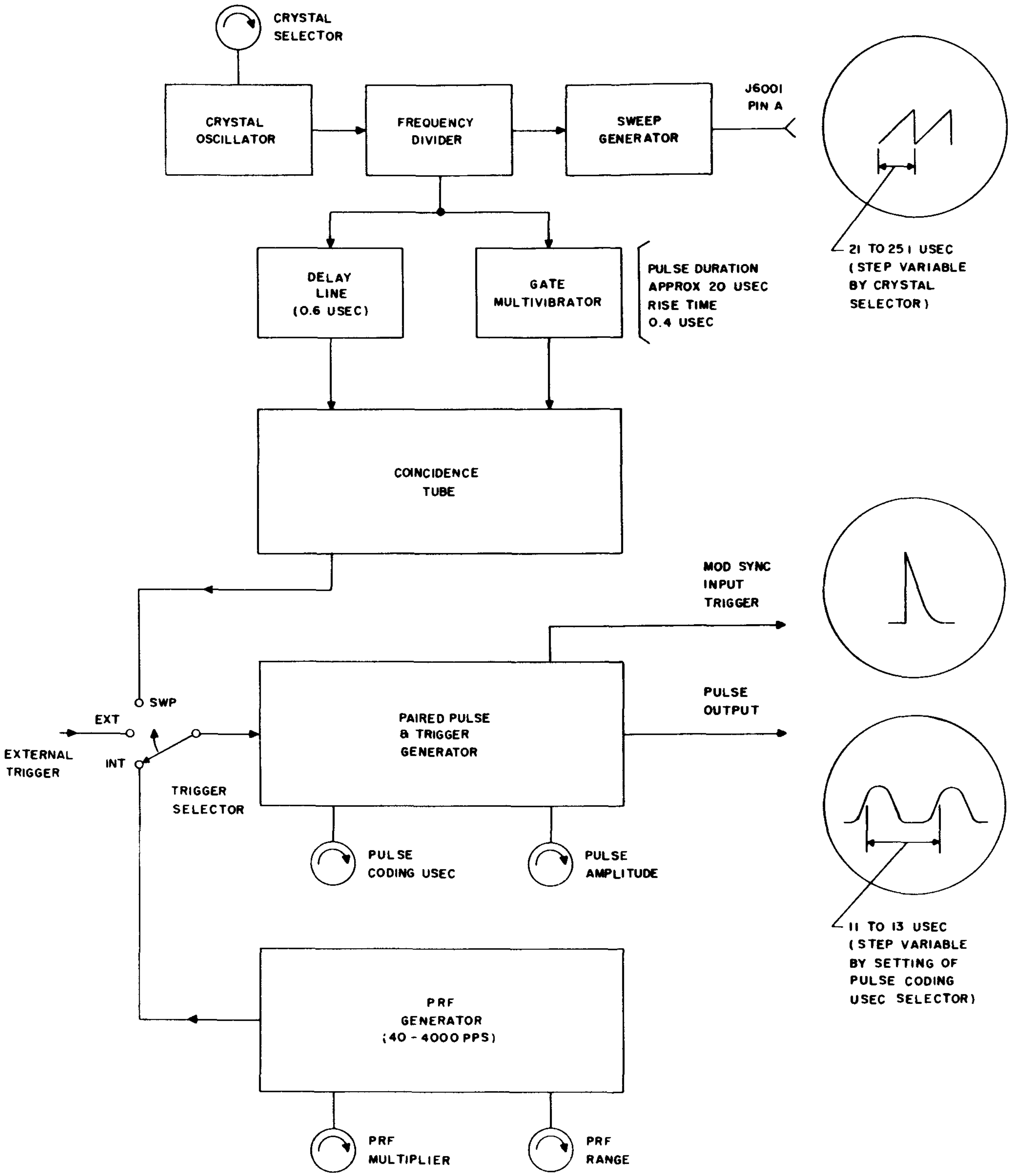


Figure 4-8. Pulse-Sweep Generator SG-121A/URN-3, Simplified Functional Block Diagram

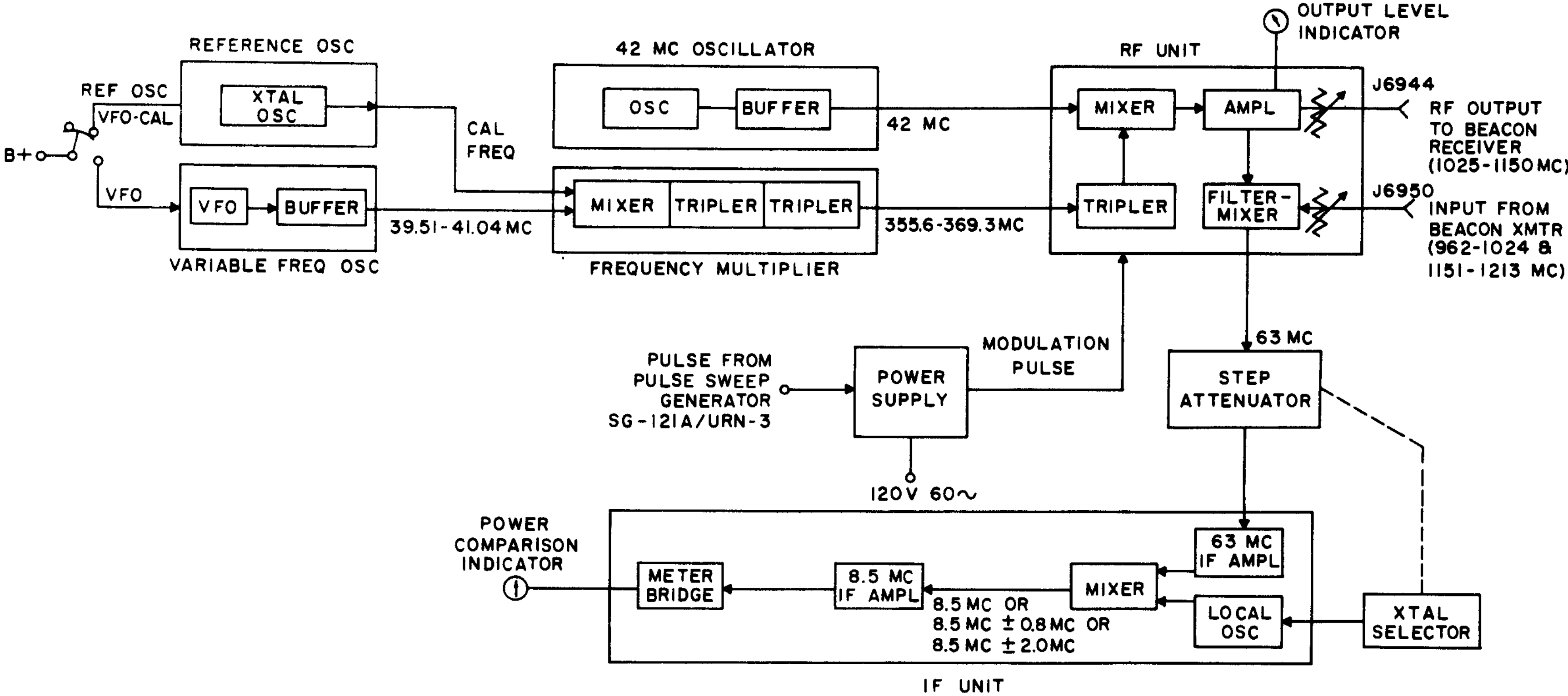


Figure 4-9. Pulse Analyzer-Signal Generator TS-890A/URN-3, Simplified Functional Block Diagram

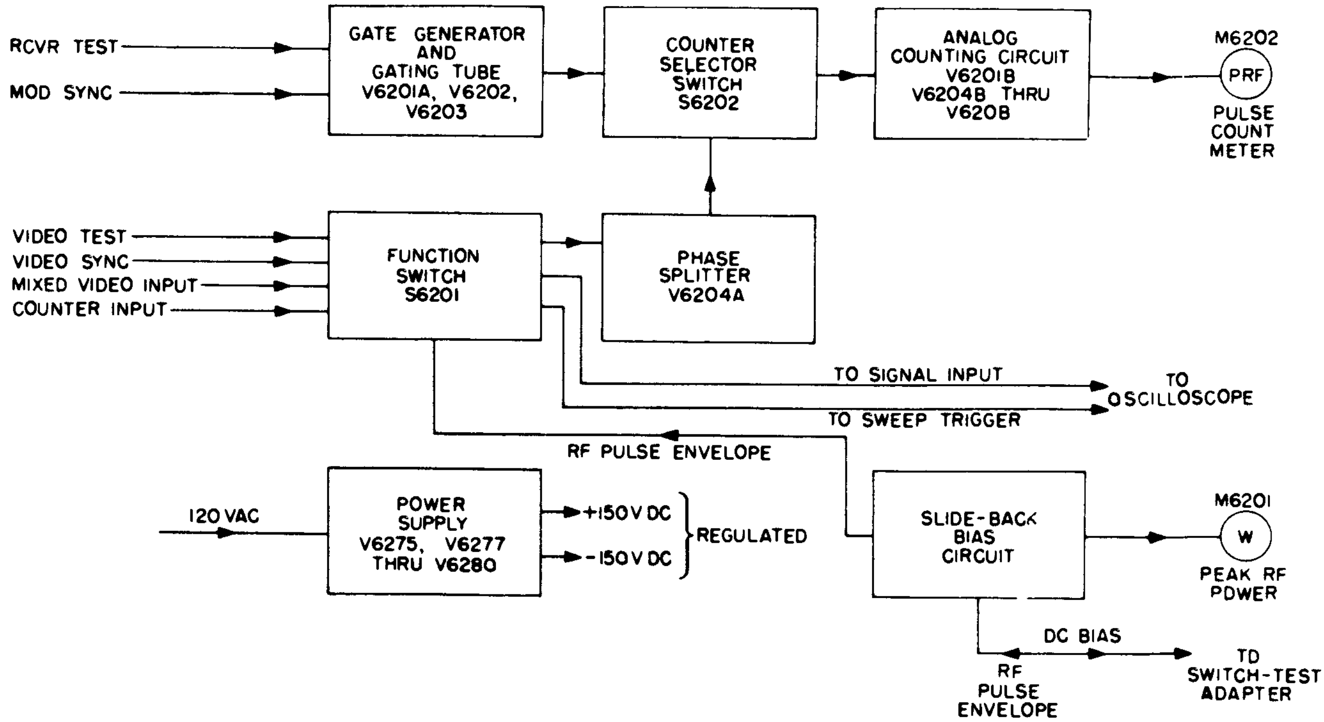


Figure 4-10. Power Meter-Pulse Counter TS-891/URN-3, Simplified Functional Block Diagram

peak-pulse amplitude, and hence peak power, is obtained. The meter that indicates the magnitude of the d-c voltage is calibrated in kilowatts.

2. PULSE COUNTER CIRCUIT. —The pulse counter circuit is arranged to perform several functions.

When counting the beacon squitter output pulses, the pulse counter accepts these pulses, shapes them for uniformity, and applies them to a vacuum tube measuring circuit which varies the meter current in direct proportion to pulse rate. The associated meter is calibrated directly in pulses per second, and has two ranges of 80 to 800 to 8000 pulses per second. Thus, the circuit measures the squitter output directly. Squitter count is defined as the random output of the beacon not due to interrogation.

When counting the reply rate (pulses that pass through the beacon receiver as a direct result of interrogations), the pulses are applied to the pulse counter exactly as for squitter count. In addition, interrogation pulses from the pulse-sweep generator are applied to the counter circuit and a gate circuit. The gate circuit prevents the passage of pulses through the counter, except for a 14-microsecond period following delivery of an interrogation signal. The start of the 14-microsecond gate is delayed 12 microseconds to compensate for a corresponding delay through the receiver. Thus the counter is gated off for all pulses except direct replies.

In addition to squitter count and reply count, a four-position FUNCTION switch also permits the counter to accept either negative or positive pulses from any external source.

(d) OSCILLOSCOPE OS-54/URN-3. —The oscilloscope (figure 4-11) is a versatile, wide-band oscilloscope with a triggered sweep. Sweep trigger may be from a recurrent source within the oscilloscope or from an external source. Sweep speed may be varied over the range of 0.4 to 40,000 microseconds per inch. Sweep blanking is provided, the sweep is inactive and blanked out in the absence of a trigger. The vertical amplifier bandwidth, between those frequencies which are 3 db down, is 5 cycles to 3 mc.

The oscilloscope provides timing markers and calibrating voltage to permit accurate measurement of signal waveform amplitude and pulse width. Markers are at intervals of 1 and 10 microseconds, and may be superimposed on the signal at will. The calibrating voltage permits peak-to-peak amplitude measurement over a range of 0.1 volt to 100 volts. An additional feature, which permits observation of the leading edge of sharply rising wavefronts, is an optional signal delay of 0.3 microsecond.

(e) SWITCH-TEST ADAPTER SA-420/URN-3. —The switch-test adapter (figure 4-12) consists of a heavy duty coaxial switch and a pick-off diode. The switch transfers the radio beacon transmitter output power from the antenna to a dummy load and the pick-off diode supplies a detected signal to the test equipment. A biasing voltage developed

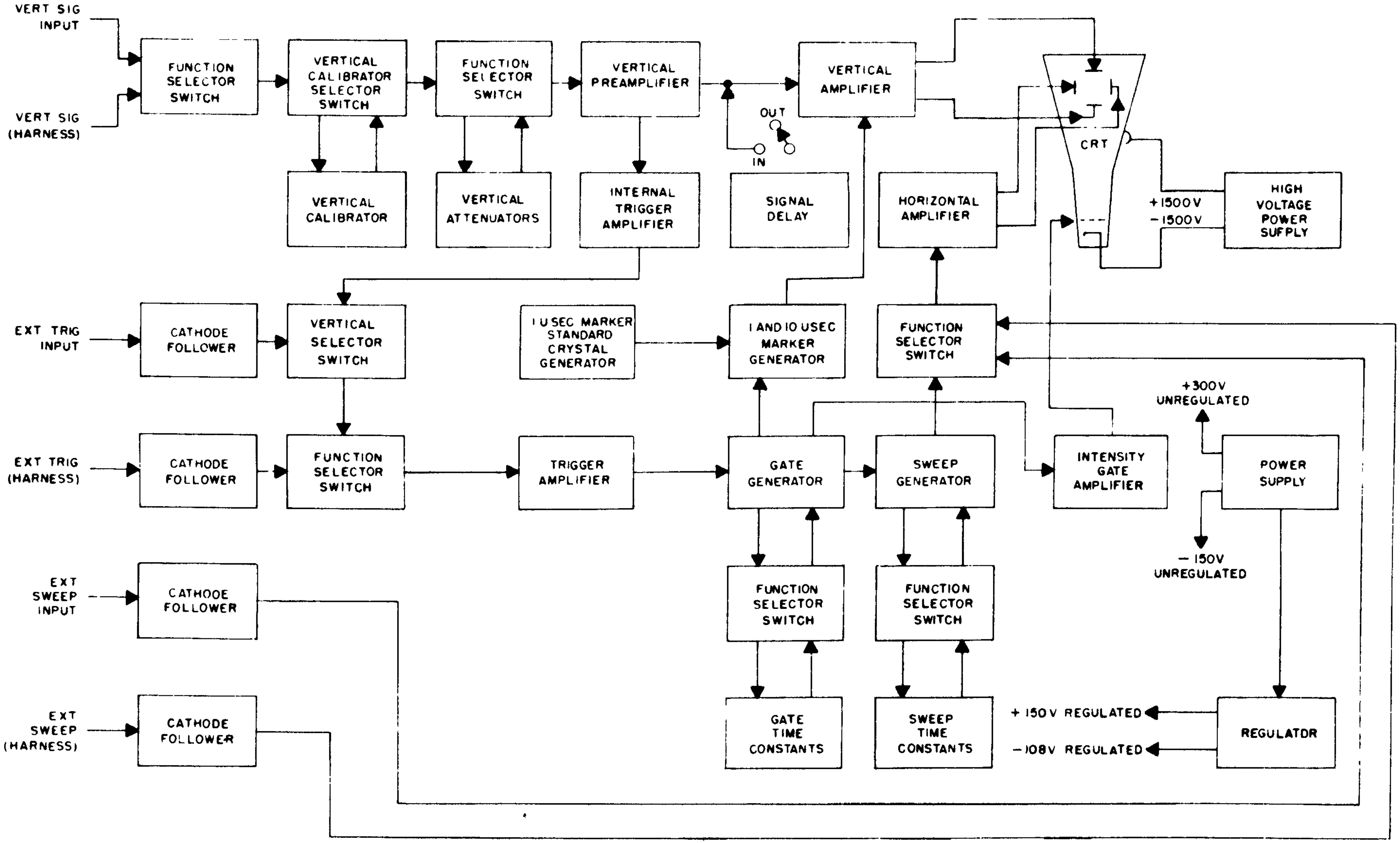
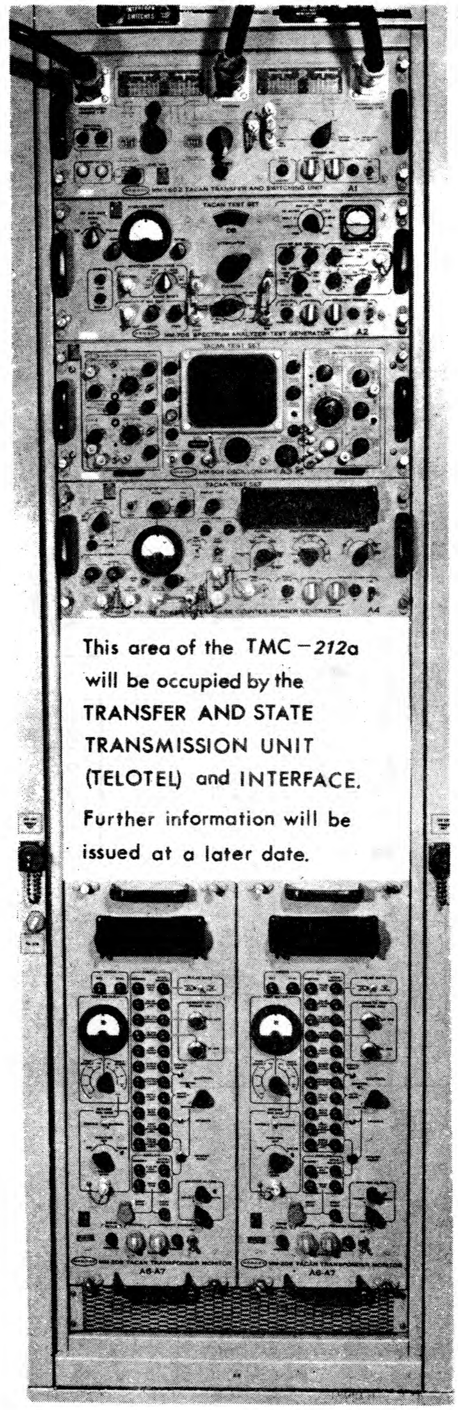


Figure 4-11. Oscilloscope OS-54 'URN-3, Simplified Functional Block Diagram

Figure 4–12a. REPLACEMENT
TEST EQUIPMENT MM–TMC–212a.



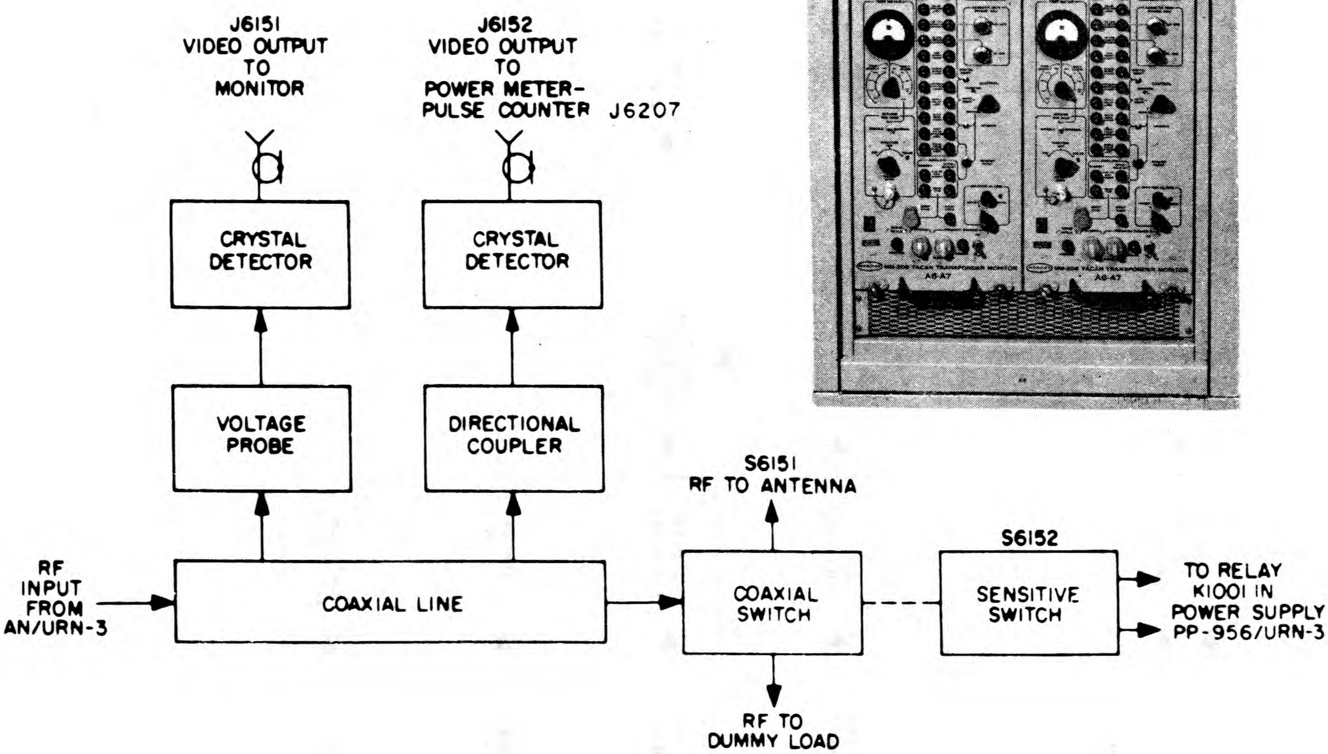


Figure 4-12. Switch-Test Adapter SA-420 URN-3, Simplified Block Diagram

in the power meter-pulse counter is applied to the diode to permit power measurement by the slide-back method.

(f) REPLACEMENT TEST EQUIPMENT (TABLE 1-2b). - This test equipment comprises the following pieces of test equipment, a functional description of which is given in this section.

Spectrum Analyzer/Test Generator MM-705
Technical Manual: AP 116C-0702-1H6H
Oscilloscope MM-504
Technical Manuals: AP 116C-0702-1J6J
AP 116C-0702-1K6K
Power Meter - Pulse Counter - Marker Generator MM-109
Technical Manual: AP 116C-0702-1G6G

These units are mounted with a Transfer and Switching Unit, a Transfer and State Transmission Unit (TELOTEL), and its assocated interface unit, and two Transponder Monitors in the Electrical Equipment Cabinet 212A and are interconnected through a cable harness and (for certain tests) two function switches, all of which permit rapid connection for standard test procedures. A block diagram of the equipment is shown in Fig 2-11a whilst Fig 3-13a shows the front panel connections required to perform certain standard tests described in Para 3-6a(12).

1. SPECTRUM ANALYZER/TEST GENERATOR MM-705 (Fig.4-12a). - This unit is designed to function separately or as an integrated unit with other special test components of the MM-TMC-212A Group.

a. The spectrum analyzer section consists of a double superheterodyne receiver, with 2 crystal-controlled local oscillators, and is capable of measuring an r.f. spectrum over a power range of 70 dB at a maximum signal of +14 dBw and a minimum signal of +5 dBw peak at the standard TACAN transponder duty cyle (specified in MIL-STD-291A), with a measurement accuracy of 3 dB. A crystal filter (at the input of the second IF amplifier) provides a well-defined bandpass response with high selectivity. A thermistor bridge at the output of the second IF amplifier is used to measure the transmitted energy in each of the six bands adjacent to the transponder transmitting frequency as well as the on-channel energy. A first local oscillator provides crystal-controlled operation at any single frequency in the range 960 to 1215 MHz to within ±0.002% of the assigned frequency.

The second local oscillator is tunable to any one of seven crystal-controlled frequencies by means of a front panel BAND SHIFT switch. The operation of this switch enables measurement of relative transmitted energy in seven bands 500 kHz wide, each with an accuracy of ±0·002% centred as follows:

1. On-channel frequency
2. ±0·8 MHz away from the on-channel frequency.
3. ±1·0 MHz away from the on-channel frequency.
4. ±2·0 MHz away from the on-channel frequency.

When the BAND SHIFT switch is in the EXT OSC position an external oscillator input can be used to shift the second IF bandpass and this enables the measurement of energy levels at frequencies other than those provided for by the specified crystals. The external oscillator must provide an input whose signal level is 1 mW into 50 ohms. A precision direct-reading input attenuator, with 3 to 5dB insertion loss, is provided at the front panel for control of the input signal. The attenuator is calibrated over the range 0 to 120dB in increments of 1dB with the following accuracies:

Frequency	Range	Accuracy
60-66 MHz	0-110dB	±1·5dB in the range 0-100dB
958-1217 MHz	0-120dB	±0·7dB in the range 0-100dB
958-1217 MHz	0-120dB	±1·0dB in the range 100-115dB

The nominal frequency bandpass of the second IF amplifier, determined primarily by the crystal filter, is 500 kHz. Ripple in the bandpass is within ±1½ dB of a selected reference level. The bandwidth at 3dB below this reference level is greater than 500 kHz whilst the bandwidths at 50 and 70dB below this reference are less than 825 and 1020 kHz respeetively.

b. The test generator section consists of a 63 MHz CW IF signal generator and an RF signal generator providing CW or pulsed operation over the frequency range 1024 to 1151 MHz. The purpose of the 63 MHz IF signal generator is to provide a signal for aligning the IF stages of the beacon receiver. The purpose of the RF signal generator is to provide RF energy (at the beacon receiver frequency) for testing and maintenance.

1. IF Signal Generator.- The output frequency of the IF signal generator is variable from 60·5 to 65·5 MHz with a capability of being set to 63·000 MHz ±0·005% and the output power is variable from 0 to -110 dBm, calibrated to an accuracy of ±2dB over the range 0 to -100 dBm. The modulation of the amplitude is less than 2% whilst that of the frequency is less than 1 kHz. Spurious output is at least 40dB down from signal output.

2. Microwave Signal Generator.- The RF Signal generator has a crystal-controlled master oscillator which establishes the operating frequency to an accuracy and stability within 0·002%. The generator provides RF output signals for interrogation at any single channel frequency from 1024·0 to 1151·0 MHz. A FREQ SEL switch is provided for the selection of on-channel frequency. The only other adjustment required when selecting any of the five opera-

ting frequencies is the output power level which can be adjusted to a reference level by means of the front panel PWR SET control and the AVERAGE POWER meter. A portion of the signal generator output is detected by a linear detector whose 'detected envelope' output can be displayed on the MM-504 Oscilloscope for examination of the pulse characteristics. The front panel PRR coarse and vernier controls enable the repetition rate of the generator output pulse pairs to be varied from 4 to 4000 pulse pairs per second, whilst the VAR and NOM controls provide a fixed 12 or 36μsec pulse spacing or a variable pulse spacing ±3μsec with a mean of 12 or 36μsec. A synchronization pulse triggers the oscilloscope 3μsec before the generation of the interrogation pulse pair. When an external pulse generator is used to control the pulse repetition rate, the PRR coarse control is set to its EXT TRIG position.

2. OSCILLOSCOPE MM-504 (Fig 4-12a). -- This unit is a general purpose, high performance oscilloscope designed to operate in a wide range of environmental conditions. Sweep trigger may be from a recurrent source within the unit or from an external source. The sweep speed may be varied over the range 5 seconds to 0·1 microseconds/cm in calibrated steps although a variable facility enables an uncalibrated sweep rate at least 2·5 times the TIME/CM switch settings. The vertical amplifier bandwidth (at the -3db point) is DC to 30 MHz, or greater when cascaded with Channel 1. Timing markers are provided by the Marker Generator (part of the Power Meter Pulse Counter Marker Generator MM-109) and are synchronized with the associated oscilloscope sweep and may be positioned upon the waveshape being viewed. Each tenth marker is automatically brightened. A COUNTER/MARKER SELECT switch is located on the front panel of the MM-109 and enables selection of marker pulses at intervals of 0·5, 1·0, 10, 100, 1000 and 10,000μsec. The calibration voltage enables peak-to-peak amplitude measurement over the range of 0·2 mV to 100V (square waves) in 18 steps, and 100V DC.

3. POWER METER – PULSE COUNTER – MARKER GENERATOR MM-109, (Fig 4-12a). – Whilst constituting one chassis within the MM-TMC-212A Group, the MM-109 comprises three separate functions as follows:–

a. POWER METER. This measures the peak r.f. power output of the beacon and associated test equipment, in the frequency range 960 to 1215 MHz. The meter is used in conjunction with the Transfer and Switching Unit MM-1602 which, in this instance of its use, provides the necessary facilities for sampling the transmitter output-signal and interrogation pulses. Sample pulses are routed via the Spectrum Analyzer/Test Generator, MM-705, reference attenuator and fed into diode detector network CR1 of the Peak Power Dectector. The resultant video output, which is from -0·3 to -1·1V peak, is fed to the various stages of the Peak Power Detector where it is amplified, sampled at the pulse peak and fed to a peak power/input level amplifier as a d.c. voltage whose amplitude is proportional to the peak amplitude of the input pulse. The output of the peak power/input level amplifier is applied across the PEAK RF POWER meter, which is calibrated in watts.

b. PULSE COUNTER. Whilst it can be used as an individual unit, the pulse counter/timer is incorporated within the TMC 212A to measure the average repetition rates of all the pulse sources of the beacon. The unit provides a direct readout of the number of pulses counted up to a total of 99·999 at a pulse spacing of 0·5μsec, or more, as required for the following:–

1. North Burst interval; hence, indirectly, antenna speed.

2. Auxiliary Burst interval.

3. Reference Burst Count.

4. Squitter Count.

5. Total Pulse Count.

6. Receiver Reply Count.

7. Identity tone and burst pulse count.

After initial amplification the pulses to be counted are applied, via various switching routes, to the Counter Control circuit which is the heart of the system and creates all commands. After further processing the pulses are fed to the counter MAIN gate and then to the Decade Counting Unit where they are used to trigger a series of flip-flops which, in turn, change the conditions of a set of AND gates associated with the Nixie indicator tubes.

The display time is variable from 0·5 to 30 seconds and means are provided to 'hold' the display indefinitely.

c. MARKER GENERATOR. The unit provides marker pulses at six intervals of 0·5, 1·0, 10, 100, and 10,000 μsec. Each tenth marker is automatically brightened for easier measurement of pulse intervals although the first brightened marker appears after the ninth interval.

The marker generator operation is controlled by two external inputs. Input 1 requires a positive-going pulse to start the generator whilst input 2 requires a negative-going pulse to stop it. For simplification both inputs are connected to the positive-going intensity gate of the oscilloscope; the leading edge is used to start the generator and the trailing edge to stop it.

When operated into the oscilloscope Z-axis, through the inter-unit cable harness, the marker rise- and fall-times and pulse widths vary according to the markers selected, but in general provide a mark-space ratio of 30:1. The nominal pulse width is stable to ±20%. Accuracy of the marker intervals is dependent upon the stability of the Marker Generator 2 MHz oscillator and means are provided internally to check its accuracy against the Pulse Counter frequency standard. A front panel control is used to adjust the Marker Generator oscillator to precisely 2.0000 MHz provided a 5-minute warm-up is allowed prior to adjustment.

d. TRANSFER AND SWITCHING UNIT MM-1602 (Fig 4-12a).- Although not actually part of the test equipment this unit, in response to a command from the TELOTEL, provides automatic transfer of TACAN beacons between antenna and dummy load and between beacons and test equipment. The transfer circuitry has an adjustable delay of approximately 1 second, initiated by a transfer command from the transfer control unit which, at the same time, opens the high voltage control line by actuating a relay. When the delay time expires, beacon transfer occurs and once completed, the high voltage control line is restored to that beacon which is connected to the antenna. The transfer and switching function also selects the identity keyer signal of the beacon connected to the antenna and routes it to the monitors, provides primary and standby pre-trigger logic switching and XPONDER ON ANT indication operation. The transfer time delay is incorporated to allow the main line RF to completely decay prior to transfer.

The unit also includes the following facilities:

1. An adjustable coupler, MM-801, which provides coupling to the main RF line for the purpose of injecting monitor interrogations.

2. A critical-switches-mis-set function whereby, providing certain critical switches in the Spectrum Analyzer/Test Generator and Transponder Monitors are correctly set, a NORMAL indication is shown on the front panel. If any critical switch is mis-set, continuity is lost, a relay is de-energized and a MIS-SET indication is shown on the front panel.

3. A manual switching facility is also incorporated in the event of automatic transfer failure.

e. TRANSFER AND STATE TRANSMISSION UNIT (TELOTEL) and INTERFACE. (Fig 4-12a).- These units provide the facility whereby, on receiving an alarm signal (confirmed by both of the Transponder Monitors) of any beacon parameter failure, the unit sends a command signal to the Transfer and Switching Unit thereby initiating a transfer of beacons between antenna and dummy load. The unit is also capable of accepting specific failure data from the Monitors and other non-electronic parts of the system (eg frequency converter) and transmitting indication of such a failure to a remote indicator.

Facilities are also provided whereby the unit can automatically call a central station, remote from the installation, and pass such failure data as it has received.

f. TACAN TRANSPONDER MONITOR MM-209 (Fig 4-12a).- There are two of these units within the MM-TMC-212A MONITOR CONTROL RACK and they are interconnected such that a failure must be registered by both units before an alarm condition is signalled.

The units automatically provide, every 4 seconds, a detailed analysis of 13 TACAN transponder parameters and upon detecting a fault in any parameter, the monitor will automatically 'lock on' to that parameter and sample it continuously until either the fault clears or, after a short delay period, an alarm condition is registered and a transfer or shut-down, as the case may be, is initiated. If the failure is intermittent or temporary and the beacon returns to proper operation prior to the end of the alarm delay time, the monitor will accept the parameter and advance to the next parameter and at the same time reset the alarm delay circuitry.

In addition, the monitor provides quick, easy readout of important counts or measurements, which results in a considerable decrease in routine maintenance time.

The following operational characteristics are evaluated by the monitor.

1. General Transponder operation.
   - (a) Pulse pair spacing
   - (b) Receiver sensitivity
   - (c) System replay delay
   - (d) Average peak radiated power
   - (e) Average pulse rate.
2. Azimuth information.
   - (f) North reference burst count
   - (g) Auxiliary reference burst count
   - (h) North reference burst spacing
   - (i) Auxiliary reference burst spacing
   - (j) 15 Hz azimuth deviation
   - (k) 135 Hz azimuth deviation
3. Identity functions
   - (l) Identity pulse spacing
   - (m) Equalising pulse spacing
   - (n) Keyer operation
   - (o) Failure of identity tone
   - (p) Continuous identity tone
4. Antenna function
   - (q) Antenna rotation rate

All of the monitoring functions are indicated at the front panel except those of 2(g) and (h) and 3(n). The continuous identity tone and identity tone failure functions have been combined in one indicator.

All beacon parameters are monitored digitally with the exception of average radiated peak power, continuous identity signal and failure of identity signal. When a beacon parameter has failed and the monitor units have initiated an alarm, and transfer, the fault is held in memory.

b. CIRCUIT ANALYSIS.

(1) RADIO RECEIVER R-824/URN.

(a) MIXER AND PREAMPLIFIERS. (See figures 4-13 and 4-14.)–The distance interrogation pulse pairs pass through low-pass filter Z501, which rejects frequencies between 1650 and 10,000 mc and passes interrogations to the mixer stage of the receiver (figure 4-13). A local oscillator signal from the frequency multiplier-oscillator in the transmitter is also applied to the mixer stage. At the mixer stage, the local oscillator signal, distance interrogations, and random noise pulses generated in the mixer itself are combined to produce an i-f signal of 63 mc. output of the mixer stage, consisting of distance interrogation pulse pairs have pulses spaced 12 microseconds apart and random noise pulses at a random spacing, is fed to the preamplifiers (figure 4-14).

The output of Z501 is fed into one arm of the coaxial hybrid balanced T-type mixer; local oscillator power from the frequency multiplier-oscillator stage is fed into the other mixer arm. Essentially, all power put into the mixer and local oscillator arms is delivered to two crystal mixers CR201 and CR202. The balanced signal output of the mixer plus random noise is fed through impedance-matching transformer T201 to the grid of tube V201.

To facilitate metering the current in the crystal mixers, position CR201 or CR202 of METER SELECTOR switch S501 connects the receiver panel meter to the appropriate crystal circuit. The low-pass filters in series with the meters prevents extraneous signals in the i-f pass band from entering the i-f amplifiers.

The output of the mixer is applied to the control grid (1) of first preamplifier stage V201 (figure 4-14). Slug-tuned coil L206 in the plate circuit of tube V201 is tuned to 63 mc. The combination of coils L206, L209, L210, and L211 produces a relatively flat i-f response centered at 63 mc. The signal is amplified in stage V201 and applied to the cathode of grounded grid amplifier V202.

The signal is further amplified in stage V202. Bias voltage for stage V202 is developed by the flow of cathode current through registor R205 which is bypassed by capacitor C210; the combination of resistor R205 with coil L205 and transformer T201 forms the d-c grid return path for tube V202. Coupling between tubes V202 and V203 is provided by a T-equivalent of a parallel-tuned transitionally coupled transformer. Slug-tuned coils L209 and L210 are tuned to 63 mc. The signal is applied to the control grid of final preamplifier V203.

Stage V203 further amplifies the signal. The plate load for stage V203 is a parallel resonant circuit consisting of the tube's output capacitance, coils L211 and L213, and capacitors C221 and C220. The output voltage is obtained across coil L213 and capacitors C220 and C221 at a low impedance level

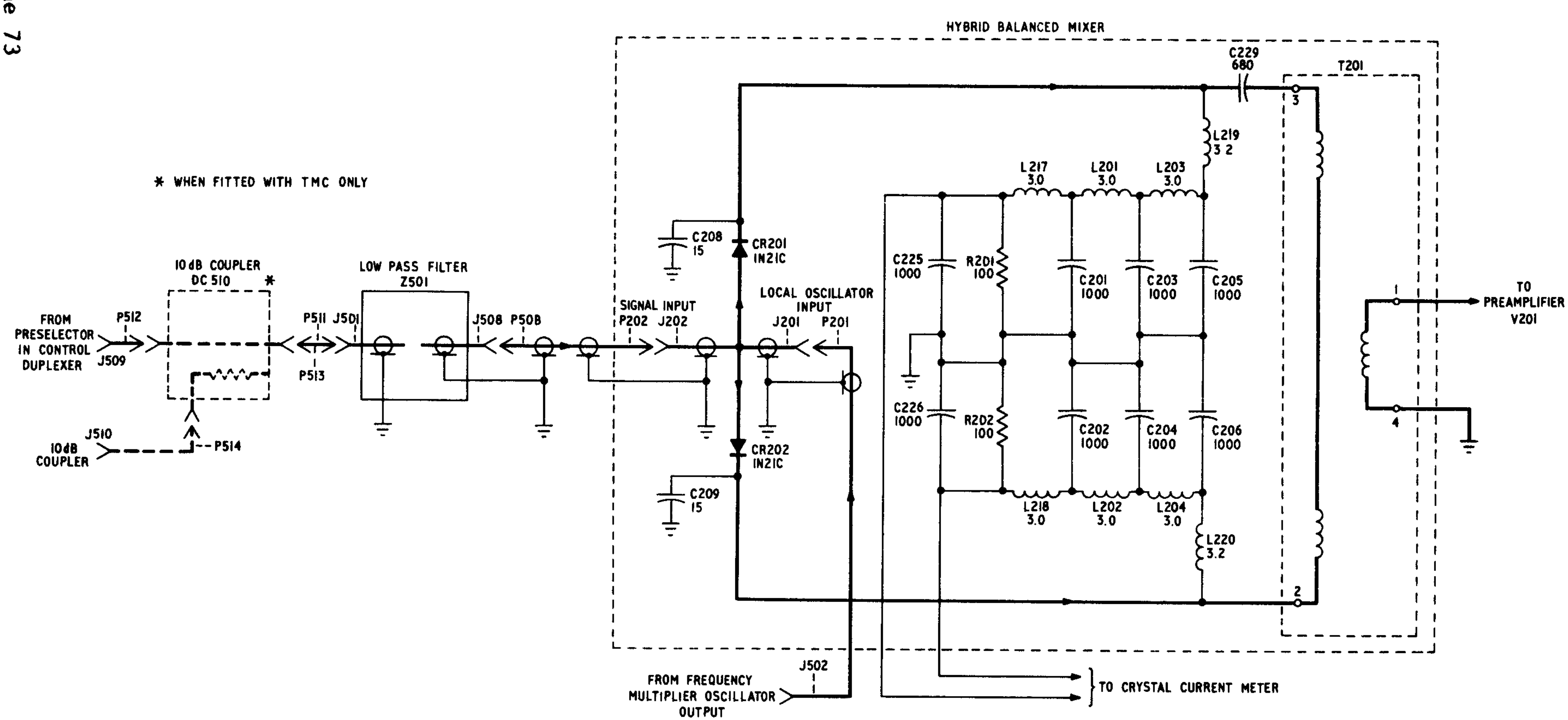


Figure 4-13. Radio Receiver R-824/URN, Hybrid Balanced Mixer, Simplified Schematic Diagram

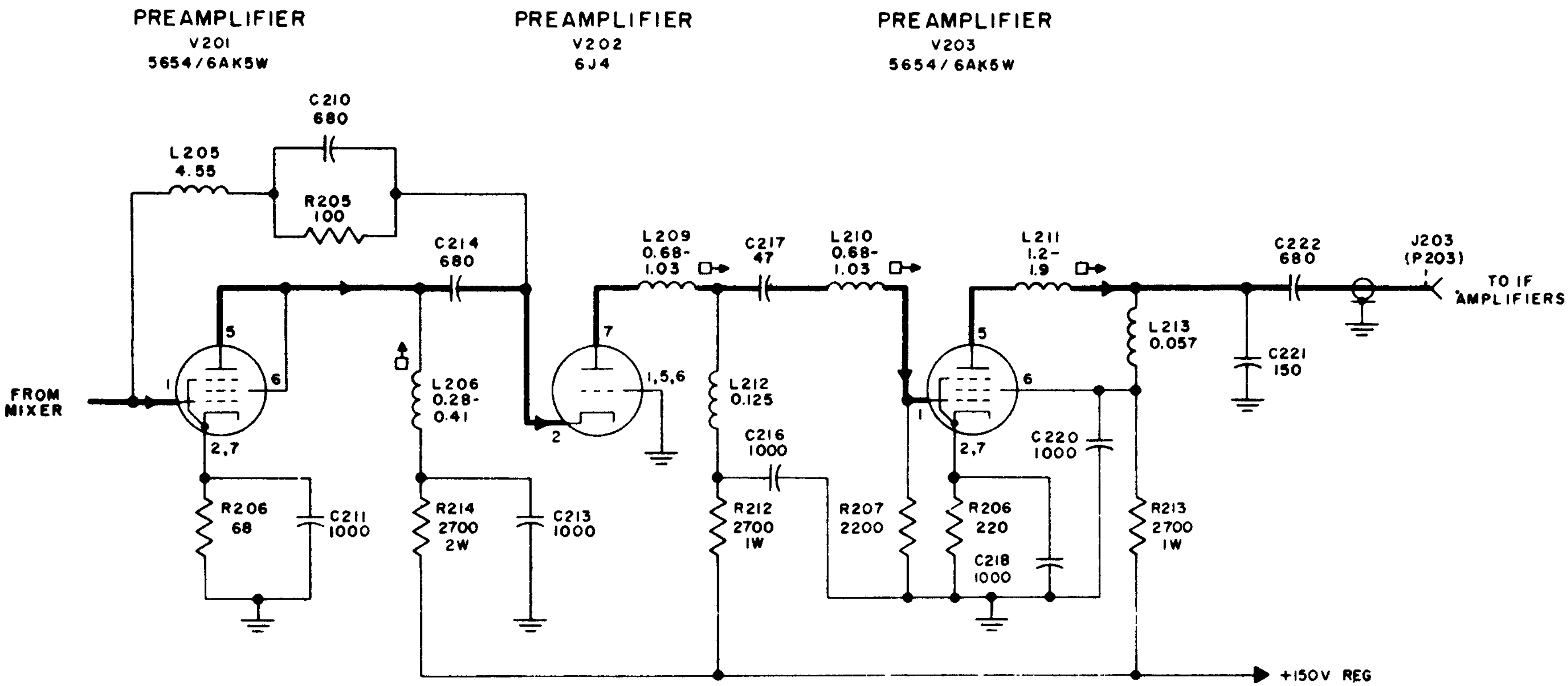


Figure 4-14. Radio Receiver R-824/URN, Preamplifier, Simplified Schematic Diagram

that matches the 50-ohm coaxial line feeding the signal to the following stage, first i-f amplifier V301.

(b) I-F AMPLIFIERS. —The receiver i-f amplifiers (figure 4-15) increase the amplitude of the signal and noise received from the preamplifiers to a level sufficient to operate the Ferris discriminator. A variable negative bias (squitter-control voltage), dependent on the number of interrogation and noise pulses out of the receiver, is applied to first and second i-f amplifiers V301 and V302. This negative voltage controls the gain of these stages and thereby controls the number of pulses out of the receiver. Also, echo-suppression circuits that allow operation of the equipment in the vicinity of large reflecting objects are employed in the i-f amplifiers.

The signal output of the preamplifier stages is applied to the control grid of i-f amplifier V301. The input circuit to the control grid of tube V301 consists of capacitor C304, coil L301, capacitor C302, coil L302, and the input capacitance of tube V301. Inductance coil L302 and the tube capacitance form a series resonant circuit which provides a stepup in voltage and impedance from the 50-ohm coaxial line. Because of the impedance matching afforded by the circuits at the input and output of the coaxial line, the i-f response is substantially independent of the cable length between the preamplifier and the i-f amplifier.

The i-f voltage is amplified in tubes V301 through V303. Inductance coils L303 through L306 are stagger tuned to center the i-f response around 63 mc and to provide an i-f bandwidth of 2 mc.

A negative bias (squitter-control voltage equal to approximately -5 volts under normal operating conditions) is applied to the control grids of tubes V301 and V302. The squitter-control voltage is derived in circuits of the video amplifier chassis of the receiver and is dependent on the number of interrogation and noise pulses received. The total number of pulses out of the receiver must be 2700 per second to sustain the sine-wave modulation envelope of the transmitted r-f carrier. When the total number distance interrogation pulses and noise pulses passing through the decoder falls below 2700 pulses per second, the squitter-control voltage is made less negative and greater i-f amplification results. Therefore, the number of pulses sufficiently amplified to pass through the coincidence decoder is increased to the point where the receiver output is 2700 pulses per second. If the number of distance interrogations received is more than 2700 pulses per second, the squitter-control voltage is made more negative and the i-f gain is reduced to the point where the excess interrogations are not amplified sufficiently to pass through the coincidence decoder.

Echo suppression is obtained by means of RC discharge networks in the grid circuits of V302, V304, and V305. Thus, in the presence of large signals, networks C308 and R304, C320 and R315, C328 and R319 each develop sufficient bias voltage to reduce the i-f gain for a period proportional to the signal level input.

(c) FERRIS DISCRIMINATOR. —The Ferris discriminator circuit (figure 4-16) consists of high- and low-Q 63-mc tuned input tank circuits, two detecting diodes, and the r-f bypass and voltage divider loading network. The two clamping diodes and two video amplifiers associated with the Ferris discriminator are included in figure 4-16 and explained in conjunction with the Ferris discriminator.

The Ferris discriminator circuit receives its input signal from the final i-f amplifier, V305. Its function is to detect the i-f signal and provide adjacent and near-adjacent channel rejection. The tank circuits are tapped at low impedance points; therefore, the tank circuits are relatively unaffected by differences in diode tube capacitance. In addition, the circuits are temperature compensated to maintain frequency stability over the temperature range of from -54°C (-65.2°F) to +85°C (+185°F). The circuit functions as follows: Both tank circuits feeding tube V306 are tuned to 63 mc. Because of loading differences, the Q of the tank circuit feeding tube V306B is reduced to approximately one-third the Q of the tank circuit feeding tube V306A. Each half of tube V306 has a different frequency characteristic because of the differences in the signal developed by each tank circuit and the voltage-dividing connection to tube V306. Tube V306A and its associated tank will pass only a negative-going narrow band of frequencies centered at 63 mc. The characteristics of the tube V306A tank circuit are shown in waveshape A of figure 4-17. Tube V306B and its associated tank will pass a positive-going wider band of frequencies also centered at 63 mc. The characteristics of tube V306B are shown in waveshape B of figure 4-17. The algebraic sum of the voltages at the input to the first triode amplifier is shown in figure 4-17. With the sum bandwidth and negative signal passing characteristics of the Ferris discriminator, as shown in waveshape C of figure 4-17, it can be seen that this circuit will only pass negative-going pulses in a narrow band of frequencies centered at 63 mc.

The output of the detecting diodes is coupled through capacitor C362 to the control grid of tube V307A and plate of tube V308A. If the incoming pulses are negative-going, tube V308A will remain inoperative and the signal will be amplified by tube V307A and passed on to tube V307B. If the incoming pulses are positive-going, tube V308A will go into conduction, shorting grid control resistor R329 and passing the positive pulses to ground. The positive portion of the signal is further rejected in stages V307B and V308B, which act in a manner similar to tubes V307A and V308A, taking into account the 180-degree phase inversion that took place in tube V307A.

The signal is then applied through plug P302 and jack J402 to the first video amplifier V402A in the video amplifier chassis.

(d) VIDEO AMPLIFIERS. —The video signal and noise pulses from the i-f amplifier chassis are routed through jack J402 to the control grid (2) of the first video amplifier V402A (figure 4-18). The video

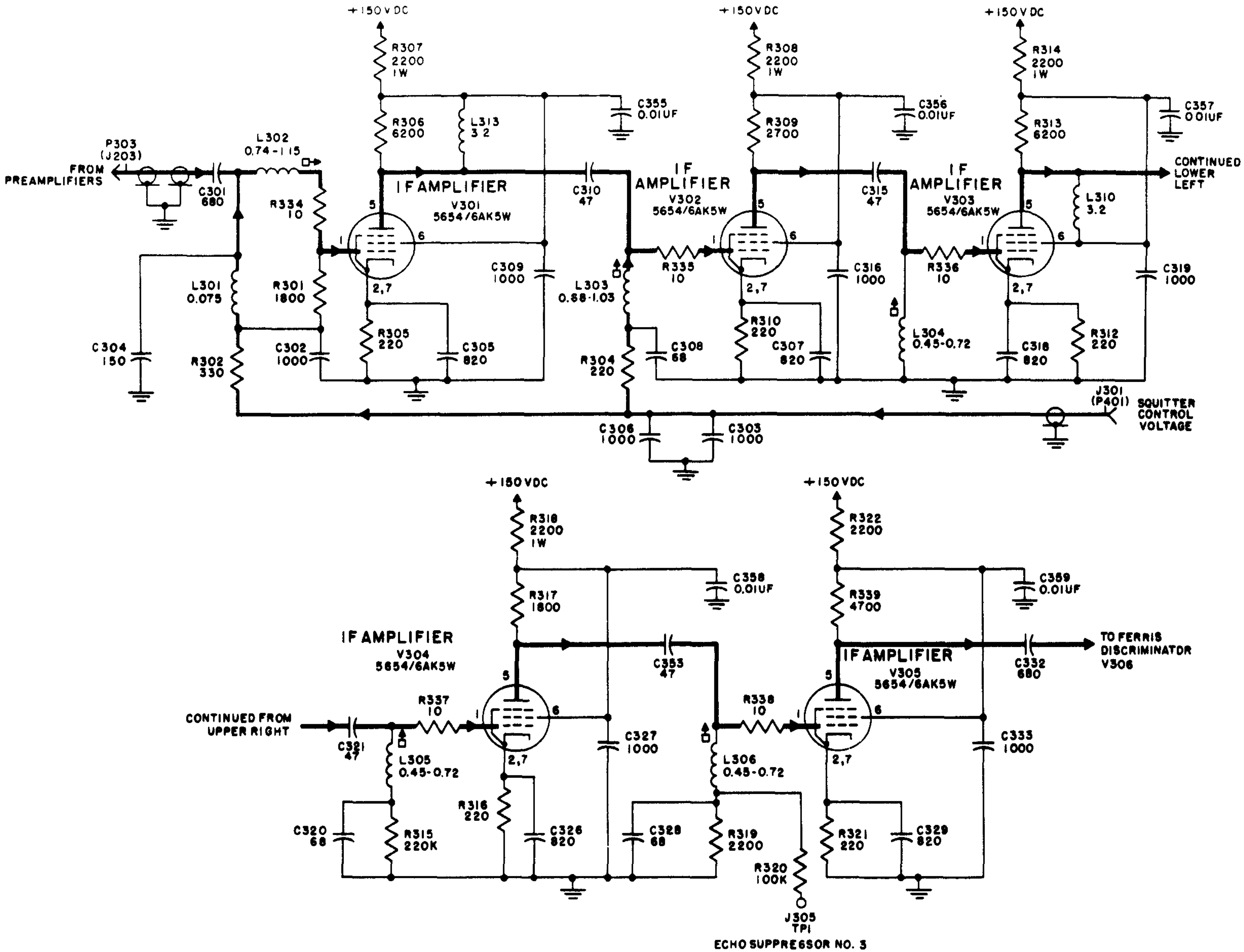


Figure 4-15. Radio Receiver R-824/URN, I-F Amplifier, Simplified Schematic Diagram

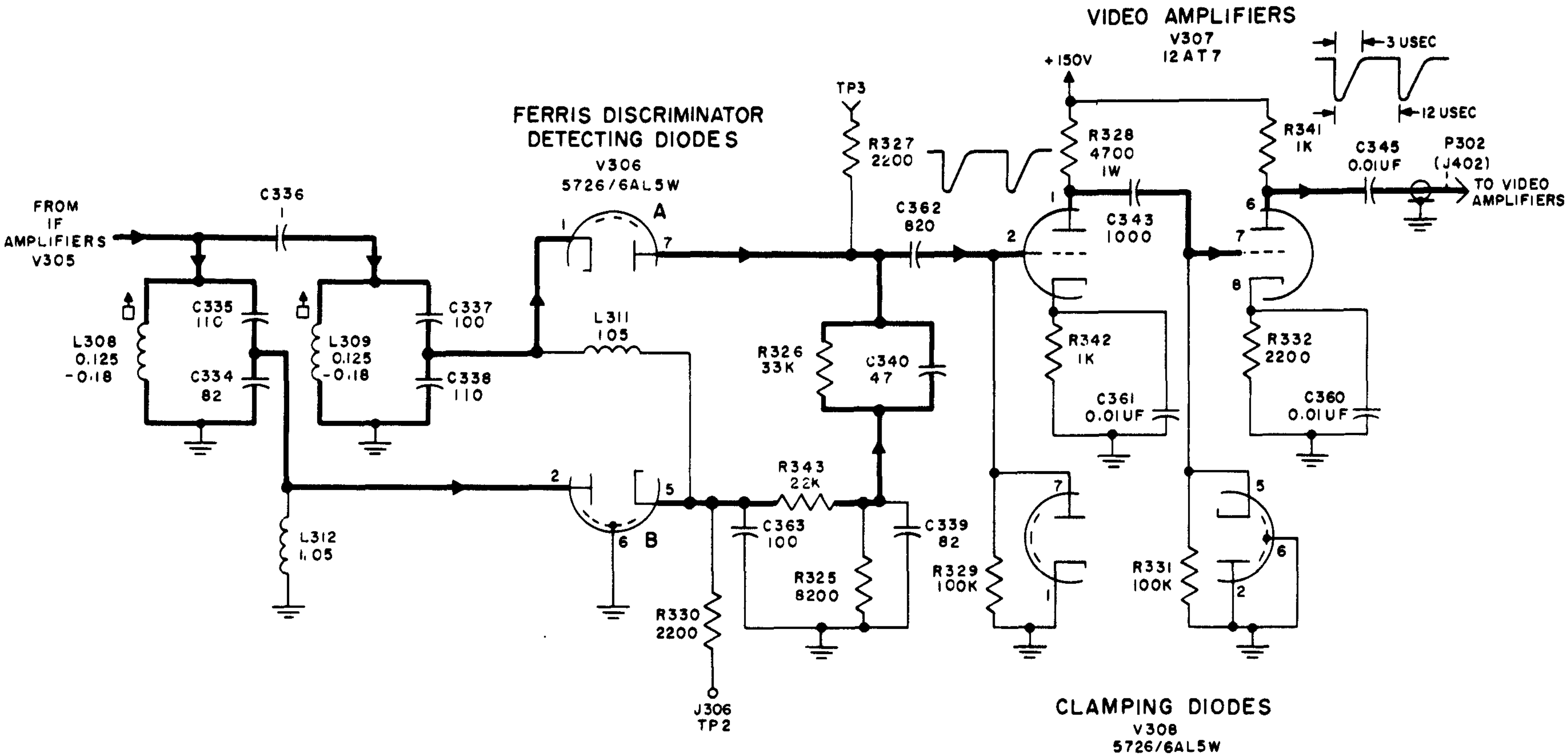


Figure 4-16. Radio Receiver R-824/URN, Ferris Discriminator, Simplified Schematic Diagram

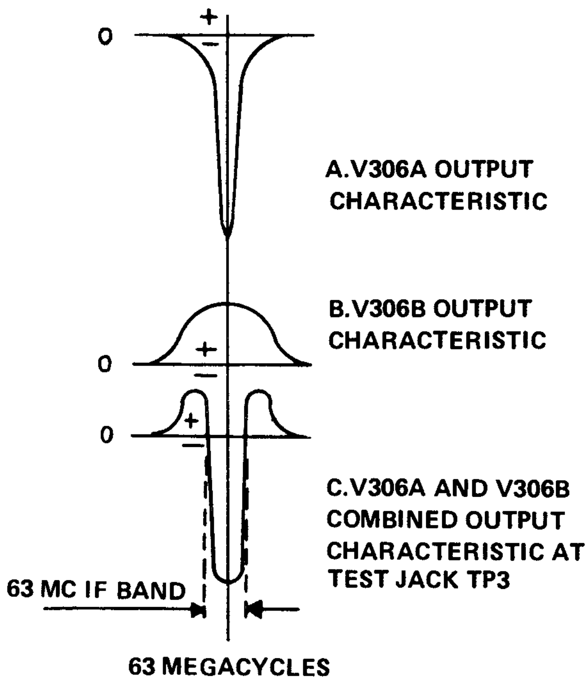


Figure 4-17. Radio Receiver R-824/URN, Ferris Discriminator, Continuous-Wave Response Curve

signal is amplified and passed through coupling capacitor C401 to the control grid (1) of the blanking gate tube V401.

The output of the i-f amplifier chassis, which is the input of the first video amplifier, can be checked at test point TP5 (jack J409).

The blanking gate, which functions as a gate-blanked video amplifier, amplifies the signal and feeds it through coupling capacitor C402 to the control grid (7) of final video amplifier V402B.

After every pulse pair is decoded however, a negative 40-microsecond blanking pulse from the blanking-gate amplifier is applied to the suppressor grid of tube V401, blanking out tube V401 and preventing pulses from passing through it. Tube V401 is also blanked out by a positive blanking pulse to its cathode circuit from the transmitter whenever the klystron is keyed on.

The second video amplifier V402B further amplifies the signal, which is then fed to a coincidence-type decoder tube V403 through coupling capacitor C403 directly to the suppressor grid (7) and through 12-microsecond delay line DL401 to the control grid (1).

(e) COINCIDENCE DECODER. – Coincidence decoder V403 (figure 4-19) is a semi-remote cutoff pentode biased to cutoff by a positive voltage applied to its cathode. As used in this circuit, conduction of tube V403 requires a simultaneous positive voltage on both the control grid (1) and suppressor grid (7). The circuit functions in the following manner: each pulse from tube V402B is applied first to the suppressor grid of tube V403 and then through a 12-microsecond delay line to the control grid of tube V403.

When a pair of interrogation pulses or random noise pulses separated by 12-microseconds arrives at the decoder, the arrival of the first pulse, delayed by 12-microseconds, at the control grid is coincidental with the arrival of the second pulse at the suppressor grid. The decoder conducts when the second pulse of a pulse pair is on the suppressor grid and the first pulse is on the control grid. This characteristic ensures the decoding of pulses (noise or interrogations) separated by 12-microseconds. However, it should be noted that since the decoder is biased to cutoff, the strength of the pulse input must be sufficient to cause conduction. This means that only those 12-microsecond spaced noise or interrogation pulse pairs above a minimum value will be decoded. The number of pulses above this value is controlled by varying the i-f gain with the squitter-control voltage. The receiver is designed to maintain this number rate at 2700 ± 90 pulses per second. The decoder output consists of a single pulse for each decoded pulse pair. These pulse trigger one-shot multivibrator V404.

(f) ONE-SHOT MULTIVIBRATOR. – One-shot multivibrator V404 (figure 4-20) is triggered once for each pulse received from the decoder tube. The pulses out of the one-shot multivibrator are all of equal amplitude and width. Stage V404 output is routed to three different stages. The plate (4) output of tube V404 is fed to blanking one-shot multivibrator V406. The cathode (2) output is routed to two different stages: one to pulse amplifier V408 (squitter-voltage generator stage) and the other to cathode follower V405 (receiver output to the coder-indicator).

(g) BLANKING GATE GENERATOR. – Blanking gate one-shot multivibrator V406 (figure 4-21) is triggered by one output of multivibrator V404. Tube V406 supplies a 40-microsecond blanking pulse for each pulse received from multivibrator V404. Blanking time adjustment potentiometer R443 controls the blanking time from 20 to 65 microseconds by changing the time constant of the multivibrator R-C network. Equipments as delivered have the blanking time preadjusted at 40 microseconds. The 40-microsecond pulse output is fed to blanking gate amplifier V407B.

Blanking gate amplifier V407B is heavily biased by the application of a fixed negative bias on its grid; conduction takes place only on strong positive pulse signals. Because of the 180-degree phase inversion in the tube, a negative output pulse of 40-microsecond duration is produced. This pulse is applied to the suppressor grid of gating tube V401, causing tube V401 to cut off for 40-microseconds. Therefore, a receiver output with a minimum of 65-microsecond spacing between pulses is accomplished due to the sum of the 40- and 10-microsecond blanking from the frequency multiplier oscillator.

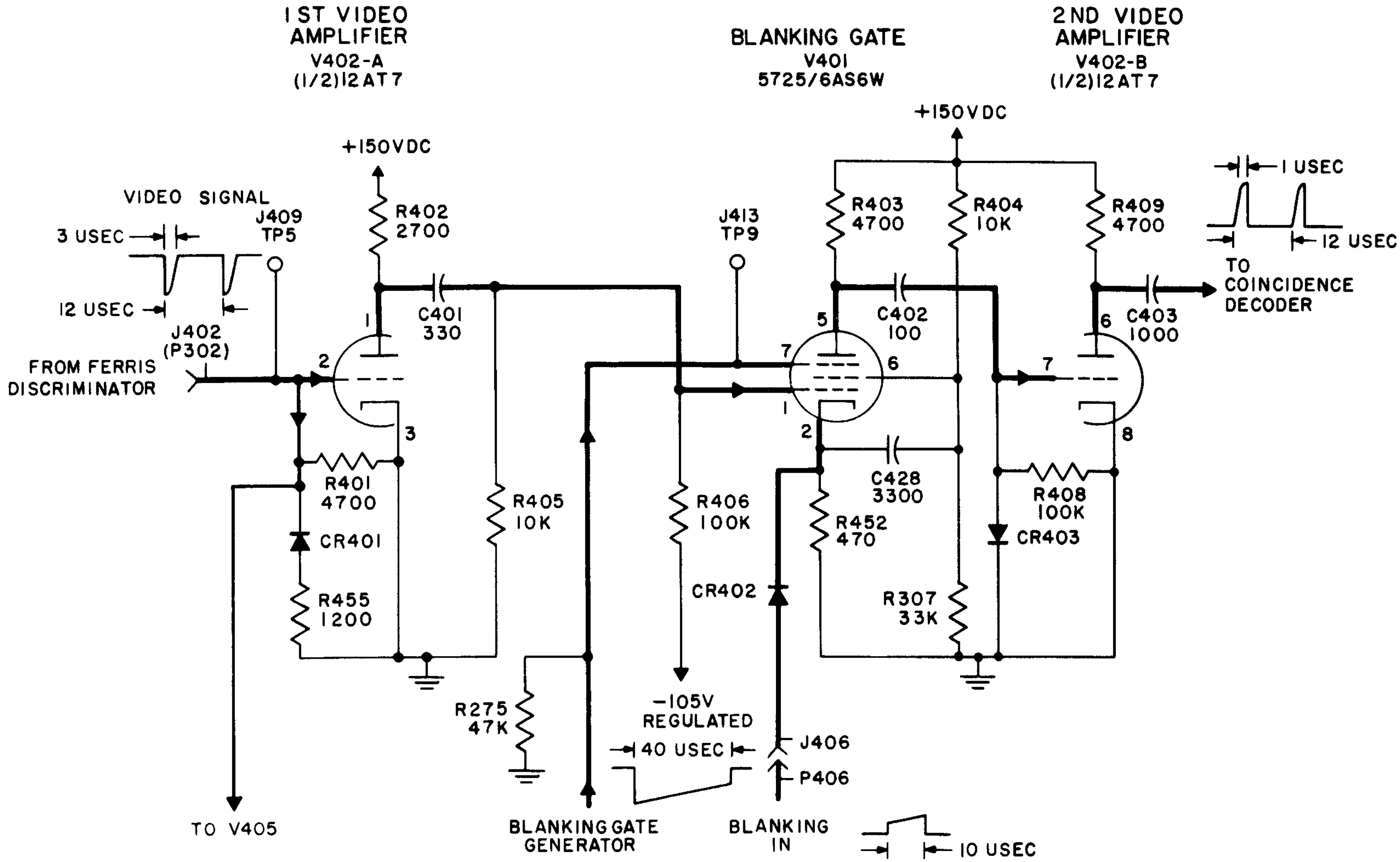


Figure 4-18. Radio Receiver R-824/URN, Video Amplifier, Simplified Schematic Diagram

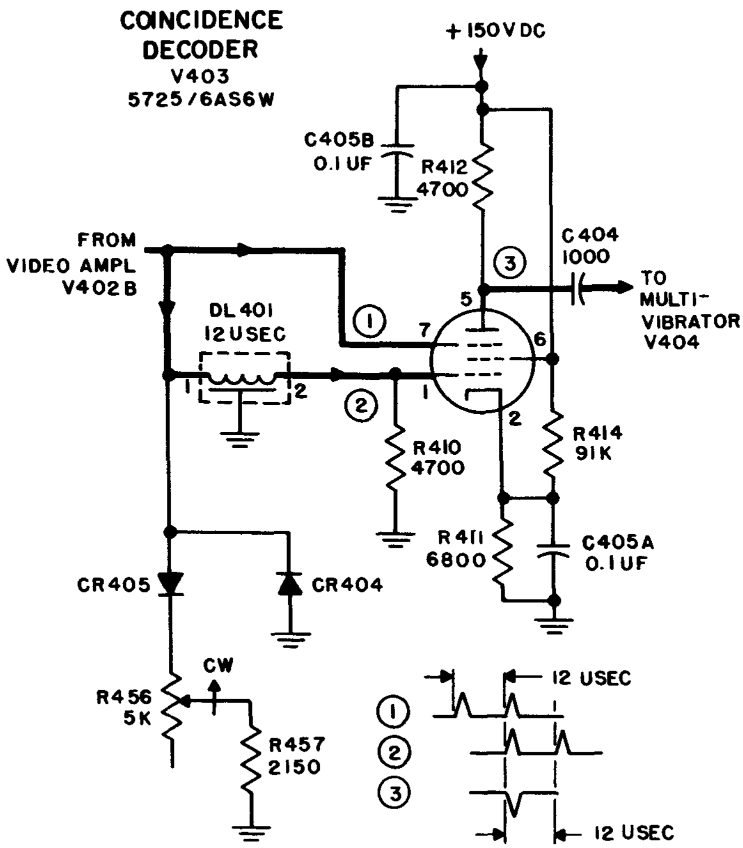


Figure 4-19. Radio Receiver R-824/URN, Coincidence Decoder, Simplified Schematic Diagram

(h) SQUITTER VOLTAGE GENERATOR. — The second output of tube V404 feeds pulse amplifier V408 (figure 4-22). Grid limiting is used in this stage to keep its output substantially independent of the amplitude of the input pulses. The output of amplifier V408 is fed by transformer T401 to the pulse stretcher and counter diode V409B.

The long time constants of the R-C networks in the plate circuit of pulse stretcher diode V409B make the voltage on the grid of tube V407A essentially dc. The cathode of tube V407A is connected through potentiometer R426 to the -105-volt source. When the bias voltage on the grid of tube V407A is the value required to effect a squitter rate of 2700 ± 90 pulse pairs per second, the voltage on the cathode, because of the drop across R426, is approximately -5 volts with respect to ground. This voltage, which is the squitter-control voltage, is applied to the grids of i-f amplifiers V301 and V302 and controls the i-f amplifier gain. If the receiver pulse output tends to fall below 2700 ± 90 pulses per second, the number of pulses fed to pulse amplifier V408 also decreases. This condition results in a lower d-c output from pulse stretcher diode V409B and a less negative bias on the grid of tube V407A. Increased current flow in this stage results in a greater voltage drop across potentiometer R426 and consequently a less negative voltage at the cathode of tube V407A with respect to ground. This reduced squitter-control voltage to the i-f amplifiers results in an increase in the level of the signal reaching the decoder. Therefore, a greater number of decodable pulses attain enough amplitude to operate the decoder and bring the receiver output back up to 2700 ± 90 pulses per second. If the pulse output tends to rise above 2700 ± 90 pulses per second, the circuit operates in the opposite manner, increasing the negative squitter-control voltage to the i-f amplifiers. Potentiometer R427 is used for squitter-voltage adjustment.

Without the application of a negative bias to the grid of tube V407A, the voltage drop across potentiometer R426 may result in application of a high positive voltage (in excess of +20 volts) to the i-f amplifiers. This would result in a complete blocking of the receiver. Therefore, tube V409A is used as a d-c clamp and prevents the voltage from rising above +5 volts while the receiver is warming up. As soon as pulses are decoded, the applied bias to tube V407A reduces the voltage drop across potentiometer R426 and the squitter-control voltage becomes negative; tube V409A then has no effect.

(i) RECEIVER OUTPUT CATHODE FOLLOWERS. —The third output of V404 is to cathode follower stage V405 (figure 4-20). V405 is a twin triode; one triode output is not used at this time. The

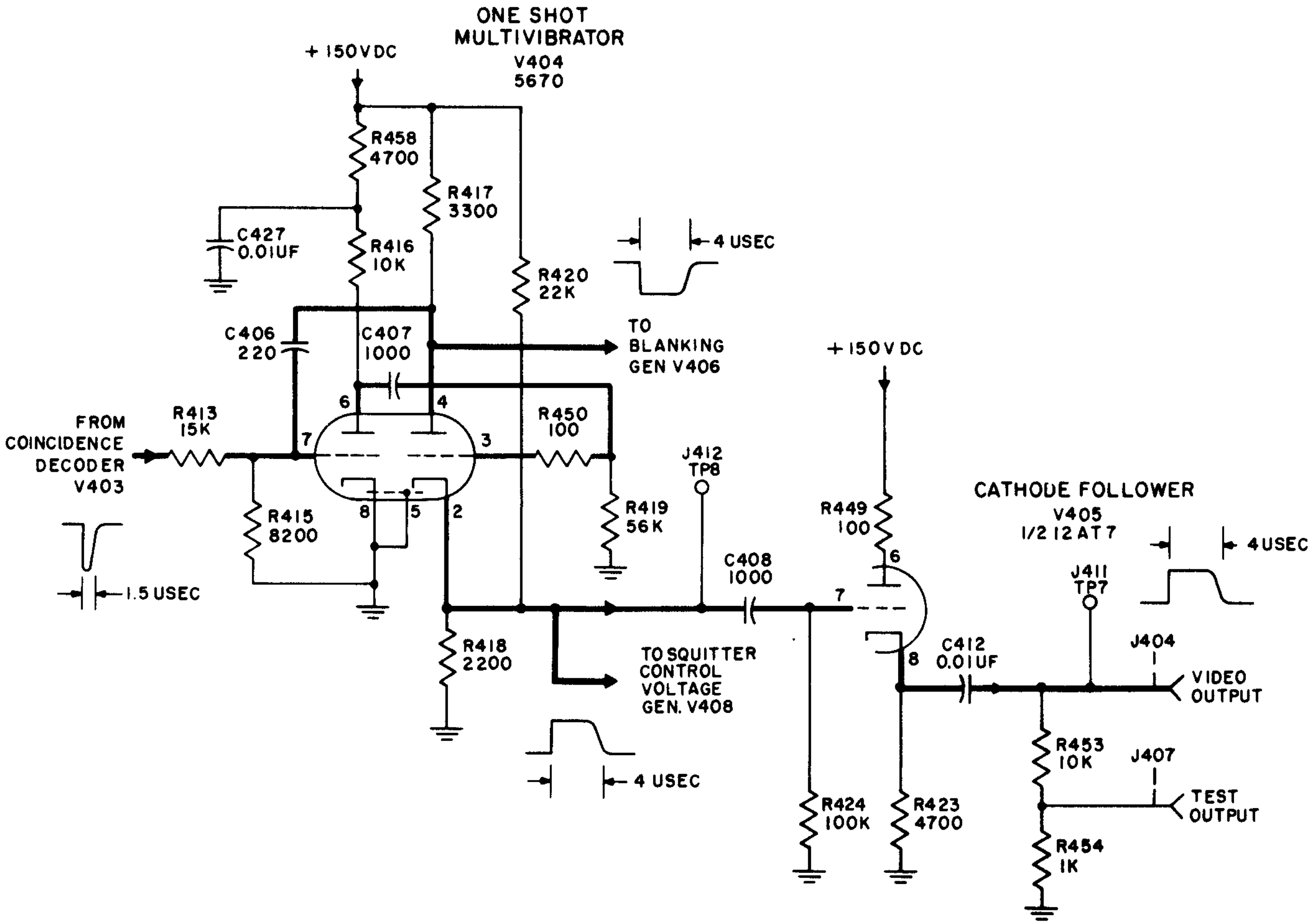


Figure 4-20. Radio Receiver R-824/URN, One-Shot Multivibrator and Receiver Output, Simplified Schematic Diagram

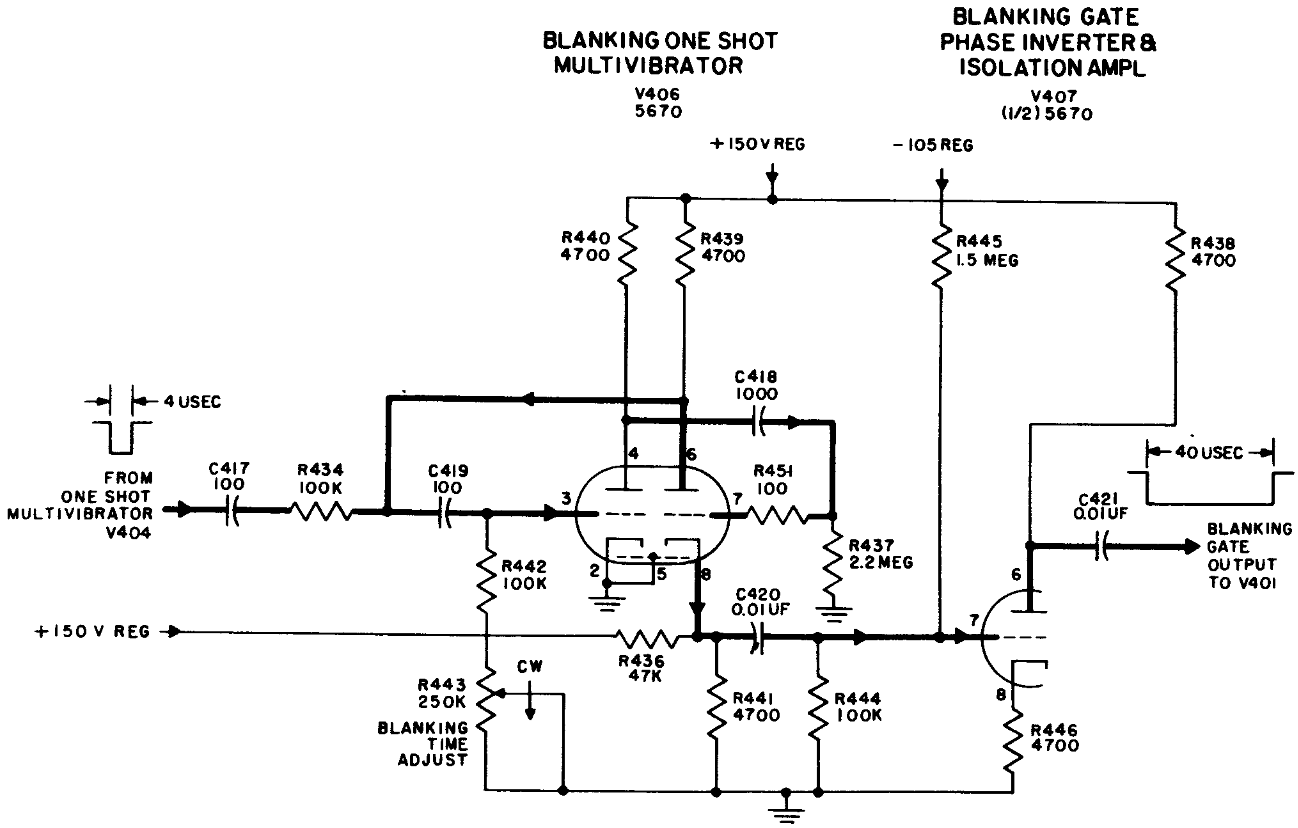


Figure 4-21. Radio Receiver R-824/URN, Blanking Gate Generator, Simplified Schematic Diagram

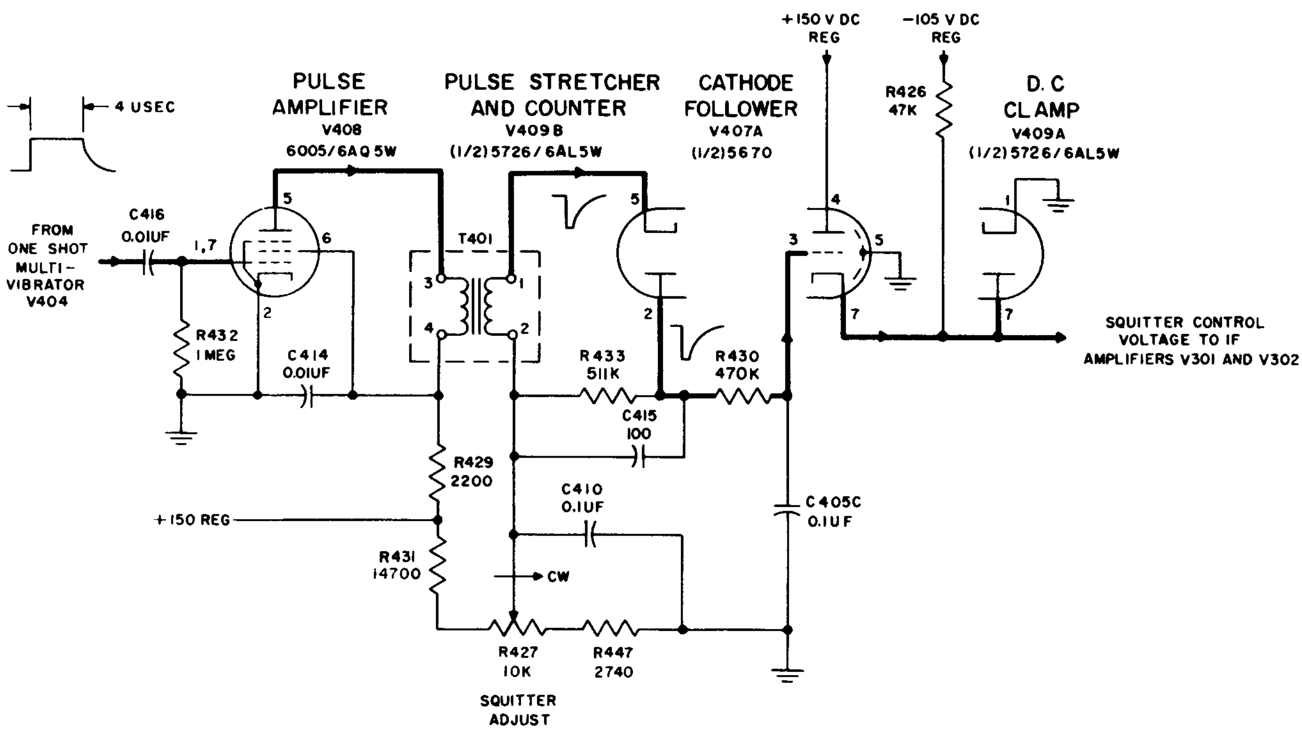


Figure 4-22. Radio Receiver R-824/URN, Squitter Control Voltage Regulator, Simplified Schematic Diagram

output of stage V405, consisting of decoded distance interrogations and random noise pulses at a 2700 ± 90 pulse per second rate with a minimum of 65-microsecond spacing between pulses, is the receiver output. It is fed through jack J404 to the input of the coder-indicator. This output can be checked at jack J411. A sample of the output is also brought out to the front panel of the receiver through TEST OUTPUT jack J507.

(2) CODER-INDICATOR KY-382/GRN-9D.

(a) 135-CPS REFERENCE BURST GENERATOR. —This stage consists of tubes V601A, V609, and V610. Figure 4-23 illustrates the 135-cps reference generator. Pulse amplifier V601A receives the trigger pulse from the 135-cps pulsing coil of the antenna system. Since its cathode is grounded, bias to pulse amplifier V601A is zero. The trigger pulses from the antenna contain both positive and negative excursions; the polarity is chosen so that the positive occurs first. When fed into tube V601A, the positive excursion is clipped; grid current produces a voltage drop across potentiometer R658, reducing the net signal at the grid to almost zero. When the trigger pulse from the antenna is negative, a sharp change in plate current occurs. This sharp change triggers multivibrator V609, which functions as a 135-cps gate. Stage V609 is a one-shot keying multivibrator which, because of the circuit constants used, has a natural period longer than the time required for the generation of six pulses by the 41.7-kc pulsed oscillator. When tube V609 is in a stable condition, tube V609B is conducting owing to B+ applied to the grid through potentiometer R663. Because of the cathode bias developed across resistor R665, tube V601A is cut off. When a positive pulse is applied to the grid of triode V609A, plate current flows, producing a negative pulse which is coupled to grid pin 2, cutting off the plate current in tube V609B. This action causes development of a positive pulse on the plate of tube V609B and a negative pulse on the cathode. The positive pulse is fed to priority gate V611 as a blocking gate, and the negative pulse keys 41.7-kc oscillator V610. Pulses originating in keyed oscillator V610 are fed back from the output of tube V606 after passing through shaping and amplitude setting circuits to the grid of tube V609A, where they appear as small negative spikes. The natural period of multivibrator V609 is determined by the time constant of the R-C circuit, ~~potentiometer~~ R663 and capacitor C625. Section V609B remains cut off until capacitor C625 charges from the B+ supply through ~~potentio~~meter R663. The feedback pulses originating in the pulsed oscillator ride on the charging curve of capacitor C625 (figure 4-24). Potentiometer R672 (figure 4-24), provides a means of adjusting the amplitude of the feedback pulses so that the sixth pulse will start tube V609B conducting and cut off the 135-cps keying gate pulse. The spacing between the 135-cps reference burst pulses is 24 microseconds at this point.

The negative keying gate from the cathode of tube V609B is applied to the grid of pulsed oscillator tube V610A, cutting off this section of the oscillator tube. When tube V610A is cut off, the ringing circuit composed of capacitors C626 and C650, and coil L602 is shock excited to produce a sine wave at a frequency of 41.7 kc to which the ringing circuit is tuned. The signal from the ringing circuit is passed through tube V610B where power amplification takes place. Capacitors C626 and C650 function as a capacitive voltage divider which feeds a portion of the signal voltage developed across ~~potentiometer~~ R790 to the grid. Although the voltage gain through a cathode follower is always less than one and signal voltage is reduced because of tapped capacitor division, sufficent feedback voltage from the cathode of tube V610B is provided to the grid circuit of tube V610B to replace tank circuit losses and sustain oscillation. Any greater feedback would drive the tube to cut off and yield a clipped output. When the negative gate on the grid of tube V610A ends, tube V610A conducts and acts as a low resistance circuit which heavily damps the ringing circuit, thus terminating oscillation. The pulsed oscillator remains in a nonoscillating condition until the next negative keying gate is impressed on the grid of tube V610A, cutting off plate current, and repeating the cycle as previously described. For each gate pulse applied to the grid of tube V410, 6 cycles of a 41.7-kc sine wave are produced. This signal is coupled through capacitor C627 and diode CR604 to the grid of tube V604A. Since only the negative portion of each cycle of the sine wave is required, diode CR604 is inserted in series with the signal path and limits the sine wave to a series of negative pulses, and, in conjunction with diode CR605, isolates the 15-cps and 135-cps pulsed oscillators.

The 135-cps reference burst pulses from the 41.7-kc keyed oscillator are amplified in reference burst amplifier V604A, the output of which is coupled to one-shot multivibrator V605.

(b) 15-CPS REFERENCE BURST GENERATOR. —The operation of this circuit consisting of tubes V601B, V602, and V603 is similar to that of the 135-cps reference burst generator. However, a 33.3-kc keyed oscillator is employed and the output consists of 12 pulses spaced 30 microseconds apart. Like the 135-cps reference burst generator, the 15-cps reference burst generator sends blocking pulses to the priority gate and passes its output through reference burst amplifier V604A to one-shot multivibrator V605.

(c) SHAPING AMPLIFIERS. —This stage consists of one-shot multivibrator V605 and triggered blocking oscillator V606 (figure 4-25). Dual triode V605 is a one-shot multivibrator which receives interrogation signal pulses from priority gate V611 and reference bursts from amplifier V604A. Triggering signal pulses to the multivibrator vary in amplitude and waveshape, while output pulses are of uniform amplitude and waveshape. The time spacing of multivibrator output pulses are an exact duplicate of the trigger pulses. In the stable condition, multivibrator V605B conducts because of a positive bias applied to grid pin 7 through potentiometer R623. Plate current through potentiometer R625 produces a positive voltage on the cathode of triode V605A, which biases this half of tube V605 to cutoff. When a

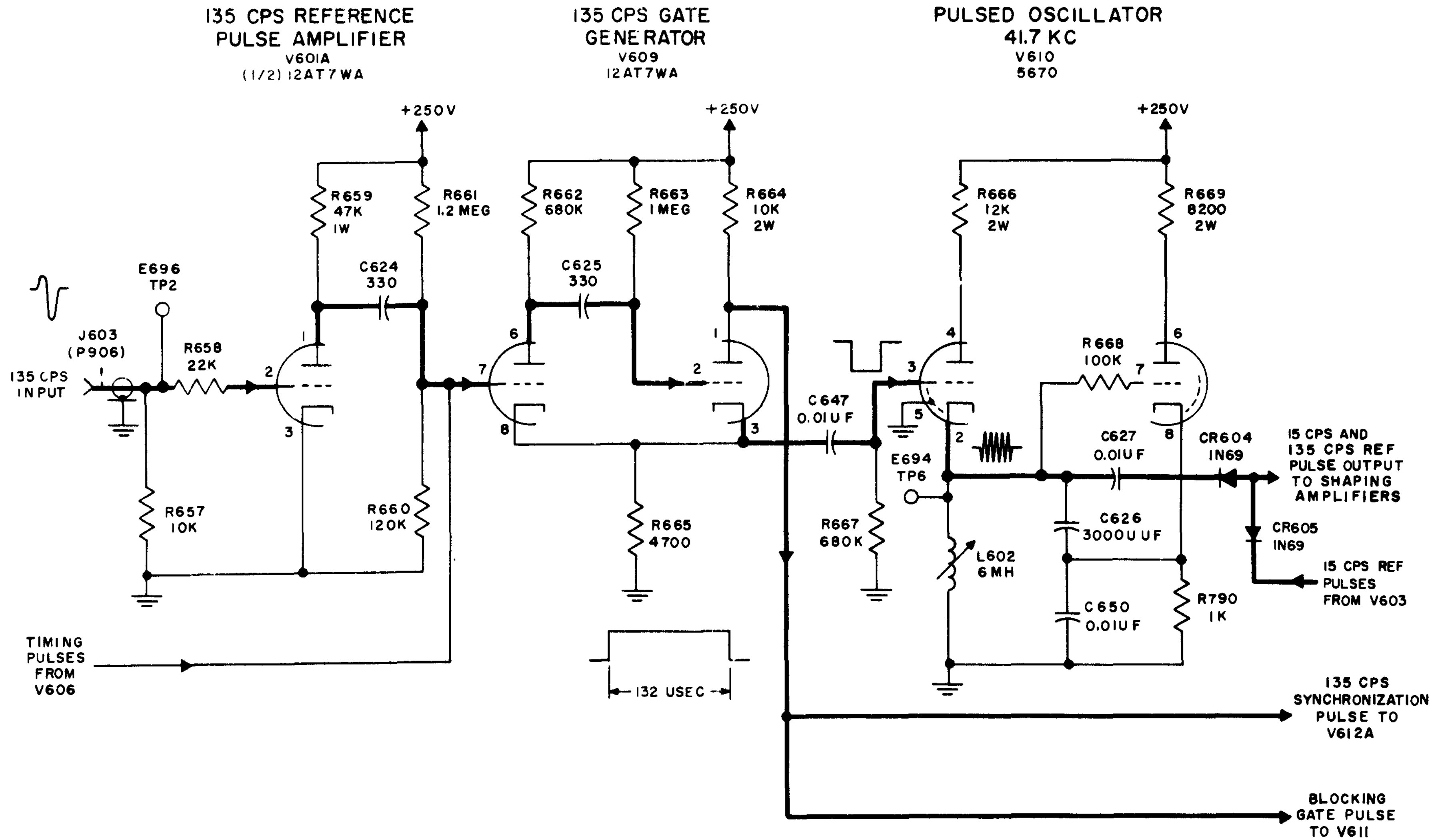


Figure 4-23. Coder-Indicator KY-382/GRN-9D, 135-CPS Reference Burst Generator, Simplified Schematic Diagram

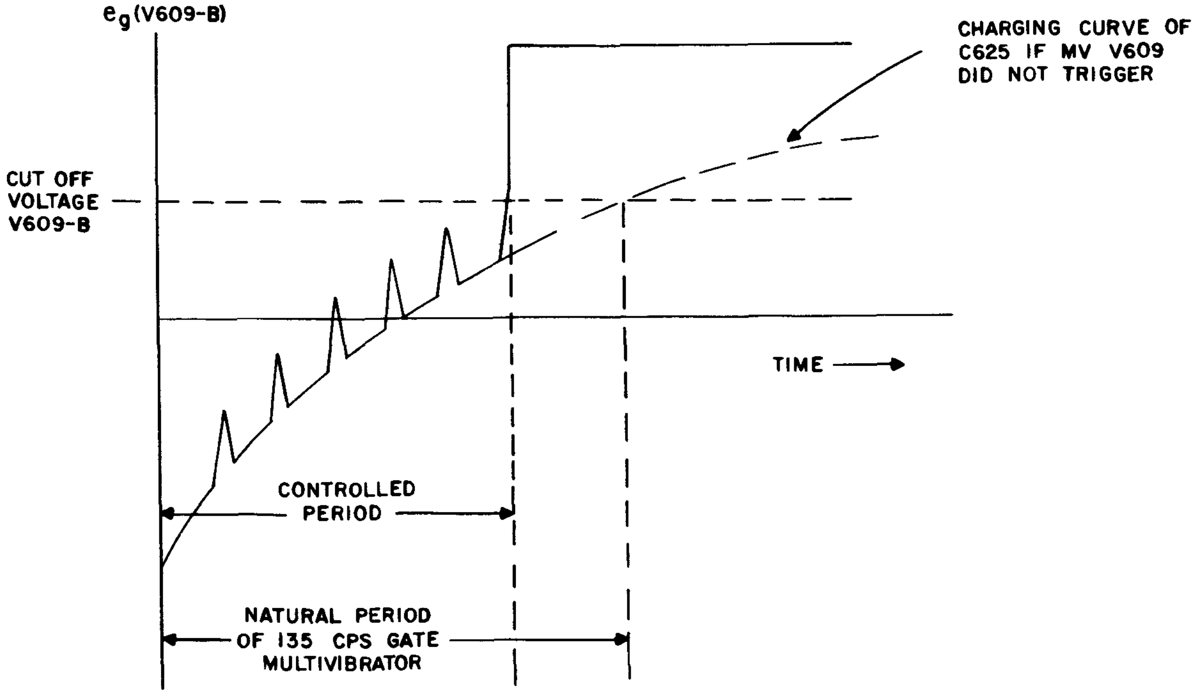


Figure 4-24. Coder-Indicator KY-382/GRN-9D, V609B Grid Voltage Curve During Charge Time of C625

positive trigger is applied to grid pin 2, triode V605A conducts and passes a negative pulse to grid pin 7 which cuts off triode V605B. Multivibrator V605 is then in the unstable condition until capacitor C611 discharges through potentiometer R623, causing grid pin 7 to go positive. Multivibrator V605 then returns to the stable condition, with triode V605B conducting and triode V605A cut off. The time required for the multivibrator to go through one complete cycle is determined by the time constant of R-C circuit, consisting of potentiometer R623 and capacitor C611. Multivibrator V605 is triggered by positive pulses from reference burst amplifier V604A applied to grid pin 2, and by negative pulses from priority gate V611 applied to grid pin 7. Negative pulses are taken from plate pin 1 of tube V605A and shaped by the network of capacitor C630 and resistors R674, R675, and R676 to provide sharp negative spikes for timing the 15-cps reference burst generator V602 as explained previously. (Negative pulses from priority tube V611 may pass through the same network to the input of tube V602 but have no effect on the multivibrator because triode V602A is already biased to cutoff during the time priority tube V611 is passing pulses.)

Sharp positive pulses from multivibrator V605 excite triggered blocking oscillator V606. In its quiescent stage, both sides of tube V606 are cut off by negative bias applied to both grids through voltage divider resistors R632, R633, and R634. A sharp positive pulse on the grid of triode V606A causes a pulse of plate current to flow through the primary of transformer T602. While the plate current is increasing from zero in the primary of transformer T602, the secondary of transformer T602 develops a positive voltage on the grid of triode V606B; this causes plate current to flow through triode V606B and the primary of transformer T602. This additional increase in current in the primary of transformer T602 causes a further increase in the positive voltage induced in the secondary of transformer T602 and applied to the grid of tube V606B. This action continues until the plate current of triode V606B has reached saturation and no further increase in plate current is possible. Since a positive feedback voltage is induced on the grid only while current through the primary of transformer T602 is increasing, the grid swings back in the negative direction toward its original voltage, thereby reducing plate current through triode V606B. Current through transformer T602 is now changing in a direction which induces a negative voltage on the grid of tube V606B.

This action continues until triode V606B is biased to cutoff. Potentiometers R627 and R629 across transformer T602 produce a damping effect, allowing the oscillator to operate effectively for only 1 cycle on application of each trigger pulse. Triode V606A is not actually a part of the oscillator, but primarily acts as a trigger amplifier converting sharp pulses of voltage from tube V605 into sharp pulses of current in transformer T602. The output signal of the blocking oscillator is developed across resistor R625 and is fed to the primary of transformer T603.

(d) ENCODING DELAY LINE. —The output pulses of tube V606 are coupled to delay line DL601 (figure 4-26) through transformer T603. Choke coil L604 and capacitor C614 filter out reflections from the input circuit delay line DL601. Transformer T603, an auto-transformer, matches the input impedance of encoding delay line DL601 and delivers a signal of approximately 500 volts peak-to-peak to the input of the encoding delay line.

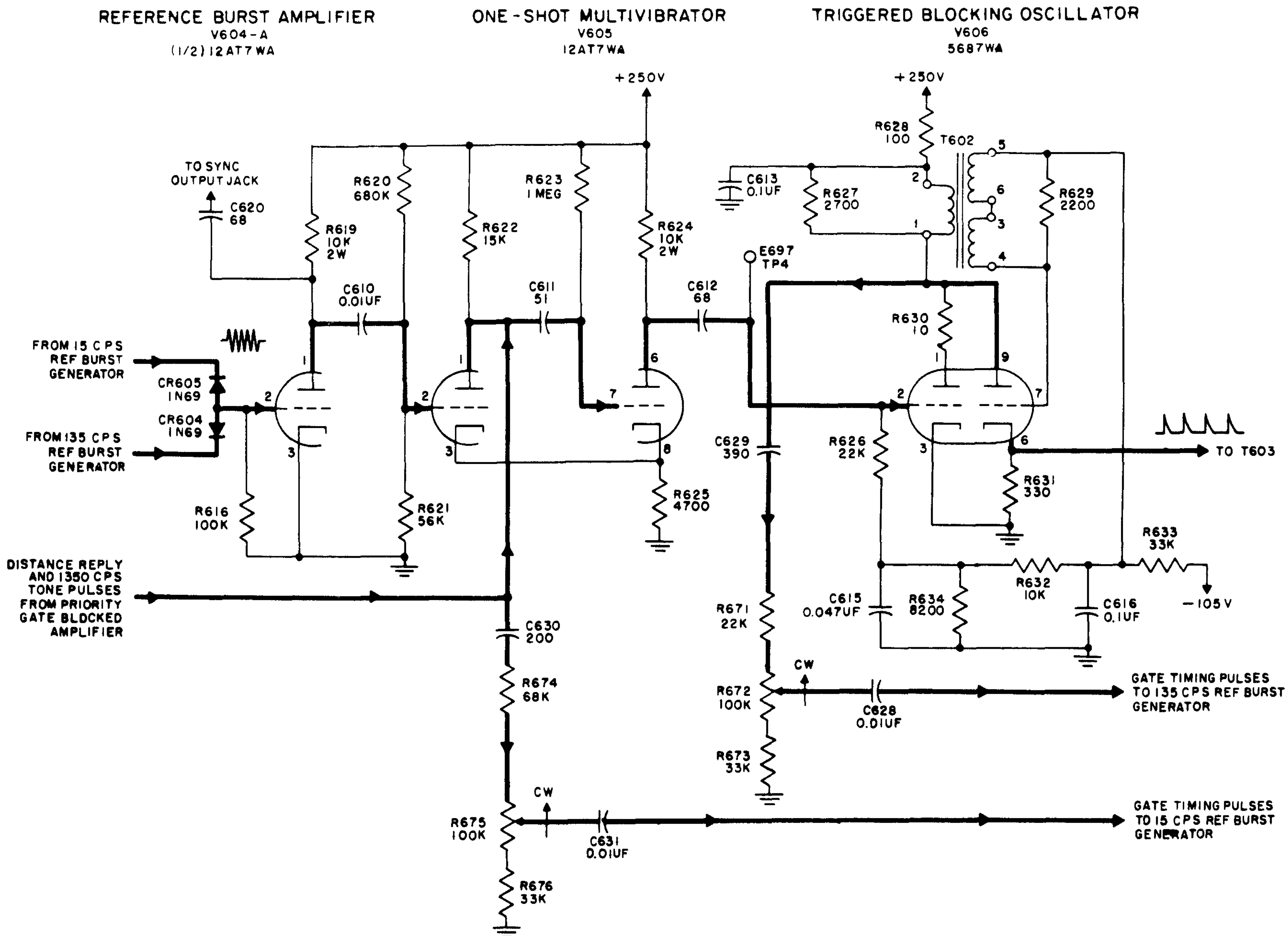


Figure 4-25. Coder-Indicator KY-382/GRN-9D, Shaping Amplifier, Simplified Schematic Diagram

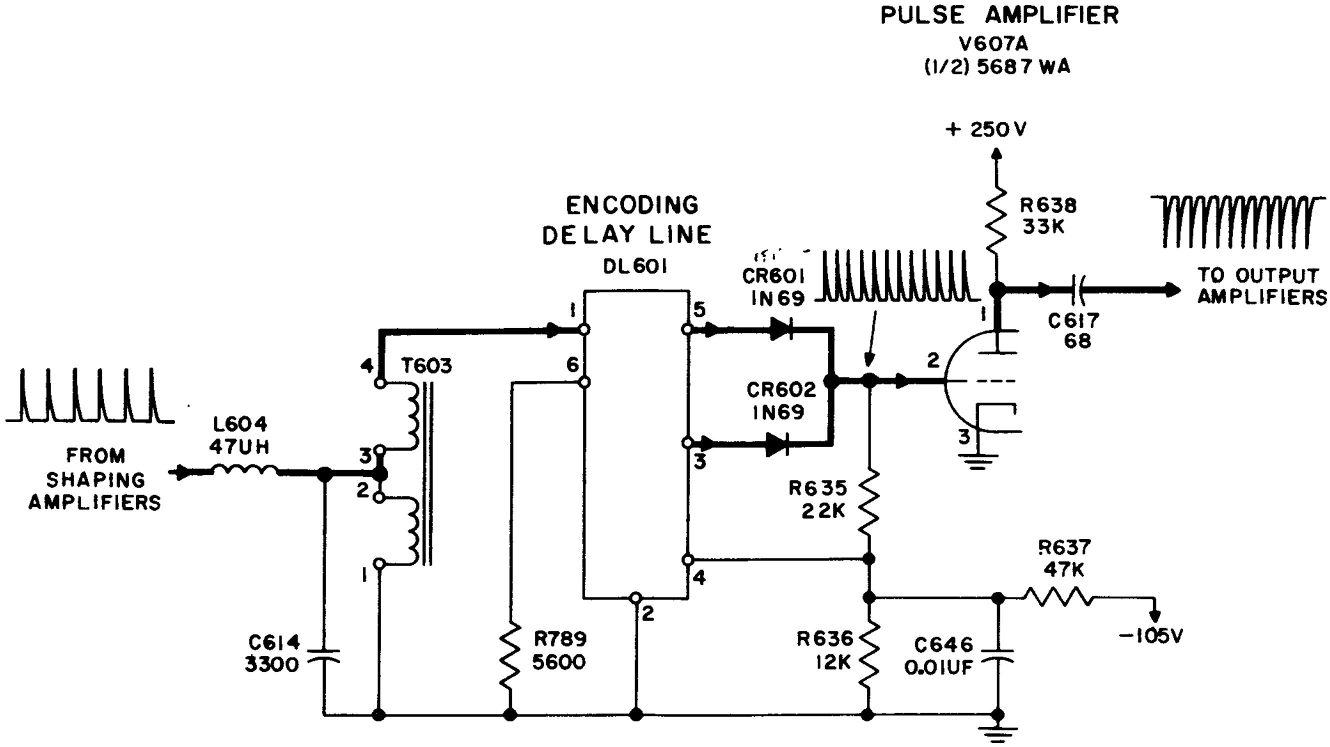


Figure 4-26. Coder-Indicator KY-382/GRN-9D, Double Encoding Circuit, Simplified Schematic Diagram

Pulses having an amplitude of approximately 15 volts peak-to-peak are tapped from encoding delay line DL601 after 32-microsecond delay and after a 44-microsecond delay. For each pulse input to encoding delay line DL601, two positive pulses spaced 12 microseconds apart are delivered to the grid of pulse amplifier V607A. Pulse amplifier V607A inverts and amplifies the doubled pulses from encoding delay line DL601.

(e) OUTPUT AMPLIFIERS. —These circuits include tubes V615 and V607B (figure 4-27).

The negative pulse output of pulse amplifier V607A is applied to one-shot multivibrator stage V615. The output of V615 consists of 1.5-microsecond pulses. Multivibrator V615 delivers one pulse to tube V607B for each pulse it receives. In the quiescent stage, because of negative bias applied to the grid of the V615B half of the multivibrator, tube V615B is cut off and tube V615A is conducting.

The application of negative pulses from tube V607A to the control grid (2) of tube V615A drives tube V615A into cutoff. Its rise in plate voltage is coupled to the grid (7) of tube V615B and drives that half of the multivibrator into conduction. The period of conduction of tube V615B is 1.5 microseconds as determined by the RC time constant of capacitor C621 and potentiometer R639. At the end of the 1.5-microsecond period, tube V615A goes into conduction, cutting off tube V615B. The multivibrator remains in this condition until the application of the next negative input pulse.

Cathode-follower stage V607B receives the uniform positive output pulse of tube V615. The positive input pulse to stage V607B causes the state to conduct. The output of stage V607B is taken off cathode resistors R649 and R650. The output of tube V607B, consisting of the north reference burst, auxiliary reference burst, identification time, distance interrogations and random noise pulses, is fed through jack J602 and plug P407 to the transmitter. The output pulses of tube V607B, which are the output of the coder-indicator, are pulse pairs having pulses 12 microseconds apart and 1.5 microseconds wide. Cathode follower V607B isolates multivibrator V615 and matches the output to the 50-ohm load which feeds the signal to the transmitter.

A portion of the output of tube V607B, taken off resistor R650, is delivered to TEST OUTPUT jack J607 on the front panel of the coder-indicator and enables the operator to examine the output of the unit.

(f) IDENTIFICATION CALL MECHANICAL KEYER. —The motor-driven code keying wheel controls the selection of either distance reply or identification tone pulses as input signals to priority gate V611 (figure 4-28).

The keying wheel, in conjunction with the code start timing cam, initiates a beacon identification coded call every 37.5 seconds. The keying wheel revolves at a speed of 8 rpm. Sections of the wheel are set farther from its center to indicate selection of a dot or dash. Each set section causes the keying

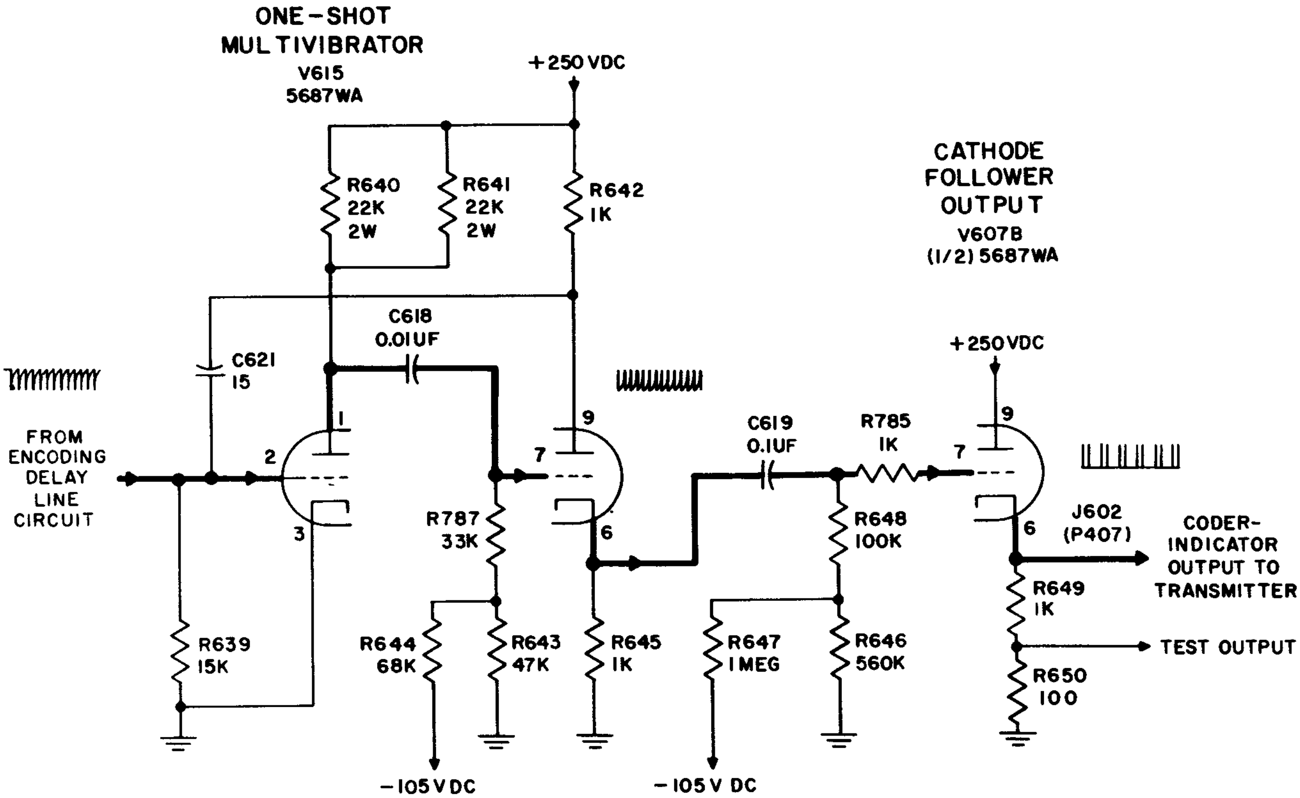


Figure 4-27. Coder-Indicator KY-382/GRN-9D, Output Amplifier, Simplified Schematic Diagram

switch S607 connection to the B- voltage divider to open.

The B- voltage divider produces, by the action of potentiometers R788 and R686, a gate potential of -50 volts whenever it is not grounded through the identification call mechanical keyer. The keying switch removes the ground connection from the B- voltage divider to initiate a dot or dash tone pulse. When the B- voltage divider is grounded, distance reply pulses are selected as the input to the priority gate.

Code start timing switch S604 is controlled by a cam revolving at 1. 6 rpm. This spdt timing switch grounds either the B- voltage divider or one side of the keying switch. The timing switch control cam is designed so that the timing switch will ground one side of the keying switch for one of every five revolutions of the code keying wheel.

With one side of the keying switch connected to ground through the timing switch, the mechanical action of the keying switch will control the application of ground potential (0 volt) to the B- voltage divider.

Both the keying switch and the timing switch connections from the B- voltage divider to ground must be open simultaneously to produce a code tone pulse. Therefore, no code tone pulses are possible during the time the timing switch applies ground potential to the B- voltage divider. This condition exists for the four revolutions of the keying wheel directly following each cycle initiating a beacon identification call.

Potentiometer R687 and capacitor C637 form a filter circuit that suppresses extraneous pulses generated by the make and break of keying contacts in the mechanical keyer.

From the preceding explanation, it is evident that the identification call keying wheel alternately keys the distance reply pulses and identification call tone, permitting only one of these two signals to reach the grid of priority gate V611 at any one time.

(g) GATE BLOCKED DISTANCE REPLY AMPLIFIER. —The application of either ground potential or -50 volts from the B- voltage divider controls the operation of tube V604B, the gate-blocked distance reply amplifier (figure 4-28). When the grid resistor for tube V604B is returned to -50 volts, the tube is biased beyond cutoff and therefore blocks passage of the distance reply pulses. When the action of switch S607 or switch S604 returns the grid resistor to ground, tube V604B functions as a cathode follower and passes distance reply output pulses to priority gate V611.

(h) KEYED 1350-CPS TONE GENERATOR. — The circuit consists of tubes V612, V613A, V614, and V613B and ~~capacitor~~ CR603 (figure 4-29).

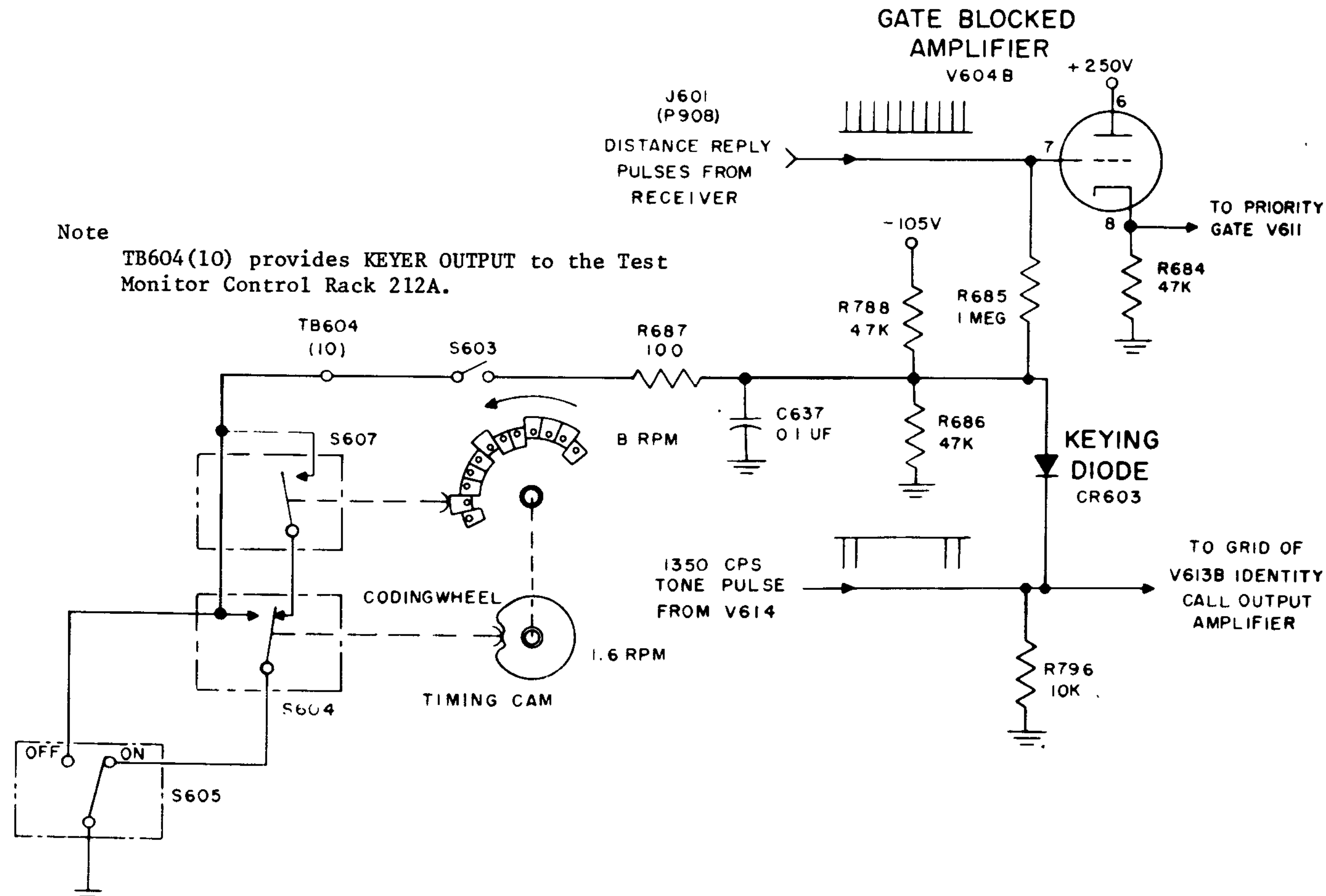


Figure 4-28. Coder-Indicator KY-382/GRN-9D, Control Function of Identity Call Mechanical Keyer, Simplified Schematic Diagram

The identification call tone of 1350 cps is generated by oscillator V612. Coil L603 is adjusted to provide the proper inductance for oscillation at 1350 cps. A positive-synchronizing 135-cps pulse from the 135-cps reference burst generator is applied to triode V612A. The plate load circuit for this tube consists of capacitors C652 and C653, and coil L603, which form a parallel resonant circuit tuned to 1350 cps, i.e., the tenth harmonic of the 135-cps pulse. The same LC combination also serves as the tank circuit for Hartley oscillator stage V612B. The output of the oscillator appears across potentiometers R692 and R693, and is coupled to tube V613A through capacitor C641.

Stage V613A amplifies and shapes the tone signal so that it can be used as a trigger for multivibrator V614. Potentiometer R798, which in conjunction with potentiometer R797 and capacitor C643 determines the period of one-shot multivibrator V614, is adjusted to provide a period of 100 microseconds. An output pulse is taken off each plate of the multivibrator and is differentiated and combined to produce sharp negative pulse pairs on the grid of identification call keyer tube V613B.

The manner in which two sharp negative pulses are obtained from each cycle of multivibrator V614 is shown in figure 4-30. Waveshape No. 1 shows the voltage changes on plate pin 6 of triode V614A as the multivibrator goes through two complete cycles, due to the application of two trigger pulses. In the quiescent state of the multivibrator, triode V614A is cut off and plate voltage is at +250 volts, the full B+ supply voltage. At the instant a trigger pulse is applied, plate voltage at pin 6 takes a sharp negative swing. This sharp negative change is passed through capacitor C645 as a negative spike as shown in waveshape No. 2 of figure 4-30. At the end of the period of multivibrator V614, the plate voltage on pin 6 changes in a positive direction until it is back to +250 volts. Since the change in the positive direction is relatively slow, a small positive pulse is passed through capacitor C645 to the grid of triode V613B as shown by waveshape No. 2. Waveshape No. 3 shows the change in plate voltage of triode V614B, which is pulsed in the positive direction during the period of multivibrator V614. A positive pulse is derived through capacitor C644 during the rise in plate voltage, and a negative pulse is derived through capacitor C644 during the fall in plate voltage. Since the change in the negative direction is very sharp as compared with

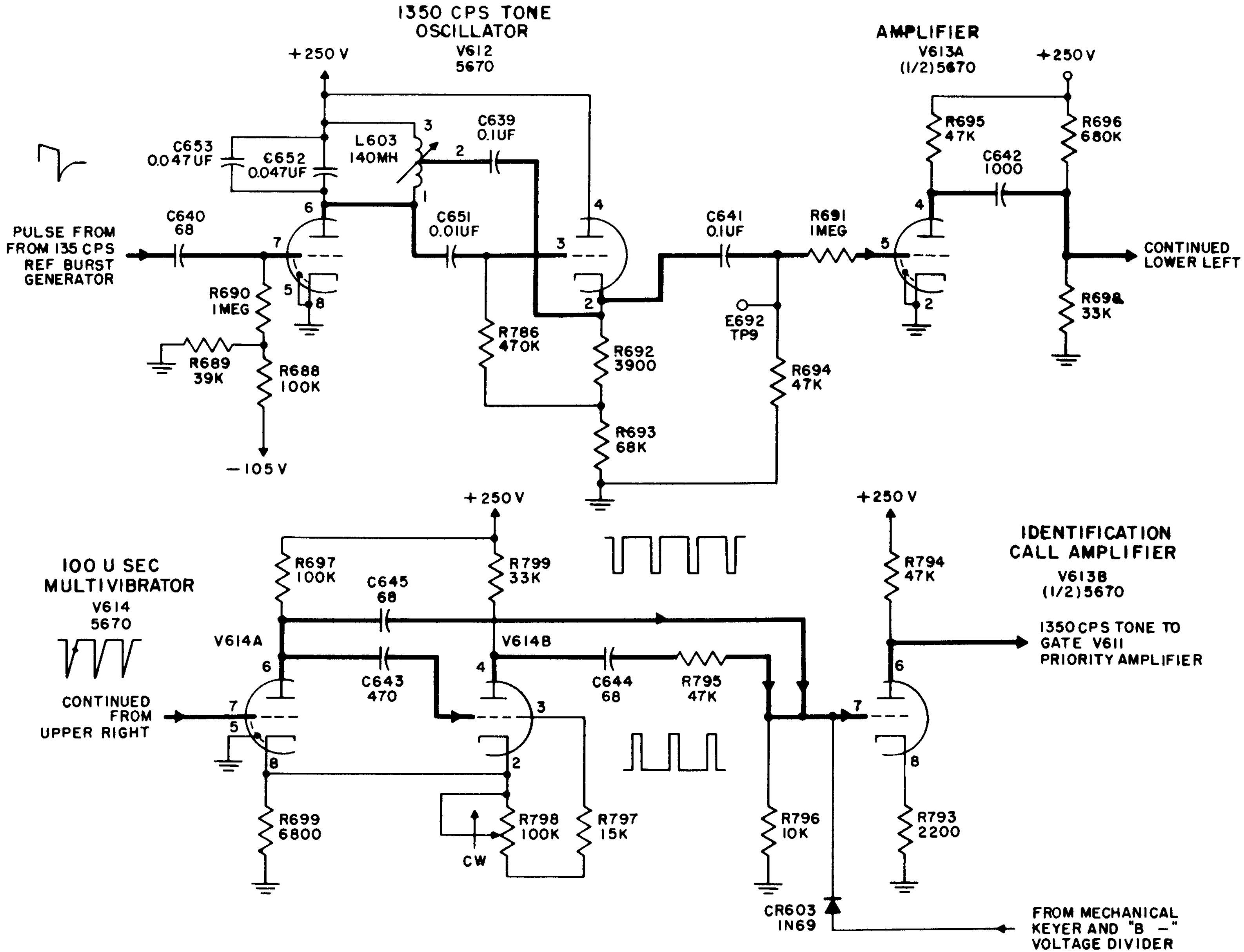


Figure 4-29. Coder-Indicator KY-382/GRN-9D, Keyed, 1350-CPS Tone Generator, Simplified Schematic Diagram

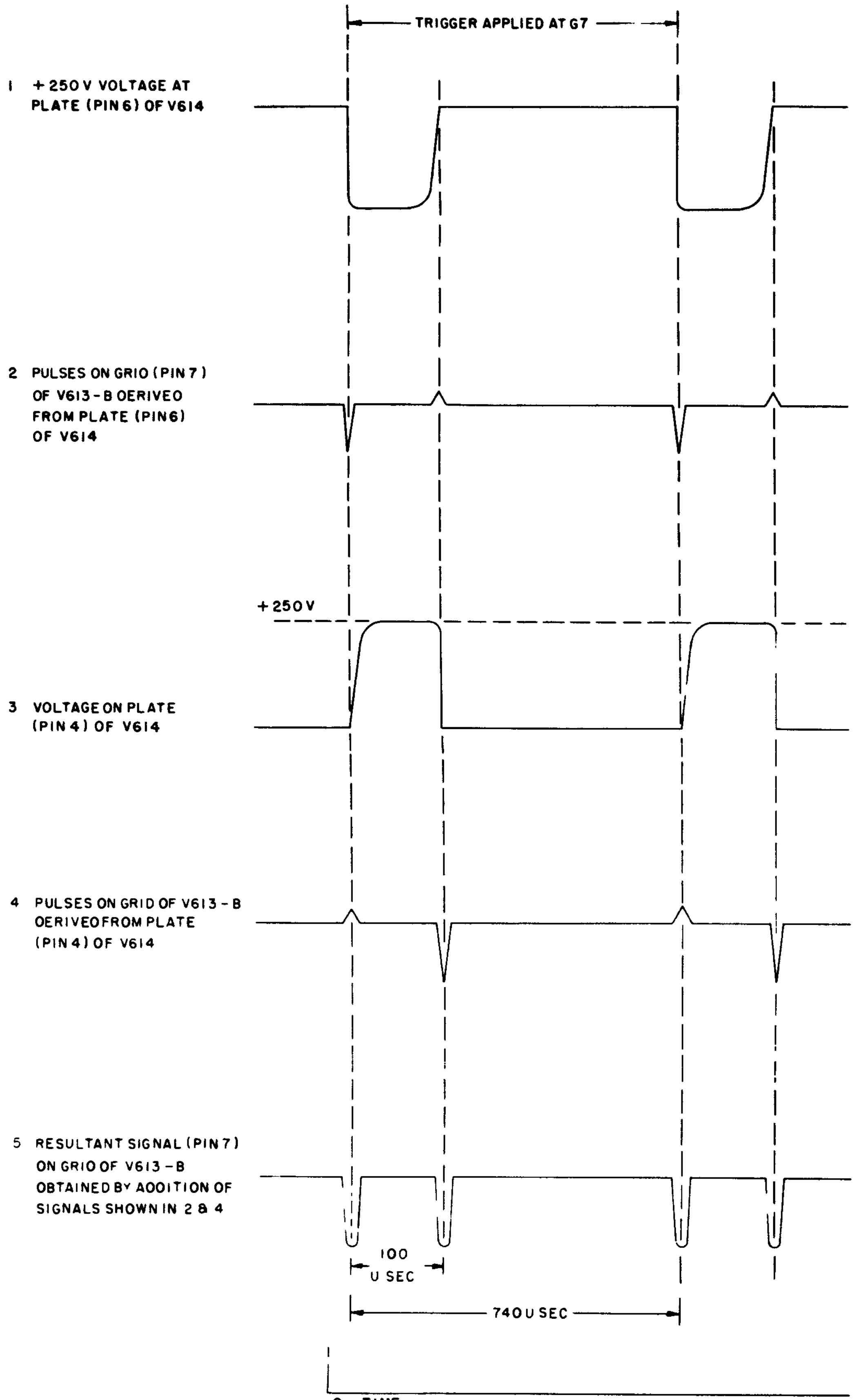


Figure 4-30. Coder-Indicator KY-382/GRN-9D, Development of Pulse Pairs on Grid of V613B

the change in the positive direction, the negative pulse passed through capacitor C644 is much larger than the positive pulse, as shown by waveshape No. 4. Waveshape No. 5 shows the signal present on grid pin 7 of triode V613B because of the addition of waveshapes No. 2 and No. 4. Each pair of pulses is separated by 740 microseconds, with the pulses in each pair separated by 100 microseconds. In this manner, a constant duty cycle of 2700 pulses per second is maintained while the tone frequency of 1350 cps is preserved in the form of pulse pairs. Clamping diode CR603 presents a low or high impedance path to ground for the identification call tone signals, depending on the position of the identification call mechanical keyer. When the microswitches in the mechanical keyer assembly are closed, ground is applied to the plate of diode CR603 through potentiometer R687. With the plate grounded, diode CR603 becomes a low impedance path to ground for negative pulses fed to the grid of tube V613B. Therefore, the tone signal is grounded out through the diode and no tone signal pulses will appear at the grid of tube V613B. When the keying wheel assembly removes ground from potentiometer R687, a negative bias of approximately -50 volts from the voltage divider, potentiometers R788 and R686, is applied to the plate of diode CR603. With -50 volts on the plate, diode CR603 will not bypass the negative signal pulses. Under these conditions, keyer tube V613B will receive and pass the 1350-cps pulse pairs to priority gate V611.

(i) PRIORITY GATE. (See figure 4-31.)— When neither reference burst gates, identification call pulses, nor distance reply pulses are present at tube V611, tube V611A has approximately zero bias and tube V611B will be at cutoff with -10 volts applied to its grid from the voltage divider, resistors R682 and R651 (figure 4-31). If only distance reply or identification call pulses appear at tube V611B, the positive input signals override grid bias, are amplified, and passed on to the shaping amplifiers. However, whenever reference burst pulses are being generated, a positive gate from the reference burst generator causes tube V611A to conduct heavily. This action causes a large voltage drop across potentiometer R681 which is the cathode bias resistor for tube V611.

This cathode bias, in combination with its fixed -10-volt grid bias, drives tube V611B so far into cutoff that the positive identification call or distance reply pulses on its grid can no longer override the cutoff bias; these signals are now blocked. Therefore, the priority of the reference burst pulses over the identification call and distance reply pulses is established.

The signals permitted to pass through the priority gate are coupled to the output amplifier circuits at tube V605. These signals are then shaped, double

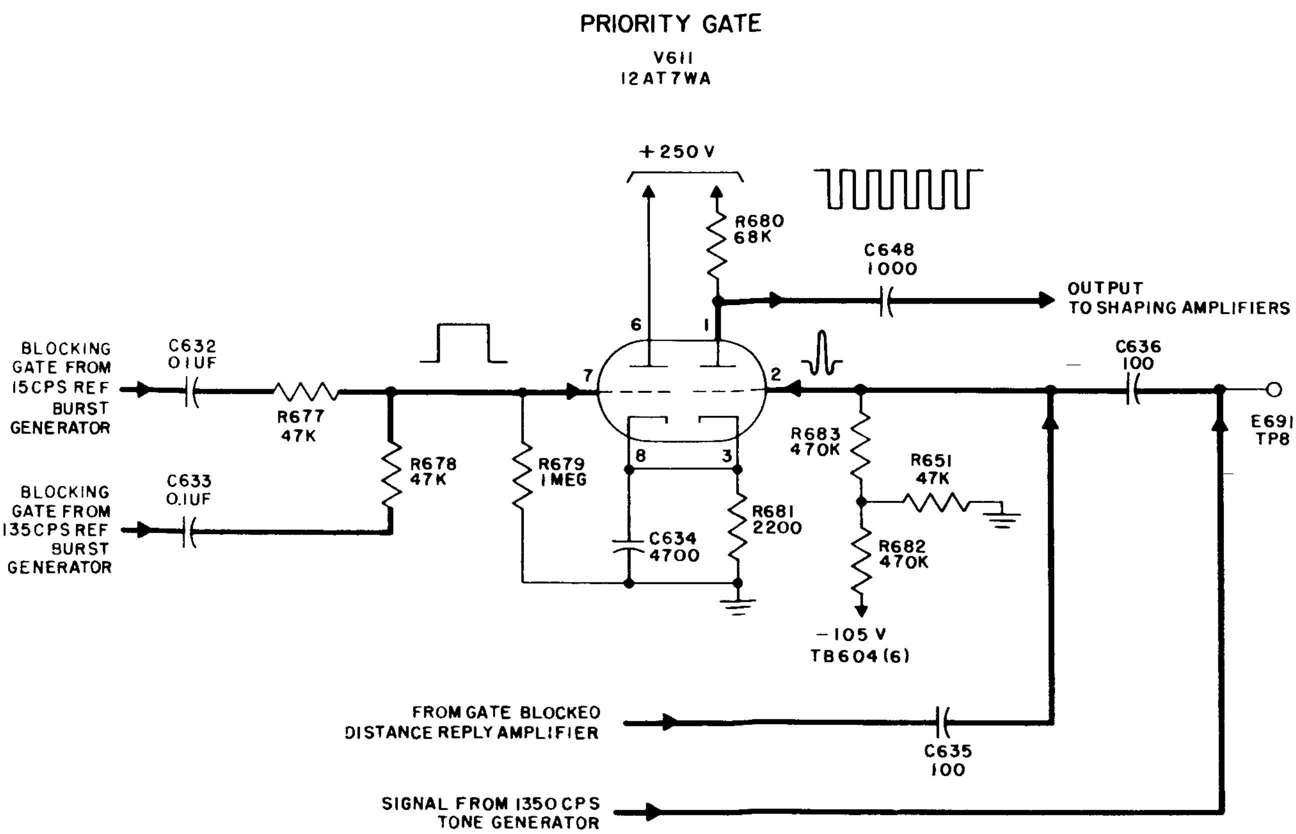


Figure 4-31. Coder-Indicator KY-382/GRN-9D, Priority Gate, Simplified Schematic Diagram

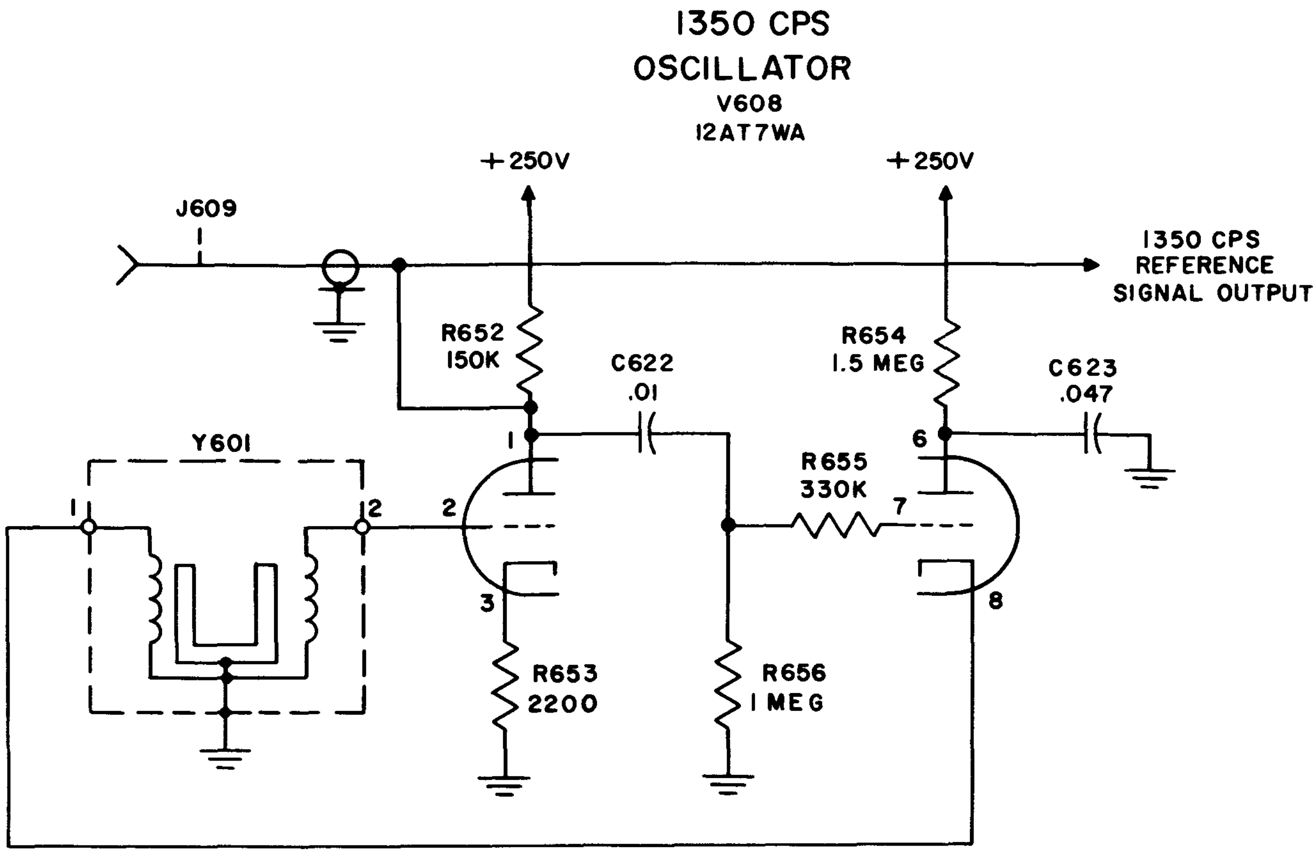


Figure 4-32. Coder-Indicator KY-382/GRN-9D, Antenna Synchronization 1350-CPS Oscillator, Simplified Schematic Diagram

encoded, amplified, and sent to the transmitter as components of a multiplexed signal as previously described for the reference burst signals.

(j) ANTENNA SYNCHRONIZATION 1350-CPS OSCILLATOR. —The frequency of this oscillator circuit is controlled by tuning fork Y601 (figure 4-32). The 1350-cps output of the tuning fork output coil is applied to the grid of tube V608A. Part of the tube V608A output is used as a 1350-cps reference frequency in checking the speed of rotation of the antenna. This voltage is coupled to tube V608B, which acts as a cathode follower with the input coil of the tuning fork as its cathode load. In this manner, the voltage generated within the oscillator circuit and fed back to the tuning fork is sufficient to sustain oscillation.

(3) TRANSMITTER.

(a) FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D. —Refer to Section 6 of this manual for complete schematic diagrams of the frequency multiplier-oscillator video chassis and r-f chassis. Figure 4-33 shows a simplified functional schematic of the transmitter output circuits described in the following paragraphs. Figure 4-34 shows the sequence of pulse formation for the radio set.

1. CARRIER GENERATING CHAIN. — The carrier generating chain, located on the r-f chassis, contains a crystal oscillator circuit which originates the radio frequency from which the transmitter carrier frequency and receiver local oscillator frequencies are derived. The oscillator circuit is a Butler or Navy-Type crystal oscillator and frequency doubler stage having an oscillator frequency output of between 40.083333 and 42.6666667 mc for the low-, or between 47.958333 and 50.541667 mc for the high-band frequencies. The low- and high-band circuits are similar except for several tuning components which have slightly different values to compensate for the difference in the frequency range to which they must tune. The following discussion refers only to the high-band circuit components. The frequency output of the following circuits is for channel 113, a typical high-band channel. The frequency output from the oscillator portion of tube V1501 is 50.000000 mc and the output from the doubler portion of tube V1501 is 100 mc.

An oscillator is basically an amplifier with a positive feedback path. Tube V1501 is a double triode connected as two separate amplifiers. Tube V1501A is a grounded grid amplifier; its input is the crystal frequency developed across potentiometer R1502. The plate circuit of tube V1501A is tuned to the oscillator frequency (50 mc); tuning is accomplished by adjustment of coil L1502. The oscillator frequency is coupled through capacitor C1504 to control grid pin 3 of tube V1501B. Triode V1501B is an harmonic generator paraphase amplifier. The cathode-follower output of triode V1501B developed across potentiometer R1503 provides regenerative feedback to the grounded grid amplifier V1501A as necessary to sustain oscillations. The frequency at which feedback takes place is established by crystal Y1501. The feedback path through the crystal is a low impedance path only at oscillator frequency.

The plate of tube V1501B is tuned to the second harmonic of the oscillator frequency (100 mc). Tuning is accomplished by adjustment of coil L1503. The output is coupled through capacitor C1505 to the second doubler stage V1502.

Coil L1501 is an r-f choke, and capacitors C1501, C1502, and C1503 are r-f bypass capacitors. Potentiometer R1501 is a decoupling resistor for tube V1501A. The combination of capacitor C1506 and coil L1504 ensures that oscillator frequency stability is maintained by cancelling the capacitive component of the crystal circuit impedance. Potentiometers R1504 and R1505 are grid leak resistors. When the TUNING meter selector is set to OSC, the oscillator V1501A grid current is fed through choke coil L1528 to the TUNING meter for checking oscillator grid current.

A frequency of 100 mc, the output of oscillator first doubler stage V1501, is fed to the control grid pin 1 of the second doubler stage V1502. Triode V1502 is tuned to the second harmonic of the input frequency. Tuning is accomplished by adjustment of coil L1509. The output frequency of second doubler stage V1502 is 200 mc and is fed to third doubler stage V1503.

Potentiometers R1507 and R1508 are grid leak resistors. The grid current is fed through choke coil L1530 to the TUNING meter for checking the first doubler output when tuning. Capacitors C1512 and C1513 are cathode bypass capacitors. Potentiometer R1510 is the cathode resistor. C1514 is a coupling capacitor. and C1515 is a screen grid bypass capacitor. Coil L1508 effectively isolates the plate from the screen while providing a d-c B+ path for the plate. Coil L1509 and capacitor C1516 form a series resonant circuit which is tuned to the second harmonic of the input frequency of second doubler stage V1502.

A frequency of 200 mc, the output of the second doubler stage V1502, is applied to the cathode of grounded grid amplifier V1503. The output of tube V1503 is coupled through tuned cavity Z1507 to the cathode of the tripler stage V1504. This circuit is tuned to the second harmonic of its input frequency by capacitors C1519 and C1522. The output frequency of this stage, the third doubler stage, is 400 mc. Coils L1510 and L1511 are r-f chokes, capacitors C1520 and C1521 are r-f bypass capacitors, and potentiometers R1511 and R1513 are cathode resistors. Cathode current is taken off potentiometer R1513, passes through choke coil L1529, and is fed to terminal 13 of jack J1509 for checking the second doubler tuning when the TUNING meter selector switch is at 2ND DOUBLER. Capacitors C1518 and C1558 are coupling capacitors. The series resonant tuned output circuit is composed of capacitor C1519, stub Z1507, and capacitor C1522.

A frequency of 400 mc, the output of third doubler V1503, is fed to tripler stage V1504, which produces an output of 1200 mc. Tripler stage V1504 employs a 2C39A lighthouse tube in conjunction with a broad band coaxial type of resonant circuit.

The third doubler output is fed to the cathode circuit of tube V1504, amplified, and appears with a large third harmonic content in the plate circuit. A coaxial line cavity is connected between the plate and grid of this circuit. The cavity is tuned by means of tuning screws. As the screws are tuned, the capacity applied across the cavity is varied, changing the resonant frequency of the grid plate circuit.

The tripler signal is picked up by loops connected to the grid line. Tripler stage V1504 has two outputs; one is fed to the mixer stage of the receiver to be used as the receiver local oscillator signal and the other is fed to the cathode of first r-f amplifier V1505.

Physically, the grid plate cavity of tripler stage V1504 consists of a concentric line. The shell and the anode cap capacity coupled to it form the outer conductor. The grid line forms the inner conductor. A screw-mounted tuning ring fits into the cavity shell. As the screw is turned, the capacity applied across the cavity is varied, changing the resonant frequency of the grid plate circuit.

Filament voltage is applied to tube V1504 through r-f chokes Z1511 and Z1512. Capacitors C1546 and C1547 are r-f bypass capacitors which effectively place the heater at zero r-f potential.

The output of this final multiplier stage is coupled to first r-f amplifier stage V1505. Circuit analysis of the r-f amplifier stage V1505 is presented in paragraph 4-3b(3)(a)3.

2. SHAPED PULSE GENERATOR. — Positive pulses from the coder-indicator video chassis are applied to jack J1401 on the frequency multiplier-oscillator chassis (figure 4-35). The pulses are 1.5 microseconds wide. This is a considerable portion of the period of multivibrator V1402. To prevent the negative-going trailing edge of the trigger pulse from affecting the operation of multivibrator V1402. crystal diode CR1402 is inserted in series with the signal path of the trigger pulse. The positive-going leading edge of the trigger pulse is passed through crystal diode CR1402 and triggers multivibrator V1402. Multivibrator V1402 is a monostable multivibrator with triode V1402B conducting during the quiescent state. The grid of tube V1402B is returned to the 250-volt B+ supply through potentiometers R1403 and R1466. The grid of tube V1402A is connected to a voltage divider consisting of potentiometers R1468. R1446, R1469. and R1407 connected between the +250- and -375-volt power supplies. With tube V1402B conducting, plate current flowing through potentiometers R1468 and R1446 causes a drop in voltage at the plate of tube V1402B and changes the voltage distribution in the voltage divider so that approximately -30 volts is

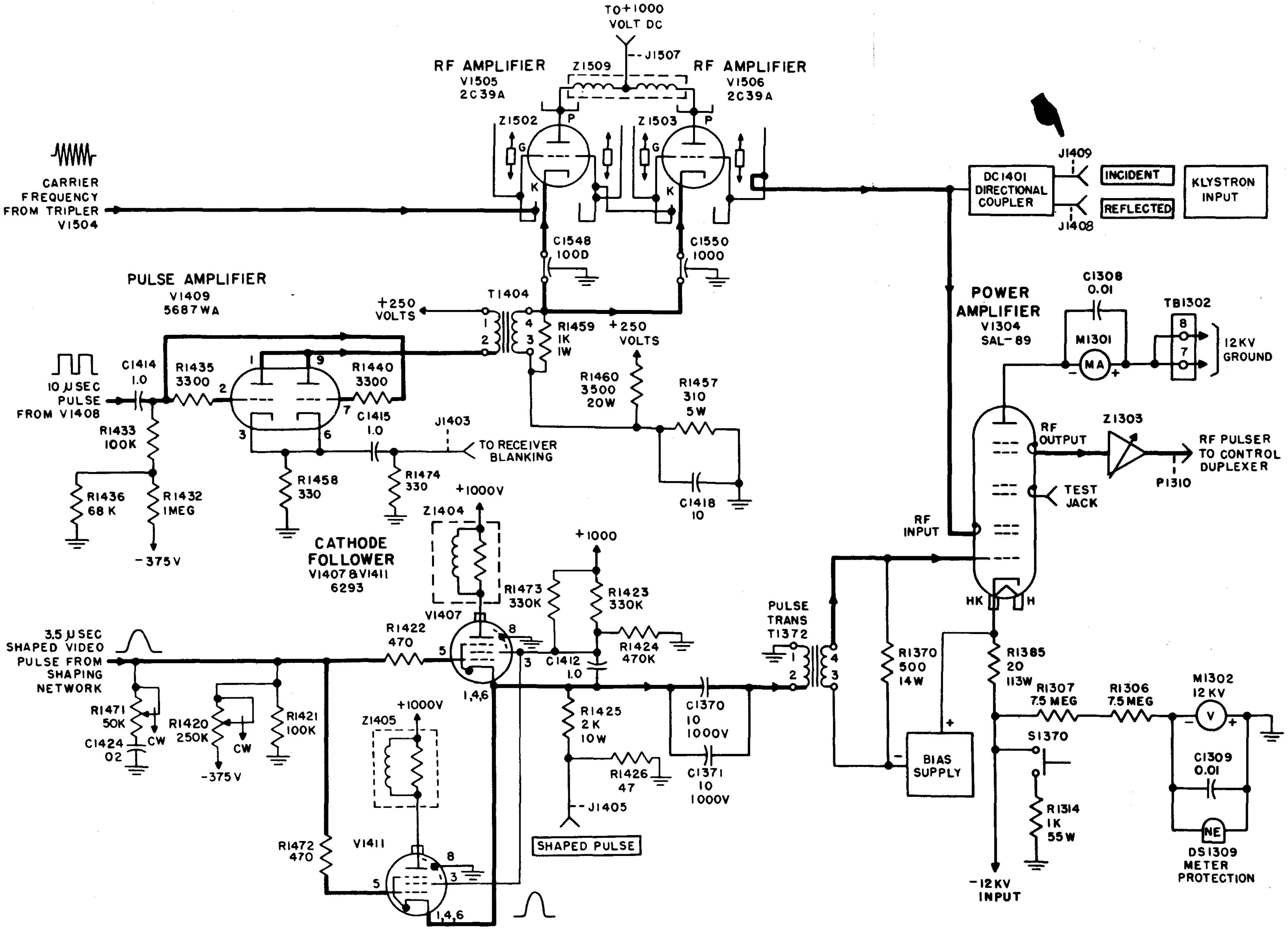


Figure 4-33. Radio Set AN/GRN-9D, Transmitter Output Circuit, Simplified Schematic Circuit

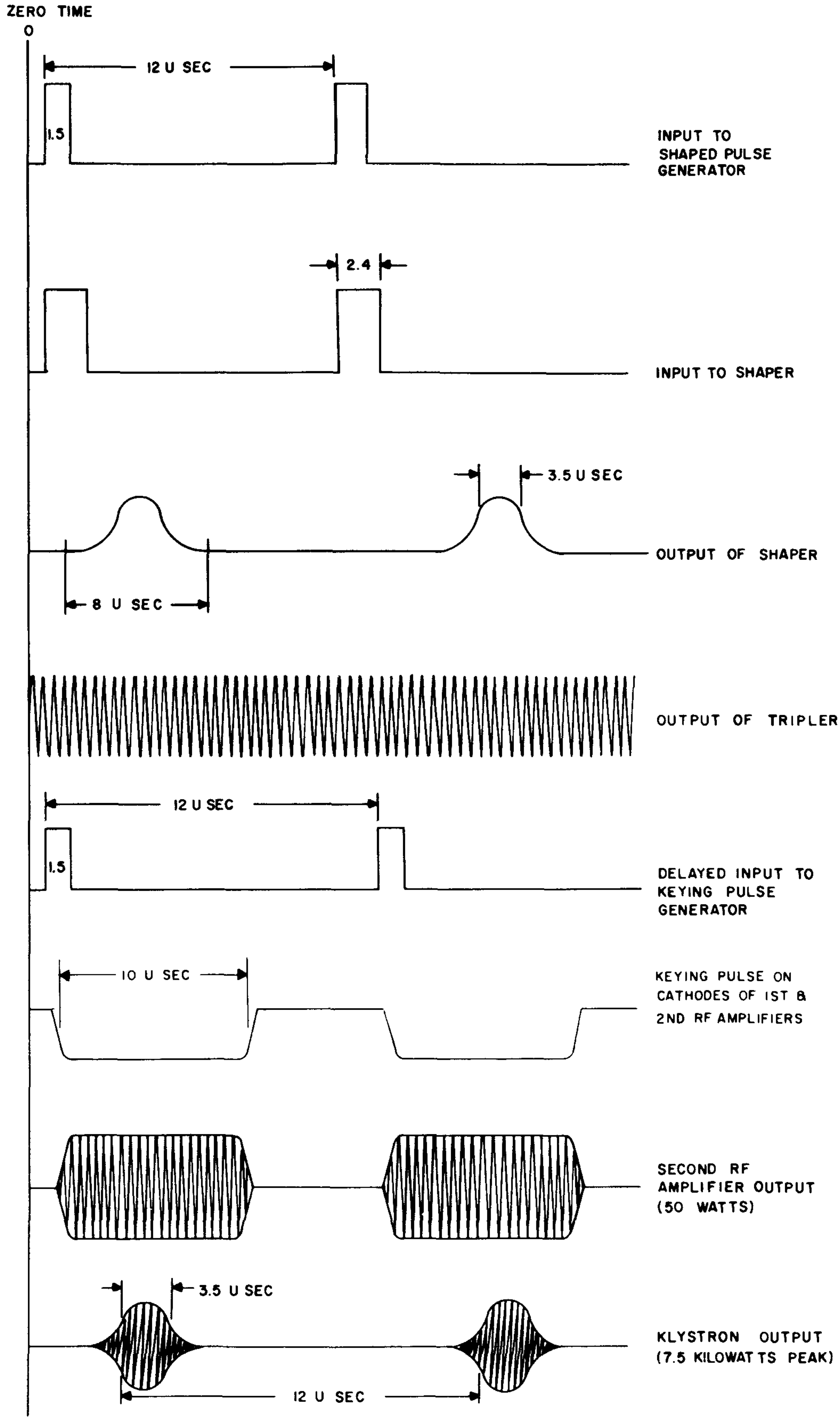


Figure 4-34. Radio Set AN/GRN-9D, Transmitter Pulse Sequence

Figure 4-35

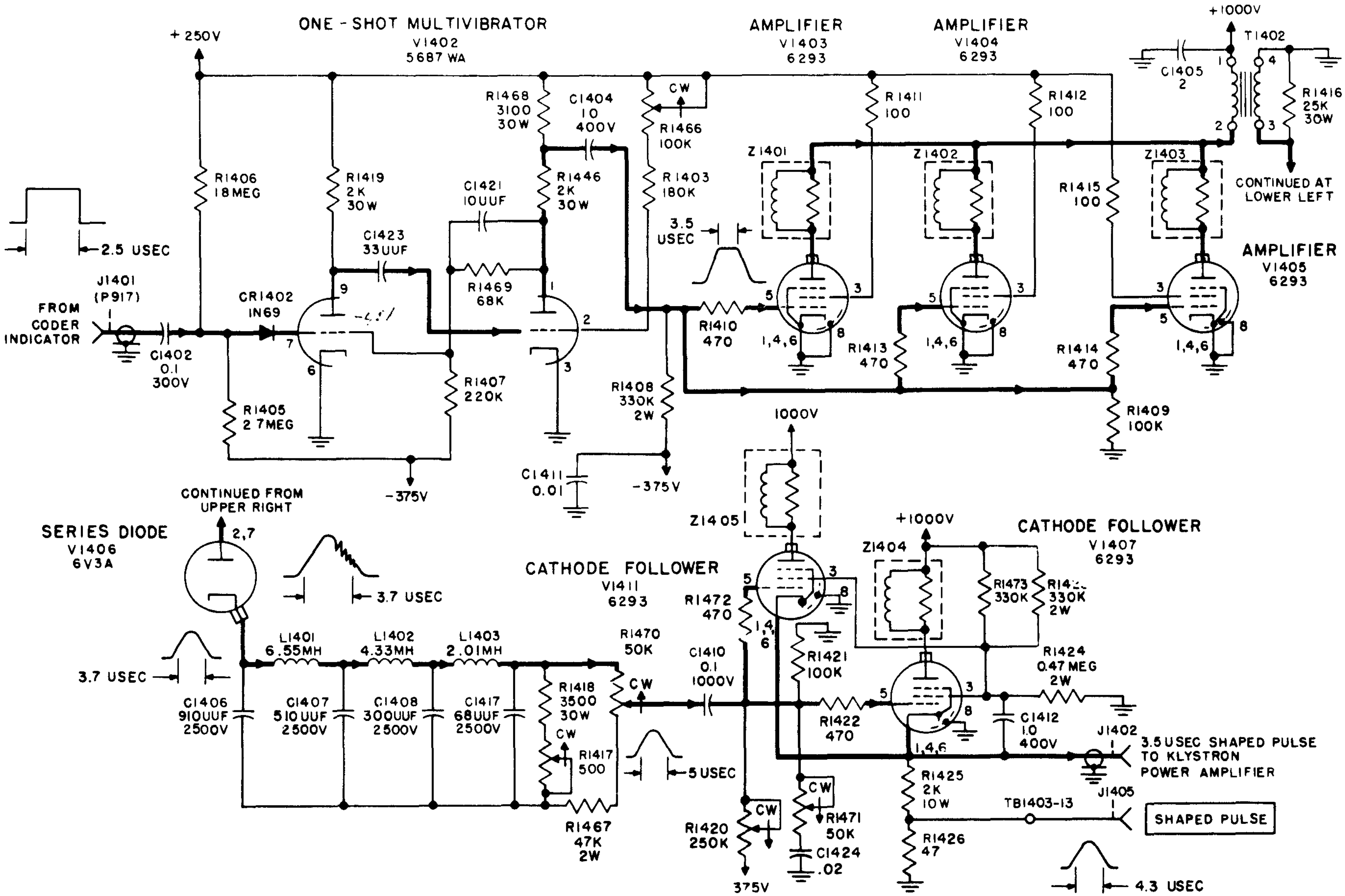


Figure 4-35. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Shaped Pulse Generator, Simplified Schematic Diagram

applied to the grid of tube V1402A. Triode V1402A is held at cutoff until positive trigger pulse is applied to its grid. A positive pulse on the grid of tube V1402A causes a negative pulse to be developed at the plate which is coupled through capacitor C1423 to the grid of tube V1402B. As the grid of tube V1402B swings negative, the plate voltage rises and a positive signal is coupled through capacitor C1421 back to the grid of tube V1402A. The positive signal fed back to the grid of tube V1402A continues the action started by the trigger pulse until tube V1402B is cut off. Triode V1402B remains cut off until capacitor C1423 discharges through potentiometers R1466 and R1403. When plate current starts to flow in tube V1402B, the multivibrator returns to its stable condition with tube V1402A cut off and tube V1402B conducting heavily. The time constant of the R-C circuit consisting of capacitor C1423 and potentiometers R1403 and R1466 determines the width of the pulse generated in multivibrator V1402 Potentiometer R1466 is adjusted to provide a square pulse approximately 2.5 microseconds wide at the output of tube V1402B.

Power amplifier pentodes V1403, V1404 and, V1405 are operated in parallel in order to obtain the high-powered pulse required to drive subsequent shaping circuits. Grid resistors R1410, R1413, and R1414, and plate networks Z1401, Z1402 and Z1403 are parasitic suppressors. Grid resistor R1408 is common to all three tubes, and is returned to the -375-volt supply to obtain enough grid bias to cut off the power amplifiers in the absence of a signal on the grid. Pulse transformer T1402 is the common plate load for the power amplifiers and provides impedance matching and phase inversion between the output of the power amplifiers and the input of the shaping network. When a positive pulse from tube V1402 is applied to the grids of power amplifiers V1403, V1404, and V1405, plate current flows through the power amplifiers and pulse transformer T1402, causing a negative rectangular pulse approximately 800 volts in amplitude to be impressed across the primary of transformer T1402. A positive pulse approximately 2300 volts in amplitude is induced in the secondary of transformer T1402 and is applied to the shaping network through series diode V1406. Potentiometer R1416 loads the secondary of transformer T1402,damping out ringing caused by the sudden collapse of the inductive field in transformer T1402 when plate current in the power amplifiers is cut off. Series diode V1406 passes the positive pulse to the shaping network while preventing negative transients in the secondary of T1402 from being passed to the shaping network. Capacitors C1406, C1407, C1408, and C1417, and coils L1401, L1402, and L1403 form a low-pass filter, which is used as the 3.5 - microsecond pulse-shaping network. Triangular pulses 3.5 microseconds wide at the input of the shaping network are reduced in amplitude and shaped into pulses 3.5 microseconds wide having a gradual rise and decay time. Control of the pulse shape at this point ensures that a minimum of r-f spectrum will be occupied by the final transmitted r-f output pulse. Potentiometers R1417 and R1418 provide the proper termination for the shaping network. Potentiometer R1417 provides a means of adjusting the terminating impedance to match the characteristic impedance of the shaping network,thereby preventing reflection in the shaping network and distortion of the pulse.

The delay time through the shaper network is approximately 2.8 microseconds. Although coils L1401, L1402, and L1403 have adjustable cores, they are set to the inductance values shown on the schematic and are not to be adjusted in the field.

Positive pulses from the shaping network are coupled through capacitor C1410 and parasitic resistor R1422 to the grid of cathode followers V1407 and V1411.

The cathode-follower output stage consists of two pentodes V1407 and V1411 connected in parallel. Operation of the two tubes in parallel causes the output impedance of the 3.5-microsecond shaped pulse generator to lower. It is essential that the shaped pulses applied to the grid of the klystron in the amplifier modulator be derived from a low impedance source. Potentiometer R1471 and capacitor C1424 form a compensating network in the grid circuit of the cathode-follower output stage. Potentiometer R1471 is adjusted to eliminate droop in the north and auxiliary reference bursts. It is required that the amplitude of any pulse in the north reference burst of 24 pulses shall not deviate from the average amplitude by more than ±2.0 percent. Any tendency toward pulse droop in the output of the radio set may be compensated for by adjustment of potentiometer R1471 to introduce enough pulse boost to equalize pulse droop.

The output output of the cathode followers, which is a specially shaped video pulse approximately 800 volts in amplitude and 3.5 microseconds wide, is fed through tube V1402 to the plates of the r-f amplifiers.

A sample of the 3.5-microsecond shaped pulse is tapped off the cathode resistance of tube V1407 and fed to SHAPED PULSE jack J1405 on the front panel of the frequency multiplier-oscillator.

3. KEYED R-F AMPLIFIERS. – Stages V1505 and V1506 are r-f amplifiers operated in cascade employing 2C39A lighthouse tubes in conjunction with a broad-band coaxial type resonant circuit. The operation of stages V1505 and V1506 is similar to that of tripler stage V1504, the only difference being that stages V1505 and V1506 are keyed. The lighthouse tube cavities are tuned by means of tuning screws (maximum output at resonance). Capacitors C1548, C1549, C1550, and C1551 are r-f bypass capacitors which effectively place the heater at zero r-f potential.

Plate current in both r-f amplifiers is cut off by a positive cathode bias of approximately 25 volts obtained from the voltage divider consisting of potentiometers R1460 and R1457 located on the video chassis of the frequency multiplier-oscillator. Negative 10-microsecond pulses from transformer T1404 are fed through jack J1509 to the cathodes of r-f amplifiers V1505 and V1506 to override the positive cathode bias and key on plate current. A constant r-f carrier signal is applied to the grid line of r-f amplifier V1505 from tripler stage V1504. The r-f carrier signal is passed through the r-f amplifiers only during the time that a negative keying pulse is present on the cathodes of the r-f amplifiers.

The r-f output signal of the frequency multiplier-oscillator, which consists of 10-microsecond pulses of r-f energy at the carrier frequency, is fed to the klystron in the amplifier-modulator drawer.

4. VOLTAGE REGULATOR STAGE V1410. —Twin triode V1410 is used as a voltage regulator to provide 150 volts B+ for the oscillator and doubler stages in the frequency multiplier-oscillator r-f chassis.

5. GATE PULSE GENERATOR. —Pulses from the coder-indicator are fed through delay lines DL1401 and DL1402 in series to the one-shot multivibrator stage consisting of tubes V1401 and V1408 (figure 4-36). The one-shot multivibrator generates one pulse 10 microseconds wide for each trigger pulse applied to the grid of tube V1408.

Vacuum tubes V1401 and V1408 form a one-shot multivibrator stage which is similar in operation to one-shot multivibrator V1402 described in paragraph 4-3b(3)(a)2. The principal difference is that the gate pulse generating multivibrator has a longer period in order to produce a 10-microsecond output pulse. The R-C circuit, consisting of capacitor C1416 and resistors R1402 and R1465, determines the period of the one-shot multivibrator. Resistor R1465 is adjusted to set the output pulse width at 10 microseconds. Both sections of the one-shot multivibrator consist of twin triodes connected in parallel to ensure conservative operation of tubes V1401 and V1408.

Cathode-follower stage V1409 consists of a twin triode with both triodes operating in parallel. Pulses from the plate of tube V1401 are coupled to the grids of tube V1409 through capacitor C1414 and parasitic suppressors R1435 and R1440. Approximately 25 volts of negative bias is applied to the grids of tube V1409 from a voltage divider consisting of potentiometers R1433 and R1436. Pulse transformer T1404 is the plate load of tube V1409, coupling the 10-microsecond output pulse from the plate of tube V1409 to the cathodes of r-f amplifiers V1505 and V1506. Potentiometers R1460 and R1457 serve as a voltage divider on the 250-volt d-c bus, and provide a source of positive bias voltage which is fed through the secondary of transformer T1404 to the cathodes of r-f amplifiers V1505 and V1506. Capacitor C1418 provides a low impedance path to ground from terminal 3 of T1404 for 10-microsecond pulses induced in the secondary of transformer T1404. A second output from tube V1409 is taken off the unbypassed cathode resistor R1458 and fed to the receiver video amplifier to provide a 10-microsecond blanking pulse. This blanking pulse will cause the receiver to be disabled during transmission of r-f output pulses to ensure that transmitted energy will not be routed back into the radio beacon.

(b) AMPLIFIER-MODULATOR AM-1701/URN. —The amplifier-modulator (figure 4-37) consists of r-f power amplifier V1304, a regulated bias supply, and associated control circuits. R-f power amplifier V1304 employs a klystron (SAL-89), which is a three-cavity amplifier having a control grid used to intensity-modulate the klystron beam current, and an r-f input jack in the first cavity used to velocity-modulate the klystron beam current. A constant negative potential of 12 kv is applied to the klystron cathode. Klystron beam current is cut off by approximately 120 volts of negative bias developed in the regulated bias supply and fed to the klystron control grid through the secondary of pulse transformer T1372. Shaped 3.5-microsecond pulses from cathode-follower stage V1407 and tube V1411 in the frequency multiplier-oscillator are fed to the primary of pulse transformer T1372. Positive pulses from the secondary of pulse transformer T1372 are applied between the control grid and cathode of klystron V1304, causing the klystron to conduct beam current. The instantaneous value of beam current is directly proportional to the instantaneous voltage of the 3.5-microsecond shaped pulse. In this manner, the flow of beam current is intensity-modulated by the 3.5-microsecond shaped pulse on the klystron grid. As the klystron beam current passes through the first resonant cavity of the klystron, it is velocity-modulated by the 10-microsecond r-f pulse fed into the r-f input jack on the klystron input cavity.

The output of the klystron, consisting of specially shaped r-f pulses having a minimum peak power of 11 kw and a repetition rate identical to the repetition rate of the pulse train at the output of the coder-indicator, is fed to cavity Z1303. Double-slug tuner Z1303 provides a means of matching the output impedance of the klystron with the impedance of the transmission line filters Z1156 or Z1157 in the control-duplexer. The r-f output signal is fed, via coaxial line, from the amplifier-modulator to the control duplexer. The regulated power supply, included in the amplifier-modulator to provide negative bias between klystron cathode and grid, is a conventional series-regulated supply similar in operation to series-regulated supplies used in this equipment. In place of rectifier tubes employed in other series-regulated supplies in the radio set, crystal rectifiers CR1370 and CR1371 are used as power supply rectifiers. In addition to saving space and reducing heat dissipation, crystal rectifiers eliminate the need for filament transformers. The output of the bias supply is applied between the cathode and control grid of klystron SAL-89, with the positive terminal connected to the cathode and the negative terminal connected to the grid through the secondary of transformer T1372. As the cathode of the klystron is operated at -12 kv below ground, all components in the bias supply are insulated from ground to withstand potential differences in excess of 12 kv between components of the bias supply and ground. Power for the primary of bias supply transformer T1371 is obtained from a 120-volt secondary winding on transformer T1370, which provides filament power to the klystron. Insulation between the primary and secondary of transformer T1370 is capable of withstanding voltages in excess of 20 kv rms; therefore, bias supply transformer T1371 can be a conventional low-voltage power supply transformer having low-voltage insulation (1800-volt rms) between windings.

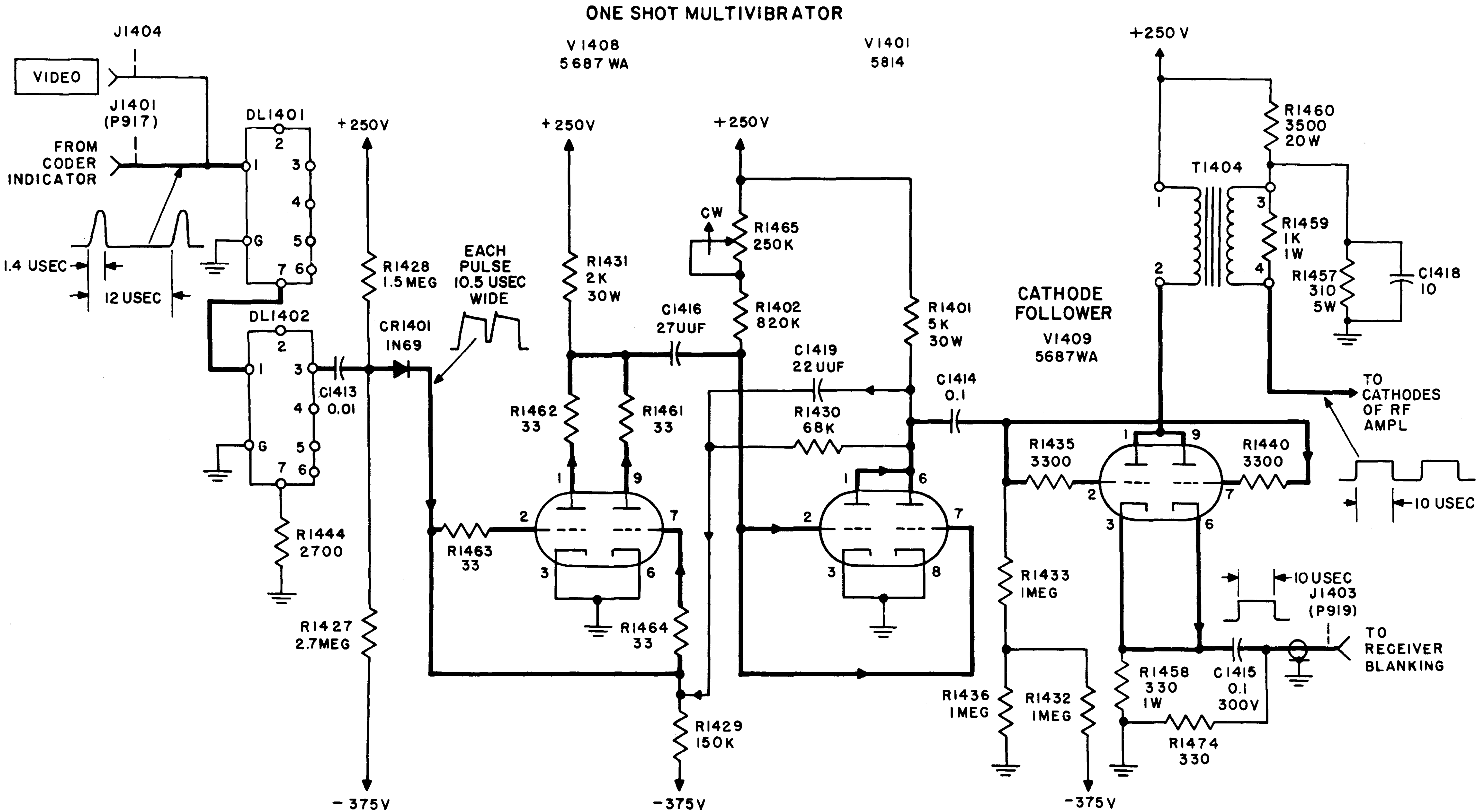


Figure 4-36. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Gate Pulse Generator, Simplified Schematic Diagram

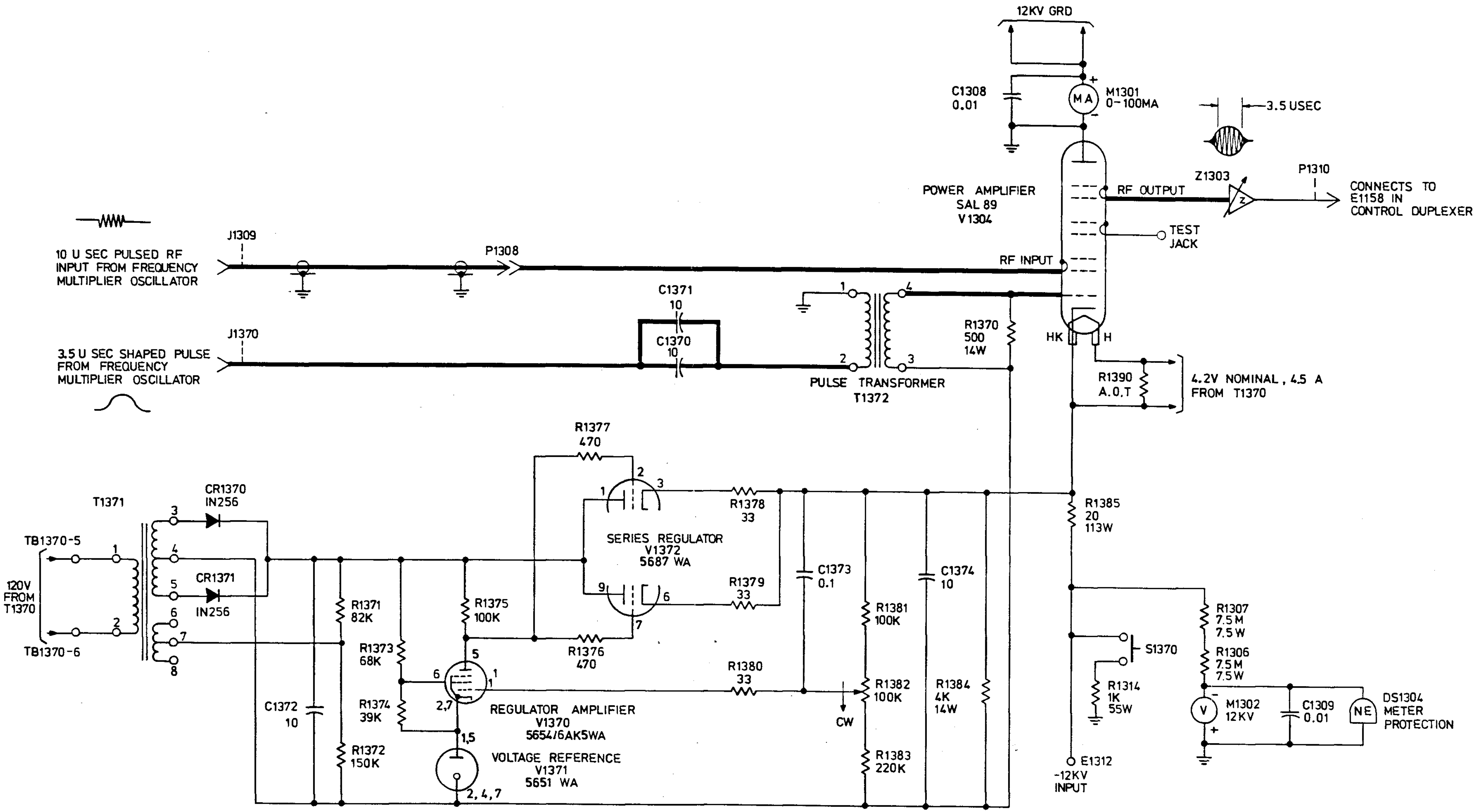


Figure 4-37 Amplifier-Modulator AM-1701/URN, Simplified Schematic Diagram

(4) CONTROL-DUPLEXER C-2226A/GRN-9. – The duplexer (figure 4-38) is a passive network which permits both the transmitter and receiver to be connected simultaneously to one antenna. Pulsed r-f transmitter output from the klystron r-f amplifier is fed to a transmission filter consisting of a pair of tunable resonant cavities critically coupled. The transmission filter is located in the line between the transmitter and the antenna, with the receiver line branching off on the antenna side of the transmission filter. The performance standards for the filter system are as follows:

(a) Signal loss at transmitter frequency, 1.4 db maximum.

(b) Response at transmitter frequency of ±0.2 mc is within 3 db of response at transmitter frequency.

(c) Response at transmitter frequency of ±0.75 mc is a minimum of 20 db down from response at transmitter frequency.

(d) Response signals are essentially completely rejected at receiver frequencies (transmitter frequency of ±63 mc).

(e) Temperature operating range from -54°C (-65.2°F) to +65°C (+149°F) (ambient).

Filter cavity operating temperature is maintained by a thermostatically controlled electrical heater system consisting of an auxiliary thermostat, a main thermostat, a blanket heater surrounding each cavity and an anticipator heater placed over the main thermostat. The system operates as follows: When first energized, power is applied to the blanket heaters but not to the anticipator heater. This minimizes warm-up time by preventing main thermostat operation under influence of heat from the anticipator heater while the cavity temperature is still below that required for normal operation. As the cavities approach operating temperature, the auxiliary thermostat applies power to the anticipator heater.

After operating temperature has been reached, the main thermostat shuts down blanket heater power. The main thermostat applies power again only after a drop in temperature but shuts down quickly due to heat from the anticipator heater (approximately 8 to 10 seconds at normal ambient temperatures).

Spaced half a wave length from the output terminal of the filter is a T-connection to which are connected the receiver preselector cavity Z1153. As the transmission filter is tuned 63 mc above or below the receiver frequency, it appears as an open circuit at the receiver frequency. From the T-junction at the transmitter, output is fed to the antenna and transmitted The preselector cavities are tuned to the receiver frequency. Therefore, signals at the receiver frequency are routed to the radio receiver while signals at the transmitter frequency are rejected. In effect, transmitter frequency signals travel from the transmitter down the line to the antenna; the receiver preselector cavities, as far as transmitter frequency is concerned, do not exist. Receiver frequency is picked up by the antenna and is routed directly to the receiver preselector cavities; the transmission filter does not exist electrically at this frequency.

Samples of the klystron incident and klystron reflected voltage are fed via directional coupler DC1151 to test jacks J1152 and J1157, respectively. In the same manner, samples of the antenna incident and antenna reflected voltages are fed via directional coupler DC1156 to test jacks J1154 and J1153. These test jacks are used during klystron and duplexer tuning as described in Section 6.

Control circuits contained in the control-duplexer are described in paragraph 4-3b(6).

(5) POWER SUPPLIES.

(a) RECEIVER POWER SUPPLY. – The receiver power supply (figure 4-39) provides regulated -105-volt dc for the video amplifier stages and regulated B+, 150-volt dc for the complete receiver. The B+ supply is regulated by tubes V503, V504, and V505. The -105-volt supply is regulated by V506.

Gas diode V505 provides a fixed negative bias for control tube V504. The voltage on the grid of tube V505 is set by the voltage divider consisting of potentiometers R506, R507 and R508 at a fixed fraction of the voltages between B+ and -105 volts. The voltage drop across the plate resistor R505 is the bias voltage for the regulator tube V503. If the B+ voltage remains constant, the voltage on the grid of tube V504 does not change, therefore the bias voltage for tube V503 remains constant. The voltage at the cathode of tube V503, because of the voltage drop across the tube, is 150 volts. If the output drops, the bias on the grid of tube V504 becomes more negative; the drop in plate current causes the voltage at the plate of tube V504 to become more positive. The bias on the grid of tube V503 becomes more positive, causing a drop in the resistance of this tube. The B+ voltage at the cathode of V503 increases, counteracting the original drop in voltage. Increases in the B+ voltage are corrected by the same principle of the variable resistance of V503.

(b) CODER-INDICATOR POWER SUPPLY.– The power supply for the coder-indicator (figure 6-22) employs a single power transformer with two separate windings for the plate and bias voltages. Stage V701 constitutes a full-wave rectifier for the plate supply voltages, and stage V702 rectifies the bias voltage.

The filter circuit of the plate supply is of the choke input type consisting of choke L701 and shunting filter capacitor C701. This type of filter network has been selected because it subjects the rectifier to less peak inverse voltage and provides better regulation.

Voltage regulation is accomplished by series regulator tube V703, amplifier V704, and regulator V705. This regulator circuit produces an output voltage which is independent of fluctuations in the a-c supply and changes in load over a wide range. The output voltage is developed across potentiometers R708,

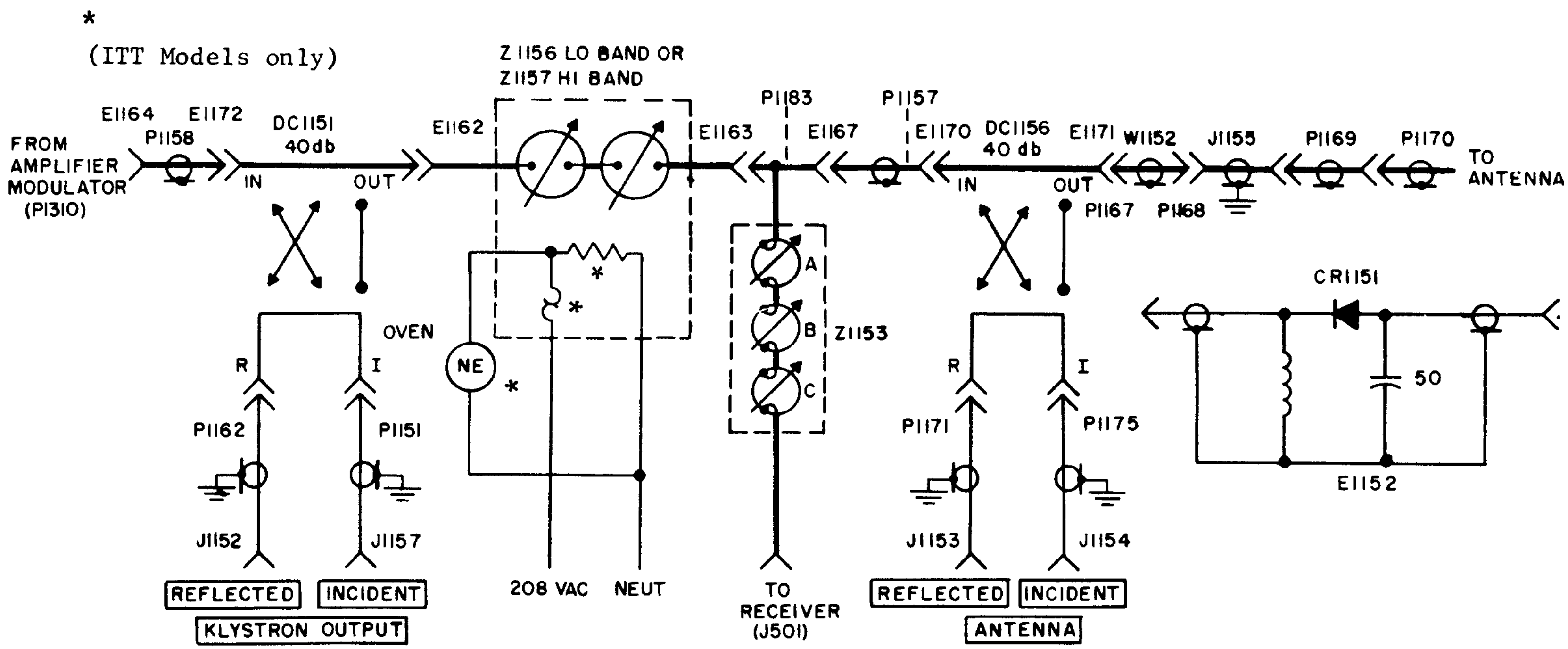


Figure 4-38. Control-Duplexer C-2226A/GRN-9, Functional Schematic Diagram

Page 4-54, Paragraph 4-3b(4), CONTROL DUPLEXER C-2226A/GRN-9D - References to the filter cavity heater system apply to the ITT models only.

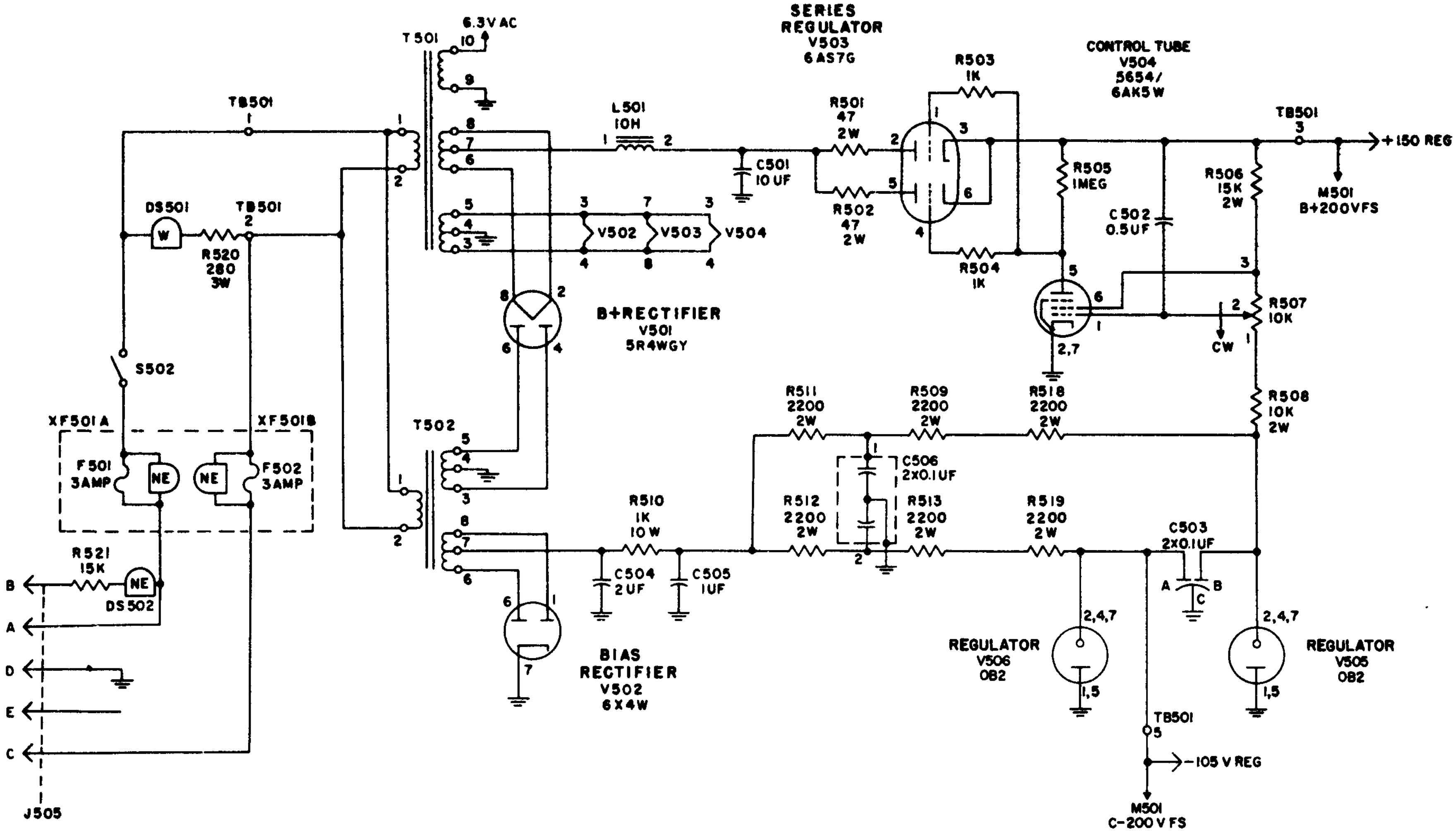


Figure 4-39. Radio Receiver R-824/URN, Power Supply, Simplified Schematic Diagram

R710, and R711 in parallel with the effective load resistance. The other resistance, through which all the load current must flow, is the plate-to-cathode resistance of vacuum tube V703. The other elements in the circuit control the resistance of tube V703 and thereby maintain a constant voltage across the load.

The cathode voltage of tube V703 is the regulated output voltage. The cathode potential of tube V703 is held at a constant positive value by grid biasing through potentiometer R710 and tube V705, and glow tube OB2. Grid potential of tube V704 is set through potentiometer R710, which is set so that the grid voltage is slightly negative by an amount (the bias) which causes tube V704 to pass a certain plate current. The magnitude of the voltage across potentiometer R705 is the bias on tube V703. Therefore, the adjustment of potentiometer R710 establishes the normal resistance of tube V703. This adjustment is used to set the value of load voltage which the regulator is to maintain.

If the load voltage tends to rise, whether from a decrease in the load current or from an increase in the input voltage, the voltage on the grid of tube V704 also tends to rise (become less negative). Tube V704 then conducts more current because the bias is smaller. A greater current flows through potentiometer R705 and causes a greater voltage drop across it; this voltage, the bias voltage for tube V703, causes the plate resistance of tube V703 to increase. A larger potion of the available voltage appears across the high resistance of tube V703, and the load voltage remains practically constant. If the load voltage tends to fall, the voltage on the grid of tube V704 also tends to fall (become more negative). Tube V704 then conducts less and a smaller current flows through potentiometer R705 and causes a smaller voltage drop across it. This bias voltage for tube V703 causes the plate resistance of tube V703 to decrease. A smaller portion of the available voltage appears across tube V703, and the load voltage remains constant.

Bias voltage is obtained from an independent secondary winding on transformer T702. Stage V702 is used as a full-wave rectifier. A T-connected R-C network is used for both filtering and for current limiting the gas regulator tube V705; a bias voltage of -105 volts results. Capacitor C703 is made large enough to have low impedance to the ripple frequency.

Warning light DS701 is prominently displayed on the chassis and warns the technician when the interlock is shorted and voltage is still applied to the power supply.

(c) LOW VOLTAGE POWER SUPPLY PP-1766/URN. The low voltage power supply unit (figure 6-24) contains two full-wave rectifiers employing tubes 5R4WGB. The rectifier plate transformers are connected to the 120-volt single-phase power by contactor K1603, operated by the control circuit. The red indicator lamp DS1603 goes on when the rectifier plate transformers are energized. Simple capacitor input filters are connected in the two unregulated d-c output circuits of the rectifiers. Two series-type voltage regulators are used. Capacitor filters are connected in the output circuits of the regulators.

Magnetic relay K1601 is connected across the -375-volt output. One set of contacts on the relay is connected in series with the control circuit to prevent the medium voltage power supply from functioning unless the -375-volt output is available. Another set of contacts on the relay closes the circuit of the green indicating lamp DS1601 when the -375-volt output is present.

The low voltage power supply contains two series voltage regulator circuits. One series regulator provides regulated +250-volt dc to the low voltage circuits in the frequency multiplier-oscillator and amplifier-modulator. This is a conventional voltage regulating circuit, employing a gas diode reference tube, two triode voltage amplifiers, and a parallel pair of twin pentodes as series regulators. As this is a common circuit, similar to other power supplies employed in this radio set, a detailed description will not be given here.

The second series regulator provides -375 volts to circuits in the frequency multiplier-oscillator and amplifier-modulator. Although this circuit has many features in common with conventional series regulators that provide a positive output voltage, there are basic differences in the first voltage amplifier stage that warrant a detailed explanation. Gas regulator tube V1613 maintains the grid of the first voltage amplifier stage at a negative potential that is a fixed voltage more positive than the output voltage. If the output voltage should go more positive or more negative, the voltage on grid (7) of tube V1612 will also go more positive or more negative by exactly the same amount. Assuming that the output voltage of -375-volt dc should go more positive due to an increase in load or decrease in line voltage, the regulator would function as follows: The voltage on grid (7) of tube V1612 will go more positive by the same amount as the output voltage. The voltage on the cathode will also go more positive but, due to the voltage divider action of resistors R1663, R1664, R1665, R1669, and R1666, the positive change in voltage on the cathode will be less than the positive change on the grid. This action will cause the bias on the grid to become more positive with respect to the cathode. As the grid bias becomes more positive, plate current will increase and cause the voltage on plate (6) and grid (2) to go more negative. As the bias on grid (2) goes more negative, plate current through that half of tube V1612 will decrease and cause the plate voltage on pin 1 to increase. Since the control grids of series regulator V1611 are connected to plate (1) through parasitic suppressors R1654 and R1655, the bias on these control grids will also go more positive. This feature will result in a reduction in the voltage drop from plate to cathode of the series regulator V1611. The output voltage of the power supply is equal to the output of rectifier V1610 minus the voltage drop across tube V1611. Therefore, as the voltage drop across tube V1611 is reduced, the output will be increased to correct for low output voltage.

If the output voltage should increase above -375-volt dc, the voltage regulator will function as explained for conditions of low output voltage except that the polarity of voltage changes will be reversed.

(d) MEDIUM VOLTAGE POWER SUPPLY PP-1765/URN. —The medium voltage power supply unit (figure 6-25) contains one full-wave rectifier employing two tubes 836. The rectifier plate transformer T1801 primary is connected to the incoming 120-volt, single-phase power by the contactor K1804, operated by the control circuit. A capacitor input filter is connected in the unregulated rectifier output circuit. A series-type regulator (figure 4-40), is connected in the filter output circuit to provide the 1000-volt output. The 1000-volt series-type regulator uses five pentodes 829B in parallel. Capacitor filter C1802 is connected in the 1000-volt output circuit of the voltage regulator. A positive 700 volts is obtained by voltage dropping across series resistors R1875 and R1876 connected to the 1000-volt regulated output bus.

The medium voltage power supply contains overload relay K1805; when an excessive current is sustained, this relay disconnects the plate voltage. Very brief transients do not trip the overload relay. This time delay feature is necessary so that large charging currents that occur when the equipment is started do not trip the overload relay.

Relay K1801 is connected across the 1000-volt regulated output. When the coil is energized, the contacts of the relay make, activating red indicating lamp DS1801 on the front panel of the medium voltage power supply unit.

The 1000-volt output is applied across potentiometer R1874 and tubes V1810 through V1814 in series. The grid bias for the series regulators is obtained in the following manner (figure 4-40): The cathode (3)

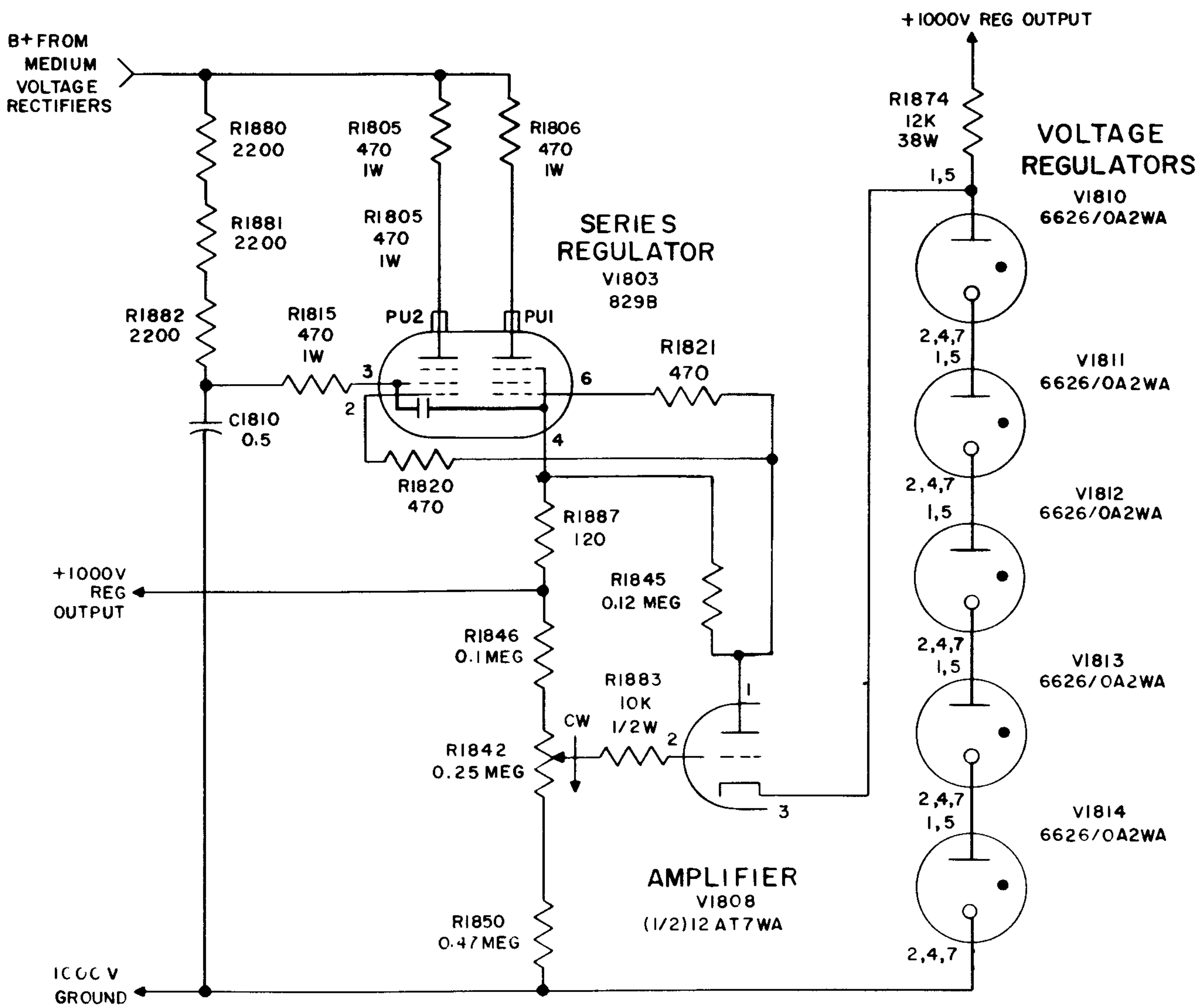


Figure 4-40. Medium Voltage Power Supply PP-1765/URN, Voltage Regulator, Simplified Schematic Diagram

of tube V1808 is kept at a constant potential by regulator tubes V1810 through V1814. The grid (2) bias is obtained from the divider network consisting of resistors R1846, R1842, and R1850. Potentiometer R1842 makes it possible to set the initial bias at the proper bias for the desired output voltage. If the load increases, the regulator input voltage decreases because of the voltage drop in the rectifier. As the voltage drop in the divider network decreases, the bias on grid (2) of tube V1808 becomes more negative, resulting in a reduction in the plate current of this tube. The reduced plate current decreases the voltage drop in potentiometer R1845 and consequently reduces the bias on series tubes V1803 through V1807, thereby lowering impedance. The reduced drop in tubes V1803 through V1807 compensates for the increased load voltage drop, and the output voltage is restored to normal. An increase in input voltage to the regulator would act in an opposite manner to increase the impedance of tubes V1803 through V1807.

The resistors in the plate, screen grid, and control grid circuits of the series tubes are parasitic suppressors.

The output of the medium voltage power supply is indicated on a voltmeter on the front panel of the frequency multiplier-oscillator chassis.

The transmitter medium voltage power supply contains overload relays so that in the case of an overload the incoming power to the medium voltage power supply plate transformer primary is disconnected. The operating point of the time delay relay K1803 circuit is set by variable resistor R1872. When an overload is sustained long enough to actuate relay K1803, contacts 3 and 4 make, energizing the coil of magnetic relay K1802. Contacts 3 and 4 of relay K1802 make, as do contacts 5 and 6; contacts 7 and 8 break. Contacts 3 and 4 of relay K1802 keep relay K1802 energized after contacts 3 and 4 of relay K1803 reopen. When contacts 7 and 8 of relay K1802 open, the holding coil of K1804 (the medium voltage power supply plate contactor) is de-energized and the medium voltage power supply is disconnected. When contacts 5 and 6 of relay K1802 make, the motor of motor-driven reclosing relay K1805 is energized. Three seconds later contact B of relay K1805 swings momentarily to the number 6 position (120-volt ac), energizing resetting relay K1806. All the contacts of relay K1806 break. When contacts T3 and L3 of relay K1806 break, the path holding relay K1802 energized is broken, and relay K1802 is de-energized. Contacts 7 and 8 of relay K1802 close, energizing relay K1804, thus restoring the equipment to normal operation. Overload reclose relay K1805 will swing contact A to the No. 5 position (120-volt ac) three times in case of a continuous overload or successive trips occurring less than 1.2 seconds after the preceding reclosure; then, contact C will open and contact A will close (No. 4 position), breaking the overload reset relay K1806 circuit and shutting down the equipment. The equipment will remain shut down until switch S1802 is manually closed. (Switch S1802 must be held closed or it returns to the open position.) The closing of switch S1802 closes contacts A (No. 5 position) and C of relay K1805. If the overload trips occur 1.2 seconds or later after each previous reclosing, K1805 will continue to reclose automatically.

(e) HIGH VOLTAGE POWER SUPPLY PP-1763/URN. —The high voltage power supply (figure 4-41) contains a three-phase, full-wave rectifier employing tubes 8020. The plate power is supplied by transformer T1001, which is mounted separately in the blower compartment of the power supply assembly cabinet. A means for reducing this plate power during the performance of the klystron-aging procedure is provided by HIGH VOLTAGE switch S1006. Connection of transformer T1001 in a delta-wye-wye arrangement depends upon the setting of this switch. If switch S1006 is set to OPERATE, transformer T001 is connected in a delta-wye arrangement; hence the secondary voltage (plate power) is equal to the product of the primary voltage and the turns ratio, multiplied by a factor of 1.73. If switch S1006 is set to BREAK IN, the transformer is connected in a wye-wye arrangement; hence the secondary voltage is equal to just the product of the primary voltage and the turns ratio.

A simple capacitor filter is connected in the 12,000-volt rectifier output circuit; the high voltage power supply does not use a voltage regulator.

The negative side of the power supply is -12 kv with respect to ground. The positive side of the power supply output is grounded through the BEAM CURRENT meter on the front panel of the amplifier-modulator chassis. Output voltage from the high-voltage power supply is fed through intercabinet cabling and applied directly to the klystron cathode as a negative potential of 12 kv which establishes the required accelerating potential between the klystron cathode and plate. Resistor R1918, which is connected between the positive side of the high voltage power supply and chassis ground, is a voltage-sensitive resistor. This resistor provides a path to ground for the positive side of the high-voltage power supply in case an open occurs in the circuit from the positive side of the power supply through the BEAM CURRENT meter to ground.

Power supply filter capacitors C1901 and C1902 are insulated from ground and connected directly across output of the high voltage rectifiers. Therefore, when the high voltage power supply is first energized, the initial surge of charging current to the power supply filter capacitors does not pass through overload relay K1904 and shunting resistor R1906.

Relay K1904, in series with potentiometers R1918 and R1912, is connected in parallel with potentiometer R1906, which is in the return path for the total output current of the high voltage power supply. A portion of the output current will be shunted through the coil of relay K1904, depending on the setting of variable resistor R1912. With resistor R1912 properly adjusted, relay K1904 will close when the current drain on the high voltage power supply exceeds approximately 125 ma. When relay K1904 closes, power is applied to the coil of overload auxiliary

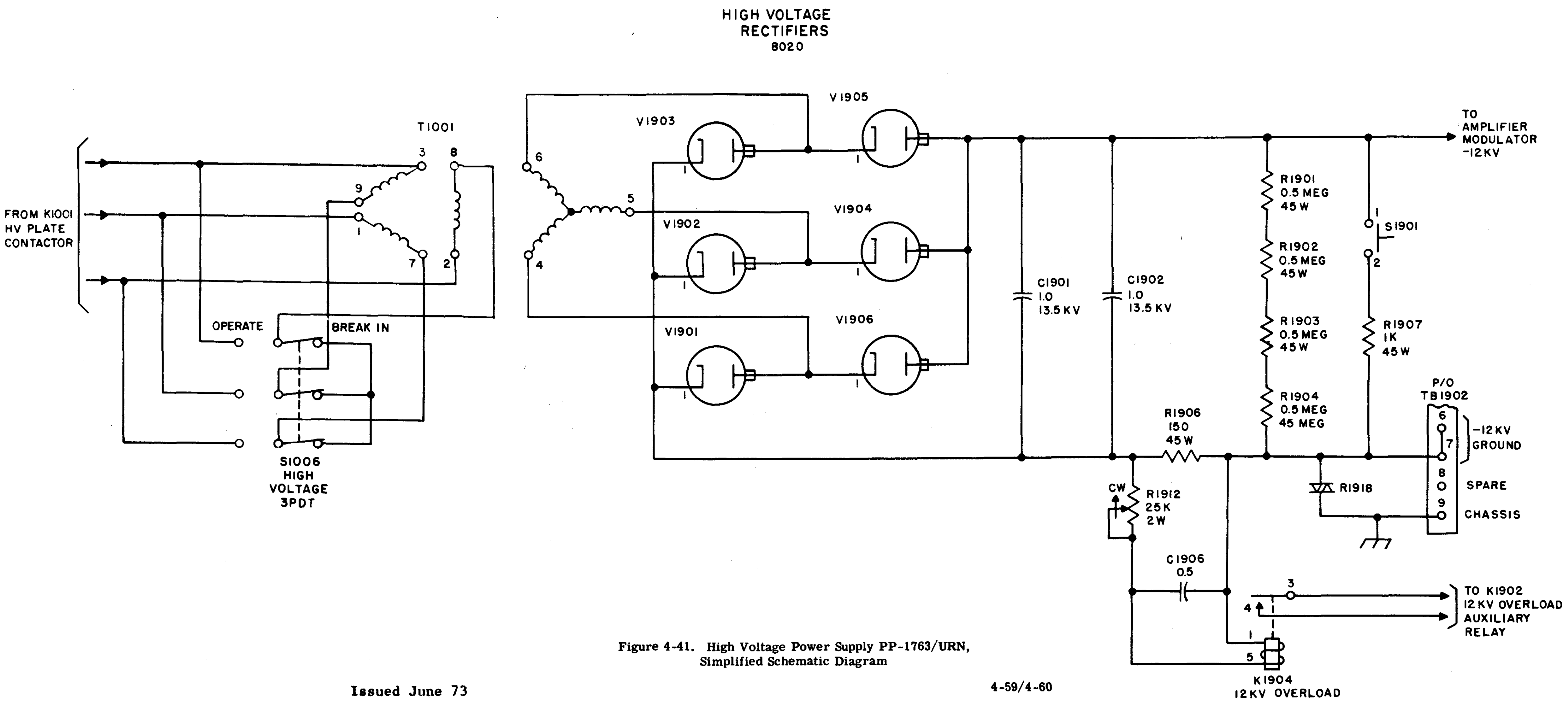


Figure 4-41. High Voltage Power Supply PP-1763/URN, Simplified Schematic Diagram

relay K1902, and the high-voltage plate supply is switched off, subject to automatic resetting (paragraph 4-3b(5)(d)).

Elapsed time indicator M1901 on the front of the high voltage power supply unit operates when the plate contactor is closed and power is supplied to the unit. Thus, it records the total time that the -12,000-volt dc has been supplied to the klystron. Red indicating light DS1901, in parallel with elapsed time indicator M1901, warns the operator that the 12,000-volt output is present. Elapsed time indicator M1902 records the total time that the high voltage power supply filament transformer is energized and the time that power is supplied to other filaments of the transmitter. Protective switch S1901 is provided on the high voltage power supply drawer that discharges the filter capacitors through a resistor, whenever the unit is pulled out.

A voltmeter on the front panel of the amplifier-modulator chassis indicates the output of the high voltage supply.

(6) POWER DISTRIBUTION AND CONTROL CIRCUITS.

The functioning of the power distribution and control circuits is described in the following paragraphs, with reference to the power distribution diagrams included in Section 6 (figure 6-15). All controls are in the off position.

(a) When EMERGENCY SWITCH S901, mounted on the receiver-transmitter cabinet, is closed, the following take place: The line power is connected to the antenna motor contactor. Power is connected to the terminals of main contactor K1101 and blower contactor K1103. Power (120-volt, single-phase, 60-cycle) is connected to the crystal oven transformer in the frequency multiplier-oscillator drawer. This power may be obtained from the convenience outlet circuit. Phase failure relays K901 and K902 are energized.

(b) When MASTER SWITCH S1101 on the control panel is set to STANDBY, the following occurs: Primary contactor K1101 closes, connecting 208-volt, three-phase, 60-cycle power to the terminals of high-voltage plate contactor K1001, and connecting 120-volt, single-phase, 60-cycle power to FIL ON switch S1108, the low and medium-voltage plate contactors, K1603, K1604, and K1804, the control circuit bus, the ANTENNA CONTROL switch, the test set switch, CODER-INDICATOR switch S601, receiver switch S502, MAIN POWER indicating lamp DS1102, and the coil of blower contactor K1103. Blower contactor K1103 closes, connecting cabinet blowers B901, B902, and B1001 to the three-phase, 60-cycle power line. When the power is shut off by the MASTER SWITCH, the blower contactor is kept closed by time delay relay K1102 for 1 minute after primary contactor K1101 has opened so that the residual heat will be dissipated rapidly.

CAUTION

Except in an emergency, the equipment must not be shut down by EMERGENCY SWITCH S901 until 1 minute has elapsed after returning the MASTER SWITCH to OFF.

ANTENNA CONTROL switch S1102, CODER-INDICATOR switch S601, RECEIVER switch S501, and FIL ON switch S1108 may now be set to the on position. ANTENNA CONTROL switch S1102 energizes the antenna control circuit. If the spin motor switch on the antenna control is closed, the antenna spin motor will rotate. CODER-INDICATOR switch S601 energizes the coder-indicator circuit and RECEIVER switch S501 energizes the receiver circuit. FIL ON switch S1108 energizes the filament transformer circuits and FIL ON white indicating lamp DS1101. The ADJUST FOR 120V knob on the control panel operates filament voltage adjusting variac T1101. Ordinarily, SUPPLY VOLTS voltmeter M1101 is connected to the regulated filament bus by LINE-REG FIL BUS switch S1106. This meter may also be used to check the unregulated voltage when switch S1106 is held at LINE. When the FIL ON switch is closed, the filament transformers of the low, medium and high voltage power supplies, filament transformers T1501 and T1403 in the frequency multiplier-oscillator, and filament transformer T1350 in the amplifier-modulator are immediately energized. Relay K1401 energizes time delay relay K1605, which prevents the low and medium voltage power supply plate voltages from being applied until the filaments have been connected for 1 minute. Filament transformers T1301 and T1303 and white indicating lamp DS1301 in the amplifier-modulator are energized through relay K1301. Simultaneously, time-delay relay K1106 is energized, providing a 5-minute delay before the high voltage power supply plates (and, indirectly, the klystron) can be energized.

(c) With the MASTER SWITCH at STANDBY, the equipment will remain in the condition just described. With the MASTER SWITCH set to ON, the drawer interlocks are connected to the 120-volt a-c control power. The low-voltage power supply is ready to be activated if the following conditions are met: the drawer and compartment covers are in place, or the INTERLOCKS SHORTED switch is closed, or the individual interlocks have been manually closed, as may be the case during tuning procedures, the 1-minute time delay relay K1605 is closed, and the blue LV-MV READY lamp is on.

If the MASTER SWITCH is set to ON without stopping at STANDBY, the equipment will arrive at operating condition after the various time delays have been completed. LV switch S1601 may now be closed; this action energizes low-voltage plate contactor K1603, causing the low voltage power supply to function. Medium voltage power supply plate contactor

K1804 will close, energizing that unit if the following conditions exist:

1. Relay K1601 is energized by the -375-volt d-c output of the low-voltage power supply.

2. Medium-voltage overload relay K1802 is de-energized.

3. Overload reset relay K1806 is de-energized.

4. MV switch S1801 has been turned on by the operator.

(d) The d-c output of the medium-voltage power supply closes screen supervisory relay K1801, which connects 120-volt ac to 1000-volt lamp DS1801. High voltage power supply plate contactor K1001 will close, connecting 208-volt three-phase, 60-cycle power to the primary of plate transformer T1001 if the following conditions exist:

1. Relay K1804, the plate contactor of the medium voltage power supply, is energized.

2. The contacts of 5-minute time-delay relay K1606 are closed. This relay is energized at the same time as filament transformer T1370 which heats the filaments of the klystron.

3. Blue indicating lamp DS1902 shows HV READY, signifying that conditions a and b have been met.

4. Overload relay K1902 in the high voltage power supply drawer is de-energized.

5. HV switch S1902 is set to ON.

(e) Additional information on the normal functioning of the control and power distribution circuits is as follows:

1. All the ON switches on the control panels may be closed before the master switch is advanced to STANDBY or ON.

2. If the master switch is moved to ON while all ON switches are closed, the equipment will be automatically energized in its proper sequence, a period of 5 minutes being required before it is fully energized.

3. Once the equipment has been fully energized, with all ON switches remaining closed, the master switch may be moved back to STANDBY, then returned to ON, and the equipment will then be fully energized immediately. Therefore the equipment may be left in the STANDBY position when not required to send or receive information.

4. If the high voltage power supply unit or the amplifier-modulator unit is pulled out or the transformer and blower compartment panel is removed, the high voltage power supply will be disconnected, but the low and medium voltage power supplies will remain functioning. If the low and medium voltage power supply units, the receiver unit, and the frequency multiplier-oscillator unit are pulled out the low medium and high voltage power supplies will be disconnected.

5. Overload protection is provided for the medium and high voltage power supplies. An overload in the medium voltage power supply disconnects that unit and also the high voltage power supply. An overload in the high voltage power supply disconnects only the high voltage power supply. Automatic reclosing relay K1805 restores the power through resetting relay K1806 after 3 seconds. The automatic relay will reset three times and then shut down until reset manually by reset switch S1802. In either case, if the cause of the overload has not been removed, the overload relay will trip again.

6. BATTLE SHORT switch S1107, used only in emergencies, in addition to shorting the drawer interlocks of the control circuit, shorts the unit interlocks on the receiver and on the coder-indicator, thereby connecting the 120-volt a-c input to the individual power supplies. The individual unit interlocks may be closed manually with the unit pulled out when necessary for tuning. Units in which high voltage is exposed have additional contacts in the interlocks which connect the red warning lamp. Interlocks closed in this manner are restored to normal functioning when the unit is closed.

7. The equipment may be energized by a remote control switch if all the ON switches on the control panel are closed and the MASTER SWITCH has been turned to REMOTE CONTROL. A white indicating lamp on the remote control switch shows that it is ready for use. The remote control switch has OFF, STANDBY and ON positions that perform the same functions as those positions on the MASTER SWITCH with identical designations. There are two red indicating lamps on the remote control unit; one tells when the low voltage power supply and the medium voltage power supply are ready for energizing, and the other shows that the high voltage power supply is ON.

c. TEST PRINCIPLES. – This paragraph shows how the test units previously described are connected together for the various positions of the test function switches. explaining the theory behind each test thus made possible.

(1) Original Test Equipment (TABLE 1-2), FUNCTION SWITCH IN POSITION 1. – Front panel connections shown in Fig 3-13 with the test function switches in position 1 enable the operating tests to be made by the adjustment of just a few of the unit controls. The oscilloscope is reset for the correct sensitivity and the required 25μsec sweep.

The signal at the video input of the beacon is fed through switch contacts of the Power Meter – Pulse Counter to the trigger input of the oscilloscope. This action synchronizes the oscilloscope so that the video pulse pair triggers a sweep trace. The r.f. output of the beacon is fed to the antenna through the switch-test adapter. This r.f. signal is detected by the diode in the switch-test adapter, fed through switch contacts in the Power Meter – Pulse Counter and applied to the oscilloscope signal input terminals. Thus the detected r.f. signal will be displayed on the oscilloscope for all position 1 tests.

The paired pulses generated by the pulse-sweep generator are fed directly to the modulator input of the TS-890A/URN-3. The resulting pulsed r.f. signal is used to interrogate the radio beacon. The radio beacon r.f. output signal is fed back to the Pulse Analyzer section, from the ANTENNA INCIDENT jack to the RECEIVER INPUT connector.

(2) Replacement Test Equipment (TABLE 1-2b).– For the following operating tests no external connections are required between the beacon and the test equipment; all connections are automatically made as the switch positions and coaxial links are selected in accordance with the specified setting up instructions.

RF peak power and beacon spectrum tests are achieved by applying the r.f. output of the beacon, via the Transfer and Switching Unit, to the Spectrum Analyzer/Test Generator and Power Meter. A total pulse count is provided when the beacon output is fed via the Transfer and Switching Unit to the Pulse Counter.

The following sub-paragraphs describe how the various signals of the Original and Replacement Test Equipment are used to provide the operating tests.

(a) RF PEAK POWER TEST.

1. Original Test Equipment. – RF peak power output is determined by observation of the video waveform on the oscilloscope. By means of the variable d.c. voltage in the Power Meter – Pulse Counter, the bias on the cathode of the detector diode is varied to cut off the diode. When the diode is cut off to just the point where the video signal is no longer presented on the oscilloscope, the d.c. voltage is equal to the peak value of the r.f. signal. Because the deflection of the PEAK POWER METER corresponds to the d.c. voltage, peak power may be read directly from the meter in kilowatts.

2. Replacement Test Equipment. – Sample r.f. output pulses are routed via the Spectrum Analyzer/Test Generator ATTENUATOR into diode detector network CR1 of the Peak Power Detector. The resultant video output is amplified by the peak power detector, sampled at the pulse peak and fed to a peak power/input level amplifier, as a d.c. voltage whose amplitude is proportional to the peak amplitude of the input pulse and attenuator setting. The output of the peak power/input level amplifier is applied across the PEAK RF POWER METER, which is calibrated in watts.

(b) VISUAL PULSE SHAPE. – The relative amplitude of any point on the video pulse may be readily determined by means of the graticule on the oscilloscope which also allows for measurement of pulse time relationships by means of accurately calibrated markers.

(c) OUTPUT PULSE COUNT. –

1. Original Test Equipment. – The detected output of the radio beacon is fed directly to the counter circuit for the operating test. By proper setting of the Power Meter – Pulse Counter controls, the PULSES PER SECOND meter will provide a continuous indication of the number of radio beacon output pulses per second.

2. Replacement Test Equipment. – After initial amplification the pulses to be counted are fed to the counter control circuit for further processing and then to the counter MAIN gate. The output of the MAIN gate is used to trigger a series of flip-flops in the Decade Counter Unit and these, in turn, change the conditions of a set of AND gates associated with the Nixie indicator tubes.

(d) BEACON SPECTRUM TEST. – The radio beacon spectrum test is made by applying beacon output r.f. pulses to the Pulse/Spectrum Analyzer. Basically the analyzer is a sharply tuned r.f. voltmeter which provides an indication of relative output power.

1. Original Test Equipment. – The analyzer is essentially a super-heterodyne receiver which uses a signal generator as its local oscillator.

The beacon transmitter output is fed through an attenuator and a filter-mixer circuit in the analyzer RF unit, before being applied to the receiver i.f. stage as a 63 MHz signal.

The filter-mixer circuit heterodynes the beacon transmitter output with that of the signal generator. The 8·5 MHz output of the 63 MHz i.f. amplifier is fed through a stepped attenuator to an 8·5 MHz i.f. unit which acts as a metering amplifier, operating an indicating meter whose readings are a function of the signal level at the output of the stepped attenuator.

2. Replacement Test Equipment.– The analyzer is a double-super-heterodyne receiver with crystal-controlled local oscillators. A crystal filter at the input of the 2nd i.f. amplifier provides a well-defined bandpass response with high selectivity. A thermistor bridge assembly at the output of the 2nd i.f. amplifier operates an indicating meter the readings of which are a function of the average power output of the spectrum analyzer receiver.

3. In the case of both types of test equipment a reference indication is first made at the centre frequency of the channel by adjusting a variable attenuator for a mid-scale reading on a power comparison indicator/ average power meter. When the analyzer is set to this

frequency a fixed attenuator reduces the meter sensitivity. The analyzer is next tuned to any one of a number of spot frequencies (there are slight differences between the Original and Replacement test equipment) either side of the centre channel frequency. Simultaneously, the attenuation is reduced. The power comparison meter will remain at the reference point if the beacon pulse characteristics are correct; if they deviate from the specification, the meter deviates correspondingly. Similar measurements are made for the other spot frequencies.

(3) Original Test Equipment (TABLE 1-2). FUNCTION SWITCH IN POSITION 2.- The interconnections shown in Fig 3-13, as applicable to position 2 of the test function switches, permit the receiver sensitivity tests. The oscilloscope sensitivity is correctly preset and a 500μsec sweep is provided. North and Auxiliary bursts at the SYNC OUT jack of the beacon are fed to the TRIGGER IN jack of the oscilloscope through switch contacts in the Power Meter - Pulse Counter. This action synchronizes the sweep trace from the reference bursts so that the number of pulses in the bursts may be visually counted. The signal at the video input of the beacon is fed through switch contacts of the Power Meter - Pulse Counter to the SIGNAL IN jack of the oscilloscope. Thus, the video signal at the receiver output is displayed on the oscilloscope screen and the reference bursts may be observed for counting.

The TEST OUTPUT signal, at the radio beacon receiver output, is applied directly to the counter input. This condition enables a check to be made to ensure that the squitter count is correct and that the reply pulses are going through the receiver.

A paired-pulse output from the Pulse-sweep Generator is applied to the Pulse Analyzer/Signal Generator and used to interrogate the beacon at any desired rate.

(4) Replacement Test Equipment.- For the following operating tests no external connections are required between the beacon and test equipment. All connections are automatically made as the switch positions and coaxial links are selected in accordance with the specific setting up instructions.

North and Auxiliary sync. pulses are fed into the Power Meter - Pulse Counter where they are routed via contacts of the REF MKR and FUNCTION switches (a) to provide system trigger for the oscilloscope and (b) for application to the Counter Control circuit whose output is coupled to a Decade Counting Unit associated with a set of Nixie tubes which register the burst interval.

Transmitted pulses from the Transfer and Switching Unit are also fed into the Power Meter - Pulse Counter where they are detected before being fed to the oscilloscope for viewing.

The principle for squitter measurement is similar to that of the total output pulse count except that during the operating test, the coder switch S605 in the beacon Coder Indicator Unit is set to OFF and the NORTH and AUX cables from the antenna base to beacon must be disconnected.

Paired-pulse output from the r.f. signal generator of the Spectrum Analyzer is used to interrogate the beacon at any desired rate. The following sub-paragraphs describe how the various signals of the Original and Replacement Test Equipment are used to provide the operating tests.

(a) REFERENCE BURST PULSE COUNT.- The number of pulses in the reference burst, as well as the spaces between the pulses, may be readily checked by observation on the oscilloscope. By manipulation of the REF MKR switch it is possible to lock the trace to the NORTH or AUX bursts. The 1- and 10μsec markers in the oscilloscope enable accurate measurement of pulse spacing.

(b) SQUITTER COUNT.- The squitter is the output of the receiver not attributable to an actual interrogation. This signal is readily counted by stopping the interrogation signal from being generated and by adjusting the Power Meter - Pulse Counter controls for squitter count. In addition to supplying the squitter pulses when the interrogation rate is below 2700 pulse pairs per second, the squitter control circuits in the receiver limit the number of output pulses when the radio set is being interrogated by more than 2700 pulse pairs per second. Both of these squitter control circuit functions may be checked by varying the interrogation rate of the test signal from the generator.

(c) REPLY COUNT.- The reply count provides an indication of the number of interrogation pulses which pass through the receiver. The pulse counter circuit is made responsive only to reply signals from a specific gate circuit. The gate is activated by the interrogation signals and permits the counter to indicate those receiver output signals which are the result of an interrogation signal.

(d) RECEIVER SENSITIVITY.- An accurate indication of receiver sensitivity may be obtained by noting the amplitude of that output signal from the Pulse/Spectrum Analyzer required to obtain a replay count equal to 60 per cent of the interrogation rate.

(5) Original Test Equipment (TABLE 1-2). FUNCTION SWITCH IN POSITION 3.

(a) Overall Zero Distance Delay.- Front Panel connections shown in Fig 3-13 with the test function switches in position 3, enable a check to be made of the overall zero distance delay of the radio beacon.

The sawtooth sweep output of the Pulse-sweep Generator is fed to the oscilloscope as the sweep deflection voltage. Paired-pulse output of the pulse-sweep generator is fed through the TS-890A/URN-3 to interrogate the beacon. For the overall zero distance delay measurement, detected r.f. output of the TS-890A/URN-3 is fed to one input of a two-channel mixer in the pulse-sweep generator. The r.f. output of the radio beacon is detected by the diode in the Switch Test Adapter and fed to the remaining input of the two-channel mixer. The input signals to the mixer are selected by switch contacts ganged to a crystal selector switch.

The mixer presents the interrogation signal, at both the input and output of the beacon, to the oscilloscope for display.

Assuming proper delay, the input and output signals will be almost superimposed. By means of crystal timing circuits in the pulse-sweep generator, the interrogation signals are spaced at precise intervals to provide a time reference used for measurement of the overall delay of the radio beacon. This reference delay will be either 49.8 or 50.2μsec, depending on the setting of the crystal selector switch. The sweep period will be exactly half this figure so the two sweeps correspond to one reference delay interval. The output pulse will be displayed approximately 1000μsec after the input pulse at a precise multiple of the reference delay. Because of the sweep multiplication provided by using two sweeps per delay interval, any small error in the timing of the overall zero distance radio beacon delay will cause a noticeable shift in the superimposition of the input and output pulse pairs displayed on the oscilloscope screen. By checking the superimposition at the 49.8 and 50.2μ sec reference delays, it may readily be determined that the beacon delay is between these two figures and is, therefore, within tolerance.

(6) Replacement Test Equipment (TABLE 1-2b).

(a) Overall Zero Distance Delay. —For the following operating test no external connections are required between the radio beacon and the test equipment; all connections are automatically made as the switch positions and coaxial links are selected in accordance with the specific setting up instructions. A 1 kHz signal, from the Power Meter – Pulse Counter MM-109, is fed to the Spectrum Analyzer modulator circuit whose 3μsec output pulse provides (i) MOD SYNC pre-trigger (via MM-109) for the oscilloscope, (ii) initiation of gate triggering in the pulse counter circuitry and (iii) an output to the modulator final driver assembly, hence the RF modulator. The output of the modulator is fed (a) via the Transfer and Switching Unit for use as interrogation pulses and (b) via the function switch of the MM-109 to the oscilloscope, where it is displayed as the interrogation pulse.

The beacon reply pulses are fed from the Transfer and Switching Unit to the Power Meter – Pulse Counter and simultaneously to the oscilloscope for display.

For this operating test, by displaying both the interrogation pulse and the reply pulse on the same sweep, and using the 10- and 1 μsec markers it is possible to determine the overall delay time between interrogation of the radio beacon and the transmission of the reply pulses.

(7) GENERAL TEST PURPOSES.

(a) Original Test Equipment (TABLE 1-2). FUNCTION SWITCH IN POSITION 4. – When the TEST FUNCTION switches are placed in position 4, the input connections of the oscilloscope are removed. Each one of the test units may then be used as an independent piece of test equipment. The oscilloscope sweep and signal circuits may then be adjusted by means of front panel controls for observation of any desired waveform in the equipment. Signal and sync. voltages may be fed to the oscilloscope by means of flexible test leads. With this arrangement, the number of operating tests is extended to include any which may be later conceived and the test equipment may be used as an aid in troubleshooting the radio beacon.

(b) Replacement Test Equipment (TABLE 1-2b).— When the FUNCTION switches of the Power Meter – Pulse Counter – Marker Generator MM-109 and spectrum Analyzer/ Test Generator MM-705 are set to the positions listed below each one of the test units may be used as an independent piece of test equipment. This facility extends the number of operating tests to include those which may be used as an aid in troubleshooting the radio beacon.

1. Power Meter – Pulse Counter – Marker Generator MM-109. Function Switch Position: GEN TEST.—In this position any suitable input at the front panel COUNTER INPUT socket is routed via the Input Amplifier, Counter Control circuit etc., to the Decade Counting Unit. With the MODE switch also set to the GEN TEST position both positive and negative pulses may be counted. The counter will operate properly only when the output of the Input Section has a positive output of the proper amplitude. Thus, when the MODE switch is in the minus position, an inverter with a gain of 1 is switched into the circuit to invert the signal from negative to positive; when the MODE switch is set for a 'plus' input, the connection is straight through and the inverter is by-passed.

The Oscilloscope MM-504 has no built-in marker generator facility, therefore when these are required it is necessary to have the MM-109 switched on in order to provide them. On the MM-109, a facility is provided whereby the marker generator output is available at the front panel MARKER OUTPUT socket and may be used for more accurate measurement of pulse intervals.

2. Spectrum Analyzer/Test Generator MM-705. Function Switch position: IF SIG GEN. – In this position the 63 MHz signal generator provides a CW sinusoidal signal, via the front panel ATTEN socket, whose frequency is variable from 60·5 to 65·5 MHz with a capability of being set to 63·0000 MHz ±0·005%. The power output is variable (via the attenuator) from 0 to -110 dBm; calibrated to an accuracy of ±2 dB over the range from 0 to -100 dBm. The signal at the FUNCTION SW socket has the same frequency characteristics as described above except that the power output is fixed at 0 dBm. When the connection link is placed between PWR BRIDGE and FUNCTION SW the

AVERAGE POWER meter is used to monitor the output signal power level of the IF Signal Generator.

POWER METER ZERO SET.- When the FUNCTION switch is in this position the input to the AVERAGE POWER meter circuitry is disconnected enabling the meter to be 'zero set' by means of that control adjacent to the meter.

SA.- This the spectrum analyzer position of the FUNCTION switch whereby the variable attenuator output is connected to the input of the double super-heterodyne receiver. The output of the receiver, at the 2nd IF amplifier, is connected to the AVERAGE POWER meter.

The BAND SHIFT selector switch on the front panel selects the second local oscillator frequency, which positions the centre frequency of the 500 kHz bandpass filter in the spectrum being measured. The attenuator adjusts the input signal amplitude until the AVERAGE POWER meter indicates POWER SET.

By repeating the foregoing at the various frequencies of the BAND SHIFT selector switch, and comparing the ATTENUATOR readings, the frequency spectrum can be measured. The spectrum analyzer gain is adjusted by the NOISE SET control on the front panel, for a NOISE SET indication on the AVERAGE POWER meter.

RF AVG PWR.- When in this position the FUNCTION switch provides the facility whereby the beacon average power may be measured on the AVERAGE POWER meter.

RF SIG GEN.- In this position the FUNCTION switch energizes the RF Signal Generator multiplier chain, which multiplies the master oscillator frequency to the RF output frequency before it is fed into the RF modulator. The output of the modulator is fed into a final RF cavity which has three outputs: (i) to the AVERAGE POWER meter for output level calibration (ii) via a linear detector in the MM-109, to the Oscilloscope MM-504 (if required) for viewing the RF envelope shape and calibration of the output when in the PULSE mode and (iii) via the attenuator as the RF Signal Generator output. Output (iii) can be taken from the ATTEN socket on the front panel.

RF PEAK PWR.- In this position the FUNCTION switch is responsible for routing the beacon primary or standby REF/INC power from the Transfer and Switching Unit to the peak power circuitry in the MM-109 where it is measured on the PEAK RF POWER meter of that unit. The signals are routed via the attenuator in the Spectrum Analyzer/Test Generator.

SECTION 5

TROUBLESHOOTING

5-1. GENERAL.

a. To localize troubles quickly and efficiently, the technician should become thoroughly familiar with the radio beacon, giving special attention to the following:

(1) The relationship between the radio beacon and Radio Set AN/ARN-21 in the aircraft, and how the radio beacon produces bearing and distance information and its identification call.

(2) The functions of the receiver-transmitter group, the power supply assembly, and the antenna group which comprise the radio beacon, and the relationship between these groups.

(3) The functions of each of the units that make up the groups.

(4) The symptoms of malfunctioning of the radio beacon, of any of the groups, and of any component unit of a group.

(5) The most probable unit or circuits in which the observed trouble may be localized.

b. When a symptom, such as failure of the transmitter output from the radio beacon, is encountered, the cause of the trouble may be localized to the exact assembly or component item by a systematic procedure. Initially, the defective group must be determined and then the defective unit within the group. Next the defective circuit must be found. Finally the trouble must be isolated to the defective assembly or part.

c. To save time and minimize disturbance of the equipment, the following troubleshooting sequence should be used as much as possible:

(1) Check for external indications of trouble.

(2) Check electronic assemblies, making a complete waveshape and voltage check.

(3) Check mechanical assemblies, making a complete visual inspection: if necessary, disassemble and examine component items.

(4) If an electrical trouble has not been isolated following completion of waveshape and voltage checks, use an ohmmeter to check resistances throughout the suspected circuit. Plugs should be disconnected and the circuit isolated from other circuits, as far as possible, to remove all resistance-shunting paths.

d. The troubleshooting information provided in this section is arranged in a manner designed to facilitate performance of the foregoing procedures. A system troubleshooting chart is included as an aid in determining the equipment group and the major components within the group which contains the trouble. The system troubleshooting chart is supplemented by individual component unit troubleshooting charts. Each such chart includes a systematic guide to trouble localization, a servicing block diagram, a comprehensive set of signal-tracing waveshapes, and a tube socket voltage and resistance diagram. Schematic and wiring diagrams for each component unit are supplied in Section 6.

e. The troubleshooting charts contain test points which are indicated by stars 1 and circles A These test points are similarly marked by stars and circles on schematic diagrams, servicing block diagrams, and photographs to facilitate their location. The test points designated by a star (major test points) are for checking the overall functions and for localizing trouble to a functional section. The circled test points (secondary and minor test points) are for isolating causes of abnormal performance both within a specific functional section and within a specific circuit.

5-2. TEST EQUIPMENT AND SPECIAL TOOLS.

a. TEST EQUIPMENT.–The test equipment required to check the operational characteristics and troubleshoot the radio set are listed in tables 5-1 and 5-1a. The test equipment includes two main groups,(1) built-in test equipment and (2) standard test equipment. The test equipment of the earlier models is installed within the beacon power supply cabinet whilst that of the MM-TMC-212A is housed, with two Transponder Monitors MM-209, a Transfer and Switching unit MM-1602 and a Transfer and State Switching Unit (TELOTEL) in the Electrical Equipment Cabinet 212A. The information contained in Section 5 applies equally to the Original and the Replacement Test Equipment, but where differences occur, these are explained in the text and appropriate drawings.

b. SPECIAL TOOLS.–No special tools are required.

5-3. OVERALL TROUBLESHOOTING

Some of the troubles encountered with the radio beacon will first be detected by the aircraft and reported to the radio beacon location. The radio beacon troubleshooting chart indicates the probable cause of the trouble and refers to the appropriate unit troubleshooting chart or test procedure.

a. PRELIMINARY CHECK. – When the trouble encountered with the radio is localized.

TABLE 5-1. ORIGINAL TEST EQUIPMENT

FIGURE NO.	NAME	AN TYPE DESIGNATION	ALTERNATE	USE
3-17	Power Meter-Pulse Counter	TS-891/URN-3		Provides metered variable d-c source used to bias diode of Switch-Test adapter SA-420 URN-3 in power measurement.
5-1	Switch-Test Adapter	SA-420/URN-3		Transfers radio beacon transmitter output power from antenna to dummy load and supplies detected signal to equipment.
3-16	Oscilloscope	OS-54/URN-3		Provides timing markers and calibrating voltage to permit accurate measurement of signal waveshape amplitude and pulse width.
3-14	Pulse Analyzer-Signal Generator	TS-890A/URN-3 or TS-890B/URN-3		Provides r-f carrier for testing beacon and calibrator receiver for spectrum analysis of beacon output signal.
3-15	Pusle Sweep Generator	SG-121A/URN-3		Provides pulsed pairs at controlled rate to simulate pulse output of one or more airborne Radio Sets AN ARN-21.
-	Multimeter	AN/PSM-4	TS-352/U	Checks various voltages and resistances throughout Radio Set AN GRN-9D.

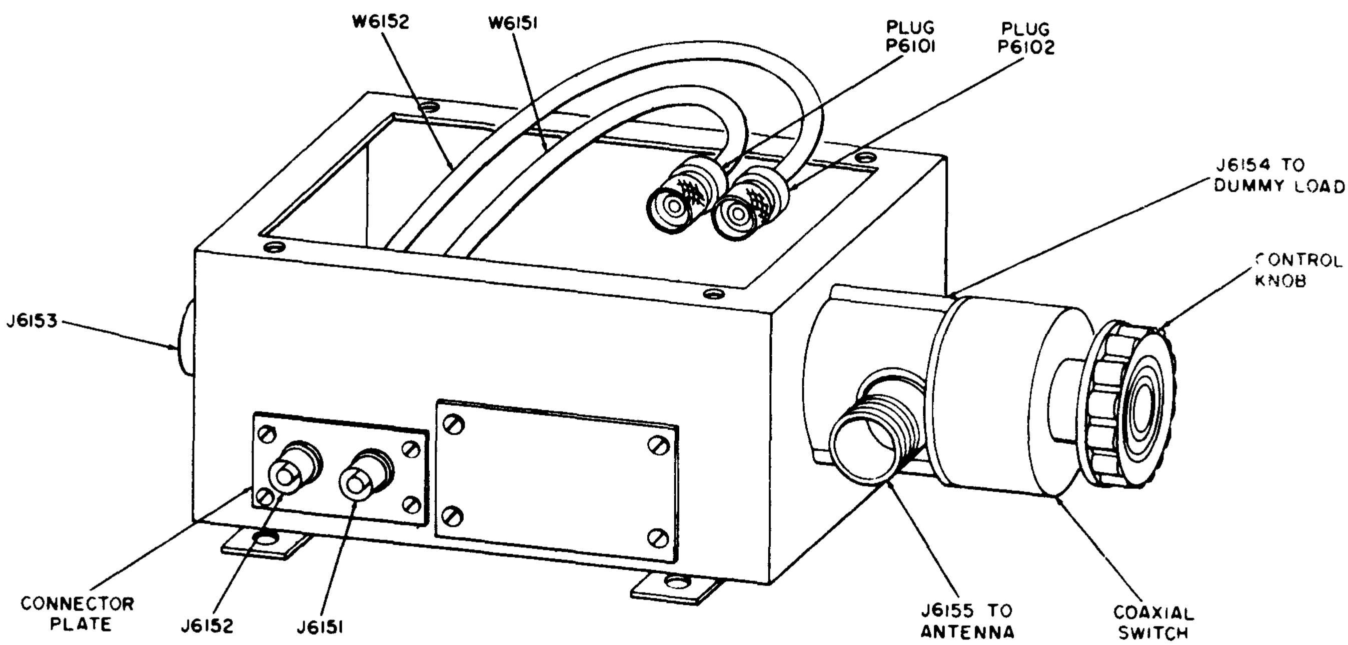


Figure 5-1. Switch-Test Adapter SA-420 URN-3

TABLE 5-1a. REPLACEMENT TEST EQUIPMENT

FIGURE NO	NAME AND DESIGNATION	USE
	Spectrum Analyzer/Test Generator MM-705	The unit tests the operation of the radio beacon and analyzes the radio beacon output. The Spectrum Analyzer section provides the facility to measure the transmitted energy in each of six bands adjacent to the transponder transmitter frequency, as well as the on-channel energy.
		The Test Generator section provides (a) a suitable signal to use for aligning the IF stages of the beacon receiver and (b) the RF energy (at beacon receiver frequency) for testing and maintenance purposes.
	Oscilloscope MM-504	This unit enables inspection and measurement of the amplitudes and pulse-widths of all signals associated with the GRN-9D and its associated equipment.
	Power Meter - Pulse Counter - Marker Generator MM-109	This unit enables the following functions to be performed by the MM-TMC-212A. (a) Power meter - measures the peak r.f. power output of the GRN-9D and its test equipment in the frequency range 960 to 1215 MHz. The unit is used in conjunction with the Transfer and Switching Unit which, in this instance of its use, provides the necessary facilities for sampling the transmitter output signal and the interrogation signals.
		(b) Pulse Counter - measures the average repetition rates of all the pulse sources in the GRN-9D and its test equipment.
		(c) Marker Generator - provides precision time marker pulses for modulating the Y and Z axis of the MM-504 Oscilloscope. The markers are used for measurements of pulse-width, pulse spacing, time intervals and frequencies.
	Multimeter Type CT498 Mk.2	Checks various voltages and resistances throughout Radio Set AN/GRN-9D.

to Radio Set AN/GRN-9D, the initial check should be for an a-c power input.

Note

Under normal operating conditions, EMERGENCY SWITCH S901, located on blower compartment panel of receiver-transmitter group cabinet, and MASTER switch S1101, located on control-duplexer panel, are in their ON position.

When the radio beacon is functioning normally, the following lamps are on:

(1) MAIN POWER ON lamp DS1102, FIL ON lamp DS1101, and ANTENNA CONTROL ON lamp DS1103 on control-duplexer panel.

(2) POWER ON lamp DS501 on receiver panel.

(3) ANTENNA CONTROL lamp DS602 on coder-indicator panel.

(4) FILAMENT lamp DS1401 and OVEN lamp DS1403 on frequency multiplier-oscillator panel.

(5) FIL lamp DS1301 on amplifier-modulator panels.

(6) LV lamp DS1603, LV-MV READY lamp DS1605, and -375 lamp DS1601 on low-voltage power supply panel.

(7) HV lamp DS1901 and HV READY lamp DS1902 on high-voltage power supply panel.

(8) +1000V lamp DS1801 on medium-voltage power supply panel.

b. TEST EQUIPMENT AND SPECIAL TOOLS.–The test equipment required to perform the Radio Set troubleshooting procedure is based on using the test equipment described in tables 5-1 and 5-1a.

c. CONTROL SETTINGS.–Table 5-2 lists all preliminary control settings required when troubleshooting.

d. SYSTEM TROUBLESHOOTING CHART.–When trouble develops in the radio beacon, the trouble may be localized to a particular functional section by following the instructions given in table 5-3. Technical personnel who are thoroughly familiar with the radio beacon may be able to determine which unit is not functioning properly from the trouble symptom without reference to table 5-3. In this case, the technician may refer directly to the troubleshooting chart pertaining to the unit suspected of malfunctioning.

Servicing block diagrams and waveshape charts, with the waveshapes arranged in signal-tracing sequence, accompany the troubleshooting charts. It is necessary to use the servicing block diagrams together with the troubleshooting charts to isolate defective units or components. The servicing block diagrams indicate the flow of signal or power. It should be noted that in figure 5-2 (the radio beacon servicing block diagram) the flow of the signal is from the antenna, through the radio set and back to the antenna. Where provided, monitoring jacks should be used as an aid in isolating the trouble to an individual unit or group.

Where trouble has been traced to power failure, reference should be made to the power distribution and control circuit troubleshooting chart in table 5-10. The primary power distribution schematic diagram (figure 6-15) will assist in tracing troubles in these circuits. Further assistance in trouble localization in the power distribution and control circuits is provided by the servicing block diagram presented in figure 5-25.

5-4. FUNCTIONAL SECTION TROUBLESHOOTING.

Tables 5-3 and 5-3a contain the necessary information to isolate a trouble existing in the radio set to a specific functional section.

a. PRELIMINARY CHECK.–Refer to paragraph 5-3a for preliminary check information.

b. TEST EQUIPMENT AND SPECIAL TOOLS.–Troubleshooting procedures included in this section require the use of built-in test equipment. Unless otherwise stated, the information contained in the following text and tables of Section 5, is equally applicable to both the Original and Replacement Test Equipment. In order to avoid confusion, information in the tables specifically referring to the Replacement Test Equipment, is printed in italics.

(1) Original Test Equipment (TABLE 5-1).–Pulse Analyzer-Signal Generator TS-890A/URN-3 operates in conjunction with Pulse-Sweep Generator SG-121A/URN-3 to provide a simulated interrogation signal that is identical to the signal received from interrogating aircraft, with the exception of the pulse pair repetition rate. Pulse pairs occur at a random frequency in aircraft interrogation signals, while the simulated signals from the pulse analyzer-signal generator contain pulse pairs which occur at a fixed frequency, dependent upon the setting of the PRF RANGE and PRF MULTIPLIER controls on the front panel of the pulse-sweep generator. By using the simulated interrogation signal provided by this test equipment, the signal can be traced from the radio receiver input, through the radio set, to the transmitter output. Before making any tests with the pulse analyzer-signal generator, the front panel controls should be set up as follows:

Step 1. Set OUTPUT ATTENUATOR to 0 DBM.

Step 2. Set INPUT ATTEN SELECTOR control to maximum attenuation.

Step 3. Set BAND SHIFT switch to 0.

Step 4. Set MODULATION SELECTOR to C.W.

Step 5. Set CHANNEL SELECTOR control to applicable channel.

TABLE 5-2. INITIAL CONTROL SETTINGS PRIOR TO TROUBLESHOOTING

CONTROL	LOCATION	SETTING
EMERGENCY switch S901	Front panel of receiver-transmitter group blower compartment	ON
MASTER switch S1101	Panel of control-duplexer	ON
ANTENNA CONTROL switch S1102	Panel of control-duplexer	ANTENNA CONTROL
FIL ON switch S1108	Panel of control-duplexer	FIL ON
BATTLE SHORT switch S1107	Panel of control-duplexer	NOR
Receiver ON/OFF switch S502	Panel of radio receiver	ON
CODER INDICATOR switch S601	Panel of coder-indicator	ON
LV switch S1601	Panel of low-voltage power supply	ON
MV switch S1801	Panel of medium-voltage power supply	ON
HV switch S1902	Panel of high-voltage power supply	ON
HIGH VOLTAGE BREAK IN OPERATE switch S1106	Panel of power supply assembly blower compartment	OPERATE

Note

If built-in crystal oscillator is to be used as a frequency-generating source, omit steps 6, 7, and 8.

Step 6. Set MAIN TUNING control to applicable channel.

Step 7. Set OSCILLATOR SELECTOR to V. F. O. CALIBRATE.

Step 8. Adjust V. F. O. CALIBRATE control until zero beat is heard in headphone plugged into V. F. O. CALIBRATE jack.

Step 9. Set OSCILLATOR SELECTOR switch to either REF. OSC. (for crystal control) or to V. F. O., depending upon oscillator used as generating source.

Step 10. Adjust for zero reading on OUTPUT LEVEL indicator, using its ZERO SET control.

Step 11. Set INTERROGATE switch to ON.

Note

Before proceeding with step 12, energize and warm up Pulse-Sweep Generator SG-121A URN-3 (figure 3-15) for at least 2 minutes.

Step 12. Set POWER SET control to midscale.

Step 13. Adjust PULSE AMPLITUDE control on pulse-sweep generator to obtain midscale reading (100) on OUTPUT LEVEL INDICATOR.

Step 14. Adjust CHANNEL SELECTOR slightly for maximum reading on OUTPUT LEVEL INDICATOR.

Note

There is a time lag between application of signal to OUTPUT LEVEL INDICATOR and indication of power level. When taking readings on this meter, allow time for needle to stabilize.

Step 15. Readjust PULSE AMPLITUDE control on pulse-sweep generator to obtain midscale reading (100) on OUTPUT LEVEL INDICATOR.

Step 16. Adjust ZERO SET control of POWER COMPARISON INDICATOR to obtain zero reading on this indicator.

Step 17. Set MODULATION SELECTOR to PULSE.

TABLE 5-3. RADIO SET AN/GRN-9D. SYSTEM TROUBLESHOOTING CHART
(Original Test Equipment, Table 5-1)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
SYMPTOM: Aircraft reports that it receives no bearing, distance, and identification call information.			
1	Check reports from other aircraft in area.	Aircraft in area report that bearing, distance, and identification information is correct.	If all aircraft in area report loss of three signal elements, beacon is at fault. Refer to step 2 and to radio beacon servicing block diagram (figure 5-2). If fault is not found, trouble is in aircraft equipment.
2	Check transmitter output by connecting Oscilloscope OS-54/URN-3 through probe E1152 to each of two test points on control-duplexer panel: ANTENNA INCIDENT jack J1154 and ANTENNA REFLECTED jack J1153. Observe waveshape and measure and record peak-to-peak voltage obtained for each.	Compare with previously logged readings. A minimum of 2 to 1 incident to reflected voltage ratio should be obtained.	If there is a considerable decrease in both INCIDENT and REFLECTED readings, check transmitter. Refer to transmitter troubleshooting chart (table 5-6). If ratio of incident to reflected meter readings is low (high reflected-low incident), check out r-f cables and connectors from directional coupler up to and including antenna central array.
3	Check waveshape at TEST OUTPUT jack J607 (panel of coder-indicator) with Oscilloscope OS-54/URN-3 and Power Meter-Pulse Counter TS-891/URN-3 test switches in position 2.	Waveshape No. 24B shown in figure 5-11 should be obtained.	If normal indication is not obtained, trouble is probably in coder-indicator. Refer to coder-indicator troubleshooting chart (table 5-5). If normal indication is obtained, proceed to step 4.
4	Check readings of D.C. SUPPLY VOLTAGE meter M1402 on front panel of frequency-multiplier oscillator with METER SELECTOR switch in positions 1 through 5.	Meter should read: Position — Voltage OFF — 0 volt dc -375 — -375 volts dc +250V — +250 volts dc +700V — +900 volts dc +1000V — +1000 volts dc	Refer to low-voltage power supply troubleshooting chart (table 5-7) if voltages read in positions 1, 2, or 3 are incorrect. Refer to medium-voltage power supply troubleshooting chart (table 5-8) if voltages read in position 4 or 5 are incorrect.
5	Check reading of H.V. SUPPLY meter M1302 on front panel of amplifier-modulator.	Meter should read between 10,800 and 13,200 volts.	Refer to high-voltage troubleshooting chart (table 5-9) if 12,000 ± 10%-volt reading is not obtained.
SYMPTOM: Aircraft reports that it receives distance and identification call, but does not receive bearing information.			
1	Check waveshape at TEST OUTPUT jack on panel of coder-indicator, with Oscilloscope OS-54/URN-3 and Power Meter-Pulse Counter TS-891/URN-3 test switches in position 2.	Waveshape No. 24B shown in figure 5-11 should be obtained.	If required waveshape is not obtained, trouble is in coder-indicator. Refer to coder-indicator troubleshooting chart (table 5-5).

TABLE 5-3. RADIO SET AN/GRN-9D, SYSTEM TROUBLESHOOTING CHART (cont)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
2	Check for presence of north and auxiliary trigger pulses, using oscilloscope at test points TP1 and TP2 in coder-indicator.	North trigger pulse obtained at test point TP1 should appear as shown in waveshape No. 1 of figure 5-11. Auxiliary trigger pulse obtained at test point TP2 should appear as shown in waveshape No. 25 of figure 5-11.	If either one or both triggers are not obtained, trouble is in portion of antenna concerned with trigger generation. Refer to technical manual for appropriate antenna.
SYMPTOM: Aircraft reports that it receives bearing and identification call information, but does not receive distance information.			
1	Check readings on TEST METER M501 on front panel of radio receiver in all positions of METER SELECTOR switch S501. Use Power Meter-Pulse Counter TS-891/URN-3 to count receiver output pulses at receiver TEST OUTPUT jack J507.	Compare with logged readings. Reading of 2700 ± 90 pulses per second.	If meter readings obtained differ considerably from logged readings or pulse count is incorrect, refer to radio receiver troubleshooting chart (table 5-4).
2	Check tuning of preselector Z1153.		If preselector is improperly tuned, retune according to instructions given in paragraph 2-6f(2) of Section 2. Check cabling and connection between preselector and mixer stage of radio receiver.
SYMPTOM: Aircraft reports that it receives bearing and distance information, but does not receive identification call.			
1	Check waveshape at test point TP8 in coder-indicator.	1,350-cps identification tone pulses should be obtained as shown in waveshape No. 48 in figure 5-11.	If normal indication is present at test point TP8, perform step 2. If normal indication is not present at test point TP8, trouble is probably in stages V612 through V614. Signal trace through these stages; refer to coder-indicator troubleshooting chart (table 5-5).
2	Check that keyer motor B602 is rotating and that switch S605 is closed.	Motor is rotating.	If motor is not rotating, check voltages at terminals 2 and 3 of terminal board TB601; voltage should read 120 volts ac. If voltage at terminals 2 and 3 is correct, motor B602 is at fault and should be replaced.

TABLE 5-3. RADIO SET AN/GRN-9D, SYSTEM TROUBLESHOOTING CHART (cont)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
3	Refer to identification keyer test in paragraph 6-2e(3) of Section 6.	Keyer switches operate correctly.	Reset or replace switches, if necessary.
SYMPTOM:	Aircraft reports that it receives all message elements, but bearing information is in error.		
1	Check antenna rotation speed and tachometer.	Required antenna rotation speed of 15 cps, or 900 rpm, will be indicated if tachometer reads 675 cps and/or 120 pps is counted at test point TP2.	If normal indications are not obtained, cause of trouble is in antenna. Refer to technical manual for appropriate antenna group.
2	Check direction of rotation of antenna spin motor.	Check that antenna is rotating in a clockwise direction, as viewed from above.	Check wiring of three-phase power to antenna from receiver-transmitter cabinet to spin motor.
3	Check reading of ANTENNA ERROR meter on panel of coder-indicator.	Meter should read in green area of scale.	If meter reads in red area, cause of trouble is in antenna. Refer to technical manual for appropriate antenna group.
4	Check 40-microsecond blanking gate at test point TP9 in radio receiver as described in paragraph 3-6a(8) of Section 3.	Blanking gate should be 40 microseconds wide and appear as shown in waveshape No. 17 of figure 5-4.	If blanking pulse is not present or is of insufficient amplitude, check stages V406 and V407B in radio receiver. Refer to radio receiver troubleshooting chart (table 5-4). If pulse is present but is of incorrect duration, adjust potentiometer R443 to obtain 40-microsecond duration.
SYMPTOM:	Aircraft reports that it receives all message elements, but that distance information is in error.		
1	Check overall delay as described in paragraph 3-6a(11) of Section 3.	Waveshape indicating proper delay should appear as shown in figure 3-20.	If normal indication is not obtained, check as follows: If 50-microsecond delay is not correct, adjust delay line DL601 as described in paragraph 6-2e(5) of Section 6. If delay line does not respond to adjustment, check electrical characteristic of delay line. Replace delay line, if necessary.

TABLE 5-3. RADIO SET AN/GRN-9D, SYSTEM TROUBLESHOOTING CHART (cont)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
SYMPTOM: Aircraft reports that it does not receive bearing and distance information over entire 200-mile range.			
1	Using built-in test equipment, make peak r-f power output measurement according to instructions given in paragraph 3-6a(2) of Section 3.	Radio beacon power output should be at least 7.5 kilowatts.	If normal indication is obtained, proceed to step 2. If power output is low, refer to power supply troubleshooting charts (tables 5-7 through 5-9) and transmitter troubleshooting chart (table 5-6).
2	Check transmitter output by connecting Oscilloscope OS-54/URN-3 through probe E1152 to each of two test points on control-duplexer panel: ANTENNA INCIDENT jack J1154 and ANTENNA REFLECTED jack J1153. Observe waveshape and measure and record peak-to-peak voltage obtained for each.	Compare with previously logged reading. A minimum of 2 to 1 incident to reflected voltage ratio should be obtained.	If normal indication is obtained, check that siting requirements are fulfilled. If normal indication is not obtained, refer to technical manual for appropriate antenna.

Note

Pulse Analyzer-Signal Generator TS-890A/URN-3 is now ready for use in making tests. Upon completion of tests, shut down equipment by turning INTERROGATE and power switches to OFF position.

Step 18. Set PRF RANGE switch on pulse-sweep generator panel to 500 position.

Step 19. Set PRF MULT switch on pulse-sweep generator panel to X1.0 position.

Step 20. Set PULSE CODING μ SEC switch on pulse-sweep generator panel to 12 position.

Step 21. Connect coaxial test lead from RF OUTPUT jack on pulse analyzer-signal generator panel to ANTENNA REFLECTED jack on control-duplexer panel.

(2) Replacement Test Equipment (TABLE 5-1a) - The setting up procedure described in Para 3-6a (12), of Section 3, enables the test equipment to be used for troubleshooting the radio set. In the event of unserviceability, checks of the radiated antenna pattern accuracy, as described in Para 3-6a(12)(j), and the presence of the correct beacon parameters, according to the Monitor, will be sufficient to localize any fault to a particular area. The procedures outlined in TABLE 5-3a should serve as a broad guide in the event of system troubleshooting.

c. CONTROL SETTINGS. —Under normal operating conditions, all power switches are left in ON position. Refer to table 5-2 for a list of control settings required prior to troubleshooting.

d. FUNCTIONAL SECTION TROUBLESHOOTING CHARTS. —Radio Set AN/GRN-9D includes the following five functional sections: radio receiver, coder-indicator, transmitter, power supplies, and power distribution and control circuits. When used in conjunction with the voltage and resistance measurement charts, the functional section troubleshooting charts serve to isolate the defective component in any one of the five functional sections.

Note

Safety interlocks on drawer units in which high voltages are present disconnect parts of the circuits when the drawers are pulled out. Therefore, when signal tracing or making voltage checks, the safety interlocks must be closed manually.

WARNING

Operation of this equipment involves high voltages which are dangerous to life. Maintenance personnel must observe all safety regulations at all times when servicing the equipment. Never service equipment without the presence or assistance of another person capable of rendering first aid immediately.

(1) TROUBLESHOOTING RADIO RECEIVER. (See figure 5-3). —When trouble has been localized to the radio receiver, follow the troubleshooting procedure presented in the following paragraphs to further localize the trouble to a specific component part of the receiver. After the defective part has been replaced, refer to the adjustment and alignment procedures given in paragraphs 6-2d and 6-3b(3) of Section 6 to restore the receiver to proper operating

TABLE 5-3a. RADIO SET AN/GRN-9D, SYSTEM TROUBLESHOOTING CHART
Replacement Test Equipment (TABLE 5-1a)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
SYMPTOM: Aircraft reports that it receives no bearing, distance, and identification call information.			
1	Check reports from other aircraft in the area and check for serviceability of beacon parameters according to the Transponder Monitor MM-209.	Aircraft in area report that bearing, distance and identification information is correct. Monitor shows beacon parameters to be present and correct.	If all the aircraft in the area report loss of three signal elements and/or if the Monitor indicates parameter failure, beacon is at fault. Refer to Step 2 and to the radio beacon servicing block diagram (Figure 5-2a). If fault is not indicated on the Monitor or found in the beacon, the trouble is in the aircraft equipment.
2	Connect the Oscilloscope MM-504, in turn, to the ANTENNA INCIDENT (J1154) jack and the ANTENNA REFLECTED (J1153) jack on the front panel of the Control Duplexer. Observe the wave shape and measure, and re record, the peak-to-peak voltage obtained for each.	Compare with previously logged readings. A minimum of 2 to 1 incident to reflected voltage ratio should be obtained.	If there is a considerable decrease in both INCIDENT and REFLECTED readings, check the transmitter. Refer to transmitter troubleshooting chart (Table 5-6). If ratio of incident to reflected meter readings is low (high reflected low incident), check out r.f. cables and connectors from directional coupler up to and including antenna central array.
3	Connect the Oscilloscope MM-504 to the TEST OUTPUT (J607) jack on the front panel of the Coder Indicator. Adjust the Oscilloscope for a 'normal indication'.	Waveshape No 24B shown in figure 5-11 should be obtained.	If normal indication is not obtained, trouble is probably in Coder Indicator. Refer to Coder Indicator troubleshooting chart (Table 5-5). If normal indication is obtained proceed to Step 4.
4	Check readings of DC SUPPLY VOLTAGE meter M1402 on the front panel of the Frequency Multiplier Oscillator with METER SELECTOR switch in positions 1 through 5.	Meter should read: Position — Voltage OFF — 0 volts dc -375V — -375 volts dc +250V — +250 volts dc +700V — Disconnected +1000V — +1000 volts dc	Refer to low-voltage power supply troubleshooting chart (Table 5-7) if voltages read in positions 1, 2 or 3 are incorrect. Refer to medium-voltage power supply troubleshooting chart (Table 5-8) if the voltage read in position 5 is incorrect.
5	Check reading of HV SUPPLY meter M1302 on the front panel of the Amplifier Modulator.	Meter should read between 10,800 and 13,200 volts.	Refer to high-voltage troubleshooting chart (Table 5-9) if 12,000 ±10% volts reading is not obtained.
SYMPTOM: Aircraft reports that it receives bearing and distance information but does not receive identification call.			
1	Check waveshape at Test Point TP8 in Coder Indicator.	1,350 Hz identification tone pulses should be obtained as shown in waveshape No 48 in figure 5-11.	If normal indication is present at Test Point TP8, perform Step 2. If normal indication is not present at Test Point TP8, the trouble is probably in stages V612 through V614. Signal trace through these stages; refer to Coder Indicator troubleshooting chart (Table 5-5).

TABLE 5-3a. RADIO SET AN/GRN-9D, SYSTEM TROUBLESHOOTING CHART (cont)
Replacement Test Equipment (TABLE 5-1a)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
2	Check that keyer motor B602 is rotating and that switch S605 is closed.	Motor is rotating	If motor is not rotating, check voltages at terminals 2 and 3 of terminal board TB601; voltage should read 120 volts ac. If voltage at terminals 2 and 3 is correct, motor B602 is at fault and should be replaced.
3	Refer to identification keyer test in paragraph 6-2e(3) of Section 6.	Keyer switches operate correctly.	Reset or replace switches if necessary.
SYMPTOM: Aircraft reports that it receives all message elements, but bearing information is in error.			
1	Check antenna rotation speed and tachometer.	Required antenna rotation speed of 15 Hz, or 900 rpm, will be indicated if tachometer reads 675 Hz and/or 120 pps is counted at TP2.	If normal indications are not obtained, cause of trouble is in antenna. Refer to technical manual for appropriate antenna group.
2	Check direction of rotation of antenna spin motor	Check that antenna is rotating in a clockwise direction, as viewed from above.	Check wiring of three-phase power supply to antenna from receiver-transmitter cabinet to spin motor.
3	Check reading of ANTENNA ERROR meter on the front panel of the Coder Indicator.	Meter should read in green area of scale.	If meter reads in red area, cause of trouble is in antenna Refer to technical manual for appropriate antenna group.
4	Check 40μsec blanking gate at Test Point TP9 in radio receiver as described in paragraph 3-6a(12) of Section 3.	Blanking gate should be 40μsec wide and appear as shown in waveshape No 17 of fig 5-4.	If blanking pulse is not present or is of insufficient amplitude, check stages V406 and V407B in radio receiver. Refer to radio receiver troubleshooting chart (Table 5-4). If pulse is present but is of incorrect duration, adjust potentiometer R443 to obtain 40μsec duration.
SYMPTOM: Aircraft reports that it receives distance and identification call but does not receive bearing information.			
1	Connect the oscilloscope MM-504 to the TEST OUTPUT (J607) jack on the front panel of the Coder Indicator. Adjust the oscilloscope for a 'normal indication'	Waveshape No 24B shown in figure 5-11 should be obtained.	If normal indication is not obtained, the trouble is probably in the Coder Indicator. Refer to the Coder Indicator troubleshooting chart (Table 5-5).
2	Check for the presence of North and Auxiliary trigger pulses, using the Oscilloscope at the Test Points TP1 and TP2 in the Coder Indicator.	North trigger pulse obtained at Test Point TP1 should appear as shown in waveshape No 1 of figure 5-11. Auxiliary trigger pulse obtained at Test Point TP2 should appear as shown in waveshape No 25 of figure 5-11.	If either one or both triggers are not obtained, trouble is in portion of antenna concerned with trigger generation. Refer to technical manual for appropriate antenna.

TABLE 5-3a. RADIO SET AN/GRN-9D, SYSTEM TROUBLESHOOTING CHART (cont)
Replacement Test Equipment (TABLE 5-1a)

STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
SYMPTOM: Aircraft reports that it receives bearing and identification call information, but does not receive distance information.			
1	Check readings on TEST METER M501 on the front panel of radio receiver, in all positions of METER SELECTOR switch S501. Set the FUNCTION switch of the Power Meter - Pulse Counter - Marker Generator MM-109 to GEN TEST and connect the COUNTER INPUT socket to the TEST OUTPUT (J507) jack on the receiver front panel.	Compare with logged readings. Reading of 2700 ±90 pulses per second.	If meter readings obtained differ considerably from logged readings, or pulse count is incorrect, refer to radio receiver troubleshooting chart (Table 5-4).
2	Check tuning of preselector Z1153.		If preselector is improperly tuned, retune according to the instructions given in paragraph 2-5f(2) of Section 2. Check cabling and connection between preselector and mixer stage of radio receiver.
SYMPTOM: Aircraft reports that it receives all message elements, but that distance information is in error.			
1	Check overall delay as described in paragraph 3-6a(12) of Section 3.	Waveshape indicating proper delay should appear as shown in figure 3-20	If normal indication is not obtained, check as follows: If 50μsec delay is not correct, adjust delay line DL601 as described in paragraph 6-2e(5) of Section 6. If delay line does not respond to adjustment, check electrical characteristic of delay line. Replace delay line, if necessary.
SYMPTOM: Aircraft reports that it does not receive bearing and distance information over entire 200-mile range.			
1	Using the built-in test equipment, make peak r.f. power output measurement according to instructions given in paragraph 3-6a(12) of Section 3.	Radio beacon power output should be at least 7.5 kilowatts.	If normal indication is obtained, proceed to Step 2. If power output is low, refer to power supply troubleshooting chart (Table 5-6).
2	Check transmitter output by connecting the Oscilloscope in turn to the ANTENNA INCIDENT (J1154) jack and the ANTENNA REFLECTED (J1153) jack on the front panel of the Control Duplexer. Observe the waveshape and measure, and record, the peak-to-peak voltage obtained for each.	Compare with previously logged readings. A minimum of 2 to 1 incident to reflected voltage ratio should be obtained.	If normal indication is obtained, check that siting requirements are fulfilled. If normal indication is not obtained, refer to technical manual for appropriate antenna.

If normal indication is obtained, proceed to Step 2, If power output is low, refer to power supply troubleshooting charts (Tables 5-7 through 5-9) and transmitter troubleshooting chart (Table 5-6).

Figure 5-2. Radio Beacon, Servicing Block Diagram

Figure 5-2a. Radio Beacon, Servicing Block Diagram
(Replacement Test Equipment, Table 5-1a)

condition. Illustrations containing information which will aid the technician in troubleshooting the radio receiver are included in both this section and in Section 6.

(a) PRELIMINARY CHECK. —When trouble has been localized to the radio receiver, the initial check is for an a-c power input to the radio receiver. If POWER ON lamp DS501 is off when receiver ON/OFF switch S502 is in the ON position, check the radio receiver interlock for damage and the condition of line fuses F501 and F502. Fuse failure is indicated by a glowing lamp in the fuseholder. Also check that all tube filaments are on.

(b) TEST EQUIPMENT AND SPECIAL TOOLS. —The test equipment required to perform the radio receiver troubleshooting procedure is based on using the built-in test equipment. This equipment is housed in the power supply assembly cabinet and consists of a power meter-pulse counter, an oscilloscope, a pulse analyzer-signal generator, and a pulse-sweep generator. No special tools are required to perform this procedure.

(c) CONTROL SETTINGS. —Table 5-2 lists the preliminary settings of all controls required when troubleshooting.

(d) RADIO RECEIVER TROUBLESHOOTING CHART. —When trouble has been localized to the radio receiver, follow the troubleshooting procedure given in table 5-4 to further localize the trouble to a specific component part of the radio receiver.

(e) ILLUSTRATIONS. —Illustrations containing information which will aid the technician in troubleshooting the radio receiver are as follows:

1. Figure 5-3. Radio Receiver R-824/URN, Servicing Block Diagram

2. Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes

3. Figures 5-5 through 5-8. Radio Receiver R-824/URN, Tube Socket Voltage and Resistance Diagrams

4. Figures 5-9 and 6-5. Radio Receiver R-824/URN, Test Point Location Illustrations

5. Figure 6-17. Radio Receiver R-824/URN, Schematic Diagram

TABLE 5-4. RADIO SET AN/GRN-9D, RADIO RECEIVER, FUNCTIONAL SECTION TROUBLESHOOTING CHART

(Information in italics refers to the Replacement Test Equipment of Table 5-1a).

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1	14 See figures 5-3 and 6-17	Check readings of TEST METER M501 on radio receiver panel with METER SELECTOR switch S501 in the following positions:		If readings show power supply to be operating normally, proceed to step 2.
		B + 200VFS	Reading of 150 ± 5 volts is normal. (Meter reading of 75 indicates 150 volts.)	If reading is incorrect, check that potentiometer R507 is set correctly and readjust if necessary. Replace tubes V501, V503, V504, and V505. If trouble persists, take voltage and resistance measurements from tube sockets and compare with values given in figure 5-5.
		C - 200VFS	Reading of -105 ± 5 volts is normal. (Meter reading of 52.5 indicates -105 volts.)	If reading is incorrect, replace tubes V502 and V506. If trouble persists, take voltage and resistance measurements from tube sockets and compare with values given in figure 5-5.
2	14 See figures 5-3 and 6-17	Set METER SELECTOR switch S501 to CR201 and then to CR202, noting reading on TEST METER M501 for each position.	Half-scale deflection at each position is normal	If normal indication is obtained, proceed to step 3. If reading is incorrect, replace diodes CR201 and CR202. If trouble persists, check continuity of cable between jack J502 on preamplifier mixer chassis and jack J1502 on frequency multiplier-oscillator r-f chassis and refer to transmitter troubleshooting chart (table 5-6).
3	2 See figures 5-3 and 6-17	Check receiver sensitivity as described in paragraph 3-6a(7) *and 3-6a(12)(f).* Check squitter count as described in paragraph 306a(6) *and 3-6a(12)(a).*	Minimum requirement is -93 db at 60-percent replies. Squitter circuit requirement is 2,700 ± 90 pps.	If requirement is not met, perform steps 4 through 16, in the order given, until cause of trouble is located. If squitter rate is low (less than 500 pps), check for: Open circuit between plug P302 on i-f amplifier and jack J402 on receiver video chassis; replace cables, if necessary. Open circuit

Note. *When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.*

TABLE 5-4. RADIO SET AN/GRN-9D, RADIO RECEIVER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
3 (cont)				between plug P303 and jack J203 on i-f amplifier; replace cable, if necessary. Tube V405A weak or inoperative; replace tube, if necessary. If squitter rate is excessively high (above 15,000 pps), check for: Open circuit between plug P401 on video chassis and jack J301 on i-f amplifier. (This condition is accompanied by squitter voltage above -10 volts.) Replace cable if necessary. Defective stages V407, V408, V409A, and V409B; replace tubes, if necessary. If squitter rate is high or low, but holding constant, check that potentiometer R427 is set correctly; readjust if necessary. Perform steps 4 through 16, in the order given, until cause of trouble is found.
4	A See figures 5-3, 6-5, and 6-17	Set oscilloscope sweep rate at 16 microseconds per inch and connect vertical input jack on oscilloscope to test prod. Connect test prod to pin 2 at tube V401 (12 volts peak-to-peak).	Waveshape No. 19 shown in figure 5-4, (blanking pulse).	If blanking pulse is not present at pin 2 of tube V401, check for pulse at jack J506. If pulse is present, then diode CR402 is defective; replace diode. If pulse is not present at jack J506, check for open cable between video chassis of frequency multiplier-oscillator and radio receiver; replace cable, if necessary. Check preselector tuning. Refer to paragraph 2-5f(2) of Section 2. Refer to transmitter troubleshooting chart (table 5-6).

 Note. When using the MM-504 Oscilloscope, there are 2.54 cm to the inch.

TABLE 5-4. RADIO SET AN/GRN-9D, RADIO RECEIVER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
5		Check tube voltage and resistance measurements of stages V201, V202 and V203 (figure 5-7).	Refer to tube voltage and resistance diagram (figure 5-7).	Check for faulty tubes, then check for faulty component. Replace defective tubes and components. Realignment of preamplifier stages should not be attempted unless test equipment required in preamplifier alignment procedure is available.
6	B C	Set oscilloscope sweep rate to 36 microseconds per inch and connect vertical input jack of oscilloscope to test prod.		
	See figures 5-3, 5-9, and 6-17	Connect test prod to test point TP2 and then TP3.	Ferris discriminator output pulses should appear as shown in waveshapes No. 1 and 2 of figure 5-4.	If normal indication is obtained, proceed to step 9. If normal indication is not obtained, proceed to step 7.
7	D See figures 5-3, 5-9, and 6-17	Set oscilloscope sweep rate to 10 microseconds per inch and connect test prod to test point TP1.	Pulse-pair waveshape with accompanying grass.	If normal indication is obtained, replace tubes V305 and V306. If substitution of these tubes does not clear receiver fault, take voltage and resistance measurements from tube sockets XV305 and XV306, comparing them with values given in figure 5-6. Replace defective components. If normal indication is not obtained, replace tubes V301 through V304. If trouble persists, proceed to step 8.
8		Check tube voltage and resistance measurements of stages V301 through V304.	Refer to i-f amplifier tube socket voltage and resistance diagram (figure 5-6).	Replace defective components.
9	E See figures 5-3, 5-9, and 6-17	Set oscilloscope sweep rate at 40 microseconds per inch and connect test prod to test point TP5 (7.5 volts peak-to-peak).	Waveshape No. 5 shown in figure 5-4.	If normal indication is obtained, proceed to step 10. If normal indication is not obtained, replace tubes V307 and V308. If trouble persists, take voltage and resistance measurements from tube sockets XV307 and XV308, comparing them with values

Note. When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.

TABLE 5-4. RADIO SET AN/GRN-9D, RADIO RECEIVER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
9 (cont)				given in figure 5-6. Replace defective components.
10	E1 See figures 5-3, 6-5, and 6-17	Connect test prod to pin 1 at tube V402 (30 volts peak-to-peak).	Waveshape No. 6 shown in figure 5-4.	If normal indication is obtained, proceed to step 11. If normal indication is not obtained, tube V402 is defective. Replace tube V402. If trouble persists, take voltage and resistance measurements from tube socket, comparing them with values given in figure 5-8.
11	F See figures 5-3, 6-5, and 6-17	Connect test prod to pin 7 of tube V402 (20 volts peak-to-peak).	Waveshape No. 7 shown in figure 5-4.	If normal indication is obtained, proceed to step 13. If normal indication is not obtained, proceed to step 12.
12	G See figures 5-3, 5-9, and 6-17	Connect test prod to test point TP9 (18 volts peak-to-peak).	Waveshape No. 17 shown in figure 5-4.	If normal indication is obtained, replace tube V401. If pulse width is incorrect, readjust potentiometer R443. If pulse is not observed, replace tubes V406 and V407. If trouble persists, proceed to step 13.
13	F1 See figures 5-3, 6-5, and 6-17 F2 See figures 5-3, 6-5, and 6-17	In sequential order, connect test prod to: Pin 7 at tube V403 (10 volts peak-to-peak). **Note** Adjust potentiometer R456 to eliminate negative overshoot. Pin 1 at tube V403 (8 volts peak-to-peak).	Waveshape No. 8 shown in figure 5-4. Waveshape No. 9 shown in figure 5-4.	If normal indication is observed at both pins, proceed to step 14. If normal indication is observed at pin 7 but not at pin 1, delay line DL401 or potentiometer R410 is defective. If normal indication is not obtained at both pins, tube V402B is defective. Replace tube V402. If trouble persists, take voltage and resistance measurements, comparing them with values given in figure 5-8.
14	F3 See figures 5-3, 6-5, and 6-17	Set oscilloscope sweep rate at 3 microseconds per inch and connect test prod to pin 5 at tube V403 (30 volts peak-to-peak).	Waveshape No. 11 shown in figure 5-4 obtained only when 12-microsecond pulse pairs appear at output of tube V204B.	If normal indication is obtained, proceed to step 15. If normal indication is not obtained, replace tube V403.

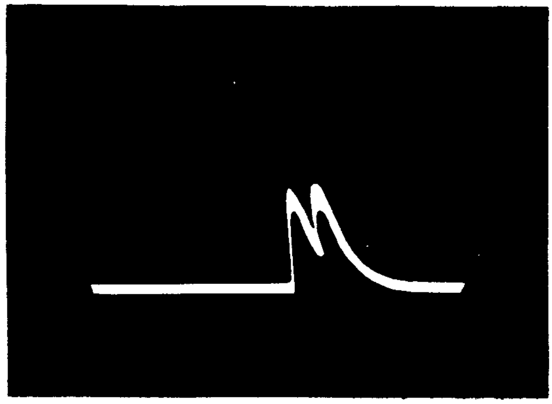
 Note. When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.

TABLE 5-4. RADIO SET AN/GRN-9D, RADIO RECEIVER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

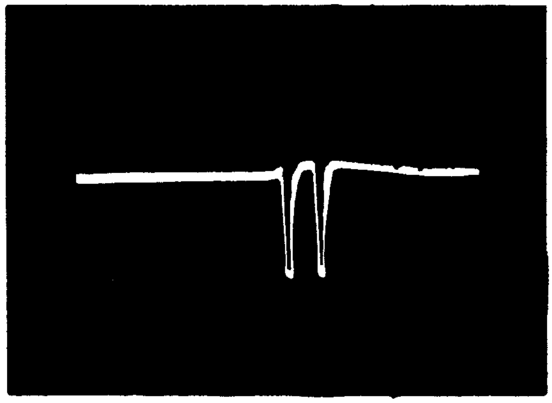
STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
15	H See figures 5-3, 5-9, and 6-17	Connect test prod to test point TP8 (25 volts peak-to-peak).	Waveshape No. 15 shown in figure 5-4.	If normal indication is observed, proceed to step 16. If normal indication is not obtained, replace tube V404.
16	5 See figures 5-3 and 6-17	Connect test prod to test point TP7 (25 volts peak-to-peak).	Waveshape No. 14 shown in figure 5-4.	Replace tube V405. If trouble persists, take voltage and resistance measurements from tube sockets XV404 and XV405, comparing them with values given in figure 5-8.

Figure 5-3. Radio Receiver R-824/URN. Servicing Block Diagram

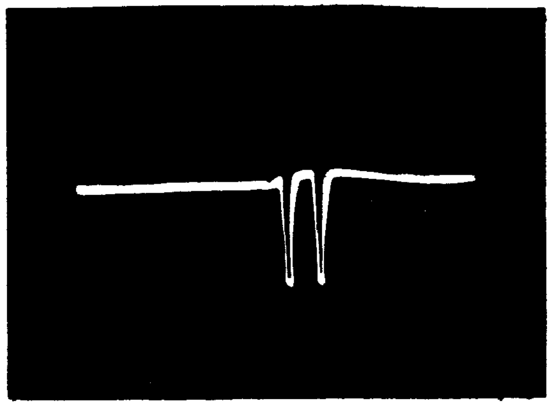
LOCATION: TP2
Sweep Rate: 36 μsec/in.
Measurement: 5 V pp
Remarks: Discriminator V306B output.
1



LOCATION: TP3
Sweep Rate: 36 μsec/in.
Measurement: 2 V pp
Remarks: Discriminator V306A output.
2



LOCATION: Grid (pin 2) V307A video amplifier
Sweep Rate: 36 μsec/in.
Measurement:
Remarks: Clipper V308A defective if excessive positive overshoot appears.
3



LOCATION: Grid (pin 7) V307B video amplifier
Sweep Rate: 36 μsec/in.
Measurement:
Remarks: Clipper V308B is defective if any negative overshoot appears.
4

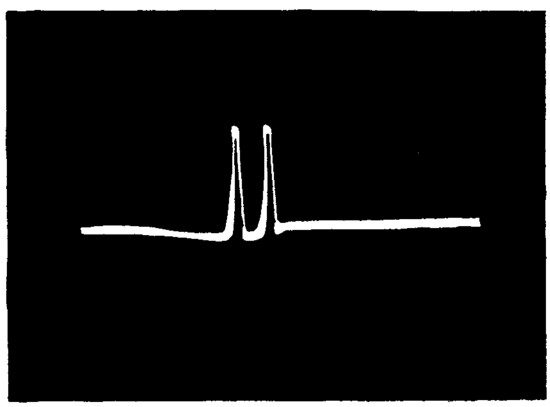
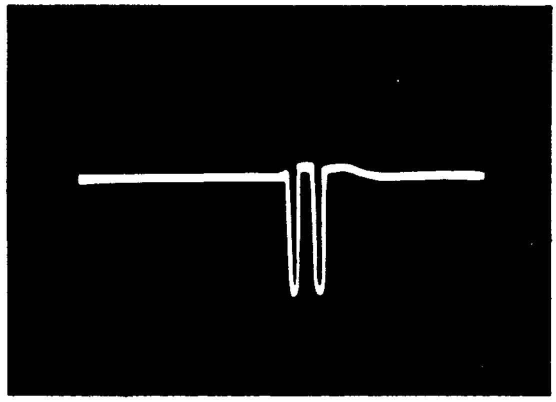


Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes (Sheet 1 of 6)

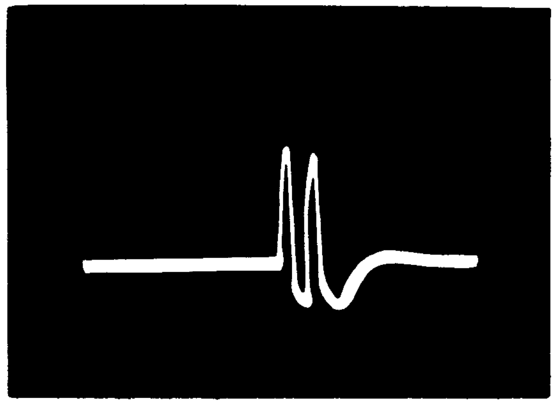
LOCATION: TP5 grid (pin 2 V402) 1st video amplifier
Sweep Rate: 40 μsec/in.
Measurement: 7.5 V pp
Remarks: Negative pulse pair; 12 μsec between pulses; 3 μsec pulse width.

5



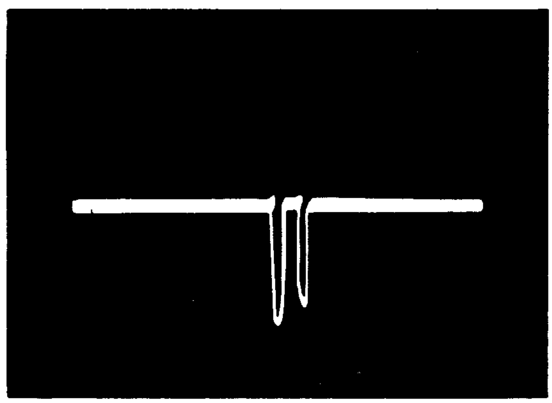
LOCATION: Plate (pin 1) V402
Sweep Rate: 40 μsec/in.
Measurement: 30 V pp
Remarks: Positive pulse pair; 12 μsec between pulses; 3 μsec pulse width.

6



LOCATION: Grid (pin 7) V402
Sweep Rate: 40 μsec/in.
Measurement: 20 V pp
Remarks: Negative pulse pair; 12 μsec between pulses; 1 μsec pulse width.

7



LOCATION: Suppressor grid (pin 7) V403, Decoder
Sweep Rate: 40 μsec/in.
Measurement: 10 V pp
Remarks: Undelayed pulse pair, 12 μsec between pulses; 1 μsec pulse width. Adjust R456 to eliminate negative overshoot.

8

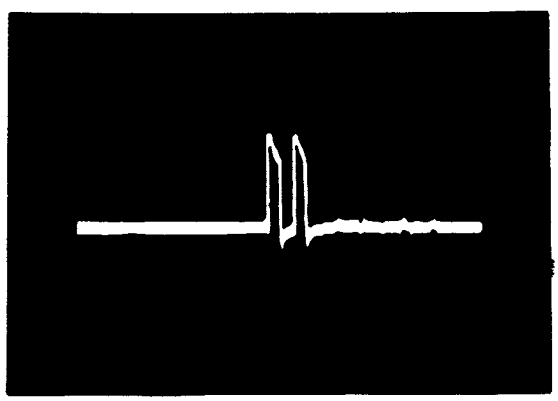
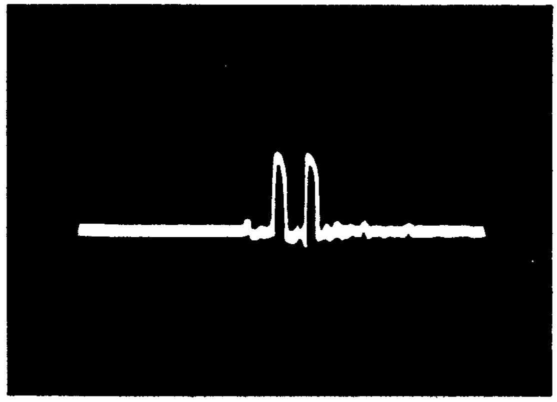


Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes (Sheet 2 of 6)

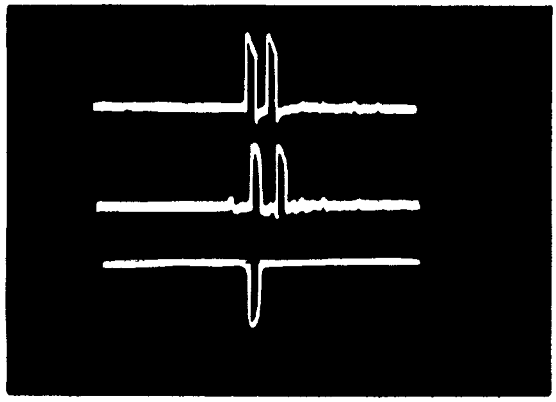
LOCATION: Grid (pin 1) V403, Decoder
Sweep Rate: 40 μsec/in.
Measurement: 8 V pp
Remarks: Pulse pair delayed by 12 μsec. 12 μsec between pulses; 1 μsec pulse width.

9



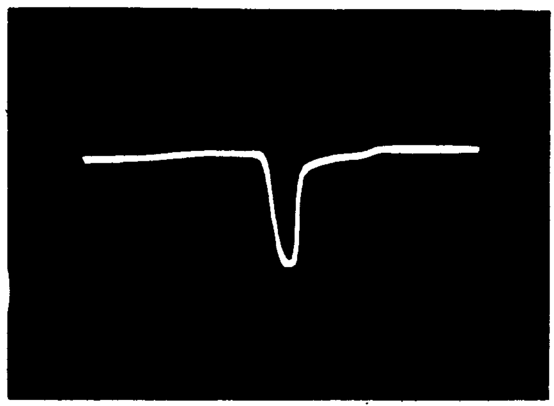
LOCATION: Composite of waveforms at pins 1 and 7 of V403
Sweep Rate: 40 μsec/in.
Measurement: (a) pin 7, V403
(b) pin 1, V403
(c) pin 5, V403
Remarks: Shows operation of delay line (DL401) - decoder (V403).

10



LOCATION: Plate (pin 5) of V403, Decoder
Sweep Rate: 3 μsec/in.
Measurement: 30 V pp
Remarks: Decoded pulse. Obtained only when 12 μsec spaced pulse pairs appear at output of V402B.

11



LOCATION: TP8 Cathode (pin 2), V404 or grid (pin 7) V405
Sweep Rate: 3 μsec/in.
Measurement: 25 V pp
Remarks: 4 μsec pulse width.

12

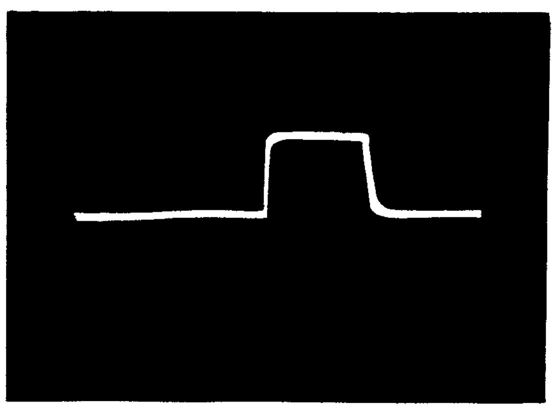
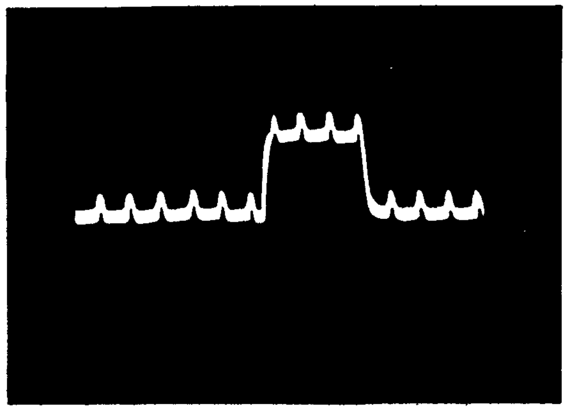


Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes (Sheet 3 of 6)

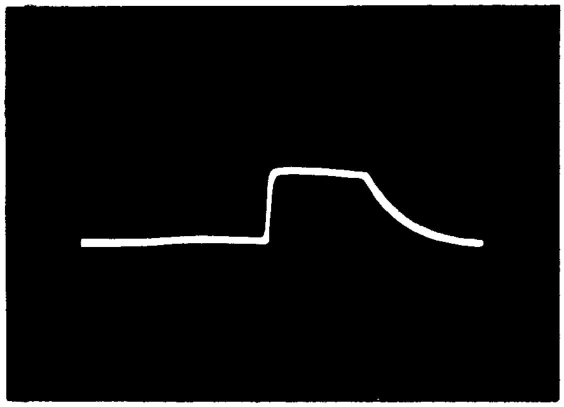
LOCATION: TP8 – Same as above
Sweep Rate: 3 μsec/in.
Measurement: 25 V pp
Remarks: 1 μsec markers added to measure 4 μsec pulse width.

13



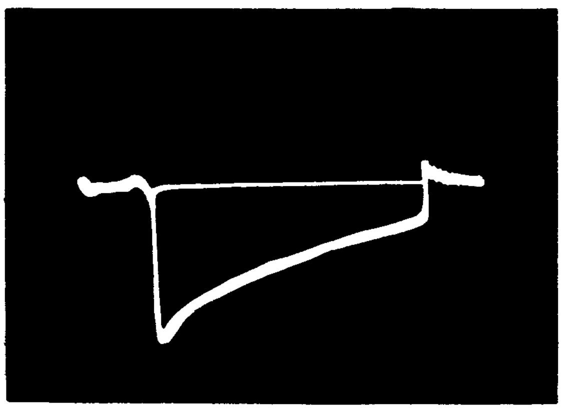
LOCATION: TP7 VIDEO OUTPUT
Sweep Rate: 3 μsec/in.
Measurement: 25 V pp
Remarks: Single pulse 3–4 μsec wide. Input pulse to coder-indicator.

14



LOCATION: Grid (pin 3) V406 Blanking multivibrator input
Sweep Rate: 16 μsec/in.
Measurement: 22 V pp; 40 μsec wide
Remarks:

15



LOCATION: Cathode (pin 8) V406 Blanking multivibrator output
Sweep Rate: 16 μsec/in.
Measurement: 23 V pp, 40 μsec wide
Remarks:

16

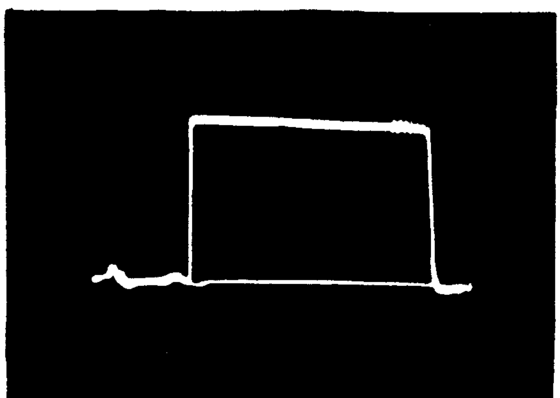
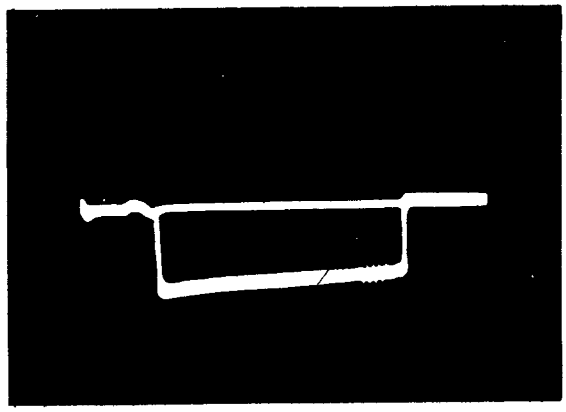
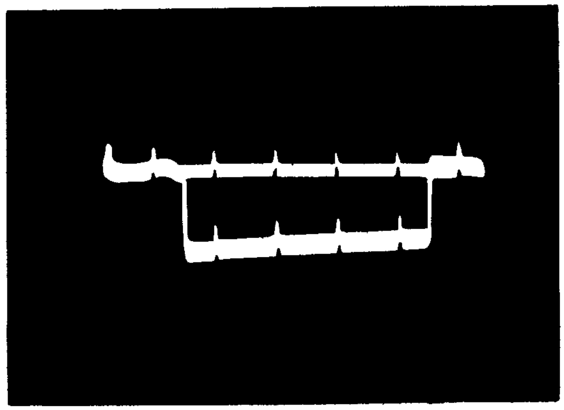


Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes (Sheet 4 of 6)

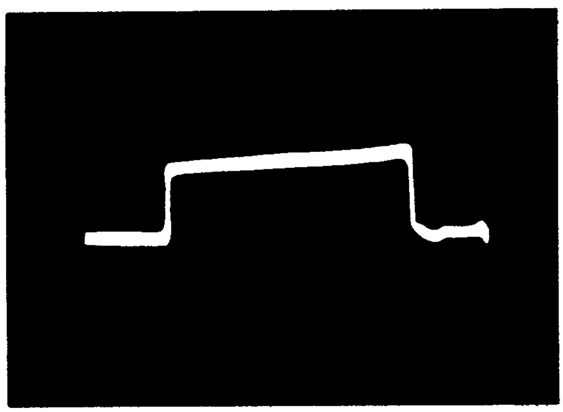
LOCATION: TP9 or suppressor grid (pin 7) V401 Blanking gate
Sweep Rate: 16 μsec/in.
Measurement: 18 V pp, 40 μsec wide
Remarks: If pulse is not 40 μsec, adjust R443 BLANKING TIME ADJ pot. (See waveform below)
17



LOCATION: TP9 or V401, pin 7
Sweep Rate: 16 μsec/in.
Measurement: 18 V pp, 40 μsec wide
Remarks: 10 μsec markers added to check pulse width and permit adjustment of R443.
18



LOCATION: Cathode (pin 2) V401, Blanking gate
Sweep Rate: 16 μsec/in.
Measurement: 12 V pp, 10 μsec width
Remarks:
19



LOCATION: TP6 or J403
Sweep Rate: 4 μsec/in.
Measurement: 3 V pp, 3 μsec pulse width
Remarks: 12 μsec between pulses of pair.
20

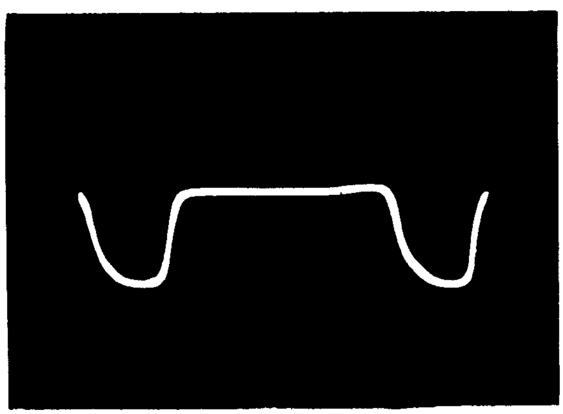
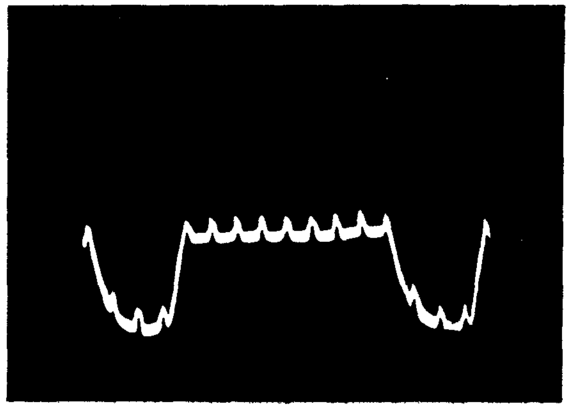


Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes (Sheet 5 of 6)

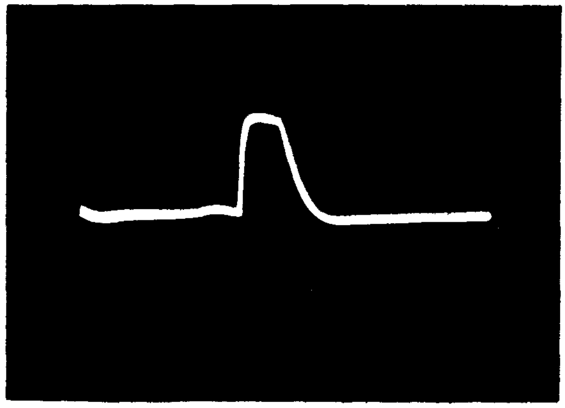
LOCATION: TP6 or J403
Sweep Rate: 4 µsec/in.
Measurement: 3 V pp, 3 µsec wide
Remarks: Same as above, 1 µsec marker added for measurement, of pulse duration and spacing.

21



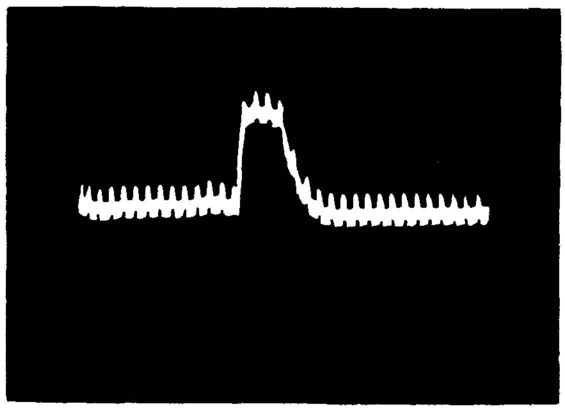
LOCATION: J407 TEST OUTPUT jack
Sweep Rate: 8 µsec/in.
Measurement: 25 V pp, 3–4 µsec wide
Remarks:

22



LOCATION: J407 TEST OUTPUT jack
Sweep Rate: 8 µsec/in.
Measurement: 25 V pp, 3–4 µsec wide
Remarks: 1 µsec markers added to measure pulse width.

23



LOCATION: J407 TEST OUPUT jack
Sweep Rate: 1600 µsec/in.
Measurement: 25 V pp
Remarks: Part of video output pulse train of radio receiver. Complete pulse train should be 2700 pulse/second.

24

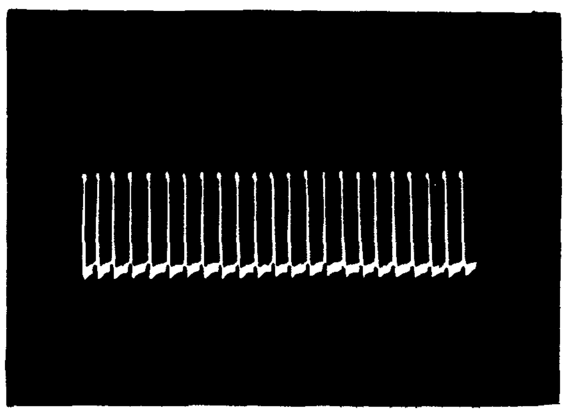
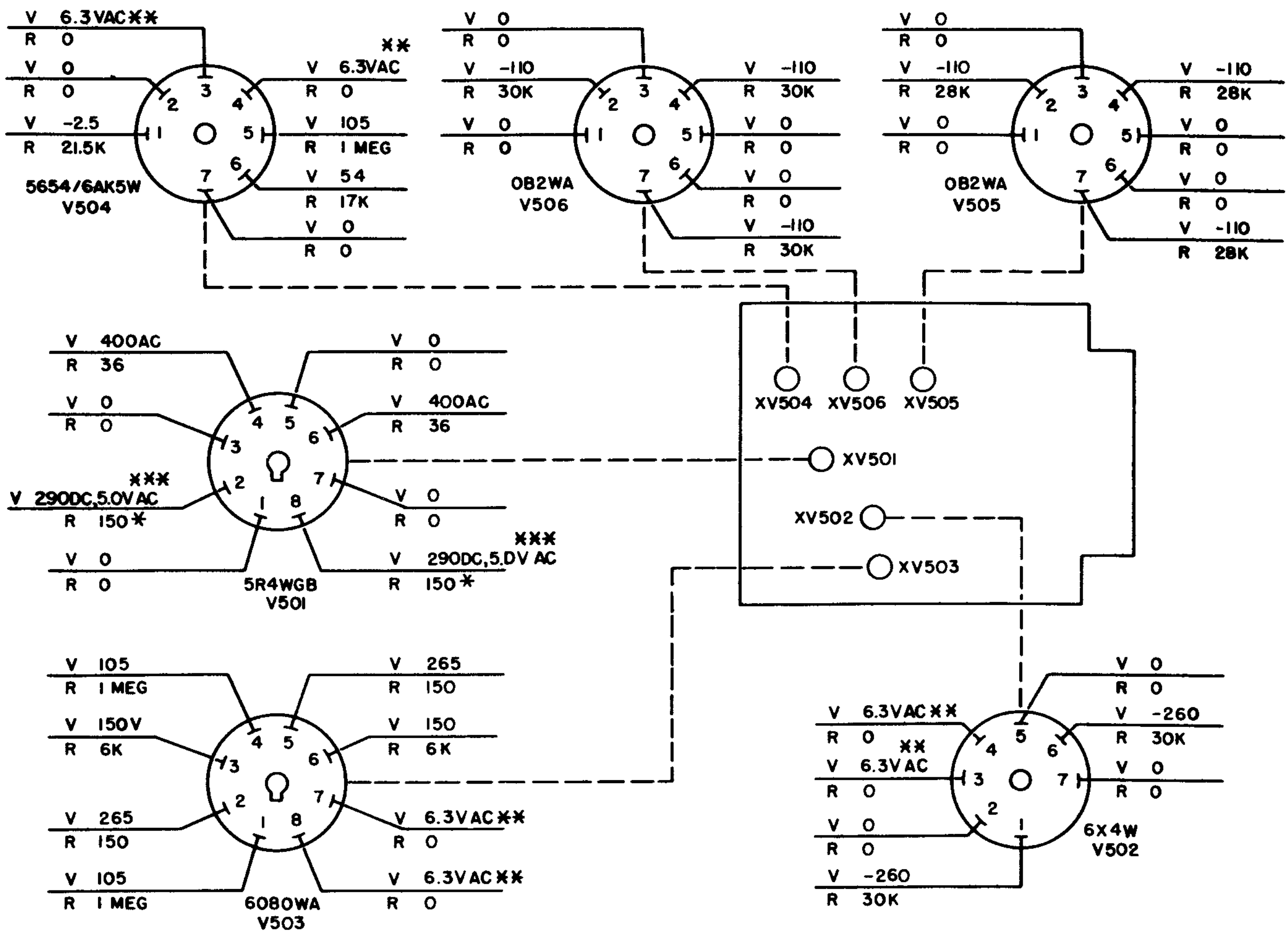


Figure 5-4. Radio Receiver R-824/URN, Signal-Tracing Waveshapes (Sheet 6 of 6)

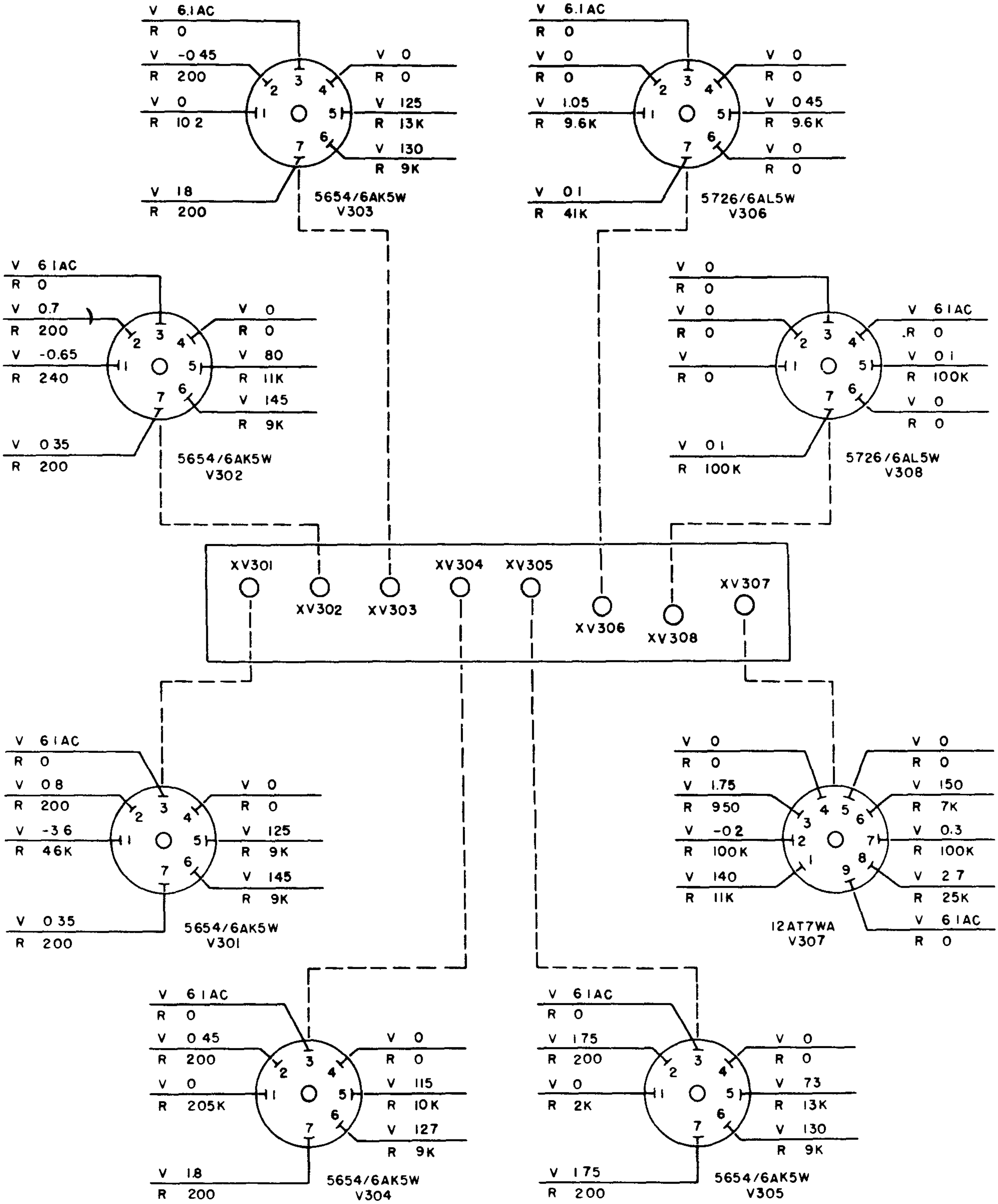


NOTES:
1. READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY.

KEY TO SYMBOLS

V	INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED
R	INDICATES DC RESISTANCE TO GROUND
*	MEASURED BETWEEN PINS 2 OR 8 OF V501
**	6.3V AC BETWEEN PINS MARKED WITH 2 ASTERISKS
***	5.0VAC BETWEEN PINS MARKED WITH 3 ASTERISKS

Figure 5-5. Radio Receiver R-824/URN, Power Supply, Tube Socket Voltage and Resistance Diagram



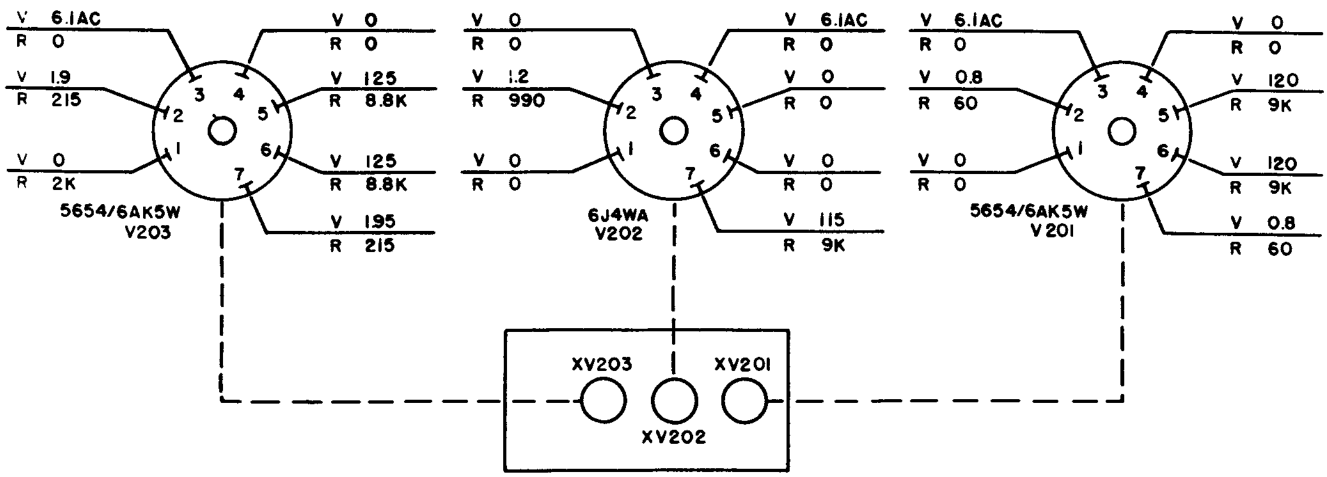
NOTES

1 READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY

KEY TO SYMBOLS

V	INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED
R	INDICATES DC RESISTANCE TO GROUND
AC	INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

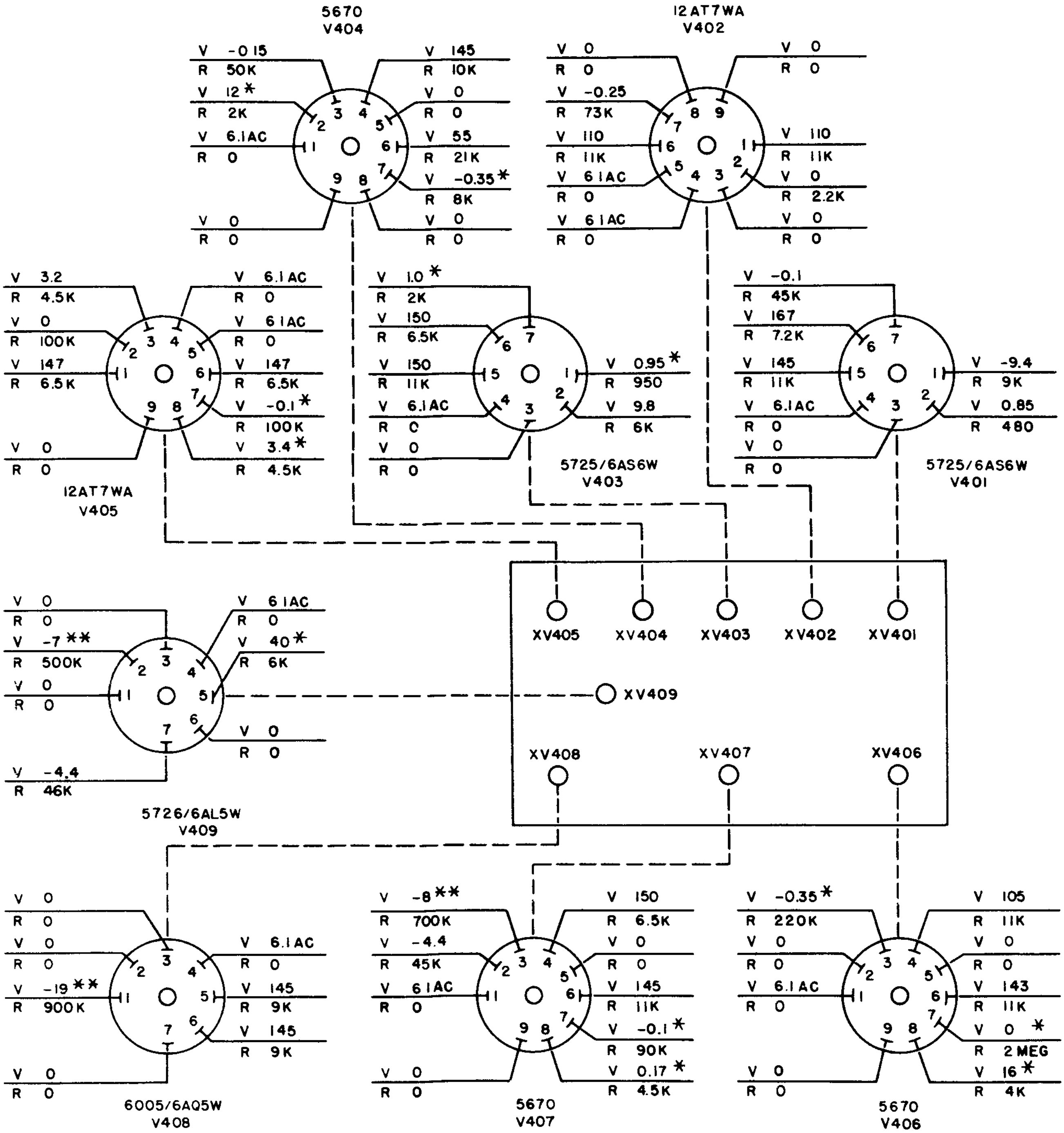
Figure 5-6. Radio Receiver R-824/URN, I-F Amplifier, Tube Socket Voltage and Resistance Diagram



NOTES
1 READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY.

KEY TO SYMBOLS
V INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
R INDICATES DC RESISTANCE TO GROUND.
AC INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

Figure 5-7. Radio Receiver R-824/URN, Preamplifier and Mixer, Tube Socket Voltage and Resistance Diagram



NOTES

1 READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY.

KEY TO SYMBOLS

V	INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
R	INDICATES DC RESISTANCE TO GROUND
*	DENOTES USE OF VTVM
**	CAUTION: TRANS HV CURRENT EXCEEDS 300 MA WHEN MEASURED ON VOLTMETER OF 1000 OHMS PER VOLT.
AC	INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

Figure 5-8. Radio Receiver R-824/URN, Video Chassis, Tube Socket Voltage and Resistance Diagram

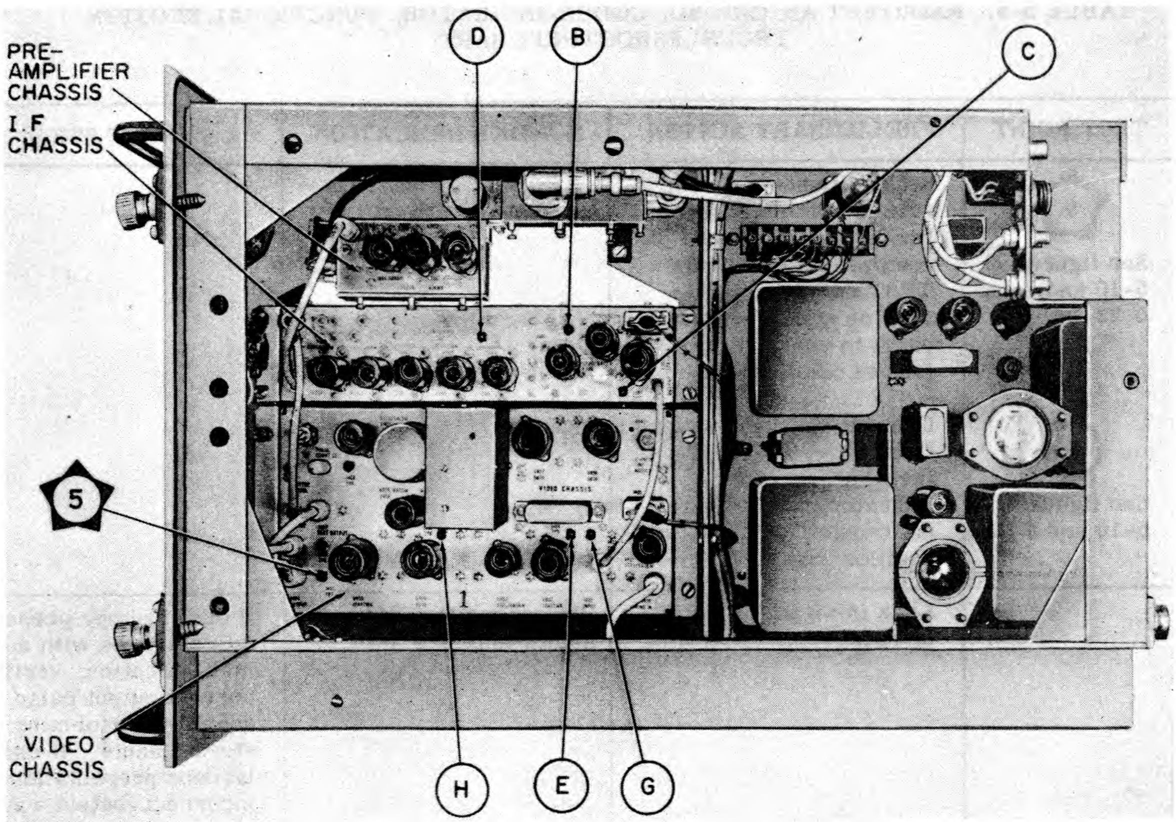


Figure 5-9. Radio Receiver R-824/URN, Right Side View, Test Point Location

(2) TROUBLESHOOTING CODER-INDICATOR. (See figure 5-10). —When trouble has been localized to the coder-indicator, follow the troubleshooting procedure presented in the following paragraphs to further localize the trouble to a specific component part of the coder-indicator. After the trouble has been corrected, refer to paragraph 6-2e of Section 6 for circuit adjustment procedures. Check that circuits associated with repaired or replaced components are properly adjusted. Illustrations containing information which will aid the technician in troubleshooting the coder-indicator are included in both this section and in Section 6.

(a) PRELIMINARY CHECK. —When trouble has been localized to the coder-indicator the initial check is for an a-c power input to the coder-indicator. If POWER ON lamp DS601 is off when CODER INDICATOR switch S601 is in the ON position, check the coder-indicator interlock for damage and the condition of line fuses F601 and F602. Fuse failure is indicated by a glowing lamp in the fuseholder. Also check that all tube filaments are on.

(b) TEST EQUIPMENT AND SPECIAL TOOLS. —The test equipment required to perform the coder-indicator troubleshooting procedure is based on using the built-in test equipment. This equipment is housed in the power supply assembly cabinet. No special tools are required to perform this procedure.

(c) CONTROL SETTINGS. —Table 5-2 lists the preliminary settings of all controls required when troubleshooting.

(d) CODER-INDICATOR TROUBLESHOOTING CHART. —When trouble has been localized to the coder-indicator, follow the troubleshooting procedure given in table 5-5.

(e) ILLUSTRATIONS. —Illustrations containing information which will aid the technician in troubleshooting the coder-indicator are as follows:

1. Figure 5-10. Coder-Indicator KY-382/GRN-9D, Servicing Block Diagram

2. Figure 5-11. Coder-Indicator KY-382/URN-9D, Signal-Tracing Waveshapes

3. Figures 5-12 and 5-13. Coder-Indicator KY-382/GRN-9D, Tube Socket Voltage and Resistance Diagrams

4. Figures 5-14, 6-52, and 6-53. Coder-Indicator KY-382/GRN-9D, Test Point Location Illustrations

5. Figures 6-21 through 6-23. Coder-Indicator KY-382/GRN-9D, Schematic Diagrams

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1	9 See figures 5-10 and 6-23 I See figures 5-10 and 6-23	Set oscilloscope sweep rate to 120 microseconds per inch. Connect coaxial test lead from TEST OUTPUT jack J607 on coder-indicator panel to vertical input panel jack of oscilloscope. Connect coaxial test lead from SYNC OUTPUT jack J606 on coder-indicator panel to external trigger input jack on oscilloscope.		
2		Lock in signal on oscilloscope.	Waveshape No. 24A shown in figure 5-11.	If oscilloscope presentation agrees with normal indication, verify correct output pulse count by performing steps 3 and 4. If oscilloscope presentation is incorrect (output waveshape missing), perform steps 7 through 16, in the order given, until cause of trouble is located.
3		Set COUNTER SELECTOR switch and FUNCTION SWITCH on power meter-pulse counter panel to + and GENERAL TESTING positions, respectively.		
4	9 See figures 5-10 and 6-23	Connect coaxial test lead from TEST OUTPUT jack J607 to counter input jack on power meter-pulse counter panel.	Reading of 2, 700 pps should be indicated on pulse count meter of power meter-pulse counter panel.	If normal pulse count is not obtained, proceed to step 5.
5	9 See figures 5-10 and 6-23 I See figures 5-10 and 6-23	Connect coaxial test lead from TEST OUTPUT jack J607 to vertical input jack on oscilloscope. Connect coaxial test lead from SYNC OUTPUT jack J606 to external trigger input jack on oscilloscope.		

Note. When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
6		Check each component of output pulse train by varying horizontal sweep speed to lock in on each component. (See waveshapes No. 24A through 24C in figure 5-11 for recommended sweep speed.) **Note** If normal indications required in steps 1 through 6 are obtained, it may be assumed that coder-indicator is operating properly.	Reference bursts should appear as shown in waveshape No. 24B of figure 5-11. Interrogation pulse from receiver should appear as shown in waveshape No. 24C of figure 5-11. The 12-microsecond coding of output pulses should appear as shown in waveshape No. 24D of figure 5-11.	If both 15- and 135-cps reference pulse bursts are missing or incorrect, proceed to step 8. If only 15-cps reference bursts is missing or incorrect, proceed to step 12. If only 135-cps reference burst is missing or incorrect, proceed to step 13. If both identification code and output of radio receiver are missing, proceed to step 14. If output of radio receiver is missing (distance interrogations and squitter pulses), proceed to step 14. If identification call pulses are missing, perform steps 15 and 16. If pulses are not double coded, proceed to step 10.
7	15 See figures 6-22 and 6-53	Connect Multimeter AN/PSM-4 to the following points and ground:		
		Terminal 1 of terminal board TB701 (B+)	B+ should be +250 volts dc	
	16 See figures 6-22 and 6-53	Terminal 6 of terminal board TB701 (bias voltage)	Bias voltage should be -105 volts dc	If both B+ and bias voltages are missing, check fuses F601 and F602 and POWER ON lamp DS601 on front panel of coder-indicator. If POWER ON lamp and FUSE BLOWN indicator lamps are out, check interlocks, OFF-ON switch, and power wiring to unit. If fuse is blown, replace fuse and turn on equipment. If fuse continues to blow, a short in coder-indicator is indicated. To localize short, make the following checks: Isolate load by lifting wires at terminals 1 and 6 of terminal board TB704. If fuse does not blow when power is reapplied, short is in load circuits. If fuse does blow, proceed as follows:

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
7 (cont)				Lift leads from terminals 2 and 3 of terminal board TB601 to isolate keyer motor B602. If fuse does not blow, check keyer motor. Replace keyer motor if necessary. If -105-volt portion of power supply fails, replace tubes V702 and V705. If -250-volt portion of power supply fails, replace tubes V701, V702, V704, and V705. If trouble persists after tube replacement, take voltage and resistance measurements and compare them with values given in figure 5-12.
8		Set oscilloscope sweep rate to 120 microseconds per inch and connect test prod to vertical input jack of oscilloscope.		
9		Connect test prod to the following points:		
	J See figures 5-10, 6-21, and 5-14	Pin 2 at tube V605 (75 volts peak-to-peak).	Waveshape No. 13 shown in figure 5-11.	If normal indication is not obtained at pin 2 of tube V605, proceed to step 11.
	K See figures 5-10, 6-21, and 5-14	Pin 1 at tube V605 (117 volts peak-to-peak).	Waveshape No. 14A shown in figure 5-11.	If normal indication is not obtained at pin 1 of tube V605, proceed to step 14.
10		Set oscilloscope sweep rate to 40 microseconds per inch and in sequential order, connect test prod to the following points:		
	L See figures 5-10, 5-14, and 6-21	Test point TP4 (70 volts peak-to-peak).	Waveshape No. 16 shown in figure 5-11.	If normal indication is not obtained, replace tube V605.

Note. When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
10 (cont)	L1 See figures 5-10, 6-21, and 5-14	Pin 6 at tube V606 (90 volts peak-to-peak).	Waveshape No. 18 shown in figure 5-11.	If normal indication is not obtained, replace tube V606.
	L2 See figures 5-10, 5-14, and 6-21	Tap 1 at delay line DL601 (500 volts peak-to-peak).	Waveshape No. 19 shown in figure 5-11.	If normal indication is not obtained, test transformer T603, L604, and capacitor C614.
	L3 See figures 5-10, 5-14, 6-21, and 6-52	Pin 2 at tube V607 (14 volts peak-to-peak).	Waveshape No. 20 shown in figure 5-11.	If normal indication is not obtained, test delay line DL601, diodes CR601 and CR602, and associated components.
	L4 See figures 5-10, 5-14, 6-21, and 6-52	Pin 2 at tube V615 (63 volts peak-to-peak).	Waveshape No. 21 shown in figure 5-11.	If normal indication is not obtained, tube V607A is defective. Replace tube V607.
	L5 See figures 5-10, 5-14, 6-21, and 6-52	Pin 6 at tube V615 (75 volts peak-to-peak).	Waveshape No. 23 shown in figure 5-11.	If normal indication is not obtained, replace tube V615. If normal indication is obtained, tube V607B is defective. Replace tube V607. If trouble persists after tube substitution, take voltage and resistance measurements from tube sockets and compare them with values given in figure 5-13.
11		Set oscilloscope sweep rate to 120 microseconds per inch and, in sequential order, connect test prod to the following points:		
	M See figures 5-10, 5-14, 6-21, and 6-52	Pin 2 at tube V604 (17 volts peak-to-peak).	Waveshape No. 11A or 11B shown in figure 5-11.	If normal indication is not observed at both pins, proceed to step 12. If normal indication is observed at pin 2 but not at pin 1, tube V604A is defective. Replace tube

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
11 (cont)	M_1 See figures 5-10, 5-14, 6-21, and 6-52	Pin 1 at tube V604 (75 volts peak-to-peak).	Waveshape No. 12 shown in figure 5-11.	V604. If trouble persists, take voltage and resistance measurements and compare them with values given in figure 5-13.
12		In sequential order, connect test prod to the following points:		
	7 See figures 5-10 and 6-21	Test point TP1 (10 volts peak-to-peak).	Waveshape No. 1 shown in figure 5-11.	Depending upon indications obtained, check one of the following: If waveshape at test point TP1 is not obtained, check cable from pulser coil to input of coder-indicator, north reference burst pickup coil, and north reference burst slug in pulse plate. Replace all defective components. If waveshape No. 3 is incorrect, replace tube V601. If trouble persists, take voltage and resistance measurements and compare them with values given in figure 5-14.
	N See figures 5-10, 5-14, 6-21, and 6-52	Pin 7 at tube V602 (40 volts peak-to-peak).	Waveshape No. 3 shown in figure 5-11.	
	N_1 See figures 5-10, 5-14, 6-21, and 6-52	Pin 3 at tube V602 (48 volts peak-to-peak).	Waveshape No. 7 shown in figure 5-11.	If waveshape No. 7 is incorrect, replace tube V602. If waveshape No. 7 is correct, replace tube V603. Check capacitor C609 and diode CR605.
13		In sequential order, connect test prod to the following points:		
	8 See figures 5-10 and 6-21	Test point TP2 (10 volts peak-to-peak).	Waveshape No. 25 shown in figure 5-11.	If correct waveshape is not obtained at test point TP2, check cable from pulser coil to input of coder-indicator and auxiliary reference burst pickup coil. Check signal through tubes V601A and V609, comparing oscillsocope presentation with waveshapes No. 26 through 30. Check tube voltages and resistances. If
	O See figures 5-10, 6-21, and 5-14	Pin 3 at tube V610 (50 volts peak-to-peak).	Waveshape No. 31 shown in figure 5-11.	

Note. When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
13 (cont)				correct waveshape is not obtained at pin 3 of tube V610, replace tubes V601 and V609. If correct waveshapes are observed at test point TP2 and at pin 3 of tube V610, replace tube V610. If trouble persists, take voltage and resistance measurements from tube sockets V601, V604, and V610 and compare them with values given in figure 5-13.
14		Set oscilloscope sweep speed to 4 microseconds per inch.		
	6 See figures 5-10, 5-14, and 6-21	Connect test prod to pin 7 at tube V604 (15 volts peak-to-peak).	Waveshape No. 37 shown in figure 5-11.	If pulse is not present, check as called for in radio receiver troubleshooting chart (table 5-4) and check cabling from radio receiver to coder-indicator.
15		Open switch S603 on video chassis of coder-indicator and set oscilloscope sweep speed to 100 microseconds per inch.		
	P See figures 5-10 and 6-21	Connect test prod to test point TP8.	Waveshape No. 48 shown in figure 5-11.	If correct presentation is observed, trouble is in keyer assembly. Replace keyer assembly.
16		Close switch S603 and check tubes V612 through V613B by connecting test prod to the following points (refer to waveshapes No. 38 through 47 shown in figure 5-11 for recommended sweep speed):		
	Q See figures 5-10, 5-14, 6-21, and 6-52	Pin 7 at tube V612 (75 volts peak-to-peak).	Waveshape No. 38 shown in figure 5-11.	If correct waveshape is not observed, test capacitor C640 and resistors R792, R688, R689, and R690.

TABLE 5-5. RADIO SET AN/GRN-9D, CODER-INDICATOR, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
16 (cont)	Q_1 See figures 5-10, 5-14, and 6-21	Test point TP9 (15 volts peak-to-peak).	Waveshape No. 41 shown in figure 5-11.	If correct waveshape is not observed, replace tube V612.
	Q_2 See figures 5-10, 5-14, 6-21, and 6-52	Pin 4 at tube V613 (150 volts peak-to-peak).	Waveshape No. 42 shown in figure 5-11.	If correct waveshape is not observed, tube V613A is defective. Replace tube V613.
	Q_3 See figures 5-10, 5-14, 6-21, and 6-52	Pin 7 at tube V614 (28 volts peak-to-peak).	Waveshape No. 43 shown in figure 5-11.	If correct waveshape is not observed, test capacitor C642 and potentiometers R696 and R698.
	Q_4 See figures 5-10, 5-14, 6-21, and 6-52	Pin 7 at tube V613	Waveshape No. 47 shown in figure 5-11.	If correct waveshape is not observed, replace tube V614.
	P See figures 5-10 and 6-21	Test point TP8	Waveshape No. 48 shown in figure 5-11.	If correct waveshape is not observed, tube V613B is defective. Replace tube V613.

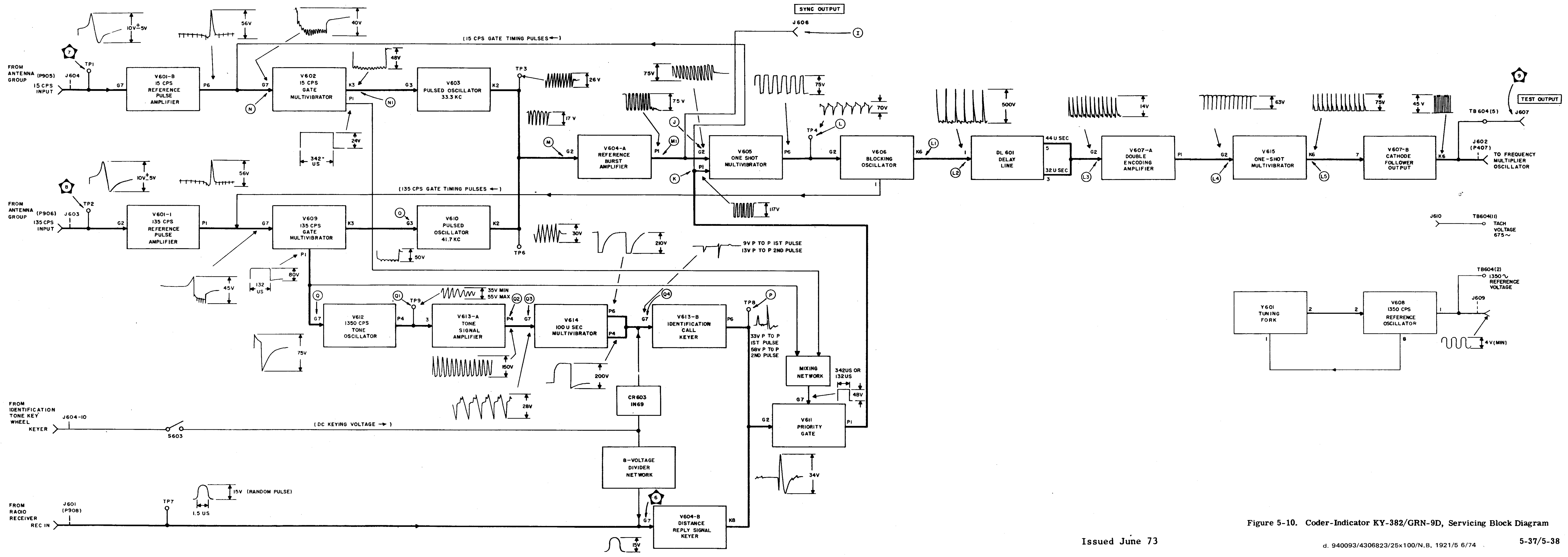
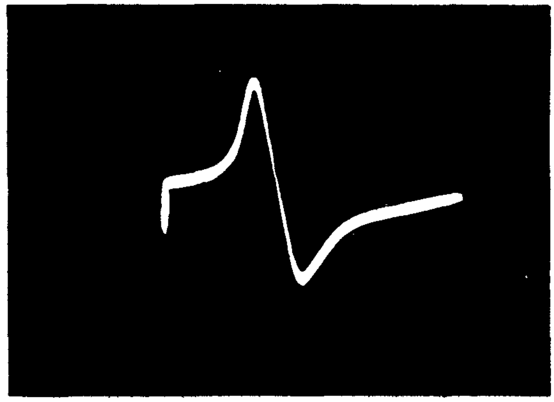
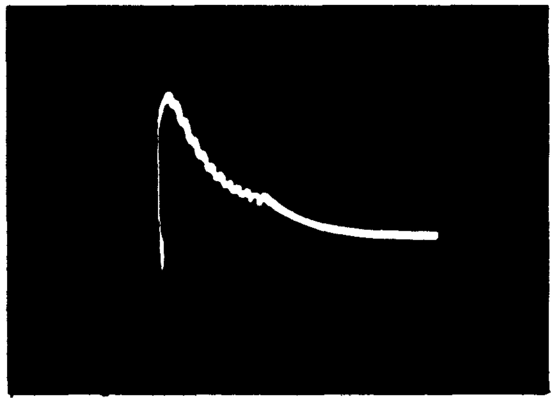


Figure 5-10. Coder-Indicator KY-382/GRN-9D, Servicing Block Diagram

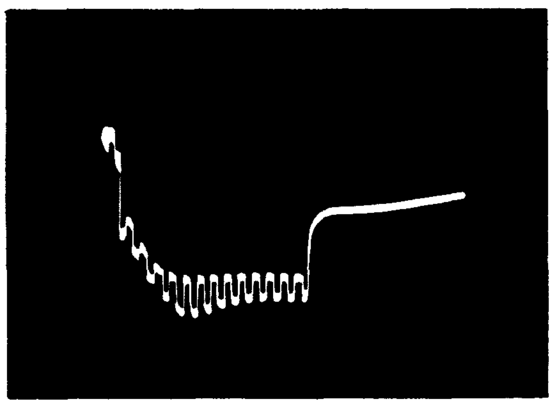
LOCATION: TP 1
Sweep Rate: 320 μsec/in.
Measurement: 10 V pp
Remarks: 15 cps reference burst trigger pulse from antenna.
1



LOCATION: Plate, pin 6, V601B
Sweep Rate: 320 μsec/in.
Measurement: 100 V pp
Remarks: Output of 15 cps trigger pulse amplifier.
2



LOCATION: Grid, pin 7, of V602A
Sweep Rate: 200 μsec/in.
Measurement: 40 V pp
Remarks: Loading of probe CG-1509/URN-3 increased the period of multivibrator V602, so that 14 timing pulses were required before the multivibrator returned to the stable condition. Under normal operation 12 timing pulses would be required.
3



LOCATION: Grid, pin 7, of V602A
Sweep Rate: 200 μsec/in.
Measurement: 40 V pp
Remarks: 15 cps trigger pulse on grid of multivibrator V602 with 12AT7WA removed from socket XV602.
4

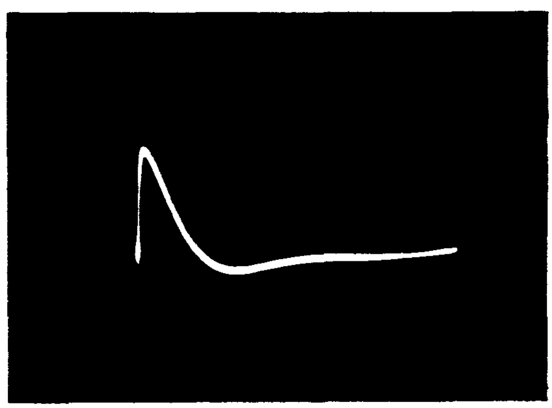
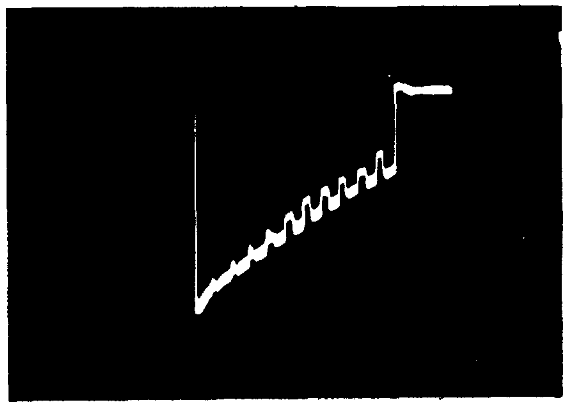


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 1 of 15)

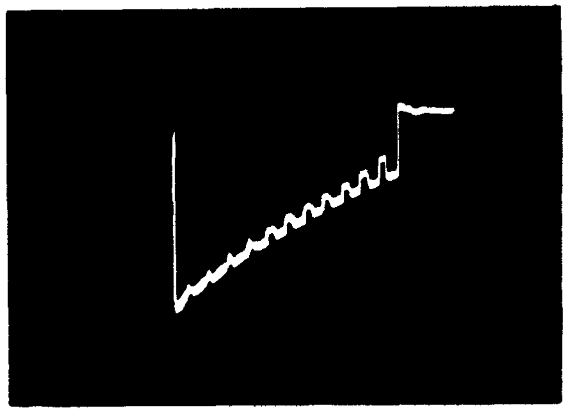
LOCATION: Grid, pin 2, of multivibrator V602B
Sweep Rate: 120 μsec/in.
Measurement: 220 V pp
Remarks: Loading of probe CG-1509/URN-3 caused multivibrator to trip after 11 timing pulses.

5A



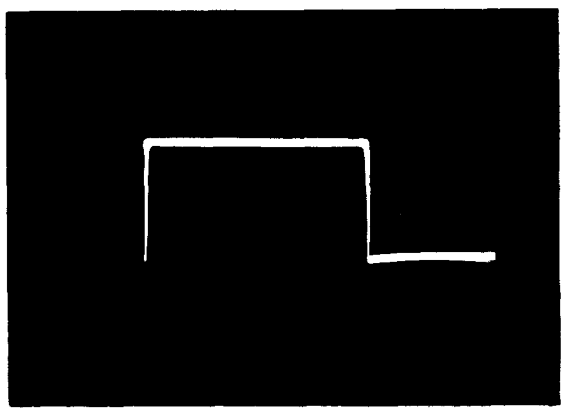
LOCATION: Grid, pin 2, of multivibrator V602B
Sweep Rate: 120 μsec/in.
Measurement: 220 V pp
Remarks: R675 adjusted to show 15 cps gate multivibrator tripping after 12 timing pulses. Note that reducing amplitude of timing pulses has increased the number of pulses required before MV602 will return to the stable condition.

5B



LOCATION: Plate, pin 1 of V602B
Sweep Rate: 120 μsec/in.
Measurement: 24 V pp
Remarks: Output pulse from 15 cps gate forming multivibrator.

6



LOCATION: Cathode, pin 3, of V602B
Sweep Rate: 120 μsec/in.
Measurement: 48 V pp
Remarks: Keying pulse to 33.3 kc pulsed oscillator.

7

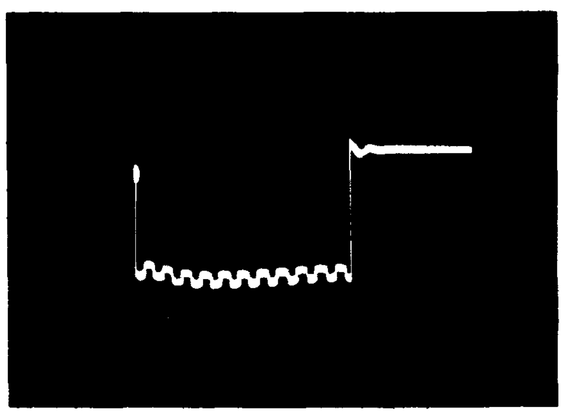
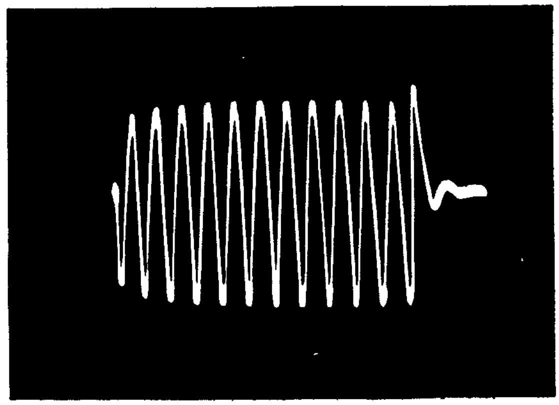
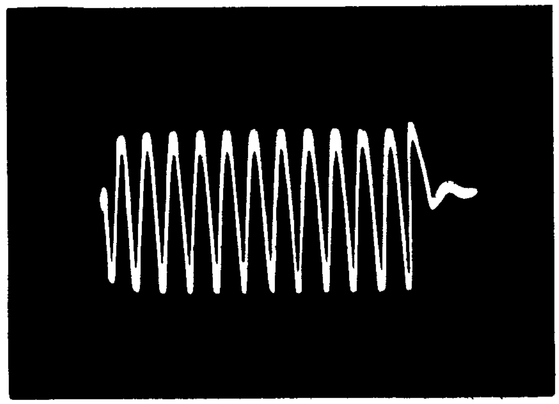


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 2 of 15)

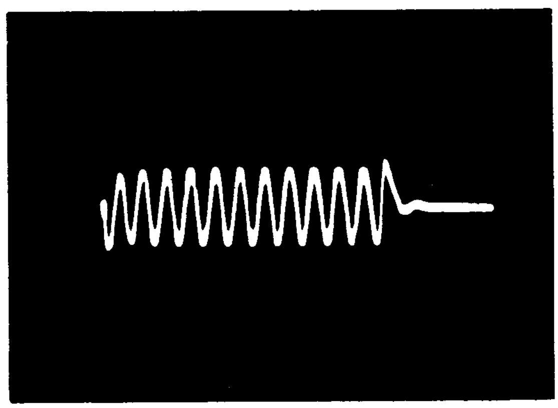
LOCATION: TP 3
Sweep Rate: 80 μsec/in.
Measurement: 26 V pp
Remarks: Output of pulsed oscillator.
8



LOCATION: Grid, pin 7, of V603B
Sweep Rate: 80 μsec/in.
Measurement: 20 V pp
Remarks: Grid of second half of 33.3 kc pulsed oscillator.
9



LOCATION: Cathode, pin 8, of V603B
Sweep Rate: 80 μsec/in.
Measurement: 9.5 V pp
Remarks: Cathode of second half of 33.3 kc pulsed oscillator.
10



LOCATION: Grid, pin 2, of amplifier V604A
Sweep Rate: 120 μsec/in.
Measurement: 17 V pp
Remarks: North reference burst only with sweep adjusted to show base line. Positive portion of sinewave output from pulsed osc. has been clipped.
11A

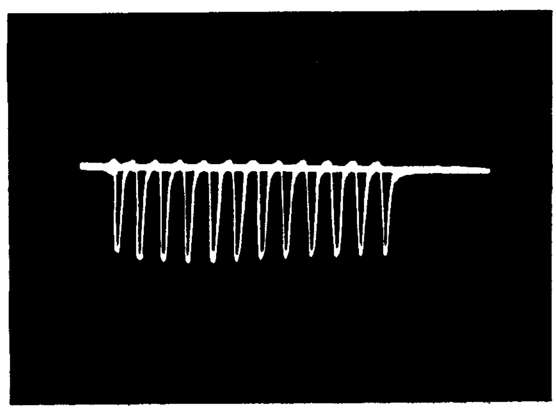
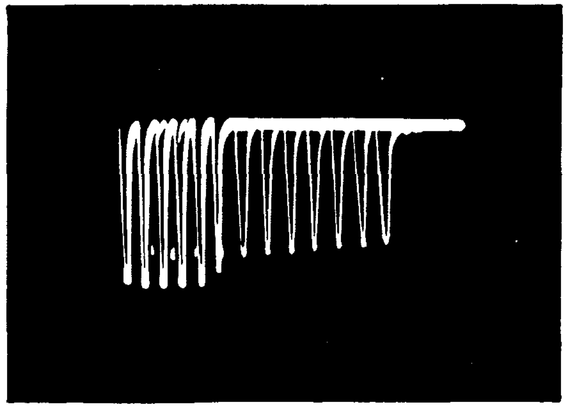
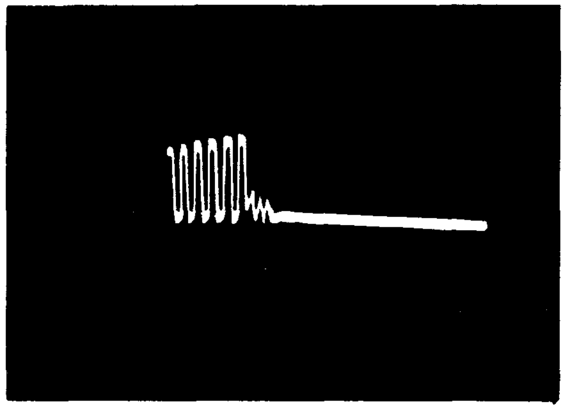


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 3 of 15)

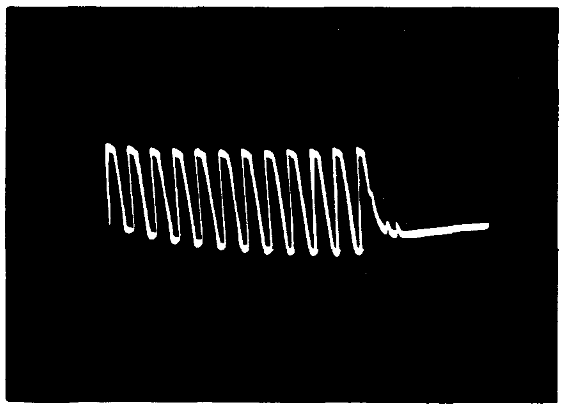
LOCATION: Grid, pin 2, of amplifier V604A
Sweep Rate: 120 μsec/in.
Measurement: 20 V pp
Remarks: Same as 11A except that both north and auxiliary bursts are present.
11B



LOCATION: Plate, pin 1, of V604A
Sweep Rate: 160 μsec/in.
Measurement: 75 V pp
Remarks: Plate of trigger amplifier V604A.
12



LOCATION: Grid, pin 2, of V605A
Sweep Rate: 120 μsec/in.
Measurement: 75 V pp
Remarks: Grid of one-shot multivibrator.
13



LOCATION: Plate, pin 1, of one-shot multivibrator V605
Sweep Rate: 120 μsec/in.
Measurement: 117 V pp
Remarks: North burst only at plate of one-shot multivibrator V605.
14A

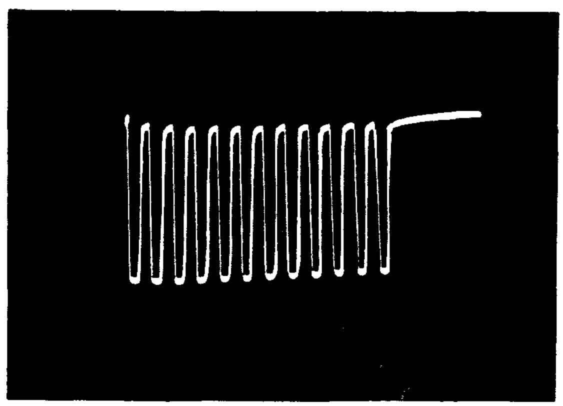
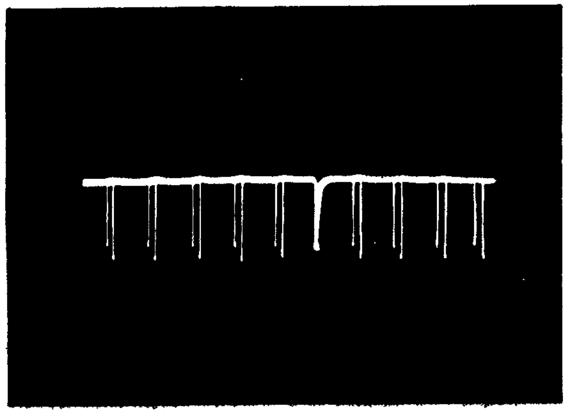
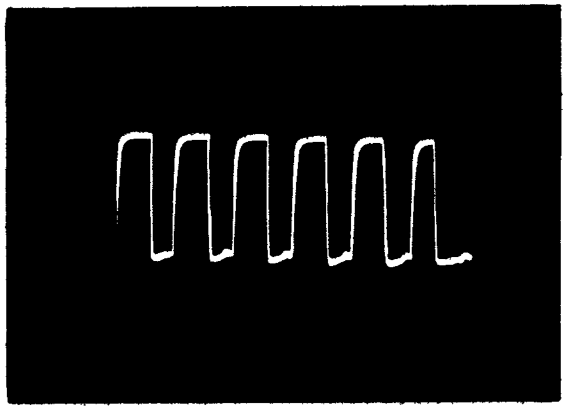


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 4 of 15)

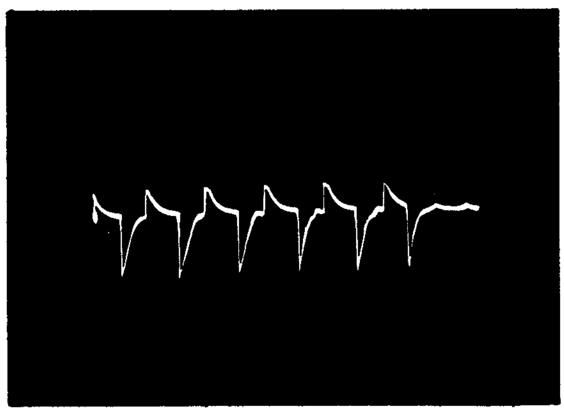
LOCATION: Plate, pin 1, of one-shot multivibrator V605
Sweep Rate: 1600 μsec/in.
Measurement: 117 V pp
Remarks: Identification code pulse pairs with auxiliary reference burst. Note that auxiliary burst occurs once for every 10 identification code pulse pairs.
14B



LOCATION: Plate, pin 6, of one-shot multivibrator V605
Sweep Rate: 40 μsec/in.
Measurement: 75 V pp
Remarks: Auxiliary burst at output of one-shot multivibrator V605.
15



LOCATION: TP 4
Sweep Rate: 40 μsec/in.
Measurement: 70 V pp
Remarks: Auxiliary burst at input grid of blocking oscillator V606. (Pin 2 of V606A).
16



LOCATION: Plate, pin 9, of V606B
Sweep Rate: 40 μsec/in.
Measurement: 75 V pp
Remarks: Auxiliary burst at plate of blocking oscillator V606B.
17

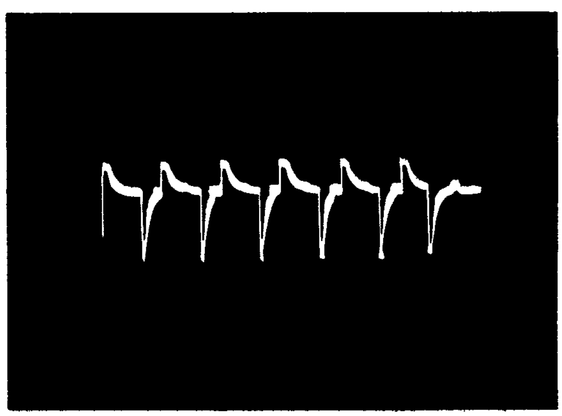
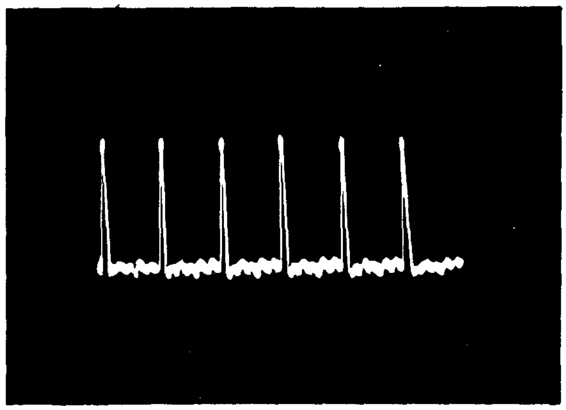
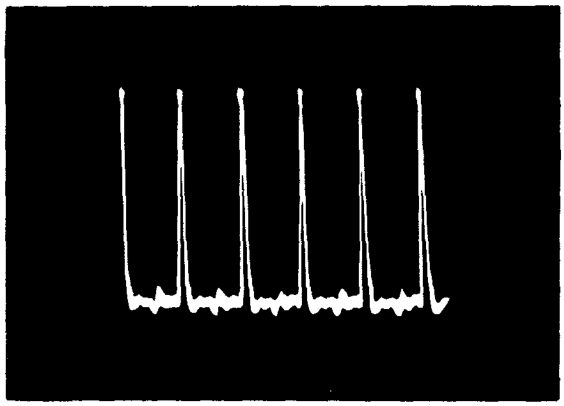


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 5 of 15)

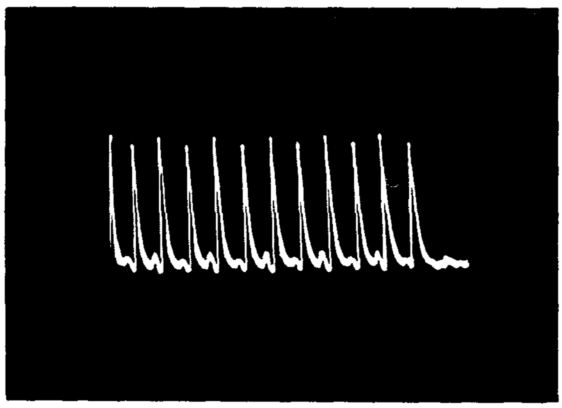
LOCATION: Cathode, pin 6, of V606.
Sweep Rate: 40 μsec/in.
Measurement: 90 V pp
Remarks: Auxiliary burst of cathode of blocking oscillator V606.
18



LOCATION: TAP 1 of DL601
Sweep Rate: 40 μsec/in.
Measurement: 500 V pp
Remarks: Auxiliary reference burst at input to delay line DL601.
19



LOCATION: Grid, pin 2 of V607A
Sweep Rate: 40 μsec/in.
Measurement: 14 V pp
Remarks: Output of delay line DL601. Auxiliary reference burst consisting of 6 pairs of pulses as a result of 12 μsec coding.
20



LOCATION: Grid, pin 2, of V615A
Sweep Rate: 40 μsec/in.
Measurement: 63 V pp
Remarks: Trigger input grid of one-shot multivibrator V615 showing auxiliary reference burst under normal operation.
21

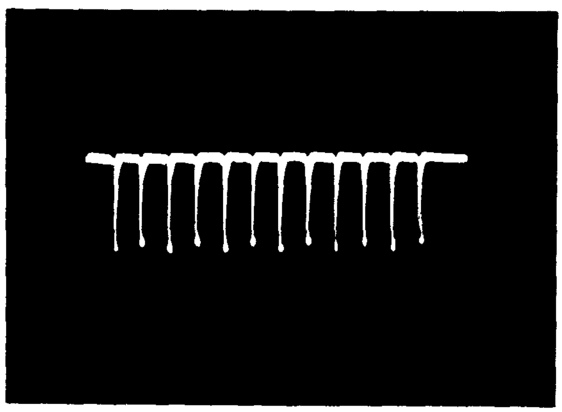
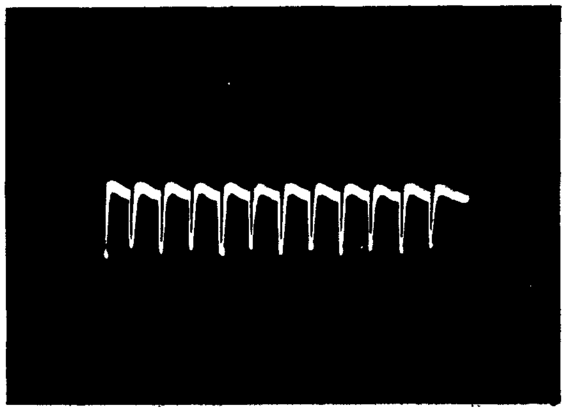
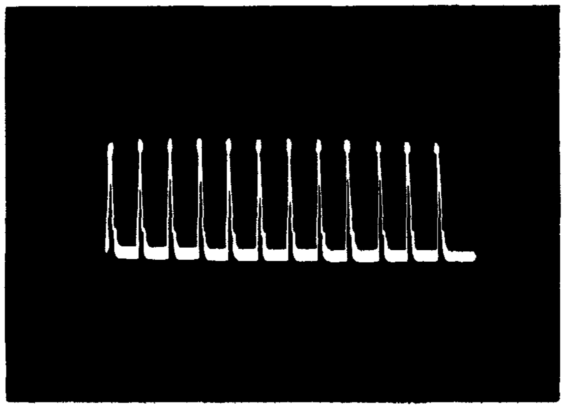


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 6 of 15)

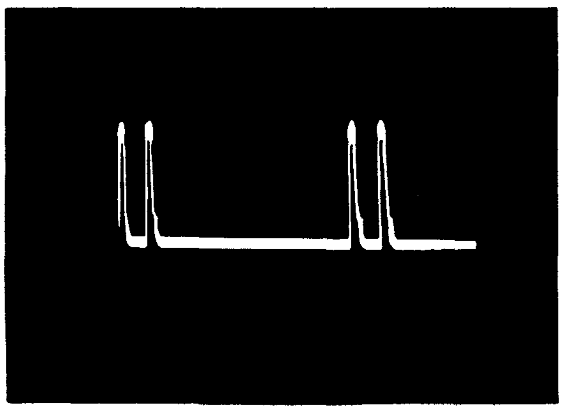
LOCATION: Grid, pin 2, of V615A
Sweep Rate: 40 μsec/in.
Measurement: 45 V pp
Remarks: Trigger input grid of one-shot multivibrator V615, with tube V615 removed from socket. Auxiliary reference burst shown as a series of twelve trigger pulses on grid.
22



LOCATION: Cathode, pin 6, of V615B
Sweep Rate: 40 μsec/in.
Measurement: 75 V pp
Remarks: Auxiliary reference burts at output of multivibrator V615.
23A



LOCATION: Cathode, pin 6, of V615B
Sweep Rate: 40 μsec/in.
Measurement: 75 V pp
Remarks: Identification code signal at output of multivibrator V615. Waveform shows two pulse pairs having a spacing of 100 μsec between pairs with 12 μsec between pulses in each pair. This pulse group is transmitted 1350 times per second during tone transmission.
23B



LOCATION: Cathode, pin 6, of V607 (cathode follower output of coder-indicator)
Sweep Rate: 120 μsec/in.
Measurement: 45 V pp
Remarks: North reference burst only. Waveforms taken at this point may be used to check the pulse count of reference bursts.
24A

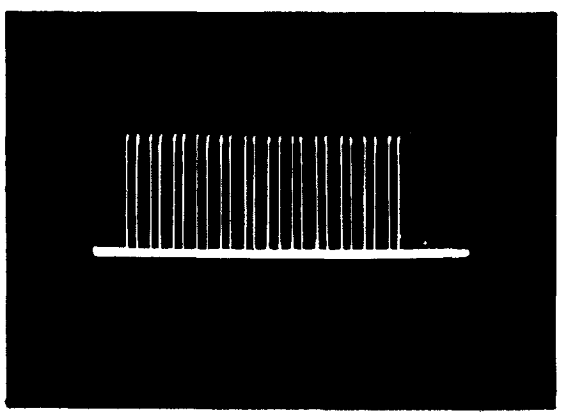
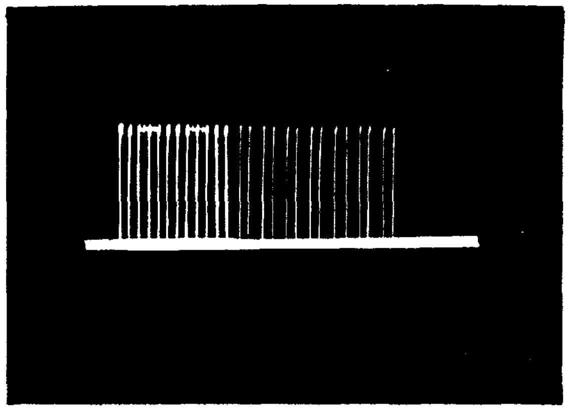


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 7 of 15)

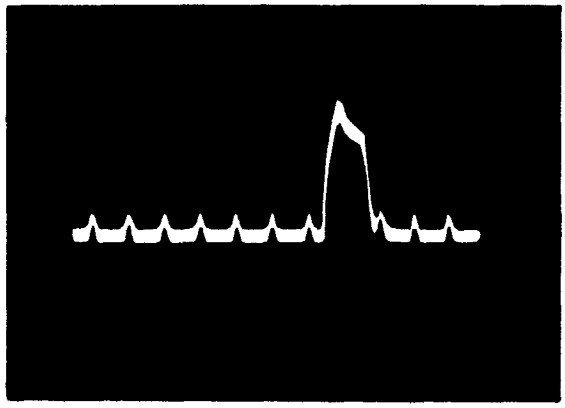
LOCATION: Cathode, pin 6, of V607
Sweep Rate: 120 μsec/in.
Measurement: 45 V pp
Remarks: Auxiliary and north reference bursts present.

24B



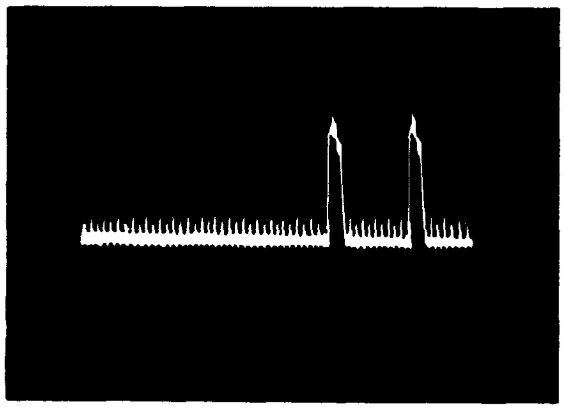
LOCATION: Cathode, pin 6, of V607
Sweep Rate: 2 μsec/in.
Measurement: 45 V pp
Remarks: Single output pulse with 1 mc markers.

24C



LOCATION: Cathode, pin 6, of V607
Sweep Rate: 16 μsec/in.
Measurement: 45 V pp
Remarks: Identification code pulse pair with 1 mc markers.

24D



LOCATION: Cathode, pin 6, of V607
Sweep Rate: 4,000 μsec/in.
Measurement: 45 V pp
Remarks: Auxiliary reference bursts with identification code pulse pairs occuring once for every 10 auxiliary reference bursts.

24E

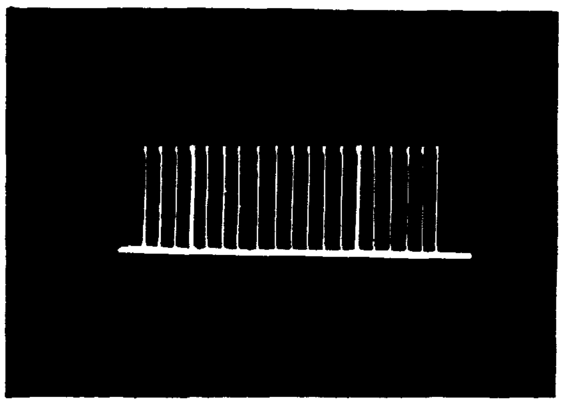
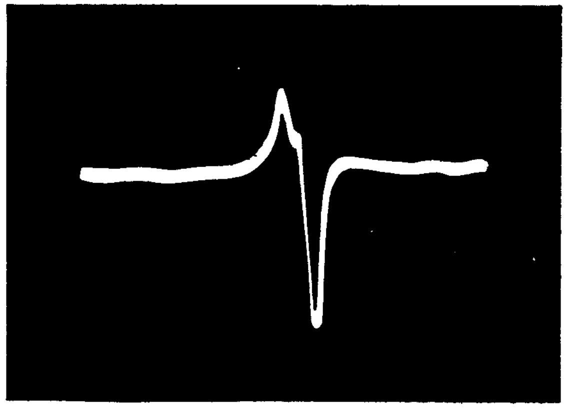
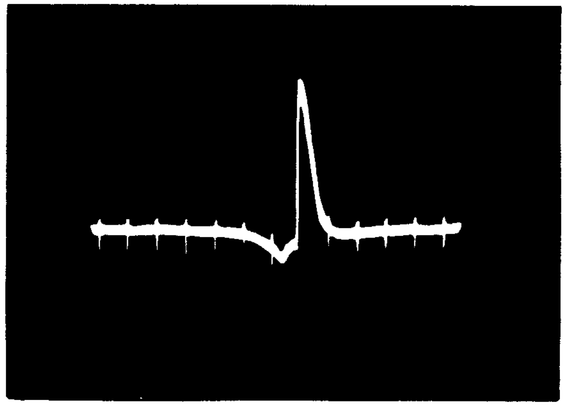


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 8 of 15)

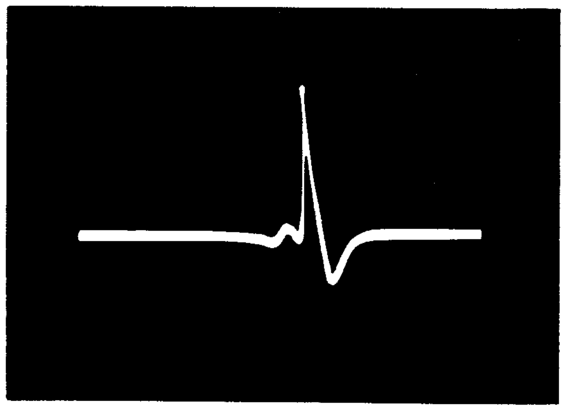
LOCATION: TP 2
Sweep Rate: 2400 μsec/in.
Measurement: 10 V pp
Remarks: Auxiliary (135 cps) reference trigger pulse from antenna.
25



LOCATION: Plate, pin 1, V601A
Sweep Rate: 2300 μsec/in.
Measurement: 56 V pp
Remarks: Output of auxiliary reference burst trigger amplifier.
26



LOCATION: Grid, pin 7, of V609A
Sweep Rate: 1200 μsec/in.
Measurement: 20 V pp
Remarks: Trigger pulse on trigger input grid of one-shot multivibrator V609. Tube V609 removed.
27



LOCATION: Grid, pin 7, of V609A
Sweep Rate: 160 μsec/in.
Measurement: 45 V pp
Remarks: Signal on trigger input grid of one-shot multivibrator V609 under normal operation.
28

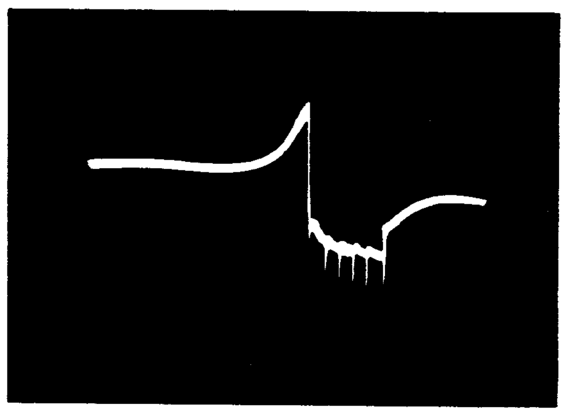
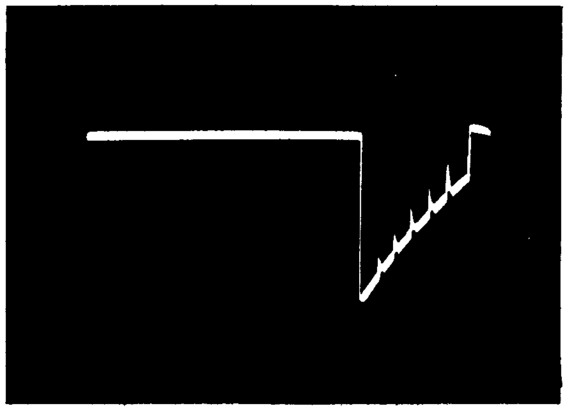


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 9 of 15)

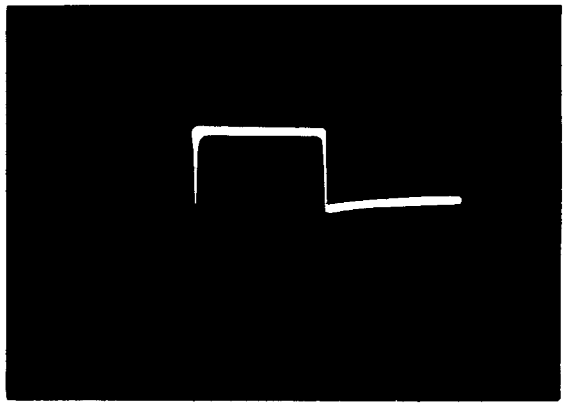
LOCATION: Grid, pin 2, of V609
Sweep Rate: 120 μsec/in.
Measurement: 220 V pp
Remarks: Grid of 135 cps gate multivibrator. Note that duration of gate is determined by pulses fed back from V606.

29



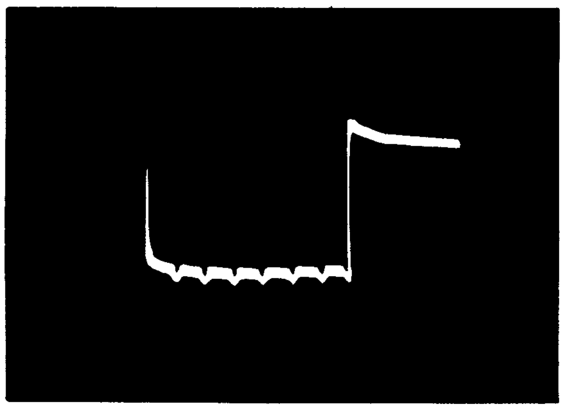
LOCATION: Plate, pin 1, of V609
Sweep Rate: 120 μsec/in.
Measurement: 80 V pp
Remarks: 135 cps gate pulse from multivibrator V609.

30



LOCATION: Grid, pin 3, of V610
Sweep Rate: 80 μsec/in.
Measurement: 50 V pp
Remarks: Timing pulse from 135 cps gate multivibrator to pulsed oscillator V610. R672 set for low amplitude of feedback pulses, causing pulsed oscillator to oscillate for 7 cycles.

31A



LOCATION: Grid, pin 3, of V610
Sweep Rate: 80 μsec/in.
Measurement: 50 V pp
Remarks: R672 set for high amplitude of feedback pulses, causing pulsed oscillator to oscillate for 5 cycles.

31B

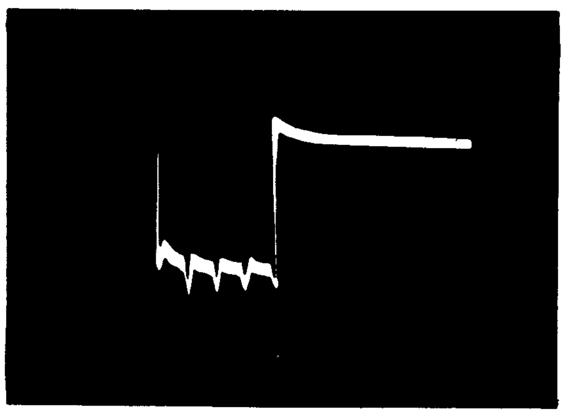
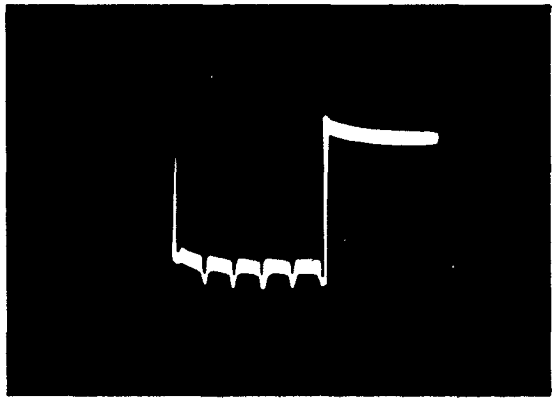
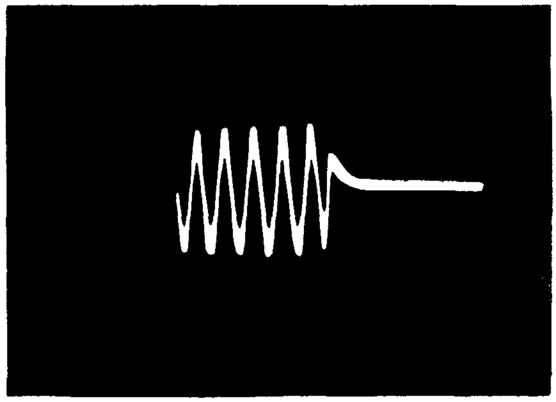


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 10 of 15)

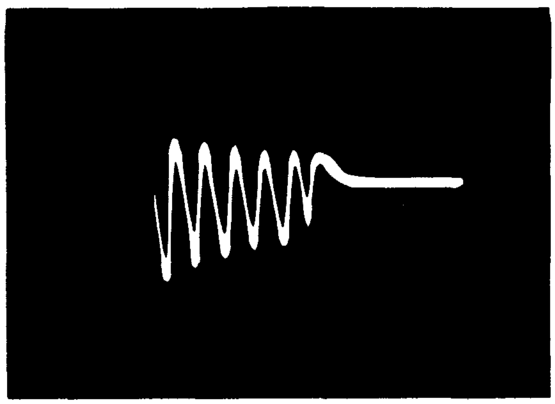
LOCATION: Grid, pin 3, of V610
Sweep Rate: 80 μsec/in.
Measurement: 50 V pp
Remarks: R672 set for correct amplitude of feedback pulses causing pulsed oscillator, V610, to oscillate for 6 pulses.
31C



LOCATION: TP 6
Sweep Rate: 80 μsec/in.
Measurement: 30 V pp
Remarks: Output of pulsed oscillator V610.
32



LOCATION: Grid, pin 7, of V610
Sweep Rate: 80 μsec/in.
Measurement: 14 V pp
Remarks: Grid of second half of 41.7 kc pulsed oscillator.
33



LOCATION: Grid, pin 7, of V611
Sweep Rate: 120 μsec/in.
Measurement: 48 V pp
Remarks: Both 15 cps and 135 cps: gate pulses at grid of priority gate.
34

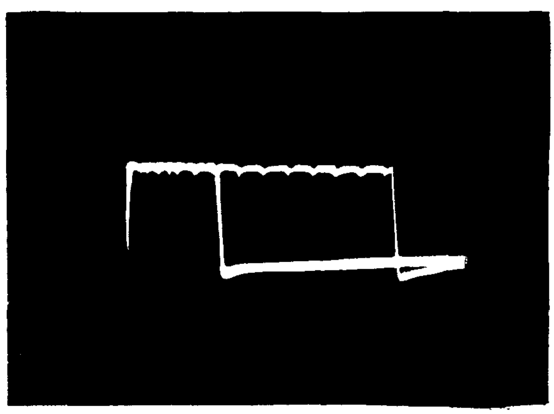
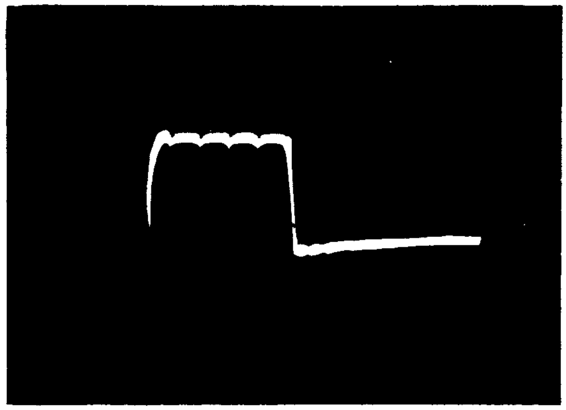
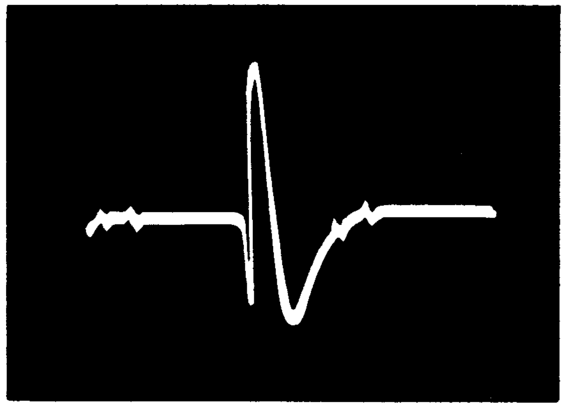


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 11 of 15)

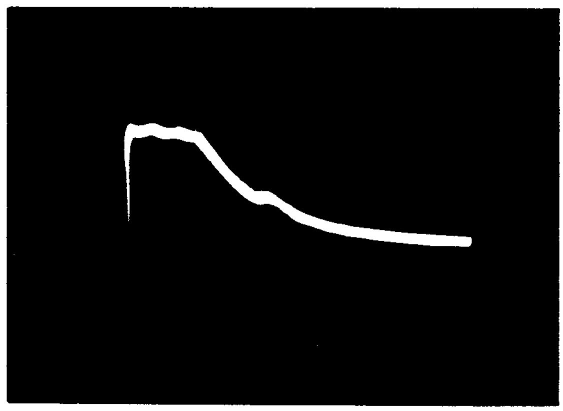
LOCATION: Cathode, pin 3, of V611
Sweep Rate: 200 μsec/in.
Measurement: 48 V pp
Remarks: 135 cps gate pulse at cathode of priority gate.
35



LOCATION: Grid, pin 2, of V611
Sweep Rate: 40 μsec/in.
Measurement: 34 V pp
Remarks: One pulse of identification tone signal at grid of priority gate.
36



LOCATION: Grid, pin 7, of V604B
Sweep Rate: 4 μsec/in.
Measurement: 15 V pp
Remarks: One interrogation pulse from receiver at grid of interrogation signal keyer.
37



LOCATION: Grid, pin 7, of V612
Sweep Rate: 200 μsec/in.
Measurement: 75 V pp
Remarks: Locking pulse from 135 cps gate multivibrator to 1350 cps oscillator.
38

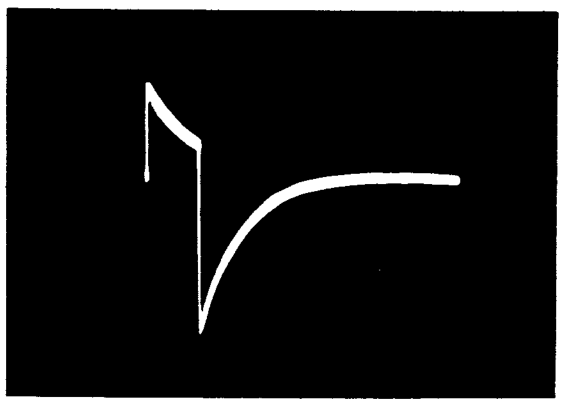
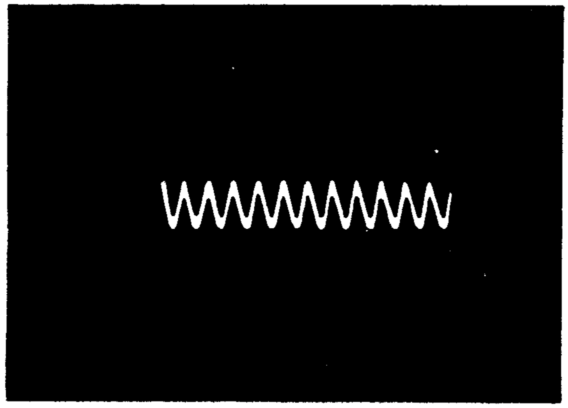
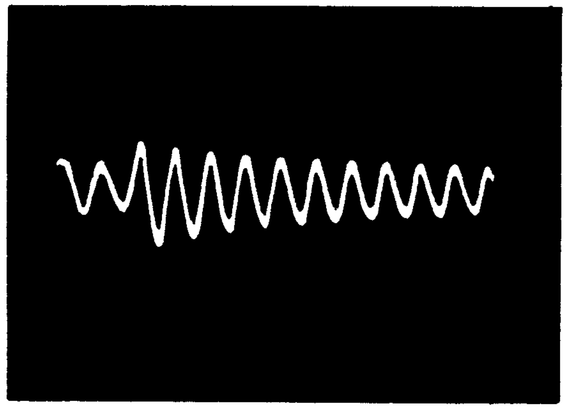


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 12 of 15)

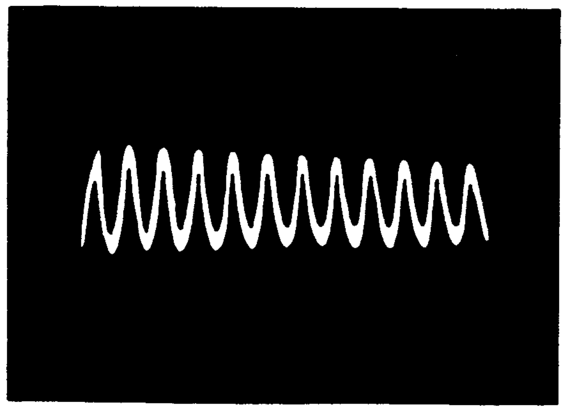
LOCATION: Grid, pin 3, of V612
Sweep Rate: 2000 μsec/in.
Measurement: 35 V pp
Remarks: 1350 cps oscillator signal without phase locking pulse from 135 cps gate multivibrator.
39



LOCATION: Grid, pin 3, of V612
Sweep Rate: 2000 μsec/in.
Measurement: 35 V pp Min
55 V pp Max
Remarks: 1350 cps oscillator signal with phase locking pulse from 135 cps gate multivibrator.
40



LOCATION: TP 9
Sweep Rate: 2000 μsec/in.
Measurement: 15 V pp
Remarks: 1350 cps oscillator output to amplifier V613A.
41



LOCATION: Plate, pin 4, of V613A
Sweep Rate: 2000 μsec/in.
Measurement: 150 V pp
Remarks: Plate of 1350 cps amplifier V613A.
42

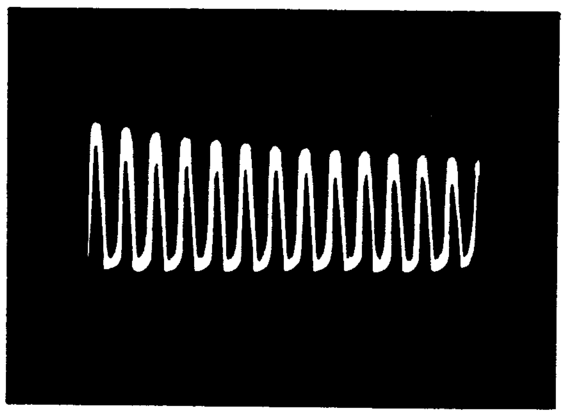
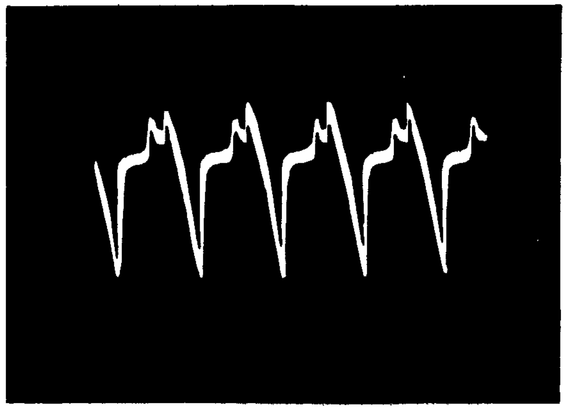
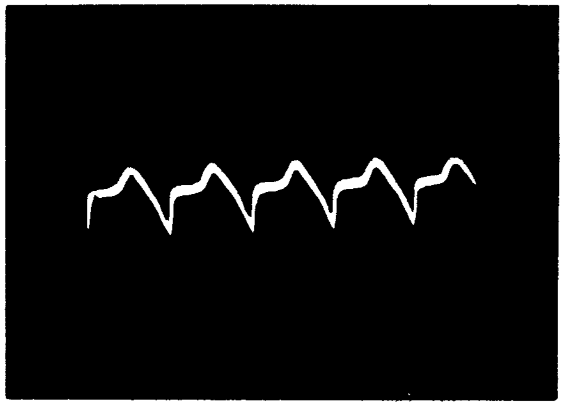


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 13 of 15)

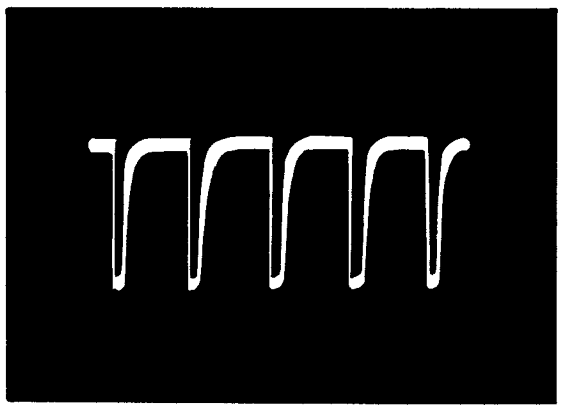
LOCATION: Grid, pin 7, of V614
Sweep Rate: 400 μsec/in.
Measurement: 28 V pp
Remarks: Grid of 100 μsec multivibrator under normal operation.
43



LOCATION: Grid, pin 7, of V614
Sweep Rate: 400 μsec/in.
Measurement: 14 V pp
Remarks: Grid of 100 μsec multivibrator with tube V614 removed.
44



LOCATION: Plate, pin 6, of V614A
Sweep Rate: 400 μsec/in.
Measurement: 210 V pp
Remarks: Plate of first half of 100 μsec multivibrator.
45A



LOCATION: Plate, pin 6, of V614A
Sweep Rate: 140 μsec/in.
Measurement: 210 V pp
Remarks: Plate of first half of 100 μsec multivibrator (expanded to show rate of change of plate voltage).
45B

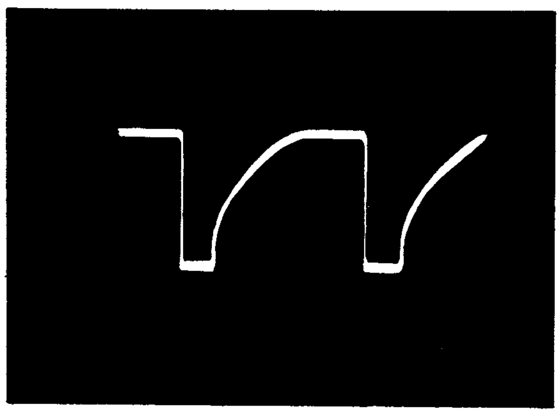
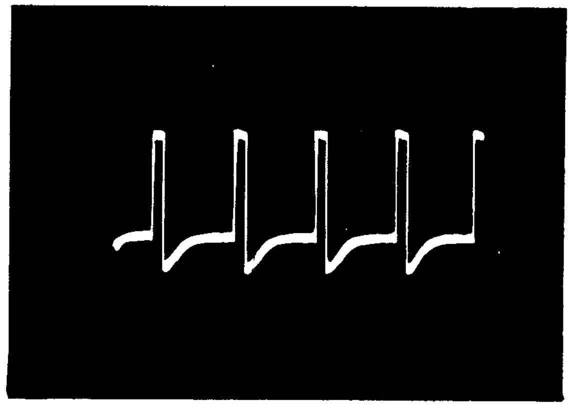
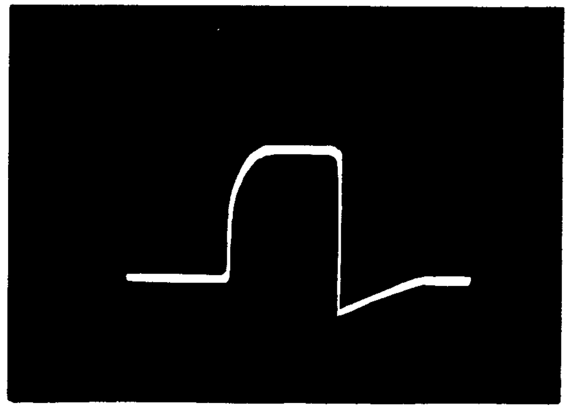


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal-Tracing Waveshapes (Sheet 14 of 15)

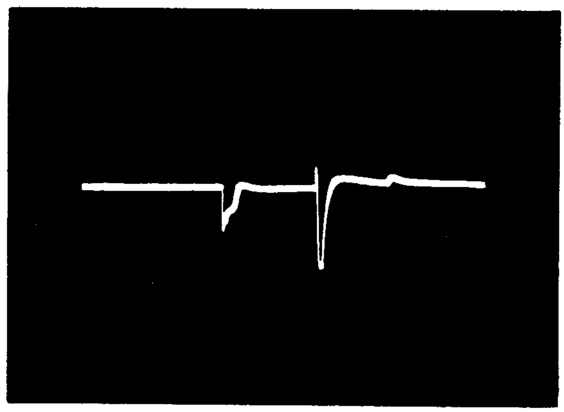
LOCATION: Plate, pin 4, of V614B
Sweep Rate: 400 μsec/in.
Measurement: 200 V pp
Remarks: Plate of second half of 100 μsec multivibrator.
46A



LOCATION: Plate, pin 4, of V614B
Sweep Rate: 40 μsec/in.
Measurement: 200 V pp
Remarks: Plate of second half of 100 μsec multivibrator (expanded to show rate of change of plate voltage).
46B



LOCATION: Grid, pin 7, of V613B
Sweep Rate: 100 μsec/in.
Measurement: 9 V pp first pulse
13 V pp second pulse
Remarks: Identification code pulse pair on grid of keyer tube V613B during transmission of code.
47



LOCATION: TP 8
Sweep Rate: 100 μsec/in.
Measurement: 33 V pp first pulse
58 V pp second pulse
Remarks: Identification code pulse pair on plate of keyer tube V613B during transmission of code.
48

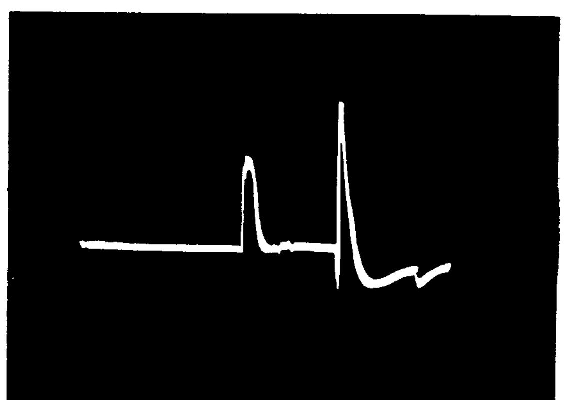
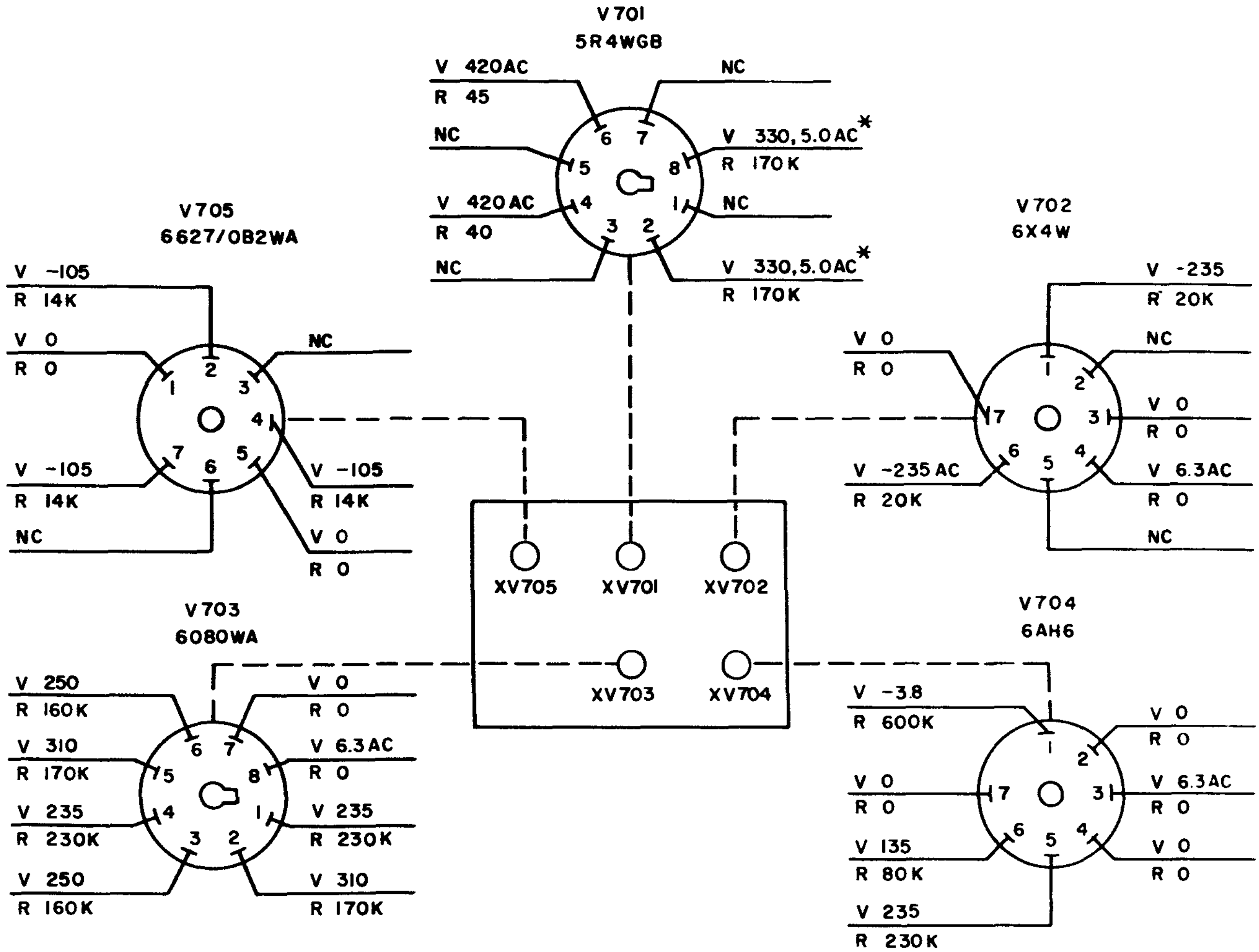


Figure 5-11. Coder-Indicator KY-382/GRN-9D, Signal Tracing Waveshapes (Sheet 15 of 15)



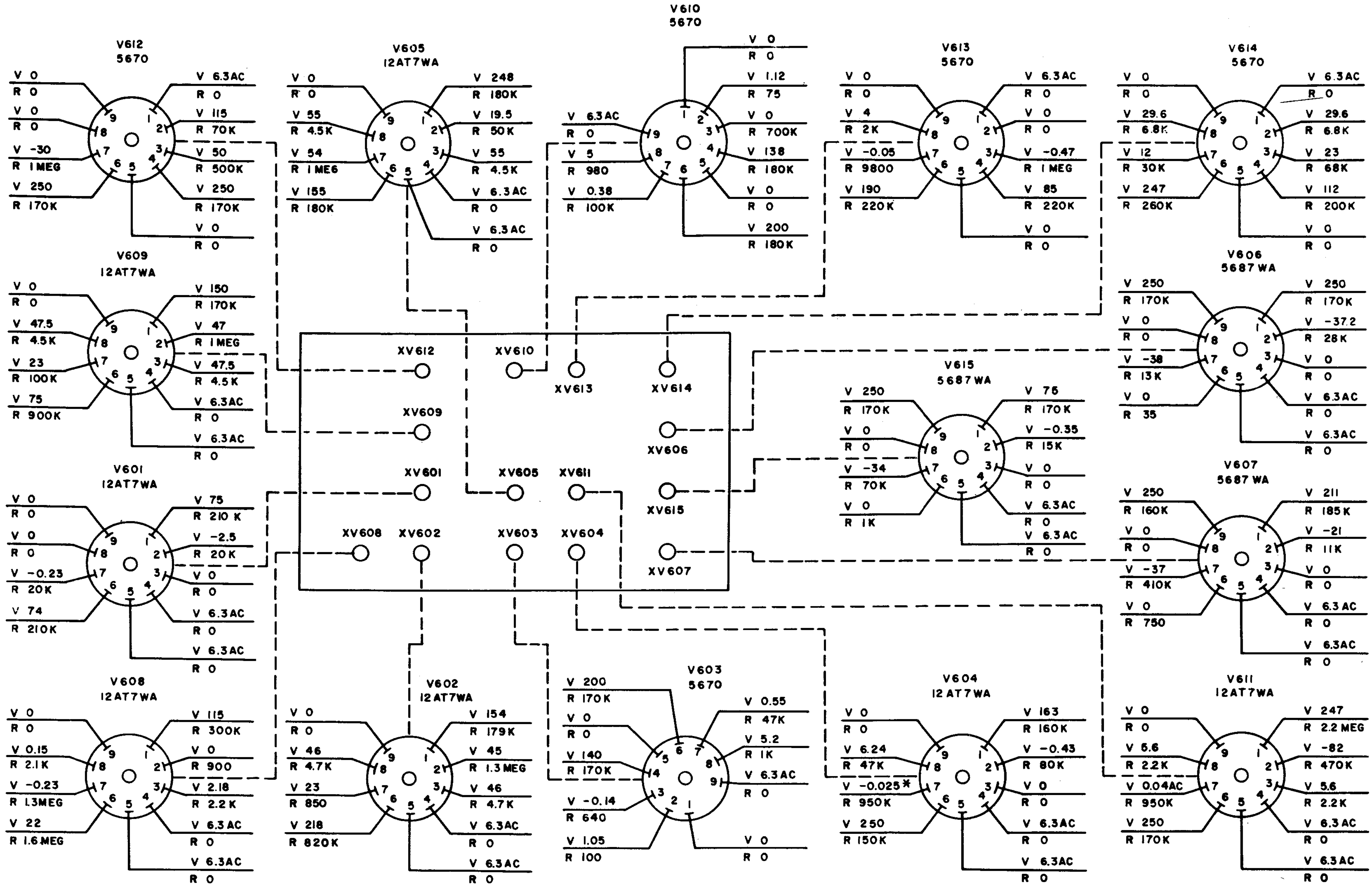
NOTES:

1 READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY.

KEY TO SYMBOLS

V	INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
AC	INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
R	INDICATES DC RESISTANCE TO GROUND.
*	5.0 VAC BETWEEN PINS MARKED WITH ONE ASTERISK.

Figure 5-12. Coder-Indicator KY-382/GRN-9D, Power Supply Chassis, Tube Socket Voltage and Resistance Diagram



NOTES:

1. READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY.

KEY TO SYMBOLS

V INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

AC INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

R INDICATES DC RESISTANCE TO GROUND

* V604 PIN 7, DURING IDENTIFICATION TRANSMISSION THIS VALUE BECOMES -50V

Figure 5-13. Coder-Indicator KY-382/GRN-9D, Video Chassis, Tube Socket Voltage and Resistance Diagram

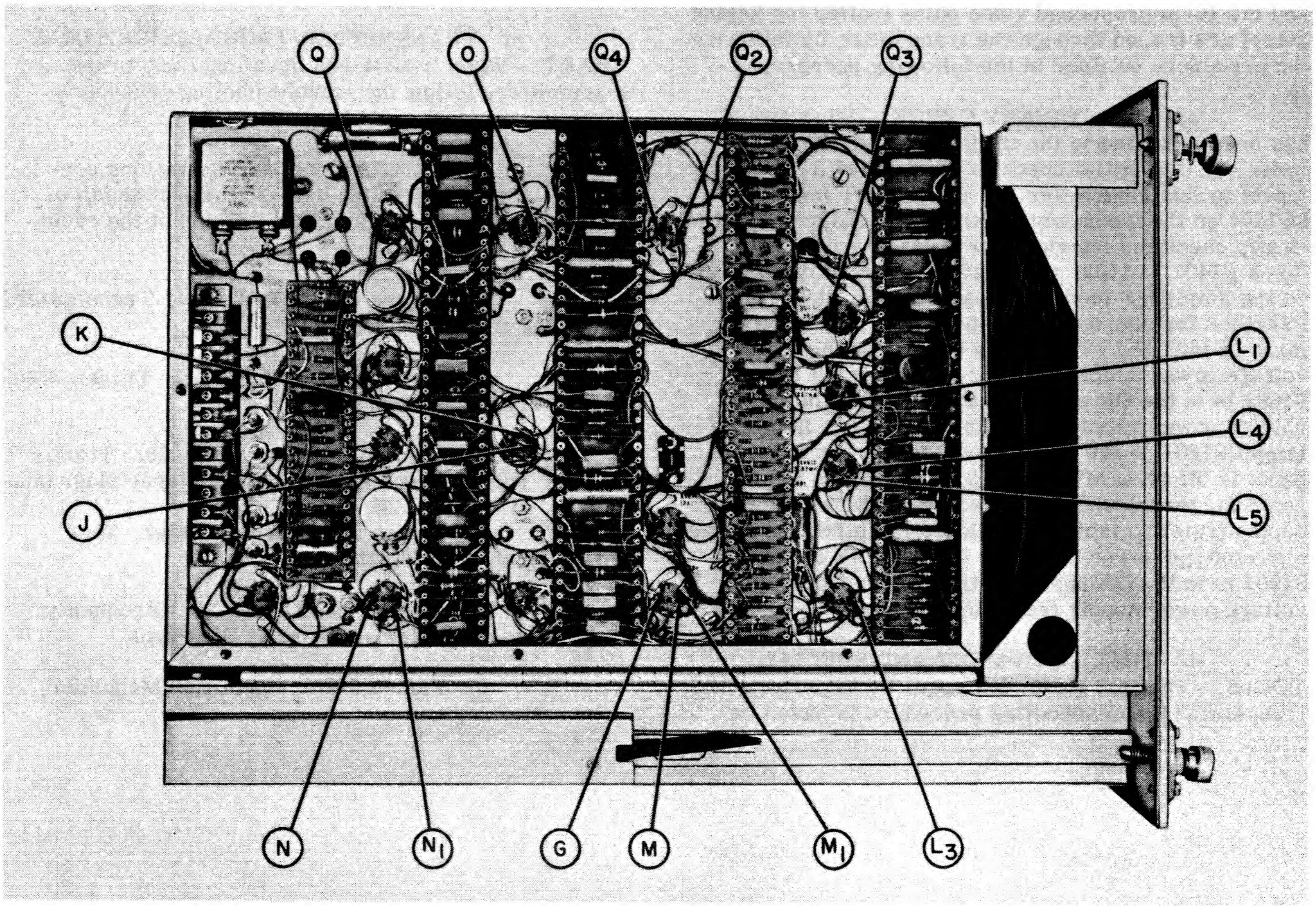


Figure 5-14. Coder-Indicator KY-382/GRN-9D, Left Side View, Test Point Location

(3) TROUBLESHOOTING TRANSMITTER. (See figure 5-15). —The transmitter portion of the radio beacon consists of the frequency multiplier-oscillator and the amplifier-modulator. These two units are treated as a single unit insofar as trouble-shooting is concerned. The carrier signal, the 3.5-microsecond video pulse (called the shaped pulse), and the 10-microsecond video pulse (called the keying pulse) are traced through the transmitter by following the procedure outlined in the following paragraphs.

(a) PRELIMINARY CHECK. —When trouble has been localized to the transmitter portion of the radio set, the initial check is for a-c and d-c power inputs to the transmitter. If FILAMENT lamp DS1401 on the frequency multiplier-oscillator panel is off, check the interlock for damage and inspect fuses F1401, F1402, and F1403. If FIL lamp DS1301 on the amplifier-modulator panel is off, check the interlock for damage and inspect fuse F1302. If LV lamp DS1603 and -375V lamp DS1601 on the low-voltage power supply panel are off when LV switch S1601 is in the ON position, troubleshoot the low-voltage power supply (refer to table 5-7). If +1000V lamp DS1801 on the medium-voltage power supply panel is off when MV switch S1801 is in the ON position, troubleshoot the medium-voltage power supply (refer to table 5-8). If HV lamp DS1902 on the high-voltage power supply is off when HV switch S1902 is in the ON position, troubleshoot the high-voltage power supply (refer to table 5-9).

(b) TEST EQUIPMENT AND SPECIAL TOOLS. —The test equipment required to perform the transmitter troubleshooting procedure is based on using the built-in test equipment. This equipment is housed in the power supply assembly cabinet. No special tools are required to perform this procedure.

(c) CONTROL SETTINGS. —Table 5-2 lists the preliminary control settings of all controls required when troubleshooting.

(d) TRANSMITTER TROUBLESHOOTING CHART. —When trouble has been localized to the transmitter, follow the troubleshooting procedure given in table 5-6.

(e) ILLUSTRATIONS. —Illustrations containing information which will aid the technician in troubleshooting the transmitter portion of the radio set are as follows:

1. Figure 5-15. Radio Set, Transmitter, Servicing Block Diagram

2. Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes

3. Figures 5-18 through 5-20. Transmitter, Tube Socket Voltage and Resistance Diagrams

4. Figure 5-21. Transmitter, Test Point Location Illustration

5. Figures 6-18 and 6-19. Frequency Multiplier-Oscillator, Schematic Diagrams

6. Figure 6-20. Amplifier Modulator, Schematic Diagram

TABLE 5-6. RADIO SET AN/GRN-9D, TRANSMITTER, FUNCTIONAL SECTION TROUBLESHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1	10 See figures 5-15 and 6-18	Set oscilloscope sweep speed to 4 microseconds per inch. Connect coaxial test lead from vertical input jack on oscilloscope to VIDEO IN jack J1404 on frequency multiplier-oscillator panel.	Pair of 1.5-microsecond wide pulses, with 12-microsecond spacing between pulses, should appear as shown in waveshape No. 1 of figure 5-16.	If normal indication is not obtained, refer to coder-indicator troubleshooting chart (table 5-5). If normal indication is obtained, proceed to step 2.
2	17 See figure 6-18	Check readings of D.C. SUPPLY VOLTAGE meter M1402 on frequency multiplier-oscillator panel with METER SELECTOR switch S1402 in position indicated.	Meter M1402 should read: Position — Voltage -375V — -375 volts dc +250V — +250 volts dc +1000V — +1000 volts dc	If normal indication is obtained, proceed to step 3. If either the -375- or +250-volt d-c voltage is incorrect, refer to low-voltage power supply troubleshooting chart (table 5-7). If +1000 voltage is incorrect, proceed to medium-voltage power supply troubleshooting chart (table 5-8).
3	18 See figure 6-20	Check reading of BEAM CURRENT meter M1301 on front panel of amplifier-modulator.	Compare with logged reading.	Amount of beam current depends upon number of shaped pulses fed to high-level modulator of amplifier-modulator. Required total number of pulses fed to amplifier-modulator is 3,600 pulse-pairs per second. Any reduction from this number of pulse-pairs will cause a corresponding reduction in beam current. Also, improper setting of klystron bias will cause an improper beam current reading. Proceed to step 4 to determine cause of change in shape or reduction in number of shaped pulses per second. Zero beam current indicates loss of shaped pulses or failure of either klystron or high-voltage power

TABLE 5-6. RADIO SET AN/GRN-9D, TRANSMITTER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
3 (cont)				supply. If beam current is zero, proceed to step 4 as a first step toward isolating trouble.
4	11 See figures 5-15 and 6-18	Set oscilloscope sweep speed to 3 microseconds per inch. Connect coaxial test lead from vertical input jack of oscilloscope to SHAPED PULSE jack J1405 on frequency multiplier-oscillator panel.	Waveshape No. 9 as shown in figure 5-16.	If shaped pulse is not present, proceed to step 5. If shaped pulse is present, but not of proper shape, refer to frequency multiplier-oscillator video adjustment procedure in paragraph 6-2f of Section 6.
5		Set oscilloscope sweep speed to 2 microseconds per inch.		
	R See figures 5-15, 5-21, and 6-18	Connect test prod to pin 5 at tube V1403 (80 volts peak-to-peak).	Waveshape No. 5 as shown in figure 5-16.	If pulse is not present, replace tube V1402.
6	S See figures 5-15, 5-21, and 6-18	Set oscilloscope sweep speed to 3 microseconds per inch. Connect test prod to pin 2 or 7 of V1406 (2200 volts peak-to-peak).	Waveshape No. 6 as shown in figure 5-16.	If pulse is not present, replace tubes V1403, V1404, and V1405. If trouble persists, test transformer T1402 and also take voltage and resistance measurements from tube sockets and compare them with values given in figure 5-18.
7	T See figures 5-15, 5-21, and 6-18	Connect test prod to vertical input jack on oscilloscope. Then, connect test prod to pin 5 at tube V1407.	Waveshape No. 8 as shown in figure 5-16.	If pulse is not present, replace tube V1406. If pulse is present, replace tube V1407.
8	19 See figure 6-18	Check readings of TUNING meter M1401 with METER SELECTOR switch S1401 in the following positions:	Compare with previously logged readings.	At stage where reading becomes abnormal, replace associated tube. Check tuning of frequency multiplier stages. Check associated circuits, using tube voltage and resistance charts (figure 5-19). Replace all defective tubes and components.

Note. When using the MM-504 Oscilloscope, there are 2·54 cm to the inch.

TABLE 5-6. RADIO SET AN/GRN-9D, TRANSMITTER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
8 (cont)		OSC 1ST DOUBLER 2ND DOUBLER 3RD DOUBLER TRIPLER AMPL KLYSTRON INPUT REFL KLYSTRON INPUT INCID		
9		Set oscilloscope sweep speed to 8 microseconds per inch and connect test prod to vertical input of oscilloscope.		
10	U See figures 5-15, 5-21, and 6-18	Connect test prod to pin 1 of tube V1409.	10-microsecond wide keying pulse.	If pulse is present, proceed to step 11. If pulse is not present, replace tubes V1409, V1401, and V1408.
11	12 See figures 5-15 and 6-18	Set oscilloscope sweep speed to 4 microseconds per inch. Connect coaxial test lead from vertical input jack of oscilloscope to KLYSTRON INPUT INCIDENT jack J1409 on frequency multiplier-oscillator panel.	Klystron input incident signal should be observed as a detected r-f pulse 10 microseconds wide. (Waveshape No. 16 shown in figure 5-16).	If normal indication is not obtained, replace tubes V1505 and V1506. If trouble persists, test transformer T1404 and potentiometers R1530 and R1532. Also take voltage and resistance measurements and compare them with values given in figure 5-19.
NOTE In order to preserve waveshape of detected r-f pulse, a 50-ohm termination must be provided for coaxial test lead. Figure 5-17 illustrates connection that should be used.				
12	19 See figure 6-18	Set METER SELECTOR switch S1401 to KLYSTRON INPUT REFL position and check reading of TUNING meter M1401.	Compare with logged reading.	If there is a considerable increase in reading obtained at this point, a defective or improperly tuned klystron is indicated. Retune klystron and replace, if necessary.

TABLE 5-6. RADIO SET AN/GRN-9D, TRANSMITTER, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
13		Check bias voltage on SAL-89 klystron as follows: Remove protective cover from klystron filament connections. Before attempting to measure voltage, short klystron filament terminals to ground with a grounding pick. Connect voltmeter between either filament terminal and grid.	Bias voltage between grid and cathode of -120 volts dc.	If necessary, adjust potentiometer R1382 to obtain a reading of -120 volts dc. If this voltage cannot be obtained, replace tubes V1370, V1371, and V1372. If trouble persists, take voltage and resistance measurements from tube sockets and compare them with values given in figure 5-20.

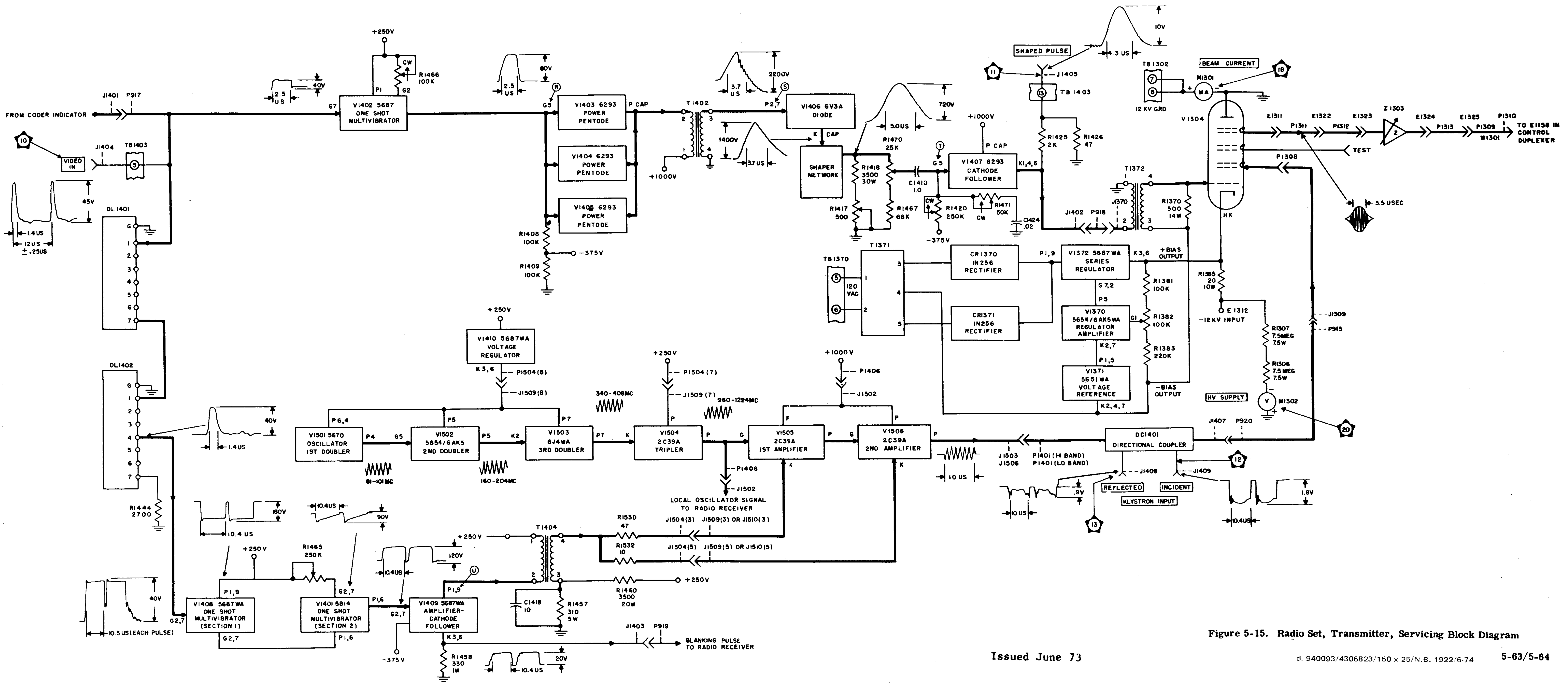
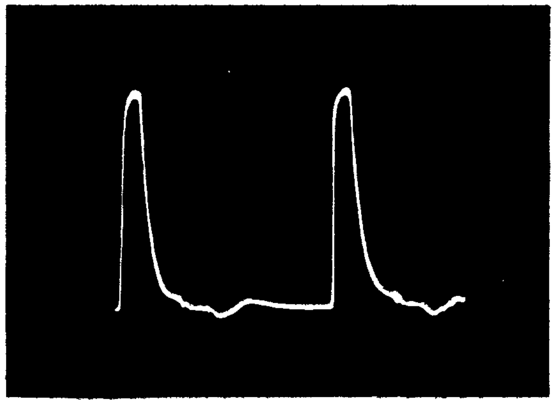
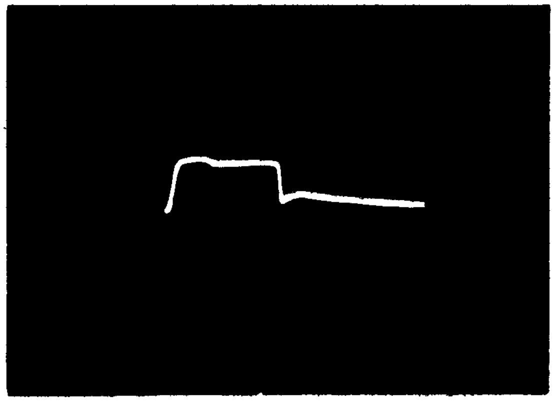


Figure 5-15. Radio Set, Transmitter, Servicing Block Diagram

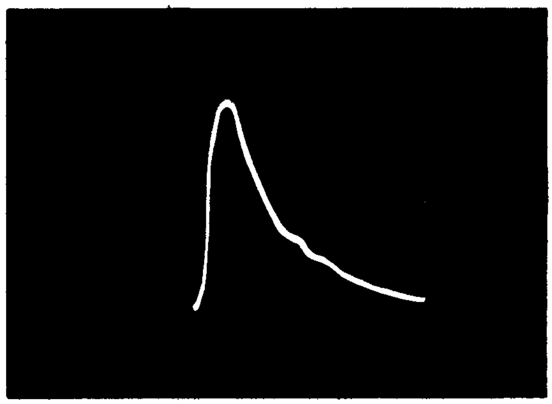
LOCATION: VIDEO IN jack J1404
Sweep Rate: 4 μsec/in.
Measurement: 45 V pp
Pulse width 1.4 μsec
Pulse pair spacing 12 $\pm$.25 μsec
Remarks: One pair of video pulses at input to FMO video circuits.
1



LOCATION: V1402, pin 7
Sweep Rate: 2 μsec/in.
Measurement: 40 V pp
2.9 μsec
Remarks: Grid of one-shot multivibrator V1402 (shaped pulse generator).
2



LOCATION: V1402, pin 7
Sweep Rate: 2 μsec/in.
Measurement: 15 V pp
1.6 μsec
Remarks: Trigger pulse on grid pin 7 with V1402 removed from socket.
3



LOCATION: V1402, pin 9
Sweep Rate: 2 μsec/in.
Measurement: 160 V pp
2.9 μsec
Remarks: Plate of first section of one-shot multivibrator V1402.
4

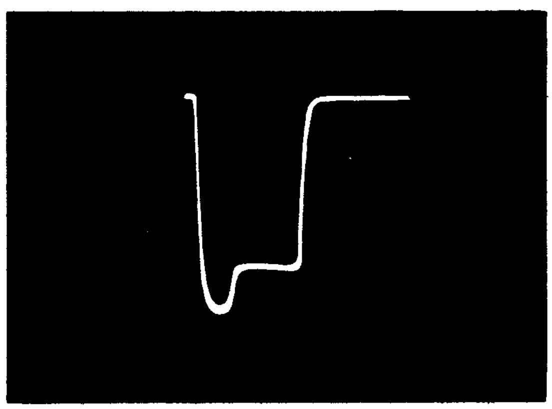
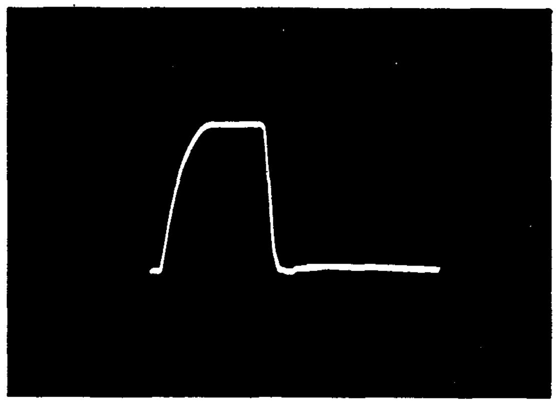
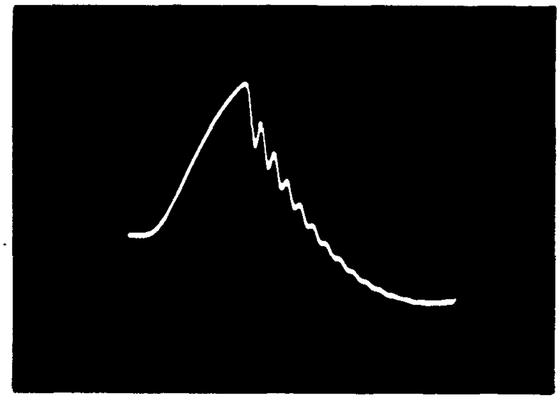


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 1 of 7)

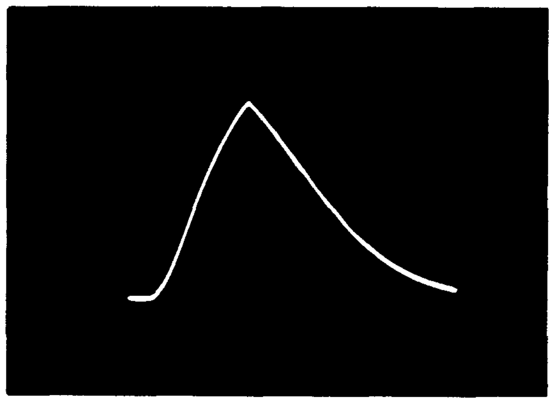
LOCATION: V1403, pin 5
Sweep Rate: 2 μsec/in.
Measurement: 80 V pp
2.6 μsec
Remarks: Grids of amplifiers V1403, V1404 and V1405 in parallel.
5



LOCATION: V1406, pin 2 or 7
Sweep Rate: 3 μsec/in.
Measurement: 2200 V pp
3.7 μsec
Remarks: Plate of series diode V1405.
6



LOCATION: V1406 Cathode Cap
Sweep Rate: 3 μsec/in.
Measurement: 1400 V pp
3.7 μsec
Remarks: Video pulse at input to shaper network.
7



LOCATION: Center tap of R1470
Sweep Rate: 3 μsec/in.
Measurement: 720 V pp
5.0 μsec
Remarks: Shaped pulse at output of shaper network.
8

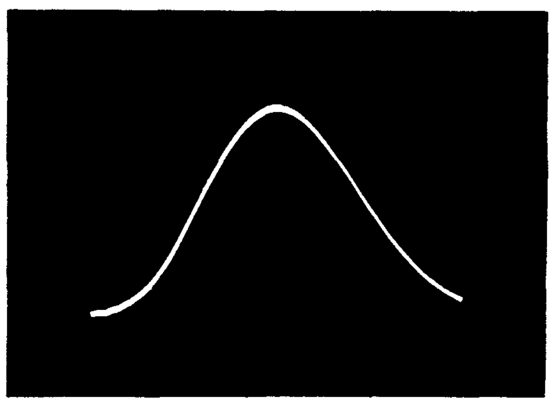
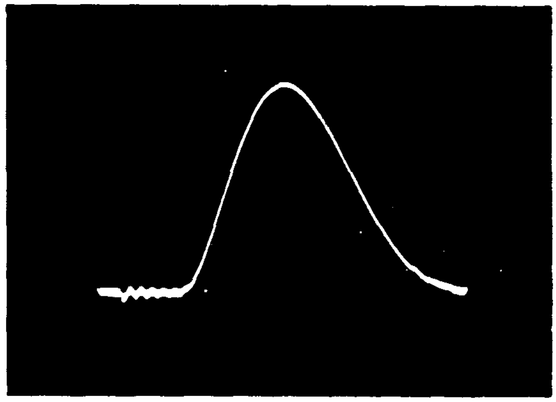


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 2 of 7)

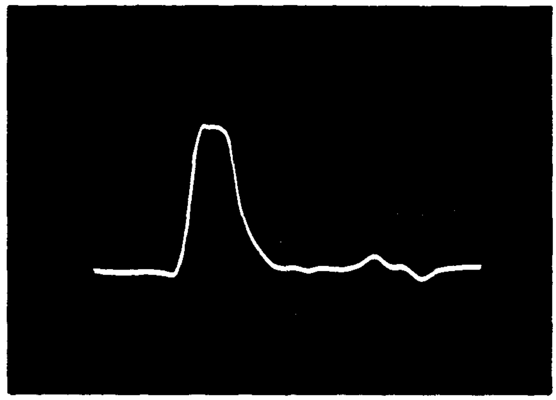
LOCATION: SHAPED PULSE jack J1405
Sweep Rate: 3 μsec/in.
Measurement: 10 V pp
4.3 μsec
Remarks: Shaped pulse at output of frequency multiplier-oscillator.

9



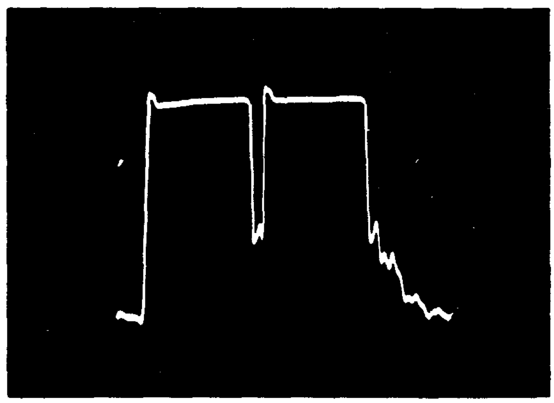
LOCATION: Junction of R1428 and C1428
Sweep Rate: 2 μsec/in.
Measurement: 40 V pp
1.4 μsec
Remarks: Video pulse at output of delay line DL1402.

10



LOCATION: V1408, pin 2
Sweep Rate: 8 μsec/in.
Measurement: 40 V pp
10.5 μsec (each pulse)
Remarks: One pair of pulses on grid (pins 2 and 7) of one-shot multivibrator V1408.

11



LOCATION: Junction of R1462 and R1461.
Sweep Rate: 8 μsec/in.
Measurement: 180 V pp
10.4 μsec
Remarks: One pair of pulses on plate (pins 1 and 9) of first half of multivibrator V1401 and V1408.

12

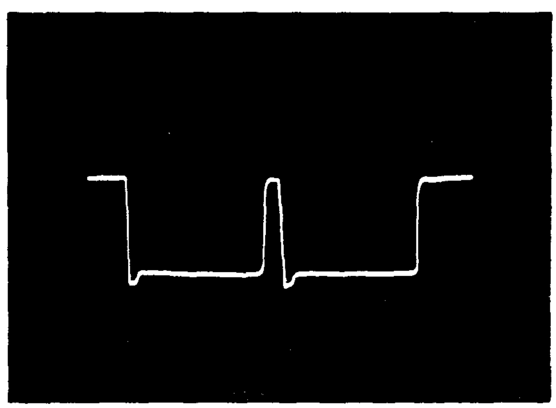
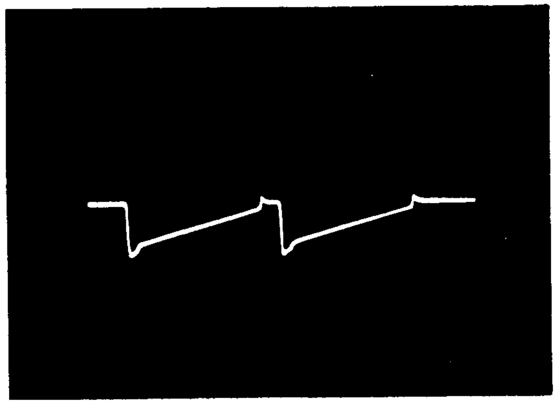


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 3 of 7)

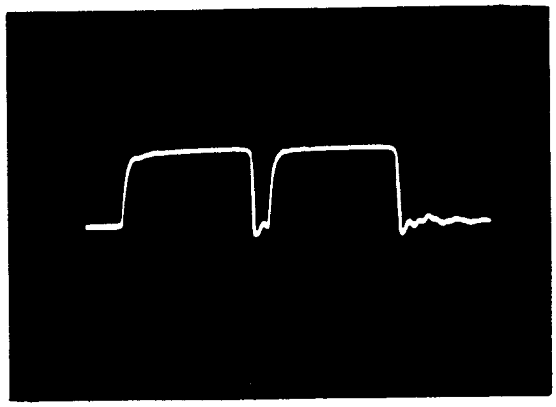
LOCATION: V1401, pin 2
Sweep Rate: 8 μsec/in.
Measurement: 90 V pp
10.4 μsec (at base)
Remarks: Grid of second half of one-shot multivibrator V1401 and V1408.

13



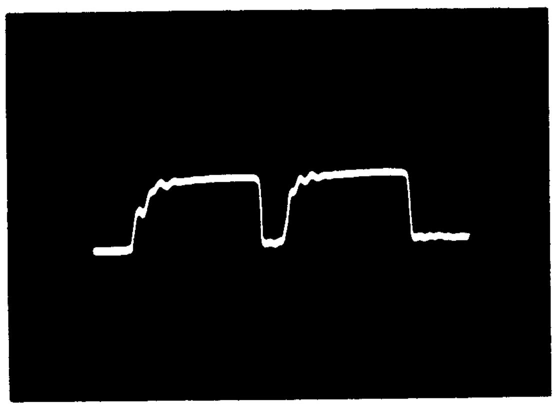
LOCATION: Junction of R1435 and R1440
Sweep Rate: 8 μsec/in.
Measurement: 120 V pp
10.4 μsec
Remarks: Grids of cathode follower V1409.

14



LOCATION: V1409, pin 6
Sweep Rate: 8 μsec/in.
Measurement: 20 V pp
10.4 μsec
Remarks: 10 μsec keying pulses at output of cathode follower V1409.

15



LOCATION: KLYSTRON INPUT INCIDENT jack J1409
Sweep Rate: 8 μsec/in.
Measurement: 1.8 V pp
10.0 μsec
Remarks: Typical waveform.

16

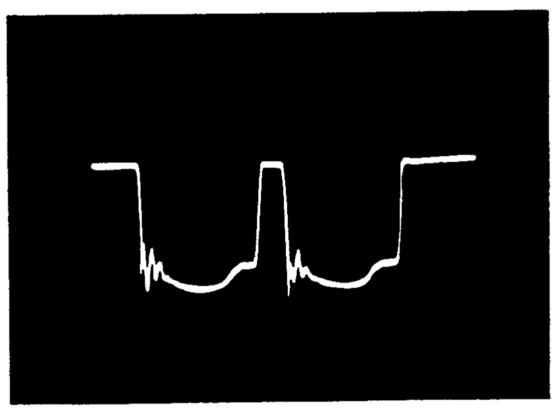
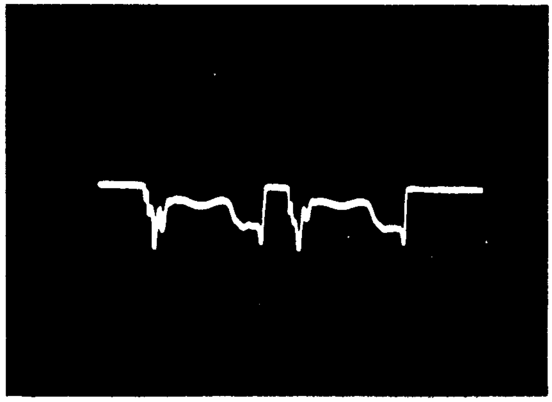


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 4 of 7)

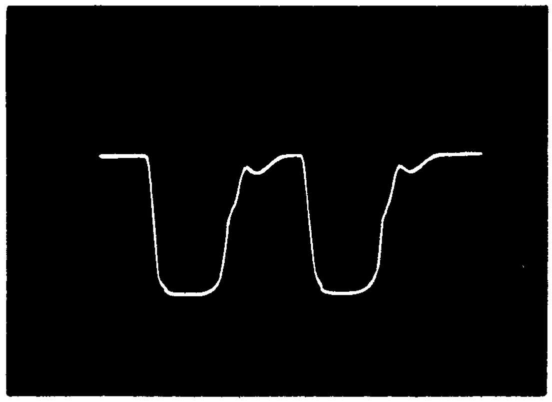
LOCATION: KLYSTRON INPUT
REFLECTED jack J1408
Sweep Rate: 8 μsec/in.
Measurement: .9 V pp
10 μsec
Remarks: Typical waveform.

17



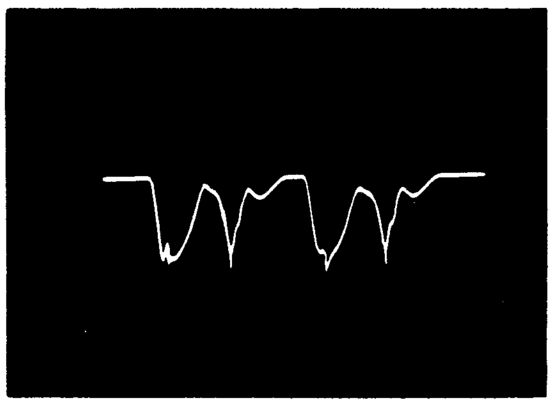
LOCATION: KLYSTRON OUTPUT
INCIDENT jack J1157
Sweep Rate: 8 μsec/in.
Measurement: 2 V pp
6 μsec
Remarks:

18



LOCATION KLYSTRON OUTPUT
REFLECTED J1152
Sweep Rate: 8 μsec/in.
Measurement: 1.3 V pp
6 μsec
Remarks:

19



LOCATION: ANTENNA INCIDENT
jack J1153
Sweep Rate: 8 μsec/in.
Measurement: 1.75 V pp
Remarks:

20

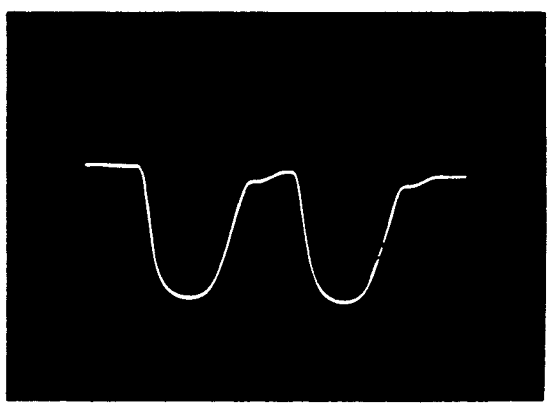
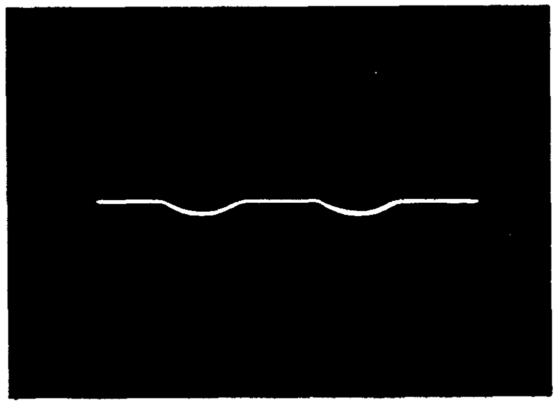
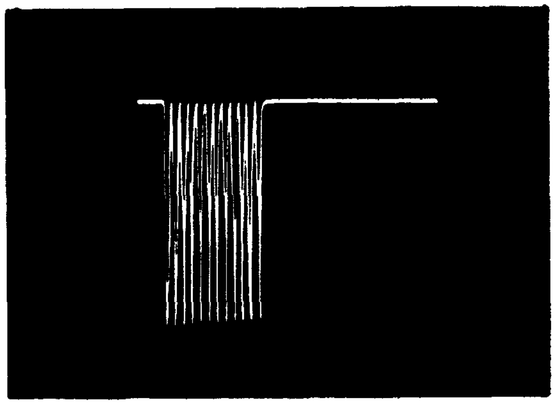


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 5 of 7)

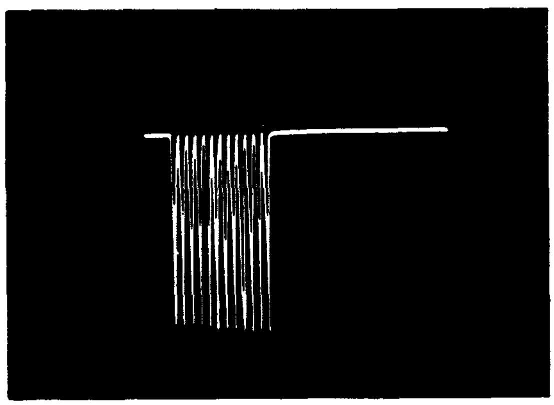
LOCATION: ANTENNA REFLECTED
jack J1153
Sweep Rate: 8 μsec/in.
Measurement: .15 V pp
Remarks: Pulse width not measured. Amplitude of this pulse should be low compared to previous waveform.
21



LOCATION: ANTENNA INCIDENT
jack J1154
Sweep Rate: 80 μsec/in.
Measurement: 1.75 V pp
Remarks: Auxiliary reference burst with R1471 improperly adjusted to show pulse droop.
22



LOCATION: ANTENNA INCIDENT
jack J1154
Sweep Rate: 80 μsec/in.
Measurement: 1.75 V pp
Remarks: Auxiliary reference burst with R1471 improperly adjusted to show pulse boost.
23



LOCATION: ANTENNA INCIDENT
jack J1154
Sweep Rate: 80 μsec/in.
Measurement: 1.75 V pp
Remarks: Auxiliary reference burst with R1471 properly adjusted. Note that pulse amplitude remains constant.
24

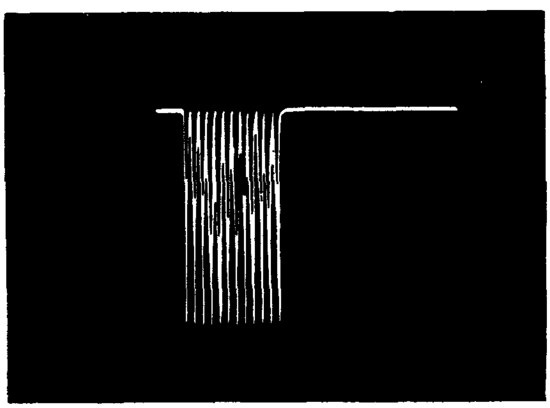
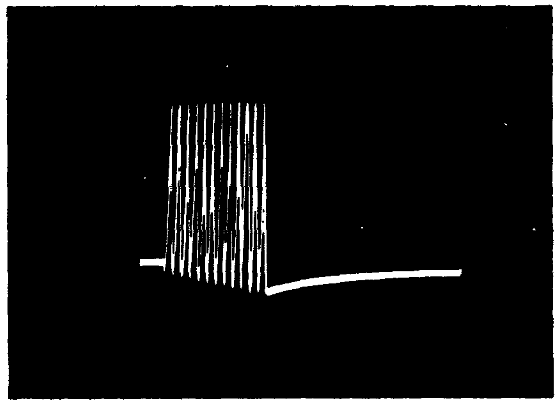


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 6 of 7)

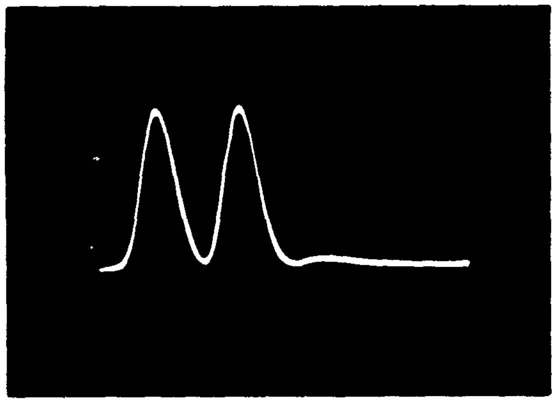
LOCATION: SHAPED PULSE jack J1405
Sweep Rate: 80 μsec/in.
Measurement: 10 V pp
Remarks: Auxiliary reference burst at J1405. R1471 correctly adjusted to boost video pulse train and correct for droop in r-f output pulse train.

25



LOCATION: Center tap of R1470
Sweep Rate: 16 μsec/in.
Measurement: 720 V pp
Remarks: One pair of shaped pulses at output of shaper network. R1417 properly adjusted to minimize reflections.

26A



LOCATION: Center tap of R1470
Sweep Rate: 16 μsec/in.
Measurement: 720 V pp (primary pulse)
60 V pp (reflected pulse)
Remarks: R1417 misadjusted to show reflection caused by improper termination of shaper network.

26B

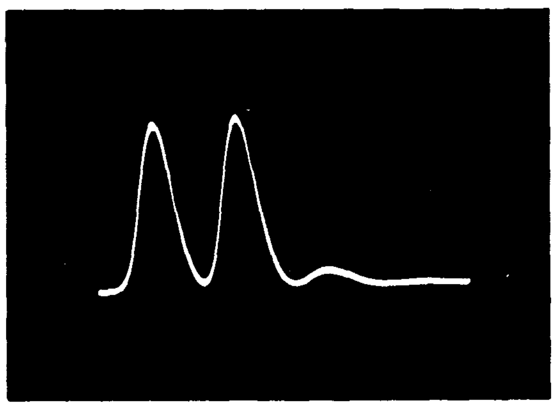


Figure 5-16. Radio Set, Transmitter, Signal-Tracing Waveshapes (Sheet 7 of 7)

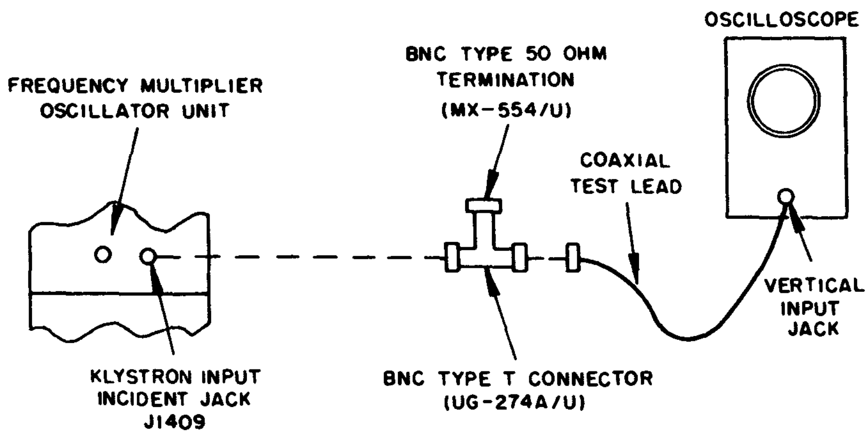
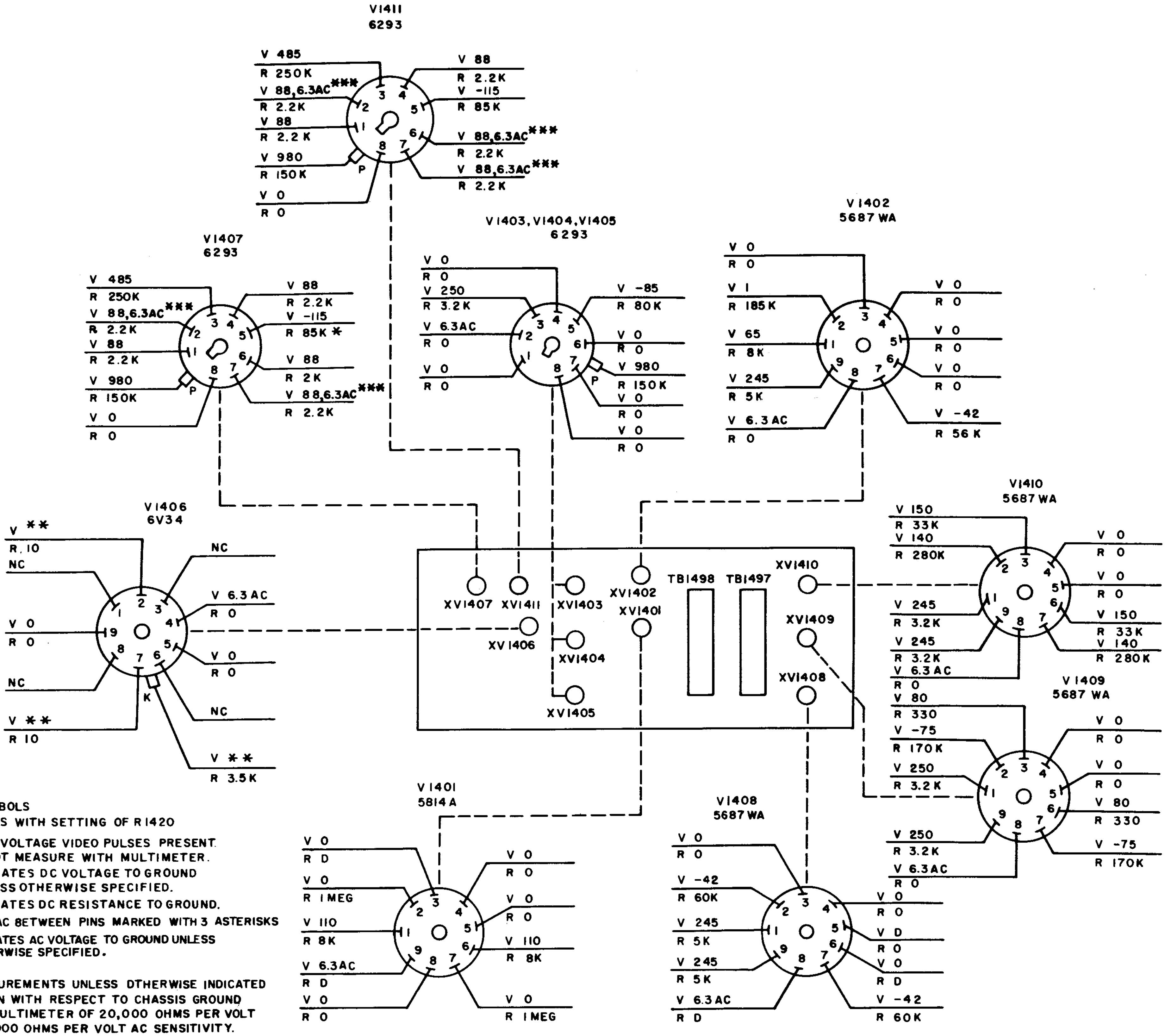


Figure 5-17. Klystron Input Incident Test Setup



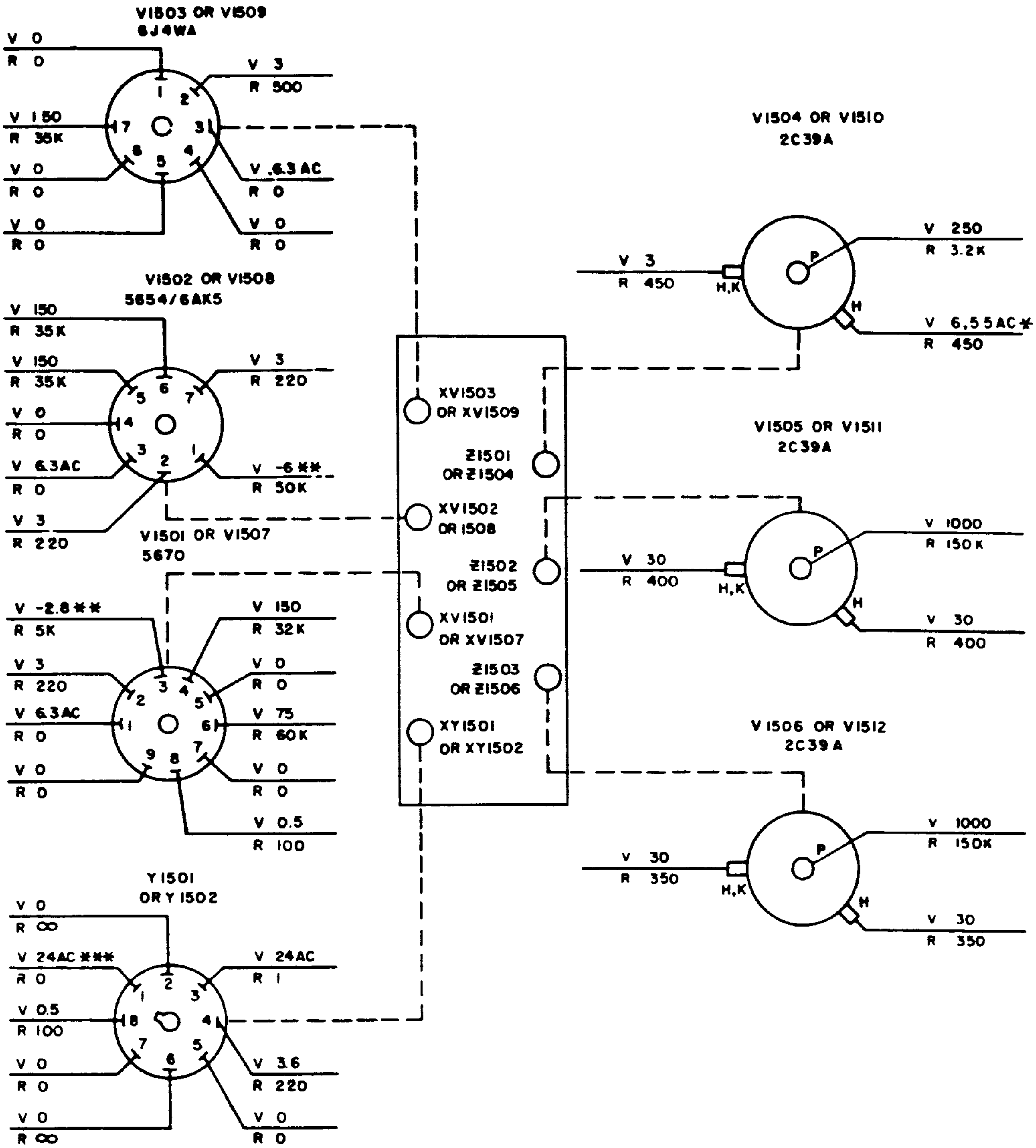
KEY TO SYMBOLS

*	VARIES WITH SETTING OF R1420
**	HIGH VOLTAGE VIDEO PULSES PRESENT. DO NOT MEASURE WITH MULTIMETER.
V	INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
R	INDICATES DC RESISTANCE TO GROUND.
***	6.3V AC BETWEEN PINS MARKED WITH 3 ASTERISKS
AC	INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

NOTES:

1. ALL MEASUREMENTS UNLESS OTHERWISE INDICATED ARE TAKEN WITH RESPECT TO CHASSIS GROUND USING A MULTIMETER OF 20,000 OHMS PER VOLT DC AND 1,000 OHMS PER VOLT AC SENSITIVITY.

Figure 5-18. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Video Chassis, Tube Socket Voltage and Resistance Diagram



NOTES

1. READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1,000 AND 20,000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY

KEY TO SYMBOLS

V INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED

AC INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED

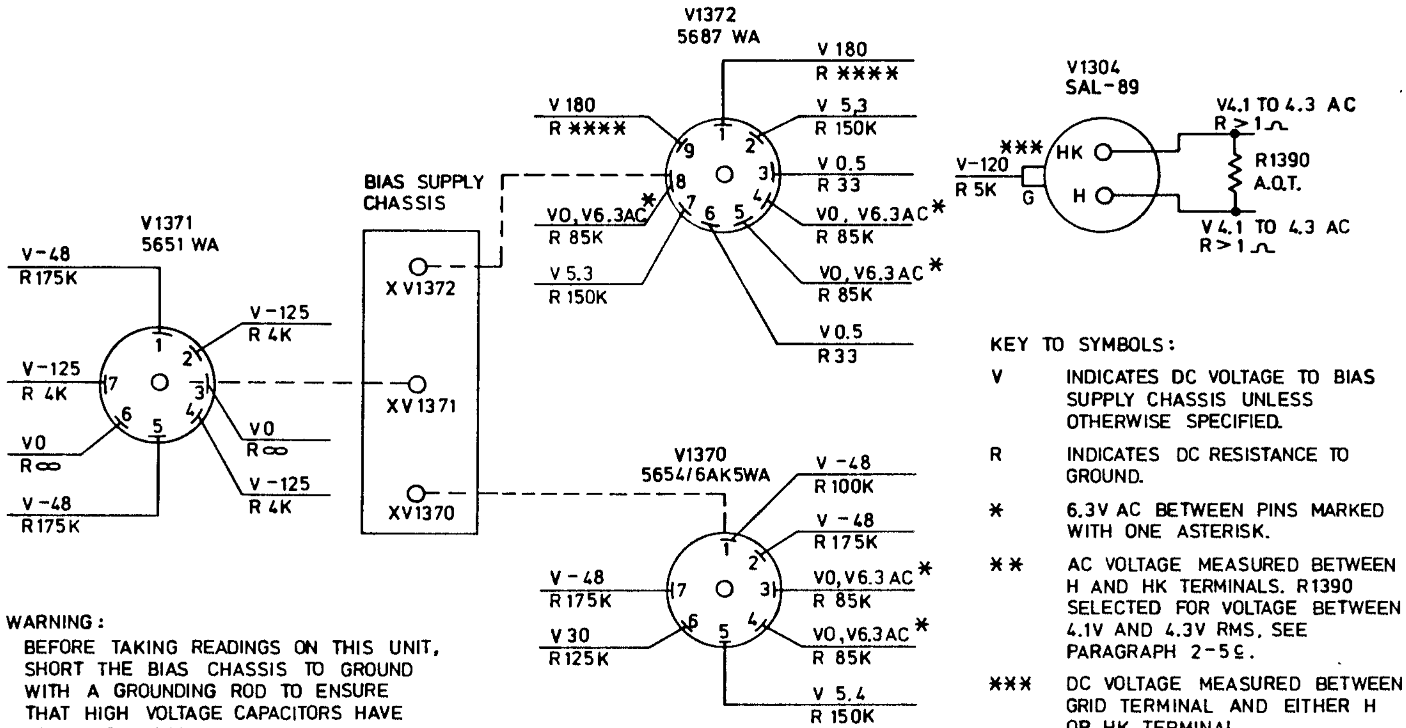
R INDICATES DC RESISTANCE TO GROUND

* 5.5V AC BETWEEN PINS MARKED WITH ONE ASTERISK

** USE A VTVM TO READ VOLTAGE AT THIS POINT

*** 24V AC ON PIN 1 WHEN CRYSTAL OVEN NORMAL LAMP, DS1402 IS NOT LIT.

Figure 5-19. Frequency Multiplier-Oscillator CV-1171/GRN-9D, High or Low Band R-F Chassis, Tube Socket Voltage and Resistance Diagram



WARNING:
BEFORE TAKING READINGS ON THIS UNIT, SHORT THE BIAS CHASSIS TO GROUND WITH A GROUNDING ROD TO ENSURE THAT HIGH VOLTAGE CAPACITORS HAVE BEEN DISCHARGED.

NOTES:
1. READINGS TAKEN WITH A MULTIMETER OF 1,000 Ω/V FOR AC AND 20,000 Ω/V FOR DC.

2. TO OBTAIN POWER ON THE BIAS SUPPLY CHASSIS WITH THE AMPLIFIER-MODULATOR DRAWER OPEN, SHORT AIR SWITCH S1301 WITH A JUMPER.

KEY TO SYMBOLS:

V	INDICATES DC VOLTAGE TO BIAS SUPPLY CHASSIS UNLESS OTHERWISE SPECIFIED.
R	INDICATES DC RESISTANCE TO GROUND.
*	6.3V AC BETWEEN PINS MARKED WITH ONE ASTERISK.
**	AC VOLTAGE MEASURED BETWEEN H AND HK TERMINALS. R1390 SELECTED FOR VOLTAGE BETWEEN 4.1V AND 4.3V RMS. SEE PARAGRAPH 2-5g.
***	DC VOLTAGE MEASURED BETWEEN GRID TERMINAL AND EITHER H OR HK TERMINAL.
****	OHMMETER READING VARIES WIDELY DEPENDING ON OHMS SCALE USED AND POLARITY OF OHMMETER LEADS.
AC	INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.

Figure 5-20. Amplifier-Modulator AM-1701/URN, Tube Socket Voltage and Resistance Diagram

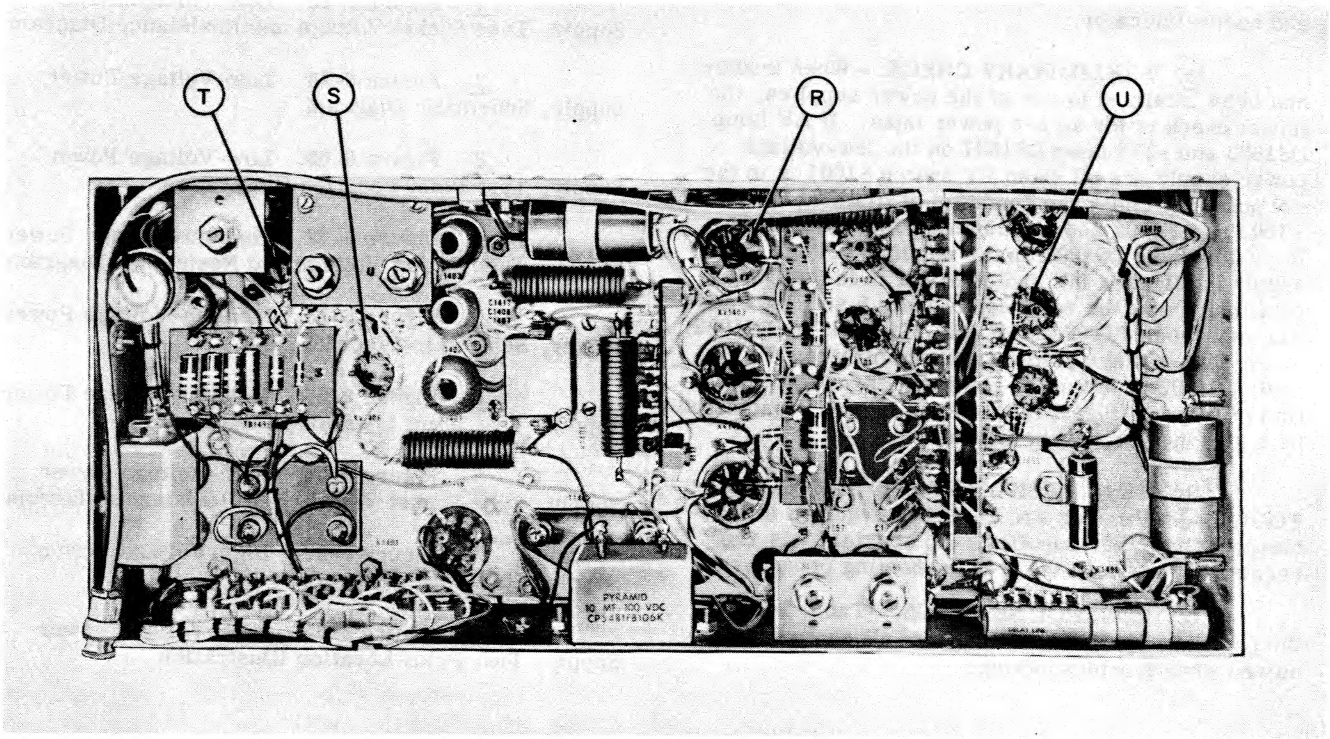


Figure 5-21. Frequency-Multiplier-Oscillator CV-1171/GRN-9D, Video Chassis, Bottom View, Test Point Location

(4) TROUBLESHOOTING POWER SUPPLIES. — When trouble has been localized to one of the power supplies in the radio set, refer to troubleshooting table which pertains to that particular power supply and follow the step-by-step procedure indicated. Various checks and adjustments which will aid in restoring the power supplies to proper operating condition are given in paragraph 5-4c(5). The klystron bias supply is covered under the troubleshooting procedure for the transmitter portion of Radio Set AN/GRN-9D. Radio receiver and coder-indicator power supply troubleshooting information is included with the troubleshooting data on the radio receiver and coder-indicator.

(a) PRELIMINARY CHECK. —When trouble has been localized to one of the power supplies, the initial check is for an a-c power input. If LV lamp DS1603 and -375 lamp DS1601 on the low-voltage power supply are off when LV switch S1601 is in the ON position, check the condition of filament fuses F1601 and F1602 and plate fuses F1603 and F1604. If +1000V lamp DS1801 on the medium-voltage power supply is off when MV switch S1801 is in the ON position, check the condition of plate fuse F1801 and filament fuses F1802 and F1803. If HV lamp DS1902 on the high-voltage power supply is off when HV switch S1902 is in the ON position, check the condition of filament fuse F1901. Fuse failure is indicated by a glowing lamp in the fuseholder.

(b) TEST EQUIPMENT AND SPECIAL TOOLS. —Multimeter AN/PSM-4 is required to troubleshoot the power supplies. No special tools are required to perform the troubleshooting procedure.

(c) CONTROL SETTINGS. —Table 5-2 lists the preliminary control settings of all controls required when troubleshooting.

(d) TROUBLESHOOTING CHARTS. —When trouble has been localized to one of the power supplies, refer to the applicable troubleshooting chart. Table 5-7 is concerned with troubleshooting the low-voltage power supply and tables 5-8 and 5-9 cover troubleshooting of the medium- and low-voltage power supplies, respectively.

(e) ILLUSTRATIONS. —Illustrations containing information which will aid the technician in troubleshooting the power supplies are as follows:

1. Figure 5-22. Low-Voltage Power Supply, Tube Socket Voltage and Resistance Diagram

2. Figure 6-24. Low-Voltage Power Supply, Schematic Diagram

3. Figure 6-63. Low-Voltage Power Supply, Test Point Location Illustration

4. Figure 5-23. Medium-Voltage Power Supply, Tube Socket Voltage and Resistance Diagram

5. Figure 6-25. Medium-Voltage Power Supply, Schematic Diagram

6. Figure 6-66. Medium-Voltage Power Supply, Test Point Location Illustration

7. Figure 5-24. High-Voltage Power Supply, Tube Socket Voltage and Resistance Diagram

8. Figure 6-26. High-Voltage Power Supply, Schematic Diagram

9. Figure 6-68. High-Voltage Power Supply, Test Point Location Illustration

TABLE 5-7. RADIO SET AN/GRN-9D, LOW-VOLTAGE POWER SUPPLY, FUNCTIONAL SECTION TROUBLESHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1	17 See figure 6-18	Check reading of D. C. SUPPLY VOLTAGE meter M1402 on frequency multiplier-oscillator panel with METER SELECTOR switch S1402 in the following positions: -375V +250V	The following readings should be obtained: -375 volts dc +250 volts dc	If both voltages measure zero, check that front panel lamps DS1605 LV-MV READY and DS1603 L. V. are on. If both lamps are on, proceed to steps 2 and 3. If one or both lamps are off, proceed as follows: If LV-MV READY lamp DS1605 is off, trouble in control circuits or 1-minute time delay relay K1605 is indicated. Isolate by checking for 120 volts ac at terminal 1 of terminal board TB1602. If voltage is present, relay K1605 is at fault. If voltage is not present, refer to control circuits troubleshooting chart (table 5-10). If LV-MV READY lamp DS1605 is on and L. V. lamp DS1603 is off, trouble in control circuits or relay K1603 is indicated. Isolate by checking for 120 volts ac at terminal 6 of terminal board TB1601. If voltage is present, check relay K1603 circuit. If voltage is not present, refer to control circuits troubleshooting chart (table 5-10). **Note** Power to relay K1603 is applied through terminals 3 and 5 at relay K1605, air switch S1005, interlock S1002A (medium-voltage power supply), interlock S1001A (low-voltage power supply), interlock S903 (frequency multiplier-oscillator), interlock S902A (amplifier-modulator), and terminals A1 and A2 at relay K1101.

TABLE 5-7. RADIO SET AN/GRN-9D, LOW-VOLTAGE POWER SUPPLY, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

<table>
<tr><th>STEP</th><th>TEST POINT</th><th>PRELIMINARY ACTION</th><th>NORMAL INDICATION</th><th>NEXT STEP</th></tr>
<tr><td>1 (cont)</td><td></td><td></td><td></td><td>Check for 120-volt a-c regulated filament voltage at terminal board TB1601, terminals 4 and 5. If voltage is present, check fuses F1601 and F1602 and transformers T1603 and T1604. Replace if necessary. If voltage is not present, refer to control circuits troubleshooting chart (table 5-10) and check regulated filament supply circuit.</td></tr>
<tr><td colspan="5">Note
Before troubleshooting power supply, isolate load to determine whether load is causing trouble. To remove load, disconnect cables connected to terminals 2, 3, 6, and 8 of terminal board TB1602.

WARNING
Before removing bias voltage, always remove all B+voltages. In addition, before making any resistance measurements, turn off power supply and discharge all capacitors.</td></tr>
<tr><td>2</td><td>17
See figure 6-18</td><td>Set METER SELECTOR switch S1402 to -375V position and check reading of D.C. SUPPLY VOLTAGE meter M1402.</td><td>Meter M1402 should indicate -375 volts dc</td><td>If -375-volt output is 0, proceed as follows: Check fuse F1603 by noting whether its associated blown fuse indicator lamp is on. If fuse is blown, replace it. If fuse blows again, check transformer T1602 and tube V1610 for short. Replace defective components. If fuse F1603 is not defective, trouble is in stages V1610, V1611, V1612, or V1613. To troubleshoot these stages, first replace tubes and then take tube voltage and resistance measurements. Compare these measurements with values given in figure 5-22. If -375-volt output is incorrect (other than 0), adjust potentiometer</td></tr>
</table>

TABLE 5-7. RADIO SET AN/GRN-9D, LOW-VOLTAGE POWER SUPPLY FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
2 (cont)				R1663, while observing meter M1402, to obtain -375 volts. If output voltage cannot be corrected by adjustment, check for weak tubes in stages V1610 through V1614 and replace all weak tubes.
3	17 See figure 6-18	Set METER SELECTOR switch S1402 to +250V position and check reading of D.C. SUPPLY VOLTAGE meter M1402	Meter M1402 should indicate +250 volts dc	If only +250-volt output is 0, proceed as follows: Check fuse F1604 by noting whether its associated blown fuse indicator lamp is on. If fuse is blown, replace it. If fuse blows again, check transformer T1601 and stages V1601 and V1602 for a short. Replace defective compcnents. If fuse F1604 is not defective and +250-volt output is still missing, trouble is in stages V1601, V1602, V1603, and V1604, V1605, or V1606. To troubleshoot these stages, first replace tubes and then take voltage and resistance measurements. Compare these measurements with values given in figure 5-22. Replace defective tubes and components. If +250-volt output is incorrect, adjust potentiometer R1623, while observing meter M1402, to obtain +250 volts. If adjustment fails to obtain required +250 volts, check for weak tubes in stages V1601 through V1606 and replace all weak tubes.

TABLE 5-8. RADIO SET AN/GRN-9D, MEDIUM-VOLTAGE POWER SUPPLY, FUNCTIONAL SECTION TROUBLESHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1	17 See figure 6-18	Set METER SELECTOR switch S1402 on frequency multiplier-oscillator panel to -1000V position and check reading of D.C. SUPPLY VOLTAGE meter M1402.	Meter M1402 should indicate +1000 volts dc	If indication is 0 or incorrect, check fuse F1801. If fuse is not blown, perform steps 4 and 5. If fuse is blown, replace fuse. If fuse blows again, proceed to step 2.
2		Remove tubes V1801 and V1802 and replace fuse.		If fuse blows again, transformer T1801 or T1802 is defective. If fuse does not blow, proceed to step 3.
3		Check tubes V1801 and V1802 for shorts.	Tubes check good	If tubes check good, replace tubes. If fuse continues to blow, check stages V1803 through V1807. First replace tubes and then take voltage and resistance measurements. Compare these measurements with values given in figure 5-23.
4		Check fuses F1802 and F1803.		If fuses are blown, check transformers T1802 and T1803 and tube filament circuits. If fuses are not blown, check that relay K1804 is closed when MV switch S1801 is in ON position. **Note** Low-voltage power supply must be on before medium-voltage power supply can be started.
5		Check whether OVERLOAD lamp DS1803 on medium voltage power supply panel is on.		If OVERLOAD lamp is off, refer to control circuits troubleshooting chart (table 5-10). If OVERLOAD lamp is off, manually depress reset overload relay button. If lamp goes on again, check relays K1802 and K1803.

TABLE 5-9. RADIO SET AN/GRN-9D, HIGH-VOLTAGE POWER SUPPLY, FUNCTIONAL SECTION TROUBLESHOOTING CHART

<table>
<tr><th>STEP</th><th>TEST POINT</th><th>PRELIMINARY ACTION</th><th>NORMAL INDICATION</th><th>NEXT STEP</th></tr>
<tr><td colspan="5">WARNING
Voltages dangerous to life are exposed in this unit. Set MASTER switch S1101 on control-duplexer panel to OFF position before pulling out high-voltage power supply and return unit to its place in cabinet before setting MASTER switch to ON position. Capacitors may retain dangerous charges; therefore, always ground components before touching them.</td></tr>
<tr><td>1</td><td>20
See figure 6-20</td><td>Check reading of H. V. SUPPLY meter M1302 on amplifier-modulator panel.</td><td>Meter M1302 should indicate 12,000 volts dc</td><td>If correct reading is not obtained, check fuses F1001, F1002, and F1003. If fuses are good, perform steps 3 and 4. If one fuse is blown, disconnect load and proceed to step 2.</td></tr>
<tr><td colspan="5">Note
To disconnect load (observing WARNING), disconnect output cable from E1001 on power supply assembly. Secure cable with tape or string in position where it will be at least 3 inches from any high-voltage point in unit.</td></tr>
<tr><td>2</td><td></td><td>Replace blown fuse and check fuses.</td><td></td><td>If new fuses do not blow with load disconnected and blown fuses replaced, refer to transmitter troubleshooting chart (table 5-6). If fuses blow again with load removed, reconnect load and check to determine whether relays K1902 and K1904 are energized. If relays are deenergized, replace relays. If relays K1902 and K1904 check out satisfactorily, check tubes and components in high-voltage power supply. Take resistance measurements and compare them with values given in figure 5-24. Replace defective tubes and components.</td></tr>
<tr><td>3</td><td></td><td>Check fuse F1901.</td><td></td><td>If fuse is blown, check tube filament circuits. Replace fuse.</td></tr>
</table>

TABLE 5-9. RADIO SET AN/GRN-9D, HIGH-VOLTAGE POWER SUPPLY, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
4		Check whether H. V. OVERLOAD lamp DS1903 on high-voltage power supply panel is on.	H. V. OVERLOAD lamp should not be on	If H. V. OVERLOAD lamp is on, manually depress reset overload relay button. If lamp goes on again, check relay K1904 and potentiometers R1906 and R1912. Replace defective components. Overload relay may trip due to high charging current. Check pulse count at coder-indicator test output jack. Refer to table 5-5. High output pulse count or trouble in transmitter may cause high charging current.

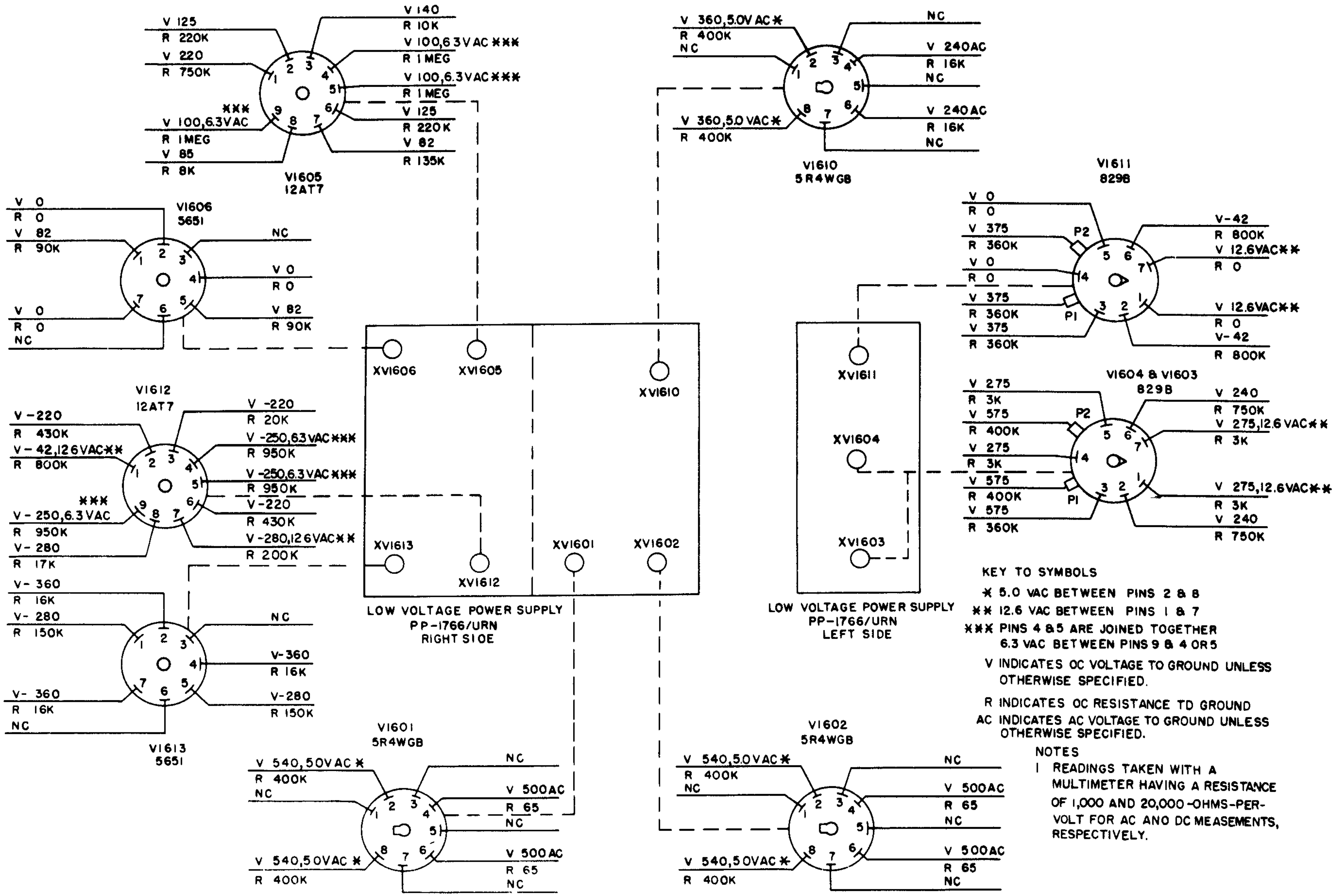
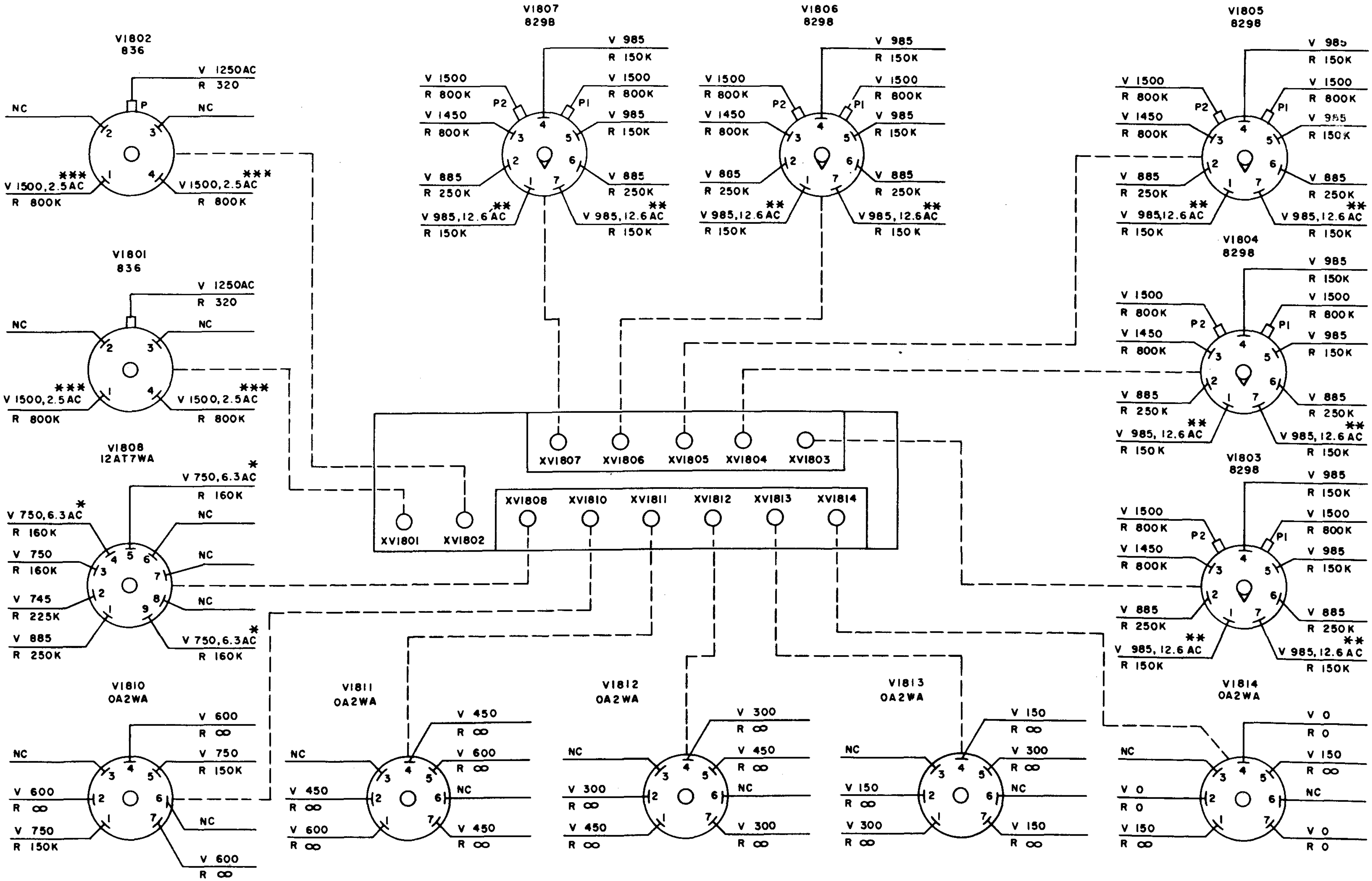


Figure 5-22. Low-Voltage Power Supply PP-1766/URN, Tube Socket Voltage and Resistance Diagram



NOTES:
READINGS TAKEN WITH A MULTIMETER HAVING A RESISTANCE OF 1000 AND 20000-OHMS-PER-VOLT FOR AC AND DC MEASUREMENTS, RESPECTIVELY.

KEY TO SYMBOLS
- V INDICATES DC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
- AC INDICATES AC VOLTAGE TO GROUND UNLESS OTHERWISE SPECIFIED.
- R INDICATES DC RESISTANCE TO GROUND.
- * 6.3 VAC BETWEEN PINS MARKED WITH ONE ASTERISK.
- ** 12.6 VAC BETWEEN PINS MARKED WITH TWO ASTERISKS.
- *** 2.5 VAC BETWEEN PINS MARKED WITH THREE ASTERISKS.

Figure 5-23. Medium-Voltage Power Supply PP-1765/URN, Tube Socket Voltage and Resistance Diagram

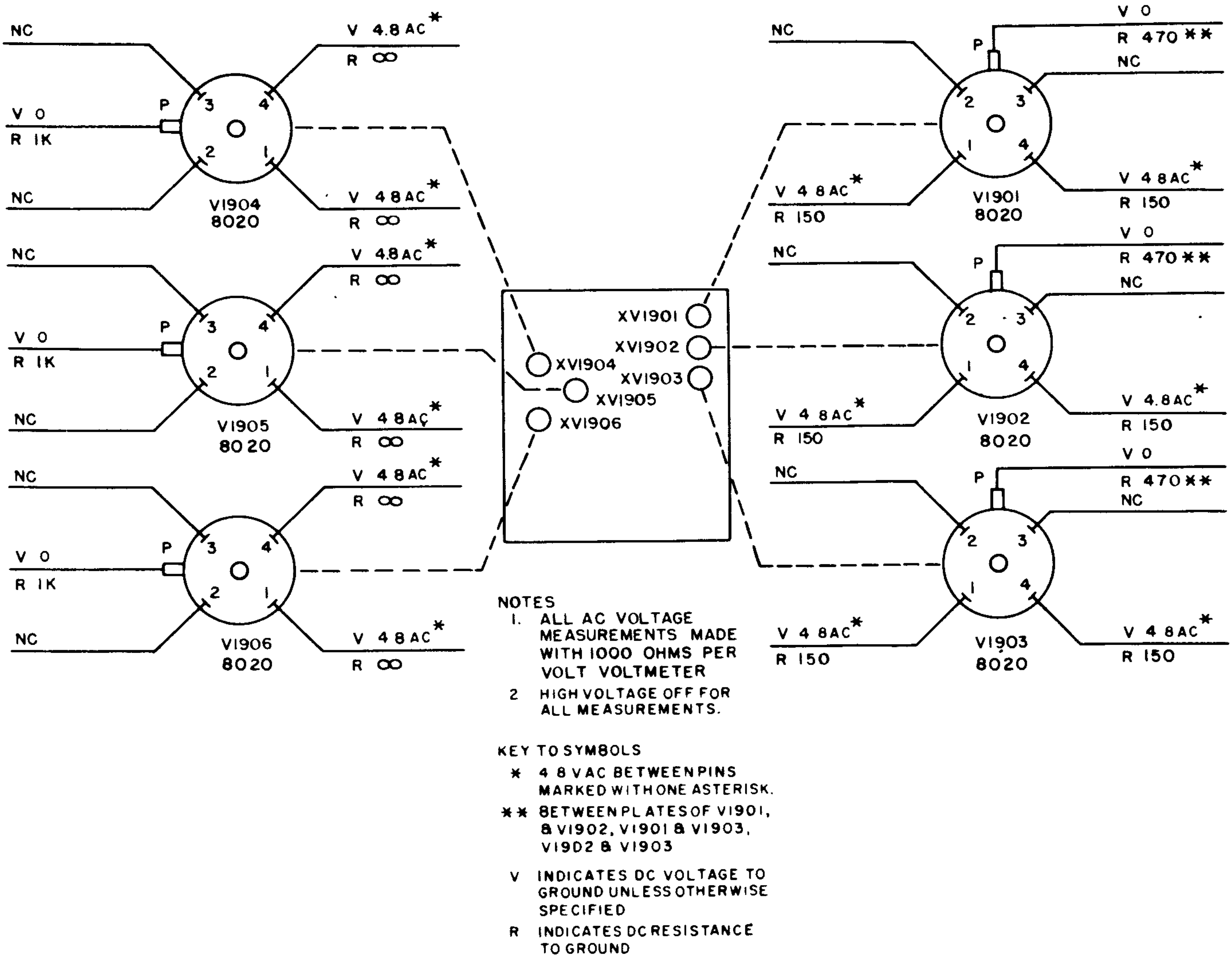


Figure 5-24. High-Voltage Power Supply PP-1763/URN, Tube Socket Voltage and Resistance Diagram

(5) TROUBLESHOOTING POWER DISTRIBUTION AND CONTROL CIRCUITS. (See figure 5-25.)–A systematic procedure for troubleshooting the power distribution and control circuits is given in the following paragraphs. This procedure is begun with the radio beacon completely deenergized. As each control circuit is energized, appropriate checks for normal operation are made. The point at which a normal indication is not obtained is the point at which detailed troubleshooting of the control circuits should start. Detailed troubleshooting consists of point-to-point voltage and resistance measurements and inspection of relays, controls, and other components in the control circuit under check.

(a) TEST EQUIPMENT AND SPECIAL TOOLS.–Multimeter AN/PSM-4 is required to troubleshoot the power distribution and control circuits. No special tools are required for this procedure.

(b) CONTROL SETTINGS.–With the exception of HIGH VOLTAGE switch S1006, set all power switches as specified in table 2-1. The HIGH VOLTAGE switch is left in the OPERATE position during the performance of this procedure.

(c) TROUBLESHOOTING CHART.–Table 5-10 presents a systematic procedure for troubleshooting the power distribution and control circuits.

5-5. TYPICAL TROUBLES.

Table 5-11 lists typical troubles which may be encountered during operation of Radio Set AN/GRN-9D.

5-6. LOCATION OF PARTS.

The location of parts in the radio set is shown in Section 6, figures 6-1 through 6-7, 6-9 through 6-11, and 6-50 through 6-68. The locating function column of the maintenance parts list (table 7-3) includes reference to the appropriate illustration on which the part is shown. This table is included in the parts list presented in Section 7.

Note

The wiring diagrams included in Section 6 also serve as an aid for the location of parts when used in conjunction with the equipment illustrations.

TABLE 5-10. RADIO SET AN GRN-9D, POWER DISTRIBUTION AND CONTROL CIRCUITS. FUNCTIONAL SECTION TROUBLESHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
Note Before starting troubleshooting procedures described in this chart, turn off all power switches. The procedures for troubleshooting in this chart are based on turning power on in proper sequence and noting point at which normal indication is not obtained.				
1		*CAVITY HEATER ON lamp applies to ITT Models only	Crystal oven heater lamps DS1402 and DS1403 on front panel of frequency multiplier-oscillator are on. OVEN lamp DS1403 will remain on: however, NORMAL lamp DS 1402 will stay on until oven has reached operating temperature and then turn off and on as additional heat is required to maintain operating temperature. *CAVITY HEATER ON lamp DS1105 on control-duplexer panel should also go on. Operation of lamp DS1105 is similar to that for lamp DS1402.	If lamps DS1402 and DS1403 do not go on, replace lamps and check fuses F1402 and F1403, transformer T1502, and line filter FL1401 in frequency multiplier-oscillator unit. Replace defective components.
			Three-phase power is applied to terminals 1, 2, and 3 of terminal board TB902 (antenna spin motor; power is applied to spin motor when MASTER SWITCH S1101 and ANTENNA CONTROL SWITCH S1102 are turned to STANDBY and ON positions, respectively.	
			Power is applied to convenience outlets on receiver-transmitter cabinet, antenna control unit, and antenna pedestal.	If power is not applied to convenience outlets, check fuses F1005 and F1004. Replace blown fuse(s).
			Loss-of-phase relay K901 is energized.	Check relay K901. Replace if necessary.
2		Turn MASTER SWITCH S1101 on front panel of control-duplexer to STANDBY position.	Blue MAIN POWER ON lamp DS1102 on control-duplexer should go on.	If MAIN POWER ON lamp does not go on. replace lamp and check fuses F1101, F1102, and F1106, L3-T3 contacts of primary contactor K1101, and contacts of loss-of-phase relay K901.

TABLE 5-10. RADIO SET AN/GRN-9D, POWER DISTRIBUTION AND CONTROL CIRCUITS, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
2 (cont)			Blowers B901 and B902 in receiver-transmitter cabinet should start operating.	If all blowers fail to operate, check blower contactor K1103 and A1-A2, B1-B2 contacts of K1103. Replace defective components. If blower B901 fails to operate, check fuses F901, F902, and F903. Check connections to blower motor by checking for 208-volt 3-phase power at terminals T1, T2, and T3 of motor B901. If voltages are present, check blower motor B901. If voltages are not present, check interconnections. Replace defective components. If blower B902 fails to operate, check fuses F905, F906, and F907. Check connections to blower motor by checking for 208-volt, 3-phase a-c power at terminals T1, T2, and T3 of motor B902. If voltages are present, check blower motor B902. If voltages are not present, check interconnections. Replace blower motor and cabling, if necessary. If blower B1001 fails to operate, check connections to blower motor by checking for 208 volts ac at terminals T1, T2, and T3 of motor B1001. If voltages are not present, check interconnections.

Note

The following sequence of operation takes place when MASTER SWITCH is set to STANDBY, as directed in step 2:

(1) Primary contactor K1101 is energized, closing contacts L1-T1, L2-T2, L3-T3, L4-T4, and A1-A2, opening contacts B1-B2, applying power to control circuit bus, and energizing MAIN POWER ON lamp DS1102.

TABLE 5-10. RADIO SET AN/GRN-9D, POWER DISTRIBUTION AND CONTROL CIRCUITS, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
2 (cont)	(2) The 1-minute delay contactor, K1102, remains deenergized; therefore, contacts 3-4 remain closed. Blower contactor K1103 is energized through normally closed contacts 3-4 of contactor K1102. Contacts L1-T1, L2-T2, and L3-T3 of contactor K1103 close, applying power to blowers B901, B902, and B1101. Contacts A1-A2 of contactor K1103 must close before contacts B1-B2 open. This transfers power from load side of K1101 contacts to line side, permitting blowers to operate after MASTER SWITCH has been set to OFF. (3) Power is applied to ANTENNA CONTROL ON switch. Antenna control unit and regulated filament bus can now be energized.			
3		Set FIL ON switch S1108 on control-duplexer panel to ON position and turn MASTER SWITCH S1101 on control-duplexer panel from STANDBY to ON position.	FIL ON lamp DS1101 and MAIN POWER ON lamp DS1102 on control-duplexer panel should go on. **Note** When switch S1108 is turned to ON position, all filaments are energized immediately except in radio receiver and coder-indicator units of radio beacon. Amplifier-modulator, bias supply, and SAL-89 filaments are not energized until modulator filament relay K1301 is energized. (Relay K1301 is not energized until air switch S1301 is closed, indicating proper functioning of blowers B901 and B902.)	Replace blower motor and cabling, if necessary. If lamps DS1101 and DS1102 do not go on, check fuses F1102, F1108, and F1110. Also check that SUPPLY VOLTS METER M1101, with METER SELECTOR switch S1106 in REG FIL BUS position, reads 120 volts ac. If voltage is not 120 volts ac, an adjustment is provided in control-duplexer (variac T1101) for obtaining this voltage. Check variac T1101, transformer T1102, and contacts L4-T4 of primary contactor K1101.
			FILAMENT lamp DS1401 on panel of frequency multiplier-oscillator should go on. **Note** FIL. SUPV. relay K1401 will be energized when primary of 2C39A filament transformer is energized (T1501). Contacts 2-4 of	Check lamps DS1101 and DS1102. Replace defective components. If lamp DS1401 does not go on, check fuse F1401 and lamp DS1401. Replace if necessary.

TABLE 5-10. RADIO SET AN/GRN-9D, POWER DISTRIBUTION AND CONTROL CIRCUITS, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
3 (cont)			relay K1401 will then close, starting 1 MIN LVPS PLATE time delay relay K1605. When 1 minute has elapsed, LVPS plates are ready to be energized.	
			LV-MV READY lamp DS1605 on panel of low-voltage power supply should go on.	If lamp DS1605 does not go on, check FIL. SUPV. relay K1401, 1 MIN LVPS PLATE relay K1605, air switch S1005 (DS1001 AIR SWITCH OPEN lamp will be on if air switch S1005 is open), and air switches S1002A, S1001A, and S903A. Replace defective components.
			FIL lamp DS1301 on panel of amplifier-modulator should go on.	If lamp DS1301 does not go on, check air switch S1301 (if switch S1301 is defective, AIR SW OPEN lamp DS1303 on amplifier-modulator panel will go on).
			FILAMENT HOURS meter M1902 on panel of high-voltage power supply should be energized.	If meter M1902 is not energized, check for 120 volts ac at terminal board TB1902. If voltage is present, check meter M1902. Replace meter, if necessary.
4		Turn ANTENNA CONTROL switch S1102 on control-duplexer panel to ON position.	ANTENNA CONTROL ON lamp DS1103 on control-duplexer panel should go on.	If lamp DS1103 does not go on, replace lamp and check fuses F1103 and F1104, resistor R1103, and contacts L1-T1 of relay K1101. Replace defective components and blown fuses.
			ANTENNA CONTROL lamp DS602 on coder-indicator panel should go on and remain steady.	If lamp DS602 flashes on and off, check antenna control power circuits.
5		Turn CODER INDICATOR switch S601 on coder-indicator panel to ON position.	POWER ON lamp DS601 on coder-indicator panel should go on.	If lamp DS601 does not go on, replace lamp and check fuses F601 and F602 on coder-indicator panel and also

TABLE 5-10. RADIO SET AN/GRN-9D, POWER DISTRIBUTION AND CONTROL CIRCUITS, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
5 (cont)				resistor R601 on coder-indicator video frame. Replace blown fuses and components.
6		Turn LV switch S1601 on low-voltage power supply panel to ON position.	LV lamp DS1603 and -375V lamp DS1601 on low-voltage power supply should go on.	If lamp DS1603 does not go on, replace lamp and check contacts of relay K1603 and interconnections. If lamp DS1601 does not go on, replace lamp and check relay K1601. Replace relays and cabling, if necessary.
7		Turn MV switch S1801 on medium-voltage power supply panel to ON position.	+1000V lamp DS1801 should go on.	If lamp DS1801 does not go on, replace lamp and check that -375 no bias relay K1601 is energized. Refer to step 6. Check that 1-kilovolt overload auxiliary relay is not energized, indicating no overload. (If an overload exists, MV OVERLOAD lamp DS1803 on medium-power supply panel will be on.) Check that overload reset relay K1806 is not energized, indicating no overload.
8		Turn HV switch S1902 on panel of high-voltage power supply to ON position.	After a 5-minute time delay, HV lamp DS1901 on high-voltage power supply panel should go on.	If lamp DS1901 does not go on, replace lamp and check that 1-kilovolt plate contactor K1804 is energized, closing contacts L4-T4, and that 2C39A filament relay K1401 is energized, closing contacts 2-4. Also check that overload reset relay K1806 is not energized, leaving its contacts in normally closed condition; that 5-minute klystron heater time delay K1606 has been allowed to run out; and that 12-kilovolt overload auxiliary relay K1902 is not energized, indicating no overload.

TABLE 5-10. RADIO SET AN/GRN-9D, POWER DISTRIBUTION AND CONTROL CIRCUITS, FUNCTIONAL SECTION TROUBLESHOOTING CHART (cont)

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
9		Set receiver switch S502 on receiver panel to ON position.	POWER ON lamp DS501 on receiver panel should go on.	If lamp DS501 does not go on, replace lamp and check fuses F501 and F502. Check resistor R580. Replace blown fuses and, if necessary, replace resistor R580.

TABLE 5-11. RADIO SET AN/GRN-9D, TYPICAL TROUBLES

TROUBLE	NATURE OF TROUBLE	SYMPTOM
No a-c power input to both receiver-transmitter group and power supply assembly.	EMERGENCY switch S901 or MASTER SWITCH S1101 in OFF position.	MAIN POWER ON lamp DS1102 not on.
	Relay K901 or K1101 defective.	
Blowers B901 and B902 in receiver-transmitter group cabinet inoperative.	Fuses F901 through F903 (blower B901 protection) and fuses F905 through F907 (blower B902 protection) blown.	Lamp in fuseholder glows. AIR SW OPEN lamp DS901 on.
	Blowers defective.	Blower motors not operating.
Blower B1001 in power supply assembly cabinet inoperative.	Fuses F1006 through F1008 blown.	Lamp in fuseholder glows. AIR SW OPEN lamp DS1001 on.
	Blowers defective.	Blower motor not operating.
No -1200-volt d-c output from high-voltage power supply.	Fuses F1001 through F1003 blown.	Lamp in fuseholder glows.
	Transformer T1001, switch S1006, or relay K1001 defective.	HV lamp DS1901 off.
	High-voltage power supply failure.	H. V. SUPPLY meter M1302 reads 0.
	Power distribution and control circuits failure.	BEAM CURRENT meter M1301 reading other than 190 to 210 milliamperes.
No +1000-volt d-c output from medium-voltage power supply.	Power distribution and control circuits failure.	+1000V lamp DS1801 off.
	Medium-voltage power supply failure.	D. C. SUPPLY VOLTAGE meter M1402 reads 0 when METER SELECTOR switch S1402 is in +1000V SCALE X 2 position.
No -375-volt d-c output from low-voltage power supply.	Power distribution and control circuits failure.	-375V lamp DS1601 off.
	Low-voltage power supply (-375-volt d-c portion) failure.	D. C. SUPPLY VOLTAGE meter M1402 reads 0 when METER SELECTOR switch S1402 is in -375V position.
No +250-volt d-c output from low-voltage power supply.	Power distribution and control circuits failure. Low-voltage power supply (+250-volt d-c portion) failure.	D. C. SUPPLY VOLTAGE meter M1402 reads 0 when METER SELECTOR switch S1402 is in +250V position.

TABLE 5-11. RADIO SET AN/GRN-9D, TYPICAL TROUBLES (cont)

TROUBLE	NATURE OF TROUBLE	SYMPTOM
No a-c power input to coder-indicator and radio receiver unit.	FIL ON switch S1108 in OFF position. Fuse F1108 blown. Variac T1101 defective.	Lamp in fuseholder glows. FIL ON lamp DS1101 off.
No a-c power input to coder-indicator.	Fuses F601 and F602 blown. CODER INDICATOR switch S601 in OFF position. Interlock S906 or transformers T701 and T702 defective.	Lamp in fuseholder glows. POWER ON lamp DS601 off.
No a-c power input to radio receiver.	Fuses F501 and F502 blown. Receiver switch S502 in OFF position. Interlock S905 or transformers T501 and T502 defective.	Lamp in fuseholder glows. POWER ON lamp DS501 off.
High or low output from high-voltage power supply.	High-voltage power supply failure.	H. V. SUPPLY meter M1302 reading other than -12 kilovolts dc.
High or low output from medium-voltage power supply.	Potentiometer R1842 improperly adjusted. Medium-voltage power supply failure.	D. C. SUPPLY VOLTAGE meter M1402 reading other than +1000 volts dc when METER SELECTOR switch S1402 is in +1000V SCALE X 2 position.
High or low output from low-voltage power supply.	Potentiometer R1663 (-375-volt d-c adjustment) or R1623 (+250-volt d-c adjustment) improperly adjusted. Low-voltage power supply failure.	D. C. SUPPLY VOLTAGE meter M1402 reading other than -375 volts dc and +250 volts dc when METER SELECTOR switch S1402 is in -375V and +250V position, respectively.
High or low output from radio receiver power supply.	Potentiometer R507 improperly adjusted. Radio receiver power supply failure.	TEST METER M501 reading other than +150 volts dc when METER SELECTOR switch S501 is in B + 200 VFS position.
High or low output from coder-indicator power supply.	Potentiometer R710 improperly adjusted. Coder-indicator power supply failure.	Multimeter connected between terminal 1 of terminal board TB701 and ground reading other than +250 volts dc.

TABLE 5-11. RADIO SET AN/GRN-9D, TYPICAL TROUBLES (cont)

TROUBLE	NATURE OF TROUBLE	SYMPTOM
Low receiver sensitivity.	Defective crystals (hybrid mixer circuit) CR201 and CR202. Defective Ferris discriminator V306. Defective i-f amplifier (tubes V301 through V305). Defective preamplifier (tubes V201 through V203). Preselector improperly adjusted.	TEST METER M501 reading other than half-scale deflection when METER SELECTOR switch S501 is in CR201 and CR202 position, respectively.
No r-f output from transmitter.	Frequency multiplier-oscillator r-f circuits (tubes V1501 through V1506) defective. High-voltage power supply failure. Klystron improperly adjusted. Klystron bias supply (transformer T1371, diodes CR1370 and CR1371, and tubes V1370 and V1371) failure. Potentiometer improperly adjusted.	BEAM CURRENT meter M1301 reading other than 190 to 210 milliamperes.
Identification call not transmitted.	Defective keyer motor B602 or keyer assembly. Failure of 1350-cps tone generating circuit (tubes V612 and V613). Switch S603, diode CR603, or tube V611 defective.	Keyer motor B602 not operating. Code not heard on headset connected to TEST OUTPUT jack J607.

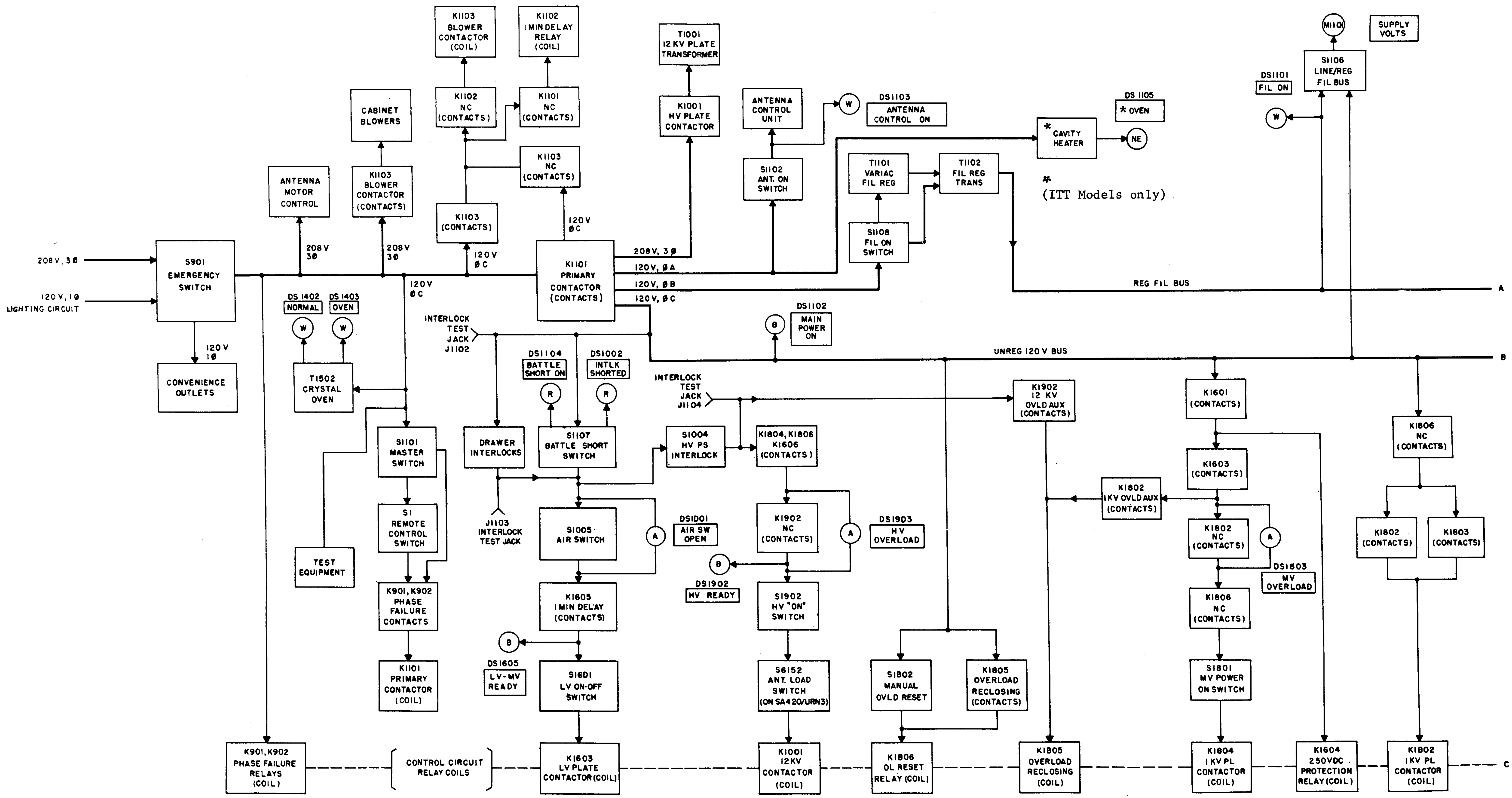


Figure 5-25. Radio Set, Power Distribution and Control Circuits, Servicing Block Diagram (Sheet 1 of 2)

NOTE

RELAY CONTACTS DESIGNATED "NC CONTACTS" ARE NORMALLY CLOSED, ALL OTHER RELAY CONTACTS ARE NORMALLY OPEN.

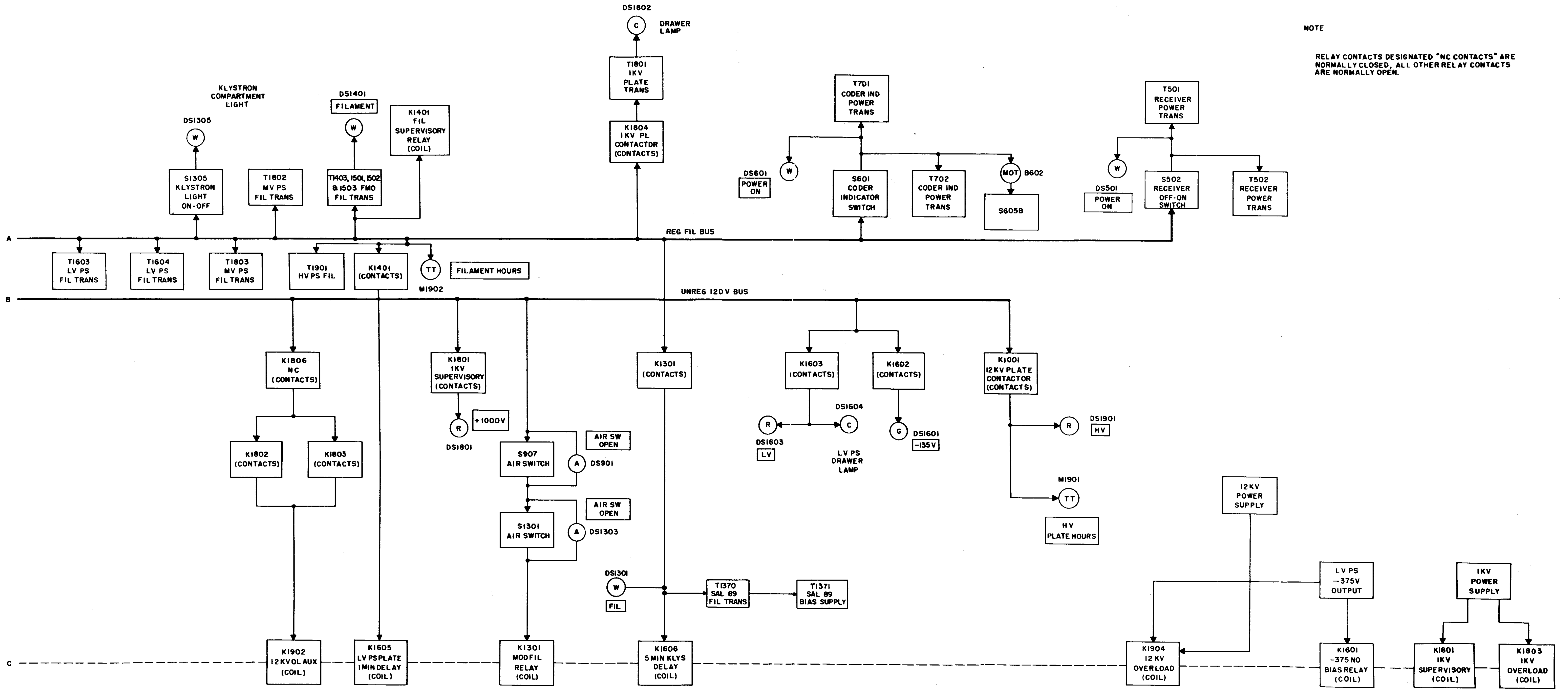


Figure 5-25. Radio Set, Power Distribution and Control Circuits, Servicing Block Diagram (Sheet 2 of 2)

SECTION 6

REPAIR

Note

Maintenance Standards Book NAVSHIPS 93881. 42 provides instructions for preventive maintenance e of Radio Set AN/GRN-9D. This technical manual also contains performance standards required to determine whether the equipment is operating properly and whether optimum performance of the equipment has been attained as a result of performing tuning and adjustment procedures.

6-1. FAILURE REPORT

Report each failure of the equipment, whether caused by a defective part, wear, improper operation, or an external cause. Use ELECTRONIC FAILURE REPORT form DD787. Each pad of the forms includes full instructions for filling out the forms and forwarding them to the Bureau of Ships. However, the importance of providing complete information cannot be emphasized too much. Be sure that you include the model designation and serial number of the equipment (from the equipment identification plate), the type number and serial number of the major unit (from the major identification plate), and the type number and reference designation of the particular defective part (from the technical manual). Describe the cause of the failure completely, continuing on the back of the form if necessary. Do not substitute brevity for clarity. And remember--there are two sides to the failure report--

YOUR SIDE

Every FAILURE REPORT is a boost for you:

1. It shows that you are doing your job.
2. It helps make your job easier.
3. It ensures available replacements.
4. It gives you a chance to pass your knowledge to every man on the team.

BUREAU SIDE

The Bureau of Ships uses the information to:

1. Evaluate present equipment.
2. Improve future equipment.
3. Order replacements for stock.
4. Prepare field changes.
5. Publish maintenance data.

Always keep a supply of failure report forms on board. You can get them from the nearest District Publications and Printing Office.

6-2. TUNING AND ADJUSTMENT

The tuning and adjustment procedures described in 6-2c through 6-2h should be performed at the following times:

Whenever the routine checks covered in Section 3 specify that realignment and adjustments are necessary in order to ensure optimum equipment performance.

Whenever the troubleshooting charts covered in Section 5 specify that realignment and adjustments are necessary.

Whenever large scale tube replacement has been made.

Periodically, as directed by experience.

The adjustment controls are located inside the individual drawer units. To gain access to a particular control and make an adjustment, proceed as follows:

Step 1. Loosen captive screws provided on front panel of drawer unit in which control is housed.

Step 2. Pull out drawer unit until stop latch on slide assembly engages.

Step 3. Manually operate interlock provided on cabinet frame. To do so, push interlock pin gently to side and pull it out until it catches.

Step 4. Loosen hex nut which locks potentiometer shaft in adjusted position.

Step 5. Use screwdriver to make required adjustment, and tighten hex nut to secure potentiometer in desired position.

Step 6. After all adjustments have been made in drawer unit, push unit back into cabinet frame and tighten captive screws. Interlocks will be released automatically.

a. TEST EQUIPMENT AND SPECIAL TOOLS.- The test equipment required to tune and adjust the radio set for optimum performance is listed in tables 5-1 and 5-1a. The Original Test Equipment is referred to as Built-in Test Equipment whilst the Replacement Test Equipment is that of the TACAN Test Monitor Group MM-TMC-212A Rack. No special tools are required to perform any of the tuning and adjustment procedures.

b. CONTROL SETTINGS.- Under normal operating conditions all power switches except those of the test equipment are left in the ON position. Refer to Section 3 for specific instructions concerning equipment turn-on procedure.

Proper adjustment of some circuits of the radio set entails the use of the test equipment. Prior to performing any of these adjustments, set up the equipment as outlined in paragraph 5-4b.

c. POWER SUPPLY ADJUSTMENTS.

(1) LOW VOLTAGE POWER SUPPLY PP-1766/URN.

Step 1. Turn meter selector switch S1402 (figure 3-3) to +250V. Check that a reading between 245 and 255 volts dc is indicated on D. C. SUPPLY VOLTAGE meter M1402 (frequency multiplier-oscillator panel).

Step 2. If reading is not correct, adjust potentiometer R1623 (figure 6-1) to obtain a reading of exactly +250 volts dc.

Step 3. Turn meter selector switch S1402 to -375V. Check that a reading between -367 and -383 volts dc is indicated on D. C. SUPPLY VOLTAGE meter M1402.

Step 4. If reading is not correct, adjust potentiometer R1663 (figure 6-1) to obtain a reading of -375 volts dc.

(2) MEDIUM VOLTAGE POWER SUPPLY PP-1765/URN.

Step 1. Turn meter selector switch S1402 (figure 3-3) to +1000V. Check that a reading between +980 and +1020 volts dc is indicated on D. C. SUPPLY VOLTAGE meter M1402 (frequency multiplier-oscillator panel).

Step 2. If reading is not correct, adjust potentiometer R1842 (figure 6-2) to obtain a reading of exactly +1000 volts dc.

(3) RADIO RECEIVER POWER SUPPLY. – Adjustment of the radio receiver power supply should be performed after receiver switch S502 (figure 3-1) has been set to ON and POWER ON lamp DS501 (radio receiver panel) has been on for at least 10 minutes. To adjust the power supply, proceed as follows:

Step 1. Turn METER SELECTOR switch S501 (figure 3-1) to B+ 200 VFS. Check that a reading of 75 scale divisions, which is equivalent to +150 volts dc is indicated on TEST METER M501 (radio receiver panel).

Step 2. If reading is not correct, adjust potentiometer R507 (figure 6-3) to obtain a reading of exactly 75 scale divisions (+150 volts dc).

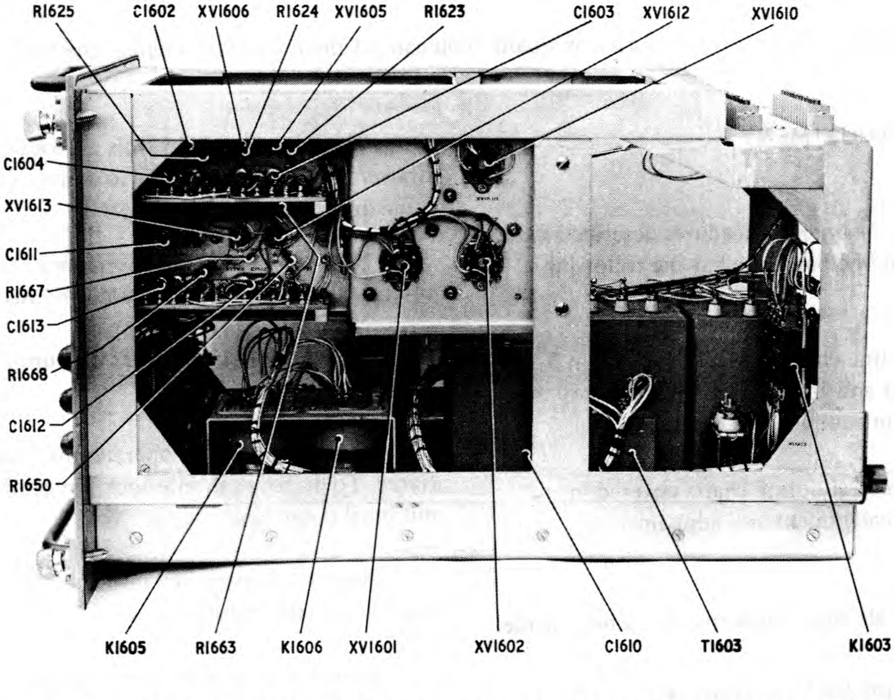


Figure 6-1. Low Voltage Power Supply PP-1766/URN, Right Side View

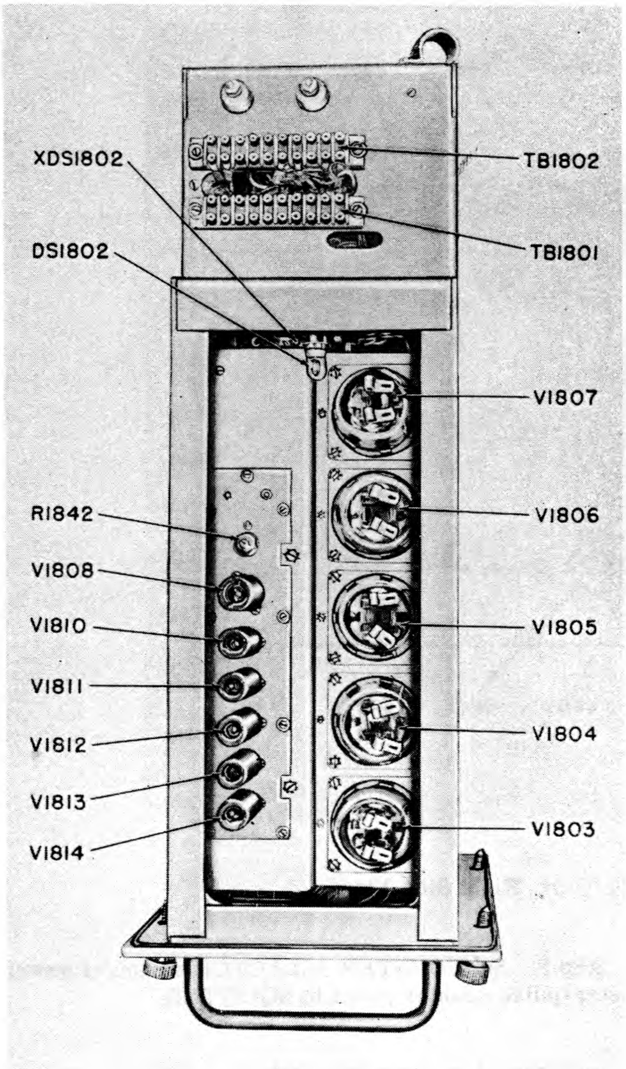


Figure 6-2. Medium Voltage Power Supply PP-1765/URN, Top View

Step 3. Turn METER SELECTOR switch S501 to C- 200 VFS. Check that a reading of 52.5 scale divisions, which is equivalent to -105 volts, is indicated on TEST METER M501.

Step 4. If reading is not correct, refer to portion of radio receiver troubleshooting chart (table 5-3) pertaining to troubleshooting radio receiver power

Note
No adjustment is provided for the -105-volt dc supply. Information up to Paragraph 6-2f is applicable to the Original Test Equipment whilst that of 6-2h is for use when setting up, troubleshooting, etc with the Replacement Test Equipment (TABLE 5-1a).

d. RADIO RECEIVER ADJUSTMENTS.—The radio receiver should be adjusted after the radio set has been turned on and allowed to warm up for a period of 10 minutes.

(1) LOCAL OSCILLATOR ADJUSTMENT.

Step 1. Turn METER SELECTOR switch S501 (figure 3-1) to CR201. Check reading indicated on TEST METER M501.

Step 2. Turn METER SELECTOR switch S501 to CR202. Check reading indicated on TEST METER M501.

Note

In each position of the switch, meter should show half-scale deflection, corresponding to 1.0 milliampere. The two readings should be nearly equal.

• Step 3. Loosen screw located on side of pick-up probe J1505 and move probe on tripler cavity V1504 (figure 6-4) in or out, as necessary, to obtain required readings. Tighten screw.

(2) SQUITTER CIRCUIT CHECK AND ADJUSTMENT.

(a) SQUITTER CONTROL VOLTAGE CHECK.

Step 1. Turn METER SELECTOR switch S501 (figure 3-1) to SQUITTER CONTROL -10 VFS. Check reading indicated on TEST METER M501.

Note

Meter should read about 5 volts (half-scale deflection) when local oscillator power is normal (1.0 milliampere). When no local oscillator power is available, squitter voltage will be about 1 volt less, or 4 volts as read on meter.

Step 2. Disconnect local oscillator input cable from jack J201 on frequency multiplier-oscillator chassis. Replace cable to local oscillator input at jack J201.

(b) SQUITTER COUNT AND ADJUSTMENT.

1. TEST EQUIPMENT AND SPECIAL TOOLS.—The built-in test equipment is required to perform the squitter count and adjustment procedure. This equipment, comprising Power Meter-Pulse Counter TS-891/URN-3, Oscilloscope OS-54/URN-3, Pulse Analyzer-Signal Generator TS-890A/URN-3, and Pulse-Sweep Generator SG-121A/URN-3, is housed in the power supply assembly cabinet. No special tools are required to perform this procedure.

2. CONTROL SETTINGS.—Set all power switches, except those on the built-in test equipment, to the on position.

3. CONNECTIONS.—To perform this procedure, make the built-in test equipment front panel connections shown in figure 3-13.

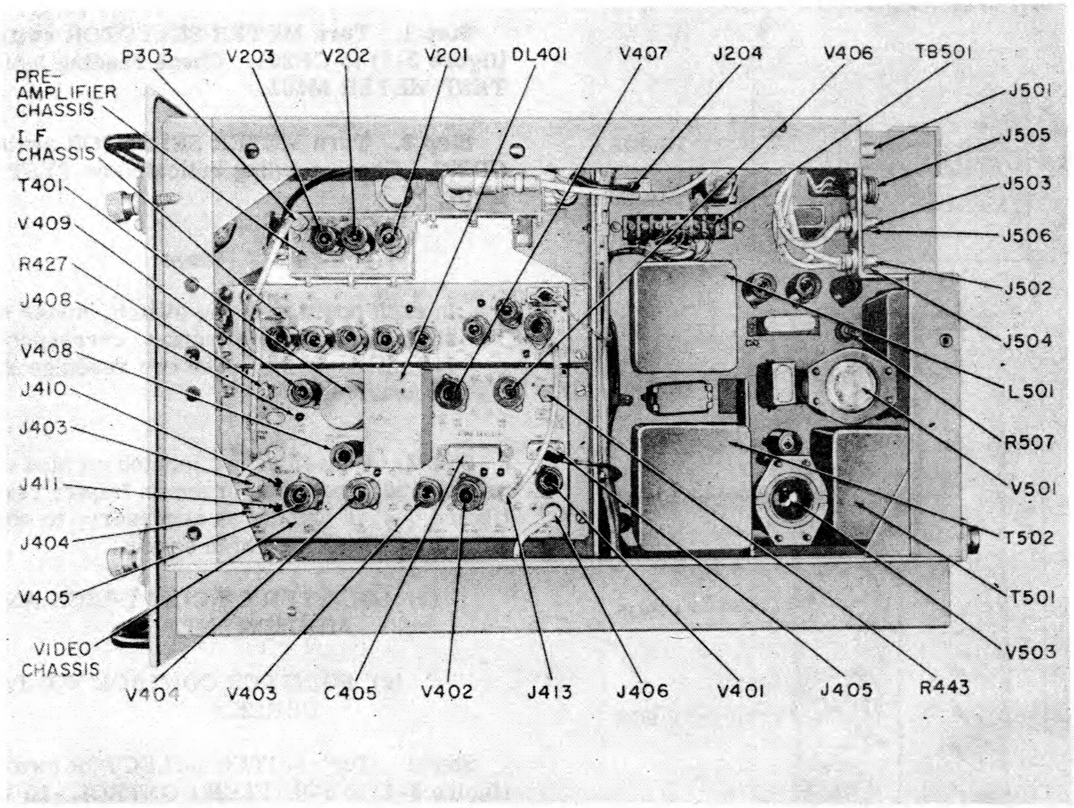


Figure 6-3. Radio Receiver, R824/URN, Right Side View

4. INSTRUCTIONS.

Step 1. Set MV switch S1801 on medium voltage power supply panel and HV switch S1902 on high voltage power supply panel to OFF.

CAUTION

Variation of squitter rate adjustment may result in an extremely high squitter rate, causing high klystron beam current to trip overload relay of transmitter.

Step 2. Set METER SELECTOR switch S501 to CR201, then to CR202. Check reading indicated on TEST METER M501. Meter should indicate about 1 milliampere (half-scale deflection in each position).

Step 3. Set METER SELECTOR switch S501 to SQUITTER CONTROL -10 VFS. This setting facilitates monitoring d-c squitter control voltage being fed back to i-f amplifiers V301 and V302.

Note

Prior to performing the following steps, set up the built-in test equipment as specified in paragraph 5-4b.

Step 4. Turn FUNCTION SWITCH of power meter-pulse counter panel to RECEIVER SENSITIVITY.

Step 5. Set COUNTER SELECTOR switch of power meter-pulse counter panel to SQUITTER.

Step 6. Set RANGE SWITCH of power meter-pulse counter panel to X10. SQUITTER rate, as read on PULSE COUNT METER, should be 2700 ± 90 pulses per second.

Step 7. Carefully adjust potentiometer R427 (figure 6-3) until count is 2700 ± 90 pulses per second. Squitter control voltage as read on TEST METER M501 should be approximately -5 volts.

(3) 40-MICROSECOND BLANKING GATE ADJUSTMENT.

(a) TEST EQUIPMENT AND SPECIAL TOOLS. —Oscilloscope OS-54/URN-3 is required to perform the 40-microsecond blanking gate adjustment. No special tools are required to perform this adjustment.

(b) CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position. Set up and energize the oscilloscope in accordance with the instructions contained in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope.

(c) INSTRUCTIONS.

Step 1. Connect coaxial test lead from TEST OUTPUT jack J507 (figure 3-1) to EXT TRIGGER INPUT jack of oscilloscope panel. Set TRIGGER SELECTOR control of oscilloscope panel to +EXT.

Step 2. Connect test prod to VERT SIGNAL INPUT jack of oscilloscope panel. Connect test prod to test point TP9 (figure 6-5) and lock in signal on oscilloscope. Horizontal sweep speed should be between 50 and 100 microseconds per inch. Waveshape 17 in figure 5-9 should be obtained.

Step 3. Using 10-microsecond markers, adjust potentiometer R443 (figure 6-3) to obtain a pulse width of 40 microseconds.

Step 4. Recheck squitter count, in accordance with 6-2d(2)(b).

e. CODER-INDICATOR ADJUSTMENTS.

(1) 1350-CPS IDENTIFICATION TONE OSCILLATOR ADJUSTMENT.

(a) TEST EQUIPMENT AND SPECIAL TOOLS. —Oscilloscope OS-54/URN-3 is required to perform the 1350-cps identification tone oscillator adjustment. No special tools are required to perform this adjustment.

(b) CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position. Set up and energize the oscilloscope in accordance with the instructions contained in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope.

(c) INSTRUCTIONS.

Step 1. Open coder-indicator drawer, manually set interlock on cabinet frame and set CODER INDICATOR switch S601 on coder-indicator panel to ON.

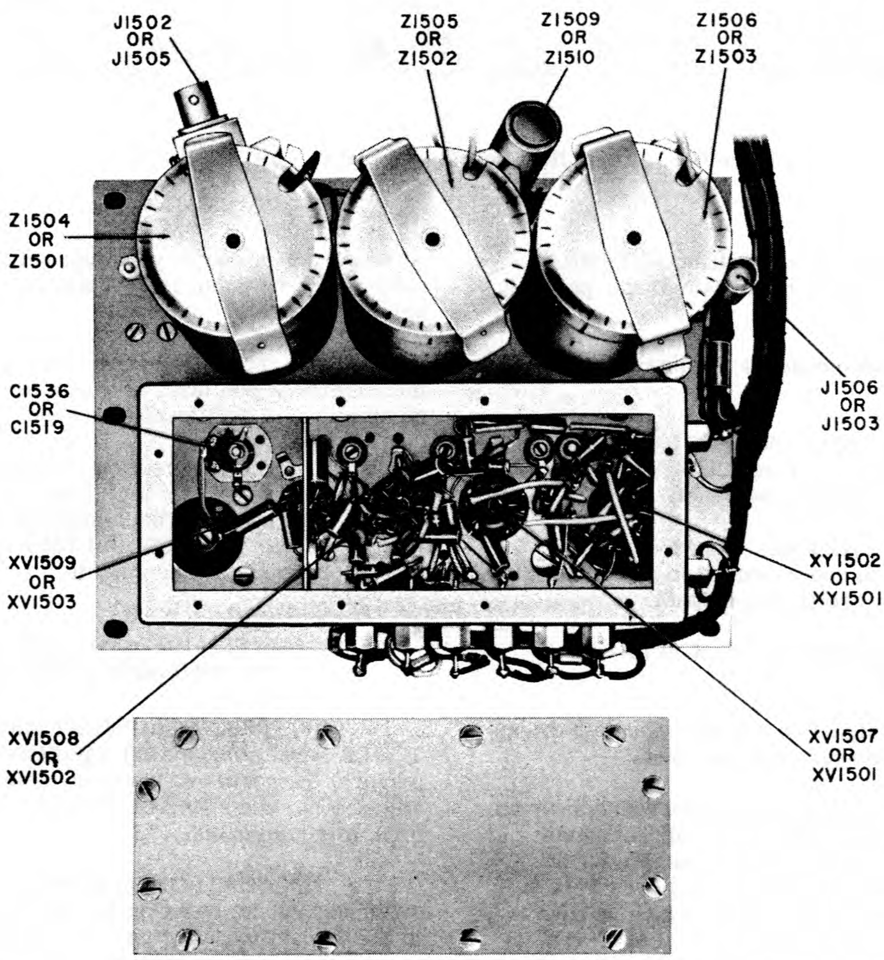


Figure 6-4. Frequency Multiplier-Oscillator CV-1171/GRN-9D, R-F Chassis, Bottom View

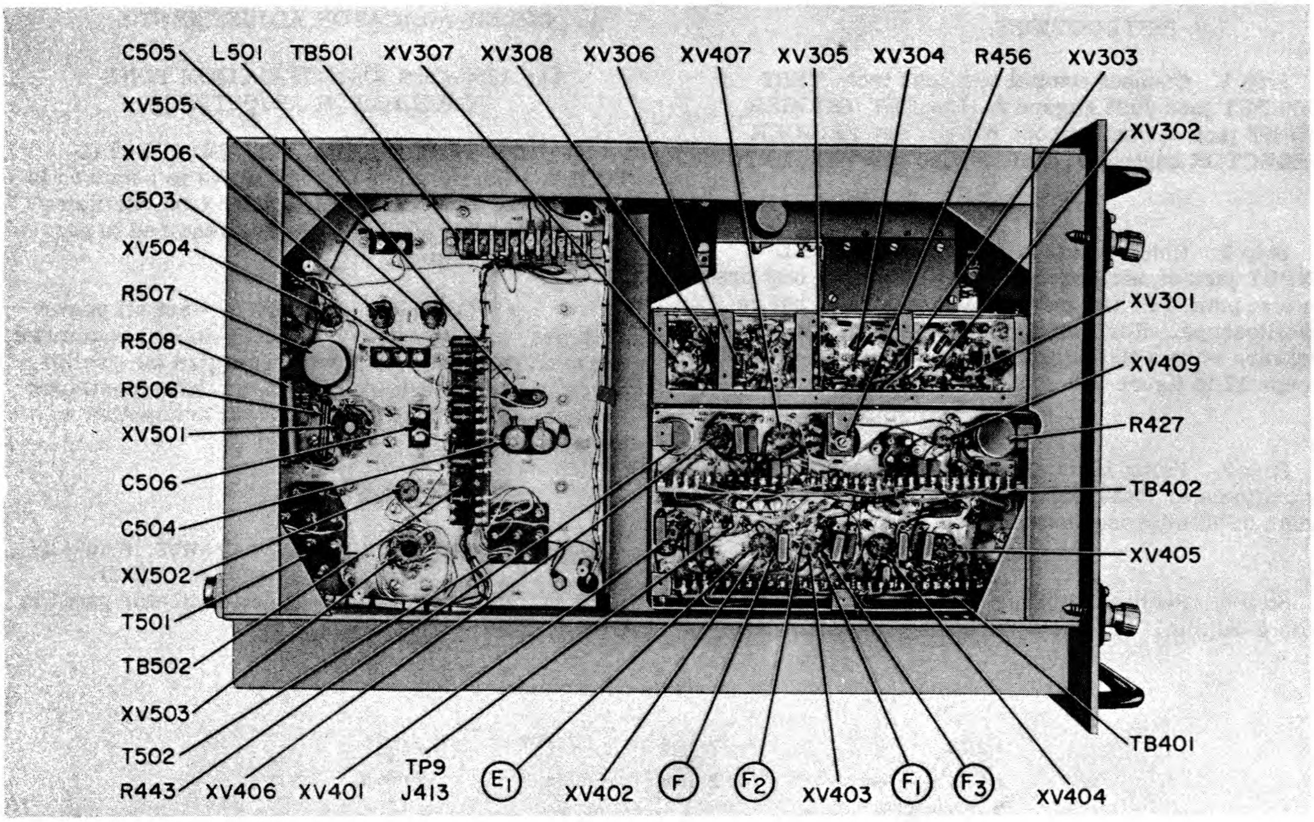


Figure 6-5. Radio Receiver R-824/URN, Left Side View

Step 2. Turn on antenna by setting ANTENNA CONTROL switch S1102 on control-duplexer panel to ON.

Step 3. Lower video chassis as shown in figure 6-6.

Step 4. Connect coaxial test lead from TEST OUTPUT jack J607 on coder-indicator panel to VERT SIG INPUT jack on oscilloscope panel.

Step 5. Connect coaxial test lead from SYNC OUTPUT jack J606 on coder-indicator panel to EXT TRIG INPUT jack on oscilloscope panel.

Step 6. Set switch S603 (figure 6-6) to CONTINUOUS TONE.

Step 7. Lock in signal on oscilloscope with sweep speed set to 4000 microseconds per inch.

Step 8. Auxiliary reference bursts will appear as heavy pulses with tone pulse groups appearing as faint pulses evenly spaced between auxiliary reference bursts. (See waveshape 24E in figure 5-11.) Count number of tone pulse groups which occurs between auxiliary reference bursts. If 1350-cps identification tone oscillator is properly adjusted, nine tone pulse groups will appear between auxiliary reference bursts.

Step 9. If necessary, adjust coil L603 (figure 6-6) until nine tone pulse groups appear between auxiliary reference bursts.

Step 10. Set oscilloscope sweep speed to 100 microseconds per inch, and lock in two identification pulse pairs on oscilloscope screen.

Step 11. Adjust potentiometer R798 on coder-indicator video chassis until spacing between leading edge of first pulses in each pulse pair is 100 ± 10 microseconds. Adjustment of 1350-cps identification tone oscillator is now complete.

(2) NORTH AND AUXILIARY REFERENCE BURSTS ADJUSTMENT.

(a) TEST EQUIPMENT AND SPECIAL TOOLS. —Oscilloscope OS-54/URN-3 is required to perform the north and auxiliary reference bursts adjustment. No special tools are required to perform this adjustment.

(b) CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position. Set up and energize the oscilloscope in accordance with the instructions contained in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope.

(c) INSTRUCTIONS.

Step 1. Perform steps 1 through 5 of paragraph 6-2e(1).

Step 2. Remove plug P906 from jack J603 (figure 6-6).

Step 3. Lock in signal on oscilloscope with sweep speed set to 110 microseconds per inch. North reference burst will appear on oscilloscope screen as a series of pulse pairs. When radio set is operating properly, north reference burst consists of 12 ± 1 pulse pairs. (See waveform 24A of figure 5-11.)

Step 4. Locate potentiometer R675 on coder-indicator video chassis. Loosen shaft locking nut, and adjust to obtain 12 pulse-pairs on oscilloscope screen. Turning shaft clockwise decreases number of pulse pairs, turning shaft counterclockwise increases number of pulse pairs. While observing north reference burst on oscilloscope, turn shaft of potentiometer R675 clockwise to obtain 11 pulse pairs, then counterclockwise to obtain 13 pulse pairs. The correct setting of potentiometer R675 is midway between settings which provide 11 and 13 pulse pairs. After potentiometer R675 is set correctly, carefully tighten locking screw.

Step 5. Check that spacing between leading edge of 1st pulse and leading edge of 23rd pulse is 330 ± 5 microseconds (3 inches on oscilloscope screen with sweep speed set at 110 microseconds per inch). If spacing is correct, adjust coil L601 on coder-indicator video chassis until spacing is correct.

Step 6. Replace plug P906 in jack J603, and remove plug P905 from jack J604 on coder-indicator video chassis.

Step 7. Lock in auxiliary reference burst with sweep speed set to 40 microseconds per inch. When radio set is operating properly, auxiliary reference burst should consist of 6 ± 1 pulse pairs.

Step 8. Locate potentiometer R672 on coder-indicator video chassis. Loosen shaft locking nut, and adjust potentiometer R672 while observing auxiliary reference burst on oscilloscope. Turn shaft

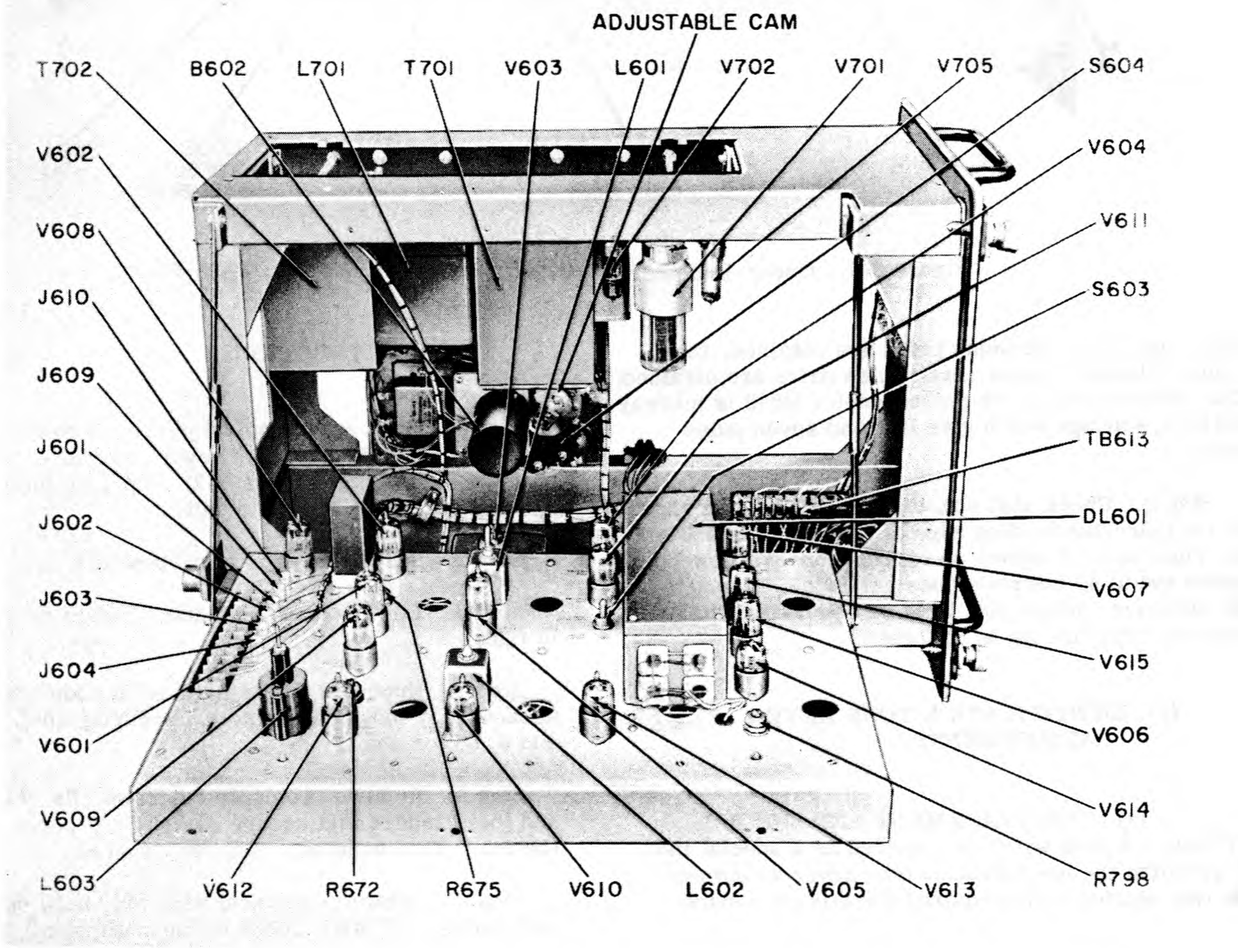


Figure 6-6. Coder-Indicator KY382/GRN-9D, Left Side View with Video Chassis Lowered

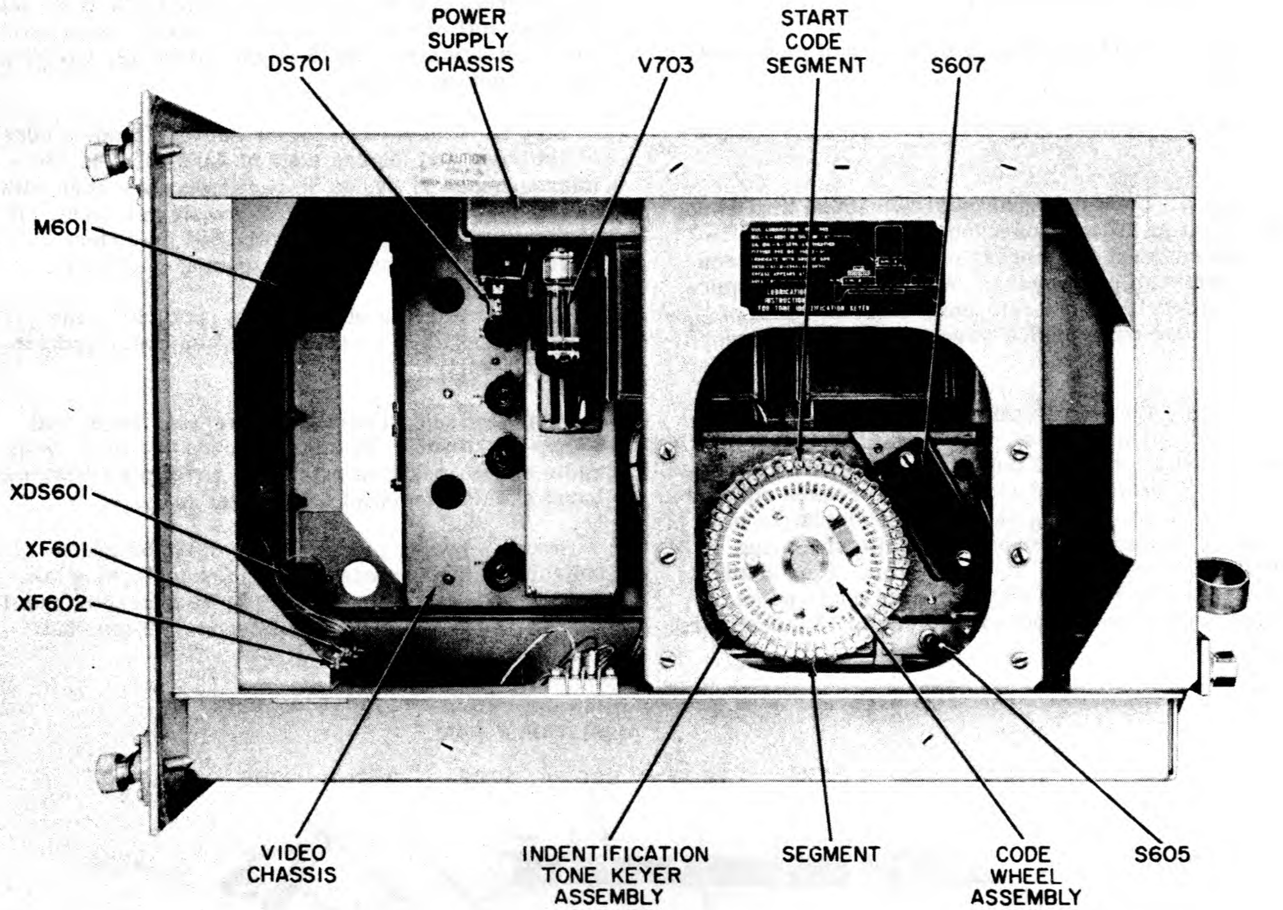


Figure 6-7. Coder-Indicator KY-382/GRN-9D, Right Side View

clockwise until five pulse pairs are obtained, then counterclockwise until seven pulse pairs are obtained. The correct setting for potentiometer R672 is midway between settings which give five and seven pulse pairs.

Step 9. Check that spacing between leading edge of 1st pulse and leading edge of 11th pulse is 120 ± 1 microseconds (3 inches on oscilloscope with sweep speed set to 40 microseconds per inch). If spacing is incorrect, adjust coil L602 on coder-indicator chassis until spacing is correct.

(3) IDENTIFICATION TONE KEYER ADJUSTMENTS.

(a) TEST EQUIPMENT AND SPECIAL TOOLS. —A stop watch is required as a special tool to perform the identification tone keyer adjustment. No test equipment is required for this procedure.

(b) CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position.

(c) INSTRUCTIONS.

Step 1. Open coder-indicator drawer to gain access to identification tone keyer assembly, mounted on right side of unit (figure 6-7). Operate interlocks to energize coder-indicator unit.

Step 2. Set switch S605 to off position.

Step 3. Lower coder-indicator chassis as shown in figure 6-6.

Step 4. Uncouple motor B602 from code wheel assembly by loosening setscrew securing coupling end to motor shaft.

Step 5. Remove two captive screws, flat washers, and lockwashers that secure switch S607 cover (figure 6-7) to housing. Remove cover.

Step 6. Rotate code wheel assembly until code just starts at START CODE segment (figure 6-7).

Step 7. Loosen screws located in slots of adjustable cam (figure 6-6) and position adjustable cam so that switch S604 is not actuated. Tighten screws.

Step 8. Rotate code wheel assembly in counterclockwise direction until segment number 58 on the code wheel assembly actuates switch S607. Rotate code wheel assembly in counterclockwise direction and check that switch S304 is actuated immediately after switch S607 is actuated. If it is not, loosen screws located in slots of adjustable cam, and position cam so that switch S604 is actuated.

Step 9. Repeat steps 6 through 8 in order to make a fine adjustment of S607 so that it is not actuated at the START CODE segment, but is actuated immediately after switch S604 is actuated by the number 58 segment.

Step 10. Couple motor B602 to code wheel assembly by tightening setscrew.

Step 11. Set keyer switch S603 (coder-indicator video chassis figure 6-6) to NORMAL KEYING.

Step 12. Connect headset to TEST OUTPUT jack J607 on coder-indicator panel.

Step 13. Set switch S605 to on position and listen to code produced in headset. If complete code is not heard, adjust coding switch S607. To do this, unlock adjustment screw (figure 3-11). By means of adjustment screw, move switch S607 closer to or further away from segments mounted on code wheel assembly, as required.

Step 14. Set switch S605 to off position and replace switch S607 cover to switch housing. Set switch S605 to on position.

Step 15. Adjust cutoff of code by using slotted cam to actuate switch S604 immediately after switch S607 actuation cycle by segment number 58 is completed.

Step 16. For fine adjustment, adjust switch S604 by loosening clamp screw and rotating switch about its pivot mounting center.

Note

The cams are cut so that code can be transmitted for two consecutive revolutions of code wheel. Initial adjustment should be made so that the code is transmitted for one out of every five revolutions. These adjustments are independent and must be made alternately. To facilitate adjustment, it is recommended that the motor be decoupled from the drive shaft and the code wheel turned manually.

Step 17. Repeat procedures called for in step 6 with motor reconnected.

(4) SETTING THE CODE (IDENTIFICATION CALL). —For information on setting the code, refer to paragraph 3-2c(2)(b).

(5) DELAY LINE DL601 ADJUSTMENT (ZERO DISTANCE DELAY). —The delay line is located on video chassis of coder-indicator unit (figure 6-6). The procedure outlined below is based on checking the overall radio beacon delay of 50 microseconds and adjusting delay line DL601 as necessary to obtain that delay. The built-in test equipment is employed for this procedure.

(a) TEST EQUIPMENT AND SPECIAL TOOLS. —The test equipment required to perform the zero distance delay adjustment is based on using the built-in test equipment. This equipment, consisting of the power meter-pulse counter, oscilloscope, pulse analyzer-signal generator, and pulse-sweep generator, is housed in the power supply assembly cabinet. No special tools are required to perform this adjustment.

(b) CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position.

(c) CONNECTIONS. —In order to perform the zero distance delay procedure, the built-in test equipment front panel connections shown in figure 3-13 must be made.

(d) INSTRUCTIONS.

Step 1. Set FUNCTION switches of oscilloscope panel and power meter-pulse counter panel to VIDEO DELAY.

Step 2. Set pulse-sweep generator TRIGGER SELECTOR switch to SWEEP, and PULSE CODING switch to 11.5 μSEC, position 2. Set CRYSTAL SELECTOR switch to position 1.

Step 3. Adjust pulse analyzer-signal generator to provide a modulated signal. (Refer to procedure in Section 2.) Then, set MODULATION SELECTOR switch to PULSE and RF OUTPUT attenuator to -35 DBM.

Step 4. Observe display on oscilloscope screen, and, if necessary, adjust oscilloscope controls for clear presentation. Note that two sets of pulses are displayed, the radio set output pulse and a pair of reference pulses.

Step 5. Adjust pulse-sweep generator BALANCE control so that reference pulses have slightly larger amplitude than radio set output pulses. A pattern similar to that shown in figure 6-8 should be obtained on oscilloscope.

Step 6. If pattern such as that shown in figure 6-8 is obtained (radio set output pulse pair to left of reference pulse pair), overall zero-distance delay is less than 50.2 microseconds and the next step should be performed. If it is to the right, the zero delay is too great; proceed to step 8.

Step 7. Change CRYSTAL SELECTOR switch on pulse-sweep generator panel to position 2. Observe that pattern is as shown in figure 6-8. If radio set output pulse pair is to left of reference pulse pair, zero-distance delay is less than 49.8 microseconds,

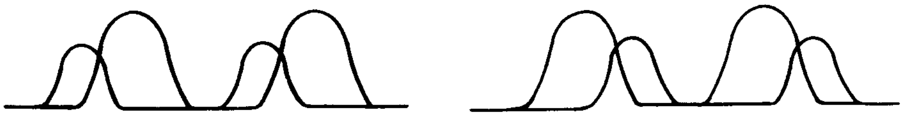


Figure 6-8. Overall System Delay Measurement Waveforms

and a readjustment of delay line is necessary. Proceed with step 8.

Note

Ideally, radio set output pulses should be as much to right of reference pulse (switch position 1) as they are to left (switch position 2).

Step 8. Remove cover on delay line DL601 and loosen delay line top locking screw.

Step 9. Slide tap on delay line DL601 to right or left, as necessary, to obtain net delay of between 49.8 and 50.2 microseconds, as determined by repeating steps 6 and 7. Lock delay line tap in position and replace cover.

f. TRANSMITTER ADJUSTMENTS.

(1) TRANSMITTER OUTPUT CIRCUIT TUNING. —Refer to Section 2 for detailed instructions on overall tuning of transmitter output circuit and aging of klystron.

(2) SHAPED PULSE ADJUSTMENT.

(a) TEST EQUIPMENT AND SPECIAL TOOLS. —Oscilloscope OS-54/URN-3 is required to perform the shaped pulse gate adjustment. No special tools are required to perform this adjustment.

(b) CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position. Set up and energize the oscilloscope in accordance with the instructions contained in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope.

(c) INSTRUCTIONS.

Step 1. Connect coaxial test lead from SHAPED PULSE jack J1405 on frequency multiplier-oscillator panel to VERT SIG INPUT jack on oscilloscope panel. Turn FUNCTION SWITCH on oscilloscope panel to GENERAL TEST.

Step 2. Observe waveshape indicated on oscilloscope; it should be similar to waveshape 9 in figure 5-16. The waveshape should meet the following requirements: The shaped pulse should be symmetrical and should have a duration of 4.5 ± 0.5 microseconds at half-amplitude point and 9 microseconds at base. The pulse should have an amplitude of approximately 10 volts.

Step 3. If above requirements are not met, perform steps 4 through 12.

Step 4. Connect test prod to VERT SIG INPUT jack on oscilloscope panel and connect test prod to pin 5 at V1403. The waveshape in figure 5-16, waveshape 5, should be indicated on oscilloscope.

Step 5. Measure pulse width at half-amplitude points. If it is not 2.6 ± 0.1 microseconds, adjust potentiometer R1466 on frequency multiplier-oscillator video chassis (figure 6-9) to obtain this pulse width.

Step 6. Disconnect plug P917 from jack J1401 on frequency multiplier-oscillator unit. Connect Multimeter AN/PSM-4 to pin 1 at V1407.

Step 7. Adjust potentiometer R1420 on frequency multiplier-oscillator video chassis to obtain a reading of +8.0 volts dc on multimeter. After this adjustment is made, disconnect multimeter and reconnect plug P917 to jack J1401.

Step 8. Connect test prod to center tap of potentiometer R1470 on frequency multiplier-oscillator video chassis. While observing shaped pulse, adjust potentiometer R1417 on frequency multiplier-oscillator video chassis for minimum reflections. See waveforms 26A and 26B in figure 5-16.

Step 9. Disconnect test prod from oscilloscope and connect coaxial test lead from VERT SIG INPUT jack on oscilloscope panel to SHAPED PULSE jack J1405 on frequency multiplier-oscillator panel.

Step 10. While observing output pulse on oscilloscope screen, adjust potentiometer R1470 to obtain maximum amplitude without limiting. See waveshape 9B in figure 5-16 for an example of a limited shaped pulse.

Step 11. Connect coaxial test lead from VERT SIG INPUT jack to ANTENNA INCIDENT jack J1154 on control-duplexer panel. Lock in auxiliary reference burst on oscilloscope screen. Check that amplitude of pulses remains constant throughout reference burst. If reference burst appears as shown in waveshape 24 of figure 5-16, no further adjustment is necessary. If reference burst appears as shown in either waveshape 22 or 23 of figure 5-16, adjust potentiometer R1471 on frequency multiplier-oscillator video chassis to obtain a constant amplitude for all pulses in reference burst as shown in wave-

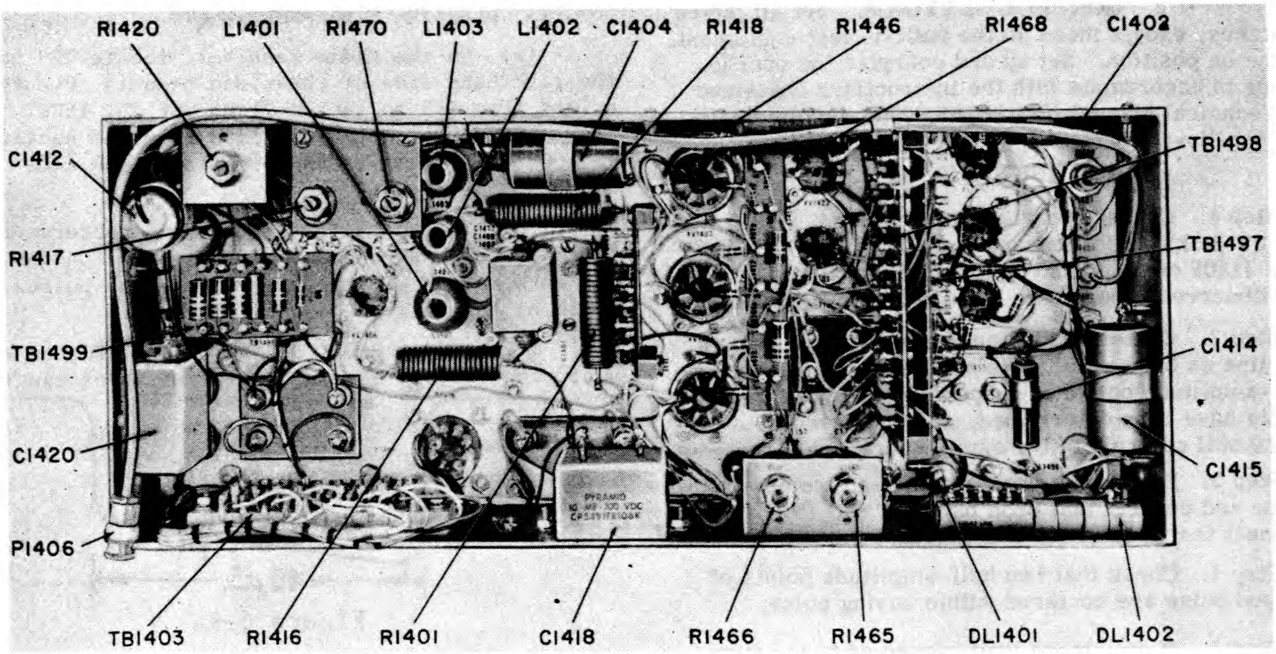


Figure 6-9. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Video Chassis, Bottom View

shape 24. The adjustment of potentiometer R1470, as described in step 10, and the adjustment of R1471 are interdependent. If it was necessary to adjust potentiometer R1471 to minimize droop, recheck adjustment of R1470 by observing a single pulse on oscilloscope and touching up adjustment of potentiometer R1470 to obtain the maximum pulse amplitude possible without limiting.

Note

After making adjustments on shaped pulse circuits, check peak power output and spectrum analysis as directed in paragraphs 3-6a(2) and 3-6a(5).

Step 12. Coils L1401, L1402, and L1403 (figure 6-9) are adjusted to proper value of inductance at factory and are not to be adjusted in field. Note that the inductance values are given to two decimal places on schematic diagram, figure 6-18. Replacement of these coils is a function of depot maintenance. Before replacing coil in shaper network, check its value on inductance bridge capable of measuring inductance in the range of 1 to 5 millihenrys to an accuracy of 100th of a millihenry.

(3) KEYING PULSE CHECKS AND ADJUSTMENTS.

(a) KEYING PULSE WIDTH ADJUSTMENT.

1. TEST EQUIPMENT AND SPECIAL TOOLS. —Oscilloscope OS-54/URN-3 is required to perform the keying pulse width adjustment. No special tools are required to perform this adjustment.

2. CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position. Set up and energize the oscilloscope in accordance with the instructions contained in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope.

3. INSTRUCTIONS.

Step 1. Connect test prod to VERT SIG INPUT jack on oscilloscope panel. Set FUNCTION SWITCH on oscilloscope panel to GENERAL TEST.

Step 2. Connect test prod to pin 3 at V1409 on frequency multiplier-oscillator video chassis. Check that the width of the keying pulse appearing on the scope screen is 1- + 0.5 -0.0 microseconds wide at half-amplitude points.

Step 3. If requirement in step 2 is not met, adjust potentiometer R1465 on frequency multiplier-oscillator video chassis to obtain proper pulse width.

(b) CENTERING OF KEYING PULSE ABOUT THE SHAPED PULSE.

1. TEST EQUIPMENT AND SPECIAL TOOLS. —Oscilloscope OS-54/URN-3 is required to perform the keying pulse positioning adjustment. No special tools are required to perform this procedure.

2. CONTROL SETTINGS. —Set all power switches, except those on the built-in test equipment, to the on position. Set up and energize the oscilloscope in accordance with the instructions contained in Technical Manual NAVSHIPS 92778 supplied with the oscilloscope.

3. INSTRUCTIONS.

Step 1. Connect coaxial test lead from VERT SIG INPUT jack on oscilloscope panel to SHAPED PULSE jack J1405 on frequency multiplier-oscillator panel and observe shaped pulse indicated on oscilloscope.

Step 2. Center shaped pulse about a vertical hairline on the scale. Note carefully positions of half-amplitude points of shaped pulse. Once these points have been determined, do not touch any of the horizontal controls of the oscilloscope.

Step 3. Disconnect coaxial test lead from oscilloscope and connect test prod to VERT SIG INPUT jack. Connect test prod to pin 3 at V1409.

Step 4. Check that two half-amplitude points of shaped pulse are centered within keying pulse.

Step 5. If not, move lead connected to tap (terminals 3, 4, 5, or 6) on delay line DL1402 (see figure 6-9), to one of the other taps as necessary to meet requirement.

Note

Delay lines DL1401 and DL1402 are connected in series to provide enough delay to center shaped pulse on keying pulse. The entire delay of DL1401 must be used. The tap on delay line DL1402 is selected to provide additional delay if required.

g. CONTROL-DUPLEXER. —Refer to paragraphs 2-5f(2) and 2-5f(3) for instructions on adjusting preselector cavities and transmission line filter.

h. TACAN ADJUSTMENTS USING REPLACEMENT TEST EQUIPMENT MM-TMC-212A (TABLE 5-1a).- Adjustment should be made after the beacon has been turned on and allowed to warm up for at least 10 minutes, or longer where stated.

(1) SQUITTER RATE ADJUSTMENT.

(a) On the Radio Receiver, turn the METER SELECTOR switch to the CR201 and CR202 positions in turn. The TEST METER should indicate approximately half scale in both positions. If this condition is not met, adjust the coupling from the Frequency Multiplier Oscillator as described in paragraph 6-2h(8)(a)9, 10 and 11.

(b) Turn the METER SELECTOR switch to the SQUITTER CONTROL -10 VFS position. The TEST METER should indicate approximately -5·0V.

(c) Continue as follows:

1. On the High Voltage Power Supply, set the HV ON/OFF switch to ON.

2. Measure the squitter rate as described in para.3-6a(12)(a), and adjust R427, on the right-hand side of the chassis, to obtain a squitter rate of 5400 pulses per second.

3. Return the HV ON/OFF switch to OFF.

(2) BLANKING TIME ADJUSTMENT.

(a) On the Radio Receiver, locate TP9 on the righthand side of the video chassis. Connect a lead from TP9 to the oscilloscope CH1 INPUT jack and connect a further lead from the Receiver TEST OUTPUT socket to the oscilloscope A time base TRIG IN jack.

(b) Set up the oscilloscope to observe the blanking pulse as shown in Figure 6-9a. Calibrate the markers and use them to measure the pulse width at the half-amplitude point.

(c) Adjust R443, BLANKING TIME ADJ, on the video chassis, to obtain a pulse width of exactly 40 µsec

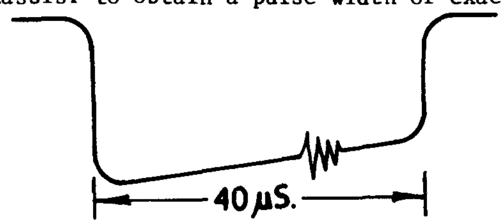


Figure 6-9a

(3) CODER INDICATOR POWER SUPPLY.

(a) Release the four securing bolts on the Coder Indicator and draw the unit fully forward. Remove the access panel from the top of the unit.

(b) Set the Multimeter to the DC 300V range. Locate tag board TB701 on the chassis and connect the multimeter negative lead to Pin 9. Connect the positive lead to Pin 1.

(c) Manually override the interlock and adjust R710 on the power supply chassis to obtain a reading of +250V. Disconnect the meter.

(d) Connect the positive lead to Pin 9 and the negative lead to Pin 6. Observe that the meter indicates between -100 and -110 volts. Disconnect the meter and replace the access panel.

(4) IDENTITY AND EQUALIZING PULSE SPACINGS.

(a) Measure and adjust the Identity and Equalizing pulse spacings as described in paragraph 3-6a(12)(d).

(b) If the requirements are not met as described, adjust L603 and R798 on the Coder Indicator video chassis for an Identity pulse spacing of 740µsec and an Equalizing pulse spacing of 100µsec respectively.

(5) NORTH REFERENCE BURST.

(a) Perform the operations as described in paragraph 3-6a(12)(c) to count the number of pulse pairs in each burst and to measure the spacing between each pulse pair.

(b) Release the three screws securing the video chassis of the Coder Indicator, and lower the chassis. Locate R675 and loosen the locking nut. Adjust R675 to obtain twelve pulse pairs in each burst. The correct setting should be midway between the positions where 11 and 13 pulse pairs are obtained. Carefully retighten the locking nut.

(c) Locate L601 and adjust it to obtain a pulse pair spacing of 30µsec.

(6) AUXILIARY REFERENCE BURST.

(a) Perform the operations as described in paragraph 3-6a(12)(c) to count the number of pulse pairs in each burst and to measure the spacing between each pulse pair.

(b) Locate R672 and loosen the locking nut. Adjust R672 to obtain six pulse pairs in each reference burst. The correct setting is mid-way between the positions where 5 and 7 pulse pairs are obtained. Carefully re-tighten the locking nut.

(c) Locate L602 and adjust it to obtain a pulse pair spacing of 24μsec.

(7) REPLY DELAY.

(a) Measure the Reply Delay as described in paragraph 3-6a(12)(e). Locate the delay line DL601 on the video chassis and remove the cover.

(b) Loosen the locking screw and adjust the sliding tapping to obtain a reply delay of exactly 50μsec.

(c) Tighten the locking screw and replace the delay line cover. Return the video chassis to its normal position and tighten the securing screws.

(8) FREQUENCY MULTIPLIER OSCILLATOR (FMO) ADJUSTMENTS.

(a) Tuning. – Allow sufficient time for the crystal oven to reach operating temperature. This will be shown by the intermittent lighting of the white NORMAL lamp. Release the hinged access panel covering the RF sub-chassis.

1. On the High Voltage Power Supply, ensure that the HV ON/OFF switch is set to OFF.

2. On the FMO, ensure that the DC supply voltages, as read on the DC SUPPLY VOLTAGE meter, are correct.

3. Set the TUNING meter selector S1401 to OSC and adjust L1502 (high band) or L1513 (low band) for maximum TUNING meter reading.

4. Set S1401 to 1ST DOUBLER and adjust L1503 (high band) or L1514 (low band) for maximum meter reading.

5. Set S1401 to 2ND DOUBLER and adjust L1509 (high band) or L1519 (low band) for maximum reading.

6. Set S1401 to 3RD DOUBLER and adjust C1519 and C1522 (high band) or C1536 and C1537 (low band) for maximum meter reading.

7. Release the four securing bolts and draw the unit fully forward. Remove the perforated cover from the RF sub-chassis and manually override the interlock.

8. Set the Radio Receiver METER SELECTOR switch to the CR201 position. Release the locking screw and adjust the tripler cavity tuning screw Z1501 (high band) or Z1504 (low band) for a maximum indication on the TEST METER.

9. Release the locking screw and adjust the local oscillator output jack J1502 (high band) or J1505 (low band) on the side of the tripler cavity untill the TEST METER indication is below mid-scale. To reduce the reading, move the jack assembly away from the cavity.

10. Repeat 8 and 9 until the TEST METER indicates a maximum reading below mid-scale. The meter should indicate between 0·6 and 1·0 mA.

11. Set the METER SELECTOR switch to CR202 and observe that the TEST METER indicates between 0·6 and 1·0 mA. If necessary, re-adjust the local oscillator output jack to meet this condition.

12. Set S1401 to AMPL. Release the locking screw and adjust Z1502 (high band) or Z1505 (low band) for a maximum indication on the TUNING meter.

13. Observe the indication on the Receiver TEST METER. If the deflection exceeds mid-scale, repeat 9, 10, 11 and 12.

14. Set S1401 to KLYSTRON INPUT INCIDENT. Release the locking screw and adjust Z1503 (high band) or Z1506 (low band) for a maximum indication on the TUNING meter.

15. Connect the Oscilloscope to the KLYSTRON INPUT INCIDENT jack and terminate the connecting lead at the oscilloscope with termination MX-554/U. Repeat 12, 13 and 14 to obtain a maximum pulse amplitude on the oscilloscope. The pulse shape should be as shown in Figure 6-9b. Re-tighten all cavity locking screws and replace the perforated cover on the RF sub-chassis. Close the sub-chassis front-access plate. Measure the power output of the FMO as described in paragraph 3-6a(12(p).

Figure 6-9b

(b) Shaped pulse adjustment. – Connect the oscilloscope vertical input (Ch1 or CH2) to Pin 5 of V1404 on the video chassis.

1. Set the oscilloscope controls to observe the waveshape shown in Figure 6-9c.

2. Adjust R1466 on the video chassis to obtain a pulse width of 2·6μsec at the half-amplitude point.

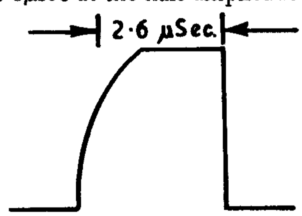


Figure 6-9c

3. Connect the oscilloscope vertical input to the centre-tapping of the potentiometer R1470 and set the oscilloscope controls to observe the waveform shown in Figure 6-9d. Adjust R1417 to eliminate reflections and obtain the waveshape shown in Figure 6-9e. Disconnect the oscilloscope.

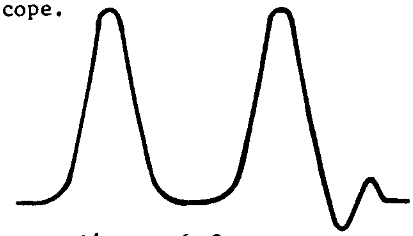


Figure 6-9d

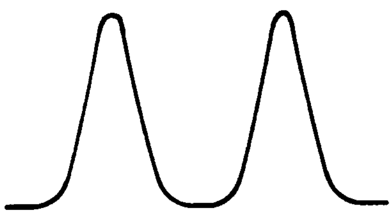


Figure 6-9e

Note

When adjustment has been made to the pulse shape, it is necessary to tune the transmitter circuits as described in paragraphs 6-2h(10)(b)1 to 23 inclusive.

(c) Gate Pulse Adjustment.- Connect the oscilloscope vertical input to Pin 11 on tag board TB1497 and set the controls to observe the waveshape shown in Figure 6-9f.

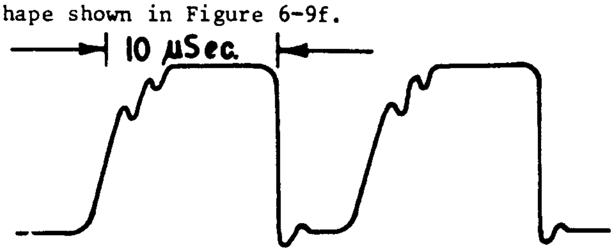


Figure 6-9f

Adjust R1465 to obtain a pulse width of 10µsec at the half-amplitude point. Disconnect the oscilloscope, return the unit to the rack and tighten the securing bolts.

(9) IDENTIFICATION TONE KEYER ADJUSTMENTS.- For information about these adjustments, refer to paragraph 6-2e(3) and (4).

(10) ADJUSTMENT OF TRANSMITTER CIRCUITS.

(a) Amplifier Modulator Bias Adjustment.

1. Set the following switches to OFF:

a. The HV ON/OFF switch on the High Voltage Power Supply Unit.

b. The MV ON/OFF switch on the Medium Voltage Power Supply Unit.

c. The LV ON/OFF switch on the Low Voltage Power Supply Unit.

d. The ON/OFF switch on The Coder Indicator Unit.

2. Release the securing bolts on the Amplifier Modulator and draw the unit forward until the AIR SW OPEN lamp is lit. Open the klystron access panel and the hinged cathode shield.

WARNING

The Amplifier Modulator employs lethal voltages. Before proceeding, discharge all high voltage points, including the bias channel, with the Brinkley earthing stick.

3. Set the multimeter to the DC 300V range and connect the positive lead to the klystron cathode terminal (marked HK). Connect the negative lead to the grid terminal. Push the Amplifier Modulator into the rack until the AIR SW OPEN lamp is extinguished and observe the indication on the meter. The multimeter should indicate 125V.

4. Adjust the bias voltage as follows:-

a. Withdraw the Amplifier Modulator fully forward.

b. Make a small adjustment of R1382 on the bias chassis.

c. Push the unit into the rack until the AIR SW OPEN lamp is extinguished.

d. Observe the multimeter indication.

e. Repeat sub-clauses a. to d. inclusive, until the meter indicates 125V.

5. Withdraw the unit until the AIR SW OPEN lamp is lit and disconnect the multimeter. Close the klystron cathode shield and front access panel. Tighten the securing screws.

6. Return the unit to the rack and tighten the securing bolts. Set the switches listed in paragraph 1 to ON, in the reverse order to switching off.

(b) Transmitter Tuning

Notes

1. The Frequency Multiplier Oscillator RF sub-chassis is assumed to be set up and the klystron bias voltage to be correct.
2. If the klystron is new or has been out of service for longer than three months, it must be aged as detailed in paragraph 6-2h(10)(c) 1 to 13, inclusive, before proceeding.
3. The klystron cavity-ring spacings should be set for the correct operating frequency as shown in the chart supplied with each klystron.
4. The filter cavities in the Control Duplexer should be set for the correct frequency as shown in the table supplied with the installation.

1. Ensure that the HV ON/OFF switch on the High Voltage Power Supply is set to OFF.

2. Disconnect plug P907 from the rear of the Coder Indicator chassis.

3. Release the securing bolts on the Frequency Multiplier Oscillator and draw the unit fully forward. Manually override the interlock. Turn potentiometers R1470 and R1471, located on the video chassis, fully anti-clockwise.

4.a. Set the multimeter to the DC 10V range. On the Frequency Multiplier Oscillator, connect the multimeter between J1405 (front panel) and J1403 (rear of chassis).

b. Adjust R1420 on the video chassis for an indication of 8V on the meter.

c. Disconnect the meter.

d. On the Coder Indicator, reconnect plug P907 to the rear of the chassis.

5.a. Release the securing bolts on the Control Duplexer and draw the unit fully forward. Manually override the interlock.

b. Set the Coder Indicator ON/OFF switch to ON.

c. Set the HV ON/OFF switch on the High Voltage Power Supply Unit, to ON.

d. Adjust R1470 on the Frequency Multiplier Oscillator clockwise until the Amplifier Modulator BEAM CURRENT meter indicates 30 mA.

e. Set the HV ON/OFF switch to OFF.

6.a. Connect the Oscilloscope CH1 vertical INPUT to the SHAPED PULSE jack on the Frequency Multiplier Oscillator. Terminate the connecting lead, at the oscilloscope, with termination MX-554/U.

b. Connect the oscilloscope CH2 vertical INPUT to the KLYSTRON INPUT INCIDENT jack.

c. Connect the A time base TRIG IN jack to the TEST OUTPUT socket on the Coder Indicator.

d. Set the oscilloscope MODE switch to CHOPPED. Using the A time base, set the oscilloscope controls to observe the waveshape shown in Figure 6-9g.

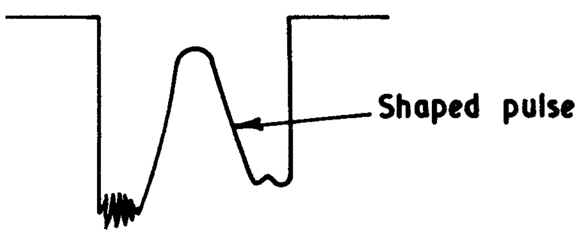


Figure 6-9g

7. Open the RF sub-chassis access plate and adjust the tuning screw of Z1503 (high band) or Z1506 (low band) for maximum amplitude of the square pulse, while maintaining its symmetry around the shaped pulse.

8. Transfer the oscilloscope CH2 vertical INPUT to the KLYSTRON INPUT REFLECTED jack and observe the waveform shown in Figure 6-9h. Adjust the klystron input cavity for minimum amplitude of the square pulse while maintaining its symmetry around the shaped pulse.

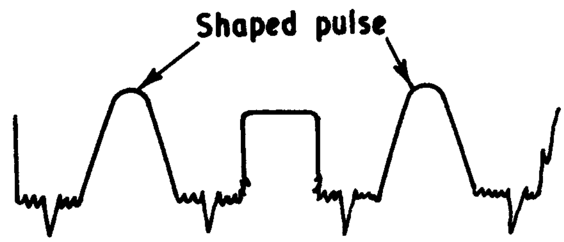


Figure 6-9h

9. Repeat 7 and 8 until there is no further improvement and the best possible symmetry of pulses around the shaped pulse is obtained. Disconnect the oscilloscope.

10. Set the HV ON/OFF switch to ON.

Note

In the following paragraphs, the oscilloscope vertical input is through the crystal detector and the lead is terminated at the oscilloscope with termination MX-554/U. Obtain trigger from the Coder Indicator TEST OUTPUT jack.

11. Connect the oscilloscope to the klystron centre cavity jack. Adjust the centre cavity for maximum pulse amplitude without flattening or loss of symmetry.

12. Connect the oscilloscope to the KLYSTRON OUTPUT INCIDENT jack on the Control Duplexer. Adjust the klystron output cavity and the double-slug tuner for maximum pulse amplitude without flattening or loss of symmetry.

13. Connect the oscilloscope to the KLYSTRON OUTPUT REFLECTED jack. On the Control Duplexer, adjust the front filter cavity for minimum pulse amplitude. Adjust the rear cavity for minimum pulse amplitude.

14. Connect the oscilloscope to the KLYSTRON OUTPUT INCIDENT jack.

CAUTION

When adjusting R1470, observe the BEAM CURRENT meter on the Amplifier Modulator to ensure that the current does not exceed 10mA.

15. Adjust R1470 for maximum pulse amplitude without limiting.

16.a. Detune the klystron centre cavity towards the high frequency side until the pulse amplitude is halved.

b. Alternately, adjust the klystron input cavity and the Frequency Multiplier Oscillator output cavity Z1503 (high band) or Z1506 (low band) for maximum pulse amplitude.

17. Alternately adjust the klystron output cavity and the double-slug tuner for maximum pulse amplitude without flattening or loss of symmetry. Adjust the klystron centre cavity for maximum pulse amplitude without flattening or loss of symmetry.

18. Repeat paragraphs 16 and 17 until a maximum pulse amplitude is obtained, while maintaining a good pulse shape.

CAUTION

The klystron output cavity must not be adjusted during the remainder of the tuning procedure.

19. Connect the oscilloscope to the ANTENNA INCIDENT jack on the Control Duplexer. Make the following adjustments for maximum amplitude without limiting and for the best pulse shape:-

a. Front and rear filter cavities.

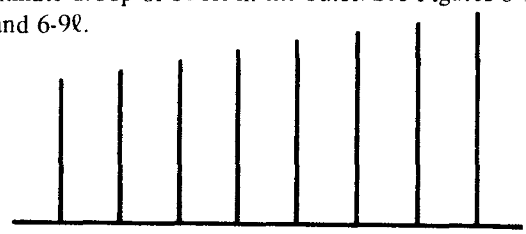
b. Double-slug tuner.

c. Klystron input and centre cavities.

Note

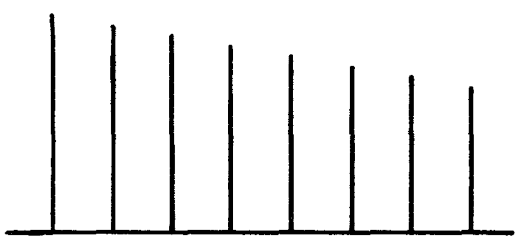
Slight adjustment of R1470 in the Frequency Multiplier Oscillator may also improve the shape.

20. Set the oscilloscope sweep to onserve a reference burst and adjust R1471 in the Frequency Multiplier Oscillator to eliminate droop or boost in the burst. See Figures 6-9j, 6-9k and 6-9ℓ.



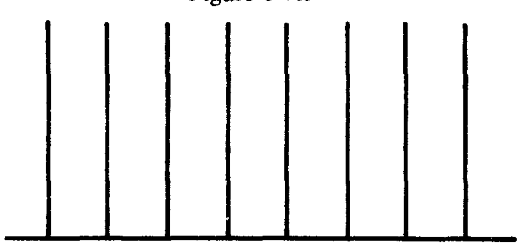
Pulse Boost

Figure 6-9j



Pulse Droop

Figure 6-9k



Pulse Correct

Figure 6-9L

Note

Interaction occurs between the adjustment of R1470 and R1471. If R1471 is adjusted, set the oscilloscope to obtain one pulse of the burst and adjust R1470 for maximum pulse amplitude without limiting and whilst preserving a good pulse shape. The Amplifier Modulator BEAM CURRENT meter should indicate between 90 and 110 mA.

21. On the Control Duplexer, adjust the three micrometer cavity tuning heads for correct frequency as shown in TABLE 205, of Section 2.

22. Disconnect the oscilloscope and return all units to normal operation.

23.a. Measure the beacon output power as described in paragraph 2-6a(12)(n).

b. Perform a spectrum analysis as described in paragraph 3-6a(12)(m).

(c) Klystron Aging.

Notes

1. The Frequency Multiplier Oscillator (FMO) is assumed to be correctly set up.
2. The klystron bias voltage is assumed to be correct.

1. Set the following switches to OFF:

a. The Coder Indicator ON/OFF switch.

b. The HV ON/OFF switch on the High Voltage Power Supply Unit.

c. The MASTER SWITCH on the Control Duplexer.

2. Release the securing bolts on the FMO and draw the unit fully forward. Manually override the interlock and set R1470 fully anti-clockwise.

3.a. On the Amplifier Modulator, open the klystron access door and disconnect the RF input cable from the klystron.

b. Remove the front panel from the Power Supply Cabinet transformer and blower compartment and set the BREAK IN/OPERATE switch to BREAK IN. Manually override the interlock.

4.a. Set the MASTER SWITCH to ON.

b. When the MASTER SWITCH has been on for fifteen minutes, set the HV ON/OFF switch to ON. Allow a further fifteen minutes warming up time.

5. Set the Coder Indicator ON/OFF switch to ON and adjust R1470 on the FMO for an indication of 10 mA on the BEAM CURRENT meter. Allow fifteen minutes to elapse before proceeding.

6. Observe the BEAM CURRENT meter and adjust R1470 to increase the indication by 10mA every five minutes until the meter indicates 50 mA.

7. Set the MASTER SWITCH to OFF and the BREAK IN/OPERATE switch to OPERATE. Replace the blower compartment front panel.

8. Set the MASTER SWITCH to ON and adjust R1470 for a meter indication of 60 mA.

9. Observe the meter and adjust R1470 to increase the indication by 10 mA every five minutes until the meter indicates 90 mA. Allow five minutes to elapse before proceeding.

10. Set the HV ON/OFF switch and MASTER SWITCH to OFF.

11.a. Discharge all high voltage points in the Amplifier Modulator.

b. Reconnect the RF input cable to the klystron and close the access door.

12. Return the FMO to the rack and tighten the securing bolts. The klystron is now fully aged.

13. Tune the klystron and transmitter circuits as described in paragraph 6-2h(10)(b)1 to 23 inclusive.

(d) High Voltage Overload Relay Adjustment.

WARNING

The High Voltage Power Supply employs lethal voltages. Before making any adjustments in the unit, discharge all high voltage points with the Brinkley earthing stick.

1. Release the securing bolts on the Receiver and draw the unit fully forward. Manually override the interlock.

2. Observe the Amplifier Modulator BEAM CURRENT meter and adjust R427 in the Receiver to increase the beam current until either:-

a. The high voltage overload relay trips, or

b. The BEAM CURRENT meter indicates 125 mA.

CAUTION

Do not allow the beam current to exceed 125 mA.

3. Set the HV ON/OFF switch on the High Voltage Power Supply Unit to OFF. Release the securing bolts and draw the unit fully forward.

4. Locate R1912 on the power supply chassis and make a slight adjustment to the control.

5. Return the unit to the rack and tighten the securing bolts. Set the HV ON/OFF switch to ON.

6. Repeat paragraphs 2-5 inclusive, until the high voltage overload relay trips when the BEAM CURRENT meter indicates 125 mA.

7. Measure the squitter rate as described in paragraph 3-6a(12)(a) of Section 3, and set R427 on the Receiver for a squitter rate of 5400 pulses per second.

8.a. Ensure that the BEAM CURRENT meter indicates between 90 and 110 mA.

b. Return the Receiver to the rack and tighten the securing bolts.

(e) Antenna Control Cabinet (5825-99-932-5319).

Note

For other types of antenna control cabinet, refer to their respective manuals.

1. Open the Antenna Control Cabinet door and locate TEST SWITCH 3. Depress the switch and observe on meter panel YJ:-

a. The TIME DELAY lamp is lit.

b. The SPIN MOTOR lamp is lit.

2. With the switch on the antenna speed control unit (YR) in the MOTOR LINE CURRENT position, the meter should indicate between 1·5 and 2·0 amps.

Notes

1. Approximately one minute after depressing TEST SWITCH 3, the SPEED CONTROL indicator on the meter panel (YJ) will light. Adjustments to the ADJUST RUN UP CURRENT control must be made during the time that the TIME DELAY and SPEED CONTROL lamps are lit together, as the control becomes in-effective after the TIME DELAY lamp is extinguished. If the TIME DELAY lamp extinguishes before the adjustment is complete, depress TEST SWITCH 3 to restart the time delay period.
2. The readings on the COUPLING CURRENT and PU COIL VOLTS meters will rise just before the TIME DELAY lamp extinguishes.

3. Set the meter switch on the Speed Control Unit (YR) to the MOTOR LINE CURRENT position and check that the meter indicates between 2·0 and 4·0 amps.

4. Set the meter switch to PU COIL VOLTS and turn the ADJUST RUN UP CURRENT control clockwise until an indication of 0·6 amps is obtained on the COUPLING CURRENT meter. Locate RV3, behind the cabinet door, and adjust it for an indication of 5V on the PU COIL VOLTS meter.

5. Check that after the TIME DELAY lamp has been extinguished:-

a. The COUPLING CURRENT meter indicates 0·5A.

b. The PU COIL VOLTS meter indicates 5·0V.

c. The meter on unit YR, when switched to the MOTOR LINE CURRENT position, indicates between 1·5 and 3·5 amps.

6. Close the Antenna Control Cabinet door.

6-3. REMOVAL, ADJUSTMENT, REPAIR AND REASSEMBLY OF PARTS AND SUBASSEMBLIES.

a. REMOVAL OF DRAWER UNITS FROM CABINET. —The component units of the receiver-transmitter group and power supply assembly are mounted in rack frames mounted in cabinets. To facilitate servicing, component units containing the actual transmitting, receiving, coding, timing, test, and power supply circuits are arranged into panel-and-chassis-type drawer units. Other components of these groups, such as filament supply and blower units, are fixed-type panel-and-chassis assemblies.

The drawer-type panel-and-chassis assemblies slide in and out of the cabinet on slide rails mounted on the rack frame. When fully inserted in the frame, the drawers are secured to the frame by means of captive screws. To open a drawer, release the captive screws and pull on the panel-mounted handles. Latches on the sides of the drawer units lock the drawer in place when partly extended for inspection, adjustment or servicing. Interunit cabling connections to the drawer units are made by means of either plug-in screw-type multiconnectors, or leads fitted with terminal lugs arranged for connection to screw-type terminal boards. No solder connections exist in the interunit cabling. The interunit cabling attached to the drawer units is retractable, and long enough to permit fully extending the unit for maintenance purposes. Opening the latches and disconnecting the interunit cabling permits completely removing the drawer unit from the rack frame.

b. ADJUSTMENT OF PARTS AND SUBASSEMBLIES.

(1) MEDIUM VOLTAGE POWER SUPPLY PP-1765/URN OVERLOAD RELAY. —Medium-voltage power supply overload relay K1803 is adjusted, by means of potentiometer R1872 (figure 6-10), to trip and actuate the overload protection circuit when a sustained overload of 225 milliamperes or more occurs. Under this condition, the relay is set to trip in less than 1 minute. The normal, full-load current provided by the power supply is 175 milliamperes. If the relay trips under normal current conditions, proceed as follows:

WARNING

This equipment employs high voltages that are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working on this equipment. Do not depend on interlock switches or high voltage shorting switches to remove dangerous voltages. Set the MV switch to OFF before opening the medium voltage drawer and short capacitor C1802 with a grounding rod before touching components.

Step 1. Pull out medium voltage power supply unit as described in paragraph 6-3a.

Step 2. Check power supply load current. Insert a 300-milliampere d-c full-scale milliammeter, Multimeter AN/PSM-4, or equivalent, in series with terminal 4 of transformer T1801 and the lead connected to it. Turn potentiometer R1872 clockwise until overload relay does not trip. If meter reads considerably more than 175 milliamperes, shut off equipment and check power supply and load circuit for cause of overload condition. If current reading is 175 milliamperes or less, turn potentiometer R1872 to extreme clockwise position.

Step 3. Shut equipment off; use grounding rod to discharge capacitor C1802. Connect a 20,000-ohm 50-watt fixed resistor between terminal E1831 and ground (do not disconnect lead from E1831).

Step 4. Turn on equipment and adjust meter current to 225 milliamperes by adjusting potentiometer R1842 (1000-volt adjustment, figure 6-2).

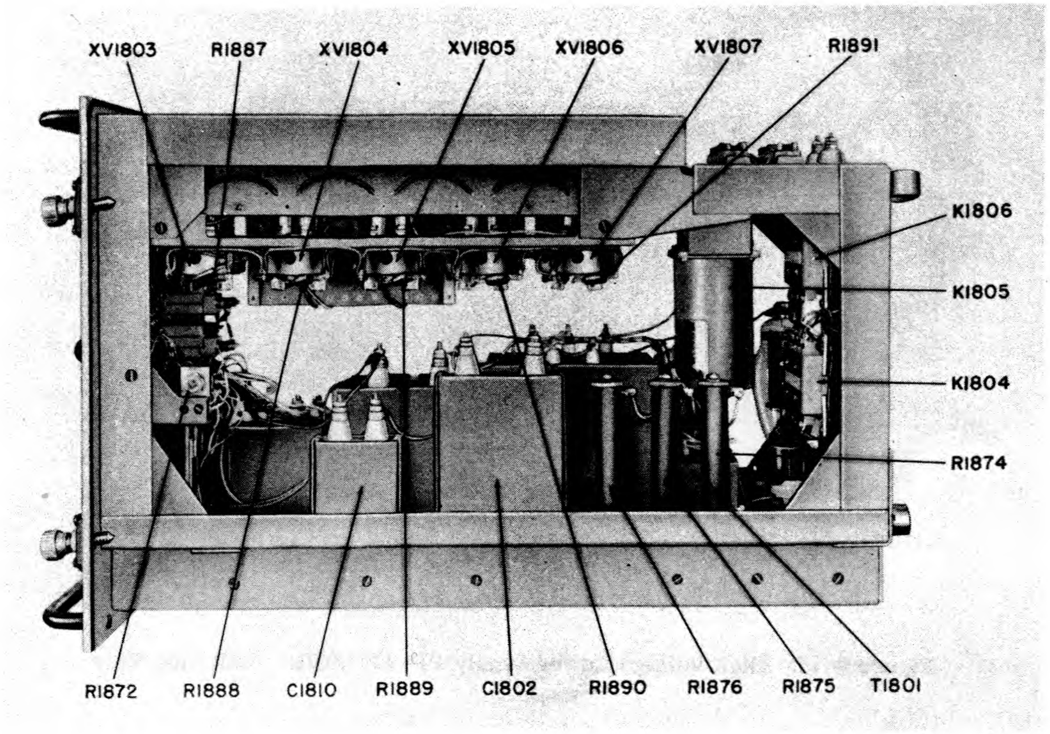


Figure 6-10. Medium Voltage Power Supply PP-1765/URN, Right Side View

Step 5. Slowly turn potentiometer R1872 (overload adjustment) counterclockwise until overload relay trips at 225 milliamperes. Remove 20,000-ohm resistor, and if necessary, recheck +1000-volt output as outlined in paragraph 6-2c(2).

(2) HIGH VOLTAGE POWER SUPPLY PP-1763/URN OVERLOAD RELAY ADJUSTMENT.

WARNING

This equipment employs high voltages that are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working on this equipment. Do not depend on interlock switches or high voltage shorting switches to remove dangerous voltages. Set the HV switch to OFF before opening the high voltage drawer and short capacitors C1901 and C1902 with a grounding rod before touching components.

High voltage power supply overload relay K1904 (figure 6-11) is set to trip at 125 milliamperes. Normal full-load current is approximately 90 milliamperes as observed on BEAM CURRENT meter M1301. If the output current is normal but the relay still trips, current relay K1904, or capacitor C1906, or resistor R1906, R1911, or R1912 is defective, and should be replaced. If any of these parts are replaced, readjust the overload relay by trial and error, turning potentiometer R1912 very slightly with the power off. Replace the unit in the cabinet and observe whether the relay trips. (The relay should trip in less than 1 minute.)

The 125-milliampere overload current can be obtained by changing the squitter control voltage of the radio receiver to obtain a higher than normal pulse rate. To do this, pull the radio receiver and manually close interlock S905. Carefully turn resistor R427 (figure 6-3) clockwise until 125 milliamperes is obtained on meter M1301.

(3) RADIO RECEIVER SUBASSEMBLIES. —In addition to the built-in test equipment, special test equipment is required for the proper alignment of some of the circuits of the radio receiver. These circuits are the receiver preamplifier, i-f amplifier, and Ferris discriminator circuits. The circuits are prealigned at the factory, and normally require no further alignment or adjustment in the field. No attempt should be made, therefore, to tamper with these circuits, unless it has been definitely established that realignment is necessary. Furthermore, alignment should not be attempted without the proper test equipment. The alignment procedure described in the following subparagraphs may be performed only with the test equipment specified or their electrical equivalent.

(a) TEST EQUIPMENT REQUIRED.

1. Signal Generator AN/USM-44A, or equivalent.

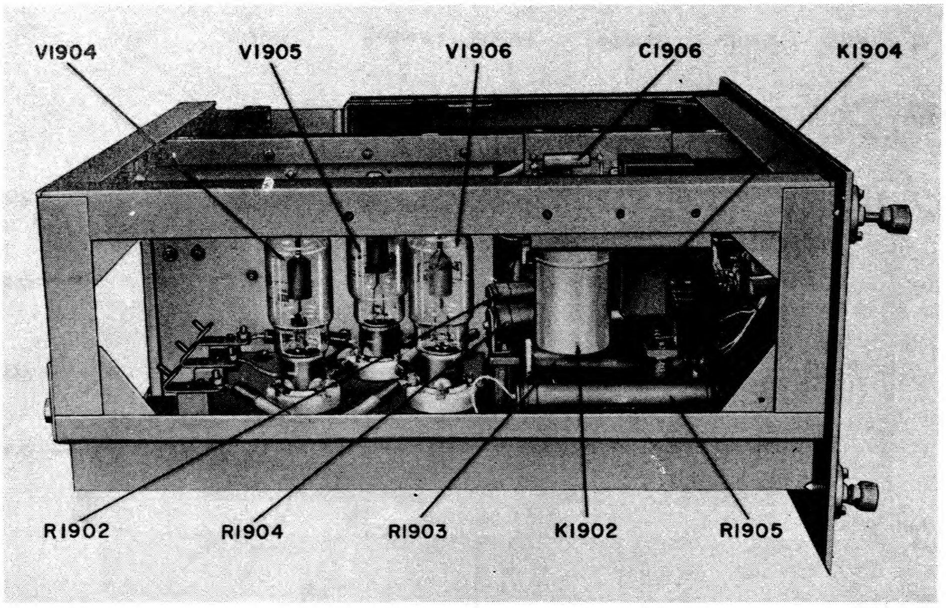


Figure 6-11. High Voltage Power Supply PP-1763/URN, Left Side View

2. High-frequency Vacuum Tube Voltmeter, General Radio Model 1800A, or equivalent.

3. Frequency Meter TS-323/UR, or equivalent capable of measuring at 63.0 megacycles per second.

4. Vacuum Tube Voltmeter, AN/USM-116, or equivalent.

5. Crystal detector, arranged as shown in figure 6-12.

6. Multimeter AN/PSM-4, or equivalent.

7. Components shown in test setup of figure 6-13.

(b) PREAMPLIFIER ALIGNMENT (CONTINUOUS WAVE METHOD). —Before proceeding with the alignment, make the filament and plate voltage measurements listed in table 6-1. With no signal input to the radio receiver, the voltages, measured from the points indicated to ground, should be as shown in the table.

1. ALIGNMENT PROCEDURE.

Step 1. Pull out radio receiver unit as described in paragraph 6-3a. Remove crystal mixers CR201 and CR202.

Step 2. Connect equipment as shown in figure 6-13.

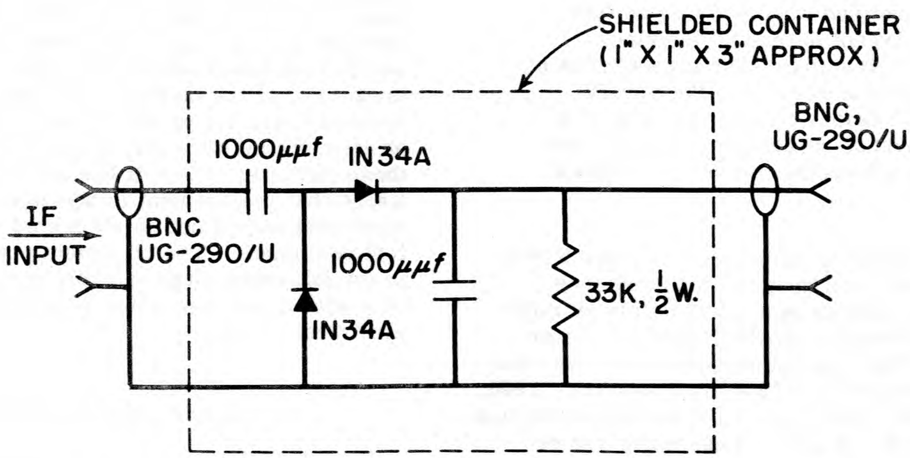


Figure 6-12. Crystal Detector for Use in Preamplifier Alignment

TABLE 6-1. PREAMPLIFIER ALIGNMENT VOLTAGE CHART

CHECK POINT	REQUIRED INDICATION
C223	150 ± 5 volts dc
Pin 3 at V201	6.3 ± 0.3 volts dc
Pin 4 at V202	6.3 ± 0.3 volts dc
Pin 3 at V203	6.3 ± 0.3 volts dc
Pins 6 and 5 V201	110 ± 10 volts dc
Pin 7 at V202 and at C216	120 ± 10 volts dc
Pins 5 and 6 at V203	120 ± 10 volts dc
Pins 2 and 7 at V201	1.0 ± 0.3 volts dc
Pin 2 at V202	1.2 ± 0.3 volts dc
Pins 2 and 7 at V203	2.0 ± 0.4 volts dc

Note

If the voltages obtained are within tolerances, the alignment may then be started. If they are not, refer to troubleshooting procedure for circuit involved.

Step 3. Set signal generator to 63 ± 0.1 megacycle.

Step 4. Apply plate and filament power. Allow 5-minute warmup time.

Step 5. Increase signal generator output level to a value that will cause approximately 0.3 volt rms to be indicated in output voltmeter.

Step 6. Adjust coils L206, L209, L210, and L211 on preamplifier chassis for maximum output on output meter. If output voltage increases beyond 0.4 volt, lower input signal level to effect 0.4 volt or less, and readjust inductances listed above for maximum output on meter.

Step 7. Repeat adjustments of step 6. Note that coil L206 is a low Q circuit and must be adjusted slowly while the output meter is carefully observed for a maximum indication.

Step 8. Set signal generator on 63 megacycles with full output, and temporarily connect a 60 ± 5-micromicrofarad capacitor that is physically small (Elmenco or equivalent) from pin 7 of tube V202 to tube socket XV202, center shield and carefully adjust coil L210 for maximum output. Adjust coil L211 carefully for maximum output; however, do not allow output voltage to exceed 0.4 volt (lower input signal as required). Make these adjustments with tube shield securely in place.

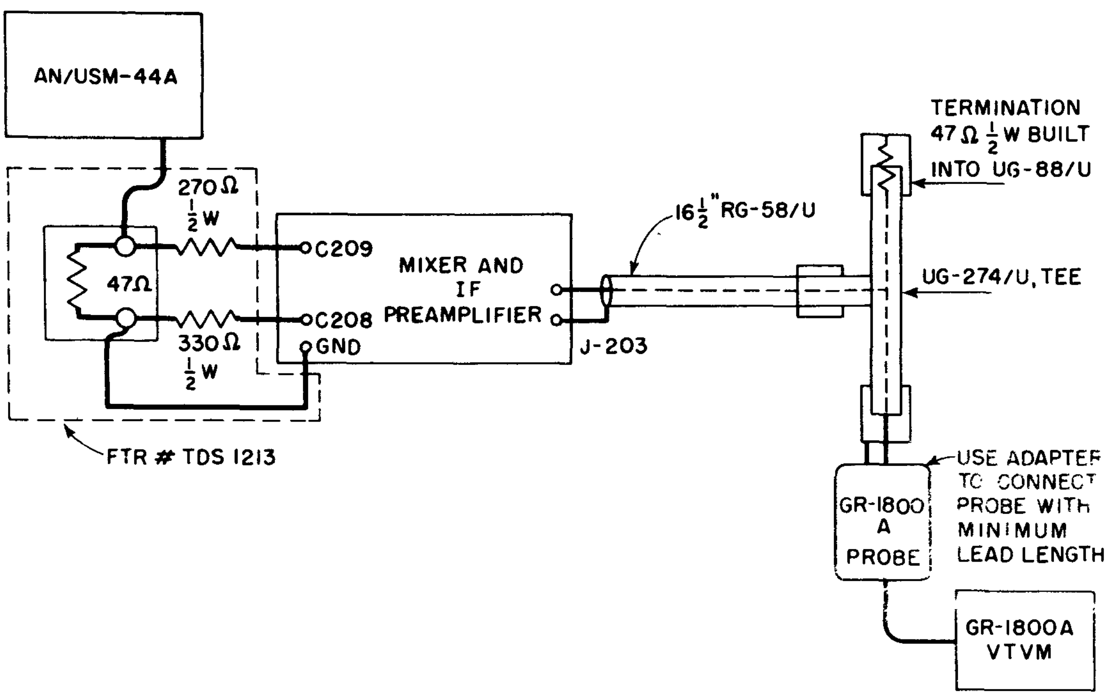


Figure 6-13. Test Circuit for Alignment Preamplifier

Step 9. Remove 60-micromicrofarad capacitor from pin 7 of tube V202 and connect 75-micromicrofarad capacitor to pin 1 of tube V203; use tube socket XV202 center shield, and carefully adjust coil L209 for maximum output. Check that signal generator is still at 63 megacycles. Make this adjustment with tube shield securely in place. Remove capacitor from pin 1 of tube V203 when adjustment is completed.

Step 10. Repeat steps 8 and 9, then fasten preamplifier shield securely, with captive screws, to preamplifier.

Step 11. Tune signal generator from low frequency (61 megacycles) to high frequency of passband (about 65 megacycles). The response should not vary from a nominal output voltage of 0.40 volt rms by more than ±0.60 volt from about 6.10 to 65 megacycles. If this condition does not exist, proceed to steps 12 and 13.

Step 12. If passband slopes upward (output increases as frequency increases, with input constant), tune slug of coil L211 clockwise (increasing inductance) very slightly (about one-half turn at a time) to flatten response to specifications in step 11. Do not tune any other adjustment to accomplish this result. Repeat this adjustment and measure flatness indicated in step 11 until passband has slope of 1 db or less. Do not allow output to exceed 0.4 volt rms for this test. If amplitude decreases markedly when tuning coil L211, tuning is probably being staggered; avoid this condition.

Step 13. If passband slopes downward (output decreases as frequency increases, with input constant), tune slug of coil L211 counterclockwise (decreasing inductance) very slightly (about one-half turn at a time) to flatten response to specifications of step 11. Do not tune any other adjustment to accomplish this result. Repeat this adjustment and measure passband flatness as indicated in step 11 until passband has slope of 1 db or less. Do not allow output to exceed 0.4 volt rms for this test. If amplitude decreases markedly when tuning coil L211, tuning is probably being staggered; avoid this condition.

2. PREAMPLIFIER CHARACTERISTICS AFTER CONTINUOUS WAVE ALIGNMENT. —An input of 20,000 to 40,000 microvolts (continuous wave) single phase is sufficient to yield an output of 0.4 volt across a 50-ohm load at 63 megacycles. The bandwidth at half-power points should be between 5.5 to 7 megacycles; at 26 db down, the width should be 18 to 21 megacycles. The response should be flat from 61 to 65 megacycles to within 1 db. At 63 megacycles (within passband) the output should be linear within 2 db to at least 2 volts rms output into 50 ohms as measured with the high-frequency vacuum tube voltmeter. The preamplifier response should be centered about 63 ± 0.5 megacycles. Symmetry should be measured from the half-power points for this width measurement.

(c) I-F AMPLIFIER ALIGNMENT. —Before proceeding with the alignment make the voltage measurements listed in table 6-2. With no signal input to the radio receiver, the voltages, measured from the points indicated to ground, should be as shown in table 6-2. Also check all i-f amplifier tubes and filament and plate supply voltages.

Step 1. Connect signal generator as shown in figure 6-13. Remove tee UG-274/U and connect cable RG-58/U from jack J203 on preamplifier to plug P303 on i-f amplifier.

Step 2. Set signal generator to 63 ± 0.1 megacycles.

Step 3. Apply filament and plate power and variable negative bias supply to squitter control of i-f amplifier. Adjust this bias to -5.0 volts dc.

Step 4. Connect Voltmeter AN/PSM-4 from test point TP2 to ground. Also connect 1000-micromicrofarad capacitor from test point TP2 to ground.

Note

All shields must be fastened securely in place.

Step 5. Increase signal generator output to level that will effect approximately 0.5-volt d-c output on Voltmeter AN/PSM-4.

Step 6. Adjust core of coils L302, L303, L304, L305, L306, and L308 on i-f chassis for maximum indication on output voltmeter. If output voltage increases beyond 1 volt at any time during alignment, reduce input signal level to effect 1 volt or less and readjust above inductances for maximum output on output vacuum tube voltmeter.

Step 7. Repeat adjustments in step 6. Note that coil L302 is a medium Q circuit and must be adjusted slowly while output meter is carefully observed for maximum indication.

Step 8. Set signal generator on 60.7 megacycles and adjust coil L303 for maximum output at this frequency. Do not allow output voltage to exceed 1 volt dc during alignment. Adjust generator output attenuator to keep output below 1 volt.

Note

Make sure squitter bias is set at -5.0 volts for adjustments described in steps 8 through 10.

Step 9. Set signal generator on 65.4 megacycles and adjust coil L304 for maximum output at this frequency. Do not allow output voltage of test point TP2 to exceed 1 volt dc during alignment.

Step 10. Set signal generator on 63 megacycles and adjust coils L302, L305, L306, and L308 (see step 6

TABLE 6-2. RADIO RECEIVER, I-F AMPLIFIER VOLTAGE CHART

TYPE NO.	TUBE TYPE	SOCKET PIN NUMBER* 1	2	3	4	5	6	7	8	9
V301	5654/6AK5W	0	2.2	6.3 ac	0	125	125	2.2	-	-
V302	5654/6AK5W	0	2.3	6.3 ac	0	130	131	2.3	-	-
V303	5654/6AK5W	0	2.3	6.3 ac	0	130	134	2.3	-	-
V304	5654/6AK5W	0	2.5	6.3 ac	0	115	129	2.5	-	-
V305	5654/6AK5W	0	2.4	6.3 ac	0	100	129	2.4	-	-

CAUTION

Make these measurements with jack J303 disconnected and jack J301 shorted to ground. Keep small shield over tubes V306 and V307 while making measurements; otherwise i-f amplifier will feed back and cause erroneous results.

TYPE NO.	TUBE TYPE	1	2	3	4	5	6	7	8	9
V306	5726/6AL5W	0.15	0	6.3 ac	0	0.15	0	0	-	-
V307	12AT7WA	140	0.2	1.75	0	0	150	-.15	2.8	6.3 ac

Note

Keep large shield over tubes V301, V302, V303, V304 and V305 while making measurements on these circuits; otherwise i-f amplifier will feed back.

*All measurements made between ground and point indicated.
All d-c measurements made with 20,000-ohm/voltmeter.
All a-c measurements made with 1000-ohm/voltmeter.

and 7) for maximum output at this frequency. Do not allow output voltage to exceed 1 volt dc during alignment.

Step 11. Repeat steps 8, 9, and 10. This completes i-f alignment up to Ferris discriminator.

(d) FERRIS DISCRIMINATOR ALIGNMENT.– Connect the test equipment as instructed in 6-3b(3)(c) for alignment of the i-f amplifier.

1. ALIGNMENT PROCEDURE.

Step 1. Set signal generator to 63 megacycles; check this frequency with frequency meter. Set squitter bias at -5.0 volts.

Step 2. Remove Voltmeter AN/PSM-4 from test point TP2 and remove 1000-micromicrofarad capacitor from test point TP2 at same time.

Step 3. Connect Voltmeter AN/PSM-4 to test point TP3; connect meter to read negative voltage with respect to ground. (Use 1000-micromicrofarad capacitor from test point TP3 to ground.)

Step 4. Adjust coil L309 until reading on Voltmeter AN/PSM-4 at test point TP3 reads maximum negative. Generator must be set to 63 megacycles. Never allow this voltage to exceed -0.8 volt during alignment. If voltage exceeds this specified amount, reduce output of signal generator to lower output to desired amount, then adjust coil L309 for maximum output.

Step 5. Tune generator from 63 megacycles to low frequency side. Observe that output at test point TP3 will fall from negative to zero volts and then reverse polarity as frequency is lowered. Keep tuning and observe maximum positive output on low frequency side. Do not allow voltage out of discriminator to exceed 1 volt on positive side during tests. Reduce generator input to effect this condition, if necessary. Keep generator output at this value for step 6, and record positive amplitude observed.

Step 6. Maintaining constant output from generator, tune signal generator toward high frequency side. Polarity will become negative before 63 megacycles and then reverse polarity again somewhere beyond 63 megacycles. With same signal generator input as in step 5, record maximum positive voltage output on high frequency side of discriminator.

Step 7. Compare amplitudes of voltage peaks measured in step 5 and 6. Amplitudes should be within 5 percent at a nominal level of 1.0 volt. If they are not within this tolerance, check whether high frequency or low frequency side is lower. If low frequency positive peak is too low, turn coil L308 clockwise slightly; this will increase amplitude of positive low frequency side of the discriminator. If low frequency positive peak is too large, turn coil L308 counterclockwise for correction.

Step 8. Repeat step 4.

Step 9. Tune signal generator through discriminator characteristic and observe heights of positive maxima of discriminator. If heights are not yet within 5 percent of each other at a level of ±1.0 volt dc, repeat steps 7 and 8, and recheck until desired characteristic is obtained.

Step 10. Set signal generator to 63 megacycles with frequency meter and check step 4. This completes tuning of i-f amplifier and Ferris discriminator.

Step 11. Replace crystal mixers CR201 and CR202 and restore equipment to original condition.

2. CHARACTERISTICS OF I-F AMPLIFIER INCLUDING FERRIS DISCRIMINATOR.—The response of the i-f amplifier at test point TP2 should approximate that of the response shown in figure 6-14. The crossover points of the negative lobe (high and low frequency points that pass through zero voltage), measured with the frequency meter, should be symmetrically placed about 63 ± 0.001 megacycles. If this is not so, readjust coil L309, using extreme care; remeasure the crossover frequencies with the frequency meter. Note that 180-degree rotation of the slug on coil L309 will shift the center frequency of the negative lobe approximately 1 megacycle.

c. REASSEMBLY OF DRAWER UNITS.—The reassembly of the equipment comprising the receiver-transmitter group and the power supply assembly is accomplished in the reverse order of the disassembly procedure given in paragraph 6-3a.

6-4. ILLUSTRATIONS.

a. SCHEMATIC DIAGRAMS.—Figures 6-15 through 6-28 are the schematic diagrams for Radio Set AN/GRN-9D.

b. WIRING DIAGRAMS.—Figures 6-29 through 6-49 are the wiring diagrams for all the units of the radio set.

c. PARTS LOCATION.—Figures 6-1 through 6-7, 6-9 through 6-11, and 6-50 through 6-68 show the location of parts in the radio set.

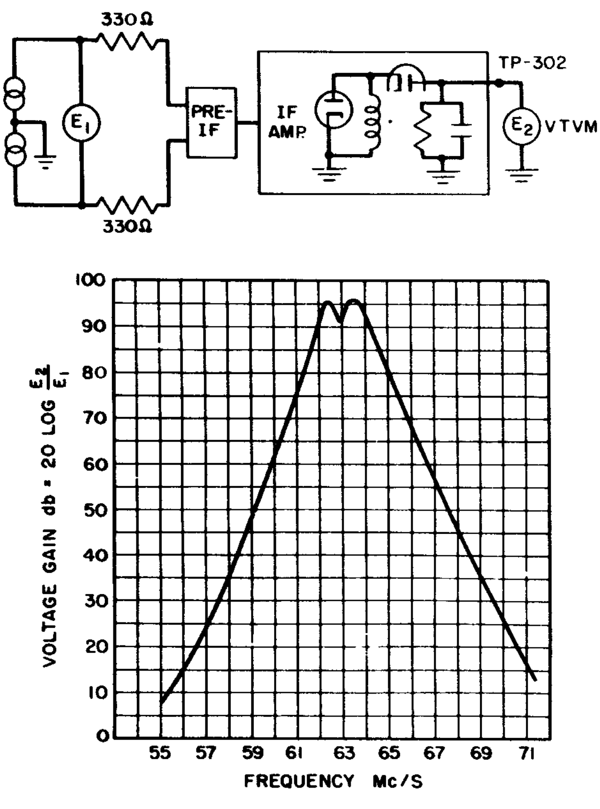


Figure 6-14. Receiver Response Characteristics

REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION
B602	50H	F1114	7M, 28B	K1804	22F,29K,93H	T1371	87I	TB1002	2A	TB1601(5)	72L, 79M
B901	9A	F1302	82H	K1805	25J	T1403	77I	TB1002(1)	22K	TB1601(6)	90E
B902	15A	F1401	76G	K1806	23G,26J,29I, 32F, 39F	T1501	76I	TB1002(3)	86D	TB1601(7)	89J
B1001	22A	F1402	7L	K1902	23I,24F,38H	T1502	8I	TB1002(7)	89K	TB1601(8)	16J
C1906	38I	F1403	7G	K1904	37H	T1601	70H, 90I	TB1002(13)	63F	TB1601(9)	29G
C6580	57I	F1601	71G	M1101	45G	T1602	91I	TB1002(14)	60F, 67F	TB1602(1)	79K
C6581	57I	F1602	72G	M1902	80H	T1603	71I	TB1002(15)	57M	TB1602(4)	16K
DS502	53E	F1603	89F	R520	53I	T1604	73I	TB1002(16)	19G, 56F	TB1602(5)	85I
DS601	48I	F1604	91F	R521	53F	T1801	93I	TB1003(7)	35J	TB1602(6)	28J
DS901	44H	F1801	93F	R601	48H	T1802	74I	TB1003(11)	21M	TB1602(8)	28G
DS1001	16J	F1802	74G	R716	49I	T1803	75I	TB1003(13)	35I	TB1602(10)	22G
DS1002	21L	F1803	75G	R1906	37L	T1901	81H	TB1003(15)	19G	TB1602(11)	22H
DS1004	21H	F1901	80G	R1912	37I	T6275	60I	TB1003(17)	19K	TB1801(1)	26G,31G,32F, 38F
DS1101	45G	F6001	68I	R1917	23J	T6561	57I	TB1003(18)	20G, 20J	TB1801(2)	25L,30L,32H, 32L
DS1102	15H	F6002	6I	S502	54G	T6576	59I	TB1004(11)	23L	TB1801(3)	74F
DS1103	5J	F6201A	60G	S601	51G	T6891	66H	TB1005	21A	TB1801(4)	74L
DS1105	26C	F6201B	60K	S605B	50I	TB104(7)	6F	TB1104(1)	8C	TB1801(5)	93E
DS1301	84I	F6576	56K	S901	3F	TB501(1)	54G	TB1104(2)	8C	TB1801(6)	93K
DS1303	44I	F6577	56G	S902A	20L	TB501(2)	54J	TB1104(3)	8D	TB1801(10)	38G
DS1305	83I	F6961	64I	S902B	20L	TB601(2)	50H	TB1104(5)	12F	TB1802(1)	22G
DS1401	78I	F6962	64I	S903A	19K	TB601(3)	50J	TB1104(6)	6K	TB1802(4)	29G
DS1402	8K	FL901	2C	S903B	19K	TB701(2)	51H	TB1104(8)	8B	TB1802(5)	25G, 25F
DS1403	8K	FL902	2C	S904	19H	TB701(3)	51J	TB1101(4)	6N,29B,31N	TB1901(2)	22J
DS1501	53H	FL903	2D	S905A	53L	TB901(8)	5N	TB1101(5)	15D	TB1901(4)	22H
DS1601	28K	FL906	2N	S905B	53K	TB901(9)	4N	TB1101(6)	6D	TB1901(5)	23F
DS1603	27K	FL1401	8J	S906	50E	TB901(10)	7E	TB1101(7)	6C	TB1901(6)	24G
DS1604	28K	FL6101	68I	S907	43G, 43H	TB901(12)	7E	TB1101(8)	5C	TB1901(9)	23M, 36M
DS1605	17K	FL6942(1)	63F	S1001A	19J	TB902	2B	TB1102(1)	31M	TB1901(17)	38G
DS1801	32I	FL6961	63I	S1001B	19J	TB902(1)	67F	TB1102(5)	20F	TB1902(1)	80F
DS1802	92I	J505(A)	54F	S1002A	19J	TB902(2)	5C	TB1102(6)	18G, 19F	TB1902(2)	80K
DS1803	29H	J505(B)	53F	S1002B	19I	TB902(3)	63F	TB1102(7)	18I	TB1902(3)	79H
DS1901	35L	J601(A)	63G	S1003A	19G	TB904(3)	6F, 6I	TB1102(8)	19L	TB1902(4)	35J
DS1902	23K	J601(B)	63K	S1003B	19G	TB904(4)	5E	TB1102(9)	89L	TB6576	56L
DS1903	22I	J605(C)	54L	S1004	19F	TB904(5)	6K	TB1102(10)	17F	TB6576(1)	56F
DS6501	57I	J605(T)	51L	S1005	16I	TB904(6)	5F	TB1102(11)	21D	TB6576(3)	58H
DS6963	67I	J605(r)	48E	S1006	11[illegible]	TB904(9)	3F	TB1103(2)	32K	TB6961(2)	63L
F501	54F	J605(w)	51F	S1101	9E	TB904(10)	3E	TB1103(4)	10G	TB6891(14)	65I
F502	54K	J605(x)	49E	S1102	6G, 6M	TB904(13)	89K	TB1103(8)	12M	TB6891(15)	65I
F601	51F	J901	5E	S1106	45E	TB904(14)	73D	TB1104(9)	6B,10G,35H, 39E	TB8907(9)	20K
F602	51K	J1001	3E	S1107A	18J	TB904(17)	48E	TB1104(10)	5B		
F901	6A	J1102	17L	S1107B	18H	TB904(19)	48E	TB1104(11)	48E		
F902	8A	J1103	17H	S1107C	19F	TB907(1)	11F	TB1104(52)	79K		
F903	7A	J1104	16F	S1108	47G	TB907(2)	10F, 19I	TB1105(7)	6H		
F905	12A	J3004	5F	S1301	43I	TB907(3)	13K	TB1300(20)	19I		
F906	14A	J1601(A)	67G	S1302	19H	TB907(4)	18F	TB1301(1)	81J		
F907	13A	J6101(B)	67K	S1305	83I	TB907(5)	43F	TB1301(2)	44L		
F1001	9C	J6208(A)	60F	S1601	16K	TB907(7)	19G	TB1301(4)	43H		
F1002	10C	J6208(B)	60L	S1801	29J	TB907(10)	19K	TB1301(5)	85I		
F1003	9D	K901	4C, 11F	S1802	24I	TB908	10B	TB1301(6)	19H		
F1004	3E	K1001	10C,23K,35I	S1902	22J	TB908(3)	18G	TB1301(7)	19H		
F1005	3F	K1101	7C,12F,14F, 16D, 18M	S6005	69H	TB908(5)	2E, 19F	TB1302(1)	81E		
F1006	20A	K1102	14G	S6152	22K	TB908(6)	2F	TB1370(5)	87I		
F1007	19A	K1103	5B,14F,15G	S6203	60J	TB908(8)	20L	TB1370(6)	87I		
F1008	18A	K1301	44K, 84H	S6576	56H	TB908(9)	19H	TB1401(1)	76L		
F1101	10E	K1401	79I	S6963	65H	TB908(11)	54L	TB1401(2)	76F		
F1102	31N	K1601	28I, 28F	T501	54H	TB908(12)	53K	TB1401(4)	7M		
F1103	6G	K1603	16L,27I,29G, 89H	T502	54I	TB908(13)	49E	TB1401(5)	7F		
F1104	6L	K1604	31K, 89G	T701	52I	TB908(16)	51E	TB1402(7)	79J		
F1106	14E	K1605	16J, 79L	T702	51I	TB908(17)	79H	TB1402(8)	79H		
F1107	47M	K1606	23G	T1001	15B	TB908(19)	79J	TB1403(12)	77J		
F1108	47H	K1801	31H	T1101	47I	TB909	9A	TB1403(14)	77H		
F1110	46E	K1802	25F,30H,32G	T1102	48I	TB909(3)	13M	TB1601(1)	70I		
F1111	89M	K1803	33G	T1370	86I	TB910	15A	TB1601(2)	27F,29F,70I		
F1113	23A					TB1001	16B	TB1601(3)	17M,27M,31L		
						TB1001(9)	4F	TB1601(4)	72F		
						TB1001(10)	3D				

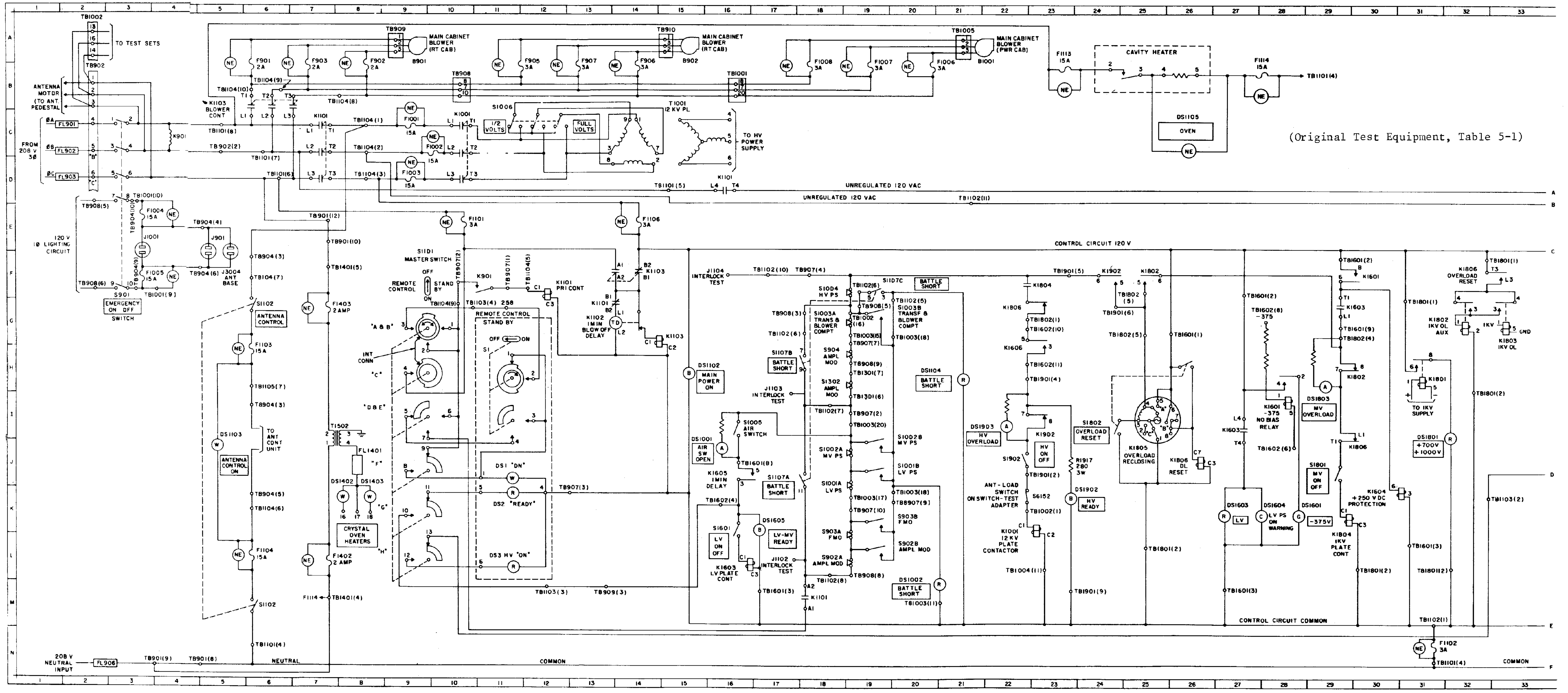


Figure 6-15. Radio Set AN/GRN-9D, Primary Power Distribution, Schematic Diagram (Sheet 1 of 3)

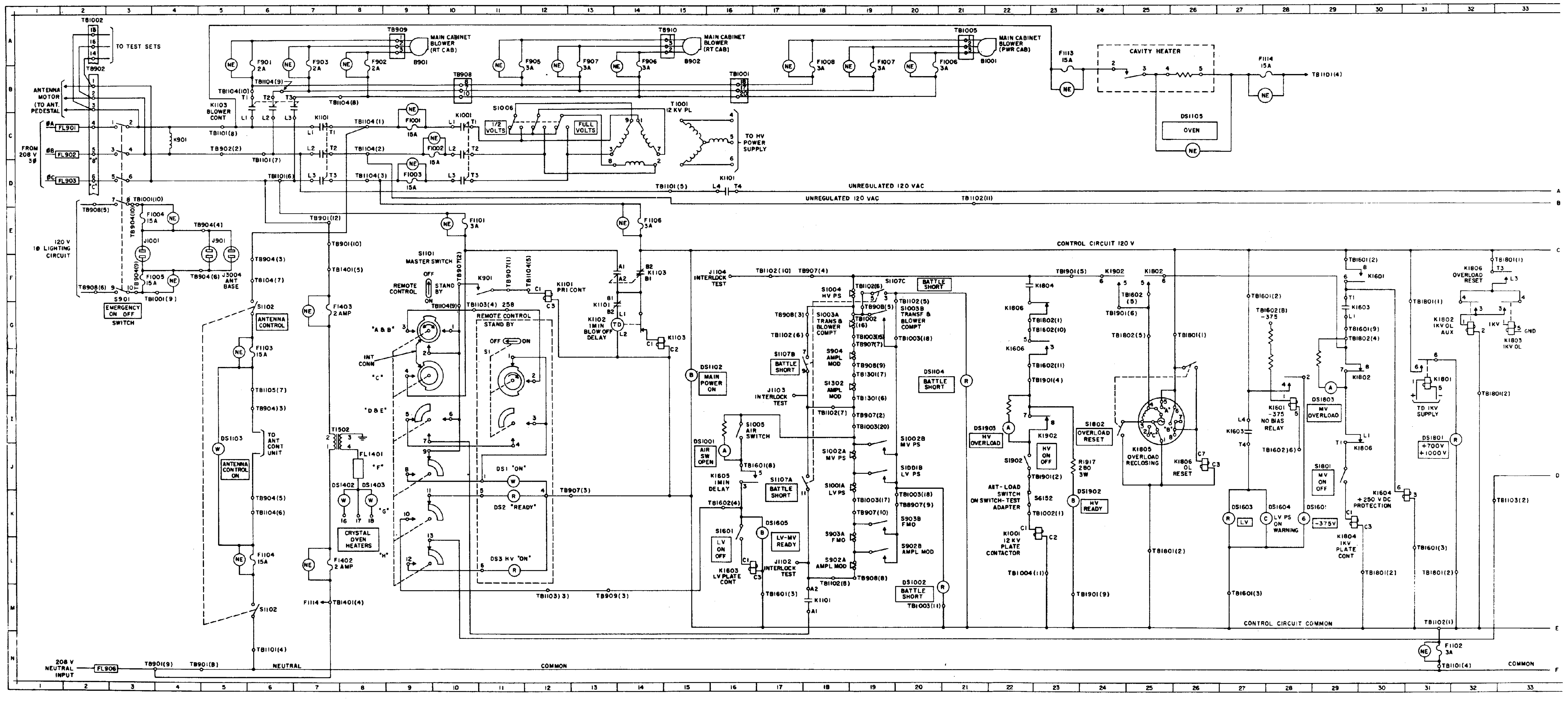


Figure 6-15. Radio Set AN/GRN-9D, Primary Power Distribution, Schematic Diagram (Sheet 1 of 3)

REF DESIG	LOCATION
B602	50H
B901	9A
B902	15A
B1001	22A
C1906	38I
C6580	57I
C6581	57I
DS502	53E
DS601	48I
DS901	44H
DS1001	16J
DS1002	21L
DS1004	21H
DS1101	45G
DS1102	15H
DS1103	5J
DS1105	26C
DS1301	84I
DS1303	44I
DS1305	83I
DS1401	78I
DS1402	8K
DS1403	8K
DS1501	53H
DS1601	28K
DS1603	27K
DS1604	28K
DS1605	17K
DS1801	32I
DS1802	92I
DS1803	29H
DS1901	35L
DS1902	23K
DS1903	22I
DS6501	57I
DS6963	67I
F501	54F
F502	54K
F601	51F
F602	51K
F901	6A
F902	8A
F903	7A
F905	12A
F906	14A
F907	13A
F1001	9C
F1002	10C
F1003	9D
F1004	3E
F1005	3F
F1006	20A
F1007	19A
F1008	18A
F1101	10E
F1102	31N
F1103	6G
F1104	6L
F1106	14E
F1107	47M
F1108	47H
F1110	46E
F1111	89M
F1113	23A

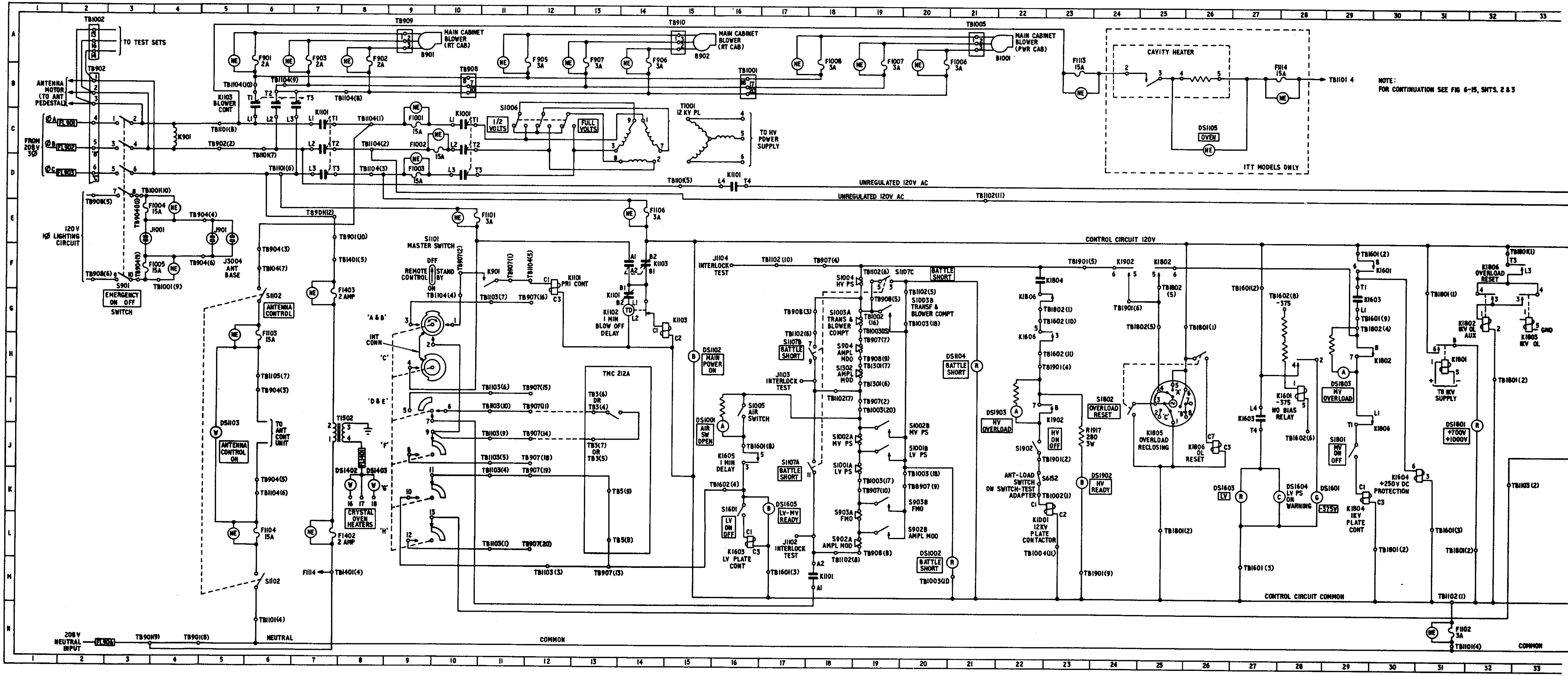
REF DESIG	LOCATION
F1114	7M, 28B
F1302	82H
F1401	76G
F1402	7L
F1403	7G
F1601	71G
F1602	72G
F1603	89F
F1604	91F
F1801	93F
F1802	74G
F1803	75G
F1901	80G
F6001	68I
F6002	6I
F6201A	60G
F6201B	60K
F6576	56K
F6577	56G
F6961	64I
F6962	64I
FL901	2C
FL902	2C
FL903	2D
FL906	2N
FL1401	8J
FL6101	68I
FL6942(1)	63F
FL6961	63I
J505(A)	54F
J505(B)	53F
J601(A)	63G
J601(B)	63K
J605(C)	54L
J605(T)	51L
J605(r)	48E
J605(w)	51F
J605(x)	49E
J901	5E
J1001	3E
J1102	17L
J1103	17H
J1104	16F
J3004	5F
J1601(A)	67G
J6101(B)	67K
J6208(A)	60F
J6208(B)	60L
K901	4C, 11F
K1001	10C,23K,35I
K1101	7C,12F,14F, 16D, 18M
K1102	14G
K1103	5B,14F,15G
K1301	44K, 84H
K1401	79I
K1601	28I, 28F
K1603	16L,27I,29G, 89H
K1604	31K, 89G
K1605	16J, 79L
K1606	23G
K1801	31H
K1802	25F,30H,32G
K1803	33G

REF DESIG	LOCATION
K1804	22F,29K,93H
K1805	25J
K1806	23G,26J,29I, 32F, 39F
K1902	23I,24F,38H
K1904	37H
M1101	45G
M1902	80H
R520	53I
R521	53F
R601	48H
R716	49I
R1906	37L
R1912	37I
R1917	23J
S502	54G
S601	51G
S605B	50I
S901	3F
S902A	20L
S902B	20L
S903A	19K
S903B	19K
S904	19H
S905A	53L
S905B	53K
S906	50E
S907	43G, 43H
S1001A	19J
S1001B	19J
S1002A	19J
S1002B	19I
S1003A	19G
S1003B	19G
S1004	19F
S1005	16I
S1006	11B
S1101	9E
S1102	6G, 6M
S1106	45E
S1107A	18J
S1107B	18H
S1107C	19F
S1108	47G
S1301	43I
S1302	19H
S1305	83I
S1601	16K
S1801	29J
S1802	24I
S1902	22J
S6005	69H
S6152	22K
S6203	60J
S6576	56H
S6963	65H
T501	54H
T502	54I
T701	52I
T702	51I
T1001	15B
T1101	47I
T1102	48I
T1370	86I

REF DESIG	LOCATION
T1371	87I
T1403	77I
T1501	76I
T1502	8I
T1601	70H, 90I
T1602	91I
T1603	71I
T1604	73I
T1801	93I
T1802	74I
T1803	75I
T1901	81H
T6275	60I
T6561	57I
T6576	59I
T6891	66H
TB104(7)	6F
TB501(1)	54G
TB501(2)	54J
TB601(2)	50H
TB601(3)	50J
TB701(2)	51H
TB701(3)	51J
TB901(8)	5N
TB901(9)	4N
TB901(10)	7E
TB901(12)	7E
TB902	2B
TB902(1)	67F
TB902(2)	5C
TB902(3)	63F
TB904(3)	6F, 6I
TB904(4)	5E
TB904(5)	6K
TB904(6)	5F
TB904(9)	3F
TB904(10)	3E
TB904(13)	89K
TB904(14)	73D
TB904(17)	48E
TB904(19)	48E
TB907(1)	11F
TB907(2)	10F, 19I
TB907(3)	13K
TB907(4)	18F
TB907(5)	43F
TB907(7)	19G
TB907(10)	19K
TB908	10B
TB908(3)	18G
TB908(5)	2E, 19F
TB908(6)	2F
TB908(8)	20L
TB908(9)	19H
TB908(11)	54L
TB908(12)	53K
TB908(13)	49E
TB908(16)	51E
TB908(17)	79H
TB908(19)	79J
TB909	9A
TB909(3)	13M
TB910	15A
TB1001	16B
TB1001(9)	4F
TB1001(10)	3D

REF DESIG	LOCATION
TB1002	2A
TB1002(1)	22K
TB1002(3)	86D
TB1002(7)	89K
TB1002(13)	63F
TB1002(14)	60F, 67F
TB1002(15)	57M
TB1002(16)	19G, 56F
TB1003(7)	35J
TB1003(11)	21M
TB1003(13)	35I
TB1003(15)	19G
TB1003(17)	19K
TB1003(18)	20G, 20J
TB1004(11)	23L
TB1005	21A
TB1104(1)	8C
TB1104(2)	8C
TB1104(3)	8D
TB1104(5)	12F
TB1104(6)	6K
TB1104(8)	8B
TB1101(4)	6N,29B,31N
TB1101(5)	15D
TB1101(6)	6D
TB1101(7)	6C
TB1101(8)	5C
TB1102(1)	31M
TB1102(5)	20F
TB1102(6)	18G, 19F
TB1102(7)	18I
TB1102(8)	19L
TB1102(9)	89L
TB1102(10)	17F
TB1102(11)	21D
TB1103(2)	32K
TB1103(4)	10G
TB1103(8)	12M
TB1104(9)	6B,10G,35H, 39E
TB1104(10)	5B
TB1104(11)	48E
TB1104(52)	79K
TB1105(7)	6H
TB1300(20)	19I
TB1301(1)	81J
TB1301(2)	44L
TB1301(4)	43H
TB1301(5)	85I
TB1301(6)	19H
TB1301(7)	19H
TB1302(1)	81E
TB1370(5)	87I
TB1370(6)	87I
TB1401(1)	76L
TB1401(2)	76F
TB1401(4)	7M
TB1401(5)	7F
TB1402(7)	79J
TB1402(8)	79H
TB1403(12)	77J
TB1403(14)	77H
TB1601(1)	70I
TB1601(2)	27F,29F,70I
TB1601(3)	17M,27M,31L
TB1601(4)	72F

REF DESIG	LOCATION
TB1601(5)	72L, 79M
TB1601(6)	90E
TB1601(7)	89J
TB1601(8)	16J
TB1601(9)	29G
TB1602(1)	79K
TB1602(4)	16K
TB1602(5)	85I
TB1602(6)	28J
TB1602(8)	28G
TB1602(10)	22G
TB1602(11)	22H
TB1801(1)	26G,31G,32F, 38F
TB1801(2)	25L,30L,32H, 32L
TB1801(3)	74F
TB1801(4)	74L
TB1801(5)	93E
TB1801(6)	93K
TB1801(10)	38G
TB1802(1)	22G
TB1802(4)	29G
TB1802(5)	25G, 25F
TB1901(2)	22J
TB1901(4)	22H
TB1901(5)	23F
TB1901(6)	24G
TB1901(9)	23M, 36M
TB1901(17)	38G
TB1902(1)	80F
TB1902(2)	80K
TB1902(3)	79H
TB1902(4)	35J
TB6576	56L
TB6576(1)	56F
TB6576(3)	58H
TB6961(2)	63L
TB6891(14)	65I
TB6891(15)	65I
TB8907(9)	20K



Issued June 73

Figure 6-15a. Radio Set AN/GRN-9D, Primary Power Distribution, Schematic Diagram
(Replacement Test Equipment, Table 5-1a)

REF DESIG	LOCATION
B602	50H
B901	9A
B902	15A
B1001	22A
C1906	38I
C6580	57I
C6581	57I
DS502	53E
DS601	48I
DS901	44H
DS1001	16J
DS1002	21L
DS1004	21H
DS1101	45G
DS1102	15H
DS1103	5J
DS1105	26C
DS1301	84I
DS1303	44I
DS1305	83I
DS1401	78I
DS1402	8K
DS1403	8K
DS1501	53H
DS1601	28K
DS1603	27K
DS1604	28K
DS1605	17K
DS1801	32I
DS1802	92I
DS1803	29H
DS1901	35L
DS1902	23K
DS1903	22I
DS6501	57I
DS6963	67I
F501	54F
F502	54K
F601	51F
F602	51K
F901	6A
F902	8A
F903	7A
F905	12A
F906	14A
F907	13A
F1001	9C
F1002	10C
F1003	9D
F1004	3E
F1005	3F
F1006	20A
F1007	19A
F1008	18A
F1101	10E
F1102	31N
F1103	6G
F1104	6L
F1106	14E
F1107	47M
F1108	47H
F1110	46E
F1111	89M
F1113	23A

REF DESIG	LOCATION
F1114	7M, 28B
F1302	82H
F1401	76G
F1402	7L
F1403	7G
F1601	71G
F1602	72G
F1603	89F
F1604	91F
F1801	93F
F1802	74G
F1803	75G
F1901	80G
F6001	68I
F6002	6I
F6201A	60G
F6201B	60K
F6576	56K
F6577	56G
F6961	64I
F6962	64I
FL901	2C
FL902	2C
FL903	2D
FL906	2N
FL1401	8J
FL6101	68I
FL6942(1)	63F
FL6961	63I
J505(A)	54F
J505(B)	53F
J601(A)	63G
J601(B)	63K
J605(C)	54L
J605(T)	51L
J605(r)	48E
J605(w)	51F
J605(x)	49E
J901	5E
J1001	3E
J1102	17L
J1103	17H
J1104	16F
J3004	5F
J1601(A)	67G
J6101(B)	67K
J6208(A)	60F
J6208(B)	60L
K901	4C, 11F
K1001	10C,23K,35I
K1101	7C,12F,14F, 16D, 18M
K1102	14G
K1103	5B,14F,15G
K1301	44K, 84H
K1401	79I
K1601	28I, 28F
K1603	16L,27I,29G, 89H
K1604	31K, 89G
K1605	16J, 79L
K1606	23G
K1801	31H
K1802	25F,30H,32G
K1803	33G

REF DESIG	LOCATION
K1804	22F,29K,93H
K1805	25J
K1806	23G,26J,29I, 32F, 39F
K1902	23I,24F,38H
K1904	37H
M1101	45G
M1902	80H
R520	53I
R521	53F
R601	48H
R716	49I
R1906	37L
R1912	37I
R1917	23J
S502	54G
S601	51G
S605B	50I
S901	3F
S902A	20L
S902B	20L
S903A	19K
S903B	19K
S904	19H
S905A	53L
S905B	53K
S906	50E
S907	43G, 43H
S1001A	19J
S1001B	19J
S1002A	19J
S1002B	19I
S1003A	19G
S1003B	19G
S1004	19F
S1005	16I
S1006	11B
S1101	9E
S1102	6G, 6M
S1106	45E
S1107A	18J
S1107B	18H
S1107C	19F
S1108	47G
S1301	43I
S1302	19H
S1305	83I
S1601	16K
S1801	29J
S1802	24I
S1902	22J
S6005	69H
S6152	22K
S6203	60J
S6576	56H
S6963	65H
T501	54H
T502	54I
T701	52I
T702	51I
T1001	15B
T1101	47I
T1102	48I
T1370	86I

REF DESIG	LOCATION
T1371	87I
T1403	77I
T1501	76I
T1502	8I
T1601	70H, 90I
T1602	91I
T1603	71I
T1604	73I
T1801	93I
T1802	74I
T1803	75I
T1901	81H
T6275	60I
T6561	57I
T6576	59I
T6891	66H
TB104(7)	6F
TB501(1)	54G
TB501(2)	54J
TB601(2)	50H
TB601(3)	50J
TB701(2)	51H
TB701(3)	51J
TB901(8)	5N
TB901(9)	4N
TB901(10)	7E
TB901(12)	7E
TB902	2B
TB902(1)	67F
TB902(2)	5C
TB902(3)	63F
TB904(3)	6F, 6I
TB904(4)	5E
TB904(5)	6K
TB904(6)	5F
TB904(9)	3F
TB904(10)	3E
TB904(13)	89K
TB904(14)	73D
TB904(17)	48E
TB904(19)	48E
TB907(1)	11F
TB907(2)	10F, 19I
TB907(3)	13K
TB907(4)	18F
TB907(5)	43F
TB907(7)	19G
TB907(10)	19K
TB908	10B
TB908(3)	18G
TB908(5)	2E, 19F
TB908(6)	2F
TB908(8)	20L
TB908(9)	19H
TB908(11)	54L
TB908(12)	53K
TB908(13)	49E
TB908(16)	51E
TB908(17)	79H
TB908(19)	79J
TB909	9A
TB909(3)	13M
TB910	15A
TB1001	16B
TB1001(9)	4F
TB1001(10)	3D

REF DESIG	LOCATION
TB1002	2A
TB1002(1)	22K
TB1002(3)	86D
TB1002(7)	89K
TB1002(13)	63F
TB1002(14)	60F, 67F
TB1002(15)	57M
TB1002(16)	19G, 56F
TB1003(7)	35J
TB1003(11)	21M
TB1003(13)	35I
TB1003(15)	19G
TB1003(17)	19K
TB1003(18)	20G, 20J
TB1004(11)	23L
TB1005	21A
TB1104(1)	8C
TB1104(2)	8C
TB1104(3)	8D
TB1104(5)	12F
TB1104(6)	6K
TB1104(8)	8B
TB1101(4)	6N,29B,31N
TB1101(5)	15D
TB1101(6)	6D
TB1101(7)	6C
TB1101(8)	5C
TB1102(1)	31M
TB1102(5)	20F
TB1102(6)	18G, 19F
TB1102(7)	18I
TB1102(8)	19L
TB1102(9)	89L
TB1102(10)	17F
TB1102(11)	21D
TB1103(2)	32K
TB1103(4)	10G
TB1103(8)	12M
TB1104(9)	6B,10G,35H, 39E
TB1104(10)	5B
TB1104(11)	48E
TB1104(52)	79K
TB1105(7)	6H
TB1300(20)	19I
TB1301(1)	81J
TB1301(2)	44L
TB1301(4)	43H
TB1301(5)	85I
TB1301(6)	19H
TB1301(7)	19H
TB1302(1)	81E
TB1370(5)	87I
TB1370(6)	87I
TB1401(1)	76L
TB1401(2)	76F
TB1401(4)	7M
TB1401(5)	7F
TB1402(7)	79J
TB1402(8)	79H
TB1403(12)	77J
TB1403(14)	77H
TB1601(1)	70I
TB1601(2)	27F,29F,70I
TB1601(3)	17M,27M,31L
TB1601(4)	72F

REF DESIG	LOCATION
TB1601(5)	72L, 79M
TB1601(6)	90E
TB1601(7)	89J
TB1601(8)	16J
TB1601(9)	29G
TB1602(1)	79K
TB1602(4)	16K
TB1602(5)	85I
TB1602(6)	28J
TB1602(8)	28G
TB1602(10)	22G
TB1602(11)	22H
TB1801(1)	26G,31G,32F, 38F
TB1801(2)	25L,30L,32H, 32L
TB1801(3)	74F
TB1801(4)	74L
TB1801(5)	93E
TB1801(6)	93K
TB1801(10)	38G
TB1802(1)	22G
TB1802(4)	29G
TB1802(5)	25G, 25F
TB1901(2)	22J
TB1901(4)	22H
TB1901(5)	23F
TB1901(6)	24G
TB1901(9)	23M, 36M
TB1901(17)	38G
TB1902(1)	80F
TB1902(2)	80K
TB1902(3)	79H
TB1902(4)	35J
TB6576	56L
TB6576(1)	56F
TB6576(3)	58H
TB6961(2)	63L
TB6891(14)	65I
TB6891(15)	65I
TB8907(9)	20K

On beacons fitted with the Test Monitor Control Pack 212A in place of the Origional Test Equipment of Table 5-1, the mains connection at TB 1002(15) and (16) are not used.

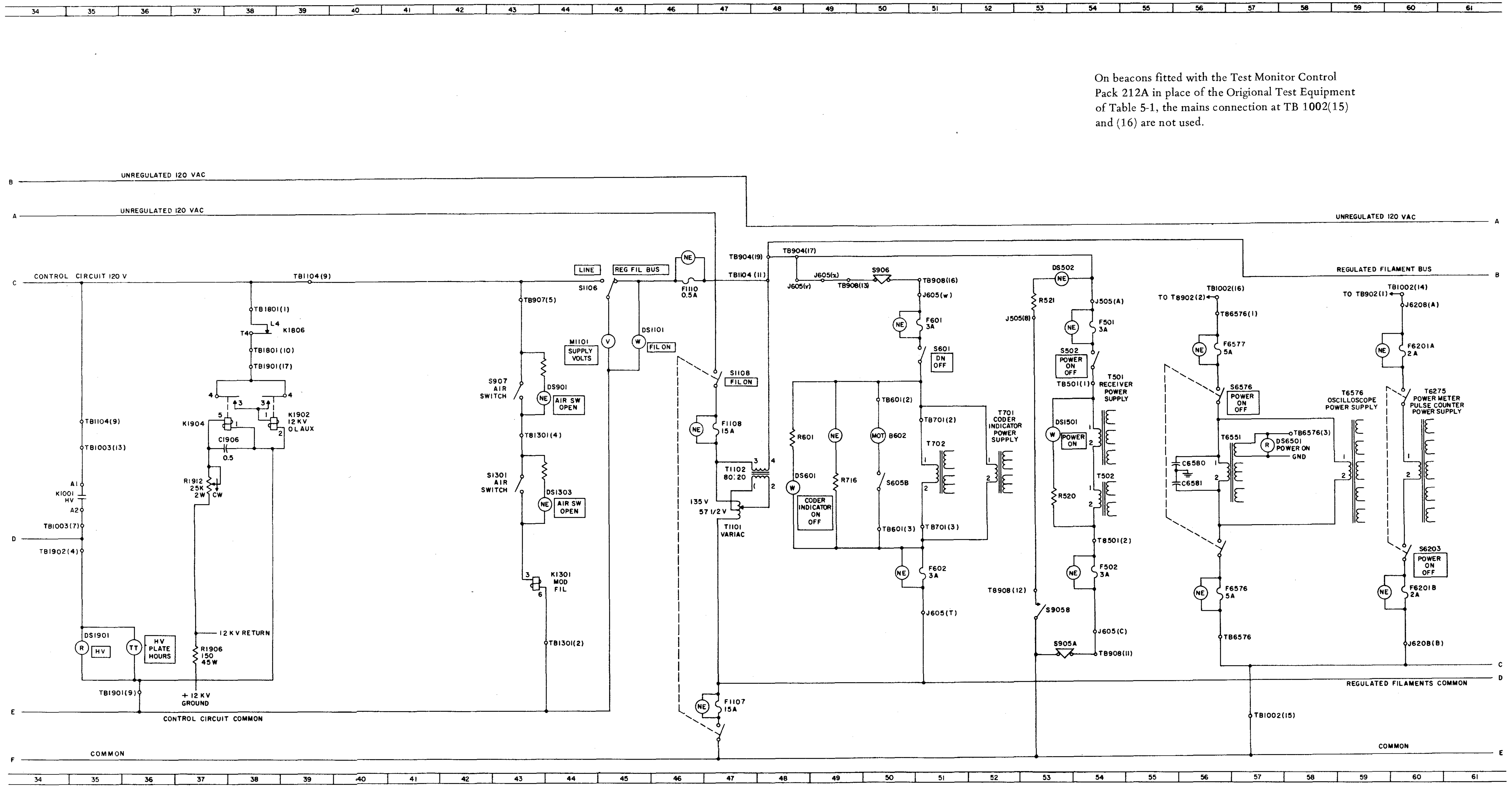


Figure 6-15. Radio Set AN/GRN-9D, Primary Power Distribution, Schematic Diagram (Sheet 2 of 3)

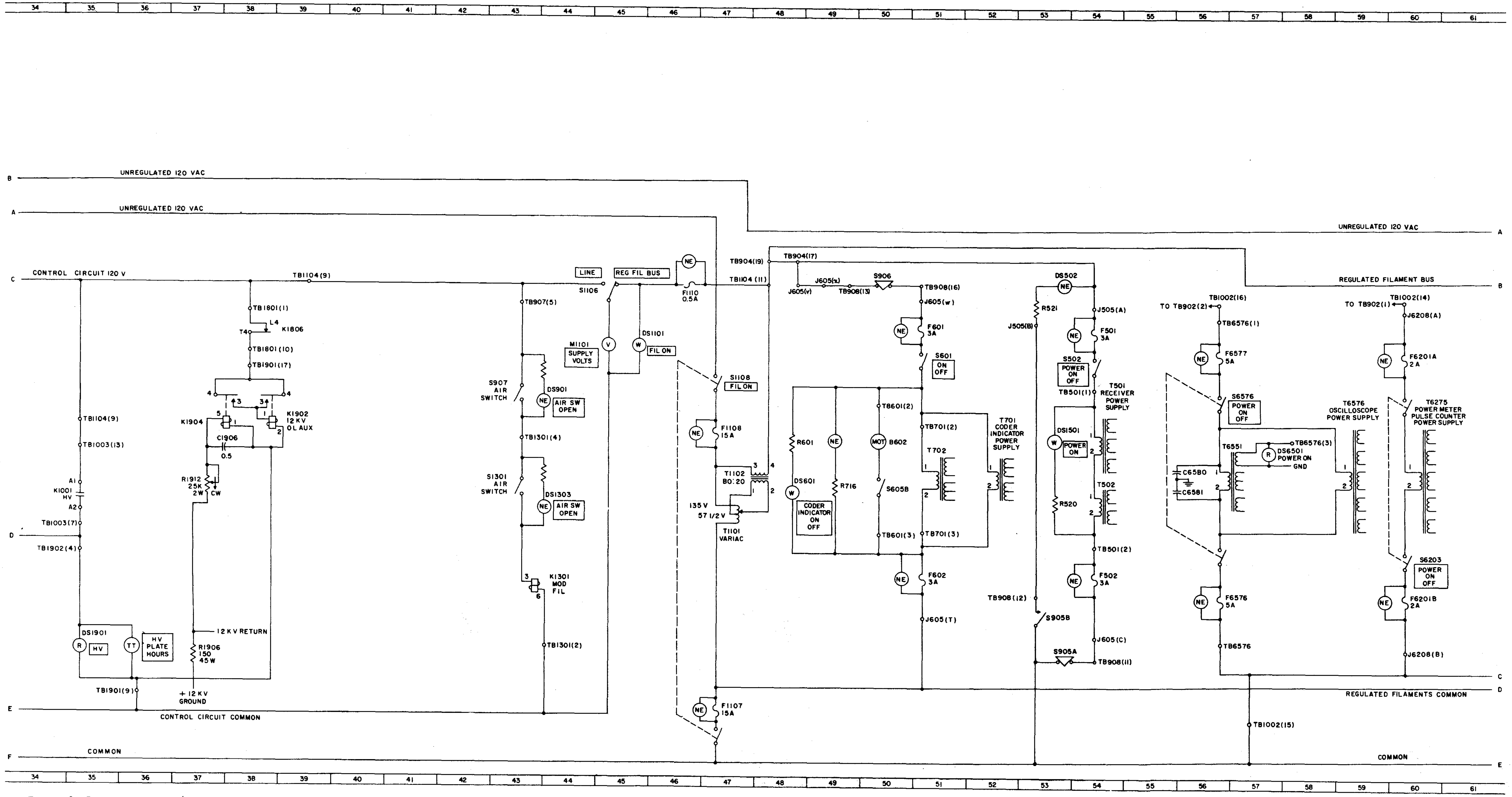


Figure 6-15. Radio Set AN/GRN-9D, Primary Power Distribution, Schematic Diagram (Sheet 2 of 3)

REF DESIG	LOCATION
B602	50H
B901	9A
B902	15A
B1001	22A
C1906	38I
C6580	57I
C6581	57I
DS502	53E
DS601	48I
DS901	44H
DS1001	16J
DS1002	21L
DS1004	21H
DS1101	45G
DS1102	15H
DS1103	5J
DS1105	26C
DS1301	84I
DS1303	44I
DS1305	83I
DS1401	78I
DS1402	8K
DS1403	8K
DS1501	53H
DS1601	28K
DS1603	27K
DS1604	28K
DS1605	17K
DS1801	32I
DS1802	92I
DS1803	29H
DS1901	35L
DS1902	23K
DS1903	22I
DS6501	57I
DS6963	67I
F501	54F
F502	54K
F601	51F
F602	51K
F901	6A
F902	8A
F903	7A
F905	12A
F906	14A
F907	13A
F1001	9C
F1002	10C
F1003	9D
F1004	3E
F1005	3F
F1006	20A
F1007	19A
F1008	18A
F1101	10E
F1102	31N
F1103	6G
F1104	6L
F1106	14E
F1107	47M
F1108	47H
F1110	46E
F1111	89M
F1113	23A

REF DESIG	LOCATION
F1114	7M, 28B
F1302	82H
F1401	76G
F1402	7L
F1403	7G
F1601	71G
F1602	72G
F1603	89F
F1604	91F
F1801	93F
F1802	74G
F1803	75G
F1901	80G
F6001	68I
F6002	6I
F6201A	60G
F6201B	60K
F6576	56K
F6577	56G
F6961	64I
F6962	64I
FL901	2C
FL902	2C
FL903	2D
FL906	2N
FL1401	8J
FL6101	68I
FL6942(1)	63F
FL6961	63I
J505(A)	54F
J505(B)	53F
J601(A)	63G
J601(B)	63K
J605(C)	54L
J605(T)	51L
J605(r)	48E
J605(w)	51F
J605(x)	49E
J901	5E
J1001	3E
J1102	17L
J1103	17H
J1104	16F
J3004	5F
J1601(A)	67G
J6101(B)	67K
J6208(A)	60F
J6208(B)	60L
K901	4C, 11F
K1001	10C,23K,35I
K1101	7C,12F,14F, 16D, 18M
K1102	14G
K1103	5B,14F,15G
K1301	44K, 84H
K1401	79I
K1601	28I, 28F
K1603	16L,27I,29G, 89H
K1604	31K, 89G
K1605	16J, 79L
K1606	23G
K1801	31H
K1802	25F,30H,32G
K1803	33G

REF DESIG	LOCATION
K1804	22F,29K,93H
K1805	25J
K1806	23G,26J,29I, 32F, 39F
K1902	23I,24F,38H
K1904	37H
M1101	45G
M1902	80H
R520	53I
R521	53F
R601	48H
R716	49I
R1906	37L
R1912	37I
R1917	23J
S502	54G
S601	51G
S605B	50I
S901	3F
S902A	20L
S902B	20L
S903A	19K
S903B	19K
S904	19H
S905A	53L
S905B	53K
S906	50E
S907	43G, 43H
S1001A	19J
S1001B	19J
S1002A	19J
S1002B	19I
S1003A	19G
S1003B	19G
S1004	19F
S1005	16I
S1006	11B
S1101	9E
S1102	6G, 6M
S1106	45E
S1107A	18J
S1107B	18H
S1107C	19F
S1108	47G
S1301	43I
S1302	19H
S1305	83I
S1601	16K
S1801	29J
S1802	24I
S1902	22J
S6005	69H
S6152	22K
S6203	60J
S6576	56H
S6963	65H
T501	54H
T502	54I
T701	52I
T702	51I
T1001	15B
T1101	47I
T1102	48I
T1370	86I

REF DESIG	LOCATION
T1371	87I
T1403	77I
T1501	76I
T1502	8I
T1601	70H, 90I
T1602	91I
T1603	71I
T1604	73I
T1801	93I
T1802	74I
T1803	75I
T1901	81H
T6275	60I
T6561	57I
T6576	59I
T6891	66H
TB104(7)	6F
TB501(1)	54G
TB501(2)	54J
TB601(2)	50H
TB601(3)	50J
TB701(2)	51H
TB701(3)	51J
TB901(8)	5N
TB901(9)	4N
TB901(10)	7E
TB901(12)	7E
TB902	2B
TB902(1)	67F
TB902(2)	5C
TB902(3)	63F
TB904(3)	6F, 6I
TB904(4)	5E
TB904(5)	6K
TB904(6)	5F
TB904(9)	3F
TB904(10)	3E
TB904(13)	89K
TB904(14)	73D
TB904(17)	48E
TB904(19)	48E
TB907(1)	11F
TB907(2)	10F, 19I
TB907(3)	13K
TB907(4)	18F
TB907(5)	43F
TB907(7)	19G
TB907(10)	19K
TB908	10B
TB908(3)	18G
TB908(5)	2E, 19F
TB908(6)	2F
TB908(8)	20L
TB908(9)	19H
TB908(11)	54L
TB908(12)	53K
TB908(13)	49E
TB908(16)	51E
TB908(17)	79H
TB908(19)	79J
TB909	9A
TB909(3)	13M
TB910	15A
TB1001	16B
TB1001(9)	4F
TB1001(10)	3D

REF DESIG	LOCATION
TB1002	2A
TB1002(1)	22K
TB1002(3)	86D
TB1002(7)	89K
TB1002(13)	63F
TB1002(14)	60F, 67F
TB1002(15)	57M
TB1002(16)	19G, 56F
TB1003(7)	35J
TB1003(11)	21M
TB1003(13)	35I
TB1003(15)	19G
TB1003(17)	19K
TB1003(18)	20G, 20J
TB1004(11)	23L
TB1005	21A
TB1104(1)	8C
TB1104(2)	8C
TB1104(3)	8D
TB1104(5)	12F
TB1104(6)	6K
TB1104(8)	8B
TB1101(4)	6N,29B,31N
TB1101(5)	15D
TB1101(6)	6D
TB1101(7)	6C
TB1101(8)	5C
TB1102(1)	31M
TB1102(5)	20F
TB1102(6)	18G, 19F
TB1102(7)	18I
TB1102(8)	19L
TB1102(9)	89L
TB1102(10)	17F
TB1102(11)	21D
TB1103(2)	32K
TB1103(4)	10G
TB1103(8)	12M
TB1104(9)	6B,10G,35H, 39E
TB1104(10)	5B
TB1104(11)	48E
TB1104(52)	79K
TB1105(7)	6H
TB1300(20)	19I
TB1301(1)	81J
TB1301(2)	44L
TB1301(4)	43H
TB1301(5)	85I
TB1301(6)	19H
TB1301(7)	19H
TB1302(1)	81E
TB1370(5)	87I
TB1370(6)	87I
TB1401(1)	76L
TB1401(2)	76F
TB1401(4)	7M
TB1401(5)	7F
TB1402(7)	79J
TB1402(8)	79H
TB1403(12)	77J
TB1403(14)	77H
TB1601(1)	70I
TB1601(2)	27F,29F,70I
TB1601(3)	17M,27M,31L
TB1601(4)	72F

REF DESIG	LOCATION
TB1601(5)	72L, 79M
TB1601(6)	90E
TB1601(7)	89J
TB1601(8)	16J
TB1601(9)	29G
TB1602(1)	79K
TB1602(4)	16K
TB1602(5)	85I
TB1602(6)	28J
TB1602(8)	28G
TB1602(10)	22G
TB1602(11)	22H
TB1801(1)	26G,31G,32F, 38F
TB1801(2)	25L,30L,32H, 32L
TB1801(3)	74F
TB1801(4)	74L
TB1801(5)	93E
TB1801(6)	93K
TB1801(10)	38G
TB1802(1)	22G
TB1802(4)	29G
TB1802(5)	25G, 25F
TB1901(2)	22J
TB1901(4)	22H
TB1901(5)	23F
TB1901(6)	24G
TB1901(9)	23M, 36M
TB1901(17)	38G
TB1902(1)	80F
TB1902(2)	80K
TB1902(3)	79H
TB1902(4)	35J
TB6576	56L
TB6576(1)	56F
TB6576(3)	58H
TB6961(2)	63L
TB6891(14)	65I
TB6891(15)	65I
TB8907(9)	20K

REF DESIG	LOCATION
B602	50H
B901	9A
B902	15A
B1001	22A
C1906	38I
C6580	57I
C6581	57I
DS502	53E
DS601	48I
DS901	44H
DS1001	16J
DS1002	21L
DS1004	21H
DS1101	45G
DS1102	15H
DS1103	5J
DS1105	26C
DS1301	84I
DS1303	44I
DS1305	83I
DS1401	78I
DS1402	8K
DS1403	8K
DS1501	53H
DS1601	28K
DS1603	27K
DS1604	28K
DS1605	17K
DS1801	32I
DS1802	92I
DS1803	29H
DS1901	35L
DS1902	23K
DS1903	22I
DS6501	57I
DS6963	67I
F501	54F
F502	54K
F601	51F
F602	51K
F901	6A
F902	8A
F903	7A
F905	12A
F906	14A
F907	13A
F1001	9C
F1002	10C
F1003	9D
F1004	3E
F1005	3F
F1006	20A
F1007	19A
F1008	18A
F1101	10E
F1102	31N
F1103	6G
F1104	6L
F1106	14E
F1107	47M
F1108	47H
F1110	46E
F1111	89M
F1113	23A
F1114	7M, 28B
F1302	82H
F1401	76G
F1402	7L
F1403	7G
F1601	71G
F1602	72G
F1603	89F
F1604	91F
F1801	93F
F1802	74G
F1803	75G
F1901	80G
F6001	68I
F6002	6I
F6201A	60G
F6201B	60K
F6576	56K
F6577	56G
F6961	64I
F6962	64I
FL901	2C
FL902	2C
FL903	2D
FL906	2N
FL1401	8J
FL6101	68I
FL6942(1)	63F
FL6961	63I
J505(A)	54F
J505(B)	53F
J601(A)	63G
J601(B)	63K
J805(C)	54L
J805(T)	51L
J605(r)	48E
J605(w)	51F
J605(x)	49E
J901	5E
J1001	3E
J1102	17L
J1103	17H
J1104	16F
J3004	5F
J1601(A)	67G
J6101(B)	67K
J6208(A)	60F
J6208(B)	60L
K901	4C, 11F
K1001	10C,23K,35I
K1101	7C,12F,14F, 16D, 18M
K1102	14G
K1103	5B,14F,15G
K1301	44K, 84H
K1401	79I
K1601	28I, 28F
K1603	16L,27I,29G, 89H
K1604	31K, 89G
K1605	16J, 79L
K1606	23G
K1801	31H
K1802	25F,30H,32G
K1803	33G
K1804	22F,29K,93H
K1805	25J
K1806	23G,26J,29I, 32F, 39F
K1902	23I,24F,38H
K1904	37H
M1101	45G
M1902	80H
R520	53I
R521	53F
R601	48H
R716	49I
R1906	37L
R1912	37I
R1917	23J
S502	54G
S601	51G
S605B	50I
S901	3F
S902A	20L
S902B	20L
S903A	19K
S903B	19K
S904	19H
S905A	53L
S905B	53K
S906	50E
S907	43G, 43H
S1001A	19J
S1001B	19J
S1002A	19J
S1002B	19I
S1003A	19G
S1003B	19G
S1004	19F
S1005	16I
S1006	11B
S1101	9E
S1102	6G, 6M
S1106	45E
S1107A	18J
S1107B	18H
S1107C	19F
S1108	47G
S1301	43I
S1302	19H
S1305	83I
S1601	16K
S1801	29J
S1802	24I
S1902	22J
S6005	69H
S6152	22K
S6203	60J
S6576	56H
S6963	65H
T501	54H
T502	54I
T701	52I
T702	51I
T1001	15B
T1101	47I
T1102	48I
T1370	86I
T1371	87I
T1403	77I
T1501	76I
T1502	8I
T1601	70H, 90I
T1602	91I
T1603	71I
T1604	73I
T1801	93I
T1802	74I
T1803	75I
T1901	81H
T6275	60I
T6561	57I
T6576	59I
T6891	66H
TB104(7)	6F
TB501(1)	54G
TB501(2)	54J
TB601(2)	50H
TB601(3)	50J
TB701(2)	51H
TB701(3)	51J
TB901(8)	5N
TB901(9)	4N
TB901(10)	7E
TB901(12)	7E
TB902	2B
TB902(1)	67F
TB902(2)	5C
TB902(3)	63F
TB904(3)	6F, 6I
TB904(4)	5E
TB904(5)	6K
TB904(6)	5F
TB904(9)	3F
TB904(10)	3E
TB904(13)	89K
TB904(14)	73D
TB904(17)	48E
TB904(19)	48E
TB907(1)	11F
TB907(2)	10F, 19I
TB907(3)	13K
TB907(4)	18F
TB907(5)	43F
TB907(7)	19G
TB907(10)	19K
TB908	10B
TB908(3)	18G
TB908(5)	2E, 19F
TB908(6)	2F
TB908(8)	20L
TB908(9)	19H
TB908(11)	54L
TB908(12)	53K
TB908(13)	49E
TB908(16)	51E
TB908(17)	79H
TB908(19)	79J
TB909	9A
TB909(3)	13M
TB910	15A
TB1001	16B
TB1001(9)	4F
TB1001(10)	3D
TB1002	2A
TB1002(1)	22K
TB1002(3)	86D
TB1002(7)	89K
TB1002(13)	63F
TB1002(14)	60F, 67F
TB1002(15)	57M
TB1002(16)	19G, 56F
TB1003(7)	35J
TB1003(11)	21M
TB1003(13)	35I
TB1003(15)	19G
TB1003(17)	19K
TB1003(18)	20G, 20J
TB1004(11)	23L
TB1005	21A
TB1104(1)	8C
TB1104(2)	8C
TB1104(3)	8D
TB1104(5)	12F
TB1104(6)	6K
TB1104(8)	8B
TB1101(4)	6N,29B,31N
TB1101(5)	15D
TB1101(6)	6D
TB1101(7)	6C
TB1101(8)	5C
TB1102(1)	31M
TB1102(5)	20F
TB1102(6)	18G, 19F
TB1102(7)	18I
TB1102(8)	19L
TB1102(9)	89L
TB1102(10)	17F
TB1102(11)	21D
TB1103(2)	32K
TB1103(4)	10G
TB1103(8)	12M
TB1104(9)	6B,10G,35H, 39E
TB1104(10)	5B
TB1104(11)	48E
TB1104(52)	79K
TB1105(7)	6H
TB1300(20)	19I
TB1301(1)	81J
TB1301(2)	44L
TB1301(4)	43H
TB1301(5)	85I
TB1301(6)	19H
TB1301(7)	19H
TB1302(1)	81E
TB1370(5)	87I
TB1370(6)	87I
TB1401(1)	78L
TB1401(2)	76F
TB1401(4)	7M
TB1401(5)	7F
TB1402(7)	79J
TB1402(8)	79H
TB1403(12)	77J
TB1403(14)	77H
TB1601(1)	70I
TB1601(2)	27F,29F,70I
TB1601(3)	17M,27M,31L
TB1601(4)	72F
TB1601(5)	72L, 79M
TB1601(6)	90E
TB1601(7)	89J
TB1601(8)	16J
TB1601(9)	29G
TB1602(1)	79K
TB1602(4)	16K
TB1602(5)	85I
TB1602(6)	28J
TB1602(8)	28G
TB1602(10)	22G
TB1602(11)	22H
TB1801(1)	26G,31G,32F, 38F
TB1801(2)	25L,30L,32H, 32L
TB1801(3)	74F
TB1801(4)	74L
TB1801(5)	93E
TB1801(6)	93K
TB1801(10)	38G
TB1802(1)	22G
TB1802(4)	29G
TB1802(5)	25G, 25F
TB1901(2)	22J
TB1901(4)	22H
TB1901(5)	23F
TB1901(6)	24G
TB1901(9)	23M, 36M
TB1901(17)	38G
TB1902(1)	80F
TB1902(2)	80K
TB1902(3)	79H
TB1902(4)	35J
TB6576	56L
TB6576(1)	56F
TB6576(3)	58H
TB6961(2)	63L
TB6891(14)	65I
TB6891(15)	65I
TB8907(9)	20K

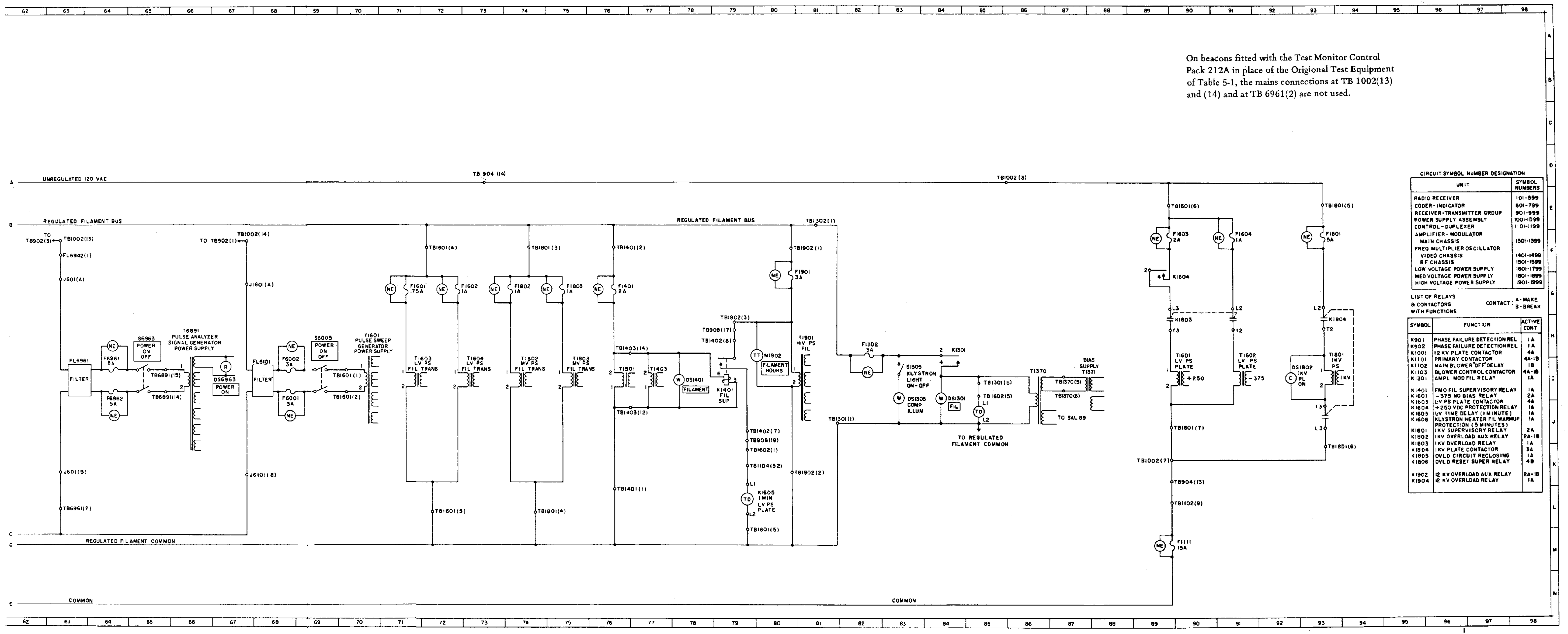
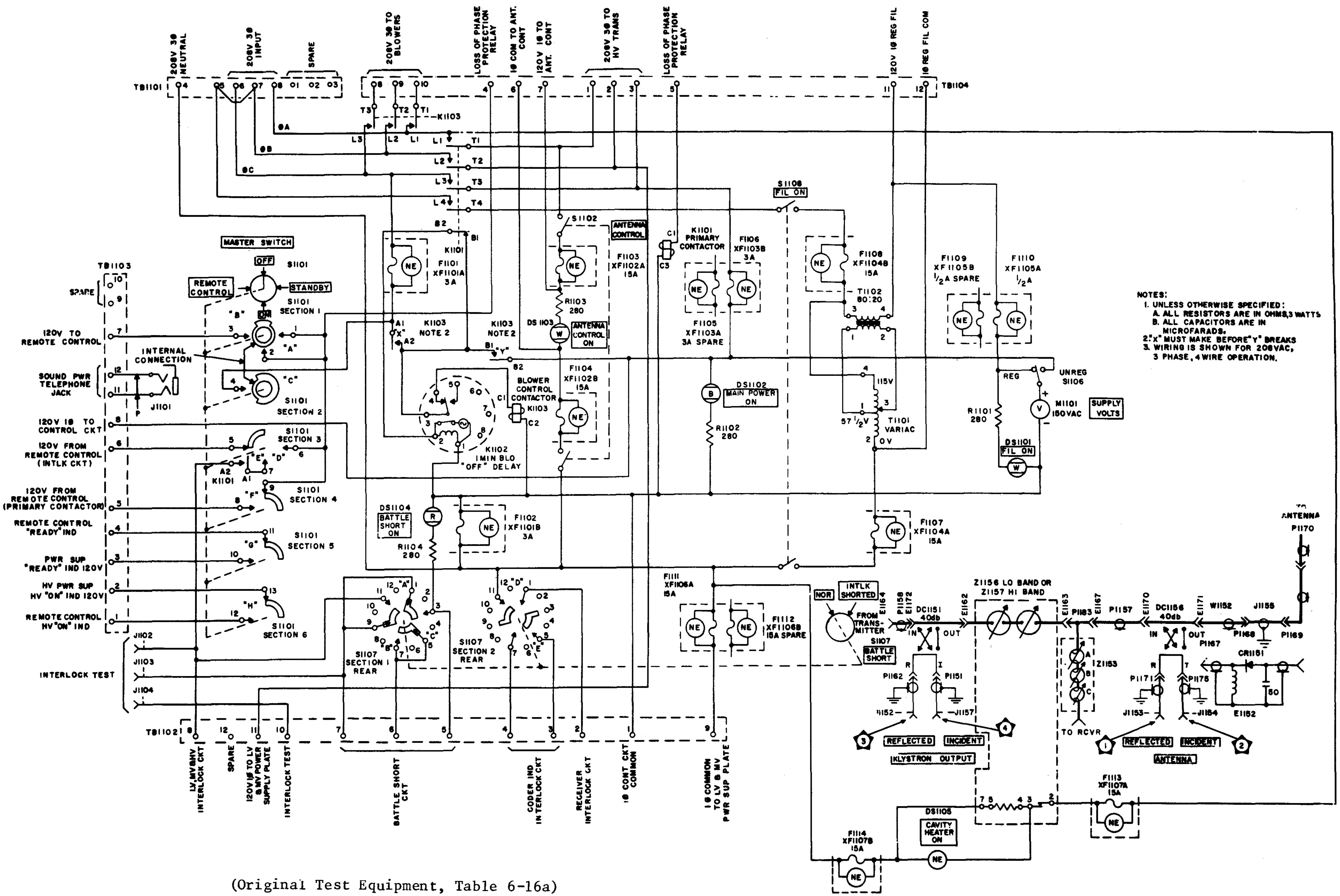


Figure 6-15. Radio Set AN/GRN-9D, Primary Power Distribution, Schematic Diagram (Sheet 3 of 3)



(Original Test Equipment, Table 6-16a)

Figure 6-16. Control Duplexer C-2226A/GRN-9, Schematic Diagram

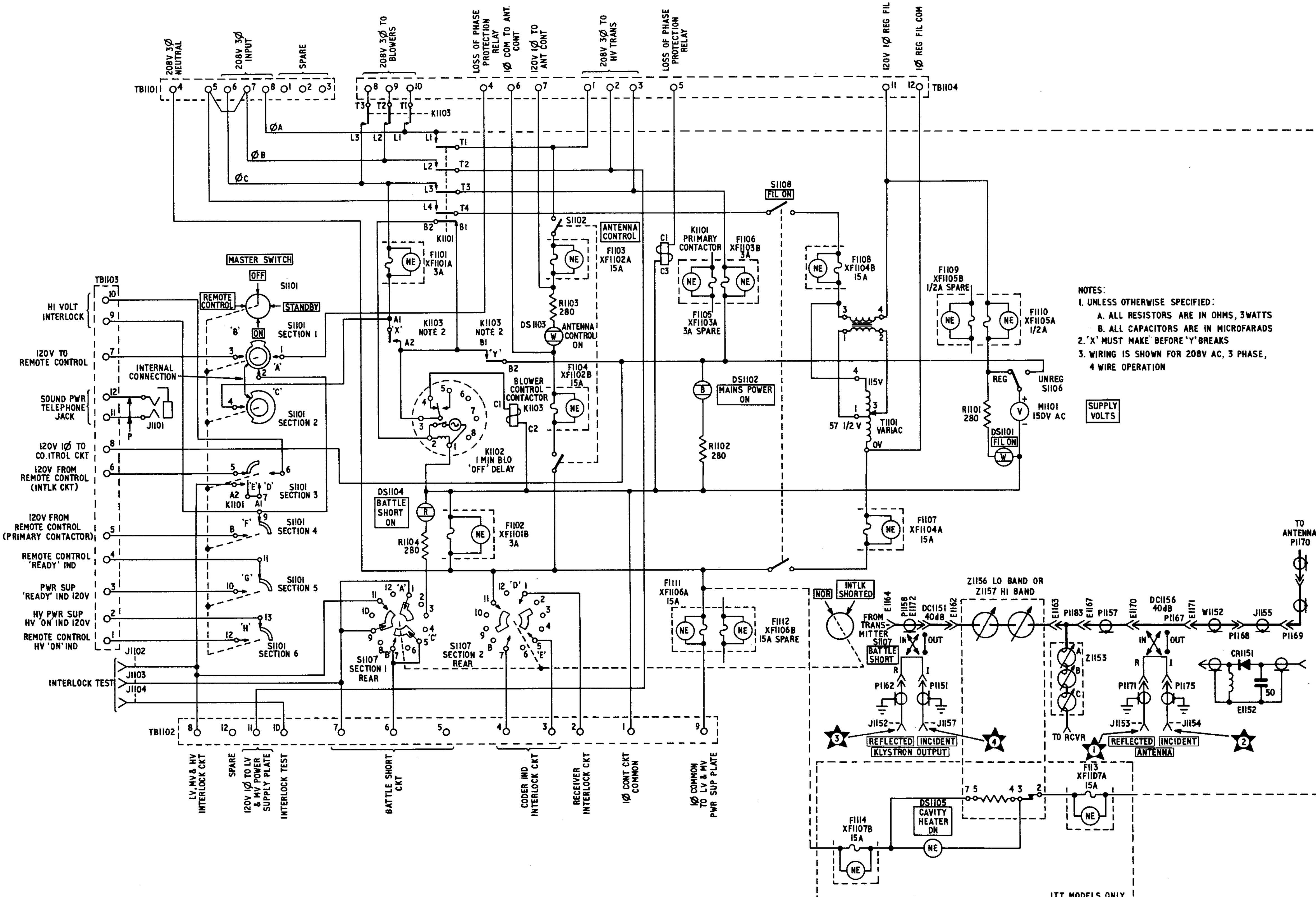
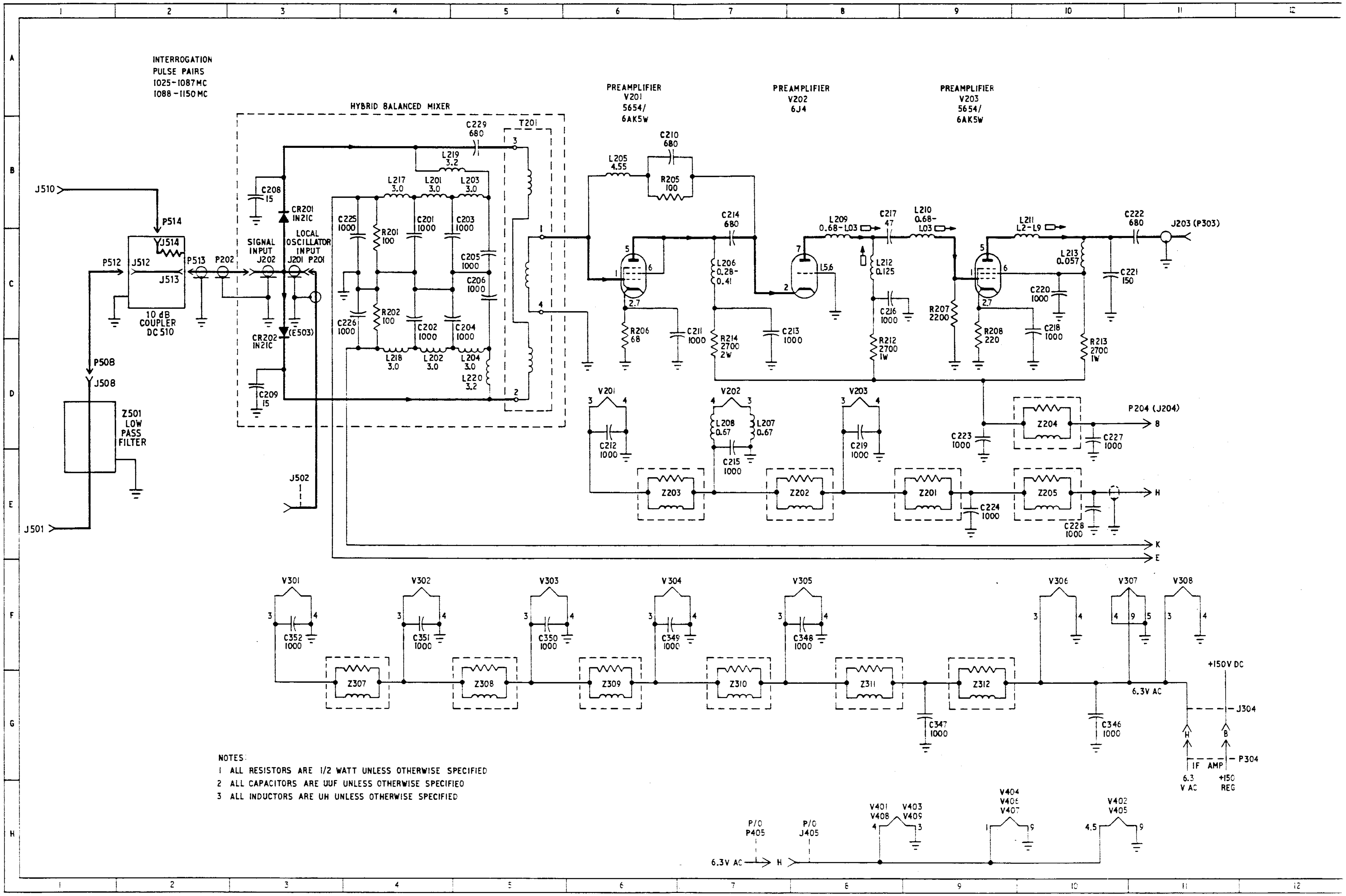


Figure 6-16a. Control Duplexer C-2226A/GRN-9, Schematic Diagram (Replacement Test Equipment, Table 5-1a)



NOTES:
1 ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED
2 ALL CAPACITORS ARE UUF UNLESS OTHERWISE SPECIFIED
3 ALL INDUCTORS ARE UH UNLESS OTHERWISE SPECIFIED

Figure 6-17. Radio Receiver R-824/URN.
Schematic Diagram (Sheet 1 of 2)

REF DESIG	LOCATION
C201	4B
C202	4C
C203	5B
C204 thru C206	5C
C208	3B
C209	3D
C210	6B
C211	7C
C212	6D
C213	7C
C214	7B
C215	7D
C216	8C
C217	8B
C218	10C
C219	8D
C220	10C
C221	10C
C222	11C
C223	9D
C224	9E
C225	4B
C226	4C
C227	10D
C228	10E
C229	5B
C301	13C
C302	14D
C303	27E
C304	13C
C305	15C
C306	16D
C307	17C
C308	16D
C309	15C
C310	15C
C312	15B
C313	16B
C315	17C
C316	17C
C318	18D
C319	18C
C320	18D
C321	19C
C323	18B
C324	20B
C326	20C
C327	20C
C328	20D
C329	21C
C331	22B
C332	22B
C333	21C
C334	23C
C335	23C
C336	23B
C337	24C
C338	24C
C339	25C
C340	25C
C341	26B
C343	27B
C344	27B

REF DESIG	LOCATION
C345	28B
C346	10G
C347	9G
C348	8F
C349	7F
C350	5F
C351	4F
C352	3F
C353	20C
C354	21B
C355	15B
C356	17B
C357	19B
C358	20B
C359	22B
C360	28C
C361	27C
C362	26B
C363	25D
C401	29C
C402	30C
C403	31C
C404	32C
C405A	32D
C405B	31B
C405C	33G
C406	33C
C407	33C
C408	34C
C409	34D
C410	33H
C411	35C
C412	35C
C414	31G
C415	32G
C416	31F
C417	28E
C418	29F
C419	28F
C420	29G
C421	29F
C427	32B
C428	30C
C501	23E
C502	25E
C503	25G
C504	22G
C505	22G
C506	23F
CR201	3B
CR202	3C
CR401	29D
CR402	30D
CR403	30D
CR404	31D
CR405	31C
DC510	2C
DL401	31C
DS501	18F
DS502	17F
E345	28E
E346	13C
E435	28C
(E503)	3C
F501	18F
F502	18E
F503	18H

REF DESIG	LOCATION
J201	3C
J202	3C
J203(P303)	11B
J204(P204)	13D
J301	28D
J304	10G
J305	21D
J306	24C
J307	25B
J402	28C
J403	35C
J404	35C
J405	27G
J406	30D
J407	35B
J408	28H
J409	28B
J410	35C
J411	35B
J412	34B
J413	29C
J501	2C
J502	3E
J503	35C
J504	35C
J505	17E
J506	31D
J507	35B
J508	2C
L201	4B
L202	4C
L203	5B
L204	5D
L205	6B
L206	7C
L207	7D
L208	7D
L209	8B
L210	9B
L211	10B
L212	8C
L213	10C
L217	4B
L218	4C
L219	5B
L220	5D
L301	14C
L302	14C
L303	15C
L304	17C
L305	19C
L306	20C
L308	22C
L309	23C
L310	18C
L311	24C
L312	23D
L313	15B
L501	23E
M501	14G
P201	3C
P202	2C
P204(J204)	11D
P302	28C

REF DESIG	LOCATION
P303(J203)	13C
P304	10G
P401	28D
P403	35C
P404	35C
P405	27G
P406	30D
P407	35B
P508	2C
R201	4B
R202	4C
R205	6B
R206	6B
R207	9C
R208	9C
R212	8D
R213	10D
R214	7C
R301	14C
R302	14D
R304	15D
R305	15C
R306	14B
R307	14B
R308	16B
R309	16B
R310	16C
R312	18C
R313	18B
R314	18B
R315	19D
R316	19C
R317	19B
R318	19B
R319	20D
R320	21D
R321	21C
R322	21B
R325	25C
R326	25C
R327	25B
R328	26B
R329	26D
R330	24C
R331	27C
R332	27C
R334	14C
R335	16C
R336	17C
R337	19C
R338	20C
R339	21B
R341	27B
R342	26C
R343	25C
R401	29C
R402	29B
R403	30B
R404	30B
R405	29C
R406	29C
R407	30D
R408	30C
R409	31B
R410	31C

REF DESIG	LOCATION
R411	32D
R412	32B
R413	32C
R414	32C
R415	33C
R416	33B
R417	33B
R418	33D
R419	33D
R420	34B
R421	34D
R422	34D
R423	34D
R424	35D
R425	29D
R426	34G
R427	32H
R429	32G
R430	33G
R431	32H
R432	31G
R433	32G
R434	28F
R436	29G
R437	29G
R438	30F
R439	29F
R440	29F
R441	29G
R442	28G
R443	28G
R444	30G
R445	30F
R447	32H
R446	30G
R448	34B
R449	34B
R450	33C
R451	29G
R452	30D
R453	35B
R454	34B
R455	29D
R456	31D
R457	31D
R458	33B
R459	33C
R501	24E
R502	24F
R503	24E
R504	24F
R505	25E
R506	26E
R507	26F
R508	26F
R509	23F
R510	22G
R511	23G
R512	23G
R513	23G
R515	16F
R516	16G
R517	14G
R518	25G
R519	24G
R520	18F
R521	17E
S501	15F

REF DESIG	LOCATION
S502	18E
T201	5B
T401	32G
T501	21E
T502	21F
TB501	19E
TP1	21D
TP2	24C
TP3	25B
TP4	28H
TP5	28B
TP6	35C
TP7	35B
TP8	34B
TP9	29C
V201	6C
V202	8C
V203	9C
V301	14C
V302	16C
V303	18C
V304	19C
V305	21C
V306	24B, 24D
V307	26B, 27B
V308	26D 27D
V401	30C
V402-1	29C
V402-2	31C
V403	32C
V404	33C
V405	34C
V406	29G
V407-1	33G
V407-2	30G
V408	31G
V409A	34G
V409B	33G
V501	21F
V502	21H
V503	24E
V504	25F
V505	26H
V506	24H
XF501A	18E
XF501B	18G
XF503	18G
Z201	9E
Z202	8E
Z203	6E
Z204	10D
Z205	10E
Z301	15B
Z302	17B
Z303	19B
Z304	20B
Z305	22B
Z306	24B
Z307	4F
Z308	5F
Z309	6F
Z310	7F
Z311	8F
Z312	9F
Z501	1D

REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION
C201	3C	P303 (J203)	13C	R411	32D	S502	18E
C202	3C	P304	10G	R412	32B	T201	5B
C203	11B	P401	28D	R413	32C	T401	32G
C204 thru	13D	P403	35C	R414	32C	T501	21E
C206	28D	P404	35C	R415	33C	T502	21F
C208	10G	P405	27G	R416	33B	TB501	19E
C209	21D	P406	30D	R417	33B	TP1	21D
C210	24C	P407	35B	R418	33D	TP2	24C
C211	25B	P508	2C	R419	33D	TP3	25B
C212	28C	R201	4B	R420	34B	TP4	28H
C213	35C	R202	4C	R421	34D	TP5	28B
C214	35C	R205	6B	R422	34D	TP6	35C
C215	27G	R206	6B	R423	34D	TP7	35B
C216	30D	R207	9C	R424	35D	TP8	34B
C217	35B	R208	9C	R425	29D	TP9	29C
C218	28H	R212	8D	R426	34G	V201	6C
C219	28B	R213	10D	R427	32H	V202	8C
C220	35C	R214	7C	R429	32G	V203	9C
C221	35B	R301	14C	R430	33G	V301	14C
C222	34B	R302	14D	R431	32H	V302	16C
C223	29C	R304	15D	R433	32G	V303	18C
C224	2C	R305	15C	R434	31G	V304	19C
C225	3E	R306	14B	R434	28F	V305	21C
C226	35C	R307	14B	R436	29G	V306	24B, 24D
C227	35C	R308	16B	R437	29G	V307	26B, 27B
C228	17E	R309	16B	R438	30F	V308	26D, 27D
C229	31D	R310	16C	R439	29F	V401	30C
C301	35B	R312	18C	R440	[illegible]	V402-1	29C
C302	2C	R313	18B	R441	[illegible]	V402-2	31C
C303	4B	R314	18B	R442	[illegible]	V403	32C
C304	4C	R315	19D	R443	[illegible]	V404	33C
C305	5B	R316	19C	R444	[illegible]G	V405	34C
C306	5D	R317	19B	R445	[illegible]F	V406	29G
C307	6B	R318	19B	R447	32H	V407-1	33G
C308	7C	R319	20D	R446	30G	V407-2	30G
C309	7D	R320	21D	R448	34B	V408	31G
C310	7D	R322	21B	R449	34B	V409A	34G
C312	8B	R325	25C	R451	29G	V409B	33G
C313	9B	R326	25C	R452	30D	V501	21F
C315	10B	R327	25B	R453	35B	V502	21H
C316	8C	R328	26B	R454	34B	V503	24E
C318	10C	R329	26D	R455	29D	V504	25F
C319	4B	R330	24C	R456	31D	V505	26H
C320	4C	R331	27C	R457	31D	V506	24H
C321	5B	R332	27C	R458	33B	XF501A	18E
C323	5D	R334	14C	R459	33C	XF501B	18G
C324	14C	R335	16C	R501	24E	XF503	18G
C326	14C	R336	17C	R502	24F	Z201	9E
C327	15C	R337	19C	R503	24E	Z202	8E
C328	17C	R338	20C	R504	24F	Z203	6E
C329	19C	R339	21B	R505	25E	Z204	10D
C331	20C	R341	27B	R506	26E	Z205	10E
C332	22C	R342	26C	R507	26F	Z301	15B
C333	23C	R343	25C	R508	26F	Z302	17B
C334	18C	R401	29C	R510	22G	Z303	19B
C335	24C	R402	29B	R511	23G	Z304	20B
C336	23D	R403	30B	R512	23G	Z305	22B
C337	15B	R404	30B	R513	23G	Z306	24B
C338	23E	R405	29C	R515	16F	Z307	4F
C339	14G	R406	29C	R516	16G	Z308	5F
C340	3C	R407	30D	R517	14G	Z309	6F
C341	2C	R408	30C	R518	25G	Z310	7F
C343	11D	R409	31B	R521	17E	Z311	8F
C344	28C	R410	31C	R580	18F	Z312	9F
				S501	15F	Z501	2B

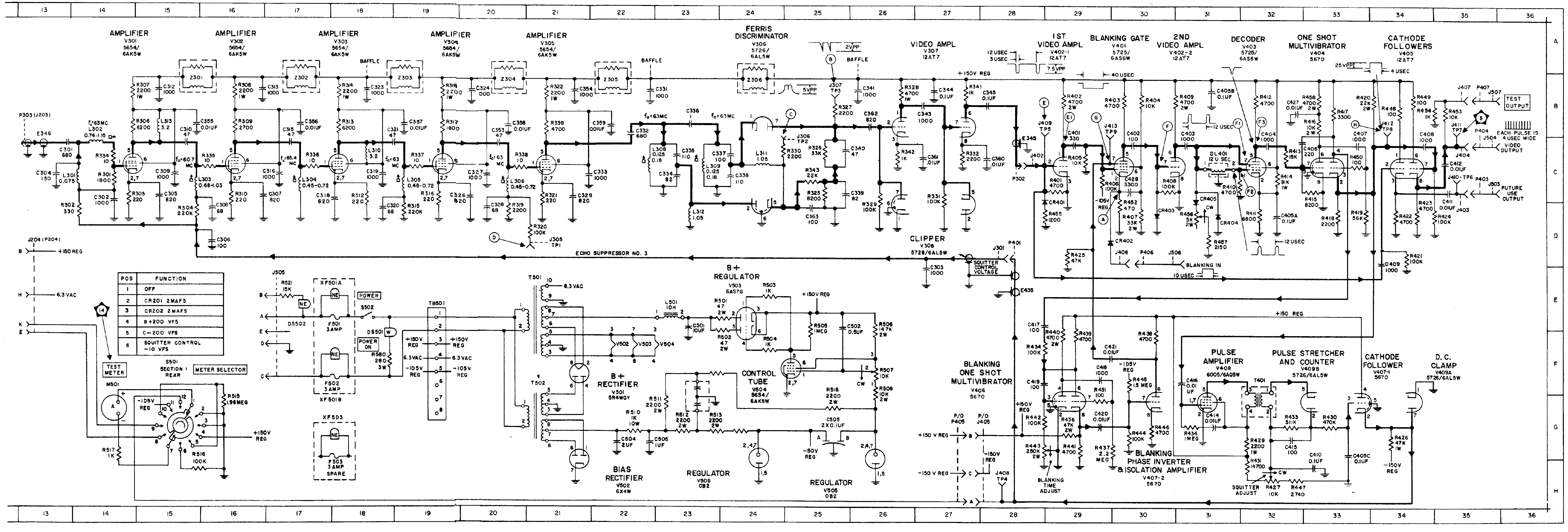


Figure 6-17. Radio Receiver R-824/URN, Schematic Diagram (Sheet 2 of 2)

REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION
C1402	3D	E1423	7C	R1401	5G	R1463	3G
C1404	6C	E1424	8C	R1402	5G	R1464	4H
C1405	10D	E1425	9G	R1403	5C	R1465	4G
C1406	12D	E1426	17D	R1405	3E	R1466	5C
C1407	3D	E1427	12D	R1406	3C	R1467	15D
C1408	14D	E1428	19C	R1407	4D	R1468	5C
C1410	15D	FL1401	25F	R1408	6D	R1469	4D
C1411	16C	F1401	26E	R1409	9E	R1470	15D
C1412	18D	F1402	26F	R1410	6D	R1471	16D
C1413	3H	F1403	26F	R1411	7C	R1472	16C
C1414	6G	F1404	26E	R1412	8C	R1473	18C
C1415	7H	J1401 (P917)	2D	R1413	8D	R1474	8I
C1416	4G	J1402 (P918)	20D	R1414	9D	R1528	22F
C1417	14D	J1403 (P919)	8H	R1415	10C	R1530	22F
C1418	6E	J1404	2E	R1416	11C	R1532	22G
C1419	5G	J1405	21G	R1417	14D	R1533	15F
C1420	6F	J1407 (P920)	12I	R1418	14D	R1534	16F
C1421	4C	J1408	9I	R1419	4C	S1401	11E, 11F
C1423	4D	J1409	9I	R1420	15C	S1402	14F, 14H
C1424	16D	J1410 (P924)	13I	R1421	17D	TB1401	27F
C1567	16F	J1509	26B	R1422	17D	TB1402	26D, 26C
C1568	20C	J1510	26B	R1423	18C	TB1402(1)	20I
C1569	20C	K1401	23G	R1424	18D	TB1403	3E,20H,24G
C1570	21D	L1401	12D	R1425	17E	TB1403(7)	20D
C1571	21C	L1402	13C	R1426	18E	TB1403(3)	20D
C1572	21D	L1403	14C	R1427	3I	T1402	10C
C1573	21C	L1542	21H	R1428	3G	T1403	23H
C1574	21D	L1543	20C	R1429	5I	T1404	6F
C1575	22C	L1544	20C	R1430	5H	T1501	23E
C1576	22D	L1545	20C	R1431	4G	T1502	26F
C1577	22C	L1546	21C	R1432	6I	T1503	24D
C1578	22D	L1547	21C	R1435	6H	V1401	5H
C1579	23C	L1548	21C	R1436	6I	V1402	3D, 5D
C1580	24C	L1549	21C	R1440	7H	V1403	7D
C1581	24C	L1550	22C	R1441	14I	V1404	8D
C1582	25C	L1551	22C	R1442	14I	V1405	9D
C1583	25C	L1552	22C	R1443	14G	V1406	12D
C1584	25C	L1553	22C	R1444	2I	V1407	17D
C1585	20H	L1554	22C	R1445	15H	V1408	3H, 4H
CR1401	3G	L1555	24C	R1446	5C	V1409	7H
CR1402	3D	L1556	24C	R1448	17G	V1410	18G
CR1403	10G	L1557	25C	R1449	17G	V1411	19D
CR1404	10G	L1558	25C	R1450	18G	W1403	12H
DC1401	11G	L1559	25C	R1451	18G	XF1401A	26F
DL1401	2F	M1401	10F	R1452	17H	XF1401B	26F
DL1402	2HG	M1402	13G	R1453	24E	XF1402A	26E
DS1401	23F	P1401 (J1503) (J1506)	12I	R1454	25C	XF1402B	26E
DS1402	25D	P1402	12G	R1455	25C	Z1401	7C
DS1403	25D	P1403	12H	R1456	10F	Z1402	8C
E1401	9G	P1404	9G	R1457	6F	Z1403	9C
E1402	9H	P1405	9H	R1458	7I	Z1404	17C
E1412	10G	P1406 (J1502) (J1505)	13G	R1459	7F	Z1405	19C
E1413	10G	P1503 (J1507) (J1508)	21H	R1460	6F		
E1421	15H	P1504	26B	R1461	4H		
E1422	15H	R443	6H	R1462	4H		

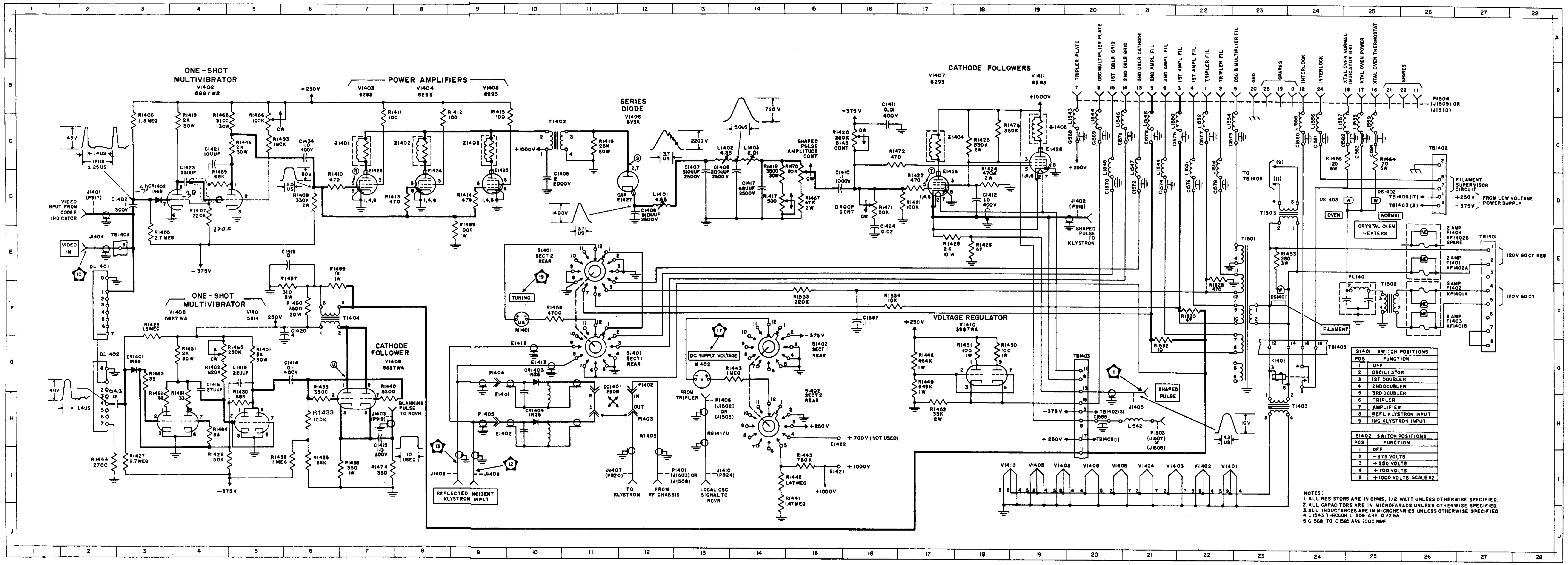


Figure 6-18. Frequency Multiplier-Oscillator CV-1171/GRN-9D Video Chassis, Schematic Diagram

d 940093/4306823/25x150/N.B. 1921/5 6/74.

REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION
C1501	1C	C1542	7K	L1507	6B	R1518	2G
C1502	4B	C1543	7J	L1508	5C	R1519	1J
C1503	1B	C1544	8J	L1509	6C	R1520	3J
C1504	3C	C1545	8J	L1510	7C	R1521	3I
C1505	3C	C1546	9E	L1511	7D	R1522	4I
C1506	2D	C1547	9D	L1512	1H	R1523	5I
C1507	2E	C1548	11E	L1513	2H	R1524	6I
C1508	1E	C1549	11D	L1514	2H	R1535	3I
C1509	3E	C1550	12E	L1515	2I	R1536	4I
C1510	4E	C1551	13D	L1516	5G	R1537	6J
C1511	4E	C1552	9J	L1517	6G	V1501	2C
C1512	4D	C1553	9J	L1518	5H	V1502	5C
C1513	5D	C1554	11J	L1519	6H	V1503	7C
C1514	5B	C1555	11I	L1520	7H	V1504	9C
C1515	6D	C1556	13J	L1521	6I	V1505	11C
C1516	6D	C1557	13I	L1522	6E	V1506	13C
C1517	7B	C1558	8C	L1523	7E	V1507	2H
C1518	7C	C1560	1J	L1524	8E	V1508	5H
C1519	8C	C1561	2J	L1525	7J	V1509	7H
C1520	7D	C1562	3J	L1526	8J	V1510	9H
C1521	6E	C1563	4J	L1527	8J	V1511	11H
C1522	9D	C1564	4J	L1528	4E	V1512	13H
C1523	1G	C1565	6J	L1529	6E	Y1501	1D
C1524	4G	C1566	1H	L1530	4E	Y1502	2I
C1525	3H	E1510	8C	L1535	4J	Z1501	9B
C1526	3H	E1511	8C	L1536	4J	Z1502	11B
C1527	2I	E1512	8H	L1537	6J	Z1503	13B
C1528	5I	E1513	8I	L1538	11B	Z1504	9H
C1529	5I	J1502 (P1406)	10B	L1539	12B	Z1505	11H
C1530	6I	J1503 (P1401)	13C	L1540	11G	Z1506	13H
C1531	5H	J1505 (P1406)	10H	L1541	12G	Z1507	8C
C1532	6I	J1506 (P1401)	13H	R1501	2B	Z1508	8H
C1533	7G	J1507 (P1503)	12B	R1502	1D	Z1509	12B
C1534	7H	J1508 (P1503)	12G	R1503	3D	Z1510	12G
C1535	7I	J1509 (P1504)	13F	R1504	3C	Z1511	9D
C1536	8H	J1510 (P1504)	13K	R1505	3D	Z1512	9D
C1537	9I	L1501	1C	R1507	4C	Z1513	9I
C1538	7F	L1502	2B	R1508	4D	Z1514	9I
C1539	7E, 8H	L1503	2B	R1510	5D	Z1515	2J
C1540	8E	L1504	2D	R1511	6D	Z1516	2D
C1541	8E	L1506	5B	R1513	6E		

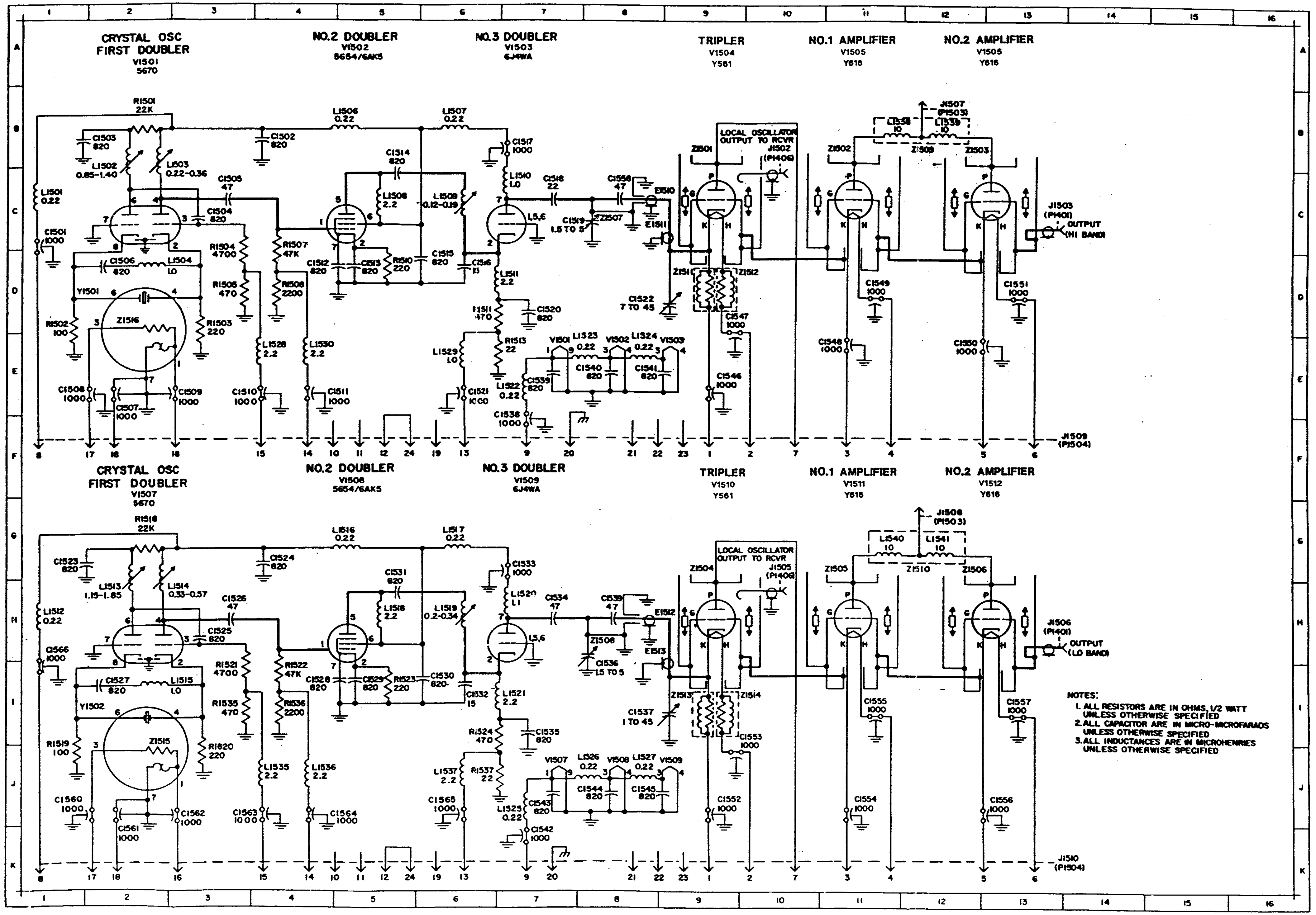
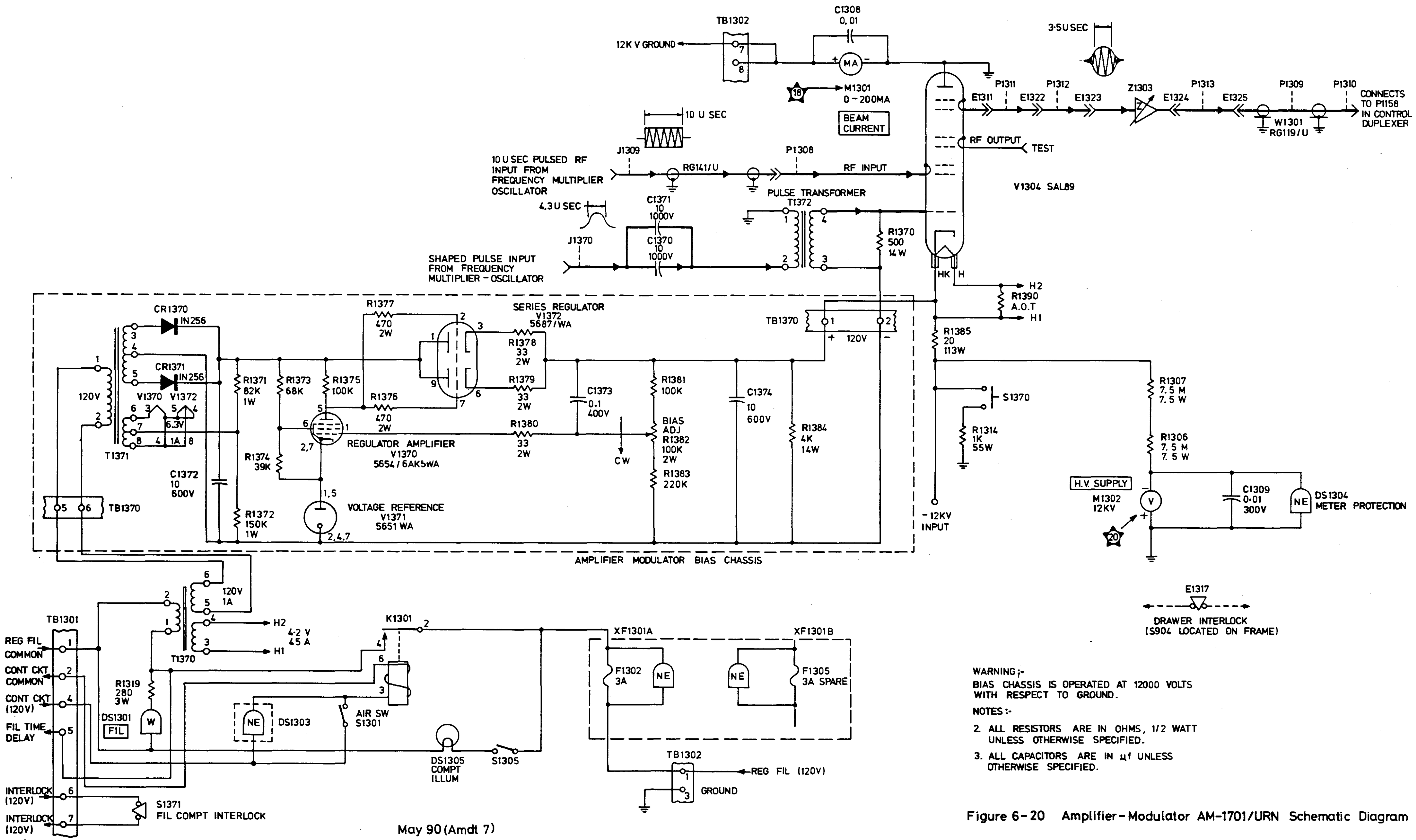


Figure 6-19. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Low or High Band R-F Chassis, Schematic Diagram



WARNING ;-
BIAS CHASSIS IS OPERATED AT 12000 VOLTS WITH RESPECT TO GROUND.

NOTES :-

2. ALL RESISTORS ARE IN OHMS, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS ARE IN μf UNLESS OTHERWISE SPECIFIED.

Figure 6-20 Amplifier-Modulator AM-1701/URN Schematic Diagram

REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION	REF DESIG	LOCATION
C604	22G	CR605	8D	R638	17B	R693	12I
C605	3C	CR606	4C	R639	18E	R694	13I
C606	5C	DL601	16D	R640	19B	R695	14G
C607	6C	E691	22H	R641	19B	R696	15G
C608	8C	E692	13I	R642	20B	R697	15G
C609	7D	E693	24H	R643	19E	R698	15I
C610	10D	E694	7I	R644	19E	R699	15I
C611	11D	E696	2G	R645	20E	R785	21D
C612	12D	E697	12C	R646	21E	R786	11I
C613	13C	E698	6D	R647	21E	R787	19E
C614	15E	E699	2C	R648	21D	R788	23H
C615	13F	J601 (P908)	24I	R649	22E	R789	16E
C616	14F	J602 (P907)	24E	R650	22E	R790	9H
C617	18D	J603 (P906)	2G	R651	22I	R791	8D
C618	19D	J604 (P905)	2C	R652	3I	R792	7J
C619	20D	J609	2I	R653	3K	R793	18I
C620	9B	J610	24F	R654	5I	R794	18G
C621	19C	L601	7D	R655	4J	R795	17H
C622	3J	L602	7H	R656	4K	R796	17I
C623	5J	L603	11G	R657	2H	R797	17I
C624	4G	L604	15E	R658	3G	R798	16I
C625	5G	R603	2D	R659	3G	R799	16G
C626	8H	R604	2C	R660	4H	S603	24I
C627	8G	R605	3B	R661	4G	TB604	25B
C628	12F	R606	4B	R662	5G	TP1	2C
C629	13C	R607	4D	R663	6G	TP2	2G
C630	11D	R608	4B	R664	6G	TP3	6D
C631	9E	R609	5B	R665	6H	TP4	12C
C632	19G	R610	6B	R666	8G	TP6	7I
C633	19J	R611	6D	R667	7H	TP7	24H
C634	20J	R612	7D	R668	8G	TP8	22H
C635	22I	R613	7B	R669	9G	TP9	13I
C636	22H	R614	8C	R671	13D	T602	14B
C637	24J	R615	8B	R672	13E	T603	15D
C638	23I	R616	9E	R673	13E	V601A	3G
C639	11G	R619	9C	R674	11E	V601B	3C
C640	8J	R620	10B	R675	11E	V602	4C, 6C
C641	13H	R621	10E	R676	11E	V603	7C, 8C
C642	14H	R622	10B	R677	19H	V604A	9D
C643	16H	R623	11C	R678	19I	V604B	23I
C644	17H	R624	11B	R679	20I	V605	10D, 12D
C645	16G	R625	11E	R680	21G	V606	14D
C646	17E	R626	13E	R681	21I	V607A	17D
C647	7H	R627	13C	R682	21I	V607B	22D
C648	20F	R628	13B	R683	22I	V608	3J, 5J
C649	8D	R629	14C	R684	23J	V609	5G, 6G
C650	8H	R630	13D	R685	23I	V610A	7G
C651	11H	R631	14E	R686	23J	V610B	9G
C652	10G	R632	14F	R687	24I	V611	20I
C653	10G	R633	15F	R688	9I	V612	10H, 12H
CR601	16D	R634	13F	R689	10I	V613A	14H
CR602	17D	R635	17E	R690	10H	V613B	18H
CR603	18J	R636	17E	R691	13H	V614	15H, 16H
CR604	8E	R637	18E	R692	12I	V615	19D, 20D
						Y601	2J

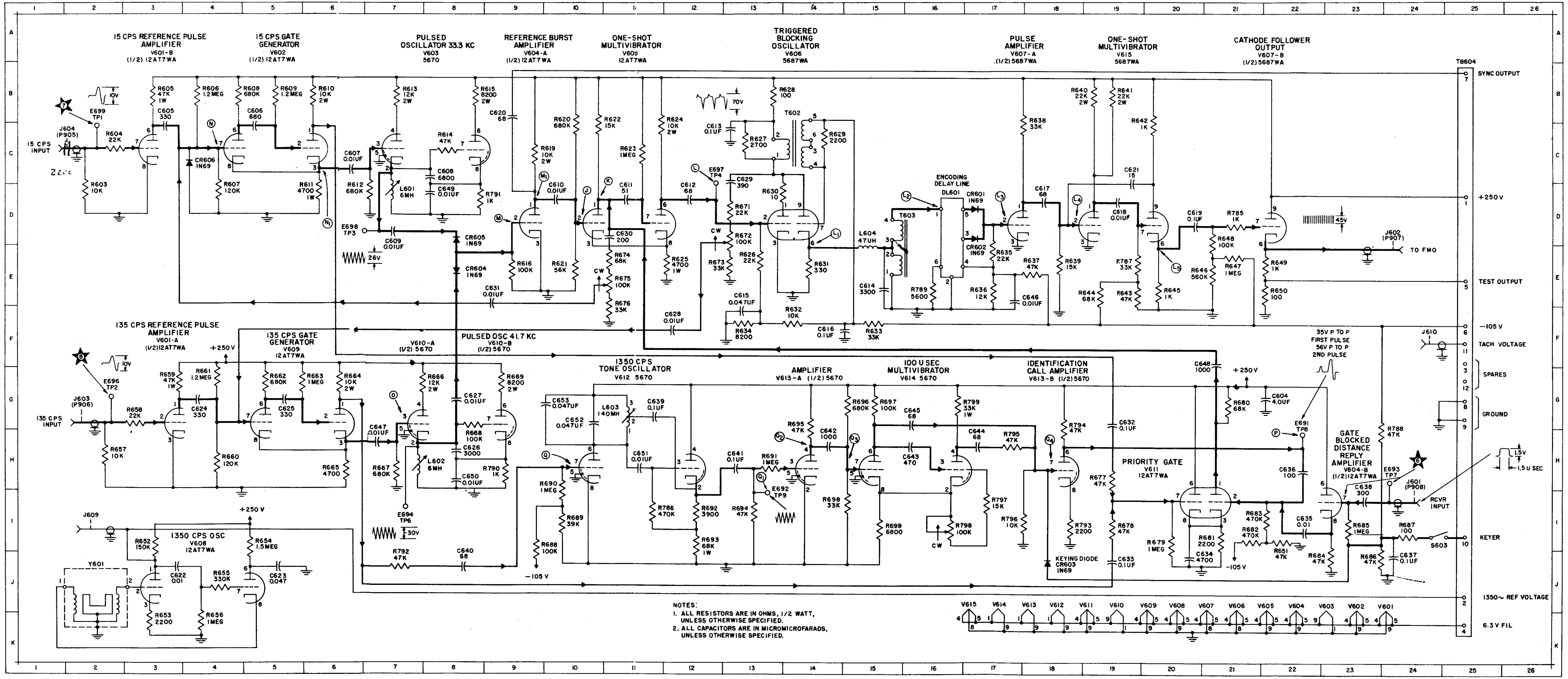
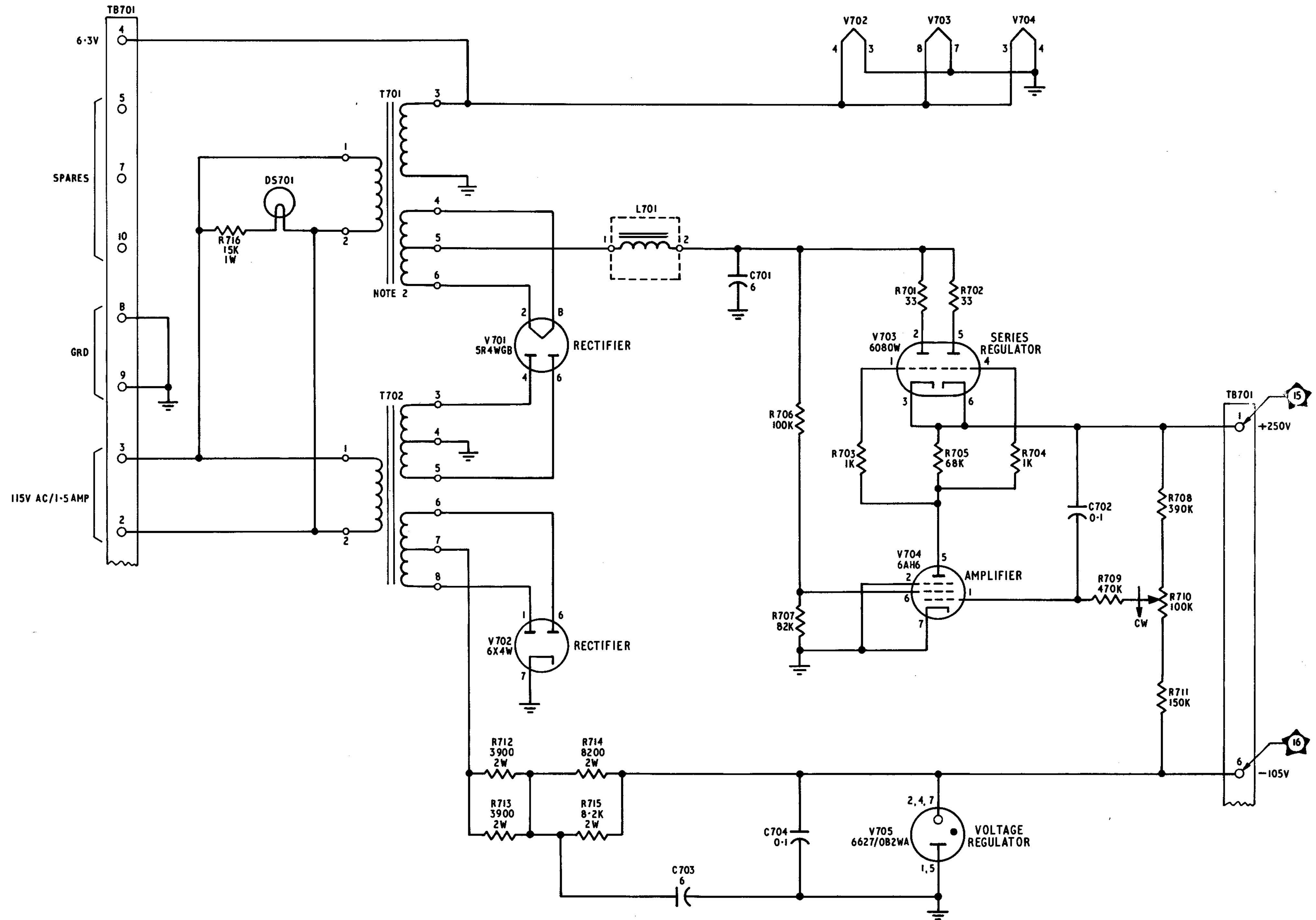


Figure 6-21. Coder-Indicator KY-382/GRN-9D, Video Chassis, Schematic Diagram



NOTES: 1. ALL RESISTORS ARE IN OHMS AND 1/2 WATT UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3. T701 PIN NUMBERS CORRECTED BY AMDT. 4

Figure 6-22. Coder-Indicator KY-382/GRN-9D Power Supply Schematic Diagram

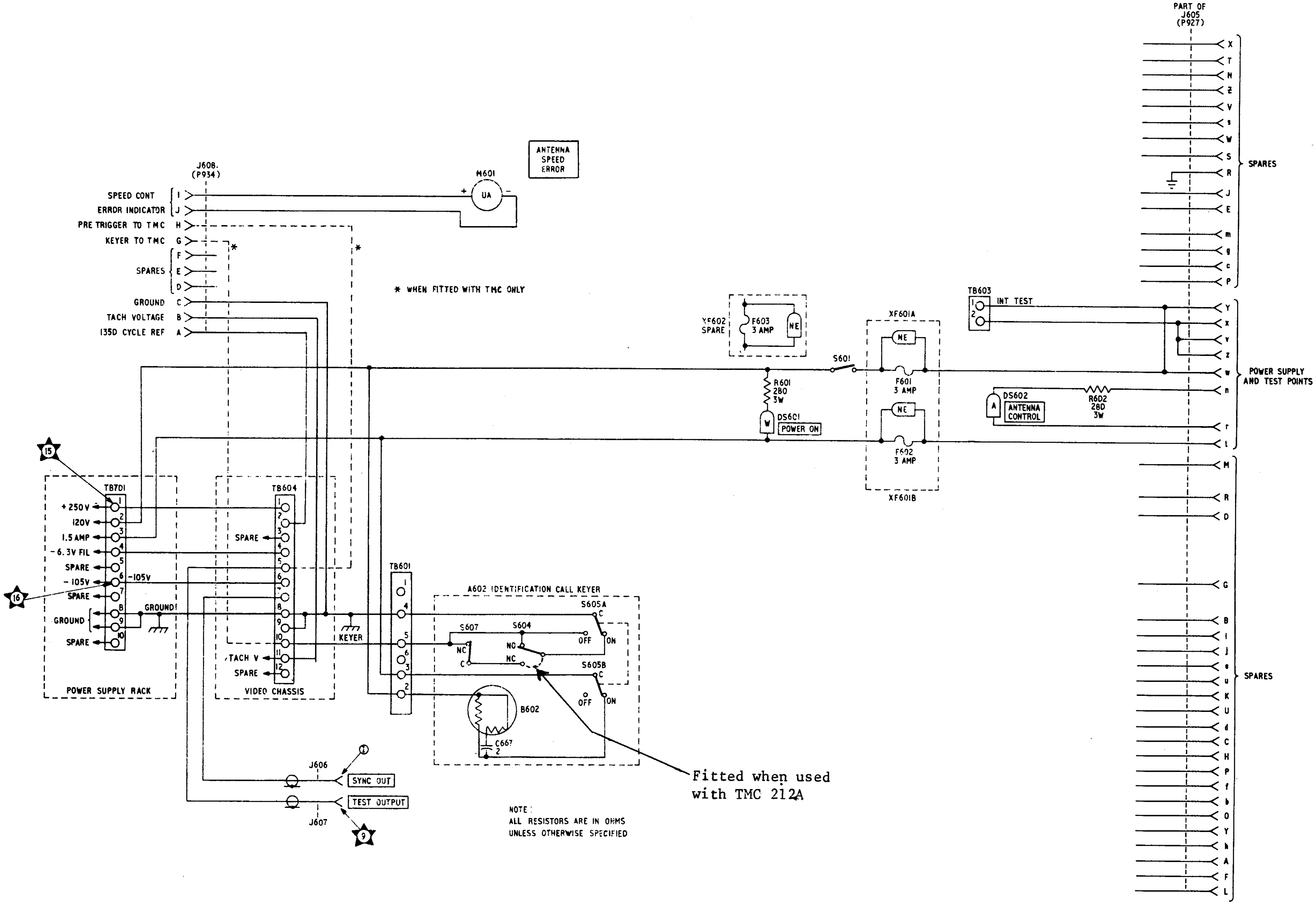


Figure 6-23. Coder-Indicator KY-382/GRN-9D, Video Frame, Schematic Diagram

Issued June 73

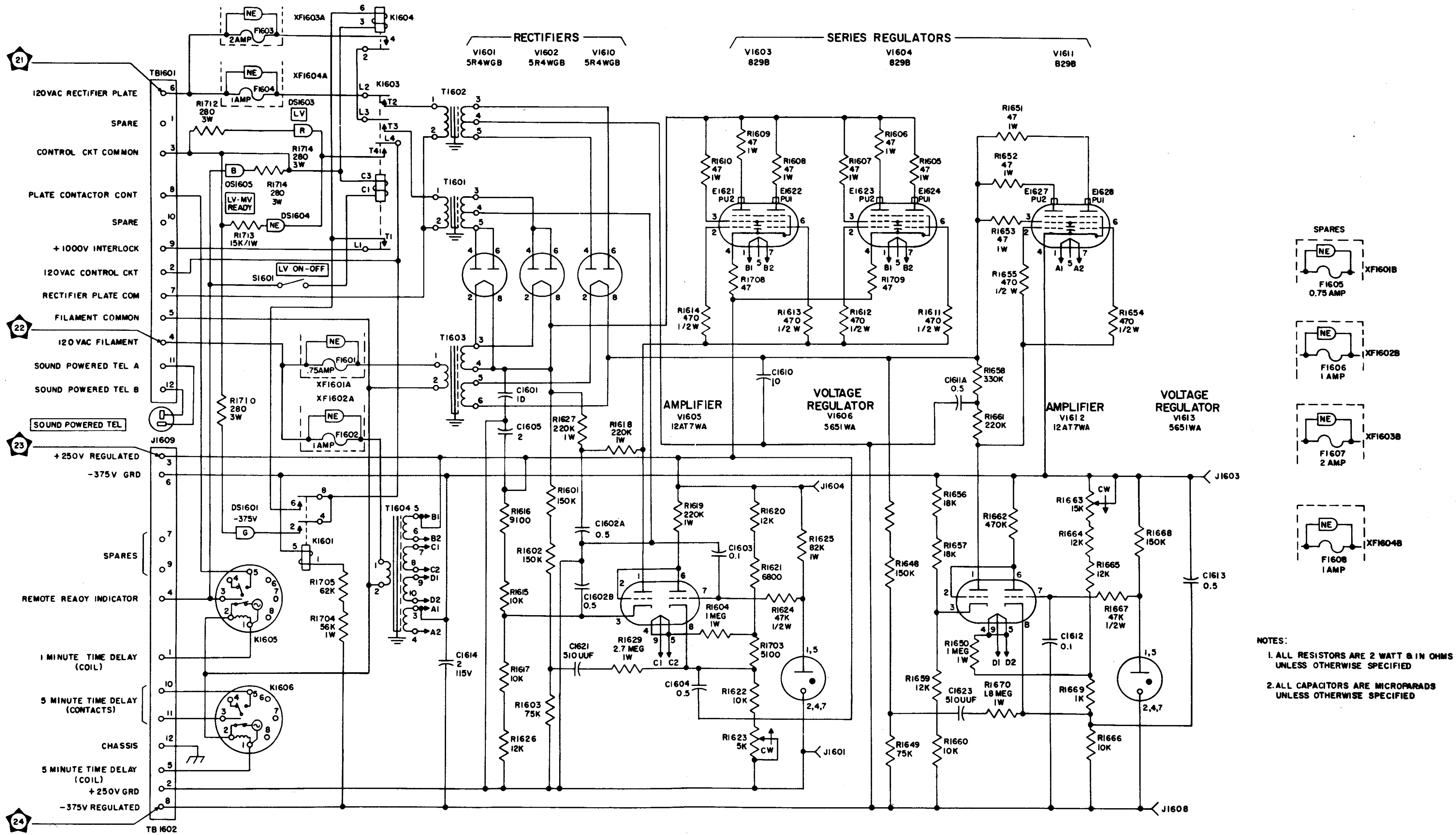


Figure 6-24. Low Voltage Power Supply PP-1766/URN, Schematic Diagram

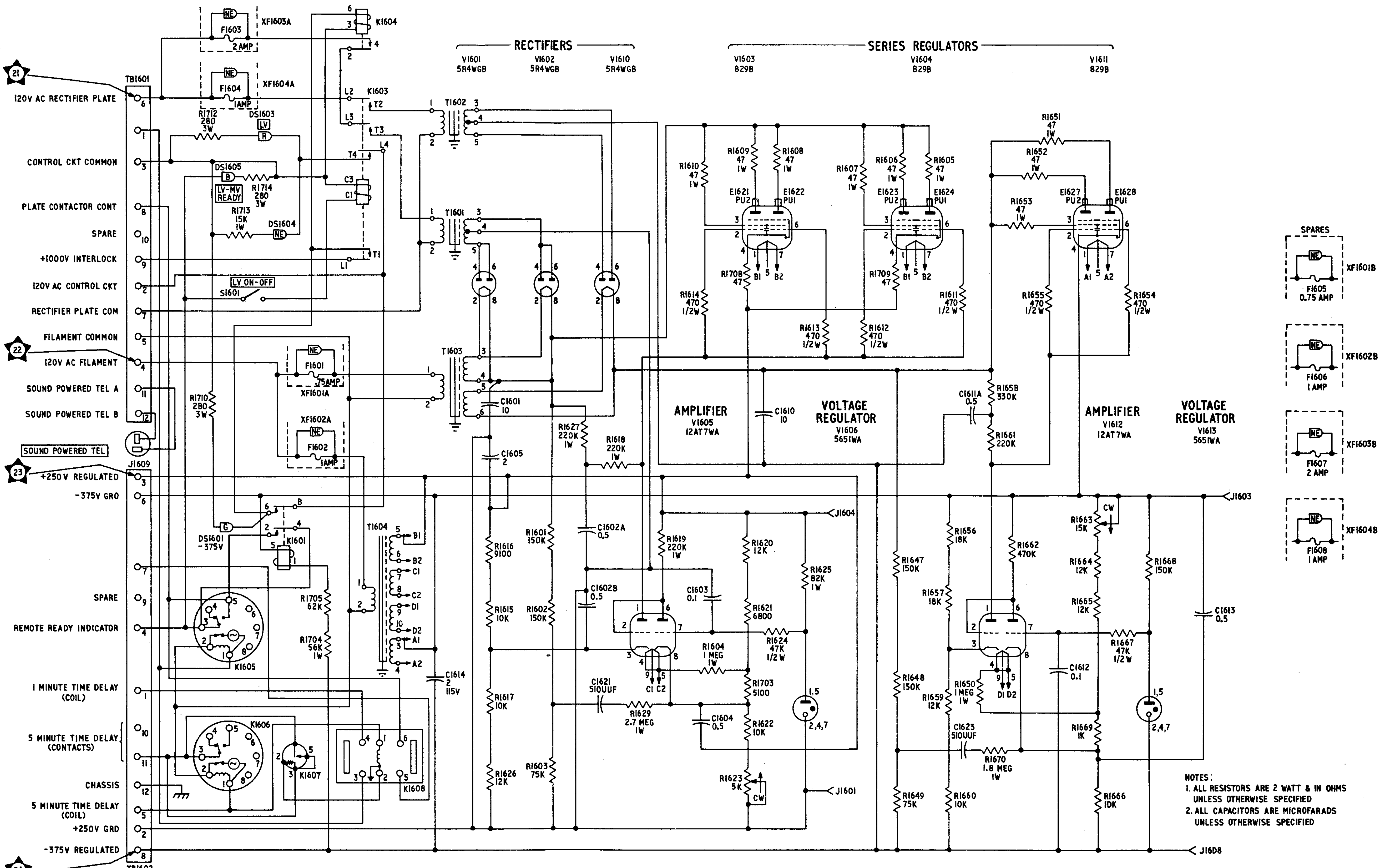
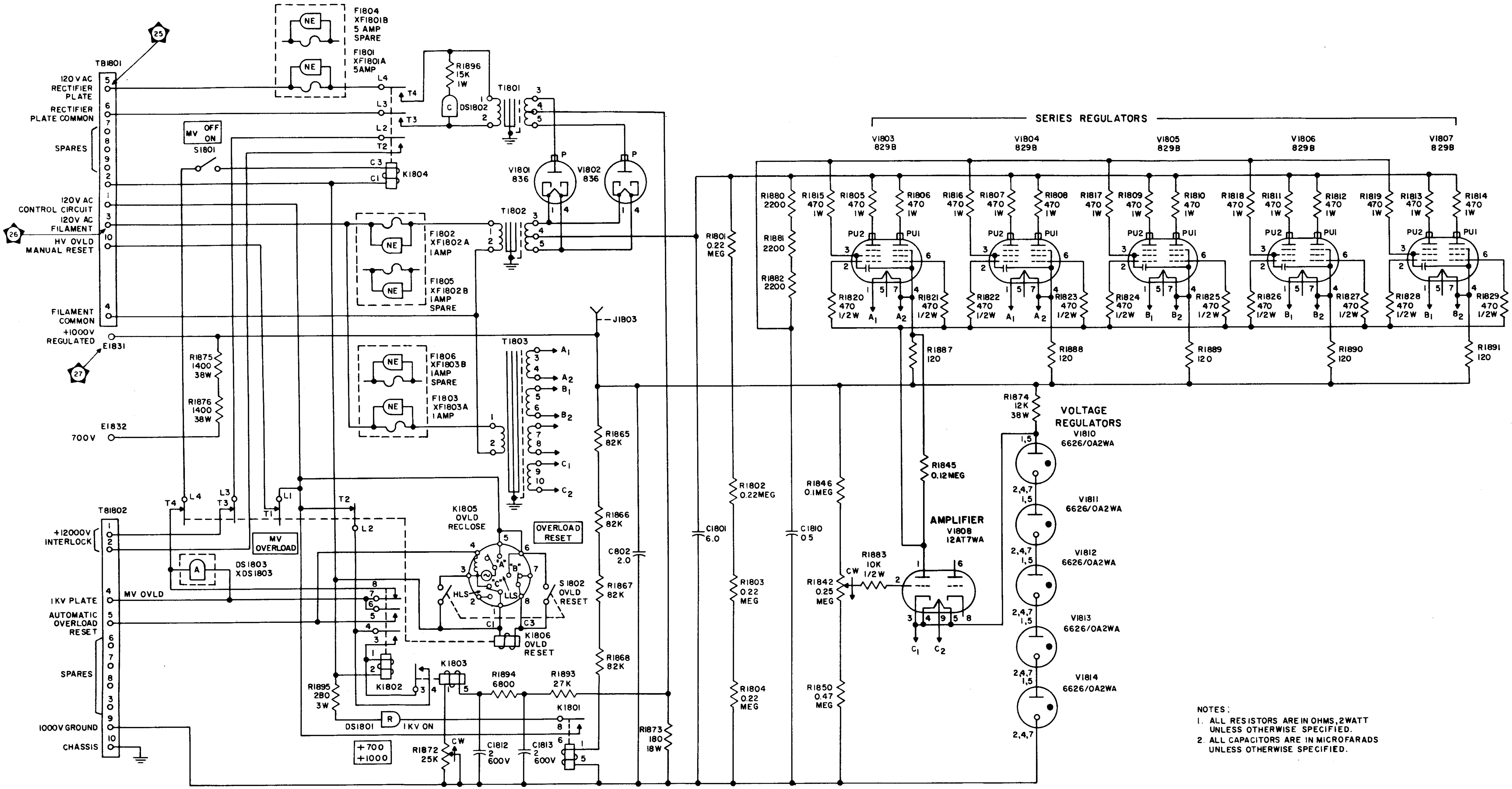
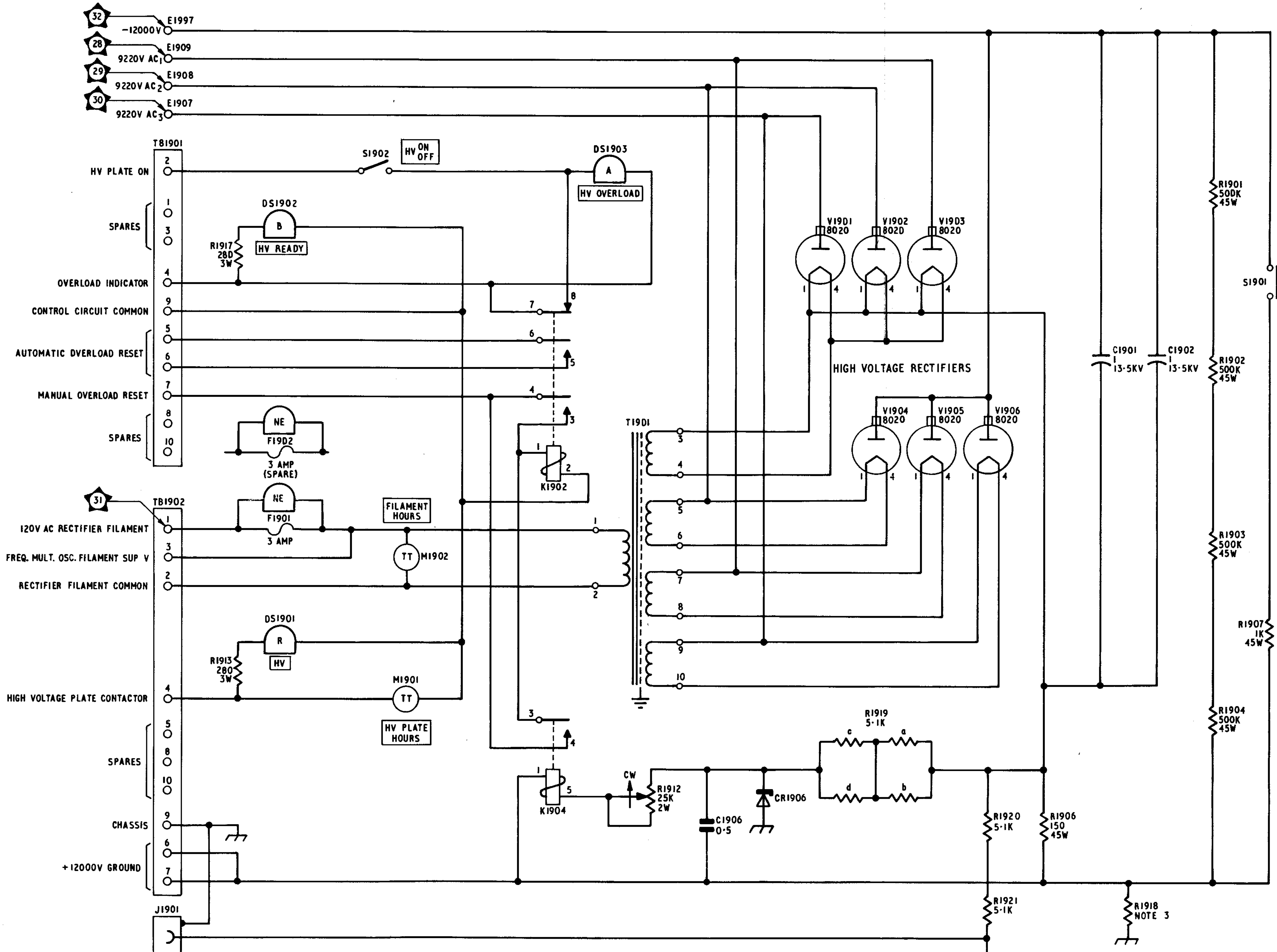


Figure 6-24a. Low Voltage Power Supply PP-1766/URN, Schematic Diagram (Replacement Test Equipment, Table 5-1a)



NOTES:
1. ALL RESISTORS ARE IN OHMS, 2WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

Figure 6-25. Medium Voltage Power Supply PP-1765/URN, Schematic Diagram



NOTES:
1. ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3. R1918 IS A NEGATIVE VOLTAGE COEFFICIENT RESISTOR
4. R1919 (4 RESISTORS), R1920, R1921, R1922 AND J1901 INTRODUCED BY AMDT 4

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Figure 6-26. High Voltage Power Supply PP-1763/URN Schematic Diagram

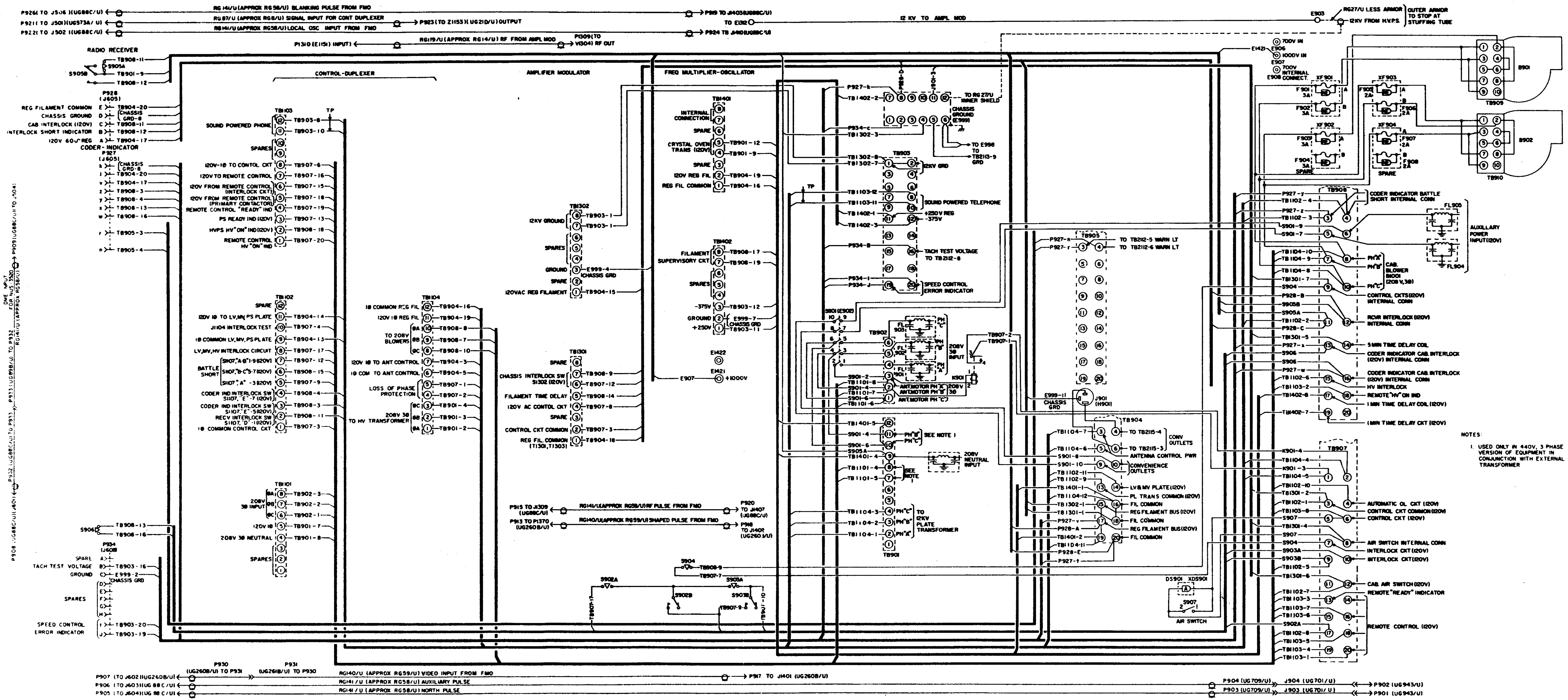


Figure 6-27. Electrical Equipment Cabinet (Receiver-Transmitter Group), Interconnecting Diagram

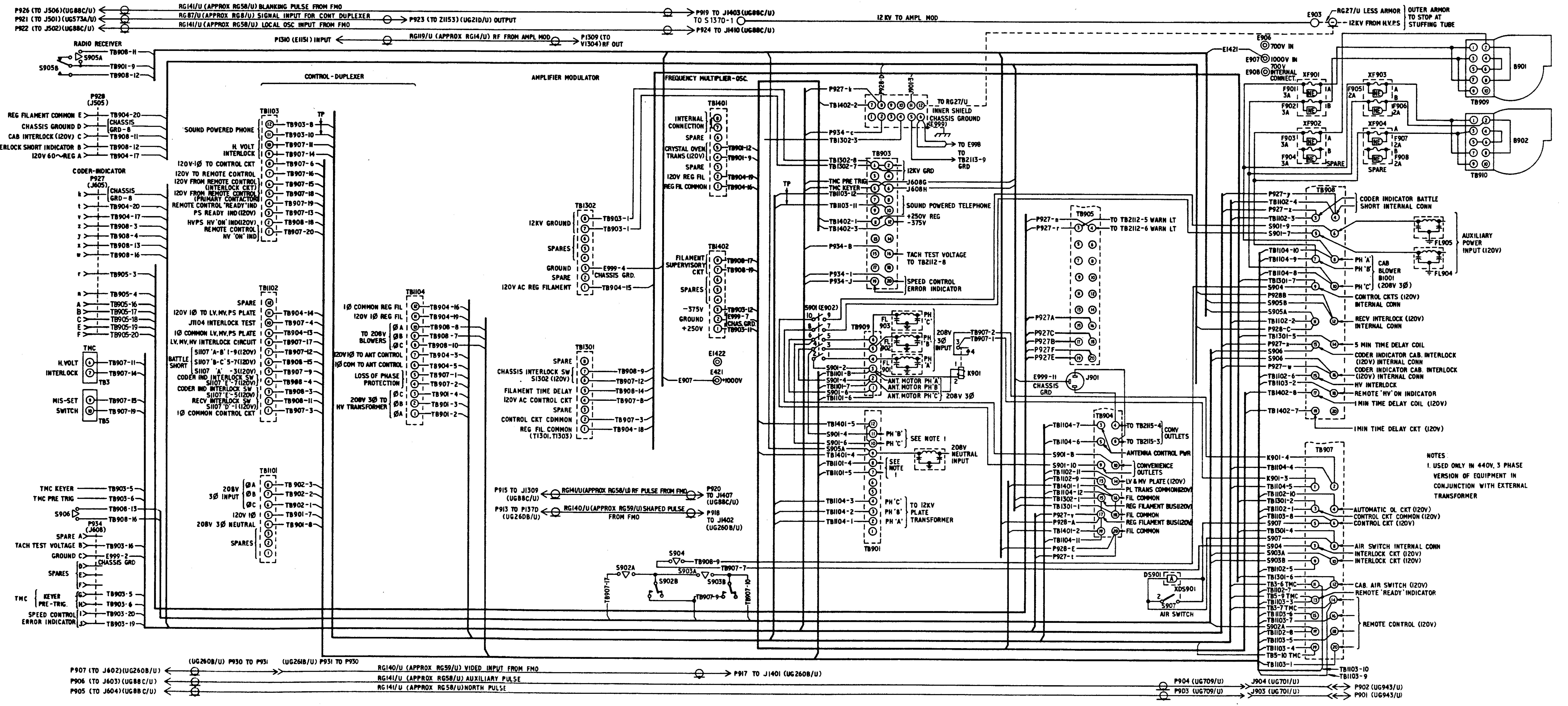


Figure 6-27a Electrical Equipment Cabinet (Receiver-Transmitter Group)
Interconnecting Diagram
(Replacement Test Equipment, Table 5-1a)

Note . . .
Wire TB1602-11 (on Terminal Block TB1004, terminal 3), and wire TB 1802-2 (on Terminal Block TB1004, terminal 9) are interchanged when beacon is fitted with the Test Monitor Control Pack 212A.

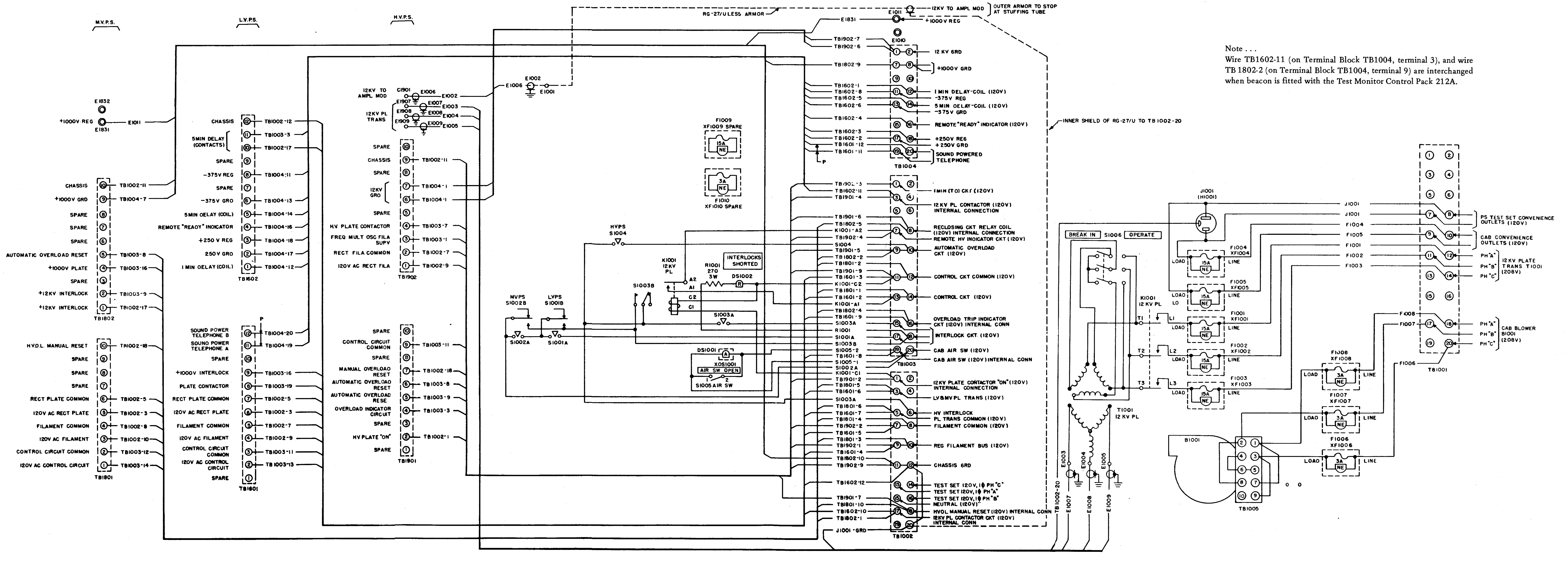
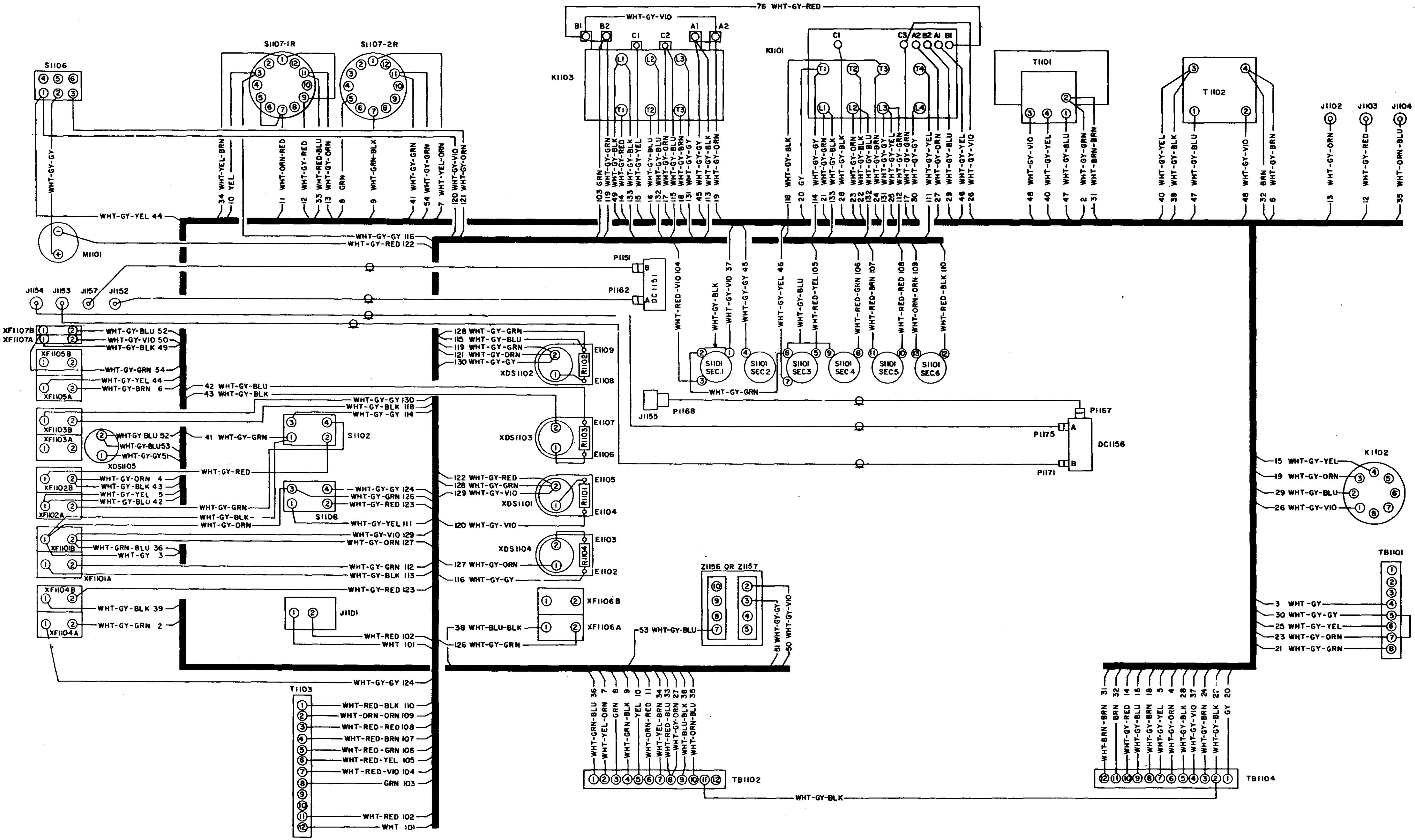


Figure 6-28. Electrical Equipment Cabinet (Power Supply Assembly), Interconnecting Diagram



(Original Test Equipment, Table 5-1)

Figure 6-29. Control-Duplexer C-2226A/GRN-9, Wiring Diagram

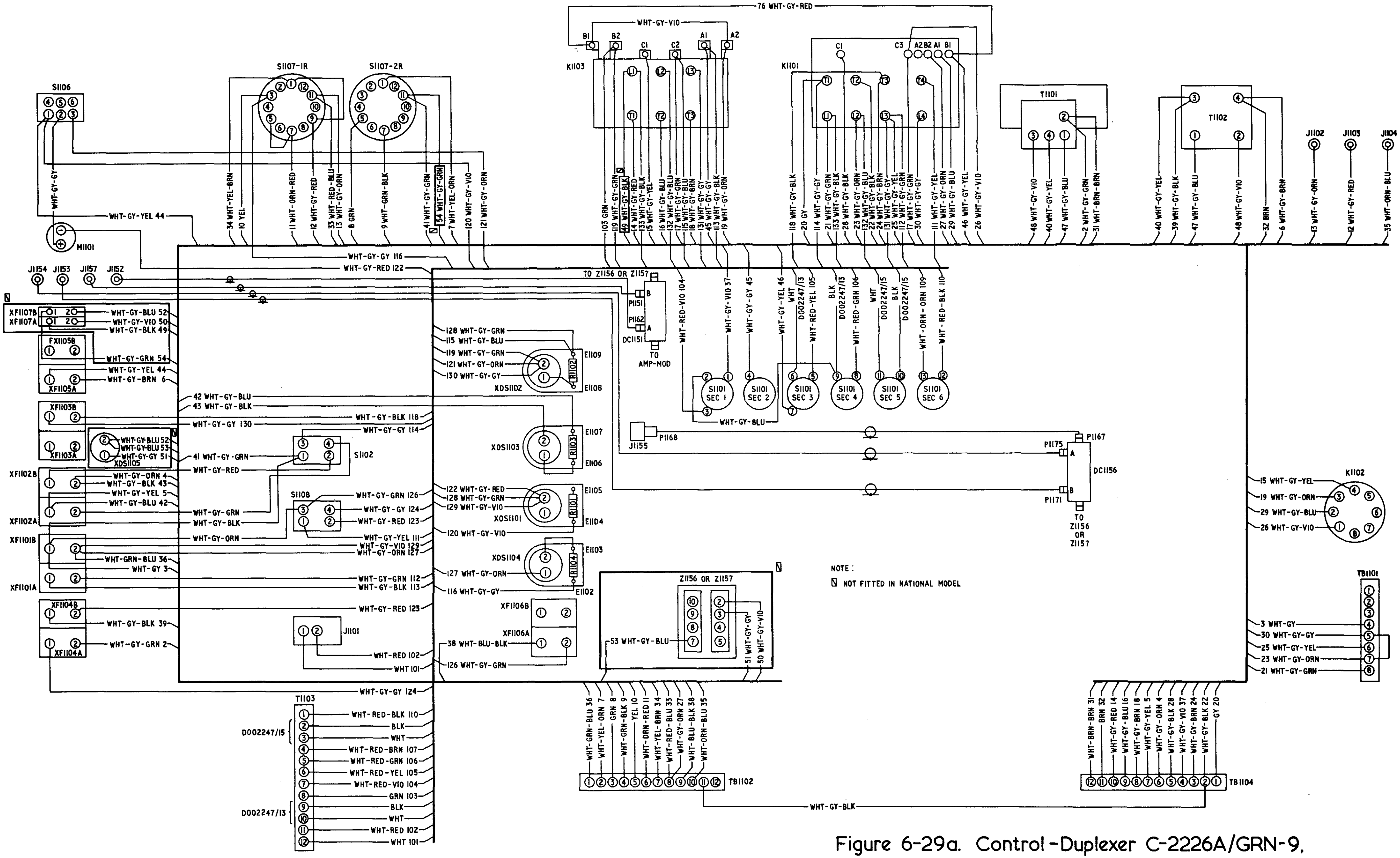


Figure 6-29a. Control-Duplexer C-2226A/GRN-9,
Wiring Diagram
(Replacement Test Equipment, Table 5-1a)

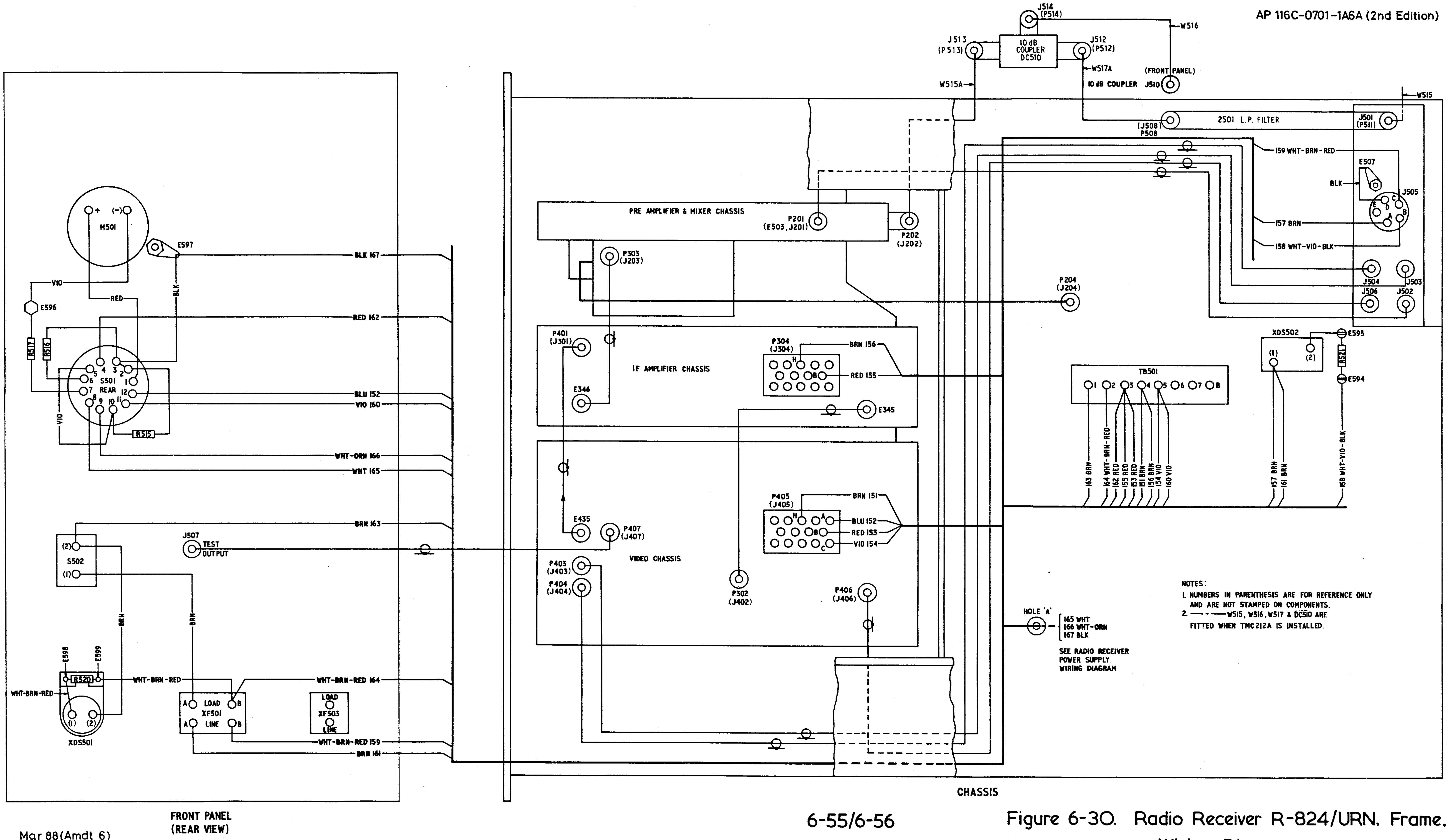


Figure 6-30. Radio Receiver R-824/URN. Frame, Wiring Diagram

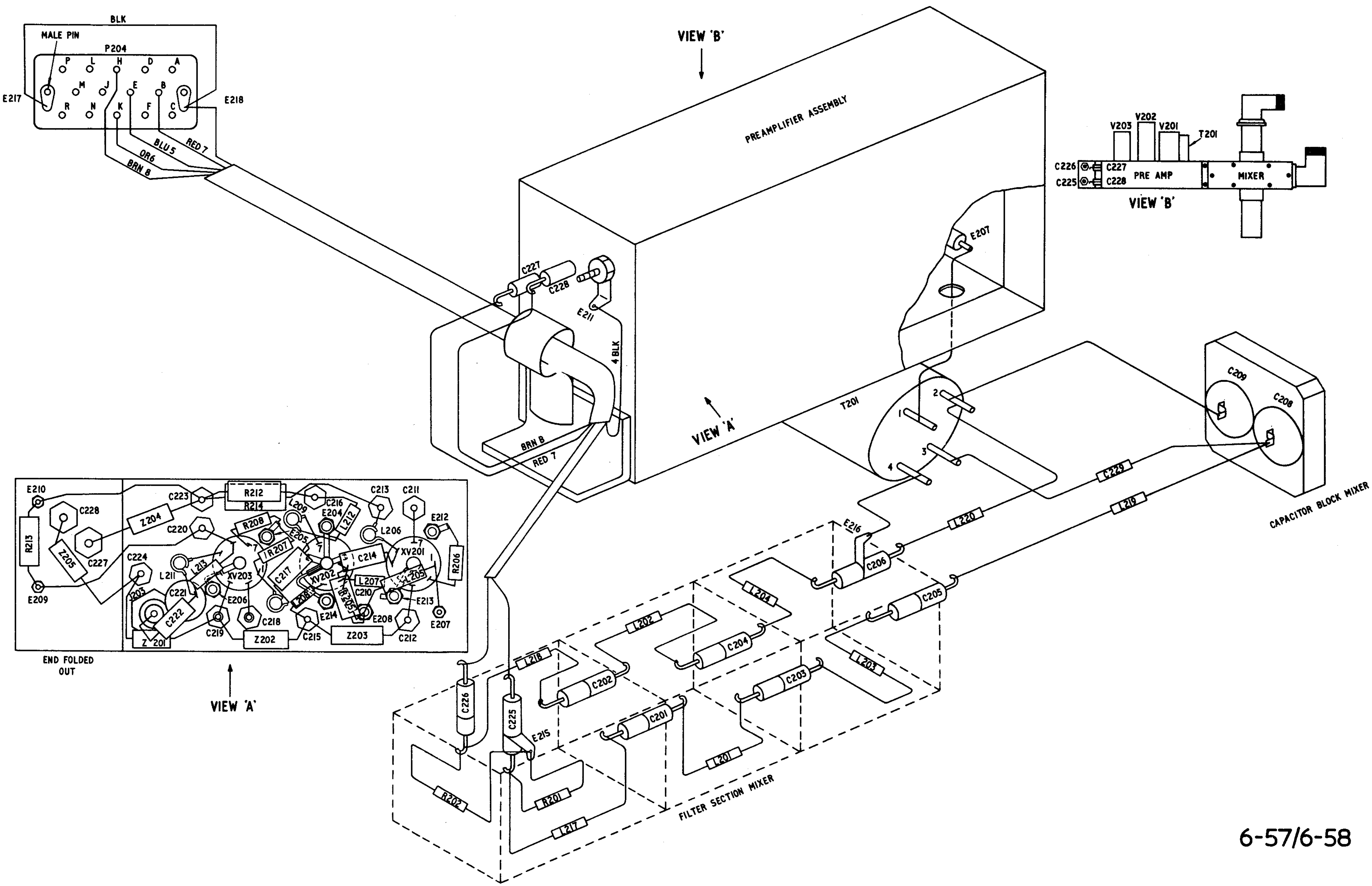


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Figure 6-31. Radio Receiver R-824/URN, Preamplifier and Mixer Subassembly, Wiring Diagram

Figure 6-32. Radio Receiver R-824/URN, I-F Amplifier Subassembly, Wiring Diagram

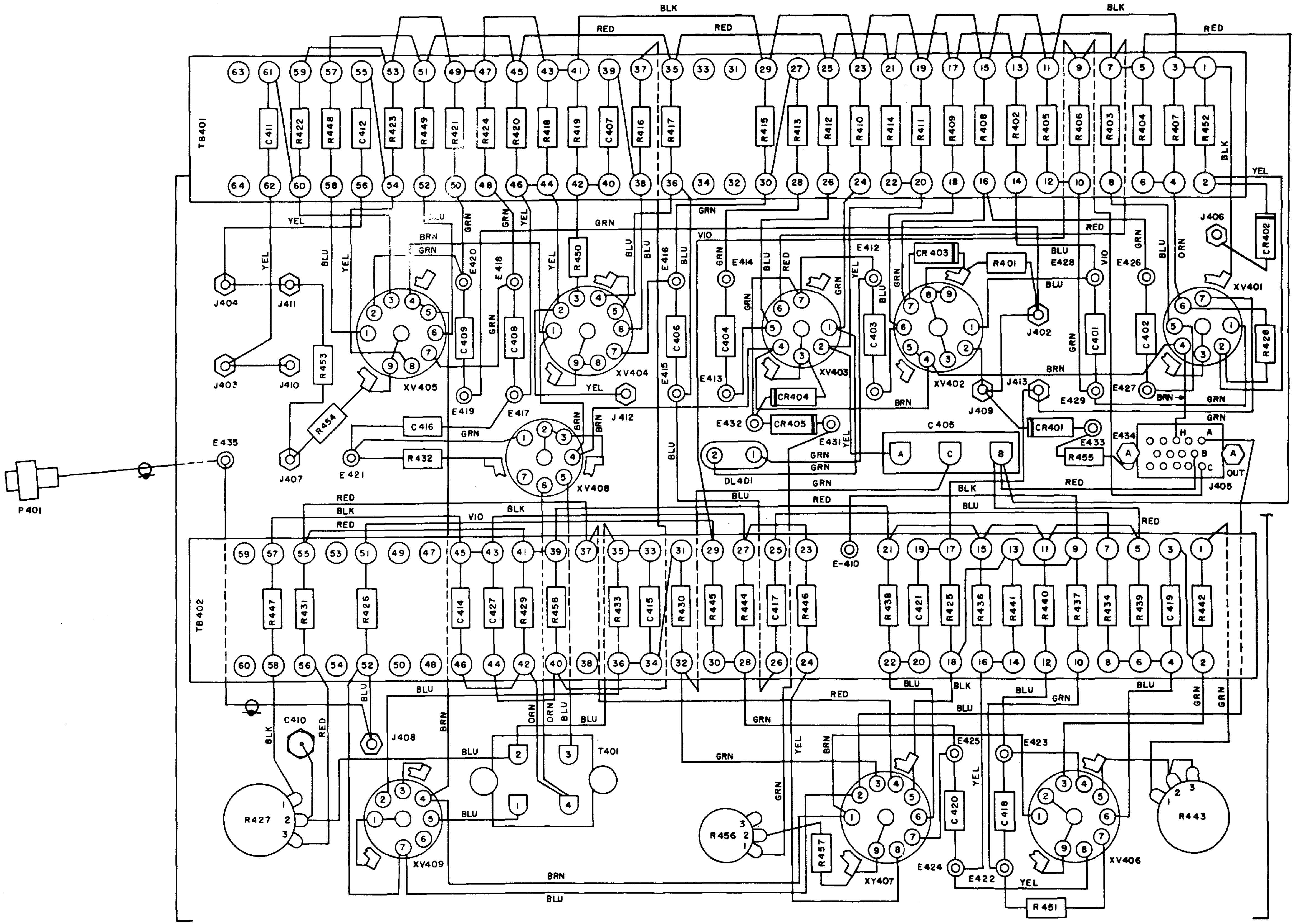


Figure 6-33. Radio Receiver R-824/URN, Video Chassis, Wiring Diagram

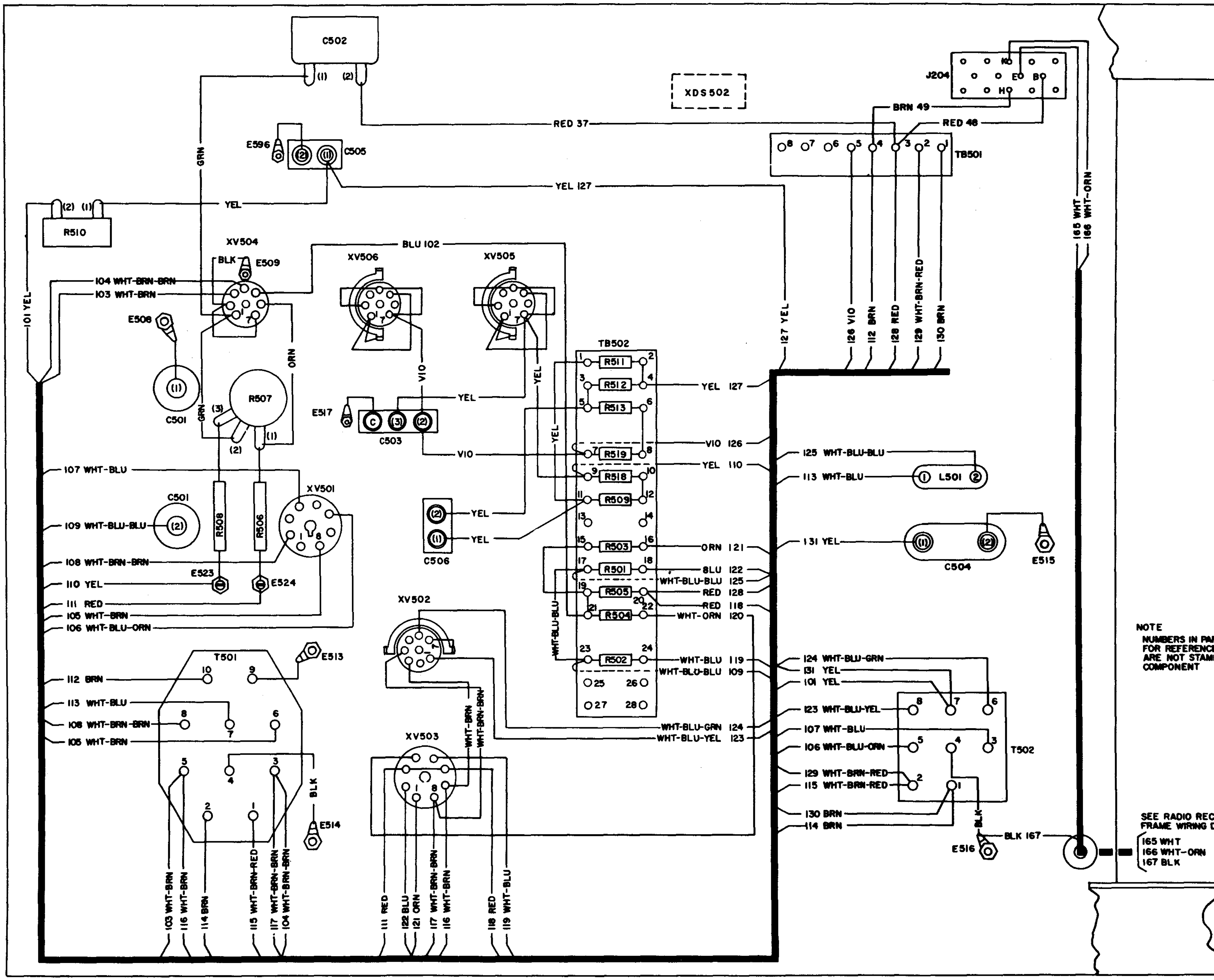


Figure 6-34. Radio Receiver R-824/URN, Power Supply Chassis, Wiring Diagram

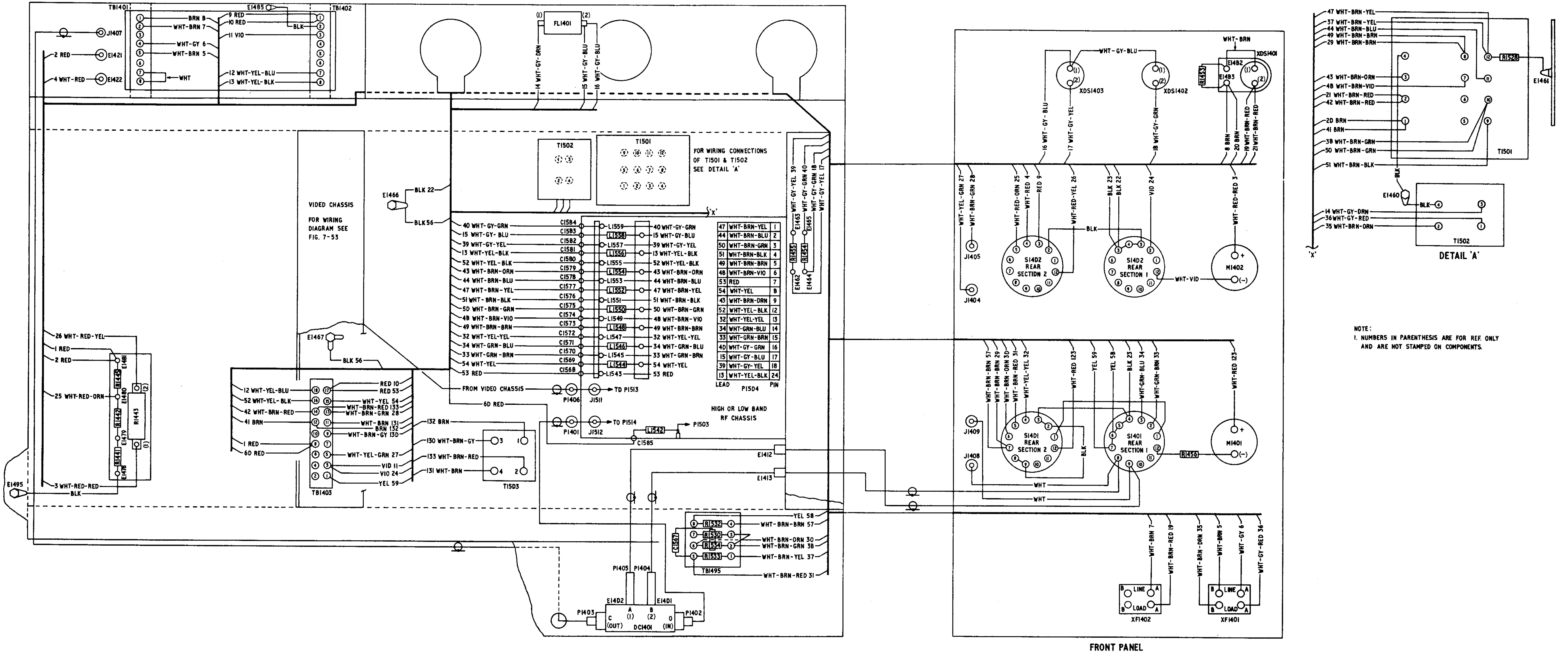
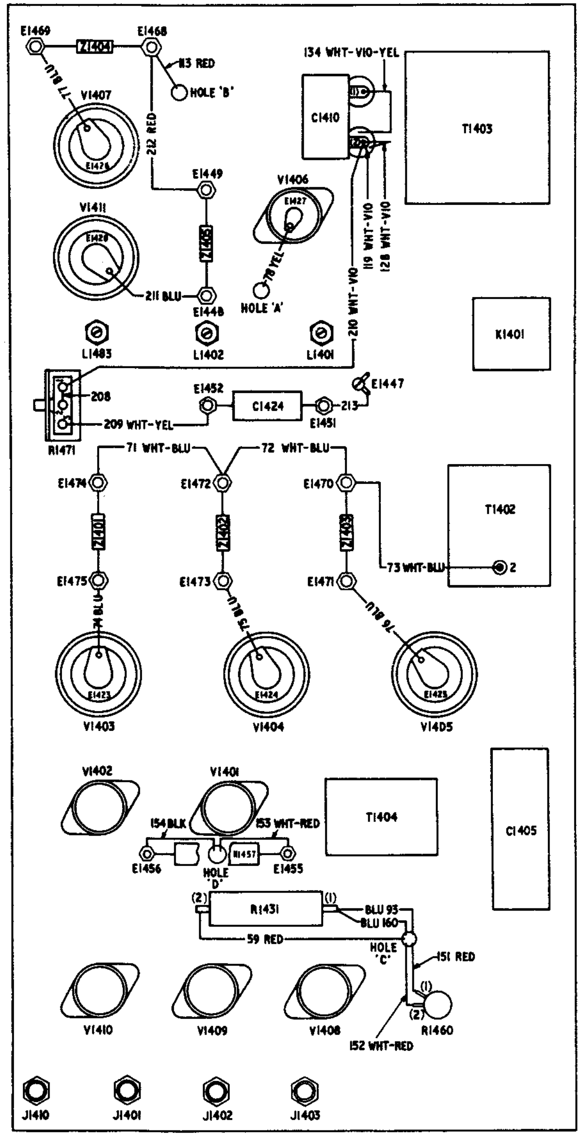


Figure 6-35. Frequency Multiplier Oscillator CV-1171/GRN-9D, Frame, Wiring Diagram



TOP VIEW
(DISPLACED FOR CLARITY)

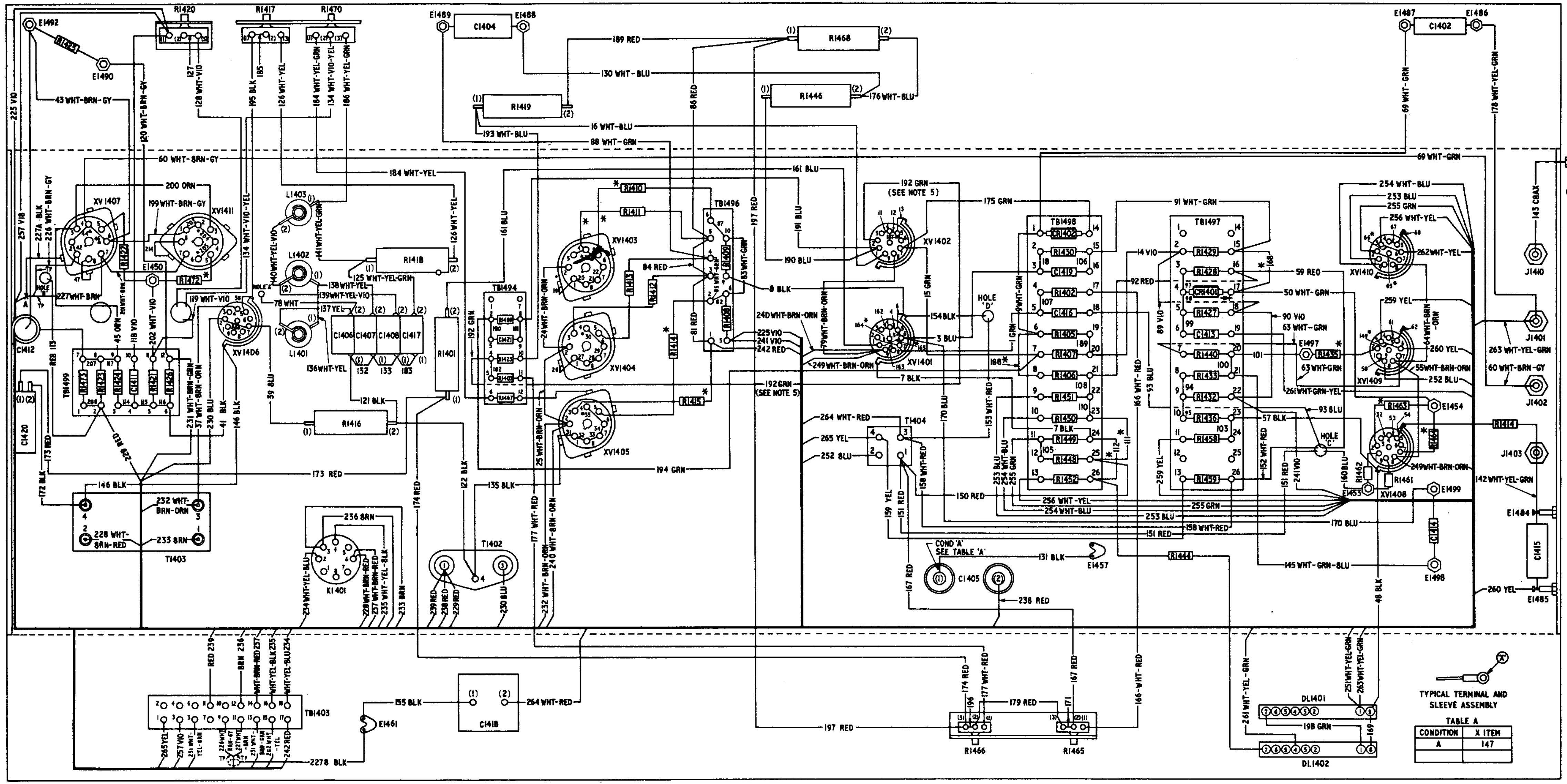
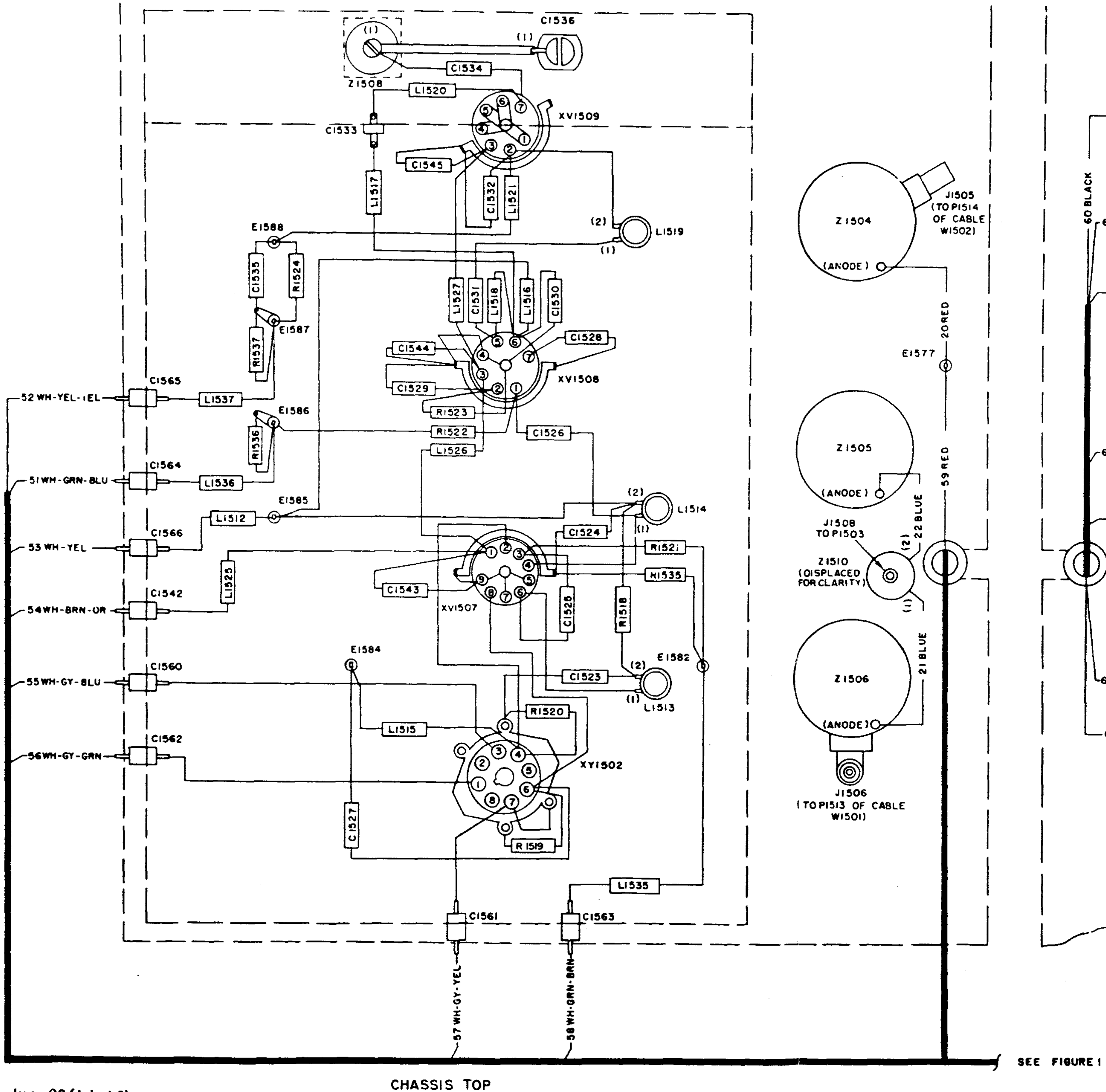


TABLE A

CONDITION	X ITEM
A	147

NOTES:
1. ALL POINT TO POINT WIRES USING RING TERMINALS TO BE SKINNED BACK 3/16" TWISTED AND TINNED.
ALL OTHER POINT TO POINT WIRES TO BE SKINNED BACK 3/8" TWISTED AND TINNED.
2. TERMINAL NUMBERS SHOWN IN PARENTHESIS ARE SHOWN FOR REFERENCE ONLY AND ARE NOT SHOWN ON THE COMPONENTS.
3. * DENOTES SLEEVE ON WIRES.
4. P1406 TO BE CONNECTED TO J1502 OR J1505 ON DWG. No. H2060028
5. ROUTE WIRE 192 GREEN IN A CLOCKWISE MANNER AROUND XV1402 KEEPING AWAY FROM WIRES No. 161 AND 170. THEN ROUTE BETWEEN XV1404 AND XV1405 TO TERMINAL 4 OF TB1494.

Figure 6-36. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Video Chassis, Wiring Diagram



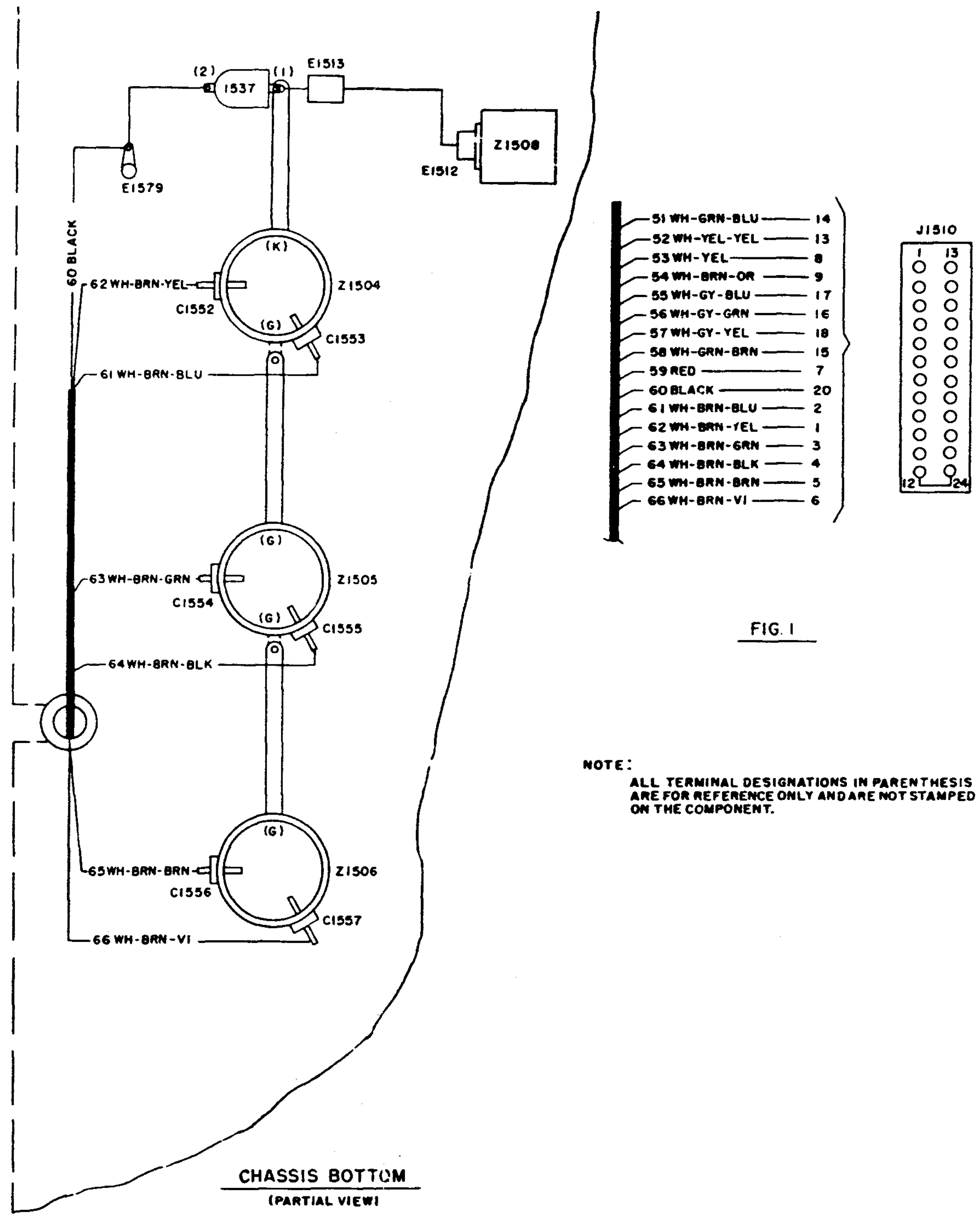
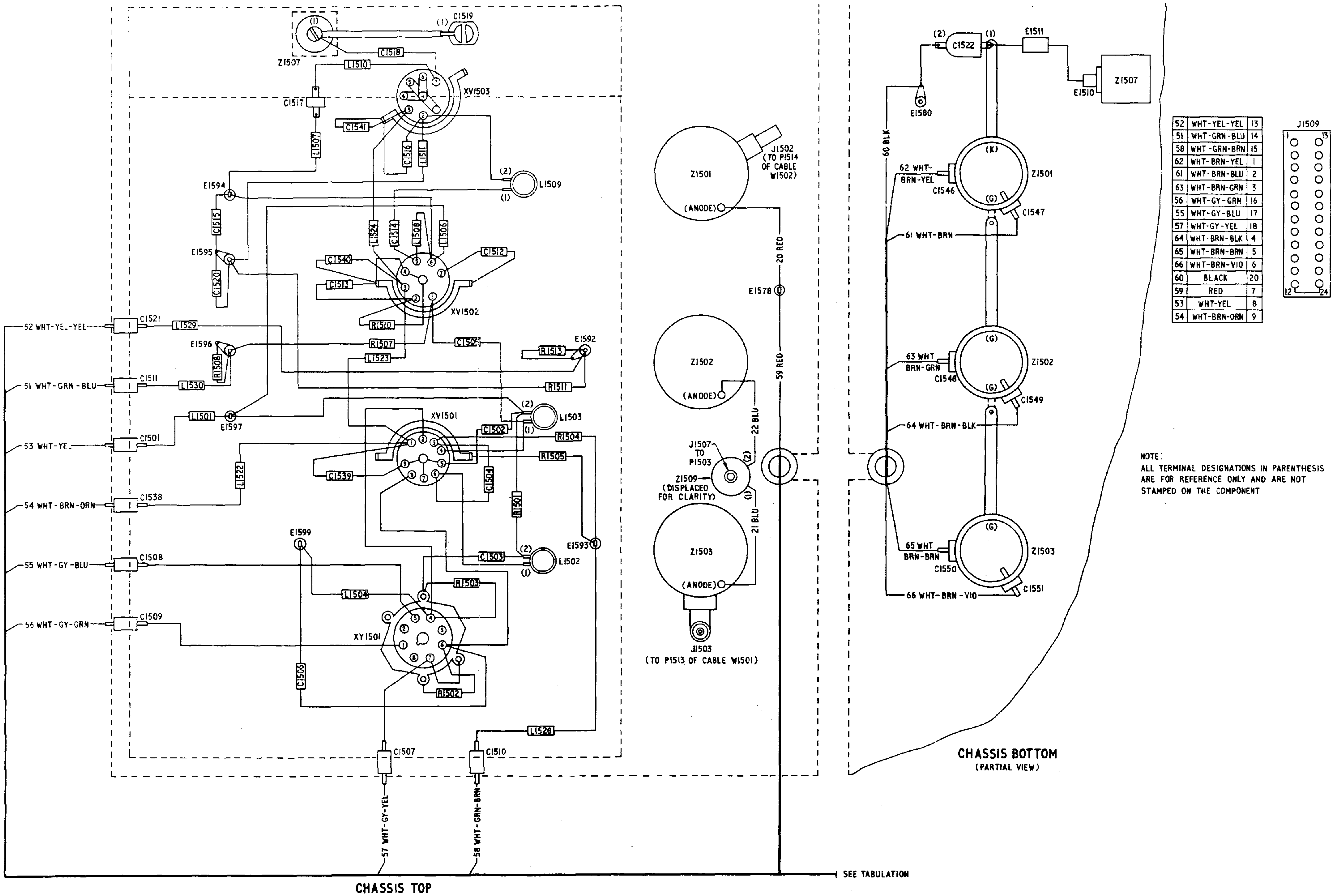
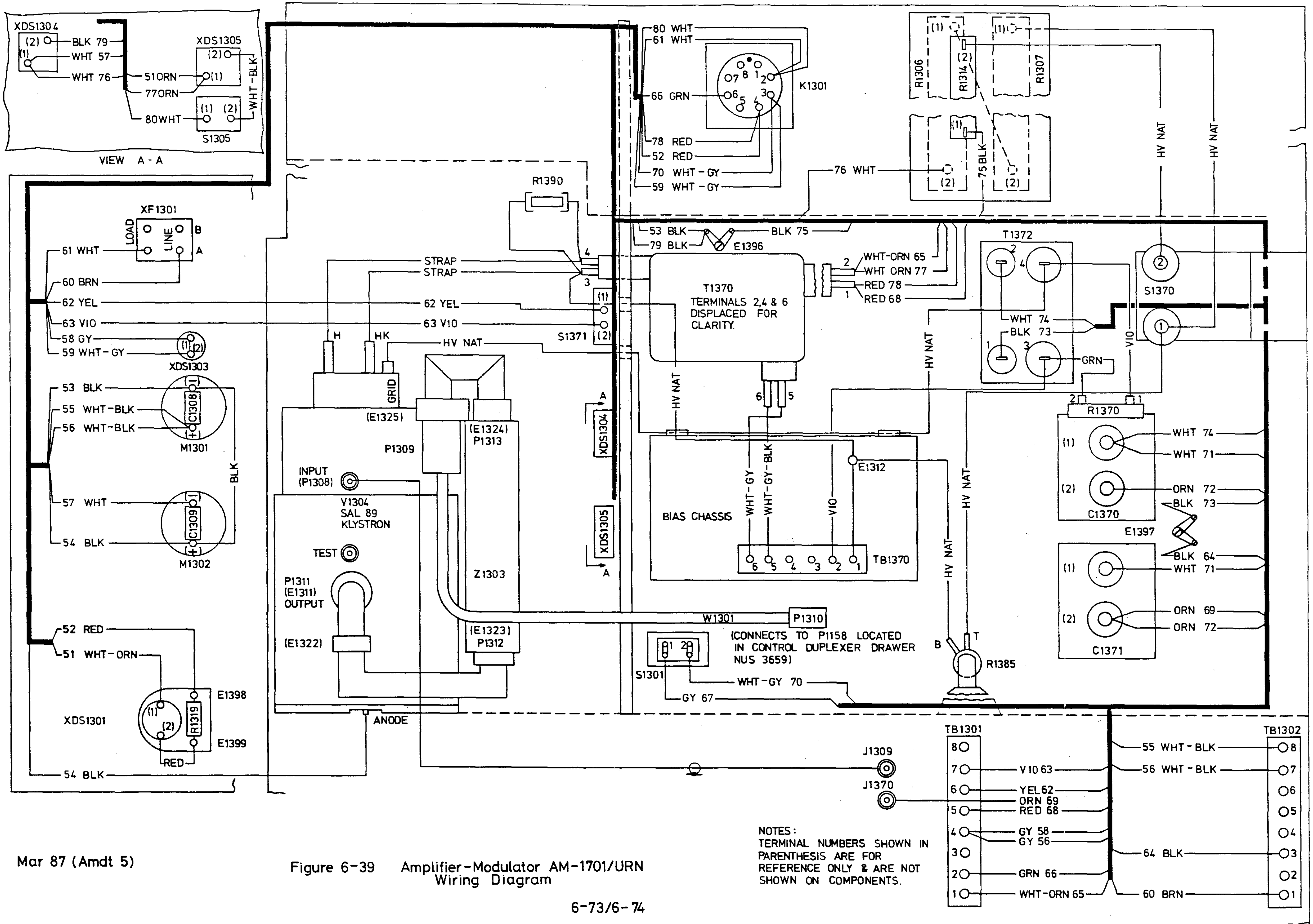


Figure 6-37. Frequency Multiplier-Oscillator CV-1171/GRN-9D, R-F Chassis (Low Band), Wiring Diagram



52	WHT-YEL-YEL	13
51	WHT-GRN-BLU	14
58	WHT-GRN-BRN	15
62	WHT-BRN-YEL	1
61	WHT-BRN-BLU	2
63	WHT-BRN-GRN	3
56	WHT-GY-GRN	16
55	WHT-GY-BLU	17
57	WHT-GY-YEL	18
64	WHT-BRN-BLK	4
65	WHT-BRN-BRN	5
66	WHT-BRN-VIO	6
60	BLACK	20
59	RED	7
53	WHT-YEL	8
54	WHT-BRN-ORN	9

Figure 6-38. Frequency Multiplier - Oscillator CV-1171/GRN-9D, R-F Chassis (High Band), Wiring Diagram



NOTES:
TERMINAL NUMBERS SHOWN IN PARENTHESIS ARE FOR REFERENCE ONLY & ARE NOT SHOWN ON COMPONENTS.

Figure 6-39 Amplifier-Modulator AM-1701/URN Wiring Diagram

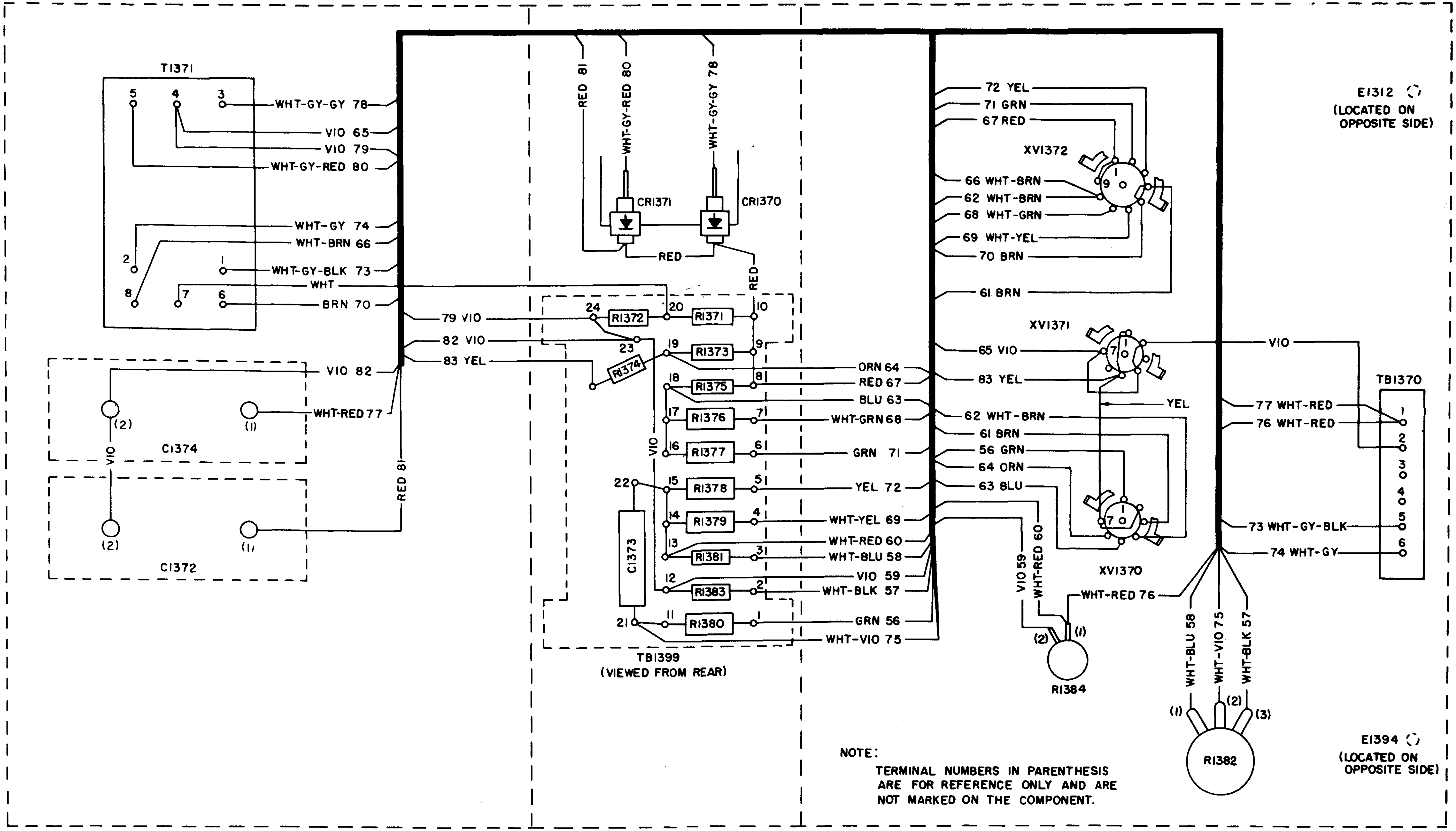


Figure 6-40. Amplifier-Modulator AM-1701/URN, Bias Supply, Wiring Diagram

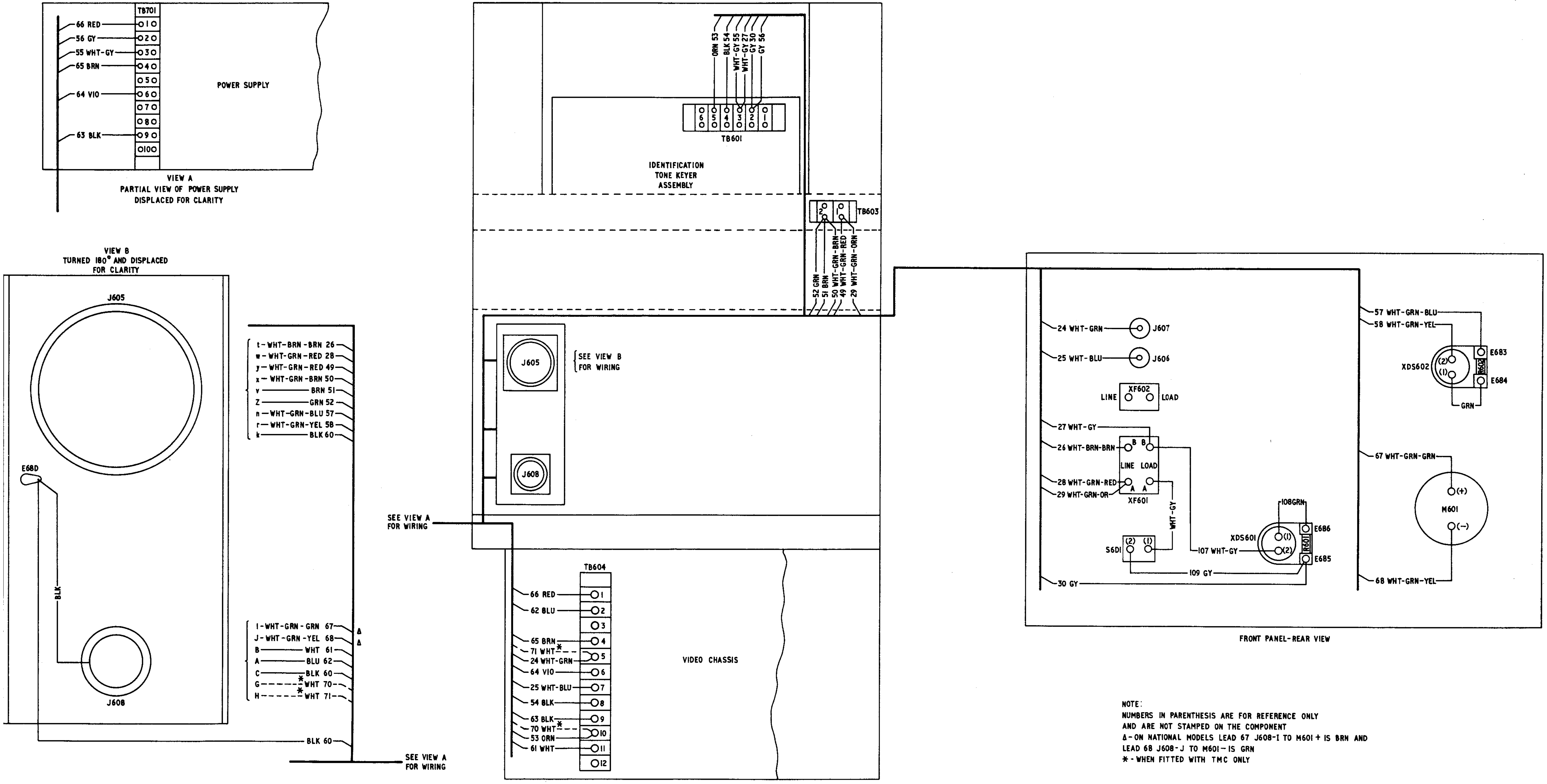


Figure 6-41. Coder-Indicator KY-382/GRN-9D, Frame, Wiring Diagram

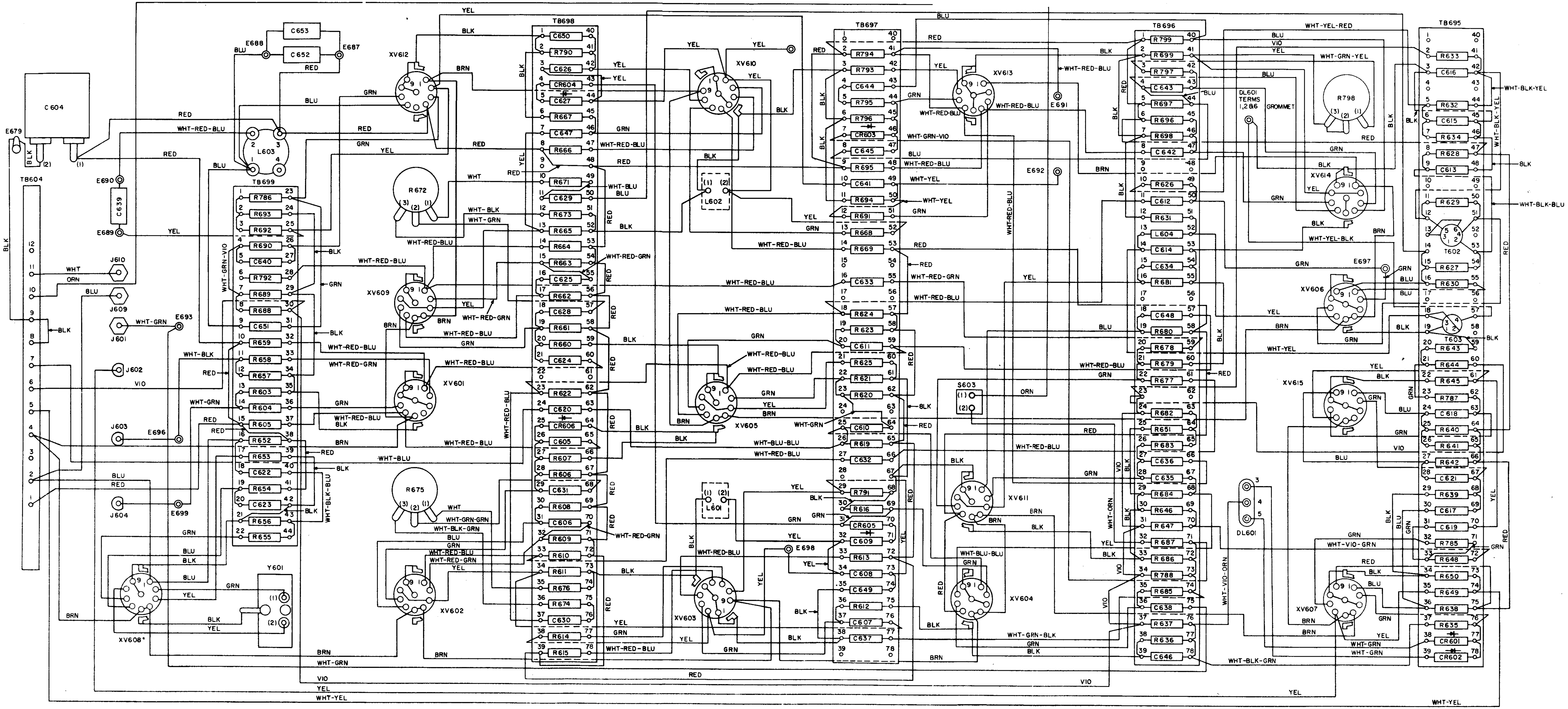
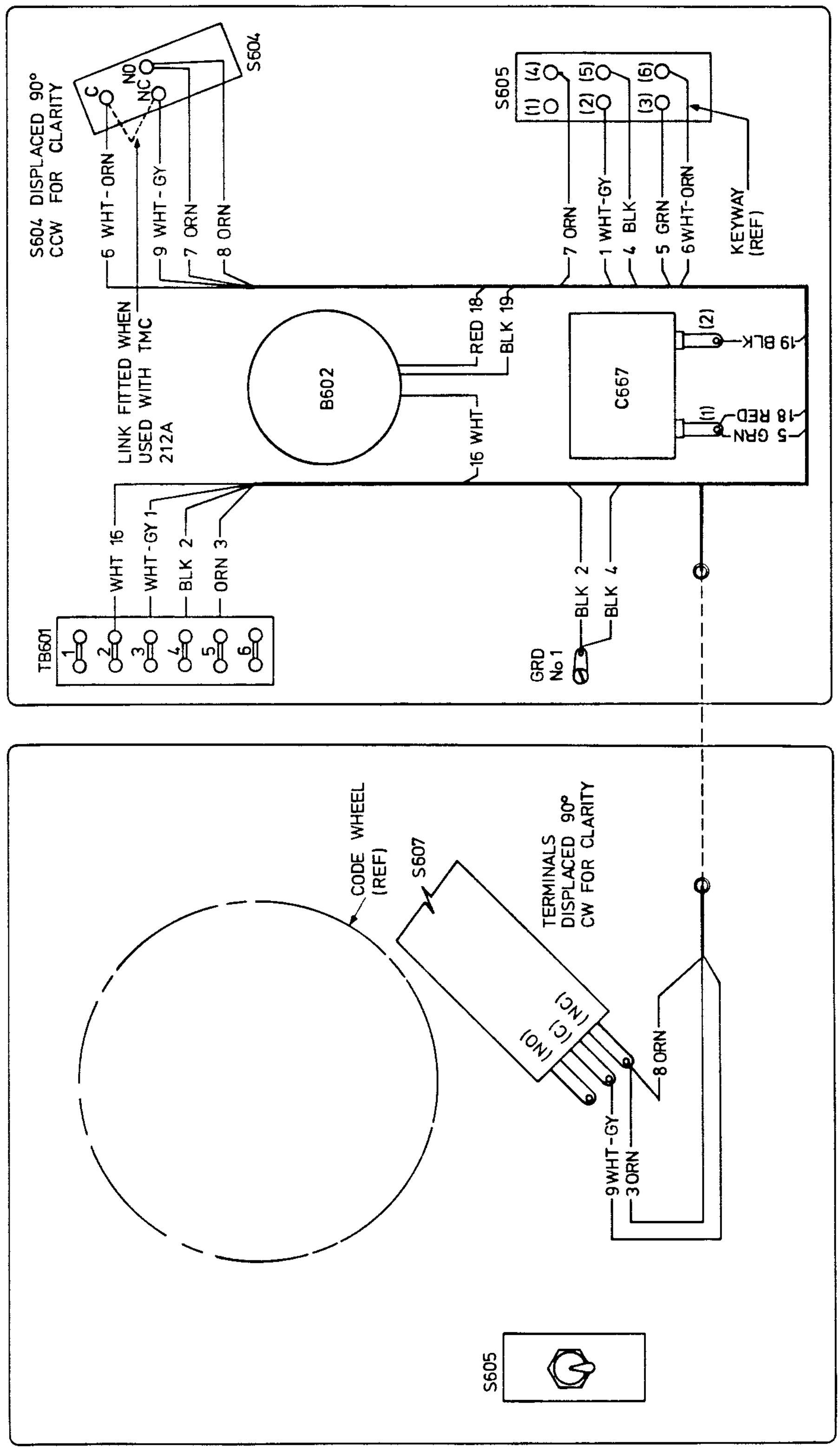
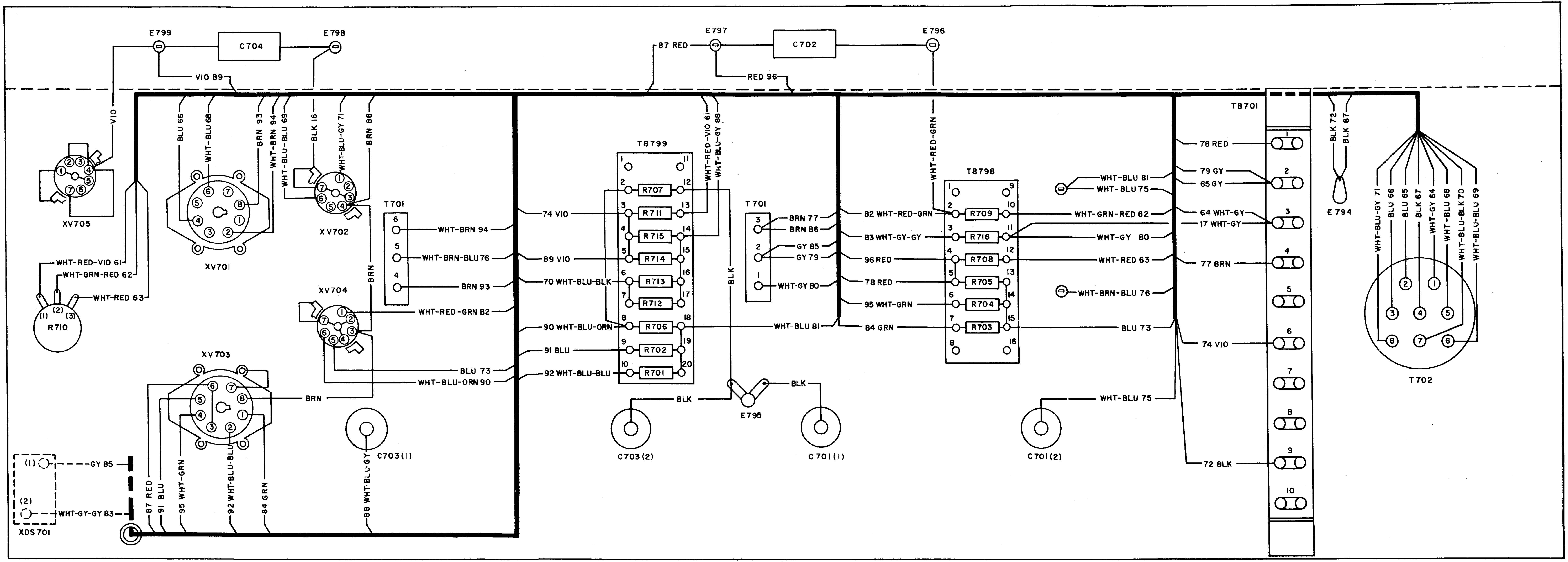


Figure 6-42. Coder-Indicator KY-382/GRN-9D, Video Chassis, Wiring Diagram



NOTE: TERMINAL NUMBERS SHOWN IN PARENTHESIS ARE FOR REFERENCE ONLY & ARE NOT SHOWN ON THE COMPONENTS.

Fig. 6-43. Coder Indicator KY-382/GRN-9D, 1350 CPS Identification Tone Keyer, Wiring Diagram



NOTE:
1. NUMBERS IN PARENTHESIS ARE FOR REF ONLY & ARE NOT STAMPED ON THE COMPONENT.

Figure 6-44. Coder-Indicator KY-382/GRN-9D, Power Supply, Wiring Diagram

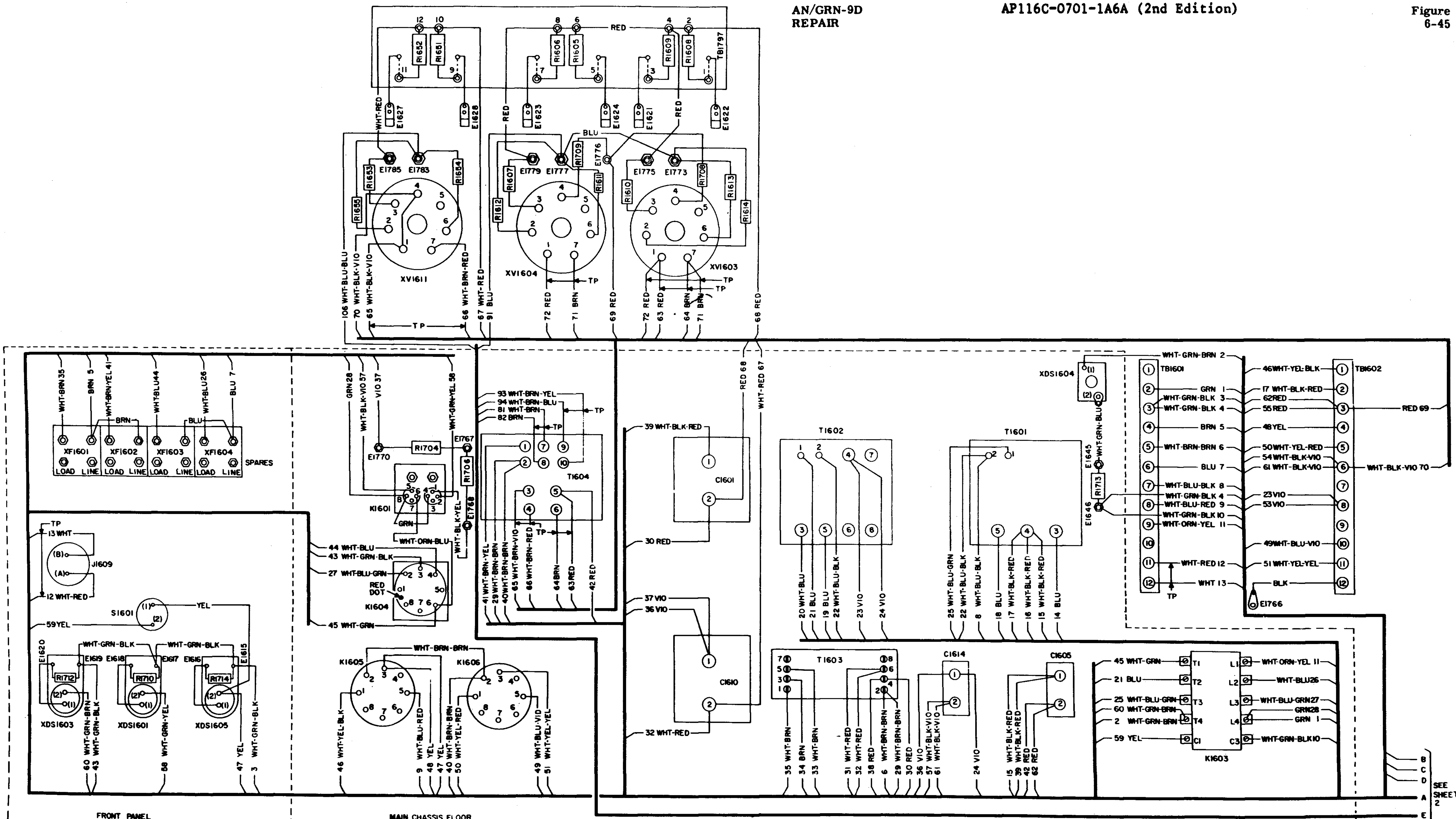


Figure 6-45. Low Voltage Power Supply PP-1766/URN, Wiring Diagram (Sheet 1 of 2)

(Original Test Equipment, Table 5-1)

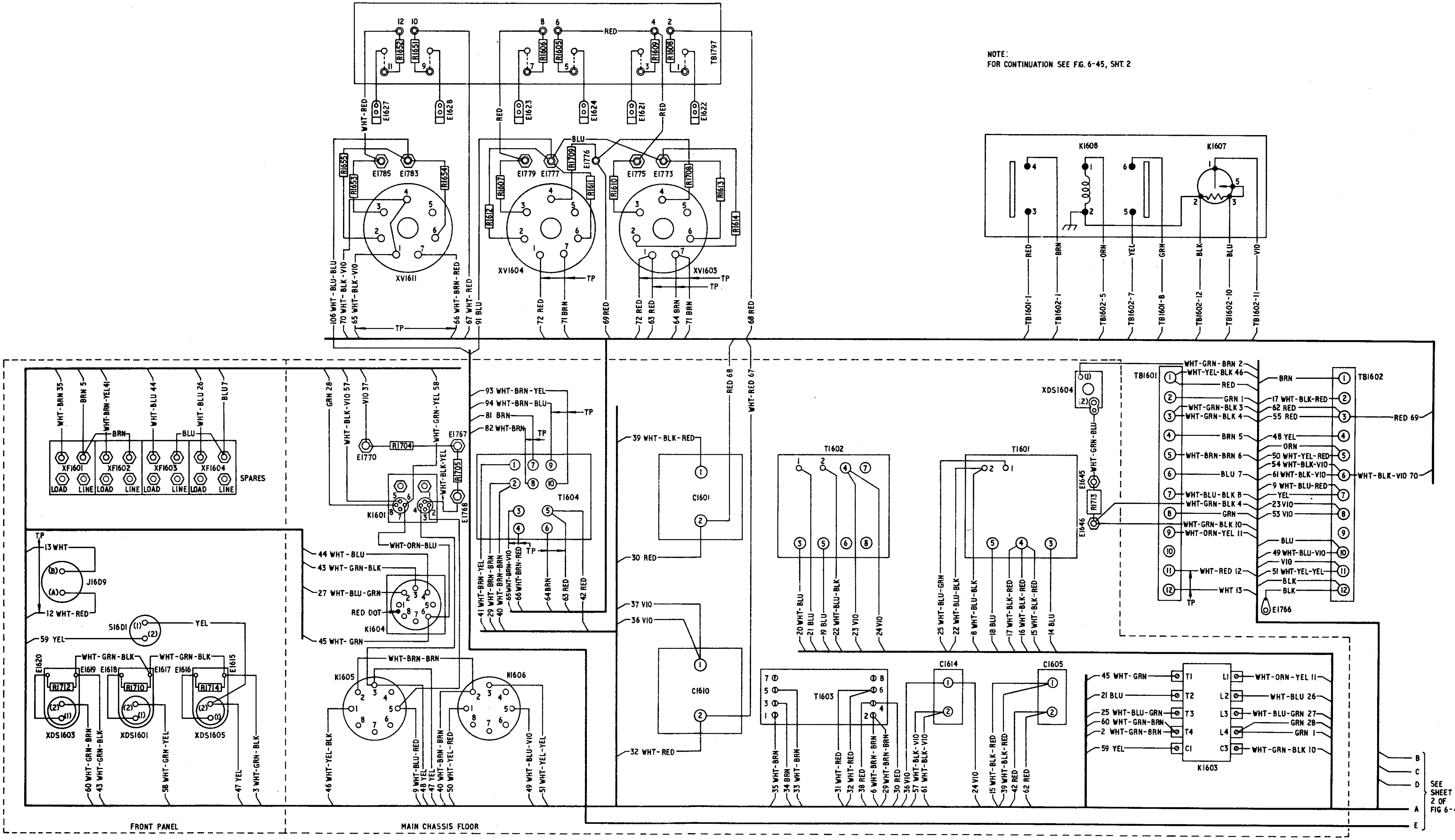


Figure 6-45a. Low Voltage Power Supply PP-1766/URN, Wiring Diagram (Replacement Test Equipment, Table 5-1a)

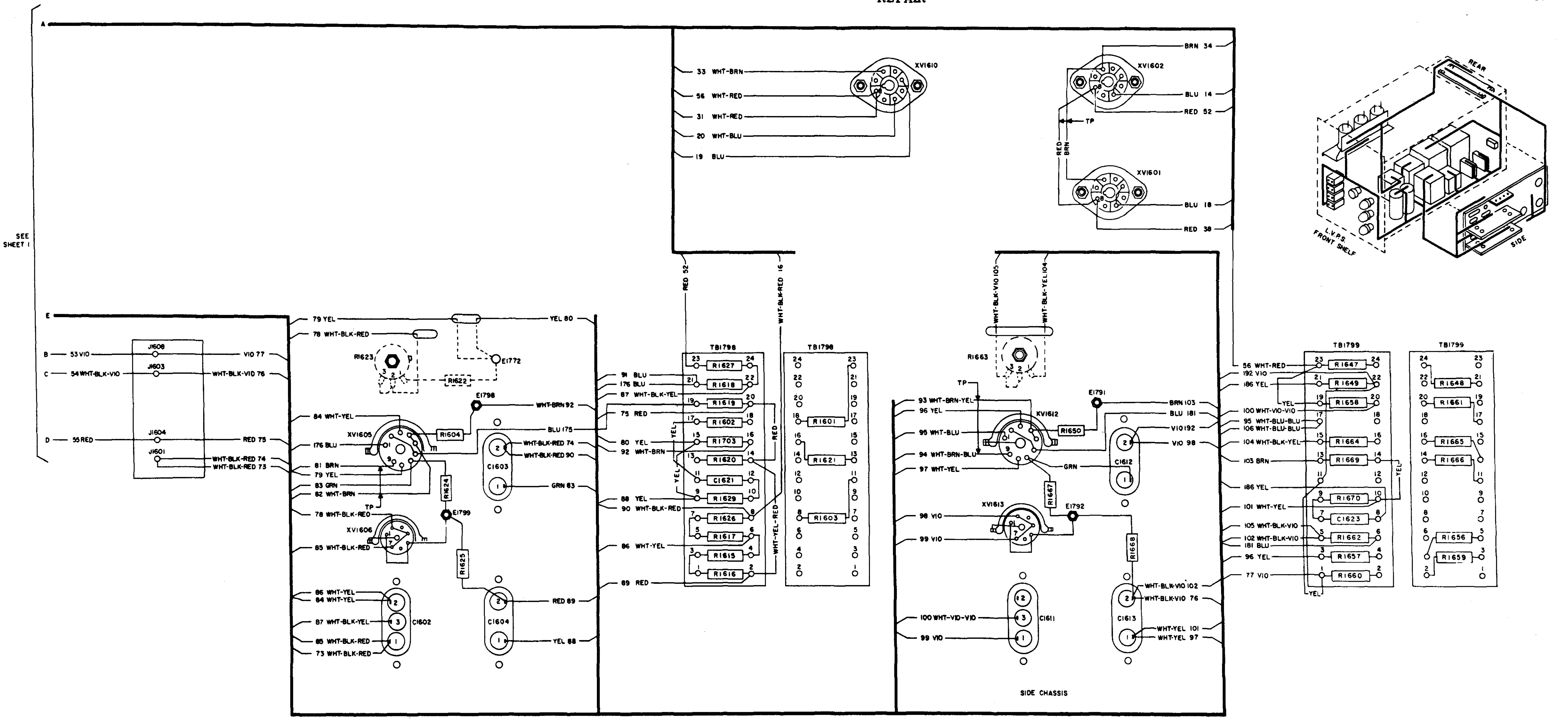


Figure 6-45. Low Voltage Power Supply PP-1766/URN, Wiring Diagram (Sheet 2 of 2)

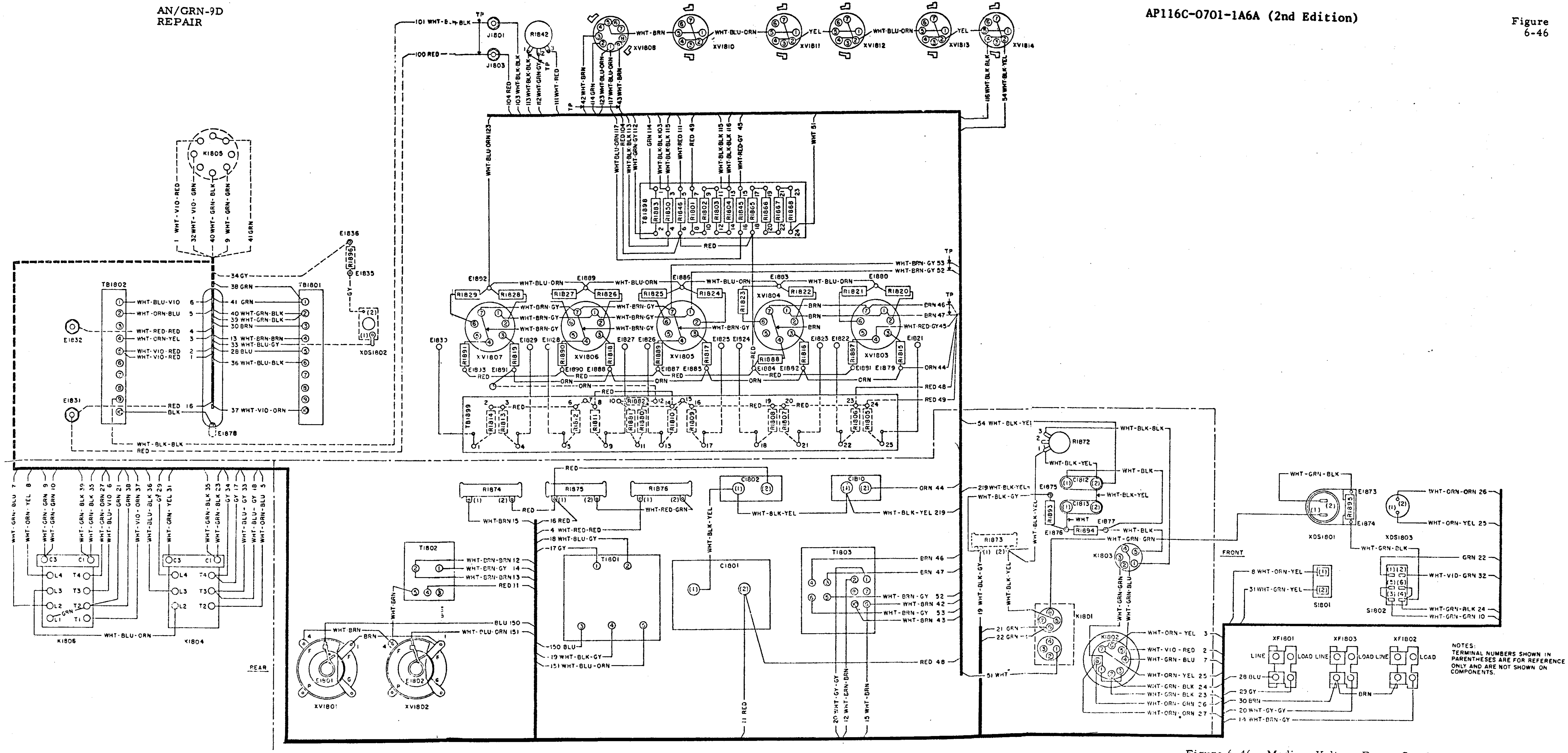
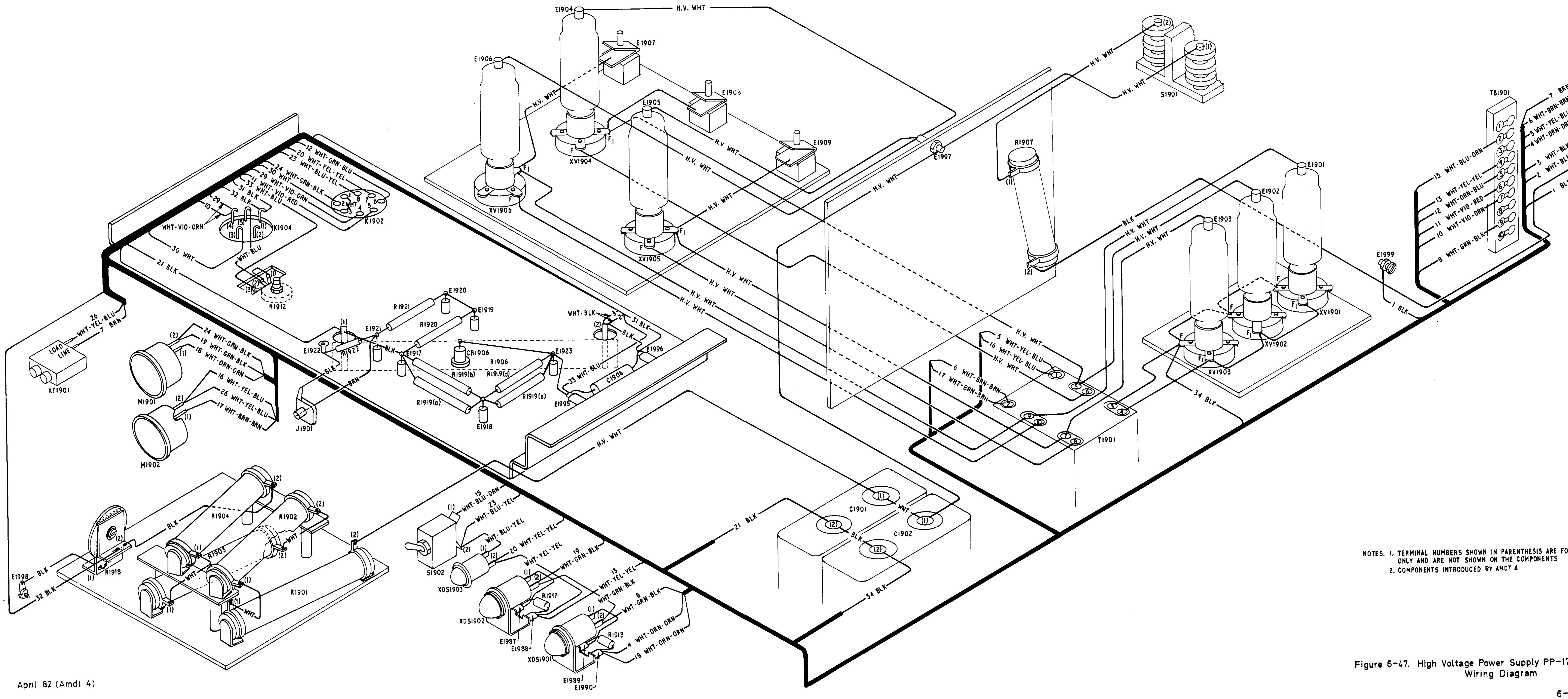


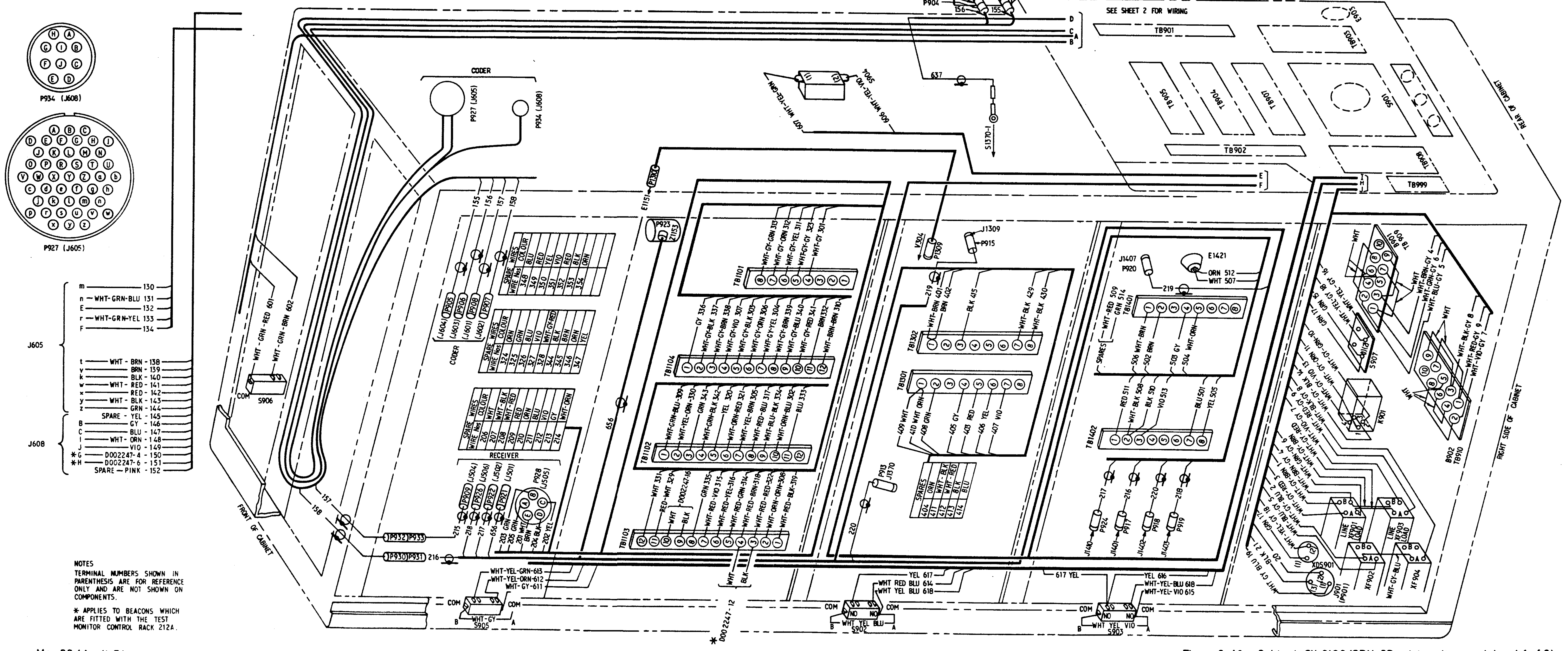
Figure 6-46. Medium Voltage Power Supply PP-1765/URN, Wiring Diagram

d. 940093/4306823/150 x 25/N.B. 1922/6-74



NOTES: 1. TERMINAL NUMBERS SHOWN IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT SHOWN ON THE COMPONENTS
2. COMPONENTS INTRODUCED BY AMDT 4

Figure 6-47. High Voltage Power Supply PP-1763/URN Wiring Diagram

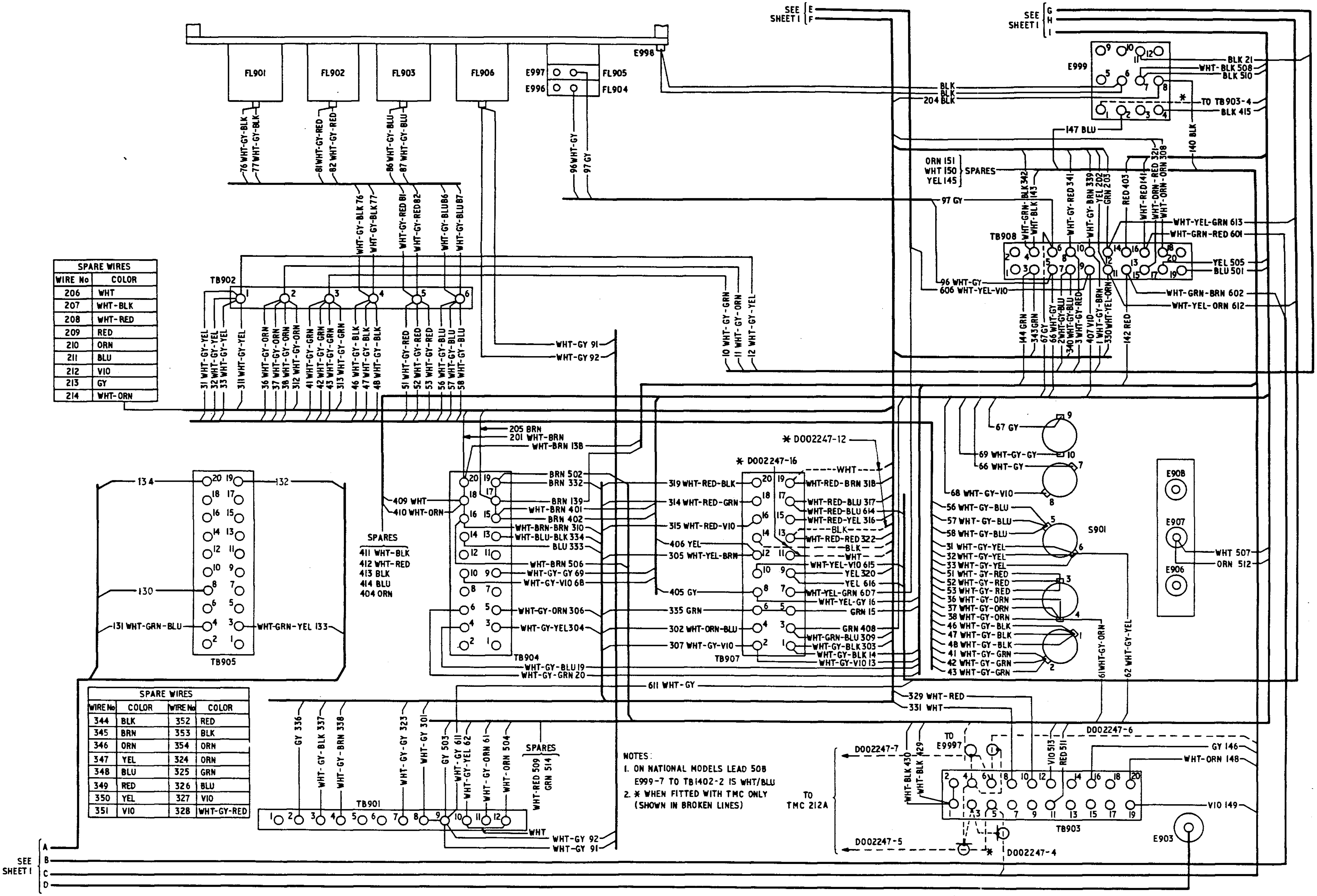


NOTES

TERMINAL NUMBERS SHOWN IN PARENTHESIS ARE FOR REFERENCE ONLY AND ARE NOT SHOWN ON COMPONENTS.

* APPLIES TO BEACONS WHICH ARE FITTED WITH THE TEST MONITOR CONTROL RACK 212A.

Figure 6-48 Cabinet CY-3163/GRN-9D, wiring diagram (sheet 1 of 2)



SPARE WIRES	
WIRE No	COLOR
206	WHT
207	WHT-BLK
208	WHT-RED
209	RED
210	ORN
211	BLU
212	VIO
213	GY
214	WHT-ORN

SPARE WIRES			
WIRE No	COLOR	WIRE No	COLOR
344	BLK	352	RED
345	BRN	353	BLK
346	ORN	354	ORN
347	YEL	324	ORN
348	BLU	325	GRN
349	RED	326	BLU
350	YEL	327	VIO
351	VIO	328	WHT-GY-RED

NOTES:

1. ON NATIONAL MODELS LEAD 508 E999-7 TO TB1402-2 IS WHT/BLU
2. * WHEN FITTED WITH TMC ONLY (SHOWN IN BROKEN LINES)

Figure 6-48. Cabinet CY-3163/GRN-9D. Wiring Diagram (Sheet 2 of 2)

NOTE :-
WIRES 127 GRN AND 201 ORN, CONNECTING TO TB 1003 TAGS 3 AND 9 RESPECTIVELY, ARE INTERCHANGED WHEN BEACON IS FITTED WITH THE TMC 212A EQUIPMENT RACK.

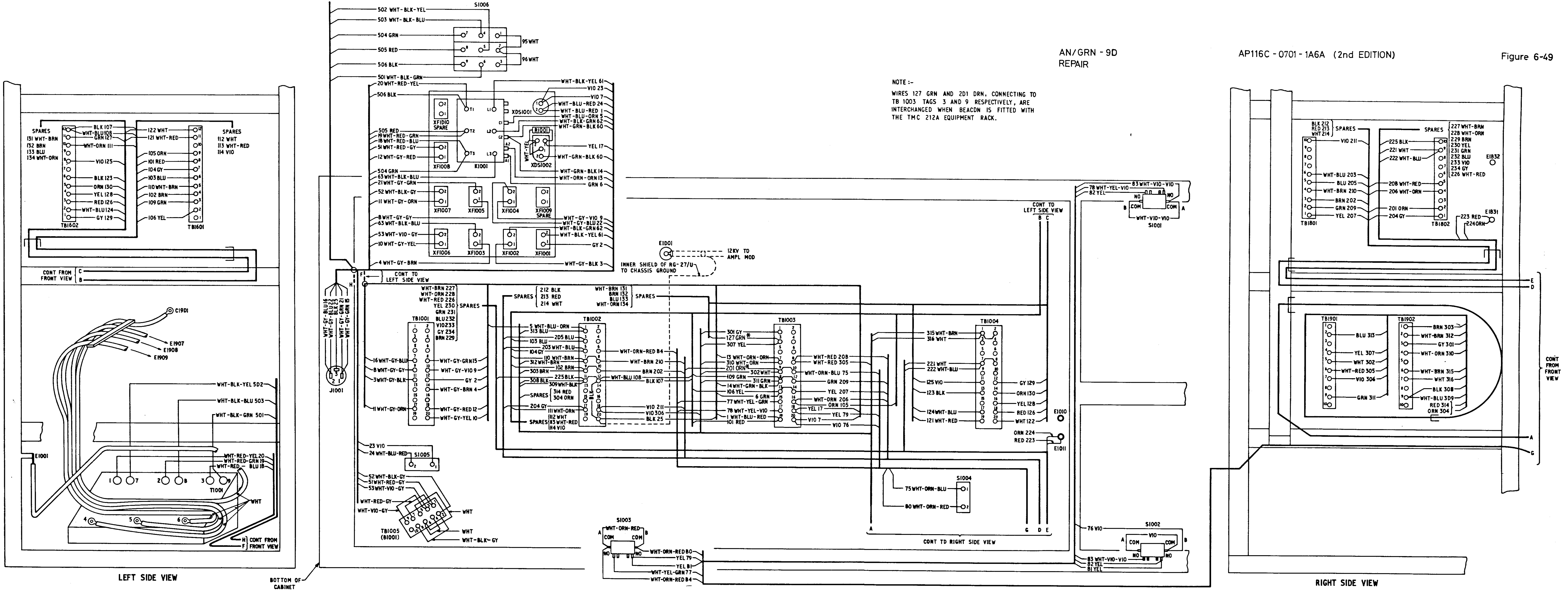


Figure 6-49 Cabinet CY-3164/GRN-9D Wiring Diagram

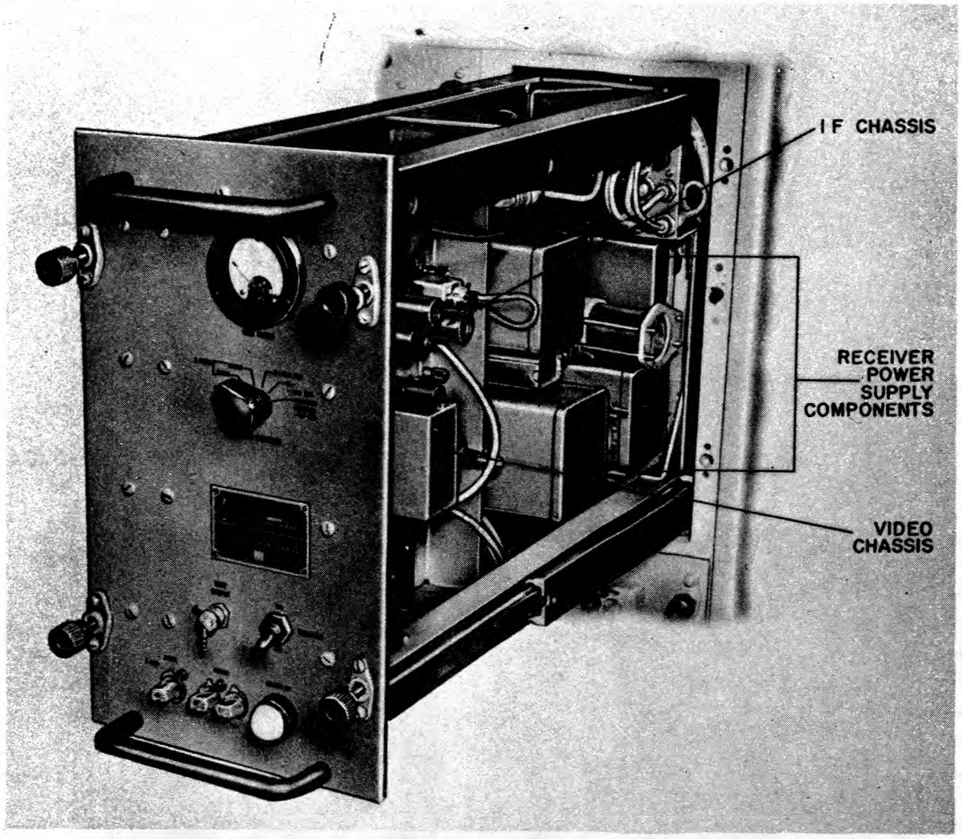


Figure 6-50. Radio Receiver R-824/URN, Overall View

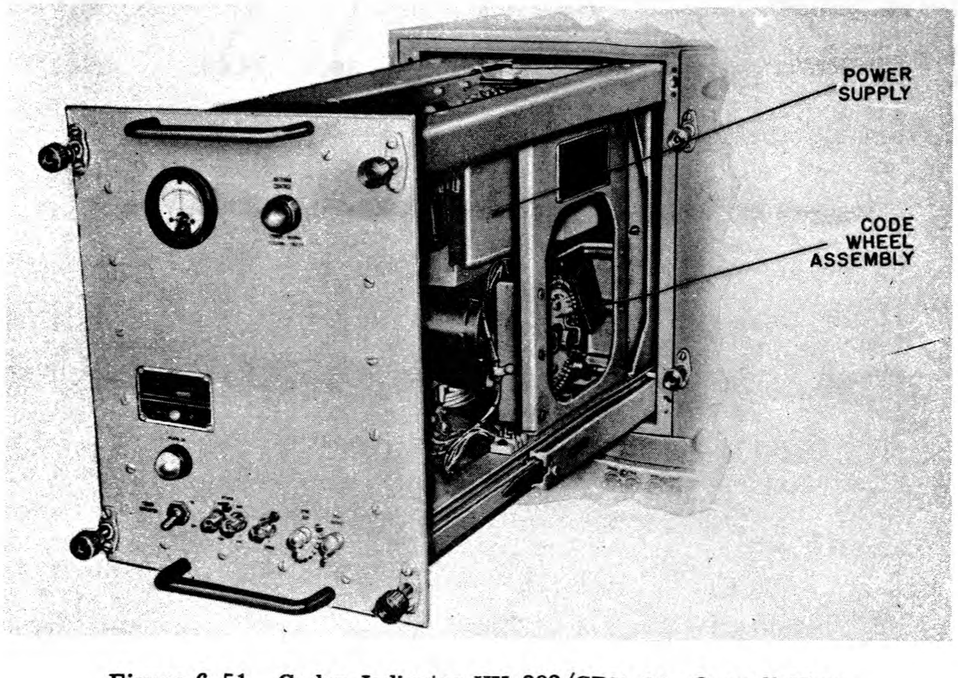


Figure 6-51. Coder-Indicator KY-382/GRN-9D, Overall View

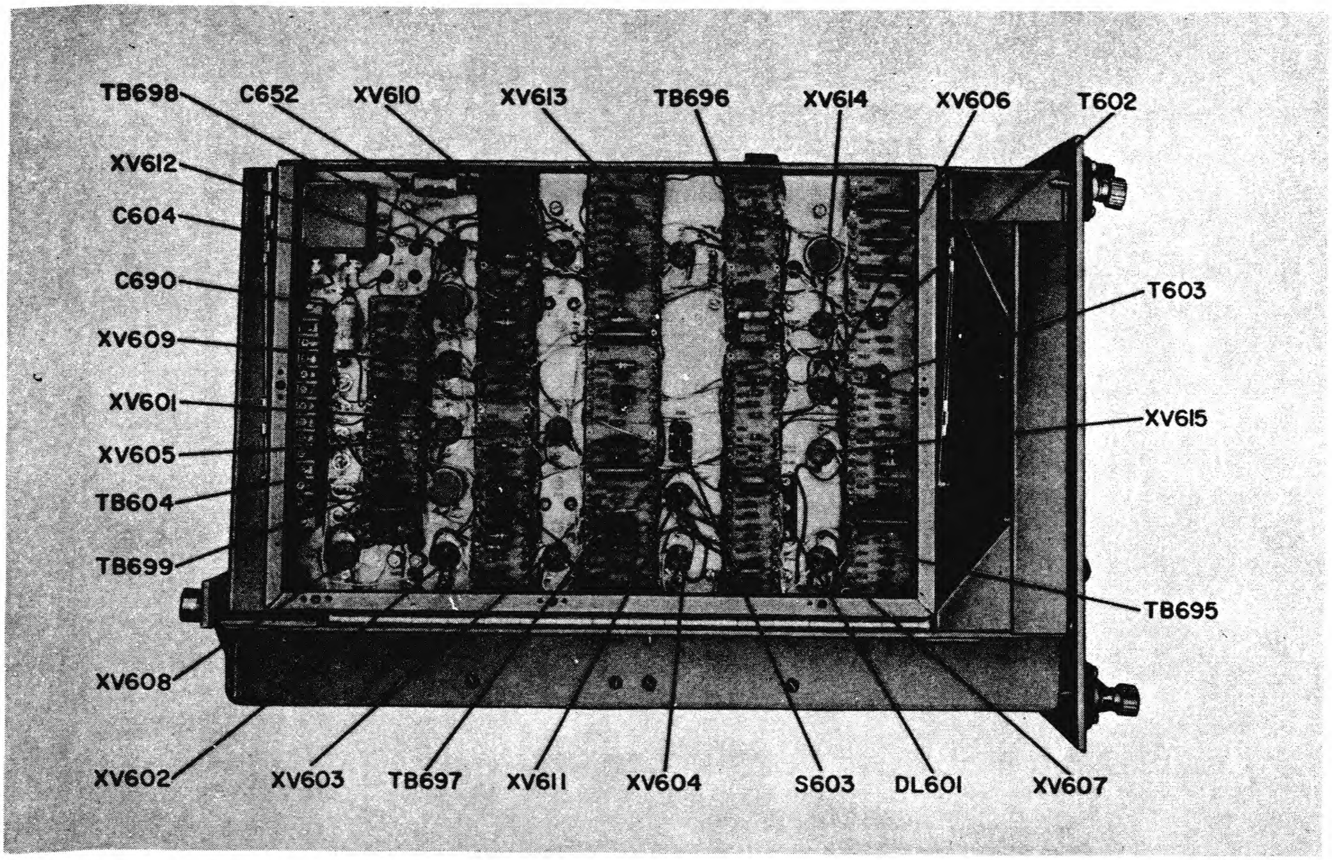


Figure 6-52. Coder-Indicator KY-382/GRN-9D, Left Side View

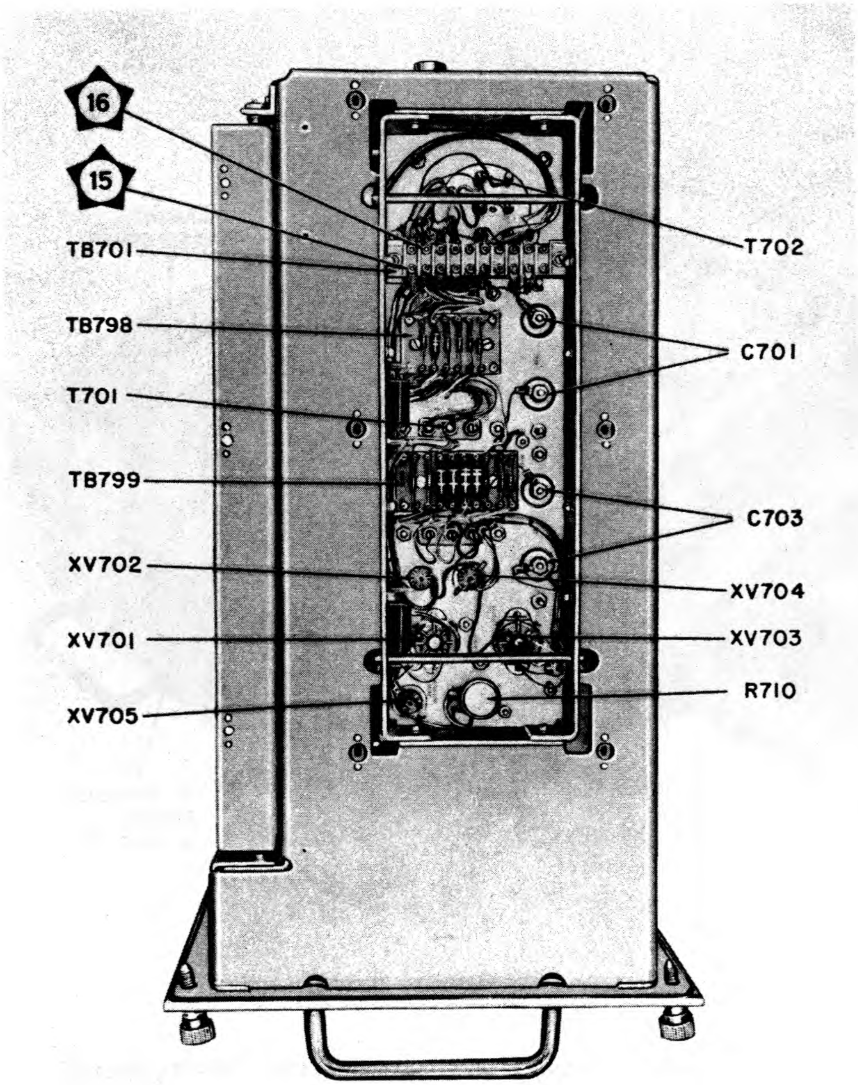


Figure 6-53. Coder-Indicator KY-382/GRN-9D, Top View

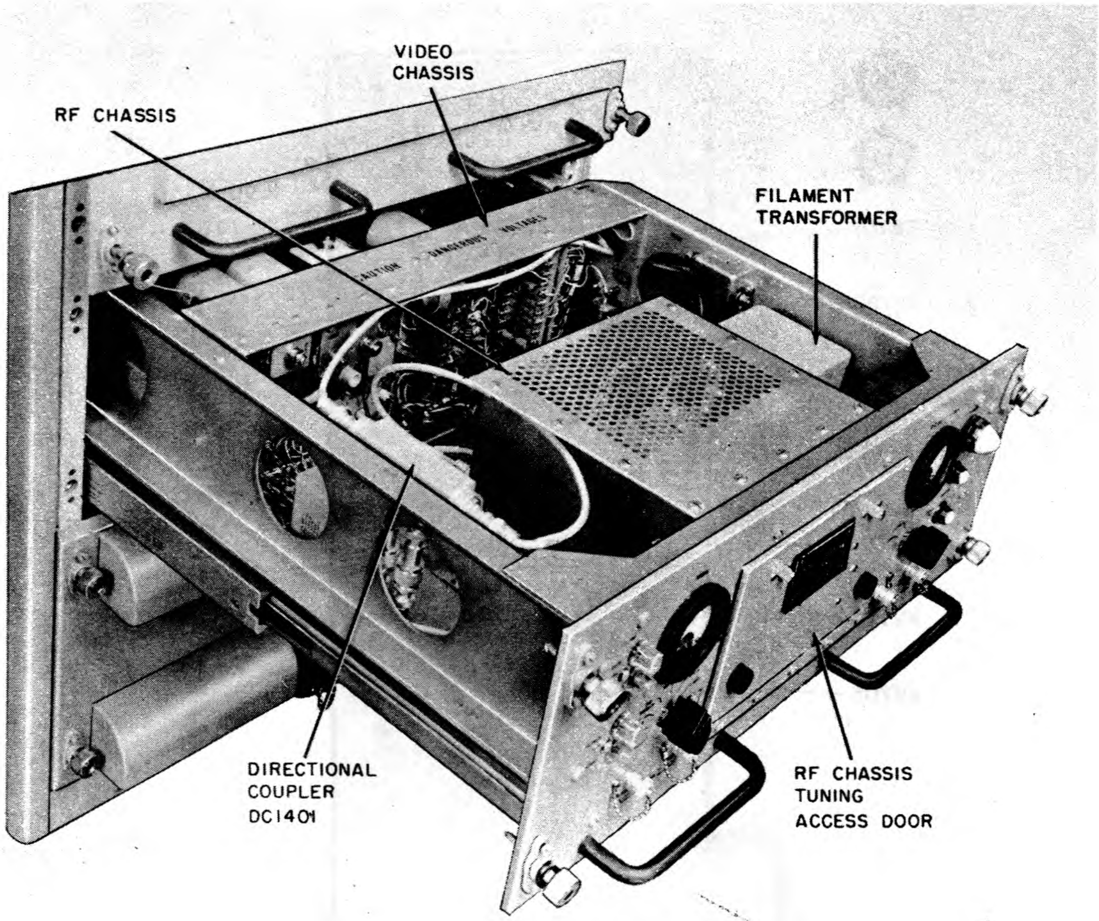


Figure 6-54. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Overall View

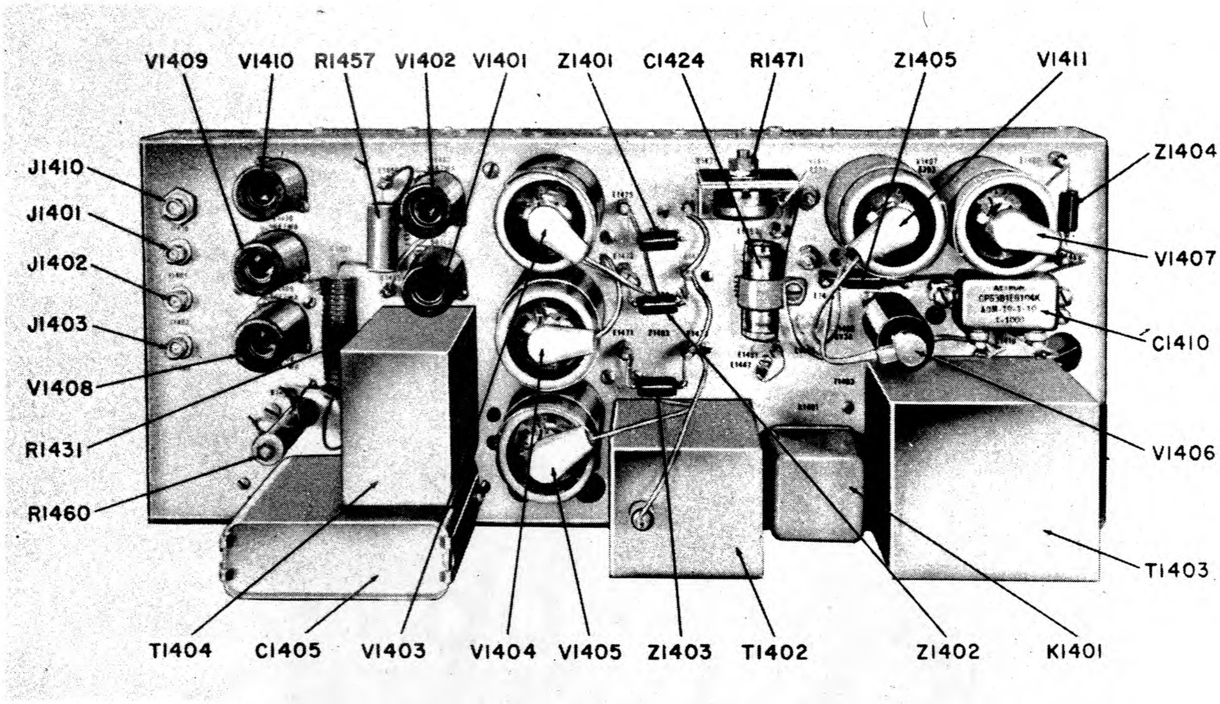


Figure 6-55. Frequency Multiplier-Oscillator CV-1171/GRN-9D, Video Chassis, Top View

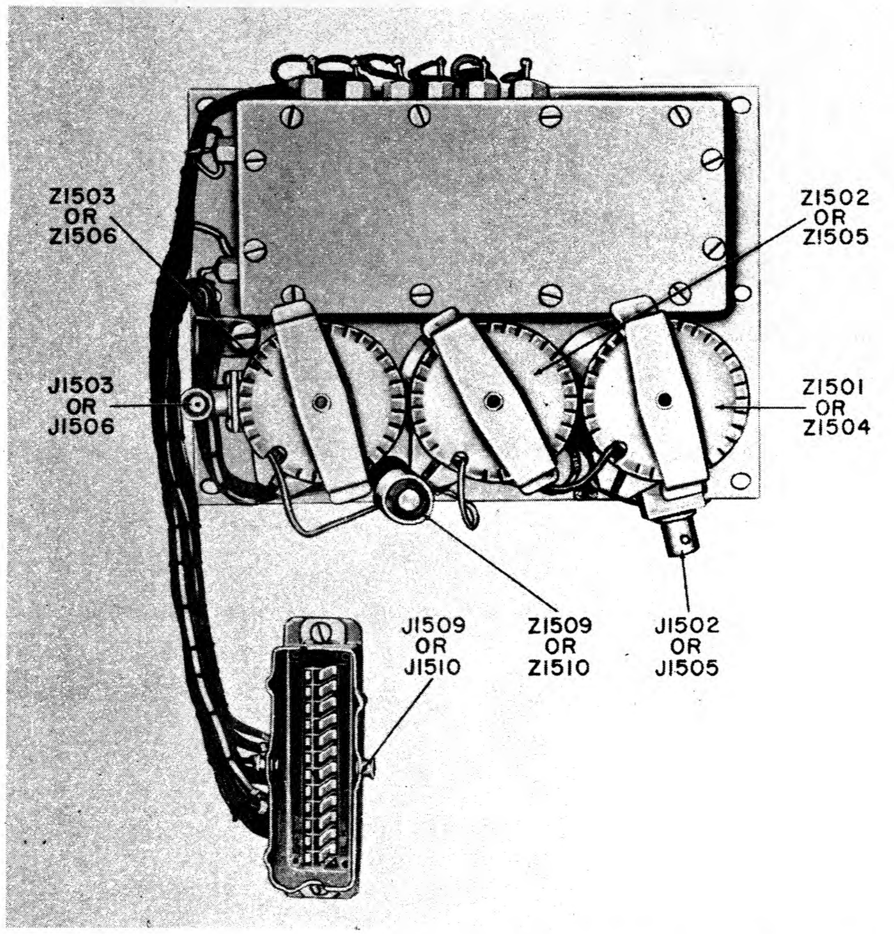


Figure 6-56. Frequency Multiplier-Oscillator R-F Chassis, Bottom View

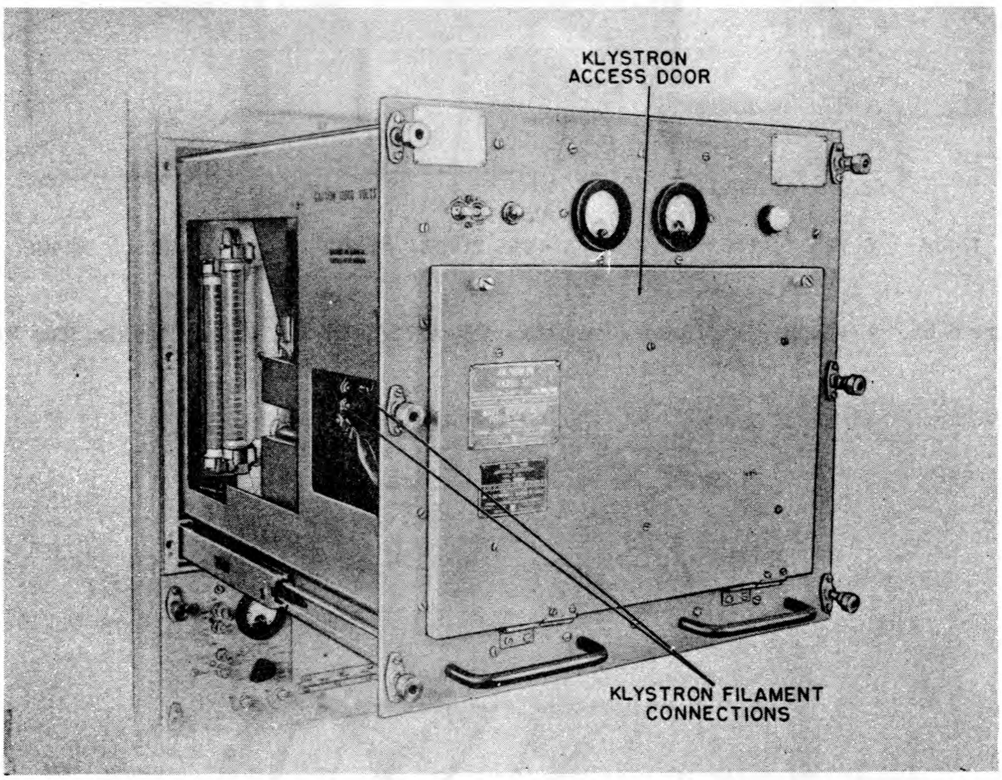


Figure 6-57. Amplifier-Modulator AM-1701/URN

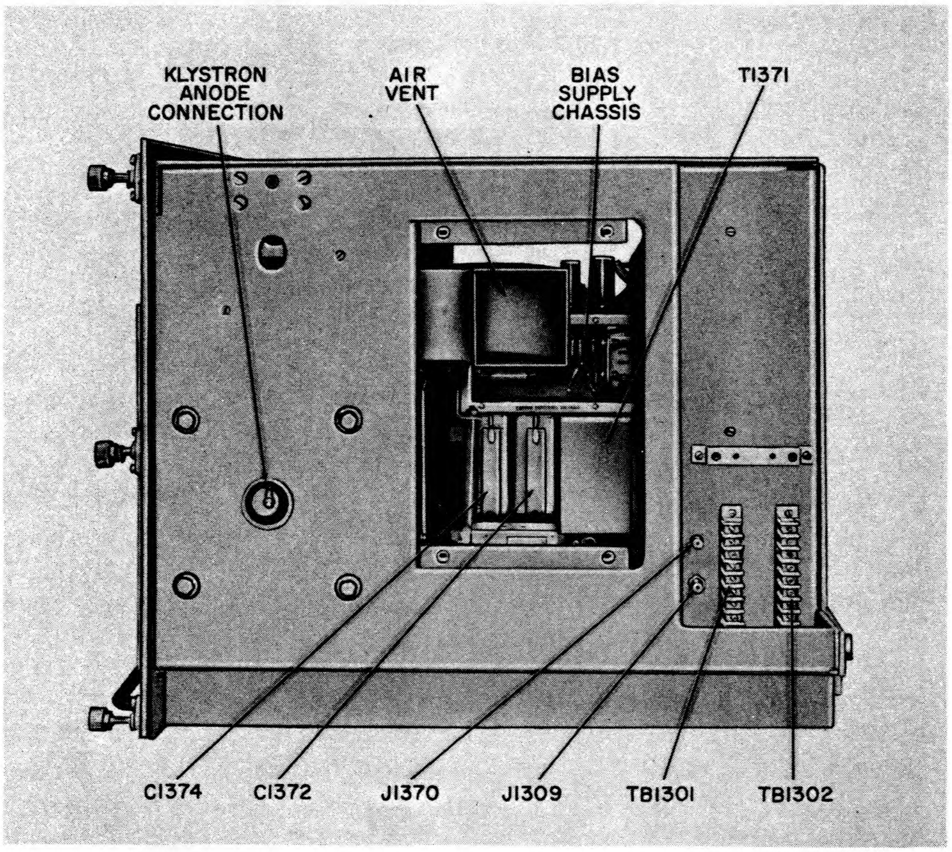


Figure 6-58. Amplifier-Modulator AM-1701/URN, Right Side View

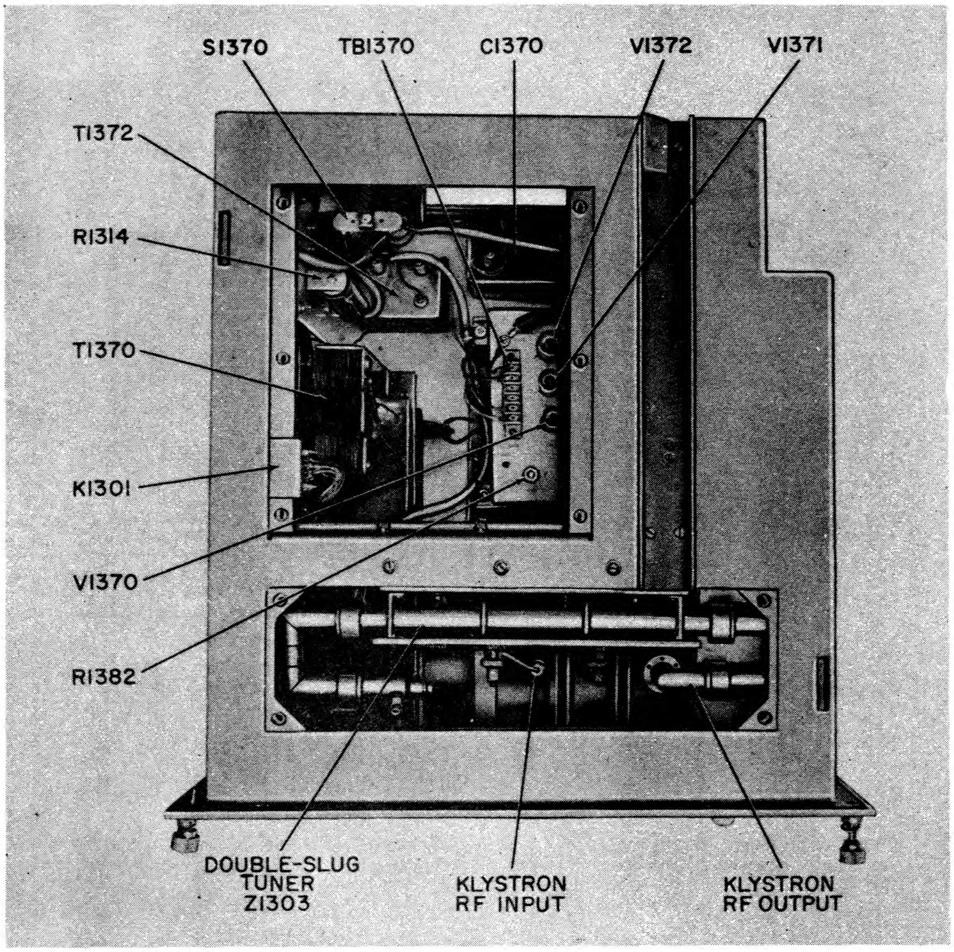


Figure 6-59. Amplifier-Modulator AM-1701/URN, Top View

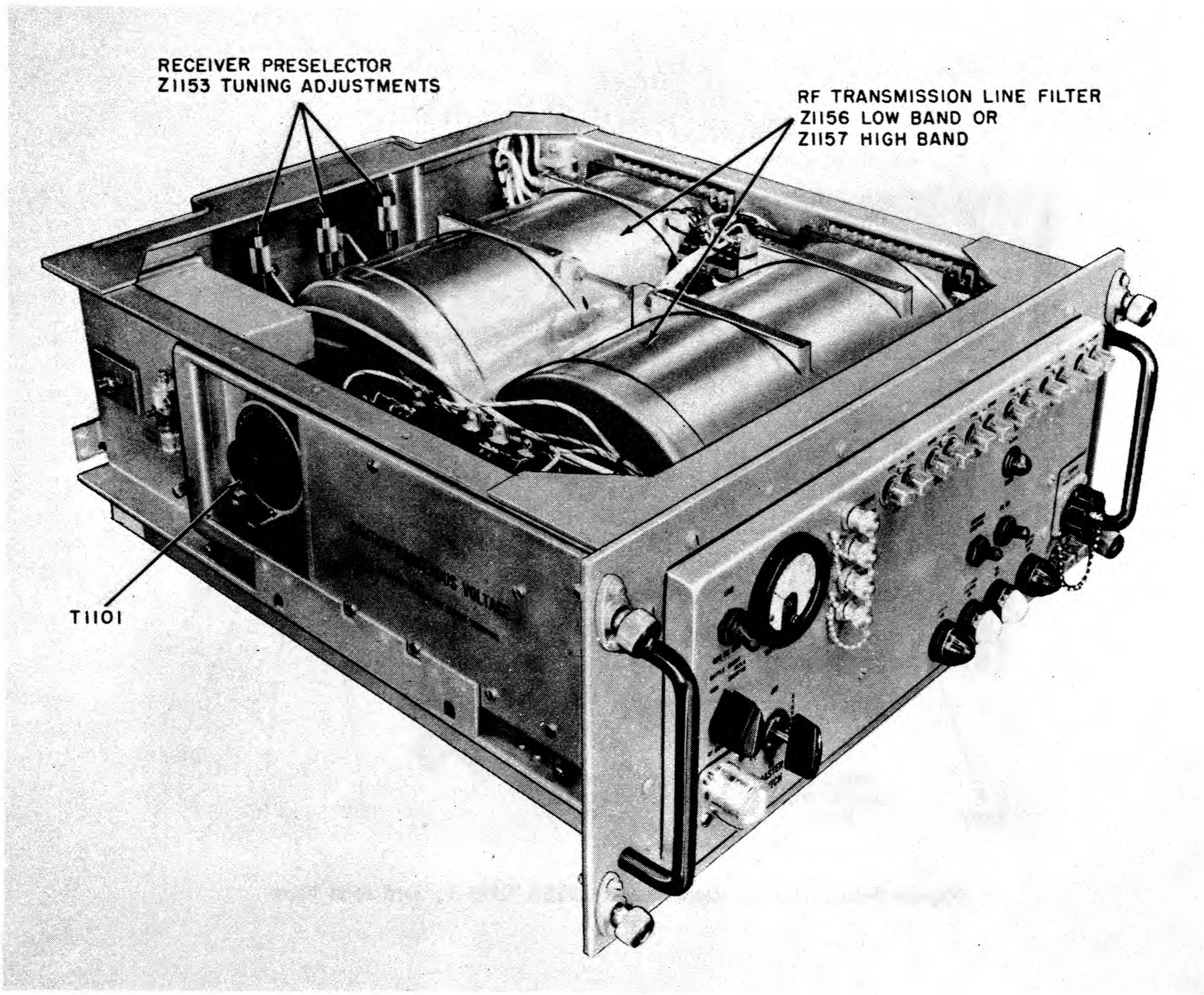


Figure 6-60. Control-Duplexer C-2226A/GRN-9

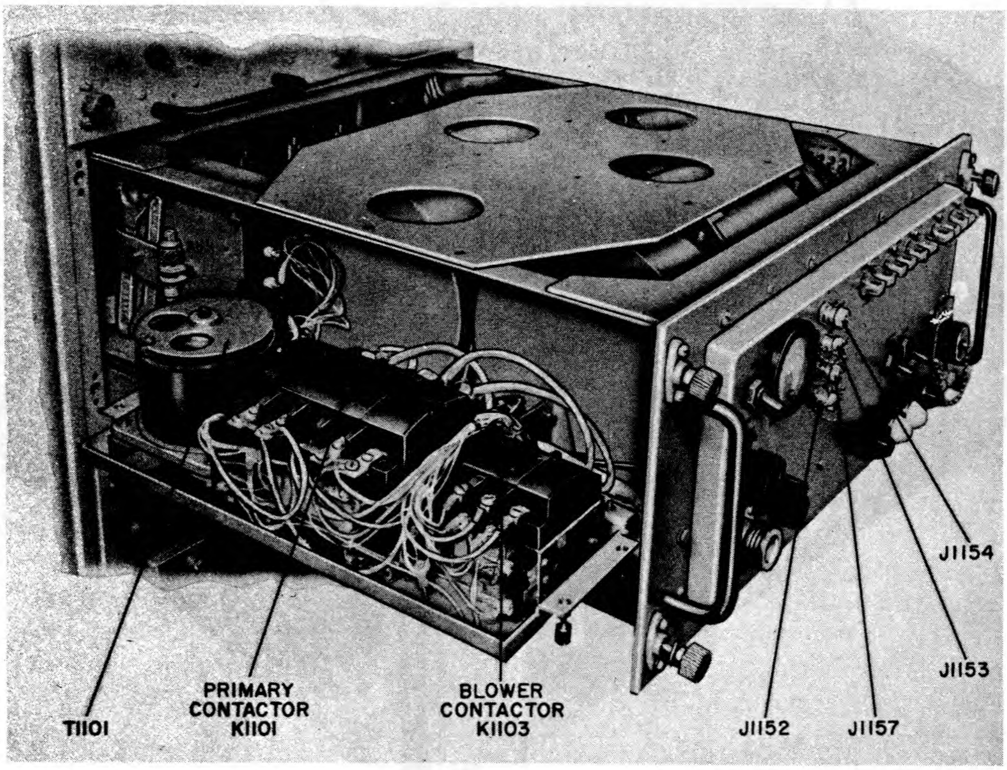


Figure 6-61. Control Duplexer C-2226A/GRN-9, Left Side View

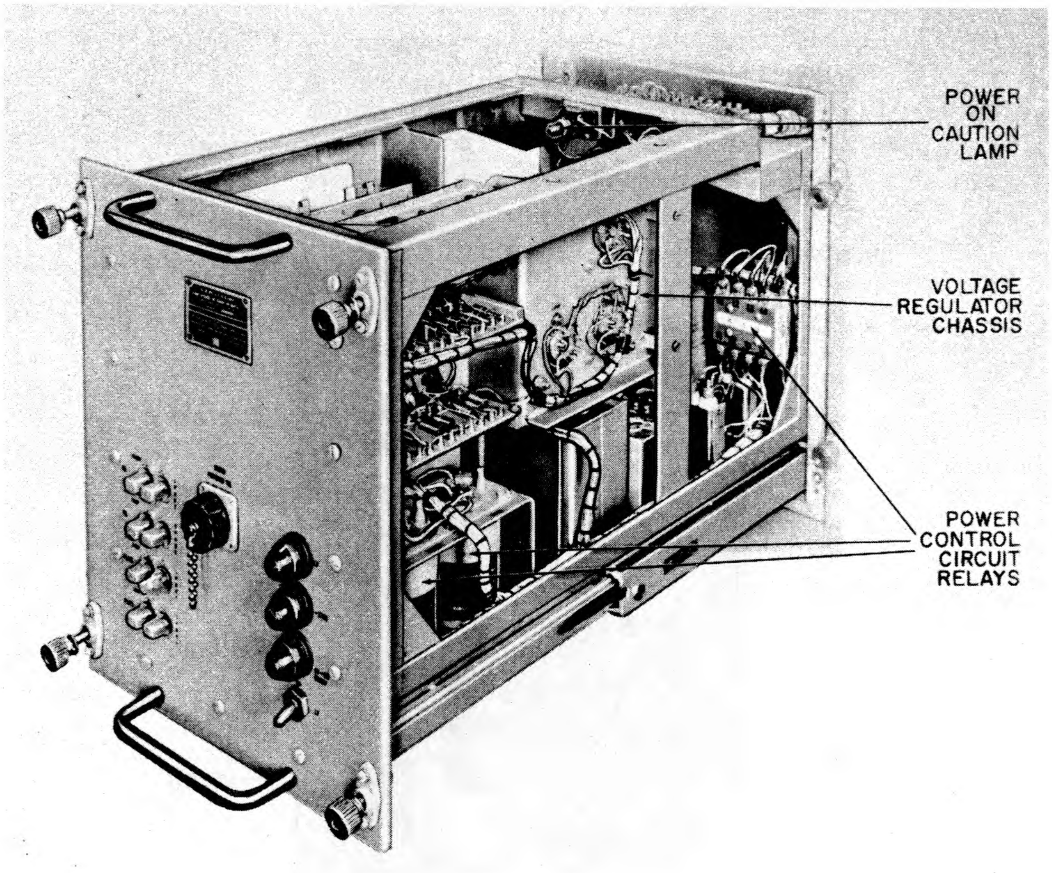


Figure 6-62. Low Voltage Power Supply PP-1766/URN, Overall View

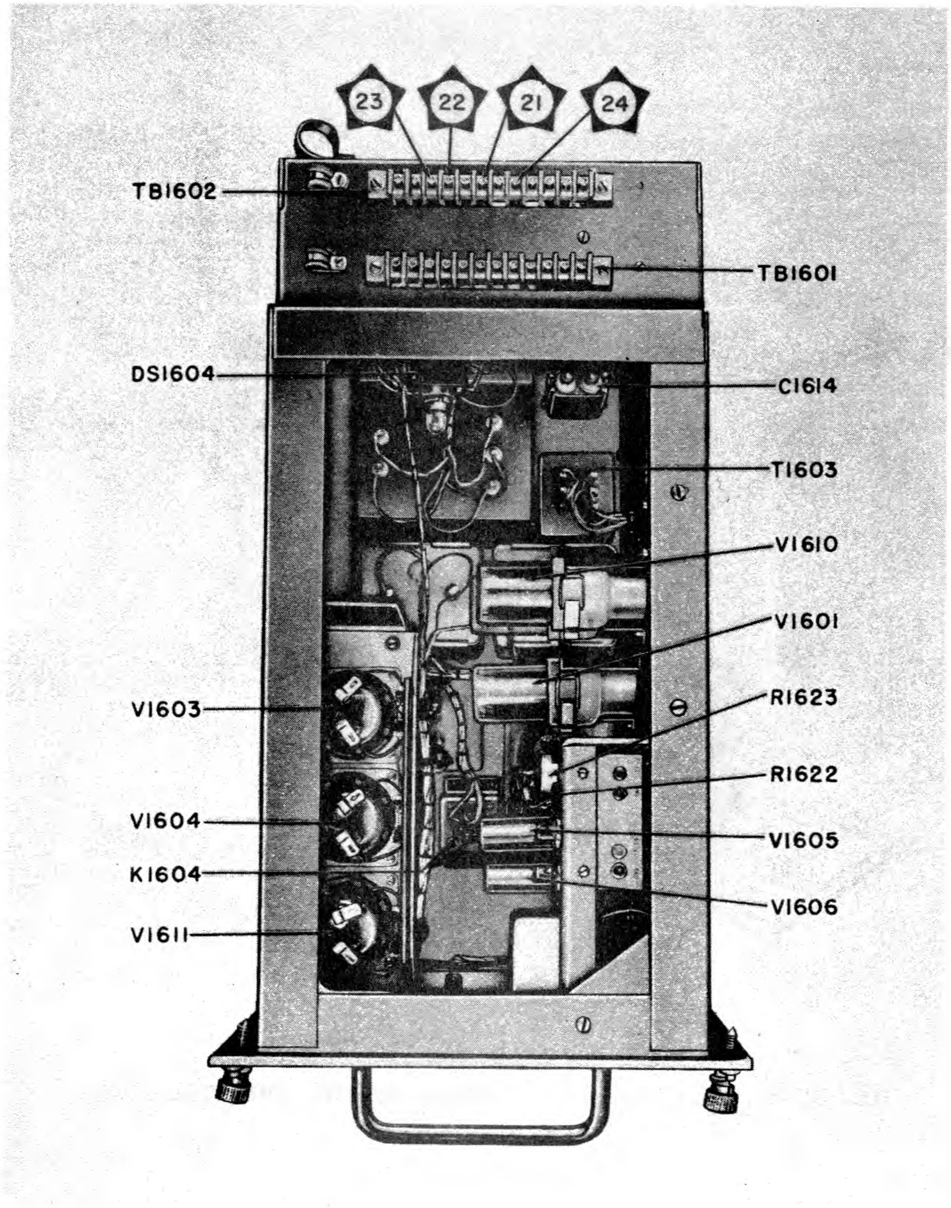


Figure 6-63. Low Voltage Power Supply PP-1766/URN, Top View

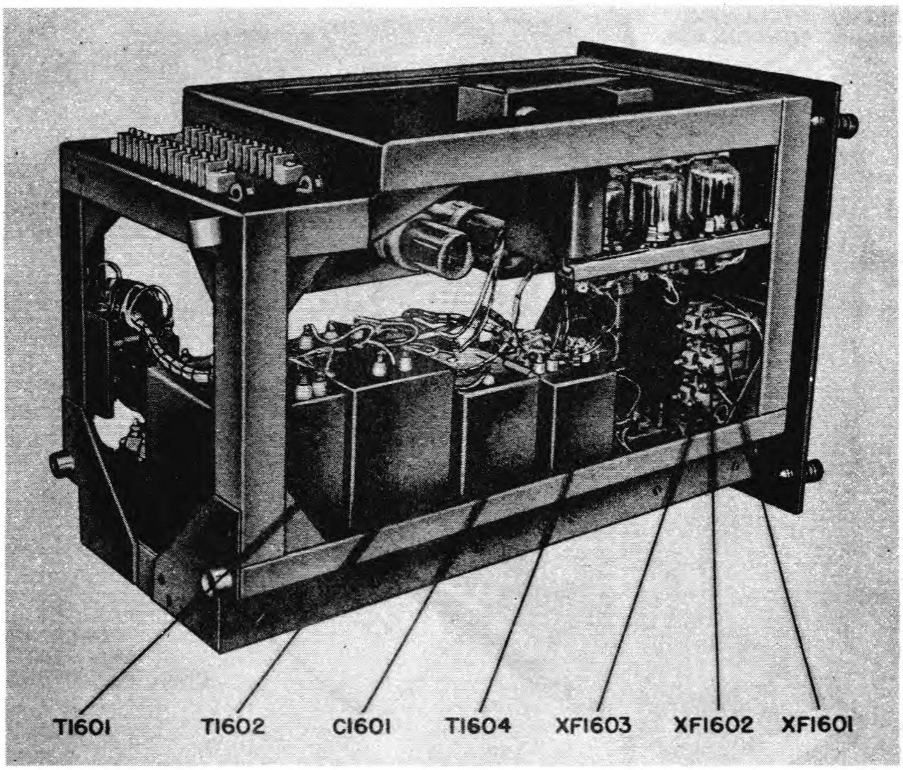


Figure 6-64. Low Voltage Power Supply PP-1766/URN, Rear Front View

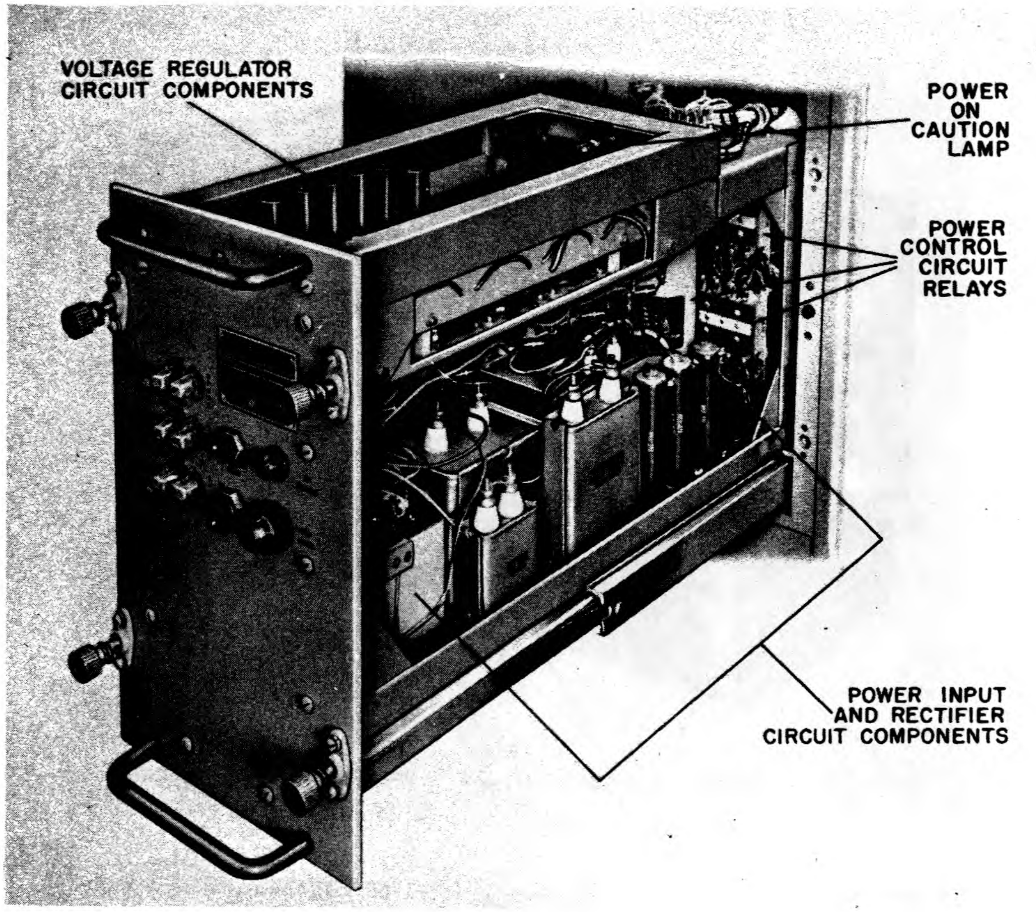


Figure 6-65. Medium Power Supply PP-1765/URN, Overall View

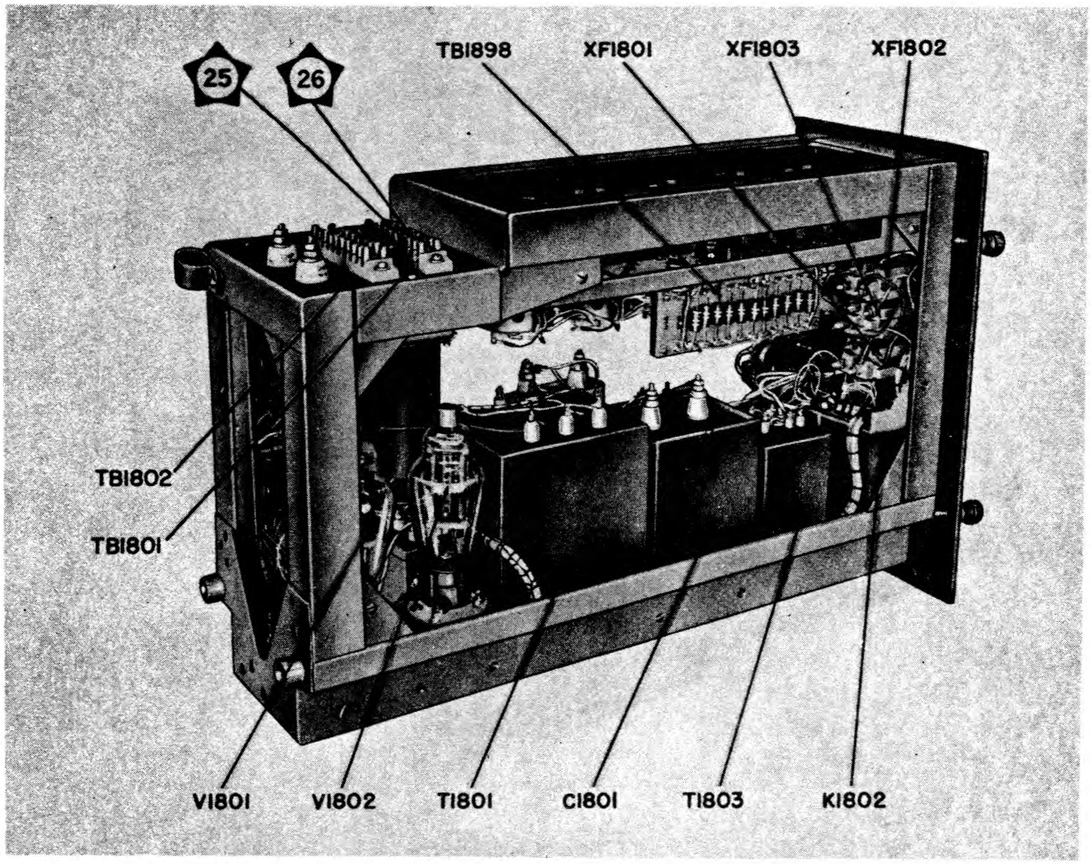


Figure 6-66. Medium Voltage Power Supply PP-1765/URN, Left Side View

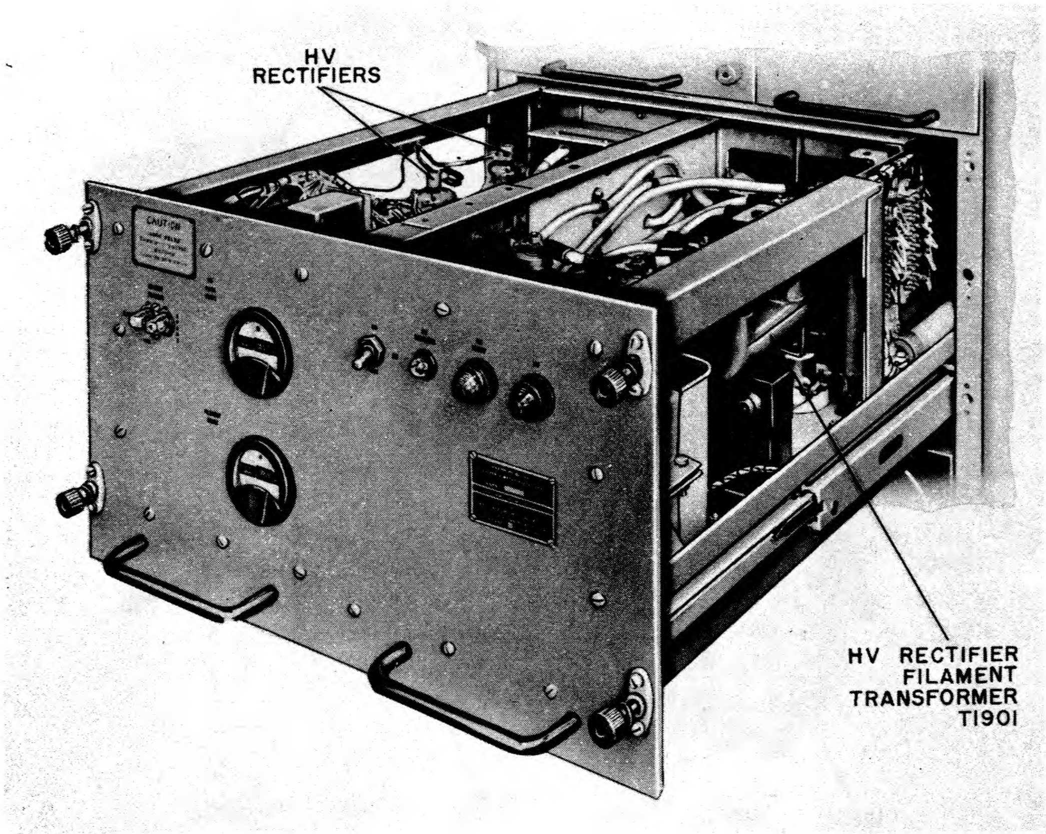


Figure 6-67. High Voltage Power Supply PP-1763/URN, Overall View

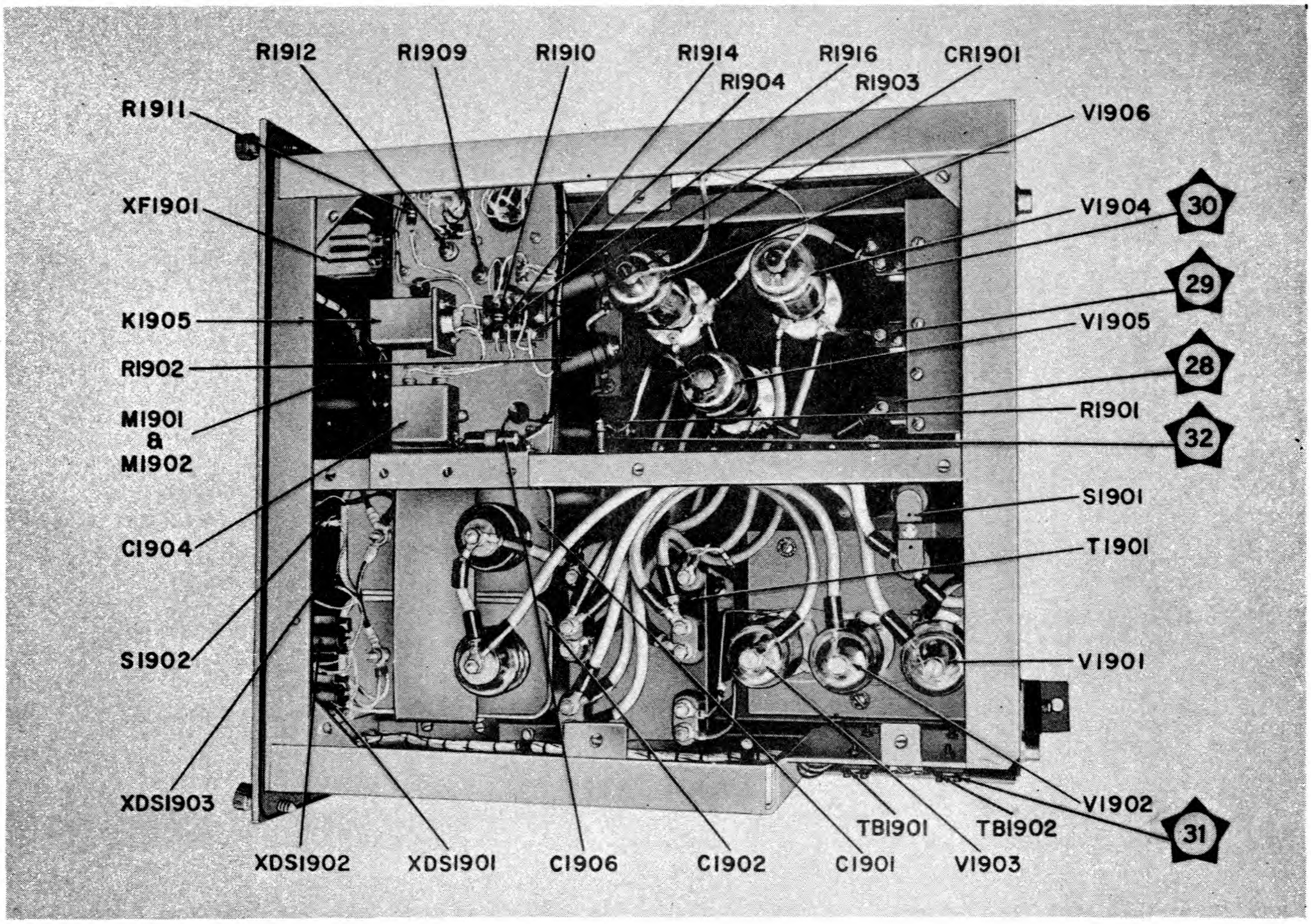


Figure 6-68. High Voltage Power Supply PP-1763/URN, Top View

SECTION 7
PARTS LIST

7-1. INTRODUCTION.

Reference designations (previously referred to as circuit symbol, reference symbol, etc.) have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams and the parts list. The letters of a reference designation indicate the kind of part (generic group) such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Parts of the first major unit are numbered from 201 to 599; parts of the second 601 to 799, etc. Two or more consecutive series of numbers have been assigned to major units in which there are more than one hundred parts of the same generic group. Sockets associated with a particular plug-in device, such as an electron tube or a fuse, are identified by reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F501 is designated XF501.

7-2. LIST OF MAJOR UNITS.

Table 7-1 is arranged by the groups of reference designations that apply to a major unit. Thus, if you know a part's reference designation, this table will give you a ready reference to the major unit it is in. The table also gives the following information for each major unit: (1) its common name (see column 5), as well as its official nomenclature (see columns 3 and 4); (2) quantity in one equipment and which equipment it is part of; and (3) location of its parts in Table 7-3.

7-3. LIST OF MAJOR UNITS BY COLLOQUIAL NAME.

Table 7-2 is arranged by the common name of major units. All major units are listed but the common name is only included when it differs from the official nomenclature. The table also locates the major unit's parts description in Table 7-3.

7-4. MAINTENANCE PARTS LIST.

Table 7-3 lists all major units and their maintenance parts. Each major unit's parts are grouped together. Column 1 lists the reference series of each major unit followed by the reference designations of the various parts in alphabetical and numerical order. Column 2 normally lists the applicable government stock numbers or supporting notes. New Stock Number Identification Tables (SNIT) issued by the Electronic Supply Office include Federal Stock Numbers and Source, Maintenance and Recoverability Codes. Therefore, reference shall be made to the SNIT for this information. Column 3 gives the name and describes the various parts. Complete information is given for all key parts (parts differing from any part previously listed in this table) and sub-key parts (parts identical with a key part but appearing for the first time for a major unit). The name and description are omitted for other parts. However, reference is made to the key part or sub-key part for the data. The manufacturer is listed by a five digit code number. For example, "21964 dwg #" means manufactured by ITT etc. Column 4 indicates how the part is used, gives its functional location in the equipment, and lists the figure number on which it is illustrated or called out.

7-5. LIST OF MANUFACTURERS.

Table 7-4 lists manufacturers of parts used in the equipment. The five digit numerical codes are those used in the Federal Supply system to identify the manufacturers.

7-6. NOTES.

The following provide additional information about items listed in Table 7-3.

1. Fabricate locally from bulk material having the stock number listed in SNIT.
2. Manufacture in a Navy Shop.
3. Will be procured on demand by the nearest Naval Shore Supply Activity.
4. Non-replaceable in this application. Listed for reference only.
5. Replace by adapting or modifying the standard item having the stock number listed in SNIT. Modify as indicated in the description.
6. Replace with the substitute part having the stock number listed in SNIT.
7. Low failure item; if required, requisition from ESO, referencing NAVSHIPS 900, 180C.
8. Assemble from component parts.

TABLE 7-1. RADIO SET AN/GRN-9D, LIST OF MAJOR UNITS

REF. DESIGNATION	QUANTITY AN/GRN-9D	NAME OF MAJOR UNIT	DESIGNATION	COLLOQUIAL NAME	PAGE
	1	RECEIVER-TRANSMITTER GROUP	OA-3352/GRN-9D		7-5
201-599	1	Radio Receiver	R-824/URN	Receiver	7-5
601-799	1	Coder-Indicator	KY-382/GRN-9D		7-35
1101-1199	1	Control-Duplexer	C-2226A/GRN-9D		7-71
1301-1399	1	Amplifier-Modulator	AM-1701/URN		7-82
1401-1599	1	Frequency Multiplier-Oscillator	CV-1171/GRN-9D		7-90
901-999	1	Electrical Equipment Cabinet	CY-3163/GRN-9D		7-58
	1	POWER SUPPLY ASSEMBLY	OA-1537A/GRN-9A		7-5
1601-1799	1	Power Supply	PP-1766/URN	Low Voltage Power Supply	7-121
1801-1899	1	Power Supply	PP-1765/URN	Medium Voltage Power Supply	7-133
1901-1999	1	Power Supply	PP-1763/URN	High Voltage Power Supply	7-144
1001-1099	1	Electrical Equipment Cabinet	CY-3164/GRN-9D		7-65

TABLE 7-2. RADIO SET AN/GRN-9D, LIST OF MAJOR UNITS BY COLLOQUIAL NAME

COLLOQUIAL NAME	NOMENCLATURE	PAGE
	RECEIVER-TRANSMITTER GROUP, OA-3352/GRN-9D	7-5
Receiver	Radio Receiver R-824/URN	7-5
	Coder-Indicator, KY-382/GRN-9D	7-35
	Control-Duplexer, C-2226A/GRN-9	7-71
	Amplifier-Modulator AM-1701/URN	7-82
	Frequency Multiplier-Oscillator, CV-1171/GRN-9D	7-90
	Electrical Equipment Cabinet, CY-3163/GRN-9D	7-58
	POWER SUPPLY ASSEMBLY, OA-1537A/GRN-9A	7-5
Low Voltage Power Supply	Power Supply PP-1766/URN	7-121
Medium Voltage Power Supply	Power Supply PP-1765/URN	7-133
High Voltage Power Supply	Power Supply PP-1763/URN	7-144
	Electrical Equipment Cabinet, CY-3164/GRN-9D	7-65

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
		RADIO SET, AN/GRN-9D: major components c/o 1, Receiver-Transmitter Group, 1, Power Supply Assembly, 21964 #B1068498	Figure 1-1
		RECEIVER-TRANSMITTER GROUP OA-3352/GRN-9D: major components c/o 1, Radio Receiver, R-824/URN; 1, Coder-Indicator, 1, Control-Duplexer, 1, Amplifier-Modulator, AM-1701/URN; 1, Frequency Multiplier-Oscillator, Electrical Equipment Cabinet, 21964 A+O #A1068487G1	Part of Radio Set AN/GRN-9D Figure 1-2
		POWER SUPPLY ASSEMBLY OA-1537A/GRN-9A: major components c/o 1, Power Supply, PP-1766/URN (Low Voltage); 1, Power Supply PP-1765/URN (Medium Voltage); 1, Power Supply PP-1763/URN (High Voltage); 1, Electrical Equipment Cabinet, 21964 #A1068706G1	Part of Radio Set AN/GRN-9D Figure 1-3
201-599		RECEIVER, RADIO R-824/URN: reception, Ref Dwg Group 5, frequency data, 1025 to 1150 mc for channel center frequency (1024. 5 mc to 1150. 5 mc including channel width) 126 channels, each channel 1 mc apart from 1025 mc to 1150 mc inclusive; operating power requirements AC 117 v or 120 v; 60 cycles, single phase, 200 watts: rack mounting, with pull-out slides, front access only; overall dim. 27" lg., 17-1/2" wide, 9-1/2" high; 26 electron tubes plus 7 crystal diodes; superheterodyne circuit; no plug-in coils; frequency of the local oscillator controlled by direct crystal multiplication; local oscillator located externally; generates random noise pulses which triggers the transmitter in the absence of interrogation pulses; adjacent channel rejection by means of Ferris Discriminator; drives the Coder-Indicator with 2700 pulses per second and provides an isolated output of the same information for future air-to-ground services; 21964 dwg H2060002 and A2060002	Part of Receiver-Transmitter Group Figure 6-50
C201		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 $\mu\mu f$, ±20%; 500 v DC working; variable temp coef; MIL type CK70A102M per MIL-C-11015; 21964 dwg #A9010576-1	Bypass
C202		Same as C201	Bypass
C203		Same as C201	Bypass
C204		Same as C201	Bypass
C205		Same as C201	Bypass
C206		Same as C201	Bypass
C207		Not Used	
C208		CAPACITOR, FIXED, MICA DIELECTRIC: 15 $\mu\mu f$ ±10%; 300 v DC -100 to +100/Million/°C; MIL type CB11RD150K, per spec MIL-C-10950A; 21964 dwg #A9010542-2	RF bypass
C209		Same as C208	RF bypass
C210	6	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 680 $\mu\mu f$ +100-20 tolerance; 500 v DC variable temp coef; MIL type CK21W681Z per spec MIL-C-11015A; 21964 dwg #A9010573-1	Coupling
C211	6	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 $\mu\mu f$ ±20%; 500 v DC variable temp coef; 323-04-S; MIL-C-11015A for electrical performance only; 21964 dwg #A2060351-1	Bypass
C212		Same as C211	Bypass

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C213		Same as C211	Bypass
C214		Same as C210	Coupling
C215		Same as C211	Bypass
C216		Same as C211	Bypass
C217		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 47 $\mu\mu$f ±2%, 500 v DC working; 750 $\mu\mu$f/μf Dec CNE; JAN type CC21UJ4-70G per spec JAN-C-20A; 21964 dwg #A9142374-5	Coupling
C218		Same as C211	Bypass
C219		Same as C211	Bypass
C220		Same as C211	Bypass
C221		CAPACITOR, FIXED, MICA DIELECTRIC: 150 $\mu\mu$f ±2%; 300 v DC working; CB21PX151G per MIL-C-10950A; 21964 dwg #A9010543-1	Tuning
C222		Same as C210	Bypass
C223		Sameas C211	Bypass
C224		Same as C211	Bypass
C225		Same as C201	Bypass
C226		Same as C201	Bypass
C227		Same as C201	Bypass
C228		Same as C201	Bypass
C229 Cont See C301		Same as C210	Coupling
CR201		SEMI-CONDUCTOR DEVICE, DIODE: JAN type 1N21C per spec MIL-E-1C; 21964 #700224	Mixer
CR202 Cont See CR401		Same as CR201	Mixer
E201	5	SHIELD, ELECTRON TUBE: JAN type TS-102U01 per spec JAN-S28A, modified 21964 #A2132988-1	Shield for V201
E201A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U01; MIL-STD-242A type #701, 21964 #A2132886-1	Insert for E201
E202	5	SHIELD, ELECTRON TUBE: JAN type TS-102U02 per spec JAN-S28A, modified 21964 dwg #A2132988-2	Shield for V202
E202A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U02; MIL-STD-242A type #702; 21964 #A2132886-2	Insert for E202
E203		Same as E201	Shield for V203
E203A Cont See E301		Same as E201A	Insert for E203

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J201		CONNECTOR, RECEPTACLE ELECTRICAL: 1 contact, female, right angle; series N; MIL type UG-997A/U per Navy dwg; REB 49245; 21964 #A21330-30	LO input
J202		Same as J201	Signal Input
J203		CONNECTOR, RECEPTACLE ELECTRICAL: 1 round female contact; MIL type UG-1094/U BNC Series, "D" hole mounting, per Navy dwg REB 49063; 21964 dwg #A2131937	IF output
J204 Cont See J301		CONNECTOR, RECEPTACLE ELECTRICAL: 14 female contacts, straight type; current up to 5 amp; 81312 MRE-14SG per spec MIL-C-8384; 21964 dwg #A9010581	IF pre-amp power Figure 6-3
L201		COIL, INTERMEDIATE FREQUENCY: single winding, single layer, close wound; 60 turns, #34E wire; 3.0 uh ±10% at 7.9 mc ±0.5%; o/a 1/2" lg., 0.125" dia., per spec MIL-C-15305A; 21964 #A9010281-1	IF filter
L202		Same as L201	IF filter
L203		Same as L201	IF filter
L204		Same as L201	IF filter
L205		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound; 56 turns; of #34E wire, 4.55 uh ±5% at 7.9 mc ±0.5; o/a dim. 1/2" lg., 0.156" dia, per spec MIL-C-15305A; 21964 #A9010281-2	Neutralizing
L206		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 6-3/4 turns of 26E wire; iron powered core, adjustable; 0.27 uh ±5% with no slug, 0.28 uh min to 0.38 uh max. with slug at 40 mc ±0.5%; per spec MIL-C-15305A; 21964 #A9010283-1	Tuning
L207		Coil, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 28 turns of #30E wire; .67 uh ±10% at 40 mc ±0.5%; o/a dim. 3/8" lg., 0.170" dia; per spec MIL-C-15305A; 21964 #A9010281-3	IF choke
L208		Same as L207	IF choke
L209		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound; 12 turns, #28E wire, iron powdered core adjustable, 58 uh ±5% with no slug, 0.68 uh min. to 1.03 uh max. with slug at 40 mc ±0.5% per spec MIL-C-15305A; 21964 #A9010283-3	IF tuning series arm tee
L210		Same as L209	IF tuning series arm tee V203
L211		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 16-1/2 turns, #30E wire, adjustable powdered iron core; 1.05 uh ±5% with no slug, 1.20 uh min. to 1.9 uh max. with slug at 30 mc ±0.5%; per spec MIL-C-15305A; 21964 #A9010283-4	IF tuning series arm of tee
L212		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, space wound, 8 turns; #26E wire, 0.125 uh ±10% at 60 mc ±0.5%; o/a dim. 3/8" lg., 0.107" dia.; per spec MIL-C-15305A; 21964 #A9010234-1	Shunt arm of tee
L213		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, space wound, 4 turns of #22E wire; 0.55 uh ±10% at 84 mc ±0.5%; o/a dim. 3/8" lg., 0.107" dia.; per spec MIL-C-15305A; 21964 #A9010234-3	Shunt arm of tee

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DES'G	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L214 thru L216		Not Used	
L217		Same as L201	IF filter
L218		Same as L201	IF filter
L219		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 46 turns of #32E wire; 3.2 uh ±10% at 7.9 mc ±0.5%; o/a dim. 1/2" lg., 0.156" dia, per spec MIL-C-15305A; 21964 #A9010281-4	IF choke
L220 Cont See L301		Same as L219	IF choke
MP201	1	GASKET: synthetic rubber, MIL-R-900A, class 2; cross-sectional style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 42" lg; 21964 #A9140800	Panel sealing
MP202		BOOT, DUST AND MOISTURE SEAL: silicon rubber bonded to a brass, nickel plated hex nut 15/32-32 thd; 3/4 in. across flats, 7/8 in. lg; 97539 #1030; 21964 #A2132649-1	Covers toggle switch on receiver panel
MP203	7	SPRING, HELICAL, COMPRESSION: cylindrical shape, Ref Dwg Group 65; 2 active coil ends squared and closed; beryllium copper wire per spec MIL-C-947; 5/32 in. lg, 5/32 in. OD; 21964 #A9010155	p/o clamp in mixer assy
MP204		Same as MP203	p/o clamp in mixer assy
MP205 Cont See MP301	1	GASKET: synthetic rubber, MIL-R-900C; 2-15/64 in. dia aperture in. center three 1/8 in. dia holes spaced 120 deg apart on 2-7/16 in. dia; 2-11/16 in. dia OD, 1/16 in. thk; 21964 #B2060910	Sealer
P201		CONNECTOR, PLUG, ELECTRICAL: 1 round male contact; one connector mating end; BNC series; 50 ohms nom impedance, 500 v peak voltage; accommodated RG-55/U and RG-58/U cables; 74868 #85000; MIL type UG-88C/U per Sig dwg #SC-D-72235; BuShips dwg #REB49064; 21964 #A2131456	Mixer LO input
P202		CONNECTOR, PLUG ELECTRICAL: 1 contact, male round, straight type; MIL type UG-21D/U per MIL STD dwg #MS-91236; 21964 #A2132719	Mixer signal input
P203		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P204 Cont See P301		Same as J304	Power input
R201	6	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt MIL type RC20GF101K, per spec MIL-R-11; 21964 #504219	Meter shunt
R202		Same as R201	Meter shunt
R203		Not Used	
R204		Not Used	
R205	6	Same as R201	Cathode bias for V202
R206	6	RESISTOR, FIXED, COMPOSITION: 68 ohms, ±10%; 1/2 watt; MIL type RC20GF680K per spec MIL-R-11; 21964 #504217	Cathode bias for V201
R207	6	RESISTOR, FIXED, COMPOSITION: 2,200 ohms ±10%; 1/2 watt; MIL type RC20GF222K per spec MIL-R-11; 21964 #504235	Damping
R208	6	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%; 1/2 watt; MIL type RC20GF221K per spec MIL-R-11; 21964 #504223	Bias V203
R209 thru R211		Not Used	
R212	6	RESISTOR, FIXED, COMPOSITION: 2700 ohms; ±10%; 1 watt; MIL type RC32GF272K per spec MIL-R-11; 21964 #503923	Plate dropping V202
R213		Same as R212	Screen resistor V203
R214 Cont See R301	6	RESISTOR, FIXED, COMPOSITION: 2700 ohms; ±10%; 2 watt; MIL type RC42GF272K per spec MIL-R-11; 21964 #501246	Voltage dropping V201
T201 Cont See T401		TRANSFORMER, INTERMEDIATE FREQUENCY: 63 mc peak frequency; phase inverter; shielded; MIL type LT8F per spec MIL-C-15305A; 21964 dwg #A2060627G1	Phase inverter
V201		ELECTRON TUBE: pentode; MIL type 5654/6AK5W per spec MIL-E-1C; 21964 #700561	IF amplifier Figure 6-3
V202		ELECTRON TUBE: triode; MIL type 6J4WA, per spec MIL-E-1 (Navy); 21964 #A2133316	IF amplifier Figure 6-3
V203 Cont See V301		Same as V201	IF amplifier Figure 6-3

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV201		SOCKET, ELECTRON TUBE: 7 contacts, beryllium silver plated, miniature type; JAN type TS102C01, per spec. JAN-S-28A; 21964 #740003	Socket for V201
XV202		Same as XV201	Socket for V202
XV203		Same as XV201	Socket for V203
Cont See XV301			
Z200		AMPLIFIER, INTEGRATOR: incoming frequencies, range 1, 1025 mc to 1087 mc (local oscillator frequency range 1, 962 mc to 1024 mc; range 2, 1151 mc to 1213 mc) resultant frequency 63 mc; 6.3 v, 60 cycles, single phase, +150 v DC, 50 ohms input impedance, 21964 #C2060282G1, (less tubes & tube shields)	Mix incoming RF signal with output of local oscillator and amplify the resultant IF
Z201		SUPPRESSOR, PARASITIC: coil 19 turns of #26E wire, wound on 470 ohm. 1/2 watt resistor, (RC20GF471K), 21964 dwg #A9010279-1	Filament decoupling
Z202		Same as Z201	Filament decoupling
Z203		Same as Z201	Filament decoupling
Z204		SUPPRESSOR, PARASITIC: coil 30 turns of #30E wire wound on 1000 ohm, 1/2 watt resistor (RC20GF102K); 21964 #A9010279-2	Plate decoupling
Z205		Same as Z201	Filament decoupling
Cont See Z300			
C301		Same as C210	Grid coupling
C302		Same as C211	Bypass squitter control filter
C303		Same as C211	Tank ckt grounding L303
C304		Same as C221	Trans primary tuning
C305		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 820 $\mu\mu f$ +100%-20%; 500 v DC working; MIL type CK60Y821Z; per spec MIL-C-11015A; for electrical performance only; MS90128; 21964 part #625020H821	Cathode bypass V301
C306		Same as C211	Bypass squitter control filter
C307		Same as C305	Cathode bypass V302
C308	6	CAPACITOR, FIXED, MICA DIELECTRIC: 68 $\mu\mu f$ ±10%; 300 v DC working; -100 to +100 Parts/Million Deg. C; MIL type CB21PD680K; per spec MIL-C-10950A, dwg MS-91105; 21964 #A9010543-8	Tank circuit grounding L303
C309		Same as C211	Screen bypass V301
C310		Same as C217	IF coupling V301 to V302
C311		Not Used	
C312		Same as C211	IF filter V301

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C313		Same as C211	IF filter V302
C314		Not Used	
C315		Same as C217	IF coupling V302 to V303
C316		Same as C211	Screen bypass V302
C317		Not Used	
C318		Same as C305	Cathode bypass V303
C319		Same as C211	Screen bypass V303
C320		Same as C308	Tank circuit grounding L305
C321		Same as C217	IF coupling V303 to V304
C322		Not Used	
C323		Same as C201	IF bypass plate circuit decoupling
C324		Same as C211	IF bypass
C325		Not Used	
C326		Same as C305	Cathode bypass V304
C327		Same as C211	Screen bypass V304
C328		Same as C308	Tank circuit grounding L306
C329		Same as C305	Cathode bypass V305
C330		Not Used	
C331		Same as C201	IF bypass
C332		Same as C210	IF coupling V305 to L308
C333		Same as C211	Screen bypass V305
C334	6	CAPACITOR, FIXED, MICA DIELECTRIC: 82 $\mu\mu$f ±2%; 300 v DC working -100 to +100 Parts/Million Deg C; MIL type CB21PD820G per spec MIL-C-10950A; 21964 #A9010542-3	Trans primary tuning
C335	6	CAPACITOR, FIXED, GLASS DIELECTRIC: 100 $\mu\mu$f ±2% tolerance; 500 v DC working; +115 to +165 Parts/Million Deg C; MIL type CY13C111G per spec MIL-C-11272A and MS15826; 21964 dwg #A9010534-1	Trans primary tuning
C336		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1.0 $\mu\mu$f ±0.25 mmf, 500 v DC working; JAN type CC21CK010C per spec JAN-C-20A; 21964 #A9010900	Coupling L308 to L309
C337	6	CAPACITOR, FIXED, GLASS DIELECTRIC: 100 $\mu\mu$f ±2% tolerance; 500 v DC working; +115 to +165 Parts/Million Deg C; MIL type CY13C101G per spec MIL-C-11272A and MS15826; 21964 dwg #A9010534-2	Trans secondary tuning

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C338		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 110 μμf ±2% tolerance; 500 v DC 150 μμf/μf DEG. C NEG +10 μμf/μf DEG C to 4. 56289/B02-110μμf/μf-500v/21964/A9010535-1	Trans secondary tuning
C339		Same as C334	IF bypass
C340		Same as C217	IF bypass
C341		Same as C201	IF bypass plate circuit decoupling
C342		Not Used	
C343	6	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 μμf ±20%; 500 v DC working temp coef. var. per spec MIL-C-11015A; for electrical performance only; 72982 GP2L1000 ±200; 21964 dwg #A9010537-1	Coupling V307A to V307B
C344		CAPACITOR, FIXED, PAPER DIELECTRIC: .1 μf μμf ±10%; 400 v DC working; MIL type CP11A3KE104K per spec MIL-C-25A; 21964 dwg #A9010541	Plate bypass V307
C345		CAPACITOR, FIXED, PAPER DIELECTRIC: .1 μμf ±10%; 200 v DC working; MIL type CP05A1KC104K per spec MIL-C-25A; 21964 dwg #A9010536-1	Coupling V307B to line
C346		Same as C201	Filament bypass V306
C347		Same as C201	Filament bypass
C348		Same as C211	Filament bypass V306
C349		Same as C211	Filament bypass V304
C350		Same as C211	Filament bypass V303
C351		Same as C211	Filament bypass V302
C352		Same as C211	Filament bypass V301
C353		Same as C217	Coupling V304 to V305
C354		Same as C211	Plate circuit bypass
C355		CAPACITOR, FIXED, CERAMIC DIELECTRIC: .01 μf +100%-20%, 500 v DC working; MIL type CK63Y103Z; per MIL-C-11015A; 21964 part #625023H103	Bypass
C356		Same as C355	Bypass
C357		Same as C355	Bypass
C358		Same as C355	Bypass
C359		Same as C355	Bypass
C360		Same as C355	Cathode bypass V307B

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C361		Same as C355	Cathode bypass V307A
C362		Same as C305	Coupling V306 to V307A
C363 Cont See C401		Same as C337	IF bypass
E301		Same as E201	Shield for V301
E301A		Same as E201A	Insert for E301
E302		Same as E201	Shield for V302
E302A		Same as E201A	Insert for E302
E303		Same as E201	Shield for V303
E303A		Same as E201A	Insert for E303
E304		Same as E201	Shield for V304
E304A		Same as E201A	Insert for E304
E305		Same as E201	Shield for V305
E305A		Same as E201A	Insert for E305
E306		Same as E201	Shield for V306
E306A		Same as E201A	Insert for E306
E307	6	SHIELD, ELECTRON TUBE: JAN type TS103U02 per spec JAN-S-28A, modified; 21964 #A2132986-5	Shield for V307
E307A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U02; MIL-STD-242A type #902; 21964 #A2132886-5	Insert for E307
E308		Same as E201	Shield for V308
E308A		Same as E201A	Insert for E308
J301		Same as J203	Squitter control input
J302		Not Used	
J303		Not Used	
J304		CONNECTOR, PLUG ELECTRICAL: 14, male, round contacts; polarized, straight type; 81312 #MRE-14PG per spec MIL-C-8384; 21964 dwg #A9010571	Power input
J305		CONNECTOR, RECEPTACLE ELECTRICAL: single female round contact; straight type; phone type connector, max operating voltage 1, 500 v peak; 74868 #225-B; MIL type MS16108-3 per MIL-STD-242A; 21964 #A2141949-1	Test point for echo suppressor no. 3
J306		Same as J305	Test point for primary dis-criminatory transformer
J307 Cont See J402		Same as J305	Test point dis-criminator output

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L301		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, space wound, 6 turns of #26E wire, 0.075 uh ±10% at 84 mc ±0.5%; o/a dim. 3/8" lg, 0.107" dia.; per spec MIL-C-15305A; 21964 #A9010234-2	Part of 50 ohm input transformer
L302		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, space wound, 12-1/2 turns of #28E wire; iron powdered core, adjustable 0.620 uh ±5% with no slug, 0.74 uh min., 1.15 uh max. with slug at 40 mc ±0.5%; per spec MIL-C-15305A; 21964 #A9010283-6	Part of 50 ohm line to grid of V301 transformer
L303		Same as L209	Interstage IF trans. V301 to V302
L304		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 10-1/4 turns of #26E wire; iron powdered core, adjustable 0.42 uh ±5% with no slug. 0.45 uh min., 0.72 uh max with slug at 40 mc ±0.5% per spec MIL-C-15305A; 21964 #A9010283-5	Interstage IF trans. V302 to V304
L305		Same as L304	Interstage IF trans. V303 to V304
L306		Same as L304	Interstage IF trans. V304 to V305
L307		Not Used	
L308		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 4-1/2 turns of 0.0325" dia wire, silver plated, adjustable iron powdered core; 0.112 uh ±5% with no slug, 0.112 uh min. to 0.152 uh max. with slug at 63 mc ±0.5%; 21964 #A9010331-1	Ferris discriminator primary
L309		Same as L308	Ferris discriminator secondary
L310		Same as L219	Choke plate feed V303
L311		COIL, INTERMEDIATE FREQUENCY: 1 winding, single layer, close wound, 35 turns of #32E wire; 1.05 uh ±10% at 40 mc ±0.5%; o/a dim. 3/8" lg., 0.107" dia, per spec MIL-C-15305A; 21964 #A9010281-8	Diode DC return V306A
L312		Same as L311	Diode DC return V306B
L313 Cont See L401		Same as L219	Choke plate feed V301

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP301	7	CLAMP, ELECTRICAL: brass, silver plated; designed to hold 0.195" nominal o/a dia. cables 74868 1025; type MX-1684/U per 21964 #A914239	Secures cable
MP302 Cont See MP401		Same as MP301	Secures cable
P301		Not Used	
P302		Same as P201	IF chassis output
P303		Same as P201	IF amp input Figure 6-3
P304 Cont See P401		Same as J204	IF amp power
R301	6	RESISTOR, FIXED, COMPOSITION: 1800 ohms; ±10%; 1/2 watt; MIL type RC20GF182K per spec MIL-R-11; 21964 #504234	Input transformer damping L302
R302	6	RESISTOR, FIXED, COMPOSITION: 330 ohms; ±10%; 1/2 watt; MIL type RC20GF331K per spec MIL-R-11; 21964 #504225	Squitter control decoupling
R303		Not Used	
R304	6	RESISTOR, FIXED, COMPOSITION: 220,000 ohms; ±10%; 1/2 watt; MIL type RC20GF224K per spec MIL-R-11; 21964 #504259	Squitter control decoupling
R305		Same as R203	Bias V301
R306		RESISTOR, FIXED, COMPOSITION: 6200 ohms; ±5%; 1/2 watt; MIL type RC20GF622J per spec MIL-R-11; 21964 #504122	Damping L203
R307	6	RESISTOR, FIXED, COMPOSITION: 2200 ohms; ±10%; 1 watt; MIL type RC32GF222K per spec MIL-R-11; 21964 #503922	Plate dropping V301
R308		Same as R307	Plate dropping V302
R309	6	RESISTOR, FIXED, COMPOSITION: 2700 ohms; ±10%; 1/2 watt; MIL type RC20GF272K per spec MIL-R-11; 21964 #504236	Damping L309
R310		Same as R208	Bias V302
R311		Not Used	
R312		Same as R208	Bias V303
R313		Same as R306	Damping L305

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R314		Same as R307	Plate dropping V303
R315		Same as R304	Echo suppressor V304
R316		Same as R208	Bias V304
R317		Same as R301	Damping L306
R318		Same as R307	Damping L306
R319		Same as R207	Echo suppressor V305
R320	6	RESISTOR, FIXED, COMPOSITION: 100,000 ohms: ±10%; 1/2 watt; MIL type RC20GF104K per spec MIL-R-11; 21964 #504255	Decoupling J305
R321		Same as R208	Bias V305
R322		Same as R307	Plate dropping V305
R323		Not Used	
R324		Not Used	
R325		RESISTOR, FIXED, COMPOSITION: 8200 ohms; ±5%; 1/2 watt; MIL type RC20GF822J per spec MIL-R-11; 21964 #504125	Diode load V306B
R326		RESISTOR, FIXED, COMPOSITION: 33,000 ohms; ±5%; 1/2 watt; MIL type RC20GF333J per spec MIL-R-11; 21964 #504139	Diode load V306A
R327		Same as R207	Decoupling J307
R328	6	RESISTOR, FIXED, COMPOSITION: 4700 ohms; ±10%; 1 watt; MIL type RC32GF472K per spec MIL-R-11; 21964 #503926	Plate load V307A
R329		Same as R320	Grid return V307A
R330		Same as R207	Decoupling to J306

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R331		Same as R320	Grid return V307B
R332		Same as R207	Bias V307B
R333		Not Used	
R334	6	RESISTOR, FIXED, COMPOSITION: 10 ohms; ±10%; 1/2 watt; MIL type RC20GF100K per spec MIL-R-11; 21964 #504207	Parasitic suppressor V301
R335		Same as R334	Parasitic suppressor
R336		Same as R334	Parasitic suppressor V303
R337		Same as R334	Parasit suppressor V304
R338		Same as R334	Parasitic suppressor V305
R339	6	RESISTOR, FIXED, COMPOSITION: 4,700 ohms; ±10%; 1/2 watt; MIL type RC20GF472K per spec MIL-R-11; 21964 #504239	Damping L308
R340		Not Used	
R341	6	RESISTOR, FIXED, COMPOSITION: 1000 ohms; ±10%; 1/2 watt; MIL type RC20GF102K per spec MIL-R-11; 21964 #504231	Plate decoupling V307B
R342		Same as R341	Cathode bias V307A
R343 Cont See R401		RESISTOR, FIXED, COMPOSITION: 22,000 ohms; ±5%, 1/2 watt; MIL type RC20GF223J per MIL-R-11; 21964 #504135	Diode load

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
V301		Same as V201	IF amplifier
V302		Same as V201	IF amplifier
V303		Same as V201	IF amplifier
V304		Same as V201	IF amplifier
V305		Same as V201	IF amplifier
V306		ELECTRON TUBE: dual diode: MIL type 5726/6AL5W per spec MIL-E-1C; 21964 #700577	Discriminator
V307		ELECTRON TUBE: dual triode; MIL type 12AT7WA per spec MIL-E-1C; 21964 #701165	Video amp and cathode follower
V308 Cont See V401		Same as V306	Clamp
W301 Cont See W501	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 53.5 ohms nominal impedance, copper, strand, #20 AWG copper wire, polyethylene dielectric, RG-141/U type; cable termination E345 at one end and P302 at the other, as per 21964 #A9010414-1	Connects to input
XV301		Same as XV201	Socket for V301
XV302		Same as XV201	Socket for V302
XV303		Same as XV201	Socket for V303
XV304		Same as XV201	Socket for V304
XV305		Same as XV201	Socket for V305
XV306		Same as XV201	Socket for V306
XV307		SOCKET, ELECTRON TUBE: 9 contacts, brass, nickel plated; miniature; JAN type TS103P01, per spec JAN-S-28A-1; 21964 #740004	Socket for V307
XV308 Cont. See XV-401	6	SOCKET, ELECTRON TUBE: 7 contacts, brass, nickel plated; miniature; JAN type TS102P01, per spec JAN-S-28A-1; 21964 #740002	Socket for V308

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
Z300	4	AMPLIFIER, INTERMEDIATE FREQUENCY: 63 mc operating frequency; 2.7 ±0.3 mc band width 3 db down; 80-90 db at zero AGC overall gain; 50 ohms input impedance, 6.3v AC, 60 cycles, single phase, +150 v DC; 21964 #D2060812G1 (less tubes & tube shields)	IF amplifier, detector and video amplifier
Z301		Same as Z204	Plate decoupling V301
Z302		Same as Z204	Plate decoupling V302
Z303		Same as Z204	Plate decoupling V303
C401	6	CAPACITOR, FIXED, MICA DIELECTRIC: 330 $\mu\mu$f ±10%, 500 v DC working; MIL type CM20B331K per spec MIL-C-5; 21964 part #600122	Coupling V402A to V401
C402	6	CAPACITOR, FIXED, MICA DIELECTRIC: 100 $\mu\mu$f ±10%, 500 v DC working; MIL type CM20B101K per spec MIL-C-5; 21964 part #600116	Coupling V401 to V402B
C403	6	CAPACITOR, FIXED, MICA DIELECTRIC: 1000 $\mu\mu$f ±10%, 500 v DC working; MIL type CM30B102K per spec MIL-C-5; 21964 dwg #A2133222-07	Coupling V401 to V402B
C404		Same as C403	Coupling V403 to V404
C405		CAPACITOR, FIXED, PAPER DIELECTRIC: 3 sections .1 μf +20% -10% each section; 600 v DC working; MIL type CP69B5EF104V per spec MIL-C-25A; 21964 #A9010539	Bypass Figure 6-3
C405A		p/o C405	V403 cathode bypass
C405B		p/o C405	+150 v bypass
C405C		p/o C405	DC filter V407A
C406	6	CAPACITOR, FIXED, MICA DIELECTRIC: 220 $\mu\mu$f ±10%; 500 v DC working; MIL type CM20B221K per spec MIL-C-5; 21964 part #600120	Coupling V404
C407		Same as C403	Coupling V404
C408		Same as C403	Coupling V405
C409		Same as C403	Coupling V405
C410		Same as C344	Video bypass R427
C411	6	CAPACITOR, FIXED, MICA DIELECTRIC: .01 μf ±10%; 300 v DC working; -200 to +200 ppm per deg C load current N/R; MIL type CM35C103K per spec MIL-C-5; 21964 dwg #A2132725-6	Coupling to output J403
C412		Same as C411	Coupling to output J404
C413		Not Used	
C414		Same as C411	Screen filter V408
C415		Same as C337	Filter V409B

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C416		Same as C411	Coupling V404 to V408
C417		Same as C402	Coupling V402 to V408
C418		Same as C403	Coupling V406
C419		Same as C402	Coupling V406
C420		Same as C411	Coupling V406 to V407B
C421		Same as C411	Coupling,V407B to V401
C422	4	CAPACITOR, FIXED, MICA DIELECTRIC: 56 $\mu\mu$f, ±2% tolerance, 300 v DC working, 00853 M-72; 21964 A9010542-1 (p/o DL401)	Delay line capacitor
C423	4	CAPACITOR ASSEMBLY, MICA DIELECTRIC: consisting of one 56 $\mu\mu$f capacitor, ±1.12 mmf tolerance and five 110 $\mu\mu$f capacitors ±2.2 $\mu\mu$f tolerance, characteristic X, 300 DC working voltage; 72982 bracket assembly #2826-01, CER type 2826-20I bracket; electrical characteristic per spec MIL-C-10950A; 21964 #B9010473-2 (p/o DL40I)	Delay line capacitor assembly
C424	4	CAPACITOR ASSEMBLY, MICA DIELECTRIC: consisting of six 110 $\mu\mu$f capacitors ±2.2 $\mu\mu$f tolerance; characteristic X, 300 DC working voltage; 72982 button bracket assembly #2826-01, 72982 2826-20I bracket; electrical characteristic per spec MIL-C-10950A; 21964 #B9010473-1 (p/o DL40I)	Delay line capacitor assy
C425		Same as C424 (p/o DL40I)	Delay line capacitor assy
C426		Same as C424 (p/o DL401)	Delay line capacitor assy
C427		Same as C411	Decoupling
C428 Cont See C501	6	CAPACITOR, FIXED, MICA DIELECTRIC: 3300 $\mu\mu$f ±10%; 500 v DC working; MIL type CM30B332K per spec MIL-C-5; 21964 dwg #A2133222-19	Cathode bypass
CR40I		SEMI-CONDUCTOR DEVICE, DIODE: JAN type IN126 per spec MIL-E-1C; 21964 part #701174	Limiter
CR402		Same as CR401	Positive polarity selector
CR403		Same as CR401	Limiter
CR404		Same as CR40I	Limiter
CR405		Same as CR401	Limiter
DL401		DELAY LINE: electromagnetic type; overall delay of 12 micro-seconds; 2700 cps driving frequency; consists of one 56 $\mu\mu$f capacitor, twenty three 110 $\mu\mu$f capacitors and twenty four 1.83 mh coils ±2%; 21964 #D2060730G1	12 m seconds delay line Figure 6-3

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E401		Same as E201	Shield for V401
E401A		Same as E201A	Insert for E401
E402		Same as E307	Shield for V402
E402A		Same as E307A	Insert for E402
E403		Same as E201	Shield for V403
E403A		Same as E201A	Insert for E403
E404	6	SHIELD, ELECTRON TUBE: JAN type TS103U01 per spec JAN-S-28A, modified 21964 #A2132988-4	Shield for V404
E404A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U01; MIL-STD-242A type #901; 21964 #A2132886-4	Insert for E404
E405		Same as E307	Shield for V405
E405A		Same as E307A	Insert for E405
E406		Same as E404	Shield for V406
E406A		Same as E404A	Insert for E406
E407		Same as E404	Shield for V407
E407A		Same as E404A	Insert for E407
E408	5	SHIELD, ELECTRON TUBE: JAN type TS102U03 per spec JAN-S-28A, modified, 21964 #A2132988-3	Shield for V408
E408A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U03; MIL-STD-242A type #703, 21964 #A2132886-3	Insert for E408
E409		Same as E201	Shield for E409
E409A Cont See E502		Same as E201A	Insert for E409
J401		Not Used	
J402		Same as J203	Video input
J403		Same as J203	Video future use output Figure 6-3
J404		Same as J203	Video output Figure 6-3
J405		Same as J304	Power and metering connector Figure 6-3
J406		Same as J203	Blanking in Figure 6-3
J407		Same as J203	Test output
J408		Same as J305	Test point squitter control output Figure 6-3
J409		Same as J305	Test point video input
J410		Same as J305	Test point future use output Figure 6-3

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J411		Same as J305	Test point video output Figure 6-3
J412		Same as J305	Test point multi-vibrator output
J413 Cont See J501		Same as J305	Test point blanking output Figure 6-3
L401	4	COIL ASSEMBLY: 8 windings, universal wound, 553 turns of #38EF wire, 1.83 uh ±2%; 34 ohms DC resistance; o/a dim. 3-1/4" lg, 15/32" dia; p/o DL401; per spec MIL-C-15305A; 21964 #A9010824-1	Delay line coil assembly
L402		Same as L401 (p/o DL401)	Delay line assembly
L403 Cont See L501		Same as L401 (p/o DL401)	Delay line assembly
MP401 Cont See MP501		Same as MP301	Secures Cable
R401		Same as R339	Grid return V402A
R402	6	RESISTOR, FIXED, COMPOSITION: 4700 ohms; ±10%; 2 watt; MIL type RC42GF472K per spec MIL-R-11; 21964 #501249	Plate load resistor V401
P401		Same as P201	Connects to J301
P402		Not Used	
P403		Same as P201	Video future use output
P404		Same as P201	Video output
P405		Same as J204	Video power
P406		Same as P201	Blanking in
P407 Cont See P501		Same as P201	Video test output

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R403		Same as R339	Plate load resistor V401
R404	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ±10%; 1/2 watt, MIL type RC20GF103K per spec MIL-R-11; 21964 #504243	Screen dropping resistor
R405	6	RESISTOR, FIXED, FILM: 10,000 ohms; ±1%; 1/2 watt, MIL type RC20GF103K per spec MIL-R-11; 21964 #501253	Grid return V401
R406	6	RESISTOR, FIXED, FILM: 100,000 ohms; ±1%; 1/2 watt, MIL type RN70B1003F per spec MIL-R-10509B; 21964 #A9010519-2	Grid bias bleeder V401
R407	6	RESISTOR, FIXED, COMPOSITION: 33,000 ohms; ±10%; 2 watt MIL type RC42GF333K per spec MIL-R-11; 21964 #501259	Screen bias resistor
R408		Same as R320	Grid return V402B
R409		Same as R402	Plate load resistor V403
R410		Same as R339	Grid return V403
R411	6	RESISTOR, FIXED, COMPOSITION: 6800 ohms; ±10%; 1/2 watt; MIL type RC20GF682K per spec MIL-R-11; 21964 #504241	Cathode bias V403
R412		Same as R339	Plate load resistor V403
R413	6	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±10%; 1/2 watt; MIL type RC20GF153K per spec MIL-R-11; 21964 #504245	Trigger coupling to V404
R414		RESISTOR, FIXED, COMPOSITION: 91,000 ohms; ±5%; 1 watt MIL type RC32GF913J per spec MIL-R-11; 21964 #503837	Cathode bias bleeder V403
R415	6	RESISTOR, FIXED, COMPOSITION: 8200 ohms; ±10%; 1/2 watt: MIL type RC20GF822K per spec MIL-R-11; 21964 #504242	Grid return V404
R416	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ±10%; 2 watt; MIL type RC42GF103K per spec MIL-R-11; 21964 #501253	Plate load resistor V404

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R417	6	RESISTOR, FIXED, COMPOSITION: 3300 ohms; ±10%; 1/2 watt; MIL type RC20GF332K per spec MIL-R-11; 21964 #504237	Plate load resistor V404
R418		Same as R207	Cathode bias V404
R419	6	RESISTOR, FIXED, COMPOSITION: 56,000 ohms; ±10%; 1/2 watt; MIL type RC20GF563K per spec MIL-R-11; 21964 #504252	Grid return V404
R420	6	RESISTOR, FIXED, COMPOSITION: 22,000 ohms; ±10%; 2 watts; MIL type RC42GF223K per spec MIL-R-11; 21964 #501257	Cathode bias bleeder V404
R421		Same as R320	Grid return V405
R422		Same as R339	Cathode load V405
R423		Same as R339	Cathode load V405
R424		Same as R320	Grid return V405
R425	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ±10%; 1/2 watt; MIL type RC20GF473K per spec MIL-R-11; 21964 #504251	Suppressor grid return V401
R426	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ±10%; 1 watt; MIL type RC32GF473K per spec MIL-R-11; 21964 #503938	Cathode lead V407A
R427		RESISTOR, VARIABLE: wirewound element, 1 section; 10,000 ohms ±10%; 2 watt nominal power rating, not tapped, no switch; JAN type RA20A1SD103AK per spec JAN-R-19; 21964 #B9010828-1	Pulse count set V409B Figure 6-3
R428		Not Used	
R429		Same as R307	Screen filter V408
R430	6	RESISTOR, FIXED, COMPOSITION: 470,000 ohms; ±10%, 1/2 watt; MIL type RC20GF474K per spec MIL-R-11; 21964 #504263	Filter V409B

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R431	6	RESISTOR, FIXED, FILM: 14,700 ohms; ±10%; 1/2 watt power dissipation; MIL type RN70B1472F per spec MIL-R-10509B 21964 #A9010519-8	Bias voltage divider for V409B
R432	6	RESISTOR, FIXED, COMPOSITION: 1 megohm; ±10%; 1/2 watt; MIL type RC20GF105K per spec MIL-R-11; 21964 #504267	Grid resistor V408
R433		RESISTOR, FIXED, FILM: 511,000 ohms; ±1%; 1/2 watt; MIL type RN70B5113F per spec MIL-C-10509B; 21964 #9010519	Pulse stretcher V409B
R434		Same as R320	Trigger coupling to V406
R435		Not Used	
R436	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ±10%; 2 watt MIL type RC42GF473K per spec MIL-R-11; 21964 #501261	Cathode bias bleeder V406
R437	6	RESISTOR, FIXED, COMPOSITION: 2.2 megohm; ±10%; 1/2 watt; MIL type RC20GF225K per spec MIL-R-11; 21964 #504271	Grid return V406
R438		Same as R339	Plate load resistor V407B
R439		Same as R339	Plate load resistor V406
R440		Same as R402	Plate load resistor V406
R441		Same as R339	Cathode load resistor V406
R442		Same as R406	Grid return V406
R443	6	RESISTOR, VARIABLE: composition element; 1 section, 250,000 ohms; ±10%; 2 watts nominal power rating, no switch; MIL type RV4LAVSA254A per spec MIL-R-94 and MIL-STD-242 (ships) 21964 #A2133049-7	Blanking time adjust V406 Figure 6-3

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R444		RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt; MIL type RC20GF104J per spec MIL-R-11; 21964 #504151	Grid return V407B
R445		RESISTOR, FIXED, COMPOSITION: 1.5 megohms; ±5%; 1/2 watt; MIL type RC20GF155J per spec MIL-R-11; 21964 #504179	Grid bias bleeder V407B
R446		Same as R339	Cathode resistor V407B
R447	6	RESISTOR, FIXED, FILM: 2,740 ohms; ±1%; 1/2 watt; MIL type RN70B2741F per spec MIL-R-10509B; 21964 #A9010519-5	Voltage divider V407A
R448		Same as R201	Parasitic suppressor V405
R449		Same as R201	Parasitic suppressor V405
R450		Same as R201	Parasitic suppressor V405
R451		Same as R201	Parasitic suppressor V404
R452	6	RESISTOR, FIXED, COMPOSITION: 470 ohms; ±10%; 1/2 watt; MIL type RC20GF471K per spec MIL-R-11; 21964 #504227	Cathode resistor V401
R453		Same as R411	Voltage divider test output
R454		Same as R309	Voltage divider test output
R455	6	RESISTOR FIXED, COMPOSITION: 1200 ohms; ±10%; 1/2 watt; MIL type RC20GF122K per spec MIL-R-11; 21964 #504232	Limiter resistor V402A
R456	6	RESISTOR, VARIABLE: wirewound element 1 section; 5000 ohms; ±10%; 2 watt nominal power rating; not tapped, no switch; JAN type RA20A1SD502AK per spec JAN-R-19; 21964 #B9010828-2	Limiter resistor V403 Figure 6-5
R457	6	RESISTOR, FIXED, FILM: 2,150 ohms; ±1%; 1/2 watt; MIL type RN70B2151F per spec MIL-R-10509B; 21964 #A9010519-10	Limiter resistor V403

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R458 Cont See R501		Same as R402	Decoupling
T401 Cont See T501		TRANSFORMER, PULSE: Interstage type; 10,000 ohms at 2700 cycle primary input impedance, 47,000 ohms at 2700 cycles secondary output impedance; direct current resistance not rated for primary or secondary; 49956 #363-6002G2; per spec MIL-T-27A; 21964 #A1069872	Impedance matching between V408 and V409B Figure 6-3
TB401	2	TERMINAL BOARD: 64 terminals; solder stud type; 21964 #A9010398-1	Terminal board in video chassis assy Figure 6-5
TB402 Cont See TB-501	2	TERMINAL BOARD: 60 terminals; solder stud type; 21964 #A9010408-1	Terminal board in video chassis assy Figure 6-5
V401		ELECTRON TUBE: pentode, MIL type 5725/6AS6W per spec MIL-E-1C; 21964 #700576	Blanking gate
V402		Same as V307	V402A: 1st video amplifier Figure 6-3 V402B: 2nd video amplifier
V403		Same as V401	Decoder Figure 6-3
V404		ELECTRON TUBE: dual triode; MIL type 5670 per spec MIL-E-1C; 21964 #700563	Multivibrator Figure 6-3
V405		Same as V307	Two cathode followers Figure 6-3
V406		Same as V404	Blanking multi-vibrator Figure 6-3
V407		Same as V404	Phase inverter and cathode followers Figure 6-3
V408		ELECTRON TUBE: pentode; MIL type 6005/6AQ5W per spec MIL-E-1C; 21964 #701131	Pulse amplifier Figure 6-3
V409 Cont See V501		Same as V306	DC clamp and pulse connector Figure 6-3

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV401		Same as XV308	Socket for V401
XV402		Same as XV307	Socket for V402
XV403		Same as XV308	Socket for V403
XV404		Same as XV307	Socket for V404
XV405		Same as XV307	Socket for V405
XV406		Same as XV307	Socket for V406
XV407		Same as XV307	Socket for V407
XV408		Same as XV308	Socket for V408
XV409 Cont See XV501		Same as XV308	Socket for V409
C501		CAPACITOR, FIXED, PAPER DIELECTRIC: 10 μf ±10%; 600 v DC working; MIL type CP70E1EF106K per spec MIL-C-25; 21964 part #641041	Filter
C502		CAPACITOR, FIXED, PAPER DIELECTRIC: .5 μf ±10%; 600 v DC working; MIL type CP54B1EF504K per spec MIL-C-25; 21964 part #640404	Filter
C503		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 sections, each section 0.10 μf +20%-10%; 600 v DC working; MIL type CP69B4EF104V per spec MIL-C-25A; 21964 #A9010883-2	Filter Figure 6-5
C504		CAPACITOR, FIXED, PAPER DIELECTRIC: 2μf ±10%; 600 v DC working; MIL type CP70E1EF205K per spec MIL-C-25; 21964 #641037	Filter Figure 6-5
C505		CAPACITOR, FIXED, PAPER DIELECTRIC: 1.0 μf ±10%; 600 v DC working; CPWB1EF105K per spec MIL-C-25; 21964 #640514	Filter Figure 6-5
C506		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 sections, each section 0.5 μf +20%-10%; 600 v DC working; MIL type CP61B6EF504V per spec MIL-C-25; 21964 #640611	Filter Figure 6-5
DS501		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear, 24446 #10C7/IDC; 21964 part #710071	Power on indicator Figure 3-1
DS502		LAMP, GLOW: neon gas, 0.25 watt, 67-87 v DC striking voltage; double contact bayonet type; MIL type NE-16 per spec MIL-L-15098; 21964 dwg #A2060350	Interlock open indicator

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E501		Not Used	
E502		Same as E408	Shield for V502
E502A		Same as E408A	Insert for E502
E503		CONNECTOR, ADAPTER: 2 contacts, 1 type BNC male, 1 type N female, MIL type UG-201A/U; ASESA 49-2A SC-D-72309; 21964 #A2120071	Mixer LO input adapter
E504		Same as E201	Shield for V504
E504A		Same as E201A	Insert for E504
E505		Same as E408	Shield for V505
E505A		Same as E408A	Insert for E505
E506		Same as E408	Shield for V506
E506A		Same as E408A	Insert for E506
E507 thru E526		Not Used	
E527		RETAINER, CAPACITOR: MIL type CP07SA4, per spec MIL-C-25; 21964 #384067	Mounting bracket for C504
E528		RETAINER, CAPACITOR: MIL type CP07SD3 per spec MIL-C-25; 21964 #384082	Mounting bracket for C501
E529 thru E549		Not Used	
E550		RETAINER, ELECTRON TUBE: 96458, similar to #BA-20353; 21964 #A9010812-1	Retainer for V501
E551		RETAINER, ELECTRON TUBE: bakelite; 21964 #A9011495-1	Retainer for V503
E552 thru E597		Not Used	
E598	6	RETAINER, CAPACITOR: MIL type CP0905A6 per spec MIL-C-25 21964/384011	Mounts capacitor C505 in power supply
E599		Same as E598	Mounts capacitor C506 in power supply
F501		FUSE, CARTRIDGE: 3 amp, 125v; time delay, MIL type F02D3R00B per MIL-STD MS90-07827-1 and spec MIL-F-16160C; 21964 #882237	Power fuse Figure 3-1
F502		Same as F501	Power fuse Figure 3-1
F503		Same as F501	Spare fuse

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J501	4	CONNECTOR, RECEPTACLE ELECTRICAL: 1 contact, round; polarized, straight type; 1000 v max, voltage, 50 ohms nominal impedance, modified as follows, all cable accommodations are deleted from the commercial connector and in its place a machined body of a low pass filter is inserted, 11/16-24 thread with a set screw 4/40-1/8" lg is the holding device, MIL type UG-571/U (p/o Z501); NOT REPLACEABLE	Signal input Figure 6-3
J502		CONNECTOR, RECEPTACLE ELECTRICAL: BNC series; 74868 #86025; MIL type UG-909/U per BuShips dwg #REB49058; 21964 #A2132720	Local oscillator input Figure 6-3
J503		Same as J502	Video future use output Figure 6-3
J504		Same as J502	Video output Figure 6-3
J505		CONNECTOR, RECEPTACLE ELECTRICAL: 5 contacts, male, round, positive polarization; straight type; MIL type AN3102A-14S-5P per MIL-C-5015B; 21964 #752190	Receiver power input Figure 6-3
J506		Same as J502	Blanking input Figure 6-3
J507		Same as J502	Test output Figure 3-1
J508	4	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 contact, round, polarized, straight type; 50 ohms nominal impedance, modified as follows, all cable accommodations are deleted from commercial connector and in its place a machined body of low pass filter inserted; 5/8-24 thread with set screw 4/40, 1/8 as a holding device; MIL type UG-23B/U (p/o Z501); NOT REPLACEABLE	Low pass filter output
L501		REACTOR: fixed inductance; one section, 10 henries; 200 ma DC; 110 ohms DC resistance; MIL type TF1RX04YY; 49956 #292-5633G1 21964 #A1069614	150 v filter choke Figure 6-3
M501		AMMETER: mounted, flush mounting panel type; DC; 0 to 100 microampere graduated in increments of 5; 50 millivolt drop across terminals for full scale deflection: calibrated for use on non-magnetic panel, MIL type MR26W100DCUAR per spec MIL-M-10304A; 21964 #A2060455-5	Test meter Figure 3-1
MP501		KNOB: pointer; black, phenolic body; MS700-18S per MIL-STD-242A; 21964 #B2137233-2	Meter switch knob
MP502		Not Used	
MP503		Not Used	
MP504		CAP, ELECTRICAL: brass; fits BNC female connectors; MIL type CW-123 A/U per Navy dwg; REA 49050 and MIL-C-3608; 21964 #A2141971	Cover for J507
P501 thru P507		Not Used	
P508		Same as P202	Low pass filter output

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R501	6	RESISTOR, FIXED, COMPOSITION: 47 ohms; ±10%; 2 watt; MIL type RC42GF470K per spec MIL-R-11; 21964 #501225	Plate decoupling V503
R502		Same as R501	Plate decoupling V503
R503		Same as R341	Grid decoupling V503
R504		Same as R341	Grid decoupling V503
R505		RESISTOR, FIXED, FILM: 1 megohm; ±1%; 1/2 watt; MIL type RN70B1004F per spec MIL-R-10509B; 21964 #A9010519-1	Plate resistor V504
R506	6	RESISTOR, FIXED, FILM: 14,700 ohms; ±1%; 2 watt, MIL type RN80B1472F per spec MIL-R-10509A and MIL-STD-242A; 21964 #A9010556-1	Divider network Figure 6-5
R507		Same as R427	Voltage control Figure 6-3
R508		RESISTOR, FIXED, FILM: 10,000 ohms; ±1%; 2 watt, MIL type RN80B1002F per spec MIL-R-10509A and MIL-STD-242A; 21964 #A9010556-2	Divider network Figure 6-5
R509	6	RESISTOR, FIXED, COMPOSITION: 2200 ohms; ±10%; 2 watt; MIL type RC42GF222K per spec MIL-R-11; 21964 #501245	Filter
R510	6	RESISTOR, FIXED, WIREWOUND: inductive winding: 1000 ohms ±5%; 10 watts; not tapped; non adjustable; MIL type RW31G102 per spec MIL-R-26A; 21964 #A9010887-1	Filter network
R511		Same as R509	Filter
R512		Same as R509	Filter
R513		Same as R509	Filter
R514		Not Used	
R515		RESISTOR, FIXED, FILM: non inductive; 1.96 megohms; ±1% 1/2 watt; MIL type RN70B1964F per spec MIL-R-10509B; 21964 #A9010519-9	Meter multiplier
R516		Same as R406	Meter multiplier

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R517	6	RESISTOR, FIXED, FILM: non inductive; 1000 ohms; ±1%; 1/2 watt; MIL type RN70B1001F per spec MIL-R-10509B; 21964 #A9010519-3	Meter series resistor
R518		Same as R509	Filter
R519		Same as R509	Filter
R520		RESISTOR, FIXED, WIREWOUND: 280 ohms; 3 watt; MIL type RW59V281 per spec MIL-R-26C; 21964 dwg #A2132711-01	Voltage dropping resistor
R521	6	RESISTOR, FIXED, COMPOSITION: 15,000 ohms; ±10%; 1 watt; MIL type RC32GF153K per spec MIL-R-11; 21964 #503932	Voltage dropping resistor
S501		SWITCH, ROTARY, SELECTOR, MINIATURE: 1 section, 6 positions 2 poles non-shorting contacts; 21964 #B2060201	Meter selector Figure 3-1
S502		SWITCH, TOGGLE: single-pole, single throw; 0.75 amp 125 v DC, 15 amp 125 v AC, JAN type ST42A, per spec JAN-S-23; 21964 #828212	Power on-off switch Figure 3-1
T501		TRANSFORMER, POWER, STEP-DOWN: primary winding; 120 v AC, 60 cycles single phase; 3 output windings, #1 secondary 5.0 v, 2 amp center tapped, #2 secondary 6.3 v, 6.5 amp, #3 secondary 6.3 v, 3.4 amp center tapped; MIL type TF1SX01YY per spec MIL-T-27A; 49956 #292-5624G1 21964 #A1069870	Filament power Figure 6-3
T502		TRANSFORMER, POWER, STEP-UP: primary winding 120 v AC, 60 cycle, single phase, secondary winding #1 770 v center tapped at 200 ma, secondary #2 450 v center tapped at 55 ma; MIL type TF1SX02YY per spec MIL-T-27A; 49956 #292-5623G1, 21964 #1069828	Plate power Figure 6-3
TB501		TERMINAL BOARD: 8 terminals; single row, thru type terminals; MIL type 7TB8 per spec MIL-T-16784 and Navy dwg 9000-S6505G-73214; 21964 #A2133072-1	Power supply terminal board Figure 6-3
TB502	2	TERMINAL BOARD: 28 terminals, solder stud type; 21964 #A9010522-1	Power supply terminal board Figure 6-5
V501	6	ELECTRON TUBE: dual diode; type 5R4WGB per spec MIL-E-1C; (Navy) 21964 #A2132449	Rectifier full wave Figure 6-3
V502	6	ELECTRON TUBE: dual diode; MIL type 6X4W per spec MIL-E-1C; 21964 #700151	Rectifier full wave
V503		ELECTRON TUBE: dual triode; MIL type 6080WA per spec MIL-E-1C; 21964 #701276	Voltage regulator Figure 6-3
V504		Same as V201	Amplifier

TABLE 7-3. RADIO SET AN/GRN-9D. MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
V505		ELECTRON TUBE: diode; MIL type 6627/0B2WA; per spec MIL-E-1 (Navy); 21964 spec #2133279	Voltage reference
V506		Same as V505	Voltage reference
W501	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, copper, stranded, #21 AWG silvered copper wire, 7 strand, single strand, 0.0270 in. ±0.0010 in., overall bare wire 0.081 in dia ±0.002 in., solid teflon dielectric, RG-115/U type; includes 2 MIL type connectors, one located on each end, P202 and P508, as per 21964 #B2060983G1	Meter signal input
W502	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; incl 2 MIL type connectors J502 and P201, as per 21964 #C2060988G4	Connects frequency multiplier oscillator to mixer
W503	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; incl 2 MIL type connections J503 and P403, one located at each end, as per 21964 #C2060988G3	Connects video chassis to future use output
W504	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; 2 MIL type connectors, one located at each end, incl J504 and P404, as per 21964 #C2060988G2	Connects video chassis to video output
W505	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; incl 2 MIL type connectors, J507 and P407, as per 21964 #C2060988G5	Connects video chassis to test output
W506	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; 2 MIL type connectors, one located each end, incl J506 and P406, as per 21964 #C2060988G1	Connects external blanking to video chassis
W507 thru W510		Not Used	
W511	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; incl 2 MIL type connectors, E346 and P303, one located at each end, as per 21964 #A9010410-3	IF amplr input
XDS501		LIGHT, INDICATOR: friction mtg lens holder; 125 v, 6 watts; enclosed frame; steel shell; black nickel; MIL type LH63PW3 per spec MIL-L-3661, dwg MS-90286; 21964 dwg #A2133069-5	Holder for DS501
XDS502	6	LAMP HOLDER: 125 v; Military Standard lampholders dwg MS90290; 72619 9S4634-L-46; per spec MIL-L-3661; type LH-71-XXO; 21964 dwg #A2142519	Holder for DS502

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

RADIO RECEIVER R-824/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XF501		FUSE HOLDER: extractor post type; accommodates 2 fuses 1-1/4" lg. by 1/4" dia; blown fuse indicating type; sealed; MIL type FHL-10G per BuShips dwg #9000-S6202-74228 and MIL-F-19207 (Ships), 21964 dwg #A2060402	Holder for F501 and F502
XF502		Not Used	
XF503		FUSE HOLDER: extractor post type; accommodates 1 fuse, 1-1/4" lg by 1/4" dia, blown fuse indicating type; sealed; MIL type FHL11-G per BuShips dwg #9000-S6202-74229 and MIL-F-19207 (Ships); 21964 dwg #A2060403	Spare fuse holder
XV501	6	SOCKET, ELECTRON TUBE: 8 contacts, beryllium, silver plated; octal dual shaped; JAN type TS101P02 per spec JAN-S-28A; 21964 #740031	Tube socket for V501 Figure 6-5
XV502		Same as XV308	Socket for V502 Figure 6-5
XV503		Same as XV501	Socket for V503 Figure 6-5
XV504		Same as XV308	Socket for V504 Figure 6-5
XV505		Same as XV308	Socket for V505 Figure 6-5
XV506		Same as XV308	Socket for V506 Figure 6-5

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
		CODER-INDICATOR KY-382/GRN-9D	
601-799		CODER-INDICATOR KY-382/GRN-9D: data regarding input signals received, 1, 15 cps reference trigger pulse, pulse generated each time antenna passes through north, 15 times per second; 135 cps reference trigger pulse, pulse generated each time antenna pattern passes through 40°, 80°, 120°, 160°, 200°, 240°, 280°, 320°, 135 times per second; 1 video pulse, pulse is either a distance interrogation pulse or random noise pulse generated by the receiver in the absence of a distance interrogation pulse; check output with cathode ray indicator; operating power requirements, AC; 177 v or 120 v, 60 cycles single phase, 300 watts; open aluminum framework; overall dim. 13-1/2" wide, 26-7/8" lg., 17-1/16" high; rack mounted, with pull-out slides, front access only; generates 135 cps reference bursts (triggered from antenna) which consists of six pulse-pairs spaced 24 microseconds apart; generates 15 cps reference bursts (triggered from antenna) which consists of 12 pulse-pairs spaced 30 microseconds apart; processes and delays distance interrogation pulses and random noise pulses; generates the identification call of the beacon and identity keys the transmitter; mixes the various component pulses and encodes the composite signal; built-in coding assembly, power supply chassis, provisions for adjusting the keyer-code without interrupting the distance interrogations or azimuth services; provides coded signal for transmitter; provides monitoring facilities for antenna control; 21964 #H2060001 and A2060001	Part of Receiver-Transmitter Group Figure 6-51
B602		MOTOR, ALTERNATING CURRENT, INDUCTION TYPE: 105-132 v AC, 60 cycles, ±5 cps; single phase, 10 watt; 1740 rpm single shaft, ccw rotation looking from shaft end; closed frame; -54 degrees C to +85 degrees C temp, range; 3 flexible wire leads, fixed mounting base, 4 mtg. screws 8-32, spaced 90 degrees apart MIL-spec. MIL-M-17509 Amend 1; 89482 #RBC-2505, per 91264 #1054983	Identification keyer driving motor Figure 6-6
C601 thru C603		Not Used	
C604		CAPACITOR, FIXED, PAPER DIELECTRIC: 4 μf, ±20%; 400 v DC working; MIL type CH53B1-EE405M per MIL-STD-242A and per spec MIL-C-18312; 21964 dwg #A2060302-7	B +filter, 250v Figure 6-52
C605	6	CAPACITOR, FIXED, MICA DIELECTRIC: 330 μμf, ±5%; 500 v DC working; MIL type CM20C331J per spec MIL-C-5A; 21964 #A2133174-30	Capacitor for V601 and V602
C606		CAPACITOR, FIXED, MICA DIELECTRIC: 680μμf, ±2%; 300 v DC working; -100 to +100 parts per million per deg C temp coefficient; MIL type CM20D681-G per spec MIL-C-5; 21964 #A2060310-14	15 cps gate multivibrator coupling capacitor
C607	6	CAPACITOR, FIXED, MICA DIELECTRIC: .01 μμf ±10%; 300 v DC working; MIL type CM35C103K per spec MIL-C-5; 21964; #A2132725-6; Same as C411	Capacitor for V602 and V603
C608		CAPACITOR, FIXED, MICA DIELECTRIC: 6800 μμf ±2%; 500 v DC working; temperature coefficient -20 to +100 parts/million/degrees C; MIL type CM35E682G, per spec MIL-C-5 21964 #A20603080-8	Tuned circuit capacitor for 33.333 kc ringing circuit
C609		Same as C607	Coupling capacitor for V603 and V610
C610		Same as C607	Capacitor for V604 and V605

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C611		CAPACITOR, FIXED, MICA DIELECTRIC: 51 μμf, ±5%; 500 v DC working; MIL type CM20C510J per spec MIL-C-5; 21964 #600171	Timing, V605 cathode coupled multi-vibrator
C612	6	CAPACITOR, FIXED, MICA DIELECTRIC: 68 μμf, ±10%; 500 v DC working; MIL type CM20B680K; per spec MIL-C-5; 21964 #600114	Grid coupling V605, delay line blocking oscillator
C613		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section, 0.10 μf, ±10%; 400 v DC working, MIL type CP0-5A1KE104K, per spec MIL-C-25A; 21964 #A2132594-1	Decoupling capacitor for V606
C614	6	CAPACITOR, FIXED, MICA DIELECTRIC: 3300 μμf, ±10%; 500 v DC working; MIL type CM30B332K per spec MIL-C-5; 21964 #A2133222-19; Same as C428	Lowpass filter capacitor for V606
C615		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section, 0.047 μf, ±10%; 400v DC working, MIL type CP05A1KE473K, per spec MIL-C-25A; 21964 #A2132594-5.	-105v filter capacitor
C616		Same as C613	-105v filter capacitor
C617		Same as C612	Grid coupling V615 output multivibrator
C618		Same as C607	Grid coupling V615, output multivibrator
C619		Same as C613	Grid coupling V607-2 output cathode follower
C620		Same as C612	Synch output coupling capacitor
C621		CAPACITOR, FIXED, MICA DIELECTRIC: 15 μμf, ±10%, 500 v DC working; MIL type CM2-0B150K per spec MIL-C-5; 21964 #600106	Timing V615, output multivibrator
C622		Same as C607	Coupling capacitor V608, V1350 ref. cycle oscillator
C623		Same as C615	Plate bypass, V608
C624		Same as C605	Grid coupling, V609, 135 cps gate multivibrator
C625		CAPACITOR, FIXED, MICA DIELECTRIC: 330 μμf, ±2%; 500 v DC MIL type CM20D331G per spec MIL-C-5; 21964 #600227	Timing V609, 135 cps gate multivibrator
C626		CAPACITOR, FIXED, MICA DIELECTRIC: 3000 μμf ±2%; 500 v DC working; -20 to +100 parts/million/degree C temperature coefficient; MIL type CM30-E302G, per spec MIL-C-5; 21964 #A2060301-18	Tuning, V610, 41.667 kc ringing circuit
C627		Same as C607	Grid coupling V604-1, ref burst amplifier
C628		Same as C607	Input coupling, auxiliary group feed back circuit

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C629	6	CAPACITOR, FIXED, MICA DIELECTRIC: 390 μμf, ±10%; 500 v DC working; MIL type CM20B391K, per spec MIL-C-5; 21964 #600123	Output coupling, auxiliary group feed-back circuit
C630	6	CAPACITOR, FIXED, MICA DIELECTRIC: 200 μμf, ±5%; 500 v DC; MIL type CM20C201-J per spec MIL-C-5A; 21964 #A2133174-25	Input coupling north group feed-back circuit
C631		Same as C607	Output coupling, north group feed-back circuit
C632		Same as C613	Grid coupling V611, priority
C633		Same as C613	Grid coupling V611, priority
C634	6	CAPACITOR, FIXED, MICA DIELECTRIC: 4700 μμf, ±10% tolerance, 500 v DC working; MIL type CM35B472K per spec MIL-C-5A; 21964 #A2060309-2	Cathode bypass V611, priority
C635		Same as C607	Grid coupling V611, priority
C636	6	CAPACITOR, FIXED, MICA DIELECTRIC: 100 μμf ±10%, 500 v DC working; MIL type CM20-B101K per spec JAN-C-15; 21964 #600116; Same as C402	Grid coupling V611, priority
C637		Same as C613	Filter, bias supply
C638	6	CAPACITOR, FIXED, MICA DIELECTRIC: 300 μμf, ±5%; 300 v DC working; MIL type CM20C301J per spec MIL-C-5A; 21964 #A2133174-29	Grid coupling V604-2 keyer
C639	6	CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 300 v DC working, .1 μf, ±5% 56289 #96P10453S2; 21964 #A2061733-2	Coupling, feed-back V612, 1350 cycle oscillator
C640		Same as C612	Grid coupling V612, 1350 cycle oscillator
C641		Same as C613	Grid coupling V613-1, 1350 cycle amplifier
C642	6	CAPACITOR, FIXED, MICA DIELECTRIC: 1000 μμf, ±10%; 300 v DC working; MIL type CM20B102K per spec MIL-C-5; 21964 #A2060311-12	Grid coupling V614
C643		CAPACITOR, FIXED, MICA DIELECTRIC: 470 μμf, ±2% 500 v DC working; -100 to +100 parts per million per deg. C temp. coefficient; MIL type CM20D471G per spec MIL-C-5; 21964 #600231	Timing, V614, 100 μsec multivibrator
C644		Same as C612	Differentiating capacitor V614, 100 μsec multivibrator
C645		Same as C612	Differentiating capacitor V614, 100 μsec multivibrator
C646		Same as C607	Filter, bias supply

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C647		Same as C607	Grid coupling, V610, 41.667 kc ringing circuit
C648		Same as C642	Coupling capacitor, V605 cathode coupled MV
C649		CAPACITOR, FIXED, MICA DIELECTRIC: .01 µf, ±2%; 300 v DC working; temperature coefficient -20 to +100 parts/million/degrees C; MIL type CM35E103G, per spec MIL-C-5; 21964 #A2060308-12	Tuned circuit capacitor for 33.333 kc ringing circuit V603
C650		Same as C649	Tuning V610, 41.667 kc ringing circuit
C651		Same as C607	Coupling capacitor V612, 1350 cycle oscillator
C652		CAPACITOR, FIXED, PLASTIC DIELECTRIC: 1 section; 400 v DC working, .047 µf, ±5% 56289 #114P47354S2; 21964 #A2060300-5	Tuning, V612, 1350 cycle tone oscillator Figure 6-52
C653		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 300 v DC working, .047 µf, ±5% tolerance; 56289 #96P47353S2; 21964 #A2061733-1	Tuning, V612 plate 1350 cycle tone oscillator
C654 thru C666		Not used	
C667 Cont. See C701		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 µf, ±20%; 600 v DC working; MIL type CH53B1EF105M per MIL-STD-242A and per spec MIL-C-18312; 21964 #A1068596	B602 motor starting capacitor
CR601		SEMI-CONDUCTOR DEVICE, DIODE: germanium type; 40 ma max. continuous forward current; 125 ma max. peak forward current; 75 v peak inverse voltage; 0.8 mmf average shunt capacitance; MIL type 1N69 per spec MIL-E-1C; 21964 #700030	Mixing diode, DL601
CR602		Same as CR601	Mixing diode, DL601
CR603		Same as CR601	Switching diode, V604-2 keyer
CR604		Same as CR601	Isolating diode V610
CR605		Same as CR601	Isolating diode V603
CR606		Same as CR601	Clamping diode V602
DL601		DELAY LINE: distributed parometer type w/output inductive coupling; total delay 49 to 53 µsec nominal; 2 output coils spaced at 32 and 44 µsec approx, two locking type coil adjustments, one varying the 32 µsec w/respect to 44 µsec coil by 12 µsec, the second to vary the o/a delay of both coils simultaneously yet keep the delay between them constant, varying the o/a delay by 44±4 µsec, incl R789; 70117 #G115; 21964 #A9160102	Zero distance time delay and pulse coding Figure 6-6
DS601		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear, 1 filament, tungsten; 24446 #10C7/1DC; 21964 #710071; Same as DS501	Coder-Indicator "POWER ON" Figure 3-2

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
DS602 Cont. See DS701		Same as DS601	Antenna warning light Figure 3-2
E601 thru E603		Not used	
E604	6	SHIELD, ELECTRON TUBE: copper or brass, heat dissipating black finish; JAN type TS103U02 per spec JAN-S-28A; modified; 21964 #A2132988-5; Same as E307	Tube shield
E605		Same as E604	Tube shield
E606		Same as E604	Tube shield
E607		Same as E604	Tube shield
E608		Same as E604	Tube shield
E609		Same as E604	Tube shield
E610		Same as E604	Tube shield
E611		Same as E604	Tube shield
E612		Same as E604	Tube shield
E613	6	SHIELD, ELECTRON TUBE: copper or brass, heat dissipating black finish; JAN type TS103U01 per spec JAN-S-28A, modified; 21964 #A2132988-4; Same as E404	Tube shield
E614		Same as E613	Tube shield
E615		Same as E613	Tube shield
E616		Same as E613	Tube shield
E617		Same as E613	Tube shield
E618		INSERT, ELECTRON TUBE SHIELD: black cad plated brass; on shield JAN type TS103U02; MIL-STD-242A type #902; 21964 #A2132886-5; Same as E307A	Insert for E604
E619		Same as E618	Tube shield insert
E620		Same as E618	Tube shield insert
E621		Same as E618	Tube shield insert
E622		Same as E618	Tube shield insert
E623		Same as E618	Tube shield insert
E624		Same as E618	Tube shield insert
E625		Same as E618	Tube shield insert

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E626		Same as E618	Tube shield insert
E627		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U01; MIL-STD-242A type #901; 21964 dwg #A2132886-4; Same as E404A	Insert for E613
E628		Same as E627	Tube shield insert
E629		Same as E627	Tube shield insert
E630		Same as E627	Tube shield insert
E631		Same as E627	Tube shield insert
E632		Same as E618	Tube shield insert
E633 Cont. See E701		Same as E604	Tube shield
F601		FUSE, CARTRIDGE: 3 amp; 250 v; instantaneous type; MIL type F02G3R00A per spec MIL-R-15160A; 21964 #882011	Main power fuse Figure 3-2
F602		Same as F601	Main power fuse Figure 3-2
F603		Same as F601	Spare fuse
J601		CONNECTOR, RECEPTACLE ELECTRICAL: 1 round female contact; one connector mating end; 50 ohm nom impedance, 500 v peak voltage; low loss plastic dielectric; straight shape; MIL type UG-1094/U BNC Series, "D" hole mounting, per Navy dwg REB 49063; 21964 #A2131837; Same as J203	Ground receiver input Figure 6-6
J602		Same as J601	Video output Figure 6-6
J603		Same as J601	135 cps trigger input Figure 6-6
J604		Same as J601	15 cps trigger input Figure 6-6
J605		CONNECTOR, RECEPTACLE ELECTRICAL: 47 male round contacts; polarized; straight type; MIL type AN3102A-36-7P, per spec MIL-C-5015; 21964 #752335	Interconnecting cable connector
J606		Same as J601	Sync. output Figure 3-2
J607		Same as J601	Test output Figure 3-2

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J608		CONNECTOR, RECEPTACLE ELECTRICAL: 10 male round contacts; polarized; straight type; MIL type AN3102A-18-1P per spec MIL-C-5015B; 21964 #752210	Input jack for P927
J609		Same as J601	Output jack, 1350 cycle ref output Figure 6-6
J610		Same as J601	Tachometer v input jack Figure 6-6
L601		COIL, RADIO FREQUENCY: single universal winding, 850 turns no. 38 AWG resin coated nylon covered for each winding, 5.7 mh to 7.5 mh at 250 kc; ceramic coil form; adjustable tuning, powdered iron slug, screwdriver adjustment; 21964 #B2060052G1	Variable coil V603 33.333 kc ringing circuit Figure 6-6
L602		Same as L601	Variable coil, V610 41.667 kc ringing circuit Figure 6-6
L603		REACTOR: mechanical adjustable inductance type; 1 coil, 50 mh ±10% to 170 mh ±5%, 50 ma max. DC current; 45 ohms ±5% resistance between terminals 1 and 2, 55 ohms ±5% resistance between terminals 2 and 3; 500 v DC test voltage; MIL type TF2SX20ZZ per spec MIL-T-27A; 21964 spec #A2060070	Variable coil, V612, 1350 cycle oscillator Figure 6-6
L604 cont. See L701		CHOKE, RADIO FREQUENCY: 700 ma DC current rating; 47 microhenries ±10%; 1.2 ohms max DC resistance; MIL type LT8K010 per spec MIL-C-15305 and MIL-STD-242A; part #MS91189-10; 21964 #866000H470	Low pass filter choke
M601		METER, ARBITRARY, SCALE: panel mounted; DC; scale data, red to green to red, 4 scale divisions for 3 scale arcs; round hermetically sealed metal case, ±2% accuracy; 50 microamperes DC for full scale deflection; 2000 ohms resistance across terminals; D' Arsonval basic movement with shaded poles for expanded center point sensitivity; 8 microamperes ±10% for 20° deflection either side of center; white background; green scale 20° either side of center; remainder red; scale marked "Normal Range"; per spec MIL-M-10304A; 21964 #A2060762	Error indicating meter Figure 3-2
MP601		CLAMP, ELECTRICAL: brass, nickel plated finish; 1 screw type; 1-3/8" lg, 3/8" dia, o/a dim.; #10-32 NF-2 mounting stud w/hex nut 3/8: across flats; 3/32" max opening of locking torque; part #K10050 or equal, modified per 21964 #A2142151G1 76487	Dial lock
MP602		CAP ELECTRICAL: brass; fits BNC female connectors; MIL type CW-123/AU per Navy dwg. REA49050 and per spec MIL-C-3608; 21964 dwg #A9152998; Same as MP504	Protective cover for J606
MP603		Same as MP606	Protective cover for J607
MP604	7	WHEEL, CODING: c/o wheel with 60 adjustable stainless steel cam segments; dim. 4-7/8 in. dia, 0.203 in. thk; four 0.149 in. dia mtg holes on 0.812 in. dia centers; markings on face, "START CODE"; 21964 #B9151588	p/o tone identification keyer assy

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP605	7	CLAMP, SHAFT: band type; steel cadmium plated; one #8-32 thd bolt employed; dim. o/a, 13/16 in. lg, 7/16 in. w, 0.245 in. max deep; hole dia 0.314 in. max 50222 #SP-130-5/16 clamp bore; 21964 #A2144413	Mounts on shaft of tone identification keyer assy
MP606		FITTING, LUBRICATION: steel, 17/32 in. lg, 0.266 in. w, 1/4-28 (NF-2) thd one end 3/32 in. lg; 57733 #1792 or equivalent; military std #MS-15002-1; 21964 #A2132909	Mounts on housing of tone identification keyer assy
MP607		BOOT, DUST AND MOISTURE SEAL: silicone rubber bonded to a brass nickel plated hex nut 15/32-32 thd; 3/4 in. across flats, 7/8 in. lg; 97537 #1030; 21964 #A2132649-1; Same as MP202	Moisture and dust proof cover for S601
MP612	1	GASKET: synthetic rubber, MIL-R-900A, class 2; cross-section style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 3 ft lg; 21964 dwg #A9140800; Same as MP201	Seals front panel
MP613	4	BEARING, BALL, ANNULAR: single row; 0.2500 in. bore dia; 0.422 in flange dia, 0.1250 wide; 40920 #SS614FCHH: 21964 #B2132900-4	Mounts on cam shaft in gear box
MP614		Same as MP613	Mounts on idler shaft in gear box
MP615	4	GEAR ASSEMBLY: corrosion resisting steel type 303 per MIL-S-853; assy c/o two gears; o/a lg 0.562 in.; gear data, gear "A", 30teeth, 0.4687 in. pitch dia, 0.500 in. OD; gear "B" 50 teeth, 1.0416 in. pitch dia, 1.0832 in. OD, 20 deg pressure angle each; 01351 #250-30 and #150-50; 21964 #B2145118	p/o idler and shaft in gear box
MP616	4	BEARING, BALL, ANNULAR: single row; bore dia, 0.1875 in.; flange dia, 0.422 in., 0.1250 in. wide; 40920 #SS6632 FCHH; 21964 #B2132900-2	Mounts on wheel shaft in gear box
MP617	4	GEAR, SPUR: corrosion resistant steel; 25 teeth, 20 deg pressure angle; gear data, 0.5625 in. OD, 0.5208 pitch dia, 0.406 in. hub dia, 0.1785 in. bore dia; #6-32 NC-2B tapped hole for setscrew mtg; 21964 #A2145770	p/o idler and cam shaft in gear box
MP618	4	BEARING, BALL, ANNULAR: single row; bore dia 0.2500 in.; o/a dia 0.3750 in., width 0.1250 in; 40920 #SS614CHH; 21964 #B2132910-4	Mounts on cam shaft in gear box
MP619		Same as MP618	Mounts on idler shaft in gear box
MP620		Same as MP618	Mounts on wheel shaft in gear box
MP621	4	GEAR, SPUR: aluminum alloy 2024-T4; 75 teeth, 20 deg pressure angle; dim. 1.2031 in. OD; 1.1718 in. pitch dia, 0.375 in. lg; one no. 6-32 NC-2B tapped hole for setscrew; 01351 #250-75; 21964 #B2132908-1; p/o MP627	p/o idler and cam shaft in gear box

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP622	1	GASKET: synthetic rubber, MIL-R-900C; 2-15/64 in. dia aperature in center; three 1/8 in. dia holes spaced 120 deg apart on 2-7/16 in. dia, 2-11/16 in. dia OD, 1/16 in. thk; 21964 #B2060910; Same as MP205	Sealer
R601		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; MIL type RW59V281 per spec MIL-R-26C; 21964 #A213271-1-01; Same as R520	Limiting resistor for DS601
R602		Same as R601	Limiting resistor for DS602
R603	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt MIL type RC20GF103K, per spec MIL-R-11; 21964 #504243; Same as R404	Grid resistor V601-2, 15 cps trigger amplifier
R604	6	RESISTOR, FIXED, COMPOSITION: 22,000 ohms; ±10%; 1/2 watt MIL type RC20GF223K per spec MIL-R-11; 21964 #504247	Grid dropping resistor, V601-2, 15 cps trigger amplifier
R605	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ±10%; 1 watt MIL type RC32GF473K per spec MIL-R-11; 21964 #503938; Same as R426	Plate load V601-2, 15 cps trigger amplifier
R606		RESISTOR, FIXED, COMPOSITION: 1.2 megohms ±5%; 1/2 watt MIL type RC20GF125J; per spec MIL-R-11; 21964 #504177	Grid voltage divider, V602, 15 cps gate MV
R607		RESISTOR, FIXED, COMPOSITION: 124,000 ohms; ±5%, 1/2 watt MIL type RC20GF124J, per spec MIL-R-11; 21964 #504153	Grid voltage divider, V602, 15 cps gate MV
R608	6	RESISTOR, FIXED, COMPOSITION: 680,000 ohms; ±10%; 1/2 watt MIL type RC20GF684K, per spec MIL-R-11; 21964 #504265	Plate load, V602, 15 cps gate MV
R609		Same as R606	Grid tuning, V602, 15 cps gate MV
R610	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ±10%; 2 watt; MIL type RC42GF103K per spec MIL-R-11; 21964 #501253; Same as R416	Plate load, V602, 15 cps gate MV
R611	6	RESISTOR, FIXED, COMPOSITION: 4700 ohms; ±10%; 1 watt; MIL type RC32GF472K, per spec MIL-R-11; 21964 #503926; Same as R328	Cathode resistor V602 15 cps gate MV
R612		Same as R608	Grid resistor V603, 33.333 kc ringing circuit
R613	6	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±10% 2 watt immersion; 2 wire lead terminals; MIL type RC42GF123K, per spec MIL-R-11; 21964 #501254	Plate load V603, 33.333 kc ringing circuit

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R614	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±10%, 1/2 watt MIL type RC20GF473K; per spec MIL-R-11; 21964 #504251; Same as R425	Grid limiting, V603, 33.333 kc ringing circuit
R615	6	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 2 watt; MIL type RC42GF822K, per spec MIL-R-11; 21964 #501252	Plate load V603, 33.333 kc ringing circuit
R616	6	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±10%; 1/2 watt MIL type RC20GF104K, per spec MIL-R-11; 21964 #504255; Same as R320	Grid resistor, V609-1 reference burst amplifier
R617		Not Used	
R618		Not Used	
R619		Same as R610	Plate load, V604-1, ref burst amplifier
R620		RESISTOR, FIXED, COMPOSITION: 680,000 ohms, ±5%; 1/2 watt MIL type RC20GF684J, per spec MIL-R-11; 21964 #504171	Grid voltage divider, V605, cathode coupled MV
R621		RESISTOR, FIXED, COMPOSITION: 56,000 ohms, ±5%; 1/2 watt MIL type RC20GF563J per spec MIL-R-11; 21964 #504145	Grid voltage divider, V605, cathode coupled MV
R622	6	RESISTOR, FIXED, COMPOSITION: 15,000 ohms; ±10%; 1/2 watt MIL type RC20GF153K per spec MIL-R-11; 21964 #504245; Same as R413	Plate load, V605, cathode coupled MV
R623		RESISTOR, FIXED, COMPOSITION: 1 megohm; ±5%; 1/2 watt MIL type RC20GF105J, per spec MIL-R-11; 21964 #504175	Grid tuning, V605, cathode coupled MV
R624		Same as R610	Plate load, V605, cathode coupled MV
R625		Same as R611	Cathode resistor, V605, cathode coupled MV
R626		Same as R604	Grid resistor, V606, delay line blocking oscillator
R627	6	RESISTOR, FIXED, COMPOSITION: 2700 ohms; ±10%; 1/2 watt MIL type RC20GF272K, per spec MIL-R-11; 21964 #504236; Same as R309	Load resistor T602 primary

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R628	6	RESISTOR, FIXED, COMPOSITION: 100 ohms; ±10%; 1/2 watt MIL type RC20GF101K per spec MIL-R-11; 21964 #504219; Same as R201	Decoupling resistor, plate supply
R629	6	RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±10%; 1/2 watt MIL type RC20GF222K per spec MIL-R-11; 21964 #504235; Same as R207	Load resistor, T602 secondary
R630	6	RESISTOR, FIXED, COMPOSITION: 10 ohms; ±10%; 1/2 watt MIL type RC20GF100K per spec MIL-R-11; 21964 #504207; Same as R334	Isolating resistor, V606 delay line blocking oscillator
R631	6	RESISTOR, FIXED, COMPOSITION: 330 ohms ±10%, 1/2 w MIL type RC20GF331K; per spec MIL-R-11; 21964 #504225; Same as R302	Cathode resistor, V606, delay line blocking oscillator
R632		RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5% tolerance; 1/2 watt; MIL type RC20GF103J; per spec MIL-R-11; 21964 #504127	Grid bias divider, V606, delay line blocking oscillator
R633		RESISTOR, FIXED, COMPOSITION: 33,000 ohms; ±5%; 1/2 watt MIL type RC20GF333J per spec MIL-R-11; 21964 #504139; Same as R326	Grid bias divider, V606, delay line blocking oscillator
R634		RESISTOR, FIXED, COMPOSITION: 8200 ohms; ±5%; 1/2 watt; MIL type RC20GF822J per spec MIL-R-11; 21964 #504125; Same as R325	Grid bias divider, V606, delay line blocking oscillator
R635		Same as R604	Grid resistor, V607-1, delay line output amplifier
R636		RESISTOR, FIXED, COMPOSITION: 12,000 ohms ±5%; 1/2 watt MIL type RC20GF123J per spec MIL-R-11B; 21964 #504129	Grid bias divider, V607-1, delay line output amplifier
R637		RESISTOR, FIXED, COMPOSITION: 47,000 ohms; ±5%; 1/2 watt MIL type RC20GF473J per spec MIL-R-11; 21964 #504143	Grid bias divider, V607-1, delay line output amplifier
R638	6	RESISTOR, FIXED, COMPOSITION: 33,000 ohms; ±10%; 1/2 watt MIL type RC20GF333K, per spec MIL-R-11; 21964 #504249	Plate load V607-1 delay line output amplifier
R639		RESISTOR, FIXED, COMPOSITION: 15,000 ohms; ±5%; 1/2 watt MIL type RC20GF153J per spec MIL-R-11; 21964 #504131	Grid tuning, V615, output MV
R640	6	RESISTOR, FIXED, COMPOSITION: 22,000 ohms; ±10%; 2 watts MIL type RC42GF223K, per spec MIL-R-11; 21964 #501257; Same as R420	Plate load, V615 output MV
R641		Same as R640	Plate load, V615, output MV

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R642	6	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±10%; 1/2 watt MIL type RC20GF102K; per spec MIL-R-11; 21964 #504231; Same as R341	Plate Load, V615, output MV
R643		Same as R637	Cathode stabilizing V615, output MV
R644		RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±5%; 1/2 watt MIL type RC20GF683J, per spec MIL-R-11; 21964 #504147	Cathode stabilizing V615, output MV
R645		Same as R642	Cathode resistor, V615, output MV
R646		RESISTOR, FIXED, COMPOSITION: 560,000 ohms, ±5% tolerance; 1/2 watt MIL type RC20GF564J, per spec MIL-R-11; 21964 #504169	Grid bias divider, V607-2, output cathode follower
R647		Same as R623	Grid bias divider, V607-2, output cathode follower
R648		Same as R616	Grid resistor, V607-2, output cathode follower
R649		Same as R642	Cathode resistor, V607-2, output cathode follower
R650		Same as R628	Test output voltage divider, V607-2, cathode follower
R651		Same as R637	Grid bias divider, V611 priority
R652	6	RESISTOR, FIXED, COMPOSITION: 150,000 ohms, ±10%; 1/2 watt MIL type RC20GF154K; per spec MIL-R-11A; 21964 #504257	Plate load V608
R653		Same as R629	Cathode resistor V608
R654	6	RESISTOR, FIXED, COMPOSITION: 1.5 megohm, ±10%; 1/2 watt MIL type RC20GF155K per spec MIL-R-11; 21964 #504269	Plate load resistor V608
R655	6	RESISTOR, FIXED, COMPOSITION: 330,000 ohms; ±10%; 1/2 watt MIL type RC20GF334K; per spec MIL-R-11; 21964 #504261	Grid limiting resistor V608
R656	6	RESISTOR, FIXED, COMPOSITION: 1 megohm, ±10%; 1/2 watt MIL type RC20GF105K; per spec MIL-R-11; 21964 #504267; Same as R432	Grid resistor V608

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R657		Same as R603	Grid resistor V601-1
R658		Same as R604	Grid limiting resistor V601-1
R659		Same as R605	Plate load, V601-1, 135 cps trigger amplifier
R660		Same as R607	Grid voltage divider, V609, 135 cps gate MV
R661		Same as R606	Grid voltage divider, V609, 135 cps gate MV
R662		Same as R608	Plate load V609, 135 cps gate MV
R663		Same as R623	Grid timing V609, 135 cps gate MV
R664		Same as R610	Plate load V609, 135 cps gate MV
R665		Same as R611	Cathode resistor V609 135 cps gate MV
R666		Same as R613	Plate load V610, 41. 667 kc ringing circuit
R667		Same as R608	Grid resistor V610, 41. 667 kc ringing circuit
R668		Same as R616	Grid limiting V610, 41. 667 kc ringing circuit
R669		Same as R615	Plate load V610, 41. 667 kc ringing circuit
R670		Not Used	
R671		Same as R604	Voltage divider, 135 cps ref burst feed-back circuit

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R672	6	RESISTOR, VARIABLE: composition element; 1 section, 0.10 megohm; ±10%; 2 watt nominal power rating; no switch; MIL type RV4LAVSA104A per spec MIL-R-94 and MIL-STD-242 (Ships); 21964 #A2133049-3	Voltage divider, 135 cps reference burst feedback circuit Figure 6-6
R673		Same as R638	Voltage divider, 135 cps ref burst feed-back circuit
R674	6	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±10%; 1/2 watt MIL type RC20GF683K, per spec MIL-R-11; 21964 #504253	Voltage divider, 15 cps reference burst feedback circuit
R675		Same as R672	15 cps feedback Figure 6-6
R676		Same as R638	15 cps feedback
R677		Same as R614	Isolating resistor, V611 priority
R678		Same as R614	Isolating resistor
R679		Same as R656	Grid resistor, V611, priority
R680	6	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±10%; 1 watt MIL type RC32GF683K; per spec MIL-R-11; 21964 #503940	Plate load, V611, priority
R681		Same as R629	Cathode resistor, V611 priority
R682		RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±5%; 1/2 watt MIL type RC20GF474J, per spec MIL-R-11; 21964 #504167	Grid bias divider, V611 priority
R683	6	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±10%; 1/2 watt MIL type RC20GF474K, per spec MIL-R-11; 21964 #504263; Same as R430	Grid resistor, V611 priority
R684		Same as R614	Cathode resistor V604-2, keyer
R685		Same as R656	Grid resistor V604-2 keyer
R686		Same as R637	Grid bais divider V604-2, keyer
R687		Same as R628	Current limiting resistor
R688		RESISTOR, FIXED, COMPOSITION: 100,000 ohms ±5%; 1/2 watt MIL type RC20GF104J per spec MIL-R-11; 21964 #504151; Same as R444	Grid voltage divider, V612, 1350 cycle oscillator

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R689		RESISTOR, FIXED, COMPOSITION: 39,000 ohms, ±5%; 1/2 watt MIL type RC20GF393J, per spec MIL-R-11; 21964 #504141	Grid voltage divider, V612, 1350 cycle oscillator
R690		Same as R656	Grid resistor V612, 1350 cycle oscillator
R691		Same as R656	Grid limiting, V613-1 1350 cycle amplifier
R692	6	RESISTOR, FIXED, COMPOSITION: 3900 ohms, ±10%; 1/2 watt; MIL type RC20GF392K per spec MIL-R-11; 21964 #504238	Cathode resistor V612, 1350 cycle oscillator
R693		Same as R680	Cathode resistor V612, 1350 cycle oscillator
R694		Same as R614	Grid resistor V613-1, 1350 cycle amplifier
R695		Same as R614	Plate load, V613-1
R696		Same as R620	Grid voltage divider, V614
R697		Same as R616	Plate load, V614
R698		Same as R633	Grid voltage divider, V614
R699 Cont. See R701	6	RESISTOR, FIXED, COMPOSITION: 6800 ohms; ±10%; 1/2 watt MIL type RC20GF682K per spec MIL-R-11; 21964 #504241; Same as R411	Cathode resistor V614, 100μsec MV
S601		SWITCH, TOGGLE: single pole, single throw; 0.75 amp 125 v DC., 15 amp 125 v AC., JAN type ST42A, per spec JAN-S-23; 21964 #828212; Same as S502	"ON-OFF" switch Figure 3-2
S602		Not Used	
S603		Same as S601	Continuous tone on normal keying switch Figure 6-6
S604		SWITCH, SENSITIVE: single pole double throw; 125 v AC, 15 amp; roller leaf spring type, 0.188" max pre-travel, 0.031" min. over travel; 6 oz max operating force; 0.5 oz min release force; 0.050" max movement differential; 0.020 nom contact separation; momentary action; one contact normally open, one contact normally closed; 3 screw type terminals; JAN type SS05A20 per spec JAN-S-63 and MIL-STD-242A; 21964 #2060306	Identification keyer keying switch Figure 6-6

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
S605		SWITCH, TOGGLE: double pole double throw; 6 amp; 125 v AC; JAN type ST22N per spec JAN-S-23: 21964 #B2061102G1	Identification keyer "ON-OFF" switch Figure 3-11
S606		Not Used	
S607		SWITCH, SENSITIVE: SPDT, 0.5 amp peak current, 75 v DC; not enclosed; roller leaf type momentary action, one contact normally closed; with adjusting screw and block; 3 solder type terminals; 21964 #C2061124	Identification keyer coding switch Figure 3-11
T601		Not Used	
T602		TRANSFORMER, PULSE: three windings of 1:1:1 ratio; nominal pulse width 2 usec; winding impedance 300 ohms with a rise time of .04 usec and pulse widths .5 to 5 usec; max pulse voltage 350 v, max peak power 200 w; 800 v DC test voltage 49956 #363-6004G2, MIL type TF2SX35ZZ per spec MIL-T-27A; 21964 #A1069475	Pulse transformer, blocking oscillator V606 Figure 6-52
T603 Cont. See T701		TRANSFORMER, PULSE: 2 windings of 1:3 ratio; nominal pulse width 20 usec; winding impedance 300/2700 ohms with a rise time of 0.8 usec and pulse widths 1 to 20 usec; max pulse voltage 350 v, max peak power 200 w; 800 v DC test voltage; 01961 type PE2030, MIL type TF2SX36ZZ per spec MIL-T-27A; 21964 #A1069827	Delay line driving pulse transformer Figure 6-52
TB601		TERMINAL BOARD: 6 terminals; double screw type; barrier type; MIL type 8TB6 per spec MIL-T-16784 and Navy dwg 9000-S6505G-73214; 21964 #A2133063-2	Terminal board identification tone keyer chassis
TB602		Not Used	
TB603		TERMINAL BOARD: 2 terminals; double screw type; barrier type; MIL type 8TB2 per spec MIL-T-16784 and Navy dwg 9000-S6505B-73214; 21964 #A2133063-1	Interlock test board
TB604		TERMINAL BOARD: 12 terminals; single row, thru type terminals; MIL type 7TB12 per spec MIL-T-16784A and Navy dwg 9000-S6505G-73214; 21964 #A2133072-2	Terminal board, video chassis Figure 6-52
TB605 thru TB694		Not Used	
TB695	2	TERMINAL BOARD: 78 solder stud terminals; 21964 #B2060935G1	Terminal board for video chassis assy Figure 6-52
TB696	2	TERMINAL BOARD: 78 hollow solder stud terminals; 21964 #B2060934G1	Terminal board for video chassis assy Figure 6-52
TB697	2	TERMINAL BOARD: 78 solder stud terminals; 21964 #B2060986G1	Terminal board for video chassis assy Figure 6-52

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
TB698	2	TERMINAL BOARD: 78 solder stud terminals; 21964 #B2060985G1	Terminal board for video chassis assy Figure 6-52
TB699 Cont. See TB701	2	TERMINAL BOARD: 44 hollow type solder stud terminals; 21964 #B2060932G1	Terminal board for video chassis assy Figure 6-52
V601		ELECTRON TUBE: twin triode; MIL type 12AT7WA; per spec MIL-E-1C; 21964 #701165; Same as V307	Reference pulse trigger amplifier Figure 6-6
V602		Same as V601	15 cps gate MV Figure 6-6
V603		ELECTRON TUBE: twin triode; MIL type 5670, per spec MIL-E-1C; 21964 #700563; Same as V404	33.333 kc pulsed oscillator Figure 6-6
V604		Same as V601	Reference burst amplifier keyer Figure 6-6
V605		Same as V601	Cathode coupled MV Figure 6-6
V606		ELECTRON TUBE: twin triode; MIL type 5687WA; per spec MIL-E-1 (Navy); 21964 #A2133281	Delay line blocking oscillator
V607		Same as V606	Delay line output amplifier, output cathode follower Figure 6-6
V608		Same as V601	1350 reference cycle oscillator Figure 6-6
V609		Same as V601	135 cps gate MV Figure 6-6
V610		Same as V603	41.667 kc pulsed oscillator Figure 6-6
V611		Same as V601	Priority tube Figure 6-6
V612		Same as V603	1350 cycle oscillator Figure 6-6
V613		Same as V603	1350 cycle amplifier Figure 6-6
V614		Same as V603	100 usec MV Figure 6-6
V615 Cont. See V701		Same as V606	Output MV Figure 6-6
XDS601		LIGHT, INDICATOR: friction mtg lens holder; accomodates style S-6 lamp; 125 v, 6 watts; MIL type LH63PW3 per spec MIL-L-3661, dwg MS-90286; 21964 #A2133069-5; Same as XDS501	Holder for DS601

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XDS602 Cont. See XDS-701		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BA3 per spec MIL-L-3661, dwg MS90286; 21964 #A2133080-3	Holder for DS602
XF601		FUSE HOLDER: extractor post type; accommodates 2 fuses 1-1/4" lg. by 1/4" dia; blown fuse indicating type; sealed; MIL type FHL10G per BuShips dwg #9000-S6202-74228 and per spec MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Fuse holder for F601
XF602		FUSE HOLDER: extractor post type; accommodates 1 fuse 1-1/4" lg by 1/4" dia; blown fuse indicating type; sealed; MIL type FHL11G per BuShips dwg #9000-S6202-74229 and per spec MIL-F-19207 (Ships); 21964 #A2060403; Same as XF503	Fuseholder for F602
XV601		SOCKET, ELECTRON TUBE: 9 contacts, brass, nickel plated; miniature; includes metal shield base, JAN type TS103P01, per spec JAN-S-28A-1; 21964 #740004; Same as XV307	Tube socket for V601
XV602		Same as XV601	Tube socket for V602
XV603		Same as XV601	Tube socket for V603
XV604		Same as XV601	Tube socket for V604
XV605		Same as XV601	Tube socket for V605
XV606		Same as XV601	Tube socket for V606
XV607		Same as XV601	Tube socket for V607
XV608		Same as XV601	Tube socket for V608
XV609		Same as XV601	Tube socket for V609
XV610		Same as XV601	Tube socket for V610
XV611		Same as XV601	Tube socket for V611
XV612		Same as XV601	Tube socket for V612
XV613		Same as XV601	Tube socket for V613
XV614		Same as XV601	Tube socket for V614
XV615 Cont. See XV701		Same as XV601	Tube socket for V615
Y604		RESONATOR, TUNING FORK: fixed frequency, 1350 cycles, hermetically sealed metal case; electrically equivalent to 95267 #J-1350-K-40-85 percent per spec MIL-K-16400A; 21964 #A2060071	1350 cycle tuning fork

TABLE 7-3 RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C701		CAPACITOR, FIXED, PAPER DIELECTRIC: 6 µf ±10%, 600 v DC working; MIL type CP70E1EF605K per spec MIL-C-25; 21964 #641039	Plate supply filter Figure 6-53
C702		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section; 0.1 µf, ±10%, 400 v DC working; MIL type CP09A1KE104K per spec MIL-C-25A; 21964 #643518	Stabilizing V704, control tube
C703		Same as C701	Bias supply filter Figure 6-53
C704		Same as C702	Bypass, V705, voltage regulator
DS701		LAMP, GLOW: neon gas, 0.25 watt, 67-87 v DC striking voltage; double contact bayonet type; T4-1/2 bulb; MIL type NE-16 per spec MIL-L-15098, 21964 #A2060350; Same as DS502	"POWER ON" warning light Figure 6-7
E701 thru E703		Not used	
E704	5	SHIELD, ELECTRON TUBE: copper or brass, heat dissipating black finish; JAN type TS102U02 per spec JAN-S-28A, modified; 21964 #A2132886-2; Same as E202	Tube shield
E705		INSERT, ELECTRON TUBE SHIELD: black cad plated brass; use on shield JAN type TS102U02; MIL-STD-242A type #702, 21964 #A2132988-2; Same as E202A	Insert for E704
E706	5	SHIELD, ELECTRON TUBE: copper or brass, heat dissipating black finish; JAN type TS102U03 per spec JAN-S-28A, modified; 21964 #A2132988-3; Same as E408	Tube shield
E707		INSERT, ELECTRON TUBE SHIELD: black cad plated brass; use on shield JAN type TS102U03 per MIL-STD-242A type #703; 21964 #A2132886-3; Same as E408A	Insert for E706
E708		Same as E706	Tube shield
E709		Same as E707	Insert for E708
E710 thru E725		Not used	
E726		RETAINER, ELECTRON TUBE: steel, retains standard octal type tube base; clamps tube with spring action; 07387 #926-C; 21964 #B2141834-8	Retainer for V701
E727		RETAINER, ELECTRON TUBE: stainless steel, type 302, c/o clip, strap and bracket; 07387 #926 H-5; 21964 #A9153393	Retainer for V703
L701		REACTOR: filter choke; one section; 10 henries; 200 ma DC; 110 ohms DCR; 440 peak wv; AC drop 200 v rms, per spec MIL-T-27; Grade 1, Class R Family O4; life expectancy X; case YY; MIL type TF1RX04YY; 21964 spec #A9010462 and dwg #B9151068; Same as L501	Plate supply filter choke Figure 6-6

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R701	6	RESISTOR, FIXED, COMPOSITION: 33 ohms; ±10%; 1/2 watt MIL type RC20GF330K per spec MIL-R-11; 21964 #504213	Balancing resistor V703, series regulator
R702		Same as R701	Balancing resistor, V703, series regulator
R703		Same as R642	Grid balancing V703, series regulator
R704		Same as R642	Grid balancing V703, series regulator
R705		Same as R674	Plate load V704, control tube
R706		Same as R688	Screen voltage divider, V704, control tube
R707		RESISTOR, FIXED, COMPOSITION: 82,000 ohms; ±5%; 1/2 watt MIL type RC20GF823J per spec MIL-R-11; 21964 #504149	Screen voltage divider, V704, control tube
R708	6	RESISTOR, FIXED, COMPOSITION: 390,.000 ohms; ±10%; 1/2 watt MIL type RC20GF394K per spec MIL-R-11; 21964 #504262	Grid bias divider, V704, control tube
R709		Same as R683	Grid limiting, V704, control tube
R710		Same as R672	Power supply B+ control, V704, control tube Figure 6-53
R711		Same as R652	Grid bias voltage divider, V704, control tube
R712	6	RESISTOR, FIXED, COMPOSITION: 3900 ohms ±10%; 2 watt; MIL type RC42GF392K per spec MIL-R-11; 21964 #501248	Current limiting resistor, for V705, voltage regulator
R713		Same as R712	Current limiting resistor for V705 voltage regulator
R714		Same as R615	Current limiting resistor for V705 voltage regulator
R715		Same as R615	Current limiting resistor for V705 voltage regulator

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R716	6	RESISTOR, FIXED, COMPOSITION: 15,000 ohms; ±10%; 1 watt MIL type RC32GF153K per spec MIL-R-11; 21964 #503932; Same as R521	Limiting resistor, DS701 warning
R717 thru R784		Not Used	
R785		Same as R642	Grid limiting resistor V607-2
R786		Same as R683	Grid resistor, V612
R787		Same as R638	Grid resistor, V615 output MV
R788		Same as R637	Grid bias resistor, V604-2
R789	6	RESISTOR, FIXED, COMPOSITION: 5600 ohms ±10%; 1/2 watt; MIL type RC20GF562K per spec MIL-R-11; 21964 #504240	Terminating resistor p/o DL601
R790		Same as R642	Cathode resistor, V610
R791		Same as R642	Cathode resistor, V603
R792		Same as R614	Isolating resistor, V612, 1350 cycle oscillator
R793		Same as R629	Cathode resistor V613-2, 1350 cycle output amplifier
R794		Same as R614	Plate load, V613-2 1350 cycle output amplifier
R795		Same as R614	Isolating resistor V613-2, 1350 cycle output amplifier
R796		Same as R603	Grid resistor V613-2 1350 cycle output amplifier
R797		Same as R622	Grid timing resistor V614, 100 µsec MV
R798		Same as R672	Grid timing, variable V614, 100 µsec MV Figure 6-6

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R799	6	RESISTOR, FIXED, COMPOSITION: 33,000 ohms ±10%; 1 watt MIL type RC32GF333K per spec MIL-R-11; 21964 #503936	Plate load, V614, 100μsec MV
T701		TRANSFORMER, POWER, STEP-DOWN: input 120 v AC, 60 cycles, single phase; output, sec no. one 5 v ct at 3 amp, sec no. two 6.4 v at 16 amp; 49956 #292-5625G1, MIL type no. TF1SX01YY; 21964 #A1069871	Filament voltage supply Figure 6-6
T702		TRANSFORMER, POWER, STEP-UP: input 120 v AC, 60 cycles, single phase, output, sec no. one 850 v ct at 200; sec no. two 450 v ct at .055; 49956 #292-5619G1; MIL type TF1SX02YY; 21964 #A1069472	Plate and bias voltage supply Figure 6-6
TB701		TERMINAL BOARD: 10 terminals; double screw type; barrier type; MIL type 8TB10 per spec MIL-T-16734 and Navy dwg 9000-S6505G-73214; 21964 #A2133063-4	Terminal board, power supply Figure 6-53
TB702 thru TB797		Not Used	
TB798	2	TERMINAL BOARD: 16 Hollow solder stud terminals; 21964 #B2060936G1	Terminal board for power supply assy Figure 6-53
TB799	2	TERMINAL BOARD: 20 hollow solder stud terminals; 21964 #B2060937G1	Terminal board in power supply assy Figure 6-53
V701	6	ELECTRON TUBE: dual diode; MIL type 5R4WGB per spec MIL-E-1C; (Navy); 21964 #A213449; same as V501	Plate supply rectifier Figure 6-6
V702	6	ELECTRON TUBE: dual diode; MIL type 6X4W per spec MIL-E-1C; 21964 #700151; Same as V502	Bias supply rectifier Figure 6-6
V703		ELECTRON TUBE: dual triode; MIL type 6080WA, per spec MIL-E-1C; 21964 #701276; Same as V503	Series regulator Figure 6-7
V704		ELECTRON TUBE: pentode; MIL type 6AH6; per spec MIL-E-1C; 21964 #700116	Control tube
V705		ELECTRON TUBE: diode; MIL type 6627/OB2WA, per spec MIL-E-1 (Navy); 21964 #A2133279; Same as V505	Bias voltage regulator Figure 6-6
XDS701	6	LAMP HOLDER: 125 v; accommodates double contact bayonet base lamp; Military Standard lampholders dwg MS90290; 72619 #9S4634-L-46; MIL type LH-71-XXO per spec MIL-L-3661; 21964 #A9152053 or A2142519; Same as XDS502	"POWER ON" warning light holder
XV701	6	SOCKET, ELECTRON TUBE: 8 contacts, beryllium silver plated octal, oval shaped; JAN type TS101P02 per spec JAN-S-28A; 71785 #51B16758; 21964 #740031; Same as XV501	Socket for V701 plate supply rectifier Figure 6-53
XV702	6	SOCKET, ELECTRON TUBE: 7 contacts, brass, nickel plated; miniature; includes metal shield base, JAN type TS10-2P01, per spec JAN-S-28A-1; 21964 #740002; Same as XV308	Socket for V702, bias supply rectifier Figure 6-53

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CODER-INDICATOR KY-382/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV703		Same as XV701	Socket for V703 series regulator Figure 6-53
XV704		Same as XV702	Socket for V704, control tube Figure 6-53
XV705		Same as XV702	Socket for V705, bias voltage regulator Figure 6-53

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
901-999		CABINET, ELECTRICAL EQUIPMENT CY-3163/GRN-9D: Steel color grey; overall dim. 34-1/8" lg., 25" wide, 72" high; cutout for specific equipment, qty. 1, 7-3/8" wide by 15-15/16" high, Receiver, Radio R-824/URN; qty. 1, dim. 11-3/8" wide by 15-5/16" high, Coder-Indicator; Qty. 1, dim. 19-7/8" wide by 9-9/16" high, Control-Duplexer; qty. 1, dim. 19-7/8" wide by 20-5/16" high, Amplifier-Modulator AM-1701/URN; qty. 1, dim. 19-7/8" wide by 7-9/16" high, Frequency Multiplier- Oscillator; carrying handles incl. qty. 2, eyebolts, adjacent corners on top of cabinet; dripproof; 4 shock mounts on bottom of cabinet & 2 shock mounts on the back of the cabinet; junction box (located on back of cabinet) large enough to accommodate incoming cables; bottom portion of cabinet has built-in blowers & filters; shock mounts are removable for equipment installation; 21964 #J2060-332 and A2060332; u/o AN/GRN-9D	Part of Receiver-Transmitter Group
B901		FAN, CENTRIFUGAL: electric motor operated; non-portable; AC motor, fixed base; single unit on common shaft, direct drive connection, one rotor stage; single inlet with rectangular discharge outlet, 480 cfm at 2 in. static pressure; ccw rotation, 82877 #AO-9293; 21964 #A2060067	General ventilation (Receiver side cooling)
B901A		MOTOR, ALTERNATING CURRENT: squirrel-cage induction type; AC, 208-220/440 v, 50-60 cps, 3 ph; 3/4 hp, single take-off shaft, 3450 rpm, cw rotation of output shaft looking at load end; 82877 #9293-01; p/o B901	p/o centrifugal fan
B902		FAN, CENTRIFUGAL: electric motor operated; non-portable; AC motor, fixed base; single unit on common shaft, direct drive connection; one rotor stage; single inlet with rectangular discharge outlet; 425 cfm at 3 in. static pressure; cw rotation, facing driving side; 82877 #AO-9294; 21964 #A20600068	Ventilation for klystron V1304
B902A		MOTOR, ALTERNATING CURRENT: squirrel-cage induction type; AC 208-220/440 v, 50-60 cps, 3 ph; 1/2 hp, single take-off shaft, 3300 rpm, ccw rotation of output shaft looking at load end; 82877 #9294-01; p/o B902	p/o centrifugal fan
DS901		LAMP, GLOW: neon gas, 0.04 watt; T-3-1/4 bulb; MIL type NE-51 per spec MIL-L-15098B; 21964 #A2141970	Indicator light Figure 3-6
E901 and E902		Not Used	
E903	6	INSULATOR, STANDOFF: MIL-STD-242A; 21964 #B2061734	HV input cable connection
E904 and E905		Not Used	
E906	6	INSULATOR, STANDOFF: Steatite, grade L4A, MIL type NS4AB2016 per MIL-STD-242A; 21964 dwg #A2133225-3	Standoff for 700 v input
E907		Same as E906	Standoff for 1000 v input
E908		Same as E906	Standoff for 700 v internal connection
F901		FUSE, CARTRIDGE: 3 amp, 125 v; time delay, 135% for 0-1 hour and 300% for 6 seconds; enclosed type; MIL type F02D3R00B per MIL-STD-MS90078-27-1 and spec MIL-F-15160C; 21964 #882237; Same as F501; u/o AN/GRN-9D	Overload protection for B901 Figure 3-6

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
F902		Same as F901; u/o AN/GRN-9D	Overload protection for B901 Figure 3-6
F903		Same as F901; u/o AN/GRN-9D	Overload protection for B901 Figure 3-6
F904		Same as F901; u/o AN/GRN-9D	Spare for F901, F902, F903
F905		FUSE, CARTRIDGE: 2 amp, 125 v, time delay, 135% for 0-1 hour and 300% for 6 sec; ferrule type terminals; dim. 0.250" lg, 0.250" dia; enclosed type, glass case; one time; non-indicating; 1-1/4" lg, 0.250" dia, 0/a dim; MIL type F02D2R00B, per MIL-STD-MS9007-8-26-1 and spec MIL-F-15160A; 21964 #882236; u/o AN/GRN-9D	Overload protection for B902 Figure 3-6
F906		Same as F905; u/o AN/GRN-9D	Overload protection for B902 Figure 3-6
F907		Same as F905; u/o AN/GRN-9D	Overload protection for B902 Figure 3-6
F908		Same as F905; u/o AN/GRN-9D	Spare for F905, F906, F907
FL901		FILTER, RADIO INTERFERENCE: 40 amps at 208 v; 60 cps; hermetically sealed; dim. 2-7/8 in. lg, 2-1/8 in. w. 4-5/16 in. h; four #10-32 NF-2A mtg studs on 1-1/8 in. by 1-7/8 in. centers; 2 thd terminals; 81831 #FA1851E; 21964 #A2060432; u/o AN/GRN-9D	External power cable
FL902		Same as FL901; u/o AN/GRN-9D	External power cable
FL903		Same as FL901; u/o AN/GRN-9D	Main input line noise filter
FL904		FILTER, RADIO INTERFERENCE: 15 amps at 125 v; 60 cps; hermetically sealed; o/a dim. 2 in. lg, 1-1/2 in. w, 3 in. h; four #8-32NC-2A mtg studs on 3/8 in. by 1-1/4 in. centers; 2 thd ceramic terminals; 81831 #FA2055A; 21964 #A2060433	Aux power line noise filter
FL905		Same as FL904	Aux power line noise filter
FL906		Same as FL901; u/o AN/GRN-9D	Main input line noise filter
J901		CONNECTOR, RECEPTACLE ELECTRICAL: 2 female flat contacts; not polarized; straight shape; 21964 #A2060427	Convenience outlet
J902		Not Used	
J903		CONNECTOR, ADAPTER: 2 contacts, female, round; straight type; MIL type UG-701/U per MIL std dwg #MS90266; per 21964 #A2141974	15 cps ref pulse input to cabinet, accepts P901 & P903
J904		Same as J903	135 cps ref pulse input to cabinet
*K901		RELAY, ARMATURE: 1A contact arrangement, 120 v AC; 60 cps, 5 amps contact rating; 1 coil, 208 AC operating voltage, 185 v AC pick-up voltage at 65 cps, 130 v AC drop-out voltage at 55 cps, 4 watt; 3-11/32 in. lg, 1-31/32 in. sq; three no. 8-32 thd mtg studs located triangularly on bottom; 02116 #RX-14-38; 21964 #A2061031-1; u/o AN/GRN-9D	Loss of phase protection relay

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
K902		Same as *K901; u/o AN/GRN-9D	Loss of phase protection relay
MP901		MOUNT, RESILIENT: mild steel; cadmium plated; 81860 part #3500-T10; 21964 #B2060795 (4 each used)	Cabinet shock mounts
MP902		IMPELLER, FAN, CENTRIFUGAL: multiblade type; forward curved blade; steel, cd pl; single w; 36 vanes; ccw rotation; 92172 #610-314H; 82877 #9293-04; p/o B901	p/o centrifugal fan
MP903		IMPELLER, FAN, CENTRIFUGAL: multiblade type; forward curved blade; steel, cd pl; single w; 32 vanes; cw rotation; 95933 #631-35-S; 82877 #9294-04; p/o B902	p/o centrifugal fan
MP904		KNOB: oblong; phenolic; black; designed to accommodate flatted shaft, 0.375" dia max, 5/8" deep shaft hole; set screw fastened, 0.2" dia holes; brass bushing; arrow marking; 3-1/2" lg. 7/8" wide, 1-1/8" deep ; per BuShips dwg #9S5363-L item #6; 21964 #A2140920	u/w emergency switch S901
MP905		CLAMP, ELECTRICAL: brass, silver plated; 1 clamp nut gland packing type; 21964 #A21431-22-1 and A2143123-1	u/w HV line goes to E903
MP906		CAP, ELECTRICAL: aluminum alloy, round; mounts by chain and 2-18NS-2A female thread; includes chain approx 5-3/4" lg between centers of attachments, brass, nickel pl; 02660 #9760-32; 21964 #A2060436	External power cable
MP907		BOLT, REDUCED SHANK: steel rod, type no. 303 per MIL-S-853, class 7, type C; passivate finish; head data not applicable to MBCA Ref Dwg Group 29; knurled thumb head socket recess, 1/2" high, 7/8" dia, o/a dim., recess dim., 0.3120" dim. across flats, 3/8" deep; reduced shank data 5/8" dia, 25/32" lg; 3/8" -16 NC-2 thd, 3/8" min. lg; 2-5/32" nominal lgth; 21964 #A9140059 (4 each used)	Used to secure unit in cabinet
MP908		BOLT, REDUCED SHANK: steel rod type no. 303 per MIL-S-853 class 7, type A; electro polish; head data not applicable to MBCA Ref Dwg Group 29, knurled thumb head slotted, 1/4" high, 1/2" dia, o/a dim., slot dim., 1/16" wide, 3/32" deep; reduced shank data 0.171" dia, 0.6875" lg, 1/4" -20 NC-2 thread, 0.3828" min. lg; 1.375" nominal lgth; 21964 #A2141567-1 (4 each used)	u/w duct section
MP909	2	HOLDER, WRENCH: beryllium copper; nickel plated finish; holds wrench by means of two 3/8" dia holes, one on each end, two 0.193" dia mounting holes on 1/4" by 3/8" mounting centers; 21964 #A2142246	Holds wrench
MP910	6	WRENCH: Allen hexagon key type; size 5/16"; steel, cadmium plated; T handle; 70276 609T, per 21964 #A2142269	Used to secure unit
MP911		CLEANER, AIR: round type; passivated stainless steel container; replaceable element; thumb head mounting bolt, 3 support straps equally spaced located at top; 00736 P-56, part #C170-66; 21964 #B2140978 (2 each used)	Air intake filter
MP912		BEARING, BALL, ANNULAR: ground; single row; radial; nonloading groove; self contained; both rings flush; 0.7874 in. bore dia, 1,8504 in. OD, 0.8125 w over-all; 2 closure shields; snap ring and groove external locating device; std internal fit-up data, ABEC-1 tolerances; high temp grease per spec MIL-G-3278; govt spec NAVY 42-B5, II std; 28443 #MRC204SFFC; p/o B901	p/o centrifugal fan motor
MP913		Same as MP912; p/o B902	p/o centrifugal fan motor

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP914	1	GASKET: synthetic rubber, JAN-R-1149, class 1; not applicable to Ref Dwg Group 75; five 0.290" dia holes for bolts on 1-1/2", 5-1/8" 7-1/4" and 4-3/4" respective mounting centers; o/a dim., 20-15/16" lg, 1" wide, 1/16" thk; 21964 #T-2141114 (2 each used)	u/w junction box
MP915	1	GASKET: synthetic rubber, JAN-R-1149, class 1; not applicable to Ref Dwg Group 75; four 0.290" dia holes for bolts on 4-3/4", and 5-1/2" respective mounting centers; o/a dim., 21-1/2" lg, 1" wide, 1/16" thk; 21964 #T-2141124	u/w junction box
MP916	1	GASKET: synthetic rubber, JAN-R-1149, class 1; not applicable to Ref Dwg Group 75; four 0.290" dia holes for bolts on 4-3/4" and 5-1/2" respective mounting centers; o/a dim., 19-7/16" lg. 1" wide, 1/16" thk; 21964 #T2141125	u/w junction box
MP917	1	GASKET: synthetic rubber, JAN-R-1149, class 1; similar to style no. 12, Ref Dwg Group 75; 4-1/8" lg by 2-7/8" wide aperture in center w/1/4" radius on corners; four 0.290" dia holes for bolts on 3-1/2" by 4-3/4" mounting centers; o/a dim., 5-1/4" lg, 4" wide, 1/16" thk, 1/4" radius on corners; 21964 #B2141112 (4 each used)	u/w junction box
MP918	1	GASKET: synthetic rubber, JAN-R-1149, class 1; similar to style no. 12, Ref Dwg Group 75; 16-1/4" lg by 4-1/8" wide aperture in center w/1/4" radius on corners; ten 0.290" dia holes for bolts on 4-3/4" by 16-7/8" mounting centers; o/a dim., 17-3/8" lg, 5-1/4" wide, 1/16" thk, 1/4" radius on corners; 21964 #C2141113 (3 each used)	u/w junction box
MP919		SHAFT ASSEMBLY, FLEXIBLE: steel; c/o wire core and fittings with attachments each end; dim. o/a 27-1/16in. lg, 1-3/16 in. dia; neoprene jacket outer covering; 24-7/8 in. lg of core, 2-7/32 in. lg of flatted shaft; one end attached to junction box assy; other end operated external to equipment; 79555; 21964 #T2061305	Drive shaft to junction box in cabinet
MP920	2	GASKET: synthetic rubber; dim.overall 3-1/4 in. lg, 2-1/2 in. w, 1/32 in. thk; aperture 2-19/32 in. lg, 1-27/32 in. w; eight 3/16 in. dia mtg holes; four on 2-15/16 in. by 1-3/16 in. centers, four on 2-3/16 in. by 1-1/2 in centers; 21964 #A2061173	Seal in cabinet Receiver-Transmitter assy
MP921	2	GASKET: synthetic rubber; 2-13/16 in. lg. 2-3/16 in. w, 1/32in thk; aperture 2 in. dia; four 3/16 in. dia mtg holes on 2-3/16 in. by 1-9/16 in. centers; 21964 #A2061190	Seals bushing assy
MP922		GASKET: filter, sponge rubber sheet; 8 in. OD; inside dia 6-3/8 in.; 56277 per 21964 #A2061116 (2 each used)	Seals air filter to flexible cuff
MP923	2	GASKET: Rubatex Division R-216-N material; o/a dim. 1-15/32 in. lg. 1/2 in. w, 1/4 in thk; 21964 #A2143267-1 (2 each used)	Seal for cabinet Receiver-Transmitter assy
MP924	2	GASKET: Rubatex Division R-216-N material; o/a dim. 14-11/32 in. lg, 1/2 in. w, 1/4 in. thk; 21964 #A2143267-2 (2 each used)	Seal for cabinet Receiver-Transmitter assy
MP925	7	HOSE, AIR DUCT: neoprene coated nylon; dim. o/a, 4-5/8 in. lg, 3-3/8 in. w, 3-1/32 in. h; 98683 CWY-1X; 21964 #A2061325	Mounted on blower
MP926	7	CONDUIT ASSEMBLY, METAL, FLEXIBLE: unshielded; neoprene coated "Flexflyte L" outer conductor; fiberglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal band terminations dim. o/a, 22 in. lg, 1-1/16 in. OD, 7/8 in. ID; 83144 FT-830; 21964 #B2143312-2	Located in wiring harness #2

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP927	7	CONDUIT ASSEMBLY, METAL FLEXIBLE: unshielded neoprene coated "Flexflyte L" outer conductor, fiberglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal band terminations; dim. o/a. 30 in. lg, 1-1/16 in. OD, 7/8 in. ID; 83144 FT-833; 21964 #B2143312-5	Located in wiring harness #3
MP928	7	CONDUIT ASSEMBLY, METAL, FLEXIBLE: unshielded; neoprene coated "Flexflyte L" outer conductor; fiberglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal band terminations; dim. o/a. 29 in. lg, 1-1/4 in. OD, 1 in. ID; 83144 FT-834; 21964 #B2143312-6	Located in wiring harness #1
MP929	7	CONDUIT ASSEMBLY, METAL, FLEXIBLE: unshielded; neoprene coated "Flexflyte L" outer conductor; fiberglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal band terminations; dim. o/a, 25 in. lg, 1-1/4 in. OD, 1 in. ID; 83144 FT-835; 21964 #B2143312-7	Located in wiring harness #4
MP930	7	CONDUIT ASSEMBLY, METAL, FLEXIBLE: unshielded; neoprene coated "Flexflyte L" outer conductor; fiberglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal bend terminations; dim. o/a, 25 in. lg, 1-1/16 in. OD, 7/8 in. ID; 83144 FT-832; 21964 #B2143312-4	Located in wiring harness #2
MP931		Same as O913	u/w junction box
MP932	7	COUPLING, HOSE: neoprene coated nylon; inch flange for mtg; dim. 8 in. dia of flange, 6-7/16 in. ID, 2-5/16 in. h; six 0.213 in. dia mtg holes equally spaced on 7.375 in. dia between centers; 98683 GWY-1X; 21964 #A2060954	Couples air filter
MP933	2	RUBBER CHANNEL: synthetic medium; solid; 20-25/32 in. lg, 1/4 in. w, 1/8 in. thk; flanges 3/16 in. deep, 1/32 in. thk; 14370 #887; 21964 #A2061063G3 (2 each used)	Seals box in cabinet
MP934	2	RUBBER CHANNEL: synthetic medium; solid; 9-11/32 in. lg, 1/4 in. w, 1/8 in. thk; flanges 3/16 in. deep, 1/32 in. thk; 14370 #887; 21964 #A2061063G4 (2 each used)	Seals air filter
P901		CONNECTOR, PLUG ELECTRICAL: 1 contact, male, round; straight type; MIL type UG-934A/U; ASESA dwg #AS-2047 and MS90277; per 21964 #A2131528	15 cps ref pulse ext cable plug, mates w/J903
P902		Same as P901	135 cps ref pulse ext cable plug, mates w/J904
P903	6	CONNECTOR, PLUG ELECTRICAL: 1 contact, male, round; straight type; MIL type UG-709A/U per MIL-STD dwg #MS90214; per 21964 #A2141976	15 cps ref pulse int cable plug, mates w/J903
P904		Same as P903	135 cps ref pulse int cable plug, mates w/J904
P905		CONNECTOR, PLUG, ELECTRICAL: 1 round male contact; one connector mating end; BNC series; 74868 #85000; MIL type UG-88C/U per Sig dwg #SC-D-72235; BuShips dwg #REB49064; 21964 #A2131456; Same as P201	15 cps ref pulse cable plug, mates w/J604
P906		Same as P905	135 cps ref pulse cable plug, mates w/J603

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P907		CONNECTOR, PLUG, ELECTRICAL: 1 contact, male, round; straight type; MIL type UG-260B/U per Sig dwg #SC-D-72247; 21964 #A2131518	Video output to frequency multiplier oscillator drawer; mates w/J602
P908		Same as P905	Dist info output to Coder-Indicator, mates w/J601
P909		Same as P905	DME input to Coder-Indicator, mates w/J504
P910		Not Used	
P911		Not Used	
P912		Not Used	
P913		Same as P907	Connects to J1350, modulator driver
P914		Not Used	
P915		Same as P905	Connects to J1309, to klystron
P916		Not Used	
P917		Same as P907	Connects to J1401, FMO
P918		Same as P907	Connects to J1402, FMO
P919		Same as P905	Connects to J1403, FMO
P920		Same as P905	Connects to J1407, FMO
P921		CONNECTOR, PLUG, ELECTRICAL: 1 contact, male, round; straight type; MIL type UG-573A/U per ASESA dwg #AS-2047; per 21964 #A2141978	Connects to J501 input Receiver
P922		Same as P905	Connects to J502, input to local oscillator
P923		CONNECTOR, PLUG, ELECTRICAL: 1 contact, male, round; N series; straight type; MIL type UG-21D/U per MIL-STD dwg #MS-91236; 21964 #A2132719; Same as P202	Connects to Z1153, output to Receiver
P924		Same as P905	Connects to J1410, FMO
P925		Not Used	
P926		Same as P905	Connects to J1506, FMO output low band

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P927	6	CONNECTOR, PLUG, ELECTRICAL: 7 size 12, 40 size 16 contacts, female round; polarized; straight type; AN3106A-36-7S, with cable clamp type AN3057-24, per spec MIL-C-5015-B; 21964 #753077	Connects to J605 Coder-Indicator
P928	6	CONNECTOR, PLUG, ELECTRICAL: 5 size 16 contacts, female, round; polarized; straight type; AN3106B-14S-5S, with cable clamp type AN3057-6 per spec MIL-C-5015; per 21964 #752939	Connects to J505 input to Power Supply
P929		Not Used	
P930		Same as P907	Connects to P931
P931		CONNECTOR, PLUG, ELECTRICAL: 1 contact, female, round; straight type; BNC; MIL type UG-261B/U per MIL-STD-242A, Navy dwg #REB49061; 21964 #A2060428	Connects to P930
P932		Same as P905	Connects to P933
P933		CONNECTOR, PLUG, ELECTRICAL: 1 contact, female, round; straight type; BNC; MIL type UG-89B/U per MIL-STD-242A and MS35169, Navy dwg #REB49132; 21964 #A2132937	Connects to P932
P934		CONNECTOR, PLUG, ELECTRICAL: 10 female contacts, size no. 16 AWG, 22 amp, four rated 700 v DC and six rated 250 v DC; straight shape; MIL type AN3106A-18-1S per spec MIL-C-5015B; 21964 #752953	Connects to J608
S901		SWITCH, ROTARY: 5 sections; 4 positions (two OFF and two ON) reciprocating action; non-pile up type, 5 poles, 2 throw; 60 amps, 450 v AC; 82181 type P, style 1 per 21964 #A2141150; 21964 #B2140975	Emergency "ON-OFF" switch Figure 3-6
S902		SWITCH, PUSH-PULL: two single pole, double throw switches; AC, 10 amp; 250 v; momentary, 91929 #4AC5 per spec MIL-S-6743; 21964 #B2141195	Interlock switch assembly, Amplifier-Modulator
S903		Same as S902	Interlock switch assembly, FMO
S904	6	SWITCH, INTERLOCK: door type; 10 amp, 110 or 220 v AC or DC, single pole double break, female type, brass, silver pl; 21964 #B2141184-1; This is one half of Navy type Switch #CG-24067A or 24446 #M-7460330-G4; (See E1317)	Interlock switch Amplifier-Modulator
S905		Same as S902	Interlock, switch assembly, Receiver
S906		SWITCH, PUSH-PULL: SPDT w/actuator; AC, 10 amp; 250 v push to operate, momentary, actuates switch; pull to operate, maintained until reset by next push stroke; 91929 #2AC6; MIL type MS16106A-1, per spec MIL-S-6743; 21964 #B2141196	Interlock switch Coder-Indicator
S907		SWITCH, PRESSURE: SPDT; vane type; rotary actuated; switch assembly shall operate at 0. 50 in max static pressure (water column) and release at 0 1 in. min static pressure (water column); 5 amp, 250 v AC; barrier type screw terminal board, MIL type 8TB2 per MIL-T-16784; 93652 #113 per spec MIL-E-16400A and MIL-S-901B; 21964 #A2061416	Air switch for B901
TB901		TERMINAL BOARD: 12 feedthru type terminals, 24 thd studs; single row; barrier type; MIL type 5TB12, per spec MIL-T-16784; 21964 #A2133120-3	External cable connection

TABLE 7-3, RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3163/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
TB902		TERMINAL BOARD: six 1/4" -20 stud type feed thru terminals w/terminal nuts; barrier type; 21964 #B2142117 and A2142118-1	External cable connection
TB903		TERMINAL BOARD: 20 thd stud terminals in double row; barrier type; MIL type 4 TB20, per spec MIL-T-16784; 21964 #A2133226-2	External cable connection
TB904		Same as TB903	External cable connection
TB905		Same as TB903	External cable connection
TB906		Same as TB903	External cable connection
TB907		Same as TB903	External cable connection
TB908		Same as TB903	External cable connection
TB909		TERMINAL BOARD: 10 terminals; double screw type; barrier type; voltage rating 600 v AC; MIL type 6TB10 per spec MIL-T-16784 and Navy dwg #9000-S6505B-73214;88223 p/o B901	p/o centrifugal fan motor
TB910		Same as TB909; p/o B902	p/o centrifugal fan motor
XDS901		LIGHT, INDICATOR: supplied w/lens 5/8" dia. amber, plain design, stovepipe shape, fluted, screw type holder; accommodates neon T-3-1/4, NE-51 lamp single contact miniature bayonet base; 125v, 75 watts; MIL type LH64PA5 per spec MIL-L-3661 and MS-90287; 21964 #A2133081-2	Lampholder for DS901
XF901		FUSE HOLDER: extractor post type; MIL type FHL10G per BuShips dwg #9000-S6202-74228 and per spec MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501; u/o AN/GRN-9D	Fuseholder for F901
XF902		Same as XF901; u/o AN/GRN-9D	Fuseholder for F902
XF903		Same as XF901; u/o AN/GRN-9D	Fuseholder for F903
XF904		Same as XF901; u/o AN/GRN-9D	Fuseholder for F904
		ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D	
1001-1099		CABINET, ELECTRICAL EQUIPMENT, CY-3164/GRN-9D: steel; color grey; overall dim. 34-1/8" lg, 25" wide, 72" high; cutout for specific equipment, qty. 2, dim. 7-1/2" wide by 13-5/8" high, space for Test Equipment; qty. 2, dim. 11-3/8" wide by 13-5/8" high, space for Test Equipment; qty. 1, dim. 7-1/2" wide by 15-1/4" high, Power Supply PP-1766/URN; qty 1, dim. 11-1/2" wide by 15-1/4" high; Power Supply PP-1765/URN; qty. 1, dim. 21" wide by 12-1/8" high, Power Supply PP-1763/URN; carrying handles incl. qty. 2, eyebolts, adjacent corners on top of cabinet; dripproof; 4 shock mounts on bottom of cabinet and 2 shock mounts on the back of the cabinet; upper portion of cabinet has space for mounting future test equipment; junction box (located on back of cabinet) large enough to accommodate incoming cables; bottom portion of cabinet has built in blowers, filters and transformers; shock mounts are removable for equipment installation; 21964 #J1069532 and A1069532; u/o AN/GRN-9D	Part of Power Supply Assembly GRN-9D

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
B1001		FAN, CENTRIFUGAL: electrical motor operated; non-portable; AC motor, fixed base; single unit on common shaft, direct drive connection; one rotor stage; single inlet with rectangular discharge outlet; 425 cfm at 3 in. static pressure; ccw rotation; 82877 #AO-9295; 21964 #A2060429	Ventilation (Power Supply side cooling)
B1001A		MOTOR, ALTERNATING CURRENT: squirrel-cage induction type; AC 208-220/440 v, 50-60 cps, 3 ph; 3/4 hp, single take-off shaft, 3350 rpm, cw rotation of output shaft looking at load end; 82877 #9295-01; p/o B1001	p/o centrifugal fan
DS1001		LAMP, GLOW: neon gas, 0.04 watt; T-3-1/4 bulk; MIL type NE-51 per spec MIL-L-15098B; 21964 #A2141970; Same as DS901	Air switch "OPEN" indicator
DS1002		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear; 24446 #10C7/1DC; 21964 #710071; Same as DS501	Interlocks shorted
E1001	6	INSULATOR, STANDOFF: MIL-STD-242A; 21964 #A2061861G2	HV input cable connection
E1002 thru E1009		Not Used	
E1010	6	INSULATOR, STANDOFF: steatite, grade L4A; MIL type NS4AB2016 per MIL-STD-242A; 21964 #A2133225-3; Same as E906	Standoff insulator for 700 v supply
E1011		Same as E1010	Standoff insulator for 1000 v supply
F1001		FUSE, CARTRIDGE: 15 amp, 500 v; normal blowing; MIL type F60H15R0C per spec MIL-F-15160B and MIL-STD MS15249-11-1 (Ships); 21964 #882290; u/o AN/GRN-9D	Pri protection HV plate T1001
F1002		Same as F1001; u/o AN/GRN-9D	Pri protection HV plate T1001
F1003		Same as F1001; u/o AN/GRN-9D	Pri protection HV plate T1001
F1004		Same as F1001; u/o AN/GRN-9D	Convenience outlet protection
F1005		Same as F1001; u/o AN/GRN-9D	Convenience outlet protection
F1006		FUSE, CARTRIDGE: 3.20 amp, 250 v; time delay; MIL type F09G3R20B and MS90085-55-1, per spec MIL-F-15160; 21964 #882326; u/o AN/GRN-9D	Blower protection B1001
F1007		Same as F1006; u/o AN/GRN-9D	Blower protection B1001
F1008		Same as F1006; u/o AN/GRN-9D	Blower protection B1001
F1009		Same as F1001; u/o AN/GRN-9D	Spare for F1001 thru F1005
F1010		Same as F1006; u/o AN/GRN-9D	Spare for F1006. F1007. F1008

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J1001		CONNECTOR, RECEPTACLE, ELECTRICAL: 2 female flat contacts; not polarized; straight shape; 1-3/8 in. dia body; 2-1/4 in. lg including mtg strips; 15 amps 125 v; phosphor bronze contacts, plastic body; grounded type; two 3/16 in. dia mtg holes on 1.937 in. centers; three no. 8-32 screws provided, two power connection screws non-removable; 21964 #A2060427; Same as J901	Convenience outlet
J1002		Not Used	
K1001		RELAY, ARMATURE: closed type; five poles single-throw contacts four poles normally open one normally open, one normally closed, 3 poles double break, 2 poles sinble break, double break contacts rated 25 amp, 220 v AC, single break contacts rated 10 amps, 250 v AC; single inductive winding, 120 v AC, 60 cycles; 2 terminals on coil and each pole; continuous duty; 2-3/8" lg, 3-7/8" wide, 3-3/16" high approx o/a dim.; three mounting holes for 0.190" dia screw, on 2" by 3-1/4" mounting centers; one single break contact makes before other single break contact breaks; per spec MIL-C-2212A; similar to 04009 size 1 type "RA" modified per 21964 #C2061343 and spec A2140748-6	12 kv plate connector
MP1001		MOUNT, RESILIENT: mild steel; cadmium plated; 81860 #3500-T10; 21964 #B2060795 (4 each used); Same as MP901	Cabinet shock mounts
MP1002		IMPELLER, FAN, CENTRIFUGAL: multiblade type; forward curved blade; steel. cd pl; sin~le w; 36 vanes' ccw rotation; 92172 #610-314H; 82877 #9295-04; p/o B1001; Same as MP902	p/o centrifugal fan
MP1003		COVER, ELECTRICAL CONNECTOR: aluminum alloy, round; 7/16" thick, 1-9/16" dia, o/a dim.; mounts by chain and 2-18NS-2A female thread; includes chain approx 5-3/4" lg between centers of attachments, brass nickel pl; 02660 #9760-32; 21964 #A2060436; Same as MP906	u/w J1001
MP1004		BOLT, REDUCED SHANK: steel rod, type no. 303 per MIL-S-853, Class 7, type C; passivate finish; head data not applicable to MBCA Ref Dwg Group 29, knurled thumb head socket recess, 1/2" high, 7/8" dia, o/a dim., 0.3130" dim. across flats, 3/8" deep; reduced shank data 5/8" dia, 25/32" lg; 3/8" -16 NC-2 thd, 3/8" min. lg 2-5/32" nominal lgth; 21964 #A9140059 (4 each used); Same as MP907	Used to secure unit in cabinet
MP1005		BOLT, REDUCED SHANK: steel rod type no. 303 per MIL-S-853, Class 7, type A; electro polish; head data not applicable to MBCA Ref Dwg Group 29, knurled thumb head slotted, 1/4" high, 1/2" dia, o/a dim., slot dim., 1/16" wide, 2/32" deep; reduced shank data 0.171" dia, 0.6875" lg, 1/4" -20 NC-2 thread, 0.3828" min. lg 1.375" nominal lg; 21964 #A2141567-1 (4 each used); Same as MP908	u/w duct section
MP1006	7	CLAMP: band type; stainless steel; 1 slotted-screw employed w/ saddle, pad and nut, 27-7/8" lg, 13/16" wide, 2-23/32" high, o/a dim. w/band extended; accommodates 11/16" min. dia to 7-1/8" max dia material; similar to 98625 #828-22; 21964 #B2142980-3	Flexible duct clamp
MP1007	2	HOLDER, WRENCH: beryllium copper; nickel plated finish; holds wrench by means of two 3/8" dia holes, one on each end, two 0.193" dia mounting holes on 1/4" by 3/8" mounting centers; 21964 #A2142246; Same as MP909	Holds wrench
MP1008	6	WRENCH: Allen hexagon key type; size 5/16"; 4-1/2" lg including handle, 4-1/2" wide across handle; steel, cadmium plated; T handle; for 5/16: recessed hexagon screw head; 70276 #609T per 21964 #A2142269; Same as MP910	Used to secure units

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP1009		CLEANER, AIR: round type; passivated stainless steel container; 8-5/32" lg, 8" dia, o/a dim.; replaceable element; thumb head mounting bolt approx 7-1/4" lg with 3/8" -16 NC-2 thd at end, 3 support straps equally spaced located at top; 00736 #P-56, part #C17066; 21964 #B2140978; Same as MP911	Air intake filter
MP1010		BEARING, BALL, ANNULAR: ground; single row, radial; nonloading groove; self contained; both rings flush; 8.7874 in. bore dia, 1.8504 in OD, 0.8125 in. w over-all; 2 closures shields; snap ring and groove external locating device; std internal fit-up data, ABEC-1 tolerances; high temp grease per spec MIL-G-3278; govt spec NAVY 42B5, II std; 38443 #MRC204FFC; Same as MP912; p/o B1001	p/o centrifugal fan motor
MP1011	2	RUBBER CHANNEL: synthetic medium; solid 10-3/32 in. lg, 1/4 in. w, 1/8 in. thk; flanges 3/16 in. deep, 1/32 in. thk; 14370 #887; 21964 #A2061063G1 (2 each used)	Seals box in cabinet
MP1012	1	GASKET: synthetic rubber, JAN-R-1149; class 1; not applicable to Ref Dwg Group 75; five 0.290" dia holes for bolts on 1-1/2", 5-1/8", 7-1/4" and 4-3/4" respective mounting centers; o/a dim., 20-15/16" lg, 1" wide, 1/16" thk; 21964 #T2141114 (2 each used); Same as MP914	u/w junction box
MP1013	1	GASKET: synthetic rubber, JAN-R-1149, class 1; not applicable to Ref Dwg Group 75; four 0.290" dia holes for bolts on 4-3/4", 4-3/4" and 5-1/2" respective mounting centers; o/a dim., 21-1/2" lg, 1" wide, 1/16" thk; 21964 #T2141124; Same as MP915	u/w junction box
MP1014	1	GASKET: synthetic rubber, JAN-R-1149, class 1; not applicable to Ref Dwg Group 75; four 0.290" dia holes for bolts on 4-3/4", 4-3/4" and 5-1/2" respective mounting centers; o/a dim., 19-7/16" lg, 1" wide, 1/16" thk; 21964 #T2141125; Same as MP916	u/w junction box
MP1015	1	GASKET: synthetic rubber, JAN-R-1149, class 1; similar to style no. 12, Ref Dwg Group 75; 4-1/8" lg by 2-7/8" wide aperture in center w/1/4" radius on corners; four 0.290" dia holes for bolts on 3-1/2" by 4-3/4" mounting centers; o/a dim., 5-1/4" lg, 4" wide, 1/16" thk, 1/4" radius on corners; 21964 #B2141112 (4 each used); Same as MP917	u/w junction box
MP1016	1	GASKET: synthetic rubber, JAN-R-1149, class 1; similar to style no. 12, Ref Dwg Group 75; 16-1/4" lg by 4-1/8" wide aperture in center w/1/4" radius on corners; ten 0.290" dia holes for bolts on 4-3/4" by 16-7/8" mounting centers; o/a dim., 17-3/8" lg, 5-1/4" wide, 1/16" thk, 1/4" radius on corners' 21964 #C2141113 (4 each used); Same as MP918	u/w junction box

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP1017	7	COUPLING, HOSE: neoprene coated nylon; incl flange for mtg; dim., 8 in. dia of flange, 6-7/16 in. ID. 2-5/16 in. h; six 0.213 in. dia mtg holes equally spaced on 7.375 in. dia between centers; 98683 CWY-1X; 21964 #A2060954; Same as MP931	Couples air filter to blower
MP1018	2	RUBBER CHANNEL: synthetic medium; solid; 9-19/32 in. lg, 1/4 in. w, 1/8 in. thk; flanges 3/16 in. deep, 1/32 in. thk; 14370 (2 each used) no. 887; 21964 #A2061063G2	Seals air filter
MP1019	2	GASKET: filter; sponge rubber sheet; 8 in. OD; inside dia 6-3/8 in.; 56277; 21964 #A2061116; Same as MP922	Seals filter ring
MP1020	2	GASKET: synthetic rubber; dim. over-al 3-1/4 in. lg, 2-1/2 in. w, 1/32 in. thk; aperture 2-19/32 in. lg, 1-27/32 in. w; eight 3/16 in. dia mitg holes, four on 2-5/16 in. by 1-5/16 in. centers, four on 2-3/16 in. by 1-1/2 in. centers, 21964 #A2061173; Same as MP920	Seal in cabinet Receiver-Transmitter assy
MP1021	2	GASKET: synthetic rubber; 2-13/16 in. lg. 2-3/16 in. w, 1/32 in. thk; aperture 2 in. dia. four 3/16 in. dia mtg holes on 2-3/16 in. by 1-9/16 in centers; 21964 #A2061190; Same as MP921	Seal for bushing assy
MP1022	7	CONDUIT ASSEMBLY, METAL, FLEXIBLE: unshielded; neoprene coated "flexflyte L" outer conductor; fibreglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal band terminations; dim. o/a 23 in. lg, 1-1/16 in OD, 7/8 in. ID, 83144 FT-831; 21964 #B2143312-3	Located in wiring harness #2
MP1023		Same as MP1022	Located in wiring harness #3
MP1024		CONDUIT ASSEMBLY, METAL, FLEXIBLE: unshielded; neoprene coated, "Flexflyte L" outer conductor; fiberglass liner, covering and cord; 2-1/2 in. bending radius; cuff and metal band terminations; dim. o/a, 25 in. lg, 1-1/16 in. OD, 7/8 in. ID; 83144 FT-832; 21964 #B2143312-4; Same as MP930	Located in wiring harness #1
R1001		RESISTOR, FIXED, WIREWOUND: 280 ohms total resistance, 3 watt power dissipation; 350°C maximum continuous operating temperature; characteristic V; body dim. 1/2" lg, 3/16" dia.; 2 wire lead terminals; MIL type RW59V281 per spec MIL-R-26C; 21964 #A2132711-01; Same as R520	Voltage dropping resistor
S1001		SWITCH, PUSH-PULL: two single pole, double throw switches; AC, 10 amp.; 250 v push to operate, momentary, actuates one switch only, pull to operate, maintained until reset by next push stroke, both switches actuated; 91929 #4AC5; per spec MIL-S-6743; 21964 #B2141195; Same as S902	Interlock switch assembly, Low Voltage Power
S1002		Same as S1001	Interlock switch assy, Medium Voltage Power Supply
S1003		Same as S1001	Interlock switch assy, transformer and blower compartment

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
S1004	6	SWITCH, INTERLOCK: door type; 10 amp, 110 or 220 v AC or DC, single pole double break, female type, 21964 #B2141184-1; This is one half of Navy type Switch #CG-250A or 24446 #M7460330G4 (see E1915); Same as S904	Interlock switch HV power supply
S1005		SWITCH, PRESSURE: SPDT; vane type rotary actuated; rotary actuated; switch assembly shall operate at 0. 50 inch max, static pressure (water column), and release at 0.1 inch min static pressure (water column); 5 amp, 250 v AC; similar to 93652 #113 per spec MIL-S-901B; 21964 #A2061416; Same as S907	Air switch for B1001
S1006		SWITCH: 3 PDT, 15605 #8795K3; 21964 #A1069541	
T1001		TRANSFORMER, POWER, STEP-UP: encapsulated, epoxy resin; input data 208 v 60 cps, 3 phase; output data, 3 output windings 9440 v between terminals at 0. 240 amp, per line; insulation to withstand 1000 v rms test on primaries and 18,000 rms on secondaries; maximum o/a dim. 9-11/16" high, 16-3/4" lg., 9-9/16" wide; terminal data; for Option 2; 12 terminals, c/o 9 screw type terminals, 11/16" high on insulated pillars, and 3 flush mounted threaded inserts, 8-32 threads by 1/4" deep for Option 3; 12 screw type terminals 11/16" ± 1/32" high on insulated pillars, four 9/16" dia. mtg holes on 7-7/16" by 13-5/8" mtg centers; grounded electrostatic shield between the primary and secondary windings; primary delta-connected secondaries starconnected for use with a 3 phase full-wave starconnected rectifier; 49956 #292-5000G1 MIL type TF2TX02ZZ, per spec MIL-T-27A; 21964 #A1069474; u o AN GRN-9( )	12 kv power supply plates
TB1001		TERMINAL BOARD: 20 thd stud terminals in double row; barrier type; MIL type 4TB20, per spec MIL-T-16784; 21964 #A2133226-2; Same as TB903	External cable connection
TB1002		Same as TB1001	External cable connection
TB1003		Same as TB1001	External cable connection
TB1004		Same as TB1001	External cable connection
TB1005		TERMINAL BOARD: 10 terminals; double screw type; barrier type; MIL type 6TB10 per spec MIL-T-16784 and Navy dwg #9000-S6505B-73214; 88223; Same as TB909; p/o B1001	p/o centrifugal fan motor
XDS1001		LIGHT, INDICATOR: supplied w/lens, 5/8" dia, amber plain design, stove-pipe shape; fluted, screw type holder; accommodates neon T-3-1/4, NE-51 lamp single contact miniature bayonet base; 125 v, 75 watt; brass shell black nickel finish, enclosed; 2-5/16" lg, 15/16" dia o/a dim , 1 mounting hole required, 11/16" dia., accommodates up to 9/32" max thick panel; horizontally mounted; lamp replaceable from front of panel; 2 terminals solder lug type, located on socket base, both insulated from shell; includes built in 51,000 ohm 1/3 watt composition resistor; MIL type LH64PA5 per spec MIL-L-3661 and MS-90287; 21964 #A2133081-2; Same as XDS901	Lampholder for DS1001

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

ELECTRICAL EQUIPMENT CABINET CY-3164/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XDS1002		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; double contact bayonet candlebra; 125 v, 6 watts; MIL type LH63BA3 per spec MIL-L-3661, dwg MS-9028-6; 21964 #A2133080-3	Lampholder for DS1002
XF1001		FUSEHOLDER: extractor post type; 450 v, 30 amp; accommodates one cartridge fuse 1-1/2 in lg by 13/32 in. dia; phenolic body; o/a dim 4-1/8 in. lg, 1-3/8 in. sq., 2 screw type terminals; built in neon lamp w/470,000 ohm resistor; MIL type FHL12G, per spec MIL-F-19207 (Ships); incl neoprene mtg gasket; 21964 #A2060404; Same as XF909	Fuseholder for F1001
XF1002		Same as XF1001	Fuseholder for F1002
XF1003		Same as XF1001	Fuseholder for F1003
XF1004		Same as XF1001	Fuseholder for F1004
XF1005		Same as XF1001	Fuseholder for F1005
XF1006		Same as XF1001	Fuseholder for F1006
XF1007		Same as XF1001	Fuseholder for F1007
XF1008		Same as XF1001	Fuseholder for F1008
XF1009		Same as XF1001	Fuseholder for F1009
XF1010		Same as XF1001	Fuseholder for F1010
		CONTROL-DUPLEXER	
1101-1199		CONTROL-DUPLEXER C-2226A/GRN-9D: duplexer cavity tuning, coaxial transmission line-frequency data, 961.5 to 1213 5 mc, 1025 to 1150 mc center frequency, 126 channels, each channel 1 mc apart from 1025 mc to 1150 mc incl; aluminum frame; overall dim. 26-25/32 in. deep, 23-1/16 in. wide. 10-21/32 in. high; rack mounted with pullout slides; front access only; unit c/o duplexer and control circuit and filter cavities; duplexer c/o 3 tunable cavities, each w/micrometer heads, 2 directional couplers; control circuits provide manual and automatic control for filaments and plate transformers of individual components, manual controls c/o master switch, 2 on-off switches, monitoring selector switxh for meter, 1 adjust for 120 v knob, 1 meter, 1 battle short switch; unit operates from 208 v, 3 phase, 60 cycles; enables same antenna to be used for receiving and transmitting; turns the units of the beacon on and off in the proper sequence; 21964 #H1068887 and A1068887; u/o AN/GRN-9A	Part of Receiver-Transmitter OA-1534/GRN-9A Figure 6-60

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
CR1151		CRYSTAL UNIT, RECTIFYING: silicon, cartridge type; 1,000 mc frequency design; 8.0 db max conversion loss; 2.5 max output noise ratio; 6.5 watts burnout test; 0.820" lg, 0.294" dia overall dimensions; ferrule type terminals, one on each end; MIL type 1N25, per spec MIL-E-1C; 21964 #700026	Crystal detector assembly rectifier u/w E1152
DC1151		COUPLER, DIRECTIONAL: two end fittings, 02114 connectors, part no. CM-1013-9036B and CM-1010-9036C without bullet, for main line; two BNC type UG-185/U connector receptacles modified for indicator; 960 to 1250 mc; 40 db coupling; 4.75" lg, 1.46" wide, 2, 34" high; incl protective end caps; type CU-430/URN-3; 21964 #C2140826 and A2140827-1	Klystron output monitoring
DC1152 thru DC1155		Not Used	
DC1156		Same as DC1151	Antenna input monitoring
DS1101		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear; 24446 #10C7/1DC; 21964 #710071, Same as DS501	Filament lamp Figure 3-5
DS1102		Same as DS1101	Main power Figure 3-5
DS1103		Same as DS1101	Antenna control Figure 3-5
DS1104		Same as DS1101	Interlock short Figure 3-5
DS1105		LAMP, GLOW: MIL type NE-51 per MIL spec MIL-L-15098B; 21964 #A2141970; Same as DS901	
E1101 thru E1151		Not Used	
E1152		HOLDER, CRYSTAL: MIL type 1N21 or 1N25 crystal diodes accommodated; 2 BNC type connector, female located on one end, male on other end; 74868 #MS-585 per 21964 #A2140845	Ref detector u/w CR1151 Figure 2-14
E1153 thru E1161		Not Used	
E1162		LINE SECTION, RADIO FREQUENCY TRANSMISSION: 50 ohms impedance, phosphor bronze, silver plated; friction mounted; cylindrical rod shaped; overall dimensions 1-9/16" lg, 0.341" dia; 02114 #215-302C; per 21964 #A2140636	Connection between DC1151 and Z1156 or Z1157
E1163		Same as E1162	Connection between Z1156 or Z1157 and P1183
E1164		Same as E1162	Connection between DS1151 and Z1156 or Z1157
E1165		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1166		Not Used	
E1167		Same as E1162	Connection between P1183 and DC1156
E1168		Not Used	
E1169		Not Used	
E1170		Same as E1162	Connection between DC1156 and P1157
E1171		Same as E1162	Connection between DC1156 and P1167
E1172		Same as E1162	Connection from P1158 to DC1151
F1101		FUSE, CARTRIDGE: 3 amp, 125 v; time delay; MIL type F02D3R00B, per spec MIL-F-15160A and MIL-STD MS90078-27-1; 21964 #882237; Same as F501	Transmitter start-stop circuit protection Figure 3-5
F1102		Same as F1101	Control circuit neut bus protection Figure 3-5
F1103		FUSE, CARTRIDGE: 15 amp; 250 v; time delay; MIL type F03G15R0B per spec MIL-F-15160A; MIL-STD MS90079-26-1; 21964 #882263	Deck unit protection Figure 3-5
F1104		Same as F1103	Deck unit protection Figure 3-5
F1105		Same as F1101	Spare for F1101. F1102. and F1106
F1106		Same as F1101	Control circuit protection Figure 3-5
F1107		Same as F1103	Regulated fil bus neut protection Figure 3-5

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
F1108		Same as F1103	Regulated fil bus protection Figure 3-5
F1109		FUSE, CARTRIDGE: 0.50 amp, 250 v; time delay; MIL type F02GR500B per spec MIL-F-15160A and MIL-STD MS90078; 21964 #882232	Spare for F1110
F1110		Same as F1109	M1101, DS1101 protection. Figure 3-5
F111		Same as F1103	Unregulated plate supply bus protection Figure 3-5
F1112		Same as F1103	Spare for F1103. F1104, F1107, F1108, F1111, F1113, F1114
F1113		Same as F1103	
F1114		Same as F1103	
J1101		JACK, TELEPHONE: accommodates 2 conductor female type plug, 0.916" max. dia; contact arrangement not incl. in MBCA Ref Dwg Group 4, 2 conductor, tip and sleeve 0.969" lg nose type contact; 1-19/32" sq by 1.718" deep overall dim.; four 5/32" dia counter-sunk mounting holes on 1-1/4" sq mounting centers on mounting plate; Navy type H-27A; BuShips dwg #9000-S6501C-74120 Rev 1 modified by painting surface grey per 21964 #A2143641 and A2143640-1	Sound powered telephone connection Figure 3-5
J1102		CONNECTOR, RECEPTACLE, ELECTRICAL: single female round contact; straight type; phone type connector, black nylon insulator overall dimensions 15/16" lg, w/hex face nut 5/16" across flats max operating voltage 1500 v peak; cylindrical shape, brass, nickel plated; silver plated contacts; one 1/4" dia mounting stud w/1/4" -32 NS-2 thd, 15/32" lg, one 1/4" -32 hex nut 11/32" across flats, one lockwasher; 74868 type 225-B; MIL type MS16108-3 per MIL-STD-242A; 21964 #A2141949-1; Same as J305	Interlock test point at S1107A (11) Figure 2-14
J1103		Same as J1102	Interlock test point at S1107A (1) and S1107B (9) Figure 2-14
J1104		Same as J1102	Interlock test point at HV power supply Figure 2-14
J1105 thru J1151		Not Used	
J1152		CONNECTOR, RECEPTACLE, ELECTRICAL: BNC series; 1-9/64" lg, 0.212" ID; 50 ohms nom impedance; accommodates RG-58/U cables; weatherproof; 74868 #86025; MIL type UG-909/U per BuShips dwg #REB49058; 21964 spec #A2132720; Same as J502	Klystron output. reflected wave test point Figure 3-5

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J1153		Same as J1152	Antenna input reflected wave test point Figure 3-5
J1154		Same as J1152	Antenna input incident wave test point Figure 3-5
J1155		CONNECTOR, ADAPTER: 2 female contacts, round; straight type; 2.207" lg, 1-9/16" wide, 1-9/16" high, o/a dimensions; radio frequency connector, 50 ohms nominal impedance, constant frequency impedance characteristic; cylindrical shape; brass, silver pl, polyethylene insert; mates with HN male and LC, UG-154/U or equivalent; includes mounting plate with four no. 9 (0.196") drill holes on 1-3/16" by 1-3/16" mounting centers; MIL type UG-259/U, per NAVY dwg #REB49204; 21964 #A2133206	RF output to antenna Figure 3-5
J1156		Not Used	
J1157		Same as J1152	Klystron output incident wave test point Figure 3-5
K1101		RELAY, ARMATURE: closed type five poles normally open, one pole normally closed, 4 poles double break, 2 poles single break, double break contacts rated 50 amp, 220 v AC, single break contacts rated 10 amp, 250 v AC; single inductive winding, 120 v AC, 60 cycles; 2 terminals on coil and each pole; continuous duty; 6" lg, 5-5/16" wide, 4-3/8" high approx o/a dim.; three mounting holes on 0.228" dia on 2-1/2" by 4-5/8" mounting centers; one single break contact makes before other single break contact breaks per spec MIL-C-2212A; similar to 04009 size 2 type "CRA" -241-U, modified per 21964 #C2060991 and spec A2140748-5	Primary power contactor Figure 6-61
K1102		RELAY, MOTOR DRIVEN: SPDT, 115/250 v, 5 amp, 60 cycles; motor data AC, synchronous type, 105 to 132 v rms, 60 cycles; 2 terminals for motor, 3 terminals for contacts; 1 min time interval; resets automatically; hermetically sealed; overall dimensions 3-23/32" high, 2-23/32" dia; mounting 2-23/32" sq w/four 0.166" dia holes; 2-5/32" C to C located at bottom; time interval factory adjusted; 14907 type HT1-2M set at 1 min; 21964 #A2142407	Blower "OFF" time delay
K1103		RELAY, ARMATURE: closed type; five poles single-throw contacts four poles normally open, one normally closed, 3 poles double break, 2 poles single break, double break contacts rated 25 amp, 220 v AC, single break contacts rated 10 amp, 250 v AC; single inductive winding, 120 v AC; 60 cycles; 2 terminals on coil and each pole; continuous duty; 4-3/8" lg, 3-7/8" wide, 3-3/16" high approx o/a dim.; three mounting holes for 0.190" dia screw, on 2" by 3-1/4" mounting centers; one single break contact makes before other single break contact breaks; per spec MIL-C-2212A; similar to 04009 size 1 type "RA" modified per 21964 #C2061343 and spec A2140748-6; Same as K1001	Blower control Figure 6-61

TABLE 7-3. RADIO SET AN/GRN-9D. MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
M1101		VOLTMETER: panel mounted; AC, 60 cycles, single phase, 2 wires; marked "volts", 0 to 150 left to right graduated in increments of 5, marked AC; round case molded thermosetting compound or metal; style no. 15, MBCA Ref Dwg Group 27; flange 2.69" dia, 0.40" max. thick, 2.21" body dia, 1.36" body depth from mounting surface, excluding terminals; satisfactory for use on either nonmagnetic panels or magnetic steel panels 1/16" to 1/8" thick without additional calibration; black markings and pointer, white background; self contained; ruggedized; three 0.125" dia mounting holes on 1.22" radius; 2 screw stud type terminals 1/4" -28 thread, 0.5" min. lg; MIL type MR26W150ACVVR, per spec MIL-M-10304A; 21964 #A2060455-1	Monitor, regulated filament bus 120 v ac input Figure 3-5
MP1101		KNOB: oblong; phenolic; black; Navy dwg #9000-S6202-A-74000-2; 21964 #A2142041	Knob for master switch, S1101
MP1102		KNOB: pointer; black; MS 700-18S per MIL-STD-242A; 21964 #B2132733-2; Same as MP501	Knob for interlock shorting switch S1107
MP1103	5	KNOB: black molded bakelite; 21964 #B2061431G1	Knob for T1101 Figure 2-14
MP1104		COVER, ELECTRICAL CONNECTOR: molded phenolic; includes beaded chain; u/w NAVY type H-27A jack; 21964 #A9141291 and A9141290-1	Covers J1101
MP1105		CAP, ELECTRICAL: brass, fits BNC female connector; includes beaded chain; 74868 #1500 MIL type CW-123A/U; per spec MIL-C-3608 and NAVY dwg #REA49050; 21964 #A2141971; Same as MP504	u/w J1152
MP1106		Same as MP1105	u/w J1153
MP1107		Same as MP1105	u/w J1154
MP1108	7	WRENCH: single open and spanner type w/two 1/8" lg, 0.113" dia pins; 15/16" size opening; 6" lg, 1-9/16" wide, 7/16" thk o/a dim.; bronze cadmium plated; straight head; flat straight handle; special for connectors; 02114 #215-301 modified per 21964 #B2141441 (2 each used)	Used to tighten connectors Figure 2-14
MP1109		BOLT, REDUCED SHANK: steel rod, type no. 303 per MIL-S-853 class 7, type C; passivate finish; head data not applicable to MBCA Ref Dwg Group 29, knurled thumb head socket recess, 1/2" high, 7/8" dia, o/a dim., recess dim., 0.3130" dim., across flats, 3/8" deep; reduced shank data 5/8" dia, 25/32" lg, 3/8" -16 NC-2 thd, 3/8" min, lg, 2-5/32" nominal lg; 21964 #A9140059 (4 each used); Same as MP907	Used to secure unit in cabinet
MP1110		Same as MP1105	u/w J1157
MP1111		Same as MP1105	
MP1112	2	BOLT, REDUCED SHANK: steel rod type no. 303; passivate finish; rd knurled head w/screw driver slot; 21964 #A130048A128 (6 each used)	Secures access door

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP1113		COUPLING ASSEMBLY: 0.248" dia steel rod, passivated finish, with 2" lg universal attached to each end by straight pin; accommodates round type shafts, 0.250" dia bores; overall dim. 7-3/8" lg. 1/2" OD; set screw mounted, four 6-32 NC-2B tapped holes; 21964 #B2061846G1	Connects to S1101 to panel
MP1114	2	GASKET: synthetic rubber, MIL-R-900C; 17/32 in. dia aperture in centre; three 0.144 in. dia holes spaced 120 deg apart on 3/4 in. dia; 1 in OD by 1/32 in. thk; 21964 #A2061686	Seal for bearing on front panel
MP1115		BOOT, DUST AND MOISTURE SEAL: silicone rubber bonded to a brass nickel plated hex nut 15/32-32 thd; 3/4 in. across flats, 7/8 in. lg; #1030; 21964 #A2132649-1; Same as MP202	Seal for toggle switch
MP1116		Same as MP1115	Seal for toggle switch
MP1117		Same as MP1115	Seal for toggle switch
MP1118	1	GASKET: synthetic rubber, JAN-R-1149, class 1; similar to style no. 18, Ref Dwg Group 75; 1-1/32" dia aperture in center; four 11/64" dia holes for bolts on 1-1/4" by 1-1/4" mounting centers; o/a dim., 2-7/32" lg, 1-9/16" wide, 1/32" thk, 5/32" radius on corners; 21964 #A2141762	Seals telephone connector plate to panel
MP1119	1	GASKET: synthetic rubber, JAN-R-1149, class 1; style no. 18, Ref Dwg Group 75; 1-5/32" dia aperture in center; four 11/64" dia holes for bolts on 1-3/16" by 1-3/16" mounting centers; o/a dim., 1-17/32" lg, 1-17/32" wide, 1/32" thk, 5/32" radius on corners; 21964 #A2141763	u/w connector adapter J1155
MP1120	1	GASKET: synthetic rubber, MIL-R-900C; 2-15/64 in. dia aperture in centre; three 1/8 in. dia holes spaced 120 deg apart on 2-7/16 in dia; 2-11/16 in. dia OD, 1/16 in thk; 21964 #B2060910; Same as MP205	Seal for M1101
MP1121	1	GASKET: synthetic rubber, MIL-R-900A, class 2; cross-section style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 65" lg; 21964 #A9140800; Same as MP201	Panel sealing
P1101 thru P1150		Not used	
P1151		CONNECTOR, PLUG, ELECTRICAL: 1 round male contact; one connector mating end; BNC series; 50 ohms nom impedance, 500 v peak voltage; accommodates RG-55/U and RG-58/U cables; weatherproof; 74868 #85000; MIL type UG-88C/U per Sig dwg #SC-D-72235; BuShips dwg #REB49064; 21964 #A2131456; Same as P201	Cable connector DC1151 (1)
P1152 thru P1156		Not Used	
P1157		CONNECTOR, ADAPTER: 2 female contacts; angle type; 90° angle; approx overall dim. 3" lg, 3" high, 1-13/32" dia; 50 ohms nominal impedance, constant frequency impedance characteristic; right angle shape, copper matl, commercial bright dip; brass couplings, one female coupling and one male coupling 1-1/4" -18 NEF-2 thd for 7/8" line; to be supplied with protective end caps; 21964 #A2061364; includes E1162	Connects DC1156 and P1183

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P1158		Same as P1157	Connects input cable DC1151
P1159 thru P1161		Not Used	
P1162		Same as P1151	Cable connector on DC1151 (R)
P1163 thru P1166		Not Used	
P1167		CONNECTOR, PLUG, ELECTRICAL: MIL type UG-1126/U; 21964 #B1069500	Cable connector on W1152
P1168		CONNECTOR, PLUG, ELECTRICAL: 1 contact, male round; straight type; HN series; 2-3/8" lg, 7/8" dia, o/a dim.; radio frequency connector, 50 ohms nominal impedance, constant frequency impedance characteristic; cylindrical shape, brass, silver plated, gland locking type; teflon insert; 0 564" max size of cable opening; MIL type UG-494A/U per NAVY dwg #REB49217; 21964 #A2133064	Cable connector on N1152
P1169	6	CONNECTOR, ADAPTER: 2 contacts, one male, one female, round; type LC; angle type 90° angle; 2.263" lg, 1.474" high, 0 975" dia, o/a dimensions; radio frequency connector, 50 ohms nominal impedance; constant frequency impedance; right angle shape; brass, silver pl, polyethylene insert; MIL type UG-216B/U, per spec MIL-C-3650 and NAVY dwg #REB49158, Revision "D"; 21964 #A2141968	Connects J1155 to P1170
P1170		CONNECTOR, PLUG: 1 contact, male round; type LC; straight type; 3" lg, 1-1/2" dia., o/a dim.; radio frequency connector, 50 ohms nominal impedance; constant frequency impedance; cylindrical shape, brass, silver pl; the insulation and center contact are provided by the dielectric and center conductor of the cable; 0.945" dia max cable opening; coupling nut 1-1/2" across flats, 1-1/4" -18 NS-2 coupling nut thread; MIL type UG-154A/U, per spec MIL-C-3650 and NAVY dwg #REB49152; 21964 #A2141969	Connects RG-18/U from antenna to RF output J1155 via P1169
P1171		Same as P1151	Cable connector on DC1156 (R)
P1172 thru P1174		Not Used	
P1175		Same as P1151	Cable connector on DC1156 (I)
P1176 thru P1182		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P1183		CONNECTOR, ADAPTER: 3 contacts, 2 female, 1 male; tee type; 4 in. lg, 1-25/32 in. wide. 50 ohms impedance; constant impedance; tee shape, copper material; brass couplings, one female coupling and one male coupling 1-1/4 in. thd, for 7/8 in. line, one connector, male; one #10-32 thd mtg hole tapped in block; 21964 #C2061380G1	Junction for P1157, Z1153 and Z1156 or Z1157
R1101		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; 350°C maximum continuous operating temperature; Characteristic V; MIL type RW59V281 per spec MIL-R-26C; 21964 #A2132711-01; Same as R520	Voltage dropping resistor, DS1101
R1102		Same as R1101	Voltage dropping resistor, DS1102
R1103		Same as R1101	Voltage dropping resistor, DS1103
R1104		Same as R1101	Voltage dropping resistor, DS1104
S1101		SWITCH, ROTARY: 6 sections; 4 position reciprocating action; non "pile-up" type, 5 poles, 3 throws; 120 v AC, 60 cycles, 10 amp; copper silver plated; phenolic sections between steel plates; 2-47/64" lg, 2-3/16" wide, 2-1/8" high overall dim.; 4 mounting holes #10-24 tap equally spaced on 2-5/16" dia circle; round type shaft, 13/16" lg, 1/4" dia; screw type terminals; special switching sequence w/both shorting and non-shorting contacts; 82121 "P", style II or CHH type "RP" per spec MIL-S-15291; 21964 #B2141774 and spec A2141773	Master unit "ON-OFF" switch Figure 3-5
S1102		SWITCH, TOGGLE: double-pole, single throw; 0.75 amp 125 v DC; 25 amp 125 v AC., resistive load rating; plastic and metal; overall dim., excluding terminals, bushing and handle 1-21/64" lg, 49/64" wide, 25/32" deep; bat type handle, 11/16" lg, excluding lg of bushing; locking action 4 terminals, solder lug type, located on back; single hole mounting type, bushing 15/32" -32 NS-2 thread, 15/32" lg from mounting surface; one mounting nut assembled, other hardware packed in bulk; JAN type ST52K per spec JAN-S-23; 21964 #828238	Deck unit "ON-OFF" switch Figure 3-5
S1103 thru S1105		Not Used	
S1106		SWITCH, TOGGLE: double-pole, double throw; 0.75 amp 125 v DC., 15 amp 125 v AC., resistive load rating; plastic and metal, overall dim., excluding terminals, bushing and handle 1-21/64' lg, 49/64" wide, 25/32" deep; bat type handle, 11/16" lg, excluding lf of bushing; locking action one side, other side momentarily on; 6 terminals, solder type lug located on back; single hole mounting type, bushing 15/32" -32 NS-2 thread, 15/32" lg from mounting surface; one mounting nut assembled, other hardware packed in bulk; JAN type ST52R, per spec JAN-S-23; 21964 #828243	u/w M1101 Figure 3-5
S1107		SWITCH, ROTARY: 2 sections; 2 positions; non pile-up type, 5 poles; solid silver alloy contacts; ceramic wafer; 1-1/2" lg, 1-1/4" wide, 1-5/16" high; mounted by 3/8" lg, -32 thread bushing; flatted type shaft 9/16" lg, 0.250" dia, o/a dim.; solder lug type terminals; per spec MIL-S-3786; 21964 #B2140830	Interlock short switch Figure 3-5
S1108		Same as S1102	Regulated filament Figure 3-5

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T1101		TRANSFORMER, VARIABLE POWER: input voltage taps at 57.5, 115 and 135 v, with respect to start of winding, 60 cycles, single phase; output data 0 to 135 v range, 6 amp, 0.9 kva rating; voltage varied by 1-1/2" dia knob; winding and brush to frame test voltage not less than 500 v rms; air cooled; open frame, metal; overall dim , excluding terminals, 4-1/2" high, 4-1/2" wide, 3-15/16" deep; 5 terminals, solder lug type, located on top; 4 mounting holes 0.265" dia 3-3/4" by 3-3/4" c to c; 24655 W-5 "Variac", as described or equal per spec MIL-T-27A; 21964 #A2061244	"ON-OFF" switch Figure 2-14
T1102		TRANSFORMER, POWER STEP-DOWN: hermetically sealed, metal case; input data 70 v max., 60 cycles, single phase; 1 output winding, 17.5 v, 14 amp; insulation to withstand 600 v rms test; dim., MBCA Ref Dwg Group 12, 3-3/4" max lg, 4-11/32" max. wide, 6-1/4" max high; 4 terminals; solder lug type, located on top; four 5/16-18 NC-2 threaded studs on 2-1/2" by 3-5/16" mounting centers; grounded electrostatic shield between the primary and the secondary; 49956 #292-6017G2 MIL type TF1SX01YY per spec MIL-T-27A; 21964 #A1069869	p/o fil bus voltage regulation circuit
TB1101		TERMINAL BOARD: 8 feedthru type terminals w/thd studs; barrier type; MIL type 5TB8, per spec MIL-T-16784; 21964 #A2133120-1	Incoming cable connector Figure 2-16
TB1102		TERMINAL BOARD: 12 terminals; single row, thru type terminals; voltage rating 600 v rms; MIL type 7TB12 per spec MIL-T-16784A and Navy dwg #9000-S6505G-73214; 21964 #A2133072; Same as TB604	Incoming cable connector Figure 2-16
TB1103		Same as TB1102	Incoming cable connector Figure 2-16
TB1104		Same as TB1102	Incoming cable connector Figure 2-16
W1152	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor 1/10 AWG stranded copper, type RG-119/U terminations; incl 2 MIL type connectors, P1167 and P1168, one located each end, as per 21964 #B2061533G1	Connects DC1156 and J1155
XDS1101		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63PW3 per spec MIL-L-3661, dwg MS-90286; 21964 #A2133069-5; Same as XDS501	Retainer for DS1101
XDS1102		LIGHT, INDICATOR; friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BB3 per spec MIL-L-3661, dwg MS-90286; 21964 #A2133080-4	Retainer for DS1102
XDS1103		Same as XDS1101	Retainer for DS1103
XDS1104		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BR3 per spec MIL-L-3661, dwg MS-90286; 21964 #A2133080-1; Same as XDS1002	Retainer for DS1104
XDS1105		LIGHT, INDICATOR: MIL type LH64PA5 per MIL-L-3661; MS90287; 21964 #A2133081-2; Same as XDS901	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

CONTROL-DUPLEXER C-2226A/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XF1101		FUSEHOLDER: extractor post type; accommodates 1 fuse; MIL type FHL10G per BuShips dwg #9000-S6202-74228 and per spec MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Holds F1101 & F1102
XF1102		Same as XF1101	Holds F1103 & F1104
XF1103		Same as XF1101	Holds F1107 & F1108
XF1104		Same as XF1101	Holds F1105 & F1106
XF1105		Same as XF1101	Holds F1109 & F1110
XF1106		Same as XF1101	Holds F1111 & F1112
XF1107		Same as XF1101	Holds F1113 & F1114
Z1153		FILTER ASSEMBLY, ELECTRICAL: c/o three band pass filters on a common mtg plate; frequency data, 12 mc approx band width, 1024 to 1151 mc frequency range; 50 ohms input, 50 ohms output; dim. o/a, 8-3/4 in. lg, 2-1/8 in. w, 7-1/2 in. high; ceased, rectangular shape, metal; mounts by four thd inserts on mtg angle and by a #8-32 screw in bottom of each cavity; type N modified series connector used as output loop; three cavities each w/micrometer adjustment; 21964 #A2061359	Receiver filter
Z1154		Not Used	
Z1155		Not Used	
Z1156		FILTER, BAND PASS: 400 kc approx band width, 960 to 1025 mc frequency range; 50 ohms input, 50 ohms output, 93341 #20B8400-L 21964 #C106585	Transmitter band pass filter for spectrum control low band Figure 6-60
Z1157		FILTER, BAND PASS: 340 kc approx band width, 1150 to 1215 mc frequency range; 50 ohms input, 50 ohms output; 93341 #20B8900-H 21964 #C1068586	Transmitter band pass filter for spectrum control high band Figure 6-60

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
		AMPLIFIER-MODULATOR, AM-1701/URN	
1301-1399		AMPLIFIER-MODULATOR, AM-1701/URN: class "A" radio frequency amplifier; 7 kw amplifier power output, 1 channel, 500 ohms impedance; AC; 120 v, 60 cycles ±2 cycles, single phase; DC; 12000 v; aluminum cabinet; overall dim. 26-25/32" lg. 23-1/16" wide, 21-13/32" high; rack mounted; 21964 #J2060340 and #A20-60340; u/o AN/GRN-9( )	Part of Receiver-Transmitter/GRN-9D Figure 6-57
C1301 thru C1307		Not Used	
C1308	6	CAPACITOR, FIXED, MICA DIELECTRIC: .01 µf ±10%; 300 v DC working; -200 to 200 parts/million/degree C temperature coefficient; MIL type CM35C-103K per spec MIL-C-5A; 21964 #A2142279-1; same as C411	Bypass M1301
C1309		Same as C1308	Bypass M1302
C1370		CAPACITOR, FIXED, PAPER DIELECTRIC: 1000 v DCW, 10 µf ±10%; MIL type CP70E1EG106K, per spec MIL-C-25A; 21964 #641050	Coupling to T1372
C1371		Same as C1370	Coupling T1372
C1372		CAPACITOR, FIXED, PAPER DIELECTRIC: 10 µf ±10%; 600 v DC working; MIL type CP70E1EF106K per spec MIL-C-25; 21964 #641041; Same as C501	Bias supply filter Figure 6-58
C1373		CAPACITOR, FIXED, PAPER DIELECTRIC: 400 v DCW, .1 µf ±10%; MIL type CP05A1EE104K, per spec MIL-C-25A; 21964 #A2133046-5	Bias supply ripple filter
C1374		Same as C1372	Bias supply output filter Figure 6-58
CR1370		SEMICONDUCTOR DEVICE, DIODE: silicon; diode; MIL type 1N256 per spec MIL-E-1C; 21964 #A2133078	Bias rectifier Figure 6-59
CR1371		Same as CR1370	Bias rectifier
DS1301		LAMP INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear, 24446 #10C7/1DC; 21964 #710071; Same as DS501	T1303 "ON" indicator Figure 2-7
DS1302		Not Used	
DS1303		LAMP, GLOW: neon gas, 0.04 watt; 120 v; T-3-1/4 bulb; miniature bayonet base; MIL type NE-51 per spec MIL-L-15098B; 21964 #A2141970; Same as DS901	S1301 "OPEN" Figure 2-7
DS1304		LAMP, GLOW: neon gas, 0.25 watt, 67-87 v DC striking voltage; double contact bayonet type; T4-1/2 bulb; MIL type NE-16 per spec MIL-L-15098; 21964 #A2060350; Same as DS502	M1302 protector
DS1305		Same as DS1301	Illumination of klystron compartment

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1311		LINE SECTION, RADIO FREQUENCY TRANSMISSION: 50 ohms impedance, phosphor bronze, silver plated; friction mounted; cylindrical rod shaped; overall dimensions 1-9/16" lg, 0.341" dia; 02114 #.215-302C; 21964 #A2140636; Same as E1162	P1311 center conductor
E1312 thru E1316		Not Used	
E1317	6	CONTACT, ELECTRICAL: u/w interlock switch; furnished conducting surface for switch; one brass contact, silver pl, rd. approx 7/16" dia; 1-7/8" lg, 1-1/2" wide, 11/16" thk, approx o/a dim.; 10 amp, 110 or 220 v AC or DC; two 0.154" dia mounting holes on 1-1/4" mounting center, recessed 5/8" deep to clear #6 hex nut; 21964 #B2141184-2, this is one half of NAVY type switch #24446-24067A or 24446 #M7460330-G3 (See S904)	u/w interlock switch
E1318 thru E1321		Not Used	
E1322		Same as E1311	P1312 center conductor
E1323		Same as E1311	Z1303 input center conductor
E1324		Same as E1311	Z1303 output center conductor
E1325		Same as E1311	P1309 center conductor
E1326		INSULATOR, STANDOFF: "Mycalex 410", grade L-4B, white glazed; square pillar; style no. 42, section M, Ref Dwg Group 9; 3/4 in. lg, 1 in. sq; two 6-32 NC-2 thd insert 9/32 in. lg, located on bottom; one 1/4-20 NC-2 thd insert 3/8 in. lg, located on top 21964 #A2143188	Standoff insulator
E1327		Same as E1326	Standoff insulator
E1328		Same as E1326	Standoff insulator
E1329		Same as E1326	Standoff insulator
E1370	6	SHIELD, ELECTRON TUBE: JAN type TS-102U01 per spec JAN-S-28A, modified; 21964 #A2132988-1; Same as E201	Shield for V1370
E1370A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U01; MIL-STD-242A type #701; 21964 #A2132886-1; Same as E201A	Insert for shield E1370
E1371	6	SHIELD, ELECTRON TUBE: JAN type TS102U02 per spec JAN-S28A, modified; 21964 #A2132988-2; Same as E202	Shield for V1371
E1371A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U02; MIL-STD-242A type #702; 21964 #A2132886-2; Same as E202A	Insert for shield E1371
E1372	6	SHIELD, ELECTRON TUBE: JAN type TS103U02 per spec JAN-S-28A modified; 21964 #A2132988-5; Same as E307	Shield for V1372

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1372A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U02; MIL-STD-242A type #902; 21964 #A2132886-5; Same as E307A	Insert for shield E1372
F1301		Not Used	
F1302		FUSE, CARTRIDGE: 3 amp, 125 v time delay, 135% for 0-1 hour and 300% for 6 sec; ferrule type terminals, silver plated; dim., 1/4" lg, 1/4" dia; enclosed type, glass case; one time; non-indicating; 1-1/4" lg, 0.25" dia, o/a dim.; MIL type F02D3R00B, per spec MIL-F-15160C and MIL-STD MS90078-27-1; 21964 #882237; Same as F501	Primary T1301 protection Figure 2-7
F1303 and F1304		Not Used	
F1305		Same as F1302	Spare fuse Figure 2-7
J1309		CONNECTOR, RECEPTACLE: BNC series; 1-9/64" lg, 0.212" ID; 50 ohms nom impedance; accommodates RG-55 and RG-58/U cables; weather-proof; 74868 #86025; MIL type UG-909/U per BuShips dwg #REB49058; 21964 #A2132720, Same as J502; p/o W1307	RF input V1304 Figure 6-58
J1370		CONNECTOR, RECEPTACLE: 1 round female contact; one connector mating end; 50 ohm nom impedance, 500 v peak voltage; low loss plastic dielectric; straight shape; 1-3/64" lg o/a; w/inclosing shell; proof; MIL type UG-1094/U BNC Series, "D" hole mounting, per Navy dwg REB49063; 21964 #A2131837; Same as J203	Shaped pulse in from FMO Figure 6-58
K1301		RELAY, ARMATURE: contact arrangement 2 form C type, DPDT, MBCA Ref Dwg Group 4, break-make, AC, 120v, 10 amp; 1 winding, inductive winding; AC, 132 v, max continuous operation, operating current not rated, 60 cycles; 6 terminals for contacts, 2 terminals for coil; continuous duty; hermetically sealed; 2-5/8" high, 1-25/32" wide, 1-21/32" deep, o/a dim.; four no. 6-32 mounting studs spaced 1.218" c to c located on bottom; 70309 PBH; per spec MIL-R-5757C; 21964 #A2060235	T1370 primary delay Figure 6-59
M1301		AMMETER: panel mounted; DC; milliamperes, 0-200 left to right graduated in increments of 5, marked "DC", round, molded thermosetting compound or metal; style no. 15, MBCA Ref Dwg Group 27; flange 2.69" dia. 0.40" max thick, 2.21" body dia, 1.85" body depth from mounting surface, excluding terminals, 2% accuracy at full scale reading; 150 millivolts drop across terminals; satisfactory for use on either non-magnetic panels or magnetic steel panels 1/16" to 1/8" thick without additional calibration; black markings and pointer, white background, self contained; ruggedized, three 0.125" dia mounting holes on 1.22" radius; 2 screw stud type terminals 1/4-28 thread, 0.5" min lg; MIL type MR26W200DCMAR, per spec MIL-M-10304A; 21964 #A2060455-6	V1304 beam current meter Figure 2-7
M1302		VOLTMETER: panel mounted; kilovolts, 0.15 left to right, graduated in increments of 0.2 marked "DC"; round, molded thermosetting compound or metal; style no. 15, MBCA Ref Dwg Group 27; flange 2.69" dia, 0.40" max thick, 2.21" body dia, 1.86" body depth from mounting surface, excluding terminals, 2% accuracy at full scale reading; 1 milliampere ±5% with 150 millivolts max terminal drop; satisfactory for use on either nonmagnetic panels or magnetic steel panels 1/16" to 1/8" thick without additional calibration; black markings and pointer, white background; used with external resistor; ruggedized 0.125" dia. mounting holes on 1.22" radius; 2 screw stud type terminals 1/4-28 thread, 0.5" min lg; MIL type MR26W0-15DCKVR; per spec MIL-M-10304A; 21964 #A2060455-3	High voltage indicator Figure 2-7

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP1301		WRENCH, OPEN END, FIXED: steel, 4-1/2 in. lg, 5/32 in. thk; double ended type; 1/2 in. opening, one end 15° angle opening, other end 75° angle opening; 65814 #1132; 21964 #A2142701	Mounted on cabinet
MP1302	7	PLUNGER, QUICK RELEASE: steel type B-1113, cadmium plated finish; 5/8 in. overall lg, thd insert #8-32 NC-2, plunger extends 3/32 in. from body, dia of plunger 0.080 in. max; 92214, #S-50; 21964 #A2142321-1	Mounted in cabinet frame
MP1303		Same as MP1302	Mounted in cabinet frame
MP1304	1	GASKET: synthetic rubber, MIL-R-900 A, class 2; cross sectional style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 65" lg; 21964 #A9140800; Same as MP201	Panel sealing
MP1305	1	GASKET: synthetic rubber, MIL-R-900C, class 1; style no. 10, MBCA Ref Dwg Group 75; 2-15/64" dia aperture in center; three 1/8" dia holes spaced 120 deg apart on 2-7/16" dia; 2-11/16" outside dia. 1/16" thk; 21964 #B2060910; Same as MP1120	Sealing for meters
MP1306		Same as MP1305	
P1308		CONNECTOR, PLUG, ELECTRICAL: 1 round male contact; one connector mating end; BNC series; 50 ohms nom impedance, 500v peak voltage; accommodates RG-55/U and RG-58/U cables; 74868 #85000; MIL type UG-88C/U per Sig dwg #SC-D-72235; SuShips dwg #REB49064; 21964 #A2131456; Same as P201, p/o W1307	RF input connector for V1304
P1309		CONNECTOR, PLUG: 1 round female inner conductor, 1 round 02114 #CM-1013-9036B female coupling on end; radio frequency connector, 50 ohms nominal impedance, constant frequency; cylindrical shape, brass body; 9/16" dia max cable opening; MIL type UG-1126/U; 21964 #B1069500; p/o W1301; Same as P1167	Connector on W1301
P1310		Same as P1309; p/o W1301	
P1311		COUPLER, TRANSMISSION LINE: coaxial line type; 950 to 1225 mc frequency range; 50 ohms nominal impedance; copper material; mounts to transmission line by two 7/8 in. female brass couplings, 1-1/4-18 NEF thd; 90° bend; 1-3/4 in. distance from center of one end to contact surface of other end; 2.375 in. distance from center of second end to contact surface of other end; 02114 #PA-8-11-2; 21964 #B2061800, #A2061788	Connects V1304 to P1312
P1312		COUPLER, TRANSMISSION LINE: coaxial line type; 950-1225 mc frequency range; 50 ohms nominal impedance; copper material; mounts to transmission line by one 7/8 in. male coupling with nut and one 7/8 in. female coupling; male coupling nut 1-1/4-18 NEF-2B thd, female coupling 1-1/4-18 NEF thd; 180° bend; 2-1/2 in. distance from center of one end to contact surface of other end; 02114 #PA-8-12-1; 21964 #B2061777G1, #A2061789	Connects Z1303 to P1311
P1313		Same as P1312	Connects Z1303 to P1309
R1390		Resistor Set, Fixed, Wirewound. Selected from: 10W/5905-99-720-2849, 10W/5905-99-720-2851 10W/5905-99-720-2853, 10W/5905-99-720-2855 10W/5905-99-720-2857, 10W/5905-99-720-2859 10W/5905-99-720-2860, 10W/5905-99-720-2862 10W/5905-99-720-2864, 10W/5905-99-720-2867	Klystron filament shunt resistor

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1306		RESISTOR, FIXED, WIREWOUND: inductive winding; 7.5 megohms, +0.5%; 1 kv per megohm of resistance voltage rating; 150°C max continuous operating temp; tempered glass case, #MFA type EX-59; 21964 #A2142549-1	High voltage metering multiplier, M1302 Figure 2-8
R1307		Same as R1306	High voltage metering multiplier, M1302 Figure 2-8
R1314		RESISTOR, FIXED, FILM (HIGH STABILITY): 1000 ohms, ±5%; 55 watt, 225°C hot spot temperature; glass insulated, excellent high frequency properties; 14674 #RW-37 pe r MIL-R-11804A; 21964 #A2141186-2	High voltage bus discharge Figure 6-59
R1319		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; 350°C maximum continuous operating temp; characteristic V; MIL type RW59V-281 per MIL-R-26C; 21964 #A2132711-01; Same as R520	DS1301 voltage dropping resistor
R1370		RESISTOR, FIXED, WIREWOUND: 14 watts; 350 deg C continuous operating temp; MIL type RW31V501, per spec MIL-R-26B; 21964 #A2133346G3	T1302 loading
R1371		RESISTOR, FIXED, COMPOSITION: 82,000 ohms, ±5%; 1 watt MIL type RC32GF823J; per spec MIL-R-11; 21964 #503836	T1371 voltage divider
R1372		RESISTOR, FIXED, COMPOSITION: 150,000 ohms, ±5%; 1.0 watt, MIL type RC32GF154J, per spec MIL-R-11; 21964 #503842	T1371 voltage divider
R1373		RESISTOR, FIXED, COMPOSITION: 68,000 ohms; ±5%; 1 watt; MIL type RC32GF683J; per spec MIL-R-11; 21964 #503834	V1370 screen voltage divider
R1374		RESISTOR, FIXED, COMPOSITION: 39,000 ohms, ± 5%; 1 watt, MIL type RC32GF393J, per spec MIL-R-11; 21964 #503828	V1370 screen voltage divider
R1375		RESISTOR, FIXED, COMPOSITION: 100,000 ohms; ±10%; 1/2 watt; MIL type RC20GF104K per spec MIL-R-11; 21964 #504255; Same as R320	V1370 plate load
R1376		RESISTOR, FIXED, COMPOSITION: 470 ohms; ±5%; 2 watt MIL type RC42GF471J, per spec MIL-R-11; 21964 #501105	V1372 grid parasitic suppressor
R1377		Same as R1376	V1372 grid parasitic suppressor
R1378		RESISTOR, FIXED, COMPOSITION: 33 ohms, ±5%; 2 watt; MIL type RC42GF330J, per spec MIL-R-11; 21964 #501077	V1372 cathode parasitic suppressor
R1379		Same as R1378	V2372 cathode parasitic suppressor
R1380		Same as R1378	V1370 grid parasitic suppressor
R1381		RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt; MIL type RC20GF104J, per spec MIL-R-11A; 21964 #504151; Same as R444	Bias supply voltage divider
R1382	6	RESISTOR, VARIABLE: composition; 100,000 ohms ±10%; one section; 2 watt; std A taper; MIL type RV4LAVSA104A per spec MIL-R-94A; 21964 #A2133049-3; Same as R672	Bias supply voltage divider Figure 6-59
R1383		RESISTOR, FIXED, COMPOSITION: 220,000 ohms; ±5%; 1/2 watt; MIL type RC20GF224J per spec MIL-R-11; 21964 #504159	Bias supply voltage divider

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1384		RESISTOR, FIXED, WIREWOUND: 4,000 ohms; 14 watts; MIL type RW31V40-2, per spec MIL-R-26C; 21964 #A2133346G2	Bias supply load
R1385		RESISTOR, FIXED, WIREWOUND: inductive winding; 20 ohms, ±5%; 113 watts; MIL type RW37V200 per spec MIL-STD-242A; 21964 #A2061920	Klystron surge protection
S1301		SWITCH, PRESSURE: SPDT; vane type rotary actuated; switch assembly shall operate at 0. 50 inch max static pressure (water column) and release at 0. 1 inch min static pressure (water column); 5 amp, 250 v AC; barrier type screw terminal board; MIL type 8TB2 per MIL-T-167-84; located on top; 5/8" mounting stud omitted, mounted by 5/8" - 18 NF-2 tapped hole; similar to 93652 #113 per spec MIL-E-16400A and MIL-S-901B; 21964 #A2061416	Air pressure switch
S1302 thru		Not Used	
S1304		SWITCH, TOGGLE: SPDT: 0.75 amp, 125 v DC., 15 amp, 115 v AC, resistive load rating; JAN type ST42A, per spec JAN-S-23; 21964 #828212; Same as S502	Trouble light switch
S1370		SWITCH, SHORTING: high voltage discharge, DC; SPST, normally closed, double break, 21964 #C2140529 and A2140528-1	High Voltage discharge Figure 6-59
S1371		SWITCH, SENSITIVE: SPDT: 115 v, 0. 4 amps; plunger type actuator; per spec JAN-S-63, part #SS03A20; 21964 #A2133423G1	Filament compartment interlock
T1370		TRANSFORMER, POWER, STEP DOWN AND STEP UP: open frame; input 120 v AC, 60 cycles, single phase; 2 output windings, no. 1 secondary 120 v at 1 amp, no. 2 secondary 4. 2 v at 43 amp; insulation to withstand 600 v rms test on primary and 23, 400 v rms test on secondaries; 6 screw type terminals; grounded electrostatic shield between primary and all secondaries, 49956 #292-6006G2 per spec MIL-T-27A; 21964 #1069476	V1304 filament transformer and bias chassis power transformer Figure 2-8
T1371		TRANSFORMER, POWER, STEP DOWN AND STEP UP: encapsulated, epoxy resin; input 120 v AC, 60 cycles, single phase; 2 output windings, no. 1 secondary 225 v at 0.1 amp, no. 2 secondary 6.3 v/CT at 1 amp; insulation to withstand 600 v rms test on primary, 1680 v rms test on HV secondary and 980 v rms test on LV secondary; 8 solder lug terminals; grounded electrostatic shield between primary and all secondaries; 49956 #292-6007G2 per spec MIL-T-27A; 21964 #A1069477	Bias chassis transformer Figure 6-58
T1372		TRANSFORMER, PULSE: hermetically sealed, metal case; 500 ohms impedance at 7200 ± 180 pps; 800 v operating voltage on primary, voltage transformation 1:1 w/500 ohm secondary load; 2400 v rms primary, 18. 5 kv rms secondary insulation test voltages; dim. o/2 4-7/8 in. lg, 3-7/16in. w, 2-29/32 in. h; 4 solder lug pillar type terminals, two 25/32 in. h, other two 2-7/8 in. h from surface of case; mounts by 4 thd studs on 2-5/8 in. by 2-1/8 in. mtg centers; 49956 #363-6009G2 per spec MIL-T-27A, part #TF1RX36JA; 21964 #A1069478	T1304 grid pulse transformer Figure 6-59
TB1301		TERMINAL BOARD: 8 terminals; thru type terminal [illegible]; voltage rating 600 v rms; MIL type 7TB8 per spec MIL-T-1[illegible],84A and NAVY dwg 9000-S6505G-73214; 21964 #A2133072-1; Same as TB501	Power input Figure 6-58
TB1302		Same as TB1301	Power input Figure 6-58

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
TB1370		TERMINAL BOARD: 6 feedthru type terminals, barrier type; MIL type 11TB6, spec MIL-T-16784; 21964 #A2133380-G2	Bias chassis connections Figure 6-59
TB1398		TERMINAL BOARD: (For Reference Only)	Resistor mtg board
TB1399	2	TERMINAL BOARD: 25 solder stud type terminals; 21964 #B2061636	Resistor mtg board, bias chassis
V1304		ELECTRON TUBE: klystron cavity; metal envelope, non-standard envelope, cylindrical shape, top 6-7/8" sq, 17-1/4" min. 19" max. lg o/a dim. excluding terminals; 7 terminals, two rigid leads from base of tube and grid connection, one BNC radio frequency input and one monitor fitting, one 7/8" coaxial radio frequency output fitting, all located at side of envelope, ceramic output connector seal; one ground connection located at top of envelope; test power output 7-5 kw; cascade amplifier klystron, control grid modulated; 56232 #SAL-89 per spec MIL-E-1; 21964 #A2061964	Power amplifier
V1370		ELECTRON TUBE: pentode; MIL type 5654/6AK5W per spec MIL-E-1C; 21964 #700561; Same as V201	Regulator amplifier bias chassis Figure 6-59
V1371		ELECTRON TUBE: diode; glass envelope; RMA envelope T-5-1/2; 7 terminations, pin type, located on bottom; miniature voltage regulator; USN type 5651 WA; per spec MIL-E-1C; (Navy); 21964 #A2133280	Voltage reference, bias chassis Figure 6-59
V1372		ELECTRON TUBE: twin triode; glass envelope; RMA type T6-1/2; 9 terminations; pin type; located on bottom mfg class, amplifier; USN type 5687 WA; per spec MIL-E-1C (Navy); 21964 #A2133281; Same as V606	Bias chassis, series regulator Figure 6-59
W1301	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, MIL type no. RG-87A/U, 50 ohms nominal impedance, 7 strands no. 20 AWG silver coated copper wire, dielectric teflon 0.290" nominal dia, double braid copper shield, round shape, 0.440" o/a cross-section dia, fibreglas silicone impregnated jacket; assembly 63" ±1/4" long overall cable 56-3/4" lg excluding terminations; connector plugs P1309 and P1310, 21964 #B2061559 located one on each end; insulation stripped 5/8" and tinned, shield stripped 7/8", jacket stripped 1-1/8"; 21964 #B2061540	RF output cable assembly, V1304
W1307	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, outermost covering teflon-tape seal, fiberglas braid jacket; 0.195 in. dia o/a cross section of cable; MIL type RG-141/U; assembly is approx 43-1/4 in. lg incl terminations; incl two MIL type connectors, P1308 and J1309, one located each end, as per 21964 #B2061204	Cable connects J1309 to V1304 input
XDS1301		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; MBCA Ref Dwg Group 7, double contact bayonet candelabra; 125 v 6 watts; enclosed frame; steel shell; black nickel, overall dim., 3-1/32" lg., 1-1/8" dia; panel mounted, 1 in. hole required; horizontally mounted; white jewel, plain design, torpedo shape, MIL type LH63PW3 per spec MIL-L-3661, dwg MS-90286; 21964 #A2133069-6; Same as XDS501	Holder for DS1301

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

AMPLIFIER-MODULATOR AM-1701/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XDS1303		LIGHT, INDICATOR: supplied w/lens, 5/8" dia, amber, plain design, stovepipe shape, fluted, screw type holder; accommodates neon T-3-1/4 NE-51 lamp single contact miniature bayonet base; 125 v, 75 watt; brass shell black nickel finish, enclosed; 2-5/16" lg, 15/16" dia o/a dim., 1 mounting hole required, 11/16" dia., accommodates up to 9/32" max thick panel; horizontally mounted; lamp replaceable from front of panel; 2 terminals, solder lug type, located on socket base; both insulated from shell; includes built in 51,000 ohm 1/3 watt composition resistor; MIL type LH64PA5 per spec MIL-L-3661 and MS-90287; 21964 #A2133081-2; Same as XDS901	Holder for DS1303
XDS1304	6	LAMP HOLDER: 125 v; accommodates double contact bayonet base lamp; MBCA Ref Dwg Group 7; molded bakelite body; body dim 1-9/16 in. lg, 1 in. wide, 1-1/8 in. high; 2 screw type terminals; two 3/16 in. dia holes on 1-3/16 in. mtg centers; Military Standard lamp-holders dwg MS90290; 72619 #9S4634-L-46; MIL spec no. MIL-L-3661; type #LH-71-XXO; 21964 #A9152053 or #A2142519; Same as XDS502	Holder for DS 1304
XDS1305		Same as XDS1304	Holder for DS1305
XF1301		FUSE HOLDER: extractor post type; accommodates 2 fuses 1-1/4" lg by 1/4" dia; blown fuse indicating type sealed; MIL type FHL10G per BuShips Dwg #9000-S6202-74228 and MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Holder for F1302 and F1305
XV1370	6	SOCKET, ELECTRON TUBE: 7 contacts, brass, nickel plated; miniature; includes metal shield base, 0.800" dia, 0.611" high; includes center shield, 0.125" ID; oval; 1-1/8" lg, 0.800" wide, 25/32" high o/a dimensions, excluding terminals; molded thermo-setting plastic body; one piece saddle mounting, 5/8" dia. chassis hole required, 2 mounting holes, 0.125" dia., 0.875" c to c; JAN type TS102P01, per spec JAN-S-28A-1; 21964 #740002; Same as XV308	Socket for V1370
XV1371		Same as XV1370	Socket for V1371
XV1372		SOCKET, ELECTRON TUBE: 9 contacts; brass, nickel plated; miniature; includes metal shield base, 0.940" dia, 0.611" high; includes center shield, 0.125" ID oval; 1-3/8" lg, 0.940" wide, 25/32" high, o/a dimensions, excluding terminals; molded thermo-setting plastic body; one piece saddle mounting, 3/4" dia. chassis hole required, 2 mounting holes, 0.125" dia., 1.125" c to c; JAN type TS103P01, per spec JAN-S-28A; 21964 #740004; Same as XV307	Socket for V1372
Z1301		Not Used	
Z1302		Not Used	
Z1303		TUNER, TRANSMISSION LINE: 960 to 1250 mc frequency tuning range; u/w 50 ohms line; 13-1/8" lg, 1-7/8" wide, 3-3/8" high, overall dim.; 27 cm range scale w/sliding pointers, slug tuned; one coupling nut on each end 1-1/4" -18 NEF-2 thd, for 7/8" line; two mounting brackets each w/two 6-32 tapped holes one near each end; 21964 #A2141750G2	Matches klystron output impedance Figure 2-20

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1401-1599		FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D: frequency data, final multiplier output, 961.5 to 1024.5 mc, 1150.5 to 1213.5 mc; operating power requirements, AC: 120 v, 60±5 cycles, single phase, 150 va, DC; -375/250/1000 v, 04/.20/.055 amps; impedance data, 50 ohms output; crystal oscillator tubes 5670 with crystal type CR-32/U with special tolerance on initial frequency accuracy; open aluminum framework; overall dim. 26-25/32" lg., 23-1/16" wide, 8-21/32" high; rack mounted with pull-out slides, front access only; to provide a crystal controlled pulsed RF signal to excite the Amplifier-Modulator; 21964 #A1068944 u/o AN/GRN-9D	GRN-9D Figure 6-54
C1401		Not Used	
C1402		CAPACITOR, FIXED, PAPER DIELECTRIC: 0.10 μf ±10%; 900 v DC working, MIL type CP05A1KE104K, per spec MIL-C-25A; 21964 dwg #A2132594-1; Same as C613	Coupling, V1401 to V1402 Figure 6-9
C1403		Not Used	
C1404		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 μf, ±10% tolerance; 400 v DC working, MIL type CP05A1KE105K per spec MIL-C-25A; 21964 dwg #A2132594-3	Coupling, V1402 to V1403, V1404 and V1405 Figure 6-9
C1405		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 μf, ±10%; 2000 v DC working; MIL type CP70E1EJ205K per spec MIL-C-25; 21964 part #641068	Plate bypass, V1403 V1404, V1405 Figure 6-55
C1406		CAPACITOR, FIXED, MICA DIELECTRIC: 910 μμf ±5%; 2,500 v DC working; MIL type CM45B911J, per spec MIL-C-5A; 21964 part #603192; u/o AN/GRN-9A	Filter, p/o shaper network
C1407		CAPACITOR, FIXED, MICA DIELECTRIC: 510μμf ±5%, 2,500 v DC working; MIL type CM45B511J, per spec MIL-C-5A; 21964 part #603186; u/o AN/GRN-9	Filter, p/o shaper network
C1408		CAPACITOR, FIXED, MICA DIELECTRIC: 300 μμf ±5%; 2,500 v DC working; MIL type CM45B301J per spec MIL-C-5A; 21964 part #603180; u/o AN/GRN-9	Filter, p/o shaper network
C1409		Not Used	
C1410		CAPACITOR, FIXED, PAPER DIELECTRIC: 1,000 v DCW 0.1 μf ±10%; MIL type CP53B1EG-104K per spec MIL-C-25A; 21964; part #640351: Same as C1301	Coupling, shaper network to V1407 Figure 6-55
C1411		CAPACITOR, FIXED, PAPER DIELECTRIC: 0.01 μf ±10%; 400 v DC working, MIL type CP05A1KE103K, per spec MIL-C-25A; 21964 part #A2132594-4	Bypass, grid bias to V1403, V1404, V1405
C1412		Same as C1404	Bypass, screen grid V1407 Figure 6-9
C1413		Same as C1411	Coupling, DL1401 to V1408
C1414		Same as C1402	Coupling, V1408 to V1409 Figure 6-9
C1415		Same as C1404	Coupling, Receiver blanking output Figure 6-9

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1416		CAPACITOR, FIXED, MICA DIELECTRIC: 27 $\mu\mu$f, ±5% v DC working; MIL type CM20C270J per spec MIL-C-5A; 21964 part #600164	Bypass, cathode V1408
C1417		CAPACITOR, FIXED, MICA DIELECTRIC: 68 $\mu\mu$f ±5%; 2, 500 v DC working; MIL type CM45B680J, per spec MIL-C-5A; 21964 part #603165; u/0 AN/GRN-9A	Filter, p/o shaper network
C1418		CAPACITOR, FIXED, PAPER DIELECTRIC: 10 μf ±10%; 100 v DC working; MIL type CP54B1FB106K per MIL-C-25; 21964 part #643645; u/o AN/GRN-9A	Bypass R1457 to ground Figure 6-9
C1419		CAPACITOR, FIXED, MICA DIELECTRIC; 22 $\mu\mu$f, ±5% 500 v DC working; MIL type CM20C220J per spec MIL-C-5A; 21964 part #600162	Coupling, V1401
C1420		CAPACITOR, FIXED, PAPER DIELECTRIC: 4 μf, ±20%; 400 v DCW; MIL type CH53B1EE405M per MIL-STD-242A and MIL spec MIL-C-18312; 21964, dwg #A2060302-7; Same as C604	Bypass +250 v supply Figure 6-9
C1421		CAPACITOR, FIXED, MICA DIELECTRIC: 300 v DC working, 10 f ±10%; MIL type CM15B100K per spec MIL-C-5A; 21964 part #603959	Coupling, V1402
C1422		Not Used	
C1423		CAPACITOR, FIXED, MICA DIELECTRIC: 300 v DC working, 33 f ±5%; MIL type CM15C330J per spec MIL-C-5A; 21964 part #604031	Coupling, V1402
C1424 Cont. See C1501		CAPACITOR, FIXED, PAPER DIELECTRIC: 02 μf, ±10%; 1000 v DC working; MIL type CP26A1EG203K per MIL-C-25A and MIL-STD-242A; 21964 dwg A2061919; u/o AN/GRN-9A	p/o compensating network Figure 6-55
CR1401		SEMI-CONDUCTOR, DEVICE, DIODE: germanium type; 40 ma max continuous forward current; 125 ma max peak forward current; 75 v peak inverse voltage; 0. 8 mmf average shunt capacitance; MIL type 1N69, per spec MIL-E-1B; 21964 part #700030; Same as CR601	Clamping Diode, grid V1408

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
CR1402		Same as CR1401	Clamping diode, grid V1402
CR1403		SEMI-CONDUCTOR DEVICE, DIODE: silicon. cartridge type; 1,000 mc frequency design; 8.0 db max conversion loss; 2.5 max output noise ratio; 6.5 watts burnout test; MIL type 1N25, per spec MIL-E-1C; 21964 part #700026; Same as CR1151	Rectifier p/o detector E1401
CR1404		Same as CR1403	Rectifier, p/o detector E1402
DC1401		COUPLER, DIRECTIONAL: two end fittings, BNC type UG-89/U connector jacks modified for main line, two BNC type UG-185/U connector receptacles modified for indicator; 480 to 1215 mc frequency range; 25 db at 1100 mc coupling loss; less than 1.06 voltage standing wave ratio at 1000 mc; CU-431/URN-3; 21964 dwg #C2090962 and A2090963-1	Directional coupler between V1506 or V1512 and klystron Figure 6-54
DL1401		DELAY LINE: distributed parameter type; output taps provided at 0.9, 1.0, 1.1, 1.2, 1.3 and 1.4 μsec time delay; 1.3 mc bandwidth; characteristic impedance 2,500 ohms ±5%; 500 v rms test voltage; 21964 dwg #A2061302	Delay line input of V1408A Figure 6-9
DL1402		Same as DL1401; u/o AN/GRN-9D	Delay line input of V1408A Figure 6-9
DL1403		Not Used	
DS1401		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear, 24446 #10C7/1DC; 21964 part #710071; Same as DS501	Filaments "ON" Figure 3-3
DS1402		LAMP, INCANDESCENT: 6.8 v, 0.15 amp, single contact miniature bayonet base; NAVY type #TB-14, MIL type MS15571-2 per MIL-STD-242A; 21964 dwg #A2141961	Oven heater booster Figure 3-3
DS1403		Same as DS1402	Oven heater normal Figure 3-3
E1401		HOLDER, CRYSTAL: MIL types 1N21 or 1N25 crystal diodes accommodated; 2 BNC type connectors, female located on one end, male on other end, cylindrical body; 74868 part no. MS-585 per 21964 dwg #A2140845; Same as E1152	Crystal detector reflected wave V1506 or V1512 output
E1402		Same as E1401	Crystal detector, klystron input; reflected wave
E1403		Not Used	
E1404A	5	SHIELD, ELECTRON TUBE: 98978 #T-12-1030; #A2132699 modified 21964 #B2061847G1	Shield for V1403
E1404B		RETAINER, ELECTRICAL SHIELD: 98978 part #T-12-1001; 21964 #A2132698	Base for E1404A
E1405A		Same as E1404A	Shield for V1404

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1405B		Same as E1404B	Base for E1405A
E1406A		Same as E1404A	Shield for V1405
E1406B		Same as E1404B	Base for E1406A
E1407A		Same as E1404A	Shield for V1407
E1407B		Same as E1404B	Base for E1407A
E1408A	6	SHIELD, ELECTRON TUBE: JAN type TS103U02 per JAN-S-28A, modified; 21964 #A2132988-5; Same as E307	Shield for V1401
E1408B		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U02; MIL-STD-242A type #902; 21964 #A2132886-5; Same as E307A	Insert for shield E1408
E1409A		Same as E1408A	Shield for V1402
E1409B		Same as E1408B	Insert for shield E1409
E1410A		Same as E1408A	Shield for V1408
E1410B		Same as E1408B	Insert for shield E1410
E1411A		Same as E1408A	Shield for V1409
E1411B		Same as E1408B	Insert for shield E1411
E1412	7	CLAMP, ELECTRICAL: brass, silver plated; 74868 #1025 MIL type MX-1684/U per 21964 #A9142339; Same as E345	Outer conductor ground, output cable from E1402
E1413		Same as E1412	Outer conductor ground, output cable from E1401
E1414		SHIELD, ELECTRON TUBE: 98978 #TR6-6025; 21964 #A2133276-6	Shield for V1406
E1415 thru E1419		Not Used	
E1420A		Same as E1408A	Shield for V1410
E1420B		Same as E1408B	Insert for shield E1420

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1421		INSULATOR, BUSHING: ceramic grade L-5A; Ref Dwg Group no. 9 style, no. 174; MIL type NS5AW4103 per JAN-I-8; 21964 #A2133203-3; Same as E1318	Ceramic feedthru insulator, 700 v DC
E1422		INSULATOR, BUSHING: ceramic grade L-5A; MIL type NS5AW4203 per JAN-I-8; 21964 #A2133204-3; Same as E1320	Ceramic feedthru insulator 1000 v DC
E1423		CLIP, ELECTRICAL: beryllium copper; silver plated; 76487 #36002-B; 21964 dwg #A2133216	Plate clip for V1403
E1424		Same as E1423	Plate cap for V1404
E1425		Same as E1423	Plate cap for V1405
E1426		Same as E1423	Plate cap for V1407
E1427		CLIP, ELECTRICAL: phosphor bronze cadmium plated; 01009 #90 1SL-2BC; 21964 dwg #A2133343	Plate clip for V1406
E1428		Same as E1423; u/o AN/GRN-9D	Plate cap for V1411
E1429		RETAINER, ELECTRON TUBE: beryllium copper, 21964 #A2060132-1	Retainer for V1504
E1430A		Same as E1404A; u/o AN/GRN-9D	Shield for V1411
E1430B		Same as E1404B; u/o AN/GRN-9D	Base for E1430A
E1431		Same as E1429	Retainer for V1506
E1432		Same as E1429	Retainer for V1510
E1433		Same as E1429	Retainer for V1511
E1434		Same as E1429	Retainer for V1512
E1435 Cont See E1501		Same as E1429	Retainer for V1505
F1401		FUSE, CARTRIDGE: 2 amp, 250 v; time delay, 135% for 0.1 hour and 300% for 6 sec; enclosed type; MIL type F02G2500A per spec MIL-F-15160A and MIL-STD MS90078; 21964 #882221	Protection primaries T1403 and T1501 Figure 3-3
F1402		Same as F1401	Protection primary T1502 Figure 3-3
F1403		Same as F1401	Protection primary T1502 Figure 3-3
F1404		Same as F1401	Spare

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
FL1401		FILTER, RADIO INTERFERENCE: capacitor-coil type; 150 v DC, 5 amp; enclosed in case, 00656 #1N-151; 21964 #A2142586	Filter, lowpass for HR1501 and HR1502 Figure 2-17
J1401		CONNECTOR, RECEPTACLE: 1 round female contact; one connector mating end; 50 ohm nom impedance, 500 v peak voltage; MIL type UG-1094/U BNC Series "D" hole mounting, per Navy dwg REB 49063; 21964 #A2131837; Same as J203	Video pulse input to V1401 Figure 6-55
J1402		Same as J1401	Beam pulse output from V1409 Figure 6-55
J1403		Same as J1401	Receiver blanking pulse output from V1409 Figure 6-55
J1404		Same as J1401	Video pulse input test point V1401 Figure 3-3
J1405		Same as J1401	Shaped pulse test point V1407 Figure 3-3
J1406		Not Used	
J1407		CONNECTOR, RECEPTACLE: BNC series; 50 ohms nom impedance; accommodates RG-55 and RG-58/U cables; 74868 #86025; MIL type UG-909/U per BuShips dwg #REB49058; dwg #A2132720; Same as J502	DC1401 output to klystron
J1408		Same as J1401	Klystron input reflected wave test point Figure 3-3
J1409		Same as J1401	Klystron input incident wave test point Figure 3-3
J1410 Cont See J1501		Same as J1407	V1504 or V1510 output to receiver Figure 6-55
K1401		RELAY, ARMATURE: contact arrangement 2 form C type, DPDT, break-make, AC, 120 v, 10 amp; 1 winding, inductive winding; AC, 132 v max continuous operation, operating current not rated, 60 cycles; 6 terminals for contacts, 2 terminals for coil; continuous duty; hermetically sealed; 70309 type PBH per spec MIL-R-5757C; 21964 dwg #A2060235; Same as K1301	Relay, supervisor for T1403 and T1501 Figure 6-55
L1401		COIL, RADIO FREQUENCY: 1 pie universal winding, 575 turns no. 5/41 litz copper wire, 6.5 mh inductance ±2%; ceramic coil form; adjustable tuning, powdered iron slug, screwdriver adjustment; 21964 #C2060141G4; u/o AN/GRN-9( )	Filter p/o shaper network Figure 6-9
L1402		COIL, RADIO FREQUENCY: 1 pie universal winding, 460 turns no. 5/41 litz copper wire, 4.3 mh inductance ±2%; ceramic coil form; adjustable tuning, powdered iron slug, screwdriver adjustment; 21964 #C2060141G5; u/o AN/GRN-9( )	Filter, p/o shaper network Figure 6-9

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY-MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L1403 Cont See L1501		COIL, RADIO FREQUENCY: 1 pie universal winding, 350 turn no. 5/41 litz copper wire, 2.0 mh inductance ±2%; ceramic coil form; adjustable tuning, powdered iron slug, screwdriver adjustment; 21964 #C2060141G6; u/o AN/GRN-9( )	Filter, p/o shaper network Figure 6-3
M1401		AMMETER: DC 0 to 100 micro-ampere graduated in increments of 5; overall dim. 50 millivolt drop across terminals for full scale deflection; calibrated for use on nonmagnetic panel; self contained, MIL type MR26W100DCUAR per spec MIL-M-10304A; 21964 #A2060455-5; Same as M501	Tuning indicator Figure 3-3
M1402		VOLTMETER: DC; marked kilovolts, 0 to 1 left to right, graduated in increments of 20; round molded thermosetting compound or metal, style no. 15, MBCA Ref Dwg Group 27; 2% accuracy at full scale reading; 1 milliampere ±5% with 150 millivolts max terminal drop; MIL type #MR26W001DCKVR, per spec MIL-M-10304; 21964 #A2060455-2	DC supply voltage indicator Figure 3-3
MP1401		KNOB: pointer; black, phenolic body; MS700-18S per MIL-STD-242A; 21964 #B2132733-2; Same as MP501	Knob for S1401
MP1402		Same as MP1401	Knob for S1402
MP1403		CAP ELECTRICAL: brass; fits BNC female connectors; MIL type CW-123A/U per Navy dwg REA49050 and MIL-C-3608; 21964 no. A2141971; Same as MP504	Cover, cap and chain for J1404
MP1404		Same as MP1403	Cover, cap and chain for J1405
MP1405		Same as MP1403	Cover, cap and chain for J1408
MP1406		Same as MP1403	Cover, cap and chain for J1409
MP1407		ALIGNMENT TOOL; combination screwdriver and wrench type, 2 working ends; 0.050" screwdriver slot; 7/32" hex socket; 21964 #B2061316G1	Mounted in cover of cabinet
MP1408	1	GASKET: synthetic rubber, MIL-R-900C, class 1; style no 10, MBCA Ref Dwg Group 75; 2-15/64" dia aperture in center; three 1/8" dia holes spaced 120 deg apart on 2-7/16" dia; 2-11/16" outside dia, 1/16" thk; 21964 #B2060910; Same as MP205	Sealing for meter M1401
MP1409		Same as MP1408	Sealing for meter M1402
P1401		CONNECTOR, PLUG, ELECTRICAL: 1 round male contact; one connector mating end: BNC series; 50 ohms nom impedance, 500 v peak voltage; accommodates RG-55/U and RG58/U cables; 74868 #85000 MIL type UG-88C/U per Sig dwg #SC-D-72235; BuShips dwg #REB-49064; 21964 #A2131456; Same as P201	Cable connector on J1503 or J1506, p/o W1403
P1402		Same as P1401; p/o W1403	Cable connection on DC1401 input
P1403		Same as P1401	Cable connection on DC1401 output
P1404		Same as P1401; p/o W1401 and W1402	Cable connection on E1401

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P1405		Same as P1401; p/o W1401 and W1402	Cable connection on E1402
P1406 Cont See P1501		Same as P1401	Cable connection on J1502 or J1505 Figure 2-17
R1401		RESISTOR, FIXED, WIREWOUND: 5000 ohms ±3%; 30 watt; MIL type RH50G502H per spec MIL-R-18546A (Ship); 21964 #A2132948-9	Plate load V1401 Figure 6-9
R1402		RESISTOR, FIXED, COMPOSITION: 820,000 ohms ±5%; 1/2 watt; MIL type RC20GF824J per spec MIL-R-11; 21964 #504173	Grid resistor V1401
R1403	6	RESISTOR, FIXED, COMPOSITION: 180,000 ohms ±10%; 1/2 watt; MIL type RC20GF184K per spec MIL-R-11; 21964 #504258	Grid leak, V1402A
R1404		Not Used	
R1405		RESISTOR, FIXED, COMPOSITION: 2.7 megohm ±5%; 1/2 watt; MIL type RC20GF275J per spec MIL-R-11; 21964 #504185	Grid and voltage divider, V1402
R1406		RESISTOR, FIXED, COMPOSITION: 1.8 megohm ±5%; 1/2 watt; MIL type RC20GF185J per spec MIL-R-11; 21964 #504181	Voltage divider V1402
R1407		RESISTOR, FIXED, COMPOSITION: 220,000 ohms ±5% tolerance; 1/2 watt; MIL spec no. MIL-R-11, type RC20GF224J; 21964 #504159	Grid return V1402
R1408	6	RESISTOR, FIXED, COMPOSITION: 330,000 ohms ±10%; 2 watt; MIL type #RC42GF334K, per spec MIL-R-11; 21964 #501271	Grid bias voltage divider, V1403, V1404, V1405
R1409	6	RESISTOR, FIXED, COMPOSITION: 100,000 ohms ±10%; 1 watt; MIL type RC32GF104K per spec MIL-R-11; 21964 #503942	Grid leak resistor, V1403, V1404, V1405
R1410	6	RESISTOR, FIXED, COMPOSITION: 470 ohms ±10%; 1/2 watt; MIL type RC20GF471K per MIL-R-11; 21964 #504227; Same as R452	Parasitic suppressor V1403
R1411	6	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%; 1/2 watt; MIL type #RC20GF101K, per spec MIL-R-11; 21964 #504219; Same as R201	Screen grid dropping resistor, V1403
R1412		Same as R1411	Screen grid dropping resistor, V1403
R1413		Same as R1410	Parasitic suppressor V1404
R1414		Same as R1410	Parasitic suppressor V1405

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1415		Same as R1411	Screen grid dropping resistor, V1405
R1416		RESISTOR, FIXED, WIREWOUND: 25,000 ohms ±3%; 30 watt MIL type RH50G253H per spec MIL-R-18546A (Ships); 21964 #A2132948-6	Damping resistor T1402 secondary Figure 6-9
R1417		RESISTOR, VARIABLE: composition element; 1 section, 500 ohms ±10%; 2 watt nom power rating; linear taper MIL type RV4LAVSA501A per MIL-R-94 and MIL-STD-242 (Ships) 21964 #580004H501	Output termination, p/o shaper network Figure 2-17
R1418		RESISTOR, FIXED, WIREWOUND: 3500 ohms; ±3%; 30 watt; MIL type RH50G352H per spec MIL-R-18546A (Ships); 21964 #A2133519G2	Output termination p/o shaper network Figure 6-9
R1419		RESISTOR, FIXED, WIREWOUND: 2000 ohms ±3%; 30 watt; MIL type RH50G202H per spec MIL-R-18546A (Ships) 21964 #A2132948-8	Plate load V1402
R1420	6	RESISTOR, VARIABLE: composition element; 1 section, 250,000 ohms ±10%; 2 watt nominal power rating; linear taper; MIL type RV4LAVSA254A per MIL-R-94 and MIL-STD-242 (Ships); 21964 #580004H254; Same as R443	Grid bias adjust, V1407 Figure 2-17
R1421		Same as R1409	Grid leak resistor, V1407
R1422		Same as R1410	Grid blocking resistor, V1407
R1423		Same as R1408; u/o AN/GRN-9D	Screen grid V1407, V1411
R1424	6	RESISTOR, FIXED, COMPOSITION: 470,000 ohms ±10%; 2 watt; MIL type RC42GF474K, per spec MIL-R-11; 21964 #501273	p/o screen grid voltage divider, V1407
R1425		RESISTOR, FIXED, WIREWOUND: 2000 ohms ±5%; 10 watt; MIL type RW56G202 per spec MIL-R-26B; 21964 #535070	Cathode load V1407
R1426	6	RESISTOR, FIXED, COMPOSITION: 47 ohms ±10%; 1/2 watt; MIL type RC20GF470K per spec MIL-R-11, 21964 #504215	Shaped pulse monitoring, V1407
R1427		Same as R1405	Voltage divider V1408
R1428		RESISTOR, FIXED, COMPOSITION: 1.5 megohm ±5%; 1/2 watt; MIL type RC20GF155J per spec MIL-R-11; 21964 #504179; Same as R445	Voltage divider V1408
R1429		RESISTOR, FIXED, COMPOSITION: 150,000 ohms ±5%; 1/2 watt; MIL type RC20GF154J, per spec MIL-R-11; 21964 #504155	Voltage divider grid V1408
R1430		RESISTOR, FIXED, COMPOSITION: 68,000 ohms ±5%; 1/2 watt; MIL type RC20GF683J, per spec MIL-R-11; 21964 #504147; Same as R644	Voltage divider grid V1408

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1431		Same as R1419	Plate load, V1408B Figure 6-55
R1432	6	RESISTOR, FIXED, COMPOSITION: 1 megohm ±10%; 1/2 watt; MIL type RC20GF105K per spec MIL-R-11; 21964 #504267; Same as R432	Grid bias voltage divider, V1409
R1433	6	RESISTOR, FIXED, COMPOSITION: 100,000 ohms ±10%; 1/2 watt; MIL type RC20GF104K per spec MIL-R-11A; 21964 #504255; Same as R320; u/o AN/GRN-9D	Grid leak resistor, V1409
R1434		Not Used	
R1435	6	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%; 1/2 watt; MIL type RC20GF332K per spec MIL-R-11; 21964 #504237; Same as R417	Grid blocking, V1409A
R1436		Same as R1430	Grid leak, V1409
R1440		Same as R1435	Grid blocking, V1409B
R1441		RESISTOR, FIXED, FILM: 1.47 megohm ±1%; 1 watt; MIL type RN-75B1474F, per spec MIL-STD-242A and MIL-R-10509; 21964 #A2060501-1	1000 v DC metering shunt
R1442		Same as R1441	1000 v DC metering shunt
R1443		RESISTOR, FIXED, WIREWOUND: 1 megohm ±0.5%; JAN type MFC105, per spec JAN-R-29; 21964 #A2142503-1	Meter multiplier M1402 Figure 2-17
R1444	6	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%; 1/2 watt; MIL type RC20GF272K per spec MIL-R-11; 21964 #504236; Same as R309	Delay line termination: DL1401
R1445		RESISTOR, FIXED, FILM: 750,000 ohms ±1%; 1 watt; MIL type RN75B7503F per MIL-STD-242A and MIL-R-10509; 21964 #A2060501-2	1000 v DC meter multiplier
R1446		Same as R1419	Plate load V1402B Figure 6-9
R1448		RESISTOR, FIXED, FILM: 464,000 ohms ±1%; 1 watt; MIL type RN75B4643F per MIL-STD-242A and MIL-R-10509; 21964 #A2060501-3	Voltage divider, V1410 grid
R1449		RESISTOR, FIXED, FILM: 649,000 ohms ±1%; 1 watt; MIL type RN75B6493F per MIL-STD-242A and MIL-R-10509; 21964 #A2060501-4	Voltage divider, V1410 grid

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1450	6	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%; 1 watt; MIL type RC32GF101K, per spec MIL-R-11; 21964 #503906	Plate dropping, V1410A
R1451		Same as R1450	Plate dropping, V1410B
R1452	6	RESISTOR, FIXED, COMPOSITION: 33,000 ohms ±10%; 2 watt; MIL type RC42GF333K per spec MIL-R-11; 21964 #501259; Same as R407	Cathode load, V1410
R1453		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; MIL type RW59V281 per spec MIL-R-26C; 21964 #A2132711-01; Same as R520	Current limiting, DS1401
R1454		RESISTOR, FIXED, WIREWOUND: 120 ohms ±5%; 5 watt; MIL type RW55G121 per spec MIL-R-26; 21964 #531704	Voltage dropping, DS1402
R1455		Same as R1454	Voltage dropping, DS1403
R1456	6	RESISTOR, FIXED, COMPOSTION: 4,700 ohms ±10%; 1/2 watt; MIL type RC20GF472K per spec MIL-R-11; 21964 #504239; Same as R339	Current limiting resistor for M1401
R1457		RESISTOR, FIXED, WIREWOUND: 310 ohms ±5%; 5 watt; MIL type RW55G311 per spec MIL-R-26C; 21964 #531712; u/o AN/GRN-9D	B+ voltage divider bias for RF amplifier Figure 6-55
R1458	6	RESISTOR, FIXED, COMPOSITION: 330 ohms ±10%; 1 watt; MIL type RC32GF331K, per spec MIL-R-11; 21964 #503912; u/o AN/GRN-9D	Cathode resistor V1409
R1459	6	RESISTOR, FIXED, COMPOSITION: 1,000 ohms ±10%; 1 watt; MIL type RC32CF102K per spec MIL-R-11; 21964 #503918; u/o AN/GRN-9D	Terminating resistor for T1404
R1460		RESISTOR, FIXED, WIREWOUND: inductive winding; 3500 ohms ±5%; 18 watt; MIL type #RW33G352 per spec MIL-R-26C; 21964 #531016; u/o AN/GRN-9D	B+ voltage divider, bias for final amplifier Figure 6-55
R1461	6	RESISTOR, FIXED, COMPOSITION: 33 ohms ±10%; 1/2 watt; MIL type RC20GF330K, per spec MIL-R-11; 21964 #504213; Same as R701	Parasitic suppressor plate V1408
R1462		Same as R1461	Parasitic suppressor plate V1408
R1463		Same as R1461	Parasitic suppressor grid V1408
R1464		Same as R1461	Parasitic suppressor grid V1408

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1465		Same as R1420	Grid resistor V1401 Figure 2-17
R1466	6	RESISTOR, VARIABLE: composition element; 1 section, 0.10 megohms, ±10%; 2 watt nominal power rating; no switch MIL type RV4LAVSA104A per MIL-R-94 and MIL-STD-242 (Ships); 21964 #580004H104; Same as R672	Grid leak V1402 Figure 2-17
R1467	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 2 watt; MIL type RC42GF473K, per spec MIL-R-11; 21964 #501261 u/o AN/GRN-9D	Shaper network termination
R1468		RESISTOR, FIXED, WIREWOUND: 3,100 ohms total resistance ±3%; 30 watt; MIL type RH50G312H per spec MIL-R-18546B (Ships); 21964 #A2133519G1	Plate load V1402 Figure 6-9
R1469		Same as R1430	Voltage divider grid V1402
R1470	6	RESISTOR, VARIABLE: composition element; 1 section 50,000 ohms, ±10%; 2 watt nominal power rating; no. switch; MIL type RV4LAVSA503A per spec MIL-R-94 and MIL-STD-242 (Ships); 21964 #580004H503; Same as R1310; u/o AN/GRN-9D	Shaper network termination Figure 2-17
R1471		Same as R1470 of AN/GRN-9D 1; u/o AN/GRN-9D	p/o compensating network Figure 2-17
R1472		Same as R1410; u/o AN/GRN-9D	Parasitic suppressor grid V1411
R1473		Same as R1408; u/o AN/GRN-9D	Screen voltage divider V1411
R1474 Cont See R1501		Same as R1447; u/o AN/GRN-9D	Blanking pulse output termination V1409
S1401	.	SWITCH ROTARY: 2 sections; 1 pole, 9 positions each section; 2 rotor contacts, 20 fixed contacts; rotor and fixed contacts solid non-shorting type; 76854 type DHC per 21964 #B2060222	Selector for M1401 Figure 3-3
S1402		SWITCH, ROTARY: 2 sections; 1 pole, 5 positions each section; 2 rotor contacts, 12 fixed contacts; non-shorting type; 76854 type DHC per 21964 #B2060034	Selector for M1402 Figure 3-3
T1401		Not Used	
T1402		TRANSFORMER, PULSE: 2 windings; primary, negative rectangular pulse 2.5 microseconds wide and 800 v amplitude at 2% duty cycle from source impedance of 500 ohms; secondary, 1350 v positive pulse across 1400 ohm load when 800 v negative pulse is impressed on primary; primary inductance 15.8 mh ±2%, secondary inductance 45.5 mh ±2%, primary 2.5 ohms; secondary 10.2 ohms; 49956 #363-2372G1 MIL type TF1SX32YY per MIL-T-27A; 21964 #A1069956	Pulse transformer, plates of V1403, V1404, V1405 to shaper network Figure 6-55

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T1403		TRANSFORMER, POWER STEPDOWN: 120 v AC, 60 cycles, single phase; 1 output winding, secondary 6.4 v 10.5 amp; 49956 #292-5620G1 MIL type TF1SX01JB per spec MIL-R-27A; 21964 #A1069615	Filament supply, V1401, V1402, V1403, V1405, V1406, V1408, V1409 Figure 6-55
T1404 Cont See T1501		TRANSFORMER, PULSE: interstage type; 75 v DC primary operating voltage, 19 ma; 25 v DC secondary operating voltage, 25 ma; 1000 v DC insulation voltage; 49956 #363-2098GI; MIL type TF1RX36YY per spec MIL-R-27; 21964 #A2061755; u/o AN/GRN-9D only	Pulse transformer plate load for V1409 Figure 6-55
TB1		TERMINAL BOARD: 9 terminals; single row, solid studs; per 21964 #B1069957G1	Component board
TB2		TERMINAL BOARD: 9 terminals; single row, solid studs; per 21964 #B1069957G2	Component board
TB1401		TERMINAL BOARD: 8 terminals; single row, thru type terminals; MIL type 7TB8 per MIL-T-16784A and NAVY dwg 9000-S6505G-73214; 21964 #A2133072-1; Same as TB501	AC power input
TB1402		Same as TB1401	DC power input
TB1403	6	TERMINAL BOARD: 18 terminals; double screw type; barrier type; 18 studs; MIL type 10T-B18 per MIL-T-16784; and NAVY dwg 9000-S6505G73214; 21964 #A2133248-3	Terminal board for video assy Figure 6-9
TB1404 thru TB1493		Not Used	
TB1494	2	TERMINAL BOARD: 12 solder stud type terminals; 21964 #B2061873G1	Mounted in video assy
TB1495	2	TERMINAL BOARD: 8 hollow solder stud type terminals; 00781 #12856; 21964 #355637	Mounts resistors R1535, R1536
TB1496	2	TERMINAL BOARD: 10 solder stud type terminals; 21964 #B2060776G1	Mounted in video assy
TB1497	2	TERMINAL BOARD: 26 solder stud type terminals; 21964 #B2061718G1; u/o AN GRN-9D	Mounted in video assy Figure 6-9
TB1498	2	TERMINAL BOARD: 26 solder stud type terminals; 21964 #B2060773G1	Mounted in video assy Figure 6-9
TB1499	2	TERMINAL BOARD: 12 solder stud type terminals; 21964 #B2060722G1	Mounted in video assy Figure 6-9
V1401		ELECTRON TUBE: MIL type 5814A per spec MIL-E-1C; 21964 #701164	p/o gate pulse multivibrator Figure 6-55

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
V1402		ELECTRON TUBE: twin triode; MIL type 5687WA per MIL spec MIL-E-1 (Navy); 21964 #A2133281; Same as V606	Pulse widener Figure 6-55
V1403		ELECTRON TUBE: MIL type 6293 per spec MIL-E-1C; 21964 #701259	Pulse amplifier Figure 2-17
V1404		Same as V1403	Pulse amplifier Figure 6-55
V1405		Same as V1403	Pulse amplifier Figure 6-55
V1406		ELECTRON TUBE: high vacuum half wave rectifier; RMA type T6-1/2; MIL type 6 V3A per spec MIL-E-1C; 21964 #A2132479	Pulse undershoot damper Figure 6-55
V1407		Same as V1403	Cathode follower Figure 2-17
V1408		Same as V1402	p/o gate pulse multivibrator Figure 6-55
V1409		Same as V1402	Cathode follower Figure 6-55
V1410		Same as V1402	Voltage divider Figure 6-55
V1411 Cont See V1501		Same as V1403; u/o AN/GRN-9D	Voltage divider Figure 2-17
W1401		Not Used	
W1402		Not Used	
W1403	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield, type RG-141/U; incl 2 MIL type connectors, P1401 and P1402, one located on each end, per 21964 dwg #B2060996G1	Connects J1503 to P1403
W1404 thru W1407		Not Used	
W1408	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric, single silver coated copper shield type RG-141/U; incl 2 MIL type connectors, P1403 and J1407, one located on each end, per 21964 #B2061035G1	Connects P1402 to P920
W1409		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
W1410	8	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial, 50 ohms nom impedance, inner conductor no. 19 AWG copper covered steel, teflon dielectric single silver coated copper shield, type RG-141/U; incl 2 MIL type connectors, P1406 and J1410, one locatedon each end, per 21964 dwg #B2060879G1	Connects output of Coder-Indicator to video assy
XDS1401		LIGHT, INDICATOR: friction mtg lens holder; 125 v, 6 watts; enclosed frame; steel shell; black nickel; MIL type LH63PW3 per MIL-L-3661, dwg MS-90286; 21964 dwg #A2133069-5; Same as XDS501	Holder for DS1401
XDS1402		LIGHT, INDICATOR: supplied w/lens, nominal voltage rating 28 v; MIL type LH62PW2 per MIL-L-3661 and MS90287; 21964 #A2133051-2	Holder for DS1402
XDS1403		Same as XDS1402	Holder for DS1403
XF1401		FUSEHOLDER: extractor post type; accommodates 2 fuses, 1-1/4" lg by 1/4" dia; blown fuse indicating type; sealed; MIL type FHL10G per BuShips dwg #9000-S6202-74228 and MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Holder for F1401, F1404
XF1402		Same as XF1401	Holds F1402 and F1403
XV1401		SOCKET, ELECTRON TUBE: 9 contacts, brass, nickel plated; miniature; JAN type #TS103P01, per spec JAN-S-28A-1; 21964 #740004; Same as XV307	Socket for V1401
XV1402		Same as XV1401	Socket for V1402
XV1403	6	SOCKET, ELECTRON TUBE: 8 contacts, copper base, silver plated, small body, JAN type TS101P01 per spec JAN-S-28A; 21964 #740000	Socket for V1403
XV1404		Same as XV1403	Socket for V1404
XV1405		Same as XV1403	Socket for V1405
XV1406		Same as XV1401	Socket for V1406
XV1407		Same as XV1403	Socket for V1407
XV1408		Same as XV1401	Socket for V1408
XV1409		Same as XV1401	Socket for V1409
XV1410		Same as XV1401	Socket for V1410
XV1411 Cont See XV1501		Same as XV1403; u/o AN/GRN-9D	Socket for V1411

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
Z1401	2	SUPPRESSOR, PARASITIC: network; 1.9 μh ±10% at 7.9 mc; coil 24 turns of #22 wire, wound on 10 ohm, 2 watt resistor (RC42GF100K); 21964 #B2060124	Parasitic suppressor V1403 Figure 6-55
Z1402		Same as Z1401	Parasitic suppressor V1404 Figure 6-55
Z1403		Same as Z1401	Parasitic suppressor V1405 Figure 6-55
Z1404		Same as Z1401	Parasitic suppressor V1407 Figure 6-55
Z1405 Cont See Z1501		Same as Z1401; u/o AN/GRN-9( )	Parasitic suppressor V1411 Figure 6-55
C1501	6	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 $\mu\mu$f ±50%; -20% tolerance, 500 v DC working; 72982 2443-01-000 with hex nut; 21964 #B2132685-1	Feedthru bypass 150 v DC
C1502		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 820 $\mu\mu$f +100% -20% 500 v DC working; Temp Coef N/R; MIL type CK60Y821Z, per MIL-C-11015A; for electrical performance only: 21964 part #625020H821; Same as C305	Bypass, plate supply, V1501B
C1503		Same as C1502	Bypass, plate supply, V1501A
C1504		Same as C1502	Coupling, V1501A plate to V1501B grid
C1505		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 47 $\mu\mu$f, ±2%, 500 v DC working: JAN CC21UJ470G per JAN-C-20A; 21964 dwg #A9142374-5; Same as C217	Coupling, V1501B to V1502
C1506		Same as C1502	DC blocking between cathode of V1501
C1507		Same as C1501	Feedthru bypass, to DS1403
C1508		Same as C1501	Feedthru bypass, 24 v AC
C1509		Same as C1501	Feedthru bypass, to DS1402
C1510		Same as C1501	Feedthru bypass, V1501A metering
C1511		Same as C1501	Feedthru bypass, V1501B metering
C1512		Same as C1502	Bypass V1502 cathode
C1513		Same as C1502	Bypass V1502 cathode

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1514		Same as C1502	Coupling, V1502 to V1503
C1515		Same as C1502	Screen grid bypass, V1502
C1516		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 15 μμf ±2%; 500 v DC working; temp coefficient SH; JAN type CC21-SH150G per JAN-C-20A; 21964 dwg #A2132736-03	Plate neutralizing, V1502
C1517		CAPACITOR, FIXED, MICA DIELECTRIC: 1000 μμf ±20% 300 v DC working; -100 to +100 parts/million Deg. C; MIL type CB11RB102M per MIL-C-10950A; 21964 part #615361	Feedthru bypass, plate supply, V1503
C1518		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 22 μμf, ±2%, 500 v DC working; JAN type CC21UJ220G per JAN-C-20A; 21964 dwg #A2132735-06	Coupling, V1503 to Z1507
C1519		CAPACITOR, VARIABLE, AIR DIELECTRIC: plate meshing type, 1 section, 5.1 μμf ±20% max., 1.5 μμf ±20% min.; each section straight line capacity; 1250 v AC peak voltage; screwdriver adjustment; 180° CW rotation; CEJ type 5M11, per JAN-C-92; 21964 dwg #A2060185	Plate tuning V1503 Figure 2-18
C1520		Same as C1502	Cathode bypass V1503
C1521		Same as C1501	Feedthru bypass V1502 metering
C1522		CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: rotary type, single section; 7 to 45 μμf; 500 v DC working; screwdriver slot adjustment; MIL type CV11C450 per MIL-C-81; 21964 part #670006	Trimmer V1504 input Figure 2-18
C1523		Same as C1502	Bypass, V1507A plate supply
C1524		Same as C1502	Bypass, V1507B plate supply
C1525		Same as C1502	Coupling, V1507A to V1507B
C1526		Same as C1505	Coupling, V1507 to V1508
C1527		Same as C1502	DC blocking between cathodes of V1507
C1528		Same as C1502	Cathode bypass V1508
C1529		Same as C1502	Cathode bypass V1508
C1530		Same as C1502	Bypass screen grid V1508
C1531		Same as C1502	Coupling, V1508 to V1509
C1532		Same as C1516	Plate neutralizing V1508

TABLE 7-3. RADIO SET AN/GRN-9D. MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1533		Same as C1517	Feedthru pybass V1509 plate supply
C1534		Same as C1505	Coupling, V1509 to Z1508
C1535		Same as C1502	Cathode bypass V1509
C1536		Same as C1519	Plate tuning V1509 Figure 2-18
C1537		Same as C1522	Trimmer V1510 Figure 2-18
C1538		Same as C1501	Feedthru bypass 6.3 v AC
C1539		Same as C1502	Filament bypass V1501
C1540		Same as C1502	Filament bypass V1502
C1541		Same as C1502	Filament bypass V1503
C1542		Same as C1501	Feedthru bypass 6.3 v AC
C1543		Same as C1502	Filament bypass V1507
C1544		Same as C1502	Filament bypass V1508
C1545		Same as C1502	Filament bypass V1509
C1546		Same as C1517	Feedthru bypass V1504 filament
C1547		Same as C1517	Feedthru bypass V1504 filament
C1548		Same as C1517	Feedthru bypass V1505 filament
C1549		Same as C1517	Feedthru bypass V1505 filament
C1550		Same as C1517	Feedthru bypass V1506 filament
C1551		Same as C1517	Feedthru bypass V1506 filament
C1552		Same as C1517	Feedthru bypass V1510 filament
C1553		Same as C1517	Feedthru bypass V1510 filament
C1554		Same as C1517	Feedthru bypass V1511 filament

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1555		Same as C1517	Feedthru bypass V1511 filament
C1556		Same as C1517	Feedthru bypass V1512 filament
C1557		Same as C1517	Feedthru bypass V1512 filament
C1558		Same as C1505	Coupling Z1507 to V1504
C1559		Same as C1505	Coupling Z1508 to V1510
C1560		Same as C1501	Feedthru bypass 24 v AC
C1561		Same as C1501	Feedthru bypass to DS1403
C1562		Same as C1501	Feedthru bypass to DS1402
C1563		Same as C1501	Feedthru bypass V1507A metering
C1564		Same as C1501	Feedthru bypass V1507B metering
C1565		Same as C1501	Feedthru bypass V1508 metering
C1566		Same as C1501	Feedthru bypass 150 v DC
C1567		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 μf, ±10%; 200 v DC working; MIL type CP05A1KC104K per spec MIL-C-25/A; 21964 part #644149; Same as C345	Cathode bypass V1510
C1568		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 μμf, ±20%, 500 vdc, per MIL-C-19321, 21964 #A1068959; Same as C201	Bypass for RF choke V1504 plate supply
C1569		Same as C1568	Bypass for RF choke V1504 plate supply
C1570		Same as C1568	Bypass for RF choke V1501A metering
C1571		Same as C1568	Bypass for RF choke V1501B metering
C1572		Same as C1568	Bypass for RF choke V1502 metering
C1573		Same as C1568	Bypass for filament choke V1506

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1574		Same as C1568	Bypass for filament choke V1506
C1575		Same as C1568	Bypass for filament choke V1505
C1576		Same as C1568	Bypass for filament choke V1505
C1577		Same as C1568	Bypass for filament choke V1504
C1578		Same as C1568	Bypass for filament choke V1504
C1579		Same as C1568	Bypass for filament choke V1501, V1502, V1503
C1580		Same as C1568	Bypass for filament supervisory choke
C1581		Same as C1568	Bypass for filament supervisory choke
C1582		Same as C1568	Bypass for RF choke crystal heater
C1583		Same as C1568	Bypass for RF choke crystal heater
C1584		Same as C1568	Bypass for RF choke crystal heater
C1585		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100 $\mu\mu$f, +80% -20%, 1000 v DC; per MIL-C-19321, 21964 #A1068960	RF bypass
E1501	5	SHIELD, ELECTRON TUBE: JAN type TS103U01 per JAN-S-28A, modified; 21964 #A2132988-4; Same as E404	Shield for V1501
E1501A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U01; MIL-STD-242A type #901; 21964 #A2132886-4; Same as E404A	Insert for shield E1501
E1502	5	SHIELD, ELECTRON TUBE: JAN type TS-102U01 per JAN-S-28A, modified 21964 #A2132988-1; Same as E201	Shield for V1502
E1502A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U01; MIL-STD-242A type #701; 21964 #A2132886-1; Same as E201A	Insert for shield E1502
E1503	6	SHIELD, ELECTRON TUBE: JAN type TS102U02 per JAN-S28A, modified 21964 #A2132988-2; Same as E202	Shield for V1503
E1503A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U02; MIL-STD-242A type #702 21964 #A2132886-2; Same as E202A	Insert for shield E1503
E1504		Same as E1501	Shield for V1507
E1504A		Same as E1501A	Insert for shield E1504

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1505		Same as E1502	Shield for V1508
E1505A		Same as E1502A	Insert for shield E1505
E1506		Same as E1503	Shield for V1509
E1506A		Same as E1503A	Insert for shield E1506
HR1501		OVEN, CRYSTAL: for crystal unit MIL type CR-32/U in MIL type HC-6/U holder; oven temperature 75°C, ambient temperature ranges -54°C to +75°C ±5°C tolerance and -25°C to +75°C ±2°C tolerance, 24 v AC, 60 cycles, single phase, 36 volt-amperes 84678 #HOD 0-2, 21964 #1068981 (p/o Z1516)	Oven for Y1501 RF assy high band
HR1502		Same as HR1501; (p/o Z1515)	Oven for Y1502 RF assy low band
J1501		Not Used	
J1502		CONNECTOR, RECEPTACLE: 1 contact, round female straight type, metal, polarized; RF connector, 50 ohms nom impedance, MIL type UG-1094/U BNC series, Navy dwg REB49063, modified 21964 #B2060628G-1	V1504 local oscillator freq. output Figure 6-56
J1503		CONNECTOR, RECEPTACLE ELECTRICAL: 1 contact, round female 90° type, 21964 #B2060086	To P1401 Figure 6-4
J1504		Not Used	
J1505		Same as J1502	V1510 local oscillator freq. output Figure 6-56
J1506		Same as J1503	To P1401 Figure 6-4
J1507		CONNECTOR, RECEPTACLE, ELECTRICAL: contains parasitic suppressor assembly, sealed c/o two uninsulated RF chokes (Z1509) mtd on board assy, plug, insulator and probe; coil data, 10 uh at 40 mc, 0.60 ohms DC resistance, 750 ma; 21964 #B2060814G1	To P1503
J1508		CONNECTOR, RECEPTACLE, ELECTRICAL: Same as J1507 except for reference symbol marking on case; 21964 #B2060814G2	To P1503
J1509		CONNECTOR, RECEPTACLE, ELECTRICAL: 24 male contacts; one connector mating end; 5 amps, 800 v DC; 02660 #26-4401-24P; 21964 #B2132197-14	Power cable connector high band RF chassis Figure 6-56

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
J1510		Same as J1509	Power cable connector, low band RF chassis Figure 6-56
L1501		COIL, RADIO FREQUENCY: 2,000 ma DC current rating; 0.22 microhenries ±20%; 0.04 max DC resistance; wire lead type; B2142 #10100-22; 21964 #A2130069-6	RF choke +150 v DC
L1502		COIL, RADIO FREQUENCY: single layer close wound, winding 14 turns no. 30R2 AWG wire, 0.86 μh to 1.15 μh inductance; ceramic coil form; adjustable tuning, powdered iron slug, screw-driver adjustment 21964 #C2060131G1	Plate tuning V1501A Figure 2-18
L1503		COIL, RADIO FREQUENCY: single layer close wound winding, 6 turns no. 27R2 AWG wire, 0.237 μh to 0.295 μh inductance; ceramic coil form; adjustable tuning, powdered iron slug, screw-driver adjustment; 21964 #C2060131G2	Plate tuning V1501B Figure 2-18
L1504		COIL, RADIO FREQUENCY: 1000 ma DC current rating; 1.0 uh ±20%; 0.3 ohms max DC resistance; cylindrical shape; wire lead type; 82142 #10100-30; 21964 #A2132611-3	Parasitic suppressor in cathode circuit of V1501
L1505		Not Used	
L1506		Same as L1501	RF choke V1502 screen grid supply
L1507		Same as L1501	RF choke V1503 plate supply
L1508		COIL, RADIO FREQUENCY: 550 ma DC current rating; 2.2 μh, ±20% tolerance; 1.10 max DC resistance; wire lead type; B2142 #10100-34; 21964 #A2130069-9	RF choke in screen circuit of V1502
L1509		COIL, RADIO FREQUENCY: single layer close wound winding, 4 turns no. 23R2 AWG wire, 0.129 μh to 0.150 μh inductance; ceramic coil form; adjustable tuning, powdered iron slug, screw-driver adjustment; 21964 #C2060131G3	Plate tuning V1502 Figure 2-18
L1510		Same as L1504	RF choke V1503 plate supply
L1511		Same as L1508	RF choke V1503 cathode
L1512		Same as L1501	RF choke +150 v DC
L1513		COIL, RADIO FREQUENCY: single layer close wound winding; 17 turns no. 30R2 AWG wire, 1.12 μh to 1.42 μh inductance; ceramic coil form; adjustable tuning, powdered iron slug, screw-driver adjustment 21964 C2060131G4	Plate tuning V1507A Figure 2-18

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L1514		COIL, RADIO FREQUENCY: single layer close wound winding; 8 turns no. 27R2 AWG wire, 0.345 μh to 0.43 μh inductance; ceramic coil form; adjustable tuning, powdered iron slug, screw-driver adjustment; 21964 #C2060131G5	Plate tuning V1507B Figure 2-18
L1515		Same as L1504	Spurious oscillator suppressor V1507
L1516		Same as L1501	RF choke V1508 screen grid supply
L1517		Same as L1501	RF choke V1509 plate supply
L1518		Same as L1508	RF choke V1508 plate supply
L1519		COIL, RADIO FREQUENCY: single layer close wound winding, 6 turns no. 23R2 AWG wire, 0.198 μh to 0.237 μh inductance; ceramic coil form; adjustable tuning, powdered iron slug, screw-driver adjustment 21964 #C2060131G6	Plate tuning V1508 Figure 2-19
L1520		Same as L1504	RF choke V1509 plate supply
L1521		Same as L1508	RF choke V1509 cathode
L1522		Same as L1501	Filament choke V1501
L1523		Same as L1501	Filament choke V1502
L1524		Same as L1501	Filament choke V1503
L1525		Same as L1501	Filament choke V1507
L1526		Same as L1501	Filament choke V1508
L1527		Same as L1501	Filament choke V1509
L1528		Same as L1508	RF choke V1501A metering
L1529		Same as L1504	RF choke V1502 metering
L1530		Same as L1508	RF choke V1501B metering

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L1531 thru L1534		Not Used	
L1535		Same as L1508	RF choke V1507A metering
L1536		Same as L1508	RF choke V1507B metering
L1537		Same as L1508	RF choke V1508 metering
L1538	4	COIL, RADIO FREQUENCY: 10 μh inductance; p/o Z1509	p/o Z1509
L1539		Same as L1538; p/o Z1509	p/o Z1509
L1540		Same as L1538; p/o Z1510	p/o Z1510
L1541		Same as L1538; p/o Z1510	p/o Z1510
L1542		COIL, RADIO FREQUENCY: 2100 ma DC current rating; 22 μh, ±20%; .04 max DC resistance; MIL type LT7K126, per MIL-C-15305A and MS75008; 21964 #866001H228	RF choke V1506 plate supply
L1543		Same as L1542	RF choke V1504 plate supply
L1544		Same as L1542	RF choke +150 v DC
L1545		Same as L1542	RF choke V1501A metering
L1546		Same as L1542	RF choke V1501B metering
L1547		Same as L1542	RF choke V1502 metering
L1548		Same as L1542	Filament choke V1506

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L1549		Same as L1542	Filament choke V1506
L1550		Same as L1542	Filament choke V1505
L1551		Same as L1542	Filament choke V1505
L1552		Same as L1542	Filament choke V1504
L1553		Same as L1542	Filament choke V1504
L1554		Same as L1542	Filament choke V1501, V1502, V1503
L1555		Same as L1542	Filament supervisory choke
L1556		Same as L1542	Filament supervisory choke
L1557		Same as L1542	RF choke crystal heater
L1558		Same as L1542	RF choke crystal heater
L1559		Same as L1542	RF choke crystal heater
P1501		Not Used	
P1502		Not Used	
P1503		CLIP, ELECTRICAL: #2, over all length 1", width 3/8", phosper bronze, nickel plate, 72307 #2, 21964 #A2140562	To J1507 or J1508

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
P1504		CONNECTOR, PLUG, ELECTRICAL: 24 female contacts; one connector mating end; 5 amps, 800 v DC; 0.5625" dia max cable accommodated; 02660 #26-4301-24S; 21964 #B2132687-2	Main power plug for RF chassis
R1501	6	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±10%; 1/2 watt; MIL type RC20GF223K per MIL-R-11; 21964 #504247; Same as R604	Voltage dropping V1501A plate
R1502		Same as R1411	Cathode bias, V1501A
R1503	6	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10% tolerance; 1/2 watt; MIL type RC20GF221K per spec MIL-R-11; 21964 #504223; Same as R208	Cathode bias, V1501B
R1504	6	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±10%; 1/2 watt; MIL type RC20GF472K per spec MIL-R-11; 21964 #504239; Same as R339	Grid leak V1501B
R1505		Same as R1410	Meter shunt V1501A
R1506		Not Used	
R1507	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±10%; 1/2 watt; MIL type RC20GF473K, per spec MIL-R-11; 21964 #504251; Same as R425	Grid leak, V1502
R1508	6	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±10%; 1/2 watt; MIL type RC20GF222K per spec MIL-R-11; 21964 #504235; Same as R207	Metering shunt, V1501B
R1509		Not Used	
R1510		Same as R1503	Cathode bias, V1502
R1511		Same as R1410	Cathode bias, V1503
R1512		Not Used	
R1513	6	RESISTOR, FIXED, COMPOSITION: 22 ohms, ±10%; 1/2 watt; MIL type RC20GF220K per spec MIL-R-11; 21964 #504211	Metering shunt, V1502
R1514 thru R1517		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1518		Same as R1501	Voltage dropping V1507A plate
R1519		Same as R1411	Cathode bias, V1507A
R1520		Same as R1503	Cathode bias, V1507B
R1521		Same as R1504	Grid leak V1507B
R1522		Same as R1507	Grid leak, V1508
R1523		Same as R1503	Cathode bias, V1508
R1524		Same as R1410	Cathode bias, V1509
R1525 thru R1527		Not Used	
R1528		Same as R1410	Cathode bias, V1504 or V1510
R1529		Not Used	
R1530		Same as R1426	Cathode bias, V1505 or V1511
R1531		Not Used	
R1532	6	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%; 1/2 watt; MIL type RC20GF100K per spec MIL-R-11; 21964 #504207; Same as R334	Cathode bias, V1506 or V1512
R1533	6	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±10%; 1/2 watt; MIL type RC20GF224K per spec MIL-R-11; 21964 #504259: Same as R304	Meter multiplier, V1504 or V1510 tuning
R1534	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%, 1/2 watt; MIL type RC20GF103K per spec MIL-R-11; 21964 #504243; Same as R404	Meter multiplier V1505 or V1511 tuning
R1535		Same as R1410	Meter multiplier V1501 or V1507 tuning

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1536		Same as R1508	Meter multiplier V1502 or V1508 tuning
R1537		Same as R1513	Cathode resistor V1509
T1501		TRANSFORMER, POWER, STEPDOWN: 120 v AC, 60 cycles, single phase; #1 secondary 6.4 v 1.5 amp, #2 secondary 6.4 v 1.0 amp, #3, #4, and #5 secondary 5.5 v 1.1 amp each; 49956 #292-5621G1; MIL type TF1SX01KA per MIL-T-27A; 21964 #A1069535	Filament supply, V1407, V1501, V1502, V1503, V1504, V1505, V1506, V1507, V1508, V1509, V1510, V1511, V1512 Figure 2-17
T1502		TRANSFORMER, POWER, STEPDOWN: 120 v AC, 60 cycles, single phase; secondary 24 v 1.6 amp; 49956 #292-6020G2; MIL type TF1SX01GA per MIL-T-27A; 21964 #A1069537	Heater supply, HR1501, HR1502 Figure 2-17
T1503		TRANSFORMER, POWER STEPDOWN: primary 120 v AC, 60 cycles, single phase; secondary 6.3 v, 2.5 amps; 49956 #292-5622G1 MIL type TF1SXO1FA per spec MIL-T-27A; 21964 #A1069867 u/o AN/GRN-9D	Filament supply Figure 2-17
V1501		ELECTRON TUBE: dual triode; MIL type 5670 per spec MIL-E-1C; 21964 #700563; Same as V404	Oscillator, frequency doubler Figure 2-18
V1502		ELECTRON TUBE: pentode; MIL type #5654/6AK5W per spec MIL-E-1C; 21964 #700561; Same as V201	Frequency doubler Figure 2-18
V1503		ELECTRON TUBE: triode; MIL type #6J4WA, per spec MIL-E-1 (Navy) 21964 #A2133316; Same as V202	Frequency doubler Figure 2-18
V1504		ELECTRON TUBE: triode; MIL type 2C39A per MIL-E-1C; 21964 #700043	Frequency tripler Figure 2-18
V1505		Same as V1504	RF amplifier Figure 2-18
V1506		Same as V1504	RF amplifier Figure 2-18
V1507		Same as V1501	Oscillator, frequency doubler Figure 2-18
V1508		Same as V1502	Frequency doubler Figure 2-18
V1509		Same as V1503	Frequency doubler Figure 2-18
V1510		Same as V1504	Frequency tripler Figure 2-18
V1511		Same as V1504	RF amplifier Figure 2-18
V1512		Same as V1504	RF amplifier Figure 2-18

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XHR1501	6	SOCKET, ELECTRON TUBE: 8 contacts, beryllium, silver plated; octal dual shaped, JAN type TS101P02 per spec JAN-S-28A; CMG 51B16758; 21964 #740031; Same as XV501	Socket for HR1501
XHR1502		Same as XHR1501	Socket for HR1502
XR1501 thru XR1568		Not Used	
XR1569		CLIP, ELECTRICAL: ferrule style no. 5, MBCA Ref Dwg Group 37; beryllium copper, nickel plated; similar to 95114 13-16-CN; 21964 #A2141510	Holder for R1569
XR1570		Same as XR1569	Holder for R1569
XR1571		Same as XR1569	Holder for R1443
XR1572		Same as XR1569	Holder for R1443
XV1501		Same as XV1401	Socket for V1501 Figure 6-4
XV1502	6	SOCKET, ELECTRON TUBE: 7 contacts, brass, nickel plated; miniature; JAN type #TS102P01 per spec JAN-S-28A-1; 21964 #740002; Same as XV308	Socket for V1502 Figure 6-4
XV1503		Same as XV1502	Socket for V1503 Figure 6-4
XV1504 thru XV1506		Not Used	
XV1507		Same as XV1401	Socket for V1507 Figure 6-4
XV1508		Same as XV1502	Socket for V1508 Figure 6-4
XV1509		Same as XV1502	Socket for V1509 Figure 6-4
Y1501		* CRYSTAL UNIT, QUARTZ: 1 crystal plate; MIL crystal holder type no. HC-6/U, MIL type #CR-65/U per spec MIL-C-21240 21964 #A1068962-1; (p/o Z1516)	Crystal oscillator, frequency determining; RF assy high band Figure 6-4
Y1502		* Same as Y1501; (p/o Z1515)	Crystal oscillator frequency determining; RF assy low band
		* Frequency depends upon channel assignment. Requisition must state channel or crystal frequency and reference crystal type and equipment application.	Figure 6-4

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
Z1501	8	CAVITY ASSEMBLY, TUNED: c/o Z1501A and Z1501B (For Reference Only)	Figure 6-56
Z1501A		CAVITY, TUNED: coaxial input frequency 383.67 mc to 404.25 mc, output frequency 1151 mc to 1213 mc; brass, silver plated, rhodium finish; power take-off from coupling loop; manual tuning by dielectric slug; lower section, high band; c/o C1546, C1547, Z1511, Z1512; 21964 dwg #B2060127-1	Tripler (high band) lower section
Z1501B		CAVITY, TUNED: c/o plunger, electron tube type 2C39A (V1504), tube retainer, anode clamp, anode contact, and an insulator cap; upper section; high band; 21964 #A2061886G1	Tripler, (high band) upper section
Z1502	8	CAVITY ASSEMBLY, TUNED: c/o Z1502A and Z1502B (For Reference Only)	Figure 6-56
Z1502A		CAVITY, TUNED: coaxial; input and output frequency range, 1151 mc to 1213 mc; brass, silver plated, rhodium finish; power take-off from coupling loop; manual tuning by dielectric slug; lower section; high band 21964 dwg #A2060039-1	1st amplifier (high band) lower section
Z1502B		CAVITY, TUNED: c/o plunger, electron tube type 2X39A (V1505), tube retainer, anode clamp, anode contact, insulator cap; upper section; high band; 21964 #A2061886G2	1st amplifier, (high band) upper section
Z1503	8	CAVITY ASSEMBLY, TUNED: c/o Z1503A and Z1503B (For Reference Only)	Figure 6-56
Z1503A		Same as Z1502A	Final amplifier (high band) lower section
Z1503B		CAVITY, TUNED: c/o plunger, electron tube type 2C39A (V1506), tube retainer, anode clamp, anode contact, insulator cap; upper section; high band; 21964 dwg #A2061886G3	Final amplifier (high band) upper section
Z1504	8	CAVITY ASSEMBLY, TUNED: c/o Z1504A and Z1504B (For Reference Only)	Figure 6-56
Z1504A		CAVITY, TUNED: coaxial; input frequency 321.4 mc to 343.3 mc, output frequency 962 to 1024 mc; brass, silver plated, rhodium finish; power take-off from coupling loop, manual tuning by dielectric slug; lower section; low band; c/o C1552, C1553, Z1514; 21964 #B2060127-2	Tripler, (low band) lower section
Z1504B		CAVITY, TUNED: c/o plunger, electron tube type 2C39A (V1510), tube retainer, anode clamp, anode contact, insulator cap; upper section; low band; 21964 #A2061886G4	Tripler, (low band) upper section
Z1505	8	CAVITY ASSEMBLY, TUNED: c/o Z1505A and Z1505B (For Reference Only)	Figure 6-56
Z1505A		CAVITY, TUNED: coaxial; input and output frequency range 962 mc to 1024 mc; brass, silver plated, rhodium finish; power take-off from coupling loop; manual tuning by dielectric slug; lower section; low band; 21964 dwg #A2060039-2	1st amplifier (low band) lower section

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

FREQUENCY MULTIPLIER-OSCILLATOR CV-1171/GRN-9D

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
Z1505B		CAVITY, TUNED: c/o plunger, electron tube type 2C39A (V1511), tube retainer, anode clamp, anode contact, insulator cap; upper section; low band 21964 #A2061886G5	1st amplifier, (low band) upper section
Z1506	8	CAVITY ASSEMBLY, TUNED: c/o Z1506A and Z1506B (For Reference Only)	Figure 6-56
Z1506A		Same as Z1505A	Final amplifier (low band) lower section
Z1506B		CAVITY, TUNED: c/o plunger, electron tube type 2C39A (V1512), tube retainer, anode clamp, anode contact, insulator cap; upper section; low band; 21964 #A2061886G6	Final amplifier (low band) upper section
Z1507		FREQUENCY MULTIPLIER, COAXIAL TUNED CAVITY: 1/4 wave-length stub; brass, silver plated; c/o 47 mmf ±5%, fixed glass capacitor (MIL type CY10C470J) and RG141/U coaxial cable assy with 2 connectors; 21964 #B2060761G1	Couples RF energy from V1503 to V1504 Figure 2-18
Z1508		FREQUENCY MULTIPLIER, COAXIAL TUNED CAVITY: 1/4 wave-length stub; brass, silver plated; c/o 47 mmf ±5%, fixed glass capacitor (MIL type CY10C470J) and RG141/U coaxial cable assy with two connectors; 21964 #B2060761G2	Couples RF energy from V1509 to V1510 Figure 2-18
Z1509		SUPPRESSOR ASSEMBLY, PARASITIC: sealed assy c/o two un-insulated RF chokes mtd on board assy, plug, insulator and probe; coil data, 10 μh at 40 mc, 0.60 ohms DC resistance, 750 ma; 21964 #B2060814G1	Parasitic suppressor between Z1502 and Z1503 Figure 6-56
Z1510	6	Same as Z1509 except for ref symbol marking on case; 21964 #B2060814G2	Parasitic suppressor between Z1505 and Z1506 Figure 6-56
Z1511	2	CHOKE, RADIO FREQUENCY: 2000 ma DC current rating; 1.0 μh ±20%; 21964 #B2061344G1	Filament choke V1504
Z1512		Same as Z1511	Filament choke V1504
Z1513		Same as Z1511	Filament choke V1510
Z1514		Same as Z1511	Filament choke V1510
Z1515	8	OVEN ASSEMBLY, CRYSTAL: c/o HR1502, Y1502, 21964 #B1068990	Crystal oven assy for RF assy low band Figure 2-18
Z1516	8	OVEN ASSEMBLY, CRYSTAL: c/o HR1501, Y1501 21964 #B1068990	Crystal oven assy for RF assy high band Figure 2-18

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
		POWER SUPPLY PP-1766/URN	
1601-1799		POWER SUPPLY PP-1766/URN: rectification data, electronic type, 5R4WGB full wave; output data, DC; 300 v, 0. 010 amp, regulated; 250 v, 0. 285 amp, regulated; -215 v, 0.006" amp, regulated; -375 v, 0. 065 amp, regulated; -400 v, 0. 05 amp, regulated; input data, AC: 120 v, 60 cycles; single phase; over-all dim. 26-25/32" lg, 13-1/2" wide, 15-31/32" high; filter incl; rack-mounted with pull-out slides, front access only; housed in an open aluminum frame-work, provides low-voltage for the system 21964 #A2060008 and 2060008	Part of Power Supply Assembly OA-1537/GRN-9A Figure 6-62
C1601		CAPACITOR, FIXED, PAPER DIELECTRIC: 10 uf, ±10%; 1500 v DC working; MIL type #CP70B1EH106K, per spec MIL-C-25; 21964 #641501	Filter for +250 v; +300 v power supply Figure 6-64
C1602		CAPACITOR, FIXED, PAPER DIELECTRIC: 0. 5 uf, +20 -10%, 1000 v DC working; MIL type #CP55B4EG504V, per spec MIL-C-25; 21964 #643695	Filter & cathode bypass Figure 6-1
C1603		CAPACITOR, FIXED, PAPER DIELECTRIC: 0. 1 uf, ±10%, 600 v DC working; MIL type #CP55B1EF104K, per spec MIL-C-25; 21964 #640459	Grid bypass V1605 Figure 6-1
C1604		CAPACITOR, FIXED, PAPER DIELECTRIC: 0. 5 uf, ±10%, 600 v DC working; MIL type #CP55B1EF504K, per spec MIL-C-25; 21964 #640461	Cathode bypass V1605 Figure 6-1
C1605		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 uf, ±10%, 600 v DC working; MIL type #CP70E1EF205K per spec MIL-C-25; 21964 #641037; Same as C504	Output filter for +250 v
C1606 thru C1609		Not Used	
C1610		Same as C1601	Filter for -375 v power supply Figure 6-1
C1611		Same as C1602	Filter, V1612, one section not used Figure 6-1
C1612		Same as C1603	Grid bypass V1612 Figure 6-1
C1613		Same as C1604	Cathode bypass V1612 Figure 6-1
C1614		Same as C1605	Output filter -375 v power supply Figure 6-63
C1615 thru C1619		Not Used	
C1620		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

• REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
C1621	6	CAPACITOR, FIXED, MICA DIELECTRIC: 510 uuf, ±5%; 500 v DC working; -55° C to 85° C operating temperature range; MIL type #CM20C511J per spec MIL-C-5A; 21964 #A2133174-35	Feedback, V1605
C1622		Not Used	
C1623		Same as C1621	Feedback, V1612
DS1601		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; clear, 24446 #10C7/1DC; 21964 #710071; Same as DS501	-375 v, "ON" Figure 3-7
DS1602		Not Used	
DS1603		Same as DS1601	LVPS "ON" Figure 3-7
DS1604		LAMP, GLOW: neon gas, 0. 25 watt, 67-87 v DC striking voltage; double contact bayonet type; MIL type NE-16 per MIL-L-15098; 21964 #A2060350; Same as DS502	LV "ON" Figure 6-63
DS1605		Same as DS1601	Ready for LV, MV Figure 3-7
E1601	7	RETAINER, ELECTRON TUBE: stainless steel; clamps tube with spring action; 2-1/4" high, 3-7/32" wide; holds material 2. 04" dia; two slots for #10 screw on 2-25/32" mounting center, CAIS type 926-Q7, bracket #195-07-35; 21964 #A2140766 (3 each used)	Tube clamp
E1602		Not Used	
E1603		Not Used	
E1604		Not Used	
E1605	5	SHIELD, ELECTRON TUBE: JAN type #TS103U02 per JAN-S-28A, modified; 21964 #A2132988-5; Same as E307	Shield for V1605
E1605A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type #TS103U02; MIL-STD-242A type #902; 21964 #A2132886-5; Same as E307A	Insert for E1605
E1606	5	SHIELD, ELECTRON TUBE: JAN type #TS102U02 per JAN-S-28A, modified; 21964 #A2132988-2; Same as E202	Shield for V1606

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1606A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type #TS102U02; MIL-STD-242A type #702; 21964 #A2132886-2; Same as E202A	Insert for E1606
E1607 thru E1611		Not Used	
E1612		Same as E1605	Shield for V1612
E1612A		Same as E1605A	Insert for E1612
E1613		Same as E1606	Shield for V1613
E1613A		Same as E1606A	Insert for E1613
E1614 thru E1620		Not Used	
E1621		CLIP, ELECTRICAL: beryllium copper; silver plated finish; 21964 #A2141702	Plate clip, V1603
E1622		Same as E1621	Plate clip, V1603
E1623		Same as E1621	Plate clip, V1604
E1624		Same as E1621	Plate clip, V1604
E1625		Not Used	
E1626		Not Used	
E1627		Same as E1621	Plate clip V1611
E1628		Same as E1621	Plate clip, V1611
E1629		Not Used	
E1630		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1631		RETAINER, CAPACITOR: for mounting capacitor; MIL type #CP07SG4, per spec MIL-C-25 modified; 21964 #B2143620-2	Mounts C1601
E1632		Same as E1631	Mounts C1601
E1633		Same as E1631	Mounts C1610
E1634		Same as E1631	Mounts C1610
E1635		Not Used	
E1636		Not Used	
E1637		RETAINER, CAPACITOR: for mounting capacitor; MIL type #CP07SA4, per spec MIL-C-25 modified; 21964 #B2143620-1; Same as E527	Mounts C1605
E1638		Not Used	
E1639		Not Used	
E1640		Same as E1637	Mounts C1605
E1641		Not Used	
E1642		Not Used	
E1643		Same as E1637	Mounts C1614
E1644		Same as E1637	Mounts C1614
F1601		FUSE, CARTRIDGE: 0.75 amp, 250 v; time delay, 135% for 0-1 hour and 300% for 6 sec; enclosed type, MIL type #F02GF750B, per spec MIL-F-15160A and MIL std MS90078-23-1; 21964 #882233	Protection, fil. transformer T1603 Figure 3-7
F1602		FUSE, CARTRIDGE: 1 amp, 250 v, time delay, 135% for 0-1 hour and 300% for 6 sec; enclosed type; MIL type #F02G1R00B, per spec MIL-F-15160A and MIL std MS90078-24-1; 21964 #882234; Same as F1303	Protection, fil. transformer T1604 Figure 3-7

TABLE 7-3, RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
F1603		FUSE, CARTRIDGE: 2 amp, 125 v time delay, 135% for 0-1 hour and 300% for 6 sec; enclosed type; MIL type #F02D2R00B, per spec MIL-F-15160A and MIL std MS90078-26-1; 21964 #882236; Same as F905	Protection plate transformer T1601 Figure 3-7
F1604		Same as F1602	Protection plate transformer T1602 Figure 3-7
F1605		Same as F1601	Spare
F1606		Same as F1602	Spare
F1607		Same as F1603	Spare
F1608		Same as F1602	Spare
H1601		CAP, ELECTRICAL: moulded phenolic; u/w NAVY type H-27A jack; 21964 #A9141290-1 and #A9141291; Same as H1101	Covers J1609
H1602		BOLT, REDUCED SHANK: steel rod, type no. 303 per MIL-S-853 class 7, type C; passivate finish; 21964 #A9140059 (4 each used) Same as H903	Used to secure unit in cabinet
J1601		CONNECTOR, RECEPTACLE: single female round contact; straight type; phone type connector, black nylon insulator, max operating voltage 1,500 v peak; silver plated contacts, 74868 type 225-B; MIL type MS16108-3 per MIL-STD-242A; 21964 #A2141949-1; Same as J305	Metering, 250/300 v
J1602		Not Used	
J1603		Same as J1601	Metering, -375 v
J1604		CONNECTOR, RECEPTACLE: single female round contact; straight type; phone type connector, red nylon insulator; max operating voltage 1,500 v peak; silver plated contacts, 74868 type 225-A; MIL type MS16082 per MIL-STD-242A; 21964 #A2141949-3	Metering, +250 v
J1605 thru J1607		Not Used	
J1608		CONNECTOR, RECEPTACLE: single female round contact; straight type; phone type connector, green nylon insulator; mac operating voltage 1,500 v peak; silver plated contacts; 74868 type 225-D; MIL type MS16108-5 per MIL-STD-242A; 21964 #A2141949-2	Metering, -375 v
J1609		JACK, TELEPHONE: accommodates 2 conductor female type plug, 0.916" max dia; Navy type H-27A; BuShips dwg #9000-S6501C-74120 modified by painting surface grey per 21964 #A2143641 and A2143640-1; Same as J1101	Sound powered telephone connection

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
K1601		RELAY, ARMATURE: contact arrangement 2C, MBCA Ref Dwg Group 4, DPDT, single break, 2 amp, 115 v AC; one inductive winding; coil resistance 8000 ohms, operating current 3 ma, pick-up current 2.3 ma; 6 terminals on contacts, 2 terminals on coil; continuous duty; 78277 #22RFCC-90510, per spec MIL-R-5757C; 21964 #A2140533	-375 v supervisory
K1602		Not Used	
K1603		RELAY, ARMATURE: closed type; four poles single-throw contacts, normally open, double break, AC, 220 v, 10 amp; single inductive winding, 120 v AC, 60 cycles; 8 contact terminals, 2 coil terminals; per spec MIL-C-2212A; similar to 04009 size 0o type "CRA"; 21964 #C2141272-1 and spec #A2140748-1	LVPS plate contactor Figure 2-12
K1604		RELAY, ARMATURE: contact arrangement 2 form C type, DPDT, AC, 120 v, 10 amp; 1 winding, inductive winding; AC, 123 v; max continuous operating, operating current not rated, 60 cycles, 6 terminals for contacts, 2 terminals for coil; continuous duty; hermetically sealed; 70309 type PBH, per spec MIL-R-5757C; 21964 #A2060235; Same as K1301	B+ protector Figure 6-63
K1605		RELAY, MOTOR DRIVEN: SPDT, 115/250 v, 5 amp, 60 cycles; motor data AC, synchronous type, 105 to 132 v rms, 60 cycles; 2 terminals for motor 3 terminals for contacts; 1 min time interval; resets automatically; hermetically sealed; time interval factory adjusted; 14907 #430H set at 1 min; per 21964 #A2142407; Same as K1102	Blower "OFF" time delay B901, B902, B1001 Figure 6-1
K1606		RELAY, MOTOR DRIVEN: SPDT, 115/250 v, 5 amp, 60 cycles motor data AC, synchronous type, 105 to 132 v rms, 60 cycles; 2 terminals for motor; 3 terminals for contacts; 5 min time interval; resets automatically; hermetically sealed; time interval factory adjusted; 14907 #430H set at 5 min; per 21964 #A2142405	V1304, Klystron heater time delay Figure 6-1
MP1601		BOOT, DUST AND MOISTURE SEAL: silicone rubber bonded to a brass nickel plated hex nut 15/32-32 thd; 3/4" across flats, 7/8" lg; 97539 part #1030; 21964 #A2132649-1; Same as MP202	Seal for switch, on panel
MP1602	1	GASKET: synthetic rubber, MIL-R-900A, class 2; cross-sectional style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 44-9/32" lg; 21964 #A9140800; Same as MP201	Panel sealing
MP1603	2	GASKET: synthetic rubber; dim. 1-9/16" w 1-9/16" h, 1/32" thk; aperture 1-1/32" hole dia; four 11/64" dia mtg holes on 1-1/4" by 1-1/4" centers; 21964 #A2141718	Seals telephone jack
R1601	6	RESISTOR, FIXED, COMPOSITION: 150,000 ohms, ±10%; 2 watt; MIL type RC42GF154K, per spec MIL-R-11; 21964 #501267	Divider, V1605
R1602		Same as R1601	Divider, V1605
R1603		RESISTOR, FIXED, COMPOSITION: 75,000 ohms, ±5%; 2 watt; MIL type #RC42GF753J, per spec MIL-R-11; 21964 #501158	Divider, V1605
R1604	6	RESISTOR, FIXED, COMPOSITION: 1.0 megohm, ±10%; 1 watt; MIL type #RC32GF105K, per spec MIL-R-11; 21964 #503954	Decoupling, V1605

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1605	6	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%; 1 watt; MIL type #RC32GF470K, per spec MIL-R-11; 21964 #503902	Damping, V1604
R1606		Same as R1605	Damping, V1604
R1607		Same as R1605	Damping, V1604
R1608		Same as R1605	Damping, V1603
R1609		Same as R1605	Damping, V1603
R1610		Same as R1605	Damping, V1603
R1611	6	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%; 1/2 watt; MIL type #RC20GF471K, per spec MIL-R-11; 21964 #504227; Same as R452	Damping, V1603
R1612		Same as R1611	Damping, V1603
R1613		Same as R1611	Damping, V1604
R1614		Same as R1611	Damping, V1604
R1615	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 2 watt; MIL type #RC42GF103K, per spec MIL-R-11; 21964 #501253; Same as R416	Voltage divider cathode V1605
R1616	6	RESISTOR, FIXED, COMPOSITION: 9100 ohms, ±5%; 2 watt; MIL type #RC42GF912J, per spec MIL-R-11; 21964 #501136	Voltage divider cathode V1605
R1617		Same as R1615	Voltage divider cathode V1605
R1618	6	RESISTOR FIXED, COMPOSITION: 220,000 ohms, ±10%; 1 watt; MIL type #RC32GF224K, per spec MIL-R-11; 21964 #503946	Plate, V1605
R1619		Same as R1618	Plate, V1605
R1620	6	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±10%; 2 watt; immersion; 2 wire lead terminals; MIL type #RC42GF123K, per spec MIL-R-11; 21964 #501254; Same as R613	Voltage divider cathode V1605
R1621	6	RESISTOR, FIXED, COMPOSITION: 6800 ohms, ±10%; 2 watt; MIL type #RC42GF682K, per spec MIL-R-11; 21964 #501251	Voltage divider cathode V1605
R1622		Same as R1615	Voltage divider cathode V1605 Figure 6-63

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1623	6	RESISTOR, VARIABLE: composition element; 1 section, 5,000 ohms ±10%; 2 watt nom power rating; no switch, MIL type RV4LAVSA502A per MIL-R-94 and MIL-STD-242 (Ships); 21964 #A2133049-4; Same as R1364	Output voltage control +250 v Figure 2-12
R1624	6	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±10%; 1/2 watt; MIL type RC20GF473K, per spec MIL-R-11; 21964 #504251; Same as R425	Decoupling, V1605 Figure 6-1
R1625	6	RESISTOR, FIXED, COMPOSITION: 82,000 ohms, ±10%; 1 watt; MIL type RC32GF823K, per spec MIL-R-11; 21964 #503941	Plate, V1606 Figure 6-1
R1626		Same as R1620	Voltage divider cathode V1605
R1627		Same as R1618	Plate, V1605
R1628		Not Used	
R1629	6	RESISTOR, FIXED, COMPOSITION: 2.7 megohm, ±10%; 1 watt; MIL type RC32GF275K, per spec MIL-R-11; 21964 #503959	Feedback, V1605
R1630 thru R1646		Not Used	
R1647		Same as R1601	Divider, V1612
R1648		Same as R1601	Divider, V1612
R1649		Same as R1603	Divider, V1612
R1650		Same as R1604	Decoupling, V1612 Figure 6-1
R1651		Same as R1605	Damping, V1611
R1652		Same as R1605	Damping, V1611
R1653		Same as R1605	Damping, V1611
R1654		Same as R1611	Damping, V1611
R1655		Same as R1611	Damping, V1611
R1656	6	RESISTOR, FIXED, COMPOSITION: 18,000 ohms, ±10%; 2 watt; MIL type RC42GF183K, per spec MIL-R-11; 21964 #501256	Voltage divider cathode V1612

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1657		Same as R1656	Voltage divider cathode V1612
R1658	6	RESISTOR, FIXED, COMPOSITION: 330,000 ohms, ±10%; 2 watt; MIL type RC42GF334K, per spec MIL-R-11; 21964 #501271; Same as R1408	Plate, V1612
R1659		Same as R1620	Voltage divider cathode V1612
R1660		Same as R1615	Voltage divider cathode V1612
R1661	6	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±10%; 2 watt; MIL type RC42GF224K, per spec MIL-R-11; 21964 #501269; Same as R1423	Plate, V1612
R1662	6	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±10%; 2 watt; MIL type RC42GF474K, per spec MIL-R-11; 21964 #501273; Same as R1424	Plate, V1612
R1663		RESISTOR, VARIABLE: composition element; 1 section, 15,000 ohms, ±10%, 2 watt nominal power rating; no switch; MIL type RV4LAVSA153A per MIL-R-94 and MIL-STD-242 (Ships); 21964 #A2133049-5	Output voltage control, -375 v Figure 2-12
R1664		RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±5%; 2 watt; MIL type RC42GF123J, per spec MIL-R-11; 21964 #501139	Voltage divider cathode V1612
R1665		Same as R1664	Voltage divider cathode V1612
R1666		RESISTOR, FIXED, COMPOSITION: 10,000 ohms; ±5%; 2 watt; MIL type RC42GF103J, per spec MIL-R-11; 21964 #501137; Same as R1353	Voltage divider cathode V1612
R1667		Same as R1624	Decoupling, V1612 Figure 6-1
R1668		Same as R1601	Plate, V1613 Figure 6-1
R1669		RESISTOR, FIXED, COMPOSITION: 1000 ohms; ±5%; 2 watt; MIL type RC42GF102J, per spec MIL-R-11; 21964 #501113	Voltage divider cathode V1612
R1670	6	RESISTOR, FIXED, COMPOSITION: 1.8 megohm, ±10%; 1 watt; MIL type RC32GF185K, per spec MIL-R-11; 21964 #503957	Feedback, V1612
Cont. See R1701			
S1601		SWITCH, TOGGLE: single pole, single throw; 0.75 amp 125 v DC, 15 amp 125 v AC; JAN type ST42A, per spec JAN-S-23; 21964 #828212; Same as S502	Air switch for LVPS Figure 3-7
T1601		TRANSFORMER, POWER STEP-UP: 120 v AC, 60 cycles, single phase; 1 output winding, center tapped, 520-0-520 v at 0 4 amp; 49956 #292-3676G1 MIL type no. TF1SX02YY per spec MIL-T-27A; 21964 #A1069534	250/300 v plate supply Figure 6-64

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T1602		TRANSFORMER, POWER, STEP-UP: 120 v AC, 60 cycles, single phase; secondary, center tapped; 550-0-550 v at 0.18 amp; 49956 #292-6012G2 MIL type no. TF1SX02YY, per spec MIL-T-27A; 21964 #A1069613	-375 v & -400 v plate supply Figure 6-64
T1603		TRANSFORMER, POWER, STEPDOWN: 120 v AC, 60 cycles, single phase; 2 output windings, secondary #1 is 5.1 v at 4 amp, secondary #2 is 5.1 v at 2 amp; 49956 #292-6008G2 MIL type no. TF1SX01GA per spec no. MIL-T-27A; 21964 #A1069992	5R4WGY fil supply Figure 6-1
T1604		TRANSFORMER, POWER, STEPDOWN: 120 v AC, 60 cycles, single phase; 4 output windings, secondary #1 is 12.7 v at 2.3 amp, secondary #2 is 12.7 v at 3.5 amp, secondaries #3 and #4 are 6.4 v at 0.3 amp; 49956 #292-5632G1 MIL type no. TF1SX01JA per spec MIL-T-27A; 21964 #A1069536	Regulator on amplifier heaters Figure 6-64
TB1601		TERMINAL BOARD: 12 terminals; single row, thru type terminals; MIL type 7TB12 per MIL-T-16784A and NAVY dwg #9000-S6505G-73214; 21964 #A2133072-2; Same as TB604	Terminal board Figure 6-63
TB1602		Same as TB1601	Terminal board Figure 6-63
Cont. See TB1701			
V1601	6	ELECTRON TUBE: diode; MIL type 5R4WGB; per MIL-E-1 (Navy); 21964 #A2132449; Same as V501	Rectifier Figure 6-63
V1602		Same as V1601	Rectifier
V1603		ELECTRON TUBE: twin pentode; MIL type #829B, per spec MIL-E-1C; 21964 #700176	Series regulator Figure 6-63
V1604		Same as V1603	Series regulator Figure 6-63
V1605		ELECTRON TUBE: twin triode; MIL type 12AT7WA, per spec MIL-E-1C; 21964 #701165; Same as V307	Amplifier Figure 6-63
V1606		ELECTRON TUBE: diode; MIL type 5651WA; per spec MIL-E-1 (Navy); 21964 #A2133280; Same as V1371	Voltage reference Figure 6-63
V1607 thru V1609		Not Used	
V1610		Same as V1601	Rectifier Figure 6-63
V1611		Same as V1603	Series regulator Figure 6-63
V1612		Same as V1605	Amplifier
V1613		Same as V1606	Voltage rectifier

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XDS1601		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BG3 per MIL-L-3661, dwg MS-90286; 21964 #A2133080-2	Holds DS1601
XDS1602		Not Used	
XDS1603		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BR3 per MIL-L-3661, dwg MS-90286; 21964 #A2133080-1; Same as XDS1002	Holds DS1603
XDS1604	6	LAMPHOLDER: 125 v accommodates double contact bayonet base lamp; Military Standard lampholders dwg MS90290; 72619 #9S4634-L-46; MIL spec no. MIL-L-3661; type #LH-71-XXO; 21964 #A9152053 or A2142519; Same as XDS502	Holds DS1604
XDS1605		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BB3 per MIL-L-3661, dwg MS-90286; 21964 #A2133080-4; Same as XDS1102	Holds DS1605
XF1601		FUSEHOLDER: extractor post type; accommodates 2 fuses 1-1/4" lg, 1/4" dia; blown fuse indicating type; sealed; MIL type FHL10G per BuShips Dwg #9000-S6202-74228 and MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Holds F1601 & F1605 Figure 6-64
XF1602		Same as XF1601	Holds F1602 & F1606 Figure 6-64
XF1603		Same as XF1601	Holds F1603 & F1607 Figure 6-64
XF1604		Same as XF1601	Holds F1604 & F1608
XV1601	6	SOCKET, ELECTRON TUBE: 8 contacts, beryllium, silver plated; octal dual shaped; MIL type TS101P02 per JAN-S-28A; 71785 51B16758; 21964 #740031; Same as XV501	Socket for V1601 Figure 6-1
XV1602		Same as XV1601	Socket for V1602 Figure 6-1
XV1603	6	SOCKET, ELECTRON TUBE: 7 contacts, phosphor bronze and beryllium copper, silver plated; 74970 #122-101-200; 21964 #B2141950	Socket for V1603
XV1604		Same as XV1603	Socket for V1604
XV1605		SOCKET, ELECTRON TUBE: 9 contacts, brass, nickel plated; miniature; includes metal shield base; JAN type TS103P01, per spec JAN-S-28A-1; 21964 #740004; Same as XV307	Socket for V1605 Figure 6-1
XV1606	6	SOCKET, ELECTRON TUBE: 7 contacts, brass, nickel plated, miniature; includes metal shield base; JAN type TS102P01, per spec JAN-S-28A-1; 21964 #740002; Same as XV308	Socket for V1606 Figure 6-1
XV1607 thru XV1609		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV1610		Same as XV1601	Socket for V1610 Figure 6-1
XV1611		Same as XV1603	Socket for V1611
XV1612		Same as XV1605	Socket for V1612 Figure 6-1
XV1613		Same as XV1606	Socket for V1613 Figure 6-1
R1701		Not Used	
R1702		Not Used	
R1703		RESISTOR, FIXED, COMPOSITION: 5100 ohms, ±5%; 2 watt; MIL type RC42GF512J, per spec MIL-R-11; 21964 #501130	Voltage divider cathode V1605
R1704	6	RESISTOR, FIXED, COMPOSITION: 56, 000 ohms, ±10%; 1 watt; MIL type RC32GF563K, per spec MIL-R-11; 21964 #503939	Voltage dropping K1601
R1705		RESISTOR, FIXED, COMPOSITION: 62, 000 ohms, ±5%; 2 watt; MIL type RC42GF623K, per spec MIL-R-11; 21964 #501156	Voltage dropping K1601
R1706		Not Used	
R1707		Not Used	
R1708	6	RESISTOR, FIXED, COMPOSITION; 47 ohms, ±10%; 2 watt; MIL type RC42GF470K, per spec MIL-R-11; 21964 #501225; Same as R501	Current balancing V1603
R1709		Same as R1708	Current balancing V1604
R1710		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; MIL type RW59V281 per MIL-R-26C; 21964 #A2132711-01; Same as R520	Voltage dropping resistor for V1601
R1711		Not Used	
R1712		Same as R1710	Voltage dropping resistor for V1603

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1766/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1713	6	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±10% tolerance; 1 watt; MIL type RC32GF153K, per spec MIL-R-11; 21964 #503932; Same as R521	Voltage dropping resistor for V1604
R1714		Same as R1710	Voltage dropping resistor for V1605
TB1701 thru TB1796		Not Used	
TB1797	2	TERMINAL BOARD: 12 brass solder stud terminals; 21964 #B2060111G1	Mounts in LVPS
TB1798	2	TERMINAL BOARD: 24 brass solder stud terminals; 21964 #C2060108	Mounts in LVPS
TB1799	2	TERMINAL BOARD: 24 brass solder stud terminals; 21964 #C2060109	Mounts in LVPS
		POWER SUPPLY PP-1765/URN	
1801-1899		POWER SUPPLY, PP-1765/URN: rectification data, electronic type, 2 type 836 tube, full-wave; output data, DC; 1000 v, 0.090 amp, regulated; 700 v, 0.085 amp, unregulated; input data; AC; 120 v, 60 cycles, single phase; over-all dim. 26-25/32" lg, 9-1/2" wide, 15-31/32" high; filter incl; rack-mounted with pullout slides, front access only; housed in an open aluminum frame work; provides medium voltage for the system; 21964 #J2060009	Part of Power Supply Assembly OA-1537/GRN-9A Figure 6-65
C1801		CAPACITOR, FIXED, PAPER DIELECTRIC: 6 uf, ±10%; 2500 v DC working; MIL type #CP70E1EK605K, per spec MIL-C-25; 21964 #641081	Input filter Figure 6-66
C1802		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 uf, ±10%; 2000 DC working; MIL type CP70E1EJ205K, per spec MIL-C-25; 21964 #641068; Same as C1405	Output bypass 1000 v Figure 6-10
C1803 thru C1809		Not Used	
C1810		CAPACITOR, FIXED, PAPER DIELECTRIC: 0.5 uf, ±10%; 2000 v DC working; MIL type CP70E1EJ504K, per spec MIL-C-25; 21964 #641066	829B screen bypass Figure 6-10
C1811		Not Used	
C1812		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 mf, ±10%; 600 v DC working; MIL type CP70E1EF205K, per spec MIL-C-25; 21964 #641037; Same as C504	Overload circuit
C1813		Same as C1812	Overload circuit

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
DS1801		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens double contact bayonet base; clear, 1 filament, tungsten; 24446 #10C7/1DC; 21964 #710071; Same as DS501	Indicator med voltage "ON" Figure 3-9
DS1802		LAMP, GLOW: neon gas, 0.25 watt, 67-87 v DC striking voltage; double contact bayonet type; MIL type NE-16 per MIL-L-15098; 21964 #A2060350; Same as DS502	MV "ON" Figure 2-13
DS1803		LAMP, GLOW: neon gas, 0.04 watt; 120 v; miniature bayonet base; MIL type NE-51 per MIL-L-15098B; 21964 #A2141970; Same as DS901	Medium voltage overload Figure 3-9
E1801		CLIP, ELECTRICAL: beryllium copper; cadmium plated finish; 42498 dwg #SD-D198 part 4; 21964 #A2141723	Plate clip for V1901
E1802		Same as E1801	Used w/V1802
E1803 thru E1807		Not Used	
E1808	5	SHIELD, ELECTRON TUBE: JAN type TS103U02 per JAN-S-28A, modified; 21964 #A2132988-5; Same as E307	Shield for V1808
E1808A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS103U02; MIL-STD-242A type #902; 21964 #A2132886-5; Same as E307A	Insert for E1808
E1809		Not Used	
E1810	5	SHIELD, ELECTRON TUBE: JAN type TS102U03 per JAN-S-28A, modified; 21964 #A2132988-3; Same as E408	Shield for V1810
E1810A		INSERT, ELECTRON TUBE SHIELD: use on shield JAN type TS102U03; MIL-STD-242A type #703; 21964 dwg #A2132886-3; Same as E408A	Insert for E1810
E1811		Same as E1810	Shield for V1811
E1811A		Same as E1810A	Insert for E1811
E1812		Same as E1810	Shield for V1812
E1812A		Same as E1810A	Insert for E1812
E1813		Same as E1810	Shield for V1813
E1813A		Same as E1810A	Insert for E1813
E1814		Same as E1810	Shield for V1814
E1814A		Same as E1810A	Insert for E1814

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1815 thru E1820		Not Used	
E1821		CLIP, ELECTRICAL: beryllium copper; silver plated finish; 21964 #A2141702; Same as E1621	u/w V1803
E1822		Same as E1821	u/w V1803
E1823		Same as E1821	u/w V1804
E1824		Same as E1821	u/w V1804
E1825		Same as E1821	u/w V1805
E1826		Same as E1821	u/w V1805
E1827		Same as E1821	u/w V1806
E1828		Same as E1821	u/w V1806
E1829		Same as E1821	u/w V1807
E1830		Same as E1821	u/w V1807
E1831 thru E1838		Not Used	
E1839		RETAINER, CAPACITOR: MIL type CP07FB2, per spec MIL-C-25; 21964 #380019	Mounts C1810
E1840		Same as E1839	Mounts C1810
E1841		RETAINER, CAPACITOR: MIL type CP07SA4, per spec MIL-C-25; modified, 21964 #B2143620-1; Same as E527	Holds C1812
E1842		Same as E1841	Holds C1812
E1843		Same as E1841	Holds C1813
E1844		Same as E1841	Holds C1813
F1801		FUSE, CARTRIDGE: 5 amp; 250 v time delay, 135% for 0-1 hour and 300% for 6 sec; enclosed type; MIL type F03G5R00B, per spec MIL-F-15160A and MIL STD MS90079-22-1; 21964 #882259; Same as F1301	Primary T1801 protection Figure 3-9

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
F1802		FUSE, CARTRIDGE: 1 amp, 250 v; time delay, 135% for 0-1 hour and 300% for 6 sec; enclosed type; MIL type F02G1R00B, per spec MIL-F-15160A and MIL STD MS90078-24-1; 21964 #882234; Same as F1303	Primaries T1802, T1804 protection Figure 3-9
F1803		Same as F1802	Primary T1803 protection Figure 3-9
F1804		Same as F1801	Spare
F1805		Same as F1802	Spare
F1806		Same as F1802	Spare
J1801		CONNECTOR, RECEPTACLE, ELECTRICAL: single female round contact; straight type; phone type connector; 74868 #225-B; MIL type MS16108-3 per MIL-STD-242A; 21964 #A2141949-1; Same as J305	Metering, ground
J1802		Not Used	
J1803		CONNECTOR, RECEPTACLE, ELECTRICAL: single female round contact; straight type; phone type connector; 74868 #225-A; MIL type MS-16108-2 per MIL-STD-242A; 21964 #A2141949-3; Same as J1604	Metering, +1000 v
K1801		RELAY, ARMATURE: contact arrangement 2C, DPDT, single break, 2 amp, 115 v AC; 1 inductive winding; coil resistance 8000 ohm, operating current 3 ma, pick-up current 2.3 ma; 6 terminals on contacts, 2 terminals on coil; continuous duty; hermetically sealed; 78277 #22RJCC-90510, per spec MIL-R-5757C; 21964 #A2140533; Same as K1601	1000 v supervisory
K1802		RELAY, ARMATURE: contact arrangement 2A1B, single break, 5 amp 115 v AC; single winding, 120 v AC, 60 cycles; 6 terminals on contacts, 2 terminals on coil; continuous duty; hermetically sealed; 71482 #SG36015 type "GAC" per spec MIL-R-5757C; 21964 #A2140532	Overload auxiliary 1000 v Figure 6-66
K1803		RELAY, ARMATURE: contact arrangement 1C, single break, 2 amp, 115 v AC; 1 inductive winding, DC; 16,000 ohms resistance, 12.8 v operating voltage, 0.8 ma continuous operating current; 3 terminals on contacts, 2 terminals on coil, continuous duty; hermetically sealed; per spec MIL-R-5757C; 78277 #5RJ90764-SIL; 21964 #A2143385	Overload 1000 v
K1804		RELAY, ARMATURE: open type; four poles single-throw contacts, normally open, double break, AC, 220 v, 10 amp; single inductive winding; 120 v AC, 60 cycles; 8 contact terminals, 2 coil terminals; per spec MIL-C-2212A; similar to 04009 "CRA" size 00; 21964 #C2141272-1 and spec A2140748-1; Same as K1603	Plate contactor Figure 6-10

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
K1805		RELAY, MOTOR DRIVEN: four SPDT contacts, 115/250 v, 5 amp, 60 cycles; motor data AC, synchronous type, 120 v, 60 cycles; 2 terminals for motor; 4 terminals for contacts; three reclosures 1/20 sec duration of each impulse, 3 sec interval between impulses; automatically resets after each reclosure if successive trips are at least 1/5 sec apart, requires electrical reset by external switching circuit after three reclosure trials; hermetically sealed; 14907 HHR3, 21964 #A2142406	Overload reset circuit reclosing relay Figure 6-10
K1806	6	RELAY, ARMATURE: closed type; four poles single-throw contacts, normally closed, double break, AC, 220 v, 10 amp; single inductive winding, 120 v AC 60 cycles; 8 contact terminals, 2 coil terminals; per spec MIL-C-2212A; similar to 04009 size 00 type "CRA"; 21964 #C2141272-2 and spec A2140748-2 *See note below	Overload reset supervisory Figure 6-10
MP1801	7	INSULATOR, WASHER: silicon resin glass cloth, type GSG; natural color; round shape; code no. 76 MBCA Ref Dwg Group; 1/4" thk, 5/8" dia 0.169" dia hole centered; shank 1/8" thk by 1/4" dia; 10,000 psi; special resistance to heat and flame; 21964 #A2141686 (2 each used)	u/w wirewound resistor
MP1802	7	INSULATOR, WASHER: silicon resin glass cloth, type GSG; natural color; round shape; code no. 76 MBCA Ref Dwg Group; 1/4" thk, 1" dia. 0.196" dia hole centered; shank 1/8" thk by 15/32" dia; 10,000 psi; special resistance to heat and flame; 21964 #A2141683-2 (3 each used)	u/w wirewound resistors
MP1803	7	INSULATOR, WASHER: silicon resin glass cloth, type GSG; natural color; round shape; code no. 76 MBCA Ref Dwg Group; 1/4" thk, 1" dia, 0.196" dia hole centered, shank 1/8" thk by 15/32" dia; 10,000 psi; special resistance to heat and flame; 21964 #A2141683-1 (3 each used)	u/w wirewound resistors
MP1804		INSULATOR, BUSHING: ceramic grade L-5A; Ref Dwg Group no. 9, style #174; MIL type NS5AW4103 per JAN-I-8; 21964 #A2133203-3; Same as E1318	Mounts C1801
MP1805		Same as MP1804	Mounts C1801
MP1806		INSULATOR, BUSHING: ceramic grade L-5A; MIL type NS5AW4203 per JAN-I-8; 21964 #A2133204-3; Same as E1320	Mounts C1802
MP1807		Same as MP1806	Mounts C1802
MP1808		BOLT, REDUCED SHANK: steel rod, type no. 303 per MIL-S-853, class 7, type C; passivate finish; head data not applicable to MBCA Ref Dwg Group 29, knurled thumb head socket recess, 1/2" high, 7/8" dia, o/a dim., recess dim., 0.3130" dim. across flats, 3/8" deep; reduced shank data 5/8" dia, 25/32" lg; 3/8" -16 NC-2 thd, 3/8" min lgth; 2-5/32" nominal lgth; 21964 #A9140059 (4 each used); Same as H903	Used to secure unit in cabinet
MP1809	1	GASKET: synthetic rubber, MIL-R-900A, class 2; cross sectional style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 40-9/32" lg; 21964 #A9140800; Same as MP201	Panel sealing
MP1810		BOOT, DUST AND MOISTURE SEAL: silicon rubber bonded to a brass nickel plated hex nut 15/32-32 thd; 3/4" across flats, 7/8" lg; 97539 #1030; 21964 #A2132649-1; Same as MP202	Seal for switch on panel
		* For field replacement use same spare as provided for K1603, reversing fixed contacts to give the desired NC contact combination.	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1801	6	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±10%; 2 watt; MIL type RC42GF224K, per spec MIL-R-11; 21964 #501269; Same as R1423	C1801 discharge
R1802		Same as R1801	C1801 discharge
R1803		Same as R1801	C1801 discharge
R1804		Same as R1801	C1801 discharge
R1805	6	RESISTOR, FIXED, COMPOSITION: 470 ohm, ±10%; 1 watt; MIL type RC32GF471K, per spec MIL-R-11; 21964 #503914	Damping, V1803
R1806		Same as R1805	Damping, V1803
R1807		Same as R1805	Damping, V1804
R1808		Same as R1805	Damping, V1804
R1809		Same as R1805	Damping, V1805
R1810		Same as R1805	Damping, V1805
R1811		Same as R1805	Damping, V1806
R1812		Same as R1805	Damping, V1806
R1813		Same as R1805	Damping, V1807
R1814		Same as R1805	Damping, V1807
R1815		Same as R1805	Damping, V1803
R1816		Same as R1805	Damping, V1804
R1817		Same as R1805	Damping, V1805
R1818		Same as R1805	Damping, V1806
R1819		Same as R1805	Damping, V1807
R1820	6	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%; 1/2 watt; MIL type RC20GF471K, per spec MIL-R-11; 21964 #504227; Same as R452	Damping, V1803
R1821		Same as R1820	Damping, V1803

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1822		Same as R1820	Damping, V1804
R1823		Same as R1820	Damping, V1804
R1824		Same as R1820	Damping, V1805
R1825		Same as R1820	Damping, V1805
R1826		Same as R1820	Damping, V1806
R1827		Same as R1820	Damping, V1806
R1828		Same as R1820	Damping, V1807
R1829		Same as R1820	Damping, V1807
R1830 thru R1841		Not Used	
R1842		RESISTOR, VARIABLE: composition element; 1 section, 250,000 ohms, ±10%; 2 watt; MIL type RV4LAVSA254A per MIL-R-94 and MIL-STD-242 (Ships); 21964 #A2133049-7; Same as R443	Control, 1000 v Figure 2-13
R1843		Not Used	
R1844		Not Used	
R1845	6	RESISTOR, FIXED, COMPOSITION: 120,000 ohms, ±10%; 2 watt; MIL type RC42GF124K, per spec MIL-R-11; 21964 #501266	Plate, V1808
R1846	6	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±10%; 2 watt; MIL type RC42GF104K, per spec MIL-R-11; 21964 #501265	Divider, V1808
R1847 thru R1849		Not Used	
R1850	6	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±10%; 2 watt; MIL type RC42GF474K, per spec MIL-R-11; 21964 #501273; Same as R1424	Divider, V1808
R1851 thru R1864		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1865		RESISTOR, FIXED, COMPOSITION: 82,000 ohms, ±5%; 2 watt; MIL type RC42GF823J per spec MIL-R-11; 21964 #501159	Relay voltage divider
R1866		Same as R1865	Relay voltage divider
R1867		Same as R1865	Relay voltage divider
R1868		Same as R1865	Relay voltage divider
R1869 thru R1871		Not Used	
R1872		RESISTOR, VARIABLE: composition element; 1 section, 25,000 ohms, ±10%; 2 watt; no switch; MIL type RV4LAVSA253A per MIL-R-94 and MIL-STD-242 (Ships); 21964 #A2133049-1; Same as R1470	Over-load adjustment Figure 6-10
R1873	6	RESISTOR, FIXED, WIREWOUND: 180 ohms, ±5%; 18 watt; MIL type RW33G181, per spec MIL-R-26A; 21964 #531003	Over-load relay shunt
R1874		RESISTOR, FIXED, WIREWOUND: 12,000 ohms, ±5%; 38 watt; MIL type RW35G123, per spec MIL-R-26; 21964 #530399	Plate V1810 Figure 6-10
R1875		RESISTOR, FIXED, WIREWOUND: 1400 ohms, ±5%; 38 watt; MIL type RW35G142, per spec MIL-R-26; 21964 #531112	700 volt series Figure 6-10
R1876		Same as R1875	700 volt series dropping Figure 6-10
R1877 thru R1879		Not Used	
R1880		RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±5%; 2 watt; MIL type RC42GF222J, per spec MIL-R-11; 21964 #501121	Screen dropping for 829B tube
R1881		Same as R1880	Screen dropping for 829B tube
R1882		Same as R1880	Screen dropping for 829B tube
R1883	6	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt; MIL type RC20GF103K, per spec MIL-R-11; 21964 #504243; Same as R404	Parasitic suppressor V1808
R1884 thru R1886		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1887	6	RESISTOR, FIXED, COMPOSITION: 120 ohms, ±10%; 2 watt; MIL type RC42GF121K, per spec MIL-R-11; 21964 #501230	Cathode current balancing V1803 Figure 6-10
R1888		Same as R1887	Cathode current balancing V1804 Figure 6-10
R1889		Same as R1887	Cathode current balancing V1805 Figure 6-10
R1890		Same as R1887	Cathode current balancing V1806 Figure 6-10
R1891		Same as R1887	Cathode current balancing V1806 Figure 6-10
R1892		Not Used	
R1893		RESISTOR, FIXED, COMPOSITION: 27, 000 ohms, ±5%; 2 watt; MIL type RC42GF273J, per spec MIL-R-11; 21964 #501147; Same as R1362	Overload circuit
R1894	6	RESISTOR, FIXED, COMPOSITION: 6800 ohms, ±10%; 2 watt; MIL type RC42GF682K, per spec MIL-R-11; 21964 #501251; Same as R1621	Overload circuit
R1895		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; MIL type RW59V281, per MIL-R-26C; 21964 #A2132711-01; Same as R520	Voltage dropping resistor for DS1801
R1896	6	RESISTOR, FIXED, COMPOSITION: 15, 000 ohms, ±10%; 1 watt; MIL type RC32GF153K, per spec MIL-R-11; 21964 #503932; Same as R521	Voltage dropping resistor for DS1802
S1801		SWITCH, TOGGLE: single-pole, single-throw; 0. 75 amp, 125 v DC, 15 amp, 125 v AC, resistive load rating; JAN type ST42A, per spec JAN-S-23; 21964 #828212; Same as S502	1 kv "ON" switch Figure 3-9
S1802		SWITCH, TOGGLE: double-pole, double throw; 0. 75 amp, 125 v DC, 15 amp, 125 v AC, resistive load rating; JAN type #ST52R, per spec JAN-S-23; 21964 #828243; Same as S1106	Overload reset for MVPS Figure 3-9
T1801		TRANSFORMER, POWER STEP UP: 120 v AC, 60 cycles, single phase; 1 output winding, center tapped, 1260-0-1260 v at 0. 28 amp; 49956 #292-3697G1B MIL type TC1SX02YY per MIL-T-27A; 21964 #A1069829	Rectifier plate Figure 6-10
T1802		TRANSFORMER, POWER, STEPDOWN: 120 v AC, 60 cycles, single phase; 1 output winding, 2. 6 v center tapped, 10 amp; 49956 #292-6009G2 MIL type TF1SX01YY per MIL-T-27A; 21964 dwg #A1069868	Rectifier heater Figure 6-66

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
T1803		TRANSFORMER, POWER, STEPDOWN: 120 v AC, 60 cycles, single phase; 4 output windings, secondary #1 is 12. 7 v at 2. 3 amp, secondary #2 is 12. 7 v at 3. 5 amp, secondaries #3 and #4 are 6. 4 v at 0. 3 amp; 49956 #292-5632G1 MIL type TF1SX01JA per MIL-T-27A; 21964 #A1069536; Same as T1604	Regulator & amplifier heaters
TB1801		TERMINAL BOARD: 10 terminals; double screw type; barrier type; MIL type 8TB10 per MIL-T-16784 and NAVY dwg #9000-S6505G-73214; 21964 #A2133063-4; Same as TB701	Terminal board Figure 2-13
TB1802		Same as TB1801	Terminal board Figure 2-13
TB1803 thru TB1897		Not Used	
TB1898	2	TERMINAL BOARD: 24 terminals; hollow solder stud type; 21964 #B2060870G1	Mounts R1867, R1868 Figure 6-66
TB1899	2	TERMINAL BOARD: 25 terminals; hollow solder stud type; 21964 #A2140479-1	Mounts in cabinet
V1801		ELECTRON TUBE: diode; MIL type 836, per spec MIL-E-1C; 21964 #700178	Rectifier Figure 6-66
V1802		Same as V1801	Rectifier Figure 6-66
V1803		ELECTRON TUBE: twin pentode; MIL type #829B, per spec MIL-E-1C; 21964 #700176; Same as V1603	Series regulator Figure 2-13
V1804		Same as V1803	Series regulator Figure 2-13
V1805		Same as V1803	Series regulator Figure 2-13
V1806		Same as V1803	Series regulator Figure 2-13
V1807		Same as V1803	Series regulator Figure 2-13
V1808		ELECTRON TUBE: twin triode; MIL type #12AT7WA, per spec MIL-E-1C; 21964 #701165; Same as V307	Regulator amplifier Figure 2-13
V1809		Not Used	
V1810		ELECTRON TUBE: diode; MIL type #OA2WA, per spec MIL-E-1C; 21964 #701166	Reference voltage Figure 2-13
V1811		Same as V1810	Reference voltage Figure 2-13
V1812		Same as V1810	Reference voltage Figure 2-13
V1813		Same as V1810	Reference voltage Figure 2-13

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
V1814		Same as V1810	Reference voltage Figure 2-13
XDS1801		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BR3 per MIL-L-3661, dwg MS-90286; 21964 #A2133080-1; Same as XDS1002	Holds DS1801
XDS1802	6	LAMPHOLDER: 125 v; accommodates double contact bayonet base lamp; Military Standard lampholders dwg MS90290; 72619 9S4634-L-46; MIL spec no. MIL-L-3661; MIL type no. LH-71-XXO; 21964 #A9152053 or A2142519; Same as XDS502	Holds DS1802 Figure 2-13
XDS1803		LIGHT, INDICATOR: supplied w/lens, accommodates neon T-3-1/4 NE-51 lamp, 125 v, 75 watt; includes built in 51, 000 ohm 1/3 watt composition resistor; MIL type LH64PA5 per MIL spec MIL-L-3661 and MS90287; 21964 #A2133081-2; Same as XDS901	Holds DS1803
XF1801		FUSEHOLDER: extractor post type; accommodates 2 fuses 1-1/4" lg by 1/4" dia; blown fuse indicating type; sealed; MIL type FHL10G per BuShips dwg #9000-S6202-74228 and MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Holds F1801 & F1804 Figure 6-66
XF1802		Same as XF1801	Holds F1802 & F1805 Figure 6-66
XF1803		Same as XF1801	Holds F1803 & F1806 Figure 6-66
XV1801	6	SOCKET, ELECTRON TUBE: 4 contacts, beryllium copper, silver plated; jumbo size; round body; 74970 #123-210-200; per 21964 #B2141951-1	Socket for V1801
XV1802		Same as XV1801	Socket for V1802
XV1803	6	SOCKET, ELECTRON TUBE: 7 contacts, phosphor bronze and beryllium copper, silver plated; jumbo size; 74970 #122-101-200; 21964 #B2141950; Same as XV1603	Socket for V1803 Figure 6-10
XV1804		Same as XV1803	Socket for V1804 Figure 6-10
XV1805		Same as XV1803	Socket for V1805 Figure 6-10
XV1806		Same as XV1803	Socket for V1806 Figure 6-10
XV1807		Same as XV1803	Socket for V1807 Figure 6-10
XV1808		SOCKET, ELECTRON TUBE: 9 contacts, brass, nickel plated; miniature; JAN type #TS103C01, per spec JAN-S-28A-1; 21964 #740005	Socket for V1808
XV1809		Not Used	

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1765/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
XV1810	6	SOCKET, ELECTRON TUBE: 7 contacts, brass, nickel plated; miniature; JAN type #TS102C01, per spec JAN-S-28A-1; 21964 #740003	Socket for V1810
XV1811		Same as XV1810	Socket for V1811
XV1812		Same as XV1810	Socket for V1812
XV1813		Same as XV1810	Socket for V1813
XV1814		Same as XV1810	Socket for V1814
		POWER SUPPLY PP-1763/URN	
1901-1999		POWER SUPPLY, PP-1763/URN: rectification data, electronic type, 8020 tube, full-wave bridge; output data, DC, -12250 v, 90 ma, unregulated; input data, AC, 120 v, 60 cycles 1 phase, 9440 v, 60 cycles, 3 phase; overall dim. 26-25/32" lg, 23-1/16" wide, 12-21/32" high; filter incl; rack mounted with pull-out slides, front access only; housed in an open aluminum framework, provides high voltage for the system; 21964 #J2060336; u/o AN/GRN-9D	Part of Power Supply Assembly OA-1537/GRN-9A Figure 6-67
C1901		CAPACITOR, FIXED, PAPER DIELECTRIC: 1.0 uf, ±25 -5%; 14,000 v DC working; similar to 56289 #25P61; per MIL-C-25A; 21964 #A2060579; u/o AN/GRN-9D	HV filter Figure 6-68
C1902		Same as C1901; u/o AN/GRN-9D	HV filter Figure 6-68
C1903 thru C1905		Not Used	
C1906		CAPACITOR, FIXED, PAPER DIELECTRIC: 0.47 uf, ±10% tolerance, 200 v DCW; MIL type CP09A1KC474K, per MIL-C-25A; 21964 #643510	Filtering capacitor Figure 6-11
DS1901		LAMP, INCANDESCENT: 115-125 v, 10 watts, 40 lumens, double contact bayonet base; 24446 #10C7/1DC; 21964 #710071; Same as DS501	HV "ON" Figure 3-8
DS1902		Same as DS1901	Ready for HV Figure 3-8
DS1903		LAMP, GLOW: neon gas, 0.04 watt; 120 v; T-3-1/4 bulb; miniature bayonet base; MIL type NE-51 per MIL-L-15098B; 21964 #A2141970; Same as DS901	High voltage overload Figure 3-8
E1901		CLIP, ELECTRICAL: beryllium copper; cadmium plated; 42498 #SD-D198 part 4; 21964 #A2141723; Same as E1801	Plate clip for V1901
E1902		Same as E1901	Plate clip for V1902
E1903		Same as E1901	Plate clip for V1903

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1763/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
E1904		Same as E1901	Plate clip for V1904
E1905		Same as E1901	Plate clip for V1905
E1906		Same as E1901	Plate clip for V1906
E1907	2	TERMINAL, STUD: two 1/4" -20 studs on mtg plate; nuts & washers not included; brass, nickel pl; 2" lg, 13/16" wide; mounts by two 0.193" dia holes on 0.353" mounting center, plate voltage connections; 21964 #A2142232 and A2142233-1	Tie point
E1908		Same as E1907	Tie point
E1909		Same as E1907	Tie point
E1910		Not Used	
E1911	6	INSULATOR, STANDOFF: ceramic; grade L-4A per JAN-I-10, brown glaze finish; cylindrical pillar; JAN type NS4AB0316 per JAN-I-8 and spec MIL-STD-242A (Ships); 21964 #A2133083-3 (4 each used)	Standoff insulator
E1912		INSULATOR, STANDOFF: "Mycalex 410", grade L-4B white glazed; square pillar; 21964 #A2143189; Same as E1330 (10 each used)	Standoff insulator
E1913	6	INSULATOR, STANDOFF: ceramic, grade L-4A, white glazed; square pillar; JAN type #NS4AW1408 per JAN-I-8; 21964 #A2133220-1 (3 each used)	Standoff insulator
E1914	6	CONTACT, ELECTRICAL: u/w interlock switch; furnishes conducting surface for switch; one brass contact, silver plated, rd, approx 7/16" dia; 1-7/8" lg, 1-1/2" wide, 11/16" thk, approx o/a dim.; 10 amp, 110 or 220 v AC or DC; two 0.154" dia mounting holes on 1-1/4" mounting center, recessed 5/8" deep to clear #6 hex nut; 21964 #B2141184-2, this is one half of Navy type Switch #CG-24067A or 24446 #M7460330-GA (See S1004); Same as E1317	u/w interlock switch
E1915		TERMINAL STUD: breakdown voltage 14,000 v DC; 2 solder connections; brass, hot tin tipped; moulded asbestos filled melamine body; 3/8" lg, 1/4" dia body; mtd by no. 4-40 thd brass insert; 81312 #756; 21964 #A2142287-1; u/o AN/GRN-9A	Standoff insulator
F1901		FUSE, CARTRIDGE: 3 amp, 125 v; time delay, 135% for 0-1 hour and 300% for 6 sec; enclosed type; MIL type F02D3R00B, per spec MIL-F-15160A and MIL STD MS90078-27-1; 21964 #882237; Same as F501	Primary T1901 protection Figure 3-8
F1902		Same as F1901	Spare
K1901		RELAY, ARMATURE: contact arrangement 2A1B, single break, 5 amp, 120 v AC; single winding, 120 v AC, 60 cycles; 6 terminals on contacts, 2 terminals on coil; continuous duty; hermetically sealed; 71482 #SG36015 type "GAC", per spec MIL-R-5757C; 21964 #A2140532; Same as K1802	HV overload auxiliary

TABLE 7-3. RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1763/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
K1902		Not Used	
K1903		RELAY, ARMATURE: contact arrangement 1C, single break, 2 amp, 115 v AC; 1 inductive winding, DC, 16,000 ohms resistance, 12.8 v operating voltage, 0.8 ma continuous operating current; 3 terminals on contacts, 2 terminals on coil; continuous duty; hermetically sealed; per spec MIL-R-5757C; 78277 #5RJ90764-SIL; 21964 #A2143385; Same as K1803	HV overload
M1901		METER, TIME TOTALIZING, ELECTRIC: calibrated in hr; max reading 9999.9 hr, 0.1 hr smallest increment, recycles, black numerals on white background, nonreset type; synchronous type, AC, 120 v, 60 cycles; single phase; self starting; ambient temperature range of -54°C to +85°C; 2 connections; per spec MIL-M-10304A; 21964 #A2060476	Plate total time Figure 3-8
M1902		Same as M1901	Filament total time Figure 3-8
MP1901		BOLT, REDUCED SHANK: steel rod, type no. 303 per MIL-S-853, class 7, type C; passivate finish; head data not applicable to MBCA Ref Dwg Group 29, knurled thumb head socket recess, 1/2" high, 7/8" dia, o/a dim., recess dim., 0.3130" dim. across flats, 3/8" deep; reduced shank data 5/8" dia, 25/32" lg; 3/8"-16 NC-2 thd, 3/8" min lgth; 2-5/32" nominal lgth; 21964 #A9140059 (4 each used); Same as H903	Used to secure unit in cabinet
MP1902	1	GASKET: synthetic rubber, MIL-R-900C, class 1; style no. 10, MBCA Ref Dwg Group 75; 2-15/64" dia aperture in center, three 1/8" dia holes spaced 120 deg apart on 2-7/16" dia; 2-11/16" OD, 1/16" thk; 21964 #B2060910; Same as MP205	Sealing for meters
MP1903	1	GASKET: synthetic rubber; MIL-R-900A, class 2; cross-sectional style no. 7, Ref Dwg Group 74; 1/8" wide, 5/32" high w/1/16" radius, approx 4 ft 1/8" lg; 21964 #A9140800; Same as MP201	Seals front panel to cabinet
MP1904		BOOT, DUST AND MOISTURE SEAL: silicone rubber bonded to a brass, nickel plated hex nut 15/32 -32 thd; 3/4" across flats, 7/8" lg; 97539 #1030; 21964 #A2132649-1; Same as MP202	Dust cover for toggle switch on front panel
R1901		RESISTOR, FIXED, FILM (HIGH STABILITY): 500,000 ohms, ±5%; 55 watt; 225°C hot spot temperature; 14674 type RW-37 per MIL-R-11804A; 21964 #A2141186-4	Bleeder Figure 6-68
R1902		Same as R1901	Bleeder Figure 6-11
R1903		Same as R1901	Bleeder Figure 6-11
R1904		Same as R1901	Bleeder Figure 6-11
R1905		Not Used	
R1906		RESISTOR, FIXED, FILM (HIGH STABILITY): 150 ohms, ±5%; 55 watt; 225°C hot spot temperature; 14674 type RW-37 per MIL-R-11804A; 21964 #A2141186-1	K1903 shunt

TABLE 7-3, RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1763/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R1907		RESISTOR, FIXED, FILM (HIGH STABILITY): 1000 ohms, ±5%; 55 watt; 225°C hot spot temperature; 14674 type RW-37; 21964 #A2141186-2; Same as R1314	HV discharge
R1908 thru R1911		Not Used	
R1912		RESISTOR, VARIABLE: composition element; 1 section, 25,000 ohms, ±10%; 2 watt; MIL type RV4LAVSA253A per MIL-R-94 and MIL-STD-242(Ships); 21964 #A2133049-1; Same as R1470	Overload relay trip adj Figure 6-68
R1913		RESISTOR, FIXED, WIREWOUND: 280 ohms, 3 watt; 350°C maximum continuous operating temperature; MIL type RW59V281 per MIL-R-26C; 21964 #A2132711-01; Same as R520	Voltage dropping resistor
R1914 thru R1916		Not Used	
R1917		Same as R1913	Limiting resistor for DS1902
R1918		RESISTOR, DISC: thyrite compound; non-linear; 3 watts maximum continuous power rating at 55 deg C; DC test conditions, 25 v ±21% at 1 amp; exponent a=0.63 ±8%; change in resistance at constant voltage is from -0.4% to -0.73% per deg C, over the temperature range 0 deg C to 100 deg C; 24446 #3993060G1; 21964 #A2130066; u/o AN/GRN-9D	Meter protection M1301
S1901		SWITCH, SHORTING: high voltage discharge, DC; SPST, normally closed, double break; 21964 #C2140529 and #A2140528-1	HV condenser shorting switch
S1902		SWITCH, TOGGLE: single-pole, single throw; 0.75 amp, 125 v DC, 15 amp, 125 v AC, resistive load rating; JAN type ST42A per spec JAN-S-23; 21964 #828212; Same as S502	HV "ON-OFF" Figure 3-8
T1901		TRANSFORMER, POWER, STEPDOWN: encapsulated, epoxy resin; primary 120 v, 60 cycles, single phase; 4 output winding, secondary no. 1, 5.1 v 18 amp, secondary no. 2, 3 and 4, 5.1 v 6 amp; insulation to withstand 600 v rms test on primary and 18,000 v rms test on secondaries; 49956 #292-3674G1; MIL type TF2TX01ZZ per MIL-T-27A; 21964 #A1069473	HV rectifier filament Figure 6-67
TB1901		TERMINAL BOARD: 10 terminals; double screw type; barrier type; 20 studs; voltage rating 300 v AC; MIL type 8TB10 per MIL-T-16784 and Navy dwg #9000-S6505G-73214; 21964 #A2133063-4; Same as TB701	Terminal board
TB1902		Same as TB1901	Terminal board

TABLE 7-3, RADIO SET AN/GRN-9D, MAINTENANCE PARTS LIST

POWER SUPPLY PP-1763/URN

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
V1901		ELECTRON TUBE: diode; glass envelope; RMA envelope T-18; 5 terminations, 4 pin type and 1 cap type, located on bottom and top respectively; high vacuum, half-wave rectifier; MIL type 8020, per spec MIL-E-1C; 21964 #700203	Rectifier Figure 6-68
V1902		Same as V1901	Rectifier Figure 6-68
V1903		Same as V1901	Rectifier Figure 6-68
V1904		Same as V1901	Rectifier Figure 6-11
V1905		Same as V1901	Rectifier Figure 6-11
V1906		Same as V1901	Rectifier Figure 6-11
XDS1901		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts, MIL type LH63BR3 per MIL-L-3661, dwg MS-90286; 21964 #A2133080-1; Same as XDS1002	Holder for DS1901 Figure 6-68
XDS1902		LIGHT, INDICATOR: friction mtg lens holder; accommodates style S-6 lamp; 125 v, 6 watts; MIL type LH63BB3 per MIL-L-3661, dwg MS-90286; 21964 #A2133080-4; Same as XDS1102	Holder for DS1902 Figure 6-68
XDS1903		LIGHT, INDICATOR: supplied w/lens, 5/8" dia, amber, plain design, stovepipe shape, fluted, screw type holder, accommodates neon T-3-1/4 NE-51 lamp; 125 v, 75 watt; MIL type LH64PA5 per MIL spec MIL-L-3661 and MS-90287; 21964 #A2133081-2; Same as XDS901	Holder for DS1903 Figure 6-68
XF1901		FUSEHOLDER: extractor post type, accommodates 2 fuses; MIL type FHL10G per BuShips Dwg #9000-S-6202-74228 and MIL-F-19207 (Ships); 21964 #A2060402; Same as XF501	Holds F1901 & F1902 Figure 6-68
XV1901	6	SOCKET, ELECTRON TUBE: 4 contacts, beryllium copper, silver plated, jumbo size; 74970 #123-210-200 per 21964 #B2141951 modified and 21964 #B2143570-1	Socket for V1901
XV1902		Same as XV1901	Socket for V1902
XV1903		Same as XV1901	Socket for V1903
XV1904		Same as XV1901	Socket for V1904
XV1905		Same as XV1901	Socket for V1905
XV1906		Same as XV1901	Socket for V1906

TABLE 7-4, RADIO SET AN/GRN-9D, LIST OF MAN FACTURERS

NAME	MFG CODE	ADDRESS
Aerovox Corp.	00656	New Bedford, Mass.
Air-Maze Corp.	00736	5200 Havard Ave., Cleveland, Ohio
Aircraft Radio Corp.	00781	Boonton, N.J.
Sangamo Electric Co.	00853	Marion, Ill,
Alden Products Co.	01009	117 North Main St., Brockton 64, Mass.
Pulse Engineering Co.	01961	2431 Spring St., Redwood City, Calif.
Prode Lin	02114	307 Bergen Ave., Kearny, N.J.
Wheelock Signal, Inc.	02116	273 Branchport Ave., Long Branch, N.J.
American Phenolic, Corp.	02660	1830 South 54th Ave., Chicago 50, Ill.
Dynamic Gear Co.	03151	Amityville, L.I., N.Y.
Arrow-Hart and Hegeman Elec. Co.	04009	100 Hawthorne St., Hartford 6, Conn.
Birtcher Corp.	07387	North Los Angeles, Calif.
Continental Rubber Co.	14370	Erie, Pa.
Corning Glass Works	14674	1943 Crystal St., Corning, N.Y.
Cramer, R.W., Inc.	14907	Miller St., Centerbrook, Conn.
Cutler Hammer, Inc.	15605	Milwaukee, Wis.
I.T.T. Federal Div.	21964	100 Kingsland Road, Clifton, N.J.
General Electric Co.	24446	1 River Road, Schenectady 5, N.Y.
General Radio Co.	24655	Cambridge, Mass.
Marlin-Rockwell Corp.	38443	402 Chandler St., Jamestown, N.Y.
Miniature Precision Bearing Co.	40920	101 Carpenter St., Keene, N.H.
National Co.	42498	61 Sherman St., Malden 48, Mass.
Raytheon Mig. Co.	49956	Waltham, Mass.
Reeves Instrument Corp.	50222	215 East 91st St., New York, N.Y.
Sperry Gyroscope Co., Div. of the Sperry Corp.	56232	Great Neck, L.I., N.Y.
Sponge Rubber Products Co.	56277	Shelton, Conn.
Sprague Electric Co.	56289	201 Beaver St., North Adams, Mass.
Steward-Warner Corp.	57733	Chicago, Ill.
Williams, J.H. and Co.	65814	Buffalo, N.Y.
Admiral Corp.	70117	3800 West Cortland St., Chicago, Ill.
Allen Mig. Co.	70276	100 Sheldon St., Hartford, Conn.
Allied Control Co.	70309	2 East End Ave., New York 21, N.Y.
C.P. Clare Co.	71482	3101 Pratt Blvd., Chicago 45, Ill.
Centralab, Div. of Globe Union Inc.	71590	900 East Keefe Ave., Milwaukee 1, Wisc.

TABLE 7-4, RADIO SET AN/URN-9D, LIST OF MANUFACTURERS (cont)

NAME	MFG CODE	ADDRESS
Cinch Mfg. Corp.	71785	1026 South Homan Ave., Chicago 24, Ill.
Dialight Corp.	72619	60 Steward Ave., Brooklyn 37, N.Y.
Erie Resistor Corp.	72982	640 West 112th St., Erie, Pa.
Industrial Products Co,	74868	Danbury, Conn.
E.F. Johnson Co.	74970	Waseca, Minn.
Millen, James Mfg. Co., Inc.	76487	150 Exchange St., Malden, Mass.
Oak Mfg. Co.	76854	1260 Clybourn Ave., Chicago 10, Ill.
Sigma Instruments, Inc.	78277	180 Pearl St., South Braintree 85, Mass.
White, SS Dental Mfg. Co.	79555	Philadelphia, Pa.
Winchester Electronics Inc.	81312	Norwalk, Conn.
Filtron Co., Inc.	81831	131-05 Fowler Ave., Flushing, L.I., N.Y.
Barry Corp, The	81860	700 Pleasant St., Watertown 72, Mass.
Electro Switch Corp.	82121	South Weymouth, Mass.
Jeffers Electronics, Division of Speer Carbon Co.	82142	Dubois, Pa.
Kewanee Private Utilities Co.	82181	Kewanee, Ill.
Rotron Mfg. Co. Inc.	82877	7-9 Schoonmaker Place, Woodstock, N.Y.
Flexible Tubing Corp.	83144	Guilford, Conn.
Hunt Corporation	84678	Carlisle, Pa.
General Products Corp.	88223	Union Springs, N.Y.
Holtzer Cabot, Division of National Pneumatic Co., Inc.	89482	Woodside, Long Island, N.Y.
Micro Switch Div. of Minneapolis-Honeywell Reg. Co.	91929	Freeport, Ill.
Torrington Co., Specialties Div.	92172	37 Field St., Torrington, Conn.
Vlier Mfg. Co.	92214	Los Angeles 4, Calif.
Frequency Standards Corp.	93341	Ashbury Park, N.J.
Dietz, H.G. Co.	93652	45 Dobbia St., Brooklyn, N.Y.
Atlas Electronics Corp.	95114	Park Square Bldg., Boston, Mass.
Philamon Labs., Inc.	95267	90 Hopper St., Westbury, L.I., N.Y.
Revcor	95933	Chicago, Ill.
Ippolito, James, Co., Inc.	96458	New York, N.Y.
Juniper Elbow Co., Inc.	97537	Middle Village, N.Y.
Automatic Precision Mfg. Co.	97539	Yonkers, N.Y.
Marman, Div. of Aeroquip Corp.	98625	Los Angeles, Calif.
Flexible Tubing Corp.	98683	Amesburg, Mass.
International Electronic Research Corp.	98978	Burbank, Calif.

SECTION 8

Chapter 1
MODIFICATIONS, ELECTRICAL DESCRIPTION

CONTROL DUPLEXER (Mod strike-off number 3)

1. A switch, S1109, has been fitted to all drawers by Modification A4295. This is wired across tags 9 and 10 of TB1103. Diagrams affected are Figures 6 - 16a, 6 - 27a, 6 - 29a and 6 - 60. These points are the external H.V. Interlock pair to the TMC equipment, and S1109 permits them to be bridged where TMC equipment is not in use at the beacon site. In Figure 1 the Switch can be seen above and to the left of the centre of the front panel.

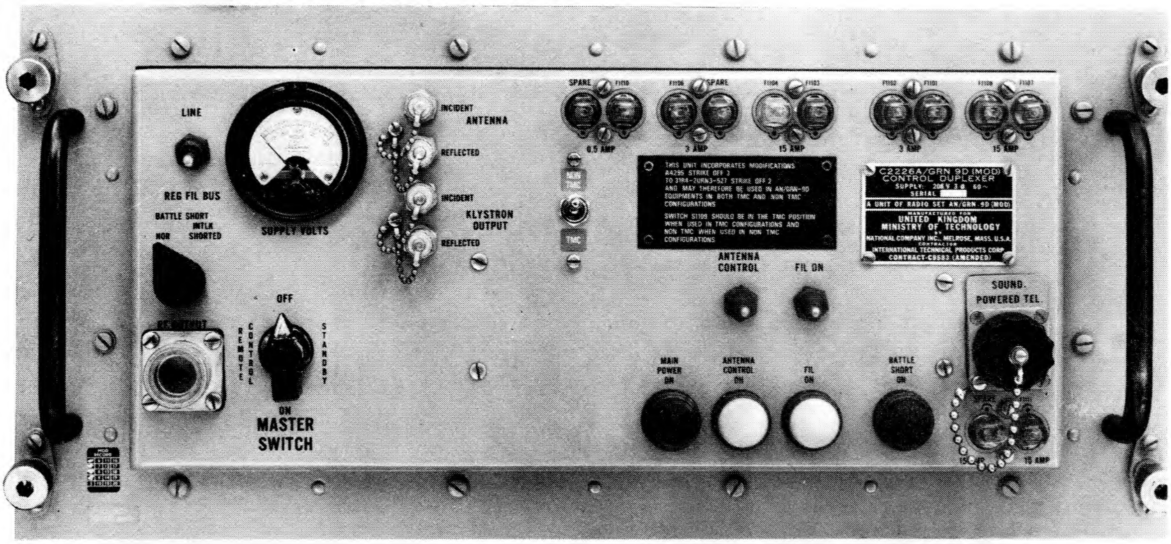


Fig.1 Control-Duplexer C-2226A/GRN-9

LOW VOLTAGE POWER SUPPLY (Mod strike off number 3.)

2. A Switch, S1602 is wired in series with the blue wire connecting between Thermal Delay Switch K1607 and TB1602 tag 10, by modification No. A4299. Diagrams affected are Figures 6 - 45a and 6 - 62. The opening of S1602 avoids K1607 becoming permanently closed in non-TMC beacon installations. In Figure 2 the Switch can be seen mounted below the socket in the centre of the front panel.

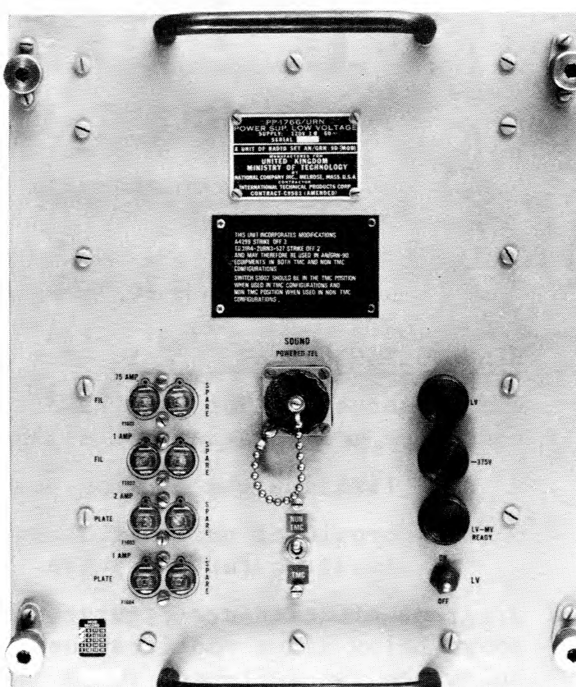


Fig.2. Low-Voltage Power Supply PP-1766/URN

AMPLIFIER MODULATOR (Mod strike-off number 3)

3. A radio frequency socket and lead is fitted to the front panel by modification No. A3825. Diagrams affected are Figures 6 - 20 and 6 - 57. The modification permits R.F. to be directed from the drawer at socket E1324 and taken to an external Filter Cavity unit. This makes the drawer compatible for use with URN 3A beacon installations. The new socket is to the right of the right-hand meter (Fig.3) and to the left of the pilot lamp. The connecting lead is stored in an internal clip when not in use.

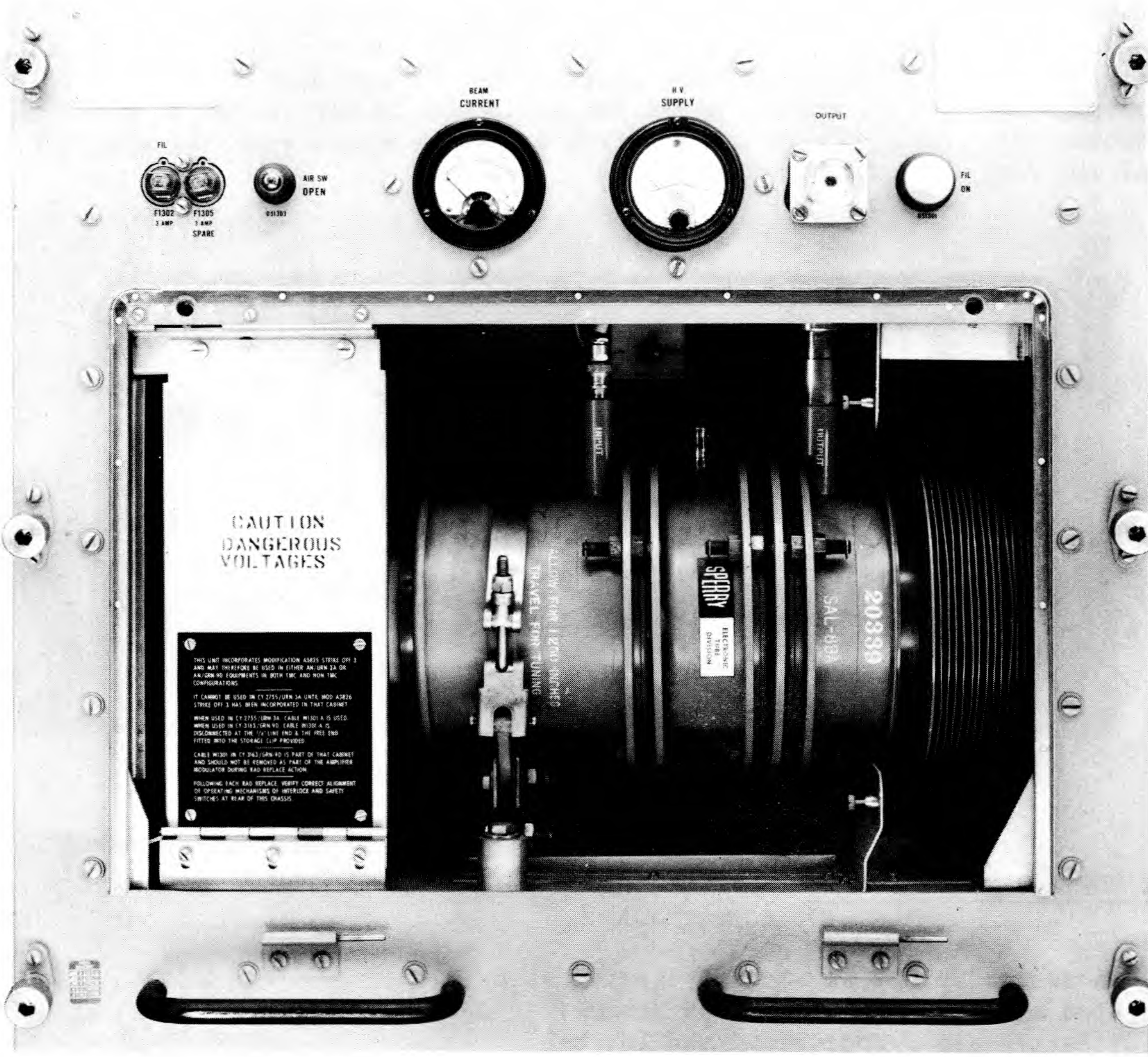


Fig.3. Amplifier Modulator AM-1701/URN

HIGH VOLTAGE POWER SUPPLY (Mod strike-off number 3)

4. A socket, J1901, and associated internal circuitry has been added by modification No. A3375 for the purpose of

a) limiting the working peak voltage across A1912 to 250 volts.

b) providing an oscilloscope monitoring point for viewing the Klystron current pulse.

Diagrams affected are Figures 6 - 26 and 6 - 47, part of which are shown below after modification (Figs. 4 and 5). J1901 is mounted below the two left-hand fuses (Figure 6).
When installed, the peak voltage shown on an oscilloscope connected to J1901 should fairly equate to the peak current in amperes drawn by the Klystron. Typical values are 2.8 Amps (High Band) to 3.1 Amps (Low Band), at best output.

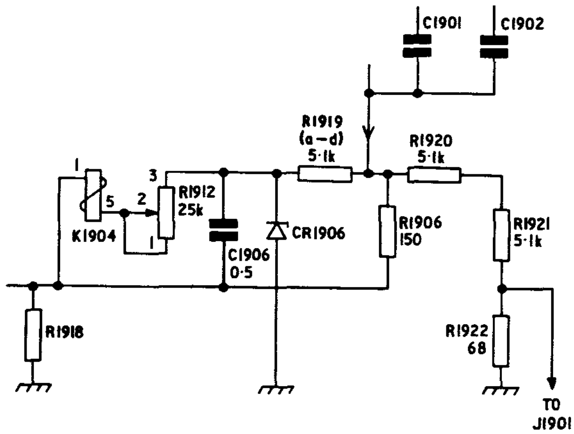


Fig.4.Part of figure 6 - 26

CONTROL-DUPLEXER (Mod strike-off number 4)

Technical Description

5. A new Filter cavity unit has been fitted by modification Nos. A4837 and A4838. The modification scarcely affects the electrical circuit diagrams, and does not alter the performance per se. Mechanical changes to the Control-Duplexer drawer involve the fitting of modified brackets, and the internal appearance is altered, (see Figures 1 and 7), in that the new filter cavity is a single cylindrical drum, rather than two, as were originally fitted.

6. In the new cavity, injection and take-off probes are mounted exactly as right-angles, i.e., the take off probe is one quarter of the way around the periphery relative to the injection probe. The plane of the injected waves is such that no output would be obtained from the take-off if the interior of the cavity were smooth. Half-way between the probes is a "coupling probe". This is in 45^{o} relationship with both injection and output, and is capable, therefore, of creating an interference wave, permitting coupling to occur which is proportional to depth.

7. Since a perfectly cylindrical drum is resonant at the same frequency across any diameter, the one cavity behaves like an accurately tuned twin circuit. To correct for manufacturing imperfections, a preset adjustment is provided exactly opposite each probe to ensure that both input and output resonances track accurately at a similar frequency, when the main turning knob is turned. The preset tracking adjustment holds good over a number of channels, and the response curve is similar to the bandpass response previously obtained with the original twin-cavity unit. Setting up, therefore, is simplified, since the two resonances cannot be misset far from each other. Otherwise the procedure to be followed is that given in 2.51 (2) step 26.

CAUTION ......

On no account must the coupling probe cover be removed or coupling adjustment attempted except by 3rd line personnel with 3rd line measuring equipment.

The coupling probe cover is also the gas seal for this adjustment, removing this cover will allow de-pressurizing to occur.

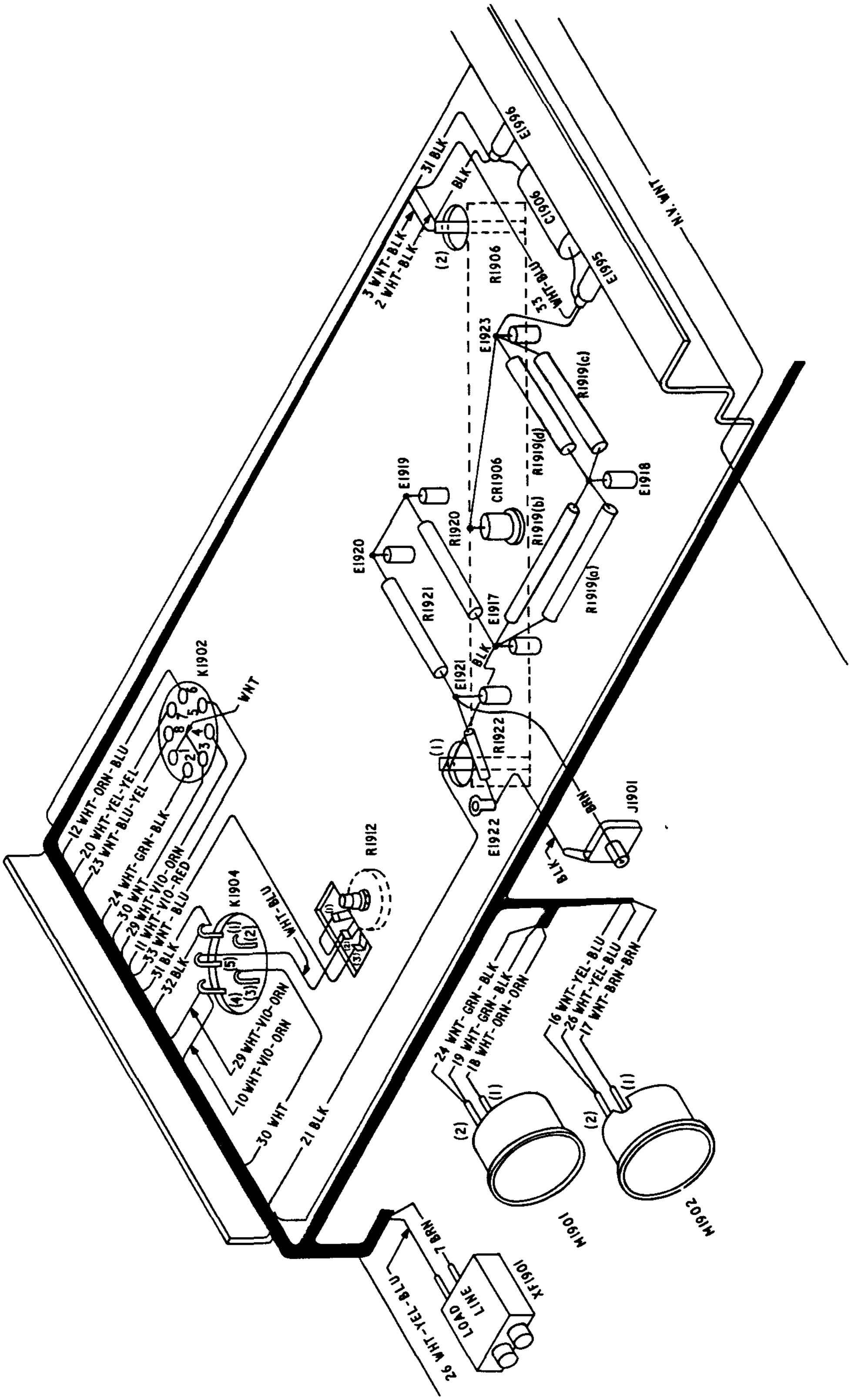


Fig 5 Part of figure 6-47

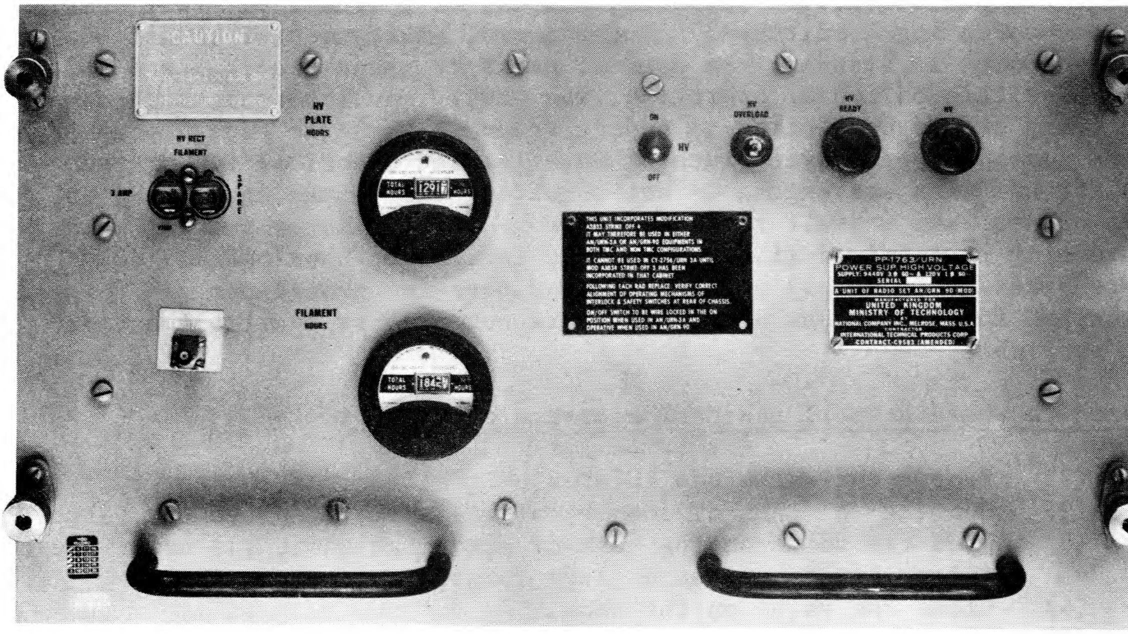


Fig.6. High Voltage Power Supply PP-1763/URN

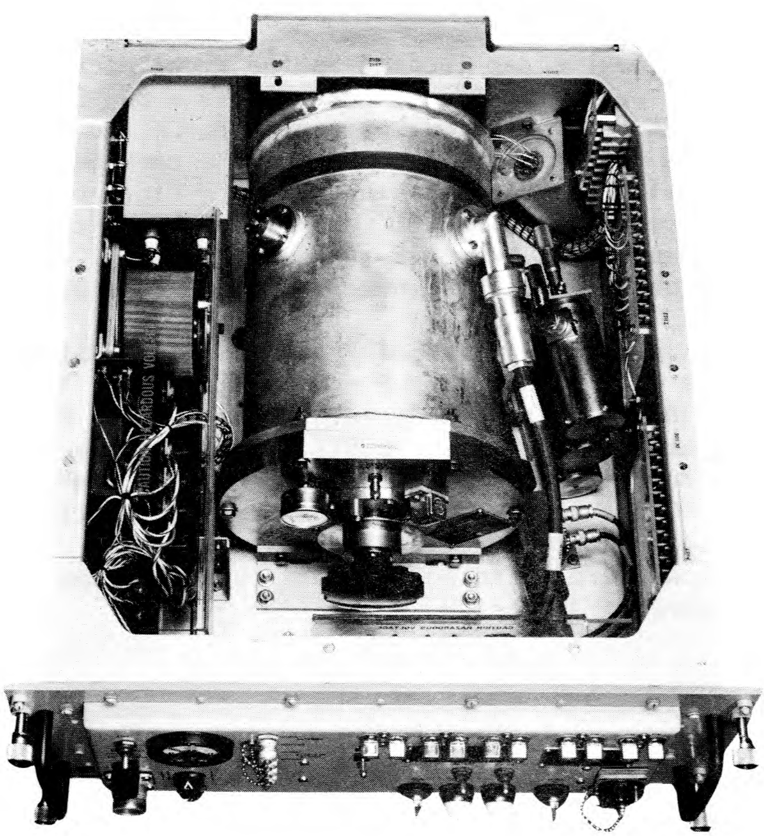


Fig.7. Control Duplexer, overhead view

MAINTENANCE AND RE-PRESSURIZING

8. The transmission filter cavity is pressurized with dry Freon 12 gas. The pressure reading on the cavity gauge is a function of both ambient temperature and barometric pressure, and may vary from 1 to 8 psi over extreme operating conditions. Under normal environmental conditions with the equipment in standby, the nominal pressure gauge reading is 3 psi. Over a certain period of operation, the cavity may lose gas, and normal servicing should be limited to adding Freon 12 when the pressure drops below one pound per square inch. This leaflet described two procedures (1) for use when scavenging is not required, (i.e., the cavity has not been opened, and a small residual pressure still exists) and (2) when scavenging is required (i.e., where the cavity has been opened, or where pressure is zero.) In the latter case two procedures are described for situations where (A), a vacuum pump is available and (B) not available.

Procedure where a small residual pressure exists

9. (1) Remove the valve cap located on the front of the cavity.
   (2) Connect a tank of commercial grade dry Freon to the valve.
   (3) Open the valve on the tank of Freon and admit gas until the filter cavity pressure gauge reads 3 psi.
   (4) Close the valve on the tank.
   (5) Disconnect the tank from the valve on the cavity.
   (6) Replace the valve cap on the cavity.
   (7) Tune the transmission line filter cavity.

Procedure A where no discernible pressure exists

10. (1) Remove the valve cap located on the front of the cavity.
   (2) Connect a pneumatic Tee connector with a tap in each of the input legs and fitted with a deflator, in the valve leg.
   (3) Connect a vacuum pump to one leg and a tank of dry commercial grade Freon to the other. Close both taps.
   (4) Open the tap to the vacuum pump and evacuate the cavity to a vacuum of at least 29 inches of mercury. Hold this vacuum for at least 20 minutes. Close the tap to the vacuum pump.
   (5) Open the tap to the tank of Freon gas and admit gas until the pressure gauge reads 3 to 5 psi. Disconnect the Tee piece.
   (6) Using a halogen gas leak locator (for example CT 105) check around all O-ring seals, joints, and the valve stem. Vary all tuning controls while checking for leaks. Any leak greater than 1/10 oz per year (8.0 mg/day approx) shall cause the assembly to be rejected.
   (7) If no leaks are detected, replace the valve cap and recheck for a pressure of 3-5 psi.

CAUTION ...

Gas leak locators such as CT105 are very sensitive to the presence of small amounts of contaminating gas or smoke in the air and should be operated only under clean-air conditions i.e., after the test bay itself has been purged of Freon gas which may have been released during the pressurization process. Avoid the use of aerosols, paints and varnishes, methylated spirits, and do not smoke in the test area. Smoke can cause actual permanent damage to the sensitive element in the gas leak locator, and will certainly cause a high "zero" setting. resulting in loss of sensitivity.

Procedure B where no discernible pressure exists

11. (1) Carry out procedure paragraph 2 (1), (2) and (3) but raise pressure to 10 psi.

(2) Repeat steps (4) and (5) of paragraph 2.

(3) Depress the valve needle on the filter cavity and allow gas to escape until the gauge reads zero.

(4) Repeat steps (1), (2), and (3) of this paragraph at least 10 times.

(5) Repeat pressurization steps (2) and (5) inclusive, of paragraph 2.

(6) Search for gas leaks as in paragraph 3 (6) observing the CAUTION.

(7) If no leaks are detected, replace the valve cap and recheck pressure.

Pressure cannot be maintained

12. If pressure is not being maintained, the unit should be returned for third-line maintenance in accordance with current instructions from the relevant authority.

FREQUENCY MULTIPLIER OSCILLATOR (Mod strike-off 3)

13. A resistor of 2.7K has been introduced in series with the drive and of R1470. (Shaped Pulse Amplitude Control) by modification No. A4620. The resistor, R1475, provides pulse current limiting in the event of R1470 and R1471 both being inadvertently adjusted to minimum resistance at the same time. Diagrams affected are Figures 4 -35, 6 - 18, 6 - 36. The resistor is mounted just to the right of R1470, to which it is connected at one end, and to a new mounting tag fitted for the purpose of supporting the opposite end of R1475.

CODER-INDICATOR (Mod strike-off number 4)

14. The mechanical keyer unit is being superseded by an Electronic keyer unit by modification No.A6364. Many diagrams and a great deal of text is affected by this change, but only insofar as the following points apply generally:-

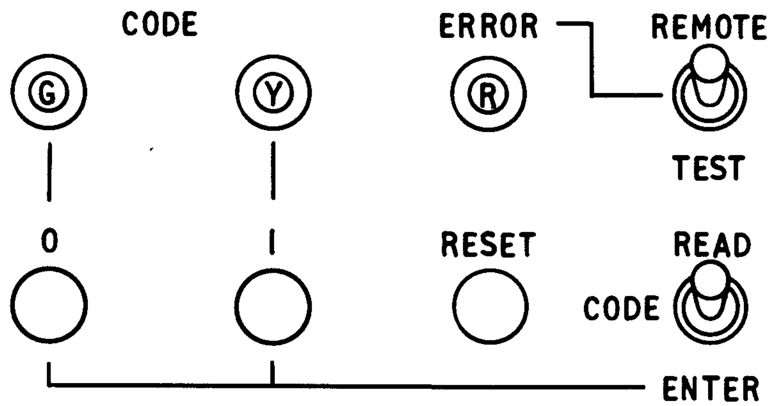


Fig.8. Keyer unit - panel controls

(1) The word "mechanical" becomes redundant.
(2) References to "mechanical keyer motor" and "motor switch" should be ignored.
(3) References to "motor lubrication" should be ignored.
(4) TB50, mounted on the side of the electronic keyer replaces and has a similar function to TB601 which is removed. The four original wires to it are used with TB50, plus a further eight.
(5) A new switch, S608, is fitted to the front panel. This is a test switch to call up an additional code message signifying that a fault condition exists, or the TACAN beacon is undergoing maintenance. This is a warning to pilots and navigators that the beacon is unreliable.
(6) The "ERROR" code of the previous paragraph can also be accessed remotely after extra wiring and equipment is laid in. (See Figure 12 for wiring changes, and chapter 2 for a technical description of the electronic keyer.)

15. The length of one dot on the electronic keyer is 1/256th of the message repetition time. In general the message will in future be repeated every 30 seconds instead of every 37½ seconds. Whereever 37½ seconds is mentioned in the text, therefore, read 30 seconds. The length of one dot is reduced from 125 milliseconds to 117 milliseconds. The keying speed is adjustable from approximately 100 to 130 milliseconds dot length by means of a preset control not accessible without taking the unit out of its box.

16. The additional facilities afforded by the electronic keyer include a gate waveform known as VOR GATE. This is for use in ground beacon stations where VOR and TACAN are co-sited or coaxially sited (VORTAC). The waveform supppresses the VOR identification whenever the TACAN sends its identification code, so that they do not both transmit ident together.

TRANSMITTER-RECEIVER CABINET CY-3163 (Mod strike-off number 4)

17. Additional frame wiring is fitted to enable all the facilities afforded by an electronic identification tone keyer unit to be used. (Modification No. A6368). The modification is mandatory with VORTAC installations. Figure 12 shows the combined effect of modification A6368 and A6364 described in paragraphs 14, 15 and 16.

18. The four external connections continue on via beacon station permanent wiring to a VORTAC INTERFACE unit. Other changes are required in the TMC equipment, so that the TMC Monitors, MM-209 can signal back to the electronic keyer directly and call up the ERROR code whenever the TACAN is unmonitored. These special installations are dealt with in AP 116C-0709-1 and 10, and in the TMC series of handbooks, AP 116C-0702-1A6A etcetera.

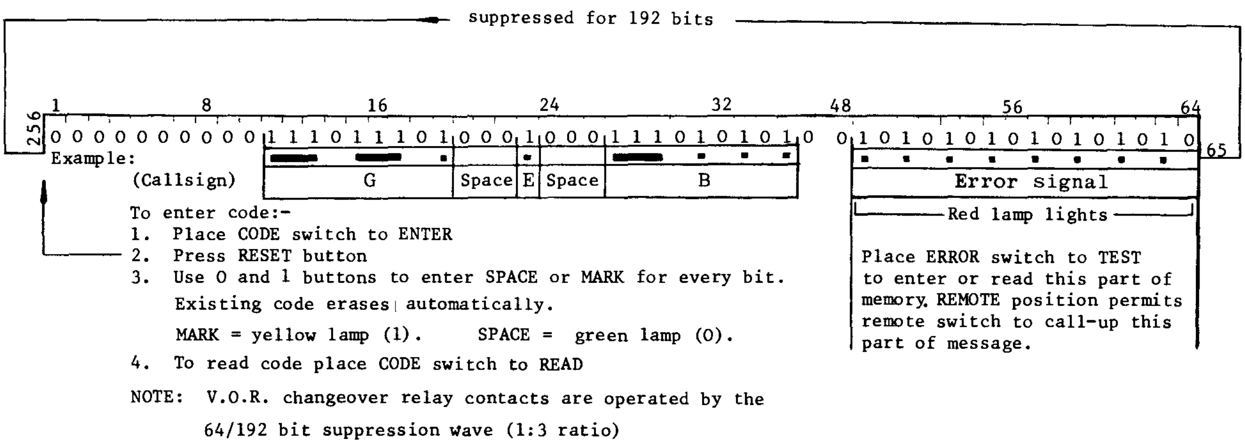


Fig.9. Setting up the code

SETTING UP IDENTIFICATION CODE

19. Instructions for setting up identification code on the Electronic Keyer are given on its facia plate and in figure 9. In principle, the operation is not different from that described for the superseded mechanical keyer in paragraph 2-5J(3) step 5 onwards in the main publication. It is advisable to precede the code by at least three spaces (step 5); ten are shown in figure 9 with twelve subsequently before the start of the ERROR code because the code shown is a short one.

Step 6. Set up first character of code by pressing the "1" button once for each dot, followed by a space, inserted by pressing the "0" button once; or pressing the "1" button three times, followed by a space, for a dash.

Step 7. After a whole character has been inserted, the space separating it from the next character should be three presses on the "0" button.

Step 8. After the last character has been inserted, continue pressing the "0" button until the red lamp on the keyer unit lights. Then place S608 on the front panel of the coder-indicator unit to ON.

Step 9. The ERROR code may now be inserted in the same way as in steps 6 and 7. At the end of the 16 bit ERROR code the red light will go out. (Alternatively the existing error code may be left intact.)

Step 10. Check keying by placing the READ/WRITE switch on the keyer unit to READ, S608 to ON.

Step 11. Place S608 to OFF and return coder indicator drawer to its normal position. With S608 at OFF, only the ident code without the error code is transmitted. (However, see also Technical Description of Keyer Unit, Chapter 2.)

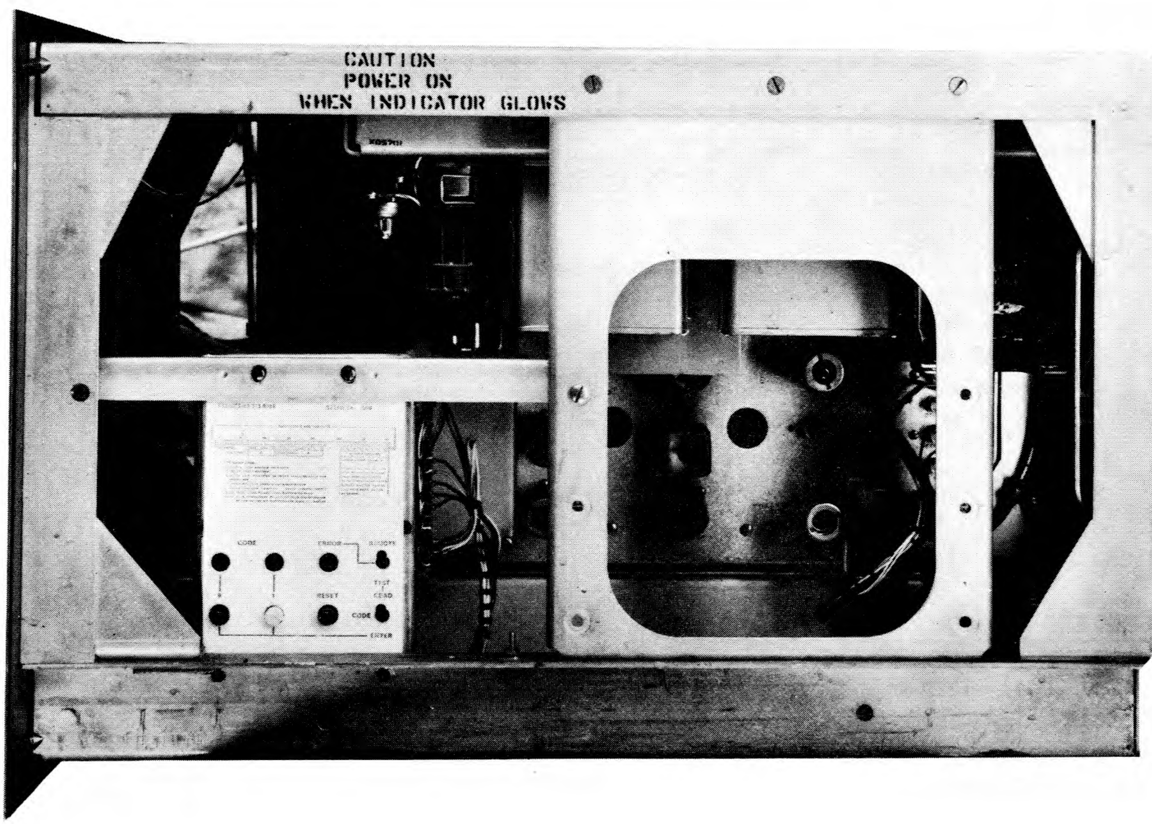


Fig.10. Coder-indicator KY-382/GRN-9D (Right side)

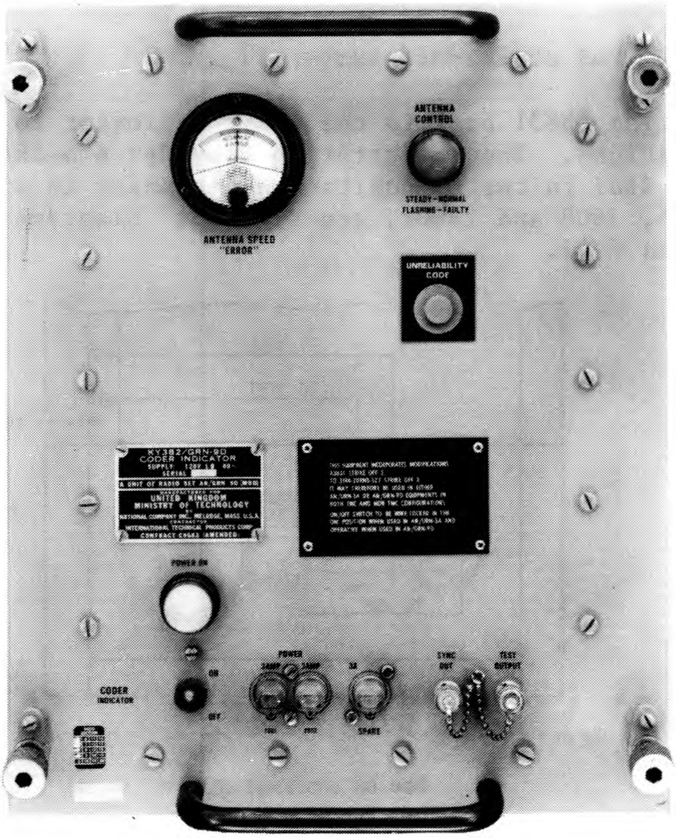


Fig. 11 Coder Indicator, Front View

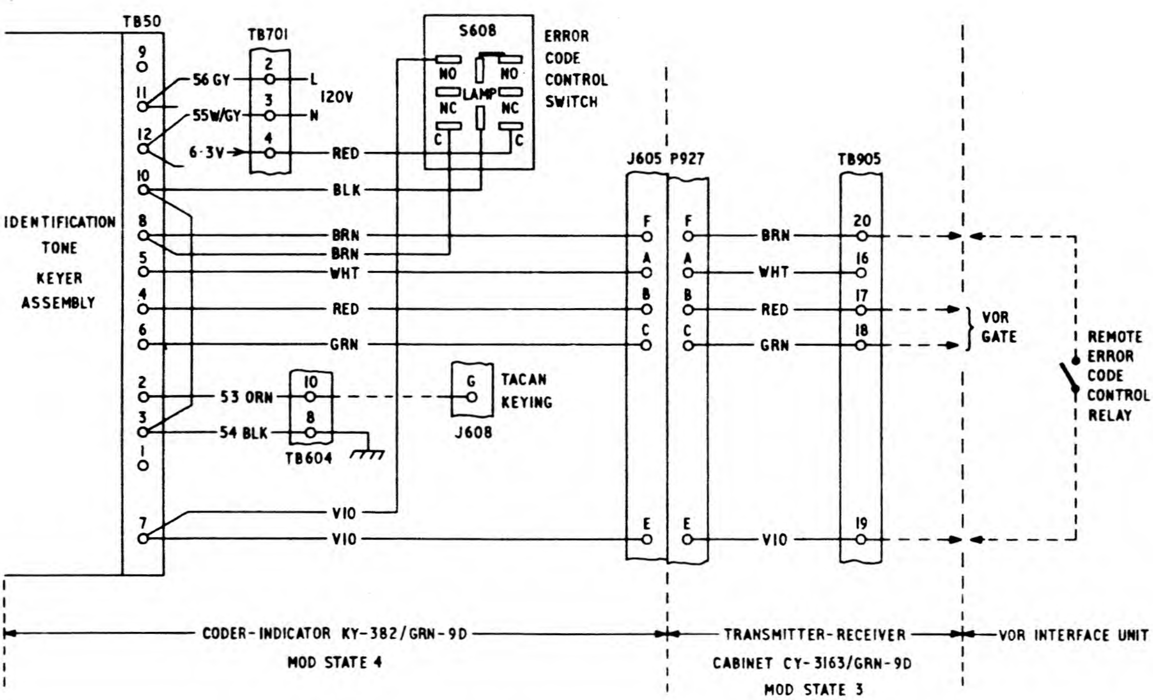


Fig. 12 Coder Indicator, Keyer Connections

CODER INDICATOR (Mod strike-off number 2)

20. Modification A3831 permits the coder indicator to be used in URN-3A beacon installations. The modification provides a method of mechanically locking switch S601 in the ON position and changes to wiring between connectors J605, J608 and TB604, see Fig. 13. Diagrams affected are Figures 6-23 and 6-41.

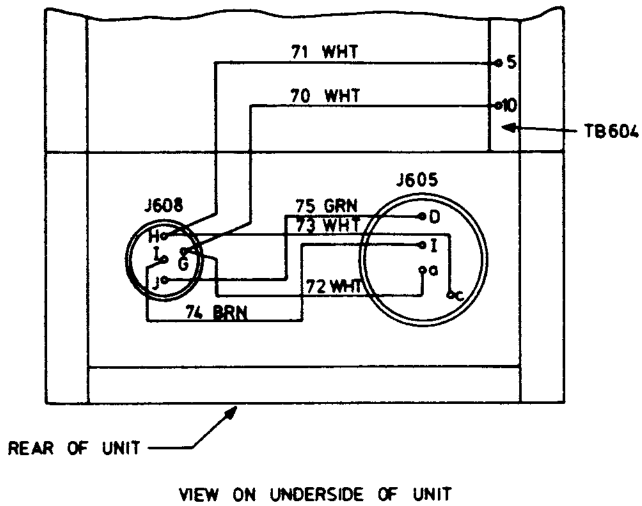


Fig. 13 Coder Indicator Wiring Change

HV POWER SUPPLY (Mod strike-off number 5)

21. Modification A6726 substitutes four resistors in series-parallel connection for the single resistor R1919 introduced by modification A3375, see paragraph 4. Figures 4 and 5 show the four resistors R1919a - R1919d.

FREQ. MULT. OSC. - OSC. SUB. ASSY. HB/LB (Mod strike-off number 3)

22. Modification A7031 substitutes valve types Y561 and Y616 for valve type 2C39A. V1504 and V1510 become type Y561; V1505 V1511 and V1512 become type Y616. The modification affects Table 1-4 and figure 6-19.

AMPLIFIER MODULATOR (Mod strike-off number 4)

23. Modification B0790 introduces a resistor (R1390) in parallel with the klystron filament to provide additional loading for the filament transformer and so reduce the filament voltage.

24. The resistor is selected from R1390 Resistor Set for the Amplifier Modulator, see Table 7-3. Resistor selection is required at initial installation of the equipment and when a new klystron is fitted. Figures 2-7, 4-37, 5-20, 6-20 and 6-39 show the details. The procedure for selecting the appropriate resistor is given in paragraph 2-5c.

SECTION 8

Chapter 2
ELECTRONIC KEYER UNIT (INTRODUCED BY MOD A6364)

INTRODUCTION

Description

1. The unit is an all electronic replacement for the mechanical coder units fitted in GRN-9D and URN-3A ground TACAN beacon transmitters.

2. It consists of a 64 bit integrated circuit read/write memory and means for programming it with the required message, and reading out that message without destroying it, repetitively.

3. The unit operates on 120/240 volts 50/60/ Hz mains and the memory is rendered non-volatile by the incorporation of a nickel/cadmium battery pack to maintain the memory during periods when power is disconnected. The estimated discharge time of the battery is 3 months approximately, and it is maintained on trickle-charge during normal operation.

4. The unit is built into a die-cast case, 185 x 120 x 56 mm, and is mounted vertically. Vertical mounting ensures that the mercury wetted contacts of the keying relays do not become excessively wetted by free mercury within the sealed capsules.

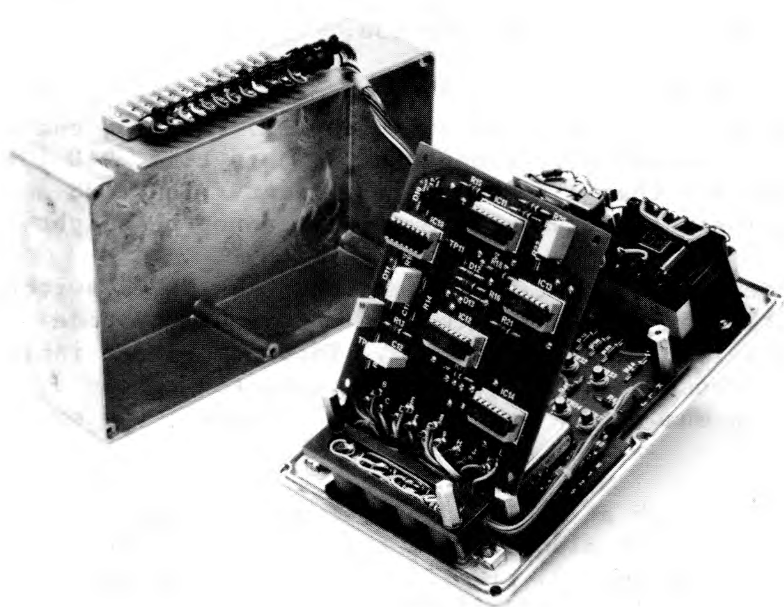


Fig. 1. Electronic Keyer Unit

CIRCUIT DESCRIPTION (see Figure 6)

5. IC11 is a 64 bit read/write memory addressed by means of a 256 bit counter, IC12. Associated gates and the coding bistable, used to operate the keying relay via TR34, are contained in IC13 and IC14. IC10 is the clock.

Reading

6. The feedback path enabling IC10 to oscillate continuously at approximately 8.5Hz, is from Q output pin 2 (Test Point 10) via the integrator R11 (100k) C12 (0.22 µf), one pair of contacts of the CODE switch S31 back to the S connection of IC10, pin 6. The time constant is C11 (0.22 µf), R10 (390K), RV10 (10K) and R13 (22K). The RV10 is the code speed control.

7. Each pulse from IC10 clocks the address counter IC12 on its clock input, pin 9. Six of the outputs of IC12 address the memory unit, which is therefore taken through all of its 64 bits in 7½ seconds approximately.

8. Pulses also leave IC10 pin 13 (STROBE,TP11) to pin 5 of IC11 (see Fig 2E). These interrogate the memory. If a "1" is stored at the selected address, a "1" pulse of 50 µs duration emerges from pin 10 (Fig 2F) and trips the code bistable, two NOR sections of IC14. A "1" transition leaves IC14 pin 10 (Fig 2G) and passes via R45 (22K) to drive TR34 into conduction, closing RLB and lighting the lamp D38 (yellow) to indicate that a "mark" is being sent.

9. The next pulse from IC10 (a) changes the address by one digit (Fig 2 B and C), and also resets the code bistable (IC14 pin 6). The pulse which emerges from IC11 pin 10 to unset the code bistable should a "1" be stored at this address also, occurs on the trailing edge of the STROBE pulse, (compare waveforms Fig 2 E and F). Should a "0" be stored at the address, no pulse leaves IC11, the coding bistable remains set, and TR34 remains cut-off, extinguishing the yellow lamp D38.

10. During periods when a space ("0") is being sent, the potential on TR34 is high. This potential, connected via R41 (22K) to TR33, enables it, and since TR35 can be assumed to be conductive at this time, D40 (Green) lamp will light to indicate that a space is being sent. Thus D38 and D40 operate on an exclusive OR basis - i.e., they cannot be alight together.

11. The description in (5) to (10) assumes that the ERROR switch, S30, is in the TEST position or S608 selecting the Unreliability Code. In the TEST position, pin 13 of IC13 is earthed. This pin is one input of a three input NAND, whose output, pin 10, is connected to pin 6 of IC11. Pin 6 of IC11 is an enable pin and with a "1" present, the memory is fully accessible.

12. With the ERROR switch at REMOTE, S608 at normal (and assuming that the remote circuit has not also earthed the connection due to a fault in the TACAN beacon equipment), pin 13 of IC13 is permanently enabled from the +14V supply rail via R22 (100K). The other two inputs cycle according to waveform F (figure 3), whence it will be seen that 16 bits of the memory become suppressed, (but not erased). These bits contain an error code to be sent after the call-sign in the event of the TACAN station being temporarily unmonitored over the full range of TACAN parameters.

10. During periods when a space ("0") is being sent, the potential on TR34 is high. This potential, connected via R41 (22K) to TR33, enables it, and since TR35 can be assumed to be conductive at this time, D40 (Green) lamp will light to indicate that a space is being sent. Thus D38 and D40 operate on an exclusive OR basis - i.e., they cannot alight together.

11. The description in (5) to (10) assumes that the ERROR switch, S30, is in the TEST position or S608 is selecting "Unreliability Code". In the TEST position, pin 13 of IC13 is grounded. This pin is one input of a three input NAND, whose output, pin 10, is connected to pin 6 of IC11. Pin 6 of IC11 is an enable pin and with a "1" present, the memory is fully accessible.

12. With the ERROR switch at REMOTE, S608 at normal (and assuming that the remote circuit has not also earthed the connection) pin 13 of IC13 is permanently enabled from the +14V supply rail via R22 (100K). The other two inputs cycle according to waveform F (figure 3), whence it will be seen that 16 bits of the memory become suppressed, (but not erased). These bits contain an error code to be sent after the call-sign in the event of the TACAN station being temporarily unmonitored over the full range of TACAN parameters.

13. In a similar manner, with S30 at TEST (or when signalled whilst at REMOTE), pin 1 of IC13, (one input of a three input NAND), is permanently enabled by IC13 pin 10. Hence the other two pins, 8 and 2, cycle, yielding waveform J (Fig 3) at the output pin 9. This is inverted and causes TR31 to conduct for the 16 bits ERROR period, lighting the ERROR lamp D35 (Fig 3K).

14. With S30 at REMOTE, and normal operation, IC13 delivers an inverted edition of waveforms 3 and 4 (waveform F, fig 3) to IC13 pin 1 at the same time as pins 8 and 2 of IC13 are receiving the normal waveforms 3 and 4. The net result is that IC13 remains inhibited, and the "1" output, inverted to become "0", cuts of TR31, inhibiting the ERROR lamp (Fig 3 H).

15. Waveform L (Fig 3) is derived from the 128 and 256 outputs of IC12 combined, and goes to three places:
(a) to pin 8 of IC11, where it inhibits the code for 192 bits out of every 256 bits, yielding a code repetition of once every 30 seconds approximately, and (b) to TR 35 via R42 (22K), and (c) TR32 via R39 (22K).

16. TR35 is an overriding enable/inhibit preventing the "0" (green) lamp remaining alight during the 192 bit period when no code is being sent. TR32 operates RLA, and this also is inhibited except when code is being sent. RLA is the V.O.R. GATE RELAY, and, hence, waveform L is known as V.O.R. GATE waveform.

Reset

17. Reset is accomplished by the RESET button (S32) which puts +14V on the reset pins of IC10, returning the address to count 1. The operation is independent of all other operations, and does not erase the memory.

Enter

18. Placing the code switch to ENTER:-

a) Breaks the feedback path of IC10 so that it no longer oscillates.
b) connects IC10 "S" input to the "1" and "0" buttons.
c) connects the second Q output of IC10 (pin 12) to the READ/WRITE connection of IC11, pin 9.

19. After pressing RESET, if S33 is now depressed once, C38, previously charged to +14 volts via R32 (470K) is made to discharge via D36 and R33 (22K). The short voltage pulse passed C33 (330pf) and travels via two contacts of S31 to IC10 pin 6. The output of IC10 at pin 2 (Test Point 1) clocks IC12 by one digit. The output at pin 12 of IC10 passes via the second pair of contacts of S31 to reach pin 9 of IC-1, allowing new data to be entered at the end of the 50μs period. An enable leaves pin 13 of IC10 and reaches pin 5 of IC11, while the same waveform resets the coding bistable, (pin 6 of IC14).

20. The initiating pulse from C38 also passes via the delaying circuit R34 (4.7K) C31 (2200pf) to pin 13 of IC11, (waveform A, fig 2) reaching it slightly after the previous operations. This allows a "1" to be injected into memory, and this is also read out from pin 10 of IC11 (waveform F, Fig 2) to set the coding bistable to the "1" state, causing the yellow "1" lamp to light.

21. Pressing the "0" button similarly causes C38 to discharge but now the pulse passes only via C33 to perform the operations described in (19). The path to R34 is inhibited by the diode D36, which is reverse biased by the pulse. Hence no potential is injected into the memory data input, and IC11 stores a "0" at that address.

Note ...

> The sequencing operations performed by the unit are the same for entering the code as for reading it out, i.e., with S30 at REMOTE, bits No.48 to 64 are inaccessible, and code can be written in only during the first 48 bits of every 256 bits.

Setting up the code

22. Instructions for setting up the code are given in paragraph 19 of Chapter 1 of this section.

Speed adjustment

WARNING ...

> DANGEROUS VOLTAGES EXIST IN THE TRANSPONDER CODER-INDICATOR DRAWER. AVOID PERSONAL CONTACT WITH LIVE PARTS.

23. The coding speed adjustment R110 can be reached by withdrawing the Coder-Indicator drawer to its fullest extent and letting down the chassis at the left-hand side. The adjustment to R110 in the electronic keyer can then be made using a grubscrewdriver through the hole in the back of the keyer case.

24. After adjusting the length of one dot to 110 ms approx, the chassis should be resecured and the drawer pushed back and secured.

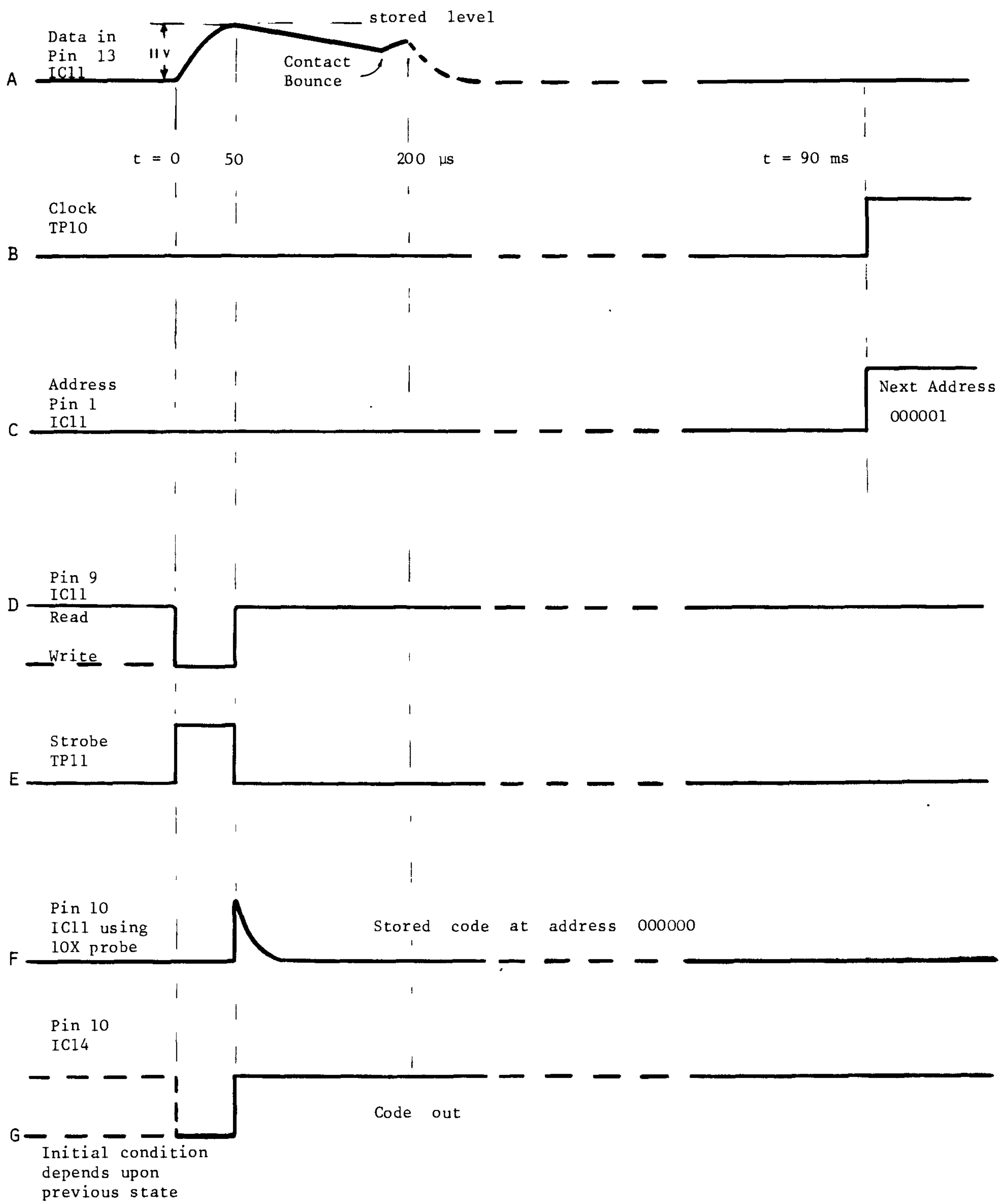


Fig.2. Timing diagram for entry of "1" at t = 0 (after reset)

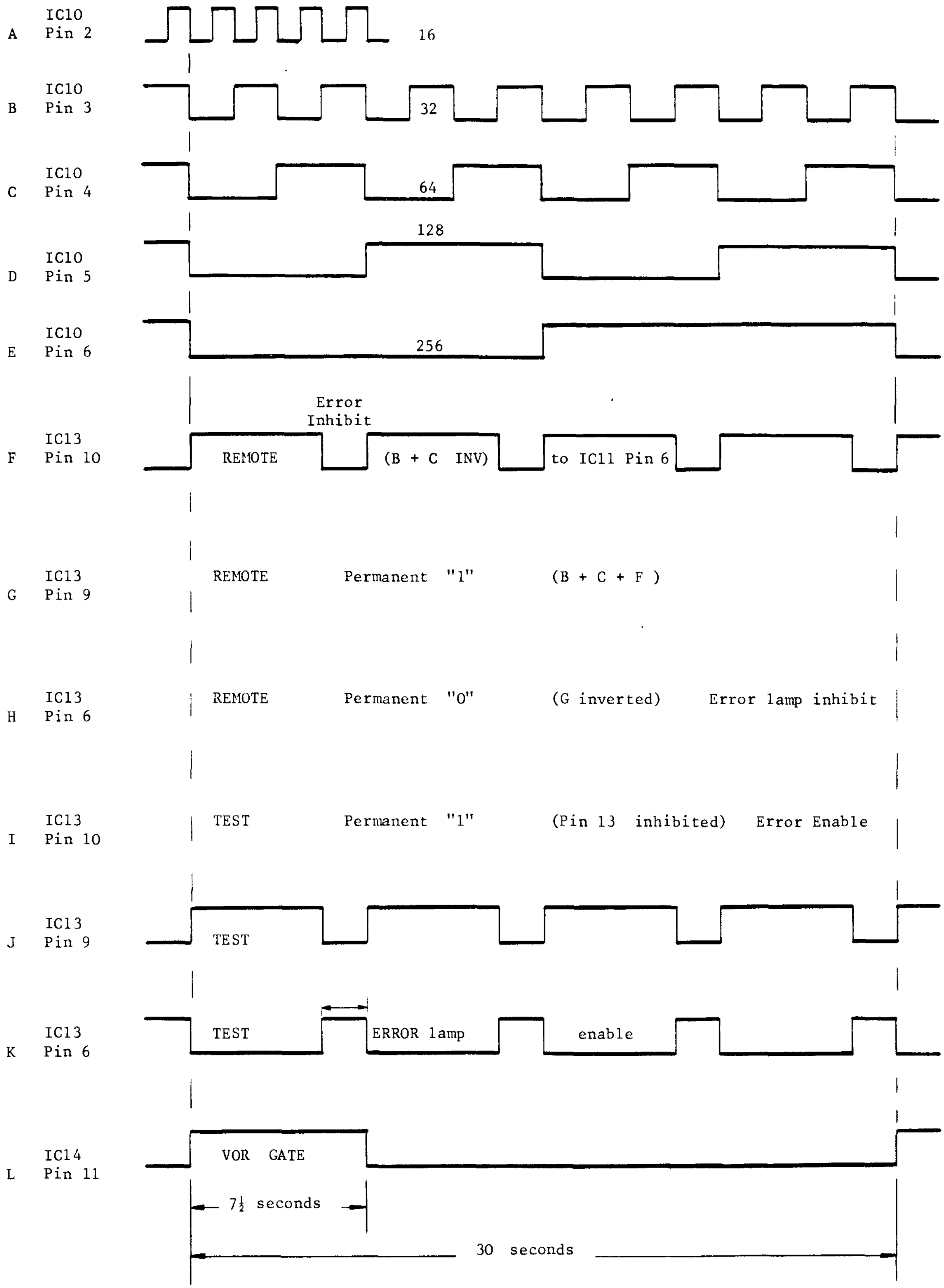


Fig.3. Clock timing diagram

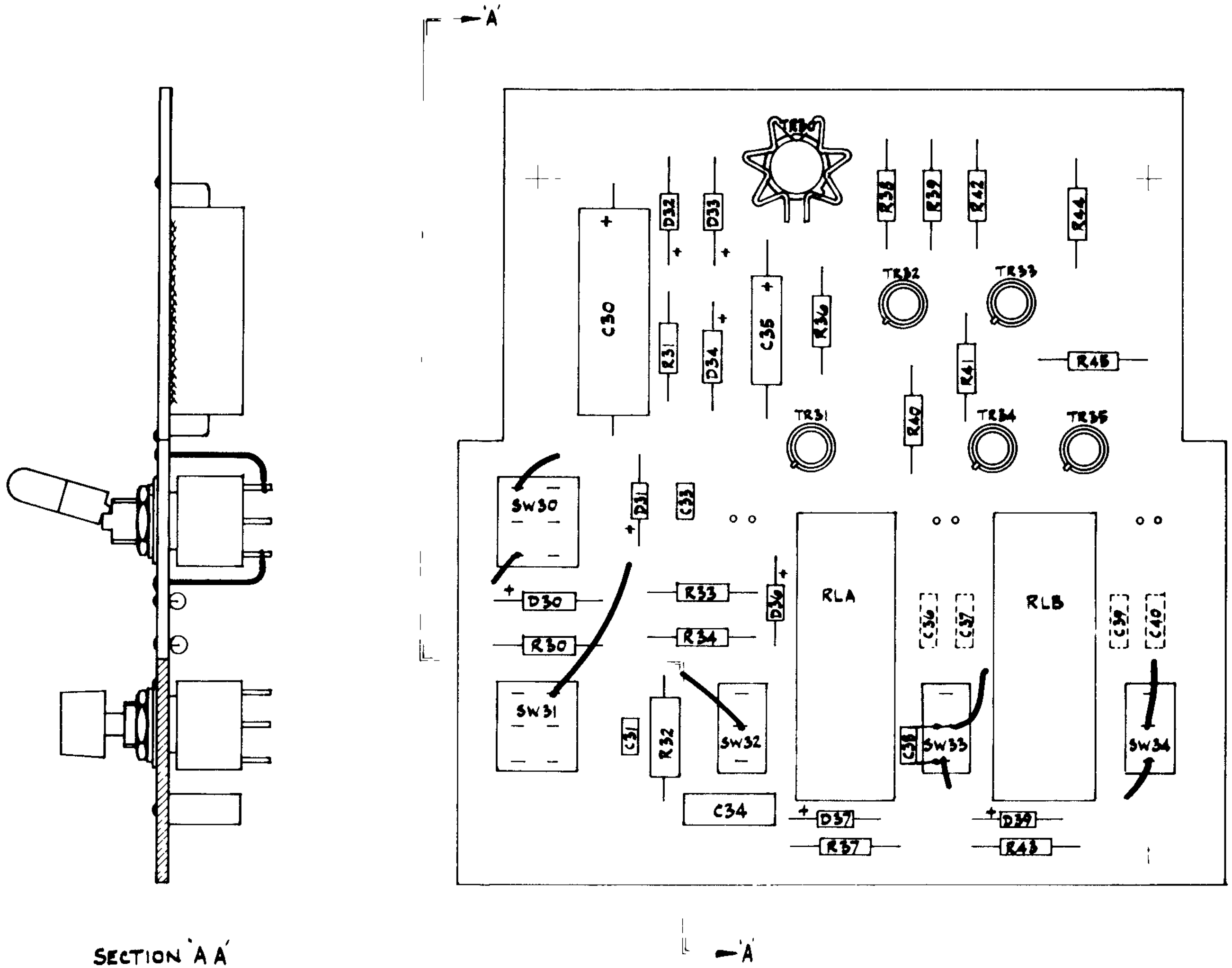


Fig 4 Control Display Board

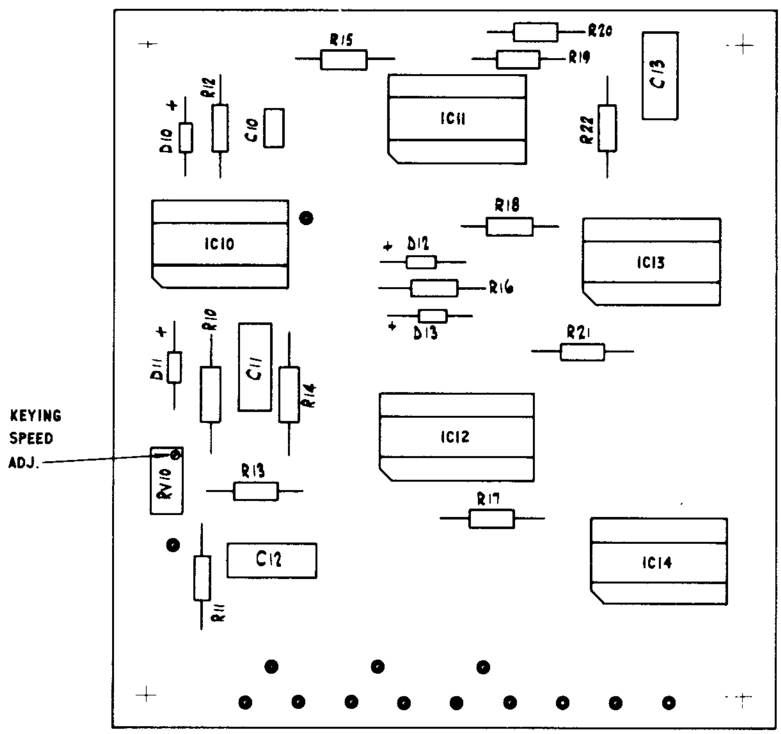


Fig 5 Logic Board

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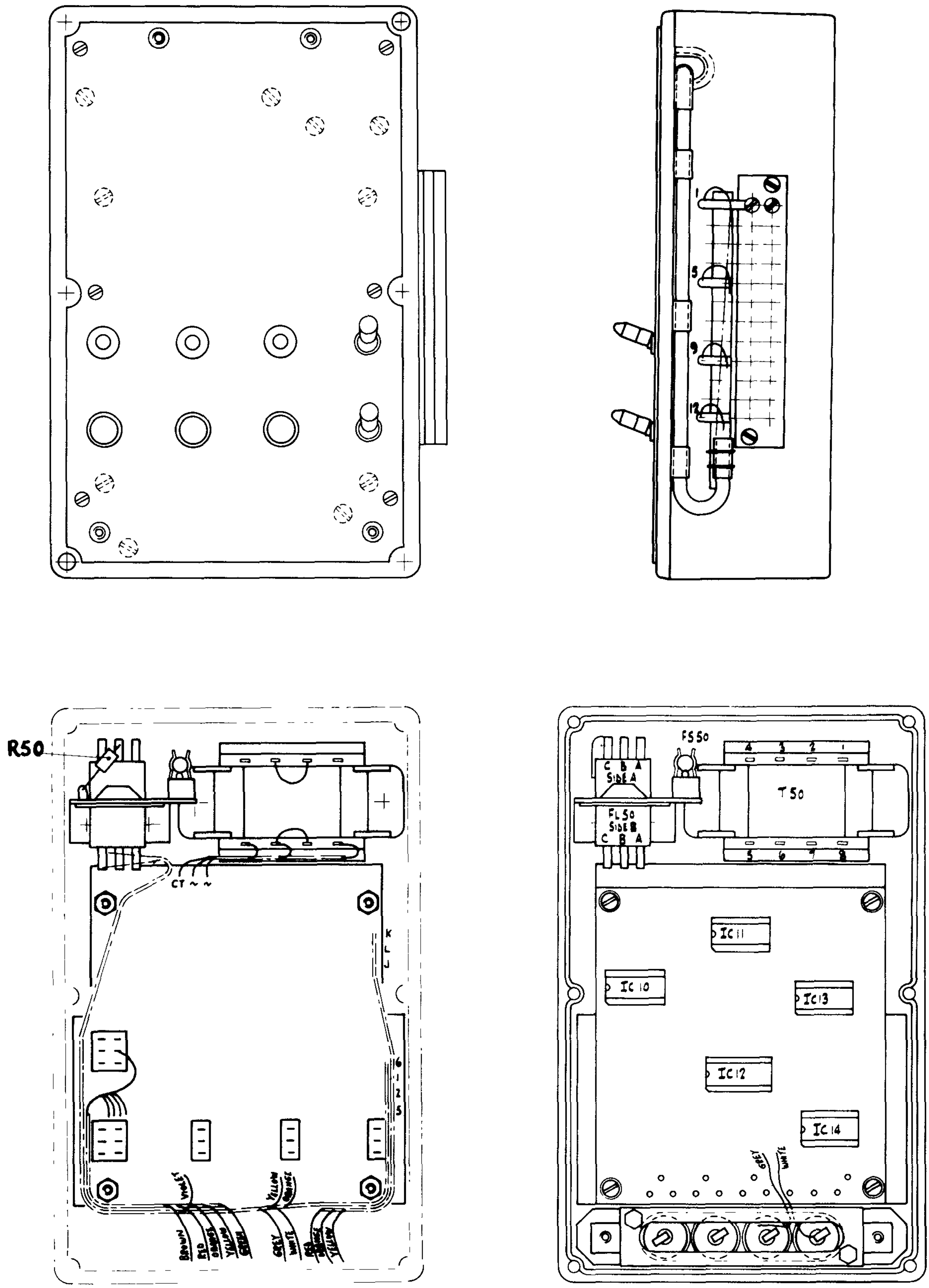
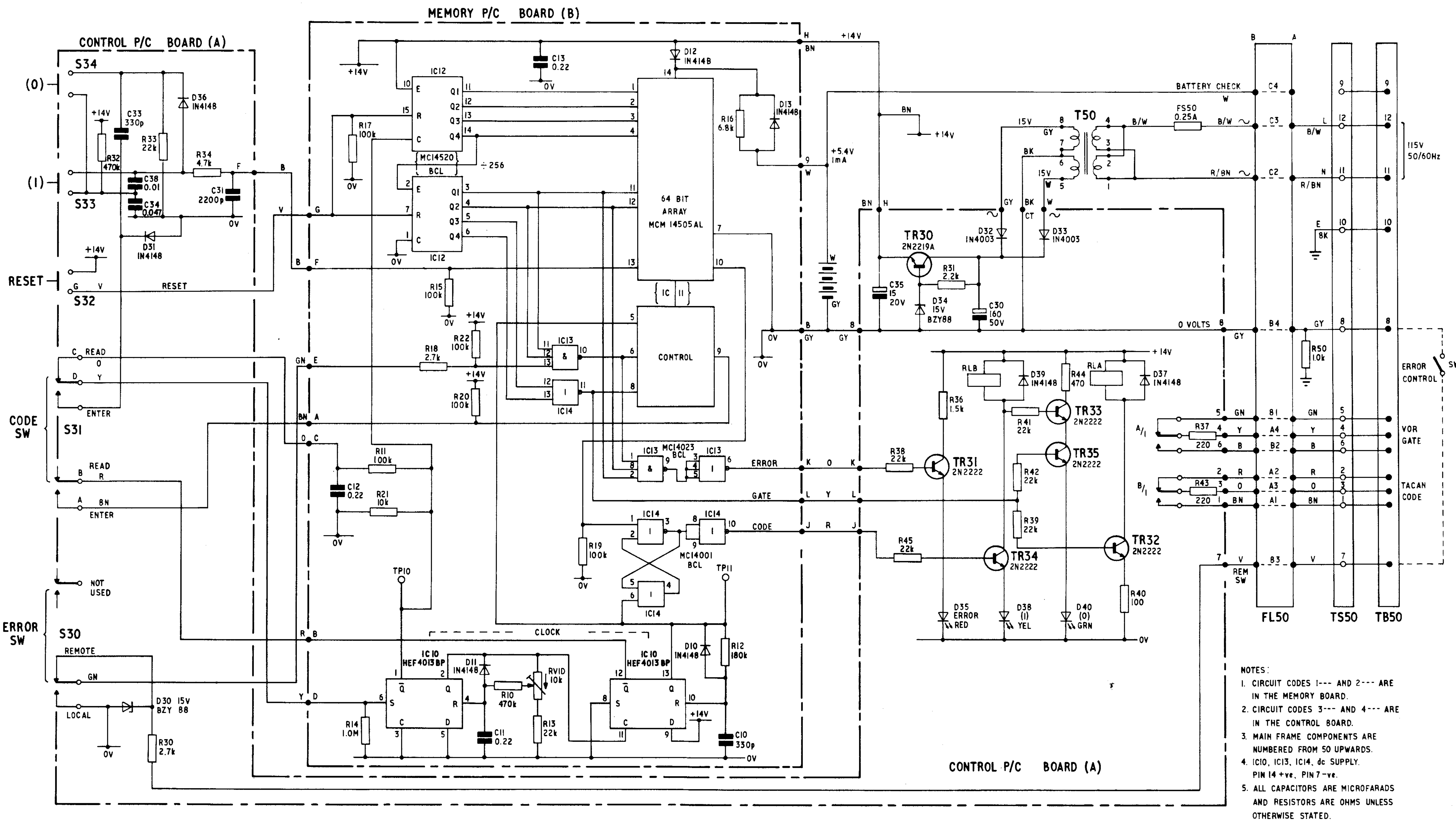


Fig 6 Key Unit Assembly



NOTES:
1. CIRCUIT CODES 1--- AND 2--- ARE IN THE MEMORY BOARD.
2. CIRCUIT CODES 3--- AND 4--- ARE IN THE CONTROL BOARD.
3. MAIN FRAME COMPONENTS ARE NUMBERED FROM 50 UPWARDS.
4. IC10, IC13, IC14, dc SUPPLY. PIN 14 +ve, PIN 7 -ve.
5. ALL CAPACITORS ARE MICROFARADS AND RESISTORS ARE OHMS UNLESS OTHERWISE STATED.

Keyer unit circuit

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