NAVSHIPS 91232 RESTRICTED

INSTRUCTION BOOK

for

KEYER
KY-30/GRT

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

BUREAU OF SHIPS NAVY DEPARTMENT

Contract: NObsr-39324

Approved by BuShips: 23 September 1949
Change 1: 5 July 1950

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
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B and C	Original	5-1	Change 1
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DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO

Code 993-100
5 July 1950

From: Chief, Bureau of Ships
To: All Activities concerned with the Installation, Operation and Maintenance of the Subject Equipment.

Subj: Change 1 to Instruction Book for Keyer KY-30/GRT (NAVSHIPS 91232)

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GUARANTEE

The equipment, including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten per cent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of the contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

INSTALLATION RECORD

Contract Number NObsr-39324 Date of Contract 25 June 1947

Serial Number of equipment_____

Date of acceptance by the Navy_____

Date of delivery to contract destination_____

Date of completion of installation_____

Date placed in service_____

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

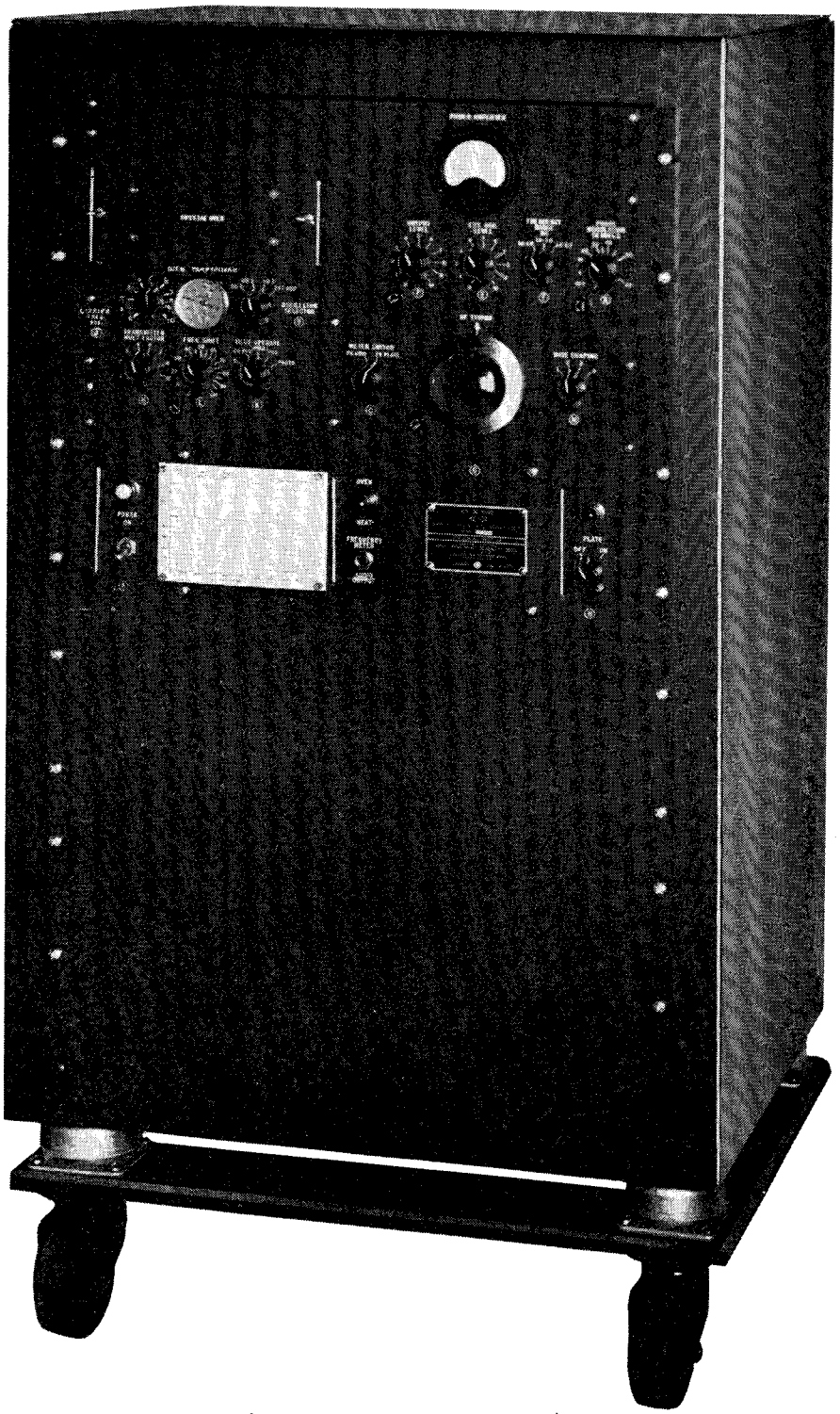


Figure 1-1. Keyer KY-30/GRT

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE AND USE.

A frequency shift keyer is used in a radio telegraph system to cause a radio transmitter to emit one frequency for a mark signal and a different frequency for a space signal rather than the more common method of transmission, interrupting a single-frequency carrier. As compared to the interrupting of single-frequency carrier, the two frequency method of operation provides better signal-to-noise ratio since receiver avc can be used effectively. This results in a considerable improvement in reception.

The radio-frequency output of Keyer KY-30/GRT (figure 1-1) is in the range 1000 to 6700 kilocycles. This frequency is shifted upward or downward a small amount to produce r-f telegraph signals corresponding to the d-c polar or neutral signals connected to the keyer. The difference between the upper and lower r-f shifts is commonly about 850 cycles, but the total shift can be set for values ranging from a few cycles to 1,000 cycles. The r-f output circuit of the keyer is designed to be connected to the power amplifiers of a radio transmitter.

Keyer KY-30/GRT is mounted in a mobile cabinet equipped with shockmounts. It is connected to a radio transmitter by cable assemblies. If desired, the keyer chassis may be installed in a standard 19 inch relay rack.

2. PRINCIPLE OF OPERATION.

Frequency shift keying is used principally for long distance communication in the high-frequency range. The keyer can be connected to different types of Navy transmitters and is arranged so that the closing of the contacts of a telegraph key, or a teletypewriter, produces a mark signal which causes the transmitter to emit a frequency above the mean assigned frequency of the transmitter. The opening of the contacts of a telegraph key, or a teletypewriter, produces a spacing signal which causes the transmitter to emit a frequency below the mean frequency of the transmitter. The upper and lower values of the shifted frequency are adjusted to be located symmetrically about the assigned transmitter frequency (above and below the carrier by about 425 cycles, if the total shift is 850 cycles).

The principle of operation of the keyer is suggested by the functional block diagram (figure 2-1). The r-f input to the keyer may be that from an oscillator associated with a Navy transmitter or that of the crystal oscillator of the keyer. The keyer oscillator is equipped with three crystals, any one of which may be selected by a CRYSTAL SELECTOR switch. The input to the keyer must be in the frequency range 0.8 to 6.5 mc, which is 200 kc less than the output frequency. As described later, the frequency of a 200 kc oscillator is raised and lowered a small amount in response to mark and space telegraph signals and added to the radio-frequency output of the transmitter (or keyer) oscillator in the balanced modulator. The transmitter (or keyer) oscillator frequency is balanced out. Only the sum and difference frequencies, resulting from mixing the keyer input and the 200 kc oscillator output, are present in the output of the balanced modulator. The plate circuit of the modulator is tuned to the higher or sum frequency, thereby eliminating the difference frequency.

The components of the Crystal Oscillator, the 200 kc Oscillator, Balanced Keyer and Phase Shifting Amplifiers are located in an oven, the temperature of which is closely regulated at about 72°C. (161.6°F.).

The output of the balanced modulator is amplified in two stages consisting of an intermediate amplifier and an output, or power, amplifier. The intermediate stage permits a low output from the balanced modulator, and provides additional filtering of the sideband output. A ganged variable capacitor tunes the output circuit of the balanced modulator, the intermediate amplifier and the output circuit of the power amplifier stage. The plate circuit of the output amplifier includes an autotransformer for matching the low impedance of the line to the radio transmitter.

The output level is controlled by adjusting the screen voltage of the PA and buffer stages. The tuned circuits of the balanced modulator and the intermediate and output amplifiers are separated into three bands in the ranges 1.0 to 1.9 mc, and 1.9 to 3.6 mc and 3.6 to 6.7 mc, any one of which may be selected by a FREQENCY RANGE switch.

The keying circuit normally operates on polar signals, or neutral signals. In ordinary cases the negative side of the external keying circuit is at ground potential. The limiter tube, V-101, prevents negative key line voltage from affecting operation. Limiter V-102 limits the maximum positive signal to the balanced keyer tube to maintain a constant value in spite of variations in amplitude of key line signals. The form of the output keying voltage may be modified by the series inductance and bridge capacity controlled by the WAVE SHAPING switch. It may also be "wobbled" at about 200 cycles per second by turning on the PHASE MODULATION switch. The amount of phase modulation is varied by adjusting an associated dial. Phase modulation of the trans-

mission may tend to improve reception under some conditions of severe selective fading.

The output voltage from the limiter tube results in mark and space signals, with or without wave shaping and phase modulation, which are coupled to the balanced keyer tube. The full output of the balanced keyer tube, or a fraction thereof, is connected to a two stage phase shifting amplifier through a point on a voltage divider selected by the TRANSMITTER MULT. FACTOR switch. The output of the phase shifting amplifier is connected to the 200 kc oscillator and causes the frequency of the 200 kc oscillator to increase a small amount (for example 425 cycles for a mark signal) or to decrease a small amount (for example, 425 cycles for a space signal). The amount the frequency of the 200 kc oscillator is changed depends upon the output of the phase-shifting amplifier, which in turn is influenced by the input from the balanced keyer tube.

The 200 kc oscillator is a self-excited single-ended type, the frequency of which is changed by the output of the phase shifting amplifier and to a limited extent by a variable capacitor, CARRIER FREQ. ADJ. The output of the 200 kc oscillator is frequency modulated by telegraph mark and space signals, with or without super-imposed wave shaping and phase modulation. This frequency modulated 200 kc oscillator output is combined in the balanced modulator with the output of the transmitter (or keyer) oscillator.

The keyer has a rectifier power-supply circuit which produces a low-voltage a-c heater supply, a positive 400 volt plate supply, a positive 250 volt plate supply, a regulated positive 150 volt supply, and a negative 45 volt bias supply.

3. UNITS OF EQUIPMENT.

a. KEYER KY-30/GRT.—The KEYER KY-30/GRT is assembled on a chassis which is equipped with a front panel containing operating control dials, switch knobs and handles, a milliammeter, a temperature-controlled oven indicator, pilots, etc. (Figure 1-2). The unit includes 19 electron tubes, five of which are associated with a self-contained power supply circuit.

The radio transmitter at the transmitting station is equipped with a Connector Panel Navy Type 62254. This panel is universal in that connections can be made to different types of frequency shift keyers. The connector panel contains coaxial jacks, power supply, and other receptacles which correspond to those of Keyer KY-30/GRT. The keyer can be quickly associated with other components of the system by connecting six patching cable assemblies. These six connections provide a primary power supply

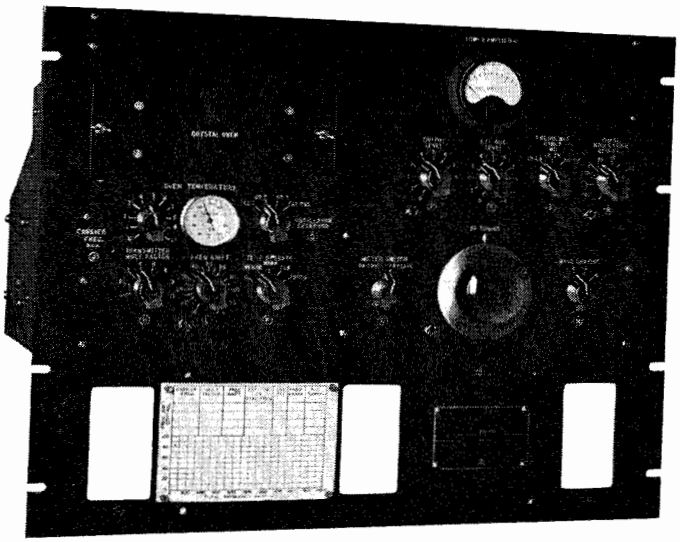


Figure 1-2. Keyer KY-30/GRT, R-F Chassis Front View

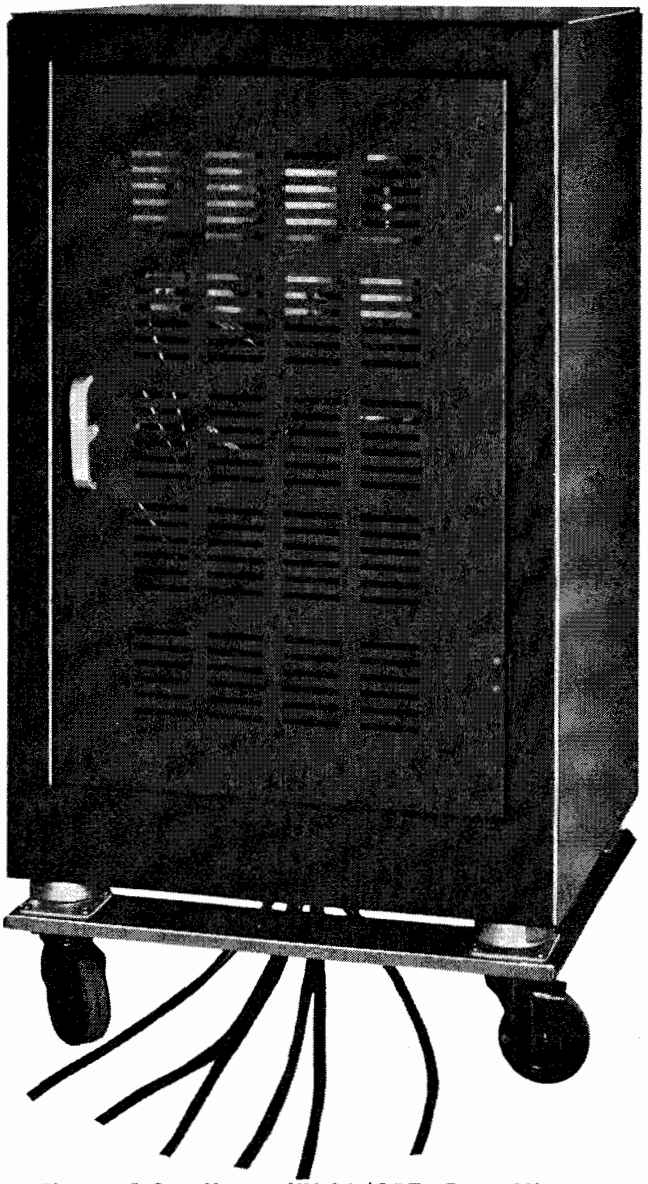


Figure 1-3. Keyer KY-30/GRT, Rear View — Door Closed

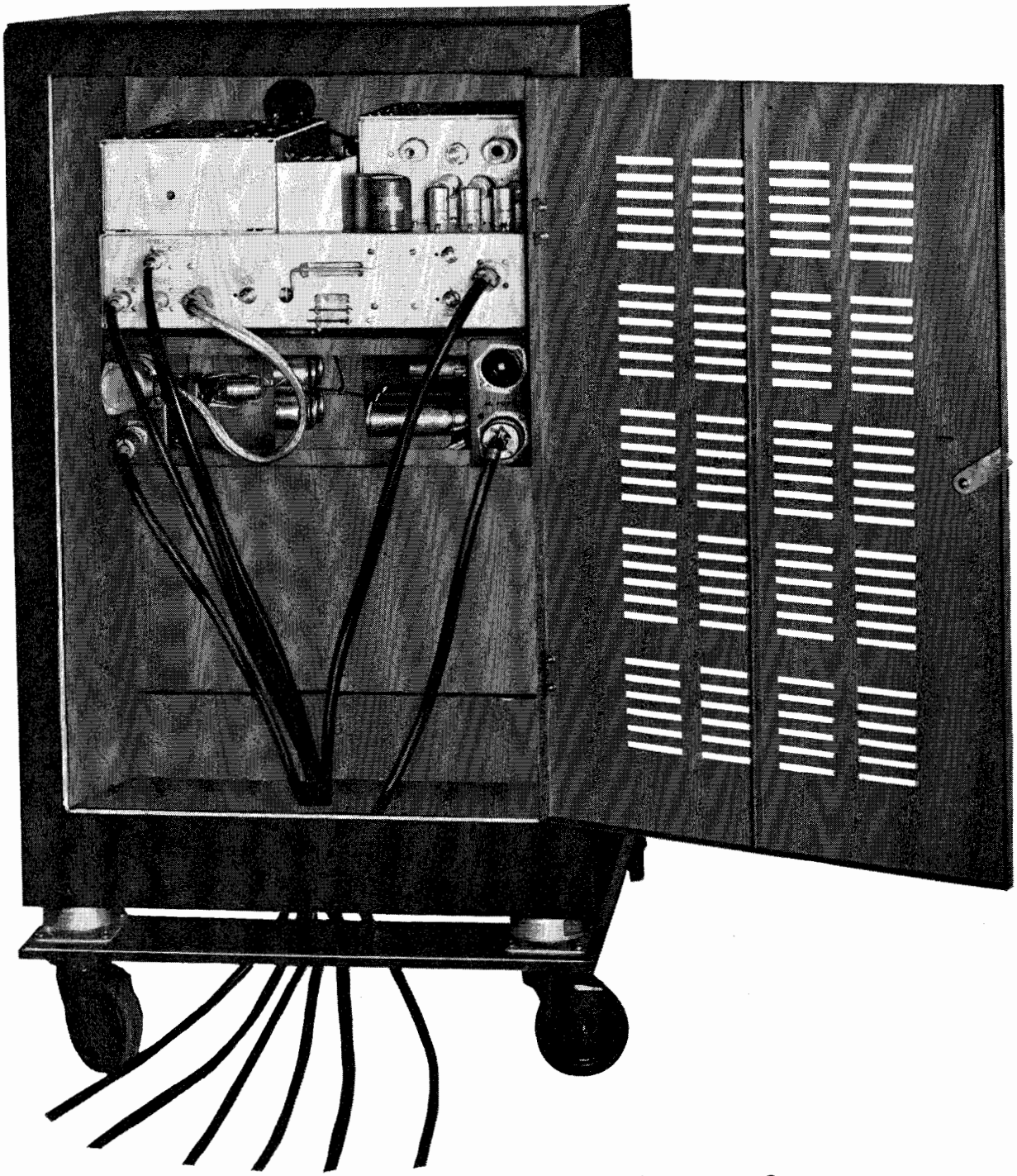


Figure 1-4. Keyer KY-30/GRT, Rear View — Door Open

to the keyer and complete the input, output, and test connections.

b. SHOCK-RESISTING CABINET.—The cabinet is about 40 inches high and is equipped with rubber shockmounts to minimize the effects of shocks and vibrations on the components of the chassis-mounted Keyer KY-30/GRT. The cabinet is equipped with 4 casters for portability.

c. CABLE ASSEMBLIES.—Six cables connect the Keyer KY-30/GRT to the radio transmitter, a primary power outlet, and other units.

d. SPARE PARTS.—Equipment spare parts for each installation are furnished, as well as stock spare parts for a group of installations. The spare parts are boxed separately.

e. TESTING FACILITIES.—No special testing equipment is required for the Model KY-30/GRT Frequency Shift Keyer other than an OCT frequency

shift monitor and test equipment ordinarily available at a radio transmitting station. Two of the six cables assemblies mentioned in paragraph 3.*c.* and the associated receptacles of the keyer, are used to connect to the radio-frequency measuring equipment of the transmitter.

4. REFERENCE DATA.

TABLE 1-1 GENERAL INFORMATION AND PHYSICAL CHARACTERISTICS

CONTRACT NUMBER AND DATE
NObsr-39324 dated 25 June, 1947
CONTRACTOR AND MANUFACTURER
Collins Radio Company, Cedar Rapids, Iowa
COGNIZANT NAVAL INSPECTOR
Assistant Inspector of Naval Materials, 855 35th St. N.E.
Cedar Rapids, Iowa

WEIGHTS AND DIMENSIONS
Overall depth: 24″ including switches projecting in front of panel and cables in rear
Height: 41″
Width: 22″
Depth: 21″
Weight: 200 lbs.

TABLE 1-2 ELECTRICAL CHARACTERISTICS

a. CRYSTAL OSCILLATOR. (OVEN)	Type	Quartz CR-27/U in HC-6/U or HC-1/U Holder Pierce Oscillator Circuit.
	Quantity	Three (switch selection).
	Frequency	Keyer output frequency (mc) less 200 kc in range 0.8 to 6.5 mc (when amplitude-modulated by 200 kc) the upper sideband is used.
	Oven	72°C (161.6°F) Thermoswitch control of heater resistors. Dial type temperature indicator. Amber guard lamp when thermoswitch connects power to heater resistors.
b. BALANCED MODULATOR AND TWO-STAGE AMPLIFIER.	Modulation	0.8 to 6.5 mc carrier which is amplitude modulated by 200 kc (carrier and lower sideband suppressed; upper sideband used).
	Level of unwanted lower sideband	At least 35 db below the carrier.
c. RF OUTPUT	Frequency Range	1000 to 6700 kc.
	Tuning	Continuous coverage in three bands.
	Power	Adjustable from maximum of six watts or more to a level 20 db below 6 watts.
	Output Impedance	75 ohms resistive load.
	Test connection RF coupling	Cable connection to frequency meter.
d. TELEGRAPH SIGNALS INPUT.	DC Polar or	(plus for mark, minus for space).
	DC Neutral	(Plus for mark and zero for space).
	Input Impedance	100,000 ohms.
	Keying Voltage	Minimum, 40 v; maximum, 120 v.
	Keying Speed	240 dot cycles per second.
e. PHOTO INPUT.	Input Impedance	600 ohms.
	Keying Voltage	Minimum, 18 v; maximum, 20 v. 30 db range.
	Keying Speed	2000 dot cycles per second.
f. FREQUENCY SHIFT.	Frequency Shift Range	0 to ±1000 cycles per second.
	Frequency Multiplication	8 values of radio frequency shift of the proper value to allow for transmitter multiplication factors of 1, 2, 3, 4, 6, 8, 9 and 12.
	Phase Modulation	At a rate of 200 cycles per second controlled by potentiometer and on-off switch and adjustable to 1 radian.
	200 kc Oscillator Accuracy	±5 cycles per second.
g. PRIMARY POWER SUPPLY.	Frequency	50-60 cycles.
	Phase	Single phase.
	Voltage	115/230 volts.
	Power Consumption	
	Oven warm-up	320 watts.

	Oven Heat OFF	Oven Heat ON
Plate Off / Power On	110 watts	220 watts
Plate On / Power On	155 watts	265 watts

TABLE 1-3 ELECTRON TUBE COMPLEMENT

SYMBOL DESIGNATION	TYPE	MAJOR CIRCUIT DIVISION	FUNCTION
V-101	JAN 6AL5	Keyer	Limiter
V-102	JAN 6AL5	Keyer	Limiter
V-103	JAN 6AK5W	Keyer	Phase Modulation Oscillator
V-104	JAN 12AU7	Oven	Balanced Keyer
V-105	JAN 6C4	Oven	Phase Shifting Amplifier
V-106	JAN 6C4	Oven	Phase Shifting Amplifier
V-107	JAN 6BA6	Oven	200 kc Oscillator
V-108	JAN 6AK5	Oven	Crystal Oscillator
V-109	JAN 12AU7	RF Section	Amplifier and Cathode Follower
V-110	JAN 6J6	RF Section	Phase Inverter
V-111	JAN 6BE6	RF Section	Balanced Modulator
V-112	JAN 6BE6	RF Section	Balanced Modulator
V-113	JAN 6BA6	RF Section	Buffer
V-114	JAN 807	RF Section	RF Power Amplifier
V-115	JAN OD3/VR150	Power Supply	Voltage Regulator
V-116	JAN 6X4	Power Supply	Rectifier L.V.
V-117	JAN 6X4	Power Supply	Rectifier L.V.
V-118	JAN 6X4	Power Supply	Rectifier Bias V.
V-119	JAN 5R4GYW	Power Supply	Rectifier H.V.

SECTION 2
THEORY OF OPERATION

1. GENERAL.

a. FREQUENCY SHIFT SYSTEM.—The Frequency Shift Keyer is ordinarily used at the transmitting station of a radiotelegraph circuit. Telegraph signals are generated at a control point equipped with teletypewriter keyboards, tape transmitters, or a hand telegraph key for frequency shift transmission. At the receiving terminal the frequency shifted signals are copied by an operator, in the case of hand sending, or they serve to actuate a teletypewriter, a re-perforator, or a tape recorder. Both the transmitting and receiving radio stations may be remote from the communication centers and they are ordinarily connected to the stations by means of wire circuits.

2. KEYER KY-30/GRT.

a. OPERATING FREQUENCIES.—This keyer requires a radio-frequency carrier between 0.8 and 6.5 mc which must be approximately 200 kc lower in frequency than the assigned mean carrier frequency of the transmitter. The carrier can be obtained either from the oscillator, included in the keyer, or from an external oscillator which can be the master oscillator or crystal controlled oscillator of the associated transmitter.

b. EQUIPMENT ARRANGEMENTS. — The frequency shift keyer is mounted on a horizontal chassis with a 15½ inch by 19 inch panel. All controls necessary for normal tuning and adjustment of

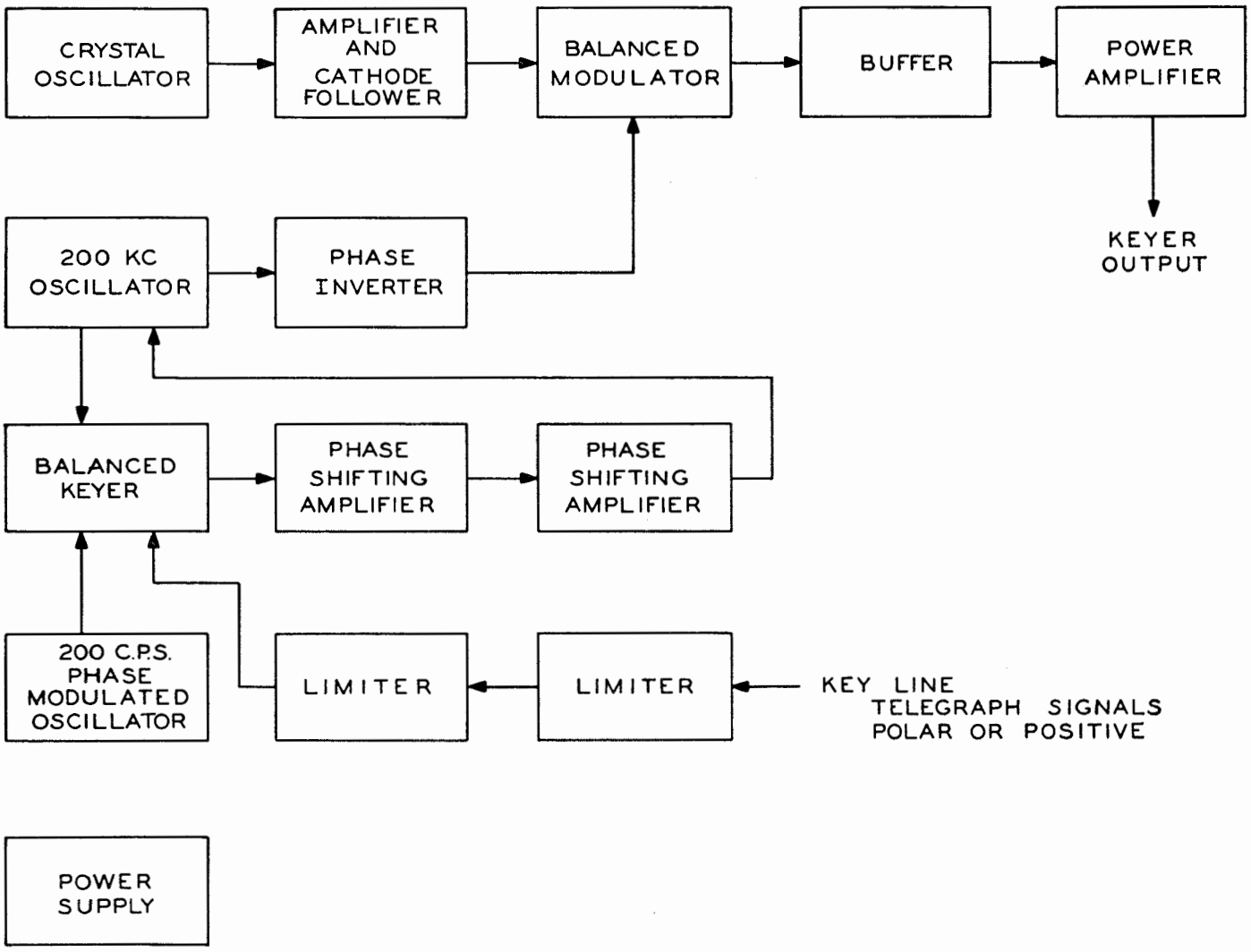


Figure 2-1. Functional Block Diagram

the equipment are located on this front panel. Controls not requiring adjustment during normal operation are located at the rear of the chassis. Fuses and receptacles for attached cable assemblies are also on the rear of the chassis. A temperature controlled oven which contains the 200 kilocycle oscillator and its components is located on the horizontal chassis. Also included in the oven are the keyer tube circuits and phase shifting amplifier circuits which are necessary to bring about frequency shift operation of the 200 kilocycle oscillator. The oven includes provisions for mounting 3 crystals. The radio frequency circuits which mix the injection voltage and the 200 kilocycle oscillator voltage and amplify the output of the mixer are located in shielded compartments to prevent interaction. A 5-gang tuning capacitor provides simultaneous tuning of all circuits within the operating range of the unit.

c. CIRCUIT ELEMENTS.—The simple block diagram of figure 2-1 shows the association of the main parts of the frequency shift keyer. In this block diagram, it may be seen that the signal from the crystal oscillator is fed into an amplifier and cathode follower which in turn, feeds a balanced modulator. Here in the balanced modulator, the output of the crystal oscillator and the output of the 200 kc oscillator are combined. The output of the balanced modulator is further amplified and filtered in an intermediate buffer-amplifier and then fed to the power amplier. The output of the power amplifier appears across a low impedance line which is available for connecting to associated radio transmitters. Telegraph signals are fed into a keying circuit consisting of limiters, wave-shaping filters and balanced keyer tubes. The 200 kc oscillator feeds into the balanced keyer tube. The output of the balanced keyer tubes has a phase relation of 0 degrees or 180 degrees with respect to the 200 kc oscillator voltage and varies in amplitude in accordance with the keying impulses. The reactance amplifiers further amplify this component and shift its phase 90 degrees negative (capacitive). It is then fed back to the 200 kilocycle oscillator, bringing about a shift in the oscillator frequency. A filter and phase inverter provides harmonic free push-pull voltages to the balanced modulator. The 200 cycle oscillator is connected into the keyer tube circuit to provide phase modulation.

To explain more clearly the operation of this unit, the various elements of the block diagram will be shown schematically and explained in greater detail in the following paragraphs.

A simplified schematic of the high frequency portions of the Frequency Shift Keyer is shown in figures 2-3 and 2-4. This section of the keyer consists of a balanced modulator, a buffer-amplifier and a power amplifier. The output of a radio-frequency source, such as crystal oscillator or external oscillator, in the range 0.8 to 6.5 megacycles is fed into V-109, which is an amplifier and cathode follower, and then to the No. 1 grids of V-111 and V-112 which constitute the balanced modulator. The No. 3 grids of V-111 and V-112 are excited in push-pull from a 200 kc voltage derived from the keyed oscillator. Since the high-frequency input supplied to the No. 1 grids of these

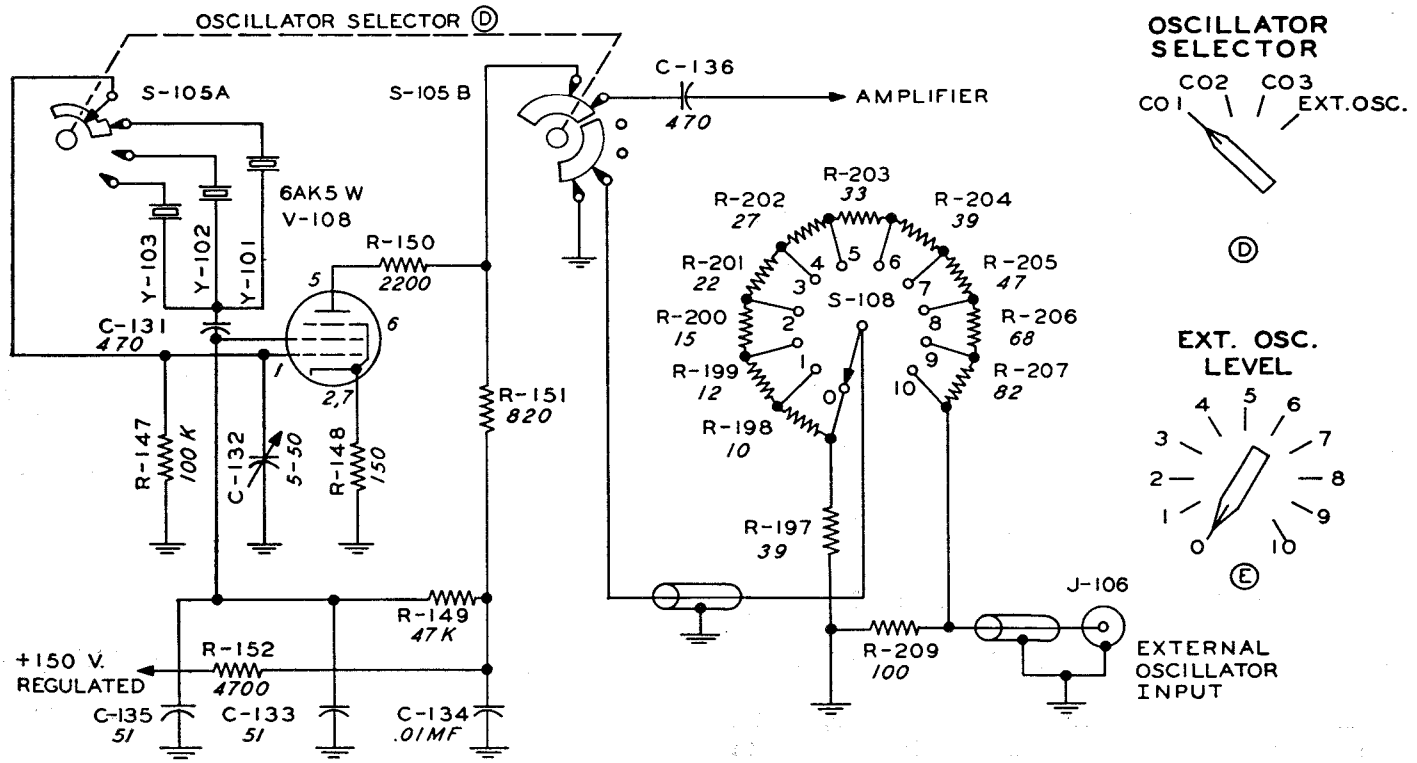


Figure 2-2. Crystal Oscillator Simplified Schematic

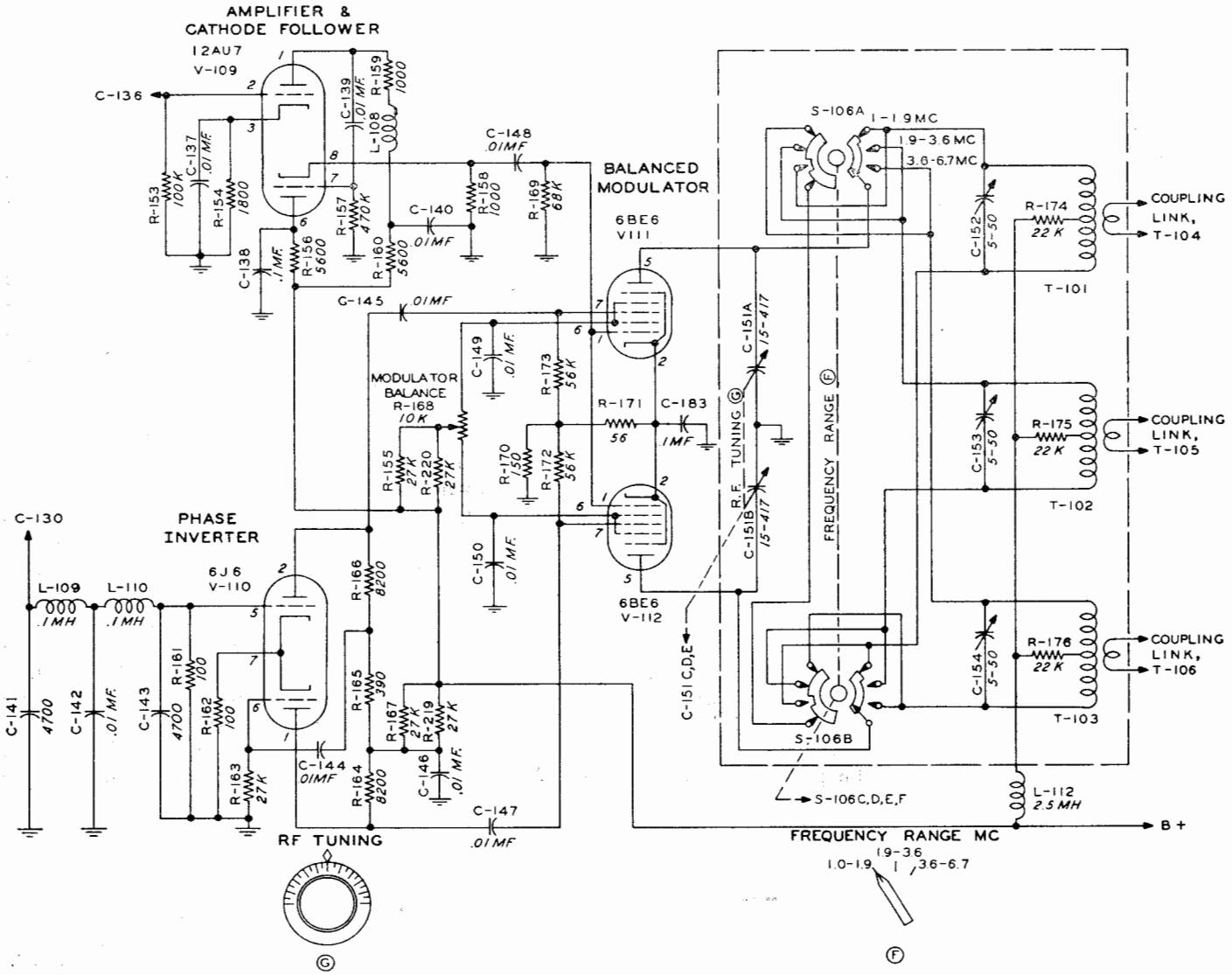


Figure 2-3. Amplifier — Cathode Follower, Phase Inverter and Balanced Modulator Simplified Schematic

tubes is identical in phase, this voltage is cancelled out in the output circuit because of its push-pull arrangement. Complete cancellation of this voltage occurs when the modulator balance potentiometer, R-168, is adjusted so that the transconductance of the two tubes is identical. With the high-frequency input cancelled, only the mixer products remain, the most important of which are the sum and difference frequencies produced by the mixing of the high frequency signals with the 200 kc shifted frequency voltage. The sum frequency is selected by tuning the output circuit, T-101. This transformer is link coupled to the grid transformer of the buffer-amplifier, T-104, which is also tuned to the sum frequency. Further amplification occurs in the buffer-amplifier, V-113. The plate circuit of this amplifier is tuned to the same frequency as its grid circuit. Additional amplification occurs in the power amplifier, V-114. The output circuit of this final amplier is tuned to the sum frequency and the tuning is ganged with the tuning of the other three high-frequency tuned circuits so that single control tuning is possible. The gang-tuned circuits are provided with inductive and capacitive trimming so that exact tracking is possible throughout the three operating ranges of 1 to1.9 mc, 1.9 to 3.6 mc, and 3.6 to 6.7 mc megacycles. Because the tubes used in the buffer-amplier and the power amplifier have effective screen grids, neutralization of these tubes is unnecessary. A meter switch, S-107, provides a convenient means of measuring the grid and plate currents of the final amplifier.

3. 200 KILOCYCLE OSCILLATOR, BALANCED RF KEYING, AND PHASE SHIFTING AMPLIFIERS.

The portion of frequency shift keyer which produces the frequency shifted signal consists of a 200 kc oscillator, balanced keyer tubes, and phase shifting amplifiers comprised of V-107, V-104, V-105 and V-106. The operation of the reactance tube circuit

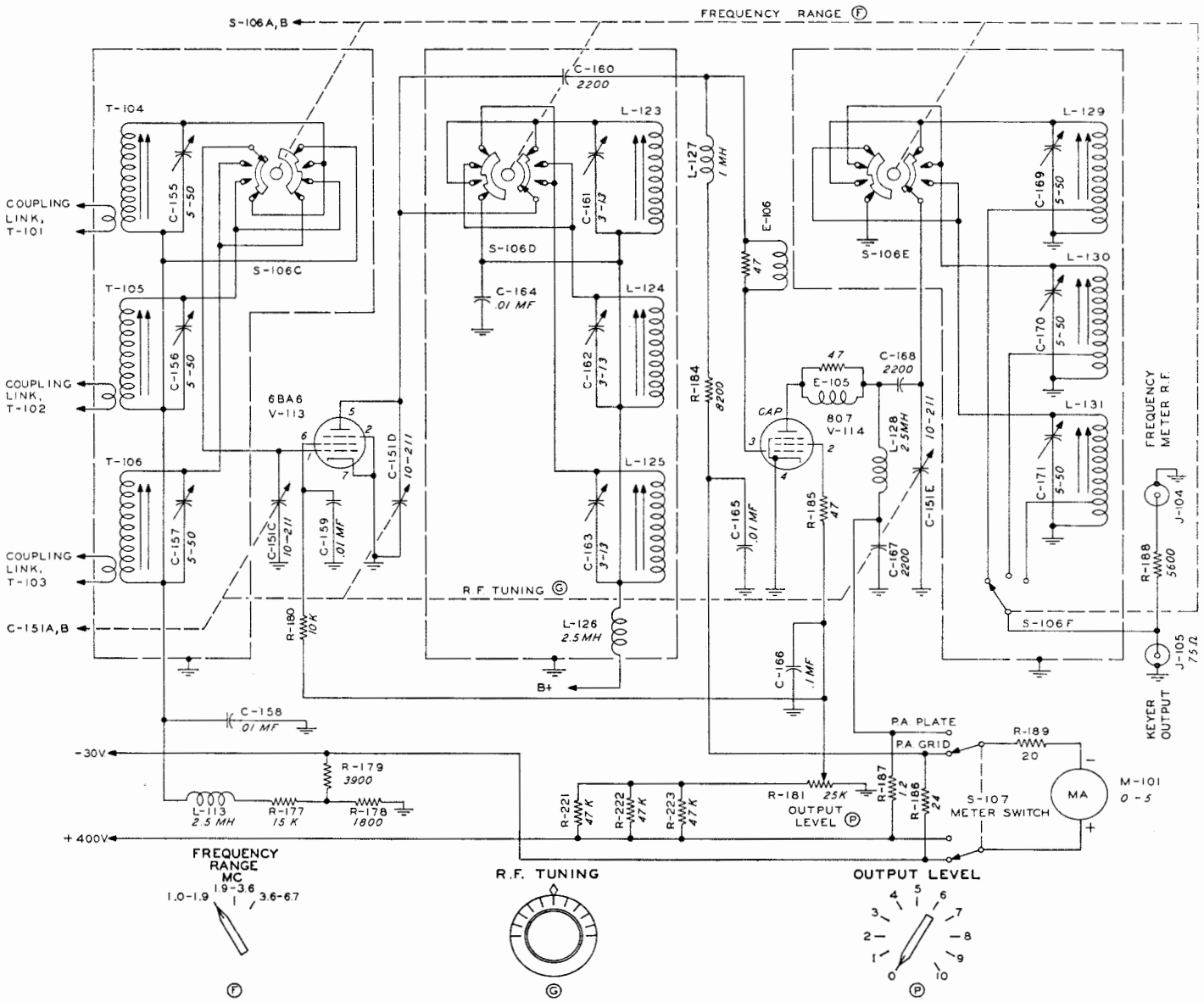


Figure 2-4. Buffer and Power Amplifier Simplified Schematic

can be most easily explained by means of vector diagrams. In figure 2-5 is shown the simplified circuit and in figure 2-6 are shown the various vector diagrams which will be used in the course of this explanation. If we let the vector E_0 represent the voltage which is present across the oscillator grid coil, then V-104A-G is the voltage at one terminal of the pick-up loop while V-104B-G is the voltage present at the opposite terminal of the pick-up loop of T-108. The two voltages, V-104-G and V-104B-G, are fed to the No. 1 grids of V-104A and V-104B respectively. The RF keyer tubes are voltage amplifiers, one of which, V-104A, operates at fixed amplification and the other, V-104B, operates under the control of keying impulses with a gain determined by the magnitude of the positive voltage applied to its grid. If positive voltage is applied to V-104B grid No. 1, the output of this tube may be represented by vector V-104B-P in figure 2-6. The output of V-104A may be represented by a vector 180° out of phase with V-104B-P. The resultant vector at the plates of the tubes across R-126 is shown at C. Because C-118 has a high capacitive reactance at 200 kc, the leading current flows through the series circuit consisting of C-118 and R-135. The values of the resistor and capacitor in this circuit are so selected that about 82 degrees of phase shift occur and the leading vector shown in D results across R-135. This voltage, which may be adjusted by positioning the arms of potentiometer R-126 and tap switch S-104, is applied to the grid of V-105. The output of this tube may be represented by vector V-105P which is 180° displaced from the voltage on the grid of V-105. Again a capacitor-resistor series circuit brings about an 8 degree phase shift and the resulting vector, V-106G, is applied to V-106 and its plate voltage is

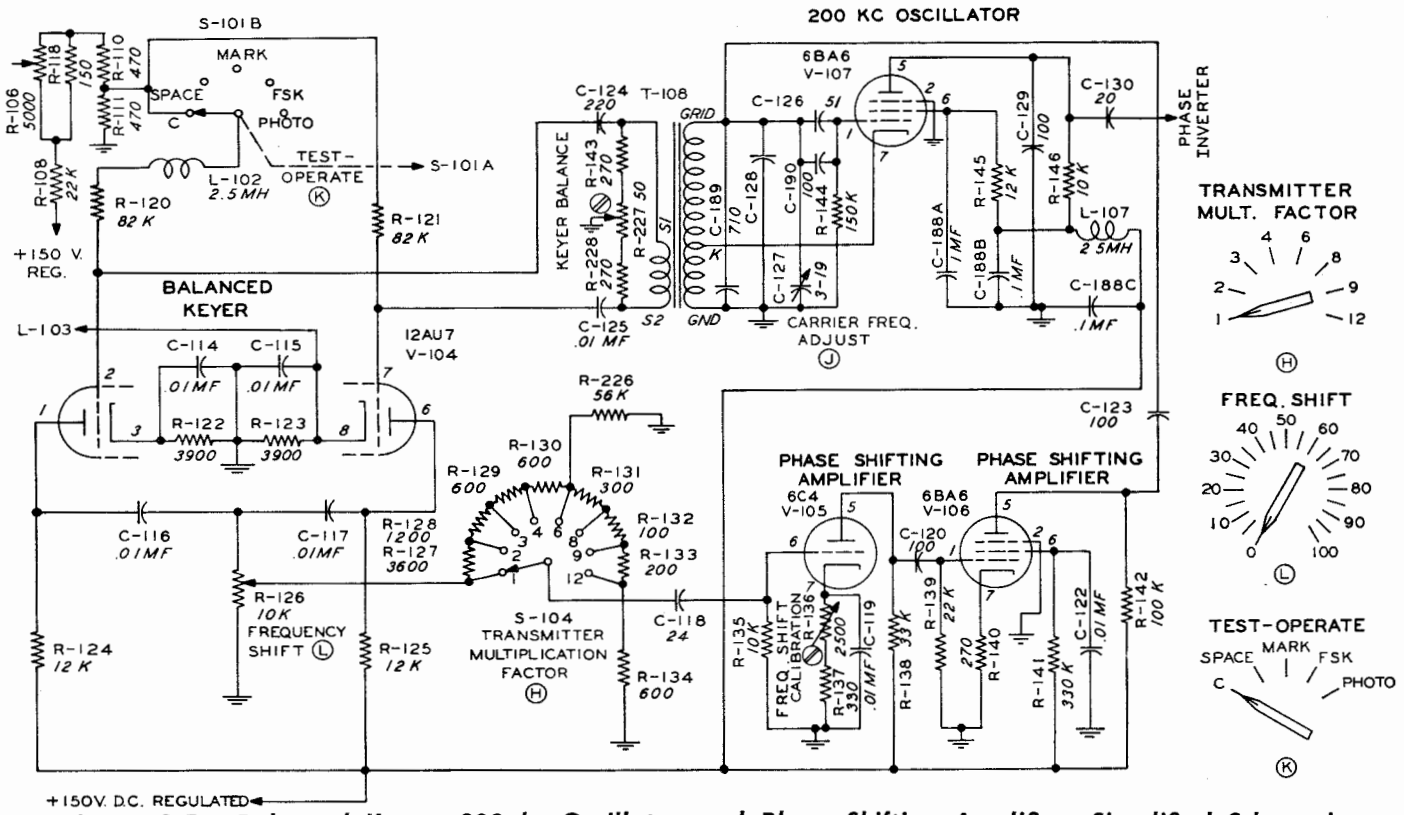


Figure 2-5. Balanced Keyer, 200 kc Oscillator and Phase Shifting Amplifiers Simplified Schematic

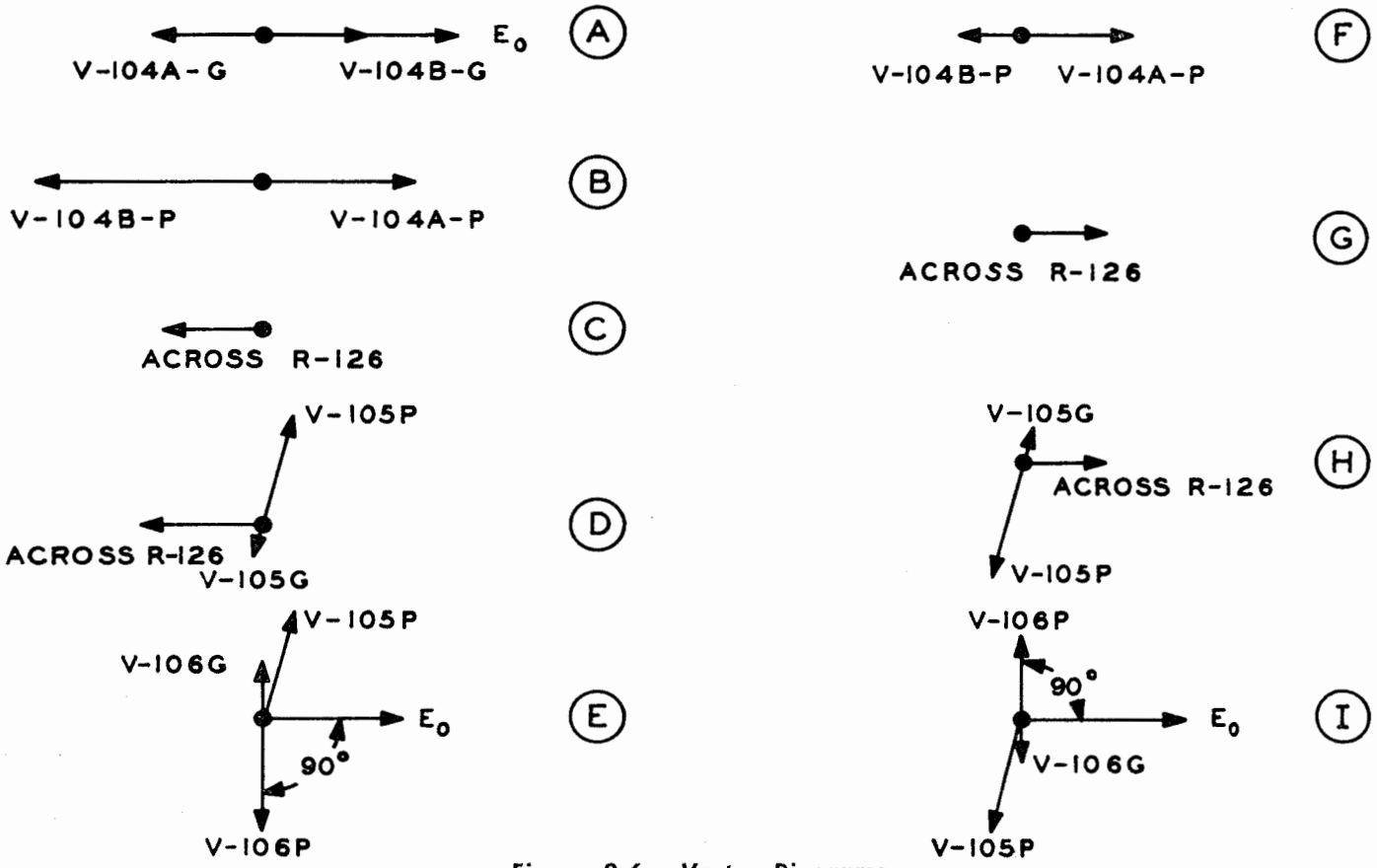


Figure 2-6. Vector Diagrams

represented by V-106P. When this voltage is compared with the original oscillator vector, E_0, it may be seen that a quadature relationship exists between these two vectors and a lagging current flows in the oscillator tank producing an effect much as if an additional inductor had been bridged across T-108.

If the voltage applied to the grid of V-104B is zero, the vector relationships are as shown in F. V-104B-P is smaller than V-104A-P and the resultant vector across R-126 appears at G. This vector encounters a phase delay through C-118 and R-135 so that the vector relationships exist as shown in H. After passing through V-105 the voltages appear as shown in I. Here the voltage, V-106P, leads the oscillator voltage and a current flows which adds to the capacitive current in the oscillator tank, effectively increasing the circuit capacity and lowering the frequency. The condition shown in E corresponds to radiotelegraph mark because it is effective in raising the frequency of the oscillator and the condition shown in I corresponds to space because it lowers the frequency of the oscillator. Intermediate values of grid voltage produce varying amounts of voltage at the plate of V-106 and the circuit constants are so chosen that a linear frequency shift versus applied voltage at V-104B occurs. The magnitude of this output voltage can be adjusted by changing the position of the arm of potentiometer R-126. Further division of this voltage is possible through the use of the transmitter multiplication switch, S-104, the function of which will be explained later.

Thus, under control of the RF keyer tubes, it is possible to produce either a leading or a lagging voltage at the plate of V-106 and this is equivalent to inductive or capacitive effect upon the oscillator frequency. The control, R-136, then provides a means by which the total amount of frequency shift can be adjusted. Because the amount of frequency shift which is present in the associated transmitter is dependent upon the degree of multiplication to which the output of this keyer is subjected, it is necessary to reduce the amount of frequency shift by means of control S-104. This switch provides for full shift, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{9}$ and $\frac{1}{12}$ shift to provide for multiplication by one, two, three, four, six, eight, nine or twelve in associated transmitter. To calibrate the frequency shift control, R-126, an adjustment in the gain of the amplifier is provided by cathode potentiometer R-136. Because of slight differences in the RF keyer tube gain characteristics and in circuit wiring, a balancing control, R-227, is provided to equalize the output of the two RF keyer tubes when the DC voltages applied to the two RF keyer tube grids are identical. A small amount of adjustment of the oscillator frequency is possible through the adjustment of C-127. Because of the temperature controlled oven and the high inherent stability of the circuit, adjustment of this control is unnecessary for extended periods of time.

Figure 2-3 shows the 200 kc filters and the phase in-

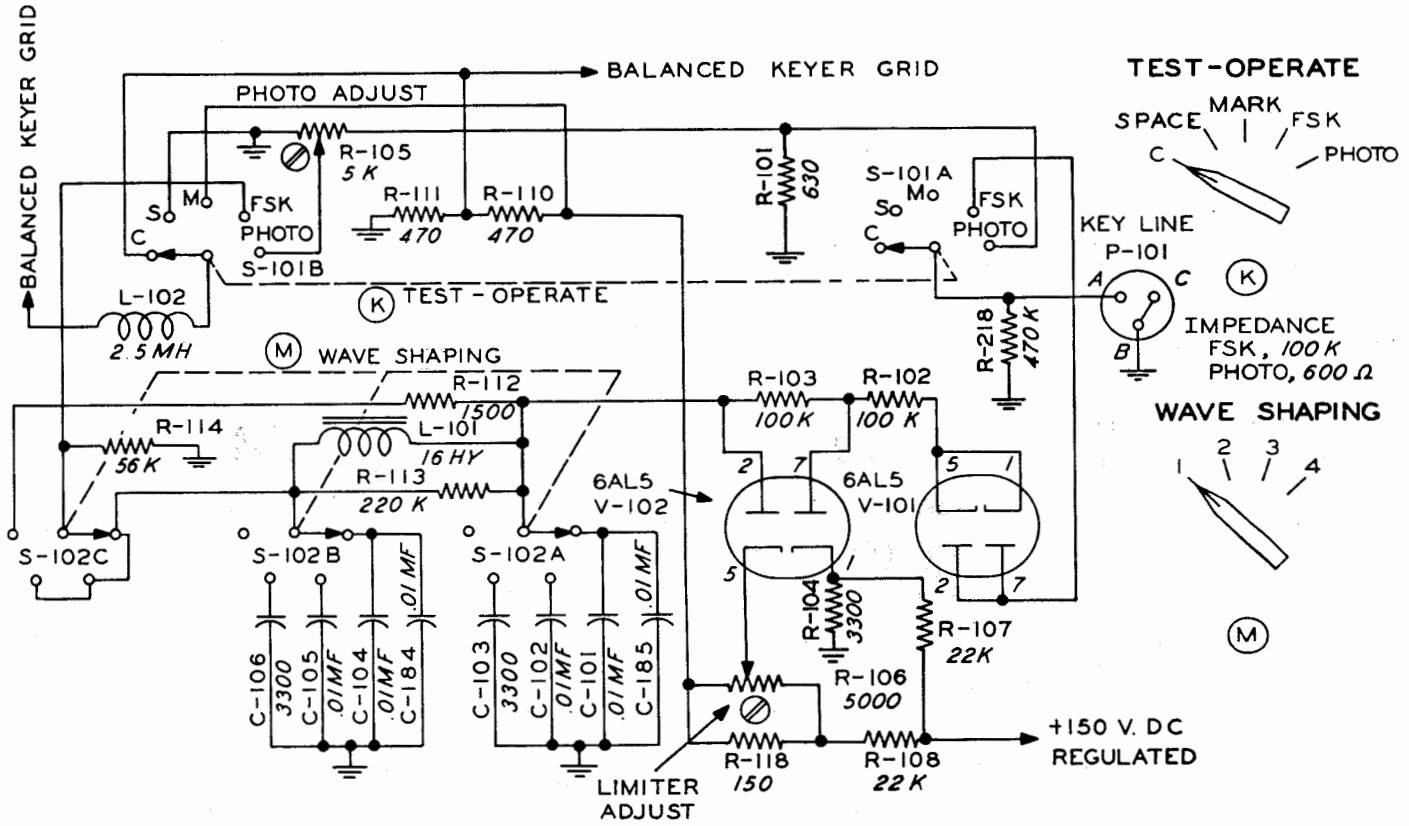


Figure 2-7. Limiters and Wave Shaping Simplified Schematic

verter in simplified form. Because harmonics of the 200 kc oscillator fall within the pass band of the high frequency circuits of this keyer, these harmonics must be suppressed to eliminate spurious output. This is done with low pass filters consisting of C-141, C-142, C-143, L-109 and L-110. This filter passes the fundamental with very little attenuation but offers a high degree of rejection to the second and higher harmonics output of the 200 kc oscillator. The phase inverter tube, V-110, serves to produce push-pull 200 kc voltage for application to the No. 3 grids of the balanced modulator tubes. This phase inverter consists of a twin triode with cathode coupling to secure the push-pull output voltages. Figure 2-7 shows the input circuits and the wave shaping filter of this keyer. Radio teletype or picture transmission signals are applied to the keyer input jack, P-101. Radio teletype signals pass through a negative peak limiter, V-101, providing only positive keying impulses at S-101A. On the FSK position of S-101A, a positive peak limiter provides essentially fixed voltage having square wave characteristics to the wave shaping filter. The wave shaping filter is a low pass pi section. Through the proper positioning of S-102, it is possible to apply the desired amount of wave shaping to the square wave delivered by the limiter tubes. Wave shaping at this point materially reduces the sideband frequency components which are present with square wave keying. The TEST-OPERATE

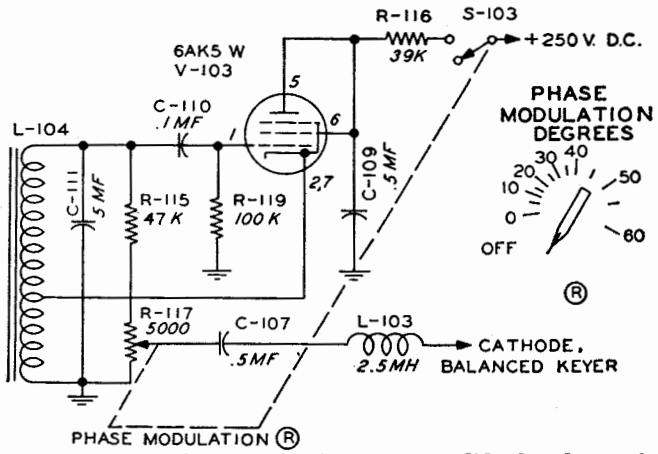


Figure 2-8. Phase Modulation Simplified Schematic

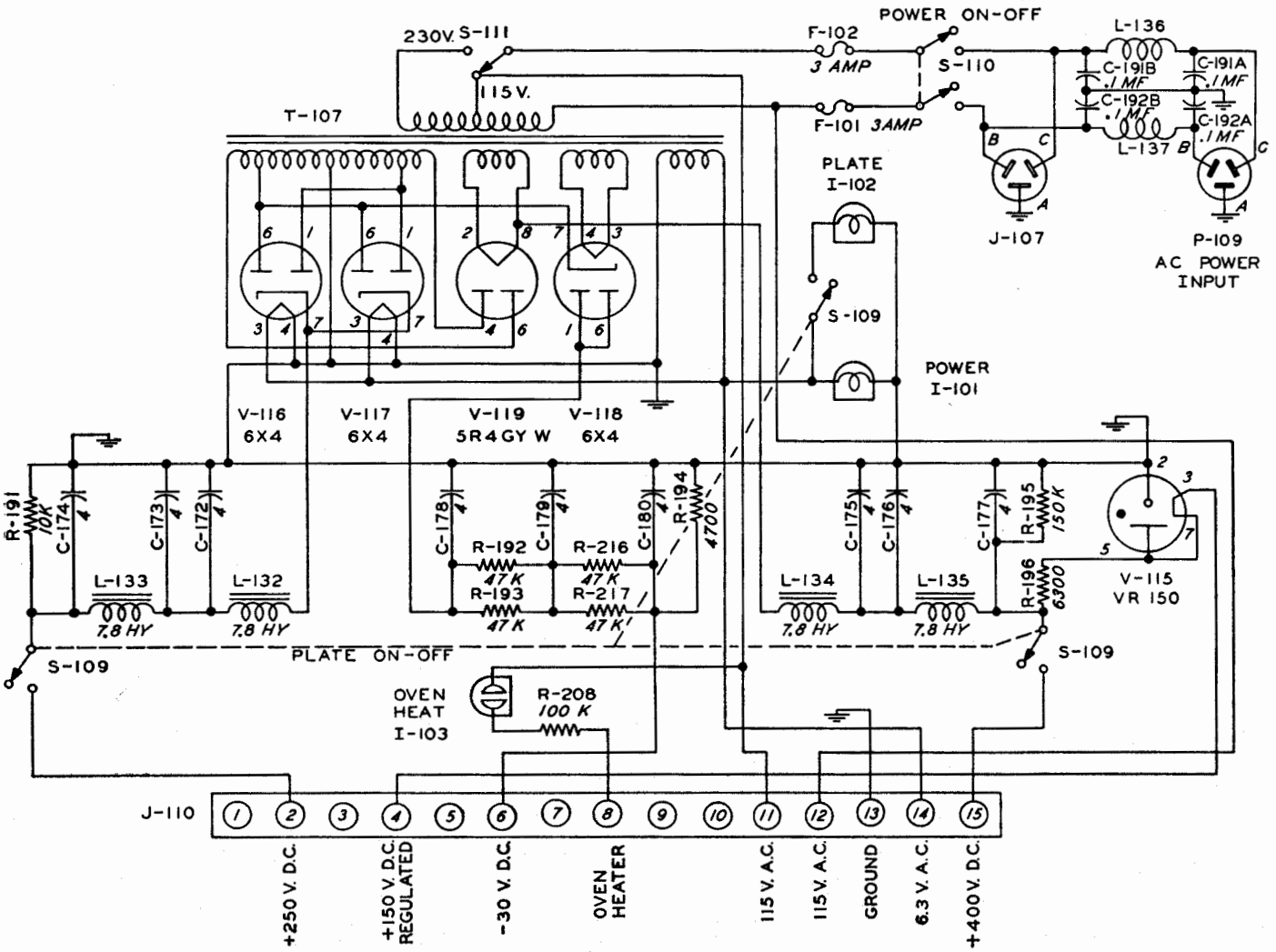


Figure 2-9. Power Supply Simplified Schematic

switch, S-101A & B, provides a means by which carrier, mark, space, FSK, or photo transmission from the keyer can be provided. In the carrier position, the input line is disconnected and the same voltage is applied to both RF keyer tube grids. This results in voltages of opposite phase but of identical magnitude at the plates of the keyer tubes, so that essentially zero voltage appears across R-126, resulting in the natural frequency of oscillation for the 200 kc oscillator. In the MARK position, a positive voltage is applied to the grid of V-104A, causing higher frequency of oscillation for the 200 kc oscillator, while in the SPACE position the input line is disconnected and zero voltage is applied to the grid of V-104A and the 200 kc oscillator operates at a lower frequency. In the FSK position the input line is connected through the peak limiters and into the grid of V-104A through the wave shaping filter. On photo transmission, S-101A & B connects the input signal without wave shaping or positive peak limiting to the grid of V-104A. In photo transmission the frequency of the 200 kc oscillator follows the keying voltage present on the line in a linear fashion.

Figure 2-8 shows the phase modulation oscillator. This simple Hartley oscillator tuned to 200 cycles provides a voltage across R-122 such that sufficient audio is delivered to the cathode of V-104B to give up to one radian of phase modulation on both mark and space signals. The use of phase modulation permits frequency diversity which is a decided advantage in the presence of severe multipath distortion in radio transmission. An external power supply provides the filament, bias, and plate potentials necessary for the operation of this unit. These power connections are made through P-110.

4. POWER SUPPLIES.

The power supply for the KY-30/GRT supplies the filament voltage to the Keyer, figure 2-9. A 115 volt AC supply is connected to the Keyer to operate the oven heaters. The high voltage output of this supply is divided into three ranges. A +250 volt output is obtained from one section of the supply, which consists of a full wave type using two type 6X4 rectifiers and a choke-capacity filter. A +400 volt output is obtained from a second section, which utilizes a type 5R4GY in a full-wave rectifier circuit with a choke-capacitance filter section. From this same filter system, a +150 volt regulated voltage is obtained. Voltage regulation is accomplished by means of a voltage regulator tube type VR-150 and the proper voltage dropping resistor. A —45 volts is supplied by a third filter. This filter consists of a half wave rectifier, type 6X4, and a R-C filter.

SECTION 3
INSTALLATION AND INITIAL ADJUSTMENTS

1. INSTALLATION.

a. UNPACKING SHIPPING CRATES.—Use ordinary care in unpacking equipment from shipping cases; inspect the units immediately for possible damage during shipment.

b. INITIAL CHECKS.—Besides a visual inspection to detect possible damage, make the following checks.

(1) Determine the voltage of the available primary 50 or 60 cycle supply.

(2) The power supply unit is provided with a switch so that either 115 volt or 230 volt input may be used. Set switch for proper voltage.

(3) Insure that all electron tube sockets are equipped with their proper tubes and that the tube shields are in place.

(4) Check that all switch handles and knobs provide positive switch action and that all dials and the associated verniers and locking devices operate properly.

(5) Determine that correct wiring for coupling the keying input signals to the keyer is available.

(6) Place crystals in proper sockets in crystal oven.

c. ENERGIZING EQUIPMENT FOR FIRST TIME.—Perform the following simple procedures carefully, keeping alert to any evidence of any irregularity which, if occurring, might provide an indication of possible trouble.

(1) Check J-110 making certain that it is plugged into the power supply.

(2) Connect the a-c cord to the power supply. Then plug into an a-c outlet.

(3) Operate the POWER ON switch to the ON position. Verify that the white and amber pilot lamps light, and that all the glass bulb electron tubes glow.

(4) Turn the PLATE ON-OFF switch to the ON position. Check that the red pilot lamp lights.

(5) Set the METER switch at PA GRID.

(6) Check that the CRYSTAL SELECTOR switch is in position 1, 2 or 3.

d. CONNECTING CABLE ASSEMBLIES. — Connect the six cable assemblies between receptacles of Keyer KY-30/GRT (figure 2-11) and the corresponding receptacles at the radio transmitter. Check carefully to be certain that the cables to the load and frequency meter are not interchanged. Connecting the output of the keyer to the frequency meter will damage the meter.

2. INITIAL ADJUSTMENT.

a. GENERAL.—The following adjustments are to be made after the equipment is completely installed and has been energized for the first time.

In making the following adjustments, the final settings of the controls for a particular transmitting frequency should be recorded to assist in re-establishing the conditions promptly at a later date. These control settings should be recorded for each transmitting frequency on a form; for example, one similar to that shown in table 4-1. A few of the control settings may require some minor readjustment during operation to insure the best performance. The operating procedures are covered in section 4.

It is assumed that the equipment is in satisfactory operating condition and has been properly connected with other units of the system. If difficulty is experienced in making any adjustment specified in the following procedures, refer to the adjustment or corrective procedures in maintenance sections 6 and 7.

In the procedures outlined in the following paragraphs, it is assumed that the total frequency shift is 850 cycles (frequency raised by 425 cycles for a mark signal and lowered 425 cycles for a space signal). The procedures are, of course, identical for a different over-all shift of frequency (for example 800 cycles) except for the slightly different numerical values which apply.

b. OVEN TEMPERATURE.—When the POWER Switch is operated to the ON position, the amber OVEN pilot lamp lights to indicate that heater resistors are energized to raise the temperature of the oven. The temperature is thermostatically controlled between 69° and 71° C. When the temperature becomes stabilized, the heating cycle should be on about two or three minutes (amber light lighted) and off ten or twelve minutes (amber lamp out), with a room temperature of about 70°F. Do not attempt the adjustments in paragraphs 2.*c.* thru 2. *i.* until the oven temperature becomes stable. The required stability is usually reached within 30 minutes after the Power Switch is operated to ON.

c. RF TUNING—USING CRYSTAL OSCILLATOR OF KEYER.—The r-f output of the keyer is equal to, or is some definite fraction of, the final transmitting frequency, depending upon the frequency multiplication of the radio transmitter. Hereafter, the term

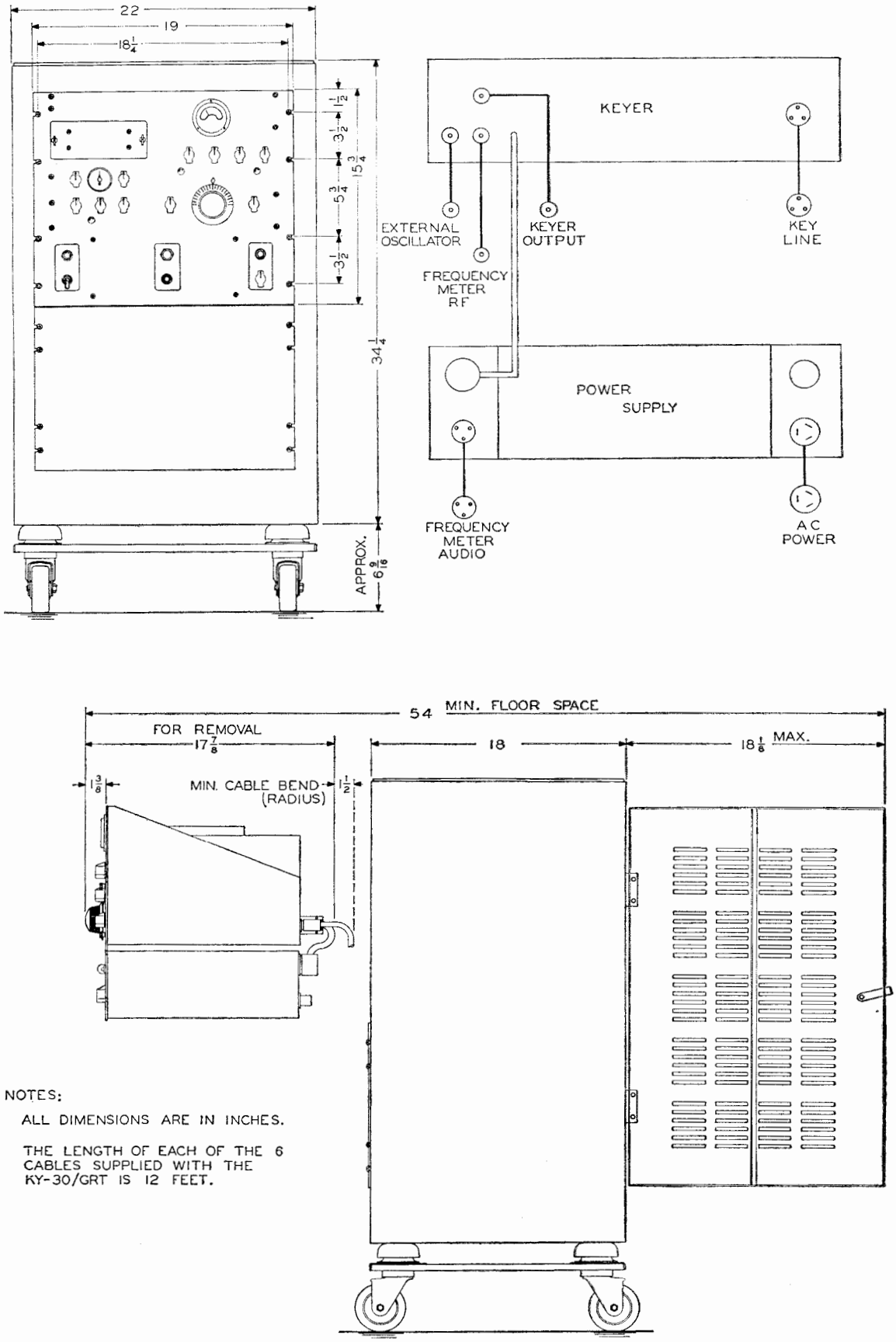


Figure 3-1. Keyer KY-30/GRT Installation

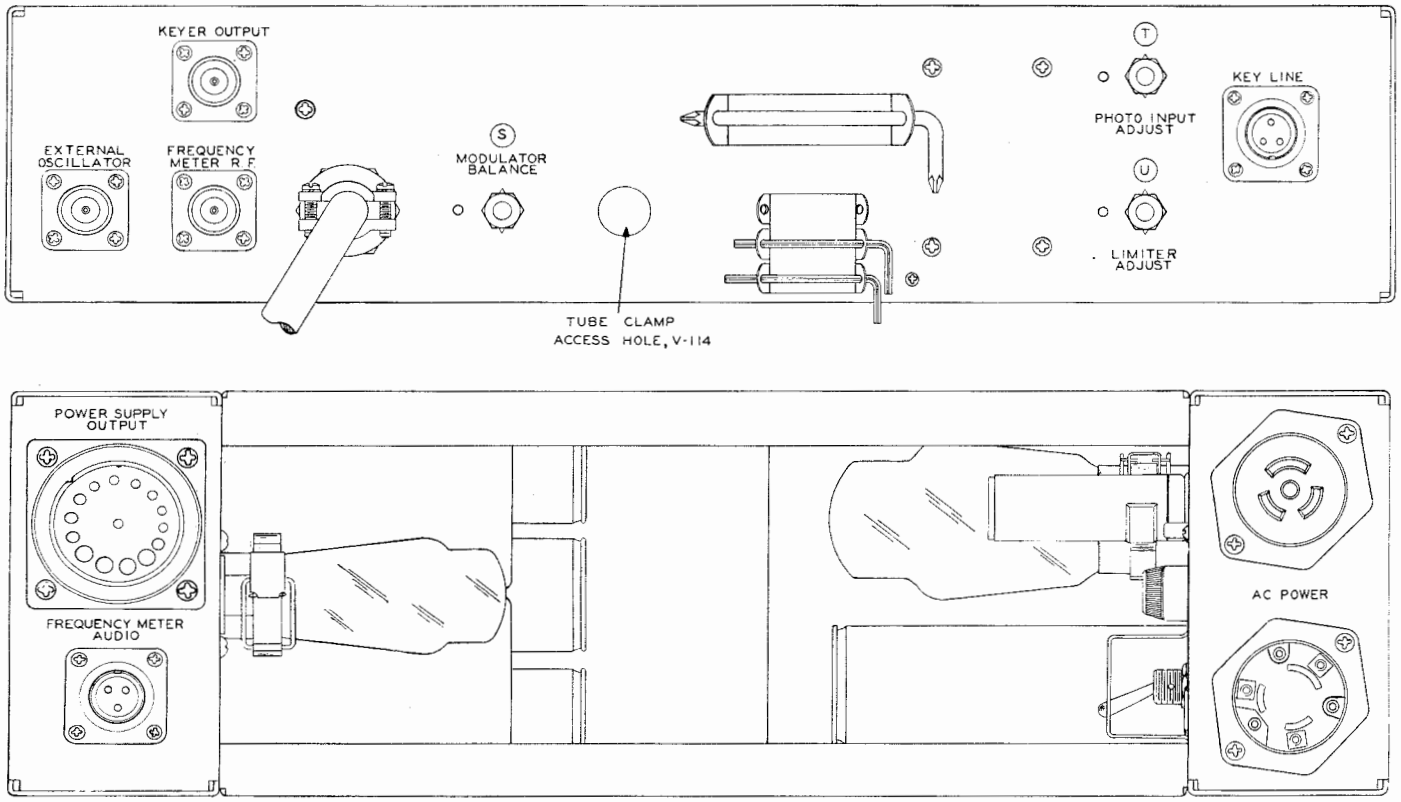


Figure 3-2. Rear Terminal Connections to Keyer KY-30/GRT

keyer output frequency will, therefore, be understood to mean the final transmitting frequency divided by the transmitter frequency multiplication factor (1, 2, 3, 4, 6, 8, 9 or 12).

(1) Determine the transmitting frequencies which are 200 kc less than the required keyer output frequencies.

(2) Turn the OSCILLATOR SELECTOR Switch to position 1 (or to position 2 or 3). The correlation between the crystal sockets and the position of the OSCILLATOR SELECTOR Switch is as follows:

SWITCH POSITION	CRYSTAL
CO 1	Y-101
CO 2	Y-102
CO 3	Y-103
EXT OSC	EXTERNAL OSCILLATOR

(3) Turn the FREQUENCY RANGE MC Switch to position 1.0-1.9 or 1.9-3.6 or 3.6-6.7 depending upon the keyer output frequency involved, and the METER SWITCH to the PA GRID position

NOTE

IN ALL PROCEDURES RELATING TO THE TURNING OF A DIAL, THE LOCKING DEVICE SHOULD FIRST BE LOOSENED.

(4) Starting at position 0, rotate the RF TUNING Control dial slowly, noting two successive peak values of current as indicated on the POWER AMPLIFIER METER. These two current peaks correspond to the two resonant peaks, one for the lower sideband and the other for the upper sideband.

(5) Turn the RF TUNING dial to a position which corresponds to the upper sideband resonant peak.

(6) Turn the METER SWITCH to the PA PLATE position.

(7) Set the OUTPUT LEVEL Switch on a position which provides the most favorable driving power to the first amplifying stage of the radio transmitter. The approximate voltages provided at the different positions of the OUTPUT LEVEL switch into a resistive load circuit of 75 ohms, are as follows:

OUTPUT LEVEL POSITION	APPROX. OUTPUT VOLTAGE
1	0
2	0
3	0.1
4	7
5	13
6	17
7	21.5
8	25
9	26.5
10	27

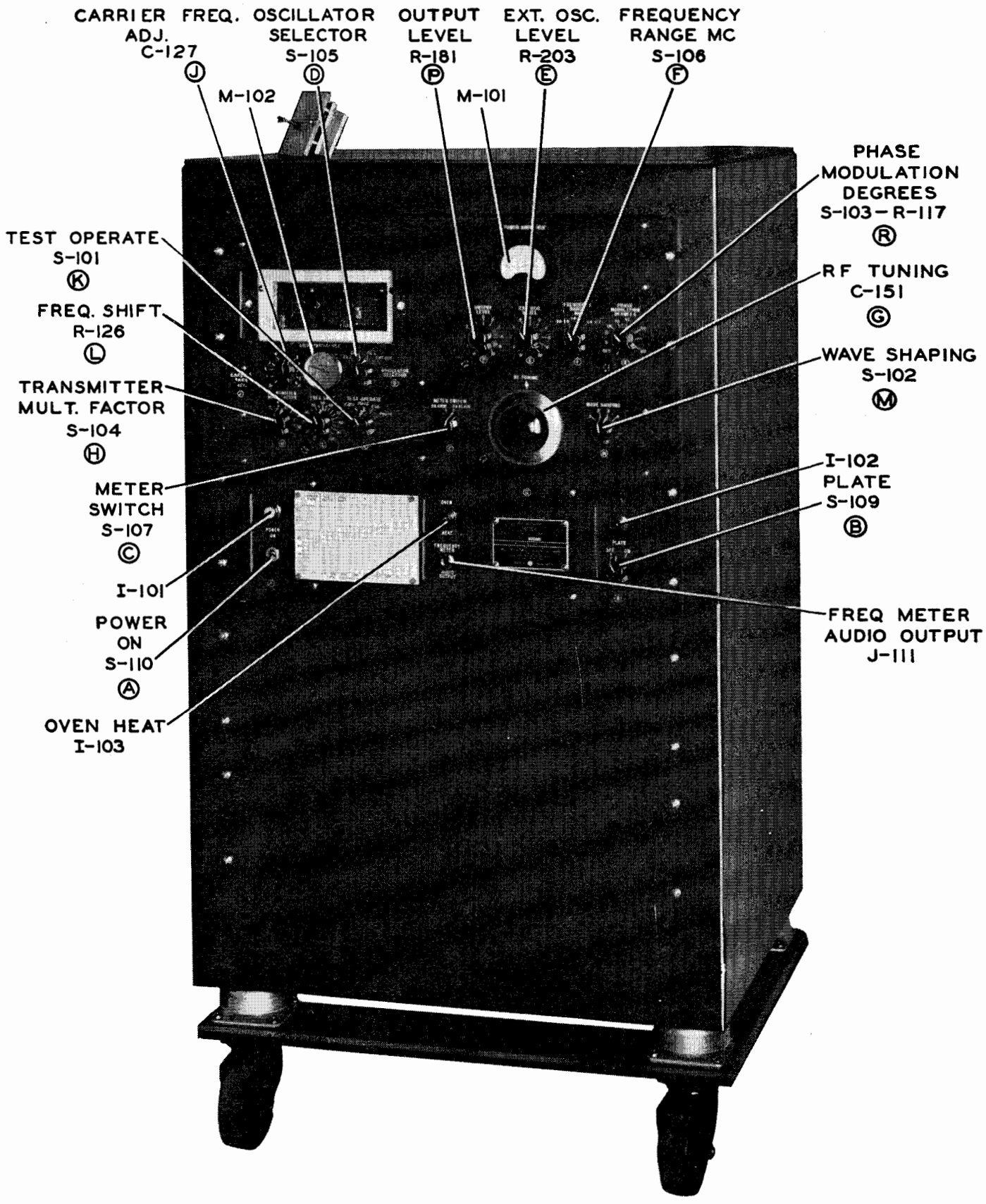


Figure 3-3. Keyer KY-30/GRT Operating Controls, Front View

(8) Reset OSCILLATOR SELECTOR and repeat steps (1) to (7), inclusive, for the other two frequencies available from the crystal oscillator.

d. RF TUNING—USING TRANSMITTER OSCILLATOR.

(1) Determine the frequency of the transmitter and adjust its oscillator frequency to 200 kc lower than the required keyer frequency as in 2.*c.*(1).

(2) Turn the OSCILLATOR SELECTOR Switch to position EXT. OSC. Set the EXT OSC LEVEL Switch on position 10. The setting of the EXT OSC LEVEL switch is tentative. The switch setting is selected more accurately in a later procedure.

(3) Perform operations as in 2.*c.*(3) to 2.*c.*(7).

(4) Set the EXT OSC LEVEL Switch in the lowest number position which provides 1 MA grid current as indicated on the 0-10 scale of the POWER AMPLIFIER meter. If several positions provide approximately equal current readings, use the lower-numbered position of the EXT OSC LEVEL Switch.

(5) Set the OUTPUT LEVEL Switch on a position which provides the most favorable driving power to the first amplifying stage of the radio transmitter.

e. CHECK OF FREQUENCY.—Each of the r-f outputs of the Keyer must be checked to insure that its frequency is accurate and stable.

(1) Turn the FREQUENCY SHIFT Control to position zero.

(2) Connect a set of headphones to the FREQUENCY METER AUDIO OUTPUT jack.

(3) Adjust the radio station frequency-measuring equipment to the final transmitting frequency.

(4) Adjust the CARRIER FREQ. ADJ. until a zero beat results, as determined by monitoring with the headphone.

NOTE

IF A TRANSMITTER VARIABLE FREQUENCY OSCILLATOR IS USED IN PLACE OF THE KEYER, THE FREQUENCY MAY BE ADJUSTED TO PRODUCE A ZERO-BEAT BY VARYING THE CONTROL ASSOCIATED WITH THE TRANSMITTER OSCILLATOR.

f. FREQUENCY SHIFT.

(1) Determine the multiplication factor of the radio transmitter.

(2) Set the TRANSMITTER MULT FACTOR Switch at the position corresponding to the multiplication factor of the transmitter.

(3) Set the FREQ SHIFT dial for the desired total frequency shift as indicated on the calibration chart mounted on the front panel.

(4) With the keyer connected to the frequency measuring equipment, superimpose the output of an adjustable audio oscillator on the leads connected to the FREQUENCY METER AUDIO OUTPUT jack. The audio oscillator output should be equal to one-half the total shift of the final transmitting frequencies. (For example, it should be one-half of 850 cycles or 425 cycles.)

(5) Connect headphones to the FREQUENCY METER AUDIO OUTPUT jack, and operate the TEST-OPERATE Switch alternately to positions SPACE and MARK.

(6) Adjust the KEYER BALANCE slotted shaft with a screwdriver until equal tones are heard in the headphone with the TEST-OPERATE switch in either the MARK or SPACE position.

(7) Operate the TEST-OPERATE Switch to the MARK position.

(8) Adjust the FREQ SHIFT dial until a zero beat condition with the superimposed audio tone (step 4) is produced.

(9) Operate the TEST-OPERATE Switch to the SPACE position and check that a near-zero-beat condition results.

NOTE

THE ADJUSTMENTS IN STEPS (6) AND (8) ARE MADE TO PROVIDE A SYMMETRICAL FREQUENCY SHIFT; THAT IS, FOR EXAMPLE, 425 CYCLES ABOVE THE TRANSMITTER FREQUENCY FOR MARK SIGNAL AND 425 CYCLES BELOW THE TRANSMITTER FREQUENCY FOR A SPACE SIGNAL.

g. KEYING SIGNAL INPUT.—If the input keying signals seem to have appreciable bias, the channel which supplies signals to the frequency shift keyer should be lined up in accordance with one of the three methods outlined in section 7, paragraph 5. Careful line-up of the tone keyer channel is very important, particularly at higher signaling speeds. Using a monitoring receiver, or equivalent means, check to be certain that the connections for the input telegraph keying signals are not reversed. Make the check in accordance with the following procedures:

(1) Operate the TEST-OPERATE Switch to position MARK, and note the effect of the transmitting radio frequency shifting upward (for example by 425 cycles).

(2) Restore TEST-OPERATE Switch to the FSK position, and deliver a marking signal voltage to the Keyer KY-30/GRT from the external tone keyer (or the equivalent).

(3) Observe that the same effect is produced as with the test signal in step (1).

(4) Repeat steps (1), (2) and (3) to compare the effects of test and line space signals in shifting the transmitting radio frequency downward (for example by 425 cycles).

(5) If necessary, check that the input signal nominal voltages and polarities are as follows:

	POLAR SIGNALS	NEUTRAL SIGNAL
MARK	+100 volts	+100 volts
SPACE	—100 volts	0 volts

h. WAVE SHAPING.—The WAVE SHAPING Switch should be set on one of its four positions, depending upon the keying speed of the key line input. The relations between the switch positions and the keying speeds of the incoming signal are as follows:

WAVE SHAPING SWITCH POSITIONS	KEYING SPEED DOT CYCLES/SECOND
1	Up to 60
2	60 to 120
3	120 to 240
4	over 240

Position 4 provides minimum wave shaping.

i. PHASE MODULATION. — Determine whether phase modulation is required. If so, operate the PHASE MODULATION control to the ON position and set it to produce one radian of phase modulation in accordance with procedures outlined in Maintenance, Section 6, paragraph 1.*g.*

SECTION 4
OPERATION

The following operating procedures assume that Keyer KY-30/GRT is installed, the initial adjustments have been made, and the radio transmitter has been tuned for frequency shift keying before connecting the frequency shift keyer. The operating controls are illustrated in figure 3-3 and are listed in table 4-2 of this section.

1. TURNING ON POWER.

a. Operate the POWER toggle (A) to ON. Note that the associated white pilot lamp lights and OVEN HEAT indicator (amber pilot lamp) lights.

b. After 30 minutes check that the temperature of the oven is between 69°C. and 75°C. as shown by the OVEN TEMP. indicator. The amber OVEN HEAT lamp lights for about two or three minutes in every ten or twelve minutes with the room temperature about 70°F.

c. Turn the PLATE Switch (B) to ON, and observe that the associated red pilot lamp lights.

NOTE

WHEN THE KEYER IS ON STANDBY, KEEP A-C POWER CONNECTED WITH THE POWER SWITCH A TURNED ON TO MAINTAIN THE CORRECT OPERATING TEMPERATURE OF THE OVEN.

2. SETTING OF CONTROLS.

a. Provide an r-f carrier locally, or from an external source, and set the operating controls, TRANSMITTER MULT. FACTOR (H), FREQ. SHIFT (L), OSCILLATOR SELECTOR (D), FREQUENCY RANGE (F) and RF TUNING (G), at the positions indicated on the associated chart (Table 4-1) for the particular transmitting frequency selected.

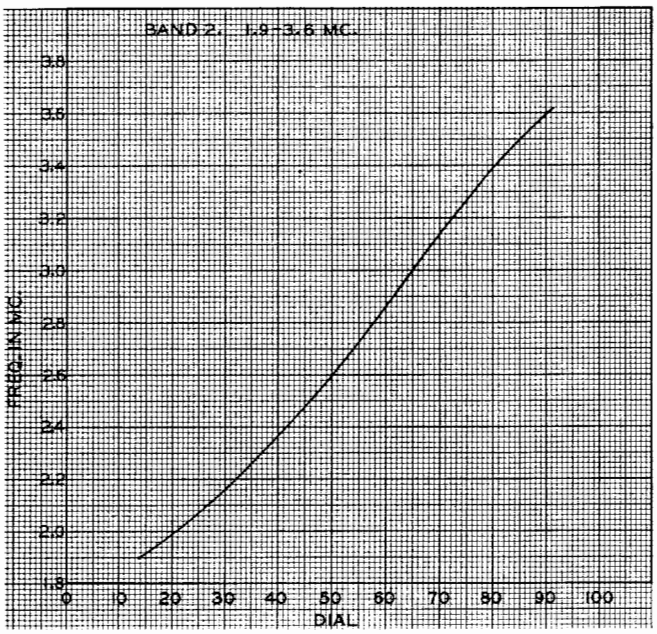


Figure 4-2. Tuning Chart 1.9–3.6 mc

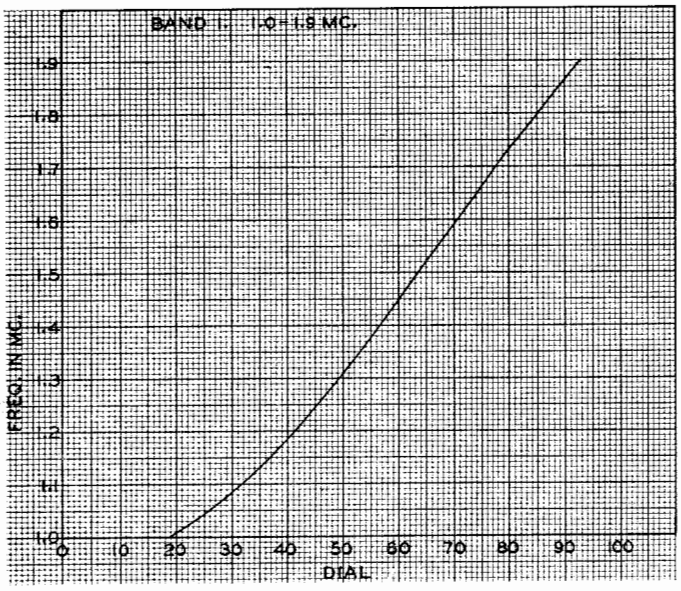


Figure 4-1. Tuning Chart 1.0–1.9 mc

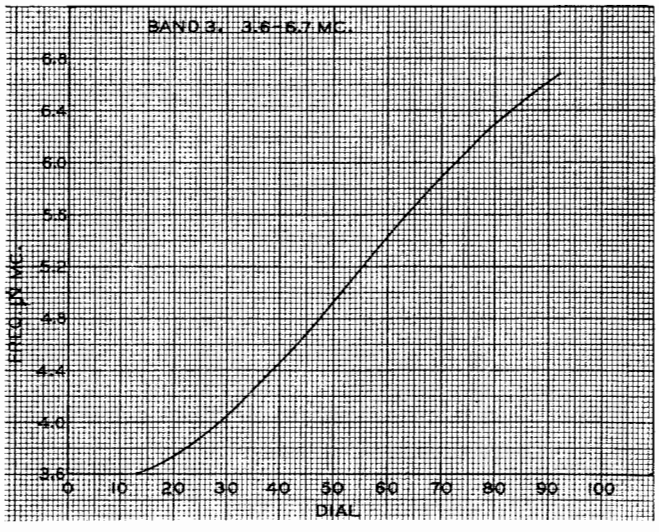


Figure 4-3. Tuning Chart 3.6–6.7 mc

CARRIER FREQ.	MULT. FACTOR (H)	FREQ. SHIFT (L)	EXT. OSC. OR XTAL FREQ	OSC. SEL. (D)	FREQ RANGE (F)	R. F. TUNING (G)
6000 K	2	850	2800 KC	2	1.9–3.6	50

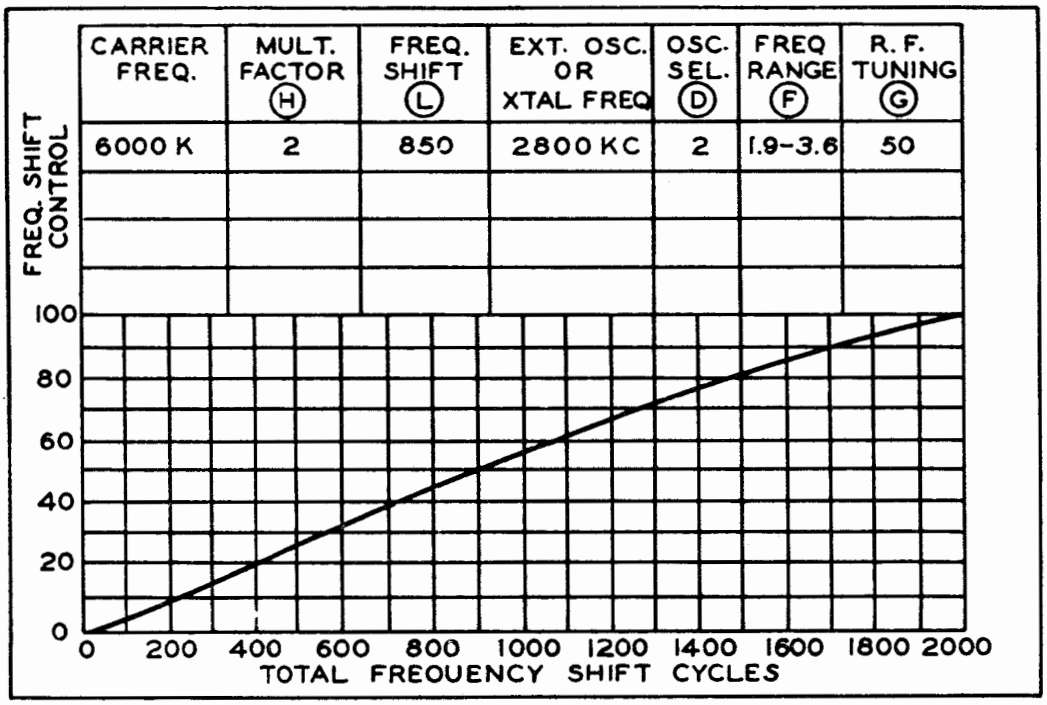


Table 4-1. Control Settings of Model KY-30/GRT Keyer

b. Turn the METER SWITCH (C) to the PA GRID position.

c. Turn the OUTPUT LEVEL control (P) to full output (position 10).

d. Readjust the RF TUNING control (G) slightly until maximum current indication is obtained on the POWER AMPLIFIER METER.

e. Turn the METER SWITCH (C) to the PA PLATE position.

3. CHECK OF FREQUENCY.

a. Set the TRANSMITTER MULT FACTOR switch (H) on position 1.

b. Connect a headphone to the FREQUENCY METER AUDIO OUTPUT jack.

c. Adjust the radio-frequency measuring equipment to the final transmitting frequency.

d. Set TEST-OPERATE Switch (K) to the CARRIER position.

e. Adjust the CARRIER FREQ. ADJ. until a zero-beat condition results.

NOTE

IF THE KEYER IS USED WITH A VARIABLE FREQUENCY EXTERNAL OSCILLATOR THE FREQUENCY ADJUSTMENT CAN BE MADE WITH THE CONTROLS ASSOCIATED WITH THE EXTERNAL OSCILLATOR.

f. Restore the TRANSMITTER MULT FACTOR switch (H) to the position designated on the chart (Table 4-1).

4. ADJUSTMENT OF FREQUENCY SHIFT.

a. Set the TEST-OPERATE switch (K) to the carrier position.

b. Set the frequency meter to the assigned carrier frequency. Assuming the keyer is exactly on the assigned carrier frequency (Step 3), a zero beat condition will result in the audio output of the frequency meter.

c. Set the TRANSMITTER MULT FACTOR switch to position 1.

d. Adjust the audio oscillator for a frequency corresponding to one-half the final shift required (for example, one-half of 850 cycles, or 425 cycles).

e. Set TEST-OPERATE switch to the SPACE position.

f. Compare the audio output of the frequency meter with the audio oscillator and adjust the FREQUENCY SHIFT until the two audio frequencies produce a zero beat.

g. Set the TEST-OPERATE switch to the MARK position, and check that a near-zero-beat is produced in this position.

5. LIST OF CONTROLS.

The controls used in Keyer KY-30/GRT are tabulated in table 4-2, together with a brief description of their function.

TABLE 4-2

LETTER DESIGNATING	CONTROL	TYPE	FUNCTIONAL DESIGNATION	PURPOSE
(A)	Toggle	Switch	Power (OFF - ON)	Controls connection of primary power to keyer power supply. A pilot (white cap) lights when the switch is in ON position.
(B)	Knob	Switch	Plate (OFF - ON)	Controls connection of +300 volt plate supply from the rectifier of the power unit to other components of the keyer. A pilot (red cap) lights when the switch is in ON position.
(C)	Knob	Switch	METER SWITCH (PA GRID - PA PLATE)	Permits switching of M-101 to either the GRID or PLATE circuit of POWER AMPLIFIER V-114.
(D)	Knob	Switch	CRYSTAL SELECTOR (CO1 - CO2 - CO3 - EXT. OSC.)	Permits selecting an RF input supply from an external source, or from an oscillator in the keyer, the frequency of which is set by one of three different crystals.
(E)	Knob	Switch	EXT. OSC. LEVEL (1 - 10)	Allows adjusting the level of the RF input supply from an external oscillator.
(F)	Knob	Switch	FREQUENCY RANGE MC (1.0 - 1.9, 1.9 - 3.6, 3.6 - 6.7)	Changes the connections of the RF tuned circuits for three bands of frequencies indicated by the markings of the switch positions.
(G)	Knob	Capacitor	RF TUNING	Tunes the output circuits of the BALANCED MODULATOR, the BUFFER, and the POWER AMPLIFIER. (With capacitor C-151A-B.)
(H)	Knob	Switch	TRANSMITTER MULT. FACTOR (1, 2, 3, 4, 6, 8, 9, 12)	Sets the magnitude of the frequency shifts in ratios corresponding to the frequency multiplication factor of the transmitter.
(K)	Knob	Switch	TEST-OPERATE (C—SPACE—MARK—FSK PHOTO)	Permits selecting carrier SPACE—MARK—FSK—PHOTO.
(L)	Knob	Potentiometer	FREQ. SHIFT (0-10-20-30-40-50-60-70-80-90-100)	The magnitude of frequency shift adjustable with potentiometer R-136.
(M)	Knob	Switch	WAVE SHAPING (1-2-3-4)	Modifies the output wave shapes of the keying tube by connecting different combinations of series inductance and bridged capacitance.
(P)	Knob	Potentiometer	OUTPUT LEVEL (1-2-3-4-5-6-7-8-9-10)	Changes the RF output level of the keyer.
(R)	Knob	Potentiometer	PHASE MODULATION DEGREES (0-10-20-30-40-50-60)	Connects +300 volt plate supply to phase-modulating oscillator V-103 with switch S-103 and modifies the magnitude of phase modulation with potentiometer R-117.
			OTHER CONTROLS	
----	Slotted Shaft	Potentiometer	MODULATOR BALANCE	Equalizes the output of the balanced modulator (vacuum tubes V-111 and V-112).
----	Slotted Shaft	Potentiometer	PHOTO INPUT ADJUST	Limits the amount of photo signal to the BALANCED KEYER tube, V-104.
----	Slotted Shaft	Potentiometer	LIMITER ADJUST	Adjusts the bias on the BALANCED KEYER tube, V-104, and LIMITER tube, V-102.
----	Slotted Shaft	Capacitor	C-127 CARRIER FREQ. ADJUST	Located in oven, this control provides means for adjusting the 200 kc oscillator frequency to 200 kc.
----	Slotted Shaft	Potentiometer	FREQ. SHIFT CALIBRATION	Adjusts the gain of the phase shifting amplifier, V-105, which in turn calibrates the FREQ. SHIFT control.
----	Slotted Shaft	Potentiometer	KEYER BALANCE	Equalizes the magnitude of the balanced keyer output voltage. This condition is reached only when the TEST-OPERATE switch is in the Carrier position.

SECTION 5
OPERATOR MAINTENANCE

1. ROUTINE CHECK CHARTS.

During normal operation of the Keyer KY-30/GRT, the oven temperature and the power amplifier plate current should be checked as indicated in Table 5-1.

2. FUSE LOCATION AND SYMPTOMS OF FAILURE.

The fuse, F-101, is located on the rear of the Keyer Power Supply chassis. Refer to figure 7-12.

CAUTION

NEVER REPLACE A FUSE WITH ONE OF HIGHER RATING UNLESS CONTINUED OPERATION OF THE EQUIPMENT IS MORE IMPORTANT THAN PROBABLE DAMAGE. IF A FUSE BURNS OUT IMMEDIATELY AFTER REPLACEMENT, DO NOT REPLACE IT A SECOND TIME UNTIL THE CAUSE OF TROUBLE HAS BEEN CORRECTED.

FUSE SYMBOL AND VALUE	FUNCTION	SYMPTOMS OF FAILURE
F-101, 3 amps.	Power Supply Protection (115 V or 230 V)	Complete operating failure. Vacuum tube and pilot filaments not lighted.

3. REPLACEMENT OF ELECTRON TUBES.

All electron tubes are located on the main chassis except V-104, V-105, V-106, V-107 and V-108. The first four tubes are located on the rear of the oven, while V-108 is located on the right hand side of the oven. To remove the tubes it is necessary to remove the tube shields. This is accomplished by gently pressing downward and turning the shield in a counterclockwise direction. To replace the tubes, it is necessary to properly orient the tube pins and press firmly into the socket. Replace the shield by gently pressing downward and turning the shield in a clockwise direction.

4. REPLACEMENT OF PILOT LAMPS.

The three pilot lamps on the front panel have conventional miniature bayonet type bases. A lamp may be replaced from the front by first unscrewing the associated cap. The lamps, caps and sockets are related as follows:

LAMP			COLOR OF CAP	SOCKET DESIGNATION
Designation	Volt	Amp.		
I-101	6.3	0.15	White (POWER)	XI-101
I-102	6.3	0.15	Red (PLATE)	XI-102
I-103	(Neon)		Amber (OVEN)	XI-103

TABLE 5-1 ROUTINE CHECK CHART—EACH WATCH

WHAT TO CHECK	HOW TO CHECK
1. Oven Temperature	a. Observe oven temp. indicator is 69°C to 75°C. If temperature exceeds these limits, report condition at once. b. Verify amber oven lamp lights for about two or three minutes, then goes out for about ten or twelve minutes.
2. P.A. Plate Current	a. Observe POWER AMPLIFIER current meter. b. If reading falls outside the range 20 to 50 milliamperes, or otherwise appears abnormal for the operating conditions, retune the RF TUNING control.

SECTION 6
PREVENTIVE MAINTENANCE

1. GENERAL.

Normal operation of the Keyer KY-30/GRT in service involves certain periodic frequency measurements for checking adjustments to assure satisfactory performance. In view of this, it is unlikely that other periodic routine mechanical and electrical checks need be made to assure continuity of service. However, it may be found desirable occasionally to make an overall check of the keyer to assure the most favorable settings of all controls, including the trimmers which ordinarily are not readjusted.

The procedures for checking the overall performance of the keyer, as outlined in paragraph 2 of this section, are based on tests which were made at the factory before Keyer KY-30/GRT was delivered. If limits specified in the tests are not met, the condition should be reported as trouble requiring corrective maintenance.

a. REGULAR PERIODIC TESTS.—THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 OF THE "BUREAU OF SHIPS MANUAL," OF THE LATEST ISSUE.

The tests listed in the following table should be made at the intervals specified:

TEST	PERIOD	PROCEDURE
Preliminary	Annually	Par. 2.*a.*
Power Supply	Semi-annually	2.*b.*
Temperature Regulation	Annually	2.*c.*
200 KC Oscillator	Annually	2.*d.*
RF Section	Annually	2.*e.*
Keying Signal Input and RF Output	Annually	2.*f.*
Phase Modulation	Annually	2.*g.*

b. LUBRICATION DATA.—No lubrication is required for Keyer KY-30/GRT.

2. OVERALL CHECK OF FREQUENCY SHIFT KEYER.

a. PRELIMINARY TESTS.

(1) MECHANICAL CHECKS.

(a) Examine the variable capacitors and insure that the plates are not bent.

(b) Check the maximum and minimum settings of all variable capacitors. If necessary, reset the associated dials at minimum and maximum scale positions corresponding to the fully disengaged and the fully meshed positions respectively of the plates.

(2) CHECK OF ATTENUATING NETWORKS.

(a) Verify that the resistances between the inner conductor of the EXTERNAL OSCILLATOR jack, J-106, and terminal 11 of the EXTERNAL OSCILLATOR LEVEL switch, with the switch in its ten different positions, are as follows:

SWITCH POSITION	RESISTANCE (ohms)
1	68.4
2	104.3
3	107.9
4	123.5
5	122.8
6	118.9
7	113.5
8	108.5
9	104.2
10	100

(b) Check the resistance between the inner conductors of the KEYER OUTPUT jack, J-105, and FREQ METER RF jack, J-104, (approx. 5600 ohms).

(c) Verify that the resistances to ground from the terminals of the KEY LINE connector, P-101, are as follows:

P-101 TERMINALS	*RESISTANCE TO GROUND (Ohms)
A	470,000 (Approx.)
B	0
C	0

*TEST-OPERATE switch in C, MARK, SPACE or FSK position.

b. TEMPERATURE-CONTROLLED OVEN.

(1) TEMPERATURE REGULATION.

(a) When the amber OVEN HEAT pilot lamp lights, check that all heater resistors in the oven actually heat.

(b) Observe that the temperature displayed by the oven temperature indicator remains between 69°C and 75°C.

(c) Verify that the temperature heating cycle, averaged over five successive cycles, is on for approximately two or three minutes and off for ten or twelve minutes (room temperature about 70°F). If heating cycle is not as indicated above, replace thermoswitch.

c. 200 KC OSCILLATOR.

(1) OUTPUT FREQUENCY.

(a) Oven heat 69°C to 75°C.

(b) Measure the frequency of the crystal oscillator (or external oscillator). This should be 200 kc lower than the required keyer output frequency.

(c) Set the frequency meter oscillator 200 kc higher than that of the frequency measured in *(b)*, i.e., the keyer output frequency.

(d) Set the FREQ. SHIFT control, R-126, to 0. Connect a headphone to the FREQUENCY METER AUDIO OUTPUT jack.

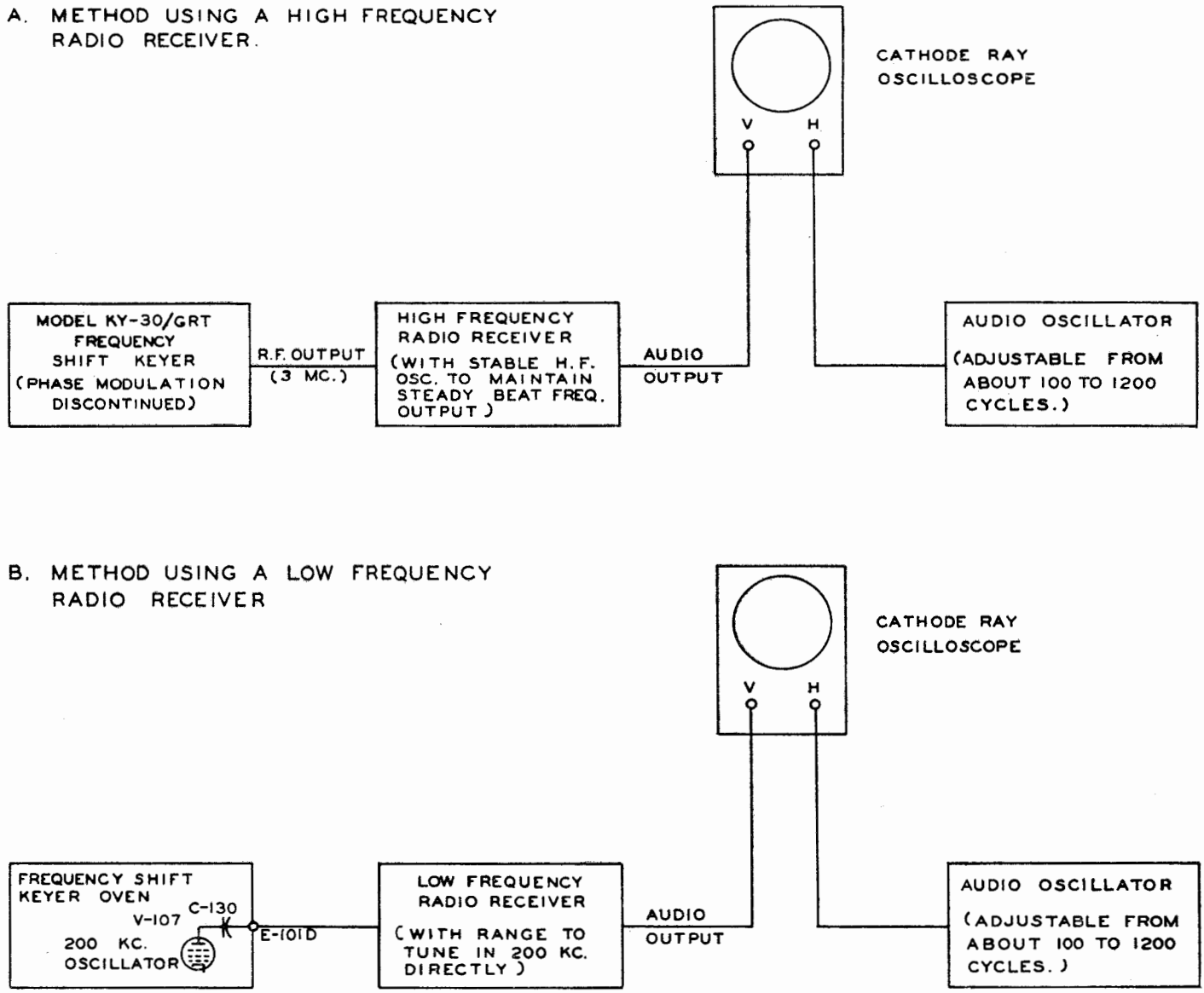


Figure 6-1. Method of Obtaining Frequency Shift Patterns

(e) Adjust CARRIER FREQ. ADJ. control, C-127, until a zero beat condition is produced. The frequency of the low frequency oscillator is then 200 kc.

(2) FREQUENCY DEVIATION.

(a) Connect the test equipment as shown in figure 6-1 and with the equipment in the condition necessary to obtain the zero beat mentioned in (1) *(e)*, set the TEST-OPERATE switch to Carrier position, the TRANSMITTER MULT FACTOR control to position 1, and turn the FREQ SHIFT control to maximum (dial reading is 100) shift. If the balanced keyer is in proper balance, the beat note in the headphones will remain at zero beat.

(b) If the audio signal is other than zero frequency the keyer balance control should be adjusted so that this audio signal is as near zero beat as possible. The balanced keyer is then operating correctly.

(c) To check the calibration of the FREQUENCY SHIFT control, set the TEST-OPERATE switch to the SPACE position with the FREQUENCY SHIFT control set to maximum shift (dial reading is 100). The resulting audio beat note should be 1000 cycles. Measure this audio frequency by comparing it with a variable calibrated audio oscillator. If the frequency is not 1000 cycles, adjust the FREQ SHIFT calibration control until the beat note is 1000 cycles. Set the TEST-OPERATE control to MARK position and check to see that the beat note thus obtained is within 50 cycles of 1000 cycles. The difference between mark and space frequencies is then approximately 2000 cycles.

(d) To check the accuracy of the TRANSMITTER MULT FACTOR control set it to position 1

with the TEST-OPERATE switch in the carrier position and the FREQ SHIFT control set to maximum shift. With the frequency meter oscillator set to the keyer output frequency, the audio beat note as heard in the headphones should be exactly zero. See paragraphs (2) *(a)* and (2) *(b)*. Turn the TEST-OPERATE control to either mark or space (resulting beat note should be very nearly 1000 cycles), and adjust the frequency of the variable frequency audio oscillator to produce a 1:1 oscilloscope pattern. Check the accuracy of the TRANSMITTER MULT FACTOR control by observing the oscilloscope patterns for the different switch positions. These patterns should be obtained by varying the frequency of the audio frequency comparison oscillator within a range of ±20 cycles which corresponds to checking the accuracy of the TRANSMITTER MULT FACTOR switch to within ±2 per cent. The ratios of the oscilloscope patterns for the different switch positions are as follows:

POSITION OF TRANSMITTER MULT FACTOR CONTROL	OSCILLOSCOPE PATTERNS
1	1:1
2	2:1
3	3:1
4	4:1
6	6:1
8	8:1
9	9:1
12	12:1

e. RF SECTION.

(1) RF ADJUSTMENT.—The following tests are made with three crystals having calibrated frequency characteristics of .8, 2.4 and 6.5 mc respectively. Place the three crystals in holders associated with positions 1, 2 and 3 of the OSCILLATOR SELECTOR switch. The three crystal frequencies correspond to radio transmitting frequencies of 1.0, 2.6 and 6.7 mc respectively (200 kc higher). The tests are based on first using the .8 mc crystal for the low range (1.0-1.9), and the 2.4 mc crystal for the middle range (1.9-3.6 mc) and the 6.5 mc crystal for the high range (3.6-6.7 mc). The tests should be made with the r-f compartment shield covers in place. Disconnect load from keyer output and set OUTPUT LEVEL control to 10.

(a) Set the OSCILLATOR SELECTOR switch in position 2 and the FREQUENCY RANGE MC switch in position 1.9-3.6 mc.

(b) Using a vacuum tube voltmeter, check that the voltage to ground from terminal A on E-101 is 1.5 to 5 volts.

(c) Turn the METER SWITCH to the PA GRID position.

(d) Turn the trimmer capacitor, C-153, to its minimum by setting solder spots opposite each other.

(e) Turn the MOD BALANCED slotted shaft with a screwdriver to its maximum clockwise position.

(f) Turn the RF TUNING dial counterclockwise, starting from position 0. Note that three positions are passed which produce maximum meter readings on M-101. Using an insulating trimming tool, adjust capacitor C-153 and at the same time, adjust the RF TUNING dial to produce a maximum meter reading at the position of the upper peak. If no peaks are noted, turn C-153 slightly and again tune for three maximum meter readings.

(g) Turn the RF TUNING dial to the middle of the three resonant peaks noted in step *(f)*.

(h) Observing the POWER AMPLIFIER meter, slowly turn the MOD BALANCE slotted shaft with a screwdriver as required to produce a minimum current reading.

(i) Again turn the RF TUNING dial to the upper resonant current peak, step *(f)*, as indicated on the POWER AMPLIFIER meter.

(j) Connect a 75 ohm resistive load to ground from the inner conductor of the KEYER OUTPUT jack, J-105.

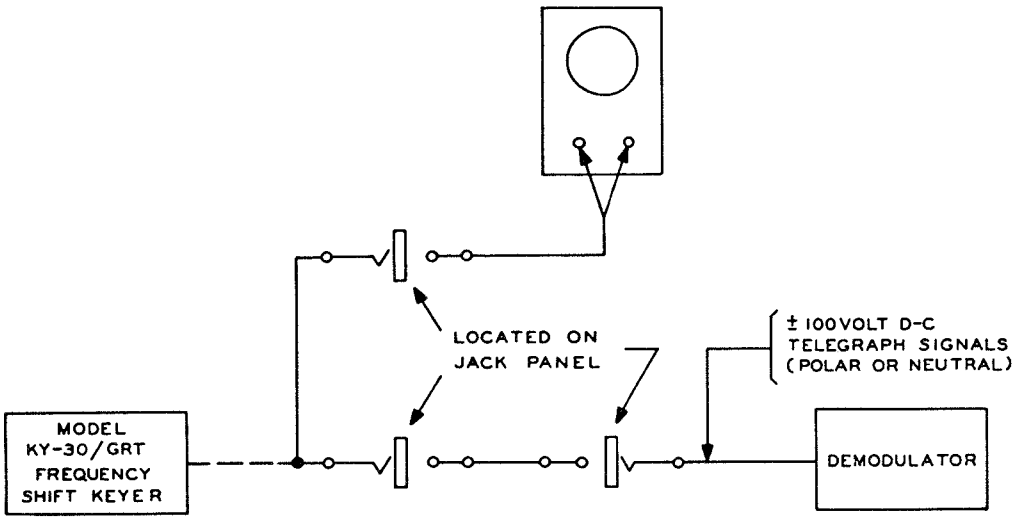
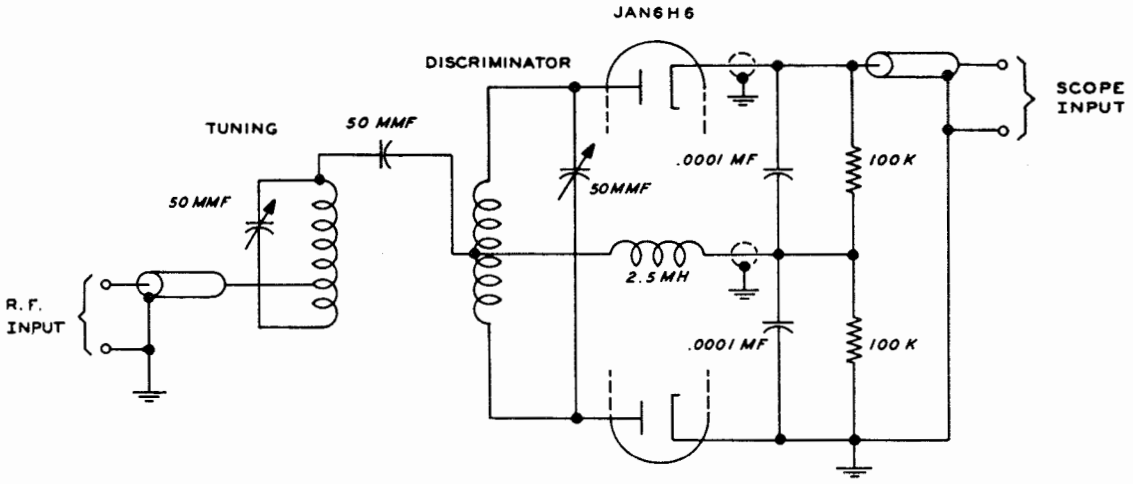
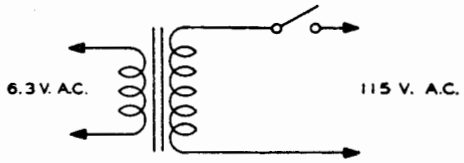


Figure 6-2. Oscilloscope Connected to Display Wave Form of Input Keying Signals

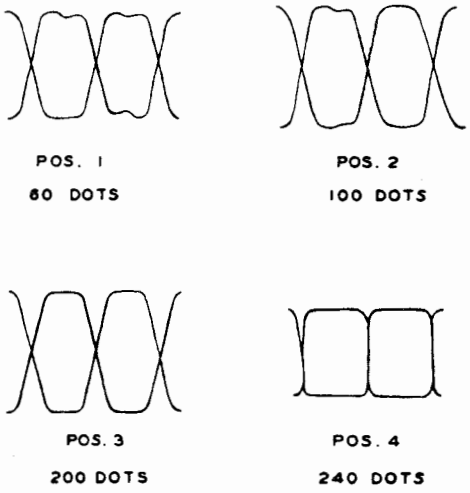


COILS ARE WOUND ON A 1 1/2 INCH DIAMETER FORM, SIDE BY SIDE, AND SINGLE LAYER CLOSE WOUND. DISCRIMINATOR COIL IS CENTER-TAPPED.

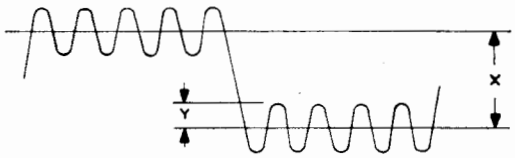


FREQ. MC	TURNS TUNING	TAP TUNING	TURNS DISCRIMINATOR	SPACING BETWEEN COILS	SIZE WIRE
1.0 – 2.7	52	3-1/2	52	1/8 IN.	28 D.C.C.
1.78 – 4.95	28	2	28	5/16 IN.	26 D.C.C.
3.86 – 8.80	13	1-3/4	13	3/8 IN.	26 D.C.C.
6.82 – 19.0	5	3/4	5	5/16 IN.	26 D.C.C.
10.8 – 28.0	3	1/3	3	5/16 IN.	26 D.C.C.

WAVE FORMS OF R.F. OUTPUT FOR DIFFERENT POSITIONS OF WAVE SHAPING SWITCH S-1404 AND FOR DIFFERENT DOT SPEEDS.



(1) WAVE FORM (APPROX. ± 1 RADIAN OF PHASE MODULATION.)



(2) APPROXIMATE DETERMINATION OF PHASE MODULATION.

$$\text{PHASE MODULATION (RADIANS)} = \frac{\frac{Y}{X} \times \text{FREQUENCY SHIFT}}{\text{FREQUENCY OF PHASE MODULATING OSCILLATOR}}$$

MULTIPLY BY $\frac{360}{2\pi}$ TO CONVERT RADIANS INTO DEGREES.

EXAMPLE:

FREQUENCY SHIFT = 850 CYCLES
FREQ. OF PHASE MOD. OSC. = 200 CYCLES
FROM ABOVE WAVE FORM Y/X = 1/4 APPROX

$$\text{PHASE MODULATION} = \frac{\frac{1}{4} \times 850}{200}$$

= 1.06 RADIANS
OR
60.7 DEGREES

Figure 6-3. Oscilloscope Connected to Show Wave Form of RF Signal Output, Typical Wave Form and Pattern for Checking One Radian of Phase Modulation

(k) Turn the METER SWITCH to the PA PLATE position.

(l) Check the RF TUNING control to see that it is set for minimum plate current as indicated on the POWER AMPLIFIER meter.

(m) Using a vacuum tube voltmeter connected across the 75 ohm load, check the approximate output voltage corresponding to the following setting of the OUTPUT LEVEL switch as follows:

OUTPUT LEVEL SWITCH POSITION	VOLTAGE
1	0
2	0
3	.1
4	7
5	13
6	17
7	21.5
8	25
9	26.5
10	27

(n) After removing the 75 ohm load, repeat procedures in steps *(a)* thru *(l)* for the 0.8 mc crystal except for the following minor differences in the setting of the controls:

CONTROL	SETTING
OSCILLATOR SELECTOR D	CO 1
Capacitor C-152	Adjust in step (f) instead of C-153
MOD BALANCE	DO NOT CHANGE

(o) After removing the 75 ohm load, repeat procedures in steps *(a)* thru *(l)* for the 6.5 mc crystal except for the following minor differences in the setting of the control:

CONTROL	SETTING
OSCILLATOR SELECTOR	CO 3
FREQUENCY RANGE MC	3.6-6.7 mc
Capacitor C-154	Adjust in step (f) instead of C-153
MOD BALANCE	DO NOT CHANGE

(2) SIDEBAND SUPPRESSION MEASUREMENT.

(a) Check to be certain that FREQUENCY RANGE switch is in position 3.6-6.7 mc.

(b) Check to be certain that the OSCILLATOR SELECTOR switch is in position CO 3 (6.5 mc crystal).

(c) Connect the FREQUENCY METER RF jack, J-104, to a radio receiver.

(d) Tune the radio receiver for a maximum audio output at a beat frequency of 1000 cycles. Adjust the gain of the receiver to set the audio output level about 45 db above the background noise. DO NOT OVERLOAD THE RECEIVER.

(e) Keeping the gain of the receiver set as in step *(d)*, tune the receiver from 5.5 to 7.5 mc in successive 200 kc steps. Verify that all signals other than at a frequency of 6.7 mc are at least 35 db lower than the 6.7 mc signal.

(f) Set the FREQUENCY RANGE MC switch in position 1.0 to 3.6.

(g) Turn the OSCILLATOR SELECTOR switch to position 2 (2.4 mc crystal).

(h) Tune the radio receiver for a maximum audio output at a beat frequency of 1000 cycles. Adjust the gain of the receiver to set the audio output level about 45 db above the background noise. DO NOT OVERLOAD THE RECEIVER.

(i) Keeping the gain of the receiver set as in step *(h)*, tune the receiver from 1.6 to 3.6 mc in successive 200 kc steps. Verify that the signal level in all positions other than at 2.6 is 35 db lower than that at 2.6 mc.

f. KEYING SIGNAL INPUT AND RF OUTPUT.

(1) Temporarily connect ground to terminal 7 of V-111.

(2) Using a high impedance voltmeter (500,000 ohms per volt) check voltage of terminal 7 of V-112 when TEST-OPERATE switch is operated alternately to MARK and SPACE positions. The meter should indicate a voltage of +1.5 to +2.5 volts with the switch in SPACE position.

(3) Remove the temporary ground connection in step (1) and connect it to terminal 7 of V-112.

(4) Connect a high impedance voltmeter from terminal 7 of V-111 to ground.

(5) Operate TEST-OPERATE switch alternately to its MARK and SPACE positions and adjust the FREQ SHIFT CALIBRATION with a screwdriver until the voltages are equal and of a polarity and magnitude specified in step (2).

(6) Adjust the Keyer until r-f output is indicated.

(7) Connect 20 cycle dot signal to the KEY LINE connector, P-101.

(8) Connect an oscilloscope as shown in figure 6-3 and verify that the input signal has zero bias as gauged by eye.

(9) Set the WAVE SHAPING switch in position 4.

(10) Connect the oscilloscope to the FREQUENCY METER RF jack, J-104, and check that the output signals have zero bias.

(11) Connect 250 cycle dot signals to the keyer.

(12) Observe the wave shapes for the different positions of WAVE SHAPING switch.

g. PHASE MODULATION.

(1) Turn the PHASE MODULATION control to the ON position.

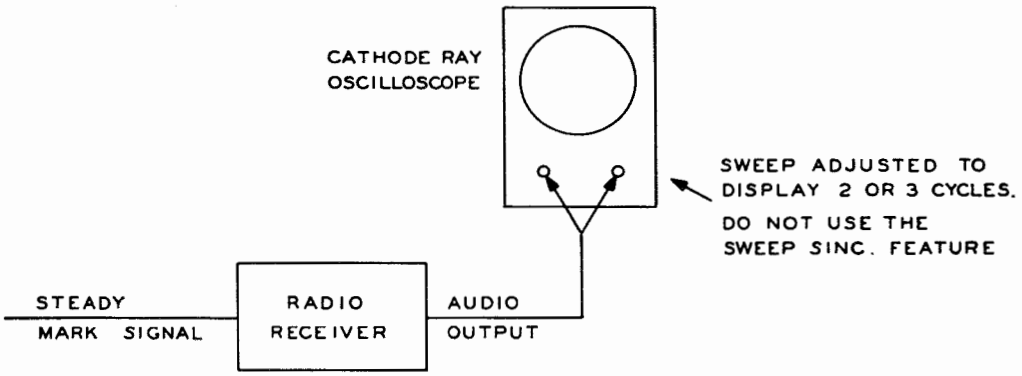
(2) Compare the output of the 200-cycles oscillator at terminal 2 on J-102 with that of an adjustable audio oscillator. The frequency of the output should be between 180 to 220 cycles per second.

(3) Set WAVE SHAPING switch on position 3.

(4) Connect 20 cycle dot signals to the keyer.

(5) Connect an oscilloscope to the keyer as shown in figure 6-3.

(6) Turn the PHASE MODULATION dial as necessary to obtain one radian of phase modulation as indicated by the oscilloscope pattern.



CONNECTION OF OSCILLOSCOPE TO DISPLAY WAVEFORM WITH PHASE MODULATION.

Figure 6-4. Connection of Oscilloscope to Display Waveform with Phase Modulation

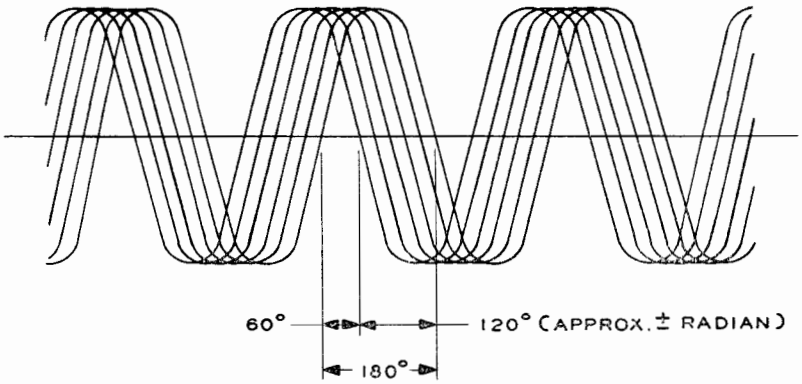


Figure 6-5. Pattern for Checking One Radian of Phase Modulation

SECTION 7
CORRECTIVE MAINTENANCE

1. ELECTRICAL ADJUSTMENT, ALIGNMENT AND CALIBRATION.

a. GENERAL—Procedures based on factory test are outlined in Section 6, paragraph 2. These tests provide an overall check of the keyer and are referred to in this section in connection with the trouble location chart.

b. REPLACEMENT OF THERMOSWITCH.

(1) The heating cycle should be on for approximately two or three minutes (amber lamp lighted) and off for ten or twelve minutes (amber lamp light out) assuming an ambient temperature of about 70°F. If for any reason the thermoswitch does not operate satisfactorily, it should be replaced with a new one.

2. TROUBLE SHOOTING.

Keyer KY-30/GRT receives d-c telegraph signals (polar or neutral) and transforms them into shifted and phase-modulated r-f signals to drive the amplifier of an associated radio transmitter. The Keyer does not introduce distortion, and accordingly, the delivery of unbiased d-c telegraph signal to the keyer results in the production of unbiased r-f telegraph signals. The production of satisfactory signals, therefore, depends not only upon the successful operation of the keyer itself, but also upon the character of the signals connected to it. Furthermore, if an external oscillator is used to generate an r-f carrier, the stability and accuracy of the oscillator output influences the reliability of the keyer output.

a. DETECTION OF TROUBLES.—Certain types of troubles can be detected quickly by observing the keyer controls such as pilot lamps, the POWER AMPLIFIER current meter, the OVEN TEMP. indicator, and the settings of switches and dials with reference to those recorded on the chart for the particular frequency. Other conditions likely to cause trouble may be detected during the performance of initial adjustments (Section 3).

In general, any important troubles which may occur probably will be reported as a result of service reactions, or as a consequence of routine monitoring of radio channel for checking transmission within assigned frequency bands.

b. TROUBLE LOCATION.—If a trouble is reported during operation, attempt to correct the condition immediately with the keyer in the cabinet. If the trouble cannot be found within a short time, remove the keyer to a bench for thorough checking. In the meantime a spare keyer may have to be patched in a working circuit.

Attempt to locate the trouble immediately, using the trouble shooting chart, table 7-1. In the event that the first of the possible corrections does not clear the trouble, proceed to the next, and in each case, carefully observe all significant effects before undertaking the next procedure. If no trouble can be found quickly with the aid of the trouble shooting chart, check the entire circuit using voltage and oscilloscope data and test procedures in this section and in Section 6. Make continuity tests with a volt-ohmmeter (or the equivalent) to locate false grounds, crosses, or opens in the circuit wiring.

TABLE 7-1 TROUBLE SHOOTING CHART

SYMPTOMS	PROBABLE CAUSE	CORRECTION
1. Pilot lamps fail to light.	1. Unit not connected to power source. 2. Pilot lamps loose in sockets. 3. Pilot lamps defective. 4. POWER switch not in ON position.	1. Connect to 110V or 230V a-c supply. 2. Remove bullseye and tighten lamp. 3. Replace with lamps from spare parts. 4. Operate switch to ON position.
2. Pilot lamps only one-half normal brilliancy.	1. Switch S-111 in 230 volt position with unit connected to 110 volt supply.	1. Operate switch to 110 volt position. (S-111 located on rear of Power Unit.)
3. Pilot lamps flash and then go out.	1. Switch S-111 in 110 volt position and unit connected to 230 volt source.	1. Operate switch to 230 volt position and replace fuse.
4. Tubes in power supply light but tubes in r-f unit do not light.	1. Connector P-110 not firmly engaged with J-110.	1. Tighten connector.
5. Oven does not heat.	1. Connector plug P-110 not firmly engaged with J-110. 2. Defective thermostat.	1. Tighten connector. 2. Replace thermostat.

TABLE 7-1 TROUBLE SHOOTING CHART (cont'd)

SYMPTOMS	PROBABLE CAUSE	CORRECTION
6. No grid current with switch in PA GRID position.	1. Crystals not in sockets. 2. FREQUENCY RANGE switch in wrong position. 3. Defective tube. 4. RF TUNING control not set correctly. 5. OSCILLATOR SELECTOR set on EXT. OSC. with no external oscillator connected. 6. Crystal holders not firmly seated in sockets.	1. Insert crystal holders. 2. Using tuning curves and charts, set switch in proper position. 3. Replace defective tube. 4. Refer to tuning curves and check setting of controls. 5. Reposition control. 6. Press crystal holders firmly into sockets.
7. Low grid current (less than .5 ma).	1. Defective tube. 2. Output circuits out of alignment.	1. Replace tube. 2. Check alignment and realign circuits where necessary.
8. Low r-f output.	1. OUTPUT LEVEL control set near zero. 2. Defective output tube (807). 3. Output circuit of unit not properly terminated. 4. Trimmer across output tank not properly adjusted. 5. Tuning slug in output tank not properly adjusted.	1. Advance control and check output. 2. Replace tube. 3. Terminate in 72 ohms. 4. Check alignment. 5. Check alignment.
9. Not possible to obtain sufficient total frequency shift.	1. Defective tube (V-104). 2. Defective tube (V-106).	1. Replace tube. 2. Replace tube.
10. Not possible to phase modulate output.	1. Defective V-103. 2. PHASE MODULATION control in wrong position.	1. Replace tube. 2. Operate control and again check output.
11. Unable to rotate controls knobs.	1. Controls locked.	1. Unlock controls.

c. WIRING DIAGRAMS.—Wiring diagrams of Keyer KY-30/GRT are shown in figures 7-14, 7-15 and 7-16. In these diagrams each piece of apparatus has the same marking as that stamped on the equipment, and the wiring terminals on each piece of apparatus are shown in their proper relative location as viewed from the wiring side. Figure 7-14 shows the wiring in the power supply. Figure 7-15 shows the wiring in the keyer temperature controlled oven and the remainder of the wiring in the keyer is shown on figure 7-16. The wiring from the oven to the main section of the keyer connects thru a terminal strip, E-101. The leads from the oven that terminate at E-101 on figure 7-15 are so designated on figure 7-16. Connections from the power supply, figure 7-14, to the keyer and the primary power source are made thru cables and the connectors on the rear of the units.

3. VOLTAGE AND RESISTANCE MEASUREMENTS.

a. VOLTAGE MEASUREMENTS.—Table 7-2 includes typical voltages with respect to ground taken at electron tube terminals. The locations of the tube sockets are shown in figures 7-15 and 7-16. Reasonable tolerances from the values shown in table 7-2 should be made to allow for possible variations in the power supply voltages and manufacturing tolerances in the resistance of components. A voltage measurement table similar to the attached may be made for a particular unit known to be in satisfactory operating condition. This separate table would, of course, reflect the specific values existing in the unit measured. Subsequently, if a large deviation from one or more of the recorded values was noted, this fact should be significant in locating a trouble.

b. RESISTANCE MEASUREMENTS.—Table 7-3 includes typical resistances to ground at tube sockets, or other specified points. Reasonable tolerances from the values shown in table 7-3 should be made to allow for possible variations in the characteristics of components. In certain cases it may be necessary to check specific resistances with reference to the circuit schematic or simplified schematic in section 2. Make allowance for commercial tolerance in the resistance of components as covered in the parts and repair parts list (Section 8). The more complex networks involve resistors connected to a common ground and one or more supply points. In such cases it is often necessary to unsolder one wired terminal of a resistor to avoid a false reading of the voltohmmeter because of other shunting paths from the common point to the particular point used in the measurement.

A resistance measurement table, similar to the table 7-3, may be made for a particular unit known to be in satisfactory operating condition. This separate table would reflect specific resistance values of the particular unit measured. Subsequently, if a large deviation from one or more of the recorded values were noted, this fact should be significant in locating a trouble.

4. REPAIRS AND REPLACEMENTS.

The repair or replacement of components of Keyer KY-30/GRT do not involve special procedures.

5. LINE-UP OF TONE CHANNEL BETWEEN CONTROL OFFICE AND RADIO TRANSMITTING STATION.

The frequency shift keyer transmits faithfully whatever signal is connected to the keying tube. If the keying wave is fairly square, the transmitted r-f signals correspond exactly with the keying wave in bias or relative lengths of the signal elements.

It is of major importance that the output wave of the tone keyer (demodulator) used to operate the frequency shift keyer has no appreciable bias. Methods are given here for lining-up the channel which supplies signals to the frequency shift keyer in order to eliminate bias as far as possible and to adjust the input level to the tone keyer. Use METHOD 1 if an oscilloscope is available and the communication office is equipped with an I-193-A Test set or Boehme keyer having the proper characteristics. Careful line-up of the tone keyer channel becomes more important as the signalling speed is increased.

a. METHOD 1 —USING DOT SIGNALS FROM I-193-A TEST SET OR BOEHME KEYER.

(1) Temporarily remove the cable assembly between the tone keyer (demodulator) output and the frequency shift keyer input.

(2) Have the communication office put a steady closed condition (tone-on) on the tone channel.

(3) Reduce the input to the tone keyer (demodulator) to zero, and adjust its output to give a reading of 100 volts on the output voltmeter.

(4) Raise the input to the tone keyer (demodulator) to give full output; note the voltmeter reading.

(5) If the reading obtained in step (4) is not 100 volts on the opposite side of zero from the reading in step (3), make an equalizing adjustment on the tone keyer (demodulator) to obtain, if possible, a reading of 100 volts for mark and space.

(6) If it is not possible to equalize the tone keyer (demodulator) output for 100 volts mark and space, set the output to 100 volts, note the mark reading and make the following calculation:

$$\text{Corrected zero reading} = \frac{M + S}{2}$$

For example, if the mark reading is +95 (deflection to the right) and the space reading is —100 (deflection to the left):

$$\text{Correct zero} = \frac{M + S}{2} = \frac{+95 - 100}{2} = \frac{-5}{2} = -2.5 \text{ volts}$$

(to the left of zero).

(7) Have the communication office apply "dot" signals (equal length marks and spaces) to the tone

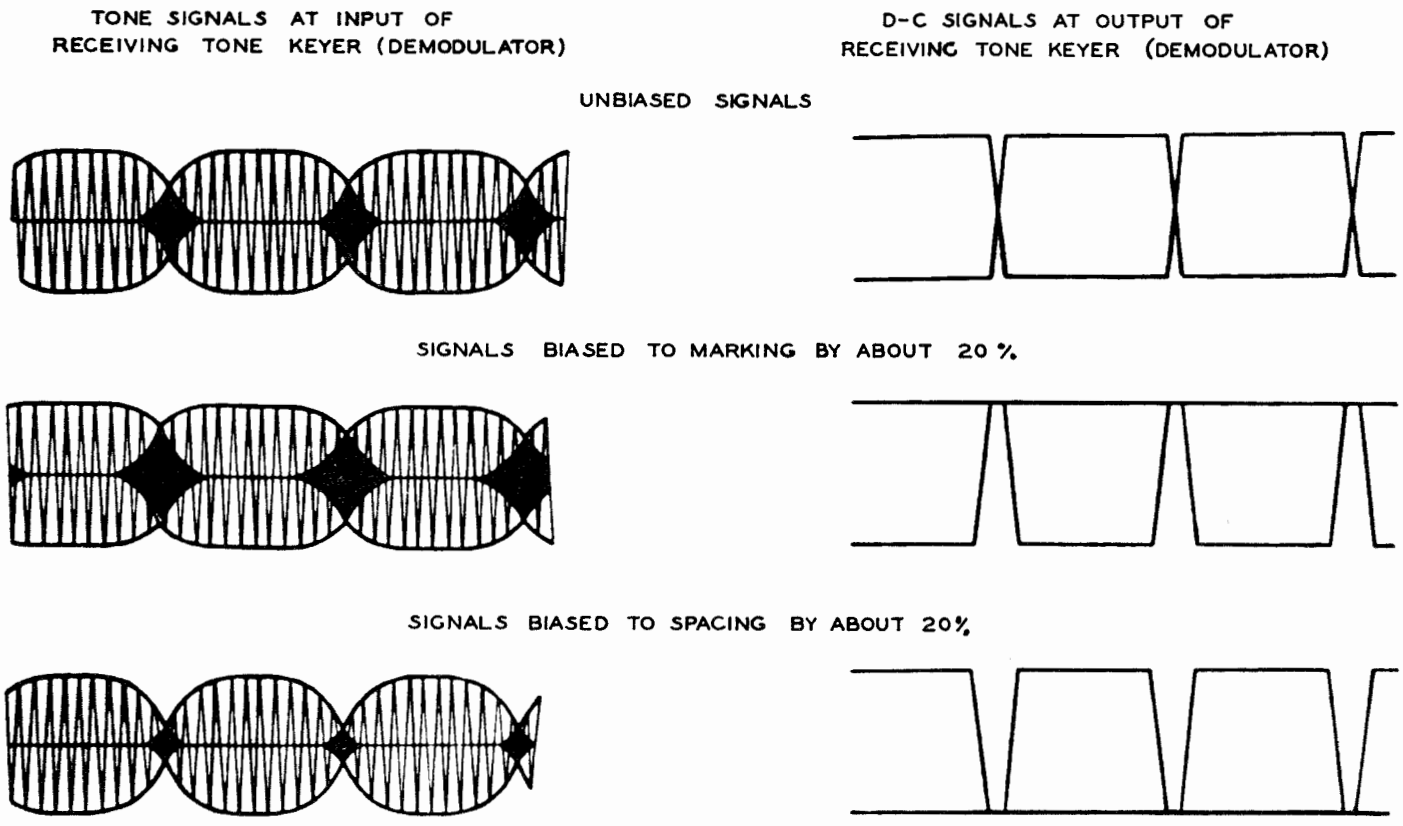


Figure 7-1. Oscilloscope Patterns for Observing Signal Bias

channel at a speed of approximately 20 dots per second. The dot signals can be obtained by patching the DOTS jack of a I-193-A Test Set to the TTY TRANS-LPG jack of an office control circuit. Instructions for obtaining 20 cycle dots from the I-193-A Test set are given in the instructions furnished with the set. Dot may also be put on the tone channel by means of a Boehme keyer known to transmit equal length open and close signals at 50 words per minute.

(8) Adjust the input potentiometer of the receiving tone keyer (demodulator) until the corrected zero reading, step (6), is obtained.

(9) If difficulty is encountered in obtaining the corrected zero reading, or if a check on the signals arriving from the sending tone keyer (modulator) is desired, these signals should be observed on a cathode-ray oscilloscope. The relative lengths of tone and no-tone intervals can be observed by operating the oscilloscope at a speed such that a tone pulse appears on the scope in each no-tone interval. If there are filters in the tone channel between the sending tone keyer (modulator) and the oscilloscope, the tone pulses will not have sharp transitions between the tone and no-tone conditions. In this case the oscilloscope should show an overlap of the tone pulse envelopes such that the front of one pulse intersects the rear of another pulse at a point halfway between zero and the maximum pulse amplitude. Typical signal patterns at the input to the tone keyer (demodulator) for biased and unbiased signals are shown at the left of figure 7-1.

(10) If the incoming signals to the tone keyer (demodulator) are biased, a request should be sent to the communication office to remove any marking or spacing bias by adjusting the sending tone keyer (modulator). The signals at the communication office should be observed on a cathode-ray oscilloscope. In this case the tone signals may not be "rounded off" by filters; and if the keyed tone pulses are not distorted, the tone-on interval will just occupy completely the no-tone interval, and a continuous trace (except for distortions occurring at the transition points) will be observed on the oscilloscope. If a condition of overlapping traces is observed near the transition points, the tone-on condition is too long or is "biased to marking." If there is a space near the transition points where no trace except the sweep circuit line appears, the signals are "biased to spacing."

(11) Having made sure that the dots as sent from the communication office are unbiased, adjust the input potentiometer of the receiving tone keyer (demodulator) until the corrected zero reading of step (6) is obtained. As an overall check, observe the signals in the output circuit of the receiving tone keyer (demodulator). Typical signal patterns for the output circuit are also shown at the right of figure 7-1. When the signals appear satisfactory, have the source of dots disconnected from the channel.

(12) Connect the tone keyer (demodulator) output to the frequency shift keyer signal input circuit and adjust the tone keyer (demodulator) output until a voltmeter reading of 30 to 40 volts is obtained.

b. METHOD 2—USING RY TAPE AND TELETYPE TRANSMITTER.—If a source of dot signals, such as the I-193-A Test Set of Boehme Keyer, is not available at the communication office, the following method may be used:

(1) Perform steps (1) to (6) of method 1, paragraph 6.*a.* of this section.

(2) Have the communication office prepare a teletype tape of repeated RYRY (---) characters, and send these signals from the teletype transmitter.

(3) Adjust the input to the receiving tone keyer (demodulator) to give the corrected zero reading, paragraph 6.*a.* step (6) of this section, plus 5 volts if the voltmeter reads to the right for the marking condition, or minus 5 volts if the voltmeter reads to the left for the marking condition.

(4) Have the communication office stop the tape transmitter.

(5) Connect the tone keyer (demodulator) output to the frequency shift keyer signal input circuit, and adjust the tone keyer output until a voltmeter reading of 30 to 40 volts is obtained.

c. METHOD 3—USING 6DB PAD.

(1) Have the communication office put a closed (tone-on) condition on the tone channel.

(2) Connect the receiving tone keyer (demodulator) to the tone line through a 6db pad in order to reduce the output of the tone channel to half value.

(3) Reduce the input to the receiving tone keyer (demodulator), by means of the input potentiometer, until the output voltmeter indicates that full spacing voltage. Then slowly increase the input until the voltmeter indication changes toward marking.

(4) If possible, adjust the input level so that the output voltmeter indicates the corrected zero (paragraph 6.*a.* step (6)).

(5) If the change from full spacing voltage to full marking voltage takes place so suddenly that it is not possible to make the adjustment of step (4), set the input potentiometer at the point at which the change from spacing to marking occurs. Leave the input potentiometer of the tone keyer (demodulator) at this point.

(6) Remove 6 db pad (step (2)) and connect the tone keyer (demodulator) to the tone line without the pad.

(7) Connect the tone keyer (demodulator) output to the frequency shift keyer signal input and adjust the tone keyer output control to give a 30 to 40 volt indication.

(8) The above procedure assures that reversal of tone keyer (demodulator) output voltage (d-c) will occur when the tone line voltage is one-half its

steady MARK value. This requires that absolute tone levels remain constant to maintain the effectiveness of the foregoing tone keyer adjustments.

6. ALIGNMENT PROCEDURE FOR RF TUNING SECTION.

In the event that the RF section of the KY-30/GRT is in need of alignment, the following procedure shall be followed. Test equipment necessary for alignment is a signal generator capable of up to two volts output in the 1-6.7 mc range, and a 75 ohm dummy load. Twelve feet of RG-8/U coaxial cable is necessary to connect the load to the keyer.

a. SET-UP PROCEDURE.

(1) Unbalance the modulator by turning the MODULATOR BALANCE completely clockwise or counterclockwise. Remove V-107 and V-108 and attach output of signal generator to E-101A. Attach the 75 ohm load, through the 12 feet of RG-8/U cable to the KEYER OUTPUT jack. With the exception of L-129, L-130, and L-131, turn the slugs of all of the inductors in the RF section approximately half way in. Turn L-129, L-130 and L-131 clockwise for nearly maximum inductance. Set all ceramic trimmers approximately 5 degrees engaged.

b. TUNING 1.0-1.9 mc BAND.

(1) Turn FREQUENCY RANGE MC switch to 1.0-1.9 mc position.

(2) Set RF TUNING to 93 and tune signal generator to 1.9 mc and approximately 2 volts output. Turn METER SWITCH to PA GRID and adjust C-152, C-155, and C-161 for maximum grid drive as indicated by the meter.

(3) Set RF TUNING to 18 and tune signal generator to 1.0 mc. Adjust T-101, T-104, and L-123 for maximum grid drive.

(4) Repeat above procedures, (2) and (3), until no further change is noted.

(5) Turn METER SWITCH to PA PLATE. Set RF TUNING at 93 and tune signal generator to 1.9 mc. Adjust C-169 for minimum plate current as indicated by the meter.

(6) Set RF TUNING at 18 and tune signal generator to 1.0 mc. Adjust L-129 for minimum plate current.

(7) Repeat above procedures, (5) and (6), until no further change is noted.

c. TUNING 1.9-3.6 mc BAND.

(1) Turn FREQUENCY RANGE MC switch to 1.9-3.6 mc position.

(2) Set RF TUNING to 90 and tune signal generator to 3.6 mc and approximately 2 volts output. Turn METER SWITCH to PA GRID and adjust C-153, C-156, and C-162 for maximum grid current.

(3) Set RF TUNING to 14 and tune signal generator to 1.9 mc and adjust T-102, T-105, and L-124 for maximum grid drive.

(4) Repeat above procedures, (2) and (3), until no further change is noted.

(5) Set RF TUNING to 90 and tune signal generator to 3.6 mc. Turn METER SWITCH to PA PLATE and adjust C-170 for minimum plate current.

(6) Set RF TUNING to 14 and tune signal generator to 1.9 mc. Adjust L-130 for minimum plate current.

(7) Repeat above procedures, (5) and (6), until no further change is noted.

d. TUNING 3.6-6.7 mc BAND.

(1) Turn FREQUENCY RANGE MC switch to 3.6-6.7 mc position.

(2) Set RF TUNING to 93 and tune signal generator to 6.7 mc with approximately 2 volts output. Turn METER SWITCH to PA GRID and adjust C-154, C-157, and C-163 for maximum grid current.

(3) Set RF TUNING to 13 and tune signal generator to 3.6 mc. Adjust T-103, T-106, and L-125 for maximum grid current.

(4) Repeat above procedures, (2) and (3), until no further change is noted.

(5) Set RF TUNING to 93 and tune signal generator to 6.7 mc. Turn METER SWITCH to PA PLATE position and adjust C-171 for minimum plate current.

(6) Set RF TUNING to 13 and tune signal generator to 3.6 mc. Adjust L-131 for minimum plate current.

(7) Repeat above procedures, (5) and (6), until no further change is noted.

(8) Replace V-108.

e. MODULATOR BALANCE.

Having re-aligned the RF section, it will be necessary to balance the modulator so the circuit will effectively cancel out the crystal or external oscillator carrier frequencies. This is accomplished as follows:

(1) Turn the FREQUENCY RANGE MC switch to 3.6-6.7 mc position. Insert a 6.5 mc crystal and turn CRYSTAL SELECTOR to the position which corresponds to that crystal. Turn METER SWITCH to PA GRID. Turn the RF TUNING to approximately 86. This tunes the RF section to about 6.5 mc. It may be necessary to move the RF TUNING slightly to obtain maximum grid drive.

(2) With a screwdriver, adjust the MODULATOR BALANCE control, located on the back of the RF section, for minimum power output as indicated by the antenna current meter, or for minimum grid current as indicated by the grid current meter. The grid current can generally be reduced to zero.

(3) Replace V-107.

7. DISCARDING ELECTRON TUBES.

ALL TUBES OF A GIVEN TYPE SUPPLIED WITH THIS EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

The circuits of Keyer KY-30/GRT employ types of electron tubes listed in the Joint Army-Navy Specification JAN-1A for Electron Tubes. When attempting to determine the possible cause of a trouble, first test the tubes if a tube tester is available. Discard the tube if it is found to have deteriorated to the extent of being indicated as defective by the tube tester in accordance with the instrument's calibration.

If a tube tester is not available, try a new tube in the place of one thought to be defective. If replacing the tube clears the trouble, discard the old tube.

CONDITIONS OF MEASUREMENT FOR TABLES 7-2 AND 7-3—

1. Measurements made with RCA Voltohmyst from tube pins to chassis.
2. Control Positions
   a. POWER Switch—Table 7-2 ON; Table 7-3 OFF.
   b. PLATE Power Switch—ON.
   c. OUTPUT LEVEL—Full On.
   d. OSCILLATOR SELECTOR—CO 1.
   e. TEST-OPERATE—C.
   f. FREQ. SHIFT—50.
   g. TRANSMITTER MULT. FACTOR—1.
   h. WAVE SHAPING—4.
   i. PHASE MODULATION—60.
   j. FREQUENCY RANGE—1.0-1.9 MC.
   k. EXT. OSC. LEVEL—0.
   l. METER SWITCH—P.A. GRID.

TABLE 7-2 TUBE OPERATING VOLTAGES

TUBE TYPE	FUNCTION	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9	PLATE CAP
V-101	JAN 6AL5 Limiter	0	—.8	6.2	0	0	0	—.8			
V-102	JAN 6AL5 Limiter	+18	0	6.2	0	+6	0	0			
V-103	JAN 6AK5 Phase Mod Osc	—7.2	+.35	6.2	0	+84	+84	+.35			
V-104	JAN 12AU7 Balanced Keyer	+115	+2.8	+8	0	0	+115	+2.8	+8	6.2	
V-105	JAN 6C4 Phase Shifting Amp	+63	0	6.2	0	+63	0	+2.4			
V-106	JAN 6C4 Phase Shifting Amp	—.1	0	6.2	0	+50	+19	+.35			
V-107	JAN 6BA6 200 kc Oscillator	—7.3	0	6.2	0	+90	+110	0			
V-108	JAN 6AK5 Crystal Osc	—7.8	+.6	6.2	0	+112	+75	+.6			
V-109	JAN 12AU7 Amp and Cathode Follower	+205	0	+9	0	0	+220	0	+7.4	6.3	
V-110	JAN 6J6 Phase Inverter	+94	+85	6.2	0	0	0	+.9			
V-111	JAN 6BE6 Balanced Mod	—.75	+3	6.2	0	+160	+98	+2			
V-112	JAN 6BE6 Balanced Mod	—.75	+3	6.2	0	+160	+98	+2			
V-113	JAN 6BA6 Buffer	—10.5	0	6.2	0	+250	+155	0			
V-114	JAN 807 RF Power Amp	0	+185	—52	0	6.2					440
V-115	JAN OD3/VR150 Voltage Regulator										
V-116	JAN 6X4 Rectifier LV	350 AC	0	6.2	0	0	350 AC	+300			
V-117	JAN 6X4 Rectifier LV	350 AC	0	6.2	0	0	350 AC	+300			
V-118	JAN 6X4 Rectifier Bias V	—540	0	350 AC		0	—540	350 AC			
V-119	JAN 5R4GY Rectifier HV		+465		560 AC		560 AC		+465		

TABLE 7-3 RESISTANCE CHARTS

TUBE TYPE	FUNCTION	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9	PLATE CAP
V-101	6AL5 Limiter	260K	Open	---	---	260K	Open	Open			
V-102	6AL5 Limiter	3K	60K	---	0	1K	Open	160K			
V-103	6AK5 Phase Mod Osc	100K	65Ω	---	0	45K	45K	65Ω			
V-104	12AU7 Balanced Keyer	22K	100K	3800	0	0	21K	100K	3800		
V-105	6C4 Phase Shifting Amp	42K	Open	---	0	42K	10K	1200			
V-106	6C4 Phase Shifting Amp	22K	0	---	0	80K	300K	250			
V-107	6BA6 200 kc Oscillator	150K	0	---	0	18.5K	20K	1			
V-108	6AK5 Crystal Oscillator	100K	140	---	0	16.5K	62K	140			
V-109	12AU7 Amp and Cathode Follower	16.5K	100K	1800	0	0	14K	50K	1K	---	
V-110	6J6 Phase Inverter	30K	30K	---	0	70Ω	34K	100Ω			
V-111	6BE6 Balanced Mod	62K	185Ω	---	0	30K	28K	56K			
V-112	6BE6 Balanced Mod	62K	185Ω	---	0	30K	28K	55K			
V-113	6BA6 Buffer	17K	0	---	0	8500	25K	0			
V-114	807 RF Power Amp	0	14.5K	11K	0	---					12K
V-115	OD3/VR150 Voltage Regulator	Open	0	9200	Open	9200		9200	Open		
V-116	6X4 Rectifier LV	20Ω	Open	---	0	Open	20Ω	8500			
V-117	6X4 Rectifier LV	20Ω	Open	---	0	Open	20Ω	8500			
V-118	6X4 Rectifier Bias V	46K	Open	20Ω	20Ω	Open	46K	20Ω			
V-119	5R4GY Rectifier HV		12.5K		45Ω		45Ω		12.5K		

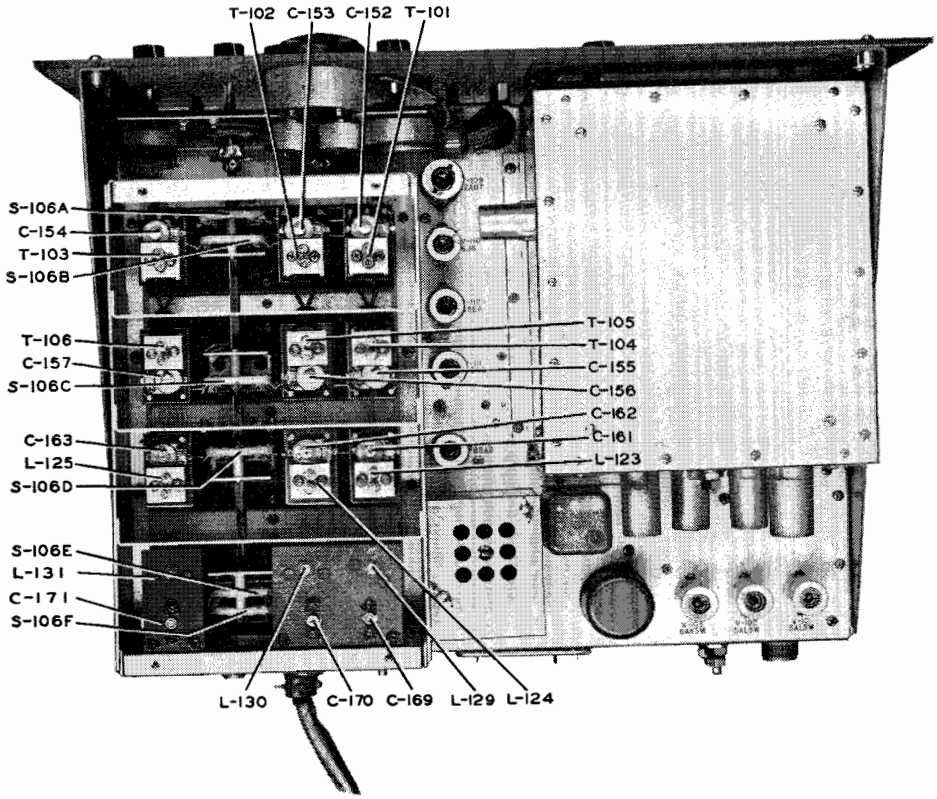


Figure 7-2. Keyer KY-30/GRT Parts Arrangement, Top View

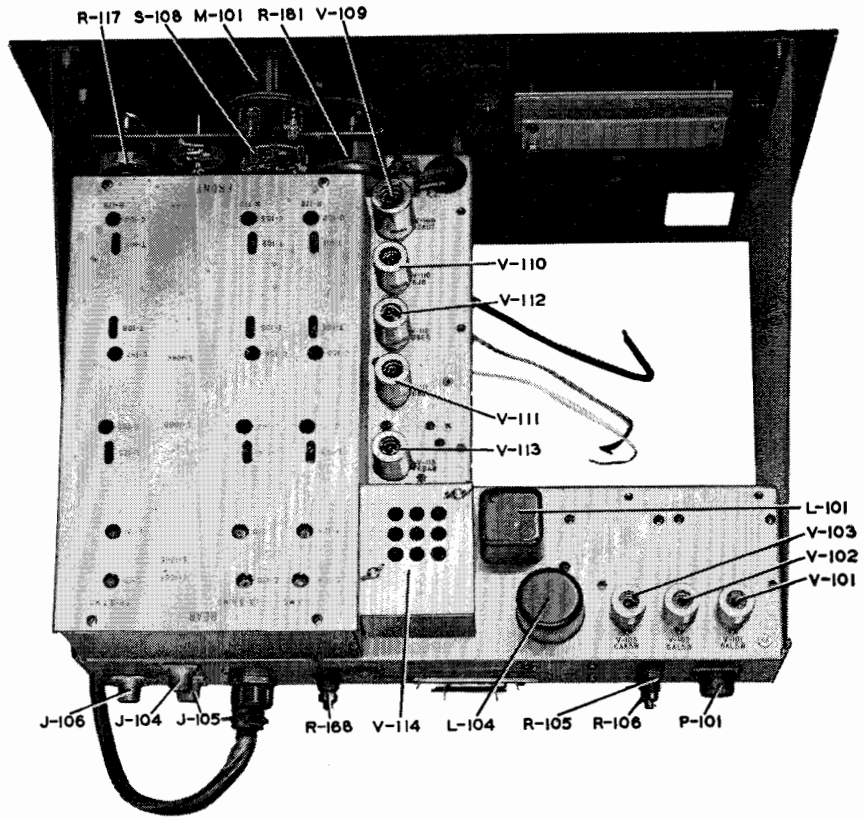


Figure 7-3. Keyer KY-30/GRT Parts Arrangement, R-F Compartment—Top View

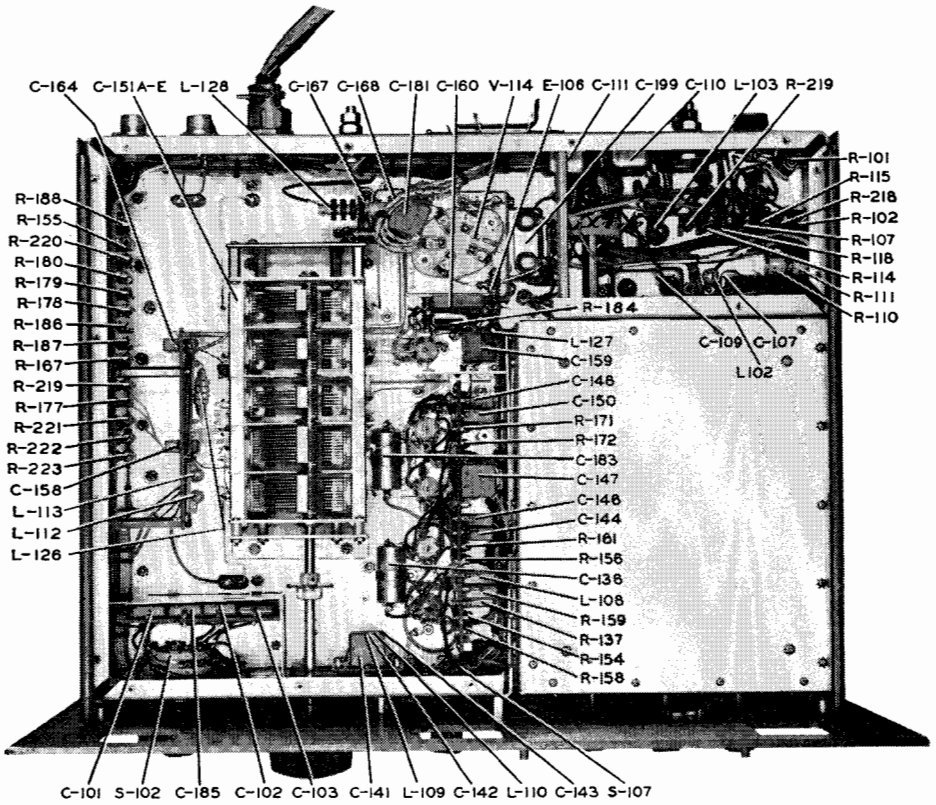


Figure 7-4. Keyer KY-30/GRT Parts Arrangement, Bottom View

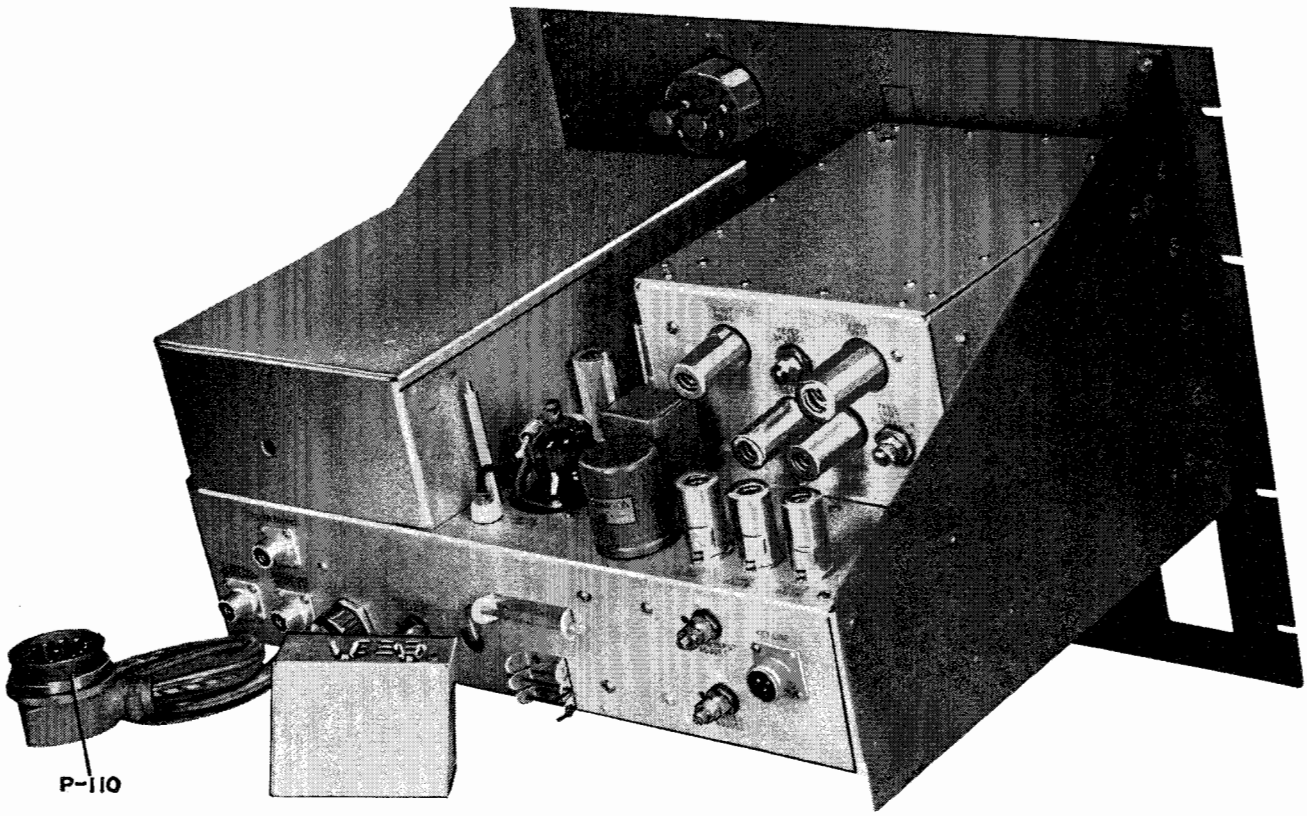


Figure 7-5. Keyer KY-30/GRT Parts Arrangement, Rear View

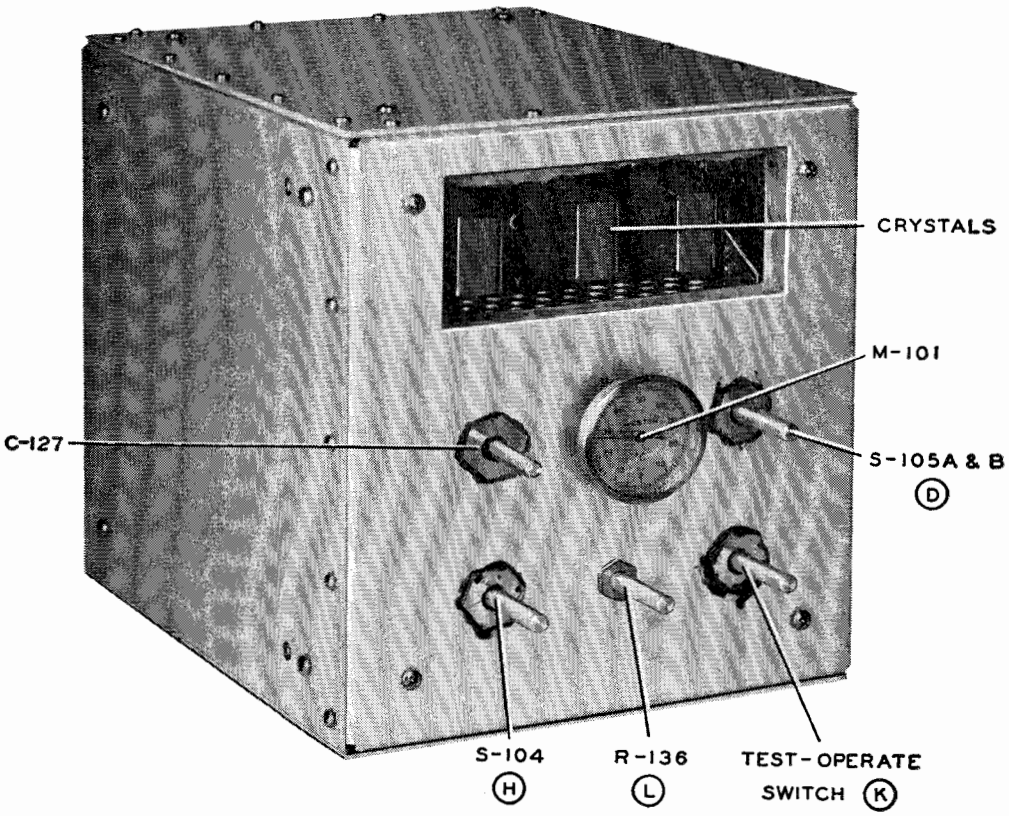


Figure 7-6. Keyer KY-30/GRT Oven, Front View

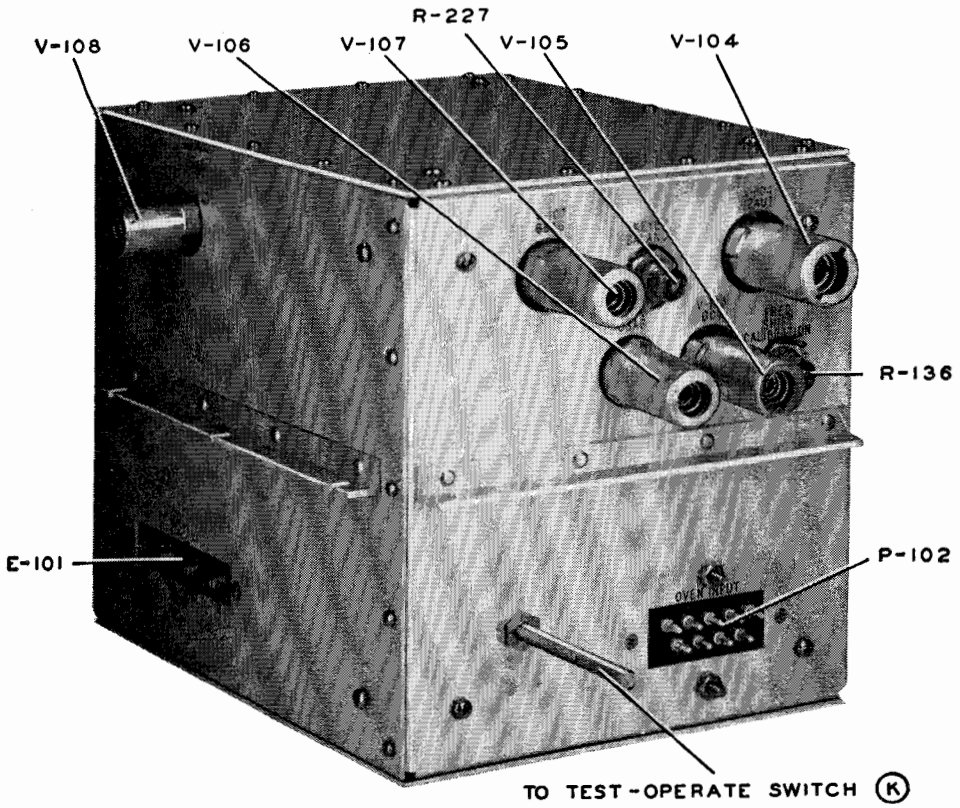


Figure 7-7. Keyer KY-30/GRT Oven, Rear View

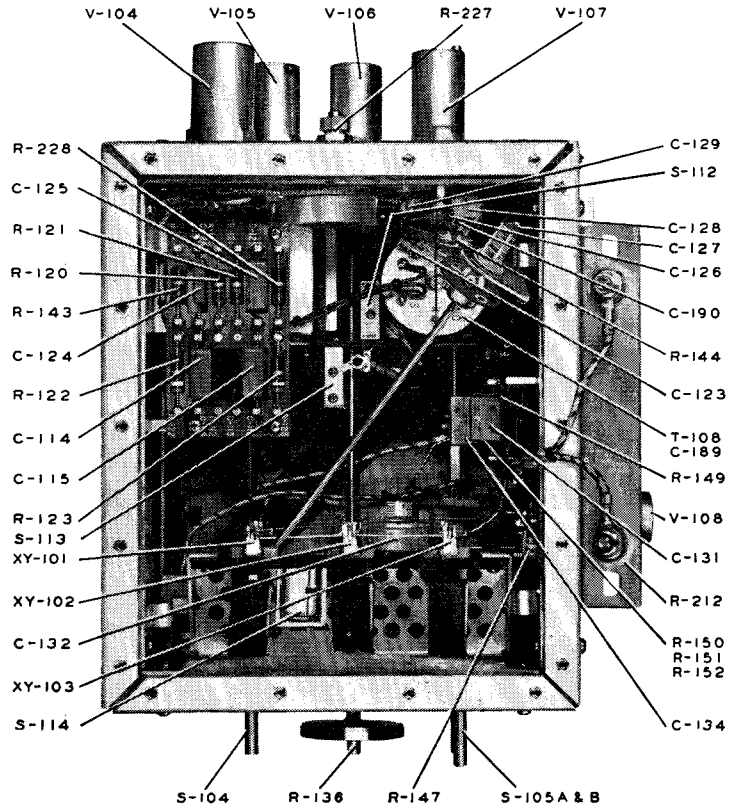


Figure 7-8. Keyer KY-30/GRT Oven Parts Arrangement, Top View

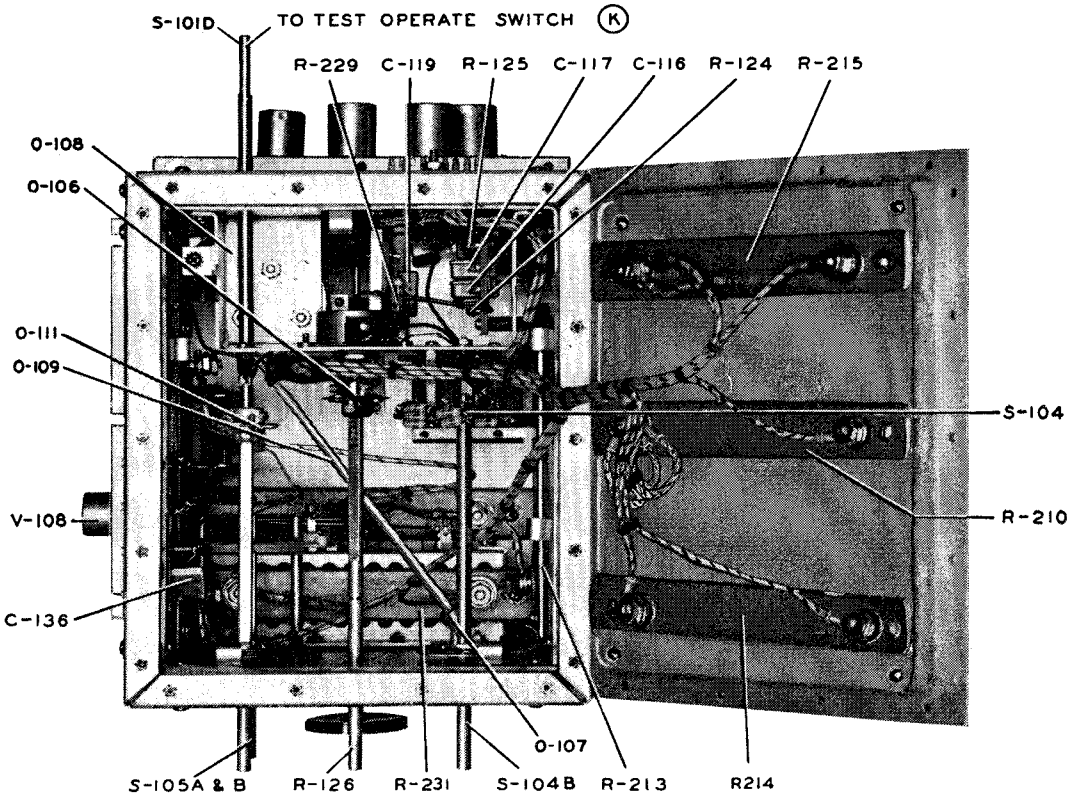


Figure 7-9. Keyer KY-30/GRT Oven Parts Arrangement, Bottom View

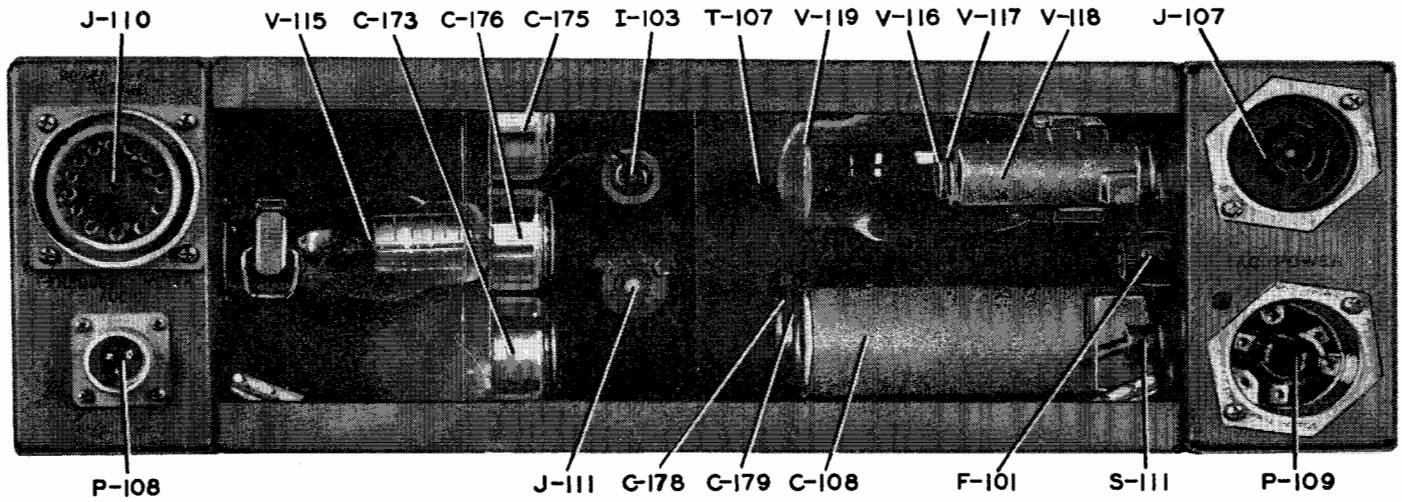


Figure 7-10. Keyer KY-30/GRT Power Supply Parts Arrangement, Rear

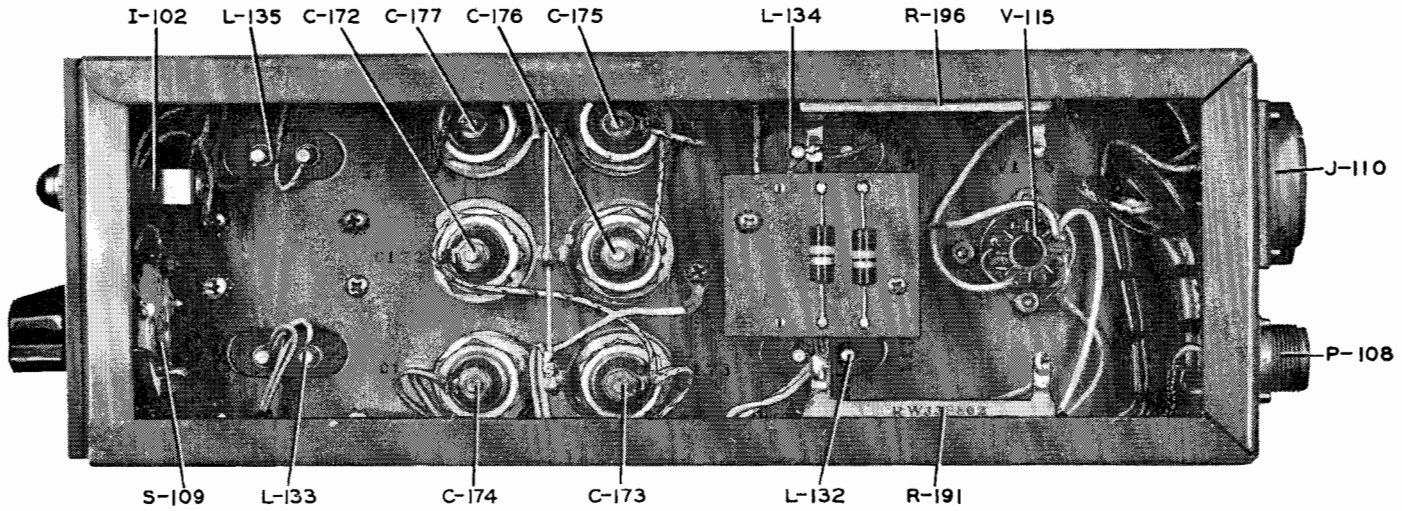


Figure 7-11. Keyer KY-30/GRT Power Supply Parts Arrangement, Right Side

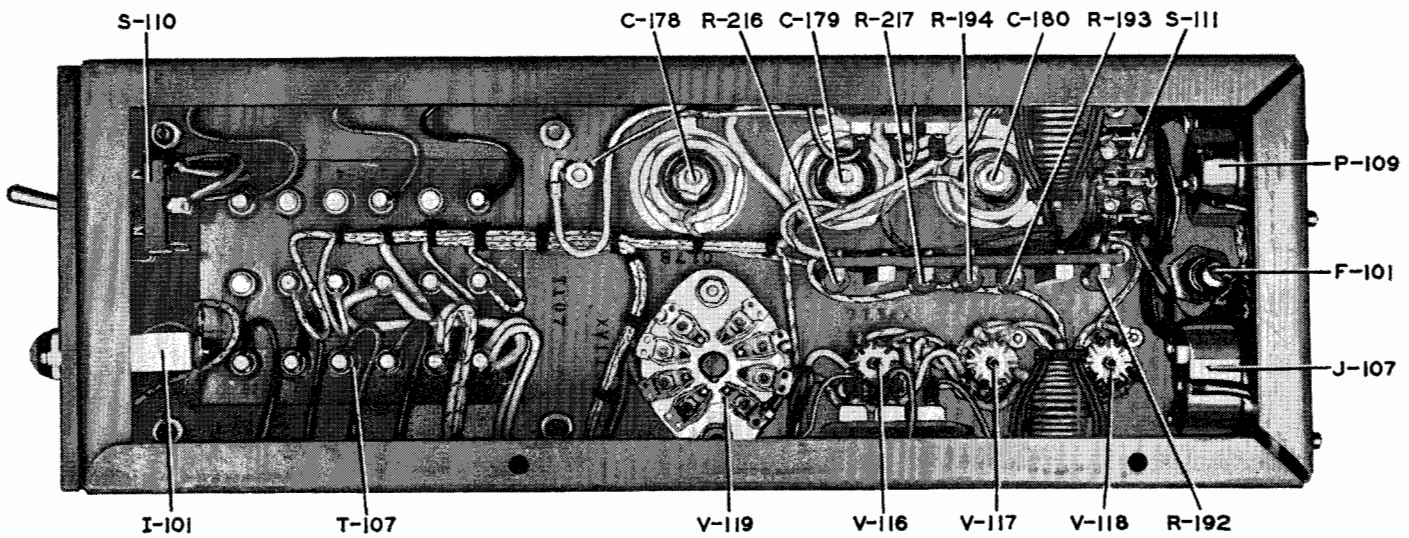


Figure 7-12. Keyer KY-30/GRT Power Supply Parts Arrangement, Left Side

KY-30/GRT
SCHEMATIC DIAGRAM

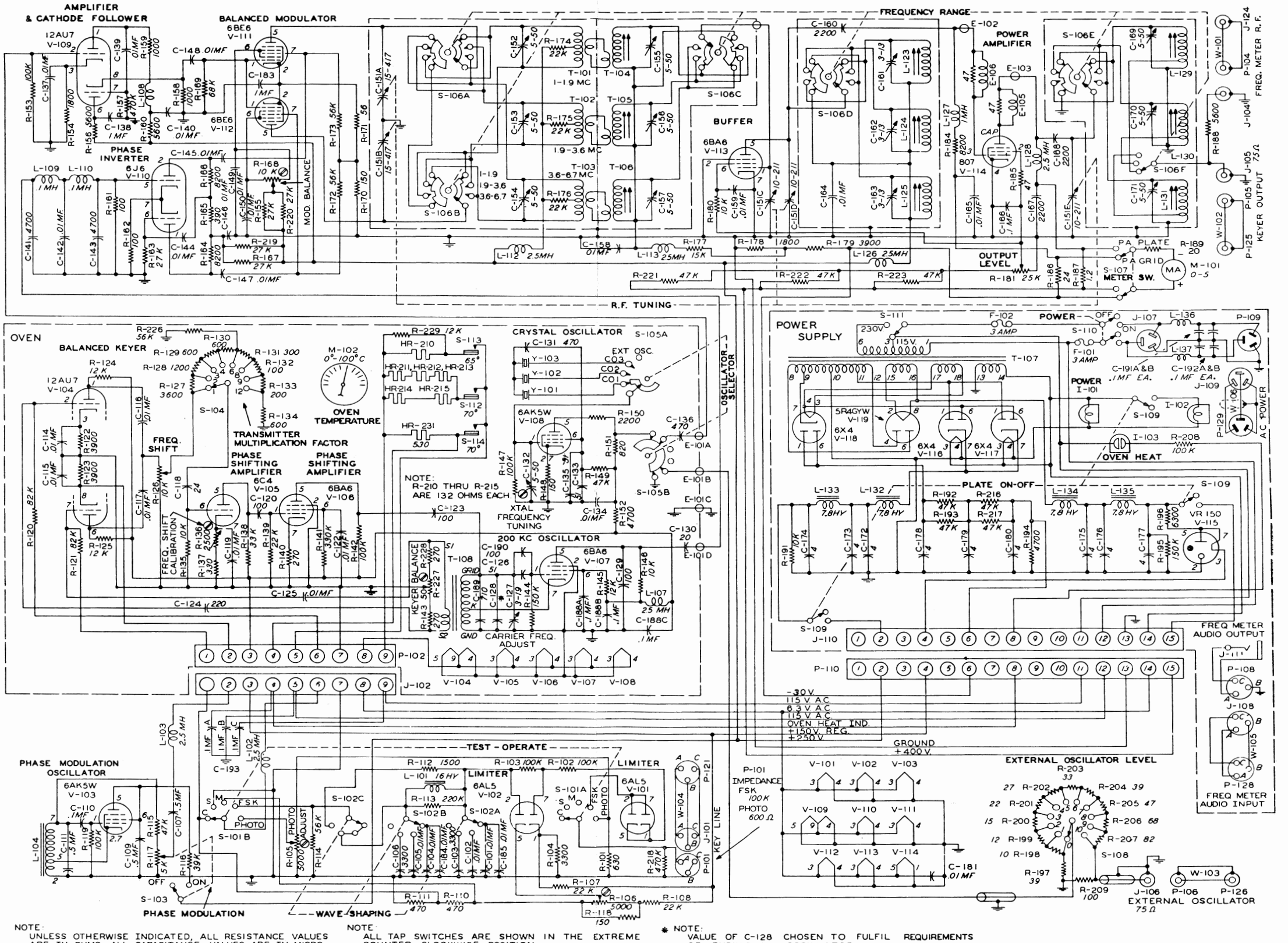


Figure 7-13. Keyer KY-30/GRT Complete Schematic

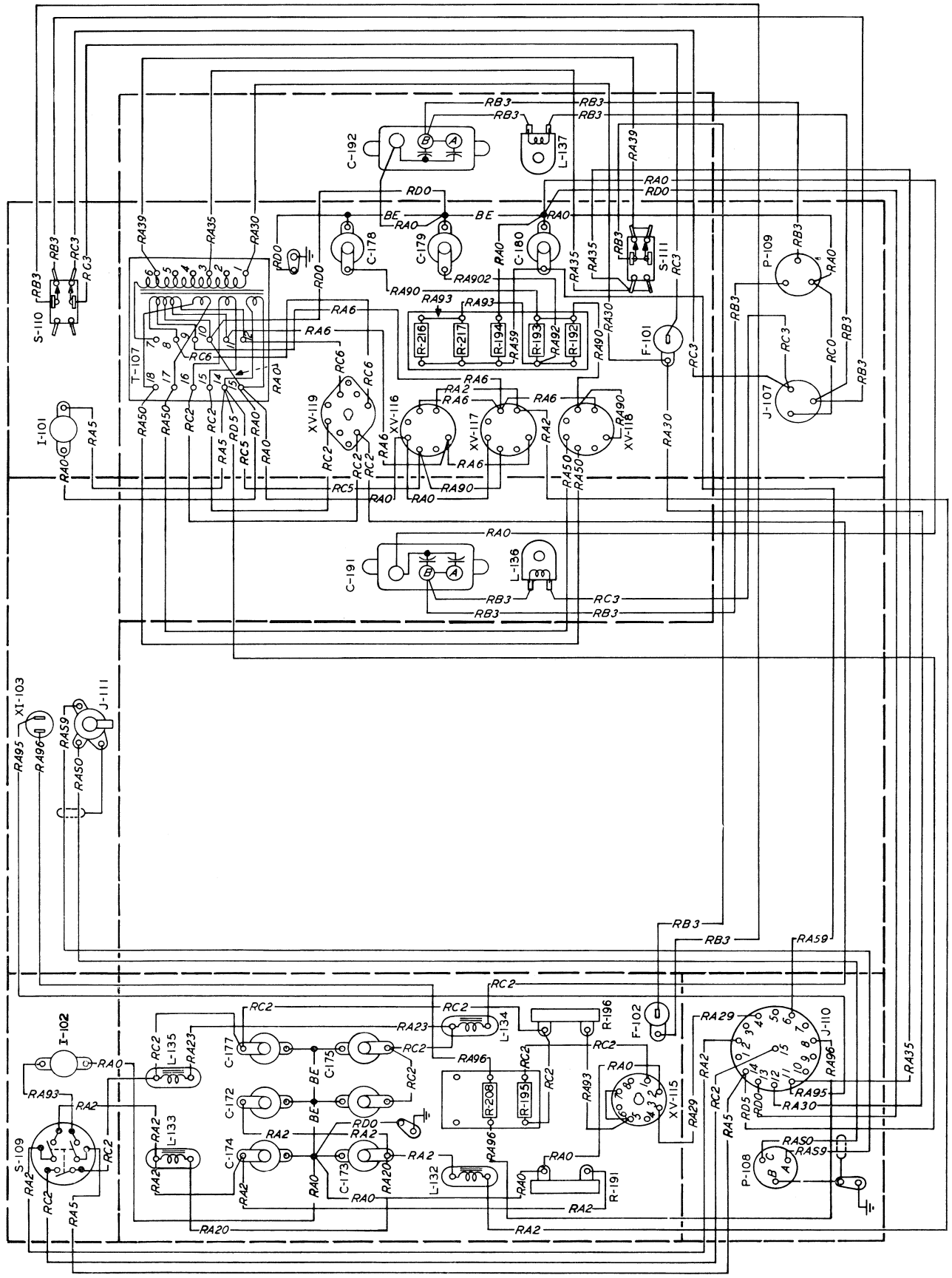


Figure 7-14. Keyer KY-30/GRT Power Supply Practical Wiring Diagram

NOTE:
ALL UNCODED WIRING IS BB (NO. 20 BUS)

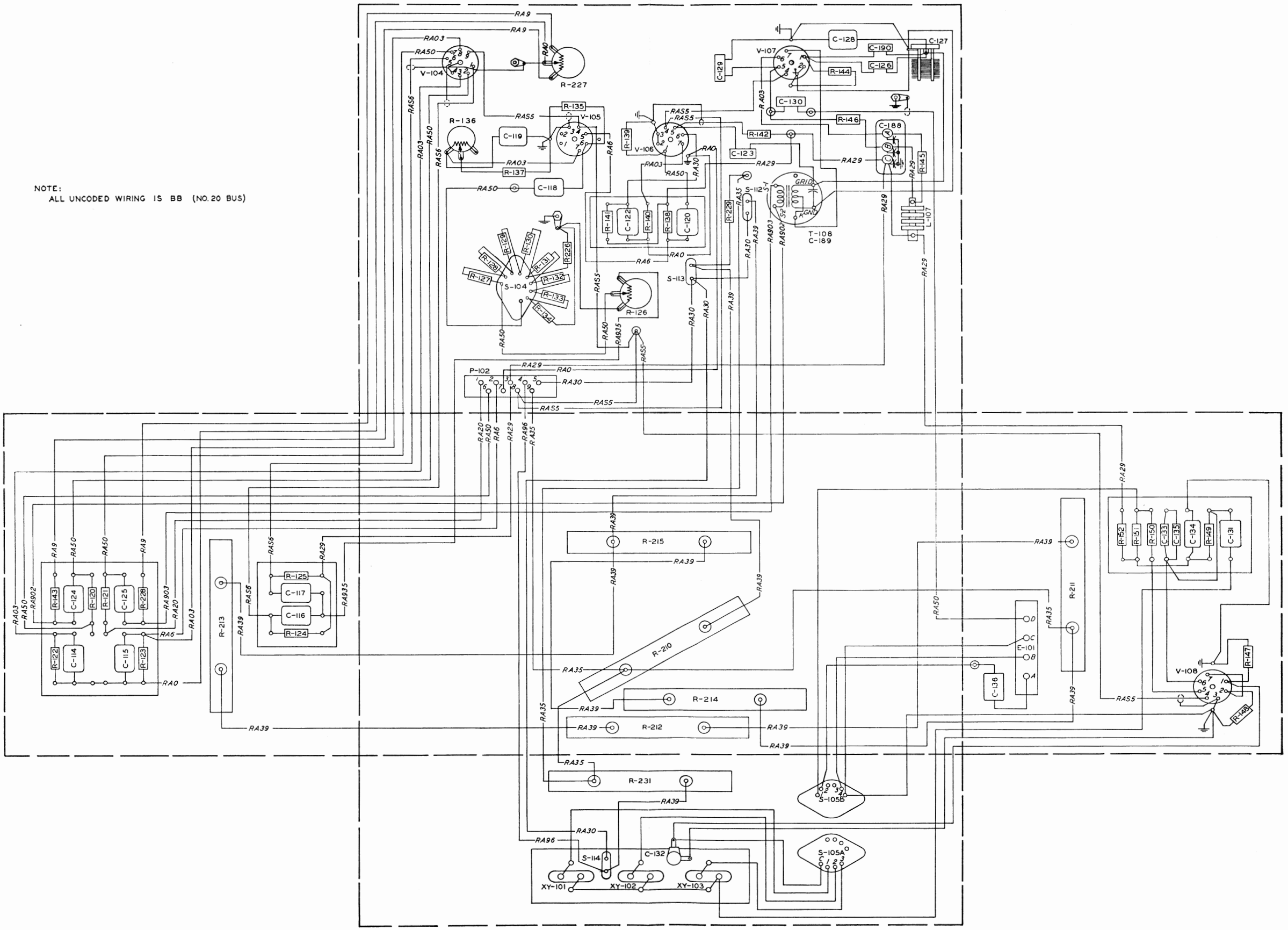


Figure 7-15. Keyer KY-30/GRT Oven Practical Wiring Diagram

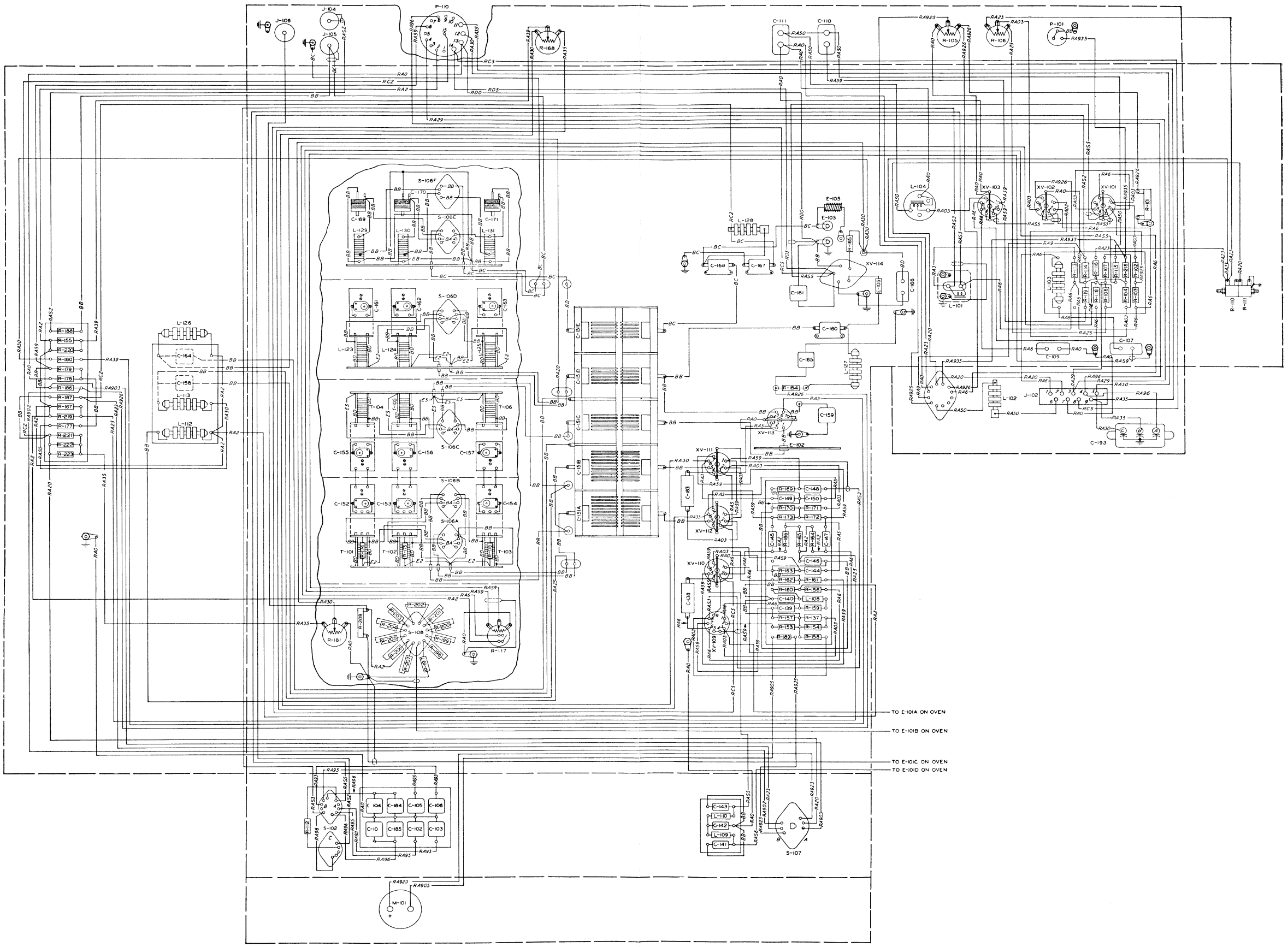


Figure 7-16. Keyer KY-30/GRT Practical Wiring Diagram

SECTION 8
PARTS LISTS

TABLE 8-1 WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

EQUIPMENT SPARES						TENDER SPARES						STOCK SPARES					
SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT
	Height	Width	Depth				Height	Width	Depth				Height	Width	Depth		

TABLE 8-2 SHIPPING WEIGHTS AND DIMENSIONS OF SPARE PARTS BOX

EQUIPMENT SPARES							TENDER SPARES							STOCK SPARES						
SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT	SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT	SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT
		Height	Width	Depth					Height	Width	Depth					Height	Width	Depth		

TABLE 8-3 LIST OF MAJOR UNITS

SYMBOL GROUP	QUANTITY				NAME OF MAJOR UNIT	NAVY TYPE DESIGNATION
	115 v. D.C.	230 v. D.C.	220/ 3/60	440/ 3/60		
101 to 299					Frequency Shift Keyer, Collins Type 709B-1	KY-30/GRT

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
	CAPACITORS								
C-101	CAPACITOR, fixed: mica; 10,000 mmf p/m 20%; 300 vdcw; temp coef letter B; 53/64" lg x 53/64" wd x 11/32" thk; molded phenolic case; 2 axial wire leads; spec JAN-C-5	Wave shaping capacitor	CM35B-103M	N16-C-33627-7705			C-101, C-102, C-104, C-105, C-114, C-115, C-116, C-117, C-119, C-122, C-125, C-134, C-137, C-139, C-140, C-142, C-144, C-145, C-146, C-147, C-148, C-149, C-150, C-158, C-159, C-164, C-165, C-181, C-184, C-185	30	
C-102	CAPACITOR: Same as C-101	Wave shaping capacitor							
C-103	CAPACITOR, fixed: mica; 3300 mmf p/m 10%; 500 vdcw; temp coef ltr B; 53/64" lg x 53/64" wd x 11/32" thk; molded phenolic case; 2 axial wire leads; spec JAN-C-5	Wave shaping capacitor	CM35B-332K	N16-C-32250-9808			C-103, C-106	2	1
C-104	CAPACITOR: Same as C-101	Wave shaping capacitor							
C-105	CAPACITOR: Same as C-101	Wave shaping capacitor							
C-106	CAPACITOR: Same as C-103	Wave shaping capacitor							

C-107	CAPACITOR, fixed: paper dielectric; 500,000 mmf p/m 10%; 400 vdcw; HS metal case; 1-13/16″ lg x 1″ wd x ⅞″ h; no int gnd connections; 2 stud term ¾″ h located on top; 2 mtg ears, with 3/16″ diam holes, 2⅛″ mtg/c; spec JAN-C-25	Ph mod osc coupling to keyes	CP54B-1FE504K	N16-C-47293-9462			C-107, C-109, C-111	3	1
C-108	Not used								
C-109	CAPACITOR: Same as C-107	V-103 screen bypass							
C-110	CAPACITOR, fixed: paper dielectric; 100,000 mmf plus 40 minus 15%; 600 vdcw; HS metal can; 1″ d x 1-13/16″ wd x ¾″ h; dykanol impr; 2 solder lug term, located on side, spaced 1″ c to c; no int gnd connections; 2 mtg feet w/ .187″ diam hole in ea on 2⅛″ centers; spec JAN-C-25	V-103 oscillator grid capacitor	CP50B1-FF104X	N16-C-45814-9330			C-110, C-166	2	
C-111	CAPACITOR: Same as C-107	V-103 grid capacitor tuning							
C-112	Not used								
C-113	Not used								
C-114	CAPACITOR: Same as C-101	V-104 cathode bypass							
C-115	CAPACITOR: Same as C-101	V-104 cathode bypass							
C-116	CAPACITOR: Same as C-101	V-104 pl coupling							
C-117	CAPACITOR: Same as C-101	V-104 pl coupling							
C-118	CAPACITOR, fixed: ceramic dielectric, 24 mmf p/m 5%; temp coef 0 (tol plus 250 minus 340) mmf/mf/°C; 500 vdcw; .460″ lg x .240″ diam; radial wire leads; uninsulated; spec JAN-C-20	V-105 coupling capacitor	CC30CK-240J	N16-C-16177-6532			C-118,	1	1
C-119	CAPACITOR: Same as C-101	V-105 cathode bypass							
C-120	CAPACITOR, fixed: mica dielectric; 100 mmf p/m 5%; 500 vdcw; temp coef ltr B; 51/64″ lg x 15/32″ h x 7/32″ thk; molded phenolic case; 2 axial wire leads; term mtg; spec JAN-C-5	V-105 pl coupling	CM20B-101J	N16-C-28553-1196			C-120	1	
C-121	Not used								
C-122	CAPACITOR: Same as C-101	V-106 screen bypass							
C-123	CAPACITOR, fixed: ceramic; 100 mmf p/m 5%; temp coef zero (tol plus 60 minus 110) mmf/mf/°C; 500 vdcw; 1.165″ lg x 0.315″ diam; radial wire leads; term mtg; uninsulated; spec JAN-C-20	V-106 pl coupling to 200 kc osc	CC35CH-101J	N16-C-17073-3201			C-123, C-129, C-190	3	1

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
C-124	CAPACITOR, fixed: mica dielectric; 220 mmf p/m 10%; 500 vdcw; temp coef ltr A; 51/64" lg x 15/32" h x 7/32" thk; molded phenolic case; 2 axial wire leads; spec JAN-C-5	V-107 coupling to keyer	CM20B-221K	N16-C-29375-8076			C-124	1	
C-125	CAPACITOR: Same as C-101	V-107 coupling to keyer							
C-126	CAPACITOR, fixed: ceramic; 51 mmf p/m 5%; neg temp coef 150 (tol plus 60 minus 140) mmf/mf/°C; 500 vdcw; 0.460" lg x 0.240" diam; radial wire leads; term mtg; uninsulated; spec JAN-C-20	V-107 grid capacitor	CC30PH-510J	N16-C-16595-1762			C-126, C-128, C-133, C-135	4	1
C-127	CAPACITOR, variable: air dielectric; single sect; 2.6 to 19.7 mmf; SLC characteristic; 750 v RMS at 2.0 mc, air gap 0.015"; 1-11/64" lg x ¾" h x ⅝" wd excluding shaft, shaft 0.188" diam x ¼" lg beyond thd, ¼-32 NEF-2 x ¼" lg, locking type; scdr adj; 21 nickel pl plates; 180° clockwise or counterclockwise; steatite insl; solder lug term; shaft mtg; split sleeve rotor brg	V-107 200KC osc. trimmer		N16-C-58716-3970	Johnson E.F. type #160	922 0033 00	C-127	1	
*C-128	CAPACITOR, fixed: ceramic; 10 mmf p/m 1 mmf; neg temp coef 150 (tol plus 60 minus 140) mmf/mf/°C; 500 vdcw; 0.460" lg x 0.240" diam; radial wire leads; term mtg; uninsulated; spec JAN-C-20	V-107 grid tuning	CC30PH-100F	N16-C-15923-1762			C-128	1	1
*C-128	CAPACITOR, fixed: ceramic; 20 mmf p/m 5%; neg temp coef 150 (tol plus 60 minus 140) mmf/mf/°C; 500 vdcw; 0.460" lg x 0.240" diam; radial wire lead; term mtg; uninsulated; spec JAN-C-20	V-107 grid tuning	CC30PH-200J	N16-C-16083-1726			C-128, C-130	2	1
*C-128	CAPACITOR: Same as C-126	V-107 grid tuning							
C-129	CAPACITOR: Same as C-123	V-107 plate bypass							
C-130	CAPACITOR: Same as C-128 (20 mmf)	V-107 coupling to filter							

* NOTE: Chosen to fulfill the requirements of each individual oscillator. Use capacitor value found in equipment or as indicated on replacement Z-105.

C-131	CAPACITOR, fixed: mica; 470 mmf p/m 20%; 500 vdcw; temp coef letter B; 51/64" lg x 15/32" wd x 7/32" thk; molded bakelite case; 2 axial wire lead term; spec JAN-C-5	V-108 xtal osc feedback	CM20B-471M	N16-C-30119-6756			C-131, C-136	2	
C-132	CAPACITOR, variable: air dielectric; single sect; 4 to 50 mmf; SLC characteristic; air gap 0.0195"; 1-9/32" lg x 1-7/32" h x 15/16" wd; sedr adj; 17 silver pl, solder brass plates; 180° clockwise or counterclockwise; ceramic insul; solder lug term; 2 mtg holes 4-40 tap on 21/32" mtg/c (part of XY-101)	V-108 grid trimmer	-483458	N16-C-59766-481	RCC type #34	922 4300 00	C-132, C-169, C-170, C-171	4	
C-133	CAPACITOR: Same as C-126	V-108 screen bypass							
C-134	CAPACITOR: Same as C-101	V-108 plate bypass							
C-135	CAPACITOR: Same as C-126	V-108 screen bypass							
C-136	CAPACITOR: Same as C-131	Coupling to S-105B							
C-137	CAPACITOR: Same as C-101	V-109 cathode bypass							
C-138	CAPACITOR, fixed: paper dielectric; 100,000 mmf p/m 20%; 600 vdcw; HS metal case; 5/8" diam x 1 7/8" lg; Dykanol impr; 2 axial term; no int gnd connections; tangential mtg bkt, w/one 5/32" diam hole; spec JAN-C-25	V-109 plate bypass	CP29A1-DF104M	N16-C-45807-7617			C-138, C-183	2	
C-139	CAPACITOR: Same as C-101	V-109 coupling 1 to 7							
C-140	CAPACITOR: Same as C-101	V-109 plate bypass							
C-141	CAPACITOR, fixed: mica; 4700 mmf p/m 10%; 500 vdcw; temp coef letter B; 53/64" lg x 53/64" wd x 11/32" thk; molded phenolic case; 2 axial wire lead term; spec JAN-C-5	Part of low pass filter	CM35B-472K	N16-C-32646-6808			C-141, C-143	2	
C-142	CAPACITOR: Same as C-101	Part of low pass filter							
C-143	CAPACITOR: Same as C-141	Part of low pass filter							
C-144	CAPACITOR: Same as C-101	V-110 coupling to inverter							
C-145	CAPACITOR: Same as C-101	V-110 output coupling							

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
C-146	CAPACITOR: Same as C-101	V-110 plate bypass							
C-147	CAPACITOR: Same as C-101	V-110 plate output coupling							
C-148	CAPACITOR: Same as C-101	Input coupling V-111 and V-112							
C-149	CAPACITOR: Same as C-101	V-111 suppressor bypass							
C-150	CAPACITOR: Same as C-101	V-111 suppressor bypass							
C-151	CAPACITOR, variable: air dielectric; 5 sect; sect #1 and #2 402 mmf, sect #3, #4 and #5 201 mmf; SLC characteristic; air gap 0.0185"; 6-3/16" lg x 3-3/16" wd x 2-13/16" h excluding shaft, shaft ¼" diam x 1½" lg; extension shaft adj; 75 aluminum plates; 180 deg p/m 1 deg counterclockwise rotation; ceramic grade L-3 or better; insl; lug term; shaft mtg	RF tuning capacitor		N16-C-63665-7049	Oak Model #50	920 0060 00	C-151	1	
C-152	CAPACITOR, variable: ceramic; rotary type, single sect; 5.0 to 50.0 mmf; 500 vdcw; temp coef minus 650 mmf/mf/°C; 23/32" lg x 27/32" wd x 41/64" thk; solder lug term; two 0.120" diam mtg holes in base, on 0.438" mtg/c; scdr slot adj; ceramic base (p/o Z-101); spec JAN-C-81	V-111 plate 1–1.9 mc trimmer	CV11D 500	N16-C-64157-5249			C-152, C-153, C-154, C-155, C-156, C-157	6	
C-153	CAPACITOR: Same as C-152 (p/o Z-101)	V-111 plate 1.9–3.6 mc trimmer							
C-154	CAPACITOR: Same as C-152 (p/o Z-101)	V-111 plate 3.6–6.7 mc trimmer							
C-155	CAPACITOR: Same as C-152 (p/o Z-102)	V-113 grid 1–1.9 mc trimmer							

C-156	CAPACITOR: Same as C-152 (p/o Z-102)	V-113 grid 1.9–3.6 mc trimmer							
C-157	CAPACITOR: Same as C-152 (p/o Z-102)	V-113 grid 3.6–6.7 mc trimmer							
C-158	CAPACITOR: Same as C-101	T-104, 5 and 6 bypass							
C-159	CAPACITOR: Same as C-101	V-113 screen bypass							
C-160	CAPACITOR, fixed: mica; 2200 mmf p/m 20%; 1200 vdcw; temp coef letter B; 1¼" lg x 1⅛" wd x 23/64" d; molded bakelite case; 2 lug term on sides; two 9/64" diam mtg holes on bottom 1¾" c to c; spec JAN-C-5	V-113 output coupling	CM45-B-222M	N16-C-31913-9493			C-160, C-167, C-168	3	1
C-161	CAPACITOR, variable: ceramic; rotary type, single sect; 3 to 13 mmf; 500 vdcw; rated temp coef neg 300 mmf/mf/°C; 23/32" lg x 41/64" wd x 27/32" h o/a; solder lug term; 2 mtg holes .120" diam, .438" c to c; scdr slot adj; phenolic base; spec JAN-C-81 (p/o Z-103)	V-113 plate 1–1.9 mc trimmer	CV11B130	N16-C-63965-2800			C-161, C-162, C-163	3	1
C-162	CAPACITOR: Same as C-161 (p/o Z-103)	V-113 plate 1.9–3.6 mc trimmer							
C-163	CAPACITOR: Same as C-161 (p/o Z-103)	V-113 plate 3.6–6.7 mc trimmer							
C-164	CAPACITOR: Same as C-101	V-113 plate bypass							
C-165	CAPACITOR: Same as C-101	V-114 grid bypass							
C-166	CAPACITOR: Same as C-110	V-114 screen bypass							
C-167	CAPACITOR: Same as C-160	V-114 plate bypass							
C-168	CAPACITOR: Same as C-160	V-114 plate coupling							
C-169	CAPACITOR: Same as C-132 (p/o Z-104)	V-114 plate 1–1.9 mc trimmer							
C-170	CAPACITOR: Same as C-132 (p/o Z-104)	V-114 plate 1.9–3.6 mc trimmer							

MODEL: KY-30/GRT **TABLE 8-4 COMBINED PARTS AND MAINTENANCE PARTS LIST**

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
C-171	CAPACITOR: Same as C-132 (p/o Z-104)	V-114 plate 3.6–6.7 mc trimmer							
C-172	CAPACITOR, fixed: paper dielectric; 4 mf plus 20 minus 10%; 600 vdcw; HS metal case; 4½" lg x 1½" diam; liquid impr; one 10-32 NF-2 stud term w/solder lug and hex nut, and one gnd solder lug mtg next to case; int gnd; two ins washers and hex nut 7/32" thk on ¾-16 NF-2 mtg stud; spec JAN-C-25	250 v power supply filter	CP40C2-FF405V	N16-C-49981-9980			C-172, C-173, C-174, C-175, C-176, C-177, C-178, C-179, C-180	9	2
C-173	CAPACITOR: Same as C-172	250 v power supply							
C-174	CAPACITOR: Same as C-172	250 v power supply							
C-175	CAPACITOR: Same as C-172	400 v input filter							
C-176	CAPACITOR: Same as C-172	400 v input filter							
C-177	CAPACITOR: Same as C-172	400 v output filter							
C-178	CAPACITOR: Same as C-172	Bias filter input							
C-179	CAPACITOR: Same as C-172	Bias filter							
C-180	CAPACITOR: Same as C-172	Bias filter output							
C-181	CAPACITOR: Same as C-101	Filament bypass							
C-182	Not used								
C-183	CAPACITOR: Same as C-138	V-111 cathode bypass							
C-184	CAPACITOR: Same as C-101	Wave shaping capacitor							
C-185	CAPACITOR: Same as C-101	Wave shaping capacitor							

C-186	Not used								
C-187	Not used								
C-188A/ C-188B/ C-188C	CAPACITOR, fixed: paper; 3 sect; 0.1/0.1/0.1 mf plus 40% minus 15%; 600 vdcw; HS metal can; 1-13/16" lg x 1" wd x ¾" thk; 3 solder lug term located on top ¾" h; int gnd; 2 mtg feet w/ 3/16" diam mtg hole in ea on 2⅛" mtg/c; spec JAN-C-25	V-107 screen bypass	CP54B5-FF104X	N16-C-54467-1577			C-188, C-193	2	1
C-189	CAPACITOR, fixed: ceramic; 710 mmf p/m 1%; neg temp coef 48.5 (tol p/m 20%) mmf/mf/°C; 500 vdcw; ¾" lg x 15/16" diam; axial lug term; one 6-32 NC-2 mtg stud (p/o Z-105: for maintenance replace complete Z-105)	V-107 grid tuning		N16-C-18437-4613	Centralab	913 0096 00	C-189	1	1
C-190	CAPACITOR: Same as C-123	V-107 grid capacitor							
C-191	CAPACITOR, fixed: paper dielectric; 2 sect, 0.1/0.1 mf plus 40% minus 15%; 600 vdcw; HS metal can; 1-13/16" lg x 1" wd x ¾" thk; Dykanol impr; 3 solder lug term located on top ¾" h; no int gnd connections; 2 mtg feet w/ 3/16" diam mtg holes in ea, 2⅛" mtg/c; spec JAN-C-25	Part of AC filter	CP54B4-DF104X	N16-C-53225-8105			C-191, C-192	2	1
C-192	CAPACITOR: Same as C-191	Part of AC filter							
C-193	CAPACITOR: Same as C-188	Oven filter cap							
	ELECTRICAL PARTS								
E-101	BOARD, terminal: general purpose strip; 4 solder lug term; term ¾" between ctr; phenolic board; 3⅝" lg x ⅞" wd x 1" thk o/a; two ⅛" diam mtg holes 3¼" mtg/c	Wiring termination for the oven			Collins Rad part/dwg #504 2750 001	504 2750 001	E-101	1	
E-102	INSULATOR, bushing: ceramic grade L-5, nickel pl; 5/16" lg; 13/32" diam; incl reverse eyelet	Ceramic feedthru		N17-I-59611-2686	Rohden Mfg Co type #502	190 1102 00	E-102	2	
E-103	INSULATOR: includes E-103A and E-103B	Ceramic feedthru					E-103		
E-103A	INSULATOR, bushing: ceramic grade L-4, white glaze on heavy lined surface; ⅜" lg; ½" diam tapered to ⅝" diam (part of of E-103); spec JAN-I-8	Ceramic feedthru	NS4W4202					1	
E-103B	INSULATOR, bushing: ceramic grade L-4, white glaze on heavy lined surface; ⅝" lg; 23/64" diam x ¼" lg, ⅝" diam tapered to ½" diam x ⅜" lg, 0.156" ID; (part of E-103); spec JAN-I-8	Ceramic feedthru	NS4W4102					1	
E-104	Not used								

MODEL: KY-30/GRT **TABLE 8-4 COMBINED PARTS AND MAINTENANCE PARTS LIST**

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
E-105	SUPPRESSOR, parasitic: resistor and coil; 3⅝" lg x 7/16" diam o/a; 47 ohm 1 w resistor wnd w/ 7 turns #18 Bus; term mtg; 2 axial term	V-114 plate suppressor			Collins Rad part/dwg #573 1064 10	573 1064 10	E-105, E-106	2	
E-106	SUPPRESSOR: Same as E-105	V-114 grid suppressor							
E-107	PLATE, electrical shield: silver pl brass; flat; mtd by tube socket hdw w/solder connection to socket ctr shield; .640" lg x .359" h inside; 2 mtg holes 4-40 NC-2, .875" c to c; provides gnd point as well as shielding between tube socket term	Gnd tie and shield for tube sockets XV-101, XV-102, XV-103, XV-110, XV-111, XV-112, XV-113 (qty 7)		N16-P-402241-110	Collins Rad part/dwg #502 1427 002	502 1427 002	E-107	7	
E-108	SHIELD, tube: cold rolled steel, cad pl; cylindrical w/19/32" diam hole in top; bayonet mtg; .950" ID x 1-15/16" lg inside; w/stainless steel spring inside	Holddown and shield for V-104, V-109 (qty 2)		N16-C-34576-6515	Cinch #16G-12627	141 0103 00	E-108	2	
E-109	SHIELD, tube: steel, cad pl; round, open top; bayonet mtg; .810" ID x 1⅜" lg inside; w/inside spring; JAN spec JAN-S-28	Holddown and shield for V-108	SOS3	N16-S-34520-3841			E-109	1	
E-110	SHIELD, tube: steel, cad pl; round, open top, bayonet mtg; .810" ID x 1¾" lg inside; w/inside spring; JAN spec JAN-S-28	Holddown and shield for V-105, V-106, V-107 (qty 3)	SOS6	N16-S-34557-8343			E-110	3	
E-111	SHIELD, tube: cold rolled steel, cad pl; cylindrical, 7/16" diam hole in top; bayonet mtg; .915" ID x 2¼" lg inside; w/ inside spring	Holddown and shield for V-116, V-117, V-118 (qty 3)		N16-S-34607-8353	Cinch type #16G-12564	141 0105 00	E-111	3	
E-112	CLAMP, tube: steel; cad pl; one rivet nut employed; 2¼" diam x ¾" lg o/a; accom 1⅜" base diam; includes 2 lugs w/ 5/32" wd x 7/32" lg slots	Holddown for V-114		N16-C-300801-101	Collins Rad part/dwg #504 2413 001	504 2413 001	E-112	1	

E-113	CLIP, vacuum tube: brass 24 ga, cad pl; 15/16" lg x 3/8" wd x 13/32" thk o/a; 3/8" max jaw opening	Pl contact for V-114		N17-C-800488-101	Natl Co. #24	301 6000 00	E-113	1
E-114	CLAMP, tube: SS type 302; 2-29/32" diam x 7/8" lg o/a; accom 1-5/32" base diam	Holddown for V-115		N16-C-300798-452	Birtcher #926A	139 0169 00	E-114	1
E-115	CLAMP, tube: SS type 304; 2-3/16" diam x 7/8" lg o/a; accom 1 3/8" base diam	Holddown for V-119		N16-C-300798-866	Collins Rad part/dwg #503 9590 002	503 9590 002	E-115	1
E-116	DIAL, vernier: c/o one ea of knob, groove pin and shaft; black bakelite; 100-0 scale divisions, 180 deg rotation clockwise; round knob; 3" diam x 4-19/32" lg approx o/a; mtd on 2-11/16" lg x 1/4" diam shaft	RF tuning		N16-D-46365-7355	Collins Rad part/dwg #504 2733 002	504 2733 002	E-116	1
E-117	KNOB, bar: black bakelite; for 1/4" diam shaft; two 8-36 NF-2 holes at 90 deg; arrow marking; 1 1/8" lg x 3/4" wd x 11/16" h o/a; brass insert; 7/16" d shaft hole	Xmtr multiplier factor, freq shift test operate sw, meter sw, wave shaping sw, osc selector sw, output level, ext osc level, freq range sw, ph modulation deg (qty 10)		N16-K-700061-486	Collins Rad part/dwg #508 1103 20	508 1103 20	E-117	10
E-118	KNOB, round: black enamel aluminum; for .188" diam shaft; #6-32 thd hole through side; engraved arrow and word LOCK; .437" diam x .343" thk; .219" d shaft hole; straight knurl	Locks ph mod knob output lever knob, RF tuning dial, freq shift knob (qty 4)		N16-K-700248-886	ARC dwg #7199-1-B 47201-1-6	503 8779 003	E-118	4
	FUSES							
F-101	FUSE, cartridge: 3 amp, blowing time, life at 110%, 1 hr at 135%, 5 to 60 sec at 200% load; 250 v; one time; glass body; ferrule term; 1/4" diam x 1 1/4" lg o/a; term 1/4" diam x 1/4" lg	A-C power supply fuse	(-28032-3)	N17-F-16302-120	Littlefuse type 3AG, catalog #1043	264 4080 00	F-101, F-102	2
F-102	FUSE, cartridge: Same as F-101	A-C power supply fuse						
	PILOT LAMPS							
I-101	LAMP, incandescent: 6.3 v, 0.15 amp; bulb T-3 1/4 clear; 1 1/8" lg o/a; miniature bayonet base; tung fil; burn any position	POWER ON pilot lamp		17-L-6297	GE type #47	262 3240 00	I-101, I-102	2

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
I-102	LAMP, incandescent: Same as I-101	PLATE ON pilot lamp							
I-103	LAMP, glow: 1/25 w, 105-125 v; bulb T-3¼ clear; 1⅛ lg o/a; miniature bayonet base; tung fil; burn any position; must be used w/an ext resistor	OVEN HEAT lamp			GE catalog #NE-51	262 0021 00	I-103	1	
	JACKS AND RECEPTACLES								
J-101	CONNECTOR, receptacle: 3 round male pol cont; straight; 1-5/16″ lg x 1-3/16″ wd x 1-3/16″ h o/a; cylindrical metal body; phenolic insert; 0.682″ cable opening; four 0.120″ diam mtg holes 29/32″ x 29/32″ mtg/c; Army-Navy spec AN-C-591	KEY LINE connector	AN-3102-14S-1P				J-101, J-108	2	
J-102	CONNECTOR, receptacle: 9 round female pol cont; straight; 3″ lg x 1″ wd x ⅛″ thk; rectangular metal body; two 5/16″ diam mtg holes 2½″ mtg/c	HEATER OVEN connector			Collins Rad part/dwg #504 2437 001	504 2437 001	J-102	1	1
J-103	Not used								
J-104	CONNECTOR, receptacle: single round female contact; straight; 1″ wd x 1″ h x 1-1/16″ lg o/a; cylindrical metal body, threaded ⅝-24 NEF-2 for locking; molded phenolic insert; metal mtg flange w/4 ⅛″ holes on .719″ x .719″ mtg/c	FREQ METER RF connector	(-49194)		Amphenol	357 9005 00	J-104, J-105, J-106	3	
J-105	CONNECTOR: Same as J-104	KEYER OUTPUT connector							
J-106	CONNECTOR: Same as J-104	EXTERNAL OSCILLATOR connector							
J-107	CONNECTOR, receptacle: 3 female pol cont; straight; 2-5/16″ lg x 1¾″ wd x 1-11/32″ d; cont 10 amp, 250 v, 15 amp, 125 v; round black bakelite body, twist lock; mtg fl w/2 5/32″ diam holes 1-15/16″ c to c; incl gnd shunt from 1 cont to casing	AC power connector	(-491014-A)	N17-C-73135-3819	Hubbell type #7557	368 1501 00	J-107	1	

J-108	CONNECTOR: Same as J-101	FREQ METER AUDIO OUTPUT connector							
J-109	CONNECTOR, receptacle: 3 curved rectangular male pol cont; straight; 2-5/16″ lg x 1¾″ wd x 1¼″ d o/a; round black bakelite body; two 5/32″ diam mtg holes 1-15/16″ c to c; twist lock	AC power connector	(-49749-A)	N17-C-73471-6407	Hubbell type #7556	368 2201 00	J-109	1	1
J-110	CONNECTOR, receptacle: 15 round female pol cont; straight; 15/16″ lg x 2⅛″ wd x 2⅛″ h o/a; aluminum alloy body, sand blasted and clear lacquer finish; phenolic insert; 1⅝″ cable opening; four 0.169″ diam mtg holes 1.680″ x 1.680″ mtg/c	POWER SUPPLY connector			Cannon-elec type #RFK-L15-31SL	371 5099 00	J-110	1	
J-111	JACK, telephone: for 2 cont plug 0.206″ diam; 1-5/16″ lg x 49/64″ diam; cont arrangement J1; incl ⅜-32NS-2 mtg bushing 9/32″ lg; mtg in ⅜″ diam hole; w/non turn pin at 6 o'clock on 0.281″ rad	FREQ METER AUDIO OUTPUT JACK	(-49025-A)		Mallory catalog #SC1A	358 1040 00	J-111	1	
	INDUCTORS								
L-101	REACTOR: filter, 15 hy, 60 ma; 1600 ohm resistance; 1500 test voltage; HS metal case; 1½″ lg x 1½″ wd x 2⅛″ h; four 6-32 NC-2 mtg studs 1″ x 1″ mtg/c; 2 solder lug term on bottom; marking part #, shall be placed on case; JAN-T-27	Wave shaping choke	(-302715)	N16-R-29317-4166	Chi Trans	Collins Rad part/dwg #678 0020 00	L-101	1	
L-102	COIL, RF: choke; 4 wnd, duolateral wnd; 2.5 mh p/m 20%, 250 ma DC, 50 ohm DC resistance; 2-7/32″ lg x 7/16″ diam; ceramic coil and form; single 6-32 NC-2 thd, ¼″ lg mtg stud; one wire lead term on ea end	Emission sw output choke		N16-C-74715-1017	Millen to Collins Rad spec #240 0057 00	240 0057 00	L-102, L-128	2	1
L-103	COIL, RF: choke; 4 wnd, duo-lateral wnd; 2.5 mh p/m 20%, 250 DC ma, 50 ohm DC resistance; 2⅛″ lg x ⅜″ diam; ceramic form and core; form 1¼″ lg x ¼″ diam; term mtg; 2 radial wire leads 2⅛″ lg from ea end	Ph modulation output choke		N16-C-74721-3586	Millen to Collins Rad spec #240 0059 00	240 0059 00	L-103, L-112, L-113, L-126	4	1
L-104	REACTOR, audio: 0.0292, 0.1192, 0.477 and 1.322 hy w/ 0 amp p/m 5%; 500 v RMS; HS in metal case; 2-1/16″ lg x 1-21/32″ diam; two #4-40 mtg screws 1.312 mtg/c; 5 solder lug term on bottom; Collins Part # and Mfr Name and Part # shall appear on case; spec JAN-T-27	Ph modulation osc coil		N16-R-29649-1238	UTC cat #D8836	Collins Rad part/dwg #678 0288 00	L-104	1	
L-105	Not used								
L-106	Not used								

PARTS									SPARE PARTS	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT	SPARES
L-107	COIL, RF: choke, one wnd, 4 pie duolateral wnd; unshielded; 2.5 mh p/m 20%, 250 DC ma, 50 ohm DC resistance, 1 mmf distributed cap; 1-31/32" lg x 3/8" diam o/a; ceramic form, air core; form 3/8" OD x 1-31/32" lg; single 6-32 NC-2, 1/4" lg mtg stud; one wire lead term on ea end	V-107 pl decoupling choke		N16-C-74714-8696	Millen to Collins Rad spec #240 0071 00	240 0071 00	L-107	1		
L-108	COIL, RF: choke; single wnd, single layer wnd; 134 turns at 166 turns per inch #36 double E magnet wire; 1" lg 0.250" diam o/a; low loss bakelite form and core; term mtg; 2 axial wire leads	V-109 pl choke		N16-C-73414-9783	Collins Rad part/dwg #504 2420 001	504 2420 001	L-108	1		
L-109	COIL, RF: choke; 3 wnd, universal wnd; 30 turns ea wnd, #12 x 40 SSE Litz wire; 3/4" lg x 13/64" diam o/a; powdered iron form and core; term mtg; 2 axial wire leads	Choke (Part of low pass filter)		N16-C-73756-6364	Collins Rad part/dwg #504 2414 001	504 2414 001	L-109, L-110	2		
L-110	COIL, RF: Same as L-109	Choke (Part of low pass filter)								
L-111	Not used									
L-112	COIL, RF: Same as L-103	Bal mod pl decoupling								
L-113	COIL, RF: Same as L-103	Buffer grid decoupling								
L-114 to L-122 incl.	Not used									
L-123	COIL, RF: RF transformer; single wnd, single layer wnd; 119 turns at 92 turns per inch, #32 SSE wire; 1 5/8" lg x 3/4" diam o/a; isolantite form; 2 mtg holes ea end, tap 6-32 NC-2, 3/8" d; one wire lead term on ea end; tuned by adj iron core not incl; (p/o Z-103)	V-113 RF coil 1.0–1.9		N16-C-72667-1888	Collins Rad part/dwg #504 2475 002	504 2475 002	L-123, T-104	2	1	
L-124	COIL, RF: RF transformer; single wnd, single layer wnd; 54 turns at 50 turns per inch, #32 SSE wire; 1 5/8" lg x 3/8" diam o/a; isolantite form; 2 mtg holes on ea end, tap 6-32 NC-2, 3/8" d; one wire lead	V-113 RF coil 1.9–3.6		N16-C-73437-7663	Collins Rad part/dwg #504 2476 002	504 2476 002	L-124, T-105	2	1	

	term on ea end; tuned by adj iron core not incl; (p/o Z-103)								
L-125	COIL, RF: RF transformer; single wnd, single layer wnd; 26 turns, #26 E wire; $1\frac{5}{8}$" lg x $\frac{3}{4}$" diam o/a; isolantite form; 2 mtg holes ea end, tap 6-32 NC-2, $\frac{3}{8}$" d; one wire lead term on ea end; tuned by adj iron core not incl; (p/o Z-103)	V-113 RF coil 3.6–6.7		N16-C-73074-5605	Collins Rad part/dwg #504 2477 002	504 2477 002	L-125, T-106	2	1
L-126	COIL, RF: Same as L-103								
L-127	COIL, RF: choke, 3 wnd, duolateral wnd; 1 mh p/m 20%, 250 v DC ma, 15 ohm DC resistance; $2\frac{1}{8}$" lg x $\frac{3}{8}$" diam; ceramic form and core; form $1\frac{1}{4}$" lg x $\frac{1}{4}$" diam; term mtg; 2 radial wire leads $2\frac{1}{8}$" lg from ea end	Power amplr grid choke		N16-C-74381-4123	Millen to Collins Rad spec #240 0058 00	240 0058 00	L-127	1	
L-128	COIL, RF: Same as L-102	Power amplr pl choke							
L-129	COIL, RF: RF transformer; single wnd, single layer wnd; 104 turns at 52 turns per inch, #26 SSE wire; 3" lg x 1" diam o/a; ceramic form; 2 mtg holes on ea end, 6-32 NC-2, $\frac{3}{8}$" d; 1 solder lug term on ea end; tuned by adj iron core not incl, tapped at 15 turns; (p/o Z-104)	V-114 RF coil 1.0–1.9		N16-C-72666-8797	Collins Rad part/dwg #504 2472 002	504 2472 002	L-129	1	
L-130	COIL, RF: RF transformer; single winding, single layer wnd; 46 turns, #24 E wire; 3" lg x 1" diam o/a; isolantite form; 2 mtg holes ea end, tapped 6-32, $\frac{1}{2}$" d; 3 term, 1 solder lug, 2 cotter pins; tuned by adj iron core not incl, tapped at 8 turns; (p/o Z-104)	V-114 RF coil 1.9–3.6 mc		N16-C-72646-7797	Collins Rad part/dwg #504 2473 002	504 2473 002	L-130	1	
L-131	COIL, RF: RF transformer; single wnd, single layer wnd; 23 turns #18 E wire; 3" lg x 1" diam o/a; isolantite form; 2 mtg holes ea end, tapped 6-32, $\frac{1}{2}$" d; 3 term, 1 solder lug, 2 cotter pins; tuned by adj iron core not incl, tapped at 3 turns; p/o Z-104)	V-114 RF coil 3.6–6.7		N16-C-72345-7983	Collins Rad part/dwg #504 2474 002	504 2474 002	L-131	1	
L-132	REACTOR: filter; 7.8 hy, 0.125 amp; 175 ohms resistance; 1600 v test voltage; HS metal case; $2\frac{1}{2}$" lg x $2\frac{1}{2}$" wd x $3\frac{1}{2}$" h; four inserts tapped #8-32 NC-2 x $\frac{3}{8}$" d mtg holes $1\frac{3}{4}$" x $1\frac{3}{4}$" mtg/c; two 9/16" lg solder lug term on standoff ins 9/16" c to c on bottom of case; Collins Part #, rated inductance and DC resistance shall be marked on case; spec JAN-T-27	Low voltage filter choke		N16-R-29180-4601	ADC type #A6525	Collins Rad part/dwg #678 0287 00	L-132, L-133, L-134, L-135	4	1
L-133	REACTOR: Same as L-132	LV filter choke							
L-134	REACTOR: Same as L-132	HV filter choke							

PARTS								SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
L-135	REACTOR: Same as L-132	HV filter choke							
L-136	COIL, RF: choke; single layer wnd; unshielded; 26 turns #14 AWG wire; 2.218" max lg x 31/32" wd x ¾" d o/a; phenolic form, powdered iron core; core 0.500" OD x 1.750" lg; single 6-32 mtg screw; 2 solder lug term on side; rustproofed core	Part of AC filter		N16-C-72410-4923	Collins Rad part/dwg #504 5125 002	504 5125 002	L-136, L-137	2	
L-137	COIL: Same as L-136	Part of AC filter							
	METERS								
M-101	METER, ammeter: DC; range 0-5 ma; round, flush, phenolic case; 2.21" diam of body, 1.60" d behind fl, 2.695" diam fl; 2% accuracy for full scale reading; 3.7 ohm p/m 10% resistance, calibrated for non-magnetic panel; 50 scale divisions, black markings on white background; requires external shunt; 3 mtg holes ⅛" OD on 1.22" rad sp 120° apart on fl; 2 stud term ¼"-28 thd ¾" max lg; scale marked 0-10 and 0-100 ma	Power amplifier plate and grid current		N17-M-19690-1211	Wemco type #0X33	476 9002 00	M-101	1	
M-102	THERMOMETER: testing type; bimetal multiple helix actuating element; 0-100°C, ½ of 1% of range accuracy in intervals of 1°C; general use; 1.730" diam x 0.272" thk; 8" x 0.140" diam mtg shaft; stainless steel w/ glass window over scale	Record oven temp			Weston type #2261	292 0040 00	M-102	1	
	MECHANICAL PARTS								
O-101	LOCK: shaft lock; mtg nut included; 19/32" lg x ½" diam o/a; brass, nickel pl; thd ⅜-32 NS-2 top	Locks R-105, R-106, R-126, R-168, R-227 (qty 5)		N16-C-300496-201	Millen cat #10061	281 0001 00	O-101	5	
O-102	PLATE, lock: aluminum alloy; flat; 1-15/16" lg x 11/16" wd x .094" thk; 0.469" shaft hole w/ .094" wd x 1-5/16" lg slot	Locks ph mod output level RF tuning dial, freq shift (qty 4)		N16-P-403981-107	Collins Rad part/dwg #503 8692 002	503 8692 002	O-102	4	

O-103	ECCENTRIC: pinned; c/o eccentric and 1/16 x ⅜ groove pin; SS type 303; round; .375″ diam x 1.103″ lg o/a; mtd through hole in panel and retained by knob	Locks RF dial		N16-E-300058-326	Collins Rad part/dwg #504 2735 002	504 2735 002	O-103	1	
O-104	ECCENTRIC: pinned; c/o eccentric and 1/16 x ⅜ groove pin; SS type 303; round; .375″ diam x .541″ lg o/a; mtd through hole in panel and retained by knob	Locks ph mod, output level, freq shift (qty 3)		N16-E-300057-426	Collins Rad part/dwg #504 2734 002	504 2734 002	O-104	3	
O-105	BAR, locking: push; SS type 302; flat; 1.500″ lg x ½″ wd x .094″ thk o/a; retained in position by actuating cam	Actuates RF tuning dial lock		N16-B-22681-1003	Collins Rad part/dwg #504 2408 001	504 2408 001	O-105	1	
O-106	COUPLING, flexible: brass body, phosphor bronze disc silver pl body; round shape; 1.094″ diam x .648″ thk o/a; ¼″ diam shaft hole through center w/ 4 set screws #8-32 thd, 2 on ea hub	Drives S-101		N17-C-98378-3896	Oak #6422-008	015 0011 00	O-106	1	
O-107	COUPLING, flexible: isolantite disc, steatite body, nickel pl metal parts; 1¼″ lg x 21/32″ wd x 21/32″ h o/a; ¼″ shaft through center	Drives C-127		N17-C-98373-2551	Millen #39001	015 0090 00	O-107	1	
O-108	COUPLING, flexible: bakelite bright nickel finish on brass section; round shape; 1.094″ diam x .672″ lg o/a; ¼″ shaft hole through one end to center, 3/16″ shaft hole through other end to center w/ 4 set screws #8-32 thd, 2 in ea end	Drives C-127		N17-C-98378-2043	Oak #64323-032	015 0054 00	O-108	1	
O-109	SHAFT: trimmer control; SS type 303; round; 6-1/16″ lg x .248″ diam; one flatted surface on ea end, 5/16″ lg one end and ½″ lg the other end	Drives C-127		N16-S-21023-8501	Collins Rad part/dwg #504 4177 001	504 4177 001	O-109	1	
O-110	SHAFT ASSEMBLY: c/o shaft and bushing; round; 2⅜″ lg x .248″ diam shaft; mtd by ½″ hex nut w/ ⅜ NS-2 shank, one flatted surface on ea end ½″ lg	Drives C-127		N16-S-21126-1074	Collins Rad part/dwg #504 4180 001	504 4180 001	O-110	1	
O-111	COUPLING, flexible: brass silver pl body; bakelite fungi resistant disc; round shape; 1.094″ diam x .672″ lg o/a; ¼″ diam shaft hole through center w/ 4 set screws #8-32 thd, 2 on ea hub	Drives R-126		N17-C-98378-3899	Oak #6432-032	015 0012 00	O-111	1	
	PLUGS								
P-101	CONNECTOR, plug: 3 round female pol cont; straight; 1-11/16″ lg x 1⅛″ diam o/a; cylindrical metal body; phenolic insert; cable opening 0.526″ diam; thd ¾-20 NEF-2 mtg; Army-Navy spec AN-C-591; (part of W-104)	KEY LINE plug	AN-3106-14S-1S				P-101, P-108	2	

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
P-101A	CLAMP: cable clamp to fit connectors; aluminum alloy; sand blast and clear lacquer; 2 bolts employed; 1-5/64" lg x 1-1/16" diam; accom 7/16" OD cable (part of W-104)		AN3057-6			357 8002 00	P-101A, P-108A, P-121A, P-128A	4	
P-102	CONNECTOR, receptacle: 9 round male banana type pol cont; straight; 3" lg x 1" wd x 1/8" thk less cont; rectangular metal body; two 3/16" diam mtg holes 2½" mtg/c	OVEN HEATER power plug		N17-C-73560-8901	Collins Rad part/dwg #504 2761 001	504 2761 001	P-102	1	
P-103	Not used								
P-104	CONNECTOR, plug: single round male contact; straight; 1-9/16" lg x 11/16" diam o/a; cylindrical metal body, thd 5/8-24 NEF-2 for locking; molded phenolic insert; cable opening .450" diam; thd 7/16-14 for mounting (part of W-101)	FREQ METER RF plug	(-49195)		Amphenol #83-ISP	357 9006 00	P-104, P-105, P-106, P-124, P-125, P-126	6	
P-105	CONNECTOR, plug: Same as P-104 (part of W-102)	KEYER OUT-PUT plug							
P-106	CONNECTOR, plug: Same as P-104 (part of W-103)	EXTERNAL OSCILLA-TOR plug							
P-107	Not used								
P-108	CONNECTOR, plug: Same as P-101 (part of W-105)	FREQ METER AUDIO INPUT plug							
P-108A	CLAMP: Same as P-101A (part of W-105)								
P-109	CONNECTOR, plug: 3 female pol cont; straight; 2-5/32" lg x 1½" diam o/a; cont 10 amp 250 v, 15 amp 125 v; round black bakelite body, twist lock; mounts w/ cable clamp and twist (part of W-106)	AC power plug		N17-C-71168-1306	Hubbell type #7559	368 1702 00	P-109	1	
P-110	CONNECTOR, plug: 15 round male pol cont; 90° angle 2-1/32" lg x 1-47/64" diam; aluminum alloy, sand blasted and clear lacquer finish; phenolic insert 19/32" cable opening; 2-1/64" OD x 1-13/16-6 coupling nut	Keyer power plug			Cannon-elec #RFK-L15-24C9/16	371 5109 00	P-110	1	

P-110A	CLAMP: cable clamp to fit connectors; aluminum alloy; sand blast and clear lacquer; 2 bolts employed; 1⅛" lg x 1-3/16" diam; accom 9/16" OD cable		AN3057-8	N17-C-781444-504	Cannon-elec	357 8003 00	P-110A	1	
P-111 to P-120 incl	Not used								
P-121	CONNECTOR, plug: 3 round male pol; straight; 1-11/16" lg x 1⅛" diam o/a; cylindrical metal body; phenolic insert; 0.526 cable opening; thd ¾-20 NEF-2 mtg; Army-Navy spec AN-C-591; (part of W-104)	KEY LINE PLUG	AN-3106-14S-1P	N17-C-70588-1327			P-121, P-128	2	
P-121A	CLAMP: Same as P-101A (part of W-104)								
P-122	Not used								
P-123	Not used								
P-124	CONNECTOR, plug: Same as P-104 (part of W-101)								
P-125	CONNECTOR, plug: Same as P-104 (part of W-102)	KEYER OUTPUT (connector)							
P-126	CONNECTOR, plug: Same as P-104 (part of W-103)	EXTERNAL OSCILLATOR PLUG							
P-127	Not used								
P-128	CONNECTOR, plug: Same as P-121 (part of W-105)	FREQ METER AUDIO INPUT plug							
P-128A	CLAMP: Same as P-101A (part of W-105)								
P-129	CONNECTOR, plug: 3 male pol cont; straight; 2¼" lg x 2" diam o/a; 20 amp, 250 v; round black bakelite body, twist-lock; mounts w/ cable clamp and twist (part of W-106)	AC power plug			Hubbell type #7311	368 1200 00	P-129	1	
	RESISTORS								
R-101	RESISTOR, fixed: WW; 630 ohms p/m 5%; 7 w at 275°C max continuous oper temp; 1" lg x 19/32" diam; resistant to humidity exposure following thermal shock in air; 2 tab term; spec JAN-R-26	Photo Input termination resistor	RW30F-631	N16-R-65935-3621			R-101	1	1
R-102	RESISTOR, fixed: comp; .10 megohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Wave shaping resistor	RC30BF-104J	N16-R-50632-751			R-102, R-103, R-119, R-142	4	
R-103	RESISTOR, fixed: Same as R-102	Wave shaping resistor							

TABLE 8-4 COMBINED PARTS AND MAINTENANCE PARTS LIST

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
R-104	RESISTOR, fixed: comp; 3300 ohm p/m 5%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Limiter cathode resistor	RC40BF-332J	N16-R-50066-171			R-104	1	
R-105	RESISTOR, variable: WW; 5,000 ohms p/m 10%; 2 w, max continuous oper temp 100° C; 3 solder lug term; metal case 1.28" diam x 0.62" d, encl, slotted shaft, metal, 0.250" diam x 0.875" lg from mtg surface; linear taper; ins cont arm, w/o off position; normal torque; bushing ⅜"-32 x ⅜" lg, non-turn device located on 17/32" rad at 9 o'clock; spec JAN-R-19	PHOTO ADJUST-MENT	RA20A1-SD502AK	N16-R-91031-1140			R-105, R-106	2	
R-106	RESISTOR, variable: Same as R-105	LIMITER ADJUST							
R-107	RESISTOR, fixed: comp; 22,000 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Voltage dropping to V-102 cathode #1	RC30BF-223J	N16-R-50371-751			R-107, R-139	2	
R-108	RESISTOR, fixed: comp; 22,000 ohm p/m 5%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Voltage dropping to V-102 cathode #5	RC40BF-223J	N16-R-50372-171			R-108	1	
R-109	Not used								
R-110	RESISTOR, fixed: WW, non-inductive; 470 ohms p/m 1%; ⅓ w at 85°C max continuous oper temp; ⅝" lg x 13/16" diam excluding term; vitreous coating, RSW; 2 radial tab term ⅜" lg x 3/16" wd; spec JAN-R-93	Bias resistor in wave shaping circuit	RB11B-470R0F	N16-R-79031-3259			R-110, R-111	2	1
R-111	RESISTOR, fixed: Same as R-110	Bias resistor in wave shaping circuit							
R-112	RESISTOR, fixed: comp; 1500 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Wave shaping resistor	RC30BF-152K	N16-R-49968-0231			R-112	1	

R-113	RESISTOR, fixed: comp; 0.22 megohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Wave shaping resistor	RC30BF-224J	N16-R-50713-751			R-113	1	
R-114	RESISTOR, fixed: comp; 56,000 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Terminating resistor for wave shaping	RC30BF-563J	N16-R-50515-751			R-114	1	
R-115	RESISTOR, fixed: comp; 47,000 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-103 grid resistor	RC30BF-473J				R-115, R-149	2	
R-116	RESISTOR, fixed: comp; 39,000 ohm p/m 5%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-103 plate resistor	RC40BF-393J	N16-R-50444-171			R-116	1	
R-117	RESISTOR, variable: WW; 5,000 ohms p/m 5%; 2 w, at 100°C max continuous oper temp; 3 solder lug term; metal case 1.28" diam x 0.62" lg, encl; round shaft metal, ¼" diam x 1½" lg from mtg surface; linear taper; ins cont arm, w/o off position; normal torque; bushing ⅜"-32 x ⅜" lg, non-turn device located on 17/32" rad at 9 o'clock; SPST, normally open at zero position of shaft, actuates to the on position at the start of clockwise rotation, 3 amp, 125 v, 2 term; spec JAN-R-19; (incl S-103)	V-103 grid resistor	RA20B1-RH502AJ	N16-R-91027-9295			R-117	1	1
R-118	RESISTOR, fixed: comp; 150 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-102 cathode divider	RC30BF-151K	N16-R-49626-231			R-118, R-170	2	
R-119	RESISTOR, fixed: Same as R-102	V-103 grid resistor							
R-120	RESISTOR, fixed: comp; 82,000 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-104 grid resistor	RC30BF-823K	N16-R-50589-231			R-120, R-121	2	
R-121	RESISTOR, fixed: Same as R-120	V-104 grid resistor							
R-122	RESISTOR, fixed: comp; 3900 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-104 cathode resistor	RC30BF-392J	N16-R-50092-751			R-122, R-123	2	
R-123	RESISTOR, fixed: Same as R-122	V-104 cathode resistors							
R-124	RESISTOR, fixed: comp; 12,000 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-105 plate resistors	RC30BF-123J	N16-R-50308-751			R-124, R-125, R-145	3	

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R-125	RESISTOR, fixed: Same as R-124	V-104 plate resistor							
R-126	RESISTOR, variable: comp; 10,000 ohm p/m 10%; 2 w; 3 solder lug term; metal case 1-3/32" diam x 19/32" d, encl; round slotted shaft, metal, ¼" diam x ⅞" lg from mtg surface; lin taper; ins cont arm w/o off position; normal torque bushing ⅜-32 NEF-2 x ⅜" lg, non-turn device located on 17/32" rad at 9 o'clock	FREQ. SHIFT pot		N16-R-87679-4360	AB type J	380 0114 00	R-126	1	1
R-127	RESISTOR, fixed: comp (deposited carbon); 3600 ohm p/m 1%; 1 w; F characteristic; 15/16" lg x 9/32" diam; ins and moisture resistant; 2 axial wire leads	Part of TRANS-MITTER MULTIPLI-CATION control		N16-R-73030-9545	IRC type DCF-1	705 3004 00	R-127	1	1
R-128	RESISTOR, fixed: comp (deposited carbon); 1200 ohm p/m 1%; 1 w; F characteristic; 15/16" lg x 9/32" diam; ins and moisture resistant; 2 axial wire leads	Part of TRANS-MITTER MULTIPLI-CATION control		N16-R-72995-8138	IRC to Collins Rad spec #705 3007 00	705 3007 00	R-128	1	1
R-129	RESISTOR, fixed: comp (deposited carbon); 600 ohm p/m 5%; 1 w; F characteristic; 15/16" lg x 9/32" diam; ins and moisture resistant; 2 axial wire leads	Part of TRANS-MITTER MULTIPLI-CATION control		N16-R-72962-2851	IRC to Collins Rad spec #705 3006 00	705 3006 00	R-129, R-130, R-134	3	1
R-130	RESISTOR, fixed: Same as R-129	Part of TRANS-MITTER MULTIPLI-CATION control							
R-131	RESISTOR, fixed: comp (deposited carbon); 300 ohm p/m 1%; 1 w; F characteristic; 15/16" lg x 9/32" diam; ins and moisture resistant; 2 axial wire leads	Part of TRANS-MITTER MULTIPLI-CATION control		N16-R-72926-9801	IRC to Collins Rad spec #705 3005 00	705 3005 00	R-131	1	1

R-132	RESISTOR, fixed: comp (deposited carbon); 100 ohm p/m 1%; 1 w; 15/16" lg x 9/32" diam; ins and moisture resistant; two ferrule term 9/32" diam x 7/32" lg; 2 axial wire leads	Part of TRANSMITTER MULTIPLICATION control		N16-R-72899-2661	IRC to Collins Rad spec #705 3000 00	705 3000 00	R-132	1	1
R-133	RESISTOR, fixed: comp (deposited carbon); 200 ohm p/m 1%; 1 w; 15/16" lg x 9/32" diam; ins and moisture resistant; two ferrule term 9/32" diam x 7/32" lg; 2 axial wire leads	Part of TRANSMITTER MULTIPLICATION control		N16-R-72918-1061	IRC to Collins Rad spec #705 3001 00	705 3001 00	R-133	1	1
R-134	RESISTOR, fixed: Same as R-129	Part of TRANSMITTER MULTIPLICATION control							
R-135	RESISTOR, fixed: comp; 10,000 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-105 grid resistor	RC30BF-103J	N16-R-502810-751			R-135, R-146	2	
R-136	RESISTOR, variable: WW; 2,500 ohm p/m 10%; 2 w; at 100°C max continuous oper temp; 3 solder lug term; metal case 1.28" diam x 0.62" lg, encl; slotted shaft, metal, ¼" diam x 1¼" lg from mtg surface; linear taper; ins arm, w/o off position; normal torque; bushing ⅜"-32 x ⅜" lg, non-turn device located on 17/32" rad at 9 o'clock; spec JAN-R-19	FREQ SHIFT CALIBRATION control	RA20A1-SG252AK	N16-R-90868-3015			R-136	1	1
R-137	RESISTOR, fixed: comp; 330 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-105 cathode resistor	RC30BF-331K	N16-R-49707-231			R-137	1	
R-138	RESISTOR, fixed: comp; 33,000 ohm p/m 10%; 1 w; BF characteristic; 0.750" lg x 0.280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-105 cathode resistor	RC30BF-333K	N16-R-50418-231			R-138	1	
R-139	RESISTOR, fixed: Same as R-107	V-106 grid resistor							
R-140	RESISTOR, fixed: comp; 270 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-106 cathode resistor	RC30BF-271J	N17-R-49687-751			R-140, R-143, R-228	3	
R-141	RESISTOR, fixed: comp; 0.33 megohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-106 screen resistor	RC30BF-334K	N16-R-50760-231			R-141	1	
R-142	RESISTOR, fixed: Same as R-102	V-106 plate resistor							

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R-143	RESISTOR, fixed: Same as R-140	Keyer bal							
R-144	RESISTOR, fixed: comp; 0.15 megohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-107 grid resistor	RC30BF-154J	N16-R-50677-751			R-144	1	
R-145	RESISTOR, fixed: Same as R-124	V-107 screen resistor							
R-146	RESISTOR, fixed: Same as R-135	V-107 plate resistor							
R-147	RESISTOR, fixed: comp; 0.10 megohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-108 grid resistor	RC30BF-104K	N16-R-50634-231			R-147, R-153	2	
R-148	RESISTOR, fixed: comp; 150 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-108 cathode resistor	RC30BF-151J				R-148	1	
R-149	RESISTOR, fixed: Same as R-115	V-108 screen resistor							
R-150	RESISTOR, fixed: comp; 2200 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-108 plate resistor	RC30BF-222J				R-150	1	
R-151	RESISTOR, fixed: comp; 820 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-108 pl	RC30BF-821J				R-151	1	
R-152	RESISTOR, fixed: comp; 4700 ohm p/m 5%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-109 pl	RC40BF-472J				R-152	1	
R-153	RESISTOR, fixed: Same as R-147	V-109 grid resistor							
R-154	RESISTOR, fixed: comp; 1800 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-109 cathode resistor	RC30BF-182J				R-154	1	

R-155	RESISTOR, fixed: comp; 27,000 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Balanced mod input	RC40BF-273K	N16-R-50400-511			R-155, R-167, R-219, R-220	4	
R-156	RESISTOR, fixed: comp; 5600 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-109 plate resistor	RC30BF-562K				R-156, R-160, R-188	3	
R-157	RESISTOR, fixed: comp; 0.47 megohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-109 grid resistor	RC30BF-474K	N16-R-50823-231			R-157, R-218	2	
R-158	RESISTOR, fixed: comp; 1000 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-109 cathode resistor	RC30BF-102K	N16-R-49923-231			R-158, R-159	2	
R-159	RESISTOR, fixed: Same as R-158	V-109 plate resistor							
R-160	RESISTOR, fixed: Same as R-156	V-109 pl decoupling							
R-161	RESISTOR, fixed: comp; 100 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-110 grid resistor	RC30BF-101K	N16-R-49581-231			R-161, R-162	2	
R-162	RESISTOR, fixed: Same as R-161	V-110 cathode resistor							
R-163	RESISTOR, fixed: comp; 27,000 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-110 grid resistor	RC30BF-273K	N16-R-50400-231			R-163	1	
R-164	RESISTOR, fixed: comp; 8200 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Voltage dropping	RC30BF-822K				R-164, R-166	2	
R-165	RESISTOR, fixed: comp; 390 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-110 pl decoupling	RC30BF-391K				R-165	1	
R-166	RESISTOR, fixed: Same as R-164	V-110 pl decoupling							
R-167	RESISTOR, fixed: Same as R-155	V-110 decoupling							

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R-168	RESISTOR, variable: WW; 10,000 ohm p/m 10%; 2 w, at 100°C max continuous oper temp; 3 solder lug term; metal case 1.28" diam x 0.62" lg, encl; slotted shaft, metal, ¼" diam x ⅞" lg from mtg surface; linear taper; ins cont arm, w/o off position; normal torque; bushing ⅜-32 x ⅜" lg, non-turn device located on 17/32" rad at 9 o'clock; spec JAN-R-19	MOD BALANCE control	RA20A1-SD103AK	N16-R-91291-4995			R-168	1	
R-169	RESISTOR, fixed: comp; 68,000 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-111 grid resistor	RC30BF-683K	N16-R-50553-231			R-169	1	
R-170	RESISTOR, fixed: Same as R-118	V-111 & V-112 cathode resistor							
R-171	RESISTOR, fixed: comp; 56 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-111 & V-112 cathode resistor	RC30BF-560K	N16-R-49464-231			R-171	1	
R-172	RESISTOR, fixed: comp; 56,000 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-112 suppressor resistor	RC30BF-563K	N16-R-50517-231			R-172, R-173	2	
R-173	RESISTOR, fixed: Same as R-172	V-111 suppressor resistor							
R-174	RESISTOR, fixed: comp; 22,000 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11 (p/o Z-101)	Voltage dropping to T-101	RC40BF-223K	N16-R-50373-551			R-174, R-175, R-176	3	
R-175	RESISTOR, fixed: Same as R-174 (p/o Z-101)	Voltage dropping to T-102							
R-176	RESISTOR, fixed: Same as R-174 (p/o Z-101)	Voltage dropping to T-103							

R-177	RESISTOR, fixed: comp; 15,000 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-113 grid resistor	RC30BF-153K	N16-R-50337-231			R-177	1	
R-178	RESISTOR, fixed: comp; 1800 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Bias divider	RC40BF-182K	N16-R-49986-551			R-178	1	1
R-179	RESISTOR, fixed: comp; 3900 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Bias divider	RC40BF-392K				R-179	1	
R-180	RESISTOR, fixed: comp; 10,000 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-113 screen resistor	RC40BF-103K	N16-R-50283-0551			R-180	1	
R-181	RESISTOR, variable: WW; 25,000 ohm p/m 10%; 4 w at 100°C continuous oper temp; 3 solder lug term; metal case 1.780" diam x 0.980" thk; encl; slotted shaft, metal, ¼" diam x 1¼" lg from mtg surface; linear taper; ins cont arm, w/o off position; normal torque; bushing ⅜"-32 x ⅜" lg, non-turn device located on 17/32" rad at 9 o'clock	V-114 screen voltage control (OUTPUT LEVEL)		N16-R-91406-1650	Ohmite type RA30	750 8026 00	R-181	1	1
R-182	**Not used**								
R-183	Not used								
R-184	RESISTOR, fixed: comp; 8200 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x 0.405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-113 plate resistor	RC40BF-822K				R-184	1	
R-185	RESISTOR, fixed: comp; 47 ohm p/m 10%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	V-114 screen parasitic	RC30BF-470K	N16-R-49428-231			R-185	1	
R-186	RESISTOR, fixed: comp; 24 ohm p/m 5%; 1 w; characteristic letter F; .750" lg x .280" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Meter M-101 shunt	RC30BF-240J				R-186	1	
R-137	RESISTOR, fixed: WW; 1.2 ohm p/m 5%; ½ w at max continuous oper temp 110°C; 21/32" lg x 15/64" diam; sealing compound encl; 2 axial wire leads 1½" lg x 0.032" diam; spec JAN-R-184	Meter M-101 shunt	RU3A1-R2J	N16-R-68275-5206			R-187	1	1
R-188	RESISTOR, fixed: comp; Same as R-156	Freq meter divider							
R-189	RESISTOR, fixed: comp; 20 ohm p/m 5%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	M-101 meter multiplier	RC20BF-200J	N16-R-49309-431			R-189	1	

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R-190	Not used								
R-191	RESISTOR, fixed: WW; 10,000 ohm p/m 5%; 18 w at max continuous oper temp 275°C; 3″ lg x 19/32″ diam; 2 tab term 11/32″ lg x 21/64″ wd x 1/64″ thk	250 v bleeder		N16-R-62071-2580	WL type RW33	747 9086 00	R-191	1	1
R-192	RESISTOR, fixed: comp; 47,000 ohm p/m 10%; 2 w; characteristic letter F; 1.41″ lg x .405″ diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Bias supply filter	RC40BF-473K	N16-R-50481-551			R-192, R-193, R-216, R-217, R-221, R-222, R-223	7	
R-193	RESISTOR, fixed: Same as R-192	Bias filter							
R-194	RESISTOR, fixed: comp; 4700 ohm p/m 10%; 2 w; characteristic letter F; 1.41″ lg x .405″ diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Bias supply bleeder	RC40BF-472K	N16-R-50130-551			R-194	1	
R-195	RESISTOR, fixed: comp; 0.15 megohm p/m 10%; 2 w; characteristic letter F; 1.41″ lg x .405″ diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	VR-150 series shunt	RC40BF-154K	N16-R-50679-551			R-195	1	
R-196	RESISTOR, fixed: WW; 6300 ohms p/m 5%; 18 w at max continuous oper temp 275°C; 3″ lg x 9/32″ diam; vitreous coating, RSW; 2 radial tab term 37/64″ lg x 17/64″ wd; accom 6/32″ screw thru center; spec JAN-R-26	VR-150 series shunt	RW33F 632	N16-R-66303-4602			R-196	1	1
R-197	RESISTOR, fixed: comp; 39 ohm p/m 10%; ½ w; characteristic letter F; .468″ lg x .249″ diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLATOR control	RC20BF-390K	N16-R-49391-811			R-197, R-204	2	
R-198	RESISTOR, fixed: comp; 10 ohm p/m 10%; ½ w; characteristic letter F; .468″ lg x .249″ diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLATOR control	RC20BF-100K	N16-R-49238-811			R-198	1	
R-199	RESISTOR, fixed: comp; 12 ohm p/m 10%; ½ w; characteristic letter F; .468″ lg x .249″ diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLATOR control	RC20BF-120K	N16-R-49256-811			R-199	1	

R-200	RESISTOR, fixed: comp; 15 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-150K	N16-R-49283-811			R-200	1	
R-201	RESISTOR, fixed: comp; 22 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-220K	N16-R-49319-811			R-201	1	
R-202	RESISTOR, fixed: comp; 27 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-270K	N16-R-49346-811			R-202	1	
R-203	RESISTOR, fixed: comp; 33 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-330K	N16-R-49364-811			R-203	1	
R-204	RESISTOR, fixed: Same as R-197	Part of EXTERNAL OSCILLA-TOR control							
R-205	RESISTOR, fixed: comp; 47 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-470K	N16-R-49427-811			R-205	1	
R-206	RESISTOR, fixed: comp; 68 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-680K	N16-R-49499-811			R-206	1	
R-207	RESISTOR, fixed: comp; 82 ohm p/m 10%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of EXTERNAL OSCILLA-TOR control	RC20BF-820K	N16-R-49535-811			R-207	1	
R-208	RESISTOR, fixed: comp; 0.10 megohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	I-103 voltage dropping resistor	RC40BF-104K	N16-R-50364-551			R-208	1	
R-209	RESISTOR, fixed: WW; 100 ohms p/m 10%; 10 w; 1¾" lg x 13/32" diam; vitreous enamel coating, moisture and acid resisting, 2 tab term 5/16" lg x 3/16" wd; 3/16" diam mtg hole thru center	Part of EXTERNAL OSCILLA-TOR LEVEL		N16-R-65683-9726	WL to Collins Rad spec #715 0052 00	715 0052 00	R-209	1	1
R-210	HEATING ELEMENT, electrical: strip type; 100 w; 115 v; single sect; rust-resisting strip sheath; 6" lg x 1" wd x ¾" h o/a; 2 screw term; two ⅜" x ¼" slots on 5¼" mtg/c; air heater	Heater element		N17-H-60018-5001	Watelec type CA-20	711 0041 00	R-210, R-211, R-212, R-213, R-214, R-215	6	1
R-211	HEATING ELEMENT, electrical: Same as R-210	Heater element							
R-212	HEATING ELEMENT: Same as R-210	Heater element							

MODEL: KY-30/GRT **TABLE 8-4 COMBINED PARTS AND MAINTENANCE PARTS LIST**

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
R-213	HEATING ELEMENT, electrical: Same as R-210	Heater element							
R-214	HEATING ELEMENT, electrical: Same as R-210	Heater element							
R-215	HEATING ELEMENT, electrical: Same as R-210	Heater element							
R-216	RESISTOR, fixed: Same as R-192	Bias supply filter							
R-217	RESISTOR, fixed: Same as R-192	Bias supply filter							
R-218	RESISTOR, fixed: Same as R-157	Input terminating resistor on P-101							
R-219	RESISTOR, fixed: Same as R-155	V-110 decoupling							
R-220	RESISTOR, fixed: Same as R-155	Balanced modulator input							
R-221	RESISTOR, fixed: Same as R-192	V-114 screen dropping							
R-222	RESISTOR, fixed: Same as R-192	V-114 screen dropping							
R-223	RESISTOR, fixed: Same as R-192	V-114 screen dropping							
R-224	Not used								
R-225	Not used								
R-226	RESISTOR, fixed: comp; 56,000 ohm p/m 5%; ½ w; characteristic letter F; .468" lg x .249" diam; ins, humidity and RSW; 2 axial wire lead term; spec JAN-R-11	Part of TRANS-MITTER MULTIPLI-CATION control	RC20BF-563J				R-226	1	

R-227	RESISTOR, variable: WW; 50 ohms p/m 10%; 2 w, at 100°C max continuous oper temp; 3 solder lug term; metal case 1.28" diam x 0.62" lg, encl, slotted shaft, metal, $\frac{1}{4}$" diam x $1\frac{1}{4}$" lg from mtg surface; linear taper; ins cont arm, w/o off position; normal torque; bushing $\frac{3}{8}$-32 x $\frac{3}{8}$" lg, non-turn device located on 17/32" rad at 9 o'clock; spec JAN-R-19	KEYER BALANCE control	RA20A1-SG500AK	N16-R-89956-7050			R-227	1	1
R-228	RESISTOR, fixed: Same as R-140	Keyer bal fixed resistor							
R-229	RESISTOR, fixed: comp; 12,000 ohm p/m 10%; 2 w; characteristic letter F; 1.41" lg x .405" diam; ins, humidity and RSW; 2 axial wire lead term; JAN-R-11	Oven heater	RC40BF-123K	N16-R-50310-551			R-229	1	
R-230	Not used								
R-231	HEATING ELEMENT, electrical: strip type; 25 w, 115 v; single sect; rust resisting strip sheath; 6" lg x 1" wd x $\frac{3}{4}$" h; 2 screw term; two $\frac{3}{8}$" x $\frac{1}{4}$" slots on $5\frac{1}{4}$" mtg/c; air heater	Oven heater		N17-H-60003-1551	Watelec type CA-20	711 0042 00	R-231	1	1
	SWITCHES								
S-101	SWITCH ASSEM: incl S-101A, B, C and D						S-101		
S-101A/ S-101B	SWITCH, rotary: 2 pole, 5 position; spring brass silver pl cont; isolantite body; $1\frac{7}{8}$" lg x 1-21/32" wd x 3/16" thk o/a; shorting type cont solder lug term; 2 holes accom #5 screw, 0.1875" x 0.250" single mtg hole (part of S-101)	TEST OPERATE switch		N17-S-91897-8767	Oak to Collins Rad spec #269 1211 00	269 1211 00	S-101 A & B	1	
S-101C	DETENT, switch: band switch detent assem; incl shaft inserted through bushing, spring and 30 deg 5 position detent; $6\frac{7}{8}$" lg x 1-15/16" diam o/a; mtg bushing $\frac{3}{8}$ x 32 NEF-2, $\frac{3}{8}$" lg (p/o S-101)	TEST OPERATE switch		N17-D-200001-114	Oak to Collins Rad spec #269 1160 00	269 1160 00	S-101C	1	
S-101D	SHAFT, switch: free cutting brass $\frac{1}{2}$ hard; round shaft flatted for 1" body ends to 0.185" diam; 6-21/32" lg x 0.249" diam (p/o S-102)	TEST OPERATE switch		N16-S-21022-6626	Collins Rad part/dwg #504 2763 001	504 2763 001	S-101D		
S-102	SWITCH, rotary: 3 pole, 4 position; 2 sect; spring silver alloy cont; steatite ceramic body; $2\frac{1}{2}$" lg x $1\frac{7}{8}$" h x 1-21/32" wd o/a; non-shorting cont; solder lug term; $\frac{3}{8}$-32 NEF-2 x $\frac{3}{8}$" lg mtg bushing	WAVE SHAPING switch		N17-S-64847-8451	Oak to Collins Rad spec #259 0356 00	259 0356 00	S-102	1	
S-102A	SWITCH, rotary: (part of S-102)								
S-102B	SWITCH, rotary: (part of S-102)								

PARTS									SPARE PARTS	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT	SPARES
S-102C	SWITCH, rotary: (part of S-102)									
S-103	SWITCH: (part of R-117)	PHASE MODULA-TION OFF–ON switch								
S-104	SWITCH ASSEMBLY: includes S-104A, B						S-104			
S-104A	SWITCH, rotary: 1 pole, 8 position; spring brass silver pl cont; isolantite body; 1⅞" lg x 1-21/32" wd x 3/16" thk o/a; shorting type cont; solder lug term; 2 holes accom #5 screw and 0.1875" x 0.250" single mtg hole (p/o S-104)	TRANS-MITTER MULTIPLI-CATION switch		N17-S-91897-8766	Oak to Collins Rad spec #269 1210 00	269 1210 00	S-104A	1		
S-104B	DETENT, switch: band switch detent assem; incl shaft inserted through bushing, spring and 30 deg 8 position detent; 6⅜" lg x 1-15/16" diam o/a; mtg bushing ⅜ x 32 NEF-2, ⅜" lg (p/o S-104)	TRANS-MITTER MULTIPLI-CATION switch		N17-D-200001-112	Oak to Collins Rad spec #269 1161 00	269 1161 00	S-104B	1		
S-105	SWITCH, rotary: 4 pole, 4 position; 2 sect; spring silver alloy cont; steatite ceramic; 3⅜" lg x 1⅞" h x 1-21/32" wd o/a; non-shorting type; solder lug term; ⅜-32 NEF-2 x ⅜" lg mtg bushing	OSCILLA-TOR SELECTOR switch			Oak to Collins Rad spec #259 0355 00	259 0355 00	S-105	1		
S-105A	SWITCH, rotary: (part of S-105)						S-105A			
S-105B	SWITCH, rotary: (part of S-105)						S-105B			
S-106	SWITCH ASSEMBLY: includes S-106A, B, C, D, E, F and G						S-106			
S-106A	SWITCH, rotary: 2 pole, 3 position; spring brass silver pl cont; isolantite body; 1⅞" lg x 1-21/32" wd x 3/16" thk; shorting type cont; solder lug term; 2 holes accom #5 screw and 0.1875" x 0.250" single mtg hole (part of Z-101)	FREQUENCY RANGE switch		N17-S-91897-8768	Oak to Collins Rad spec #269 1209 00	269 1209 00	S-106A, S-106B, S-106C, S-106D, S-106E, S-106F	6	1	
S-106B	SWITCH: Same as S-106A (part of Z-101)	FREQUENCY RANGE switch								
S-106C	SWITCH: Same as S-106A (part of Z-102)	FREQUENCY RANGE switch								

S-106D	SWITCH: Same as S-106A (part of Z-103)	FREQUENCY RANGE switch							
S-106E	SWITCH: Same as S-106A (part of Z-104)	FREQUENCY RANGE switch							
S-106F	SWITCH: Same as S-106A (part of Z-104)	FREQUENCY RANGE switch							
S-106G	DETENT, switch: band switch detent assem; incl shaft inserted through bushing, spring and 30 deg position detent; 2¼" lg x 1-15/16" diam o/a; mtg bushing ⅜ x 32 NEF-2, ⅜" lg	FREQUENCY RANGE switch		N17-D-200001-113	Oak to Collins Rad spec #269 1159 00	269 1159 00	S-106G	1	
S-106H	SHAFT, switch: FC brass ½ hard, bright alloy pl finish; 11¼" lg x 0.250" wd x 0.1875" thk o/a	FREQUENCY RANGE switch			Collins Rad part/dwg #504 2429 001	504 2429 001	S-106H	1	
S-107	SWITCH, rotary: 2 pole, 2 position; spring brass silver alloy cont; phenolic body; 1⅞" lg x 1⅞" h x 1-21/32" wd o/a; non-shorting type; solder lug term; ⅜-32 NEF-2 x ⅜" lg mtg bushing, shaft 1¼" lg x ¼" diam	M-101 METER switch			Oak to Collins Rad spec #259 0354 00	259 0354 00	S-107	1	
S-108	SWITCH, rotary: 1 pole 11 position; spring silver alloy cont; steatite ceramic body; 2¼" lg x 1⅞" h x 1-21/32" wd o/a; shorting type cont; solder lug term; ⅜-NEF-2 x ⅜" lg mtg bushing	EXTERNAL OSCILLA-TOR switch		N17-S-60549-2021	Oak to Collins Rad spec #259 0357 00	259 0357 00	S-108	1	
S-109	SWITCH, rotary: 3 pole, 2 position; spring silver alloy cont; steatite ceramic body; 2" lg x 1⅞" h x 1-21/32" wd o/a; shorting type cont; solder lug term; ⅜-32 NEF-2 x ⅜" lg mtg bushing	PLATE ON–OFF switch		N17-S-59272-7049	Oak to Collins Rad spec #259 0358 00	259 0358 00	S-109	1	
S-110	SWITCH, toggle: DPDT; 30 amp continuous cur carrying capacity; metal case; 1-21/64" lg x 49/64" wd x 2-7/32" d o/a; 11/16" lg bat type handle; lug term; 15/32-32 NS-2 x 15/32" lg mtg sleeve; JAN-S-23	POWER ON–OFF	ST52N	N17-S-73959-1025			S-110, S-111	2	
S-111	SWITCH, toggle: Same as S-110	115 volt to 230 volt switch							
S-112	SWITCH, thermostatic: oper temp 60°C plus 1°C to 71°C minus 1°C; 0.75 amp 115 v AC or DC, 2.0 amp 12.5 v AC or DC; metal body; 13/16" lg x 19/32" wd x ¼" thk o/a; shorting type cont; lug terminals; four 1/16" diam mtg holes 7/16" x 25/32" mtg/c	70° thermostat switch		N17-S-69906-5256	Stevens Mfg Co type #CM	292 0025 00	S-112, S-114	2	2

MODEL: KY-30/GRT **TABLE 8-4 COMBINED PARTS AND MAINTENANCE PARTS LIST**

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
S-113	SWITCH, thermostatic: SPST; oper temp 63°C plus 1°C to 67°C minus 1°C; 0.75 amp 115 v AC or DC, 2.0 amp 12.5 v AC or DC; metal case; 53/64" lg x 19/32" wd x 5/16" thk o/a; shorting type cont; lug term; four 1/16" diam mtg holes 7/16" x 25/32" mtg/c	65° thermo-stat switch		N17-S-69906-5206	Stevens Mfg Co type #CM	292 0027 00	S-113	1	1
S-114	SWITCH, thermostatic: Same as S-112	70° thermo-stat switch							
	TRANSFORMERS								
T-101	COIL, RF: RF transformer; pri wnd; single wnd, single layer wnd; 125 mh; 119 turn, #32 wire; 1⅝" lg x ¾" diam o/a; isolantite form, air core; 2 mtg holes ea end tap 6-32 NC-2, ⅜" d; 3 wire lead term, one on ea end and one in ctr tapped 59.5th turns (p/o Z-101)	Balanced modulator plate coil 1–1.9 mc		N16-C-73840-8208	Collins Rad part/dwg #504 2478 002	504 2478 002	T-101	1	
T-102	COIL, RF: RF transformer; single wnd, single layer wnd; 32 mc; 54 turns #32 wire; 1⅝" lg x ¾" diam o/a; isolantite form, air core; 2 mtg holes ea end tap 6-32 NC-2, ⅜" d; 3 wire lead term, one on ea end and one in ctr tapped 27th turn (p/o Z-101)	Balanced modulator plate coil 1.9–3.6 mc		N16-C-73437-7667	Collins Rad part/dwg #504 2479 002	504 2479 002	T-102	1	
T-103	COIL, RF: RF transformer; single wnd, single layer wnd; 9 mh at 5 mc; 26 turns #26E wire; 1⅝" lg x ¾" diam o/a; isolantite form, air core; 2 mtg holes on end, tap 6-32 NC-2, ⅜" d; 3 wire lead term, one on ea end, one in ctr tapped 13th turn (p/o Z-101)	Balanced modulator plate coil 3.6–6.7 mc		N16-C-73074-5609	Collins Rad part/dwg #504 2480 002	504 2480 002	T-103	1	
T-104	COIL, RF: Same as L-123 (p/o Z-102)	Buffer grid coil 1–1.9 mc							
T-105	COIL, RF: Same as L-124 (p/o Z-102)	Buffer grid coil 1.9–3.6 mc							
T-106	COIL, RF: Same as L-125 (p/o Z-102)	Buffer grid coil 3.6–6.7 mc							

T-107	TRANSFORMER, power: filament and pl type; input 105 v, 115 v, 125 v, 210 v, 230 v, 250 v 50/60 cps single phase; 4 output wnds; secd #1—1100 v CT, secd #2—6.3 v at 6 amp RMS, secd #3—5 v at 2 amp RMS, secd #4—6.3 v at 0.6 amp RMS; HS metal case; 5⅛" lg x 4⅛" wd x 5½" h excluding term; 18 solder lug term on bottom 9/16" lg incl ceramic bushing; four 10-32 NF-2 mtg studs 4-9/16" x 3⅝" mtg/c; JAN-T-27	HV transformer plate and filament			ADC type #A6524	Collins Rad part/dwg #672 0286 00	T-107	1	
T-108	COIL, RF: oscillator; pri and secd wnd; 200 turns of #36 DE wire, 5½ turns ea side of tap of #36 SSE wire; 1½" lg x 13/16" diam; iron form, air core; 2 retainer mtg rings; four wire leads, two from pri wnd to ea end of form, two from secd wnd brought to retainer rings (p/o Z-105: for maintenance replace complete Z-105)	200 kc osc grid coil		N17-T-82064-3711	Collins Rad part/dwg #504 2772 002	504 2772 002	T-108	1	
	TERMINAL BOARDS								
TB-101	SUB-ASSEMBLY: mounts resistors; consists of term board and 34 solder term; rectangular; 7⅞" lg x 2½" wd x ⅛" thk; three ⅛" diam mtg hole 3-11/16" mtg/c	Mounting board R-155, R-167, R-177, R-178, R-179, R-180, R-186, R-187, R-188, R-219, R-220, R-221, R-222, R-223			Collins Rad part/dwg #504 2464 002	504 2464 002	TB-101	1	
TB-102	SUB-ASSEMBLY: mounts resistors and capacitors; consists of term board and 50 solder term; rectangular; 6⅝" lg x 2⅜" wd x ⅛" thk; four ⅛" mtg holes 7¼" x 1¼" mtg/c	Mounting board C-137, C-139, C-140, C-144, C-145, C-146, C-147, C-148, C-149, C-150, L-108, R-153, R-154, R-156, R-157, R-158, R-159, R-160, R-161, R-162,			Collins Rad part/dwg #504 2465 002	504 2465 002	TB-102	1	

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
TB-102	(Cont'd)	R-163, R-164, R-165, R-166, R-169, R-170, R-171, R-172, R-173, R-189							
TB-103	SUB-ASSEMBLY: mounts resistors and inductors; consists of term board and 20 solder term; rectangular; 4-5/16" lg x 3" wd x 1/8" thk; four 1/8" diam mtg holes 4" x 1¼" mtg/c	Mounting board L-103, R-102, R-103, R-104, R-107, R-108, R-113, R-114, R-115, R-116, R-119, R-218			Collins Rad part/dwg #504 3250 002	504 3250 002	TB-103	1	
TB-104	SUB-ASSEMBLY: mounts capacitors; consists of term board and 12 solder term; rectangular; 3½" lg x 3" wd x 1/8" thk; four 1/8" diam mtg holes 3⅛" x 1¼" mtg/c	Mounting board C-101, C-102, C-103, C-104, C-105, C-106, C-184, C-185			Collins Rad part/dwg #504 2445 002	504 2445 002	TB-104	1	
TB-105	SUB-ASSEMBLY: mounts capacitors and inductors; consists of terminal board and 10 solder lugs; rectangular; 2½" lg x 1⅝" wd x 1/8" thk; two 1/8" diam mtg holes 2-3/16" mtg/c	Mounting board C-141, C-142, C-143, L-109, L-110			Collins Rad part/dwg #504 2424 001	504 2424 001	TB-105	1	
TB-106	SUB-ASSEMBLY: mounts resistors; consists of terminal board and 4 solder lugs; rectangular; 2⅜" lg x 2-1/16" wd x 1/8" thk; two 3/16" diam mtg holes 1-15/16" mtg/c	Mounting board R-195, R-208			Collins Rad part/dwg #504 2412 001	504 2412 001	TB-106	1	

TB-107	Not used								
TB-108	SUB-ASSEMBLY: mounts resistors; consists of terminal board and 10 solder term; rectangular; 3-5/16" lg x 2⅛" wd x 1/16" thk; four ⅛" diam mtg holes 2" x 1¼" mtg/c	Mounting board R-192, R-193, R-194, R-216, R-217			Collins Rad part/dwg #504 2426 001	504 2426 001	TB-108	1	
TB-109	Not used								
TB-110	Not used								
TB-111	SUB-ASSEMBLY: mounts resistors and capacitors; consists of term board and 14 solder term; rectangular; 3⅜" lg x 1⅝" wd x ⅛" thk; two 3/16" mtg holes 3¼" mtg/c	Mounting board C-131, C-134, R-149, R-150, R-151, R-152			Collins Rad part/dwg #504 2748 001	504 2748 001	TB-111	1	
TB-112	SUB-ASSEMBLY: mounts resistors and capacitors; consists of term board and 24 solder term; rectangular; 3½" lg x 2" wd x ⅛" thk; four ⅛" diam mtg holes 3⅛" x 1¼" mtg/c	Mounting board C-114, C-115, C-124, C-125, R-120, R-121, R-122, R-123, R-143, R-228			Collins Rad part/dwg #504 2777 002	504 2777 002	TB-112	1	
TB-113	SUB-ASSEMBLY: mounts resistors and capacitors; consists of term board and 10 solder term; rectangular; 2-3/16" lg x 1¾" wd x ⅛" thk; four ⅛" diam mtg holes 1⅞" x 1¼" mtg/c	Mounting board C-120, C-122, R-138, R-140, R-141			Collins Rad part/dwg #504 2757 001	504 2757 001	TB-113	1	
TB-114	SUB-ASSEMBLY: mounts resistors and capacitors; consists of term board and 8 solder term; rectangular; 2" lg x 1⅝" wd x ⅛" thk; two 3/16" diam mtg holes 1⅝" mtg/c	Mounting board C-116, C-117, R-124, R-125			Collins Rad part/dwg #504 2759 001	504 2759 001	TB-114	1	
TB-115	SUB-ASSEMBLY: mounts inductors and capacitors; consists of term board and 8 solder term; rectangular; 4⅞" lg x 2½" wd x ⅛" thk; two ⅛" mtg holes 3¾" mtg/c	Mounting board L-112, L-113, C-138, C-183			Collins Rad part/dwg #504 2488 002	504 2488 002	TB-115	1	
	TUBES								
V-101	TUBE, electron: twin diode; JAN-1A	First LIMITER	JAN-6AL5	N16-T-56195			V-101, V-102	2	

MODEL: KY-30/GRT

TABLE 8-4 COMBINED PARTS AND MAINTENANCE PARTS LIST

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
V-102	TUBE, electron: Same as V-101	Second LIMITER							
V-103	TUBE, electron: pentode; JAN-1A	PHASE MODULA-TION OS-CILLATOR	JAN-6AK5W	N16-T-56191-50			V-103, V-108	2	
V-104	TUBE, electron: twin triode; JAN-1A	BALANCED KEYER	JAN-12AU7	N16-T-58241			V-104, V-109	2	
V-105	TUBE, electron: triode; JAN-1A	First PHASE SHIFTING AMPLI-FIER	JAN-6C4	N16-T-56214			V-105	1	
V-106	TUBE, electron: pent; JAN-1A	Second PHASE SHIFTING AMPLI-FIER	JAN-6BA6	N16-T-56211			V-106, V-107, V-113	3	
V-107	TUBE, electron: Same as V-106	200 KC OSCILLA-TOR							
V-108	TUBE, electron: Same as V-103	CRYSTAL OSCILLA-TOR							
V-109	TUBE, electron: Same as V-104	AMPLIFIER AND CATHODE FOLLOW-ER							
V-110	TUBE, electron: double tri; JAN-1A	PHASE INVERTER	JAN-6J6	N16-T-56360			V-110	1	
V-111	TUBE, electron: pentagrid; JAN-1A	BALANCED MODULA-TOR	JAN-6BE6	N16-T-56211-50			V-111, V-112	2	
V-112	TUBE, electron: Same as V-111	BALANCED MODULA-TOR							
V-113	TUBE, electron: Same as V-106	Buffer stage							

V-114	TUBE, electron: transmitting beam power amplr; JAN-1A	POWER AMPLI-FIER	JAN-807	N16-T-68070			V-114	1	
V-115	TUBE, electron: voltage regulator; JAN-1A	Voltage Regulator	JAN-VR-150				V-115	1	
V-116	TUBE, electron: twin diode; JAN-1A	Rectifier	JAN-6X4	N16-T-56840			V-116, V-117, V-118	3	
V-117	TUBE, electron: Same as V-116	Rectifier							
V-118	TUBE, electron: Same as V-116	Rectifier							
V-119	TUBE, electron: rectifier; JAN-1A	Rectifier	JAN-5R4GY	N16-T-55444			V-119	1	
	WIRES								
W-101	LINE, RF transmission: uses Army-Navy cable RG-8/U; 12′ lg excluding termination; 12′ lg o/a; Sig C connector PL-259A on ea end (incl P-124 and P-104)	RF coaxial cable			Collins Rad part/dwg #504 2538 003	504 2538 003	W-101	1	
W-102	LINE, RF transmission: uses Army-Navy cable RG-8/U; 12′ lg excluding termination; 12′ lg o/a; Sig C connector PL-259A on ea end (incl P-105 and P-125)	RF coaxial cable			Collins Rad part/dwg #504 2539 003	504 2539 003	W-102	1	
W-103	LINE, RF transmission: uses Army-Navy cable RG-8/U; 12′ lg excluding termination; 12′ lg o/a; Sig C connector PL-259A on ea end (incl P-106 and P-126)	RF coaxial cable			Collins Rad part/dwg #504 2540 003	504 2540 003	W-103	1	
W-104	CABLE ASSEMBLY, power: uses Navy #MCOS-2; 12′ lg excluding terminations; connector AN-3106-14S-1P on one end, AN-3106-14S-1S on other end (incl P-121 and P-101)	Power cable			Collins Rad part/dwg #504 2541 003	504 2541 003	W-104	1	
W-105	CABLE ASSEMBLY, power: uses Navy #MCOS-2; 12′ lg excluding terminations; connector AN-3106-14S-1P on one end, AN-3106-14S-1S on other end (incl P-128 and P-108)	FREQ METER cable			Collins Rad part/dwg #504 2542 003	504 2542 003	W-105	1	
W-106	CABLE ASSEMBLY, special purpose: uses Navy #MCOS-2; 12′ lg excluding terminations; connector Hubbell #7559 on one end and Hubbell #7311 on other end; (incl P-109 and P-129)	AC power cable			Collins Rad part/dwg #504 2543 003	504 2543 003	W-106	1	

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
	FUSE HOLDERS								
XF-101	HOLDER, fuse: extractor post type; for single 3AG cartridge fuse; bakelite; 5 amp, 125 v; 2-5/16" lg x 13/16" diam o/a; ½-24 NS-2 threaded body for panel hole mtg; 2 solder lug term	Holder for F-101		N17-F-74266-9261	Buss type HKP	265 1002 00	XF-101, XF-102	2	
XF-102	HOLDER, fuse: Same as XF-101	Holder for F-102							
	PILOT LAMP SOCKETS								
XI-101	LIGHT, indicator: w/o lens; for miniature bayonet base, T-3-¼ bulb; 6 to 8 v; open shell; cadmium pl metal shield 1¼" lg x 15/16" diam; 11/16" mtg hole required, 0" to ¼" panel thk; horiz mtg; 2 solder lug term located on base of socket	Socket for I-101			Drake Mfg type #50	262 1260 00	XI-101, XI-102	2	
XI-101A	LENS, indicator light: white; threaded type; ½" diam plain lens; 31/32" lg x ¾" diam w/ 9/16-27 NS-2 thd, 3/16" lg; brass, white nickel pl finish; var light intensity	Lens for I-101			Johnson EF	262 0162 00	XI-101A	1	
XI-102	LIGHT, indicator: Same as XI-101	Socket for I-102							
XI-102A	LENS, indicator light: red; threaded type; ½" diam plain lens; 31/32" lg x ¾" diam w/ 9/16-27 NS-2 thd, 3/16" lg; brass, white nickel pl finish; var light intensity	Lens for I-102			Johnson EF	262 0159 00	XI-102A	1	
XI-103	LIGHT, indicator: w/o lens for miniature bayonet base T-3-¼ bulb; enclosed shell; dull black metal finish; 1-19/32" lg x 11/16" diam; 45/64" diam mtg holes required, 1/16" panel thk; horiz mtg socket lamp, replaceable from front of panel; two solder lug term located on base of socket	Socket for I-103			Dialco type #88410-11	262 0109 00	XI-103	1	
XI-103A	LENS, indicator light: amber; threaded type; ½" diam plain lens; 31/32" lg x ¾" diam w/ 9/16-27 NS-2 thd, 3/16" lg; brass, white nickel pl finish; var light intensity	Lens for I-103			Johnson EF	262 0161 00	XI-103A	1	

TUBE SOCKETS

XV-101	SOCKET, tube: miniature octal; cont #2 missing; above chassis base mtg; two ¼" diam mtg holes ⅞" c to c; round mica filled phenolic body .8" diam x 7/32" lg excluding term; beryllium copper, silver pl cont; w/ ¾" h metal shock shield; JAN-S-28	Socket for V-101	SO10M	N16-S-62603-6674			XV-101, XV-102, XV-103, XV-105, XV-106, XV-107, XV-108, XV-110, XV-111, XV-112, XV-113, XV-116, XV-117, XV-118	14	
XV-102	SOCKET, tube: Same as XV-101	Socket for V-102							
XV-103	SOCKET, tube: Same as XV-101	Socket for V-103							
XV-104	SOCKET, tube: 9 cont miniature; one piece saddle mtg 1-11/32" lg; two .125" diam mtg holes on 1.125" mtg/c; round phenolic body 11/16" lg x .940" diam less cont incl shield; beryllium copper silver pl cont; incl metal shield, ctr shield .260" diam	Socket for V-104	(-491894)		Cinch 53F12875	220 1063 00	XV-104, XV-109	2	
XV-105	SOCKET, tube: Same as XV-101	Socket for V-105							
XV-106	SOCKET, tube: Same as XV-101	Socket for V-106							
XV-107	SOCKET, tube: Same as XV-101	Socket for V-107							
XV-108	SOCKET, tube: Same as XV-101	Socket for V-108							
XV-109	SOCKET, tube: Same as XV-104	Socket for V-109							
XV-110	SOCKET, tube: Same as XV-101	Socket for V-110							
XV-111	SOCKET, tube: Same as XV-101	Socket for V-111							
XV-112	SOCKET, tube: Same as XV-101	Socket for V-112							
XV-113	SOCKET, tube: Same as XV-101	Socket for V-113							
XV-114	SOCKET, tube: 5 cont small; under chassis wafer mtg; two 11/64" x 17/64" mtg holes spaced 1-49/64" c to c; oval ceramic body, 2-5/16" lg x 1-11/16" wd x ¼" h excluding term; phosphor bronze cad pl cont	Socket for V-114	(-49363)	N16-S-61706-1481	Johnson E. F. catalog #225	220 5520 00	XV-114	1	

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
XV-115	SOCKET, tube: octal; one piece saddle mtg; two 0.156" diam mtg holes 1.312" mtg/c; round, low loss mica filled bakelite 1⅝" lg x 1-3/16" wd x ½" thk excluding term; phosphor bronze, silver pl cont	Socket for V-115	(-49423-A)	N16-S-63511-6461	Amphenol type #88-8TM	220 1005 00	XV-115	1	
XV-116	SOCKET, tube: Same as XV-101	Socket for V-116							
XV-117	SOCKET, tube: Same as XV-101	Socket for V-117							
XV-118	SOCKET, tube: Same as XV-101	Socket for V-118							
XV-119	SOCKET, tube: octal; under chassis wafer mtg; two 17/64" x 11/64" mtg holes on 1-49/64" mtg/c; oval ceramic body, 2-5/16" lg x 1-11/16" wd x 7/32" h excluding term; phosphor bronze cad pl cont	Socket for V-119	(-49367)	N16-S-63471-2924	Johnson E. F. catalog #228	220 5810 00	XV-119	1	
	SOCKET CRYSTAL								
XY-101/ XY-104	SOCKET, crystal: consists of one term board, one 12-62 mmf capacitor, 3 sockets and hardware; rectangular; 4¾" lg x 2" wd x	Socket for Y-101/Y-104			Collins Rad part/dwg	504 2781 002	XY-101/ XY-104, XY-102/	1	

PARTS									SPARE PARTS
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (NAVY) TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S. DESIG-NATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	QUANTITY PER EQUIPMENT	EQUIPMENT SPARES
Z-105	TRANSFORMER, variable RF: osc; pri and secd wnd; shielded; 200 turns of # 36 DE wire, 5½ turns ea side of tap of #36 SSE wire; 2.625" lg x 1.750" diam o/a; iron form, air core; 1½" lg x 13/16" diam coil form; three 6-32 x ½" lg PH mtg screws equally spaced on .562" rad; 5 solder lug term on top; HS in cans (includes C-189 and T-108) BOX: Metal	200 kc tank in grid of V-107		N17-T-81314-3713	Collins Rad part/dwg #504 2789 003	504 2789 003	Z-105	1	

TABLE 8-5. CROSS REFERENCE PARTS LIST

JAN (or AWS) DESIGNATION	KEY SYMBOL
CC30CK240J	C-118
CC30PH100F	C-128
CC30PH200J	C-128
CC30PH510J	C-126
CC35CH101J	C-123
CM20B101J	C-120
CM20B221K	C-124
CM20B471M	C-131
CM35B103M	C-101
CM35B332K	C-103
CM35B472K	C-141
CM45B222M	C-160
CP29A1DF104M	C-138
CP40C2FF405V	C-172
CP50B1FF104X	C-110
CP54B1FE504K	C-107
CP54B4DF104X	C-191
CP54B5FF104X	C-188
CV11B130	C-161
CV11D500	C-152
JAN-VR-150	V-115
JAN-12AU7	V-104

JAN (or AWS) DESIGNATION	KEY SYMBOL
JAN-5R4GY	V-119
JAN-6AK5W	V-103
JAN-6AL5	V-101
JAN-6BA6	V-106
JAN-6BE6	V-111
JAN-6C4	V-105
JAN-6J6	V-110
JAN-6X4	V-116
JAN-807	V-114
NS4W4102	E-103B
NS4W4202	E-103A
RA20A1SD103AK	R-168
RA20A1SD502AK	R-105
RA20A1SG252AK	R-136
RA20A1SG500AK	R-227
RA20B1RH502AJ	R-117
RB11B470R0F	R-110
RC20BF100K	R-198
RC20BF120K	R-199
RC20BF150K	R-200
RC20BF200J	R-189
RC20BF220K	R-201

JAN (or AWS) DESIGNATION	KEY SYMBOL
RC20BF270K	R-202
RC20BF330K	R-203
RC20BF390K	R-197
RC20BF470K	R-205
RC20BF563J	R-226
RC20BF680K	R-206
RC20BF820K	R-207
RC30BF101K	R-161
RC30BF102K	R-158
RC30BF103J	R-135
RC30BF104J	R-102
RC30BF104K	R-147
RC30BF123J	R-124
RC30BF151J	R-148
RC30BF151K	R-118
RC30BF152K	R-112
RC30BF153K	R-177
RC30BF154J	R-144
RC30BF182J	R-154
RC30BF222J	R-150
RC30BF223J	R-107
RC30BF224J	R-113

JAN (or AWS) DESIGNATION	KEY SYMBOL
RC30BF240J	R-186
RC30BF271J	R-140
RC30BF273K	R-163
RC30BF331K	R-137
RC30BF333K	R-138
RC30BF334K	R-141
RC30BF391K	R-165
RC30BF392J	R-122
RC30BF470K	R-185
RC30BF473J	R-115
RC30BF474K	R-157
RC30BF560K	R-171
RC30BF562K	R-156
RC30BF563J	R-114
RC30BF563K	R-172
RC30BF683K	R-169
RC30BF821J	R-151
RC30BF822K	R-164
RC30BF823K	R-120
RC40BF103K	R-180
RC40BF104K	R-208
RC40BF123K	R-229

JAN (or AWS) DESIGNATION	KEY SYMBOL
RC40BF154K	R-195
RC40BF182K	R-178
RC40BF223J	R-108
RC40BF223K	R-174
RC40BF273K	R-155
RC40BF332J	R-104
RC40BF392K	R-179
RC40BF393J	R-116
RC40BF472J	R-152
RC40BF472K	R-194
RC40BF473K	R-192
RC40BF822K	R-184
RU3A1R2J	R-187
RW30F631	R-101
RW33F632	R-196
S0S3	E-109
S0S6	E-110
S010M	XV-101
ST52N	S-110

NAVY TYPE	KEY SYMBOL
-28032-3	F-101
-302715	L-101
-483458	C-132
-49025-A	J-111
-491014-A	J-107
-491894	XV-104
-49194	J-104
-49195	P-104
-49363	XV-114
-49367	XV-119
-49423-A	XV-115
-49749-A	J-109

NAVY TYPE	KEY SYMBOL

ARMY-NAVY TYPE	KEY SYMBOL
AN-3057-6	P-101A
AN-3057-8	P-110A
AN-3102-14S-1P	J-101
AN-3106-14S-1P	P-121
AN-3106-14S-1S	P-101

ARMY-NAVY TYPE	KEY SYMBOL

SIGNAL CORPS STOCK NO.	KEY SYMBOL

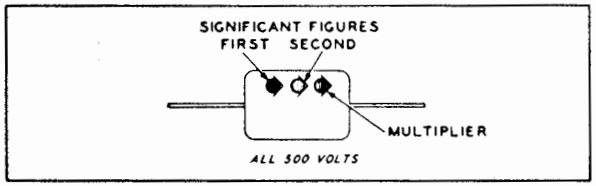
TABLE 8-5. CROSS REFERENCE PARTS LIST (Con't)

FEDERAL STOCK NO.	KEY SYMBOL	FEDERAL STOCK NO.	KEY SYMBOL	FEDERAL STOCK NO.	KEY SYMBOL	FEDERAL STOCK NO.	KEY SYMBOL	FEDERAL STOCK NO.	
N16-B-22681-1003	O-105	N16-M-43208-4975	Z-101	N16-R-50823-231	R-157	N17-D-200001-114	S-101C		
N16-C-15923-1762	C-128	N16-M-43208-5075	Z-104	N16-R-62071-2580	R-191	N17-F-16302-120	F-101		
N16-C-16083-1726	C-128	N16-P-402241-110	E-107	N16-R-65683-9726	R-209	N17-F-74266-9261	XF-101		
N16-C-16177-6532	C-118	N16-P-403981-107	O-102	N16-R-65935-3621	R-101	N17-H-60003-1551	R-231		
N16-C-16595-1762	C-126	N16-R-29180-4601	L-132	N16-R-66303-4602	R-196	N17-H-60018-5001	R-210		
N16-C-17073-3201	C-123	N16-R-29317-4166	L-101	N16-R-68275-5206	R-187	N17-I-59611-2686	E-102		
N16-C-18437-4613	C-189	N16-R-29649-1238	L-104	N16-R-72899-2661	R-132	17-L-6297	I-101		
N16-C-28553-1196	C-120	N16-R-49238-811	R-198	N16-R-72918-1061	R-133	N17-M-19690-1211	M-101		
N16-C-29375-8076	C-124	N16-R-49256-811	R-199	N16-R-72926-9801	R-131	N17-R-49687-751	R-140		
N16-C-300496-201	O-101	N16-R-49283-811	R-200	N16-R-72962-2851	R-129	N17-S-59272-7049	S-109		
N16-C-300798-452	E-114	N16-R-49309-431	R-189	N16-R-72995-8138	R-128	N17-S-60549-2021	S-108		
N16-C-300798-866	E-115	N16-R-49319-811	R-201	N16-R-73030-9545	R-127	N17-S-64847-8451	S-102		
N16-C-300801-101	E-112	N16-R-49346-811	R-202	N16-R-79031-3259	R-110	N17-S-69906-5206	S-113		
N16-C-30119-6756	C-131	N16-R-49364-811	R-203	N16-R-87679-4360	R-126	N17-S-69906-5256	S-112		
N16-C-31913-9493	C-160	N16-R-49391-811	R-197	N16-R-89956-7050	R-227	N17-S-73959-1025	S-110		
N16-C-32250-8808	C-103	N16-R-49427-811	R-205	N16-R-90868-3015	R-136	N17-S-91897-8766	S-101A		
N16-C-32646-6808	C-141	N16-R-49428-231	R-185	N16-R-91027-9295	R-117	N17-S-91897-8767	S-101A		
N16-C-33627-7705	C-101	N16-R-49464-231	R-171	N16-R-91031-1140	R-105	N17-S-91897-8768	S-106A		
N16-C-34576-6515	E-108	N16-R-49499-811	R-206	N16-R-91291-4995	R-168	N17-T-81314-3713	Z-105		
N16-C-45807-7617	C-138	N16-R-49535-811	R-207	N16-R-91406-1650	R-181	N17-T-82064-3711	T-108		
N16-C-45814-9330	C-110	N16-R-49581-231	R-161	N16-S-21022-6626	S-101D				
N16-C-47293-9462	C-107	N16-R-49626-231	R-118	N16-S-21023-8501	O-109				
N16-C-49981-9980	C-172	N16-R-49707-231	R-137	N16-S-21126-1074	O-110				
N16-C-53225-8105	C-191	N16-R-49923-231	R-158	N16-S-34520-3841	E-109				
N16-C-54467-1577	C-188	N16-R-49968-0231	R-112	N16-S-34557-8343	E-110				
N16-C-58716-3970	C-127	N16-R-49986-551	R-178	N16-S-34607-8353	E-111				
N16-C-59766-481	C-132	N16-R-50066-171	R-104	N16-S-61706-1481	XV-114				
N16-C-63665-7049	C-151	N16-R-50092-751	R-122	N16-S-62603-6674	XV-101				
N16-C-63965-2800	C-161	N16-R-50130-551	R-194	N16-S-63471-2924	XV-119				
N16-C-64157-5249	C-152	N16-R-50281-751	R-135	N16-S-63511-6461	XV-115				
N16-C-72345-7983	L-131	N16-R-50283-0551	R-180	N16-T-55444	V-119				
N16-C-72410-4923	L-136	N16-R-50308-751	R-124	N16-T-56191-50	V-103				
N16-C-72646-7797	L-130	N16-R-50310-551	R-229	N16-T-56195	V-101				
N16-C-72666-8797	L-129	N16-R-50337-231	R-177	N16-T-56211	V-106				
N16-C-72667-1888	L-123	N16-R-50364-551	R-208	N16-T-56211-50	V-111				
N16-C-73074-5605	L-125	N16-R-50371-751	R-107	N16-T-56214	V-105				
N16-C-73074-5609	T-103	N16-R-50372-171	R-108	N16-T-56360	V-110				
N16-C-73414-9783	L-108	N16-R-50373-551	R-174	N16-T-56840	V-116				
N16-C-73437-7663	L-124	N16-R-50400-231	R-163	N16-T-58241	V-104				
N16-C-73437-7667	T-102	N16-R-50400-511	R-155	N16-T-68070	V-114				
N16-C-73756-6364	L-109	N16-R-50418-231	R-138	N17-C-70588-1327	P-121				
N16-C-73840-8208	T-101	N16-R-50444-171	R-116	N17-C-71168-1306	P-109				
N16-C-74381-4123	L-127	N16-R-50481-551	R-192	N17-C-73175-3819	J-107				
N16-C-74714-8696	L-107	N16-R-50515-751	R-114	N17-C-73471-6407	J-109				
N16-C-74715-1017	L-102	N16-R-50517-231	R-172	N17-C-73560-8901	P-102				
N16-C-74721-3586	L-103	N16-R-50553-231	R-169	N17-C-781444-504	P-110A				
N16-D-46365-7355	E-116	N16-R-50589-231	R-120	N17-C-800488-101	E-113				
N16-E-300057-426	O-104	N16-R-50632-751	R-102	N17-C-98373-2551	O-107				
N16-E-300058-326	O-103	N16-R-50634-231	R-147	N17-C-98378-2043	O-108				
N16-K-700061-486	E-117	N16-R-50677-751	R-144	N17-C-98378-3896	O-106				
N16-K-700248-886	E-118	N16-R-50679-551	R-195	N17-C-98378-3899	O-111				
N16-M-43208-4916	Z-103	N16-R-50713-751	R-113	N17-D-200001-112	S-104B				
N16-M-43208-4940	Z-102	N16-R-50760-231	R-141	N17-D-200001-113	S-106G				

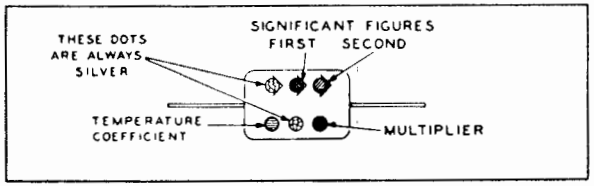
TABLE 8-6 APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

CAPACITOR COLOR CODES

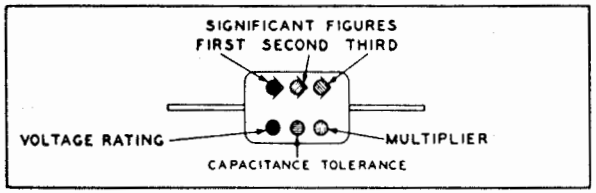
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



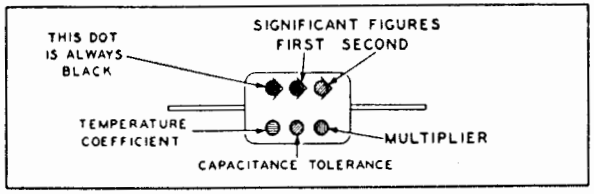
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



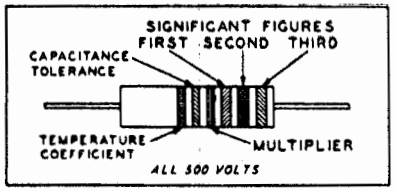
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

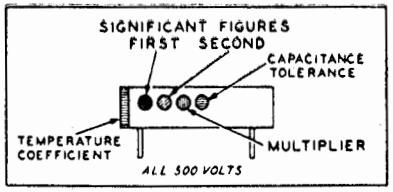


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

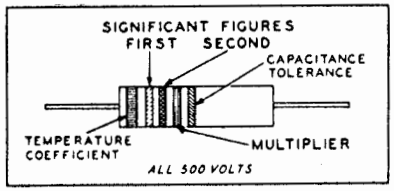


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



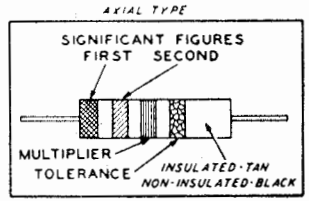
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS				CAPACITORS				
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

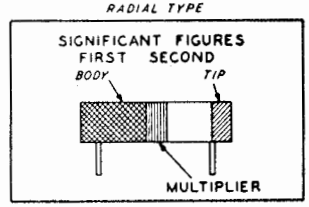
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

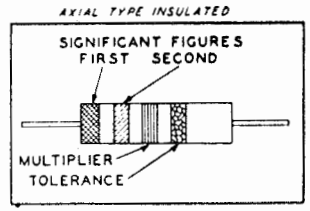


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

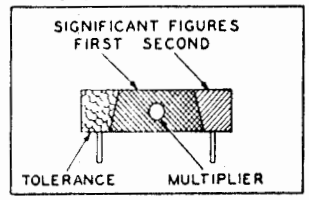


TABLE 8-7. LIST OF MANUFACTURERS

ABBREVIATIONS	PREFIX	NAME	ADDRESS
ADC	CUD	Audio Development Co.	2833 3rd Ave. So. Minneapolis 7, Minn.
Amphenol	CPH	American Phenolic Corp.	1830 So. 54th Ave. Chicago 50, Cicero P.O., Ill.
Birtcher	CAIS	Birtcher Corp., The	5087 Huntington Drive Los Angeles 32, California
Buss	CFA	Bussman Mfg. Co.	Div. of the McGraw Electric Co. University at Jefferson St. Louis 7, Mo.
Cannonelec	CED	Cannon Electric Development Co.	3209 Humboldt St. Los Angeles 31, Calif.
Centralab	CBN	Centralab	900 E. Keefe Ave. Milwaukee 1, Wis.
Chi Trans	CTR	Chicago Transformer Div.	Essex Wire Corp. 3501 Addison St. Chicago 18, Ill.
Cinch	CMG	Cinch Mfg. Co.	Howard B. Jones Div. 2460 W. George St. Chicago 18, Ill.
Collins Rad	COL	Collins Radio Co.	855 35th St. N.E. Cedar Rapids, Iowa
Dialco	CAYZ	Dial Light Co. of America, Inc.	900 Broadway New York 3, N.Y.
Drake Mfg.	CAYS	Drake Mfg. Co.	1713 W. Hubbard St. Chicago 22, Ill.
GE	CG	General Electric Co.	Schnectady 5, New York
General Etching & Mfg. Co.		General Etching & Mfg. Co.	3070 82W Grand Ave. Chicago 22, Ill.
Hubbell	CHU	Harvey Hubbell, Inc.	Bridgeport, Conn.
IRC	CIR	International Resistance Co.	401 N. Broad St. Philadelphia 8, Pa.
Johnson E. F.	CEJ	E. F. Johnson Co.	Waseca, Minnesota
Littelfuse	CLF	Littelfuse, Inc.	4757 Ravenswood Ave. Chicago 40, Ill.
Mallory	CMA	P. R. Mallory, Inc.	3029 E. Washington St. Indianapolis 6, Ind.
Millen	CJA	James Millen Mfg. Co.	150 Exchange St. Malden, Mass.
Natl. Co.	CNA	National Company Inc.	61 Sherman Street Malden 48, Massachusetts
Oak	COC	Oak Mfg. Co.	1260 Clyborn Ave. Chicago 10, Ill.
Ohmite	COM	Ohmite Mfg. Co.	4835 W. Flourney St. Chicago 44, Ill.
RCC	CRK	Radio Condenser Co.	Thorne & Copewood Sts. Camden 4, N.J.
Rohden Mfg		Rohden Mfg. Co.	1753 N. Honore St. Chicago, Ill.
Stevens Mfg. Co.		Stevens Mfg. Co.	1850 W. Henderson St. Chicago 13, Ill.
Thordorson	CTH	Thordorson Electric Mfg. Co.	Div. of Maquire Industries, Inc. 500 W. Huron St. Chicago 10, Ill.
UTC	CUT	United Transformer Corp.	150 Varick Street New York 13, New York
Watelec	CAYF	Watlow Electric Mfg. Co.	1320 N. 23rd St. St. Louis 6, Mo.
Wemco	CAY	Westinghouse Electric Corp.	P.O. Box 146 Pittsburgh 30, Pa.
Weston	CV	Weston Electrical Instrument Co.	Newark 5, New Jersey
WL	CAD	Ward Leonard Electric Co.	Mt. Vernon, N.Y.

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