NAVSHIPS 91612 Non-Registered

INSTRUCTION BOOK

for

RECEIVER, CARRIER TELEGRAPH R-466/UC

C.G.S. LABORATORIES, INC.
Stamford, Connecticut

BUREAU OF SHIPS NAVY DEPARTMENT

Contract NObsr -52314 *Approved by BuShips 25 FEBRUARY 1952*

LIST OF EFFECTIVE PAGES

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DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
25 February 1952

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

Subj: Instruction Book for Receiver, Carrier Telegraph R-466/UC NAVSHIPS 91612

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the BuShips ELECTRON and in the Index of Bureau of Ships General and Electronics Publications, NAVSHIPS 250-020.

H. N. WALLIN
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION
1	11-12-52	R. Thompson

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GUARANTEE

Notwithstanding the provisions of Section 5 of these General Provisions, entitled "Inspection", the Contractor guarantees that at the time of delivery thereof the supplies provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or non-conformance shall be given by the Government to the Contractor within one year of the delivery of the defective or non-conforming item, unless a different period of Guaranty is specified in the Schedule. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective or non-conforming item or part thereof. When such correction or replacement requires transportation of the item or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guaranty shall then continue as to corrected or replacing supplies or, if only parts of such supplies are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guaranty is specified in the Schedule. If the Government does not require correction or replacement of a defective or non-conforming item, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the item as is equitable in the circumstances.

INSTALLATION RECORD

Contract No.: NObsr-52314 Date of Contract: 8 March 1951

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.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised) except for Marine Corps equipment, in which case the "Signal Equipment Failure Report" form shall be used and distributed in accordance with instructions pertaining thereto. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the "Bureau of Ships Manual" or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number, or when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR BE USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available firearms.
5. Burying all debris, where possible and when time permits.
6. Throwing overboard or disposing of in streams or other bodies of water.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water cooling systems in gas engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the Bureau of Ships Manual or superseding instructions on the subject of radio safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection, but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

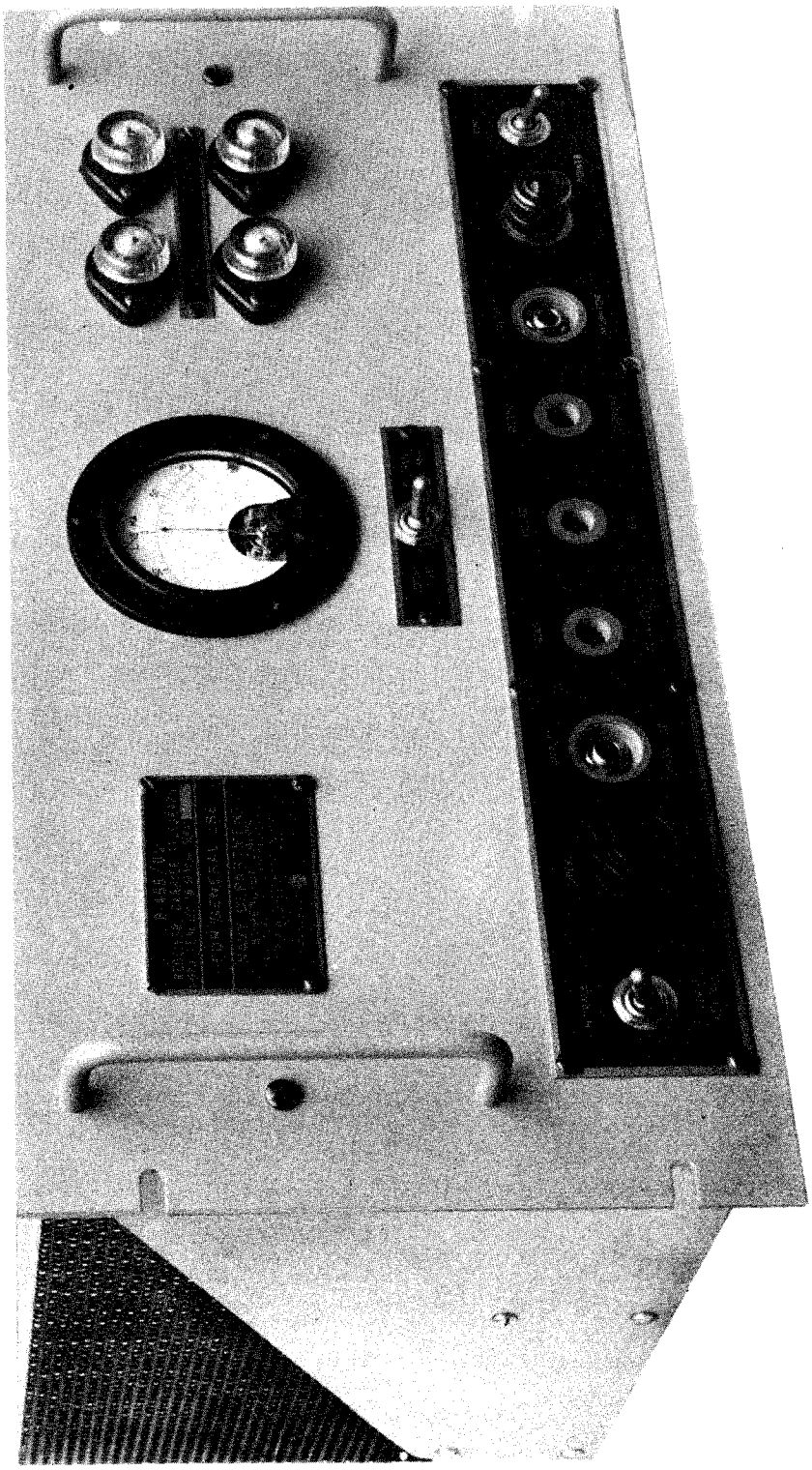


Figure 1-1. Receiver, Carrier Telegraph R-466/UC

SECTION 1
GENERAL DESCRIPTION

1. EQUIPMENT ILLUSTRATION

Figure 1-1 illustrates the Receiver, Carrier Telegraph R-466/UC which can be mounted on a standard relay rack.

2. PURPOSE AND BASIC PRINCIPLES

The Receiver, Carrier Telegraph R-466/UC (hereafter referred to as Receiver) is capable of accepting an on-off tone telegraph signal and emitting a corresponding direct current signal.

a. The Receiver is capable of keying the following:

(1) 20 to 60 MA neutral telegraph loop with battery supplied from the Receiver.

(2) 20 to 60 MA neutral telegraph loop with battery supplied from the loop.

(3) 30 MA polar telegraph loop with battery supplied from the Receiver.

b. Transformation of the on-off tone telegraph signal into a corresponding direct current signal is accomplished by electronic means. The on-off tone telegraph signal is rectified and applied to trigger circuits which key the output of the Receiver.

c. Figures 1-2 and 1-3 illustrate applications of the Receiver, Carrier Telegraph R-466/UC.

3. DESCRIPTION OF UNIT

The Receiver, Carrier Telegraph R-466/UC is illustrated in Figure 1-1. The panel is 3/16" thick by 19" long by 8-23/32" high and is finished in gray enamel. The chassis extends 12-7/8" behind the panel and is supported to the panel on each side by brackets. Fuses and controls most often used are located on the Receiver panel. Input, output, and power connections are located at the rear of the Receiver chassis. All vacuum

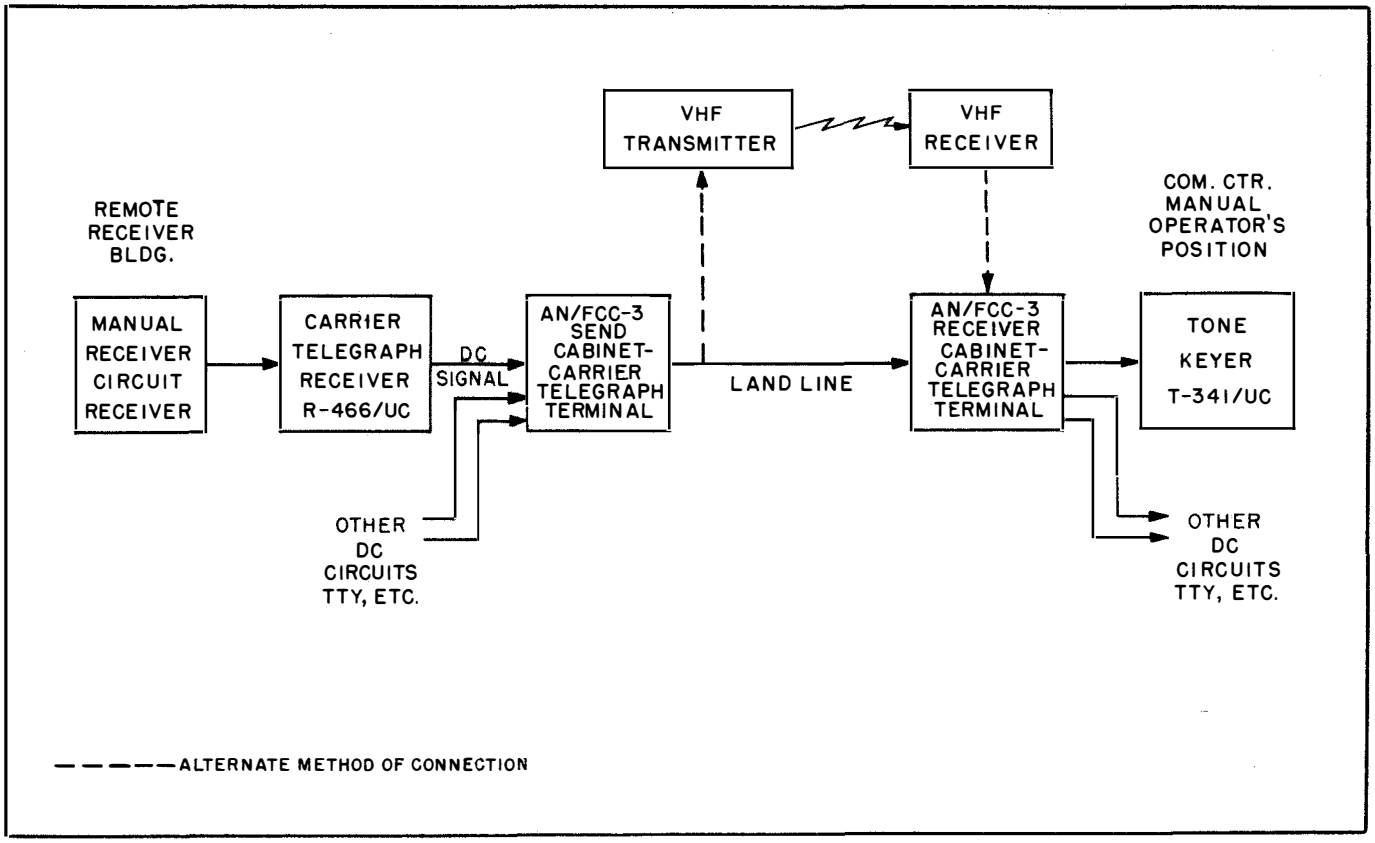


Figure 1-2. Receiver, Carrier Telegraph R-466/UC, Application

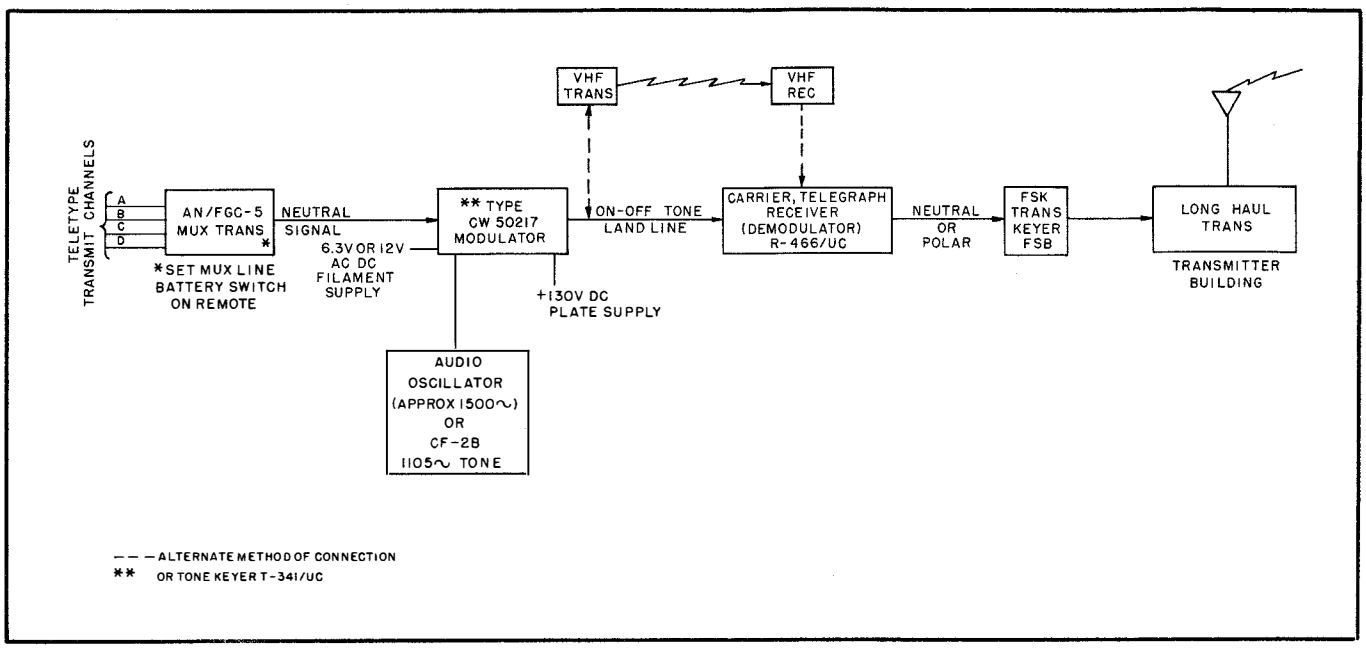


Figure 1-3. Receiver, Carrier Telegraph R-466/UC, Application

tubes are readily accessible from the rear of the Receiver after a protective cover is removed and are mounted in a vertical position. The Receiver functions as an individual unit with a self-contained power supply.

4. REFERENCE DATA

a. Nomenclature: Receiver, Carrier Telegraph R-466/UC

b. Contract NObsr-52314, 8 March 1951

c. Contractor: C.G.S. Laboratories, Inc.

d. Cognizant Naval Inspector: Inspector of Naval Material, Bridgeport, Ct.

e. Number of packages per complete equipment: 1

f. Total cubical contents including equipment spares: 9.25 cu. ft.

g. Total weight including equipment spares: 94.5 lb.

h. Input: 600 ohm balanced or unbalanced, for on-off tone, 400 to 8000 cps

i. Output keying:
20 to 60 MA neutral remote battery
20 to 60 MA neutral local battery
30 MA polar local battery
either side of ground may be grounded

j. Output distortion: Correction to zero for ±20% bias distortion at input

k. Input level: The input circuit is capable of adjustment to signals at any level in the range from -24 to +10 DBM. Input level variations of ±7.5 DBM will be tolerated during operation.

l. Input keying speed: 20 to 200 dot cycles (equivalent to 60 to 600 wpm. operation). Higher keying speeds may be handled if input level variations are not over ±5 DBM.

m. Input tone frequency: 400 to 8000 cps. Tone frequencies above 2000 cps are desirable to minimize fortuitous distortion. This is especially true for higher keying speeds.

n. Power requirements: 115/230 volts, 50/60 cps. 150 watts.

o. Visual operation indicator:
Indicator light on front panel.
Meter for DBM level and output current.

p. Power supply: Built in on each Receiver.

TABLE 1-1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
			HEIGHT	WIDTH	DEPTH		
1	Receiver, Carrier Telegraph	R-466/UC	8-23/32	19	14-3/8	1.38	36.5
1	Equipment Spare Parts Carton		8	12	8	.44	24
2	Instruction Books		Mounted in Equipment				

TABLE 1-2. SHIPPING DATA

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Receiver, Carrier Telegraph	R-466/UC	24	37	18	9.25	94.5
1	Equipment Spare Parts Carton		Packed with Equipment				

Unless otherwise stated, dimensions are inches, volume cubic feet, weight pounds.

TABLE 1-3. RECEIVER, CARRIER TELEGRAPH R-466/UC
Vacuum Tube Complement

SYMBOL	TYPE	CIRCUIT
V1	JAN 12AT7	Audio Amplifier
V2	JAN 12AT7	Limiter-Amplifier
V3	JAN 6AL5W	Signal Full Wave Rectifier
V4	JAN 12AU7	Trigger
V5	JAN 12AU7	DC Amplifier, Inverter
V6	JAN 12AU7	Audio Amplifier, Half Wave Rectifier
V7	JAN 6Y6G	Output Keying
V8	JAN 6Y6G	Output Keying
V9	JAN 5U4G	Full Wave Rectifier
V10	JAN 6Y6G	Series Voltage Regulator
V11	JAN 6Y6G	Series Voltage Regulator
V12	JAN 6AU6	Voltage Regulator Control
V13	JAN 6X4W	Half Wave Rectifier
V14	JAN OB2	Voltage Regulator
V15	JAN OB2	Voltage Regulator

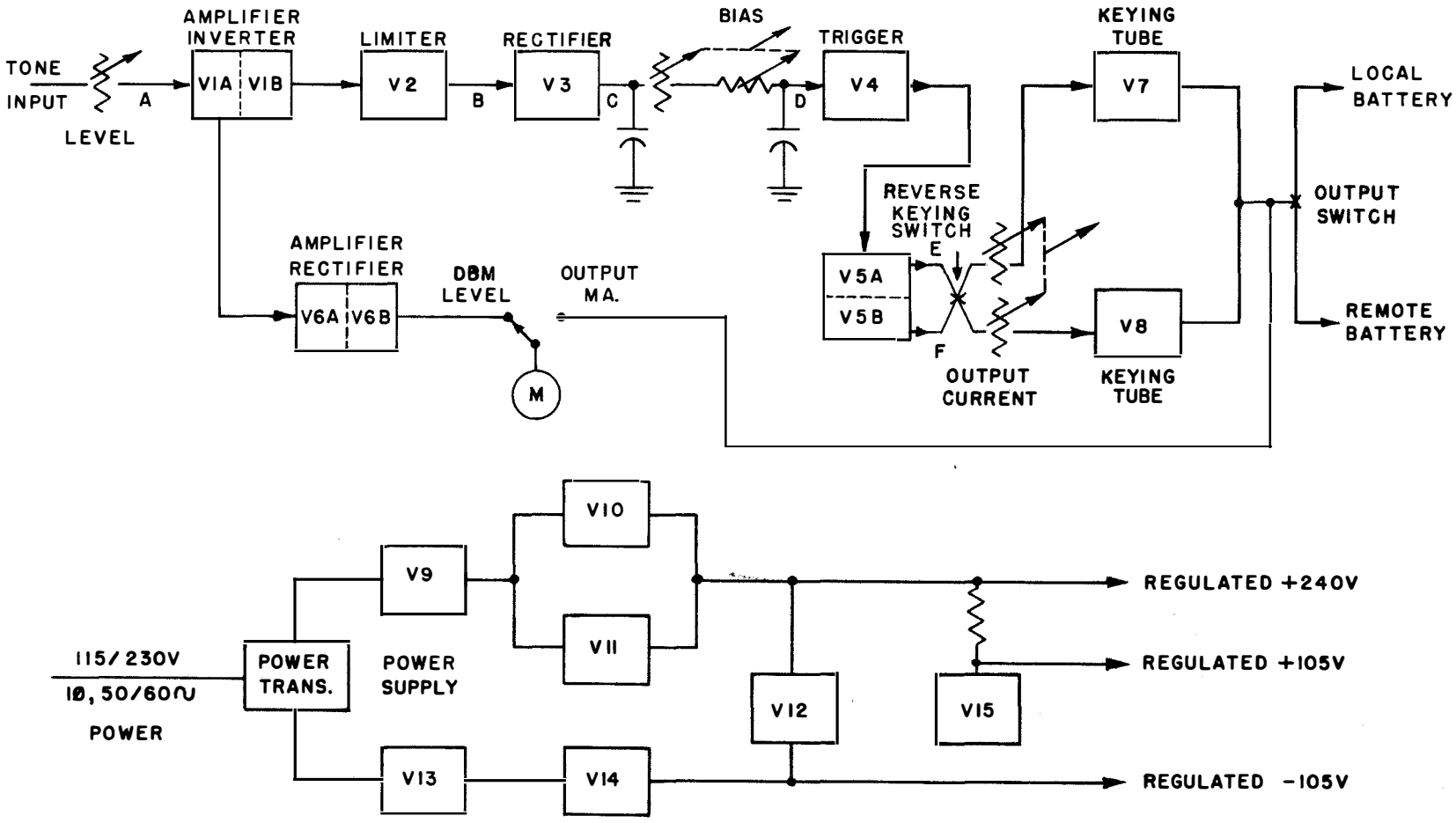


Figure 2-1. Receiver, Carrier Telegraph R-466/UC, Block Diagram

SECTION 2

THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS

a. Figure 2-1 illustrates a block diagram of the Receiver showing routing of signal from input to output. Figure 2-2 illustrates waveforms of the character "Y" at pertinent points of the circuit on a time base. The letters opposite each line in Figure 2-2 refer to the waveforms seen at the lettered points in Figure 2-1. Reference will be made during the following discussion to tubes, points, or lines designated by letters or numbers in Figures 2-1 and 2-2. Reader's reference to these Figures should be made when necessary without further discussion.

(1) Keyed tone input to the Receiver is connected through the LEVEL control to the triode amplifier tube V1A. (See Line A). The LEVEL control is used in conjunction with meter M1 to set the signal level for optimum operation of the Receiver. Output from tube V1A is coupled to triode tube V1B which provides push-pull output to drive limiter-amplifier tube V2, a dual triode. This tube is automatically biased by the signal level so that output to full wave rectifier tube V3 is held relatively constant for input level variations of plus or minus 7.5 DBM from normal. Tube V3 converts the keyed tone signal to a keyed DC signal having ripple. (See line C).

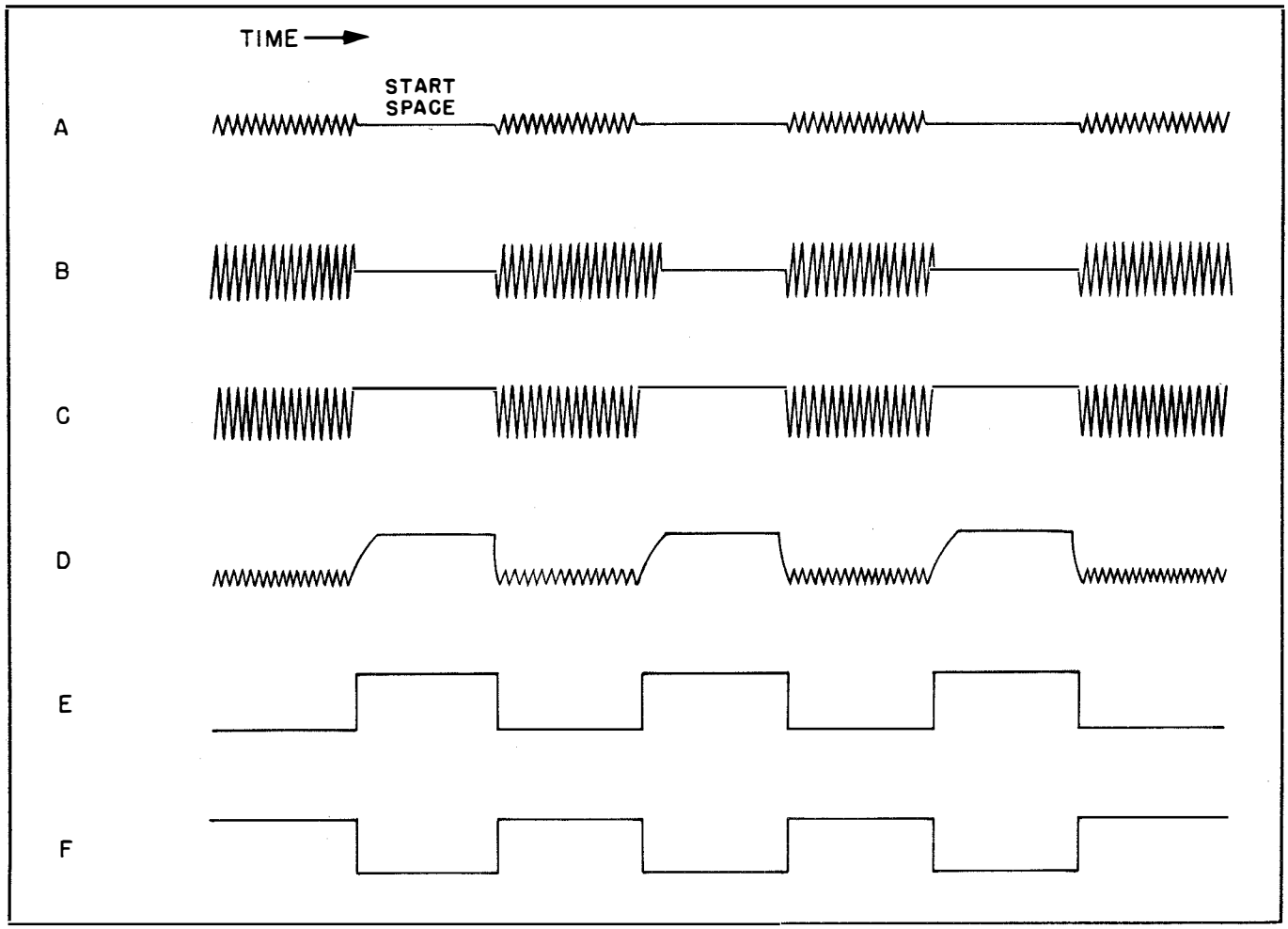


Figure 2-2. Waveforms

(2) The BIAS CORRECT control is a dual potentiometer and regulates the amplitude of the DC signal fed to trigger tube V4 and also varies the rise and decay time slope of this signal. (See line D). Filtering is accomplished by using capacitors in conjunction with the BIAS control.

(3) The TRIGGER circuit incorporating dual triode tube V4 is used to square up the signal of Line D. Additional half sections of dual triode tube V5 produce outputs as indicated in lines E and F. Coupling from the input of tube V4 through tubes V7 and V8 is of a direct nature and responds to steady input states as well as to keyed signals.

(4) Vacuum tubes V7 and V8 are power pentodes used to provide a keyed DC polar or neutral signal at the output of the Receiver when battery supply is from the Receiver. When battery supply is from the line, a neutral output can be obtained from the Receiver. An OUTPUT switch of the rotary type is connected between the output of tubes V7 and V8 and the output terminals of the Receiver to select the desired type of operation. A toggle KEYING switch is connected between the output of tube V5 and the input to tubes V7 and V8 to invert the output keying if desirable. A dual potentiometer connected in the grid circuits of tubes V7 and V8 provides adjustment of the output current for either 20 to 60 MA neutral operation or 30 MA polar operation. Output line current is measured by meter M when the meter toggle switch is thrown one way. In the other position of the switch, the meter is connected through dual triode tube V6 to the output of tube V1A and indicates the level of signal at that point. Tube V6A amplifies the signal from tube V1A sufficiently to drive tube V6B. Tube V6B is connected as a half wave rectifier to operate meter M which is a direct current meter. A steady tone signal is desirable at the input of the keyer when LEVEL adjustments are made in conjunction with meter M as a varying input signal will cause the meter needle to vary.

(5) The power supply for the Receiver utilizes four vacuum tubes and two gaseous regulator tubes. Tube V9 is a full wave rectifier for the B+ supply. Tubes V10 and V11 are series type regulators for the B+. Tube V12 controls tubes V10 and V11. Tube V13 is used as a half wave regulator for the negative voltage supply. VR tube V14 regulates the negative voltage supply. VR tube V15 regulates the screen grid voltage for keying tubes V7 and V8. The high degree of regulation employed in the power supply results in extremely stable operation of the Receiver under changes of line voltage or output load conditions.

2. CIRCUIT ANALYSIS

Circuit analysis for the Carrier Telegraph Receiver R-466/UC will be divided into sections of the circuit which accomplish specific individual functions. These functions are combined to produce the overall tone to DC keying function.

a. AMPLIFIER-RECTIFIER CIRCUITS - The

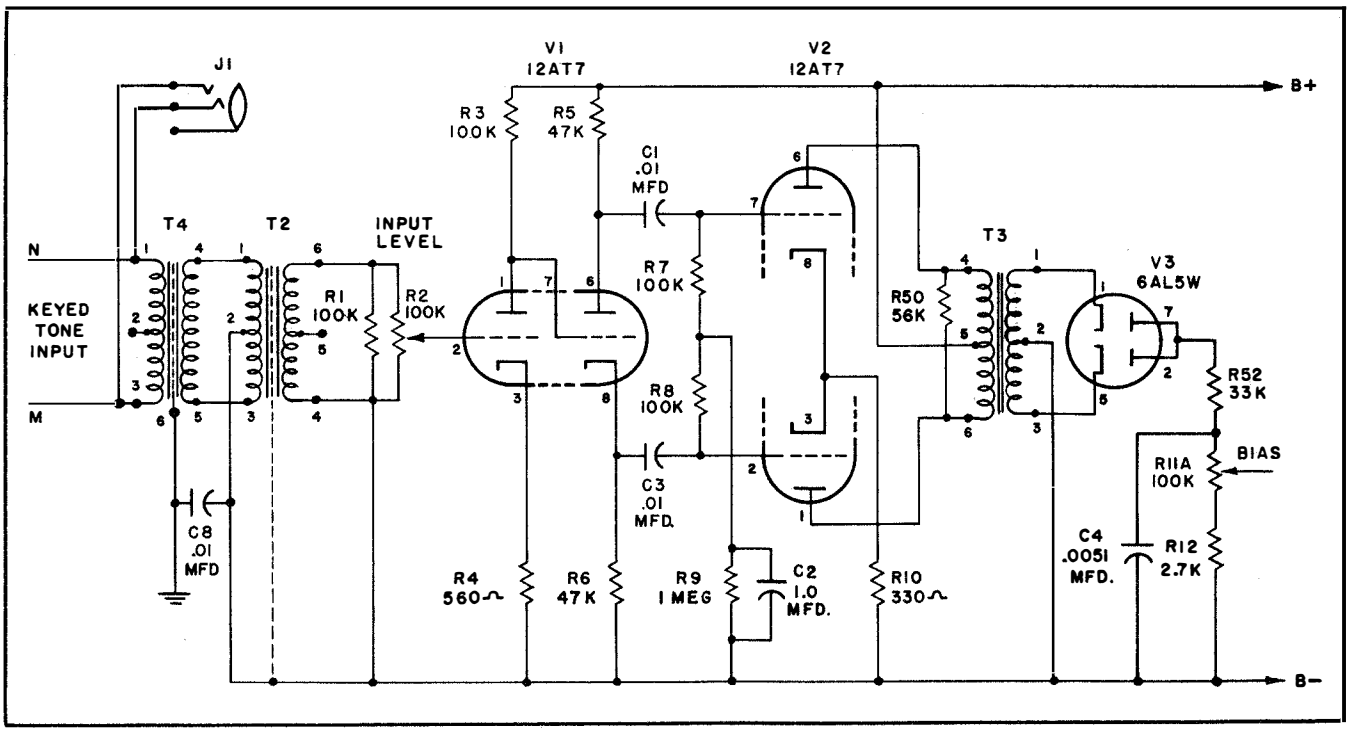


Figure 2-3. Amplifier-Rectifier Circuits

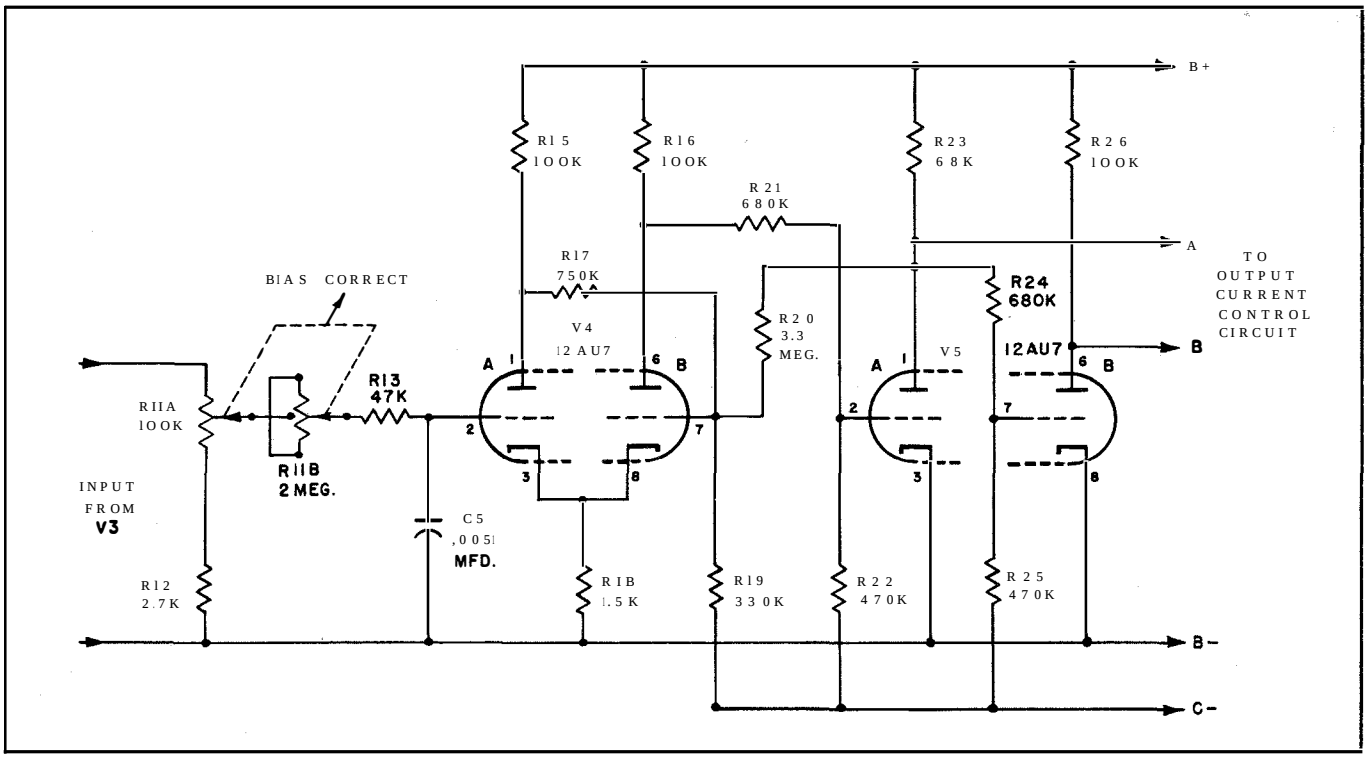


Figure 2-4. Bias Correct and D.C. Squaring Circuits

amplifier-rectifier circuits are illustrated in Figure 2-3. Keyed tone input to the audio amplifier is connected to the primary of line to line transformer T1 which is in turn connected to line to grid transformer T2. The purpose of using transformer T1 is to isolate the grid side of T2 completely from any capacity pick-up from the input line. Such capacity coupling would cause instability in the Receiver under some conditions of operation when both output and input is connected to ground since feedback from output to input could occur through the capacity coupling. It will be noted that the B- line in the Receiver is not grounded and, depending on output ground connection, the B- line is off ground by the output signal potential. Capacitor C8 helps reduce undesired output to input coupling in the Receiver Jack J1 provides a means of connection of a type PL-55 plug for monitoring the input signal with an oscilloscope. Potentiometer R2 is used to set the input level of the Receiver. Resistor R1 is of close tolerance providing a closer impedance match to transformer T2 than the potentiometer tolerance alone would allow. Amplifier tube V1A is one half section of a type 12AT7 tube and utilizes resistor R4 for cathode biasing and resistor R3 for plate loading. The output of V1A is directly coupled from the plate to the grid of phase inverter tube V1B. Cathode resistor R6 and plate load resistor R5 are of the same value and allow push-pull output to be taken from tube V1B. Output from V1B is coupled by means of capacitors C1 and C2 to the grids of tube V2, a 12AT7 dual triode. The center connection of grid resistors R7 and R8 returns to B- through a 1 megohm resistor R9 which is bypassed by a 1 MFD capacitor C3. Cathode resistor R10 furnishes a minimum bias to V2 when no signal is present. When signal level to the grids of V2 exceeds a certain amount, grid current is drawn by V2 causing a negative bias to be developed across R9. Capacitor C3 is charged up by this current and stores the charge so that change in keying speed has little effect on the operation of the circuit. As the signal level to the grids of V2 increases further, a greater biasing voltage is developed across C3. This keeps the output from V2 relatively constant for changing input levels to V2 over a wide (±7.5 DB) variation in input signal level. Output from V2 is transformer coupled to full wave rectifier V3 and the keyed tone signal is converted into a keyed DC signal appearing across bias potentiometer R11A and limiting resistor R12 connected in series. Capacitor C4 supplies some filtering to the rectified signal. Output from bias potentiometer R11A is fed to circuits to amplify and square the signal from rectifier V3. The amplifier-rectifier circuits provide sufficient gain so that tone signal levels of -24 DBM may operate the keyer properly. The frequency response of the amplifier provides uniform operation with tone frequencies of 400 cps to 8000 cps.

b. BIAS CORRECT AND DC SQUARING CIRCUITS - The DC squaring circuits employing

two type 12AU7 tubes V4 and V5 are direct coupled trigger circuits. (See Figure 2-4).

(1) Input to tube V4A is from the BIAS CORRECT dual potentiometer R11 which varies the keyed DC level as well as the amount of filtering on the signal between rectifier V3 and trigger tube V4. Resistor R13 and capacitor C5 provide a minimum of filtering in the circuit. The function of the BIAS CORRECT potentiometer is to vary the relation of the mark to space duration (bias) so that if the signal from V3 has bias distortion, such distortion may be corrected by adjustment of R11. Figure 2-5 illustrates waveforms at the input and output of R11 for various settings. The waveforms of a mark pulse applied to R11A is shown at (A). The output from R11B as applied to V4 is illustrated at (B) for a half way setting of R11. A line illustrating the level of voltage required to trigger V4 is drawn in Figure 2-5 and where this line intersects with the waveform of voltage, a measurement of the mark duration that will be secured from the output of V4 is shown. When the BIAS CORRECT potentiometer is retarded, a waveform of voltage as illustrated at (C) will be secured at the output and the mark duration as secured from V4 is reduced. When the BIAS CORRECT potentiometer is advanced, the mark duration will be lengthened at the output of V4 to the extent indicated at (D). In actual practice, the trigger circuit triggers "off" at a lower potential than the "on" potential and this is not considered in Figure 2-5. In equipment designed to operate over a limited range of keying speeds, the R11B section of the BIAS CORRECT potentiometer would not be required, as a fixed amount of filtering could be established. Operation of the R-466/UC Carrier Telegraph Receiver is designed for keying speeds of 20 cps to 200 cps with bias adjustments of at least ±20%. If a fixed amount of filtering were used between V3 and V4 to provide bias adjustments at 20 cps keying operation, the bias adjustment at 200 cps would be very critical and the amplitude of voltage is reduced to the extent of making proper operation impossible. (See waveform E in Figure 2-5).

(2) Tubes V4 and V5 are direct coupled cascade amplifiers in which positive feedback is secured between V4B and V4A by the common cathode resistor R18. Positive feedback is also secured between amplifier tube V5A and V4B by resistor R20. Initially the circuit is kept in a locked state by the selection of resistor values so that V4A and V5A draw current while V4B and V5B are cut off. If a negative voltage increasing in value is applied to the grid of V4A, the circuit will suddenly trigger at some V4A grid potential, to a second state of operation wherein V4A and V5A are cut off and V4B and V5B are drawing current. The switching transition is very sharp due to the positive feedback. When the negative voltage to the grid of V4A is reduced, a value will be reached at which the trigger circuit suddenly triggers back to its original state. Thus, the input to V4A may have rounded rise and decay times but the output will be a square wave. Output from the squaring circuits is taken from the plates of tube V5 and is in push-pull (output A is 180° out of phase with output B but of equal amplitude).

c. OUTPUT CIRCUITS - The output circuits of the Receiver are illustrated in Figure 2-6. They

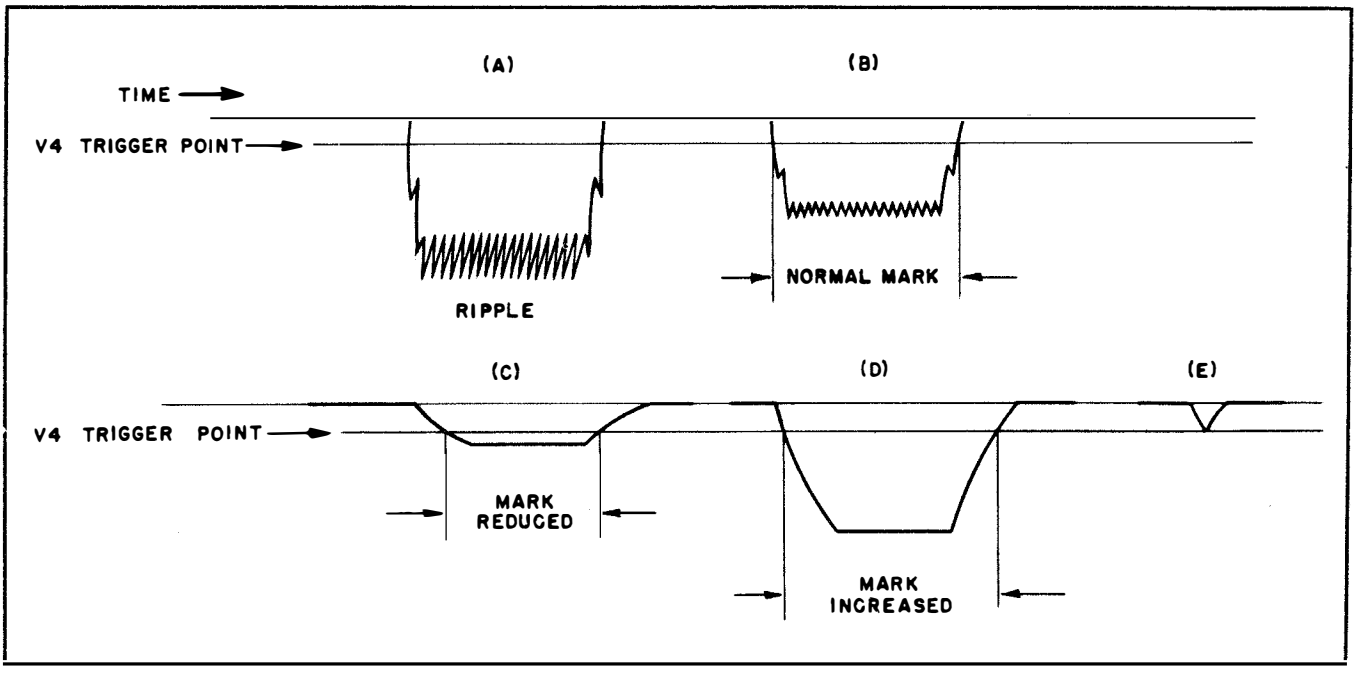


Figure 2-5. Bias Control Functions

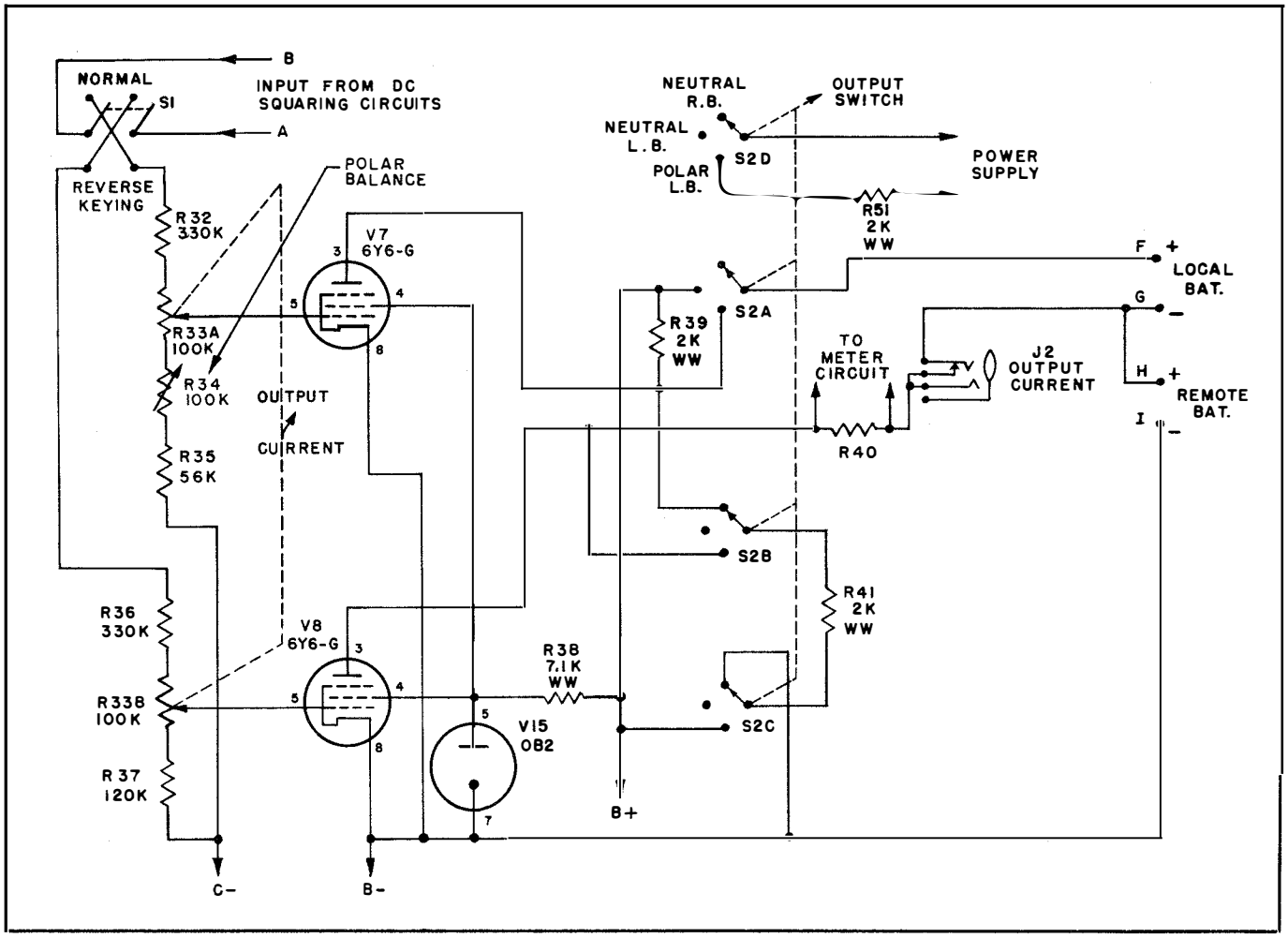


Figure 2-6. Output Circuits

utilize type 6Y6-G beam power tubes V7 and V8 which are keyed by the output of the DC squaring amplifier. OUTPUT CURRENT potentiometer R33 is a dual potentiometer with section A feeding the grid voltage to V7, and section B feeding the grid voltage to tube V8. When one tube is drawing current the other tube is completely cut off. By adjusting potentiometer R33 the maximum current drawn by V7 or V8 during an "on" cycle may be set to any value from under 20 MA to over 120 MA. For balancing out tolerances of circuit resistors and variations in tubes, a variable resistor R35 is incorporated so that the voltage to the grid of V7 may be adjusted independently of the voltage to V8. Thus the plate currents of these tubes (for "on" cycles) may be adjusted to the same values. Variable resistor R35 is labled POLAR BALANCE because it is used primarily for equalizing the polar output currents of the Receiver. The screen grid supply voltage to tubes V7 and V8 is held constant by VR tube V15 so that excessive grid swing is not required to completely cut off V7 or V8. A double pole double throw toggle switch S1 reverses the input to tubes V7 and V8 so that keying may be inverted by throwing this switch. The functions of the OUTPUT SWITCH S2 are best described by observing the Simplified Output Circuits of Figure 2-7. Switch S2 is a three position rotary switch located at the back of the Receiver since it will normally be set at the time the Receiver is installed and need no adjustment until a different type of operation is desired. In the most clockwise position of S2, a neutral remote battery type of operation is secured. Under these conditions tube V8 alone is in the output circuit. See Figure 2-7 (A). The positive pole of the output line connects to the plate of V8 while the negative pole connects to the cathode. Resistors R39 and R41 present a load to the internal B+ supply which is not connected to the output line. Tube V7 is keyed but its output has no significance. Tube V8 acts simply as a keying device in the neutral remote battery line. Figure 2-7(B) illustrates the circuit for the NEUTRAL L. B. position of switch S2. In this case the output line is connected in series with the internal B+ supply and the plate of V8. Tube V8 acts again as a keying device which is open

when the grid of the tube is cut off, and as a resistor in the line which is adjusted to provide the correct line current when the tube is drawing current. Tube V7 is also keyed and its keyed output appears across resistor R39 but serves no useful purpose as far as the output line is concerned. Figure 2-7(C) illustrates the output connections for POLAR L. B. operation. In this case both tubes contribute to the output. When tube V7 is drawing current, output line (a) is negative due to the large voltage drop across resistor R39 while output line (b) is positive (V8 drawing no current). When V8 draws current and V7 is cut off, the potential at (a) and (b) is reversed. Thus, polar output is secured. Tubes V7 and V8 are required to draw 120 MA during their "on" period to supply a 30 MA 120 volt polar output. One section of switch S2 (S2D) connects resistor R51 across the regulator tubes in the power supply during POLAR operation when the maximum current requirements exist. The type 6Y6-G tube used for V7 and V8 will supply this heavy plate current with about 8 watts plate dissipation which is well under its rating of 12 so that it makes a suitable keying tube. Since the entire Receiver is "floating" with respect to ground, any output terminal may be grounded under any conditions of operation. A special type of chassis construction with a small internal chassis connected to B- and not to ground plus a special isolating transformer at the input of the Receiver (described in Section 2-A) provide freedom from output to input feedback effects when grounds are made to output circuits. Resistor R40 in the output circuit line is the meter shunt necessary for making a basic 500-0-500 microammeter read 100-0-100 milliamperes for which the meter is calibrated. A jack J2 is connected in the output circuit and an external meter or printer may be connected by means of a PL-55 plug to this jack for OUTPUT MONITOR purposes.

d. METER CIRCUITS - The meter used on the Receiver measures both output line current and the tone level in the audio amplifier. The schematic of the meter circuits is illustrated in Figure 2-8. The 3-1/2 inch meter M1 has a basic 500-0-500 microampere movement but is calibrated for 100-0-100 milliamperes and -15 DBM to +6 DBM. A DPDT toggle switch S3 connects the meter across the meter shunt resistor R40 in the output line to measure line current or to the output of rectifier V6A to measure signal level of the aufio amplifier. Signal is taken from the plate of V1A in the audio amplifier through capacitor C6. Amplifier tube V6A is one half section of a 12AU7 tube used to step the audio signal level up further and to drive shunt rectifier tube V6B. Output from V6A is coupled to V6B by capacitor C7. Resistor R30 is connected in series with V6B and the meter to provide the correct DBM reading on the meter in relation to the audio level essential for proper operation of the amplifier-rectifier circuits.

e. POWER SUPPLY CIRCUITS - The power supply circuits for the Receiver are illustrated in Figure 2-9. The power supply provides a well regulated B+ voltage at heavy current as well as a regulated C- biasing voltage having small current capabilities. The primary of transformer T1 has two windings which may be connected in parallel for 115 volt operation or in series for 230 volt operation. Terminals are provided on the Receiver terminal board at the rear of the unit for this connection. Rectifier tube V9 provides full wave rectification for the B+ supply.

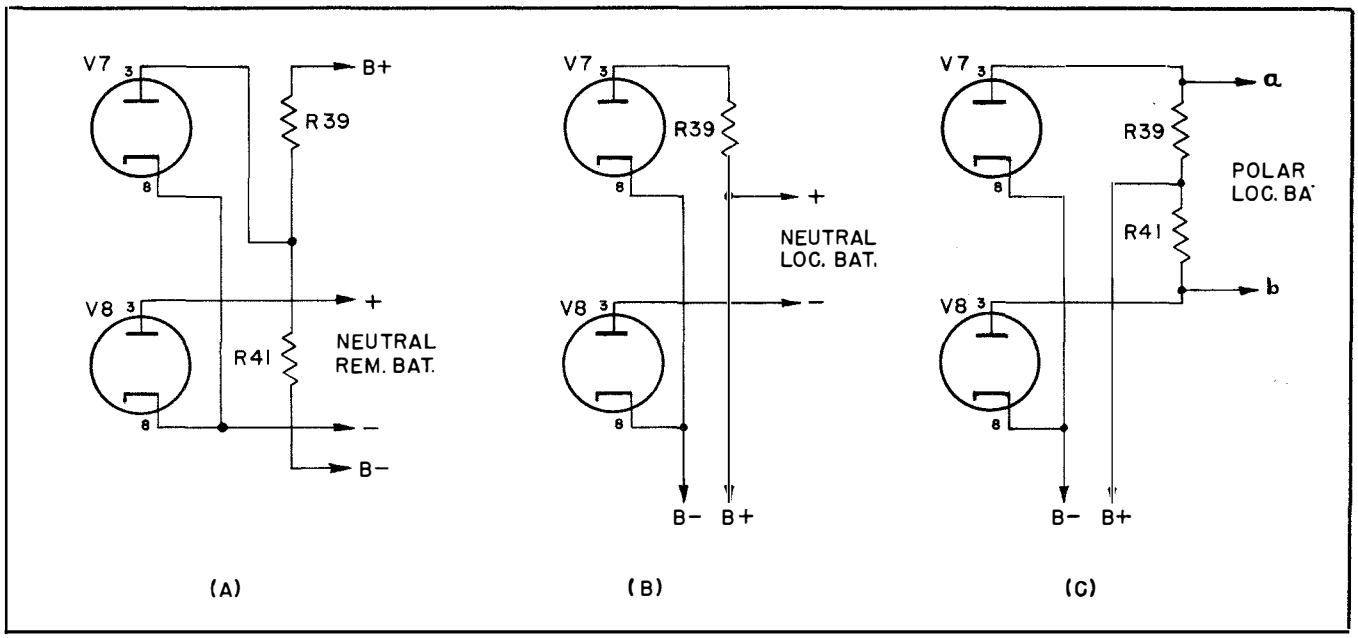


Figure 2-7. Simplified Output Circuits

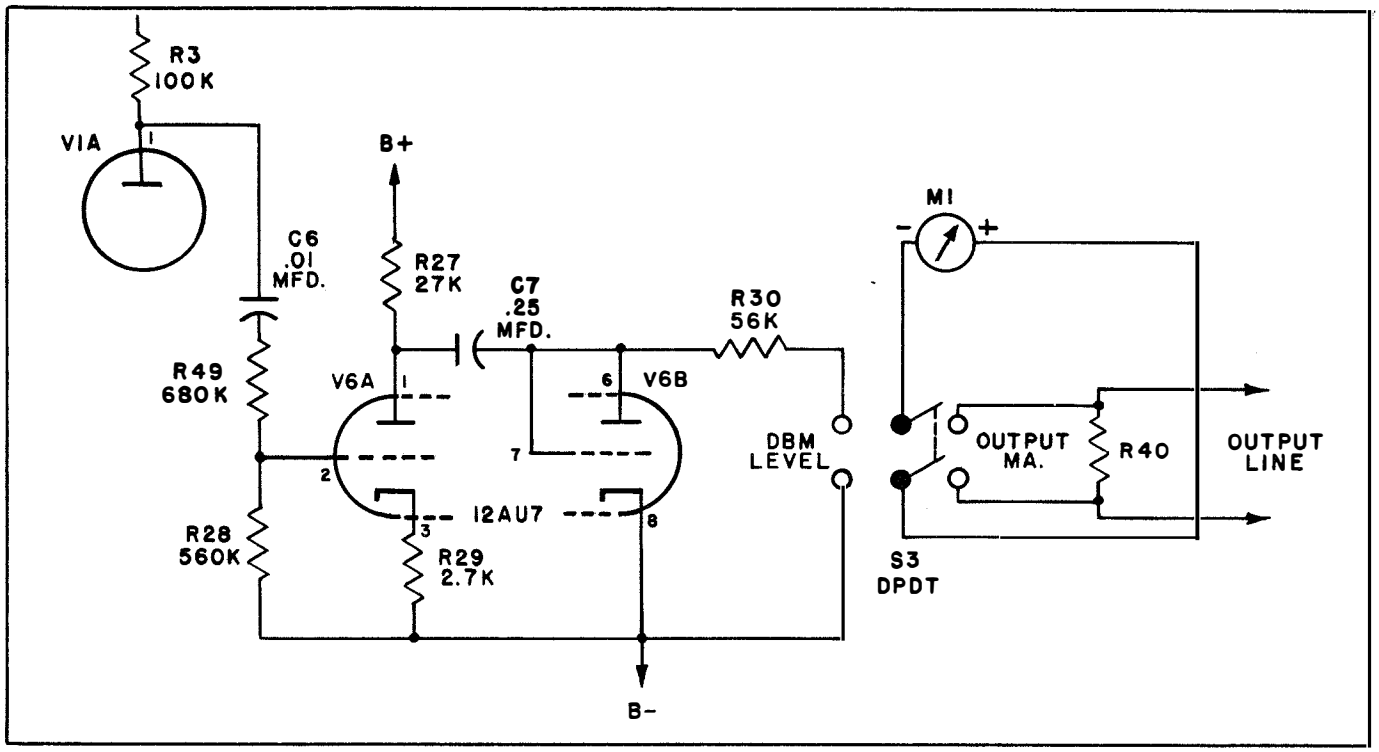


Figure 2-8. Meter Circuits

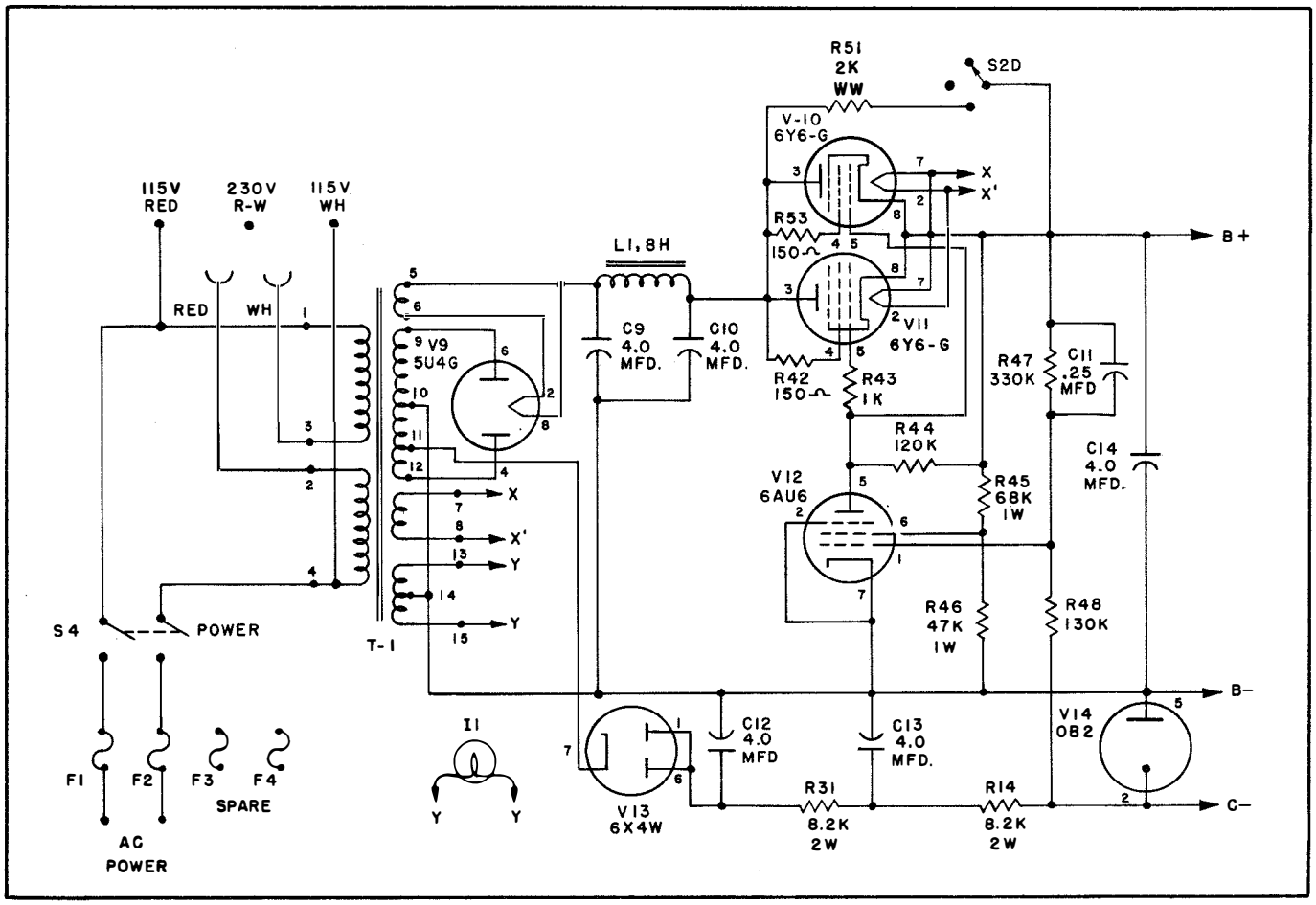


Figure 2-9. Power Supply

Filter capacitors C9 and C10 and inductor L1 supply filtering of the output of V9 before connection to regulator tubes V10 and V11. The regulator circuit employing tubes V10, V11, V12, and V14 is well-known except that in most cases V14 is connected in the cathode circuit of V12. In the Receiver power supply, regulator tube V14 is connected through a filter consisting of C12, C13 and R31, R14 to rectifier tube V13 to secure a regulated negative biasing supply. The cathode of tube V12 is returned directly to ground and bias for V12 is determined by resistors R47 and R48 connected between the B+ supply and the C- supply. If the B+ voltage starts to drop due to additional load, the grid of V12 goes more negative. This causes less voltage drop across plate load resistor R44 resulting in less negative bias on the grids of V10 and V11. The internal resistance of V10 and V11 is thereby reduced causing the B+ voltage at the cathode of V10 and V11 to remain practically constant for load currents varying from a few milliamperes to 160 milliamperes. During high current requirements (polar operstion) an additional resistor R51 is shunted across V10 and V11 to relieve these tubes of full current drain. This does not impair the regulation of the power supply. Capacitor C11 between B+ and the grid of V12 reduces the ripple on the B+ as V12 regulates to reduce ripple as well as to hold the DC B+ voltage constant. Capacitor C14 is used in the power supply to reduce its output impedance at higher frequencies. The regulating action makes it a very low impedance at low frequencies. The power supply operates uniformly over ±10% power line voltage variations.

SECTION 3
INSTALLATION

1. UNPACKING

The steps for unpacking the Receiver, Carrier Telegraph R-466/UC are illustrated in Figure 3-1. After removal of the Receiver from its packing crate, the equipment should be thoroughly inspected for damage.

2. INSTALLATION

The outline drawing for the Receiver, Carrier Telegraph R-466/UC is illustrated in Figure 3-2. The Receiver should be installed using the following procedure:

a. The Receiver is designed for rack mounting and has a standard E size panel. Handles are provided on the front of the panel for placement in the rack. A position in the rack which provides adequate ventilation should be selected. Place the Receiver in the selected position in the rack and insert rack screws to hold in place. Access to the rear of the Receiver is necessary for replacing tubes. A location convenient to a source of AC power and to the input and output lines is desirable.

b. Make up cables to connect power and signal voltages to the equipment and from the equipment to the teletypewriter printer, or equivalent output circuit. Cables carrying AC primary power to the equipment should be adequate to carry a current of two amperes.

c. The Receiver is designed for 115 volt or 230 volt 60 cycle operation and comes connected for 115 volt operation. These connections are located on the terminal board at the rear of the chassis. Connect the two wire leads extending through an opening in the chassis above the terminal board as follows:

(1) For operation on 115 volt AC, connect the red lead to the terminal marked "115 V R" and the white lead to the terminal marked "115 V W". (See Figure 3-3(A)).

(2) For 230 volt operation, connect both the red and white leads to the terminal marked "230 V R-W". (See Figure 3-3(B)).

d. Figure 3-4 illustrates the Receiver output connections. Make output connections to the Receiver terminal board as follows:

(1) For local battery polar operation, connect the output line which is desired to be positive during mark conditions to the +LOC BAT. terminal. Connect the other line to the -LOC BAT. terminal. Polarities will be reversed during space conditions. Set output switch to polar L.B. (See Figure 3-4 (A)).

(2) For local battery neutral operation, connect the output line which is desired to be negative during mark conditions to the -LOC BAT. terminal. Connect the other line to the +LOC BAT. terminal. No potential will exist at the output during space conditions. Set output switch to NEUT. L.B. (See Figure 3-4 (B)).

(3) For remote battery neutral operation, connect the output line which is positive to the +REM. BAT. terminal and the line which is negative to the -REM. BAT. terminal. Set output switch to NEUT. R.B. (See Figure 3-4(C)).

(4) Use shielded output leads from the Receiver if radiation may be troublesome to radio receivers in the vicinity. Ground the shielding to the GND output terminal of the Receiver.

e. In making input wiring to the equipment the following considerations should be observed:

(1) Tone input to the Receiver is normally 600 ohms balanced to ground but one of the tone input terminals may be grounded to provide unbalanced input if desired. In some cases, faulty operation may result when one side of the input line is grounded. In a case such as this, the input leads to the Receiver should be reversed, grounding the other input terminal.

(2) Input lines should be shielded if there is much chance of noise, pick-up by the leads, or if there is noise radiation from the leads.

3. INITIAL ADJUSTMENTS

After the Receiver, Carrier Telegraph R-466/UC has been installed and wired, it should be put into operation and checked. Adjustments

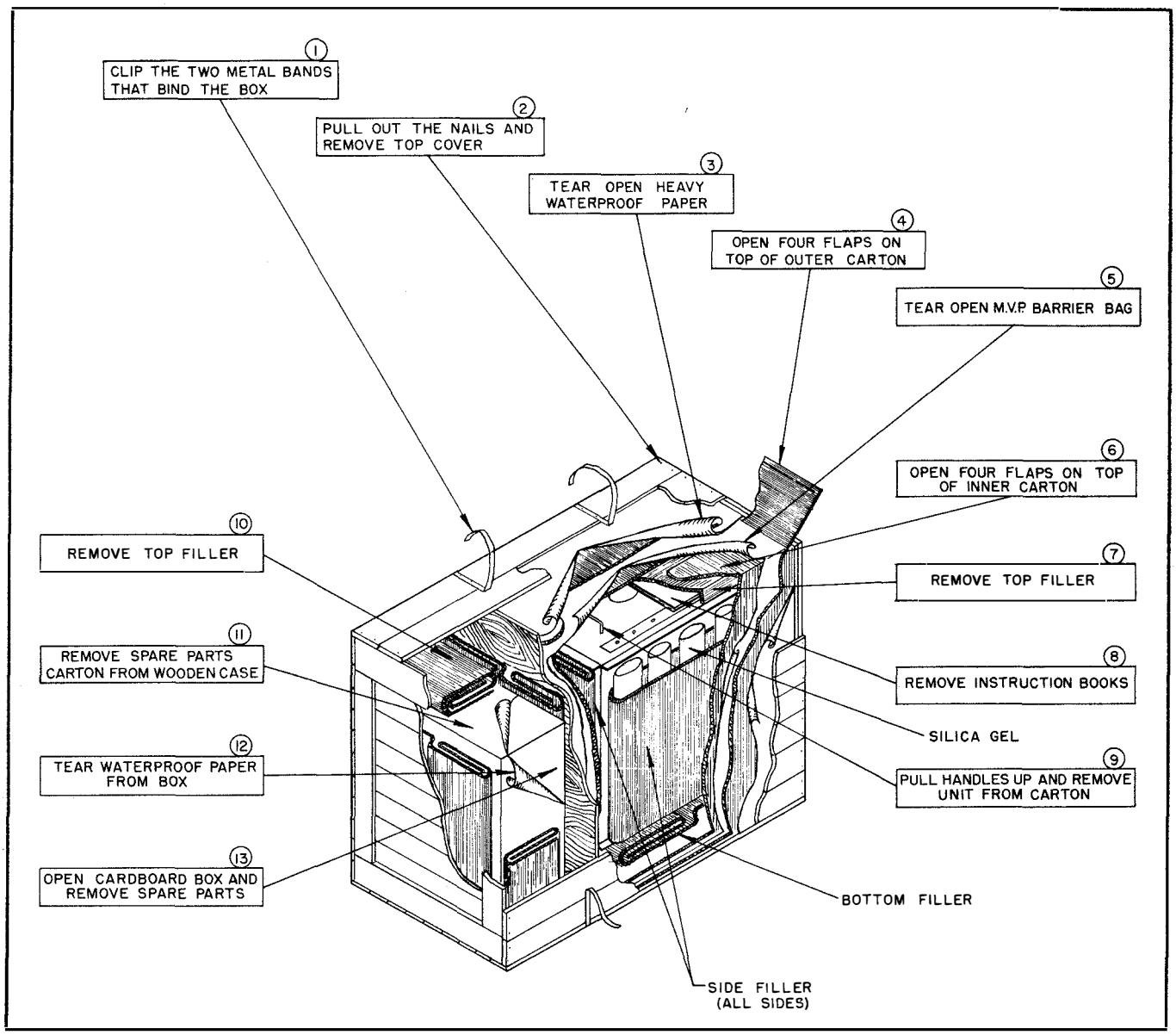


Figure 3-1. Receiver, Carrier Telegraph R-466/UC, Unpacking Procedure

should be made only if checks indicate such a need.

a. Initial Check - make an initial check on the Receiver as follows:

(1) Turn the POWER switch to ON. The pilot light should light immediately. Turn the equipment off.

b. Operational Check and Adjustments - an operational check should be performed on the Receiver after installation to make sure the equipment is properly adjusted for operation.

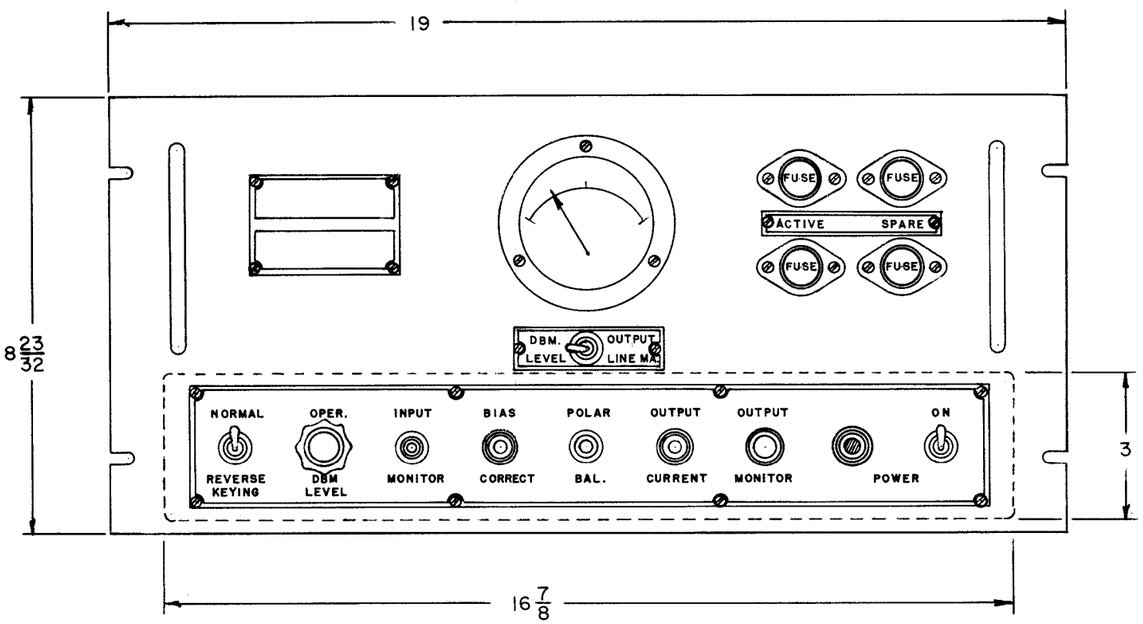
(1) Check that the polarity of the output circuit connections of the Receiver is correct for the printer or other output circuit used.

(2) Set the OUTPUT switch for the required type of output operation (Neutral Remote Battery, Neutral Local Battery, or Polar Local Battery).

(3) Set the toggle switch with NORMAL - REVERSE designations to NORMAL unless an output with reverse keying is required or if the input keying is reverse and normal output keying is desired.

(4) Turn the Receiver POWER switch to ON and allow a five minute warm-up period.

(5) Apply a steady tone signal to the input of the Receiver. Set the meter switch to DBM LEVEL and adjust the OPER. DBM LEVEL control so that the needle of the meter is at 0 DBM. If the input line level is too low to secure a read-



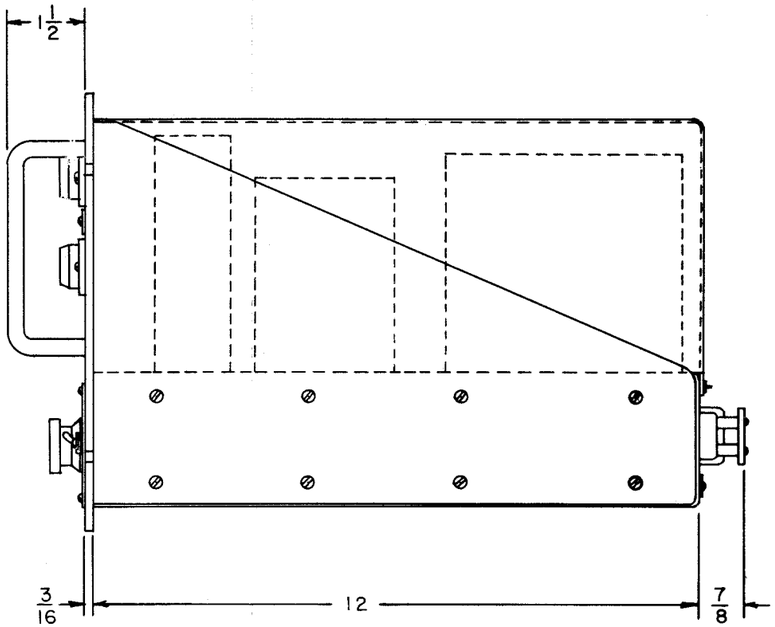


Figure 3-2. Receiver, Carrier Telegraph R-466/UC, Outline Drawing

ing of 0 DBM, the level at the transmitting end should be increased.

(6) Set the meter switch to OUTPUT CURRENT and rotate the OUTPUT CURRENT control until the desired output current is secured. A steady tone input must be used for this setting.

NOTE

Under some conditions with the BIAS CORRECT control in the extreme counterclockwise position, there may be no output from the Receiver even though the meter indicates a signal at the input. If the meter does not indicate an output, set the BIAS CORRECT control at the center of its range.

(7) Key the input tone using a teletype or telegraph signal and check the output signal by the operation of a teletypewriter printer or other device.

(8) Correct for bias distortion by adjusting the BIAS CORRECT control of the Receiver. The teletypewriter printer or bias measuring equipment may be used at the output of the Receiver for indicating when zero bias is obtained.

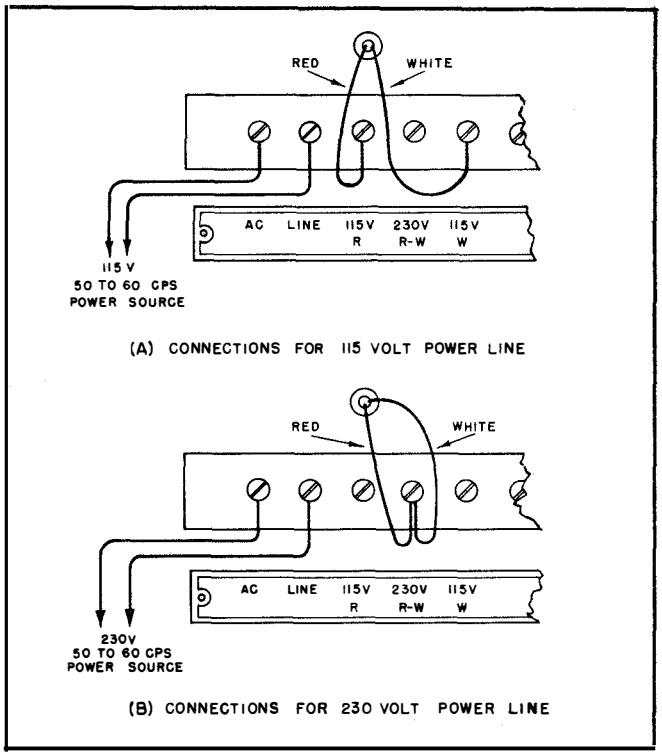


Figure 3-3. Receiver, Carrier Telegraph R-466/UC, A.C. Power Line Connections

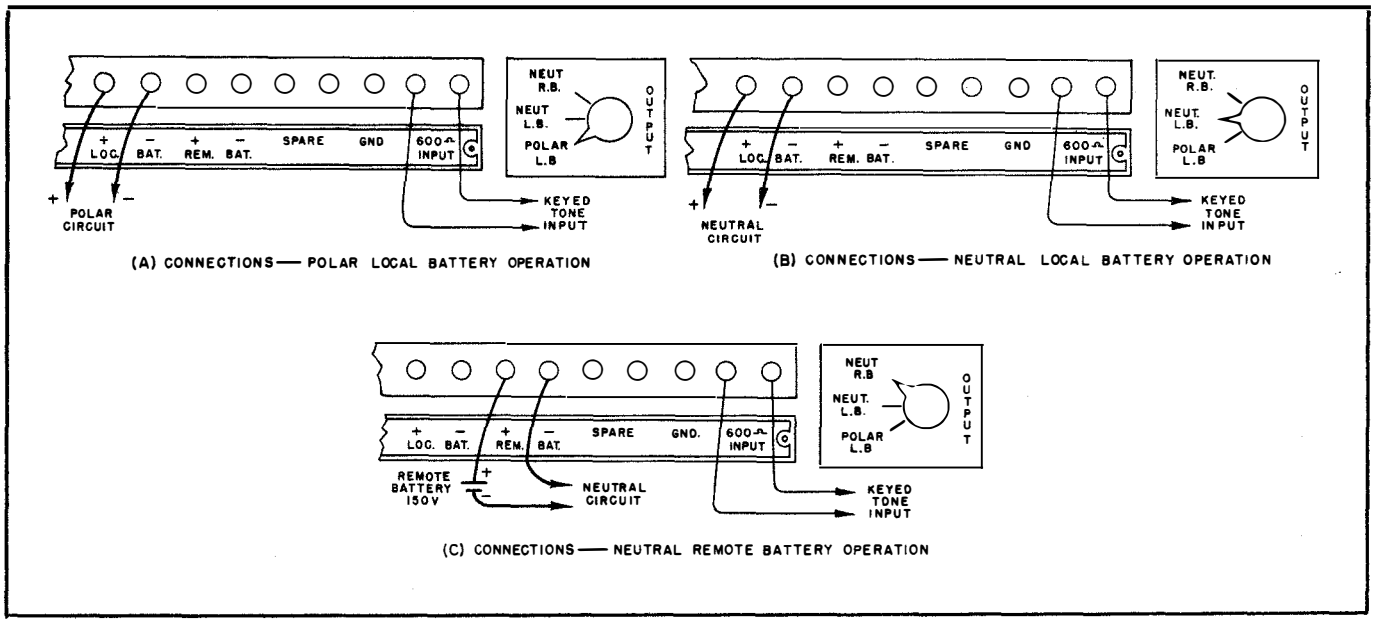


Figure 3-4. Receiver, Carrier Telegraph R-466/UC, Output Connections

SECTION 4
OPERATION

1. INTRODUCTION

The Receiver, Carrier Telegraph R-466/UC should seldom require attention from the operator after the equipment is installed, checked and adjusted as outlined in Section 3-3. While the adjustments of the Receiver are very important to secure optimum performance, it should not be necessary for the operator to readjust the equipment unless another signal input circuit is connected to the Receiver, or unless bias distortion of the input signal changes. A large change (more than ±10 DBM) in input level may necessitate readjustment.

2. CAPABILITIES AND LIMITATIONS

a. The Receiver is capable of accepting keyed tone signals of any frequency in the range from 400 to 8000 cycles per second. Optimum operation of the Receiver is secured using the highest possible tone frequency since fortuitous distortion (or jitter) is greatly reduced as the tone frequency is increased. Unless the use of filters in the line necessitate the use of a frequency at the low end of the range, use as high a tone frequency to the Receiver as the telegraph line will tolerate.

b. The Receiver is designed to accept input level variations of ±7.5 DBM when initially adjusted for any level in the range of -24 DBM to +10 DBM. Bias distortion caused by line level variations will generally be less than ±2%, being somewhat higher for keying speeds above 240 wpm. and lower for reduced keying speeds. Keying speeds of 600 wpm. are readily handled by the Receiver when the tone frequency is in the upper end of the range.

c. During keyed operation of the Receiver, the DBM meter reading will be less than that for a steady tone. In general, the DBM meter reading

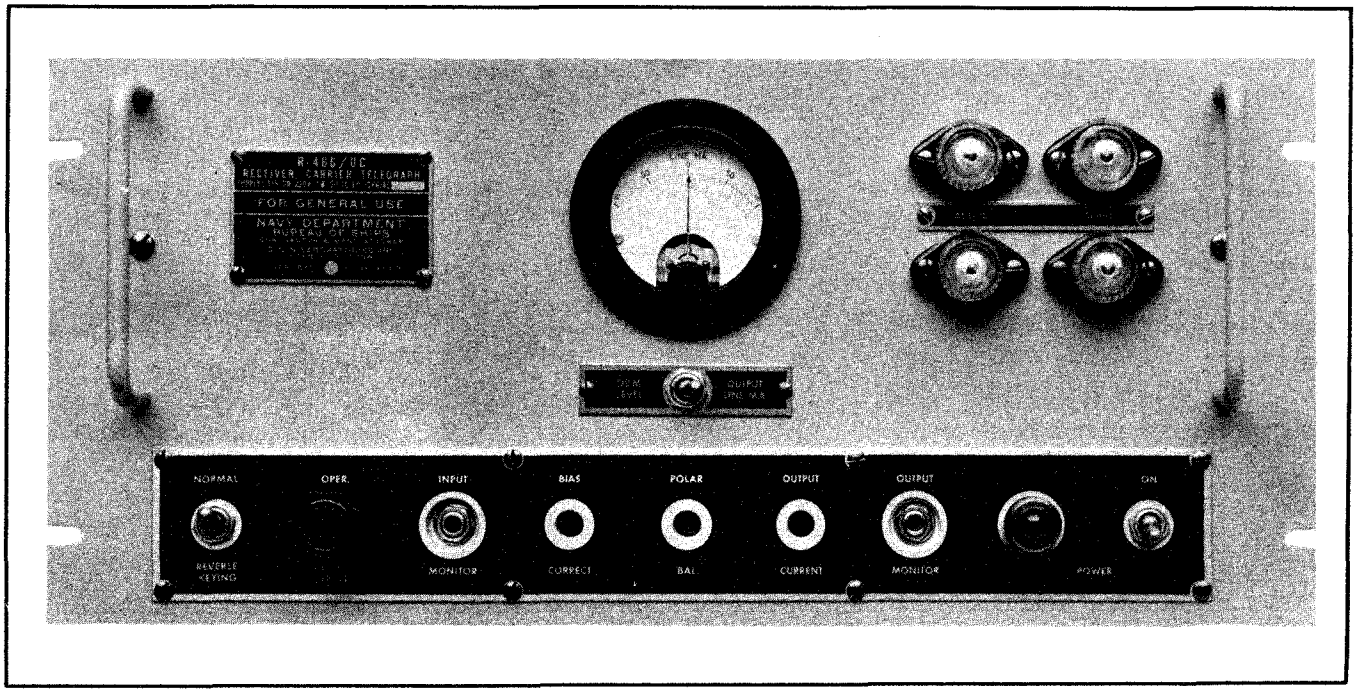


Figure 4-1. Receiver, Carrier Telegraph R-466/UC, Panel Controls

should not fall below -15 DBM with keying. The normal adjustment point is 0 DBM for a steady tone or about -4 DBM with a keyed tone signal.

d. Since the Receiver employs a compression type of limiter, optimum operation on teletypewriter signals is secured with normal input keying (tone on for stop period).

e. Bias distortions in the input signal to the Receiver may be corrected to zero at the Receiver output by adjustment of the BIAS CORRECT control providing the initial distortion does not exceed ±20%.

f. Output currents for neutral operation may readily be adjusted for values of greater than 60 MA to less than 20 MA by means of the OUTPUT CURRENT control. Inability to secure an output current of 60 MA on neutral remote battery operation may be due to insufficient remote battery supply voltage. For polar operation, 30 MA is the maximum current which should be taken from the Receiver. Inability to secure proper output current could be caused by weak tubes or excessively low line voltages. A slight increase in line current may occur during a long steady state condition if output tubes are slightly gassy. (See NOTE 1 at end of section)

g. The Receiver is designed for continuous operation and may be powered continuously unless there is a long interval (a day or more) when there will be no signals applied to the Receiver input. Power line variations of ±10% produce no appreciable change in operating performance.

3. OPERATIONS OF EACH FUNCTION

The Receiver is intended to transform an on-off tone telegraph signal into a corresponding direct current signal for the operation of a teletypewriter printer or similar equipment. The Receiver can key a polar telegraph loop or a neutral telegraph loop. It will be assumed that the Receiver has been connected and checked as outline in Section 3. Figure 4-1 illustrates Panel Controls.

a. Operation of a Polar Local Battery Telegraph Loop.

(1) Set the OUTPUT switch at the rear of the chassis to POLAR L.B. (local battery).

(2) Turn the POWER switch to ON. Allow five minutes for warmup of the equipment.

(3) Set the REVERSE KEYING switch to NORMAL if input and output keying are desired to be alike, or to REVERSE if input and output keying are desired to be reversed.

(4) Turn the METER switch to DBM LEVEL.

(5) Apply a steady tone signal to the Receiver and adjust the OPER. DBM LEVEL control so that the meter reading is 0 DBM. If a steady tone is not available the control should be set so the meter reads -4 DBM on a keyed tone.

(6) Turn the METER switch to OUTPUT LINE MA. and adjust the OUTPUT CURRENT control until the meter indicates 30 on the MA scale. A steady tone input is required for this adjustment.

(7) Check the output current on space by removing signal to the Receiver. The output line current should be the same as for mark conditions except that the meter needle will swing in the reverse direction. If the reading is not the same as for space, adjust the POLAR BAL. control until a reading of 30 MA is secured during space conditions. Check reading on mark again and readjust OUTPUT CURRENT and POLAR BAL. controls again if necessary to secure identical output currents for mark and space conditions. Once the POLAR BAL. control is adjusted to equalize output current, further adjustment of the control should not be necessary unless tube characteristics change or a tube is replaced. A gassy keying tube may cause the output current to increase slightly during steady state condition.

NOTE: When the REVERSE KEYING switch is thrown from NORMAL to REVERSE, the output current as indicated by the meter will reverse. If there is a slight difference in reading, no faulty adjustment is indicated. A large difference in reading indicates considerable unbalance in output keying tubes.

(8) Key the telegraph signal applied to the Receiver and check operation of the teletypewriter printer or equipment connected at the output of the Receiver.

(9) Check bias distortion at the Receiver output. This may be done with bias measuring equipment connected to the Receiver output or by any low impedance (1000 ohms or less) test device connected to the OUTPUT MONITOR jack on the front panel of the Receiver. If no bias measuring equipment is available, apply a signal containing reversals to the Receiver input.

(10) Set the BIAS CORRECT control to secure zero bias at the Receiver output. If reversals are connected to the Receiver input, adjust the BIAS CORRECT control to secure a reading of zero current on the meter with the meter switch in the OUTPUT LINE MA position. This indicates zero bias distortion at the output of the Receiver only if reversals are connected to the Receiver input.

(11) Check operation with normal traffic messages at the Receiver input. Operation of

the teletypewriter printer or output equipment should be normal. If any difficulty exists, check the quality of the input signal using an oscilloscope (similar to the OS-8/U) connected to the INPUT MONITOR Jack.

b. Operation of a Neutral Local Battery Telegraph Loop.

(1) Set the OUTPUT switch at the rear of the chassis to NEUTRAL L.B.

(2) Perform steps 2, 3, 4, and 5 as outlined in Section 4-3a.

(3) Turn the meter switch to OUTPUT LINE MA and adjust the OUTPUT CURRENT control until the meter indicates the desired neutral current.

(4) Connect bias distortion measuring equipment to the OUTPUT MONITOR jack. This must be a low impedance device (1000 ohms or less).

(5) Supply a keyed signal to the input of the Receiver and adjust the BIAS CORRECT control to secure minimum bias distortion.

(6) Check operation with normal traffic messages at the Receiver input. If operation is not normal, check the quality of the input signal using an oscilloscope (similar to the OS-8/U) connected to the INPUT MONITOR JACK.

c. Operation of a Neutral Remote Battery Telegraph Loop.

(1) Follow the same steps as outlined in Section 4-3b except that the OUTPUT switch at the rear of the Receiver must be set to NEUTRAL R.B.

(2) Increase the remote battery supply voltage if it is impossible to secure 60 MA current on the output line.

4. SUMMARY OF OPERATION

a. Set OUTPUT switch at rear of chassis to secure the output desired.

b. Turn POWER switch to ON. Allow five minutes warm-up.

c. Set REVERSE KEYING switch to NORMAL if output keying is desired to be the same as input keying, or to REVERSE if reverse keying is desired.

d. Turn METER switch to DMB LEVEL and adjust the OPER. DBM LEVEL control for a meter reading of 0 DBM on a steady tone or -4 DBM on a keyed tone.

e. Set METER switch to OUTPUT CURRENT and adjust OUTPUT CURRENT control for desired output (30 MA or less on polar, 60 MA or less on neutral). A steady tone input is required for this adjustment.

f. For polar operation remove tone input to the Receiver and adjust the POLAR BALANCE control for the same current as in step e.

g. Adjust BIAS CORRECT control for minimum bias distortion at output.

h. Turn the POWER switch of the Receiver down to remove power from the unit.

NOTE 1

In the event that type 6Y6-G keying tubes are not available, as a temporary measure, tubes V7 and V8 may be replaced with type 6L6-G tubes, in which case tube V15 must be removed from its socket.

SECTION 5
OPERATOR'S MAINTENANCE

1. ROUTINE CHECK CHART

Table 5-1 illustrates routine checks which should be made on the Receiver daily. Such checks will assure that the Receiver is in optimum adjustment. They will also disclose the quality of the signals applied to the Receiver and delivered from the Receiver.

TABLE 5-1. ROUTINE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS
Signal at input to Receiver	Connect oscilloscope with low frequency sweep, similar to the OS-8/U, to INPUT MONITOR jack on front panel.	Wave at input should be clean (no noise and no signal during space periods).
Signal at output of Receiver	Connect distortion measuring device (under 1000 ohm impedance) to OUTPUT MONITOR jack on front panel.	Output signals should have minimum bias distortion. Correct with BIAS CORRECT control adjustment.
Input level	Set METER switch to DBM level.	Level should be 0 DBM as indicated by meter. Correct by setting OPER. DBM LEVEL knob for -4 DBM reading during keyed operation or 0 DBM for steady mark.
Output current	Set METER switch to OUTPUT LINE MA.	Output current with steady input tone should be 20 MA to 60 MA for neutral circuits or 30 MA for polar circuits. Adjust for desired current.

2. EMERGENCY MAINTENANCE

a. Notice to Operators:

Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

b. Replacement of Fuses and Tubes.

(1) Replacement of Fuses

WARNING

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 unless the cause has been corrected.

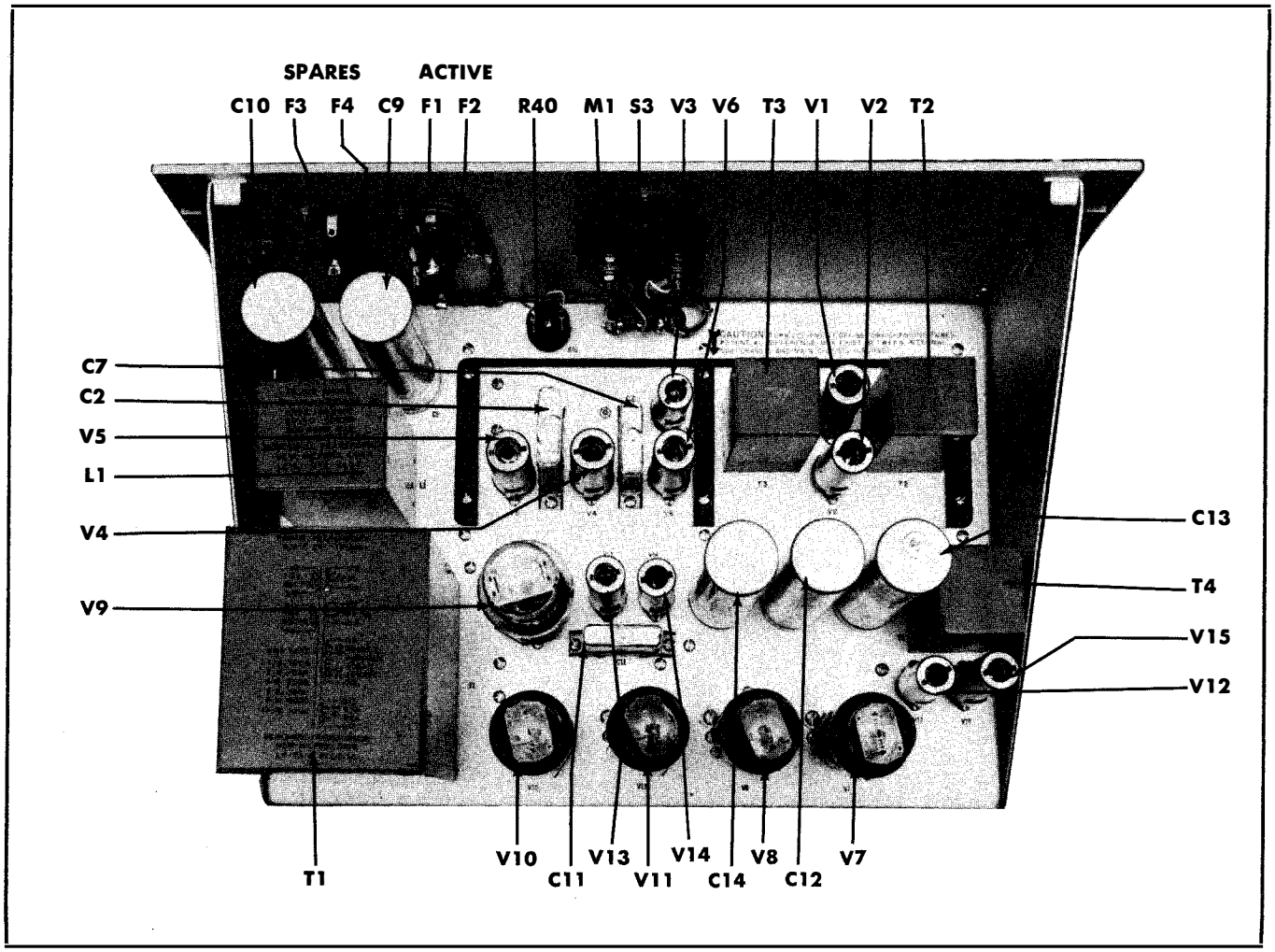


Figure 5-1. Receiver, Carrier Telegraph R-466/UC, Tube Locations

(a) Fuse failure in the Receiver, Carrier Telegraph R-466/UC would normally be indicated by failure of the indicator light to be on when the POWER switch is turned on. Vacuum tubes in the Receiver would not be lighted. The two ACTIVE fuses on the panel cf the Receiver should be checked in this event. Two SPARE fuses are located directly beside the active fuses on the Receiver panel.

(2) Replacement of Tubes

The location of all tubes is indicated in Figure 5-1. Tubes may be checked visually to see if they are lighted. All electron tubes in the Receiver are accessible from the rear of the rack after the dust cover is removed. The dust cover may be removed by turning the Dzus fasteners at the rear of the cover counterclockwise and pulling the cover away from the panel. Tubes may be tested in any standard tube tester for quality.

WARNING

No tube replacements should be attempted with the power ON. The small internal chassis of the Receiver may be hot with respect to the main chassis depending on output grounding. If tubes are removed from the Receiver for testing, they should not all be removed at one time and replaced indiscriminately. Remove, test and replace one tube at a time in its respective socket. Changing type JAN 6Y6G tubes may necessitate slight readjustment to the OUTPUT CURRENT CONTROL.

SECTION 6
PREVENTIVE MAINTENANCE

1. ROUTINE MAINTENANCE CHECK CHART

Table 6-1 illustrates checks which should be made at intervals as indicated. There are no lubrications or mechanical parts to check in the equipment.

NOTE

The attention of maintenance personnel is invited to the requirements of Chapter 67 of the Bureau of Ships Manual of the latest issue.

TABLE 6-1. ROUTINE MAINTENANCE CHECK CHART

WHAT TO CHECK	WHEN TO CHECK	HOW TO CHECK	PRECAUTIONS
Signal at input to Receiver	Daily	Connect oscilloscope with low frequency sweep, similar to the OS-8/U, to INPUT MONITOR jack on front panel.	Wave at input should be clean (no noise and no signal during space periods).
Signal at output of Receiver	Daily	Connect distortion measuring device (under 1000 ohms impedance) to OUTPUT MONITOR jack on front panel.	Output signals ahould have minimum bias distortion. Correct with BIAS CORRECT control adjustment.
Input Level	Daily	Set METER switch to DBM level.	Level should be 0 DBM as indicated by meter. Correct by setting OPER. DBM LEVEL knob for -4 DBM reading during keyed operation or 0 DBM for steady mark.
Output Current	Daily	Set METER switch to OUTPUT LINE MA	Output current with steady input tone should be 20 MA to 60 MA for neutral circuits or 30 MA for polar circuits. Adjust for desired current.
Tubes	Semi-annually	Check one at a time in tube tester.	Replace tubes in smae sockets from which removed. Check adjustment of controls if new tubes are put into the Receiver.

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803 in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronics Officer.

U. S. NAVY
ELECTRONIC
FAILURE REPORT
NAVSHIPS 383 (REV. 4-49)

NOTICE: 1. Read instructions interleaved in this pad prior to preparing report.
2. Report all failures (Electronic, electrical, and mechanical).
3. Use separate sheet to report each part failure.

REPORT—SHIPS-84

REPORT NO. _____

DATE OF FAILURE _____

EQUIPMENT INSTALLED IN (*Number and name of ship or station*) | REPAIRS MADE BY (*Number and name of ship, yard, tender, etc.*) | LEAVE BLANK | REPAIRED BY (*Name and rate of person*)

SERVICE USING EQUIPMENT (*Check one*)
1 ☐ NAVY 2 ☐ USCG 3 ☐ USMC
4 ☐ ARMY 5 ☐ AIR FORCE

TYPE ACTIVITY USING EQUIPMENT (*Check one*)
1 ☐ SHIP 2 ☐ SHORE 3 ☐ AMPHIBIOUS
4 ☐ AIR-BORNE 5 ☐ OTHER _____ (*Specify*)

EQUIPMENT CATEGORY (*Check one*)
1 ☐ RADIO 2 ☐ RADAR 3 ☐ SONAR 4 ☐ TEST
5 ☐ ORDNANCE 6 ☐ NANCY AND RADIAC 8 ☐ POWER 9 OTHER (*Specify*)

NAME PLATE DATA — EQUIPMENT

MODEL DESIGNATION	SERIAL NO.	NAME OF CONTRACTOR	MAJOR UNIT INVOLVED — TYPE NO. AND NAME
LEAVE BLANK	CONTRACT NO.	DATE INSTALLED	SERIAL NO.

PART FAILURE DATA (*Check one*) ☐ TUBE ☐ OTHER

COMPLETE TUBE TYPE, OR NAME AND NAVY-TYPE NO. OF PART	STANDARD NAVY STOCK NO. (*See note 10*)	SYMBOL DESIGNATION (*V-101, R-201, etc.*)	FAILED IN (*Check one*)
			1 ☐ OPERATION 2 ☐ FAULTY PACKAGING 3 ☐ HANDLING 4 ☐ OTHER (*Specify*)

APPROXIMATE LIFE (*Hours*)	LEAVE BLANK	MANUFACTURER'S NAME	SERIAL NO. OF TUBE OR PART	ARMY STOCK NO. (*USMC only*)	MFRS' DATA (*See note 13*)

CHECK TYPE OF FAILURE

002 ☐ AIRLEAK
007 ☐ ARCING
070 ☐ BROKEN
014 ☐ BROKEN BASE
015 ☐ BROKEN GLASS
080 ☐ BURNED OUT
130 ☐ CHANGE OF VALUE
170 ☐ CORRODED
190 ☐ CRACKED
330 ☐ EXCESSIVE HUM
001 ☐ GASSY
016 ☐ GLASS STRAIN
300 ☐ GROUNDED
310 ☐ HANDLING IMPROPER
320 ☐ HIGH VOLTAGE BREAK-DOWN
340 ☐ INSTALLED IMPROPERLY
350 ☐ INSULATION BREAK-DOWN
360 ☐ INTERMITTENT OPERATION
380 ☐ LEAKAGE
013 ☐ LOOSE BASE
012 ☐ LOOSE ELEMENTS
004 ☐ LOW EMISSION
040 ☐ MECHANICAL BINDING
225 ☐ MFR'S DEFECT
009 ☐ MICROPHONIC
008 ☐ NOISY
022 ☐ NO OSCILLATION
440 ☐ OLD AGE (*Specify in remarks*)
450 ☐ OPEN
003 ☐ OPEN FILAMENT
460 ☐ OPEN PRIMARY
470 ☐ OPEN SECONDARY
480 ☐ OVERHEATED
021 ☐ OVERLOADED
010 ☐ POOR FOCUS
540 ☐ PUNCTURED
011 ☐ SCREEN DEFECTS
005 ☐ SHORTED INTERMITTENT
006 ☐ SHORTED PERMANENT
600 ☐ SHORTED TO CASE
610 ☐ SHORTED TO FRAME
620 ☐ SHORTED TO PRIMARY
630 ☐ SHORTED TO SECONDARY
020 ☐ UNSTABLE OPERATION
☐ OTHER (*Specify in remarks*)

REMARKS: INCLUDE CAUSE OF FAILURE AND SUGGESTED CHANGES (*Continue remarks on reverse side*)

LEAVE BLANK

GPO 16—58703-1

Figure 7-1. Failure Report, Sample Form

SECTION 7
CORRECTIVE MAINTENANCE

1. SYSTEM TROUBLE SHOOTING

Each Receiver, Carrier Telegraph R-466/UC has its own power supply and works as a complete separate unit in the rack. For this reason the system trouble shooting that may be involved will be in regard to an individual receiver and its input and output circuits.

a. Input Circuits - If there is no output when the Receiver is properly adjusted and powered for operation, there may be a defect in the input line or in the equipment supplying input signals to the Receiver. The input signal to the Receiver should be checked with an oscilloscope. If there is suitable input signal to the Receiver, inability to make proper adjustments as outlined in Section 3 indicates a defective unit.

b. Output Circuits - If there is input signal to the Receiver, the teletypewriter printer to which the Receiver is connected should be printing. If it does not print, make the following checks:

(1) Check that the OUTPUT SWITCH is properly set. Check remote battery source if used and that the output wiring is properly connected. (See Section 3).

(2) Check that the teletypewriter printer is in operating condition.

(3) Check the signal at the output of the Receiver with an oscilloscope. If no signal is found here, the Receiver is defective.

2. UNIT TROUBLE SHOOTING AND REPAIR

a. Trouble Shooting - Trouble shooting in the Receiver will generally fall into two classifications: static checks which are made with a voltmeter or ohmeter and require no input signal, and dynamic checks of signal which are made with an oscilloscope connected to critical points in the circuit and entail supplying a signal to the input. Generally, static checks are made first to indicate presence of voltage in the unit. In any event, testing and replacement of tubes should be done first as outlined in Section 5-2b since this may be accomplished without removing the Receiver from the rack. Static and dynamic checks will necessitate removing the Receiver from the rack and placement on a bench for test.

(1) Trouble Shooting Chart - A chart showing symptoms of trouble and circuits to check is illustrated in Table 7-1. This chart requires dynamic testing in some cases using an oscilloscope connected to indicated points and a keyed signal fed to the unit. The Schematic Diagram, Figure 7-3 includes typical waveforms to be seen at indicated points. Before using the trouble chart, B+ voltage (240 V) across capacitor C14 and C- voltage (105 V) across VR tube V14 should be checked.

(2) Circuit Constants

(a) All circuit components mentioned in Table 7-1 are illustrated in Figures 5-1 and 7-2 which show the location of parts above the chassis and the location of parts below the chassis. All parts shown on the Schematic Diagram, Figure 7-3, may be found in either Figures 5-1 or 7-2.

(b) All tube pin connections at which measurements are made by means of an oscilloscope, voltmeter, or ohmeter are illustrated in Table 7-2, Voltage and Resistance Chart. The values of voltage and resistance tabulated in Table 7-2 are nominal and may vary within 5%. All measurements are from socket pin to B- (not main chassis) and are made with a 20,000 ohm per volt meter using the appropriate scale for the reading taken. See Section 7-2b on making measurements with instruments.

b. Repair

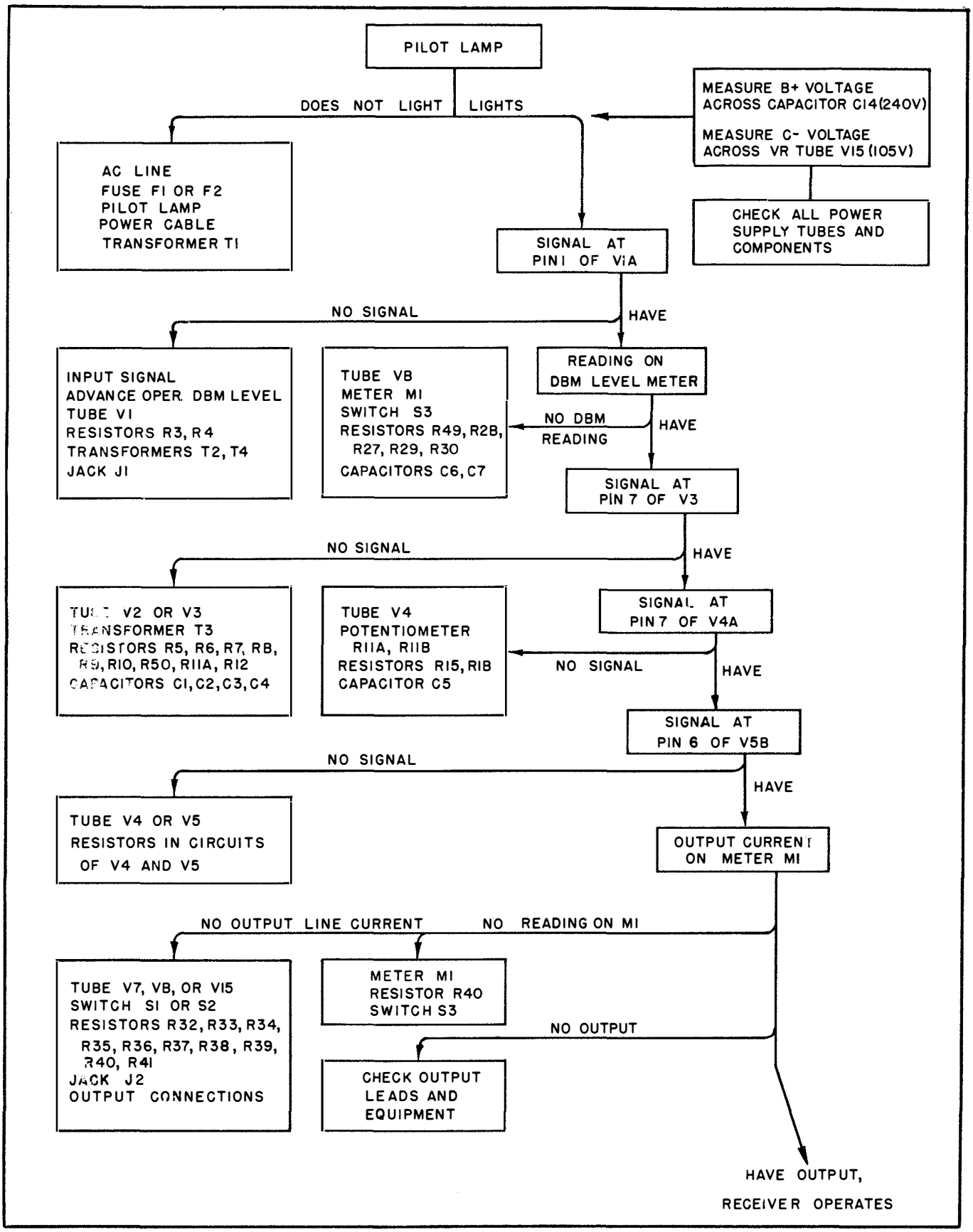
(1) Electrical Adjustments

(a) Inability to secure proper readings as outlined in Section 3 when making adjustments may be resolved by using the following procedures:

DBM LEVEL - Check and set level of input signal to be in the range of -24 DBM to +10 DBM. Check all circuits of tubes V1 and V6 for voltages. Check meter.

OUTPUT CURRENT - Turn BIAS CORRECT adjustment clockwise. Check output load to have proper resistance (approximately 4000

TABLE 7-1. TROUBLE SHOOTING CHART



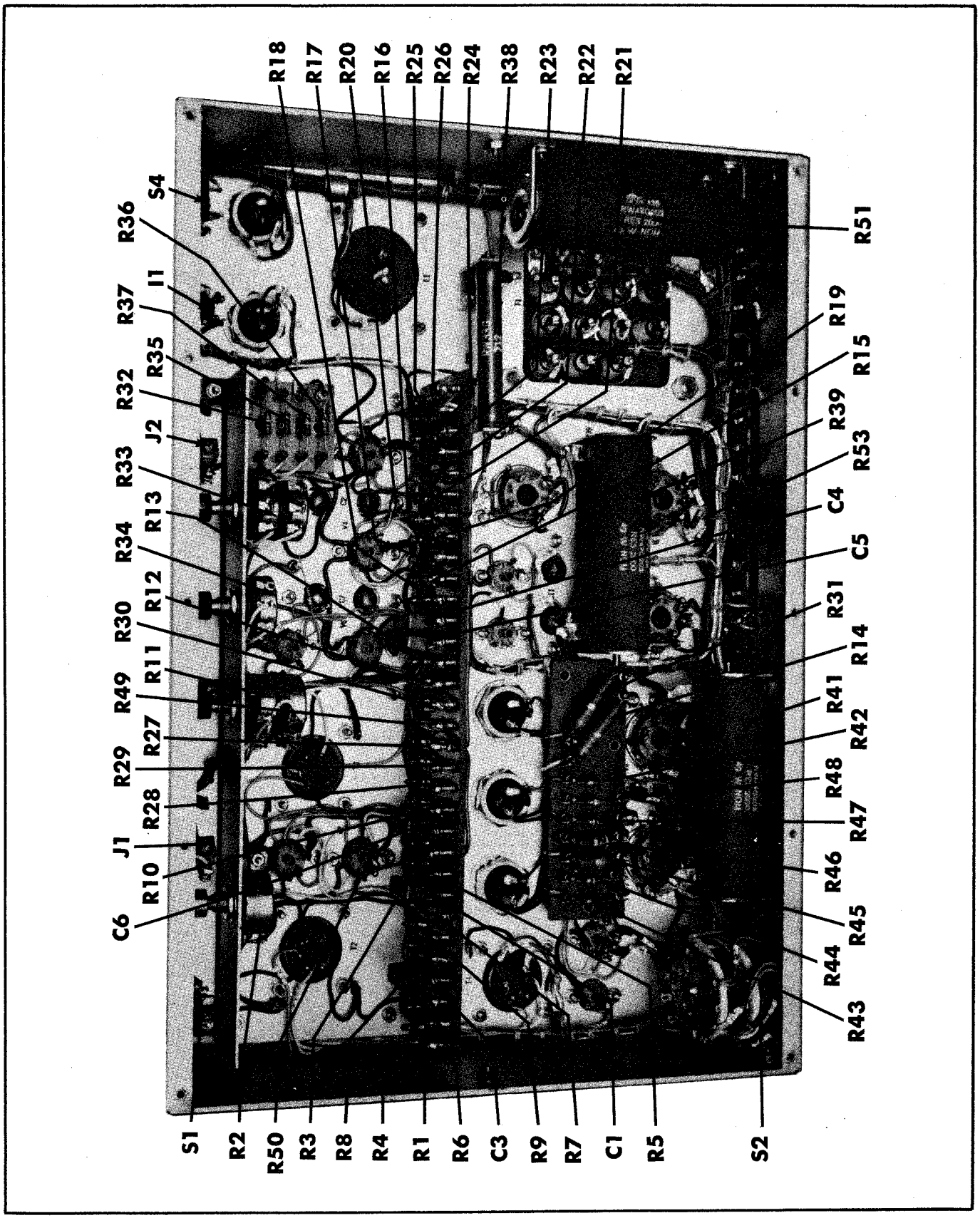
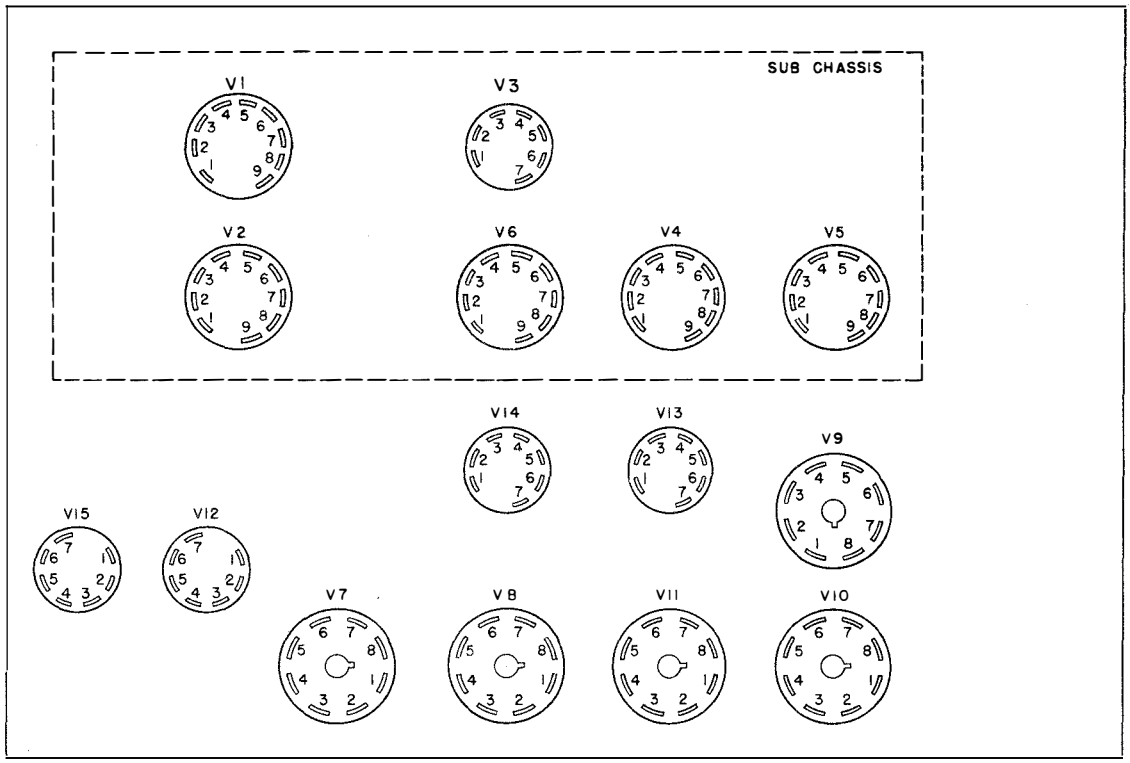


Figure 7-2. Receiver, Carrier Telegraph R-466/UC, Part Locations Below the Chassis

TABLE 7-2. VOLTAGE AND RESISTANCE CHART

TUBE LAYOUT



(BOTTOM VIEW)

TABLE 7-2 VOLTAGE AND RESISTANCE CHART

TUBE	PIN 1		PIN 2		PIN 3		PIN 4		PIN 5		PIN 6		PIN 7		PIN 8		PIN 9		TUBE TYPE
	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	
V1	75	220K	0	***4K	0	560~	*3.2	.1~	*3.2	.1~	175	160K	75	220K	82	4.7K	*3.2	1~	12AT7
V2	260	115K	0	1.1M	3.8	330~	*3.2	.1~	*3.2	.1~	260	115K	0	1.1 M	3.8	330--	*3.2	1~	12AT7
V3	0	210~	-.5	150K	*3.2	.1~	*3.2	.1~	0	210~	0	∞	-.5	150K	—	—	—	—	6AL5
V4	75	210K	-.1	200K	2.5	1.5K	*3.2	.1~	*3.2	.1~	215	200K	-34	400K	25	1.5K	*3.2	.1~	12AU7
V5	75	180K	.5	470K	0	0	*3.2	.1~	*3.2	.1~	195	220K	-23	470K	0	0	*3.2	.1~	12AU7
V6	180	150K	0	580K	7.8	2.7K	*3.2	.1~	*3.2	.1~	-.8	56K	-.8	56K	0	0	*3.2	.1~	12AU7
V7	0	∞	*3.2	.1~	92	120K	105	127K	-38	320K	0	∞	*3.2	.1~	0	0	—	—	6Y6-G
V8	0	∞	*3.2	.1~	92	120K	105	127K	-2.2	320K	0	∞	*3.2	1~	0	0	—	—	6Y6-G
V9	0	∞	0	120K	0	∞	**425	80~	0		**425	80~	0	∞	420	120K	—	—	5U4G
V10	0	∞	*32	.1~	400	120K	400	125K	235	310K	0	∞	*3.2	115K	260	115K	—	—	6Y6-G
V11	0	∞	*3.2	.1~	400	120K	400	125K	235	310K	0	∞	*3.2	115K	260	115K	—	—	6Y6-G
V12	-4	280K	0	0	*3.2	.1~	*3.2	.1~	235	240K	105	47K	0	0	—	—	—	—	6AU6
V13	-260	230K	0	∞	*3.2	.1~	*3.2	.1~	0		-260	230K	***205	37~	—	—	—	—	6X4W
V14	0	0	-105	250K	0	∞	-105	250K	0	0	0	∞	-105	250K	—	—	—	—	OB2
V15	105	120K	0	0	0	∞	0	0	105	120K	0	∞	0	0	—	—	—	—	OB2

NOTES —

1. MEASUREMENTS MADE WITH V.T.V.M. WITH NO SIGNAL AT INPUT
2. NORMAL REVERSE SWITCH S1 SET TO NORMAL
3. OUTPUT SWITCH S2 SET TO "POLAR LOCAL BATTERY"
4. METER SWITCH S3 SET TO "DBM LEVEL"
5. ALL MEASUREMENTS MADE TO INTERNAL CHASSIS GROUND
6. * AC VOLTAGE
7. ** MEASUREMENT MADE TO C.T. (TERM NO.10) OF POWER TRANSFORMER
8. *** R2 SET TO MAXIMUM
9. K = X 1000
10. M = X 1,000,000

ohms for polar operation or 2000 ohms to 6000 ohms for 20 MA to 60 MA neutral operation). Check and increase remote battery supply if necessary to secure proper current on remote battery operation. Check voltages in Receiver. Check all tubes. Check dual potentiometer R33.

POLAR BALANCE - Check tubes V7 and V8. Check voltages in Receiver. Check variable resistor R34.

BIAS CORRECT - Check tube V3. Check dual potentiometer R11A. Check all voltages in Receiver.

(b) In making voltage checks on the Receiver, a voltmeter having at least 20,000 ohms per volt should be used. The common (usually negative) lead of the voltmeter should be connected to the B- line. The internal chassis in the Receiver, on which the miniature tubes are mounted, is connected to B-. Do not make any tests with test equipment connected to the main chassis (ground). During bench work on the Receiver, it is recommended that a dummy load resistor be connected to the output of the Receiver and the output terminals left ungrounded. A 2000 ohm, 20 watt resistor would be suitable for neutral output, or a 4000 ohm, 20 watt resistor for polar output.

WARNING

If any of the output terminals of the Receiver are grounded, a dangerous potential may exist between the small internal chassis of the Receiver (B-) and the main chassis. Caution must be exercised not to touch anything connected to the B- line if one of the output terminals is grounded.

In making dynamic tests on the Receiver, an oscilloscope having low frequency sweeps (such as the OS-8/U) should be used. The ground of the oscilloscope should be connected to the B- of the Receiver and the vertical input of the oscilloscope connected to test points as indicated in Table 7-1.

In lieu of a keyed signal at the input, an audio oscillator set at 1000 cps. may be connected to the INPUT TERMINALS of the Receiver to supply a steady tone. Test keying may be accomplished by manual means.

(2) Mechanical Adjustments - There are no mechanical devices in the Receiver which require adjustment. Mechanical replacement of parts is readily accomplished. In replacing more complicated parts such as the OUTPUT switch S2, the Wiring Diagram, Figure 7-5, should be closely followed in rewiring the replacement part.

(3) Component Characteristics - Electron tube currents and voltages as operated in the Receiver are illustrated in Table 7-3. Table 7-4 lists the tube characteristics for tubes used in the Receiver.

(4) Drawings -

(a) Schematic Diagram - The Schematic Diagram of the Receiver is illustrated in Figure 7-3.

(b) Wiring Diagram - The Wiring Diagram of the Receiver is illustrated in Figure 7-4. Routing of all wires to various parts in the equipment is illustrated.

TABLE 7-3. TUBE OPERATING VOLTAGES AND CURRENTS

TUBE TYPE	FUNCTION	PLATE (E)		PLATE (MA)		SCREEN		CATHODE (E)		GRID (E)		HEATER (E)
		A	B	A	B	(E)	(MA)	A	B	A	B	AC
12AT7 V1	Audio Amplifier	75	175	1.7	1.8			0	82	0	75	6.3
12AT7 V2	Limiter-Amplifier	260	260	5	5			3.8	3.8	0	0	6.3
6AL5 V3	Full Wave Rectifier	-.5	-.5	0	0			0	0			6.3
12AU7 V4	Trigger	75	215	1.8	0			2.5	2.5	-.1	-34	6.3
12AU7 V5	Audio Amplifier Inverter	75	195	2.4	0			0	0	.5	-23	6.3
12AU7 V6	Audio Amplifier Half Wave Rectifier	180	-.8	3.0	0			7.8	0	0	-.8	6.3
6Y6G V7	Output	92		120		105	8.5	0		-38		6.3
6Y6G V8	Output	92		0		105	0	0		-2.2		6.3
5U4G V9	Full Wave Rectifier	425		167 MA (B+)								5.0
6Y6G V10	Voltage Regulator	400		53		400	3.0	260		235		6.3
6Y6G V11	Voltage Regulator	400		54		400	3.3	260		235		6.3
6AU6 V12	Voltage Regulator	235		2		105	.05	0		-4		6.3
6X4W V13	Half Wave Rectifier	-260		10.5				205				6.3
OB2 V14	Voltage Regulator	0		7.6				-105				
OB2 V15	Voltage Regulator	105		14.0				0				

NOTE

CONTROL SETTINGS ARE THE SAME
AS INDICATED FOR TABLE 7--2

TABLE 7-4. TUBE CHARACTERISTICS

TUBE TYPE	FILAMENT VOLTAGE (V)	FILAMENT CURRENT (V)	PLATE VOLTAGE (V)	GRID BIAS (V)	SCREEN VOLTAGE (V)	PLATE CURRENT (MA)	SCREEN CURRENT (MA)	AC PLATE RESISTANCE (OHMS)	VOLTAGE AMPLIFICATION FACTOR (MU)	TRANSCONDUCTANCE (MICROMHOS)		EMISSION	
										NORMAL	MINIMUM	IS (MA)	TEST VOLT
12AU7 Each Sect.	*6.3	* .3	250	-8.5		10.5		7700	17	2200	1750	70	30
12AT7 Each Sect.	*6.3	* .3	250	0		10.5		10900	60	5500	4500	50	10
6AL5 Each Sect.	6.3	.3	165 AC			12.5						40	10
6AU6 Each Sect.	6.3	.3	250	-1	150	10.8	4.3	6900	36	5200	4150	60	20
6Y6G	6.3	1.25	200	-14	135	61	2.2			7100	5800	180	30
6X4W	6.3	.6	400 AC			210						140	50
5U4G	5.0	3.0	500 AC			750 Max.						225	75
OB2			108			17.5							

*Filaments Wired in Parallel

NOTE

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

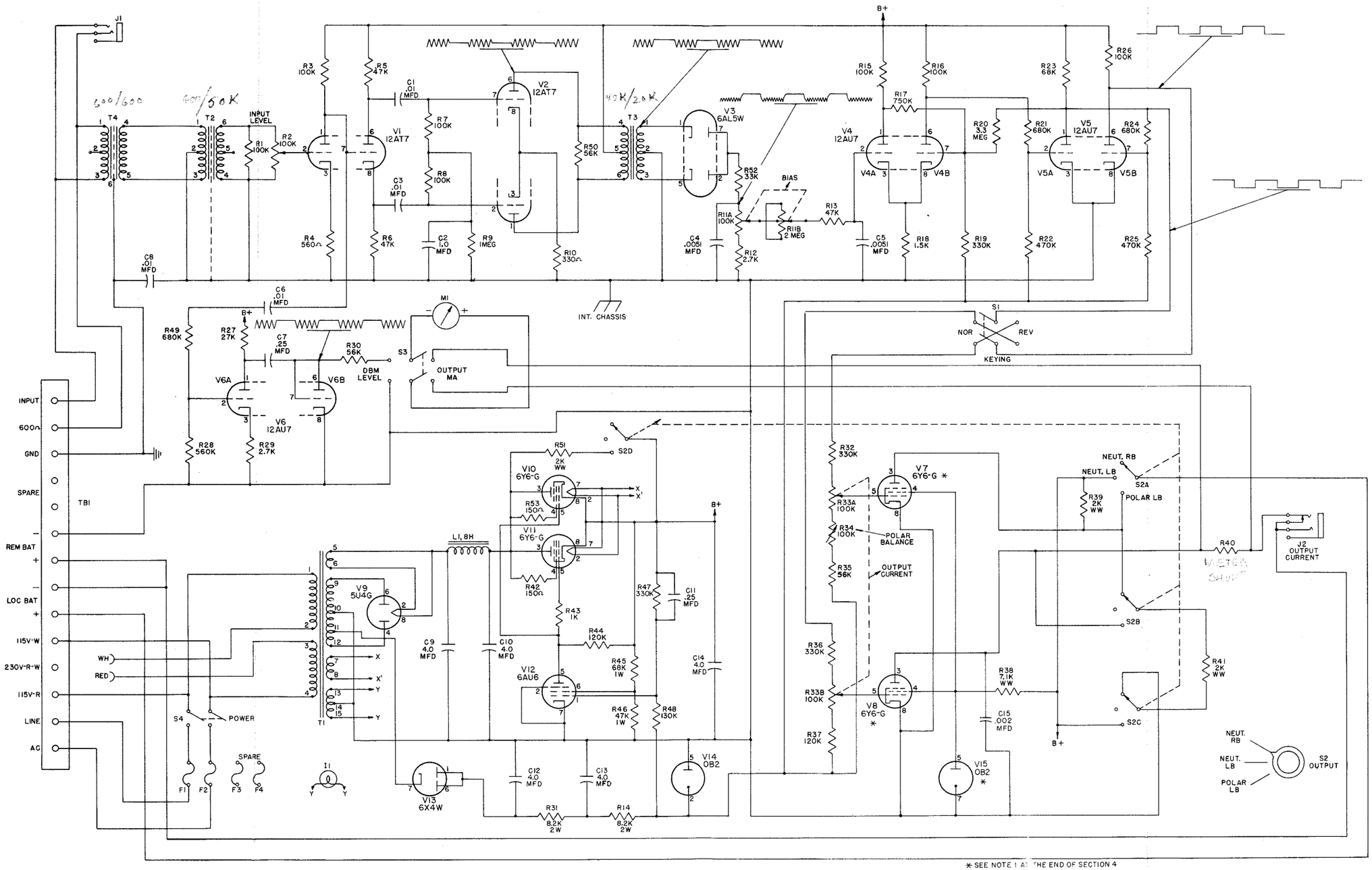


Figure 7-3. Receiver, Carrier Telegraph R-466/UC, Schematic Diagram

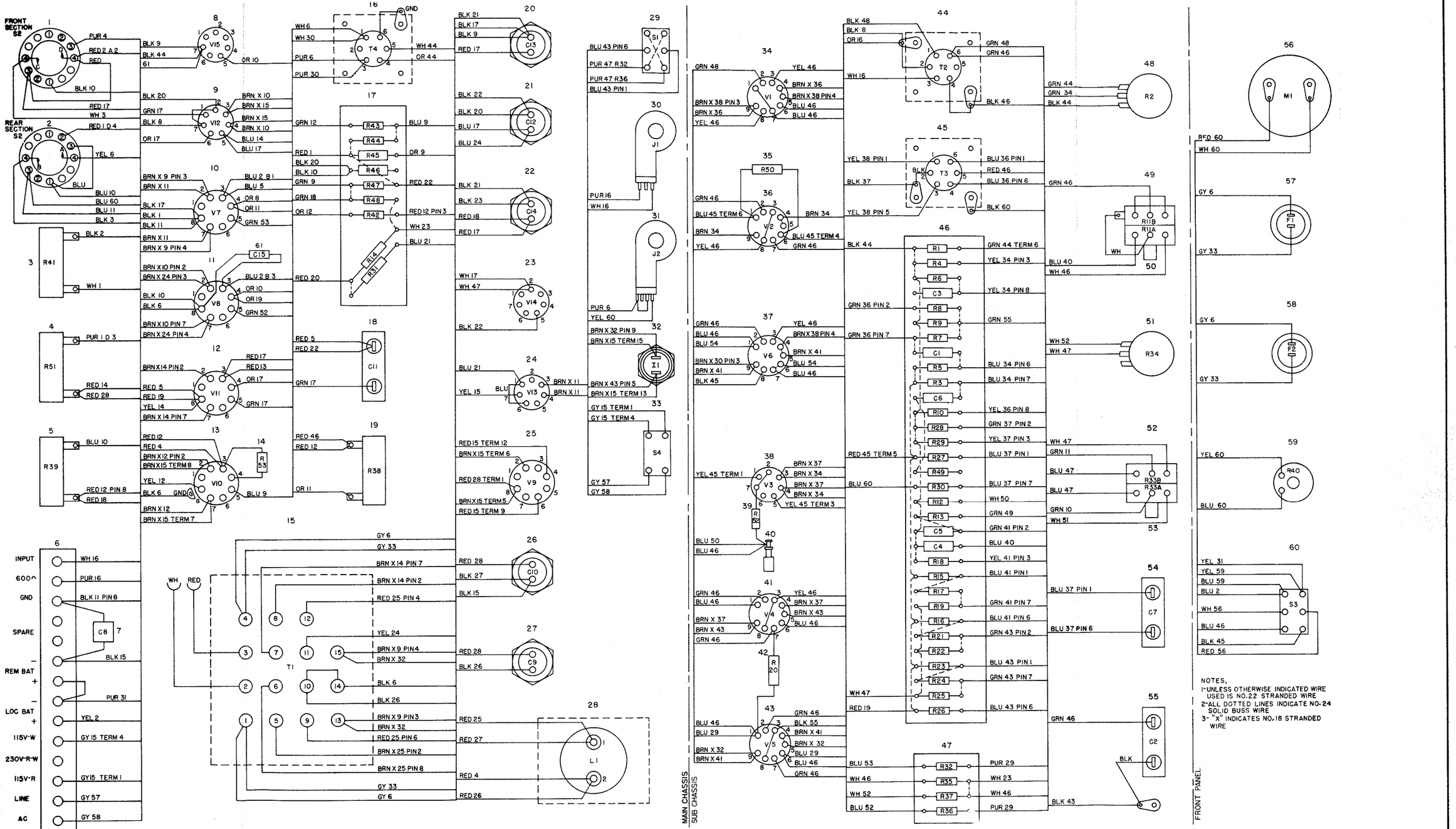


Figure 7-4. Receiver, Carrier Telegraph R-466/UC, Wiring Diagram

SECTION 8
PARTS LIST

TABLE 8-1. WEIGHTS AND DIMENSIONS OF SPARE BOXES

EQUIPMENT SPARES					
SPARE PARTS CARTON	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	HEIGHT	WIDTH	DEPTH		
1	8	12	8	.44	24

TABLE 8-2. SHIPPING WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

EQUIPMENT SPARES						
SHIPPING BOX NO.	SPARE PARTS BOX	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
		HEIGHT	WIDTH	DEPTH		
	packed with equipment					

TABLE 8-3. TABLE OF REPLACEABLE PARTS

REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CON-TRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
C1	N16-C-53448-1650	Capacitor, Fixed: JAN type, Spec. JAN-C-5; 53/64'' lg; 53/64'' wide; 11/32'' thick; mounts by terminals	V1B-V2A coupling	CM35C103K	Sangamo #C-06110		C1,C3, C6,C8
C2	N16-C-48841-9611	Capacitor, Fixed: JAN type, Spec. JAN-C-25; 1 3/4'' lg; 41/64'' wide; 2 1/2'' high; 2 .156'' mtg. slots on 2 1/8'' mtg/c	V2 grid	CP69B1FF105V	Cornell-Dubilier*		C2
C3		Same as C1	V1B-V2B coupling				
C4	N16-C-32720-7533	Capacitor, Fixed: JAN type, Spec. JAN-C-5; 53/64'' lg; 53/64'' wide; 11/32'' thick; mounts by terminals	V3 bypass	CM35C512J	Sangamo #C-1251		C4,C5
C5		Same as C4	V4A bypass				
C6		Same as C1	V1A-V6A coupling				
C7	N16-C-46371-9886	Capacitor, Fixed: JAN type, Spec. JAN-C-25; 1 3/4'' lg; 41/64'' wide; 1 1/2'' high; 2 .156'' mtg. slots on 2 1/8'' mtg/c	V6A-V6B coupling	CP69B1FF254V	Cornell-Dubilier*		C7,C11
C8		Same as C1	B- bypass to ground				
C9	N16-C-49981-9991	Capacitor, Fixed: JAN type, Spec. JAN-C-25; 4 1/2'' lg; 1 1/2'' dia; mounts by bushing 1/2'' lg, 3/4''-16	B+ input filter	CP41B1FF405V	Cornell-Dubilier*		C9,C10 C12,C13 C14
C10		Same as C9	B+ output filter				
C11		Same as C7	B+ filter				
C12		Same as C9	-105V input filter				
C13		Same as C9	-105V output filter				
C14		Same as C9	B+ output filter				
C15	N16-C-31797-5533	Capacitor, Fixed: JAN type, Spec. JAN-C-5; 53/64'' lg; 53/64'' wide; 11/32'' thick; mounts by terminals	Plate capacitor	CM35C202J	Sangamo #C-1220		C15

REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CON-TRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
E1	N16-S-34576-6513	Shield, Electron Tube: JAN type, Spec. JAN-S-28A; 1 15/16" lg; 1.05" dia.	Shield for V1	TS103UO2	Cinch #13376		E1,E2 E4,E5 E6
E2		Same as E1	Shield for V2				
E3	N16-S-34520-3862	Shield, Electron Tube: JAN type, Spec. JAN-S-28A; 1 3/8" lg; .930" dia.	Shield for V3	TS102UO1	Cinch #8690-1		E3
E4		Same as E1	Shield for V4				
E5		Same as E1	Shield for V5				
E6		Same as E1	Shield for V6				
E7	N16-C-300798-866	Clamp, Electrical: nickel plated steel; lever type fastening; 1 3/8 in. dia, 3/4 in. high; 1 mtg slot, 3/16 in. wide by 5/16 in. long	Clamp for V7		Birtcher Type 926C	B-2035	E7,E8, E9,E10 E11
E8		Same as E7	Clamp for V8				
E9		Same as E7	Clamp for V9		*Mfr's designation same as JAN no.		
E10		Same as E7	Clamp for V10				
E11		Same as E7	Clamp for V11				
E12	N16-S-34557-8350	Shield, Electron Tube: JAN type, Spec. JAN-S-28A; 1 3/4" lg; .930" dia.	Shield for V12	TS102UO2	Cinch #8691-1		E12
E13	N16-S-34607-8400	Shield, Electron Tube: JAN type, Spec. JAN-S-28A; 2 1/4" lg; .930" dia.	Shield for V13	TS102UO3	Cinch #8698-1		E13,E14 E15
E14		Same as E13	Shield for V14				
E15		Same as E13	Shield for V15				
E16	MIL-K-700314-588	Knob, Octagonal: phenolic; black; accommodates shaft, round, 1/4 in. dia; 7/16 in. deep shaft hole; 2 set screws; brass insert; arrow marking; 1 1/8 in. dia., 5/8 in. thick overall	Knob for output switch		I.C.A. #1166S	B2063	E16

E17	NGK-700314-470	Knob, Octagonal: phenolic; black; accommodates shaft, round, 1/4 in. dia; 7/16 in. deep shaft hole; 2 set screws; brass insert; without marking; 1 1/8 in. dia., 5/8 in. thick overall	Knob for OPER. DBM LEVEL control		I.C.A. #1165S	B2065	E17
E18	N17-C98431-7306	Clamp, Electrical: nickel plated steel; 4 set screws; 3/4 in. long, 1/2 in. dia. overall; holds material 1/4 in. dia.	Couples shaft to OPER. DBM LEVEL control		C.G.S. Labs. #B2059	B2059	E18
E19	N17-S-20883-8201	Clamp, Electrical: plastic; 2 set screws, 7/8 in. long, 1/2 in. dia. overall; holds material 1/4 in. dia.	Insulator for shaft of R11		C.G.S. Labs. #B2038	B2038	E19,E20 E21
E20		Same as E19	Insulator for shaft of R33				
E21		Same as E19	Insulator for shaft of R34				
E22	N17-C945002-148	Cover, Terminal Board: plastic; 8 7/8 in. long, 1 5/16 in. wide, 1/8 in. thick, overall; 4 5/32 in. dia. Mounting holes on 1/2 in. by 8 1/2 in. mounting centers; contains 14 3/8 in. dia. holes for access to terminals on terminal board	Cover for TB1		C.G.S. Labs. #B2021	B2021	E22
E23	N17-I-41434-6023	Insulation Rod, Electrical: plastic; 400 Test per mil of thickness; 1 5/16 in. long, 1/4 in. dia. overall	Couples Knob E17 to OPER. DBM LEVEL control		C.G.S. Labs. #B2060	B2060	E23
F1	N17-F-17411	Fuse, Cartride: 2 amp. instaneous; ferrule term, 3/8 in. long, 13/32 in. dia.; enclosed fibre body; one time; pin extends from fuse when fuse blows; 1 1/2 in. long 13/32 dia.	Component protection		Bussman #Min 2	B2036	F1,F2 F3,F4
F2		Same as F1	Component protection				
F3		Same as F1	Spare fuse				
F4		Same as F1	Spare fuse				
H1	N17-C-600001-210	Spacer: nickel plated brass: 1/4 in. long; 1/4 in. O.D.; 1/8 in. I.D.	Spacer for E22		C.G.S. Labs. #B2020	B2020	H1,H2 H3,H4
H2		Same as H1	Spacer for E22				

REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CON-TRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
H3		Same as H1	Spacer for E22				
H4		Same as H1	Spacer for E22				
H5A	NAZ-S-4120	Fastener, Captive Screw: 5/8" lg., 9/16 in. wide o/a; cadmium plated steel; mounts in 3/16" dia. hole	Fastener for cover		Dzus Fastener #AW3-25	B2098	H5A
H5B	NAZ-F-3875	Grommet, Captive Screw: .20" high; 7/32" dia.; aluminum; mounts in 7/32" hole	Grommet for H5A		Dzus Fastener #GA3-200	B2099	H5B
H5C	NAS-046807-2301	Spring, captive screw: 1" lg., 1/4" wide; .15" high, o/a; music wire, .045" dia.; 2 3/32" dia. mounting holes spaced 5/8" center to center	Spring for H5A		Dzus Fastener #S3-150	B2100	H5C
H6	*N17-C-945002-136	Cover: 16-27/32" lg., 12.035" wide; 5-7/8" high; perforated sheet steel, .035" thick; ebonel "C" finish; mounts with 3 captive screws spaced 7-7/16" apart	Cover for unit		C.G.S. Labs. Dwg. #D4013	D4013	H6
I1	N17-L-6297	Lamp, Incandescent: 6-8V,1W, bulb T-1 3/4 clear, 1-3/16 long, min. bayonet base; tungsten filament, burn any pos.	Power indicator		General Electric Co. #47	B2040	I1
J1	N17-J-39525-4047	Jack, Telephone: JAN type, Spec. JAN-J-641; 1 11/16" lg; 1 5/8" wide; 3/4" high; 3/8" mtg hole required	Input monitoring	JJ 103	Switchcraft SF-JAX #22B		J1
J2	N17-J-39675 3005	Jack, Telephone: for 2 cond. plug, 1-3/16 long 1/4 in. dia., break contacts; overall dim: 2 in. long, 7/8 in. wide, 11/16 in. high 3/8 in. mtg. hole req.	Output monitoring		Switchcraft SF-JAX #23B	B2033	J2
L1	N16-R-29189-1506	Reactor, Filter Choke: Specification Mil-T-27; 1 section; 8 henries ind.; 160 MA DC; 300 ohms DC resistance; 800 VRMS test voltage; hermetically sealed steel case; 2-3/4 in. lg, 2-3/8 in. wide, 3-13/16 in. high; 4 mtg. studs, 6-32 x 3/8" on	Filter choke	TF1AO4GA	Berkshire Transformer #BTC 1137	B2028	L1

		2-1/8 in. by 1-3/4 in. mtg/c; 2 post type terminals located on bottom.					
M1	N17-M-29304-5709	Ammeter: DC; MA scale black on white background 100-0-100 MA; DBM scale red on white background -15 to 0 to +6 DBM; panel mounted; round bakelite case 2-3/4 dia., .97 in. deep, 3/16 in. thick 3 1/2 dia. flange; 3 .156 in. mtg holes on 1.58 in. radius equally spaced; ±2% accuracy; 105 ohms sensitivity across terminals; 2 screw stud type terminals, 1/4''-28 thread, 3/4'' long; requires external shunt	DBM level-Output line MA		Weston Model 301 (Special Scale)	B2044	M1
R1	N16-R-50632-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468'' lg; .249'' dia.; mounts by terminals	T2 matching	RC20BF104J	IRC #BTS		R1,R3, R7,R15, R16,R26, R8
R2	N16-R-88011-9317	Resistor, variable: JAN type, Spec. JAN-R-94; 1 9/32'' dia; 21/32'' deep; mounts with bushing 3/8''-32	Variable input attenuator	RV3AYRE104B	Clarostat #CM10357		R2,R34
R3		Same as R1	V1A plate loading				
R4	N16-R-49804-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468'' lg; .249'' dia; mounts by terminals	V1A cathode biasing	RC20BF561J	IRC #BTS		R4
R5	N16-R-50479-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468'' lg; .249'' dia.; mounts by terminals	V1B plate loading	RC20BF473J	IRC #BTS		R5,R6, R13
R6		Same as R5	V1B cathode biasing				
R7		Same as R1	V2A grid				
R8		Same as R1	V2B grid				
R9	N16-R-50974-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468'' lg; .249'' dia.; mounts by terminals	V2A grid	RC20BF105J	IRC #BTS		R9
R10	N16-R-49705-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468'' lg; .249'' dia.; mounts by terminals	V2 cathode biasing	RC20BF331J	IRC #BTS		R10

* Not furnished as a maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated.

REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CONTRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
R11	NIAR-89043-6634	Resistor, variable: composition; 2 sect., sect. A 100,000 ohms, sect. B 2 meg; ±20% tolerance each sect. 1/2 watt power rating each sect.; sect. B center tapped, both sect. A taper; 3 solder lug terminals first sect, 4 solder lug terminals second sect.; 1-3/32 in. dia. 1-1/16 in. deep; round metal shaft 1/4 in. dia. 1 in. long; bushing mounted, 3/8-32, 3/8 in. lg.; non turn device on 35/64 radius at 9 o'clock	V3-V4A coupling		Clarostat #CM10345	B-2043	R11
R12	N16-R-50038-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V3 plate loading	RC20BF272J	IRC #BTS		R12,R29
R13		Same as R5	V3-V4A coupling				
R14	N16-R-50238-551	Resistor, fixed: JAN type, Spec. JAN-R-11; 1.41" lg; .405" dia.; mounts by terminals	Negative supply filter	RC40BF822K	IRC #BT-2		R14,R31
R15		Same as R1	V4A plate loading				
R16		Same as R1	V4B plate loading				
R17	N16-R-50911-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V4A-V4B coupling	RC20BF754J	IRC #BTS		R17
R18	N16-R-49966-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V4 cathode biasing	RC20BF152J	IRC #BTS		R18
R19	N16-R-50758-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V4B grid	RC20BF334J	IRC #BTS		R19,R32 R36,R47
R20	N16-R-51109-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V5A-V4B feedback	RC20BF335J	IRC #BTS		R20
R21	N16-R-50893-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V4B-V5A coupling	RC20BF684J	IRC #BTS		R21,R24, R49

R22	N16-R-50821-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V5A grid bias	RC20BF474J	IRC #BTS		R22,R25
R23	N16-R-50551-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V5A plate loading	RC20BF683J	IRC #BTS		R23
R24		Same as R21	V5A-V5B coupling				
R25		Same as R22	V5B grid bias				
R26		Same as R1	V5B plate loading				
R27	N16-R-50398-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V6A plate loading	RC20BF273J	IRC #BTS		R27
R28	N16-R-50857 431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V6A grid	RC20BF564J	IRC #BTS		R28
R29		Same as R12	V6A cathode bias				
R30	N16-R-50515-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	Meter circuit series resistor	RC20BF563J	IRC #BTS		R30
R31		Same as R14	Negative supply filter				
R32		Same as R19	V5B-V7 coupling				
R33	N16-R-89043-1630	Resistor, variable: composition, 2 sect., each 100,000 ohms; ±20% tolerance each sect. 1/2 watt power rating each sect., both sect. "A" taper; 3 solder lug terminals each sect.; 1-3/32 in. dia., 1-1/16 in. deep; round metal shaft 1/4 in. dia., 1 in. lg; bushing mounted, 3/8-32 by 3/8 in lg; non turn device on 35/64 in. radius at 9 o'clock	Variable output resistor		Clarostat #CM1035B	B-2042	R33
R34		Same as R2	Polar balance				
R35		Same as R30	V7 grid				
R36		Same as R19	V5A-V8 coupling				

REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CON-TRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
R37	N16-R-50650-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V8 grid	RC20BF124J	IRC #BTS		R37,R44
R38	N16-R-66329-6741	Resistor, fixed: JAN type, Spec. JAN-R-26A; 3" lg; 19/32" dia.; mounts by terminals	Output	RW33G712	Ohmite		R38
R39	N16-R-66105-5951	Resistor, fixed: JAN type, Spec. JAN-R-26A; 4" lg; 1 5/16" dia.; mounts by terminals	Output	RW42G202	IRC #EP		R39,R41, R51
R40	N16-R-64830-9581	Resistor, fixed: wire-wound; non-inductive winding; .502 ohms resistance; 2% tolerance; 2 mw power rating; .515" lg, 1" dia.; fungicidal wax coated; 2 solder lug terminals; screw or pin mounted; .129" dia. mtg. hole required	Shunt for M1		Weston	B-2039	R40
R41		Same as R39	Output				
R42	N16-R-49624-431	Resistor, Fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V11 screen grid	RC20BF151J	IRC #BTS		R42,R53
R43	N16-R-49921-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V12-V11 coupling	RC20BF102J	IRC #BTS		R43
R44		Same as R37	V12 loading				
R45	N16-R-50551-751	Resistor, fixed: JAN type, Spec. JAN-R-11; .750" lg; .280" dia.; mounts by terminals	V12 screen grid voltage divider	RC30BF683J	IRC #BTA		R45
R46	N16-R-50479-751	Resistor, fixed: JAN type, Spec. JAN-R-11; .750" lg; .280"dia.; mounts by terminals	V12 screen grid voltage divider	RC30BF473J	IRC #BTA		R46
R47		Same as R19	V12 grid				
R48	N16-R-50659-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia; mounts by terminals	V12 grid	RC20BF134J	IRC #BTS		R48

R49		Same as R21	V1A-V6A coupling				
R50		Same as R35	T3 loading				
R51		Same as R39	V10, V11 shunt				
R52	N16-R-50416-431	Resistor, fixed: JAN type, Spec. JAN-R-11; .468" lg; .249" dia.; mounts by terminals	V3-V4A coupling	RC20BF333J	RCA #BTS		R52
R53		Same as R42	V10 screen grid				
S1	N17-S-74139-4844	Switch, toggle: JAN type, Spec. JAN-S-23; 1 9/32" lg.; 23/32" deep; 23/32" wide; mounts by bushing 15/32"-32, 15/32" lg.	Keying inversion	ST22N	Arrow-Hart & Hegeman #82305		S1,S3
S2		Switch, rotary: 2 sections; 6 positions; 2 poles each sect.; silver plated brass contacts; ceramic insulation; 1-5/8 in. lg., 1-5/8 in. wide, 1-7/8 in. high; mounted by 3/8 in. lg., 3/8 in.-32 bushing; round shaft 2 in. lg, 1/4 in. dia.; solder lug terminals	Output		Mallory #177C	B-2041	S2
S3		Same as S1	Meter				
S4	N17-S-73082-9028	Switch, toggle: JAN type, Spec. JAN-S-23; 1 9/32" lg.; 23/32" deep; 23/32" wide; mounts by bushing 15/32"-32; 15/32 lg.	AC Line	ST22K	Arrow-Hart & Hegeman #82304		S4
T1	N17-T-74397-6801	Transformer, power: step down and step up; Spec. MIL-T-27; upright steel case; 115/230 V, 50/60 cps. single phase input; 4 output windings: #1 sec, 5V at 2 amp; #2 sec. 800V at 160 MA; #3 sec. 6.3V at 2.5 amp; #4 sec. 6.3V at 5.2 amp; #2 sec. center tapped and tapped for 200V potential to center tap; #4 sec. center tapped; 1500V insulation; PG4 varnish impregnated; Biwax 260 filled; 4-11/16 in. lg, 4 in. wide, 4-15/16 in. high; 14 stud terminals located on bottom; 4 mtg. studs 1/4 in.-20 by 5/8 in. lg. on 3-11/16 in. by 3 in. mtg. centers; no internal shield; Pri. consists of 2 windings, to be connected in series for 230V, in parallel for 115V	Plate and filament supply for all tubes	TF1A03MB	Berkshire Transformer #BTC1135		T1

REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CON-TRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
T2	N17-T-61606-2801	Transformer, AF: input type, Spec. Mil-T-27; 600 ohms pri. impedance; 50,000 ohms sec. impedance; pri. center tapped; upright steel case, audio "A" core; 1-15/16 in. lg., 1-13/16 in. wide, 2-3/4 in. high, excl. term; 1 to 9.13 ratio of turns pri. to sec; ±.5 DB from 400 to 5000 cps. freq. response; not tuned; electrostatic shield connected to case; 6 post type terminals located on bottom; 4 mtg. studs 6-32 x 3/8 in. on 3/8 in. by 1-1/4 in. mtg/c; PG4 varnish impregnated; Biwax 260 filled.	Input transformer	TF1A10EA	Berkshire Transformer #BTC-1133	B-2025	T2
T3	N17-T-65938-5502	Transformer, AF: plate coupling type; Spec. Mil-T-27; 20,000 ohms pri. impedance; 40,000 ohms sec. impedance; pri. and sec. center tapped; 8 MA. pri.; upright steel case; audio "A" core; 1-15/16 in. lg., 1-13/16 in. wide, 2-3/4 in. high excl. terminals; 1 to 1.414 ratio of turns pri. to sec.; ±.5 DB from 400 to 5000 cps. freq. response; not tuned; not shielded; 5 post type terminals located on bottom; 4 mtg. studs, 6-32 by 3/8 in. on 1-3/8 in. by 1-1/4 in. mtg/c; PG4 varnish impregnated; Biwax 260 filled.	Interstage transformer	TF1A15EA	Berkshire Transformer #BTC-1134	B-2026	T3
T4	N17-T-62661-4791	Transformer, AF: line type; Spec. Mil-T-27; 600 ohms pri. impedance; 600 ohms sec. impedance; center tapped pri.; upright steel case; audio "A" core; 1-15/16 in. lg., 1-13/16 in. wide, 2-3/4 in. high, excl. term.; 1 to 1 ratio of turns, pri. to sec.; ±.5 DB from 400 to 5000 cps. freq. response; not tuned; electrostatic shield connected to terminal; 6 post type terminals located on bottom; 4 mtg. studs, 6-32 by 3/8 in. on 3/8 in. by 1-1/4 in. mtg/c; PG4 varnish impregnated; Biwax 260 filled.	Isolation transformer	TF1A16EA	Berkshire Transformer #BTC-1138	B-2027	T4

TB1	N17-B-78042-1555	Terminal Board: 14 screw and solder lug term; molded phenolic board; barrier type; 8-7/8 in. lg. 1-5/16 wide, 5/8 in. thick; 4 3/16 in. dia. mtg. holes on 8-7/16 in. by 1/2 in. mtg/c; nickel plated terminals	Input and output termination		H. B. Jones #14-142-Y	B-2029	TB1
TB2	*N17-B-77833-4426	Terminal Board: plastic; 8 solder lug terminals; w/o barriers; 1-3/4 in. lg., 1-5/8 in. wide, .125" thick; 2 .187" dia. mtg. holes on 1-1/8" mtg/c	Mounting board for component parts		C.G.S. Labs. Dwg. #B-2023	B-2023	TB2
TB3	*N17-B-78114-7726	Terminal Board: plastic; 18 solder lug terminals; w/o barriers; 5" lg., 1-9/16" wide, .125" thick; 3 .187" dia. mtg. holes on 1-3/4" by 3-3/16" by 4-9/16" mtg/c	Mounting board for component parts		C.G.S. Labs. Dwg. #B-2022	B-2022	TB3
TB4	*N17-B-78331-5691	Terminal Board: plastic; 64 solder lug terminals; w/o barriers; 12-1/4" lg., 2" wide, .125" thick; 5 .156" dia. mtg. holes spaced 2.718", 2.844", 2.781", 2.782" apart	Mounting board for component parts		C.G.S. Labs Dwg. #C-3010	C-3010	TB4
V1	N16-T-58240-10	Tube Electron: JAN type, Double Triode; Spec. JAN-1-A	Audio amplifier	JAN 12AT7			V1,V2
V2		Same as V1	Limiter-amplifier				
V3	N16-T-56195	Tube, Electron: JAN type, Double Diode; Spec. JAN-1-A	Signal full wave rectifier	JAN 6AL5			V3
V4	N16-T-58241	Tube, Electron: JAN type, Double Triode; Spec. JAN-1-A	Trigger	JAN 12AU7			V4,V5 V6
V5		Same as V4	Audio amplifier, inverter				
V6		Same as V4	Audio amplifier; half-wave rectifier				
V7	N16-T-56916	Tube, Electron: JAN type, Tetrode; Spec. JAN-1-A	Output	JAN-6Y6-G			V7,V8 V10,V11
V8		Same as V7	Output				
V9	N16-T-55464	Tube, Electron: JAN type, Full Wave Rectifier; Spec. JAN-1-A	Full wave rectifier	JAN 5U4G			V9

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REF. DESIG.	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTIONS	JAN AND NAVY TYPE NO.	MANUFACTURER AND MFGR'S DESIGNATION	CON-TRACTOR DWG. AND PART NO.	ALL SYMBOL DESIG. INVOLVED
V10		Same as V7	Voltage regulator				
V11		Same as V7	Voltage regulator				
V12	N16-T-56203-50	Tube, Electron: JAN type, Pentrode; Spec. JAN-1-A	Voltage regulator	JAN 6AU6			V12
V13	N16-T-56840-50	Tube, Electron: JAN type, Double Diode; Spec. JAN-1-A	Half wave rectifier	JAN 6X4W			V13
V14	N16-T-52001-5	Tube, Electron: JAN type, Volt. Regulator; Spec. JAN-1-A	Voltage regulator	JAN OB2			V14,V15
V15		Same as V14	Voltage regulator				
XI1A	*N17-L-76656-24652	Lampholder: accommodates miniature bayonet base lamp; 8V; 1W; brass shell; 1 11/16 in. lg. .800 in. dia.; 2 solder lug terminals; 11/16 in. dia. mtg. holes required; threaded for lens holder	Holder for I1		Dialco #12410	B2031	XI1A
XI1B	*N17-L-250308-271	Lens, indicator light: green; 1/2 in. dia.; hemispherical; glass; sand-blasted back; 13/16 in. dia., 13/16 in. deep; dull black brass mounting; threaded mounting, 11/16 in. -27 female thread, 5/8 in. lg.	Lens for I1		Dialco #12-112	B2064	XI1B
XF1	N17-F-74269-8401	Fuseholder: extractor post type; 250V, 15 amp.; accommodates 1 cartridge type fuse 1-1/2 in. lg, 3/8 in. dia.; phenolic body; nickel plated brass contacts, pressure type in holder, sleeve type in cover; 2-1/8 in. lg., 1-3/4 in. max. width; 2 solder lug terminals; 2-5/8 in. dia. mtg. holes, spaced 1-5/16 in. apart; transparent knob accommodates blown fuse indicator	Holder for Fuse F1		Bussman #HPC-C	B2032	XF1,XF2 XF3,XF4
XF2		Same as XF1	Holder for Fuse F2				
XF3		Same as XF1	Holder for Fuse F3				
XF4		Same as XF1	Holder for Fuse F4				

XV1	N16-S-64063-6718	Socket, Electron Tube: JAN type, Spec. JAN-S-28A; 1 3/8" lg.; 1.035" wide; 1 3/16" deep; 2 .125" dia. mtg. holes spaced 1.125"; requires .940" dia. chassis hole	Socket for V1	TS103P01	Cinch #13373		XV1,XV2 XV4,XV5 XV6
XV2		Same as XV1	Socket for V2				
XV3	N16-S-62603-6692	Socket, Electron Tube: JAN type, Spec. JAN-S-28A; 1 1/8" lg; .900" wide; 1 3/16" deep; 2 .125" dia. mtg holes spaced .875"; requires .800" dia. chassis hole	Socket for V3	TS102P01	Cinch #9356		XV3,XV12 XV13, XV14, XV15
XV4 to and incl. XV6		Same as XV1	Sockets for XV4 to and incl. XV6				
XV7 to and incl. XV11	N16-S-63529-1976	Socket, Electron Tube: JAN type, Spec. JAN-S-28A; 1 7/8" lg; 1 3/8" wide; 13/16" deep; 2 .156" dia. mtg. holes spaced 1.5"; required 1 7/64" dia. chassis hole	Sockets for V7 to and incl. V11	TS101P01	Cinch #16-203		XV7,XV8 XV9,XV10 XV11
XV12 to and incl. XV15		Same as XV3	Sockets for V12 to and inc. V15				

* Not furnished as a maintenance part. If failure occurs, do not request replacement unless the item cannot be repaired or fabricated.

TABLE 8-4. MAINTENANCE PARTS KIT

KEY DESIGNATIONS	QUANTITY	KEY DESIGNATIONS	QUANTITY	KEY DESIGNATIONS	QUANTITY
L 1	1	R 40	1	T 2	1
R 11	1	S 2	1	T 3	1
R 33	1	T 1	1	T 4	1

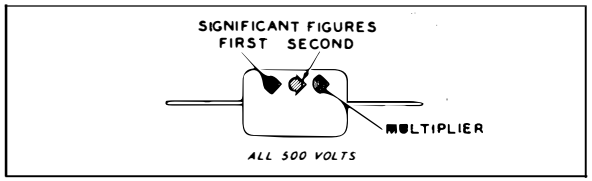
TABLE 8-5. CROSS REFERENCE PARTS LIST

JAN DESIGNATIONS	REFERENCE DESIGNATIONS	JAN DESIGNATIONS	REFERENCE DESIGNATIONS	JAN DESIGNATIONS	REFERENCE DESIGNATIONS
CM35C103K	C1	RC20BF134J	R48	RC40BF822K	R14
CM35C202J	C15	RC20BF151J	R42	RV3AYRE104B	R2
CM35C512J	C4	RC20BF152J	R18	RW33G712	R38
CP41B1FF405V	C9	RC20BF272J	R12	RW42G202	R39
CP69B1FF105V	C2	RC20BF273J	R27	ST22K	S4
CP69B1FF254V	C7	RC20BF331J	R10	ST22N	S1
JAN OB2	V14	RC20BF333J	R52	TF1A03MB	T1
JAN 5U4G	V9	RC20BF334J	R19	TF1A04GA	L1
JAN 6AL5	V3	RC20BF335J	R20	TF1A10EA	T2
JAN 6AU6	V12	RC20BF473J	R5	TF1A15EA	T3
JAN 6X4-W	V13	RC20BF474J	R22	TF1A16EA	T4
JAN 6Y6-G	V7	RC20BF561J	R4	TS101P01	XV7 to & incl. XV11
JAN 12AU7	V4	RC20BF563J	R30		
JAN 12AT7	V1	RC20BF564J	R28	TS102P01	XV3
JJ 103	J1	RC20BF683J	R23	TS102U01	E3
RC20BF102J	R43	RC20BF684J	R21	TS102U02	E12
RC20BF104J	R1	RC20BF754J	R17	TS102U03	E13
RC20BF105J	R9	RC30BF473J	R46	TS103P01	XV1
RC20BF124J	R37	RC30BF683J	R45	TS103U02	E1

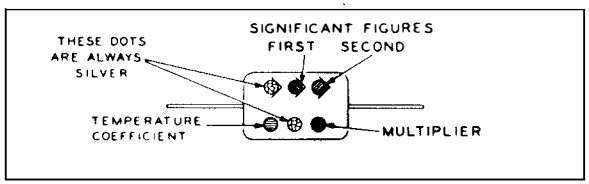
TABLE 8-6. APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

CAPACITOR COLOR CODES

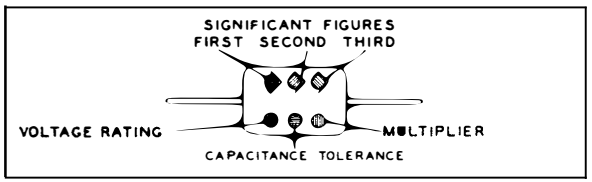
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



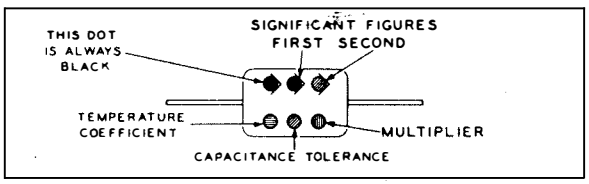
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



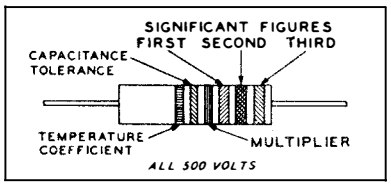
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

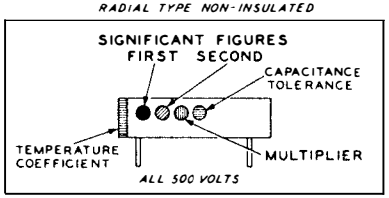


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

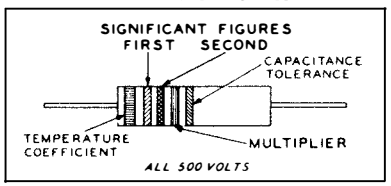


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



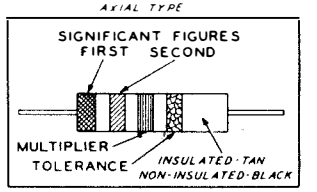
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

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	

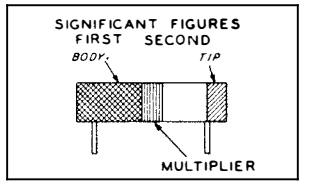
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

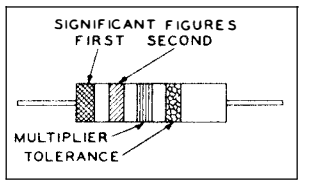


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

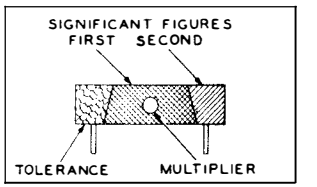


TABLE 8-7. LIST OF MANUFACTURERS

ABBREVIATIONS	PREFIX	NAME	ADDRESS
Arrow-Hart & Hegeman	CHH	Arrow-Hart & Hegeman Electric Company	102 Hawthorne Street Hartford, Connecticut
Berkshire Transformer		Berkshire Transformer Company	15 South Street New Milford, Conn.
Birtcher	CAIS	The Birtcher Corp.	5087 Huntington Drive Los Angeles 32, Calif.
Bussman	CFA	Bussman Mfg. Co.	2530 W. University St. St. Louis, Mo.
C.G.S. Labs.	CBTA	C.G.S. Laboratories, Inc.	391 Ludlow Street Stamford, Connecticut
Cinch	CMG	Cinch Mfg. Co.	2339 W. Van Buren St. Chicago, Illinois
Clarostat	CMC	Clarostat Mfg. Co.	285-287 N. 6th Street Brooklyn, N.Y.
Cornell-Dubilier	CD	Cornell-Dubilier Corp.	1000 Hamilton Blvd. South Plainfield, N.J.
Dialco	CAYZ	Dial Light Corp.	900 Broadway New York, New York
Dzus Fastener		Dzus Fastener Co., Inc.	Babylon, New York
General Electric Co.	CG	General Electric Co.	One River Road Schenectady, N.Y.
I.C.A.	CAXD	Insuline Corp. of America	30-30 Northern Blvd. Long Island City, N.Y.
I.R.C.	CIR	International Resistance Corp.	401 N. Broad Street Philadelphia, Pa.
H. B. Jones	CJC	Howard B. Jones	2300 W. Wabansia Ave. Chicago, Illinois
Mallory	CMA	P.R. Mallory Co., Inc.	1941 Thomas Street Indianapolis, Ind.
Ohmite	COM	Ohmite Mfg. Co.	4835 W. Flournoy St. Chicago, Illinois
Sangamo	CAN	Sangamo Electric Co.	1935 Funk Street Springfield, Illinois
Switchcraft	CBIM	Switchcraft Co.	1328-30 N. Halsted St. Chicago, Illinois
Weston	CV	Weston Electrical Instrument Corp.	619 Frelinghuysen Ave Newark, N.J.