T.O. 31X2-20-9-1

TECHNICAL MANUAL

OPERATION AND SERVICE

RADIO FREQUENCY MONITOR SET LA 800D

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

AF-WP-O-OCT 61 500 -REPRINT

31 AUGUST 1960

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SECTION I
INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION.

1-2. SCOPE OF MANUAL.

1-3. This manual provides operation and service instructions for the Radio Frequency Monitor Set LA 800D. The set is composed of the Model 800D WWV Frequency Comparator and two antennas. (See figures 1-1 and 1-2.) The set is manufactured by Lavoie Laboratories, Incorporated, Morganville, New Jersey. This manual contains a general description, principles of operation, preparation for use, storage, and shipment, operating instructions, and inspection, lubrication, maintenance, troubleshooting, and calibration data.

1-4. PURPOSE AND CAPABILITY OF EQUIPMENT.

1-5. The WWV comparator is capable of accepting submultiples of 400 kilocycle, 2.0 megacycle or 10 megacycle signals and converting these signals to 10 megacycles for comparison with a pure 10 megacycle signal, which is converted from either the 5 megacycle or the 15 megacycle transmissions from the National Bureau of Standards. Separate antennas for 5 megacycle and 15 megacycle reception are included in the set. The WWV comparator can indicate the accuracy of these sub-multiple signals to 1 part in 10,000,000. Frequency deviations can be monitored either as an audio beat, for relatively large deviations in frequency, or by means of a rotating pattern on the screen of the CRT (cathode ray tube) for small deviations.

1-6. DESCRIPTION.

1-7. PHYSICAL CHARACTERISTICS.

1-8. The WWV comparator is composed of frequency multiplier circuits, a two channel superheterodyne receiver, audio and video monitoring circuitry, and a regulated power supply, all mounted in a single chassis. The unit is 19-1/2 inches wide, 17 inches deep, 10 inches high, weighs 51 pounds, and can either be installed in a standard relay rack or used as a portable bench instrument. The WWV comparator utilizes 115 volt, 60 cycle, single phase power.

1-9. PRINCIPLES OF OPERATION.

1-10. BASIC PRINCIPLES. The WWV comparator is used to compare two signals, the first known to be highly accurate and the second being checked for accuracy. In order to obtain a highly accurate comparison signal, the instrument receives either the 5 megacycle or the 15 megacycle transmission of the National Bureau of Standards and converts it to a pure 10 megacycle sine wave. This 10 megacycle signal is applied to the vertical deflection plates of the CRT. The signal is also phase-shifted 90 degrees and applied to the horizontal deflection plates. The resultant trace is a circular pattern formed by an electron beam rotating at ten million revolutions per second.

1-11. The local signal being checked for accuracy is converted to approximately 10 megacycles and applied

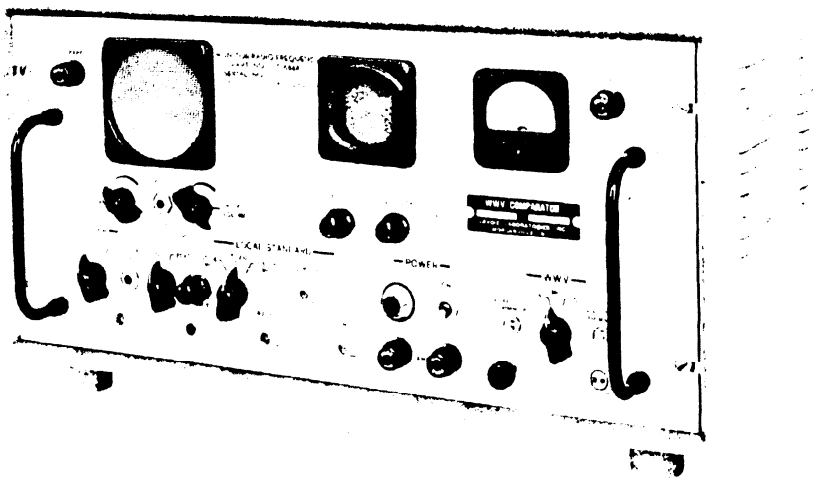


Figure 1-1. Model 800D WWV Frequency Comparator

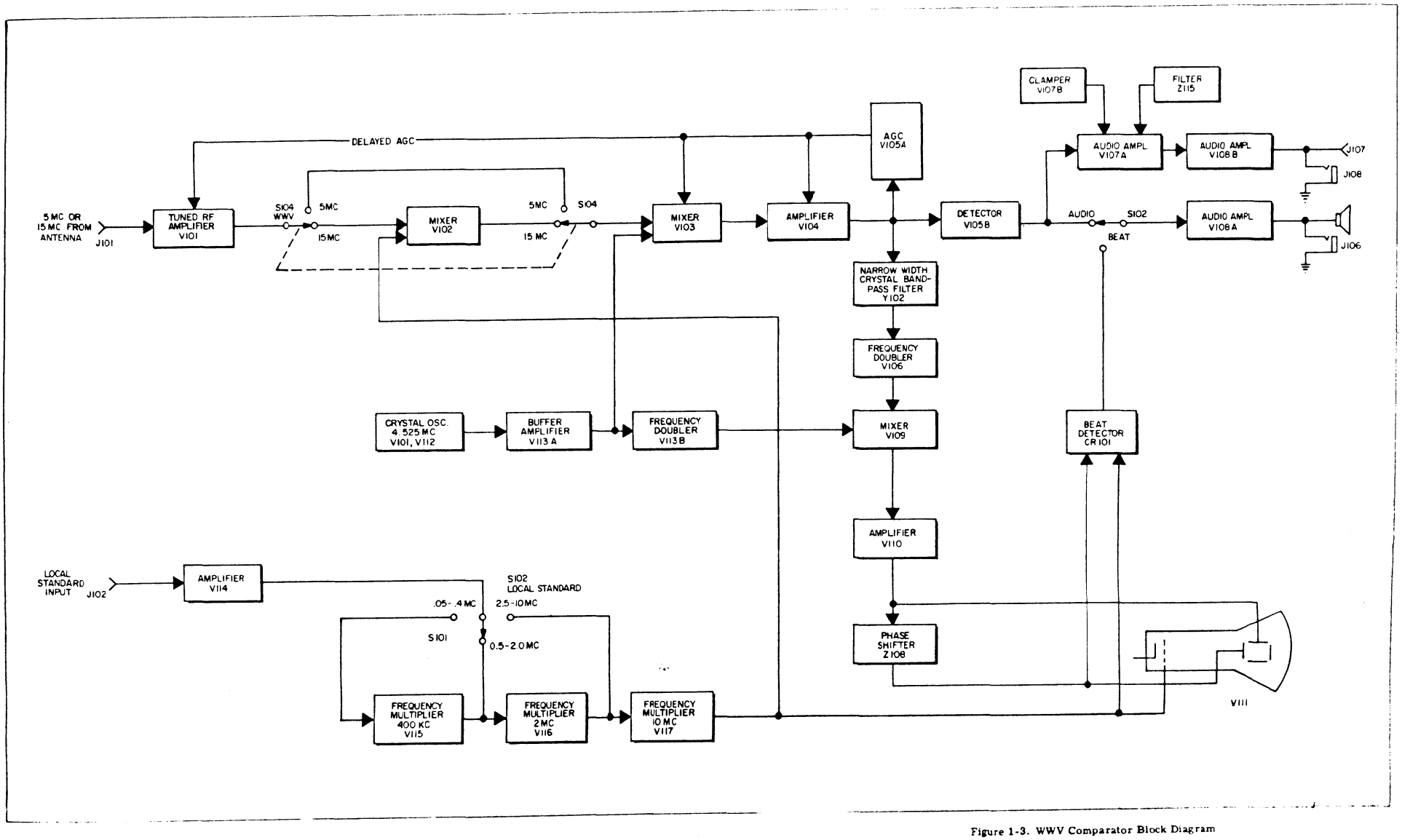


Figure 1-3. WWV Comparator Block Diagram

megacycle signal is used (10 megacycles plus frequency error of local signal). Thus, the difference in frequency between the signal applied to the deflection plates and the signal applied to the grid is three times as great as when the 5 megacycle signal is used. Therefore, if the intensified segment of arc rotates at 1 revolution per second it represents an error in frequency of 0.33 parts in 10,000,000.

1-19. ADDITIONAL EQUIPMENT.

1-20. No additional equipment is required for operation of the radio frequency monitor set.

SECTION II
SPECIAL SERVICE TOOLS

2-1. This section is not applicable because special tools are not required.

SECTION III
PREPARATION FOR USE, STORAGE, OR SHIPMENT

3-1. PREPARATION FOR USE.

3-2. UNPACKING.

3-3. WWV COMPARATOR. The WWV comparator is packed in a double container. The inner container is a fiberboard carton which is taped and stapled shut. The outer container is a wooden packing box secured by nails and a heavy metal strap. Unpack the WWV comparator as follows:

a. Remove heavy metal strap which binds packing box.

b. Pull out nails that secure lid of packing box and remove lid.

c. Remove cushioning surrounding inner fiberboard carton.

d. Carefully lift out inner fiberboard carton which houses WWV comparator.

e. Pull out staples and remove tape that secures top of carton.

f. Open carton and remove cushioning material.

g. Carefully lift out WWV comparator.

h. Remove tape and uncoil power cord.

3-4. 5 MEGACYCLE OR 15 MEGACYCLE ANTENNA. Both the 5 megacycle and the 15 megacycle antenna are shipped in a plywood packing box secured by nails and a heavy metal strap. Unpack the antenna as follows:

a. Remove heavy metal strap which binds packing box.

b. Pull out nails that secure lid of packing box and remove lid.

c. Remove loose wadding from packing box.

d. Carefully lift out antenna masts and remove wadding.

e. Remove staples and wadding securing guy wire to packing box and lift out guy wire.

f. Remove individually wrapped items of antenna hardware from packing box. Keep hardware for each antenna separate.

g. Remove wadding and tape from antenna hardware.

3-5. ASSEMBLY AND INSTALLATION.

3-6. WWV COMPARATOR. Because the equipment is completely assembled before shipment, no installation of parts is required. The WWV comparator should be aligned and calibrated prior to operation as described in Section VII.

3-7. 5 MEGACYCLE OR 15 MEGACYCLE ANTENNA. The installation procedure for either the 5 megacycle or 15 megacycle antenna is identical except that the distance between antenna masts is different. The masts are positioned 103 feet apart for the 5 megacycle antenna and 39 feet apart for the 15 megacycle antenna. Install the antenna as follows:

a. Measure off required distance between antenna masts and mark each end of measured distance with an X. (See figure 3-1.)

b. Set one swivel base plate (9) directly on each of the X's marked in step a so that masts swivel at right angles to imaginary line between two base plates. Secure plates with eight mounting screws.

c. Insert 10 foot mast in base plate clamp (8) and tighten clamp.

d. Slip collar (7) onto mast and tighten collar 24 inches from unsecured end of mast.

e. Slip floating ring (6) onto mast.

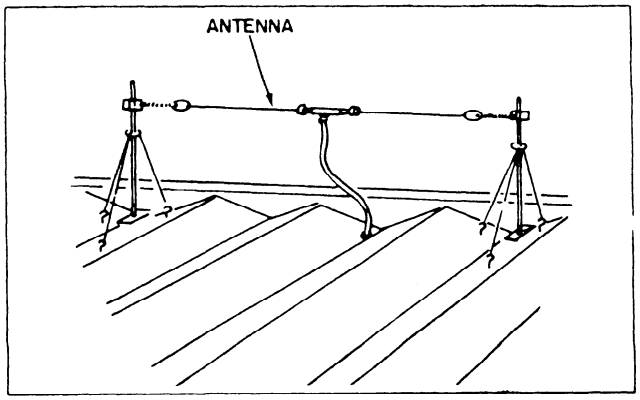


Figure 1-2. Antenna as Erected

to the control grid of the CRT, thereby intensifying the rotating electron beam during each positive half cycle of the signal. The resultant trace is a circle with an intensified segment. The intensified segment remains stationary only if the converted signal on the control grid is exactly 10 megacycles. Any deviation of the converted signal from 10 megacycles is indicated by rotation of the intensified segment of the trace, at a rate determined by the inaccuracy of the converted signal. If the intensified segment of the trace rotates clockwise, the frequency of the local signal is too high. If the intensified segment of the trace rotates counterclockwise, the frequency of the local signal is too low.

1-12. DETAILED OPERATION. This discussion is divided into five megacycle and 15 megacycle reception.

1-13. Five Megacycle Reception. The National Bureau of Standards carrier wave received by the antenna is applied to J101. (See figure 1-3.) The signal is fed into a tuned RF stage which provides preselection and amplification. When WWV frequency switch S104 has been preselected for 5 megacycle reception, the 5 megacycle signal is fed directly to second stage mixer V103. Mixer V103 also receives a 4.525 megacycle signal from the local signal oscillator/buffer amplifier stages. The output of mixer V103 is the difference between the two input signals, or 0.475 megacycles plus any error derived from inaccuracy of the local signal oscillator. This signal is amplified in V104 and sent to the AGC (automatic gain control) circuit, the detector, and the narrow width crystal bandpass filter. A portion of the output picked off V104 and fed to V105A is returned to V101, V103, and V104 to stabilize the output level of the receiver.

1-14. Another portion of the output of V104 is detected by V105B. When switch S102 is set to allow the signal to reach V108A, the signal is amplified and fed to the built-in speaker.

1-15. The remaining portion of the output of V104 is fed to narrow width crystal bandpass filter Y102. This filter blocks any signal deviation greater than 50 cycles per second from 0.475 megacycles. The output of Y102 is doubled in V106 to produce 0.950 megacycles plus an error signal and then is passed to mixer V109. Mixer V109 also receives a signal generated by the local signal oscillator and doubled by V113B. The errors in the two signals cancel out and the resultant output of V109 is a pure 10 megacycle sine wave. This 10 megacycle signal is amplified in V110. A portion of the V110 output signal is applied to the vertical deflection plates of the CRT and the remainder of the output is phase-shifted 90 degrees by Z108 and applied to the horizontal deflection plates. The resultant trace is a circular pattern formed by an electron beam rotating at ten million revolutions per second.

1-16. The local signal is applied to the input amplifier V114. This input frequency must be a subharmonic of 400 kilocycles, 2 megacycles, or 10 megacycles. The output from V114 is applied to one of the three cascaded multiplier stages. The number of stages used is determined by the input frequency of the local signal. The output of the multiplier stages is approximately a 10 megacycle signal. The signal error present is proportional to the error in the local signal. The approximate 10 megacycle signal is fed to beat detector CR101, where it is compared with the 10 megacycle signal from Z108. The resultant of these two signals is an error signal equal to the difference in frequency between the converted highly accurate standard and the converted local signal.

1-17. With AUDIO-BEAT switch S102 set to allow the error signal to pass to the audio amplifier V108A, an audible beat is heard from the speaker for normal frequency deviations. By listening to the pitch of the audio beat and adjusting the local signal, the frequency deviation can be decreased. (Decreasing the deviation lowers the pitch of the audio beat.) Because frequencies near zero cycles are beyond the spectrum of human hearing, it is necessary to observe the trace on the CRT to completely eliminate frequency deviations. To accomplish this, the output of multiplier stages is applied to the control grid of the CRT, where its intensity modulates the electron beam and causes an intensified segment of arc to appear on the trace. The intensified segment rotates at 1 revolution per second for a frequency error of 1 part in 10,000,000.

1-18. Fifteen Megacycle Reception. If a 15 megacycle National Bureau of Standards signal is used, S104 is switched to bring mixer V102 into the receiver circuit. Mixer V102 receives the 15 megacycle carrier signal and the approximate 10 megacycle output of V117. The resulting output is an approximate 5 megacycle signal. From this point in the circuit, signal paths and frequency conversions are identical to those used when a 5 megacycle signal is used. However, the signal that reaches the deflection plates of the CRT is not a pure 10 megacycle signal, but contains a frequency error twice as great as the error of the local signal. The approximate signal applied to the grid of the cathode ray tube is identical to the signal applied when a 5

f. Slip antenna clamp (1) onto mast and tighten antenna clamp four inches from unsecured end of mast.

g. Secure three hook-eye fasteners (10) eight feet from base plate and at approximately equal distances from each other. (See figure 3-1.)

h. Cut three 9-foot lengths of guy wire (11) and secure one 9-foot length to each of three holes in floating ring (6).

i. Attach one turnbuckle (12) to each of three 9-foot lengths of guy wire at unsecured end.

j. Cut three 4-foot lengths of guy wire (13).

k. Attach one 4-foot length of guy wire to free end of each turnbuckle (12).

l. Attach one end of antenna to antenna clamp (1).

m. Raise mast (5) to vertical position.

n. Secure three guy wires to hook-eye fasteners (10) and tighten turnbuckles (12) as necessary.

o. Unroll antenna to position of other base plate.

p. Repeat steps c through k for mast number two.

q. Slip antenna through antenna clamp (1), take in slack, and secure antenna to antenna clamp.

r. Raise mast (5) to vertical position.

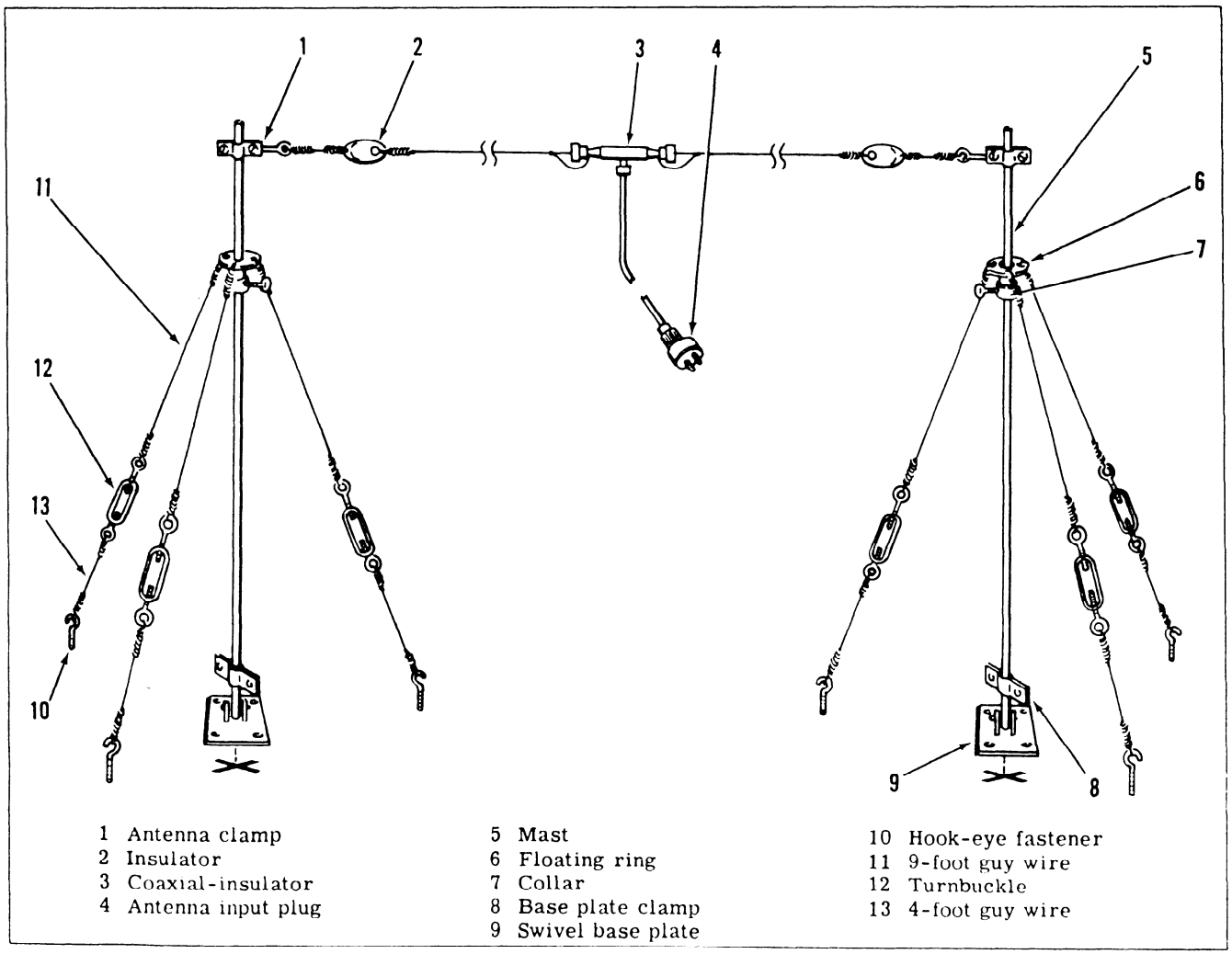
s. Secure three guy wires to hook-eye fasteners (10) and tighten turnbuckles (12) as necessary.

t. Channel antenna input plug (4) into bench area where WWV comparator is located.

3-8. FACILITY REQUIREMENTS.

3-9. POWER REQUIREMENT.

3-10. The WWV comparator requires 115 (±10) volt, 60 (±3) cycle, 138 watt, single phase power.



1 Antenna clamp
2 Insulator
3 Coaxial-insulator
4 Antenna input plug
5 Mast
6 Floating ring
7 Collar
8 Base plate clamp
9 Swivel base plate
10 Hook-eye fastener
11 9-foot guy wire
12 Turnbuckle
13 4-foot guy wire

Figure 3-1. Antenna Installation

3-11. SPACE REQUIREMENT.

3-12. The WWV comparator requires a floor space six feet wide and five feet deep. The equipment is usually positioned on a work bench when in use.

3-13. The 5 megacycle antenna requires an area at least 120 feet long and 20 feet wide and should be erected higher than surrounding terrain. The 15 megacycle antenna requires an area 56 feet long and 20 feet wide. (The 20 foot widths indicated are only needed immediately adjacent to the two masts of the antenna.)

3-14. PREPARATION FOR STORAGE.

3-15. Neither the WWV comparator nor the 5 megacycle or 15 megacycle antenna require special treatment prior to or during normal storage.

3-16. PREPARATION FOR SHIPMENT.

3-17. WWV COMPARATOR PACKAGING.

3-18. The following procedure shall be utilized when preparing the WWV comparator for shipment:

a. Coil power cord and secure cord to back of unit with tape.

b. Put cushioning material on bottom of fiberboard carton that is slightly larger than unit.

c. Carefully set WWV comparator in carton.

d. Put cushioning material on all four sides and top of unit.

e. Close carton and secure with staples and tape.

f. Put cushioning material on bottom of wooden packing box slightly larger than fiberboard carton.

g. Carefully set fiberboard carton in packing box.

h. Put cushioning material on all four sides and top of carton.

i. Close packing box and secure with nails and heavy metal strap.

j. Label packing box FRAGILE and THIS SIDE UP.

3-19. ANTENNA PACKAGING.

3-20. The following procedure shall be utilized when preparing the 5 megacycle and 15 megacycle antenna for shipment.

a. Disassemble antenna by following reverse order of assembly procedures, keeping hardware of two antenna separated.

b. Wrap hardware for both antenna as indicated in Table 3-1.

c. Place one complete set of wrapped antenna hardware in each end of plywood box 10-1/2 feet long, 7 inches wide, and 6 inches deep.

d. Secure two 100-foot rolls of guy wire in center of packing box with webbing and staples.

e. Wrap each antenna mast separately with wadding and lay masts side-by-side in packing box.

f. Add additional wadding as necessary to ensure safe shipment.

g. Nail lid of packing box in place and secure with metal strap.

h. Label packing box FRAGILE and THIS SIDE UP.

Table 3-1. Antenna Hardware Wrapping Procedures

Hardware Item	Wrapping Procedure
Collars (7, figure 3-1)	Place two collars in polyethlyne coated paper bag and close with staples.
Turnbuckles (12)	Wrap six turnbuckles in wadding and secure with tape.
Hook-eye fasteners (10)	Wrap six hook-eye fasteners in wadding and secure with tape.
Antenna clamps (1)	Wrap two antenna clamps in wadding and secure with tape.
Coaxial-insulators (3)	Wrap coaxial-insulator with wadding, secure with tape, and place in polyethylene coated paper bag along with antenna. Close bag with staples.
Swivel base plates (9)	Wrap each swivel base plate separately in wadding and secure with tape.

SECTION IV
OPERATING INSTRUCTIONS

4-1. OPERATING CONTROLS, INDICATORS, AND JACKS.

4-2. Table 4-1 lists the functions of these items. (See figure 4-1.)

4-3. PRELIMINARY PROCEDURES.

4-4. Before operating the WWV comparator, place the unit on a work bench near sources of power required for operation. Provide sufficient space for the equipment to be tested. Check to insure that POWER switch (10, figure 4-1) is turned off.

4-5. Connect the WWV comparator to the antenna and power source as follows:

a. Connect antenna to antenna INPUT jack (14, figure 4-1).

b. Plug WWV comparator into 115 volt, 60 cycle, single phase power outlet.

c. Set POWER switch (10) to ON.

d. Check that power lamp (17) is lighted.

e. Allow five minutes for warmup.

4-6. OPERATING PROCEDURE.

4-7. After allowing a five minute warmup period, proceed as follows:

a. Set AUDIO-BEAT switch (24) to AUDIO.

b. Adjust AUDIO VOLUME control (4) until audio note and time ticks of station are audible.

c. Set INTENSITY control (7) three-quarters clockwise.

d. Set FOCUS control (5) three-quarters clockwise.

e. Adjust ANTENNA TRIMMER control (13) until peak is obtained on bias level voltmeter (8).

f. Adjust XTAL. OSC. TRIMMER control (11) until stable trace is obtained on CRT (6).

g. Adjust INTENSITY control (7) until trace on CRT (6) is just barely visible.

h. Connect local standard to INPUT jack (22).

i. Set local standard selector (21) to lowest-range position containing frequency or local standard.

j. Adjust INPUT control (23) until bright pattern is visible on CRT (6).

NOTE

If pattern of CRT (6) does not collapse when antenna is disconnected in step k, WWV comparator is tuned to false 5 megacycle harmonic of local standard. Input must be decreased by turning INPUT control (23) counterclockwise.

k. Disconnect antenna from INPUT jack (14). Pattern of CRT (6) should collapse.

l. Reconnect antenna to INPUT jack (14).

m. Set AUDIO-BEAT switch (24) to BEAT. Beat note corresponding to difference of two 10 megacycles frequencies shall be heard.

n. Observe CRT (6) and adjust local standard further until speed of rotation of trace is zero or as near to zero as possible.

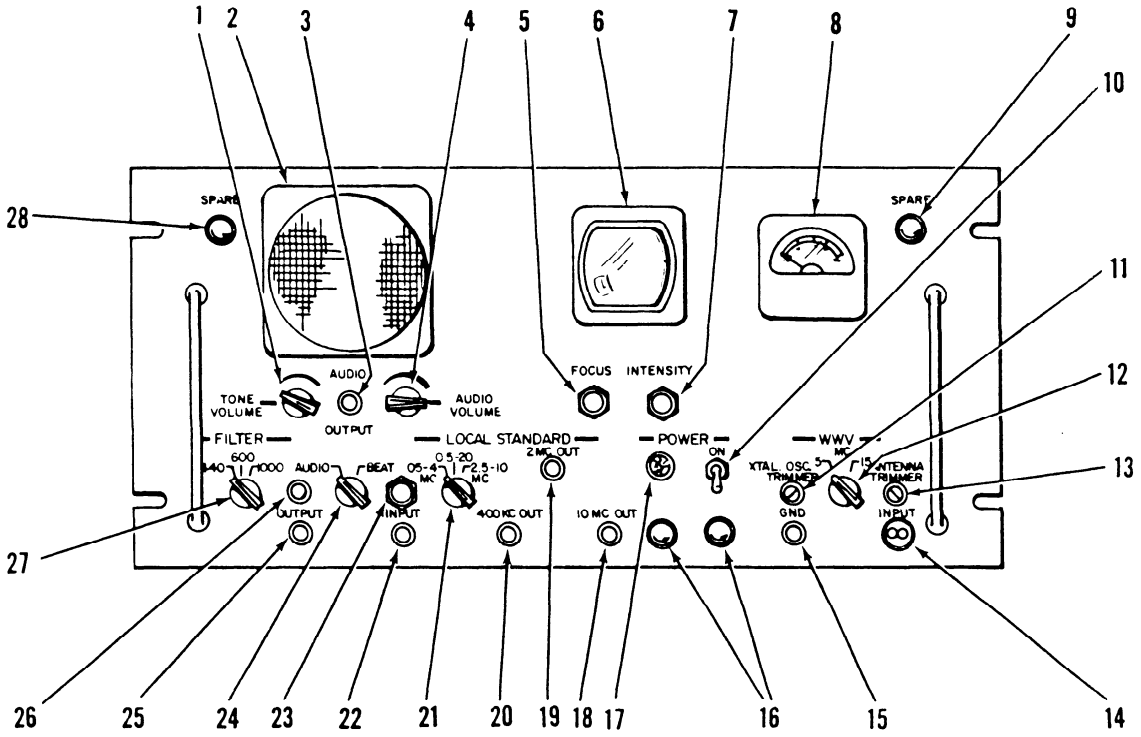
o. After completion of operation, disconnect local standard from INPUT jack (22).

p. Disconnect antenna from INPUT jack (14).

q. Set POWER switch (10) to off.

Table 4-1. Operating Controls, Indicators, and Jacks

ITEM	INDEX NO. Figure 4-1	FUNCTION
TONE VOLUME control (R140)	1	Varies output level of filtered tone output
AUDIO VOLUME control (R129)	4	Varies output level at built in speaker
FOCUS control (R181)	5	Sharpens rotary trace on face of CRT
INTENSITY control (R179)	7	Increases or decreases brilliance of trace on CRT
POWER switch (S105)	10	Energizes equipment
XTAL, OSC. TRIMMER control (C146)	11	Adjusts frequency of local oscillator
WWV frequency switch (S104)	12	Selects reception of 15 megacycles or 5 megacycles, National Bureau of Standards transmission
ANTENNA TRIMMER control (C103)	13	Provides optimum input to first stage of receivers
LOCAL STANDARD selector (S101)	21	Selects one of three frequency multipliers that convert local signal input to 10 mc
AUDIO-BEAT switch (S102)	24	Provides either WWV modulation (AUDIO) or beat note (BEAT) corresponding to difference in 10 megacycle signals
FILTER selector (S103)	27	Selects 440 cycle, 600 cycle, or 1000 cycle modulations for presentations at phone jacks or connector
CRT (V111)	6	Presents visual indication of frequency deviation between WWV standard and local standard
Bias level	8	Provides visual indication of tuned RF stage bias level
AUDIO OUTPUT (J106)	3	Provides phone jack (600 ohms)
INPUT (J101)	14	Provides for connection of antenna
GND (E101)	15	Provides receiver ground connection
10 MC OUT (J105)	18	Provides 10 megacycle output when local standard is a subharmonic of 10 megacycles
2 MC OUT (J104)	19	Provides 2 megacycle output when local standard is a subharmonic of 2 megacycles
400 KC OUT (J103)	20	Provides 400 kilocycle output when local standard is subharmonic of 400 kilocycles
INPUT (J102)	22	Provides for connection of local standard
OUTPUT (J107)	25	Provides noise free 440, 600, or 1000 cycle modulation of WWV signal
TONE (J108)	26	Provides output of 440, 600, or 1000 cycles, tone depending on position of S103



1 TONE VOLUME control
2 Speaker
3 AUDIO OUTPUT jack
4 AUDIO VOLUME control
5 FOCUS control
6 CRT
7 INTENSITY control
8 Bias level voltmeter
9 SPARE fuse
10 POWER switch
11 XTAL OSC. TRIMMER control
12 WWV frequency switch
13 ANTENNA TRIMMER control
14 INPUT jack
15 GND jack
16 2 AMP fuses
17 Power lamp
18 10 MC OUT jack
19 2 MC OUT jack
20 400 KC OUT jack
21 Local standard selector
22 INPUT jack
23 INPUT control
24 AUDIO-BEAT switch
25 OUTPUT jack
26 TONE output jack
27 FILTER selector
28 SPARE fuse

Figure 4-1. WWV Comparator Front Panel

SECTION V
PERIODIC INSPECTION, MAINTENANCE, AND LUBRICATION

5-1. SIX MONTH INSPECTION.

5-2. To ensure continued usefulness and reliability, the WWV comparator shall be inspected every six months. Proceed as follows:

a. Check front panel and cabinet for burrs, chips, scratches, rust, and dirt. Correct discrepancies.

b. Check WWV comparator for dust accumulation and poorly secured components. Correct discrepancies.

c. Check all front panel markings. All markings should be permanent and legible.

d. Replace power lamp (17, figure 4-1) and spare 2 ampere fuses (9) as necessary.

e. Calibrate WWV comparator in accordance with procedures outlined in Section VII.

f. Check security of antenna and antenna connections.

5-3. MAINTENANCE.

5-4. The WWV comparator and antenna do not require periodic maintenance. If a malfunction develops, follow the troubleshooting procedure outlined in Section VI.

5-5. CLEANING.

5-6. No special cleaning procedures or cleaning agents are required for the WWV comparator and antenna.

5-7. LUBRICATION.

5-8. The WWV comparator and antenna do not require lubrication.

SECTION VI
TROUBLESHOOTING

6-1. BASIC PROCEDURE.

6-2. Malfunctions of the WWV comparator may usually be traced to relatively simple causes such as blown fuses, broken wires, or poor connections. Check these possible trouble sources before making more detailed investigations. Perform all checks carefully and systematically.

6-3. TROUBLESHOOTING GUIDES.

6-4. The troubleshooting guide, table 6-1, lists the most likely malfunctions with probable causes and recommended remedial action.

6-5. Use voltage and resistance check (table 6-2) in isolating a malfunction to a definite stage of the WWV comparator. Voltage measurements should be taken only when the National Bureau of Standards signal is being received by the WWV comparator. If abnormal indications are encountered when performing voltage and resistance checks, the resistors and capacitors listed in table 6-2 should be checked individually and replaced as necessary.

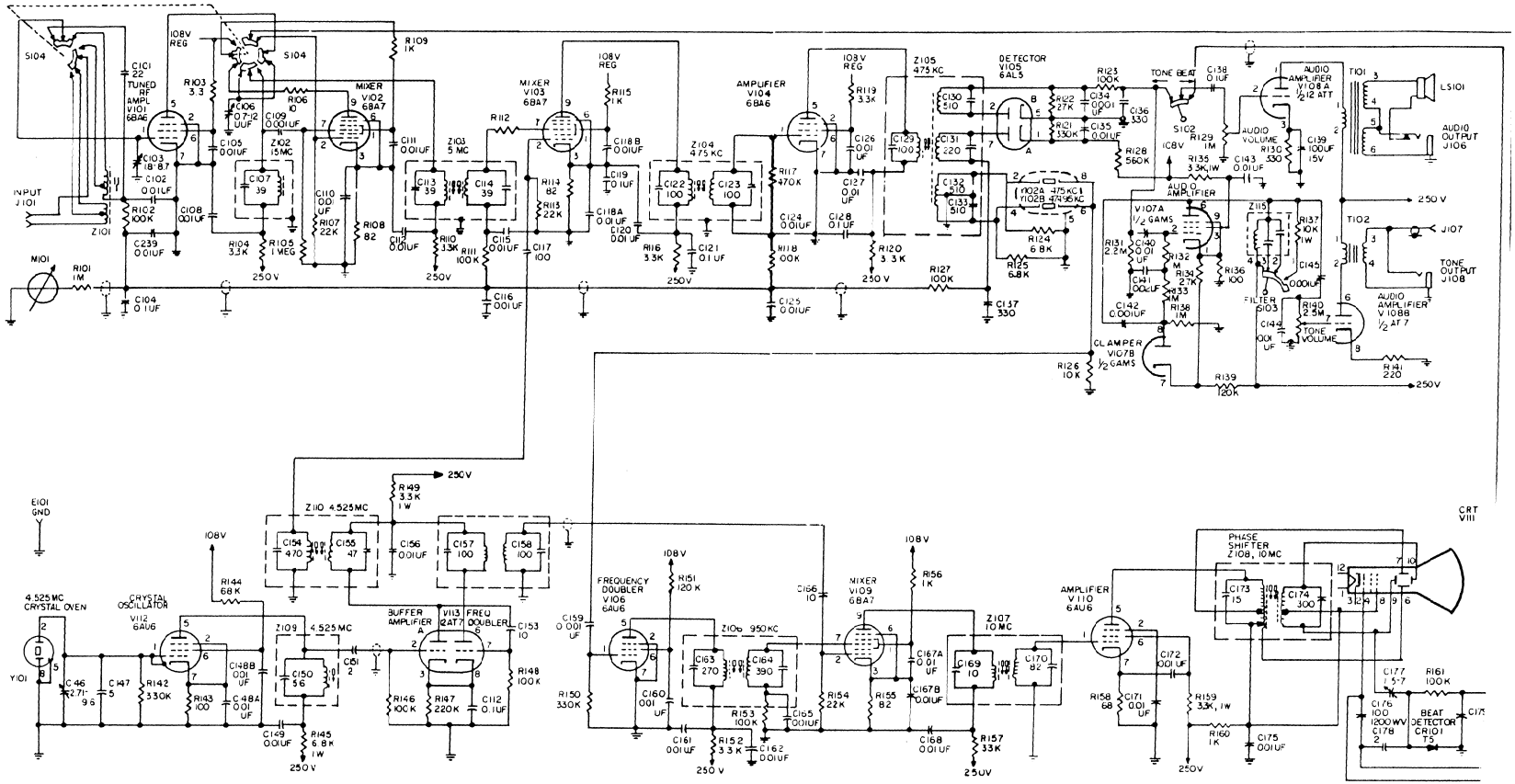
6-6. All voltages and resistances contained in table 6-2 are given in volts and ohms unless otherwise indicated and all measurements are made between the pin designated and ground with an AN/PSM-4 multimeter. The WWV comparator schematic diagram (figure 6-1) may be utilized to aid in pin-pointing a malfunction.

Table 6-1. Troubleshooting Guide

Trouble	Probable Cause	Remedy
5 mc beat not audible.	Mixer V103	Perform voltage and resistance checks in accordance with table 7-1 and replace electronic components as necessary.
15 mc beat not audible.		
Pin-point rather than circular trace on CRT.	Amplifier V110 Mixer V109 Frequency Doubler V106 Frequency Doubler V113B L.O. Trimmer (adjust) C146	Check tubes. Perform voltages and resistance checks in accordance with table 6-2 and replace electronic components as necessary.
No trace on CRT. Vertical trace on CRT. Horizontal trace on CRT.	Cathode Ray Tube V111 Pins 9 and 10, CRT V111 Pins 6 and 7, CRT V111	
No beat and no intensity modulation on CRT on 5 mc or 15 mc.	Input amplifier V114 400 KC Multiplier V115 2 mc Multiplier V116 10 mc Multiplier V117	
No video, no audio. Power lamp (17, figure 4-1) lit.	Rectifier V118 R.F. Amplifier V101 Mixer V103 I.F. Amplifier V104 Local Oscillator V112 Buffer Amplifier V113A	
No tone, no beat. Trace is normal.	Audible Amplifier V108A	
No tone, beat normal.	Detector V105B	
Tone and beat are present on speaker but not at J107 and J108.	Audio Amplifier V107 - V108A	
Inability to obtain 1 microvolt sensitivity during calibration.	Improper alignment of WWV comparator	Align WWV comparator as in table 7-1.

Table 6-2. Voltage and Resistance Check (Sheet 1 of 4)

CONTROL SETTING	TUBE	PIN NO.	VOLTAGE (DC)	RESISTANCE (OHMS)	IF INDICATION IS ABNORMAL, CHECK
Optional	V101	1	-0.75	1.15M	C103, R102, S104, wiring
		5	200	80K	S104, Z103, R110, wiring, 250 volt power supply, Z102, R104
		6	98	80K	R103, 108 volt power supply
		7	0	0	wiring to ground
S104 at 15 mc	V102	1	92	78K	R109, S104, C111, C112, 108 volt power supply
		2	0	22K	R107
		3, 6	1.5	85	R108



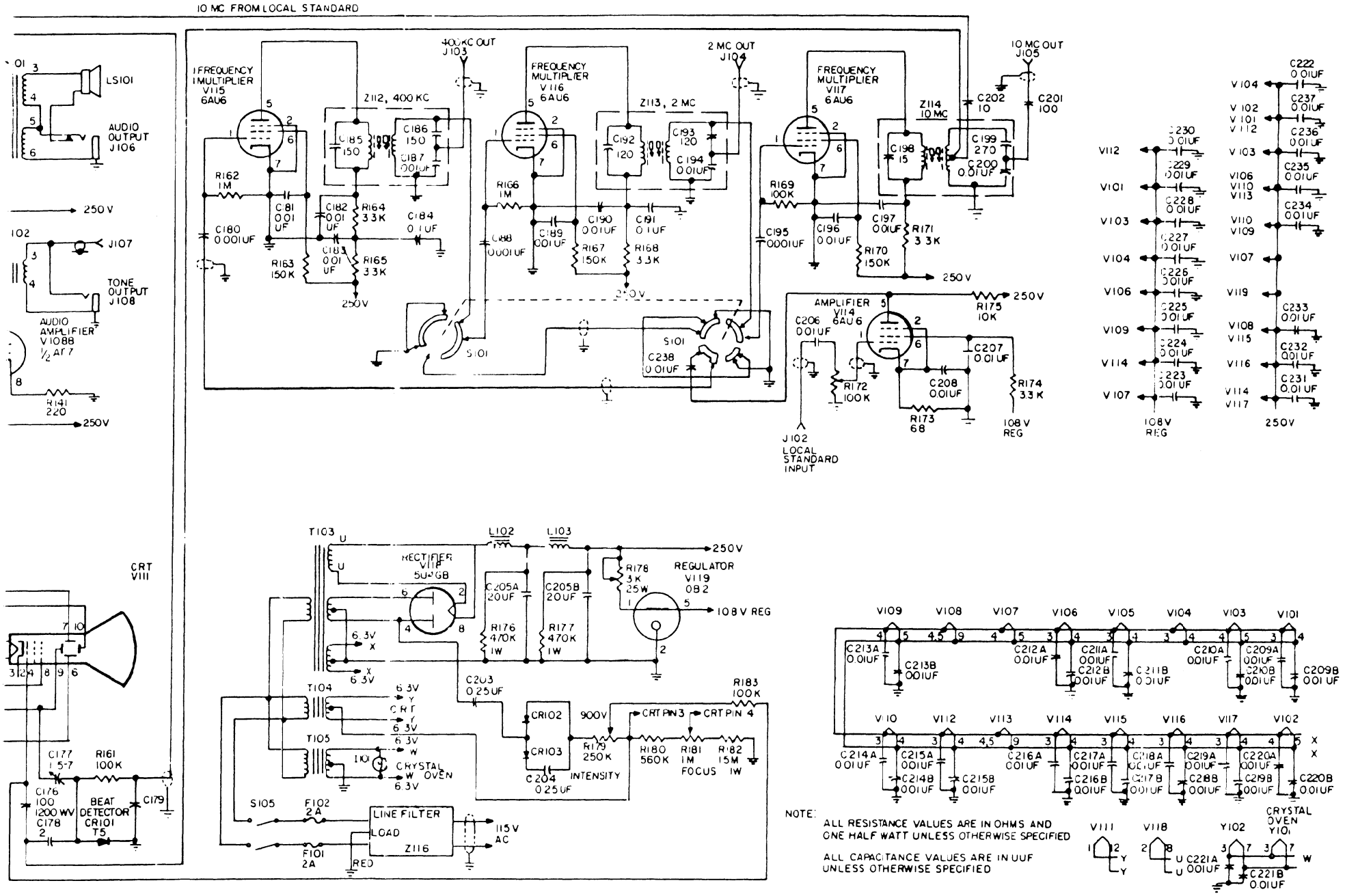


Table 6-2. Voltage and Resistance Check (Sheet 2 of 4)

CONTROL SETTING	TUBE	PIN NO.	VOLTAGE (DC)	RESISTANCE (OHMS)	IF INDICATION IS ABNORMAL, CHECK
S104 at 15 mc (Continued)	V102 (Continued)	7	0	80K	R105, C109
		9	175	80K	R106, S104, Z103, R110, 250 volt power supply
	V108 (Audio volume set full clockwise, tone volume set full clockwise)	1	220	75K	T101, 250 volt power supply
		2	0	1.15M	R129
		3	2	380	R130
		6	220	75K	T102, 250 volt power supply
		7	0	2M	R140
		8	0	250	R141
	V109	1	105	80K	R156, 108 volt power supply
		2	0	22K	R154
		3, 6	0	85	R155
		7	0	100K	Z106, R153
		9	220	80K	Z107, R157, 250 volt power supply
	V110	1	0	0	Z107, wiring to ground
		2, 7	0.65	1.8	R158
		5	208	70K	Z108, R160, 250 volt power supply
		6	116	110K	R159, 250 volt power supply
	V112	1	11.4	340K	R142, wiring to ground
		2, 7	0.3	75	R143
		5	175	80K	Z109, R145, 250 volt power supply
		6	100	80K	R144, 108V power supply
	V113	1	190	80K	Z110, R149, 250 volt power supply
		2	-0.58	100K	R146, C151
		3, 8	1.7	230	R147
		6	190	78K	Z111, R149
		7	-37.5	100K	R148, C153
S104 at 5 mc	V103	1	95	80K	R115, 108 volt power supply
		2	0	23K	R113, C117
		3, 6	1	80	R114, C119, C120, C118A, 250 volt power supply
		7	-0.8	12M	R112, Z103, R111, C115, R101
		9	200	80K	Z104, R116
	V104	1	-0.8	1.15M	R117, R118, C124, C125, Z104, R101
		2, 7	0	0	C126, C127, wiring to ground
		5	180	80K	Z105, R120, 250 volt power supply
		6	93	80K	R119, 108 volt power supply
	V105	1	38.5	220K	R121, R128, 108 volt power supply
		2	-0.14	28K	Z105, R122
		5	0	0	wiring to ground
		7	-0.7	1.15M	Z105, R101, R127
	V106	1	-0.2	350K	R150, Y102A, Y102B, R126, C159
		2, 7	0	0	wiring to ground

Table 6-2. Voltage and Resistance Check (Sheet 3 of 4)

CONTROL SETTING	TUBE	PIN NO.	VOLTAGE (DC)	RESISTANCE (OHMS)	IF INDICATION IS ABNORMAL, CHECK
S104 at 5 mc (Continued)	V106 (Continued)	5	215	80K	Z106, R152, 250 volt power supply
		6	38	200K	R151, C160, 108 volt power supply
	V107	1, 9	0.985	100	R134, R136
		2	-0.01	3M	R132, R133, R138
		3	102	80K	C143, R135, 108 volt power supply
		6	220	75K	Z115, 250 volt power supply
		7	6	3K	R139, 250 volt power supply, R134, R136
		8	0	1.05M	R138, C142
	V114	1	-0.12	40K	R172
		2, 7	0.52	70	R173, C207, C208
		5	160	90K	R175, 250 volt power supply
		6	99	80K	R174, 108 volt power supply, C207
	V115	1	-0.35	1.1M	R162
		2, 7	0	0	wiring to ground
		5	210	80K	Z112, R164, R165, 250 volt power supply
		6	88	220K	R163, C181, 250 volt power supply
	V116	1	-0.33	1M	R166, C188
		2, 7	0	0	wiring to ground
		5	210	80K	Z113, R168, 250 volt power supply
		6	58	220K	R167, C189, 250 volt power supply
	V117	1	-0.22	100K	R169, C195
		2, 7	0	0	wiring to ground
		5	210	80K	Z114, R171, C197, 250 volt power supply
		6	52	220K	R170, C196, 250 volt power supply
	V118	8	270	70K	L102, L103, T103, C205A, C205B, R176, R177
		4	350	1.7	T103
		6	350	2	T103
	V119	1	110	80K	R178, 250 volt power supply
		2	0	0	wiring to ground
		5	110	80K	V119, 250 volt power supply
			WARNING		
			Do not measure voltages at pins of V111 (CRT) without high-voltage probes.		
INTENSITY control full clockwise	V111	1	740	3M	T104
		2	540	3.4M	R183, R179, CR102, CR103, C204, C203, T103, C176, R180, R181, R182.
		3	540	3M	T104
		4	370	2.2M	R181, R180, R179, CR102, CR103, C204, C203, T103

Table 6-2. Voltage and Resistance Check (Sheet 4 of 4)

CONTROL SETTING	TUBE	PIN NO.	VOLTAGE (DC)	RESISTANCE (OHMS)	IF INDICATION IS ABNORMAL, CHECK
INTENSITY control full clockwise (Continued)	V111 (Continued)	6	190	80K	Z108, R160, 250 volt power supply
		7	190	80K	Z108, R160, 250 volt power supply
		8	190	80K	Z108, R160, 250 volt power supply
		9	190	80K	Z108, R160, 250 volt power supply
		10	190	80K	Z108, R160, 250 volt power supply

SECTION VII
CALIBRATION

7-1. SENSITIVITY CALIBRATION.

7-2. A sensitivity calibration of the WWV comparator shall be accomplished every six months. If a sensitivity of one microvolt cannot be attained, the WWV comparator shall be subjected to troubleshooting as outlined in section VI.

7-3. EQUIPMENT REQUIRED.

7-4. A signal generator, Measurements model 65B or equivalent, is required in performing the sensitivity calibration of the WWV comparator.

7-5. PROCEDURES.

7-6. 15 MEGACYCLE RECEPTION. Perform the sensitivity calibration as follows:

a. Connect signal generator to INPUT jack J101 (14, figure 4-1).

b. Set signal generator frequency to 14 megacycles and output to approximately 100 microvolts.

c. Set WWV frequency switch (12) to 15 megacycles.

d. Adjust ANTENNA TRIMMER control (13), INTENSITY control (7), and XTAL OSC TRIMMER control (11) as necessary to obtain optimum trace on CRT (6).

e. Decrease signal generator output until trace on CRT disappears.

f. Determine signal generator output. Output should be one microvolt or less.

7-7. 5 MEGACYCLE RECEPTION. The sensitivity calibration for 5 megacycles reception is accomplished in the same manner as the 15 megacycles calibration except that the signal generator output frequency is 5 megacycles and the WWV frequency switch (12) shall be set to 5 megacycles.

7-8. ALIGNMENT.

7-9. The WWV comparator shall be aligned on initial receipt of the unit, after replacement of major components in the unit, and when directed by the troubleshooting guide, table 6-1.

7-10. To align the WWV comparator, accomplish the procedures contained in table 7-1, utilizing a Hewlett-Packard 400H Vacuum Tube Voltmeter and a Measurements model 65B Signal Generator, or equivalents. (See figures 7-1 and 7-2.) All voltages contained in table 7-1 are peak-to-peak unless otherwise specified. If input is applied to J101, adjust ANTENNA TRIMMER (13, figure 4-1) for maximum output for each test.

Table 7-1. Alignment Procedure

ALIGN	INPUT			OUTPUT		SPECIAL PROCEDURES
	Source	Jack	Level and Frequency	Jack	Level and Frequency	
Z112	Local signal	J102	13.5 volts 10 KC	J103 (400 KC out)	1.59 volts ac	Adjust R172 until minimum trace on CRT is obtained.
Z113	Local signal	J102	13.5 volts 100 KC	J104 (2 MC out)	0.96 volts ac	
Z114	Local signal	J102	13.5 volts 100 KC	J105 (10 MC out)	0.192 volts ac	
Z109	Local signal	J102	13.5 volts 100KC	V113-2	3.4 volts 4.525 mc	Set C146 XTAL. OSC. TRIMMER to center position. Adjust Z109 until oscillations stop. Turn back 1/4 turn.

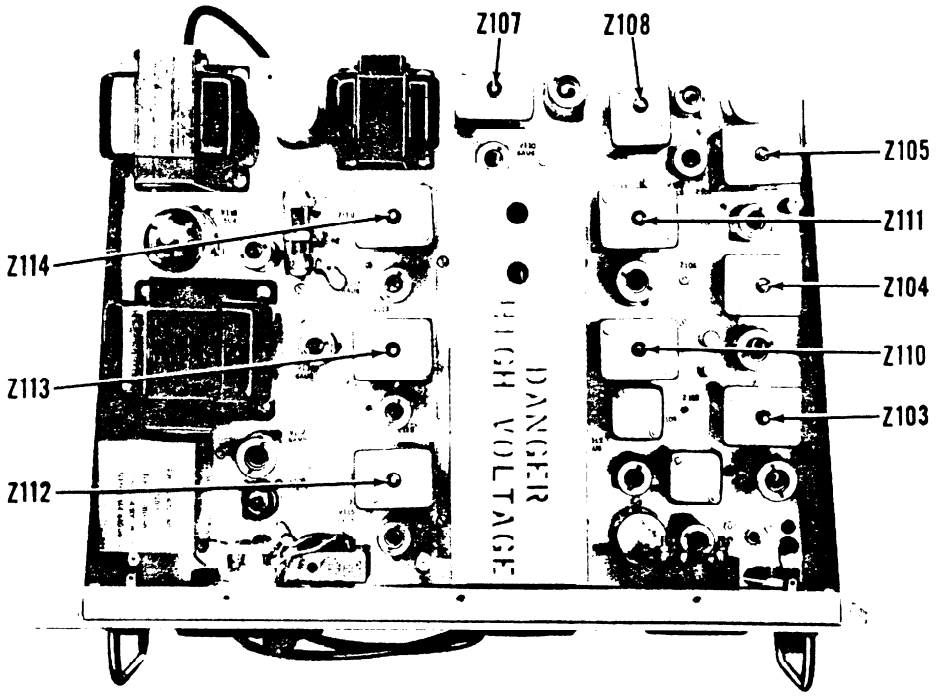


Figure 7-1. WWV Comparator Top View

Figure 7-2. WWV Comparator Bottom View