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NAVSHIPS 94198

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TECHNICAL MANUAL

for

ANTENNA TUNING GROUP
AN/BRA-6

ITT FEDERAL LABORATORIES

A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

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From: Chief, Bureau of Ships
To: All Activities concerned with the Installation, Operation,
and Maintenance of the Subject Equipment
Subj: Technical Manual for Antenna Tuning Group AN/BRA-6, NAVSHIPS
94198

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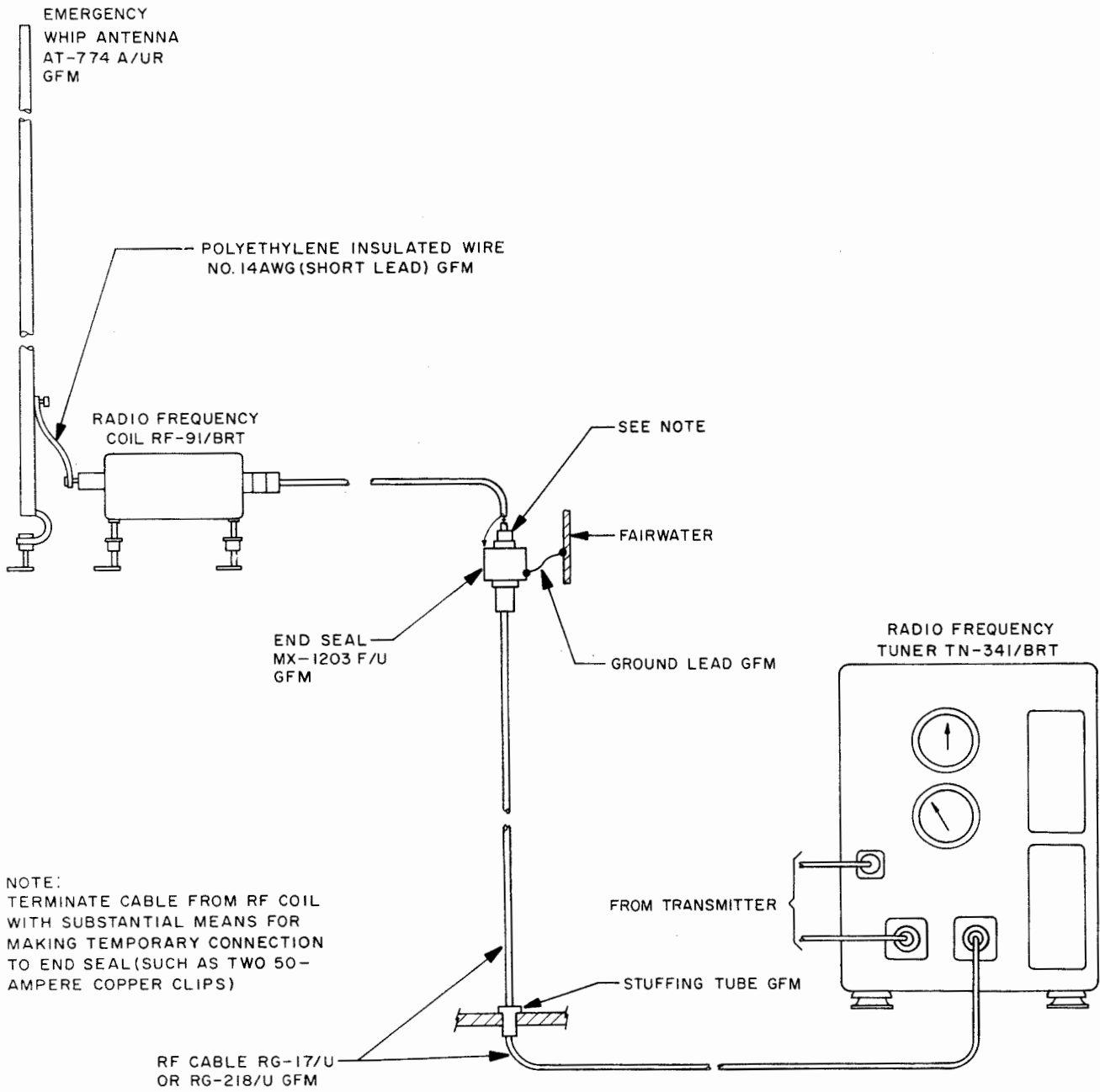


Figure 1-1. Antenna Tuning Group AN/BRA-6

SECTION 1

GENERAL INFORMATION

1-1. EQUIPMENT ILLUSTRATION.

This technical manual describes the procedures for the installation, operation, and maintenance of Antenna Tuning Group AN/BRA-6 (see figure 1-1).

1-2. FUNCTIONAL DESCRIPTION.

Antenna Tuning Group AN/BRA-6, consisting of Radio Frequency Tuner TN-341/BRT (see figure 1-2) and Radio Frequency Coil RF-91/BRT (see figure 1-3), provides for emergency communication for submarines when normally used antenna equipment is inoperable. The equipment is a tuning network for matching the input impedance of Antenna AT-774A/UR to a 50-ohm transmitter feedline, within a standing wave ratio of 3:1. The antenna tuning group operates over a frequency range of 2 to 30 mc at an average power input of up to 750 watts. The rf tuner and rf coil provide the proper matching of antenna to transmitter by the removal or insertion of inductance and capacitance in the antenna circuit, thus increasing or decreasing the effective antenna impedance. The AN/BRA-6 is designed for surface operation only.

a. RADIO FREQUENCY TUNER TN-341/BRT. - The manually operated Radio Frequency Tuner TN-341/BRT consists basically of a coil with shorting links, two adjustable vacuum capacitors, a reflectometer circuit for monitoring the voltage standing wave ratio (SWR) and an rf output meter circuit. Two meters on the front panel indicate rf power and SWR. The tuner is shock-mounted on a bulkhead or table top close to the transmitter to facilitate operation after tuning the transmitter.

b. RADIO FREQUENCY COIL RF-91/BRT. - The radio frequency coil is enclosed in a cover equipped with C-clamps for mounting topside close to the antenna. The three shorting bars supplied are used as required on transmission frequencies in the 2 to 6-mc range. In the 6 to 30-mc frequency range, Radio Frequency Coil RF-91/BRT is not used.

1-3. FACTORY OR FIELD CHANGES.

There are no factory or field changes on this equipment.

1-4. QUICK REFERENCE DATA.

a. Frequency range: tunable from 2 to 30 mc (manually).

b. Power rating:

(1) Average power input up to 750 watts, continuous wave (cw).

(2) Carrier - 500 watts, amplitude modulated up to 100 percent.

(3) Cw pulsed - 5000 watts; duration of pulse - 3 seconds; pulse repetition rate - not to exceed one pulse every 3 minutes.

c. Input impedance: 50 ohms at SWR of 3:1 or better.

d. Output impedance: 50 ohms at SWR of 3:1 or better; the AN/BRA-6 matches the impedance of emergency whip antenna AT-774A/UR and also any antenna that can be corrected for emergency operation at 2 to 30 mc through a 50-ohm cable of 25 to 100-foot length.

e. Efficiency:

(1) At 2 mc - 2 percent.

(2) At 6 mc - 30 percent.

(3) At 6 to 30 mc - 30 to 80 percent.

(4) Low efficiency at 2 mc is due to the short antenna length and the shunting effect of the base insulator. These combine to give a low antenna input resistance.

f. Loss:

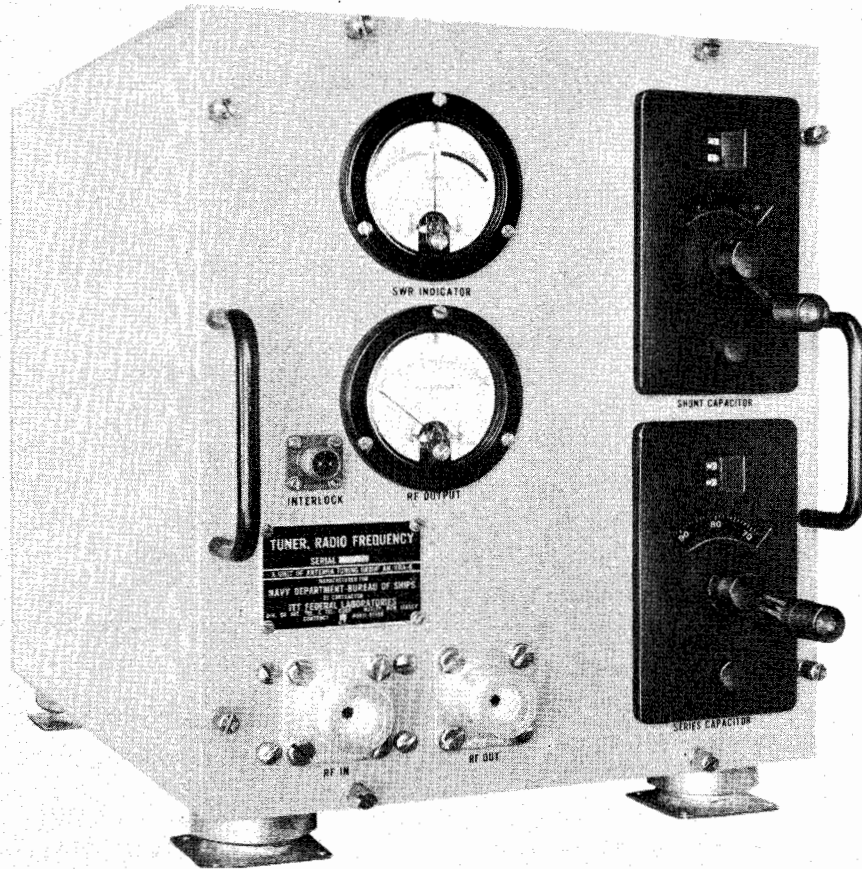


Figure 1-2. Radio Frequency Tuner TN-341/BRT

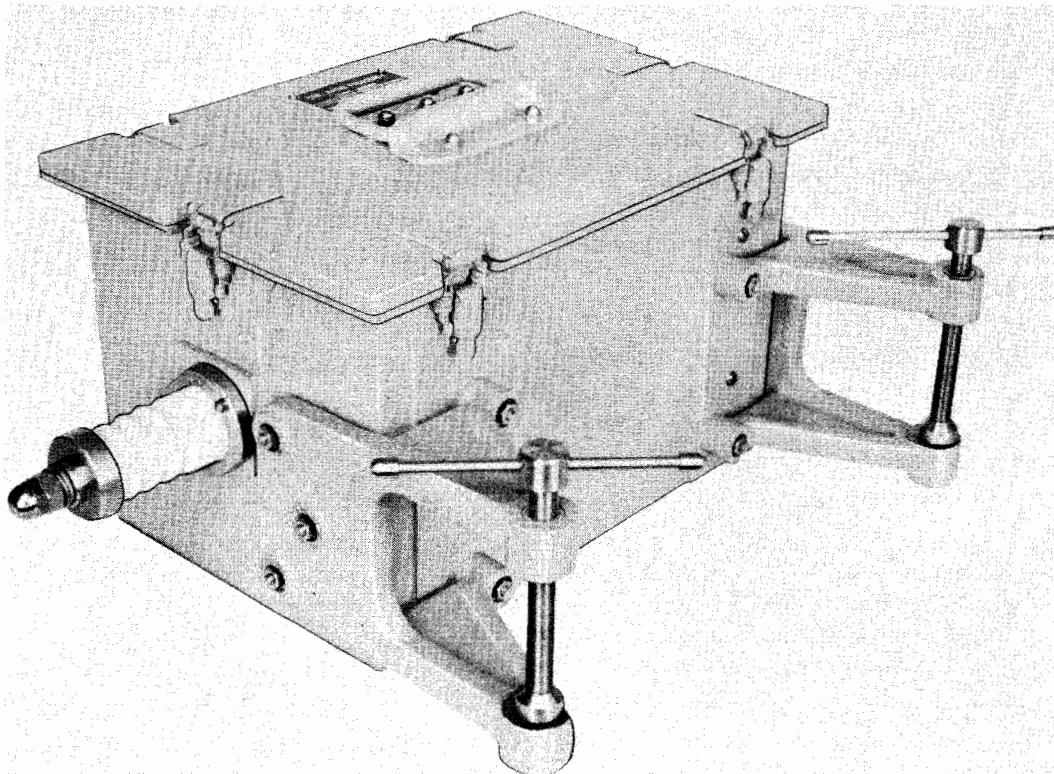


Figure 1-3. Radio Frequency Coil RF-91/BRT

(1) Cable loss. - At unity SWR, RG-218/U cable has an attenuation of 0.1 db per 100 feet at 2 mc and rises to 0.5 db at 30 mc. However, a high SWR causes a substantial increase in loss, especially at lower frequencies. This is due to low antenna resistance and high reactance.

(2) Tuner loss. - At the lower frequencies, tuning coil L103 and series capacitor C112 carry heavy current. At 2 mc this is approximately 25 amp rms at 750 watts input and 65 amp rms at 5000 watts. Although the Q of the tuning coil is high, a large amount of power is dissipated therein.

g. Interlock input rating: 10 amp at 125 to 250 vac.

h. Monitoring indicators:

(1) SWR meter - M101.

(a) Range: 100-0-100 ua, nonlinear.

(b) Accuracy: $\pm 2\%$.

(2) RF Output Meter - M102.

(a) Range: 0-100 ua, nonlinear.

(b) Accuracy: $\pm 2\%$, arbitrary scale.

1-5. EQUIPMENT LISTS.

a. EQUIPMENT SUPPLIED. - Table 1-1 lists the equipment supplied.

b. EQUIPMENT REQUIRED BUT NOT SUPPLIED. - Table 1-2 lists the equipment required but not supplied.

c. SHIPPING DATA. - Table 1-3 lists the shipping data.

TABLE 1-1. ANTENNA TUNING GROUP AN/BRA-6, EQUIPMENT SUPPLIED

QUANT. PER EQUIP.	NOMENCLATURE		*OVERALL DIMENSIONS			*VOL	*WT
	NAME	DESIGNATION	H	W	D		
1	Radio Frequency Tuner	TN-341/BRT	15-5/8	12-1/2	16-7/8	1.8	73
1	Radio Frequency Coil	RF-91/BRT	10-1/4	9-1/16	14-7/8	0.6	33
1	Connector, Plug	UG-154/U					
2	Connector, Plug	UG-154A/U					
1	Connector, Plug	MS3106E10SL-4S					
2	Technical Manual	NAVSHIPS 94198					

*Dimensions are in inches, volume in cubic feet, and weight in pounds.

TABLE 1-2. ANTENNA TUNING GROUP AN/BRA-6, EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANT. PER EQUIP.	NOMENCLATURE		REQUIRED USE
	NAME	DESIGNATION	
1	Antenna	AT-774A/UR	RF radiator
1 (length as required)	RF Cable	RG-218/U or RG-17/U	Connection between rf tuner and rf coil
1 (3 ft. max.)	Polyethylene insulated wire #14AWG	--	Connection between rf coil and antenna
1	Stuffing Tube	--	Deck feedthrough
1	End Seal	MX-1203F/U	Cable ending
3	Dummy Load	DA-91/U	Test equipment
2	Tee Connector	UG-566A/U	Test setup
3	Connector	UG-573A/U	Test setup
as required	Cable	RC-8/U	Test setup
1	Potentiometer (250 k 2 w)	Allen Bradley Type CU-2541 or equivalent	Test setup

TABLE 1-3. ANTENNA TUNING GROUP AN/BRA-6, SHIPPING DATA

BOX NO.	NOMENCLATURE		*OVERALL DIMENSIONS			*VOL	*WT
	NAME	DESIGNATION	H	W	D		
1	Antenna Tuning Group	AN/BRA-6	18	32	24	8	135

*Unless otherwise stated, dimensions are in inches, volume in cubic feet, weight in pounds; equipment crated and ready for shipment.

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

Antenna Tuning Group AN/BRA-6 requires standard care in unpacking and handling. Do not drop the shipping crate or thrust pinch bars or other tools into it while unpacking.

To avoid excess handling, uncrate the Antenna Tuning Group as close as possible to the place of installation. After unpacking, inspect the equipment for damaged components, dials, etc.; then check the equipment received with the list given in table 1-1. Then, install the equipment in accordance with instructions given in paragraph 2-4.

2-2. MOUNTING LOCATION.

The rf tuner is designed primarily for table top, bulkhead, or rack mounting; for the latter two methods, mounting brackets are required but are not supplied. The rf coil is designed for clamping to any edge topside convenient to the antenna.

2-3. POWER REQUIREMENTS.

The AN/BRA-6 does not require any power connections.

2-4. INSTALLATION.

Install the rf tuner in the radio room. Select a site where there are sufficient clearances for operating and servicing the equipment. Be certain there is adequate clearance in front of the rf tuner to permit extending the chassis from the unit for servicing (see figure 2-1).

a. RADIO FREQUENCY TUNER TN-341/BRT MOUNTING. (See figures 1-2 and 2-1.) - The rf tuner is ready for installation as soon as it is removed from the shipping container. To mount the unit, proceed as follows:

Step 1. Place the unit in a clear flat deck area with sufficient room in front of the unit so that the chassis can be removed.

Step 2. Loosen the eight captive screws on the front panel and pull the chassis out as far as it will go. Push it back a few inches, then reach inside the top front of the unit and push the retaining bar upward. Hold the bar in this position and withdraw the chassis completely (slowly, to avoid pinching fingers).

Step 3. Set the chassis aside.

Step 4. Place the cabinet in its designated mounting position. Make sure that there will be sufficient vertical space for the unit when the shockmounts are attached.

Step 5. With the cabinet in position, scribe four locating circles on the table top through the mounting holes in the bottom of the cabinet.

Step 6. Make a template, using figure 2-2 as a guide.

Step 7. Place the template so that its center is over the center of the locating circles and its outside edge is parallel with the outside edge of the cabinet in its installed position.

Step 8. Scribe the marks for the shockmount mounting screws. Perform this step at the three other locating circles.

Step 9. Drill 16 1/4-inch holes in the table top at the locations marked in step 8 and secure the shockmounts to the table top with 16 3/16-inch bolts, nuts, and lockwashers.

Step 10. Place the cabinet on the shockmounts and secure it with the 1/4-inch screws supplied.

Step 11. Replace the chassis within the cabinet. Tighten the eight captive screws.

b. RADIO FREQUENCY COIL RF-91/BRT MOUNTING. (See figures 1-1 and 2-3.) - Before installing the rf coil, adjust it according to the instructions given in paragraph 2-5b. At frequencies

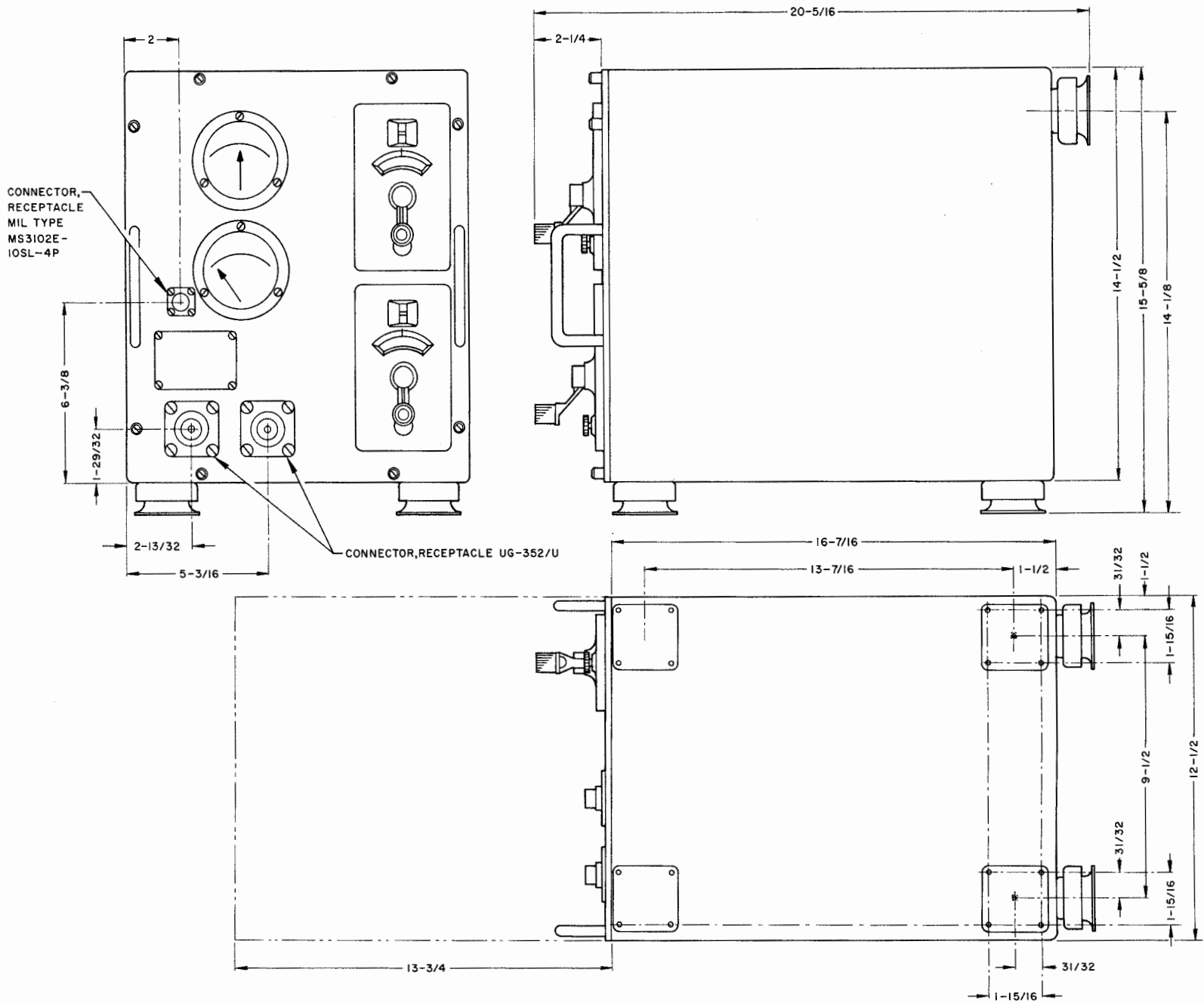


Figure 2-1. Radio Frequency Tuner TN-341/BRT, Mounting Dimensions

above 6 mc, the rf coil is not used. After adjusting the rf coil, mount it topside close to the antenna. Clamp it to a ledge as close as possible to the antenna to keep lead length between the rf coil and the antenna to a minimum (between one and three feet, if practical). Excessive length will reduce the output of the antenna. The loss in decibels per foot is 1/10 db per 100 feet at 2 mc and 5/10 db per 100 feet at 30 mc at unity SWR, but the high SWR encountered in this application will result in loss much greater than that at unity SWR.

NOTE

Radio Frequency Coil RF-91/BRT is designed for surface operation only. Store it below decks when not in use.

c. INTERCONNECTING CABLE INSTALLATION. (See figures 1-1 and 3-2.) Disconnect the transmitter output cable from its usual antenna and connect it to the RF IN jack on the rf tuner. If necessary, install a UG-154/U connector to the transmitter cable to permit connection to the rf tuner. Figure 2-4 gives assembly instructions for this connector.

Run type RG-218/U cable from RF OUT jack J102 of the rf tuner to an end seal type MX-1203F/U on the fairwater. Make a good permanent electrical connection from the shell of the end seal to the metallic structure of the fairwater. Provide a length of RG-218/U cable to run from J201 (UG-352B/U) of the rf coil to the end seal. Terminate the cable (both inner conductor and outer braid) with substantial means for making temporary connection to the end seal. Fifty-ampere copper test clips are adequate. The cable length will vary with each installation. Install a UG-154/U connector (see figure 2-4) to the RG-218/U cable for connecting to J102 on the rf tuner and install RG-154A/U (see figure 2-5) to the other RG-218/U cable for connecting to J201 on the rf coil.

After installing and connecting the cables, connect E201 (see figure 5-5) of the rf coil to the antenna. Use no. 14 AWG polyethylene insulated wire. The recommended length is one to three feet. Keep the wire at least three inches away from the superstructure.

2-5. EQUIPMENT ADJUSTMENT.

Both Radio Frequency Tuner TN-341/BRT and Radio Frequency Coil RF-91/BRT are equipped with shorting bars to adjust the equipment for transmission at various frequencies.

a. RADIO FREQUENCY TUNER TN-341/BRT COIL ADJUSTMENT. (See figure 2-6.) - Adjust coil L103 according to figure 2-6. There are two shorting links (one 3-section and one slotted) which are screwed onto blocks mounted on the coil. When not in use, the links are stowed in the top front right-hand corner of the tuner chassis. Table 2-1 lists the shorting links used at the various frequency ranges.

b. RADIO FREQUENCY COIL RF-91/BRT ADJUSTMENT. - The rf coil is used only when operating on frequencies between 2 and 6 mc. Adjustment of the rf coil is accomplished by inserting the proper number of shorting bars. The bars are numbered and each one shorts out a specific number of turns on the coil.

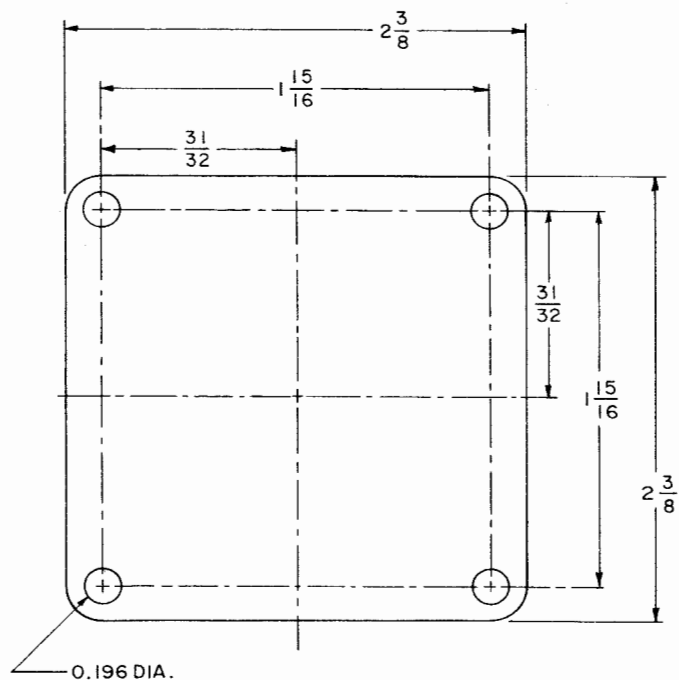


Figure 2-2. RF Tuner Shockmount Template

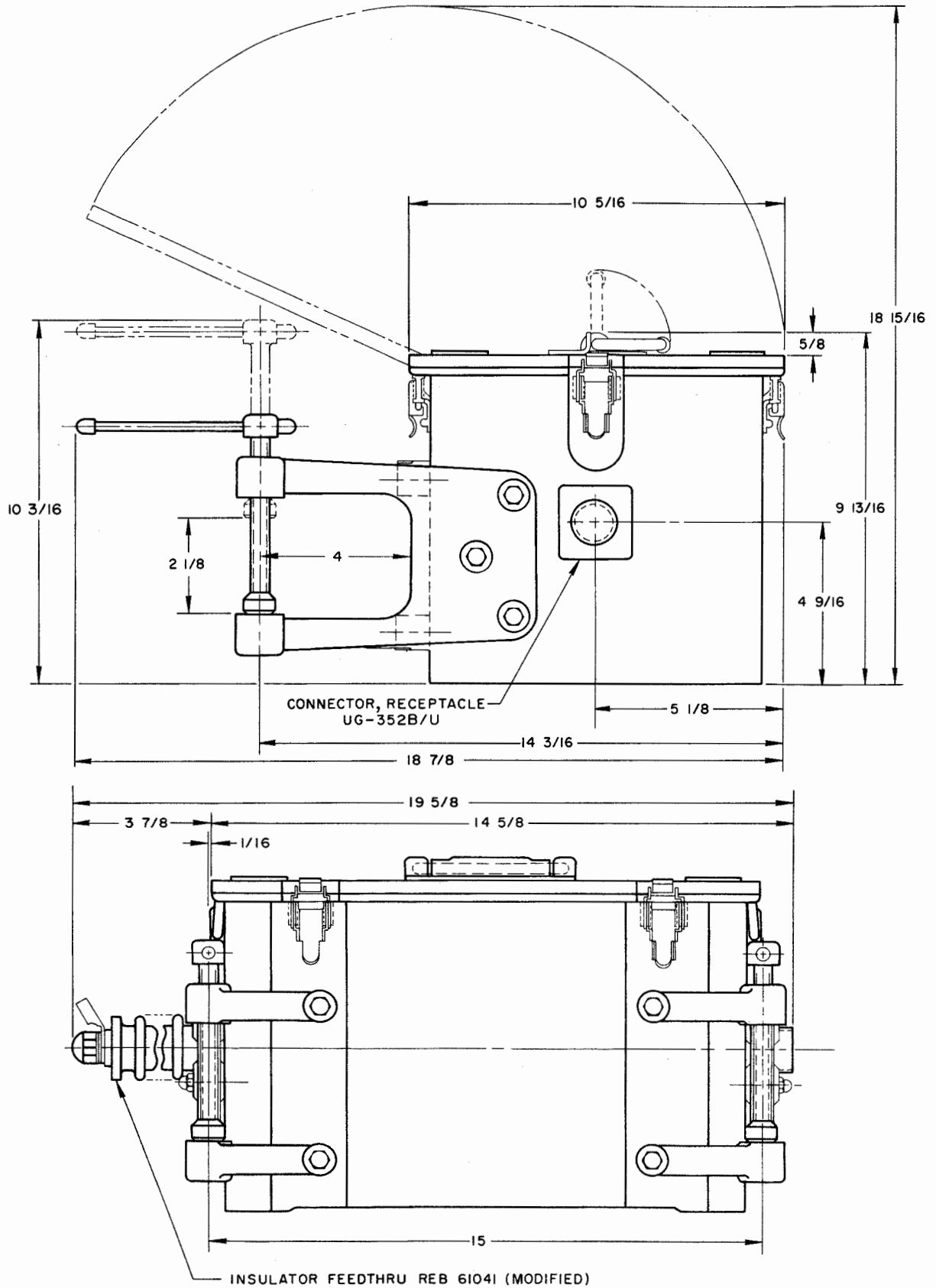
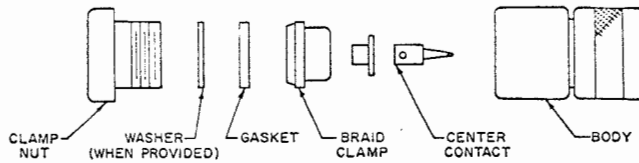
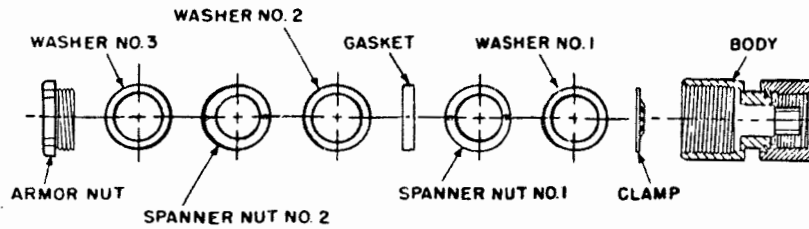


Figure 2-3. Radio Frequency Coil RF-91/BRT, Mounting Dimensions



	<p>STEP 1. Slide clamp nut and gasket back over cable. Cut cable jacket square to dimension A (1-19/32 inches). Do not nick braid.</p>
	<p>STEP 2. Comb out braid.</p>
	<p>STEP 3. Taper braid over end of cable. Insert braid clamp, butting inner shoulder firmly against end of jacket.</p>
	<p>STEP 4. Dress braidback over braid clamp and trim as shown. Check that projection of dielectric beyond braid clamp is equal to dimension B (1-3/32 inches).</p>
	<p>STEP 5. Slide center contact over inner conductor and butt firmly against end of dielectric or insulating bushing. Solder contact to conductor taking care not to damage dielectric. Remove excess solder.</p>
	<p>STEP 6. Slide gasket forward, seating V-groove over braid clamp as shown.</p>
	<p>STEP 7. Insert cable, less clamp nut, into connector body. Cable dielectric must butt firmly against body insulator. Thread clamp nut into body, holding cable and body rigid, while rotating nut. Wrench tight.</p>

Figure 2-4. Assembly Instructions for UG-154/U Connector and RG-218/U or RG-17/U Cable



	<p>STEP 1. Slip armor nut and washer No. 3 over cable armor. Cut armor sharp and square at desired point allowing approximately 1/4 inch for fanning the armor and using connector body to determine first cut. This applies to cable which has been installed in run. Allow approximately 4 inches for making assembly. Cut off remaining cable end.</p>
	<p>STEP 2. Cut cable jacket sharp and square with knife 3/8 inch from cut of armor. Do not damage conductor braid. Push back shield conductor braid and cut off approximately 3/4 inches of dielectric and inner conductor.</p>
	<p>STEP 3. Pull braid forward and taper to a point. Fan 1/4 inches of armor against washer No. 3 and trim flush with washer. Slide spanner nut No. 2, washer No. 2, gasket, and spanner nut No. 1 against fanned out armor, pushing armor back to allow parts to slide over jacket. Slide washer No. 1 over braid and against jacket.</p>
	<p>STEP 4. Cut off braid 1/4 inch from washer and fan against washer. Trim flush with outside diameter of washer.</p>
	<p>STEP 5. Slide clamp against fanned out braid. Splitfingers on clamp should extend towards end of cable.</p>
	<p>STEP 6. Push spanner nut No. 1 back to bulging armor, allowing approximately 2 inches for spanner wrench. Insert prepared end of cable into plug body.</p>
	<p>STEP 7. Apply a small amount of dielectric compound to spanner nut threads and gasket. Screw spanner nut No. 1 tightly into Body using wrench TL-323/U. Slide gasket and washer No. 2 into body. Screw spanner No. 2 tight against washer No. 2. Push armor and washer No. 3 into body by smoothing bulge in armor. Screw up armor nut tightly securing armor. Tap end of dielectric with hammer to allow braid and armor to set properly. Cut dielectric of cable flush with forward edge of coupling ring. Do not nick center conductor. Remove dielectric with gas pliers. Cut center conductor 1/2 inch from dielectric. Round off center conductor with file.</p> <p style="text-align: center;">CAUTION Make sure no filings are left on dielectric.</p>

Figure 2-5. Assembly Instructions for UG-154A/U Connector and RG-218/U or RG-17/U Cable

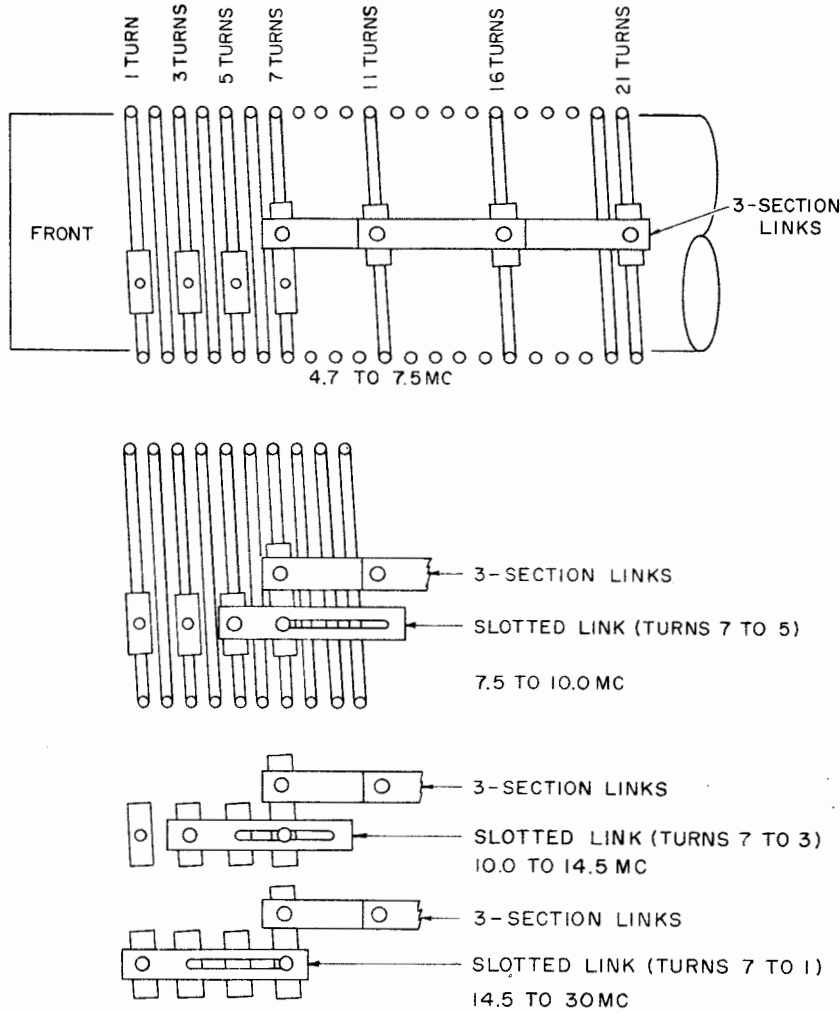


Figure 2-6. Radio Frequency Tuner TN-341/BRT, Shorting Links Adjustment

Table 2-2 lists the rf coil shorting bars required for the various frequencies between 2 and 6 mc.

NOTE

Always install the shorting bars before mounting the rf coil to avoid risk of losing shorting bars overboard.

2-6. INTERFERENCE REDUCTION.

Since the AN/BRA-6 is virtually nonsusceptible

to radio interference, no special interference reduction procedures are required.

2-7. PREPARATION FOR RESHIPMENT.

It is not necessary to remove any parts from the equipment when packaging for reshipment. Check that the eight captive screws on the front panel are tight. Use the original shipping container if available. No special procedures are required for packing except that desiccant bags and moisture-vaporproof wrapping should be used.

TABLE 2-1. RADIO FREQUENCY TUNER TN-341/BRT SHORTING LINKS
USED AT VARIOUS FREQUENCY RANGES

FREQUENCY RANGE (mc)	SHORTING LINKS USED	COIL TURNS SHORTED
2.0 to 4.7	None	None
4.7 to 7.5	One (3-section)	7-21
7.5 to 10.0	Two (3-section and slotted)	5-21
10.0 to 14.5	Two (3-section and slotted)	3-21
14.5 to 30.0	Two (3-section and slotted)	1-21

TABLE 2-2. RADIO FREQUENCY COIL RF-91/BRT SHORTING BARS USED AT VARIOUS
FREQUENCY RANGES WITH AT-774A/UR ANTENNA WITH BASE AND FIVE 3-FOOT
SECTIONS

FREQUENCY RANGE (mc)	SHORTING BARS USED	NUMBER OF COIL TURNS SHORTED
2.0 - 2.2	None	None
2.2 - 2.5	No. 1	7
2.5 - 2.8	No. 3	14
2.8 - 3.3	No. 2	21
3.3 - 4.0	Nos. 1 and 2	28
4.0 - 6.0	Nos. 2 and 3	35

SECTION 3 OPERATOR'S SECTION

3-1. GENERAL.

This section describes the operating controls and procedures for Antenna Tuning Group AN/BRA-6. Operating controls are located on the front panel of the rf tuner, and the shorting links for L103 are stored inside the unit. The shorting bars for the rf coil are stored inside the rf coil cover.

3-2. OPERATING CONTROLS AND INDICATORS.

(See figure 3-1.)

Table 3-1 lists the operating controls and indicators and describes their functions.

3-3. INITIAL ADJUSTMENTS.

Before operating Antenna Tuning Group AN/BRA-6, insert the shorting bars and links required for the operating frequency in use (see tables 2-1 and 2-2). Refer to SECTION 2, INSTALLATION, for equipment installation procedures. If the operating frequency is above 6 mc, Radio Frequency Coil RF-91/BRT is not used. At frequencies above 12 mc, the rf tuner need not be used provided the antenna length is approximately 1/4 wavelength.

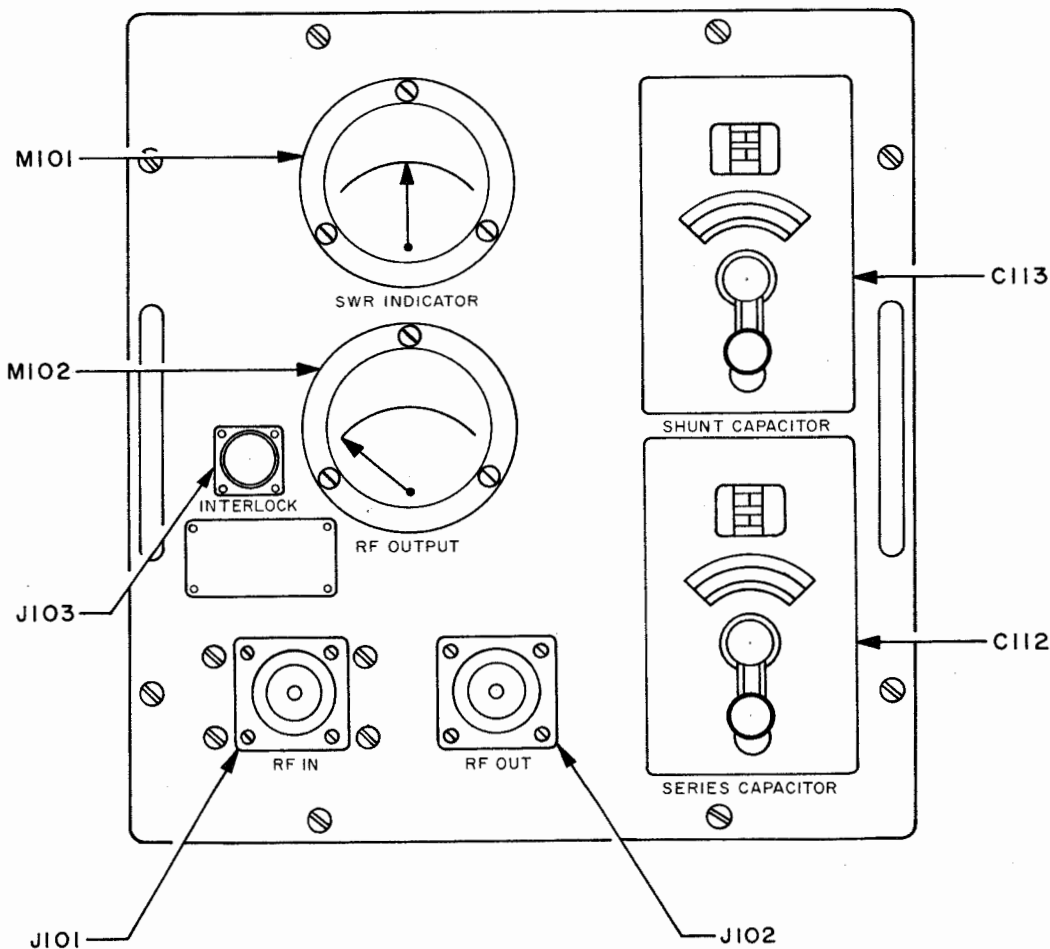


Figure 3-1. Operating Controls and Indicators

TABLE 3-1. OPERATING CONTROLS AND INDICATORS

CONTROL OR INDICATOR	TYPE	USE
SERIES CAPACITOR (C112)	Manually adjusted, vacuum dielectric	Adjusts TN-341/BRT for minimum SWR*.
SHUNT CAPACITOR (C113)	Manually adjusted, vacuum dielectric	Adjusts RF OUTPUT meter for maximum indication*.
SWR INDICATOR (M101)	Dc meter, arbitrary scale	Indicates voltage standing wave ratio (SWR). Indication should be 3:1 or better; i.e., in center or in the green area of the meter.
RF OUTPUT (M102)	Dc meter, arbitrary scale	Indicates rf power output.
RF IN (J101)	UG-352/U panel mounted jack	Rf input jack from transmitter.
RF OUT (J102)	UG-352/U panel mounted jack	Rf output to antenna circuit.
INTERLOCK (J103)	MS-3102E-10SL-4P panel mounted jack	Prevents transmitter from being keyed when rf tuner drawer is opened.

*Both SERIES CAPACITOR and SHUNT CAPACITOR are used together for these functions.

3-4. OPERATING PROCEDURES.

a. OPERATION BETWEEN 2 AND 6 MC.

(See figure 3-2.) - To operate the equipment between 2 and 6 mc, proceed as follows:

Step 1. Insert the required shorting links and bars in the rf tuner and rf coil (see tables 2-1 and 2-2) and set the SERIES CAPACITOR and SHUNT CAPACITOR to minimum capacitance by cranking fully counterclockwise.

Step 2. Install the rf coil adjacent to the emergency antenna.

Step 3. Start the transmitter in accordance with the operating instructions given in the transmitter technical manual. Tune the transmitter to the desired frequency at a low power output level, approximately 100 watts.

Step 4. Note the reading on the SWR INDICATOR. The initial deflection is likely to be in the HIGH region (i.e. greater than 3:1).

Step 5. Note the RF OUTPUT reading. The initial deflection is likely to be near zero.

Step 6. Adjust the SERIES CAPACITOR (C112) until a dip is observed on the SWR INDICATOR.

Step 7. Adjust the SHUNT CAPACITOR (C113) for maximum indication on the RF OUTPUT meter.

Step 8. Readjust the SERIES CAPACITOR and the SHUNT CAPACITOR alternately until the SWR INDICATOR meter indicates 3:1 or better (i.e. in the LOW end of the scale), and the RF OUTPUT meter indicates a maximum.

Step 9. At the transmitter, increase rf output to the desired level.

Step 10. After Antenna Tuning Group AN/BRA-6 has been adjusted for a specific frequency, record the settings of the SERIES CAPACITOR and the SHUNT CAPACITOR on a chart such as the one shown in table 3-2. This simplifies future tuning to the same frequency.

b. OPERATION BETWEEN 6 AND 30 MC.
(See figure 3-3.) - At frequencies above 6 mc,

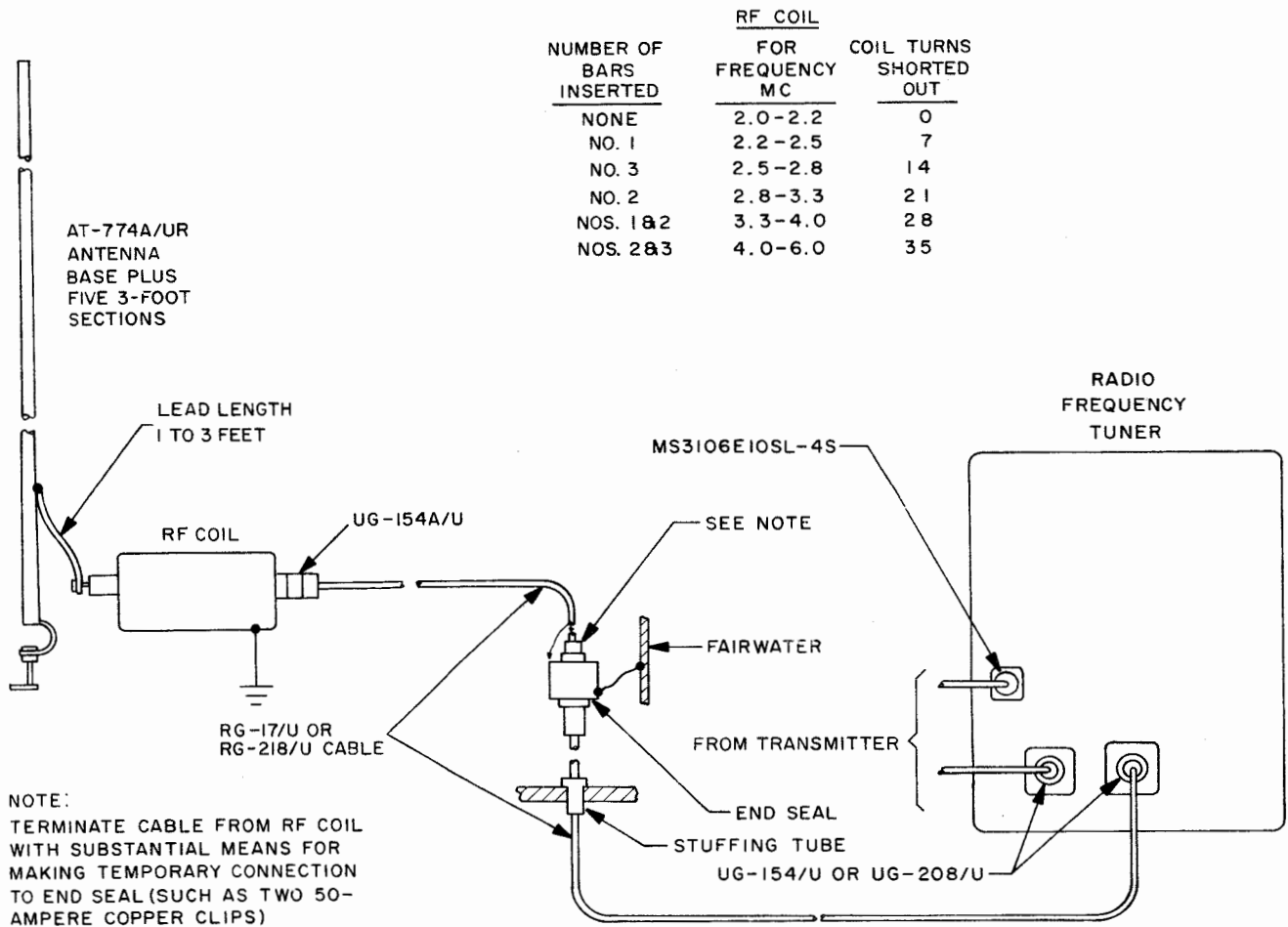


Figure 3-2. Equipment Setup for Operation Between 2 and 6 MC

Radio Frequency Coil RF-91/BRT is not used. The operating procedure is the same as given in paragraph 3-4a except as noted herein. Above 9 mc, a deflection of the SWR INDICATOR during initial adjustment of the SERIES CAPACITOR from minimum to maximum may not be observed. The settings of the SERIES CAPACITOR and SHUNT CAPACITOR must be searched until a combination is found that gives a meter indication. After an indication is obtained, the settings may be refined as given in paragraph 3-4a, step 8.

Especially at high frequencies, the actual settings of the two capacitors will vary con-

siderably from installation to installation since cable length differences as small as five feet will result in a large change in impedance of the cable.

c. OPTIONAL OPERATION BETWEEN 12 AND 30 MC. (See figure 3-4.) - In the 12 to 30-mc frequency range, it is possible to transmit without using Antenna Tuning Group AN/BRA-6, provided the proper length of Antenna AT-774A/UR is used. Figure 3-4 lists the proper antenna length required and the method of connecting the cables when the AN/BRA-6 equipment is not used.

TABLE 3-2. SAMPLE CHART FOR RECORDING SETTINGS OF RF TUNER AND RF COIL AT VARIOUS FREQUENCIES*

FREQUENCY	SERIES CAPACITOR DIAL SETTINGS			SHUNT CAPACITOR DIAL SETTINGS			SHORTING BAR INSERTED		ANTENNA AT-774A/UR
	1st	2nd	3rd	1st	2nd	3rd	TN-341/BRT	RF-91/BRT	NO. OF SECTIONS USED

*Since each installation is unique, it is impossible to give exact settings of the dials at a specific frequency. The exact settings must be determined experimentally after installation.

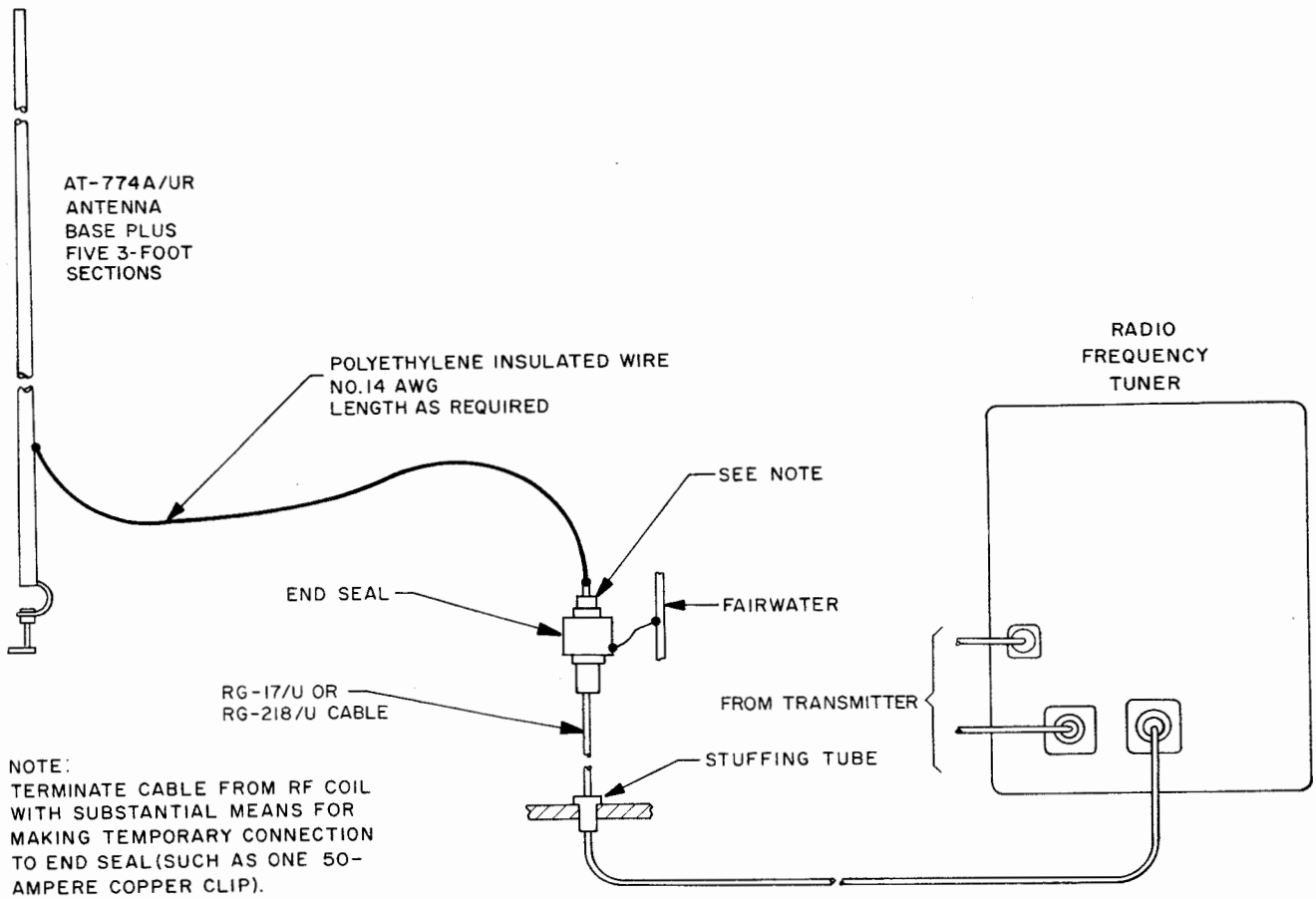


Figure 3-3. Equipment Setup for Operation between 6 and 30 MC

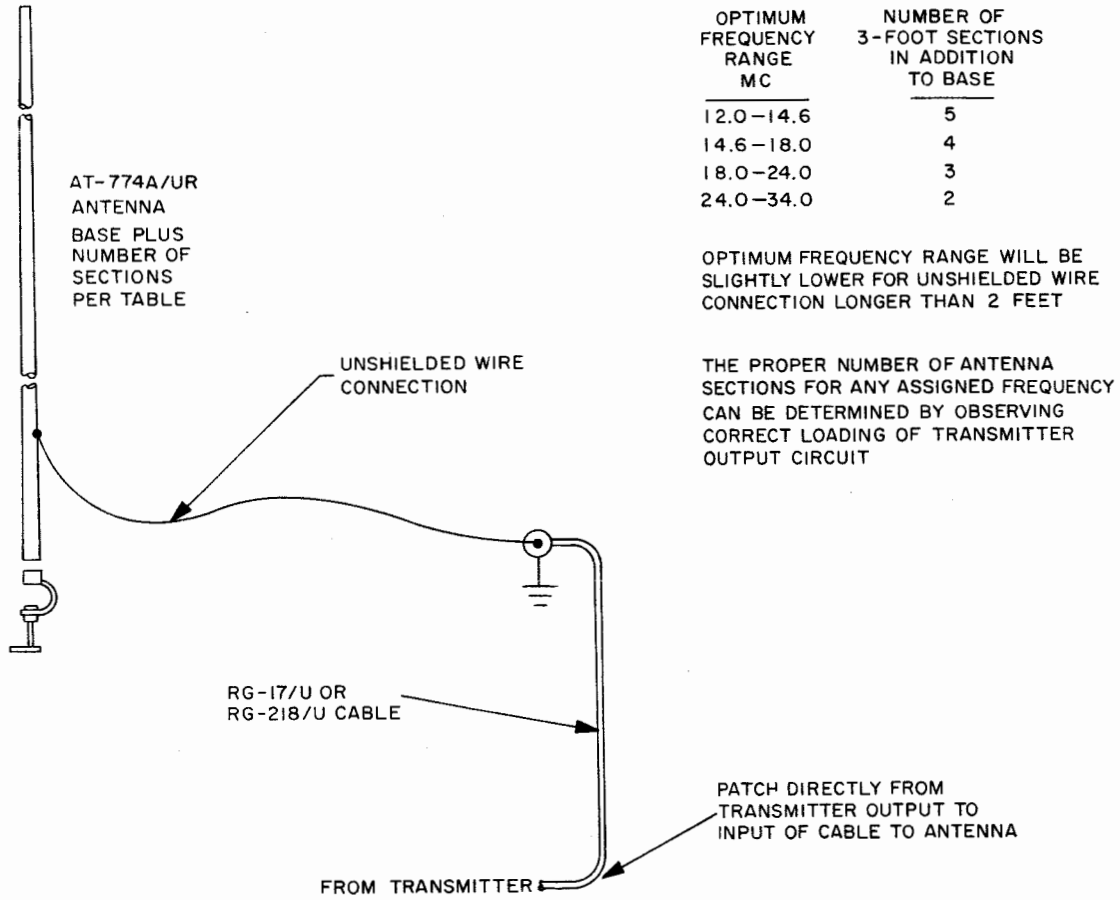


Figure 3-4. Alternative Method for Operation between 12 and 30 MC

SECTION 4

PRINCIPLES OF OPERATION

4-1. OVERALL FUNCTIONAL DESCRIPTION. (See figure 4-1.)

Antenna Tuning Group AN/BRA-6 couples Antenna AT-774A/UR or other emergency antenna to a 50-ohm transmission line at a voltage standing wave ratio of 3:1 or better. Radio Frequency Tuner TN-341/BRT consists of an LC circuit with variable capacitance and an adjustable tapped inductance. The rf tuner contains a reflectometer circuit to measure the voltage standing wave ratio (SWR). The SWR is shown on the SWR INDICATOR meter on the front panel. Power output is shown on the RF OUTPUT meter on the front panel.

Radio Frequency Coil RF-91/BRT is used in conjunction with the rf tuner to obtain proper impedance match between the rf tuner and the antenna at frequencies between 2 and 6 mc. The rf coil is adjusted by means of shorting bars which are inserted as required. Above 6 mc the rf coil is not used.

4-2. FUNCTIONAL SECTIONS.

a. RADIO FREQUENCY TUNER TN-341/BRT. (See figure 6-2.) - The rf tuner matches the input impedance of the antenna to the characteristic impedance of a 50-ohm transmission line by adjusting the inductance and capacitance of the rf tuner circuits to tune the antenna to any frequency within the range of 2 to 30 mc. Coil L103 in the rf tuner, and coil L201 in the rf coil (used only at frequencies between 2 and 6 mc), are adjusted to the proper inductance by inserting the required shorting bars. The SHUNT CAPACITOR (C113) and SERIES CAPACITOR (C112) are manually adjusted by means of cranks on the front panel of the rf tuner. By inserting the required shorting bars in the coils, and then adjusting the SERIES CAPACITOR and SHUNT CAPACITOR for minimum voltage standing wave ratio and maximum power output, the antenna is matched to the 50-ohm line.

A simplified schematic diagram is shown in figure 4-2. The output line presents an impedance load across C113. This impedance can be any value over a wide range depending on the frequency, the line length and the particular antenna load at the far end of the line. The impedance is transformed by SHUNT CAPACITOR C113 to another value that appears in series with SERIES CAPACITOR C112 and L103. The latter value can be changed by adjustment of C113. This impedance has a definite resistance and a reactance (either positive or negative). By choosing the proper tap on L103 (see table 2-1) and adjusting C112, the series circuit is tuned to resonance. Only resistance now remains in the circuit. The single-turn input tap on the coil transforms this resistance to another one that loads the input line. By adjusting C113 to the proper capacitance, the resistance in the series circuit (including coil loss resistance) can be brought to the proper value to reflect a 50-ohm load onto the input line.

Each change in setting of C113 requires a change in C112 in order to restore resonance. A combination can be found that will give good SWR and good RF OUTPUT meter reading. However, at the lower frequencies it is possible to load all the power into the coil. Then the SWR meter might indicate SWR of 3:1, but the RF OUTPUT meter would show almost no indication. In order to avoid this condition, the operational procedures (see Par. 3-4a) direct that the SHUNT CAPACITOR C113 be set at minimum capacitance at the start of the tuning adjustment.

(1) SWR MONITOR. - The SWR monitoring circuit detects and monitors the voltage standing wave ratio present on the rf input transmission line. The circuit operates as a bidirectional reflectometer. It measures the incident and reflected waves at a point along the 50-ohm transmission line by comparing the vector sum

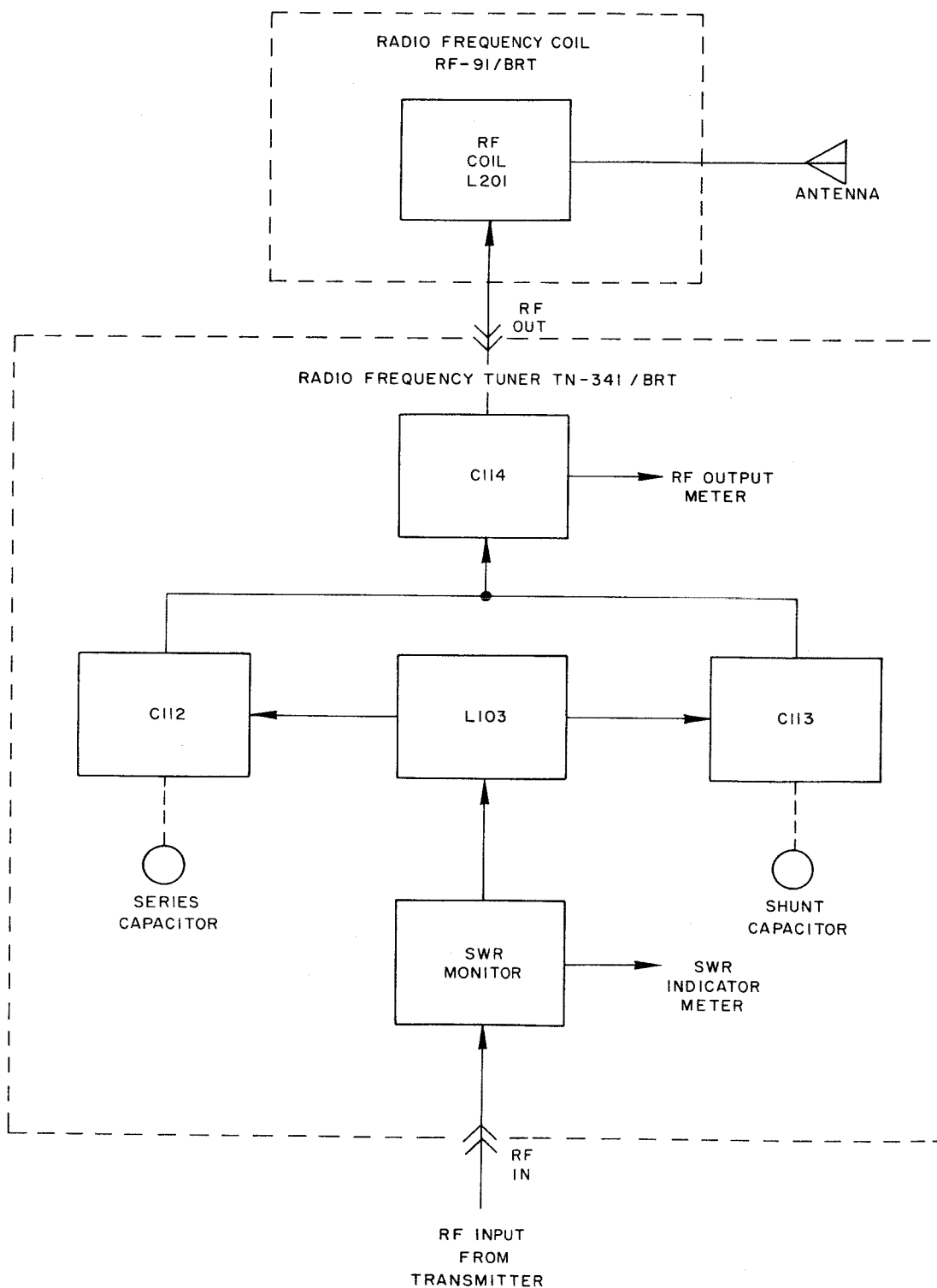


Figure 4-1. Antenna Tuning Group AN/BRA-6, Functional Block Diagram

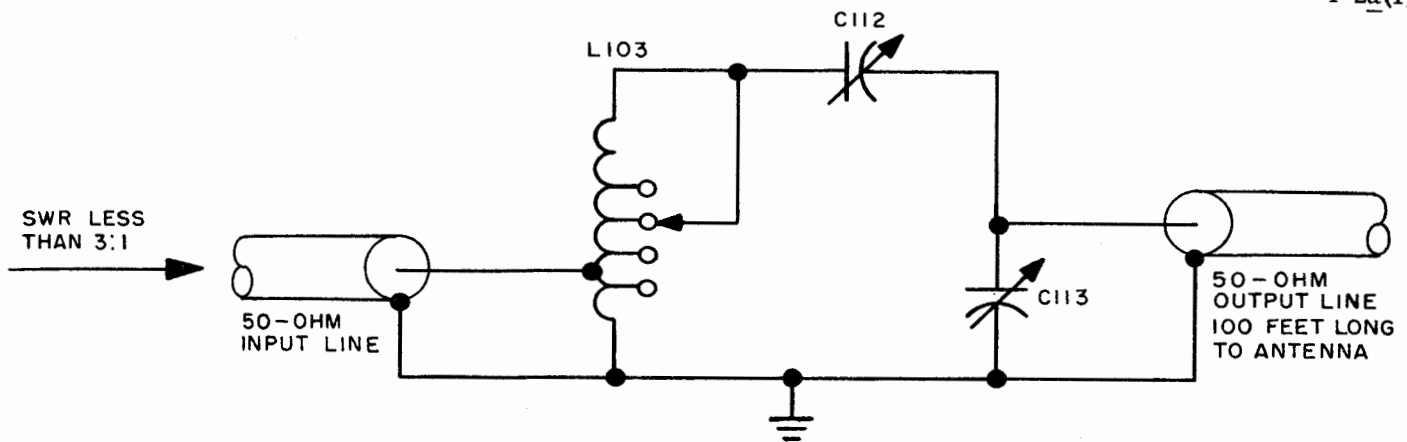


Figure 4-2. Radio Frequency Tuner TN-341/BRT, Resonant Circuit Simplified Schematic

and difference of the two rf voltages developed across a voltage divider and two current transformers. Figure 4-3 shows a simplified reflectometer SWR monitoring circuit. Details such as the dc return for the diodes are omitted. Transformer T1 and resistor R1 develop a voltage proportional to the feedline current for the incident wave; C1 and C2 are a capacitive voltage divider which develops a voltage proportional to feedline voltage. Transformer T2 and resistor R2 develop a voltage 180° out of phase with the voltage across R1; C3 and C4 are a voltage divider which develops a voltage proportional to the reflected wave. The sum of the voltages across C2 and R1 is rectified by

CR1, and the sum of the voltages across C4 and R2 is rectified by CR2 to produce opposing currents proportional to the incident and reflected waves, respectively. The resultant voltage at the center tap of R3 deflects meter M1. The sliding contact of R3 is set so that the meter current is zero when the reflected wave is half the value of the incident wave.

In figure 6-2, current induced on a coaxial sleeve by the 50-ohm antenna feedline produces a voltage proportional to feedline current across each of the two load circuits. These circuits consist of current transformer T101 with load resistors R102 and R103, and current transformer

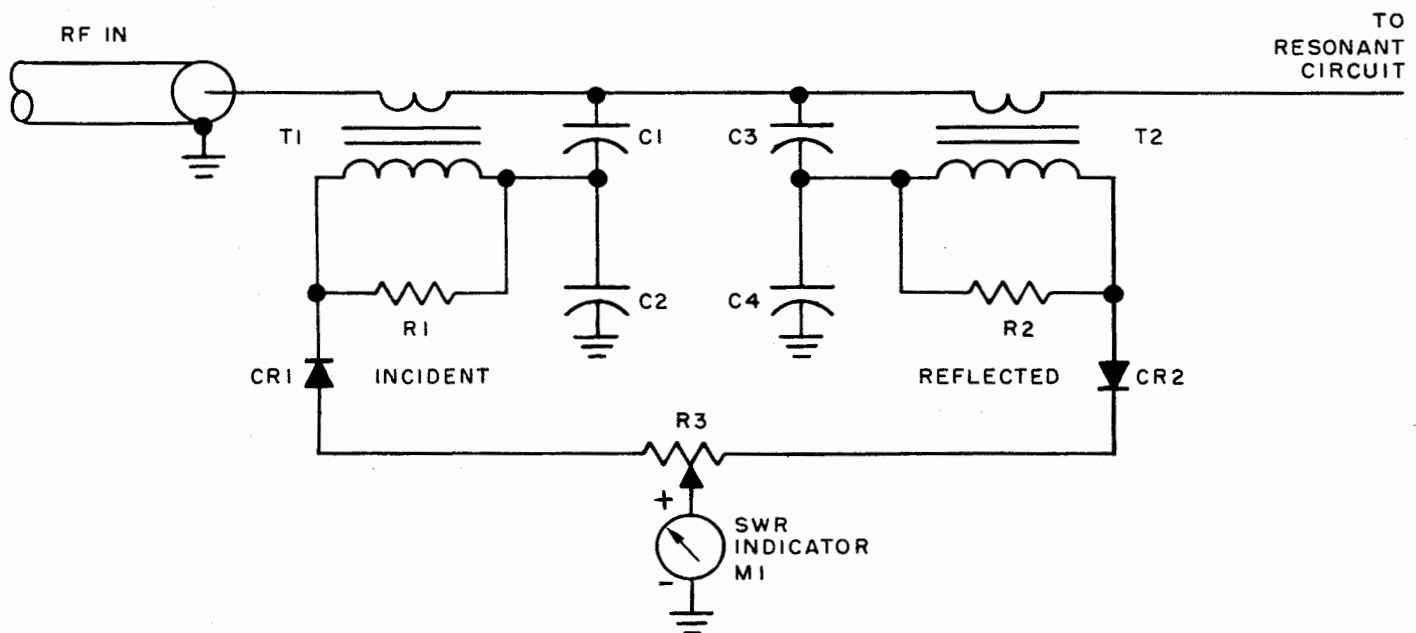
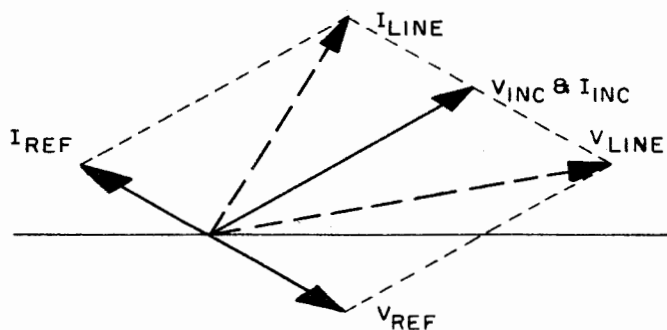


Figure 4-3. Typical Reflectometer with SWR Monitoring Circuit, Simplified Schematic

T102 with load resistors R104 and R105. Voltage proportional to feedline voltage is developed across a capacitive voltage divider consisting of C111 in series with C101, C102, C103, C104, C105, and C106. The transmitter output applied to the rf tuner input is the incident wave (V_{inc}); energy not absorbed in the rf tuner, the output line, and the antenna is reflected back toward the input and is called the reflected wave (V_{ref}).

The reflected voltage may either aid or oppose the applied voltage, depending on the time required to travel to the load and back. The reflected voltage therefore increases or decreases the applied voltage. Since the transmission line voltage equals V_{inc} plus V_{ref} , and line current equals I_{inc} plus I_{ref} and is directly proportional to V_{inc} minus V_{ref} , the sum of a line voltage sample plus a voltage sample proportional to line current is proportional to V_{inc} while the difference in samples is proportional to V_{ref} . (See figure 4-4.) The two resulting voltages are rectified by diodes CR101 and CR102 to produce a positive incident and a negative reflected voltage. The resultant voltage at the center tap of R108 deflects meter M101. C107 and C110 are rf decoupling capacitors. High frequency compensation is accomplished by the network made up of L101, L102 and R101, R106.



$$V_{LINE} = V_{INC} + V_{REF}$$

$$I_{LINE} = I_{INC} + I_{REF} = (V_{INC} - V_{REF}) / Z_0$$

THEN

$$V_{INC} \propto V_{LINE} + Z_0 I_{LINE}$$

$$V_{REF} \propto V_{LINE} - Z_0 I_{LINE}$$

Figure 4-4. Vector Diagram of Line Voltages and Line Currents

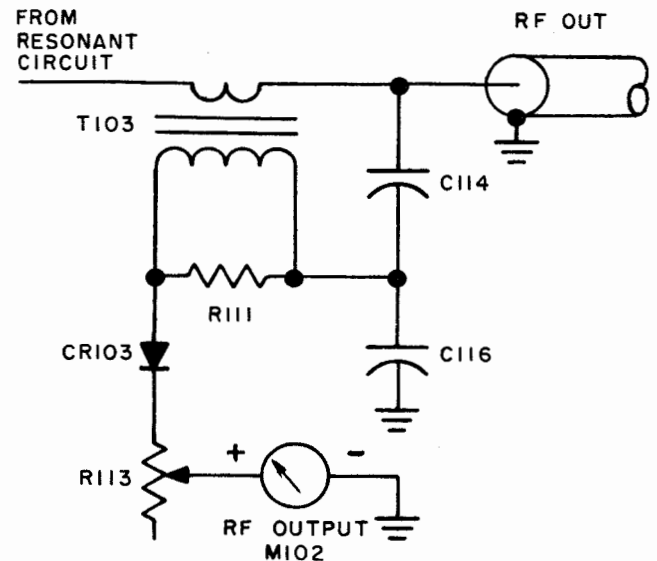


Figure 4-5. RF Output Monitoring Circuit, Simplified Schematic

When the load is matched, all power in the line is delivered to the load and the reflected wave is zero. All points along the line operate at the same voltage and the SWR is unity. When the load is not matched, a reflected wave is present which causes variations in current and voltage along the line. The SWR will then be greater than one, indicating that all the power is not being absorbed by the load.

(2) RF POWER INDICATOR. - Rf output power is indicated on RF OUTPUT meter M102. Figure 4-5 is a simplified schematic of the rf output metering circuit. Rf line voltage is sampled by capacitive voltage divider C114 and C116. Line current is sampled by T103 which then gives a voltage that is added to that across C116. This is rectified by CR103 to deflect meter M102. R114 is a dc return and C115 is an rf bypass capacitor. R112 is a voltage dropping resistor, R115 is the meter shunt, and R113 is the meter sensitivity adjustment. Meter indications are actually proportional to the square root of the incident power into the rf output cable.

b. RADIO FREQUENCY COIL RF-91/BRT. (See figure 6-5.) - The radio frequency coil is only used for transmission in the 2 to 6-mc frequency range. This coil provides a tapped inductance adjustable by means of shorting bars to obtain the required matching at different frequencies.

SECTION 5

TROUBLE - SHOOTING

5-1. GENERAL.

This section provides the information required to locate troubles in Antenna Tuning Group AN/BRA-6. A logical succession of observations and a logical process of reasoning are the most effective means for determining trouble sources. When trouble occurs, it is necessary to follow a series of steps to eliminate the various functional sections as sources of trouble and to isolate the trouble to a particular section. Once the faulty section has been found, the trouble is then isolated to a single stage within the section, and finally to the specific component that is causing the trouble.

In trouble-shooting, make use of the operating data accumulated in the course of operating the equipment, and of the various aids included in this manual. Some of these aids are:

- a. Antenna Tuning Group Block Diagram (see figure 4-1).
- b. Schematic diagrams (see figures 6-2 and 6-5).
- c. Trouble-shooting charts (see tables 5-2 through 5-5).
- d. Typical troubles chart (see table 5-6).
- e. Illustrations showing component and test point locations (see figures 5-1 through 5-5).

Major test points are used to localize trouble to a functional section and are identified by a number enclosed in a star; for example $\star 1$, $\star 2$. Test points used for isolating a trouble within a functional section are identified by a capital letter enclosed in a circle; for example: \textcircled{A} , \textcircled{B} . Test points used for isolating a trouble within a specific circuit are identified by a capital letter and a sub-script number enclosed in a circle; for example:

$\textcircled{A_1}$, $\textcircled{A_2}$.

5-2. TEST EQUIPMENT AND SPECIAL TOOLS.

Special tools are not required for trouble-shooting this equipment. The test equipment required to perform the trouble-shooting procedures given in this section are listed in table 5-1.

TABLE 5-1. TEST EQUIPMENT REQUIRED

ITEM	DESCRIPTION
AN/USM-116	VTVM
AN/PSM-4C	Multimeter
DA-91/U (3 each)	Dummy Load
UG-566A/U (2 each)	Tee Connector
UG-573A/U (3 each)	Connector
RG-8/U	Test Cable
Potentiometer, Allen Bradley type CU-2541 or equivalent	250 K ohms, 2 watts

5-3. OVERALL TROUBLE-SHOOTING.

a. **PRELIMINARY CHECKS.** - When trouble is encountered in the Antenna Tuning Group, first determine that the malfunction is not caused by trouble in equipment connected to it. Next make a visual inspection of the units. Check for loose or broken connections, damaged cables, and incorrect connections. Check for proper tuning of the AN/BRA-6 for the frequency in use (see paragraph 3-4). Check the equipment internally for damaged parts, broken leads, and other visible defects. A system trouble-shooting chart (see table 5-2) is provided to help determine the cause of the malfunction. Figures 6-2 and 6-5 are the schematic diagrams of the equipment.

b. **CONTROL SETTINGS.** - As described in paragraph 3-4, install the shorting links and shorting bars, and adjust the SERIES CAPACITOR and SHUNT CAPACITOR, according to the frequency in use.

c. **SYSTEM TROUBLE-SHOOTING CHART.** - Table 5-2 outlines the procedures to be followed to localize the functional section at fault. See figure 4-1 for a functional block diagram of the equipment, and see figures 6-2 and 6-5 for schematic diagrams.

5-4. **FUNCTIONAL SECTION TROUBLE-SHOOTING.**

Antenna Tuning Group AN/BRA-6 is divided into three functional sections, the reflectometer section, the rf tuner section, and the rf coil section.

a. **PRELIMINARY CHECK.** - A failure in the AN/BRA-6 can usually be isolated to the faulty functional section by following the procedures given in paragraph 5-3a and table 5-2.

b. **TEST EQUIPMENT AND SPECIAL TOOLS.** - No special tools are required for trouble-shooting. The test equipment required is listed in table 5-1.

c. **CONTROL SETTINGS.** - Set the controls, and shorting links and bars, as instructed in paragraph 3-4.

d. **FUNCTIONAL SECTION TROUBLE-SHOOTING CHARTS.** - The functional section trouble-shooting charts are contained in tables 5-3 through 5-5.

e. **TYPICAL TROUBLES.** - Table 5-6 lists typical troubles which may be encountered during operation of the AN/BRA-6.

5-5. **LOCATION OF PARTS.**

a. Figures 5-1 through 5-5 show the location of each circuit part in the rf tuner and rf coil, plus those mechanical parts which may require replacement during the service life of the AN/BRA-6.

b. Figure 6-4 is a practical wiring diagram of the rf tuner. No wiring diagram is required for the rf coil.

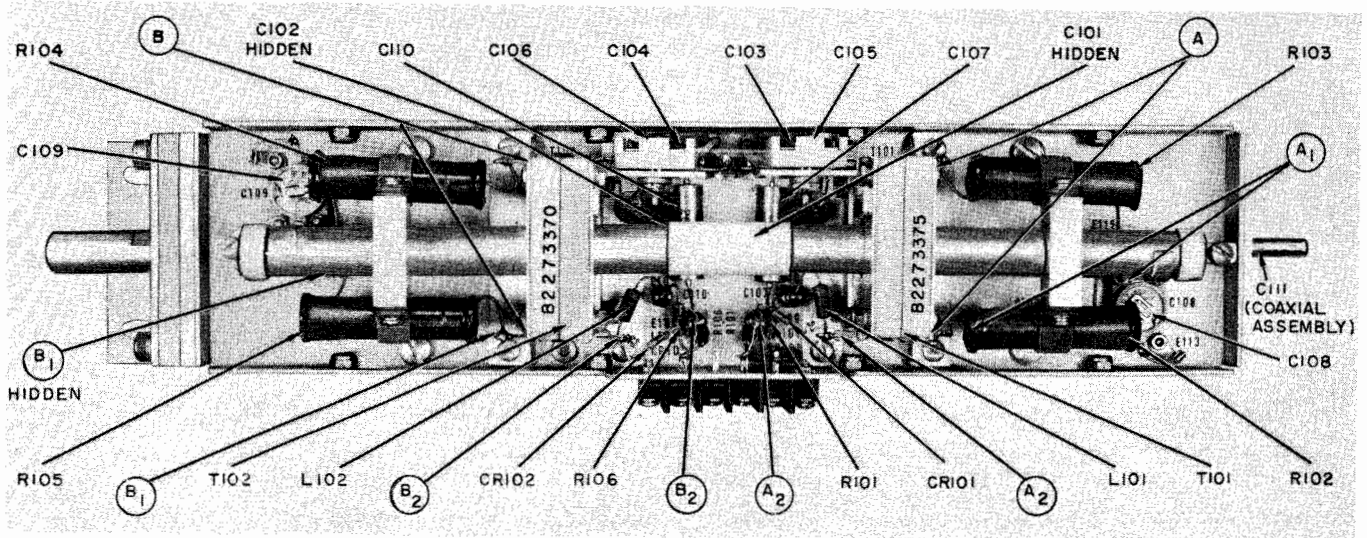


Figure 5-1. Reflectometer, Location of Test Points and Parts

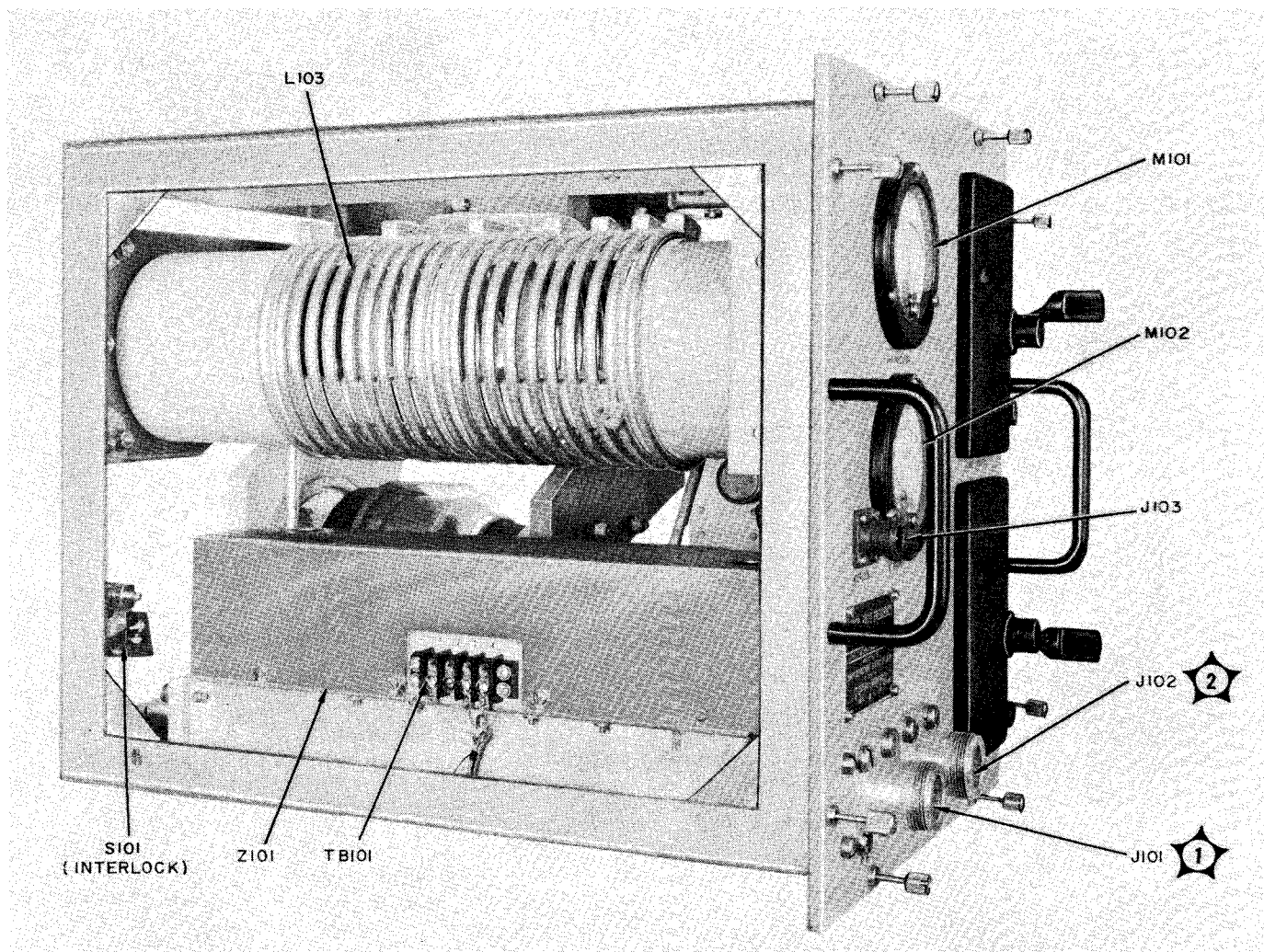


Figure 5-2. Radio Frequency Tuner TN-341/BRT, Left Side View, Cover Removed

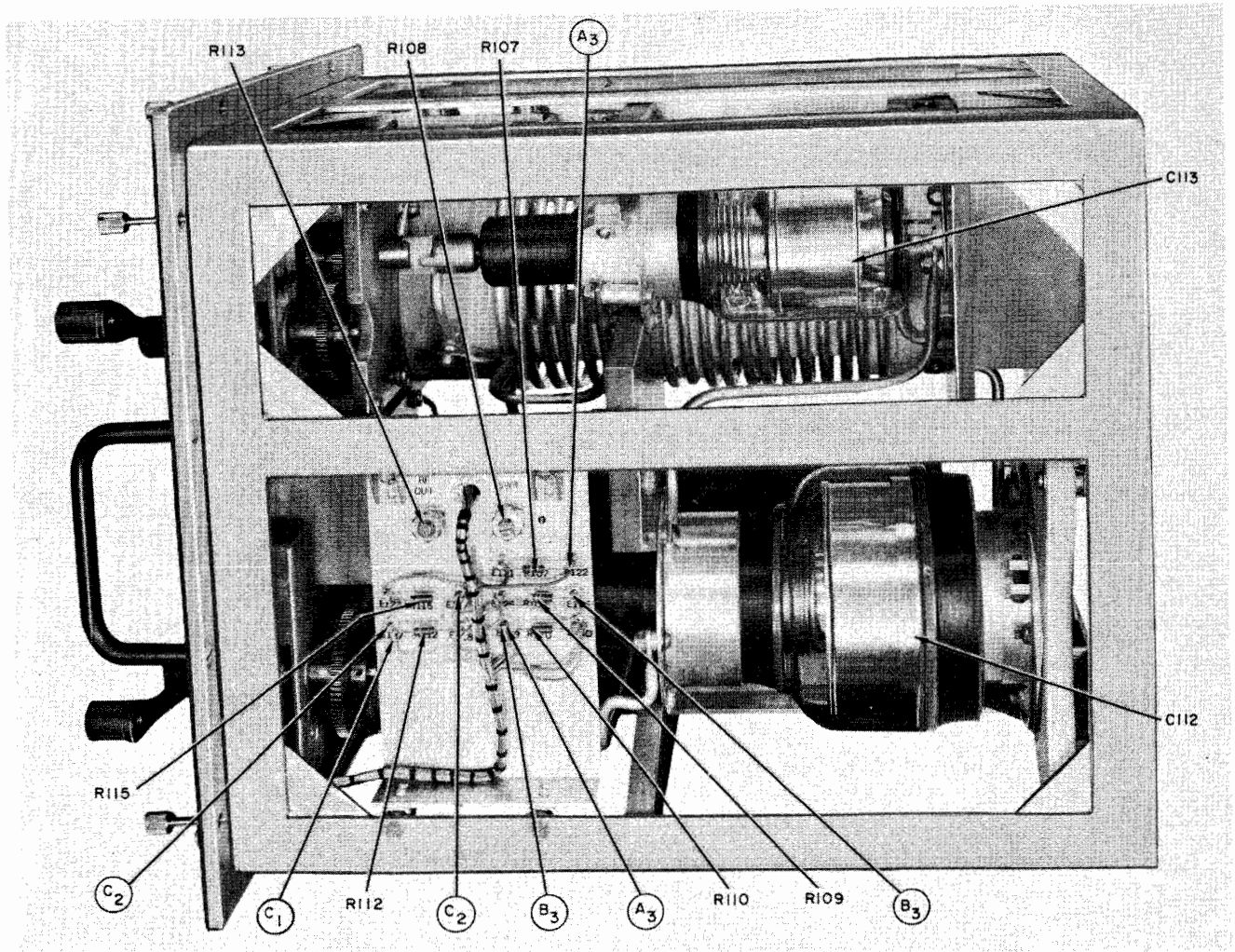


Figure 5-3. Radio Frequency Tuner TN-341/BRT, Right Side View, Cover Removed

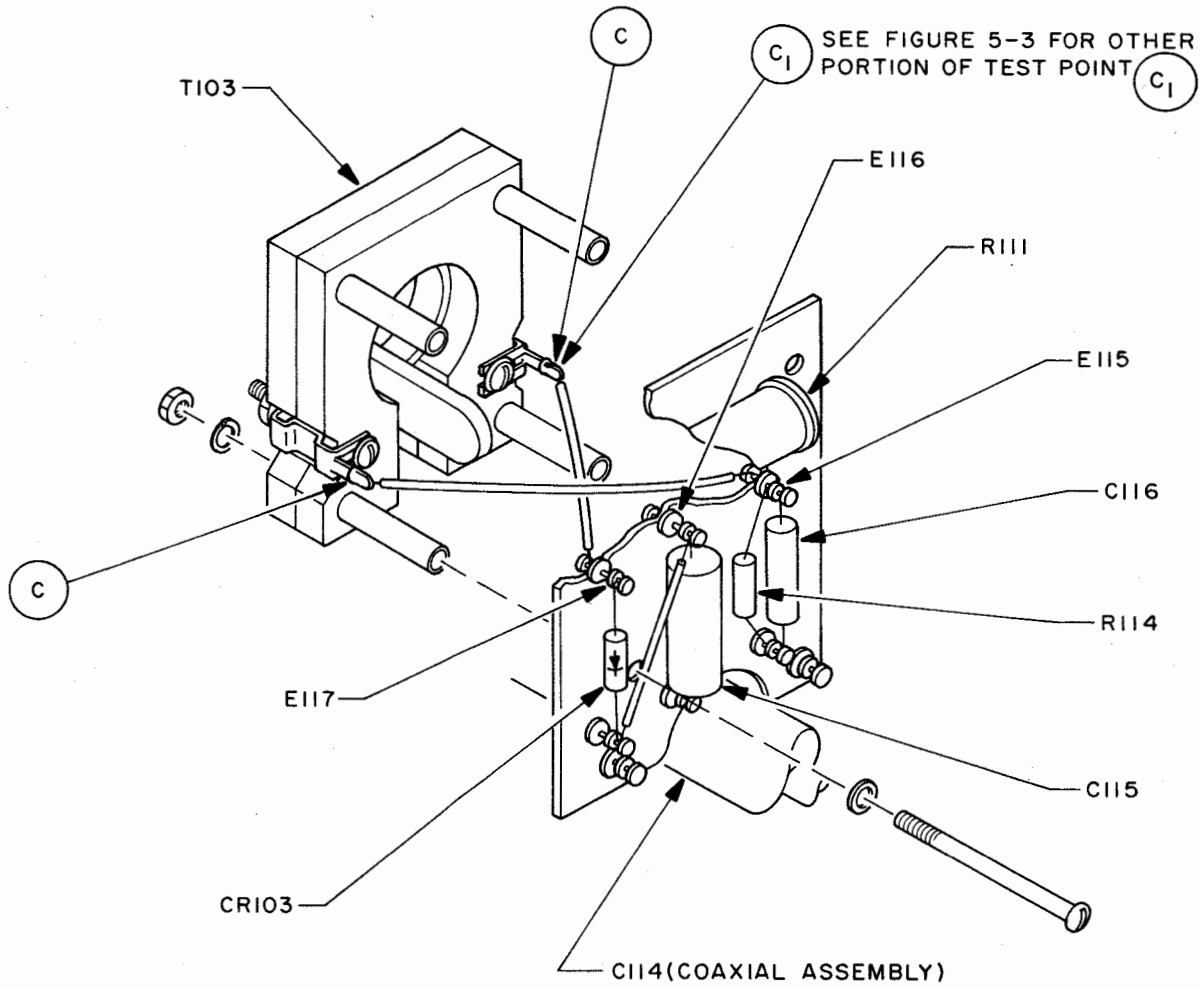


Figure 5-4. RF Output Meter Component Board, Test Points and Parts Location

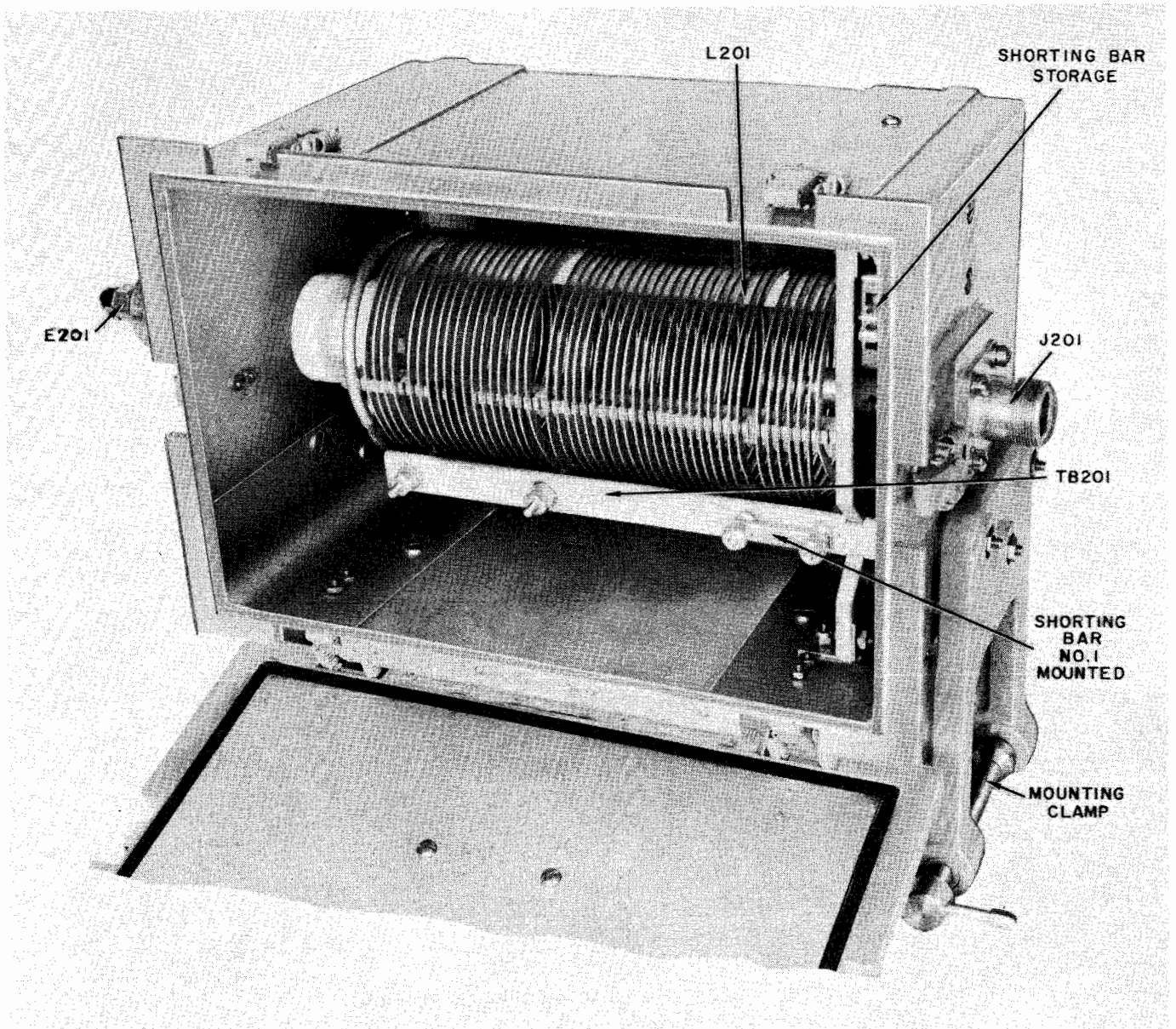


Figure 5-5. Radio Frequency Coil RF-91/BRT, Parts Location

TABLE 5-2. ANTENNA TUNING GROUP AN/BRA-6, SYSTEM TROUBLE-SHOOTING CHART


STEP	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1.	Tune equipment for desired frequency.	Equipment tunes properly; SWR INDICATOR reads 3:1 or better; RF OUTPUT meter indicates power out.	<p>a. If SWR INDICATOR reads in black area and RF OUTPUT meter does not read, check antenna, rf output cable and connectors, and Radio Frequency Coil RF-91/BRT (refer to table 5-5); if normal, check Radio Frequency Tuner TN-341/BRT (refer to table 5-4, step 1).</p> <p>b. If SWR INDICATOR reads 3:1 or better (Normal) and RF OUTPUT meter gives no indication, check rf output meter circuit (refer to table 5-4, Step 4).</p> <p>c. If RF OUTPUT meter indicates power out and SWR INDICATOR reads in the black area at all times, refer to table 5-4 step 1; if indicator reads in green area at all times, refer to table 5-4 step 5; if indicator reads 3:1 at all times, refer to table 5-3.</p> <p>d. If SWR INDICATOR does not move off 3:1 indication during tuning and RF OUTPUT meter indicates no power out, check for rf input at test point  and check that INTERLOCK switch S101 is closed.</p>

TABLE 5-3. REFLECTOMETER CIRCUIT, FUNCTIONAL SECTION TROUBLE-SHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1.	(A) Figure 5-1	Connect AN/PSM-4C multimeter across terminals 1 and 2 of T101 and measure resistance.	Zero or very low resistance.	If indication is normal, proceed with step 2. If abnormal, check T101 for open circuit.
2.	(A) ₁ Figure 5-1	Connect multimeter across R102, and measure resistance.	40 ohms.	If indication is normal, proceed with step 3. If abnormal, check R102 and R103 for open or short circuit.
3.	(A) ₂ Figure 5-1	Connect multimeter across CR101. Note resistance reading, reverse leads, and note reading again.	Resistance should be 1 to 2 megohms in one direction and 200 to 300 ohms in the opposite direction.	If indication is normal, proceed to step 4. If abnormal, replace CR101.
4.	(A) ₃ Figure 5-3	Connect multimeter between junction of CR101, C107 and center arm of R108. Measure resistance.	68,000 to 80,000 ohms.	If indication is normal, proceed to step 5. If abnormal, check R107 through R110, and C107.
5.	(B) Figure 5-1	Connect multimeter across terminals 1 and 2 of T102.	Same as step 1.	If indication is normal, proceed with step 6. If abnormal, check T102 for open circuit.
6.	(B) ₁ Figure 5-1	Connect multimeter across R105, and measure resistance.	Same as step 2.	If indication is normal, proceed with step 7. If abnormal, check R104 and R105 for open or short circuit.
7.	(B) ₂ Figure 5-1	Connect multimeter across CR102. Note resistance, reverse meter leads, and note resistance again.	Same as step 3.	If indication is normal, proceed with step 8. If abnormal, replace CR102.
8.	(B) ₃ Figure 5-3	Connect AN/PSM-4 C between junction of CR102, C110 and center arm of R108. Measure resistance.	33,000 to 45,000 ohms.	If indication is normal, proceed with step 9. If abnormal, check R107 through R110, and C110.
9.		Make visual check of M101 circuit.		If visual check discloses no trouble, check M101 by operating equipment.

TABLE 5-4. RF TUNER CIRCUIT, FUNCTIONAL SECTION TROUBLE-SHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1.		Make visual check of L103, C112, and C113 for broken or loose connections.	Capacitors can be cranked throughout their full range.	If indication is normal, proceed with step 2. If abnormal, repair or replace parts as required.
2.	Ⓒ Figure 5-4	Connect multimeter across terminals 1 and 2 of T103, and measure resistance.	Zero or very low resistance.	If indication is normal, proceed to step 3. If abnormal, check T103 for open circuit.
3.	Ⓒ ₁ Figures 5-3 and 5-4	Disconnect one lead of R112 from board. Connect multimeter across CR103 and note resistance. Reverse leads and note resistance again. Reconnect resistor.	Resistance should be 1 to 2 megohms in one direction, and 200 to 300 ohms in opposite direction.	If indication is normal, proceed to step 4. If abnormal, replace CR103.
4.	Ⓒ ₂ Figure 5-3	Check resistance from junction of CR103 and C115 to positive side of meter M102.	47,000 ohms to 97,000 ohms.	If indication is normal, proceed to step 5. If abnormal, check R112, R113, R115, and C115.
5.		Make visual check of M102 circuit.		If visual check discloses no trouble, check M102 by operating equipment.

TABLE 5-5. RF COIL, FUNCTIONAL SECTION TROUBLE-SHOOTING CHART

STEP	TEST POINT	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1.	Figure 5-2	Disconnect rf output cable from test point ② and J201. Check cable for continuity or short.		If normal, proceed to step 2. If abnormal, repair or replace cable or connectors.
2.		Check rf coil for proper shorting bars, broken or loose connections.		If normal, proceed to step 3. If abnormal, repair or replace parts as necessary.
3.		Check antenna for proper connection to E201.		Repair or replace connector or cable.

TABLE 5-6. ANTENNA TUNING GROUP AN/BRA-6, TYPICAL TROUBLES

TROUBLE	NATURE OF TROUBLE	SYMPTOMS
No rf output	<ol style="list-style-type: none"> 1. Improper tuning; interconnecting cables damaged or improperly connected; S101 open. 2. Broken or loose connections on L103. 3. RF OUTPUT metering circuit faulty. 	RF OUTPUT meter shows no output.
Cannot obtain 3:1 or better on SWR INDICATOR meter.	Improper tuning; incident portion of reflectometer circuit faulty; SWR metering circuit faulty.	SWR INDICATOR meter reads in black area at all times.
SWR INDICATOR meter functions improperly.	Faulty reflected portion of reflectometer; faulty SWR metering circuit.	SWR INDICATOR meter reads in green area at all times.
No rf input.	S101 open; transmitter defective; RF IN connector broken or loose; input cable faulty.	SWR INDICATOR meter reads 3:1; RF OUTPUT gives no indication.

SECTION 6**REPAIR****6-1. FAILURE, AND PERFORMANCE AND OPERATIONAL REPORTS.****NOTE**

The Bureau of Ships no longer requires the submission of failure reports for all equipments. Failure Reports, and Performance and Operational Reports are to be accomplished for designated equipments (refer to EIB 565 and 571) to the extent required by existing directives. All failures shall be reported for those equipments requiring Failure Reports.

6-2. TUNING AND ADJUSTMENT.

Tuning procedures for the AN/BRA-6 are given in paragraph 3-4. The following paragraphs give the procedures for alignment and adjustment. The reflectometer, SWR INDICATOR meter, and RF OUTPUT meter circuits are aligned and adjusted only when maintenance or trouble-shooting indicates that such adjustment is required. Mechanical adjustment of the gear train stops for the SERIES CAPACITOR and SHUNT CAPACITOR is described in paragraph 6-3b(3).

a. TEST EQUIPMENT AND SPECIAL TOOLS. -

The test equipment required for alignment and adjustment of the AN/BRA-6 is listed in table 5-1. In addition, an rf source, 100 to 500 watts output, 2 to 30 mc is required.

b. CONTROL SETTINGS. - Front panel control settings are determined by the tuning procedures given in paragraph 3-4. Trimmer capacitors and variable resistors are set as determined by alignment procedures in paragraph 6-2c through 6-2e.

c. REFLECTOMETER ALIGNMENT. - The following steps give the procedure for alignment and adjustment of the reflectometer.

NOTE

All adjustments and measurements are made with the reflectometer cover in place.

Step 1. Remove reflectometer from unit. (Refer to paragraph 6-3 for removal procedures.)

Step 2. Connect test equipment to reflectometer as shown in figure 6-1. Refer to figures 6-2, 6-4, and 6-5 for schematic and wiring diagrams.

Step 3. Adjust C108 and C109 for minimum capacitance (fully counterclockwise), and the potentiometer for maximum resistance.

Step 4. Apply 100 watts of rf power (as indicated by transmitter power output indicator) at 3.25 mc.

Step 5. Set switch to measure incident current. Adjust potentiometer for full-scale deflection of meter.

Step 6. Set switch to measure reflected current. Adjust C106 for minimum reflected current indication. Record meter reading.

Step 7. Turn off transmitter. Disconnect 50-ohm dummy load from reflectometer output.

Step 8. Connect AN/USM-116 vtvm to reflectometer output.

Step 9. Turn on transmitter (at 3.25 mc) and adjust its output to obtain a reading of 120 volts on the vtvm. It is essential that this voltage be kept constant during step 10.

Step 10. Set switch to reflected current. Adjust the potentiometer for a reading of 80 ua reflected. Then alternately adjust C105 and C106 until both incident and reflected current readings are 80 ua. Set switch to incident and reflected as required to obtain the current readings.

Step 11. Turn off transmitter. Disconnect the vtvm and reconnect the 50-ohm dummy load. Apply 100 watts at 3.25 mc. Set the switch to incident and adjust the potentiometer for incident current reading of 100 ua. Check reflected current

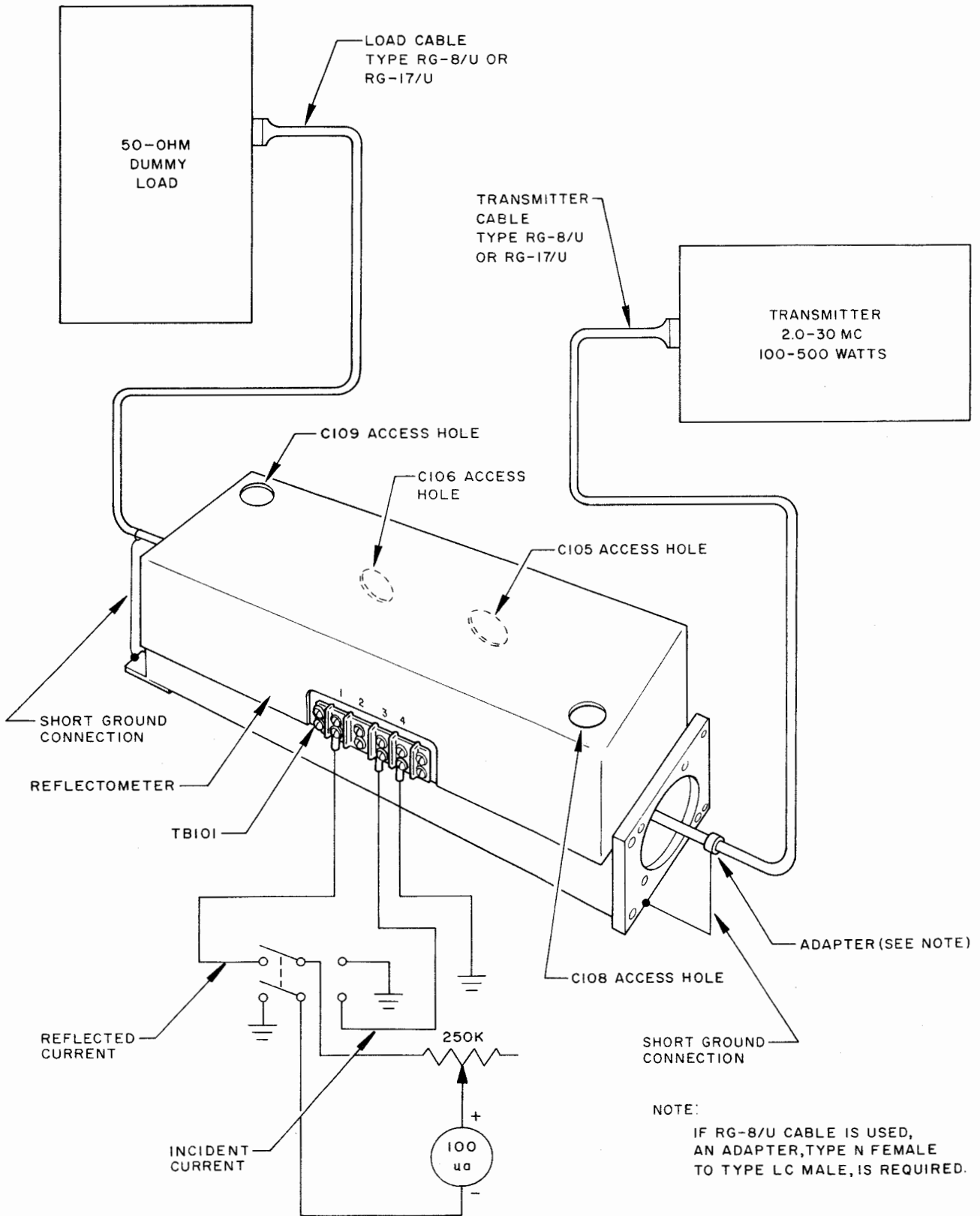
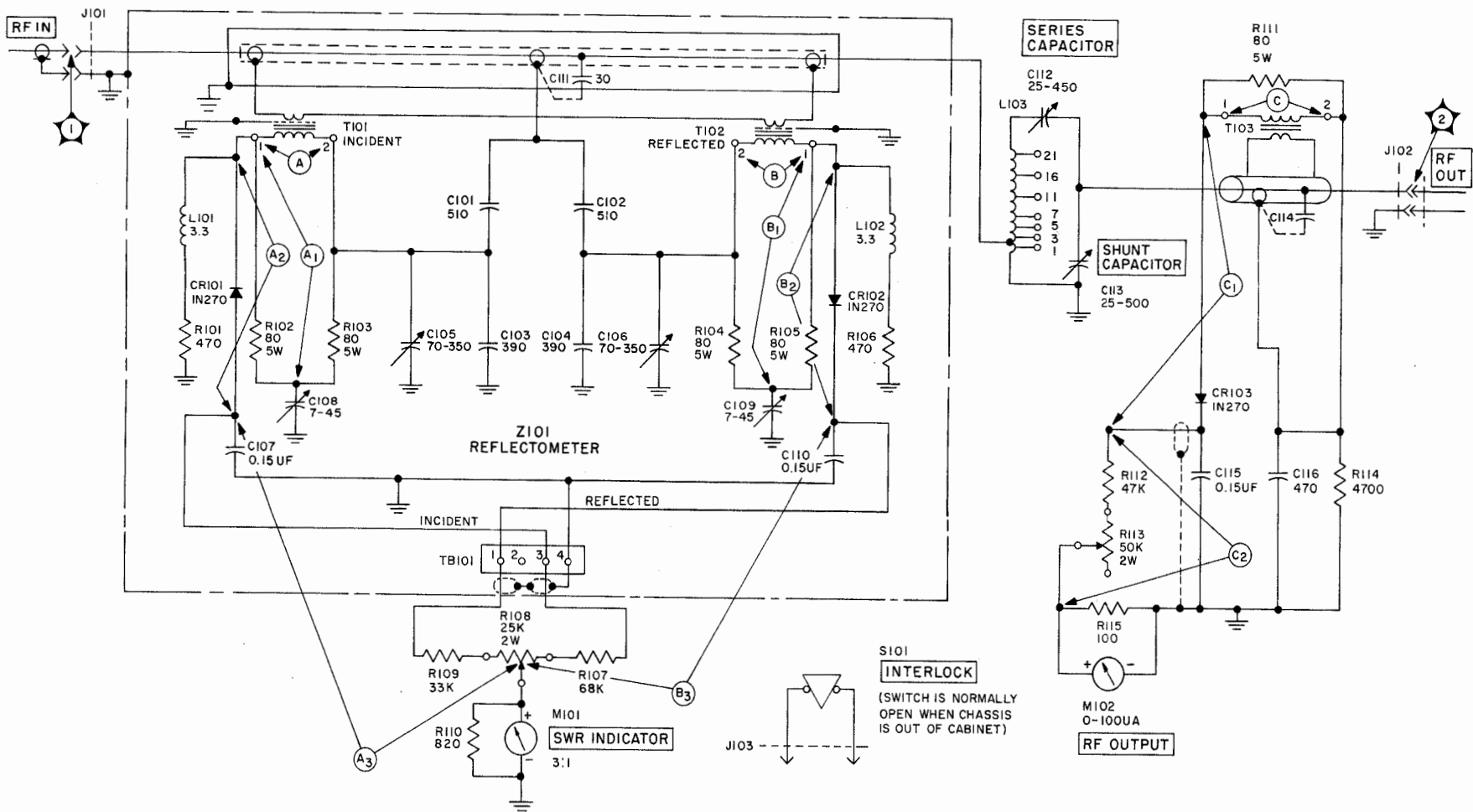


Figure 6-1. Reflectometer Alignment Test Setup



NOTE:
 UNLESS OTHERWISE SPECIFIED:
 CAPACITANCE VALUES ARE EXPRESSED IN MICROMICROFARADS
 RESISTANCE VALUES ARE EXPRESSED IN OHMS, 1/2 WATT
 INDUCTANCE VALUES ARE EXPRESSED IN MICROHENRIES

Figure 6-2. Radio Frequency Tuner TN-341/BRT, Schematic Diagram

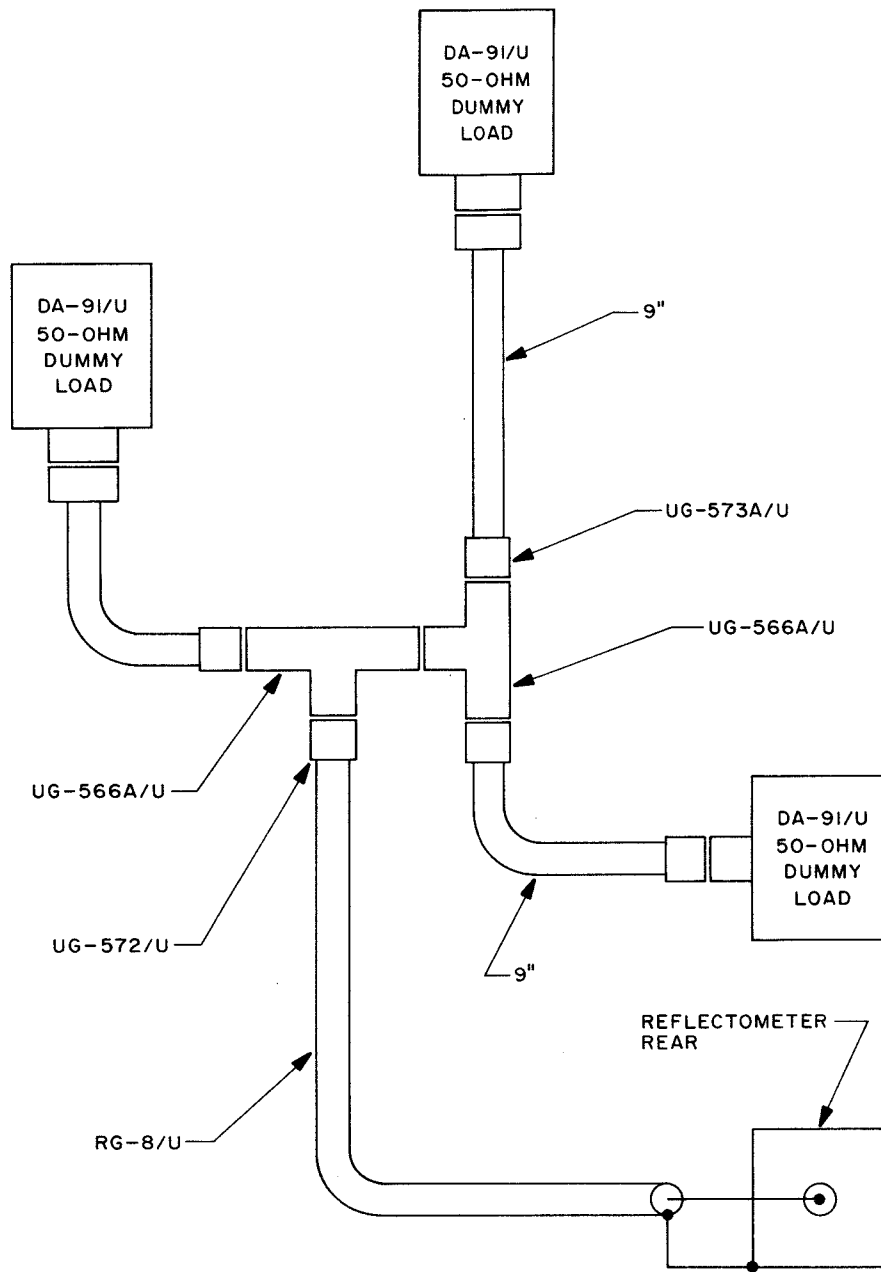


Figure 6-3. Test Equipment Setup Using Three Dummy Loads in Parallel

reading. It should be the same as recorded in step 6. If it is higher, repeat steps 7 through 11.

Step 12. Connect three 50-ohm dummy loads in parallel to the reflectometer output. (See figure 6-3.) This gives a standing wave ratio of 3:1. Apply 500 watts rf power at 3.25 mc. Adjust the potentiometer to obtain a reading of 100 ua incident current. Set the switch to measure reflected current. Record the reflected current. The reflected current should be 50 ua \pm 5 for a 3:1 SWR.

Step 13. Disconnect the three 50-ohm dummy loads and reconnect one 50-ohm dummy load to the reflectometer output. Apply 100 watts rf power at 26.0 mc. Adjust the potentiometer to obtain an incident current reading of 100 ua. Set the switch to measure reflected current and adjust C109 for minimum reflected current.

Step 14. Turn off transmitter and disconnect 50-ohm dummy load from the reflectometer.

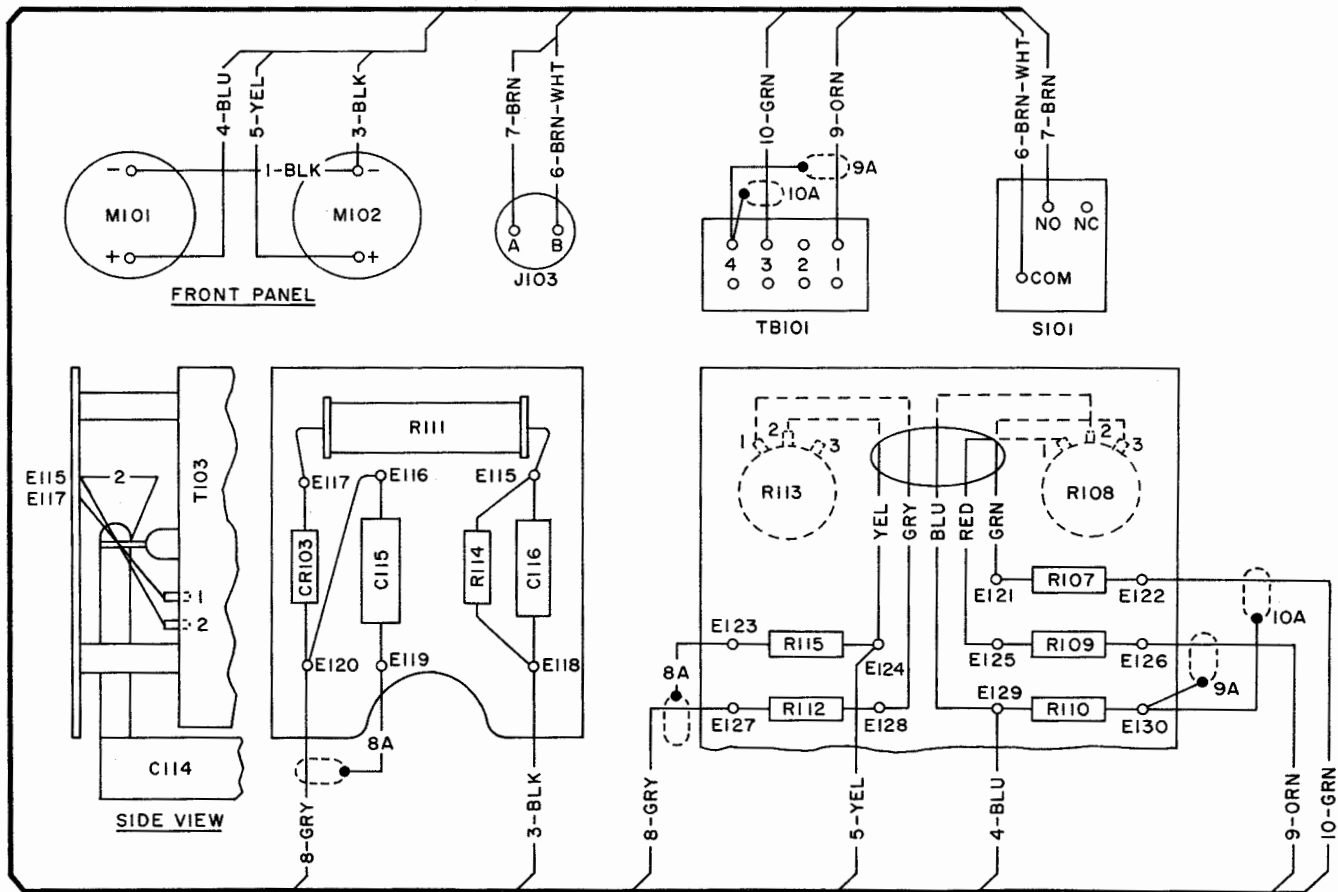
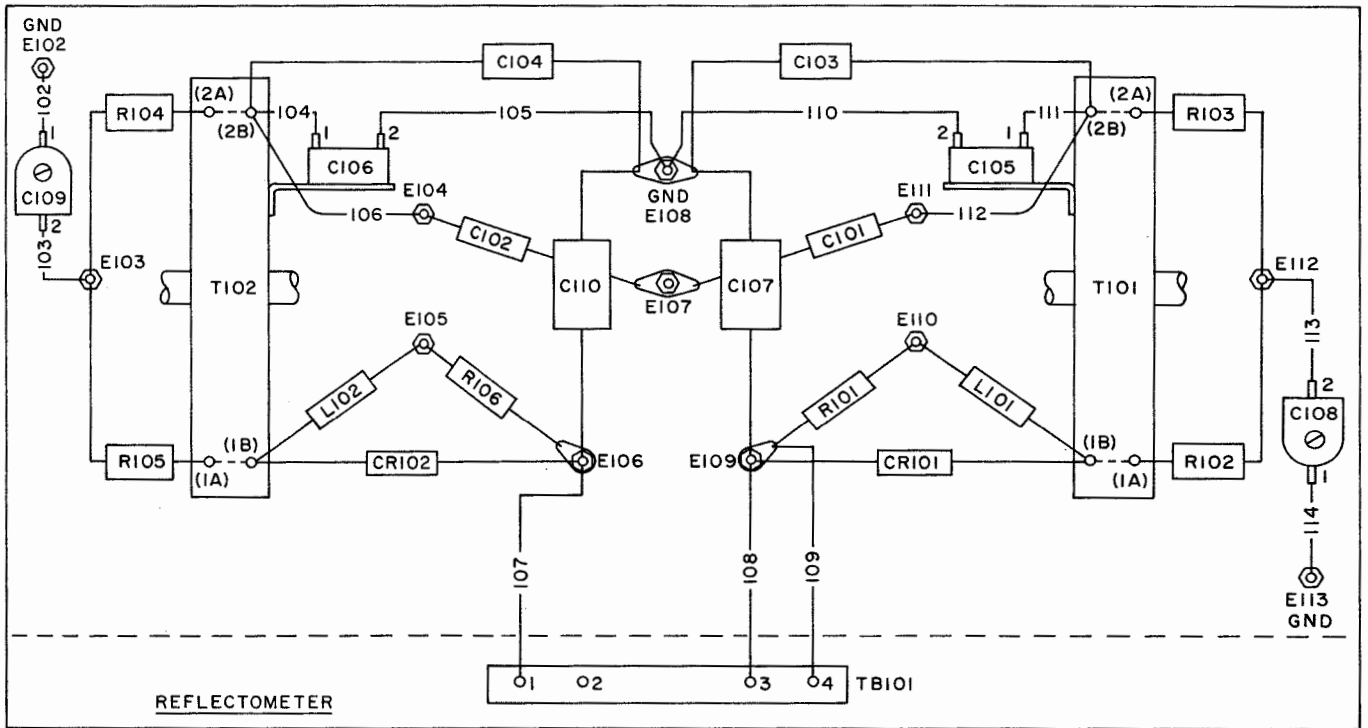


Figure 6-4. Radio Frequency Tuner TN-341/BRT, Wiring Diagram

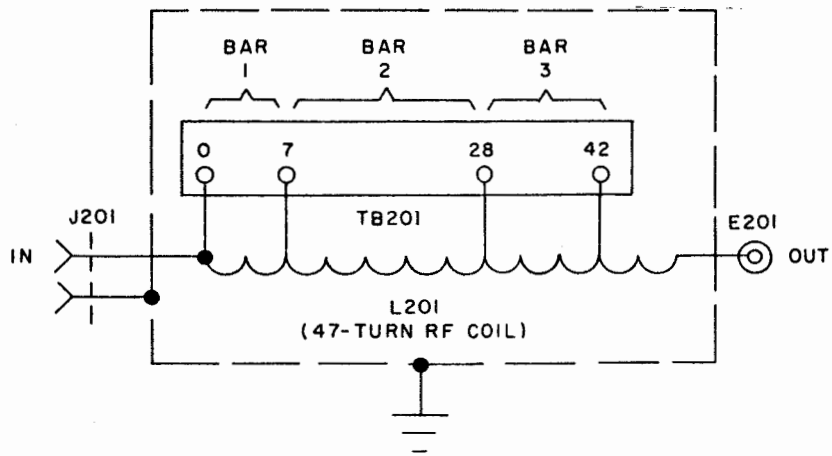


Figure 6-5. Radio Frequency Coil RF-91/BRT, Schematic Diagram

Step 15. Apply 100 watts rf power at 26.0 mc. Set the switch to measure reflected current and adjust the potentiometer to obtain a reflected current reading of 80 ua. Set the switch to measure incident current and adjust C108 for an incident current reading of 80 ua.

Step 16. Place a short circuit from ground to the rf output terminal of the reflectometer. Set the switch to measure reflected current and adjust the potentiometer to obtain a reflected current reading of 80 ua.

NOTE

Meter readings will vary greatly between open and short circuit.

Step 17. Adjust C108 to obtain a minimum difference between incident and reflected current for short circuit and open circuit conditions.

Step 18. Repeat step 12, except use a frequency of 26.0 mc instead of 3.25 mc.

d. SWR INDICATOR METER CIRCUIT ALIGNMENT. - Align the SWR INDICATOR meter circuit according to the following steps.

Step 1. Remove chassis from rf tuner. Jumper INTERLOCK switch S101.

WARNING

Exercise care when performing this alignment as the INTERLOCK has been defeated and dangerous voltages exist in the tuner.

Step 2. Disconnect lead from output of reflectometer and connect three 50-ohm dummy loads in parallel to the output.

Step 3. Connect 100 watts rf power at 3.25 mc to the RF IN jack J101.

Step 4. Adjust variable resistor R108 to obtain a reading of 3:1 on SWR INDICATOR meter M101.

e. RF OUTPUT METER CIRCUIT ALIGNMENT. - Align the RF OUTPUT meter circuit according to the following steps.

NOTE

Perform this alignment after the SWR INDICATOR meter circuit alignment.

Step 1. Remove chassis from rf tuner. Jumper INTERLOCK switch S101.

WARNING

Exercise care when performing this alignment as the INTERLOCK has been defeated and dangerous voltages exist in the tuner.

Step 2. Connect three 50-ohm dummy loads in parallel to RF OUT jack J102.

Step 3. Connect 500 watts average rf power at 3.25 mc to RF IN jack J101.

Step 4. Tune for minimum SWR on SWR INDICATOR meter M101. (Refer to paragraph 3-4.)

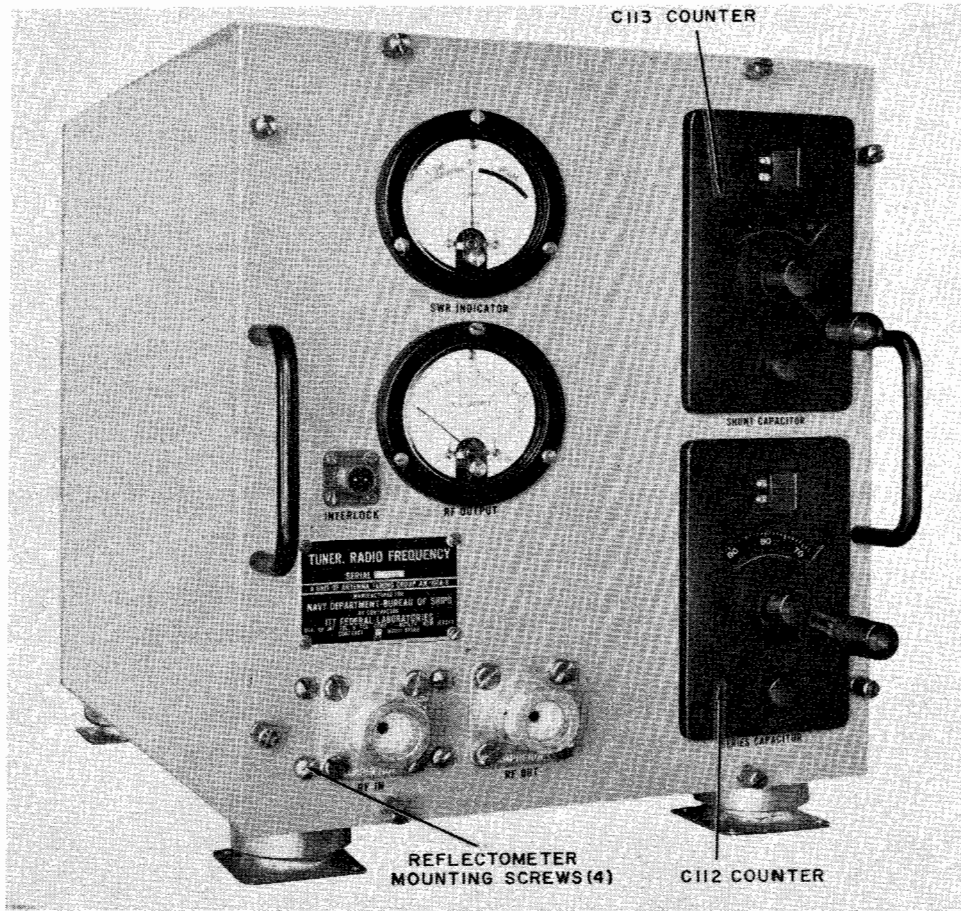


Figure 6-6. RF Tuner, Front View, Removal of Parts

Step 5. Adjust variable resistor R113 for indication of 1.5 to 2 on RF OUTPUT meter M102.

6-3. REMOVAL, ADJUSTMENT, REPAIR, AND REASSEMBLY OF PARTS AND SUBASSEMBLIES.

a. REMOVAL OF SUBASSEMBLIES.

(1) REFLECTOMETER. - Remove the reflectometer according to the following steps.

Step 1. Remove four screws holding RF IN jack J101 and remove the four screws holding the reflectometer to the front panel. (See figure 6-6.)

Step 2. At the rear of the reflectometer, disconnect output lead and remove two screws from reflectometer mounting bracket. (See figure 6-7.)

Step 3. Remove and tag leads from TB101.

Step 4. Remove S101.

ORIGINAL

Step 5. Remove reflectometer from chassis.

(2) COIL L103. - Remove rear fiberglass mounting bracket (see figure 6-7). Disconnect four coil leads. Remove coil from rear of chassis.

(3) VACUUM CAPACITORS C112 AND C113. - Remove each vacuum capacitor according to the following steps. (See figures 6-7 and 6-8.)

Step 1. Adjust capacitor to minimum capacitance (counterclockwise rotation of crank handles on front panel).

Step 2. Remove capacitor leads.

Step 3. Remove L103 rear mounting board if necessary.

Step 4. Remove capacitor mounting screws from fiberglass mounting boards.

Step 5. Remove capacitor and the plastic coupling between capacitor and gear train assembly.

(4) FRONT PANEL. - Remove the front panel according to the following steps. (See figures 6-6, 6-7, and 6-8.)

Step 1. Adjust C112 and C113 to minimum capacitance.

Step 2. Remove four screws holding RF IN jack J101.

Step 3. Remove seven 1/4-20 nuts from front panel studs. Remove four screws holding reflectometer to front panel.

Step 4. Remove two 10-32 nuts from left side-front mounting bracket of coil L103 and one 10-32 screw from ground connection of L103 mounting bracket.

Step 5. Loosen Allen screw in coupling of lead from SERIES CAPACITOR to RF OUT jack J102.

Step 6. Remove front panel and Teflon couplings of C112 and C113.

Step 7. Unsolder and tag interconnecting wires, if necessary.

(5) VACUUM CAPACITOR COUNTER ASSEMBLIES.

(a) Remove the vacuum capacitor C112 counter according to the following steps. (See figures 6-7, 6-8, and 6-9.)

Step 1. Remove front panel. (Refer to paragraph 6-3a (4).)

Step 2. Remove C112 counter from front panel by removing three screws from panel and removing large gear from counter shaft.

(b) Remove vacuum capacitor C113 counter according to the following steps.

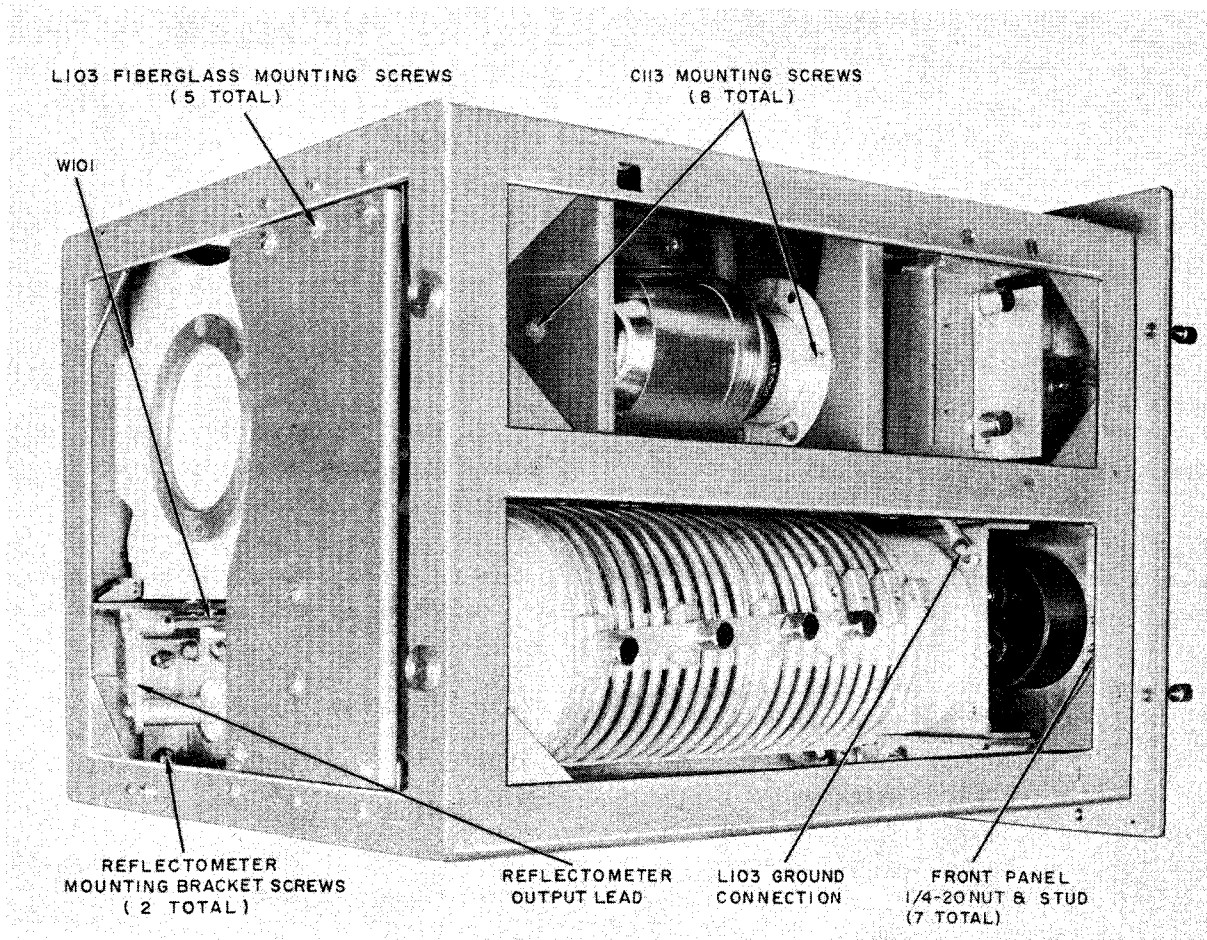


Figure 6-7. RF Tuner, Top View, Removal of Parts

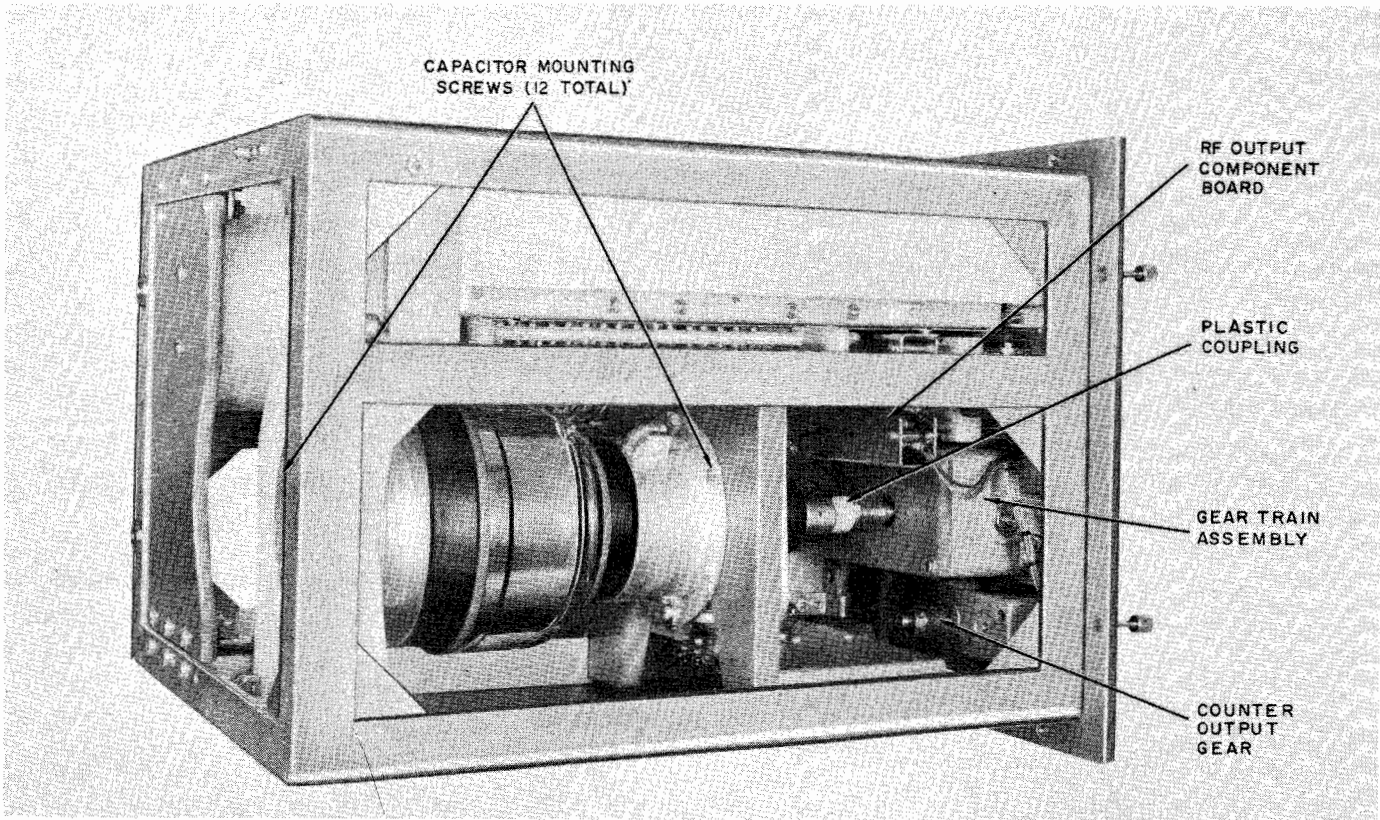


Figure 6-8 RF Tuner, Bottom View, Removal of Parts

Step 1. Remove front panel and counter for C112 as in (a), above.

Step 2. Remove cover from RF OUTPUT meter component board and loosen screws holding board to front panel.

Step 3. Remove C112 gear box. This exposes mounting screws for C113 counter.

Step 4. Remove C113 counter by removing three mounting screws.

b. REPLACEMENT OF SUBASSEMBLIES.

Replacement of subassemblies is generally performed by reversing the corresponding removal instructions given in paragraph 6-3a. Whenever special procedures are required for replacing a subassembly, they are given in the following subparagraphs.

(1) VACUUM CAPACITORS C112 AND C113. - Observe the following precautions during replacement.

(a) Before installation, manually adjust each capacitor for minimum capacitance, clockwise rotation, and set its counter to zero.

(b) If the coupling will not line up for connection to the gear shaft, loosen the setscrew on the capacitor end of the coupling and align the coupling. Then tighten the set screw.

(2) FRONT PANEL. - Be sure that vacuum capacitors C112 and C113 are set for minimum capacitance and their counters set to zero before recoupling them to the front panel.

(3) VACUUM CAPACITOR COUNTER ASSEMBLIES. - Be sure C112 and C113 are set for minimum capacitance, the counters set to zero, and the stops in the gear train assemblies set correctly. To determine that the gear train stops are set correctly, check that as the crank on the capacitor counter is rotated above zero (increasing capacitance) and back to zero, the stops halt rotation when the zero setting is reached. If not, unmesh the counter output gear from the capacitor drive gear and manually rotate the capacitor drive gear counterclockwise when

viewed from rear of panel until the minimum end stops become effective. Reinsert the counter assembly so that its zero mark lines up with the stop setting.

NOTE

If it is impossible to crank the counter after reinserting it, the stops are set to the wrong end. Unmesh the counter output gear and rotate the gear train until the stops at the opposite end have been reached. Then reinsert the counter as described above.

(4) GEAR TRAIN ASSEMBLY. - If a gear train assembly is defective, remove and disassemble the gear train assemblies according to the following steps (see figures 6-10 and 6-11).

Step 1. Remove the front panel. (Refer to paragraph 6-3a(4).)

Step 2. Remove the vacuum capacitor counter assemblies. (Refer to paragraph 6-3a(5).)

Step 3. Loosen the set screw in the crank handle and remove from the gear assembly shaft.

Step 4. Remove the four screws (1), lock washers (2), and flat washers (3).

Step 5. Remove gear housing cover (4).

Step 6. Remove setscrew (5) and straight pin (6) from miter gear (7). Remove miter gear.

Step 7. Remove setscrew (8) and straight pin (9) from gear (10). Remove gear.

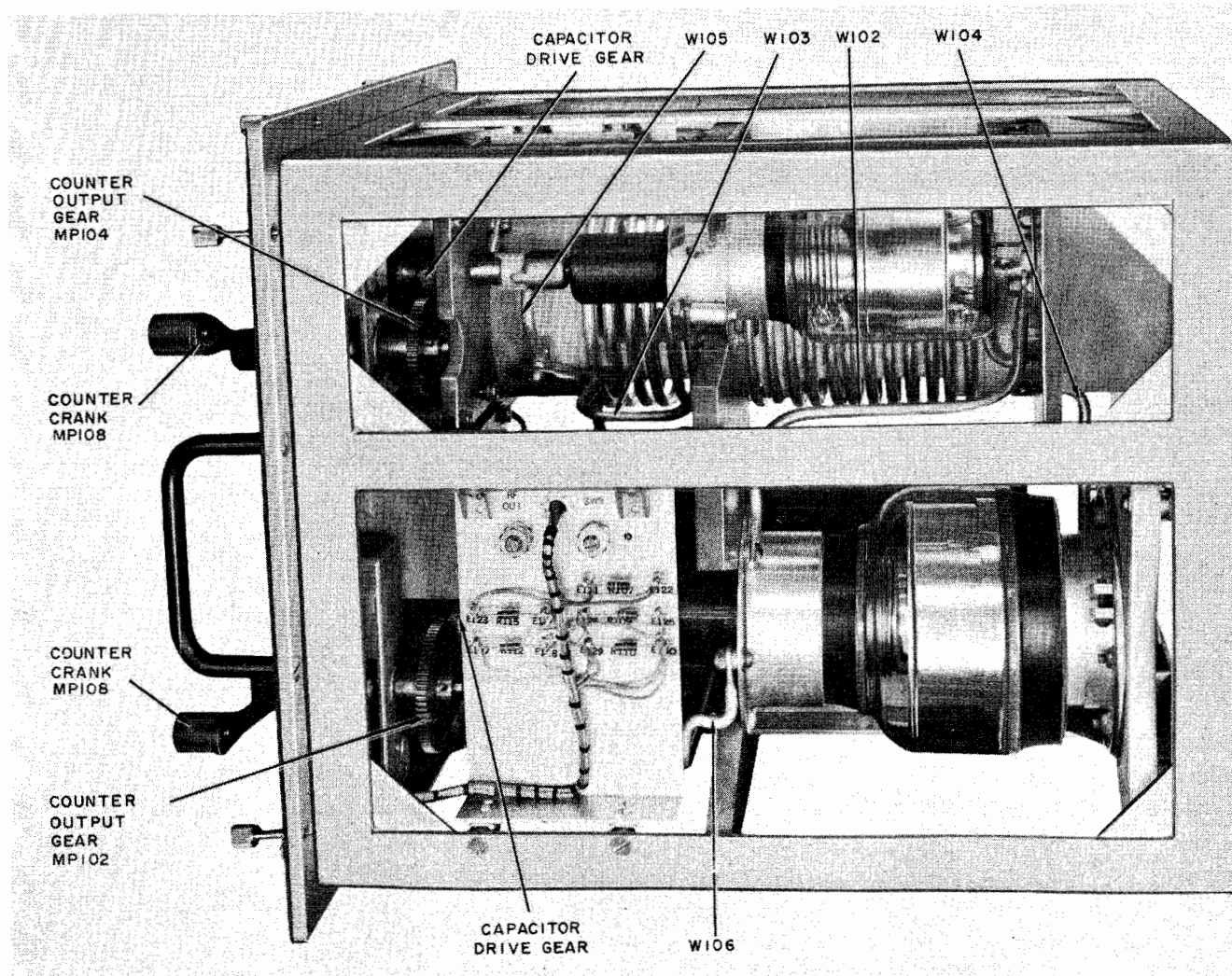


Figure 6-9. RF Tuner, Right Side View, Removal of Parts

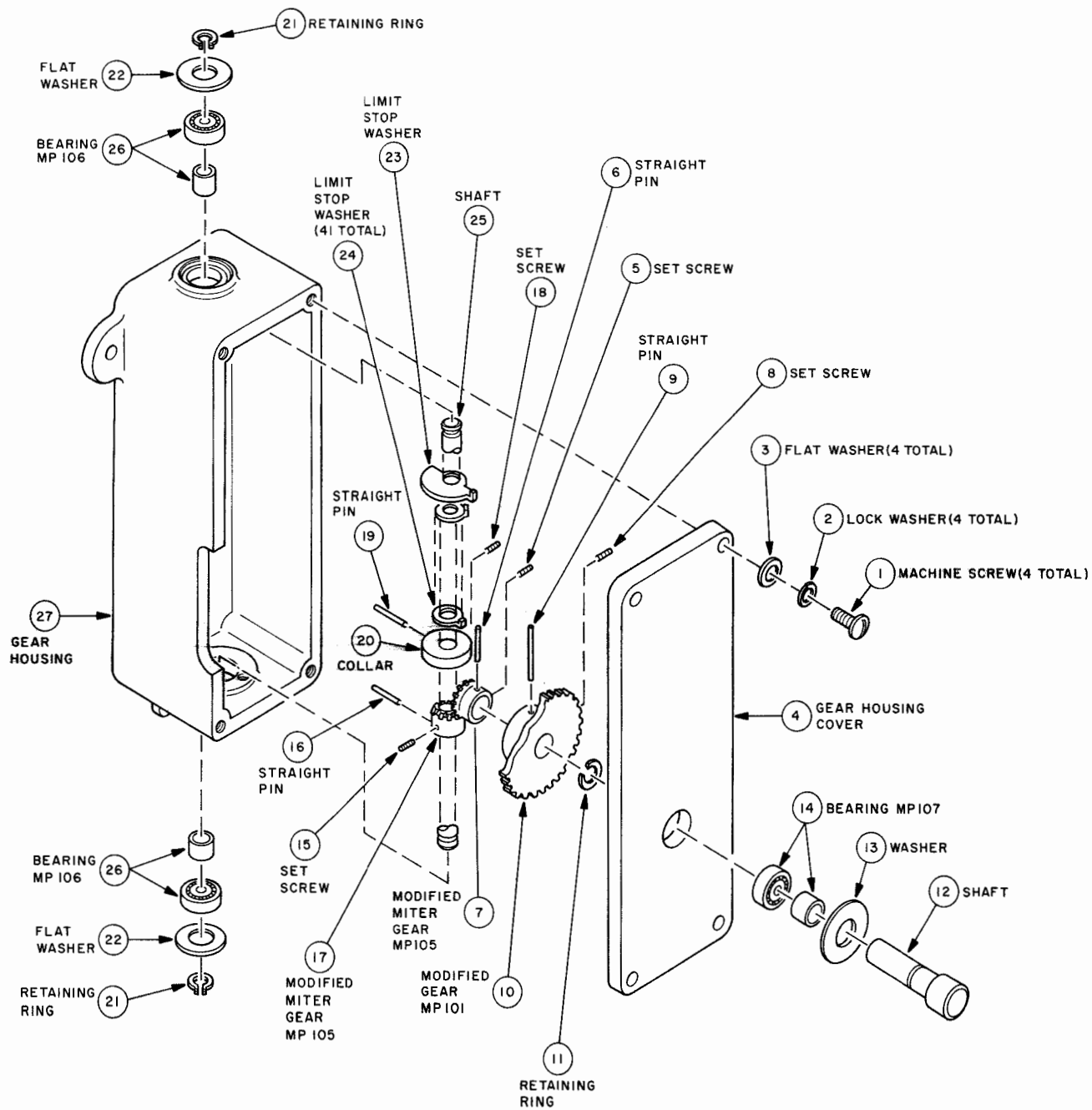


Figure 6-10. SERIES CAPACITOR Gear Train, Location of Parts

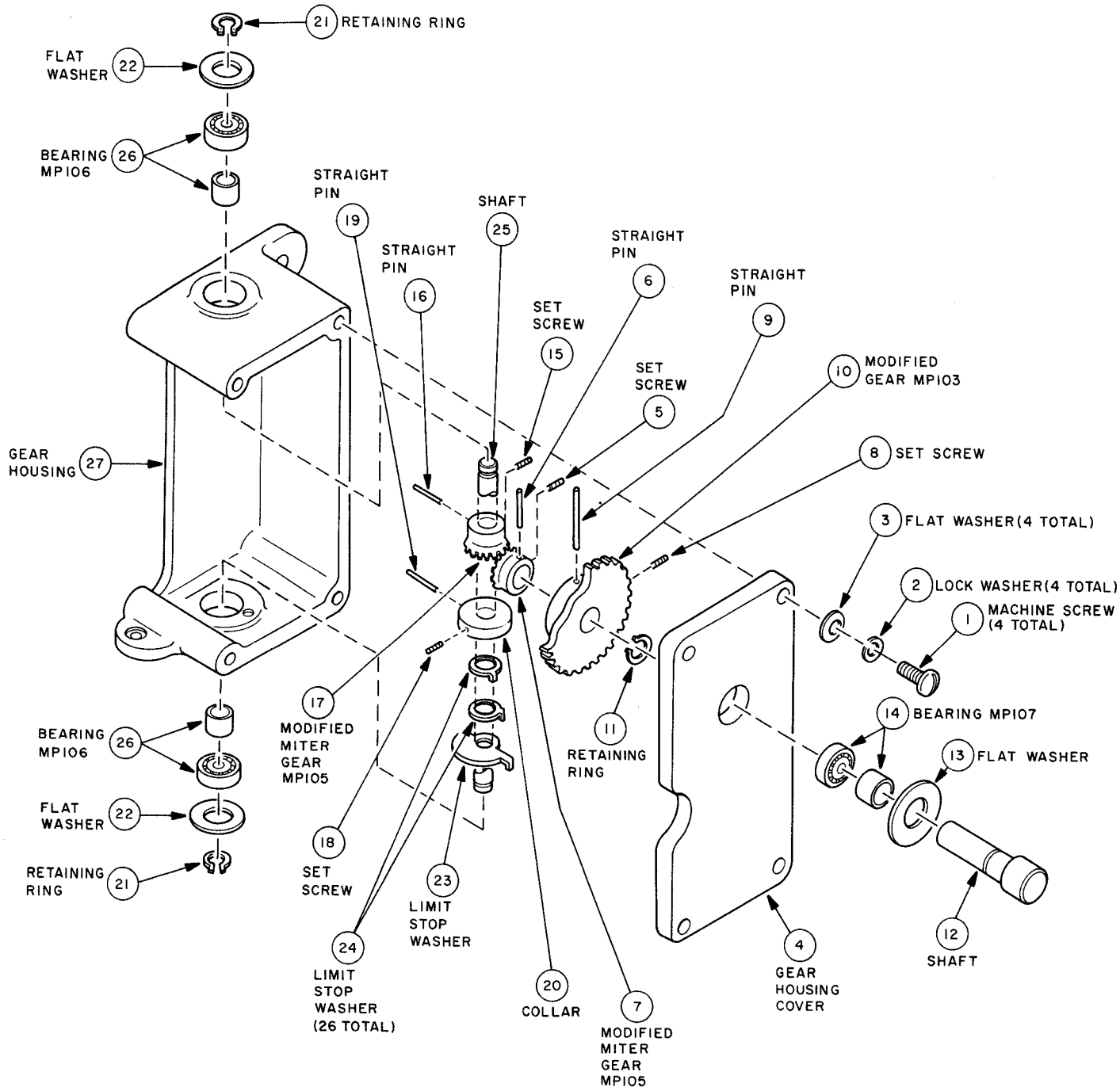


Figure 6-11. SHUNT CAPACITOR Gear Train, Location of Parts

Step 8. Remove retaining ring (11) and slide shaft (12) clear of gear housing cover (4).

Step 9. Remove washer (13) from shaft (12).

Step 10. Press bearing (14) from gear housing cover (4).

Step 11. Remove setscrew (15) and straight pin (16) from miter gear (17).

Step 12. Remove setscrew (18) and straight pin

(19) from collar (20).

Step 13. Remove retaining rings (21) and washers (22) from shaft (25).

Step 14. Remove shaft (25) from gear housing (27).

Step 15. Remove miter gear (17), collar (20), and limit stop washers (23) and (24), from shaft (25).

Step 16. Press bearings (26) from gear housing (27).

SECTION 7

PARTS LIST

7-1. INTRODUCTION.

Reference designations have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams and parts lists. The letters of a reference designation indicate the kind of part (generic group) such as resistor, amplifier, electron tube, miscellaneous mechanical parts, etc. Parts of the equipment are numbered from 100-205. Stock Numbers of parts used in this equipment may be obtained by referring to the Allowance Parts List (APL) published by E.S.O.

7-2. MAINTENANCE PARTS LIST.

Table 7-1 lists the equipment and its maintenance parts. Column 1 lists the entire reference series for the equipment followed by the reference designations of the parts in alpha-numeric order.

All of the reference designations in each series of one hundred numbers are listed before the reference designations in the next series of one hundred numbers are listed. Column 2 is not applicable. Column 3 gives the name and description of the various parts. Complete information is given for all key parts (parts differing from any previously listed in this table). The name and description are omitted for other than key parts. In these instances, however, reference is made to the key parts for the data. Column 4 indicates the manner in which the part is used and gives its functional location in the equipment. It also includes the figure number of the pictorial illustration on which the part is identified.

7-4. LIST OF MANUFACTURERS.

Table 7-2 lists the manufacturers of parts used in the equipment. These codes are listed in the Cataloging Handbook H4-1, Federal Supply Code for Manufacturers.

TABLE 7-1. ANTENNA TUNING GROUP AN/BRA-6, MAINTENANCE PARTS LIST

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
100-199		ANTENNA TUNING GROUP AN/BRA-6: consists of TUNER, RADIO FREQUENCY TN-341/BRT, and COIL, RADIO FREQUENCY RF-91/BRT	
CR101		TUNER, RADIO FREQUENCY TN-341/BRT: capacity tuned, operating frequency 2-30 mc, 21964 part no. 2273398-1	Rectifier Figure 5-1
CR102		SEMICONDUCTOR DEVICE, DIODE: MIL-E-1 type 1N270	Rectifier Figure 5-1
CR103		Same as CR101	Rectifier Figure 5-4
C101		CAPACITOR, FIXED, MICA DIELECTRIC: 510 μmf $\pm 2\%$, 500 vdc, MIL-C-5A type CM20D511G	Voltage Divider Figure 5-1
C102		Same as C101	Voltage Divider Figure 5-1
C103		CAPACITOR, FIXED, MICA DIELECTRIC: 390 μmf $\pm 2\%$, 500 vdc, MIL-C-5A, type CM20D391G	Voltage Divider Figure 5-1
C104		Same as C103	Voltage Divider Figure 5-1
C105		CAPACITOR, VARIABLE, MICA DIELECTRIC: 70 μmf min to 350 μmf max, 250 vdc, 72136 part no. 303	Trimmer Figure 5-1
C106		Same as C105	Trimmer Figure 5-1
C107		CAPACITOR, FIXED, PAPER DIELECTRIC: 1 section, 200 vdcw, 150,000 μmf $\pm 10\%$, metallic case, insulated, hermetically sealed, 1.188 in. lg. x 0.463 dia, MIL-C-25A type CP05A1KC154K	RF Bypass Figure 5-1
C108		CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 7 μmf min to 45 μmf max 500 vdc, MIL-C-81, type CV11C450	Trimmer Figure 5-1
C109		Same as C108	Trimmer Figure 4-1
C110		Same as C107	RF Bypass Figure 5-1
C111		CAPACITOR, FIXED, PLASTIC DIELECTRIC: 30 μmf $\pm 15\%$, 11,000 vac, metal case, 12 in. lg, by 0.750 dia, 21964 part no. 2273359	Voltage Divider Figure 5-1
C112		CAPACITOR, VARIABLE, VACUUM DIELECTRIC: 25 μmf min to 450 μmf max, 40,000 vac, 60 amps max rms, 73905 part no. UCSXHF25-450	Series Tuning Figure 5-3
C113		CAPACITOR, VARIABLE, VACUUM DIELECTRIC: 25 μmf min to 500 μmf max, 15,000 vac, 42 amps max rms, 73905 part no. UCS25-500	Shunt Tuning Figure 5-3
C114		CAPACITOR ASSEMBLY: polyethylene dielectric, 21964 part no. 2273576	Voltage Divider Figure 5-4
C115		Same as C107	RF Bypass Figure 5-4
C116		CAPACITOR, FIXED, MICA DIELECTRIC: 470 μmf $\pm 2\%$, 500 vdc, MIL-C-5A type CM20D471G	Voltage Divider Figure 5-4
J101		CONNECTOR, RECEPTACLE, ELECTRICAL: 21964 part no. 2273877	RF Power Input Figure 5-2
J102		Same as J101	RF Power Output Figure 5-2
J103		CONNECTOR, RECEPTACLE, ELECTRICAL: MIL-C-5015 type MS3102E10SL-4P	Interlock Figure 5-2
L101		COIL, RADIO FREQUENCY: 1 winding, 9 turns, single layer wound; 82142 part no. 10102-20	Hi Frequency Compensation Figure 5-1

TABLE 7-1. ANTENNA TUNING GROUP AN/BRA-6, MAINTENANCE PARTS LIST (CONT'D)

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
L102		Same as L101	Hi Frequency Compens- ation Figure 5-1
L103		COIL FORM ASSEMBLY: 1 winding 21 turns, single layer wound, 21964 part no. 2273549	Tuning Figure 5-2
MP101		GEAR, SPUR: bronze, 21964 part no. 2273304-1	Series Capacitor Gear Figure 6-10
MP102		GEAR, SPUR: bronze, 21964 part no. 2273304-2	Series Capacitor Gear Figure 6-9
MP103		GEAR, SPUR: bronze, 21964 part no. 2273313-1	Shunt Capacitor Gear Figure 6-11
MP104		GEAR, SPUR: bronze, 21964 part no. 2273313-2	Shunt Capacitor Gear Figure 6-9
MP105		GEAR, SET, BEVEL MATCHED: brass, 21964 part no. 2273323	P/O Gear Assy Figure 6-10
MP106		BEARING, BALL, THRUST: 21335 part no. F4DD	Shaft Bearing Figure 6-10
MP107		BEARING, BALL, THRUST: 21335 part no. F5DD	Shaft Bearing Figure 6-10
MP108		COUNTER, ROTATING, FIXED MOUNTING: 2 scales, brass ni pl scale with black background, nonreset, designed to subtract, 21964 part no. 2273767	Capacitor Tuner Figure 6-9
M101		AMMETER: dc, arbitrary scale, non-linear, 21964 part no. 2273869	SWR Indicator Figure 5-2
M102		AMMETER: dc, scale 0-10, non-linear, 21964 part no. 2273868	RF Output Figure 5-2
R101		RESISTOR, FIXED, COMPOSITION: 470 ohms +5% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF471J	Hi-Frequency Compens- ation Figure 5-1
R102		RESISTOR, FIXED, FILM: 80 ohms +1%, 5 w, 72223 part no. X5-800PORM1	Current Sampling Load Figure 5-1
R103		Same as R102	Load Figure 5-1
R104		Same as R102	Load Figure 5-1
R105		Same as R102	Load Figure 5-1
R106		Same as R101	Hi Frequency Compens- ation Figure 5-1
R107		RESISTOR, FIXED, COMPOSITION: 68,000 ohms +10% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF683K	RF Tuner Load Figure 5-3
R108		RESISTOR, VARIABLE: composition, 25,000 ohms +10%, 2 w, single shaft, slotted, 0.750 in. lg, MIL-R-94B typē RV4LAYS253A	Balance Figure 5-3
R109		RESISTOR, FIXED, COMPOSITION: 33,000 ohms +5% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF333J	Load Figure 5-3
R110		RESISTOR, FIXED, COMPOSITION: 820 ohms +10% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF821K	Meter Shunt Figure 5-3
R111		Same as R102	Load Figure 5-4

TABLE 7-1. ANTENNA TUNING GROUP AN/BRA-6, MAINTENANCE PARTS LIST (CONT'D)

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
R112		RESISTOR, FIXED, COMPOSITION: 47,000 ohms +10% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF473K	Load Figure 5-3
R113		RESISTOR, VARIABLE: composition, 50,000 ohms +10%, 2 w, single shaft, slotted, 0.750 in. lg, MIL-R-94B type RV4LAYS503A	Meter Adjustment Figure 5-3
R114		RESISTOR, FIXED, COMPOSITION: 4700 ohms +10% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF472K	DC Return Figure 5-4
R115		RESISTOR, FIXED, COMPOSITION: 100 ohms +10% 1/2 w, rated at 70°C ambient temperature, F characteristic, MIL-R-11C type RC20GF101K	Meter Shunt Figure 5-3
S101		SWITCH, SENSITIVE: SPDT, 40228 part no. 2AC6	RF Interlock Figure 5-2
TB101		TERMINAL BOARD: 4 terminals, screw type, 75382 part no. 600Y4M	Reflectometer Metering Figure 5-2
T101		COIL, RF: 1 winding 22 turns, single layer wound, 21964 part no. 2273375	Incident Current Figure 5-1
T102		COIL, RF: 1 winding 22 turns, single layer wound, 21964 part no. 2273370	Reflected Current Figure 5-1
T103		COIL, RF: 1 winding 17 turns, multiple layer wound, 21964 part no. 2273618	Output Current Figure 5-4
W101		CABLE, POWER, ELECTRICAL: 1 conductor, copper, silver plated, solid, 250 cir mils, 21964 part no. 2273848	RF Power Inter- connection Figure 6-7
W102		CABLE, POWER, ELECTRICAL: 1 conductor, copper, silver plated, solid, 250 cir mils, 21964 part no. 2273850	RF Power Inter- connection Figure 6-9
W103		CABLE, POWER, ELECTRICAL: 1 conductor, copper, silver plated, solid, 250 cir mils, 21964 part no. 2273851	RF Power Inter- connection Figure 6-9
W104		CABLE, POWER, ELECTRICAL: 1 conductor, copper, silver plated, solid, 250 cir mils, 21964 part no. 2273857	RF Power Inter- connection Figure 6-9
W105		CABLE, POWER, ELECTRICAL: 1 conductor, copper, silver plated, solid, 250 cir mils, 21964 part no. 2273858	RF Power Inter- connection Figure 6-9
W106		CABLE, POWER, ELECTRICAL: 1 conductor, copper, silver plated, solid, 250 cir mils, 21964 part no. 2273858	RF Power Inter- connection Figure 6-9
Z101		REFLECTOMETER ASSEMBLY: 2-30 mc frequency range, used with transmission line, 21964 part no. 2273408	Standing Wave Indi- cator Figure 5-2
201 to 205		COIL, RADIO FREQUENCY RF-91/BRT: operating frequency 2-6 mc, 9.375 in. lg by 14.75 in. h by 19.625 in. d, 1 winding 50 turns, single layer wound, 21964 part no. 2273779-1	
E201		INSULATOR, FEEDTHRU: teflon; 21964 part no. 2273476	Antenna Terminal Figure 5-5
J201		CONNECTOR, RECEPTACLE, ELECTRICAL: plastic dielectric, 21964 part no. 2273459	Loading Coil Input Figure 5-5
L201		COIL, RADIO FREQUENCY: 1 winding 50 turns, single layer wound, 21964 part no. 2273617	Loading Figure 5-5

TABLE 7-1. ANTENNA TUNING GROUP AN/BRA-6, MAINTENANCE PARTS LIST (CONT'D)

REF DESIG	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
MP201		CATCH ASSEMBLY: drawer pull, 21964 part no. 2272993	P/O Coil Assy
MP202		HANDLE ASSEMBLY: 21964 part no. 2273539	P/O Coil Assy
MP203		CATCH, ELBOW: cad pl stl, 21964 part no. 2273960	P/O Coil Assy
TB201		TERMINAL BOARD: P/O coil L201 assembly, 21964 part no. 2273474	P/O Coil Assy Figure 5-3

TABLE 7-2. ANTENNA TUNING GROUP AN/BRA-6, LIST OF MANUFACTURERS

CODE	NAME	ADDRESS
21335	Fafnir Bearing Co., The	New Britain, Conn.
21964	ITT Federal Laboratories, Division of International Telephone and Telegraph Corp.	Nutley, N. J.
40228	Micro Switch Division of Honeywell Regulator Co.	Freeport, Ill.
72136	Electro Motive Mfg. Co.	Willimantic, Conn.
72223	Continental Carbon Division of Wirt Co.	Cleveland, Ohio
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
75382	Kulka Electric Mfg. Co., Inc.	Mount Vernon, N. Y.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.

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