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UNCLASSIFIED

TECHNICAL MANUAL

*for*

ANTENNA TUNING SYSTEM  
MODEL ATS-2

(AN/URA-27 AND AN/URA-34)



THE TECHNICAL MATERIEL CORPORATION  
MAMARONECK, N.Y.

OTTAWA, ONTARIO

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IN-2001

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C O M M U N I C A T I O N S   E N G I N E E R S

700 FENIMORE ROAD

MAMARONECK, N. Y.

## W a r r a n t y

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,\*fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes\*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

\*Electron tubes also include semi-conductor devices.

### *PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT*

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

### *PROCEDURE FOR ORDERING REPLACEMENT PARTS*

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

### *PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT*

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION  
Engineering Services Department  
700 Fenimore Road  
Mamaroneck, New York





ANTENNA TUNING SYSTEM  
 MODEL ATS-2A

Antenna Tuning System, Model ATS-2A is similar to Antenna Tuning System ATS-2. The ATS-2A contains a d-c motor braking system for its resistance stepping circuit; mechanical adjustment of detent-sensing switch S204 is therefore less critical.

The ATS-2 instruction manual (IN-2001) will apply as written with the following exceptions:

1. All reference to ATS-2 should be changed to ATS-2A.
2. Figure 2-5. Interconnecting Diagram, Model ATS-2.

a. Change description of W105 to:

ARMORED CABLE, 12 CONDUCTORS  
 AWG 18 or 20. (Supplied by customer)

b. Change table (E201-P101 connections) to read:

ATS-TU-2 CONNECTION	TO P101 PIN NO.	
E201 Term. —	7	A
	4	B
	8	C
	1	D
	5	E
	3	F
	9	G
	10	H
	2	J
	6	K
E208 Term. —	1	I

3. Items listed below should be added to the parts list (section 7).

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C213	<p>Page 7-2</p> <p>CAPACITOR, FIXED, ELECTROLYTIC: 40 uf, +100% -10%; 250 volts DC; operating temperature range -20°C to +85°C; tinned copper leads, cardboard sleeve, aluminum case, aluminum mounting strap.</p>	CE103-7
CR201	<p>SEMICONDUCTOR DEVICE, DIODE: rectifier; max. operating voltage 600 V; current rated at 1.2 amps DC at 25°C; surge peak 20 amps at 25°C; surge peak 20 amps at 25°C; forward voltage drop 1.0 V, 0.80 amp at 100°C; 0.22" dia. x 0.375" long o/a.</p>	1N2071A
E208	<p>TERMINAL BOARD, BARRIER: 3 terminals, plastic.</p>	TM100-3
R211	<p>Page 7-3</p> <p>RESISTOR, FIXED, COMPOSITION: 100 ohms, +5%; 1/2 watt.</p>	RC20GF101J
R212	<p>RESISTOR, FIXED, COMPOSITION: 200 ohms, +5%; 1/2 watt.</p>	RC20GF201J
	<p>Change the following part as shown:</p>	
S102	<p>Page 7-7</p> <p>SWITCH, PUSHBUTTON: 4PST; 2 normally open contacts, 2 normally closed contacts.</p>	SW347

Addendum #1 to  
 ATS-2 Instruction  
 Manual (IN-2001)

4. Figures 8-2 and 8-3 should be changed in accordance with the information shown on figures 1 and 2 respectively of this addendum.

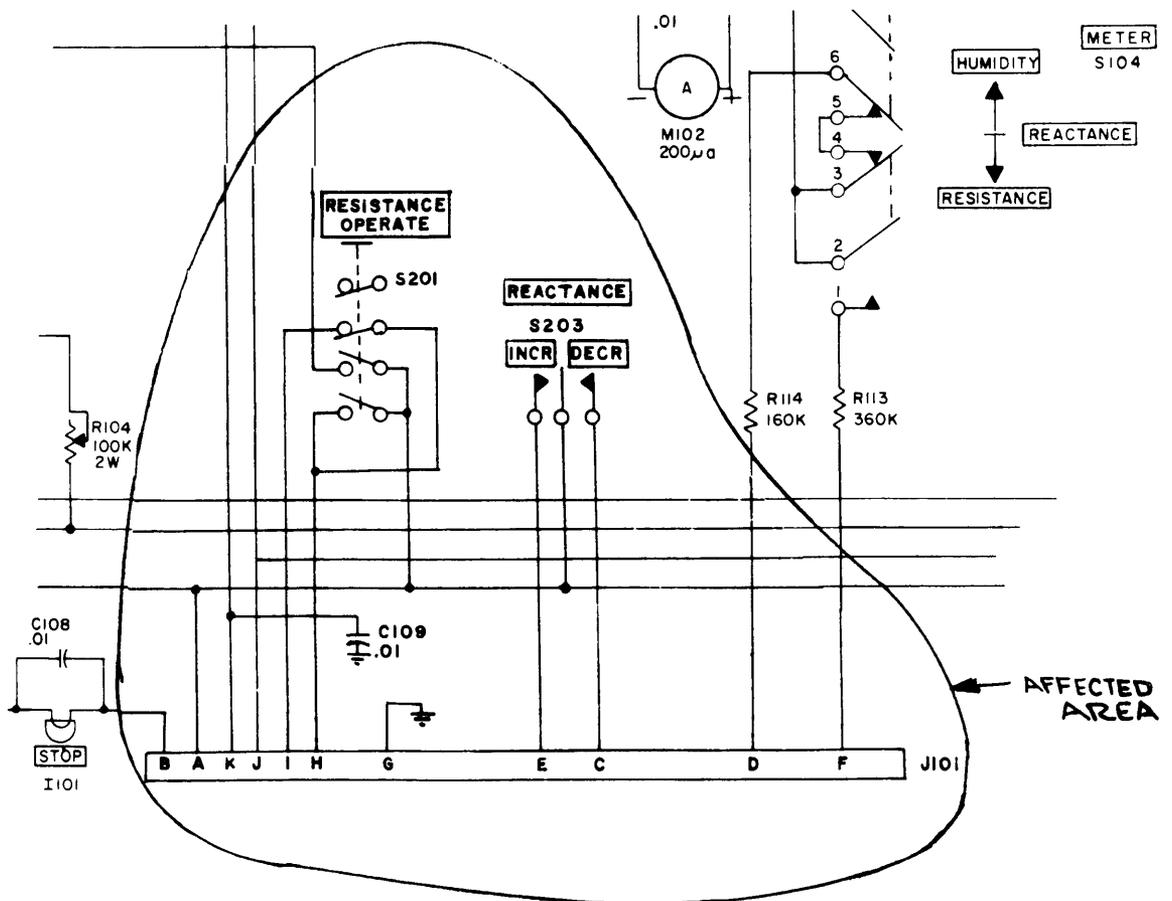


Figure 1

Addendum #1 to  
 ATS-2 Instruction  
 Manual (IN-2001)

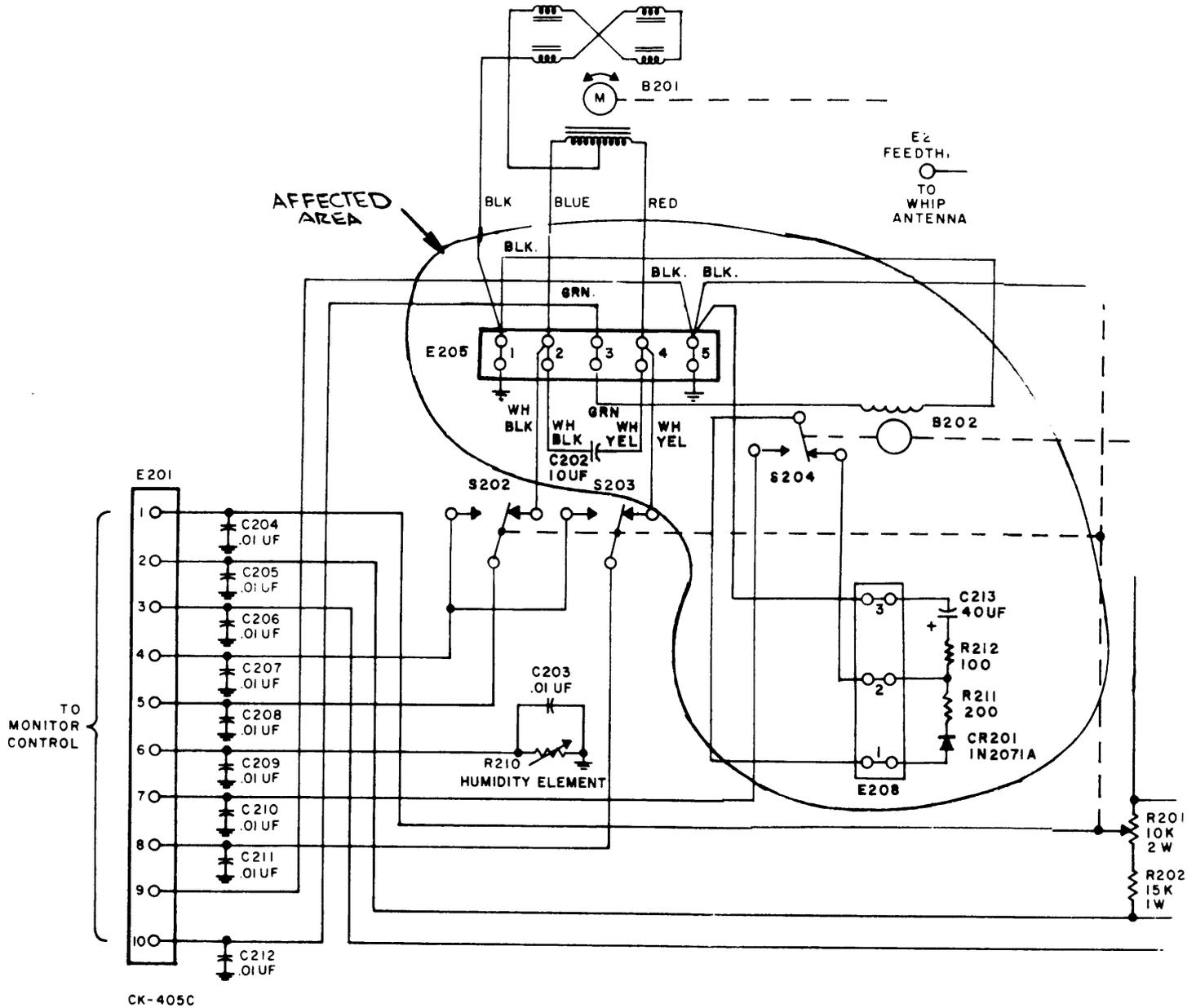


Figure 2

# TABLE OF CONTENTS

<u>Paragraph</u>	<u>Page</u>	<u>Paragraph</u>	<u>Page</u>
<b>SECTION 1—GENERAL DESCRIPTION</b>		<b>SECTION 3—OPERATOR'S SECTION</b>	
1-1	General . . . . . 1-1	3-1	Operating Instructions . . . . . 3-1
1-2	Description . . . . . 1-1	3-2	Operator's Maintenance . . . . . 3-1
1-3	Leading Particulars . . . . . 1-1	<b>SECTION 4—PRINCIPLES OF OPERATION</b>	
1-4	Capabilities and Limitations . . . . . 1-1	4-1	Introduction . . . . . 4-1
1-5	Equipment Supplied . . . . . 1-1	4-2	Antenna Tuner . . . . . 4-1
1-6	Equipment Required But Not Supplied . . . . . 1-1	4-3	Directional Coupler . . . . . 4-3
		4-4	Monitor Control . . . . . 4-3
<b>SECTION 2—INSTALLATION</b>		<b>SECTION 5—TROUBLE-SHOOTING</b>	
		5-1	General . . . . . 5-1
2-1	Initial Inspection . . . . . 2-1	<b>SECTION 6—MAINTENANCE</b>	
2-2	115- VS 230-Volt Power Supply Connections . . . . . 2-1	6-1	Introduction . . . . . 6-1
2-3	Installation . . . . . 2-1	6-2	Alignment . . . . . 6-1
2-4	Counterpoise for 35-Foot Vertical Whip Antenna . . . . . 2-1	<b>SECTION 7—PARTS LIST</b>	
2-5	Initial Adjustments . . . . . 2-1	7-1	Introduction . . . . . 7-1
		<b>SECTION 8—SCHEMATIC DIAGRAMS</b>	

## LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Page</u>	<u>Figure</u>	<u>Page</u>
<b>SECTION 1—GENERAL DESCRIPTION</b>		<b>SECTION 4—PRINCIPLES OF OPERATION (Cont.)</b>	
1-1	Antenna Tuning System, Model ATS-2 . . . . . 1-0	4-5	Power Supply Circuit, Simplified Schematic Diagram . . . . . 4-5
<b>SECTION 2—INSTALLATION</b>		4-6	HUM./REACT./RES. Meter Circuit, Simplified Schematic Diagram . . . . . 4-6
2-1	115- vs 230- Volt Power Supply Connections . . . . . 2-1	4-7	Control, Power/VSWR Meter, and Overload Circuit, Simplified Schematic Diagram . . . . . 4-7/4-8
2-2	Antenna Tuner, Installation Dimensions . . . . . 2-2	<b>SECTION 5—TROUBLE-SHOOTING</b>	
2-3	Monitor Control, Installation Dimensions . . . . . 2-3	5-1	Voltage and Resistance Diagram . . . . . 5-1
2-4	Directional Coupler, Installation Dimensions . . . . . 2-4	5-2	Monitor Control Front Panel, Component Identification . . . . . 5-2
2-5	Interconnecting Diagram, Model ATS-2 . . . . . 2-5	5-3	Rear of Monitor Control, Component Identification . . . . . 5-3
2-6	Assembly Instructions for Terminal Tubes . . . . . 2-6	5-4	Top of Monitor Control, Component Identification . . . . . 5-4
2-7	Rooftop Installation, 35-foot Whip Antenna With Radial Counterpoise . . . . . 2-6	5-5	Bottom of Monitor Control, Component Identification . . . . . 5-5
<b>SECTION 3—OPERATOR'S SECTION</b>		5-6	Directional Coupler, Component Identification . . . . . 5-6
3-1	Monitor Control, Controls and Indicators . . . . . 3-2	5-7	Antenna Tuner, Component, Identification . . . . . 5-7
<b>SECTION 4—PRINCIPLES OF OPERATION</b>		<b>SECTION 8—SCHEMATIC DIAGRAMS</b>	
4-1	Antenna Tuner, Simplified Schematic Diagram . . . . . 4-1	8-1	Directional Coupler, Schematic Diagram . . . . . 8-2
4-2	Capacitive Antenna . . . . . 4-2	8-2	Antenna Tuner, Schematic Diagram . . . . . 8-3/8-4
4-3	Inductive Antenna . . . . . 4-2	8-3	Monitor Control, Schematic Diagram . . . . . 8-5/8-6
4-4	Directional Coupler, Simplified Schematic Diagram . . . . . 4-3		

## LIST OF TABLES

<u>Table</u>	<u>Page</u>	<u>Table</u>	<u>Page</u>
<b>SECTION 1—GENERAL DESCRIPTION</b>		<b>SECTION 6—MAINTENANCE</b>	
1-1	1-2	6-1	6-1
1-2	1-3	6-2	6-3
1-3	1-4	6-3	6-4
1-4	1-5/1-6	6-4	6-5/6-6
<b>SECTION 3—OPERATOR'S SECTION</b>		<b>SECTION 7—PARTS LIST</b>	
3-1	3-1	7-1	7-1
3-2	3-3	7-2	7-2
3-3	3-4	7-3	7-4
<b>SECTION 5—TROUBLE-SHOOTING</b>		7-4	7-5
5-1	5-8		

## INTRODUCTION

Whenever information in this manual applies to both the 50-ohm ATS(50)-2 and the 70-ohm ATS(70)-2 systems, the unit will be referred to as the ATS-2. When impedance of a system is mentioned, 50-ohms is arbitrarily used. However, users of ATS(70)-2 should assume the impedance to be 70-ohms.

While essentially similar, the ATS(50)-2 and the ATS(70)-2 have two important differences.

## NOTES

Notes used in this manual, contain conditions that should be highlighted.

## CAUTIONS

Cautions used in this manual, contain conditions which if not strictly observed, will result in equipment damage or destruction.

## WARNING

Warnings used in this manual, contain conditions which if not strictly observed, will result in personnel injury or loss of life.

Chart of Commercial Designation Versus Military Nomenclature

TMC NUMBER	NAME	MILITARY NOMENCLATURE	NAME
ATS-2-50	Antenna Tuning System	AN/URA-27	Antenna Coupler Group
MCU-2	Monitor Control	C-2995/URA-27	Control-Indicator
CU-2-50	Directional Coupler	CU-773/URA-27	Coupler, Directional
TU-2	Antenna Tuner	*CU-772/URA-27	Coupler, Antenna
ATS-2-70	Antenna Tuning System	AN/URA-34	Antenna Coupler Group
MCU-2	Monitor Control	C-2995/URA-27	Control-Indicator
CU-2-70	Directional Coupler	CU-653/UR	Coupler, Directional
TU-2	Antenna Tuner	*CU-651/UR	Coupler, Antenna

\*CU-651/UR and CU-772/URA-27 are electrically and mechanically interchangeable

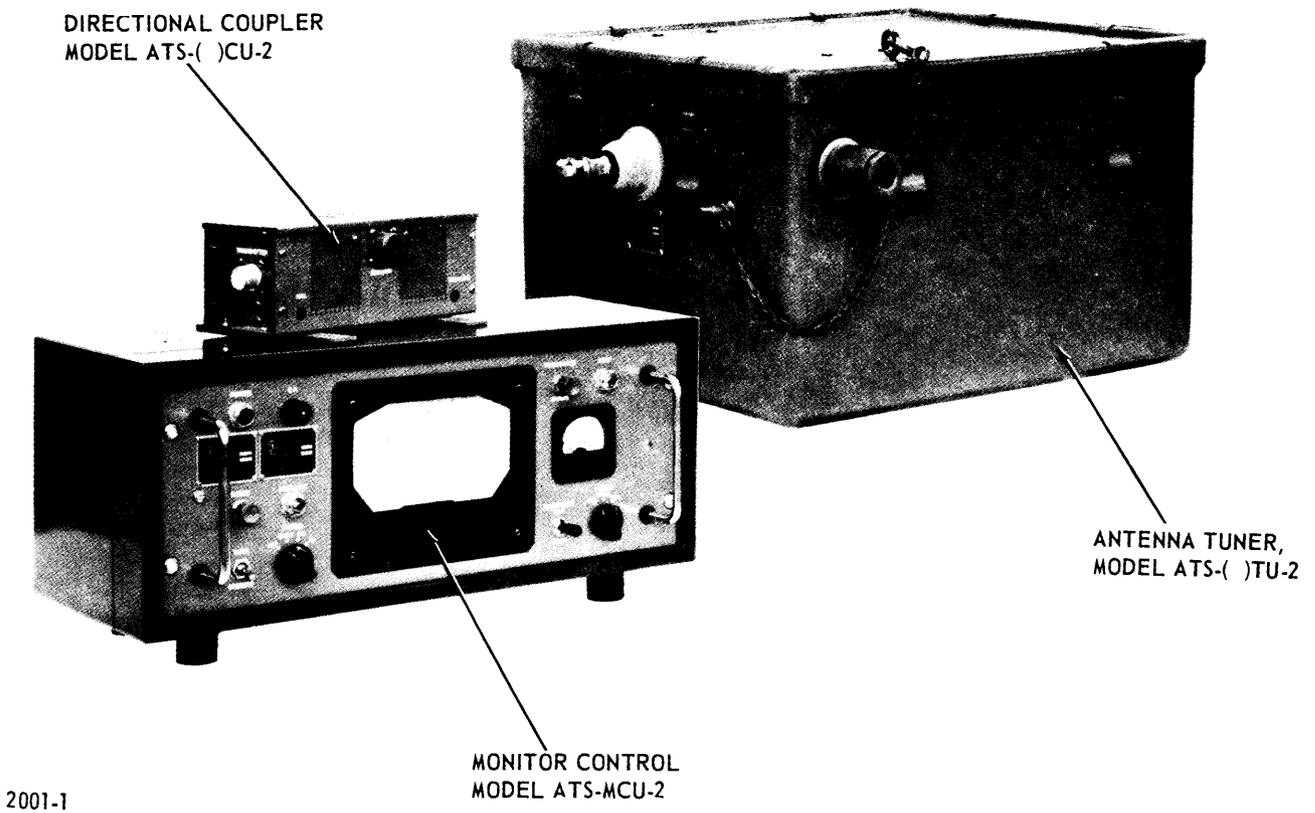


Figure 1-1. Antenna Tuning System, Model ATS-2

5911.6-15

# SECTION 1

## GENERAL DESCRIPTION

### 1-1. GENERAL.

The Antenna Tuning System, Model ATS-2, figure 1-1, impedance matches the output of any 1000-watt transmitter with a nominal output impedance of 50 ohms to a 35-foot vertical whip antenna. This is accomplished by inserting the necessary inductance or capacitance to resonate the antenna to the transmitter operating frequency, in the 2- to 30-mc range.

### 1-2. DESCRIPTION.

The ATS-2 consists of three units: antenna tuner, monitor control, and directional coupler.

The antenna tuner, employs (1) a helical transmission line as an inductance tuning element whose electrical length is varied by a motor-driven rolling contact, (2) a fixed air-dielectric capacitor, (3) a ferrite-core autotransformer with taps selected by a motor-driven rotary switch, used to match various antenna resistance values, and (4) a humidity sensing circuit.

The monitor control has two meters, controlling switches, and an overload protection circuit. A triple-scale meter indicates the position of the motor-driven short on the helical transmission line, the position of the antenna resistance selector switch, or the humidity in the unit. A large dual-pointer meter indicates the forward and reflected transmitter power, and indicates, at the intersection of the two pointers, the voltage standing wave ratio (vswr). Switches are located on the front panel to remotely control the motors in the antenna tuner. An overload circuit will disable the transmitter to prevent damage to the equipment when the vswr or transmitter power exceed preset levels.

The directional coupler is a balanced radio-frequency bridge, and is calibrated to operate with a 50-ohm coaxial line. Balancing and equalizing controls are provided.

### 1-3. LEADING PARTICULARS.

Table 1-1 lists logistic type leading particulars of the antenna tuning system and its major subassemblies. Characteristics listed cover nomenclature, input power, dimensions, and weight. Some of the data represents approximate or nominal values. Blank spaces indicate unavailable values; in which case, the value indicated for the next higher assembly incorporates the missing valve(s).

### 1-4. CAPABILITIES AND LIMITATIONS.

Table 1-2 lists operational capabilities and limitations of the antenna tuning system. Data cover specific functional and environmental characteristics.

### 1-5. EQUIPMENT SUPPLIED.

Table 1-3 lists all major equipment supplied by quantity, TMC part numbers, and reference symbol designations. Also a brief function of each item is provided. Subassemblies of assemblies listed are not called-out; identification of subassemblies can be obtained by referring to section 7. Spare parts are not included in the table.

### 1-6. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-4 lists equipment required to install and maintain the antenna tuning system. The list covers non-specialized installation and maintenance tools, test equipment, and peripheral inter-equipment cabling. Non-specialized items are not supplied, since an equipped maintenance shop should contain them.

Table 1-1. Leading Particulars

NOMENCLATURE		POWER REQUIREMENTS				DIMENSIONS IN INCHES			WEIGHT IN LB	
FORMAL	COMMON	VOLTS	AMP	W	PH	FREQ IN CPS	HGT	W		D
Antenna Tuning System, Model ATS-2	Antenna tuning sys- tem or ATS-2	115/ 230	2/1	150	1	50 to 60				
Antenna Tuner, Model ATS-( )TU-2	Antenna tuner or TU	-	-	-	-	-	20 (OA)	19-1/4 (OA)	12-1/2 (OA)	49
Monitor Control, Model ATS-MCU-2	Monitor control or MCU	115/ 230	2/1	150	1	50 to 60	7 <sup>a</sup> (OA)	19 <sup>a</sup> (OA)	9-1/8 <sup>a</sup> (OA)	14 <sup>b</sup>
Directional Coupler, Model ATS-50 CU-2	Directional coupler or CU	-	-	-	-	-	9-1/4 (OA)	6-1/4 (OA)	3-1/2 (OA)	2
Directional Coupler, Model ATS-70 CU-2	Directional coupler or CU	-	-	-	-	-	9-1/4 (OA)	6-1/4 (OA)	3-1/2 (OA)	2

<sup>a</sup> When mounted in cabinet: HGT = 8-1/4, W = 20-3/8, and D = 10-1/2

<sup>b</sup> When mounted in cabinet: 25 pounds

Table 1-2. Capabilities and Limitations

CAPABILITIES	LIMITATIONS
<p>Functional characteristics:</p> <p>Frequency range</p> <p>Power dissipation: Antenna tuner</p> <p>Directional coupler</p> <p>Impedance: Transmission line Input Output: 50-ohm system</p> <p>70-ohm system</p> <p>Efficiency</p> <p>Attainable voltage standing wave ratio</p> <p>Environmental characteristics: Operating temperature</p>	<p>2 to 30 megacycles</p> <p>1000 watts continuous at 100% modulation</p> <p>1000 watts continuous at 100% modulation for vswr up to 2.5 to 1</p> <p>50 or 70 ohms Nominally 50 or 70 ohms unbalanced</p> <p>Matches any antenna with a resistance of 5 to 500 ohms and - j 850 to + j 750 reactance to obtain a vswr of less than 2.5 to 1</p> <p>Matches any antenna with a resistance of 7 to 650 ohms and - j 850 to + j 750 reactance to obtain a vswr of less than 2.5 to 1.</p> <p>Better than 80% over the 2- to 30-mc range, when used with the TMC A-1486 35' antenna and Base Insulator</p> <p>Better than 2.5 to 1</p> <p>0° to 50° C (32° to 122° F)</p>

Table 1-3. Equipment Supplied

ITEM	EQUIPMENT	QTY	DESIGNATION		FUNCTION
			TMC P/N	SYMBOL	
1	Antenna Tuner, Model ATS-( )TU-2	1		200 series	
2	Monitor Control, Model ATS-MCU-2			100 series	
3	Directional Coupler, Model ATS-( )CU-2			300 series	
4	Cables, Electrical: A-c Power Antenna Interlock Interconnect Control (optional)	1 1 1 1 1	CA-103-72 CA-484 CA-498 CA-499-1	W101 W102 W103 W104 W105	A-c power cable for item 2. Interconnect item 1 to antenna. Interconnect item 2 to transmitter. Interconnect items 2 and 3.  Interconnect items 1 and 2; shipped as per customers requirements. Except for armor shielding same as cable CA-541-XX.
5	Connector, Plugs: R-f	2	UG-59B/U	P301 and P302	Plug P301 for transmitter r-f output cable that connects to item 3. Plug P302 for r-f cable that connects to jack J302 on item 3.
	Signal	1	MS-3106A20-27P	P101	Part of cable W105 (if supplied). Otherwise attached to equivalent cable that connects to jack J101 on item 2.
6	Clamps, Cable: Armor	2 1	MX-564A/U MS-3057-12		For plugs P301 and P302, when armor shielded cables are used. Part of cable W105 (if supplied).
7	Bushing, Rubber	1	MS-3420-12A		Part of cable W105 (if supplied).
8	Lug, Spade	10	TE-120-2		Part of cable W105 (if supplied). Otherwise attached to equivalent cable that connects to terminal board E201 in item 1.
9	Tool, Tuning	1	TP-119-1		Alignment
10	Compound, Silicone	1-ounce tube	GL-114		
11	Manuals, Instruction	2			
12	Data, Test	1 set			

Table 1-4. Equipment Required But Not Supplied

EQUIPMENT	PURPOSE
<p>1. Coaxial transmission lines:</p> <p>a. 10-feet of RG-8/U for ATTS(50)-2 or 10-feet of RG-11/U for ATTS(70)-2; preferably armor shielded</p> <p>b. 10-wire AWG 22; preferably armor shielded. Length determined by distance between MCU and TU</p> <p>c. RG-8/U for ATTS(50)-2 or RG-11/U for ATTS(70)-2. Length determined by distance between CU and TU; preferably armor shielded.</p> <p>2. 35-foot vertical whip antenna</p> <p>3. Copperweld AWG 6, 6 to 12 35-foot lengths</p> <p>4. Drill, Electric</p> <p>5. Drill bits, sizes: 1/4 and 25/64 inch</p> <p>6. Screws, sizes 1/4 and 25/64 (four each)</p> <p>7. Spin tights, assorted sizes</p> <p>8. Screw drivers, flat blade and Phillips head, assorted sizes</p> <p>9. 100-watt soldering gun or equivalent</p> <p>10. Resin-core solder</p> <p>11. Vacuum tube voltmeter, 0- to 300-volts ac/dc, 20,000 ohms/volt</p> <p>12. Low-capacitance r-f voltmeter probe, 2 to 30mc</p> <p>13. 50-ohm/1000-watt resistive load equipped with r-f ammeter (ATTS(50)-2 only)</p> <p>14. 70-ohm/1000-watt resistive load equipped with r-f ammeter (ATTS(70)-2 only)</p>	<p>Connect transmitter to directional coupler</p> <p>Control cable</p> <p>Connect directional coupler to antenna tuner.</p> <p>Antenna counterpoise radials</p> <p>Drill holes for mounting CU and TU</p> <p>Mounting hardware for CU and TU</p> <p>Installation, testing, maintenance</p>



## SECTION 2 INSTALLATION

### 2-1. INITIAL INSPECTION

The ATS-2 has been tested and calibrated before shipment. Only minor preparations are required to put the unit into operation.

Inspect the cases and their contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items". Although the carrier is liable for any damage in the equipment, Technical Material Corporation will assist in describing and providing for repair or replacement of damaged items. The monitor control is shipped with tubes installed. Check that all such components are properly seated in their sockets.

### 2-2. 115-VS 230-VOLT POWER SUPPLY CONNECTIONS.

ATS-2's power supply is designed for 115- or 230-volt, 50- or 60-cps, single-phase power; it is factory wired for 115-volts. If 230-volt operation is desired, a minor wiring change is required. The change is shown in figure 2-1.

### 2-3. INSTALLATION.

The physical installation of the ATS-2 varies considerably from site to site. The three units should always be placed so that the interconnecting cables are as short as possible. Note that two cable lengths are critical. The cable between the transmitter and the directional coupler must not exceed 10 feet in length. The cable between the antenna tuner and the whip antenna must not be longer than 27 inches.

Dimensions for mounting the components of the ATS-2 are shown in figures 2-2, 2-3, and 2-4.

After mounting components, connect cables as shown in Figure 2-5.

Since the antenna tuner is normally exposed to the weather, it is essential that cable connections to the unit be waterproof. Cables to the antenna tuner are passed through water-tight terminal tubes (see Figure 2-6).

Install the cables as follows:

- a. Loosen and remove gland nut and gland ring from the tube body.
- b. Insert cable through gland nut, gland ring, and tube body. Allow sufficient cable length within case to permit connection to terminal board.
- c. Wind packing around cable and press firmly into tube body until packing is within 3/8 inch of tube rim.
- d. Replace gland ring and tighten gland nut.

### 2-4. COUNTERPOISE FOR 35-FOOT VERTICAL WHIP ANTENNA.

Performance of a vertical whip antenna is unusually improved when 6 to 12 radials, each 35-feet long, are installed at the base of the antenna as shown in Figure 2-7. Locate the radials in the plane of the base of the antenna at 90-degree angle to the mast, and space them 30 to 60 degrees apart. Make the radials from No. 6 copperweld wire. Join the radials at a point of intersection near the antenna base and connect the junction to one of the metal mounting lugs of the antenna tuner.

Use of a counterpoise is especially recommended for rooftop installations or in locations where ground conductivity is poor.

### 2-5. INITIAL ADJUSTMENTS.

Initial adjustments of the ATS-2 are included in Table 3-2.

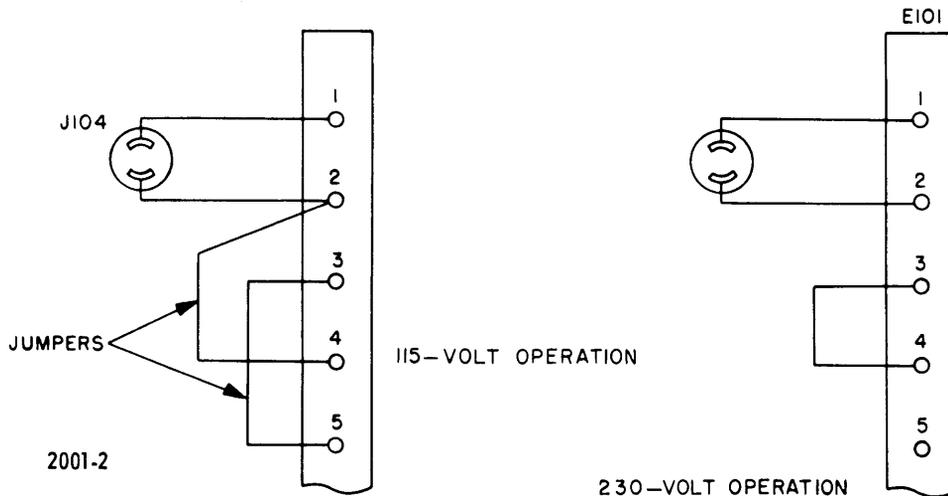


Figure 2-1. 115- vs 230-Volt Power Supply Connections

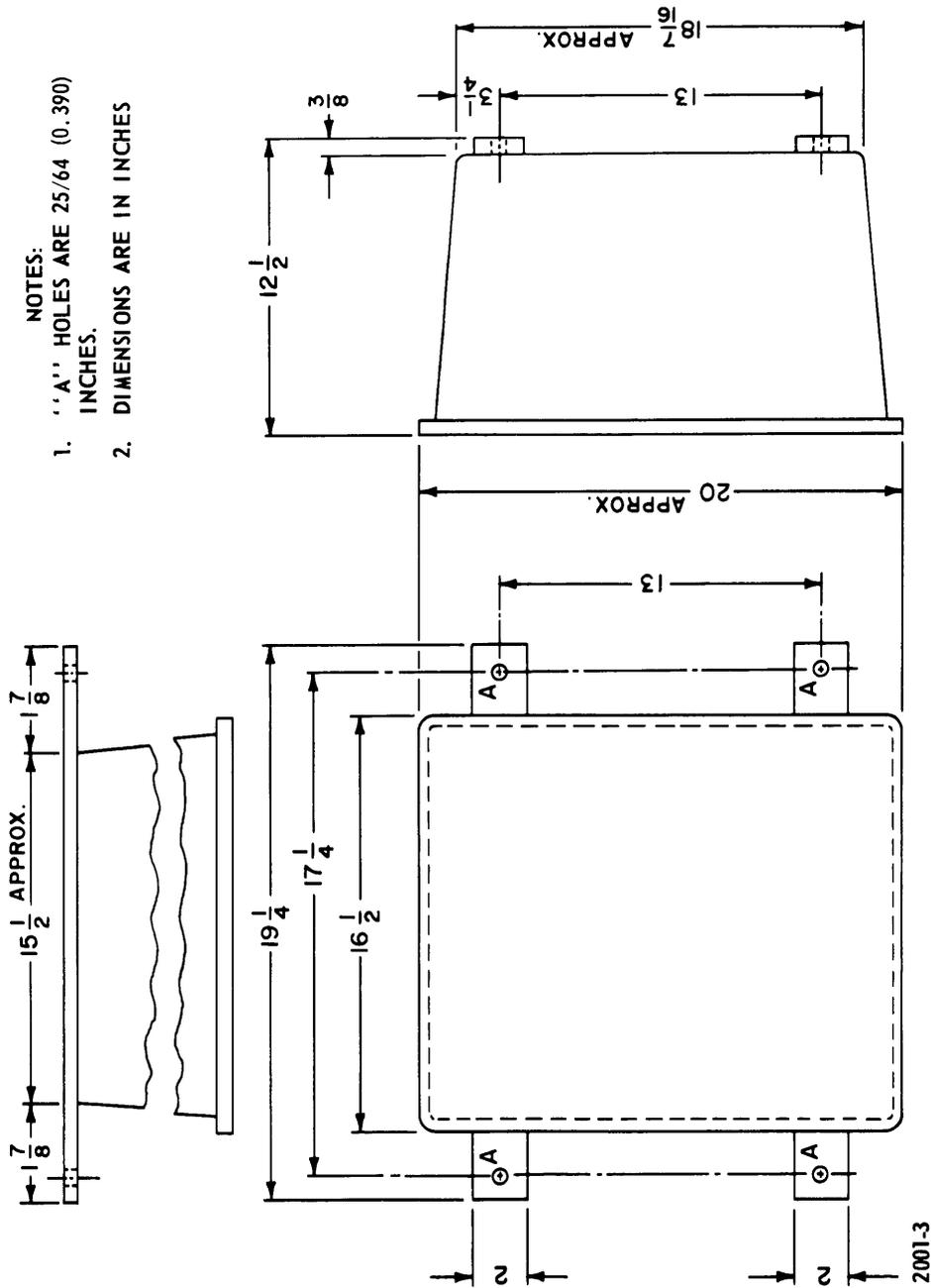
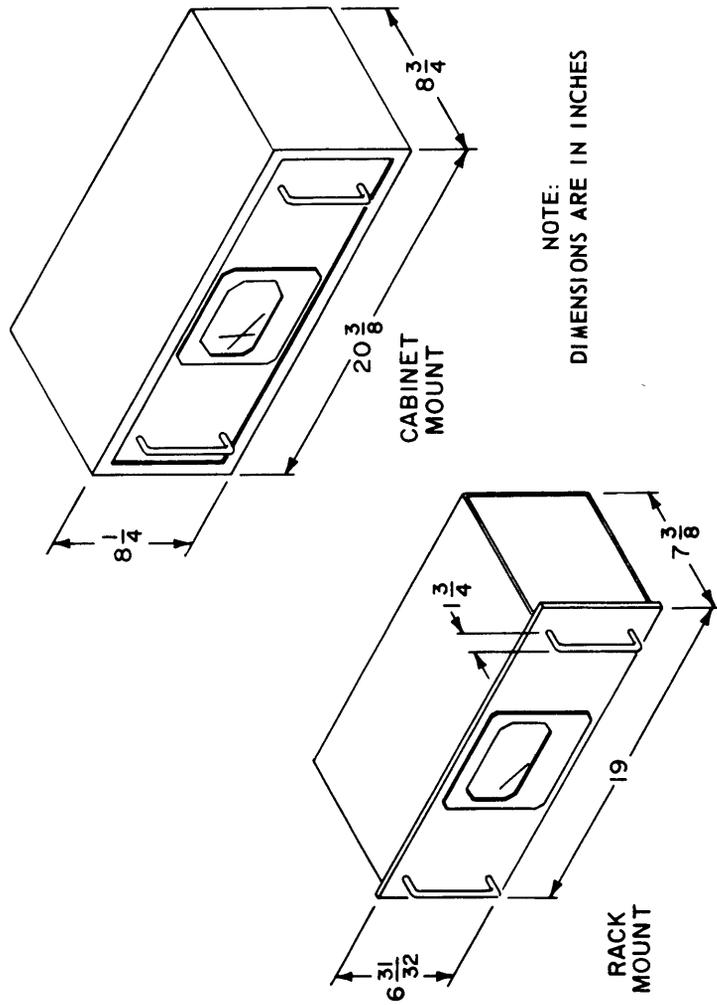
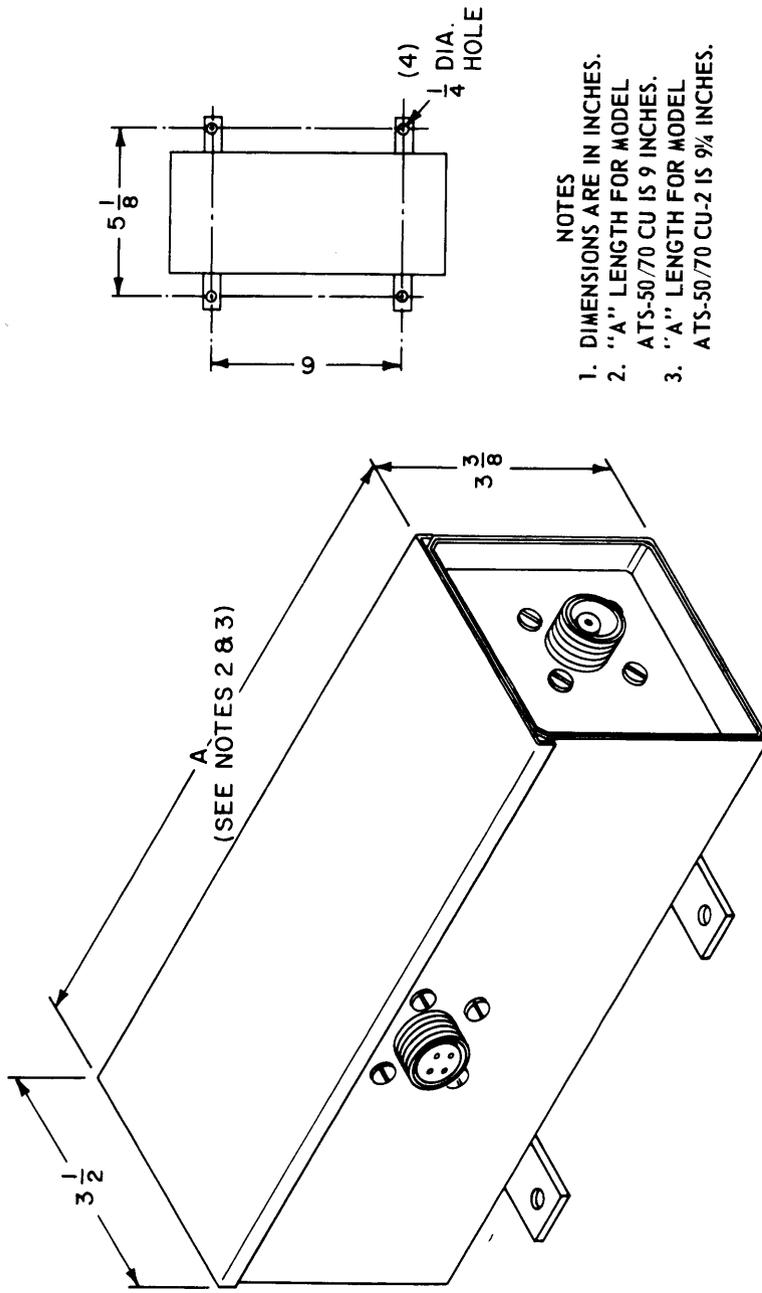


Figure 2-2. Antenna Tuner, Installation Dimensions



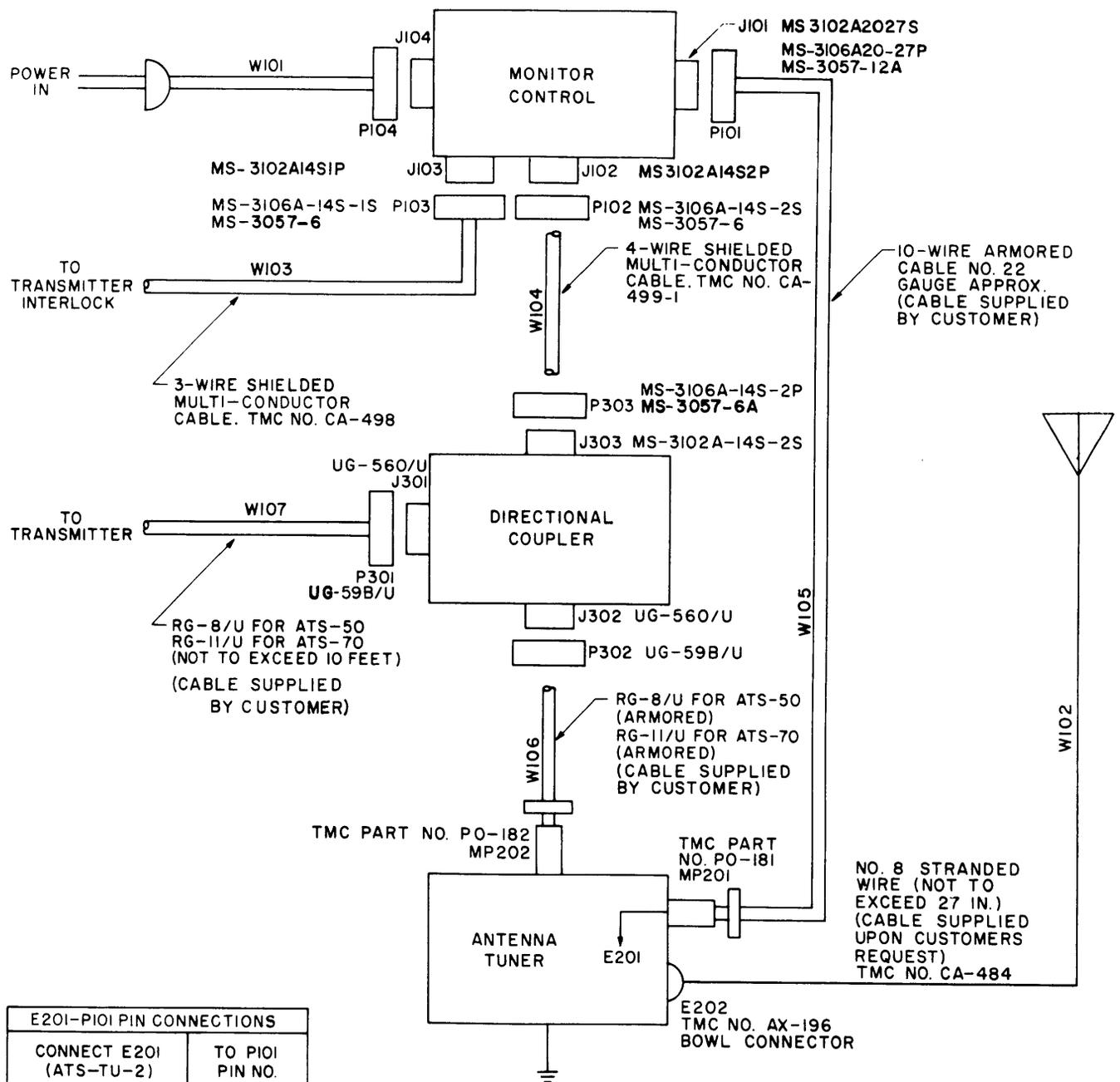
2001-4

Figure 2-3. Monitor Control, Installation Dimensions



2001-5

Figure 2-4. Directional Coupler, Installation Dimensions

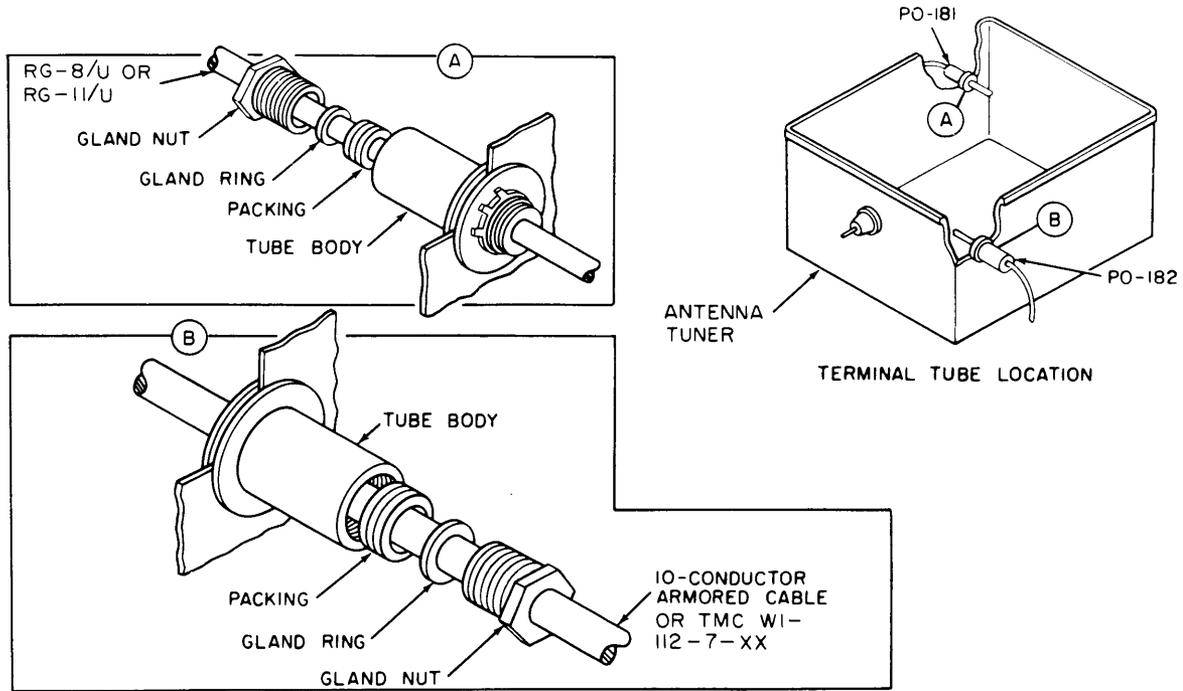


E201-PI01 PIN CONNECTIONS	
CONNECT E201 (ATS-TU-2)	TO PI01 PIN NO.
7	A
4	B
8	C
1	D
5	E
3	F
9	G
10	H
2	J
6	K

PI02- P303 CONNECTIONS		
CONNECT PI02 PIN NO.	TO P303 PIN NO.	REMARKS
A	A	
B	B	COMMON
C	C	COMMON
D	D	

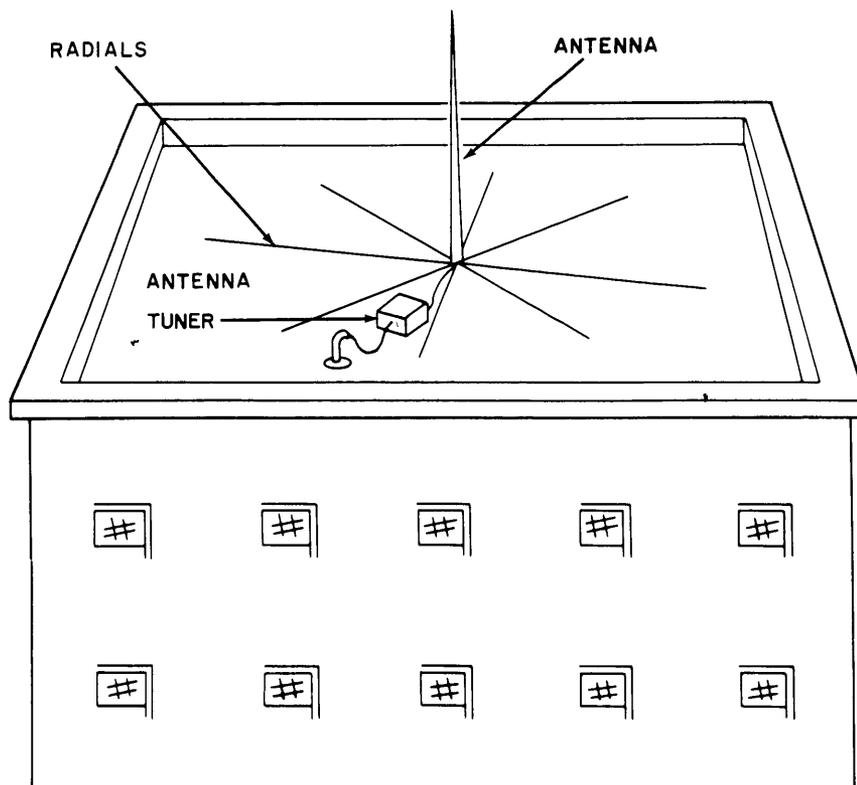
2001-6

Figure 2-5. Interconnecting Diagram, Model ATS-2



2001-7

Figure 2-6. Assembly Instructions for Terminal Tubes



2001-8

Figure 2-7. Rooftop Installation, 35-foot Whip Antenna with Radial Counterpoise

## SECTION 3 OPERATOR'S SECTION

### 3-1. OPERATING INSTRUCTIONS.

Table 3-1 lists controls and indicators of the monitor control. The antenna tuner and directional coupler have no operating controls or indicators. Use Table 3-1 and Figure 3-1 while employing Table 3-2 as an operating procedure.

### 3-2. OPERATOR'S MAINTENANCE.

Operator's maintenance consists of lamp and fuse replacement; refer to Section 6. All other maintenance should be done by a qualified maintenance technician.

Table 3-1. Controls and Indicators

ITEM NO.	CONTROLS AND INDICATORS	SYMBOL	FUNCTION
1	POWER indicator	I102	Indicator that lights to indicate that monitor control is turned on.
2	2A fuse	F101	Protect power supply a-c input circuits.
3	Power meter (Standing wave indicating meter)	M101	Dual-pointer meter with scales calibrated for forward-watts, reflected-watts, and VSWR (voltage standing wave ratio). The watts scales are calibrated 0 to 100. The scale readings are multiplied by 10 when the POWER (ON-SHORT-X10-X1) switch is in the X10 position. The vswr on the transmission line is indicated by the point of intersection of the meter pointers.
4	RESISTANCE-OPERATE switch	S102	Push-button switch that controls and unidirectional motor that drives the selector switch in the antenna tuner for selection of autotransformer taps to match antenna resistance. The selector switch contacts resistance positions 1 to 6 in a clockwise direction and repeats the cycle.
5	STOP indicator	I101	Indicator that indicates when maximum or minimum inductances of the variable inductor in the antenna tuner have been reached. Microswitches are incorporated in the antenna tuner to prevent the reactance changing motor from overdriving at either end of the moving contact travel. These switches interrupt the motor power and energize the STOP indicator.
6	Resistance, reactance, humidity meter	M102	Three-scale meter that indicates reactance on an upper black scale calibrated 0 to 100, resistance on a middle red scale calibrated 1 to 6, and humidity on a lower scale.
7	METER (RES. - REACT. - HUM.) selector switch	S104	Three-position rotary switch that returns to REACT. position when released. When in RES. position, read the red RESISTANCE scale of meter M102, calibrated 1 to 6. When in REACT. position, read the upper black reactance scale of meter M102, calibrated 0 to 100. When in HUM. position, read the lower humidity scale of meter M102.
8	REACTANCE (INCR. - DECR.) lever action switch	S103	Three-position level action switch that returns to a neutral-center open circuit position when released. Controls and direction of the reversible motor that drives the contact on the variable inductance in the antenna tuner. When the switch is held in the INCR. position, the motor shaft rotates in a direction to increase the inductance of the DECR. position, the motor shaft rotates in a direction to decrease the inductance of the variable inductor.

Table 3-1. Controls and Indicators (Cont).

ITEM NO.	CONTROLS AND INDICATORS	SYMBOL	FUNCTION
9	POWER (ON-SHORT-X10-X1) selector switch	S101	Four-position rotary switch that turns on monitor control, selects watts scales factors, and shorts power meter coils.
10	TUNE-OPERATE switch	S106	Toggle switch that limits transmitter output power to 100 watts when in TUNE position.
11	OVERLOAD indicator	I103	Indicator that lights to indicate that relay K103 has tripped, interrupting transmitter main power.
12	RESET switch	S105	Push-button switch that operates relay K103 to return it to the latched position if it has tripped due to excessive vswr or transmitter output.

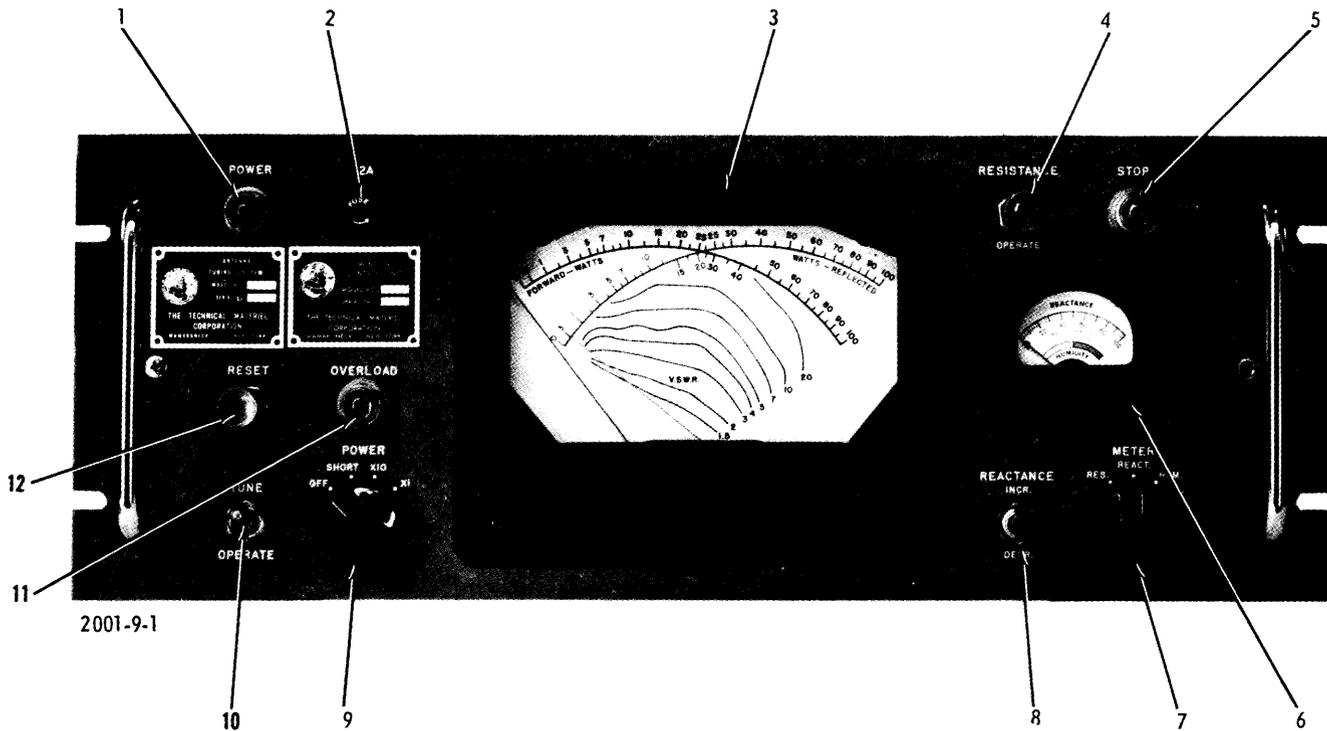


Figure 3-1. Monitor Control, Controls and Indicators

Table 3-2. Tuning Procedure (Example For 4-Megacycle Transmitter Frequency With Dry Antenna)

STEP	CONTROL	OPERATION	PURPOSE
<b>CAUTION</b>			
Initial tuning, required to produce a minimum voltage standing wave ratio on the transmission line, must be performed at low transmitter output. This will prevent overheating of components in the directional coupler, particularly if the voltage standing wave ratio is greater than 3 to 1. Keep the maximum power output below 100 watts so that all tuning may be accomplished with POWER switch 9 (see figure 3-1) in the X1 position and the TUNE-OPERATE switch 10 in the TUNE position. Do not turn on transmitter until step 9.			
1	POWER switch 9	Turn to X10 position.	Turns system on and selects 1000-watt range for power meter.
<b>NOTE</b>			
Table 3-3 indicates the approximate setting of the ATS-2 before operation. During operation, the visual indication of voltage standing wave ratio is the best guide.			
2	METER switch 7	Place in RES. position.	Sets meter to indicate auto-transformer tap position.
3	Meter 6	Read resistance switch position indication on meter 6.	Determines autotransformer tap position.
<b>CAUTION</b>			
Do not operate RESISTANCE-OPERATE switch 4 unless transmitter output is 100 watts or less.			
4	RESISTANCE-OPERATE switch 4	Depress for 2 seconds and release. Read meter 6.	Changes resistance switch position one tap.
5	RESISTANCE-OPERATE switch 4	Repeat step 5 until resistance switch position is that determined in step 2.	Establishes correct resistance switch position
6	METER switch 7	Place in REACT. position.	Sets meter to indicate inductance tap position.
7	TUNE-OPERATE switch 10	Place in TUNE position.	
8		Turn transmitter on. Adjust power output to not more than 100 watts. If 100 watts is exceeded, the overload relay will trip, shutting off the transmitter. If this occurs, reduce power and press RESET switch 12.	
9	Power meter 3	Observe forward-watts and reflected-watts indications. If less than 100 watts, turn POWER switch 9 to X1 position.	Determines that power output is sufficiently low.

Table 3-2. Tuning Procedure (Example For 4-Megacycle Transmitter Frequency With Dry Antenna)(Cont)

STEP	CONTROL	OPERATION	PURPOSE
<b>CAUTION</b>			
Observe reactance scale readings on meter 6 while performing step 11 to make certain that reactance scale readings never exceed 20 when frequencies above 10-mc are being transmitted.			
10	REACTANCE switch 8	Operate to INCR. or DECR. positions to minimize reflected-watts and vswr readings on power meter 8.	Brings antenna into resonance at transmitter frequency.
11	TUNE-OPERATE switch 10	Place in OPERATE position.	
12	POWER switch 9	Turn to X10 position.	
13		Increase transmitter power not to exceed 1000 watts.	
14	REACTANCE switch 8	Operate to INCR. or DECR. positions to minimize reflected-watts and vswr readings on power meter 8.	Brings antenna into resonance at transmitter frequency.
15	POWER switch 9	Turn to SHORT position to prevent meter damage due to surges in the transmitter power output.	Protects power meter.

Table 3-3. Operating Frequency VS Resistance Switch Positioning

OPERATING FREQUENCY IN MC	RESISTANCE SWITCH POSITION	
	HIGH HUMIDITY CONDITIONS	LOW HUMIDITY CONDITIONS
2 Through 5	1	1
6	3	3
7	4	4
8 Through 9	6	6
10 Through 11	5	5
12	3	3
13 Through 15	1	1
16	2	2
17	4	2
18	1	1
19 Through 22	3	3
24	1	1
26	3	3
28 Through 30	4	4

## SECTION 4 PRINCIPLES OF OPERATION

### 4-1. INTRODUCTION.

The ATS-2 provides impedance matching of a transmitter to a 35-foot whip antenna. The properties of the antenna that affect matching are antenna resistance and antenna reactance. These properties vary with transmitter frequency and environmental conditions at the antenna site.

Matching an antenna to a transmission line requires that:

- a. The antenna be made resonant at the transmitter frequency.
- b. The antenna resistance be made equal to the characteristic impedance of the transmission line.

If the above requirements are not met, the length of the line will be critical with transmitter frequency, and reflected power will result in losses. The ATS-2 has three units. Their principles of operation are discussed in the following paragraphs.

### 4-2. ANTENNA TUNER.

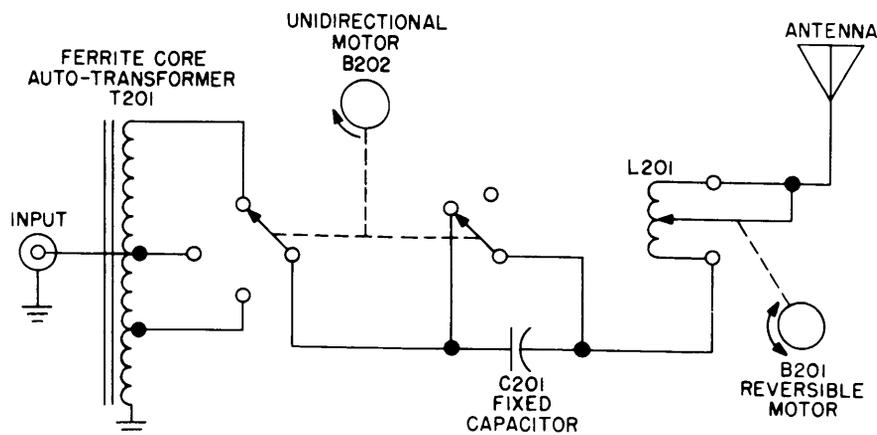
When the antenna displays capacitive reactance (denoted by the symbol  $-j$  before its reactance value in ohms), the antenna may be brought to

resonance by operation of motor B201 (see figure 4-1) to change the series inductance provided by L201. When the inductive reactance provided by L201 (denoted by the symbol  $+j$  before the reactance value in ohms) balances the antennas capacitive reactance, the antenna becomes a purely resistive load. Figure 4-2 illustrates the vector relationship of an antenna whose impedance is  $175-j 305$  ohms.

When the antenna displays inductance reactance, a fixed capacitor C201 is inserted into the circuit. Variable inductance L201 is adjusted until its reactance plus the antennas reactance is neutralized by C201's reactance. Figure 4-3 illustrates the vector relationship of antenna whose impedance is  $r + j235$  ohms. Related values are:

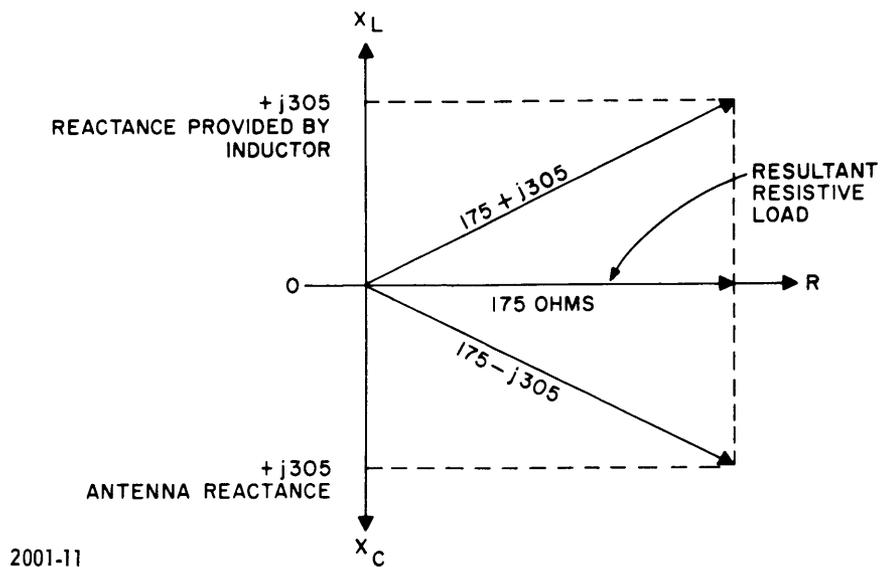
antenna	=	$r + j235$
L201	=	$0 + j150$
C201	=	$0 - j385$
<hr/>		
net	=	$r + j0$

Antenna resistance matching is accomplished by autotransformer T201. Taps on T201 are selected



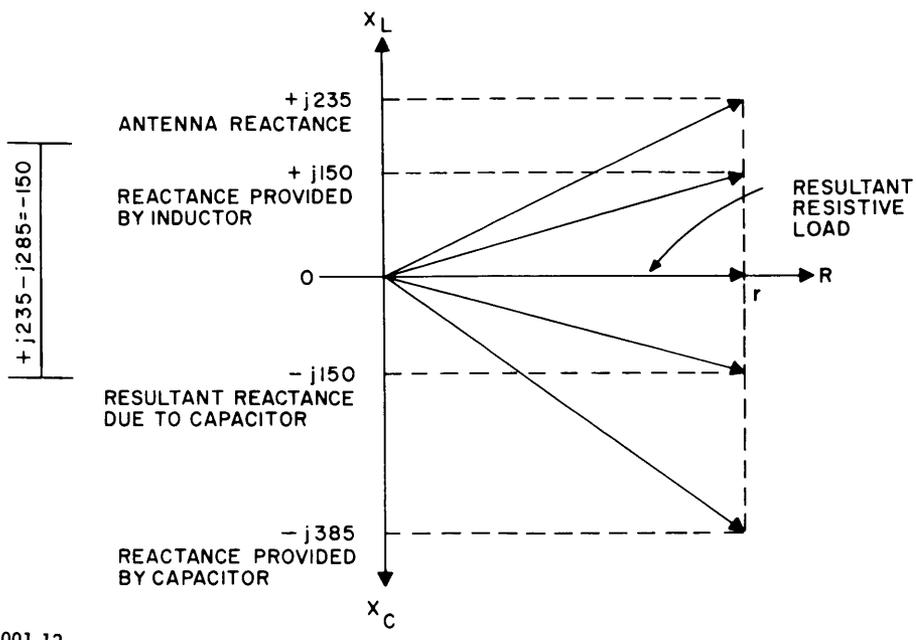
2001-10

Figure 4-1. Antenna Tuner, Simplified Schematic Diagram



2001-11

Figure 4-2. Capacitive Antenna



2001-12

Figure 4-3. Inductive Antenna

by operation of motor B202 to match the antenna resistance to the transmission line.

### 4-3. DIRECTIONAL COUPLER.

The directional coupler, Figure 4-4, provides the monitor control with signals that are proportional to forward and reflected power. These signals are derived from the r-f input applied to bridge circuit ABCD.

After the input and output connections have been made, r-f input power applied, and input and output impedances matched, NULL and EQUALIZER capacitors are adjusted to balance the bridge (voltage measured between B and D is zero). Note that the output load is connected across bridge leg CD. Circuit BD provides the equivalent zero-level reflected-power signal to the monitor control. The circuit connected to AE provides the monitor control with a forward-power signal proportional to transmitter output power, or that essentially developed across R301.

When the bridge is unbalanced due to input/output impedance mismatch, the circuit between BD (C303, L301, and CR301) causes an increased reflected-power signal to be filtered by L302 and C307 and

applied to the monitor control. The unbalanced condition also effects the circuit between AE (C306, L303, and CR302) such that a decreased forward-power signal is filtered by L304 and C308 and applied to the monitor control. Forward and reflected power are inversely proportional.

### 4-4. MONITOR CONTROL.

a. POWER SUPPLY CIRCUIT. - The power supply circuit, Figure 4-5, provides operating voltages for the circuits in the monitor control and antenna tuner. The circuit operates on 115- or 230- volt ac, 60-cycle, single phase power.

With a-c power applied and POWER switch S101 placed at SHORT, X10, or X1, a-c line voltage is connected to the primary windings of T101. The secondary voltage (117- or 123- volt ac) of T101 is applied to the half-wave rectifier/filter/regulator circuit; the result is a regulated 105-volt d-c bias and plate voltage. The secondary windings also provide a 6.3-volt a-c filament voltage, and a 117/230-volt a-c for monitor control relays and the antenna tuner.

b. HUM./REACT./RES. METER CIRCUIT. - The meter circuit, Figure 4-6, provides visual indications of humidity, amount of reactance added, and resistance switch position in the antenna tuner.

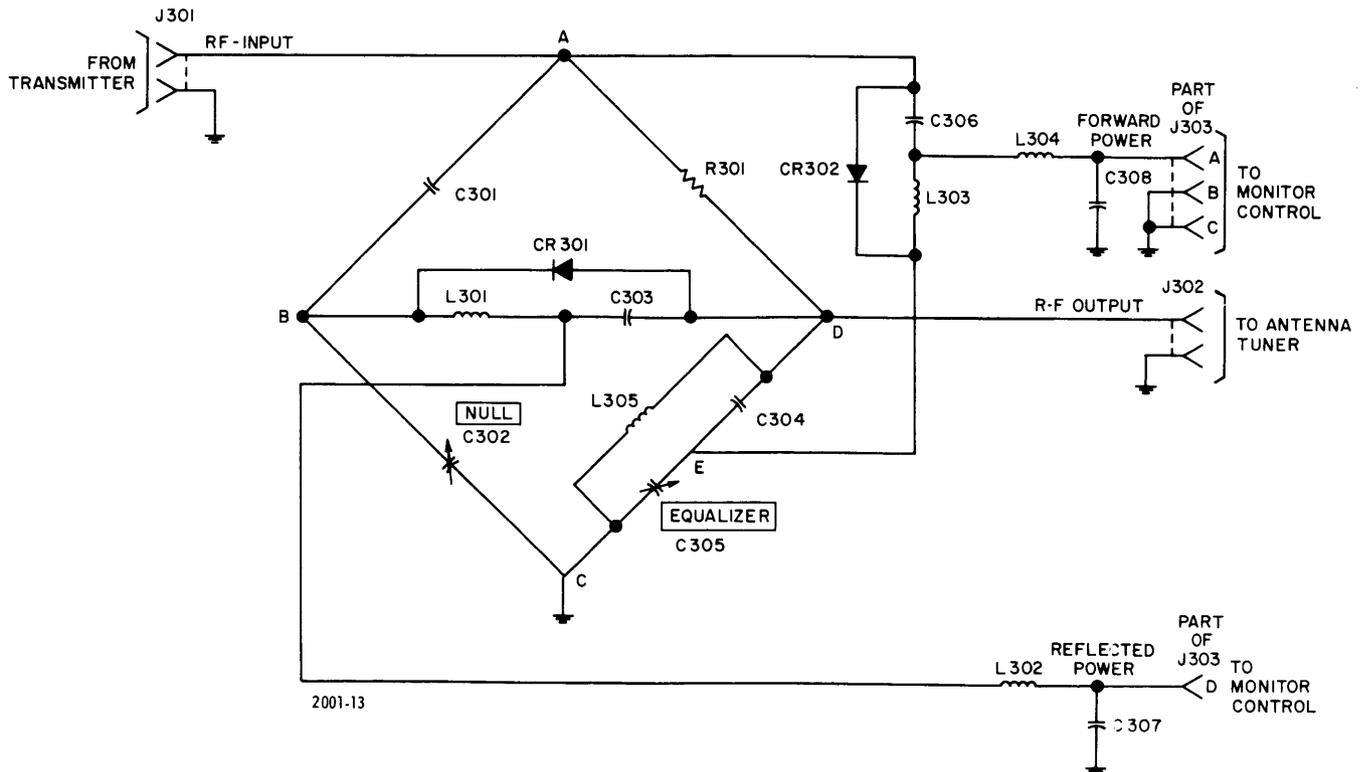


Figure 4-4. Directional Coupler, Simplified Schematic Diagram

When S104 is placed at HUM., meter M102 measures the voltage across the bridge circuit consisting of R107, R108 and humidity sensing element in the antenna tuner, R109, and R110. Initially R108 is adjusted (in conjunction with a dry antenna tuner) so that the meter needle deflection is minimum. If humidity increases, the bridge circuit becomes unbalanced and the meter produces an indication proportional to antenna tuner humidity.

When S104 is set at REACT., meter M102 is provided with a signal that is proportional to the amount of reactance the antenna tuner is adding to the antenna.

When S104 is set at RES., meter M102 indicates the position of the antenna tuner resistance switch (essentially the amount of resistance being added to the antenna).

c. CONTROL, POWER/VSWR METER, AND OVERLOAD CIRCUIT. - This circuit, Figure 4-7, controls the antenna tuner. Also, the circuit provides overload protection against excessive forward and reflected power. The circuit covers two ranges of transmitter output power: 0 to 100 watts (X1) or 0 to 1000 watts (X10).

Initially, R120 is adjusted so that the maximum permissible reflector-power signal (proportional to a vswr of 2:1) turns V102B on. Next, S106 is set at TUNE and R122 is adjusted so that a forward-power signal (proportional to 100 watts) turns V102A on; similarly S106 is set at OPERATE and R121 is adjusted so that a forward-power signal (proportional

to 1,000 watts) turns V102A on. For purpose of simplifying the discussion, it is assumed that S101 is set at X10. Resistors R102 through R105 are adjusted with POWER switch S101 in respective X1 and X10 positions, so that meter M101 is calibrated to indicate amounts of forward and reflected power. RESISTANCE/OPERATE switch S102 and REACTANCE switch S103 are also initially operated to have the antenna tuner add the necessary impedance components to resonate the antenna to a specific transmitter operating frequency. If the STOP lamp lights, it indicates that one of the maximum physical reactance extremes have been reached in the antenna tuner; to extinguish the lamp, REACTANCE switch S103 must be set at INCR. or DECR. and it may be necessary to press S102 (select a different resistance range) and retune the ATS.

Under these initial conditions and if the forward power exceeds 1,000 watts, a positive-going forward-power signal causes: V102A to conduct, relay K101 to energize, contacts 1 and 6 of K101 to close, set windings of K103 to energize, contacts of K103 to open and turn the transmitter off, and overload contacts 1 and 5 of K103 to close and light OVERLOAD lamp I103. Subsequently, the loss of the positive forward-power signal on grid of V102A (due to transmitter turn off) restores the initial V102A cut off condition; relay K101 de-energizes. To fully restore operation, RESET switch S105 must be pressed to reset K103, restore continuity in the interlock circuit, and permit the transmitter to be turned on again at reduced power.

If reflected power exceeds a level that is proportional to a vswr of 2:1, and positive-going signal causes: V102B to conduct, relay K102 to energize and result in the same circuit operation outlined for excessive forward power.

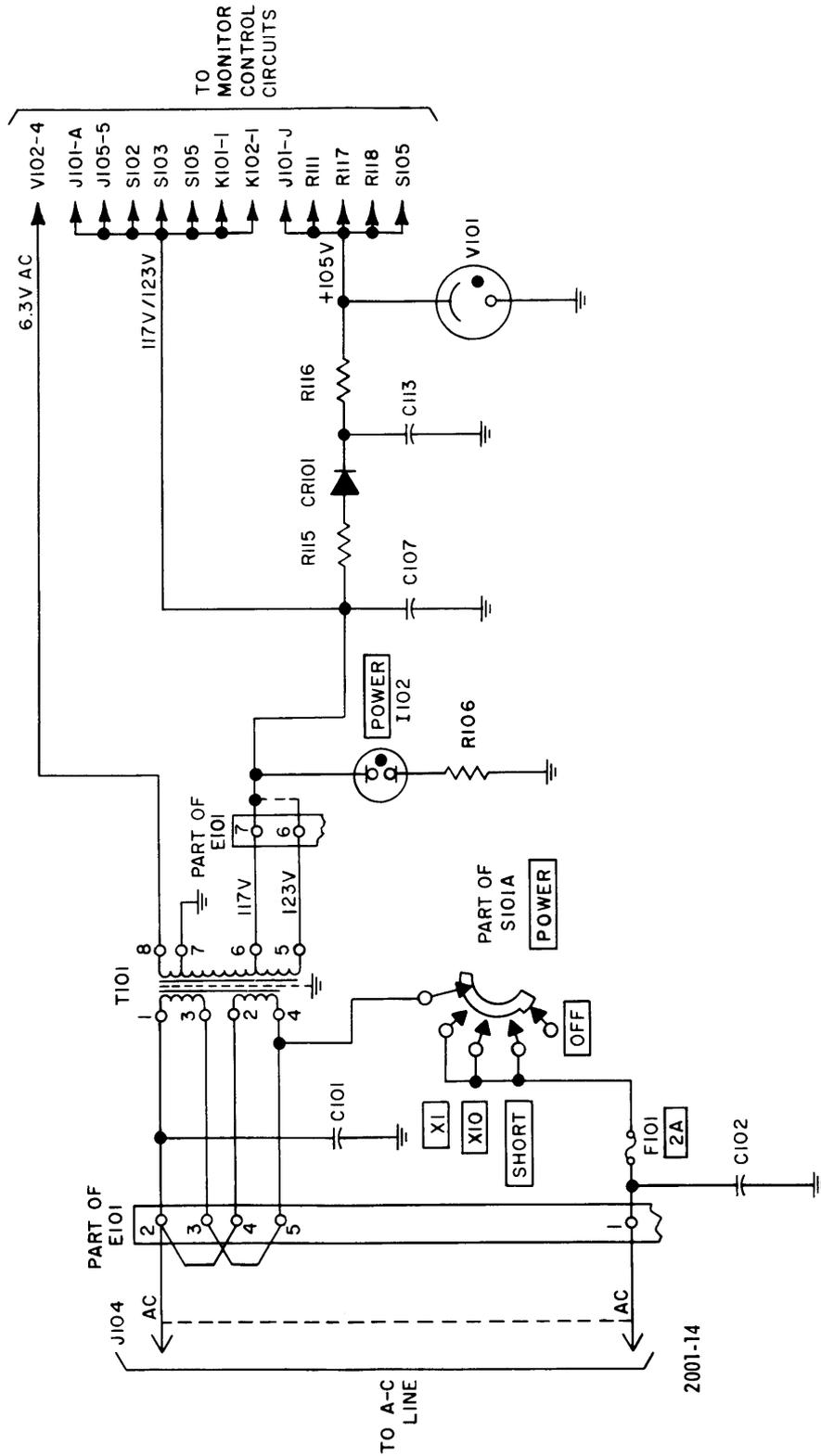


Figure 4-5. Power Supply Circuit, Simplified Schematic Diagram

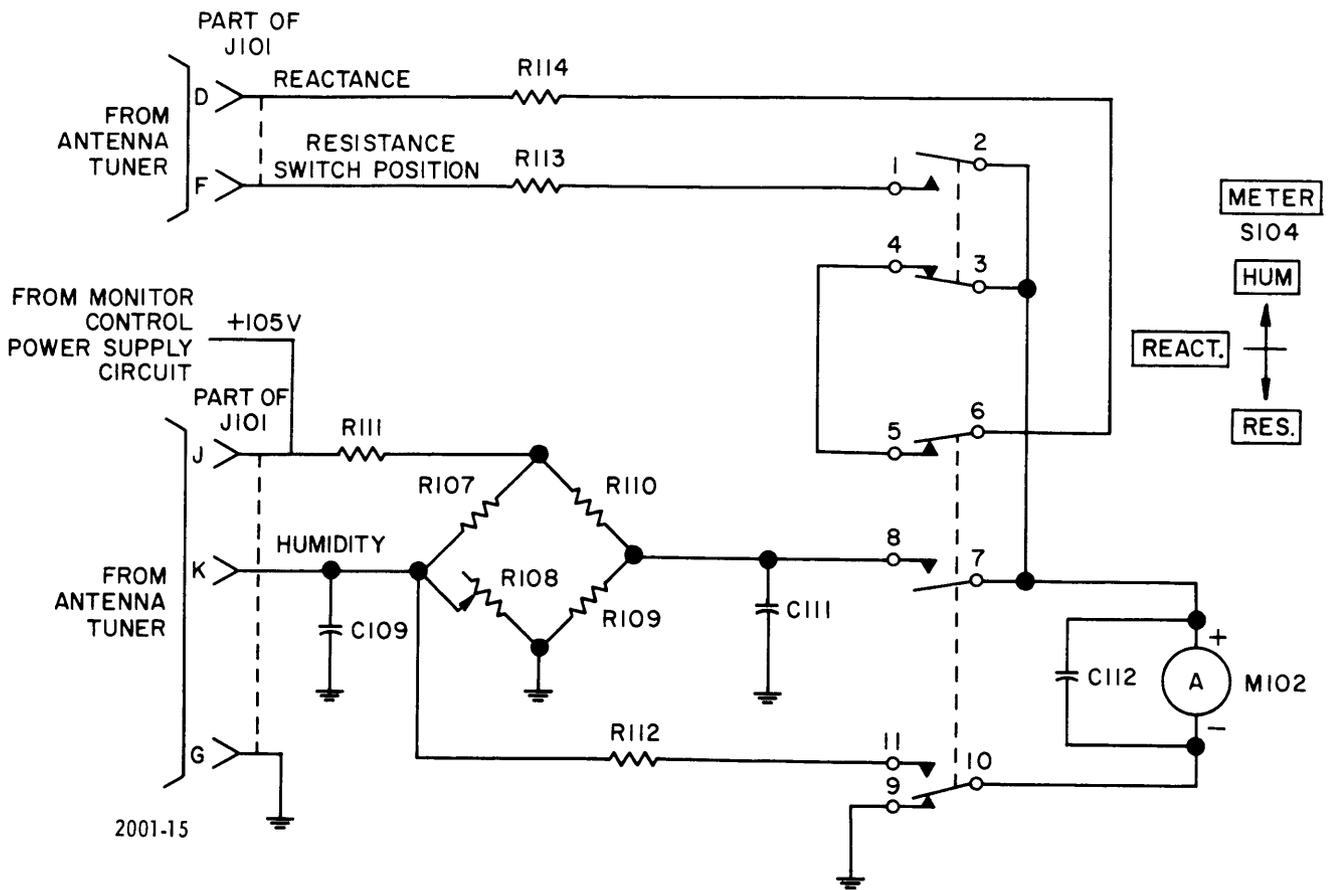


Figure 4-6. HUM./REACT./RES. Meter Circuit, Simplified Schematic Diagram

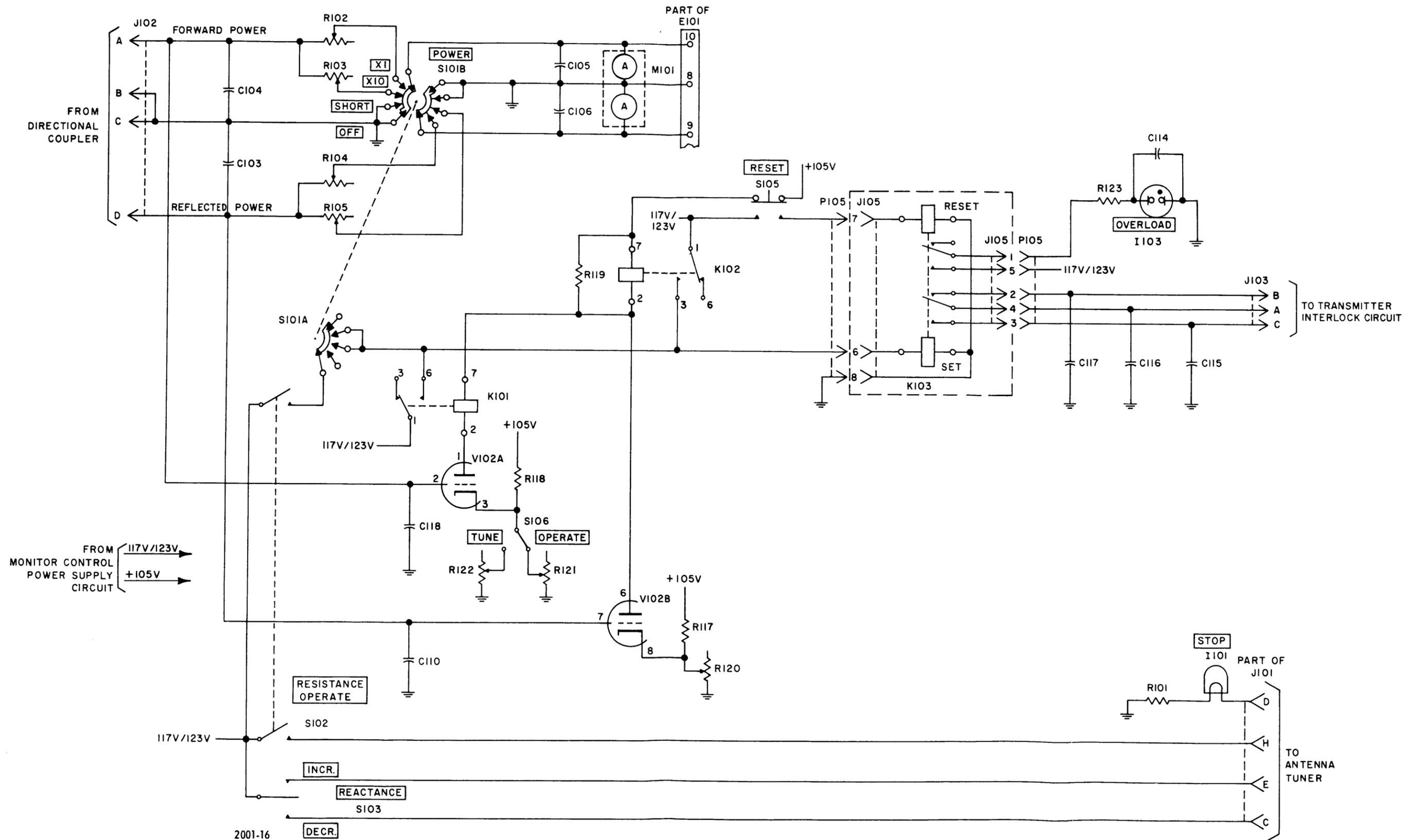


Figure 4-7. Control, Power/VSWR Meter, and Overload Circuit, Simplified Schematic Diagram

## SECTION 5 TROUBLE-SHOOTING

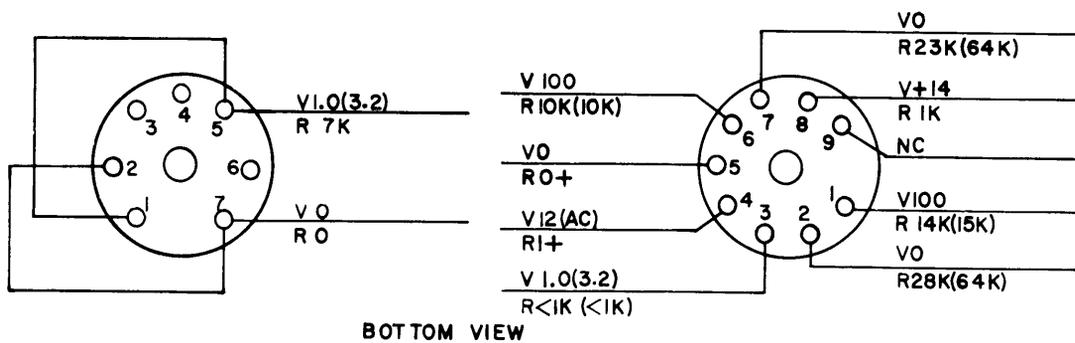
### 5-1. GENERAL.

A systematic troubleshooting chart (Table 5-1) is given to localize a cause of trouble to a particular circuit, section, or component. However, the units should first be visually inspected; common causes of trouble such as arcing in the r-f circuits and mechanical defects in switches and other components may usually be determined in this manner. Where correc-

tion involves realignment, see Section 6 of this manual. Tube voltage and resistance data are given in Figure 5-1. Figures 5-2 through 5-7 may be used to simplify component identification.

#### NOTE

Check the stability of line voltage, absence of power, and condition of fuses and electron tubes before extensive troubleshooting.



#### Notes:

1. Resistances are in ohms, voltages and resistances are measured from tube socket pins to ground with a 20,000 ohms-per-volt meter. For resistances only, measurements are made with main power disconnected.
2. Voltages not in parentheses are measured with tune-operate switch in tune position; voltages in parentheses are measured with tune-operate switch in operate position.
3. Resistances not in parentheses are measured with power switch in XI position; resistances in parentheses are measured with power switch in XIO position.
4. Voltages are dc unless otherwise indicated.

Figure 5-1. Voltage and Resistance Diagram

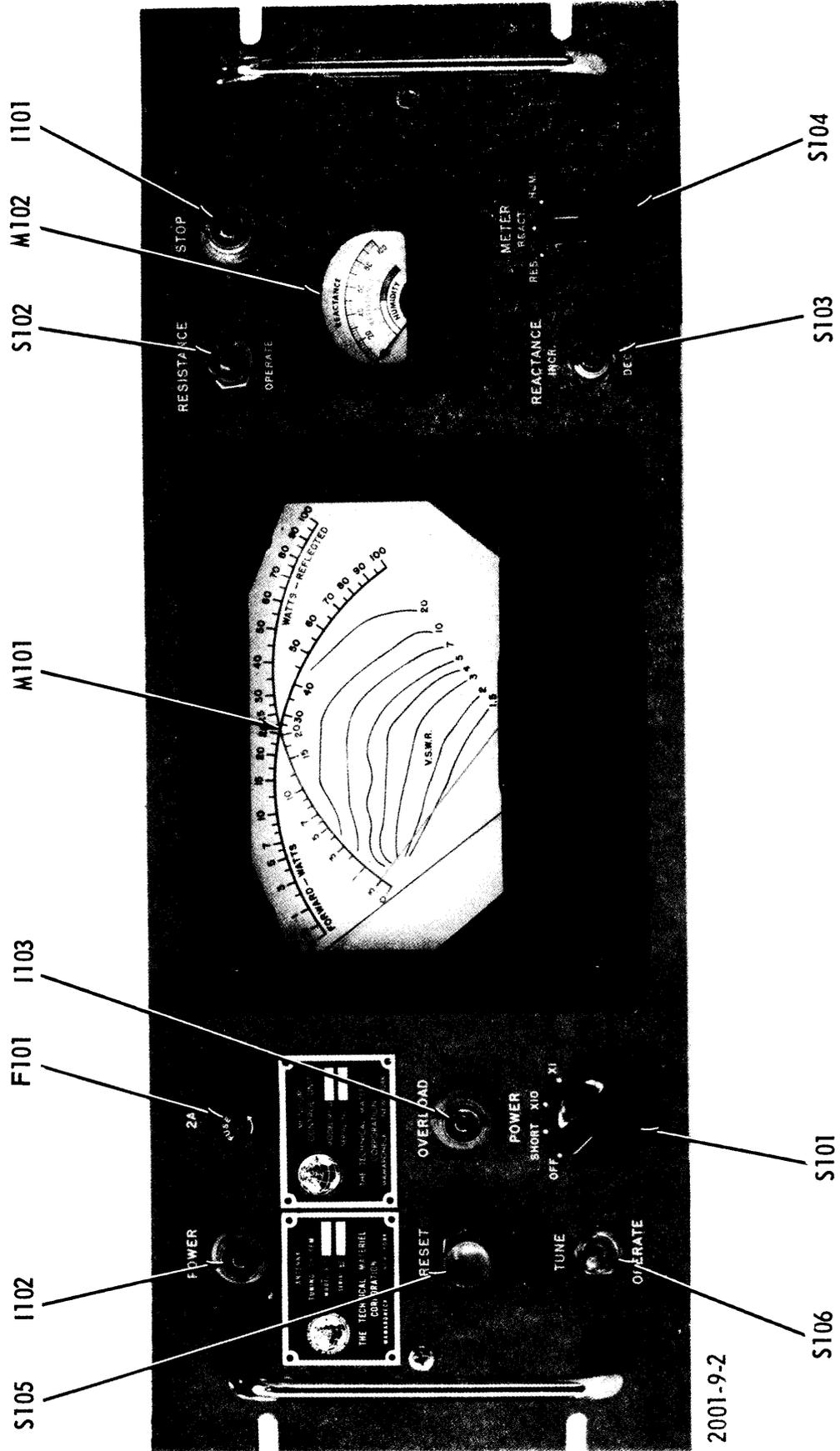


Figure 5-2. Monitor Control Front Panel, Component Identification

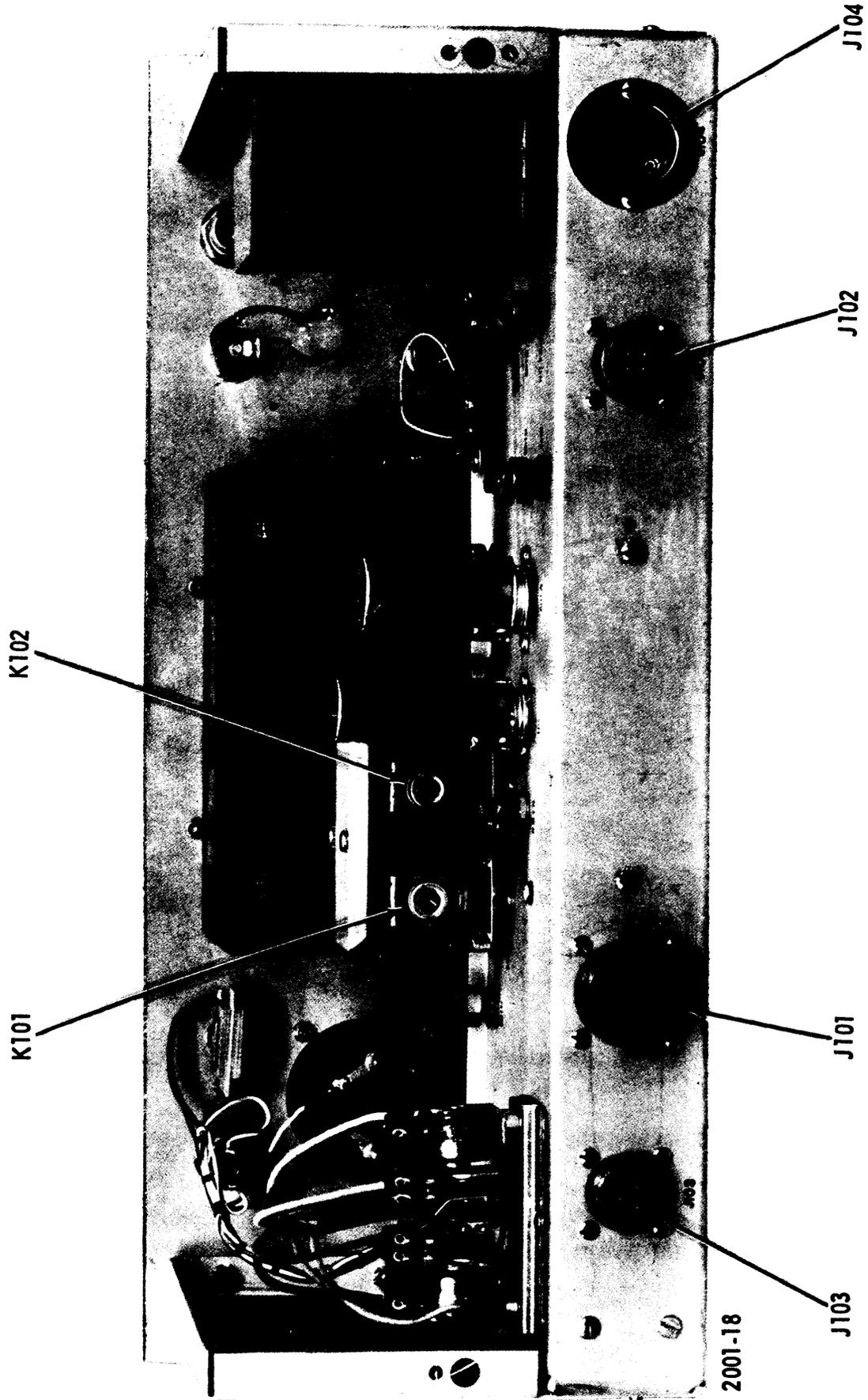
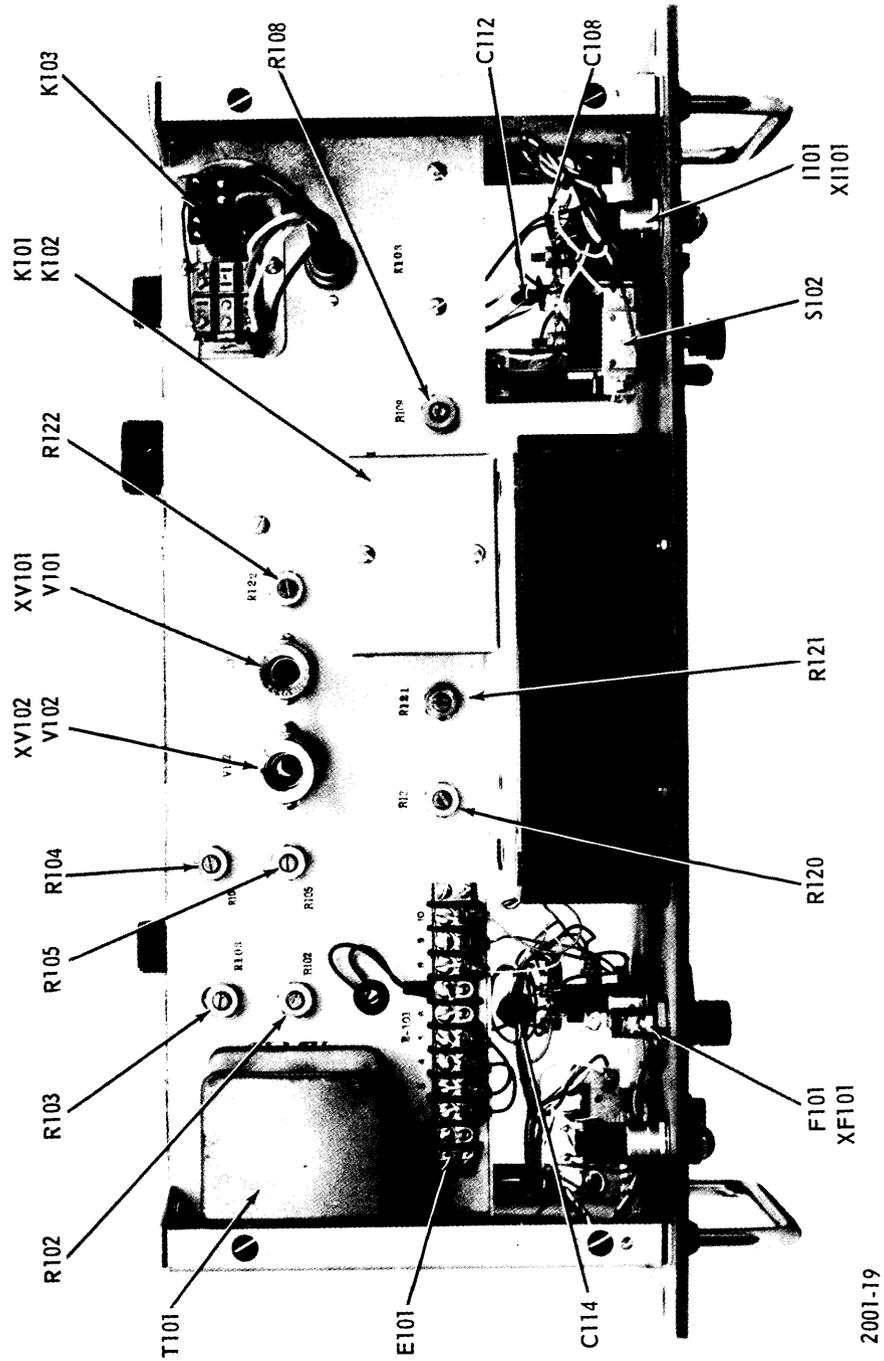
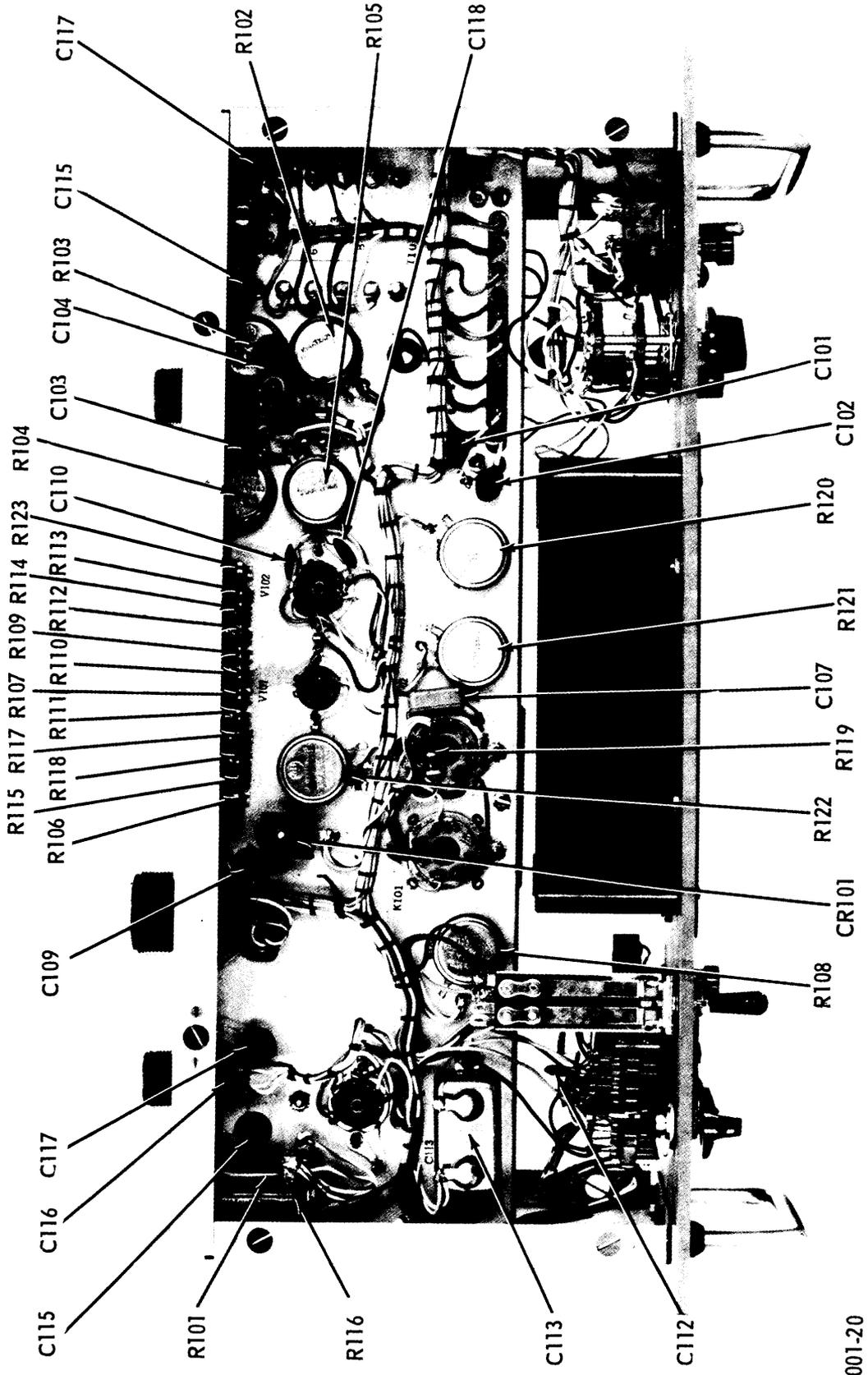


Figure 5-3. Rear of Monitor Control, Component Identification



2001-19

Figure 5-4. Top of Monitor Control, Component Identification



2001-20

Figure 5-5. Bottom of Monitor Control, Component Identification

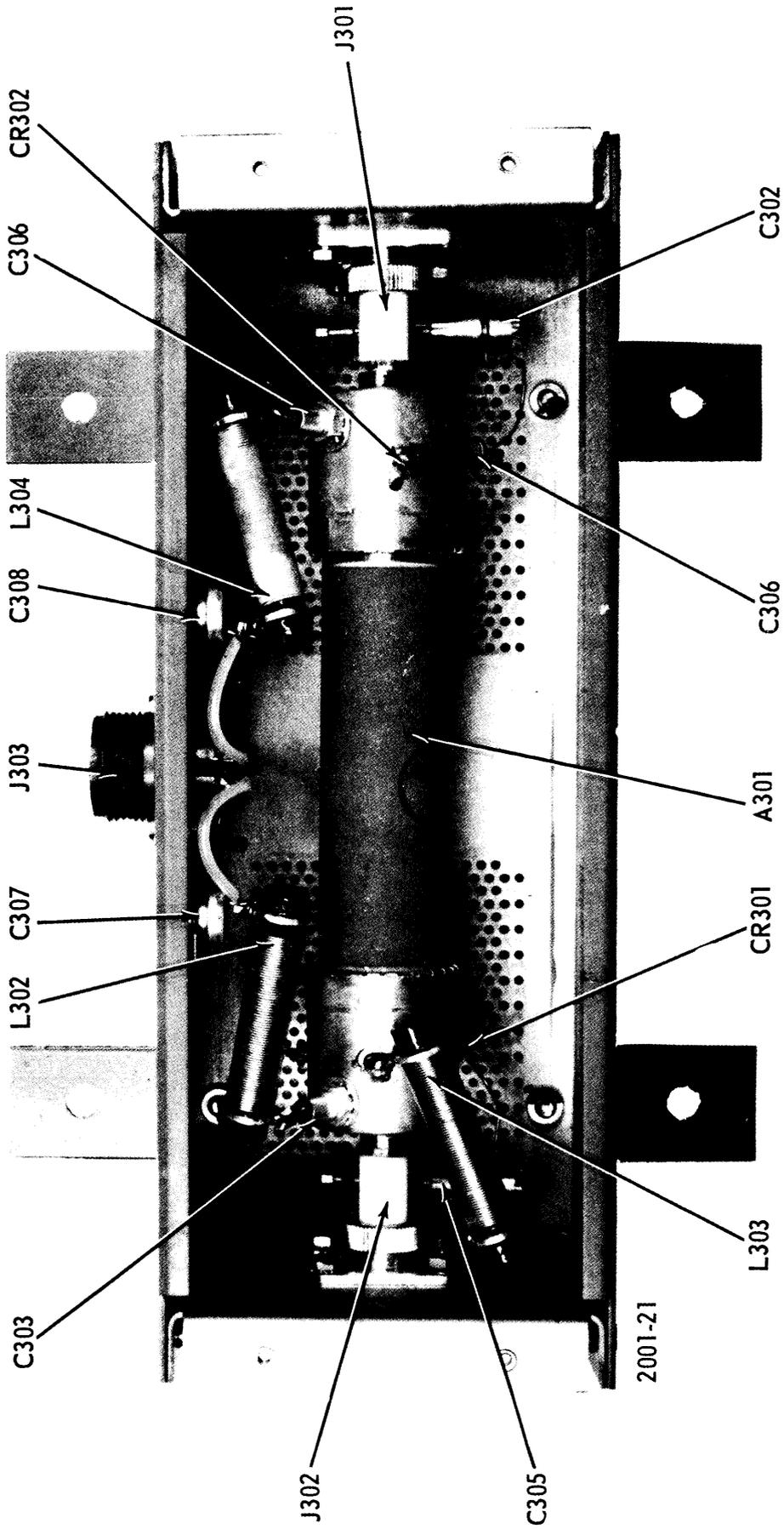
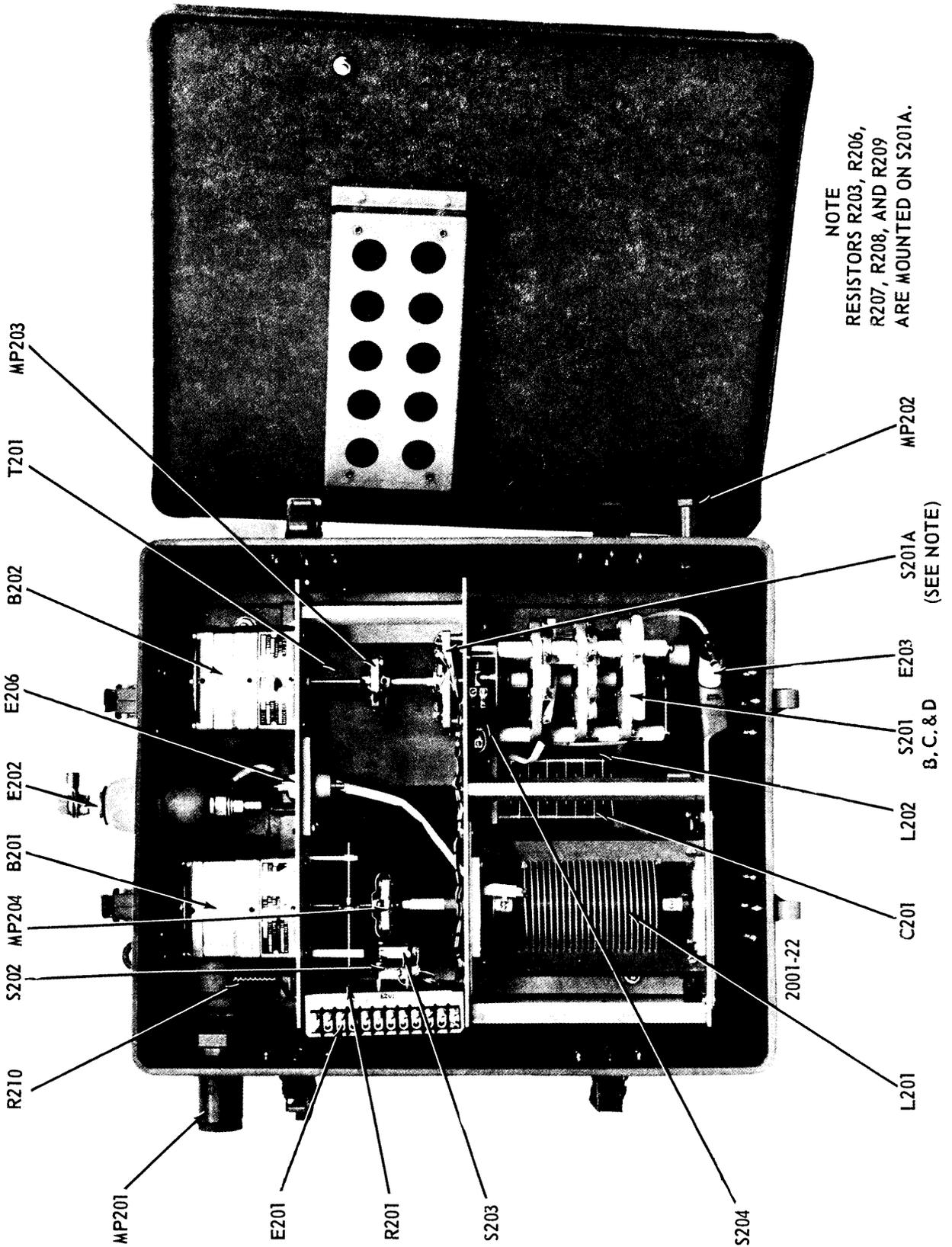


Figure 5-6. Directional Coupler, Component Identification

9-9'559X



NOTE  
RESISTORS R203, R206,  
R207, R208, AND R209  
ARE MOUNTED ON S201A.

Figure 5-7. Antenna Tuner, Component Identification



Table 5-1. Trouble-Shooting Chart (Cont.)

STEP	TROUBLE	PROBABLE CAUSE	REMEDY
4	Excessive power in TUNE or OPERATE positions does not activate overload protection circuits	Overload plate relays K101 and K102 improperly set or inoperative.  Latching relay K103 does not release on overload.  Tube V102 defective.	Check and adjust or replace.  Check and replace, if necessary.  Check and replace, if necessary.
5	POWER indicator I102 does not glow when POWER switch S101 is set at SHORT, X10, or X1.	Defective connector J104.  Fuse F101 blown.  Defective POWER switch.  Defective power transformer.  Terminal board E101 connected for 230-volt operation when 115-volt supply is available at connector J104.  Defective neon lamp I102 or socket.  Open current-limiting resistor for neon lamp.  Short to ground through one of following capacitors: C101, C102, C107, or C113.	Replace connector.  Replace fuse.  Replace switch S101.  Replace transformer T101.  Rearrange jumpers for 115-volt operation as shown in Figure 2-1.  Replace lamp or socket.  Replace resistor R106.  Replace defective capacitor.
6	POWER indicator lamp I102 glows purple when POWER switch S101 is set at SHORT, X10, or X1.	Current-limiting resistor R106 shorted or reduced in value.  Terminal board E101 connected for 115-volt operation when 230-volt supply is available at connector J104.	Replace resistor.  Reconnect for 230-volt operation as shown in Figure 2-1.
7	VSWR meter M101 does not read power on either scale when POWER switch S101 is set at X10 or X1.	Transmitter inoperative or intersystem connections defective.  Defective directional coupler.  Defective POWER switch.  Open circuit in potentiometer R102 or R105.  Open circuit in potentiometer R103 or R104.	See Figure 2-5 for proper connections; replace defective connectors or cables.  Replace directional coupler.  Replace POWER switch S101.  Replace potentiometer when there is no reading in X1 position only.  Replace potentiometer when there is no indication in X10 position only.

Table 5-1. Trouble-Shooting Chart (Cont.)

STEP	TROUBLE	PROBABLE CAUSE	REMEDY
7 (Cont)		<p>One of following capacitors shorted to ground: C103 through C106, C110, or C118.</p> <p>Defective vswr meter M101.</p>	<p>Replace shorted capacitor.</p> <p>Replace meter when either meter movement is defective.</p>
8	<p>VSWR meter M101 gives abnormal indications with POWER switch S101 set at X1 and X10.</p>	<p>Zero settings incorrect.</p> <p>Defective directional coupler.</p> <p>High-resistance contact or loose contact on POWER switch S101.</p> <p>Defective potentiometer R102 or R105.</p> <p>Defective potentiometer R103 or R104.</p> <p>One of following capacitors defective: C103 through C106, C110, or C118.</p> <p>Defective resistance selector switch S201 in antenna tuner unit.</p> <p>Open or shorted impedance-matching transformer T201.</p> <p>Open or shorted tuning coil L201.</p> <p>Open loading coil L202.</p> <p>Defective capacitor C201.</p>	<p>Remove power and set pointers at zero.</p> <p>Replace directional coupler.</p> <p>Replace POWER switch S101 when contact cannot be cleaned or tightened.</p> <p>Replace potentiometer when trouble occurs only in X1 position.</p> <p>Replace potentiometer when trouble occurs only in X10 position.</p> <p>Replace defective capacitor.</p> <p>Return to factory for replacement of resistance selector switch S201.</p> <p>Repair or replace.</p> <p>Return to factory for replacement.</p> <p>Return to factory for replacement.</p> <p>Replace when abnormal indication on vswr meter occurs at tap position 2, 4, or 6 of resistance switch.</p>
9	<p>No step advance shown on multiple indication meter when RESISTANCE OPERATE switch S102 is depressed METER switch S104 is held in RES. position</p>	<p>Defective RESISTANCE OPERATE switch S102.</p> <p>Defective METER switch S104.</p> <p>Defective multiple indication meter M102.</p> <p>Open or high-resistance current-limiting resistor R113.</p>	<p>Replace switch.</p> <p>Replace switch.</p> <p>Replace meter.</p> <p>Replace resistor if open or above 378,000 ohms.</p>

Table 5-1. Trouble-Shooting Chart (Cont)

STEP	TROUBLE	PROBABLE CAUSE	REMEDY
9 (Cont)		Switch S201A, or associated resistors R203 through R209, defective or open.  Motor B202 inoperative.  Shorted capacitor C205, C206, or C212.	Switch S201A in resistance transformer and capacitance switch assembly of antenna tuner is not replaceable. Individual resistors, when accessible, can be replaced.  Check motor and replace when necessary.  Replace capacitor.
10	Reactance indication does not increase or decrease when REACTANCE switch S103 is held in either INCR. or DECR. positions.	Defective meter M102.  Defective METER switch S104.  Defective potentiometer R201 or resistor R202.  Defective motor B201.  Shorted capacitor C202, C208 or C211.  Defective microswitch S202 or S203.  Open or high-resistance current-limiting resistor R114.	Replace meter.  Replace switch.  Replace defective potentiometer and resistor.  Replace motor.  Replace capacitor.  Replace microswitch.  Replace resistor when open or when resistance is above 168,000 ohms.
11	STOP indicator I101 does not glow when meter M102 reads 0 or 100 on REACTANCE scale.	Defective lamp.  Shorted capacitor C108  Open resistor R101.  Defective microswitch S202 or S203.  Shorted capacitor C207.  Microswitch actuating arm slipping on shaft.	Replace lamp.  Replace capacitor.  Replace resistor.  Replace microswitch.  Replace capacitor.  Tighten arm after resetting as discussed in section 6.
12	Abnormal indication when meter switch S104 is held in HUM. position.	Defective humidity-sensing element R210.  Defective switch S104.  Defective resistor in humidity sensing bridge, resistors R107 through R112.  Defective capacitor C111 or C203.  Shorted capacitor C209.	Replace humidity-sensing element.  Replace switch.  Replace defective resistor  Replace defective capacitor.  Replace capacitor.



## SECTION 6 MAINTENANCE

### 6-1. INTRODUCTION

a. **CLEANING.** Inspect interior of units for dirt, dampness, charring, or corrosion. Correct any defect. Clean the electronic components with a clean, soft brush moistened with trichloroethylene.

### WARNING

When using trichloroethylene, make certain that adequate ventilation exists. Avoid prolonged contact with the skin.

b. **VOLTAGE AND RESISTANCE TESTING.** Test voltages and resistances as discussed in paragraph 5-2. Investigate any large discrepancies from values given.

c. **ELECTRON TUBE TESTING.** Test each electron tube with a reliable tube tester or by substitution. Replace each satisfactory tube in the socket from which it was removed. Discard defective electron tubes.

d. **DESSICANT.** A 16-unit bag of dessicant is attached to the antenna tuner cover to prevent moisture from gathering on the internal components. Should

the humidity meter show that a change of dessicant is necessary, replace with a fresh bag. Allow time for dessicant action to change the indication on the humidity meter.

The dessicant may be reconditioned by baking the bag(s) in an oven.

e. **SPARK GAP.** Make sure the spark gap adjustment in the antenna tuner is set at a 1/8 of an inch.

f. **LAMP AND FUSE REPLACEMENT.**

### CAUTION

Do not replace fuse with a fuse of higher rating. If the fuse blows immediately after replacement, do not replace again until the trouble has been corrected.

In the event of lamp or fuse failure replace with exact replacement.

### 6-2. ALIGNMENT.

Table 1-4 lists the test equipment required for alignment of the antenna tuning system. Tables 6-1 through 6-4 outline the alignment procedures for the antenna tuning system.

Table 6-1. Complete Calibration Procedure for VSWR Meter

STEP	OPERATION	PURPOSE
1	Couple system cabling as shown in figure 2-5. Do not connect antenna tuner.	Readies system for calibration of vswr meter.
2	Connect the 50-ohm, ATS(50)-2, or 70-ohm, ATS(70)-2, resistive load to J302 of the directional coupler.	Loads the transmitter.
3	Connect r-f vacuum tube voltmeter across resistive load at J302 of the directional coupler.	Permits measurement of r-f voltage across resistive load.
4	Rotate all potentiometers on rear of monitor control fully counter clockwise.	Prepares monitor control for calibration.
5	Zero meter M101 pointers by turning screwheads at pointer hubs.	Zeros vswr meter.
6	Set power switch of monitor control at X10.	Selects 1000-watt range for VSWR meter.

Table 6-1. Complete Calibration Procedure for VSWR Meter (Cont)

STEP	OPERATION	PURPOSE
7	Tune transmitter to an output frequency of 6.0-mc.	Applies r-f energy through directional coupler.
8	Increase transmitter power until VTVM at dummy load indicates 224 volts, ATS(50), or 265 volts, ATS(70).	Brings transmitter output power to 1000 watts.
9	Adjust R104 until vswr meter indicates approximately 3/4 scale on reflected power (red) scale.	Increases sensitivity of reflected power indicator.
10	Adjust null capacitor C302 in directional coupler until meter M101 indicates minimum power on the REFLECTED-WATTS scale.	Nulls r-f bridge in directional coupler.
11	Repeat steps 9 and 10 until no further reduction in reflected power indication can be obtained.	Nulls r-f bridge in directional coupler.
12	Rotate R104 fully counter clockwise.	Reduces sensivity at reflected power indicator.
13	Turn transmitter off. Interchange coaxial cables at the directional coupler by connecting resistive load to J301 and the transmitter to J302.	Interchanges resistive load and transmitter output.
14	Turn transmitter on. Increase power until vtvm indicates as in step 8 above.	Applies r-f energy through directional coupler.
15	Adjust R103 until VSWR meter indicates approximately 3/4 scale on forward power (black) scale.	Increases sensitivity of forward power indicator.
16	Adjust equalizer capacitor C305 on the directional coupler until meter M101 indicates minimum power on the FORWARD-WATTS black scale.	Equalizes r-f bridge in directional coupler.
17	Repeat steps 15 and 16 until no further reduction in forward power indication can be obtained.	Equalizes r-f bridge in directional coupler.
18	Adjust R104 of monitor control until meter M101 indicates 100 (1000/10) on the REFLECTED-WATTS red scale.	Calibrates meter M101 for reflected power indication.
19	Reduce transmitter power until vtvm at dummy load indicates 70.7 volts, ATS(50), or 83.7 volts, ATS(70).	Sets transmitter output at 100 watts.
20	Set POWER switch on monitor control at X1.	Selects 100-watt range for vswr meter.
21	Adjust R105 of monitor control until meter M101 indicates 100 on the REFLECTED-WATTS red scale.	Calibrates meter M101 for reflected power indication.

Table 6-1. Complete Calibration Procedure for VSWR Meter (Cont)

STEP	OPERATION	PURPOSE
22	Turn transmitter off. Restore original coaxial connections at the directional coupler as instructed in steps 1 and 2.	Restores original connections at directional coupler.
23	Set POWER switch on monitor control at X10.	Selects 1000-watt range for vswr meter.
24	Turn transmitter on. Adjust output level until r-f vacuum tube voltmeter indicates 224 volts, ATS(50)-2, or 265 volts, ATS(70)-2.	Brings transmitter output to 1000 watts.
25	Adjust R103 of monitor control until meter M101 indicates 100 on the FORWARD-WATTS black scale.	Calibrates meter M101 for forward power indication.
26	Reduce transmitter power output as indicated in step 19.	Sets transmitter output at 100 watts.
27	Set POWER switch on monitor control at X1.	Selects 100-watt range for vswr meter.
28	Adjust R102 of monitor control until meter M101 indicates 100 (1000/10) on the FORWARD-WATTS black scale.	Calibrate meter M101 for forward power indication.

Table 6-2. Calibration Procedure for Meter M102

STEP	OPERATION	PURPOSE
1	Connect system cabling as shown in figure 2-5.	Readies system for calibration of meter M102.
2	Disconnect cable from J101 on monitor control.	Disconnects antenna tuner.
3	Set switch S101 in SHORT position.	Shorts meter M101.
4	Hold switch S104 in HUM. position. Adjust R108 until meter M102 indicates zero on the humidity scale.	Calibrates meter M102 for humidity indication.
5	Connect cable to J101 on monitor control.	Connects antenna tuner.
6	Set switch S101 in SHORT position.	Shorts meter M101.
7	Hold switch S103 in INCR. position until indicator I101 lights.	Increases reactance to maximum.
8	Hold switch S104 in REAC. position.	Permits meter M102 to indicate reactance.
9	Determine that meter M102 reads 100 on the reactance scale.	Confirms accuracy of reactance indication on meter M102.

Table 6-3. Adjustment Procedure for Overload Circuitry

STEP	OPERATION	PURPOSE
1	Connect the 50-ohm (ATS(50)-2) or 70-ohm (ATS(70)-2) resistive load to J302 of the directional coupler.	Loads the transmitter.
2	Couple system cabling as shown in Figure 2-5.	Readies system for adjustments of overload circuits.
3	Set power switch on monitor control at X1.	Turns on monitor control and selects 0 to 100 watts ranges for meter M101.
4	Place switch S106 in TUNE position.	Readies monitor control for adjustment of 100-watt overload trip.
5	Wait one minute before proceeding.	Allows V102 warmup time.
6	Turn R120, R121, and R122 fully counterclockwise.	Sets potentiometers for maximum resistance.
7	Tune transmitter to an output frequency of 6.0 mc. Adjust transmitter power output to 120 watts.	Provides transmitter output required to adjust overload circuit.
8	Turn R122 clockwise until relay K103 trips and cuts transmitter main power.	Sets threshold for 100-watt output trip.
9	Reduce transmitter output power. Press switch S105 to reset relay K103.	Prepares for retesting of 100-watt output trip.
10	Increase transmitter output power slowly. Determine that relay K103 trips when 120 watts is reached.	Tests threshold adjustment for 100-watt output trip.
11	Repeat steps 7 through 10 until R122 is correctly set. Tighten locknut after setting.	Confirms correct adjustment of R122.
12	Turn switch S101 to X10 position.	Selects 0 to 1000-watts ranges for meter M101.
13	Place switch S106 in OPERATE position.	Readies monitor control for adjustment of 1000-watt overload trip.
14	Adjust transmitter output to 1200 watts. Note that meter M101 forward-watts indication exceeds full scale by 1/4 inch. If the transmitter is not rated for 1200 watts, tune for maximum output.	Provides transmitter output required to adjust overload circuit.
15	Turn R121 clockwise until relay K103 trips and cuts transmitter power. Proceed as in steps 9 and 10 until R121 is properly adjusted. Tighten locknut after setting.	Sets the threshold for 1000-watt overload trip.
16	Turn transmitter off, disconnect dummy load from directional coupler, and connect antenna tuner as indicated in Figure 2-5.	Connects system for SWR overload calibration.

Table 6-3. Adjustment Procedure for Overload Circuitry (Cont)

STEP	OPERATION	PURPOSE
17	Turn transmitter on, tune transmitter and antenna to obtain 1000-watts output with minimum vswr.	Provides r-f power necessary for vswr overload calibration.
18	Operate switch S103 until vswr meter indicates 3:1 vswr.	Provides reflected power required for vswr overload.
19	Turn R120 clockwise until relay K103 trips and cuts transmitter power. Proceed as in steps 9 and 10 until R121 is properly adjusted. Tighten locknut after setting.	Sets the threshold for excessive vswr trip.
20	Perform vswr meter alignment (except Null and Equalization adjustments) as outlined in Table 6-1.	Compensates for interaction between overload adjustments and vswr meter adjustments.

Table 6-4. Adjustment Procedure for Inductance Drive System

STEP	OPERATION	PURPOSE
1	Connect antenna tuner to monitor control as shown in figure 2-5.	Readies system for adjustment of inductance drive system.
2	Unclamp and remove antenna tuner housing cover.	Exposes inductance drive system.
3	Loosen setscrews that secure gear and micro-switch actuating arms to control shaft of R201.	Permits gear and arms to be rotated on control shaft.
4	Turn switch S101 on monitor control to SHORT position.	Applies control voltage to antenna tuner.
5	Hold switch S103 in DECR. position until motor-driven tap of L201 is 1/4 turn from end of coil (end away from motor).	Establishes end point for motordriven tap travel.
6	Turn control shaft of R201 by hand until meter M102 reads zero when switch S104 is in REACT. position.	Zero positions R201.
7	Tighten gear setscrews.	Secures gear to control shaft of R201.
8	Turn switch S101 on monitor control to OFF.	Disconnects power from motor B201.
9	Rotate arm that actuates switch S203 until it depresses the switch plunger. Tighten setscrews.	Positions arm.
10	Turn switch S101 on monitor control to SHORT.	Applies control voltages to antenna tuner.
11	Hold switch S103 in INCR. position until motor-driven tap is 1/4 turn from the other end of the coil.	Establishes end point for motor-driven tap travel.
12	Turn switch S101 on monitor control to OFF.	Disconnects power from motor B201.
13	Rotate arm that actuates switch S202 until it depresses the switch plunger. Tighten setscrews.	Positions arm.



## SECTION 7 PARTS LIST

7-1. INTRODUCTION. Reference designations have been assigned to identify all electrical parts of the equipment. These designations are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, capacitor, transistor, etc. The number differentiates be-

tween parts of the same generic group. Sockets associated with a particular plug-in device, such as transistor or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F101 is designated XF101. To expedite delivery, when ordering replacement parts, specify the TMC part number and the model number of the equipment.

Table 7-1. Antenna Tuning System

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
	Antenna Tuning Unit	TU-2
	Coupler Unit	ATS 50/70 CU-2
	Monitor Control Unit	MCU-2/ATS-50/70
P101	CONNECTOR, PLUG, ELECTRICAL: male.	MS3106A2027P
P102	CONNECTOR, PLUG, ELECTRICAL: female.	MS3106A14S2S
P103	CONNECTOR, PLUG, ELECTRICAL: female.	MS3106A14S1S
P301	CONNECTOR, PLUG, ELECTRICAL: RF	UG59B/U
P302	Same as P301.	
P303	CONNECTOR, PLUG, ELECTRICAL: male.	MS3106A14S2P
W101	For reference see Monitor Control Unit parts breakdown.	
W102	CABLE ASSEMBLY, ELECTRICAL: #8 stranded wire, not to exceed 27" in length. (Shipped only on customer's request)	CA484
W103	CABLE ASSEMBLY, ELECTRICAL: 3-wire shielded, multi-conductor.	CA498
W104	CABLE ASSEMBLY, ELECTRICAL: 4-wire shielded, multi-conductor.	CA499
W105	CABLE ASSEMBLY, ELECTRICAL: 10-wire armored cable, 22 gauge approx. (Shipped only on customer's request. (Length as per customer's request))	CA541-XX

Table 7-2. Antenna Tuner

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B201	MOTOR, REVERSIBLE: split phase, 2 pole, 115 VAC, 50/60 cps, 38 watts.	MO108
B202	MOTOR, UNIDIRECTIONAL: 2 pole, 115 VAC, 50/60 cps, 20 watts.	MO109
C201	CAPACITOR, FIXED, AIR DIELECTRIC: 46 uuf, 12 plates, 0.250 air gap.	CO105
C202	CAPACITOR, FIXED, PAPER DIELECTRIC: 10 uf, $\pm 10\%$ , char. F, 1000 WVDC.	CP70B1FG106K
C203	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV, 500 WVDC.	CC100-16
C204 thru C212	Same as C203.	
E201	TERMINAL BOARD, BARRIER: 10 terminals, plastic.	TM100-10
E202	INSULATOR, FEEDTHRU: bowl type.	AX196
E203	INSULATOR, PILLAR: round, white glazed steatite; 1" lg. x 3/4" dia. tapped 10-32 x 3/8" deep each end.	NS3W0308
E204	GROUND LUG ASSEMBLY. Screw, Machine, 10-32 x 3/4 long. Nut, Hexagon, 10-32.	SCBP1032BN12 NTH1032BN12
E205	TERMINAL BOARD, BARRIER: 5 terminals, plastic.	TM102-5
E206	BUSHING, FEED-THRU: steatite insulators; neoprene gland; hot tin brass stud 7/8" dia. x 2-1/8" lg. o/a.	NS118-3
E207	SPARK ROD ASSEMBLY. Rod, Spark Post, Spark Rod Lockwasher, External, #4 Screw, Machine, 4-40 x 3/8 long	PM103 PM230 LWE04MRN SCBP0440BN6
L201	COIL ASSEMBLY: 21 uh; consists of tank coil, coil mounting supports, contact wheel, contact wheel shaft and coil lug.	AC106
L202	COIL ASSEMBLY: 20 uh; consists of coil, coil mounting supports and insulators.	AC104
MP201	TERMINAL TUBE: type D; mounts 1" hole, 2-5/8 in. long x 1-1/8 in. dia. o/a.	PO181
MP202	TERMINAL TUBE: type B; mounts in 3/4" hole, 2-3/8 in. long x 1-1/8 in. dia. o/a.	PO182
MP203	COUPLING, FLEXIBLE: steatite; peak volts 5000.	MC114-2

Table 7-2. Antenna Tuner (Cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
MP204	Same as MP203.	
R201	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, $\pm 10\%$ ; 2 watts.	RV105ATRL103A
R202	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, $\pm 5\%$ ; 1 watt.	RC32GF153J
R203	RESISTOR, FIXED, COMPOSITION: 3,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF302J
R204	RESISTOR, FIXED, COMPOSITION: 9,100 ohms, $\pm 5\%$ ; 1 watt.	RC32GF912J
R205	RESISTOR, FIXED, COMPOSITION: 1,800 ohms, $\pm 5\%$ ; 1 watt.	RC32GF182J
R206	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF332J
R207 thru R209	Same as R206.	
R210	SENSOR, HUMIDITY: plug in type.	RR128
S201A	SWITCH ASSEMBLY: consists of wafer and rotor.	AS114
S201B, C, D	SWITCH ASSEMBLY: consists of complete switch, plus all jumpers, teflon sleeving.	AS113
S202	SWITCH, MICRO: push; 10 amps at 115/250 VAC, 1/2 amp at 125 VDC.	SW189
S203	Same as S202.	
S204	SWITCH, MICRO: roller, 15 amp at 125 VAC, solder terminals.	SW260
T201	TRANSFORMER, RADIO FREQUENCY: input, 13 or 17, 50 or 70, 200 or 250 ohms; output 50 or 70 ohms, 2-30 MC, frequency range.	TR151
XR210	SOCKET, MINIATURE: 4 pin; 4-5/64" dia. x 15/32" high w/o lugs; retainer ring mounting.	TS144

Table 7-3. Directional Coupler

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C301	CAPACITOR, FIXED, CERAMIC FEED-THRU: 750 uuf, $\pm 20\%$ ; char. AW; 500 WVDC.	CK70AW751M
C302	CAPACITOR, VARIABLE, GLASS DIELECTRIC: 0.8 to 10.0 uuf, quartz dielectric; 3000 WVDC.	CV102
C303	CAPACITOR, FIXED, CERAMIC FEED-THRU: 1,000 uuf, $\pm 20\%$ ; char. AW; 500 WVDC.	CK70AW102M
C304	Same as C301.	
C305	Same as C302.	
C306	Same as C303.	
C307	CAPACITOR, FIXED, MICA DIELECTRIC: button style; 1,500 uuf, $\pm 10\%$ ; char. X; 300 WVDC.	CB21PX152K
C308	Same as C307.	
CR301	SEMICONDUCTOR DEVICE, DIODE: high frequency.	1N277
CR302	Same as CR301.	
J301	CONNECTOR, RECEPTACLE, ELECTRICAL: female; teflon insulated.	UG560/U
J302	Same as J301.	
J303	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 female contacts.	MS3102A14S2S
L301	COIL, RADIO FREQUENCY: 2.5 mh; 100 ma; molded phenolic.	CL140-1
L302	COIL, RADIO FREQUENCY: 185 mh, $\pm 15$ mh, Q is less than 50 at 790 KC test frequency.	CL254
L303	Same as L301.	
L304	Same as L302.	
L305	COIL, RADIO FREQUENCY: 185 mh, $\pm 15$ mh, Q is less than 50 at 790 KC test frequency.	CL178
R301	RESISTOR, FIXED, CARBON: 0.6 ohms, $+10\%$ - $20\%$ 40 watts.	RR122-0.6

Table 7-4. Monitor Control

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C101	CAPACITOR, FIXED, MICA DIELECTRIC: 10,000 uuf, ±10%; 300 WVDC; char. B.	CM35B103K
C102	Same as C101.	
C103	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C104 thru C106	Same as C103.	
C107	Same as C101.	
C108 thru C112	Same as C103.	
C113	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 10 uuf; char. C; 300 WVDC.	CE64C100N
C114 thru C118	Same as C103.	
CR101	RECTIFIER: metallic; 1/2 wave, 130 V, 65 ma.	RX104
E101	TERMINAL BOARD, BARRIER: 10 terminals; molded phenolic body.	TM100-10
F101	FUSE, CARTRIDGE: 2.0 amps; quick acting; 1/4" dia. x 1-1/4" long.	FU100-2
I101	LAMP, INCANDESCENT: 6-8 volts, 0.15 amp, T-3-1/4 bulb; miniature bayonet base.	BI101-47
I102	LAMP, NEON: 100-125 volts, 1/25 watt, T-3-1/4 bulb; miniature bayonet base.	BI100-51
I103	Same as I102.	
J101	CONNECTOR, RECEPTACLE, ELECTRICAL: female.	MS3102A2027S
J102	CONNECTOR, RECEPTACLE, ELECTRICAL: female.	MS3102A14S2P
J103	CONNECTOR, RECEPTACLE, ELECTRICAL: female.	MS3102A14S1P
J104	CONNECTOR, RECEPTACLE, ELECTRICAL: 2 male contacts, twist lock type; rated for 10 amps at 250 volts or 15 amps at 125 volts.	JJ100
J105	SOCKET, ELECTRON TUBE: bakelite; phosphor bronze contacts; with center shield.	TS131-M-P-W

Table 7-4. Monitor Control (Cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
K101	RELAY, ARMATURE: octal; SPDT; 500 ohms, silver contacts rated at 2 amps 115 VAC; 7.2 ma pull-in.	RL120-5-502
K102	Same as K101.	
K103	RELAY, ARMATURE: dual; locking 4PDT; 1,460 ohms, 33 ma; silver contacts rated at 5 amps 115 VAC.	AR115
M101	METER, SWR: dual meter, forward and reflected power.	MR112
M102	METER, REACTANCE/RESISTANCE/HUMIDITY: 260 ohms, $\pm 10\%$ ; 0-200 ma movement.	MR100-7
P101 thru P103	Refer to Interconnect System Parts List Breakdown.	
P104	CONNECTOR, PLUG, ELECTRICAL: twist lock; female; with cord grip, brown bakelite. Integral part of W101.	
P105	Non-replaceable item. Integral part of K103.	
R101	RESISTOR, FIXED, WIREWOUND: 1,000 ohms, 25 watt.	RW111-20
R102	RESISTOR, VARIABLE, COMPOSITION: 25,000 ohms, $\pm 20\%$ ; 2 watts; linear taper.	RV4ATXA253B
R103	RESISTOR, VARIABLE, COMPOSITION: 100,000 ohms, $\pm 20\%$ ; 2 watts; linear taper.	RV4ATXA104B
R104	Same as R103.	
R105	Same as R102.	
R106	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, $\pm 10\%$ ; 1 watt.	RC32GF104K
R107	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, $\pm 10\%$ ; 1 watt.	RC32GF273K
R108	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms, $\pm 20\%$ ; 2 watts; linear taper.	RV4ATXA503B
R109	Same as R107.	
R110	Same as R107.	
R111	RESISTOR, FIXED, COMPOSITION: 75,000 ohms, $\pm 5\%$ ; 1 watt.	RC32GF753J
R112	RESISTOR, FIXED, COMPOSITION: 82,000 ohms, $\pm 10\%$ ; 1 watt.	RC32GF823K
R113	RESISTOR, FIXED, COMPOSITION: 360,000 ohms, $\pm 5\%$ ; 1 watt.	RC32GF364J

Table 7-4. Monitor Control (Cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R114	RESISTOR, FIXED, COMPOSITION: 160,000 ohms, $\pm 5\%$ ; 1 watt.	RC32GF164J
R115	RESISTOR, FIXED, COMPOSITION: 22 ohms, $\pm 10\%$ ; 1 watt.	RC32GF220K
R116	RESISTOR, FIXED, WIREWOUND: 1,000 ohms, $\pm 5\%$ ; 10 watts.	RW109-24
R117	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, $\pm 10\%$ ; 2 watts.	RC42GF153K
R118	Same as R117.	
R119	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 10\%$ ; 1 watt.	RC32GF472K
R120	RESISTOR, VARIABLE, COMPOSITION: 1,000 ohms, $\pm 20\%$ ; 2 watts; linear taper.	RV4ATXA102B
R121	Same as R120.	
R122	Same as R120.	
R123	Same as R106.	
S101	SWITCH, ROTARY: 4 positions, 30° detent, 2 sections, non-shorting type contacts; mycalex insulation.	SW208
S102	SWITCH, PUSHBUTTON: DPST; momentary contact; 1 amp, 250 volts; 3 amps, 125 volts; solder type lugs.	SW168-DPST-2-NOBR
S103	SWITCH, TOGGLE: 3 position, non-locking type, 25° angle of throw; silver contacts rated at 3 amps, 120 volts AC non-inductive load.	SW186-2
S104	SWITCH, ROTARY: 3 position, non-locking, spring return; 45° angle of throw; silver contacts.	SW214
S105	SWITCH, PUSHBUTTON: momentary contact; slow make and break, 2 circuit, NO and NC; rated at 1 amp, 125 VAC.	SW227R
S106	SWITCH, TOGGLE: DPDT; 6 amps, 250 VAC; 28° angle of throw; solder lug terminals.	ST22N
T101	TRANSFORMER, POWER: primary 115/230 V, 50/60 cps; secondary 12.6 V at 1 amp, 123/117 V at 0.35 amp.	TF207
V101	TUBE, ELECTRON: voltage regulator; 7 pin miniature.	OB2
V102	TUBE, ELECTRON: medium-mu, duo-triode; 9 pin miniature.	12AT7
W101	CABLE, POWER, ELECTRICAL: with connector P104.	CA103-72

Table 7-4. Monitor Control (Cont)

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XF101	FUSEHOLDER: extractor post type.	FH100-3
XI101	LIGHT, INDICATOR: with red frosted lens, for miniature bayonet base T-3-1/4 bulb.	TS106-1
XI102	LIGHT, INDICATOR: with white frosted lens, for miniature bayonet base T-3-1/4 bulb.	TS106-2
XI103	Same as XI102.	
XK101	SOCKET, ELECTRON TUBE: octal.	TS101P01
XK102	Same as XK101.	
XV101	SOCKET, ELECTRON TUBE: 7 pin miniature.	TS102P01
XV102	SOCKET, ELECTRON TUBE: 9 pin miniature.	TS103P01

**SECTION 8**  
**SCHEMATIC DIAGRAMS**

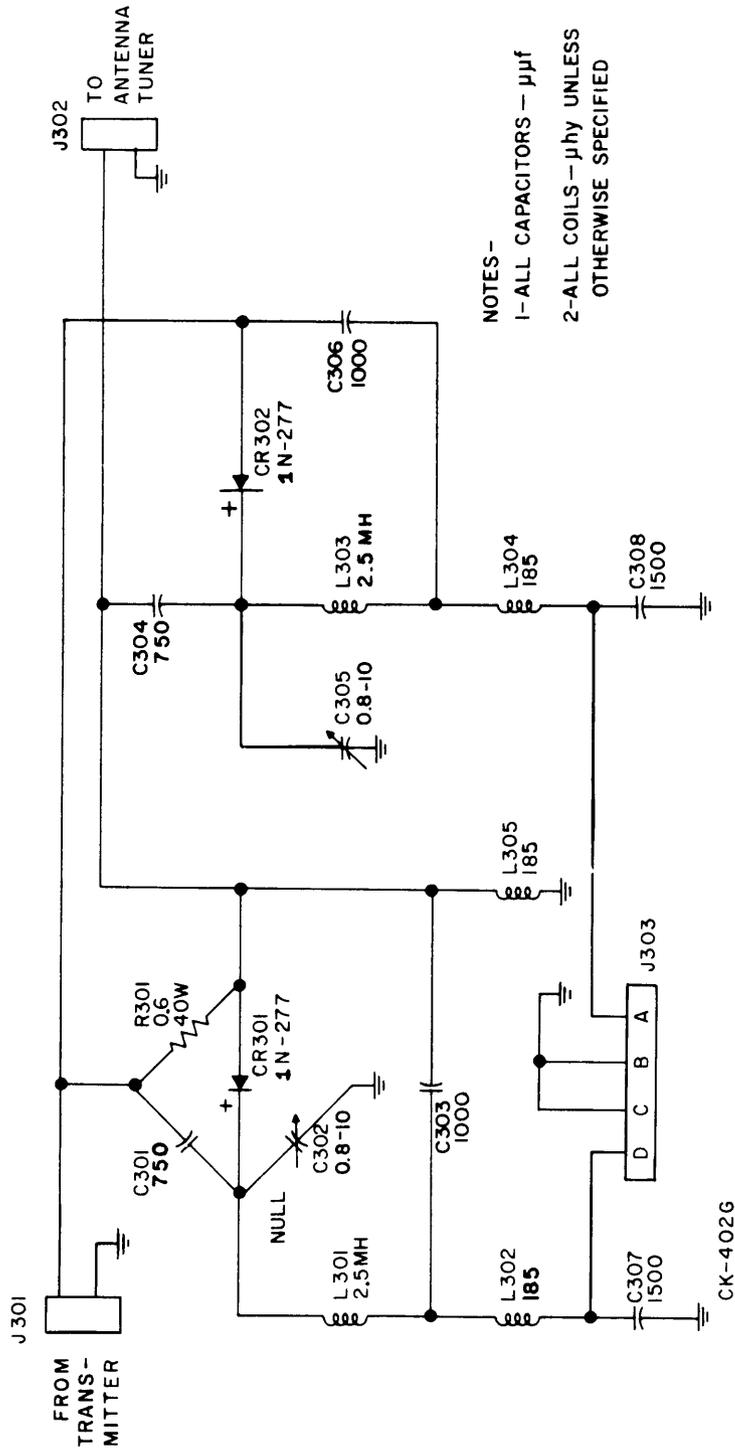
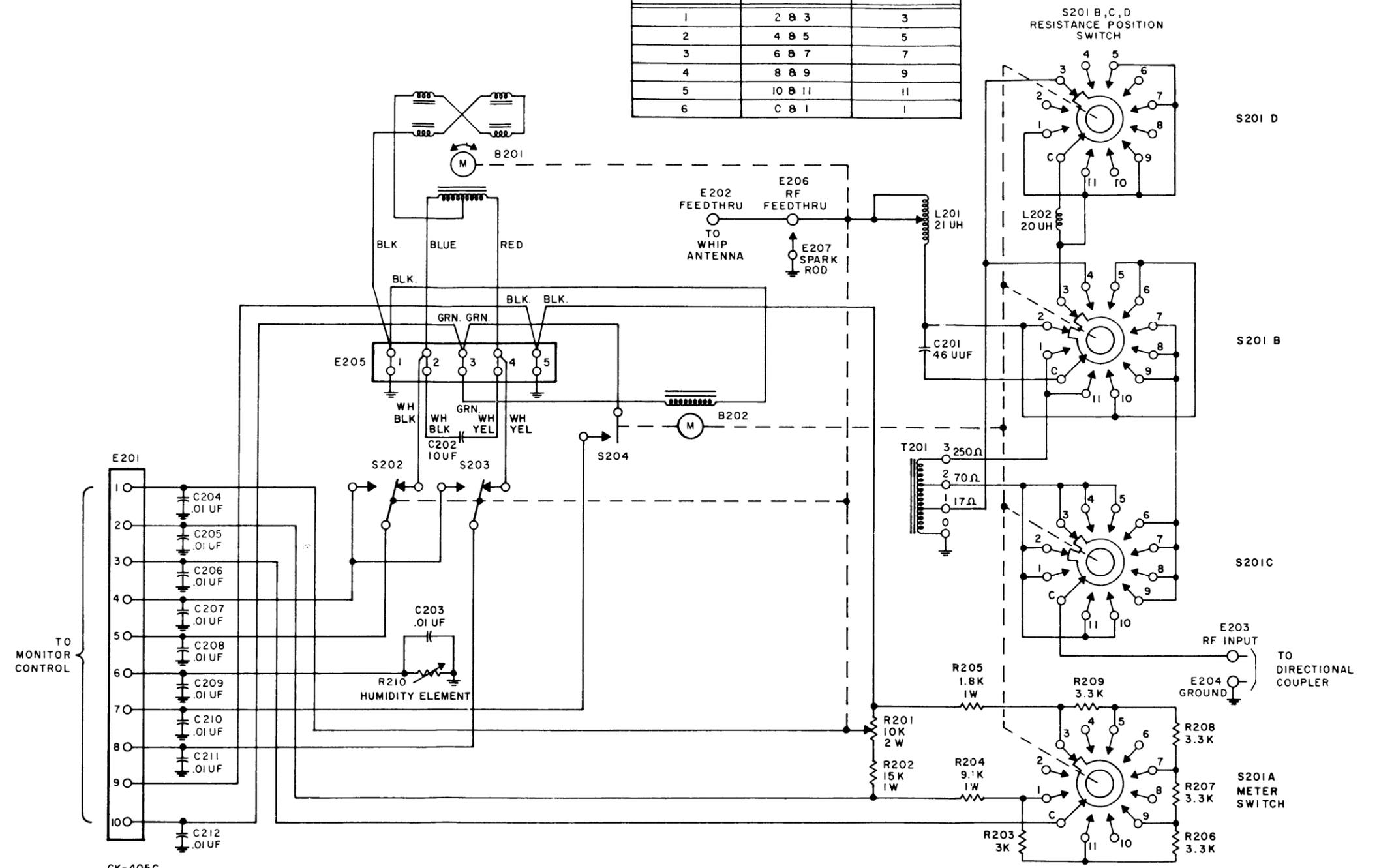


Figure 8-1. Directional Coupler, Schematic Diagram

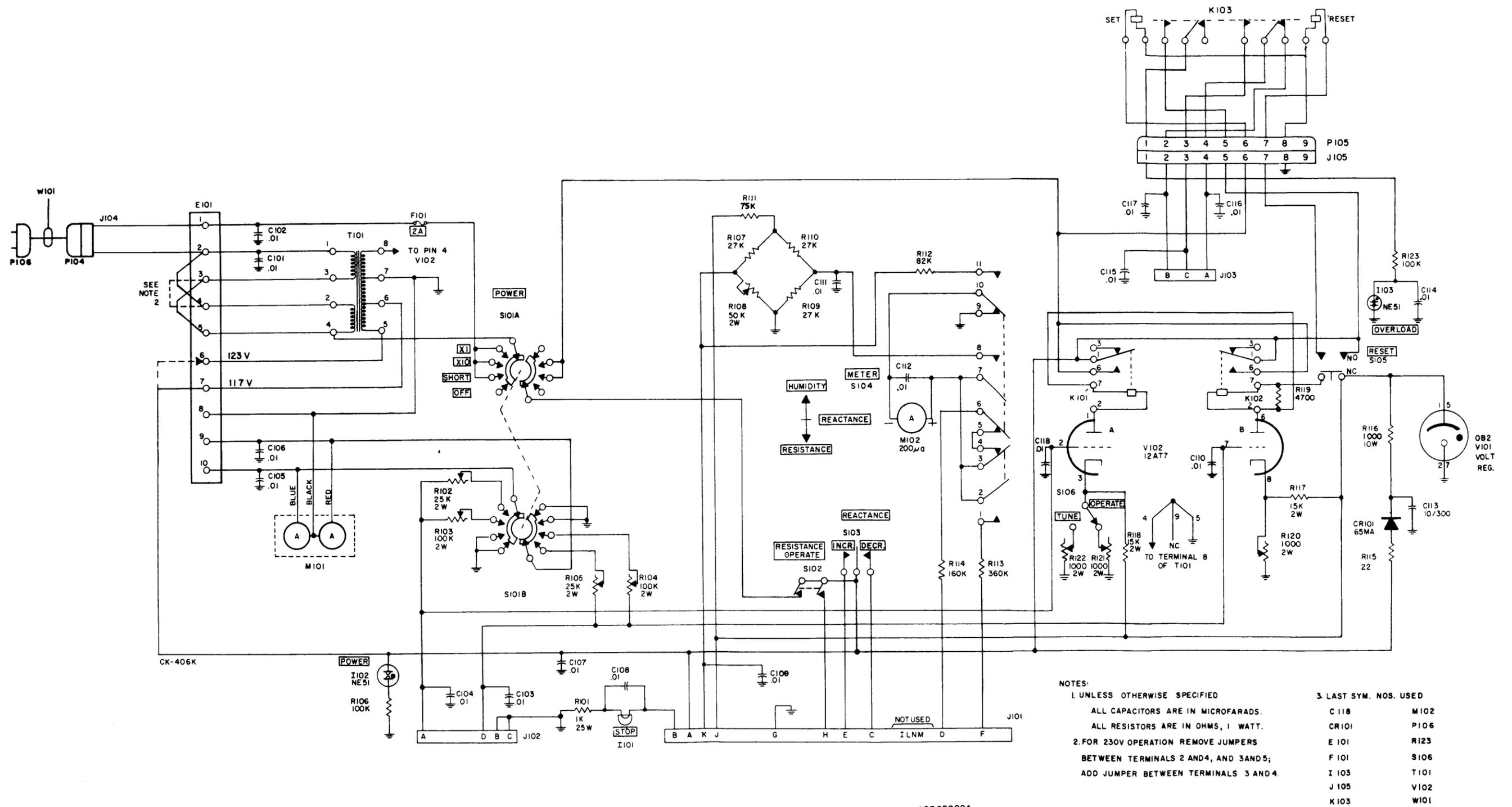
S201 RESISTANCE POSITION	SECTION B&C CENTER ARM (C) CONNECTED TO	SECTION A&D CENTER ARM (C) CONNECTED TO
1	2 & 3	3
2	4 & 5	5
3	6 & 7	7
4	8 & 9	9
5	10 & 11	11
6	C & I	I



NOTES:  
 1. ALL RESISTORS ARE 1/2 WATT, UNLESS OTHERWISE SPECIFIED.

2. LAST SYMBOLS -  
 B201  
 C212  
 E207  
 L202  
 MP202  
 R210  
 S204  
 T201

Figure 8-2. Antenna Tuner, Schematic Diagram



105652001

Figure 8-3. Monitor Control, Schematic Diagram