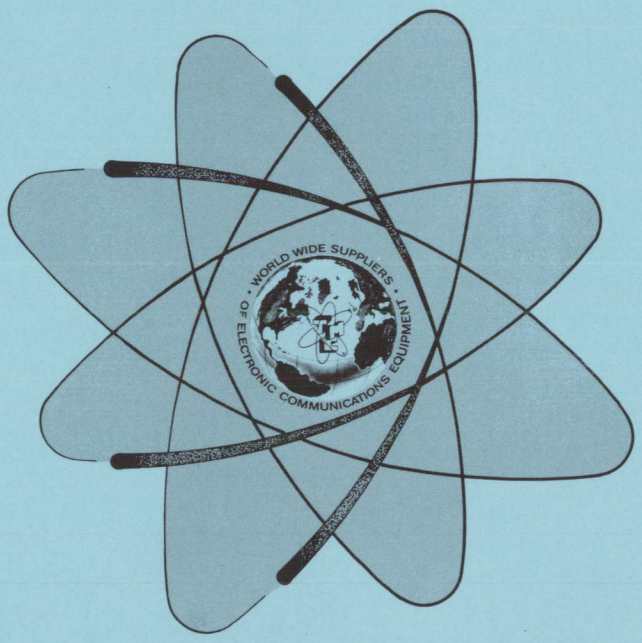
TECHNICAL MANUAL
for

STANDING WAVE RATIO INDICATOR

MODEL SWR-1K (50)

MODEL SWR-1K (70)



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

Printed in U.S.A.

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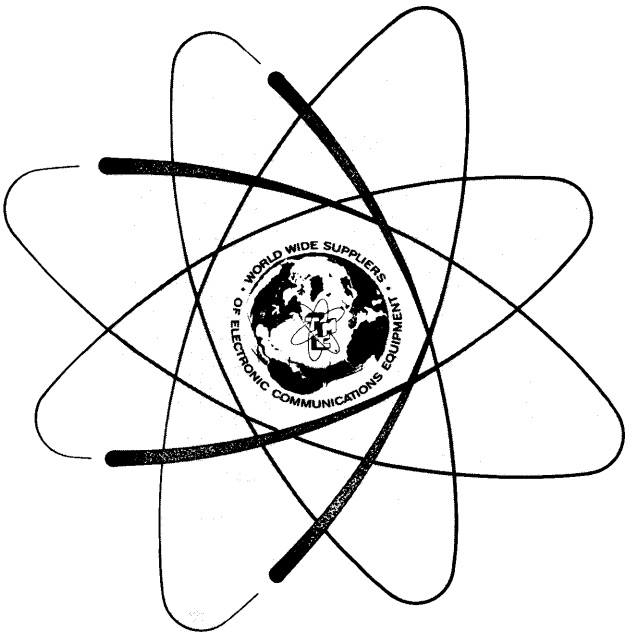

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THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

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

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By
1	incorporated	February 1973	
2	incorporated	February 1973	

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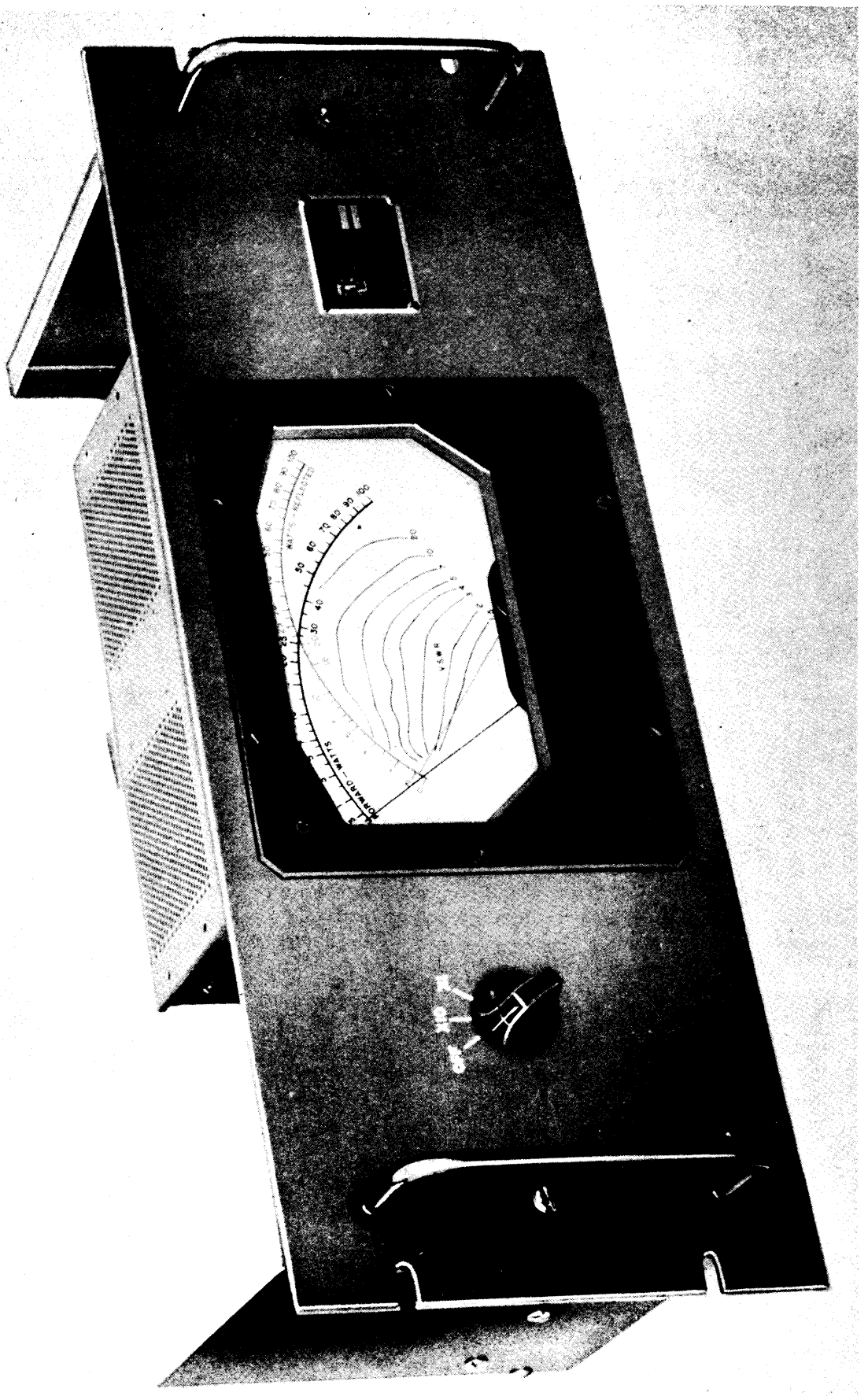

Figure 1-1. Standing Wave Ratio Indicator, Model SWR-1K ( )

SECTION 1
GENERAL DESCRIPTION

1-1. INTRODUCTION.

This manual contains technical information for the Standing Wave Ratio Indicator, Model SWR-1K, illustrated in figure 1-1. This unit provides accurate indication of the voltage standing wave ratio in a transmitter antenna. It is useful over a frequency range from 2 to 32 megacycles. It also provides indications of forward and reflected rf power. Standing Wave Ratio Indicator, Model SWR-1K (50) is used with 50 ohm transmission lines. Standing Wave Ratio Indicator, Model SWR-1K (70) is used with 70 ohm transmission lines.

1-2. GENERAL DESCRIPTION.

The indicator has a selector switch S301 and a meter M301. Switch S301 is a three-position rotary switch. It selects the ranges for the meter and turns the unit on and off. Meter M301 is a dual-pointer instrument. It has three scales: FORWARD-WATTS (forward power), WATTS-REFLECTED (reflected power), and VSWR (voltage standing wave ratio). VSWR is read by observing the location at which the two pointers cross each other. All components are mounted on a standard 19 inch relay rack panel. The panel is fitted with an aluminum dust cover, which is removed when the indicator is mounted on a relay rack.

The indicator has low insertion loss and may be used with any high frequency transmitter producing up to 1000 watts when operated into a transmission line with a VSWR less than 3 to 1 in the frequency range from 2 to 32 megacycles. If a VSWR more than 3 to 1 exists, a reduction in transmitter output must be made. Table 1-1 lists the physical characteristics of the indicator.

Operation of the indicator requires no power supply. The scale selector switch on the panel is the only operating control. Table 1-2 lists the electrical characteristics of the indicator.

TABLE 1-1. PHYSICAL CHARACTERISTICS

CHARACTERISTICS	DIMENSIONS
CASE	
Length	20-1/2 inches
Depth	9-3/4 inches
Height	8-1/2 inches
Volume	1.0 cubic feet
RACK	
Length	19 inches
Depth	8 inches
Height	7 inches
Volume	0.6 cubic feet
Weight	16 pounds

TABLE 1-2. ELECTRICAL CHARACTERISTICS

Frequency Range	2 to 32 megacycles
Input:	
Model SWR-1K (50)	50 ohm transmission lines, RG-8/U connectors
Model SWR-1K (70)	70 ohm transmission lines, RG-11/U connectors
Rating	1000 watts maximum with a VSWR not greater than 3 to 1

SECTION 2
INSTALLATION

2-1. PACKAGING.

Open shipping case and carefully remove instrument. Inspect all packing materials for parts shipped as "loose items". Visually inspect the indicator for shipping damage.

2-2. INSTALLATION DETAILS.

The indicator is shipped with small rubber pads in the meter case to prevent damage to the meter movements. Remove the four screws from the meter face and draw the housing back from the panel. Remove pads and reinstall meter. Make certain that the eccentric zero adjust pins fit into their slots.

The indicator may be mounted in any conventional position. The location should be sheltered, and the transmission lines should not exceed ten feet in length. The indicator may be mounted in a standard relay rack or console, or left in its case for tabletop use.

The indicator does not require an external chassis ground when the system cables are correctly connected.

2-3. INITIAL ADJUSTMENT.

No initial adjustment of the indicator is required.

SECTION 3
OPERATOR'S SECTION

3-1. OPERATING INSTRUCTIONS.

The indicator is operated by setting the three-position selector switch S301. The switch is used to turn the indicator on and off and to select the 100 or 1000 watt meter ranges.

3-2. OPERATOR'S MAINTENANCE.

The indicator should be inspected quarterly to determine its general condition and to remove dust or foreign matter from the case. Clean the internal components with a soft brush or use a vacuum cleaner.

Inspect wiring and internal components for evidence of overheating and mechanical damage. Tighten loose screws. Remove moisture with a soft cloth or tissue.

SECTION 4
PRINCIPLES OF OPERATION

4-1. METER INDICATION.

The pointers of the meter indicate FORWARD-WATTS, WATTS-REFLECTED, and VSWR. VSWR is read by observing the location at which the two pointers cross each other.

4-2. R-F BRIDGE.

Figure 4-1 is a schematic diagram of the R-F bridge circuit. The bridge consisting of R301, C301, C302, antenna impedance R_O, and CR301 registers zero on forward voltages provided that R301: R_O: : C302:C301. Bridge consisting of R301, C304, C305, antenna impedance R_O, and CR302 indicates forward voltages and power. Bridge consisting of R301, C304, C305, transmitter impedance R_O, and CR302 registers zero on reflected voltages provided R301:R_O : : C305: C304. Bridge consisting of R301, C301, C302, transmitter impedance R_O and CR301 indicated reflected voltages and power. When the resistances of the antenna and coaxial line change, the bridge is unbalanced and the voltages supplied to meter M301 change. The changes in voltage at the bridge allow the meter to indicate VSWR (voltage standing wave ratio) as follows:

$$VSWR = \frac{E_f + E_r}{E_f - E_r} = \frac{1 + \sqrt{\frac{P_r}{P_f}}}{1 - \sqrt{\frac{P_r}{P_f}}}$$

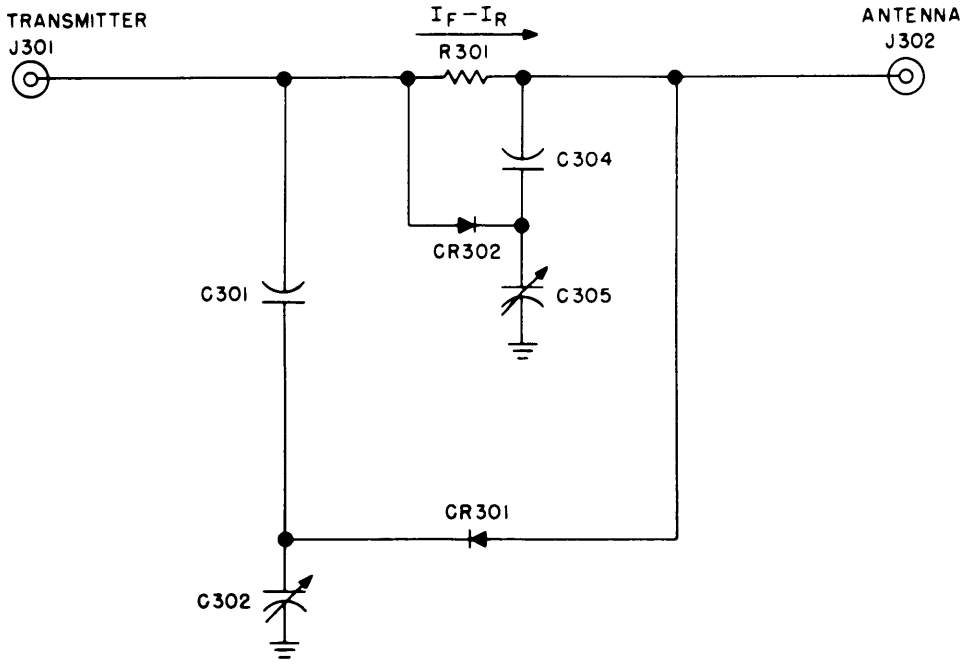

Figure 4-1. Schematic Diagram of R-F Bridge Circuit

SECTION 5
TROUBLE-SHOOTING

5-1. Consider the symptoms and define the nature of the trouble. Visually inspect the components for evidence of damage. If a component is defective, determine if the defective component caused the equipment failure or was a result of other trouble. Correct the trouble, replace the defective component, and resume operation. Avoid abnormal operating conditions which may cause component failure.

TABLE 5-1. TROUBLE-SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Meter pointers do not return to zero.	Incorrectly zeroed pointers.	Zero pointers using zeroing screws.
WATTS-REFLECTED pointer does not zero when adjusting null capacitor C302.	Defective null capacitor C302.	Replace.
FORWARD-WATTS pointer does not approach zero when adjusting equalizer capacitor C305.	Defective equalizer capacitor C305.	Replace.
FORWARD-WATTS pointer does not go to full scale when performing Step 17 of Table 6-2.	Defective resistor R302.	Replace.
WATTS-REFLECTED pointer does not go full scale when performing Step 20 of Table 6-2.	Defective resistor R305.	Replace.
FORWARD-WATTS pointer does not go full scale when performing Step 24 of Table 6-2.	Defective resistor R303.	Replace.
WATTS-REFLECTED pointer does not go full scale when performing Step 27 of Table 6-2.	Defective resistor R304.	Replace.

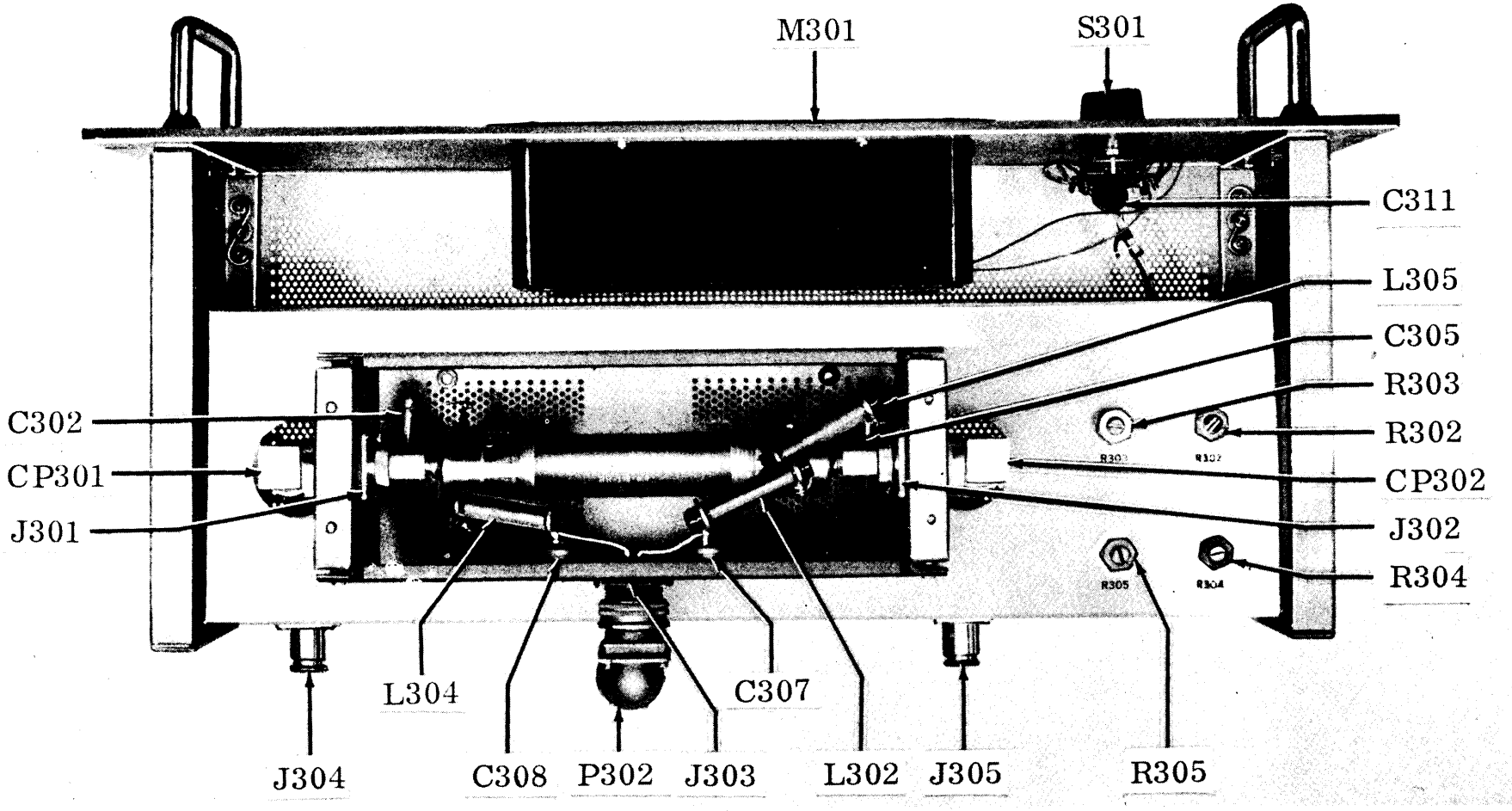

Figure 5-1. Reference Designations for Standing Wave Ratio Indicator, Model SWR-1K ( ), Top View

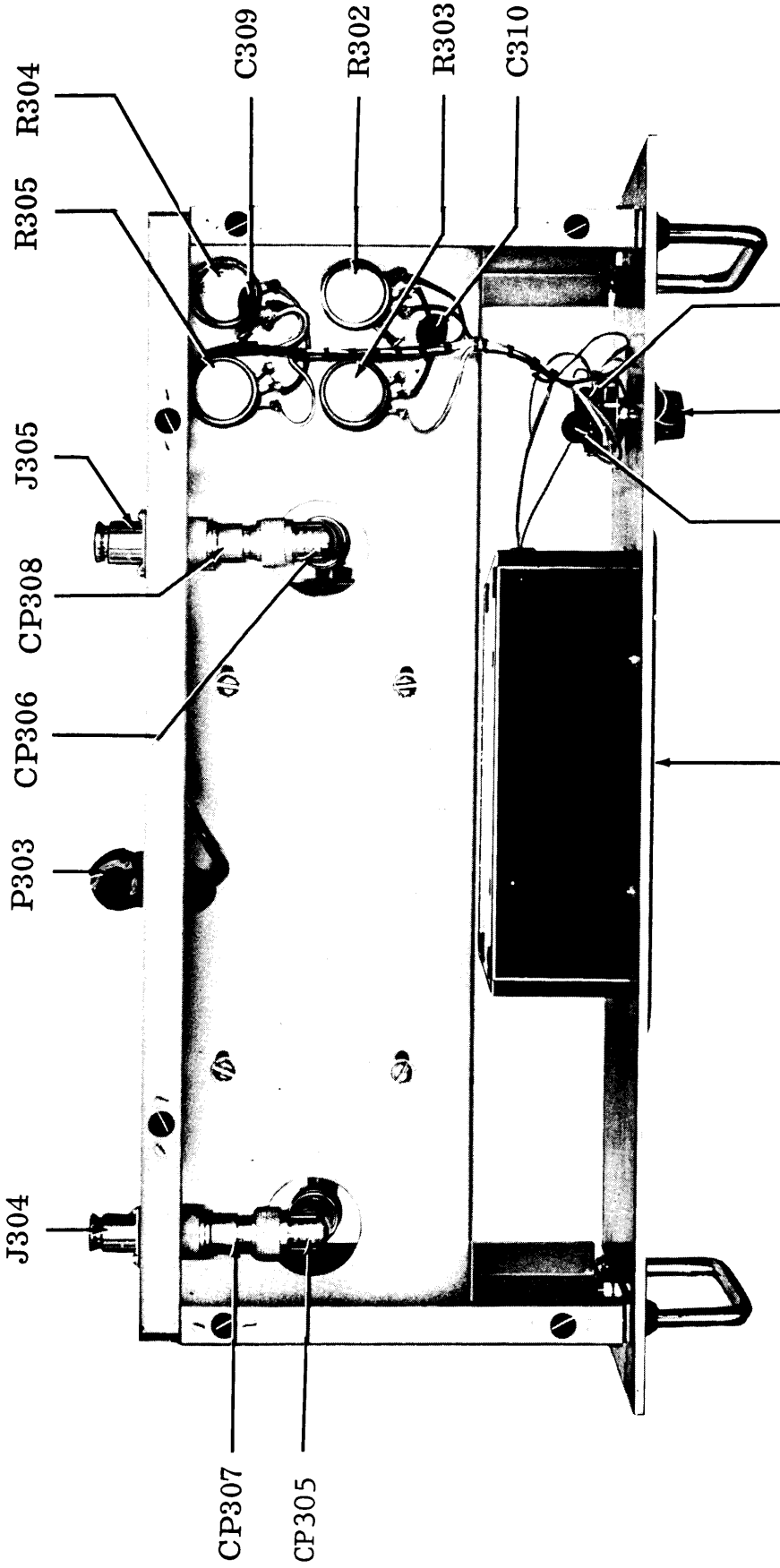

Figure 5-2. Reference Designations for Standing Wave Ratio Indicator, Model SWR-1K (·), Bottom View

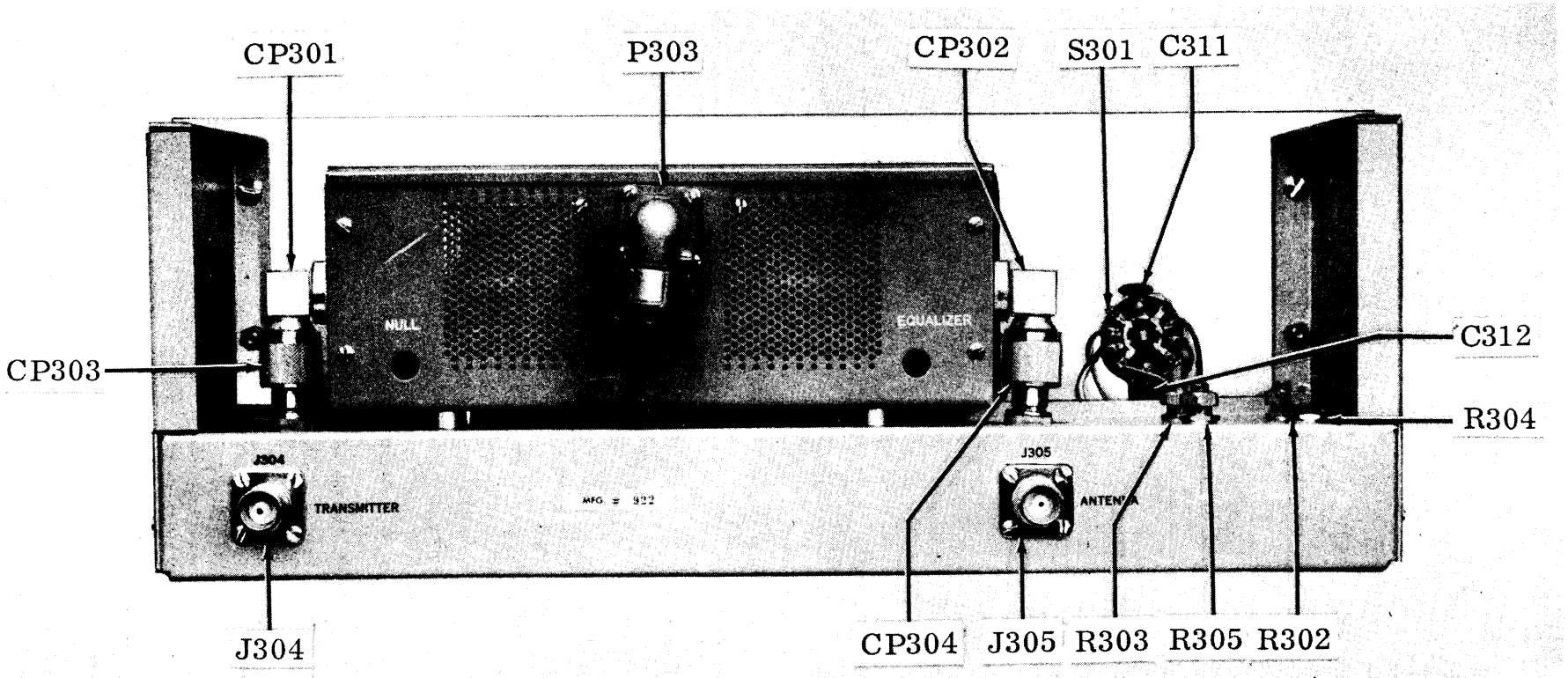

Figure 5-3. Reference Designations for Standing Wave Ratio Indicator, Model SWR-1K ( ), Rear View

SECTION 6
MAINTENANCE

6-1. CORRECTIVE MAINTENANCE.

The only components of the indicator that require special adjustment techniques are the components of the directional coupler. The calibration and adjustment sequences presented in Table 6-2 are to be used if readjustment is required.

TABLE 6-1. TEST EQUIPMENT FOR ALIGNMENT

ITEM	MANUFACTURER
Adjustment Tool	TMC Part Number TP-110
70 ohm, 1000 watt Resistive Load (Model SWR-1K (70) only)	
50 ohm, 1000 watt Resistive Load (Model SWR-1K (50) only)	
Transmitter used with system	
RF VTVM	

TABLE 6-2. ALIGNMENT PROCEDURE

STEP	OPERATION
	WARNING The following procedures require the use of RF energy from the transmitter. Follow instructions carefully. When the procedures specify that transmitter power should be OFF, make certain that it is off. Use the final plate switch or its equivalent.
1	Connect the resistive load specified in Table 6-1 to J305.
2	Connect the RF output of the transmitter to J304.
3	Remove dust cover of indicator.
4	Adjust R302, R303, R304 and R305 to minimum resistance (fully clockwise).
5	Zero meter pointers, if necessary, using zero adjust screws.
6	Rotate switch S301 to X1 position.
7	Tune the transmitter to an output frequency of 6.0 megacycles on low power (less than 100 watts).
8	Increase power slowly until meter reads 100 on the FORWARD-WATTS scale.

TABLE 6-2. ALIGNMENT PROCEDURE (C nt.)

STEP	OPERATION
9	Adjust the null capacitor C302 of the directional coupler until the WATTS-REFLECTED reading on the meter is at a minimum.
10	Turn the transmitter OFF. Reverse the RF cables by connecting the resistive load to J305 and the transmitter to J304.
11	Turn the transmitter ON. Increase power until the WATTS-REFLECTED reading on the meter is 100.
12	Adjust the equalizer capacitor C305 on the directional coupler until the FORWARD-WATTS reading on the meter is at a minimum.
13	Turn the transmitter final plates OFF. Restore cable connections of the directional coupler to normal operating positions (transmitter to J304; resistive load to J305).
14	Adjust R302, R303, R304, and R305 to maximum resistance (fully counter-clockwise).
15	Connect the RF VTVM across the resistive load.
16	Turn the transmitter ON and adjust its output level until the RF VTVM indicates 70.7 volts, Model SWR-1K(50) or 83.7 volts, Model SWR-1K(70).
17	Adjust variable resistor R302 until the FORWARD-WATTS reading on the meter is 100.
18	Turn the transmitter OFF. Reverse RF connections as before so that the transmitter connects to J305 and the resistive load to J304.
19	Turn the transmitter ON and adjust its output level until the RF VTVM indicates 70.7 volts, Model SWR-1K(50) or 83.7 volts, Model SWR-1K(70).
20	Adjust variable resistor R305 until the WATTS-REFLECTED reading on the meter is 100.
21	Turn the transmitter OFF. Restore the RF cables and load to their normal operating positions (transmitter to J304; resistive load to J305).
22	Rotate switch S301 to the X10 position.
	NOTE If a 1000 watt resistive load is not available, refer to Table 6-3 for alternative voltages and loads.
23	Turn the transmitter ON and adjust its output voltage to 224 volts, SWR-1K(50) or 265 volts, Model SWR-1K(70) as read on the RF VTVM.
24	Adjust variable resistor R303 until the FORWARD-WATTS reading on the meter is 100.
25	Turn the transmitter OFF. Reverse the RF connections.
26	Turn the transmitter ON and adjust its output level to read 224 volts, SWR-1K(50) or 265 volts, Model SWR-1K(70) as read on the RF VTVM.

TABLE 6-2. ALIGNMENT PROCEDURE (C nt.)

STEP	OPERATION
27	Adjust variable resistance R304 until WATTS-REFLECTED reading on the meter is 100.
28	Turn the transmitter OFF. Restore connections to their normal operating positions.

TABLE 6-3. VOLTAGE ACROSS LOAD VS POWER

Voltage across resistive load measured with RF VTVM		Corresponding reading of FORWARD-WATTS scale
Model SWR-1K(50)	Model SWR-1K(70)	
224	265	1000
200	237	800
173	205	600
141	167	400
100	118	200
86.6	102	150
70.7	83.7	100

SECTION 7
PARTS LIST

INTRODUCTION

Reference designations have been assigned to identify all maintenance parts of the system. They 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, electron tube, etc. The number differentiates between parts of the same generic group. Sockets are identified by a reference designation which contains the reference designation of the plug-in device preceded by an X. Column 1 lists the reference designations of the various parts in numerical and alphabetical order. Column 2 gives the names and describes the various parts. Major part assemblies are listed in their entirety; subparts of a major assembly are listed in alphabetical and numerical order with reference to the major assembly. Column 3 indicates how each part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

STANDING WAVE RATIO INDICATOR SWR-1K ( )

SYM.	DESCRIPTION	FUNCTION	TMC DWG OR PT NO
C301	CAPACITOR, fixed: ceramic; feed-thru; 750 uuf. Not a replaceable item, part of DC301.	Voltage Divider	CK70A751M
C302	CAPACITOR, variable: glass; 0.7-9.0 uuf, 1500 wvdc. Not a replaceable item, part of DC301.	Voltage Divider Null Balancing	CV-102
C303	CAPACITOR, fixed: ceramic; feed-thru; 1000 uuf. Not a replaceable item, part of DC301	RF Bypass	CK 70A102M
C304	Same as C301. Not a replaceable item, part of DC301.	Voltage Divider	
C305	Same as C302. Not a replaceable item, part of DC301.	Voltage Divider Equalizer Bal.	
C306	Same as C303 Not a replaceable item, part of DC301.	RF Bypass	
C307	CAPACITOR, fixed: silver mica; button type, 1500 uuf, ±10%. Not a replaceable item, part of DC301.	RF Bypass	CB21PX152K
C308	Same as C307. Not a replaceable item, part of DC301.	RF Bypass	
C309	CAPACITOR, fixed: ceramic; .01 uf, GMV, 500 wvdc.	RF Bypass	CC-100-16
C310	Same as C309.	RF Bypass	
C311	Same as C309.	RF Bypass	
C312	Same as C309.	RF Bypass	
CP301	ADAPTER, connector, angle.	Coupling to Transmitter	UG-212C/U
CP302	Same as CP301.	Coupling to Antenna	
CP303	ADAPTER, connector, straight.	Coupling to Transmitter	SA103
CP304	Same as CP303.	Coupling to Antenna	
CP305	ADAPTER, connector, angle.	Coupling to Transmitter	SA129
CP306	Same as CP305.	Coupling to Antenna	
CP307	ADAPTER, connector, straight.	Coupling to Transmitter	UG-146/U
CP308	Same as CP307.	Coupling to Antenna	

SYM.	DESCRIPTION	FUNCTION	TMC DWG OR PT NO
CR301	DIODE, crystal: high frequency. Not a replaceable item, part of DC301.	Rectifier, Reflected Power	1N277
CR302	Same as CR301. Not a replaceable item, part of DC301.	Rectifier, Forward Power	
J301	CONNECTOR, receptacle: female; teflon insulated, mtg. dim. four 1/8" holes on 29/32" mtg. centers. Not a replaceable item, part of DC301.	Transmitter Coupling	UG-560/U
J302	Same as J301. Not a replaceable item, part of DC301.	Antenna Coupling	
J303	CONNECTOR, receptacle: female; 4 contacts. Not a replaceable item, part of DC301.	Output to Meter	MS3102A-14S-2S
J304	CONNECTOR, receptacle: QDS.	Coupling to Transmitter	JJ-168
J305	Same as J304.	Coupling to Antenna	
L301	COIL, R. F.: 2.5 mh; 100 ma. Not a replaceable item, part of DC301.	RF Decoupling	CL-140-1
L302	COIL, R. F.: 185 uh. Not a replaceable item, part of DC301.	RF Decoupling	CL-254
L303	Same as L301. Not a replaceable item, part of DC301.	RF Decoupling	
L304	Same as L302. Not a replaceable item, part of DC301.	RF Decoupling	
L305	COIL, R. F.: fixed; 185 uh. Not a replaceable item, part of DC301.	RF Blocking DC Return	CL-178
M301	METER, standing wave ratio.	VSWR Indicator	MR-112
P301	CONNECTOR, plug: QDS. Supplied as Loose Item.	Transmitter Coupling	PL-149
P302	Same as P301. Supplied as Loose Item.	Antenna Coupling	
P303	CONNECTOR, plug: male; angle.	Output, DC301 to Meter	MS3108A-14S-2P
R301	RESISTOR, fixed: glass; silver contacts; 0.6 ohms, +10 -20%, 40 watts. Not a replaceable item, part of DC301.	Voltage Divider	RR-122-0.6
R302	RESISTOR, variable: composition; 25,000 ohms, ±20%, 2 watts.	Calibrate Adjustment	RV4LAYA253B
R303	RESISTOR, variable: composition; 100,000 ohms, ±20%, 2 watts.	Calibrate Adjustment	RV4LAYA104B
R304	Same as R303.	Calibrate Adjustment	

STANDING WAVE RATIO INDICATOR SWR-1K ( )

SYM.	DESCRIPTION	FUNCTION	TMC DWG OR PT NO
R305	Same as R302.	Calibrate Adjustment	
S301	SWITCH, rotary: 2 pole, 3 position, single section; silver plated brass contacts (non-shorting); phenolic	Metering Switch	SW-112
DC301	NOTE: CU-2 Coupler Assembly is replaced as a unit. It requires precise alignment at the factory before use. Consists of the following items: C301, 302, 303, 304, 305, 306, 307, 308, CR201, 302, J301, 302, 303, L301, 302, 303, 304, 305, R301.	Antenna Coupling Unit	CU-2

SECTION 8
SCHEMATIC DIAGRAMS

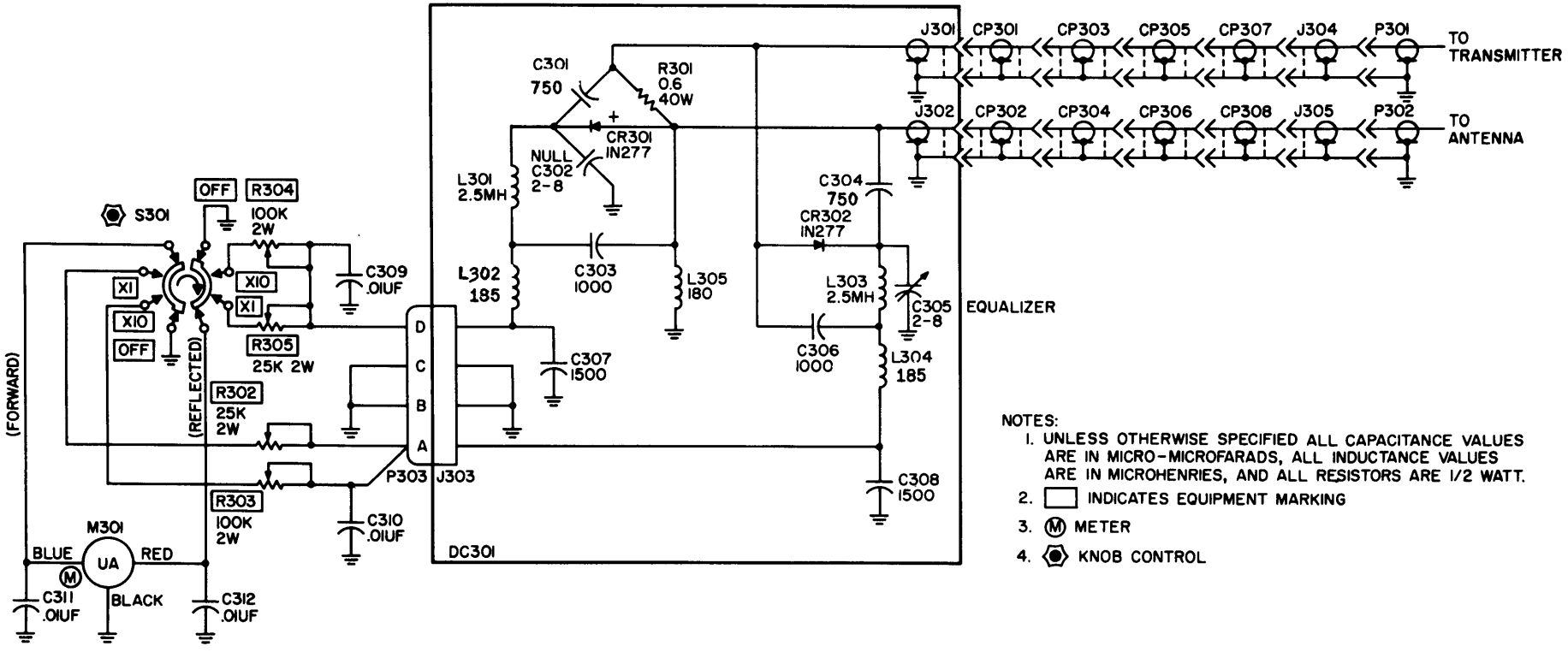

Figure 8-1. Schematic Diagram for Standing Wave Ratio Indicator, Model SWR-1K ( )