UNCLASSIFIED

TECHNICAL MANUAL

for

STANDING WAVE RATIO INDICATOR

MODEL SWR-10K/50U

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

UNCLASSIFIED

TECHNICAL MANUAL

for

STANDING WAVE RATIO INDICATOR

MODEL SWR-10K/50U

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, ONTARIO

IN-2031

ISSUE DATE: 3/1/65

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

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

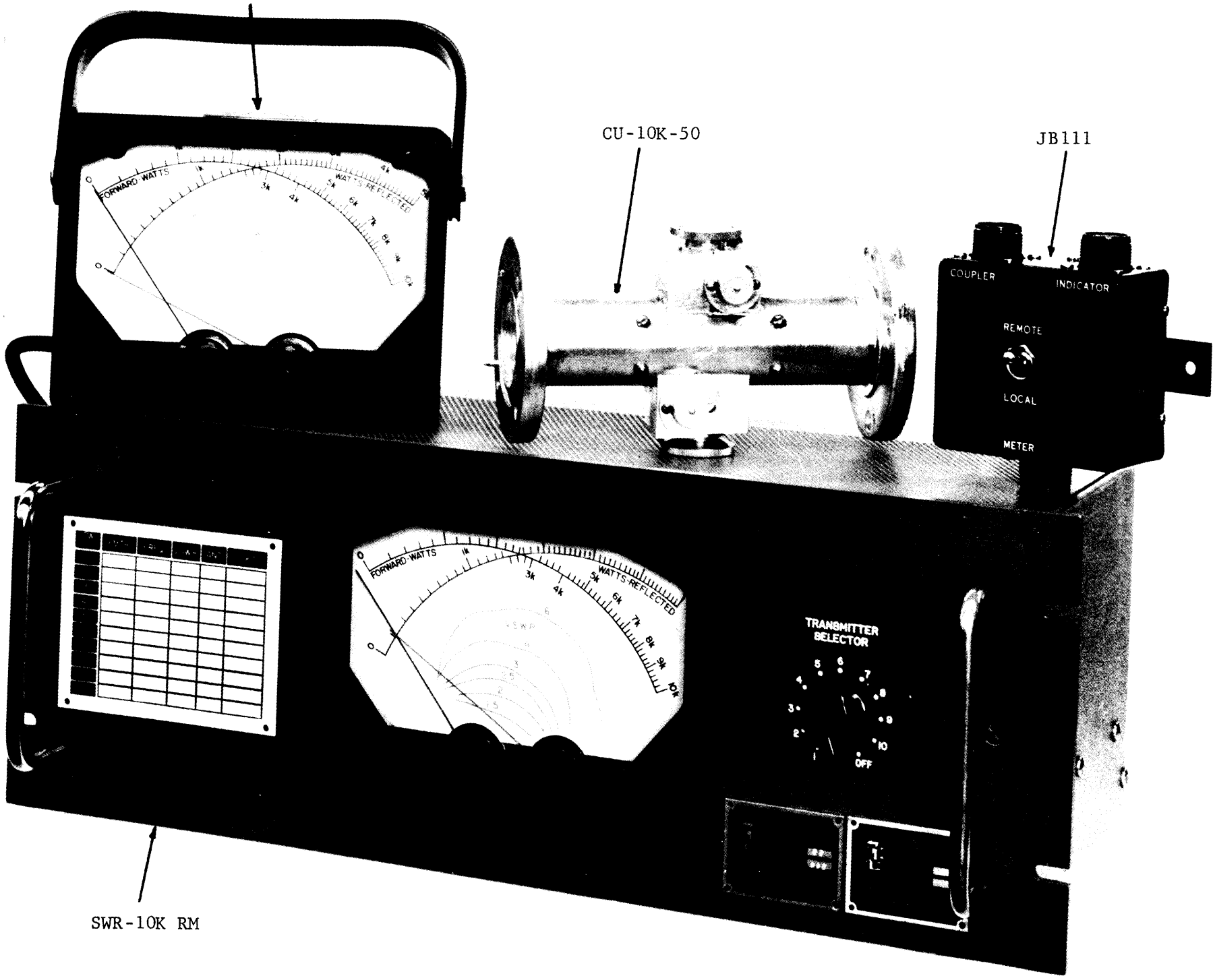


Figure 1-1. Standing Wave Ratio Indicator, Model SWR-10K/50U

SECTION 1

GENERAL INFORMATION

1-1. PURPOSE AND DESCRIPTION.

a. PURPOSE. - Standing Wave Ratio Indicator, Model SWR-10K/50U provides an accurate, direct indication of forward power, reflected power, and VSWR measurements for as many as ten 50-ohm transmission circuits over the frequency range of 2 to 30 megacycles. A ten-position switch serves to select the transmission line on which measurements are to be made. Power rating for the SWR-10/50U is 10,000 watts average with a maximum VSWR of 6:1. The SWR-10K/50U does not require a power supply, either internal or external, for operation.

b. DESCRIPTION. - The SWR-10K/50U contains 4 major units as described in paragraphs (1), (2), (3), and (4) below.

(1) DIRECTIONAL COUPLER, MODEL SWR-10K CU-50. - The SWR-10K CU-50 (coupler) is a balanced rf bridge network designed and calibrated for use with Models SWR-10K RM and PM indicators. The coupler unit is connected between the transmitter and the antenna of a system using an unbalanced line of 50 ohms characteristic impedance. The coupler contains two removable detector units: the unit marked 5KW is the reflected power detector, and the unit marked 10KW is the forward power detector. Each detector unit provides a dc output voltage corresponding to the forward and reflected power measurements made along the transmission line. These voltages are connected to either the RM or PM indicators via Junction Box JB-111.

(2) JUNCTION BOX, MODEL JB-111. - Junction Box, Model JB-111 contains three 4-conductor connectors and a switch, and is required only when the SWR-10K PM indicator is used in conjunction with the SWR-10K RM indicator. Junction Box JB-111 is connected to the dc output voltages of Directional Coupler SWR-10K/50U and the SWR-10K RM and PM indicators. The switch permits the coupler output voltages to be switched to either indicator. A bracket is furnished with the JB-111 unit for ease in mounting to the transmitter.

(3) CONTROL INDICATOR UNIT, MODEL SWR-10 K RM. - Control Indicator Unit, Model SWR-10K RM contains: a triple scale, dual-pointer meter for indication of forward power, reflected power, and VSWR; input connections for as many as ten transmission line measurements; and a ten-position rotary switch for selecting the transmission line to be measured. The unit can be mounted in a standard 19-inch relay rack merely by removing it from its case.

(4) PORTABLE INDICATOR, MODEL SWR-10K PM. - Portable Indicator, Model SWR-10K PM contains the same meter movement as the SWR-10K RM indicator (paragraph (3) above) but is mounted in a smaller case and is equipped with a cable connection to the SWR-10K/50U Directional Coupler or to the JB-111 Junction Box. If desired, the SWR-10K PM can be bracket mounted to the transmitter.

1-2. TECHNICAL SPECIFICATIONS.

Technical Specifications of the SWR-10K/50U are as follows:

TECHNICAL SPECIFICATIONS

Frequency Range	2 to 30 mcs.
Power Capacity	10,000 watts average with a maximum VSWR of 6:1.
Meter Accuracy	Within ±5% for SWR readings.
Dial Calibration	Analog isolines directly read VSWR. Power indication on linear scales.
Transmission Lines	50 ohm - RG17/U or 1 5/8" coaxial.
Controls:	
SWR-10K RM Indicator	Input selector switch (10 position rotary).
SWR-10K PM Indicator	Output selector switch (2 position toggle).
Dimensions:	
Model SWR-10K CU-50 Directipnal Coupler	6 3/4" x 3 1/2"
JB-1 Junction Box	3" x 3" x 1 1/2"
Model SWR-10K RM Indicator	
In Cabinet	20 1/2: x 8 1/2" x 9 3/4"
Rack Mounted	19" x 7" x 8"
Weight:	
Model SWR-10K CU-50 Directional Coupler	5 lbs. (approx.)
JB-111 Junction Box	1 lb. (approx.)

SECTION 2

INSTALLATION AND OPERATION

2-1. UNPACKING.

The SWR-10K/50U has been tested and calibrated at the factory before shipment. When it arrives at the operating site, inspect the shipping cases and contents for damage that may have occurred during transit. With respect to equipment damage for which the carrier is liable, the Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

2-2. POWER REQUIREMENTS.

The SWR-10K/50U can be used with any antenna using a coaxial transmission line and tuneable to a VSWR of 6:1 or better. Transmitter power reductions must be made where higher VSWR's are encountered. The SWR-10K/50U requires no power supply for operation. When properly installed it is ready for use.

2-3. INSTALLATION.

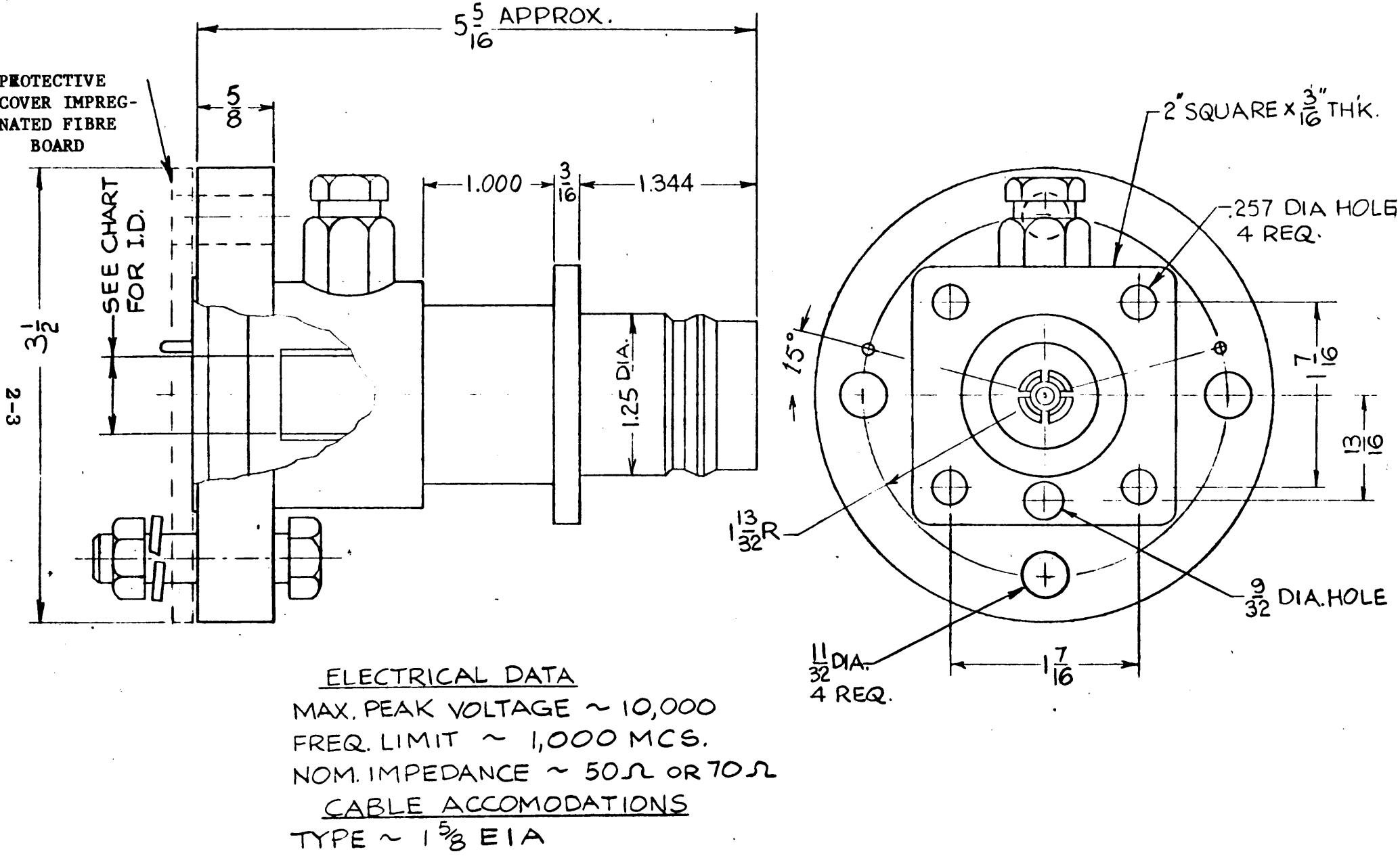
Generally, the system can be mounted in any convenient manner. The components should be located in a sheltered area with the directional couplers not more than ten feet from their respective transmitters.

The SWR-10K RM indicator can be mounted in any standard relay rack or console or left in its case for tabletop use. The SWR-10K PM is generally used as a portable meter and not permanently installed. Note, however, that a mounting bracket is furnished for this unit so that it may be temporarily or permanently mounted to a transmitter.

The CU-10K-50 directional coupler contains two removable detector units, (a 5 kw reflected power detector unit (CR202) and a 10 kw forward power detector unit (CR201)). Both units are properly positioned when turned to their extreme clockwise or counterclockwise positions. When they are properly positioned, the arrow on the 5 kw detector unit points towards the transmitter end of the coupler; the arrow on the 10 kw detector unit points toward the antenna end of the coupler.

The CU-10K-50 directional coupler can be connected to a transmitter and an antenna by either 1 5/8 inch coaxial or by RG-17/U coaxial. When 1 5/8 inch coaxial is used the coupler can be directly connected. When RG-17/U coaxial is used, adapters are required for connection. Figures 2-1 and 2-2 illustrate two types of adapters that can be used for connection to the directional coupler when RG-17/U coaxial is used. Figure 2-3 gives assembly instructions for connecting cable to QDL plugs.

After securing the SWR-10K/50U units, interconnect them as shown in figure 2-4. Special case or chassis ground connections are not required when systems cable connections are properly made. Figure 2-5 shows how multiple system installations can be made; figure 2-6 illustrates a rear view of the Model SWR-10K RM indicator.



ELECTRICAL DATA

MAX. PEAK VOLTAGE ~ 10,000

FREQ. LIMIT ~ 1,000 MCS.

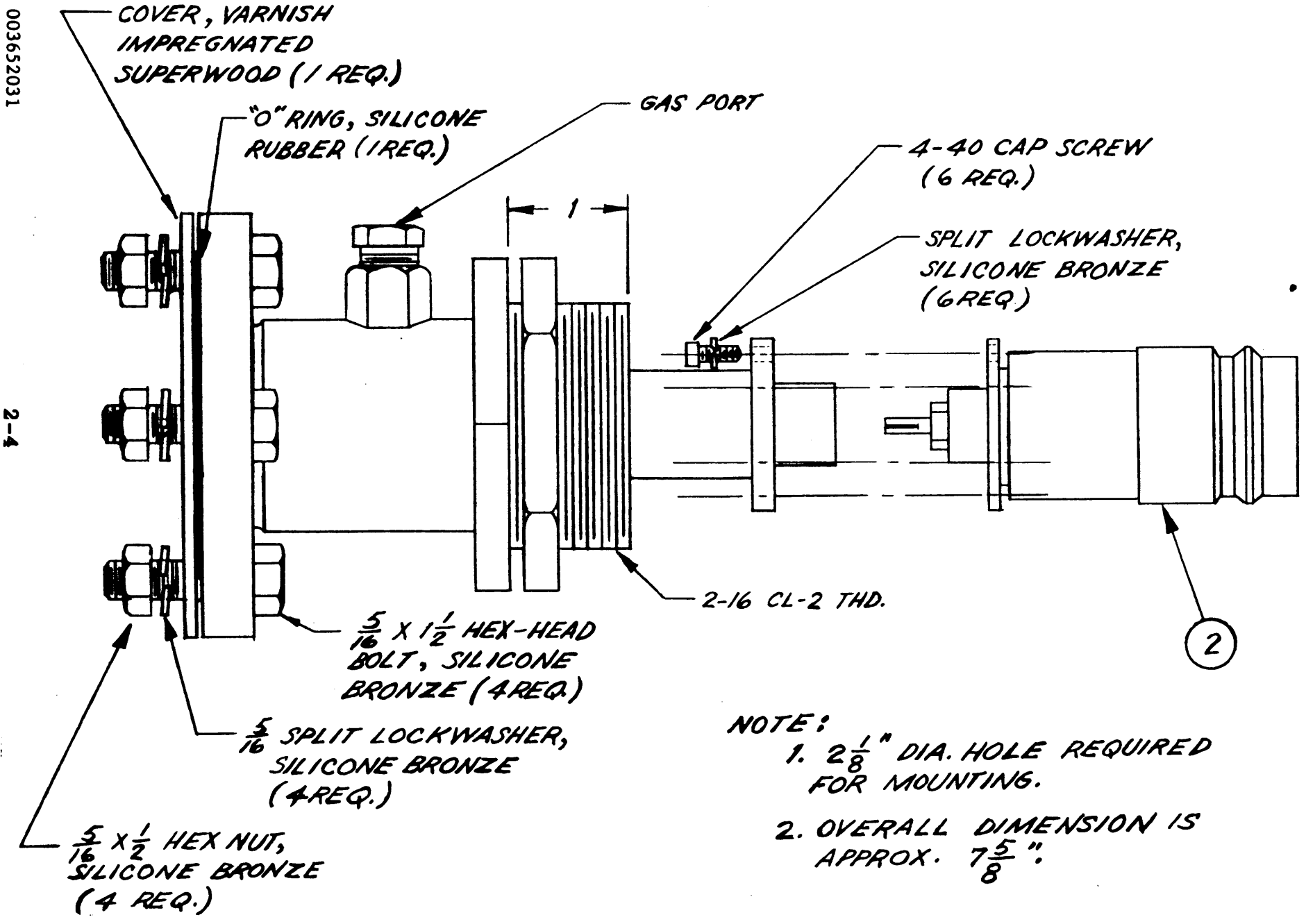
NOM. IMPEDANCE ~ 50Ω OR 70Ω

CABLE ACCOMODATIONS

TYPE ~ 1 5/8 EIA

Figure 2-1. Electrical Feedthrough 1 5/8" EIA 50 Ohm to QDL, Panel Mount Type

JJ-246A



TCA-EIA 51625/QDL A

Figure 2-2. Electrical Feedthrough, 1 5/8" EIA 50 Ohm to QDL, Wall-Mount Type.

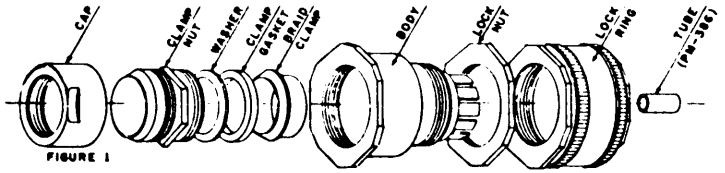


FIGURE 1

1. Disassemble plug. Lay it out as shown in Figure 1.

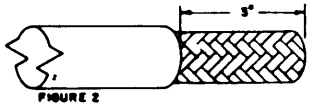


FIGURE 2

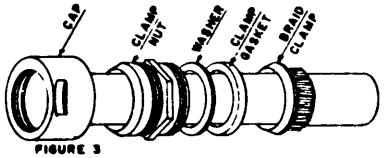


FIGURE 3

2. Remove approximately 3 inches of cable outer jacket as shown in Figure 2. Be extremely careful not to nick braid.

3. Slide CAP, CLAMP NUT, WASHER and CLAMP GASKET over cable as shown in Figure 3. Note that V groove of CLAMP GASKET must face toward BRAID CLAMP.

4. Slide BRAID CLAMP over braid sothat internal shoulder of BRAID CLAMP butts against end of cable outer jacket. (See Figure 3)

5. With BRAID CLAMP held in place, comb out braid. Fold braid back smoothly over BRAID CLAMP. Trim off excess braid. (See Figure 3)

6. Slide BODY carefully over CLAMP NUT. Tighten CLAMP NUT. (Hold BODY rigid, rotate CLAMP NUT).

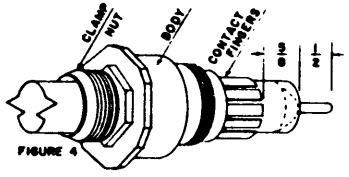


FIGURE 4

7. Measuring from CONTACT FINGERS, leave 5/8 inches of dielectric. Remove balance of dielectric with sharp, heated knife so that conductor is exposed. Cut conductor, if necessary, to 1/2 inch as shown in Figure 4. DO NOT SCRATCH OR NICK CONDUCTOR.

8. Using TMC tool TP-106, taper dielectric as shown by dotted lines. At finish of operation tool must butt against CONTACT FINGERS to assure proper shape and length of taper. (See Figure 4)

NOTE:

When TUBE PM-386 is not required, round off end of conductor to smooth, full radius. (See Figure 4)

When TUBE PM-386 is required, slide it over conductor so that it butts against dielectric. Solder it securely in place. Round off end of TUBE and conductor to smooth, full radius.

REMOVE ALL EXCESS SOLDER AND OTHER FOREIGN PARTICLES FROM CONDUCTOR AND PLUG

RG-17/U, RG-18/U	TUBE PM-386 not required.
RG-35/U, RG-85/U, RG-164/U	TUBE PM-386 required.

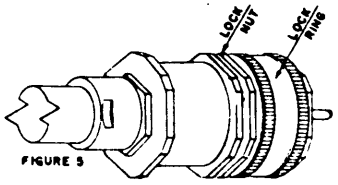


FIGURE 5

9. Tighten CAP securely to CLAMP NUT. Hand tighten LOCK NUT and LOCKING RING on BODY as shown in Figure 5.

ACCESSORY EQUIPMENT

TAPERING TOOL (TMC No. TP-106) Use to taper cable.

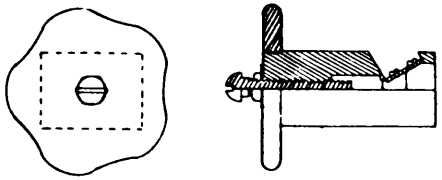
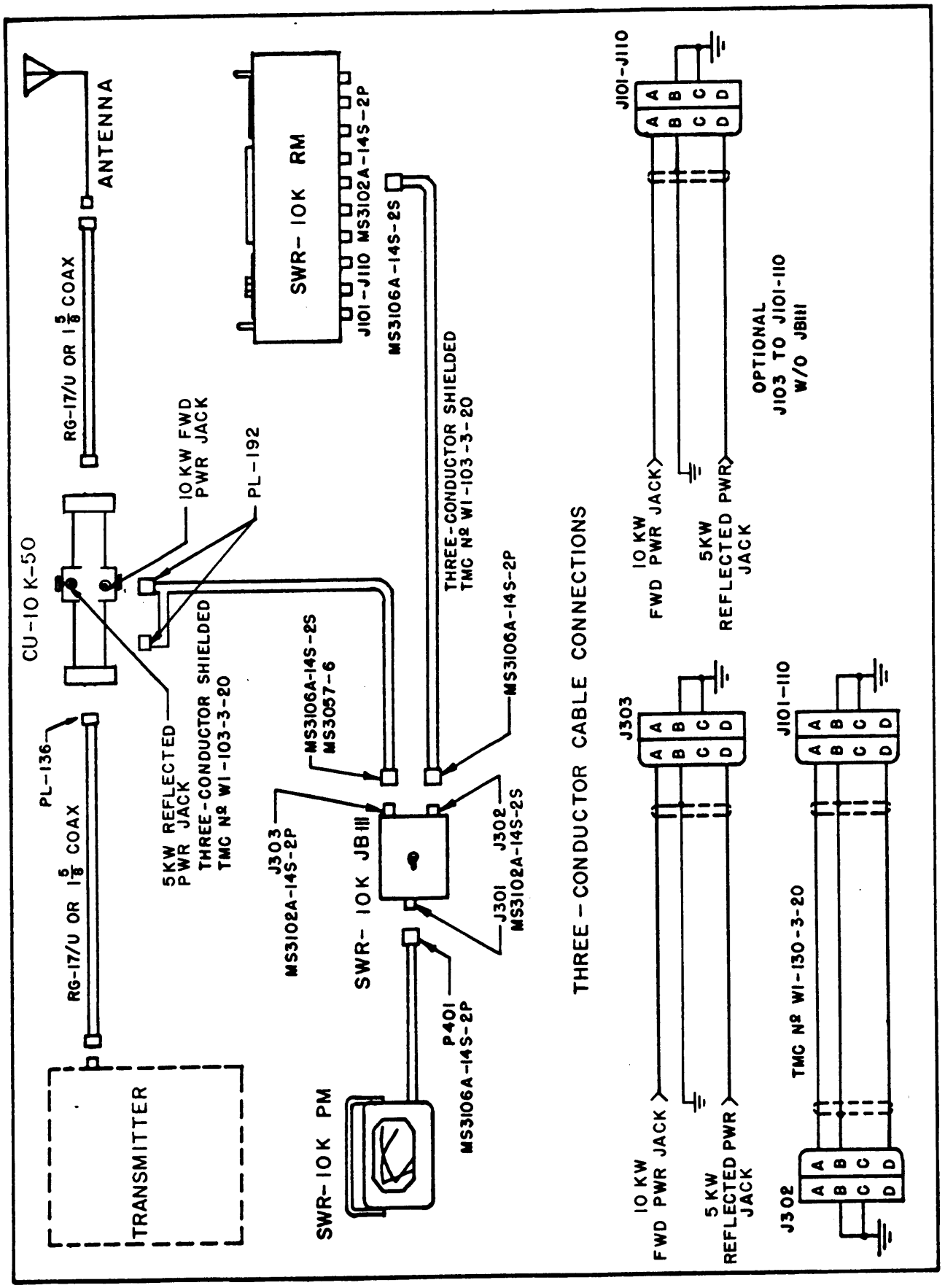


Figure 2-3 Assembly Instructions Cable to QDL Plugs



Figur 2-4 Cable Connections Model SWR-10K/50U

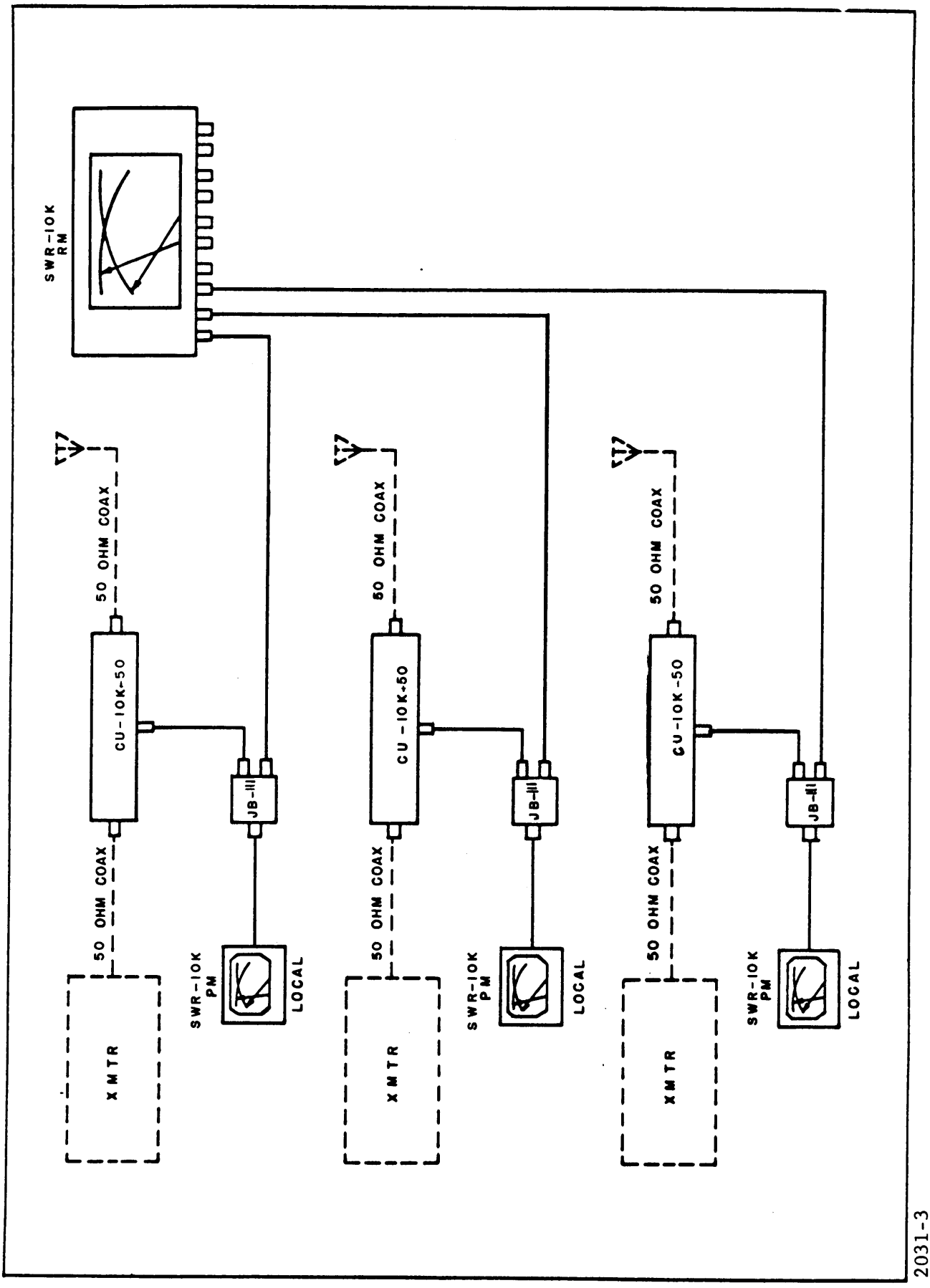


Figure 2-5 Typical Multiple Installation

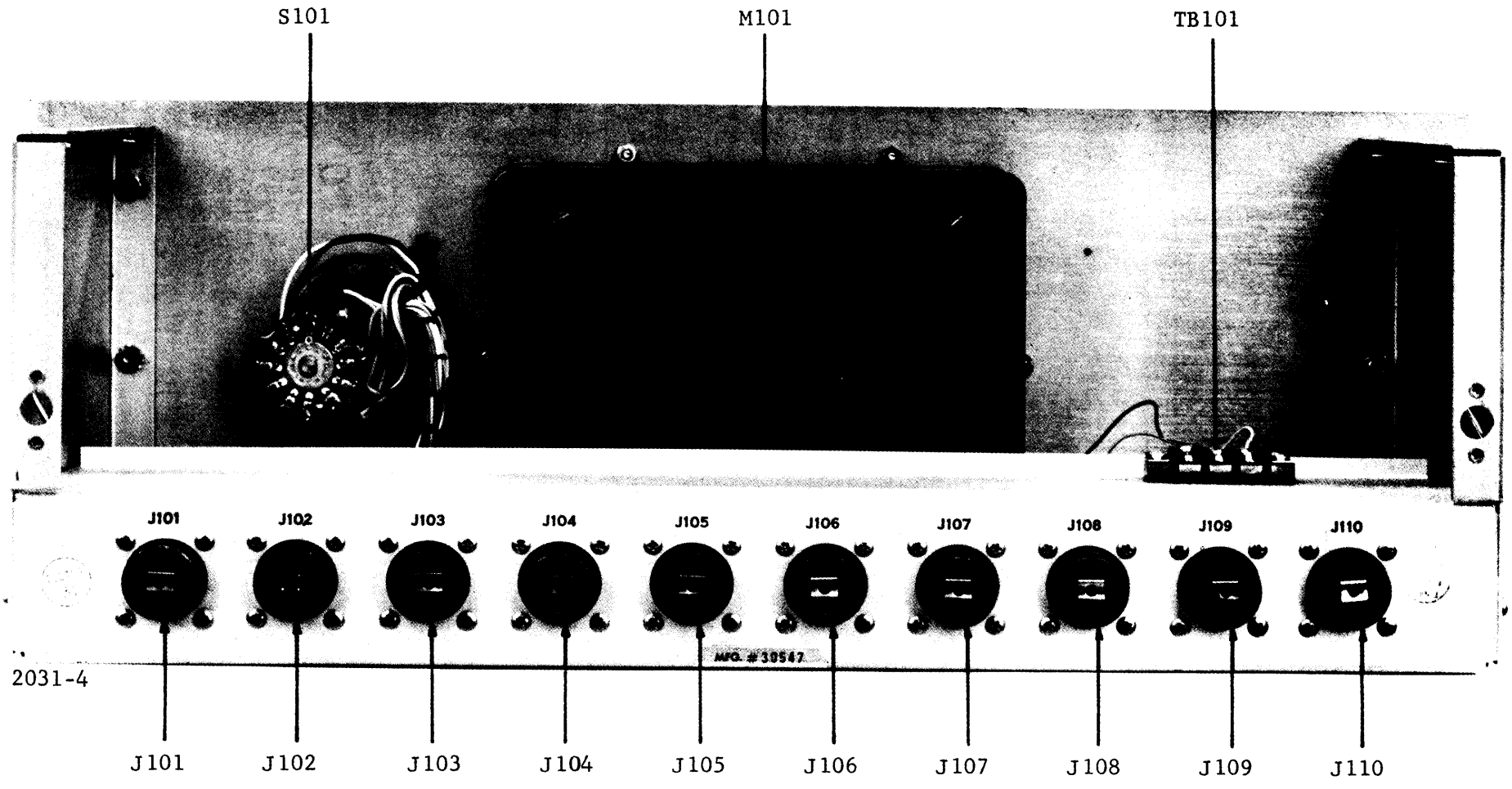


Figure 2-6. Model S -10K RM, Rear View

SECTION 3

OPERATOR'S SECTION

Operation of the SWR-10K/50U consists of operating the TRANSMITTER SELECTOR switch and the REMOTE/LOCAL switch. The TRANSMITTER SELECTOR switch, located on the SWR-10K RM indicator, is a 10-position switch that selects the transmission line on which measurements are to be made. The REMOTE/LOCAL switch, located on Junction Box JB-111, is a two-position switch that connects the output voltage of the directional coupler to SWR-10K RM indicator when set at REMOTE and to the SWR-10K PM indicator when set at LOCAL.

SECTION 4

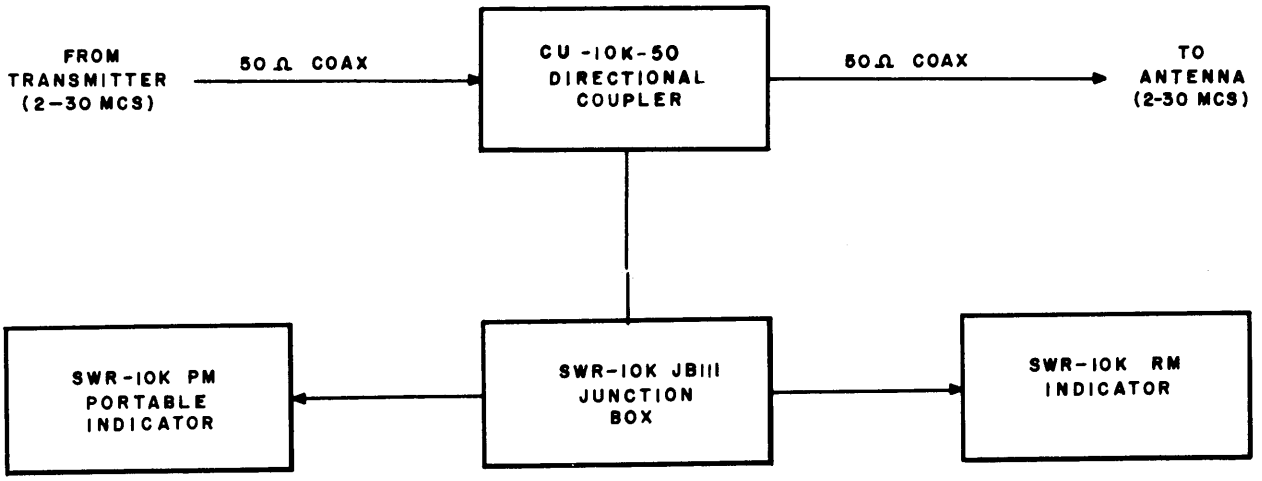
PRINCIPLES OF OPERATION AND TROUBLESHOOTING

4-1. OVERALL FUNCTIONAL DESCRIPTION. -

a. GENERAL.- The SWR-10K/50U provides direct indications of forward power, reflected power, and VSWR measurements for as many as ten 50-ohm transmission circuits over the frequency range of 2 to 30 megacycles. The system power rating is 10,000 watts average with a maximum VSWR of 6:1.

b. DIRECTIONAL COUPLER SWR-10K CU-50. - Refer to figure 4-1. The SWR-10K/50U directional coupler is connected between the transmitter and antenna of a system using an unbalanced transmission line of 50 ohms characteristic impedance. The directional coupler should be placed within ten feet of the transmitter for best results.

Voltage measurements made along a transmission line in operation can vary according to the standing wave conditions on that line. Standing waves are characterized by voltage and current nodes and anti-nodes. The positions of these nodes and the values measured are determined primarily by the operating power and frequency of the transmitter, the length of the transmission line and the manner in which it is terminated (matched to the antenna). The standing wave ratio (SWR) is determined by all of these conditions except transmitter power. The transmitter forward power and reflected power measured along the transmission line are detected by associated detector circuits and the resultant dc voltages are routed to the Junction Box JB-111.



2031-5

Figure 4-1. Model SWR-10K/50U, Functional Block Diagram

Essentially the directional coupler is an r-f bridge that serves as a sensing element for the RM and PM indicators. When the resistance of the antenna and the 50- ohm coaxial line change, the bridge is unbalanced and the voltages supplied to the voltmeter change. The changes in voltage at the bridge allow the meter to indicate VSWR.

c. JUNCTION BOX JB-111. - Refer to figure 4-1. Junction Box JB-111 receives dc voltages corresponding to forward and reflected power measurements from the directional coupler and routes these dc voltages to the SWR-10K RM or PM indicators.

d. SWR-10K RM INDICATOR. - The SWR-10K RM indicator is equipped to receive d-c inputs from one or more directional couplers connected to J101 - J110 on the rear of the RM chassis. Signals at these inputs are then selected for meter measurement by S101, a ten-position rotary switch located on the front panel of the unit.

The meter pointers indicate forward watts, reflected watts, and VSWR corresponding to the standing wave conditions on each transmission line. VSWR values are taken at the point on the meter face which falls directly behind the place of intersection of the two pointers.

e. SWR-10K PM INDICATOR. - The SWR-10K PM indicator is a portable meter equal electrically to the RM model, but containing facilities for attachment to only one signal source at a time.

4-2. TROUBLESHOOTING

a. GENERAL. - Troubleshooting the SWR-10K/50U system consists of first observing the SWR-10K RM and PM indicators, and then using the displayed data to localize the malfunction to a particular component. Before troubleshooting the SWR-10K/50U system, make sure that the malfunction does not exist in the transmitter.

b. SWR-10K RM AND PM INDICATORS. - Use the information displayed on the SWR-10K RM and PM indicators to localize system malfunctions that may occur. For example, if the RM indicator displays normal system operation and the PM indicator reading is abnormal, the malfunction is probably in the PM indicator. On the other hand, if both indicator readings are abnormal, the malfunction is probably in Junction Box JB-111 or in the CU-10K-50 directional coupler.

When troubleshooting the SWR-10K RM indicator, refer to figure 4-2 for parts location and to the schematic diagram (figure 7-1). When troubleshooting the SWR-10K PM indicator, refer to schematic diagram figure 7-3.

c. JUNCTION BOX JB-111. - Junction Box JB-111 contains only a toggle switch and connecting jacks. Troubles that may exist in this unit can be easily located by simple ohmmeter checks. When troubleshooting the junction box, refer to figure 4-3 for parts locations and to the schematic diagram (figure 7-2).

CAUTION

Make sure that all transmitter power is turned off or that the unit is disconnected from the system before performing ohmmeter checks.

d. DIRECTIONAL COUPLER CU-10K-50. - The first step in troubleshooting the directional coupler is to replace the removable 10 KW and 5 KW detectors with detectors that are known to be good. Replacement of these detectors will normally correct malfunctions that occur in the directional coupler. For detector replacement part numbers see section 6, Parts List. Checks should also be made for loose plug and jack connections, loose flange couplings, and for signs of moisture. Gently remove moisture with an absorbent cloth. As a last resort, if the malfunction cannot be located, replace the directional coupler.

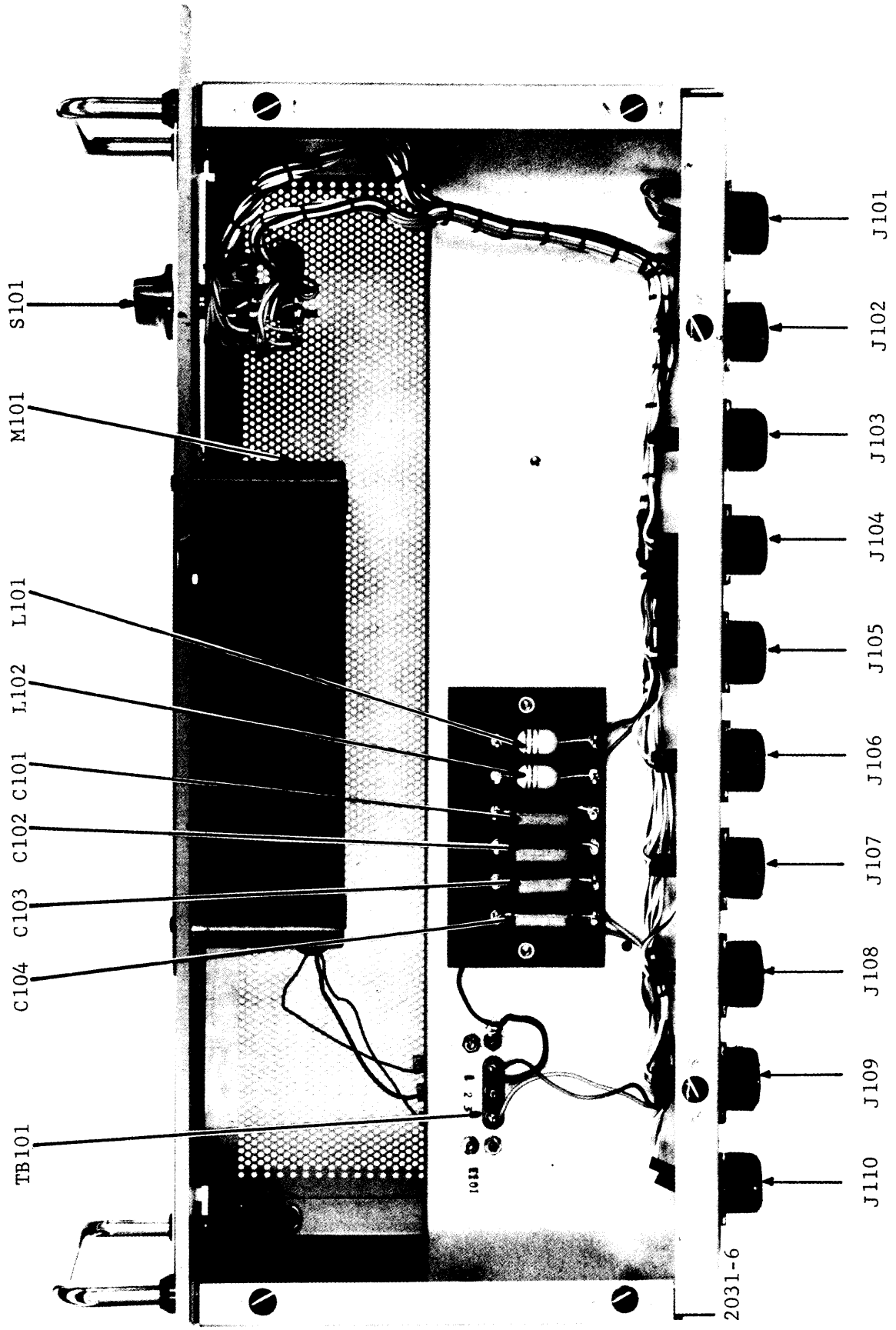


Figure 4-2. Model SWR-10K RM Indicator, Top View

651.15-2

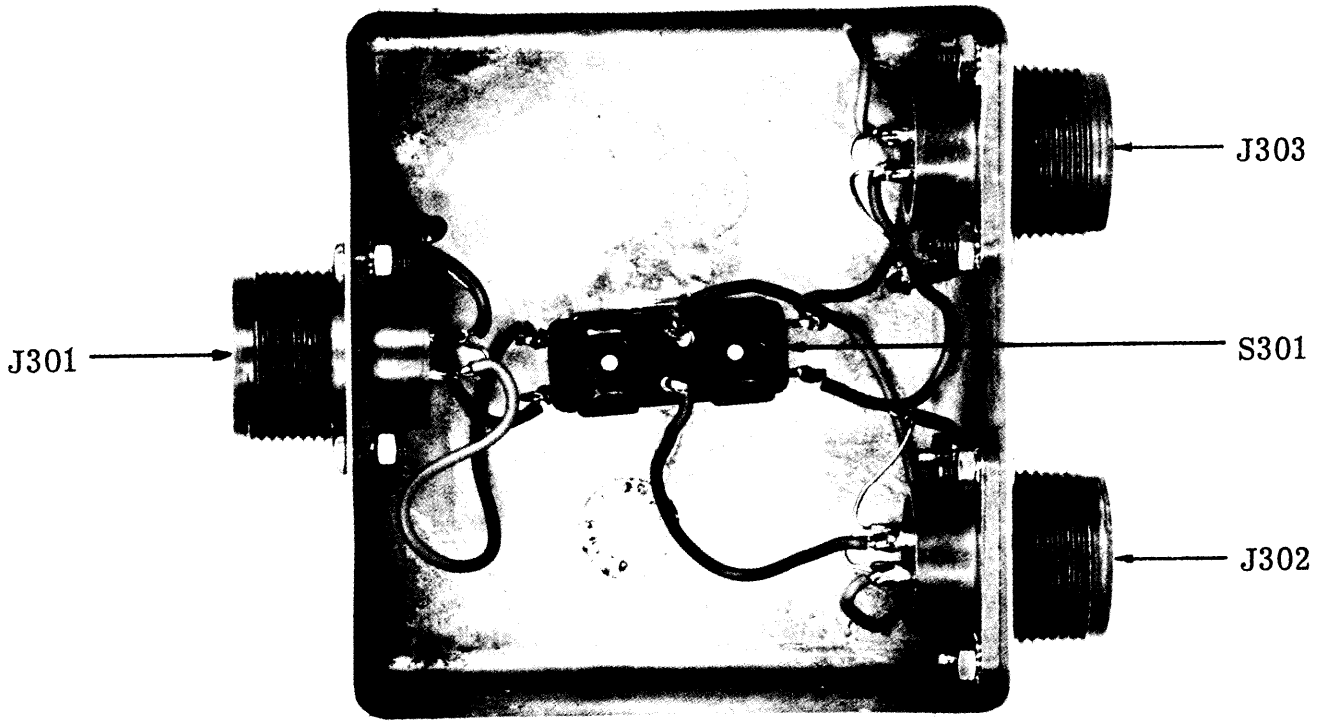


Figure 4-3. Model SWR-10K JB111, Bottom View

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE. - All units should be inspected periodically for the purpose of determining their general condition and for the removal of dust or other foreign matter which may have accumulated within the cases. A soft brush is the best cleaning implement for internal parts. A vacuum cleaner may also be used if one is available. Inspect wiring and components for signs of excessive heating or mechanical breakage. Retighten any sheet metal or parts mounting screws found loose. Gently remove any signs of moisture with an absorbent cloth or paper material.

5-2. CORRECTIVE MAINTENANCE. - Corrective maintenance procedures for the SWR-10K/50U are obvious upon inspection, and therefore no further instruction is provided in this manual.

SECTION 6
PARTS LIST

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 between 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. To expedite delivery, when ordering replacement parts, specify the TMC part number and the model number of the equipment.

PARTS LIST

SWR-10K-RM INDICATOR-CONTROL

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C101	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±2%; 500 WVDC; char. E.	CM30E102G
C102	Same as C101.	
C103	Same as C101.	
C104	Same as C101.	
J101	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 number 16 male contacts; straight type. Part of W101.	MS3102A14S2P
J102 thru J110	Same as J101. Part of W101.	
L101	COIL, RADIO FREQUENCY: fixed; 2.5 mh, ±10%; 26 ohms DC resistance; current rating 100 ma; molded case.	CL140-1
L102	Same as L101.	
M101	METER, SWR	MR188
S101	SWITCH, ROTARY: 2 section, 11 position, 30° angle of throw; shorting type silver alloy contacts.	SW223
TB101	TERMINAL BOARD, BARRIER: 3 terminals; 6-32 thd. x 1/4" long binder head screws; phenolic black bakelite.	TM100-3
W101	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of various lengths and colors of MWC wire, insulation sleeving, hardware and 10 connectors, J101 thru J110.	CA979

CU-10K-50 DIRECTIONAL COUPLER

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR201	DETECTING ELEMENT: SWR; frequency range 2-30 MC; power calibrated to read average power single tone 10 KW, full scale; calibration to be within ±5% at 5 KW.	DD119-1
CR202	DETECTING ELEMENT: SWR; frequency range 2-30 MC; power calibrated to read average power single tone 5 KW, full scale; calibration to be within ±5% at 2.5 KW.	DD119-2

JUNCTION BOX JB111

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J301	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 number 16 female contacts; straight type.	MS3102A14S2S
J302	Same as J301.	
J303	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 number 16 male contacts; straight type.	MS3102A14S2P
S301	SWITCH, TOGGLE: DPDT	ST103-16-63

SWR-10K-PM PORTABLE INDICATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C401	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C402	Same as C401.	
M401	METER, MOVEMENT: 1700 ohms, ±20% resistance; 0-100 ma, ±2% range; 13" blue lead, black pointer.	MM100-2
M402	METER, MOVEMENT: 1700 ohms, ±20% resistance; 0-100 ma, ±2% range; 13" red lead, red pointer.	MM100-1
P401	CONNECTOR, PLUG, ELECTRICAL: 4 number 16 male contacts; straight type.	MS3106A14S2P
TB401	TERMINAL BOARD: solder lug type; phenolic body; single 0.140" dia. mounting hole.	TM117-13

SECTION 7

SCHEMATIC DIAGRAMS

NOTE: CONNECTORS SHOWN AS VIEWED FROM CONTACT END. PIN A = FORWARD WATTS, PIN D = REFLECTED WATTS.

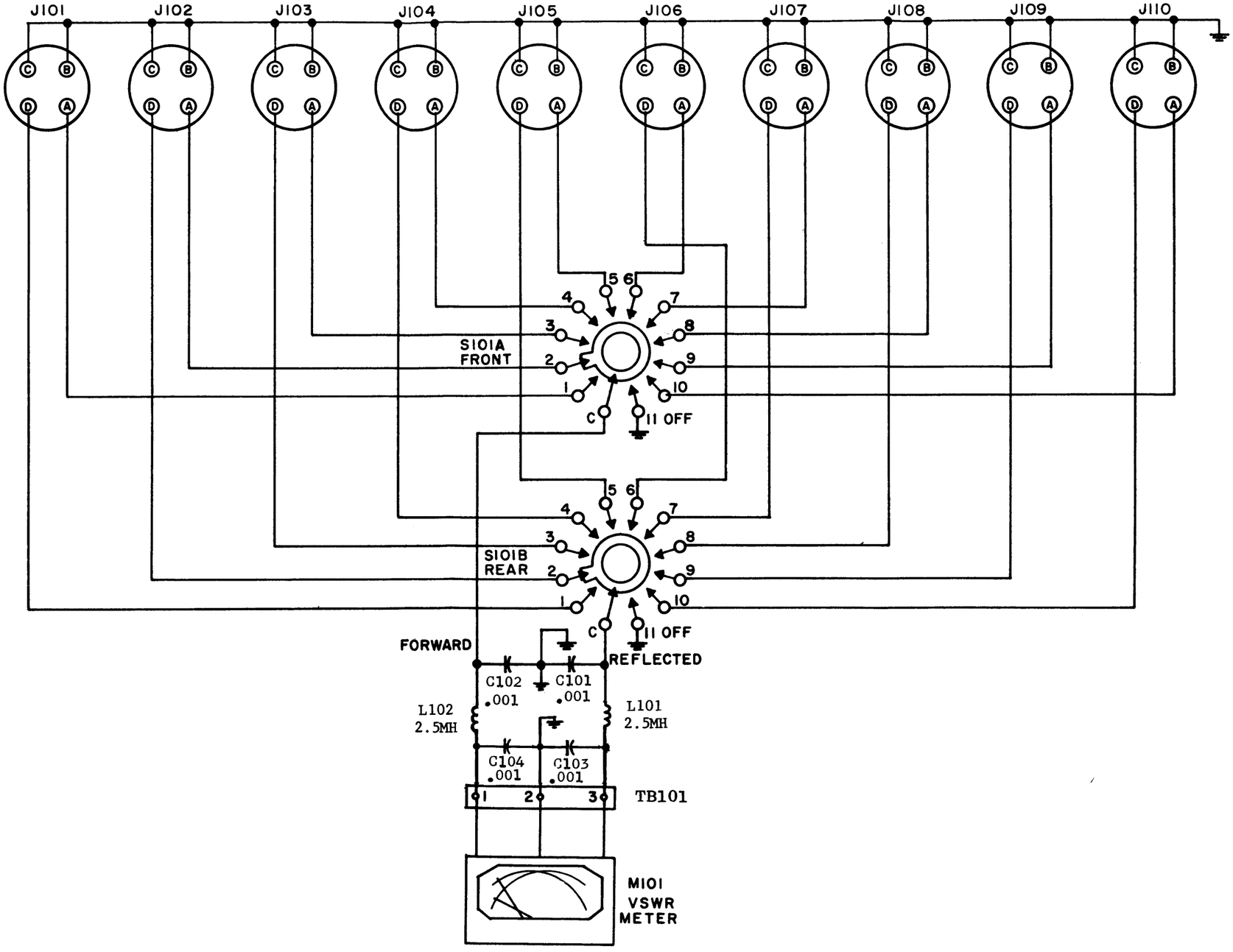
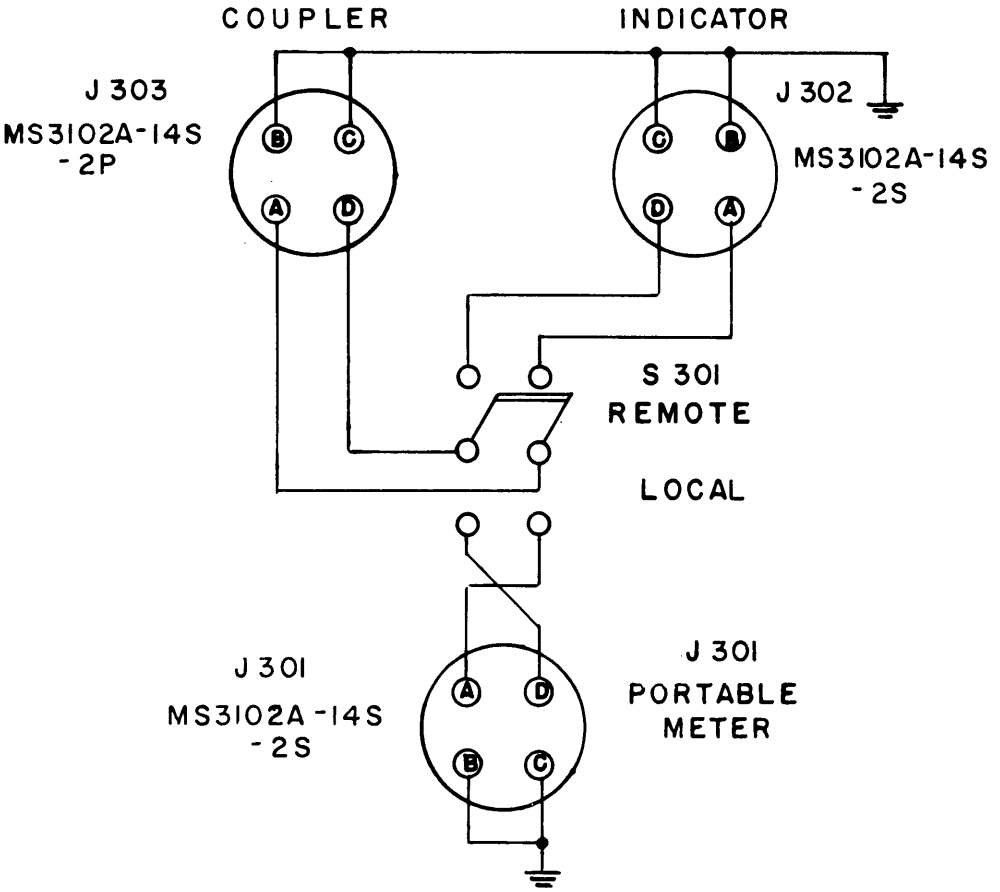
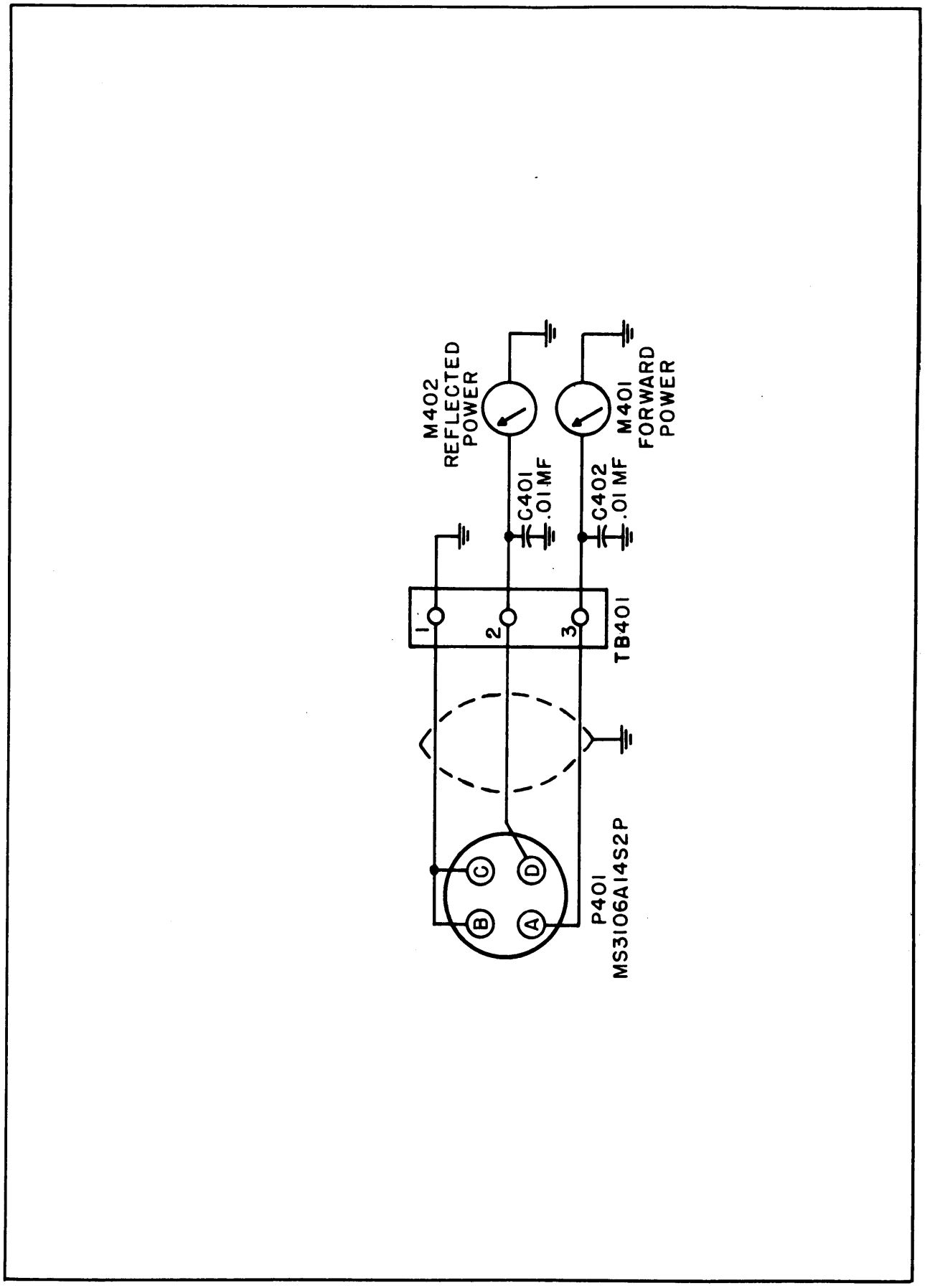


Figure 7-1. Model SWR-10K RM, Schematic Diagram



CK-363

Figure 7-2. Schematic Diagram, Model SWR-10K JB111



CK364

Figure 7-3. Schematic Diagram, Model SWR-10K PM