NAVSHIPS 91669

INSTRUCTION BOOK

for

FREQUENCY–POWER METER TS-230 C/AP

HYCON MFG. COMPANY
PASADENA 8, CALIFORNIA

KINGS ELECTRONICS CO., INC.
TUCKAHOE, NEW YORK

ELECTRO IMPULSE LABORATORY, INC.
RED BANK, NEW JERSEY

NAVY DEPARTMENT BUREAU OF SHIPS

Contract: NObsr 52598
Contract: NObsr 64254
Contract: NObsr 71876
Contract: NObsr 75541

Approved by BuShips: 6 May 1952
Change 1: 11 September 1956

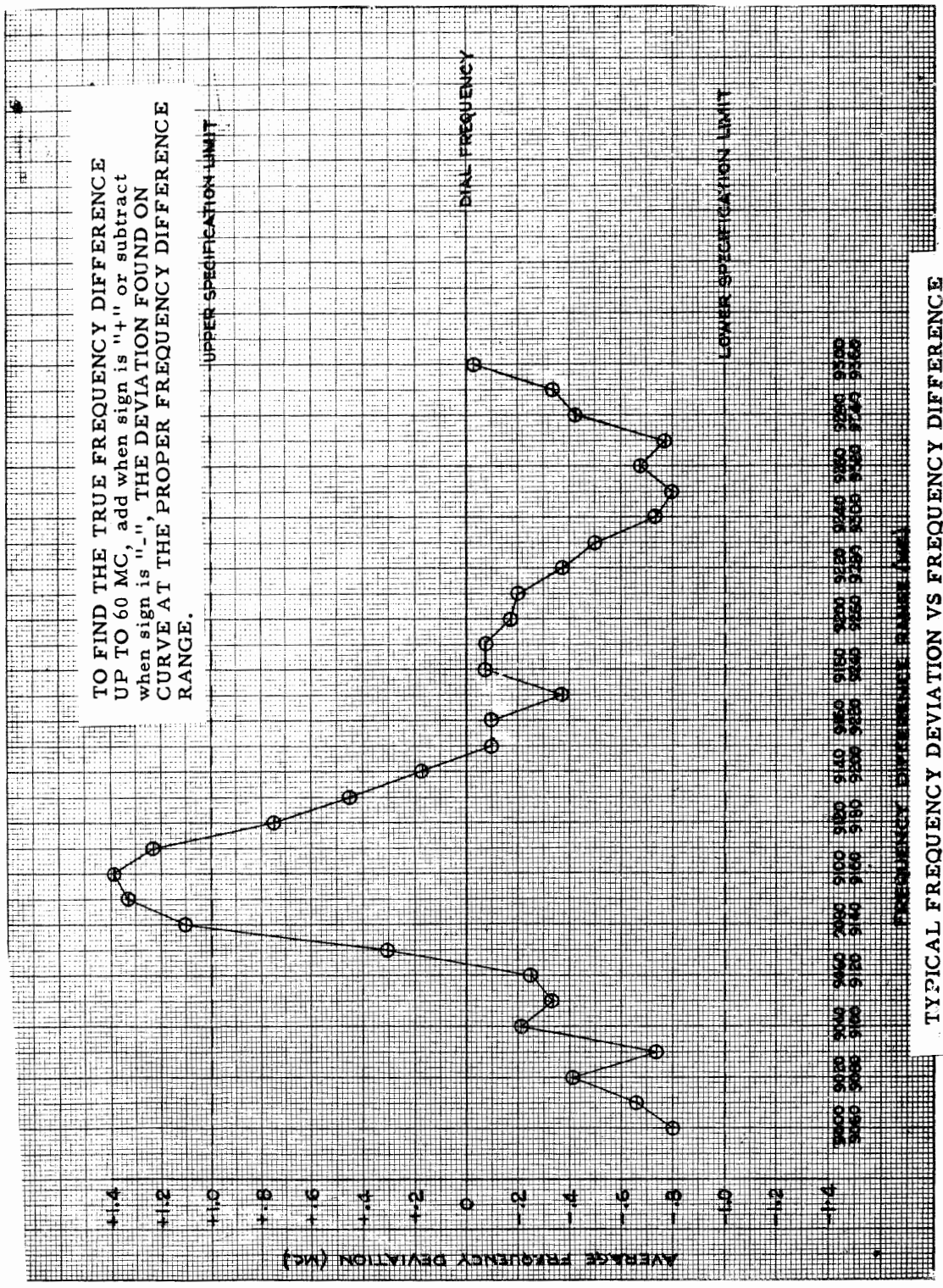
LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	1	4-1 to 4-3	Original
A	1	5-0 to 5-2	Original
B & C	Original	5-3	1
i	Original	5-4	Original
ii & iii	1	5-5	1
1-0 to 1-2	1	5-6	Original
1-3	Original	6-0A & 6-0	1
2-0 to 2-6	Original	6-1 to 6-5	Original
3-1	Original	6-6	1
3-2	1		

TEMPORARY CORRECTION T-1 TO INSTRUCTION BOOK FOR FREQUENCY-POWER METER TS-230C/AP NAVSHIPS 91669

This temporary correction is in effect upon receipt, and changes the Instruction Book to reflect the addition of a frequency correction curve, applicable to equipments supplied on Contracts NObsr - 71876, and NObsr 75541.

Insert this temporary correction in the instruction book immediately after the front cover.



TYPICAL FREQUENCY DEVIATION VS FREQUENCY DIFFERENCE RANGE FOR FREQUENCY-POWER METER TS-230C/AP.

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
6 May 1952

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Frequency-Power Meter TS-230C/AP NAVSHIPS 91669

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the Bureau of Ships Journal and in the Index of Bureau of Ships General and Electronics Publications, NAVSHIPS 250-020.

H. M. Wallin
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTY

The Contractor guarantees that at the time of delivery thereof the supplies provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of the contract. Notice of any such defect or non-conformance shall be given by the Government to the Contractor within one year of the delivery of the defective or non-conforming item. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective or non-conforming item or part thereof. When such correction or replacement requires transportation of the item or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guaranty shall then continue as to corrected or replacing supplies or, if only parts of such supplies are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guaranty is specified in the Schedule. If the Government does not require correction or replacement of a defective or non-conforming item, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the item as in equitable in the circumstances.

INSTALLATION RECORD

Contract Number NObsr-52598 Date of Contract, 15 June 1951

Contract Number NObsr-64254 Date of Contract, 28 June 1954

Contract Number NObsr-71876 Date of Contract, 26 June 1957

Serial Number of equipment .....

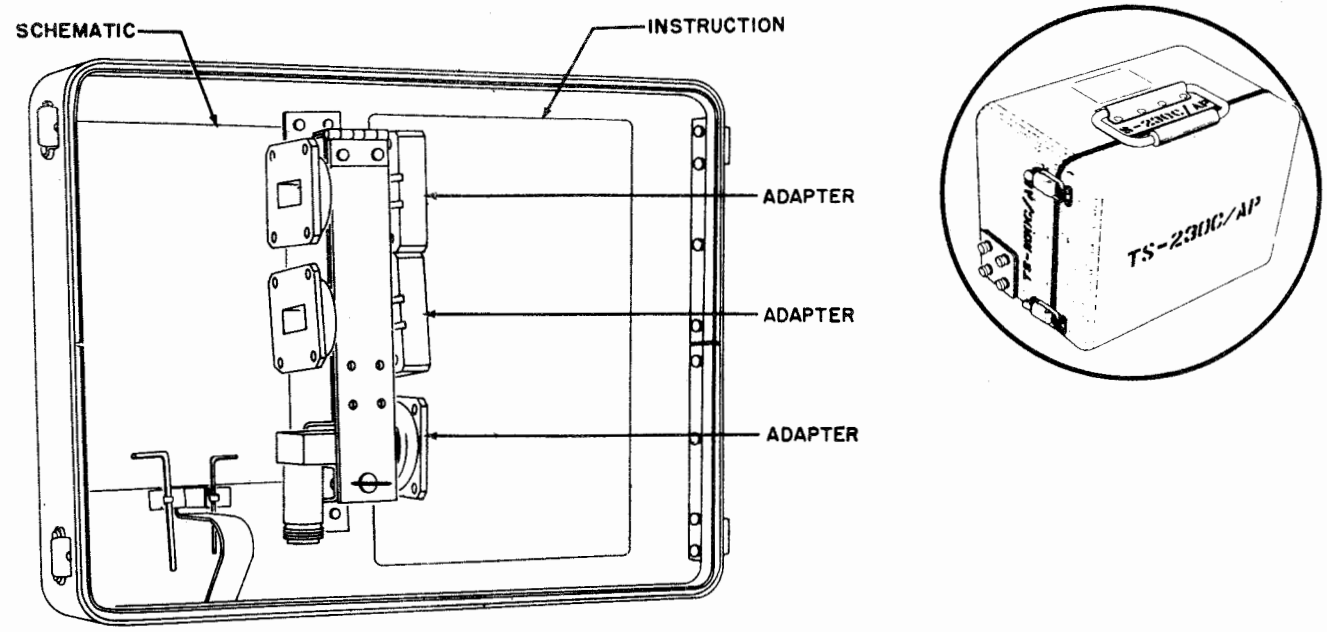
Date of Acceptance by the Navy .....

Date of delivery to contract destination .....

Date of completion of installation .....

Date placed in service .....

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.



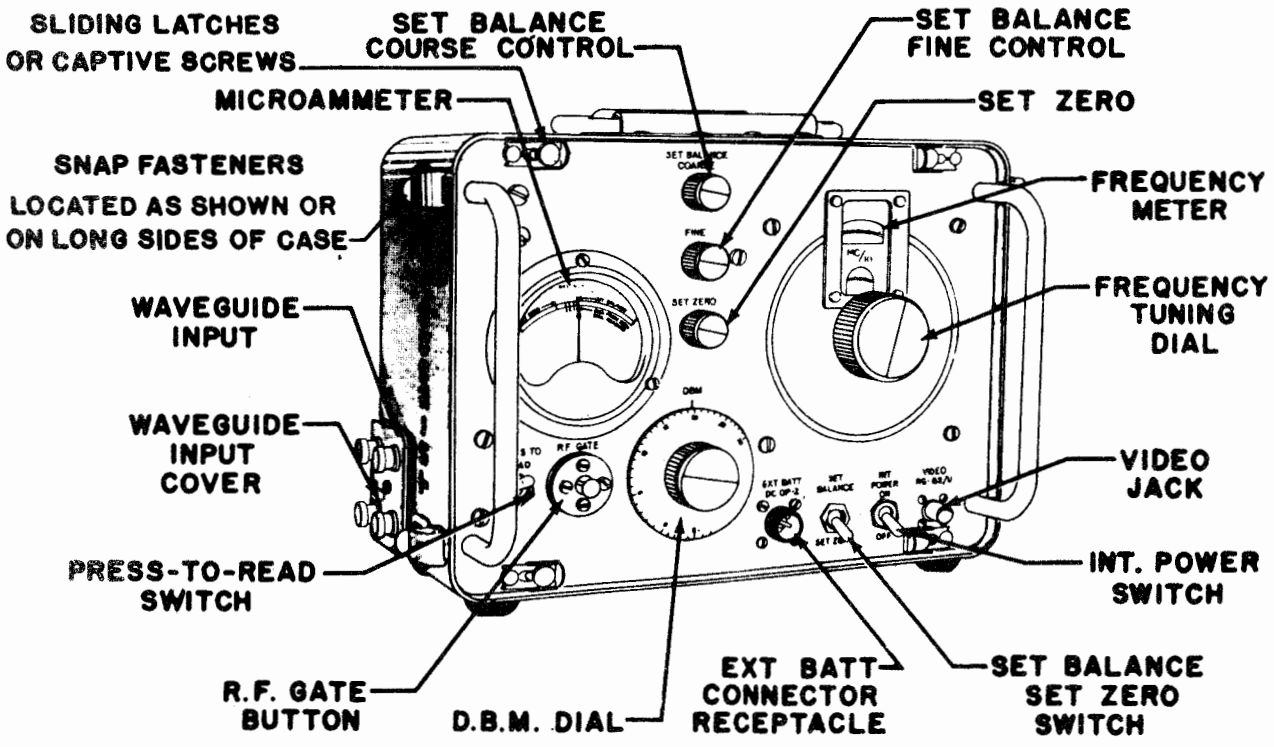


Figure 1-1. Frequency-Power Meter TS-230C/AP

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE AND BASIC PRINCIPLES. ***(See fig. 1-1.)***

The Frequency-Power Meter TS-230C/AP is a test set designed to measure the frequency of unmodulated and pulsed signals in the range from 8500 to 9700 megacycles and the average power in the range from 0.1 to 1000 milliwatts. It is suitable for use between temperatures of —40 and 55°C (—40 and 131°F).

The main functions of the Frequency-Power Meter TS-230C/AP are:

a. The meter is capable of measuring the AVERAGE POWER of either unmodulated or pulse-modulated signals within limits of 0.1 to 1000 milliwatts (—10 to +30 dbm) with an absolute accuracy of ±2 db between 0.1 and 1.0 milliwatts. On differences, the error is less than ±0.2 db.

b. The meter is capable of measuring the FREQUENCY of unmodulated and pulsed signals in the range from 8500 to 9700 megacycles with an absolute accuracy of ±4 megacycles at normal humidities. Relative accuracy is better than ±0.5 megacycle on frequency differences up to 60 megacycles. Resettability is less than 0.5 megacycle including backlash. The meter reads frequency directly (megacycles/10).

c. DC power supply only is required to operate the TS-230C/AP Frequency Power Meter. An internal battery is provided for normal operation. However, provision is made to connect an external power source for greater stability in continuous service.

d. The detector circuit may be used for observation of signals from the radar system. The resulting video pulses may be viewed on Oscilloscope TS-239/UP or TS-34/AP Series.

TABLE 1-1. REFERENCE DATA

SUBJECT	DESCRIPTION
Frequency-Power Meter	TS-230C/AP
Contract Number	NObsr 52598, 15 June 1951
Contractor	Hycon Mfg. Company, 2961 East Colorado St., Pasadena 8, Calif.
Cognizant Naval Inspector	Inspector of Naval Material, 1206 Santee St., Los Angeles, Calif.
Contract Number	NObsr-64254, 28 June 1954
Contractor	Kings Electronics Co., Inc., 40 Marbledale Rd., Tuckahoe, N.Y.
Cognizant Naval Inspector	Inspector of Naval Material, 250 Hudson St., New York 13, N.Y.
Contract Number	NObsr-71876, 26 June 1957
Contractor	Electro-Impulse Laboratory, Inc., 204 River St., Red Bank, New Jersey
Cognizant Naval Inspector	Inspector of Naval Material, Naval Industrial Reserve Shipyard, Building No. 3, Port Newark, Newark 5, New Jersey
Number of packages per complete shipment (including equipment spares)	One
Total cubical content (including equipment spares)	0.410 cu ft unpacked 2.94 cu ft packed
Total weight (including equipment spares)	18.25 lbs unpacked 22.0 lbs packed
Frequency Range	8500 to 9700 megacycles
Frequency-Measuring Accuracy	±4.0 megacycle absolute ±0.5 megacycle on frequency differences
Power-Measuring Range	0.1 to 1000 milliwatts (—10 to +30 dbm)
Power-Measuring Accuracy	±2 db, 0.1 to 1.0 mw ±2.5 db, 1.0 to 1000 mw
Ambient Temperature Range	—40 to +55°C (—40 to +131°F)
Maximum Input Power	1 watt average
Minimum Input Power	0.1 mw average
Power Source: Internal	6 volts DC, 4 Navy Type 19031 (Type C) (Army BA-30) dry cells
External	24-30 volts DC, 0.25 amp, 7.5 watts

TABLE 1-2. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NOMENCLATURE OR SYMBOL	OVERALL DIMENSIONS (inches)			VOLUME cu ft	WEIGHT Pounds
			Height	Width	Depth		
1	Frequency-Power Meter	TS-230C/AP	9-3/4	12-1/2	8	0.564	16.09
1	Instruction Book	NAVSHIPS 91669	9.0	11.5	0.25	0.04	1.10
1	Adapter, Waveguide	E-108	1-15/16	1-7/8	1-7/8	0.370	0.69
1	Adapter, Waveguide	E-107	2-1/8	2-11/32	1-5/8	0.460	0.78
1	Adapter, Waveguide	E-109	1-29/32	1-7/8	1-7/8	0.62	0.69
1	Wrench, Allen Key No. 4						
1	Wrench, Allen Key No. 8						

TABLE 1-3. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NOMENCLATURE OR SYMBOL	REQUIRED CHARACTERISTICS
1	Oscilloscope	TS-34/AP Series	
	or		
1	Oscilloscope	TS-239/UP Series	
4	Batteries	19031 (Type C)	

TABLE 1-4. SHIPPING DATA

SHIPPING BOX NO.	NAME	NOMENCLATURE	OVERALL DIMENSIONS (inches)			VOLUME cu ft	WEIGHT Pounds
			Height	Width	Depth		
1	Frequency-Power Meter Equipment	TS-230C/AP	16.5	15.5	20.5	2.94	22.0

2. DESCRIPTION.

The equipment is portable, enclosed in a two-piece water-tight metal box provided with rubber feet and a carrying handle on one side. The cover is secured to the lower part of the case with four snaplock fasteners. The control panel is secured into the lower part of the case by either four sliding latches or four captive screws.

Operating controls and switches are mounted on the top panel, or front of the instrument. (See figure 1-2.) A projection inside the cover prevents the attachment of the cover when the battery switch is in the "ON" position.

Incoming signals to be measured are introduced through the waveguide input flange located on the left side of case when facing the front of the instrument. Clamped inside the lid of the instrument case are three flange adapters to accommodate different types of connectors.

Frequency-Power Meter TS-230C/AP is similar to Frequency-Power Meters TS-230/AP and TS-230A/AP in function only.

3. PHYSICAL CHARACTERISTICS.

In considering cubic content and weight, the three TS-230's differ from one another. The approximate gross dimensions of the TS-230/AP are 6 x 10 x 12½ inches and its unpacked weight (including batteries) is 10½ pounds.

The TS-230A/AP has an unpacked cubic content of 0.69 cu. ft. and an unpacked weight (including equipment spares) of 18.7 pounds.

The TS-230A/AP has an unpacked cubic content of 0.564 cu. ft. and an unpacked weight (including equipment spares) of 18.25 pounds. Its gross dimensions are 12½ x 9¾ x 8 inches.

4. SIGNAL INPUT CONNECTION.

The signal input connection of the TS-230C/AP is an RG-52/U (1 x ½ inch) Waveguide. Three waveguide adapters are furnished with this unit. The microwave attenuator uses a nichrome-coated glass vane to obtain stable attenuation characteristics with frequency and temperature changes. The dial is direct reading in dbm of power.

The signal input connections of previous models of the TS-230 are RG-51/U (1½ x ⅝ inch), and use carbon-coated vanes in attenuators requiring separate calibration charts.

5. FREQUENCY METER.

The TS-230C/AP direct-reading frequency meter utilizes a high-Q cavity operating in the TE_{011} mode. The dial is calibrated in megacycles.

This differs from previous models of the TS-230()/AP which use coaxial type frequency meters with separate calibration charts.

6. R-F GATE.

The R-F Gate of the TS-230C/AP is a broad-band device which requires no adjustment to the particular operating frequency.

The R-F Gate of previous models of the TS-230()/AP is a narrow-band device which requires adjustment for significant changes in operating frequency.

7. CRYSTAL MOUNT.

The crystal mount of the TS-230C/AP is a broad-band type requiring no adjustment by the operator. Previous models of the TS-230()/AP require tuning adjustment by the operator.

8. THERMISTOR BRIDGE.

The thermistor bridge meter of the TS-230C/AP is directly calibrated in dbm of power so that the power reading is obtained by adding the meter reading to the calibrated attenuator reading. The bridge circuit is temperature-stabilized to reduce zero drift and facilitate measurement of low power levels. Previous models of the TS-230()/AP did not include this feature.

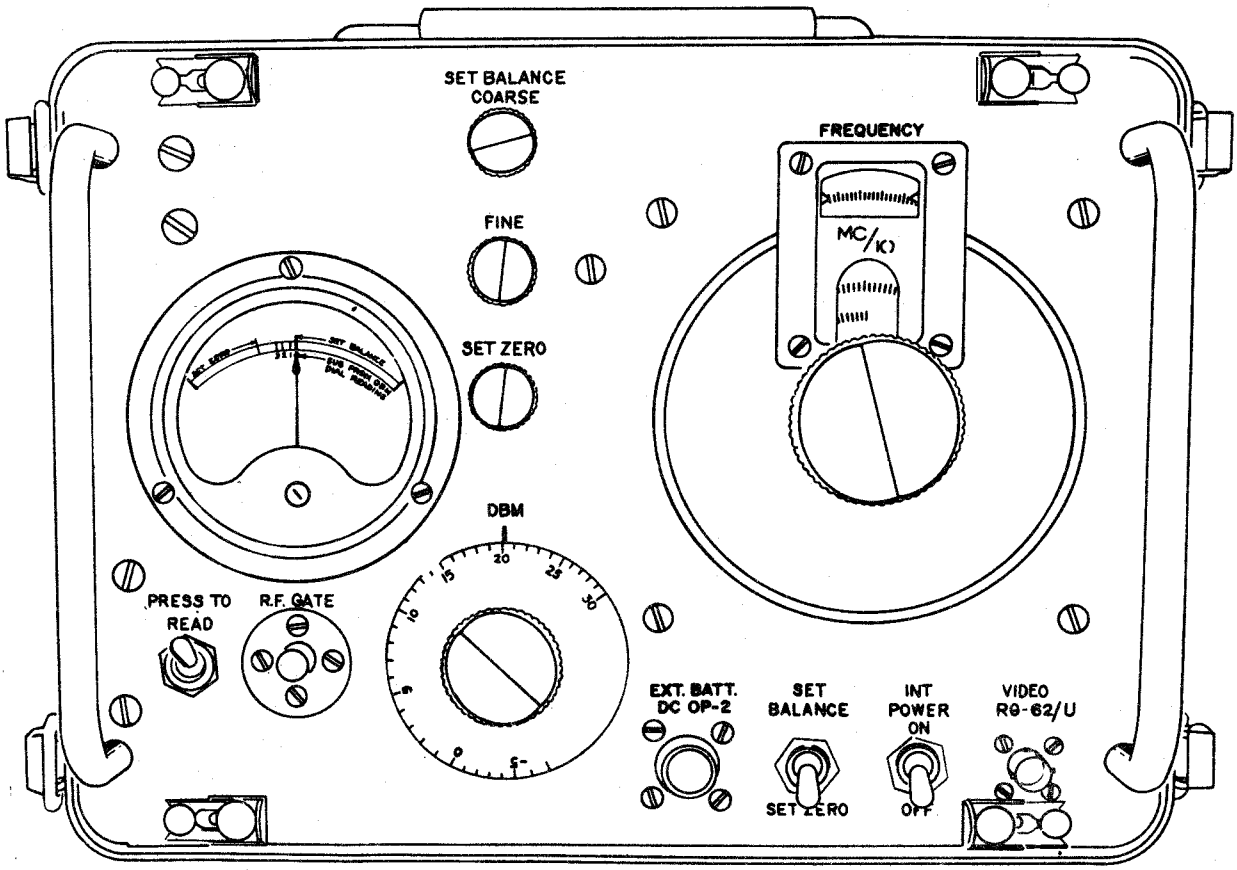


Figure 1-2. Control Panel

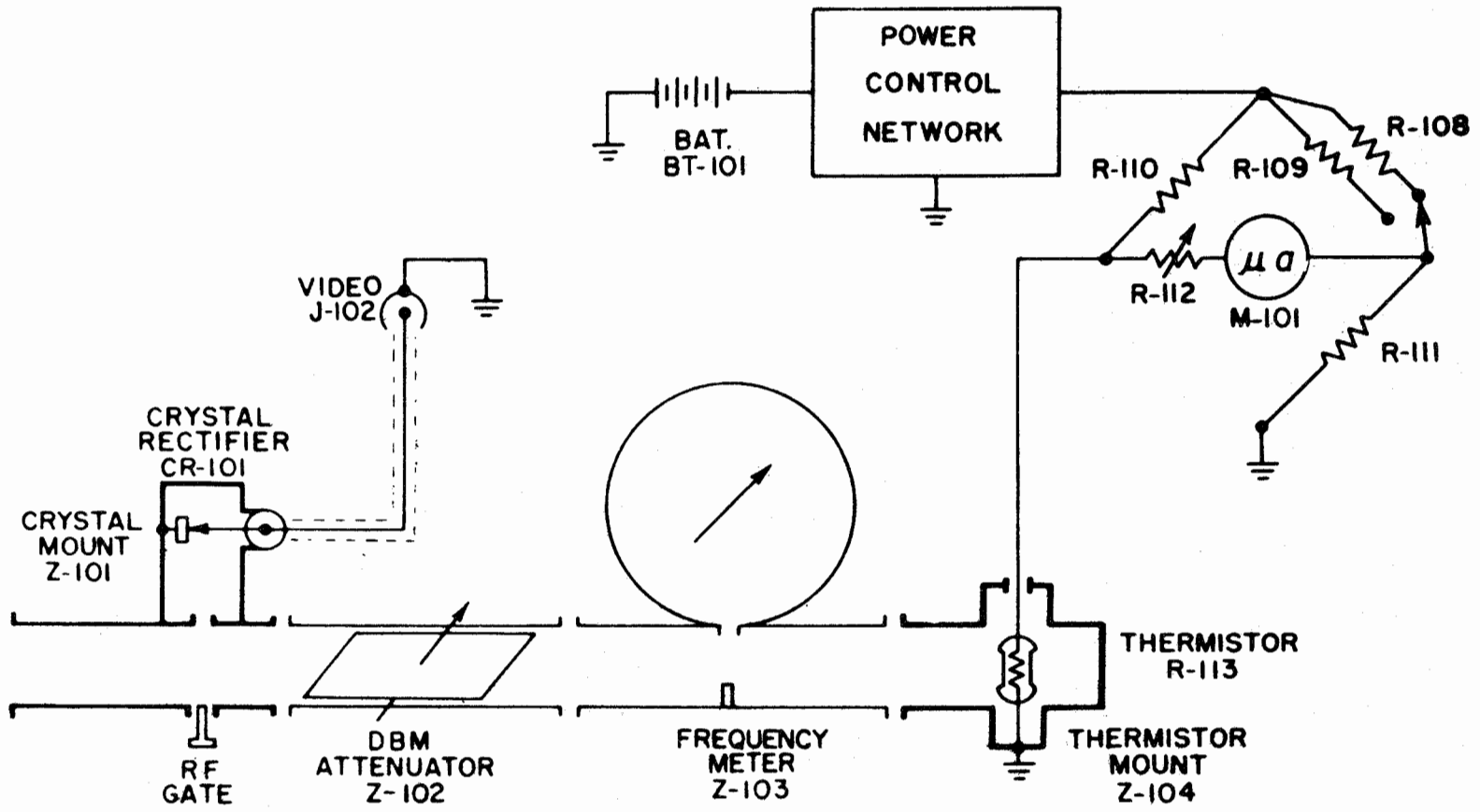


Figure 2-1. Functional Block Diagram

SECTION 2
THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS.

Frequency-Power Meter TS-230C/AP includes a waveguide-transmission path, calibrated attenuator, crystal detector, frequency meter, power meter, power-measuring circuit, and dry battery for power. These are shown in the schematic diagram, figure 5-4. The functional relation between parts is shown in the simplified block diagram, figure 2-1. The location of units is shown in figure 2-4.

2. CIRCUIT ANALYSIS.

a. THERMISTOR BRIDGE CIRCUIT.

(1) GENERAL. — The thermistor circuit is a Wheatstone bridge which reacts to changes in the resistance of a power sensitive resistor called a thermistor. The thermistor has a negative temperature coefficient of resistance; i.e., as the temperature is increased, the resistance decreases. The temperature, and therefore the resistance, of the thermistor is determined by the ambient temperature, by the current flowing through it, and by the absorbed power. If the current and ambient temperature are properly controlled, RF power can be determined by measuring the change in thermistor resistance caused by the applied power.

(2) BASIC BRIDGE CIRCUIT. *(See figure 2-3.)*— Two types of thermistors are used in the test set: a BEAD THERMISTOR used for power measurement; and a DISK THERMISTOR, used for temperature compensation.

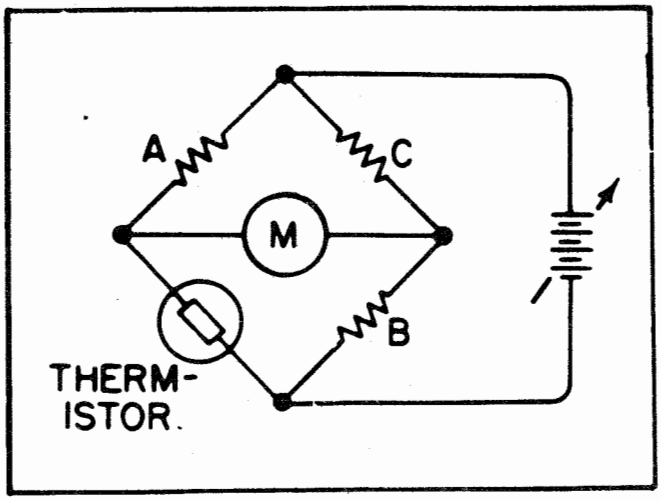


Figure 2-2. Simplified Thermistor Bridge Circuit

(a) The BEAD THERMISTOR is of small size and mass. Consequently, it is subject to the temperature variations as outlined in paragraph 2*a*(1) of Section 2. The DISK THERMISTOR, however, has a large mass. Therefore, its resistance is relatively independent of the current flowing through it but is dependent primarily on the ambient temperature.

(b) A simplified circuit of a thermistor bridge is shown in figure 2-2. The Wheatstone bridge consists of three resistors (A, B, and C) and the bead thermistor in its mount. When the Wheatstone bridge is balanced, no current flows through the meter.

(c) In the test set, the bridge is designed to balance when 0.1 milliwatt of RF power is applied to the bead thermistor. This is accomplished by adjusting the initial thermistor resistance so that, when 0.1 milliwatt of power is applied, its resistance decreases by the exact amount required to balance the bridge.

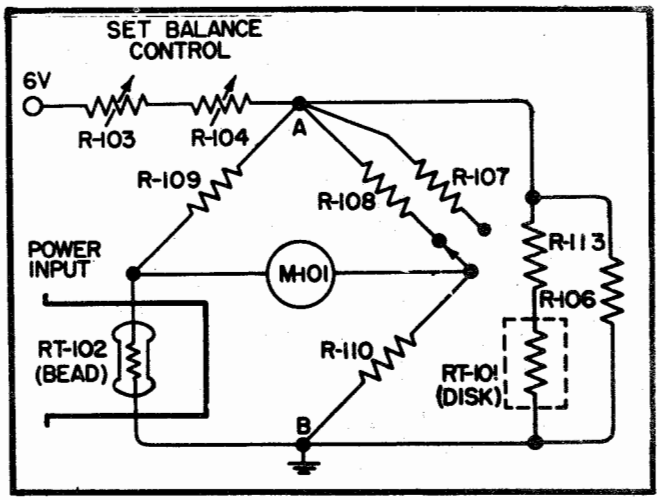


Figure 2-3. Basic Thermistor Bridge Circuit

(d) The initial setting of the thermistor resistance is obtained by switching resistor R-108 into the bridge and balancing the bridge. This is accomplished by adjusting the SET BALANCE potentiometers (R-103 and R-104). When resistance R-107 is then switched into the circuit, the bridge becomes unbalanced by the predetermined amount. (Refer to paragraph 2*a*(2)*(b)* of Section 2.) Calibration is accomplished by adjusting the SET ZERO control (R-112) to place the meter indicator at the SET ZERO point on the dial. The application of 0.1 milliwatt of RF power to the thermistor will then cause bridge to return to balance.

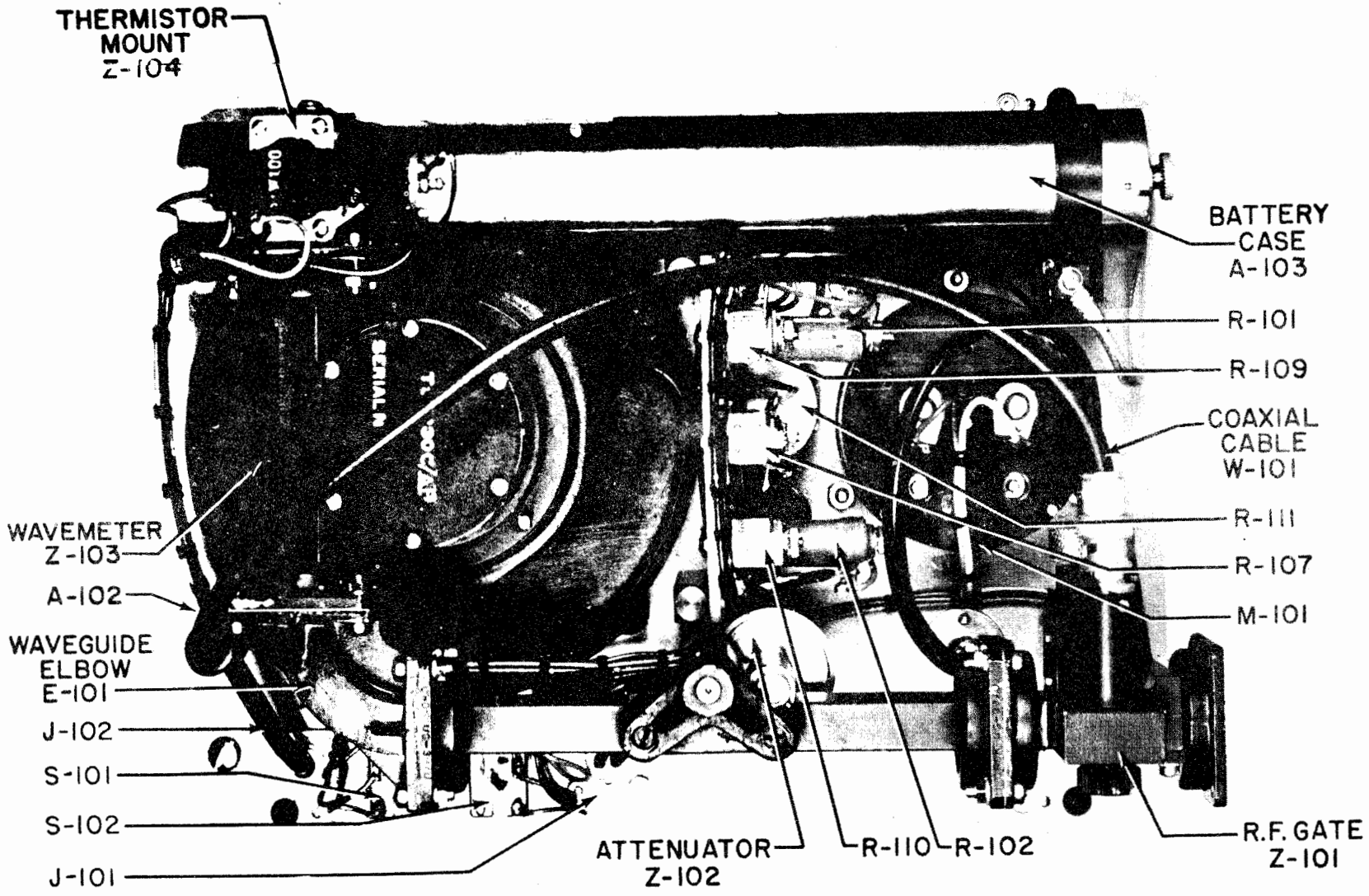


Figure 2-4. Rear of Control Panel

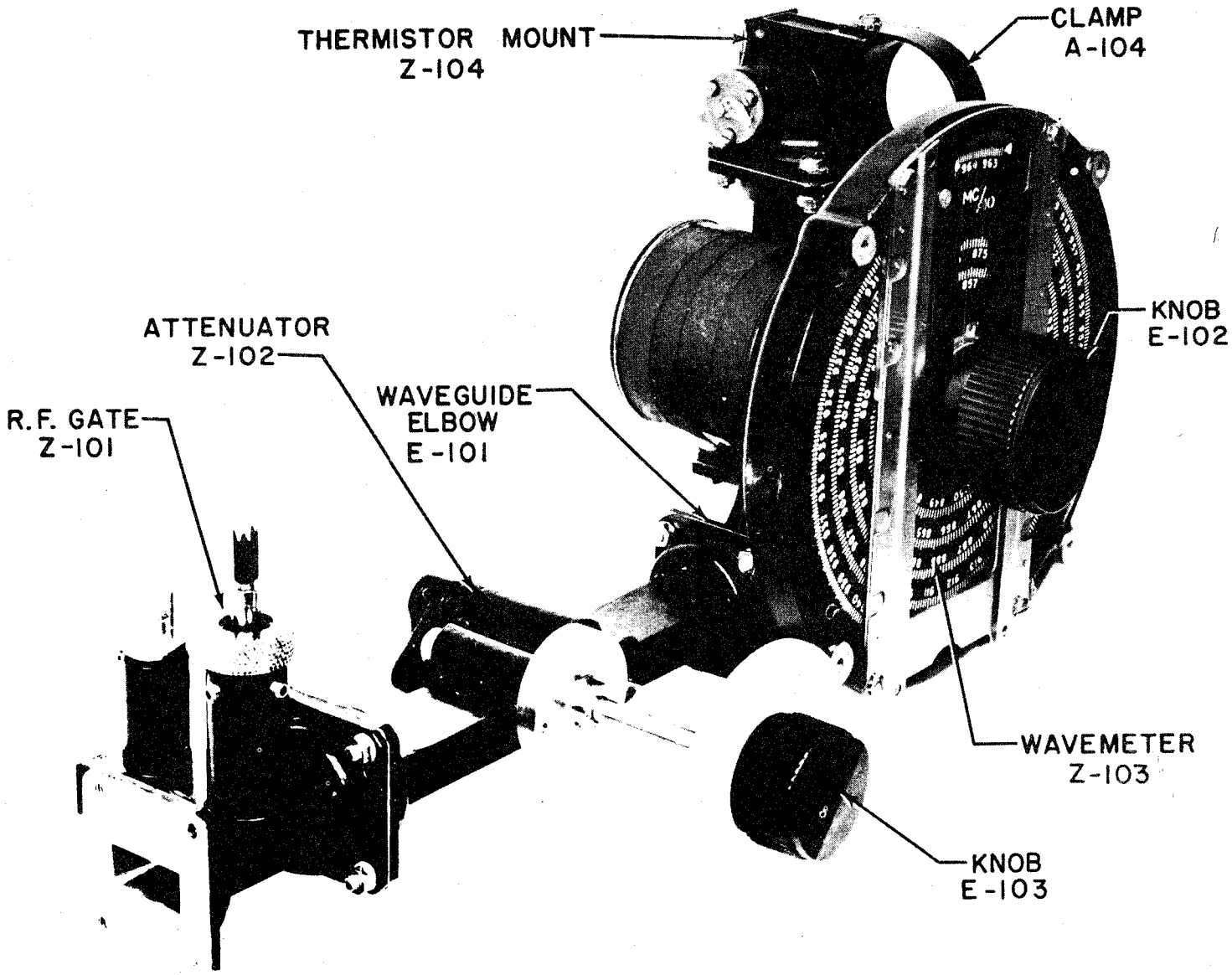


Figure 2-5. Microwave Circuit Assembly

(3) SENSITIVITY CORRECTION. *(See figure 2-3.)*

(a) The thermistor bridge shown in figure 2-3 increases in sensitivity with decrease in temperature. The sensitivity (ohms/watt) of the thermistor bead remains constant over a broad temperature range, but the bridge sensitivity (microamperes meter reading per milliwatts RF power) increases with decrease in temperature. As temperature decreases, the thermistor resistance tends to increase, making it necessary to apply a higher voltage to the bridge to balance it. This is effected by adjusting the SET BALANCE control (R-103, R-104). Because of this higher voltage, the change in current through the meter, due to a given change in thermistor resistance, is greater at lower temperature.

(b) To compensate for this variation in sensitivity, the meter resistance must be increased as the temperature decreases. This is accomplished by adjusting resistance (R-111) each time the bridge is put in operation, to attain uniform bridge sensitivity regardless of ambient temperature.

(4) ZERO DRIFT COMPENSATION.

(a) To obviate frequent resetting of the SET BALANCE control, automatic regulation increases the current through the bead thermistor when the temperature decreases. A disk thermistor whose resistance increases with decreasing temperature is connected in parallel with the bridge. (See figure 2-3.) Since more current flows through the bridge at lower temperature, the ratio of the shunting disk thermistor resistance to the resistance of the bridge (across points A and B) is greater at lower temperature.

(b) To effect compensation throughout the required temperature range, the disk thermistor is combined in a network with resistances R-105 and R-106. Compensation provided eliminates short-time drift which would otherwise impede measurements.

b. POWER SUPPLY CIRCUIT.

(1) This instrument can be operated with power supplied by either a 6-volt internal battery or a 24- to 30-volt external DC power source.

(2) For a short test at location remote from external power source, the internal battery is used. It comprises four 1½-volt standard Navy Type 19031 (Type C) (BA-30) cells connected in series and mounted in battery case. (See figure 2-4.) To energize the unit with internal battery, the INT POWER switch is thrown to "ON" position. An obstruction on the cover of the case prevents assembly of the cover on the instrument with this switch in the "ON" position.

Note

If internal battery is used for prolonged periods, its voltage decreases, necessitating frequent adjustments during test.

(3) When the instrument is used for prolonged tests, a 24- to 30-volt DC external power source should be used. With the INT POWER switch in "OFF" position, the external source should be connected to the EXT BATT jack. The applied voltage is reduced by a voltage divider (R-101 and R-102) to approximately 6 volts and is fed into the control circuit of the power-measuring bridge.

c. MICROWAVE CIRCUIT.

(1) GENERAL.

(a) Figure 2-5 shows the waveguide assembly. It includes five waveguide sections making up the waveguide circuit. These sections are:

1. RF Gate Subassembly (Z-101)
2. DBM Attenuator Subassembly (Z-102)
3. 'E' Plane Bend (E-101)
4. Frequency Meter Subassembly (Z-103)
5. Thermistor Mount Subassembly (Z-104)

CAUTION

None of these five components should be disassembled for repair or adjustments in the field. If servicing is required, the subassembly should be replaced as a unit.

(2) The RF energy source to be measured is coupled to the input flange (UG-39 U) which is located on the left side of lower section of the case. Three adapters, clamped inside the case cover, are provided to accommodate the following:

(a) Type N plug.
(b) 1¼ x ⅝-inch waveguide flange.
(c) 1¼ x ⅝-inch choke flange.

(3) The component assemblies of the RF waveguide assembly are connected by means of a gasket-flange joint. (See figure 2-5.) This type is used instead of the more familiar choke-flange joint commonly employed in most 3.2-cm band systems because of superior leakage characteristics. The gasket flange joint consists of two flanges between which is sandwiched a thin copper gasket of the same shape as the flange face. The joint is secured by four screws, one through each corner of the flanges and gasket.

d. RF GATE SUBASSEMBLY. *(See figure 2-6.)*—This subassembly includes the RF GATE and a SILICON RECTIFIER.

(1) RF GATE.—The RF GATE is used to check the zero balance without disturbing the attenuator setting. It is a plunger which introduces a high reactance in the waveguide. The depth to which the plunger travels is preset for optimum performance and should not be adjusted in the field.

(2) CRYSTAL MOUNT SUBASSEMBLY.—The CRYSTAL MOUNT proper is a section of waveguide housing a silicon rectifier and appended to the main waveguide circuit. A small percentage of the RF power is bled from the main waveguide through a small aperture and detected by the rectifier. The coupling coefficient is approximately 30 db (or 0.1%).

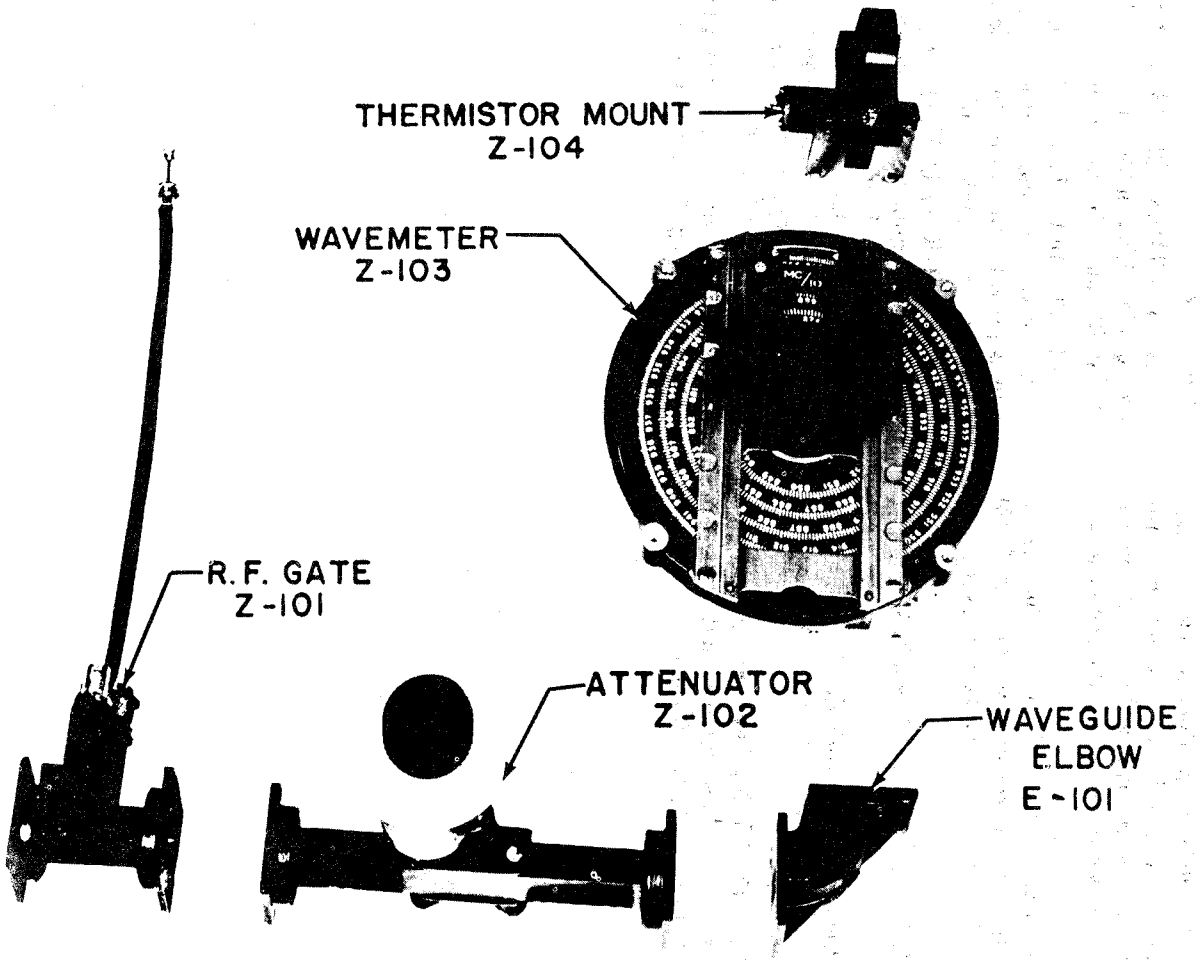


Figure 2-6. Microwave Circuit Assembly, Exploded View

e. DBM CALIBRATED ATTENUATOR SUBASSEMBLY. *(See figure 2-6.)*

(1) The DBM ATTENUATOR is a section of waveguide which encloses a movable rectangular glass vane coated with resistive material. The vane is mounted parallel to the electric field on two sliding rods which are used to adjust its position between the walls. The two rods are driven by a linear cylindrical cam operated by the DBM knob. Since the electric field increases from zero at the wall, to a maximum at the center of the guide, the loss caused by the attenuator increases as the vane is moved toward the center of the waveguide.

(2) When the attenuator is adjusted to the correct position to balance the thermistor bridge, the DBM dial indicates directly the test signal-power level at the RF receptacle.

f. FREQUENCY METER SUBASSEMBLY. *(See figure 2-6.)*

(1) This subassembly includes the FREQUENCY METER RESONATOR and dial together with a short section of waveguide.

(2) The FREQUENCY METER proper is a cylindrical cavity resonator whose length, and therefore volume, is adjusted by means of a plunger. A common aperture couples the cavity to the waveguide circuit. When the length of the cavity is adjusted to one-half wavelength the cavity resonates and presents low impedance at this aperture. As a result, some of the transmitted power is reflected by the cavity causing a decrease in the power level at the thermistor bridge.

g. THERMISTOR MOUNT SUBASSEMBLY. *(See figure 2-6.)*

(1) The THERMISTOR MOUNT is a section of waveguide which houses the THERMISTOR element of the thermistor bridge circuit.

(2) The BEAD THERMISTOR is mounted parallel to the voltage field in the waveguide. A matching stub is provided to match the section impedance to the connecting waveguide circuit.

(3) A DISK THERMISTOR for temperature compensation is mounted on the outside of the waveguide. This thermistor has a relatively large mass and its resistance is affected principally by the ambient temperature of the thermistor mount. The operation of the termistor bridge circuit is described in paragraphs 2*a*(1) and 2*a*(2) of Section 2.

(4) The thermistor mounts can be interchanged without affecting the accuracy of power measurements.

SECTION 3
INSTALLATION

1. UNPACKING. ***(See figure 3-1.)***

The equipment should be removed carefully from the packing case to avoid damaging the watertight metal housing and seals. Two instruction books are packed with the equipment.

2. INSTALLATION.

a. Frequency-Power Meter TS-230C/AP is a portable instrument and requires no permanent installation.

b. To prepare the instrument for operation it is necessary to install four Navy Type 19031 (Type C) (Army BA-30) dry cells, using the following procedure:

(1) Unfasten the four snap rasteners on the ends of the case and remove cover. (See figure 3-2.)

(2) Disengage the four sliding latches (see figure 3-2) located on the panel board at each corner.

(3) Grasp the handles (see figure 3-2) at either end of the panel board and carefully lift the chassis out of the case.

(4) Remove cap (see figure 2-4) from battery case.

(5) Insert four Navy Type 19031 (Type C) (Army BA-30) dry cells, terminal end first.

(6) Replace battery case cap and secure.

(7) Replace chassis case and secure the four sliding latches on the panel board.

3. INSTALLATION BEFORE OPERATING THE INSTRUMENT.

a. Adjust zero setting of microammeter if necessary.

b. Check each knob for backlash. Tighten set screws if necessary.

c. Turn the DBM dial clockwise until it is against the limit stop. In this position the dial reading should be —7. If this reading is not obtained in this position, loosen knob set-screw and remove knob. Loosen dial hub set-screws and rotate dial until reading is —7. Then tighten set-screws and replace knob.

d. Throw INT POWER switch to "ON" position. Check battery by turning SET BALANCE COARSE control, first clockwise then counterclockwise, and observing the deflections on the microammeter. If within its full excursion the SET BALANCE control does not produce full scale meter deflection to both right and left, the battery is not delivering sufficient voltage and all four dry cells should be replaced.

The procedure set forth above will indicate that the frequency-power meter is ready for operation. Operating instructions will be found in Section 4.

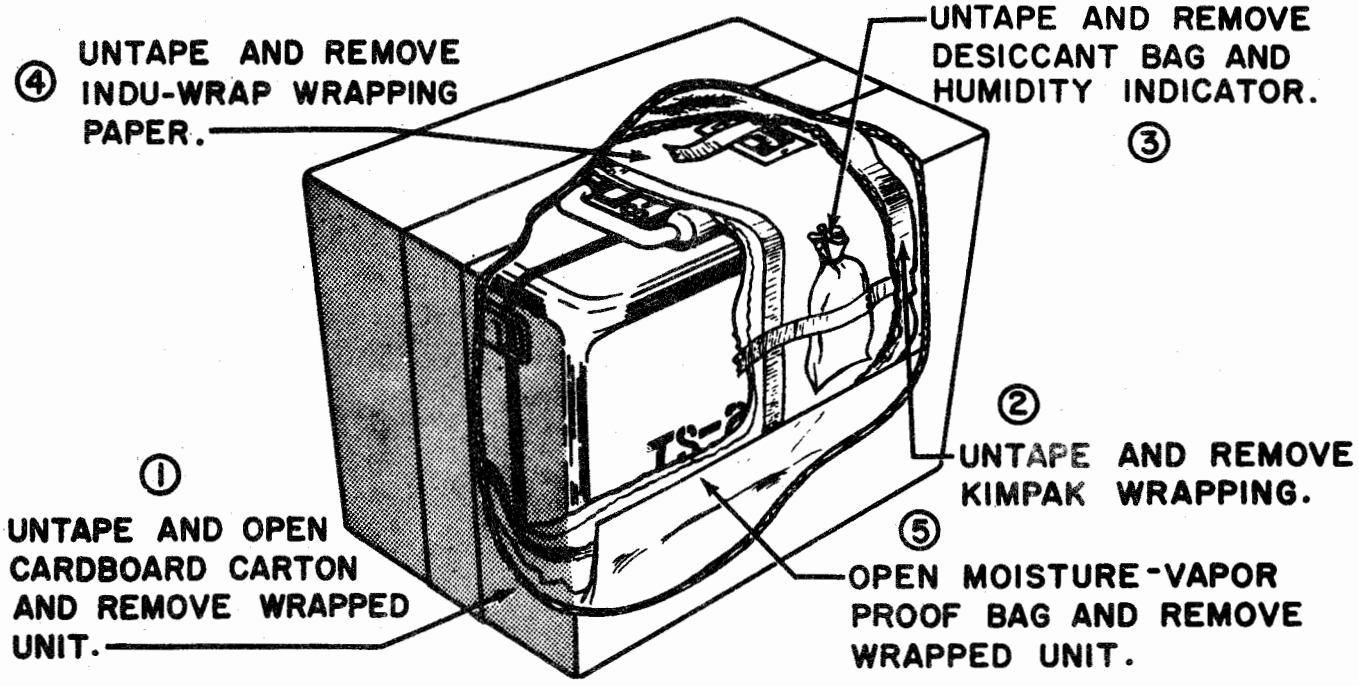


Figure 3-1. Unpacking Procedure

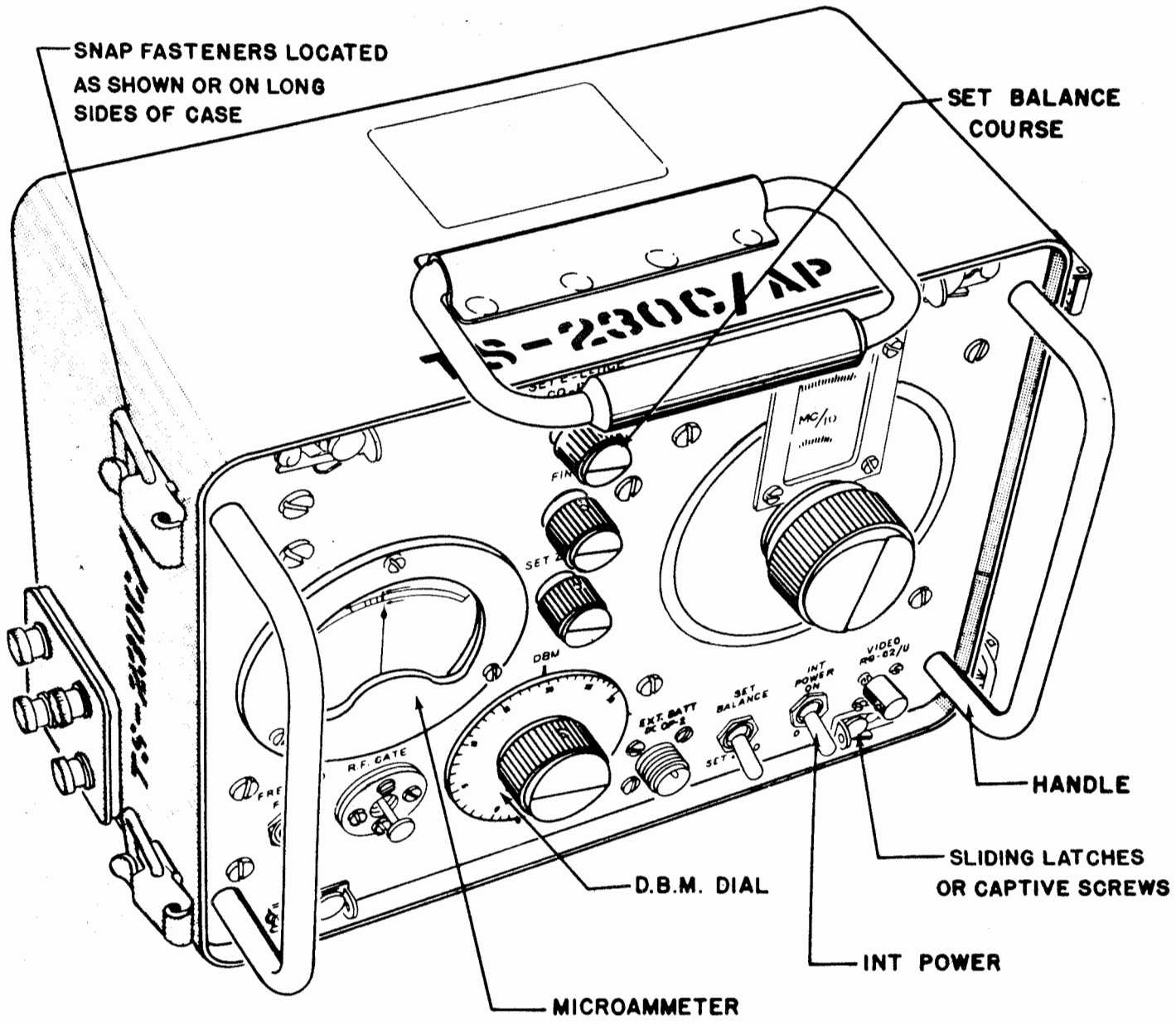


Figure 3-2. Frequency Power Meter TS-230C/AP, With Cover Removed

SECTION 4
OPERATION

WARNING

RF input to this instrument must not exceed one watt average power.

1. GENERAL.

a. Frequency-Power Meter TS-230C/AP is designed to measure unmodulated and pulsed signals in the frequency range of 8500 to 9700 megacycles and the average power range of 0.1 to 1000 milliwatts. It is suitable for use at any temperature from —40 to +55°C (—40 to +131°F).

b. It can be operated with power supplied by either a 6-volt internal battery or a 24- to 30-volt constant potential external DC power source. (Refer to paragraph 2*b* of Section 2.)

2. POWER MEASUREMENT.

To measure power, proceed as follows:

a. Set the "DBM" dial (lower center of panel) at its maximum position by turning it counterclockwise to its limit.

b. Connect the RF power source to the flange of the waveguide input (on left side of case). If necessary, use the appropriate adapter which is clamped inside the cover of the case.

c. To apply power to the instrument:

(1) When the INTERNAL BATTERY is to be used, throw the INT. POWER switch (lower right of panel) to the "ON" position.

(2) When an EXTERNAL DC POWER SOURCE is to be used, throw the INT. POWER switch to the "OFF" position and plug in the power leads from the external power supply to the EXT. BATT. connector receptacle (lower center of panel). The external source should be from 24 to 30 volts DC.

Note

When Power is turned on, meter pointer will "pin" momentarily. After a few seconds, calibration can be undertaken. To minimize bridge drift errors, allow 15 minutes "warm-up" time.

d. Throw the SET BALANCE—SET ZERO switch (lower right of panel) to the "SET BALANCE" position. Next adjust the SET BALANCE COARSE control (upper center of panel) until the microammeter (left center of panel) reads "SET BALANCE". Then depress the switch marked PRESS TO READ (lower left of panel) and use the FINE control (below SET BALANCE COARSE) for the final adjustment.

e. Throw the SET BALANCE—SET ZERO switch to the "SET ZERO" position. Then engage the PRESS TO READ switch and adjust the SET ZERO control (center of panel) until the microammeter reads "SET ZERO".

The bridge is now properly adjusted to obtain a power measurement. The PRESS TO READ switch must be depressed during each of the following steps.

f. Adjust the "DBM" dial until the microammeter reading is between zero and —3.

g. Vary the tuning of the FREQUENCY METER (right center of panel) slightly to make certain it is set out of frequency range of the signals to be measured.

h. Depress the RF GATE button and repeat the adjustments outlined in paragraph 2 (*d* and *e*) of Section 4 if the meter readings differ from those described in these paragraphs.

i. To make the POWER READING, release RF GATE button and repeat adjustment of paragraph 2*f*. The difference between the value of the DBM dial setting and that of the MICROAMMETER reading is the AVERAGE POWER in dbm. (Refer to paragraph 1*a* of Section 1.)

Note

If the microammeter reading is outside the zero to —3 range, either the RF power input exceeds an average of one watt, which is beyond the range of the instrument, or else an error has been made in the following instructions outlined in paragraphs 2*a* through 2*h* of Section 4.

3. FREQUENCY MEASUREMENT.

To measure frequency proceed as follows:

a. Set the "DBM" dial (lower center panel) at its maximum position by turning it counterclockwise to its limit.

b. Connect the RF power source to the flange of the waveguide input (on top of the case). If necessary, use the appropriate adapter which is clamped inside the cover of the case.

c. To apply power to the instrument:

(1) When the INTERNAL BATTERY is to be used, throw the INTERNAL POWER switch (lower right of panel) to the "ON" position.

(2) When an EXTERNAL DC POWER SOURCE is to be used, throw the INTERNAL POWER switch to the "OFF" position and plug in the lower leads from the external supply to the EXTERNAL BATTERY connector receptacle (lower center of panel).

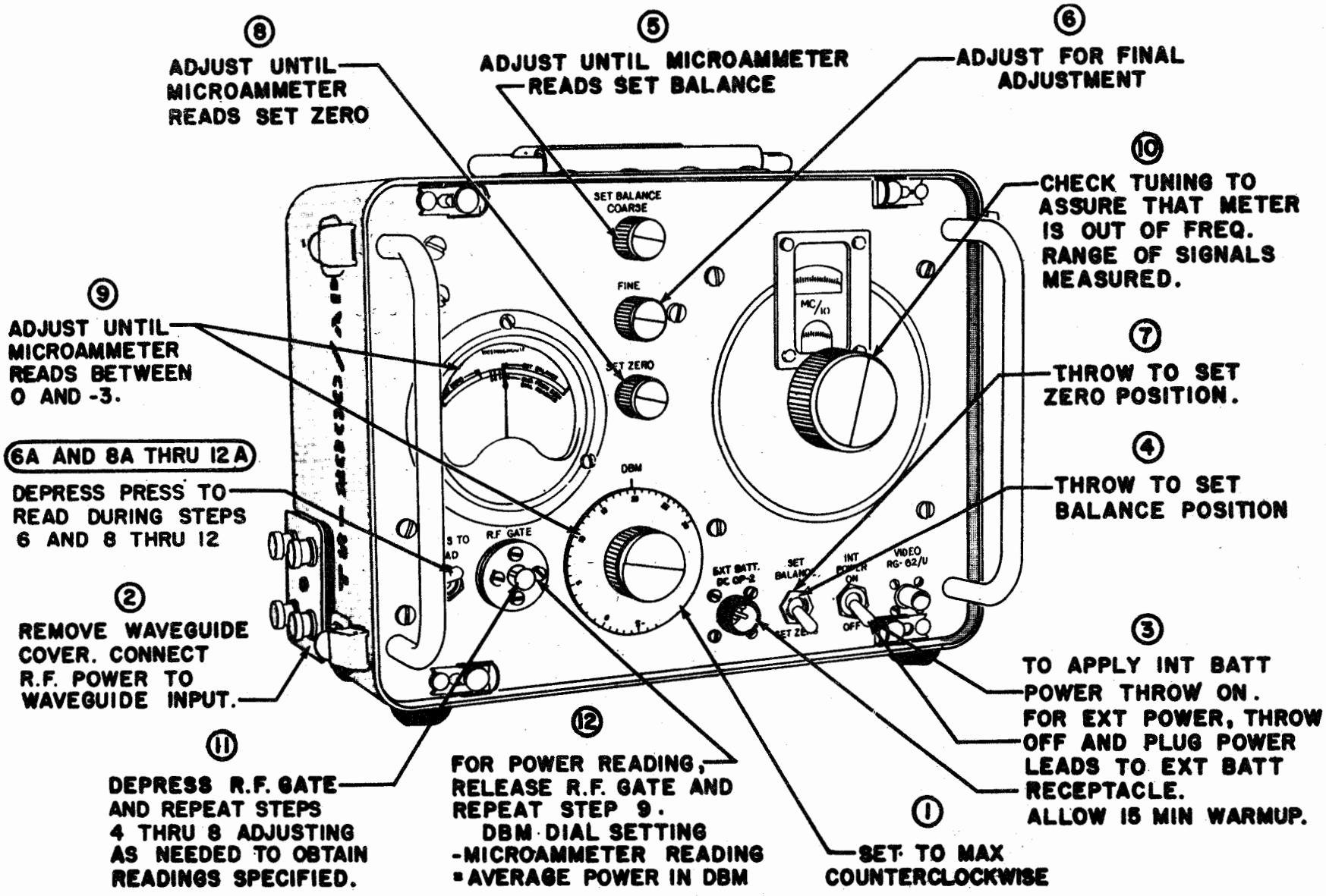


Figure 4-1. Frequency Power Meter—Power Measurement

Note

When power is turned on, meter pointer will "pin" momentarily. After a few seconds, calibration can be undertaken. To minimize bridge drift errors, allow 15 minutes "warm-up" time.

d. Throw the SET BALANCE—SET ZERO switch (lower right of panel) to the "SET BALANCE" position. Next, adjust the SET BALANCE COARSE control (upper center of panel) until the microammeter (left center of panel) reads "SET BALANCE". Then depress the switch marked "PRESS TO READ" (lower left of panel) and use the FINE control (below SET BALANCE COARSE) for the final adjustment.

e. Throw the SET BALANCE—SET ZERO switch to the "SET ZERO" position. Then engage the PRESS TO READ switch and adjust the SET ZERO control (center of panel) until the microammeter reads "SET ZERO".

The bridge is now properly adjusted to obtain a frequency measurement. The PRESS TO READ switch must be depressed during each of the following steps.

f. Adjust the "DBM" dial until the microammeter is between zero and 3.

g. Tune the FREQUENCY METER slowly until a reaction is observed on the meter.

h. The FREQUENCY is then read directly from the FREQUENCY METER SCALE at the setting which produces the maximum meter reaction. (Refer to paragraph 1*b* of Section 1.)

4. VIDEO.

Signals from the radar system can be observed by using an oscilloscope in conjunction with the detector circuit. To accomplish this use an Oscilloscope TS-239/UP or TS-34/AP series, or equivalent, connected to the VIDEO jack (lower right of panel) using a BNC male connector.

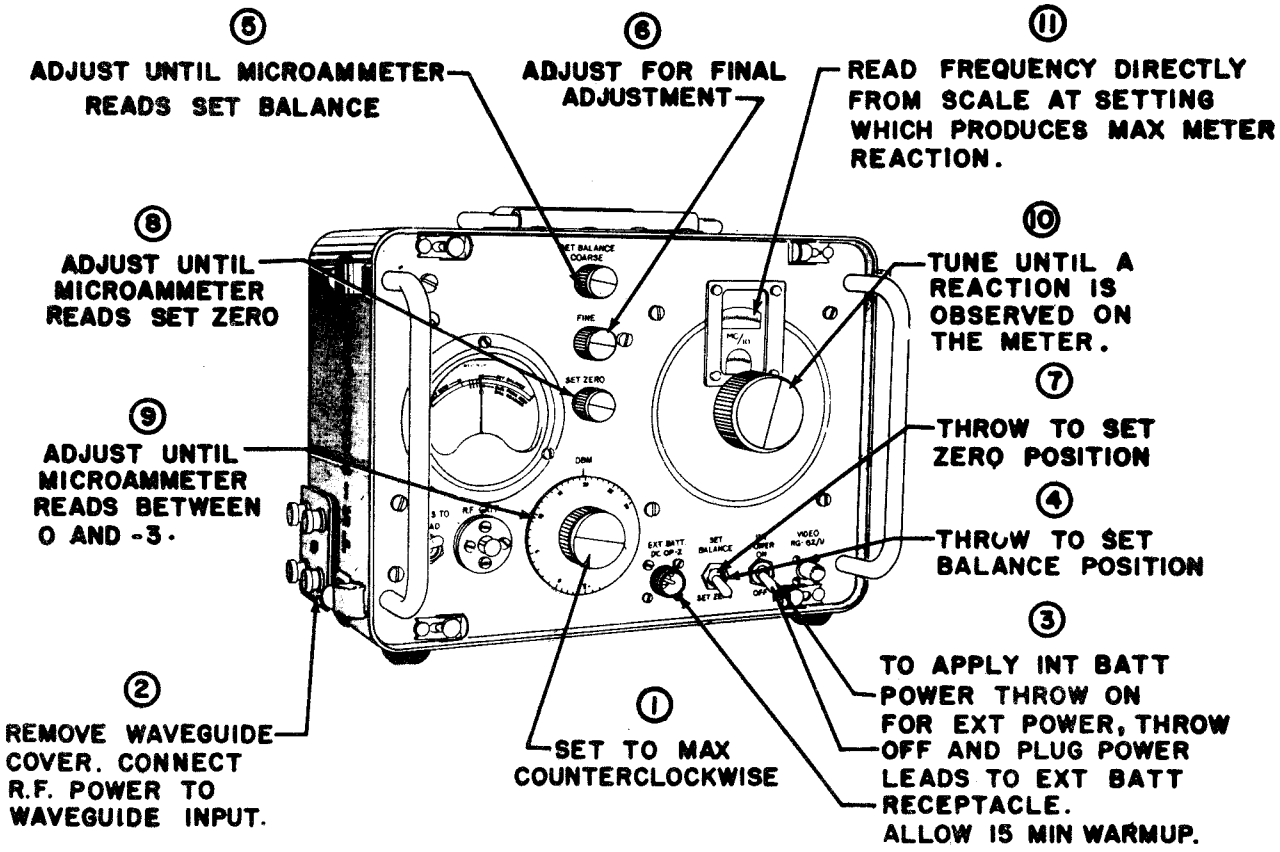


Figure 4-2. Frequency Power Meter—Frequency Measurement

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from any Electronics Officer.

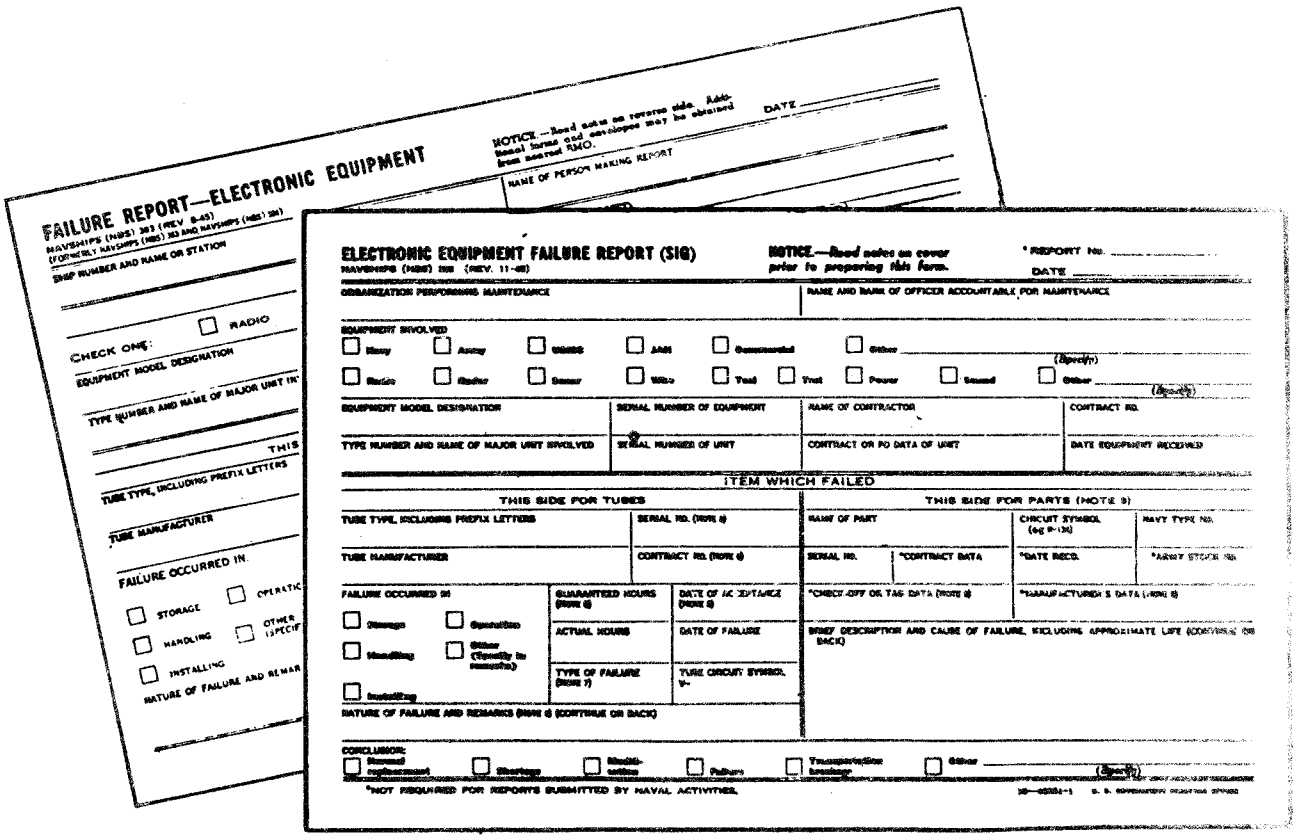


Figure 5-1. Failure Report, Sample Form

SECTION 5
MAINTENANCE

1. OPERATOR'S MAINTENANCE.

a. While the Frequency-Power Meter TS-230C/AP has been ruggedly constructed to withstand normal abuse encountered in the field, nevertheless it should be borne in mind that it is a highly accurate scientific instrument comprised of many delicate and sensitive parts. Consequently, it should be handled carefully and operated according to the instructions set forth in this manual.

b. Care should be exercised to conserve the life of the dry battery cells. When the equipment is not in use, the INT. POWER switch should be thrown to the "OFF" position. To protect the front panel assembly the cover should be fastened to the case when the instrument is not in use.

2. ROUTINE CHECKS.

a. BATTERY. Should calibration difficulty be encountered, it may be caused by exhausted battery cells. Check by depressing PRESS TO READ switch and turning SET BALANCE COARSE control, first clockwise then counterclockwise, and observing the deflections on the microammeter. If within its full excursion the SET BALANCE control does not produce full scale meter deflection to both right and left, all four dry cells should be replaced (Use four 1½-volt standard Navy Type 19031 (Type C) (BA-30) cells.

b. METER. With the power OFF, check microammeter for zero reading before making a test. Adjust if necessary.

c. KNOBS. Check each knob for backlash. Tighten set-screws if necessary.

d. DBM DIAL. Turn the DBM dial clockwise until it is against the limit stop. In this position the dial reading should be —7. If this reading is not obtained in this position, loosen knob set-screws and remove knob. Loosen dial hub set-screws and rotate dial until reading is —7. Then tighten set-screws and replace knob.

Note

Each DBM dial is uniquely calibrated for use with one attenuator assembly only. Dial and mated attenuator assembly carry the same serial numbers. Replacement of one necessitates replacement of its related component.

e. WATERTIGHT SEAL. Before fastening cover to the lower part of case inspect the watertight seal. If damaged, it should be replaced. Exercise care when placing cover on the lower part of the case to avoid damaging the watertight seal.

TABLE 5-1.
PREVENTIVE MAINTENANCE CHECK CHART

PART OR PARTS	POSSIBLE TROUBLE	HOW TO CHECK	REMEDY
1. Mechanical	Loose	Observation	Tighten
2. Mechanical	Damaged	Observation	Replace
3. Hardware	Loose	Observation	Tighten
4. Hardware	Damaged	Observation	Replace
5. Electrical	Defective Insulation	Observation	Replace
6. Moving Parts of Attenuator Assembly	Rod motion binds	Observation	Replace complete unit
7. Set-Screws on Knobs	Loose	Observation	Tighten to eliminate backlash
8. Battery	Incorrect voltage (exhausted)	Voltmeter (refer to paragraph 2*a*(1) of Section 2)	Replace all 4 cells
9. Waterproof Seal	Damaged	Observation	Replace

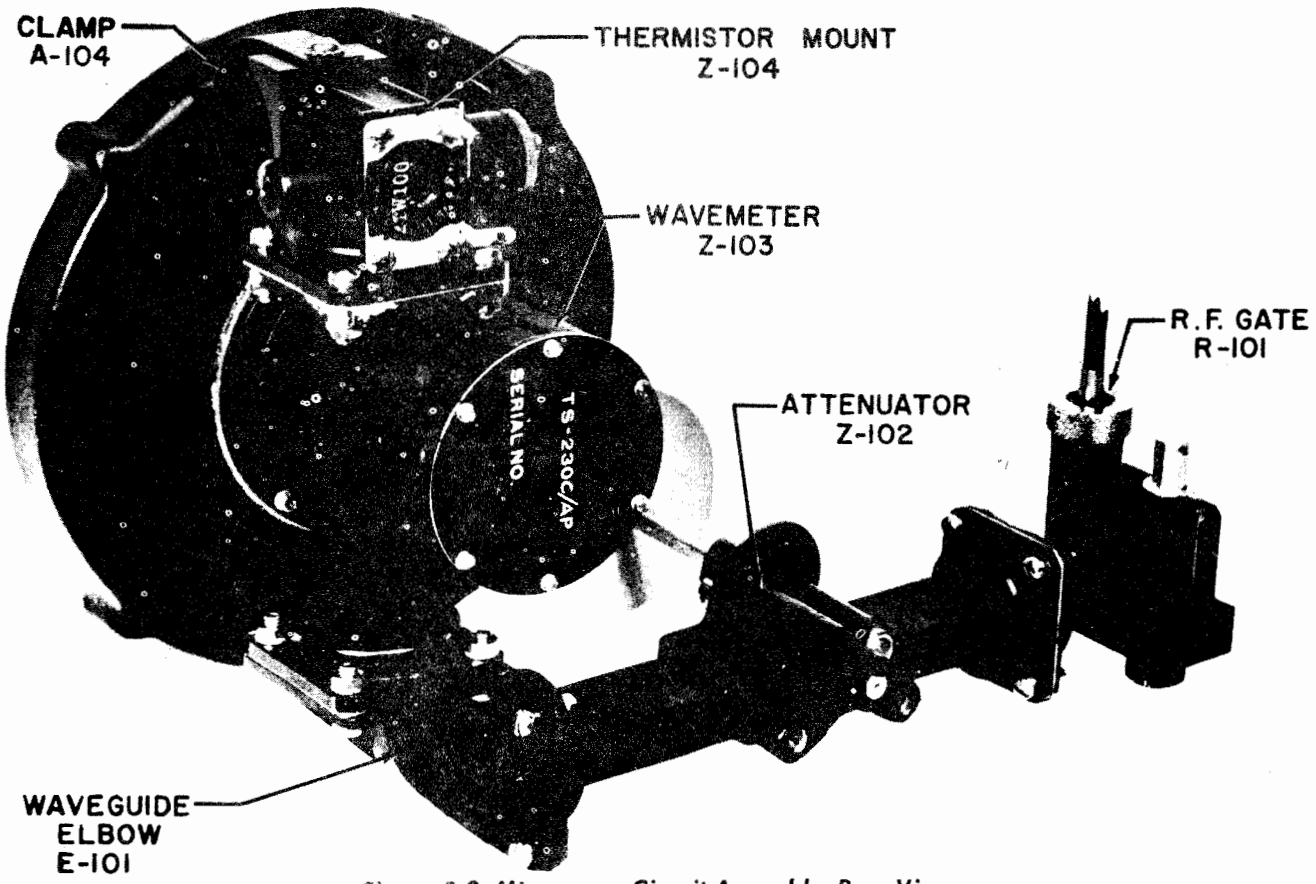


Figure 5-2. Microwave Circuit Assembly, Rear View

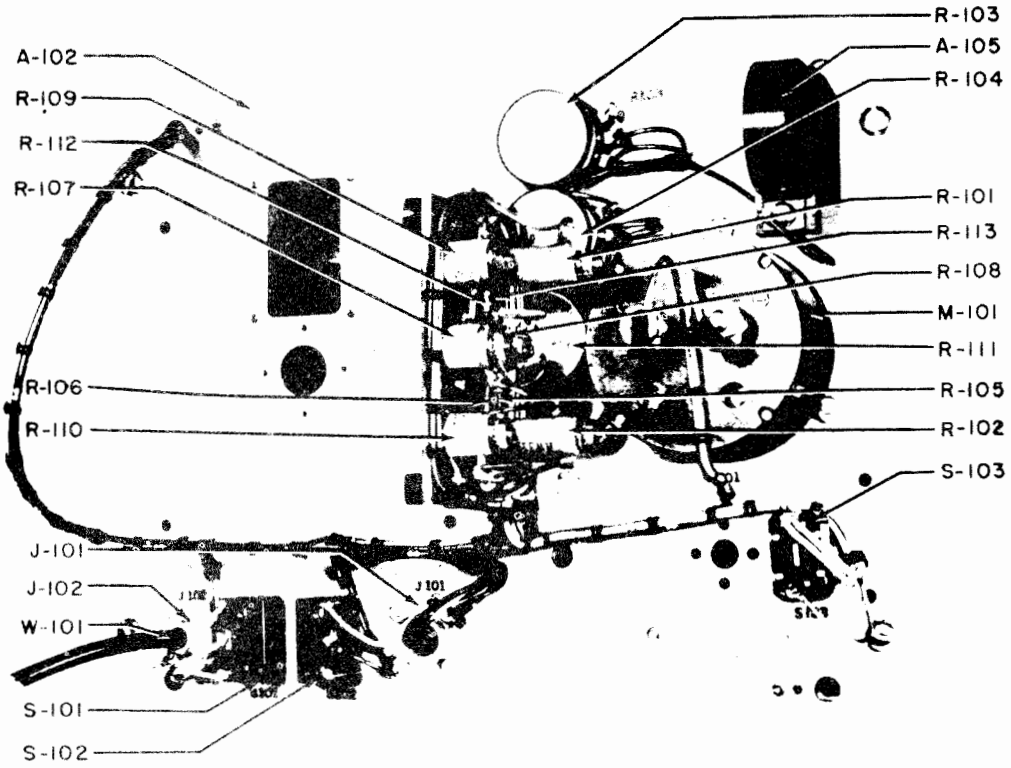


Figure 5-3. Rear View Panel with Microwave Assembly Removed

3. PREVENTIVE MAINTENANCE.

a. Frequency-Power Meter TS-230C/AP, under normal conditions, should give satisfactory service over long periods of time if it is used properly and handled carefully.

CAUTION

Since this is a pre-calibrated instrument, field maintenance should therefore be limited to trouble shooting in the electrical circuits and to replacement of complete assemblies in the microwave circuit. At all times field personnel must avoid disturbing the fixed adjustments of any calibrated assembly. If the calibration of any part is changed, the only practicable field procedure is to replace the entire assembly with a calibrated unit.

b. Equipment used infrequently should be inspected semi-annually. An instrument used frequently should be inspected monthly. Table 5-1 should be used as a guide when making these checks.

CAUTION

Due to manufacturing tolerances, the range of the frequency meter dial stop varies from instrument to instrument. Hence, there is a variation in the amount the frequency meter may be tuned beyond the specified range of from 8500 mc to 9700 mc.

Personnel are cautioned not to attempt to rotate the dial beyond the dial stops located at the extremities of the scale. Failure to comply with this suggestion may result in serious mechanical injury to the dial mechanism.

4. CORRECTIVE MAINTENANCE.

CAUTION

Do not use test equipment which will allow more than 20 milliamperes to pass through the thermistors.

When an ohmmeter is employed for circuit testing always use its highest resistance scale. Disconnect both terminals of the microammeter before testing circuits.

*The attenuator dial is calibrated in conjunction with the absolute sensitivity characteristic of the bead thermistor in the power mount. If unable to calibrate properly, it may be necessary to replace the attenuator and/or the dial. Recalibration facilities in the 8.5 to 9.7 kmc frequency range with power at known levels of ± 1.0 db or better from -10 to 30 dbm are required to accomplish this. If recalibration facilities are not available, replace all three parts as a matched set. Stock numbering data for ordering a matched set appears in Section 6.

The Frequency-Power Meter TS-230C/AP should require very little servicing. The most probable causes of trouble, together with their remedies, are listed in Table 5-1, Maintenance Check Chart, and Table 5-2, Trouble Shooting Chart.

TABLE 5-2.
TROUBLE SHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Full scale deflection of microammeter not obtained in either direction	Weak battery Defective "PRESS TO READ" switch	Replace all 4 cells Replace switch
2. Microammeter does not deflect	Battery dead R-103, R-104, R-105, R-111, or R-112 open Meter M-101 open or damaged	Replace all 4 cells Replace open resistor Replace M-101
3. Microammeter needle "pins" and will not balance after warmup	R-107, R-108, R-109, R-110, or RT-102 open	Replace open resistor
4. Batteries exhaust rapidly and drift is excessive	RT-101 shorted	Replace RT-101 (disk thermistor)
5. Bridge will not balance when external power source is used	R-101 or R-102 open	Replace open resistor
6. Excessive drift	R-113 or RT-101 open	Replace R-113 or RT-101
7. Set-zero and set-balance settings cannot be repeated	S-102 has faulty contact	Replace S-102
8. Low-video output	1N23A crystal has low back resistance	Replace CR-101
9. Erratic power readings	Damaged vane in attenuator	Replace attenuator assembly, dial, and thermistor mount. * See CAUTION, para. 4 above.

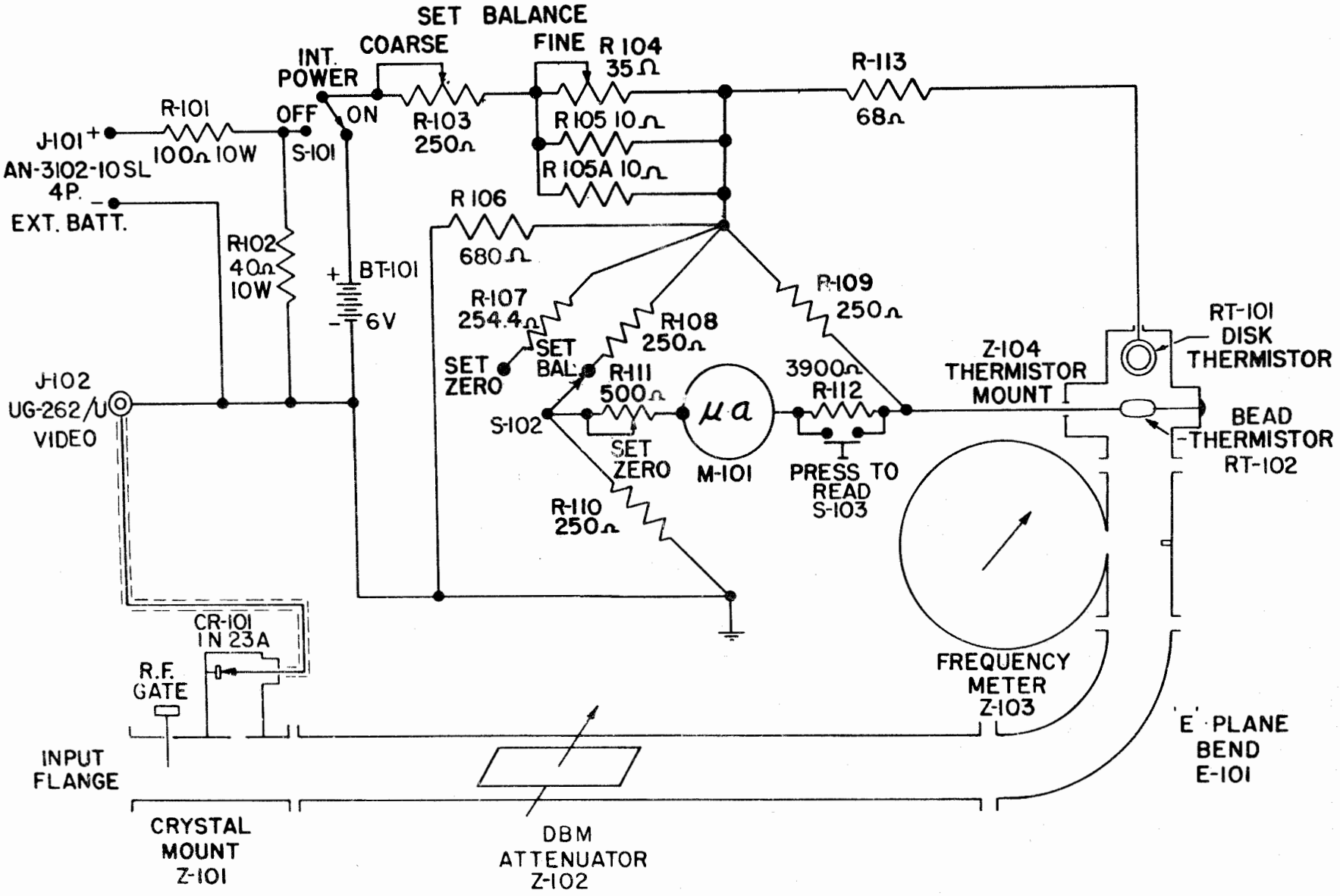


Figure 5-3. Schematic Diagram, Wiring Diagram

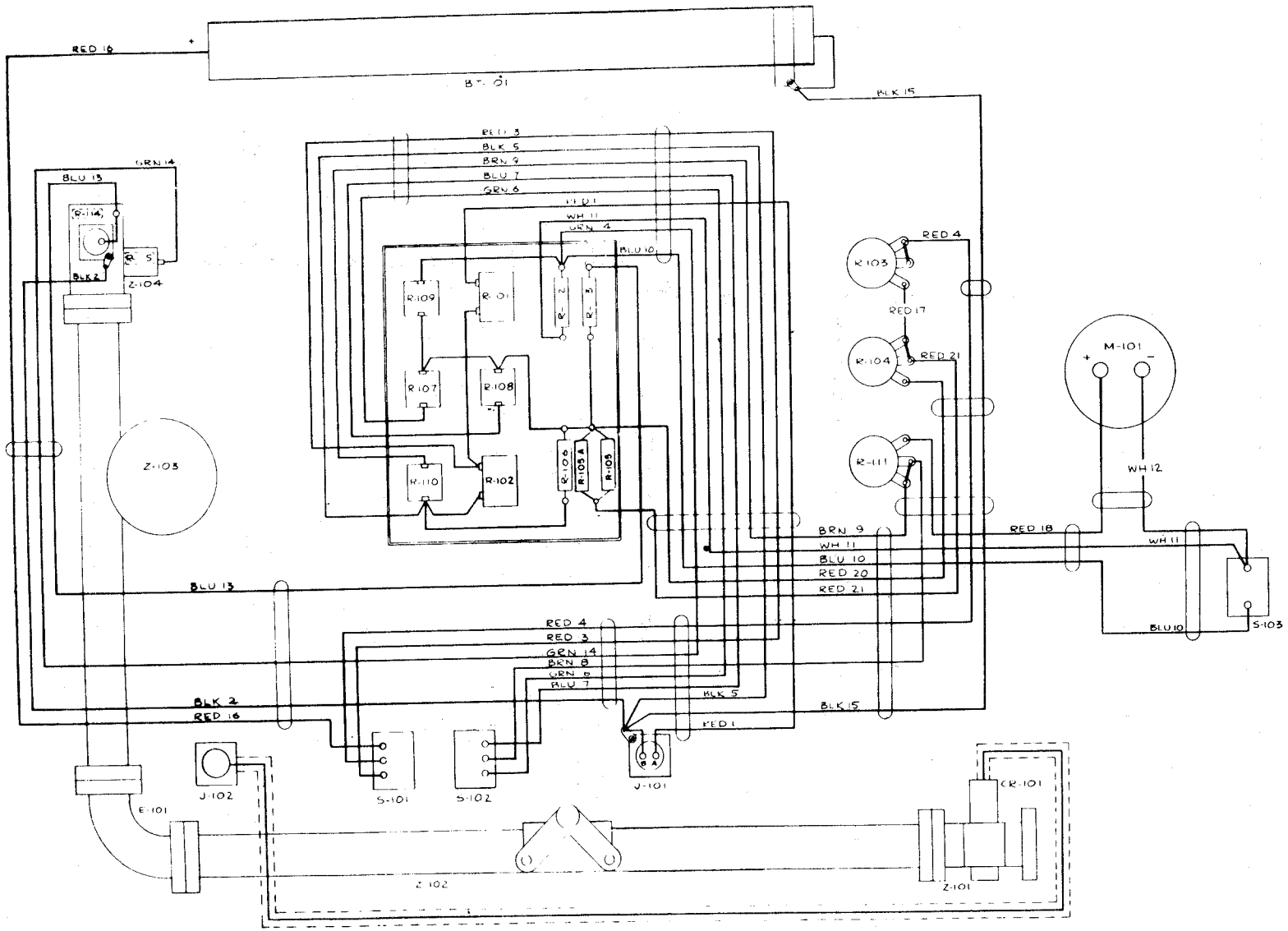


Figure 5-5. Wiring Diagram For Units Under Contract NObsr 52598

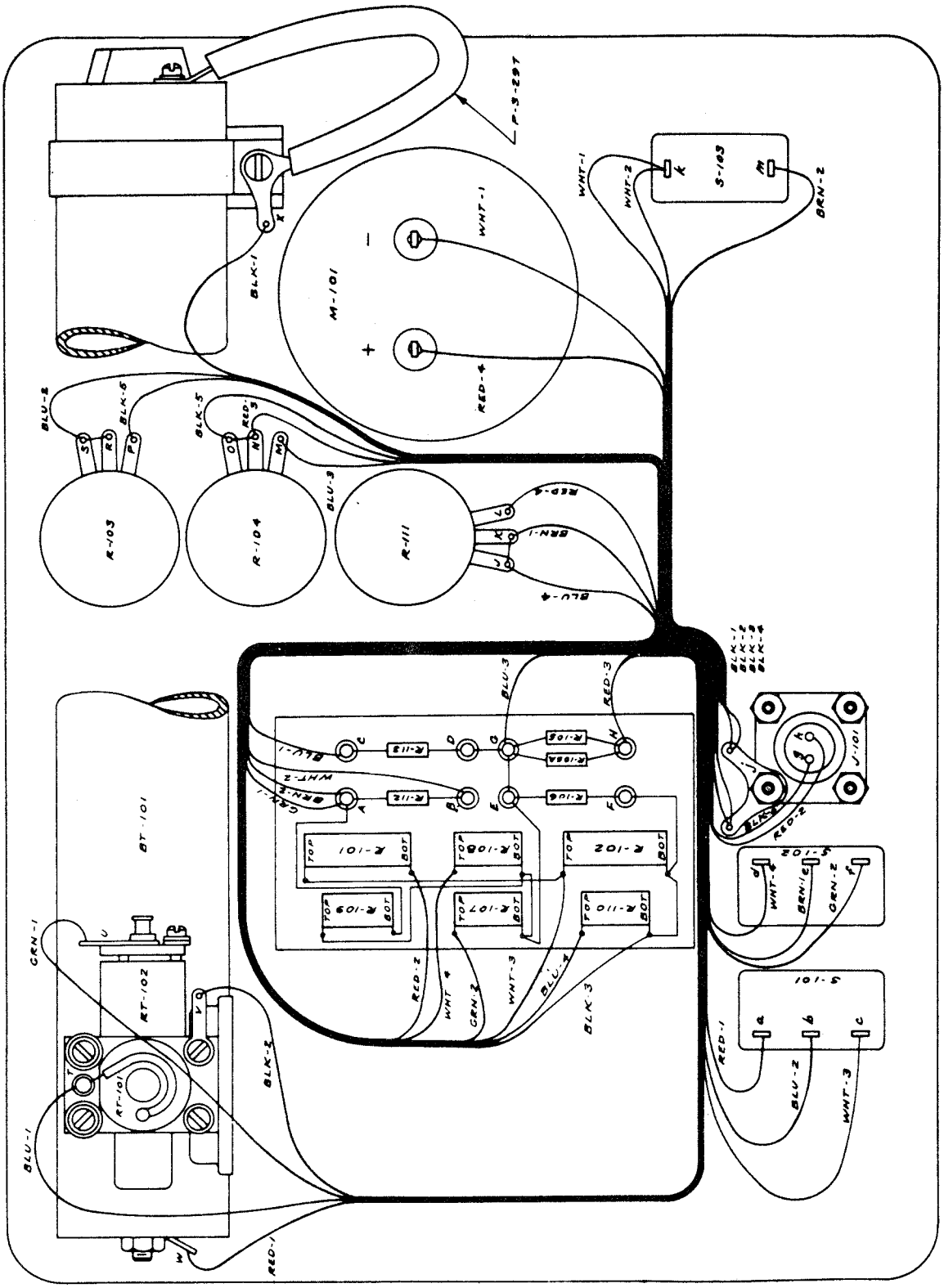


Figure 5-5A. Wiring Diagram For Units Under Contract NObsr 64254

SECTION 6
PARTS LIST

The parts list section has been corrected by means of the following supplementary tables. Always refer to the appropriate supplementary table for a given item first as it completely superseded any corresponding listing in the basic table. If no information is shown for a given item then refer to the basic table for the required information.

SECTION 6
PARTS LIST

TABLE 6-1A. SUPPLEMENTARY TABLE OF REPLACEABLE PARTS

REFERENCE SYMBOL	STOCK NUMBERS: SIGNAL CORPS STANDARD NAVY AIR FORCE	DESCRIPTION	LOCATING FUNCTION
H-110	— — 7CKE-P3-264	SCREW, captive; 6-32NC-2 thd, CRES; Kings Electronics part/dwg #P-3-264;	Fastens Panel Board to Case Assembly
H-111		SAME AS H-110	
H-112		SAME AS H-110	
H-113		SAME AS H-110	
Z-109	— — 7CAC-075607-8	MATCHED SET OF ATTENUATOR, ATTENUATOR DIAL ASSEMBLY, AND THERMISTER MOUNT; consists of factory calibrated set of Z-102, Z-104, Z106; Kings Electronics part/dwg #P-3-324;	

TABLE 6-1. TABLE OF REPLACEABLE PARTS

REFERENCE SYMBOL	STOCK NUMBERS SIGNAL CORPS / STANDARD NAVY / AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTION
A-101	— §N16-C-170001-441 —	CASE ASSEMBLY: watertight, 2 pc, housing freq pwr meter and accesories; alum body, anodized, gray enam; lower section (single compartment) houses operating components; aperture 1-15/16" sq on left end gives access to waveguide input flange; removable cover 2-11/32" sq w/watertight gasket secured to waveguide input flange by means of 4 knurled screws; upper section (single compartment) equipped w/watertight sealing gasket, mts waveguide flange adapters in clamp brkt; 4 draw-type catches located 2 on each short side of case; lower section has 4 rubber feet on one long side, 4 rubber feet on bottom, one hinged handle on long side; o/a dim. complete case, 11-19/32" lg x 8-17/32" wd x 7-25/32" h; lower sect only, 11-19/32" lg x 8-17/32" wd x 5-5/8" h; upper sect only, 11-19/32" lg x 8-17/32" wd x 2-3/8" h; Hycon Mfg Co part/dwg #110300 and 110320;	Frequency Power Meter Housing
A-102	— §N17-P-23194-1002 —	PANELBOARD, control; mtg for switches, meters, controls, terminals for freq pwr meter; sheet alum, lacquer finish anodized; o/a dim. 11-5/16" lg x 8-3/8" wd x 3/32" thk, rounded corners; secured to studs in lower sect of case by means of 4 latches (AN3195-11); 2 handles provided, one at either end; Hycon Mfg Co part/dwg #110330;	Instrument Mount
A-103	— §N17-B-150001-142 —	BATTERY BOX: houses four 1-1/2v standard Navy type 19031 type C (JAN BA-30) cells; cyl w/plug in one end, removable brass cover; w/compression spring at removable end; brass body, bright alloy pl; dim. 10-7/8" lg x 1-1/2" dia; Hycon Mfg Co part/dwg #110234;	Battery Case
A-104	— §N17-C-783798-821 —	CLAMP, mechanical: battery case holder (left); metal block w/ semi-circular strap attached by 2 bolts; alum, anodized, fits 1-1/2" dia cyl; o/a dim. 25/32" lg x 2" wd x 2-21/32" h; Hycon Mfg Co part/dwg #110327;	Holds battery case
A-105	— §N17-C-782920-408 —	CLAMP, mechanical; batt case holder, (right); metal block w/semi-circular strap attached by 2 bolts; alum, anodized; fits 1-1/2" dia cyl; o/a dim. 1" lg x 2-1/16" wd x 1-11/16" h; Hycon Mfg Co part/dwg #110333;	Holds battery case
BT-101	— —	BATTERY, dry; cylindrical 1-1/2v, standard Navy type 19031 type C (JAN-BA-30) cells, o/a dim. 2-3/8" lg x 1-5/17" dia;	Power Source
BT-102		SAME AS BT-101	
BT-103		SAME AS BT-101	
BT-104		SAME AS BT-101	
CR-101	— N16-T-51723-0005 —	RECTIFIER, crystal; JAN type 1N23A; silicon crystal diode; 10,000-mc converter; 13/16" h x 5/16" base dia; brass case; Spec JAN-1-A; CBXV 1N23A; Hycon Mfg Co part No. CR-101;	Detector
E-101	— N16-E-16805-7564 —	WAVEGUIDE, section; "E" plane bend; 90° angle; waveguide inside dim. 0.900" h x 0.400" wd; freq range 8100 to 12,400 mc; max vswr 1.05; flange AN type UG-39/U each end; brass body, bright alloy pl, zinc chromate painted, black enam; o/a dim. 2-1/8" lg x 1-5/8" wd x 2-1/8" h; mean radius, 1.125"; Hycon Mfg Co part/dwg #182524;	Part of microwave circuit
E-102	— N16-K-700381-306 —	KNOB, round; w/skirt; for 1/4" shaft; molded plastic matte finish; o/a dim. 1.088" h x 1.755" dia; CRP175-2-2G; Hycon Mfg Co part/dwg #110371;	For frequency power meter
E-103	— N16-K-700331-306 —	KNOB, round; w/skirt; for 1/4" shaft; molded plastic, matte finish; o/a dim. 0.870" h x 1.255" dia; CRP #125-2-2G; Hycon Mfg Co part/dwg #110372;	For DBM dial
E-104	— N16-K-700274-414 —	KNOB, round: w/skirt; for 1/4" shaft; molded plastic, matte finish; o/a dim. 0.803" h x 0.708" dia; CRP #70-2-2G; Hycon Mfg Co part/dwg #110373;	Set balance coarse adjustment
E-105		SAME AS E-104	Set balance fine adjustment
E-106		SAME AS E-104	Set Zero

§"Not furnished as a maintenance part. If failure occurs, do not request replacement unless the item can not be repaired or fabricated."

TABLE 6-1. TABLE OF REPLACEABLE PARTS (Cont'd)

REFERENCE SYMBOL	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION LOCATING
E-107	— N16-A-15630-7501 —	ADAPTER, waveguide; one end terminated w/coupling flange AN-type UG-39/U, other end coax coupler to mate w/type N conn UG-21B/U; 2" lg o/a dim; brass body, bright alloy pl; Century Metal Craft Corp, Guardian Electronics Div #103; Hycon Mfg Co part/dwg #110357;	Input Waveguide Adapter
E-108	— N16-A-23031-7051 —	ADAPTER, waveguide: one end terminated w/coupling flange AN type UG-39/U; other end choke flange to mate with AN type UG-51/U; 1-15/16" lg o/a dim; brass body, bright alloy pl, zinc chromate painted; Century Metal Craft Corp, Guardian Electronics Div #107; Hycon Mfg Co part/dwg #110358;	Input Waveguide Adapter
E-109	— N16-A-23031-7701 —	ADAPTER, waveguide: one end terminated w/coupling flange AN type UG-39/U; other end coupling flange to mate with AN type UG-52/U or UG-52A/U; 1-29/32" lg o/a; brass body, bright alloy pl; Century Metal Craft Corp, Guardian Electronics Div #106; Hycon Mfg Co part/dwg #110359;	Input Waveguide Adapter
E-110	— — —	COVER ASSY, battery case; rd, brass, bright alloy pl, .0005" min, o/a dim 1-1/2", composed of one knurled knot E-111, Hycon Mfg Co part/dwg #110241;	Battery cover Assy
E-111	—	KNOB, knurled; 7/16" dia x 15/32" lg, part of E-110, Hycon Mfg Co part/dwg #110242;	Knob for Battery Cover Assy
E-112	— — —	GASKET, flange; waveguide, 1-3/4 x .003" thk brass, bright alloy pl .0002" thk; o/a dim. 1-5/8 x 1-5/8", Hycon Mfg Co part/dwg #110074;	Gasket for Waveguide
E-113	— — —	COVER, Waveguide input; square, alum, anodized, zinc chromate, primed and painted light grey per Spec MIL-E-15090, o/a dim. 2-7/16 x 2-7/16", Hycon Mfg Co part/dwg #110353;	Cover for E-101
H-101	—	WRENCH, Allen Key, No. 4	
H-102	—	WRENCH, Allen Key, No. 8	
H-103	—	"O" RING; o/a dim. 1-3/8 x 1-1/8", CAQY AN 6227B-21, Hycon Mfg Co part/dwg #110248;	Battery Case
H-104	— — —	SPRING, compression, tapered; phosphor bronze wire, nickel pl, .0003" min; wire dia .064" approx, No. 14 gage; coils left- or right-hand wound, spring to be compressed to 5/8" length by force of 3 lb ± 1/4 lb; Hycon Mfg Co part/dwg #110246;	Battery Case
H-105	—	SCREW, knurled; 8-32 NC-2 thd, CRES, type 303, Hycon Mfg Co part/dwg #110355;	Cover screw
H-106		SAME AS H-105	
H-107		SAME AS H-105	
H-108		SAME AS H-105	
H-109	—	CHAIN, bead; #6, nickel pl, 6" lg; Bead Chain Mfg Co;	Fastening device for cover plate
J-101	— N17-C-72595-1793 —	CONNECTOR RECEPTACLE: AN type AN-3102-10SL-4P; 2 male contacts, #16 wire, alum shell; molded phenolic ins; coupling thd size 5/8-24; lgth of shell 29/32"; skirt dia 0.651", mtg flange 1" wd x 1" h x 5/64" thk w/4 holes 0.120" dia on 23/32" mtg/c. CIA #AN-3102-10SL-4P; Hycon Mfg Co part/No. J-101;	External battery
J-102	N2Z-7390-262 N17-C-73108-7760 —	JACK: AN type UG-262/U; one round female contact; straight type; approx 1-3/32" lg x 11/16" wd x 11/16" h o/a dim.; non-const impedance 500v peak; cylindrical silver pl brass body; styramic HT insert; cable opening 0.258" dia; #3-56NF-2 tap 4 holes spaces 1/4" from and perpendicular to ctr lines of mtg plate; weather-proof, has bayonet coupling, coax, BNC type; CARO 2000; Hycon Mfg Co part/No. J-102;	Video Jack
M-101	— — —	METER, microammeter: D.C., scale 75-0-75 microamperes; 197 ohms nominal resistance; cylindrical flush mtg panel type instrument, for use on non-magnetic panel; black pointer and markings on white background; molded phenolic case, 1-5/8" lg x 2.795" dia; flange 3-1/2" dia x 7/32" d; CAY type NX-35 style, LA-58283-1, identical to MR35W150DCUA (Spec JAN-1-6) except revision to O-center calibration or dial per Hycon #110252; Hycon Mfg Co part/dwg #110251;	Bridge meter

TABLE 6-1. TABLE OF REPLACEABLE PARTS (Cont'd)

REFERENCE SYMBOL	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	FUNCTION LOCATING
P-101	N2Z-7390-260 N17-C-71408-3452 —	PLUG: AN type UG-260/U; 1 rd male cont, straight type; approx 9/16″ dia x 61/64″ lg o/a; 500v peak non-const impedance, produces very little electrical discontinuity in coax line of 52 ohm, recommended for use at freq as high as 3000 mc when matching is important; cylindrical silver pl brass body; cable opening 0.250″ dia, weatherproof, has bayonet coupling, u/w AM Radio Freq Cables RG-59/U, RG-62/U, RG-71/U; CPH 31-012; Hycon Mfg Co part/No. P-101;	Video Cable Plug Part of Video Cable Assembly
R-101	— N16-R-65679-8399 —	RESISTOR, fixed: JAN type #RW31G101; wire-wound, pwr type, 100 ohms ±10%; 10w at 275°C (527°F) max continuous oper temp; tubular body 1-1/2″ ±1/16″ lg x 5/16″ +1/64″ —1/8″ I.D., 19/32″ max O.D. vitreous enamel coating; moisture resistant following thermal shock in air; 2 tab. term. 11/16″ to 21/64″ wd x 0.016″ min thk x 5/8″ ±1/8″ lg to centerline; Spec JAN-R-26A; CAO RW31G101, Hycon Mfg Co part/No. R-101;	Ext voltage divider
R-102	— N16-R-65495-5646 —	RESISTOR, fixed: JAN type RW31D400; wire-wound, pwr type; 40 ohms ±10%; 10w at 275°C (527°F) max continuous oper temp; tubular body, 1-1/2″ ±1/16″ lg x 5/16″ +1/64″ —1/8″ I.D., 19/32″ max O.D.; vitreous enam coating; resistant to salt-water immersion after thermal shock in water; 2 tab. term. 11/16″ to 21/64″ wd x 0.016″ min thk x 5/8″ ±1/8″ lg to centerline; Spec JAN-R-26A; CAO RW31D400; Hycon Mfg Co part/No. R-102;	Ext voltage divider
R-103	— N16-R-90331-1550 —	RESISTOR, variable: JAN type RA20A1SD251AK; wire-wound; 250 ohms ±10% 2w 100°C (212°F) max continuous oper temp; 3 lug term., no switch; normal torque; 1.28″ max dia x 0.62″ max thk; encl body; slotted shaft 0.250″ ±1/32″ lg from mtg surface; taper A; Spec JAN-R-19; CTC RA20A15D251AK; Hycon Mfg Co part/No. R-103;	Set balance coarse adjustment
R-104	— — —	RESISTOR, variable: JAN type RA20A1SD350AK; wire-wound; 35 ohms ±10% 2w 100°C (212°F) max continuous oper temp; 3 lug term., no switch; normal torque; 1.28″ max dia x 0.62″ max thk; encl body; slotted shaft 0.250″ +0.001″ —0.002″ dia x 7/8″ ±1/32″ lg from mtg surface; taper A; Spec JAN-R-19; CTC RA20A1SD350AK; Hycon Mfg Co part/No. R-104;	Set balance fine adjustment
R-105	— N16-R-68296-7561 —	RESISTOR, fixed: JAN type RU3A4R7K; wire-wound; 4.7 ohms ±10%; 1/2w at 110°C (230°F); A characteristics; 7/16″ max lg x 11/64″ max dia; insulated, salt-water immersion resistant; 2 axial wire lead term.; Spec JAN-R-184; IRC Type BW-1/2 RU3A4R7K; Hycon Mfg Co part/No. R-105;	Shunt for set balance FINE resistor R-104
R-105A		SAME AS R-105	
R-106	— N16-R-49840-431 —	RESISTOR, fixed: JAN type RC20BF681J; comp; 680 ohm ±5%; 1/2w; F characteristics; 0.375″ lg x 0.140 dia; insulated, salt-water immersion resistant; 2 axial wire lead term; Spec JAN-R-11; COM RC20BF681J; Hycon Mfg Co part/No. R-106;	Bleeder
R-107	— N16-R-78983-7059 —	RESISTOR, fixed: wire-wound, precision; 254.4 ohm ±0.1%; 1/2w at 105°C (221°F) max continuous oper temp; 9/16″ lg x 1/2″ dia; 2 lug term. 3/8″ lg x 0.016″ thk; insulated; salt-water immersion resistant; CBDY B-111 XM 254.4 ohms ±0.1%; Hycon Mfg Co part/No. R-107;	Accurate bridge unbalance resistor
R-108	— N16-R-78980-1599 —	RESISTOR, fixed; wire-wound, precision; 250 ohms ±0.1%; 1/2w at 105°C (221°F) max continuous oper temp; 9/16″ lg x 1/2″ dia; 2 lug term. 3/8″ ±1/8″ lg, 0.016″ thk; insulated, salt-water immersion resistant; CBDY B-111XM 250 ohm ±0.1%; Hycon Mfg Co part/No. R-108;	Bridge resistor
R-109		SAME AS R-108	Bridge resistor
R-110		SAME AS R-108	Bridge resistor
R-111	— N16-R-90493-8445 —	RESISTOR, variable; JAN type RA20A1RD501AK; wire-wound; 500 ohms ±10%; 2w at 100°C (212°F) max continuous oper temp; 3 lug term; no switch; normal torque; 1.28″ dia x 0.62″ dia; encl body; rd shaft 0.250″ +0.001″ —0.002″ dia x 7/8″ ±1/32″ lg from mtg surface; taper A; Spec JAN-R-19; CTC RA20A1RD-501AK; Hycon Mfg Co part/No. R-111;	Set ZERO adjustment

TABLE 6-1. TABLE OF REPLACEABLE PARTS (Cont'd)

REFERENCE SYMBOL	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTION
R-112	— N16-R-50092-431 —	RESISTOR, fixed; JAN type RC20BF392J; comp; 3900 ohms ±5%, 1/2w; F characteristics; 0.375" lg x 0.140" dia; insulated, salt-water immersion resistant; 2 axial wire lead term; Spec JAN-R-11; COM RC20BF392J; Hycon Mfg Co part/No. R-112;	Meter sensitivity
R-113	— N16-R-49498-431 —	RESISTOR, fixed; JAN type RC20BF680J; comp; 68 ohms ±5%; 1/2w; F characteristics; 0.375" lg x 0.140" dia; insulated, salt-water immersion resistant; 2 axial wire lead term; Spec JAN-R-11; COM RC20BF680J; Hycon Mfg Co part/No. R-113;	Series dropping resistor
RT-101	— — —	THERMISTOR, disk; 100 ohms nominal cold resistance at 25°C (77°F); coef of resistance —44%/degree C at 25°C (77°F); mtd on metal plate, 1-1/4" lg x 7/8" wd x 3/32" thk; 1 axial wire term.; Victory Engineering Corp #21W100; Hycon Mfg Co part/No. RT-101;	Temperature compensating
RT-102	— — —	THERMISTOR, bead; 2000 ohms nominal cold resistance at 25°C (77°F); coef of resistance —44%/degree C at 25°C (77°F); mtd glass bulb 0.40" lg x 5/32" dia; 2 axial wire lead term.; Victory Engineering Corporation #32A3; Hycon Mfg Co part/No. RT-102;	Power detector
S-101	— N17-S-72018-7701 —	SWITCH, toggle; JAN type ST13D; spdt; resistive load, 5 amp at 125v, 2 amp at 250v; inductive load, 3 amp at 125v; 1.5 amp at 250v; dull white non-glare nickel or cadmium finish, bat type handle 11/16" h; locking action; single hole bushing, 15-32 thd, flush mtd; sleeve length 1/4"; keyway 0.068" x 0.035"; Spec JAN-S-23; CHH #82303BS; Hycon Mfg Co part/No. S-101;	Internal power switch
S-102		SAME AS S-101	Set ZERO, set BALANCE switch
S-103	— N17-S-70412-3664 —	SWITCH, toggle; JAN type ST42C; spst; resistive load, 15 amp at 30v D.C., 0.75 amp at 125v D.C.; non-locking action; up position "off," down position "on," bat type handle 11/16" lg; 2 term. solder lug type; single hole mtg, 15/32" dia bushing; plastic body; o/a dim. 2-7/32" lg x 41/64" wd x 1-9/64" h; Spec JAN-S-23; CAE ST42C; Hycon Mfg Co part/No. S-103;	Press to read
*W-101	NIF425-59 N15-C-12202-0025 —	RADIO FREQUENCY CABLE: JAN-type RG-62/U; coax type; characteristic impedance 93 ohms nominal, capacitance 13.5 mmf/ft nominal; max oper voltage 750v rms inner cond, #22 AWG plain "Copperweld" wire, $.0253" nominal dia, outer cond single plain copper braid, 0.191" max dia; solid polyethylene dielectric 0.146" ±0.005" OD; poly-vinyl-chloride or copolymer vinyl-chloride-vinyl acetate outer jacket 0.242" ±0.008" OD; Spec JAN-C-17A; CPH #21-025; Hycon Mfg Co part/No. W-101;	Video Cable Part of Video Cable Assembly
Z-101	— N16-D-57157-2801 —	COUPLER, directional: Assembly; includes crystal detector and r-f gate; crystal detector is housed in waveguide section which is affixed to another section of waveguide housing r-f gate and forming part of main microwave circuit; o/a dim. 2-1/4" lg x 2-3/4" wd; freq range 8500 to 9700 mc, 23 db coupling loss; 1:1 voltage 1-5/8" h x 1/8" thk; inside dim. of waveguide 0.900" h x 0.400" wd; freq range 8500 to 9700 mc, 23 db coupling loss; 1.1 voltage standing wave ratio at 9000 mc; Hycon Mfg Co part/dwg #110400;	RF Gate and Crystal detector
**Z-102	— N16-A-99167-2001 —	ATTENUATOR ASSEMBLY: waveguide; contains movable rectangular glass vane coated with resistive material and mtd on 2 sliding rods, rods are driven by linear cyl cam; vane is parallel to elec field in waveguide; 6" lg o/a, conn flange on each end 1-5/8" wd x 1-5/8" h x 1/8" thk; inside dim. of waveguide 0.900" h x 0.400" wd; assy incl guide post assy, strip resistor, shaft assy, roller and shaft assy, housing assy; Hycon Mfg Co part/dwg #110003;	Microwave attenuator
Z-103	— — —	WAVEMETER ASSEMBLY; 8500 to 9700 mc range; ±1 mc accuracy; aborption type; spiral dial, 5-1/4" turn scale; reads directly in mc/10; invar body, black lacquer finish; o/a dim. 3-7/8" lg x 6-1/8" dia; Hycon Mfg Co part/dwg #110022;	Frequency measurement
Z-104	— N16-R-85013-5526 —	THERMISTOR MOUNT (waveguide): incl bead thermistor and disk thermistor; 8500 to 9700 mc range; 250 ohms impedance; broad band mount, pre-tuned at factory; brass body, silver pl, rhodium flashed, zinc chromate painted, black lacquered; single term., solder lug type; o/a dim. 2-7/16" lg x 1-5/8" wd x 1-1/2" h; Hycon Mfg Co part/dwg #110440;	Thermistor housing

*J-102 and P-101 attached to cable.
**Individually calibrated with Dial Z-106. Return to test equipment repair facility if replacement is required.

TABLE 6-1. TABLE OF REPLACEABLE PARTS (Cont'd)

REFERENCE SYMBOL	STOCK NUMBERS SIGNAL CORPS STANDARD NAVY AIR FORCE	NAME AND DESCRIPTION	LOCATING FUNCTION
Z-105	— — —	STOP, Dial: stop for freq meter spiral dial, allowing 5 turns full excursion; brass, dull black nickel pl; o/a dim. 1-3/8" dia x 0.266" d; four 0.935" mtg holes equally spaced on 1.187" dia bolt circle; Hycon Mfg Co part/dwg #110240;	For Frequency Meter
***Z-106	— N16-S-117101-714 —	DIAL ASSEMBLY: dial and collar; alum, anodized, gray lacquered; for 1/4" shaft; o/a dim. 0.343" h x 2-1/2" dia; collar secured to dial with 3 No. 2-56NC-2 x 1/2" lg brass mach screws; Hycon Mfg Co #110337;	DBM dial
Z-107	— — —	PLUNGER ASSEMBLY: flex. metal shaft encl in flex. housing; shaft terminated one end with pushbutton, other end with plunger; mtg data, one center hole 3/8" dia, four #29 mtg holes on 3/4" bolt circle; dim. 11-7/16" lg x 3/16" dia; pushbutton dim. 5/16" dia; Camera Works S-#12, Hycon Mfg Co part/No. 110426;	R-F Gate control
Z108	— — —	VIDEO CABLE ASSEMBLY; composed of connector BNC, UG-262/U (AN type); Connector BNC, UG-260/U (AN type); and Cable-Coaxial (Hycon dwg No. 110424). Connectors are soft soldered to cable with type SN-60 solder per Spec. QQ-S-571;	Video Cable

***May not be replaced without replacing attenuator assembly Z-102.

TABLE 6-2. LIST OF MANUFACTURERS

PREFIX	NAME	ADDRESS
	Hycon Mfg. Company	2961 E. Colorado St. Pasadena 6, California
CAE	Cutler Hammer, Inc.	1333 W. St. Paul Ave. Milwaukee, Wisconsin
CAO	Ward Leonard Company	45 South Street Mt. Vernon, New York
CARO	Industrial Products Company	Danbury, Connecticut
CAQY	Parker Appliance Company	5827 W. Century Blvd. Los Angeles 43, Calif.
CAY	Westinghouse Electric Corp.	2519 Wilkins Ave. Baltimore 3, Md.
CBDY	Cinema Engineering Company	1510 W. Verdugo Ave. Burbank, California
CBQV	Kemtron Electron Products Company	23 Brown St. Salem, Mass.
CHH	Arrow-Hart & Hegeman Electric Co.	102 Hawthorne St. Hartford 6, Connecticut
CIA	Airplane and Marine Instruments, Inc.	Clearfield, Penna.

TABLE 6-2. LIST OF MANUFACTURERS (Cont'd)

PREFIX	NAME	ADDRESS
CIR	International Resistance Corp.	401 N. Broad St. Philadelphia, Penna.
COM	Ohmite Mfg. Company	4835 W. Flournoy St. Chicago, Illinois
CPH	American Phenolic Corp.	1830 S. 54th Ave. Chicago, Illinois
CRP	Raytheon Mfg. Co.	190 Willow Street Waltham, Mass.
CTC	Chicago Telephone Supply Co.	1243 Riverside Drive Elkhart, Indiana
CANS	Kings Electronics Co., Inc.	40 Marbledale Road Tuckahoe, New York
	Victory Engineering Corp.	Los Angeles, California
	Camera Works	St. Louis, Missouri
	The Bead Chain Manufacturing Company	20 Mountain Grove St. Bridgeport 5, Connecticut
	Century Metal Craft Corp. Guardian Electronics Division	1406 Oxnard St. Van Nuys, Calif.