J64070A (70A) AND J64070B (70B) POWER METERS
DESCRIPTION

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1. GENERAL

1.01 This section replaces Issue 4. It is reissued to give supplementary information which will insure maximum accuracy in the use of the meters and to make minor corrections in the text.

1.02 The 70A and 70B meters were designed primarily to facilitate transmission measurements on video transmission facilities when used with a 61B or 61C signal generator or equivalent.

1.03 The 70A power meter consists of two separate thermocouple circuits, one operating at 75-ohms, unbalanced, and the other at 110-ohms, balanced.

1.04 The 70B power meter consists of two separate thermocouple circuits, one operating at 75-ohms, unbalanced, and the other at 124-ohms, balanced.

1.05 The measuring ranges of the 70A and 70B power meters are from −10 db to +3 db with respect to a reference level as selected by a key at the time of calibration, of one milliwatt or a power equal to that produced by a sinusoidal voltage of one volt peak-to-peak.

1.06 Two patching cords are provided for each test set for connecting to the circuit under measurement. The cords are 6 feet long, one for the 75-ohm unbalanced impedance, the other for the 110-ohm or 124-ohm balanced impedance.

Two patching plugs are provided for use in calibrating. A spare thermocouple and cartridge are provided for each impedance and are mounted in the cover.

1.07 The 70A and 70B power meters are provided with a nonlocking switch designated METER SHORT, activated when the cover is replaced on the power meter, to prevent damage to the microammeter, (M1), during handling and transit.

1.08 The 70A and 70B power meters are identical as to size and weight and are portable sets contained in a metal case which is approximately 15 inches long by 10 inches wide and 8 inches in height. Each set weighs approximately 20 pounds. A KS-14711 or KS-6522, 1.5-volt dry cell supplies the power necessary for calibrating. The top views of the 70A and 70B power meters are shown in Figs. 1 and 6.

2. DESCRIPTION — 70A POWER METER (J64070A)

(A) General

2.01 The 70A power meter is designed to measure power over a frequency range from dc to 10 megacycles at 75- and 110-ohm impedance levels by means of a 75-ohm and a 110-ohm thermocouple. The direct current generated by either thermocouple produces a deflection on a sensitive calibrated meter. Each thermocouple unit is so designed as to minimize the length of leads in the high-frequency portion of the circuit, providing uniform performance over the desired frequency band. This permits the use of direct current in making initial calibration. Protective pads are provided to guard the thermocouples from accidental overload.

(B) 75-Ohm Thermocouple Circuit

2.02 This circuit is shown in Fig. 2. The 75-ohm thermocouple heater is mounted directly at the end of the 75^{w} 1 MW IN jack. The jack and the thermocouple are enclosed in a removable cartridge, which also serves as a shield. The two flexible leads connecting to the cartridge carry the thermocouple galvanometer current, which is direct current, through a potentiometer 75^{w} CAL DIAL 2, to the CAL and IMPEDANCE switches and thence to the 0-200 microammeter. The potentiometer 75^{w} CAL DIAL 2 permits adjustment of the thermocouple output when calibrating. The IMPEDANCE switch connects the meter to either the 75-ohm or the 110-ohm thermocouple circuit. The CAL switch permits the use of the meter and associated 75^{w} SHUNT, to set the exact value of the direct current used in calibrating the thermocouple. The 75^{w} CAL DIAL 1 potentiometer allows adjustment of the dc calibrating current to the desired value. The REF LEVEL key is provided to change fixed resistance values in the two circuits so that either

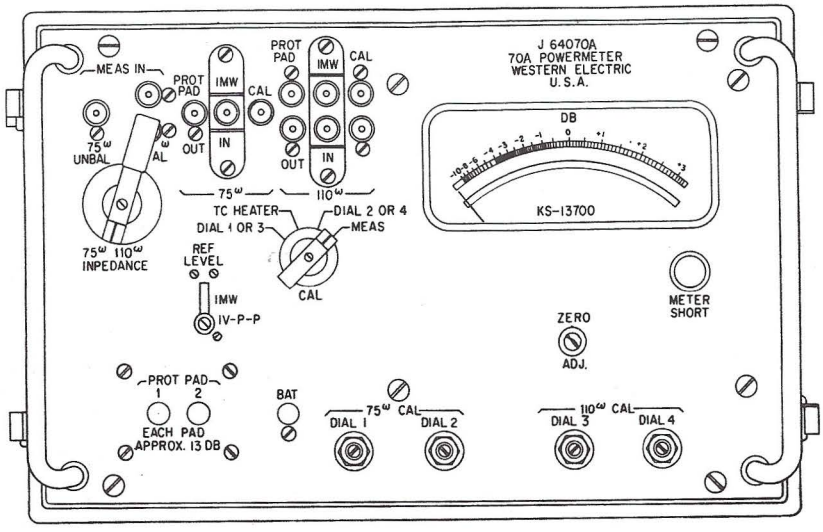


Fig. 1 – Panel of 70A Power Meter

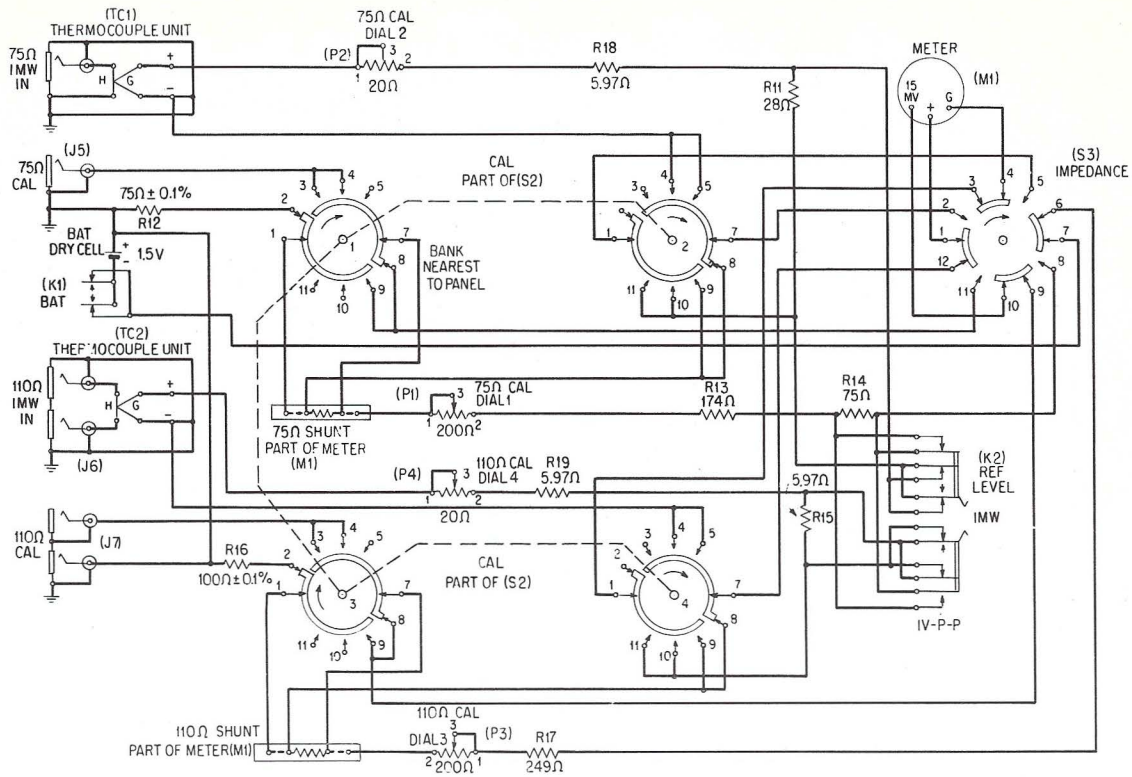


Fig. 2 – 75-Ohm and 110-Ohm Thermocouple Circuits

a reference level of 1 MW or 1 V P-P (peak-to-peak), may be used. A precise 75-ohm resistor R12 is provided for the initial adjustment of the dc calibrating current. The 75^{w} CAL jack permits connection of the calibrating circuit to the thermocouple heater by means of a 372A patching plug carried in the cover.

(C) 75-Ohm Protection Pad Circuit

2.03 This circuit is shown in Fig. 3(a). It is provided with a MEAS IN 75^{w} UNBAL jack and a 75^{w} PROT PAD OUT jack. Between these jacks are connected, by means of shielded coaxial cable, two resistance pads each having approximately 13 db loss. Each pad is eliminated from the circuit by depressing a nonlocking push-button type key. Thus when a current is patched through the protection pad circuit to the thermocouple set, both protection keys must be depressed in order to obtain a normal reading on the instrument. For this use the protection pad circuit is connected through to the thermocouple circuit by means of a 372A patching plug provided in the cover of the set.

(D) 110-Ohm Thermocouple Circuit

2.04 This circuit is shown in Fig. 2 along with the 75-ohm thermocouple circuit. Its circuit arrangement is identical to that described in Part 2(B) except that, since the circuit is balanced, both the thermocouple input and the dc calibrating circuit are equipped with double jacks. Certain resistances and the 110^{w} SHUNT are different in value but otherwise serve functions similar to those described in Part 2(B). Separate calibrating potentiometers such as the 110^{w} CAL DIAL 4 and 110^{w} CAL DIAL 3 are provided and serve the same purpose as the 75^{w} CAL DIAL 2 and 75^{w} CAL DIAL 1 potentiometers.

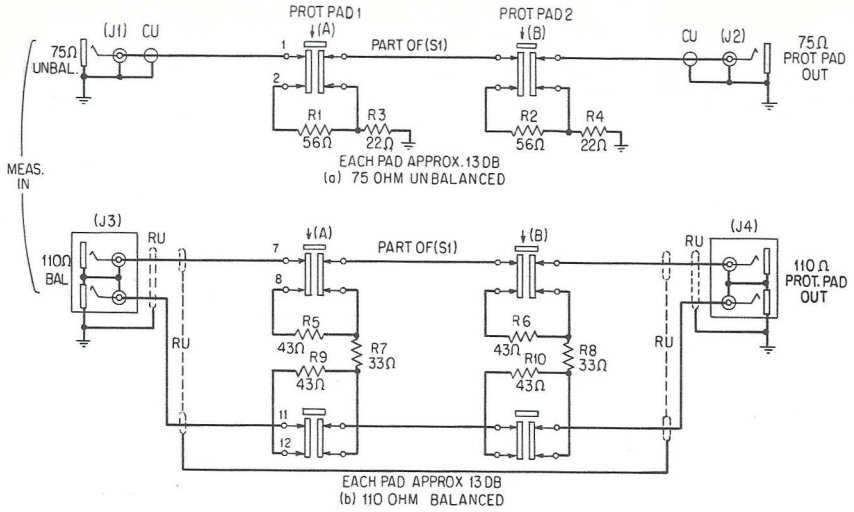


Fig. 3 – 75-Ohm and 110-Ohm Protection Pad Circuits

(E) 110-Ohm Protection Pad Circuit

2.05 This circuit, shown in Fig. 3(b) is similar in function to that described in Part 2(C). It is equipped with a balanced input and output, as well as with balanced pads. The jacks and pads are connected by means of a shielded, balanced cable. Connection to the 110-ohm thermocouple from the protection circuit is made by means of two 372A patching plugs.

3. PERFORMANCE

(A) Frequency Range

3.01 The 70A power meter nominally operates from direct current to 10 megacycles. Above 10 megacycles, reflection loss reduces the power indicated by the 75-ohm thermocouple. With a matched 75-ohm source, the power indication is lower than the dc value by 0.0 to 0.10 db between 10 and 100 megacycles, and by 0.05 to 0.25 between 100 and 200 megacycles. No data is available on 110-ohm thermocouple operation above 10 megacycles.

(B) Level Range

3.02 The test set indicates power levels between −10 db to +3 db with respect to a reference level of one milliwatt or one volt peak-to-peak, as selected by key.

(C) Accuracy

(For frequencies below 10 megacycles)

3.03 The absolute accuracy expected at 0 db on the meter scale is ±0.1 db. Elsewhere on the scale the error increases due to several factors, such as: (a) increased meter error, (b) departure of thermocouple from average characteristic, (c) greater observational errors at −db indications. The error between meter limits of ±1 db may be as great as ±0.2 db.

SOURCES OF ERROR	MAXIMUM ERRORS POWER DBM	VOLTAGE 75-OHM	—DBV 110-OHM
1. Meter*	±0.043	±0.043	±0.043
2. 75- or 110-ohm calibrating resistance tolerance	±0.004	+0.03	+0.04
3. Thermocouple heater resistance tolerance	±0.030	−0.08	−0.12
4. Observational error	±0.01	±0.01	±0.01
5. Root-mean-square sum	±0.053	+0.05 −0.09	+0.06 −0.13

* Error at 77° Fahrenheit with meter in horizontal position.

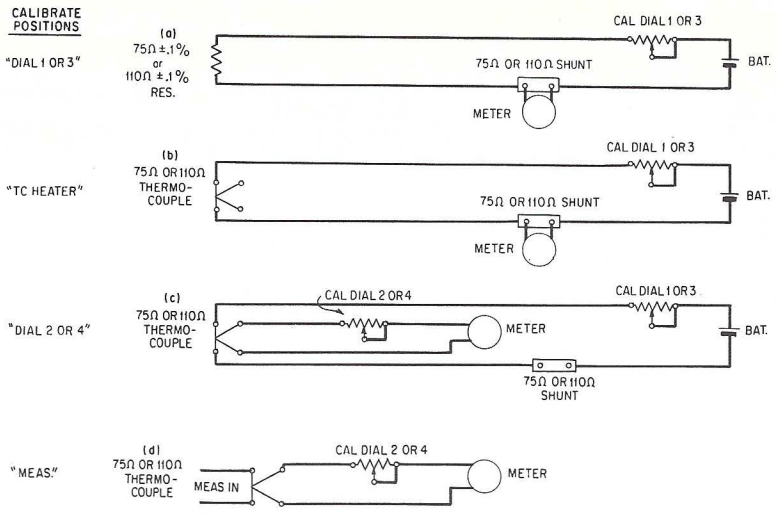


Fig. 4 – 70A Power Meter Calibration Schematic

3.04 The differential accuracy over the frequency range between meter limits of ±1 db, is within ±0.1 db. Approximately half of this variation is due to the cable in the protection pad circuit and may be eliminated for special cases by patching directly into the 75ω 1MW IN jack or the 110ω 1 MW IN jack.

4. OPERATION

(A) Calibration

4.01 The 70A power meter is designed and balanced for use with the meter face in the horizontal position. Thus, while it will measure when in an upright position, it will not be accurate.

4.02 The following calibration should be made whenever maximum absolute accuracy is desired and at least at the start of each day's tests, or whenever a thermocouple has been changed or severely overloaded. If the thermocouple calibration as outlined in the calibration procedures do not check, the thermocouple element should be replaced. If a calibration becomes necessary in the middle of a series of measurements in which the maximum differential accuracy is desired, measurements already made should be repeated. In the following procedures refer to Fig. 4 which shows the essential circuit conditions prevailing for each of the four CAL dial positions. Always tap the meter case lightly to eliminate friction in the needle bearing.

4.03 ***IN ALL CASES, THE FOLLOWING PARAGRAPH IS MOST IMPORTANT FOR MAXIMUM ACCURACY:*** With no input to the meter, check that the meter pointer lines up with the line at the left of the −10 DB scale marking. See Fig. 5. If it does not, adjust the meter ZERO ADJUST screw for correct alignment.

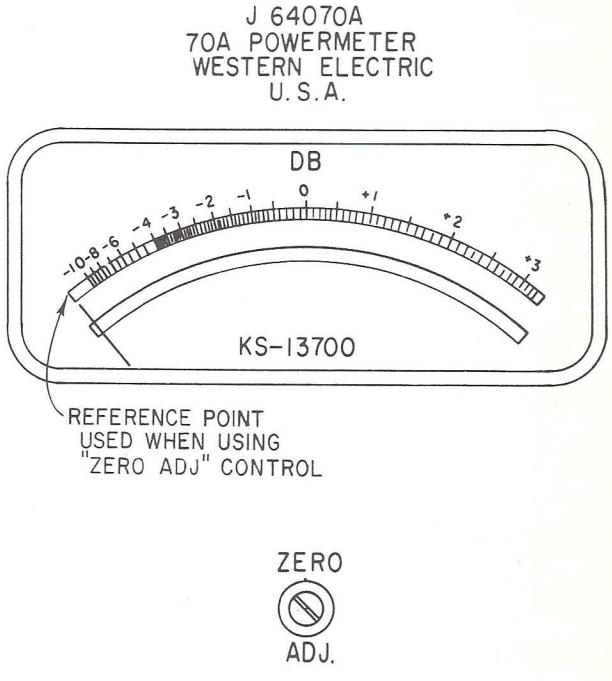


Fig. 5 – Zero Adjust Point on 70A Power Meter

75^{w} UNBAL — REF LEVEL 1 MW

4.04 ***Procedure:***

(1) Insert the 372A patching plug into the 75^{w} 1 MW IN and the 75^{w} CAL jacks.

(2) Turn the IMPEDANCE switch to the 75^{w} position.

(3) Place the REF LEVEL key in the 1 MW position.

(4) Turn the CAL switch to DIAL 1 OR 3 position.

(5) Depress the BAT key.

(6) Adjust the 75^{w} CAL DIAL 1 potentiometer until the meter indicates exactly 0 db.

(7) Turn the CAL switch to the TC HEATER position.

(8) Check that the meter indicates 0 db ±0.03 db.

(9) Turn the CAL switch to the DIAL 2 OR 4 position.

(10) Adjust the 75^{w} CAL DIAL 2 potentiometer until the meter indicates exactly 0 db. (The observational error when using the mirrored scales to eliminate parallax should not exceed ±0.01 db.)

(11) Release the BAT key.

(12) Remove the 372A patching plug from the 75^{w} 1 MW IN and the 75^{w} CAL jacks and insert it into the 75^{w} 1 MW IN and 75^{w} PROT PAD OUT jacks.

(13) The circuit is now ready for operation for the 75^{w} UNBAL input with respect to a reference level of one milliwatt.

75^{w} UNBAL — REF LEVEL 1 V P-P

4.05 ***Procedure:***

(1) Make the same circuit preparations as in Paragraph 4.03(1-5) with the exception of placing the REF LEVEL key (K2) in the 1 V P-P position.

(2) Adjust the 75^{w} CAL DIAL 1 potentiometer until the meter indication is exactly on the red line CAL-1V-75^{w}.

(3) Turn the CAL switch to the TC HEATER position.

(4) Check that the meter indication is on the red line CAL-1V-75^{w} to within ±0.03 db.

(5) Make the circuit adjustments exactly as in Paragraph 4.03(9-12).

(6) The circuit is now ready for operation for the 75^{w} UNBAL input with respect to a reference level of one volt peak-to-peak.

110^{w} BAL — REF LEVEL 1 MW

4.06 ***Procedure:***

(1) Connect the 110^{w} 1 MW IN jacks to the 110^{w} CAL jacks by means of two 372A patching plugs.

(2) Turn the IMPEDANCE switch to the 110^{w} position.

(3) Place the REF LEVEL key in the MW position.

(4) Turn the CAL switch to the DIAL 1 OR 3 position.

(5) Depress the BAT key.

(6) Adjust the 110^{w} CAL DIAL 3 potentiometer until the meter indicates exactly 0 db.

(7) Turn the CAL switch to the TC HEATER position.

(8) Check that the meter indicates 0 db ±0.03 db.

(9) Turn the CAL switch to the DIAL 2 OR 4 position.

(10) Adjust the 110^{w} CAL DIAL 4 potentiometer until the meter indicates 0 db. (The observational error when using the mirrored scale to eliminate parallax should not exceed ±0.01 db.)

(11) Release the BAT key.

(12) Remove the 372A patching plugs from the 110^{w} 1 MW IN and the 110^{w} CAL jacks and by means of them make connection between the 110^{w} 1 MW IN and the 110^{w} PROT PAD OUT jacks.

(13) The circuit is now ready for operation for the 110^{w} BAL input with respect to a reference level of one milliwatt.

110^{w} BAL — REF LEVEL 1 V P-P

4.07 ***Procedure:***

(1) Make the same circuit preparations as in Paragraph 4.05(1-5) with the exception of placing the REF LEVEL key in the 1 V P-P position.

(2) Adjust the 110^{w} CAL DIAL 3 potentiometer until the meter indication is exactly on the red line CAL-1V-110^{w}.

(3) Turn the CAL switch to the TC HEATER position.

(4) Check that the meter indication is on the red line CAL-1V-110^{w} to within ±0.03 db.

(5) Make the circuit adjustments exactly as in Paragraph 4.05(9-12).

(6) The circuit is now ready for operation for the 110^{w} BAL input with respect to a reference level of one volt peak-to-peak.

(B) Preliminary Measurements

4.08 After making the proper calibration by the procedures described in Part 4(A) and with the protection pads patched in the circuit, the appropriate MEAS IN jack of the power meter may be connected to the apparatus under test by using either the balanced or the unbalanced cord provided in the cover of the carrying case.

Caution: Precautions should be taken to avoid connecting the power meter to a signal having a level in excess of +3 dbm. The protection pads in the power meter, if left in circuit, will protect the thermocouple from burnout at levels up to +30 dbm but should not be used to measure high levels.

(1) Before depressing either of the PROT PAD keys, note that the meter deflection does not exceed −10 db on the scale.

(2) Depress the PROT PAD 1 key. The indication should not exceed −10 db on the scale.

(3) Depress the PROT PAD 1 and 2 keys. The indication should now be somewhere on the meter scale.

(4) For high differential accuracy the region between −1 and +1 db may be used.

(5) For the greatest absolute accuracy, measurements should be made at 0 db on the meter scale.

(6) The meter case should be tapped lightly, when making a measurement, in order to eliminate friction in the needle bearing.

(7) The protection pads each have approximately 13 db loss. Measurements should not be made with either pad in circuit.

(C) Final Measurements

4.09 If extreme differential accuracy with frequency is required and if the steps of Paragraph 4.07 have first been taken to ascertain that a safe level exists, then the equipment under test may be directly connected to the 110^{w} 1 MW IN or the 75^{w} 1 MW IN jack. This connection eliminates the protection pad and associated cabling, and thereby improves the accuracy. Great care must be exercised to avoid burning out or severely overloading the thermocouple.

5. DESCRIPTION — 70B POWER METER (J64070B)

(A) General

5.01 The 70B power meter is designed to measure power over a frequency range from dc to 20 megacycles at 75-ohm and 124-ohm impedance levels by means of a 75-ohm and a 124-ohm thermocouple. The direct current generated by either thermocouple produces a deflection on a sensitive calibrated meter. The thermocouple units are so designed as to minimize the length of leads in the high-frequency portion of the circuit providing uniform performance over the desired frequency band. A direct current circuit permits calibration at a reference of 0 dbm or 0 dbv. The top view of the 70B power meter is shown in Fig. 6.

(B) 75-Ohm and 124-Ohm Thermocouple Circuits

5.02 The 75-ohm unbalanced and the 124-ohm balanced thermocouple circuits, together with their calibrating circuits, are shown in Fig. 7. The 75-ohm thermocouple, (TC1), and the 124-ohm thermocouple, (TC2), are of the insulated bead type. The impedance of the thermocouple's heaters has a negligible reactance up to 20 megacycles. Stray inductance is kept small by making leads as short and straight as pos-

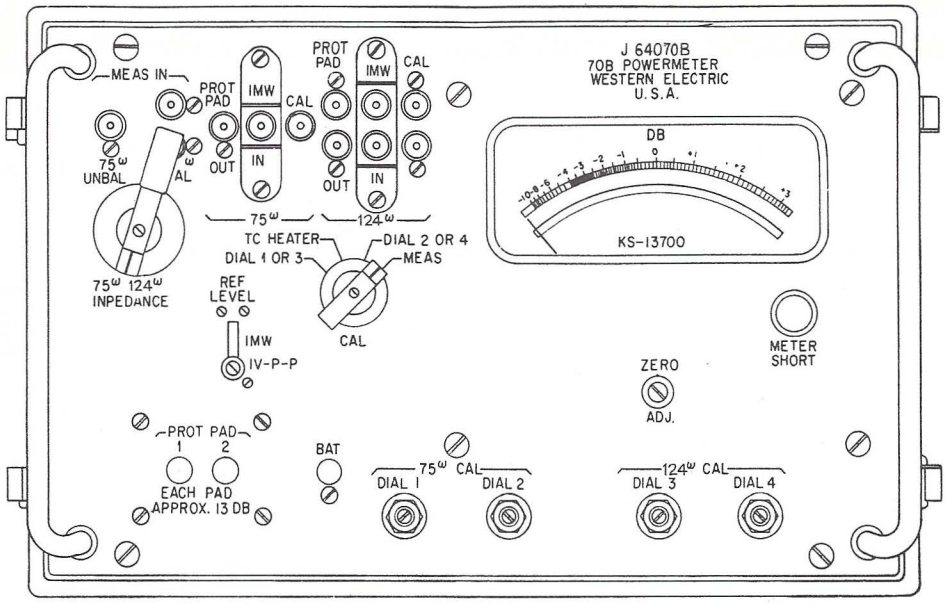


Fig. 6 – Panel of 70B Power Meter

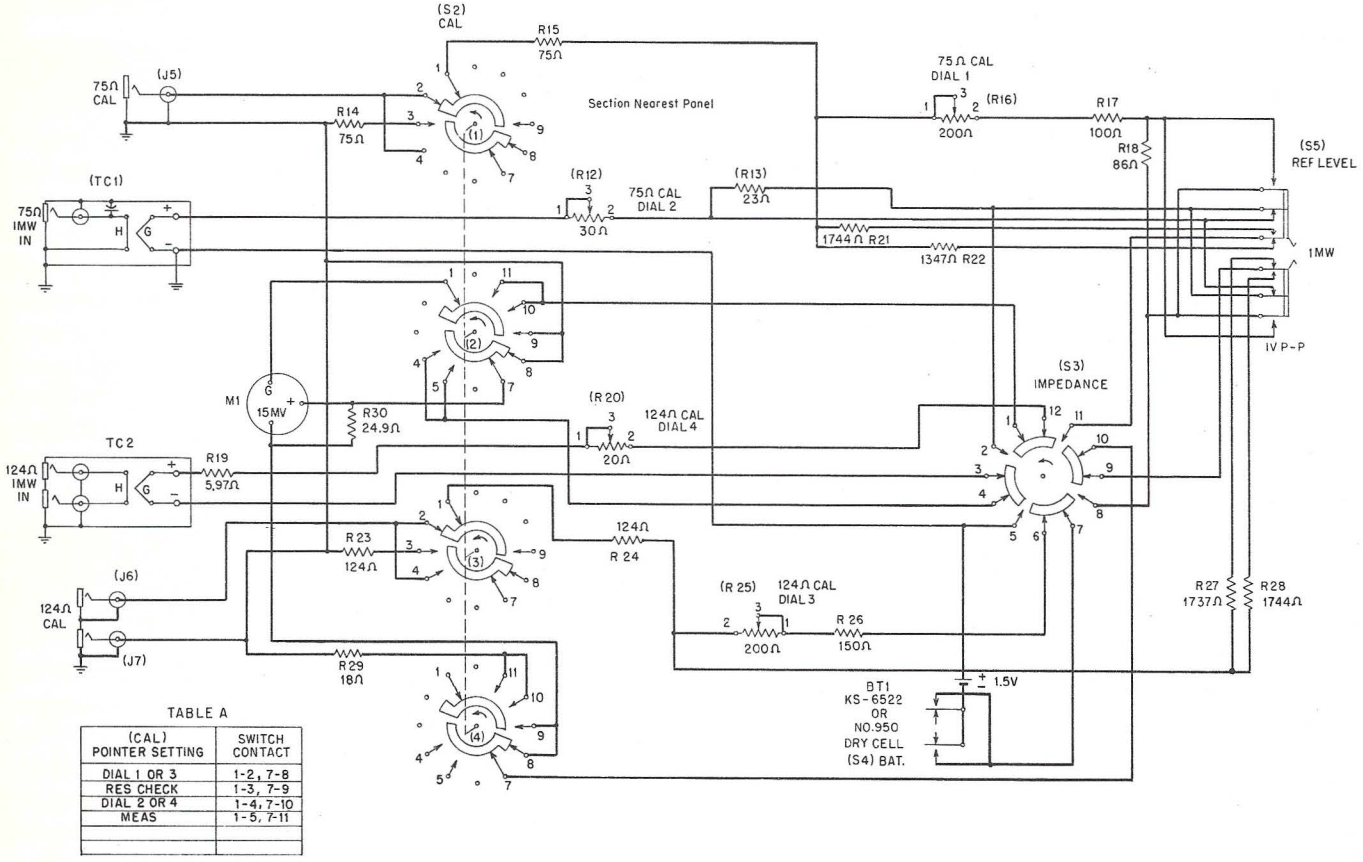


TABLE A

(CAL) POINTER SETTING	SWITCH CONTACT
DIAL 1 OR 3	1-2, 7-8
RES CHECK	1-3, 7-9
DIAL 2 OR 4	1-4, 7-10
MEAS	1-5, 7-11

Fig. 7 – 75-Ohm and 124-Ohm Thermocouple Circuits

sible. A small capacitor is connected across the input of TC1, the 75-ohm thermocouple, to improve the impedance match up to 20 megacycles. Up to 20 megacycles the return loss at the input jack is higher than 28 db without this capacitance and 42 db with the capacitance. No capacitance is connected across the 124-ohm thermocouple; its return loss is higher than 40 db up to 20 megacycles. The two circuits are separate except for the meter, (M1), which is used with one or the other as required. The operation of the circuits is identical. Both the 75-ohm and the 124-ohm thermocouples are mounted directly at the end of their associated jacks. The jack and thermocouple are enclosed in a removable cartridge which also serves as a shield. The two flexible leads connecting to the cartridge carry the thermocouple galvanometer current, which is direct current, through the potentiometer 75Ω CAL DIAL 2; or 124Ω CAL DIAL 4, depending on the position of the IMPEDANCE switch; to the CAL and IMPEDANCE switches and to the microammeter M1. The potentiometers 75Ω CAL DIAL 2 and 124Ω CAL DIAL 4 permit adjustment of the thermocouple output when calibrating. The IMPEDANCE switch connects the meter M1 to either the 75-ohm or the 124-ohm thermocouple circuit. The CAL switch permits the use of the meter and associated shunts to set the exact value of the direct current in calibrating the thermocouples. The 75Ω CAL DIAL 1 and the 124Ω CAL DIAL 3 potentiometers provide the adjustment of the dc calibrating voltage to the required value. The REF LEVEL key is provided to change fixed resistance values in the two circuits so that either a reference level of 1MW or 1 V P-P (peak-to-peak), may be used. Precise resistors of 75 ohms (R14) and 124 ohms (R23) are provided for checking the thermocouple heater resistances. The 75Ω CAL and 124Ω CAL jacks permit connection of the calibrating circuit to the thermocouple heaters by means of 372A patching plugs, carried in the cover.

(C) 75-Ohm and 124-Ohm Protection Pad Circuits

5.03 The protection pad circuits are shown in Fig. 8. Jacks designated MEAS IN 75Ω UNBAL and 75Ω PROT PADS OUT, MEAS IN 124Ω BAL and 124Ω PROT PADS OUT are pro-

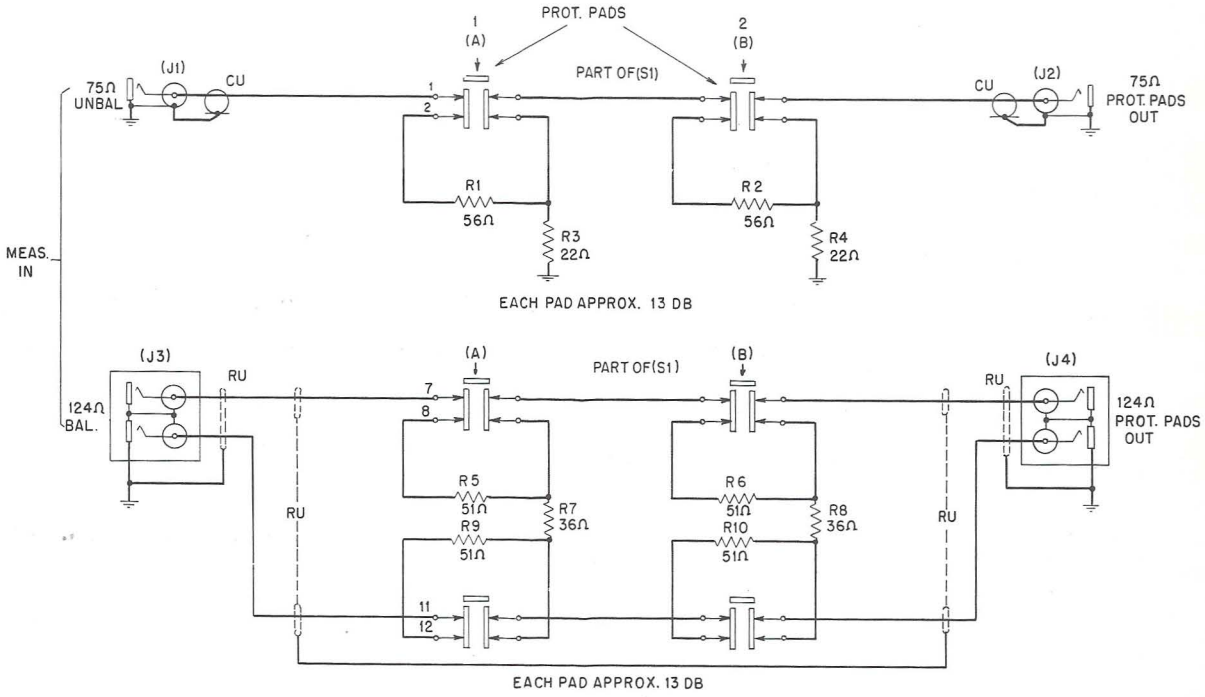


Fig. 8 – 75-Ohm and 124-Ohm Protection Pad Circuits

vided and these jacks are connected, by means of shielded coaxial cable and two resistance pads, each having approximately 13 db loss. The protection pad circuits are under control of PROT PADS keys (1) and (2). Each pad is eliminated from the circuit by depressing a nonlocking push-button type key. Both protection pad keys must be depressed to shunt the current around the protection pad circuit to the thermocouple circuit. The protection pad circuit is connected to the thermocouple circuit by means of 372A patching plugs. One 372A patching plug is required for the 75-ohm unbalanced circuit and two 372A patching plugs are required for the 124-ohm balanced circuit and are provided in the cover of the set.

6. PERFORMANCE

(A) Frequency Range

6.01 The 70B power meter provides 75-ohm unbalanced and 124-ohm balanced thermocouples for measurement of power in the frequency range from direct current to 20 megacycles. Above 20 megacycles, reflection loss reduces the power indicated by the 75-ohm thermocouple. With a matched 75-ohm source, the power indication is lower than the dc value by 0.00 to 0.1 db between 20 and 100 megacycles, and by 0.05 to 0.25 between 100 and 200 megacycles. No data is available on 124-ohm thermocouple operation above 20 megacycles.

(B) Level Range

6.02 The 70B power meter indicates power levels in a range between −10 db and +3 db with respect to a reference level of one milliwatt or one volt peak-to-peak, as selected by the REF LEVEL key.

(C) Accuracy

(For frequencies below 20 megacycles)

6.03 The maximum errors at 0 dbm and 0 dbv are ±0.04 dbm ±0.07 dbv and ±0.09 dbv. Assuming a normal probability distribution for which 99.7% of the instruments have errors not exceeding the above two values, then one-half of the instruments will have errors not exceeding ±0.03, ±0.05, ±0.06 for power and 75- and 124-ohm voltage measurements respectively. Elsewhere on the scale the error increases due to several factors such as (a) increased meter error, (b) departure of thermocouple from average linearity characteristic, (c) greater observational errors at −db indications. The error at meter indications of ±1 db may be as great as ±0.2 db.

	MAXIMUM ERRORS		
SOURCES OF ERROR	POWER DBM	VOLTAGE 75-OHM	—DBV 124-OHM
1. Meter (±0.5% at midscale)*	±0.04	±0.04	±0.04
2. Calibrating resistors tolerance (±0.1%)	±0.01	±0.01	±0.01
3. Thermocouple heater resistance tolerance	±0.00	±0.06	±0.08
4. Observational errors (Calibrating and measuring)	±0.01	±0.01	±0.01
5. Root-mean-square sum	±0.04	±0.07	±0.09

* Error at 77° Fahrenheit with meter in horizontal position.

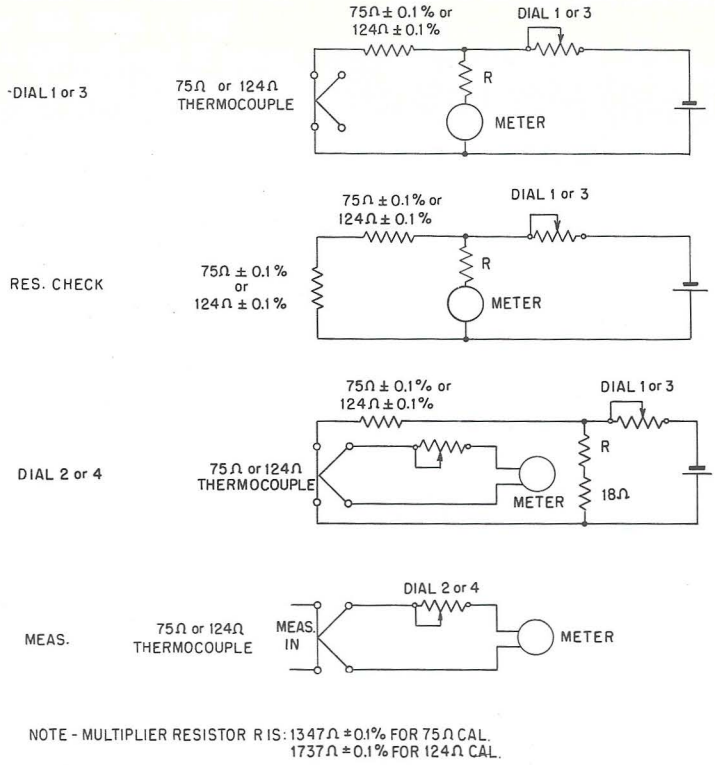
6.04 The differential accuracy over the frequency range, between meter limits of ±1 db, is within ±0.1 db. Approximately half of this variation is due to the cable in the protection pad circuit and should be eliminated for accurate measurements by patching directly into the 75Ω 1 MW IN jack or the 124Ω 1 MW IN jack.

7. OPERATION

(A) Calibration

7.01 The 70B power meter is designed and balanced for use with the meter face in the horizontal position. Thus, while it will measure when in an upright position, it will not be accurate.

7.02 The following calibration should be made whenever maximum absolute accuracy is desired and at least at the start of each day's tests, or whenever a thermocouple has been changed or severely overloaded. If the thermocouple calibration tolerance as outlined in the calibration procedures do not check, the thermocouple element should be replaced. If a calibration becomes necessary in the middle of a



NOTE - MULTIPLIER RESISTOR R IS: 1347Ω ±0.1% FOR 75Ω CAL.
1737Ω ±0.1% FOR 124Ω CAL.

Fig. 9 — 70B Power Meter Calibration Schematic

series of measurements in which the maximum differential accuracy is desired, measurements already made should be repeated. In the following procedures refer to Fig. 9, which shows the essential circuit conditions prevailing for each of the four CAL dial positions. Always tap the meter case lightly to eliminate friction in the needle bearing.

7.03 ***IN ALL CASES, THE FOLLOWING PARAGRAPH IS MOST IMPORTANT FOR MAXIMUM ACCURACY:*** With no input to the meter, check that the meter pointer lines up with the line at the left of the −10 DB scale marking. See Fig. 10. If it does not, adjust the meter ZERO ADJUST screw for correct alignment.

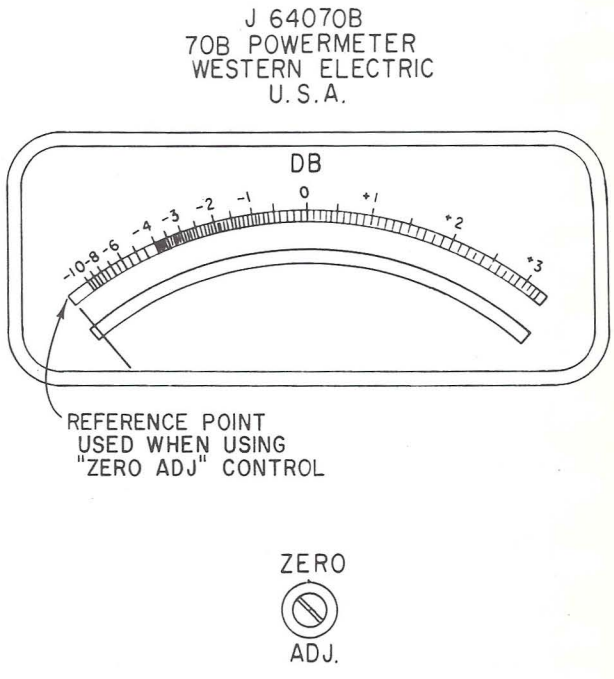


Fig. 10 – Zero Adjust Point on 70B Power Meter

75Ω UNBAL — REF LEVEL 1 MW

7.04 ***Procedure:***

(1) Insert a 372A patching plug into the 75Ω 1 MW IN and the 75Ω CAL jacks.

(2) Turn the IMPEDANCE switch to the 75Ω position.

(3) Place the REF LEVEL key in the 1 MW position.

(4) Turn the CAL switch to the DIAL 1 OR 3 position.

(5) Depress the BAT key.

(6) Adjust the 75Ω CAL DIAL 1 control until the meter indicates 0 db.

(7) Turn the CAL switch to the RES CHECK position.

(8) Check that the meter indicates within ±0.02 db of 0 db.

(9) Turn the CAL switch to the DIAL 2 OR 4 position.

(10) Adjust the 75Ω CAL DIAL 2 control until the meter indicates 0 db.

(11) Release the BAT key.

(12) Turn the CAL switch to the MEAS position.

(13) Remove the 372A patching plug from the 75Ω 1 MW IN and 75Ω CAL jacks and insert it into the 75Ω 1 MW IN and 75Ω PROT PADS OUT jacks.

(14) The circuit is now ready for operation for the 75Ω UNBAL input with respect to a reference level of one milliwatt.

75Ω UNBAL — REF LEVEL 1 V P-P

7.05 ***Procedure:***

(1) Make the same circuit preparations as in Paragraph 7.03(1-5) with the exception of placing the REF LEVEL key in the 1 V P-P position.

(2) Adjust the 75Ω CAL DIAL 1 control until the meter indicates 0 db.

(3) Turn the CAL switch to the RES CHECK position.

(4) Check that the meter indicates within ±0.02 db of 0 db.

(5) Turn the CAL switch to the DIAL 2 OR 4 position.

(6) Adjust the 75Ω CAL DIAL 2 control until the meter indicates 0 db.

(7) Release the BAT key.

(8) Turn the CAL switch to the MEAS position.

(9) Remove the 372A patching plug from the 75Ω 1 MW IN and 75Ω CAL jack and insert it into the 75Ω 1 MW IN and 75Ω PROT PADS OUT jacks.

(10) The circuit is now ready for operation for the 75Ω UNBAL input with respect to a reference level of one volt peak-to-peak.

124Ω BAL — REF LEVEL 1 MW

7.06 ***Procedure:***

(1) Connect the 124Ω 1 MW IN jacks to the 124Ω CAL jacks by means of two 372A patching plugs.

(2) Turn the IMPEDANCE switch to the 124Ω position.

(3) Place the REF LEVEL key in the 1 MW position.

(4) Turn the CAL switch to the DIAL 1 OR 3 position.

(5) Depress the BAT key.

(6) Adjust the 124Ω CAL DIAL 3 control until the meter indicates 0 db.

(7) Turn the CAL switch to the RES CHECK position.

(8) Check that the meter indicates within ±0.02 db of 0 db.

(9) Turn the CAL switch to the DIAL 2 OR 4 position.

(10) Adjust the 124Ω CAL DIAL 4 control until the meter indicates 0 db.

(11) Release the BAT key.

(12) Turn the CAL switch to the MEAS position.

(13) Remove the 372A patching plugs from the 124Ω CAL and 124Ω 1 MW IN jacks and patch each 124Ω 1 MW IN jack to the adjacent 124Ω PROT PADS OUT jack with the two 372A patching plugs.

(14) The circuit is now ready for operation for the 124Ω BAL input with respect to a reference level of one milliwatt.

124Ω BAL — REF LEVEL 1 V P-P

7.07 ***Procedure:***

(1) Make the same circuit preparations as in Paragraph 7.05(1-5) with the exception of placing the REF LEVEL key in the 1 V P-P position.

(2) Adjust the 124Ω CAL DIAL 3 control until the meter indicates 0 db.

(3) Turn the CAL switch to the RES CHECK position.

(4) Check that the meter indicates within ±0.02 db of 0 db.

(5) Turn the CAL switch to the DIAL 2 OR 4 position.

(6) Adjust the 124Ω CAL DIAL 4 control until the meter indicates 0 db.

(7) Release the BAT key.

(8) Turn the CAL switch to the MEAS position.

(9) Remove the 372A patching plugs from the 124Ω CAL and 124Ω 1 MW IN jacks and patch each 124Ω 1 MW IN jack to the adjacent 124Ω PROT PADS OUT jack with the two 372A patching plugs.

(10) The circuit is now ready for operation for the 124Ω BAL input with respect to a reference level of one volt peak-to-peak.

(B) Preliminary Measurements

7.08 After making the proper calibration by the procedures described in Part 7(A) and with the protection pads patched in the circuit, the appropriate MEAS IN jack of the power meter may be connected to the apparatus under test by using either the balanced or the unbalanced cord provided in the cover of the carrying case.

Caution: Precautions should be taken to avoid connecting the power meter to a signal having a level in the excess of +3 dbm. The protection pads in the power meter, if left in circuit, will protect the thermocouple from burnout at levels up to +30 dbm but should not be used to measure high levels.

(1) Before depressing either of the PROT PADS keys, note that the meter deflection does not exceed −10 db on the scale.

(2) Depress the PROT PADS 1 key. The indication should not exceed −10 db on the scale.

(3) Depress the PROT PADS 1 and 2 keys. The indication should now be somewhere on the meter scale.

(4) For highest differential accuracy the region between −1 and +1 db should be used.

(5) For the greatest absolute accuracy, measurements should be made at 0 db on the meter scale.

(6) The meter case should be tapped lightly, when making measurements, in order to eliminate friction in the needle bearing.

(7) The protection pads each have approximately 13 db loss. Measurements should not be made with either pad in circuit.

(C) Final Measurements

7.09 For best absolute and differential accuracy with frequency and after the steps of Paragraph 7.07 have been taken to ascertain that a safe level exists, the equipment under test should be directly connected to the 124Ω 1 MW IN or the 75Ω 1 MW IN jack. This connection eliminates the protection pad and associated cabling, and thereby improves the accuracy. Great care must be exercised to avoid burning out or severely overloading the thermocouple.

8. MAINTENANCE — 70A and 70B POWER METERS

(A) Caution

8.01 The 70A and 70B power meters are precision instruments incorporating a delicate microammeter and sensitive thermocouple elements. Great care should be exercised in handling, to avoid mechanical shock and electrical overloads.

(B) Dry Cell

8.02 The 1.5-volt dry cell, coded KS-14711 or KS-6522, must be replaced when the dry cell voltage drops to such a value that the calibrating conditions cannot be obtained. To replace the dry cell, loosen the four captive screws in the panel and remove the unit from its case. The dry cell can readily be replaced by undoing the metal strap fastening it. Care should be exercised to maintain the correct polarity.

(C) Thermocouple Unit (Field Change)

8.03 The 75-ohm, 110-ohm and 124-ohm thermocouples may be replaced when burned out or damaged, by loosening the two screws on

the panel holding the thermocouple units. The thermocouple units are comprised of a jack, appropriately designated, thermocouple element and cartridge which acts as a shield. When the unit to be replaced has been removed from the panel as far as the connecting leads will permit, the leads may be removed by loosening two screws at the rear of the unit. Replace the complete unit with one of the spares carried in the cover, making certain to connect the leads in the polarity indicated. The unit containing the burned out or damaged thermocouple should be returned to the repair depot for replacement. The 70A power meter thermocouple units are shown in Fig. 11(a) (b) and the 70B power meter thermocouple units are shown in Fig. 11(c) (d). The 75-ohm thermocouple unit provided with the 70A and 70B power meters are similar in physical dimensions with the exception that the unit provided with the 70B power meter contains a small capacitor as outlined in Paragraph 5.02. See Fig. 11. The same type of thermocouple element is installed in both and the units are interchangeable. Slightly better performance up to 20 megacycles will be obtained if the unit containing the capacitor is installed in the 70A power meter. The unit for the 70A power meter is designated ED-62934-01 and for the 70B power meter, ED-59013-01. This is not intended as a modification but merely to expedite replacement when both types are available. The capacitor is not shown in the 70A power meter thermocouple circuit of Fig. 2.

(D) Thermocouple Unit (Repair)

8.04 Burned out or damaged thermocouple elements may be replaced by removing the four screws holding the coverplate on the side of the cartridge. See Fig. 11. This will expose the thermocouple element. Unsolder the four thermocouple leads and replace with a new thermocouple of the proper type. Extreme care should be exercised in keeping the length of the two leads to the coaxial jack so that they do not exceed 1/4-inch and to avoid excessive heat to the terminals. A KS-14440 soldering copper or equivalent is recommended for their repair. The thermocouple elements are coded as follows:

75-ohm	Thermocouple	— KS-13489
110-ohm	"	— KS-13699
124-ohm	"	— KS-14690

9. DRAWINGS

9.01 Drawings (not attached) covering the circuits and equipments of these sets are as follows:

(1) 70A Power Meter (J64070A)

Equipment Drawing — ED-62943-01

Schematic Diagram — SD-59280-011

(2) 70A Power Meter Modified for 124^{w} (J64070A)

Equipment Drawing — ED-62943-01

Schematic Diagram — SD-59280-012

(3) 70B Power Meter (J64070B)

Equipment Drawing — ED-59407-01

Schematic Diagram — SD-59663-01

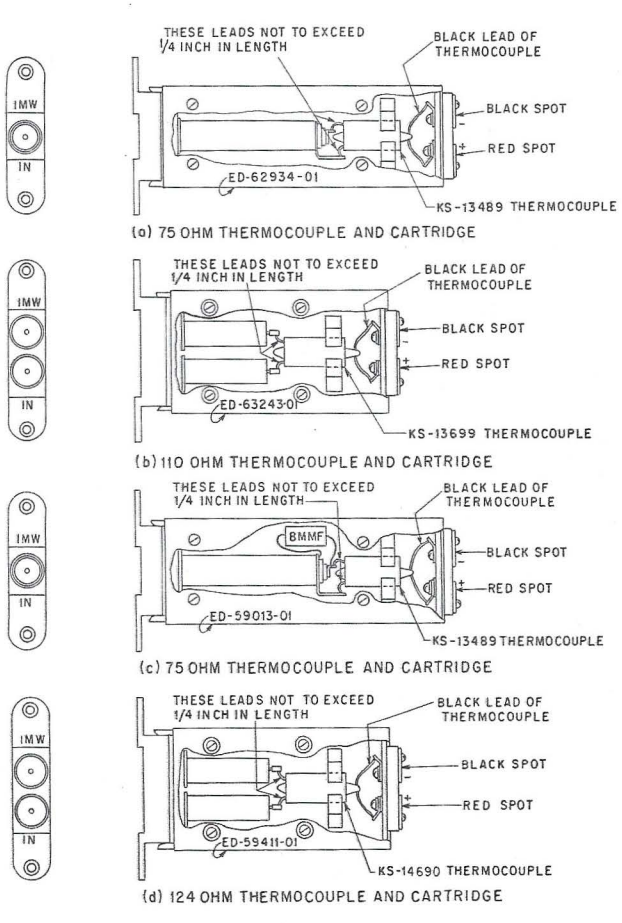


Fig. 11 – Thermocouple Units