sierra

INSTRUCTION MANUAL

BI-DIRECTIONAL POWER MONITOR MODEL 164B

SIERRA ELECTRONIC DIV.
OF
PHILCO
A SUBSIDIARY OF Ford Motor Company

Manufactured by

SIERRA ELECTRONIC DIV.

OF

PHILCO

A SUBSIDIARY OF *Ford Motor Company*

TELEPHONE (415) 322-7222 TWX 910-373-1282

Warranty

SIERRA ELECTRONIC DIVISION, PHILCO CORPORATION warrants instruments manufactured by it and bearing Sierra commercial model numbers, except Ion Gauge Tubes, to be free from defective material and factory workmanship and agrees to repair such instruments, which under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any such instrument which in our sole opinion upon our examination proves to be so defective, when returned to our factory, transportation prepaid by the purchaser, within one year from the date of original purchase from us.

This warranty does not apply to any of our products which have been repaired, worked upon or altered by persons not authorized by us so as, in our sole judgment, to injure the stability or reliability of such instrument, or which have been subject to misuse, negligence or accident, or the serial number of which has been altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by us. Nor does SIERRA ELECTRONIC DIVISION, PHILCO CORPORATION assume any liability for consequential damages, and in any event our liability shall in no case exceed the original purchase price of the instrument. Accessories, including but not limited to all vacuum tubes, fuses and batteries, not of our manufacture used with this product are not covered by this warranty.

SIERRA ELECTRONIC DIVISION, PHILCO CORPORATION reserves the right to make changes in the design or construction of any of its instruments at any time without incurring any obligation to make any changes whatever on units previously purchased.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to represent nor assume for us any liability in connection with the sale of our products other than set forth herein.

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LIST OF FIGURES

MANUAL CHANGES

Change the Replaceable Parts List as follows:

MODEL 270A-30

C101 CAPACITOR, mica 901810142

092366

Figure 1-1. Model 164B Bi-Directional Power Monitor

SECTION I
GENERAL

A. PURPOSE

The Model 164B Bi-Directional Power Monitor measures power flowing in 50 ohm coaxial transmission line systems. Using specially designed inserts, the instrument measures incident or reflected average power up to 5000 watts. The meter scale is also calibrated to read VSWR directly. The frequency range covered is 2 to 1000 megacycles. Each insert covers a given frequency range and four power ranges. Inserts are available separately, ordered according to user requirements.

The Model 164B is designed to be connected in series with the coaxial transmission line being tested, at any point between the rf source and the load. Rotation of the insert is all that is required to read incident or reflected power in any power range.

B. DESCRIPTION

The instrument is contained in a small, lightweight metal case. The indicating meter is shock mounted behind a sloping panel. The insert projects through a hole in the top of the case. On the exposed end of the insert there is an etched dial and a knob by which the desired power range is selected. The outer rim of the insert is knurled so that it may be easily turned. 180 degree rotation selects the direction in which power flow along the coaxial line is to be measured. A pin stop determines the insert position in either direction.

Insert units 180A-52, 180A-148, 270A-30 and 271A-30 have a frequency correction chart mounted on the power range selector knob. The multiplier is to be applied to power readings taken at or near the frequencies indicated. No correction is required for the remainder of the frequency range.

The upper and lower parts of the case are held together with quick-acting fasteners which permit easy access to the insert, the primary line body and the indicating meter. The case must be opened in order to remove or replace the insert. Three nylon wedges hold the insert firmly in place. These wedges are held in position by a clamp located on the primary line body.

The instrument is entirely self-contained and requires no external source of power, aside from that which is being measured.

Sierra "Twist-Off" RF connectors make it possible to directly mate the instrument to most coaxial line systems without the use of an adapter. See specifications for connector types available.

C. SPECIFICATIONS

1. MODEL 164B UNIT

Meter Scales	
Watts	0-10, 0-50
VSWR	1 to 20
Power Ranges	See Insert Specifications
Impedance, Primary Line	50 ohms
RF Connectors	Sierra "Twist-Off", one male, one female (Type N Supplied unless otherwise specified)
Connectors Available	Type C, N, HN, LC, BNC, TNC, UHF 1-5/8 Rigid Line
Dimensions	
Height	6-5/8 inches
Width (over connectors)	7 inches
Depth	7-7/16 inches
Weight (164B unit only)	7 pounds

2. INSERT UNITS

Model No.	Freq. mc	Power Range Watts	Insertion VSWR		Lowest Power Range Directivity	
			Lowest Power Range	Highest Power Range	Numerical ratio	db
180A-52	25-52	1, 5, 10, 50	1.05	1.05	63:1	18
180A-148	50-148	1, 5, 10, 50	1.08	1.05	200:1	23
180A-470	144-470	1, 5, 10, 50	1.16	1.08	300:1	25
180A-1000	460-1000	1, 5, 10, 50	1.16	1.08	300:1	25
181A-250	25-250	10, 50, 100, 500	1.08	1.05	1000:1	30
181A-1000	200-1000	10, 50, 100, 500	1.08	1.05	1000:1	30
270A-30	2-30	50, 100, 500, 1000	1.08	1.08	200:1	23
270A-75	10-75	50, 100, 500, 1000	1.08	1.05	600:1	28
270A-470	70-470	50, 100, 500, 1000	1.08	1.08	1000:1	30
271A-30	2-30	100, 500, 1000, 5000	1.08	1.08	200:1	23

Accuracy

Incident Power	±5% of full scale
Reflected Power	
±5% full scale (reflected power range) + $\frac{\text{Measured incident power}}{\text{Numerical directivity ratio}}$	
Weight	1 pound

3. ACCESSORIES

Carrying Case (164B and Four Inserts)	164B-CC
Equivalent Line Section	164-LS

SECTION II
OPERATION

A. INSERTION AND REMOVAL OF INSERT UNIT

1. INSERTION

a. Loosen quick acting fasteners and lift off case top.

b. Set power range knob to highest power range. This retracts coupling loop within recess and protects it from damage.

CAUTION

Bending or distortion of coupling loop will destroy instrument calibration. Keep loop end of insert covered with plastic cap when not in use.

c. Release wedge clamp buckle.

d. Orient insert so the pin on the side will fit into the recessed portion of the seat on the primary line body.

e. Place insert in position and close wedge clamp buckle. The nylon wedges fit into a circular groove on the insert. The pin engages a spring clip at each end of rotational travel so that it is held in either the forward or reverse reading position.

f. Connect meter cable to connector on side of insert.

g. Replace case top.

2. REMOVAL

a. Loosen quick acting fasteners and lift off case top.

b. Disconnect meter cable connector from side of insert.

c. Set power range knob to highest power range.

d. Open clamp wedge buckle and withdraw insert.

e. Place protective plastic cap over end of insert.

B. INCIDENT POWER MEASUREMENT

1. Remove all rf power from the transmission line to be tested.

2. Connect the Power Monitor into the transmission line between the rf source and the load.

3. Be sure Function switch (on VSWR CAL control) is in WATTS position.

4. Place the power range knob of the insert in the highest power range position.

5. Rotate the insert so that the power flow indicating arrow points toward the load.

NOTE

After the Power Monitor has been installed in the transmission line the insert may be rotated without removing the rf power from the line.

6. Apply rf power to line under test.

7. Select the power range that will give a convenient reading on the meter.

CAUTION

Use care in selecting the power range setting. The meter or rectifier diode may be damaged by overloads exceeding 300% of full scale.

C. REFLECTED POWER MEASUREMENT

1. Follow steps 1-4, paragraph B, above, if Power Monitor is not already connected into the transmission line.

2. Rotate insert so that power flow indicating arrow points toward the rf source.

3. Select the power range that will give a convenient reading on the meter.

4. Place power range knob in the highest power range position before rotating insert to read incident power.

D. VSWR

1. Using Direct Reading VSWR Scale

a. Check power in transmission line using procedure of paragraph B. above. Leave Insert set in incident power position (arrow pointing toward load).

NOTE

Power available must be about 20% greater than the maximum of the lowest range of the insert used. This is due to the effect on the meter of the VSWR calibrating circuit. If required power is not being transmitted, use a lower range insert or increase power in transmission line.

b. Turn Function switch (on VSWR CAL control) to VSWR CAL position.

c. Turn Insert to next lower power range.

d. Adjust VSWR CAL control until meter reads on CAL mark of VSWR scale.

e. Turn Insert to reflected power position (arrow pointing toward power source).

f. Read VSWR scale.

A more exact determination of VSWR may be made by using the procedure given in paragraph 2. below.

✳2. Using VSWR Chart

a. Follow steps 1-4, paragraph B, above, if Power Monitor is not already connected into the transmission line.

b. Read the Incident Power and record reading.

c. Read the Reflected Power and record reading.

d. Enter the VSWR chart, Figure 2-1, with the recorded readings and read the VSWR at the intersection of these readings.

For example: Incident Power is 500 watts, Reflected Power is 20 watts. Enter the chart with these readings and read VSWR as 1.5

Figure 2-1 is based on the equation:

$$VSWR = \frac{\sqrt{P_i} + \sqrt{P_r}}{\sqrt{P_i} - \sqrt{P_r}}$$

Where P_i = Incident Power
P_r = Reflected Power

This equation may be used for exact determination of intermediate points.

E. POWER ABSORBED BY LOAD

The radio frequency power absorbed by the load may be determined by subtracting the reading of the reflected power from the reading of the incident power.

For example: The incident power reading is 50 watts, and the reflected power reading is 5.5 watts. The power absorbed by the load is: 50 - 5.5 = 44.5 watts.

F. PERCENTAGE OF MODULATION

The average power of an amplitude modulated carrier increases over the CW level because of the additional power developed in the side bands. Provided the modulation is symmetrical, the modulation percentage of such a modulated carrier may be determined as follows:

1. Determine the power of the carrier without modulation.

2. Determine the power of the modulated carrier.

3. Apply the following equation:

$$\text{Percentage of Modulation} = 141 \sqrt{\frac{P_m}{P_{cw}} - 1}$$

Where P_m = Power under modulated conditions
P_{cw} = Power under CW conditions

NOTE

If carrier frequency shift is present it will introduce an error into this measurement.

G. DIRECTIVITY ERROR

The effect of imperfect directivity of the insert directional coupler for incident power readings is included within the specified accuracy of ±5%.

The effect on reflected power readings is according to the following equation:

$$\text{Error} = \pm 5\% \text{ full scale (reflected power range)} + \frac{\text{Measured incident power}}{\text{Numerical directivity ratio}}$$

For example: Incident power is 40 watts; Reflected power is 2 watts, read on the 5 watt scale; Insert numerical directivity ratio is 300:1 (25 db). Directivity error is:

$$\pm 0.05 \times 5 + \frac{40}{300} = \pm 0.38 \text{ watts}$$

As another example: The above conditions of measured power, but the numerical directivity ratio of the insert is 100:1 (20 db). Directivity error is:

$$\pm 0.05 \times 5 + \frac{40}{100} = \pm 0.65 \text{ watts}$$

H. APPLICATION NOTE

Under certain conditions insertion of the Power Monitor into the transmission line may cause a change in the rf power delivered to the load. This condition is usually observed when the power source is operating with a load that is not matched to the transmission line. When the Power Monitor is inserted the short section of line contained in the Monitor changes the electrical length of the system and therefore causes a change in the impedance into which the power source works. This condition may be handled by one of the following methods.

1. Retune or readjust the rf power source for delivery of normal power to the load.

2. Add a section of transmission line to the Power Monitor such that the combined length of the added section plus that in the Power Monitor equals one half wavelength for the frequency in use. Remove this added section when the Power Monitor is removed from the system.

3. Permanently include in the transmission line a short section equal in length to the electrical length of the line contained in the Power Monitor. (Sierra Model 164 LS, Equivalent Line Section is designed for this purpose.) When using the Power Monitor remove the short section from the line.

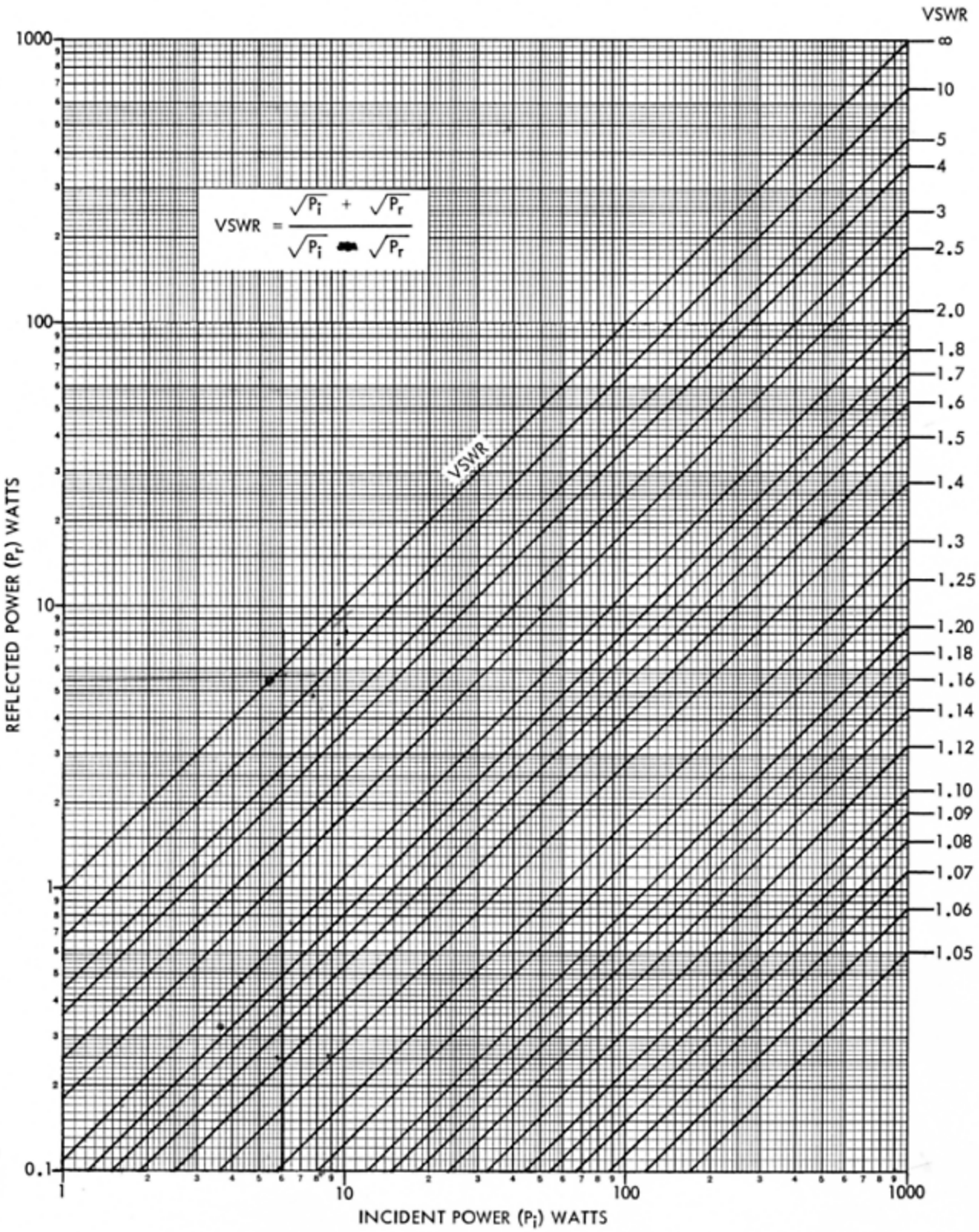


Figure 2-1. VSWR Chart

SECTION III
THEORY OF OPERATION

A. LINE AND METER UNIT

The Model 164B is made up of a 50 ohm coaxial primary line section and an indicating meter mounted in a suitable case. The primary line section is so designed that when the insert unit is properly clamped in place there will be a minimum effect on the VSWR of the line. The meter is a sensitive microammeter that reads directly the output of the insert unit to indicate power. When switched to the direct reading VSWR position, a calibrating network is connected across the meter. See Schematic Diagram Figure 3-1.

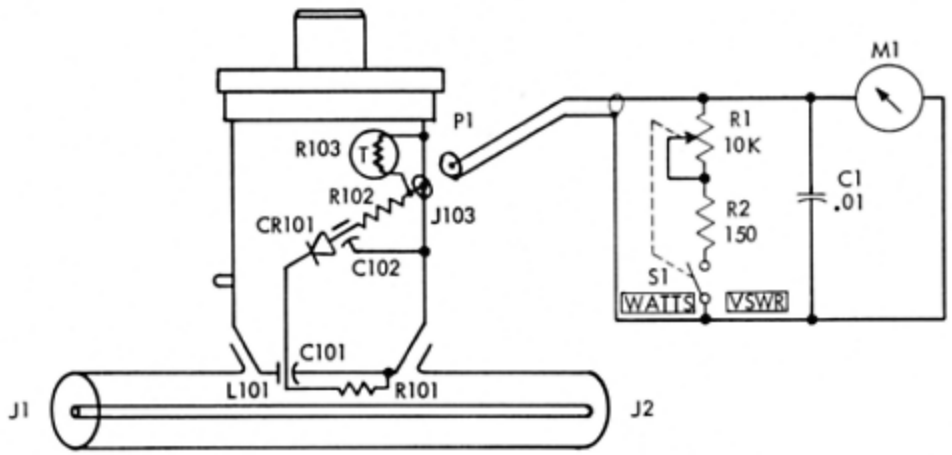


Figure 3-1. Model 164B Bi-Directional Power Monitor Schematic Diagram

B. INSERT UNITS

The insert units, Model 180A, 181A, 270A and 271A series, contain the directional coupler and the remainder of the meter circuitry.

The secondary line loop, L101, terminated on one end with R101 and on the other end by the meter rectifier diode, CR101, forms the directional coupler (See Figure 3-1.) C101 and the rf input resistance to the rectifier diode are a frequency compensating circuit that provides a constant coupling factor. C102 is a storage capacitor and R102 the rectifier diode load resistance. R102 also serves as the meter sensitivity resistor. R103 is a temperature compensating thermistor.

Power from one direction in the primary line is coupled into the secondary line loop and rectified. The dc output of the rectifier is indicated by the meter. Because of the rectifier characteristics and the circuit parameters, the meter reads average power directly on a linear scale.

The directional coupler loop and the meter rectifier components are mounted on a spring loaded sliding assembly within the insert unit. The knob on top of the insert unit operates a cam that precisely adjusts the distance the coupling loop projects into the primary line by positioning the sliding assembly. The position of the sliding assembly is adjustable, for calibration purposes, by four screws mounted inside the unit. The four coupling loop positions determine the power ranges of the insert.

SECTION IV
MAINTENANCE

A. MAINTENANCE

The primary line body should be kept free of dirt and foreign matter. Keep the mating surfaces between the primary line and the insert clean. Lubricate with a thin film of "Lubriplate" or similar lubricant as necessary.

No attempt should be made to clean the coupling loop since any distortion in shape will destroy the instrument calibration. Set the power range selector knob at the highest power range whenever the insert is handled. Keep the plastic cap on the end of the insert whenever it is not in the instrument.

B. CALIBRATION EQUIPMENT

The following equipment, or equivalent, is required to calibrate the Model 164 Power Monitor:

1. Power Signal Source.

2. Low-Pass Filter (Sierra Model 184 series).

3. 50 Ohm Terminations (Sierra Model 160 series).

4. Directional Coupler (Sierra Model 640A-645A series). Special coupling factor calibration.

5. Power Meter (Hewlett Packard 430C). Special high accuracy calibration.

6. Bolometer (Hewlett Packard 476A). Special high accuracy calibration.

A precision rf wattmeter or calorimeter of the required accuracy may be used instead of items 3 through 6.

C. CALIBRATION PROCEDURE

1. Connect equipment as shown in Figure 4-1.

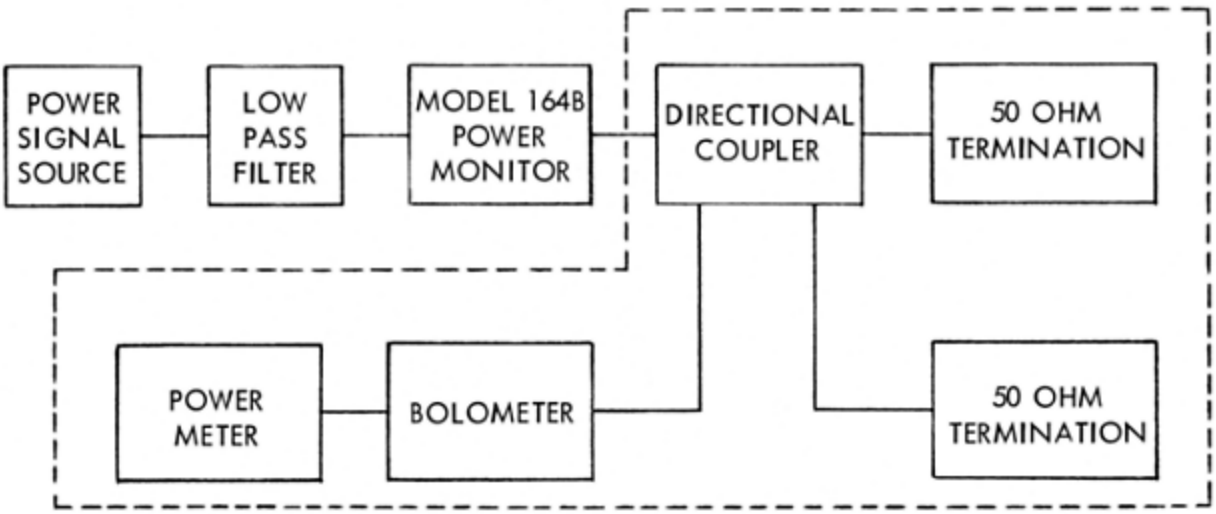
2. Rotate insert so that the power flow indicating arrow points toward the 50 ohm termination load.

3. Set power range knob to power level at which calibration is to be made.

4. Remove nameplate from top of insert. Unscrew the two 2-56 screws and lift off over knob. (Removal of knob is not necessary.)

5. Apply power from signal source. Any frequency within range of insert may be used.

6. Compare reading of Power Monitor with reading of Power Meter, taking into account the coupling factor of Directional Coupler for frequency being used.



A precision rf wattmeter or calorimeter may be used instead of units inside dotted lines.

Figure 4-1. Calibration Test Set-up

7. Adjustment

For each power range, the hole in top of insert through which adjustment is made is directly in line with arrow on knob.

a. Rotate Range Adjust knob about 15° clockwise from normal position, until hole in cam lines up with hole in top of insert.

b. Insert a hexagonal wrench, 1/8" across flats (3/32" in some units), through holes and engage calibrating screw.

c. If Power Monitor reading is low, turn wrench a small amount counter-clockwise.

d. If Power Monitor reading is high, turn wrench a small amount clockwise.

e. If correct reading cannot be obtained with a half turn in either direction, replace rectifier diode.

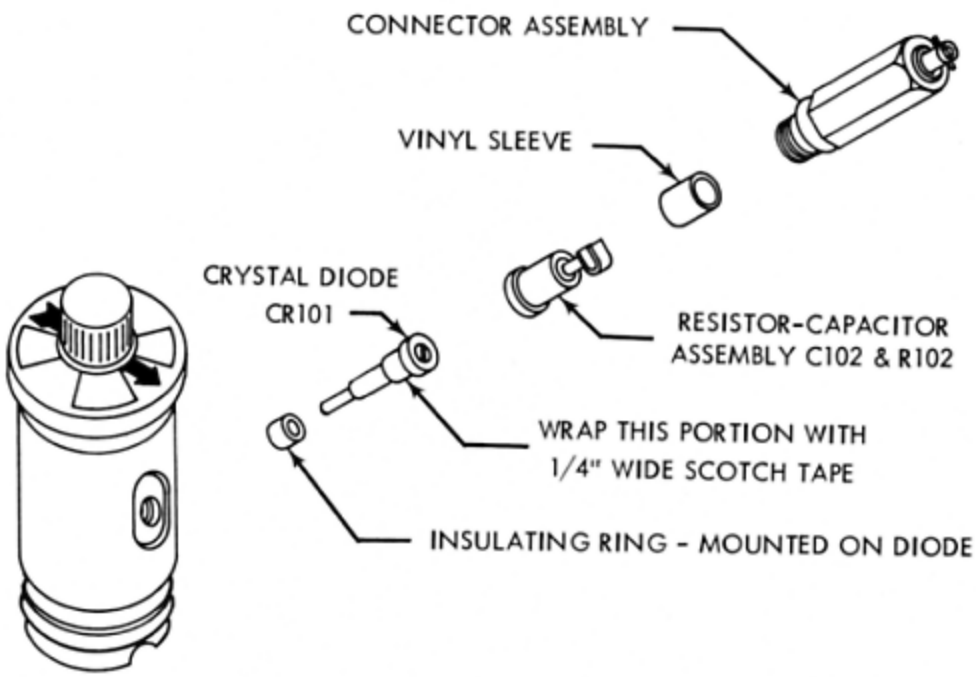


Figure 4-2. Diode Mounting Assembly

D. METER RECTIFIER DIODE REPLACEMENT

The Rectifier Diode may be replaced by removing the meter cable plug assembly from the side of the insert. (See Figure 4-2.) A hexagonal socket wrench, 1/2" between flats, should be used for this purpose.

The resistor-capacitor assembly will fall out and the diode will come out if the unit is tapped lightly.

Refer to Replaceable Parts List for Silicon Diode type number.

The instrument may be returned to Sierra Electronic Division, for recalibration and repair.

SECTION V
REPLACEABLE PARTS LIST

PARTS REPLACEMENT

Standard components have been used in this instrument whenever possible. Both standard and special components may be ordered direct from the factory.

When ordering parts always include:

1. Sierra Stock Number.
2. Circuit Reference and Commercial Description.
3. Name, Model and Serial Number of the Instrument.

Parts for this instrument, or further service information may be obtained from:

SIERRA ELECTRONIC DIVISION
Philco Corporation
3885 Bohannon Drive
Menlo Park, California 94025

Telephone (415) 322-7222
TWX 910-373-1282

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODEL 164B				
C1	CAPACITOR, ceramic .01 mfd ±20% 600WVDC	901420103	Erie	811-ED-01	1
J1	CONNECTOR, female Type N*	914600013	Sierra	SA-6823-2	1
J2	CONNECTOR, male Type N*	914600012	Sierra	SA-6822-2	1
M1	POWER METER	911800068	Sierra	A01974400	1
P1	PLUG, Type MB	914600088	FXR	44925	1
R1	POTENTIOMETER, 10K composition, audio taper with SPST switch	907900167	Chicago Tel. of Calif.	36938	1
R2	RESISTOR, 150 ohm ±5% 1/2 watt Fixed Comp.	905000151	AB	EB	1
S1	Part of R1				
	MODEL 180A-52				
C101	CAPACITOR, mica, button 160 mmf ±2% 500WVDC	901810161	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	075452000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 330 ohms ±10% 1/2 Watt Fixed Comp.	905200331	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX862	1
	MODEL 180A-148				
C101	CAPACITOR, mica, button 110 mmf ±2% 500 WVDC	901810111	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	075362000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 270 ohms ±10% 1/2 Watt Fixed Comp.	905200271	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX862	1
	*See Specifications Page 1-2				

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODEL 180A-470				
C101	CAPACITOR, mica, button 60 mmf ±2% 500 WVDC	901810600	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500008	Sierra	SS-13154-1-4	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	065571000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 1500 ohms ±10% 1/2 Watt Fixed Comp.	905200152	AB	EB	1
R103	THERMISTOR, 10K nominal	913600003	VECO	41D2	1
	MODEL 180A-1000				
C101	CAPACITOR, mica, button 25 mmf ±1 mmf 500 WVDC	901810250	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	075281000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 270 ohms ±10% 1/2 Watt Fixed Comp.	905200271	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX 862	1
	MODEL 181A-250				
C101	CAPACITOR, mica, button 280 mmf ±2% 500WVDC	901810281	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	065571000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 470 ohms ±10% 1/2 Watt Fixed Comp.	905200471	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX862	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODEL 181A-1000				
C101	CAPACITOR, mica, button 52.5 mmf ±2% 500 WVDC	901810500	Sangamo	M100	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500008	Sierra	SS-13154-1-4	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	065561000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 1800 ohms ±10% 1/2 Watt Fixed Comp.	905200182	AB	EB	1
R103	THERMISTOR, 10K nominal	913600003	VECO	41D2	1
	MODEL 270A-30				
C101	CAPACITOR, mica, button 1400 mmfd ±2% 500 WVDC	902610142	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	075452000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt, Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 270 ohms ±10% 1/2 Watt Fixed Comp.	905200271	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX862	1
	MODEL 270A-75				
C101	CAPACITOR, mica, button 800 mmf ±2% 500 WVDC	901810801	Sangamo	M110	1
C102	CAPACITOR, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, type MB	914600011	IPC	46,000	1
L101	LOOP	078202000	Sierra		1
R101	RESISTOR, 68 ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 270 ohms ±10% 1/2 Watt Fixed Comp.	905200271	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX862	1

REPLACEABLE PARTS LIST

Schem. Ref. No.	Description	Sierra Stock No.	Mfr.	Dwg. or Mfr. No.	Tot. Quan.
	MODEL 270A-470				
C101	CAPACITOR, mica, button 160 mmf ±2% 500 WVDC	901810161	Sangamo	M110	1
C102	CAPACITOR, ceramic, button 1000 mmf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500008	Sierra	SS-13154-1-4	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	075281000	Sierra		1
R101	RESISTOR, 68 Ohms ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 1200 Ohms ±10% 1/2 Watt Fixed Comp.	905200122	AB	EB	1
R103	THERMISTOR, 10K nominal	913600003	VECO	41D2	1
	MODEL 271A-30				
C101	CAPACITOR, mica, button 1950 pf ±2% 500 WVDC	901801951	Sierra	SS-10417-1-2	1
C102	CAPACITOR, ceramic button, 1000 pf GMV 500 WVDC	902620102	Centralab	ZB-102	1
CR101	DIODE, silicon, cartridge type (Special 1N21)	910500007	Sierra	SS-13154-1-2	1
J101	CONNECTOR, Type MB	914600011	IPC	46,000	1
L101	LOOP	075452000	Sierra		1
R101	RESISTOR, 68 ohms, ±5% 1/2 Watt Fixed Comp.	905000680	AB	EB	1
R102	RESISTOR, 270 ohms, ±10% 1/2 Watt Fixed Comp.	905200271	AB	EB	1
R103	THERMISTOR, 8000 ohms nominal	913600002	VECO	TX862	1

K4XL's  BAMA

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