HP Archive

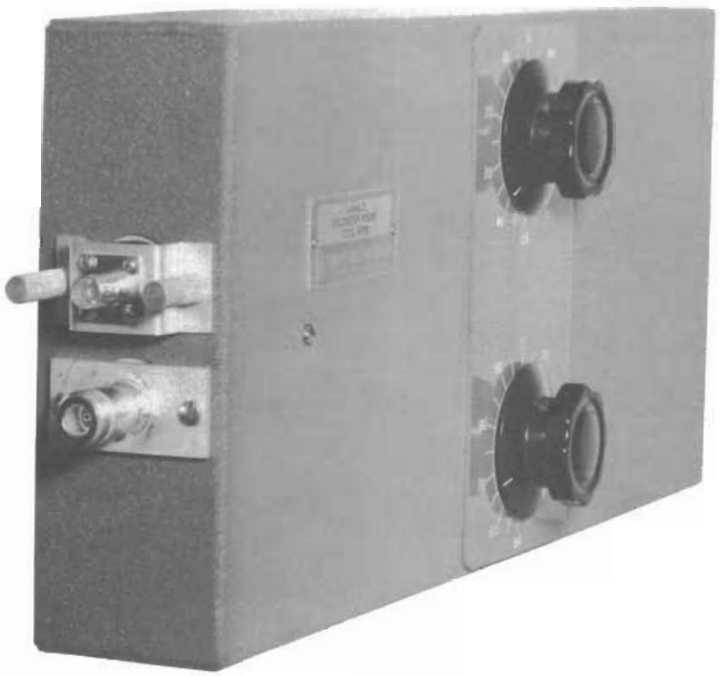
OPERATING AND SERVICING MANUAL

FOR

MODEL 475B

TUNABLE BOLOMETER MOUNT

Serial 11 and Above



HEWLETT-PACKARD COMPANY
275 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

SPECIFICATIONS

FREQUENCY RANGE:	Approximately 1000 - 4000 MC (varies with SWR and phase of source and value of bolometer load.)
POWER RANGE:	0.1 to 10 milliwatts (with -hp- Model 430C Microwave Power Meter.)
FITTINGS:	Input Connector - Type N female (UG 23/U). Output Connector (bolometer dc connection) - Type BNC (UG 89/U). Type N Male Connector (UG 21/U) supplied to replace bolometer connector so that mount may be used as a conventional double-stub transformer.
POWER SENSITIVE ELEMENT:	Selected 1/100 ampere instrument fuse. Sperry 821 or Narda N821 Barretter. Western Electric Type D166382 Thermistor.
OVERALL DIMENSIONS:	18" long x 7-3/8" wide x 3-5/8" deep.
WEIGHT:	8 pounds.

OPERATING INSTRUCTIONS

INSPECTION

This instrument has been thoroughly tested and inspected before being shipped and is ready for use when received.

After the instrument is unpacked, it should be carefully inspected for any damage received in transit. If any shipping damage is found, follow the procedure outlined in the "Claim for Damage in Shipment" page at the back of this instruction book.

OPERATION

Power Measurements

Connect a signal generator or other source of power to the Type N input connector on the end of the instrument. Mount a fuse, barretter or other bolometer element in the output connector assembly (see paragraph on "Bolometer Replacement") and connect a Hewlett-Packard Model 430C Power Meter to the Type BNC output connector. A substitution bridge or other means of measuring power may be substituted for the Model 430C. Tune the two stubs until a maximum reading is obtained on the power meter. Care must be taken to get a true maximum as at some frequencies it is possible to get a false maximum by tuning each stub individually. To insure getting a true match, either stub may be tuned slightly in one direction and then in the other while the other stub is rocked back and forth. This will yield the true maximum. Dials are provided on the tuning knobs so that in production testing, the approximate stub positions for each frequency may be noted. This allows rapid tuning and insures using the best combination of stub susceptances at all frequencies.

At the higher frequencies, it is usually possible to obtain the same combination of susceptances at different dial readings. This occurs because the stubs are more than one-half wavelength long and the susceptance obtainable at one setting is also obtainable at all points which are a multiple of a half-wavelength away from that setting. Occasionally a slight difference in the power readings at these different dial settings may be noted. For highest accuracy, the lowest dial setting attainable should be used.

At frequencies where the available stub travel is no limitation, it is always possible to match a given load to the line with two combinations of stub susceptances. At some frequencies the susceptances required by one combination can become great enough that

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stub losses will cause the power reading to be less than for the other combination. This effect shows up at the low end of the 475B range and rarely amounts to more than a db. Care should be taken to find the proper combination for greatest accuracy.

Operation as a Double-Stub Transformer

When the Model 475B is to be used as a double stub tuner, it is necessary to remove the bolometer and Type BNC output connector and substitute a Type N connector. Changing these assemblies is done as follows:

1. Unfasten the two thumbscrews and remove the output connector assembly.

2. Pull out the split-disk bolometer socket and instrument fuse. The capacitor, which is a laminated disk, will come out with the instrument fuse.

3. Unscrew the split-cup bolometer socket and remove from the hole in the center conductor.

4. Remove the four Phillips head screws along the bottom edge of the cabinet and lift out the bottom plate. Remove the center conductor D and the male input connector assembly from the bottom plate.

5. Screw the center conductor D into the hole from which the bolometer socket A was removed.

6. Slip the male connector assembly over the center conductor and fasten in place with the two thumbscrews. This completes the change to a double stub tuner.

7. When returning the instrument to its original condition, reverse the above procedure. Be careful to assemble the capacitor disk to the end of the stub so that the shoulder side of the disk fits into the end of the stub. Push the fuse into the split-cup bolometer socket as far as it will go.

The openings at the terminal ends of the stubs are identical so that the male connector assembly or female input connector assembly may be used on either stub. This also applies to the output connector assembly.

Bolometer Replacement

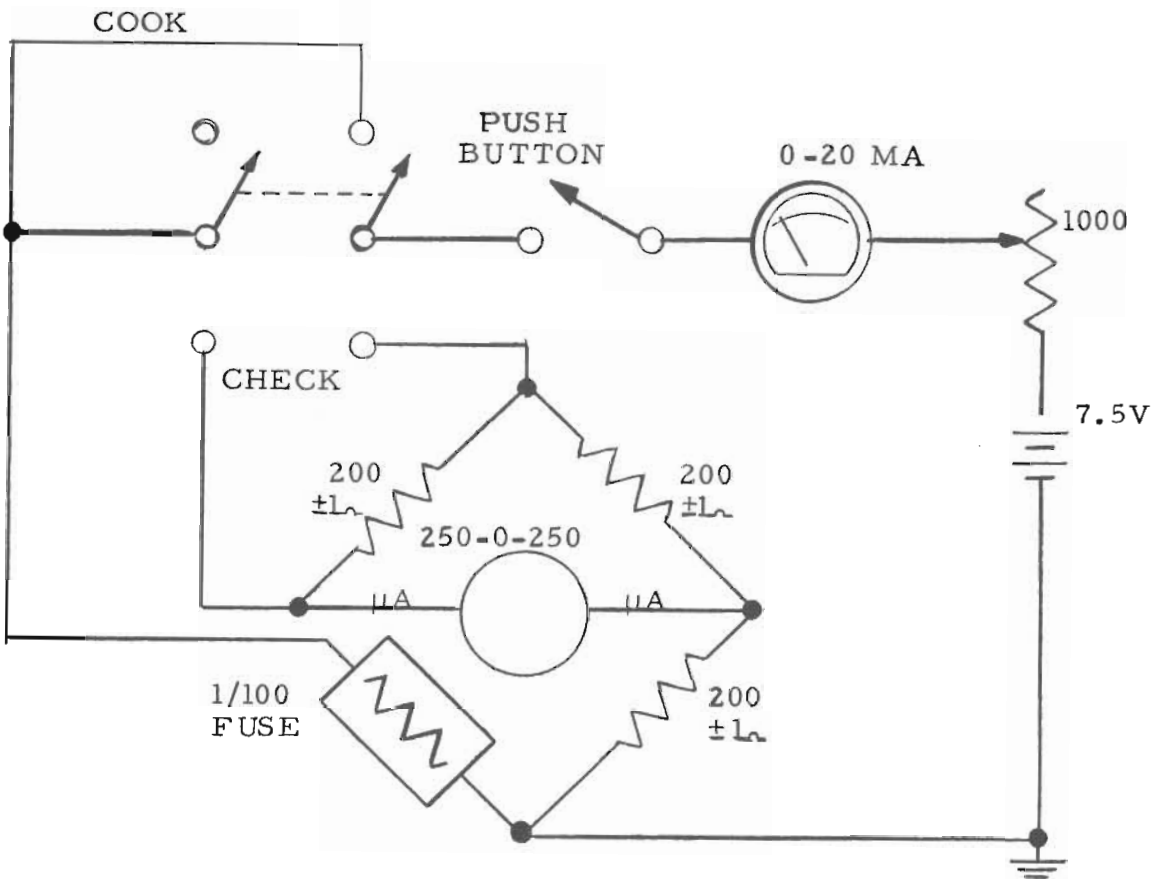
The Model 475B is shipped from the factory with a 1/100 ampere instrument fuse installed in the bolometer socket. These 1/100 ampere instrument fuses, such as the #MJB - 1/100 fuse manu-

factured by the Bussman Mfg. Co., St. Louis 7, Mo., have proven to be fully equivalent in performance to barretters up to about 3500 MC when used in a tunable mount. Above this frequency, power readings will be lower with the fuse than with the barretter. The error amounts to less than .5 db at 4000 MC.

When using the Model 475B in conjunction with the Model 430C, it is necessary that the 1/100 ampere instrument fuse have suitable resistance characteristics. A fuse can be used on any range of the Model 430C on which it is possible to set the meter to zero. Most fuses not usable on the top range will be usable on some lower ranges.

Some of the fuses failing to zero with the Model 430C may be treated to change their resistance characteristics and thus bring them within the operating range. The fuses having too low resistance are run momentarily at higher than normal temperature. This results in a permanent increase in resistance. Thus treated, many refected fuses may be brought into tolerance.

A circuit for rapidly checking and treating 1/100 ampere fuses is shown below.



The procedure for checking and treating fuses is as follows: (Ambient temperature should be 25°C ±1°C during this procedure.)

1. With fuse clipped in and DPDT switch in CHECK position, push button and adjust 1000 ohm potentiometer until galvanometer reads zero (center). Meter indicates total bridge current, half of which is current required to make fuse resistance 200 ohms. If between 8.50 and 9.00 MA (17 - 18 MA on meter) fuse is usable.*

2. If meter current is below 17, fuse cannot be used. (See note below.)

3. If meter current is above 18, throw switch to COOK and adjust potentiometer to give approximately 12 MA on meter. Check fuse again. Repeat, increasing current cautiously each time until fuse reaches 200 ohms at between 8.50 and 9.00 MA. When "cooking" temperature is reached, the current will be seen to drift downward. Do not hold the current for more than a second or so at a time.

Two barretter adapters are clipped to the bottom plate near the male connector assembly parts. These are provided to slip over the ends of a Sperry barretter to bring it up to the dimensions of a fuse. If difficulty is encountered in mounting the bolometer in the split-disk bolometer socket, it may be sprung open slightly with a screwdriver. Do not spring it too far as this socket must make good contact to the bolometer.

A capsule enclosed bead thermistor such as the W.E. Type D166382 can be used if it is provided with fuse or barretter type mountings. An uninsulated bead type, such as the W.E. 23A, can be mounted in a burned out barretter cartridge and used.

THEORY

The bolometer mount is essentially a double-stub transformer, used to match a 200-ohm load to a 50-ohm line. The stubs add shunt susceptance at two points and these, together with the length of line between them, give impedance transformation in a manner

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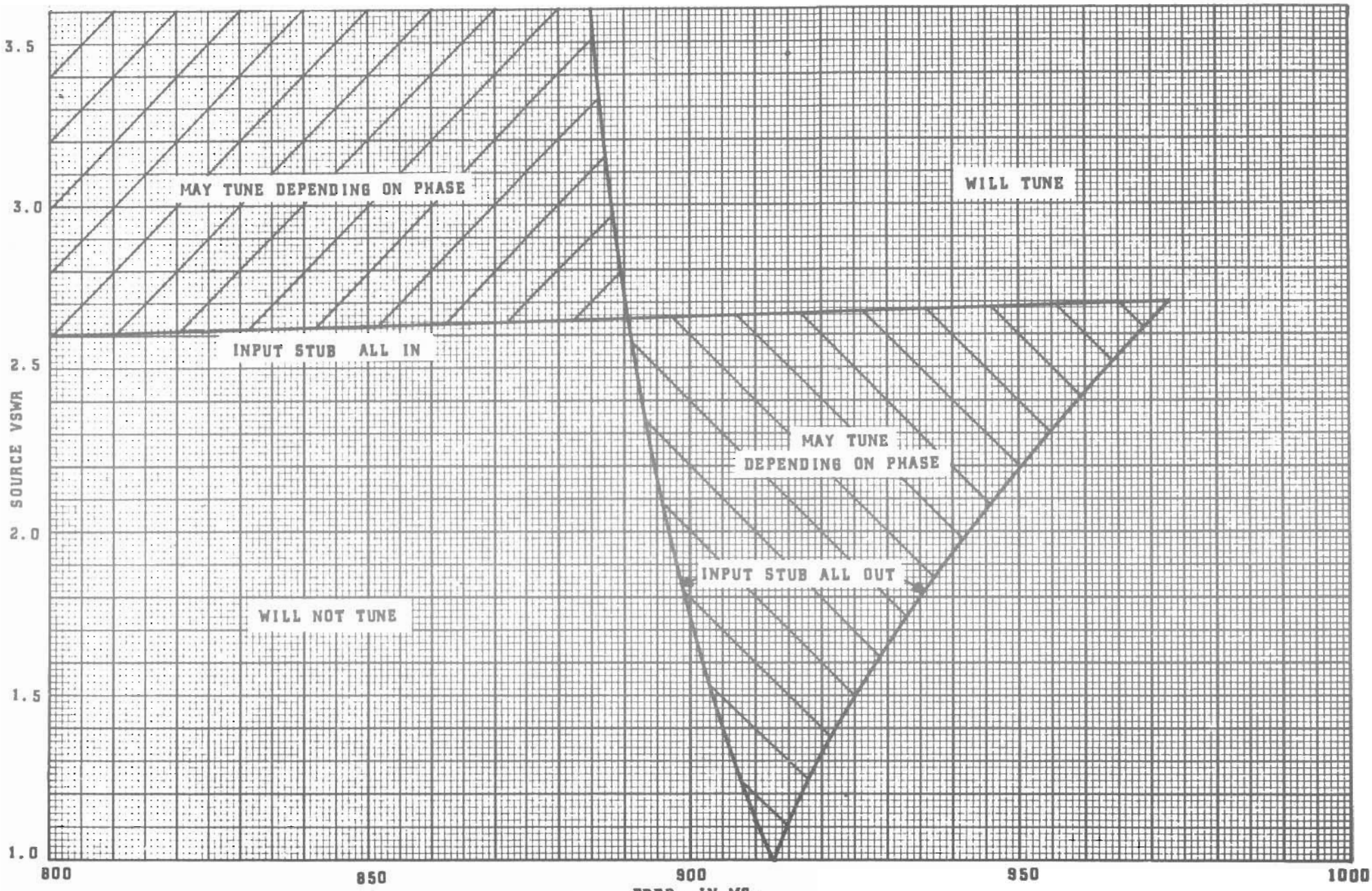
*A current of 8.50 to 9.00 MA is specified on the fuse for the Model 430C to work at any ambient from 0 to 50°C. Fuses which are 200 ohms at currents just below this may still work satisfactorily at 25°C on all ranges and if they don't work on the 10 MW range, may still work on lower ranges because of the greater range of DC available through zero set circuit. The sole criterion in any case is whether the Model 430C meter can be zero set.

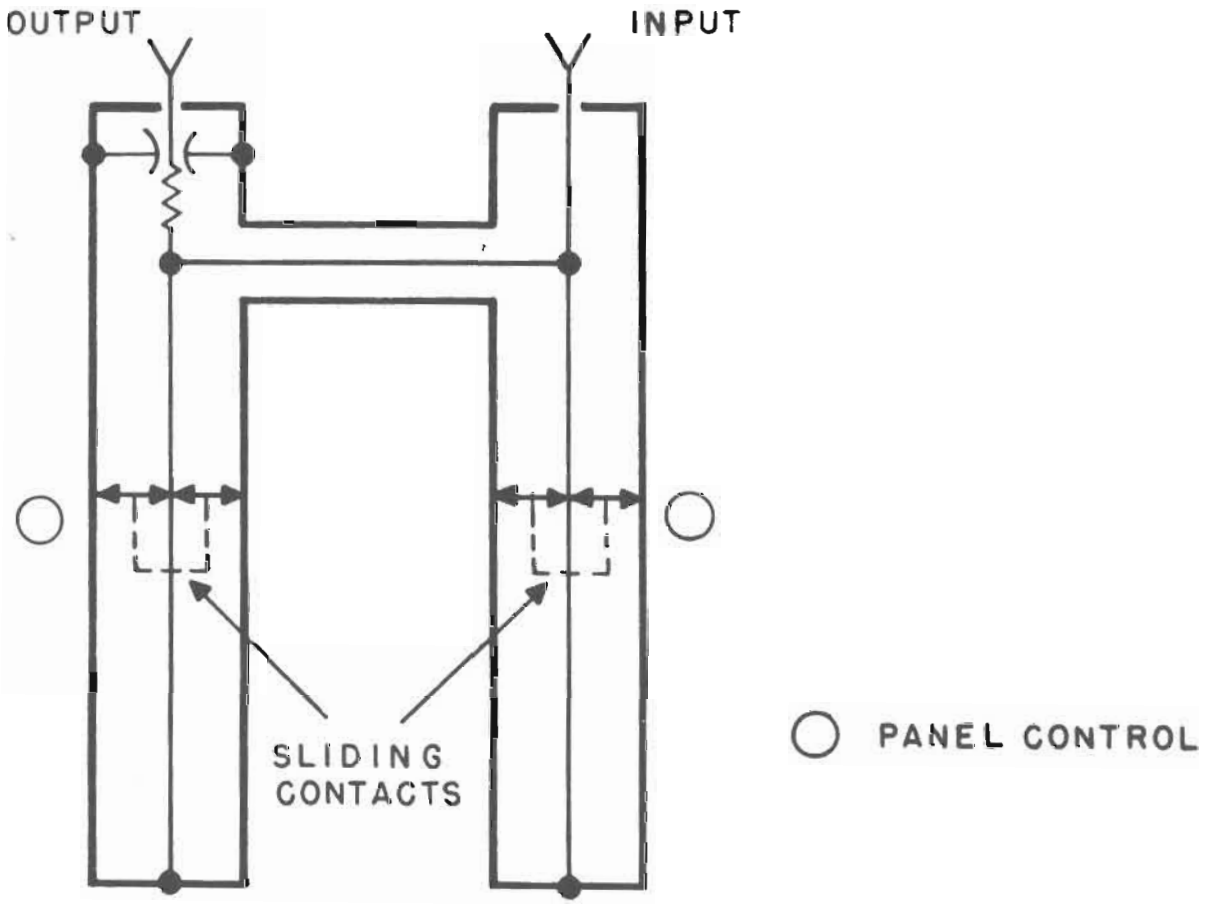
similar to a pi network. However, there is always an inherent limitation to the load a double-stub transformer can match to a line. At any frequency, the maximum value of load conductance component it is possible to match to a line with unity (Yo) admittance is equal to $1 + \cot^2 \beta\ell$, where $\beta\ell$ is the stub spacing in electrical degrees at that frequency.* If the load has a lower value of conductance, the line can have a higher value, and conversely. At the frequency for which the stub spacing is a quarter wavelength, these values are reciprocal.

At frequencies above 1000 MC, high line SWR's are quite commonly encountered. Also, because it is not practical to have the bolometer element right at the output stub, the conductance at the output stub increases with increasing frequency and this reduces the maximum permissible line SWR. To overcome these difficulties, special steps are taken in the design of the Model 475B. The line between stubs is designed to have a characteristic impedance of approximately 25 ohms instead of 50-ohms. A given load conductance, normalized on a 25-ohm basis, is half as great as on a 50-ohm basis. Taking the reciprocal of this to find the maximum source conductance gives a value twice as great as on a 50-ohm basis and reconverting to a 50-ohm basis gives a value four times as great. Thus by increasing the characteristic admittance between stubs by a factor of 2 to 1, the inherent limitation at the quarter-wave length frequency has been pushed up by a factor of 4 to 1. With the bolometer spacing used in the 475B, there is no inherent limitation up to a source SWR of at least 10 for any phase condition at any frequency in its range.

*Shown, for example, in Fig. 6-36 of "Microwave Transmission Design Data", by Moreno.



TYPICAL
FREQUENCY CUTOFF CURVE
MODEL 475B



SCHEMATIC DIAGRAM OF MODEL 475B TUNABLE BOLOMETER MOUNT

TABLE OF REPLACEABLE PARTS

NOTE

Any changes in the Table of Replaceable Parts will be listed on a Production Change sheet at the front of this manual.

When ordering parts from the factory always include the following information:

Instrument model number
Serial number
-hp- stock number of part
Description of part

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	-hp- Stock No.	Mfr. * & Mfrs. Designation
	Knob	37-13	HP
	Input Connector Assembly: (Female)	475B-95A	HP
	Connector Assembly: (Male)	475B-34S	HP
	Center Conductor "C":	475B-34K	HP
	Center Conductor "D":	475B-34Z	HP
	Thumb Screws:	475B-34F	HP
	Output Connector Assembly:	475B-95B	HP
	Capacitor:	475B-95C	HP
	Bolometer Socket A:	475B-34G	HP
	Bolometer Socket B:	475B-34H	HP
	Panel Plate:	475B-43A	HP
	Barretter Adapter:	475B-34V	HP
	Fuse, 1/100 amp. (treated and selected)	G28-A	HP
	Thermistor	211-23	HP
	NOTE Any changes in the Table of Replaceable Parts will be listed on a Production Change sheet at the front of this manual. When ordering parts from the factory always include the following information: Instrument model number Serial number -hp- stock number of part Description of part		

*See "List of Manufacturers **Code Letters For** Replaceable Parts Table."

LIST OF MANUFACTURERS CODE LETTERS FOR REPLACEABLE PARTS TABLE

Code Letter	Manufacturer
A	Aerovox Corp.
B	Allen-Bradley Co.
C	Amperite Co.
D	Arrow, Hart & Hegeman
E	Bussman Manufacturing Co.
F	Carborundum Co.
G	Centralab
H	Cinch-Jones Mfg. Co.
HP	Hewlett-Packard Co.
I	Clarostat Mfg. Co.
J	Cornell Dubilier Elec. Co.
K	Hi-Q Division of Aerovox
L	Erie Resistor Corp.
M	Fed. Telephone & Radio Corp.
N	General Electric Co.
O	General Electric Supply Corp.
P	Girard-Hopkins
Q	Industrial Products Co.
R	International Resistance Co.
S	Lectrohm, Inc.
T	Littlefuse, Inc.
U	Maguire Industries Inc.
V	Micamold Radio Corp.
W	Oak Mfg. Co.
X	P.R. Mallory Co., Inc.
Y	Radio Corp. of America
Z	Sangamo Electric Co.
AA	Sarkes Tarzian
BB	Signal Indicator Co.
CC	Sprague Electric Co.
DD	Stackpole Carbon Co.
EE	Sylvania Electric Products Co.
FF	Western Electric Co.
GG	Wilkor Products, Inc.
HH	Amphenol
II	Dial Light Co. of America
JJ	Leecraft Manufacturing Co.
KK	Switchcraft, Inc.
LL	Gremar Mfg. Co.
MM	Carad Corp.
NN	
OO	
PP	
QQ	
RR	
SS	
TT	
UU	
VV	
WW	
XX	
YY	
ZZ	Any tube having RETMA standard characteristics.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Hewlett-Packard Company warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Klystron tubes as well as other electron tubes, fuses and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid, to the factory or to the authorized repair station indicated on the instructions. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

All shipments of Hewlett-Packard instruments should be made via Truck or Railway Express. The instruments should be packed in a strong exterior container and surrounded by two or three inches of excelsior or similar shock-absorbing material.

DO NOT HESITATE TO CALL ON US

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