Instruction Manual
Bandpass Cavity Filters
6 5/8" and 10" Diameter

Manual Part Number

7-9145

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Warranty

This warranty applies for one year from shipping date.

TX RX Systems Inc. warrants its products to be free from defect in material and workmanship at the time of shipment. Our obligation under warranty is limited to replacement or repair, at our option, of any such products that shall have been defective at the time of manufacture. **TX RX Systems Inc.** reserves the right to replace with merchandise of equal performance although not identical in every way to that originally sold. **TX RX Systems Inc.** is not liable for damage caused by lightning or other natural disasters. No product will be accepted for repair or replacement without our prior written approval. The purchaser must prepay all shipping charges on returned products. **TX RX Systems Inc.** shall in no event be liable for consequential damages, installation costs or expense of any nature resulting from the purchase or use of products, whether or not they are used in accordance with instructions. This warranty is in lieu of all other warranties, either expressed or implied, including any implied warranty or merchantability of fitness. No representative is authorized to assume for **TX RX Systems Inc.** any other liability or warranty than set forth above in connection with our products or services.

TERMS AND CONDITIONS OF SALE

PRICES AND TERMS:
Prices are FOB seller's plant in Angola, NY domestic packaging only, and are subject to change without notice. Federal, State and local sales or excise taxes are not included in prices. When Net 30 terms are applicable, payment is due within 30 days of invoice date. All orders are subject to a $100.00 net minimum.

QUOTATIONS:
Only written quotations are valid.

ACCEPTANCE OF ORDERS:
Acceptance of orders is valid only when so acknowledged in writing by the seller.

SHIPPING:
Unless otherwise agreed at the time the order is placed, seller reserves the right to make partial shipments for which payment shall be made in accordance with seller's stated terms. Shipments are made with transportation charges collect unless otherwise specified by the buyer. Seller's best judgement will be used in routing, except that buyer's routing is used where practicable. The seller is not responsible for selection of most economical or timeliest routing.

CLAIMS:
All claims for damage or loss in transit must be made promptly by the buyer against the carrier. All claims for shortages must be made within 30 days after date of shipment of material from the seller's plant.

SPECIFICATION CHANGES OR MODIFICATIONS:
All designs and specifications of seller's products are subject to change without notice provided the changes or modifications do not affect performance.

RETURN MATERIAL:
Product or material may be returned for credit only after written authorization from the seller, as to which seller shall have sole discretion. In the event of such authorization, credit given shall not exceed 80 percent of the original purchase. In no case will Seller authorize return of material more than 90 days after shipment from Seller's plant. Credit for returned material is issued by the Seller only to the original purchaser.

ORDER CANCELLATION OR ALTERATION:
Cancellation or alteration of acknowledged orders by the buyer will be accepted only on terms that protect the seller against loss.

NON WARRANTY REPAIRS AND RETURN WORK:
Consult seller's plant for pricing. Buyer must prepay all transportation charges to seller's plant. Standard shipping policy set forth above shall apply with respect to return shipment from TX RX Systems Inc. to buyer.

DISCLAIMER

Product part numbering in photographs and drawings is accurate at time of printing. Part number labels on TX RX products supersede part numbers given within this manual. Information is subject to change without notice.

Manual Part Number 7-9145

First Printing: August 1996

Version Number	Version Date
1	08/05/96

Symbols Commonly Used

WARNING

ESD Elecrostatic Discharge

CAUTION or ATTENTION

Hot Surface

High Voltage

Electrical Shock Hazard

Use Safety Glasses

NOTE **Important Information**

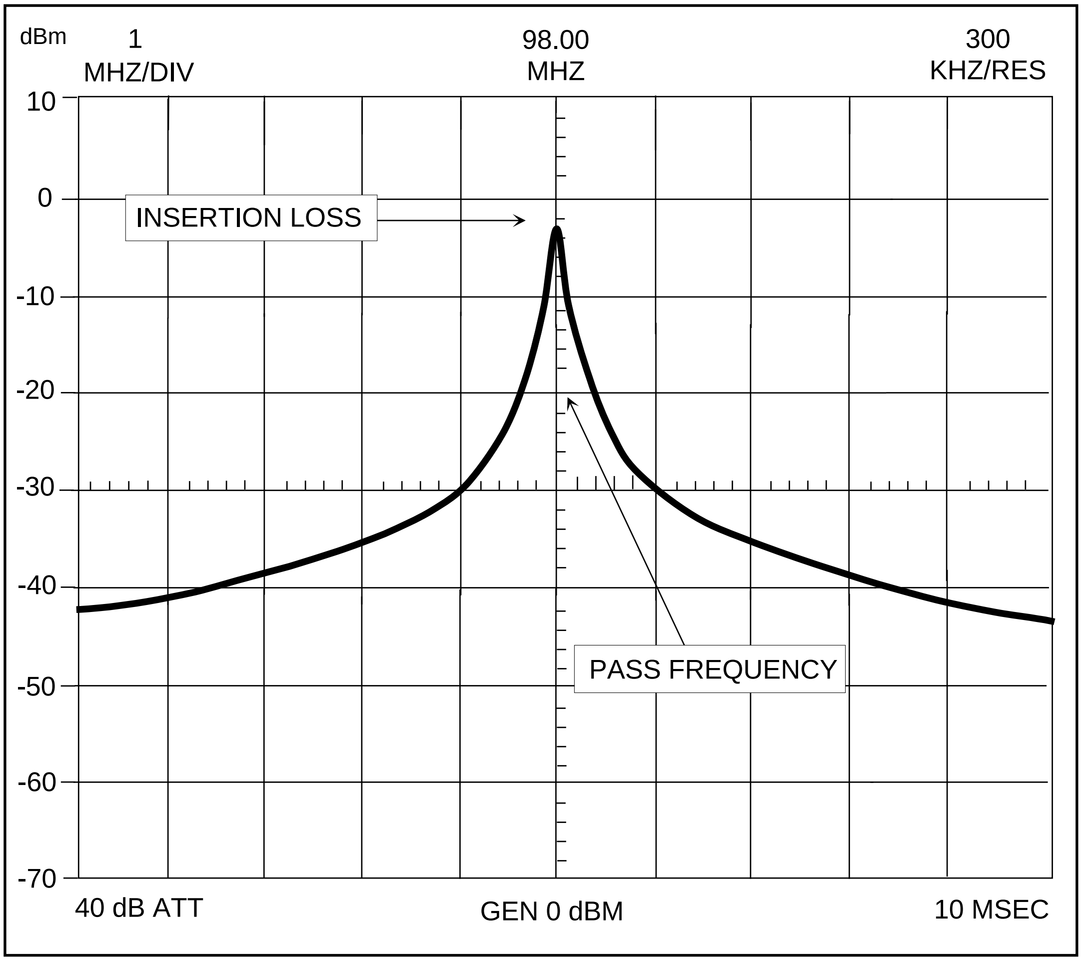


Figure 1: Spectrum Analyzer / Tracking Generator display of the Bandpass filter.
Response curve shown for model # 11-29-01 (88 - 108 MHz)

GENERAL DESCRIPTION

The Bandpass cavity filter passes one narrow band of frequencies (***passband***) and attenuates all others with increasing attenuation above and below the pass frequency. Bandpass filters have adjustable selectivity characteristics which allows a trade off between insertion loss and selectivity, with a higher loss giving greater selectivity. Maximum power handling is determined by the insertion loss setting. A variety of models are available that cover the range of frequencies from 30 to 960 MHz. The portion of the frequency range that each model will tune across is determined by the cavity's physical length.

Either 6-5/8" or 10" diameter resonator shells may be used to construct the filters. The difference between the two sizes determines the filters selectivity and it's maximum power dissipation. The 10" diameter filters have slightly higher selectivity compared to the 6-5/8" models and can safely dissipate up to 40 Watts of RF Power. The 6-5/8" filters can dissipate up to 30 Watts. Maximum input power for the 6" and 10" diameter filters is listed in table 1. When a filter is operated above 1.0 dB loss in transmitter applications, we recommend inserting a ferrite isolator between a transmitter and the Bandpass filter because the VSWR may exceed 1.5 : 1.

Insertion loss	6" diameter Power Rating	10" diameter Power Rating
0.5 dB	275 Watts	368 Watts
1.0 dB	146 Watts	194 Watts
3.0 dB	60 Watts	80 Watts

Table 1: Input power ratings.

There are two adjustable parameters found in a bandpass filter including the **pass frequency** and the **insertion loss**. Each of these parameters is

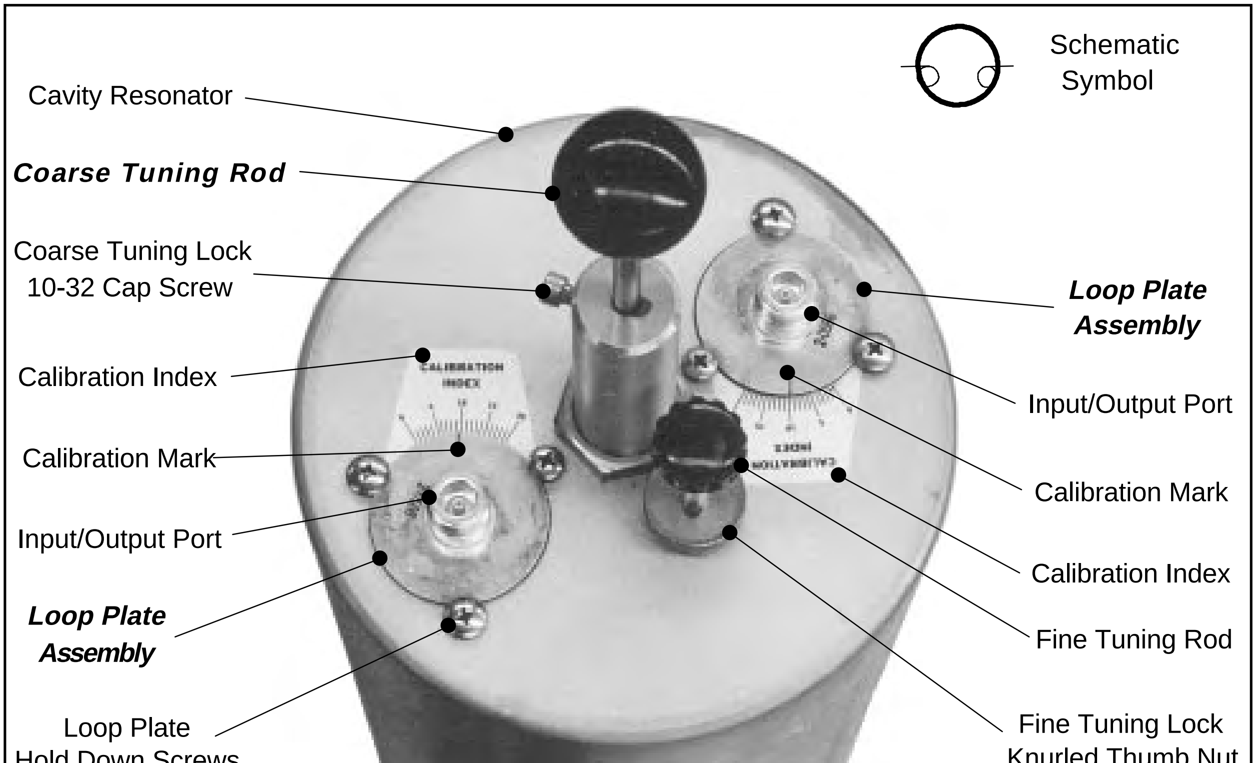


Figure 2: The Bandpass filter.

labeled in figure 1. All of the physical components of the filter are labeled in figure 2, with the adjustable parts shown in emboldened italics. Coarse and fine tuning rods are used to adjust the pass (resonant) frequency. The insertion loss is changed by rotating the two loop plate assemblies.

TUNING

Required Equipment

The following equipment or its **equivalent** is recommended in order to properly perform the tuning adjustments for the Bandpass filter.

1. IFR A-7550 Spectrum Analyzer with optional Tracking Generator installed.

2. Double shielded coaxial cable test leads (RG142 B/U or RG223/U).

3. 5/32" hex wrench.

4. Connector - female union (UG29-N or UG914-BNC)

5. Connector - tee (UG-107 B/U).

General Tuning Procedure

Tuning of the filter requires adjustment of the *pass frequency.* The pass frequency is adjusted by monitoring the output of a tracking generator after it passes through the filter. Adjustment of the insertion loss is optional on units that are preset by the factory, which is most often the case. To insure proper tuning of the Bandpass filter, all adjustments should be performed in the following order;

1. Preset loops to an index value of 10 if not factory set.

2. Tune the pass frequency.

3. Set the insertion loss if other than 1.0 dB loss is desired.

4. Fine tune the pass frequency

Cavity Tuning Procedure

1. Setup the analyzer / generator for the desired frequency and bandwidth (center of display) and also a vertical scale of 2 dB/div.

2. The resonant frequency of the filter is checked by connecting the tracking generator to the input of the cavity filter while the spectrum analyzer is connected to the output, as shown in figure 3.

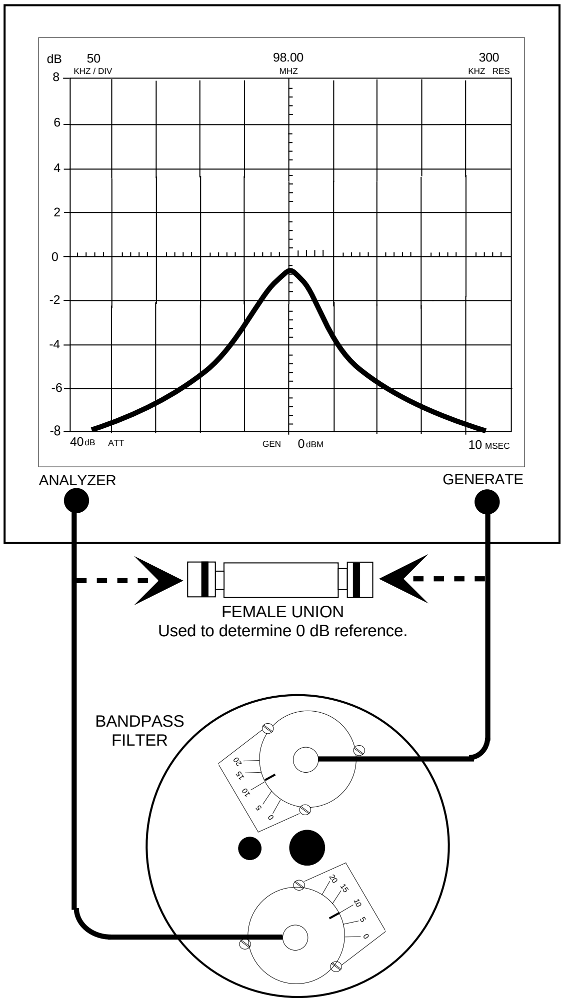


Figure 3: Checking cavity tuning.

3. Insure the IFR A-7550 menu's are set as follows: DISPLAY - line
   MODE - live
   FILTER - none
   SETUP - 50 ohm/dBm/gen1.

4. Set the fine tuning knob at it's mid-point. Adjust the pass frequency by setting the peak (minimum loss value) of the response curve to the desired frequency (should be the center-vertical graticule line on the IFR A-7550's display). See figure 3. The resonant frequency is adjusted by using the coarse tuning rod, which is a sliding adjustment (invar rod) that rapidly tunes the filter's response curve. The resonant frequency is increased by pulling the rod out of the cavity and is decreased by pushing the rod into the cavity. Additionally, the fine tuning rod, also a sliding adjustment (silver-plated-brass rod), allows a more precise setting of the response curve after the coarse adjustment is made. The resonant frequency is increased by pushing the fine tuning rod in and is decreased by pulling it out, the exact opposite of the coarse tuning rod.

5. Once the desired response is obtained using the coarse and fine tuning rods, they are "locked" in place. The coarse rod is secured by tightening the 10-32 cap screw and the fine tuning rod is held in place by tightening the knurled thumb nut. **Failure to lock the tuning rods** will cause a loss of temperature compensation and detuning of the cavity.

Cavity Tuning Tip

When tuning a cavity that has been in service for some time it is not unusual to find the main tuning rod hard to move in or out. This occurs because TX RX Systems Inc. uses construction techniques borrowed from microwave technology that provide large area contact surfaces on our tuning probes. These silver plated surfaces actually form a pressure weld that maintains excellent conductivity. The pressure weld develops over time and must be broken in order for the main tuning rod to move. This is easily accomplished by gently tapping the tuning rod with a plastic screwdriver handle or small hammer so it moves into the cavity. The pressure weld will be broken with no damage to the cavity.

Measuring and Adjusting Insertion Loss

1. A zero reference must first be established at the IFR A-7550 before the insertion loss can be measured. This is accomplished by temporarily placing a "female union" between the generator output and analyzer input, see figure 3.

2. The flat line across the screen is the generator's output with no attenuation, this value will become our reference by selecting the "Mode" main menu item and choosing the "Store" command.

3. Next select the "Display" main menu item and choose the "Reference" command. This will

cause the stored value to be displayed on the screen as the 0 dB reference value.

4. Connect the generator output and analyzer input to the input/output ports of the loop plates and the insertion loss will be displayed on the IFR A-7550's screen, refer to figure 3.

5. Insertion loss is usually factory adjusted, at which time index labels are attached to the top of the cavity next to the loop plates and calibration marks are stamped into the loop plates themselves. The index label serves as a relative index with insertion loss settings keyed to index numbers on the label. The calibration mark is normally factory aligned so that the index value of 10 will be equal to an insertion loss of 1.0 dB. The relative index labels are used to log specific filter performance. Insertion loss can be adjusted by loosening the 10-32 hold down screws and rotating the loop plates.

6. Rotating the loop plate assemblies and moving the calibration marks above or below 10 causes the insertion loss to be increased or decreased (above 10 increases the loss while below 10 decreases it). The insertion loss is adjustable across a useable range of from 0.5 dB to 3.0 dB. **It is important to set both loops to the same index number** so that the cavity's insertion loss remains balanced.

7. The insertion loss setting determines the selectivity of the filter and a change of loss will cause a shift in the width of the passband. The pass frequency of the cavity must be retuned after the insertion loss is adjusted, as changes in coupling also change the cavity's resonant frequency. Repeat steps 4 and 5 of the cavity tuning procedure in order to complete the cavity's tuning.

CONVERTING CAVITY RESONANT FILTERS

TX RX Systems Inc. produces four types of cavity filters, including the Vari-Notch®, Series-Notch®, Bandpass, and T-Pass®. The cavity resonator shell along with the coarse and fine tuning controls are standard subassemblies found in each type of filter for a specified frequency band. Differences between the types are determined by the loop plate assemblies installed in the filter.

Bandpass Filter Part #	Vari-Notch Lowpass Conversion Kit Part #	Vari-Notch Highpass Conversion Kit Part #	Series-Notch Lowpass Conversion Kit Part #	Series-Notch Highpass Conversion Kit Part #	T-Pass Conversion Kit Part #
11-28-01 11-28-05	76-28-02	76-28-03	76-28-04	76-28-05	76-28-07
11-29-01 11-29-05	76-29-02	76-29-03	76-29-04	76-29-05	76-29-07
11-35-01 11-35-05	76-35-02	76-35-03	76-35-04	76-35-05	76-35-07
11-36-01 11-36-05	76-36-03	76-36-04	76-36-05	76-36-06	76-38-01
11-37-01 11-37-05	76-37-03	76-37-04	76-37-05	76-37-06	76-38-01
11-54-01 11-54-05	N/A	N/A	N/A	N/A	76-53-01
11-55-01 11-55-05	N/A	N/A	N/A	N/A	76-53-01
11-65-01/-11 11-65-05/-25	76-65-03		76-65-04	76-65-05	76-67-01
11-69-01/-11 11-69-05/-25	76-69-03		76-69-04	76-69-05	76-67-01
11-70-01/-11 11-70-05/-25	76-70-03		76-70-04	7670-05	76-67-01

Note: The last two digits of the filters model number indicate it's diameter and wavelength as listed below;
1.) Last digit of "01" indicates 6-5/8" diameter and 1/4 λ. 2.) Last digit of "11" indicates 6-5/8" diameter and 3/4 λ.
3.) Last digit of "05" indicates 10" diameter and 1/4 λ. 4.) Last digit of "25" indicates 10" diameter and 3/4 λ.

Table 2: Conversion kit part numbers.

The filter's loop plate assembly may be changed in order to convert the cavity from one type of filter to another. Conversion kits can be ordered which contain all required parts for the conversion. The available conversion kits are listed by part number in table 2. Refer to the appropriate TX RX Systems Inc. manual for the specific filter type once the kit is installed.

Converting to Bandpass

When converting a Series-Notch or Vari-Notch filter into a Bandpass filter an additional index label must be applied to the cavity. Follow the procedure listed below for correct placement.

1. Install the bandpass loop plates into the loop plates holes of the cavity.

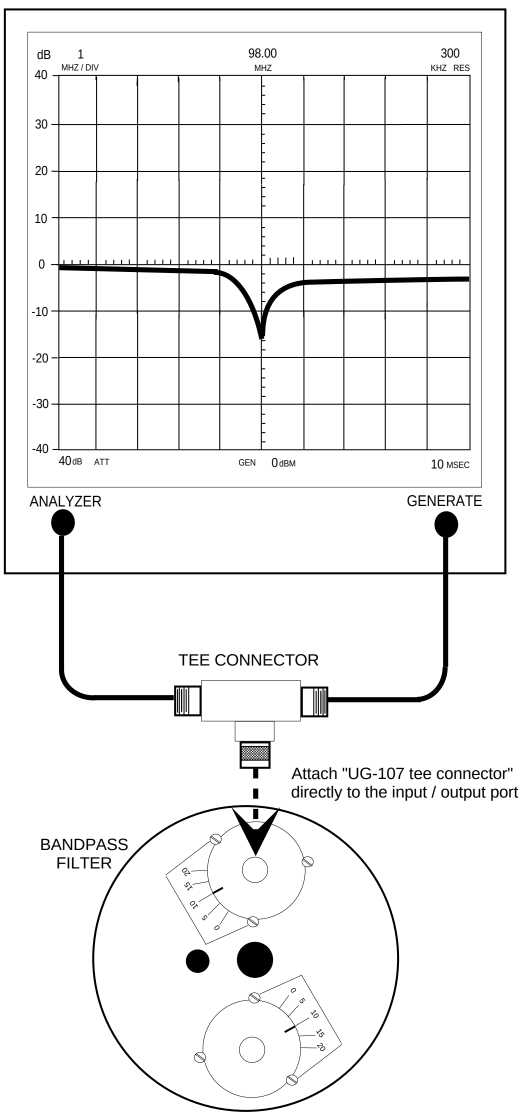


Figure 4: Measuring the rejection notch.

2. The bandpass loop plate installed at the position of the existing index label should be rotated until it's calibration mark aligns with the index value of 10 and then tightened down into place

3. Measure its rejection notch as shown in figure 4 and record the value for comparison with the unlabeled port. The amplitude of the rejection notch is directly proportional to the insertion loss .

4. Connect the tee to the remaining loop plate and rotate it until its rejection notch is equal in value, then tighten it down into place.

5. Apply the second index label so that the value of 10 lines up with the calibration mark.

6. Tighten all loop hold down screws.

When converting from a T-Pass filter into a Bandpass the six steps listed above will not be necessary. The T-Pass filter already has two properly affixed index labels.

MULTIPLE CAVITY BANDPASS FILTERS

Bandpass filters can be ordered in multiple cavity arrangements of either two or three combined cavities. The filters are connected in a cascaded fashion with the output of each filter fed to the input port of the succeeding filter. The advantage of this is that the amount of attenuation provided by each of the filters is additive.

The interconnecting cable between the two filters, when cut to the correct length (odd multiple of 1/4 λ), will provide up to 6 dB of additional attenuation due to a mismatch of impedance between the cable and the filters. The 6 dB of mismatch attenuation does not occur at the filters passband but, only at frequencies where moderate to high attenuation occurs.

Because each of the filters in the multi-cavity arrangement are identical, the passband for the entire arrangement is generally the same as the passband for the individual filters. However, each filters individual insertion loss is also additive. When tuning a multi-cavity arrangement, each filter is tuned individually prior to interconnecting them. Then each is fine tuned to peak the overall response of the multi-cavity arrangement.

Power Ratio and Voltage Ratio to Decibel Conversion Chart

Loss or Gain	Power Ratio	Voltage Ratio
+9.1 dB	8.128	2.851
-9.1 dB	0.123	0.351

← - dB + →

Voltage Ratio	Power Ratio	dB	Voltage Ratio	Power Ratio
1	1	0	1	1
0.989	0.977	0.1	1.012	1.023
0.977	0.955	0.2	1.023	1.047
0.966	0.933	0.3	1.035	1.072
0.955	0.912	0.4	1.047	1.096
0.944	0.891	0.5	1.059	1.122
0.933	0.871	0.6	1.072	1.148
0.923	0.851	0.7	1.084	1.175
0.912	0.832	0.8	1.096	1.202
0.902	0.813	0.9	1.109	1.23
0.891	0.794	1	1.122	1.259
0.881	0.776	1.1	1.135	1.288
0.871	0.759	1.2	1.148	1.318
0.861	0.741	1.3	1.161	1.349
0.851	0.724	1.4	1.175	1.38
0.841	0.708	1.5	1.189	1.413
0.832	0.692	1.6	1.202	1.445
0.822	0.676	1.7	1.216	1.479
0.813	0.661	1.8	1.23	1.514
0.804	0.646	1.9	1.245	1.549
0.794	0.631	2	1.259	1.585
0.785	0.617	2.1	1.274	1.622
0.776	0.603	2.2	1.288	1.66
0.767	0.589	2.3	1.303	1.698
0.759	0.575	2.4	1.318	1.738
0.75	0.562	2.5	1.334	1.778
0.741	0.55	2.6	1.349	1.82
0.733	0.537	2.7	1.365	1.862
0.724	0.525	2.8	1.38	1.905
0.716	0.513	2.9	1.396	1.95
0.708	0.501	3	1.413	1.995
0.7	0.49	3.1	1.429	2.042
0.692	0.479	3.2	1.445	2.089
0.684	0.468	3.3	1.462	2.138
0.676	0.457	3.4	1.479	2.188
0.668	0.447	3.5	1.496	2.239
0.661	0.437	3.6	1.514	2.291
0.653	0.427	3.7	1.531	2.344
0.646	0.417	3.8	1.549	2.399
0.638	0.407	3.9	1.567	2.455
0.631	0.398	4	1.585	2.512
0.624	0.389	4.1	1.603	2.57
0.617	0.38	4.2	1.622	2.63
0.61	0.372	4.3	1.641	2.692
0.603	0.363	4.4	1.66	2.754
0.596	0.355	4.5	1.679	2.818
0.589	0.347	4.6	1.698	2.884
0.582	0.339	4.7	1.718	2.951
0.575	0.331	4.8	1.738	3.02
0.569	0.324	4.9	1.758	3.09

← - dB + →

Voltage Ratio	Power Ratio	dB	Voltage Ratio	Power Ratio
0.562	0.316	5	1.778	3.162
0.556	0.309	5.1	1.799	3.236
0.55	0.302	5.2	1.82	3.311
0.543	0.295	5.3	1.841	3.388
0.537	0.288	5.4	1.862	3.467
0.531	0.282	5.5	1.884	3.548
0.525	0.275	5.6	1.905	3.631
0.519	0.269	5.7	1.928	3.715
0.513	0.263	5.8	1.95	3.802
0.507	0.257	5.9	1.972	3.89
0.501	0.251	6	1.995	3.981
0.496	0.246	6.1	2.018	4.074
0.49	0.24	6.2	2.042	4.169
0.484	0.234	6.3	2.065	4.266
0.479	0.229	6.4	2.089	4.365
0.473	0.224	6.5	2.113	4.467
0.468	0.219	6.6	2.138	4.571
0.462	0.214	6.7	2.163	4.677
0.457	0.209	6.8	2.188	4.786
0.452	0.204	6.9	2.213	4.898
0.447	0.2	7	2.239	5.012
0.442	0.195	7.1	2.265	5.129
0.437	0.191	7.2	2.291	5.248
0.432	0.186	7.3	2.317	5.37
0.427	0.182	7.4	2.344	5.495
0.422	0.178	7.5	2.371	5.623
0.417	0.174	7.6	2.399	5.754
0.412	0.17	7.7	2.427	5.888
0.407	0.166	7.8	2.455	6.026
0.403	0.162	7.9	2.483	6.166
0.398	0.159	8	2.512	6.31
0.394	0.155	8.1	2.541	6.457
0.389	0.151	8.2	2.57	6.607
0.385	0.148	8.3	2.6	6.761
0.38	0.145	8.4	2.63	6.918
0.376	0.141	8.5	2.661	7.079
0.372	0.138	8.6	2.692	7.244
0.367	0.135	8.7	2.723	7.413
0.363	0.132	8.8	2.754	7.586
0.359	0.129	8.9	2.786	7.762
0.355	0.126	9	2.818	7.943
0.351	0.123	9.1	2.851	8.128
0.347	0.12	9.2	2.884	8.318
0.343	0.118	9.3	2.917	8.511
0.339	0.115	9.4	2.951	8.71
0.335	0.112	9.5	2.985	8.913
0.331	0.11	9.6	3.02	9.12
0.327	0.107	9.7	3.055	9.333
0.324	0.105	9.8	3.09	9.55
0.32	0.102	9.9	3.126	9.772

TECH-AID NO.79001

CONVERSION ASSEMBLY NOMENCLATURE AND BASIC TUNING ADJUSTMENTS

6 5/8 AND 10 IN. DIA. FILTERS 66-512 MHZ

BANDPASS T-PASS Tm VARI-NOTCH® SERIES NOTCH Tm

GENERAL

The information provided in this Tech-Aid is basic to most filter and Multicoupler systems. Measurement circuits and test equipment for tuning the various filters are provided in Tech-Aid 79002. Specific system tuning instructions will contain the particular electrical and mechanical data applicable to that system, supported by Tech-Aids 79001 and 79002.

DESCRIPTION OF FILTER CONVERTIBILITY

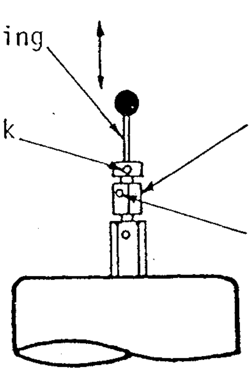
All 6 5/8" and 10" Dia. filters have two 1.5" Dia. openings in the top of the cavity which, with the proper conversion assemblies, will allow the cavity to function as any one of four basic filter types, these being Bandpass, T-PassTm, Vari-NotchR and Series NotchTm. All conversion assemblies are interchangeable between 6 5/8" and 10" dia. cavities. Indexing labels are provided for all assemblies to allow logging and field resetability to specific performance levels. This calibration data is provided on individual filter labeling or in specific system instruction manuals. The purpose of this Tech-Aid is to identify the basic tuning adjustments and calibration procedures for ready reference. T-PassTm, and Series NotchTm are trademarks for Patent Pending designs in the United States and Canada. Vari-Notch is the registered trademark of a line of highly efficient pseudo-bandpass filters, constructed under TX RX Systems patent number 4186359.

FUNDAMENTAL CAVITY "RESONANCE" OR FREQUENCY ADJUSTMENT

The adjustment of cavity resonance may control the pass or the reject frequency, depending on the circuit design. The central cavity probe adjusts cavity resonance. On later designs, an inductive fine tuning rod, ¼" in dia. provides a smooth, sliding vernier control. Earlier designs use a threaded tuning bolt mechanism. Both are detailed below.

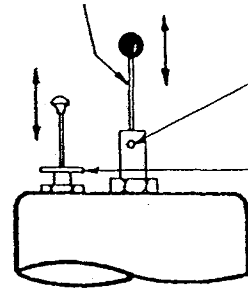
FINE TUNING USING DUAL TUNING BOLTS
(lefthand/righthand threads for non-rotating plunger)

With coarse tuning locked and tension screws loosened, rotate fine tuning bolt for fine longitudinal travel of tuning plunger.



INDUCTIVE FINE TUNING

Fine tuning usually set mid-range of 4" travel at VHF and 3" travel at UHF
Sliding coarse tuning rod.



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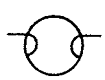
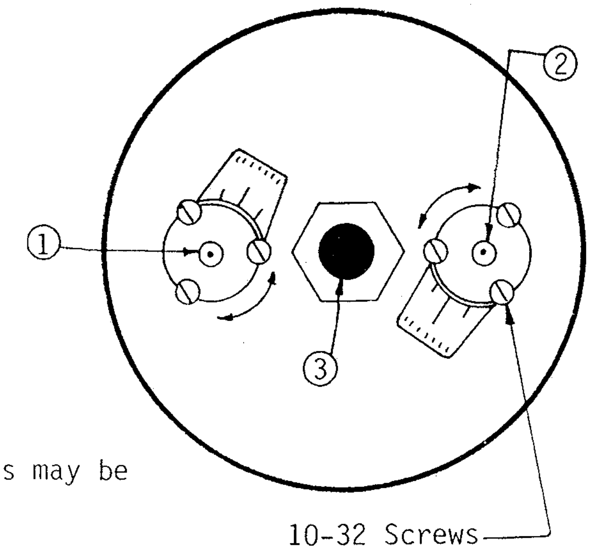
BANDPASS





① ② Input/Output Loop Assemblies. Loosen three 10-32 screws and rotate Loop Assembly for desired insertion loss. (See Note below).

③ Adjust cavity probe (and/or fine inductive tuning, if provided) for minimum loss.

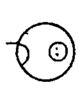
Cavity must be retuned after insertion loss adjustments, as coupling changes also change cavity resonant frequency. Raising loss lowers resonant frequency, and vice-versa.

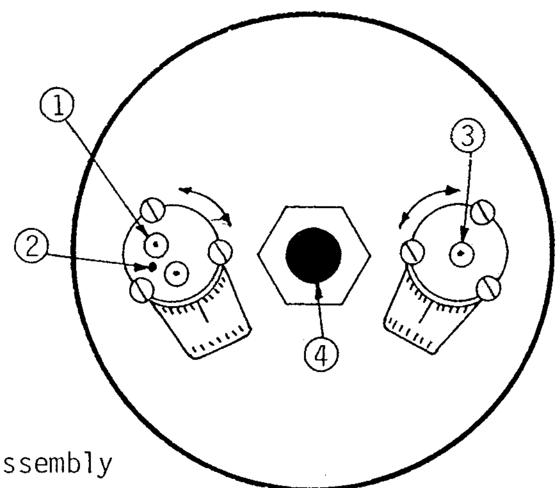
NOTE: Loop settings for desired insertion loss may be calibrated in one of two ways:

1. The insertion loss label is calibrated at 0.5, 1.0 and 3.0 dB.

2. The insertion loss label is an index label and the loss settings are keyed to various index numbers on the label. These index settings are noted on the cavity.

T-PASS™





① T-Pass Conversion Assembly, antenna thruline connectors for channel interconnection into main antenna line.

② Red dot terminal normally faces toward antenna connection of system. Double red dots mean assembly is bi-directional, having no preferred port for best VSWR.
Placing system terminating stub on non-red dot port (if not bi-directional) of T-Pass assembly allows cavity to be tuned as a standard bandpass filter. Settings for the relative calibration index label are available for specific T-Pass filter models for 0.5 and 1.0 dB loss. All T-Pass filters are calibrated for 1.0 dB loss at 10 on the relative index label. Assembly rotation adjusts insertion loss.

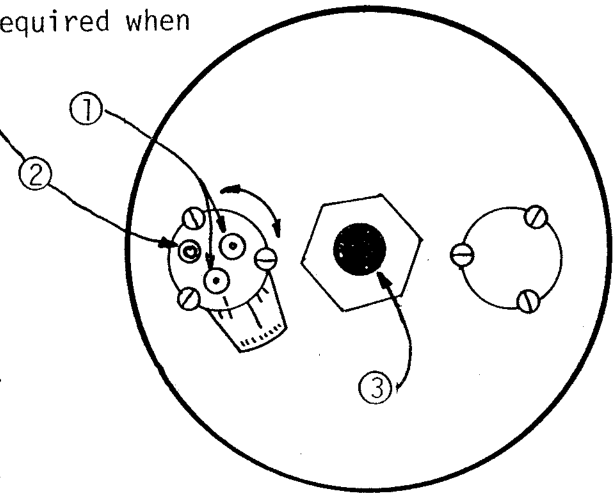
③ Standard Bandpass Loop assembly, calibrated at 0.5, 1.0 and 3.0 dB loss.

④ Adjust cavity probe for minimum insertion loss, once insertion loss calibration has been made. Filter response for various cavity losses follows standard bandpass filter performance data.

VARI-NOTCH®

Pat. No. 4186359

Note: Insulated tuning tool required when tuning notch



① Input/Output connectors on Vari-Notch conversion assembly.

② Air variable capacitor adjusts notch frequency. Red half of rotor adjacent barrel stripe indicates full capacity.

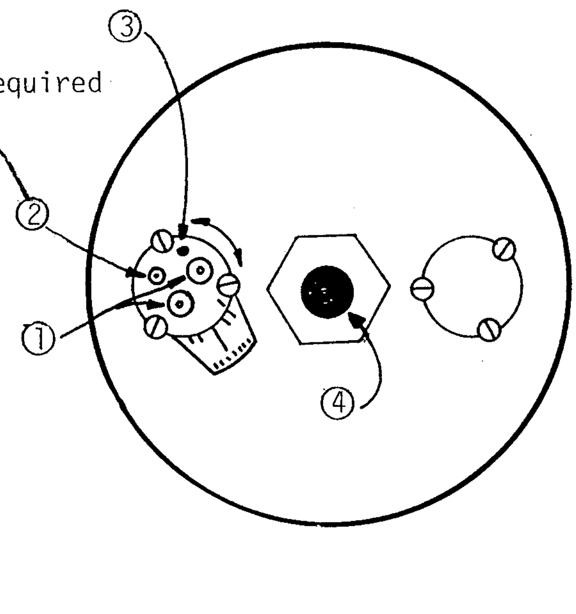
③ Cavity probe, and related fine tuning controls, adjusts pass frequency.

Rotation of Vari-Notch Assembly adjusts insertion loss. Relative index label is used to log specific filter performance. Standard calibration is 0.6 loss at index setting of 15, calibrated at center of filter tuning range.
Most frequency bands have high pass and low pass Vari-Notch assemblies, though all assemblies tune high and low pass to some degree.
When tuning filter, always make notch adjustment last, as notch tends to track with pass band (cavity) tuning.

② On UHF models (400 MHz and over) capacitor access barrel is omitted and a 6-32 screw is removed from plate for access to piston trimmer under plate. Use small insulated tuning tool.

SERIES NOTCH™

Note: Insulated tuning tool required when tuning passband



① Input/Output connectors on Series Notch conversion assembly.

② Air variable capacitor adjusts pass band insertion loss. Red half of rotor adjacent barrel stripe indicates full capacity.

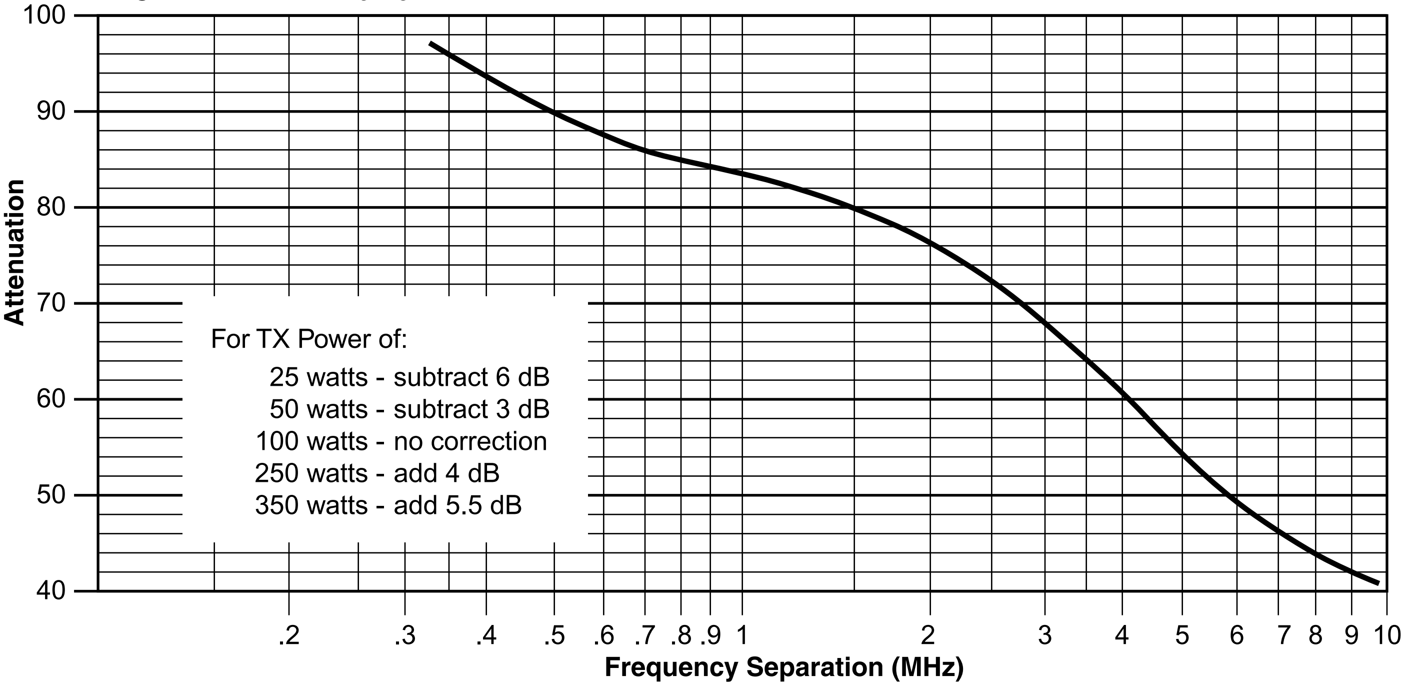
③ Red dot indicates input terminal for best VSWR. In multiple cavity systems, non-red dot port connects to next S/N red dot terminal.

④ Cavity probe, and related fine tuning controls, adjust notch frequency.
Rotation of Series Notch assembly adjusts notch depth, 15 to 25+ db. The relative calibration index label is used to log specific filter performance. Standard calibration is at 15 db at high end of frequency band, with index at 0.
Increasing index value increases depth of notch.
SERIES NOTCH conversion assemblies are supplied in high pass and low pass models. Low pass assemblies also tune symetrical pass band responses.

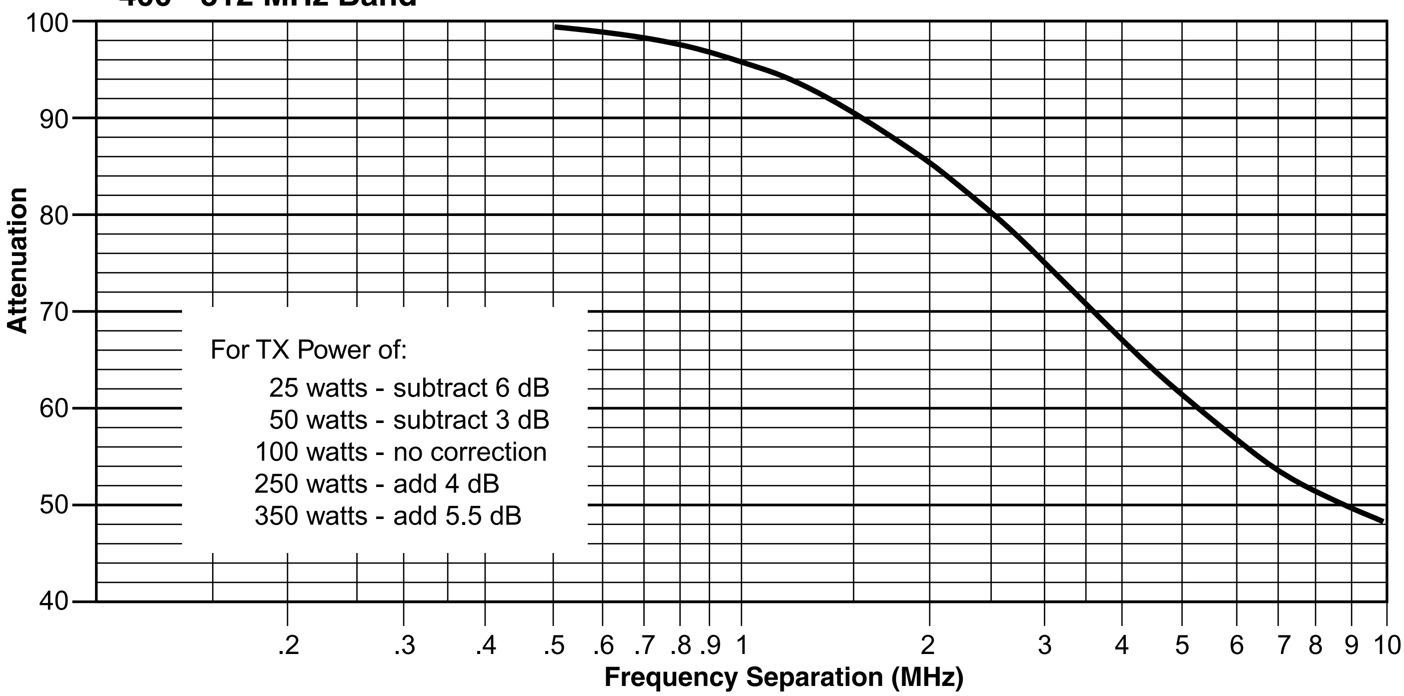
Isolation Curves for Transmitter/Receiver

The curves shown below for use with filters, duplexers, and multicouplers, indicate the amount of isolation or attenuation required between a typical 100 watt transmitter and its associated receiver at the TX (carrier suppression) and RX (noise suppression) frequency which will result in no more than a 1 dB degradation of the 12 dB SINAD sensitivity.

132 - 174 MHz Band



400 - 512 MHz Band

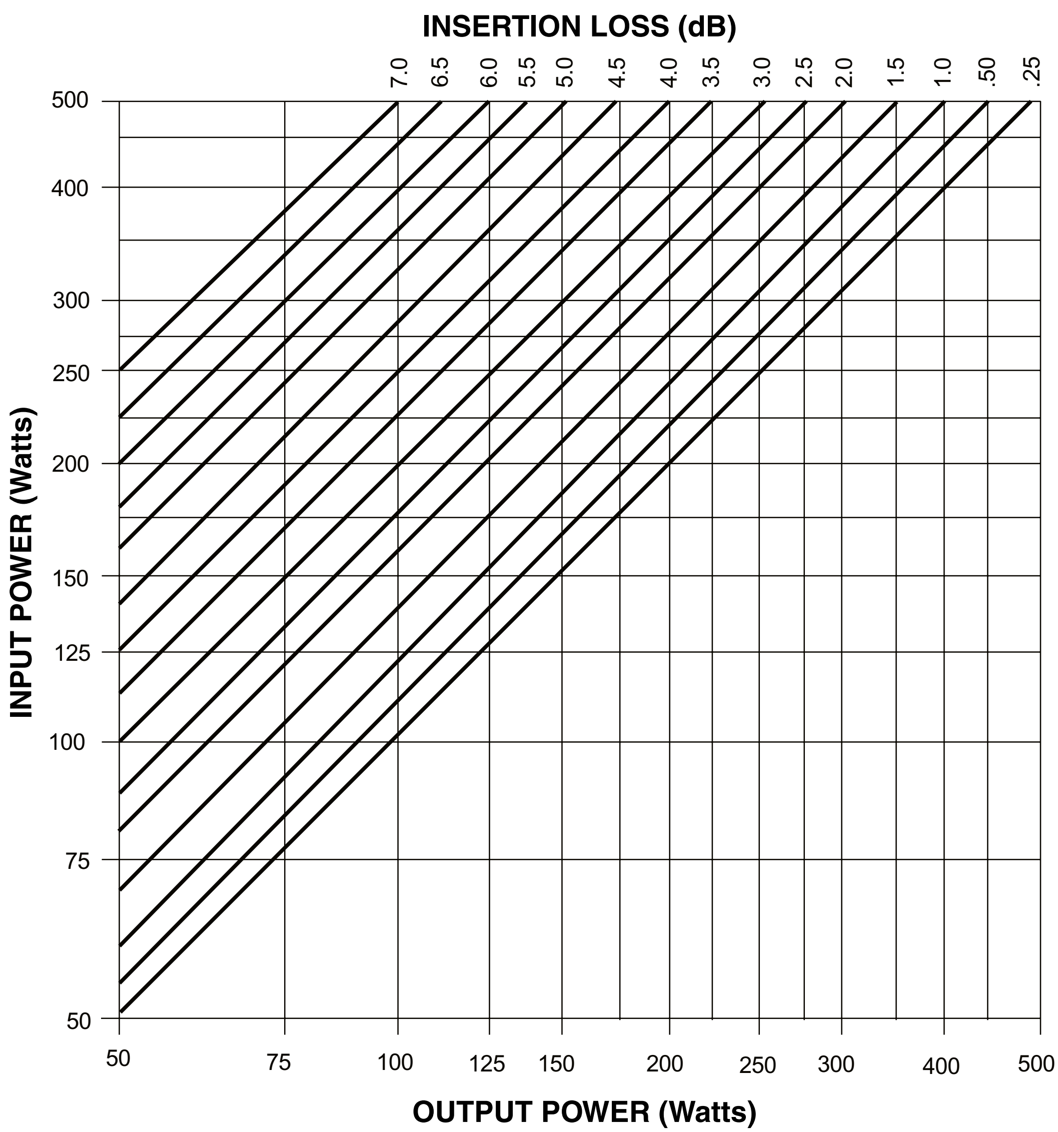


NOTE

These are only "typical" curves. When accuracy is required, consult the radio manufacturer.

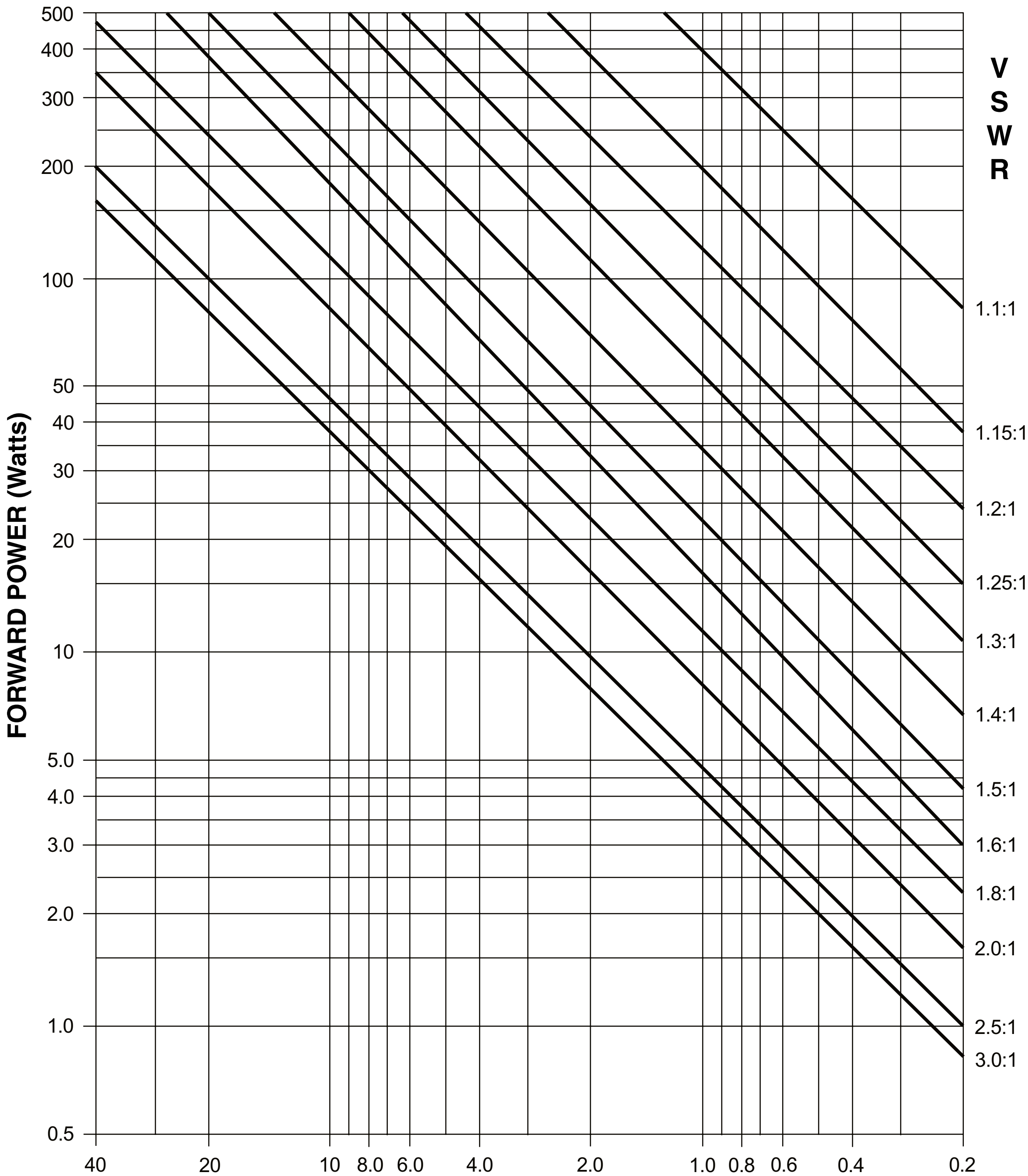
POWER IN/OUT
VS
INSERTION LOSS

The graph below offers a convenient means of determining the insertion loss of filters, duplexers, multicouplers and related products. The graph on the back page will allow you to quickly determine VSWR. It should be remembered that the field accuracy of wattmeter readings is subject to considerable variance due to RF connector VSWR and basic wattmeter accuracy, particularly at low end scale readings. However, allowing for these variances, these graphs should prove to be a useful reference.



FOR LOWER POWER LEVELS
DIVIDE BOTH SCALES
BY 10 (5 TO 50 WATTS)

POWER FWD./REV.
VS
VSWR



REFLECTED POWER (Watts)

FOR OTHER POWER LEVELS
MULTIPLY BOTH SCALES
BY THE SAME MULTIPLIER

Power Conversion Chart

dBm to dBw to Watts to Volts

dBm	dBw	Watts	Volts 50Ω
80	50	100kW	2236
75	45	31.6 kW	1257
70	40	10.0 kW	707
65	35	3.16 kW	398
60	30	1000	224
55	25	316	126
50	20	100	70.7
45	15	31.6	39.8
40	10	10.0	22.4
38	8	6.31	17.8
36	6	3.98	14.1
34	4	2.51	11.2
32	2	1.58	8.90
30	0	1.00	7.07
29	-1	0.79	6.30
28	-2	0.63	5.62
27	-3	0.50	5.01
26	-4	0.40	4.46
25	-5	0.32	3.98
24	-6	0.25	3.54
23	-7	0.20	3.16
22	-8	0.16	2.82
21	-9	0.13	2.51
20	-10	0.10	2.24
19	-11	79 mW	1.99

dBm	dBw	Watts	Volts 50Ω
18	-12	63 mW	1.78
17	-13	50 mW	1.58
16	-14	40 mW	1.41
15	-15	32 mW	1.26
14	-16	25 mW	1.12
13	-17	20 mW	1.00
12	-18	16 mW	0.890
11	-19	13 mW	0.793
10	-20	10 mW	0.707
9	-21	7.9 mW	0.630
8	-22	6.3 mW	0.562
7	-23	5.0 mW	0.501
6	-24	4.0 mW	0.446
5	-25	3.2 mW	0.398
4	-26	2.5 mW	0.354
3	-27	2.0 mW	0.316
2	-28	1.6 mW	0.282
1	-29	1.3 mW	0.251
0	-30	1.0 mW	0.224
-5	-35	316 uW	0.126
-10	-40	100 uW	0.071
-15	-45	31.6 uW	0.040
-20	-50	10 uW	0.022
-25	-55	3.16 uW	0.013
-30	-60	1 uW	0.007

Free Space Path Loss Estimator

Path Length (miles)	Frequency in MHz 50	150	170	450	500	800	900
0.1	50.58	60.12	61.21	69.66	70.58	74.66	75.68
0.25	58.54	68.08	69.17	77.62	78.54	82.62	83.64
0.5	64.56	74.10	75.19	83.64	84.56	88.64	89.66
1	70.58	80.12	81.21	89.66	90.58	94.66	95.68
2	76.60	86.14	87.23	95.68	96.60	100.68	101.71
3	80.12	89.66	90.75	99.21	100.12	104.20	105.23
4	82.62	92.16	93.25	101.71	102.62	106.70	107.73
5	84.56	94.10	95.19	103.64	104.56	108.64	109.66
6	86.14	95.68	96.77	105.23	106.14	110.22	111.25
7	87.48	97.02	98.11	106.57	107.48	111.56	112.59
8	88.64	98.18	99.27	107.73	108.64	112.72	113.75
9	89.66	99.21	100.29	108.75	109.66	113.75	114.77
10	90.58	100.12	101.21	109.66	110.58	114.66	115.68
12	92.16	101.71	102.79	111.25	112.16	116.25	117.27
14	93.50	103.04	104.13	112.59	113.50	117.58	118.61
16	94.66	104.20	105.29	113.75	114.66	118.74	119.77
18	95.68	105.23	106.31	114.77	115.68	119.77	120.79
20	96.60	106.14	107.23	115.68	116.60	120.68	121.71
30	100.12	109.66	110.75	119.21	120.12	124.20	125.23
40	102.62	112.16	113.25	121.71	122.62	126.70	127.73
50	104.56	114.10	115.19	123.64	124.56	128.64	129.66

Formula: Path Loss (dB) = 36.6 + 20 log (MHz) + 20 log (miles)

Return Loss vs. VSWR

Return Loss	VSWR
30	1.06
25	1.11
20	1.20
19	1.25
18	1.28
17	1.33
16	1.37
15	1.43
14	1.50
13	1.57
12	1.67
11	1.78
10	1.92
9	2.10

Watts to dBm

Watts	dBm
300	54.8
250	54.0
200	53.0
150	51.8
100	50.0
75	48.8
50	47.0
25	44.0
20	43.0
15	41.8
10	40.0
5	37.0
4	36.0
3	34.8
2	33.0
1	30.0

dBm = 10log P/1mW
Where P = power (Watt)

Insertion Loss

Input Power (Watts)

Insertion Loss	50	75	100	125	150	200	250	300
3	25	38	50	63	75	100	125	150
2.5	28	42	56	70	84	112	141	169
2	32	47	63	79	95	126	158	189
1.5	35	53	71	88	106	142	177	212
1	40	60	79	99	119	159	199	238
.5	45	67	89	111	134	178	223	267

Output Power (Watts)

Free Space Loss

Distance (miles)

Frequency (MHz)	.25	.50	.75	1	2	5	10	15
150	68	74	78	80	86	94	100	104
220	71	77	81	83	89	97	103	107
460	78	84	87	90	96	104	110	113
860	83	89	93	95	101	109	115	119
940	84	90	94	96	102	110	116	120
1920	90	96	100	102	108	116	122	126

Free Space Loss (dB)

Free space loss = 36.6 + 20log D + 20log F
Where D = distance in miles and F = frequency in MHz