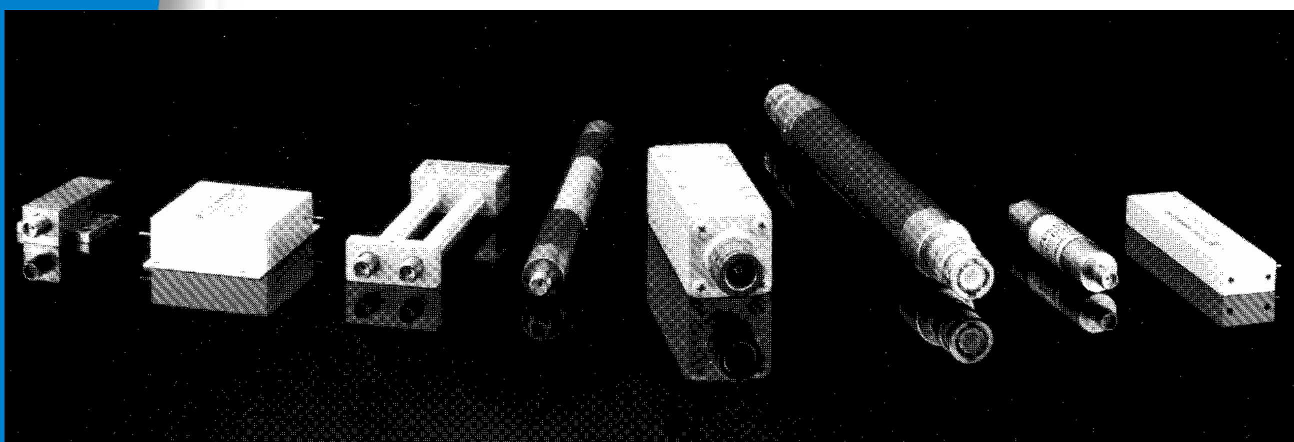
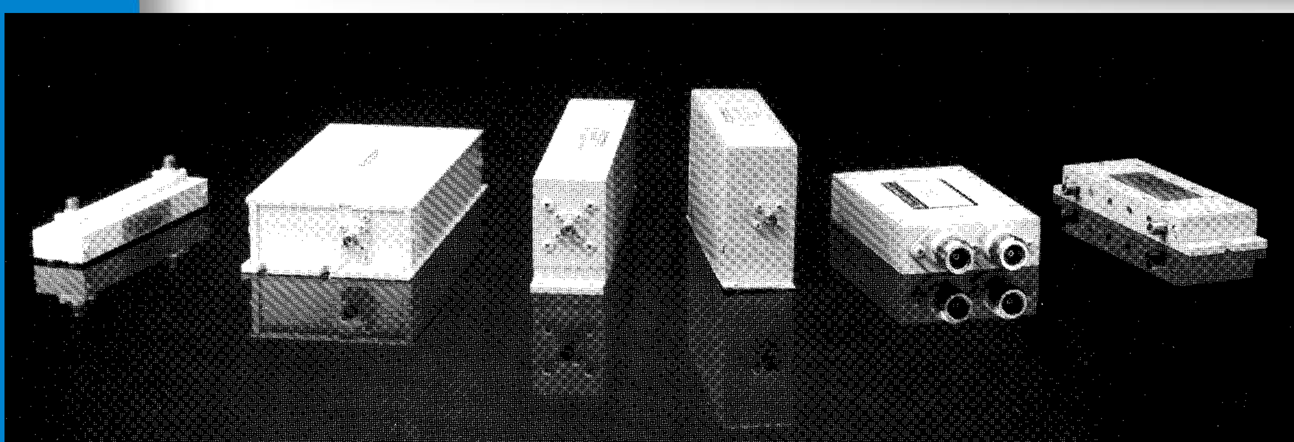
TELONIC FIXED FREQUENCY FILTERS

ENGINEERS' DESIGN HANDBOOK



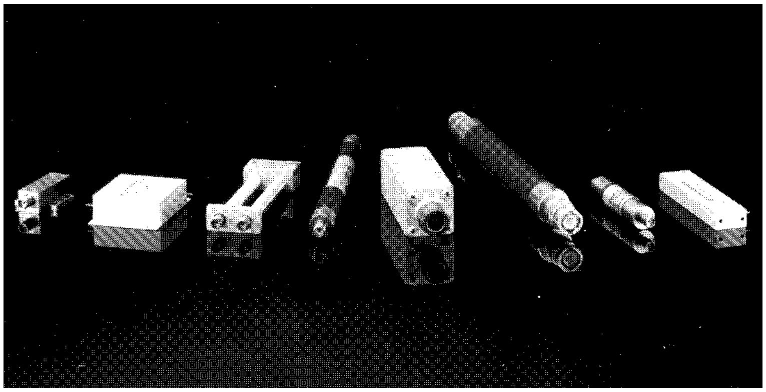


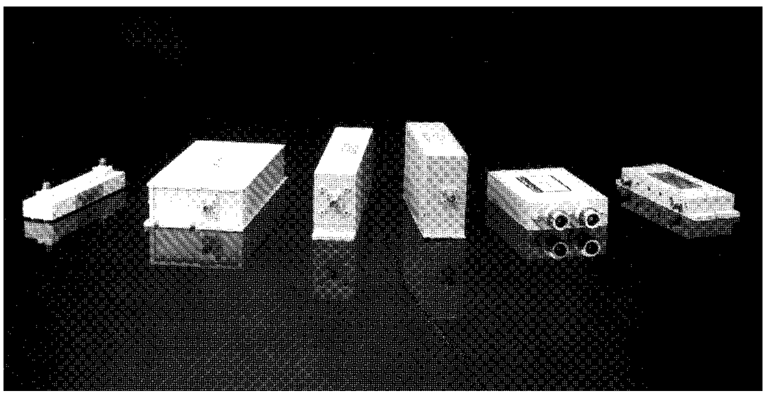
TELONIC/BERKELEY

TABLE OF CONTENTS

FILTER INDEX BY SERIES

TELONIC BERKELEY FIXED FREQUENCY FILTERS





LOW PASS FILTERS

- Tubular
- Lumped Element
- Stripline

HIGH PASS FILTERS

BANDPASS FILTERS

- Tubular
- Lumped Element
- Hi Q Cavity
- Helical Resonators
- Interdigital
- Combline

A world leading manufacturer of RF and microwave components, Telonic Berkeley has a unique approach in the manufacture of filters: To offer an unlimited number of filter models in the widest selection of filter types, that can be ordered easily by the customer. As an example, this catalog contains over 20 types of filters from 10 MHz to 12GHz. Complementing this impressive array of filter types is the most complete assortment of GUARANTEED electrical and mechanical design data ever published.

Telonic Berkeley also manufactures a broad line of tunable filters. For complete information, contact our Customer Service Department and request the Tunable Filters Catalog.

- GUARANTEED Filter Design and Specifying Data – These conservative and comprehensive performance data include the effects of time, temperature, shock and vibration, and – for the first time – permit you to establish guaranteed performance specifications for custom filters in the field.
- Attenuation Curves
- Insertion Loss Curves
- Passband Relationship Curves
- Frequency and Bandwidth Tolerance Curves
- Filter Length Curves
- Outline Drawings

AIDS TO USE OF THIS CATALOG

If you are not familiar with specifying filters, we suggest you first read pages 6, 7 and 8.

ORIENTATION

1. Bandpass data in this catalog is presented as a function of 3 dB bandwidths and all curves are normalized to the nominal 3 dB bandwidth.
2. Lowpass data in this catalog is presented in terms of the VSWR cutoff frequency.
3. In general, insertion loss is inversely proportional to physical size. To reduce insertion loss for a fixed set of parameters, generally size must increase.

TO SELECT BANDPASS FILTERS:
(Refer to Fig. 1)

1. Determine frequencies to be passed. ('B' to 'C') From ____ MHz to ____ MHz.
2. Estimate 3 dB BW if different from 1. above, _____ MHz.
3. Calculate nominal center frequency 'A'; (Arithmetic mean of 'B' & 'C') ________ MHz.
4. Calculate % BW: $\dfrac{\text{3dB BW}}{\text{Center Freq.}}$ X 100%
5. Determine frequencies to be rejected 'D', _______ MHz 'E', _________MHz.
6. Determine amount of attenuation required at frequencies to be rejected, _________dB.
7. Determine maximum allowable insertion loss at point 'A', ________ dB.
8. Calculate Δ BW+ and Δ BW− which will be used in later calculations.

$$\Delta\text{BW+} = \frac{\text{Freq @ E} - \text{Freq @ A,}}{\text{3 dB BW}}$$

$$\Delta\text{BW−} = \frac{\text{Freq @ A} - \text{Freq @ D,}}{\text{3 dB BW}}$$

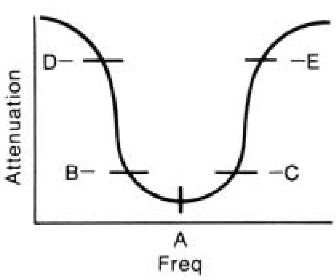


Figure 1 Bandpass

9. Refer to Filter Selection Guide (pg. 4-5) and write down the series names of the products which:
   a) Operate in the passband frequency range desired.
   b) Have the percentage bandwidth desired.
   c) Perform the bandpass function desired.
10. Turn to pages indicated by types selected and complete calculations to determine:
    a) Number of sections required to perform filtering function adequately.
    b) Filter series required for insertion loss or size considerations.

TO SELECT LOWPASS FILTERS:
(Refer to Fig. 2)

1. Determine VSWR cutoff frequency: 'A' _________ MHz.
2. Determine frequency where attenuation is required 'B' _________ MHz.
3. Calculate relative frequency as ratio of frequency to be attenuated to frequency to be passed: $R = \dfrac{\text{'B' MHz}}{\text{'A' MHz}}$
4. Determine attenuation level, ________dB.
5. Determine maximum insertion loss allowable, ________dB.
6. Refer to pages 9, 10 and 11 for proper filter selection.

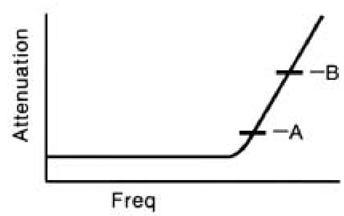
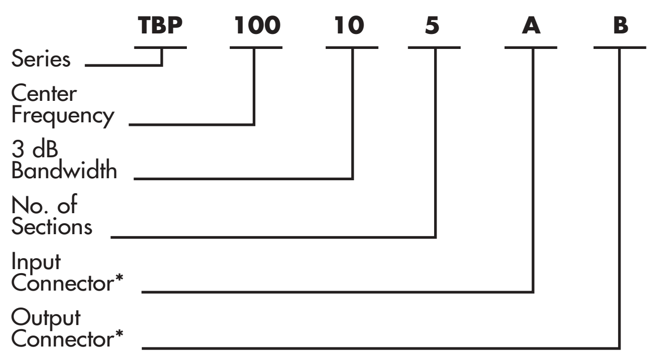


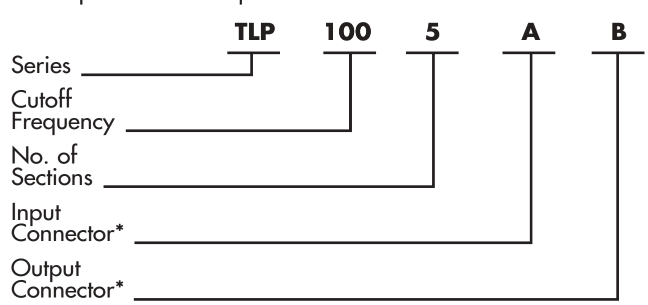
Figure 2 Lowpass

TO WRITE THE PROPER PART NO.

1. Bandpass filter example



2. Lowpass filter example



*See connector code for each filter series

ORDERING INFORMATION

HOW TO ORDER
Significant specifications and specific instructions should be included in your order whenever you desire special options or features.

Filters may be ordered by **(A)** standard model numbers that can easily be derived by following the ordering instructions in each filter section of this catalog or **(B)** by sending your specific requirements to Telonic Berkeley.

WHERE TO ORDER
In the United States and Canada your order may be placed through our local representative or placed directly with the factory:

TELONIC BERKELEY
P.O. Box 277
Laguna Beach, California
92652

TECHNICAL DATA
Telonic Berkeley filters are 100% inspected to verify that all electrical and mechanical specifications are met. Written test data is provided on 10% of units shipped, or ten units, whichever is greater. This test data is recorded for performance at room temperature only. All units are, however, exposed to temperatures in excess of rated limits to ensure that they meet and exceed published specifications.

Test data covering an entire lot of filters ordered is available at an additional charge. Data recorded at temperature extremes may also be provided at extra cost. Telonic Berkeley would be pleased to quote our customers' specific test data requirements, and to supply such data as specified by purchase order.

TECHNICAL ASSISTANCE
Telonic Berkeley is represented throughout the world by a qualified staff of field engineers and representatives. They are available to supply you, without obligation, with technical data, literature, application engineering and assistance in selecting, specifying and ordering Telonic filters and instruments.

SHIPPING INSTRUCTIONS
Unless specific instructions accompany the order we shall use our own judgment as to the best method of shipment. Unless otherwise specified normal shipments will be by express or truck transportation. Small items are sent via parcel post. The price for our products includes packing but does not include shipping.

PRICES AND DELIVERY
Prices for all products are published on a separate price schedule and are in effect at the date of publication. All prices are f.o.b. factory and are subject to change without notice. Contact your nearest Telonic representative to confirm prices and obtain current delivery information. Formal price and delivery quotations remain in effect for 30 days.

CONDITIONS AND TERMS
Determination of prices, terms, conditions of sale and final acceptance of order are made only at Telonic, Laguna Beach, California. Terms are net 20 days and prices are f.o.b. factory. Unless credit has already been established shipments will be made C.O.D., or on receipt of cash in advance.

MINIMUM BILLING
The minimum billing per order is $50.00. This applies to all purchases.

WARRANTY
Standard filters manufactured by Telonic are guaranteed for a period of ONE YEAR from date of purchase against defective materials and workmanship. Telonic expressly limits its liability to replacement or repair of the article furnished except for tubes or batteries. This warranty does not apply to products that have been disassembled, modified or subjected to conditions exceeding the applicable specifications and ratings. In the event of any of the foregoing, the guarantee will be void. Telonic disclaims any warranty other than as specifically set forth herein and may discontinue models or alter their specifications without notice.

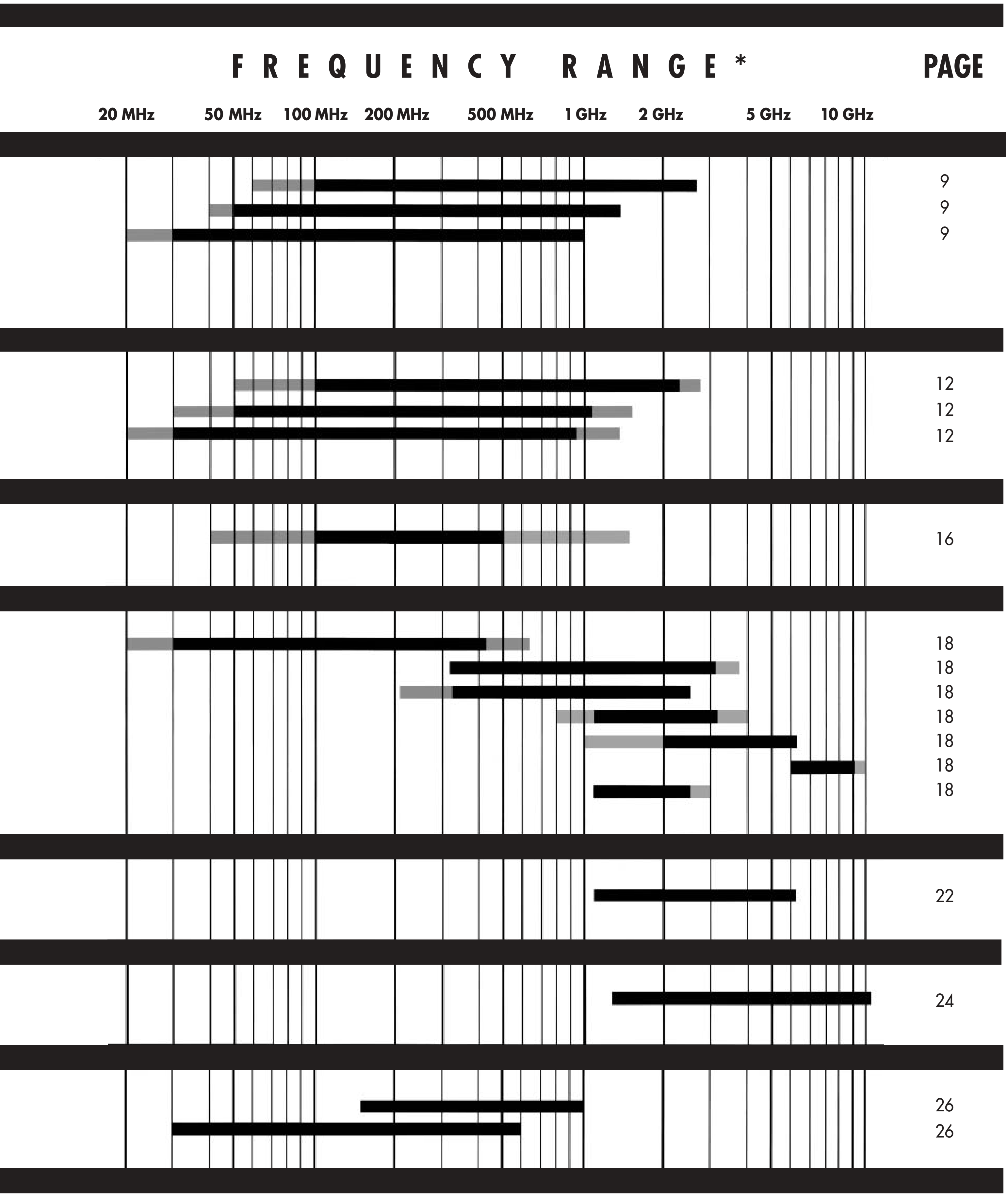
SERVICE AND PARTS
Repair service and parts are available from our plant at Laguna Beach, California.

To return items for repair, please contact the Sales Department at the factory for permission to return. All returned goods are to be shipped prepaid and must be identified by purchase order number, model number, serial number and nature of malfunction.

OUR TOLL FREE LINE
800-854-2436

FILTER SELECTION GUIDE

	BANDWIDTH
SECTION 1. TUBULAR LOW/PASS FILTERS	
Series TLP — Lumped constant, 1/2″ diam., low cost, small size	—
Series TLA — Lumped constant, 3/4″ diam., intermediate loss, size, power	—
Series TLC — Lumped constant, 1 1/4″ diam., low loss, highest power	—
SECTION 2. TUBULAR BANDPASS FILTERS	
Series TBP — Lumped constant, 1/2″ diam., lowest cost, most popular	2 – 30%
Series TBA — Lumped constant, 3/4″ diam., medium loss and power	2 – 30%
Series TBC — Lumped constant, 1 1/4″ diam., lowest loss, highest power	2 – 30%
SECTION 3. HIGHPASS FILTERS	
Series THP — Distributed constant, small size, low loss	—
SECTION 4. CAVITY BANDPASS FILTERS	
Series TSF — Lowest loss helical resonator series	1 – 3%
Series TCF — Quarter-wavelength, coaxial, modular slotted box construction	.3 – 3%
Series TCC — Quarter-wavelength, coaxial, lowest loss, re-entrant cavity	.3 – 3%
Series TCA — Quarter-wavelength, coaxial, ideal size vs. performance parameters for general cavity filter req.	.3 – 3%
Series TCG — Quarter-wavelength, coaxial, highest frequency, re-entrant cavity	.3 – 2%
Series TCH — TM-010 mode extremely narrow band	.1 – 1%
Series TCB — Adjustable quarter-wavelength, coaxial, up to 10% tuning range	.3 – 3%
SECTION 5. INTERDIGITAL BANDPASS FILTERS	
Series TIF — Strip line, air dielectric	3 – 30%
SECTION 6. COMBLINE BANDPASS FILTERS	
Series TSJ — Miniature combline filters utilizing air dielectric	1 – 15%
SECTION 7. MINIATURE BANDPASS FILTERS	
Series TSA — Smallest available helical filter, P.C.B. mounting available	1 – 15%
Series TSC — Intermediate size helical, P.C.B. mounting available	1 – 15%



* Gray areas indicate special extended ranges.

FREQUENCY AND BANDWIDTH TOLERANCE CURVES

A DISCUSSION OF FREQUENCY AND BANDWIDTH TOLERANCES AS THEY APPLY TO FILTERS MANUFACTURED BY TELONIC.

Figures 1 and 2 illustrate the standard specification format for lowpass and bandpass filters. The shaded areas represent specification limits which apply under all operating conditions defined in the filter specifications.

A plot of the filter performance will always lie outside of the shaded areas.

Figures 3 and 4 show the plot of a typical filter superimposed on the same specification limits.

Each filter built to the same specifications may be slightly different, but will meet or exceed the electrical specifications while being exposed to the specified operating environmental conditions.

Should a requirement arise for a unit with a specific bandwidth tolerance, submit all of your requirements (mechanical, environmental, and electrical) to the factory. This will assure the optimal design to meet your needs.

FREQUENCY AND BANDWIDTH

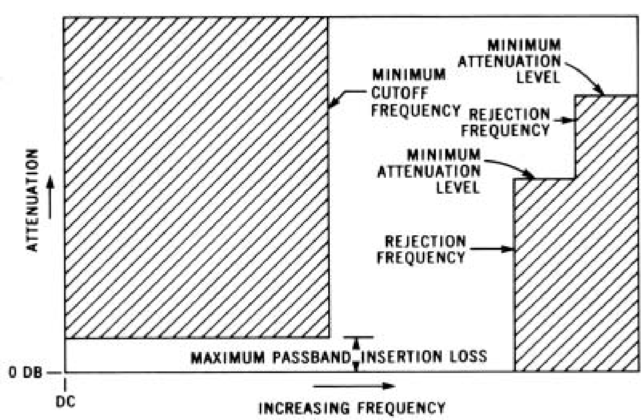


Figure 1. Lowpass Filter Performance Limits.

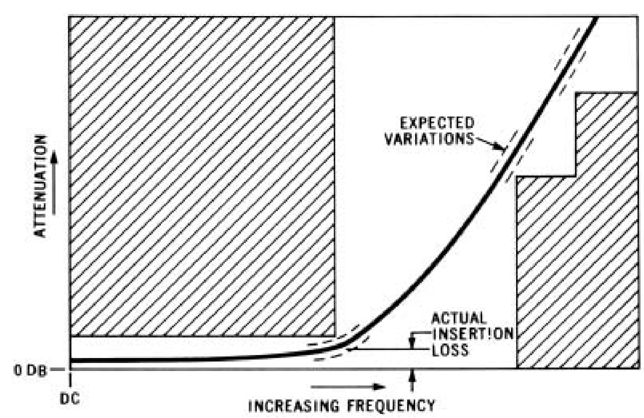


Figure 3. Typical Lowpass Filter Curve.

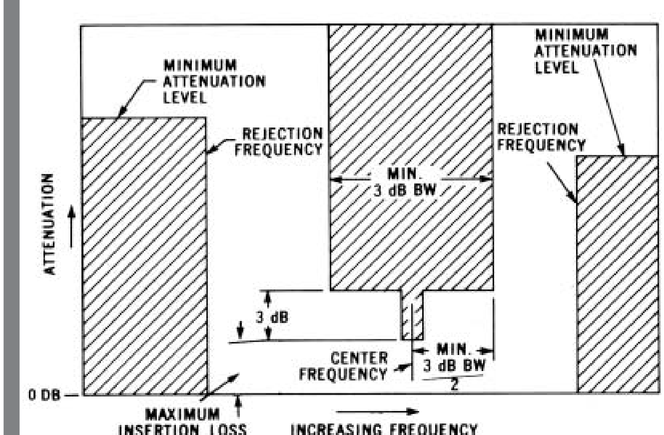


Figure 2. Bandpass Filter Performance Limits.

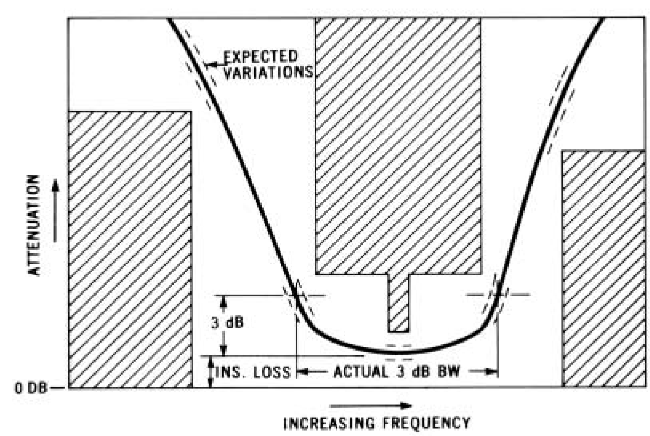


Figure 4. Typical Bandpass Filter Curve.

PASSBAND RELATIONSHIPS

A DISCUSSION OF THE SHAPE OR FORM OF THE PASSBAND IN BANDPASS FILTERS.

In many cases it is necessary to know more about the passband of a filter than its insertion loss at the center frequency and its 3 db bandwidth.

The information on this page is intended as a design aid, to help in the selection of the best filter for each application.

Figure 5 illustrates the response of a "lossless" (infinite Q) filter of X db Chebyschev design. All of the attenuation is due to reflection and not dissipation. This theoretical filter design would provide a flat passband of X db ripple.

In practice, however, finite values of Q result in dissipative losses and therefore Figure 6 is a more realistic representation of the response of a typical filter.

The dissipative losses are greater at the band edges than at the center frequency. The passband of the filter becomes rounded at these edges.

Since both reflective and dissipative losses are present in each filter, the ripple caused by the reflective losses becomes superimposed on the rounded passband created by the dissipative losses. As a consequence, it is more meaningful to specify a "relative" bandwidth, as shown in Fig. 6, than a ripple bandwidth.

Figures 7 through 10 show the approximate relationships of the VSWR bandwidth and other relative bandwidths to the 3 db relative bandwidth. The number of sections and the insertion loss of the filter affect these relationships.

For Example:

A six section filter with an insertion loss of 1.5 db and a 3 db bandwidth of 60 MHz would have the following bandwidths:

VSWR bandwidth . . . . .90% of 60 MHz . . . .approx. 54 MHz
0.5 db relative bandwidth . . .73% of 60 MHz . . . .approx. 44 MHz
1.0 db relative bandwidth . . .85% of 60 MHz . . . .approx. 51 MHz
2.0 db relative bandwidth . . .92% of 60 MHz . . . .approx. 55 MHz

SPECIAL FILTER CHARACTERISTICS

The following data will serve as general guidelines for filter requirements in the areas of phase matching, phase linearity and group delay.

Phase Matching:

A. Plus or Minus 2 degrees over 30 to 40% of the 3dB bandwidth
B. Plus or Minus 3 degrees over 50 to 60% of the 3dB bandwidth
C. Plus or Minus 5 degrees over 70 to 85% of the 3 dB bandwidth
D. Plus or Minus 1 degree over 5 to 15% of the 3dB bandwidth

Phase Linearity:

If the filter can be tuned to less than 1.3/1 VSWR

A. Plus or Minus 2 degrees over 30% of the 3dB bandwidth
B. Plus or Minus 3 degrees over 50 to 60% of the 3dB bandwidth
C. Plus or Minus 5 degrees over 60 to 70% of the 3 dB bandwidth

Group Delay:

The group delay response of all our filters very closely approximates the theoretical response for the Chebychev family (including Butterworth). As there are an infinite number of combinations of bandwidth, number of sections and design element values, questions regarding group delay must be currently answered by the factory.

Figure 5. Response Curve of a Theoretical Bandpass Filter with Infinite Q.

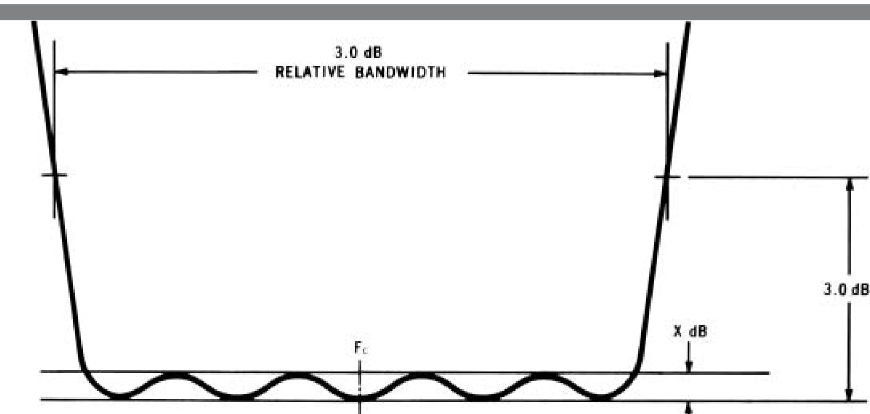
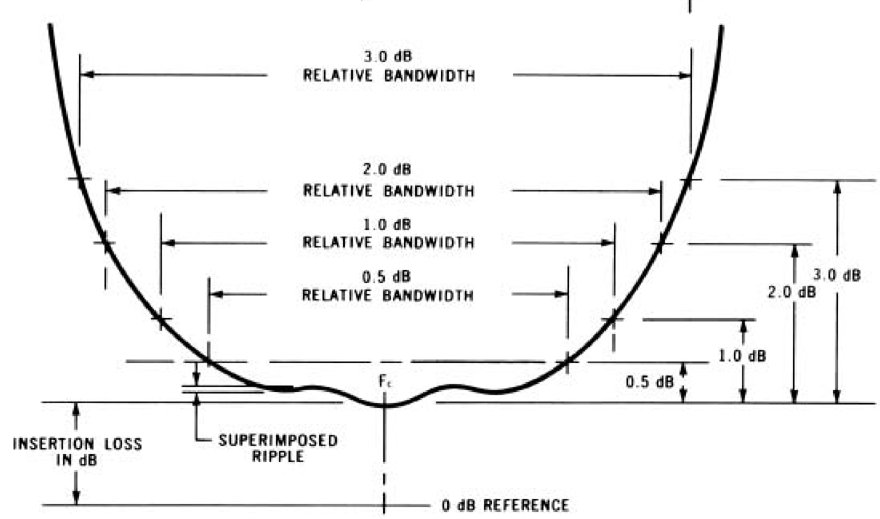


Figure 6. Actual Filter Response Curve with Finite Q Values.



PASSBAND RELATIONSHIP CURVES

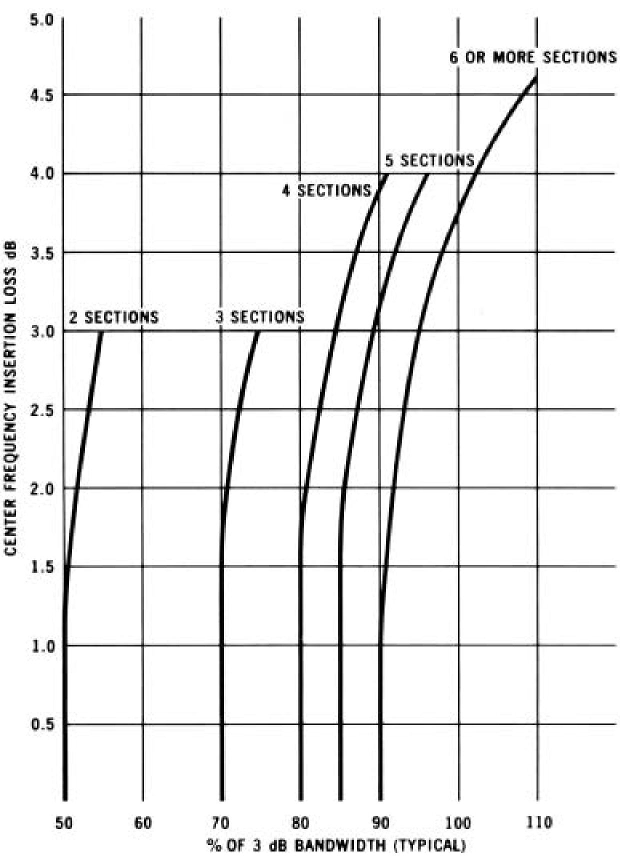


Figure 7. VSWR Bandwidth.

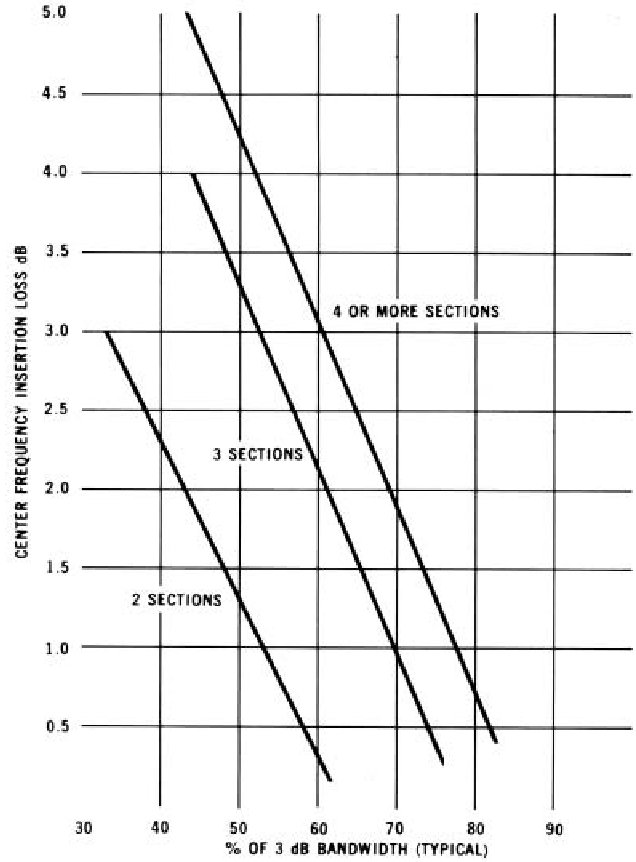


Figure 8. 0.5 dB Relative Bandwidth.

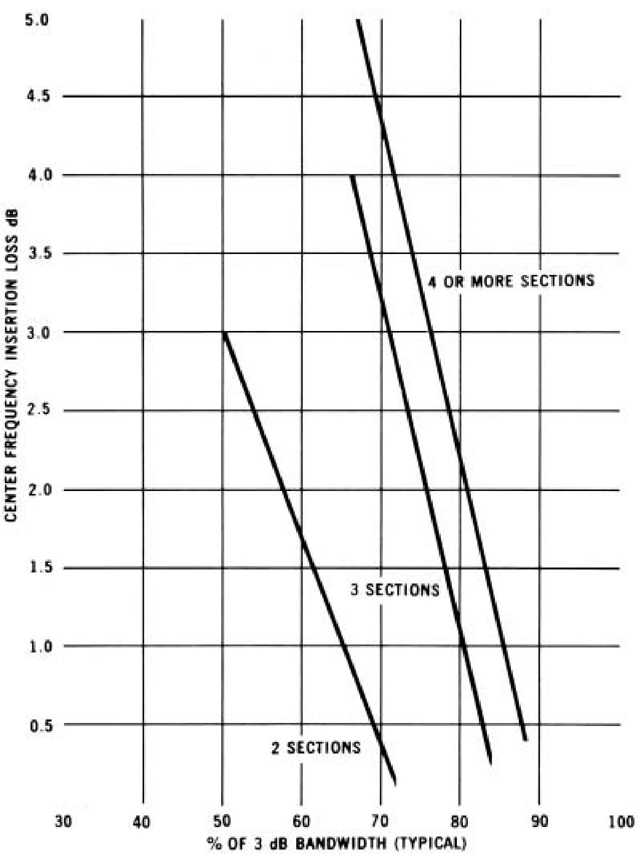


Figure 9. 1.0 dB Relative Bandwidth.

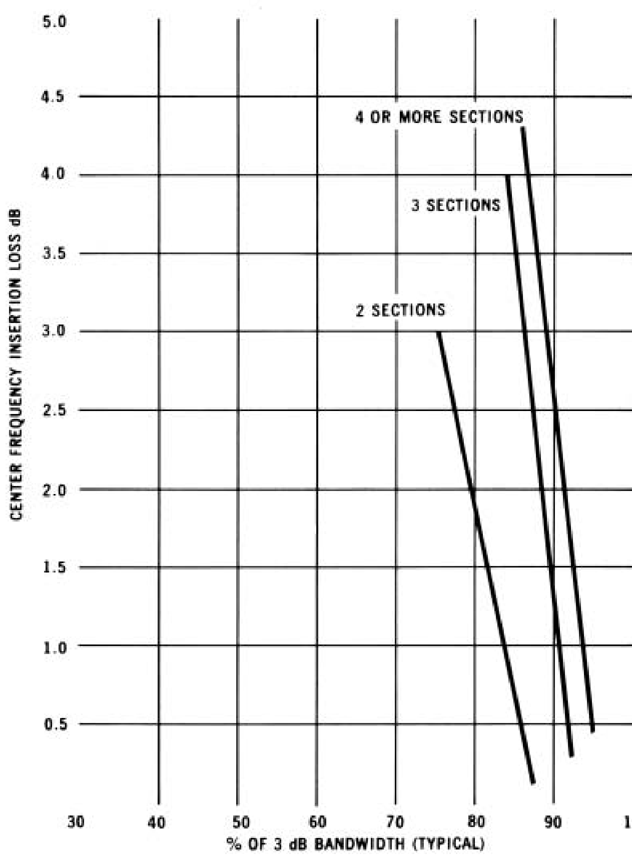


Figure 10. 2.0 dB Relative Bandwidth

TUBULAR LOWPASS FILTERS

■ 30 TO 2,750 MHz ■ 2 TO 12 SECTIONS

DESCRIPTION

All Lowpass Series are typically of 0.1 db Chebyschev Design and are available with 2 thru 12 sections and practically any available RF connector (see pages 16, 17). Special designs are available on request.

The specifications for the example shown here are as follows: 1/2″ diameter Lowpass Filter, VSWR cutoff frequency = 1600 MHz, 5 sections, TNC female conn.

TLP 1600 — 5 C C □

- Series — TLP
- Nominal Cutoff Frequency in MHz — 1600
- Number of Sections — 5
- See Connector Code, Below: Input Conn. — C
- See Connector Code, Below: Output Conn. — C
- Suffix Number to be Assigned by the Factory to Identify the Specific Customer and Application — □

SERIES TLP
100 to 2,750 MHz
1/2″ diam.
low cost
small size

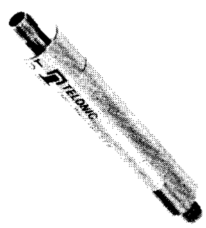
SERIES TLA
50 to 1,500 MHz
3/4″ diam.
intermediate loss
size power

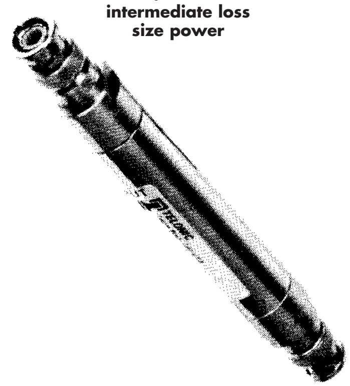
SERIES TLC
30 to 1,000 MHz
1 1/4″ diam.
low loss
highest power

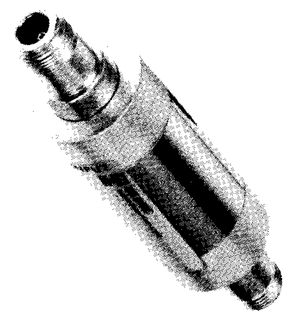
CONNECTOR CODE

- * A — BNC Jack
- * B — BNC Plug
- C — TNC Jack
- D — TNC Plug
- E — N Jack
- F — N Plug
- S — SMA Jack
- T — SMA Plug
- X — Special

* BNC Connectors not standard above 1000 MHz





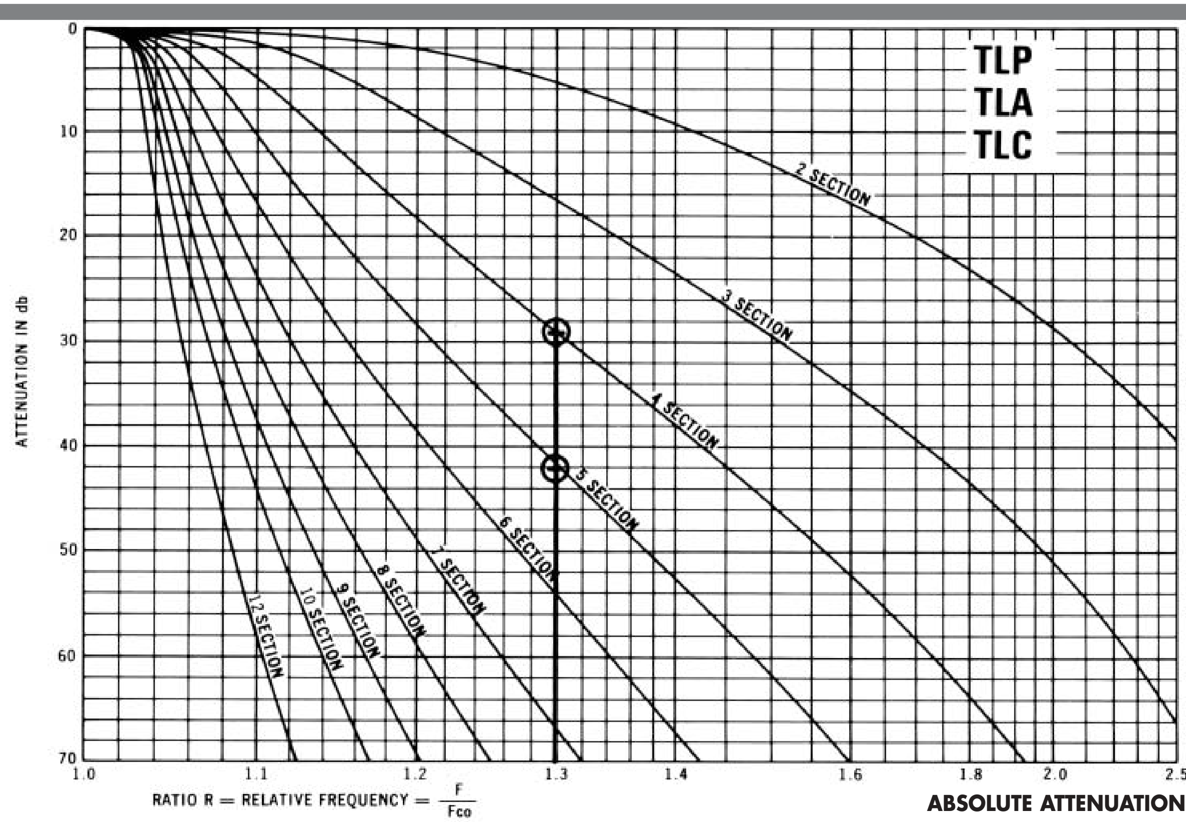


SPECIFICATIONS			TLP	TLA	TLC
ELECTRICAL SPECIFICATIONS					
Cutoff Frequency Range		**Normal Spec. Limit**	100 MHz to 2750 MHz (See Note 1)	50 MHz to 1500 MHz (See Note 1)	30 MHz to 1000 MHz (See Note 1)
		***Areas of Interest**	As Low as 60 MHz	As Low as 40 MHz	As Low as 10 MHz
Maximum Insertion Loss In Passband		**Normal Spec. Limit**	See Graph	See Graph	See Graph
		***Areas of Interest**	Submit Requirements	Submit Requirements	Submit Requirements
Nominal Impedance (in and out)		**Normal Spec. Limit**	50 ohms	50 ohms	50 ohms
		***Areas of Interest**	50 to 100 ohms	50 to 100 ohms	50 to 100 ohms
Maximum VSWR In Passband		**Normal Spec. Limit**	1.5:1	1.5:1	1.5:1
		***Areas of Interest**	As Low As 1.2:1	As Low As 1.2:1	As Low As 1.2:1
Stop Band Attenuation		**Normal Spec. Limit**	See Page11	See Page11	See Page11
		***Areas of Interest**	Submit Requirements	Submit Requirements	Submit Requirements
Number of Sections		**Normal Spec. Limit**	2 to 8	2 to 8	3 to 6
		***Areas of Interest**	2 to 12	2 to 12	2 to 12
Average Input Power (watts max. to 10,000 ft.)		**Normal Spec. Limit**	$\frac{5}{\text{Loss Constant}}$	$\frac{8}{\text{Loss Constant}}$	$\frac{15}{\text{Loss Constant}}$
		***Areas of Interest**	$\frac{12}{\text{Loss Constant}}$	$\frac{20}{\text{Loss Constant}}$	$\frac{40}{\text{Loss Constant}}$
Input Peak Power (watts max. to 10,000 ft.)		**Normal Spec. Limit**	500	500	1000
		***Areas of Interest**	10,000	10,000	10,000
ENVIRONMENTAL SPECIFICATIONS					
OPERATING	**Shock**	**Normal Spec. Limit**	30G	15G	15G
		***Areas of Interest**	1000G	75G	75G
	Vibration	**Normal Spec. Limit**	10G	5G	5G
		***Areas of Interest**	50G	30G	30G
	Humidity	**Normal Spec. Limit**	Up to 90%	Up to 90%	Up to 90%
		***Areas of Interest**	To 100% with Condensation	To 100% with Condensation	To 100% with Condensation
	Altitude	**Normal Spec. Limit**	Unlimited	Unlimited	Unlimited
	Temp. Range	**Normal Spec. Limit**	-20°C to +50°C	-20°C to +50°C	-20°C to +50°C
		***Areas of Interest**	-54°C to +125°C	-54°C to +125°C	-54°C to +125°C
STORAGE	**Shock**	**Normal Spec. Limit**	30G	15G	15G
		***Areas of Interest**	1000G	75G	75G
	Vibration	**Normal Spec. Limit**	10G	5G	5G
		***Areas of Interest**	100G	30G	30G
	Temp. Range	**Normal Spec. Limit**	– 54°C to + 71°C	– 54°C to + 71°C	– 54°C to + 71°C
		***Areas of Interest**	– 62°C to +150°C	– 62°C to +150°C	– 62°C to +150°C
MECHANICAL SPECIFICATIONS					
Diameter			1/2 inch	3/4 inch	1 1/4 inch
Approx. Weight			3/4 oz. per inch	3/4 oz. per inch	1 1/4 oz. per inch

NOTE 1: See page 6 for standard tolerance on cutoff frequency. The normal specification passband is from 0.4 x cutoff frequency to cutoff. A wider specification passband can be supplied. Telonic will be happy to advise on all such special requirements.

***Submit specific requirements**

TUBULAR LOWPASS FILTERS ATTENUATION CURVES



ABSOLUTE ATTENUATION

★ GUARANTEED SPECIFICATIONS TO 5X CUTOFF FREQUENCY

The curves above define the normal specification limits on attenuation for Telonic lowpass filters. The minimum attenuation level in db is shown as a function of the relative frequency.*

Calculate relative frequency as ratio of frequency to be attenuated to frequency to be passed: $R = \frac{\text{'B' MHz}}{\text{'A' MHz}}$

For example:

Requirements—

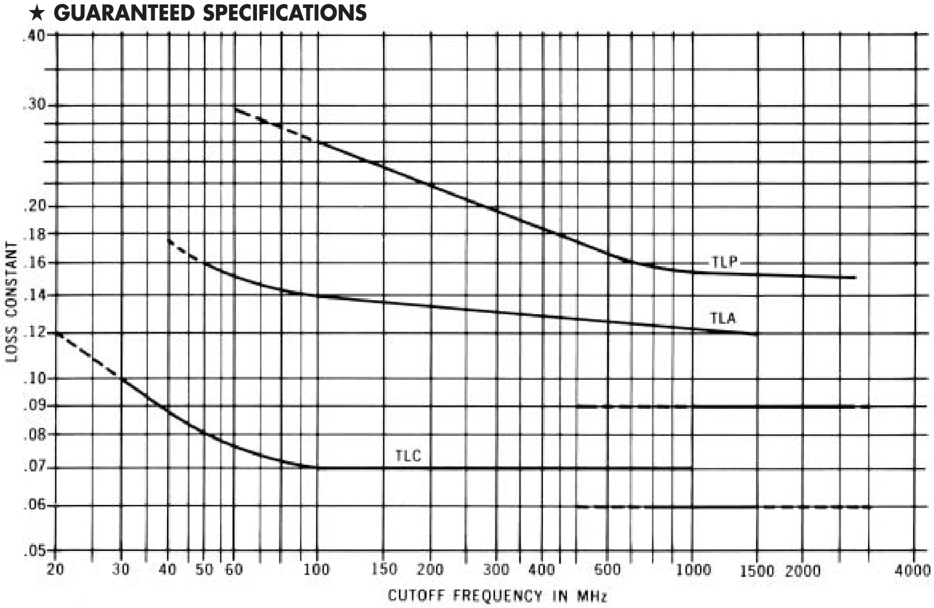
1. Min. cutoff frequency = 1,600 MHz.
2. 35 db min. attenuation at 2,080 MHz.

1,600 MHz is within the standard frequency ranges of two different lowpass types — TLP and TLR. 2,080 MHz is at a relative frequency of 1.3 with respect to 1600 MHz. $\frac{2080}{1600} = 1.3$

Reading from the 4-sec. curve (note ref. line) at a relative frequency of 1.3, we find that a four section TLP has a normal specification limit of 29 db and a five section TLP has a normal specification limit of 42 db. Therefore a TLP of five or more sections would be required to meet the 35 db attenuation specification.

INSERTION LOSS CURVES

★ GUARANTEED SPECIFICATIONS



INSERTION LOSS:

Loss = KN + .05

Where:

K = Loss constant
N = Number of sections

The insertion loss graph defines the loss constant which must be used to calculate the insertion loss specification.

In addition, it illustrates the relative insertion loss and frequency ranges of the standard Telonic lowpass filters.

For example:

A five section filter with a cutoff frequency of 1,600 MHz is available in a TLP or a TLR configuration.

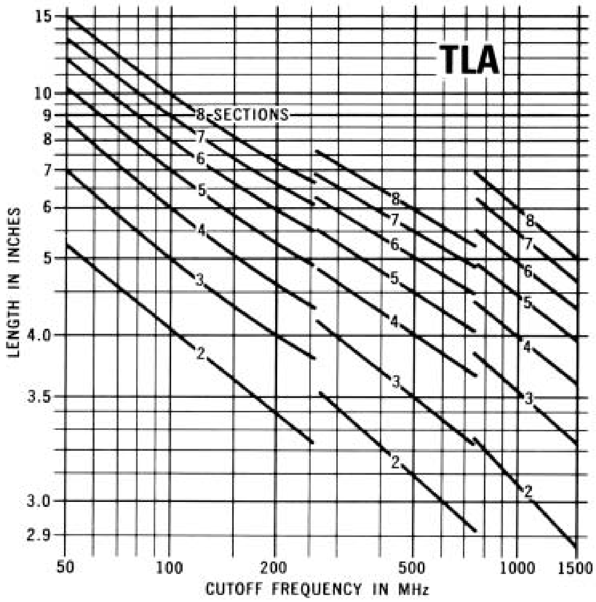
In accordance with the formula above, the maximum insertion loss specifications are as follows.

TLP 1600 – 5CC:

KN + .05 = .15 X 5 + .05 = .8 db

TLR 1600 – 5CC:

KN + .05 = .09 X 5 + .05 = .5 db



LENGTH OF LOWPASS FILTERS:

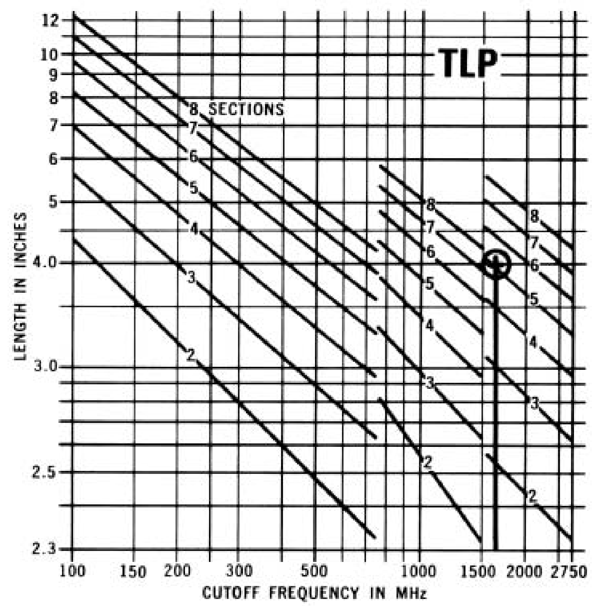
The approximate length of any Telonic lowpass filter can be read directly from these graphs.

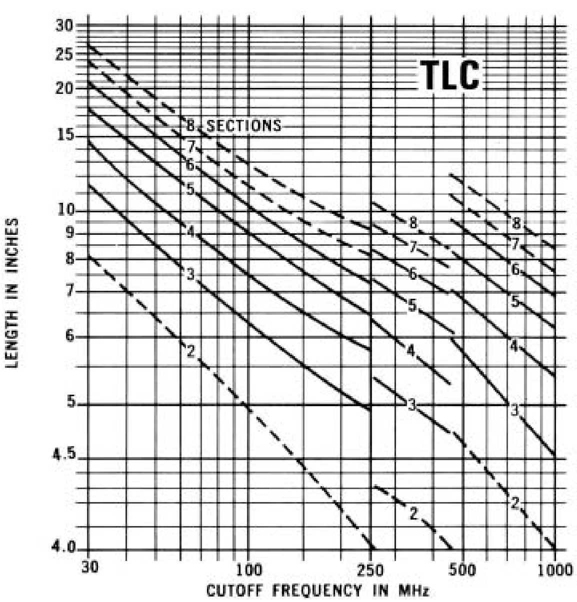
Select the graph which represents the correct series of filter. On the frequency scale, locate the proper value of cut-off frequency. Read straight up to the length-curve line which corresponds to the proper number of sections. Then, from the point where the cutoff frequency and section line cross, read horizontally to get the proper filter length, in inches.

For example:

The approximate length of TLP 1600-5CC is 4.0 inches. Note example reading shown flagged on the TLP length curve.

All of the length information shown here is approximate. Exact length specifications must be quoted by the factory. In most cases a filter can be constructed shorter than the length shown here, but this may cause an increase in insertion loss. If a shorter unit or one with a specific length is needed, please submit all of your requirements — both electrical and mechanical. This will enable Telonic to quote the optimum design for your application.





TUBULAR BANDPASS FILTERS

■ 30 TO 2,400 MHz ■ 2 TO 30% BANDWIDTH ■ 2 TO 12 SECTIONS

DESCRIPTION

Telonic Tubular Bandpass Filters are of 0.1 db Chebyschev design and are available with from 2 to 12 sections.

Three different sizes and frequency ranges allow for the selection of an optimal design for each requirement. Almost any type of input or output connection is available as a standard item.

The specifications for example shown here are as follows: 1/2" diameter Bandpass Filter with center frequency at 500 MHz 3 db BW of 50 MHz minimum, 5 pole attenuation response as defined in curves on page 13, connector type is TNC female.

TBP 500 — 50 — 5 C C □

- TBP — Series
- 500 — Nominal Center Freq. in MHz
- 50 — Minimum 3 db Relative Bandwidth in MHz
- 5 — Number of Sections
- C — See Connector Code, Below: Input Conn.
- C — See Connector Code, Below: Output Conn.
- □ — Suffix Number to be Assigned by the Factory to Identify the Specific Customer and Application

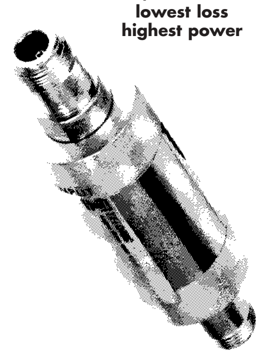
CONNECTOR CODE

- * A — BNC Jack
- * B — BNC Plug
- C — TNC Jack
- D — TNC Plug
- E — N Jack
- F — N Plug
- S — SMA Jack
- T — SMA Plug
- X — Special

* BNC Connectors not standard above 1000 MHz

SERIES TBP
100 to 2,400 MHz
1/2" inch diam.
lowest cost
most popular

SERIES TBA
50 to 1,000 MHz
3/4" inch diam.
medium loss
and power



SERIES TBC
30 to 900 MHz
1 1/4" inch diam.
lowest loss
highest power

ELECTRICAL SPECIFICATIONS		TBP	TBA	TBC
Cutoff Frequency Range	Normal Spec. Limit	100 MHz to 2400 MHz (See Note 1)	50 MHz to 1000 MHz (See Note 1)	30 MHz to 900 MHz (See Note 1)
	*Areas of Interest	60 MHz to 2700 MHz	35 MHz to 1500 MHz	20 MHz to 1200 MHz (See Note 1)
Minimum 3 db Relative Bandwidth (in % of center frequency)	Normal Spec. Limit	2% to 30% (See Note 1)	2% to 30% (See Note 1)	2% to 30% (See Note 1)
	*Areas of Interest	1.5% to 70%	1.5% to 70%	1.5% to 70%
Other Relative Bandwidths	*Areas of Interest	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)
Nominal Impedance (in and out)	Normal Spec. Limit	50 ohms	50 ohms	50 ohms
	*Areas of Interest	50 to 100 ohms	50 to 100 ohms	50 to 100 ohms
Maximum VSWR at Center Frequency	Normal Spec. Limit	1.5:1	1.5:1	1.5:1
	*Areas of Interest	As Low As 1.2:1	As Low As 1.2:1	As Low As 1.2:1
Minimum VSWR Bandwidth	Normal Spec. Limit	See Page 15	See Page 15	See Page 15
	*Areas of Interest	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)
Stop Band Attenuation	Normal Spec. Limit	See Page 13	See Page 13	See Page 13
	*Areas of Interest	Spl. Requirements	Spl. Requirements	Spl. Requirements
Number of Sections	Normal Spec. Limit	2 to 6	2 to 6	2 to 6
	*Areas of Interest	2 to 12	2 to 12	2 to 12
Average Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	300 (3 dB bw MHz) (Loss Constant) Fc MHz)	500 (3 dB bw MHz) (Loss Constant) Fc MHz)	1000 (3 dB bw MHz) (Loss Constant) Fc MHz)
Peak Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	Below 500 MHz: 200 (3 dB bw MHz) / Fc MHz	Below 300 MHz: 200 (3 dB bw MHz) / Fc MHz	Below 200 MHz: 400 (3 dB bw MHz) / Fc MHz
		Above 500 MHz: 600 (3 dB bw MHz) / Fc MHz	Above 300 MHz: 400 (3 dB bw MHz) / Fc MHz	Above 200 MHz: 800 (3 dB bw MHz) / Fc MHz
	*Areas of Interest	10 KW	10 KW	50 KW
ENVIRONMENTAL SPECIFICATIONS				
OPERATING — Shock	Normal Spec. Limit	30G	15G	15G
	*Areas of Interest	1000G	75G	75G
OPERATING — Vibration	Normal Spec. Limit	10G	5G	5G
	*Areas of Interest	50G	30G	30G
OPERATING — Humidity	Normal Spec. Limit	Up to 90%	Up to 90%	Up to 90%
	*Areas of Interest	up to 100% with Condensation	up to 100% with Condensation	up to 100% with Condensation
OPERATING — Altitude	Normal Spec. Limit	Unlimited	Unlimited	Unlimited
OPERATING — Temp. Range	Normal Spec. Limit	0°C to + 50°C	0°C to + 50°C	0°C to + 50°C
	*Areas of Interest	−54°C to + 125°C	−54°C to + 125°C	−54°C to + 125°C
STORAGE — Shock	Normal Spec. Limit	30G	15G	15G
	*Areas of Interest	1000G	75G	75G
STORAGE — Vibration	Normal Spec. Limit	10G	5G	5G
	*Areas of Interest	100G	30G	30G
STORAGE — Temp. Range	Normal Spec. Limit	−54°C to + 55°C	−54°C to + 55°C	−54°C to + 55°C
	*Areas of Interest	−62°C to +150°C	−62°C to +150°C	−62°C to +150°C
MECHANICAL SPECIFICATIONS				
Diameter		1/2 inch	3/4 inch	1 1/4 inch
Approx. Weight		3/4 oz. per inch	3/4 oz. per inch	1 1/4 oz. per inch

NOTE 1: See page 6 for standard tolerance and definition of center frequency and bandwidth.

STOP BAND ATTENUATION:

These graphs show the minimum stop band attenuation in db for all three series of Telonic Tubular Bandpass Filters. Since the filter characteristics and production tolerances vary for differing bandwidths, it is necessary to establish differing specifications for each bandwidth of filter. Intermediate values may be interpolated.

In each case the rejection frequency is plotted in "3 db bandwidths from center frequency." The exact relationships are as follows:

(I) 3 db bandwidths from center freq. = $\dfrac{\text{Rejection freq. MHz} - \text{Fc MHz}}{\text{Min. 3 db BW MHz}}$

or

(II) Min. 3 db bandwidth in MHz = $\dfrac{\text{Rejection freq. MHz} - \text{Fc MHz}}{\text{3 db BW Fc}}$

Any one of the following parameters may be identified if the other three and the center frequency are known.

(1) Min. 3 db bandwidth (in MHz) **(2)** Number of Sections
(3) Rejection Frequency (in MHz) **(4)** Attenuation Level (in db)

Always verify that the frequency and bandwidth you have selected are within the limitations shown for that series of filter.

Example 1: (See page 14, 10% curve).

Given:
Center frequency = 500 MHz
Minimum 3 db BW = 50 MHz
Number of sections = 5
Find: Minimum attenuation levels at 580 MHz and 425 MHz

From (I) above —

$$\text{3 db BWs from Fc} = \frac{580\text{-}500}{50} = +1.60$$

$$\text{and} = \frac{425-500}{50} = -1.50$$

Since the 3 db bandwidth is exactly 10 % of the center frequency, the answer can be read directly from the graph marked 10% bandwidth.

Using the 5-section curve and the point +1.60 (580 MHz) we find the min. attenuation level is 50 db. At –1.50 (425 MHz) the minimum attenuation level is 40 db.

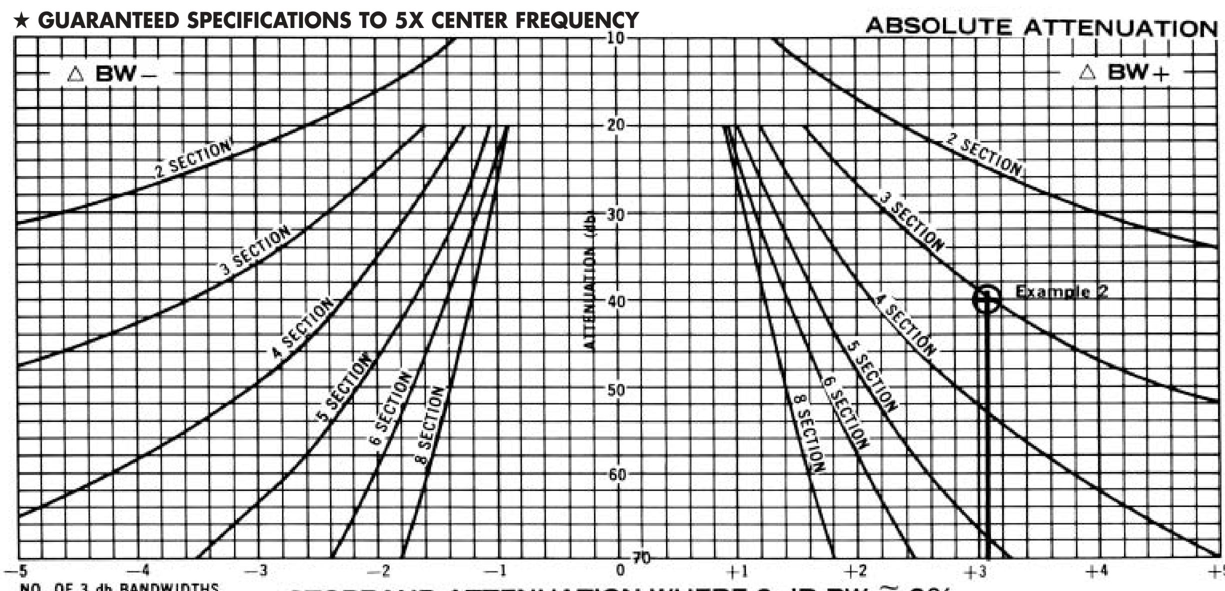
Example 2:
Given:
Center frequency = 300 MHz
Number of sections = 3
Atten. at 336 MHz = 40 db min.
Find: The 3 db bandwidth

From (II) above—

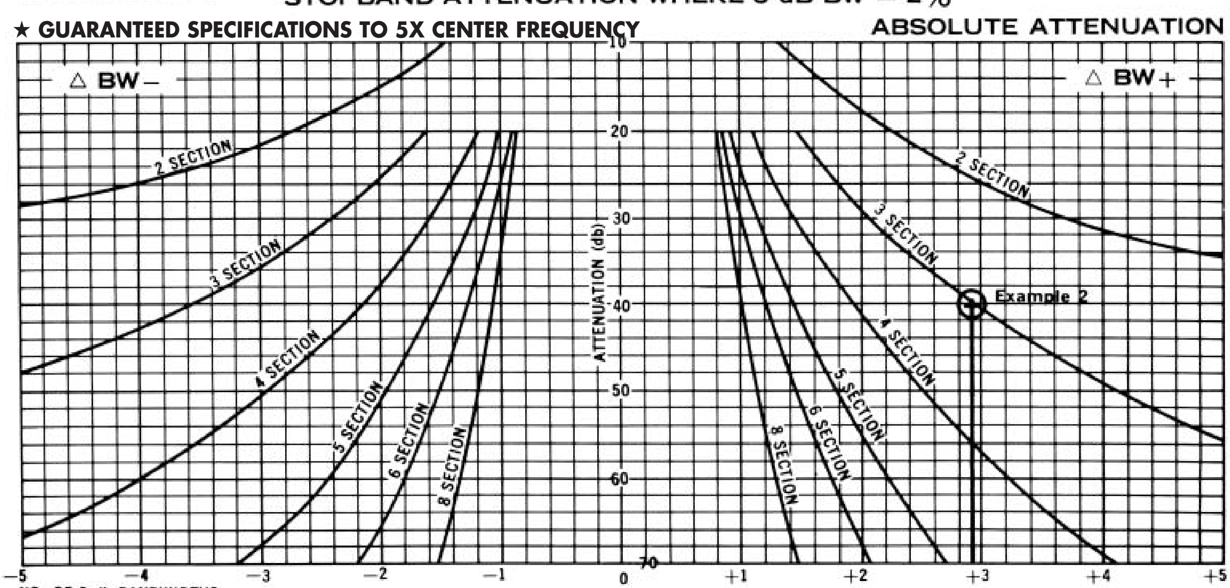
$$\text{Min. 3 db BW} = \frac{336-300}{\text{3 db BW from Fc}}$$

Since we do not know the exact bandwidth we must estimate it and solve by an iterative process.

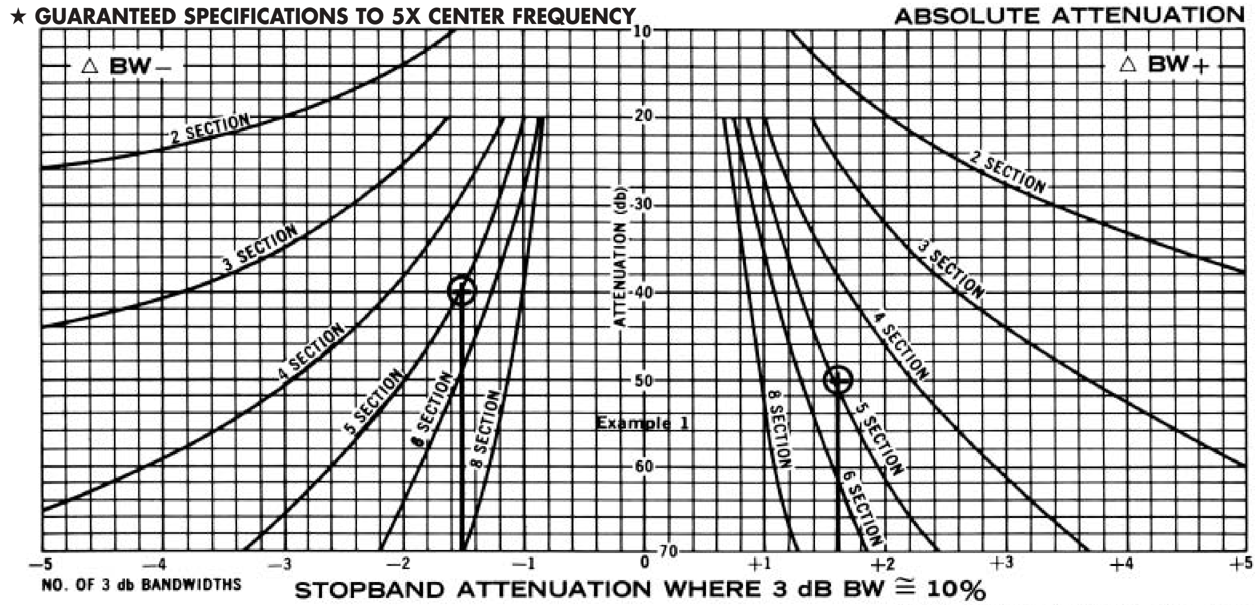
All of the 3 section curves show the high frequency 40 db point at between +2.5 and +3.1 3 db bandwidths from center freq. If we assume 2.8 we find an approximate value for the 3 db BW of 36/2.8 = 13 MHz.13 MHz is approximately 4% of 300 MHz, therefore we now know that we must interpolate between the 2% and 5% bandwidth graphs. The 2% graph shows +3.1 and the 5% graph shows +2.95. We now know that +3.0 is an accurate number to use in the above equation. The accurate value for the 3 db bandwidth is 36/3.0 = 12 MHz.



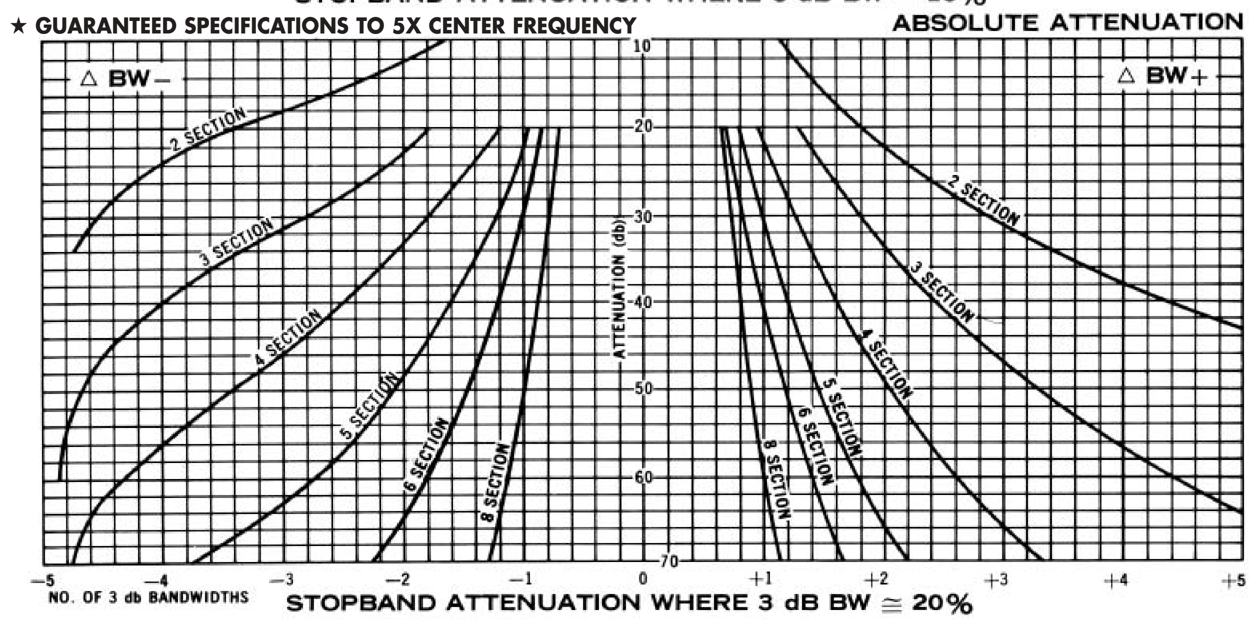
STOPBAND ATTENUATION WHERE 3 dB BW ≅ 2%



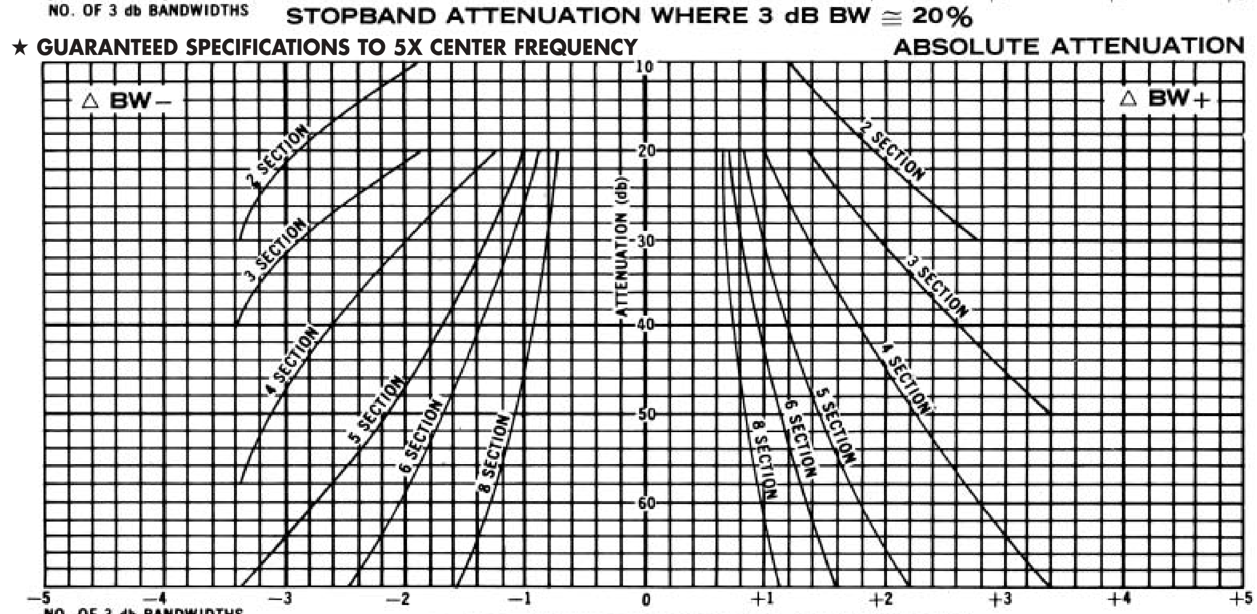
STOPBAND ATTENUATION WHERE 3 dB BW ≅ 5%



STOPBAND ATTENUATION WHERE 3 dB BW ≅ 10%



STOPBAND ATTENUATION WHERE 3 dB BW ≅ 20%



STOPBAND ATTENUATION WHERE 3 dB BW ≅ 30%

APPROXIMATE LENGTH OF TUBULAR BANDPASS FILTERS:

To determine the approximate length of Telonic Tubular Bandpass Filters, calculate the % BW and use the formulae and graphs shown here. Your answer will be the approximate overall length including type TNC female connectors.

Exact length specifications must be quoted by the factory. In most cases a filter can be constructed shorter than the length shown here, but this may cause an increase in insertion loss.

If a shorter unit or one with a specific length is needed, please submit all of your requirements, both electrical and mechanical. This will enable Telonic Berkeley to quote the optimal design for your application.

$$\% \text{ BW} = \frac{100 \text{ (min. 3 db BW MHz)}}{\text{Nominal Fc MHz}}$$

When using the graphs shown here, read the length constant which corresponds with the nominal center frequency and % bandwidth of your filter.

Example 1:

MODEL NO. TBP 500 - 50 - 5CC ☐

$$\% \text{ BW} = \frac{100 \times 50}{500} = 10$$

$$\text{Approx. length} = K\left(N + \frac{3}{\% \text{ BW}}\right) + 1.6$$

$$= 0.68\left(5 + \frac{3}{10}\right) + 1.6$$

$$= 0.68 \times 5.3 + 1.6$$

$$= 5.2 \text{ inches}$$

Example 2:

MODEL NO. TBA 300 - 12 - 3CC ☐

$$\% \text{ BW} = \frac{100 \times 12}{300} = 4$$

$$\text{Approx. length} = K\left(N + \frac{3}{\% \text{ BW}}\right) + 2.4$$

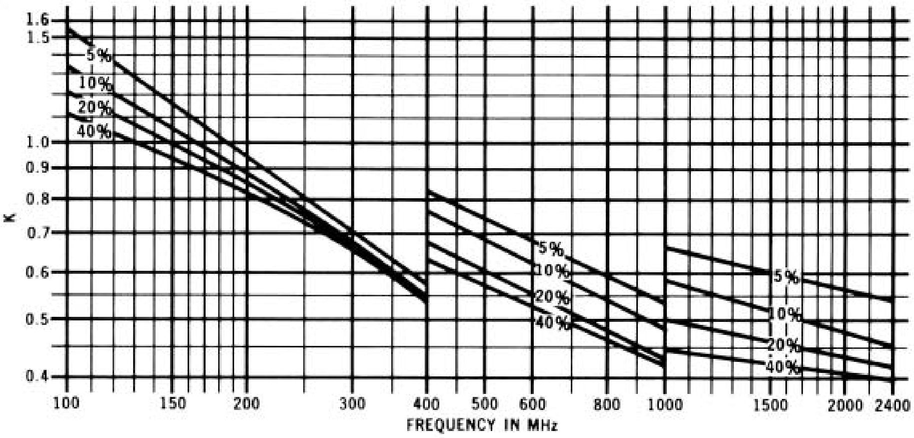
$$= 0.77\left(3 + \frac{3}{4}\right) + 2.4$$

$$= 0.77 \times 3.75 + 2.4$$

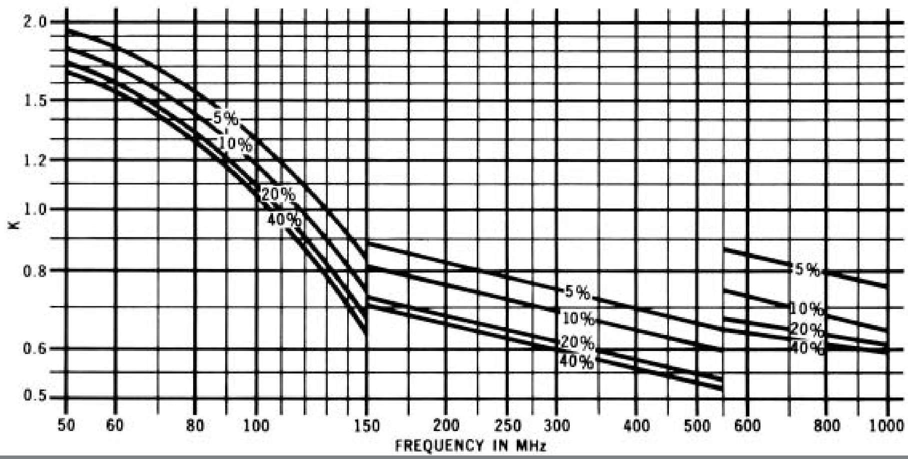
$$= 5.3 \text{ inches}$$

TBC: Consult factory.

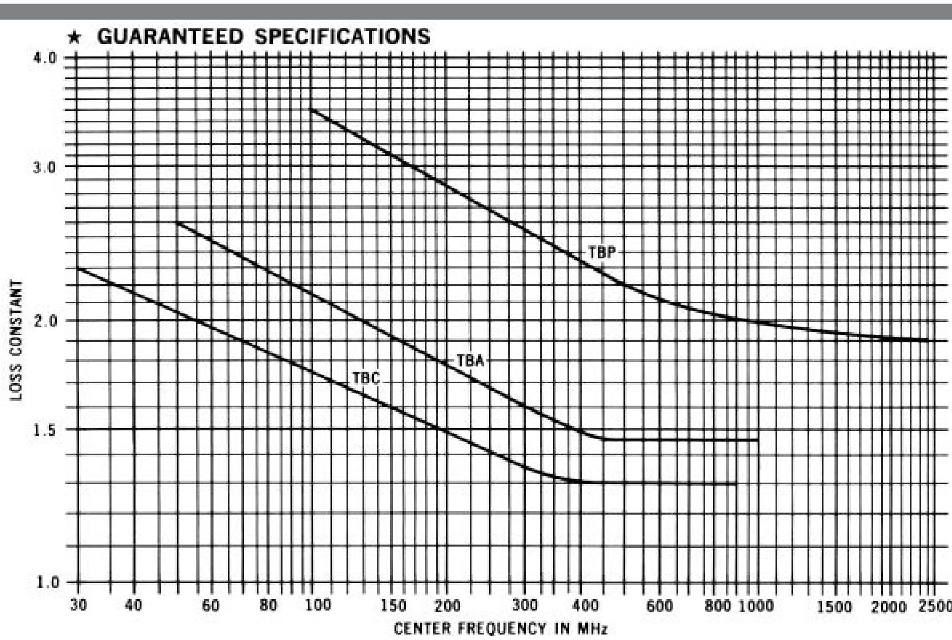
TBP Approx. length $= K\left(N + \frac{3}{\% \text{ BW}}\right) + 1.6$ WHERE K = LENGTH CONSTANT, N = NUMBER OF SECTIONS



TBA Approx. length $= K\left(N + \frac{3}{\% \text{ BW}}\right) + 2.4$ WHERE K = LENGTH CONSTANT, N = NUMBER OF SECTIONS



INSERTION LOSS CURVES



CENTER FREQUENCY INSERTION LOSS:

$$\text{LOSS} = \frac{K\,(N + 0.5)}{\% \text{ BW}} + 0.2 \text{ dB}$$

Where:

K = Loss constant from graph
N = Number of sections

$$\% \text{ BW} = \frac{100 \text{ (3 db BW)}}{\text{Nominal Fc MHz}}$$

The graph defines the loss constant which must be used to calculate insertion loss. It also illustrates the relative insertion loss and frequency ranges of standard Telonic Tubular Bandpass Filters.

For example:

TBP 500 - 50 - 5CC
No. of sections = 5
Center freq. = 500 MHz

$$\% \text{ BW} = \frac{100 \times 50}{500} = 10$$

Loss constant = 2.2 (Read directly from the TBP insertion loss curve at 500 MHz.)

Therefore: Max. insertion loss at Fc

$$= \frac{2.2 \times 5.5}{10} + 0.2 = 1.4 \text{ db}$$

VSWR Bandwidth

NO. OF SECTIONS	2	3	4	5	6 0R MORE
VSWR Bandwidth / Min. 3 db Bandwidth	0.4	0.7	0.8	0.85	0.9

TELONIC HIGHPASS FILTERS

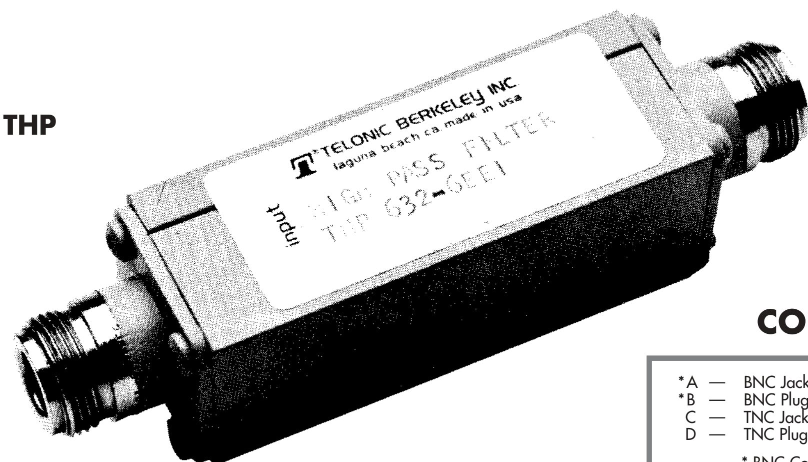
■ 50 TO 1500 MHz ■ 2 TO 10 SECTIONS

All Highpass Series are typically of 0.1 db Chebyschev Design and are available with 2 thru 10 sections. Special designs are available on request.

THP 350 5 C C □

- Series — THP
- Nominal Center Freq. MHz — 350
- Sections — 5
- See Connector Code, Below { Input Conn. — C; Output Conn. — C
- Suffix Number to be Assigned by the Factory to Identify the Specific Customer and Application — □

SERIES THP



CONNECTOR CODE

*A — BNC Jack	E — N Jack	S — SMA Jack
*B — BNC Plug	F — N Plug	T — SMA Plug
C — TNC Jack		X — Special
D — TNC Plug		

* BNC Connectors not standard above 1000 MHz

ELECTRICAL SPECIFICATIONS		Normal Spec. Limit	Areas of Interest
Cutoff Frequency Range		100 MHz to 500 MHz	50 MHz to 1500 MHz
Maximum Insertion Loss In Passband*		See Graph	Submit Requirements
Nominal Impedance (in and out)		50 ohms	50 to 100 ohms
Maximum VSWR In Passband		1.7:1	as low as 1.3:1
Stop Band Attenuation		See Graph	Submit Requirements
Number of Sections		3 to 7	2 to 10
Average Input Power (watts max. to 10,000 ft.)		5	12
Input Peak Power (watts max. to 10,000 ft.)		20	100
ENVIRONMENTAL SPECIFICATIONS			
OPERATING	Shock	30G	1000G
	Vibration	10G	50G
	Humidity	Up to 90%	To 100% with Condensation
	Altitude	Unlimited	Unlimited
	Temp. Range	-20°C to + 50°C	-54°C to + 125°C
STORAGE	Shock	30G	1000G
	Vibration	10G	50G
	Temp. Range	– 54°C to +71°C	– 62°C to +150°C

*All highpass filters have an upper passband limit caused by distributed effects of the individual elements. This upper limit is dependent upon both frequency and number of sections, and can vary from 2x to 7x the cutoff frequency. Consult factory for further information.

The curves at right define the normal specification limits on attenuation for Telonic highpass filters. The minimum attenuation level in db is shown as a function of the relative frequency.

Calculate relative frequency as ratio of frequency to be attenuated to frequency to be passed:

$$R = \frac{\text{'B' MHz}}{\text{'A' MHz}}$$

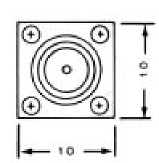
For example:

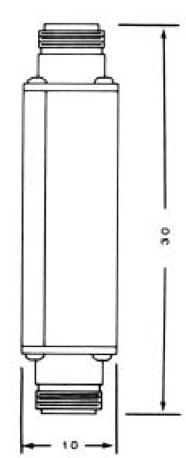
Requirements –

1. Min. cutoff frequency = 350 MHz.
2. 35 db min. attenuation at 250 MHz.
   250 MHz is at a relative frequency of .71 with respect to 350 MHz.

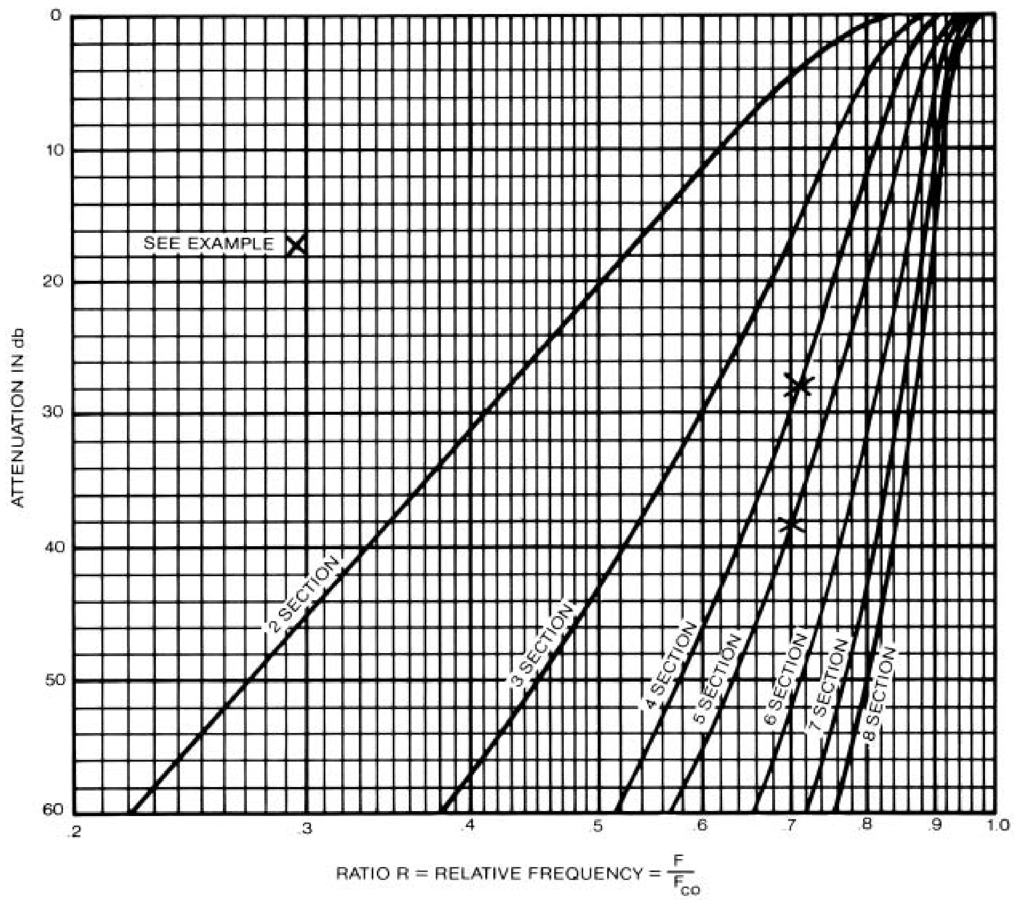
$$R = \frac{250}{350} = .71$$

Reading from the 4 - sec. curve at a relative frequency of .71, we find that a four section THP has a normal specification limit of 28 db and a five section THP has a normal specification limit of 38 db. Therefore a THP of five or more sections would be required to meet the 35 db attenuation specification.

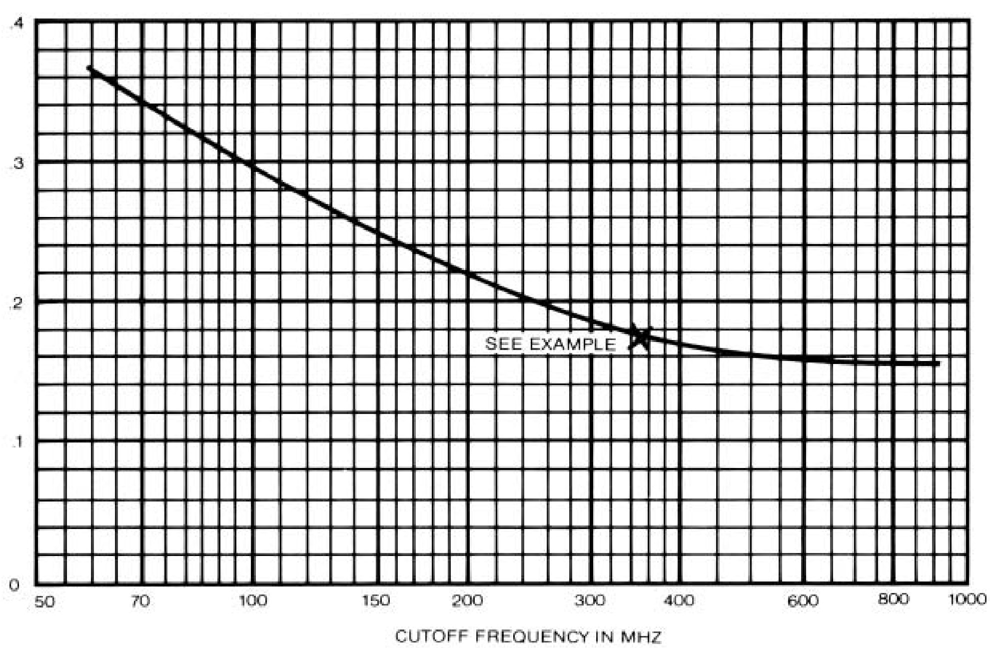




HIGHPASS ATTENUATION CURVE



INSERTION LOSS CURVES



INSERTION LOSS:

Loss = KN + .2 (in db)

Where:

K = Loss constant

N = Number of sections

The insertion loss graph defines the loss constant which must be used to calculate the insertion loss specification.

For example:

In accordance with the formula above, the maximum insertion loss specifications are as follows.

THP 350 - 5CC

KN + 0.2 = .18 x 5 + .2 =1.1db

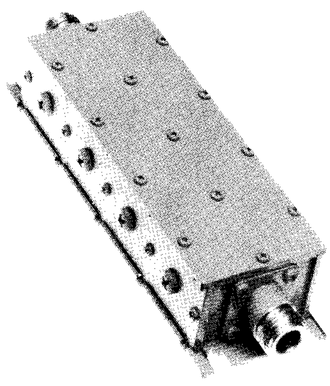
CAVITY BANDPASS FILTERS

■ 30 TO 12,000 MHz ■ 0.1 TO 3.0% BANDWIDTHS

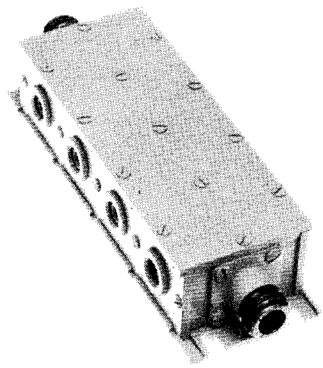
Telonic Cavity Bandpass Filters exhibit lower losses and narrower bandwidths than Telonic Tubular Filters, as well as higher frequency ranges. For extremely high stability over the operating temperature range, most Cavity Filters can be temperature compensated. Where the normal attenuation characteristic is not appropriate, traps, or "band-reject sections" may be added for special applications.

These filters utilize helical resonators, coaxial resonators or resonant cavities. Resonant elements are subject to higher frequency spurious responses which can usually be suppressed with a Telonic Lowpass Filter, if required.

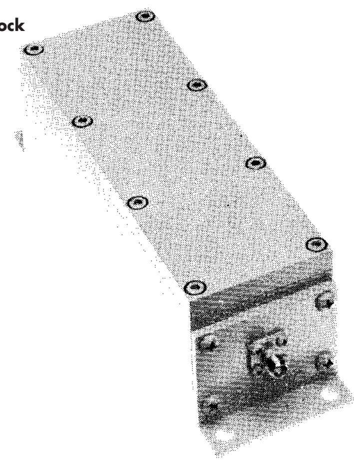
SERIES TSF
- 30 to 400 MHz
- Helical resonators
- Slotted aluminum box



SERIES TCF
- 400 to 3,000 MHz
- Coaxial 1/4"- wavelength resonators
- Slotted aluminum box



SERIES TCC
- 500 to 2,500 MHz
- Coaxial 1/4"- wavelength resonators
- Lowest insertion loss of the cavity designs
- Bored aluminum block



ELECTRICAL SPECIFICATIONS		TSF	TCF	TCC
Cutoff Frequency Range	Normal Spec. Limit	30 to 400 MHz (See Note 1)	0.4 to 3.0 GHz (See Note 1)	0.5 to 2.5 GHz (See Note 1)
	*Areas of Interest	20 to 600 MHz	0.3 to 4.0 GHz	
Minimum 3 db Relative Bandwidth (in % of center frequency)	Normal Spec. Limit	1.0% to 3.0% (See Note 1)	0.3% to 3.0% (See Note 1)	0.3% to 3.0% (See Note 1)
	*Areas of Interest	0.2% to 3.5%	0.2% to 3.5%	0.1% to 3.5%
Other Relative Bandwidths	*Areas of Interest	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)
Maximum insertion loss At Center Frequency	Normal Spec. Limit	See page 20	See page 20	See page 20
	*Areas of Interest	Spl. Requirements	Spl. Requirements	Spl. Requirements
Nominal Impedance (in and out)	Normal Spec. Limit	50 ohms	50 ohms	50 ohms
	*Areas of Interest	50 to 100 ohms	60 ohms	60 ohms
Maximum VSWR at Center Frequency	Normal Spec. Limit	1.5:1	1.5:1	1.5:1
	*Areas of Interest	1.2:1	1.2:1	1.1:1
Minimum VSWR Bandwidth	Normal Spec. Limit	See Table 1	See Table 1	See Table 1
	*Areas of Interest	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)
Stop Band Attenuation	Normal Spec. Limit	See Page 20	See Page 20	See Page 20
	*Areas of Interest	Spl. Requirements	Spl. Requirements	Spl. Requirements
Number of Sections	Normal Spec. Limit	2 to 6	2 to 6	2 to 6
	*Areas of Interest	up to 10	up to 10	up to 10
Average Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	300 (3 dB rel. bw MHz) / (Loss Constant) (Fc MHz)	See Peak	20% of Peak
	*Areas of Interest	5 to 20	10 to 100	100 to 1000
Input Peak Power (watts max. to 10,000 ft.)	Normal Spec. Limit	1500 (3 dB rel. bw MHz) / (Fc MHz)	1500 (3 dB rel. bw MHz) / (Fc MHz)	10,000 (3 dB rel. bw MHz) / (Fc MHz)
	*Areas of Interest	20 to 100	20 to 200	100 to 1000

ENVIRONMENTAL SPECIFICATIONS			TSF	TCF	TCC
OPERATING	Shock	Normal Spec. Limit	5G	5G	25G
		*Areas of Interest	15G	15G	75G
	Vibration	Normal Spec. Limit	5G	5G	10G
		*Areas of Interest	15G	15G	30G
	Humidity	Normal Spec. Limit	Up to 90%	Up to 90%	Up to 90%
		*Areas of Interest	up to 100% with Condensation	up to 100% with Condensation	up to 100% with Condensation
	Altitude	Normal Spec. Limit	Unlimited	Unlimited	Unlimited
	Temp. Range	Normal Spec. Limit	0°C to 50°C	0°C to 50°C	0°C to 50°C
		*Areas of Interest	−54°C to + 125°C	−54°C to + 125°C	−54°C to + 125°C
STORAGE	Shock	Normal Spec. Limit	15G	15G	75G
		*Areas of Interest	75G	75G	150G
	Vibration	Normal Spec. Limit	10G	10G	30G
		*Areas of Interest	20G	20G	60G
	Temp. Range	Normal Spec. Limit	−54°C to + 71°C	−54°C to + 100°C	−54°C to + 100°C
		*Areas of Interest	−62°C to +150°C	−62°C to +150°C	−62°C to +150°C

NOTE 1: See page 6 for standard tolerance and definition of center frequency and bandwidth.

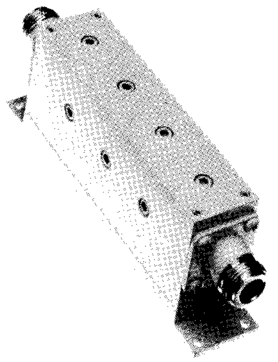
TCA 1680 — 42 — 4 E E □

- Series
- Nominal Center Frequency
- Minimum 3 db Bandwidth
- Number of Sections
- See page 21 for Connector Code { Input Conn. / Output Conn.
- Suffix Number to be Assigned by the Factory to Identify the Specific Customer and Application.

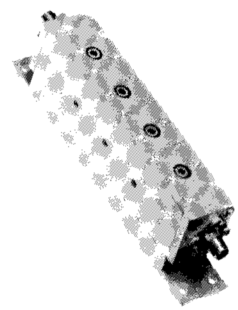
The specifications for the example shown here are as follows:

This model is a fixed frequency cavity bandpass filter. It has a nominal center frequency of 1680 MHz and a minimum 3 db relative bandwidth of 42 MHz. The maximum insertion loss at 1680 MHz is 0.47 db (see page 20). The nominal input and output impedance is 50 ohms. The maximum VSWR at center frequency is 1.5:1. From Table 1, 0.8 x 42 MHz (minimum 3 db bandwidth) is 33.6 MHz for a VSWR of 1.5:1 or less from 1663.2 MHz to 1696.8 MHz.

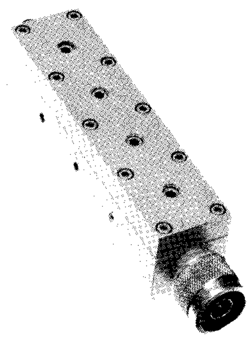
SERIES TCA
■ 1.0 to 3.0 GHz
■ Coaxial 1/4″- wavelength resonators
■ Bored aluminum block



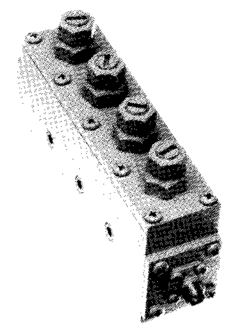
SERIES TCG
■ 2.0 to 6.0 GHz
■ Coaxial 1/4″- wavelength resonators
■ Bored aluminum block



SERIES TCH
■ 6.0 to 12.0 GHz
■ TM010 resonant cavity
■ Bored aluminum block



SERIES TCB
■ 1.0 to 2.4 GHz
■ Coaxial 1/4″- wavelength resonators
■ Adjustable center frequency
■ Bored aluminum block

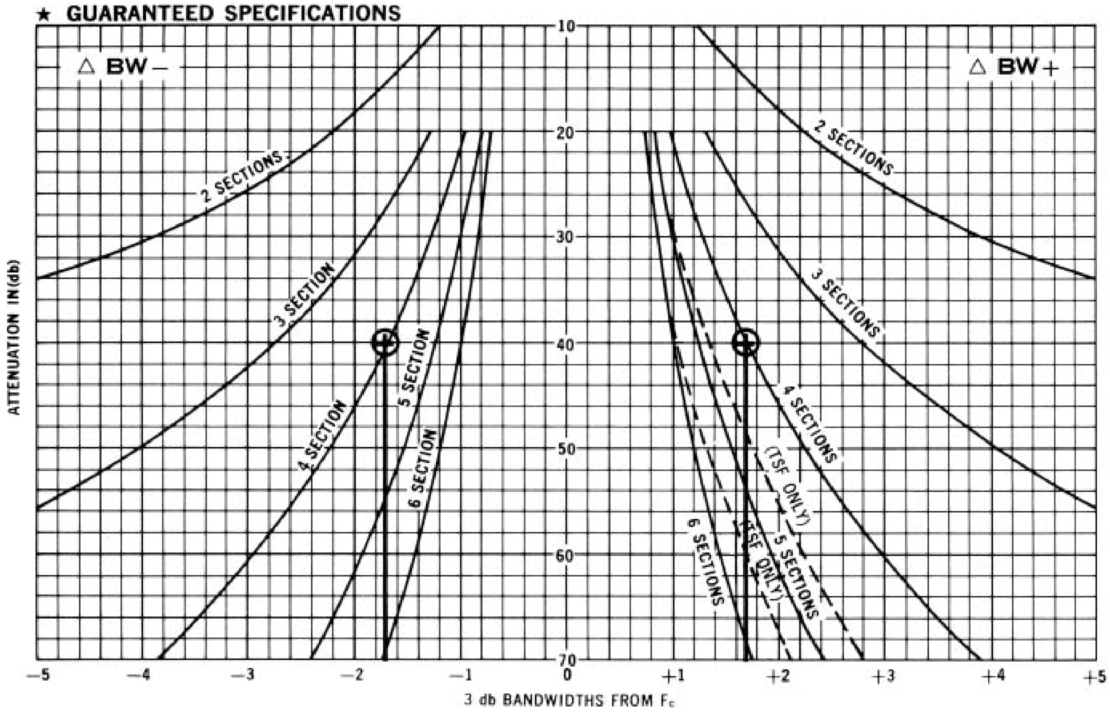


TCA	TCG	TCH	TCB
1.0 to 3.0 GHz (See Note 1)	2.0 to 6.0 GHz (See Note 1)	6.0 to 12.0 GHz (See Note 1)	1.0 to 2.4 GHz Tuning Range up to 10% (See Note 1)
0.8 to 4.0 GHz	1.0 to 6.0 GHz	6.0 to 12.0 GHz (See Note 1)	1.0 to 3.0 GHz
0.3% to 3.0% (See Note 1)	0.3% to 2.0% (See Note 1)	0.1% to 1.0% (See Note 1)	0.3% to 3.0% (See Note 1)
0.2% to 3.5%	0.2% to 3.0%	0.1% to 2.0% (See Note 1)	0.2% to 3.5%
Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)
See page 20	See page 20	————	————
Spl. Requirements	Spl. Requirements	Spl. Requirements (See page 20)	Spl. Requirements (See page 20)
50 ohms	50 ohms	50 ohms	50 ohms
60 ohms			60 ohms
1.5:1	1.5:1 to 4 GHz 2.0:1 to 6 GHz	2.0:1	1.5:1
1.2:1		1.5:1	
See Table 1	See Table 1		See Table 1
Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)	Spl. Requirements (See page 7)
See Page 20	See Page 20	See Page 20	See Page 20
Spl. Requirements	Spl. Requirements	Spl. Requirements	Similar to TCA
2 to 6	2 to 6	2 to 4	2 to 4
up to 10	up to 10	1 to 8	
See Peak	See Peak	10% of Peak	See Peak
15 to 150	15 to 150	5 to 200	2 to 150
1500 (3 dB rel. bw MHz) / (Fc MHz)	1500 (3 dB rel. bw MHz) / (Fc MHz)	15,000 (3 dB rel. bw MHz) / (Fc MHz)	1,000 (3 dB rel. bw MHz) / (Fc MHz)
45 to 300	45 to 300	100 to 5000	2 to 300
25G	25G	25G	5G
75G	75G	150G	15G
10G	10G	10G	5G
30G	30G	60G	10G
Up to 90%	Up to 90%	Up to 90%	Up to 90%
up to 100% with Condensation	up to 100% with Condensation	up to 100% with Condensation	up to 100% with Condensation
Unlimited	Unlimited	Unlimited	Unlimited
0°C to 50°C	0°C to 50°C	0°C to 50°C	0°C to 50°C
−54°C to + 125°C	−54°C to + 125°C	−54°C to + 125°C	−54°C to + 125°C
75G	75G	75G	5G
150G	150G	300G	25G
30G	30G	30G	5G
60G	60G	120G	15G
−54°C to + 100°C	−54°C to + 100°C	−54°C to + 100°C	−54°C to + 100°C
−62°C to +150°C	−62°C to +150°C	−62°C to +150°C	−62°C to +150°C

***Submit specific requirements for quotation**

CAVITY BANDPASS FILTERS

ATTENUATION



STOP BAND ATTENUATION:

This graph shows the minimum stop band attenuation in db for Telonic cavity bandpass filters with less than 3 db insertion loss. Filters with higher loss must be quoted by the factory.

The rejection frequency is plotted in "3 db bandwidths from center frequency." The exact relationships are:

(I) 3 db bandwidths from Fc

$$= \frac{\text{Rej. freq. MHz} - \text{Fc MHz}}{\text{Min. 3 db BW MHz}}$$

or **(II)** Min. 3 db bandwidth in MHz

$$= \frac{\text{Rej. freq. MHz} - \text{Fc MHz}}{\text{3 db BWs from Fc}}$$

Any one of the following parameters may be identified if the other three and the center frequency are known.

(1) Min. 3 db bandwidth (in MHz).

(2) Number of sections.

(3) Rejection Frequency (in MHz).

(4) Attenuation Level (in db).

Always verify that the frequency and bandwidth you have selected are within the limitations shown for that series of filter.

For example:

Given:

Center frequency = 1,680 MHz
Minimum 3 db BW = 42 MHz
Number of sections = 4

Find: Minimum attenuation level at 1,608 MHz and 1,752 MHz.

From (I) above: 3 db BWs from Fc

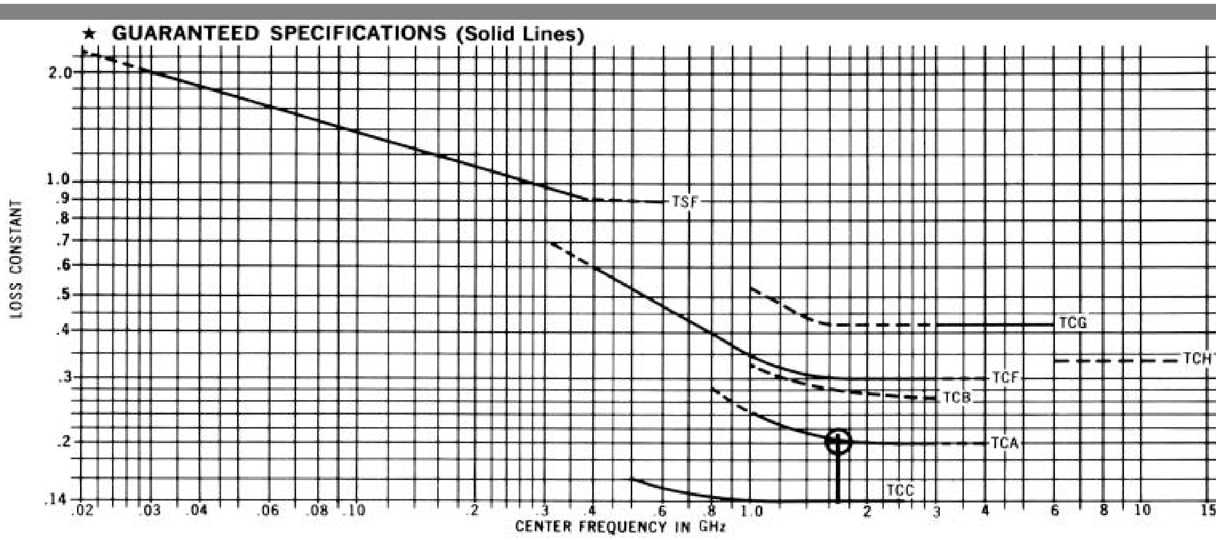
$$= \frac{1608 - 1680}{42} = -1.71$$

and

$$\frac{1752 - 1680}{42} = +1.71$$

Reading directly from the graph at the points −1.71 and +1.71 we find the minimum attenuation level of 40 db.

INSERTION LOSS



INSERTION LOSS:

$$\text{Max. loss at Fc} = \frac{K(N + 0.5)}{\% \text{ BW}} + 0.1 \text{ db}$$

Where: K = Loss constant
N = Number of sections

$$\% \text{ BW} = \frac{\text{100 x min. 3 dB BW MHz}}{\text{Nominal Fc MHz}}$$

The insertion loss graph defines the loss constant used to calculate the insertion loss specification. It also illustrates the relative insertion loss and frequency ranges of standard Telonic cavity bandpass filters.

For example:

TCA 1680- 42- 4EE
No. of sections = 4
Fc = 1,680 MHz = 1.68 GHz

$$\% \text{ BW} = \frac{100 \times 42}{1680} = 2.5$$

Loss constant = 0.205 (Read directly from the TCA insertion loss curve at 1.68 GHz.)

Therefore: Max insertion loss at Fc

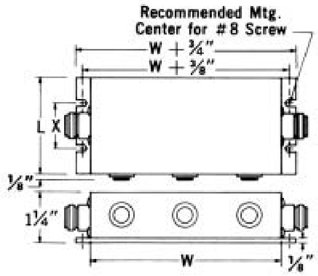
$$= \frac{0.205\,(4 + 0.5)}{2.5} + 0.1 = 0.47 \text{ db}$$

OUTLINE DRAWINGS

CONNECTORS: See table 2, below.

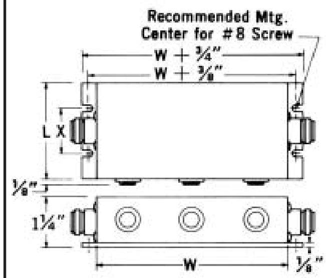
Finish: Light Blue Paint or Lacquer

TSF



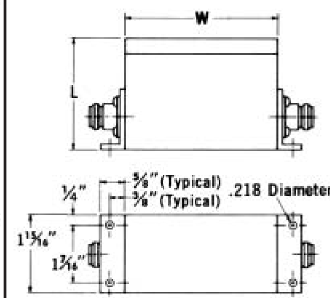
FREQUENCY	"L"	"X"
30 to 50 MHz	— 37/8" —	2.625
50 to 60 MHz	— 2 7/8" —	1.625
60 to 100 MHz	— 2 3/8" —	1.125
100 to 400 MHz	— 1 7/8" —	1.125

TCF



FREQUENCY	"L"	"X"
400 to 600 MHz	— 4 7/8" —	3.625
600 to 900 MHz	— 3 7/8" —	2.625
900 to 1400 MHz	— 2 7/8" —	1.625
1400 to 1800 MHz	— 2 3/8" —	1.125
1800 to 3000 MHz	— 1 7/8" —	1.125

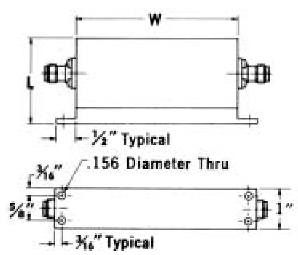
TCC



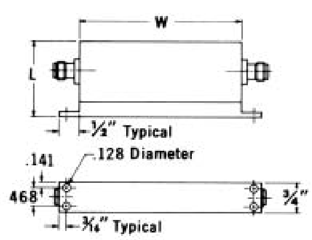
MECHANICAL SPECIFICATIONS

	TSF	TCF	TCC
Approx. Weight in oz.	.8 LW + 3.5	.8 LW + 4	2 LW + 6
"L" Dimension	See Chart	See Chart	[2.4 / Fc GHz] + .750 approx.
"W" Dimension	1/4 + [1 1/8 x (No. of Sect.)]	1/4 + [1 1/8 x (No. of Sect.)]	3/16 + [1 7/8 x (No. of Sect.)] approx.

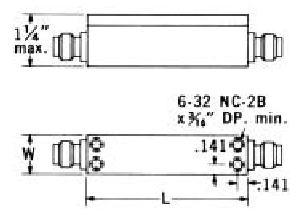
TCA



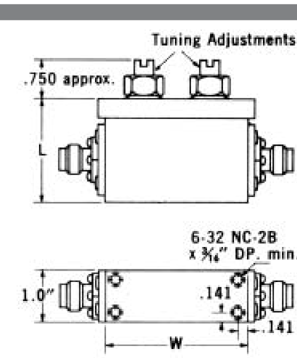
TCG



TCH



TCB



MECHANICAL SPECIFICATIONS

TCA	TCG	TCH	TCB
LW + 4	.8 LW + 3	LW + 2	LW + 6
[2.6 / Fc GHz] + .750 (approx.)	[3.0 / Fc GHz] + .750 approx.	[9.5(No. of Sect.)/Fc GHz] + .370 approx.	[2.6 / Fc GHz] + .750 approx.
3/16 + [15/16 x (No. of Sect.)] approx.	19/32 + [11/16 x (No. of Sect.)] approx.	[8.9 / Fc GHz] + .120 approx.	3/16 + [15/16 x (No. of Sect.)] approx.

Table 1 VSWR Bandwidth

NO. OF SECTIONS	2	3	4	5	6 0R MORE
VSWR Bandwidth / Min. 3 db Bandwidth	0.4	0.7	0.8	0.85	0.9

Table 2 CONNECTOR CODE

*A — BNC Jack	E — N Jack	S — SMA Jack
*B — BNC Plug	F — N Plug	T — SMA Plug
C — TNC Jack		X — Special
D — TNC Plug		

* BNC Connectors not standard above 1000 MHz

INTERDIGITAL BANDPASS FILTERS

■ 1,000 TO 9,000 MHz ■ 3.0 TO 30% 3 DB BANDWIDTHS ■ 4 TO 17 SECTIONS

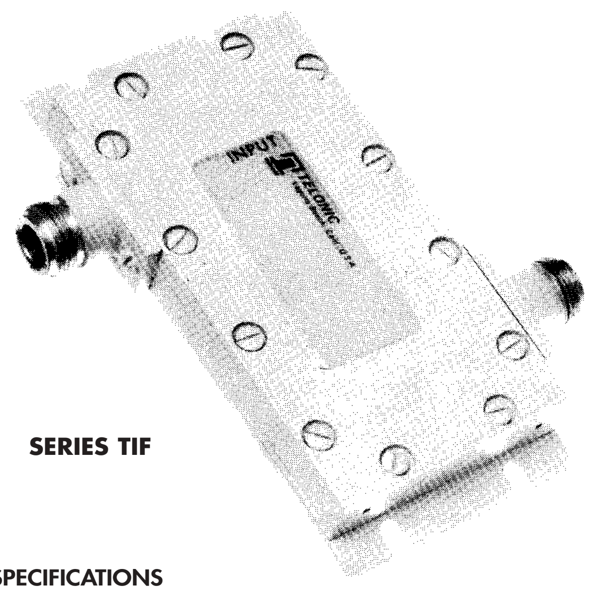
DESCRIPTION

Telonic Interdigital Bandpass Filters fill the need for moderate and wide bandwidth filters in the 1.0 to 6.0 GHz spectrum. The standard unit is available with as many as 17 sections, to meet extreme selectivity requirements.

These 0.1 db Chebyschev filters exhibit almost exact duplication of the mathematical model. Their skirts or stopbands are geometrically symmetrical.

TIF 2175 — 350 — 8 C C □

- Series — TIF
- Nominal Center Frequency in MHz — 2175
- Minimum 3 db Relative Bandwidth in MHz — 350
- Number of Sections — 8
- See Connector Code, Below: Input Conn. — C
- See Connector Code, Below: Output Conn. — C
- Suffix Number to be Assigned by the Factory to Identify the Specific Customer and Application. — □



SERIES TIF

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS		
Center Frequency Range	Normal Spec. Limit	1.0 to 9 GHz (See Note 1)
Minimum 3 db Relative Bandwidth (in % of center frequency)	Normal Spec. Limit	3.0% to 30% (See Note 1)
	*Areas of Interest	3.0% to 50%
Other Relative Bandwidths	*Areas of Interest	Spl. Requirements (See page 7)
Maximum Insertion Loss At Center Frequency	Normal Spec. Limit	See page 23
	*Areas of Interest	Spl. Requirements
Nominal Impedance (in and out)	Normal Spec. Limit	50 ohms
Maximum VSWR at Center Frequency	Normal Spec. Limit	1.5:1 to 5.0 GHz 2.0:1 to 9 GHz
Minimum VSWR Bandwidth	Normal Spec. Limit	See Page 15
	*Areas of Interest	Spl. Requirements (See page 7)
Stop Band Attenuation	Normal Spec. Limit	See Nomograph (Page 23)
	*Areas of Interest	Spl. Requirements
Number of Sections	Normal Spec. Limit	4 to 8 (up to 17 *)
Average Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	300 (3 dB BW MHz) / Loss Constant (Fc MHz)
	*Areas of Interest	10 to 100
Input Peak Power (watts max. to 10,000 ft.)	Normal Spec. Limit	(1500) (3 dB BW MHz) / (Fc MHz)
	*Areas of Interest	100 to 1000

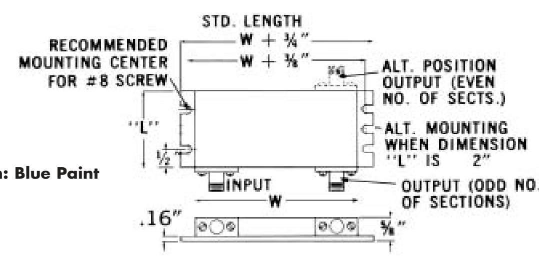
ENVIRONMENTAL SPECIFICATIONS			
OPERATING	Shock	Normal Spec. Limit	5G
		*Areas of Interest	15G
	Vibration	Normal Spec. Limit	2G
		*Areas of Interest	15G
	Humidity	Normal Spec. Limit	90%
		*Areas of Interest	Up to 100% with Condensation
	Altitude	Normal Spec. Limit	Unlimited
	Temp. Range	Normal Spec. Limit	0°C to 50°C
		*Areas of Interest	−54°C to + 125°C
STORAGE	Shock	Normal Spec. Limit	15G
		*Areas of Interest	75G
	Vibration	Normal Spec. Limit	10G
		*Areas of Interest	20G
	Temp. Range	Normal Spec. Limit	−54°C to + 100°C
		*Areas of Interest	−62°C to +150°C

The specifications for the example shown here as follows:

This unit is a fixed frequency interdigital bandpass filter. It has a nominal center frequency of 2,175 MHz and a minimum 3 db relative bandwidth of 350 MHz. The maximum insertion loss at 2,175 MHz is .55 dB. (See Insertion Loss Curve page 23). The nominal input and output impedance is 50 ohms. The maximum VSWR at 2,175 MHz is 1.5:1. The minimum bandwidth over which the VSWR remains less than 1.5:1 is 315 MHz (from 2,017.5 MHz to 2,332.5 MHz).

The filter has 8 sections and its minimum stopband attenuation is 60 db at 1811.1 MHz and 2595.1 MHz.

OUTLINE DRAWINGS



Finish: Blue Paint

MECHANICAL SPECIFICATIONS

Approx. Weight in oz.	.86 LW + 5.5
"L" Dimension	$0.625 + \frac{2.95}{(\text{Fc GHz})}$ Approx.
"W" Dimension	2.125 + (.500) No. of Section; Approx.

VSWR Bandwidth

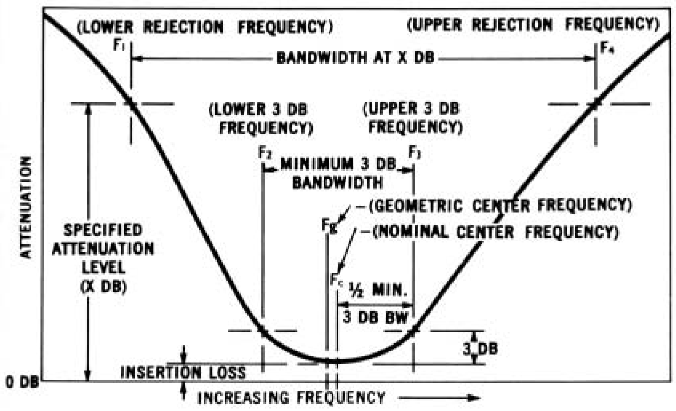
C — TNC Jack
D — TNC Plug
†E — Type "N" Jack
†F — Type "N" Plug
S — SMA Jack
T — SMA Plug
X — Special

† Type "N" connectors are larger in diameter than the thickness of the filter on which they are mounted.

NOTE 1: See page 6 for standard tolerance and definition of center frequency and bandwidth.

***Submit specific requirements**

INTERDIGITAL BANDPASS FILTERS ATTENUATION CURVES



STOP BAND ATTENUATION:

The TIF response curve shown above identifies most of the terms and relationships needed for the calculation of a stop band attenuation specification.

The form factor at any specified attenuation level (X db) is defined as follows:

(I) X db Form Factor $= \dfrac{\text{BW at X db in MHz}}{\text{Min. 3 db BW MHz}} = \dfrac{F_4 - F_1}{F_3 - F_2}$

The form factor nomograph defines the relationship between number of sections, form factor, and attenuation level. Whenever two variables are known, the third can be determined by drawing the indicated straight line.

For example:

The 60 db form factor for an 8 section filter is 2.24

Since these filters are geometrically symmetrical, the following relationship must be used to determine the rejection frequencies.

(II) $F_1\ F_4 = F_2\ F_3$, or

(III) $\sqrt{F_1 F_4} = \sqrt{F_2 F_3} = F_g$

Fg, the geometric center frequency, is **not** the same as the nominal center frequency which appears in the model number.

Fc, the nominal center frequency, is the arithmetic mean of the 3 db band edges.

(IV) $F_c = \dfrac{F_2 + F_3}{2}$

In the case of wide bandwidths, the difference between these two numbers is very significant.

To calculate the **exact** rejection frequencies:

$F_3 - F_2 = 3$ db BW

$F_4 - F_1 = X$ db BW

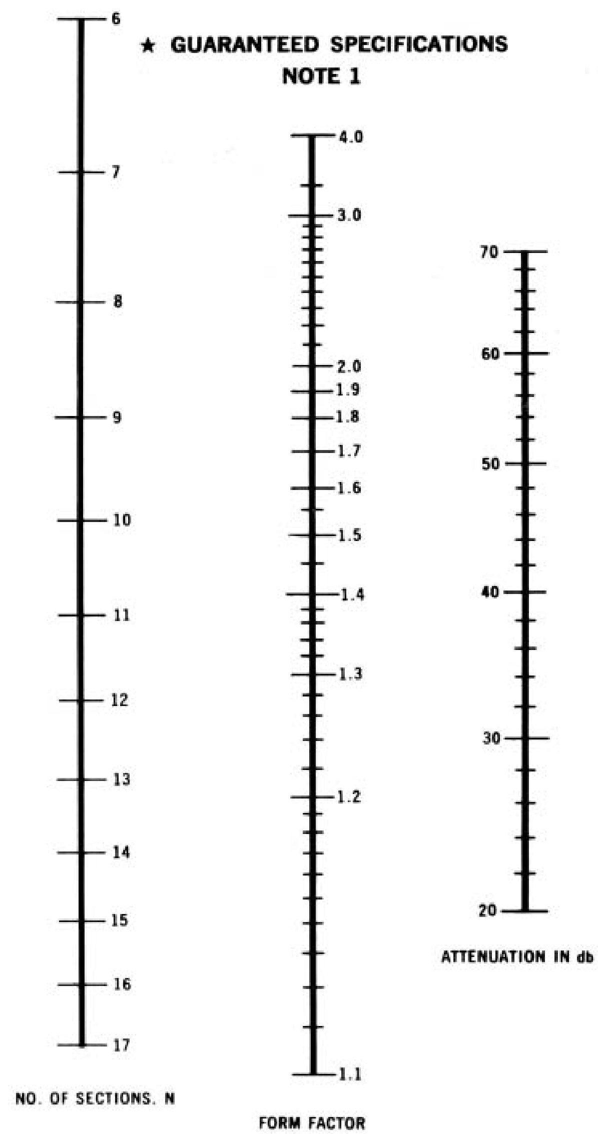
$\therefore F_4 = X$ db BW $+ F_1$

From **(II)**: F_1 (X db BW + F_1) = $F_2\ F_3$

$(F_1)^2 + (\text{X db BW})\,F_1 - F_2\,F_3 = 0$

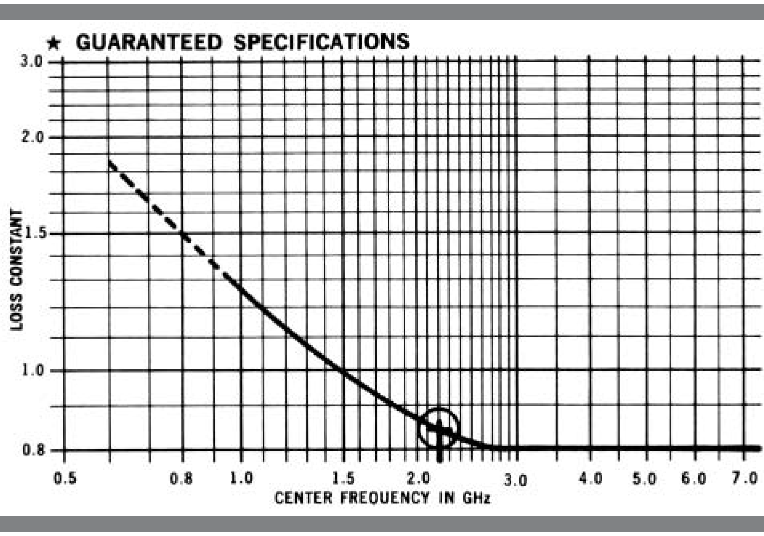
(V) $\therefore F_1 = \sqrt{F_2 F_3 + \left(\dfrac{\text{X db BW}}{2}\right)^2} - \dfrac{\text{X db BW}}{2}$

(VI) and $F_4 = (\text{X db BW}) + F_1$



NOTE 1: Consult factory when selectivity requirement exceeds 8 sections.

INSERTION LOSS CURVES



INSERTION LOSS:

Maximum insertion loss at center frequency

$= \dfrac{K\,(N + 0.5)}{\%\ BW} + 0.1$ db

Where: K = Loss constant
N = Number of sections

$\%\ BW = \dfrac{100 \times \text{min. 3 db BW MHz}}{\text{Nominal Fc MHz}}$

The Insertion Loss Graph defines the loss constant which must be used to calculate the insertion loss specification.

For example: MODEL NO. TIF 2175 - 350 - 8CC☐

No. of sections = 8

Center freq. = 2,175 MHz = 2.175 GHz

$\%\ BW = \dfrac{100 \times 350}{2175} = 16.1$

Loss constant = .85

(Read directly from the insertion loss curve at 2.175 GHz.)

Therefore:

Maximum insertion loss at center freq.

$= \dfrac{.85\,(8 + 0.5)}{16.1} + 0.1$ db $= 0.55$ db

MINIATURE COMBLINE BANDPASS FILTERS

■ WIDE RANGE 1.4 TO 10 GHz (TSJ) ■ MINIATURE SIZE ■ LIGHT WEIGHT
■ MINIMUM INSERTION LOSS ■ HIGH REJECTION WIDE STOPBAND

DESCRIPTION

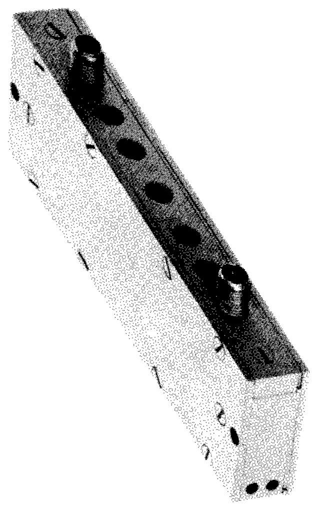
The Telonic Series TSJ Miniature Combline Bandpass Filters are designed for compact size and provide the lowest possible passband insertion loss consistent with their size. They offer wide stopband rejection extending up to 28 GHz, and 3 dB bandwidths varying from 1 to 15%. Because these filters are extremely small and light weight, they are well suited for use in aircraft, missile, and satellite transceivers and receivers.

These filters are of the 0.1 dB Chebyschev combline design and are available with three to eight sections. Measuring 1/2 inch thick the TSJ filters provide compactness with exceptional mechanical rigidity. Several styles of miniature connectors are available.

Customer requirements can be used to design a standard filter as shown below.

TSJ 6000 — 300 — 4 S S □

- Series — TSJ
- Nominal Center Frequency in MHz — 6000
- Minimum 3 db Relative Bandwidth in MHz — 300
- Number of Sections — 4
- Input Conn. — S
- Output Conn. — S
- Suffix Number to be Assigned by the Factory to Identify the Specific Customer and Application. — □



SERIES TSJ

ELECTRICAL SPECIFICATIONS		
Center Frequency Range	Normal Spec. Limit	1.4 to 10 GHz
	*Areas of Interest	0.5 to 12 GHz
Minimum 3 db Relative Bandwidth (in % of center frequency)	Normal Spec. Limit	1.0% to 15%
Other Relative Bandwidths	*Areas of Interest	See note 1
Maximum insertion loss At Center Frequency	Normal Spec. Limit	See insertion loss curves
	*Areas of Interest	Spl. Requirements
Nominal Impedance (in and out)	Normal Spec. Limit	50 ohms
	*Areas of Interest	50 to 100 ohms
Maximum VSWR at Center Frequency	Normal Spec. Limit	1.5
	*Areas of Interest	1.2
Minimum VSWR Bandwidth	Normal Spec. Limit	See Table 3
	*Areas of Interest	Spl. Requirements
Stopband Attenuation	Normal Spec. Limit	See attenuation curves
	*Areas of Interest	Spl. Requirements
Number of Sections	Normal Spec. Limit	3 to 8
	*Areas of Interest	2 to 15
Average Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	See peak input power
	*Areas of Interest	(100 x 3 dB BW) ÷ Fc
Peak Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	1000 (3 dB rel BW MHz) / Fc MHz
	*Areas of Interest	20 to 100 watts

ENVIRONMENTAL SPECIFICATIONS			
OPERATING	Shock	Normal Spec. Limit	25G
		*Areas of Interest	50G
	Vibration	Normal Spec. Limit	10G, 5 to 500 Hz
		*Areas of Interest	20G, 5 to 500 Hz
	Humidity	Normal Spec. Limit	up to 90%
		*Areas of Interest	Up to 100% with Condensation
	Altitude	Normal Spec. Limit	Unlimited
		*Areas of Interest	———
	Temp. Range	Normal Spec. Limit	0°C to 50°C
		*Areas of Interest	−54°C to + 125°C
STORAGE	Shock	Normal Spec. Limit	30G
		*Areas of Interest	70G
	Vibration	Normal Spec. Limit	15G, 5 to 500 Hz
		*Areas of Interest	20G, 5 to 500 Hz
	Temp. Range	Normal Spec. Limit	−54°C to + 71°C
		*Areas of Interest	−62°C to +150°C

Connector Code

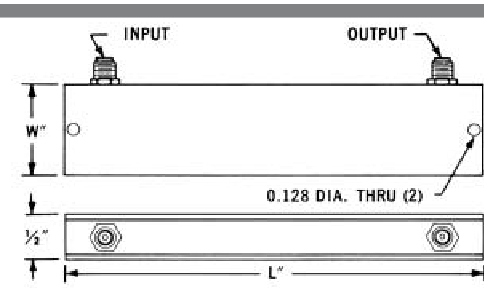
S — SMA Jack
T — SMA Plug

Other connector types are available. Contact factory.

VSWR Bandwidth

NO. OF SECTIONS	2	3	4	5	6 0R MORE
VSWR Bandwidth / Min. 3 db Bandwidth	0.4	0.7	0.8	0.85	0.9

OUTLINE DRAWINGS



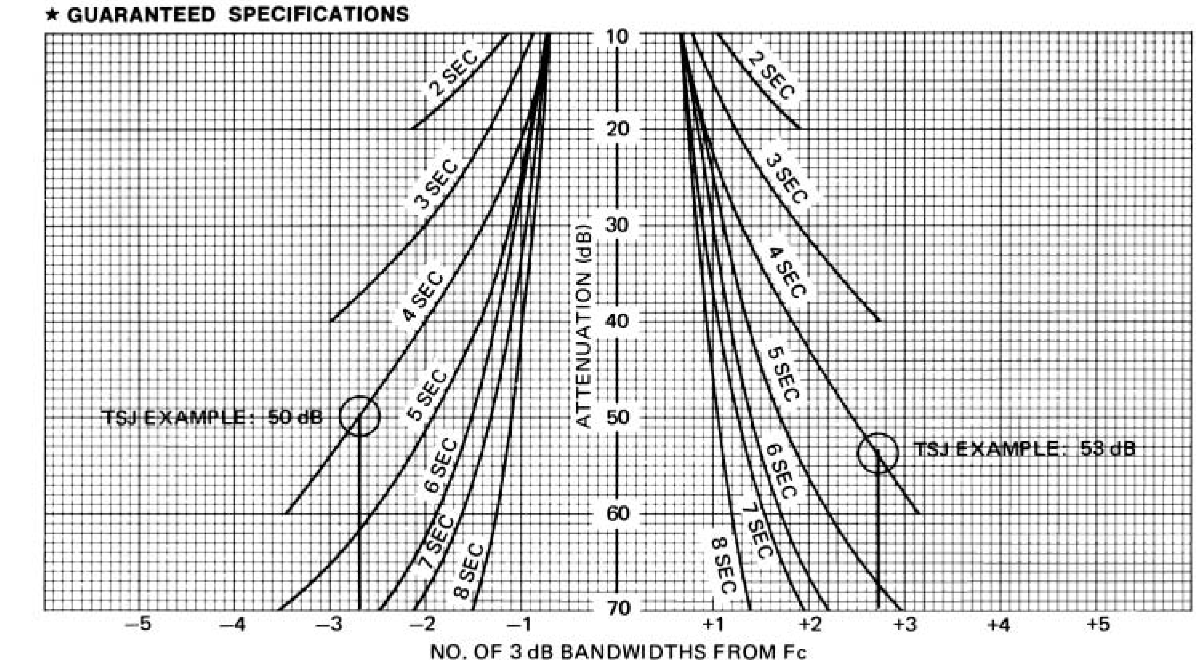
FREQUENCY RANGE	DIMENSION W
1.4 to 2.0 GHz	1.40 in.
2.0 to 3.0 GHz	1.25 in.
3.0 to 4.0 GHz	1.1 in.
4.0 to 7.0 GHz	0.8 in.
7.0 to 10.0 GHz	0.7 in.

MECHANICAL SPECIFICATIONS	
Approx. Weight in oz.	2/3 LW (Also see note 2)
"L" Dimension	2" + 0.5 (No. Sections) (Also see note 2)
Thickness	1/2"
"W" Dimension	See outline drawing
Connectors	See code above.
Finish	Light blue paint or lacquer, color 25526. Fed. Std. 595.

* Submit specific requirements.
1. For information regarding relative bandwidths other than 3 dB and other VSWR levels, refer to page 7.
2. Dimensions and weight vary according to frequency and bandwidth, and therefore should be quoted from factory when critical.
3. "L" dimensions, see specifications.

ATTENUATION CURVES

Figure 1. TSJ Attenuation Curves



STOP BAND ATTENUATION:

This graph shows the minimum stop band attenuation in db for Telonic combline bandpass filters.

The rejection frequency is plotted in "3 db bandwidths from center frequency." The exact relationships are:

(I) 3 db bandwidths from Fc

$$= \frac{\text{Rej. freq. MHz} - \text{Fc MHz}}{\text{Min. 3 db BW MHz}}$$

or **(II)** Min. 3 db bandwidth in MHz

$$= \frac{\text{Rej. freq. MHz} - \text{Fc MHz}}{\text{3 db BWs from Fc}}$$

Any one of the following parameters may be identified if the other three and the center frequency are known.

(1) Min. 3 db bandwidth (in MHz).
(2) Number of sections.
(3) Rejection Frequency (in MHz).
(4) Attenuation Level (in dB).

Always verify that the frequency and bandwidth you have selected are within the limitations shown for that series of filter.

For example (from Table 1):

Given:
Center frequency = 6000 MHz
Minimum 3 db BW = 300 MHz

Find: Minimum attenuation level at 5190 MHz and 6810 MHz. and No. of sections required.
From (I) above: 3 db BWs from Fc

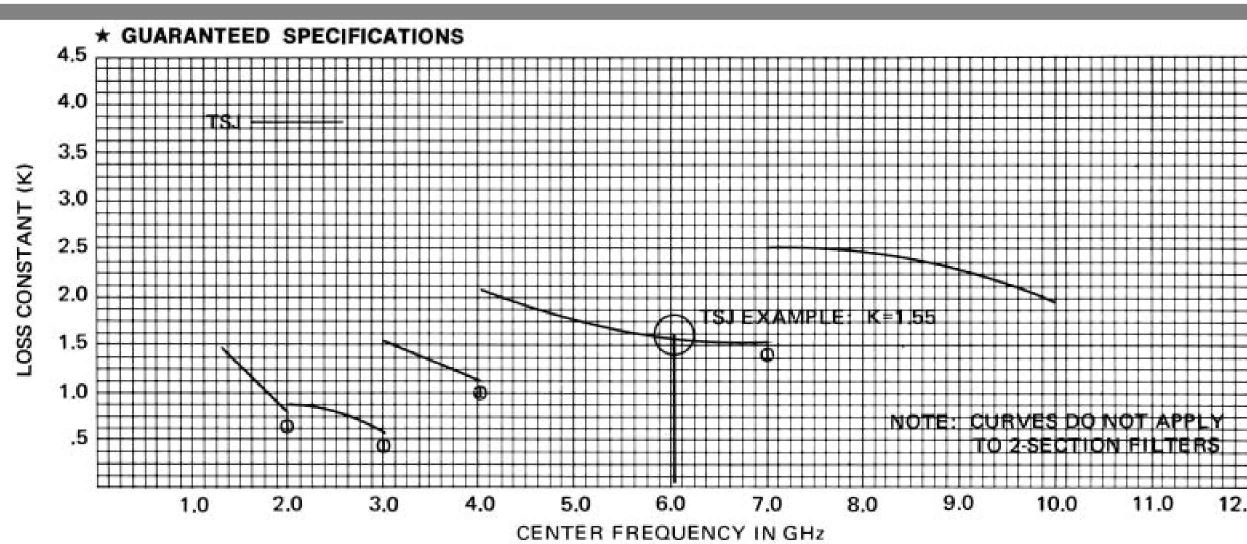
$$= \frac{5190 - 6000}{300} = -2.7$$

and $\frac{6810 - 6000}{300} = +2.7$

Reading directly from the Attenuation curves, points −2.7 and +2.7, we find the minimum attenuation level of 50 dB. and 54dB respectively.

INSERTION LOSS CURVES

Figure 2. Insertion Loss Curves



INSERTION LOSS:

Max. loss at Fc = $\frac{K\,(N + 0.5)}{\%\,BW}$ + 0.2 db

Where: K = Loss constant
N = Number of section

$$\%\,BW = \frac{100 \times \text{min. 3 dB BW MHz}}{\text{Nominal Fc MHz}}$$

For example:
TCA 6000 - 300 - 4 - SS
No. of sections = 4
Fc = 6000 MHz

$$\%\,BW = \frac{100 \times 300}{6000} = 5$$

K Loss constant = 1.55 (Read directly from the TSJ insertion curve at 6000 GHz.)

Therefore: Max insertion loss at Fc

$$= \frac{1.55\,(4 + 0.5)}{5} + 0.21\text{dB} = 1.6 \text{ db}$$

At border or crossover frequencies (2, 3, 4, and 7 GHz) the loss constant (K) may be specified for either higher stop band limit or lower insertion loss. For example: (1) the higher the loss constant, the greater the upper stop band limit but the higher the insertion loss; (2) the lower the loss constant, the lower the insertion loss but the upper stop band is also slightly decreased (see Table 5).

MINIATURE BANDPASS FILTERS

■ MINIATURE SIZE ■ 40 TO 1000 MHz ■ CONVENIENT PACKAGING ■ PRINTED CIRCUIT BOARD APPLICATIONS

DESCRIPTION

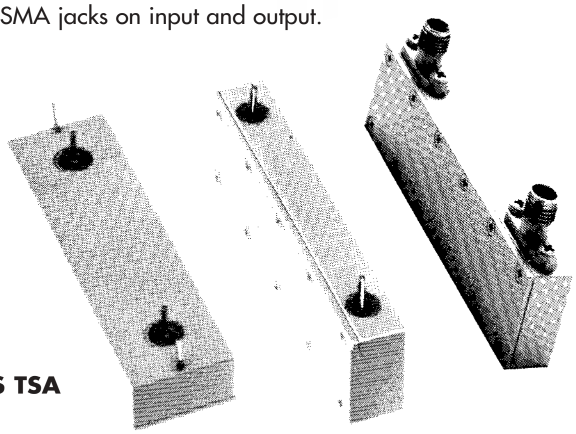
Telonic Series TSA and TSC Miniature Bandpass Filters employ a unique helical resonator design to achieve "state-of-the-art" performance. These small, 0.1 dB Chebyschev Filters are packaged for maximum convenience.

TSA and TSC Filters can be supplied with a wide variety of standard co-axial connectors, or flexible or semi-rigid cable of any length. The filters can also be supplied with pins for direct attachment to a printed circuit board. All connectors can be on any set of the narrower faces of the filter.

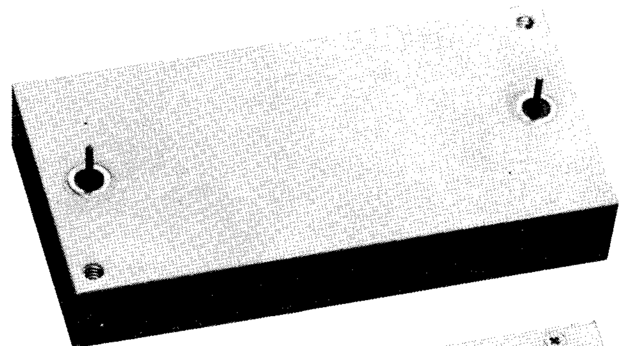
The specifications for the example shown here are as follows: Series TSC filter, nominal center frequency of 300 MHz, 3 dB relative bandwidth of 30 MHz and has 5 sections. Connectors are SMA jacks on input and output.

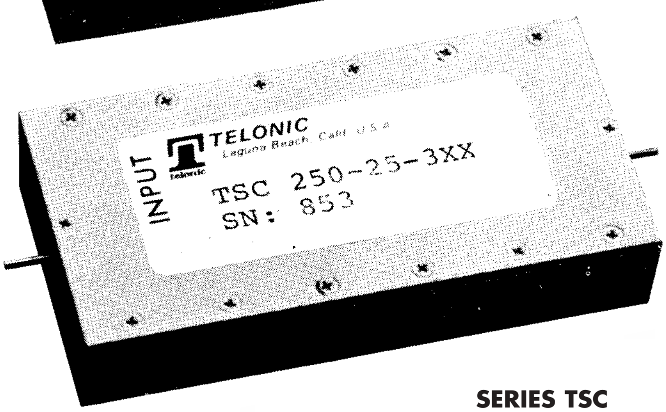
TSC 300 — 30 — 5 S S □

- Series — TSC
- Nominal Center Frequency in MHz — 300
- Minimum 3 db Relative Bandwidth in MHz — 30
- Number of Sections — 5
- Connector Code – (Input Connector) — S
- (Output Connector) (See table no. 2, page 28) — S
- Suffix to be assigned by the Factory to Identify the Specific Customer and Application. — □



SERIES TSA





SERIES TSC

ELECTRICAL SPECIFICATIONS		
Center Frequency Range TSA	Normal Spec. Limit	200 – 600 MHz
	*Areas of Interest	160 – 1000 MHz
Center Frequency Range TSC	Normal Spec. Limit	40 to 500 MHz
	*Areas of Interest	30 to 600 MHz
Minimum 3 db Relative Bandwidth (in % of center frequency)	Normal Spec. Limit	1.0% – 15%
	*Areas of Interest	up to 20%
Maximum insertion loss At Center Frequency	Normal Spec. Limit	See insertion loss curves
	*Areas of Interest	Special Requirements
Nominal Impedance (in and out)	Normal Spec. Limit	50 ohms
	*Areas of Interest	50 – 100 ohms
Maximum VSWR at Center Frequency	Normal Spec. Limit	1.5: 1.0
	*Areas of Interest	1.25 : 1.0
Minimum VSWR Bandwidth	Normal Spec. Limit	See Table 1
	*Areas of Interest	Special Requirements
Stop Band Attenuation	Normal Spec. Limit	See Attenuation curves
	*Areas of Interest	Special Requirements
Number of Sections	Normal Spec. Limit	2 to 6
	*Areas of Interest	Up to 8
Average Input Power (watts max. to 10,000 ft.)	Normal Spec. Limit	$\frac{115\ (3\ \text{dB BW MHz})}{\text{Loss Constant x Fc MHz}}$
	*Areas of Interest	Special Requirements
Peak Power Input (watts max. to 10,000 ft.)	Normal Spec. Limit	$\frac{100\ (3\ \text{dB BW MHz})}{\text{Fc MHz}}$
	*Areas of Interest	Special Requirements
OPERATING ENVIRONMENTAL SPECIFICATIONS		
Shock	Normal Spec. Limit	30g. 11 m sec.
	*Areas of Interest	Special Requirements
Vibration	Normal Spec. Limit	10g, 5 to 500 Hz
	*Areas of Interest	Special Requirements
Humidity	Normal Spec. Limit	90% Relative
	*Areas of Interest	100%
Altitude	Normal Spec. Limit	120,000 ft.
	*Areas of Interest	Unlimited
Temperature	Normal Spec. Limit	0°C to 50°C
	*Areas of Interest	−54°C to + 125°C

***Submit specific requirements.**

ATTENUATION CURVES

These graphs show the minimum stop band attenuation in dB for the TSC Miniature Filters at different bandwidths. Intermediate values may be interpolated.

For Example: TSC 300 - 30 - 5SS

$$\text{3 dB Bandwidths from Center Frequency} = \frac{\text{Rejection freq. MHz} - \text{Fc MHz}}{\text{Minimum 3 db Bandwidth MHz}}$$

To determine the frequencies corresponding to 40 dB attenuation, read from stop band attenuation 10% bandwidth the number of 3 dB bandwidths away from center frequency corresponding to 40 dB level. On the lower frequency side, it is −1.2, and 1.5 on the higher frequency side.

The frequency corresponding to 40 dB on the lower skirt = 300 −1.2 x 30 = 264 MHz. The frequency corresponding to 40 dB on the upper skirt = 300 +1.5 x 30 = 345 MHz. Based on specific requirements:

1. If a certain minimum 3 dB bandwidth and definite rejection at specified frequencies are required, the appropriate number of sections can be selected from the attenuation curve. The insertion loss can then be determined from the insertion loss curve.
2. If a certain min. 3 dB bandwidth and a definite insertion loss are required, the maximum number of sections is found by using the insertion loss curves, estimating rejection at specified frequencies, or determining the frequencies corresponding to any attenuation level using the attenuation curves.

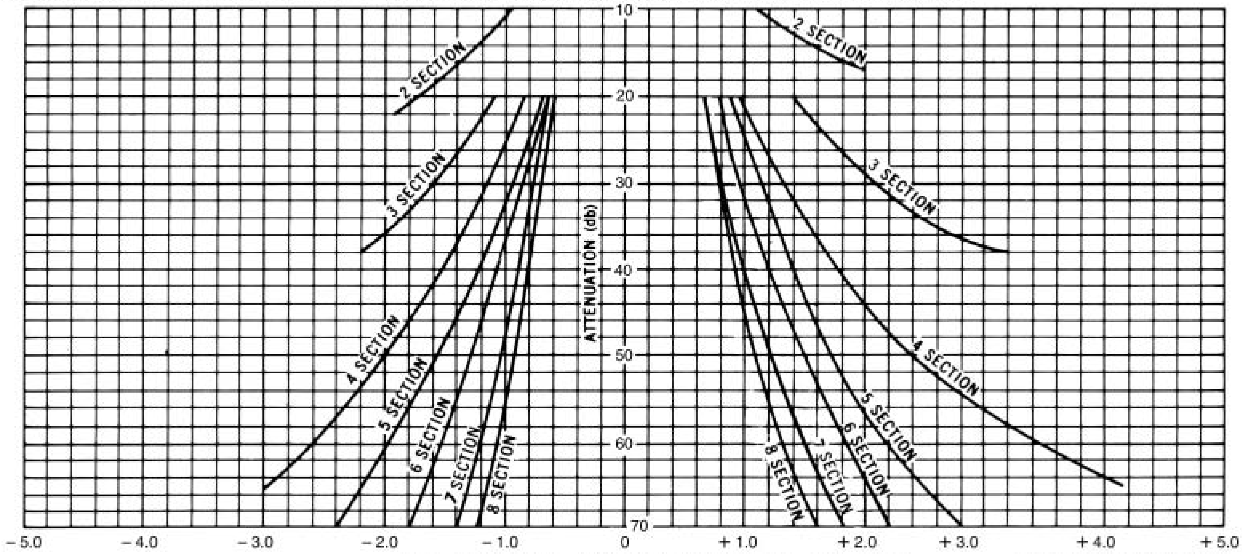
In case of special requirements not encompassed in the above data, Telonic Berkeley should be contacted directly.

ATTENUATION CURVES

★ GUARANTEED SPECIFICATIONS

Consult factory for attenuation specs for filters with bandwidths less than 5%.

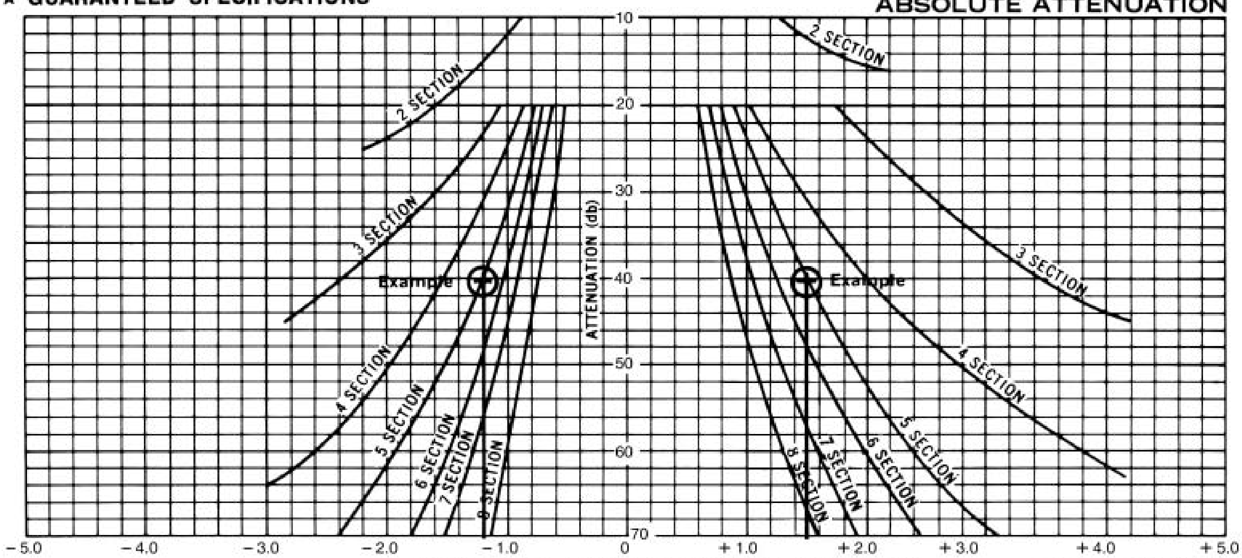
ABSOLUTE ATTENUATION



STOPBAND ATTENUATION 5% BW

★ GUARANTEED SPECIFICATIONS

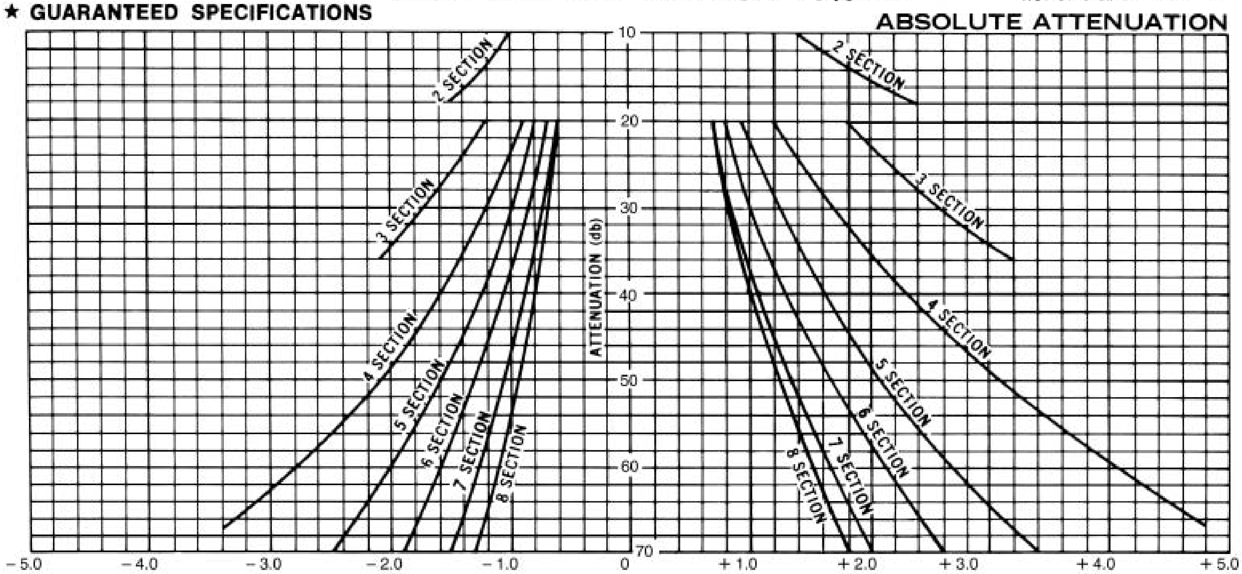
ABSOLUTE ATTENUATION



STOPBAND ATTENUATION 10% BW

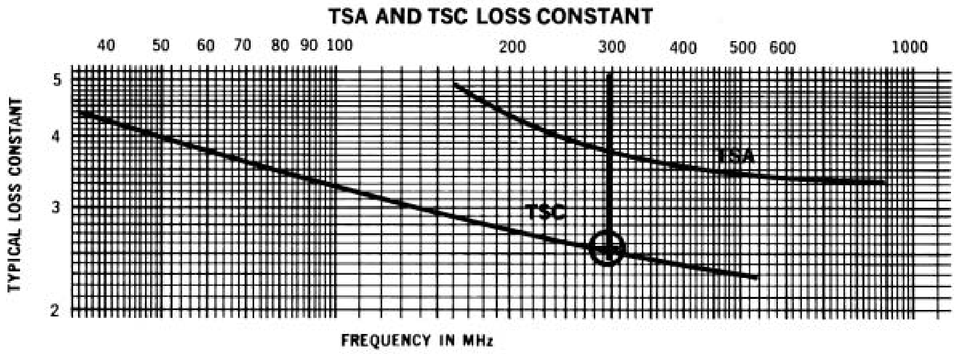
★ GUARANTEED SPECIFICATIONS

ABSOLUTE ATTENUATION



STOPBAND ATTENUATION 15% BW

INSERTION LOSS CURVES



INSERTION LOSS:

The approximate value for insertion loss at center frequency is found with the following formula.

$$\text{Insertion loss in db} = \frac{KN}{\%\ BW} + 0.2$$

Where: K = Loss constant
N = Number of sections*

$$\%\ BW = \frac{100 \times \text{min. 3 dB BW MHz}}{\text{Fc MHz}}$$

The loss constant is read directly from the insertion loss graph at the point which corresponds to the center frequency of the filter.

For example:

A 5 section filter at 300 MHz with a bandwidth of 30 MHz would have an approximate insertion loss of 1.5 db:

$$\text{Ins. Loss} = \frac{2.6 \times 5}{10} + 0.2 = 1.5 \text{ db}$$

*Consult factory for insertion loss when N = 2

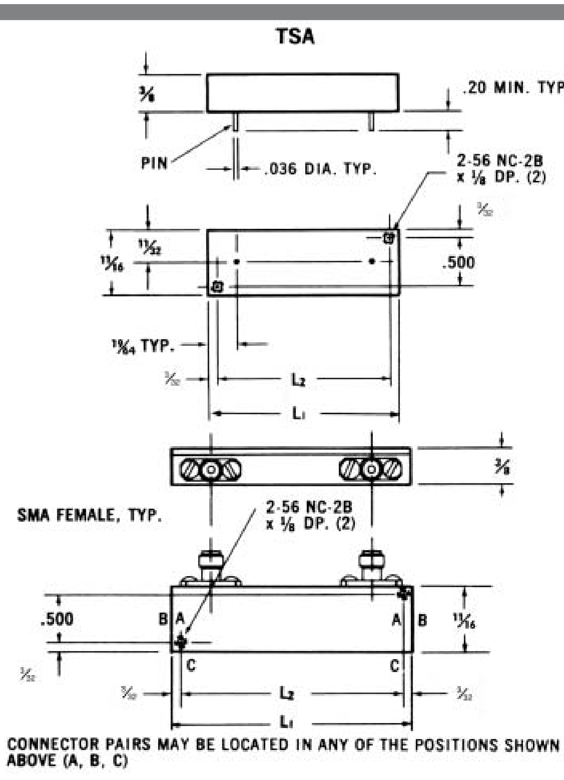
Table 1 VSWR Bandwidth

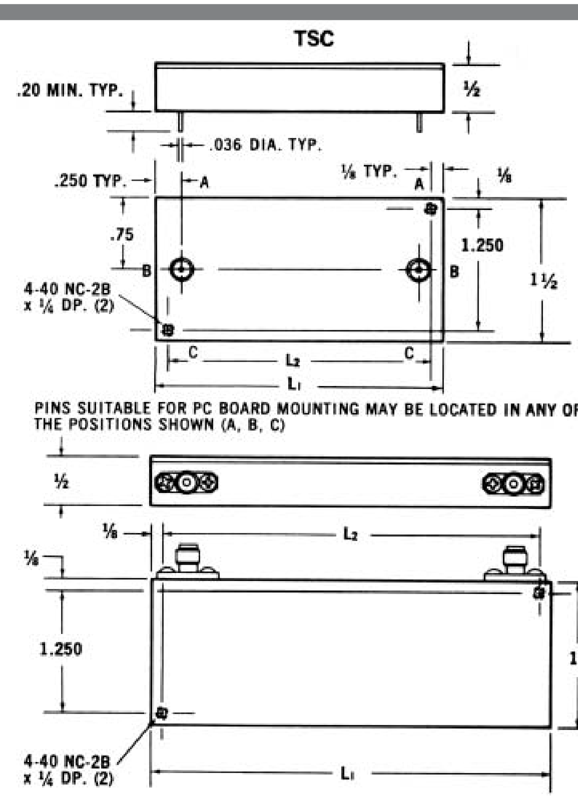
NO. OF SECTIONS	2	3	4	5	6 0R MORE
VSWR Bandwidth / Min. 3 db Bandwidth	0.4	0.7	0.8	0.85	0.9

Table 2 CONNECTOR CODE

Standard
P — Pins for printed circuit board
S — SMA Jack
T — SMA Plug
Available
X — All other configurations including semi rigid, RG188, RG196 (Specify requirement).

OUTLINE DRAWINGS





MECHANICAL SPECIFICATIONS	
Size	$3/8 \times 11/16 \times L_1$, $L_1 = 1\,1/2 + \frac{n}{4}$ approx. where n = no. of sections
Weight	Usually less than 1.5 oz. max without connector.

MECHANICAL SPECIFICATIONS	
Size	$1/2 \times 1\,1/2 \times L_1$, $L_1 =$ N (1″) + 0.5″ where N = no. of sections
Weight	Approx. 25 grams / Linear inch

The products covered in this catalog represent Telonic Berkeley's general filter product line. We specialize in fulfilling your unique filter requirements and welcome the opportunity to discuss your specifications with you.

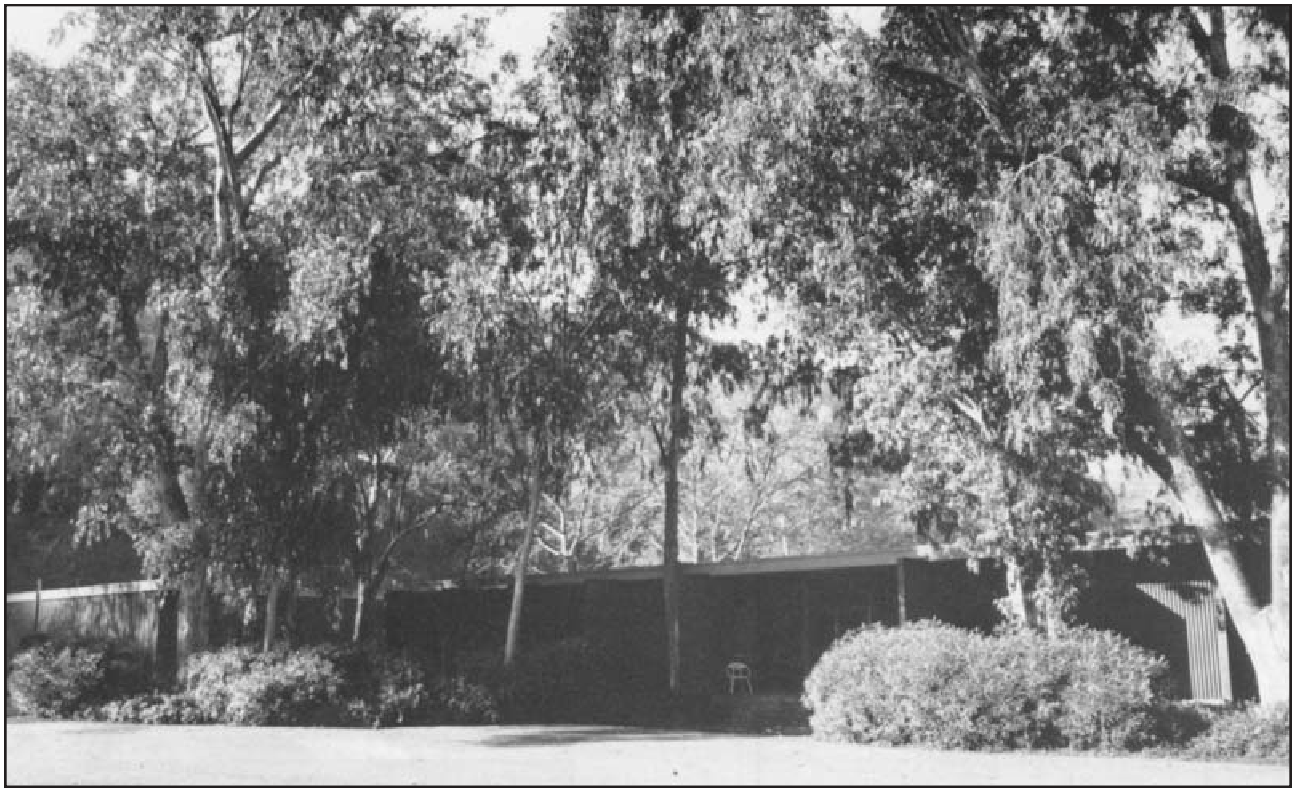
We have the capabilities to build filters to meet your exact needs. For more information, please call our Customer Service Department:

Our Toll Free Telephone:

(800) 854-2436

FAX: (949) 497-7331

Web: www.telonicberkeley.com
email: info@telonicberkeley.com



Telonic Berkeley, Inc. manufacturing facility in Laguna Beach, California.

Our Toll Free Telephone:

(800) 854-2436

Telonic Berkeley, Inc.
P.O. Box 277
Laguna Beach, CA 92652
(949) 494-9401
FAX: (949) 497-7331
Web: www.telonicberkeley.com
email: info@telonicberkeley.com

Printed in U.S.A. 1M1195