# 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

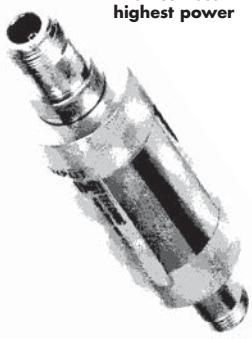
**CONNECTOR CODE**

* 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<br>Above 500 MHz: 600 ( 3 dB bw MHz ) / Fc MHz | Below 300 MHz: 200 ( 3 dB bw MHz ) / Fc MHz<br>Above 300 MHz: 400 ( 3 dB bw MHz ) / Fc MHz | Below 200 MHz: 400 ( 3 dB bw MHz ) / Fc MHz<br>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.

# TUBULAR BANDPASS FILTERS

**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

# ATTENUATION CURVES

**From (I)** above —

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

and = $\dfrac{425 - 500}{50} = -1.50$

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.

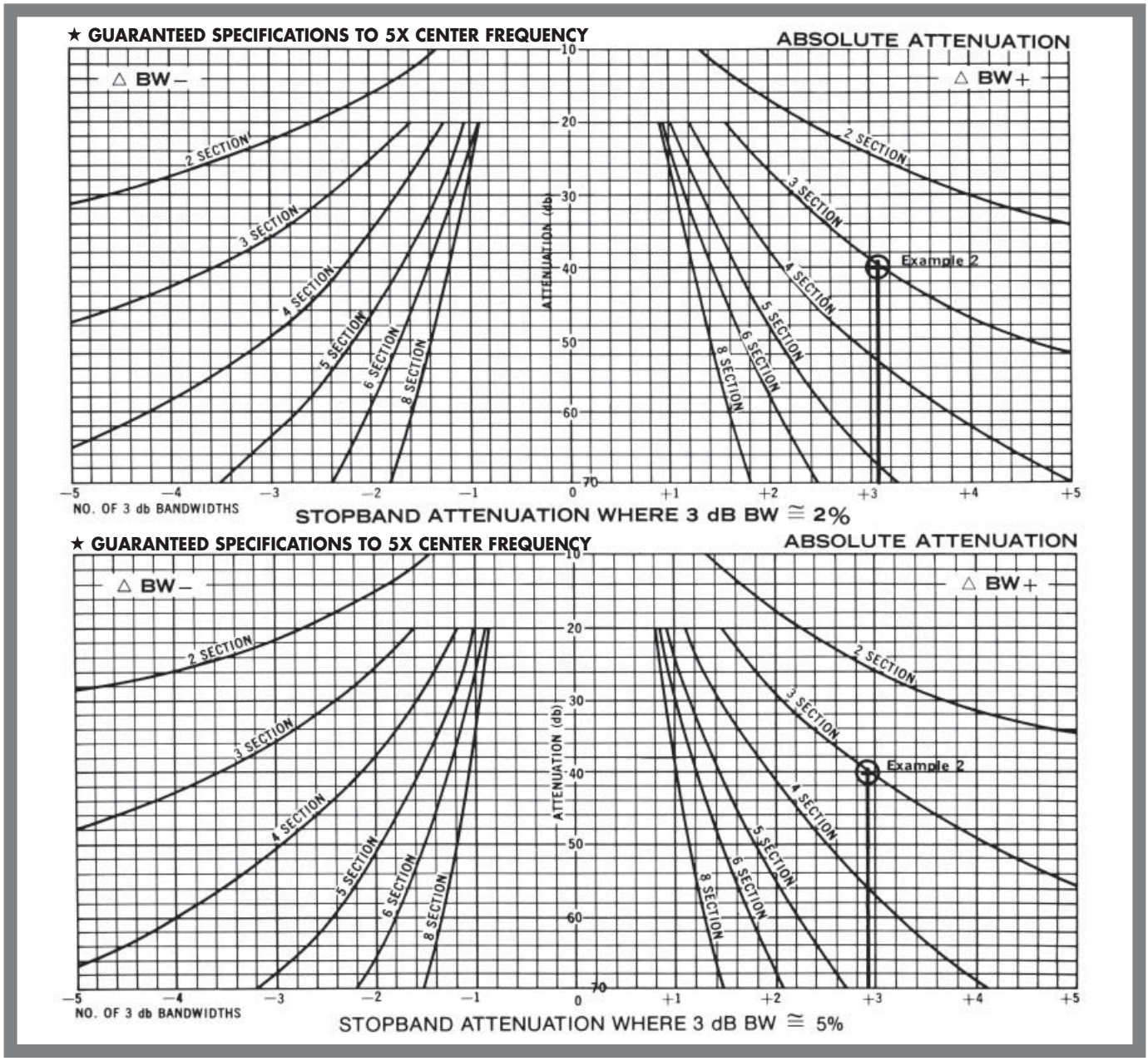
**Example 2:**
**Given:**
Center frequency = 300 MHz
Number of sections = 3
Atten. at 336 MHz = 40 db min.
**Find:** The 3 db bandwidth

**From (II)** above—

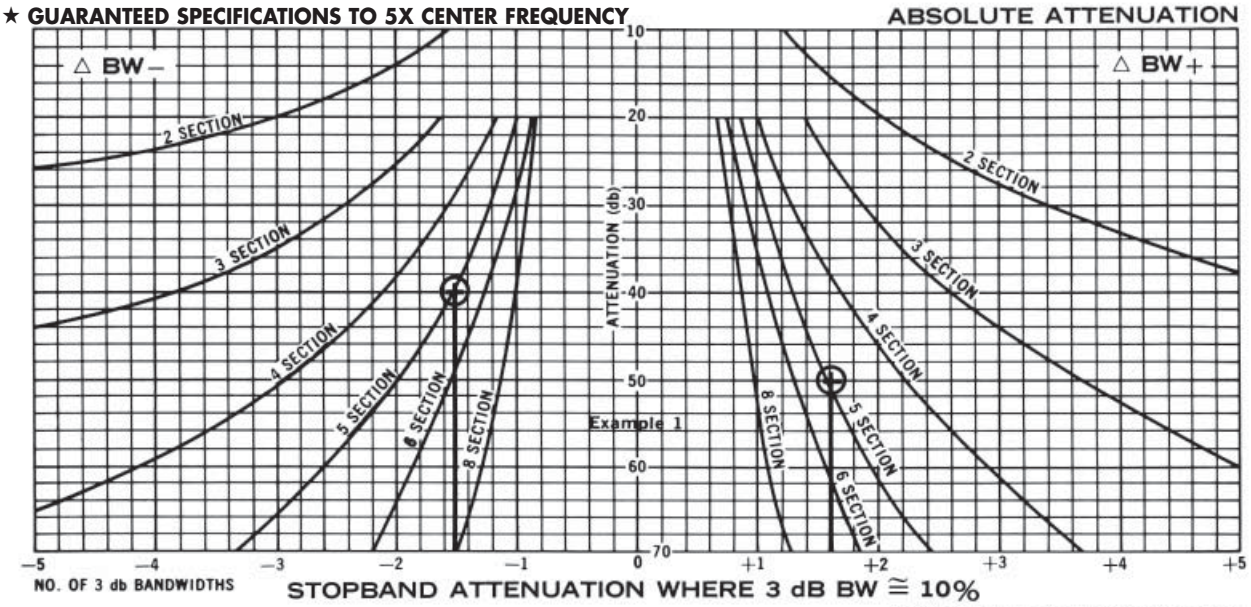
Min. 3 db BW = $\dfrac{336 - 300}{\text{3 db BW from Fc}}$

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.

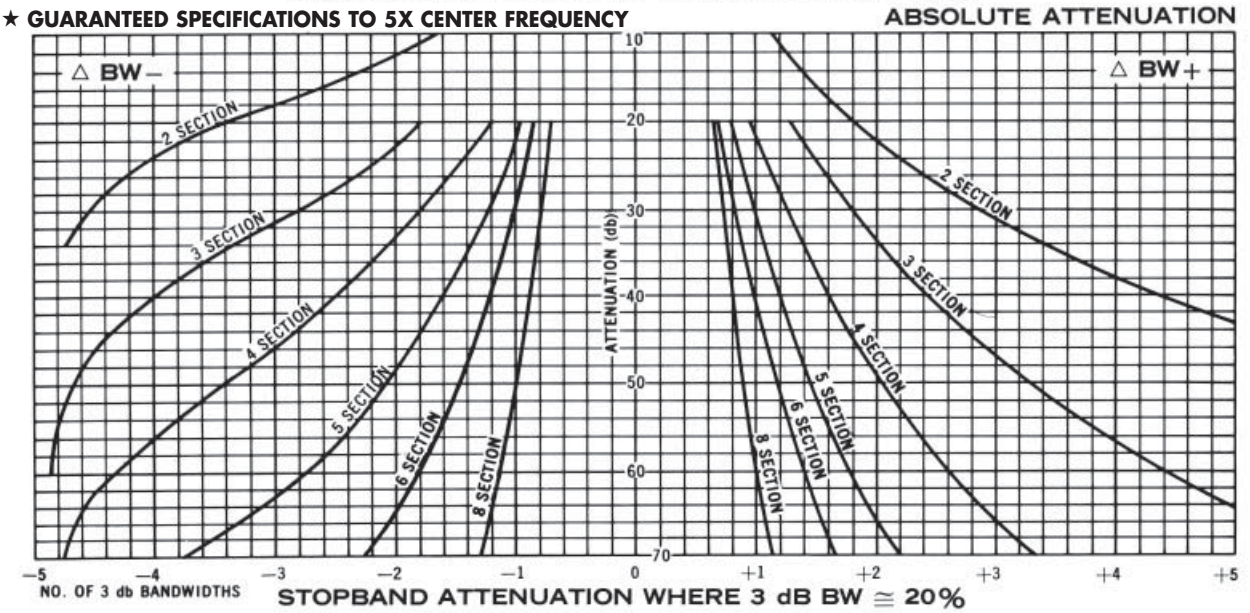


★ GUARANTEED SPECIFICATIONS TO 5X CENTER FREQUENCY



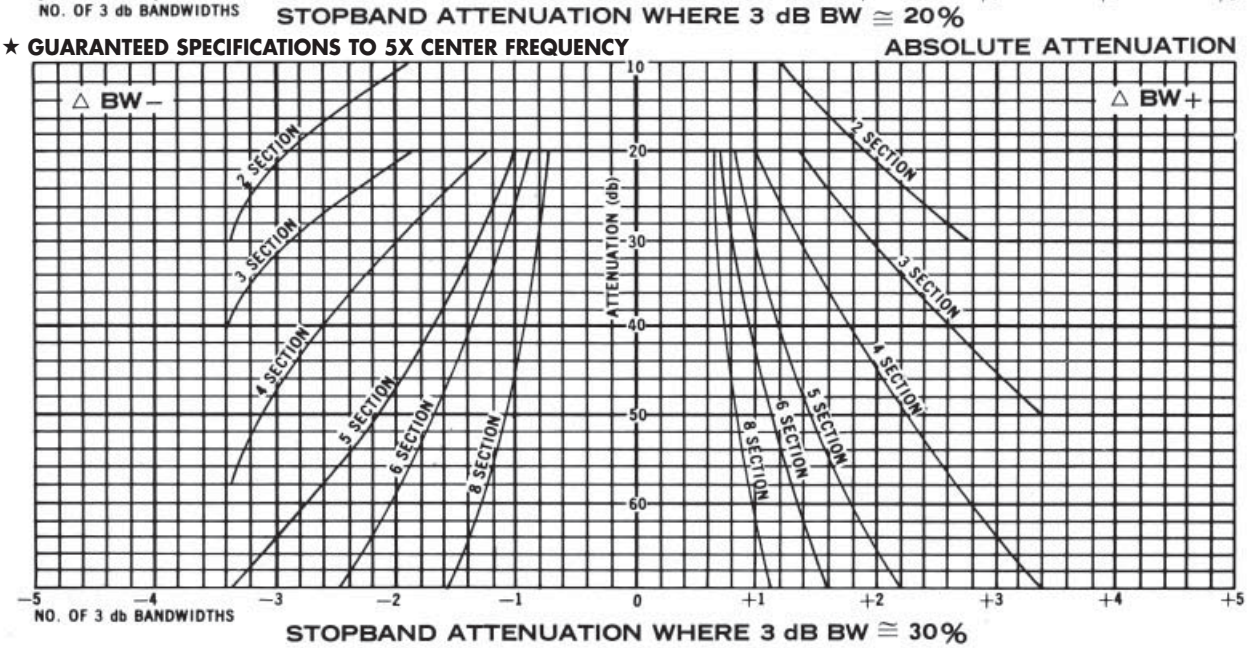

STOPBAND ATTENUATION WHERE 3 dB BW ≅ 10%

★ GUARANTEED SPECIFICATIONS TO 5X CENTER FREQUENCY




STOPBAND ATTENUATION WHERE 3 dB BW ≅ 20%

★ GUARANTEED SPECIFICATIONS TO 5X CENTER FREQUENCY




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** ☐

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

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

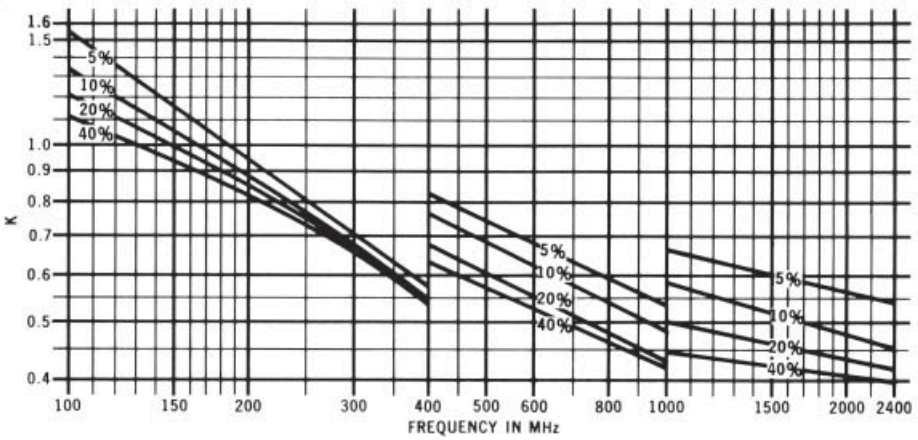
$$= 0.77\left(3 + \frac{3}{4}\right) + 2.4$$

$$= 0.77 \times 3.75 + 2.4$$

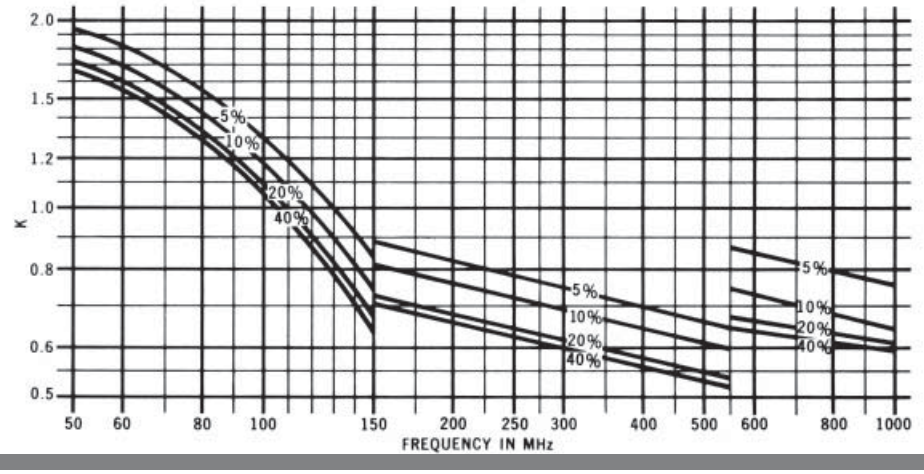
$$= 5.3 \text{ inches}$$

**TBC: Consult factory.**

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

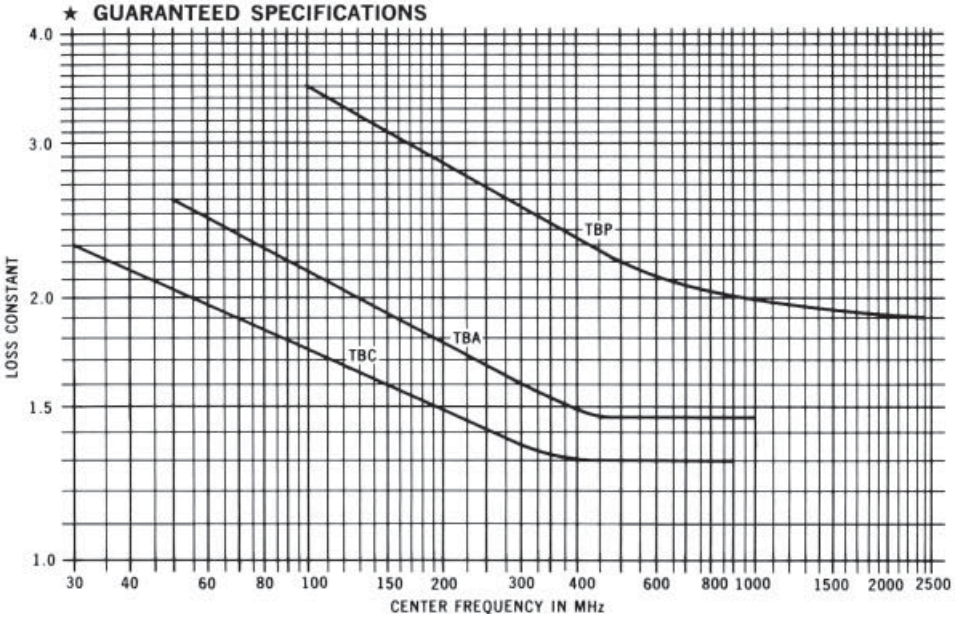



**TBA** $\text{Approx. length} = K\left(N + \frac{3}{\% \text{ BW}}\right) + 2.4$ WHERE K = LENGTH CONSTANT, N = NUMBER OF SECTIONS




# INSERTION LOSS CURVES

★ GUARANTEED SPECIFICATIONS




**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

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

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 OR MORE |
|---|---|---|---|---|---|
| VSWR Bandwidth / Min. 3 db Bandwidth | 0.4 | 0.7 | 0.8 | 0.85 | 0.9 |