

# The Company

Since it was established in January 1979, Reactel, Incorporated has been dedicated to the design and manufacture of RF & Microwave Filters, Multiplexers and Multifunction Assemblies using the latest in design, manufacturing and test equipment. As a result of our efforts, we have developed and produced some of the most reliable products in the industry.

Our engineers and technicians are highly skilled and have broad experience in their areas of responsibility. This level of skill provides effective and efficient performance in all phases of the design, manufacturing, assembly and testing processes. The designs of our products have been developed with the objective of using standardized component parts to the greatest extent possible. By utilizing this approach, we are able to manufacture in advance and stock nearly all of the principle filter components. This allows us to design a filter to your custom requirements using standard components from our stockroom. In addition to accelerating the design, manufacturing and assembly processes, this enables us to price the product as a standard unit rather than as a completely customized filter.

Through our rigorous R&D program and in conjunction with our ISO-9001 accreditation, we have developed and introduced into our products many new ideas resulting in improved design and manufacturing processes. The hundreds of thousands of filters we have produced have successfully satisfied the most demanding requirements of commercial, defense and space programs. We pledge that we shall continually strive to develop new designs, techniques, products and applications to meet the demands of this ever-expanding field of technology. Reactel, Incorporated's Quality Assurance Program is in compliance with ISO-9001:2008, and we have been accredited since 1996. This Program assures that our products are manufactured in an environment of the highest quality with respect to material, workmanship, and technical performance through a continuous effort to monitor and improve our processes. It is our objective that no product shall leave our factory without fully complying with all quality and performance standards and requirements.

All of us at Reactel, Incorporated appreciate the confidence and support offered by our many customers. We dedicate this catalog to you, our most valued asset, in the hope it will provide you with a more useful tool for the fulfillment of your requirements.

*— The Reactel, Incorporated Team*



**Reactel, Incorporated — Reacting First to Your Filter Requirements**

8031 Cessna Avenue ♦ Gaithersburg, Maryland 20879

Phone: 301-519-3660 ♦ Fax: 301-519-2447 ♦ [reactel@reactel.com](mailto:reactel@reactel.com) ♦ [www.reactel.com](http://www.reactel.com)

# General Ordering Information

## • How to Order

Most customers prefer to order products for which the part number has been worked out by our application engineers. This catalog does, however, provide guidance so that customers can work out a part number without consulting the factory. In cases where this approach is used, please include your specifications when ordering so that an applications engineer can verify that the correct part number was used.

## • Where to Order

Your orders can be placed directly with the factory.

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## • Pricing

You may obtain prices for our products by contacting the factory using the contact information found at the bottom of each catalog page. Our prices do not include freight, handling or any applicable taxes. Prices are subject to change without notice. All quotations are valid for a period of sixty (60) days unless otherwise stated. All new accounts may be subject to a C.O.D. delivery or advance payment at Reactel, Incorporated's option. All shipments are FOB factory unless other arrangements are made in advance. All orders are non-cancelable 3 days ARO unless permission to cancel is obtained.

## • Delivery

Unless otherwise specified at the time of order, all deliveries will be made by either UPS Air or UPS Ground at Reactel, Incorporated's option. All items purchased from Reactel, Incorporated will be packaged using "Best Commercial Practices". Additional services such as MIL-SPEC packaging, bar-coding, or palletized deliveries are available upon request. Please contact the factory with your requirements.

## • Payment Options

Reactel, Incorporated offers several convenient payment methods including: Net 30 Account (subject to credit approval) MasterCard, Visa and wire transfer. Please specify payment method when you place your order.

## • Warranty

Reactel, Incorporated warrants its manufactured products to be free of defects in material or workmanship under conditions of normal use for a period of one (1) year from the date of original delivery. Reactel, Incorporated limits its liability to repair or replacement of any manufactured product found to be defective, and such action shall be at Reactel, Incorporated's option. This warranty is the extent of the obligation accepted by Reactel, Incorporated, and in no event will Reactel, Incorporated assume liability for any incurred costs or damages. No other warranty is expressed or implied.

## • Service

Reactel, Incorporated pledges fast and complete service of its products when such action is required. Please contact the factory for a return authorization and these items must be returned pre-paid.

## • Terms and Conditions

A complete listing of our most current terms and conditions can be found on our website: [www.reactel.com](http://www.reactel.com).



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# Environmental Specifications

The following chart lists the most common environmental conditions that Reactel, Incorporated products are expected to operate within. Additionally, specifications not listed below are obtainable in many instances. Reactel, Incorporated has the ability to test their products in accordance with these or any other specification; please contact the factory with your complete requirement.

## Environmental Specifications

Specification		MIL-STD-202G (revised February 8, 2002)
Humidity		Method 103B
Seal	Gross Leak	Method 112E
	Fine Leak	Method 112E
Salt Atmosphere		Method 101E
Shock	Mechanical Shock	Method 207B / 213B
	Thermal Shock	Method 107G
Vibration	Random Vibration	Method 214A
	High Frequency Vibration	Method 204D
Temperature	Operating Temperature	-55° to +85° C
	Storage Temperature	-55° to +125° C



# Discrete Component Filters

Reactel Discrete Component Filters can satisfy a variety of filter requirements. These versatile units cover the broad frequency range of 2 kHz to 5 GHz, and are available in either tubular or rectangular packages, connectorized or surface mount, and standard or high power versions. All standard discrete component filters utilize a low ripple Chebyshev design which offers the best compromise of low loss, low VSWR, and high selectivity. Each filter situation is unique, and the data provided on the following pages offers only a small glimpse of our capabilities. Should a different design become necessary to meet your requirements, we can provide these units with Bessel, Butterworth, Elliptic, Gaussian or Linear Phase responses. Please contact the factory for filters designed to your unique requirement.

- 2 kHz to 5 GHz
- Bandwidths up to 150%
- Low Profile
- Connectorized or Surface Mount
- Lowpass, Bandpass, Highpass, Notch and Multiplexer Designs Available

## Part Numbering System

5 B M — 500 — 50 S 1 1  
1 2 3      4      5 6 7 8

### Part Number Definition:

- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Series Identification (See Page 6)
- 4 - Center Frequency
- 5 - 3 dB Bandwidth in MHz
- 6 - Connector Definition (See Page 6)
- 7 - Input Connector Type
- 8 - Output Connector Type



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# Discrete Component Filters

## Discrete Component Specifications

	Package Type		
	Series 5 (Tubular)	Series 6 (Rectangular)	Series M (Rectangular)
3 dB BW for Bandpass (% of CF)	1 - 150%	1 - 150%	1 - 150%
Available Impedances	50Ω, 75Ω, 93Ω	50Ω, 75Ω, 93Ω	50Ω, 75Ω, 93Ω
Maximum VSWR @ CF	1.5:1	1.5:1	1.5:1
Size (inches)	1.25 od x *L	0.75 x 1.0 x *L	0.2 x 0.3 x *L
** Standard Input Power	5 Watts	5 Watts	5 Watts
Shock	30G @ 11 mS	30G @ 11 mS	30G @ 11 mS
Vibration	10G	10G	10G
Humidity	up to 95%	up to 95%	up to 95
Altitude	Space Rated	Space Rated	Space Rated
Temperature	-55° to +125° C	-55° to +125° C	-55° to +125° C

\* See length table on page 7.

\*\* Higher power is available, please consult the factory.

## Discrete Component Connectors

Connector Type	Connector Code	* Connector Length (inches)
BNC Female	B1	1.00
BNC Male	B2	0.930
SMA Female	S1	0.400
SMA Male	S2	0.500
TNC Female	T1	1.00
TNC Male	T2	0.925
Type N Female	N1	1.28
Type N Male	N2	1.25
Surface Mount	Q	**
Gull Wing Pins	M	**
PC Pins	P	**

\* Dimensions are approximate and are subject to change.

\*\* Consult factory for pin options.



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# Discrete Component Filters

## \* Discrete Component Filter Lengths (inches)

Series	Number of Sections								
	2	3	4	5	6	7	8	9	10
Series 5 (Tubular)	3.25	4.05	4.85	5.65	6.45	7.25	8.05	8.85	9.65
Series 6 (Rectangular)	2.75	2.75	2.75	2.75	2.75	4.00	4.00	4.00	4.00
Series M (Rectangular)	0.75	0.75	1.00	1.00	1.00	1.00	1.50	1.50	1.50

The lengths listed above do not include connectors, see page 6 for connector lengths.

For filters in the frequency range of 2 kHz to 2 MHz, the length will be approximately 1.5 times the values given above.

\* Dimensions are approximate and are subject to change.



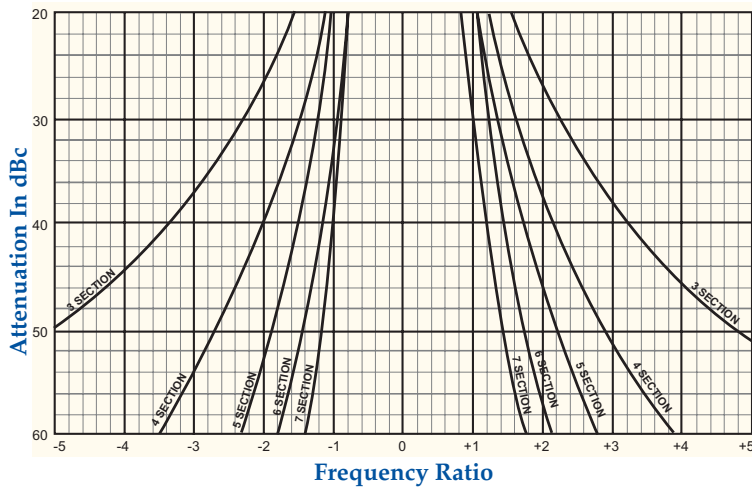
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# Discrete Component Filters

## Discrete Component Bandpass Attenuation Curves



The rejection for bandpass filters can be determined from the curves. Calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency} - \text{Center Frequency}}{\text{3 dB Bandwidth}}$$

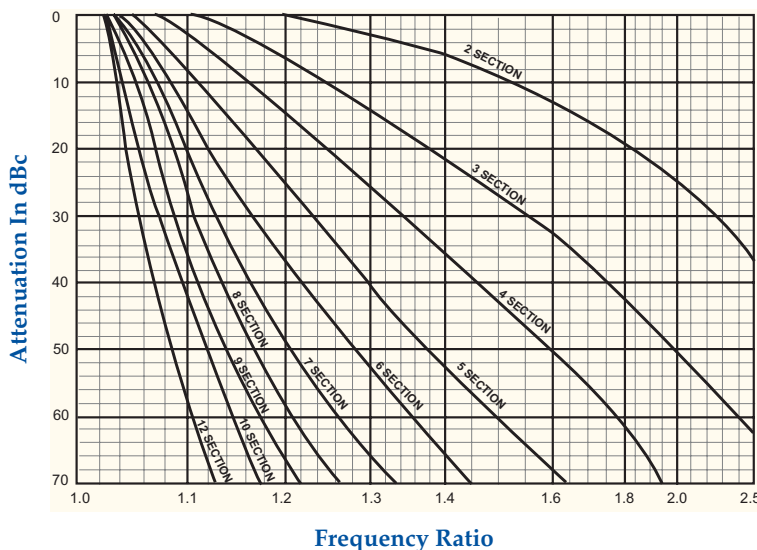
Example:

Center Frequency = 500 MHz  
 3 dB Bandwidth = 50 MHz  
 Number of Sections = 4  
 Reject Frequencies = 400 & 600 MHz

$$\text{Frequency Ratio} = \frac{400 - 500}{50} = -2$$

Rejection from Curve = 40 dB

## Discrete Component Lowpass Attenuation Curves



The rejection for lowpass filters can be determined from the curves. For frequencies above the 3 dB cutoff frequency, calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency}}{\text{3 dB Cutoff Frequency}}$$

Example:

Rejection Frequency = 100 MHz  
 3 dB Cutoff Frequency = 65 MHz  
 Number of Sections = 5

$$\text{Frequency Ratio} = \frac{100}{65} = 1.54$$

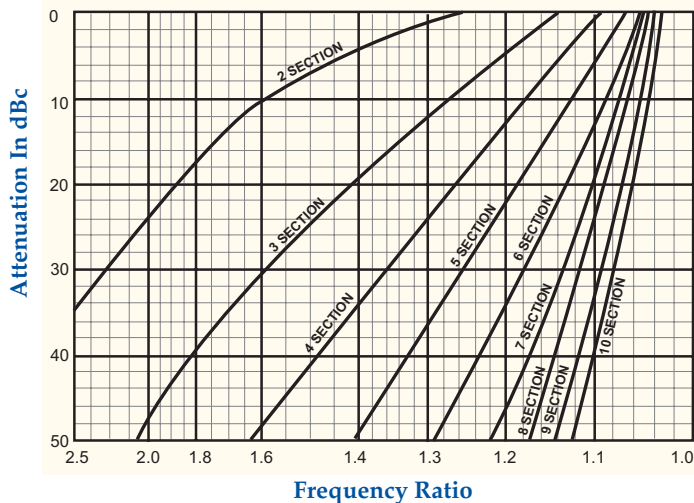
Rejection from Curve = 63.8 dB





# Discrete Component Filters

## Discrete Component Highpass Attenuation Curves



The rejection for highpass filters can be determined from the curves. For frequencies below the 3 dB cutoff frequency, calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{3 \text{ dB Cutoff Frequency}}{\text{Rejection Frequency}}$$

Example:

Rejection Frequency = 75 MHz  
 3 dB Cutoff Frequency = 100 MHz  
 Number of Sections = 5

$$\text{Frequency Ratio} = \frac{100}{75} = 1.33$$

Rejection from Curve = 41.3 dB

## Insertion Loss

Insertion loss can be calculated for discrete component filters using the following formulas and loss factors (LF).

## Bandpass Filters

$$\text{IL} = \frac{(\text{LF})(\text{N}+.5)}{\% \text{ 3 dB BW}} + .4$$

## Loss Factors

% 3 dB BW	Series 5	Series 6	Series M
1 to 15	3.9	4.8	5.1
15 and Up	5.8	6.0	6.4

Example for a 5 Section Series 6 Filter with 14.3% 3 dB BW

$$\text{IL} = \frac{(4.8)(5+.5)}{14.3} + .4$$

IL = 2.25 dB

## Lowpass & Highpass Filters (up to 90% F<sub>c</sub>)

$$\text{IL} = (\text{LF})(\text{N}+.5) + .25 \text{ dB}$$

where LF = .12 for Series 5

LF = .14 for Series 6

LF = .14 for Miniature

Example for a 4 Section Series 5 Filter

$$\text{IL} = (.12)(4+.5) + .25 \text{ dB}$$

IL = .79 dB



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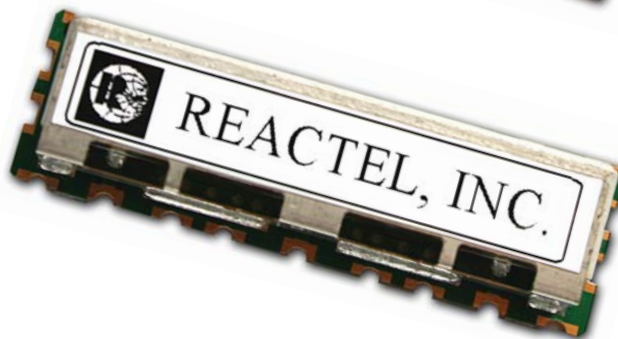
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# Ceramic Filters

Reactel Ceramic Filters are suitable for high-volume, low-cost applications as well as the stringent requirements found in military applications. These units are available in surface mount design or they can also be fitted with most any style of RF connector. All ceramic filters utilize a low ripple Chebyshev design and are available in bandpass and multiplexer configurations. Please contact us so we may design the unit which is a perfect fit for your unique requirement.

- 300 MHz to 6 GHz
- Bandwidths up to 25%
- Surface Mount or Connectorized
- Tape and Reel Available
- Bandpass and Multiplexer Designs Available



## Part Numbering System

5 C X — 800 — 40 Q  
1 2 3    4    5 6

### Part Number Definition:

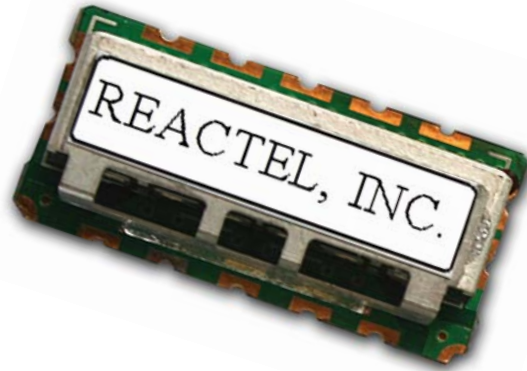
- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Series Identification
- 4 - Center Frequency in MHz
- 5 - 3 dB Bandwidth in MHz
- 6 - Connector Definition (See Below)

## Ceramic Filter Connectors

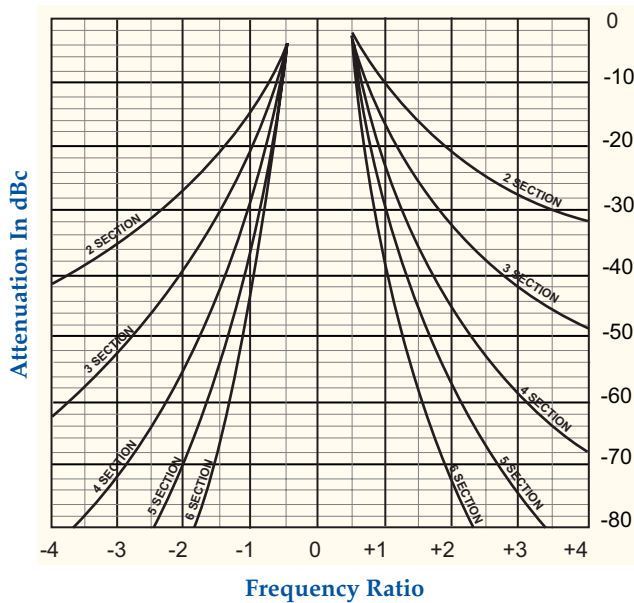
Connector Type	Connector Code
Surface Mount	Q
Gull Wing Pins	M
PC Pins	P



# Ceramic Filters



## Ceramic Bandpass Filter Attenuation Curves



The rejection for ceramic bandpass filters can be determined from the curves.

Calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency} - \text{Center Frequency}}{\text{3 dB Bandwidth}}$$

**Example:**

Center Frequency = 1000 MHz

3 dB Bandwidth = 100 MHz

Number of Sections = 5

Reject Frequencies = 800 & 1200 MHz

$$\text{Frequency Ratio} = \frac{800 - 1000}{100} = -2$$

Rejection from Curve = 70 dB



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# Cavity Filters

Reactel Cavity Filters are designed to meet the most stringent requirements with low loss and high selectivity. Depending on the frequency and loss specifications, these units can be manufactured in sizes as small as 0.25" wide and as large as 2.5" wide, covering a frequency range from 30 MHz to 50 GHz. Reactel's C7 series is the most versatile of the cavity filter family. They are machined from solid aluminum bar stock and silver plated to keep losses at a minimum. All units can be designed with 2 to 16 sections, depending on your requirements. By using resonant modes, and quarter wave or helical resonators we are able to produce filters with 3 dB bandwidths from 0.5 to 10% wide. All of Reactel, Incorporated's cavity filters are designed using the latest in CAD/CAM equipment and machinery. This approach assures that accuracy and repeatability will be maintained throughout the manufacturing process regardless of quantity ordered, and also allows us to offer you the most cost competitive pricing available.

- 500 MHz to 40 GHz
- Bandwidths up to 10%
- Low Loss
- High "Q"
- Bandpass, Notch and Diplexer Designs Available



# Cavity Filters

## Part Numbering System

**5 C 7 — 500 — 50 S 1 1**  
 1 2 3      4      5 6 7 8

### Part Number Definition:

- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Series Identification
- 4 - Center Frequency in MHz
- 5 - 3 dB Bandwidth in MHz
- 6 - Connector Definition (See Below)
- 7 - Input Connector Type
- 8 - Output Connector Type



## Cavity Filter Specifications

Series	Frequency Range	% 3 dB BW	Typical VSWR	* Standard Power
C0	4 to 40 GHz	0.5 to 10%	1.5:1	5 Watts
C1	3 to 20 GHz	0.5 to 10%	1.5:1	10 Watts
C2	2 to 20 GHz	0.5 to 10%	1.5:1	15 Watts
C3	1.5 to 10 GHz	0.5 to 10%	1.5:1	15 Watts
C7	1 to 10 GHz	0.5 to 10%	1.5:1	15 Watts
C9	0.5 to 8 GHz	0.5 to 5%	1.5:1	5 Watts
C10	0.03 to 1.0 GHz	0.5 to 5%	1.5:1	5 Watts

\* Higher power is available, please consult the factory.

## Cavity Filter Connectors

Connector Type	Connector Code	* Connector Length (inches)
BNC Female	B1	0.710
BNC Male	B2	0.890
SMA Female	S1	0.375
SMA Male	S2	0.507
TNC Female	T1	0.720
TNC Male	T2	0.800
Type N Female	N1	0.740
Type N Male	N2	0.800

\* Dimensions are approximate and are subject to change.



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# Cavity Filters



## Cavity Filter Body Dimensions (dimensions in inches)

Series	Width	Approximate Height	*Filter Length
C0	0.50	$\frac{1625}{CF(\text{MHz})} + 0.5$	** N x 0.25 + 0.4
C1	0.50		N x 0.375 + 0.4
C2	0.50		N x 0.437 + 0.3
C3	0.75		N x 0.625 + 0.3
C7	1.00		N x 0.75 + 0.3
C9	***	***	***
C10	***	***	***

\* Not including connector length.

\*\* N = Number of sections.

\*\*\* Exact dimensions to be determined at time of design, please consult the factory.



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# Standard Comblines & Interdigital Filters

Reactel Standard Comblines and Interdigital Filters satisfy the need for moderate to wide band units over the 500 MHz to 40 GHz frequency range. These filters are typically a 0.1 dB Chebyshev design and can have as many as 20 elements for extremely sharp selectivity. All of Reactel's comblines and interdigital filters are designed using the latest in CAD/CAM equipment and machinery. This approach assures that accuracy and repeatability will be maintained throughout the manufacturing process regardless of quantity ordered, and also allows us to offer you the most competitive pricing available. Since these units are designed to meet your exact requirements, please contact the factory with your electrical specifications.

- 500 MHz to 40 GHz
- Bandwidths up to 70%
- Up to 20 sections
- Low Loss
- Bandpass and Diplexer Designs Available



## Part Numbering System

5 C 11 — 8000 — 250 S 1 1  
 1 2 3      4      5 6 7 8

### Part Number Definition:

- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Series Identification
- 4 - Center Frequency in MHz
- 5 - 3 dB Bandwidth in MHz
- 6 - Connector Definition (See Below)
- 7 - Input Connector Type
- 8 - Output Connector Type



## Comblines & Interdigital Connectors

Connector Type	Connector Code	* Connector Length (inches)
BNC Female	B1	0.710
BNC Male	B2	0.890
SMA Female	S1	0.375
SMA Male	S2	0.507
TNC Female	T1	0.720
TNC Male	T2	0.800
Type N Female	N1	0.740
Type N Male	N2	0.800

\* Dimensions are approximate and are subject to change.



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# Flat Pack Comblines & Interdigital Filters

Reactel Flat Pack Comblines and Interdigital Filters combine the performance of our standard comblines and interdigital filters with a compact and lightweight form factor for portable applications. All of Reactel's flat pack comblines and interdigital filters are designed using the latest in CAD/CAM equipment and machinery. This approach assures that accuracy and repeatability will be maintained throughout the manufacturing process regardless of quantity ordered, and also allows us to offer you the most competitive pricing available. Since these units are designed to meet your exact requirements, please contact the factory with your electrical specifications.

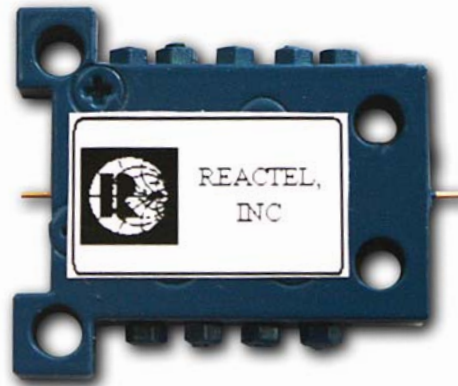
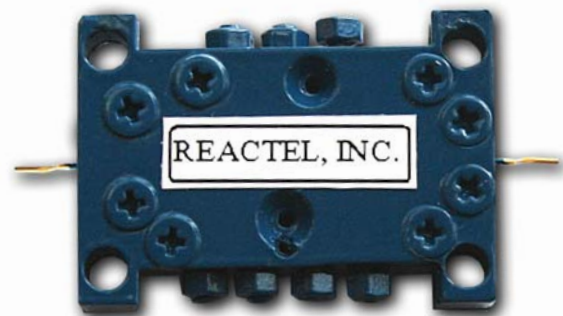
- 5 to 40 GHz
- Bandwidths up to 20%
- Low Profile
- Compact size
- Bandpass and Diplexer Designs Available

## Part Numbering System

5 FP — 16500 — 300 S 1 1  
 1 2      3      4 5 6 7

### Part Number Definition:

- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Center Frequency in MHz
- 4 - 3 dB Bandwidth in MHz
- 5 - Connector Definition (See Below)
- 6 - Input Connector Type
- 7 - Output Connector Type



## Flat Pack Filter Connectors

Connector Type	Connector Code	* Connector Length (inches)
SMA Female	S1	0.375
SMA Male	S2	0.507
Pins	M	**

\* Dimensions are approximate and are subject to change.  
 \*\* Consult factory for pin options.

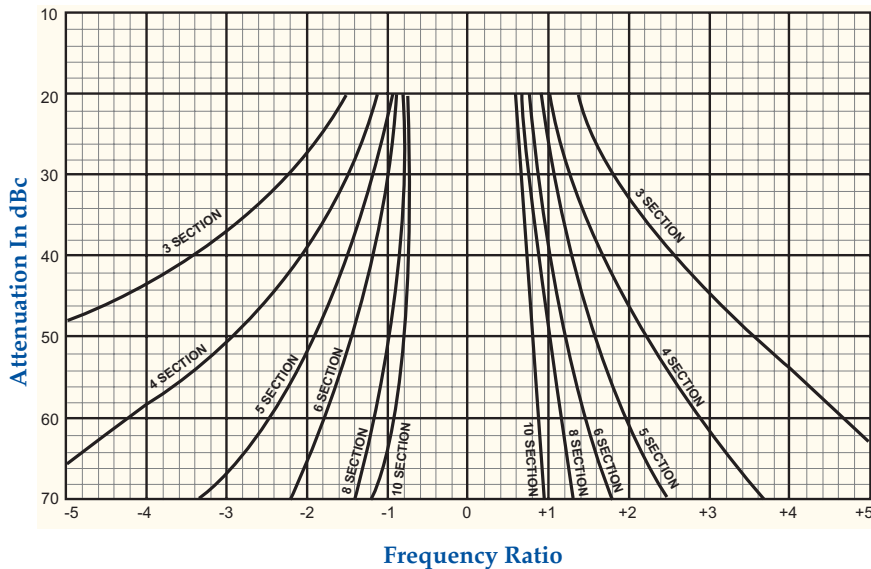




# Standard and Flat Pack Comblines & Interdigital



## Standard and Flat Pack Comblines and Interdigital Attenuation Curves



The rejection for Cavity & Interdigital filters can be determined from the curves. Calculate the frequency ratio as follows:

Frequency Ratio =

$$\frac{\text{Rejection Frequency} - \text{Center Frequency}}{3 \text{ dB Cutoff Frequency}}$$

Example:

Center Frequency = 2500 MHz

3 dB Bandwidth = 200 MHz

Number of Sections = 5

Reject Frequencies = 2000 & 3000 MHz

$$\text{Frequency Ratio} = \frac{2000 - 2500}{200} = -2.5$$

Rejection from Curve = 61.3 dB



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# Waveguide Filters & Diplexers

Reactel Waveguide Filters and Diplexers utilize inductive irises in their design for ease of manufacture and to maintain reasonable prices. These robust units are available in both bandpass and lowpass configurations covering 2 to 50 GHz. Our waveguide filters are available in all waveguide sizes and are suitable for both military and commercial applications. Typical bandwidths range from 0.1 to 25%. Please contact the factory for units designed to your unique requirement.

- 2 to 50 GHz
- Bandwidths up to 25%
- Suitable for Pressurization
- Waveguide Flanges or RF Connectors Available
- Lowpass, Bandpass and Diplexer Designs Available

## Part Numbering System

**5 W 8 — 10000 — 10 S 1 1**  
 1 2 3      4      5 6 7 8

### Part Number Definition:

- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Series Identification
- 4 - Center Frequency in MHz
- 5 - 3 dB Bandwidth in MHz
- 6 - Connector Definition (See Below)
- 7 - Input Connector Type
- 8 - Output Connector Type



## Waveguide Filter Connectors

Connector Type	Connector Code	* Connector Length (inches)
BNC Female	B1	0.710
BNC Male	B2	0.890
SMA Female	S1	0.375
SMA Male	S2	0.507
TNC Female	T1	0.720
TNC Male	T2	0.800
Type N Female	N1	0.740
Type N Male	N2	0.800
Waveguide Flange	F	**

\* Dimensions are approximate and are subject to change.

\*\* Consult factory for pin options.



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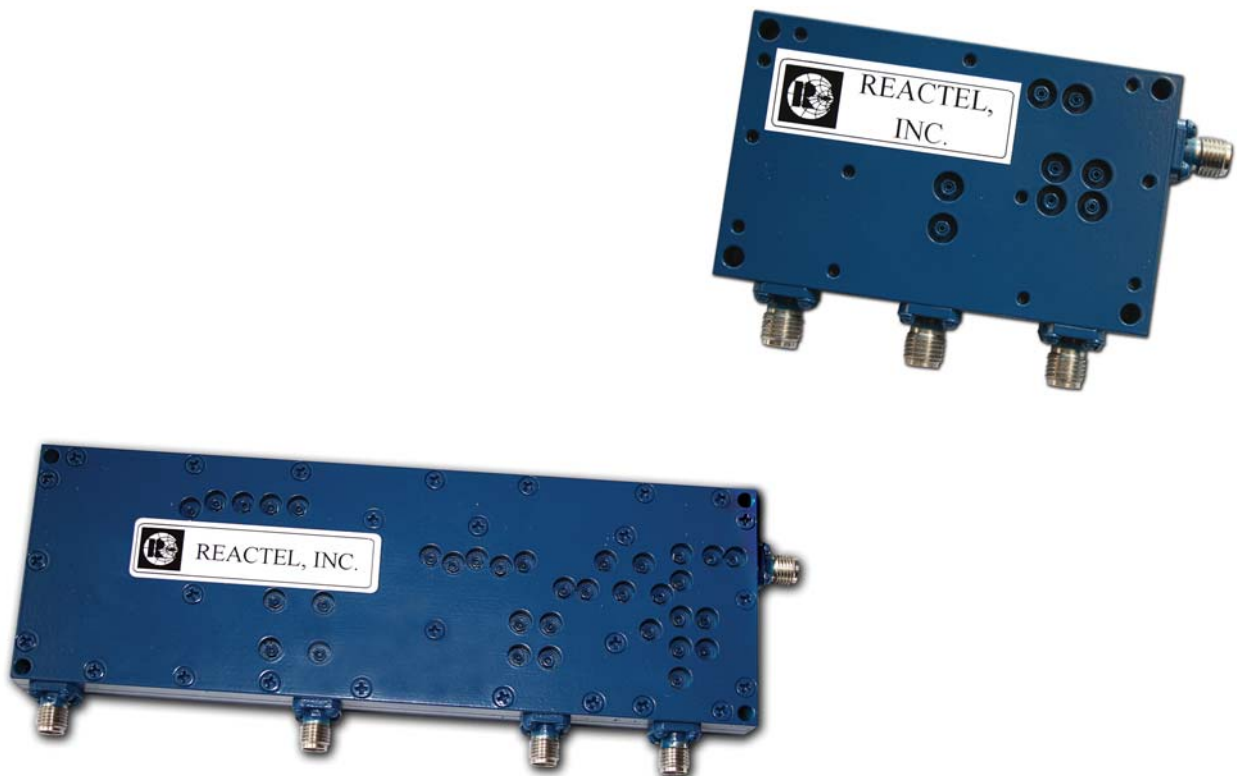
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## Suspended Substrate Filters & Diplexers

Reactel Suspended Substrate Filters are manufactured on a copper clad dual-sided board offering extremely low loss and high selectivity. The appropriate circuit is chemically etched directly onto the board substrate providing excellent repeatability. These units are manufactured in a computer controlled environment and are the optimal topology for extremely wide bandwidths, up to 150%. This method of construction is suitable for bandpass, lowpass, highpass, notch and multiplexer designs. Suspended substrate filters are able to withstand stringent military applications due to their rugged construction. Shock and vibration are not a concern due to the limited mechanical components used. The construction methods for suspended substrate can also be incorporated into our other product lines offering unprecedented flexibility to meet tough requirements. Since these units are designed to meet your exact requirements, please contact the factory with your electrical specifications.

- 2 to 40 GHz
- Bandwidths up to 150%
- High Q
- Low Loss
- Bandpass, Lowpass, Highpass, Notch and Multiplexer Designs Available



**Reactel, Incorporated — Reacting First to Your Filter Requirements**

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## Multifunction Assemblies

Reactel has a long history of manufacturing Multifunction Assemblies. From Switched Filter Banks to Amplified Filters and Diplexers to Iso-Filter Assemblies, we can produce the design that can satisfy the most demanding requirements.

Switched filter banks combine any number of our filters with the proper switch to provide a superior performing unit in a compact, lightweight package.

Similarly, a Reactal filter is combined with the appropriate amplifier or isolator to produce the desired amplified filter, diplexer or iso-filter assembly.

Reactel's multifunction assemblies offer the convenience of a single package performing multiple tasks. The benefits are many as all elements of the multifunction assembly are tuned together to offer the best possible VSWR matching, provide the lowest possible insertion loss, eliminate costly cable runs and reduce overall size when compared to individual components.

Please contact the factory for assemblies designed to your unique requirement.



# Multifunction Assemblies

## 4 Channel Switched Filter Bank

Comblines filters are integrated with PIN diode switches to make this X – band / Ku – band switched filter bank. The extremely fast switching speed is TTL controlled by way of external pins, with a D-sub connector as an option. Featuring low loss and high isolation, this compact assembly is suitable for demanding military environments.



Frequency	6 to 20 GHz
Insertion Loss	≤ 7.5 dB
Isolation	≥ 60 dB
DC Supply Voltage	+5 Vdc @ 100 mA -5 Vdc @ 60 mA
Switching Speed	1 μS
Size	0.45" x 2.7" x 4.5"

## Wireless Band Amplified Diplexer

Combining a high performance combline diplexer with a low noise amplifier, this unit offers low loss, high isolation and can handle power up to 100 W. This unit has 4 separate amplified outputs with +20 dB of gain and is suitable for outdoor applications.



Passbands	800 – 915 & 935 – 960 MHz, minimum
Insertion Loss	≤ 1.0 dB
LNA Gain	+20 dB
Channel – to – Channel Isolation	≥ 75 dB
Ultimate Attenuation	≥ 60 dB up to 3500 MHz
DC Supply Voltage	+12 V dc



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# Multifunction Assemblies

## L – Band High Power Iso-Filter

Two externally terminated circulators are paired with a High-Q combline filter to make this high power iso-filter. This robust unit can handle power levels up to 250 W while offering a return loss of better than 20 dB in-band and 15 dB out of band.



Passband	1024.5 – 1060.5 MHz, minimum
Insertion Loss	≤ 1.5 dB
Return Loss (in band)	≥ 20 dB
Return Loss (out of band)	≥ 15 dB
Attenuation	≥ 70 dB @ 950 & 1132 MHz

## Dual Passband Cavity Filter

Two cavity filters are built in parallel to realize this dual passband unit. This approach, which can be repeated for virtually any set of frequencies, is perfect for applications where passing multiple signals while using a 2 port device is required.



Passbands	1212 – 1242 & 1530 – 1590 MHz, minimum
Insertion Loss	≤ 1.0 dB
VSWR	≤ 1.5:1 @ Passbands
Rejection	≥ 40 dB @ 1450 & 1625 MHz
Size	1.15" x 1.25" x 3.0"



# Tubular Filters

Reactel Tubular Filters are able to satisfy a variety of filter requirements. These versatile units cover the broad frequency range of 10 MHz to 18 GHz, range in diameters from 1/4" to 1 1/8" and can handle power up to 200 watts in our standard design. All standard tubular filters utilize a low ripple Chebyshev design which offers the best compromise of low loss, low VSWR, and high selectivity. Each filter situation is unique, and the data provided on the following pages offers only a small glimpse of our capabilities. Should a different design become necessary to meet your requirements, Bessel, Butterworth, Gaussian or Linear Phase responses are also available. Please contact the factory for filters designed to your unique requirement.

- 10 MHz to 18 GHz
- Bandwidths up to 50%
- Low Loss
- Flexible Design Options
- Lowpass and Bandpass Designs Available

## Part Numbering System

**8 B 2 — 1500 — 100 S 1 1**  
1 2 3    4        5 6 7 8

### Part Number Definition:

- 1 - Number of Sections
- 2 - Filter Type Designation
- 3 - Series Identification
- 4 - Center Frequency in MHz
- 5 - 3 dB Bandwidth in MHz
- 6 - Connector Definition (See Page 27)
- 7 - Input Connector Type
- 8 - Output Connector Type



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# Tubular Filters



## Tubular Filter Specifications

	Series 0	Series 1	Series 2	Series 3	Series 4
Frequency Range (MHz)	100-18000	100-10000	40-6000	20-3500	10-1000
3 dB BW for Bandpass (% of CF)	1 - 70%	1 - 70%	1 - 85%	1 - 90%	0.5 - 95%
Available Impedances	50Ω & 75Ω	50Ω & 75Ω	50Ω & 75Ω	50Ω & 75Ω	50Ω & 75Ω
Maximum VSWR @ CF	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Diameter (inches)	0.25	0.375	0.50	0.75	1.125
* Standard Input Power	5 Watts	10 Watts	20 Watts	50 Watts	200 Watts
Shock	30G @ 11mS	30G @ 11mS	30G @ 11mS	15G @ 11mS	15G @ 11mS
Vibration	10G	10G	10G	10G	10G
Humidity	up to 95%	up to 95%	up to 95%	up to 95%	up to 95%
Altitude	Space Rated	Space Rated	Space Rated	Space Rated	Space Rated
Temperature	-55° to +125° C	-55° to +125° C	-55° to +125° C	-55° to +125° C	-55° to +125° C

\* Higher power is available, please consult the factory.

All Reactel standard tubular filters are designed to a low ripple Chebyshev configuration. Other configurations are available. Please call the factory to discuss your specific requirements.

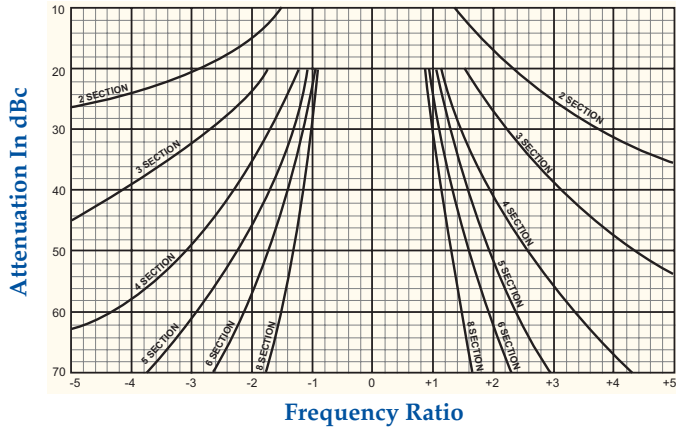




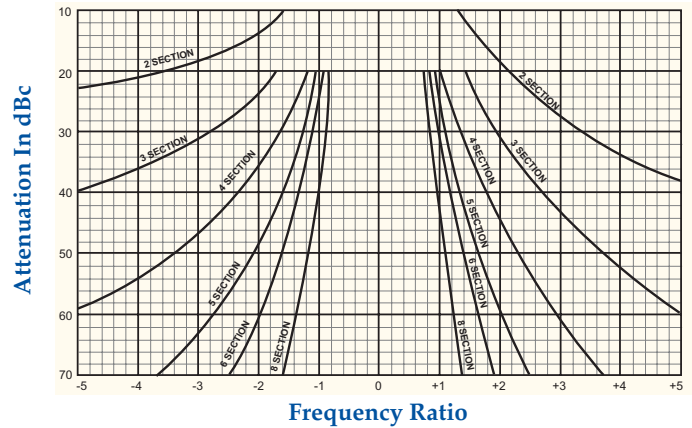
# Tubular Filter Attenuation Curves

## Tubular Bandpass Filter Attenuation Curves

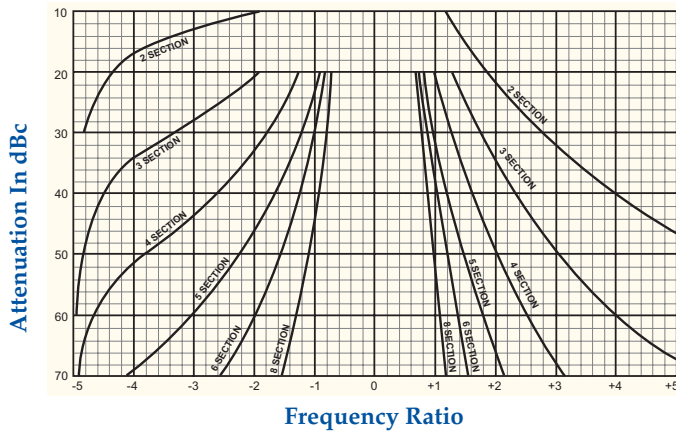
### 2 - 5% 3 dB Bandwidth



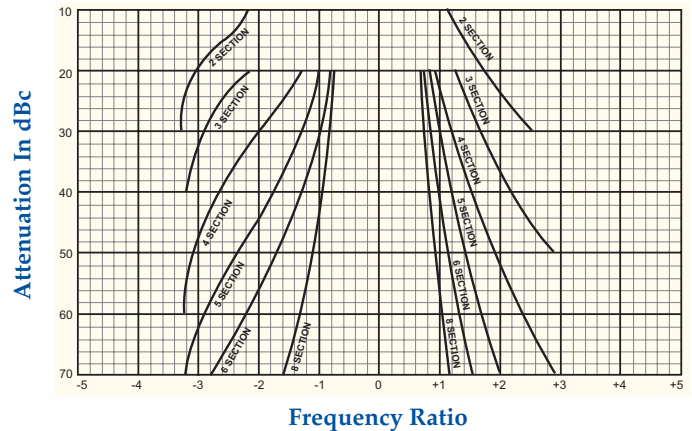
### 5 - 10% 3 dB Bandwidth



### 10 - 20% 3 dB Bandwidth



### 20 - 30% 3 dB Bandwidth



These attenuation curves are normalized to be reasonably representative of performance characteristics for filters with 3 dB bandwidths approximating the percentages shown. For more precise values at specific frequency points, please contact Reactel.

The rejection for bandpass filters can be determined from the curves. Calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency} - \text{Center Frequency}}{3 \text{ dB Cutoff Frequency}}$$

Example:

Center Frequency = 1000 MHz

3 dB Bandwidth = 150 MHz

Number of Sections = 6

Reject Frequencies = 800 & 1200 MHz

% Bandwidth = 15%

$$\text{Frequency Ratio} = \frac{800 - 1000}{150} = -1.33$$

Rejection from Curve = 42.8 dB



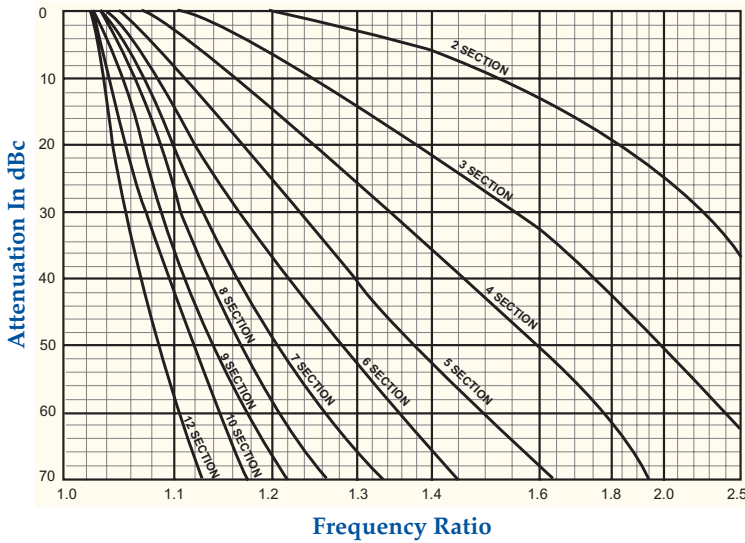
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# Tubular Filter Data

## Tubular Lowpass Filter Attenuation Curves



The rejection of lowpass filters can be determined from the attenuation curves. For frequencies above the 3 dB cutoff, calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency}}{\text{3 dB Cutoff Frequency}}$$

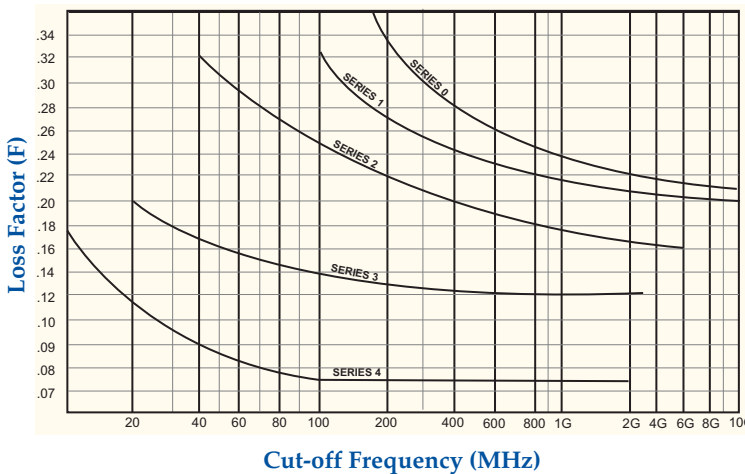
Example:

Rejection Frequency = 196 MHz  
 3 dB Cutoff Frequency = 150 MHz  
 No. of Sections = 6

$$\text{Frequency Ratio} = \frac{196}{150} = 1.3$$

Rejection from Curve = 53.5 dB

## Tubular Bandpass Filter Insertion Loss Curves



Insertion Loss =  $F \times N + .05$   
 Where F = Loss Factor  
 And N = Number of Sections

Example:

Number of Sections = 5  
 Series = 2  
 Cut-off Frequency = 1500 MHz  
 Insertion Loss =  $FN + .05$   
 Insertion Loss =  $.17 \times 5 + .05$   
 Insertion Loss = .9 dB max up to  
 90% of 3 dB cutoff

The curves on this page are theoretical values only. For more precise values at specific frequency points, please contact the factory.



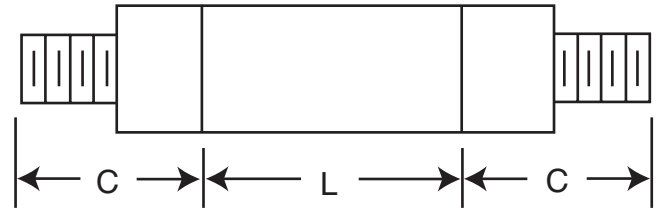
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# Tubular Filter Data

## Length Definition



**L = Filter Length** (see tables on pages 28 & 29)

**C = Connector Length** (see table below)

### \* Tubular Filter Connector Length "C" (inches)

Connector Type	Connector Code	Type M/F	Filter Series				
			0	1	2	3	4
SMA	S	2/1	0.72/0.60	0.75/0.75	0.75/0.75	0.75/0.75	0.90/0.75
SMA Right Angle	SR	2/1	N/A	0.60/0.60	0.60/0.60	0.60/0.60	0.60/0.60
SMA Flush	SF	2/1	0.75/0.75	0.75/0.75	0.75/0.75	0.75/0.75	0.90/0.75
SMB (Snap On)	M	2/1	0.60/0.60	0.75/0.75	0.75/0.75	0.75/0.75	0.75/0.75
SMC (Screw On)	O	2/1	0.60/0.60	0.75/0.75	0.75/0.75	0.75/0.75	0.75/0.75
BNC	B	2/1	N/A	1.10/1.10	1.00/1.00	1.42/1.42	1.42/1.42
TNC	T	2/1	N/A	1.10/1.10	1.00/1.00	1.42/1.42	1.42/1.42
Type N	N	2/1	N/A	1.35/1.37	1.25/1.27	1.67/1.70	1.67/1.70
PC Pin	P	---	0.50	0.60	0.60	0.60	0.75
Cable	G	---	TBD	TBD	TBD	TBD	TBD

\* Dimensions are approximate and are subject to change.

### 3 dB BW Tolerance

(Unless Otherwise Specified)

3 dB BW % of $f_0$	Tolerance on % BW
1 - 5%	+0.5 to -0%
5.1 - 25%	+2.5 to -0%
25.1 - 55%	+4.5 to -0%
55.1% - and up	+5.5 to -0%

### Insertion Loss v. 1.5:1 VSWR BW And Number of Sections

I.L. dB	Number of Sections				
	2	3	4	5	6 & up
0 - 3	50 - 55%	65 - 75%	75 - 80%	80 - 90%	95% & up
3 - 4	55 - 65%	75 - 82%	83 - 90%	89 - 95%	95% & up
4 - 5	60 - 70%	80 - 95%	90% & up	95% & up	95% & up



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# Tubular Bandpass Filter Lengths

## Series B0 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
160-200	2.75	3.75	4.75	5.25	6.75	7.75	8.75	9.75	10.25
201-300	2.75	3.5	4.25	5.0	5.75	6.5	7.25	8.0	8.75
301-800	2.5	3.25	3.75	4.25	4.75	5.25	6.5	7.25	8.0
801-2000	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
2001-4000	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
4001-6000	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5

## Series B1 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
100-200	3.0	4.0	5.0	5.5	6.0	6.5	7.0	8.5	9.0
201-300	2.75	3.0	3.75	3.75	4.0	5.0	5.5	6.5	6.75
301-500	2.5	2.75	3.5	3.5	3.75	4.75	5.0	6.25	6.5
501-700	2.0	2.5	3.0	3.25	3.75	4.5	5.0	6.0	6.5
701-1000	1.75	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.25
1001-2000	1.5	1.75	2.0	2.5	3.0	3.5	3.75	4.0	4.5
2001-3000	1.25	1.5	1.75	2.25	2.5	3.0	3.5	3.75	4.25
3001-5000	1.0	1.25	1.5	2	2.25	2.5	3.0	3.5	4.0

## Series B2 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
50-70	5.5	8.0	10.0	12.0	14.5	17.0	17.5	18.5	19.5
71-100	3.5	4.5	6.0	8.0	9.75	11.5	13.5	15.5	17.0
101-140	3.0	3.5	5.0	6.5	7.5	8.5	9.5	11.0	12.5
141-200	2.5	3.0	4.25	5.25	6.25	7.0	8.0	9.0	10.0
201-300	2.25	2.75	3.5	4.25	5.0	5.5	6.25	7.0	8.0
301-400	2.0	2.5	3.0	3.5	4.25	5.0	5.5	6.5	7.5
401-700	1.5	2.0	2.5	3.0	3.5	4.5	5.0	6.0	7.0
701-3000	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

## Series B3 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
40-50	5.0	7.0	9.0	11.5	14.0	17.0	19.0	21.5	24.0
51-75	4.5	6.5	8.0	9.5	11.5	13.0	15.0	16.0	17.0
76-150	3.0	3.5	4.0	5.5	6.5	8.0	9.0	10.0	11.0
151-300	2.5	3.0	3.5	4.0	5.0	5.5	6.5	7.0	8.0
301-700	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0
701-2000	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0

## Series B4 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
20-40	4.5	6.5	9.0	10.5	13.0	16.0	19.0	22.0	25.0
41-60	4.0	5.0	6.5	8.5	10.0	13.0	15.0	17.0	19.0
61-80	3.5	4.0	5.5	7.0	8.5	9.5	11.0	13.0	14.5
81-200	3.0	4.0	4.5	6.0	7.0	8.0	9.5	11.0	12.0
201-500	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
501-1000	2.5	3.0	3.5	4.5	5.0	5.5	6.5	7.0	8.0

## Tubular Bandpass Weight per Section (oz.)

Series	B0	B1	B2	B3	B4
Weight	0.25	0.50	0.75	1.00	1.50

The lengths and weights shown in these tables are approximate and should only be used as a guide. Reactel reserves the right to alter these dimensions to meet a particular specification.



# Tubular Lowpass Filter Lengths

## Series L0 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
100-200	1.75	2.5	3.25	4.0	4.75	5.5	7.25	8.0	8.75
201-300	1.25	1.75	2.25	2.75	3.25	3.75	4.25	4.75	5.25
301-800	1.0	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0
801-2000	1.0	1.5	1.75	2.0	2.25	2.5	2.75	3.5	3.75
2001-4000	1.0	1.5	1.75	2.0	2.25	2.5	2.5	3.0	3.5
4001-7000	0.75	1.0	1.75	1.5	1.75	2.0	2.25	2.5	3.0
7001-10000	0.5	0.75	1.0	1.25	1.5	2.0	2.25	2.5	2.75
10001-18000	0.5	0.65	0.75	0.9	1.0	2.0	2.25	2.5	2.75

## Series L1 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
100-200	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.0
201-400	1.5	2.0	3.0	3.5	4.0	4.5	5.5	6.5	7.0
401-600	1.5	2.0	2.5	3.0	3.5	4.5	4.75	5.0	5.5
601-1000	1.5	2.0	2.25	2.5	3.0	4.0	4.25	4.5	5.0
1001-2000	1.0	1.5	1.75	2.5	2.75	3.25	3.5	4.0	4.5
2001-3000	1.0	1.5	1.75	2.0	2.5	3.0	3.25	3.5	4.0
3001-4000	0.75	1.25	1.5	2.0	2.5	2.75	3.0	3.25	3.5
4001-10000	0.75	1.0	1.25	1.75	2.25	2.5	3.0	3.25	3.5

## Series L2 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
40-50	4.0	6.0	8.5	10.5	12.5	15.0	17.5	18.0	19.5
51-70	3.0	5.0	6.5	8.5	10.5	12.5	15.0	16.0	19.0
71-100	2.5	4.0	5.5	6.5	8.0	10.0	11.5	13.0	14.5
101-250	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.0	8.5
251-500	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
501-1000	1.25	1.5	2.25	2.5	3.0	3.5	4.0	4.5	5.0
1001-2500	1.0	1.5	2.0	2.25	2.5	3.0	3.5	4.0	4.5
2501-6000	0.75	1.0	1.5	2.0	2.5	2.75	3.0	3.5	4.0

## Series L3 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
20-40	5.0	8.0	11.5	15.5	18.0	21.5	25.0	26.5	28.0
41-60	3.0	6.0	8.0	10.5	13.0	15.0	17.5	21.0	24.0
61-90	2.5	4.5	6.0	8.0	10.0	11.5	12.5	14.5	16.0
91-150	1.5	3.0	4.5	5.0	6.0	6.5	7.5	8.0	9.0
151-500	1.5	3.0	3.5	4.5	5.5	6.0	6.5	7.0	8.0
501-1000	1.5	2.5	3.5	4.5	5.0	5.25	6.0	6.5	7.5
1001-3500	1.0	2.5	3.0	3.5	4.5	4.75	5.0	6.0	6.5

## Series L4 Length (inches)

CF (MHz)	Number of Sections								
	2	3	4	5	6	7	8	9	10
10-20	7.0	10.5	13.5	17.5	20.5	23.0	26.0	28.5	30.0
21-35	5.0	7.0	9.5	13.0	15.0	17.0	21.0	22.0	24.5
36-60	4.0	5.5	6.5	7.5	10.0	11.5	13.0	14.5	16.0
61-150	3.5	4.0	4.5	5.5	7.0	8.0	9.0	10.0	11.0
151-400	3.0	3.5	4.0	5.0	5.5	6.5	7.5	8.0	8.5
401-1000	2.5	3.0	3.5	4.5	5.5	6.5	7.0	7.5	8.0

## Tubular Lowpass Weight per Section (oz.)

Series	L0	L1	L2	L3	L4
Weight	0.25	0.50	0.75	1.00	1.50

The lengths and weights shown in these tables are approximate and should only be used as a guide. Reactel reserves the right to alter these dimensions to meet a particular specification.



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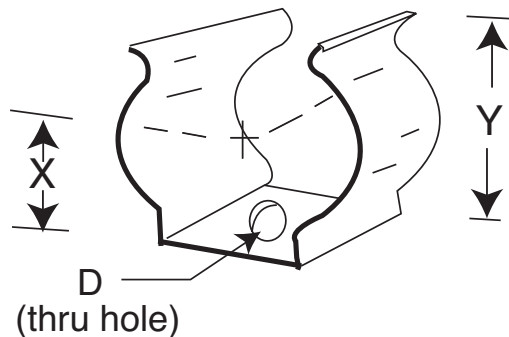
# Tubular Filter Mounting Options

The "Type S Spring Clip" is a light to medium duty fastening method, and is good for most applications.

For more rugged environments the "Type R High Shock Bracket" would be appropriate.

## Type S Spring Clip (dimensions in inches)

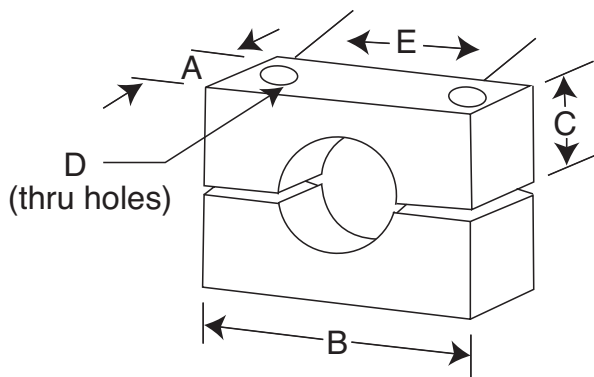
Series	X	Y	D	Material
0	0.30	0.50	0.130	Phos-Bronze
1	0.32	0.50	0.085	Plastic
2	0.45	0.75	0.200	Phos-Bronze
3	0.50	0.80	0.150	Plastic
4	0.62	1.15	0.130	Phos-Bronze
5	0.62	1.15	0.130	Phos-Bronze



All tubular filters ordered in quantities of 10 or fewer are supplied with Type S Spring Clips free of charge. For larger quantities, please consult the factory.

## Type R High Shock Bracket (dimensions in inches)

Series	A	B	C	D	E
0	0.12	0.50	0.22	0.093	0.375
1	0.25	0.87	0.35	0.113	0.620
2	0.25	1.00	0.47	0.144	0.750
3	0.37	1.50	0.70	0.169	1.125
4	0.37	2.00	1.00	0.193	1.575
5	0.50	2.00	1.00	0.193	1.575



Type R High Shock Brackets can be supplied with tubular filters for an additional charge. Please consult the factory for a price quote.



# High Power Filters

Reactel High Power Filters are manufactured in discrete component or tubular designs with a power handling capability of up to 25 kW. These stout units are available in bandpass, lowpass, or highpass responses covering the frequency range of 5 MHz to 5 GHz. Typically, these units are intended to be used with convection cooling, forced air cooling or heat sink plates however the low loss characteristics will keep heat transfer to a minimum. Since these units are designed to meet your exact requirements, please contact the factory with your electrical specifications.

- 5 MHz to 5 GHz
- Power Levels up to 25 kW
- Low Loss
- Low Heat Transfer
- Bandpass, Lowpass and Highpass Designs Available

## Part Numbering System

4 P B 4 — 100 — 10 N 1 1  
1 2 3 4      5      6 7 8 9

### Part Number Definition:

- 1 - Number of Sections
- 2 - High Power Designator
- 3 - B = Bandpass, L = Lowpass, H = Highpass
- 4 - Series Definition
- 5 - Center Frequency (omit for lowpass and highpass)
- 6 - 3 dB Bandwidth (bandpass) or  
3 dB Cutoff (lowpass and highpass)
- 7 - Connector Definition (see page 27)
- 8 - Input Connector Type
- 9 - Output Connector Type



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# High Power Filters



## High Power Filter Specifications

	Bandpass	Lowpass	Highpass
Frequency Range	5 - 3000 MHz	5 - 5000 MHz	5 - 3000 MHz
Power Capacity	up to 5 kW	up to 25 kW	up to 5 kW
Impedance	50Ω	50Ω	50Ω
Maximum VSWR	1.5:1	1.5:1	1.5:1
Number of Sections	2 - 10	2 - 10	2 - 10
Shock	30G	30G	30G
Vibration	10G	10G	10G
Operating Temperature	-55° to +125° C	-55° to +125° C	-55° to +125° C
Altitude	Space Rated	Space Rated	Space Rated
Humidity	up to 95%	up to 95%	up to 95%





# Special Shape Filters

There are times where our customers have space and form factor limitations which preclude the use of a standard filter configuration. In these instances, there are options to design and package the filter in a shape which is convenient for the end user. Most often, a special shape is accomplished by “folding” the filter upon itself one or more times. This permits the end user to have the high performing filter he requires while allowing it to fit in the space allocated. Each situation is unique, please contact the factory to explore available options.

## Folded Tubular Filter



## Folded Cavity Filter



## Folded Comblines Filter



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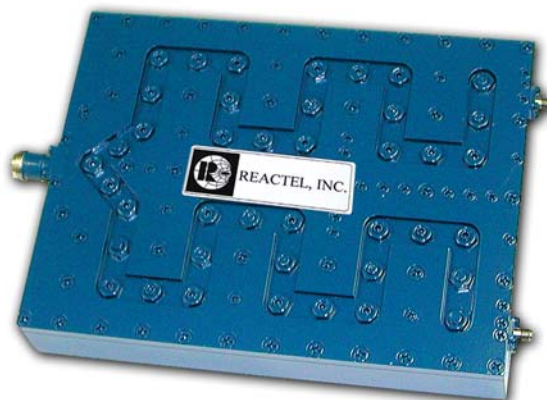
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# Wireless Filters

Reactel has an extensive library of filters and multiplexers for wireless applications. These units cover all aspects of a wireless system: Antennas, Base Stations, Co-Site Interference, Repeaters, Point-to-Point Radios or any other function. These units are available in cavity, discrete component, ceramic, suspended substrate and tubular configurations. Packaging styles range from low cost drop in to high power connectorized, and offer the option of weather resistant packaging for outdoor applications.

We have units for all current wireless bands such as 3G, 4G, AMPS, AWS, Cellular, CDMA, DCS, EGSM, GPS, GSM, Inmarsat, Iridium, LTE, MMDS, PCS, SMR, UMTS, WCDMA, WiFi, WiMax, WLAN, and WLL. Looking forward, our talented team of engineers are continually researching emerging bands and applications so that Reactel has the most complete and current offerings possible.



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## GPS Filters

Reactel has a complete line of filter products designed for GPS applications. Our line includes bandpass, multiple bandpass, notch, multiple notch, and multiplexers for L1 – 1557.42 MHz, L2 – 1227.6 MHz and L5 – 1176.45 MHz frequencies. These units are available in cavity, discrete component and ceramic configurations. Packaging styles range from low cost drop in to high power connectorized, and offer the option of weather resistant packaging for outdoor applications. Looking forward, our talented team of engineers are continually researching emerging applications so that Reactel has the most complete and current offerings possible.



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# Notes

