



# Q MICROWAVE

*The Fast Filter-Company*

*Your On-Call Filter Department*



## MICROWAVE FILTERS

- *LC, Cavity & Ceramic Resonator Filters*
- *20 MHz to 20 GHz.*
- *Rapid Prototypes*
- *Low Cost Production*
- *Custom Surface Mount Packaging*



# Q MICROWAVE



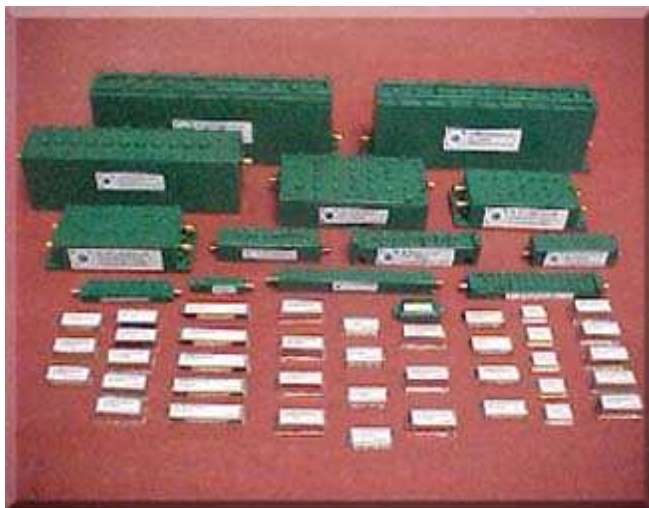
**Q Microwave** is a leader in microwave design and manufacturing, specializing in quick-turn and low-cost production of microwave and RF filter products used by wireless, military, and hi-rel industries.

Our corporation was established in 1998 within San Diego's East County region, in the city of El Cajon. San Diego's wireless community provides an excellent resource for highly trained personnel and technological capabilities.

## Corporate Strategy

The corporation's strategy is based upon an attitude of teamwork with our customers and suppliers to provide top-notch engineering solutions and highly responsive manufacturing. We know that in today's competitive environment success is determined through successful partnerships that remove traditional barriers and treat suppliers as an extension of the team.

## Products



Q Microwave has broad experience in the design and construction of RF & microwave filters from 20 MHz to 20 GHz, with special capabilities in miniature filters realized in lumped-element, ceramic, and combine topologies. We take pride in our ability to develop filters that integrate seamlessly into our customer's systems. Information on customer manufacturing processes and how the filter will be used in the circuit is often used to design better solutions.

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## Capabilities

**Partnerships.** Q Microwave's strategy is based upon partnering with our customers and suppliers and a belief that success is achieved as a team. The advantage of this partnership is apparent at all stages of the design and production process. Q Microwave's engineering approach, concurrent design process, reliable manufacturing capabilities, and supplier partnerships provide the right product, at the right time, at the right price.

**Product Development.** Q Microwave offers a full range of product development support capabilities including design analyses, design reviews, first article inspection per AS9100, qualification testing, configuration control, and program management.

**Rapid Build Cycle.** Our rapid prototyping capability provides significant delivery schedule advantage over competitors. When standard packaging is utilized, initial prototype units are typically delivered within 2 to 6 weeks of contract acceptance. In situations where system evaluation of performance is required, customers can use our rapid prototyping capability to provide design feedback prior to any commitment regarding flight-worthy hardware.

**Manufacturing.** The company maintains a partitioned manufacturing capability that addresses prototype orders as well as higher volume production. Production flow is monitored using the company's MRP system in conjunction with operator reporting using workstation computers and barcode readers. Scheduling and work center priorities are adjusted as required to meet delivery commitments.

Assembly capabilities include a mixture of automation and hand-soldering that is blended based upon order quantities and design requirements. Standard soldering inspection criteria is provided per J-STD-01 and all key positions are filled by certified operators.

Test & Tune capabilities are supported by a full range of microwave network analyzers. Automated testing can be provided with fully retrievable S-parameter data available for each delivered unit. Standard Environmental Stress Screening (ESS) is available, including thermal shock and vibration tests.

Our suppliers have been selected based upon their ability to achieve our aggressive schedule, price, and quality requirements. All received material is inspected and assigned a lot traceability number that is tracked throughout the manufacturing process.

**Quality System.** Q Microwave's Quality System meets the requirements of ISO-9001. This system includes a quality program designed to achieve continuous process and product improvement. All suppliers, material, and processes are controlled and traceability maintained. Inspection and test equipment are calibrated and maintained per ISO-10012.





# Q MICROWAVE

## Standard Filter Products

Q Microwave's standard filter products are categorized by the filter function (bandpass, lowpass, highpass or notch), topology (lumped element, combline, or ceramic resonator), and transfer function. The following table illustrates the available combinations for our standard filter products.

Types	Topologies	Transform Functions
<ul style="list-style-type: none"> <li>• Bandpass</li> <li>• Lowpass</li> <li>• Highpass</li> <li>• Bandreject</li> </ul>	<ul style="list-style-type: none"> <li>• Lumped Element</li> <li>• Combline</li> <li>• Cavity</li> <li>• Ceramic Resonator</li> </ul>	<ul style="list-style-type: none"> <li>• Chebychev</li> <li>• Butterworth</li> <li>• Gaussian, to 6 dB, to 12 dB</li> <li>• Elliptic</li> </ul>

## Performance Capabilities

Standard filter products will typically be guaranteed to meet the following specifications. The actual specifications for each product will be provided based upon our customer's requirements. Additional requirements such as amplitude matching, phase matching, phase noise, and high power performance can be addressed through in-house design and test capabilities.

Specification	Standard Performance Capability
Frequency Range	20 MHz to 20 GHz
3dB Bandwidth	1% to 100%
VSWR	1.5:1 over 70% of 3dBc bandwidth
Insertion Loss	0.5 dBa to 3 dBa typical
Power	1 Watt typical; high power capabilities available (e.g., 5 kW)
Operating Temperature	-55°C to +95°C
Non-Operating Temperature	-65°C to +125°C; See reflow profile for SMT designs
Thermal Shock	25 cycles -55°C to +100°C
Random Vibration	12 G <sub>rms</sub> , 50-2000 Hz spectrum
Mechanical Shock	50 G half-sine
Hermeticity (*)	1x10 <sup>-5</sup> atm-cc/sec
Humidity (*)	90-95% relative humidity
Corrosion (*)	48 hour salt fog

Note (\*): Only applies to hermetic designs.

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## Packaging

Q Microwave's design approach emphasizes the use of standard components. For our customers, this means standardized packaging and inputs are preferred in order to reduce cost and delivery time. Q Microwave's standard packaging includes the following configurations.

	Lumped Element	Ceramic Resonator	Cavity / Combine
Connectors	√	√	√
SMT	√	√	√
Leads	√	√	√

## Surface Mount Configurations

**SMT Packaging** achieves the most popular solution based upon ease of installation and small size.

- **Construction** – The filter is built on a soft substrate and covered with an EMI shield. The input, output, and ground contacts are provided on the under side of the package. High temperature solder is used in its construction in order to improve yield during installation.
- **Mounting** - This packaging approach requires your substrate layout to accept the input/output pad configuration for the filter. These layout requirements can be provided in advance of your purchase. Installation is typically achieved with common Sn63 solder reflow processes. During installation, care must be taken to ensure that the filter's internal temperature is not permitted to exceed 220C. Recommended solder reflow profiles are available at our website.
- **Applications** -Typically used for applications below 6 GHz. Performance is heavily dependent upon the quality of the ground as determined by the circuit layout and attachment. Rejection performance is typically limited to 50 dBc.

**Leaded SMT Packaging** provides a surface mountable design while allowing the use larger metal packages that may be required for hermetic devices or filters with machined packages.

- **Construction** – The filter is typically built within a stainless steel, kovar, or brass housing with RF feedthrus at the input/output. The filter is EMI sealed and can be hermetically sealed if necessary.
- **Mounting** – Given the relative mass of the package, mounting is typically achieved through mechanical fasteners. The base of the housing provides ground and the input and output pins are pre-formed to make contact with your substrate's circuit.

**Microstrip Packaging** is typically used to achieve higher performance transitions at higher frequencies. The microstrip geometry provides lower loss and improved isolation performance. The filter is typically built within a kovar housing and a non-hermetic EMI seal. The package should be epoxy attached or solder reflowed into your assembly. Interconnects must be made and optimized by the customer using either wire bonding or soldering processes.





# Q MICROWAVE

## Lumped-Element Filters

Q Microwave's miniature lumped-element filter capability extends the full frequency range of our capability: 20 MHz to 20 GHz. The principal advantage of this type of filter is its small size. Disadvantages include lower "Q" or higher loss for a given rejection requirement. Typical prototype delivery is 2 to 4 weeks.



## QLB Series—Lumped-Element Bandpass Filters

**Description Code:** QLB(Field 1)M(Field 2)P(Field 3)S(Field 4)(Field 5)

	Field 1	Field 2	Field 3	Field 4	Field 5
Parameter	Center Frequency in MHz	3dBc Bandwidth in Percent	Rejection in terms of number of sections	Package Styles: CS = SMA Connectors, SM = SMT, MS = Microstrip, FS = Formed leads	Nonstandard item codes
Std Values	1000-6000 MHz	5-20%	2-6 sections	"CS"	N/A

### QLB-Series Product Examples:

Description Code	Filter Type	F <sub>c</sub> (MHz)	BW <sub>3dB</sub> (MHz)	Sect	Rejection	I/L (dB) at F <sub>c</sub>	I/O Style
QLB00040M10P5SFS	LE, BPF	40	4	5	50 dBc @ 25 MHz & 55 MHz	5	Lead
QLB00060M3P3SSM	LE, BPF	60	2	3	30 dBc @ 50 MHz & 70 MHz	2	SMT
QLB00070M57P9SCS	LE, BPF	70	40	9	60 dBc @ 28 MHz & 115 MHz	1	SMA
QLB150M33P5SSM	LE, BPF	150	50	5	40 dBc @ 75 MHz & 225 MHz	2	SMT
QLB350M21P5SSM	LE, BPF	350	75	5	40 dBc @ 275 MHz & 425 MHz	2.5	SMT
QLB00400M10P5SCS	LE, BPF	400	40	5	50 dBc @ 300 MHz & 500 MHz	2.5	SMA
QLB00680M13P-SM	LE, BPF	680	88	5	40 dBc @ 560 MHz & 800 MHz	3	SMT
QLB01000M18P7SSM	LE, BPF	1000	180	7	50 dBc @ 770 MHz & 1290 MHz	2	SMT
QLB01000M10P4SFS	LE, BPF	1000	100	4	50 dBc @ 500 & 1500 MHz	2	Lead
QLB1250M120P5SCS	LE, BPF	1250	1500	5	30 dBc @ 200 MHz & 3700 MHz	2	SMA
QLB3000M67P5SCS	LE, BPF	3000	2000	5	30 dBc @ 1600 MHz & 6000 MHz	2	SMA
QLB03500M23P5SCS	LE, BPF	3500	800	5	30 dBc @ 2500 & 4500 MHz	2	SMT
QLB03680M4P6SFS	LE, BPF	3680	150	6	50 dBc @ 3200 & 4200 MHz	2.5	Lead
QLB05250M11P8SFS	LE, BPF	5250	578	8	40 dBc @ 4390 MHz & 6250 MHz	3	Lead
QLB5800M7P3SSM	LE, BPF	5800	400	3	20 dBc @ 5400 MHz & 6200 MHz	3	SMT
QLB6000M67P5SCS	LE, BPF	6000	4000	5	30 dBc @ 2600 & 11000 MHz	2	SMA
QLB10000M40P5SCS	LE, BPF	10000	4000	5	30 dBc @ 6000 & 16000 MHz	2	SMA
QLB15000M40P5SCS	LE, BPF	15000	6000	5	30 dBc @ 12000 & 18000 MHz	2	SMA

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## QLL Series—Lumped-Element Lowpass Filters

**Description Code:** QLL(Field 1)M(Field 3)E(Field 4)-(Field 5)

	Field 1	Field 2	Field 3	Field 4	Field 5
Parameter	Cutoff Frequency in MHz	Not used	Rejection in terms of number of elements	<b>Package Styles:</b> CS = SMA Connectors, SM = SMT, MS = Microstrip, FS = Formed leads	Nonstandard item codes
Standard Values	1500-8000 MHz	Bandwidth DC to cutoff frequency	3-15 elements	"CS"	N/A

### QLL-Series Product Examples

Description Code	Filter Type	F <sub>co</sub> (MHz)	Passband (MHz)	Elmt	Rejection	I/L (dB) in PB	I/O Style
QLL500M7ECS	LE, LPF	500	DC to 500	7	40 dBc @ 1000 MHz	1.5	SMA
QLL1000M7ECS	LE, LPF	1000	DC to 1000	7	40 dBc @ 2000 MHz	1.5	SMA
QLL2000M7ECS	LE, LPF	2000	DC to 2000	7	40 dBc @ 4000 MHz	1.5	SMA
QLL4000M7ECS	LE, LPF	4000	DC to 4000	7	40 dBc @ 8000 MHz	1.5	SMA
QLL-8000M7ECS	LE, LPF	8000	DC to 8000	7	40 dBc @ 16000 MHz	1.5	SMA

## QLH Series—Lumped-Element Highpass Filters

**Description Code:** QLH(Field 1)M(Field 2)X(Field 3)E(Field 4)-(Field 5)

	Field 1	Field 2	Field 3	Field 4	Field 5
Parameter	Cutoff Frequency (F <sub>co</sub> ) in MHz	Passband bandwidth in multiples of F <sub>co</sub>	Rejection in terms of number of elements	<b>Package Styles:</b> CS = SMA Connectors, SM = SMT, MS = Microstrip, FS = Formed leads	Nonstandard item codes
Standard Values	1000-20000 MHz	As required	3-12 elements	"CS"	N/A

### QLH-Series Product Examples:

Description Code	Filter Type	F <sub>co</sub> (MHz)	Passband (MHz)	Elmt	Rejection	I/L (dB) in PB	I/O Style
QLH500M4X7ECS	LE, HPF	500	500 to 2000	7	40 dBc @ 250 MHz	1.5	SMA
QLH1000M4X7ECS	LE, HPF	1000	1000 to 4000	7	40 dBc @ 500 MHz	1.5	SMA
QLH2000M3X7ECS	LE, HPF	2000	2000 to 6000	7	40 dBc @ 1000 MHz	1.5	SMA
QLH4000M2X7ECS	LE, HPF	4000	4000 to 8000	7	40 dBc @ 2000 MHz	1.5	SMA
QLH8000M2X7ECS	LE, HPF	8000	8000 to 16000	7	40 dBc @ 4000 MHz	1.5	SMA



# Q MICROWAVE

## Comblines Filters

Q Microwave's standard combline filters are available from 1 to 20 GHz. The primary advantage of combline filters is the higher "Q" or low loss and high rejection capabilities. Disadvantages include large size and weight compared to lumped element filters. Typical prototype delivery is 4 to 6 weeks.



## QCB Series—Comblines Bandpass Filters

**Description Code: QCB(Field 1)M(Field 2)P(Field 3)S(Field 4)(Field 5)**

	Field 1	Field 2	Field 3	Field 4	Field 5
Parameter	Center Frequency in MHz	3dBc Bandwidth in Percent	Rejection in terms of number of sections	Package Styles: CS = SMA Connectors, SM = SMT, MS = Microstrip, FS = Formed leads	Nonstandard item codes
Std Values	1000-20000 MHz	1-10%	2-6 sections	"CS"	N/A

### QCB-Series Product Examples:

Description Code	Filter Type	F <sub>c</sub> (MHz)	BW <sub>3dB</sub> (MHz)	Sect	Rejection	I/L (dB) at F <sub>c</sub>	I/O Style
QCB00859M8P9SCS	CL, BPF	859	100	9	60 dBc @ 754 & 964 MHz	1	SMA
QCB01090M2P3SCS	CL, BPF	1090	20	3	50 dBc @ 1040 & 1140 MHz	1.5	SMA
QCB01300M22P7SCS	CL, BPF	1300	286	7	60 dBc @ 1030 & 1600 MHz	1	SMA
QCB02140M1P9SCS	CL, BPF	2140	35	9	60 dBc @ 2065 & 2215 MHz	1	SMA
QCB02333M1.5P5SSM	CL, BPF	2333	35	5	23 dBc @ 2290 & 2375 MHz	2	SMT
QCB03000M20P7SSM	CL, BPF	3000	600	7	20 dBc @ 2500 & 3500 MHz	1.5	SMT
QCB03360M1P5SFS	CL, BPF	3360	40	5	50 dBc @ 3040 & 3200 MHz	4	Lead
QCB03850M18P6SSM	CL, BPF	3850	700	6	20 dBc @ 2700 & 7000 MHz	1.5	SMT
QCB04140M2P5SFS	CL, BPF	4140	70	5	50 dBc @ 4000 & 4280 MHz	1.5	Lead
QCB05800M2P7SCS	CL, BPF	5800	100	7	50 dBc @ 5550 & 5650 MHz	1.8	SMA
QCB06600M2P5SFS	CL, BPF	6600	100	5	50 dBc @ 6000 & 7200 MHz	2	Lead
QCB07800M1P5SFS	CL, BPF	7800	100	5	50 dBc @ 7200 & 8400 MHz	2	Lead
QCB08825M5P3SSM	CL, BPF	8825	400	3	40 dBc @ 7800 & 9800 MHz	1	SMT
QCB09760M3P6SCS	CL, BPF	9760	273	6	70 dBc @ 9200 & 10270 MHz	2	SMA
QCB10720M3P8SCS	CL, BPF	10720	270	8	70 dBc @ 10240 & 11300 MHz	2	SMA
QCB12000M10P6SCS	CL, BPF	12000	1200	6	70 dBc @ 8000 & 16000 MHz	0.9	SMA
QCB15250M2P4SMS	CL, BPF	15250	230	4	20 dBc @ 14185 & 16300 MHz	1.5	MS
QCB16480M10P10SCS	CL, BPF	16480	1650	10	30 dBc @ 15400 & 17560 MHz	2	SMA
QCB17000M1P3SCS	CL, BPF	17000	100	3	20 dBc @ 16620 & 17380 MHz	1.8	SMA

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## Ceramic Resonator Filters

Q Microwave's ceramic resonator filters offer the middle ground in performance between lumped-element filters and combine filters over the range of 500 MHz to 6 GHz. The standard product is provided in an SMT package. Typical prototype delivery is 4 to 6 weeks.



## QRB Series—Ceramic Bandpass Filters

**Description Code:** QRB(Field 1)M(Field 2)P(Field 3)S(Field 4)(Field 5)

	Field 1	Field 2	Field 3	Field 4	Field 5
Parameter	Center Frequency in MHz	3dBc Bandwidth in Percent	Rejection in terms of number of sections	Package Styles: CS = SMA Connectors, SM = SMT, MS = Microstrip, FS = Formed leads	Nonstandard item codes
Std Values	500-6000 MHz	1-5%	2-6 sections	"CS"	N/A

### QRB-Series Product Examples:

Description Code	Filter Type	F <sub>c</sub> (MHz)	BW <sub>3dB</sub> (MHz)	Sect	Rejection	I/L (dB) at F <sub>c</sub>	I/O Style
QRB00320M3P6S-CS	RC, BPF	320	10	6	40 dBc @ 310 & 340 MHz	5	SMA
QRB00346M3P5SCS	RC, BPF	346	10	5	20 dBc @ 326 & 366 MHz	1.5	SMA
QRB00855M1P4SSM	RC, BPF	855	10	4	20 dBc @ 841 & 869 MHz	4	SMT
QRB00900M2P5SSM	RC, BPF	900	20	5	40 dBc @ 800 & 1000 MHz	3	SMT
QRB01030M1.5P4SFS	RC, BPF	1030	16	4	54 dBc @ 980 & 1090 MHz	3.6	Lead
QRB01030M1.6P5SFS	RC, BPF	1030	16	5	55 dBc @ 980 & 1090 MHz	4.9	Lead
QRB01030M1.9P5SFS	RC, BPF	1030	20	5	27 dBc @ 1008 & 1052 MHz	5	Lead
QRB01090M1.1P4SFS	RC, BPF	1090	12	4	50 dBc @ 1030 & 1150 MHz	6.5	Lead
QRB01090M1.8P4SFS	RC, BPF	1090	20	4	28 dBc @ 1067 & 1113 MHz	2.5	Lead
QRB01090M1.8P5SFS	RC, BPF	1090	20	5	20 dBc @ 1067 & 1113 MHz	4.5	Lead
QRB01090M1.8P6SFS	RC, BPF	1090	20	6	30 dBc @ 1067 & 1113 MHz	7.5	Lead
QRB01320M1P6SFS	RC, BPF	1320	18	6	50 dBc @ 1280 & 1370 MHz	6.5	Lead
QRB01400M7P3SMS	RC, BPF	1400	100	3	15 dBc @ 1282 & 1564 MHz	0.5	MS
QRB01430M1P4SSM	RC, BPF	1430	14	4	40 dBc @ 1396 & 1464 MHz	6	SMT
QRB01600M6P5SFS	RC, BPF	1600	96	5	50 dBc @ 1280 & 2100 MHz	2	Lead
QRB01680M1P5SFS	RC, BPF	1680	20	5	50 dBc @ 1600 & 1780 MHz	5.5	Lead
QRB02300M2P4SSM	RC, BPF	2300	57	4	35 dBc @ 2200 & 2400 MHz	3.0	SMT
QRB02560M10P4SFS	RC, BPF	2560	256	4	50 dBc @ 1280 & 4500 MHz	1.5	Lead
QRB02800M5P6SFS	RC, BPF	2800	140	6	50 dBc @ 2560 & 3130 MHz	2.5	Lead



## Custom Filter Products

Q Microwave's design tools are provided to assist our customers in specifying a filter requirement. It is not intended to make you a filter designer. The below list identifies the key decisions made by our filter designers when developing a solution for your specific requirement. Obviously, the more detail you provide as to critical features or specifications, the more relevant the proposal provided by our staff. Additional pertinent technical information is offered at [www.qmicrowave.com](http://www.qmicrowave.com). Before proceeding, the following information must be collected with as much detail as possible. Noting specifications of little concern or areas with flexibility is equally important.

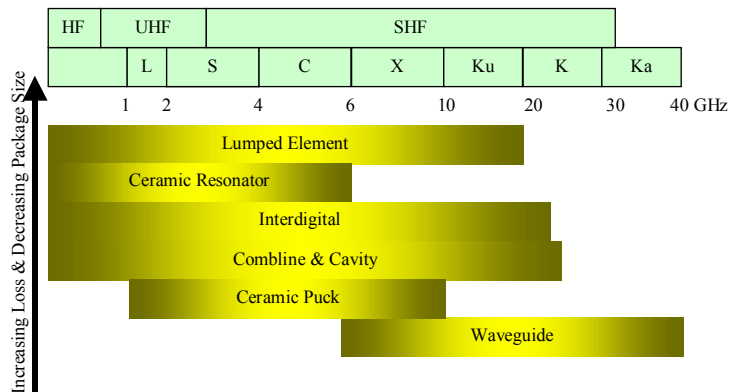
- ✓ Center frequency and passband
- ✓ Rejection in terms of signal attenuation levels and frequency or sections in the filter circuit.
- ✓ Optional Specifications: Loss limitations, phase or time domain requirements, size constraints, etc.
- ✓ Price targets

## Design Considerations

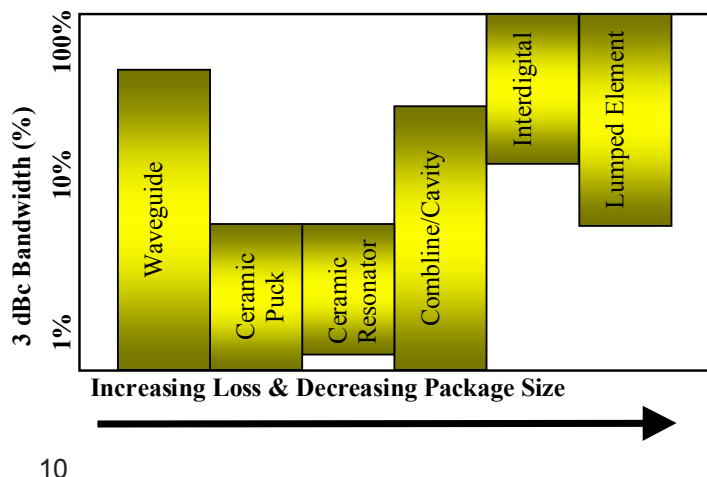
**FILTER TRANSFER-FUNCTION.** The filters shape factor is primarily determined by the transfer function, or mathematical function, used to realize the circuit. Chebychev transfer functions are typically used in applications requiring higher performance in the frequency domain (i.e., a sharp cutoff between passband and rejection bands).

**TOPOLOGY SELECTION** The filter's topology is typically selected based upon the frequency of operation, relative bandwidth, shape factor, and insertion loss, and rejection requirements:

**1. Operating Frequency.** The following plot provides the approximate frequency capability of various topologies available at Q Microwave.

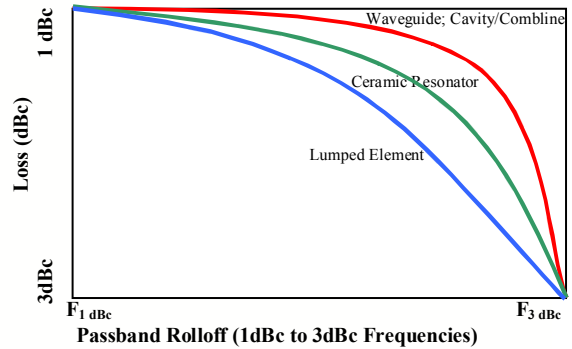


**2. Relative Bandwidth.** The passband's relative size as defined by the 3 dBc bandwidth divided by the center frequency. As noted in the below plot, this can restrict the available filter topologies.

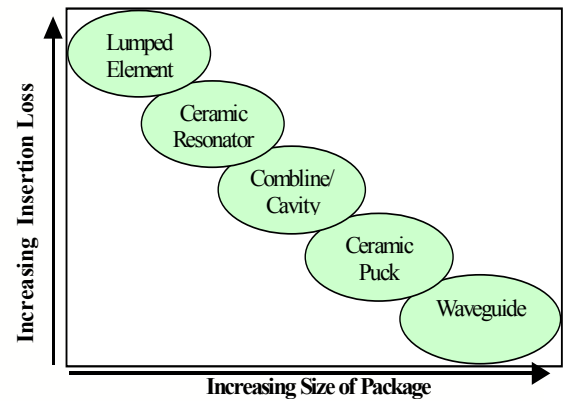


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**3. Passband Shape Factor.** The relative rolloff or shape of the filter's passband, as defined by the loss characteristics between the 1 dBc and 3 dBc bandwidths, is provided below for comparison of available topologies. Customers should note that this relationship is an approximation using typical performance requirements and does vary based upon other specification issues. A more detailed estimate of rejection performance is available at our website.



**4. Insertion Loss Requirements.** Passband loss will limit the available topologies as illustrated in the figure below. Typically, larger topologies provide lower loss solutions. Customers should note that this relationship is an approximation using typical performance requirements and does vary based upon other specification issues. A more detailed estimate of insertion loss is available by following this link. These capabilities also do vary from manufacturer to manufacturer.



**5. Rejection Performance.** With all other factors being equal, each topology provides the same rejection performance outside of the 3 dBc bandwidth. Some exceptions include the following:

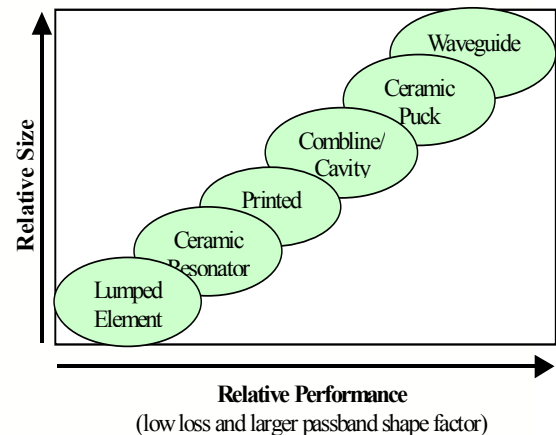
- ✓ **Ultimate Rejection.** Combine/cavity topology can provide up to 100 dBc of rejection while other topologies will consistently provide no more than 50 dBc.
- ✓ **Resonances.** Circuit re-resonances will limit rejection performance at higher frequencies. This will limit the upper rejection band frequency range.

**6. Physical Topology Issues.** Physical concerns may dictate the selection of one topology over another. Most of these concerns relate to size limitations. A rough tradeoff analysis with size versus electrical performance can be done using the above plots and discussions.

**PACKAGING SELECTION** - Considerations for packaging options are provided at our website. Variables considered include topology, size constraints, installation method, and desired input/output interface.

**OTHER CONCERNS** - Probably the single most important issue not addressed here is cost. Cost tradeoffs are not easily quantified without a specific requirement for evaluation and tradeoff comparisons. Q Microwave's sales and engineering staff will gladly provide the necessary review of our customer's requirements to ensure that the optimal solution is proposed.

Topology	Re-resonance Frequency
Ceramic Resonator	2 x Center Frequency
Cavity / Combine	3 x Center Frequency
Lumped Element	4 x Center Frequency





# Q MICROWAVE

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## Contact Methods

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 El Cajon, CA 92020



Your Information			
Your Name		Your Title	
Company		E-Mail	
Phone		Fax	
Purchasing Requirements			
Planned Purchase Qty		Planned Order Date	
Size Requirements		Input/Mounting Type	

