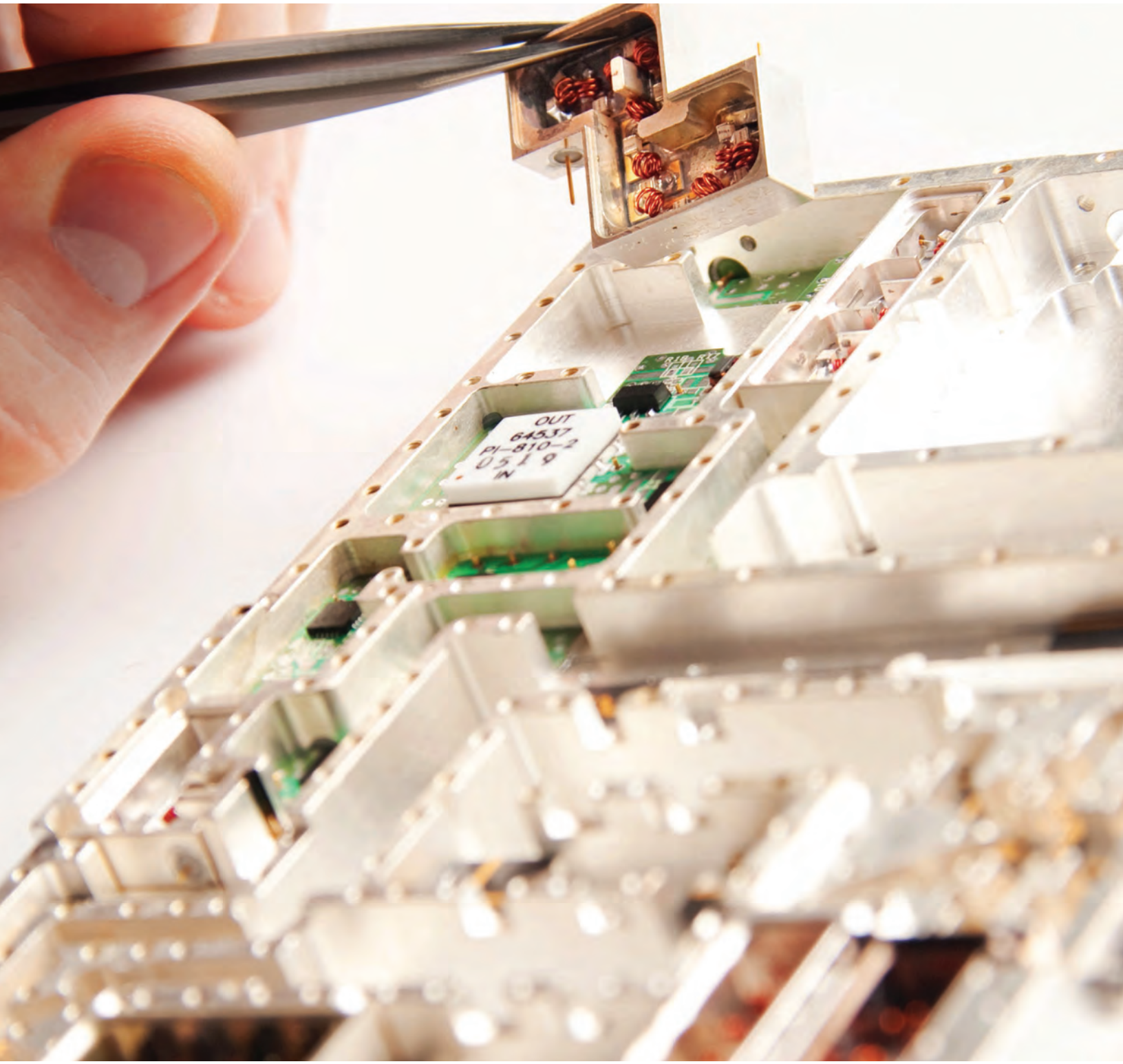
RF & Microwave Filters



api technologies corp.

API's reputation for designing and delivering some of today's most challenging RF & Microwave filters is the reason why RF engineers trust us with their designs. We maintain that level of expertise through training, employing modern equipment, and by utilizing the most advanced microwave design software available on the market today. Whether your design is a bandpass, lowpass, highpass, or a notch filter. . . API continues to be your top source for microwave components.

API Technologies specializes in custom filters for military and commercial applications. Topologies and filter product types include:

- Lumped Element
- Cavity
- Tubular/Coaxial
- Switched Filter Banks
- Ceramic
- Diplexers
- Triplexers
- Multiplexers
- Suspended Substrate
- SAW Filters
- Waveguide

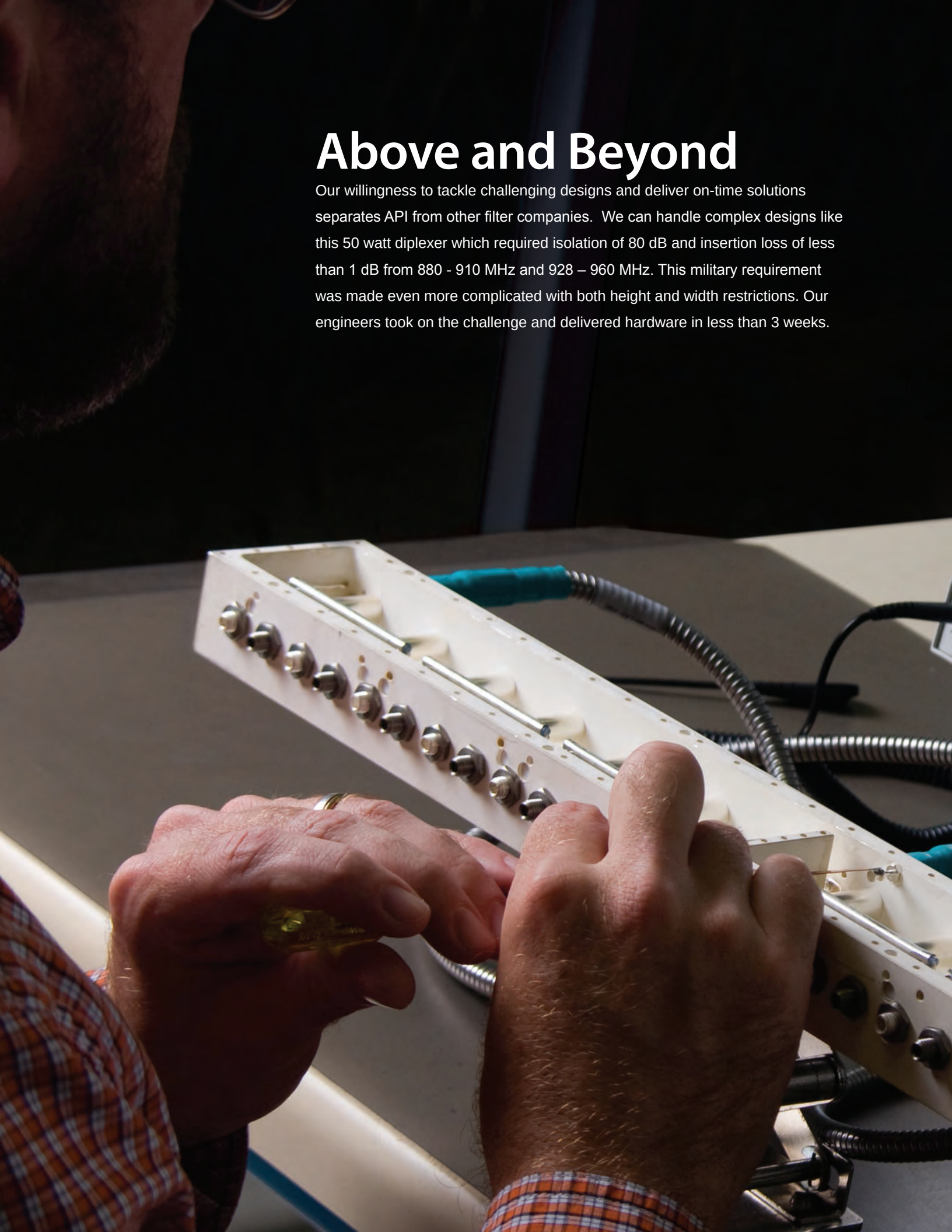
A Wide Variety Of Options

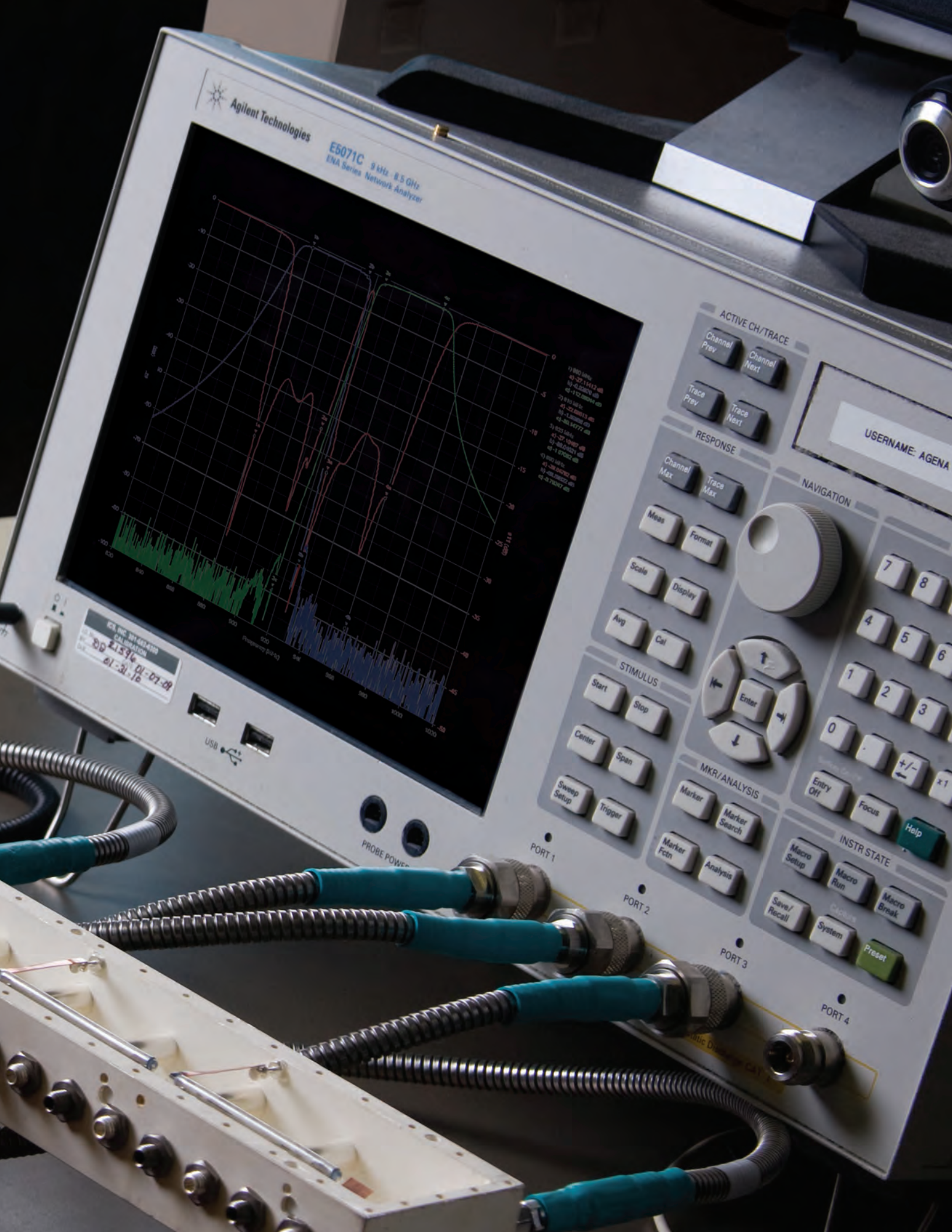
Versatility is a hallmark that separates API Technologies from other filter companies. Choosing from a wide assortment of topologies, including lumped element, cavity, ceramic, SAW, tubular, suspended substrate, and waveguide, our engineers match the optimum topology to your requirements. Unlike other one dimensional filter companies, API continues to prove that by offering multiple options, a customer can weigh the benefits of: size vs. loss, rejection vs. size, selectivity vs. group delay... and select the perfect filter to optimize system performance.


Cavity Filters
Waveguide Filters
Lumped Element
Tubular Filters
SAW Filters
Suspended Substrate
Ceramic Filters
Rejected

Above and Beyond

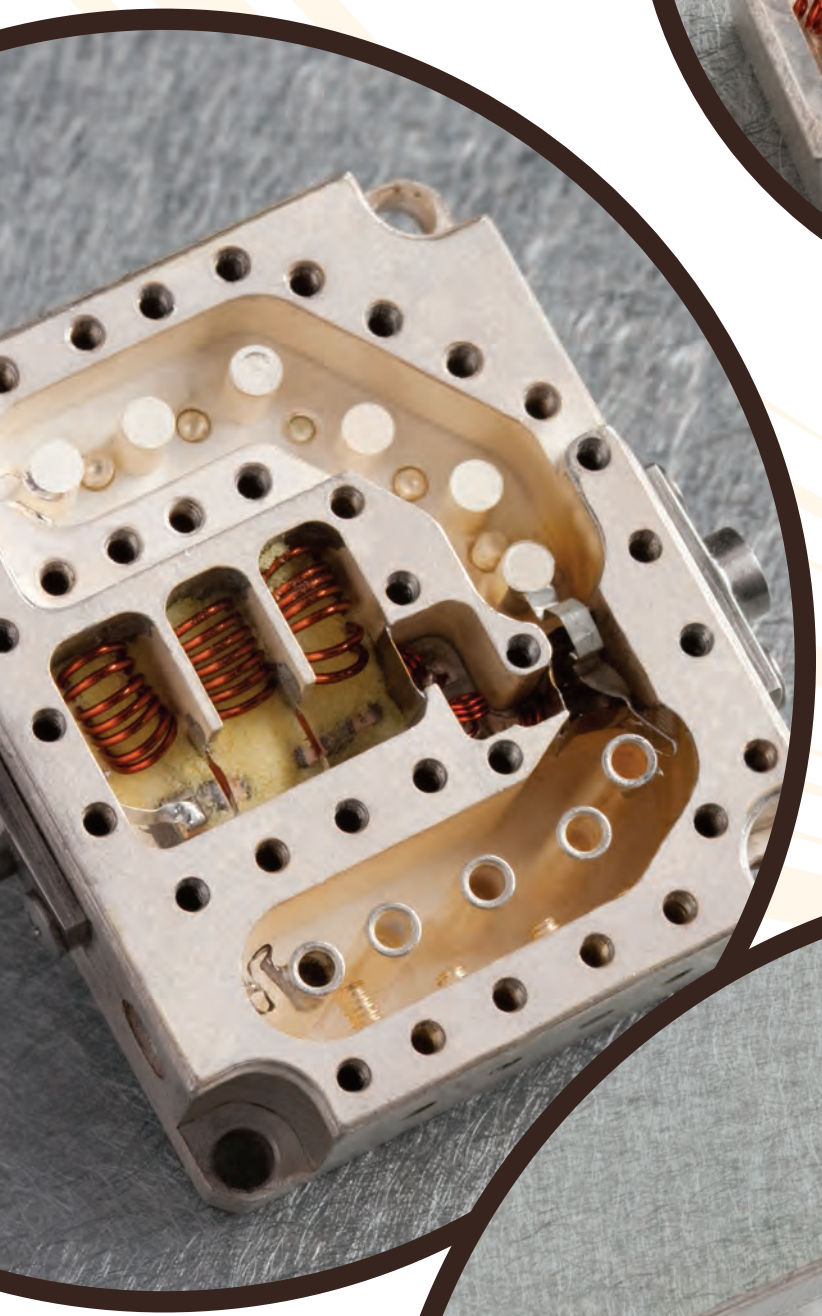
Our willingness to tackle challenging designs and deliver on-time solutions separates API from other filter companies. We can handle complex designs like this 50 watt diplexer which required isolation of 80 dB and insertion loss of less than 1 dB from 880 - 910 MHz and 928 – 960 MHz. This military requirement was made even more complicated with both height and width restrictions. Our engineers took on the challenge and delivered hardware in less than 3 weeks.




Agilent Technologies
E5071C 9 kHz - 8.5 GHz
ENA Series Network Analyzer
ACTIVE CH/TRACE
Channel Prev
Channel Next
Trace Prev
Trace Next
RESPONSE
Channel Max
Trace Max
Meas
Format
Scale
Display
Avg
Cal
NAVIGATION
Enter
STIMULUS
Start
Stop
Center
Span
Sweep Setup
Trigger
MKR/ANALYSIS
Marker
Marker Search
Marker Fctn
Analysis
INSTR STATE
Macro Setup
Macro Run
Macro Break
Save/ Recall
System
Preset
Entry Off
Focus
Help
USB
PROBE POWER
PORT 1
PORT 2
PORT 3
PORT 4

Creative Layouts

Utilizing sophisticated software such as Sonnet EM Simulator and SolidWorks, creative layouts can be realized to optimize package size and electrical performance.



Innovative Designs

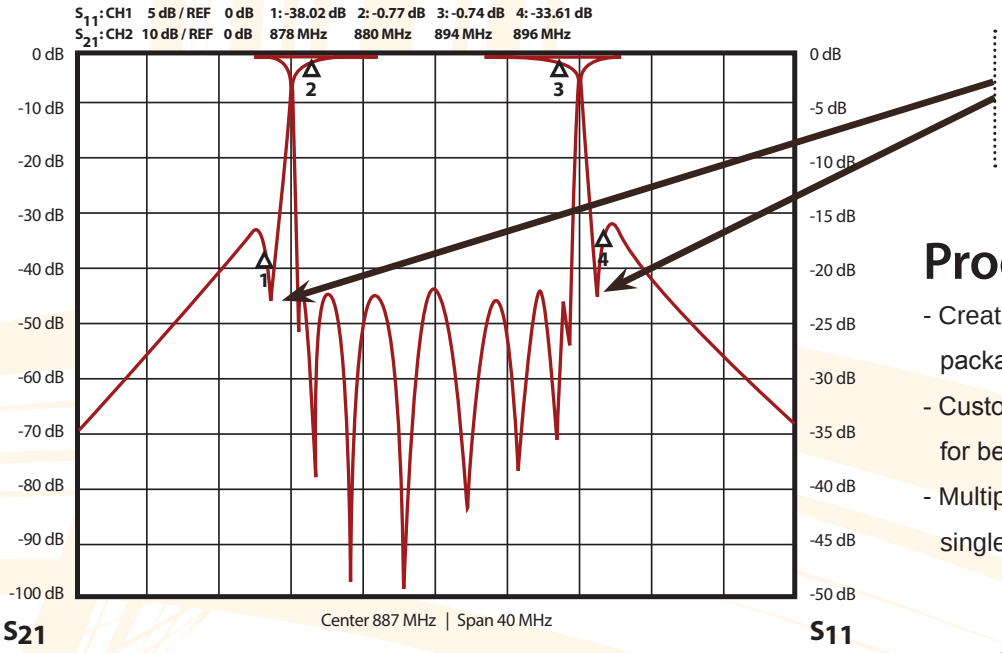
In order to optimize rejection and minimize loss, API engineers blend multiple topologies into a single small housing.

High Power Strategies

Careful analysis of current densities and heat dissipation allow for higher power handling and smaller package size.

Lumped Element

Lumped element designs are best suited for applications where size and weight are critical. Our filter engineers are experts in Lumped Element design techniques and use a number of innovative methods to meet today's demanding specifications.



For maximum rejection at specific frequencies, we incorporate strategically placed poles of attenuation

Product Features

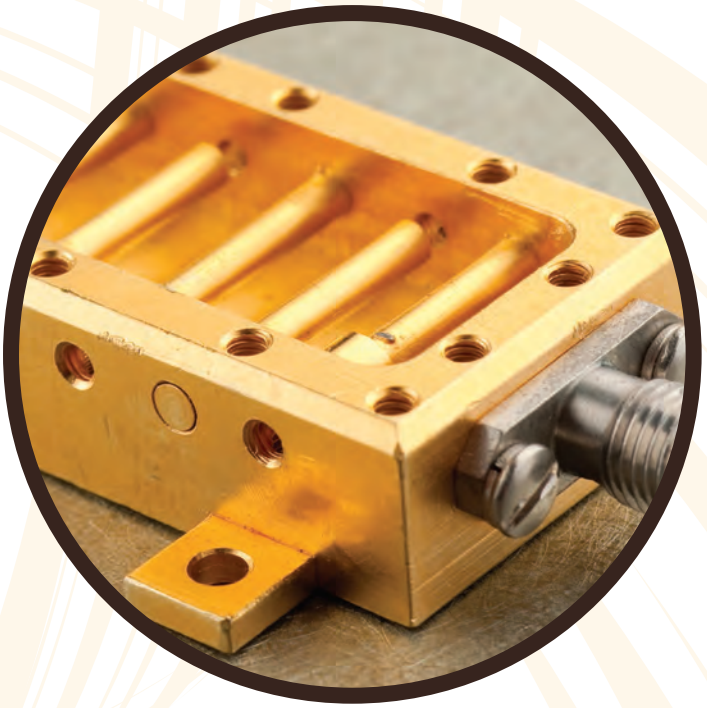
- Creative component layouts offer reduced package sizes when needed.
- Customized housings provide superior shielding for better rejection
- Multiple topologies can be integrated within a single package for broad frequency coverage

Cavity Filters

One of the advantages characterizing cavity filter designs is their low insertion loss and higher power handling ability. API engineers researched the suppression of intermodulation products in low loss, high power cavity designs and through careful process control and component selection devised specialized design techniques to satisfy our customers' unique requirements. Pseudo-elliptic designs our engineers generate reduce the number of sections required to meet a specified attenuation response, thereby generating a smaller filter with lower passband loss, and reduced costs. Similar techniques may be employed to provide passband group delay equalization or increase attenuation over a specified stopband region.

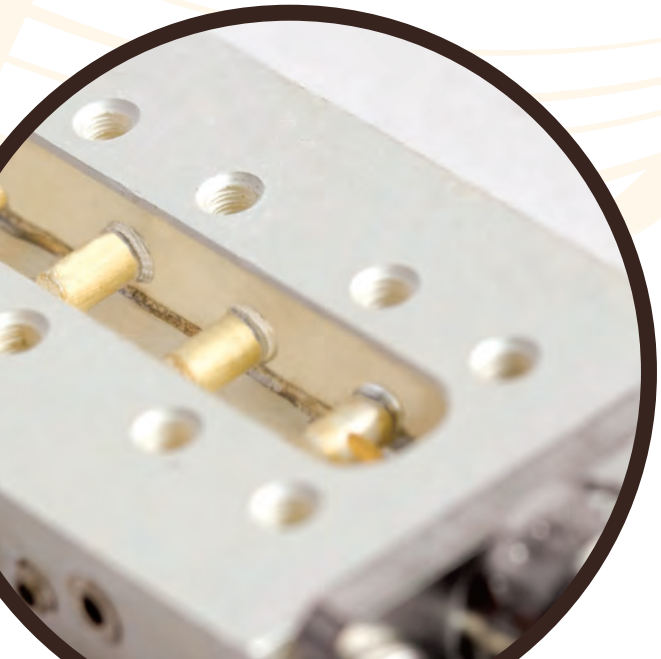
Weight Reduction

To reduce weight and minimize passband loss, API Technologies' cavity filters are generally machined from lightweight aluminum alloys and plated with high purity Gold or Silver using NADCAP controlled processes.



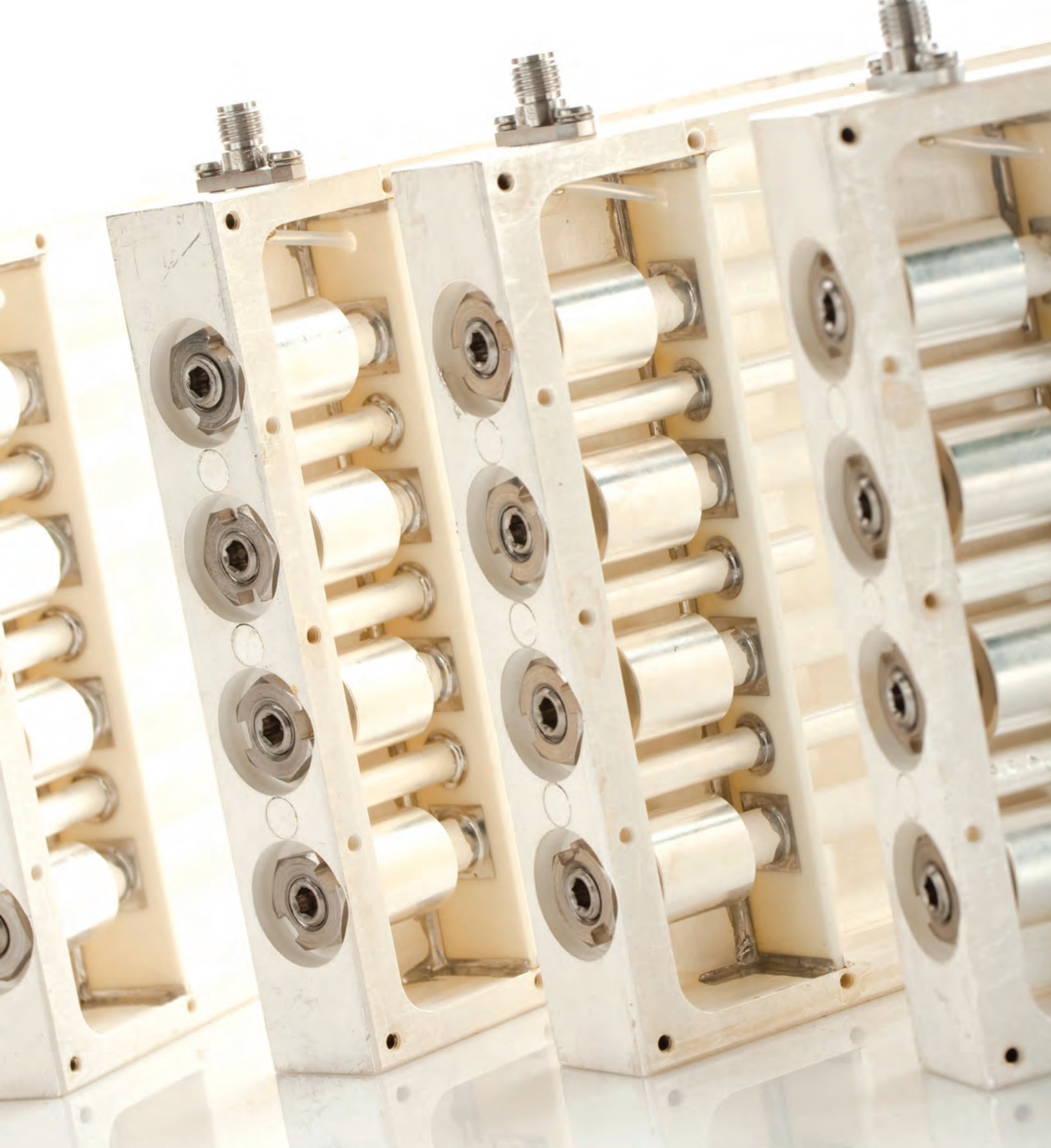
Minimal Temperature Drift

Proprietary design techniques ensure minimal temperature drift of narrowband transfer functions. API has even designed and manufactured cavity filters with temperature drifts of less than 1 ppm/°C.



Enhanced Rejection

API's pseudo-elliptic designs incorporate cross coupling to create transmission zeros resulting in enhanced close-in rejection performance without increased loss.



Designed To Be Better

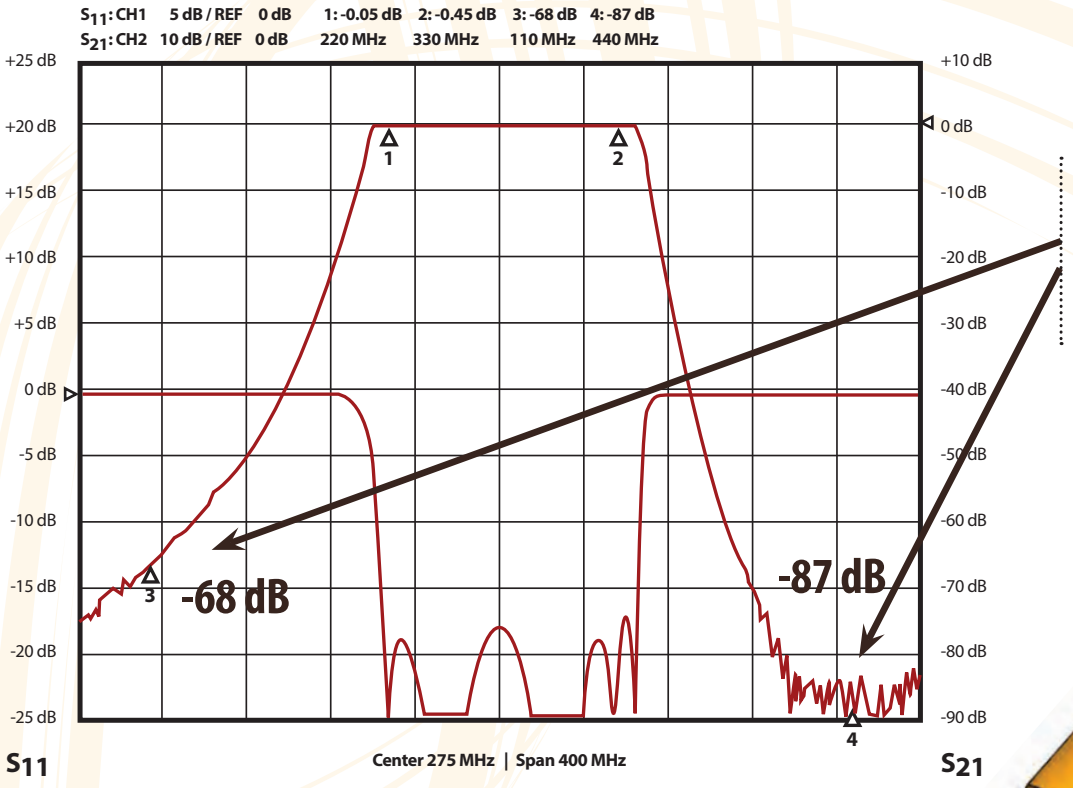
Unique resonator designs reduce overall size and increase peak power handling. Using silver plating on our resonators and internal cavity surfaces reduces loss and offers higher Q than other less expensive plating methods. The unique low dielectric constant stabilizing structure helps to diminish overall sensitivity to shock and vibration.

Innovation

Known for their high unloaded Q, API tubular filters have inherently broad stopbands with very high rejection levels. With low recorded insertion loss performance of less than 0.1 dB, our tubular filters consist of a series of semi-lumped capacitively coupled lowpass sections, using low loss dielectric spacers. Providing both excellent harmonic suppression and rejection of out of band noise, these designs answer many quick turn-around time requirements as well as handling high power applications.

| Tubular/Coaxial |

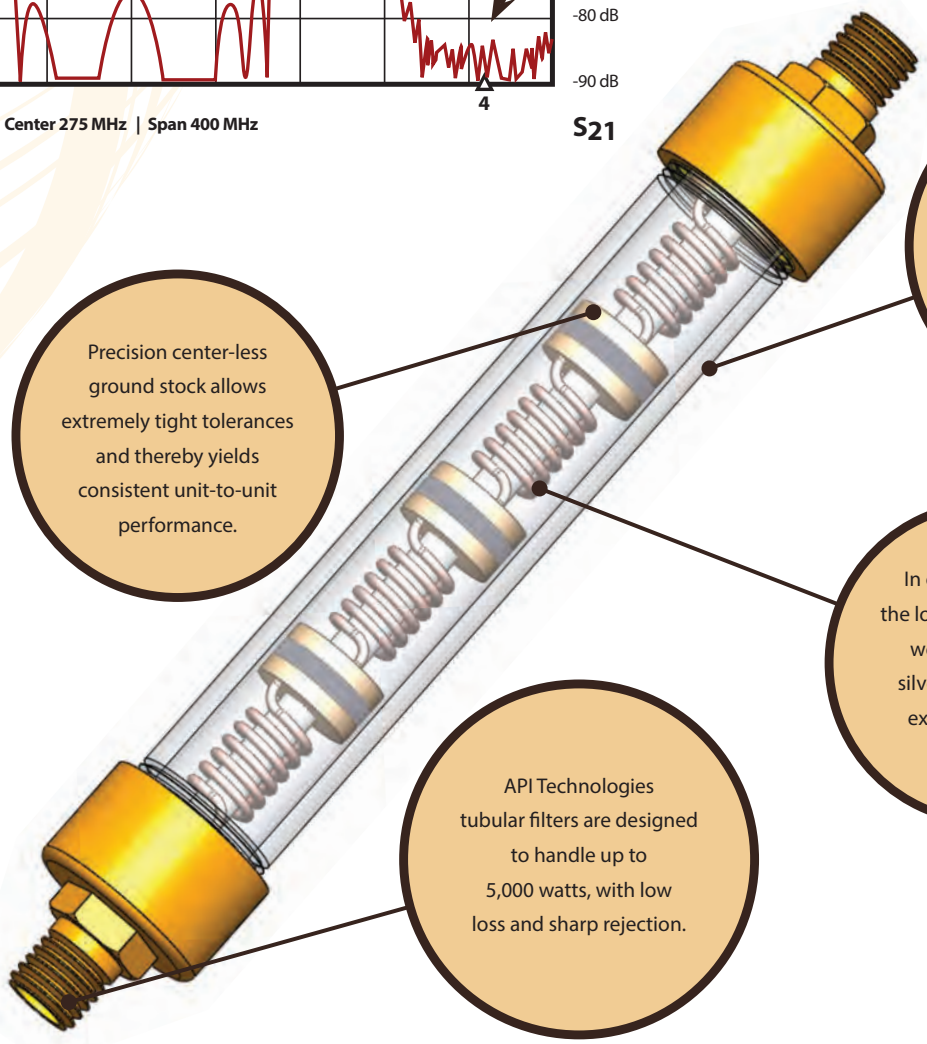
Tubular/Coaxial filters offer many advantages over other topologies for bandpass and lowpass filters. Because of the mechanical configuration, they offer very broad stopbands and very high rejection. Using capacitively coupled dielectric spacers, tubular filters are ideal for handling power levels up to 5,000 watts.



API Technologies designs offer the highest ultimate rejection possible, providing superior out of band attenuation

Key Features

Looking at the cutaway view of a tubular filter shows several of the features that API Technlogies engineers into each and every design.



Precision center-less ground stock allows extremely tight tolerances and thereby yields consistent unit-to-unit performance.

We use a combination of low loss dielectric materials and high precision surface finishes to handle higher power requirements

In order to achieve the lowest loss possible, we choose to use silver plating during extreme Low Loss applications.

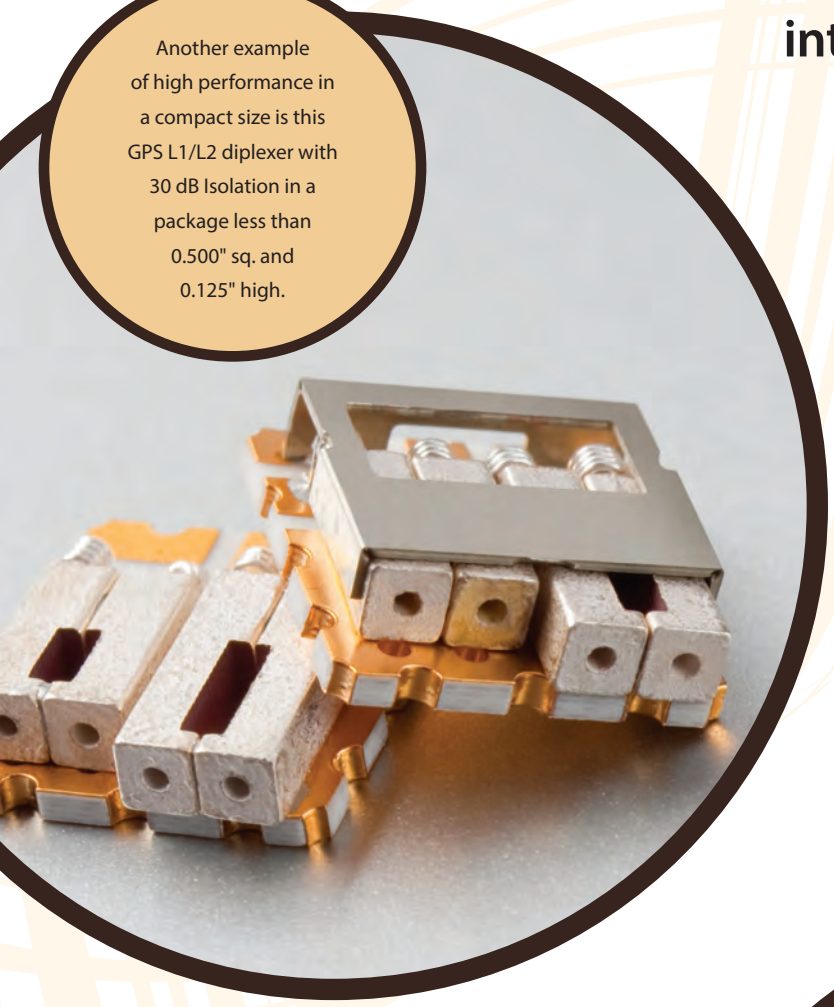
API Technologies tubular filters are designed to handle up to 5,000 watts, with low loss and sharp rejection.

Ceramic Filters

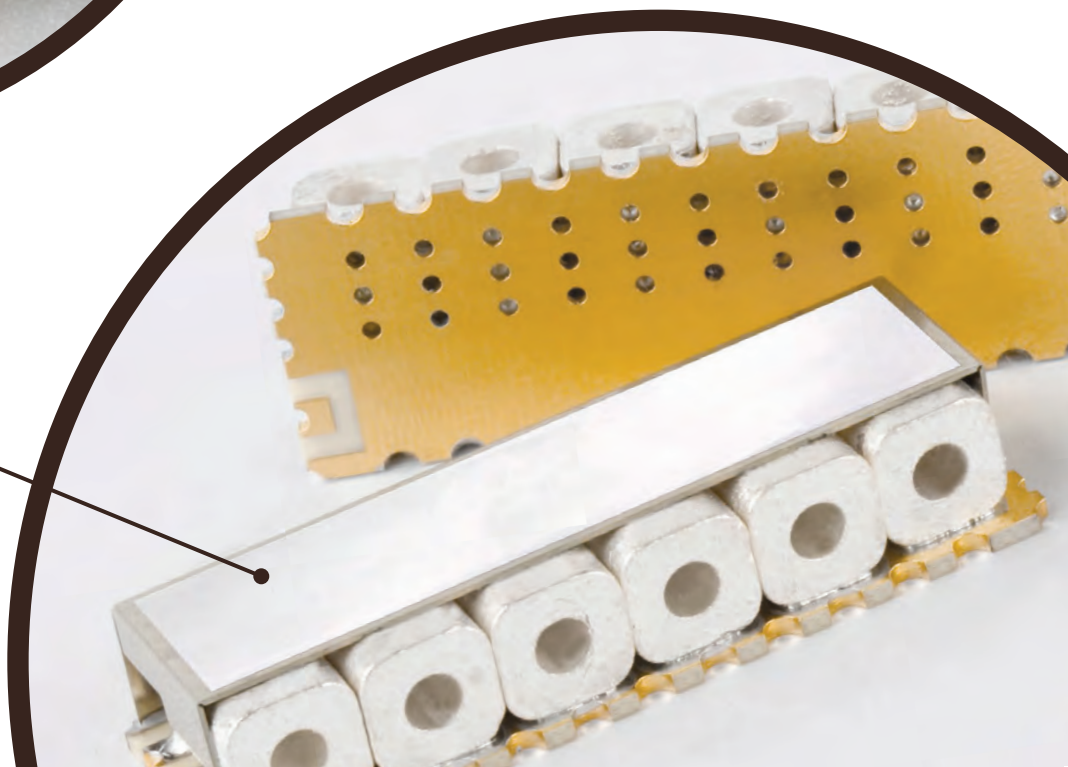
Affordability without quality is never good business, which is why we follow strict ISO9001:2000 controlled guidelines when manufacturing our ceramic filters. Quality is a mainstay in our ceramic filter lineup. Quality, coupled with aggressive pricing guarantees API Technologies customers receive a filter that is both affordable and superior to products from other filter providers.

Quality that is designed into each ceramic filter includes:

- Gold plating on surface mount packages offers better solderability and corrosion resistance than other finishes.
- Alternative coupling structures offers design flexibility and superior performance. Capacitive coupling arrays also offer enhanced reliability and repeatability.
- For size critical applications, we design in ceramic resonators as small as 2 mm (0.0787").
- When needed, we use lead-free solders (such as SN96 and SAC305) to comply with strict RoHS standards.
- For added protection and reliability, we laser seal select designs using our in-house sealing equipment



Another example of high performance in a compact size is this GPS L1/L2 diplexer with 30 dB Isolation in a package less than 0.500" sq. and 0.125" high.



High complexity ceramic filters, like this 6 pole 2100 MHz design with a 45/0.5 dB shape factor of less than 3:1, are examples of the exceptional performance available.

Engineering Solutions

API Technologies designers are experts in the application of multiple topologies and when needed mix topologies in a single unit. Below is an example of a 4-pole ceramic filter with an integrated Bias-T to power an active circuit further down the line.

| Advanced SAW Filters |

API Technologies continues to provide cutting edge SAW technology for today's military and commercial markets. These filters, in frequencies from 20 MHz to 2600 MHz, offer many outstanding features including:

- ✓ Loss less than 2 dB
- ✓ Fractional bandwidths from 0.04 to 60%
- ✓ Shape factors below 1.10:1
- ✓ Hermetically sealed packages

100% Testing

API Technologies performs 100% on-wafer probe testing for every SAW die. This extra step provides superior yield rates and eliminates time wasting rework effort.

100% Pre-Aging

We ensure that 100% of our SAW filters are pre-aged at 100°C. This stabilization step to lock in the center frequency is critical, assuring you that your filter is locked to within 0.0005%.

For more information please call us at

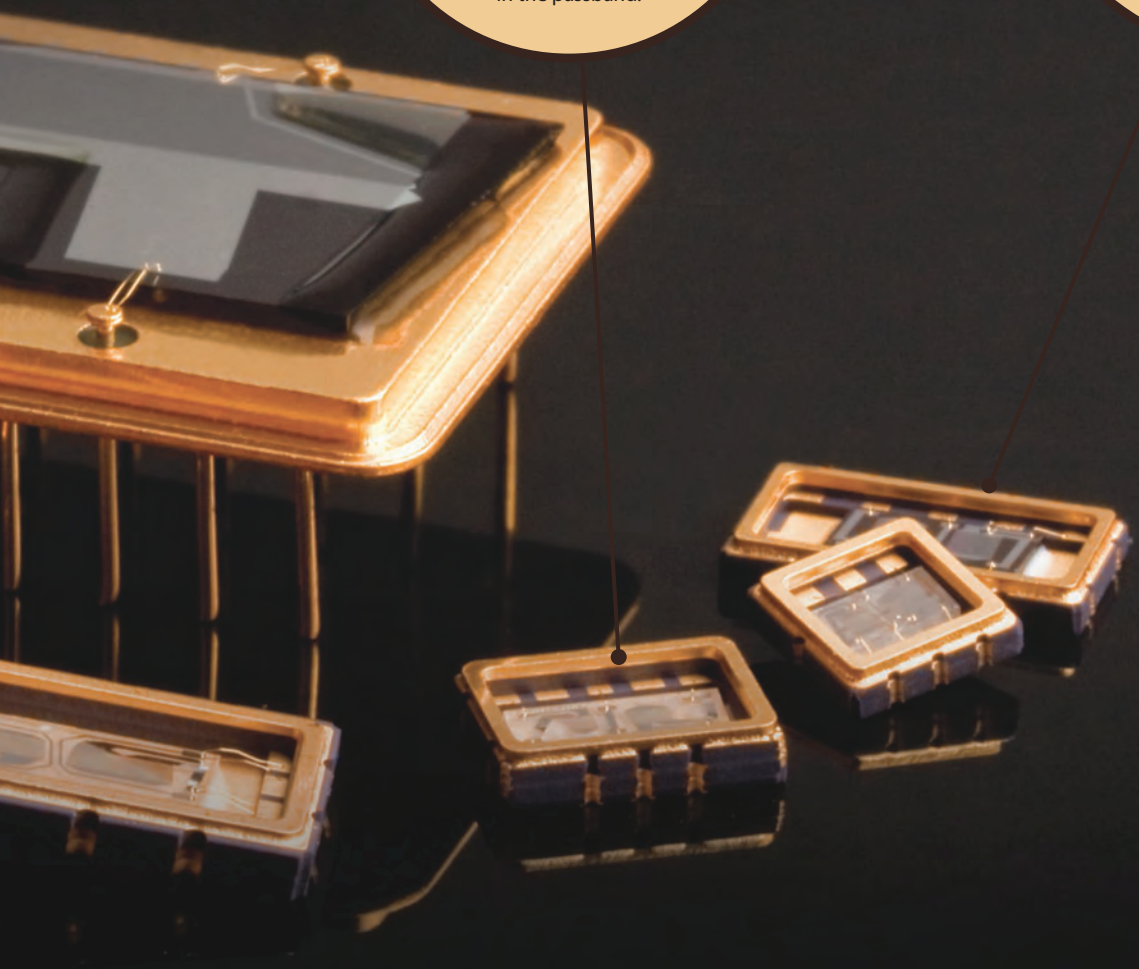
888.553.7531

Precision Bonding

In addition to using Gold wires on all ball bonds, API incorporates a silicon based thermo-set resin, which further dampens stray acoustic energy and reduces signal distortion in the passband.

Hermetic Sealing

API Technologies' inventory of sealing alternatives includes seam sealing which provides a very reliable hermetic seal, while maintaining a stable environment for the package and its sensitive contents. Hermetic seam sealing also maintains environmental integrity to pass the rigors of MIL-STD-883 Method 1014 Conditions A & C for both gross and fine leak detection.



Superior Group Delay Performance

Ultra-Flat Group Delay is a critical step in eliminating linear distortion, a leading cause of interference to digitally modulated signals. Our proprietary design technologies provide superior Group Delay Performance of as low as 8 ns part to part.

Meeting The Challenge

The broad bandwidth requirement of this diplexer, forced engineers to think outside the box.

Since the PCB had to provide a broadband match, they cleverly contoured the PCB resulting in enhanced matching over the broad bandwidth.

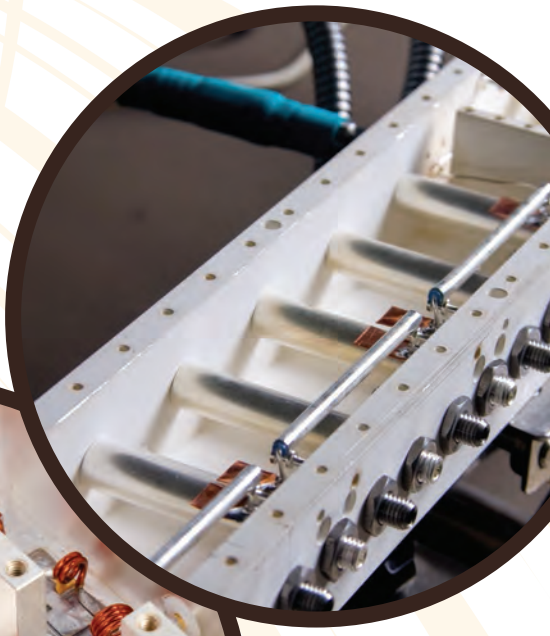
Solutions like these are why API Technologies is the obvious choice for complex diplexer designs.

Diplexers

One more way our engineers separate themselves from other designers is in how they engineer solutions, not parts. Drawing from their expertise in a wide range of topologies, API is the obvious choice for leading edge diplexer solutions. This application required the rejection of two high power tones.

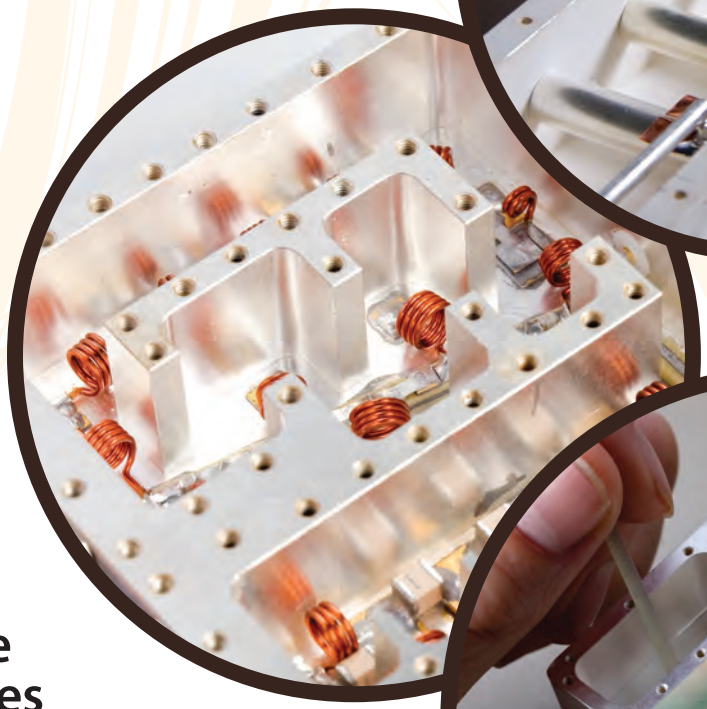
Custom Housings

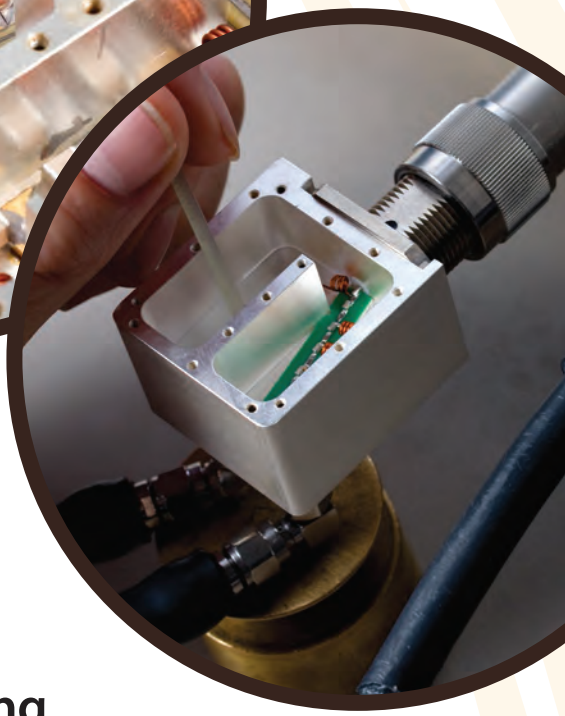
A customer requested a diplexer with very low insertion loss, extremely high rejection and the housing had to fit a narrow opening. API engineers responded with a diplexer incorporating unconventional cross coupling which exceeded the customer's requirements.

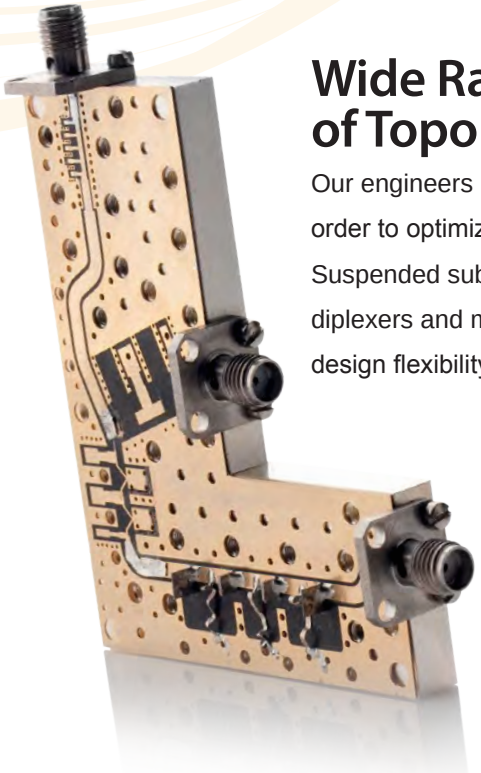


Innovative Designs

This high power, notch diplexer is another example of API Technologies delivering customer specific solutions. This customer needed to reject two high power tones, so our engineers designed a pole-placed, highpass-lowpass notch diplexer providing just the right amount of rejection without suffering increased loss on either side of the passband.







Wide Range of Topologies

Our engineers look at all topologies in order to optimize… and not compromise. Suspended substrate is ideal for broadband diplexers and multiplexers offering superior design flexibility and low loss.

Novel Packaging

Because of our customer's preexisting interface conditions, the output ports of this diplexer had to exit the bottom of the housing. Our engineers designed the diplexed output connectors to exit the bottom of the housing, matching up to the customer's connectors.

Suited for Integrated Topologies

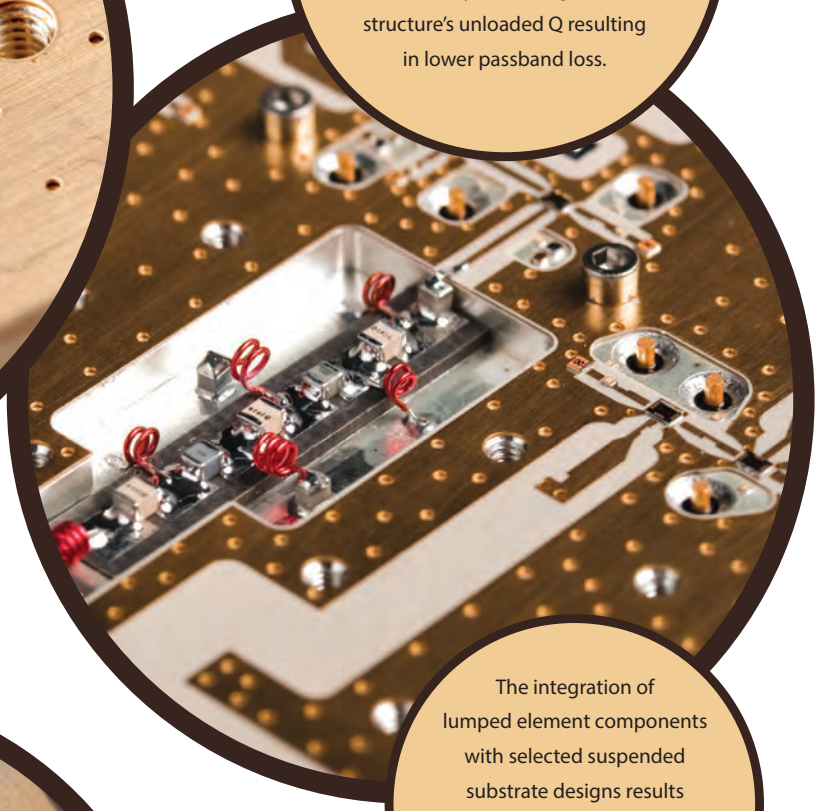
Our engineers select Cauer, pole-placed transfer functions in many of their suspended substrate designs, resulting in highly selective, low insertion loss devices. In addition, the compact structure and the flexibility of the printed circuit technology make suspended substrate designs particularly well suited for integrated topologies.

Suspended Substrate

Realizing complex transfer functions requiring multiple filter topologies in a single package is an option few filter companies can offer. Our engineers are experts in multiple topology suspended substrate designs. Combining both lumped and distributed elements onto one suspended substrate board, provides enhanced unloaded Q and exceptionally low insertion loss in one design.

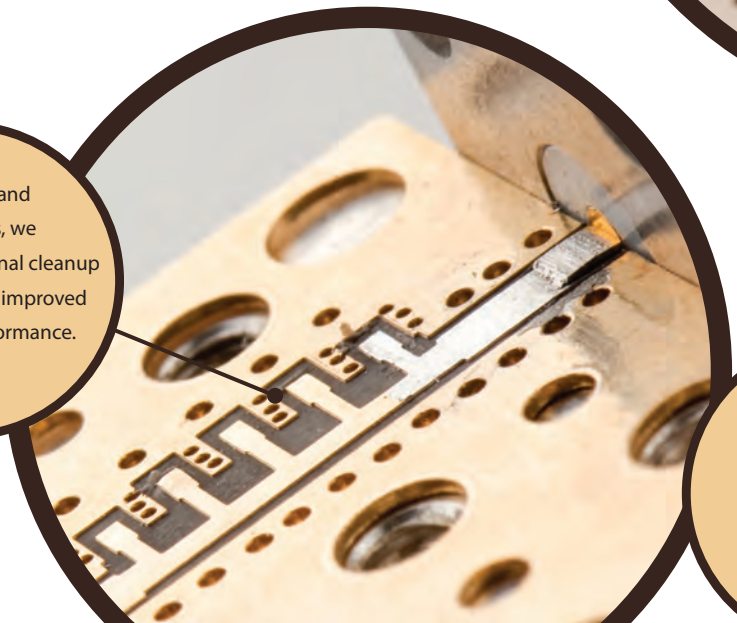
Gold vias provide improved grounding for superior isolation.

One additional benefit of a suspended substrate topology over stripline is the removal of much of the surrounding dielectric material, thereby increasing the structure's unloaded Q resulting in lower passband loss.



The integration of lumped element components with selected suspended substrate designs results in smaller package sizes and better performance than using any single topology.

For broadband applications, we often place additional cleanup lowpass filters for improved broadband performance.



The partial removal of dielectric material allows the realization of higher impedances resulting in wider stopbands.

Waveguides

API Technologies designs and manufactures waveguide filters to 40 GHz with peak power level handling of up to 50 kW. The TE10 mode, the dominant mode in rectangular waveguides, is utilized in most of our designs. Some of the features offered in API Technologies' waveguide filters include extremely low loss and high power handling.

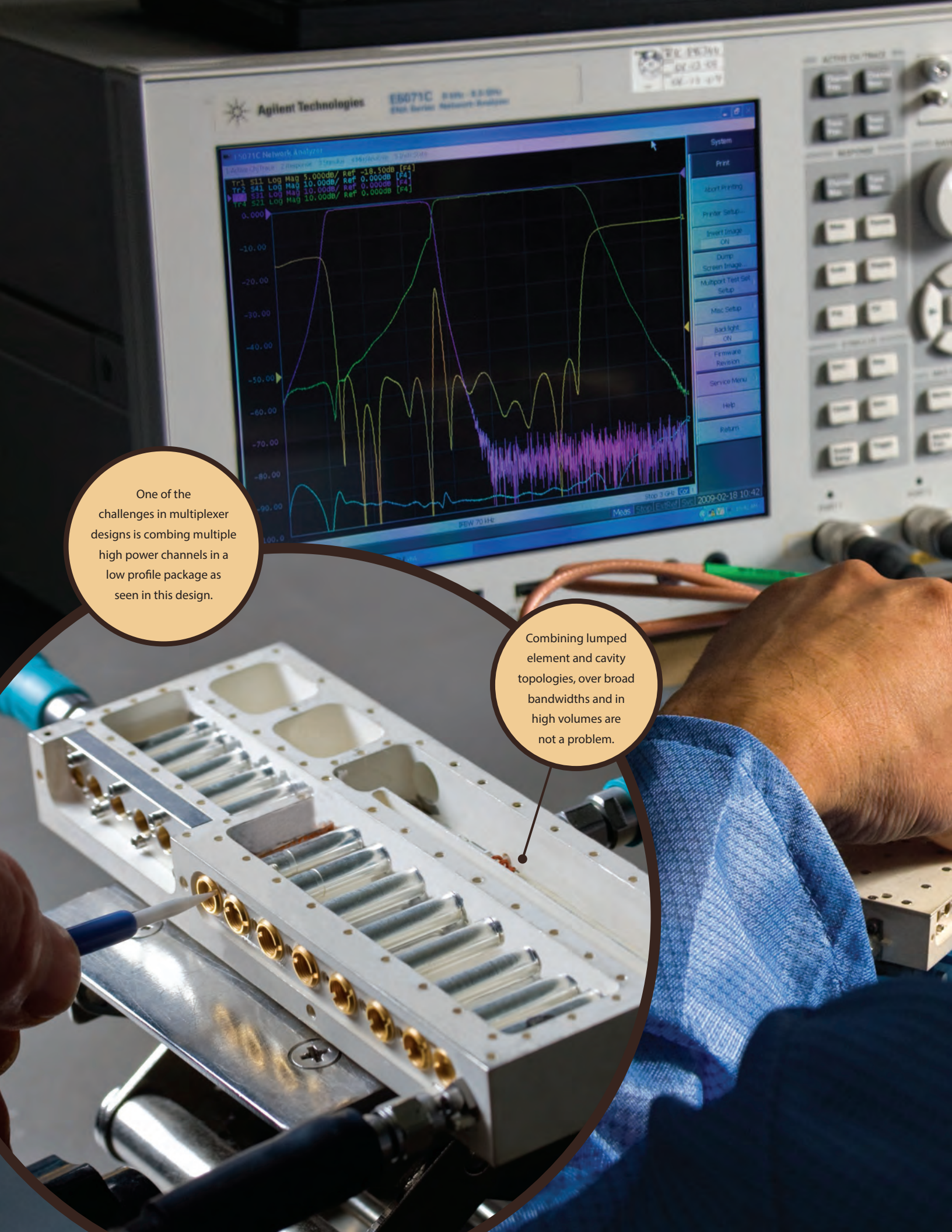
Product Features:

- We offer higher power handling diplexers through the use of integral heat dissipation methods.
- To achieve high isolation in TX/RX applications, we can utilize high order waveguide designs.

Invar is a material option when enhanced temperature stability is required.

Eliminating expensive adaptors, we offer SMA, TNC and Type N connectors when coaxial interfaces are specified.

For narrow bandwidth designs, API uses inductive irises to control coupling between cavities.


Agilent Technologies
E5071C
System
Print
Abort Printing
Printer Setup...
Invert Image
ON
Dump
Screen Image...
Multiport Test Set
Setup
Misc Setup
Back light
ON
Firmware
Revision
Service Menu
Help
Return
2009-02-18 10:42
One of the challenges in multiplexer designs is combing multiple high power channels in a low profile package as seen in this design.
Combining lumped element and cavity topologies, over broad bandwidths and in high volumes are not a problem.

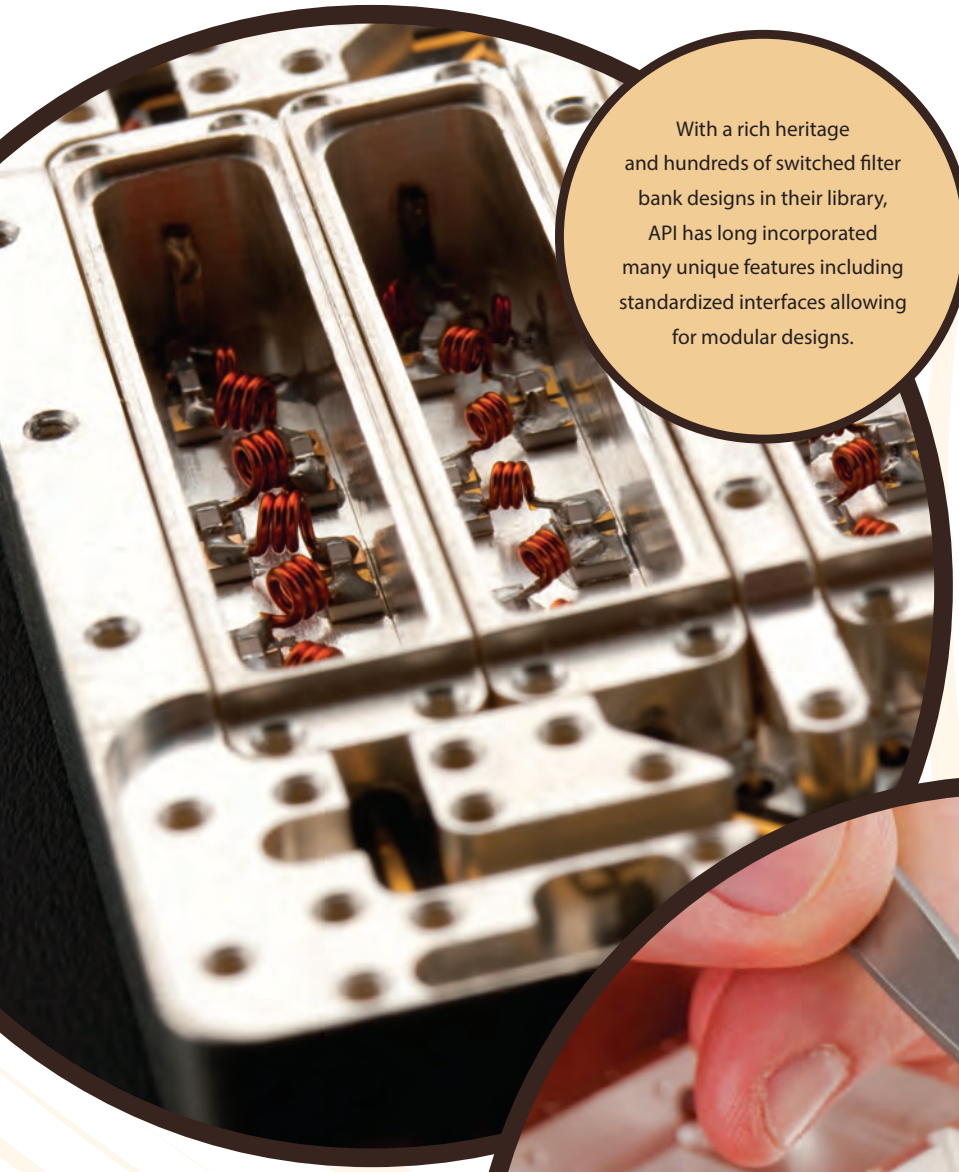
Complex Designs

Higher order filter designs, like our line of Triplexers, are engineered to surpass our customer's expectations each and every time. API Technologies achieves this level of performance through the use of modern techniques including:

- Multiple topologies can be integrated within a single package for broad frequency coverage
- Iris coupling to reduce unit size
- Cross Coupling to realize transmission zeros for better out-of-band rejection and lower loss
- Silver plating for lower loss
- Integrating lowpass filters into the same housing to improve broadband spurious performance

Filter Integration

Integral to optimizing a microwave assembly is selecting the correct components with complementary performance. API Technologies, known in the RF community for exceptional filter designs, also plays a leading role in filter based solutions and subsystems. From 16 channel Multiplexers, to amplified switched filter banks, we continue to provide enhanced filter solutions to major markets around the world.



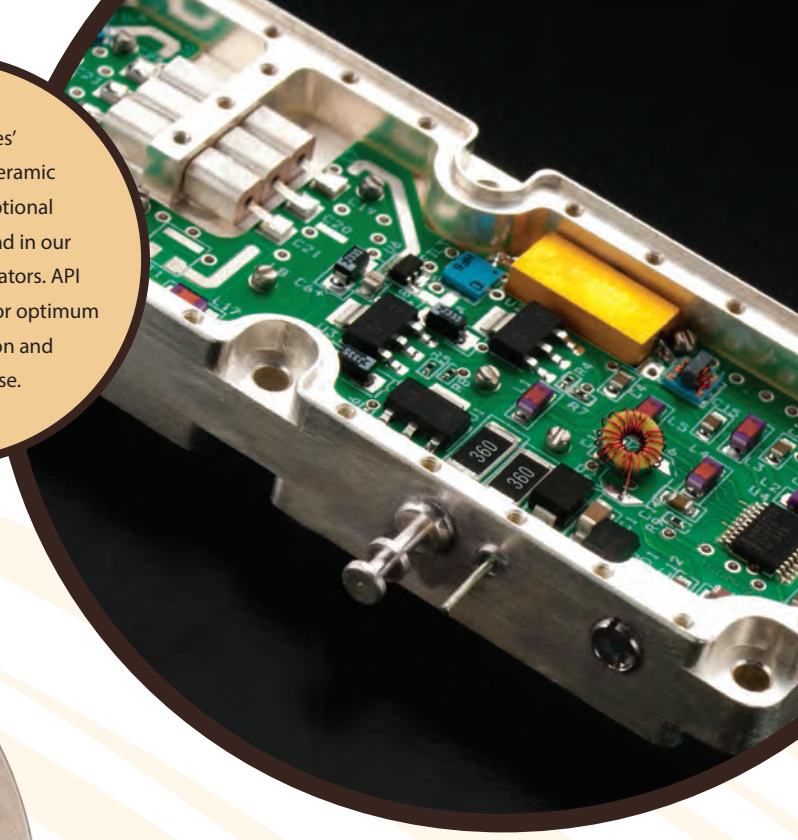
With a rich heritage and hundreds of switched filter bank designs in their library, API has long incorporated many unique features including standardized interfaces allowing for modular designs.

Better Systems Through Better Filters

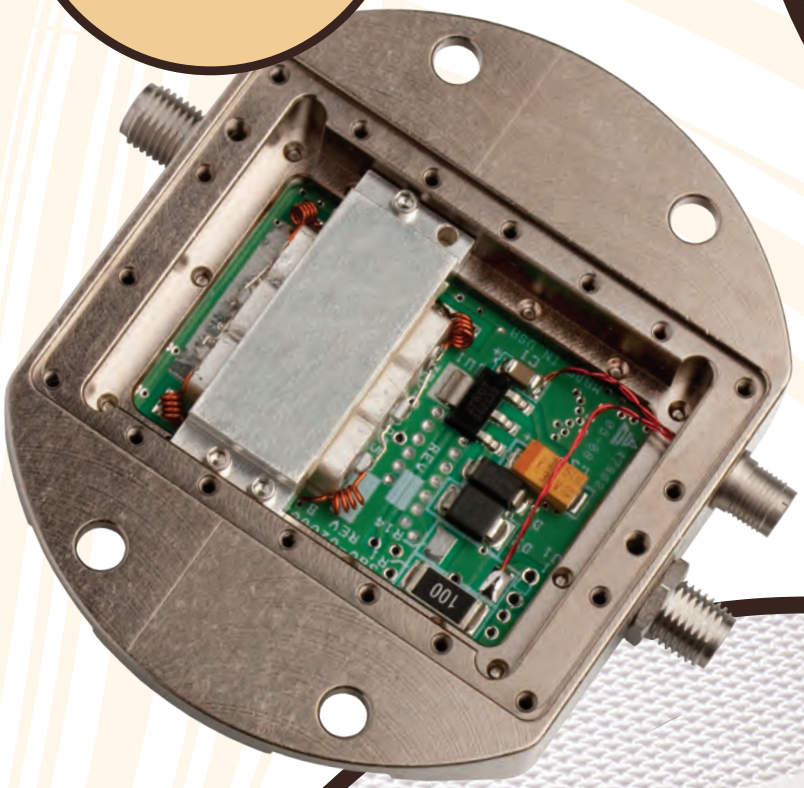
API integration engineers collaborate with their filter engineering co-workers in order to optimize complex designs. Using advanced modeling programs like ADS, SolidWorks, Ansoft, Genesys, and Sonnet EM Simulator, allows our talented core of engineers produce industry leading designs which exceed expectations.

Integrating both lumped element and cavity filters into API Technologies' line-up of downconverters allows very broadband operation in a small package with low in-band ripple.

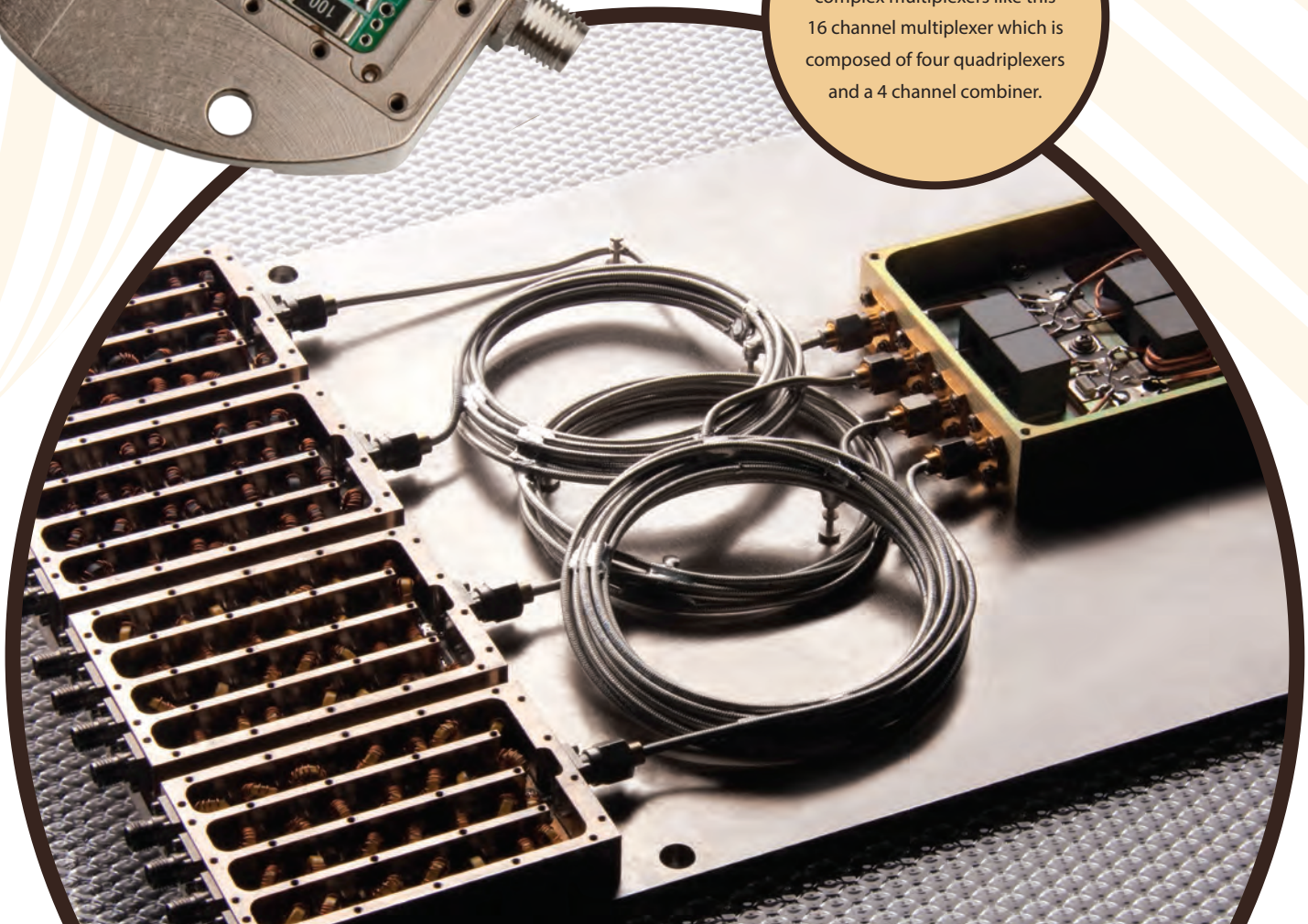
API Technologies' high performance ceramic filters provide exceptional spectral purity as found in our line of harmonic generators. API resonators are selected for optimum out-of-band rejection and spurious response.



Our full line of Filtered GPS Low Noise Amplifiers incorporates two 3-pole API ceramic filters which reduce out-of-band interference while achieving high dynamic range



Beyond simple diplexers and triplexers, we also design complex multiplexers like this 16 channel multiplexer which is composed of four quadriplexers and a 4 channel combiner.

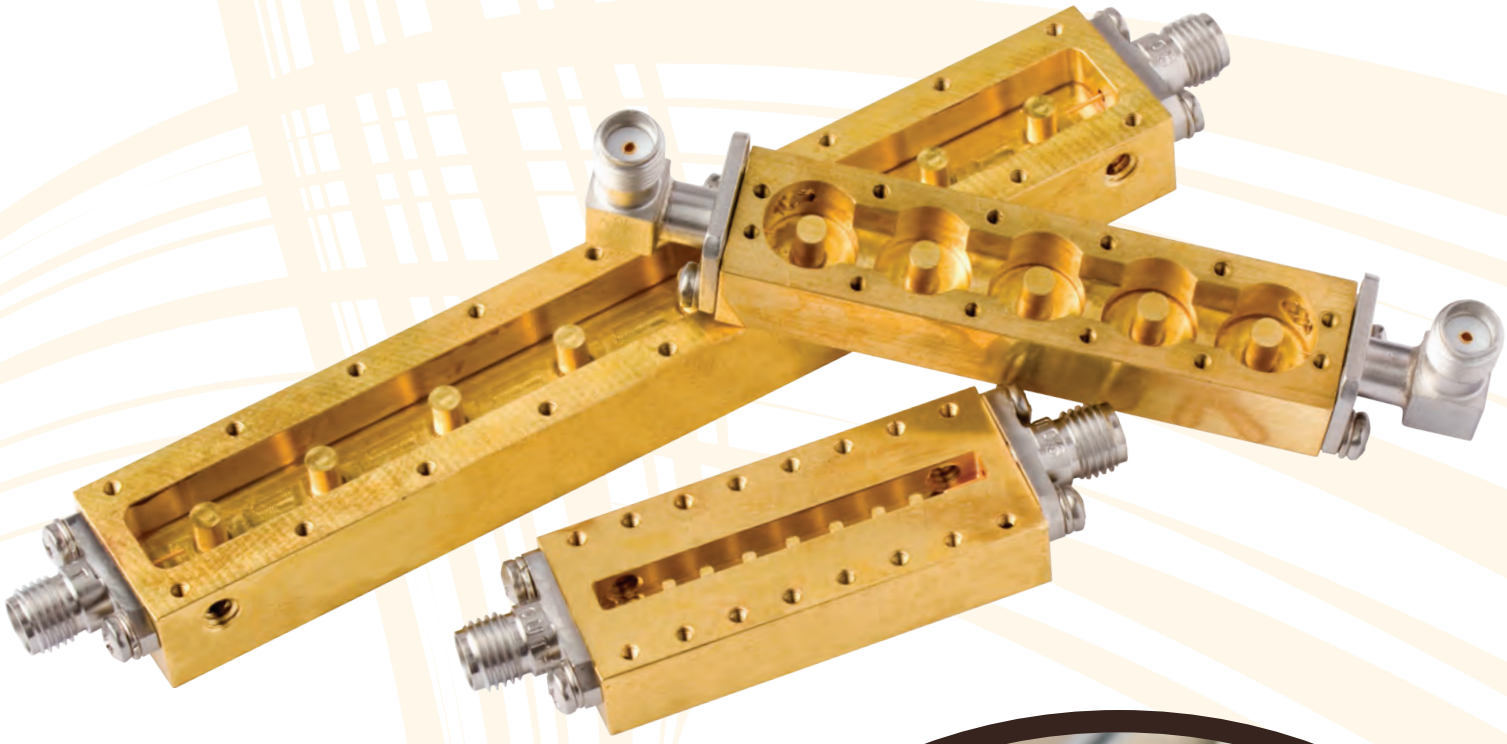


Speed Counts

Not every customer tolerates “industry standard” lead times for a custom filter. To address these needs API Technologies created 2 week Rapid Filter Centers. Each filter is specially designed to a unique set of customer specifications and manufactured in dedicated process cells.

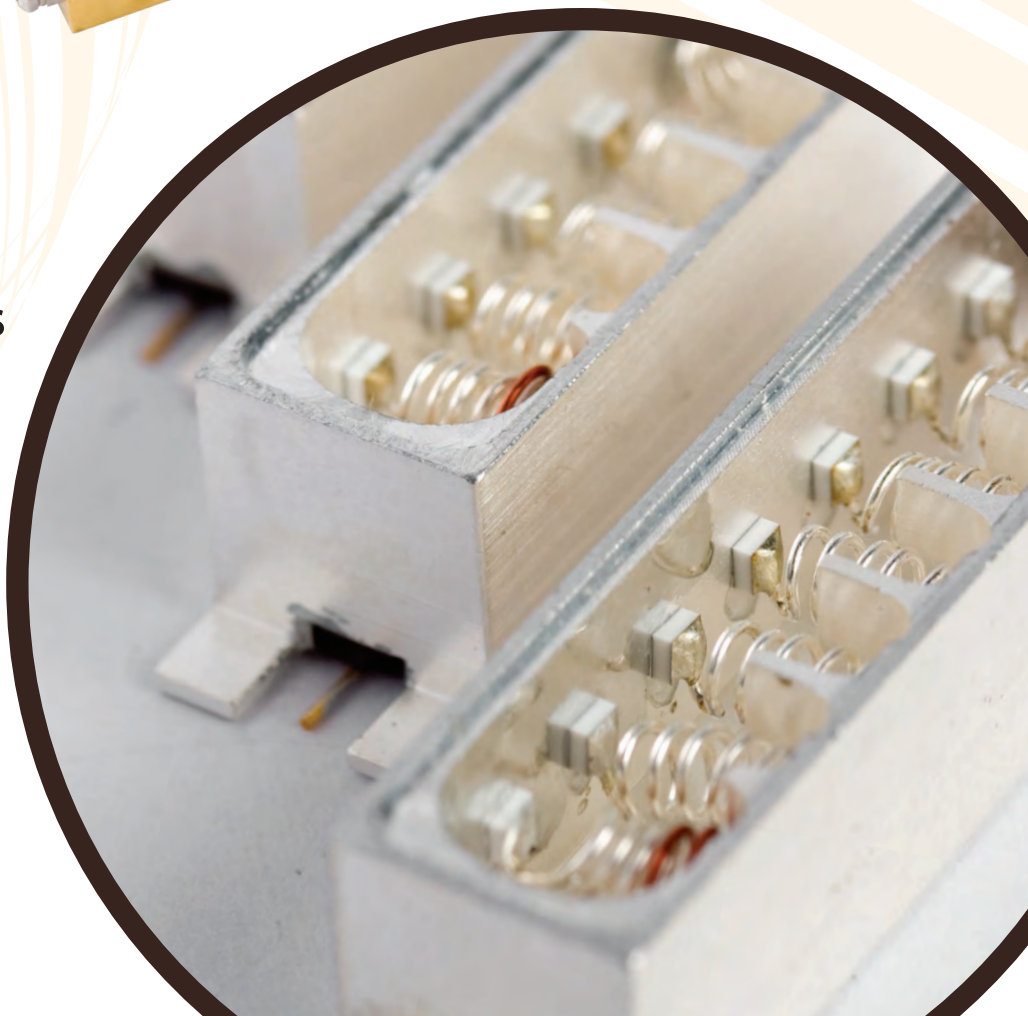
Rapid Filter Centers

API Technologies' rapid filter centers, offer bandpass, lowpass, and highpass filters in as little as two weeks. This innovative approach uses high level computer modeling and a state-of-the-art machine shop which is tied directly to the company's engineering lab.



API's rapid filter centers offer customized filter options, including:

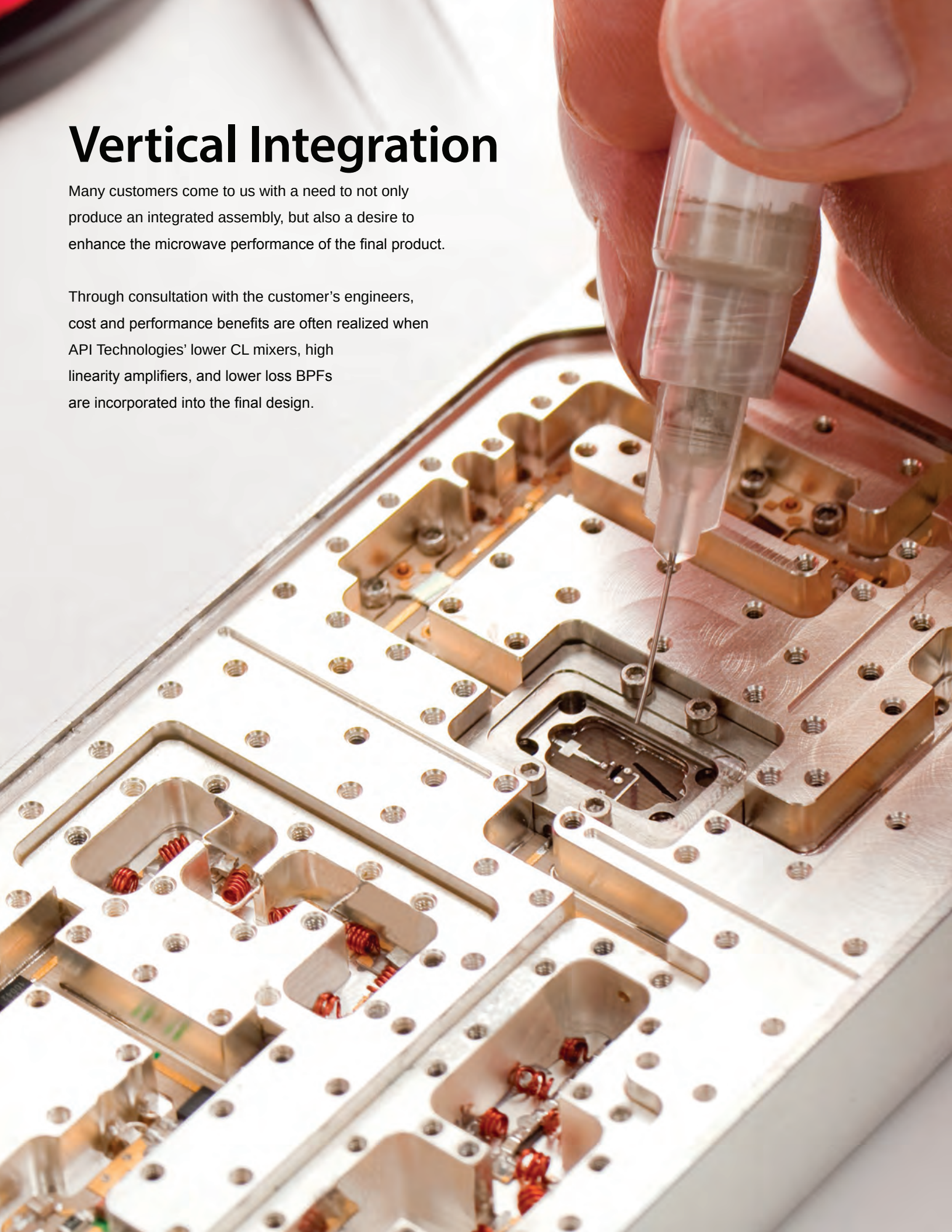
- Surface mount packages
- SMA connectorized packages
- PC through-hole Packages
- Complex designs up to 15th Order
- Pole Placed Designs
- Freq.'s up to 20 GHz
- Optional integrated Clean-up filters
- Chebyshev and Elliptic Functions



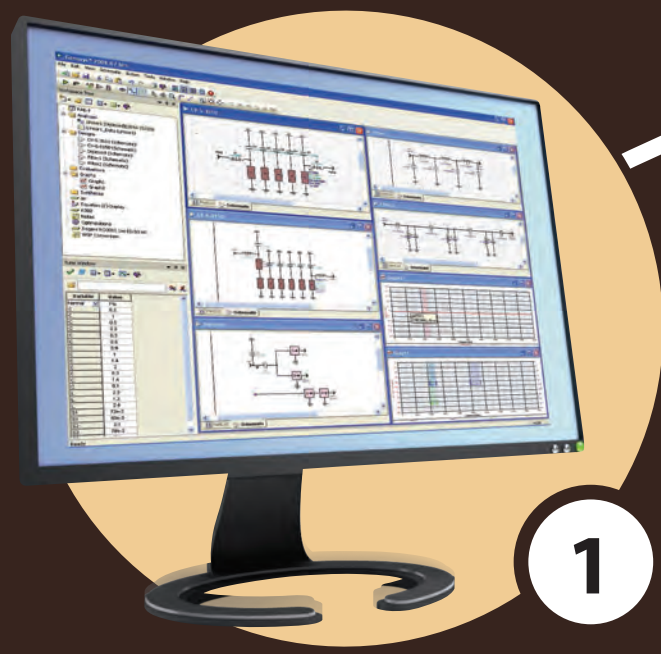
Vertical Integration

Many customers come to us with a need to not only produce an integrated assembly, but also a desire to enhance the microwave performance of the final product.

Through consultation with the customer's engineers, cost and performance benefits are often realized when API Technologies' lower CL mixers, high linearity amplifiers, and lower loss BPFs are incorporated into the final design.



RF & Microwave Filter
Design & Development Process



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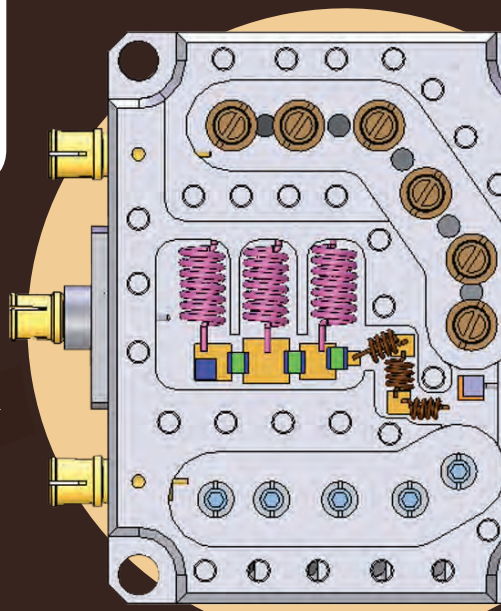


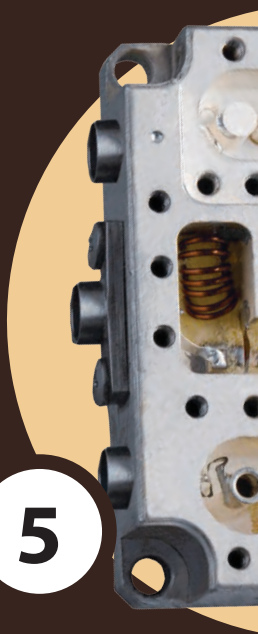
Design Optimization

Using the latest in modeling software technology to optimize filter designs, API Technologies is able to customize filter and multiplexer shapes to achieve maximum rejection at specific frequencies.

API engineers routinely simulate proposed designs, meeting the customer's specifications while optimizing performance, size and cost. State-of-the-art tools such as *Agilent ADS, Agilent Genesys, Cadence Allegro, Solid-Works, HFSS, AutoCAD, Sonnet Professional EM Simulator,* and our *FLIR thermal imaging system* help guide the design process.

Designed to Perform

Through the use of modern software, API Technologies engineers are able to accurately account for all thermal and environmental considerations. This includes linear and nonlinear parameters in both the frequency and time domains, guaranteeing the customer a filter which will perform flawlessly.



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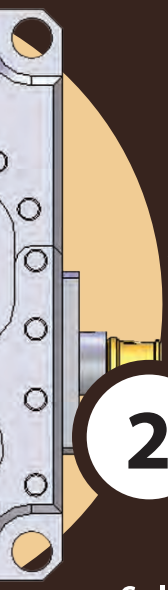

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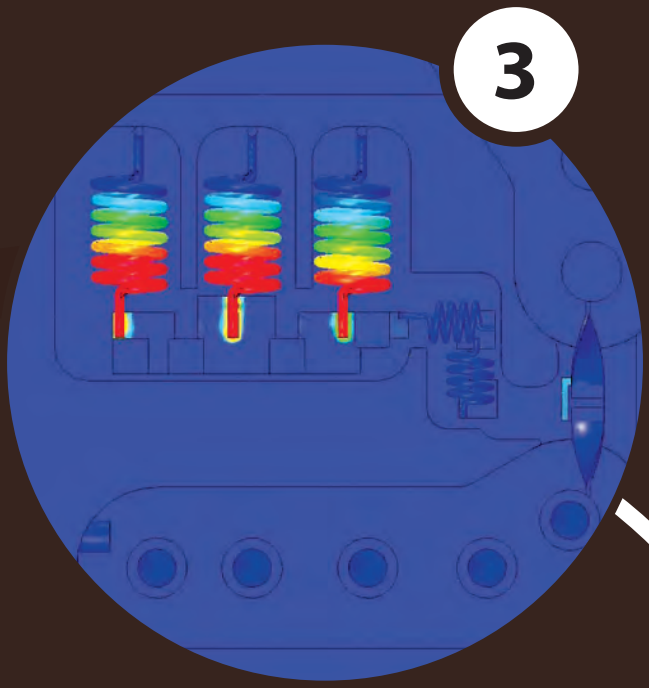
SolidWorks Simulations

Sophisticated 3D mechanical layout programs like SolidWorks help API engineers to arrange inductors, capacitors, and other filter elements to reduce overall package size.

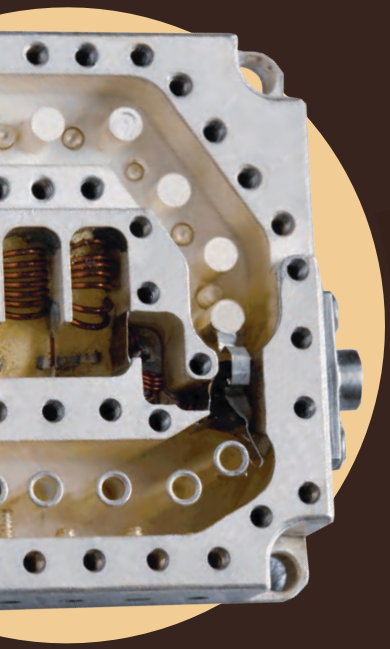


3

Thermal Analysis Software

API engineers routinely run thermal prediction algorithms through SolidWorks Simulation thermal analysis module. This insures the material selected matches the customer's temperature and power requirements.

4

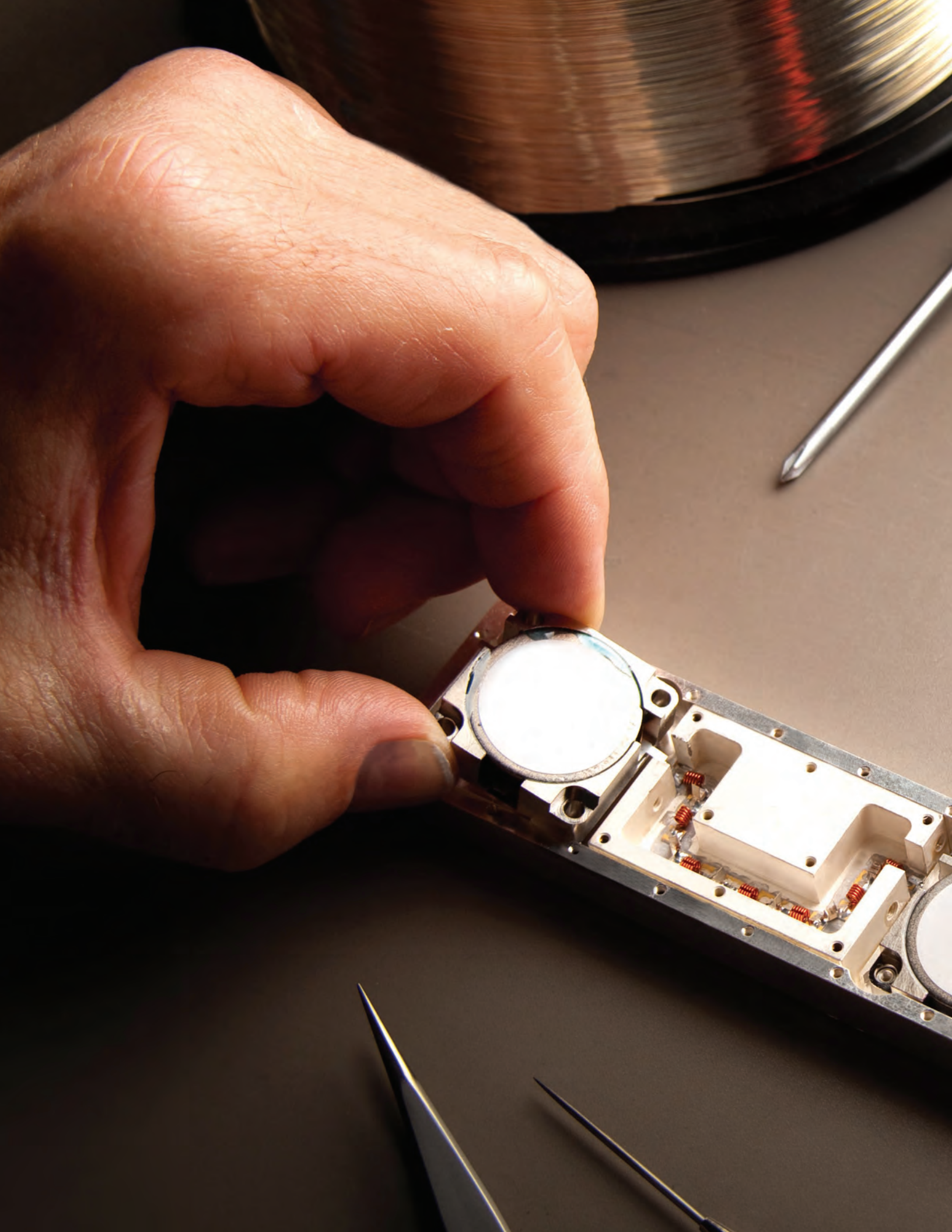


FLIR Thermography

API Technologies is one of the few filter manufacturers that verifies thermal predictions with its own thermography lab. This additional feature assures you that the filter's actual performance accurately follows both the designer's calculations and the software's predictions.

For more information please call us at

888.553.7531



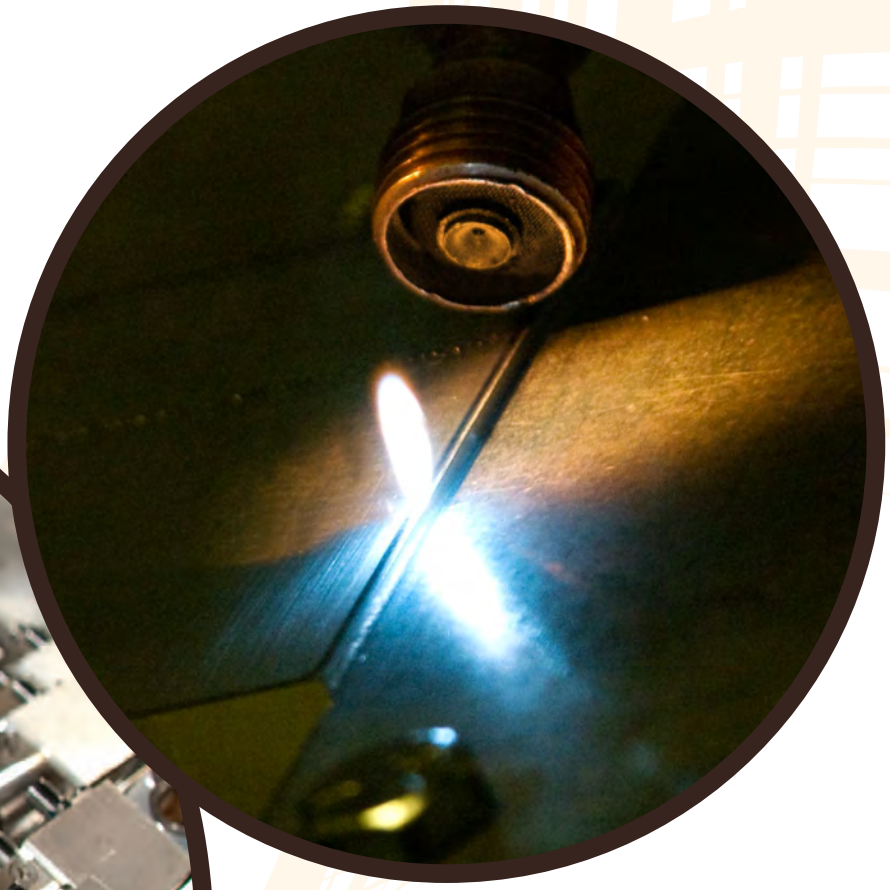
Adding Value

There are many filter companies competing for your business, but one stands out from all others. Adding value defines how API continues to be the leader in the microwave filter industry. This custom ISO filter illustrates this point by providing filtering in addition to broadband impedance matching.

| Environmentals |

High Temperature Burn-in

To ensure reliability, all API filters undergo high temperature, pre-conditioning stabilization bakes, and are then final tested on a 100% basis.



Automated Laser Sealing

API Technologies can provide laser sealed components to maintain hermeticity and environmental integrity.

Vibration Testing

On-site random and sinusoidal vibration to 30g, along with shock testing allow our engineers to validate their designs under extreme conditions.

Automated Reflow Process

We have developed many automated processes geared toward supporting high volume production. An example of this is our 5 zone reflow system which precisely controls temperature, speed, ramp up, dwell, and curing time to achieve consistent product quality.

Quality Assurance

API Technologies promotes an environment where all of our employees are encouraged to suggest product improvements and identify any imperfections. Our employees continually strive to exceed the goals placed before them, knowing that our success is directly related to the success of our customers.

Examples of the kinds of quality techniques that our design engineers build into every filter include:

- Spring loaded, self locking tuning bushings and rotors reducing the risk of metallic slivers which lead to premature failure in cavity designs.
- Annealing of all inductors to remove any metal stress memory for consistent and reliable inductor performance.
- Designs incorporating smooth angles and edges for superior plating adhesion and higher operating power.

Close Monitoring

We monitor critical phases of the production process with proprietary data logging technology.

World Class Quality

The efficiencies gained from our manufacturing procedures enable us to produce small volume custom products and high run requirements. We also monitor critical phases of the production process with automated SPC data measurement tools.

Preventing Problems

API utilizes the latest in systematic failure process controls including FMEA (Failure Mode & Effects Analysis) which is one of our primary risk mitigation tools and prevention strategies.

Ahead of the curve

Our key manufacturing facilities also incorporate strategic disciplined processes including APQP (Advanced Product Quality Planning) to ensure that a specific, structured sequence of operations are completed to prevent potential quality problems which would damage our reputation.

| Design Resources |

micro.apitech.com

API Technologies' website features complete information on all standard products with updated versions of more than 900 product datasheets. API's customers enjoy FREE engineering tools, tours, application notes, white papers, and the ability to create a custom designed product per individual specifications.

Cascade Design Suite

With over 750 datasheets on API Technologies' Amplifiers, Mixers, Oscillators & Control Products, this CD also offers the industry's best manufacturer's cross reference. The System Simulator lets you optimize your design by viewing an individual component's contribution to overall system performance. You can also quickly evaluate trade-offs in component selection and their impact on system performance (e.g. Gain, Noise, P1dB, IP3, Dynamic Range,.....)

api technologies corp.

API Technologies Corp. is a trusted provider of RF/microwave, microelectronics, and security solutions for critical and high-reliability applications. The company designs, develops and manufactures electronic components, modules, systems and products for technically demanding defense, commercial/industrial and aerospace applications. API Technologies' customers include many leading Fortune 500 companies, as well as a majority of NATO governments. While API was founded in 1981, our heritage brands have served the demanding, hi-rel marketplace for more than 60 years. API Technologies trades on the NASDAQ under the symbol ATNY.

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