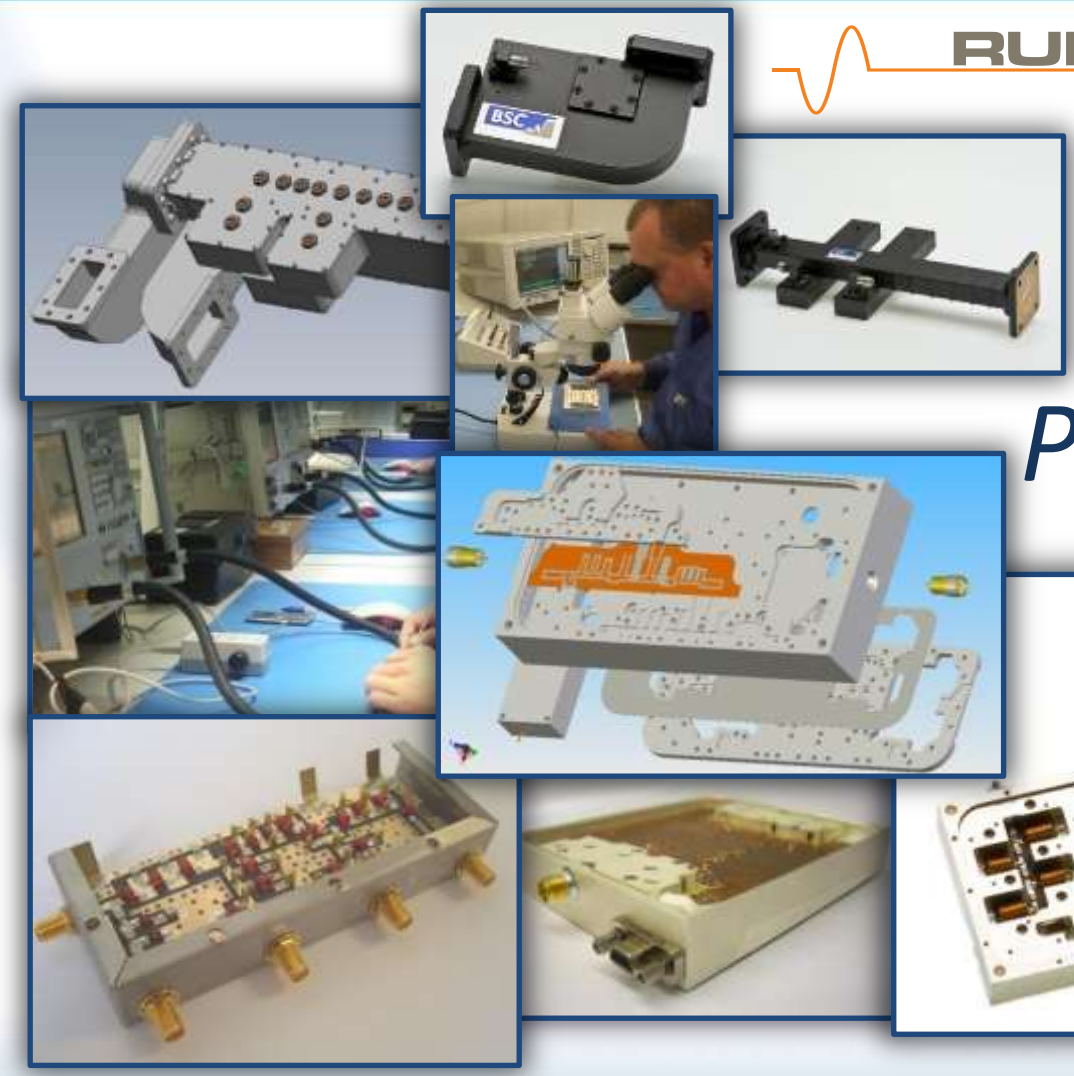
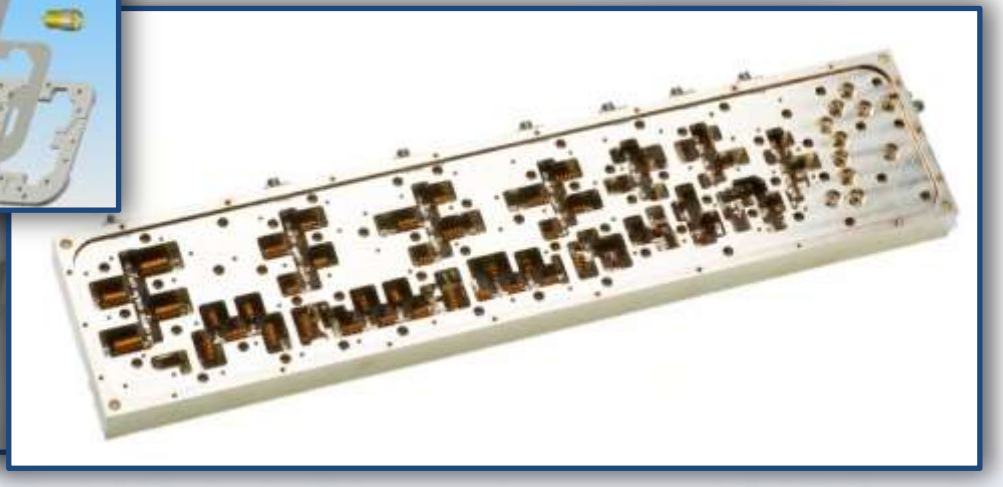
Introducing BSC Filters

RUPP tronik

BSC Filters
A DOVER COMPANY



Company and Product Overview



CERAMIC & MICROWAVE PRODUCTS
Electronic Components & Microwave Solutions
A DOVER COMPANY

BSC Filters · DowKey Microwave · NOVACAP · SYFER · DIELECTRIC LABORATORIES · K&L MICROWAVE · PALE ZERO · Voltronics

Dover House, York, UK

Located in the heart of the Pennines in Northern England, our fully integrated Design and Manufacturing facilities take the product from inception through design & simulation, manufacture, test, painting and finish.

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CERAMIC & MICROWAVE PRODUCTS
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Industry Sectors

BSC Filters have more than two decades' experience in RF design and manufacture across all industry sectors, and are specialists in Aerospace & Defence solutions.

Telecoms

WG Diplexers 7 to 38 GHz Backhaul Point-to-Point – Cavity Filters – Test Diplexers

Aerospace & Defence

Radar – SatComs – Radio Coms Sensing – EW – ECM – IED Jammers Fighters – UAV – Missile – Space

Commercial & Industrial

SatComs – Telematics – Radio Communications – SNG – Outside Broadcast

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Our Production Facilities

Our comprehensive manufacturing suite enables the design and production of right-first-time devices, and utilising BSC Exact Technology, we can even create tuning-free solutions above 90 GHz.

Workshop Capability

- *5 x CNC Mills*
- *2 x Semi-Automatic Mills*
- *CMM Inspection*
- *CNC PCB Mill*

Surface Treatment

- *Passivation*
- *Brightening*

Solder Assembly

- *Fully Automated Reflow*
- *Auto Solder Dispense*
- *Irons / Hotplates*
- *X-Ray*

Test, Alignment & Certification

- *Scalar Network Analysers*
- *Vector Network Analysers*
- *Dedicated Anti-Static Work Area*
- *Secure Test & Alignment Room*

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BSC Filter Technologies

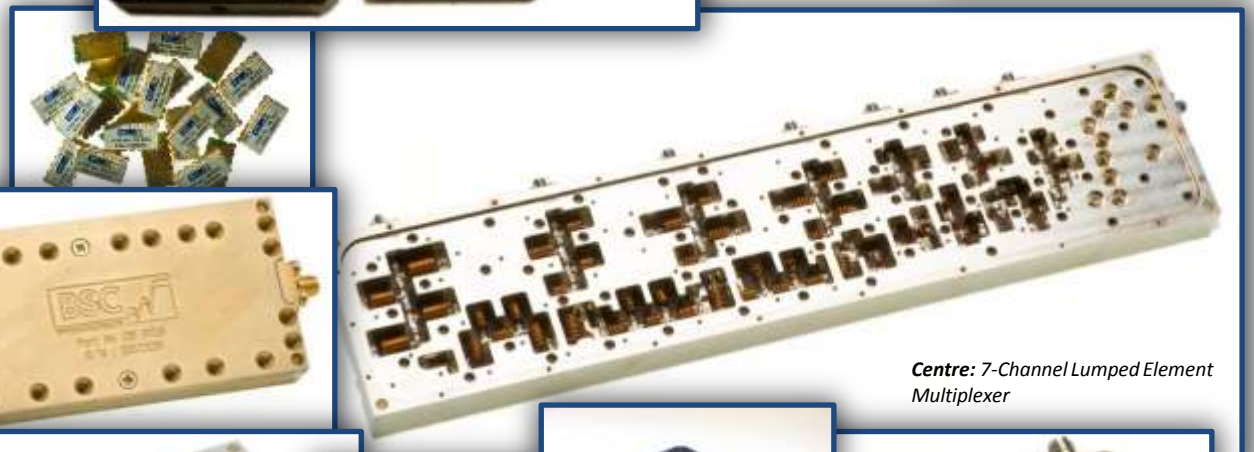
Our Engineering Team have far-reaching experience of RF filter technology design, with specialists in Waveguide, Cavity, Lumped Element and Suspended Substrate Stripline technologies. We currently have a catalogue of over 5000 manufactured devices, offering an enormous range of design precedent.

Below: *BSC-Patented Ultra-Short End Launch Transition (USELT).*

Right: *Suspended Substrate Equaliser.*

Filter Technologies:

- *Waveguide*
- *Lumped Element*
- *Suspended Substrate Stripline*
- *Base Station Cavity*
- *Combline*
- *Interdigital*
- *Tubular*
- *Ceramic*
- *Helical*



Centre: *7-Channel Lumped Element Multiplexer*

Filter Topologies:

- *Bandpass*
- *Notch*
- *Lowpass / Highpass*
- *Diplexers, Multiplexers & Power Splitters/Combiners*
- *Switched Filter Banks*
- *Equalizers*

Right: *Suspended Substrate Triplexer.*

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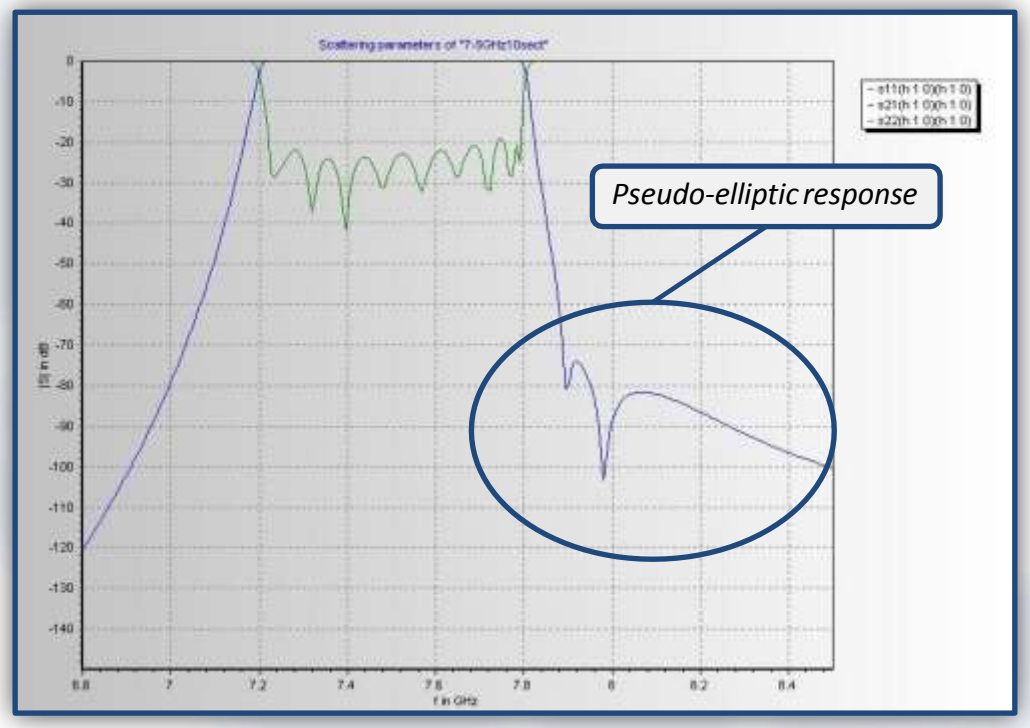
Technologies

		Lumped	Suspended	Helical	Combline	Cavity	Ceramic	Tubular	Cavity Notch	Interdigital	Waveguide
Freq GHz	Low	DC	DC	0.1	0.2	0.4	0.8	1	1	1	2
	High	3.5	50	1	14	3	4.5	14	12	33	100
Bandwidth	%	200%	181%	3%	60%	5%	20%	100%	5%	110%	30%
Unloaded Qu	Typical	200	500	600	2000	3500	600	600	800	2500	7000
Topology	Bandpass	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
	Notch / Bandstop	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes
	Diplexer	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
	Lowpass	Yes	Yes	No	No	No	No	Yes	No	No	Yes
	Highpass	Yes	Yes	No	No	No	No	No	No	No	Yes
	Muliplexer	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Size Comparison	1=Small	1	3	5	6	7	2	4	9	8	10
Power	1 to 10 (Best)	4	1	3	6	7	2	9	5	8	10
Cost (1=Low)		5	8	9	4	6	1	7	10	3	2

Pseudo-Elliptic Technology



Our team of specialised RF Design Engineers have a wealth of experience in using Pseudo-Elliptic Technology in waveguide devices.

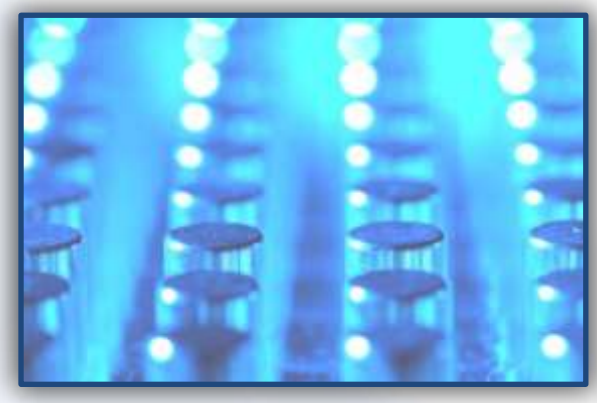
Using carefully-designed cavities, the Stopband Rejection performance and skirt gradient can be greatly increased, allowing up to 40% lower Insertion Loss in the Passband.

BSC can manufacture high-performance filters in a smaller space envelope when compared with traditional designs. This makes our pioneering Pseudo-Elliptic filters an ideal choice for the Aerospace Industry where weight and size are important.

Above: *A performance curve demonstrating Pseudo-Elliptic response.*
Below: *An ATC Radar filter with Pseudo-Elliptic cavities.*

Filter Examples

High Power Lowpass Structures



Left: *A Waffle Iron Lowpass Structure is ideal for high-power handling and low Insertion Loss.*

Below: *A typical WG10 (WR284) Waffle Iron Lowpass filter specification*

Passband:	From 2700 MHz to 2900 MHz (target 3100 MHz)
Passband Insertion Loss at Bandedges:	0.2 dB max
Passband Return Loss:	20 dB min
Rejection from 5400 MHz to 6200 MHz:	40 dB min
Rejection from 8100 MHz to 9300 MHz:	30 dB min
Peak Power:	70kW
Average Power:	1.7kW
Duty Ratio:	2.4%
Max Pulse Length:	100µs
Cooling:	Natural, convection and radiation
Output Match at Fundamental:	1.5:1 max
Output Match at 2nd and 3rd Harmonic:	Unknown
Source Match at Fundamental:	2:1 max
Source Match at 2nd and 3rd Harmonic:	Reflective
Altitude:	10000 feet max
Dimensions:	
Leak Rate at 3psi:	<50cc/min
Operating Pressure:	15psi absolute
Flanges:	Input: CPR284 DES 13 cover with ¼ UNC thro holes Output: CPR284 DES 13 cover with ¼ UNC thro holes
Material:	Aluminium
Operating Temperature Range:	-40°C to +50°C
External Paint Finish:	Matt Black

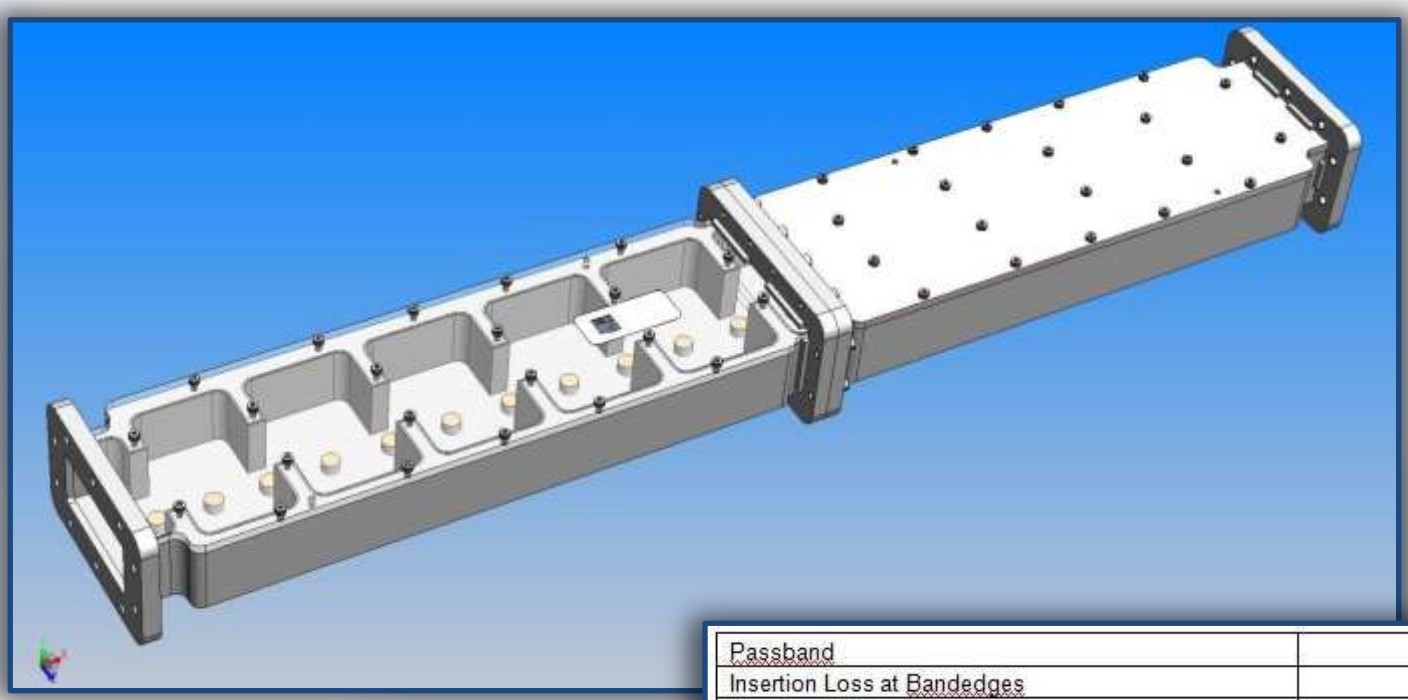
BSC Filters' waveguide design experience allows us to push the boundaries of performance in high power RADAR applications.

Our Waveguide Lowpass design precedent extends to applications involving:

- *70 kW+ Power Handling*
- *Insertion Loss as low as 0.06 dB*
- *Pressurised Systems*

Filter Examples *S-Band*

BSC Filters' design precedent and manufacturing expertise includes a wide range of UHF Band filters, from very small surface-mount devices, to large cavity and waveguide structures.



Left: *A Symmetrical-iris in-line Waveguide filter operating in the upper UHF band.*

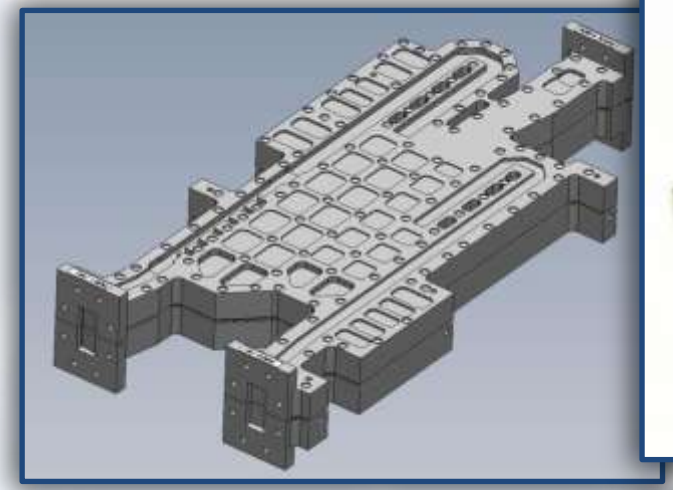
This structure and format lends itself well to high selectivity, low loss, and very high power handling.

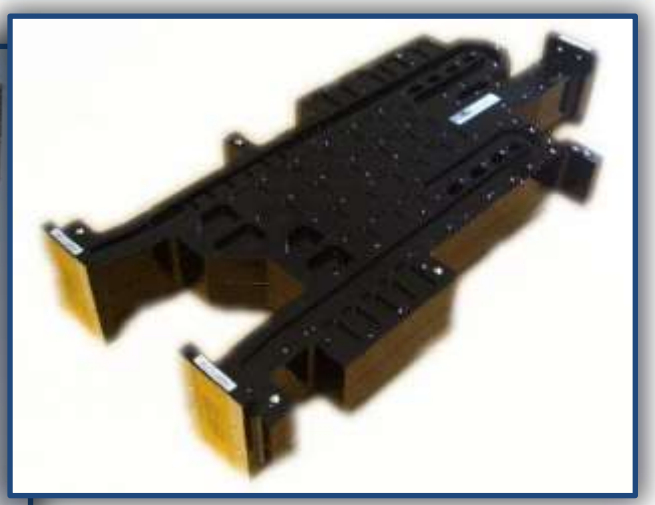
Radars are a common application, with pulses exceeding many tens of kilowatts in peak power.

Passband	From 2700MHz to 2800MHz
Insertion Loss at Bandedges	0.3 dB max; 0.2dB typical
Passband Return Loss	18dB min
Rejection from DC to 2645MHz	55dB min
Rejection from 2855MHz to 4000MHz	55dB min
Peak Power Handling Capability	3.2 kW min
Length	750mm typical
External Finish	Matt Black

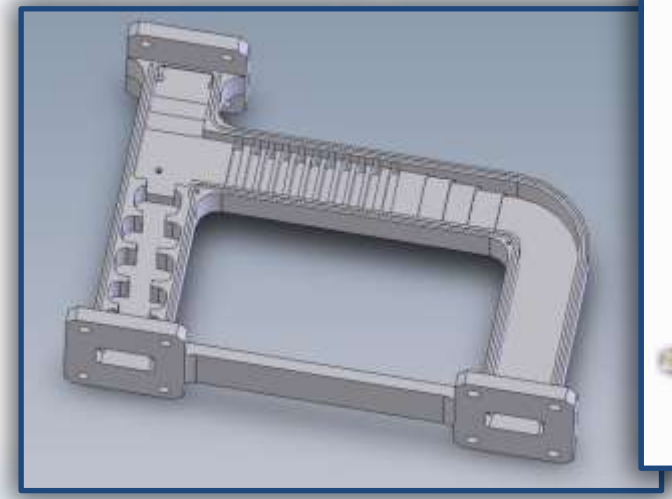
Right: *A typical Waveguide specification in the upper S-band, demonstrating low insertion loss and high selectivity.*

Filter Examples *C- and Ku-Band*





C-Band: *A quad-folded Diplexer in WG15 (WR112), joining Pseudo-Elliptic technology with a high-order filter combination to provide exceptional Stopband performance with near contiguous Passbands.*



Ku-Band: *A Lowpass/Bandpass Diplexer in WG17 (WR75) with integral flanges and support bracing. A repeatable, dependable format very popular with common Satcom applications.*

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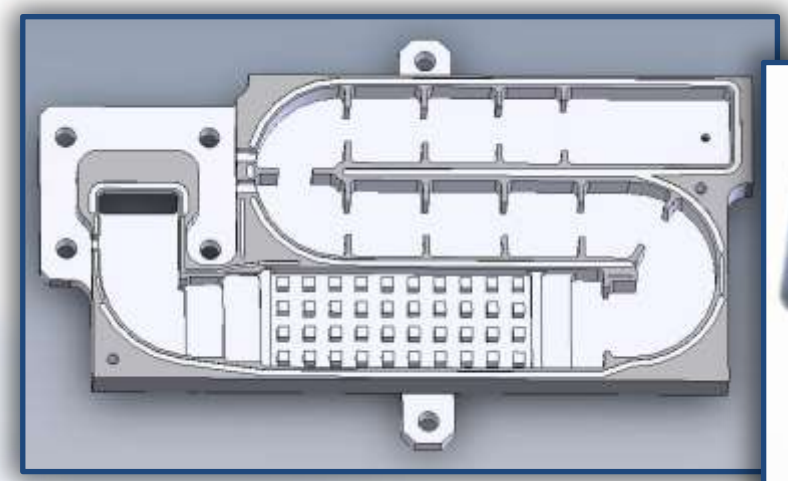
Filter Examples

K- and Ka-Band

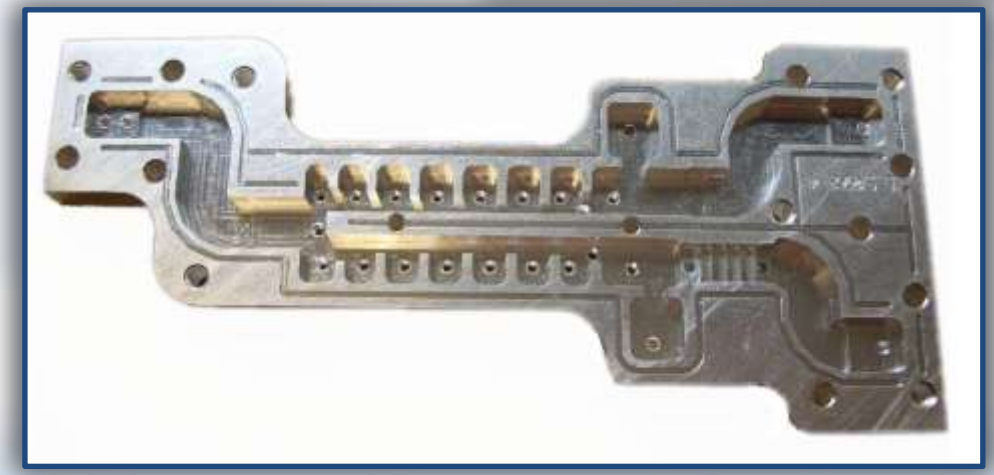
K-Band: *An airborne communications filter in WG20 (WR42) with Bandpass structure and integrated Waffle Iron Lowpass.*

Power handling and wide operating temperature were key features of this design.

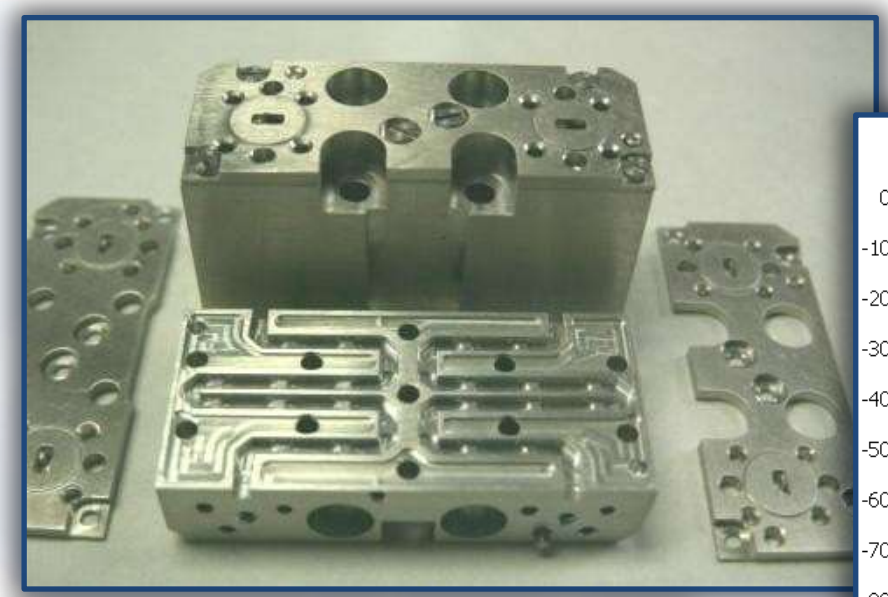


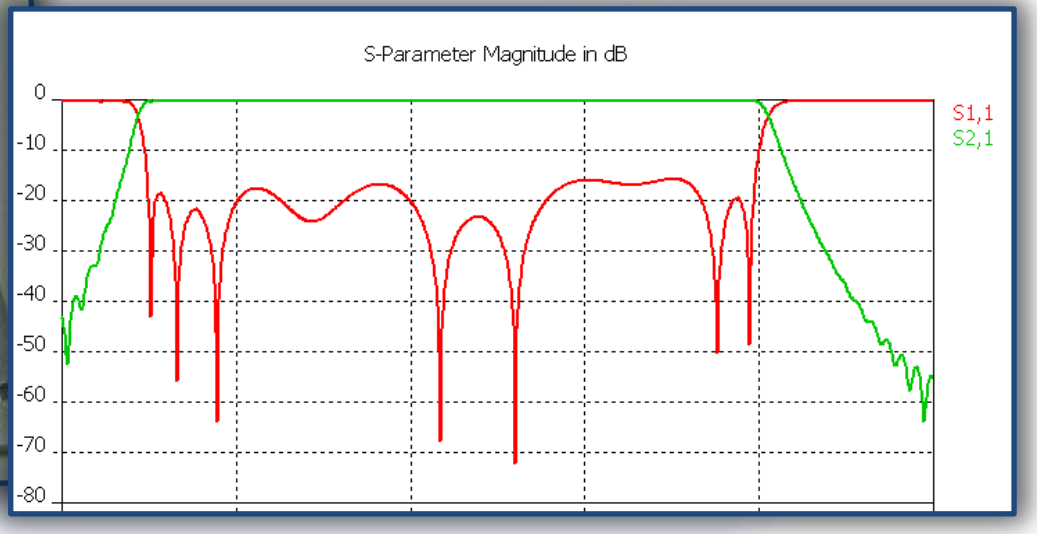
Ka-Band: *A Diplexer in WG22 (WR28). Low loss and small physical size was achieved by using Pseudo-Elliptic technology.*

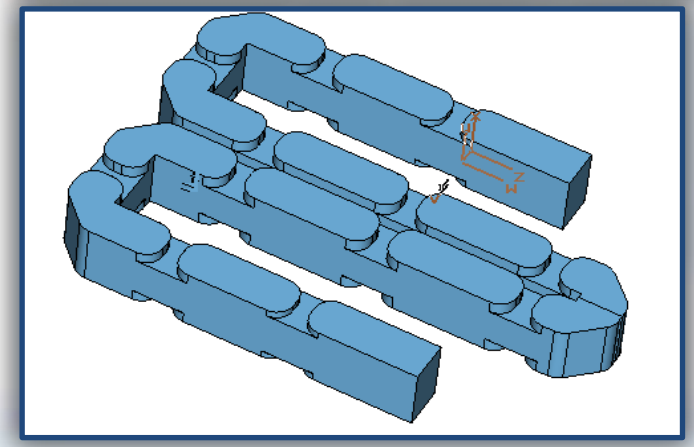
The lower arm incorporates a Lowpass structure to suppress transmitter harmonics.



Filter Examples *W-Band*





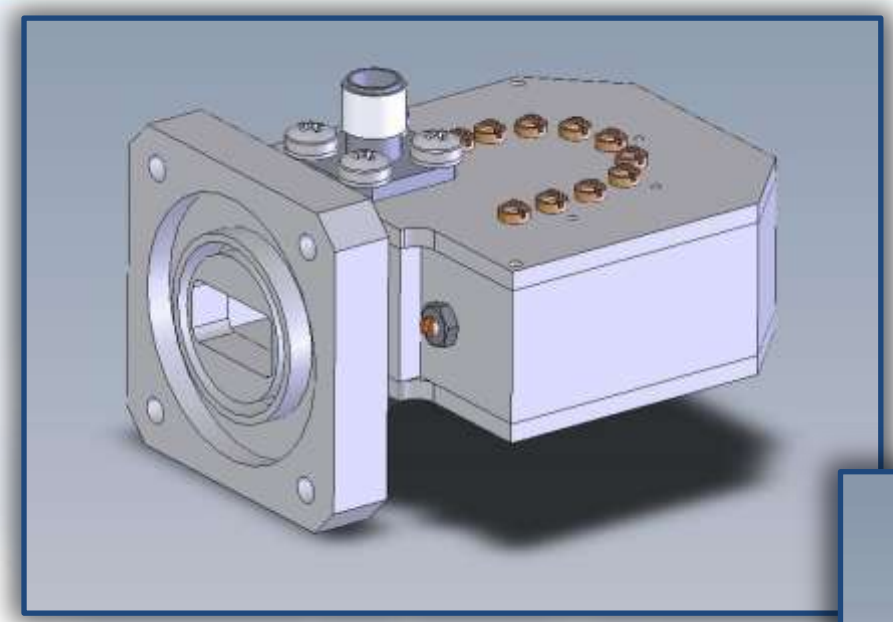


W-Band: *An example of BSC Exact Technology; this tuning-free filter operates above 90 GHz. The eleven-section dual-bandpass structure was designed using our own Mode-Matching Software in WG25 (WR15). The waveguide itself is machined to a tolerance of +/- 0.008 mm.*

Key design features were a demanding Military operating environment of extreme temperature, shock and acceleration.

Top left: *The completed device, showing matching Rotation Plates.*
Top right: *S-Parameter data indicating Insertion Loss and Return Loss.*
Bottom left: *Cavity volume model during design phase.*

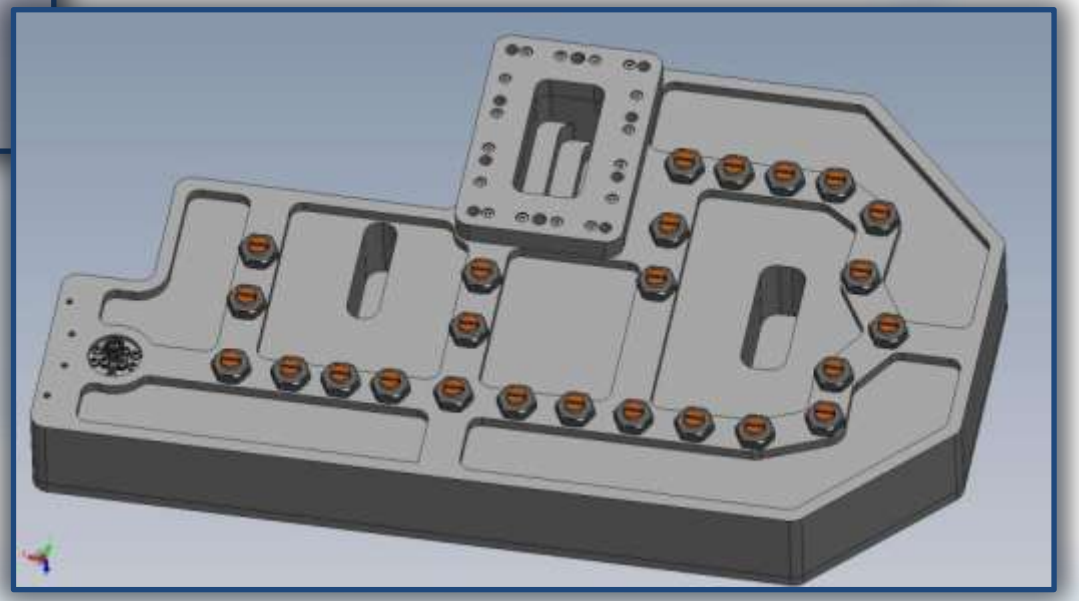
Complex Structure Design



BSC can work in synergy with our Customers to find a solution for mechanically challenging systems.

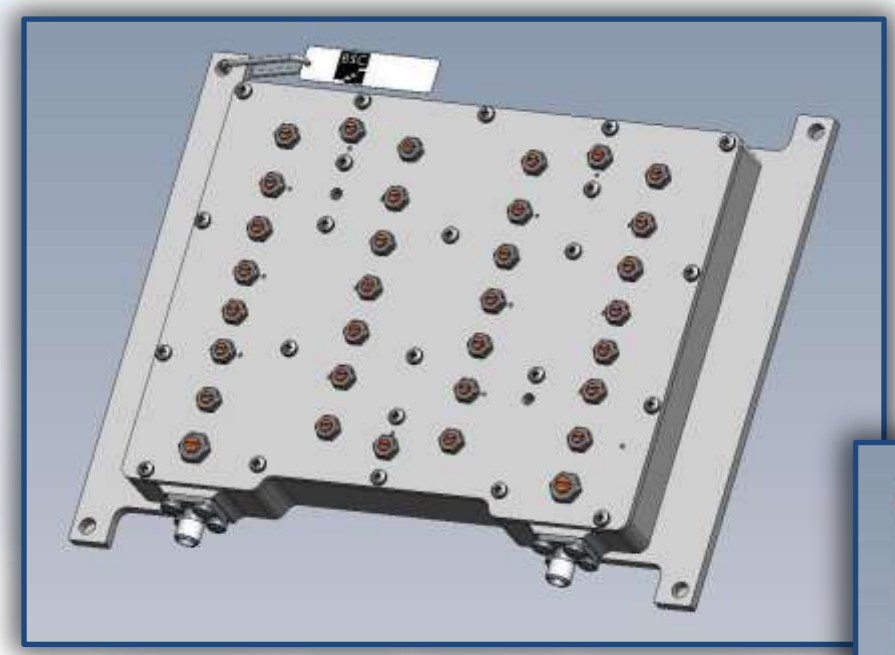
Our design teams can import 3D CAD models in all industry-standard formats, or work from drawings and even sketches to design high-performance filters to fit into small spaces.

Above: *A triple-folded Ku-Band filter in WG19 (WR51) with integrated SMA transition. The space envelope required is less than 50mm x 40mm x 30mm.*



Right: *An S-Band filter in WG10 (WR284) with integrated SMA transition. The mechanical layout was designed to fit retrospectively into an existing system.*

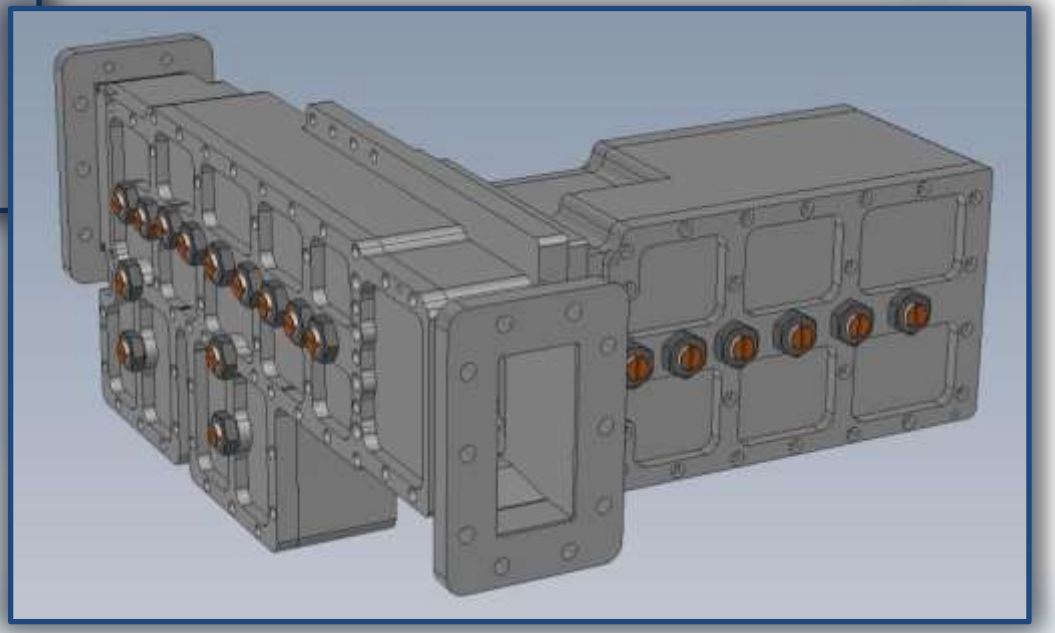
Complex Structure Design



BSC are able to design bespoke solutions to integrate perfectly within system layouts and mechanical constraints.

Many of our designs incorporate multiple folds and combinations of E and H plane bends to allow large-filter performance in a small space envelope.

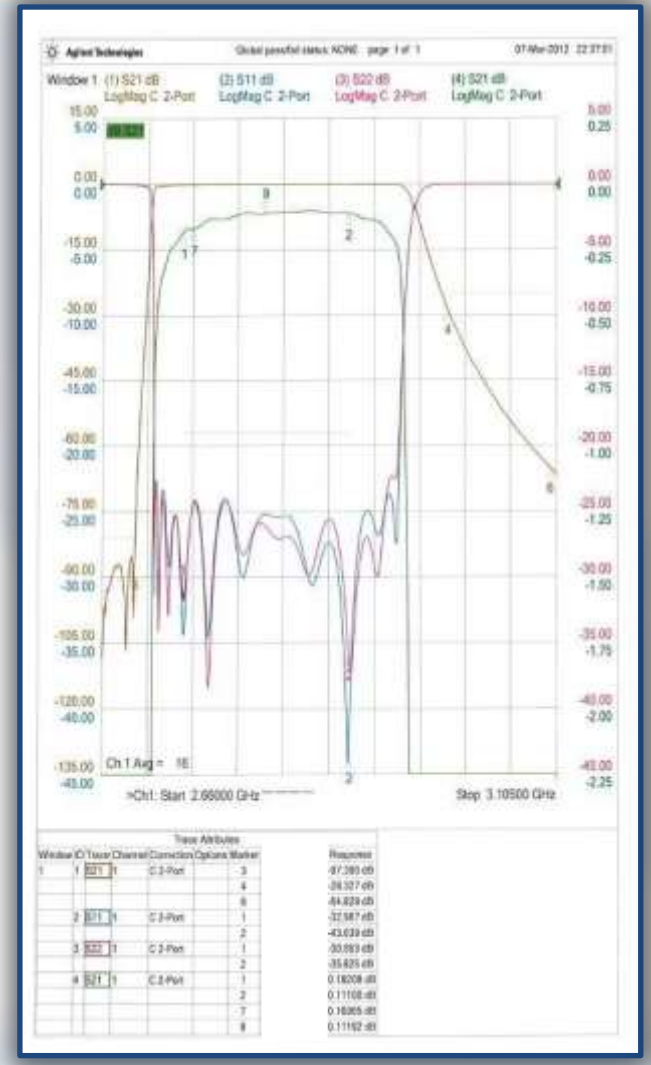
Above: *An X-Band connectorised filter incorporating a triple-folded waveguide with integrated transitions.*

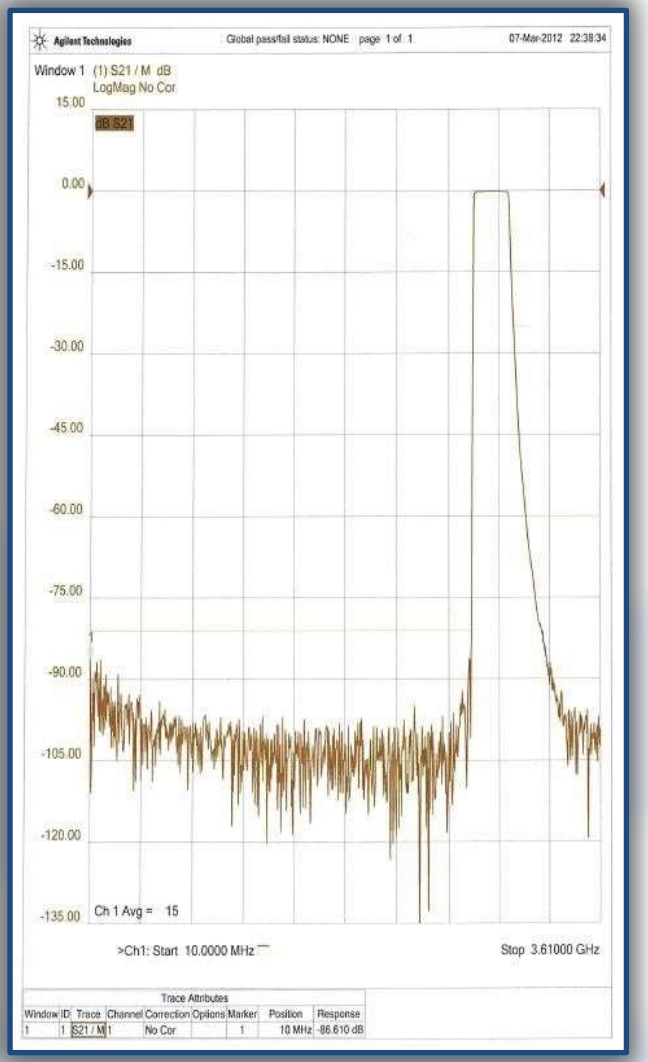


Right: *An S-Band filter in WG10 (WR284), folded using multi-plane bends to fit into a waveguide cut-out only one-third of the actual filter length. This filter also makes use of Pseudo-Elliptic technology to enhance rejection performance.*

Filter Examples

ATC 4G Reject Filters





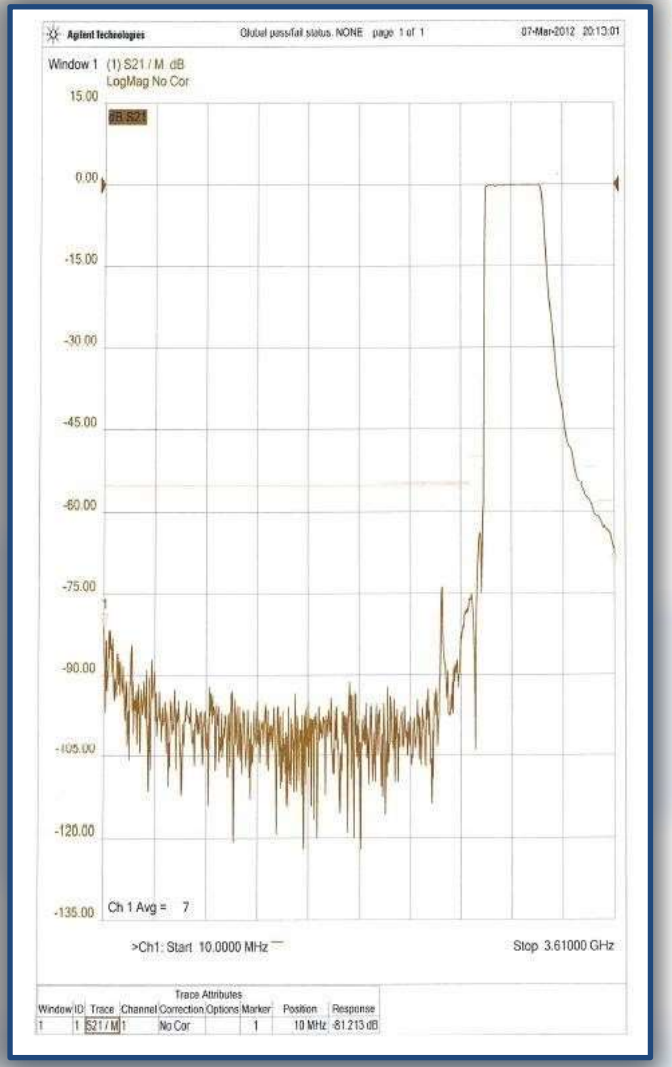
BSC have designed ATC waveguide filters covering the frequency band of 2720MHz to 3055MHz (currently 10 different filter types in this range); these filters are designed to reject the 4G telecommunications band up to 2690MHz, that is currently awaiting auction.

In addition, to help future-proof ATC RADAR systems against other bands that might be reallocated our designs offer rejections up to 4GHz and beyond.

***Far Left:** A typical passband from a BSC-manufactured S-Band ATC filter.*
***Immediate Left:** Rejection plot from the same device.*

Filter Examples

ATC 4G Reject Filters

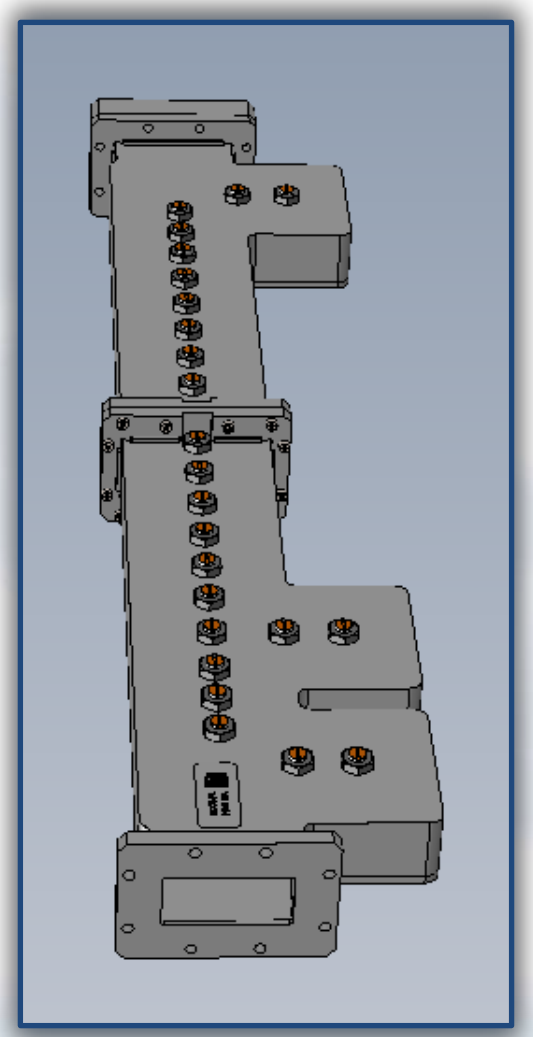


Current designs are extremely low loss, generally better than 0.2dB insertion loss for the waveguide-to-waveguide designs, offering rejection levels of the 4G band of 50dB to over 80dB depending on application. In addition excellent phase linearity is assured over the operating band by making use of a generalised Chebyshev design which is inherently a low loss design approach. The input and output interface has connections ranging from WG10 flange to SMA or N-type connectors depending upon the application.

A number of the waveguide-flanged filters are designed to handle power levels of 65kW pulse with additional capability of phase-matched pairs.

***Far Left:** A typical passband from a BSC-manufactured S-Band ATC filter.*
***Immediate Left:** Rejection plot from the same device.*

ATC/4G Inline Filter 6424



Specifications:

Insertion Loss at 2740 to 2750MHz	0.26dB max
Insertion Loss at 2750 to 2900MHz	0.25dB max
Rejection from DC to 2690MHz	80dB min
Rejection from 3000 MHz to 3100 MHz	25dB min
Rejection from 3100 MHz to 3600 MHz	60dB min
Rejection from 3150 MHz to 3600 MHz	70 dB typical
Group Delay Variation over passband	12ns max
Length	815mm
Operating Temperature Range	0°C to 40°C
External Finish	**Gloss Black**
Power Handling	35kW max[1]
VSWR	1.25:1 max
Leakage at 50mbar Pressure	< 5 to 10 litres per hour

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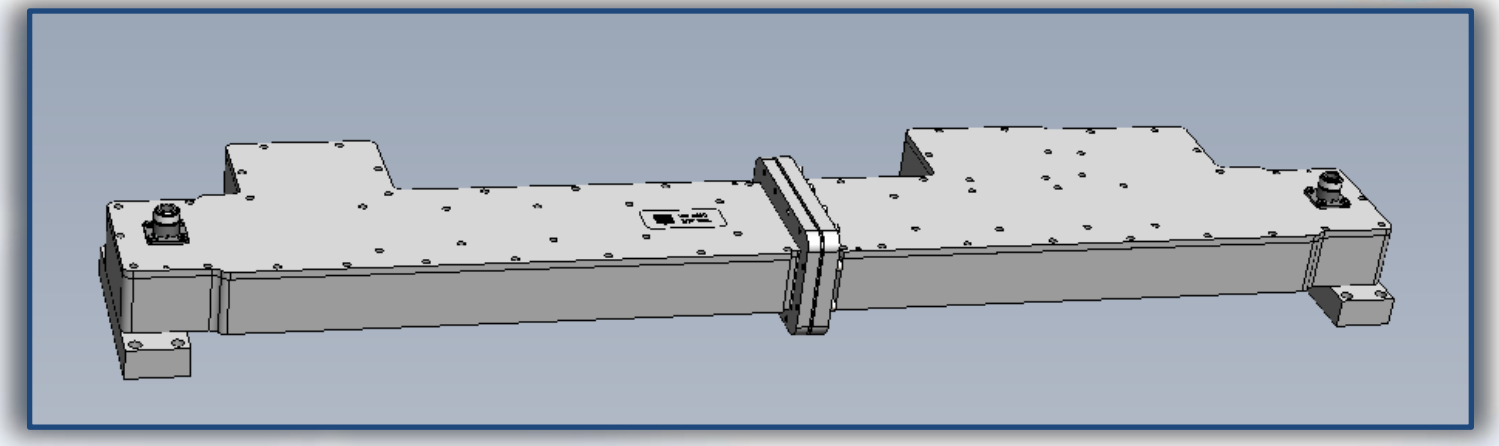
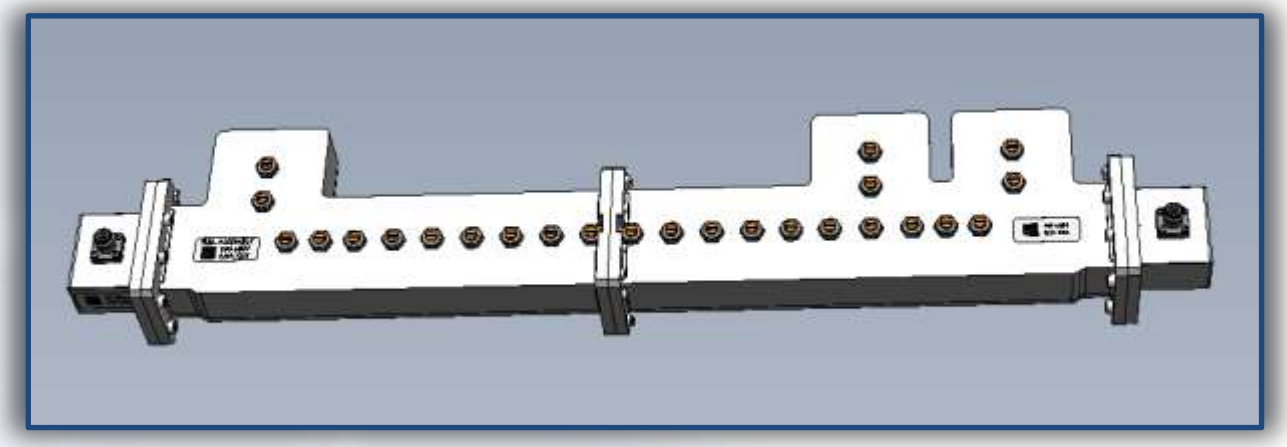
ATC/4G Inline Filter – Coax. 6580



- Passband 2.745 – 3.055 GHz
- Rejection
  - 2.5 – 2.675Ghz >55dB
  - 3.4 -3.75GHz >60dB
- Passband Loss 0.2dB

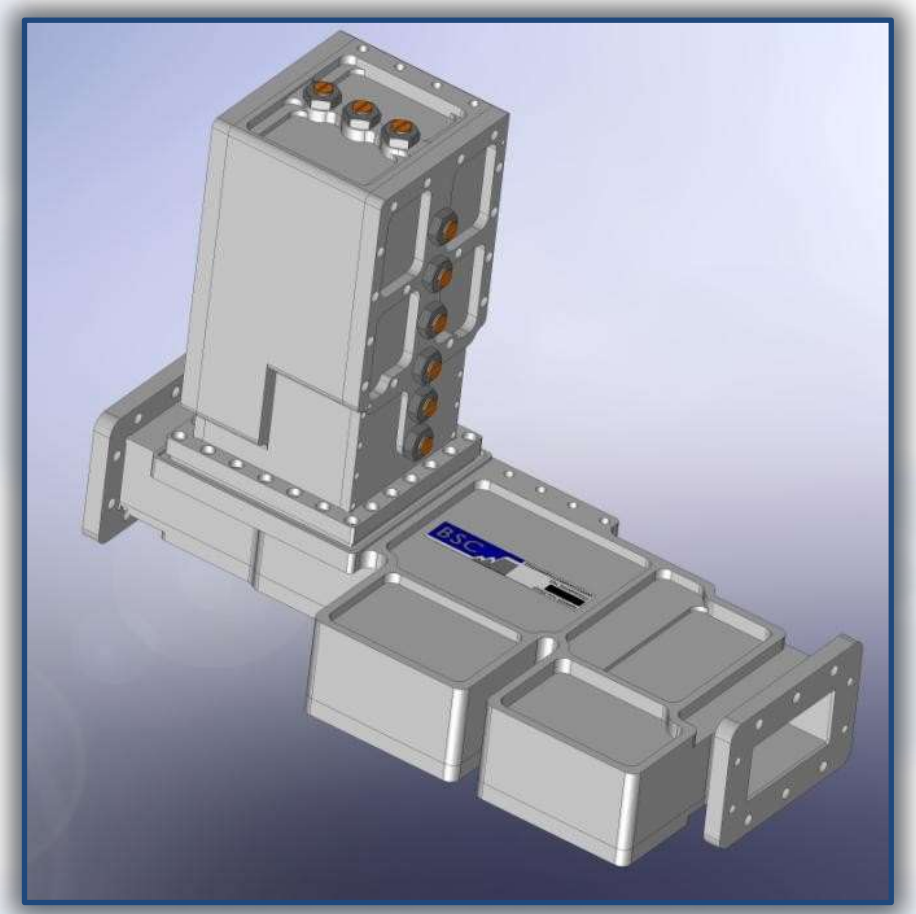
Devn from linear Phase
1deg over any 5MHz
GD Change - 60nsecs max
Return Loss - 17dB min
Power Handling
10KW normal
65KW in fault condition, 40usec PW

ATC/4G WG/Co-ax filter 6599



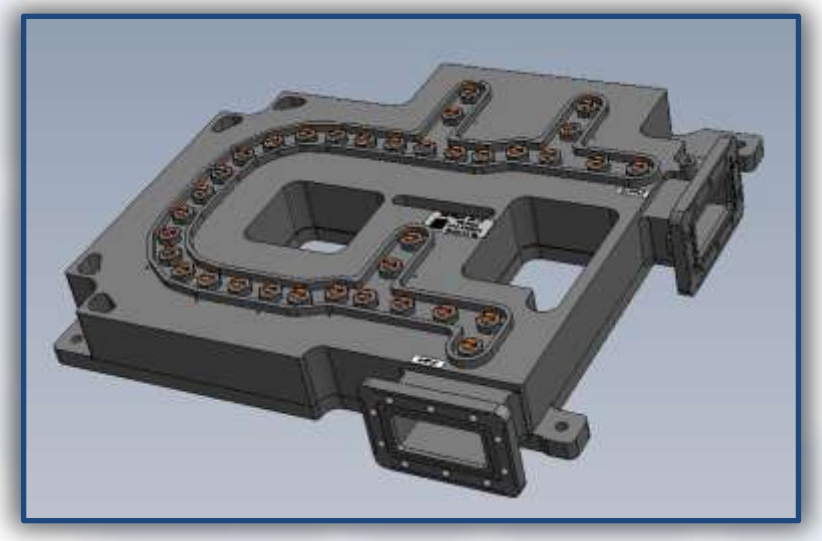
Pass band	2740MHz to 2900MHz
Power Handling	200W CW
Insertion Loss over 2740MHz to 2900MHz	0.38dB max
Rejection from DC to 2690MHz	80dB min
Rejection from 3000 MHz to 3100 MHz	25dB min
Rejection from 3100 MHz to 3600 MHz	60dB min
Length	955mm typical
Leakage at 50mbar pressurised above ambient (filter only)	<10 litres per hour[1]
Operating Temperature Range	0°C to 40°C
External Finish	Gloss Black
WU 6599 comprises of 1off WB 6424 and 2off WT 6514. Painted separately	

ATC/4G Inline filter 6394



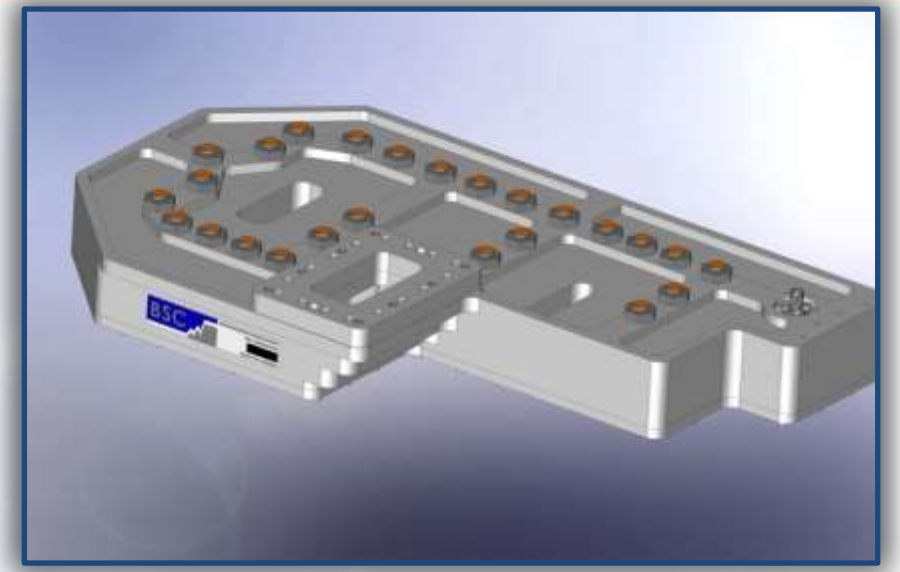
- Passband 2.745 – 3.055 GHz
- Rejection
  - 2.5 – 2.675Ghz >50dB
  - 3.4 -3.75GHz >60dB
- Passband Loss 0.2dB
- Devn from lin Phase
  - 1deg over any 5MHz
- GD Change - 60nsecs max
- Return Loss - 17dB min
- Power Handling
  - 10KW normal
  - 65KW in fault condition

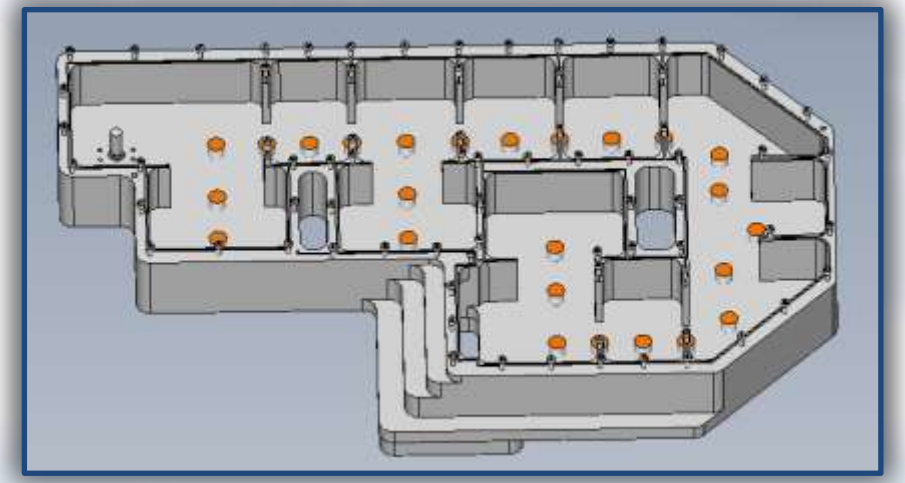
ATC/4G – H-plane 6604



Passband	2.75GHz to 3.1 GHz
Passband Insertion Loss	0.2dB (design aim) 0.25dB max
Insertion Loss ripple over any 5MHz band within the passband	0.05dB pk-pk max
Deviation from linear phase over any 5MHz band within the passband	10° max
GD across the passband	8ns max
Input / Output port RL	17dB 20dB (design aim)
Amplitude tracking over the frequency and temperature range	0.1dB max (matched pair)
Phase tracking over the frequency and temperature range	10° max (matched pair)
Rejections	55dB, 1.5 to 2.57GHz
	65dB, 2.57 to 2.69GHz
	60dB, 3.4 to 3.6GHz
	50dB, 3.6 to 3.75 GHz
Pulse power	3KW pk max, 100usec pulse (normal operation)
	26KW pk max 100usec pulse (fault condition)
Operating Temp	0degC to +50 deg C

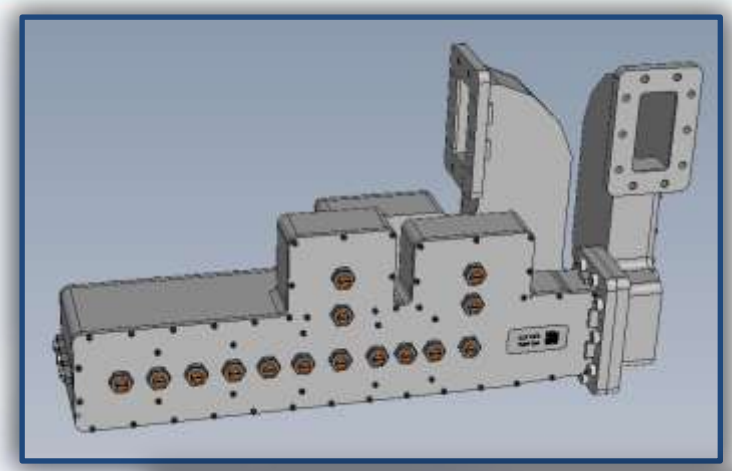
ATC/4G – H-plane Folded 6498

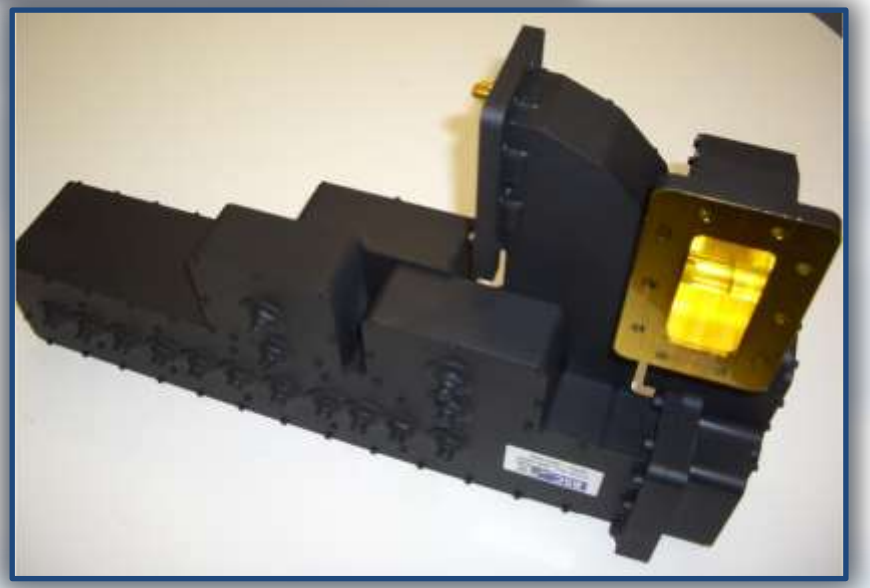




Passband	2720MHz to 3100MHz
Passband Insertion Loss (2720MHz to 2730MHz)	0.4dB max
Passband Insertion Loss (2730MHz to 3100MHz)	0.35dB max
Passband Return Loss	18dB min
Rejection DC to 2675MHz	60dB min
Rejection 2600MHz to 2690MHz	55dB min
Rejection 3400MHz to 3500MHz	45dB min
Rejection 3500MHz to 3600MHz	50dB min
Maximum Power Handling	200W Peak
Output Connector	SMA Male
Operating Temperature Range	0°C to 70°C
External Finish	Matt Black

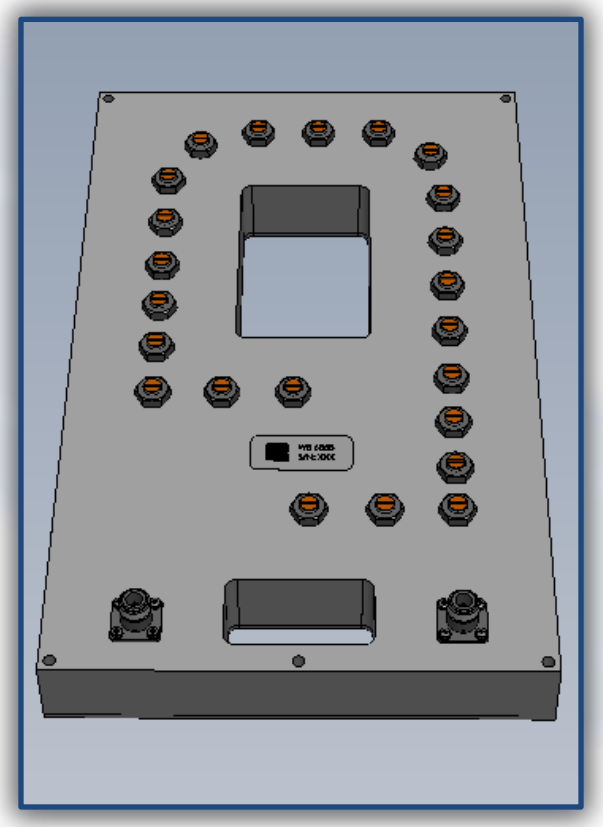
ATC/4G – E-Plane 6506





Passband	2750MHz to 3051.3MHz
Insertion Loss at Bandedges	0.25dB max
Passband Return Loss	18dB min
Rejection from DC to 2600MHz	55dB min
Rejection from 2600MHz to 2690MHz	50dB min
Rejection from 3400MHz to 3500MHz	52dB min
Rejection from 3500MHz to 3600MHz	58dB min
Maximum Power Handling (into short cct)	10kW Peak
Flanges	UDR 32
Operating Temperature Range	0°C to 50°C
External Finish	Matt Black

ATC/4G – Receive filter 6558



Passband	From 2750MHz to 2900MHz
Insertion Loss at Bandedges	0.4dB max
Passband Flatness	0.4dB max
VSWR	1.3:1 max
Rejection from DC to 2700MHz	60dB min
Rejection from 3100MHz to 3600MHz	60dB min
Maximum Power Handling	300W Peak
Maximum Power Handling	20W CW
Group Delay Variation over passband	20ns max
Group Delay Variation over passband	15ns typical
Connectors	N-Type Female
	N-Type Male
Operating Temperature Range	10°C to 40°C
External Finish	Matt Black
Group Delay Variation at 2760MHz	0.23ns/MHz max
Group Delay Variation at 2885MHz	0.23ns/MHz max

Contact Details

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