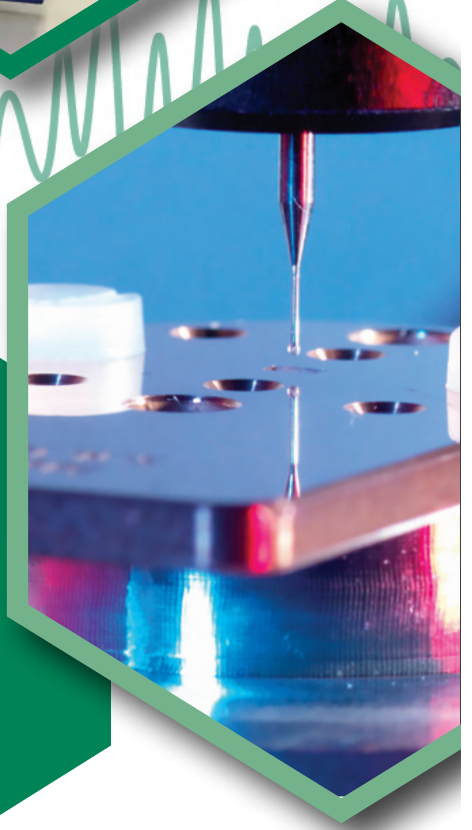


# FLANN



UNLOCKING THE POWER OF WAVEGUIDE

## BROCHURE 2024



## INTRO & CONTENTS

- 1) Calibration and Verification Kits
- 2,3) Attenuators
- 4) Waveguide to Coaxial Adaptors
- 5) Terminations
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Welcome to our 2024 Brochure, produced to highlight a selection of critical components and solutions required to deliver, test, measure and calibrate systems operating from 300 MHz to 1.1 THz.

But this year hasn't just been about how we can help you our customers, but also how we can move forward as a company with nearly 70 years heritage.

So after careful consideration and planning, we are excited to announce that Flann has a fresh new look. This visual transformation includes a brand new logo and an updated colour scheme that aligns with our growth and aspirations for the future.

Our dedication to provide the Microwave Industry with the design, development and manufacture of precision, high quality, high performance microwave equipment and components will remain the same.

That is why you can continue to rely on Flann to be your key solution partner for years to come.

Flann offers a wide range of calibration and verification kits to suit many applications and price points. Compatibility with the vast majority of current and legacy VNAs can be provided. Additionally full customisation of our kits is possible to suit your requirements.

### Calibration Kits

Flann Waveguide Calibration Kits have been developed in close cooperation with manufacturers and users of both modern and legacy network analysers. Our kits enable users to perform accurate calibrations of the test configuration each time an analyser is to be used. Each Calibration Kit contains reference standards used to correct systematic errors due to imperfect test equipment, so that whatever is being measured can be characterised with a high degree of accuracy.

Calibration Kits are available in either Precision or Metrology grade, and are suitable for analyser configurations requiring TRL, OOL and LRL calibration methods. Customisation of our kits is possible to suit your calibration accuracy and price requirements.

**Precision (Series 760)**

**Metrology (Series 761)**

For use with network analysers from 320 MHz to 1.1 THz

Precision Grade Kits offer precise performance at a modest cost and are preferred by many test laboratories, industrial and academic customers, and users requiring a reduced uncertainty of measurement.

Metrology Grade Kits offer market-leading accuracy and are often preferred by national calibration laboratories or for applications where absolute minimal calibration error is critical.

The contents of a calibration kit depend on the type of calibration to be performed, and on the model of VNA, but will typically include: 2x Waveguide to Coaxial Adaptors (up to WG22/WR28), Flush Short, 1/4 Lambda Line (offset), Fixed Termination, calibration file containing key parameters on a USB drive and Fixing kit.

\*Special kits and supply for OEM kits are available upon request.



### Verification Kits

Flann Waveguide Verification Kits enable users of network analysers to verify system measurement performance. Each Verification Kit consists of five 2-port mismatch waveguide sections and two precision fixed attenuators.

The components within the Verification Kit are manufactured to the same exacting standard as our Precision and Metrology Grade Calibration Kits and offer extremely stable, quantifiable RF performance across the whole waveguide band.

## ATTENUATORS

Flann offers an extensive range of attenuators to cover many different applications and budgets. Combining our range of Fixed, Manual Variable and Programmable Variable Attenuators, we can meet almost any attenuation requirement from 1.1 GHz to 1.1 THz

### Variable Attenuators

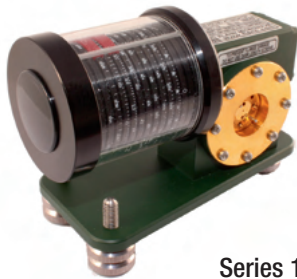
Our flagship Precision Rotary Attenuators are considered by many to represent the 'Industry Standard' in precision waveguide attenuators, offering high accuracy and unsurpassed repeatability and reliability.

These can be found in the following versions:

**Manual Precision Rotary Vane Attenuator (Series 110)**

**Programmable Rotary Vane Attenuator (Series 620 & Series 621)**

**Ethernet Programmable Rotary Vane Attenuator (Series 625-03)**



Series 110



Series 620/621



Series 625-03

Features

- 0 dB to 60 dB variable attenuation with ability to drive to max. attenuation
- 1% accuracy across the full waveguide band
- Attenuation increments of 0.1 dB or better
- High accuracy, high reliability and proven repeatability

Flann also offer a range of more cost effective Variable Attenuators.

These include the following models:

**Field Rotary Vane Attenuator (Series 113)**

**Compact Rotary Attenuator (Series 114)**

**System Rotary Vane Attenuator (Series 624)**



Series 113



Series 114

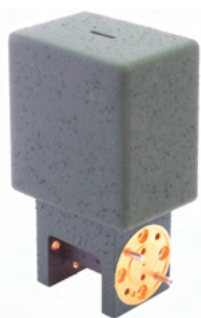


Series 624

Features

- 0 dB to 50 dB variable attenuation
- 2% accuracy across the full waveguide band
- Cost effective solution
- Optional drive interfaces and control (Series 624)

## New Solution: Compact Attenuator Series 024 and 020



Series 024

Expanding on recent improvements in RF performance for our Series 020, Calibrated Variable Attenuators, Flann's new cost-effective Series 024, Compact Motorised Attenuator boasts an impressive  $\pm 10\%$  attenuation flatness across the whole waveguide band from 0 to 50 dB

Both our motorised (024) and manual (020) series attenuators offer the performance expected of a Level Set Attenuator.

### Features

- 0 to 50 dB range
- $\pm 10\%$  attenuation flatness
- Control of attenuation via USB interface or micrometer



Series 020

## New Solution: Compact Fixed Attenuator Series 587

Flann's new Series 587 Compact Fixed Attenuator provides level attenuation across the full waveguide band in compact, rigid solution.

Our 587 series expands upon our high performance 580 & 582 series Precision Fixed Attenuators.

### Features

- 3 dB to 60 dB options
- Very High Stability
- Improved Attenuation flatness



Series 580/582/587

## Fixed Attenuators Series 081



### Features

- 3 dB to 60 dB options
- $\pm 10\%$  Attenuation flatness
- Low Frequency Sensitivity

## High Power Fixed Attenuator Series 584



### Features

- 3 dB to 60 dB options
- $\pm 10\%$  Attenuation flatness
- High Power handling with optional cooling methods

## WAVEGUIDE TO COAXIAL ADAPTORS

Our comprehensive range of waveguide to coaxial adaptors covers all waveguide bands up to 173 GHz\*. Available in either right-angle (Series 09\*) or end-launch (Series 37\*) topography, Flann's adaptors are designed for low loss and low VSWR. Additionally, Flann offer optimised narrow band devices, Low PIM versions, High Power versions and adaptors designed for WRD double ridge applications.

Customisations such as flange type, base material, finish and TVAC suitability are available.

Improved VSWR options are available upon request.

Connector options include: 7-16 DIN, APC7, N-type, SMA, 3.5mm, 2.92mm (K-type), 2.4mm, 1.85mm, 1.35mm, 1.0mm & 0.8mm. Male and Female options are available in each connector type other than APC7, which is sexless.

### End Launch Adaptors



Series 373/378

#### Features

- 320 MHz to 173 GHz\*
- Low Loss
- Very Compact
- Various connector options available, including 1.0mm & 0.8mm
- High Power, Ruggedised & improved VSWR options available

### Top Launch Adaptors

Various adaptor options available including:

**High Power (Series 097)**

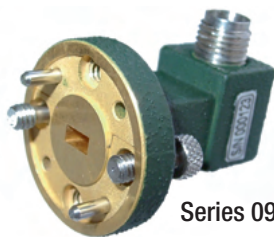
**Low PIM (Series 098)**

**Improved VSWR (Series 094)**

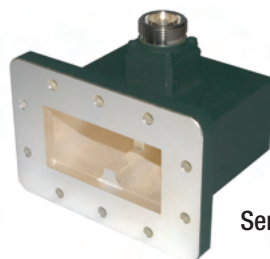
**Compact (Series 099)**

**TVAC**

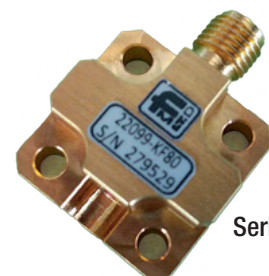
**Spaceflight**



Series 093/094



Series 097/098



Series 099

#### Features

- 320 MHz to 173 GHz\*
- Low VSWR
- Low Loss

\*0.8mm coaxial connector limits guaranteed performance to 145 GHz, but in some cases it's possible to offer WR-6.5/WG29 units up to 173 GHz

Flann manufactures a wide range of loads and terminations to suit many applications from 320 MHz to 1.1 THz. Our range includes the following options:

## Precision Low Power Termination Series 040



### Features

- Very Low VSWR

## Short Low Power Terminations Series 170



### Features

- Low VSWR
- Compact

## Ultra-Short Termination Series 171



### Features

- Low VSWR
- Smallest physical size possible

## Sliding Terminations Series 540



### Features

- Low Housing VSWR
- Low Sliding Element VSWR

## High Power Terminations Series 101

Flann's range of High Power Terminations (HPTs) offer guaranteed power handling ratings, providing users with the assurance that they will not experience failure during use if operated within recommended guidelines.

Cooling options include: Convection, Fan cooled, Sink plate and Liquid cooling.

### Features

- Low VSWR over full waveguide band
- Guaranteed power handling rating
- Industry leading performance
- TVAC compatible options available
- Available to >1kW in many waveguide sizes.

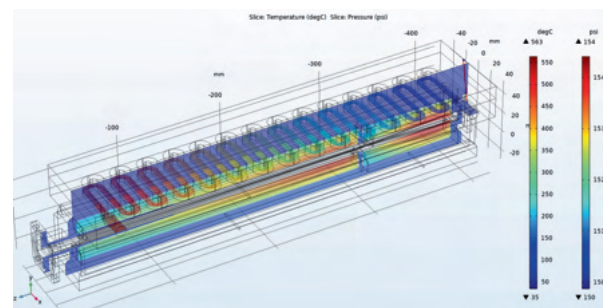


We're happy to discuss your specific requirement to ensure you have the best solution for your application.

## CASE STUDY:

Ever more sectors are making use of higher powers for many different applications, whether this is for satellite or Space Communications, Defence & Security or cutting-edge research facilities.

Using design tools which allow analysis of multipaction & corona (where required), in conjunction with thermal heat transfers in vacuum, our highly skilled engineers can carry out in-depth feasibility studies to 'qualify by design' before any manufacture begins.



Simulation showing the heat transfer through an X-band, liquid-cooled High Power Termination being used at 4.5kW CW power and under specific usage conditions. Simulation confirmed with multipaction TVAC test carried out at ESA-VSC Laboratory

## HORNS & ANTENNAS

Flann offer a wide range of antenna designs and probes. Using various manufacture techniques including electroforming, machining, plates and additive manufacturing, we can offer these instruments in most waveguide sizes.

Orthomode Transducers (OMT's), Polarisers, Diplexers, Combiners and other feed system instruments are available to provide the optimal solution for any application.

All instruments are customisable to meet High Power, Low PIM, TVAC compatibility, Aerospace and Spaceflight requirements, with Flann boasting fully qualified products in many ranges.

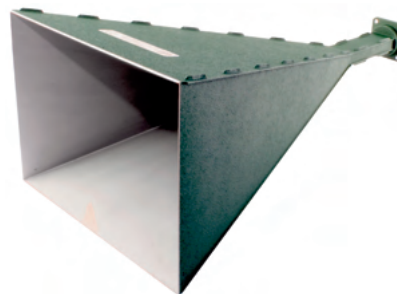
### Dual Polarised Horn Antennas Series DP240/DP241



#### Features

- 2 to 18 GHz, 18 to 40 GHz & 6 to 50 GHz options available
- Close Phase and Amplitude Tracking Between Ports
- High isolation and Low cross polarisation
- Rated to IP54

### Standard Gain Horns Series 240



#### Features

- 10 dB to 35 dBi gain models
- Weatherproof and mounting bracket options
- NRL options available

### Conical Horn Series 243



#### Features

- For circular or linear polarisation
- Customisable to application

### Sectoral Horns Series 244/245



#### Features

- 10 dB to 35 dBi gain models
- E and H plane available
- Greater spectrum efficiency



## Lens Horn Antennas Series 810/820/880



### Features

- Linear and circular feed options
- High radiation efficiency
- Superior sidelobe and cross polar performance
- Inherently robust with weatherproofing options
- WG15 to WG27 (WR-112 to WR-10)

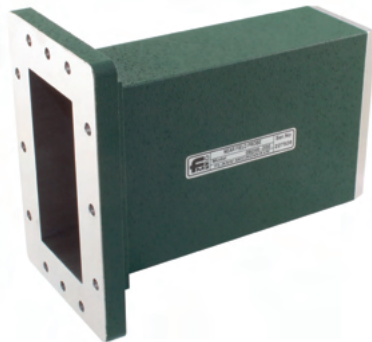
## Omni-Directional Antennas Series 249



### Features

- Coaxial structure
- Waveguide or coaxial interface
- 360° Azimuth coverage
- 60° Elevation coverage
- Typically up to 20% bandwidth

## Near Field Probe Series 246



### Features

- Knife-edge waveguide probe
- Low diffraction
- Custom lengths

## New Solution: Array Antenna Series 250



Flann's capabilities extend to the design and manufacture of flat panel antennas for a range of extreme environments. Using our custom waveguide topology, these antennas are suitable for use in high-powered microwave (HPM) scenarios.

Custom designs are available to cover user specific frequencies.

### Features

- Fully customisable
- Extreme environment options
- Suitable for high power microwave (HPM) applications

Defence and Military applications are always challenging. Our ability to customise products to offer high reliability across a range of environments is why we're trusted by the leading organisations in this sector.

Specific areas where we have provided support through critical componentry and services are:

- Antennas
- Waveguide Assemblies
- Complex Waveguide Systems
- High Power Solutions
- Feasibility Studies and Reporting

Feasibility Studies are key to support our defence customers in understanding whether a potential solution can be achieved. Through a combination of RF Design, Mechanical Design, Prototyping, Manufacture and Validation, all on-site at our premises, Flann can offer a full service to ensure the most critical of products, assemblies or systems are suitable and ready to deploy.

### CASE STUDY:



One of Flann's main objectives is to enable our customers to be successful. Often this results in our solving of problems that other suppliers aren't able to solve.

A recent case in point is a UK Defence Prime contractor who needed an antenna for a very high-power directed energy application. The System is capable of bringing moving targets to a controlled stop at a safe distance, without collateral damage, in various environments.

Flann:

- Performed the RF & mechanical modelling, analysis and design using 'state of the art' Electromagnetic, Physical, and Multi- Physics FEA (Finite Element Analysis) tools.
- Completed the mechanical design, taking care of issues surrounding: mechanical strength, centre of gravity, mounting and maneuvering of the finished assembly, heat dissipation and transfer, thermal stresses, weatherproofing and environmental aspects etc.
- Project managed the build, through a complex supply chain.
- Units have been demonstrated and successfully tested.

We have held a prominent presence in the SATCOM markets for decades, offering instruments such as antennas, antenna feed systems, waveguide switches and other components required by our customers.

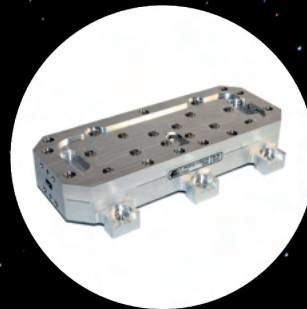
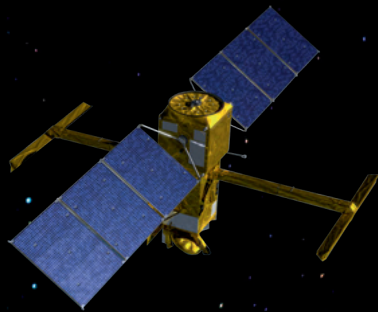
Flann are relied upon by many of the World's high power and thermal vacuum test facilities, as well as satellite integrators, to provide critical hardware in the testing of their systems. Our reliability and guaranteed performance mean we are seen as a trusted partner.

In 2015 Flann took a considered step toward establishing ourselves as a key part of the growing space industry after being approached by the Jet Propulsion Laboratory (JPL NASA) to provide critical components not available elsewhere. From here, we have continued to provide bespoke solutions for spaceflight missions occurring around the world.

### NASA JPL SWOT satellite mission - CASE STUDY:

As part of the NASA JPL Surface Water and Ocean Topography (SWOT) satellite mission, a requirement was identified for fixed attenuators with very stable performance over time, and across the range of environmental conditions, within the extreme space environment. In response Flann designed and built a selection of spaceflight fixed attenuators that would retain their calibrated performance, ready for installation into two phase matched Ka-band waveguide channels.

SWOT, launched on December 16th 2022 with our two attenuators installed. It conducts consistent, high accuracy mapping of Earth's surface water, from its harsh space environment.



Flann have supplied and have in development, a range of products which are currently qualified or soon to be qualified for spaceflight. These include:

- Electromechanical Waveguide Switches
- Fixed Attenuators
- Terminations
- Waveguide to Coaxial Adaptors
- Dual Polarised Horns
- Antennas
- Polarisers
- Filters
- Complex Waveguide Sections



More recently, Flann have been working with integrators and operators of LEO, MEO and GEO satellites to support them in achieving their requirements. Whether through a traditional or new space approach, we can offer a professional and reliable service to meet our customers' needs for passive waveguide components and systems.

## ORTHOMODE TRANSDUCERS (OMT's)

Flann's full-band OMT's offer the high performance demanded by today's communication systems, in which good polarisation purity and isolation are paramount.

The OMT is a bi-directional device which allows signals to be sent from, or received at, the rectangular ports via an antenna supporting dual polarisation (at the common port). It can also be used to separate the vertical and horizontal components of a circularly polarised or elliptically-polarised wave, or to combine two signals to transmit a circularly or elliptically-polarised wave from a suitable horn antenna.

Narrow band optimised performance OMT's are available upon request.

### New Solution: Full Waveguide Band Orthomode Transducer Series 785

#### Features

- Full waveguide band
- High polarisation purity
- High isolation
- Circular common port (Square port options are available)



## POLARISERS

Polarisers are used to convert from linear to left-hand or right-hand circular polarisation. Flann offer a range of models to suit fixed or variable polarisation requirements, with high power handling and which are customisable to the application.

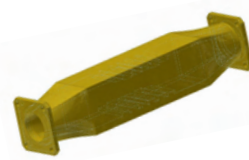
### Left-hand or Right-hand Rectangular to Circular Polarisers Series 648



#### Features

- Low ellipticity ratio
- Customisable circular diameter port on request

### Corrugated Polarisers Series 651



#### Features

- Linear to circular conversion
- High power options

### Electrically-Switchable Polarisers Series 652



#### Features

- TTL Driven
- Full waveguide band

### Septum Polarisers Series 782



#### Features

- Linear to circular conversion
- Rigid, compact design
- Customisable to application

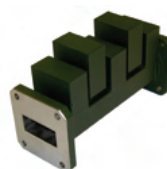
Flann's filters simplify measurements in microwave systems and enhance system performance by effectively reducing undesirable signals i.e. harmonics, to an acceptably low level.

Our standard range of Low Pass filters are available from 2.6 GHz to 330 GHz, reducing 2nd and 3rd harmonics. Alternatively, a more compact model is available reducing the 2nd harmonic only.

Custom filters are available on request.

These filters can be found in the form of:

- Low Pass Filter (Series 280)**
- High Pass Filter (Series 281)**
- Band Pass Filter (Series 282)**
- Band Stop Filter (Series 283)**
- Compact 2nd Harmonic Filter (Series 289)**



### Features

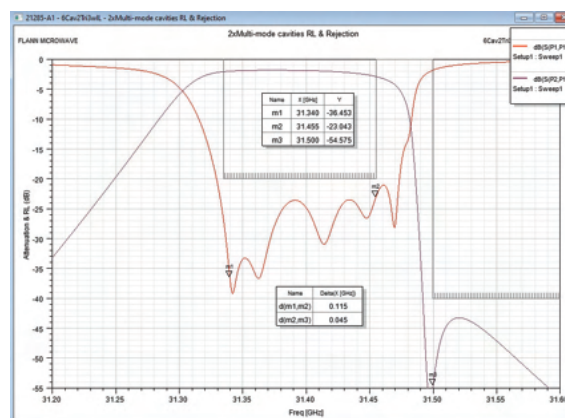
- High stop band rejection
- Rigid, compact design
- Specific harmonic rejection models available
- Customisable to application

## CASE STUDY:

Flann's filter speciality is aimed at high specification, high Q low loss waveguide filters.

Many designs use multimode cavities to achieve 1,2,3,4 & even higher attenuation nulls that give high attenuation with very small guard bands. We have a unique topology that allows a planar design which can be realised in a simple cap & channel construction, thus minimising cost.

Finally, we use the most sophisticated design software that allows direct design to metal cutting, thus not requiring a prototype. The correlation between design is so accurate we don't need any tuning elements, again reducing cost & time.



WR34/WG21 Band Pass Filter with pair of co-incident attenuation nulls to achieve narrow guard band with high rejection.

Flann offer standard and special custom diplexers designed for the demanding millimeter wave applications.

## Diplexers Series 286



### Features

- Low Loss
- Rigid, compact design
- Customisable to application

## WAVEGUIDE SWITCHES

Flann offers a comprehensive range of waveguide switches in both manual and motorised versions. A number of different control schemes are available including TTL, Direct Drive, Power over Ethernet (PoE), RS485 and using the Flann Switch Driver.

Flann Test & Measurement grade switches (Series 333, 333-\*E, 334-\*E, 338-\*E) are 4 port devices and are optionally available with 2 or 3-channel rotor. Efficient choke design ensures a high RF isolation between noncoupled ports.

### Features

- High Accuracy
- High Repeatability
- High Isolation
- 2 or 3-Channel

### Manual Series 333



#### Features

- Manual Control

### Motorised Series 333-\*E



#### Features

- For use with Flann Switch Driver SD5902

### DC-Motor Driven Series 334-\*E



#### Features

- For use with Simple TTL - Level control and indicators

### Power-over-Ethernet Series 338



#### Features

- Power and remote control over Ethernet

### DC-Operated 2-Channel Series 336



#### Features

- 2.6 GHz to 40.1 GHz
- High isolation & Low insertion loss
- High Reliability (>1,000,000 actuations)
- Sealed, pressurisable to 15 psi(g) standard

Designed for both internal and External usage  
 Applications include: SATCOM Systems, Switching Networks and SNG.  
 Available options include: Weatherproofing, custom voltage, and various connector types.

**New Solution: Compact H-Plane Switch, Series 337**  
**Spaceflight H-Plane Switch, Series 330**

We are proud to launch a new range of millimetric waveguide switches to suit the increasing demand for the next stage of 5G, 6G & LEO/MEO satellites and expanding use by Military & Astronomy over 28 GHz to 500 GHz.

The new Series 337/330 Switches are a range of small, compact, low mass, low inertia, low insertion loss, high power switches with higher isolation and minimal PIM.

Customisable to suit specific application needs or available as a COTS test & measurement device, the switch provides unrivalled performance and repeatability.

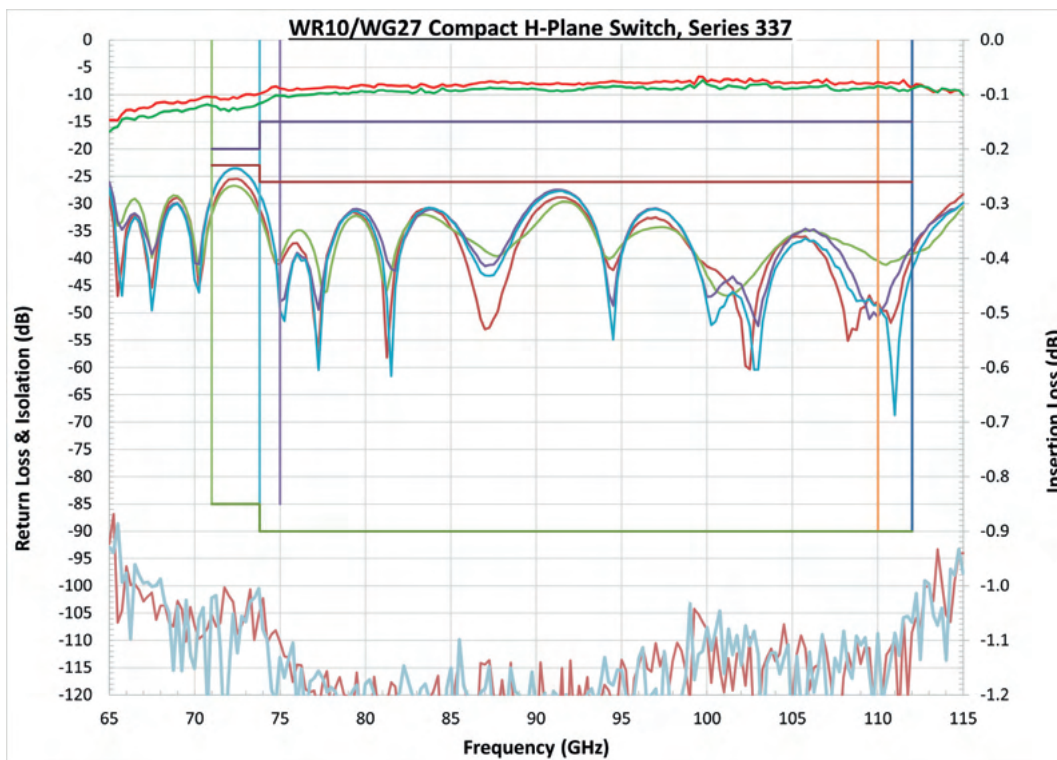


Series 330

Series 337

### Features

- Extended Frequency range
- Exceptional RF and Mechanical performance
- High repeatability, better than -47 dB
- H-Plane structure allows easy integration with other components



## COUPLERS, POWER SPLITTERS/COMBINERS

Flann offers a wide range of couplers, combiners and power splitters to meet specific requirements from 1.1 GHz to 1.1 THz. Options are available to suit various applications, coupling and directivity requirements.

Instruments are customisable to meet High Power, Low PIM, TVAC compatibility, Aerospace and Spaceflight requirements, with Flann boasting fully qualified products in many ranges.

### Couplers

**Branchguide Multihole Couplers (Series 13\*)** offer a combination of high directivity and low sensitivity vs. frequency for the coupling while maintaining low VSWR. Coupling values are available from 3 dB to 60 dB as standard.



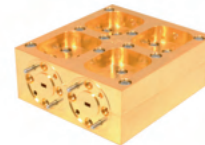
**Crossguide Couplers (Series 270)** suits many applications where space is at a premium and directivity is not the prime consideration. This may be preferred for pressurisation or low mass applications.



**Compact branchguide couplers (Series 140)** are particularly suited to applications where space is limited, and optimum coupling and directivity performance are required over a limited bandwidth.



**3 dB Sidewall Couplers (Series 144)** are an alternative that is ideally suited to high power applications where available space is also a constraint. Its rigidity makes this an ideal solution for Aerospace and Spaceflight applications.



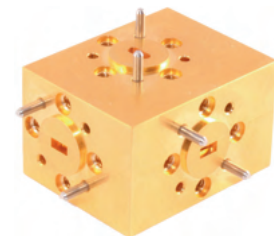
### Splitters

Multihole Power Splitter (Series 230/231) is designed to divide the input signal into three signals of equal magnitude. Full band frequency sensitivity between secondary waveguide ports is better than  $\pm 0.2$  dB, offering a high performance solution.



### Combiners/Tees

Matched Hybrid Tees (Magic-T) (Series 385) are 4-port devices which can also be used for splitting and combining signals. Each tee is optimised to produce the best combination of matching, balance and isolation. Specific 3-port, E-plane and H-plane Tees are also available.





At millimeter wave frequencies, traditional flexible waveguide products are not viable and often not available. Flann offers a number of solutions for flexible waveguide interconnect including waveguide-coaxial-waveguide, semi-rigid and formable.

Flann have integrated waveguide to coaxial adapters with high performance flexible and semi-rigid cable to provide a practical alternative to flexible waveguide.

### Coaxial Flange to Flange Adaptor, Flexible Series 350



#### Features

- Most flexible option
- Models up to 165 GHz (with a view to moving higher)

### Coaxial Flange to Flange Adaptor, Semi-Rigid Series 352



#### Features

- Reasonable flex versus stability
- Models up to 220 GHz
- Suitable in applications with constant vibration and temperature changes.

### Seamless Semi-Rigid Flange to Flange Adaptor Series 562



A low loss, hand formable waveguide section suitable for millimeter wave applications. For most applications a low loss flexible section that can be bent or formed a few times might be all that is required.

#### Features

- Formable up to 3 times in each plane
- Models up to 330 GHz
- Very low loss (comparable to copper waveguide)
- Low VSWR
- Available pre-formed
- Suitable for extreme environments

## PHASE CHANGERS

Flann manufactures a portfolio of both manual and programmable phase changers that cover a wide range of applications and waveguide bands.

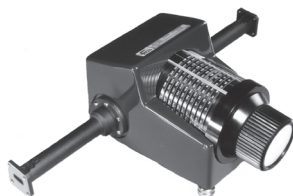
**Calibrated (Series 060 & 061)**

**Rotary Vane (Series 063)**

**Programmable Rotary Vane (Series 670)**



**Series 060 & 061**



**Series 063**



**Series 670**

### Features

- 1.14 GHz to 330 GHz
- Low Insertion Loss
- High Repeatability
- 0 to 180° Calibrated phase change range (Series 060, 061 & 670)
- 0 to 360° Continuous phase change (Series 063)

## STUB TUNERS

To enable waveguide tuners in higher frequencies, Flann have developed a non-conducting element to replace the normal conducting screw tuner element. We use 3 very low loss dielectric stubs spaced at  $\frac{1}{4}$  Lambda.

They are ideal for tuning out an amplitude RL of up to -5 dB

Under development is a programmable version using the same linear actuator as in our new 024 series compact programmable attenuator.

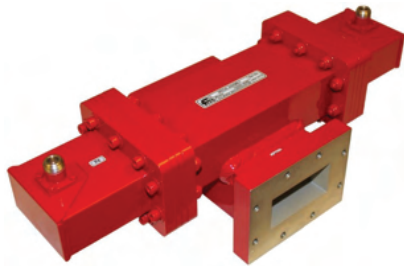
### Features

- Developing models to work up to WM-380 (750 GHz)
- High Repeatability & Reliability
- Low Loss
- High Power

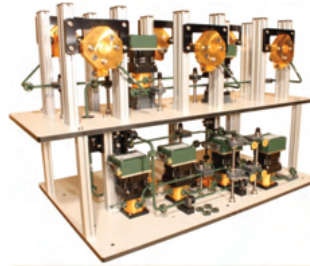
## ASSEMBLIES

Flann offers a comprehensive build-to-print and fully custom design capability. With decades of experience, we are able to offer complete solutions to complex customer requirements. Please contact us to discuss your requirements.

Some examples are shown below:



High power, pressurised, S-band Coupler assembly.



E-band switching network for radio testing.



Antenna and Polariser assembly qualified for Space through a 'New Space' approach.

## SUB-MILLIMETER WAVEGUIDE

Flann are proud to announce a new range of seamless precision waveguide operating up to 1.1 THz.

Standard seamless waveguide is not commercially available above 220 GHz resulting in the necessity to machine waveguide instruments and assemblies. While this is suitable in some instances, the higher mass and bulk of the instruments can cause difficulties in critical scenarios where lower mass or a more complex waveguide structure is required.



## OTHER PRODUCTS

Flann offer a wide range of other products, some of which can be found below:

- Straights, Rectangular or Circular
- Bends
- Twists
- Taper Transitions
- Arc Detectors
- Individual Calibration Kit grade components
- Variable Short Circuits
- Frequency Meters
- Complex Waveguide Sections
- Waveguide Spacers
- Delay Lines
- Rectangular to Circular Transitions



Delay Line



Frequency Meter



Variable Short Circuit



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