

Flann Microwave

FLANN MICROWAVE LIMITED

Founded in 1956, internationally renowned, Flann Microwave Limited specialise in the design and manufacturer of precision, high quality, high performance microwave equipment and components in the frequency range of 320 MHz to 500 GHz.

MISSION STATEMENT

To provide the Microwave Industry with the design, development and manufacture of reliable and consistent product with competitive pricing.

CAPABILITY

RF Design: tools include Ansoft HFSS, Mician Microwave Wizard, Mathematical Modelling and In-house Developed Design and Synthesis tools

Mechanical Design: AutoCAD Inventor 3D modelling and Edge CAM

Electronic Design: Motion Control/Robotics, System Design, Control Software & Control Processors utilizing IEEE-488, RS-232, RS-485 and Ethernet

Manufacturing: CNC Machine tools, Vertical machining centres, Lathes, Manual Machine tools – Milling and Turning

Fabrication & In-house Processes: Highly skilled fitters / assemblers, soldering and brazing, Electro-Plating, Electro-Forming, Anodising, Achromic and Paint Spraying

Test and Measurement: Vector Network Analysers up to 500 GHz, Strong relations with Research and National Standards Laboratories.

CUSTOMERS

We serve our customers in a broad range of markets including Test & Measurement, Commercial & Military Communications, Radar, Satellite, Industrial Applications, EW as well as Research and National Standards Laboratories.

Flann are actively involved in easing customer project time, space and weight limitations by design and optimisation of multi-function assemblies, using either discrete components or single block designs.

PRODUCTS

Standard and custom waveguide components, antennas, sub assemblies and programmable instrumentation available from 320 MHz to 500 GHz in rectangular waveguide and 2 GHz to 40 GHz in double ridged, with power capability ranging from microwatts to Megawatts.



ООО «4TECT»

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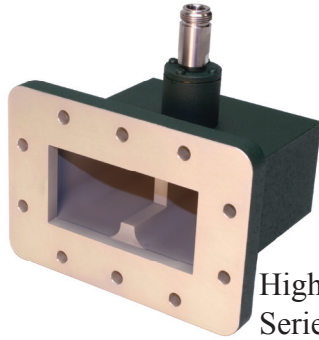


New Products

Waveguide to Coaxial Products



Flexible TEM Waveguide Series 350



High Power Series 097



Low PIM Series 098



Seamless Semi-rigid Waveguide Series 562



Semi-rigid TEM Waveguide Series 352



High Frequency Series 373-W

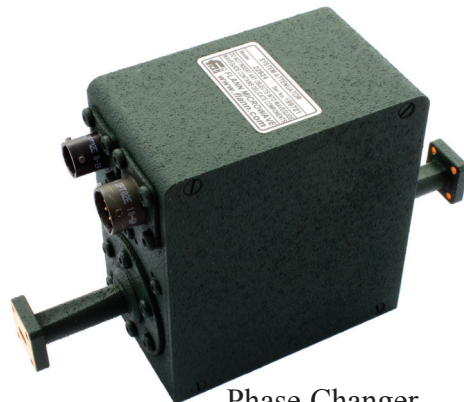
Automated Test & Measurement



Ethernet Control with Power over Ethernet Series 624



Waveguide Switch Series 336



Phase Changer Series 674

New Products

Millimetre Wave Point to Point Products



Lens Horn Antenna
Series 820



Diplexer
Series 286



Lens Horns Passive Repeater
Series 830

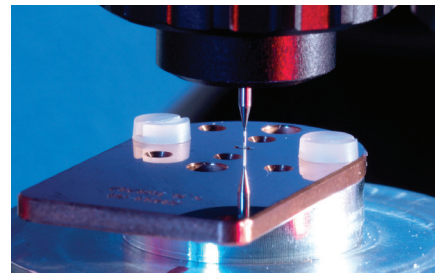


Diplexer
Series 286

Metrology



Millimeter Calibration Kit
Series 704



Short Circuit & Driver
Series SD5902-23051



Calorimeter
Series 180

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For the latest in our product range please view our web site at www.flann.com Or contact our Sales Team, details on the back cover of this catalogue.



Product Series Number Index

The third, fourth and fifth digits of Flann instrument model numbers denote the generic instrument series number.

Listed below are the Instrument Series numbers and their descriptions.

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Programmable Rotary Vane Attenuators, Phase Changers & Control Processors



Model CP2021



Model 23621

Our new generation of Programmable Attenuators & Phase Changers provide higher measurement resolution, faster drive speed and an extendable attenuation range (85 dB) when used with the new Flann Control Processor CP2021. Additionally, the CP2021 will recognise any Flann Programmable unit connected to either of its drive ports.

Features:

- Models from 3.22 GHz (WR229) to 330 GHz (WR3)
- IEEE-488.2 (GPIB) and USB control interfaces
- Full waveguide frequency ranges
- High accuracy
- High repeatability
- Proven reliability

Applications:

- Automated test & measurement systems (ATE)
- Remote control systems
- Automated production testing of microwave radios
 - Fade margin
 - Bit error rate (BER)
 - Gain control

Programmable Rotary Vane Attenuators:

- 0 dB to 60 dB continuously variable attenuators - up to 85 dB in Steps Mode
- Direct dB scale read-out with manual control option
- Low phase change variation with attenuation
- Attenuation increments of 0.1 dB or better (0.01 dB below 21 dB)

Programmable Rotary Vane Phase

Changers:

- Continuously variable 0° to 360°
- Phase change increments of 0.2 degrees
- Direct reading

Programmable Rotary Vane Attenuators & Phase Changers

General Description

Flann Programmable Rotary Vane Attenuators and Phase Changers are well proven Precision Rotary Vane instruments driven by high resolution stepper motors, ensuring high accuracy and repeatability. The translation between the mechanical positioning of the instruments and the attenuation or phase shift characteristics is interpreted by the microprocessor based Control Processor.

Control Processors are available offering combinations of local (front panel) control and control via GPIB (IEEE-488.2) and USB interfaces. Sophisticated error detection and reporting verifies system performance, guaranteeing error free system operation. Positional stepping errors are non-cumulative.

Programmable Rotary Vane Attenuators

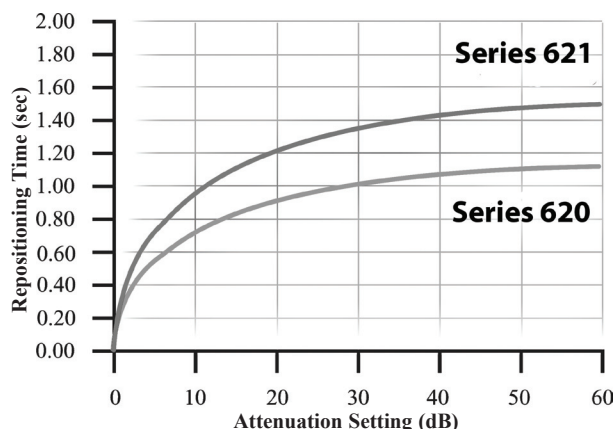
This range of Programmable Rotary Vane Attenuators uses a very high speed five phase stepper motor which, when used in conjunction with the sophisticated motor control circuitry and software of the Control Processor, provides precise, very fast positioning typically 1 second from 0 dB to 60 dB.

Programmable Rotary Vane Phase Changers

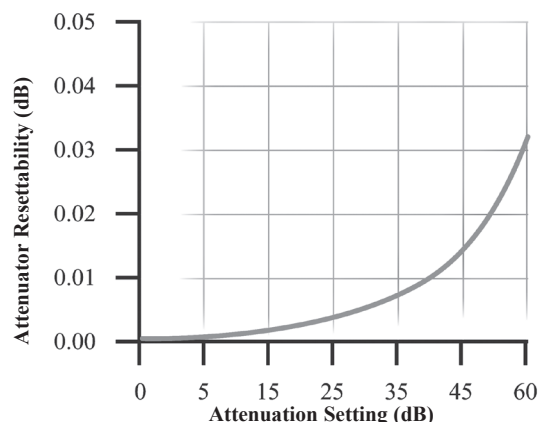
The Series 670 Rotary Vane Phase Changers employ the same high performance drive circuitry and precision mechanisms as the programmable attenuator range and operate at a repositioning rate of 1480 degrees per second with continuous phase change in both the forward and reverse directions. The smallest incremental phase change is 0.2°.

Figure 1 below illustrates the repositioning and resettability performance for the Series 620 and 621 Programmable Rotary Vane Attenuators.

Attenuator Repositioning Time (secs)



Attenuator Resettability



Other features include:

- **High repeatability / resettability**
- **Continuously variable over full attenuation / phase change range**
- **No momentary loss of signal during repositioning**
- **High Reliability**
- **Proven Performance!**

Two options of Programmable Attenuators are available:

- **Series 620 Programmable Rotary Vane Attenuators** without helical readout scale.
- **Series 621 Programmable Rotary Vane Attenuators** offering the additional feature of a high resolution visual helical scale. This unit can also be used as a stand-alone manual attenuator, i.e. not under power from a Control Processor.

Please note:

The programmable attenuators can be used with either the previous series of CP92 and CP2021 control processors or the current series CP2021; an adaptor cable must be specified with order when using the CP92 versions of Control Processor.

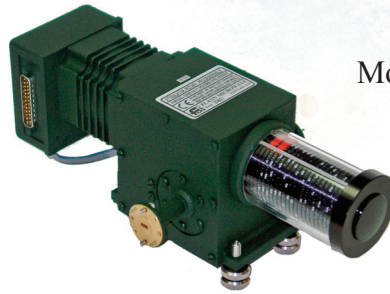
Programmable Rotary Vane Attenuators

Series 620 and Series 621

Two basic types of Programmable Rotary Vane Attenuators, Series 620 and 621, are available. The Series 620 has been extended to include models down to 3.22 GHz. The new Series 621 models offer an additional high resolution helical readout scale offering manual control.

High Speed Operation:

Programmable Rotary Vane Attenuators are fitted with a high speed drive motor capable of repositioning the attenuator from 0 dB to 60 dB (see note 1) in less than 1.1 seconds when driven by our dedicated Control Processors.



Model 23621



Model 15620

Specifications: All ranges 0 dB to 60 dB with the following accuracy¹

	WG10 to WG29	WG30	WG31	WG32	(260-400)	(325-500)
Attenuation accuracy	0 dB to 60 dB 0.1 dB or 1% whichever is greater	0 dB to 50 dB 0.15 dB or 1.2% whichever is greater	0 dB to 45 dB 0.2 dB or 1.5% whichever is greater	0 dB to 40 dB 0.3 dB or 2% whichever is greater	0 dB to 35 dB 0.4 dB or 2.5% whichever is greater	0 dB to 30 dB 0.5 dB or 3% whichever is greater

Operating temperature range: +5°C to +35°C (Refer to Flann for wider temperature range consideration)

Note 1: Customised models with extended attenuation ranges can be supplied. Please contact our Sales Team for further details.

Model Series 620 or 621	Frequency Range (GHz)	Waveguide				VSWR (better than)	Max Insertion Loss (dB)	Max Power (Watts)
		WG	WM	R	WR			
11A620/11A621	3.22 - 4.90	11A	-	40	229	1.15	0.25	10.0
12620/12621	3.94 - 5.99	12	-	48	187	1.15	0.25	10.0
13620/13621	4.64 - 7.05	13	-	58	159	1.15	0.25	9.0
14620/14621	5.38 - 8.18	14	-	70	137	1.15	0.25	8.0
15620/15621	6.58 - 10.0	15	-	84	112	1.15	0.25	6.0
16620/16621	8.20 - 12.5	16	-	100	90	1.15	0.25	4.0
17620/17621	9.84 - 15.0	17	-	120	75	1.15	0.25	3.0
18620/18621	11.9 - 18.0	18	-	140	62	1.15	0.3	2.0
19620/19621	14.5 - 22.0	19	-	180	51	1.15	0.4	1.5
20620/20621	17.6 - 26.7	20	-	220	42	1.15	0.6	1.0
21620/21621	21.7 - 33.0	21	-	260	34	1.15	0.8	0.75
22620/22621	26.4 - 40.1	22	-	320	28	1.15	0.9	0.5
23620/23621	33.0 - 50.1	23	-	400	22	1.15	1.0	0.3
24620/24621	39.3 - 59.7	24	-	500	19	1.15	1.0	0.25
25620/25621	49.9 - 75.8	25	-	620	15	1.15	1.0	0.15
26620/26621	60.5 - 92.0	26	-	740	12	1.15	1.3	0.1
27620/27621	73.8 - 112.0	27	-	900	10	1.15	1.5	0.07
28620/28621	92.3 - 140	28	-	1200	8	1.20	1.8	0.05
29620/29621	114 - 173	29	-	1400	6	1.25	2.2	0.035
30620/30621	145 - 220	30	-	1800	5	1.30	2.7	0.02
31620/31621	172 - 261	31	-	2200	4	1.40	3.0	0.015
32620/32621	217 - 330	32	-	2600	3	1.55	3.5	0.01
710620/710621	260 - 400	-	710	-	'2.8'	1.75	4.0	0.007
570620/570621	330 - 500	-	570	-	'2.2'	2.20	4.5	0.005

ORDERING INFORMATION

Model: Description

Example: Model 19620 or 19621 Programmable Rotary Vane Attenuator

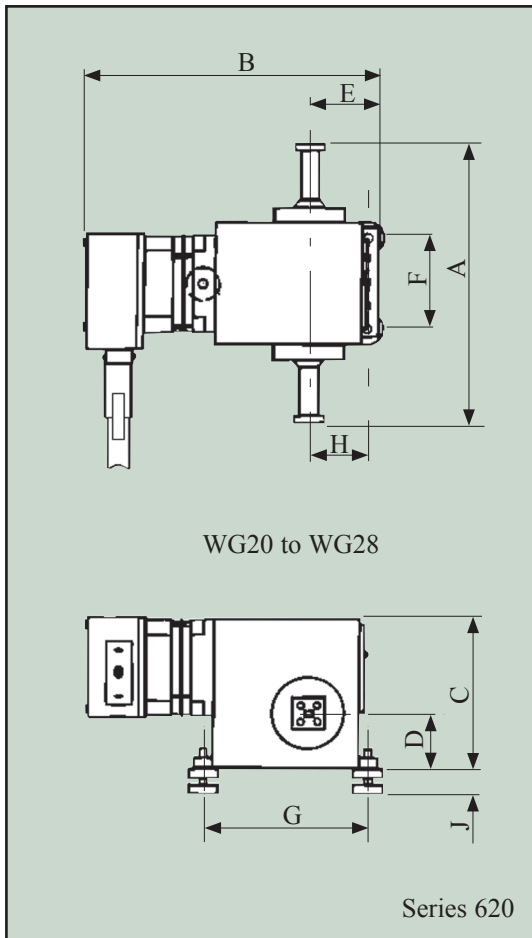
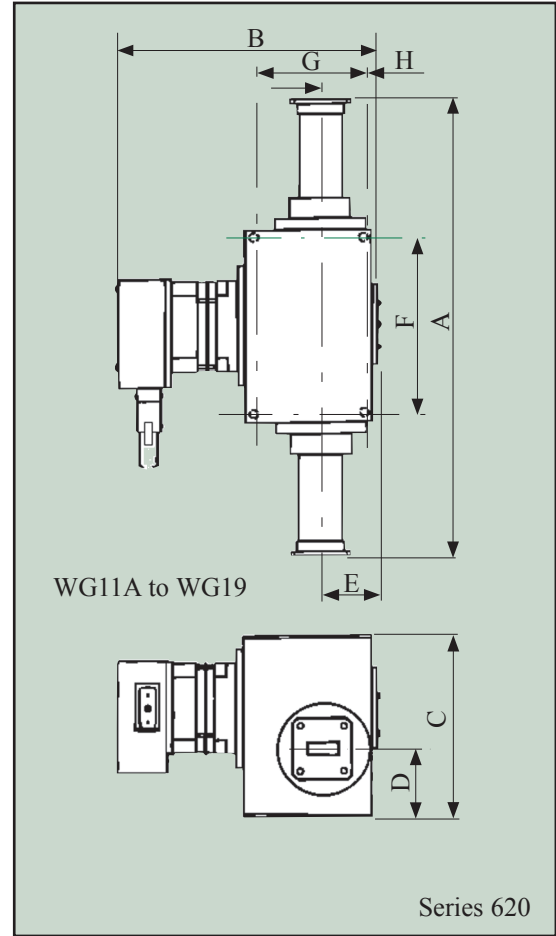
Outline dimensions available on request.

Series 620/621

Programmable Rotary Vane Attenuators Series 620

Outline Dimensions

Model	Series 620 WG 11A-WG19							
	Dimensions (mm)							
	A	B	C	D	E	F	G	H
11A620	687	206.8	166	66	64	110	110	54
12620	560	196	155	55	63.8	110	92	51.3
13620	520	196	155	55	63.8	110	92	51.3
14620	420	196	155	55	63.8	110	92	51.3
15620	340	173	120	43	40.9	116	73	30.9
16620	300	173	120	43	40.9	116	73	30.9
17620	276	173	120	43	40.9	116	73	30.9
18620	250	173	120	43	40.9	116	73	30.9
19620	250	173	120	43	40.9	116	73	30.9



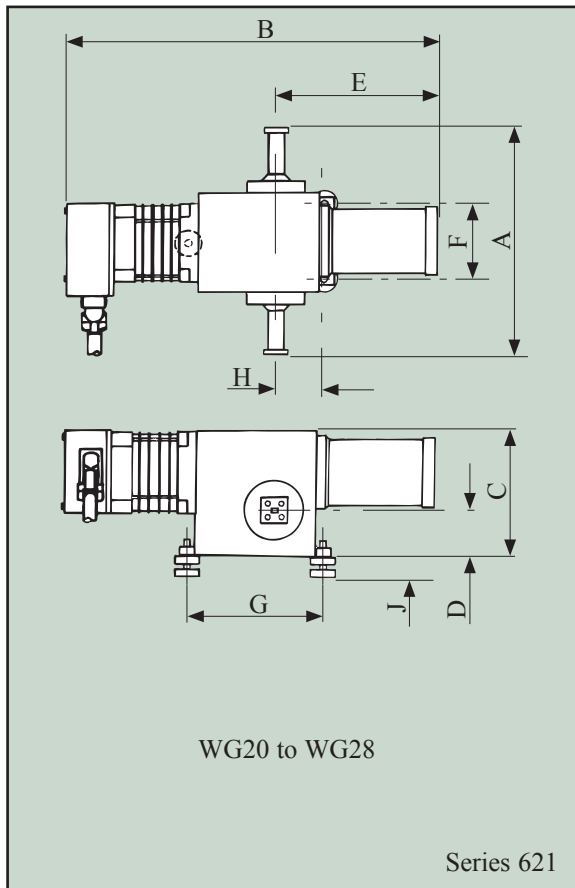
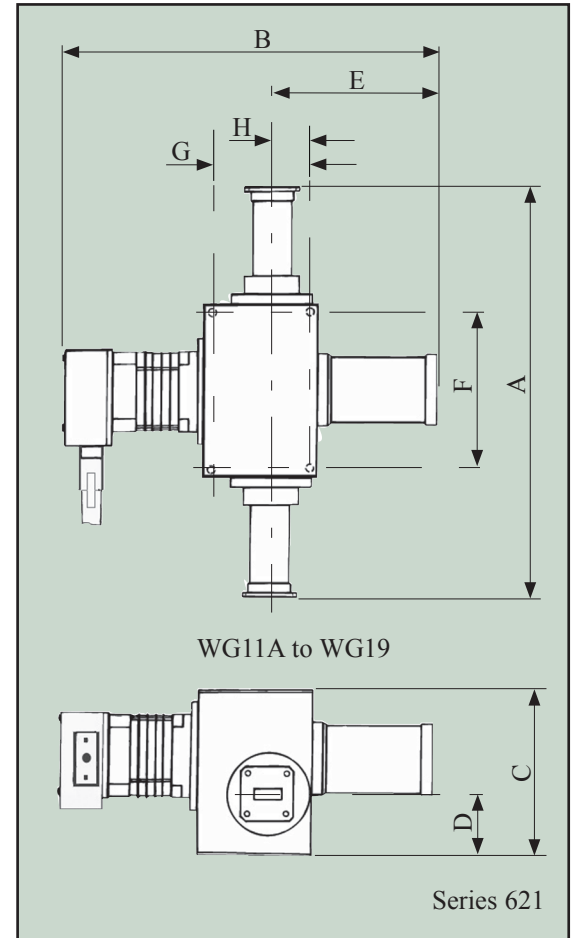
Model	Series 620 WG20 - WG32								
	Dimensions (mm)								
	A	B	C	D	E	F	G	H	J
20620	250	173.5	94	35	43	95	100	37	13/21
21620	225	173.5	94	35	43	95	100	37	13/21
22620	174	173.5	95.5	35	43	56	100	37	13/21
23620	140	173.5	95.5	35	43	50	100	37	13/21
24620	134	173.5	95.5	35	43	50	100	37	13/21
25620	100	181.5	95.5	35	46.7	56	103	41.7	13/21
26620	89	181.5	95.5	35	46.7	56	103	41.7	13/21
27620	89	181.5	95.5	35	46.7	56	103	41.7	13/21
28620	89	181.5	95.5	35	46.7	56	103	41.7	13/21
29620	Dimensions available on request								
30620									
31620									
32620									

Customised systems are available to suit special applications. Please contact our sales team for full details.

Programmable Rotary Vane Attenuators Series 621

Outline Dimensions

	Series 621 WG11A -WG19							
	Dimensions (mm)							
	A	B	C	D	E	F	G	H
11A621	687	311	166	66	148.5	110	110	54.0
12621	560	296	155	55	145.8	110	92	51.3
13621	520	296	155	55	145.8	110	92	51.3
14621	420	296	155	55	145.8	110	92	51.3
15621	340	273	120	43	122.9	116	73	32.9
16621	300	273	120	43	122.9	116	73	32.9
17621	276	273	120	43	122.9	116	73	32.9
18621	250	273	120	43	122.9	116	73	32.9
19621	250	273	120	43	122.9	116	73	32.9



Model	Series 621 WG20 -WG32								
	Dimensions (mm)								
	A	B	C	D	E	F	G	H	J
20621	250	273.5	95.5	35	118.7	95	100	37	13/21
21621	225	273.5	95.5	35	118.7	95	100	37	13/21
22621	174	274.5	95.5	35	118.7	56	100	37	13/21
23621	140	274.5	95.5	35	118.7	50	100	37	13/21
24621	134	274.5	95.5	35	118.7	50	100	37	13/21
25621	100	281.5	95.5	35	125.7	56	103	41.7	13/21
26621	89	281.5	95.5	35	125.7	56	103	41.7	13/21
27621	89	281.5	95.5	35	125.7	56	103	41.7	13/21
28621	89	281.5	95.5	35	125.7	56	103	41.7	13/21
29621	Dimensions available on request								
30621									
31621									
32621									

Customised systems are available to suit special applications. Please contact our sales team for full details.

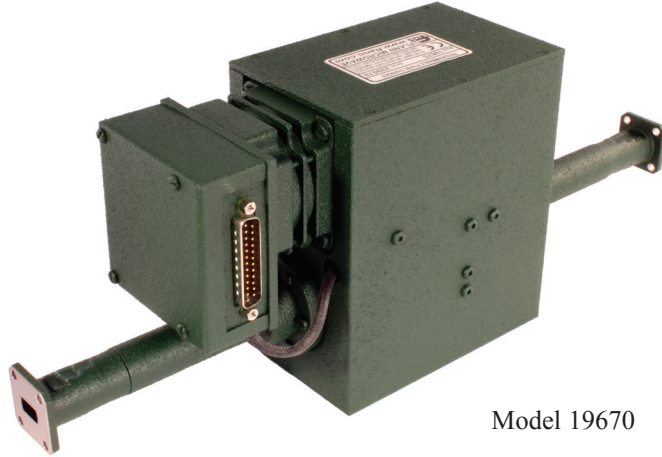
Programmable Rotary Vane Phase Changers Series 670

Features

- 3.22 GHz - 500 GHz
- 0.2 Degree Increments

The Programmable Rotary Vane Phase Changers Series 670 includes models suitable for operation in frequency bands from 3.22 GHz to 500 GHz.

The stepper motor driven units provide continuous phase change in both forward and reverse direction with the smallest increment of 0.2 degrees; the rate of phase change is 1480 degrees per second when driven by the CP2021 Flann Control Processor.



Model 19670

Specifications:

Operating Temperature Range 5°C to 35°C

(Please refer to Flann for wider temperature range consideration.)

Model	Frequency Range (GHz)	Waveguide				Accuracy	VSWR (better than)	Max Insertion Loss (dB)	Max Power (Watts)
		WG	WM	R	WR				
11A670	3.22 - 4.90	11A		40	229	3°	1.25	1.0	10.0
12670	3.94 - 5.99	12		48	187	3°	1.25	1.0	10.0
13670	4.64 - 7.05	13		58	159	3°	1.25	1.0	10.0
14670	5.38 - 8.18	14		70	137	3°	1.25	1.0	10.0
15670	6.58 - 10.0	15		84	112	3°	1.25	1.0	10.0
16670	8.20 - 12.5	16		100	90	3°	1.25	1.0	10.0
17670	9.84 - 15.0	17		120	75	3°	1.25	1.0	5.0
18670	11.9 - 18.0	18		140	62	4°	1.30	1.0	5.0
19670	14.5 - 22.0	19		180	51	4°	1.30	1.0	4.0
20670	17.6 - 26.7	20		220	42	4°	1.30	1.0	3.0
21670	21.7 - 33.0	21		260	34	4°	1.30	1.0	2.5
22670	26.4 - 40.1	22		320	28	4°	1.30	1.0	2.0
23670	33.0 - 50.1	23		400	22	4°	1.30	1.0	1.5
24670	39.3 - 59.7	24		500	19	4°	1.30	1.5	1.0
25670	49.9 - 75.8	25		620	15	5°	1.30	1.5	0.7
26670	60.5 - 92.0	26		740	12	5°	1.30	2.0	0.5
27670	73.8 - 112.0	27	2540	900	10	6°	1.30	2.5	0.2
28670	92.3 - 140.0	28	2032	1200	8	6°	1.50	2.5	0.2
29670	114 - 173	29	1651	1400	6	Specifications available on request			
30670	145 - 220	30	1295	1800	5				
31670	172 - 261	31	1092	2200	4				
32670	217 - 330	32	864	2600	3				
710670	260 - 400	-	710	-					
570670	330 - 500	-	570	-					

Dimensions: Full details are available on request

ORDERING INFORMATION

Model: Description

Example: Model 12670 Programmable Rotary Vane Phase Changer

Outline dimensions available on request.

Control Processor Series CP2021



Model CP2021

Control Processor Model CP2021 controls all Flann programmable products including Rotary Vane Attenuators, Phase Changers and Polarizers.

Applications:

- Automated production testing of microwave radios and satellite communication payloads
 - Fade margin testing
 - Gain control
 - Bit Error Rate
- Automated test and measurement systems
- Remote control systems
- Extraordinary resolution & settability at low attenuations

Attenuator Performance

- 0 dB to 60 dB in less than 1.1 seconds
- 0 dB to 120 dB in less than 2.2 seconds (2 attenuators connected in series)
- 3 GHz to 140 GHz (in waveguide bands)
- IEEE488.2 GPIB Bus and USB Control

Will position to:

- 0.01 dB between 0 dB & 21 dB
- 0.02 dB between 21 dB & 30 dB
- 0.05 dB between 30 dB & 48 dB
- 0.1 dB between 48 dB & 60 dB

- Unchallenged accuracy, reliability and repeatability
- Built in self test and diagnostics
- Control of 1 or 2 attenuators giving a possible attenuation range of 120 dB
- Universal line input, automatically switched between 115 V and 230 V
- Steps mode operation allows greater control over instrument positioning
- Recognises any Flann programmable products when connected to the drive ports
- Extended drive cable capability to 20 meters, with extended (slower drive) up to 50 meters
- HS488 High speed GPIB capability - up to 8 Mb/s
- Ability to learn previous CP92 series GPIB commands

Phase Changer Performance

- Continuous phase change in either forward or reverse direction
- Smallest phase change increment is 0.2°
- Rate of phase change is 1480 degrees per second.

Controlling Cable Requirements

- A conversion cable is required when driving
 - Series 610
 - Series 611
 - Series 660
- instrumentation using a CP2021

Precision Rotary Vane Attenuators Series 110

Features

- 1% accuracy
- 0 dB - 60 dB
- Direct Reading
- Unsurpassed Reliability
- 2.60 GHz to 500 GHz

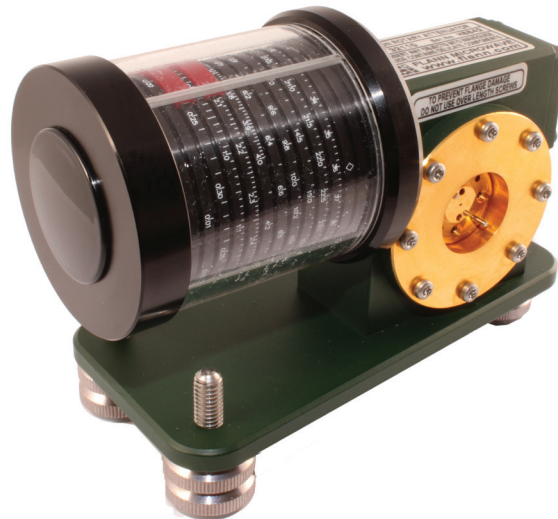
Applications

- Instrumentation
- Calibration

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

The Rotary Vane Attenuator is the ideal instrument for use in waveguide systems where broadband direct reading of attenuation is required, particularly as a standard for reflectometer and swept systems.

The Flann Rotary Vane Attenuator consists of a rotating circular waveguide section flanked by a pair of low VSWR rectangular to circular transitions. The three waveguide sections are fitted with stable high attenuation elements which ensure close agreement of the attenuation characteristic to the theoretical law. The attenuation is directly related to the relative angular position of the attenuating element in the centre section (\emptyset) and can be seen to follow the law $40 \log (\sec \emptyset)$. The attenuation is insensitive to frequency;



Model 32110

variations of phase with attenuation are negligible. Choking of the rotating joints is employed to minimise RF leakage whilst sound mechanical design ensures the instruments are free from backlash. A precision 10 turn, 75 mm diameter helical drum scale provides extremely high resolution as the table below indicates:-

Attenuation scale range	1-4dB	4-30dB	30-40dB	40-60dB
Scale increment	0.01dB	0.1dB	0.2dB	0.5dB

Discrimination of the drum scale over a 0 dB to 60 dB attenuation range

By using high value attenuation markings on the scale, symmetrically positioned about the maximum attenuation position, the user is able to verify the attenuation characteristic alignment which gives the highest confidence in the accuracy of subsequent measurements.

Custom Built Units:-

Special attenuators can be supplied with a calibration range in excess of 60 dB. Combined rotary vane attenuator and rotary vane phase changer units are also available; these units are usually coupled at the circular waveguide section thereby minimising mismatch errors at low attenuation settings.

Attenuation (dB)	Repeatability (dB)
10	0.002
20	0.003
40	0.005
60	0.008

Attenuation repeatability over a 0 dB to 60 dB attenuation range

Precision Rotary Vane Attenuators Series 110

Specifications: All ranges 0 dB to 60 dB with the following accuracy¹

	WG10 to WG29	WG30	WG31	WG32	WM710	WM570
Attenuation accuracy	0 dB to 60 dB	0 dB to 50 dB	0 dB to 45 dB	0 dB to 40 dB	0 dB to 35 dB	0 dB to 30 dB
	0.1 dB or 1% whichever is greater	0.15 dB or 1.2% whichever is greater	0.2 dB or 1.5% whichever is greater	0.2 dB or 1.5% whichever is greater	0.3 dB or 2.0% whichever is greater	0.4 dB or 2.5% whichever is greater

Operating temperature range: +5°C to +35°C (Refer to Flann for wider temperature range consideration)

Note 1: Customised models with extended attenuation ranges can be supplied. Please contact our Sales Team for further details.

Model	Frequency Range (GHz)	Waveguide				VSWR (better than)	Maximum Insertion Loss (dB)	Maximum Power (Watts)	Dimensions (mm)					Weight (kg)
		WG	WM	R	WR				A	B	C	D	E	
10110	2.60 - 3.95	10	-	32	284	1.15	0.25	12	935	358	198	88.2*	108	28
11A110	3.22 - 4.90	11A	-	40	229	1.15	0.25	10	687	358	198	81.2*	108	13
12110	3.94 - 5.99	12	-	48	187	1.15	0.25	10	560	244	149	66/75	58	8.5
13110	4.64 - 7.05	13	-	58	159	1.15	0.25	9	520	244	149	66/75	58	8.0
14110	5.38 - 8.18	14	-	70	137	1.15	0.25	8	420	244	149	66/75	58	6.0
15110	6.58 - 10.0	15	-	84	112	1.15	0.25	6	340	226	119	45/54	44	4.0
16110	8.20 - 12.5	16	-	100	90	1.15	0.25	4	300	226	119	45/54	44	3.8
17110	9.84 - 15.0	17	-	120	75	1.15	0.25	3	276	226	119	45/54	44	3.8
18110	11.9 - 18.0	18	-	140	62	1.15	0.3	2	250	226	119	45/54	44	3.4
19110	14.5 - 22.0	19	-	180	51	1.15	0.4	1.5	250	226	119	45/54	44	3.4
20110	17.6 - 26.7	20	-	220	42	1.15	0.6	1	250	226	119	45/54	44	3.3
21110	21.7 - 33.0	21	-	260	34	1.15	0.8	0.75	225	226	119	45/54	44	3.2
22110	26.4 - 40.1	22	-	320	28	1.15	0.9	0.5	174	227	119	55/64	36	2.6
23110	33.0 - 50.1	23	-	400	22	1.15	1.0	0.3	140	227	119	55/64	36	2.6
24110	39.3 - 59.7	24	-	500	19	1.15	1.0	0.25	134	227	119	55/64	36	2.6
25110	49.9 - 75.8	25	-	620	15	1.15	1.0	0.15	100	227	119	55/64	36	2.5
26110	60.5 - 92.0	26	-	740	12	1.15	1.3	0.1	89	227	119	55/64	36	2.5
27110	73.8 - 112.0	27	-	900	10	1.15	1.5	0.07	89	227	119	55/64	36	2.5
28110	92.3 - 140	28	-	1200	8	1.20	1.8	0.05	89	227	119	55/64	36	2.3
29110	114 - 173	29	-	1400	6	1.25	2.2	0.035	58	227	119	55/64	36	2.3
30110	145 - 220	30	-	1800	5	1.28	2.7	0.02	42.8	127.5	79.5	46/55	41.5	1.1
31110	172 - 261	31	-	2200	4	1.40	3.0	0.015	38	127.5	79.5	46/55	41.5	1.1
32110	217 - 330	32	-	2600	3	1.55	3.5	0.01	32	127.5	79.5	46/55	41.5	1.1
710110	260 - 400	-	710	-	'2.8'	1.75	4.0	0.007	28	127.5	79.5	46/55	41.5	1.1
570110	330 - 500	-	570	-	'2.2'	2.20	4.5**	0.005	23	127.5	79.5	46/55	41.5	1.1

* Non-adjustable mounting feet

**5.3 dB @ 500 GHz

ORDERING INFORMATION
 Model: Description
 Example: Model 16110 Rotary Vane Attenuator

For standard flange types and recommendations see pages 118 onwards

Field Useable Rotary Vane Attenuators Series 113

Features

- **Direct Reading**
- **Continuously Variable**
- **Splash Proof**
- **Ruggedised Transportation Case**
- **Low Cost**

Specifications

Attenuation Range	0 dB to 50 dB (Optionally 0 dB to 60dB)
Attenuation Accuracy	0.5 dB
VSWR	1.15 : 1

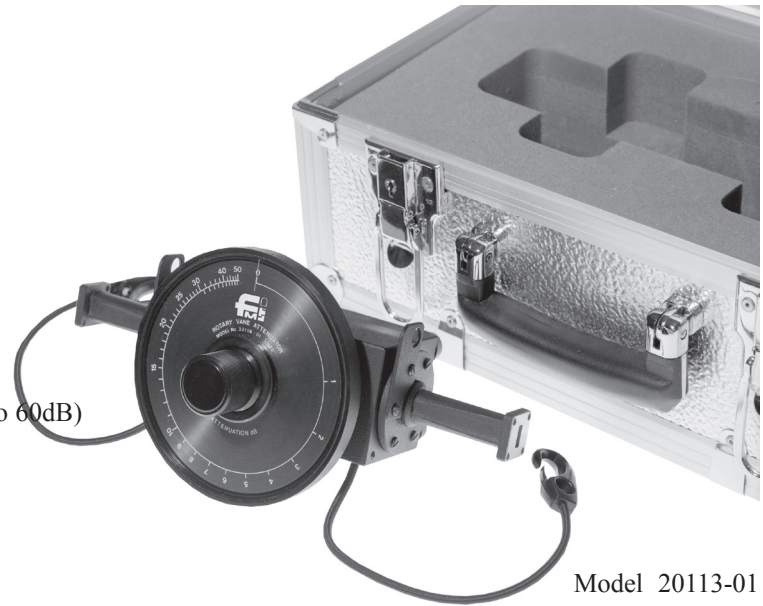
The Flann range of Field Useable Rotary Vane Attenuators, Series 113, has been developed in response to the specific requirements of major UK and European communication companies, operating national point to point Microwave Radio Networks, for Fade Margin and Bit Error Rate measurements in a field test environment.

Models in the range utilise many of the components from the highly regarded precision rotary vane attenuators produced by the company. Each instrument features a direct reading scale calibrated in 1 dB increments from 0 dB to 50 dB. The attenuation accuracy is 0.5 dB over the full waveguide frequency band. Models with an extended attenuation range up to 60 dB are available to special order.

Reliability in a field test environment is enhanced by the splash proof design. Two expandable securing straps allow hands-free attenuator operation in difficult situations. The units are optionally available housed in a fitted rugged aluminium transportation case.

The attenuators can be supplied fitted with ancillary pieces of test equipment to suit specific applications; in some instances these may be accommodated within the transportation case. For example, ancillary components could include flexible waveguides, waveguide to coaxial adaptors or fixed attenuators for an extended attenuation range.

Models are available in other waveguide sizes and frequency ranges. Details on request.



Model 20113-01

Model	Waveguide			Frequency Range (GHz)	Flange to Flange Length (mm)
	WG	WR	R		
15113	15	112	84	6.58 - 10.0	340
17113	17	75	120	9.84 - 15.0	276
18113	18	62	140	11.9 - 18.0	250
20113	20	42	220	17.6 - 26.7	250
22113	22	28	320	26.4 - 40.1	174

Model	Dimensions (mm)									
	A	B	C	D	E	F	G	H	ØJ	ØK
15113	340	140	95.5	55	89	44.5	12	10	120	28
17113	276	108	79.5	39	57	28.5	12	10	120	28
18113	250	108	79.5	39	57	28.5	12	10	120	28
20113	250	108	79.5	39	57	28.5	12	10	120	28
22113	174	108	79.5	39	57	28.5	12	10	120	28

Option Suffix	Model
50 dB model - case and securing straps supplied	-01
50 dB model - case and securing straps not supplied	-02
60 dB model - case and securing straps supplied	-11
60 dB model - case and securing straps not supplied	-12

ORDERING INFORMATION
Model: option suffix; description
Example: Model 17113-01 special rotary vane attenuator, 50 dB option with case and securing straps

Series 113

Variable Attenuators Series 080

Features

- 0 dB - 20 dB Attenuation
- VSWR Better than 1.10:1

The Flann Series 080 of Variable Attenuators is suitable for applications where calibrated attenuators are not required, such as level-setting or padding.

Models 11A080 to 20080 inclusive

Each unit consists of a length of waveguide with a bearing tube mounted on an external H plane wall. Passing through the tube is a close fitting plunger which carries, and varies the position of, the attenuation element within the waveguide. A locking screw is provided to secure the element at the required position. The attenuating elements are ni-chromed glass.

Model 22080 to 24080

These units are similar to the above but provided with a threaded drive mechanism to the attenuating element and a locking ring for securing at a fixed position. The attenuating element is of ni-chrome evaporated on glass.

Model 25080 to 27080

On these units the attenuating element of ni-chromed glass is introduced into the waveguide via a slot in the broad wall. Vane position is varied by a threaded drive mechanism.

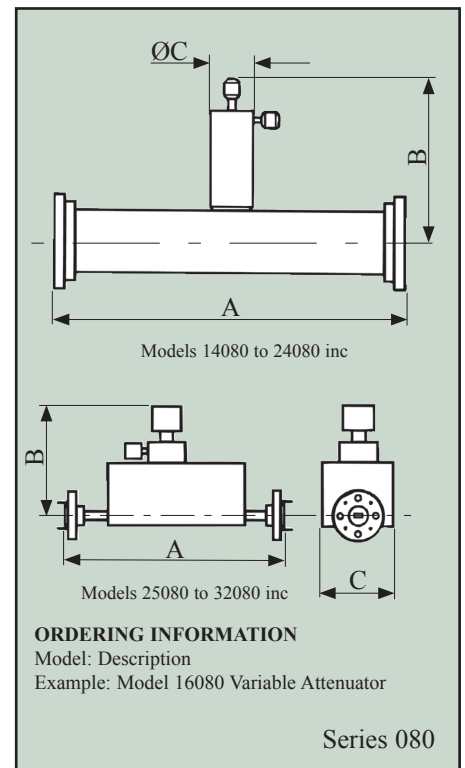


Model 20080

Specifications:

Attenuation Range	0 dB - 20 dB
VSWR (maximum)	1.10 : 1

Model	Frequency Range (GHz)	Waveguide			Maximum Insertion Loss (dB)	Maximum Power (Watts)	Dimensions (mm)		
		WG	R	WR			A	B	C
11A080	3.22 - 4.90	11A	40	229	0.2	2.0	275	125	22
12080	3.94 - 5.99	12	48	187	0.2	2.0	229	11	22
13080	4.64 - 7.05	13	58	159	0.2	1.5	ON REQUEST		
14080	5.38 - 8.18	14	70	137	0.2	1.0	240	93	22
15080	6.58 - 10.0	15	84	112	0.2	1.0	180	85	19
16080	8.20 - 12.5	16	100	90	0.2	0.75	131	84	19
17080	9.84 - 15.0	17	120	75	0.2	0.75	120	80	19
18080	11.9 - 18.0	18	140	62	0.3	0.75	100	70	19
19080	14.5 - 22.0	19	180	51	0.3	0.75	90	67	19
20080	17.6 - 26.7	20	220	42	0.3	0.5	76	56	19
21080	21.7 - 33.0	21	260	34	0.4	0.5	76	52	19
22080	26.4 - 40.1	22	320	28	0.4	0.5	70	45	16
23080	33.0 - 50.1	23	400	22	0.5	0.5	69	42	16
24080	39.3 - 59.7	24	500	19	0.6	0.5	90	45	16
25080	49.9 - 75.8	25	620	15	0.5	0.3	90	45	30
26080	60.5 - 92.0	26	740	12	0.5	0.3	90	45	30
27080	73.8 - 112	27	900	10	0.6	0.3	90	45	30



For standard flange types and recommendations see pages 118 onwards

Precision Fixed Attenuators

Series 580 / 582

Features

- **Very High Stability**
- **Attenuation variation with frequency less than ± 1.5 dB over full waveguide band @ 500 GHz**
- **Very Low Coupling Sensitivity vs Temperature**
- **High Power Versions Available**

The Flann range of Precision Fixed Attenuators, Series 580 & 582, are very highly stable devices **eminently suitable for use in attenuation transfer standards and verification standards** for attenuation measurement systems or network analysers. The units are based on directional couplers and offer low attenuation variation with frequency, typically less than 0.5 dB, and low VSWR over the full waveguide band.

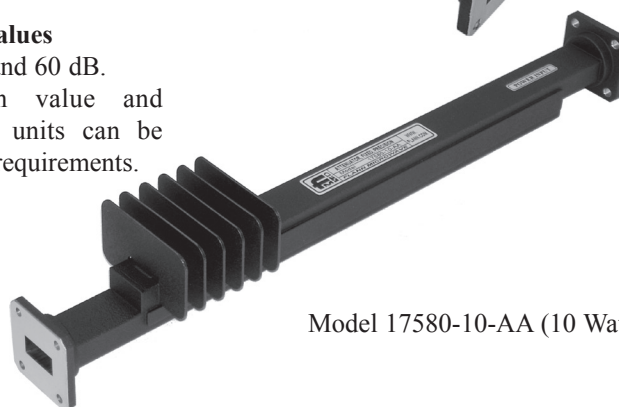
Standard attenuation values

3, 6, 10, 20, 30, 40, 50 and 60 dB.

Alternative attenuation value and high power handling units can be manufactured to special requirements.



Model 22580-20



Model 17580-10-AA (10 Watts)

Model	Frequency Range (GHz)	Waveguide				Attenuation				VSWR (better than)
		WG	WM	R	WR	Sensitivity (\pm dB)	Nominal Accuracy (dB)			
							3 - 6	10	20 - 60	
14580	5.38 - 8.18	14	-	70	137	0.5	0.5	0.5	1.0	1.10
15580	6.58 - 10.0	15	-	84	112	0.5	0.5	0.5	1.0	1.10
16580	8.20 - 12.50	16	-	100	90	0.5	0.5	0.5	1.0	1.10
17580	9.84 - 15.0	17	-	120	75	0.5	0.5	0.5	1.0	1.10
18580	11.9 - 18.0	18	-	140	62	0.5	0.5	0.5	1.0	1.10
19580	14.5 - 22.0	19	-	180	51	0.5	0.5	0.5	1.0	1.10
20580	17.6 - 26.7	20	-	220	42	0.75	0.5	0.75	1.2	1.10
21580	21.7 - 33.0	21	-	260	34	0.75	0.5	0.75	1.2	1.10
22580	26.4 - 40.1	22	-	320	28	0.75	0.5	0.75	1.2	1.10
23582	33.0 - 50.1	23	-	400	22	0.75	0.5	0.75	1.2	1.15
24582	39.3 - 59.7	24	-	500	19	0.75	0.5	0.75	1.2	1.15
25582	49.9 - 75.8	25	-	620	15	0.75	0.5	0.75	1.2	1.15
26582	60.5 - 92.0	26	-	740	12	1.0	0.5	0.75	1.5	1.15
27582	73.8 - 112	27	-	900	10	1.0	0.75	1.0	1.5	1.15
28582	92.3 - 140	28	-	1200	8	1.0	0.75	1.0	1.5	1.15
29582	114 - 173	29	-	1400	6	1.0	0.75	1.0	1.5	1.20
30582	145 - 220	30	-	1800	5	1.0	0.85	1.2	2.0	1.25
31582	172 - 261	31	-	2200	4	1.2	0.85	1.2	2.0	1.30
32582	217 - 330	32	-	2600	3	1.2	0.85	1.2	2.0	1.40
710582	260 - 400	-	710	-	'2.8'	1.5	1.0	1.5	2.5	1.60
570582	330 - 500	-	570	-	'2.2'	1.5	1.0	1.5	2.5	2.00

ORDERING INFORMATION

Model: attenuation value suffix; description Example: Model 22580-20 precision fixed 20 dB attenuator

For standard flange types and recommendations see pages 118 onwards

Calibrated Variable Attenuators Series 020

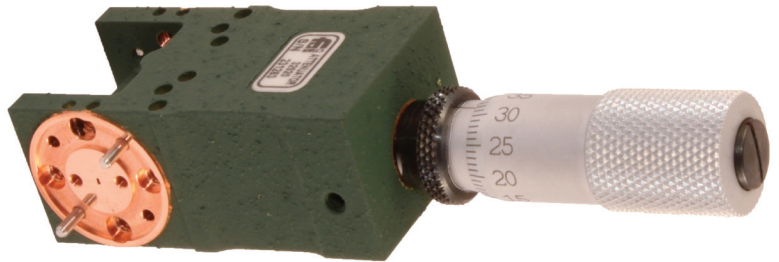
Features

- Models from 1.72 GHz to 500 GHz
- 0 dB - 30 dB* Calibrated Attenuation Range
- Low VSWR

The Flann Series 020 of Calibrated Variable attenuators are fitted with a stable precision attenuating elements driven across the waveguide section by a micrometer.

The micrometer drive is free from backlash, permitting attenuation calibration to a high accuracy. The micrometer is fitted with a locking device which enables the adjusting mechanism to be set and locked at any setting. The attenuating elements are constructed from an extremely stable ni-chromed glass composite.

*WG29 - WM570 calibrated attenuation range 0 - 25 dB



Model 32020

On models 08020 to 21020 the vane is introduced transversely across the waveguide.

Models 22020 - 570020 have a vane introduced through a slot in the centre of the broad wall.

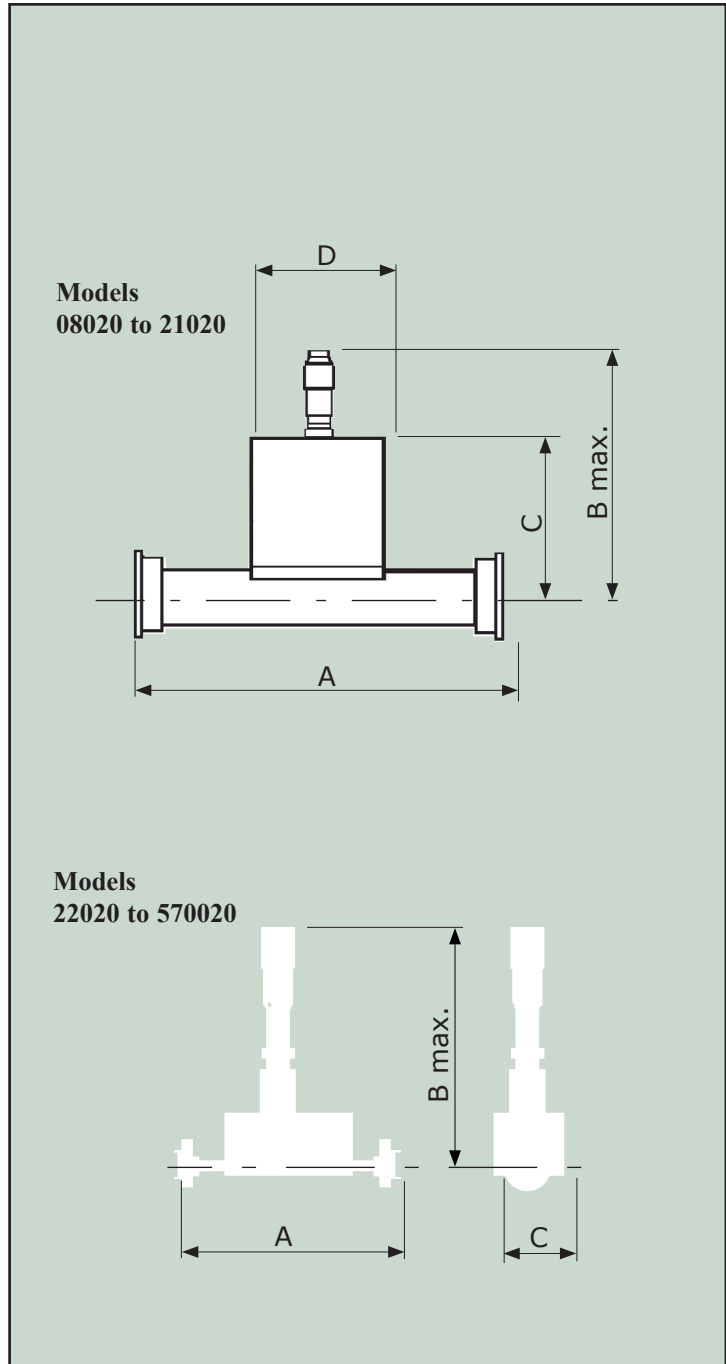
A calibration is provided at the centre band frequency unless otherwise specified.

Calibration at additional frequencies can be provided at extra cost.

Model	Frequency Range (GHz)	Waveguide				VSWR (Max)	Calibration Accuracy (\pm dB)	Calibration Frequency (GHz)	Maximum Insertion Loss (dB)	Maximum Power (Watts)
		WG	WM	R	WR					
08020	1.72 - 2.61	8	-	22	430	1.07	0.2	2.17	0.2	4.0
10020	2.60 - 3.95	10	-	32	284	1.07	0.2	3.28	0.2	2.5
11A020	3.22 - 4.90	11A	-	40	229	1.07	0.2	4.10	0.2	2.0
12020	3.94 - 5.99	12	-	48	187	1.07	0.2	4.97	0.2	2.0
13020	4.64 - 7.05	13	-	58	159	1.07	0.2	5.85	0.2	2.0
14020	5.38 - 8.18	14	-	70	137	1.07	0.2	6.78	0.2	1.0
15020	6.58 - 10.0	15	-	84	112	1.07	0.2	8.29	0.2	1.0
16020	8.20 - 12.5	16	-	100	90	1.07	0.2	10.35	0.2	1.0
17020	9.84 - 15.0	17	-	120	75	1.07	0.2	12.42	0.2	0.75
18020	11.9 - 18.0	18	-	140	62	1.07	0.3	14.95	0.3	0.75
19020	14.5 - 22.0	19	-	180	51	1.07	0.3	18.25	0.3	0.75
20020	17.6 - 26.7	20	-	220	42	1.07	0.3	22.15	0.3	0.5
21020	21.7 - 33.0	21	-	260	34	1.07	0.35	27.35	0.3	0.5
22020	26.4 - 40.1	22	-	320	28	1.07	0.4	33.25	0.4	0.4
23020	33.0 - 50.1	23	-	400	22	1.07	0.2	41.55	0.2	0.35
24020	39.3 - 59.7	24	-	500	19	1.07	0.2	49.50	0.2	0.3
25020	49.9 - 75.8	25	-	620	15	1.07	0.25	62.85	0.2	0.25
26020	60.5 - 92.0	26	-	740	12	1.07	0.3	76.25	0.3	0.2
27020	73.8 - 112	27	-	900	10	1.07	0.4	92.9	0.4	0.15
28020	92.3 - 140	28	-	1200	8	1.09	0.6	116.2	0.5	0.12
29020*	114 - 173	29	-	1400	6	1.11	0.9	140	0.7	0.1
30020*	145 - 220	30	-	1800	5	1.15	1.3	180	0.8	0.08
31020*	172 - 261	31	-	2200	4	1.18	1.0	215	0.7	0.06
32020*	217 - 330	32	-	2600	3	1.24	1.5	275	1.0	0.05
710020*	260 - 400	-	710	-	'2.8'	1.3	2.0	330	1.2	0.04
570020*	330 - 500	-	570	-	'2.2'	1.4	2.0	415	3.0	0.03

Calibrated Variable Attenuators Series 020

Model	Dimensions (mm)			
	A	B Max	C	Dia D
10020	430	223	138	151
11A020	380	217	132	151
12020	370	145	92	86
13020	340	141	89	86
14020	310	138	86	64
15020	240	132	83	64
16020	180	127	79	64
17020	180	125	78	64
18020	150	100	54	35
19020	125	97	52	35
20020	80	95	51	35
21020	80	94	50	35
22020	80	90	31	-
23020	75	85	31	-
24020	75	85	31	-
25020	60	80	22	-
26020	60	80	22	-
27020	60	80	22	-
28020	60	80	22	-
29020	60	80	22	-
30020	30	80	22	-
31020	25	80	22	-
32020	25	80	22	-
710020	20	80	22	-
570020	20	80	22	-



ORDERING INFORMATION

Model: description, calibration frequency (if different from centre band)

Example: Model 18020 calibrated variable attenuator, calibration frequency 14.95GHz

Series 020

For standard flange types and recommendations see pages 118 onwards

Fixed Attenuators Series 081

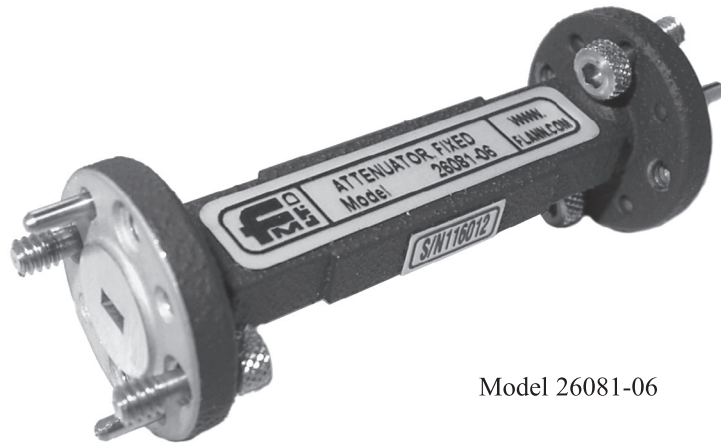
Features

- Full Waveguide Band
- Low Frequency Sensitivity

The fixed attenuators, Series 081, are low VSWR devices suitable for operating over the full waveguide band.

The absolute attenuation is within $\pm 10\%$ of nominal value.

Standard models are available in a range of attenuation values from 3 dB to 30 dB. Units with attenuation values of 40 dB and 50 dB are available to special order. Higher attenuation values can also be accommodated details on request.



Model 26081-06

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)		Mean Power (W)	Flange to Flange length (mm)
		WG	R	WR	Models 3 to 25 dB	Models >30 dB		
12081	3.94 - 5.99	15	48	187	1.10	1.20	1.0	229
14081	5.38 - 8.18	14	70	137	1.10	1.20	0.5	280
15081	6.58 - 10.0	15	84	112	1.10	1.20	0.5	180
16081	8.20 - 12.5	16	100	90	1.10	1.20	0.5	130
17081	9.84 - 15.0	17	120	75	1.10	1.20	0.5	120
18081	11.9 - 18.0	18	140	62	1.10	1.20	0.5	120
19081	14.5 - 22.0	19	180	51	1.10	12.0	0.4	110
20081	17.6 - 26.7	20	220	42	1.10	1.20	0.3	76
21081	21.7 - 33.0	21	260	34	1.10	1.20	0.3	76
22081	26.4 - 40.1	22	320	28	1.10	1.20	0.3	70
23081	33.0 - 50.1	23	400	22	1.10	1.20	0.25	70
24081	39.3 - 59.7	24	500	19	1.10	1.20	0.25	70
25081	49.9 - 75.8	25	620	15	1.10	1.20	0.2	60
26081	60.5 - 92.0	26	740	12	1.10	1.20	0.2	50
27081	73.8 - 112	27	900	10	1.10	1.20	0.15	50
28081	92.3 - 140	28	1200	8	1.10	1.20	0.1	50
29081	114 - 173	29	1400	6	1.10	1.20	0.1	40
30081	145 - 220	30	1800	5	1.10	1.20	0.5	40
31081	172 - 261	31	2200	4	1.10	1.20	0.5	40
32081	217 - 330	32	2600	3	1.10	1.20	0.5	50

Standard Attenuation Values	Suffix
3 dB	03
6 dB	06
10 dB	10
20 dB	20
30 dB	30

ORDERING INFORMATION

Model: attenuation value suffix; description

Example: Model 26081-06 fixed attenuator

OTHER ATTENUATION VALUES ARE AVAILABLE TO ORDER

Series 081

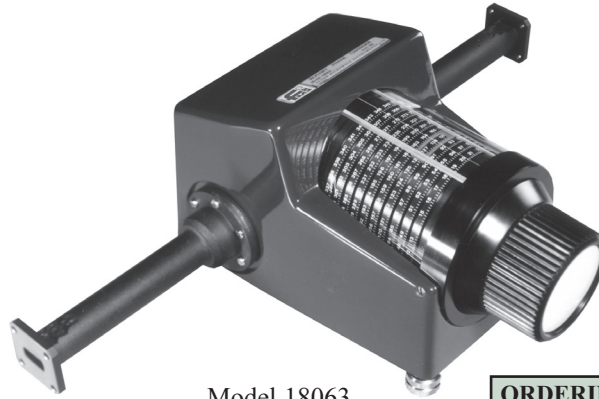
For standard flange types and recommendations see pages 118 onwards

Rotary Vane Phase Changers: Series 063

Features

- **Direct Reading**
- **0° – 360° Continuous Phase Change**
- **High Repeatability**
- **Low Insertion Loss**

The Flann Series 063 of instruments facilitates the continuous control of phase change over the range 0° to 360°. A ten turn drum scale is linearly calibrated in degrees and indicates differential phase change to a smallest increment of 0.2°.



Model 18063

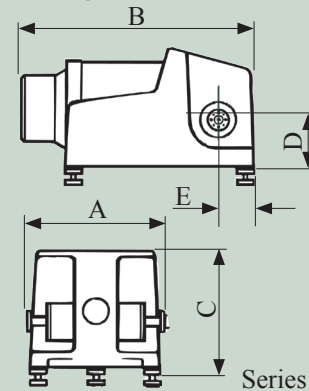
The rotary vane phase changer consists of a dielectric half wave plate housed in the rotating circular waveguide section. The Rotary Vane Phase Changer is direct reading and frequency insensitive making it suitable for use in microwave bridges and precise phase change measurements.

The rotary vane phase changer consists of a pair of rectangular to circular, stepped or tapered, electroformed transitions providing good VSWR whilst ensuring minimal overall length. Each transition incorporates a mode suppression vane and dielectric quarter wave plate.

The differential phase change is determined by the relative angular position of the

ORDERING INFORMATION

Model: Description
Example: Model 23063 Rotary Vane Phase Changer



Series 063

For Programmable Rotary Phase Changers see page 12

Model	Frequency Range (GHz)	Waveguide			Accuracy	Maximum Insertion Loss (dB)	VSWR (better than)	Maximum Power (Watts)	Dimensions (mm)				
		WG	R	WR					A	B	C	D	E
08063	1.72 - 2.61	8	22	430	3°	1.0	1.25	15	ON REQUEST				
10063	2.60 - 3.95	10	32	430	3°	1.0	1.25	15	1375	358	198	88.2*	108
11A063	3.22 - 4.90	11A	40	229	3°	1.0	1.25	15	991	340	153	81.2*	85
12063	3.94 - 5.99	12	48	187	3°	1.0	1.25	10	777	244	147	66/75	58
13063	4.64 - 7.05	13	58	159	3°	1.0	1.25	10	750	244	147	66/75	58
14063	5.38 - 8.18	14	70	137	3°	1.0	1.25	10	680	244	147	66/75	58
15063	6.58 - 10.0	15	84	112	3°	1.0	1.25	10	620	226	117	45/54	44
16063	8.20 - 12.5	16	100	90	3°	1.0	1.25	10	496	226	117	45/54	44
17063	9.84 - 15.0	17	120	75	3°	1.0	1.25	5	446	226	117	45/54	44
18063	11.9 - 18.0	18	140	62	4°	1.0	1.30	5	388	226	117	45/54	44
19063	14.5 - 22.0	19	180	51	4°	1.0	1.30	4	388	226	117	45/54	44
20063	17.6 - 26.7	20	220	42	4°	1.0	1.30	3	378	226	117	45/54	44
21063	21.7 - 33.0	21	260	34	4°	1.0	1.30	2.5	335	226	117	45/54	44
22063	26.4 - 40.1	22	320	28	4°	1.0	1.30	2.0	230	227	117	55/64	36
23063	33.0 - 50.1	23	400	22	4°	1.0	1.30	1.5	196	227	117	55/64	36
24063	39.3 - 59.7	24	500	19	4°	1.5	1.30	1.0	184	227	117	55/64	36
25063	49.9 - 75.8	25	620	15	5°	1.5	1.30	0.7	156	227	117	55/64	36
26063	60.5 - 92.0	26	740	12	5°	2.0	1.30	0.5	136	227	117	55/64	36
27063	73.8 - 112	27	900	10	6°	2.5	1.30	0.2	119	227	117	55/64	36
28063	92.3 - 140	28	1200	8	6°	2.5	1.50	0.2	119	227	117	55/64	36
29063	114 - 173	29	1400	6	Specifications available on request				Dimensions available on request				
30063	145 - 220	30	1800	5									
31063	172 - 261	31	2200	4									
32063	217 - 330	32	2600	3									

For standard flange types and recommendations see pages 118 onwards

* Non adjustable mounting feet

Calibrated Phase Changers: Series 060 / 061

Features

- **0° – 180° Calibrated Phase Change Range**
- **Low Insertion Loss**

The Flann Series 060 / 061 instruments are fitted with low VSWR dielectric elements coupled to a precision micrometer drive. The micrometer indicates the relative position of the dielectric element in the waveguide. All models provide a minimum of 180 degrees phase change and exhibit a very low insertion loss. The micrometer is fitted with a locking device which enables the adjusting mechanism to be locked at any setting. Two calibrations are provided at standard frequencies within each waveguide band. Alternatively the two calibration frequencies may be specified by the customer.

In the standard models 06060 to 22060 the dielectric element is introduced into the waveguide in a transverse manner. The standard 060 series instruments do not cover the top 15% of the waveguide frequency band.



Model 20060

When full band coverage is essential special models can be supplied at extra cost and are designated the 061 Series. For example, model 18061 is a full band model covering the frequency range 11.9 GHz to 18.0 GHz. Models 06061 to 22061 have VSWR better than 1.3:1 over the full waveguide band.

Models in the waveguide sizes WG23 (WR22) to WG32 (WR8) introduce the dielectric element into the waveguide via a slot on the centre line of the broad wall and are suitable for the full band operation as standard.

* For full waveguide band coverage order Model 061.

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	Calibration Accuracy	Standard Calibration Frequencies (GHz)	
		WG	R	WR				
06060*	1.14 - 1.73	6	14	650	1.1	2°	1.34	1.53
08060*	1.72 - 2.61	8	22	430	1.1	2°	2.02	2.31
10060*	2.60 - 3.95	10	32	284	1.1	2°	3.05	3.50
11A060*	3.22 - 4.90	11A	40	229	1.1	2°	3.83	4.37
12060*	3.94 - 5.99	12	48	187	1.1	2°	4.62	5.31
13060*	4.64 - 7.05	13	58	159	1.1	2°	5.44	6.25
14060*	5.38 - 8.18	14	70	13	1.1	2°	6.31	7.25
15060*	6.58 - 10.0	15	84	112	1.1	2°	7.72	8.86
16060*	8.20 - 12.5	16	100	90	1.1	2°	9.63	11.07
17060*	9.84 - 15.0	17	120	75	1.1	2°	11.56	13.28
18060*	11.9 - 18.0	18	140	62	1.1	2°	13.93	15.97
19060*	14.5 - 22.0	19	180	51	1.1	2°	17.00	19.50
20060*	17.6 - 26.7	20	220	42	1.15	2°	20.63	23.67
21060*	21.7 - 33.0	21	260	34	1.15	3°	25.46	29.23
22060*	26.4 - 40.1	22	320	28	1.15	3°	30.97	35.53
23061	33.0 - 50.1	23	400	22	1.15	3°	38.70	44.40
24061	39.3 - 59.7	24	500	19	1.15	3°	46.10	52.90
25061	49.9 - 75.8	25	620	15	1.25	3°	58.53	67.17
26061	60.5 - 92.0	26	740	12	1.25	3°	71.00	81.50
27061	73.8 - 112	27	900	10	1.25	3°	85.87	97.93
28061	92.3 - 140	28	1200	8	1.25	3°	108.20	124.1
29061	114 - 173	29	1400	6				
30061	145 - 220	30	1800	5				
31061	172 - 261	31	2200	4				
32061	217 - 330	32	2600	3				

Specifications available on request

Calibrated Phase Changers

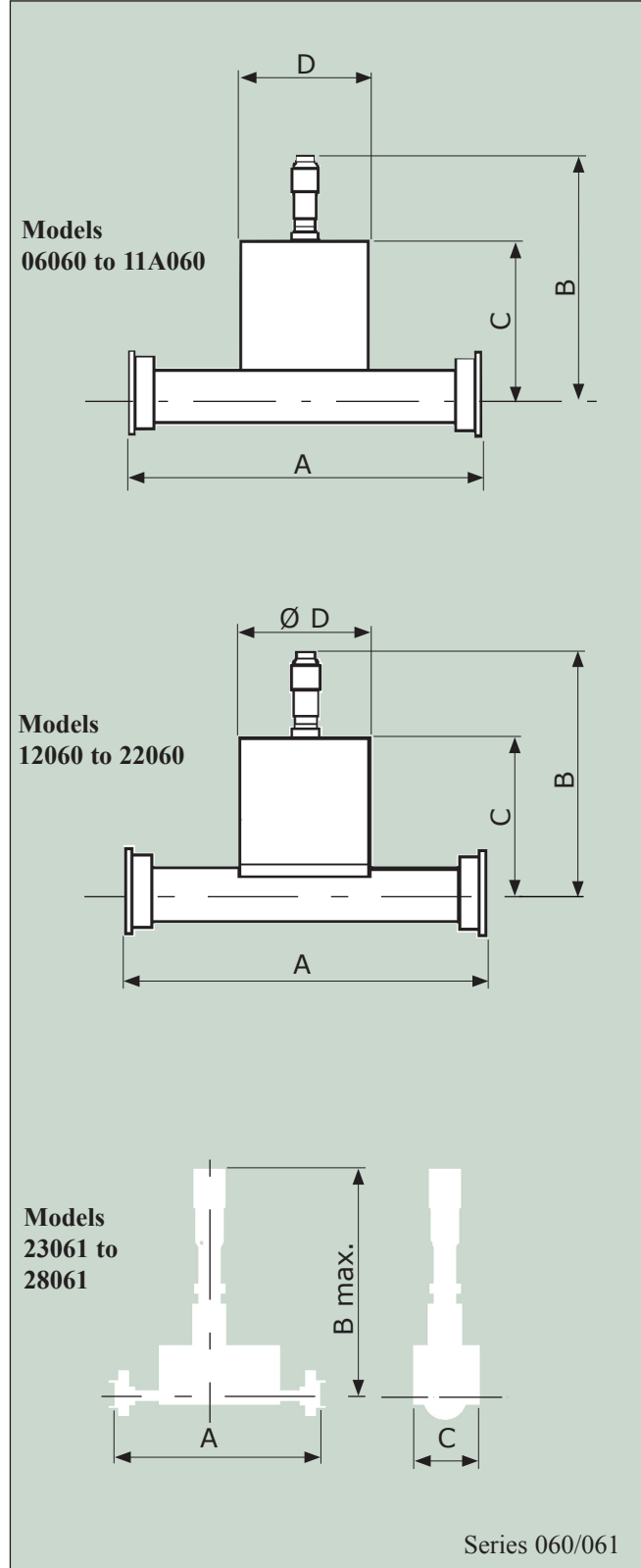
Series 060 / 061

Outline Dimensions

Model	Dimensions (mm)			
	A	B Max	C	D
06060	1250	372	216	400
08060	850	242	157	151
10060	480	223	138	151
11A060	450	217	132	151

Model	Dimensions (mm)			
	A	B Max	C	Dia D
12060	370	145	92	86
13060	340	141	89	86
14060	310	138	86	64
15060	240	132	83	64
16060	180	127	79	64
17060	180	125	78	64
18060	150	100	54	35
19060	125	97	52	35
20060	80	95	51	35
22060	70	100	49	12

Model	Dimensions (mm)		
	A	B Max	C
23061	75	96	30
24061	75	96	30
25061	60	96	30
26061	60	96	30
27061	60	96	30
28061	60	96	30
29061	Dimensions available on request		
30061			
31061			
32061			

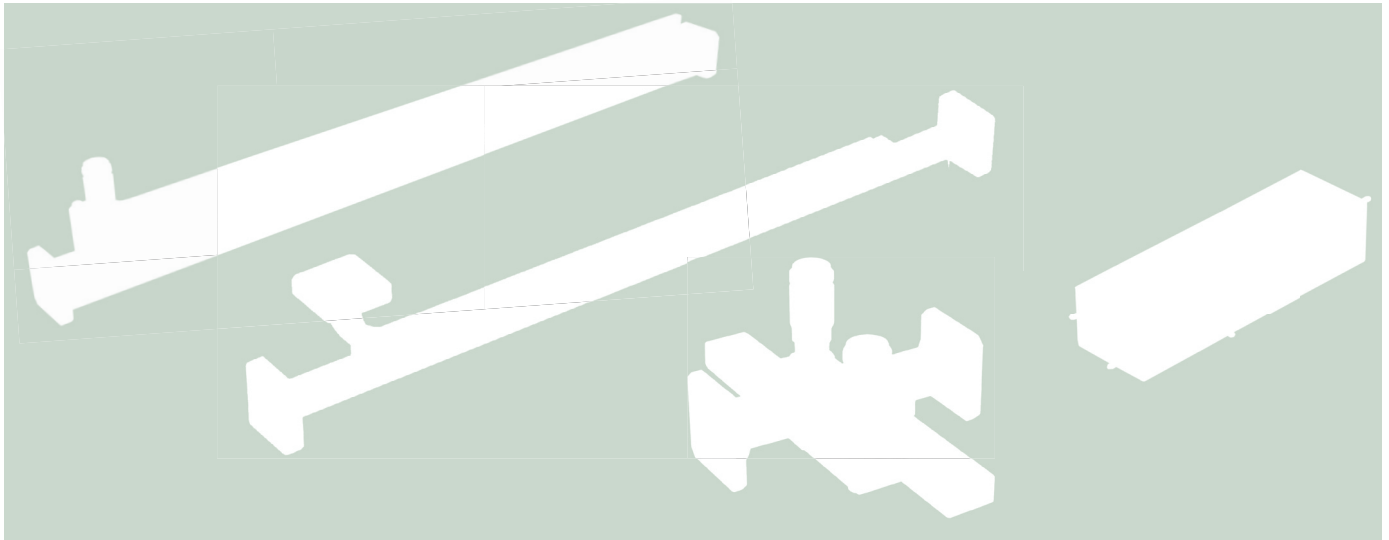


ORDERING INFORMATION

Model: Description
 Example: Model 13060 Calibrated Phase Changer
 The Full waveguide band model would be 13061

Series 060/061

Couplers Selection Guide



OPTIONS AVAILABLE:

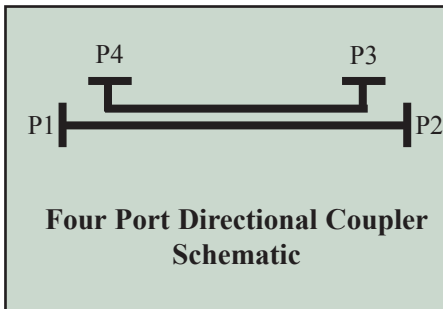
Series 130	Systems Grade	Page 27
Full band, 35 dB nominal directivity entry level multihole directional coupler. 2.6 GHz to 40.1 GHz.		
Series 131	High Directivity	Pages 28-29
Full band, 40 dB nominal directivity multihole directional coupler. 2.6 GHz to 40.1 GHz		
Series WRD131/WRD132	High Directivity	Page 30
Full band, 40 dB nominal directivity double ridged multihole directional coupler. 2.0 GHz to 40 GHz		
Series 132	Very High Directivity	Page 31-32
Full band, 46 dB nominal directivity multihole directional coupler. 2.6 GHz to 40.1 GHz		
Series 133	Ultra High Directivity	Page 33
Full band, 50 dB nominal directivity multihole directional coupler. 3.22 GHz to 40.1 GHz		
Series 136	High Directivity	Page 34
Full band, 40 dB nominal directivity multihole directional coupler. 33.0 GHz to 330 GHz		
Series 137	Very High Directivity	Page 34
Full band, 44 dB nominal directivity multihole directional coupler. 33.0 GHz to 330 GHz		
Series 230	3 Way Splitter	Page 35
Full band, 40 dB nominal directivity multihole 3 way splitter. 2.6 GHz to 140 GHz		
Series 231	3 Way Splitter	Page 35
Full band, 40 dB nominal directivity multihole 3 way splitter. 140 GHz to 220 GHz		
Series 270	Crossguide (Relatively compact design)	Page 36
Full band, 20 dB nominal directivity crossguide coupler. 2.6 GHz to 330 GHz		
Series 140	Branch Guide Couplers	Page 37
Narrow band, 25 dB nominal directivity branch guide coupler.		
Special and Customised Directional Couplers & Series 300/301 Dual Couplers		Page 38-39

Multihole Directional Couplers

General Information

Flann Directional Couplers have many applications: it is important that their capabilities and specifications are understood.

Consider the 4 port directional coupler illustrated schematically.



For the purpose of this analysis if P1 is the power incident at Port 1 then the output powers at Ports 2, 3 and 4 are P2, P3 and P4 respectively. If P2' is the power incident at Port 2 then P1', P3' and P4' are the output powers at Ports 1, 3 and 4 respectively.

The three most important parameters in the specification of directional coupler performance are Coupling, Directivity and Through Loss which can be defined as follows:-

$$\begin{aligned} \text{Coupling (dB)} &= 10 \log (P1/P3) \quad \dots(1) \\ \text{or} &= 10 \log (P2'/P4') \\ \text{Directivity (dB)} &= 10 \log (P3/P4) \\ \text{or} &= 10 \log (P4'/P3') \\ \text{Through Loss (dB)} &= 10 \log (P1/P2) \quad \dots(2) \\ \text{or} &= 10 \log (P2'/P1') \end{aligned}$$

In determining the above expressions, unused ports should be terminated with reflectionless loads.

A parameter referred to as Isolation is sometimes used when characterising directional couplers where:-

$$\begin{aligned} \text{Isolation (dB)} &= 10 \log (P1/P4) \\ \text{or} &= 10 \log (P2'/P3') \end{aligned}$$

It can be shown that:-

$$\text{Isolation (dB)} = \text{Coupling (dB)} + \text{Directivity (dB)}$$

This must be borne in mind whilst comparing the specifications from other manufacturers. For a matched coupler in low loss waveguide the main arm through power, P2, is equal to the input power minus the powers coupled to the secondary arm, i.e. $P2 = P1 - (P3 + P4)$ or $P1' = P2' - (P4' + P3')$

For a high directivity coupler P4 and P3' are negligible, hence:-

$$\begin{aligned} P2 &= P1 - P3 \\ \text{or} &P1' = P2' - P4' \end{aligned}$$

also

$$\begin{aligned} \text{Through Loss (dB)} &= 10 \log (P1/(P1 - P3)) \\ \text{or} &= 10 \log (P2/(P2' - P4')) \end{aligned}$$



The table shows, for power incident at Port 1 only, the percentage powers at Ports 2 and 3 and Through Loss for a matched high-directivity coupler of negligible waveguide loss. At lower frequencies waveguide absorption losses are small. However at millimetric frequencies absorption losses are significant and affect the measured performance of couplers. If the power absorbed within the coupler is Pa then the through loss in dB can be defined as:-

$$\text{Through loss} = 10 \log (P1/(P1 - P3 - Pa)) \dots(3)$$

assuming $P4 \ll P3$ (ie high directivity).

Consider a 3 dB coupler with an absorption loss of 0.5 dB. If engineered to have a coupling of 3 dB, as in expression (1), 50.11% of the input power at Port 1 is coupled to Port 3. By using expression (3) it can be shown that an absorption loss of 0.5 dB represents 10.875% of the input power, thus effectively reducing the power at Port 2 to 39.01%. This represents a Through Loss of 4.09 dB.

The table also illustrates the effect of an absorption loss of 0.1 dB and 0.25 dB on the relative powers at Ports 2 and 3:- the coupling value of Flann directional couplers is the true value as defined in the expression (1) above. Millimetre band models must be used with the understanding that there is an additional main guide loss.

The Directivity of a coupler is essentially dependent on the following factors:-

- (i) The design of coupling structure and the accuracy to which it can be manufactured.
- (ii) The inherent VSWR of the coupler's internal termination (3 port devices).
- (iii) Discontinuities and perturbations in the waveguide.
- (iv) The dimensional accuracy of the waveguide at the measurement port.

In four port couplers the VSWR of the bends in the secondary arm are often the most significant factor limiting directivity performance. For example a 4 port coupler with a 1.05 VSWR bend in the secondary arm

will give, at best, a 32.2 dB directivity.

Flann directional couplers have specified directivities which include the interface at the measurement port when connected to an ideal termination. It is important when making comparisons that users should enquire whether alternative manufacturers have also followed similar test procedures when quoting performance. It is not uncommon that when measuring directivity, terminations are inserted into the measuring port's terminal flange. This is not a Flann recommended procedure.

The terms used in Flann Directional Coupler specifications are:-

Nominal Coupling Accuracy

This is the mean coupling value expressed as a percentage of the Nominal Coupling. For example a 10 dB coupler which has a specified Nominal Coupling Accuracy of 5% could have a mean coupling value within the limits 9.5 to 10.5 dB.

Coupling Sensitivity

This is the variation of actual coupling about the mean coupling value over the specified operating frequency band. For example the actual coupling value of a nominal 9.6 dB coupler could vary from 9.1 to 10.1 dB over the specified frequency range.

Directivity

The directivity of a directional coupler is the ratio, in dB, of the power in the forward direction of the secondary guide to that in the reverse direction of the secondary guide when the primary guide is fed only in the forward direction.

i.e. Directivity (dB) = $10 \log_{10} (P3/P4)$ when signal is input to P₁ only.

Coupling (dB)	% Power at Port 3	Waveguide Absorption Loss							
		0 dB @ 5 GHz		0.1 dB @ 25 GHz		0.25 dB @ 65 GHz		0.5 dB @ 140 GHz	
		% Power at Port 2	Through Loss (dB)	% Power at Port 2	Through Loss (dB)	% Power at Port 2	Through Loss (dB)	% Power at Port 2	Through Loss (dB)
3	50.1	49.0	3.02	47.60	3.22	44.29	3.54	39.01	4.09
6	25.1	74.9	1.26	72.60	1.39	69.29	1.59	64.01	1.94
10	10.0	90.0	0.46	87.72	0.57	84.41	0.74	79.13	1.02
20	1.09	9.0	0.044	96.72	0.14	93.41	0.30	88.13	0.55
30	0.1	99.9	0.044	97.62	0.10	94.31	0.255	89.03	0.505
40	0.01	99.99	0.0004	97.71	0.10	94.40	0.250	89.12	0.500

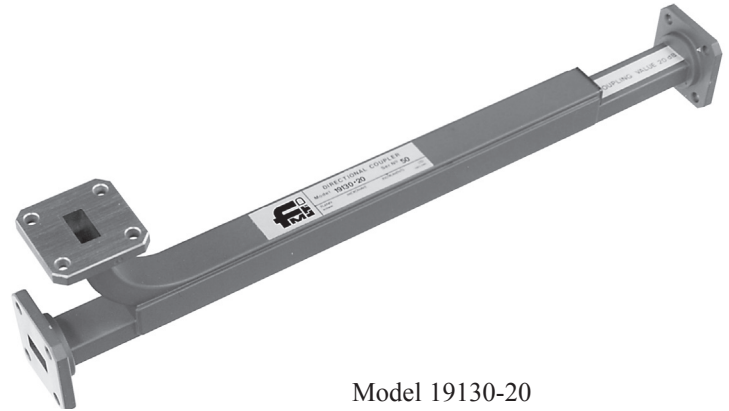
Multihole Directional Couplers Series 130

Features

- Systems Grade
- Ideal For Power / Frequency Sampling & Monitoring

The Flann series 130 of multihole directional couplers provides the user with a measurement facility over the entire waveguide frequency range at very modest cost.

These couplers have a good directivity performance whilst retaining the minimal frequency sensitivity associated with higher quality units. The standard coupling values are 10 dB and 20 dB.



Model 19130-20

IMPORTANT! All directivities quoted include the measuring port and flange performance when connected to an ideal termination.

Specifications:

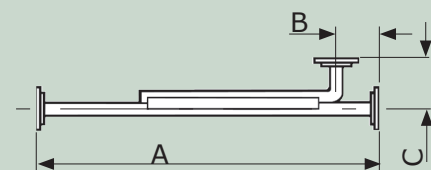
Model	Frequency Range (GHz)	Waveguide			Minimum Directivity (dB)	Coupling (10 dB & 20 dB)		Primary Arm VSWR	Secondary Arm VSWR
		WG	R	WR		Sensitivity (\pm dB)	Nominal Accuracy (dB)		
10130	2.60 - 3.95	10	32	284	35	0.5	5%	1.03	1.10
11A130	3.22 - 4.90	11A	40	229	35	0.5	5%	1.03	1.10
12130	3.94 - 5.99	12	48	187	35	0.5	5%	1.03	1.10
13130	4.64 - 7.05	13	58	159	35	0.5	5%	1.03	1.10
14130	5.38 - 8.18	14	70	137	35	0.5	5%	1.03	1.10
15130	6.58 - 10.0	15	84	112	35	0.5	5%	1.03	1.10
16130	8.20 - 12.5	16	100	90	35	0.5	5%	1.03	1.10
17130	9.84 - 15.0	17	120	75	35	0.5	5%	1.03	1.10
18130	11.9 - 18.0	18	140	62	35	0.5	5%	1.03	1.10
19130	14.5 - 22.0	19	180	51	33	0.5	5%	1.03	1.10
20130	17.6 - 26.7	20	220	42	33	0.75	7%	1.03	1.20
21130	21.7 - 33.0	21	260	34	33	0.75	7%	1.03	1.20
22130	26.4 - 40.1	22	320	28	33	0.75	7%	1.03	1.20

Model	Dimensions (mm)				Weight (kg)	
	A		B	C	Weight (kg)	
	10 dB	20 dB			10 dB	20 dB
10130	1215	1029	85	130	10.6	8.0
11A130	965	817	70	100	5.7	4.6
12130	853	733	60	90	4.3	3.0
13130	785	676	55	75	3.5	2.6
14130	706	615	50	60	2.6	2.2
15130	534	460	35	50	1.5	1.3
16130	476	417	35	45	1.0	0.8
17130	387	338	35	40	0.8	0.6
18130	340	298	30	35	0.5	0.4
19130	300	262	30	35	0.4	0.3
20130	228	201	25	25	0.18	0.16
21130	215	194	25	25	0.18	0.16
22130	180	162	24	29	0.16	0.14

ORDERING INFORMATION

Model: Coupling Value Suffix; Description
Example: Model 10130-10 Multihole Directional Coupler
10 dB coupling Directivity >35 dB

Coupling Values	Suffix
10 dB	10
20 dB	20



Series 130

Multihole Directional Couplers Series 131

Features

- **High Directivity**
- **Models from 2.6 GHz to 40.1 GHz**

The Flann Series 131 Directional Couplers are suitable where high quality is to be incorporated at moderate cost.

A high directivity is offered in all waveguide sizes within the frequency range 2.6 GHz to 40.1 GHz. The standard coupling values are 3, 10 and 20 dB, other values for example 6, 30 and 40 dB can be supplied.

IMPORTANT! All directivities quoted include the measuring port and flange performance when connected to an ideal termination.

4 port couplers can be supplied to order, however the directivity will be less than for 3 port units.



Model 18131-10

Specifications:

Model	Frequency Range (GHz)	Waveguide			Minimum Directivity (dB)	Coupling (3, 10 & 20 dB)		Additional Primary Arm Loss (dB)	Primary Arm VSWR *	Secondary Arm VSWR	
		WG	R	WR		Sensitivity (\pm dB)	Nominal Accuracy (dB)**				
10131	2.60 - 3.95	10	32	284	40	0.5	5%	Not Applicable	1.03	1.10	
11A131	3.22 - 4.90	11A	40	229	40	0.5	5%		1.03	1.10	
12131	3.94 - 5.99	12	48	187	40	0.5	5%		1.03	1.10	
13131	4.64 - 7.05	13	58	159	40	0.5	5%		1.03	1.10	
14131	5.38 - 8.18	14	70	137	40	0.5	5%		1.03	1.10	
15131	6.58 - 10.0	15	84	112	40	0.5	5%		1.03	1.10	
16131	8.20 - 12.5	16	100	90	40	0.5	5%		1.03	1.10	
17131	9.84 - 15.0	17	120	75	40	0.5	5%		1.03	1.10	
18131	11.9 - 18.0	18	140	62	40	0.5	5%		1.03	1.10	
19131	14.5 - 22.0	19	180	51	40	0.5	5%		1.03	1.10	
20131	17.6 - 26.7	20	220	42	40	0.75	7%		0.3	1.03	1.20
21131	21.7 - 33.0	21	260	34	40	0.75	7%		0.4	1.03	1.20
22131	26.4 - 40.1	22	320	28	40	0.75	7%		0.5	1.03	1.20

See Series 136 for higher frequency models up to 330 GHz.

* Primary arm VSWR specification is 1.10:1 for all 3 dB couplers

** Nominal coupling accuracy for 3 dB and 6 dB couplers is \pm 0.5 dB.

See overleaf for dimensions and ordering information.

Multihole Directional Couplers Series 131

Outline Dimensions

Model	Dimensions (mm)					Weight (kg)		
	A			B	C	3 dB	10 dB	20 dB
	3 dB	10 dB	20 dB					
10131	On request	1215	1029	85	130	On request	10.6	8.0
11A131	1432	965	817	70	100	8.4	5.7	4.6
12131	1233	853	733	60	90	6.2	4.3	3.0
13131	1108	785	676	55	75	4.7	3.3	2.6
14131	991	706	615	50	60	3.7	2.6	2.2
15131	766	534	460	35	50	2.0	1.5	1.3
16131	658	476	417	35	45	1.3	1.0	0.8
17131	538	387	338	35	40	1.0	0.8	0.6
18131	465	340	298	30	35	1.0	0.8	0.6
19131	397	300	262	30	35	0.4	0.4	0.3
20131	314	228	201	25	25	0.25	0.18	0.16
21131	284	215	194	25	25	0.25	0.18	0.16
22131	237	180	162	24	29	0.20	0.16	0.14

ORDERING INFORMATION

Model: Coupling Value Suffix; Description

Example: Model 10131-20 Multihole Directional Coupler

Directivity >40 dB, 20 dB coupling

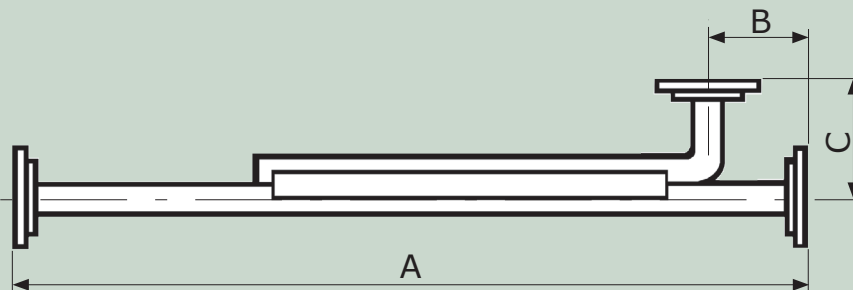
Note:

If a 4 port coupler is required, add 4P to the ordering code:
For example 18131-20-4P. Please note that the directivity will be reduced by approximately 8 dB for 4 port couplers.

Standard Coupling Values	Suffix
3 dB	03
10 dB	10
20 dB	20

Other Coupling Values	Suffix
6 dB	06
30 dB	30
40 dB	40

Dimensions & Weights upon request



Series 131

For standard flange types and recommendations see pages 118 onwards

Double Ridge Couplers Series WRD131

Features

- **Directivity > 40 dB - a new industry standard**
- **Flat Coupling Response**
- **Models up to 40 GHz**
- **Coupling values from 10 dB to 50 dB**



Flann has developed a new range of double ridge multihole coupler for standard double ridge waveguide sizes and tailored to any special bandwidth requirements.

Our unique design of the coupler array combined with precision machining practice provides better than 40 dB directivity full band with typical directivities better than 45 dB achieved.

Flann is now able to provide a service to make any standard or non-standard type of coupler within the constraints of commercial viability.

We are now able to offer the industry's only 40 dB directivity coupler with a full band coupling flatness of less than +/-1 dB.

All double ridge couplers are available in nominal coupling values from 10 dB to 50 dB.

Specifications:

Model	Frequency Range (GHz)	Waveguide Size	Minimum Directivity dB	Nominal Coupling Accuracy	Coupling Sensitivity ± dB	Primary Arm VSWR (better than)	Secondary VSWR (better than)
WRD200131	2.0 - 4.8	WRD200D24	40	0.8	1.0	1.06	1.35
WRD350131	3.5 - 8.2	WRD350D24	40	0.8	1.0	1.06	1.35
WRD475131	4.75 - 11.0	WRD475D24	40	0.8	1.0	1.06	1.35
WRD580131	5.8 - 16.0	WRD580D28	40	0.8	1.0	1.06	1.35
WRD650131	6.5 - 18.0	WRD650D28	40	0.8	1.0	1.06	1.35
WRD750131	7.5 - 18.0	WRD750D24	40	0.8	1.0	1.06	1.35
WRD110131	11.0 - 26.5	WRD110C24	35	0.8	1.0	1.1	1.35
WRD180131	18.0 - 40.0	WRD180C24	35	0.8	1.0	1.1	1.35

Options Include:

- **Higher Directivity**
- **Ultra Flat Coupling**
- **Improved Secondary Arm VSWR**
- **SMA and N Type Connectors**

ORDERING INFORMATION

Model: Coupling value suffix; description
 Example Model WRD650131-10 Double ridge multihole coupler, 10 dB coupling, 40 dB directivity

Please contact our Sales Team for more details.

Series WRD131

Multihole Directional Couplers Series 132

Features

- 46 dB High Directivity
- Models up to 40.1 GHz
- Low Coupling Sensitivity

The Flann Series 132 directional couplers provide a very high directivity and have been designed for use in quality waveguide measurement systems within the frequency range 3.3 GHz to 40.1 GHz.

The configuration is of a 3 port instrument incorporating a built-in low reflection termination. The coupling array is designed to achieve low sensitivity of coupling versus frequency whilst maintaining main arm VSWR. The standard coupling values are 3, 10 and 20 dB for each waveguide size. Other values can be supplied, for example 6, 30 and 40 dB.



Model 22132-20

IMPORTANT! All directivities quoted include the measuring port and flange performance when connected to an ideal termination.

Specifications:

Model	Frequency Range (GHz)	Waveguide			Minimum Directivity (dB)	Coupling (3, 10 & 20 dB)		Additional Primary Arm Loss (dB)	Primary Arm VSWR*	Secondary Arm VSWR
		WG	R	WR		Sensitivity (\pm dB)	Nominal Accuracy (dB)**			
10132	2.60 - 3.95	10	32	284	46	0.5	5%	N/A	1.03	1.10
11A132	3.22 - 4.90	11A	40	229	46	0.5	5%	N/A	1.03	1.10
12132	3.94 - 5.99	12	48	187	46	0.5	5%	N/A	1.03	1.10
13132	4.64 - 7.05	13	58	159	46	0.5	5%	N/A	1.03	1.10
14132	5.38 - 8.18	14	70	137	46	0.5	5%	N/A	1.03	1.10
15132	6.58 - 10.0	15	84	112	46	0.5	5%	N/A	1.03	1.10
16132	8.20 - 12.5	16	100	90	46	0.5	5%	N/A	1.03	1.10
17132	9.84 - 15.0	17	120	75	43	0.5	5%	N/A	1.03	1.10
18132	11.9 - 18.0	18	140	62	43	0.5	5%	N/A	1.03	1.10
19132	14.5 - 22.0	19	180	51	43	0.5	5%	0.2	1.03	1.10
20132	17.6 - 26.7	20	220	42	43	0.75	7%	0.3	1.03	1.20
21132	21.7 - 33.0	21	260	34	43	0.75	7%	0.4	1.03	1.20
22132	26.4 - 40.1	22	320	28	43	0.75	7%	0.5	1.03	1.20

See Series 137 for higher frequency models up to 330 GHz.

* Primary arm VSWR specification is 1.10:1 for all 3 dB couplers.

** Nominal coupling accuracy for 3 dB and 6 dB couplers is ± 0.5 dB.

Please refer to page 26 for definitions of Flann coupler specifications.

See overleaf for dimensions and ordering information.

Multihole Directional Couplers Series 132

Outline Dimensions

Model	Dimensions (mm)					Weight (kg)		
	A			B	C	3 dB	10 dB	20 dB
	3 dB	10 dB	20 dB					
10132	On request	1215	1029	85	130	On request	10.6	8.0
11A132	1432	965	817	70	100	8.4	5.7	4.6
12132	1233	853	733	60	90	6.2	4.3	3.0
13132	1108	785	676	55	75	4.7	3.3	2.6
14132	991	706	615	50	60	3.7	2.6	2.2
15132	766	534	460	35	50	2.0	1.5	1.3
16132	658	476	417	35	45	1.3	1.0	0.8
17132	538	387	338	35	40	1.0	0.8	0.6
18132	465	340	298	30	35	1.0	0.8	0.6
19132	397	300	262	30	35	0.4	0.4	0.3
20132	314	228	201	25	25	0.25	0.18	0.16
21132	284	215	194	25	25	0.25	0.18	0.16
22132	237	180	162	24	29	0.20	0.16	0.14

ORDERING INFORMATION

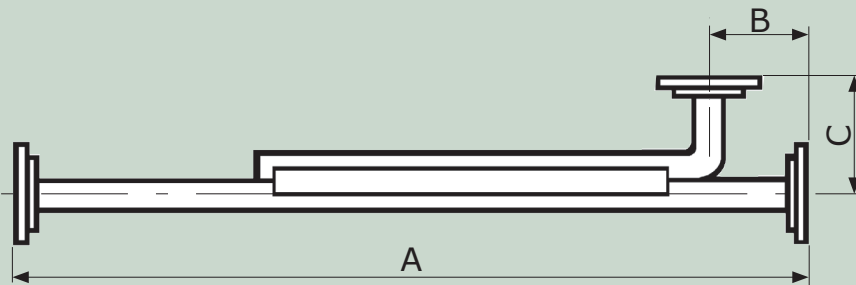
Model: coupling value suffix; description

Example: Model 16132-03 multihole directional coupler 03 dB coupling, directivity >46 dB

Standard Coupling Values	Suffix
3 dB	03
10 dB	10
20 dB	20

Other Coupling Values	Suffix
6 dB	06
30 dB	30
40 dB	40

Dimensions & Weights upon request



Series 132

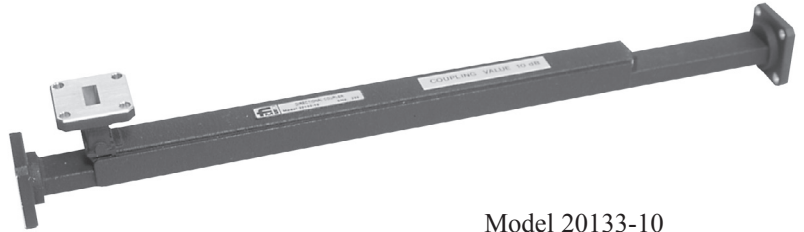
For standard flange types and recommendations see pages 111 onwards

Multihole Directional Couplers Series 133

Features

- 50 dB Directivity
- Low Coupling Sensitivity

The Flann Series 133 of ultra-high directivity multihole couplers has been developed principally for laboratory applications involving network analyser or reflectometer systems.



Model 20133-10

The couplers are a 3 port design with an extremely low reflection termination built into the fourth arm. The standard coupling values are 10 dB and 20 dB.

IMPORTANT! All directivities quoted include the measuring port and flange performance when connected to an ideal termination.

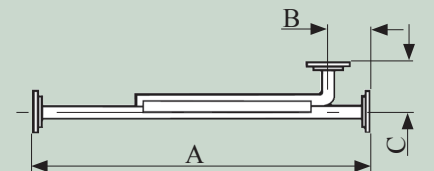
Specifications:

Model	Frequency Range (GHz)	Waveguide			Minimum Directivity (dB)	Coupling (10 dB & 20 dB)		Primary Arm VSWR	Secondary Arm VSWR
		WG	R	WR		Sensitivity (\pm dB)	Nominal Accuracy (dB)		
11A133	3.22 - 4.90	11A	40	229	50	0.5	5%	1.03	1.10
12133	3.94 - 5.99	12	48	187	50	0.5	5%	1.03	1.10
13133	4.64 - 7.05	13	58	159	50	0.5	5%	1.03	1.10
14133	5.38 - 8.18	14	70	137	50	0.5	5%	1.03	1.10
15133	6.58 - 10.0	15	84	112	50	0.5	5%	1.03	1.10
16133	8.20 - 12.5	16	100	90	50	0.5	5%	1.03	1.10
17133	9.84 - 15.0	17	120	75	50	0.5	5%	1.03	1.10
18133	11.9 - 18.0	18	140	62	48	0.5	5%	1.03	1.10
19133	14.5 - 22.0	19	180	51	48	0.5	5%	1.03	1.10
20133	17.6 - 26.7	20	220	42	46	0.75	7%	1.03	1.20
21133	21.7 - 33.0	21	260	34	46	0.75	7%	1.03	1.20
22133	26.4 - 40.1	22	320	28	46	0.75	7%	1.03	1.20

Model	Dimensions (mm)				Weight (kg)
	A		B	C	
	10 dB	20 dB			
11A133	1044	1044	70	100	6.0
12133	920	920	60	90	5.0
13133	802	802	55	75	2.5
14133	765	765	50	60	3.0
15133	620	620	35	50	1.8
16133	528	528	35	45	1.1
17133	427	427	35	40	0.85
18133	356	356	30	35	0.50
19133	330	330	30	35	0.40
20133	250	250	25	25	0.20
21133	235	235	25	25	0.20
22133	180	180	24	29	0.18

ORDERING INFORMATION

Model: coupling value suffix; description
Example: Model 14133-20 multihole directional coupler 20 dB coupling, directivity >50 dB



Series 133

Note: Please refer to page 26 for definitions of Flann coupler specifications.

Multihole Directional Couplers

Series 136 / 137

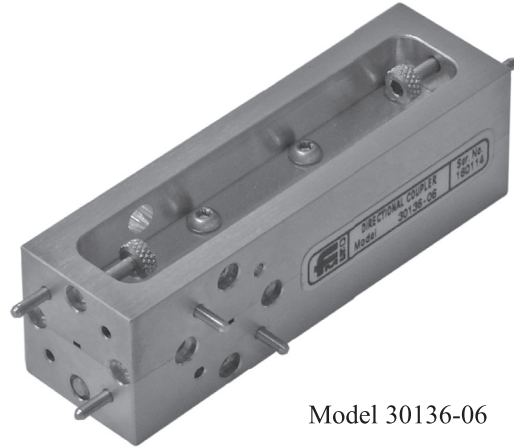
Features

- High Directivity - up to 40 dB (Series 136)
- Very High Directivity - up to 44 dB (Series 137)
- Models from 33.0 GHz to 500 GHz

Applications

- Power Sensing
- Network Analyser
- Reflectometer Systems

Series 136, high directivity and Series 137, very high directivity, are offered in all waveguide sizes within the frequency range 33.0 GHz to 500 GHz. The standard coupling values are 3, 10 and 20 dB, other values, for example 6, 30, 40, 50 and 60 dB, can be supplied.



Model 30136-06

IMPORTANT! All directivities quoted include the measuring port and flange performance when connected to an ideal termination.

The specifications shown below are for 3 port models. 4 port models are available to special order in Series 136 only. - with a reduced directivity specification

Specifications:

Model	Frequency Range (GHz)	Waveguide				Minimum Directivity by coupling value (dB)			Coupling				Additional Primary Arm Loss (dB)	Primary Arm VSWR	Secondary Arm VSWR
		WG	WM	R	WR	3 - 30dB Coupling	40dB Coupling	50dB Coupling	Sensitivity (±dB)	Nominal Accuracy (dB)					
										3 - 6	10	15 - 60			
23136	33.0 - 50.1	23	-	400	22	40	40	36	0.75	0.50	0.75	1.20	0.6	1.06	1.10
24136	39.3 - 59.7	24	-	500	19	38	37	35	0.75	0.50	0.75	1.20	0.7	1.06	1.10
25136	49.9 - 75.8	25	-	620	15	38	35	33	0.75	0.50	0.75	1.20	0.8	1.06	1.10
	60.5 - 92.0	26	-	740	12	38	33	31	1.00	0.50	0.75	1.50	1.0	1.08	1.10
27136	73.8 - 112	27	2540	900	10	36	32	30	1.00	0.75	1.0	1.50	1.1	1.08	1.10
28136	92.3 - 140	28	2032	1200	8	34	30	28	1.00	0.75	1.0	1.50	1.3	1.12	1.15
29136	114 - 173	29	1651	1400	6	32	27	26	1.00	0.75	1.0	1.50	1.4	1.12	1.20
30136	145 - 220	30	1295	1800	5	30	26	24	1.00	0.85	1.20	2.00	1.6	1.12	1.25
31136	172 - 261	31	1092	2200	4	28	25	23	1.20	0.85	1.20	2.00	1.8	1.15	1.30
32136	217 - 330	32	864	2600	3	26	22	21	1.20	0.85	1.20	2.00	2.0	1.20	1.40
710136	260 - 400	-	710	-	'2.8'	24	20	19	1.50	1.0	1.50	2.50	2.2	1.30	1.60
570136	330 - 500	-	570	-	'2.2'	22	18	17	1.50	1.0	1.50	2.50	2.6	1.40	2.00

Model	Frequency Range (GHz)	Waveguide				Minimum Directivity by coupling value (dB)			Coupling				Additional Primary Arm Loss (dB)	Primary Arm VSWR	Secondary Arm VSWR
		WG	WM	R	WR	3 - 30dB Coupling	40dB Coupling	50dB Coupling	Sensitivity (±dB)	Nominal Accuracy (dB)					
										3 - 6	10	15 - 60			
23137	33.0 - 50.1	23	-	400	22	44	44	40	0.75	0.50	0.75	1.20	0.6	1.06	1.10
24137	39.3 - 59.7	24	-	500	19	42	41	39	0.75	0.50	0.75	1.20	0.7	1.06	1.10
25137	49.9 - 75.8	25	-	620	15	42	39	37	0.75	0.50	0.75	1.20	0.8	1.06	1.10
26137	60.5 - 92.0	26	-	740	12	42	37	35	1.00	0.50	0.75	1.50	1.0	1.08	1.10
27137	73.8 - 112	27	2540	900	10	40	36	34	1.00	0.75	1.0	1.50	1.1	1.08	1.10
28137	92.3 - 140	28	2032	1200	8	38	34	32	1.00	0.75	1.0	1.50	1.3	1.12	1.15
29137	114 - 173	29	1651	1400	6	36	31	30	1.00	0.75	1.0	1.50	1.4	1.12	1.20
30137	145 - 220	30	1295	1800	5	34	30	28	1.00	0.85	1.20	2.00	1.6	1.12	1.25
31137	172 - 261	31	1092	2200	4	32	29	27	1.20	0.85	1.20	2.00	1.8	1.15	1.30
32137	217 - 330	32	864	2600	3	30	26	25	1.20	0.85	1.20	2.00	2.0	1.20	1.40
710136	260 - 400	-	710	-	'2.8'	28	24	23	1.50	1.0	1.50	2.50	2.2	1.30	1.60
570136	330 - 500	-	570	-	'2.2'	26	22	21	1.50	1.0	1.50	2.50	2.6	1.40	2.00

Note: Please refer to page 26 for definitions of Flann coupler specifications.

Multihole Directional Couplers

Series 230 / 231

Features

- **High Directivity**
- **3 Way Signal Splitter**
- **± 0.2 dB Balance Between Coupled Arms**

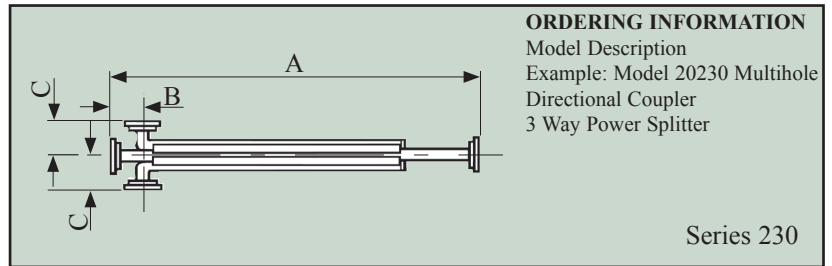
The Flann Multihole Power Splitter consists of a central waveguide with coupling arrays in the broad walls designed to divide the input signal into three signals of equal magnitude.

Normally the instrument is a 4 port device as illustrated. However, for network analyser applications where only two equal amplitude signals are required the central output port may be terminated. Precision machining methods ensure that the full band frequency sensitivity between secondary waveguide ports is better than ± 0.2 dB. The coupling to each output port is 4.8 dB down with respect to the input signal. Directivity for most models is greater than 40 dB.

IMPORTANT! All directivities quoted include the measuring port and flange performance when connected to an ideal termination.



Model 22230



Specifications:

Model	Frequency Range (GHz)	Waveguide			Maximum Directivity (dB)	Sensitivity Between Coupled Ports (dB)	Dimensions (mm)			Weight (kg)
		WG	R	WR			A	B	C	
10230	2.60 - 3.95	10	32	284	40	±0.2	1773	85	130	19.0
11A230	3.22 - 4.90	11A	40	229	40	±0.2	1407	79	100	9.3
12230	3.94 - 5.99	12	48	187	40	±0.2	1213	60	90	8.4
14230	5.38 - 8.18	14	70	137	40	±0.2	976	50	60	5.0
15230	6.58 - 10.0	15	84	112	40	±0.2	753	35	50	3.0
16230	8.20 - 12.5	16	100	90	40	±0.2	649	35	45	1.9
17230	9.84 - 15.0	17	120	75	40	±0.2	522	35	40	1.4
18230	11.9 - 18.0	18	140	62	40	±0.2	438	30	35	0.9
19230	14.5 - 22.0	19	180	51	40	±0.2	392	30	35	0.7
20230	17.6 - 26.7	20	220	42	38	±0.3	314	25	25	0.4
22230	26.4 - 40.1	22	320	28	38	±0.3	228	24	29	0.3
23231	33.0 - 50.1	23	400	22	36	±0.3				
24231	39.3 - 59.7	24	500	19	33	±0.3				
25231	49.9 - 75.8	25	620	15	33	±0.3				
26231	60.5 - 92.0	26	740	12	30	±0.4				
27231	73.8 - 112	27	900	10	27	±0.5				
28231	92.3 - 140	28	1200	8						
29231	114 - 173	29	1400	6						
30231	145 - 220	30	1800	5						
31231	172 - 261	31	2200	4						
32231	217 - 330	32	2600	3						

Specifications available on request

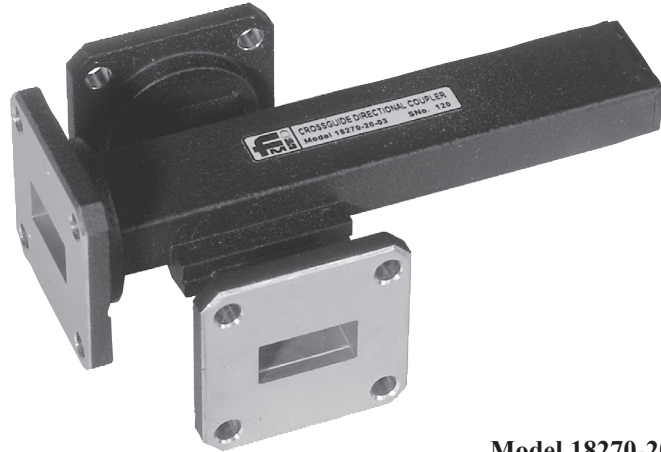
Note: Please refer to page 26 for definitions of Flann coupler specifications.

For standard flange types and recommendations see pages 118 onwards

Crossguide Directional Couplers Series 270

Flann Crossguide Couplers consist of two waveguides joined at 90° with the coupling element mounted in the common broad wall. Couplers are available in 3 or 4 port configurations and standard coupling values are 20, 30, 40 and 50 dB; directivity for models up to 18 GHz is better than 20 dB over the specified frequency range.

The compactness of the crossguide coupler suits many applications where space is at a premium and directivity is not the prime consideration, e.g. power and frequency monitoring and isolating local oscillators. Models are available with combinations of waveguide and coaxial ports. Special multiport crossguide couplers can be manufactured to suit customers' requirements.

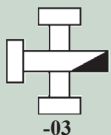
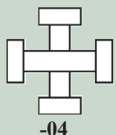


Model 18270-20-03

Specifications:

Model	Frequency Range (GHz)	Waveguide			Minimum Directivity (dB)	Coupling		Dimensions (mm)			Weight (kg)	
		WG	R	WR		Sensitivity (dB)	Nominal Accuracy (dB)	A	B	C	3 Port	4 Port
10270	2.60 - 3.95	10	32	284	20	±1.5	±2	90	34	308	5.0	4.9
11A270	3.22 - 4.90	11A	40	229	20	±1.5	±2	62.5	29	256	2.3	1.9
12270	3.94 - 5.99	12	48	187	20	±1.5	±2	61.5	22	227	2.1	2.0
13270	4.64 - 7.05	13	58	159	20	±1.5	±2	58	21	224	1.8	1.7
14270	5.38 - 8.18	14	70	137	20	±1.5	±2	55	15.5	179	1.4	1.3
15270	6.58 - 10.0	15	84	112	20	±1.5	±2	42.5	12.6	164	0.7	0.65
16270	8.20 - 12.5	16	100	90	20	±1.5	±2	36	10.5	136	0.4	0.4
17270	9.84 - 15.0	17	120	75	20	±1.5	±2	32.5	9.5	108	0.35	0.35
18270	11.9 - 18.0	18	140	62	20	±1.5	±2	30	8	96	0.25	0.25
19270	14.5 - 22.0	19	180	51	18	±1.5	±2	30	7	90	0.22	0.22
20270	17.6 - 26.7	20	220	42	18	±1.5	±2	22.5	4.5	65	0.1	0.1
21270	21.7 - 33.0	21	260	42	18	±2	±2	22.5	4.7	73	0.1	0.1
22270	26.4 - 40.1	22	320	28	18	±2	±2	20.7	3.8	50	0.07	0.07
23270	33.0 - 50.1	23	400	22	15	±2	±2	20	3.0	48	0.08	0.08
24270	39.3 - 59.7	24	500	19	15	±2	±2	20	2.5	48	0.08	0.08
25270	49.9 - 75.8	25	620	15	15	±2	±2	14	2.0	34.5	0.07	0.07
26270	60.5 - 92.0	26	740	12	10	±2.5	±2.5	14	1.6	34.5	0.07	0.07
27270	73.8 - 112	27	900	10	10	±2.5	±2.5	14	1.4	34.5	0.07	0.07
28270	92.3 - 140	28	1200	8	10	±2.5	±2.5	14	1.1	34.5	0.07	0.07
29270	114 - 173	29	1400	6								
30270	145 - 220	30	1800	5								
31270	172 - 261	31	2200	4								
32270	217 - 330	32	2600	3								

Specifications available on request

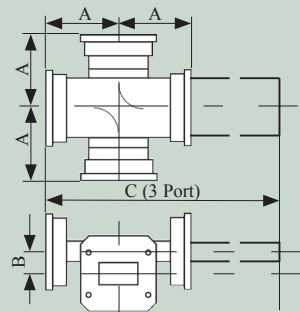


- 13 (APC7) Models 10270 to 18270 only
- 23 (Type N) Models 10270 to 18270 only
- 33 (SMA) Models 14270 to 20270 only
- 43 (K Type) Models 19270 to 22270 only

ORDERING INFORMATION

Model: Coupling Value Suffix-Type and Number of Ports; Description
 Example: Model 17270-30-33 Crossguide Directional Coupler 30 dB Coupling 3 Port with SMA in coupled arm (the fourth arm is fitted with a termination)

Note: Please refer to page 26 for definitions of Flann coupler specifications.



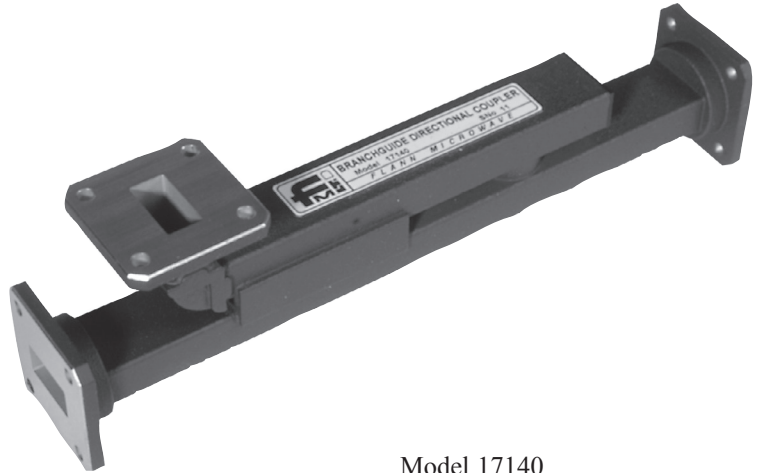
Series 270

For standard flange types and recommendations see pages 118 onwards

Branch Guide Directional Couplers Series 140

Branch Guide Directional Couplers from the Flann Series 140 are particularly suited to applications where multihole couplers cannot be accommodated or tighter coupling values than those achievable from cross guide couplers are required.

Models are available in both 3 and 4 port configurations and standard coupling values are 3 dB, 6 dB and 10 dB. Couplers operating over the full waveguide band are available but for optimum coupling and directivity performance we recommend that the operating frequency range is limited to 25% of the full waveguide band. Please state the operating frequency range required when ordering.



Model 17140

Specifications:

Model	Frequency Range (GHz)	Waveguide			Typical performance for models operating over 25% of the full waveguide band.				
		WG	R	WR	Coupling Accuracy (dB)			Coupling Sensitivity(dB)	Directivity better than (dB)
					3 dB	6 dB	10 dB		
10140	2.60 - 3.95	10	32	284	0.3	0.4	0.5	±0.25	25
11A140	3.22 - 4.90	11A	40	229	0.3	0.4	0.5	±0.25	25
12140	3.94 - 5.99	12	48	187	0.3	0.4	0.5	±0.25	25
13140	4.64 - 7.05	13	58	159	0.3	0.4	0.5	±0.25	25
14140	5.38 - 8.18	14	70	137	0.3	0.4	0.5	±0.25	25
15140	6.58 - 10.0	15	84	112	0.3	0.4	0.5	±0.25	25
16140	8.20 - 12.5	16	100	90	0.3	0.4	0.5	±0.25	25
17140	9.84 - 15.0	17	120	75	0.3	0.4	0.5	±0.25	25
18140	11.9 - 18.0	18	140	62	0.3	0.4	0.5	±0.25	25
19140	14.5 - 22.0	19	180	51	Specifications available on request				
20140	17.6 - 26.7	20	220	42					
21140	21.7 - 33.0	21	260	34					
22140	26.4 - 40.1	22	320	28					

ORDERING INFORMATION

Model: Coupling value suffix: number of ports: operating frequency range; Description

Example: Model 16140-06 8.93 GHz to 11.07 GHz Branch Guide Directional Coupler, 6 dB, 3 Port, 8.93 GHz to 11.07 GHz (operating frequency range)

**Note: When ordering please state the required operating frequency range.
For 4 Ports add -4P**

Models are available in other waveguide sizes and alternative coupling values for special applications. Full details on request.

Please refer to page 26 for definitions of Flann coupler specifications.

Standard Coupling Values	Suffix
3 dB	03
6 dB	06
10 dB	10

Series 140

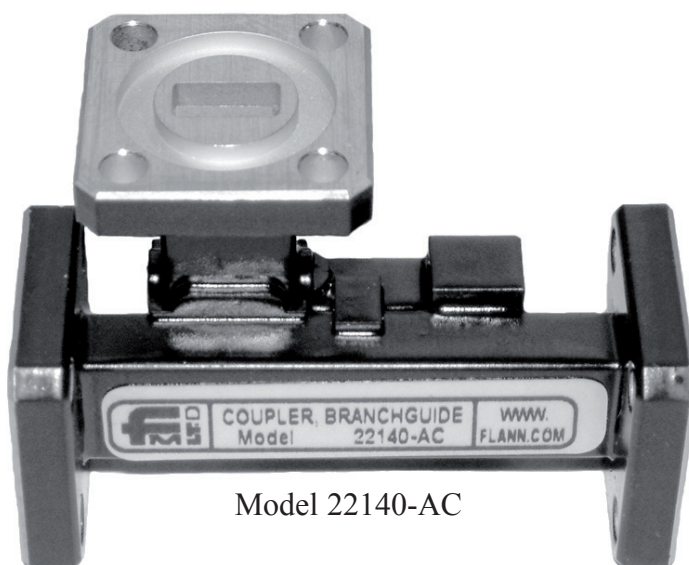
For standard flange types and recommendations see pages 118 onwards

Special & Customised Directional Couplers

Flann are able to design and manufacture Directional Couplers for special customer applications. Shown below is an example of a special very high power coupler; many other configurations of multi-hole, branch guide and cross guide are available up to 330 GHz.

Example:

- 20 kW peak at 30 GHz to 39 GHz
- 30 % Bandwidth
- Compact
- Robust
- Models up to 330 GHz



Model 22140-AC

To provide the compactness of a crossguide coupler but with greater power handling capability, Flann have developed a special branchguide coupler design.

Evaluation has shown the coupler to be able to handle a pulsed signal of 20 kW peak through the main arm with no degradation over time.

The 20 dB coupler illustrated above has been manufactured in WG22 (WR28) and is capable of operating over a 30% bandwidth.

This model has been proven to operate at greater than 20 kW peak power.

Model	Frequency (GHz)	Coupling (dB)	Directivity (dB)
22140 - AC	30 - 39	20	20

ORDERING INFORMATION

PLEASE CONTACT THE SALES TEAM FOR MORE INFORMATION ON OUR STANDARD AND OPTIONAL MODELS

Special & Customised Directional Couplers

In addition to our standard range of Multihole, Crossguide and Branch Guide Directional Couplers we are able to provide special and multiple couplers designed and manufactured to meet customer requirements.

All Couplers can be manufactured in brass, copper or aluminium.

Customised designs for systems applications include:

- Non-standard coupling values
- Special configurations
- Custom designs for narrowband applications
- Multiple Element
- Couplers integrated with other devices for example Attenuators, Phase Changers and Waveguide to Coax Adaptors.
- Compact, lightweight Aluminium units for system applications
- High Power applications

Double and Triple Crossguide Couplers

Among the most commonly requested special directional couplers are Double and Triple Crossguide Couplers. The elements of the coupler may have differing coupling values, coupling directions and port configurations. Special couplers are also available which include the integration of other devices such as attenuators, phase changers and waveguide to coax adaptors.

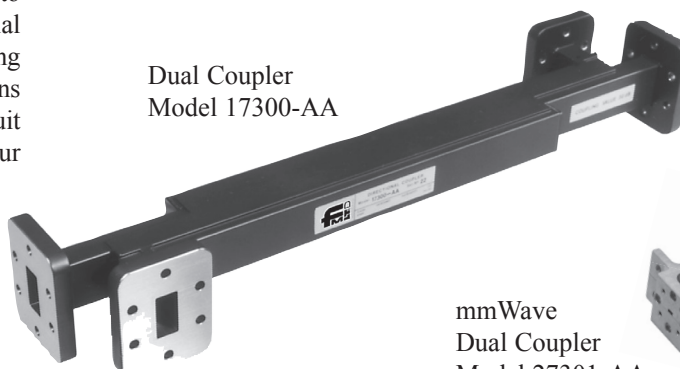
Due to the specialised nature of multiple element coupler applications it is not possible to detail fully specific models. Please contact our sales office to discuss your special application requirements.



Dual Multihole Couplers - Series 300

Flann is able to provide Dual Multihole Couplers designed and manufactured to meet the requirements of your special applications. The units may have coupling values, directivities, coupling directions and input/output ports configured to suit customer requirements. Please contact our sales office for applications assistance.

Dual Coupler
Model 17300-AA



mmWave
Dual Coupler
Model 27301-AA



Note: Please refer to page 26 for definitions of Flann coupler specifications.

For standard flange types and recommendations see pages 118 onwards

Terminations Product Overview

Low Power

Short

Series 170	Compact models offering VSWR better than 1.10:1	Page 41
Series 171	Ultra Short, narrow band	Page 42

Precision

Fixed (Rectangular and Double Ridge)

Series 040	VSWR better than 1.01:1 Models available up to 330 GHz	Page 43
Series WRD040	Double Ridge full band Models up to 40 GHz	Details on request
Series 043, 044 & 045	Metrology Grade, VNA Calibration Kit models Precision Flanges Models up to 110 GHz	Pages 107 - 109

Sliding (Rectangular and Double Ridge)

Series 540	Low VSWR	Page 44
Series 541, 542 & 543	Metrology Grade, VNA Calibration Kit Models Very Low VSWR Precision Flanges Models up to 110 GHz	Pages 107 - 109
Series 54*	Metrology Grade, VNA Calibration Kit Models Finite VSWR of sliding element Precision Flanges Models up to 110 GHz	Details on request

High Power

Rectangular

Series 101	Models up to 10 kW Natural Convection Forced Air Liquid cooled	Pages 45 - 47
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Double Ridge

Series WRD101	Models up to 10 kW Natural Convection Forced Air Liquid cooled	Page 48
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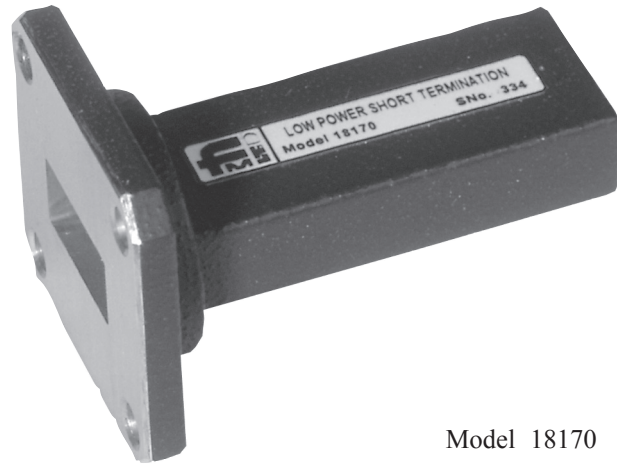
Short Low Power Terminations Series 170

Features

- **Low VSWR**
- **Ideal for Systems Use**
- **Robust**

Flann series 170, short, low power terminations provide a maximum VSWR of 1.10 : 1 within a minimal overall length. They are particularly suitable where space is at a premium.

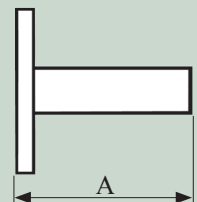
Higher frequency models are also available. Please contact our Sales Office for details.



Model 18170

Specifications:

Model	Frequency Range (GHz)	Waveguide			Max Mean cw power (Watts)	VSWR (better than)	Dimension A (mm)	Weight (kg)
		WG	R	WR				
10170	2.60 - 3.95	10	32	284	5	1.10	200	2.10
11A170	3.22 - 4.90	11A	40	229	4	1.10	170	1.10
12170	3.94 - 5.99	12	48	187	2	1.10	140	0.90
13170	4.64 - 7.0	13	58	159	1.5	1.10	125	0.75
14170	5.38 - 8.18	14	70	137	1	1.10	105	0.60
15170	6.58 - 10.0	15	84	112	1	1.10	80	0.25
16170	8.20 - 12.5	16	100	90	0.5	1.10	70	0.15
17170	9.84 - 15.0	17	120	75	0.3	1.10	55	0.11
18170	11.9 - 18.0	18	140	62	0.3	1.10	50	0.08
19170	14.5 - 22.0	19	180	51	0.3	1.10	43	0.06
20170	17.6 - 26.7	20	220	42	0.3	1.10	32	0.03
21170	21.7 - 33.0	21	260	34	0.2	1.10	30	0.02
22170	26.4 - 40.1	22	320	28	0.2	1.10	25.5	0.02
23170	33.0 - 50.1	23	400	22	Specifications available on request			
24170	39.3 - 59.7	24	500	19				
25170	49.9 - 75.8	25	620	15				
26170	60.5 - 92.0	26	740	12				
27170	73.8 - 112	27	900	10				



ORDERING INFORMATION
Model: description
Example: Model 22170 short low power termination

Series 170

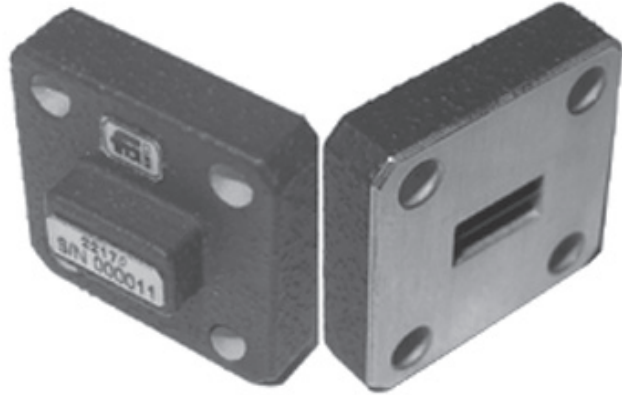
Higher frequencies are available on request

For standard flange types and recommendations see pages 118 onwards

Ultra - Short Terminations Series 171

Features

- **Minimal Length**
- **Broadband**
- **Higher Power Options**



A very short termination has been developed for integration into systems where space is a premium. The WG22 version offers the following performance for a total length of 8 mm. Other frequencies and higher powered versions are also available, specifications on request.

Specifications:

Model	Frequency Range (GHz)	VSWR (better than)
16171-AA	9.3 - 9.9	1.12
22171	26.4 - 40.1	1.8
22171-A*	30 - 33	1.3
22171-AA	33.0 - 35.0	1.15
22171-A*	36.0 - 40.0	1.25

ORDERING INFORMATION

PLEASE CONTACT THE SALES TEAM FOR MORE INFORMATION ON OUR STANDARD AND OPTIONAL MODELS

Precision Low Power Terminations Series 040

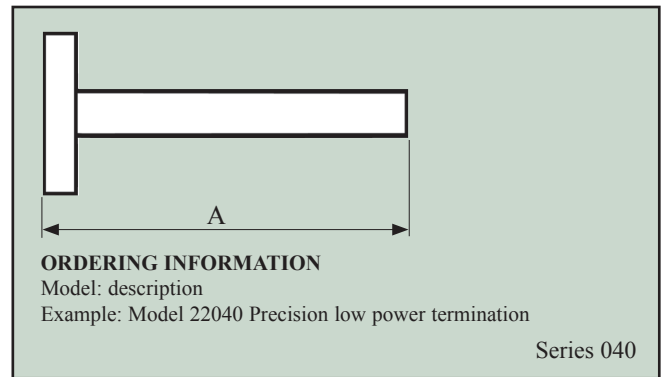


Model 19040

Features

- **Low VSWR**
- **Models from 1.14 GHz to 500 GHz**

Flann series 040, precision - low power terminations have a very low VSWR which makes them eminently suitable for use in VSWR measurements.



Model	Frequency Range (GHz)	Waveguide				VSWR (better than)	Max Mean CW Power (Watts)	Dimension A (mm)	Weight (kg)
		WG	WM	R	WR				
06040	1.14 - 1.73	6	-	14	650	1.01	30	On Request	On Request
08040	1.72 - 2.61	8	-	22	430	1.01	20		
09A040	2.17 - 3.3	9A	-	26	340	1.01	15	382	3.2
10040	2.60 - 3.95	10	-	32	284	1.01	10		
11A040	3.22 - 4.90	11A	-	40	229	1.01	6	347	1.65
12040	3.94 - 5.99	12	-	48	187	1.01	5	302	1.25
13040	4.64 - 7.05	13	-	58	159	1.01	4	282	1.15
14040	5.38 - 8.18	14	-	70	137	1.01	3	252	1.0
15040	6.58 - 10.0	15	-	84	112	1.01	2	202	0.75
16040	8.20 - 12.5	16	-	100	90	1.015	1	192	0.45
17040	9.84 - 15.0	17	-	120	75	1.015	0.75	152	0.26
18040	11.9 - 18.0	18	-	140	62	1.02	0.75	132	0.18
19040	14.5 - 22.0	19	-	180	51	1.02	0.75	112	0.13
20040	17.6 - 26.7	20	-	220	42	1.02	0.75	82	0.08
21040	21.7 - 33.0	21	-	260	34	1.02	0.75	78	0.07
22040	26.4 - 40.1	22	-	320	28	1.02	0.50	78	0.05
23040	33.0 - 50.1	23	-	400	22	1.02	0.50	66	0.04
24040	39.3 - 59.7	24	-	500	19	1.025	0.50	52	0.03
25040	49.9 - 75.8	25	-	620	15	1.025	0.40	42	0.03
26040	60.5 - 92.0	26	-	740	12	1.03	0.40	35	0.02
27040	73.8 - 112	27	-	900	10	1.03	0.30	30	0.015
28040	92.3 - 140	28	-	1200	8	1.04	0.20	25	0.015
29040	114 - 173	29	-	1400	6	1.05	0.15	20	0.015
30040	145 - 220	30	-	1800	5	1.06	0.12	20	0.015
31040	172 - 261	31	-	2200	4	1.08	0.10	20	0.015
32040	217 - 330	32	-	2600	3	1.1	0.08	20	0.015
710040	260 - 400	-	710	-	'2.8'	1.12	0.07	On Request	On Request
570040	330 - 500	-	570	-	'2.2'	1.15	0.05		

For standard flange types and recommendations see pages 118 onwards

Sliding Terminations Series 540

Features

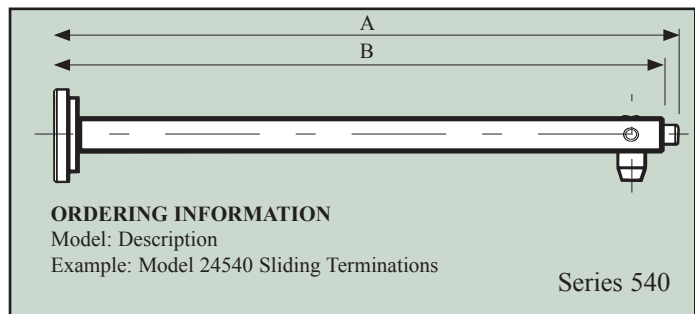
- **Low Housing VSWR**
- **Low Sliding Element VSWR**
- **Models from 1.14 GHz to 140 GHz**



Model 17540

The Flann Series 540 Terminations consist of a length of uniformly sized waveguide. Within the waveguide is a close fit sliding load which moves in a precisely controlled manner. It is desirable to use a sliding termination when measuring low VSWR values.

The effect of sliding the termination enables the user to deduce low VSWR values to a greater accuracy than that achieved by a fixed termination technique.



Model	Frequency Range (GHz)	Waveguide			Housing VSWR (better than)	Sliding Element VSWR (better than)	Dimensions (mm)		
		WG	R	WR			A	B	C
06540	1.14 - 1.73	6	14	650	1.006	1.020	On Request		
08540	1.72 - 2.61	8	22	430	1.006	1.020	1097	856	73
10540	2.60 - 3.95	10	32	284	1.006	1.015	719	543	48
11A540	3.22 - 4.90	11A	40	229	1.006	1.015	771	632	42
12540	3.94 - 5.99	12	48	187	1.006	1.010	638	506	37
13540	4.64 - 7.05	13	58	159	1.006	1.010	575	462	32
14540	5.38 - 8.18	14	70	137	1.006	1.010	492	388	28
15540	6.58 - 10.0	15	84	112	1.006	1.008	406	322	24
16540	8.20 - 12.5	16	100	90	1.006	1.006	347	289	19
17540	9.84 - 15.0	17	120	75	1.008	1.006	317	255	18
18540	11.9 - 18.0	18	140	62	1.010	1.008	267	218	18
19540	14.5 - 22.0	19	180	51	1.010	1.010	237	184	15
20540	17.6 - 26.7	20	220	42	1.010	1.010	185	140	14
22540	26.4 - 40.1	22	320	28	1.012	1.015	117	97	12
23540	33.0 - 50.1	23	400	22	1.015	1.020	156	136	15
24540	39.3 - 59.7	24	500	19	1.02	1.025	156	136	15
25540	49.9 - 75.8	25	620	15	1.025	1.030	101	85	14
26540	60.5 - 92.0	26	740	12	1.03	1.035	94	79	14
27540	73.8 - 112	27	900	10	1.035	1.040	84	71	14

Note: Other models of sliding terminations are available from our range of calibration kit components detailed on pages 104 to 110. Special models are available with micrometer drive and extra low leakage levels, for use in high sensitivity systems.

For standard flange types and recommendations see pages 118 onwards

High Power Terminations Series 101

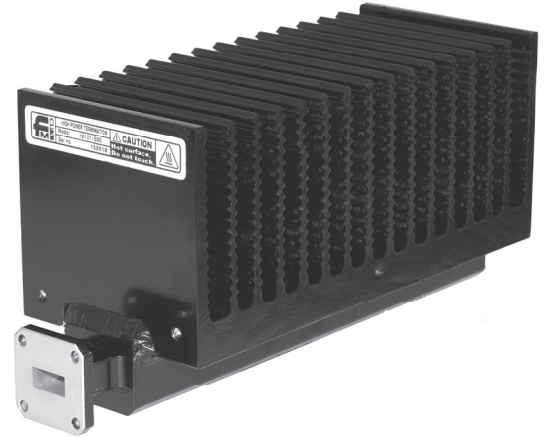
Features

- 0.32 GHz to 330 GHz
- Industry leading performance
- Low VSWR over full waveguide range
- Sealed, 15 psig Standard
- Models up to 10 kW

Applications

- System Dummy Loads
- HPA Testing

Please note the tables below detail Flann standard high power terminations that are available from stock or on short delivery. Other models with alternative power handling or body styles are also available - please contact our Sales Team for product assistance.



Model 18101-1500-CH10 UBR140

Natural Convection High Power Range up to 300 Watts

Model	Frequency Range (GHz)	Waveguide			Maximum Power Mean / CW (Watts)		Maximum VSWR	Dimensions (mm)		
		WG	R	WR	Natural Convection	Forced Air (3 m/s)		L	BX	AX
10101-150-CN0	2.60 - 3.95	10	32	284	150	220	1.08	247	38.1	76.2
10101-200-CV1					200	300	1.08	273	80.4	84
11A101-125-CN0	3.22 - 4.90	11A	40	229	125	180	1.08	205	32.3	61.4
11A101-200-CV1					200	300	1.08	243	75.5	84
12101-100-CN0	3.94 - 5.99	12	48	187	100	150	1.08	170	25.4	50.8
12101-300-CH3					300	450	1.08	170	63	88.9
13101-75-CN0	4.64 - 7.05	13	58	159	75	110	1.08	140	23.4	43.6
13101-250-CH3					250	370	1.08	140	62.7	81.8
14101-55-CN0	5.38 - 8.2	14	70	137	55	80	1.08	120	19.1	38.1
14101-300-CH1					300	450	1.08	173	122.2	120
15101-40-CN0	6.58 - 10.0	15	84	112	40	60	1.08	106	15.6	31.8
15101-250-CH1					250	370	1.08	131	119	94
16101-27-CN0	8.20 - 12.5	16	100	90	27	40	1.08	82	12.7	25.4
16101-240-CV1					240	600	1.08	240	81	84
17101-19-CN0	9.84 - 15.0	17	120	75	19	28	1.08	63.5	12.1	21.6
17101-300-CH1					300	450	1.08	240	121.8	45
18101-19-CN0	11.9 - 18.5	18	140	62	19	28	1.08	76	9.9	17.8
18101-275-CH1					275	410	1.08	240	113	40
19101-14-CN0	14.5 - 22.0	19	180	51	14	21	1.08	62	8.5	15.0
19101-275-CH1					275	410	1.08	240	117	40
20101-11-CN0	17.6 - 26.7	20	220	42	11	16	1.08	58	6.4	12.7
20101-250-CH1					250	375	1.07	237	106	35
21101-9-CN0	21.7 - 33.0	21	260	34	9	13	1.08	52	6.4	10.7
21101-250-CH1					250	375	1.07	237	106	35
22101-7-CN0	26.4 - 40.1	22	320	28	7	10	1.08	47	5.6	9.1
22101-250-CH1					250	375	1.08	127	119	81
23101-6-CN0	33.0 - 50.1	23	400	22	6	9	1.08	45	4.9	7.7
23101-250-CV1					250	375	1.08	127	68.5	138

Many models available from
STOCK

General Specifications

Maximum Power is Mean /CW
Non shedding ceramic elements.
Low out-gassing (load element total mass loss < 1.0%, collected volatile condensable materials < 0.10%)

Natural Convection

Terminations incorporating heat sinks are orientation sensitive due to the direction of air flow over the heat sink. Flann model number includes a 'V' or 'H' code to differentiate which is the recommended orientation. It should be noted that the waveguide broad wall should be vertical in the 'H' configuration.

Forced Air

Where stated the standard natural convection design can be used at 1.5 times its rated power with forced air cooling; 3 m/s velocity over all heatsink surfaces.

Blown Version (Fan Assisted) details on request

Liquid Cooled (Water, Oil, Glycol) details on request

Natural Convection Ratings

Natural Convection specified power rating @ +20°C ambient – no direct sunlight.
Ambient power rating adjustment is +/-5%W per +/-10°C.
Vertical design rating is with flange mounted below heatsink - or derate 25%
Vertical design mounted horizontally derate 35%
Horizontal design mounted vertically derate 30%
Horizontal design mounted horizontally but axis through 90° derate 15%

High Power Terminations Series 101

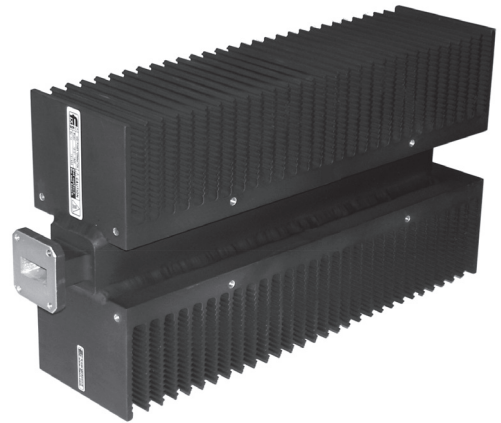
Natural Convection Very High Power Range up to 1.5 kWatts

Model	Frequency Range (GHz)	Waveguide			Maximum Power Mean / CW (Watts)		Maximum VSWR	Dimensions (mm)		
		WG	R	WR	Natural Convection	Forced Air (3 m/s)		L	BX	AX
10101-600-CV1	2.60 – 3.95	10	32	284	600	900	1.08	273	124.4	200
11A101-1500-CH1	3.22 – 4.90	11A	40	229	1500	2250	1.10	438	154	198
12101-1500-CH1	3.94 – 5.99	12	48	187	1500	2250	1.10	438	147	198
13101-1500-CH1	4.64 – 7.05	13	58	159	1500	2250	1.09	438	145.5	198
14101-1500-CH1	5.38 – 8.2	14	70	137	1500	2250	1.08	438	132.8	198
15101-1500-CH2	6.58 – 10.0	15	84	112	1500	2250	1.10	247	215.5	161
16101-1500-CH1	8.20 – 12.5	16	100	90	1500	2250	1.08	415	125	198
17101-1500-CH2	9.84 – 15.0	17	120	75	1500	2250	1.07	415	205.8	92
18101-1500-CV2	11.9 – 18.5	18	140	62	1500	2250	1.07	430	233	90
19101-1500-CV2	14.5 – 22.0	19	180	51	1500	2250	1.07	430	233	90
20101-1000-CV2	17.6 – 26.7	20	220	42	1000	1500	1.07	237	222	90
21101-1000-CV2	21.7 – 33.0	21	260	34	1000	1500	1.07	237	222	90
22101-1000-CV2	26.4 – 40.1	22	320	28	1000	1500	1.08	237	219	90
23101-500-CV2	33.0 – 50.1	23	400	22	500	750	1.08	127	218.5	90

Many models available from
STOCK

Natural Convection Ultra High Power Range up to 10.0 kWatts

Model	Frequency Range (GHz)	Waveguide			Maximum Power Mean / CW (Watts)		Maximum VSWR	Dimensions (mm)		
		WG	R	WR	Natural Convection	Forced Air (3 m/s)		L	BX	AX
11A101-4000-CH2	3.22 – 4.90	11A	40	229	4000	6000	1.10	438	238	278
12101-3800-CH2	3.94 – 5.99	12	48	187	3800	5700	1.10	438	231	262
13101-3700-CH2	4.64 – 7.05	13	58	159	3700	5500	1.09	438	229.5	253
14101-3600-CH2	5.38 – 8.2	14	70	137	3600	5400	1.08	438	216.8	246
15101-3400-CH2	6.58 – 10.0	15	84	112	3400	5100	1.08	422	215.5	229
16101-3200-CH2	8.20 – 12.5	16	100	90	3200	4800	1.08	415	209	214
17101-2900-CH2	9.84 – 15.0	17	120	75	2900	4350	1.07	415	205.8	191
18101-2700-CH2	11.9 – 18.5	18	140	62	2700	4000	1.07	415	201	176
19101-2500-CH2	14.5 – 22.0	19	180	51	2500	3750	1.07	415	201	161



Model 17101-1500-CH20 UBR120

TML (Total Mass Loss) < 1%

CVCM (Collected Volatile Condensable Mass) < 0.1%

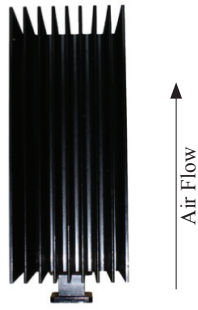
ORDERING INFORMATION: - BASIC OPTIONS

Model Description: Waveguide WG15, 1500 Watts, PBR 84 Flange	Model Number: 15 101 -1500 -C H 2 0 PBR84
Waveguide: WG Waveguide Designation	
Series: 101	
Power: Maximum Power Handling (Watts)*	
Cooling Style: C = Convection, F = Integral Fan, L = Liquid, P = Plate/Heatpipe	
Preferred Orientation: N = None, H = Horizontal, V = Vertical	
Heat Sink Style: 0 = No Fins, 1 = Single, 2 = Double, 3 = Peripheral	
Other Options: 0 = Standard	
Flange Type: For standard flange types and recommendations see page 111 onwards	

* Dependent on Cooling / Heat Sink Style and orientation. Please contact the Sales Team for other standard values

High Power Terminations

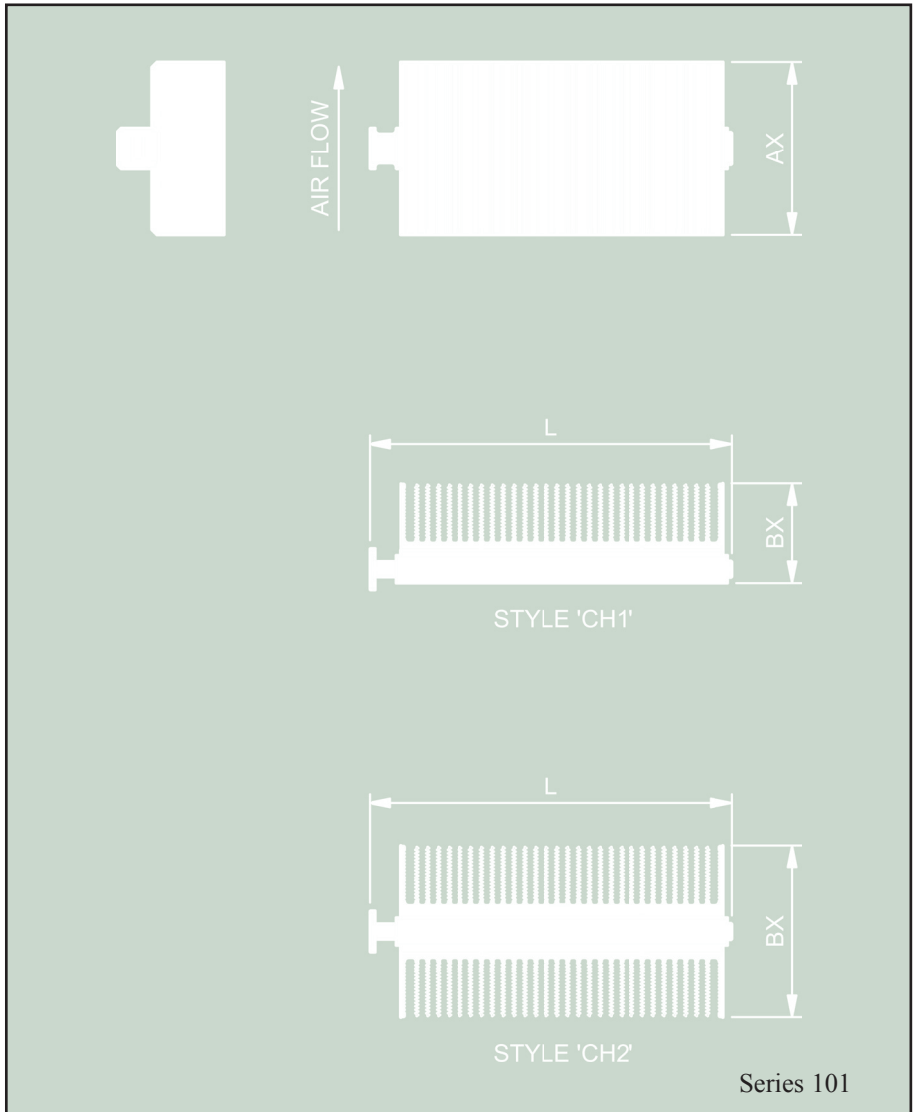
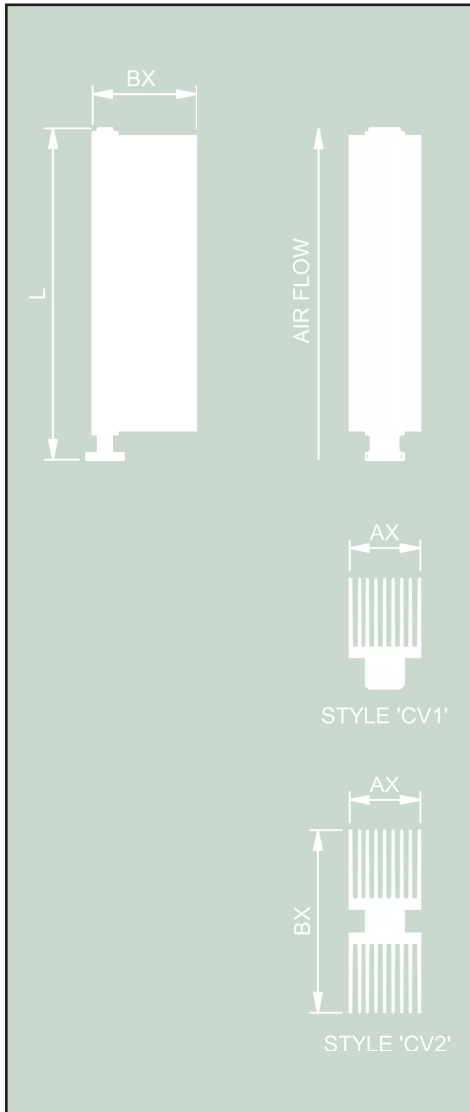
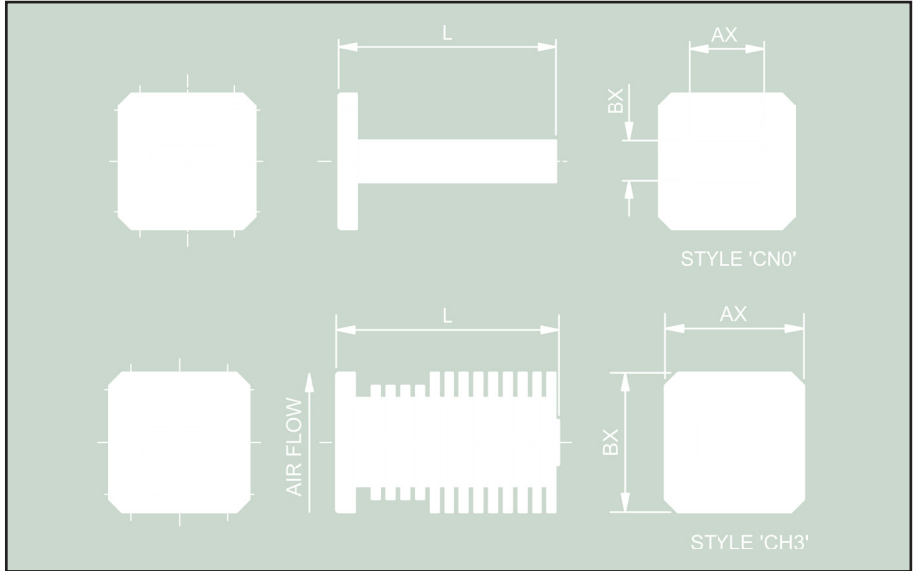
Series 101



Vertical Orientation



Horizontal Orientation



Series 101

For standard flange types and recommendations see pages 118 onwards

Double Ridge High Power Terminations

Series WRD101

Features

- 2.0 GHz to 40 GHz
- Low VSWR over full frequency range
- Models up to 7500 Watts

Applications

- Radar
- System Dummy Loads

All terminations have been designed to give high durability and reliability using ceramic elements encapsulated in aluminium body.

Terminations operating at higher power levels can be manufactured on request.



Model WRD750101-700-CH20

Model	Frequency Range (GHz)	Waveguide Size	Maximum Power Mean / CW* (Watts)		Maximum VSWR	Dimensions** (mm)		
			Natural Convection	Forced Air (3 m/s)		L	BX	AX
WRD350101-85-CN0	3.5 - 8.2	WRD350D24	85	120	1.1	245	21	41
WRD350101-3000-CH2			3000	4500	1.1	416	219	210
WRD475101-55-CN0	4.75 - 11.0	WRD475D24	55	80	1.1	175	16	31
WRD475101-2500-CH2			2500	3700	1.1	416	204	170
WRD580101-40-CN0	5.80 - 16.0	WRD580D28	40	60	1.1	136	12	23
WRD580101-2500-CH2			2500	3700	1.1	416	203	170
WRD650101-32-CN0	6.50 - 18.0	WRD650D28	32	48	1.1	117	11	21
WRD650101-2000-CH2			2000	3000	1.1	416	203	132
WRD750101-30-CN0	7.50 - 18.0	WRD750D24	30	45	1.1	110	11	21
WRD750101-2500-CH2			2500	3700	1.1	416	203	171
WRD110101-20-CN0	11.0 - 26.5	WRD110C24	20	30	1.1	95	8	14
WRD110101-1000-CH2			1000	1500	1.1	236	194	95
WRD180101-10-CN0	18.0 - 40.0	WRD180C24	10	15	1.1	60	6	10
WRD180101-500-CH1			500	750	1.1	226	106	95

* Maximum powers may need pressurising or SF6 to prevent cw breakdown

** See Page 47 for definition of dimensions

ORDERING INFORMATION: - BASIC OPTIONS

Model Description: Waveguide WRD180, 500 Watts, Model Number: WRD180 101 -500 -C H 2 0 CIA
CIA Flange

Waveguide: WRD200 to WRD180

Series: 101

Power: Maximum Power Handling (Watts)***

Cooling Style: C = Convection, F = Integral Fan, L = Liquid, P = Plate/Heatpipe

Preferred Orientation: N = None, H = Horizontal, V = Vertical

Heat Sink Style: 0 = No Fins, 1 = Single, 2 = Double, 3 = Peripheral

Other Options: 0 = Standard

Flange Type: For standard flange types and recommendations see page 111 onwards

*** Dependent on Cooling / Heat Sink Style and orientation.

Please contact the Sales Team for other standard values

Calibrated Frequency Meters Series 070

Features

- High Accuracy
- High Q
- Full Band

In designing a satisfactory frequency meter cavity, great care must be used in the selection of the operating mode of resonance, the diameter and the coupling elements in order that non-ambiguous operation is achieved over the full waveguide band.

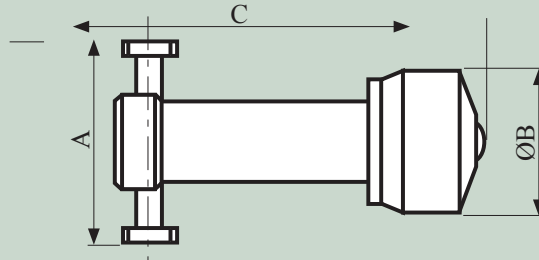
The Flann Series 070 Frequency Meters consist of a high Q electroformed precision cavity located on the rectangular waveguide narrow wall. The cavity operates in the TE₁₁₁ mode and is tuned by a non-contacting choked piston. All models have a minimum tuned response of 1 dB. A micrometer drive ensures precise control of the piston position enabling frequency measurement to a high accuracy. Each instrument is supplied with calibration data.



Model 17070

ORDERING INFORMATION

Model: Description
Example: Model 22070 Calibrated frequency meter



Series 070

Model	Frequency Range (GHz)	Waveguide			Calibrated Accuracy (%)	Typical Loaded Q	Dimensions (mm)		
		WG	W	WR			A	B	C
14070	5.38 - 8.18	14	70	137	0.010	7000	110	63	173
15070	6.58 - 10.0	15	84	112	0.010	6300	102	63	161
16070	8.20 - 12.5	16	100	90	0.010	5500	90	50	125
17070	9.84 - 15.0	17	120	75	0.010	5200	90	50	111
18070	11.9 - 18.0	18	140	62	0.012	4700	90	50	107
19070	14.5 - 22.0	19	180	51	0.012	4200	90	50	104
20070	17.6 - 26.7	20	220	42	0.012	3700	90	50	101
22070	26.4 - 40.1	22	320	28	0.025	3000	70	50	122
23070	33.0 - 50.1	23	400	22	0.025	2800	60	50	113
24070	39.3 - 59.7	24	500	19	0.030	2300	60	50	104
25070	49.9 - 75.8	25	620	15	0.035	2100	60	50	103
26070	60.5 - 92.0	26	740	12	0.035	1800	60	50	105
27070	73.8 - 112.0	27	900	10	0.050	1600	60	50	101
28070	92.0 - 140	28	1200	8	0.080	1200	60	50	95
29070	114 - 173	29	1400	6					
30070	145 - 220	30	1800	5					
31070	172 - 261	31	2200	4					
32070	217 - 330	32	2600	3					

Specification available
on
request

For standard flange types and recommendations see pages 118 onwards

Direct Reading Frequency Meters Series 072

Features

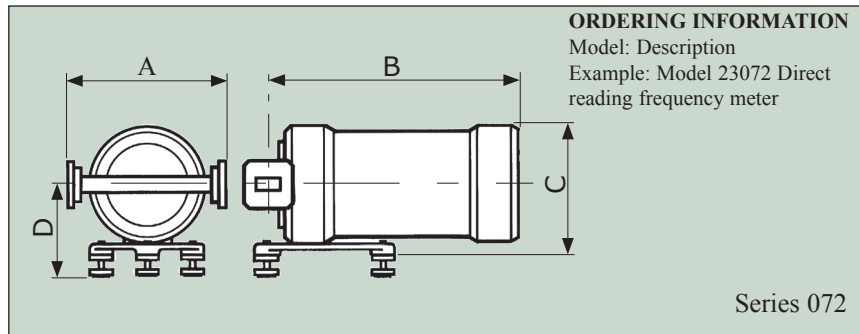
- **Direct Reading**
- **Up to 0.08% Accuracy**
- **High Q**
- **High Resolution**

The Flann Series 072 Direct Reading Frequency Meters are simple to operate and offer a high degree of measurement accuracy over the appropriate recommended waveguide frequency range. The design uses a TE₁₁₁ mode high Q cavity tuned by a precision non-contacting piston. Care has been exercised in the design to achieve wide band operation without ambiguous response.

The drive mechanism is coupled to a helical drum scale directly calibrated in GHz. The frequency scale length for most models is in excess of 2500 mm and provides high resolution throughout the frequency band. The Frequency Meters are of the absorption type and the minimum tuned response for all models is 1 dB, so the customer is able to detect the resonance absorption. Models are available in most waveguide bands covering 3.94 GHz to 330 GHz.



Model 20072



Specifications:

Model	Frequency Range (GHz)	Waveguide			Accuracy (%)	Typical Loaded Q	Smallest Scale Increments (MHz)	Dimensions (mm)			
		WG	R	WR				A	B	C	D min/max
12072	3.94 - 5.99	12	48	187	0.08	8,000	2	160	192	108	71/80
15072	6.58 - 10.0	15	84	112	0.08	6,300	2	135	226	109	71/80
16072	8.20 - 12.5	16	100	90	0.10	5,500	2	135	217	109	71/80
17072	9.84 - 15.0	17	120	75	0.10	5,200	5	135	212	109	71/80
18072	11.9 - 18.0	18	140	62	0.12	4,700	5	135	206	109	71/80
19072	14.5 - 22.0	19	180	51	0.12	4,200	5	135	205	109	71/80
20072	17.6 - 26.7	20	220	42	0.12	3,700	10	135	203	109	71/80
22072	26.4 - 40.1	22	320	28	0.12	3,000	10	100	169	110	71/80
23072	33.0 - 50.1	23	400	22	0.15	2,300	20	116	183	109	71/80
24072	39.3 - 59.7	24	500	19	0.15	2,300	20	92	176	109	71/80
25072	49.9 - 75.8	25	620	15	0.18	2,100	25	86	176	109	71/80
26072	60.5 - 92.0	26	740	12	0.18	1,800	26	86	176	109	71/80
27072	73.8 - 112	27	900	10	0.25	1,600	50	86	162	109	71/80
28072	92.3 - 140	28	1200	8	0.40	1,200	50	82	162	109	71/80

For standard flange types and recommendations see pages 118 onwards

Waveguide to Coax Adaptors Model Selection

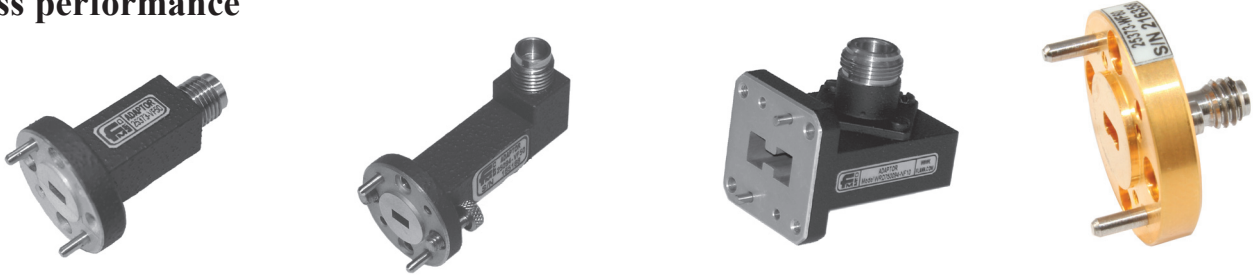
Models 750 MHz to 173 GHz

Male (Plug) and Female (Jack) variants available

Brass, Copper & Aluminium Options

Standard & Special Flange Styles

Narrow-band versions available with further improved return loss performance



Connector	Full Band - 90 degree	High Power - 90 degree	Low PIM - 90 degree
7/16 DIN		097-DF10	098-DF
N	093-NF10 & 094-NF10	097-NF10	098-NF10
SMA	094-SF40		
K (2.9mm)	093-KF20 & 094-KF20	097-KF20	098-KF10
APC7	093-AP70 096-AP70		
2.4mm	093-TF30	097-TF	098-TF
V(1.85mm)	093-VF50 & 093-VF50	097-VF	098-VF
1.00mm	093-WF60	097-WF	
0.8mm	093-FF60	097-FF	

Connector	Full Band - End Launch	High Power - End Launch	Low PIM - End Launch
7/16 DIN	373-DF10	377-DF10	378-DF
N	373-NF10	377-NF10	378-NF
SMA			
K (2.9mm)	373-KF20	377-KF20	378-KF20
APC7	373-AP		
2.4mm	373-TF	377-TF	378-TF
V(1.85mm)	373-VF50	377-VF50	378-VF50
1.00mm	373-WF60	377-WF60	
0.88mm	373-FF60	377-FF60	

**Other connector types are also available including: Cable Direct Entry
Special & Customised**

Broadband Waveguide to Coax N Type Adaptors

Series 093-NF10 / 094-NF10

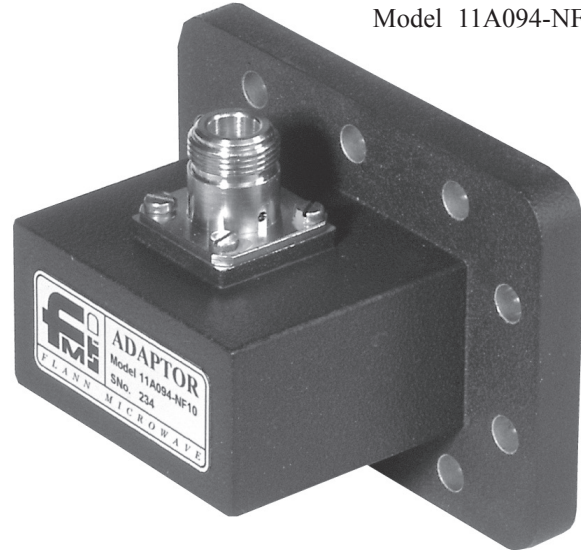
Features

- **Very Low VSWR**
- **Full Waveguide Band Models**
- **Manufactured from Brass or Aluminium***

The series 093/094-NF broadband Waveguide to Coax Adaptors offer enhanced VSWR performance over the full waveguide frequency band. Models in WG14 to WG18 feature an improved mechanical design offering greater durability and reliability whilst maintaining existing high performance specifications. Minor dimensional changes may be incorporated from time to time; please contact our Sales Team for latest information if the space available is limited.

The adaptors are fitted with Type N Female connectors as standard; adaptors fitted with type N male connectors are available to special order, please contact our Sales Team for further details.

Narrowband models covering typically 20% of the full waveguide band with a VSWR of 1.05 are also available. Please see Series 093-NF** and 094-NF** for details.



Model 11A094-NF10

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	*Dimensions (Brass)			Weight (kg) [Brass]
		WG	R	WR		A	B	C	
06093-NF10	1.14 - 1.73	6	14	650	1.20	108.2	169.5	65.5	3.95
08093-NF10	1.72 - 2.61	8	22	430	1.20	61.4	110.5	51.5	2.23
09A093-NF10	2.17 - 3.3	9A	26	340	1.20	64.0	98.4	45.8	1.80
10094-NF10	2.6 - 3.95	10	32	284	1.15	66.6	89.5	41.2	0.98
11A094-NF10	3.3 - 4.9	11A	40	229	1.15	50.9	74.0	38.4	0.70
12094-NF10	3.94 - 5.99	12	48	187	1.14	49.5	66.5	36.4	0.67
13094-NF10	4.64 - 7.05	13	58	159	1.13	51.0	66.0	33.8	0.57
14094-NF10	5.38 - 8.18	14	70	137	1.10	55.8	69.0	33.2	0.38
15094-NF10	6.58 - 10.0	15	84	112	1.12	45.8	59.9	31.6	0.33
16094-NF10	8.2 - 12.5	16	100	90	1.12	54.0	64.0	44.9	0.18
17094-NF10	9.84 - 15.0	17	120	75	1.12	42.2	52.0	44.2	0.15
18094-NF10	11.9 - 18.0	18	40	62	1.12	47.2	56.0	44.0	0.12

ORDERING INFORMATION

Model: Description

Example: Model 14094-NF10 Broadband waveguide to type N female coax adaptor

If the adaptor is required to be manufactured in aluminium please suffix the order information with \ AL

Example: Model 14094-NF10\AL

*Note 1 The dimensions of aluminium adaptors may vary from those manufactured in brass.

Note 2 Models with suffix NF10 are broadband units. Please see page 53 for narrowband models.

Series 094-NF

For standard flange types and recommendations see pages 118 onwards

Narrow Band Waveguide to N Type Coax Adaptors

Series 093-NF** / 094-NF**

Features

- Very Low VSWR
- Alternative Narrow Band Models on Request
- Brass or *Aluminium models available

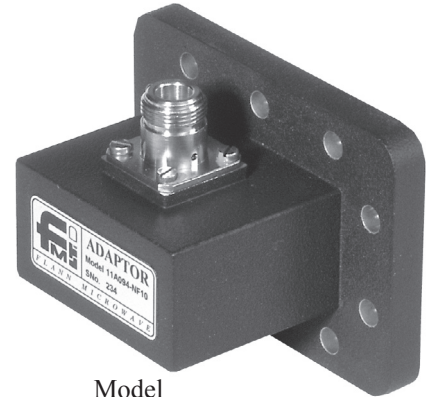
For some applications, where full waveguide band operation is not essential, it might be desirable to opt for an optimised VSWR performance over a narrow band.

For such applications Flann are able to offer narrow band models with a typical VSWR of 1.05 depending on waveguide size and operating frequency range.

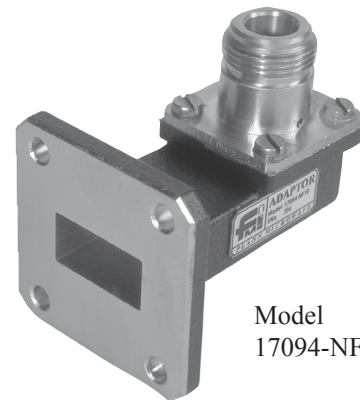
Please contact our Sales Office in the first instance for assistance to identify the most suitable model for your requirement.

Models are available fitted with either Male or Female Type N connectors.

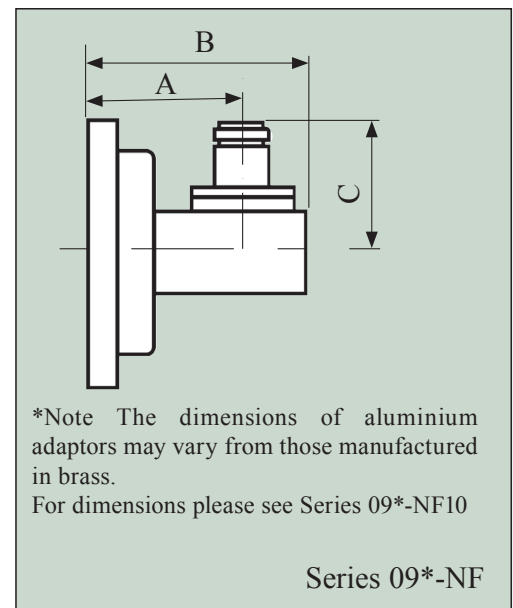
Narrow band models fitted with SMA connectors are also available. Please see Series 094-SF** for details



Model
11A094-NF16



Model
17094-NF19



For standard flange types and recommendations see pages 118 onwards

Waveguide to APC7 Coax Adaptors Series 093-AP

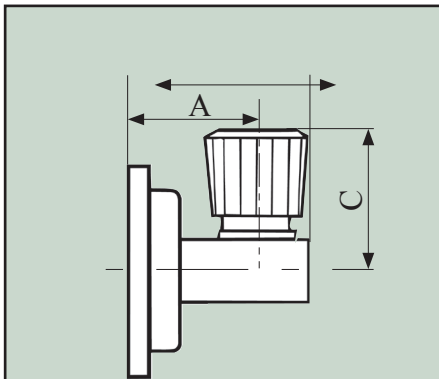
Features

- **Full Band & Narrow Band Models Available**
- **Manufactured from Brass or Aluminium***

The Flann Series 093-AP Waveguide to Coax Adaptors are fitted with a precision APC7 hermaphroditic connector.



Model 18093-AP70



ORDERING INFORMATION

Model: frequency band suffix;
Description
Example: Model 16093-AP75
Waveguide to APC7 coax adaptor
(Frequency Range 11.40 GHz to 12.00 GHz, VSWR 1.05 max)
If the adaptor is required to be manufactured in aluminium please suffix the order information with \AL
Example: Model 16093-AP75\AL

*Note: The dimensions of aluminium adaptors may vary from those manufactured in brass.

Series 093-AP

Models are available for both full waveguide band operation and also for limited band applications where much improved VSWR performance is offered.

The following tables indicate a wide choice of adaptor specification. Alternative requirements can be accommodated provided the customer submits full details of the specification required.

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	*Dimensions (Brass)			Weight (kg) [Brass]
		WG	R	WR		A	B	C	
06093-AP70	1.14 - 1.73	6	14	650	1.10	105.8	151.0	75.8	3.30
06093-AP71	1.2 - 1.56	6	14	650	1.05	105.8	151.0	75.8	3.30
06093-AP72	1.215 - 1.365	6	14	650	1.05	105.8	151.0	75.8	3.30
08093-AP70	1.72 - 2.61	8	22	430	1.15	111.8	150.0	61.8	2.10
08093-AP71	1.75 - 1.95	8	22	430	1.05	111.8	150.0	61.8	2.10
09A093-AP70	2.17 - 3.3	9A	26	340	1.10	Details on Request			
10093-AP70	2.6 - 3.95	10	32	284	1.10	59.4	85.5	51.5	1.30
10093-AP72	2.9 - 3.1	10	32	284	1.03	59.4	85.5	51.5	1.30
10093-AP73	2.4 - 2.6	10	32	284	1.05	59.4	85.5	51.5	1.30
11A093-AP70	3.3 - 4.9	11A	40	229	1.10	45.8	65.0	47.6	0.60
11A093-AP71	3.7 - 4.2	11A	40	229	1.05	45.8	65.0	47.6	0.60
12093-AP70	3.94 - 5.99	12	48	187	1.10	44.0	62.0	38.0	0.60
12093-AP71	5.45 - 5.65	12	48	187	1.05	44.0	62.0	38.0	0.60
12093-AP72	5.2 - 5.4	12	48	187	1.05	44.0	62.0	38.0	0.60
13093-AP70	4.64 - 7.05	13	58	159	1.10	51.8	68.5	44.1	0.50
13093-AP71	5.5 - 6.0	13	58	159	1.05	51.8	68.5	44.1	0.50
13093-AP72	5.0 - 5.1	13	58	159	1.05	51.8	68.5	44.1	0.50
14093-AP70	5.38 - 8.18	14	70	137	1.10	34.9	50.0	41.9	0.40
15093-AP70	6.58 - 10.0	15	84	112	1.10	45.5	58.0	40.3	0.18
15093-AP71	7.1 - 7.5	15	84	112	1.05	45.5	58.0	40.3	0.18
15093-AP72	7.5 - 7.9	15	84	112	1.05	45.5	58.0	40.3	0.18
15093-AP73	7.5 - 9.0	15	84	112	1.07	45.5	58.0	40.3	0.18
16093-AP70	8.2 - 12.5	16	100	90	1.10	54.0	64.0	39.1	0.13
16093-AP71	8.6 - 9.4	16	100	90	1.05	54.0	64.0	39.1	0.13
16093-AP72	9.7 - 10.4	16	100	90	1.05	54.0	64.0	39.1	0.13
16093-AP73	10.6 - 11.4	16	100	90	1.05	54.0	64.0	39.1	0.13
16093-AP74	10.9 - 11.7	16	100	90	1.05	54.0	64.0	39.1	0.13
16093-AP75	11.4 - 12.0	16	100	90	1.05	54.0	64.0	39.1	0.13
17093-AP70	9.84 - 15.0	17	120	75	1.10	42.2	52.0	38.8	0.10
17093-AP71	11.7 - 14.5	17	120	75	1.07	42.2	52.0	38.8	0.10
18093-AP70	11.9 - 18.0	18	140	62	1.10	47.2	56	38.4	0.08
18093-AP71	14.0 - 14.5	18	140	62	1.03	47.2	56	38.4	0.08
18093-AP72	15.5 - 17.5	18	140	62	1.07	47.2	56	38.4	0.08
18093-AP73	14.5 - 16.5	18	140	62	1.07	47.2	56	38.4	0.08
18093-AP74	17.3 - 18.1	18	140	62	1.10	47.2	56	38.4	0.08
18093-AP75	16.3 - 16.7	18	140	62	1.05	47.2	56	38.4	0.08
18093-AP76	13.0 - 14.5	18	140	62	1.10	47.2	56	38.4	0.08

Alternative narrowband units can generally be accommodated, details on request.

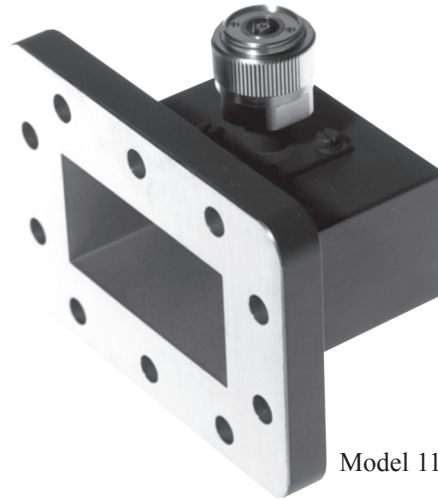
For standard flange types and recommendations see pages 118 onwards

Waveguide to APC7 Coax Adaptors Series 096-AP

Features

- **VSWR better than 1.05:1**
- **Full Waveguide Band Coverage**
- **7 mm Precision (APC) Connector**
- **Manufactured from Brass or Aluminium***

The Series 096-AP Waveguide to Coax Adaptors offer a very low VSWR over full waveguide bands up to 18 GHz. The units are fitted with a precision 7 mm (APC7) connector for repeatable connection.



Model 11A096-AP70

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	*Dimensions (Brass)		
		WG	R	WR		A	B	C
06096-AP70	1.14 - 1.73	6	14	650	1.05	105.8	151.0	75.8
08096-AP70	1.72 - 2.61	8	22	430	1.05	111.81	148.5	61.8
10096-AP70	2.6 - 3.95	10	32	284	1.05	59.4	85.5	51.5
11A096-AP70	3.3 - 4.9	11A	40	229	1.05	55.8	76.0	47.6
12096-AP70	3.94 - 5.99	12	48	187	1.05	62.70	81.5	41.7
13096-AP70	4.64 - 7.05	13	58	159	1.05	51.8	68.5	42.9
14096-AP70	5.38 - 8.18	14	70	137	1.05	55.9	71.0	41.90
15096-AP70	6.58 - 10.0	15	84	112	1.05	45.5	58.0	40.3
16096-AP70	8.20 - 12.5	16	100	90	1.05	54.0	64.0	39.1
17096-AP70	9.84 - 15.0	17	120	75	1.07	42.2	52.0	38.8
18096-AP70	11.9 - 18.0	18	140	62	1.07	47.2	56.0	38.5

ORDERING INFORMATION

Model: Description

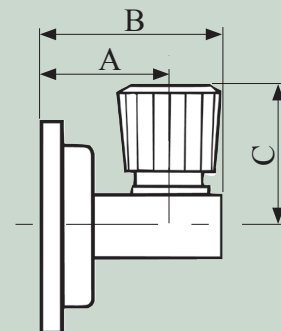
Example: Model 16096-APC70 Waveguide to APC7 coax adaptor

Please note: Narrowband options are not available for this series of Waveguide to Coax Adaptors.

If the adaptor is required to be manufactured in aluminium please suffix the order information with \AL

Example: Model 16096-APC70\AL

*Note The dimensions of aluminium adaptors may vary from those manufactured in brass.



Series 096-AP

For standard flange types and recommendations see pages 118 onwards

Waveguide to SMA Coax Adaptors

Series 094-SF40

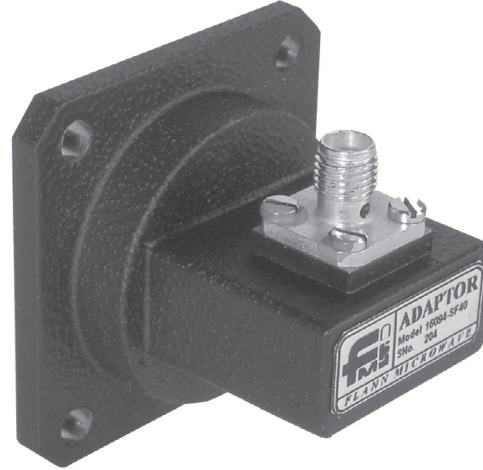
Features

- **Very Low VSWR**
- **Full Waveguide Band models**
- **Manufactured from Brass or *Aluminium**

The Flann Series 094-SF waveguide to coax adaptors offer enhanced VSWR performance over the full waveguide frequency band.

The adaptors are fitted with SMA Female connectors as standard. However, models are optionally available with male connectors, please contact our sales team for further details.

Narrowband models covering typically 20% of the full waveguide band with a VSWR of 1.05 are also available. Please see Series 094-SF** for details.



Model 16094-SF40

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	*Dimensions (Brass)		
		WG	R	WR		A	B	C
11A094-SF40	3.3 - 4.9	11A	40	229	1.15	51.5	72.3	59.0
12094-SF40	3.94 - 5.99	12	48	187	1.15	60.2	78.5	24.5
13094-SF40	4.64 - 7.05	13	58	159	1.15	32.6	46.5	22.8
14094-SF40	5.38 - 8.18	14	70	137	1.15	35.8	46.5	21.4
15094-SF40	6.58 - 10.0	15	84	112	1.12	37.5	48.5	19.8
16094-SF40	8.2 - 12.5	16	100	90	1.12	34.5	45.3	17.9
17094-SF40	9.84 - 15.0	17	120	75	1.12	26.2	34.5	17.1
18094-SF40	11.9 - 18.0	18	140	62	1.12	38.5	47.3	17.0
19094-SF40	14.5 - 22.0	19	180	51	1.20	27.3	34.5	16.4
20094-SF40	17.6 - 26.7	20	220	42	1.20	21.5	27.9	15.1

ORDERING INFORMATION

Model: description

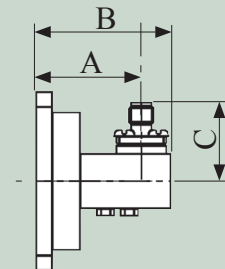
Example: Model 18094-SF40 waveguide to SMA female coax adaptor

If the adaptor is required to be manufactured in aluminium please suffix the order information with \AL

Example: Model 18094-SF40\AL

Note: models with suffix SF40 are full band units. Please see page 58 for narrowband models.

*Note The dimensions of aluminium adaptors may vary from those manufactured in brass.



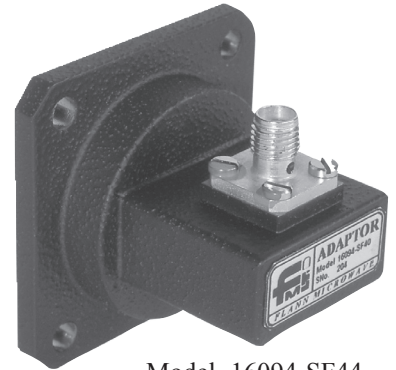
Series 094-SF

For standard flange types and recommendations see pages 118 onwards

Narrow Band Waveguide to SMA Coax Adaptors Series 094-SF**

Features

- **Very Low VSWR**
- **Alternative Narrowband Models on Request**
- **Brass or *Aluminium models available**

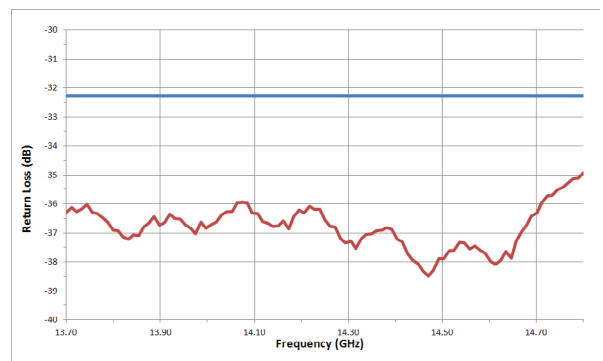


Model 16094-SF44

For some applications, where full waveguide band operation is not essential, it might be desirable to opt for an optimised VSWR performance over a narrow band. For such applications Flann are able to offer narrow band models with a typical VSWR of better than 1.05 depending on waveguide size and operating frequency range. Please contact our Sales Office in the first instance for assistance to identify the most suitable model for your requirement.

Models are available fitted with either Male or Female SMA connector.

Narrow band models fitted with Type N connectors are also available. Please see Series 094-NF** for details.



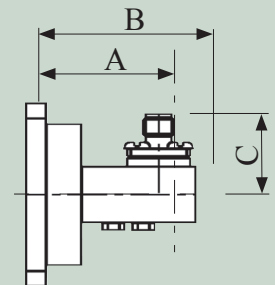
Typical Return Loss for Model 17094-SF48

ORDERING INFORMATION

Model: frequency band suffix; description

Example: Model 17094-SF44 Narrow Band waveguide to SMA coax adaptor (frequency range 14.00 GHz to 14.50 GHz VSWR 1.05 max)

*Note The dimensions of aluminium adaptors may vary from those manufactured in brass.



For dimensions please see 094-SF40

Series 094-SF**

For standard flange types and recommendations see pages 118 onwards

Waveguide to K Type Coax Adaptors

Series 093-KF/KM and 094-KF

Features

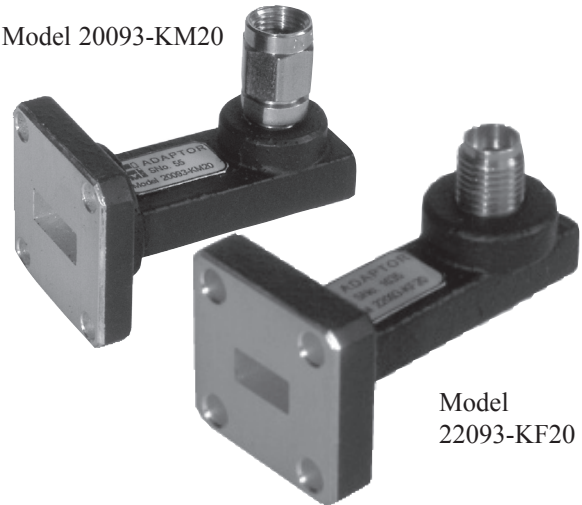
- **Low VSWR**
- **Models up to 40 GHz**
- **Manufactured from Brass or *Aluminium**

The new Series 093-KF/KM and 094-KF range of Waveguide to Coax Adaptors feature an improved mechanical design offering greater durability and reliability. Minor dimensional changes may have been incorporated; please contact our Sales Team for further information if available space is limited.

Adaptors in this range are fitted with Precision 'K' type connectors and are available for frequency ranges up to 40 GHz. Narrowband models, specifically optimised and offering reduced VSWR, are also available.

Male and Female connectors are offered, see table below for full details.

Model 20093-KM20



Model
22093-KF20

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	*Dimensions (Brass)		
		WG	R	WR		A	B	C
18094-KF20	11.9 - 18.0	18	140	62	1.10	37.1	45.5	17.9
18093-KF20	11.9 - 18.0	18	140	62	1.12	37.1	45.5	17.9
19094-KF20	14.5 - 22.0	19	180	51	1.10	36.3	45.5	17.0
19093-KF20	14.5 - 22.0	19	180	51	1.20	36.3	45.5	17.0
19093-KM20	14.5 - 22.0	19	180	51	1.20	36.3	45.5	19.4
19093-KF21	20.2 - 20.8	19	180	51	1.05	36.3	45.5	19.4
20094-KF20	17.6 - 26.7	20	220	42	1.10	28.6	37.0	16.1
20093-KF20	17.6 - 26.7	20	220	42	1.20	28.6	37.0	16.1
20093-KM20	17.6 - 26.7	20	220	42	1.20	28.6	37.0	19.3
20093-KF21	21.2 - 23.6	20	220	42	1.10	28.6	37.0	16.1
20093-KM21	21.2 - 23.6	20	220	42	1.10	28.6	37.0	19.3
20093-KM23	23.0 - 24.0	20	220	42	1.10	28.6	37.0	19.3
21094-KF20	21.7 - 33.0	21	260	34	1.15	28.7	37.0	16.1
21093-KF20	21.7 - 33.0	21	260	34	1.25	28.7	37.0	16.1
21093-KM20	21.7 - 33.0	21	260	34	1.25	28.7	37.0	18.8
21093-KF22	24.5 - 27.0	21	260	34	1.10	28.7	37.0	16.1
22094-KF20	26.4 - 40.1	22	320	28	1.15	28.4	36.5	15.7
22093-KF20	26.4 - 40.1	22	320	28	1.20	28.4	36.5	15.7
22093-KM20	26.4 - 40.1	22	320	28	1.20	28.4	36.5	17.9
22093-KF22	37.0 - 39.5	22	320	28	1.10	28.4	36.5	15.7
22093-KF23	27.0 - 29.5	22	320	28	1.10	28.4	36.5	15.7
22093-KF24**	40.5 - 42.5	22	320	28	1.30	28.4	36.5	15.7
22093-KF25	28.0 - 32.0	22	320	28	1.15	28.4	36.5	15.7
22093-KF26	33.0 - 35.0	22	320	28	1.10	28.4	36.5	15.7
22093-KF27	28.0 - 31.0	22	320	28	1.10	28.4	36.5	15.7
22093-KM21	28.0 - 28.7	22	320	28	1.15	28.4	36.5	15.7
22093-KM22	37.0 - 39.5	22	320	28	1.10	28.4	36.5	15.7
22093-KM23	27.0 - 29.0	22	320	28	1.10	28.4	36.5	15.7
22093-KM24	40.5 - 42.5	22	320	28	1.30	28.4	36.5	15.7
22093-KM25	28.0 - 32.0	22	320	28	1.15	28.4	36.5	15.7
22093-KM26	33.0 - 35.0	22	320	28	1.10	28.4	36.5	15.7

ORDERING INFORMATION

Adaptor, Waveguide to Coax, Precision K Female

Model: Frequency band and adaptor type suffix; Description

Example: Model 22094-KF20 Waveguide to K type female coax adaptor (Frequency Range 26.4 GHz to 40.1 GHz, VSWR 1.15)

Adaptor, Waveguide to Coax, Precision K Male

Model: Frequency band and adaptor type suffix; Description

Example: Model 20093-KM20 Waveguide to K Type male coax adaptor (Frequency Range 17.6 GHz to 26.7 GHz, VSWR 1.20)

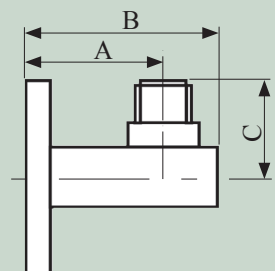
Models optimised for narrowband applications are also available - details on request.

If the adaptor is required to be manufactured in aluminium please suffix the order information with \AL

Example: Model 20093-KM20\AL

*Note The dimensions of aluminium adaptors may vary from those manufactured in brass.

**Note This adaptor is a special model optimised for use outside the frequency band.



Series 093-KF/KM 094-KF

For standard flange types and recommendations see pages 118 onwards

Waveguide to 1.85 mm V Connector®* Coax Adaptor Series 093/094-VF and VM

Features

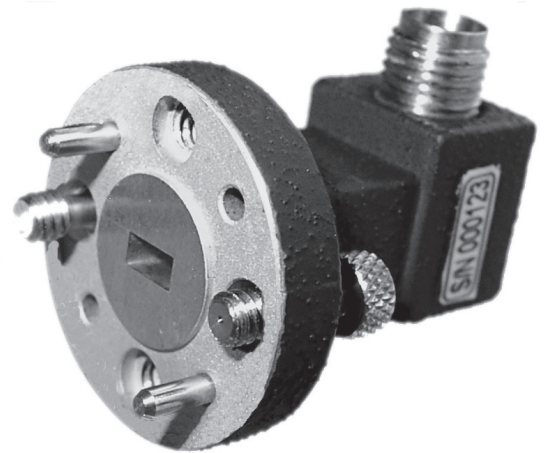
- 1.85 mm V Connector®*
- Low VSWR
- Models Available in 3 bands from 33 GHz
- Male or Female Connectors Available
- Two Grades Available

The Flann adaptors fitted with 1.85 mm coax connectors incorporate a split pin centre conductor providing excellent reliability and repeatability; these adaptors can also be integrated with filters, couplers, attenuators and antennas.

The model illustrated above is a 25094-VF50, fitted with a standard UG-385/U flange.

Please contact our Sales Team with your requirements for all waveguide to coax adaptors.

If you cannot find a suitable waveguide to coax adaptor in our extensive range we are able to design a model to your specific needs.



Model 25094-VF50

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)	Dimensions (mm)		
		WG	R	WR		A	B	C
23093-VF50	33.0 to 50.0	23	400	22	1.40	24.0	29.0	16.6
23094-VF50	33.0 to 50.0	23	400	22	1.30	24.0	29.0	16.6
23093-VM50	33.0 to 50.0	23	400	22	1.40	24.0	29.0	21.2
23094-VM50	33.0 to 50.0	23	400	22	1.30	24.0	29.0	21.2
24093-VF50	39.3 to 60.0	24	500	19	1.40	20.0	25.0	14.5
24094-VF50	39.3 to 60.0	24	500	19	1.30	20.0	25.0	14.5
24093-VM50	39.3 to 60.0	24	500	19	1.40	20.0	25.0	19.3
24094-VM50	39.3 to 60.0	24	500	19	1.30	20.0	25.0	19.3
25093-VF50	49.9 to 67.0	25	620	15	1.30	30.4	35.0	14.4
25094-VF50	49.9 to 67.0	25	620	15	1.25	30.4	35.0	14.4
25093-VM50	49.9 to 67.0	25	620	15	1.30	30.4	35.0	19.2
25094-VM50	49.9 to 67.0	25	620	15	1.25	30.4	35.0	19.2

ORDERING INFORMATION

Adaptor, waveguide to coax, precision V female

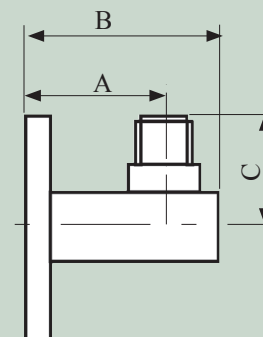
Model: description

Example: Model 24094-VF50 Waveguide to 1.85 female coax adaptor (frequency range 39.3 GHz to 60 GHz, VSWR 1.30)

Adaptor, waveguide to coax, precision V male

Model: description

Example: Model 25094-VM50 Waveguide to 1.85 male coax adaptor (frequency range 50 GHz to 67 GHz, VSWR 1.25)



Series 093/094-VF/VM

* V Connector® is a registered trademark of the Anritsu Corporation

For standard flange types and recommendations see pages 118 onwards

Waveguide to 2.4 mm Coax Adaptors

Series 093-TF/TM

Features

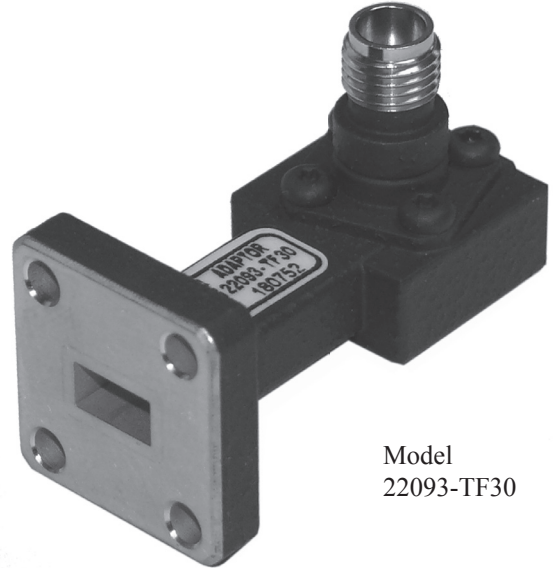
- Male and Female Connectors Available
- Models up to 50 GHz
- Full Band & Narrow Band Models

The Series 093-TF/TM Waveguide to Coax Adaptors feature an improved mechanical design offering greater durability and reliability.

The Adaptors are fitted with 2.4 mm male or female coaxial connectors which are suitable for operation over full waveguide bands up to 50 GHz.

Models optimised for limited and narrowband applications are also available to special order.

Full details on request.



Model
22093-TF30

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)
		WG	R	WR	
19093-TF30	14.5 - 22.0	19	180	51	1.25
19093-TM30	14.5 - 22.0	19	180	51	1.25
20093-TF30	17.6 - 26.7	20	220	42	1.20
20093-TM30	17.6 - 26.7	20	220	42	1.20
21093-TF30	21.7 - 33.0	21	260	34	1.25
21093-TM30	21.7 - 33.0	21	260	34	1.25
22093-TF30	26.4 - 40.1	22	320	28	1.25
22093-TM30	26.4 - 40.1	22	320	28	1.25
23093-TF30	33.0 - 50.1	23	400	22	1.40
23093-TM30	33.0 - 50.1	23	400	22	1.40
23093-TF31	40.0 - 50.0	23	400	22	1.20
23093-TM31	40.0 - 50.0	23	400	22	1.20

ORDERING INFORMATION

Model: Adaptor type suffix; Description

Example: Model 22093-TF30 Waveguide to 2.4 mm female coax adaptor

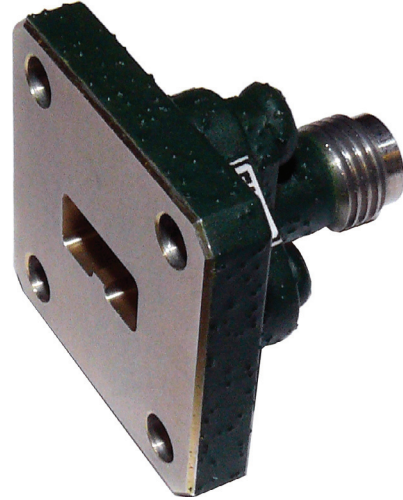
Series 093-TF/TM

For standard flange types and recommendations see pages 118 onwards

Broad Band End Launch Adaptors Series 373

Features

- **Compact Design**
- **Low VSWR across the band**
- **Designs up to WG29 (WR6)**
- **Available in DC or Non-DC coupled designs**
- **Narrow Band Models Available**



Flann is pleased to announce our new line of end launch waveguide to coaxial adaptors. The Series 373 of end launch adaptors are available in waveguide sizes from WG10 (WR284) to WG29 (WR6)

The compact, precision Flann design keeps costs to a minimum and enables short lead times to be offered. Depending on the operating frequency band, coaxial connectors are available in APC7, Type N, SMA, 2.92, 2.4 mm and 1.85 mm configuration.

Model	Frequency Range (GHz)	Waveguide			VSWR (better than)
		WG	R	WR	
19373-TF30	14.5 - 22.0	19	180	51	1.25
19373-TM30	14.5 - 22.0	19	180	51	1.25
20373-KF20	17.6 - 26.7	20	220	42	1.25
20373-KM20	17.6 - 26.7	20	220	42	1.25
21373-TF30	21.7 - 33.0	21	260	34	1.25
21373-TF31	19.7 - 30.0	21	260	34	1.25
22373-KF20	26.4 - 40.1	22	320	28	1.25
22373-KM20	26.4 - 40.1	22	320	28	1.25
23373-TF30	33.0 - 50.1	23	400	22	1.25
23373-TM30	33.0 - 50.1	23	400	22	1.25
25373-VF50	49.9 - 67.0	25	400	22	1.25

ORDERING INFORMATION

Model: Adaptor type suffix; Description

Example: Model 23373-TF30 Waveguide to 2.4 mm female coax adaptor

Series 373

For standard flange types and recommendations see pages 118 onwards

End Launch Adaptor Series 373

Features

- Models 2.6 GHz to 173 GHz
- Low VSWR
- Low Insertion Loss
- Connector types include:
 - 7-16 DIN
 - Type N
 - K Connector® (2.92 mm)
 - V Connector® (1.85 mm)
 - W1 Connector® (1.00 mm)
 - 0.8 mm
- Compact design
- Air line coax construction



Model 17373-NF10

Flann End Launch Adaptors offer high performance over the full waveguide band.

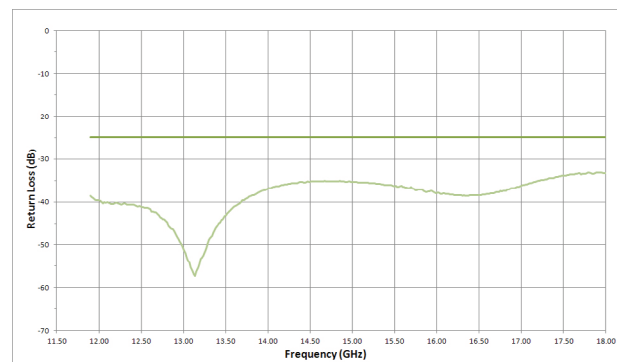
The Flann design is very compact: in fact we believe it to be the shortest unit of its type currently available.

Models up to WG19 (WR51) are constructed in aluminium with chromate passivation to the internal surfaces and flange face.

Models WG20 (WR42) to WG29 (WR6) are constructed in brass with gold plate surface treatment. Connectors are stainless steel for all models.

All models use a precision air line connector for enhanced repeatability.

NB: All models are designed to provide optimum performance when connected to 'standard' rectangular waveguide.



Typical Return Loss for Model 18373 - KF20w

All models use a precision air line connector for enhanced repeatability.

NB: All models are designed to provide optimum performance when connected to 'standard' rectangular waveguide.

End Launch Adaptor Series 373

Microwave Specifications

Waveguide Designation			Frequency (GHz)	Coaxial Connector Options						VSWR (better than)
WG	R	WR		7-16 DIN	Type N	K 2.92 mm	V 1.85 mm	W1 1.00 mm	0.8 mm	
8	22	430	1.72 - 2.61	•						1.1
9A	26	340	2.17 - 3.30	•						
10	32	284	2.60 - 3.95	•	•	•				
11A	40	229	3.22 - 4.90	•	•	•				
12	48	187	3.94 - 5.99	•	•	•				
13	58	159	4.64 - 7.05	•	•	•				
14	70	137	5.38 - 8.18		•	•			1.12	
15	84	112	6.58 - 10.0		•	•				
16	100	90	8.20 - 12.5		•	•				
17	120	75	9.84 - 15.0		•	•				
18	140	62	11.9 - 18.0		•	•			1.15	
19	180	51	14.5 - 22.0		•	•				
20	220	42	17.6 - 26.7			•	•			
21	260	34	21.7 - 33.0			•	•		1.20	
22	320	28	26.4 - 40.1			•	•			
23	400	22	33.0 - 50.1				•		1.25	
24	500	19	39.3 - 59.7				•		1.40	
25	620	15	49.9 - 75.8				•	•		
26	740	12	60.5 - 92.0					•		
27	900	10	73.8 - 112.0					•	1.5	
28	1200	8	92.3 - 140.0					•		
29	1400	6	114.0 - 173.0					•		

Ordering

Please specify the following:

WG designation	Series	-	Coax Connector	Gender	XX	Flange
08-29	373		D,N,K,V,W,F	F (Female) or M (Male)	<small>AP = 70 D & N = 10 K = 40 V, W & F = 60</small>	See flann.com

Example: 23373-VM50 UG-383/U. A WG22 (WR28) End Launch Adaptor with 1.85mm male coax connector and UG-383/U flange.

Options- Gold or silver plating available on request

Connector Type	Flann Designation	Connector Type	Flann Designation
7-16 DIN	D	V Connector® (1.85 mm)	V
Type N	N	W1 Connector® (1.00 mm)	W
K Connector® (2.92 mm)	K	0.8 mm	F

K Connector®, V Connector® & W1 Connector® are registered trademarks of the Anritsu Company.

For standard flange types and recommendations see pages 118 onwards

Waveguide to 1 mm Coax End Launch Adapter Series 373-W

Features

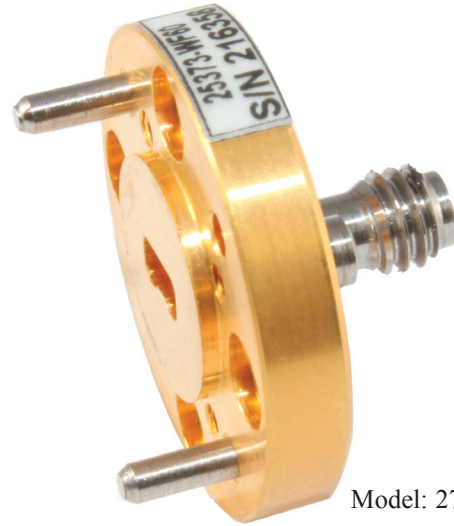
- **Models 49.9 Ghz to 110 Ghz**
- **Female and male models available**
- **Very low loss**
- **Very Compact**
- **Precision 1mm airline W1 Connector®**

The new Flann series 373-W End Launch Adaptors offer a compact option to the bulky size usually associated with both right angle and end launch transitions

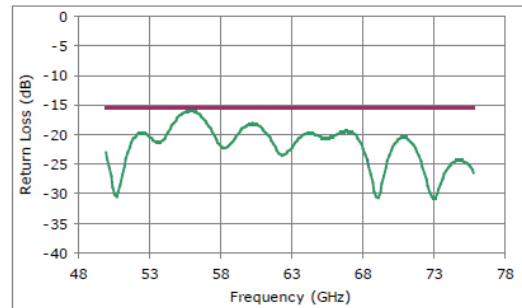
The simpler robust construction gives low VSWR performance over the full waveguide band

Models are available in waveguide bands from 49.9 to 110GHz. The precision 1mm w1 airline connector is available in both female and male variants

Also available with 0.8mm connector for use up to 173GHz - see Model 373-F



Model: 27373-WF60



Typical Return Loss for Model 25373-WF60

Ordering

Please specify the following:

WG designation	Series	-	Coax Connector	Gender	60	Flange
25-27	373		W1(1mm)	F (Female) or M (Male)		See flann.com

Example: 26373-WF60 UG-387/U. A WG26 End Launch Adapter with 1.00mm female connector and UG387/U flange.

Microwave Specifications

Waveguide Designation			Frequency (GHz)	VSWR* (better than)	VSWR Options* (better than)	
WG	R	WR			1.25	1.20
25	620	15	49.9 - 75.8	1.40	1.25	TBA
26	740	12	60.5 - 92.0	1.40	1.25	TBA
27	900	10	73.8 - 110	1.40	1.25	1.20

Options

Models offering enhanced VSWR of 1.25 and 1.20 are also available - details on request. Models with precision and anti-cocking flanges are also available

Also available with 0.8mm connector for use up to 173 GHz - see model 373-F

Waveguide to 0.8 mm Coax End Launch Adapter Series 373-F

Features

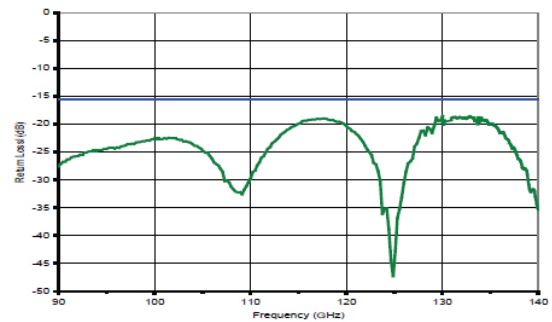
- Models 50 GHz to 173 GHz
- Female and male models available
- Low VSWR
- Very low loss
- Very compact
- Precision 0.8mm airline connector

Flann are proud to announce the introduction of a 173 GHz Waveguide to Coaxial Adaptor using a precision 0.8mm connector.

The design offers the same compact construction as the Flann series 373-W 1 mm model but features a precision 0.8mm airline connector available in both female and male variants



Model: 27373-FF60



Typical Return Loss for Model 28373-FF60

Ordering

Please specify the following:

WG designation	Series	-	Coax Connector	Gender	60	Flange
25-29	373		F (0.8mm)	F (Female) or M (Male)		See flann.com

Example: 26373-WF60 UG-387/U. A WG26 End Launch Adapter with 1.00mm female connector and UG387/U flange.

Microwave Specifications

Waveguide Designation			Frequency (GHz)	VSWR* (better than)	Standard Flange
WG	R	WR			
25	620	15	49.9 - 75.8	1.4	UG - 385/U Mod
26	740	12	60.5 - 92.0	1.4	UG - 385/U
27	900	10	73.8 - 110	1.4	UG - 387/U Mod
28	1200	8	92.3 - 140.0	1.4	UG - 387/U Mod
29	1400	6	114.0 - 173.0	1.5	UG - 387/U Mod

Options

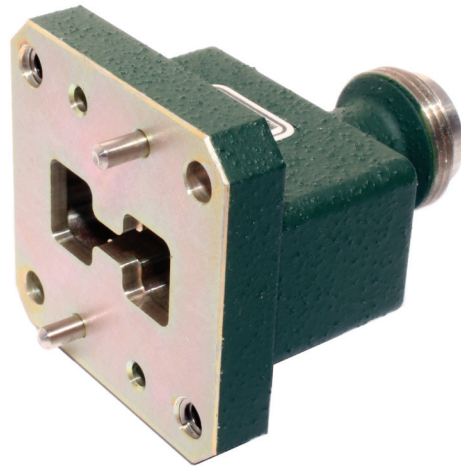
*Models offering enhanced VSWR are also available - details on request.

Models with precision and anti-cocking flanges are also available - details on request

Double Ridge End Launch Adapter Series 373

Features

- **Models 2.0 GHz to 40 GHz**
- **Low VSWR**
- **Low insertion loss**
- **Connector Options include:**
Type N
K Connector (2.92mm)
7-16 DIN
- **Enhanced power handling**
- **Enhanced power handling**
- **Air line coax construction with grounded center contact**



Model: WRD580373-NF10

Flann Double Ridge End Launch Adapters offer high performance over the full waveguide band. The design is very compact, in fact we believe it is the shortest unit of its type currently available

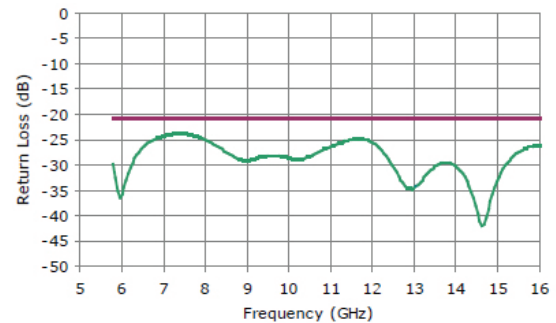
WRD200 to WRD750

Construction is of aluminium with Chromate passivation surface treatment to internal surfaces and flange face. The precision connector is stainless steel. ROHS surface treatment is compliant also available

WRD110 to WRD 180

Construction is brass with gold plate to internal surfaces and flange face. The precision connector is stainless steel

All models use a precision air line connector for enhanced repeatability



Typical Return Loss for Model WRD580393-NF10

Ordering

Please specify the following:

WG designation	Series	-	Coax Connector	Gender	60	Flange
WRD200-WRD180	373		N, K, D	F (Female) or M (Male)	$\frac{N \& D}{K=20} = 10$	See flann.com

Example: WRD11037-KF20 C1A. A Double Ridge End Launch Waveguide to Coax Adapter 11-26.5GHz with K-type female coaxial connector and C1A flange

Double Ridge End Launch Adapter Series 373

Microwave Specifications

Waveguide Designation	Frequency (GHz)	Coaxial Connector	VSWR (max)	Insertion Loss (Db)
WRD200373	2.0 - 4.8	7-16 DINw	1.20	0.15
WRD250373	2.5 - 8.0	Type N	1.20	0.15
WRD350373	3.5 - 8.2			
WRD475373	4.75 - 11.0			
WRD580373	5.80 - 16.0			0.20
WRD650373	6.50 - 18.0			
WRD750373	7.50 - 18.0			
WRD110373	11.0 - 26.5	K Connector	1.25	0.25
WRD180373	18.0 - 40.0			

Waveguide Designation	Insertion Loss (Db)
7-16 DIN	D
Type N	N
K Connector (2.92 mm)	K

Options

- Iridite NCP, Silver and Gold finish are also available
- Sealed and pressurised models

Environmental Specifications

- Operating ambient temperature : 30⁰ C to 70⁰ C
- Non operating ambient temperature: -40⁰ C to 80⁰ C

Construction

- Aluminium with chromate passivation (Alcrom 1200) s standard on all models up to 18GHz
- Brass with gold plate on WRD 110 and WRD180 models
- Iridite NCP (RoHS compliant), silver and gold finish are also available

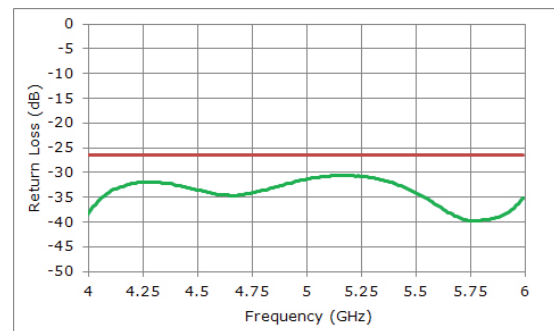
Low PIM Waveguide to Coaxial Adapter Series 098

Features

- **Low PIM**
- **Models 1.72GHz to 40 GHz**
- **Low VSWR**
- **Low insertion loss**
- **Connector Options include:**
Type N
K Connector (2.92mm)
7-16 DIN
- **Minimal junctions/surface materials**
- **Low Outgassing (TML <1% CVCH <0.1%**
- **Grounded center conductor**
- **Precision Air Line Connector**



Model: 12098-NF CPR187G



Typical Return Loss for Model 12098-NF10

The Flann Series 098 Waveguide to Coaxial Adapters have been designed and constructed to provide optimally low levels of Passive Intermodulation (PIM)

Standard connector types include:
Type N, K Connector and 7-16 DIN

For High Power Models please see series 097

Ordering

Please specify the following:

WG designation	Series	-	Coax Connector	Gender	XX	Flange
08 - 22	098		N, K, D	F (Female) or M (Male)	N & D = 10 K = 20	See flann.com

Example: 17098-NF10 UBR120 A WG17 (WR75) Low PIM Waveguide to Coax Adapter with N-type female coax connector with UBR 120 flange

Low PIM Waveguide to Coaxial Adapter Series 098

Microwave Specifications

Waveguide Designation			Frequency (GHz)	Coaxial Connector Options			VSWR max	Insertion Loss max (dB)
WG	R	WR		D	N	K		
8	22	430	1.72 - 2.61	•			1.1	
9A	26	340	2.17 - 3.30	•				
10	32	284	2.60 - 3.95	•	•			
11A	40	229	3.22 - 4.90	•	•		0.12	
12	48	187	3.94 - 5.99	•	•			
13	58	159	4.64 - 7.05	•	•			
14	70	137	5.38 - 8.18		•	•	0.15	
15	84	112	6.58 - 10.0		•	•		
16	100	90	8.20 - 12.5		•	•		
17	120	75	9.84 - 15.0		•	•	1.12	
18	140	62	11.9 - 18.0		•	•		
19	180	51	14.5 - 22.0			•		
20	220	42	17.6 - 26.7			•	1.17	
21	260	34	21.7 - 33.0			•		
22	320	28	26.4 - 40.1			•		
							1.20	0.20

Waveguide Designation	Insertion Loss (Db)
7-16 DIN	D
Type N	N
K Connector (2.92 mm)	K

Environmental Specifications

- Operating ambient temperature : 30⁰ C to 70⁰ C
- Non operating ambient temperature: -40⁰ C to 80⁰ C
- TML (Total Mass Loss) : <1%
- CVCM (Collected Volatile Condensable Mass) : <0.1%

Construction

- D option - Aluminium and Chromate Passivation
- N option - Aluminium and Chromate Passivation
- K option - Brass and Gold Plate

Coaxial Guide, Flange to Flange Adapter Series 350 & Series 352

Features

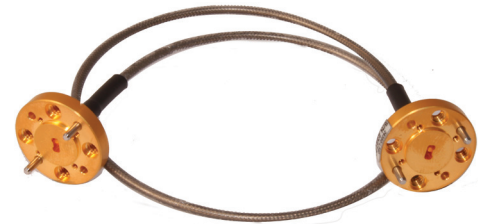
- Models 33 GHz to 112 GHz
- Flexible Option - Series 350
- Semi-Rigid Option - Series 352
- Low VSWR
- Low Loss
- Stable and Repeatable

A practical alternative to flexible waveguide at millimeter wave frequencies

At millimeter wave frequencies flexible waveguides are not viable and often not available. Flann have integrated waveguide to coaxial adapters with high performance flexible and semi rigid cable to provide a practical alternative to flexible waveguide upto 112GHz



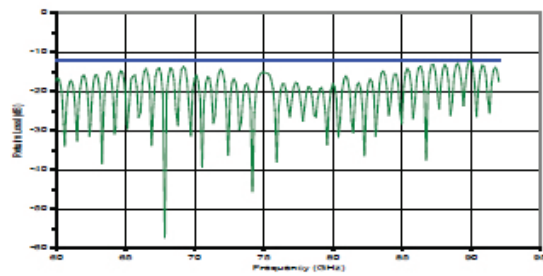
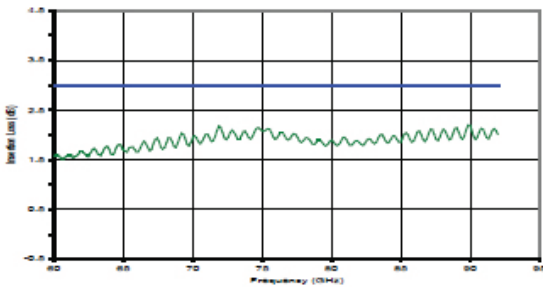
Model: 25352



Model: 26350

Microwave Specifications

Waveguide Designation			Frequency (GHz)	VSWR (better than)	Series 350		Series 352	
WG	R	WR			Insertion Loss (dB/m)	Min. Bend Radius (mm)	Insertion Loss (dB/m)	Min Bend Radius (mm)
23	400	22	33.0 - 50.1	1.40	3.5	40	5.5	7
24	500	19	39.3 - 59.7	1.40	6.5	25	6.5	7
25	620	15	49.9 - 75.8	1.50	12.5	10	10.0	7
26	740	12	60.5 - 92.0	1.50	14.5	10	12.5	7
27	900	10	73.8 - 112.0	1.50	17.0	10	15.0	7



Typical Insertion Loss and Return Loss for Model 26350-150

Ordering

Please specify the following:

WG designation	Series	-	Flange 1	Flange 2
25 - 27	350 or 352		See flann.com	See flann.com

Example: 23350 UG-383/U UG-383/U. A Wg23 (WR22) Coaxial Guide, Flange to Flange Adapter with two UG-383/U flanges

Seamless Semi-Rigid Waveguide Flange to Flange Adapter - Series 562

Features

- **Models 50 GHz to 112 GHz***
- **A practicable alternative to flexible waveguide**
- **Low Loss - Comparable to drawn copper wavelength**
- **Low VSWR**
- **Ideal for installations**
- **Can be formed/reformed up to 5 times**
- **Weatherproofed & Waterproofed**

A low loss, hand formable waveguide section suitable for millimeter wave applications

At millimeter wave frequencies flexible waveguides are often not available or the performance and reliability are considered unsatisfactory. For most applications a low loss flexible section that could be bent or formed a few times might be all that is required

To meet the needs of this type of application Flann have introduced the Series 562 range of Seamless Semi-Rigid Waveguides which provide a low loss formable section encased in a ruggedised jacket *, with an insertion loss comparable to that of drawn copper waveguide.

Related Products

Series

- 350: Coaxial Guide, Flange to Flange Adaptor (Cable Version)
- 352: Coaxial Guide, Flange to Flange Adaptor (Semi-Rigid Cable Version)

Construction

Performed models can be built to customer requirements. Custom built instruments can be supplied; Please contact the sales team for more information

Ordering

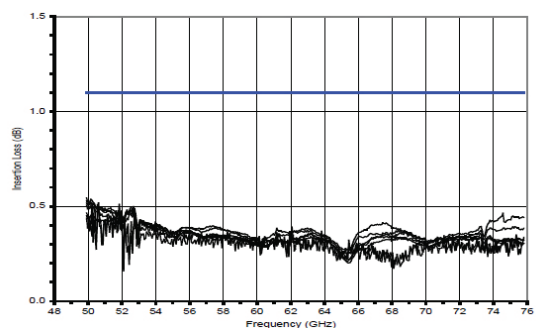
Please specify the following:

WG designation	Series	-	L (Length mm)	Flange
25 - 27	562		Nominal Flange to Flange Length in mm	See flann.com

Example: 25562-L300 UG-385/U A WG25 (WR15) Seamless Semi-Rigid Waveguide, Flange to Flange Adaptor 300mm long with UG-385/U flange



Model: 25562-L300 UG-385/U
Fitted to a pair of Flann Lens Horn Antennas Series 800



The data above shows the change in Insertion Loss of a 300mm length of a Flann WG25 (WR15) Semi Rigid Waveguide when formed 90o and straightened 3 times in the E plane then formed 90o and straightened 3 times in the H Plane. In each case the internal bend radius was 40mm

* Higher frequency models are available - details on request

Double Ridge Waveguide to Coax Adaptors

Series WRD093

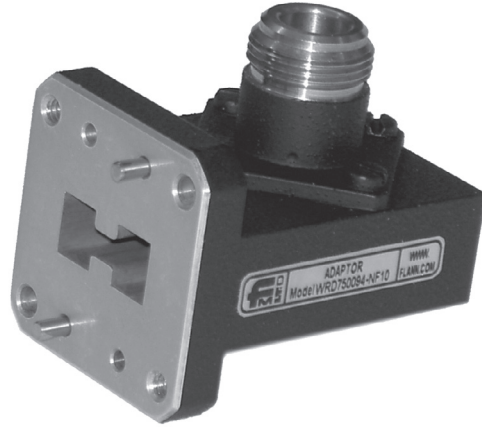
Features

- **1.25:1 VSWR Fullband**
- **Narrow Band Versions Available**
- **Models up to 40GHz**
- **Female & Male Coax Connectors**

We are proud to include in our latest catalogue, our new series of WRD waveguide to coax adaptors which have been designed to give high durability and reliability.

Adaptors can be fitted with SMA, APC7 and N type connectors for use up to 18 GHz, K connectors are fitted to the WRD 180 units covering the 18 GHz to 40 GHz band.

Narrowband models, specifically optimised can be manufactured on request.



Model	Frequency Range GHz	Waveguide Size	Connector Options	Waveguide Flange	Fullband VSWR Max
WRD200093-SF40	2.0-4.8	WRD-200D24	SMA	WRD200C1	1.25
WRD350093-SF40	3.5-8.2	WRD-350D24	SMA	WRD350C1	1.25
WRD475093-SF40	4.75-11.0	WRD-475D24	SMA	WRD475C1	1.25
WRD580093-SF40	5.8-16.0	WRD-580D28	SMA	WRD580C1	1.25
WRD650093-SF40	6.5-18.0	WRD-650D28	SMA	WRD650C1	1.25
WRD750093-SF40	7.5-18.0	WRD-750D24	SMA	WRD750C1	1.25
WRD200093-AP70	2.0-4.8	WRD-200D24	APC	WRD200C1	1.25
WRD350093-AP70	3.5-8.2	WRD-350D24	APC	WRD350C1	1.25
WRD475093-AP70	4.75-11.0	WRD-475D24	APC	WRD475C1	1.25
WRD580093-AP70	5.8-16.0	WRD-580D28	APC	WRD580C1	1.25
WRD650093-AP70	6.5-18.0	WRD-650D28	APC	WRD650C1	1.25
WRD750093-AP70	7.5-18.0	WRD-750D24	APC	WRD750C1	1.25
WRD200093-NF10	2.0-4.8	WRD-200D24	N	WRD200C1	1.25
WRD350093-NF10	3.5-8.2	WRD-350D24	N	WRD350C1	1.25
WRD475093-NF10	4.75-11.0	WRD-475D24	N	WRD475C1	1.25
WRD580093-NF10	5.8-16.0	WRD-580D28	N	WRD580C1	1.25
WRD650093-NF10	6.5-18.0	WRD-650D28	N	WRD650C1	1.25
WRD750093-NF10	7.5-18.0	WRD-750D24	N	WRD750C1	1.25
WRD110093-KF20	11.0-26.5	WRD-110C24	K(female)	WRD110C1	1.25
WRD110093-KM20	11.0-26.5	WRD-110C24	K(Male)	WRD110C1	1.25
WRD180093-KF20	18.0-40.0	WRD-180C24	K(Female)	WRD180C1	1.25
WRD180093-KM20	18.0-40.0	WRD-180C24	K(Male)	WRD180C1	1.25

ORDERING INFORMATION

Model: Adaptor type suffix; Description

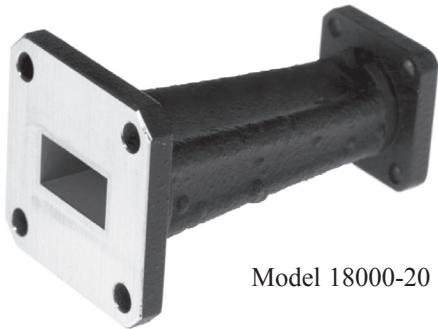
Example: Model WRD18093-KF20 Double Ridge Waveguide to K female coax adaptor

Series WRD093

Rectangular Waveguide to Waveguide Tapered Transitions Series 000

Features

- **Low VSWR**
- **Minimal length**



Model 18000-20

Waveguide to waveguide tapered transitions provide a gradual dimensional change between two sizes of waveguide.

The larger components are accurately fabricated from laser cut plates; smaller tapers are precision electroformed “in house”. In applications where waveguide frequency bands overlap the transitions exhibit low VSWR and low insertion loss whilst maintaining high mode purity.

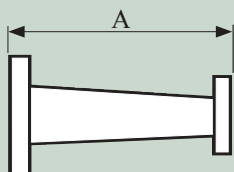
For most models with overlapping frequency bands, the VSWR is typically better than 1.03 in the common part of the frequency ranges. Tapered Transitions not listed can be made to special order.

ORDERING INFORMATION

Model: Description

Example: Model 18000-22 Waveguide tapered transition

WG18 (WR62) to WG22 (WR28)



Series 000

Model	Waveguide to Waveguide						Overall Length (mm)	Weight (kg)
	WG	R	WR	WG	R	WR		
08000-10	8	22	430	10	32	284	210	Details on request
09A000-10	9A	26	340	10	32	284	134	
10000-11A	10	32	284	11A	40	229	130	1.60
10000-12	10	32	284	12	48	187	130	1.58
10000-15	10	32	284	15	84	112	173	1.38
10000-16	10	32	284	16	100	90	173	1.36
11A000-12	11A	40	229	12	48	187	110	0.93
11A000-14	11A	40	229	14	70	137	135	0.95
12000-13	12	48	187	13	58	159	85	0.90
12000-14	12	48	187	14	70	137	85	0.85
12000-17	12	48	187	17	120	75	105	0.75
13000-14	13	58	159	14	70	137	80	0.78
14000-15	14	70	137	15	84	112	75	0.45
14000-16	14	70	137	16	100	90	75	0.40
15000-16	15	84	112	16	100	90	72	0.25
16000-17	16	100	90	17	120	75	58	0.18
16000-18	16	100	90	18	140	62	50	0.25
16000-20	16	100	90	20	220	42	50	0.13
16000-25	16	100	90	25	620	15	75	0.10
16000-26	16	100	90	26	740	12	69	0.09
17000-18	17	120	75	18	140	62	60	0.15
17000-19	17	120	75	19	180	51	60	0.15
17000-22	17	120	75	22	320	28	65	0.10
18000-19	18	140	62	19	180	51	60	0.13
18000-20	18	140	62	20	220	42	56	0.10
18000-22	18	140	62	22	320	28	50	0.10
19000-20	19	180	51	20	220	42	50	0.12
20000-22	20	220	42	22	320	28	50	0.05
20000-23	20	220	42	23	400	22	40	0.05
20000-24	20	220	42	24	500	19	40	0.05
20000-25	20	220	42	25	620	15	60	0.05
21000-22	21	260	34	22	320	28	50	0.05
22000-23	22	320	28	23	400	22	50	0.05
22000-24	22	320	28	24	500	19	35	0.05
22000-25	22	320	28	25	620	15	35	0.04
22000-26	22	320	28	26	740	12	30	0.04
22000-28	22	320	28	28	1200	28	30	0.03
23000-24	23	400	22	24	500	19	35	0.04
23000-25	23	400	22	25	620	15	30	0.05
24000-25	24	500	19	25	620	15	35	0.05
24000-26	24	500	19	26	740	12	35	0.04
25000-26	25	620	15	26	740	12	25	0.03
25000-27	25	620	15	27	900	10	35	0.03
26000-27	26	740	12	27	900	10	25	0.03
26000-28	26	740	12	28	1200	8	25	0.03
27000-28	27	900	10	28	1200	8	25	0.02
27000-29	27	900	10	29	1400	6	25	0.03
28000-31	28	1200	8	31	2200	4	25	0.02
28000-32	28	1200	8	32	2600	3	25	0.02
30000-31	30	1800	5	31	2200	4	25	0.02
30000-32	30	1800	5	32	2600	3	Specification available on request	
31000-32	31	2200	4	32	2600	3		

For standard flange types and recommendations see pages 118 onwards

Flange to Flange Waveguide Straights, Adaptors and Spacers Series 441 / 445

Manufactured in:-

- Brass
- Copper
- Aluminium

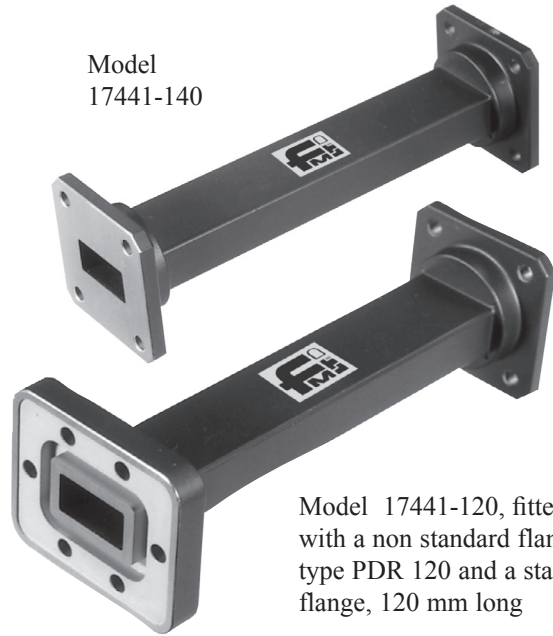
The Flann Series 441/445 of Waveguide Straights and Flange to Flange Adaptors are available in waveguide bands from 1.14 GHz to 330 GHz.

The overall length and flange types fitted at each end, must be specified at time of enquiry.

Note: Waveguide Straights are supplied fitted with Flann standard flanges unless otherwise specified by the customer. See page 111 for standard flange types and recommendations.

Customers requiring precision waveguide sections offering greater aperture and length dimensional accuracy are requested to refer to the Waveguide Calibration Kit section, (starting on page 104) for details.

Model
17441-140



Model 17441-120, fitted with a non standard flange type PDR 120 and a standard flange, 120 mm long

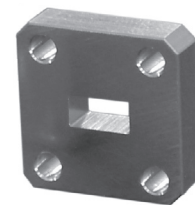
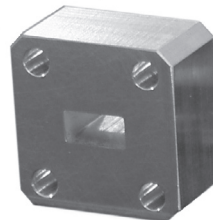
Waveguide Straights and Flange to Flange Adaptors

Model	Frequency Range (GHz)	Waveguide		
		WG	R	WR
06441	1.14 - 1.73	6	14	650
08441	1.72 - 2.61	8	22	430
10441	2.60 - 3.95	10	32	284
11A441	3.22 - 4.90	11A	40	229
12441	3.94 - 5.99	12	48	187
13441	4.64 - 7.05	13	58	159
14441	5.38 - 8.18	14	70	137
15441	6.58 - 10.0	15	84	112
16441	8.20 - 12.5	16	100	90
17441	9.84 - 15.0	17	120	75
18441	11.9 - 18.0	18	140	62
19441	14.5 - 22.0	19	180	51
20441	17.6 - 26.7	20	220	42
22441	26.4 - 40.1	22	320	28
23441	33.0 - 50.1	23	400	22
24441	39.3 - 59.7	24	500	19
25441	49.9 - 75.8	25	620	15
26441	60.5 - 92.0	26	740	12
27441	73.8 - 112	27	900	10
28441	92.3 - 140.0	28	1200	8
29441	114.0 - 173.0	29	1400	6
30441	145 - 220	30	1800	5
31441	172 - 261	31	2200	4
32441	217 - 330	32	2600	3

Waveguide Spacers

Model	Frequency Range (GHz)	Waveguide		
		WG	R	WR
16445	8.20 - 12.5	16	100	90
17445	9.84 - 15.0	17	120	75
18445	11.9 - 18.0	18	140	62
19445	14.5 - 22.0	19	180	51
20445	17.6 - 26.7	20	220	42
22445	26.4 - 40.1	22	320	28
23445	33.0 - 50.1	23	400	22
24445	39.3 - 59.7	24	500	19
25445	49.9 - 75.8	25	620	15
26445	60.5 - 92.0	26	740	12
27445	73.8 - 112	27	900	10
28445	92.3 - 140.0	28	1200	8
29445	114.0 - 173.0	29	1400	6
30445	145 - 220	30	1800	5
31445	172 - 261	31	2200	4
32445	217 - 330	32	2600	3

Model 22445-10



Model 22445-5

ORDERING INFORMATION

STRAIGHTS & FLANGE TO FLANGE ADAPTORS - SERIES 441

Model - Length (mm) Input Flange : Output Flange

If the adaptor Spacer is required to be manufactured in aluminium please suffix the order information with \AL

Description Example: Model 22441-120-UG599/U. UBR 320

WG flange to flange Adaptor, 120 mm long, flange UG599/U. And PBR 320

ORDERING INFORMATION

Spacers - Series 445

Description Example: Model 22445-5-UG599/U

WG22 Spacer, 5 mm long, flange detail: UG.599/U

Series 441/445

For standard flange types and recommendations see pages 118 onwards

Rectangular to Circular Waveguide Transitions

Series 64*

Features

- **Low Ellipticity Ratio**
- **Precision Electroformed**
- **Linear to Linear Polarization Versions**
- **Linear to Circular Polarization Versions**

Each transition consists of a short length of rectangular waveguide and a stepped or tapered section leading into circular waveguide.

Models are available optionally fitted with combinations of rectangular port flanges, circular port flanges, resistive elements and dielectric elements. The standard rectangular flange types are listed in the table below. Alternative flange types can be fitted to order. The circular waveguide ports are fitted with the flange as detailed below or to customers requirements as other flange styles are available to special order.

The simple rectangular to circular waveguide transition will launch linearly polarized waves into the circular waveguide section (10643 to 32643). However, line reflections from the circular waveguide section may interact with the incident wave resulting in cross polarization.

If cross polarization is undesirable then the transition selected should be one fitted with a resistive film element to absorb the cross polarized waves (models 10644 to 32644).

For circular polarization, the transitions are fitted with resistive film element and have an extended circular waveguide section containing a dielectric quarter wave plate (models 10648 to 32648).



Model 17648-RH

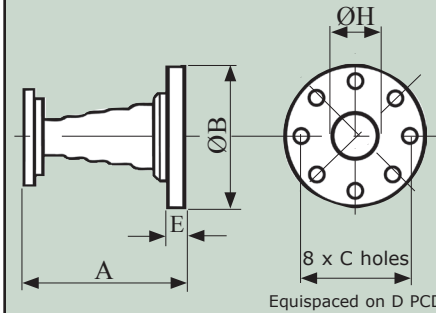
Model 17648-LH

ORDERING INFORMATION

Model: polarization suffix (Series 648 only); description

Example: Model 18648-RH rectangular to circular waveguide transition, right hand polarization (fitted with a dielectric quarter wave plate producing right hand polarization)

Series	Rectangular Port Flange Fitted	Circular Port Flange Fitted	Resistive Vane Fitted	Dielectric Quarter Wave Plate Fitted
643	Yes	Yes	No	No
644	Yes	Yes	Yes	No
648-*	Yes	Yes	Yes	Yes
↑	LH for left hand polarization (standard)			
	RH for right hand polarization (optional)			



Series 64*

Model	Frequency Range (GHz)	Waveguide			Overall Length A		Rectangular Port Flange Type	Circular Port Flange Dimensions					Weight (kg) Series 643/4 Only	
		WG	R	WR	Series 643 & 644	Series 648		B	C	D (PCD)	E	H		
1064*	2.6 - 3.95	10	32	284	241	on request	5985-99-083-1560/0010	146	6.9	132.0	11	73.91	4.30	
11A64*	3.22 - 4.9	11A	40	229	178	330	UDR 40	101	5.4	93.0	7	59.69	1.90	
1264*	3.94 - 5.99	12	48	187	140	249	UAR 48	89	5.4	80.0	7	48.77	1.50	
1364*	4.64 - 7.05	13	58	159	120	on request	UAR 58	89	5.4	80.0	7	41.42	1.10	
1464*	5.38 - 8.18	14	70	137	102	232	UAR 70	76	4.4	60.3	7	35.81	0.80	
1564*	6.58 - 10.0	15	84	112	82.5	222	UBR 84	60	3.2	52.0	7	28.58	0.30	
1664*	8.2 - 12.5	16	100	90	76.0	174	UBR 100	56	3.2	48.0	6	23.36	0.25	
1764*	9.84 - 15.0	17	120	75	64.0	149	UBR 120	56	3.2	48.0	6	19.35	0.20	
1864*	11.9 - 18.0	18	140	62	51.0	120	UBR 140	50	3.2	41.0	6	16.10	0.10	
1964*	14.5 - 22.0	19	180	51	51.0	120	UBR 180	50	3.2	41.0	6	13.25	0.10	
2064*	17.6 - 26.7	20	220	42	77.5	141	UBR 220	50	3.2	41.0	5	10.93	0.10	
2164*	21.7 - 33.0	21	260	34	67.5	122.5	UBR 260	50	3.2	41.0	5	8.76	0.10	
2264*	26.4 - 40.1	22	320	28	51.5	79.5	UG-599/U	44	3.2	35.0	3.5	7.24	0.06	
2364*	33.0 - 50.1	23	400	22	46.0	on request	UG-383/U	Fixing detail as for UG-383/U					5.80	0.06
2464*	39.3 - 59.7	24	500	19	43.0	68	UG-383/U MOD	Fixing detail as for UG-383/U					4.85	0.05
2564*	49.9 - 75.8	25	620	15	33.5	61.5	UG-385/U	Fixing detail as for UG-385/U					3.86	0.03
2664*	60.5 - 92.0	26	740	12	28.0	51.5	UG-387/U	Fixing detail as for UG-387/U					3.12	0.03
2764*	73.8 - 112	27	900	10	28.0	43	UG 387/U MOD	Fixing detail as for UG-387/U					2.57	0.03
2864*	92.3 - 140	28	1200	8	28.0	on request	UG 387/U MOD	Fixing detail as for UG-387/U					2.03	0.03
2964*	114 - 173	29	1400	6			Dimensions available on request							
3064*	145 - 220	30	1800	5										
3164*	172 - 261	31	2200	4										
3264*	217 - 330	32	2600	3										

For standard flange types and recommendations see pages 118 onwards

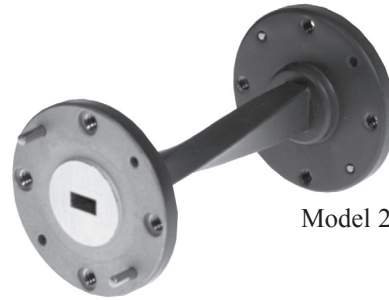
Waveguide Twists Series 450

Features

- **Manufactured from Brass or Aluminium**
- **Low VSWR**
- **Right and Left Hand Models Available**
- **Models from 2.60 GHz to 330 GHz**

Flann Twists are manufactured from sections of standard waveguide which have been precisely twisted whilst maintaining the internal waveguide dimensions. Standard models are 90° left hand twists. Other configurations are available to special order, including:

- 90° left hand (standard)
- 45° left hand
- 90° right hand
- 45° right hand

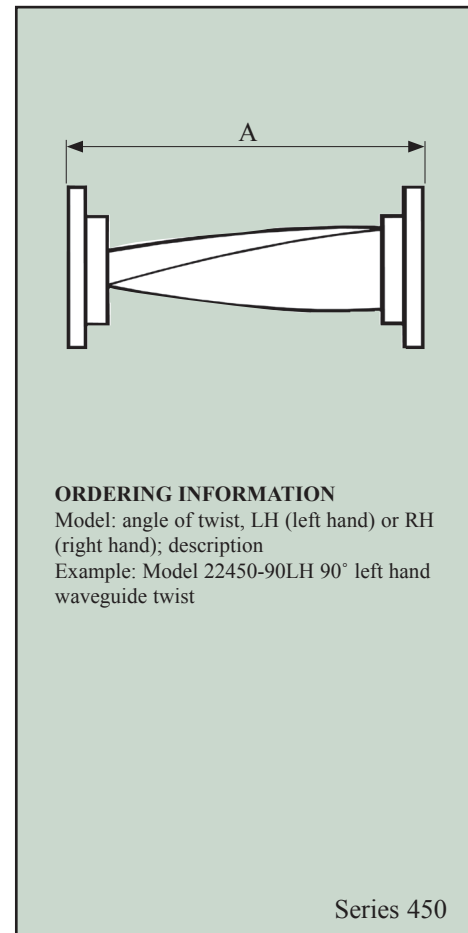


Model 24450 - 90LH



Model 21450-90LH

Model	Frequency Range (GHz)	Waveguide			Dimension A (mm)	VSWR (max)	Weight (kg)
		WG	R	WR			
10450	2.60 - 3.95	10	32	284	Specification/dimensions available on request		
11A450	3.22 - 4.90	11A	40	229			
12450	3.94 - 5.99	12	48	187			
13450	4.64 - 7.05	13	58	159			
14450	5.38 - 8.18	14	70	137			
15450	6.58 - 10.0	15	84	112			
16450	8.20 - 12.5	16	100	90	150	1.03	0.25
17450	9.84 - 15.0	17	120	75	150	1.03	0.20
18450	11.9 - 18.0	18	140	62	150	1.03	0.14
19450	14.5 - 22.0	19	180	51	120	1.03	0.10
20450	17.6 - 26.7	20	220	42	85	1.03	0.06
21450	21.7 - 33.0	21	260	34	85	1.055	0.05
22450	26.4 - 40.1	22	320	28	54	1.035	0.035
23450	33.0 - 50.1	23	400	22	54	1.06	0.035
24450	39.3 - 59.7	24	500	19	54	1.06	0.035
25450	49.9 - 75.8	25	620	15	46	1.07	0.045
26450	60.5 - 92.0	26	740	12	46	1.08	0.025
27450	73.8 - 112.0	27	900	10	42	1.09	0.025
28450	92.3 - 140	28	1200	8	42	1.07	0.025
29450	114 - 173	29	1400	6			
30450	145 - 220	30	1800	5	Specifications/dimensions available on request		
31450	172 - 261	31	2200	4			
32450	217 - 330	32	2600	3			



For standard flange types and recommendations see pages 118 onwards

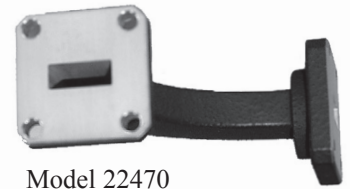
Waveguide E and H Plane Bends

Series 460 / 470

Features

- **Low VSWR**
- **E Plane Models - Series 460**
- **H Plane Models - Series 470**
- **Brass or Aluminium**
- **90° Standard; 30° 45° & 60° Available**

Model 22460



Model 22470

Model	Frequency Range (GHz)	Waveguide			VSWR Max	Dimension (A)	Weight (kg) Brass
		WG	R	WR			
10460	2.60 - 3.95	10	32	284	1.05	100	2.5
10470							
11A460	3.22 - 4.9	11A	40	229	1.05	90	1.05
11A470							
12460	3.94 - 5.99	12	48	187	1.05	80	1.05
12470							
13460	4.64 - 7.05	13	58	159	1.05	75	0.90
13470							
14460	5.38 - 8.18	14	70	137	1.05	70	0.66
14470							
15460	6.58 - 10.0	15	84	112	1.05	60	0.31
15470							
16460	8.20 - 12.5	16	100	90	1.05	50	0.20
16470							
17460	9.84 - 15.0	17	120	75	1.05	40	0.18
17470							
18460	11.9 - 18.0	18	140	62	1.05	30	0.12
18470							
19460	14.5 - 22.0	19	180	51	1.1	30	0.09
19470							
20460	17.6 - 26.7	20	220	42	1.05	38	0.05
20470							
21460	21.7 - 33.0	21	260	34	1.06	38	0.045
21470							
22460	26.4 - 40.1	22	320	28	1.06	38	0.035
22470							
23460	33.0 - 50.1	23	400	22	1.06	28	0.045
23470							
24460	39.3 - 59.7	24	500	19	1.06	28	0.045
24470							
25460	49.9 - 75.8	25	620	15	1.07	21	0.025
25470							
26460	60.5 - 92.0	26	740	12	1.08	21	0.025
26470							
27460	73.8 - 112	27	900	10	1.09	21	0.025
27470							
28460	92.3 - 140	28	1200	8	1.10	21	0.020
28470							
29460	114 - 173	29	1400	6	1.12	Dimensions available on request	
29470							
30460	145 - 220	30	1800	5	Specifications/dimensions available on request		
30470							
31460	172 - 261	31	2200	4			
31470							
32460	217 - 330	32	2600	3			
32470							

Flann Waveguide Bends are available in E and H plane configuration with an angle of 90°. Bends of 30°, 45° and 60° can be supplied to special order.

Bends in the range WG10 to WG19 inclusive utilise a mitred casting with a VSWR typically better than 1.05. Bends from WG20 to WG28 inclusive are sections of waveguide which are precisely bent to the required angle with a VSWR of typically 1.05 to 1.10 depending on the model.

Precision Bent

Mitred Casting

ORDERING INFORMATION
 Model: Bend Angle Suffix; Description
 Example: Model 23460-45 45° waveguide bend.
 WG23, 45°, E plane bend

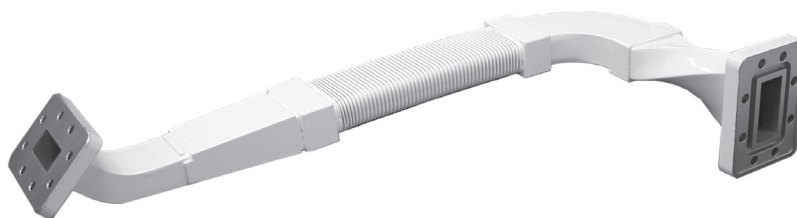
Bend Angle (°)	Suffix
90	90
60	60
45	45
30	30

Series 460/470

Customised Waveguides and Assemblies

Below are examples of customised and customer specific designs, please consult our Sales Team for your special requirements.

Customised Waveguide Assemblies

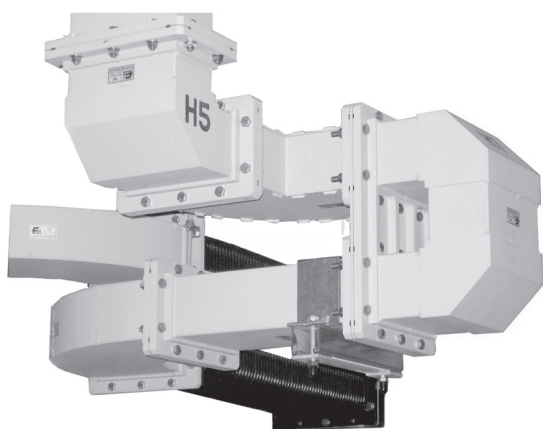


Hybrid flexible / rigid waveguide system assembly in WG14 & 15 [R70 & R84, WR137 & WR112]

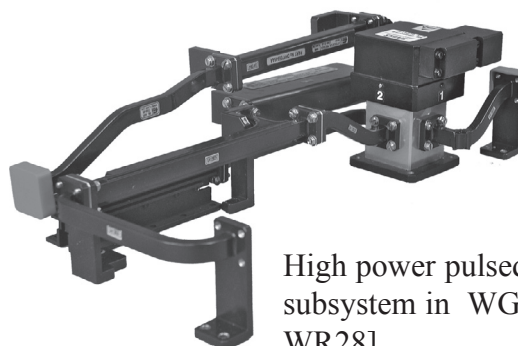


Millimetric waveguide sections in WG25 [R620, WR15]

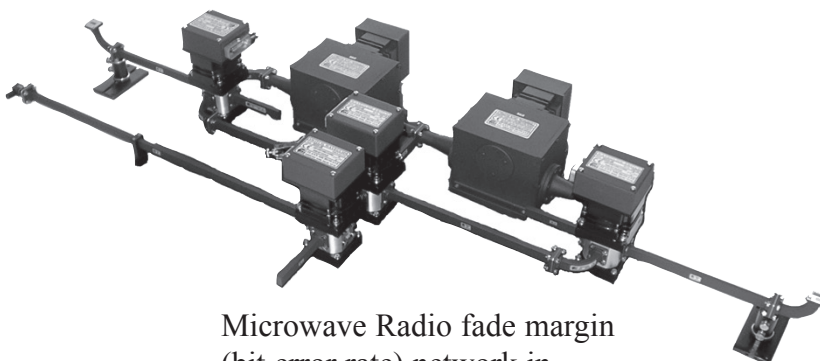
Custom Waveguide Networks



High power pulsed radar subsystem in WG6 [R14, WR650]



High power pulsed radar subsystem in WG22 [R320, WR28]



Microwave Radio fade margin (bit error rate) network in WG20 [R220, WR42]

Please contact our Sales Team for further information.

Waveguide Switches & Driver

SWITCHES

Features

- **Manual and Motorised Models**
- **2 or 3-Channel Rotor**
- **High Repeatability**
- **High Reliability**
- **High Isolation**
- **Motorised Speed & Precision modes of operation**
- **Low VSWR**



DRIVER

Features

- **GPIB**
- **USB**
- **19" Rack Mountable**

The Flann range of waveguide switches, Series 333, includes manual and motorised models operating in the frequency bands up to 140 GHz.

The 4 port switches are optionally available with 2-channel or 3-channel rotors in most waveguide sizes and offer high isolation between non-coupled ports.

Test & Measurement Manual Switches - Series 333-2 (or -3)

Page 80

Precision manual switches offering unsurpassed accuracy and repeatability. Available with 2 or 3-channel rotor.

Test & Measurement Motorised Switches - Series 333-2E (or -3E)

Page 81

Stepper motor driven switches offering superior reliability and repeatability to alternative solenoid operated units.

A feature unique to the Flann Series 333 of electrical switches is the user's ability to choose between "speed" and "precision" modes of operation. In "speed" mode switching time is minimised by using all possible rotor positions. In "precision" mode, only one of the two possible rotor positions is used ensuring optimum microwave path repeatability. Standard drive cable length is 2 metres for all models - cable lengths of up to 5 metres available. Available with 2 or 3-channel rotor.

Switch Driver - Model SD5902

Page 82

Available for the control of one or two Series 333 switches. The Model SD5902 offers local control via the front panel and remote control via both USB and GPIB interfaces. Refer to page 74 for specifications.

Test & Measurement DC Motor Driven Switches - Series 334-2E (or -3E)

Page 83

Series 334 is a DC motor driven switch operating in the frequency bands from 8.2 GHz to 112 GHz with the same high performance specification as the Series 333 manual switch. A high speed DC Motor driven switch offering high reliability alternative to solenoid or TTL operated units. Available with 2 or 3-channel rotor.

Test & Measurement Double Ridge Waveguide Switches DC Motor Driven - Series WRD334-2E

Page 83

Double ridge waveguide version switches of the Series 334 switch. Manual versions also available on request.

System & Network Switches - Series 336

Page 84

2.6 GHz to 40.1 GHz

Low Loss & High Power

Very Cost Competitive

Many Models available from stock



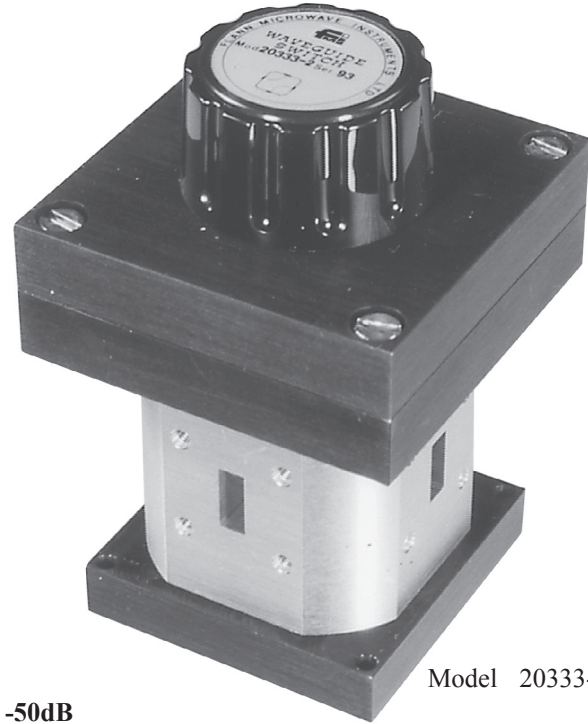
Manual Waveguide Switches Series 333

Features

- **Models up to 330 GHz**
- **High Accuracy**
- **High Repeatability**
- **2 or 3-Channel Rotor**
- **High Isolation**

The Flann range of Manual Waveguide Switches, Series 333, are 4 port devices and are optionally available with 2 or 3-channel rotor. Efficient choke design ensures a high RF isolation between non-coupled ports.

Accurate channel to port alignment and excellent repeatability are achieved by a light yet positive rotor indexing mechanism. The well proven design ensures long reliable service without deterioration in performance.



Model 20333-2

Specification: Isolation (minimum): 75 dB Repeatability better than -50dB

Model	Frequency Range (GHz)	Waveguide			VSWR (max)	Insertion Loss (dB)	Dimensions (mm)**							Weight (kg)	Model
		WG	R	WR			A	B	C	D	E	F	G		
15333-*	6.58 - 10.0	15	84	112	1.10	0.15	Dimensions available on request								15333-*
16333-*	8.2 - 12.5	16	100	90	1.10	0.15									16333-*
17333-*	9.84 - 15.0	17	120	75	1.10	0.2									17333-*
18333-*	11.9 - 18.0	18	140	62	1.10	0.2									18333-*
19333-*	14.5 - 22.0	19	180	51	1.10	0.2	55	29	71	92	50	60	56	0.95	19333-*
20333-*	17.6 - 26.7	20	220	42	1.10	0.3	44	30	73	94	45	60	50	0.8	20333-*
21333-*	21.7 - 33.0	21	260	34	1.10	0.3	44	30	73	94	45	60	50	0.55	21333-*
22333-*	26.4 - 40.1	22	320	28	1.10	0.3	44	28	69	90	45	60	50	0.7	22333-*
23333-*	33.0 - 50.1	23	400	22	1.10	0.3	47	28	69	90	45	60	50	0.7	23333-*
24333-*	39.3 - 59.7	24	500	19	1.10	0.4	47	28	69	90	45	60	50	0.7	24333-*
25333-*	49.9 - 75.8	25	620	15	1.10	0.5	44	28	69	90	45	60	50	0.6	25333-*
26333-*	60.5 - 92.0	26	740	12	1.10	0.5	44	28	69	90	45	60	50	0.6	26333-*
27333-*	73.8 - 112	27	900	10	1.10	0.6	44	28	69	90	45	60	50	0.6	27333-*
28333-*	93.2 - 140	28	1200	8	1.15	0.8	44	28	69	90	45	60	50	0.6	28333-*
29333-*	114 - 173	29	1400	6	1.20	1.3	44	28	69	90	45	60	50	0.6	29333-*

The suffix "-2" denotes a 2-channel rotor whilst "-3" denotes a 3-channel rotor.

** These dimensions refer to 2-channel rotor switches only; for 3-channel rotor switch dimensions consult our Sales Team.

2-Channel Rotor Type 2

3-Channel Rotor Type 3

A Flange to Flange

ORDERING INFORMATION
 Model: Rotor Type; Description
 Example: Model 22333-2 Manual waveguide switch 2-Channel Rotor

Series 333

Motorised Waveguide Switches

Series 333-*E

Features

- Models up to 330 GHz
- High Accuracy
- High Repeatability
- 2 or 3-Channel Rotor
- High Isolation

Specification:

Isolation (minimum): 75 dB
 Repeatability better than -50 dB



Model 27333-3E

Model	Frequency Range (GHz)	Waveguide			VSWR (Max)	Insertion Loss Max (dB)	Dimensions			Model
		WG	R	WR			A (mm)	B (mm)	C (mm)	
15333-*E	6.58 - 10.0	15	84	112	Specification/dimensions available on request				15333-*E	
16333-*E	8.2 - 12.5	16	100	90					16333-*E	
17333-*E	9.84 - 15.0	17	120	75	1.10	0.2	56.0	152	34.8	17333-*E
18333-*E	11.9 - 18.0	18	140	62	1.10	0.2	50.0	147	32.2	18333-*E
19333-*E	14.5 - 22.0	19	180	51	1.10	0.3	55.0	140	29	19333-*E
20333-*E	17.6 - 26.7	20	220	42	1.10	0.3	44.0	140	29.7	20333-*E
21333-*E	21.7 - 33.0	21	260	34	1.10	0.4	44.0	140	30	21333-*E
22333-*E	26.4 - 40.1	22	320	28	1.10	0.4	44.0	137	28	22333-*E
23333-*E	33.0 - 50.1	23	400	22	1.10	0.4	47.0	137	28	23333-*E
24333-*E	39.3 - 59.7	24	500	19	1.10	0.5	47.0	137	28	24333-*E
25333-*E	49.9 - 75.8	25	620	15	1.10	0.6	44.0	137	28	25333-*E
26333-*E	60.5 - 92.0	26	740	12	1.10	0.8	44.0	137	28	26333-*E
27333-*E	73.8 - 112	27	900	10	1.10	1.0	44.0	137	28	27333-*E
28333-*E	92.3 - 140	28	120	8	1.15	1.2	44.0	137	28	28333-*E

The suffix "-2E" denotes a 2-channel rotor whilst "-3E" denotes a 3-channel rotor.

** These dimensions refer to 2-channel rotor switches only; for 3-channel rotor switch dimensions consult our Sales Team.

2-Channel Rotor Type 2

3-Channel Rotor Type 3

ORDERING INFORMATION
 Model: rotor type, E; description
 Example: Model 22333-2E Motorised waveguide switch, 2-channel rotor

Our range of waveguide switches is subject to continual development and additional models, not detailed in this catalogue, may be available to special order. Please consult our sales office for information.

A Flann switch driver is essential for driving any of the electrically operated switches listed. Please see page 82 for details.

Series 333-*E

For standard flange types and recommendations see pages 118 onwards

Switch Driver Series SD5902

For use with Series 333-*E Switches

Features

- **Speed and Precision Modes of Operation**
- **GPIB**
- **USB**
- **19" Rack Mountable**
- **Universal Line Supply**



Model SD5902

Speed and Precision Modes of Operation

The Series SD5902 Waveguide Switch Driver is designed to control the Flann microwave range of Series 333-*E Precision Waveguide Switches. It provides the interface between an IEEE 488 Bus (GPIB) or Universal Serial Bus (USB) and Precision Waveguide Switches, and allows for manual operation with display of current status. The SD5902 will drive either a 2-channel or a 3-channel switch without the need to reconfigure.

The Series SD5902 operates on any mains supply voltage without the need to select.

An important new feature of our GPIB based driver, when used in conjunction with series 333-2E and 333-3E switches, is user selectable “Speed” or “Precision” operating modes. In “Speed” mode the switch repositioning time is minimised by using all possible rotor positions. In “Precision” mode only one of the 2 possible rotor positions is utilised providing optimum microwave path repeatability by ensuring the same rotor position is used each time a particular path is selected. Users who do not require such precision should use the “Speed” mode, to optimise the setting time.

Operation

The opto electronic position sensors provide either two or four signals depending upon the type of rotor (2 or 3 channel). The outputs of the sensors are TTL compatible, positive logic. The motor output shaft drives the microwave switch rotor through a loose coupling, which is designed to allow the precision indexing mechanism to operate correctly without excessive settling time. Full power is only applied to the motor during switch repositioning.

System Performance	Max Switching Time	(2-Channel)	180ms* (Speed Mode), 475ms* (Precision Mode – worst case)
		(3-Channel)	250ms* (Speed Mode), 500ms* (Precision Mode – worst case)
Power Requirements	Line Voltage	90 - 264 V AC	
	Line Frequency	47 - 63 Hz	
	Power Consumption	50 W Max (Motor Running), 25W Max (Motor Stationary)	
	Supply Fuse	20mm T2.5A Slow Blow (On rear panel)	
Electrical Specifications	GPIB Connector	24-Way, compatible with Amphenol 57 Series (IEEE488 Standard)	
	Switch Output Connector	15-Way D-Type Female	
	Switch Cable Length	5 m Max	
	Motor Steps per Revolution	500	
Mechanical Specifications	Operating Orientation	Any	
	Dimensions (mm)	58H × 483W × 300D (2.28"H × 19.0"W × 11.8"D)	
	Weight	2.15 kg (4.74 lb)	
	Direction of Rotation	Unidirectional: Counter-clockwise when viewed from the top	

DC-Motor Driven Waveguide Switches

Series 334-*E / WRD334-*E

Features

- **Switching Time < 500 ms**
- **High Accuracy**
- **High Repeatability**
- **High Isolation**
- **2 or 3-Channel**
- **Simple TTL - Level Control & Indicators**



Model WRD180334-2E



Model 20334-2E

Operation

The Flann Series 334 DC-Motor driven waveguide switches use the same high-repeatability rotor/stator design as the unrivalled Series 333 switches. They may be controlled directly by a PC (for example by the standard printer port) or remote buttons and indicators. TTL-level control pins are provided for each of the switch positions: four for 3-channel switches and two for 2-channel switches. A logic 'low' on the appropriate control line causes the switch to move to the corresponding position. Indicator pins are provided for each switch position that indicate 'high' when the switch is correctly positioned. These are capable of sourcing up to 25mA at 5V (more than adequate to directly drive an LED).

Model	Frequency Range (GHz)	Waveguide			VSWR (Max)	Insertion Loss Max (dB)	Isolation Minimum (dB)	Model
		WG	R	WR				
16334-*E	8.2 - 12.5	16	100	90	1.10	0.2	75	16334-*E
17334-*E	9.84 - 15.0	17	120	75	1.10	0.2	75	17334-*E
18334-*E	11.9 - 18.0	18	140	62	1.10	0.2	75	18334-*E
19334-*E	14.5 - 22.0	19	180	51	1.10	0.3	75	19334-*E
20334-*E	17.6 - 26.7	20	220	42	1.10	0.3	75	20334-*E
21334-*E	21.7 - 33.0	21	260	34	1.10	0.4	75	21334-*E
22334-*E	26.4 - 40.1	22	320	28	1.10	0.4	75	22334-*E
23334-*E	33.0 - 50.1	23	400	22	1.10	0.4	75	23334-*E
24334-*E	39.3 - 59.7	24	500	19	1.10	0.5	75	24334-*E
25334-*E	49.9 - 75.8	25	620	15	1.10	0.6	75	25334-*E
26334-*E	60.5 - 92.0	26	740	12	1.10	0.8	75	2633 -*E
27334-*E	73.8 - 112	27	900	10	1.10	1.0	75	27334-*E
WRD180334-*E	18.0 - 40.0	WRD180-C24			1.15	0.2	75	WRD180334-*E

The suffix "-2E" denotes a 2-channel rotor whilst "-3E" denotes a 3-channel rotor.

Electrical Specifications	Supply voltage	10 V - 28 V DC
	Power Consumption	2 W Peak
	Control Interface	TTL-level control and indicators
	Connector	MIL-C-26482 Shell 12, 10 Pin Plug (Mating cable socket supplied) (Pattern 105 compatible)

ORDERING INFORMATION

Model description
Example: Model 22334-2E D.C. Operated waveguide switch, 75 dB isolation, 2-channel rotor.

Our range of waveguide switches is subject to continual development and additional models, not detailed in this catalogue may be available to special order. Please consult our sales office for information.



2-Channel Rotor Type 2



3-Channel Rotor Type 3

Series 334/WRD334

DC-Operated 2-Channel Waveguide Switches

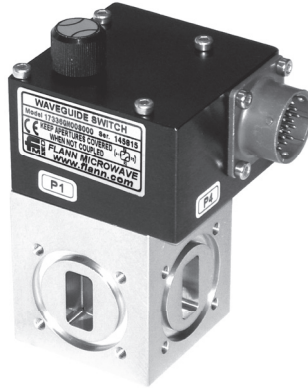
Series 336

Features

- 2.6 GHz to 40.1 GHz
- Low Loss & High Power
- High Speed
- High Reliability
- Internal and External Usage
- Sealed, 15 psig Standard

Applications

- SATCOM Systems
- Networks
- SNG



Many models available from
STOCK

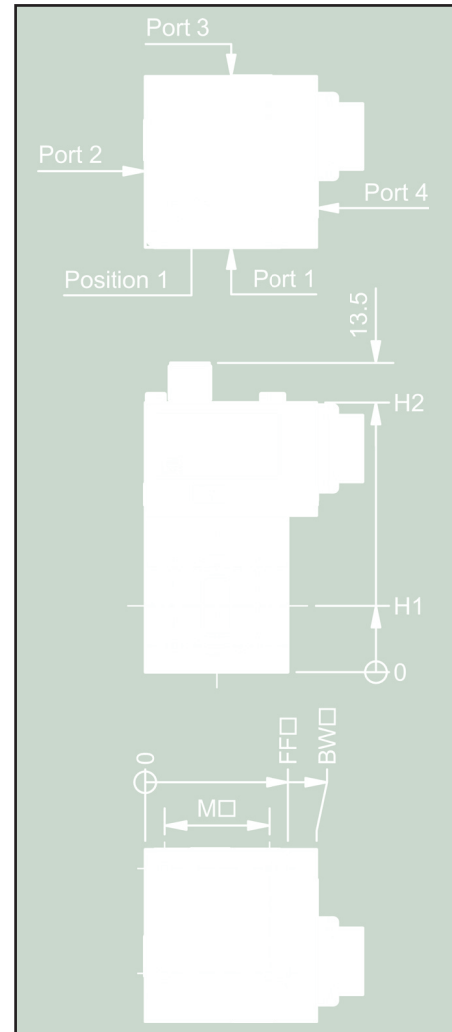
Specifications:

Model Number	Frequency Range (GHz)	Waveguide			Return Loss (dB)	Isolation (dB)	Insertion Loss (dB)	Max Mean Power (kW)	Switching Speed (ms)
		WG	R	WR					
14336	5.38 – 8.20	14	70	137	> 32.3	> 85	< 0.02	12	< 70
15336	6.58 – 10.0	15	84	112	> 32.3	> 85	< 0.03	8	< 60
16336	8.2 - 12.5	16	100	90	> 32.3	> 85	< 0.04	5.5	< 60
17336	9.84 – 15.0	17	120	75	> 32.3	> 85	< 0.04	5	< 50
18336	11.9 - 18.5	18	140	62	> 32.3	> 85	< 0.05	3.5	< 50
22336	26.4 - 40.1	22	320	28	> 28.3	> 75	< 0.10	0.8	< 50
WRD580336	5.8 - 16.0	WRD580-D28			> 23.1	> 65	< 0.20	1.1	< 60

Dimensions & Weight:

Model Number	BW mm (inch)	FF mm (inch)	H1 mm (inch)	H2 mm (inch)	M mm (inch)	Weight kg (lb)
14336	62 (2.44)	57.2 (2.25)	34.9 (1.37)	119 (4.69)	44.5 (1.75)	< 0.8 (1.76)
15336	62 (2.44)	57.2 (2.25)	25.5 (1.00)	101 (3.98)	44.5 (1.75)	< 0.7 (1.54)
16336	57.2 (2.25)	47.6 (1.87)	26.7 (1.05)	98 (3.86)	34.9 (1.375)	< 0.6 (1.32)
17336	57.2 (2.25)	47.6 (1.87)	22.2 (0.87)	90 (3.55)	34.9 (1.375)	< 0.55 (1.21)
18336	57.2 (2.25)	47.6 (1.87)	19.7 (0.78)	84 (3.31)	34.9 (1.375)	< 0.55 (1.21)
22336	47.6 (1.87)	35.0 (1.38)	14.6 (0.57)	73.5 (2.89)	28.6 (1.125)	< 0.4 (0.88)
WRD580336	57.2 (2.25)	47.6 (1.87)	22.2 (0.87)	90.5 (3.56)	34.9 (1.375)	< 0.55 (1.21)

PLEASE CONTACT OUR SALES TEAM FOR MORE INFORMATION ON OUR STANDARD AND OTHER MODELS



ORDERING INFORMATION: - BASIC OPTIONS

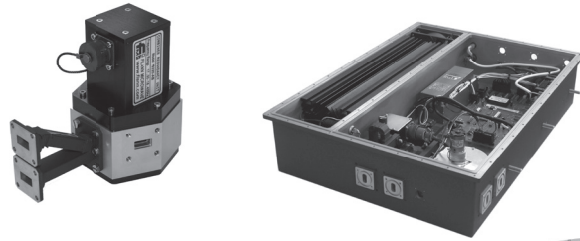
Model Description: Waveguide WG17, PBR 120 Flange, +28 Volt DC, M4 34.9mm, Side Connector, MIL connector 14 shell 19 Pin, Circuit A, Latching, No Locking Key, No additional option
Model Number: 17 336 -0 0 0 S 0 A L 0 0

Waveguide Type / Size: WG10 (WR284) to WG22 (WR28) and WRD580 to WRD180
 Series: 336
 Flange Type: 0 = Grooved, 1 = Cover
 Voltage: 0 = +28Vdc, 1 = -28Vdc, 2 = +12Vdc, 3 = -12Vdc
 Mounting Holes: 0 = Metric, 1 = Imperial
 Connector Position: S = Side, T = Top
 Control/Connector Type/Style: 0 = MIL 14-19, 1 = MIL 14-12, 2 = MIL 12-10, 3 = MIL 10-6, 4 = RS-485 MIL 10-6, 8-2
 Electrical Arrangement: Circuits A, B, C, D, E, F, G, H, I, J, K, L M
 Latching: L = Latching, F = Fail-Safe
 Locking and Key Removal: 0 = No locking, 1 = Tubular lockable position '1'
 Options: 0 = No option, 1 = Weatherproof (Manual override knob protected from ice)

Phase Combining / Redundancy Solutions Series 520

Features

- **Efficient HPA Combining**
- **Full Power HPA Redundancy**
- **High Speed Switching**
- **Fully Integrated Solution**



Applications

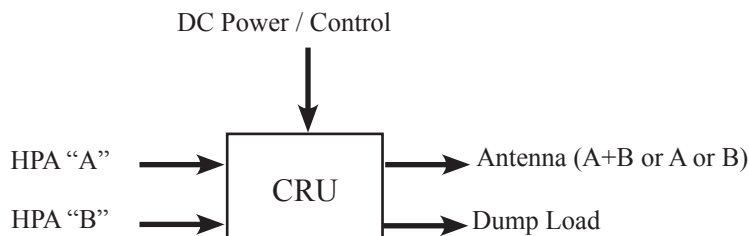
- **Mobile Installations**
- **Fixed / Ground Installations**
- **SNG Trucks**



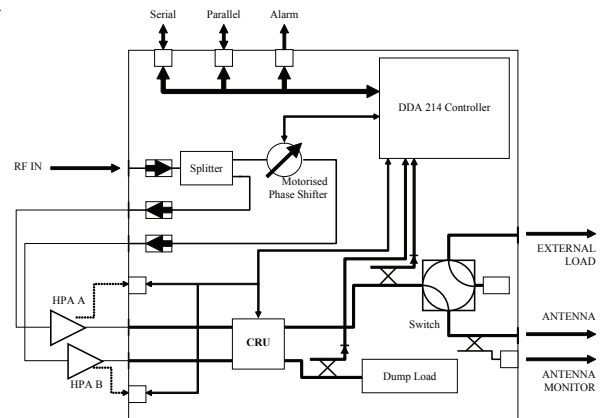
The Series 520 suite offers various solutions supporting multiple High Power Amplifier configuration and combining requirements.

The entry level CRU module routes the outputs of two HPAs to an Antenna and High Power Load as in a "Hot Standby" system. Or it combines both HPA outputs to an Antenna to increase power in difficult Satcom uplink budget situations.

The complete phase optimised Combiner / Redundancy System is available with a separate Hub Box and rack mount Controller or fully integrated into a single box controlled via a laptop dialogue box.



General System Schematic



A Typical System Schematic

Typical RF Specification	
Frequency Range	12.75 GHz - 14.5 GHz
RF Power handling	> 1 kW on both channels simultaneously
System Insertion Loss (Redundancy Mode)	< 0.35 dB
Switching Speed (Combining to Redundancy Mode)	< 50 ms
VSWR	< 1.25 : 1
Antenna Power Monitor	-50 dB

ORDERING INFORMATION

PLEASE CONTACT THE SALES TEAM FOR MORE INFORMATION ON OUR STANDARD AND OPTIONAL MODELS

Matched Hybrid Tees Series 380

Features

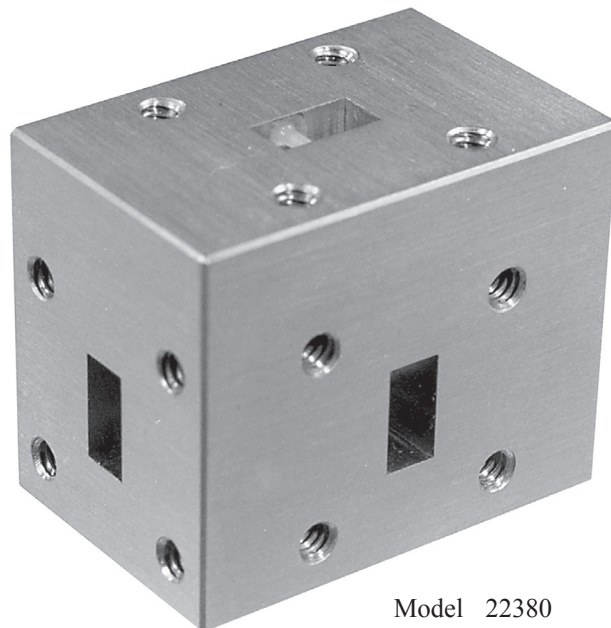
- **Models from 1.14 GHz to 330 GHz**
- **30 dB Isolation**
- **1.30 : 1 VSWR (maximum)**

The Series 380 Matched Hybrid Tees manufactured by Flann have been designed to provide very high quality performance in terms of isolation, VSWR and bandwidth, in frequency bands up to 330 GHz.

Each Matched Hybrid Tee is constructed from precision machined sections and accurately assembled to ensure a high degree of symmetry within the device. Signal introduced into either the series, E plane or shunt, H plane input port results in a balanced power split at the output ports of the “through” waveguide.

When the E plane input is used the balanced output signals will be 180° out of phase: using the H plane input produces balanced output signals which are in phase.

The specification relates to 20% bandwidths. However, other requirements can be considered upon request.



Model 22380

Matched hybrid tees are available in lower frequency bands; details on request.

Model	Frequency Range (GHz)	Waveguide			Bandwidth	VSWR	Balance	Isolation	
		WG	R	WR					
20380	17.6 - 26.7	20	220	42	20% of frequency range	1.3 max (with 'through' waveguide ports correctly terminated)	± 0.5 dB	30 dB minimum	
22380	26.4 - 40.1	22	320	28					
23380	33.0 - 50.1	23	400	22					
24380	39.3 - 59.7	24	500	19					
25380	49.9 - 75.8	25	620	15					
26380	60.5 - 92.0	26	740	12					
27380	73.8 - 112	27	900	10					
28380	92.3 - 140	28	1200	8					
29380	114 - 173	29	1400	6					Specifications available on request
30380	145 - 220	30	1800	5					
31380	172 - 261	31	2200	4					
32380	217 - 330	32	2600	3					

Model	Dimensions (mm)					
	A	B	C	D	E	F
20380	28	17	34	17	22	11
22380	25	15	30	15	20	10
23380	37.5	22.5	45	22.5	30	15
24380	37.5	22.5	45	22.5	30	15
25380	25	15	30	15	20	10.4
26380	25	15	30	15	20	10.4
27380	25	15	30	15	20	10.4
28380	25	15	30	15	20	10.4
29380	Dimensions available on request					
30380						
31380						
32380						

ORDERING INFORMATION
 Model: Centre Frequency;
 Description
 Example: Model 27380-94
 Matched Hybrid Tee, Centre Frequency 94 GHz

Series 380

For standard flange types and recommendations see pages 118 onwards

Un-matched Hybrid Tees Series 390

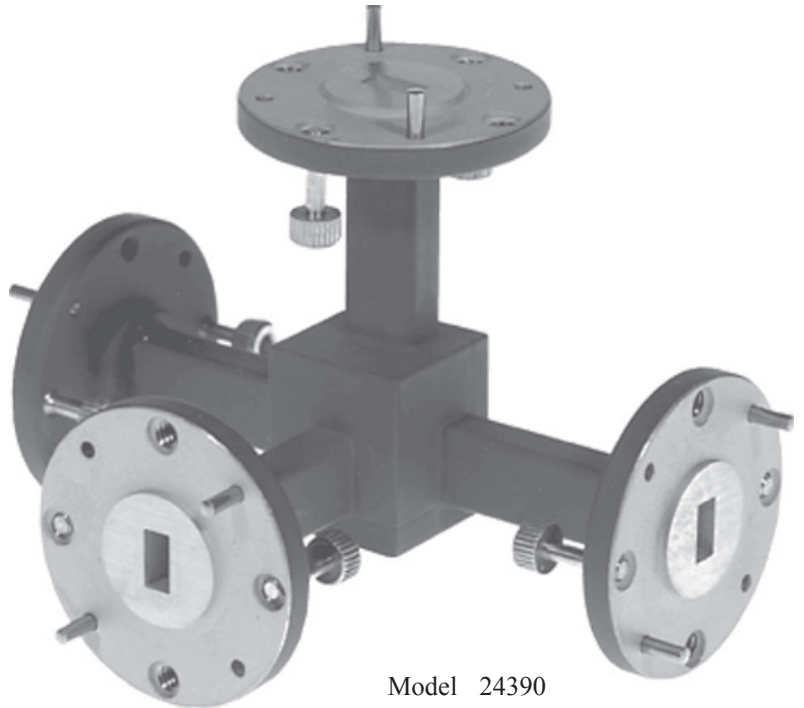
Features

- **Models from 1.14 GHz to 140GHz**

The Flann Series 390 range of un-matched Hybrid Tees are waveguide sections accurately machined and assembled to form a conventional hybrid tee junction.

Precise machining yields the symmetrical construction necessary to ensure high isolation between the E and H plane ports and balanced power division in the “through” waveguide.

The H plane input provides in-phase outputs whilst the E plane input provides outputs of opposite phase.



Model 24390

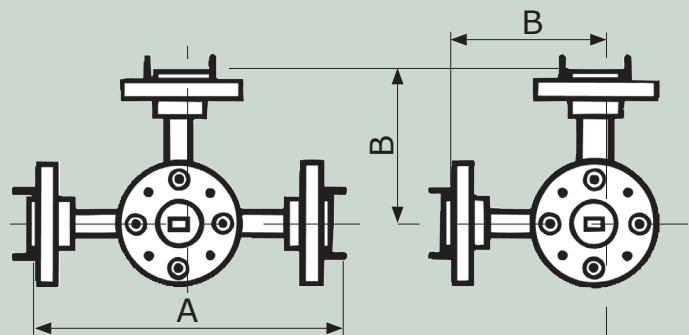
Un-matched hybrid tees are available in lower frequency bands; details on request.

Model	Frequency Range (GHz)	Waveguide			Dimensions (mm)	
		WG	R	WR	A	B
20390	17.6 - 26.7	20	220	42	70	35
22390	26.4 - 40.1	22	320	28	70	35
23390	33.0 - 50.1	23	400	22	70	35
24390	39.3 - 59.7	24	500	19	70	35
25390	49.9 - 75.8	25	620	15	48	24
26390	60.5 - 92.0	26	740	12	48	24
27390	73.8 - 112	27	900	10	48	24
28390	92.3 - 140	28	1200	8	48	24

ORDERING INFORMATION

Model: Description

Example: Model 22390 Hybrid Tee, Un-matched



Series 390

For standard flange types and recommendations see pages 118 onwards

Matched E and H Plane Tees

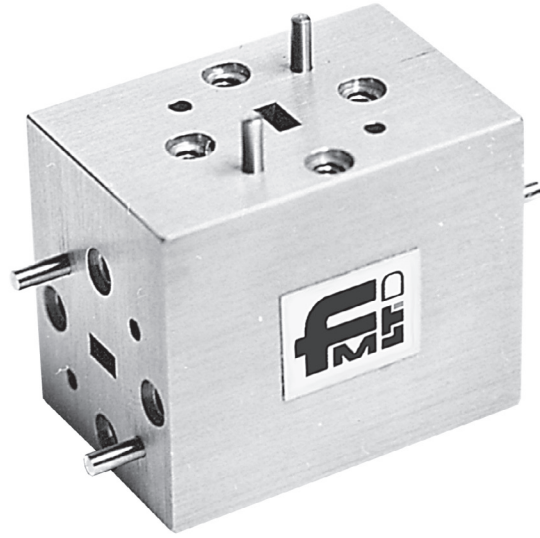
Series 400 / 410

Features

- Models from 1.14 GHz to 330 GHz
- E Plane Models - Series 400
- H Plane Models - Series 410

The Series 400 E plane and Series 410 H plane matched tees are constructed from precision machined sections accurately assembled to form the completed component.

H plane tees, when fed via the shunt arm, divide the signal equally between the through ports and in phase. When E plane tees are fed via the series arm the signal divides equally but 180° out of phase.



Model 25400

Matched tees are available in lower frequency bands; details on request.

Model		Frequency Range (GHz)	Waveguide			VSWR	Balance Between Co-linear Ports
E Plane	H Plane		WG	R	WR		
20400	20410	17.6 - 26.7	20	220	42	1.3 max (with 'through' waveguide ports correctly terminated)	±0.5 dB
22400	22410	26.4 - 40.1	22	320	28		
23400	23410	33.0 - 50.1	23	400	22		
24400	24410	39.3 - 59.7	24	500	19		
25400	25410	49.9 - 75.8	25	620	15		
26400	26410	60.5 - 92.0	26	740	12		
27400	27410	73.8 - 112	27	900	10		
28400	28410	92.3 - 140	28	1200	8		
29400	29410	114 - 173	29	1400	6		
30400	30410	145 - 220	30	1800	5		
31400	31410	172 - 261	31	2200	4		
32400	32410	217 - 330	32	2600	3		

ORDERING INFORMATION
 Model: Description
 Example: Model 25410; Tee, Matched, H Plane

Series 400/410

Model		Dimensions (mm)					
E Plane	H Plane	A	B	C	D	E	F
20400	20410	28	17	34	17	22	11
22400	22410	25	15	30	15	20	10
23400	23410	37.5	22.5	45	22.5	30	15
24400	24410	37.5	22.5	45	22.5	30	15
25400	25410	25	15	30	15	20	10.4
26400	26410	25	15	30	15	20	10.4
27400	27410	25	15	30	15	20	10.4
28400	28410	25	15	30	15	20	10.4
29400	29410	Dimensions available on request					
30400	30410						
31400	31410						
32400	32410						

For standard flange types and recommendations see pages 118 onwards

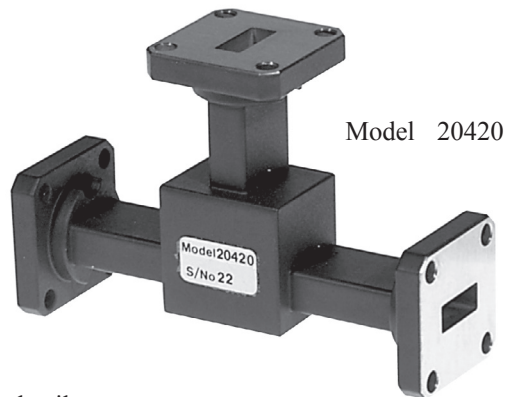
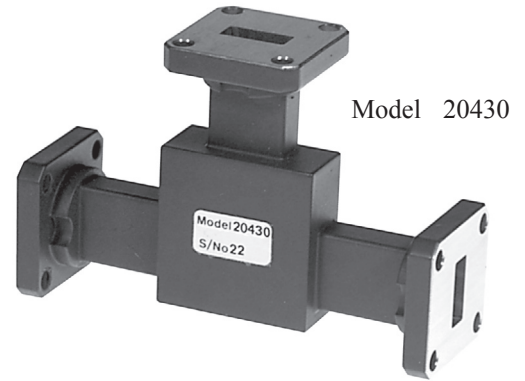
Un-matched E and H Plane Tees

Series 420 / 430

Features

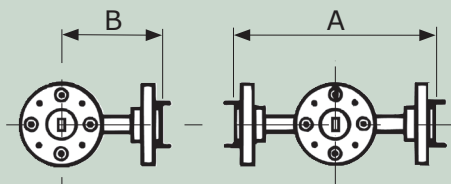
- Models from 1.14 GHz to 140 GHz
- E Plane Models - Series 420
- H Plane Models - Series 430

The tees are manufactured from sections of standard waveguide precisely assembled to produce excellent dimensional symmetry ensuring good power division characteristics. Outputs from H plane tees are in phase whereas E plane tees outputs are of opposite phase.



Un-matched tees are available in lower frequency bands; details on request.

Model		Frequency Range (GHz)	Waveguide			Dimensions (mm)	
E Plane	H Plane		WG	R	WR	A	B
20420	20430	17.6 - 26.7	20	220	42	70	35
22420	22430	26.4 - 40.1	22	320	28	70	35
23420	23430	33.0 - 50.1	23	400	22	70	35
24420	24430	39.3 - 59.7	24	500	19	70	35
25420	25430	49.9 - 75.8	25	620	15	48	24
26420	26430	60.5 - 92.0	26	740	12	48	24
27420	27430	73.8 - 112	27	900	10	48	24
28420	28430	92.3 - 140	28	1200	8	48	24



ORDERING INFORMATION

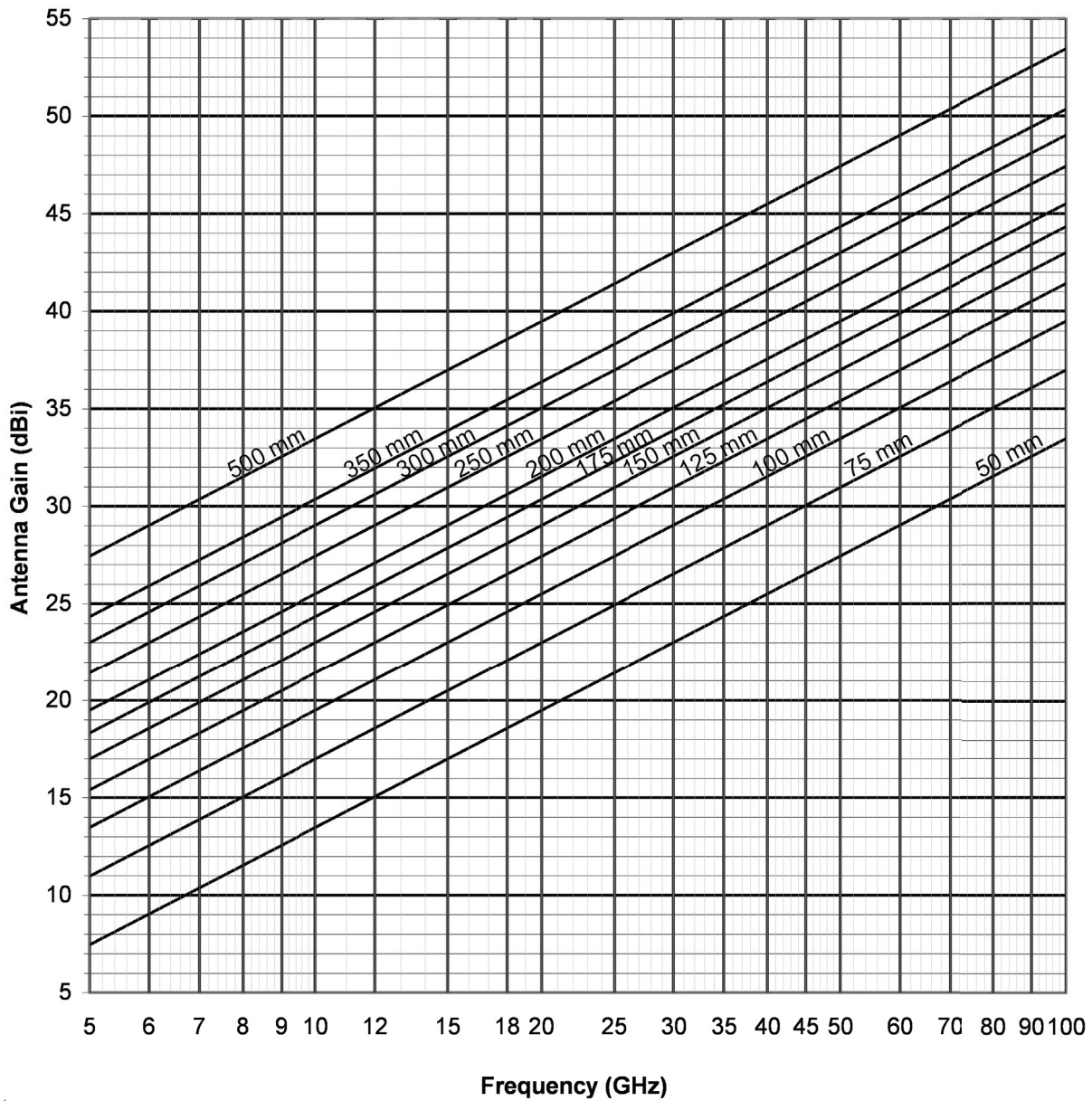
Model: Description

Example: Model 27420 Tee, Un-matched, E Plane

For standard flange types and recommendations see pages 118 onwards

Lens Horn Antennas

Lens Horn Gain



Notes

Approximate Gain is given by:

$$Gain \approx \frac{8D^2}{\lambda^2}$$

D is antenna diameter

λ is the free space wavelength

Options

- Full band in some waveguide sizes
- Narrow band models
- Finish in gloss white or matt black
- Pole or box mounting

Sectoral Horns Series 244 / 245

Features

- **Low Cost**
- **High Performance**
- **Customised Designs Available**
- **Greater Spectrum Efficiency**
- **Manufactured from Brass or Aluminium**
- **E or H Plane Available**
- **Quotations on Request**

The use of the sector antenna has become a very effective method of achieving the broadcast type of coverage required of the base station transmission system as used in LMDS/MVDS systems.

Flann Microwave has developed a series of compact, high performance, low cost sectoral hub antennas for LMDS/MVDS applications. The 64° azimuth beam angle is designed to provide the best circular coverage pattern when illuminated from the circle edge taking into account path losses and attenuation due to rain.

Sectoral Antenna v Omnidirectional Alternatives

More revenue potential per base station

Omnidirectional antennas are always located at the centre of the coverage area whereas sectoral antenna base stations can be located anywhere on the cell edge and can therefore illuminate up to 4 cells from one base station allowing a 4:1 ratio of revenue generating cells to cost generating transmitter sites.

Customised Base Station Antennas

The requirement to serve a number of small areas from a single base station has resulted in the development of the multiple beam technique, for which the sectoral antenna is ideal. Power splitting is through the use of branch guide couplers whilst polarization and direction orientation can be achieved using compact waveguide bends and twists.

Customised Foot Prints

A multiplicity of elements and arrays can be incorporated in a single enclosure to provide a defined radiation pattern. Edge fed circular and centre fed circular are possible configurations.

Customised Antenna, Filter and Splitter Assemblies

Assemblies of antenna elements fitted with purpose designed filters fed via two or three way power divider networks can be designed and manufactured to suit the special needs of individual applications. The arrays and the elements within each array can be positioned either prior to, or after installation to enable fine tuning.

Model 24244



Model 24245

Simple and compact design

The design and manufacture of omnidirectional antennas at millimetre wave frequencies is both complex and costly whereas the sector antenna and in particular the 64° sector antenna is a simple device offering **much lower manufacturing costs**.

Customised Antenna Enclosures

In order to be sure of a design which does not in any way compromise system performance, it is important to give careful considerations to all aspects of the antenna radome assembly and its integration with the transmitter. Flann can provide efficient, practical and individually customised solutions to your transmitter construction which minimize installation, servicing and system running costs while assuring you of the system's durability and high performance in all conditions.

Standard Gain Horns

Series 240

Features

- Weatherproof Options
- Mounting Brackets Options
- Manufactured Brass or Aluminium
- Higher frequency models available

The Flann Standard Gain Horns have a wide range of applications, (e.g. as transmitting, receiving or sampling antennas or for feeding reflectors).

The absolute gain of a standard gain horn is calculable from the flare dimensions. Flann Standard Gain Horns are precision components providing accurate and repeatable gain references.

In general the lower frequency horns, models 06240 to 17240 inclusive, are accurately fabricated from brass sheet or aluminium. Models 18240 to 32240 inclusive are copper electroformed on precision mandrels which ensure high accuracy and repeatability. Typical gain/bandwidth curves are provided for all standard gain horns. 10 dB, 15 dB, 20 dB, 25 dB, 30 dB and 33 dB gain horns are also available in many waveguide sizes.

NB:- 25 dB models are approximately three times the overall length of the corresponding 20 dB models

Specifications:

Variation of mid-band gain with frequency ± 2 dB

Maximum VSWR (20 dB models)..... 1.2 : 1



Model 22240-25

ORDERING INFORMATION

Model: Gain Suffix; Description

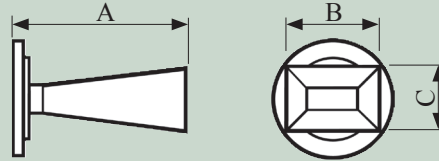
Example: Model16240-20 Standard Gain Horn, 20 dB

-01 Membrane

-02 Mounting Bracket

-03 Membrane and Mounting Bracket

Gain	Suffix
10 dB	10
15 dB	15
20 dB	20
25 dB	25



Series 240

Model	Frequency Range (GHz)	Waveguide			Standard Mid-Band Gain (dB)	Dimensions (mm)		
		WG	R	WR		A Overall	B Internal	C Internal
06240	1.14 - 1.73	6	14	650	10	478	240	175
08240	1.72 - 2.61	8	22	430	10	318	160	115
10240	2.60 - 3.95	10	32	284	15	352	203	145
11A240	3.22 - 4.90	11A	40	229	15	290	154	114
12240	3.94 - 5.99	12	48	187	20	495	230	165
13240	4.64 - 7.05	13	58	159	20	419	209	148
14240	5.38 - 8.18	14	70	137	20	375	170	123
15240	6.58 - 10.0	15	84	112	20	328	146	110
16240	8.20 - 12.5	16	100	90	20	245	109	79
17240	9.84 - 15.0	17	120	75	20	215	94	67
18240	1.9 - 18.0	18	140	62	20	153	75	57
19240	14.5 - 22.0	19	180	51	20	139	67	50
20240	17.6 - 26.7	20	220	42	20	120	52	38
22240	26.4 - 40.1	22	320	28	20	85	35	25
23240	33.0 - 50.1	23	400	22	20	68	28	20
24240	39.3 - 59.7	24	500	19	20	54.5	23	18
25240	49.9 - 75.8	25	620	15	20	45.5	19	13
26240	60.5 - 92.0	26	740	12	20	38.5	15	11
27240	73.8 - 112	27	900	10	20	32.5	12.4	9
28240	92.3 - 140	28	1200	8	20	27.5	10	8
29240	114 - 173	29	1400	6	20	24.5	8.5	6.5
30240	145 - 220	30	1800	5	20	21.0	7.0	5.0
31240	172 - 261	31	2200	4	20	18.0	6.5	4.5
32240	217 - 330	32	2600	3	20	12.0	6.0	4.0

For more compact horn antennas and higher gains see Lens Horn Antennas pages 90 and 91
For standard flange types and recommendations see pages 118 onwards

NRL Standard Gain Horns

Series 240-NRL

Features

- Models up to 40 GHz
- Comply with U.S. Naval Research Lab Report (NRL) Report No. 4433
- Standard and Special Flange Types Available

Applications

- Measurement Standard
- Calibration

Typical Performance

- VSWR better than 1.2:1
- Variation of gain wrt mid-band ± 2 dB



Model 12240-18NRL

Flann offer a complete range of Standard Gain Horn Antennas designed to the requirements of the Naval Research Laboratory (NRL) Report No. 4433.

These antennas are the industry recognised standard for gain calibration by the substitution method as described by ANSI/IEEE Standard 149-1979 Test Procedure for Antennas.

Model	Frequency Range (GHz)	Waveguide			Design Point	
		WG	R	WR	Frequency (MHz)	Gain (dBi)
05240-13NRL	0.950 - 1.150	5	12	770	1000	13.7
06240-15NRL	1.130 - 1.700	6	14	650	1300	15.5
08240-15NRL	1.700 - 2.600	8	22	430	1970	15.5
10240-18NRL	2.600 - 3.950	10	32	284	3000	18.0
12240-18NRL	3.950 - 5.880	12	48	159	4500	18.0
14240-22NRL	5.770 - 8.330	14	70	137	6315	22.1
15240-18NRL	6.980 - 10.000	15	84	112	7595	18.0
16240-22NRL	8.100 - 12.400	16	100	90	9375	22.1
18240-24NRL	12.400 - 18.070	18	140	62	16040	24.7
20240-24NRL	18.070 - 26.550	20	220	42	24000	24.7
22240-24NRL	26.550 - 38.960	22	320	28	35290	24.7

Scaled versions to 330 GHz are also available - details on request.

ORDERING INFORMATION

Model: Gain suffix; NRL; Description

Example: Model 12240-18NRL-AA NRL Standard Gain Horn, 18 dB

Series 240-NRL

Near Field Probes

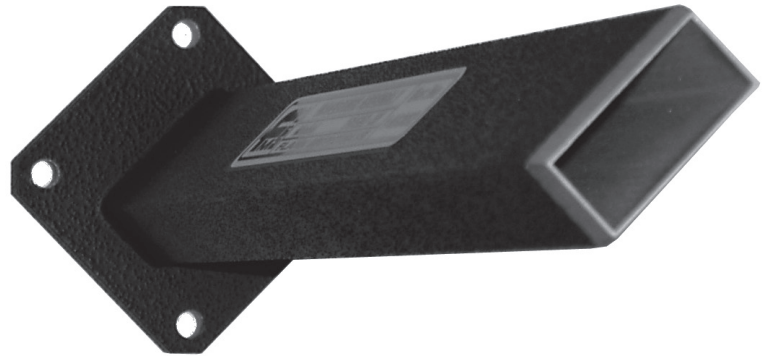
Series 246

Features

- **Models up to 330 GHz**
- **Low End Diffraction**

Applications

- **Planar & Cylindrical Near Field Measurements**
- **Calibration**



Flann offer a complete range of small aperture open-ended near field waveguide probes designed specifically for planar and cylindrical near field measurements and calibration.

The end diffraction is minimised by utilising a 10° chamfer to give a knife edge aperture of less than 0.5 mm.

Standard probe lengths include 100 mm, 200 mm & 300 mm.

Custom lengths and flanges are available on request.

Typical Performance

- VSWR better than 2.5:1
- Gain 5.5 dB
- Gain variation ± 2 dB

ORDERING INFORMATION

Model: Description

Example: Model 18246 WG18 Near-field probe

Series 246

Dual Polarized Horn Series DP240

Features

- Frequency Range 2 GHz to 18 GHz
- Dual Polarization
- Close Phase and Amplitude Tracking Between Ports
- High Isolation
- Low Cross Polarization
- Integral Mounting Bracket Option
- Rated to IP54*



Model DP240-AB

Typical applications include:

- Electromagnetic Interference (EMI) Measurement
- Antenna Measurement
- Radar Cross Section Measurement

The Flann Dual Polarized Horn, Model DP240 is a multi-octave, coaxially fed, quadridged horn suitable for many applications requiring a high performance over a broad band.

*SMA, K and 2.4mm connectors are not hermetically sealed. Therefore to achieve IP54 rating the mated cable connection must be adequately sealed.

These high performance units covering the frequency range 2 GHz to 18 GHz offer high isolation with low phase and amplitude imbalance between ports. The horn maintains a low VSWR while the precision electroformed construction ensures very low cross polarization levels.

Electrical Specifications	Frequency Range	2 GHz to 18 GHz
	Gain	5 dBi to 18 dBi
	Polarization	Simultaneous Horizontal & Vertical
	3 dB Beamwidth	60° to 10° Nominal
	Typical VSWR Better than	2.5:1
	Cross Polarization	-20 dB Maximum
	Isolation Between Ports	25 dB Typical
	Maximum Power CW	10 Watts
	Phase Tracking Between Ports	± 17° Maximum
Amplitude Tracking Between Ports	± 1.3 dB Maximum	
RF Coaxial Connectors	SMA Female	
Dimensions	Aperture Diameter	135 mm
	Overall Length	300 mm
	Weight	2.75 kg (3.2 kg DP240-AB)

ORDERING INFORMATION:

Model DP240-AA; Dual Polarized Horn, 2 GHz to 18 GHz

Model DP240-AB; Dual Polarized Horn, 2 GHz to 18 GHz with integral mounting bracket

Series DP240

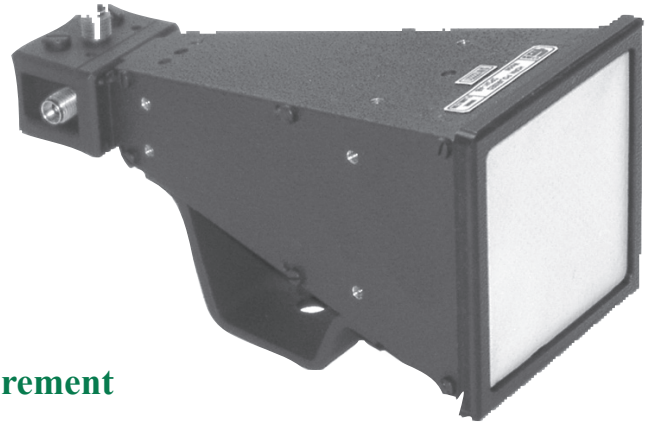
Dual Polarized Horn Series DP241

Features

- Frequency Range 18 GHz to 40 GHz
- Optional Ranges in 6 GHz to 50 GHz
- Close Phase and Amplitude Tracking Between Ports
- High Isolation
- Low Cross Polarization
- Rated to IP54*

Typical applications include

- Electromagnetic Interface (EMI) measurement
- Antenna Measurement
- Radar Cross Section Measurement



Model DP241- AB

The Flann Dual Polarized Horn, Model DP241 - AB, is a multi-octave, coaxially fed, quadridged horn suitable for many applications requiring a high performance over a broad band. The standard antenna covers the frequency range 18 GHz - 40 GHz and offers high isolation with low phase and amplitude imbalance between ports. Other frequency options are available within the 6 GHz to 50 GHz band.

The horn maintains a low VSWR while the precision-machined construction ensures very low cross polarization levels.

Special Dual Polarized Horns are also available operating up to 50 GHz using 2.4 connectors.

The standard DP241-AB will function down to 6 GHz with a reduced performance.

*SMA, K and 2.4mm connectors are not hermetically sealed. Therefore to achieve IP54 rating the mated cable connection must be adequately sealed.

Electrical Specifications	Frequency Range	18 GHz to 40 GHz (Options, operational from 6 GHz to 50 GHz)
	Gain	10 dBi to 18 dBi
	Polarization	Simultaneous Horizontal & Vertical
	3 dB Beamwidth	25° to 17° Nominal
	Typical VSWR Better than	2.5:1
	Cross Polarization	-20 dB
	Isolation Between Ports	25 dB
	Maximum Power CW	5 Watts
	Phase Tracking Between Ports	± 25° Maximum
	Amplitude Tracking Between Ports	± 1.5 dB Maximum
RF Coaxial Connectors		2.9 K Type Female
Dimensions	Aperture	50 mm x 50 mm
	Overall Length	150 mm
	Weight	< 0.5 kg

ORDERING INFORMATION:

Model DP241-AB; Dual Polarized Horn, 18 GHz to 40 GHz with integral mounting bracket
Model DP241-AC; Dual Polarized Horn, 6 GHz to 50 GHz (2.4 mm connector)

Series DP241

Omni Directional Antenna Series MD249

Features

- **Low VSWR**
- **360° Azimuth Coverage**
- **60° Elevation Coverage**
- **Models within the range 1.5 GHz - 330 GHz available**
- **Waveguide Interface Models available**

The Flann Omni Directional Antennas series MD249, provide 360° coverage in azimuth and 60° coverage in elevation; these antennas are suitable for applications requiring a good all round coverage.

Typical applications include:-

- **Wireless LAN**
- **Source Tracking**
- **Outside Broadcast**
- **Air to Ground Downlinks**



Model MD249-AB



Model MD249-AA

Typical Specification:- (Model MD 249-AA)

Specified Frequency Range	59 GHz to 65.5 GHz All Broadband widths up to 2:1
Functional Frequency Range	50 GHz to 70 GHz All Broadband widths up to 2:1
Nominal Gain	2 dB
Gain Variation Elevation	±1.5 dB
Gain Variation Azimuth	±1 dB
Polarization	Vertical
Nominal Half Angle 3 dB Beamwidth	Typically Greater than 30°
Nominal Half Angle 10 dB Beamwidth	Typically Greater than 60°
VSWR (Max)	1.65:1
Typical Power Handling	5 Watts
RF Coaxial Connectors	1.85 mm Male or Female or Type N, SMA, K for lower frequency ranges

V & E Band Diplexers Series 286

Features

- **Models 49.9 GHz to 92 GHz**
- **Low loss**
- **Innovative compact design**
- **Tuning free**
- **Available in small & large quantities**
- **Standard and customised models**

Flann offer standard and special custom diplexers designed for the demanding millimeter wave applications at both V (58 to 63 GHz) and E (71 to 76 GHz and 81 to 86 GHz) bands.

Aluminium, Copper, Gold plate or Silver plate options are available depending on customer requirements.

The diplexer 25286-5947 shown on the next page is an example of a custom product designed and manufactured to meet a specific customers exacting requirement.

The Diplexer Model 26286-AA, shown above is an example of an arrangement of a typical E band diplexer designed to operate over the 71 to 86 GHz frequency band. For other examples of custom designed diplexers please see the following page



Model: 25286-7225

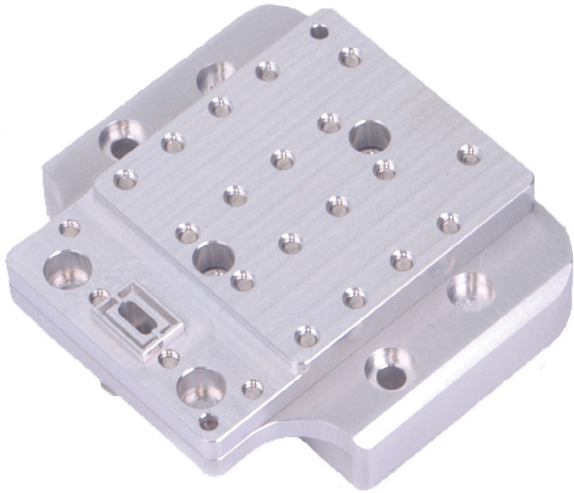
Ordering

Please specify the following:

WG Designation	Series
25 & 26	286

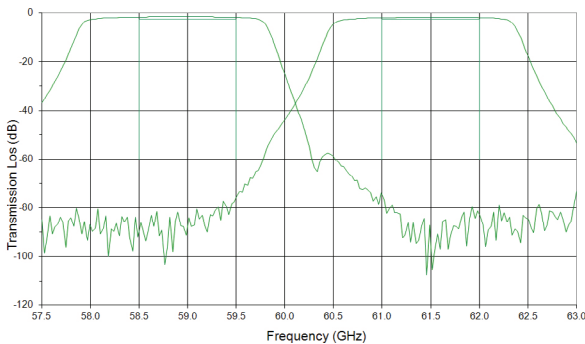
Example: 26286. A WG26 (WR12) 71-86GHz Diplexer.

V & E Band Diplexers Series 286

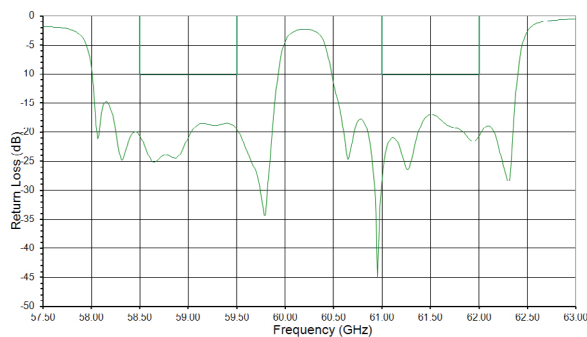


Specification:- Model 25286-5947

WG25/WR15 V-band Diplexer (25286-5947)		
Band port	Low	High
Frequency (GHz)	58.5 to 59.5	61 to 62
VSWR (max)	1.9	1.9
Insertion Loss (dB)	2.5	2.5
Group delay variation	600ps max	600ps max
Stop Band Rejection	60dB	
Operating temperature	-45° C to +85° C	
Flange types	custom interface	



Typical Transmission Loss for model 25286-5947

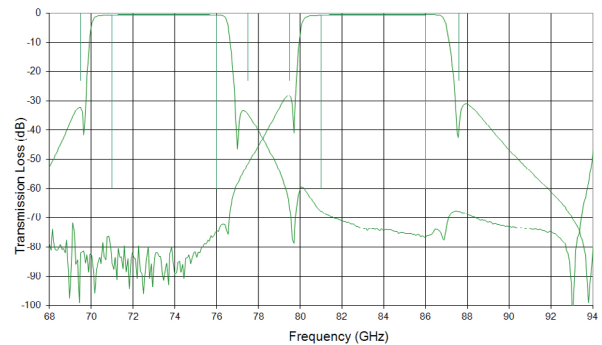


Typical Return Loss for model 25286-5947

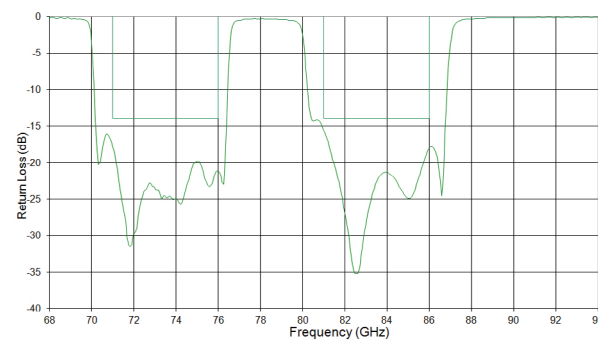


Specification:- Model 26286-AA

WG26/WR12 E-band Diplexer (26286-AA)		
Band port	Low	High
Frequency (GHz)	71-76	81-86
VSWR (max)	1.5	
Insertion loss (dB)	0.7 max	
Amplitude variation	≤ 0.1 dB in any 150MHz Band	
Group delay variation	≤ 0.1 ns in any 150 MHz Band	
Isolation (dB)	≥63	
Rejection	>20 dB @ 1.5 GHz from passbands	
Operating temperature	-30° C to +70° C	
Flange types	UG-387/U	



Typical Transmission Loss for model 26286-AA



Typical Return Loss for model 26286-AA

Low Pass Filters Series 280

Features

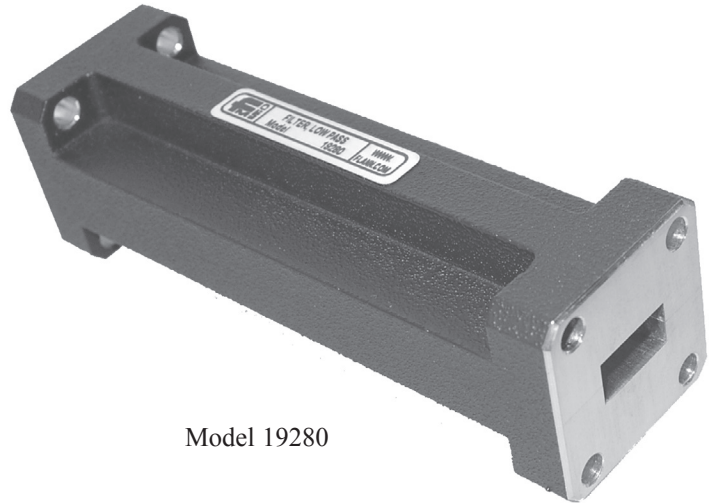
- **40 dB Stop Band Rejection**
- **Models Available from 2.6 GHz to 112 GHz**
- **High Frequency Models Available on Request**

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

All models provide a very wide 'stop band' of frequencies above the recommended waveguide band. The pass band VSWR is generally better than 1.5:1 and insertion loss less than 1.5 dB.

Filters of this type are particularly suitable for applications involving swept or slotted line measurements.

A range of standard models is available as detailed below. Customised and special models can be combined with other devices. For example a low pass filter combined with waveguide to coax adaptor can also be supplied.



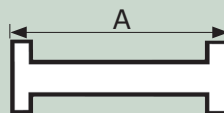
Model 19280

Model	Waveguide			Passband Frequency Range (GHz)	Stop Band Frequency Range (GHz)	Stop Band Rejection (dB)	Maximum Insertion Loss (dB)	VSWR Generally better than	Dimension A (mm)
	WG	R	WR						
10280	10	32	284	2.60 - 3.95	5.20 - 11.85	>40	0.5	1.15	500
11A280	11A	40	229	3.22 - 4.90	6.60 - 14.70	>40	0.5	1.15	450
12280	12	48	187	3.94 - 5.99	7.88 - 17.97	>40	0.5	1.15	375
14280	14	70	137	5.38 - 8.18	10.76 - 24.54	>40	0.5	1.15	250
15280	15	84	112	6.58 - 10.0	13.16 - 30.00	>40	0.5	1.15	215
16280	16	100	90	8.20 - 12.5	16.40 - 37.50	>40	0.5	1.15	160
17280	17	120	75	9.84 - 15.0	19.68 - 45.00	>40	0.5	1.15	140
18280	18	140	62	11.9 - 18.0	23.80 - 54.00	>40	0.5	1.15	110
19280	19	180	51	14.5 - 22.0	29.00 - 66.00	>40	0.5	1.15	100
20280	20	220	42	17.6 - 26.7	35.20 - 80.10	>40	0.5	1.15	80
21280	21	260	34	21.7 - 33.0	43.4 - 99.0	>40	0.5	1.2	80
22280	22	320	28	26.4 - 40.1	52.80 - 120.3	>40	0.75	1.2	60
23280	23	400	22	33.0 - 50.1	66.00 - 150.3	>38	1.0	1.3	50
24280	24	500	19	39.3 - 59.7	78.60 - 179.1	>38	1.0	1.3	50
25280	25	620	15	49.9 - 75.8	99.8 - 227.4	>38	1.0	1.4	35
26280	26	740	12	60.5 - 92.0	102.5 - 184	>40	0.6	1.5	15
27280	27	900	10	73.8 - 112	128 - 224	>40	0.4	1.66	12

ORDERING INFORMATION

Model: Description

Example: Model 22280 Low pass filter



Models are available at higher frequency bands. Details upon request.

Series 280

For standard flange types and recommendations see pages 118 onwards

Microwave Tuneable Filters

Programmable Series 287 & Manual Series 288

Features

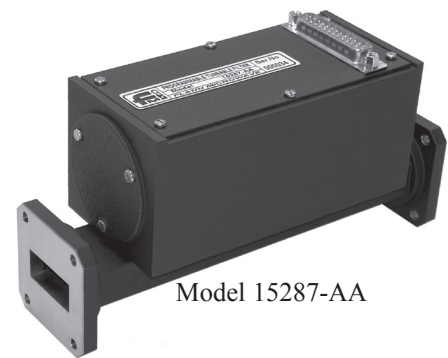
- **Bandpass & Bandstop**
- **Narrow bandwidths < 0.5%**
- **15% frequency tuning range**
- **Passband designs within the 1 GHz to 45 GHz Range**
- **Bus controlled or manual**
- **High power versions**
- **Very low insertion loss & high Q**
- **Programmable - BUS Controlled GPIB or Manual**
- **Other Interfaces available**

Flann have developed a range of tuneable bandpass and bandstop filters. The generally expected combination of high power handling with very low insertion loss, by convention, mutually necessitated the use of high Q cavity filters.

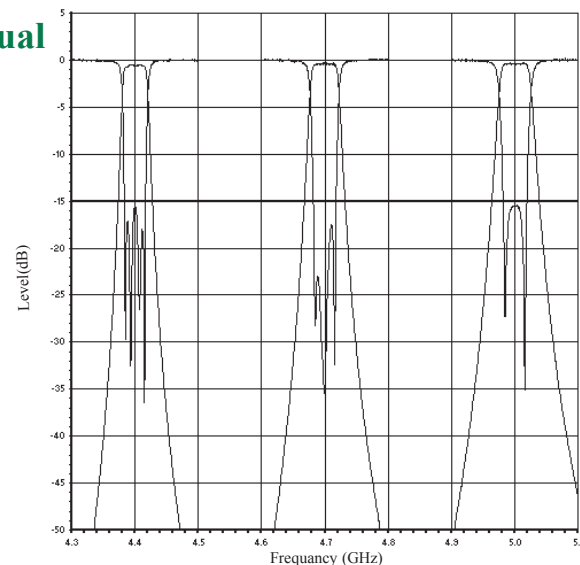
Flann have addressed these needs by designing new tuning techniques to derive mechanically tuned filters; such filters were previously regarded as not practically achievable.

The Flann tuning technique provides high reliability with a sustained repeatable performance.

Models with BUS control can be integrated into automated / remotely controlled applications.



Model 15287-AA



Response of a narrow passband tuneable filter over the frequency range 4.3 GHz to 5.1 GHz

Advantages of using Flann Tuneable Filters

Band Pass Type

- **System designers can now use a single filter rather than networks of switched filters**
- **Power budgets have more margin than using varactor tuned filters**
- **Mobile operators can meet tighter emissions criteria when channel switching**
- **Radio users can have frequency agility with better security**

Band Stop / Notch Type

- **Radar operators can "low cost" test their own spurious emissions**
- **Communications users can trace unwanted received signals causing interference**

Fixed Filters

Features

- **In Rectangular, Single or Double Ridge Waveguide**
- **Lowpass, Highpass or Bandpass types**
- **Bandwidths from 0.1 % to 40 %**
- **Passbands within the range 1 GHz to 130 GHz**
- **1st, 2nd, 3rd & 4th Harmonic types**
- **Reflective and Absorptive**

Orthomode Transducers

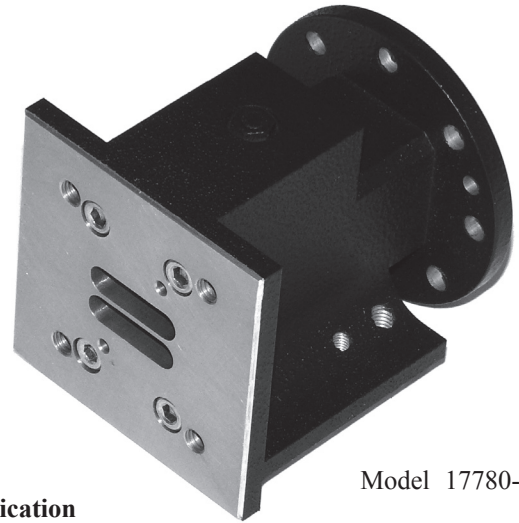
Series 780

Features

- Isolation > 50 dB
- Models up to 140 GHz
- Broad & Narrow Band Options
- High Polarization Purity 50 dB (typical)
- Circular or Square Guide Interface Options

Applications

- For Use With Dual Polarized Antennas
- For Polarization Diplexing



Model 17780-AB

Flann's OMT's offer the high performance demanded by today's communication systems, in which high polarization purity and high isolation are paramount.

The combination of low cross polar and high isolation characteristics provide optimum link performance.

Some examples of the models available are detailed in the table below. Other models are available to suit many applications, frequency bands and power levels. Details on Request.

Model	In-Line Port (GHz)	Ortho Port (GHz)	Port Isolation (dB)	X- Polarization (dB)	Return Loss (dB)	Insertion Loss (dB)
15780 **	7.25 - 7.75	7.9 - 8.4	50	50	26	0.1
17780 **	10.7 - 12.75	13.75 - 14.5	48	48	26	0.1
20780 **	21.2 - 23.6	21.2 - 23.6	47	47	25	0.1
22780 **	27.5 - 29.5	27.5 - 29.5	45	45	23	0.2

Complimentary components are available for a complete antenna fed system from:

- High performance lens horn Antennas
- Polarizers - linear and circular
- Filters and Diplexers
- Isolators
- Waveguide to Coax adaptors (including NEW range of end feed coax)

For other radio products:

See pages 101 & 102 for filters, page 51 for waveguide to coax adaptors & page 90 for antennas.
Please contact our Sales Team for more information on our new range of Radio Products.

Series 780

Waveguide Calibration Kits

- **Three Grades, each with defined accuracy**



For use with Vector Network Analysers - 1.14 GHz to 500 GHz.

Three grades of calibration kits and components are available that enable VNA users to select the one most suitable for the analyser type and measurement requirement. Various manufacturing techniques are employed and selected according to waveguide size and required accuracy.

Critical components in each grade of kit have defined accuracies - a feature unique to Flann Waveguide Calibration Kits.

Flann calibration kits contain all the components necessary to fully calibrate VNAs configured for waveguide measurements. A typical kit would include waveguide to coax adaptors, fixed terminations, a sliding termination, offsets, flush shorts and a waveguide section. Kits are supplied in a fitted hardwood case complete with connecting hardware, data disc and handbook.



Waveguide Calibration Kits

Model Selection Table

Kit Grade	Kit Type	
	OOL	TRL / LRL
Metrology Bronze	708 series	703 series
Metrology Silver	730 series	720 series
Metrology Gold	750 series	740 series

Each kit type contains the following components

Components	Contents	
	OOL	TRL / LRL
Waveguide to Coax Adaptors 1.14 GHz to 22 GHz (WG6, WR650, R14) to (WG19, WR51, R180)	2 off	2 off
17.6 GHz to 110 GHz (WG20, WR42, R220) to (WG27, WR10, R900)	2 off optional extra	2 off optional extra
Fixed Termination	2 off	2 off
Flush Short	2 off	2 off
1/8 λ Offset	1 off	optional extra
1/4 λ Offset	optional extra	1 off
3/8 λ Offset	1 off	optional extra
Waveguide Section	1 off	1 off
Sliding Termination	1 off	optional extra
Data Disk	included	included
Torque Driver	included	included
Flange Bolts etc	1 set included	1 set included
Precision Flange dowels	1 set included	1 set included
Hardwood Case	included	included
Handbook	included	included

Note 1 - Flanges

Flann Calibration Kit components are fitted with “Precision Flanges” that are fully compatible with standard flanges whilst providing enhanced accuracy and repeatability. Please see page 126 - 128 for details. Kits are also available fitted with alternative flange styles or special flanges to customer specification. Details on request.

Note 2 - Waveguide to Coax Adaptors

The Waveguide to Coax Adaptors supplied with Flann Calibration Kits are of sufficient length to ensure the decay of unwanted evanescent modes.

Note 3 - Offsets

The length of each Flann offset section is designed to provide a phase balanced response over the recommended frequency range. Fractional wavelengths are specified with respect to a wavelength $\lambda_{g^{\circ}}$ where:-

$$\lambda_{g^{\circ}} = 2 \left[\frac{\lambda_{ghf} \cdot \lambda_{glf}}{\lambda_{ghf} + \lambda_{glf}} \right]$$

λ_{glf} is the waveguide wavelength at the lowest frequency of the operating range and λ_{ghf} is the waveguide wavelength at the highest frequency of the operating range.

ORDERING INFORMATION REQUIRED

1. Waveguide designation (size)
Example: WG27
2. Series selected
Example: 730 see above
3. Description
Example: Metrology Silver Grade, OOL type
4. Vector analysers to be used
Example: HP8513

Complete Ordering Example: 27730 Metrology Silver Waveguide Calibration Kit type OOL for use with HP8513 vector network analysers

Please Note: Calibration Kits in WG 20 and higher frequencies (17.6 GHz upwards) do not include Waveguide to Coax Adaptors. Please state at time of ordering if adaptors are required to be included in the kit.

A Guide to Calibration Kit Selection

Flann Calibration Kits have been developed in close cooperation with manufacturers and users of network analysers. Kits are available in each of the three grades, suitable for analyser configurations requiring OOL, TRL and LRL calibration kit styles. The selection of a calibration kit and its contents is largely dictated by the combination of analyser model, test set model and type of calibration routine to be implemented, i.e. full 12 term, single path 2 port, reflection only or TRL/LRL.

OOL - Offset/Offset/Load

TRL - Thru/Reflect/Line

LRL - Line/Reflect/Line

The waveguide Calibration Kits, as described in the preceding pages, contain the components necessary to fully calibrate Vector Network Analysers. Flann Calibration Kit components are available individually or to supplement standard kits. Specialised Calibration Kits or components for use with alternative measurement systems, such as six port reflectometers, are also available. Full details are available on request.

Note: The components included in Flann Offset/Offset/Load type calibration kits can also be used with the Anritsu/Wiltron 360 to achieve an LRL calibration.

The specifications and capabilities of network analysers are subject to constant evolution and development. Please consult us for Calibration Kit applications assistance if required.

Note 1 - Flanges

Flann Calibration Kit components are fitted with "Precision Flanges" that are fully compatible with standard flanges whilst providing enhanced accuracy and repeatability. Please see page 126 - 129 for details. Kits are also available fitted with alternative flange styles or special flanges to customer specification. Details on request.

Note 2 - Waveguide to Coax Adaptors

The Waveguide to Coax Adaptors supplied with Flann Calibration Kits are of sufficient length to ensure the decay of unwanted evanescent modes.

Note 3 - Corner Radius

Calibration Kits with specified corner radius are available - please contact our Sales Department for more details

Please Note: Calibration Kits in WG 20 and higher frequency sets (17.6 GHz upwards) do not include waveguide to coax adaptors. Please state at time of ordering if adaptors will be required.

Double Ridge Waveguide Calibration Kits are also available - please see page 110

ORDERING INFORMATION

Calibration Kit Model: model of specific analyser model with which Calibration Kit is to be used; Description

Example: Model 22730-HP8513 waveguide calibration kit, metrology silver, OOL, for use with HP 8513 analyser

METROLOGY BRONZE CALIBRATION KITS - 703 & 708 Series

Modest cost components realised from selected precision drawn waveguide intended for routine use offering a performance comparable to other commercially available kits. Suitable for basic measurement standards.



New

Calibration devices up to 500 GHz have been developed and supplied to support worldwide measurement activities. Please contact our Sales Team for further details

NOW UP TO 500 GHz

Waveguide Designation	WG WR R	06 650 1.4	08 430 2.2	09A 340 2.6	10 284 3.2	10 284 3.2	11A 229 4.0	11A 229 4.0	12 187 4.8	12 187 4.8	13 159 5.8	13 159 5.8	14 137 7.0	14 137 7.0	15 112 8.4	15 112 8.4	16 90 10.0	16 90 10.0	17 75 12.0	17 75 12.0	18 62 14.0	18 62 14.0	19 51 18.0	19 51 18.0	20 42 22.0	20 42 22.0	21 34 26.0	21 34 26.0	22 28 32.0	22 28 32.0	23 22 40.0	23 22 40.0	24 19 50.0	24 19 50.0	25 15 62.0	25 15 62.0	26 12 74.0	26 12 74.0	27 10 90.0	27 10 90.0				
Frequency Range (GHz)		1.14 to 1.7	1.72 to 2.61	2.17 to 3.30	2.60 to 3.95	3.30 to 4.90	3.30 to 4.90	3.30 to 4.90	3.94 to 5.99	3.94 to 5.99	4.64 to 7.05	4.64 to 7.05	5.38 to 8.18	5.38 to 8.18	6.58 to 10.0	6.58 to 10.0	8.20 to 12.50	8.20 to 12.50	9.84 to 15.0	9.84 to 15.0	11.9 to 18.0	11.9 to 18.0	14.5 to 22.0	14.5 to 22.0	17.6 to 26.7	17.6 to 26.7	21.7 to 33.0	21.7 to 33.0	26.4 to 40.1	26.4 to 40.1	33.0 to 50.1	33.0 to 50.1	39.3 to 59.7	39.3 to 59.7	49.9 to 75.8	49.9 to 75.8	60.5 to 92.0	60.5 to 92.0	73.8 to 112.0	73.8 to 112.0				
Definitive Waveguide Dimensions (mm)		165.10 x 82.55	109.22 x 54.61	86.36 x 43.18	72.14 x 34.04	58.17 x 29.083	58.17 x 29.083	58.17 x 29.083	47.55 x 22.149	47.55 x 22.149	40.390 x 20.193	40.390 x 20.193	34.85 x 15.799	34.85 x 15.799	28.499 x 12.624	28.499 x 12.624	22.86 x 10.16	22.86 x 10.16	19.05 x 9.525	19.05 x 9.525	15.799 x 7.899	15.799 x 7.899	14.5 x 6.477	14.5 x 6.477	10.668 x 4.318	10.668 x 4.318	86.36 x 4.318	86.36 x 4.318	7.112 x 3.556	7.112 x 3.556	5.690 x 2.845	5.690 x 2.845	4.775 x 2.388	4.775 x 2.388	3.759 x 1.880	3.759 x 1.880	3.099 x 1.549	3.099 x 1.549	2.540 x 1.270	2.540 x 1.270				
Precision Flange Type	(See Note 1)	UG417BU	UG435BU	UDR26	UDR32	UDR40	UDR40	UDR40	UAR48	UAR48	UAR58	UAR58	UAR70	UAR70	UBR84	UBR84	UBR100	UBR100	UBR120	UBR120	UBR140	UBR140	UBR180	UBR180	UBR220	UBR220	UBR260	UBR260	UG599U	UG599U	UG833U mod	UG833U mod	UG833U	UG833U	UG855U	UG855U	UG877U mod	UG877U mod	UG877U mod	UG877U mod				
Waveguide Aperture/Tolerance (microns)		130	v90	80	60	50	50	50	40	40	35	35	35	30	30	20	20	20	20	18	18	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15			
WAVEGUIDE TO COAX ADAPTOR Model**091 VSWR (better than) Connector Type	(See Note 2)	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.10 APC7	1.20 K	1.20 K	1.20 K	1.20 K	1.25 K	1.25 K	1.20 K	1.20 K	1.30 K	1.30 K	1.30 V	1.30 V	1.25* V	1.25* V	1.03 V	1.03 V	1.03 V	1.03 V	1.04	1.04			
FIXED TERMINATION Model**045 VSWR (better than)		1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02		
FLUSH SHORT Model**191 Flatness (better than) (microns)		70	60	60	50	30	30	30	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
OFFSET (λ _g , 2 port) Model**491-01 Nominal Length (mm) Tolerance (mm) Measured Length Tolerance (microns)		34.665 0.20 100	23.310 0.20 100	18.240 0.20 100	15.227 0.20 50	12.032 0.10 50	12.032 0.10 50	12.032 0.10 50	10.051 0.10 50	10.051 0.10 50	8.537 0.10 50	8.537 0.10 50	7.356 0.10 40	7.356 0.10 40	6.016 0.10 35	6.016 0.10 35	4.815 0.10 30	4.815 0.10 30	4.012 0.10 30	4.012 0.10 30	3.334 0.10 25	3.334 0.10 25	2.730 0.10 25	2.730 0.10 25	2.251 0.10 20	2.251 0.10 20	1.824 0.05 20	1.824 0.05 20	1.499 0.05 20	1.499 0.05 20	1.199 0.04 20	1.199 0.04 20	1.007 0.03 20	1.007 0.03 20	0.793 0.03 20	0.793 0.03 20	0.654 0.02 20	0.654 0.02 20	0.537 0.02 20	0.537 0.02 20				
OFFSET (λ _g , 2 port) Model**491-02 Nominal Length (mm) Tolerance (mm) Measured Length Tolerance (microns)		69.331 0.20 100	46.026 0.20 100	36.480 0.20 100	30.453 0.20 50	24.063 0.10 50	24.063 0.10 50	24.063 0.10 50	20.102 0.10 50	20.102 0.10 50	17.074 0.10 50	17.074 0.10 50	14.711 0.10 40	14.711 0.10 40	12.032 0.10 35	12.032 0.10 35	9.630 0.10 30	9.630 0.10 30	8.025 0.10 30	8.025 0.10 30	6.668 0.10 25	6.668 0.10 25	5.461 0.10 25	5.461 0.10 25	4.501 0.10 20	4.501 0.10 20	3.648 0.05 20	3.648 0.05 20	2.997 0.05 20	2.997 0.05 20	2.399 0.04 20	2.399 0.04 20	2.014 0.03 20	2.014 0.03 20	1.587 0.03 20	1.587 0.03 20	1.308 0.02 20	1.308 0.02 20	1.074 0.02 20	1.074 0.02 20				
OFFSET (λ _g , 2 port) Model**491-03 Nominal Length (mm) Tolerance (mm) Measured Length Tolerance (microns)		103.996 0.20 100	69.039 0.20 100	54.720 0.20 100	45.680 0.20 50	36.095 0.10 50	36.095 0.10 50	36.095 0.10 50	30.154 0.10 50	30.154 0.10 50	25.611 0.10 50	25.611 0.10 50	22.067 0.10 40	22.067 0.10 40	18.048 0.10 35	18.048 0.10 35	14.445 0.10 30	14.445 0.10 30	12.037 0.10 30	12.037 0.10 30	10.003 0.10 25	10.003 0.10 25	8.191 0.10 25	8.191 0.10 25	6.752 0.10 20	6.752 0.10 20	5.472 0.05 20	5.472 0.05 20	4.496 0.05 20	4.496 0.05 20	3.598 0.04 20	3.598 0.04 20	3.021 0.03 20	3.021 0.03 20	2.380 0.03 20	2.380 0.03 20	1.963 0.02 20	1.963 0.02 20	1.612 0.02 20	1.612 0.02 20				
SLIDING TERMINATION Model**541 Element VSWR (better than)		1.02	1.02	1.02	1.015	1.015	1.015	1.015	1.01	1.01	1.01	1.01	1.01	1.01	1.008	1.008	1.006	1.006	1.006	1.008	1.008	1.01	1.01	1.01	1.01	1.015	1.015	1.015	1.015	1.02	1.02	1.025	1.025	1.03	1.03	1.035	1.035	1.04	1.04	1.04	1.04			
WAVEGUIDE SECTION Model**440 Nominal Length (mm) Tolerance (mm) Measured Length Tolerance (microns)		590 0.20 280	450 0.20 180	450 0.20 180	410 0.20 150	360 0.10 130	360 0.10 130	360 0.10 130	320 0.10 100	320 0.10 100	273 0.10 90	273 0.10 90	236 0.10 80	236 0.10 80	192 0.10 70	192 0.10 70	154 0.10 60	154 0.10 60	128 0.10 55	128 0.10 55	107 0.10 50	107 0.10 50	87 0.10 40	87 0.10 40	71 0.10 30	71 0.10 30	65 0.05 30	65 0.05 30	60 0.05 20	60 0.05 20	46 0.04 20	46 0.04 20	39 0.03 20	39 0.03 20	35 0.03 20	35 0.03 20	35 0.02 20	35 0.02 20	35 0.02 20	35 0.02 20	35 0.02 20	35 0.02 20		

Note 1 - See Page 105 for details

Note 2 - See Page 105 for details

* VSWR is specified to 67 GHz, V Connector overmodes at 72 GHz

METROLOGY GOLD CALIBRATION KITS - 740 & 750 Series

High precision components eminently suited to demanding applications which extend VNA measurement capability.



New

Calibration devices up to 500 GHz have been developed and supplied to support worldwide measurement activities. Please contact our Sales Team for further details

NOW UP TO 500 GHz

Waveguide Designation	WG WR R	06 650 14	08 430 22	09A 340 26	10 284 32	11A 229 40	12 187 48	13 159 58	14 137 70	15 112 84	16 90 100	17 75 120	18 62 140	19 51 180	20 42 220	21 34 260	22 28 320	23 22 400	24 19 500	25 15 620	26 12 740	27 10 900
Frequency Range (GHz)		1.14 to 1.73	1.72 to 2.61	2.17 to 3.30	2.60 to 3.95	3.30 to 4.90	3.94 to 5.99	4.64 to 7.05	5.38 to 8.18	6.58 to 10.0	8.20 to 12.50	9.84 to 15.0	11.9 to 18.0	14.5 to 22.0	17.6 to 26.7	21.7 to 33.0	26.4 to 40.1	33.0 to 50.1	39.3 to 59.7	49.9 to 75.8	60.5 to 92.0	73.8 to 112.0
Definitive Waveguide Dimensions (mm)		165.10 x 82.55	109.22 x 54.61	86.36 x 43.18	72.14 x 34.04	58.17 x 29.083	47.55 x 22.149	40.390 x 20.193	34.85 x 15.799	28.499 x 12.624	22.86 x 10.16	19.05 x 9.525	15.799 x 7.899	12.954 x 6.477	10.668 x 4.318	86.36 x 4.318	7.112 x 3.556	5.690 x 2.845	4.775 x 2.388	3.759 x 1.880	3.099 x 1.549	2.540 x 1.270
Precision Flange Type	(See Note 1)	UG417BU	UG435BU	UDR26	UDR32	UDR40	UAR48	UAKS8	UAR70	UBR84	UBR100	UBR120	UBR140	UBR180	UBR220	UBR260	UG599U	UG383U mod	UG383U	UG385U	UG387U mod	UG387U mod
Waveguide Aperture/Tolerance (microns)		35	25	20	15	15	10	10	7	7	5	5	5	5	5	5	5	5	5	5	5	5
WAVEGUIDE TO COAX ADAPTOR Model**095 VSWR (better than) Connector Type	(See Note 2)	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.05 APC7	1.07 APC7	1.07 APC7	1.10 K	1.10 K	1.15 K	1.15 K	1.30 2.4mm	1.3 V	1.25* V	1.03	1.04
FIXED TERMINATION Model**044 VSWR (better than)		1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.015	1.015	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.035	1.04
FLUSH SHORT Model**193 Flatness (better than) (microns)		15	15	15	12	8	8	5	5	5	5	5	5	5	5	5	3	3	3	3	3	3
OFFSET (1/8 λ _g , 2 port) Model**493-01 Nominal Length (mm) Measured Length Tolerance (microns)		34.665 to 0.20	23.310 to 0.20	18.240 to 0.20	15.227 to 0.20	12.032 to 0.10	10.051 to 0.10	8.537 to 0.10	7.356 to 0.10	6.016 to 0.10	4.815 to 0.10	4.012 to 0.10	3.334 to 0.10	2.730 to 0.10	2.251 to 0.10	1.824 to 0.05	1.499 to 0.05	1.199 to 0.04	1.007 to 0.03	0.793 to 0.03	0.654 to 0.02	0.537 to 0.02
OFFSET (1/4 λ _g , 2 port) Model**493-02 Nominal Length (mm) Measured Length Tolerance (microns)		69.331 to 0.20	46.026 to 0.20	36.480 to 0.20	30.453 to 0.20	24.063 to 0.10	20.102 to 0.10	17.074 to 0.10	14.711 to 0.10	12.032 to 0.10	9.630 to 0.10	8.025 to 0.10	6.668 to 0.10	5.461 to 0.10	4.501 to 0.10	3.648 to 0.05	2.997 to 0.05	2.399 to 0.04	2.014 to 0.03	1.587 to 0.03	1.308 to 0.02	1.074 to 0.02
OFFSET (3/8 λ _g , 2 port) Model**493-03 Nominal Length (mm) Measured Length Tolerance (microns)		103.996 to 0.20	69.039 to 0.20	54.720 to 0.20	45.680 to 0.20	36.095 to 0.10	30.154 to 0.10	25.611 to 0.10	22.067 to 0.10	18.048 to 0.10	14.445 to 0.10	12.037 to 0.10	10.003 to 0.10	8.191 to 0.10	6.752 to 0.10	5.472 to 0.05	4.496 to 0.05	3.598 to 0.04	3.021 to 0.03	2.380 to 0.03	1.963 to 0.02	1.612 to 0.02
SLIDING TERMINATION Model**543 Element VSWR (better than)		1.02	1.02	1.02	1.015	1.015	1.01	1.01	1.01	1.008	1.006	1.006	1.008	1.01	1.01	1.015	1.015	1.02	1.025	1.03	1.035	1.04
WAVEGUIDE SECTION Model**443 Nominal Length (mm) Measured Length Tolerance (microns)		590 to 0.20	495 to 0.20	450 to 0.20	410 to 0.20	360 to 0.10	320 to 0.10	273 to 0.10	236 to 0.10	192 to 0.10	154 to 0.10	128 to 0.10	107 to 0.10	87 to 0.10	71 to 0.10	65 to 0.05	60 to 0.05	46 to 0.04	39 to 0.03	35 to 0.03	35 to 0.02	35 to 0.02

Note 1 - See Page 105 for details

Note 2 - See Page 105 for details

* VSWR is specified to 67 GHz. V Connector overmodes at 72 GHz

Double Ridge Waveguide Calibration Kits

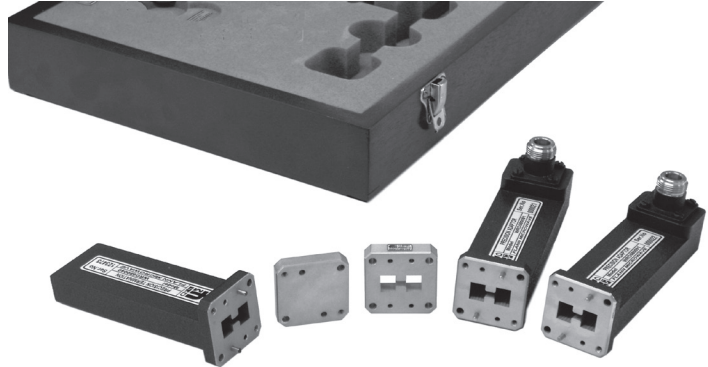
A range of Double Ridge Calibration Kits has been added to the company's extensive selection of rectangular waveguide Kits.

The Double Ridge Calibration Kits contain the standards and components required to fully calibrate VNA's configured for waveguide measurements. Kits are available to suit all models of VNA's in double ridge waveguide sizes from 3.5 GHz to 40 GHz.

A kit would typically include:

- Waveguide to Coaxial Adaptors
- Fixed Terminations
- Flush Short
- Offsets
- Offset Shorts
- Sliding Termination (optional - depending on analyser type and calibration method)
- Data disc, hardware and handbook

All the components are supplied in a fitted hardwood case.



Model	Waveguide Designation	Frequency Range (GHz)	Calibration Type*
WRD200703	WRD200D24	2.0 to 4.8	TRL/LRL
WRD200708	WRD200D24	2.0 to 4.8	OOL
WRD350703	WRD350D24	3.5 to 8.2	TRL/LRL
WRD350708	WRD350D24	3.5 to 8.2	OOL
WRD580703	WRD580D28	5.8 to 16.0	TRL/LRL
WRD580708	WRD580D28	5.8 to 16.0	OOL
WRD650703	WRD650D28	6.5 to 18.0	TRL/LRL
WRD650708	WRD650D28	6.5 to 18.0	OOL
WRD750703	WRD750D24	7.5 to 18.0	TRL/LRL
WRD750708	WRD750D24	7.5 to 18.0	OOL
WRD180703	WRD180C24	18.0 to 40.0	TRL/LRL
WRD180708	WRD180C24	18.0 to 40.0	OOL

* TRL signifies Thru' Reflect Line LRL signifies Line Reflect Line OOL signifies Offset Offset Load

Kits in other double ridge waveguide sizes are also available. Details are available upon request.

New

Double Ridge Components additional to the Flann range

Also NEW to the Flann range of components is a comprehensive selection of other Double Ridge products including special designs to suit customer applications

NEW

- Double Ridge Directional Couplers - including dual and triple designs to customer requirement
- Double Ridge Waveguide to Coax Adaptors
- Double Ridge Terminations, Fixed, Sliding & High Power
- Double Ridge Switches, Manual & Electrically Operated
- Double Ridge Waveguide Assemblies

Millimeter & Sub-millimeter Calibration Kits series 704/721/741

Features

- **Models 90 GHz to 500 GHz**
- **Thru-Reflect-Line (TRL) Calibration**
- **$3/4 \lambda_g$ or $5/4 \lambda_g$ lines**
- **3 Grades**
 - Bronze Grade (Series 704)
 - Silver Grade (Series 721)
 - Gold Grade (Series 704)
- **National Physical Laboratory Technology Applied**



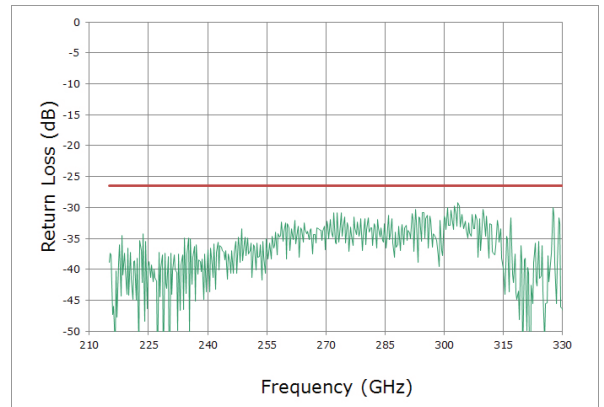
At millimeter wave frequencies the quarter wavelength lines required to carry out a TRL calibration become so thin as to become fragile and prone to damage and distortion.

By using multiple $1/4 \lambda_g$ lines the need to use very thin, fragile sections is negated, ensuring a more reliable and repeatable calibration.

Flann millimeter wave calibration kits have been designed in close co-operation with NPL and incorporate $3/4 \lambda_g$ or $5/4 \lambda_g$ sections. Flann has been awarded a licence by NPL to manufacture devices using this technology.

Further information on this calibration technique can be found from:

21st International Symposium on Space Terahertz Technology, Oxford, 23-25 March 2010



Typical Return Loss for termination Model 32045

Ordering

Please specify the following:

WG designation	Series	-	Vector analyzer used
WG28 - 32 WM 2032-570	704 721 741		

Example: 570704. A WM570 Bronze Grade Calibration Kit 500 GHz

Standard Kit Contents
2 x Fixed Terminations
2 x Flush Shorts
2 x Waveguide Sections
2 x $3/4 \lambda_g$ or 3 x $5/4 \lambda_g$ Lines
Set of flange bolts
Precision flange dowels
Torque driver
USB data stick
Hardwood case
Handbook

Microwave Specifications

Waveguide Designation				Frequency (GHz)	Termination VSWR (max)
WM	WG	R	WR		
2032	28	1200	8	90- 140	1.04
1651	29	1400	6	110 - 170	1.05
1295	30	1800	5	140 - 220	1.06
1092	31	2200	4	170 - 260	1.08
864	32	2600	3	220 - 330	1.10
710	-	-	2.8*	260 - 400	1.12
570	-	-	2.2*	330 - 500	1.15

* Designation not formally standardised

Millimeter & Sub-millimeter Calibration Kits series 704/721/741

Dimensional Specifications

WM*	Waveguide Dimensions (microns)	Dimensional Tolerances from Nominal (microns)									Flush Short Flatness better than (microns)		
		Waveguide Aperture			Line Length			Waveguide Section Overall Length					
		Bronze	Silver	Gold	Bronze	Silver	Gold	Bronze	Silver	Gold	Bronze	Silver	Gold
2032	2032 x 1016	12.0	8.0	4.0	18.0	9.0	4.5	20	10	5	12	6	3
1651	1651 x 826	10.0	6.0	3.0	15.0	7.5	4.0						
1295	1295 x 648	8.0	5.0	2.5	12.0	6.0	3.0						
1092	1092 x 546	6.5	4.5	2.5	9.5	5.0	2.5						
864	864 x 432	5.0	3.5	2.0	7.0	3.5	2.0						
710	710 x 355	4.0	3.0	1.5	6.5	3.0	1.5						
570	570 x 285	3.5	2.5	1.2	5.0	2.5	1.5						

WM* - IEEE 1785.1:2012 Standard for Rectangular Metallic Waveguides and Their Interfaces for Frequencies of 110 GHz and Above.

WM*	Line	Nominal Length (mm ± 0.01)	Line Changeover Frequency (GHz)
2032	1	3.39	108
	2	2.31	
1651	1	2.81	131
	2	1.91	
1295	1	2.22	168
	2	1.47	
1092	1	1.74	203
	2	1.24	
864	1	1.29	260
	2	1.00	
710	1	2.10	291
	2	1.61	
	3	1.26	
570	1	1.74	362
	2	1.33	
	3	1.02	

Waveguide Verification Kits

Metrology Gold Series 710 Metrology Silver Series 711

The Flann Series 710 of Waveguide Verification Kits enables VNA users to verify system measurement performance. Each Verification Kit consists of five 2-port mismatch waveguide sections and two precision fixed attenuators.

Each mismatch waveguide section is highly accurate, stable and provides a precisely quantifiable VSWR that is directly calculable from its physical dimensions. The mismatches, nominally quarter wavelength long, are manufactured to the same exacting standard as our Metrology Gold Calibration Kit Components.

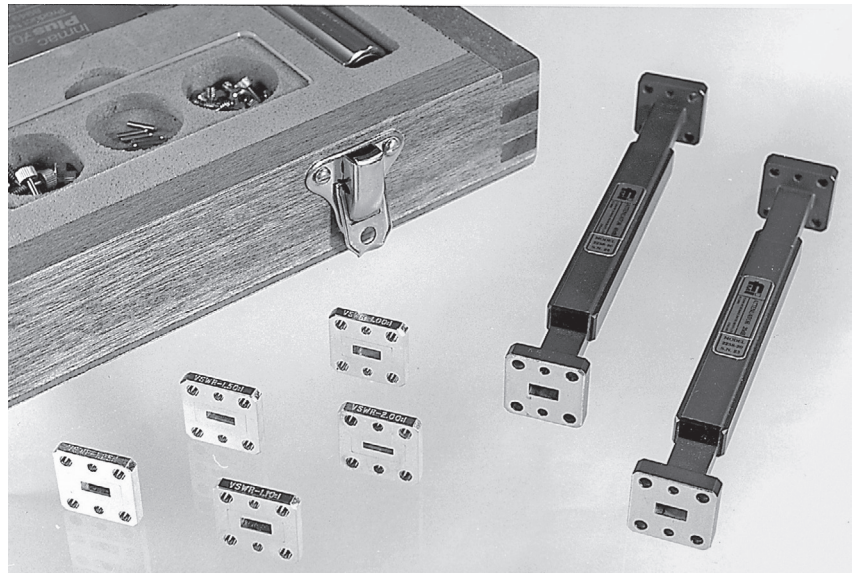
The fixed attenuator designs are based on those of our extremely stable directional couplers, offering a very flat attenuation response over the full waveguide frequency band.

All components are fitted with modified flanges featuring precision dowels to ensure enhanced alignment and repeatability.

Each kit contains the following components:-

- Mismatch, 2 Port 1.00 : 1
- Mismatch, 2 Port 1.10 : 1
- Mismatch, 2 Port 1.25 : 1
- Mismatch, 2 Port 1.50 : 1
- Mismatch, 2 Port 2.00 : 1
- Precision Fixed Attenuator 20 dB
- Precision Fixed Attenuator 40 dB

Kits are supplied in a fitted hardwood case complete with the necessary connection hardware and tools.



Model 22710

Model	Frequency Range (GHz)	Waveguide			Waveguide Aperture Tolerance of Mismatches Gold (microns)	Waveguide Aperture Tolerance of Mismatches Silver (microns)
		WG	R	WR		
06710 / 711	1.14 - 1.73	6	14	650	35	65
08710 / 711	1.72 - 2.61	8	22	430	25	45
10710 / 711	2.60 - 3.95	10	32	284	15	40
11A710 / 711	3.22 - 4.90	11A	40	229	15	30
12710 / 711	3.94 - 5.99	12	48	187	10	30
13710 / 711	4.64 - 7.05	13	58	159	10	20
14710 / 711	5.38 - 8.18	14	70	137	7	20
15710 / 711	6.58 - 10.0	15	84	112	7	15
16710 / 711	8.20 - 12.5	16	100	90	5	15
17710 / 711	9.84 - 15.0	17	120	75	5	10
18710 / 711	11.9 - 18.0	18	140	62	5	10
19710 / 711	14.5 - 22.0	19	180	51	5	10
20710 / 711	17.6 - 26.7	20	220	42	5	10
22710 / 711	26.4 - 40.1	22	320	28	5	10
23710 / 711	33.0 - 50.1	23	400	22	5	10
24710 / 711	39.3 - 59.7	24	500	19	5	10
25710 / 711	49.9 - 75.8	25	620	15	5	10
26710 / 711	60.5 - 92.0	26	740	12	5	10
27710 / 711	73.8 - 112.0	27	900	10	5	10

MODELS AVAILABLE UP TO 500 GHz. Details on request

ORDERING INFORMATION

Model: Description
 Example: Model 16710 Waveguide Verification Kit

Series 710 / 711

Waveguide Slotted Lines Series 030

Features

- **Low Residual VSWR**
- **Low Slope VSWR**

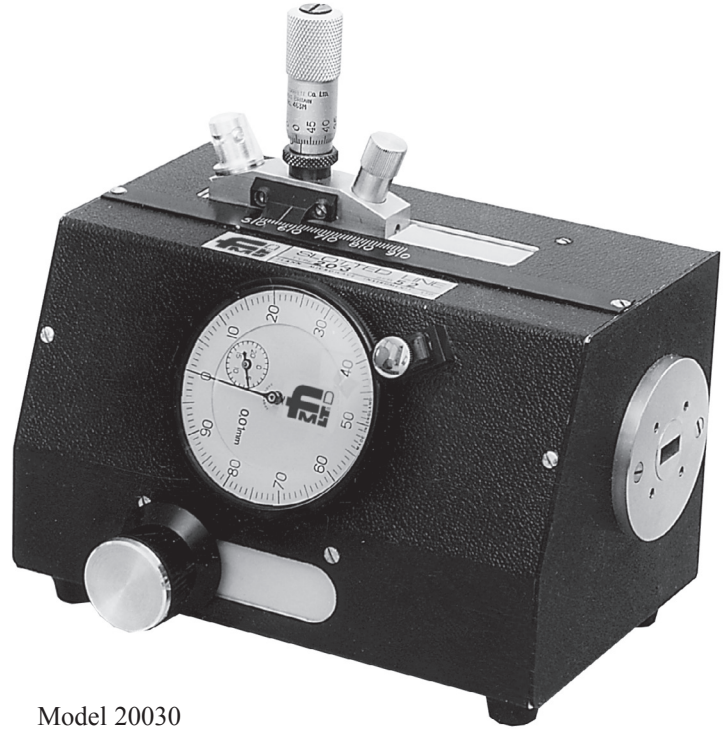
The Flann Series 030 of waveguide Slotted Lines is designed to facilitate the very accurate measurement of VSWR and impedance in waveguide.

The waveguide slotted section is precision machined and the slot matched to minimise slot effects on the waveguide impedance. High reliability is achieved by using selected ball races at all moving points and the use of sound kinematic principles of design. The tunable cavity and crystal detector ensure high sensitivity (not greater than 20 dB down for minimal probe insertion) over the full frequency range of each instrument.

The probe coupling is variable and carriage position is indicated to an accuracy of 0.01 mm relative to the reference flange face. A close fitting case surrounds the entire waveguide and carriage assembly* thereby preventing harmful dust particles from entering the mechanism.

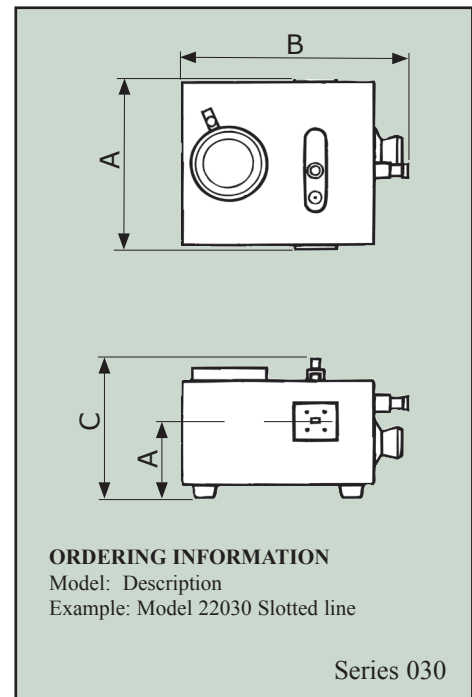
[* except Model 10030 where only the carriage is fully enclosed.]

All models can, optionally, be fitted with precision flanges featuring precisely positioned alignment dowels which provide enhanced flange alignment and repeatability. See page 126 for details.



Model 20030

Model	Frequency Range (GHz)	Waveguide			Maximum residual VSWR	Dimensions (mm)			
		WG	R	WR		A	B	C	D
10030	2.6 - 3.95	10	32	284	1.007	432	225	265	90
11A030	3.22 - 4.9	11A	40	229	1.007	362	143	200	24
12030	3.94 - 5.99	12	48	187	1.007	320	168	200	60
14030	5.38 - 8.18	14	70	137	1.007	267	150	135	43
15030	6.58 - 8.18	15	84	112	1.007	240	140	123	43
16030	8.2 - 12.5	16	100	90	1.007	206	147	152	60
17030	9.84 - 15.0	17	120	75	1.007	206	147	152	60
18030	11.9 - 18.0	18	140	62	1.007	206	147	152	60
20030	17.6 - 26.7	20	220	42	1.01	152	138	121	50
22030	26.4 - 40.1	22	320	28	1.01	130	175	108	58
23030	33.0 - 50.1	23	400	22	1.02	130	175	108	58
24030	39.3 - 59.7	24	500	19	1.02	88	75	102	40
25030	49.9 - 75.8	25	620	15	1.03	75	75	102	40
26030	60.5 - 92.0	26	740	12	1.03	75	75	102	40
27030	73.8 - 112	27	900	10	1.04	91	91	102	40



For standard flange types and recommendations see pages 118 onwards

Precision, Variable Waveguide Short Circuits

Series 050 / 051

Features

- **Non-Contacting Choked Piston**
- **Precision Micrometer Lockable Drive**

The Flann Series 050 of Waveguide Short Circuits features a length of waveguide which houses a non-contacting choked, low-high-low impedance piston.

Millimetre wave units utilise a precision machined waveguide section. Careful choke design ensures freedom from spurious resonances. The piston is driven by a precision calibrated mechanism which enables accurate and resettable piston positioning.

The drive mechanism is fitted with a lock. All units provide a high VSWR and an accurate reference to the flange face.

The piston movement for each model is greater than half of the waveguide wavelength at the lowest frequency. Variable short circuits can be used to establish an accurate reference plane for VSWR and impedance measurements.



Model 22050

The Flann Series 051 of Waveguide Short Circuits offers the user an automated version. Please contact Sales for further information.

Model	Frequency Range (GHz)	Waveguide			Reflection coefficient	Dimension A (mm)
		WG	R	WR		
10050	2.6 - 3.95	10	32	284	>0.995	493
11A050	3.22 - 4.9	11A	40	229	>0.995	456
12050	3.94 - 5.99	12	48	187	>0.995	410
13050	4.64 - 7.05	13	58	159	>0.995	364
14050	5.38 - 8.18	14	70	137	>0.995	318
15050	6.58 - 8.18	15	84	112	>0.995	278
16050	8.20 - 12.5	16	100	90	>0.995	263
17050	9.84 - 15.0	17	120	75	>0.995	253
18050	11.9 - 18.0	18	140	62	>0.995	260
19050	14.5 - 22.0	19	180	51	>0.995	204
20050	17.6 - 26.7	20	220	42	>0.990	205
22050	26.4 - 40.1	22	320	28	>0.985	150
23050	33.0 - 50.1	23	400	22	>0.985	140
24050	39.3 - 59.7	24	500	19	>0.985	140
25050	49.9 - 75.8	25	620	15	>0.985	127
26050	60.5 - 92.0	26	740	12	>0.980	127
27050	73.8 - 112	27	900	10	>0.980	126
28050	92.3 - 140	28	1200	8	>0.980	126
29050	114 - 173	29	1400	6	Specification / dimensions available on request	
30050	145 - 220	30	1800	5		
31050	172 - 261	31	2200	4		
32050	217 - 330	32	2600	3		

ORDERING INFORMATION
 Model: Description
 Example: Model 22050 Precision variable waveguide short circuit

Series 050

For standard flange types and recommendations see pages 111 onwards

Waveguide Screw Tuners

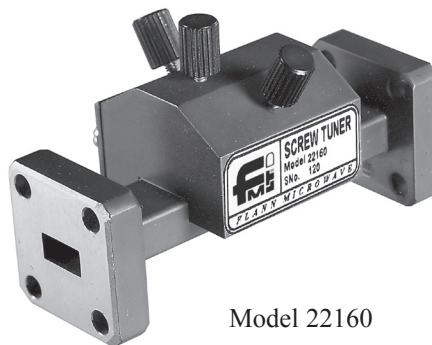
Series 160 / 161

Features

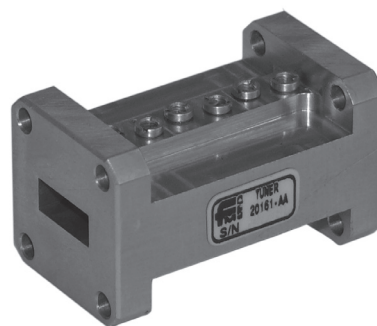
- Models from 1.72 GHz to 40 GHz
- Anti-backlash Adjustment
- Full Range Tuning

In the Flann Series 160 and Series 161 designs, the screw stubs have sufficient penetration to ensure that, even at the lowest frequency, they can become resonant.

Anti-backlash arrangements are fitted to the screw threads to avoid erratic behaviour and minimise RF leakage.



Model 22160



Model 20161

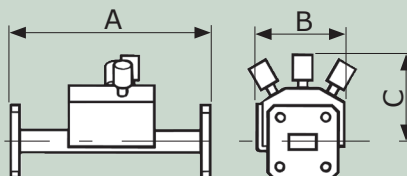
See Series 210 for higher frequency models up to 330 GHz.
Series 161 dimensions available on request

Model	Frequency Range (GHz)	Waveguide			Dimensions (mm)		
		WG	R	WR	A	B	C
08160	1.72 - 2.61	8	22	430	134	113	78
10160	2.60 - 3.95	10	32	284	95	76	59
11A160	3.22 - 4.9	11A	40	229	86	62	55
12160	3.94 - 5.99	12	48	187	75	51	54
14160	5.38 - 8.18	14	70	137	ON REQUEST		
15160	6.58 - 10.0	15	84	112	58	32	35
16160	8.20 - 12.5	16	100	90	48	28	43
17160	9.84 - 15.0	17	120	75	45	25	35
18160	11.9 - 18.0	18	140	62	34	22	34
19160	14.5 - 22.0	19	180	51	35	22	34
20160	17.6 - 26.7	20	220	42	44	19	30
22160	26.4 - 40.1	22	320	28	54	23	15

ORDERING INFORMATION

Model: Description

Example: Model 22160 Waveguide Screw Tuner



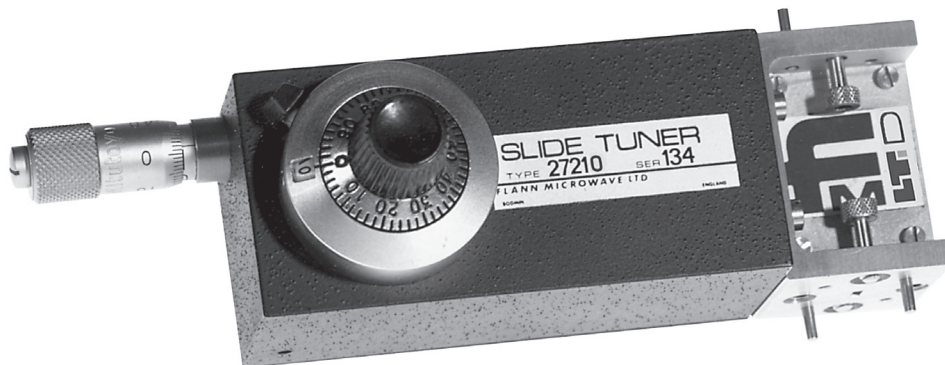
Series 160

For standard flange types and recommendations see pages 118 onwards

Waveguide Slide Tuners Series 210

Features

- Models up to 330 GHz
- Highly Repeatable
- Full Range Tuning
- Lockable



Model 27210

The Flann Series 210 Slide Tuners consist of a precision waveguide machined in two halves, with a slot along the centre of one broad wall. A variable penetration capacitive probe is introduced through the slotted wall of the waveguide.

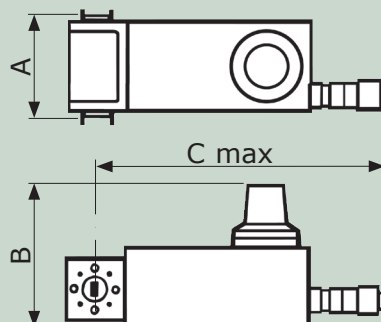
Longitudinal movement of the probe is adjusted by a vernier control which may be locked after positioning. Slide tuners are often easier to adjust than other types of tuners in which the tuning controls are interactive. The units are of a mechanically sound design and adequate precautions are taken to avoid erratic tuning and slot resonance.

Model	Frequency Range (GHz)	Waveguide			Dimensions (mm)		
		WG	R	WR	A	B	C
23210	33.0 - 50.1	23	400	22	31.5	49	113
24210	39.3 - 59.7	24	500	19	31.5	49	112
25210	49.9 - 75.8	25	620	15	31.5	49	108
26210	60.5 - 92.0	26	740	12	31.5	49	108
27210	73.8 - 112	27	900	10	31.5	49	108
28210	92.3 - 140	28	1200	8	31.5	49	108
29210	114 - 173	29	1400	6	Dimensions available on request		
30210	145 - 220	30	1800	5			
31210	172 - 261	31	2200	4			
32210	217 - 330	32	2600	3			

ORDERING INFORMATION

Model: Description

Example: Model 23210 Slide Tuner



Series 210

For standard flange types and recommendations see pages 118 onwards

Waveguide and Flange Data

The following table details the Flann standard flanges. Most products are available with other flange styles and special Flanges

Frequency Range (GHz)	Waveguide Designation			Internal Dimensions (mm)	Flann 'Standard' flange details Please see page 113 - 118 for outline dimensions	
	British WG	IEC R	EIA WR		Flange Designation	Description
1.14 - 1.73	6	14	650	165.100 x 82.550	UG-417B/U Type (but without groove)	Rectangular, Ten hole fixing + 2 dowel holes
1.72 - 2.61	8	22	430	109.220 x 54.610	UG-435B/U Type (but without groove)	Rectangular, Ten hole fixing + 2 dowel holes
2.17 - 3.30	9A	26	340	90.42 x 47.24	UDR26	Rectangular, Ten hole fixing
2.60 - 3.95	10	32	284	72.140 x 34.040	5985-99-083-1560 also drilled for the 5985-99-083-0010	Circular, Six/Eight hole fixing
3.22 - 4.90	11A	40	229	58.170 x 29.083	UDR 40	Rectangular, Ten hole fixing
3.94 - 5.99	12	48	187	47.550 x 22.149	UAR 48	Circular, Eight hole fixing
4.64 - 7.05	13	58	159	40.390 x 20.193	UAR 58	Circular, Six hole fixing
5.38 - 8.18	14	70	137	34.850 x 15.799	UAR 70	Circular, Six hole fixing
6.58 - 10.0	15	84	112	28.449 x 12.624	UBR 84	Square, Four hole fixing
8.20 - 12.5	16	100	90	22.860 x 10.160	UBR 100	Square, Four hole fixing
9.84 - 15.0	17	120	75	19.050 x 9.525	UBR 120	Square, Four hole fixing
11.9 - 18.0	18	140	62	15.799 x 7.899	UBR 140	Square, Four hole fixing
14.5 - 22.0	19	180	51	12.954 x 6.477	UBR 180	Square, Four hole fixing
17.6 - 26.7	20	220	42	10.668 x 4.318	UBR 220 Type	Square, Four hole fixing
21.7 - 33.0	21	260	34	8.636 x 4.318	UBR 260 Type	Square, Four hole fixing
26.4 - 40.1	22	320	28	7.112 x 3.556	UG-599/U	Square, Four hole fixing
33.0 - 50.1	23	400	22	5.690 x 2.845	*UG-383/U	Circular, Four hole fixing/doweled
39.3 - 59.7	24	500	19	4.775 x 2.388	*UG-383/U (Modified)	Circular, Four hole fixing/doweled
49.9 - 75.8	25	620	15	3.759 x 1.880	*UG-385/U	Circular, Four hole fixing/doweled
60.5 - 92.0	26	740	12	3.099 x 1.549	*UG-387/U	Circular, Four hole fixing/doweled
73.8 - 112	27	900	10	2.540 x 1.270	*UG-387/U (Modified)	Circular, Four hole fixing/doweled
92.3 - 140.0	28	1200	8	2.032 x 1.016	*UG-387/U (Modified)	Circular, Four hole fixing/doweled
114.0 - 173.0	29	1400	6	1.651 x 0.826	*UG-387/U (Modified)	Circular, Four hole fixing/doweled
145.0 - 220.0	30	1800	5	1.295 x 0.648	*UG-387/U (Modified)	Circular, Four hole fixing/doweled
172.0 - 261.0	31	2200	4	1.092 x 0.546	*UG-387/U (Modified)	Circular, Four hole fixing/doweled
217.0 - 330.0	32	2600	3	0.864 x 0.432	*UG-387/U (Modified)	Circular, Four hole fixing/doweled

Note: Products fitted with flange types marked thus * are supplied with two fixing screws per flange and provided with alignment dowels in accordance with MIL-DTL-3922/67C.

Standard product finishes

Plate: Tin nickel for the larger, low frequency products; gold plate for smaller and millimetric products.

Paint: Two part epoxy paint in mid brunswick green.

Waveguide Flanges, General Information

See pages 113 to 118 for “Standard” Flange Details and outline dimensions

- Most waveguide flange types are available from WG6 (WR650) to WG32 (WR3)
- Special waveguide flanges can be supplied to order

Flann is able to provide ‘free fit’ waveguide flanges for WG6 (WR650) to WG32 (WR3) for customers’ own manufacturing assemblies.

Flange fixing hardware (nuts, bolts, gaskets, shims, etc) is also available. We are also able to supply special flanges to customers’ requirements.



Standard Flanges

All waveguide products in this catalogue are fitted with Flann “Standard Flanges” as listed on page 111, except where stated.

Note: Choke flanges are not recommended for broadband waveguide equipment.

Details of the “Standard Flanges” as fitted to Flann products are shown on Pages 113 to 118.

Double Ridge Flange Definitions: C = Cover Flange, G = Grooved : 1 = Tap and Clear, 2 = All Tapped, 3 = All Clear : A = Aluminium, B = Brass. All instruments will be fitted with C1 flanges as standard.

Flanges and flange hardware - quotations for standard and special flanges are available on request. Flange fixing bolts, nuts, dowels and O ring seals are also available - details on request.

Anti-Cocking Flanges for Millimetric Waveguide Bands

- Greatly improved performance and repeatability
- Fully compatible with standard “Mil spec” flanges

The Millimetric flanges in the Series UG-381/U to UG-387/U are notorious for “cocking” during connection which results in leakage, increased insertion loss, discontinuity and poor repeatability. Flann produces a range of millimetric “Anti-cocking” flanges which provide greatly improved performance and repeatability whilst maintaining full compatibility with standard Mil spec flanges. “Anti-cocking” flanges are optionally available on most millimetric products in the Flann product range. Refer to page 122 for details. Customers requiring millimetric products fitted with anti-cocking flanges must request such flanges at the time of the initial enquiry. Purchase orders must specify anti-cocking flanges, if required, as such flanges can not be retro-fitted to products.

NOTE: Anti-cocking flanges must be specified at time of order.

Precision Flanges

Precision flanges are fitted as standard to all Flann calibration kit components and individual Metrology Grade Components. Flann precision flanges are fully compatible with “standard” flange types. Precision flanges in the millimetric waveguide sizes also incorporate the “anti-cocking” feature. See from page 119 for details.

Waveguide Materials

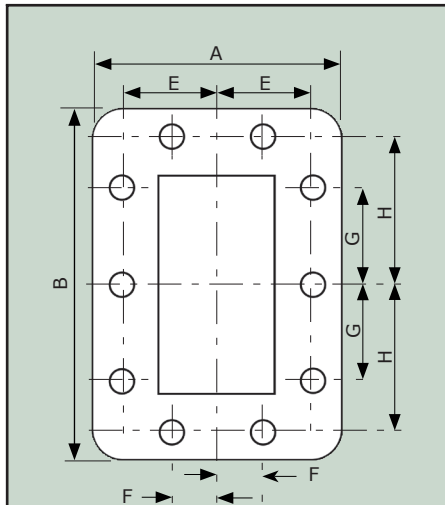
Flann is able to supply most products either in brass / copper waveguide or in aluminium. Metrology grade products have the waveguide sections machined to a high accuracy from solid material. The remaining products utilise premium drawn waveguide supplied to MIL specification or equivalent.

“Standard” Flange Data

The following flange details show the “standard” flange types as fitted to Flann products, unless otherwise stated. Full dimensional details of all “standard” flange types are available on request.

Alternative and custom flanges can be fitted to special order.

Flann is also able to supply most types of Flanges as separate items. Please contact our sales office for price and availability information.



Flann Standard Flanges

WG6 R14 WR650

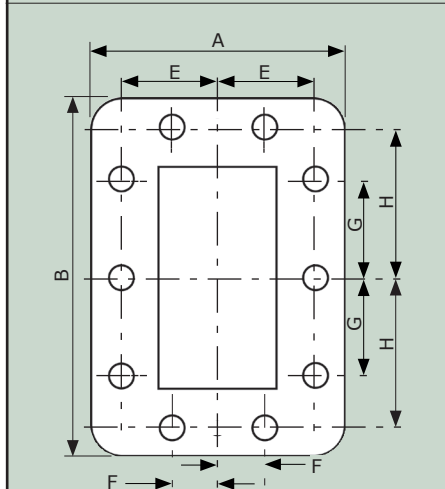
UG417B/U TYPE (without groove)

A	138.90
B	221.50
E	58.69
F	31.73
G	60.30
H	100.00
Holes	10 x 8.20 dia
Dowel Holes	6.35dia

Non-Standard Flanges

Full details on request

UDR 14
CPR 650F

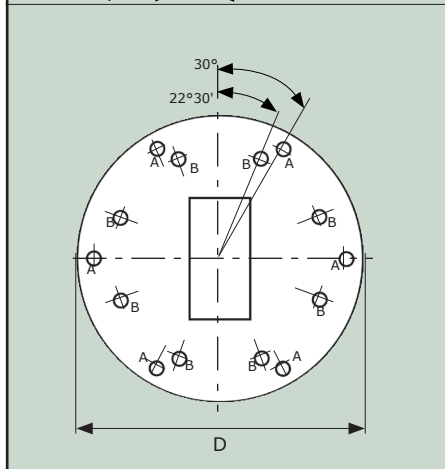


WG8 R22 WR430

UG435B/U TYPE (without groove)

A	106.38
B	161.14
E	43.69
F	23.83
G	45.39
H	70.99
Holes	10 x 6.71 dia
Dowel Holes	6.35dia

UDR 22
CPR 430F



WG10 R32 WR284

5985 - 99 - 083 --1560/0010

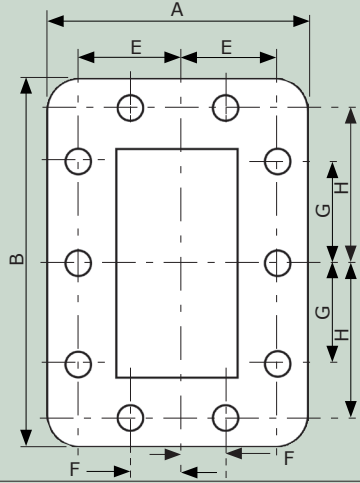
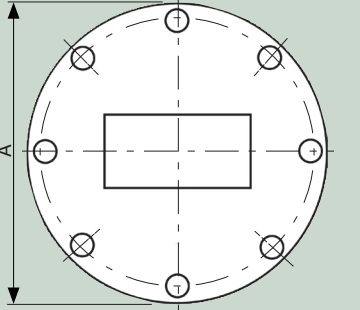
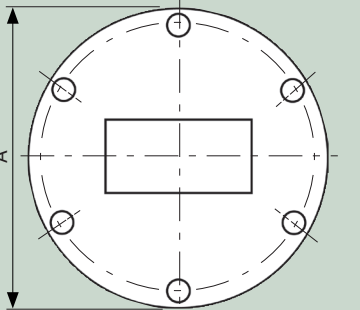
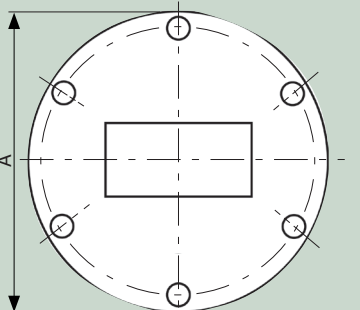
Holes A	6 x 6.52 dia
	on 136.52 PCD
Holes B	8 x 6.52 dia
	on 120.65 PCD
D	149.20 dia

UDR 32
CPR 284F
5985-99-083-0058 Type
UAR 32
UG-53/U

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

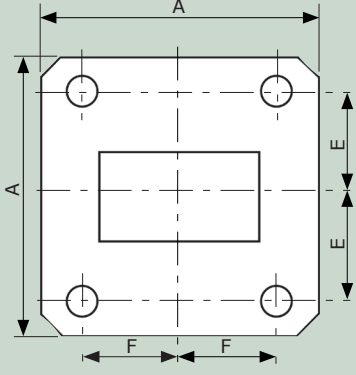
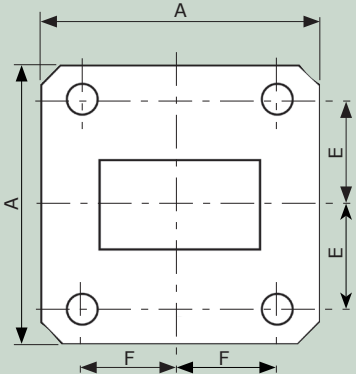
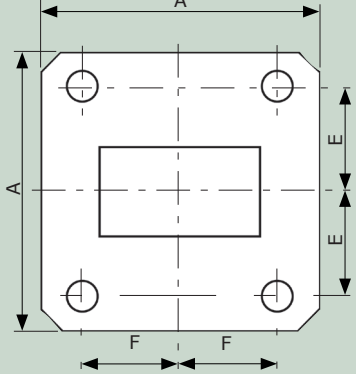
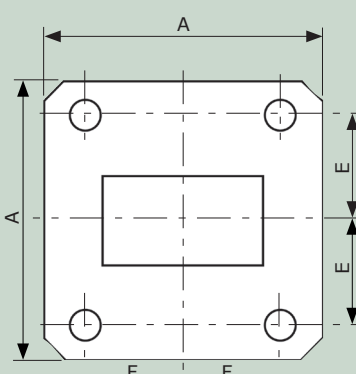
See pages 126 - 129 for details of Flann precision style flanges.

“Standard” Flange Data

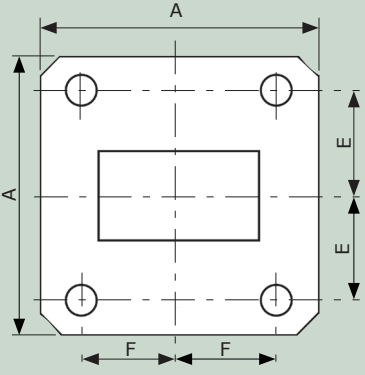
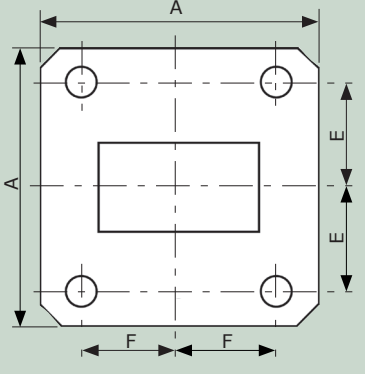
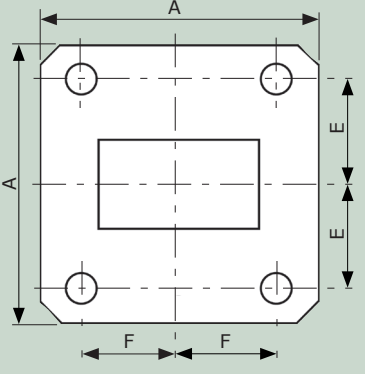
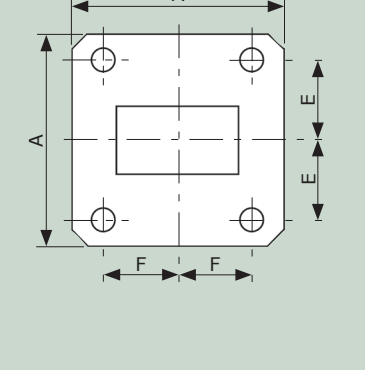
	<p>Flann Standard Flanges</p> <p>WG11A R40 WR229 UDR 40</p> <p>A 70.20 B 98.73 E 26.67 F 12.70 G 27.18 H 41.15 Holes..... 10 x 6.50 dia</p>	<p>Non-Standard Flanges Full details on request</p> <p>UER 40 CPR 229F CMR 229</p>
	<p>WG12 R48 WR187 UAR 48</p> <p>Holes..... 8 x 5.15 dia on 82.55 PCD A 92.33 dia</p>	<p>UDR 48 UER 48 CPR 187F CMR 187</p>
	<p>WG13 R58 WR159 UAR 58</p> <p>Holes..... 6 x 5.15 dia on 76.20 PCD A 85.915 dia</p>	<p>UDR 58 UER 58 CPR 159F CMR 159</p>
	<p>WG14 R70 WR137 UAR 70</p> <p>Holes..... 6 x 5.15 dia on 69.85 PCD A 79.50 dia</p>	<p>UDR 70 UER 70 CPR 137F CMR 137</p>

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS
See pages 126 - 129 for details of Flann precision style flanges.

“Standard” Flange Data

	<p style="text-align: center;">Flann Standard Flanges</p> <p>WG15 R84 WR112 UBR 84</p> <p>A..... 47.90 E..... 18.72 F..... 17.17 Holes..... 4 x 4.255 dia</p>	<p style="text-align: center;">Non-Standard Flanges Full details on request</p> <p>UDR 84 UER 84 CPR 112F CMR 112</p>
	<p>WG16 R100 WR90 UBR 100</p> <p>A..... 41.40 E..... 16.26 F..... 15.49 Holes..... 4 x 4.255 dia</p>	<p>UDR 100 UER 100 CPR 90F CMR 90</p>
	<p>WG17 R120 WR75 UBR 120</p> <p>A..... 38.30 E..... 14.25 F..... 13.21 Holes..... 4 x 4.085 dia</p>	<p>UDR 120</p>
	<p>WG18 R140 WR62 UBR 140</p> <p>A..... 33.30 E..... 12.14 F..... 12.63 Holes..... 4 x 4.085 dia</p>	<p>UDR 140 UG-419/U</p> <p>NOTE: ALL DIMENSIONS ARE IN MILLIMETERS See pages 126 - 129 for details of Flann precision style flanges.</p>

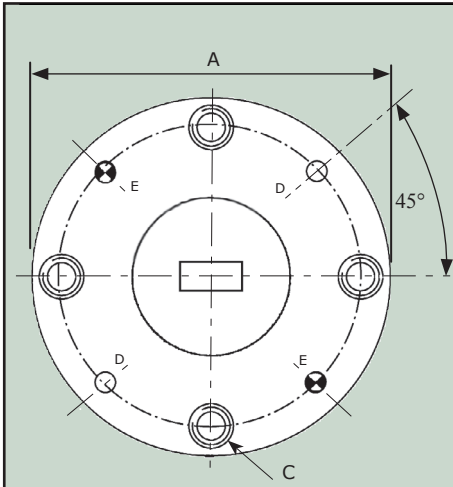
“Standard” Flange Data

	<p>Flann Standard Flanges</p> <p>WG19 R180 WR51 UBR 180</p> <p>A..... 30.10 E..... 11.25 F..... 10.29 Holes..... 4 x 4.085 dia</p>	<p>Non-Standard Flanges Full details on request</p> <p>UDR 180</p>
	<p>WG20 R220 WR42 UBR 220 TYPE</p> <p>A..... 22.41 E..... 8.51 F..... 8.13 Holes..... 4 x 3.07 dia</p>	<p>UG-595/U UG-425/U</p>
	<p>WG21 R260 WR34 UBR 260 TYPE</p> <p>A..... 22.10 E..... 7.90 F..... 7.50 Holes..... 4 x 3.07 dia</p>	<p>Custom flanges can be considered</p>
	<p>WG22 R320 WR28 UG-599/U</p> <p>A..... 19.05 E..... 6.73 F..... 6.35 Holes..... 4 x 2.98 dia</p>	<p>UBR 320</p> <p>NOTE: ALL DIMENSIONS ARE IN MILLIMETERS See pages 126 - 129 for details of Flann precision style flanges.</p>

“Standard” Flange Data

Note: Products fitted with Circular, Four hole fixing/Doweled flanges WG23 (WR22) to WG28 (WR8) are supplied with two captive fixing screws per flange.

“Anti-cocking” Flanges - We strongly recommend that customers specify “anti-cocking” flanges on instruments in the waveguide range WG23 (WR22) to WG28 (WR8). “Anti-cocking” flanges provide better performance and repeatability than standard flanges whilst maintaining full compatibility with MIL spec types. Please refer to page 122 for details and outline dimensions.

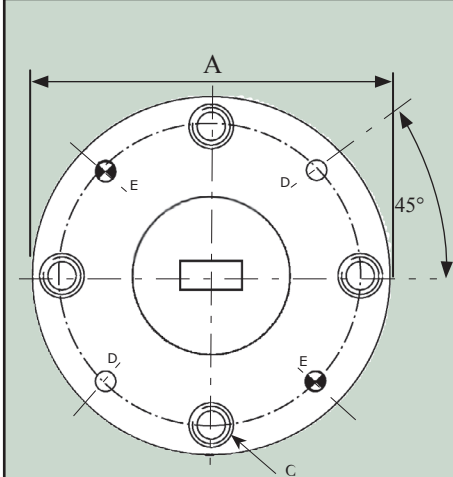


Flann Standard Flanges

WG23 R400 WR22
UG-383/U (MIL-DTL-3922/67C-006)

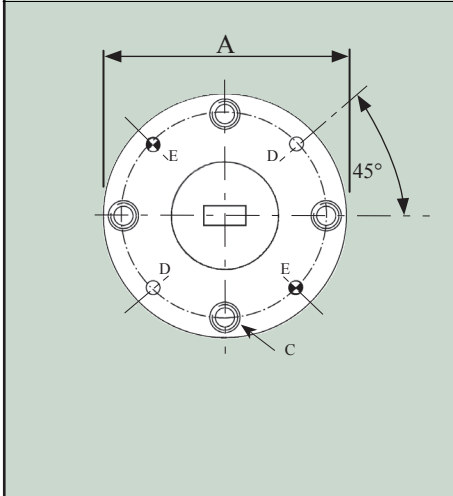
- Holes C4 x 4-40 UNC-2B
- Holes D2 x 1.65 dia
- Holes E2 x dowels 1.549/
1.562 dia x 4
projection
- All Holes on 23.81 PCD
- A28.55

Non-Standard Flanges
Full details on request



WG24 R500 WR19
UG-383/U Modified (MIL-DTL-3922/67C-007)

- Holes C4 x 4-40 UNC-2B
- Holes D2 x 1.65 dia
- Holes E2 x dowels 1.549/
1.562 dia x 4
projection
- All Holes on 23.81 PCD
- A28.55



WG25 R620 WR15
UG-385/U modified (MIL-DTL-3922/67C-08)

- Holes C4 x 4-40 UNC-2B
- Holes D2 x 1.65 dia
- Holes E2 x dowels 1.549/
1.562 dia x 4
projection
- All Holes on 14.29 PCD
- A19.05

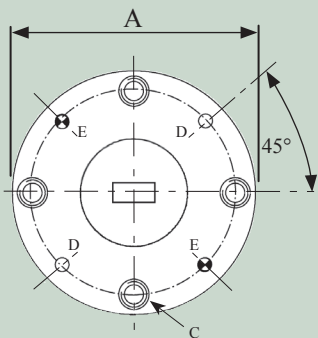
NOTE: ALL DIMENSIONS ARE IN MILLIMETERS
See pages 126 - 129 for details of Flann precision style flanges.

“Standard” Flange Data

Note: Products fitted with Circular, Four hole fixing/Doweled flanges WG23 (WR22) to WG28 (WR8) are supplied with two captive fixing screws per flange.

“Anti-cocking” Flanges - We strongly recommend that customers specify “anti-cocking” flanges on instruments in the waveguide range WG23 (WR22) to WG28 (WR8). “Anti-cocking” flanges provide better performance and repeatability than standard flanges whilst maintaining full compatibility with MIL spec types. Please refer to page 122 for details and outline dimensions.

Flann Standard Flanges



WG26 R740 WR12

UG-387/U (MIL-DTL-3922/67C-009)

Holes C 4 x 4-40 UNC-2B

Holes D 2 x 1.65 dia

Holes E 2 x dowels 1.549/
1.562 dia x 4
projection

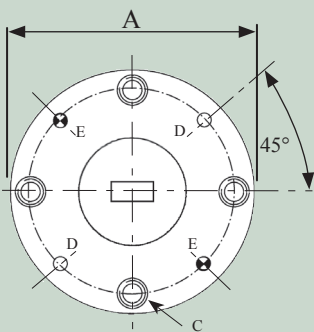
All Holes on 14.29 PCD

A 19.05

Non-Standard Flanges

Full details on request

MIL-F3922/74-001



WG27 R900 WR10

UG-387/U Modified (MIL-DTL-3922/67C-010)

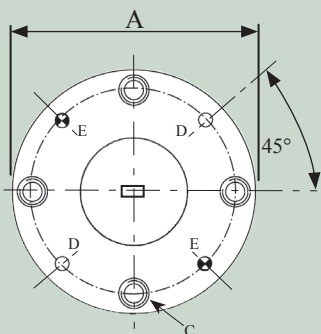
Holes C 4 x 4-40 UNC-2B

Holes D 2 x 1.65 dia

Holes E 2 x dowels 1.549/
1.562 dia x 4
projection

All Holes on 14.29 PCD

A 19.05



WG28 R1200 WR8

UG-387/U Modified

Holes C 4 x 4-40 UNC-2B

Holes D 2 x 1.65 dia

Holes E 2 x dowels 1.549/
1.562 dia x 4
projection

All Holes on 14.29 PCD

A 19.05

MIL-F3922/74-001

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

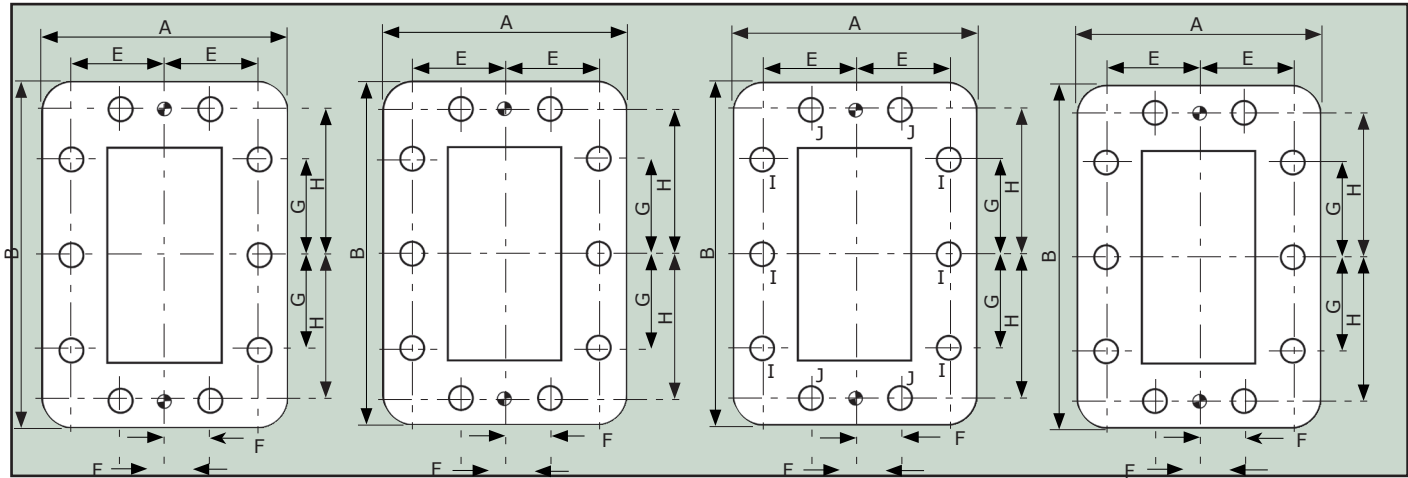
See pages 126 - 129 for details of Flann Precision Style Flanges.

Precision Style Flange Details

The following flange details show the precision style flange types as fitted to Flann calibration grade products, unless otherwise stated.

Full dimensional details of all precision style flange types are available on request.

Alternative flanges may be supplied to special order.



WG6 R14 WR650

UG417B/U TYPE (Without Groove)-PF

A.....	138.90
B.....	221.50
E.....	58.69
F.....	31.73
G.....	60.30
H.....	100.00
Holes.....	10 x 8.20 dia
Dowel Holes.....	2 x 6.375 dia

WG8 R22 WR430

UG435B/U TYPE (Without Groove)-PF

A.....	106.38
B.....	161.14
E.....	43.69
F.....	23.83
G.....	45.39
H.....	71.0
Holes.....	10 x 6.71 dia
Dowel Holes.....	2 x 6.375 dia

WG10 R32 WR284

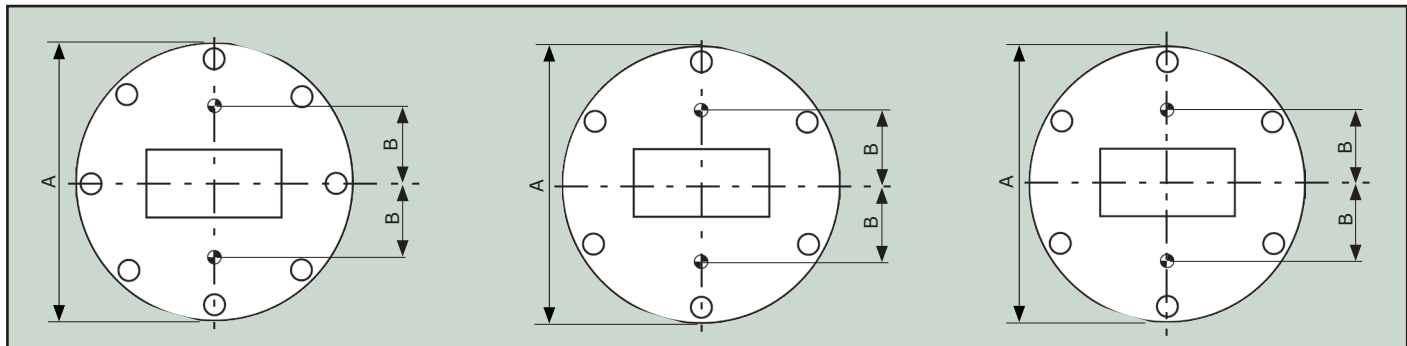
UDR 32

A.....	76.20
B.....	114.3
E.....	29.57
F.....	14.68
G.....	32.54
H.....	48.61
Holes I.....	6 x 7 dia
Holes J.....	4 x 6.6 dia
Dowel Holes.....	2 x 6.375 dia

WG11A R40 WR229

UDR 40 -PF

A.....	70.20
B.....	98.73
E.....	26.67
F.....	12.70
G.....	27.18
H.....	41.15
Holes.....	10 x 6.50 dia
Dowel Holes.....	2 x 6.375 dia



WG12 R48 WR187

UAR 48 -PF

Holes.....	8 x 5.15 dia on 82.55 PCD
A.....	92.33 dia
Dowel Holes.....	2 x 6.375 dia
B.....	29.188

WG13 R58 WR159

UAR 58 -PF

Holes.....	6 x 5.15 dia on 76.20 PCD
A.....	85.915 dia
Dowel Holes.....	2 x 6.375 dia
B.....	26.94

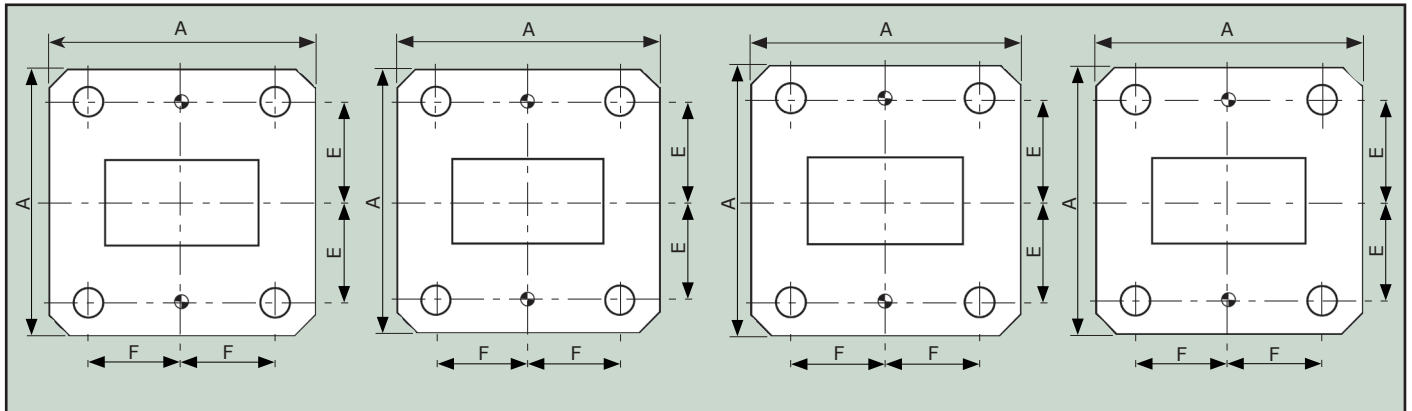
WG14 R70 WR137

UAR 70 -PF

Holes.....	6 x 5.15 dia on 69.85 PCD
A.....	79.50 dia
Dowel Holes.....	2 x 6.375 dia
B.....	24.695

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

Precision Style Flange Details



WG15 R84 WR112

UBR 84 -PF

A..... 47.90
 E..... 18.72
 F..... 17.17
 Holes..... 4 x 4.255 dia
 Dowel Holes..... 2 x 2.38 dia

WG16 R100 WR90

UBR 100 -PF

A..... 41.40
 E..... 16.26
 F..... 15.49
 Holes..... 4 x 4.255 dia
 Dowel Holes..... 2 x 2.38 dia

WG17 R120 WR75

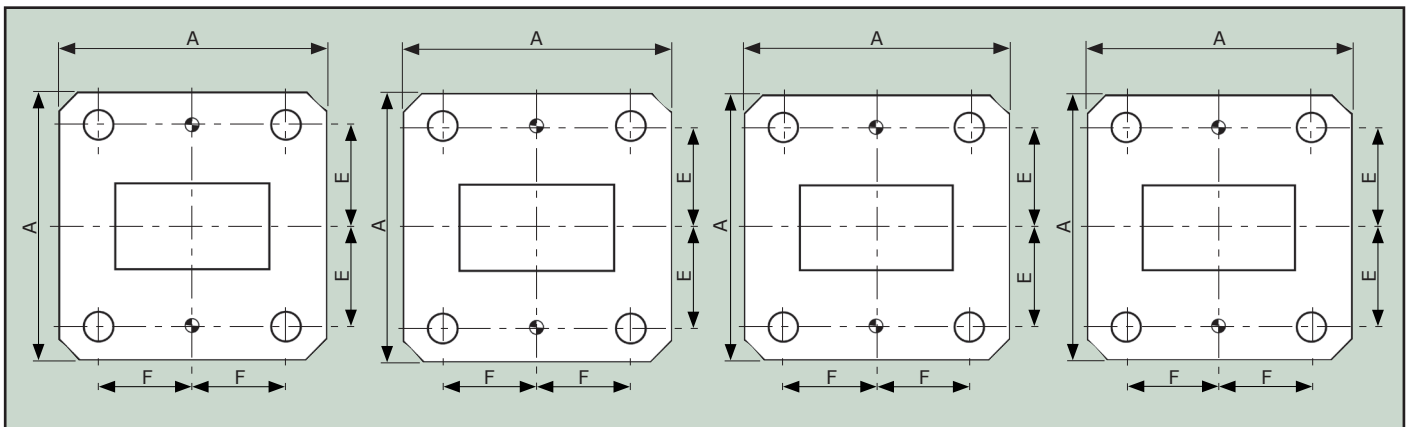
UBR 120 -PF

A..... 38.30
 E..... 14.25
 F..... 13.21
 Holes..... 4 x 4.085 dia
 Dowel Holes..... 2 x 2.38 dia

WG18 R140 WR62

UBR 140 -PF

A..... 33.30
 E..... 12.14
 F..... 12.63
 Holes..... 4 x 4.085 dia
 Dowel Holes..... 2 x 2.38 dia



WG19 R180 WR51

UBR 180 -PF

A..... 30.10
 E..... 11.25
 F..... 10.29
 Holes..... 4 x 4.085 dia
 Dowel Holes..... 2 x 2.38 dia

WG20 R220 WR42

UBR 220 TYPE -PF

A..... 22.40
 E..... 8.51
 F..... 8.13
 Holes..... 4 x 3.07 dia
 Dowel Holes..... 2 x 2.38 dia

WG21 R260 WR34

UBR 260 TYPE -PF

A..... 22.10
 E..... 7.90
 F..... 7.50
 Holes..... 4 x 3.07 dia
 Dowel Holes..... 2 x 2.38 dia

WG22 R320 WR28

UG-599/U -PF

A..... 19.05
 E..... 6.73
 F..... 6.34
 Holes..... 4 x 2.98 dia
 Dowel Holes..... 2 x 2.38 dia

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

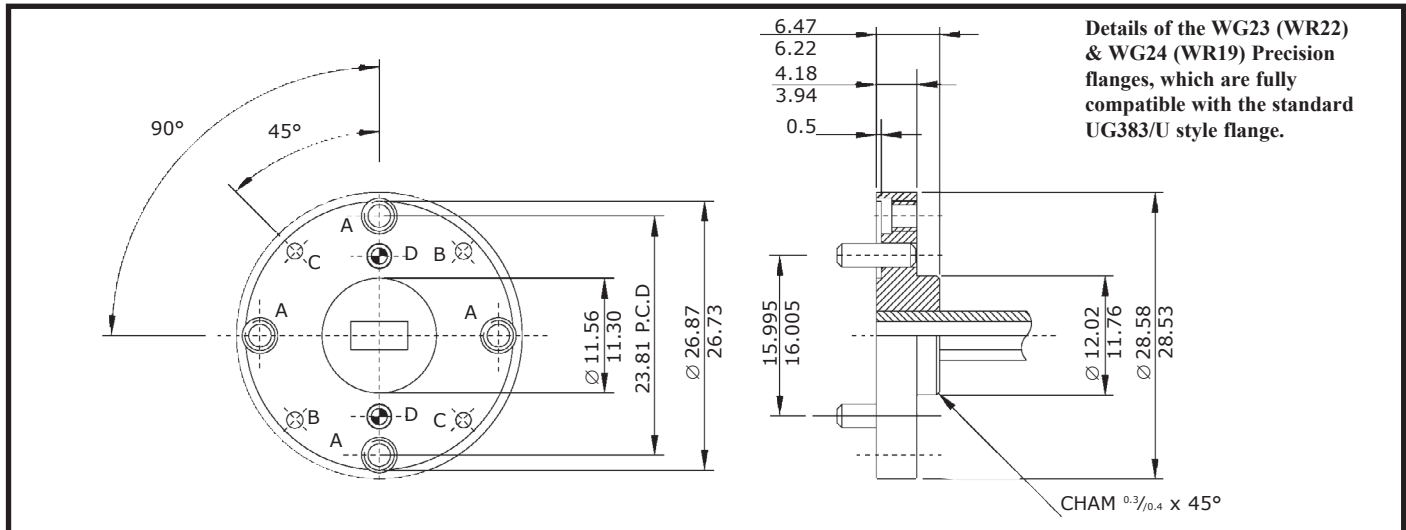
Precision Style Flange Details

WG 23 (WR 22) to WG 32 (WR 3) inclusive

- **Enhanced accuracy & performance**
- **Fully compatible with the standard “MIL spec” flanges**

Flann Precision millimetric flanges are fitted as standard to the Company’s range of Network Analyser Calibration Kits and Metrology grade components. Our precision millimetric flanges incorporate an “anti-cocking” feature which minimizes the risk of leakage or discontinuity occurring at the interface.

Note: Flann Precision flanges are compatible with standard MIL spec types if the additional precision dowels are not used.



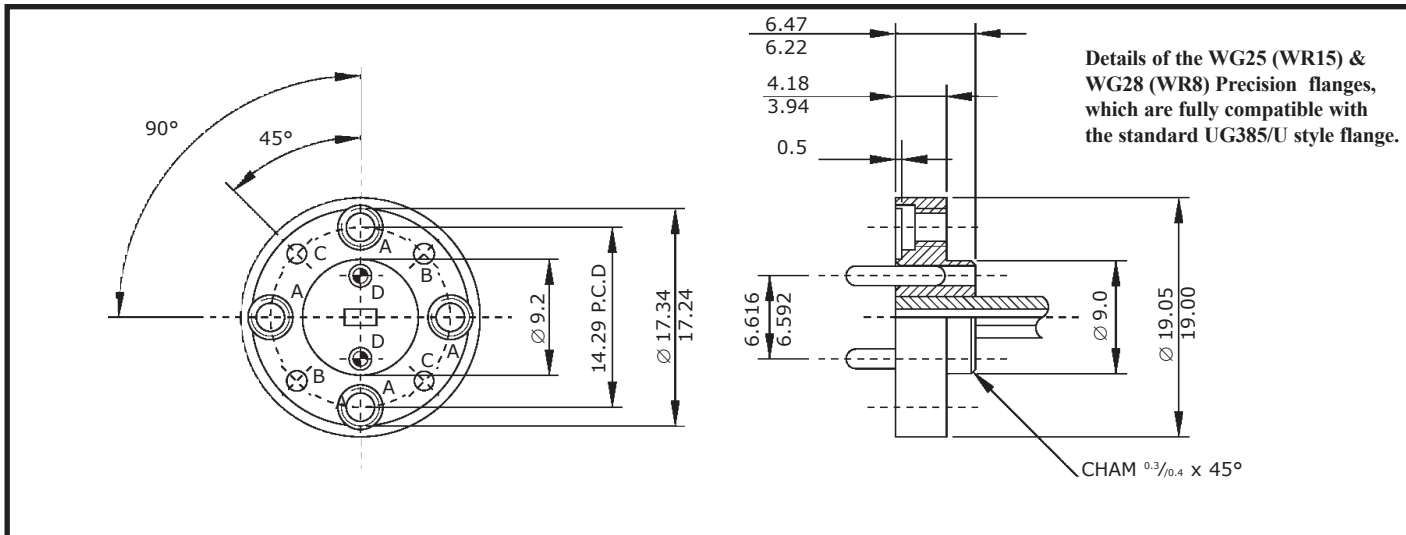
A Holes 4 off - 4.40 UNC-2B. C’bore 3.56 dia x 1.6 deep from flange face

B Holes 2 off - 1.65/1.66 dia. C’sink 2.0 dia @ 90° on front face

C Holes 2 off - Alignment pins 1.562/1.549 dia

D Holes 2 off - Drill and bore 2.25 dia through C’sink 2.8 dia @ 90° and ream 2.395/2.379 dia

Note: Dowels ‘C’ & Dowel holes ‘B’ & ‘D’ are precisely positioned with respect to the waveguide aperture after the flange has been fitted to the waveguide.



A Holes 4 off - 4.40 UNC-2B. C’bore 3.56 dia x 1.6 dia deep from flange face

B Holes 2 off - 1.65/1.66 dia. C’sink 2.0 dia @ 90° on front face

C Holes 2 off - Alignment pins 1.562/1.549 dia

D Holes 2 off - Drill and bore 1.5 dia through C’sink 2.3 dia @ 90° and ream 1.588/1.600 dia

Note: Dowels ‘C’ & Dowel holes ‘B’ & ‘D’ are precisely positioned with respect to the waveguide aperture after the flange has been fitted to the waveguide.

Note: Instruments fitted with precision flanges are supplied with two fixing screws per flange.

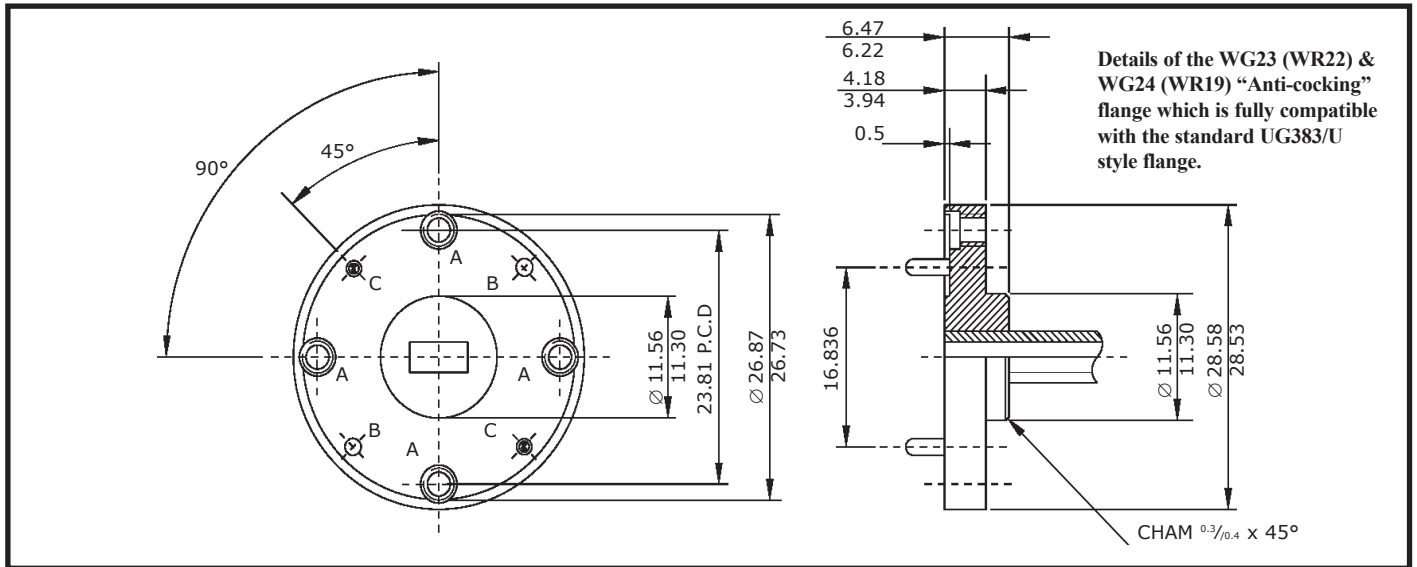
NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

Anti-Cocking Flanges

- Greatly improved performance & repeatability
- Fully compatible with standard “MIL spec” flanges

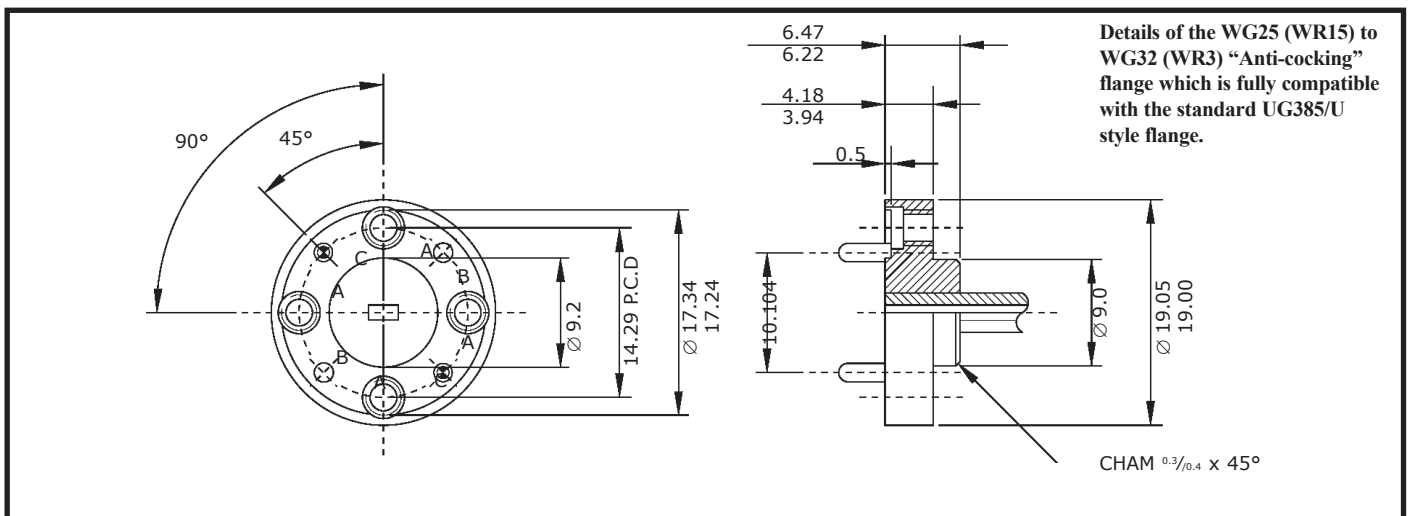
The standard MIL spec style of flanges, normally used in the frequency bands from 26.0 to 220 GHz, are designs with the serious disadvantage that “cocking” can easily take place unless extreme care is taken when tightening the clamping screws. “Cocked” flanges introduce high leakage levels and unnecessary discontinuities. In common with many other major manufacturers Flann offers “anti-cocking” flanges, which prevent cocking when connected to similar “anti-cocking” flanges; these flanges are fully compatible with standard MIL spec designs.

*“Anti-cocking” flanges must be specified at time of order.
The Flann “anti-cocking” flanges are detailed below.*



- A Holes 4 off - 4.40 UNC-2B. C’bore 3.56 dia x 1.6 deep from flange face
 B Holes 2 off - 1.65/1.66 dia. C’sink 2.0 dia x 90° on front face
 C Holes 2 off - Alignment pins 1.562/1.549 dia

Note: Dowels ‘C’ & Dowel holes ‘B’ are precisely positioned with respect to the waveguide aperture after the flange has been fitted to the waveguide.



- A Holes 4 off - Drill 4.40 UNC-2B. C’bore 3.56 dia x 1.6 dia deep from flange face
 B Holes 2 off - 1.65/1.66 dia. C’sink 2.0 dia x 90° on front face
 C Holes 2 off - Alignment pins 1.562/1.549 dia

Note: Dowels ‘C’ & Dowel holes ‘B’ are precisely positioned with respect to the waveguide aperture after the flange has been fitted to the waveguide.

Note: Instruments fitted with an anti-cocking flange are supplied with two fixing screws per flange.

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

VSWR & Return Loss Data

VSWR	STANDING WAVE RATIO (dB)	RETURN LOSS (dB)	TRANSMISSION LOSS (dB)	REFLECTION COEFFICIENT	TRANSMITTED POWER %	REFLECTED POWER %
1.00	0	∞	0	0	100.0	0
1.01	0.1	46.1	0	0	100.0	0
1.02	0.2	40.1	0	0.01	100.0	0
1.03	0.3	36.6	0.001	0.01	100.0	0
1.04	0.3	34.2	0.002	0.02	100.0	0
1.05	0.4	32.3	0.003	0.02	99.9	0.1
1.06	0.5	30.7	0.004	0.03	99.9	0.1
1.07	0.6	29.4	0.005	0.03	99.9	0.1
1.08	0.7	28.3	0.006	0.04	99.9	0.1
1.09	0.7	27.3	0.008	0.04	99.8	0.2
1.10	0.8	26.4	0.010	0.05	99.8	0.2
1.11	0.9	25.7	0.012	0.05	99.7	0.3
1.12	1.0	24.9	0.014	0.06	99.7	0.3
1.13	1.1	24.3	0.016	0.06	99.6	0.4
1.14	1.1	23.7	0.019	0.07	99.6	0.4
1.15	1.2	23.1	0.021	0.07	99.5	0.5
1.16	1.3	22.6	0.024	0.07	99.5	0.5
1.17	1.4	22.1	0.027	0.08	99.4	0.6
1.18	1.4	21.7	0.030	0.08	99.3	0.7
1.19	1.5	21.2	0.033	0.09	99.2	0.8
1.20	1.6	20.8	0.036	0.09	99.2	0.8
1.21	1.7	20.4	0.039	0.10	99.1	0.9
1.22	1.7	20.1	0.043	0.10	99.0	1.0
1.23	1.8	19.7	0.046	0.10	98.9	1.1
1.24	1.9	19.4	0.050	0.11	98.9	1.1
1.25	1.9	19.1	0.054	0.11	98.8	1.2
1.26	2.0	18.8	0.058	0.12	98.7	1.3
1.27	2.1	18.5	0.062	0.12	98.6	1.4
1.28	2.1	18.2	0.066	0.12	98.5	1.5
1.29	2.2	17.9	0.070	0.13	98.4	1.6
1.30	2.3	17.7	0.075	0.13	98.3	1.7
1.32	2.4	17.2	0.083	0.14	98.1	1.9
1.34	2.5	16.8	0.093	0.15	97.9	2.1
1.36	2.7	16.3	0.102	0.15	97.7	2.3
1.38	2.8	15.9	0.112	0.16	97.5	2.5
1.40	2.9	15.6	0.122	0.17	97.2	2.8
1.42	3.0	15.2	0.133	0.17	97.0	3.0
1.44	3.2	14.9	0.144	0.18	96.7	3.3
1.46	3.3	14.6	0.155	0.19	96.5	3.5
1.48	3.4	14.3	0.166	0.19	96.3	3.7
1.50	3.5	14.0	0.177	0.20	96.0	4.0
1.52	3.6	13.7	0.189	0.21	95.7	4.3
1.54	3.8	13.4	0.201	0.21	95.5	4.5
1.56	3.9	13.2	0.213	0.22	95.2	4.8
1.58	4.0	13.0	0.225	0.22	94.9	5.1
1.60	4.1	12.7	0.238	0.23	94.7	5.3
1.62	4.2	12.5	0.250	0.24	94.4	5.6

VSWR & Return Loss Data

VSWR	STANDING WAVE RATIO (dB)	RETURN LOSS (dB)	TRANSMISSION LOSS (dB)	REFLECTION COEFFICIENT	TRANSMITTED POWER %	REFLECTED POWER %
1.64	4.3	12.3	0.263	0.24	94.1	5.9
1.66	4.4	12.1	0.276	0.25	93.8	6.2
1.68	4.5	11.9	0.289	0.25	93.6	6.4
1.70	4.6	11.7	0.302	0.26	93.3	6.7
1.72	4.7	11.5	0.315	0.26	93.0	7.0
1.74	4.8	11.4	0.329	0.27	92.7	7.3
1.76	4.9	11.2	0.342	0.28	92.4	7.6
1.78	5.0	11.0	0.356	0.28	92.1	7.9
1.80	5.1	10.9	0.370	0.29	91.8	8.2
1.82	5.2	10.7	0.384	0.29	91.5	8.5
1.84	5.3	10.6	0.398	0.30	91.3	8.7
1.86	5.4	10.4	0.412	0.30	91.0	9.0
1.88	5.5	10.3	0.426	0.31	90.7	9.3
1.90	5.6	10.2	0.440	0.31	90.4	9.6
1.92	5.7	10.0	0.454	0.32	90.1	9.9
1.94	5.8	9.9	0.468	0.32	89.8	10.2
1.96	5.8	9.8	0.483	0.32	89.5	10.5
1.98	5.9	9.7	0.497	0.33	89.2	10.8
2.00	6.0	9.5	0.512	0.33	88.9	11.1
2.50	8.0	7.4	0.881	0.43	81.6	18.4
3.00	9.5	6.0	1.249	0.50	75.0	25.0
3.50	10.9	5.1	1.603	0.56	69.1	30.9
4.00	12.0	4.4	1.938	0.60	64.0	36.0
4.50	13.1	3.9	2.255	0.64	59.5	40.5
5.00	14.0	3.5	2.553	0.67	55.6	44.4
5.50	14.8	3.2	2.834	0.69	52.1	47.9
6.00	15.6	2.9	3.100	0.71	49.0	51.0
6.50	16.3	2.7	3.351	0.73	46.2	53.8
7.00	16.9	2.5	3.590	0.75	43.7	56.2
7.50	17.5	2.3	3.817	0.76	41.5	58.5
8.00	18.1	2.2	4.033	0.78	39.5	60.5
8.50	18.6	2.1	4.240	0.79	37.7	62.3
9.00	19.1	1.9	4.437	0.80	36.0	64.0
9.50	19.6	1.8	4.626	0.81	34.5	65.5
10.00	20.0	1.7	4.807	0.82	33.1	66.9
11.00	20.8	1.6	5.149	0.83	30.6	69.4
12.00	21.6	1.5	5.466	0.85	28.4	71.6
13.00	22.3	1.3	5.762	0.86	26.5	73.5
14.00	22.9	1.2	6.040	0.87	24.9	75.1
15.00	23.5	1.2	6.301	0.88	23.4	76.6
16.00	24.1	1.1	6.547	0.88	22.1	77.9
17.00	24.6	1.0	6.780	0.89	21.0	79.0
18.00	25.1	1.0	7.002	0.89	19.9	80.1
19.00	25.6	0.9	7.212	0.90	19.0	81.0
20.00	26.0	0.9	7.413	0.90	18.1	81.9
25.00	28.0	0.7	8.299	0.92	14.8	85.2
30.00	29.5	0.6	9.035	0.94	12.5	87.5

Waveguide Parameters

Rigid Rectangular Waveguide Data

Frequency Range (GHz) For TE ₁₀ Mode	Cut-off Freq (GHz) For TE ₁₀ Mode	Band Designation			WG Designation				Internal Dimensions		Theoretical Peak Power Rating (MW)	Theoretical Attenuation dB/30m /A, /B, /S*
		UK	USA	New	53-IEC R	RCSC WG	EIA WR	US (JAN)	Inches	mm approx		
0.32-0.49	0.256			B	3	00	2300		23.0 x 11.5	584.0 x 292.0	153.0-212.0	0.051-0.031/A
0.35-0.53	0.281			B, C	4	0	2100		21.0 x 10.5	533.0 x 267.0	120.0-173.0	0.054-0.034/A
0.41-0.62	0.328			B, C	5	1	1800	RG-201/U	18.0 x 9.0	457.0 x 229.0	93.4-131.9	0.056-0.038/A
0.49-0.75	0.393			C	6	2	1500	RG-202/U	15.0 x 7.5	381.0 x 191.0	67.6-93.3	0.069-0.050/A
0.64-0.98	0.513	P		C	8	3	1150	RG-203/U	11.5 x 5.75	292.0 x 146.0	35.0-53.8	0.128-0.075/A
0.76-1.15	0.605			C, D	9	4	975	RG-204/U	9.75 x 4.875	248.0 x 124.0	27.0-38.5	0.137-0.095/A
0.96-1.46	0.766			D	12	5	770	RG-205/U	7.7 x 3.85	196.0 x 98.0	17.2-24.1	0.201-0.136/A
1.14-1.73	0.908	L	L	D	14	6	650	RG-69/U	6.5 x 3.25	165.1 x 82.55	11.9-17.2	0.317-0.212/B 0.269-0.178/A
1.45-2.20	1.157			D, E	18	7	510		5.1 x 2.55	129.54 x 64.77	7.5-10.7	
1.72-2.61	1.372		LS, R	E	22	8	430	RG-104/U	4.3 x 2.15	109.22 x 54.61	5.2-7.5	0.588-0.385/B 0.501-0.330/A
2.17-3.30	1.736			E, F	26	9A	340	RG-112/U	3.4 x 1.7	86.36 x 43.18	3.1-4.5	0.877-0.572/B 0.751-0.492/A
2.60-3.95	2.078	S	S	E, F	32	10	284	RG-48/U	2.84 x 1.34	72.14 x 34.04	2.2-3.2	1.102-0.752/B 0.940-0.641/A
3.22-4.90	2.577			F, G	40	11A	229		2.29 x 1.145	58.17 x 29.083	1.6-2.2	
3.94-5.99	3.152	C	C	F, G	48	12	187	RG-49/U	1.872 x 0.872	47.55 x 22.149	1.4-2.0	2.08-1.44/B 1.77-1.12/A
4.64-7.05	3.711			G, H	58	13	159		1.590 x 0.795	40.39 x 20.193	0.79-1.0	
5.38-8.18	4.301			H	70	14	137	RG-50/U	1.372 x 0.622	34.85 x 15.799	0.56-0.71	2.87-2.30/B 2.45-1.94/A
6.58-10.0	5.259			I	84	15	112	RG-51/U	1.122 x 0.497	28.499 x 12.624	0.35-0.46	4.12-3.21/B 3.50-2.74/A
8.20-12.50	6.557	X	X	I, J	100	16	90	RG-52/U	0.9 x 0.4	22.86 x 10.16	0.20-0.29	6.45-4.48/B
9.84-15.00	7.868			J	120	17	75		0.75 x 0.375	19.05 x 9.525	0.17-0.23	5.49-3.83/A
11.90-18.00	9.486	J	Ku	J	140	18	62	RG-91/U	0.622 x 0.311	15.799 x 7.899	0.12-0.16	9.51-8.31/B-/A 6.14-5.36/S
14.50-22.00	11.574			J, K	180	19	51		0.510 x 0.255	13.0 x 6.48	0.080-0.107	
17.60-26.70	14.047			J, K	220	20	42	RG-53/U	0.420 x 0.170	10.668 x 4.318	0.043-0.058	20.7-14.8/B 17.6-12.6/A
21.70-33.00	17.328			K	260	21	34		0.340 x 0.170	8.636 x 4.318	0.034-0.048	13.3-9.5/S
26.40-40.10	21.081	Q	Ka	K	320	22	28	RG-96/U	0.280 x 0.140	7.112 x 3.556	0.022-0.031	-/B -/A 21.9-15.0/S
33.00-50.10	26.342			K, L	400	23	22	RG-97/U	0.224 x 0.112	5.69 x 2.845	0.014-0.020	-/B 31.0-20.9/S
39.30-59.70	31.357			L	500	24	19		0.188 x 0.094	4.775 x 2.388	0.011-0.015	
49.90-75.80	39.863		V	L, M	620	25	15	RG-98/U	0.148 x 0.074	3.759 x 1.880	0.0063-0.0090	-/B 52.9-39.1/S
60.50-92.00	48.350	O	E	M	740	26	12	RG-99/U	0.122 x 0.061	3.099 x 1.549	0.0042-0.0060	-/B 93.3-52.2/S
73.80-112.0	59.010		W	M	900	27	10		0.100 x 0.050	2.54 x 1.27	0.0030-0.0041	
92.30-140.00	73.840			M	1200	28	8	RG-138/U	0.080 x 0.040	2.032 x 1.016	0.0018-0.0026	152-99/S
114.0-173.00	90.840				1400	29	6	RG-136/U	0.065 x 0.0325	1.651 x 0.826	0.0012-0.0017	163-137/S
145.00-220.00	115.750		T		1800	30	5	RG-135/U	0.051 x 0.0255	1.295 x 0.648	0.00071-0.00107	308-193/S
172.00-261.00	131.520				2200	31	4	RG-137/U	0.043 x 0.0215	1.1 x 0.55	0.00052-0.00075	384-254/S
217.00-330.00	173.280				2600	32	3	RG-139/U	0.034 x 0.017	0.87 x 0.44	0.00035-0.00047	512-348/S

* Suffix /A, /B or /S denotes material alloy of aluminium, brass or silver

Reference Data

Power Conversion Chart

dBm		(mW)	dBm		(mW)	dBm		(W)	dBm		(W)
-20	=	0.010	0	=	1.00	+20	=	0.100	+40	=	10.0
-19	=	0.012	+1	=	1.25	+21	=	0.120	+41	=	12.6
-18	=	0.016	+2	=	1.58	+22	=	0.159	+42	=	15.8
-17	=	0.020	+3	=	2.00	+23	=	0.200	+43	=	20.0
-16	=	0.025	+4	=	2.51	+24	=	0.251	+44	=	25.1
-15	=	0.032	+5	=	3.16	+25	=	0.316	+45	=	31.6
-14	=	0.040	+6	=	3.98	+26	=	0.398	+46	=	39.8
-13	=	0.050	+7	=	5.01	+27	=	0.501	+47	=	50.1
-12	=	0.063	+8	=	6.30	+28	=	0.631	+48	=	63.1
-11	=	0.079	+9	=	7.94	+29	=	0.794	+49	=	79.4
-10	=	0.100	+10	=	10.00	+30	=	1.000	+50	=	100.0
-9	=	0.130	+11	=	12.60	+31	=	1.260	+51	=	126.0
-8	=	0.160	+12	=	15.80	+32	=	1.590	+52	=	158.0
-7	=	0.200	+13	=	19.90	+33	=	2.000	+53	=	200.0
-6	=	0.250	+14	=	25.10	+34	=	2.550	+54	=	251.0
-5	=	0.316	+15	=	31.60	+35	=	3.160	+55	=	316.0
-4	=	0.398	+16	=	39.80	+36	=	3.910	+56	=	398.0
-3	=	0.501	+17	=	50.10	+37	=	5.010	+57	=	501.0
-2	=	0.630	+18	=	53.10	+38	=	6.310	+58	=	631.0
-1	=	0.794	+19	=	79.40	+39	=	7.940	+59	=	794.0
									+60	=	1 KILOWATT

Conversion Factors and Fundamental Constants

1 inch (in) = 1000 mil	= 25.4 mm
1 mm ~ 0.0394 in	= 39.4 mil
Speed of Light in Vacuum	c 299 792 458 m/s
Permeability of Vacuum	μ_0 $4\pi \times 10^{-7} = 12.5663706144 \times 10^{-7}$ H/m
Permittivity of Vacuum	ϵ_0 $8.85418782 \times 10^{-12}$ F/m

Metric Units

Exa	E	10^{18}	Deci	d	10^{-1}
Peta	P	10^{15}	Centi	c	10^{-2}
Tera	T	10^{12}	Milli	m	10^{-3}
Giga	G	10^9	Micro	μ	10^{-6}
Mega	M	10^6	Nano	n	10^{-9}
Kilo	k	10^3	Pico	p	10^{-12}
Hecto	h	10^2	Femto	f	10^{-15}
Deca	da	10	Atto	a	10^{-18}



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