WAVEGUIDE COMPONENTS

2016 CATALOG

LIEDER DEVELOPMENT

1839 South Lake Place
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liederdev.com

Table of Contents

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Waveguide Size and Frequency

Waveguide Size	Band	Frequency Range (GHz)	Inside Dimensions	Outside Dimensions
WR 3	J	220.00 - 325.00	.034 x .017	.094 x .077
WR 5	G	140.00 - 220.00	.051 x .0255	.111 x .0855
WR 6	D	110.00 - 170.00	.065 x .0325	.125 x .0925
WR 8	F	90.00 - 140.00	.080 x .040	.140 x .100
WR 10	W	75.00 - 110.00	.100 x .050	.180 x .130
WR 12	E	60.00 - 90.00	.122 x .061	.202 x .141
WR 15	V	50.00 - 75.00	.148 x .074	.228 x .154
WR 19	U	40.00 - 60.00	.188 x .094	.268 x .174
WR 22	Q	33.00 - 50.00	.224 x .112	.304 x .192
WR 28	Ka	26.50 - 40.00	.280 x .140	.360 x .220
WR 34	-	22.00 - 33.00	.340 x .170	.420 x .250
WR 42	K	18.00 - 26.50	.420 x .170	.500 x .250
WR 51	N	15.00 - 22.00	.510 x .255	.590 x .335
WR 62	Ku	12.40 - 18.00	.622 x .311	.702 x .391
WR 75	M	10.00 - 15.00	.750 x .375	.850 x .475
WR 90	X	8.20 - 12.40	.900 x .400	1.000 x .500
WR 112	H	7.05 - 10.00	1.122 x .497	1.250 x .625
WR 137	C	5.85 - 8.20	1.372 x .622	1.500 x .750
WR 159	-	4.90 - 7.05	1.590 x .795	1.718 x .923
WR 187	G	3.95 - 5.85	1.872 x .872	2.000 x 1.000
WR 229	U	3.30 - 4.90	2.290 x .1.145	2.418 x 1.273
WR 284	S	2.60 - 3.95	2.840 x 1.340	3.000 x 1.500
WR 340	-	2.20 - 3.30	3.400 x 1.700	3.560 x 1.860
WR 430	LS	1.70 - 2.60	4.300 x 2.150	4.460 x 2.310
WR 510	-	1.45 - 2.20	5.100 x 2.550	5.260 x 2.710
WR 650	L	1.12 - 1.70	6.500 x 3.250	6.660 x 3.410

Lieder Development has manufacturing capabilities from WR 3 to WR650. We have testing capabilities up to 65GHz.

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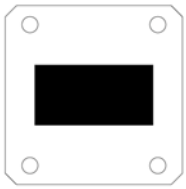
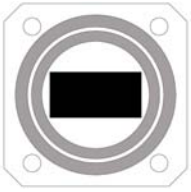
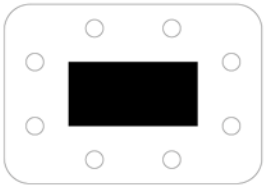
Flange Specifications

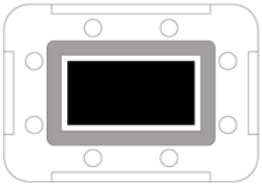
Standard Flange Types

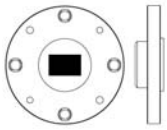

Cover

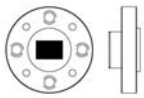

Groove

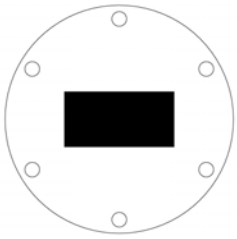

Choke

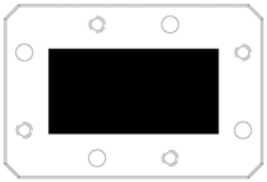

CPR Flat


Contact Groove


Millimeter
Pin Contact
WR19-28


Millimeter
Pin Contact
WR3-15


Cover Circular


CMR

North American (EIA Standard)

WR SIZE	UG STYLE						MIL-F-3922/( )					
	COVER		CHOKE	CPR CONTACT		CMR	COVER		CHOKE	CPR CONTACT		CMR
	SQUARE	CIRCULAR		FLAT	GROOVED		SQUARE/CIRCULAR			FLAT	GROOVED	
WR3		UG387/U MOD						67-010-MO3				
WR5		UG387/U MOD						67-010-MO5				
WR6		UG387/U MOD						67-010-MO6				
WR8		UG387/U MOD						67-010-MO8				
WR10		UG387/U MOD						67-010				
WR12		UG387/U						67-009				
WR15		UG385/U						67-008				
WR19		UG383/U MOD						67-007				
WR22	UG-599/U MOD	UG383/U						67-006				
WR28	UG-599/U	UG383/U MOD	UG-600/U				54-003		59-005			
WR34	UG-1530/U											
WR42	UG-595/U		UG-596A/U				54-001		59-003			
WR51							70-010		69-004			
WR62	UG-419/U		UG-541/U				53-005		59-001			
WR75							53-007		59-010			
WR90	UG-39/U		UG-40B/U	UG-1736/U	UG-1360/U	UG-1478/U	53-001		59-006	52-021	55-043	63-004
WR112	UG-51/U		UG-52B/U	UG-1734/U	UG-1358/U	UG-1477/U	53-002		59-007	52-019	52-041	63-003
WR137		UG-344/U	UG-343B/U	UG-1732/U	UG-1356/U	UG-1476/U		55-001	60-001	52-017	52-039	63-002
WR159				UG-1730/U	UG-1354/U					52-015	52-037	
WR187		UG-149A/U	UG-148C/U	UG-1728/U	UG-1352/U	UG-1475/U		57-002	62-002	52-013	52-035	63-001
WR229				UG-1726/U	UG-1350/U					52-011	52-033	
WR284		UG-53/U	UG-54B/U	UG-1724/U	UG-1348/U	UG-1479/U		56-001	61-002	52-009	52-031	64-001
WR340				UG-1712/U	UG-1346/U					52-007	52-029	
WR430				UG-1716/U	UG-1344/U					52-005	52-027	
WR510				UG1717/U	UG1719/U					52-003	52-025	
WR650				UG-1714/U	UG-1362/U					52-001	52-023	

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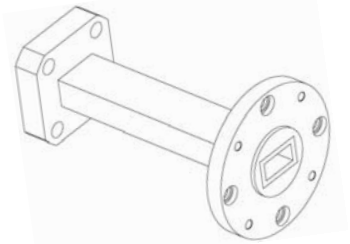
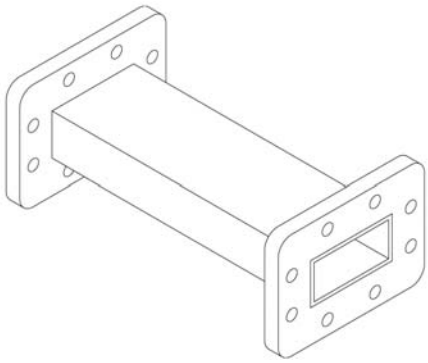
Rigid Straight Sections, Flange Adapters, Spacers

Lieder Development offers a full line of straight rigid waveguide assemblies, flange adapters, spacers, shorting plates and shims from **WR3 to WR650** (1.12GHz – 325GHz).

Features: VSWR

- 1.05:1 max, full band for WR28-WR650
- 1.08:1 max, full band for WR10-22
- 1.1:1 max for WR 3-WR8 full band.





Rigid Twist Waveguide

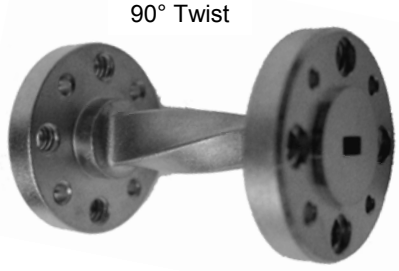
Lieder Development offers a full line of formed twist waveguide assemblies. Standard rigid twist waveguide is available in all waveguide sizes. All lengths are built to customer specifications.

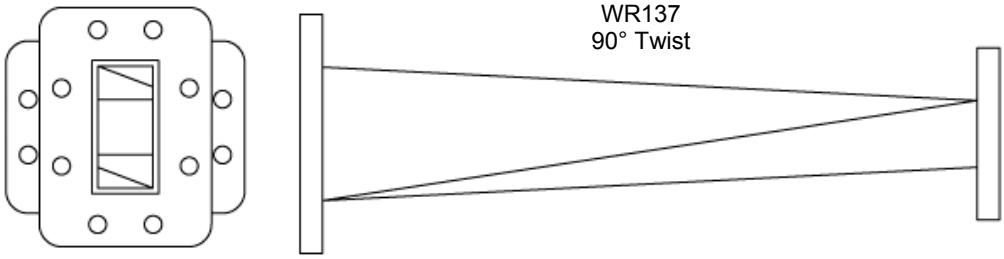
- 90° left hand
- 90° right hand
- 45° left hand
- 45° right hand
- Custom twist specifications also available.

Features: **VSWR**

- 1.05:1 max for WR28-WR650
- 1.08:1 max for WR10-WR22
- 1.1:1 max for WR 3-WR 8.
- Manufactured from Copper, Brass, Silver or Stainless Steel
- Plating also available (See page 14)
- General length tolerance ± 0.010”

WR15
90° Twist





WR137
90° Twist

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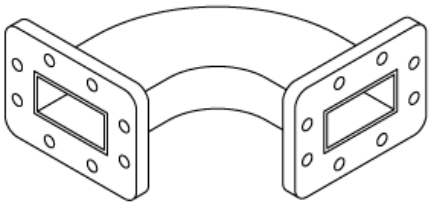
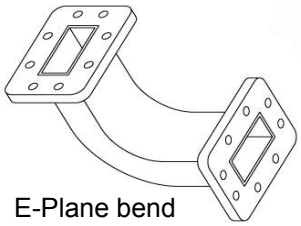
Waveguide Bends: E, H and Custom

Features:

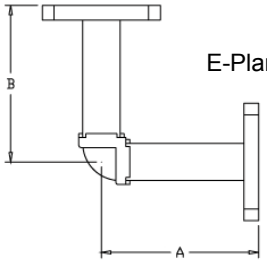
- Mitered and Precision Formed bends available in WR28-WR284.
- Precision form bends are available in WR3-WR22 and WR340-WR650.
- Custom ***multi-bend*** pieces are also available per customer request and design.



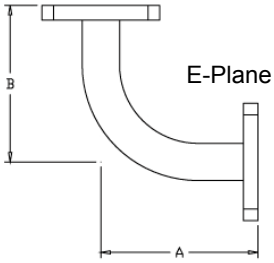
H-Plane bend



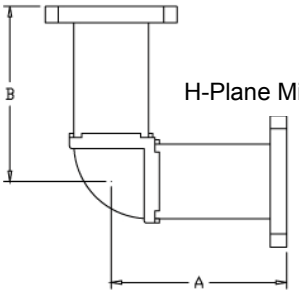
E-Plane bend



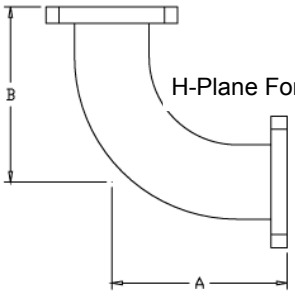
E-Plane Miter



E-Plane Formed



H-Plane Miter



H-Plane Formed

Waveguide Size	Band	Frequency Range (GHz)	VSWR Typical	Formed Bend	Mitered Bend
WR 3	-	220.00 - 325.00	1.10	•	NA
WR 5	G	140.00 - 220.00	1.10	•	NA
WR 6	-	110.00 - 170.00	1.10	•	NA
WR 8	-	90.00 - 140.00	1.10	•	NA
WR 10	W	75.00 - 110.00	1.10	•	NA
WR 12	Y	60.00 - 90.00	1.10	•	NA
WR 15	V	50.00 - 75.00	1.08	•	NA
WR 19	-	40.00 - 60.00	1.08	•	NA
WR 22	Q	33.00 - 50.00	1.08	•	•
WR 28	Ka	26.50 - 40.00	1.08	•	•
WR 34	-	22.00 - 33.00	1.06	•	•
WR 42	K	18.00 - 26.50	1.06	•	•
WR 51	N	15.00 - 22.00	1.05	•	•
WR 62	Ku	12.40 - 18.00	1.05	•	•
WR 75	M	10.00 - 15.00	1.05	•	•
WR 90	X	8.20 - 12.40	1.05	•	•
WR 112	H	7.05 - 10.00	1.05	•	•
WR 137	C	5.85 - 8.20	1.05	•	•
WR 159	D	4.90 - 7.05	1.05	•	•
WR 187	J	3.95 - 5.85	1.05	•	•
WR 229	U	3.30 - 4.90	1.05	•	•
WR 284	S	2.60 - 3.95	1.05	•	•
WR 340	F	2.10 - 3.00	1.05	•	NA
WR 430	L	1.70 - 2.60	1.05	•	NA
WR 510	-	1.45 - 2.20	1.05	•	NA
WR 650	T	1.12 - 1.70	1.05	•	NA

When ordering specify waveguide size, E or H bend, mitered or precision formed, A and B dimensions and flange types. ***Example***: L75-EM-2.5-CV-3-CV = WR 75 E plane mitered bend, 2.5" on **A** dimension, 3" on **B** dimension, Cover Flange on both ends. Call for part designation and flange abbreviation detail.

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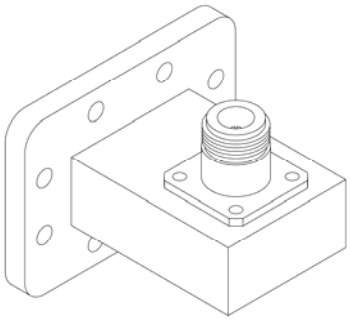
Adapters: Coax to Waveguide

Lieder Development offers a full line of Waveguide to Coax adapters. Manufactured in copper and brass. Female connectors are standard. Male connectors are also available on most models.

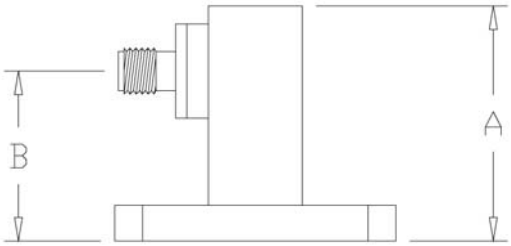
Ordering Information Example

Waveguide to Coax Adapter

Example Part Number:	L	137	A-	NF-	CF-	5.85-7.1
Lieder Designation						
Waveguide Size						
Part Designation (see listing pg. 18)						
Connector Type (N-Female)						
Flange type (Example: CPR Flat (CF), Cover (CV), Cover Groove (G)						
Frequency Range						



WR 137 Type "N" Waveguide to Coax Adapter



Waveguide Size	Band	Frequency Range (GHz)	VSWR Typical	Connector Types Available	Dimension A (in.)	Dimension B*
WR 15	V	50.00 - 65.00	1.35:1	V	1.063	0.839
WR 22	Q	33.00 - 50.00	1.35:1	2.44	1.250	0.998
WR 28	Ka	26.50 - 40.00	1.25:1	K, 2.44	1.250	0.998
WR 34	-	22.00 - 33.00	1.25:1	K, 2.44	1.250	0.978
WR 42	K	18.00 - 26.50	1.25:1	SMA, K, 2.44	1.250	0.963
WR 51	N	15.00 - 22.00	1.25:1	N, SMA, K	1.250	0.969
WR 62	Ku	12.40 - 18.00	1.25:1	N, SMA	1.250	0.941
WR 75	M	10.00 - 15.00	1.20:1	N, SMA	1.250	0.902
WR 90	X	8.20 - 12.40	1.20:1	N, SMA	1.750	1.354
WR 112	H	7.05 - 10.00	1.20:1	N, SMA	1.750	1.235
WR 137	C	5.85 - 8.20	1.10:1	N, SMA	2.250	1.753
WR 159	D	4.90 - 7.05	1.10:1	N, SMA	2.250	1.645
WR 187	J	3.95 - 5.85	1.10:1	N, SMA	2.750	1.900
WR 229	U	3.30 - 4.90	1.10:1	N, SMA	2.750	1.790
WR 284	S	2.60 - 3.95	1.10:1	N, SMA	3.000	1.931
WR 340	F	2.10 - 3.00	1.10:1	N, SMA	3.500	1.929
WR 430	L	1.70 - 2.60	1.10:1	N	4.750	2.748
WR 510	-	1.45 - 2.20	1.10:1	N	call	call
WR 650	T	1.12 - 1.70	1.10:1	N	call	call

Note: Narrow band models covering typically 20% or less of the full waveguide band offer better VSWR performance. Contact our sales staff for information.

* Measurement for reference only. Measurement will change depending upon connector type.

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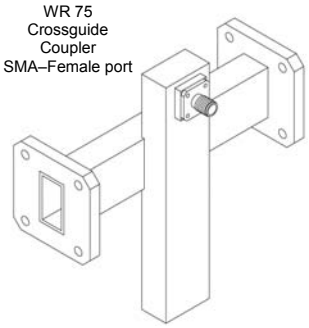
Directional Crossguide Couplers

Lieder Development Crossguide Couplers consist of two waveguides joined at 90˚ with the coupling element mounted in the mainline broad wall. Couplers are available in 3 or 4 port configurations; available with both waveguide and coaxial connections on the coupled ports. Special **multi-port crossguide couplers** can be manufactured to suit customer needs. Standard coupling values are 20, 30, 40 and 50dB. Directivity for models up to 33GHz is typically better than 20dB over the specified frequency range.

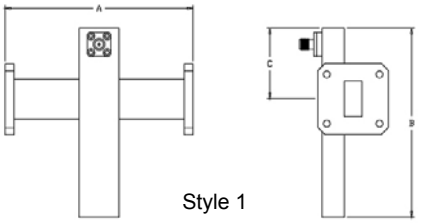


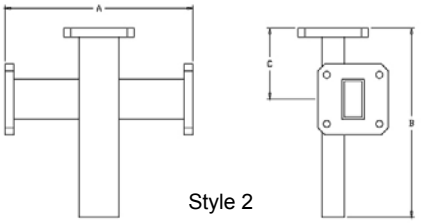
Ordering Information Example

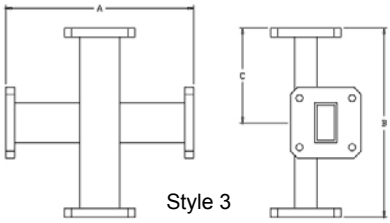
Crossguide Coupler

Example Part Number:	L	75	CG-	40-	SF	CV	12.75-14
Lieder Designation							
Waveguide Size							
Part Designation (see listing pg. 18)							
Coupling Value							
Connector Type (SMA-Female)							
F Flange type: CPRG (CG), CPRF (CF), Cover (CV), Cover Groove (G), Choke (CK)							
Frequency Range							

* Where differing flanges types are required please specify input flange, output flange and/or coupled fitting types. For example: Input Cover flange is ICV and output cover flange is OCV.


Style 1


Style 2


Style 3

Waveguide Size	Band	Frequency Range (GHz)	Minimum Directivity	Dimension A (in)	Dimension B (in)			Dimension C (in)		
					Style 1	Style 2	Style 3	Style 1	Style 2	Style 3
WR 22	Q	33.00 - 50.00	17dB	3.000	3.500	3.500	3.000	1.000	0.875	1.500
WR 28	Ka	26.50 - 40.00	20dB	3.000	3.500	3.500	3.000	1.000	0.875	1.500
WR 34	-	22.00 - 33.00	20dB	3.500	3.500	3.500	3.500	1.000	0.875	1.500
WR 42	K	18.00 - 26.50	20dB	3.500	3.500	3.500	3.500	1.125	1.000	1.750
WR 51	N	15.00 - 22.00	20dB	3.500	3.500	3.500	3.500	1.250	1.250	1.750
WR 62	Ku	12.40 - 18.00	20dB	3.500	4.000	4.000	3.500	1.500	1.250	1.750
WR 75	M	10.00 - 15.00	20dB	4.000	4.000	4.000	4.000	1.500	1.500	2.000
WR 90	X	8.20 - 12.40	20dB	4.000	4.000	4.000	4.000	1.500	1.500	2.000
WR 112	H	7.05 - 10.00	20dB	4.000	5.000	5.000	4.000	2.000	2.000	2.000
WR 137	C	5.85 - 8.20	20dB	4.000	6.000	6.000	4.000	2.000	2.000	2.000
WR 159	D	4.90 - 7.05	20dB	4.000	7.000	7.000	4.000	2.250	2.250	2.000
WR 187	J	3.95 - 5.85	20dB	5.000	8.000	8.000	5.000	3.000	2.500	2.500
WR 229	U	3.30 - 4.90	20dB	6.000	8.000	8.000	6.000	3.000	2.500	3.000
WR 284	S	2.60 - 3.95	20dB	9.000	10.00	10.00	9.000	3.250	3.250	4.500
WR 340	F	2.10 - 3.00	20dB	10.000	12.00	12.00	10.00	4.500	4.500	5.000
WR 430	L	1.70 - 2.60	20dB	10.000	18.00	18.00	10.00	5.000	4.500	5.000
WR 510	-	1.45 - 2.20	20dB	call	call	call	call	call	call	call
WR 650	T	1.12 - 1.70	20dB	call	call	call	call	call	call	call

All couplers are available in a variety of custom input/output, port and termination configurations.
Nominal coupling accuracy: ±0.2dB @ 40% max of bandwidth

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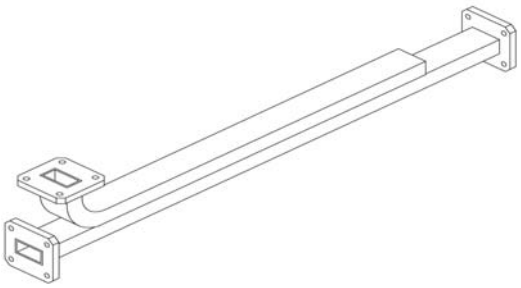
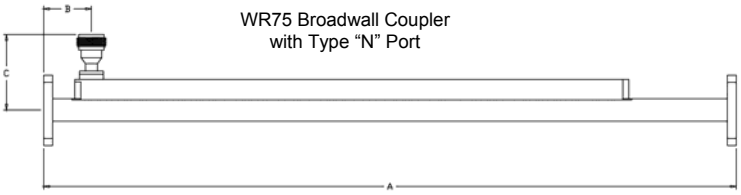
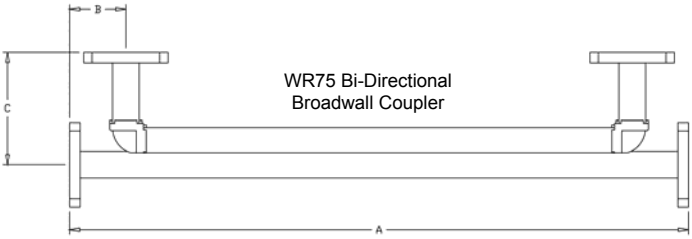
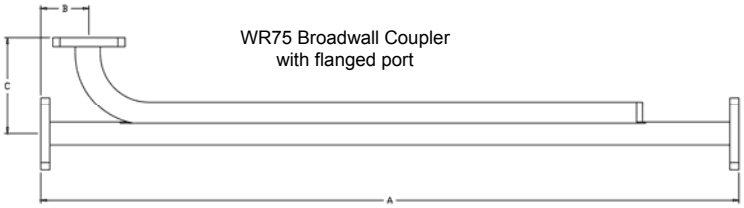
Directional Broadwall Couplers

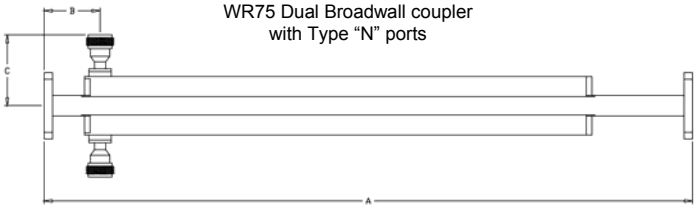
Lieder Development directional broadwall couplers provide the user with a measurement instrument over the entire waveguide frequency range. These couplers have outstanding directivity performance and are available in a wide variety of custom configurations. Standard coupling values are 3, 6, 10 and 20 dB. Other values can be supplied, please contact our sales department to discuss your particular needs.











Waveguide Size	Band	Frequency Range (GHz)	Minimum Directivity	Nominal Coupling Accuracy	Dimensions (in.)		
					A	B	C*
WR 22	Q	33.00 - 50.00	30dB	± 0.2dB	7.00	.750	1.125
WR 28	Ka	26.50 - 40.00	30dB	± 0.2dB	7.00	.750	1.125
WR 34	-	22.00 - 33.00	30dB	± 0.2dB	8.00	.750	1.50
WR 42	K	18.00 - 26.50	30dB	± 0.2dB	8.00	.750	1.50
WR 51	N	15.00 - 22.00	30dB	± 0.2dB	12.00	1.00	1.75
WR 62	Ku	12.40 - 18.00	30dB	± 0.2dB	13.50	1.00	1.75
WR 75	M	10.00 - 15.00	30dB	± 0.2dB	14.50	1.00	2.00
WR 90	X	8.20 - 12.40	30dB	± 0.2dB	16.00	1.50	2.00
WR 112	H	7.05 - 10.00	30dB	± 0.2dB	17.00	1.50	2.50
WR 137	C	5.85 - 8.20	30dB	± 0.2dB	22.00	1.50	2.50
WR 159	D	4.90 - 7.05	30dB	± 0.2dB	24.00	2.00	3.00
WR 187	J	3.95 - 5.85	30dB	± 0.2dB	26.00	2.00	3.00
WR 229	U	3.30 - 4.90	30dB	± 0.2dB	32.00	2.00	3.50
WR 284	S	2.60 - 3.95	30dB	± 0.2dB	40.00	3.00	4.00
WR 340	F	2.10 - 3.00	30dB	± 0.2dB	call	call	call
WR 430	L	1.70 - 2.60	30dB	± 0.2dB	call	call	call
WR 510	-	1.45 - 2.20	30dB	± 0.2dB	call	call	call
WR 650	T	1.12 - 1.70	30dB	± 0.2dB	call	call	call

* Measurement for reference only. Measurement will change depending upon connector type.

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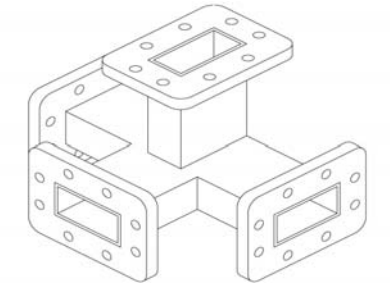
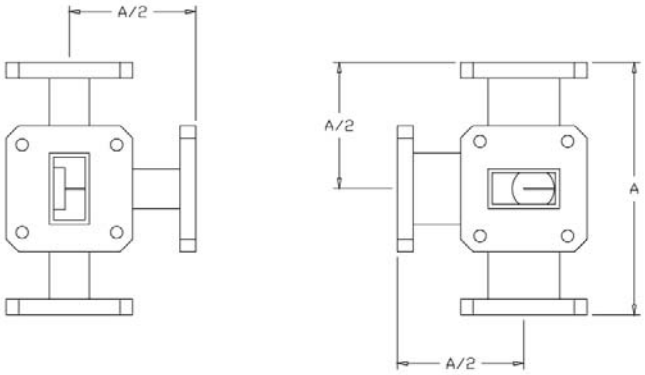
Matched Magic Tees and Hybrid Tees

Lieder Development offers a full line of matched magic tees and hybrid tees. Lieder can manufacture a broad line of magic tees to fit a variety of waveguide sizes. In most tees, the collinear arms are folded to form a common wall at either the broad waveguide surface or the narrow waveguide surface. These are commonly called E or H plane folded tees to differentiate them from the classic magic tee.
Most Lieder tees that cover 10 to 15% bandwidths have power splits with 0.2dB equality or better, regardless of which port is used as the input. The isolation between perpendicular ports is typically 35dB or better. Co-linear arm isolation is typically 16dB or better.



WR137 Matched Magic Tee



Waveguide Size	Band	Frequency Range (GHz) **	VSWR Maximum E	VSWR Maximum H	Isolation dB Min E & H Arms	Unbalanced dB	Dimensions (in.) A	Dimensions (in.) A/2
WR 22*	Q	33.00 - 50.00	1.15	1.15	34dB	± 0.25dB	call	call
WR 28	Ka	26.50 - 40.00	1.25	1.25	35dB	± 0.2dB	2.50	1.25
WR 34	-	22.00 - 33.00	1.25	1.25	35dB	± 0.2dB	3.00	1.50
WR 42	K	18.00 - 26.50	1.25	1.30	35dB	± 0.2dB	3.00	1.50
WR 51	N	15.00 - 22.00	1.15	1.15	35dB	± 0.2dB	3.00	1.50
WR 62	Ku	12.40 - 18.00	1.30	1.20	35dB	± 0.2dB	3.00	1.50
WR 75	M	10.00 - 15.00	1.25	1.25	35dB	± 0.2dB	3.00	1.50
WR 90	X	8.20 - 12.40	1.25	1.30	35dB	± 0.1dB	4.00	2.00
WR 112	H	7.05 - 10.00	1.10	1.15	35dB	± 0.1dB	4.00	2.00
WR 137	C	5.85 - 8.20	1.15	1.10	40dB	± 0.1dB	5.00	2.50
WR 159	D	4.90 - 7.05	1.15	1.15	40dB	± 0.1dB	5.00	2.50
WR 187	J	3.95 - 5.85	1.15	1.15	40dB	± 0.1dB	6.00	3.00
WR 229	U	3.30 - 4.90	1.25	1.25	40dB	± 0.1dB	6.00	3.00
WR 284	S	2.60 - 3.95	1.25	1.25	40dB	± 0.1dB	7.00	3.50

* WR22 Available as H-plane folded hybrid tee only.
** Electrical specifications are for a reduced Frequency Range.
Please call for customized options and available frequency ranges for each waveguide size.

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Flexible Waveguide: Seamless & Jacketed

Rectangular Seamless Flexguide (Non-Twistable)

Lieder Development offers a standard product line of rectangular seamless corrugated flexible waveguide. All units are RF leak free, stable during dynamic flexure (E and H plane bendins) and pressure tight.

- For use in Hi Power Applications
- Finished with high temperature paint
- Differing flange types available with all waveguide sizes

Waveguide Size	Frequency Range (GHz)	Max I.L. (dB/1ft.)	VSWR <36"	VSWR >36"	Power Rating Avg (kW)	Power Rating Peak (kW)	Pressure max (psig)
WR 284	2.60 - 3.95	0.02	1.08	1.10	10	2000	30
WR 229	3.30 - 4.90	0.02	1.08	1.10	8	1550	30
WR 187	3.95 - 5.85	0.03	1.08	1.10	6.5	1250	30
WR 159	4.90 - 7.05	0.04	1.08	1.10	6	1100	30
WR 137	5.85 - 8.20	0.05	1.08	1.10	5	500	30
WR 112	7.05 - 10.00	0.06	1.10	1.20	4	315	15
WR 90	8.20 - 12.40	0.09	1.10	1.20	3	180	15
WR 75	10.00 - 15.00	0.13	1.10	1.20	1.5	140	15
WR 62	12.40 - 18.00	0.15	1.10	1.20	1	100	15
WR 51	15.00 - 22.00	0.32	1.25	1.30	0.5	70	15
WR 42	18.00-26.50	0.32	1.25	1.30	0.3	39	15
WR 34	22.00 – 33.00	0.35	1.30	1.35	0.2	30	15
WR 28	26.50 – 40.00	0.50	1.30	1.35	0.15	20	15

Jacketed Flexible Waveguide (Twistable)

For use where both bending and twisting of the Waveguide is required. Waveguide is supplied with a Neoprene® jacket, as standard, in order to hold pressure.
Operating temperature range: -67° – 266° F (-55° – 130° C).

Waveguide Size	Frequency Range (GHz)	Max I.L. (dB/1ft.)	VSWR <36"	VSWR >36"	Power Rating Avg (kW)	Pressure max (psig)
WR 284	2.60 - 3.95	0.02	1.04	1.07	6.50	20
WR 229	3.30 - 4.90	0.02	1.05	1.07	4.00	30
WR 187	3.95 - 5.85	0.05	1.05	1.07	3.00	30
WR 159	4.90 - 7.05	0.06	1.05	1.08	2.50	30
WR 137	5.85 - 8.20	0.07	1.05	1.09	2.00	30
WR 112	7.05 - 10.00	0.08	1.07	1.10	1.30	35
WR 90	8.20 - 12.40	0.10	1.07	1.10	1.00	45
WR 75	10.00 - 15.00	0.15	1.08	1.10	0.95	45
WR 62	12.40 - 18.00	0.20	1.10	1.13	0.40	45
WR 51	15.00 - 22.00	0.35	1.15	1.18	0.20	45
WR 42	18.00-26.50	0.35	1.18	1.23	0.15	45
WR 34	22.00 – 33.00	0.50	1.17	1.20	0.10	45
WR 28	26.50 – 40.00	0.60	1.30 @ 36" max		0.10	45

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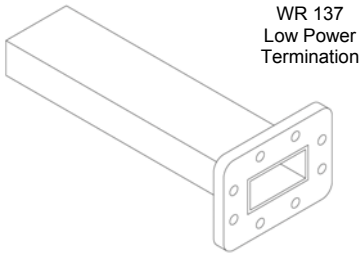
Terminations

Low Power Terminations

Waveguide Size	Band	Frequency Range (GHz)	Power Max (Watts-CW)	Max VSWR	Minimum Dimension (inches)
WR15	V	50.00-75.00	.125 watt	1.01	2.00
WR 22	Q	33.00 - 50.00	.25 watt	1.01	2.00
WR 28	Ka	26.50 - 40.00	.5 watt	1.01	2.00
WR 34	-	22.00 - 33.00	.5 watt	1.01	2.00
WR 42	K	18.00 - 26.50	.5 watt	1.01	3.00
WR 51	N	15.00 - 22.00	1 watt	1.01	3.00
WR 62	Ku	12.40 - 18.00	1.5 watts	1.01	4.00
WR 75	M	10.00 - 15.00	2.5 watts	1.01	4.00
WR 90	X	8.20 - 12.40	4 watts	1.01	6.00
WR 112	H	7.05 - 10.00	4 watts	1.01	6.00
WR 137	C	5.85 - 8.20	6 watts	1.01	6.50
WR 159	D	4.90 - 7.05	7 watts	1.01	7.50
WR 187	J	3.95 - 5.85	8 watts	1.01	8.50
WR 229	U	3.30 - 4.90	10 watts	1.01	10.00
WR 284	S	2.60 - 3.95	10 watts	1.01	10.50
WR 340	F	2.10 - 3.00	12 watts	1.01	11.00
WR 430	L	1.70 - 2.60	20 watts	1.02	11.00
WR 650	T	1.12 - 1.70	25 watts	1.02	20.00

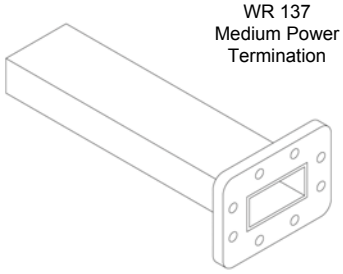


WR 137
Low Power
Termination

Lieder Development offers a full line of precision low power terminations. We also manufacture shorter low power terminations for smaller bandwidth operation. Our standard length, full-band, low power terminations have very low VSWR. Models available from 1.12GHz to 75GHz. Dimensions listed in chart reflect our standard length, full band, low power terminations. Please call our sales staff for smaller length dimensions available and frequency options.

Medium Power Terminations

Waveguide Size	Band	Frequency Range (GHz)	Power Max (Watts-CW)	Max VSWR	Minimum Dimension (inches)
WR 22	Q	33.00 - 50.00	20 watts	1.07	2.00
WR 28	Ka	26.50 - 40.00	50 watts	1.10	4.50
WR 34	-	22.00 - 33.00	75 watts	1.10	4.50
WR 42	K	18.00 - 26.50	150 watts	1.10	4.50
WR 51	N	15.00 - 22.00	110 watts	1.10	4.50
WR 62	Ku	12.40 - 18.00	200 watts	1.06	4.00
WR 75	M	10.00 - 15.00	200 watts	1.07	5.00
WR 90	X	8.20 - 12.40	225 watts	1.10	6.00
WR 112	H	7.05 - 10.00	425 watts	1.07	7.50
WR 137	C	5.85 - 8.20	500 watts	1.05	8.00
WR 159	D	4.90 - 7.05	625 watts	1.06	8.50
WR 187	J	3.95 - 5.85	750 watts	1.07	9.00
WR 229	U	3.30 - 4.90	1000 watts	1.10	10.50
WR 284	S	2.60 - 3.95	1200 watts	1.10	12.00
WR 340	F	2.10 - 3.00	700 watts	1.10	12.50
WR 430	L	1.70 - 2.60	450 watts	1.10	10.00



WR 137
Medium Power
Termination

Lieder Development offers a full line of medium power terminations. Depending on power specifications, terminations may also feature brass fins used for optimum heat dissipation. Our medium power terminations have very low VSWR. Models available from 1.70GHz to 50GHz. Dimensions listed in chart reflect our standard length, full band, medium power terminations.

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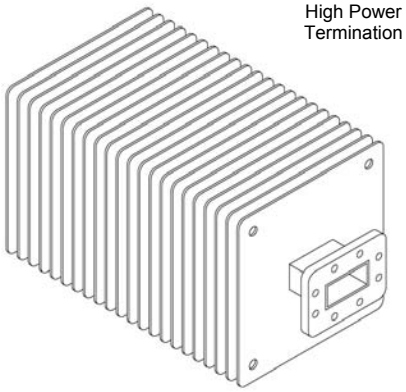
Terminations

High Power Terminations

Waveguide Size	Band	Frequency Range (GHz)	Power Avg. (Watts)	Max VSWR	Minimum Dimension (inches)
WR 62	Ku	12.40 - 18.00	2200 watts	1.10	19.00
WR 75	M	10.00 - 15.00	2200 watts	1.10	19.00
WR 90	X	8.20 - 12.40	2200 watts	1.10	19.00
WR 112	H	7.05 - 10.00	2200 watts	1.10	19.00
WR 137	C	5.85 - 8.20	3500 watts	1.10	19.00
WR 159	D	4.90 - 7.05	3500 watts	1.10	19.00
WR 187	J	3.95 - 5.85	3500 watts	1.10	14.00
WR 229	U	3.30 - 4.90	4000 watts	1.10	24.00
WR 284	S	2.60 - 3.95	4000 watts	1.10	18.00
WR 430	L	1.70 - 2.60	5000 watts	1.10	30.00


WR 137
High Power
Termination

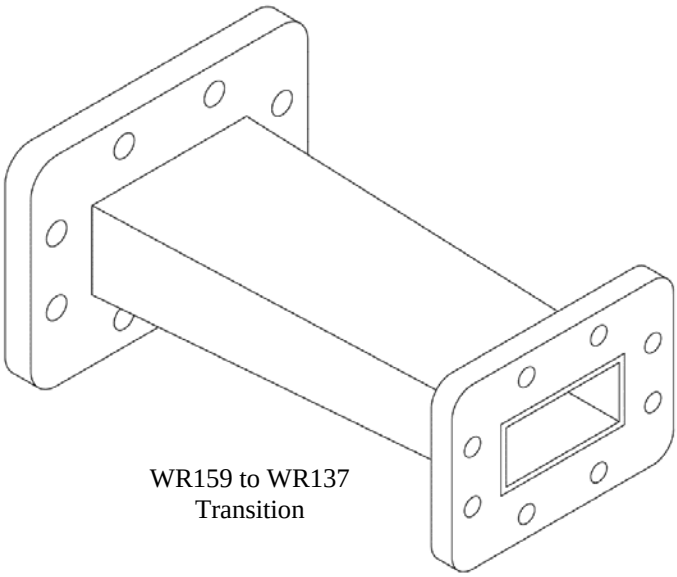
Lieder Development offers high power terminations from 1.70GHz to 18GHz. These terminations are manufactured from 6061 aluminum waveguide with aluminum fins for optimum heat dissipation.

- VSWR is 1.10:1 max over the full waveguide bandwidth.
- Standard exterior finish is flat black high temp enamel
- No forced air cooling required
- Lower VSWR available over narrower bandwidths.
- Units are pressurized upon request.

Tapered Transition Waveguides

Waveguide to waveguide tapered transitions provide a gradual dimensional change between two sizes of waveguide. Lieder Development offers a full line of fabricated **waveguide to waveguide transitions** and **rectangular to circular transitions**. All our transition components are fabricated using the precision of electrical discharge machining (EDM). In applications where waveguide frequency bands overlap, the transitions exhibit low VSWR and low insertion loss while maintaining high mode purity.

In addition to our standard rectangular waveguide adapters in overlapping bands, we also manufacture custom transitions spanning multiple bands. Our production process allows us to manufacture transitions in frequencies as high as 325GHz (WR3) down to 1.12GHz (WR650). Please call us and discuss your needs with our design engineer.


WR159 to WR137
Transition

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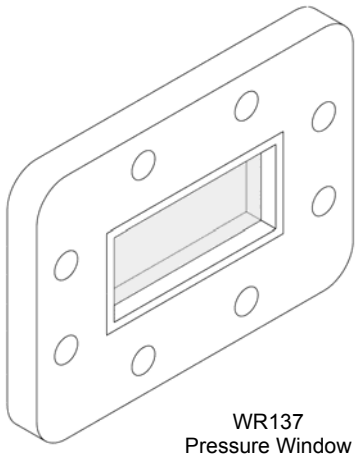
Pressure Windows

Lieder Development offers a full line of kapton pressure windows and mica pressure windows covering waveguide sizes from WR22 to WR430. Our pressure windows are designed to isolate pressurized sections from non-pressurized sections in waveguide systems, keep containments out and provide an efficient seal at pressures as high as 40 psi. Flange: Brass. Window: Kapton or Mica. Flange type: Cover, Grove, CPR, CPR-G. Custom window specifications available. Contact our sales staff for your particular design needs

Waveguide Size	Band	Frequency Range (GHz)	Typical VSWR	Pressure (PSIG)	Thickness (in)*
WR 22	Q	33.00-50.00	1.20	15	0.20
WR28	Ka	26.50-40.00	1.20	15	0.20
WR 34	-	22.00-33.00	1.15	15	0.20
WR 42	K	18.00-26.50	1.12	15	0.20
WR 51	N	15.00-22.00	1.10	15	0.20
WR 62	Ku	12.40 - 18.00	1.10	15	0.20
WR 75	M	10.00 - 15.00	1.10	15	0.20
WR 90	X	8.20 - 12.40	1.10	15	0.20
WR 112	H	7.05 - 10.00	1.10	15	0.25
WR 137	C	5.85 - 8.20	1.10	15	0.25
WR 159	D	4.90 - 7.05	1.10	15	0.25
WR 187	J	3.95 - 5.85	1.10	15	0.25
WR 229	U	3.30 - 4.90	1.10	15	0.25
WR 284	S	2.60 - 3.95	1.10	15	0.25
WR 340	F	2.10-3.00	1.10	15	0.25
WR 430	L	1.70 - 2.60	1.10	15	0.25



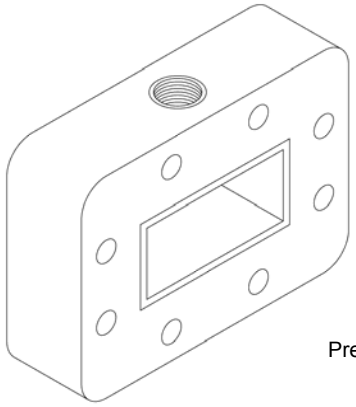
WR137
Pressure Window

The dimension is based on a standard model. Thickness may vary depending on flange type.

Pressure Inlet Flanges

Lieder Development offers a standard line of Pressure Inlets for pressurizing waveguide systems with clean air or other gasses. These flanges are available in all combinations of flange type and have a 1/8" NPT female inlet. We can customize pressure inlets to your specifications upon request.

- 1.70GHz to 50.00GHz Performance Frequency
- 1.10 Typical Max VSWR (VSWR varies with design)
- Male or Female Connectors available
- Numerous Flange Configurations available
- Aluminum (6061) or Copper WR Waveguide Available



WR112
Pressure Inlet
Flange

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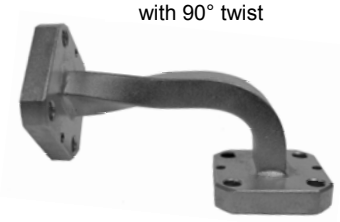
Millimeter Waveguide

Lieder Development offers a full line of millimeter waveguide products. Manufacturing materials available include Copper, Silver, Stainless Steel and brass. Standard E and H bend constructions are available as well as custom multi-bend parts in all millimeter waveguide sizes.

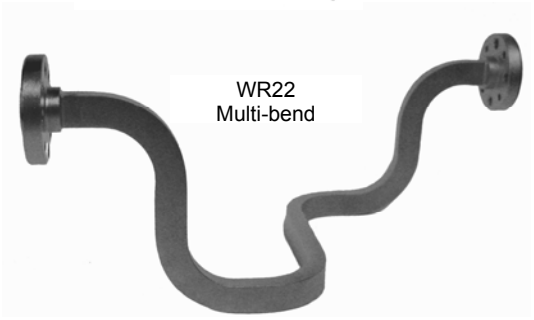
Straight Sections and Flange Adapters
Twist Sections,
E and H Bends, Custom Bends

Waveguide Size	Band	Frequency Range (GHz)	VSWR Typical	Formed Bend	Mitered Bend
WR 3	-	220.00 - 325.00	1.10	YES	N.A.
WR 5	G	140.00 - 220.00	1.10	YES	N.A.
WR 6	-	110.00 - 170.00	1.10	YES	N.A.
WR 8	-	90.00 - 140.00	1.10	YES	N.A.
WR 10	W	75.00 - 110.00	1.10	YES	N.A.
WR 12	Y	60.00 - 90.00	1.10	YES	N.A.
WR 15	V	50.00 - 75.00	1.08	YES	N.A.
WR 19	-	40.00 - 60.00	1.08	YES	N.A.
WR 22	Q	33.00 - 50.00	1.08	YES	YES
WR 28	Ka	26.50 - 40.00	1.08	YES	YES
WR 34	-	22.00 - 33.00	1.06	YES	YES
WR 42	K	18.00 - 26.50	1.06	YES	YES

WR28 E-bend with 90° twist



WR22 h-bend



WR22 Multi-bend

Plating:

Lieder offers the following plating services:

- **Gold Electroplate (MIL-G45204)**
- **Electroless Gold Plate**

WR22 and WR10 90° twist Gold Electroplated

- **Nickel Brush Plate**

Galvanic corrosion is the process by which certain materials (electrochemically dissimilar metals), in contact with each other, oxidize or corrode over time.

Often when a design requires that dissimilar metals come in contact, the galvanic compatibility of these metals is managed by finishes and/or plating the relevant surfaces.

The nickel brush plate on the flange face of the waveguide part prevents corrosion between the base materials that are in contact with each other.

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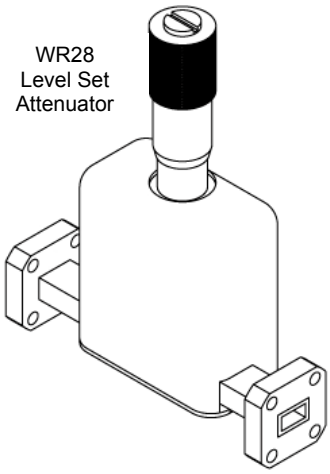
ATTENUATORS

Features:

- Rugged waveguide configuration
- Full band operation
- Up to 60dB attenuation

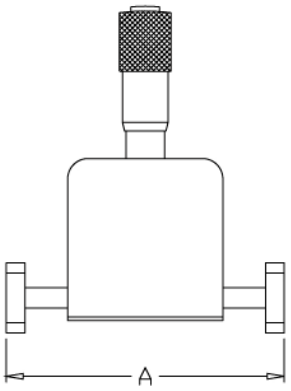
Applications:

- Test Benches
- Subsystems
- Prototypes



LEVEL SET ATTENUATORS

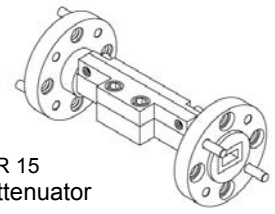
Waveguide Size	Band	Frequency Range (GHz)	Attenuation dB	Max VSWR	"A" Dimension (inches)
WR 5	G	140.0 - 220.0	0 – 25dB	1.3:1	2.965
WR 6	D	110.0 - 170.0	0 – 25dB	1.3:1	2.965
WR 8	F	90.0 - 140.0	0 – 25dB	1.3:1	2.965
WR 10	W	75.0 - 110.0	0 – 25dB	1.3:1	2.965
WR 12	E	60.00 - 90.00	0 – 25dB	1.3:1	2.965
WR 15	V	50.00 - 75.00	0 – 25dB	1.3:1	2.965
WR 19	U	40.00 - 60.00	0 – 25dB	1.3:1	2.965
WR 22	Q	33.00 - 50.00	0 – 25dB	1.3:1	2.965
WR 28	Ka	26.50 - 40.00	0 – 25dB	1.25:1	2.965
WR 34	--	22.00 - 33.00	0 – 25dB	1.25:1	2.965
WR 42	K	18.00 - 26.50	0 – 25dB	1.25:1	2.965

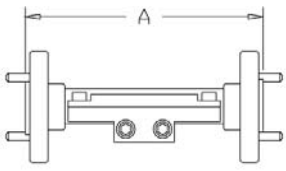


Lieder Development level set attenuators consist of a section of waveguide with a precisely cut mica resistive vane. In the level set attenuator, the micrometer drive sets the level of attenuation by movement of the vane.

FIXED ATTENUATORS

Waveguide Size	Band	Frequency Range (GHz)	Attenuation dB	Max VSWR	"A" Dimension (inches)
WR 5	G	140.0 - 220.0	0 – 30dB	1.3:1	1.600
WR 6	D	110.0 - 170.0	0 – 30dB	1.3:1	1.600
WR 8	F	90.0 - 140.0	0 – 30dB	1.3:1	1.600
WR 10	W	75.0 - 110.0	0 – 30dB	1.3:1	1.600
WR 12	E	60.00 - 90.00	0 – 30dB	1.3:1	1.600
WR 15	V	50.00 - 75.00	0 – 30dB	1.3:1	1.600
WR 19	U	40.00 - 60.00	0 – 30dB	1.3:1	2.000
WR 22	Q	33.00 - 50.00	0 – 30dB	1.25:1	2.000
WR 28	Ka	26.50 - 40.00	0 – 30dB	1.1:1	2.000
WR 34	--	22.00 - 33.00	0 – 30dB	1.1:1	2.000
WR 42	K	18.00 - 26.50	0 – 30dB	1.1:1	2.000





Fixed attenuators are made using a rugged split-block design. These devices can be used as the laboratory standard against which other instruments or components are calibrated. The attenuating element is manufactured from a mica resistive card vane. This vane version (***Fixed*** Attenuator) is supported in the waveguide using two brass brackets and is accurately positioned to give a desired value between 0 and 30dB as required.

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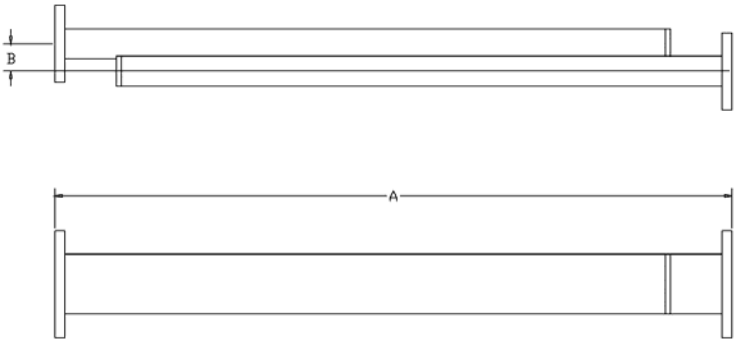
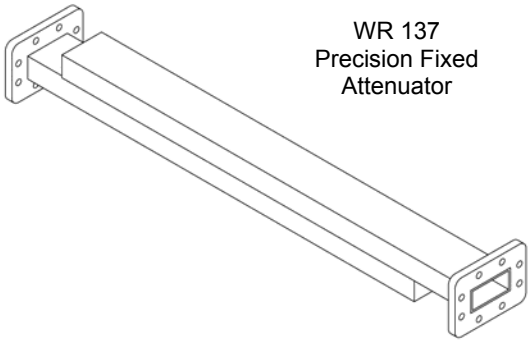
ATTENUATORS

PRECISION FIXED ATTENUATORS

Waveguide Size	Band	Frequency Range (GHz)	Attenuation dB	Max VSWR	Power Handling (watts cw) Low	High	"A" Dimesion (inches)*	"B" Dimension (inches)
WR 22	Q	33.00-50.00	3 – 60dB	1.1:1	.25	20	7.75	.152
WR 28	Ka	26.50-40.00	3 – 60dB	1.1:1	.50	50	11.0	.180
WR 34	-	22.00-33.00	3 – 60dB	1.1:1	.50	150	11.5	.210
WR 42	K	18.00-26.50	3 – 60dB	1.1:1	.50	150	13.5	.210
WR 51	N	15.00-22.00	3 – 60dB	1.1:1	1.0	110	16.5	.295
WR 62	Ku	12.40 - 18.00	3 – 60dB	1.1:1	1.5	200	17.0	.351
WR 75	M	10.00 - 15.00	3 – 60dB	1.1:1	2.0	200	20.0	.425
WR 90	X	8.20 - 12.40	3 – 60dB	1.1:1	2.0	225	23.5	.450
WR 112	H	7.05 - 10.00	3 – 60dB	1.1:1	3.0	400	25.0	.561
WR 137	C	5.85 - 8.20	3 – 60dB	1.1:1	3.0	500	30.5	.686
WR 159	D	4.90 - 7.05	3 – 60dB	1.1:1	5.0	625	36.5	.859
WR 187	J	3.95 - 5.85	3 – 60dB	1.1:1	8.0	750	38.5	.936
WR 229	U	3.30 - 4.90	3 – 60dB	1.1:1	10	1000	45.0	1.209
WR 284	S	2.60 - 3.95	3 – 60dB	1.1:1	10	1200	52.5	1.420
WR 340	F	2.10-3.00	3 – 60dB	1.1:1	12	call	call	1.780
WR 430	L	1.70 - 2.60	3 – 60dB	1.1:1	15	call	call	2.230

* "A" dimensions are maximum dimensions for high power attenuators. Custom lengths and configurations are available. Please contact our sales staff.





WR 137
Precision Fixed
Attenuator

For most models the variation of attenuation with frequency, over the operational frequency range, is typically 10% of the nominal attenuation value.

All of the standard fixed attenuators listed are manufactured from selected waveguide tube.

Precision fixed models are available in a range of attenuation values from 3 dB to 60 dB. Units with different attenuation values are available by special order. Higher attenuation values can also be accommodated – Please call our sales staff for details.

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Waveguide Calibration Kits

Lieder Development offers waveguide calibration kits from WR22 to WR284. Including in each waveguide calibration kit are two full-band adapters, two terminations and standard offset shorts for each waveguide size.

Waveguide Size	Band	Frequency Range (GHz)	Adapter VSWR	Connector Type	Termination VSWR	Offset Short Dimensions
WR 22	Q	33.00 - 50.00	1.35:1	2.44	1.1:1	call
WR 28	Ka	26.50 - 40.00	1.25:1	K	1.05:1	call
WR 34	-	22.00 - 33.00	1.25:1	K	1.05:1	call
WR 42	K	18.00 - 26.50	1.25:1	K	1.05:1	call
WR 51	N	15.00 - 22.00	1.25:1	SMA	1.05:1	call
WR 62	Ku	12.40 - 18.00	1.25:1	SMA	1.05:1	call
WR 75	M	10.00 - 15.00	1.20:1	SMA	1.05:1	call
WR 90	X	8.20 - 12.40	1.20:1	SMA	1.05:1	call
WR 112	H	7.05 - 10.00	1.20:1	SMA	1.05:1	call
WR 137	C	5.85 - 8.20	1.10:1	SMA or N	1.05:1	call
WR 159	D	4.90 - 7.05	1.10:1	SMA or N	1.03:1	call
WR 187	J	3.95 - 5.85	1.10:1	N	1.03:1	call
WR 229	U	3.30 - 4.90	1.10:1	N	1.03:1	call
WR 284	S	2.60 - 3.95	1.10:1	N	1.03:1	call

Electrical Testing Services

Lieder Development has testing capabilities for full 12-term S-parameters from 40MHz to 65GHz. We operate two Anritsu 37397D Vector Network Analyzers.

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Lieder Abbreviation Index

Flange Abbreviation Reference

Cover Flat Through	CV
Cover Groove Through	G
Cover Flat Tapped	CVT
Cover Groove Tapped	GT
Cover Circular	CV
Choke Flange Through	CKM (modified)
Choke Flange Tapped	CK
CPR Flat:	CF
CPR Groove:	CG
CMR Clear:	CC
CMR Alt. Tap:	CCT
Millimeter Round:	RD

Part Designation Reference

Part Description:	Designation	Part Description:	Designation
Straight Section	L75SS	Rectangular Seamless Flex	L75SF
E-bend	L75E	Jacketed Twist Flex	L75TF
H-Bend	L75H		
Twists	L75TW	Transition	L75TR
		Pressure Window	L75PW
Shims/Spacers	L75SPCR	Pressure Inlet Flange	L75PIF
Adapters	L75A	Level Set Attenuators	L42LSA
Crossguide Coupler	L75CG	Fixed Attenuators	L42FA
Broadwall Coupler	L75BW	Precision Fixed Attenuators	L75PFA
Dual Broadwall Coupler	L75DBW		
Bi-Directional Broadwall Coupler	L75DBW-40dBF-40dBR	Waveguide Calibration Kits	L75CK-WG
Matched Magic Tee	L75MMT		
Hybrid Tee	L75HT		

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