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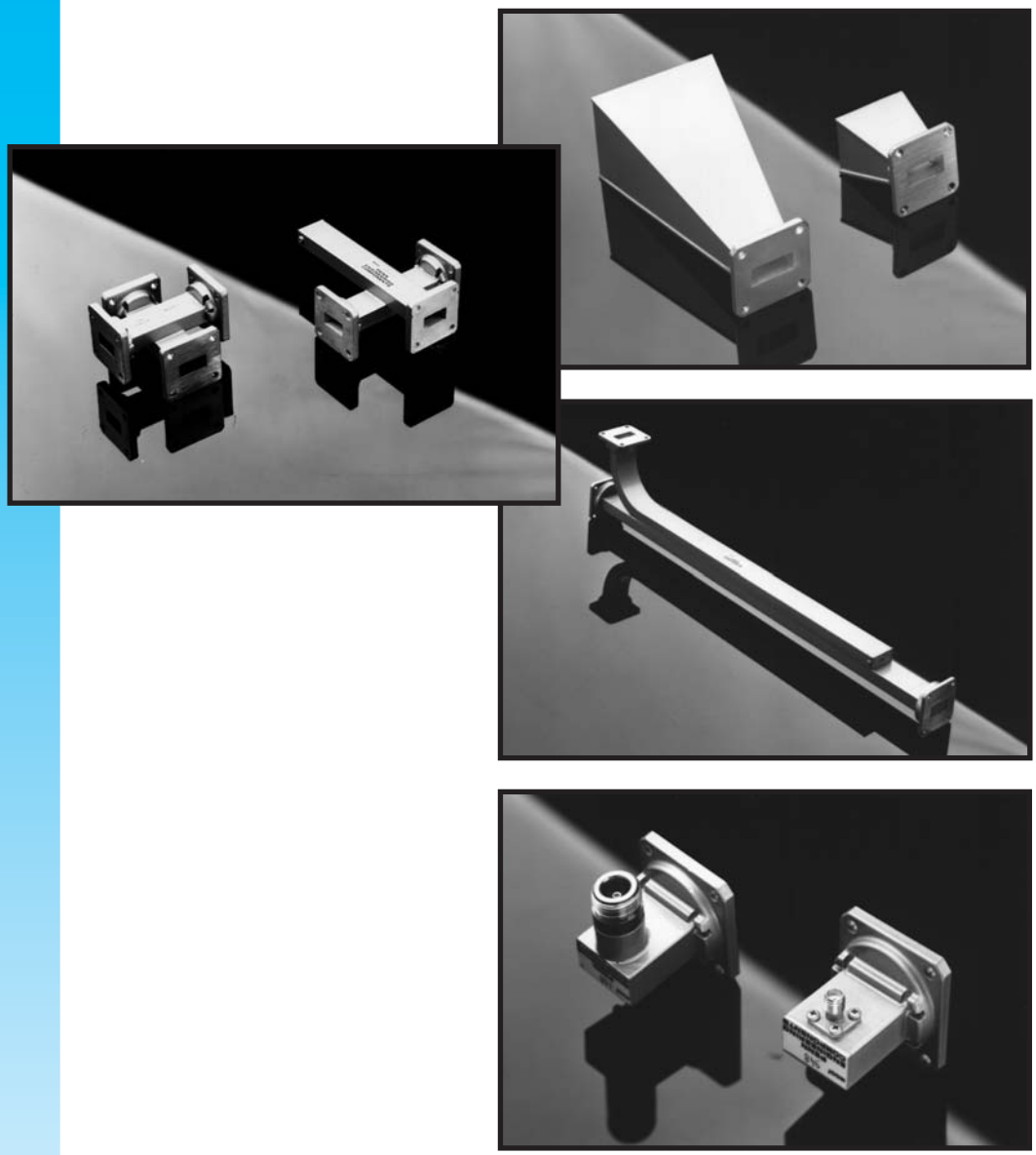

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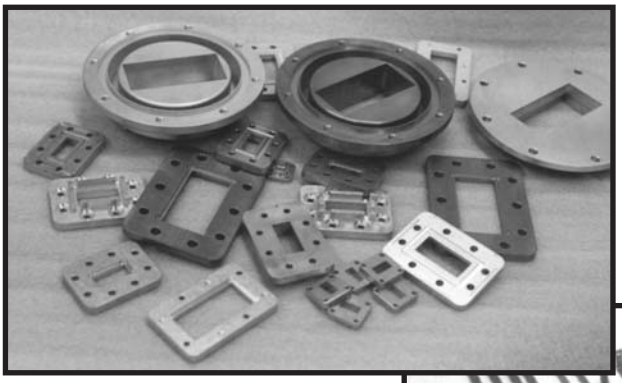

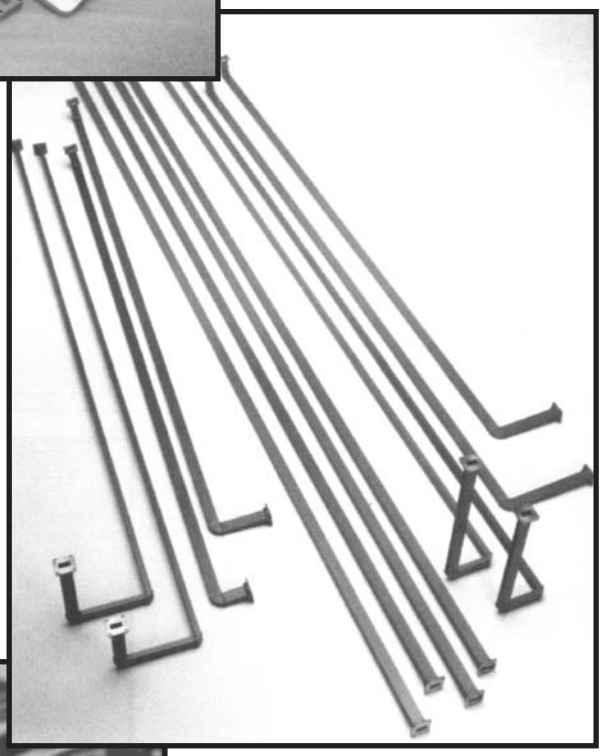

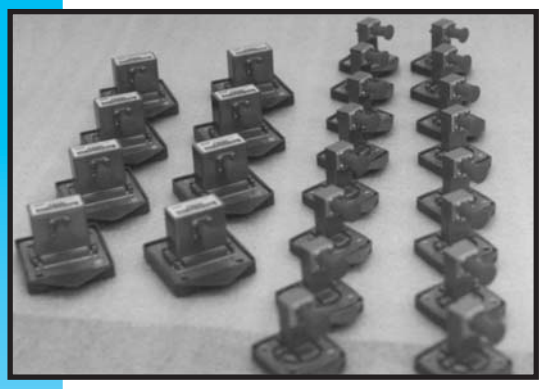

Established in California in 1971, Penn Engineering has many years of Experience and Knowledge in Designing and Manufacturing Waveguide Components for the Laboratory, Radar, Communications, Government, Military, Medical, Aerospace, Space Flight, and various other industries. We are committed to continuous improvement in our Manufacturing, Design, and Test Capabilities.

In addition to our Standard Waveguide Components, we will design and build one of a kind Custom Components to your specifications. On request, we also target, design, install, and test Full Waveguide Systems. With our CAD/CAM, and CNC production capabilities, we have the capacity to do prototypes as well as production runs of Microwave Components, Machined Parts, Flanges, and Castings.

Penn Engineering is an **ISO 9001:2000 Certified** and **AS9003:2001** Compliant Company. We maintain traceability of all materials that we sell and that we use in our components. Our commitment to Quality is extended to our goal of continuous improvement of our Products and to our Customer Service.

Data subject to change [Rev. 12/10]

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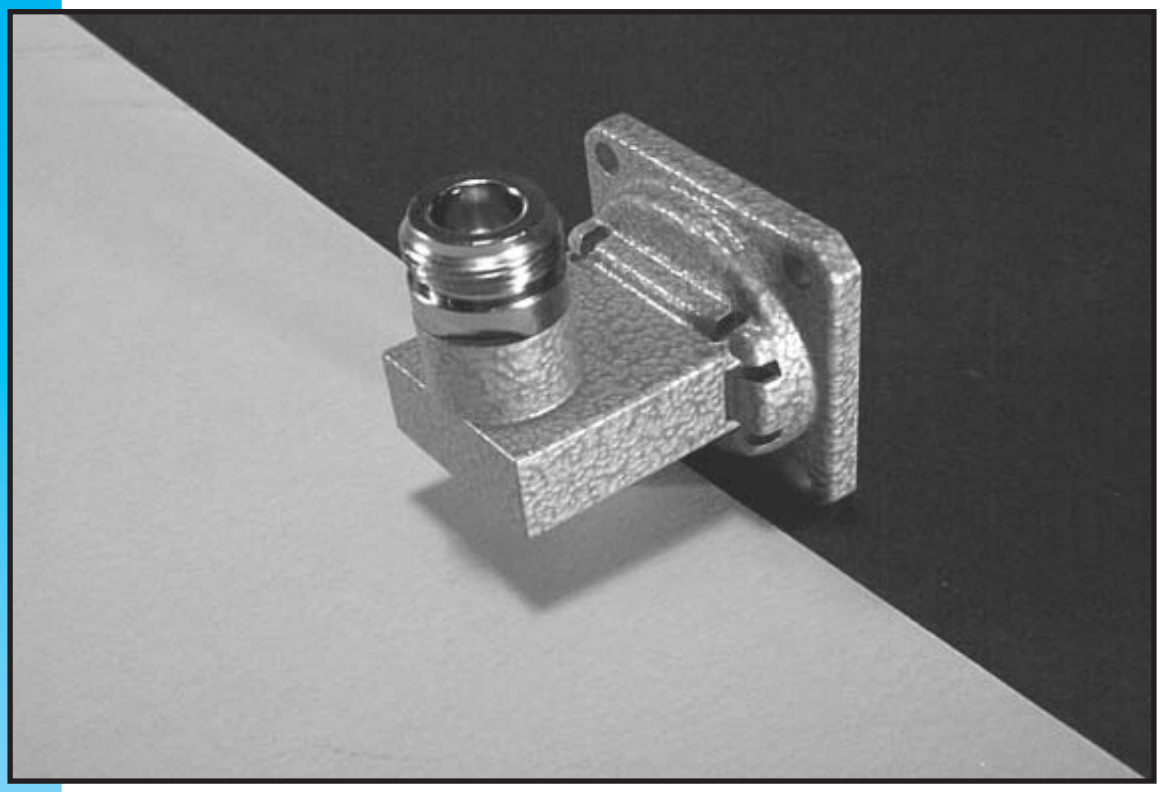
ADAPTERS- WAVEGUIDE TO TYPE "N"



PENN ENGINEERING offers a line of Type "N" Coax to Waveguide Adapters covering the frequency range of 1.12 to 18.0 GHz. These units are widely used in the test lab and in many commercial applications. Typical Insertion Loss is .1 dB and power handling is typically 150 watts.

Brass/Bronze Adapters are Silver plated per QQ-S-365D Class A, Aluminum Adapters are Chem-Filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Low VSWR (1.10:1) Adapters, covering portions of the waveguide band are also available as well as pressure-sealed adapters and High-Power adapters. We will design and build Custom Waveguide to Coax Adapters to your specifications.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 1242-1B ..... Is a WR-90 to Type "N" female with cover flange in bronze/brass material

- 1 — COMPONENT TYPE
- 2 — WAVEGUIDE SIZE CODE
- 4 — FLANGE
- B — ALLOY

ALLOY: **A**= ALUMINUM **B**=BRONZE/BRASS
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

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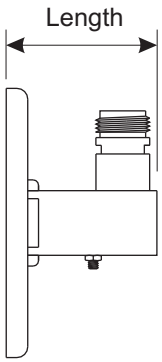
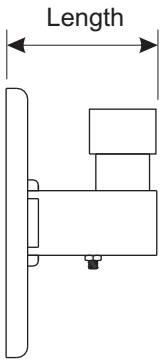
WAVEGUIDE TO TYPE "N" CONNECTOR



1200 SERIES FEMALE

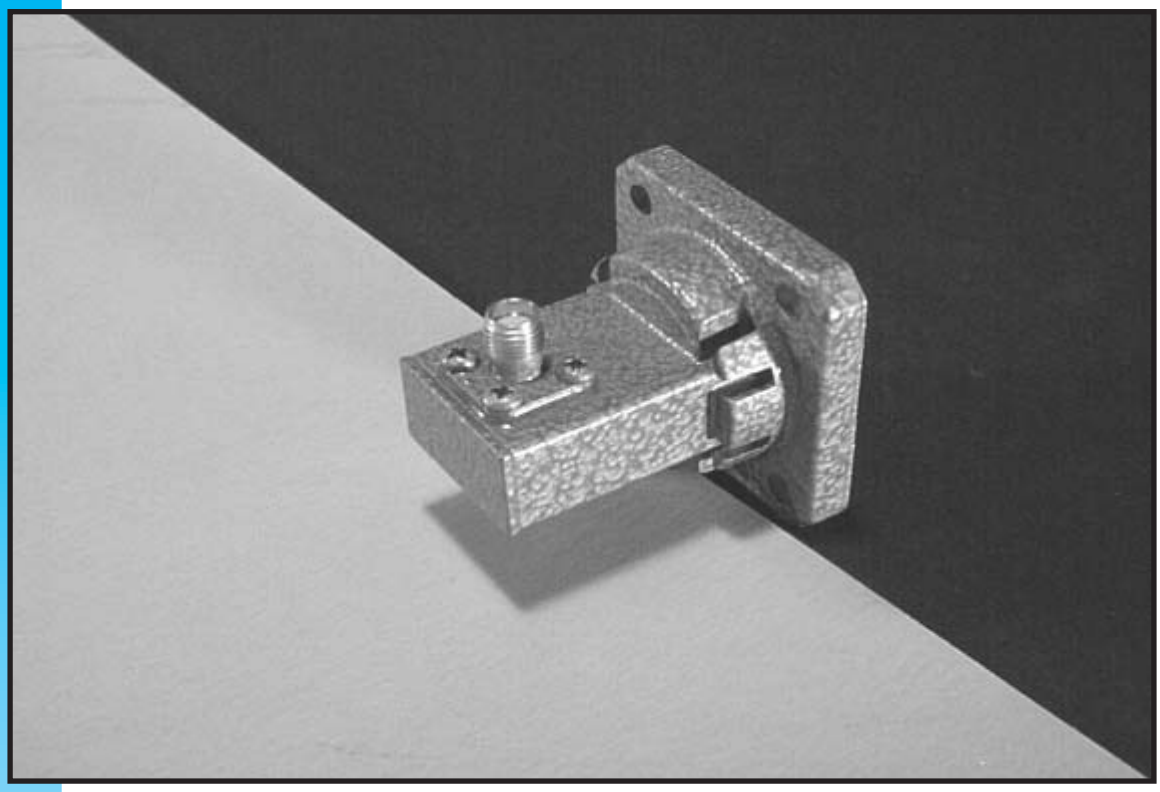


1300 SERIES MALE

Model #		Waveguide Size EIA	Frequency Range(GHz)	VSWR (Max.)	Length (inches)
Female	Male				
1264	1364	WR-650	1.12-1.70	1.25	5.62
1260	1360	WR-430	1.70-2.60	1.25	4.12
1258	1358	WR-340	2.20-3.30	1.25	3.50
1256	1356	WR-284	2.60-3.95	1.25	3.00
1254	1354	WR-229	3.30-4.90	1.25	2.12
1252	1352	WR-187	3.95-5.85	1.25	2.00
1250	1350	WR-159	4.90-7.05	1.25	2.00
1248	1348	WR-137	5.85-8.20	1.25	1.75
1246	1346	WR-112	7.05-10.0	1.25	1.50
1244	1344	WR-102	7.00-11.0	1.25	1.50
1242	1342	WR-90	8.2-12.4	1.25	1.50
1240	1340	WR-75	10.0-15.0	1.25	1.50
1238	1338	WR-62	12.4-18.0	1.25	1.00

ADAPTERS-WAVEGUIDE TO COAX

SMA, SSMA, 3.5mm, 2.92mm(K), 2.4mm, and 1.85mm(V) Connectors



PENN ENGINEERING offers a complete line of Coax to Waveguide Adapters with, SMA, SSMA, 3.5mm, 2.92mm(”K”), 2.4mm, and 1.85mm(”V”) connectors covering the frequency range of 1 to 75 Ghz.

These units are widely used in the test lab and in many commercial applications. Typical Insertion Loss is .1 dB and typical Power Handling is 50 watts.

Brass/bronze Adapters are Silver plated per QQ-S-365D Class A, Aluminum Adapters are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Low VSWR (e.g., 1.10:1) Adapters, covering portions of the waveguide band are also available as well as pressure-sealed adapters. We will design and build Custom Adapters to your specifications.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 1442-1B ..... Is a WR-90 Type “SMA” with a cover flange in brass/bronze

- ALLOY
- FLANGE
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS/BRONZE **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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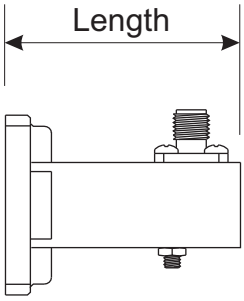
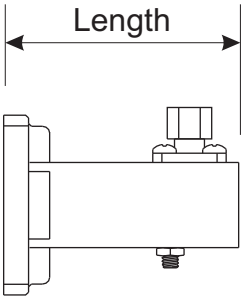
WAVEGUIDE TO TYPE SMA, SSMA, 3.5, 2.92(K), 2.4mm, and 1.85mm(V)



1400 SERIES FEMALE

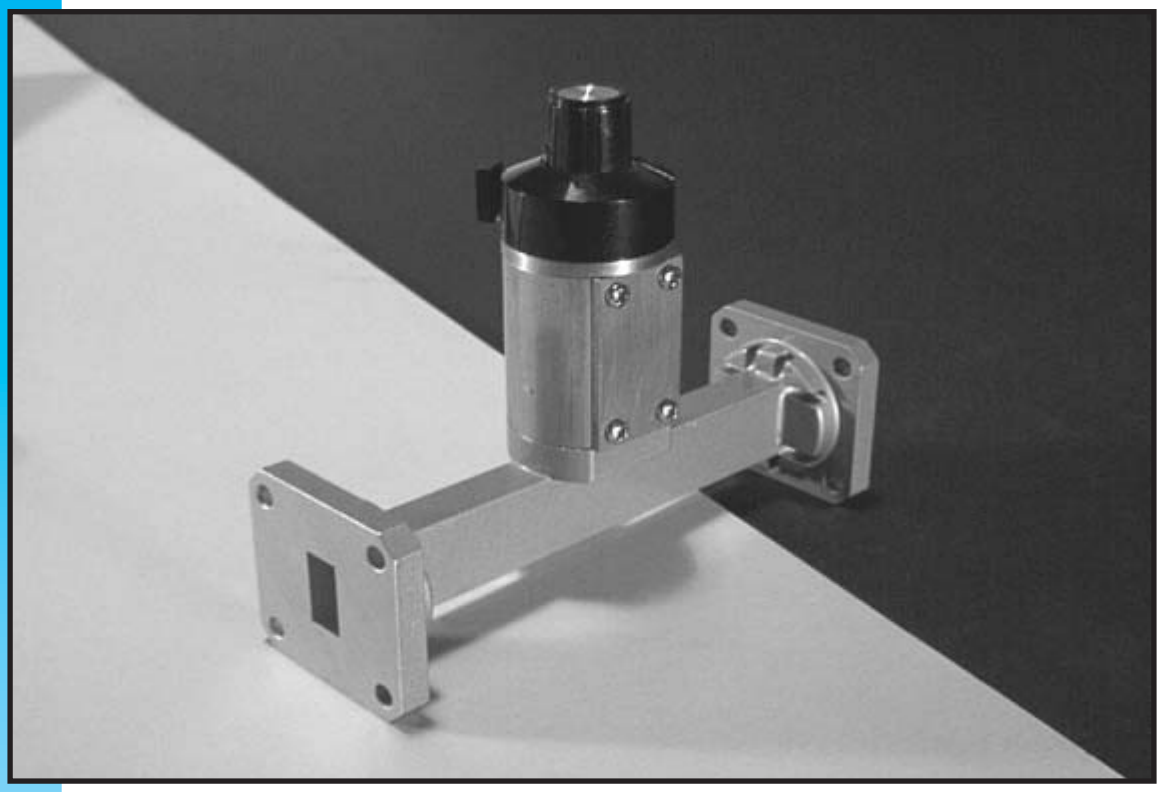


1500 SERIES MALE

Model #		Connector Type	Waveguide Size EIA	Frequency Range(GHz)	VSWR (max.)	Length (inches)
Female	Male					
1460	1560	SMA	WR-430	1.70-2.60	1.25	4.12
1458	1558	SMA	WR-340	2.20-3.30	1.25	3.50
1456	1556	SMA	WR-284	2.60-3.95	1.25	3.00
1454	1554	SMA	WR-229	3.30-4.90	1.25	2.12
1452	1552	SMA	WR-187	3.95-5.85	1.25	2.00
1450	1550	SMA	WR-159	4.90-7.05	1.25	2.00
1448	1548	SMA	WR-137	5.85-8.20	1.25	1.75
1446	1546	SMA	WR-112	7.05-10.0	1.25	1.50
1444	1544	SMA	WR-102	7.00-11.0	1.25	1.50
1442	1542	SMA	WR-90	8.2-12.4	1.25	1.50
1440	1540	SMA	WR-75	10.0-15.0	1.25	1.50
1438	1538	SMA	WR-62	12.4-18.0	1.25	1.00
1436	1536	SMA	WR-51	15.0-22.0	1.25	1.00
1434	1534	SMA	WR-42	18.0-26.5	1.25	1.00
1432	1532	2.92mm	WR-34	22.0-33.0	1.25	1.00
1430*	1530	2.92 or 2.4mm	WR-28	26.5-40.0	1.30	1.00
1428*	1528	2.92 or 2.4mm	WR-22	33.0-50.0	1.30	1.00
1426*	1526	2.4mm	WR-19	40.0-60.0	1.50	1.00
1424*	1524	1.85mm	WR-15	50.0-67.0	1.50	1.00

*Contact Penn for Full Part Number

ATTENUATORS-VARIABLE



PENN ENGINEERING offers a line of Variable Waveguide Attenuators for manually adjusting the power level in a waveguide system. These units are typically used when a repeatable attenuation level is desired for calibration and other purposes.

Attenuation range is 0 dB to 40 dB (WR 42, WR 34, and WR 28 are 0 dB to 25 dB). VSWR is 1.20:1 max. Insertion loss is 0.5 dB max. Variable Attenuators can be supplied with a calibration sheet upon request. Calibration is mid-band unless otherwise specified by customer.

Brass/Bronze Attenuators are Silver plated per QQ-S-365D Class A, Aluminum Attenuators are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 3742-11B ..... Is a WR-90 Variable Attenuator with cover flanges in brass/bronze

- 3 — COMPONENT TYPE
- 7 — WAVEGUIDE SIZE CODE
- 1 — PORT 1 FLANGE
- 1 — PORT 2 FLANGE
- B — ALLOY

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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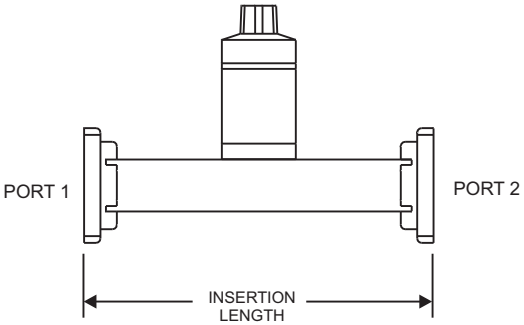
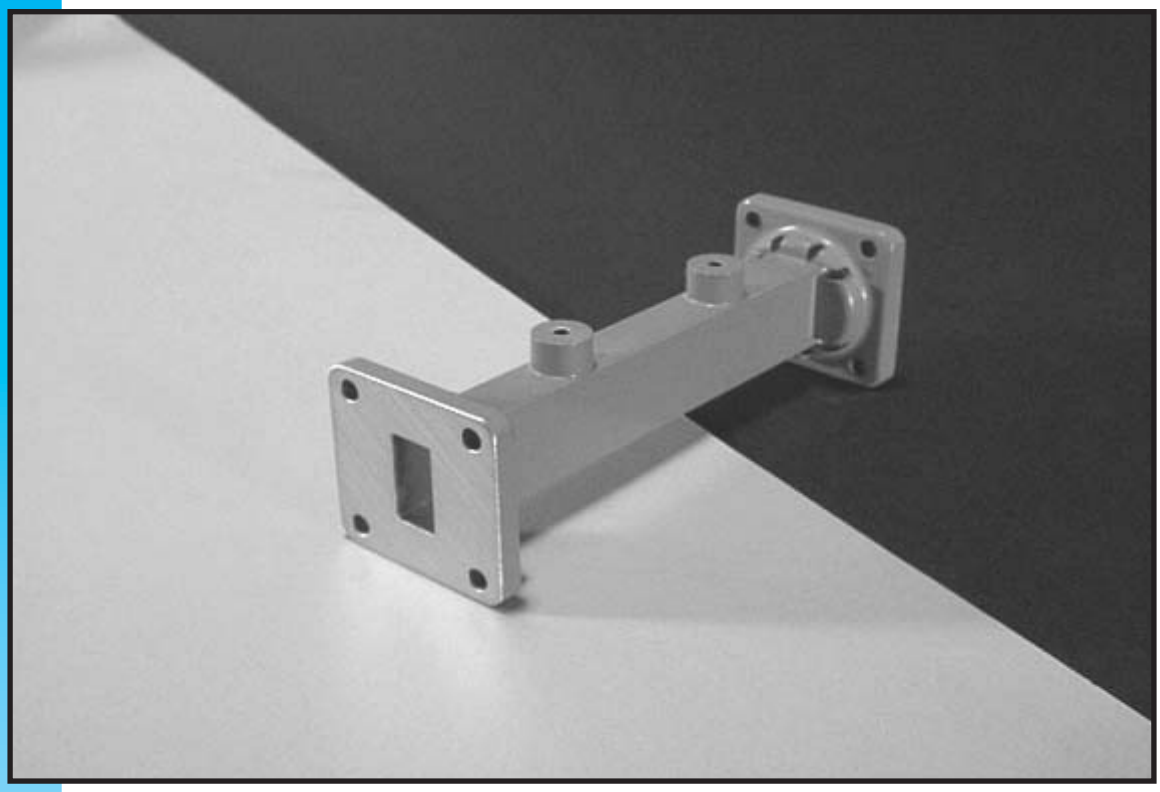
VARIABLE ATTENUATORS



Model #	Waveguide EIA	Calibration Freq. (GHz)	Insertion Length
3756	**WR-284**	3.20	16.00
3754	**WR-229**	4.10	13.00
3752	**WR-187**	4.90	11.00
3750	**WR-159**	6.00	10.50
3748	**WR-137**	7.00	8.00
3746	**WR-112**	8.50	6.50
3744	**WR-102**	9.00	6.00
3742	**WR-90**	10.30	5.50
3740	**WR-75**	12.50	5.00
3738	**WR-62**	15.20	4.50
3736	**WR-51**	18.50	4.00
3734	**WR-42**	22.20	4.00
3732	**WR-34**	27.50	4.00
3730	**WR-28**	33.20	4.00

ATTENUATORS-FIXED



PENN ENGINEERING'S Fixed Pad Attenuators are useful for reducing the amount of power in a line, reflections of loads, or isolating units in a waveguide system. Attenuators can be supplied with any attenuation from 3 dB to 40 dB (WR 42, WR 34, and WR 28 are 3dB to 30 dB). Standard units are 3, 6, 10, 20, 30, and 40 dB. Typical VSWR is 1.20:1

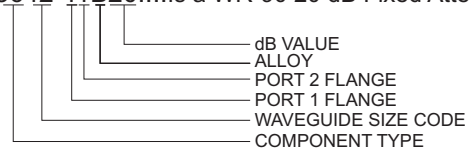
Calibration frequency is set at mid band unless otherwise specified by customer.

Brass/bronze Attenuators are Silver plated per QQ-S-365D Class A, Aluminum Attenuators are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

We will build Custom Fixed Attenuators to your specifications.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 3642-11B20....Is a WR-90 20 dB Fixed Attenuator with cover flanges in brass/bronze



ALLOY: **A**= ALUMINUM **B**=BRASS/BRONZE **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

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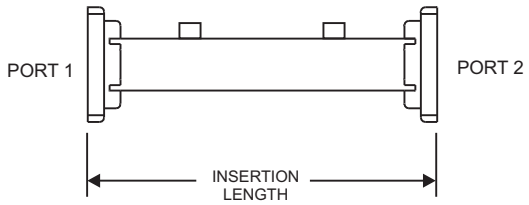
FIXED ATTENUATORS

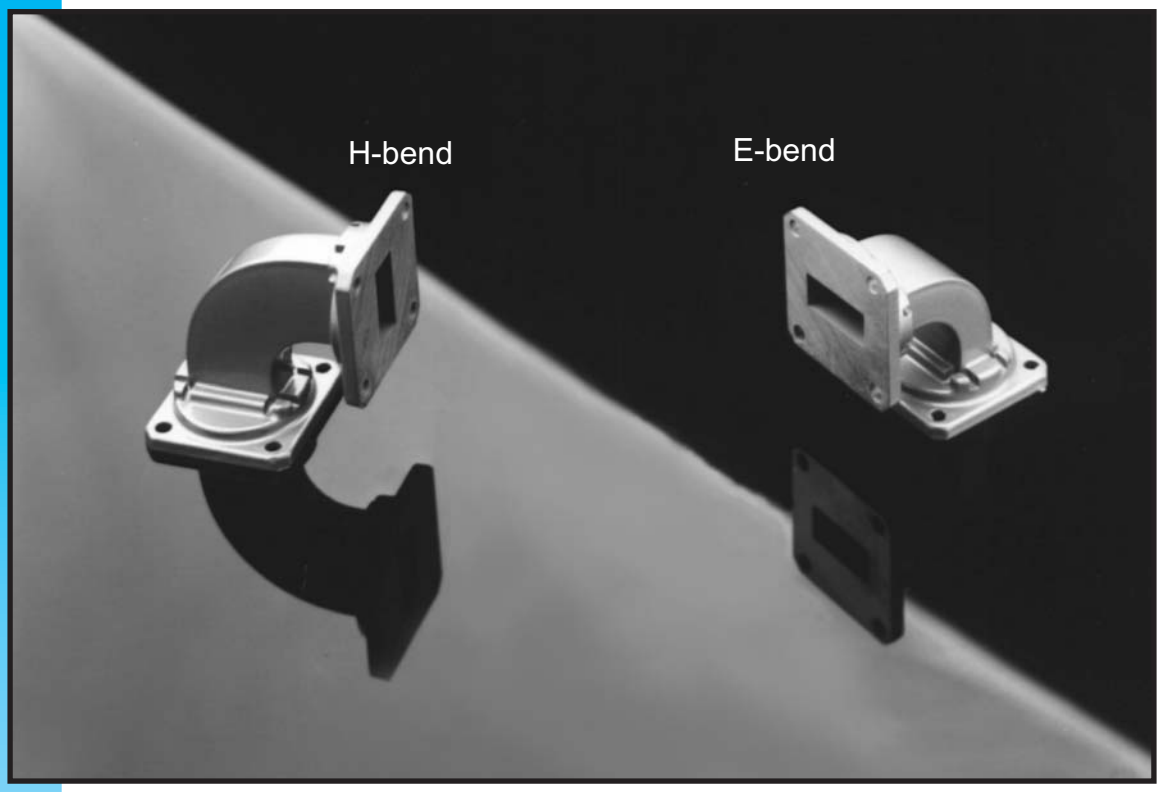


Model #	Waveguide EIA	Calibration Freq. (GHz)	Insertion Length
3656	**WR-284**	3.20	16.00
3654	**WR-229**	4.10	13.00
3652	**WR-187**	4.90	11.00
3650	**WR-159**	6.00	10.50
3648	**WR-137**	7.00	9.00
3646	**WR-112**	8.50	7.00
3644	**WR-102**	9.00	7.00
3642	**WR-90**	10.30	6.00
3640	**WR-75**	12.50	5.00
3638	**WR-62**	15.20	4.00
3636	**WR-51**	18.50	4.00
3634	**WR-42**	22.20	3.00
3632	**WR-34**	27.50	3.00
3630	**WR-28**	33.20	2.50

Typical frequency sensitivity:

	VARIATION OVER BAND	
ATTENUATION	**WR 284 to WR 51**	**WR 42, WR 34, and WR 28**
3 dB	+/- 0.5 dB	+/- 1.0 dB
6 dB	+/- 1.0 dB	+/- 2.0 dB
10 dB	+/- 1.5 dB	+/- 2.5 dB
20 dB	+/- 2.0 dB	+/- 3.0 dB
30 dB	+/- 2.5 dB	+/- 4.0 dB
40 dB	+/- 3.0 dB	-

BENDS E AND H PLANE



PENN ENGINEERING offers a series of standard 45 and 90 degree E plane and H plane formed bends for use in a waveguide system. Typical VSWR is 1.05:1 over the full frequency range.

Brass/bronze bends are Silver plated per QQ-S-365D Class A, Aluminum bends are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Custom bends offering various angles and configurations are also available upon request.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 2042-12B.....Is a WR-90 "E" plane bend with cover/choke flanges in brass/bronze

- 2042-12B — COMPONENT TYPE
- 2042-12B — WAVEGUIDE SIZE CODE
- 2042-12B — PORT 1 FLANGE
- 2042-12B — PORT 2 FLANGE
- 2042-12B — ALLOY

ALLOY: **A**= ALUMINUM **B**=BRASS/BRONZE **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

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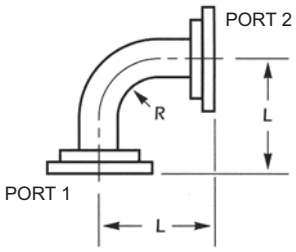
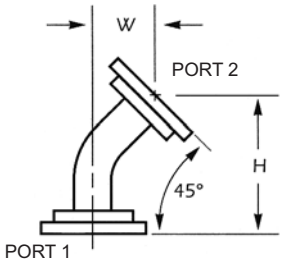
RADIUS BEND 90°



Model #	90 Deg. E-Bend		Model #	90 Deg. H-Bend		Waveguide EIA	Frequency Range(GHz)
	L	R		L	R		
2058	12.0	7.0	**2158**	12.0	5.0	**WR-340**	2.20-3.30
2056	7.75	6.0	**2156**	7.25	4.0	**WR-284**	2.60-3.95
2054	3.625	2.0	**2154**	4.25	2.0	**WR-229**	3.30-4.90
2052	5.062	2.0	**2152**	5.562	2.0	**WR-187**	3.95-5.85
2050	2.5	1.0	**2150**	2.875	1.0	**WR-159**	4.90-7.05
2048	2.375	1.0	**2148**	2.75	1.0	**WR-137**	5.85-8.20
2046	2.062	.750	**2146**	2.375	.750	**WR-112**	7.05-10.0
2044	2.00	.750	**2144**	2.00	.5	**WR-102**	7.00-11.0
2042	1.437	.5	**2142**	1.687	.5	**WR-90**	8.20-12.4
2040	1.437	.5	**2140**	1.687	.5	**WR-75**	10.0-15.0
2038	1.656	.5	**2138**	1.812	.5	**WR-62**	12.4-18.0
2036	1.656	.5	**2136**	1.812	.5	**WR-51**	15.0-22.0
2034	1.25	.5	**2134**	1.375	.5	**WR-42**	18.0-26.5
2032	1.25	.5	**2132**	1.375	.5	**WR-34**	22.0-33.0
2030	1.234	.5	**2130**	1.312	.5	**WR-28**	26.5-40.0
2028	1.234	.5	**2128**	1.312	.5	**WR-22**	33.0-50.0
2026	1.234	.5	**2126**	1.312	.5	**WR-19**	40.0-60.0
2024	1.234	.5	**2124**	1.312	.5	**WR-15**	50.0-75.0
2022	1.234	.5	**2122**	1.312	.5	**WR-12**	60.0-90.0
2020	1.234	.5	**2120**	1.312	.5	**WR-10**	75.0-110.0

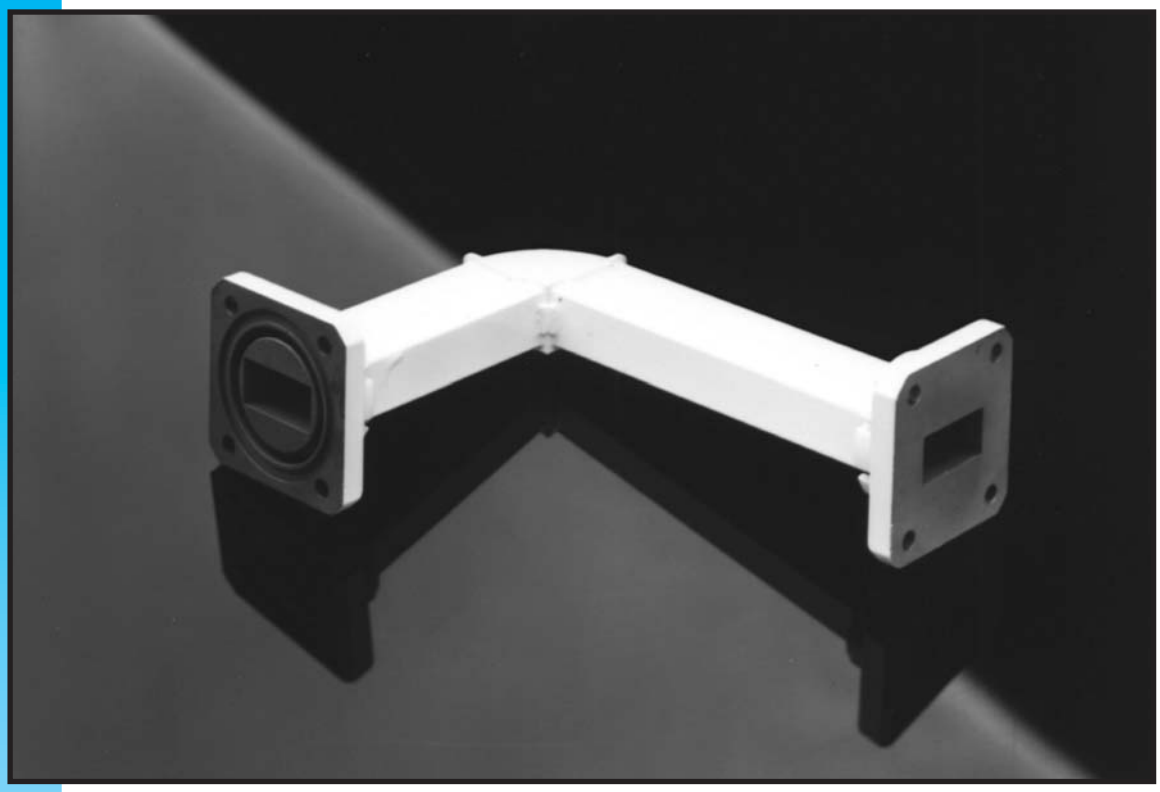
RADIUS BEND 45°



(ALL BEND RADII SAME AS 90 DEG. BENDS)

Model #	45 Deg. E-Bend		Model #	45 Deg. H-Bend		Waveguide EIA	Frequency Range(GHz)
	W	H		W	H		
2256	1.875	4.5	**2356**	2.093	5.031	**WR-284**	2.60-3.95
2254	1.062	2.656	**2354**	1.312	3.062	**WR-229**	3.30-4.90
2252	1.437	3.468	**2352**	1.593	3.812	**WR-187**	3.95-5.85
2250	1.25	3.0	**2350**	1.218	2.906	**WR-159**	4.90-7.05
2248	1.125	2.687	**2348**	1.218	2.937	**WR-137**	5.85-8.20
2246	1.093	2.625	**2346**	1.187	2.875	**WR-112**	7.05-10.0
2244	1.093	2.625	**2344**	1.187	2.875	**WR-102**	7.00-11.0
2242	0.968	2.312	**2342**	1.031	2.5	**WR-90**	8.20-12.4
2240	0.687	1.687	**2340**	0.687	1.687	**WR-75**	10.0-15.0
2238	0.687	1.687	**2338**	0.687	1.687	**WR-62**	12.4-18.0
2236	0.687	1.687	**2336**	0.687	1.687	**WR-51**	15.0-22.0
2234	0.687	1.687	**2334**	0.687	1.687	**WR-42**	18.0-26.5
2232	0.687	1.687	**2332**	0.687	1.687	**WR-34**	22.0-33.0
2230	0.687	1.687	**2330**	0.687	1.687	**WR-28**	26.5-40.0
2228	0.687	1.687	**2328**	0.687	1.687	**WR-22**	33.0-50.0
2226	0.687	1.687	**2326**	0.687	1.687	**WR-19**	40.0-60.0
2224	0.687	1.687	**2324**	0.687	1.687	**WR-15**	50.0-75.0
2222	0.687	1.687	**2322**	0.687	1.687	**WR-12**	60.0-90.0
2220	0.687	1.687	**2320**	0.687	1.687	**WR-10**	75.0-110.0

BENDS - MITRE E & H PLANE



H-plane bend shown

PENN ENGINEERING will build mitre bend assemblies to your dimensions and specifications. Specify “E” or “H” plane bend, leg length, and flange type, and you have a custom bend to fit into your waveguide system.

Typical VSWR for mitred bend assemblies is 1.05:1 over the full frequency range.

Brass/Bronze bends are Silver Plated per QQ-S-365D Class A, Aluminum Bends are Chem-Filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 2442-12B12.600-3.956 .....Is a WR-90 Mitre E-plane with cover/choke flanges in bronze

- LEG 2 LENGTH (In Inches)
- **LEG 1 LENGTH (In Inches)**
- ALLOY
- LEG 2 FLANGE
- **LEG 1 FLANGE**
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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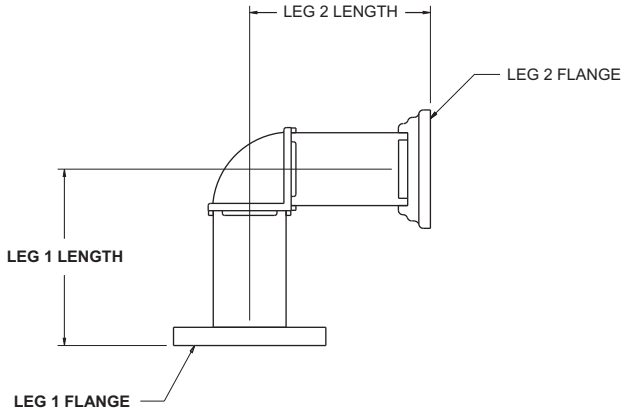
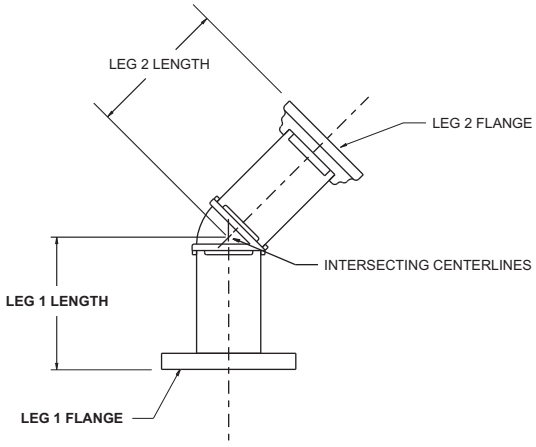
MITERED BEND 90º



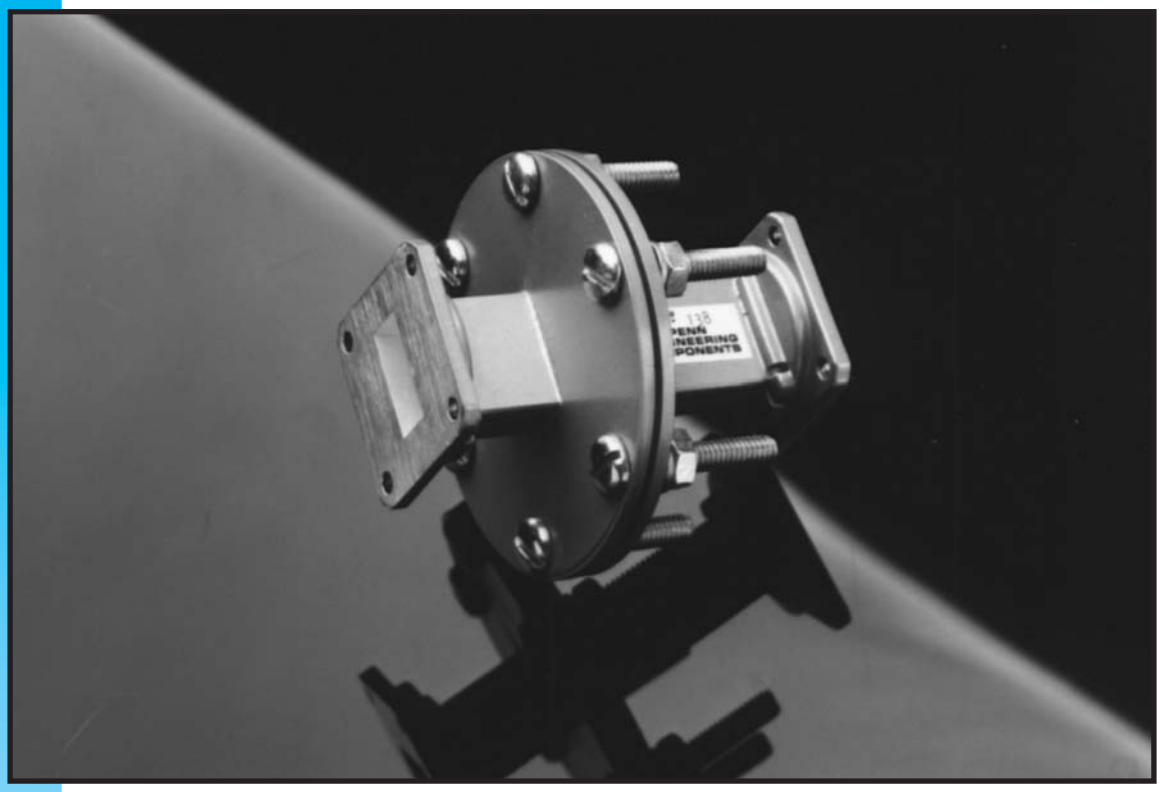
90 Degree "E" Plane Model #	90 Degree "H" plane Model #	Waveguide EIA	Frequency Range (GHz)
2456	**2556**	**WR 284**	2.60-3.95
2454	**2554**	**WR 229**	3.30-4.90
2452	**2552**	**WR 187**	3.95-5.85
2450	**2550**	**WR 159**	4.90-7.05
2448	**2548**	**WR 137**	5.85-8.20
2446	**2546**	**WR 112**	7.05-10.0
2444	**2544**	**WR 102**	7.00-11.0
2442	**2542**	**WR 90**	8.20-12.4
2440	**2540**	**WR 75**	10.0-15.0
2438	**2538**	**WR 62**	12.4-18.0
2436	**2536**	**WR 51**	15.0-22.0
2434	**2534**	**WR 42**	18.0-26.5
2430	**2530**	**WR 28**	26.5-40.0

MITERED BEND 45º



90 Degree "E" Plane Model #	90 Degree "H" plane Model #	Waveguide EIA	Frequency Range (GHz)
2656	**2756**	**WR 284**	2.60-3.95
2654	**2754**	**WR 229**	3.30-4.90
2652	**2752**	**WR 187**	3.95-5.85
2650	**2750**	**WR 159**	4.90-7.05
2648	**2748**	**WR 137**	5.85-8.20
2646	**2746**	**WR 112**	7.05-10.0
2644	**2744**	**WR 102**	7.00-11.0
2642	**2742**	**WR 90**	8.20-12.4
2640	**2740**	**WR 75**	10.0-15.0
2638	**2738**	**WR 62**	12.4-18.0
2636	**2736**	**WR 51**	15.0-22.0
2634	**2734**	**WR 42**	18.0-26.5
2630	**2730**	**WR 28**	26.5-40.0

BULKHEAD FEED-THROUGH



Bulkhead Feed-through units are used when a waveguide system must pass through a pressurized wall or cabinet. A Neoprene gasket, a backing ring, and stainless steel mounting hardware are included with each unit. *(Note: You can use the backing ring as a drilling template!)*

Brass/Bronze units are Silver plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Custom Bulkhead Flanges can be fabricated to your specifications.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 4242-11B .....Is a WR-90 unit with cover flanges in brass

- ALLOY
- PORT 2
- PORT 1
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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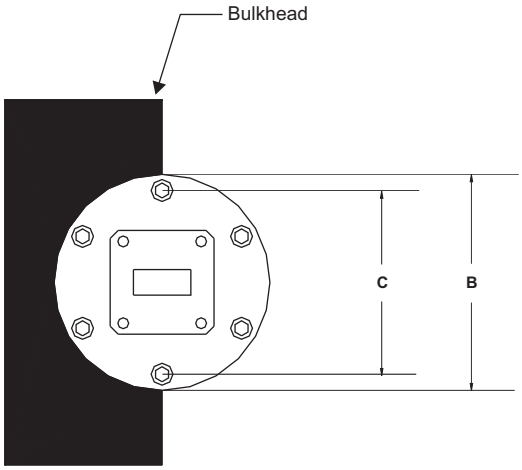
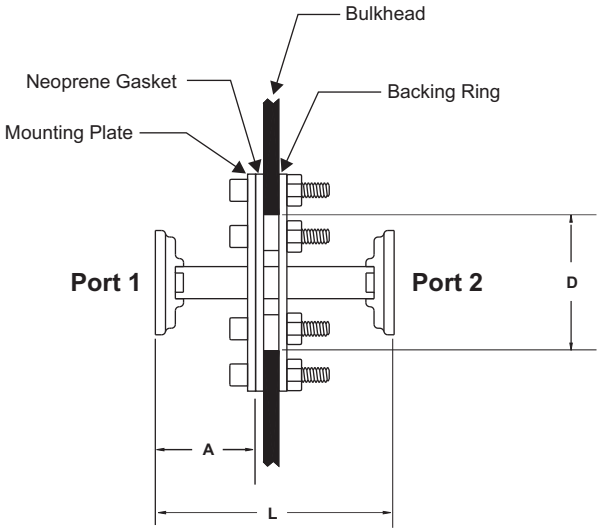
BULKHEAD FEED-THROUGH

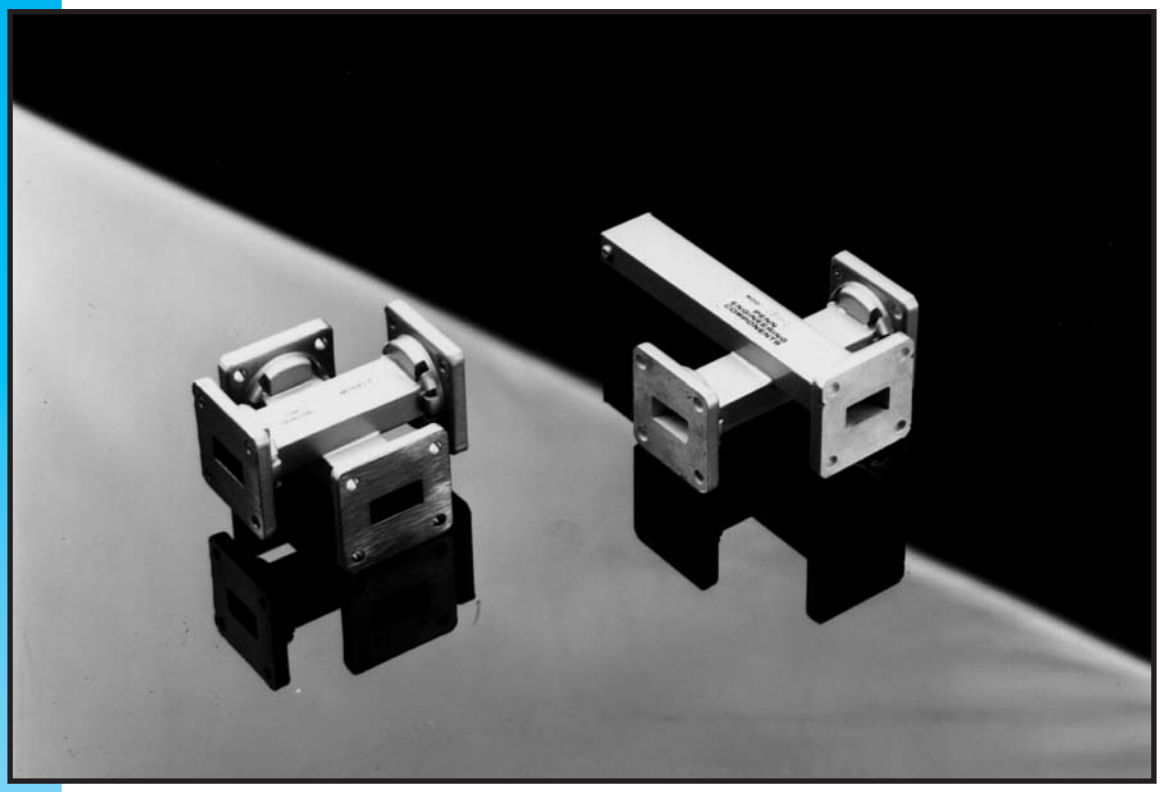




Model #	Waveguide Size EIA	Frequency Range GHz	A	B	C (Bolt Circle)	D (Hole in Bulkhead)	L
4256	**WR 284**	2.60-3.95	1.625	7.25	6.5*	5.5	4.25
4254	**WR 229**	3.30-4.90	1.625	6.75	6.00*	5.00	4.25
4252	**WR 187**	3.95-5.85	1.625	5.25	4.625*	3.75	4.25
4250	**WR 159**	4.90-7.05	1.625	6.00	5.250*	4.25	4.25
4248	**WR 137**	5.85-8.20	1.625	4.75	4.00*	3.125	4.25
4246	**WR 112**	7.05-10.0	1.625	4.00	3.250*	2.625	4.25
4244	**WR 102**	7.00-11.0	1.625	4.00	3.250*	2.625	4.25
4242	**WR 90**	8.20-12.4	1.375	3.375	2.875**	2.125	3.75
4240	**WR 75**	10.0-15.0	1.375	3.375	2.875**	2.125	3.75
4238	**WR 62**	12.4-18.0	1.00	3.375	2.875**	2.125	3.00
4236	**WR 51**	15.0-22.0	1.00	3.375	2.875**	2.125	3.00
4234	**WR 42**	18.0-26.5	1.00	3.375	2.875**	2.125	3.00
4232	**WR 34**	22.0-33.0	1.00	3.00	2.875**	2.125	3.00
4230	**WR 28**	26.5-40.0	1.00	3.00	2.500**	1.875	3.00
4228	**WR 22**	33.0-50.0	1.00	3.00	2.500**	1.875	3.00
4226	**WR 19**	40.0-60.0	1.00	3.00	2.500**	1.875	3.00
4224	**WR 15**	50.0-75.0	1.00	3.00	2.500**	1.875	3.00
4222	**WR 12**	60.0-90.0	1.00	3.00	2.500**	1.875	3.00
4220	**WR 10**	75.0-110.0	1.00	3.00	2.500**	1.875	3.00

***Diameter of bolt hole circle for 8 holes 1/4" in diameter**
****Diameter of bolt hole circle for 6 holes 1/4" in diameter**

CROSS GUIDE DIRECTIONAL COUPLERS



PENN ENGINEERING'S Cross guide Directional Couplers are a cost effective method of sampling the power traveling through a waveguide system. Terminated models sample power in one direction while 4 port models sample power in both directions. Our Couplers are CNC machined for high precision and individually tuned. Fullband directivity is 15 dB min.

Mid-band nominal coupling values of 20, 30, 40, & 50 dB are standard. Other values are available upon request.

Brass/Bronze Couplers are Silver plated per QQ-S-365D Class A, Aluminum Couplers are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 5442-1111B-20 ..... Is a WR-90 20 dB unterminated model with cover flanges on all ports in brass

- COUPLING VALUE
- ALLOY
- PORT 4 FLANGE (unterminated models)
- PORT 3 FLANGE
- PORT 2 FLANGE
- PORT 1 FLANGE
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF **6**=SMA (Female) **7**="N" (Female)

(See last page for complete list of flanges and materials)

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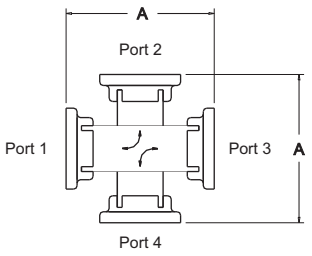
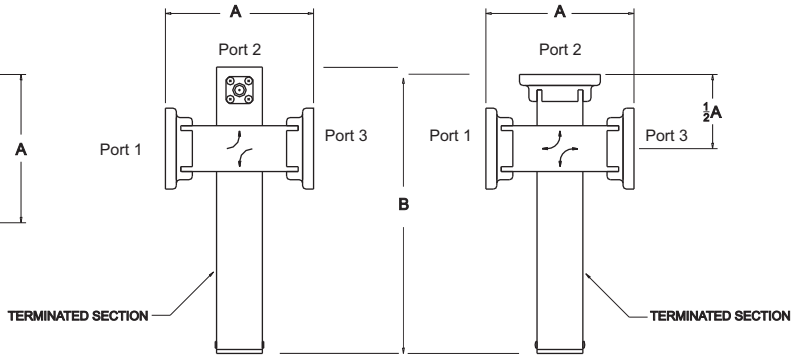
CROSS GUIDE DIRECTIONAL COUPLERS



5400 Series



5500 Series

Unterminated Model No.	Terminated Model No.	Waveguide Size EIA	Frequency Range GHz	Dimension "A"	Dimension "B" *
5464	**5564**	**WR-650**	1.12-1.70	10.75	size on request
5460	**5560**	**WR-430**	1.70-2.60	9	size on request
5456	**5556**	**WR-284**	2.60-3.95	7.5	15.50
5454	**5554**	**WR-229**	3.30-4.90	6.5	14.12
5452	**5552**	**WR-187**	3.95-5.85	5.75	12.50
5450	**5550**	**WR-159**	5.90-6.50	5.25	10.56
5448	**5548**	**WR-137**	5.85-8.20	5	8.87
5446	**5546**	**WR-112**	7.05-10.0	4	8.68
5444	**5544**	**WR-102**	7.00-11.0	3.5	8.50
5442	**5542**	**WR-90**	8.20-12.4	3	6.50
5440	**5540**	**WR-75**	10.0-15.0	2.75	6.00
5438	**5538**	**WR-62**	12.4-18.0	2.5	4.87
5436	**5536**	**WR-51**	15.0-22.0	2.5	4.31
5434	**5534**	**WR-42**	18.0-26.5	2.5	4.25
5432	**5532**	**WR-34**	22.0-33.0	2.5	4.25
5430	**5530**	**WR-28**	28.5-40.0	1.5	4.25

*** Terminated models only**

DIRECTIONAL COUPLERS-MULTIHOLE

PENN ENGINEERING'S Directional Couplers are an excellent method for measuring the microwave energy traveling through a waveguide system. Coupling values of 3, 6, 10, and 20 dB are available with nominal coupling values of +/- .4dB. Coupling values of 30 and 40 dB are available with nominal coupling value of +/- 1.0 dB (models in WR 28, WR 34, WR 42, and WR 51 coupling values are +/- .6 dB and +/- 1.2 dB) *Custom coupling values are available on request*.

Main line VSWR is 1.05:1 maximum (1.10:1 for the 3 dB coupling)

Broad band directivity is greater than 40 dB (except for the WR-28, WR-42, and WR-51 which is 35 dB.) Broad band VSWR through coupled port (with flange) is 1.15-1.2 dB.

Brass/Bronze units are Silver plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 5042-111B-10..... Is a WR-90 10dB coupler in copper alloy with cover flanges on all three ports

- COUPLING VALUE
- ALLOY
- PORT 3 FLANGE
- PORT 2 FLANGE
- PORT 1 FLANGE
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF **6**=SMA (Female) **7**="N" (Female)

(See last page for complete list of flanges and materials)

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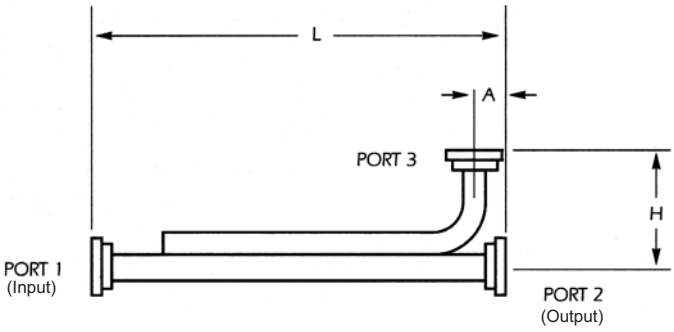
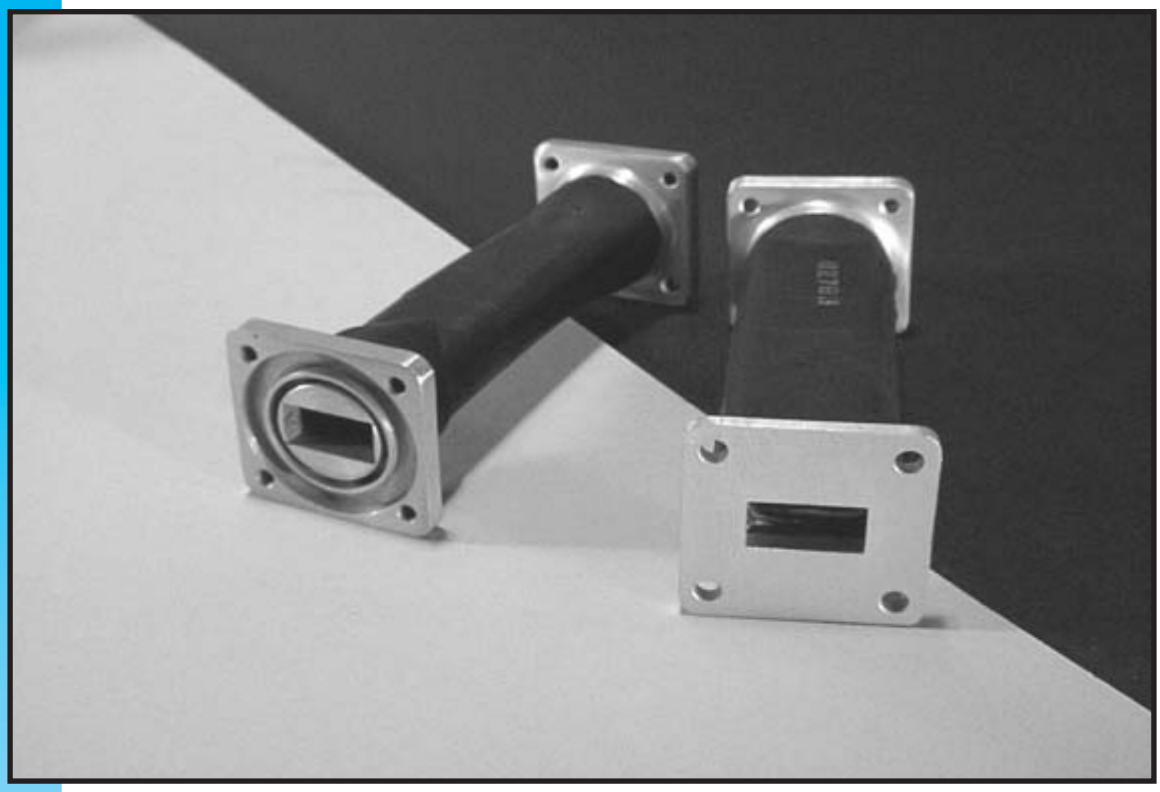
DIRECTIONAL COUPLERS-MULTIHOLE



Model No.	Waveguide Size EIA	Frequency Range GHz	L	A	H
5064	**WR 650**	1.12-1.70	on request	on request	on request
5060	**WR 430**	1.70-2.60	on request	on request	on request
5058	**WR 340**	2.20-3.30	on request	on request	on request
5056	**WR 284**	2.60-3.95	50.25	2.656	9.18
5054	**WR 229**	3.30-4.90	42.0	1.0	6.81
5052	**WR 187**	3.95-5.85	34.625	1.812	6.43
5050	**WR 159**	4.90-7.05	32.5	0.875	5.25
5048	**WR 137**	5.85-8.20	26.5	1.562	3.06
5046	**WR 112**	7.05-10.0	18.625	0.937	3.06
5044	**WR 102**	7.00-11.0	18.0	0.875	2.25
5042	**WR 90**	8.20-12.4	16.687	0.812	1.93
5040	**WR 75**	10.00-15.0	15.0	0.75	2.50
5038	**WR 62**	12.4-18.0	13.75	0.656	2.18
5036	**WR 51**	15.0-22.0	12.0	0.656	2.12
5034	**WR 42**	18.0-26.5	9.5	0.437	1.25
5032	**WR 34**	22.0-33.0	9.0	0.437	1.25
5030	**WR 28**	26.5-40.0	6.5*	0.375	1.12
5028	**WR 22**	33.0-50.0	6.0	0.375	1.12

*10dB, 6dB, and 3dB models are 8.62" Length

FLEXIBLE SEAMLESS WAVEGUIDE



PENN ENGINEERING offers a wide variety of Flexible Seamless Waveguide Sections in many different sizes and configurations. These sections flex without impairing VSWR or attenuation. Standard Flex sections are silver plated brass with brass flanges with or without neoprene/vinyl jacket. Seamless flex will hold pressure with or without jacket.

Aluminum flanges are also available.

We will quote you on custom Flex sections built to your specifications.

Ordering Information - To order use the following example:

Model 4642-12A12V.....is a WR-90 Seamless Flex section 12" long w/ Vinyl Jacket and aluminum cover/choke flanges

- **Jacket Composition or Paint Type (Optional)**
- **Length in Inches**
- **Flange Alloy**
- **Port 2 Flange**
- **Port 1 Flange**
- **Waveguide Size Code**
- **Component Type**

ALLOY: **A**= ALUMINUM **B**=BRASS
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF
JACKET: **N**=NEOPRENE **V**=VINYL

(See last page for complete list of flanges and materials)

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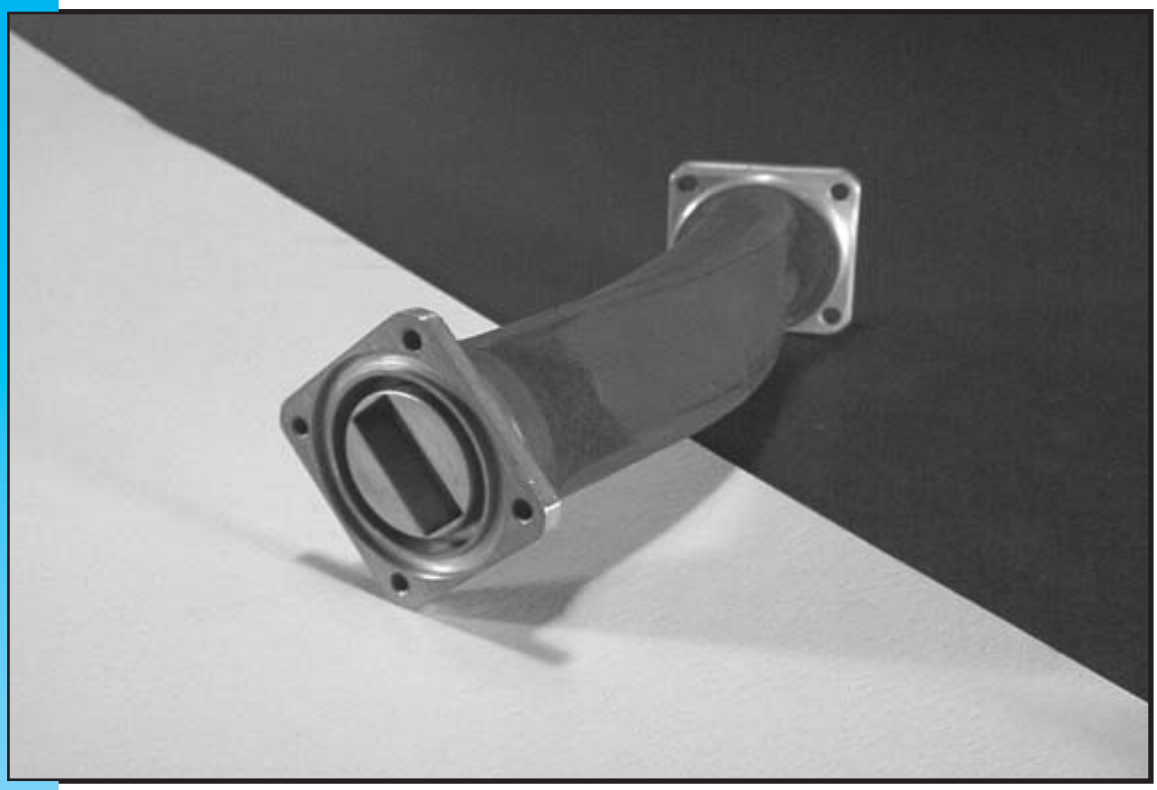
FLEXIBLE SEAMLESS WAVEGUIDE SPECIFICATIONS

Typical Electrical Specifications					*Typical Mechanical Specifications*				*Power Handling*	
MODEL NO.	EIA WR SIZE	FREQ. RANGE GHz	*VSWR	**ATTEN.	Bend Radii to Centerline				CW Power In **Watts**	Peak Power In **Kilowatts**
					With Jacket (in inches)		Without Jacket (In Inches)			
					E-Plane	H-Plane	E-Plane	H-Plane		
4628	**22**	33.0-50.0	1.35	1.000	.75	1.13	.44	.94	75	12
4630	**28**	26.5-40.0	1.30	0.500	.75	1.13	.44	.94	150	20
4632	**34**	22.0-33.0	1.30	0.350	.88	1.25	.57	.88	200	30
4634	**42**	18.0-26.5	1.20	0.320	.88	1.25	.57	.88	300	39
4636	**51**	15.0-22.0	1.20	0.320	.90	1.40	.63	1.0	500	70
4638	**62**	12.4-18.0	1.12	0.150	1.00	1.88	.69	1.25	1,000	90
4640	**75**	10.0-15.0	1.10	0.120	1.13	2.25	.63	1.25	1,500	140
4642	**90**	8.20-12.4	1.10	0.100	1.75	2.50	1.25	1.50	3,000	180
4644	**102**	7.00-11.0	1.10	0.060	2.00	2.88	1.30	1.94	4,000	300
4646	**112**	7.05-10.0	1.10	0.060	2.25	3.25	1.40	1.82	4,000	315
4648	**137**	5.85-8.20	1.10	0.050	2.38	3.38	1.50	2.07	5,000	500
4650	**159**	4.90-7.05	1.10	0.040	4.00	6.00	1.60	2.25	6,000	1,100
4652	**187**	3.95-5.85	1.08	0.030	4.38	6.50	1.94	3.00	6,500	1,250
4654	**229**	3.30-4.90	1.07	0.020	6.50	8.00	2.13	3.25	8,000	1,550
4656	**284**	2.60-3.95	1.07	0.018	7.00	9.50	2.94	5.50	10,000	2,000
4658	**340**	2.20-3.30	1.07	0.010	10.0	16.0	4.25	6.00	16,000	3,700
4660	**430**	1.70-2.60	1.07	0.010	12.0	25.0	4.82	6.63	20,000	4,700
4664	**650**	1.12-1.70	1.06	0.010	20.0	40.0	14.0	28.0	20,000	10,700

*VSWR is per 2 Ft. Section **Attenuation (Insertion Loss) is dB per Ft.

FLEXIBLE TWISTABLE WAVEGUIDE



PENN ENGINEERING offers a wide variety of Twistable Flexible waveguide in many different sizes and configurations. These sections flex on the E and H planes as well as twist without impairing VSWR or attenuation. Standard Flex sections are silver plated brass with brass flanges and are available with or without neoprene/vinyl jacket. Note: Twistable flex sections do not hold pressure without jacket.

Aluminum flanges are also available.

We will quote you on custom Flex sections built to your specifications.

Ordering Information - To order use the following example:

Model 4742-11B12N.....is a WR-90 Twistable Flex section 12" long w/ Neoprene Jacket and brass cover flanges

- Component Type
- Waveguide Size Code
- Port 1 Flange
- Port 2 Flange
- Flange Alloy
- Length in Inches
- Jacket Composition or Paint Type (Optional)

ALLOY: **A**=ALUMINUM **B**=BRASS
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF
JACKET: **N**= NEOPRENE **V**= VINYL

(See last page for complete list of flanges and materials)

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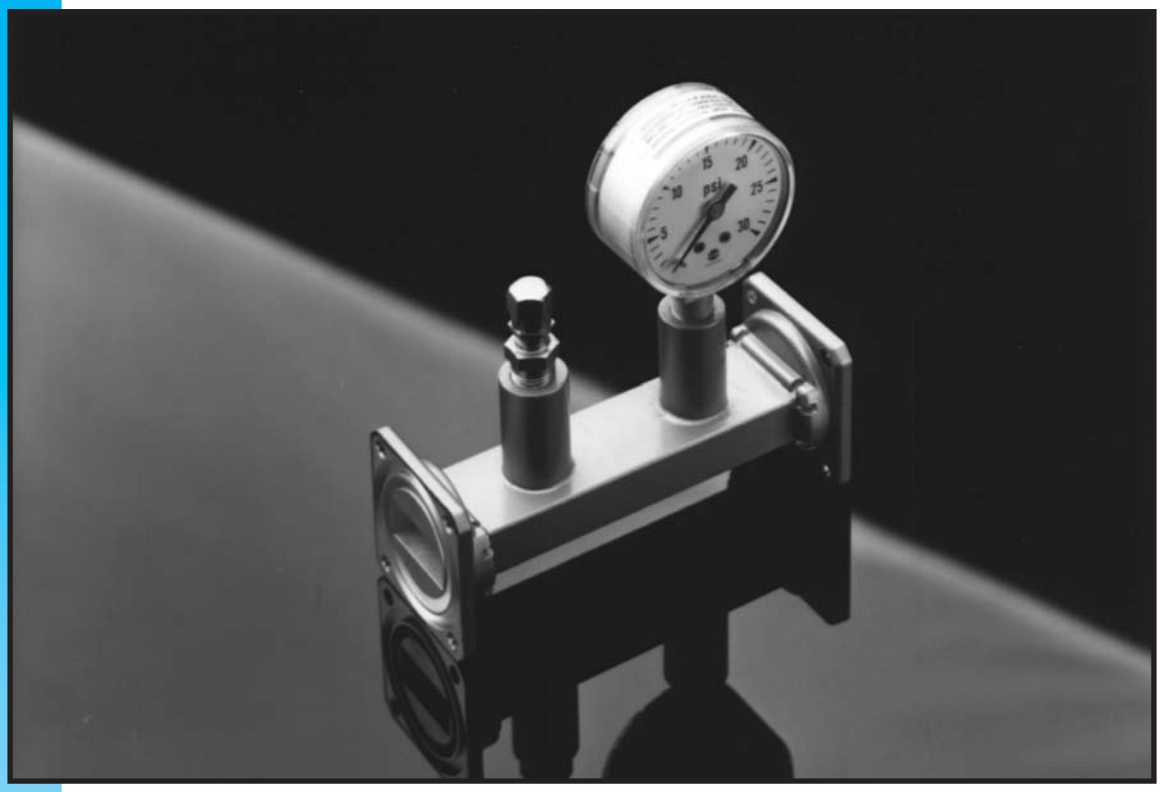
FLEXIBLE TWISTABLE WAVEGUIDE SPECIFICATIONS

Typical Electrical Specifications					*Typical Mechanical Specifications*				*Power Handling*	
MODEL NO.	EIA WR SIZE	FREQ. RANGE GHz	*VSWR	**ATTEN.	Bend Radii to Centerline With Jacket (in inches) E-Plane	Bend Radii to Centerline With Jacket (in inches) H-Plane	Bend Radii to Centerline Without Jacket (In Inches) E-Plane	Bend Radii to Centerline Without Jacket (In Inches) H-Plane	Power (Watts)	Peak Power (KW)
4728	**22**	33.0-50.0	1.35	1.200	.75	1.13	.44	.94	25	12
4730	**28**	26.5-40.0	1.30	0.600	.75	1.13	.44	.94	75	20
4732	**34**	22.0-33.0	1.30	0.500	.75	1.13	.44	.94	100	30
4734	**42**	18.0-26.5	1.20	0.350	.88	1.25	.57	.88	100	39
4736	**51**	15.0-22.0	1.21	0.210	.90	1.40	.63	1.0	300	70
4738	**62**	12.4-18.0	1.12	0.200	1.00	1.88	.69	1.25	400	100
4740	**75**	10.0-15.0	1.12	0.150	1.13	2.25	.63	1.25	750	140
4742	**90**	8.20-12.4	1.10	0.100	1.75	2.50	1.25	1.50	1,000	180
4744	**102**	7.00-11.0	1.10	0.090	2.00	2.88	1.30	1.94	1,500	300
4746	**112**	7.05-10.0	1.10	0.080	2.25	3.25	1.40	1.82	1,500	315
4748	**137**	5.85-8.20	1.09	0.070	2.38	3.38	1.50	2.07	2,000	500
4750	**159**	4.90-7.05	1.09	0.060	4.00	6.00	1.60	2.25	2,500	1,100
4752	**187**	3.95-5.85	1.09	0.050	4.38	6.50	1.94	3.00	3,000	1,250
4754	**229**	3.30-4.90	1.07	0.023	6.50	8.00	2.13	3.25	4,000	1,550
4756	**284**	2.60-3.95	1.09	0.018	7.00	9.50	2.94	5.50	4,000	2,000
4758	**340**	2.20-3.30	1.07	0.010	10.0	16.0	4.25	6.00	8,000	3,700
4760	**430**	1.70-2.60	1.07	0.010	12.0	25.0	4.82	6.63	10,000	4,700
4764	**650**	1.12-1.70	1.06	0.005	20.0	40.0	14.0	28.0	10,000	10,700

*VSWR is per 2 Ft. Section **Attenuation (Insertion Loss) is dB per Ft. Mechanical Specifications are approximate for Flexible Twistable Waveguide.

PRESSURIZING SECTIONS



PENN ENGINEERING'S Pressure Sections are used where air or other gases are to be introduced into the waveguide system. Stainless Steel Schrader valves are supplied as standard for inlets for air/gasses. Pressure Gauges are supplied in either 0-15 PSI or 0-30 PSI ranges to monitor internal pressure. Standard Pressure Ports have 1/8-27 NPT threaded receptacles and are 1.06 VSWR typ.

Brass/Bronze units are Silver Plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

We will build custom Pressurizing Sections to your specifications.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 4142-11B15 ..... Is a WR-90 unit with cover/cover flanges in copper alloy material with a 15 psi pressure gauge

- 15 — PRESSURE GAUGE RANGE (0-15 psi or 0-30 psi)
- B — ALLOY
- 1 — PORT 1 FLANGE
- 1 — PORT 2 FLANGE
- 42 — WAVEGUIDE SIZE CODE
- 4 — COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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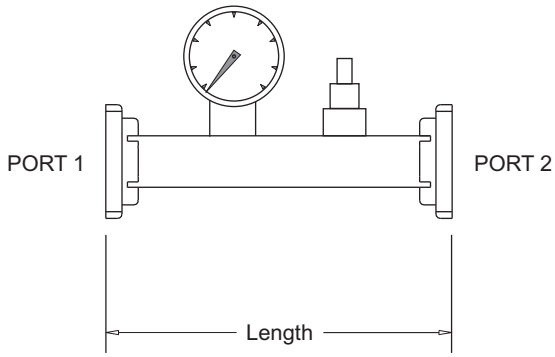
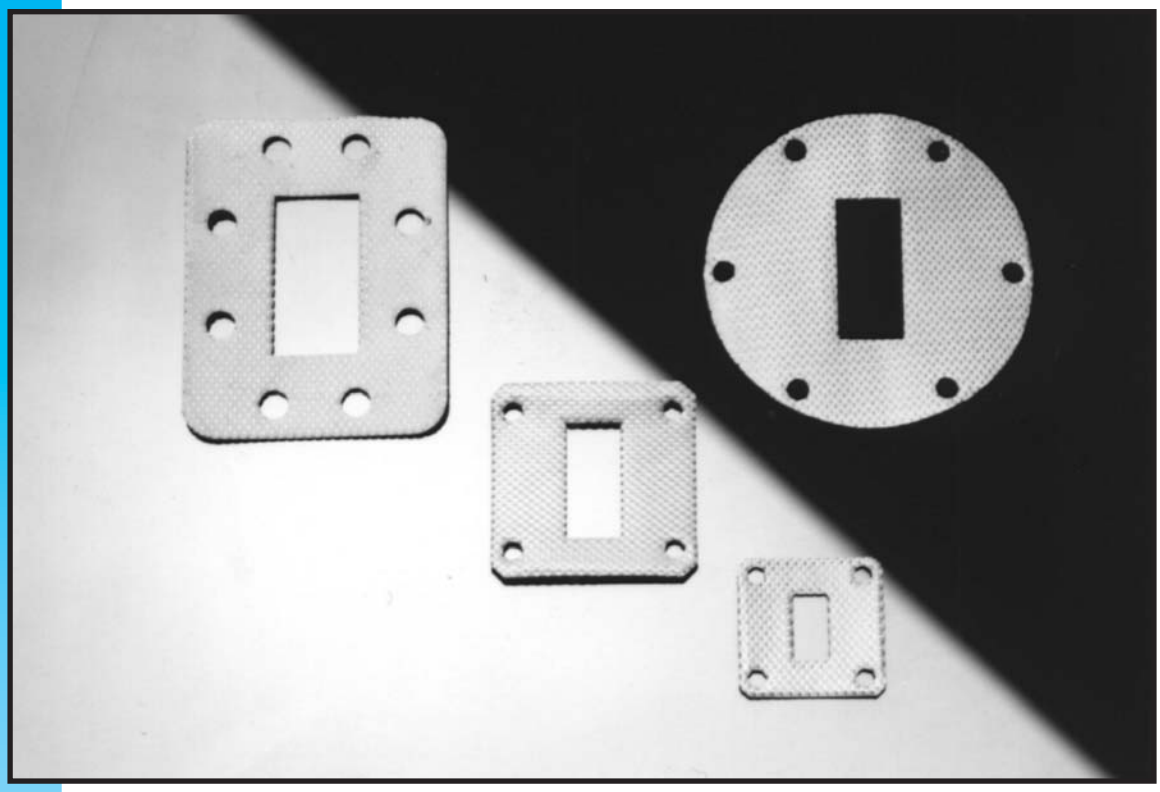
PRESSURIZING SECTIONS



Model No.	Waveguide Size EIA	Frequency Range GHz	Length
4156	WR 284	2.60-3.95	6.00
4154	WR 229	3.30-4.90	6.00
4152	WR 187	3.95-5.85	5.00
4150	WR 159	4.90-7.05	5.00
4148	WR 137	5.85-8.20	4.25
4146	WR 112	7.05-10.0	4.25
4144	WR 102	7.00-11.0	4.25
4142	WR 90	8.20-12.4	4.25
4140	WR 75	10.00-15.0	4.25
4138	WR 62	12.4-18.0	4.25
4136	WR 51	15.0-22.0	4.25
4134	WR 42	18.0-26.5	4.25
4132	WR 34	22.0-33.0	4.25
4130	WR 28	26.5-40.0	4.25
4128	WR 22	33.0-50.0	4.25
4126	WR 19	40.0-60.0	4.25
4124	WR 15	50.0-75.0	4.25
4122	WR 12	60.0-90.0	4.25
4120	WR 10	75.0-110.0	4.25

RF GASKETS



PENN ENGINEERING offers a line of RF waveguide flange gaskets to prevent RF leakage. The material is a high quality MIL-grade silicone filled expanded Monel.

Temperature range is -80 F to +400 F (-62 C to +204 C).

Styles are available in UG, CMR, and CPR types. We will quote you on your custom RF gaskets.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 6242-5..... Is for a WR-90 CPR style flange.

- 6 — COMPONENT TYPE
- 24 — WAVEGUIDE SIZE CODE
- 2 — FLANGE STYLE

FLANGE STYLE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

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RF GASKETS

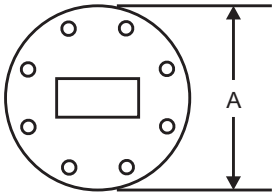


Fig. 1

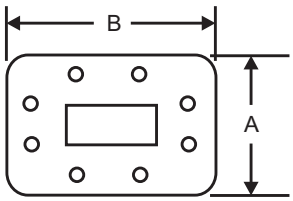


Fig. 2

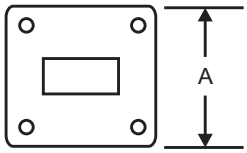
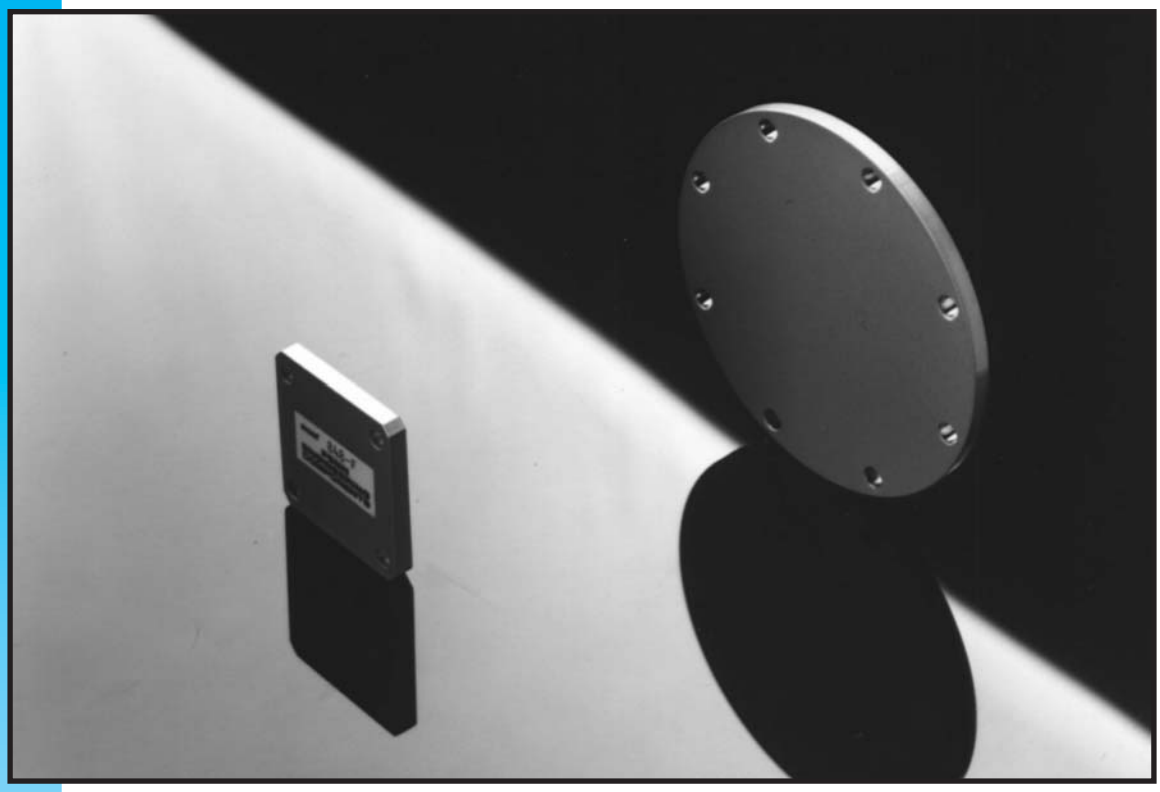


Fig. 3

Model	Waveguide EIA	Frequency	Flange Style	Fig.	A (inches)	B (inches)
6264-5	**WR-650**	1.12-1.17	**UG-1720/CPR**	2	5-7/16	8-11/16
6260-5	**WR-430**	1.70-2.60	**UG-1711/CPR**	2	4-3/16	6-11/32
6256-1	**WR-284**	2.60-3.95	**UG-53/U**	1	5-5/16	-
6256-3			**CMR-284**	2	2-11/32	3-27/32
6256-5			**CPR-284**	2	3	4-1/2
6254-3	**WR-229**	3.30-4.90	**CMR-229**	2	2	3-5/32
6254-5			**CPR-229**	2	2-3/4	3-7/8
6252-1	**WR-187**	3.95-3.85	**UG-149A/U**	1	3-5/8	-
6252-3			**CMR-187**	2	1-25/32	2-25/32
6252-5			**CPR-187**	2	2-1/2	3-1/2
6250-3	**WR-159**	4.90-7.05	**CMR-159**	2	1-3/4	2-1/2
6250-5			**CPR-159**	2	2-7/16	3-3/16
6248-1	**WR-137**	5.82-8.20	**UG-344/U**	1	3-1/8	-
6248-3			**CMR-137**	2	1-17/32	2-9/32
6248-5			**CPR-137**	2	1-15/16	2-11/16
6246-1	**WR-112**	7.05-10.0	**UG-51/U**	3	1-7/8	-
6246-3			**CMR-112**	2	1-3/8	2-1/64
6246-5			**CPR-112**	2	1-3/4	2-1/2
6244-1	**WR-102**	7.00-11.0	**UG-1493/U**	3	1-11/16	-
6242-1	**WR-90**	8.20-12.4	**UG-39/U**	3	1-5/8	-
6242-3			**CMR-90**	2	1-17/64	1-49/64
6242-5			**CPR-90**	2	1-19/32	2-3/32
6240-1	**WR-75**	10.0-15.0	**WR-75**	3	1-1/2	-
6238-1	**WR-62**	12.4-18.0	**UG-419/U**	3	1-15/16	-
6236-1	**WR-51**	15.0-22.0	**WR-51**	3	1-13/16	-
6234-1	**WR-42**	18.0-26.5	**UG-595/U**	3	7/8	-
6232-1	**WR-34**	22.0-33.0	**UG-1530/U**	3	7/8	-
6230-1	**WR-28**	26.5-40.0	**UG-599/U**	3	3/4	-

SHORTING PLATES



PENN ENGINEERING offers a line of Shorting Plates which provide almost perfect RF reflection. They are also used with gaskets to seal waveguide for pressure testing purposes. Other Shorts are available in various styles such as UG, CPR/CPRG, CMR, European style, and Double Ridge.

We will also make custom Shorting Plates to your specifications.

Brass Shorts are Silver plated per QQ-S-365D Class A, Aluminum Shorts are Chem-filmed per MIL-C-5541E, and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 6142-1B ..... Is a WR-90 Shorting Plate cover flange style in brass

- ALLOY
- FLANGE STYLE
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE STYLE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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SHORTING PLATES

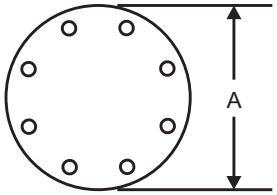

Fig. 1

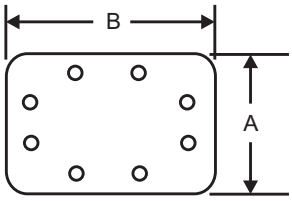

Fig. 2

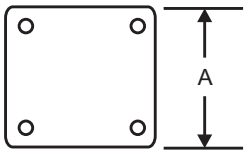

Fig. 3

SHORTING PLATES ARE .187 THICK TYP.

Model Number	Waveguide EIA	Frequency range (GHz)	Flange	Fig.	Dimension "A"	Dimension "B"
6164-5	WR 650	1.12-1.70	UG Style	2	5.437	8.687
6160-5	WR 430	1.70-2.60	UG Style	2	4.187	6.343
6156-1	WR 284	2.60-3.95	UG Style	1	5.312	–
6156-3			CMR-284	2	2.343	3.843
6156-5			CPR-284	2	3	4.5
6154-3	WR 229	3.30-4.90	CMR-229	2	2	3.156
6154-5			CPR-229	2	2.75	3.875
6152-1	WR 187	3.95-3.85	UG Style	1	3.625	–
6152-3			CMR-187	2	1.781	2.781
6152-5			CPR-187	2	2.5	3.5
6150-3	WR 159	4.90-7.05	CMR-159	2	11.75	2.5
6150-5			CPR-159	2	2.437	3.187
6148-1	WR 137	5.85-8.20	UG Style	1	3.125	–
6148-3			CMR-137	2	1.531	2.281
6148-5			CPR-137	2	1.312	2.687
6146-1	WR 112	7.05-10.0	UG Style	3	1.875	–
6146-3			CMR-112	2	1.375	2.015
6146-5			CPR-112	2	1.75	2.5
6144-1	WR 102	7.00-11.0	UG Style	3	1.687	–
6142-1	WR 90	8.20-12.4	UG Style	3	1.625	–
6142-3			CMR-90	2	1.265	1.765
6142-5			CPR-90	2	1.593	2.093
6140-1	WR 75	10.0-15.0	WR 75	3	1.5	–
6140-5			CPR-75	2	1.325	1.7
6138-1	WR 62	12.4-18.0	UG Style	3	1.312	–
6136-1	WR 51	15.0-22.0	WR 51	3	1.187	–
6134-1	WR 42	18.0-26.5	UG Style	3	0.875	–
6132-1	WR 34	22.0-33.0	UG Style	3	0.875	–
6130-1	WR 28	26.5-40.0	UG Style	3	0.75	–
6128-1	WR 22, 19	33.0-60.0	UG Style	1	1.125	–
6124-1	WR 15, 12, 10	50.0-110.0	UG Style	1	0.75	–
6184-1	WRD 350	3.50-8.20	–	2	2	2.75
6190-1	WRD 650	6.5-18.0	–	3	1.375	–
6192-1	WRD 750	7.50-18.0	–	3	1.375	–

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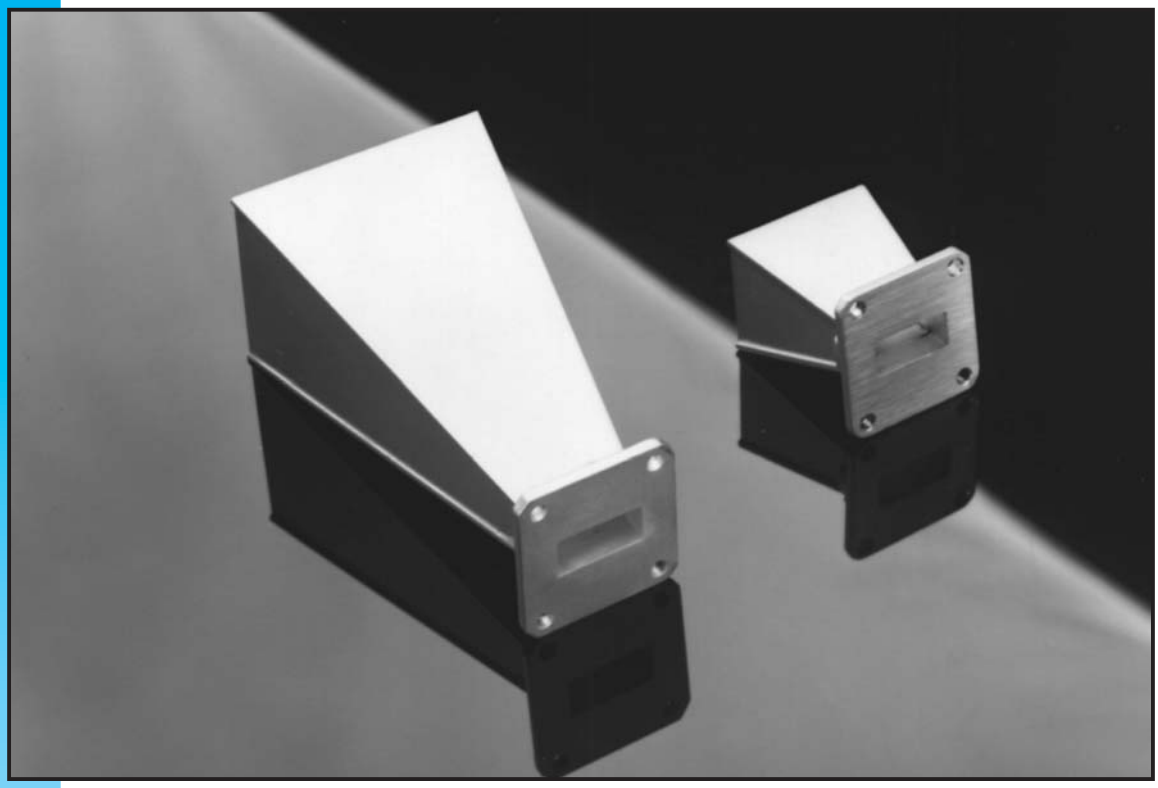
STANDARD GAIN HORNS



Standard Gain Horns are available with mid-band gains of 10,15, or 20 dB. The beam width of these horns is approximately 50 degrees for 10 dB, 32 degrees for 15 dB and 15 degrees for 20 dB. Typical VSWR is 1.5:1 Max.

Horns are available in Brass, Silver Plated per QQ-S-365D Class A or Aluminum Chem-filmed per MIL-C-5541E. Horns are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Gains and beam widths other than those listed are available upon request.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 9042-1B15 ..... Is a WR-90 15 dB Horn with a cover flange in brass

- 15 — GAIN IN dB
- B — ALLOY
- 1 — FLANGE
- 42 — WAVEGUIDE SIZE CODE
- 90 — COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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STANDARD GAIN HORNS

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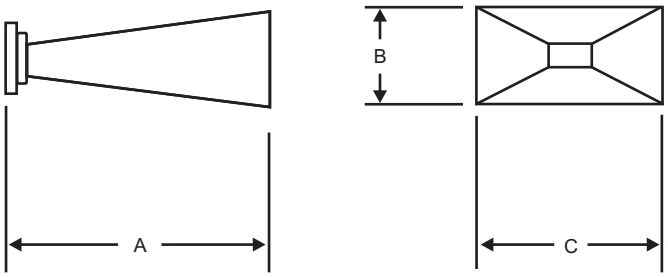
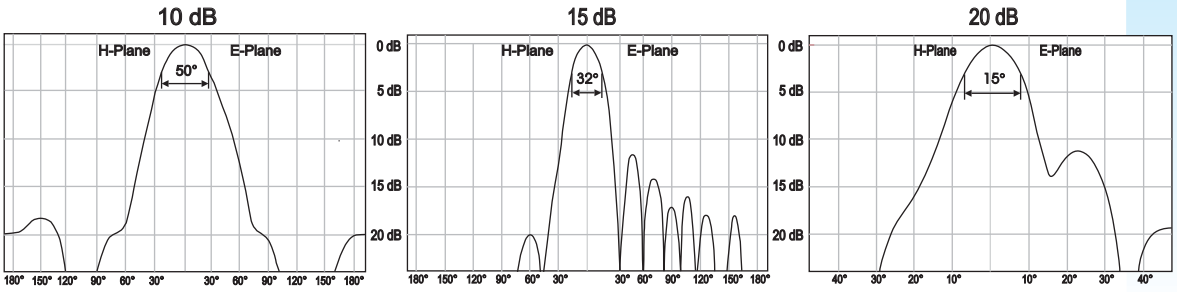


			10 dB Gain			15 dB Gain			20 dB Gain		
Model No.	WR Size	Frequency (GHz)	A	B	C	A	B	C	A	B	C
9060	WR 430	1.70-2.60	10.5	4	8	23.72	9.4	12.8	*on*	*request*	
9058	WR 340	2.20-3.30	*on*	*request*							
9056	WR 284	2.60-3.95	7.5	3.46	4.72	15.34	5.83	7.96	29.75	10.67	15.57
9054	WR 229	3.30-4.90	*on*	*request*							
9052	WR 187	3.95-5.85	5.4	2.12	2.89	9.4	3.57	4.88	15.05	6.53	8.92
9050	WR 159	4.90-7.05	*on*	*request*							
9048	WR 137	5.85-8.20	3.15	1.48	2.02	6.51	2.5	3.42	12.19	4.57	6.26
9046	WR 112	7.05-10.0	2.55	1.18	1.63	5.21	1.99	2.75	10.78	3.64	4.97
9044	WR 102	7.00-11.0	*on*	*request*							
9042	WR 90	8.20-12.4	2.01	1.15	1.58	5.46	1.95	2.66	10.06	3.62	4.87
9040	WR 75	10.0-15.0	1.94	0.92	1.26	4.69	1.33	2.25	8	2.98	3.88
9038	WR 62	12.4-18.0	1.61	0.68	0.93	3.31	1.15	1.57	5.75	2.11	2.88
9036	WR 51	15.0-22.0	*on*	*request*							
9034	WR 42	18.0-26.5	1.25	0.44	0.6	2.37	0.75	1.02	4	1.36	1.86
9032	WR 34	22.0-33.0	*on*	*request*							
9030	WR 28	26.5-40.0	1	0.33	0.45	1.87	0.55	0.76	3.12	1.01	1.38

dimensions are in inches

Typical Radiation Patterns



WAVEGUIDE STRAIGHT SECTIONS

PENN ENGINEERING offers Straight Waveguide Section/Flange Adapters with almost any flange combination. Straight Sections are available in various materials such as OFHC Copper, 90-10 Bronze, Aluminum, Silver, Invar, and Stainless Steel.

Copper alloys are Silver Plated per QQ-S-365D Class A. Aluminum parts are Chem-filmed per MIL-C-5541E. Straights Sections are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Overall **Length** is specified in part number.

Note: Stainless Steel and Invar Straight Sections have Brass Flanges and no plate or paint as standard. Copper Straight Sections are Painted, but not Plated as standard. Special finishes and flanges are available on request.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 4042-11B12.5 .....Is a WR-90 straight section cover/cover in brass 12.5" long

- **LENGTH IN INCHES**
- ALLOY
- PORT 2 FLANGE
- PORT 1 FLANGE
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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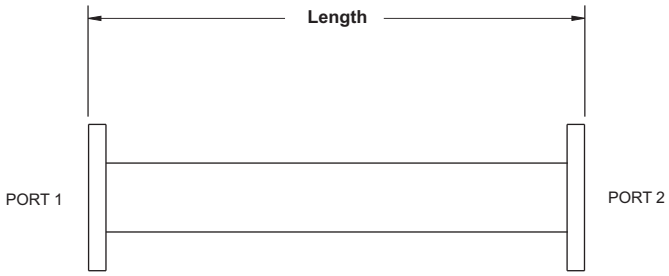
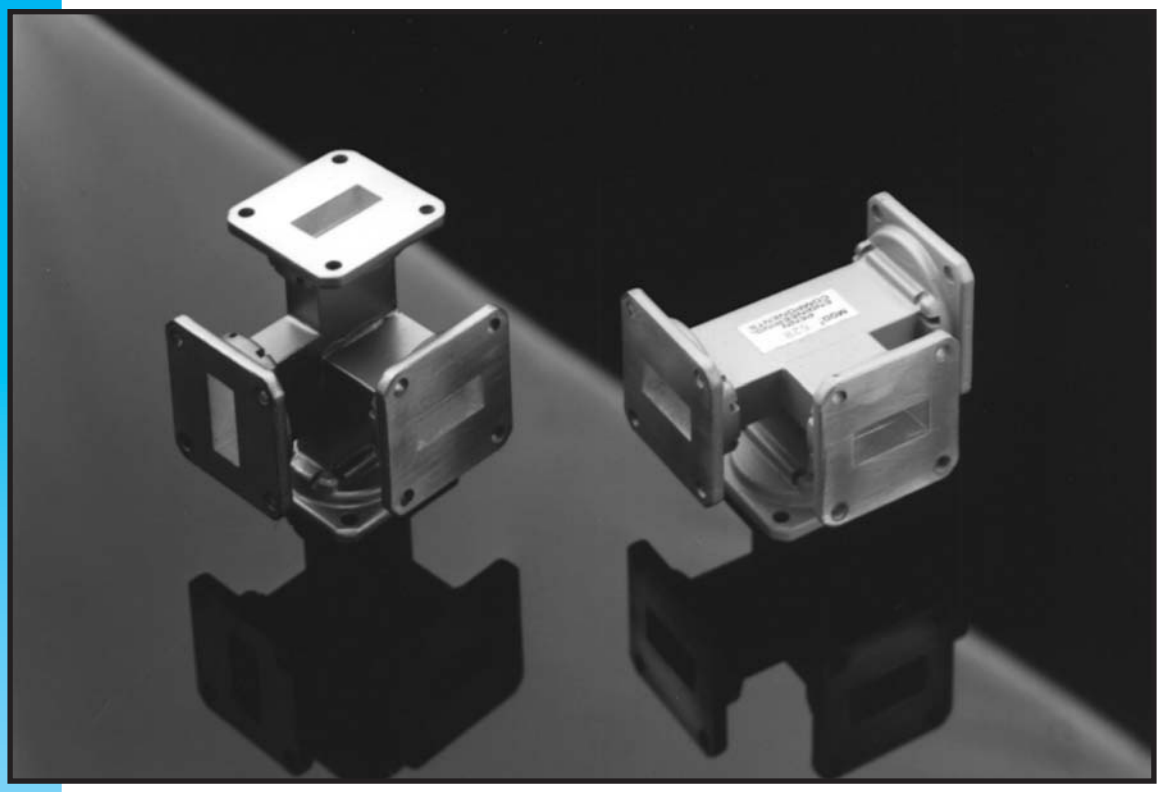
STRAIGHT SECTIONS



Model No.	Waveguide EIA	Frequency range GHz
4064	WR 650	1.12 - 1.70
4062	WR 510	1.45 - 2.20
4060	WR 430	1.70 - 2.60
4058	WR 340	2.20 - 3.30
4056	WR 284	2.60 - 3.95
4054	WR 229	3.30 - 4.90
4052	WR 187	3.95 - 5.85
4050	WR 159	4.90 - 7.05
4048	WR 137	5.85 - 8.20
4046	WR 112	7.05 - 10.0
4044	WR 102	7.00 - 11.0
4042	WR 90	8.20 - 12.4
4040	WR 75	10.0 - 15.0
4038	WR 62	12.4 - 18.0
4036	WR 51	15.0 - 22.0
4034	WR 42	18.0 - 26.5
4032	WR 34	22.0 - 33.0
4030	WR 28	26.5 - 40.0
4028	WR 22	33.0 - 50.0
4026	WR 19	40.0-60.0
4024	WR 15	50.0 - 75.0
4022	WR 12	60.0 - 90.0
4020	WR 10	75.0 - 110.0

TEES - WAVEGUIDE



PENN ENGINEERING'S line of Waveguide Tees are excellent for adding components in a test situation. Tees are unmatched as standard. Matched tees are available upon request.

We will also make Custom Waveguide Tees to your specifications.

Brass/Bronze units are Silver Plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 8242-1111B..... is a WR-90 hybrid model with cover flanges on all ports in brass

- ALLOY
- PORT 4 FLANGE
- PORT 3 FLANGE
- PORT 2 FLANGE
- PORT 1 FLANGE
- WAVEGUIDE SIZE CODE
- COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF **6**=SMA **7**=TYPE N

(See last page for complete list of flanges and materials)

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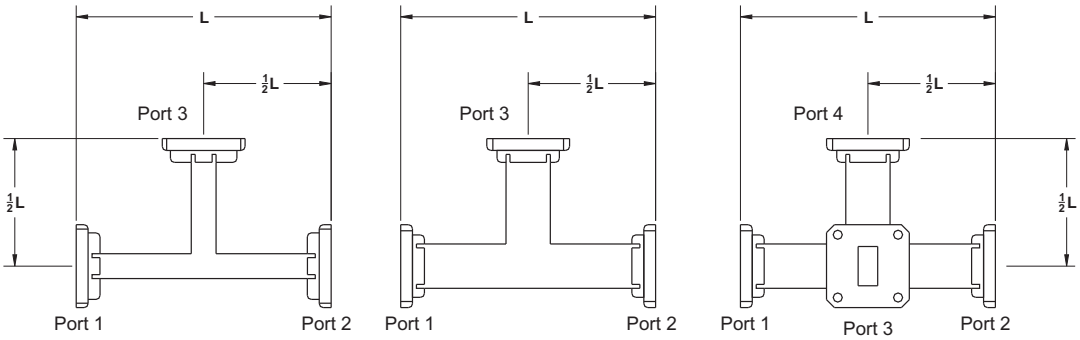
TEES-WAVEGUIDE



8000 Series E-Plane

8100 Series H-Plane

8200 Series 180 Deg. Hybrid

Series (E-plane) Model #	Shunt (H-plane) Model #	Hybrid (E and H) Model#	Waveguide Size	Frequency GHz	"L" (inches)
8064	8164	8264	WR 650	1.12-1.70	10.5
8060	8160	8260	WR 430	1.70-2.60	9
8056	8156	8256	WR 284	2.60-3.95	7.5
8054	8154	8254	WR 229	3.30-4.90	6.5
8052	8152	8252	WR 187	3.95-5.85	5.75
8050	8150	8250	WR 159	4.90-7.05	5.25
8048	8148	8248	WR 137	5.85-8.20	5.125
8046	8146	8246	WR 112	7.05-10.0	3.312
8044	8144	8244	WR 102	7.00-11.0	3.25
8042	8142	8242	WR 90	8.20-12.4	3.125
8040	8140	8240	WR 75	10.0-15.0	2.75
8038	8138	8238	WR 62	12.4-18.0	2.625
8036	8136	8236	WR 51	15.0-22.0	2.375
8034	8134	8234	WR 42	18.0-26.5	2.5
8032	8132	8232	WR 34	22.0-33.0	2.5
8030	8130	8230	WR 28	26.5-40.0	2.375
8028	8128	8228	WR 22	33.0-50.0	2.375
8026	8126	8226	WR 19	40.0-60.0	2.375
8024	8124	8224	WR 15	50.0-75.0	2.375
8022	8122	8222	WR 12	60.0-90.0	2.375
8020	8120	8220	WR 10	75.0-110.0	2.375

TERMINATIONS-FIXED, LOW POWER

PENN ENGINEERING'S Low Power Terminations are a low VSWR (1.02:1 typ.) component used to terminate a waveguide run.

Brass/Bronze units are Silver Plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 7142-1B ..... Is a WR-90 Termination with a cover flange in brass

- 1 — COMPONENT TYPE
- 4 — WAVEGUIDE SIZE CODE
- 2 — FLANGE
- B — ALLOY

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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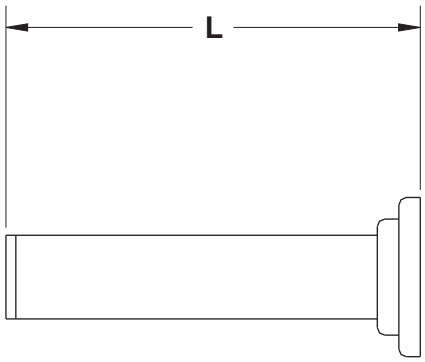
TERMINATIONS FIXED, LOW POWER



Model No.	Waveguide size (EIA)	Frequency Range (GHz)	Average Watts	VSWR typ.	"L"
7160	**WR 430**	1.70-2.60	*on*	*request*	
7158	**WR 340**	2.20-3.30	*on*	*request*	
7156	**WR 284**	2.50-3.95	10	1.02	11.00
7154	**WR 229**	3.30-4.90	10	1.02	8.00
7152	**WR 187**	3.95-5.85	8	1.02	6.50
7150	**WR 159**	4.90-7.05	5	1.02	5.75
7148	**WR 137**	5.85-8.20	6	1.02	6.25
7146	**WR 112**	7.05-10.0	5	1.02	4.75
7144	**WR 102**	7.00-11.0	5	1.02	3.75
7142	**WR 90**	8.20-12.4	4	1.02	3.50
7140	**WR 75**	10.0-15.0	2.5	1.02	3.75
7138	**WR 62**	12.4-18.0	1.5	1.02	3.37
7136	**WR 51**	15.0-22.0	1	1.02	3.12
7134	**WR 42**	18.0-26.5	1	1.02	3.00
7132	**WR 34**	22.0-33.0	1	1.02	2.50
7130	**WR 28**	26.5-40.0	0.5	1.02	2.37
7128	**WR 22**	33.0-50.0	0.25	1.02	2.37
7126	**WR 19**	40.0-60.0	0.25	1.02	2.00
7124	**WR 15**	50.0-75.0	0.125	1.02	2.00
7122	**WR 12**	60.0-90.0	0.125	1.02	2.00

TERMINATIONS-FIXED, MEDIUM POWER

PENN ENGINEERING'S Medium Power Terminations are a low VSWR component used to terminate a waveguide run.

Brass/Bronze units are Silver Plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 7242-1B ..... Is a WR-90 Termination with a cover flange in brass

- 1B — ALLOY
- 1 — FLANGE
- 2 — WAVEGUIDE SIZE CODE
- 7242 — COMPONENT TYPE

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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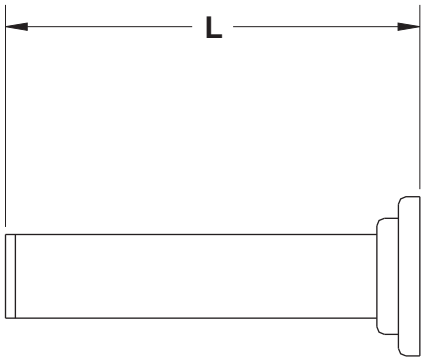
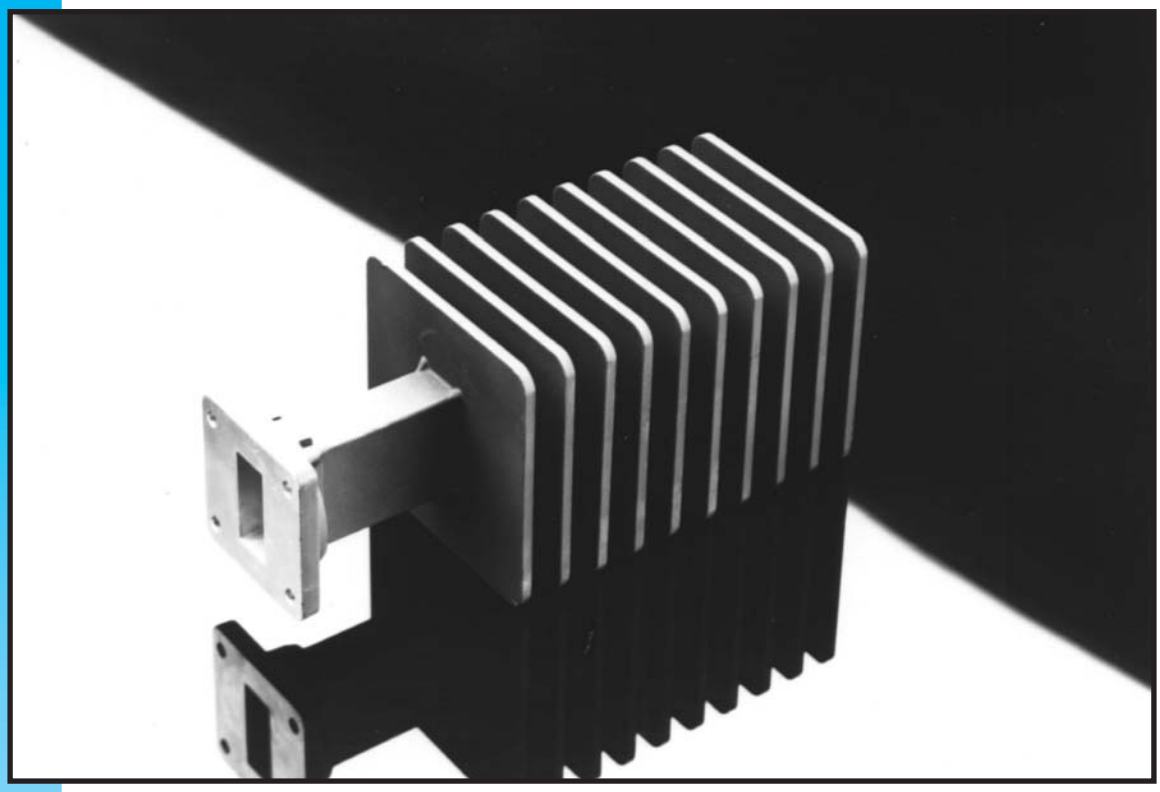
TERMINATIONS FIXED, MEDIUM POWER



Model No.	Waveguide size (EIA)	Frequency Range (GHz)	Average Watts	VSWR typ.	"L"
7252	**WR 187**	3.95-5.85	30	1.04	6.50
7248	**WR 137**	5.85-8.20	30	1.03	6.25
7246	**WR 112**	7.05-10.0	50	1.03	4.75
7242	**WR 90**	8.20-12.4	50	1.03	3.50
7240	**WR 75**	10.0-15.0	60	1.04	3.75
7238	**WR 62**	12.4-18.0	60	1.03	3.37
7236	**WR 51**	15.0-22.0	50	1.04	3.12
7234	**WR 42**	18.0-26.5	25	1.04	3.37
7232	**WR 34**	22.0-33.0	25	1.04	2.50
7230	**WR 28**	26.5-40.0	25	1.04	2.37

TERMINATIONS-FIXED, HIGH POWER



PENN ENGINEERING'S High Power Terminations can terminate a high power waveguide run and still offer a low VSWR (1.10:1 max.). These units are made of premium alloy aluminum and have large cooling fins that dissipate heat efficiently.

We will also design and build custom Terminations to your specifications.

High Power Terminations are Chem-filmed per MIL-5541E and painted Flat Black.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 7342-1A ..... Is a WR-90 HP Termination with a cover flange in aluminum

- 7 — COMPONENT TYPE
- 3 — WAVEGUIDE SIZE CODE
- 4 — FLANGE
- 2 — ALLOY

ALLOY: **A**= ALUMINUM
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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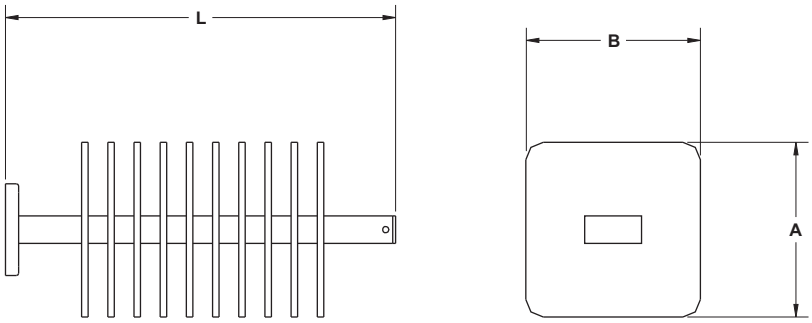
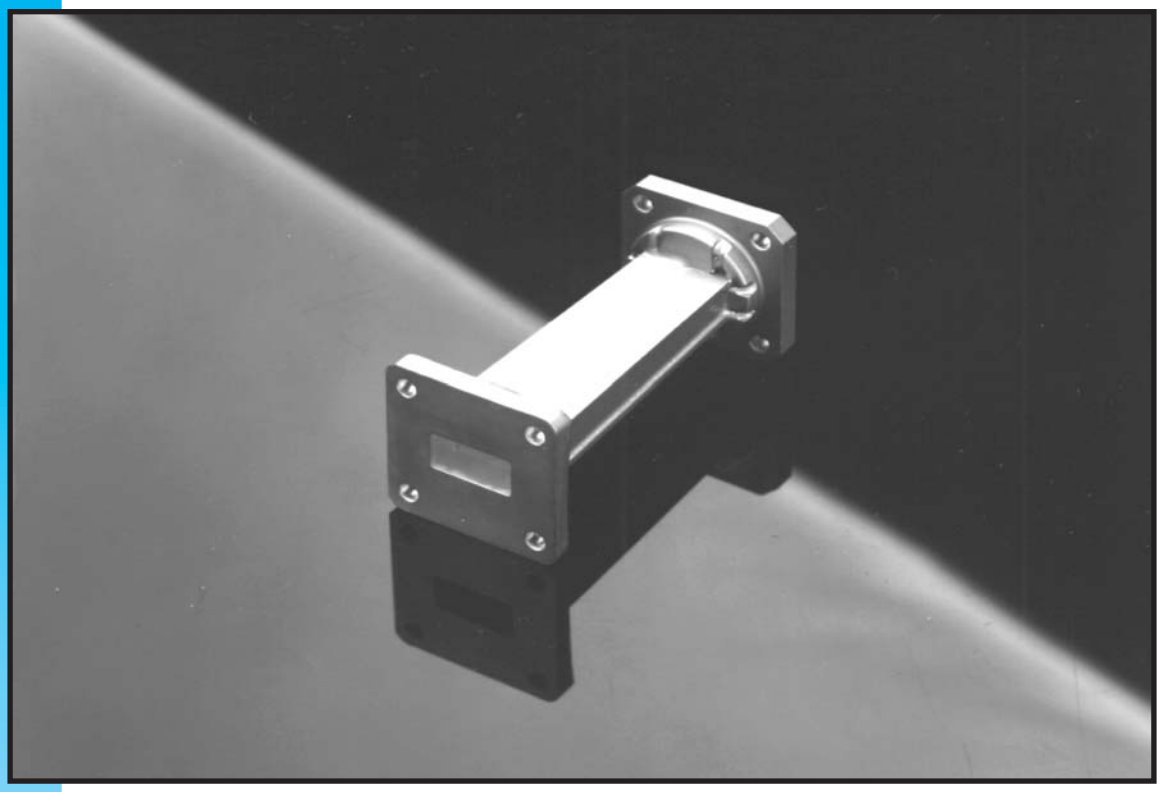
HIGH POWER TERMINATIONS



Model #	Waveguide size (EIA)	Frequency (GHz)	Average Power (watts)	Peak Power (kW)	Dim. "L"	Dim. "A"	Dim. "B"
7364	**WR650**	1.12-1.70	1500	1500	22	11	10.50
7360	**WR430**	1.70-2.60	1200	1100	*on*	*request*	
7358	**WR340**	2.20-3.30	1000	950	*on*	*request*	
7356	**WR284**	2.60-3.95	1200	950	12	6	5.00
7354	**WR229**	3.30-4.90	800	750	11	6	5.00
7352	**WR187**	3.95-5.85	750	750	10	4	3.50
7350	**WR159**	4.90-7.05	625	625	8.5	4	3.50
7348	**WR137**	5.85-8.20	500	400	8.5	3.5	3.00
7346	**WR112**	7.05-10.0	325	300	7.5	3	3.00
7344	**WR102**	7.00-11.0	125	100	4.5	3	3.00
7342	**WR90**	8.20-12.4	225	225	6	2.75	2.75
7340	**WR75**	10.0-15.0	100	90	5	2.5	2.50
7338	**WR62**	12.4-18.0	250	160	6	2.5	2.50
7336	**WR51**	15.0-22.0	100	90	5	2	2.00
7334	**WR42**	18.0-26.5	150	120	4	2	2.00
7332	**WR34**	22.0-33.0	75	100	5	2	2.00
7330	**WR28**	26.5-40.0	75	100	5	2	2.00

TRANSITIONS-TAPERED



Our Tapered Waveguide Transitions are a means of propagating RF energy from one waveguide size to another.

Standard Transitions are available in 2 Lengths:

The Longer Transitions are for better VSWR (1.05 :1 Typ.)
The Shorter Transitions (VSWR 1.08 :1 Typ.) are for shorter length requirements

Brass/Bronze Transistions are Silver Plated per QQ-S-365D class A. Aluminum Transitions are Chem-filmed per MIL-C-5541E and both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

High frequency Transitions are Gold plated and painted black.

Other Standard and Custom Transitions are available upon request

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 4442-11B ..... Is a WR-90 To WR-75 short model Transition with cover flanges in brass.

- 4 — COMPONENT TYPE
- 4 — WAVEGUIDE SIZE CODE (LARGER FLANGE)
- 1 — PORT 1 (LARGER) FLANGE
- 1 — PORT 2 (SMALLER) FLANGE
- B — ALLOY

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

(See last page for complete list of flanges and materials)

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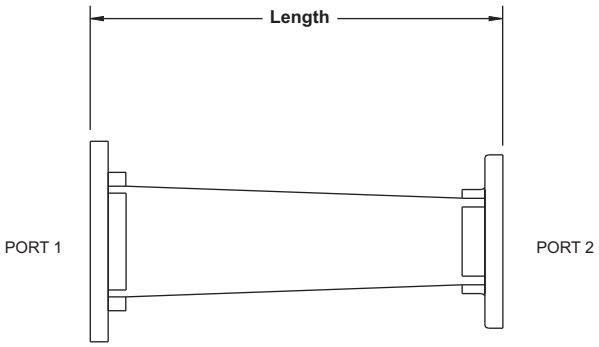
TRANSITIONS -TAPERED

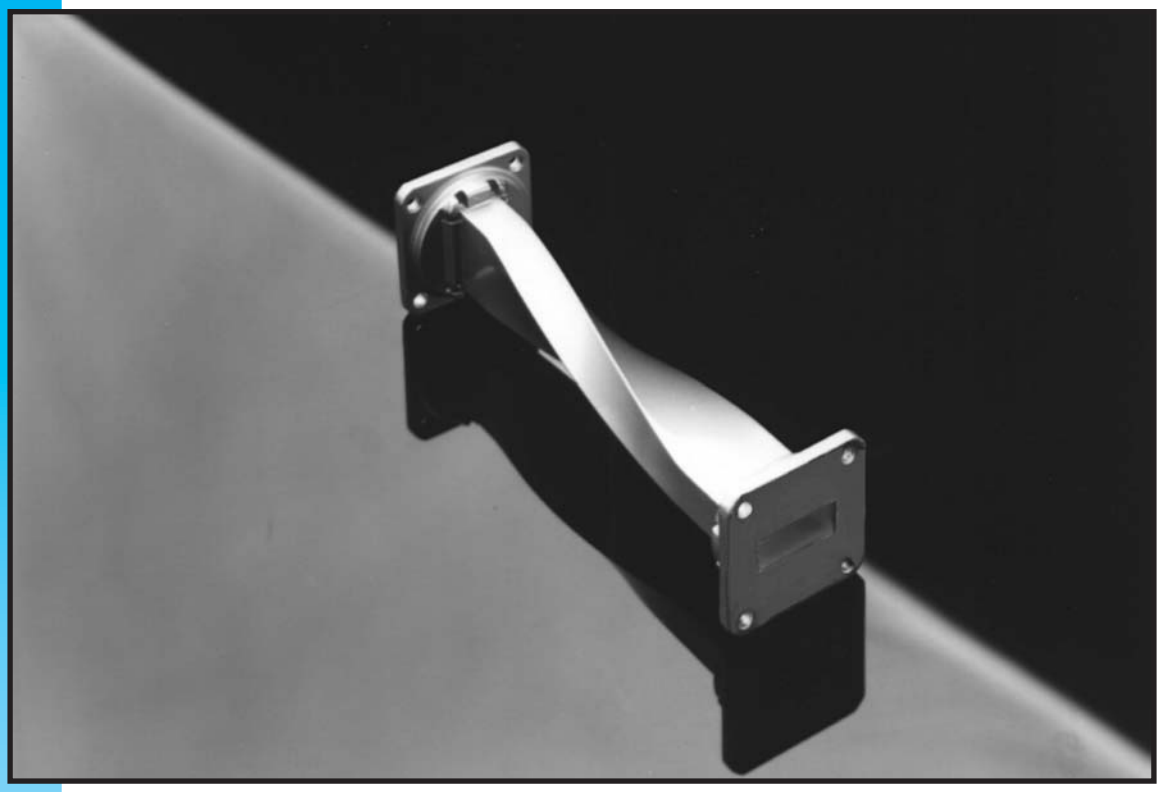


From Size (Port 1)	To Size (Port 2)	Length	Short Model #	Long Model #
WR-284	WR-229	6" or 12"	4456	4556
WR-229	WR-187	6" or 12"	4454	4554
WR-187	WR-159	6" or 12"	4452	4552
WR-159	WR-137	6" or 12"	4450	4550
WR-137	WR-112	6" or 12"	4448	4548
WR-112	WR-90	3" or 6"	4446	4546
WR-102	WR-90	3" or 6"	4444	4544
WR-90	WR-75	3" or 6"	4442	4542
WR-75	WR-62	3" or 6"	4440	4540
WR-62	WR-51	3" or 6"	4438	4538
WR-51	WR-42	3" or 6"	4436	4536
WR-42	WR-34	2" or 4"	4434	4534
WR-34	WR-28	2" or 4"	4432	4532
WR-28	WR-22	2	4430*	–
WR-22	WR-19	1.8	4428*	–
WR-19	WR-15	1.6	4426*	–
WR-15	WR-12	1.4	4424*	–
WR-12	WR-10	1.3	4422*	–
WR-10	WR-8	1.2	4420*	–
WR-8	WR-6	1.1	4418*	–
WR-6	WR-5	1	4416*	–
WR-5	WR-4	1	4414*	–
WR-4	WR-3	0.75	4412*	–

***Electro-Formed and Gold Plated with black finish**

dimensions are in inches

TWISTS



Right-hand twist shown

PENN ENGINEERING offers a line of waveguide Twists for changing the horizontal/vertical orientation of a waveguide system. VSWR is 1.05:1 typ. over the full bandwidth.

Brass/Bronze units are Silver Plated per QQ-S-365D Class A, Aluminum units are Chem-filmed per MIL-C-5541E, and Both are finished with PENN ENGINEERING'S Polyurethane Blue Paint.

Twists are Left-Handed as standard. Special Twist angles and lengths are available upon request.

ORDERING INFORMATION - TO ORDER, USE THE FOLLOWING EXAMPLE:

MODEL 3042-11B ..... Is a WR-90 Twist 90 deg. with cover flanges in brass

- 3 — COMPONENT TYPE
- 0 — WAVEGUIDE SIZE CODE
- 1 — PORT 1 FLANGE
- 1 — PORT 2 FLANGE
- B — ALLOY

ALLOY: **A**= ALUMINUM **B**=BRASS **C**=COPPER **S**=SILVER **SS**=STAINLESS STEEL
FLANGE: **1**=COVER **2**=CHOKE **3**=CMR **4**=CPRG **5**=CPRF

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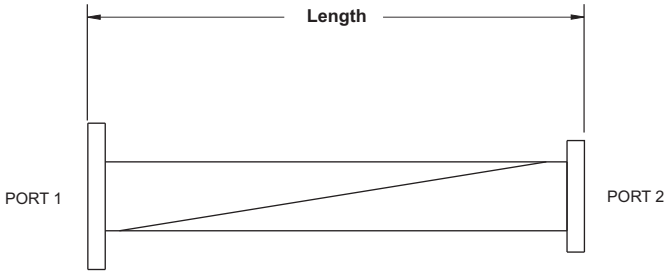
TWISTS



90 Degree Model	45 Degree Model	Waveguide Size	Frequency Range(GHz)	Length
3058	**3158**	**WR 340**	2.10-3.00	12.0
3056	**3156**	**WR 284**	2.60-3.95	10.0
3054	**3154**	**WR 229**	3.30-4.90	10.0
3052	**3152**	**WR 187**	3.95-5.85	8.0
3050	**3150**	**WR 159**	4.90-7.05	8.0
3048	**3148**	**WR 137**	5.85-8.20	8.0
3046	**3146**	**WR 112**	7.05-10.0	6.0
3044	**3144**	**WR 102**	7.00-11.0	6.0
3042	**3142**	**WR 90**	8.20-12.4	6.0
3040	**3140**	**WR 75**	10.0-15.0	5.0
3038	**3138**	**WR 62**	12.4-18.0	5.0
3036	**3136**	**WR 51**	15.0-22.0	4.0
3034	**3134**	**WR 42**	18.0-26.5	3.0
3032	**3132**	**WR 34**	22.0-33.0	3.0
3030	**3130**	**WR 28**	26.5-40.0	3.0
3028	**3128**	**WR 22**	33.0-50.0	2.0
3024	**3124**	**WR 15**	50.0-75.0	2.0
3022	**3122**	**WR 12**	60.0-90.0	2.0
3020	**3120**	**WR 10**	75.0-110.0	2.0

Penn Engineering's Standard Component Number Guide

First two numbers:

10 = Type N Female end launch
11 = Type N Male end launch
12 = Type N Female adapter
13 = Type N Male adapter
14 = SMA Female adapter
15 = SMA Male adapter
16 = SMA Female end launch
17 = SMA Male end launch
18 = TNC Female adapter
19 = TNC Male adapter
20 = 90 degree E bend formed
21 = 90 degree H bend formed
22 = 45 degree E bend formed (or specified angle)
23 = 45 degree H bend formed (or specified angle)
24 = 90 degree E bend mitered
25 = 90 degree H bend mitered
26 = 45 degree E bend mitered
27 = 45 degree H bend mitered
28 = 180 degree U bend E plane
29 = 180 degree U bend H plane
30 = 90 degree twist
31 = 45 degree twist (or specified angle)
32 = S-Bend, E-plane, Formed
33 = S-Bend, H-plane, Formed
35 = Phase shifter
36 = Fixed pad attenuator
37 = Variable attenuators
38 = S-Bend, E-plane, Mitered
39 = S-Bend, H-plane, Mitered
40 = Straight Section
41 = Waveguide Pressurizing section
42 = Bulkhead feed-through
43 = Pressure Inlet
44 = Waveguide Transition (short models)
45 = Waveguide Transition (long models)
46 = Flexible Seamless Waveguide Section
47 = Flexible Twistable Waveguide Section
48 = Flange Spacer
49 = Step Transition
50 = Top-wall coupler
51 = Side-wall coupler
52 = Dual Broad-wall coupler
53 = Dual cross-guide coupler
54 = Cross-guide coupler
55 = Cross-guide terminated
56 = Power sampler type N Female
57 = Power sampler type SMA Female
58 = Dual Sidewall Coupler
59 = Bi-Directional Top-wall Coupler
60 = Pressure window
61 = Fixed shorting plate
62 = RF flange gasket
63 = O-Ring / Gasket
64 = Conductive O-Ring/Gasket
65 = Shielded O-Ring
66 = Flange Adapter
67 = Waveguide to Waveguide Adapter
68 = Waveguide Hanger
71 = Waveguide Termination (low power)
72 = Waveguide Termination (medium power)
73 = Waveguide Termination (high power)
74 = Sliding load
75 = Adjustable short
76 = Offset Short
77 = Short Load
78 = Shorting Plate Pressure Inlet
80 = E plane series Tee
81 = H plane shunt Tee
82 = Hybrid Tee
90 = Standard gain horn antenna
91 = Standard gain horn, Weather Proof
92 = Standard gain horn/ Type N Male Adapter
93 = Standard gain horn/ Type N Female Adapter
94 = Standard gain horn/ Type SMA Male Adapter
95 = Standard gain horn/ Type SMA Female Adapter
96 = Protective Flange Cover, Plastic
97 = Flange hardware kit
98 = Flange hardware kit w/ RF gasket
99 = Flange hardware kit w/ O-ring/Gasket

Second two numbers:

10 = WR 3
12 = WR 4
14 = WR 5
16 = WR 6
18 = WR 8
20 = WR 10 (W-Band)
22 = WR 12
24 = WR 15 (V-Band)
26 = WR 19 (U-Band)
28 = WR 22 (Q-Band)
30 = WR 28 (R-Band)
32 = WR 34
34 = WR 42 (K-Band)
36 = WR 51
38 = WR 62 (P-Band)
40 = WR 75
42 = WR 90 (X-Band)
44 = WR 102
46 = WR 112
48 = WR 137 (C-Band)
50 = WR 159
52 = WR 187
54 = WR 229
56 = WR 284 (S-Band)
58 = WR 340
60 = WR 430
62 = WR 510
64 = WR 650
66 = WR 770
68 = WR 975
70 = WR 1150
72 = WR 1800
74 = WR 2100
76 = WR 2300
80 = WRD 180
82 = WRD 200
84 = WRD 350
86 = WRD 475
87 = WRD 500
88 = WRD 580
90 = WRD 650
92 = WRD 750
94 = WRD 840

Flange Designation(s):

0= No flange on Port
1= Cover flange
2= Choke flange
3= CMR flange
4= CPRG flange
5= CPRF flange
6= SMA Female Connector
7= Type N Female Connector
8= Cover Flange - ALL TAP
9= Choke Flange - ALL CLEAR
C= TNC Female Connector
D= CPRG ALL TAP
E= CPRF ALL TAP
F= CMR w/ all through holes
G= CMR w/ all tapped holes
H= PDR flange
K= PBR flange
L= UDR flange
M= UBR flange
P= PAR flange
Q= BRJ flange
R= CBR flange
T= UER flange
V= CAR flange
X= UAR flange
Y= UG Pressure Cover
Z= UG Pressure Cover - ALL TAP

ALLOY CODES:

A= ALUMINUM
B= BRONZE/BRASS
C= COPPER
S= SILVER
SS= STAINLESS STEEL

FLEX JACKET CODES:

E= SILICONE (MOLDED)
K= BLACK PAINT
N= NEOPRENE (MOLDED)
S= BRUSH-ON JACKET
U= NO JACKET
V= VINYL (BRUSH-ON)

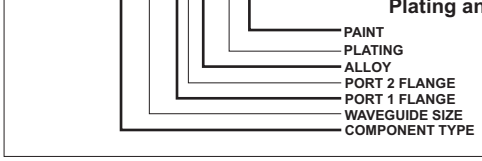
FINISH CODES:

PLATING CODES: **C**= CHEM-FILM, **G**= GOLD(IMMERSION), **L**=NICKEL, **P**=8P IRRIDITE, **S**=SILVER(IMMERSION), **T**=TIN, **N**=NONE

PAINT CODES: (SEMI-GLOSS): **B**=BLUE, **G**=GREY, **H**= HAMMERTONE-SILVER, **K**=BLACK, **W**=WHITE, **Z6**=Z306 (BLACK), **Z7**=Z307(BLACK), **N**=NONE

TO BUILD A PART NUMBER, USE THE FOLLOWING EXAMPLE:

MODEL 3042-12B-GW ..... **Is a Standard 90 Deg. Twist with Cover/Choke Flanges in Copper Alloy Material with Gold Plating and White Paint**



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