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## Waveguide Size and Frequency

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

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

<table>
<thead>
<tr>
<th>WR Size</th>
<th>UG Style</th>
<th>MIL-F-3922/()</th>
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<tr>
<td></td>
<td>Cover Circular</td>
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</tr>
<tr>
<td>WR3</td>
<td>UG387/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR5</td>
<td>UG387/U MOD</td>
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</tr>
<tr>
<td>WR8</td>
<td>UG387/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR8</td>
<td>UG387/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR10</td>
<td>UG387/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR12</td>
<td>UG387/U</td>
<td></td>
</tr>
<tr>
<td>WR15</td>
<td>UG385/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR19</td>
<td>UG383/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR22</td>
<td>UG-599/U MOD</td>
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<td>UG-599/U MOD</td>
<td></td>
</tr>
<tr>
<td>WR34</td>
<td>UG-1539/U</td>
<td></td>
</tr>
<tr>
<td>WR42</td>
<td>UG-595/U</td>
<td></td>
</tr>
<tr>
<td>WR51</td>
<td>UG-595/U</td>
<td></td>
</tr>
<tr>
<td>WR62</td>
<td>UG-419/U</td>
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</tr>
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<td>WR75</td>
<td>UG-39/U</td>
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<tr>
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<td>UG-51/U</td>
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</tr>
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<td>WR137</td>
<td>UG-344/U</td>
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<td>UG-1730/U</td>
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</tr>
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<td>WR187</td>
<td>UG-1494/U</td>
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<td>UG-1726/U</td>
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<td>WR284</td>
<td>UG-53/U</td>
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<td>UG-1712/U</td>
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</tr>
<tr>
<td>WR430</td>
<td>UG1717/U</td>
<td></td>
</tr>
<tr>
<td>WR510</td>
<td>UG1717/U</td>
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</tr>
<tr>
<td>WR650</td>
<td>UG-1714/U</td>
<td></td>
</tr>
</tbody>
</table>

# Flange Specifications

North American (EIA Standard)
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”
E-Plane Miter

E-Plane Formed

H-Plane Miter

H-Plane Formed

**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.

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

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.
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

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

#### Waveguide to Coax Adapter

**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.
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.

**Directional Crossguide Couplers**

### Ordering Information Example

**Crossguide Coupler**

**Example Part Number:**

<table>
<thead>
<tr>
<th>Lider Designation</th>
<th>Waveguide Size</th>
<th>Part Designation (see listing pg. 18)</th>
<th>Coupling Value</th>
<th>Connector Type (SMA-Female)</th>
<th>Frequency Range</th>
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</thead>
<tbody>
<tr>
<td>L 75 CG- 40- SF CV</td>
<td>12.75-14</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**F Flange type:** CPRG (CG), CPRF (CF), Cover (CV), Cover Groove (G), Choke (CK)

*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.*

### Waveguide Size and Band Information

<table>
<thead>
<tr>
<th>Waveguide Size</th>
<th>Band</th>
<th>Frequency Range (GHz)</th>
<th>Minimum Directivity</th>
<th>Dimension A (in)</th>
<th>Dimension B (in)</th>
<th>Dimension C (in)</th>
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</thead>
<tbody>
<tr>
<td>WR 22 Q</td>
<td></td>
<td>33.00 - 50.00</td>
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<td>3.500</td>
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<tr>
<td>WR 28 Ka</td>
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<td>26.50 - 40.00</td>
<td>20dB</td>
<td>3.00</td>
<td>3.500</td>
<td>3.500</td>
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<tr>
<td>WR 34 -</td>
<td></td>
<td>22.00 - 33.00</td>
<td>20dB</td>
<td>3.500</td>
<td>3.500</td>
<td>3.500</td>
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<tr>
<td>WR 42 K</td>
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<td>18.00 - 26.50</td>
<td>20dB</td>
<td>3.500</td>
<td>3.500</td>
<td>3.500</td>
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<td>20dB</td>
<td>3.500</td>
<td>3.500</td>
<td>3.500</td>
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<td>WR 62 Ku</td>
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<td>12.40 - 18.00</td>
<td>20dB</td>
<td>3.500</td>
<td>4.000</td>
<td>4.000</td>
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<td>WR 75 M</td>
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<td>10.00 - 15.00</td>
<td>20dB</td>
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<td>4.000</td>
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<td>7.05 - 10.00</td>
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<td>5.000</td>
<td>5.000</td>
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<td>WR 137 C</td>
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<td>5.85 - 8.20</td>
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<td>4.000</td>
<td>6.000</td>
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<td>20dB</td>
<td>4.000</td>
<td>7.000</td>
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<td>WR 187 J</td>
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<td>20dB</td>
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<td>8.000</td>
<td>8.000</td>
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<td>WR 229 U</td>
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<td>3.30 - 4.90</td>
<td>20dB</td>
<td>6.000</td>
<td>8.000</td>
<td>8.000</td>
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<td>10.000</td>
<td>10.000</td>
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<td>12.000</td>
<td>12.000</td>
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<td>20dB</td>
<td>10.000</td>
<td>18.000</td>
<td>18.000</td>
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<td>WR 510 -</td>
<td></td>
<td>1.45 - 2.20</td>
<td>20dB</td>
<td>call</td>
<td>call</td>
<td>call</td>
</tr>
<tr>
<td>WR 650 T</td>
<td></td>
<td>1.12 - 1.70</td>
<td>20dB</td>
<td>call</td>
<td>call</td>
<td>call</td>
</tr>
</tbody>
</table>

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

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

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

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

* 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.
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 bends) and pressure tight.

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

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

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).

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

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

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

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

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.
Terminations

High Power Terminations

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

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.
- Lower VSWR available over narrower bandwidths.
- Standard exterior finish is flat black high temp enamel
- No forced air cooling required
- 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.
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.

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

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

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
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.

**Millimeter Waveguide**

**Straight Sections and Flange Adapters**

**Twist Sections, E and H Bends, Custom Bends**

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

**Plating:**

Lieder offers the following plating services:

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

**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.
ATTENUATORS

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

Applications:
- Test Benches
- Subsystems
- Prototypes

LEVEL SET ATTENUATORS

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

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) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WR 5</td>
<td>G</td>
<td>140.0 - 220.0</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>1.600</td>
</tr>
<tr>
<td>WR 6</td>
<td>D</td>
<td>110.0 - 170.0</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>1.600</td>
</tr>
<tr>
<td>WR 8</td>
<td>F</td>
<td>90.0 - 140.0</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>1.600</td>
</tr>
<tr>
<td>WR 10</td>
<td>W</td>
<td>75.0 - 110.0</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>1.600</td>
</tr>
<tr>
<td>WR 12</td>
<td>E</td>
<td>60.00 - 90.00</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>1.600</td>
</tr>
<tr>
<td>WR 15</td>
<td>V</td>
<td>50.00 - 75.00</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>1.600</td>
</tr>
<tr>
<td>WR 19</td>
<td>U</td>
<td>40.00 - 60.00</td>
<td>0 – 30dB</td>
<td>1.3:1</td>
<td>2.000</td>
</tr>
<tr>
<td>WR 22</td>
<td>Q</td>
<td>33.00 - 50.00</td>
<td>0 – 30dB</td>
<td>1.25:1</td>
<td>2.000</td>
</tr>
<tr>
<td>WR 28</td>
<td>Ka</td>
<td>26.50 - 40.00</td>
<td>0 – 30dB</td>
<td>1.1:1</td>
<td>2.000</td>
</tr>
<tr>
<td>WR 34</td>
<td>--</td>
<td>22.00 - 33.00</td>
<td>0 – 30dB</td>
<td>1.1:1</td>
<td>2.000</td>
</tr>
<tr>
<td>WR 42</td>
<td>K</td>
<td>18.00 - 26.50</td>
<td>0 – 30dB</td>
<td>1.1:1</td>
<td>2.000</td>
</tr>
</tbody>
</table>

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.
ATTENUATORS

PRECISION FIXED ATTENUATORS

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

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

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.
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.

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

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

#### Flange Abbreviation Reference

<table>
<thead>
<tr>
<th>Description</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Cover Flat Through</td>
<td>CV</td>
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<tr>
<td>Cover Groove Through</td>
<td>G</td>
</tr>
<tr>
<td>Cover Flat Tapped</td>
<td>CVT</td>
</tr>
<tr>
<td>Cover Groove Tapped</td>
<td>GT</td>
</tr>
<tr>
<td>Cover Circular</td>
<td>CV</td>
</tr>
<tr>
<td>Choke Flange Through</td>
<td>CKM (modified)</td>
</tr>
<tr>
<td>Choke Flange Tapped</td>
<td>CK</td>
</tr>
<tr>
<td>CPR Flat</td>
<td>CF</td>
</tr>
<tr>
<td>CPR Groove</td>
<td>CG</td>
</tr>
<tr>
<td>CMR Clear</td>
<td>CC</td>
</tr>
<tr>
<td>CMR Alt. Tap</td>
<td>CCT</td>
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<td>Millimeter Round</td>
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#### Part Designation Reference

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