5G Solutions
RF Components for the Next Generation
In-Stock and Shipped Same Day
The 5G Outlook

5G promises to deliver lightning-speed data rates, increased user capacity, reduced latency, and overall improved network efficiencies through new delivery technologies and distribution techniques like network splicing. Although many factors affect network speed, 5G will be at least 10 times faster than 4G networks, which often average less than 10 Mbps.

The global 5G infrastructure being built today will be the backbone of RF wireless innovation for years to come and also enable a new era for big data, where near-real-time processing and intelligence shared to and from a plethora of connected devices will provide enhanced user experiences, safety, and responsiveness.

New 5G devices and applications are in various stages of development, testing and deployment. Three major use cases for 5G have been defined:

**Mission Critical Applications**  
Including autonomous vehicles, remote health care, intelligent grids, industrial automation, and more – where low latency, ultra-high reliability connectivity is essential.

**Enhanced Mobile Broadband**  
Offering increased speed and capacity through further rollout of MIMO, small cell, DAS, and fixed wireless technologies.

**The Internet of Things (IoT)**  
Comprised of billions of connected devices, communicating without human intervention, creating new opportunities for big data exchange and analysis, and set to revolutionize manufacturing, business communications, agriculture, and more.

5G Use Cases in a Shared Network Infrastructure

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Enhanced Mobile Broadband, Mission Critical Applications, and the Internet of Things (IoT) are the three major use cases defined for 5G.
5G Solutions from Pasternack

RF Components for the Next Generation

Pasternack meets the urgent needs of engineers and technicians around the world for high-grade RF components and cable assemblies to support 5G innovation development, testing and deployments in the global sub-6 GHz (e.g. the 3.5 GHz mid-band) and mmWave bands (e.g. 26 GHz, 28 GHz and 39 GHz).

All Pasternack 5G solutions components are in-stock and shipped same day, and they are backed by first-class technical and engineering support. Our applications engineers are standing by ready to assist with answering your questions and selecting the right product for your specific application. Visit us online at Pasternack.com to view detailed datasheets, CAD drawings, real-time pricing and inventory, or to place your order and have it shipped today!

RF Interconnects

Connectors
Configure and customize your signal exactly as required with Pasternack’s ready-to-ship RF connectors for 5G applications.

- A variety of options for size, frequency, signal power, PIM, durability, and space limitations
- Optimized for premium VSWR and PIM levels
- Connector series include: 4.3-10, 7/16 DIN, NEX10, 4.1/9.5 Mini DIN, MMBX, QMA, Type-N, QN, TNC, SMA, SMP, 3.5 mm, 2.92 mm, 2.4 mm, 1.85 mm
- Types include: male, male right-angle, female, female bulkhead and flange mount, female right-angle, male snap-on, male quick disconnect (QD)

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<th>Connectors</th>
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<th>Genders</th>
<th>Body Style</th>
<th>Termination Type</th>
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<td>4.3-10</td>
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<td>6</td>
<td>●</td>
<td>–</td>
<td>-160</td>
</tr>
<tr>
<td>7/16 DIN</td>
<td>Low PIM, Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>Coax, PCB</td>
<td>7.5</td>
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<td>NEX10</td>
<td>Low PIM</td>
<td>Male</td>
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<td>–</td>
<td>-160</td>
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<tr>
<td>4.1/9.5 Mini DIN</td>
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<td>Right Angle, Straight</td>
<td>Coax</td>
<td>6</td>
<td>●</td>
<td>–</td>
<td>-160</td>
</tr>
<tr>
<td>MMBX</td>
<td>Standard</td>
<td>Jack, Plug</td>
<td>Right Angle, Straight</td>
<td>Coax, PCB, Terminal</td>
<td>12.4</td>
<td>●</td>
<td>–</td>
<td>–</td>
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<td>QMA</td>
<td>Standard</td>
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<td>Right Angle, Straight</td>
<td>Coax, PCB</td>
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<td>●</td>
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<td>Type-N</td>
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<td>Coax, Terminal</td>
<td>11</td>
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Connectors Continued

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<tr>
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<th>Design</th>
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<th>Termination Type</th>
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<th>PIM (dBc)</th>
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<tr>
<td>TNC</td>
<td>Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>Coax, PCB, Terminal</td>
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<td>●</td>
<td>–</td>
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<tr>
<td>SMA</td>
<td>Low PIM, Precision, Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>Coax, Field Replaceable Contact, PCB, Terminal</td>
<td>27</td>
<td>●</td>
<td>–</td>
<td>-160 to -155</td>
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<tr>
<td>SMP</td>
<td>Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>Coax, PCB, Terminal</td>
<td>50</td>
<td>●</td>
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<tr>
<td>3.5 mm</td>
<td>Precision, Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>Coax</td>
<td>34</td>
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<tr>
<td>2.92 mm</td>
<td>Precision, Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>Coax, Field Replaceable Contact, PCB</td>
<td>45</td>
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</tr>
<tr>
<td>2.4 mm</td>
<td>Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>Coax, PCB, Terminal</td>
<td>50</td>
<td>–</td>
<td>●</td>
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</tr>
<tr>
<td>1.85 mm</td>
<td>Precision, Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>Coax, PCB</td>
<td>70</td>
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</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Connectors. View all online at pasternack.com.

Adapters

Get the reliable performance you expect and protect expensive test equipment with Pasternack’s ready-to-ship RF adapters for 5G applications.

- A variety of options for size, frequency, signal power, PIM, durability, and space limitations
- Optimized for premium VSWR and PIM levels
- Connector series include: 4.3-10, 7/16 DIN, 4.5/9.5 Mini DIN, MMBX, QMA, Type-N, TNC, SMA, SMP, 3.5 mm, 2.92 mm, 2.4 mm, 1.85 mm, Mini SMP
- Types include: male, male right-angle, female, female bulkhead and flange mount, female right-angle, male snap-on, male quick disconnect (QD)

<table>
<thead>
<tr>
<th>Adapters</th>
<th>Design</th>
<th>Genders</th>
<th>Body Style</th>
<th>Mount Method</th>
<th>Max. Frequency (GHz)</th>
<th>Sub-6 GHz Band</th>
<th>mmWave Band</th>
<th>PIM (dBc)</th>
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<tbody>
<tr>
<td>4.3-10</td>
<td>Low PIM</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
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<td>6</td>
<td>●</td>
<td>–</td>
<td>-168</td>
</tr>
<tr>
<td>7/16 DIN</td>
<td>Low PIM, Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight, Tee</td>
<td>Bulkhead</td>
<td>8</td>
<td>●</td>
<td>–</td>
<td>-170</td>
</tr>
<tr>
<td>4.5/9.5 Mini DIN</td>
<td>Low PIM, Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>Bulkhead</td>
<td>6</td>
<td>●</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MMBX</td>
<td>Standard</td>
<td>Plug</td>
<td>Straight</td>
<td>–</td>
<td>12.4</td>
<td>●</td>
<td>–</td>
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<th>Max. Frequency (GHz)</th>
<th>Sub-6 GHz Band</th>
<th>mmWave Band</th>
<th>PIM (dBc)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>QMA</strong></td>
<td>Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>–</td>
<td>18</td>
<td>●</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Type-N</strong></td>
<td>Low PIM, Precision, Standard</td>
<td>Male, Female</td>
<td>Cross, Radius Right Angle, Right Angle, Straight, Tee</td>
<td>Bulkhead, 4 Hole Flange</td>
<td>18</td>
<td>●</td>
<td>–</td>
<td>-168 to -130</td>
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<tr>
<td><strong>TNC</strong></td>
<td>Low PIM, Precision, Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight, Tee</td>
<td>Bulkhead, 4 Hole Flange</td>
<td>18</td>
<td>●</td>
<td>–</td>
<td>-150</td>
</tr>
<tr>
<td><strong>SMA</strong></td>
<td>Low PIM, Precision, Ruggedized, Standard</td>
<td>Male, Female</td>
<td>45 Degree Right, Radius Right Angle, Right Angle, Straight, Tee</td>
<td>2 Hole Flange, 4 Hole Flange, Bulkhead</td>
<td>27</td>
<td>●</td>
<td>-</td>
<td>-170 to -160</td>
</tr>
<tr>
<td><strong>SMP</strong></td>
<td>Precision, Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>2 Hole Flange, 4 Hole Flange, Bulkhead</td>
<td>40</td>
<td>●</td>
<td>●</td>
<td>–</td>
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<tr>
<td><strong>3.5 mm</strong></td>
<td>Precision, Ruggedized, Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>4 Hole Flange, Bulkhead</td>
<td>34.5</td>
<td>●</td>
<td>●</td>
<td>–</td>
</tr>
<tr>
<td><strong>2.92 mm</strong></td>
<td>Precision</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>4 Hole Flange, Bulkhead</td>
<td>40</td>
<td>●</td>
<td>●</td>
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<tr>
<td><strong>2.4 mm</strong></td>
<td>Precision, Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>Bulkhead</td>
<td>50</td>
<td>●</td>
<td>●</td>
<td>–</td>
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<tr>
<td><strong>1.85 mm</strong></td>
<td>Standard</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>–</td>
<td>67</td>
<td>●</td>
<td>●</td>
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</tr>
<tr>
<td><strong>Mini SMP</strong></td>
<td>Standard</td>
<td>Male, Female</td>
<td>Straight</td>
<td>–</td>
<td>65</td>
<td>●</td>
<td>●</td>
<td>–</td>
</tr>
</tbody>
</table>

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Cable Assemblies

Count on the high-performance and rugged reliability of Pasternack’s ready-to-ship RF cable assemblies for your 5G application.

- Low VSWR and insertion loss
- Excellent phase stability under flexure
- Maximum operating frequencies up to 110 GHz, depending on cable type
- Coax types include low PIM and low loss options
- Cable connector options include: 4.3-10, 7/16 DIN, NEX10, 2.92 mm, 2.92 mm NMD, 2.4 mm, 1.85 mm, 1.0 mm, 3.5 mm, 3.5 mm NMD, SMA, QMA, Type-N, TNC, 4.1/9.5 Mini DIN
- Standard and custom lengths available

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<th>Connector Series</th>
<th>Connector Gender</th>
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<th>Max. Frequency (GHz)</th>
<th>PIM (dBc)</th>
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<tbody>
<tr>
<td>Low PIM</td>
<td>PE-SR401FLJ Low PIM, SPF-250, SPF-375, SPF-500, SPO-250-LLPL, SPF-375-LLPL, SPF-500-LLPL</td>
<td>76-83</td>
<td>4.1/9.5 Mini DIN, 4.3-10, 7/16 DIN, Type-N, SMA</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>3-6</td>
<td>-163 to -155</td>
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<tr>
<td>mmWave Band</td>
<td>PE-P106LL, PE-P160, PE-TC110, PE-TC151, PE-TC195</td>
<td>70-78</td>
<td>1.0 mm, 1.85 mm</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
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<tr>
<td>Test &amp; Measurement</td>
<td>PE-VNA-R</td>
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<td>2.4 mm, 2.92 mm, 2.92 mm NMD, 3.5 mm, 3.5 mm NMD, Type-N, SMA</td>
<td>Male, Female</td>
<td>Straight</td>
<td>18-40</td>
<td>–</td>
</tr>
<tr>
<td>Low Loss</td>
<td>PE-P142LL, PE-P300LL</td>
<td>83</td>
<td>Type-N, SMA</td>
<td>Male, Female</td>
<td>Right Angle, Straight</td>
<td>18</td>
<td>–</td>
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</tbody>
</table>

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5G Efficiencies

- **10x Decrease in Latency**
  Delivering latency as low as 1 ms

- **10x Connection Density**
  Enabling more efficient signaling for IoT connectivity

- **3x Spectrum Efficiency**
  Achieving even more bits per Hz with advanced antenna techniques

- **3x Traffic Capacity**
  Driving network hyper-densification with more small cells everywhere

- **10x Experience Throughput**
  Bringing more uniform, multi-Gbps peak rates

- **100x Network Efficiency**
  Optimizing network energy consumption with more efficient processing

Source: www.visualcapitalist.com/5g-next-generation-mobile-connectivity/
RF Actives

Amplifiers

Expect reliable signal amplification with Pasternack’s ready-to-ship, connectorized RF amplifiers for 5G applications.

- Over 65 models ideal for sub-6 GHz and mmWave frequency bands
- Amplifier designs include: bench-top, broadband, gain block, GaN power, high power, input protected low noise, limiting, low noise, waveguide, power, rack mount, USB, variable gain
- Noise figures as low as 0.5 dB
- Saturated output power up to 200 W
- Latest GaN and GaAs PHEMT semiconductor technology
- Qualified for 5G applications, including point-to-point radio links, telecom, and test & measurement

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<th>Amplifiers</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Gain (dB)</th>
<th>NF (dB)</th>
<th>Output Power Range P1dB (dBm)</th>
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<th>IP3 (dBm)</th>
<th>Connector Type</th>
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<tr>
<td>Bi-Directional</td>
<td>0.03</td>
<td>2.7</td>
<td>20-36</td>
<td>2-2.5</td>
<td>37-43</td>
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<td>–</td>
<td>SMA</td>
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<tr>
<td>Bench-Top</td>
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<td>40</td>
<td>30-60</td>
<td>5</td>
<td>10-22</td>
<td>–</td>
<td>–</td>
<td>2.92 mm</td>
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<td>Sub-6 GHz Broadband</td>
<td>0.00001</td>
<td>6</td>
<td>13-46</td>
<td>4-7</td>
<td>10-35</td>
<td>–</td>
<td>25.5-45</td>
<td>SMA</td>
</tr>
<tr>
<td>mmWave Broadband</td>
<td>0.03</td>
<td>40</td>
<td>12-60</td>
<td>3-11</td>
<td>8-22</td>
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<td>22-26</td>
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<td>Gain Block</td>
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<td>14.5-26</td>
<td>4.5</td>
<td>14-15</td>
<td>–</td>
<td>26</td>
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</tr>
<tr>
<td>GaN Power</td>
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<td>43-60</td>
<td>7-10</td>
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<td>40-53</td>
<td>52</td>
<td>SMA, Type-N</td>
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<td>High Power</td>
<td>0.1</td>
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<td>50-60</td>
<td>7-10</td>
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<td>40-47</td>
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<tr>
<td>Input Protected Low Noise</td>
<td>3.1</td>
<td>3.5</td>
<td>28-35</td>
<td>0.85</td>
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<td>–</td>
<td>20</td>
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<td>Limiting</td>
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<td>18</td>
<td>40-80</td>
<td>2.5-5</td>
<td>15-19</td>
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<td>Sub-6 GHz Low Noise</td>
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<td>9-61.5</td>
<td>0.5-6.5</td>
<td>7-21.5</td>
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<td>20-41</td>
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<td>mmWave Low Noise</td>
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<td>40</td>
<td>43</td>
<td>2</td>
<td>12</td>
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<td>Waveguide</td>
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<td>13.5</td>
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<td>WR-28</td>
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<th>IP3 (dBm)</th>
<th>Connector Type</th>
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<tr>
<td>Sub-6 GHz</td>
<td>0.0005</td>
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<td>8-55</td>
<td>N/A</td>
<td>19-43</td>
<td>-</td>
<td>28-60</td>
<td>SMA, 2.92 mm</td>
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<tr>
<td>mmWave</td>
<td>18</td>
<td>40</td>
<td>35</td>
<td>4.5-10</td>
<td>19-23</td>
<td>-</td>
<td>28</td>
<td>2.92</td>
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<tr>
<td>Rack Mount</td>
<td>0.1</td>
<td>18</td>
<td>50</td>
<td>6.5</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>SMA</td>
</tr>
<tr>
<td>USB</td>
<td>0.05</td>
<td>18</td>
<td>12</td>
<td>4.5-5.5</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>WR-28</td>
</tr>
<tr>
<td>Variable Gain</td>
<td>0.1</td>
<td>18</td>
<td>50</td>
<td>6.5</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>SMA</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Amplifiers. View all online at pasternack.com.

Phase Shifters and Trimmers

Reliably convert frequencies with Pasternack’s ready-to-ship, high-quality RF phase shifters and trimmers for 5G applications
- Covering select frequency bands up to 40 GHz
- Adjustable up to 120 degrees
- Available in manual and programmable varieties
- Covering the full operational temperature range
- Some models offering MIL-SPEC compliance with environmental test conditions for hermeticity and temperature cycle
- Ideal for a variety of 5G applications, including communication systems and test instrumentation

<table>
<thead>
<tr>
<th>Phase Shifters and Trimmers</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Insertion Loss (dB)</th>
<th>Adjustable Phase (Deg/GHz)</th>
<th>Connector Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>0</td>
<td>8.2</td>
<td>0.5-13</td>
<td>0-360</td>
<td>SMA</td>
</tr>
<tr>
<td>mmWave</td>
<td>18</td>
<td>40</td>
<td>2.5</td>
<td>0-360</td>
<td>2.92 mm</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Phase Shifters and Trimmers. View all online at pasternack.com.
Switches

Meet your signal processing requirements with Pasternack’s ready-to-ship RF electromechanical relay and PIN diode switches for 5G applications.

- Covering broadband frequencies DC to 40 GHz
- Over 165 models available in coaxial, waveguide, and SMT packaged configurations
- Popular combinations of actuators and features
- High-reliability performance rated up to 10 million lifecycles
- Exhibiting insertion loss as low as 0.02 dB and isolation as high as 80 dB
- Qualified for 5G applications, including wireless communications and test & measurement

<table>
<thead>
<tr>
<th>Switches</th>
<th>Switch Type</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Insertion Loss (dB)</th>
<th>Isolation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz Electromechanical Relay</td>
<td>A/B Coaxial, SP4T, SP6T, SPST, Transfer</td>
<td>DC</td>
<td>6</td>
<td>0.25-0.7</td>
<td>40-85</td>
</tr>
<tr>
<td>mmWave Electromechanical Relay</td>
<td>SP4T, SP6T, SP8T, Transfer</td>
<td>DC</td>
<td>50</td>
<td>0.2-1.1</td>
<td>45-100</td>
</tr>
<tr>
<td>High Isolation</td>
<td>SP4T</td>
<td>DC</td>
<td>20</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>Manual</td>
<td>SP4T</td>
<td>DC</td>
<td>22</td>
<td>0.1-0.5</td>
<td>50-80</td>
</tr>
<tr>
<td>Sub-6 GHz PIN Diode</td>
<td>SPST, SP4T, SP3T, SP4T, SP6T, Transfer</td>
<td>0.005</td>
<td>6</td>
<td>0.4-1.2</td>
<td>35-80</td>
</tr>
<tr>
<td>mmWave PIN Diode</td>
<td>SPST, SP4T, SP3T, SP4T, SP8T</td>
<td>0.05</td>
<td>67</td>
<td>4-10</td>
<td>20-60</td>
</tr>
<tr>
<td>Surface Mount Electromechanical Relay</td>
<td>SP4T</td>
<td>DC</td>
<td>8</td>
<td>0.3-0.8</td>
<td>30-40</td>
</tr>
<tr>
<td>Sub-6 GHz Waveguide Electromechanical Relay</td>
<td>SP4T</td>
<td>5.85</td>
<td>18</td>
<td>0.012-0.08</td>
<td>85-105</td>
</tr>
<tr>
<td>mmWave Waveguide Electromechanical Relay</td>
<td>SP4T</td>
<td>18</td>
<td>40</td>
<td>0.012-0.013</td>
<td>90</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Switches. View all online at pasternack.com.
The Expanded 5G Wireless Spectrum

- **Sub-6 GHz**: Current Mobile Frequency Band
- **mmWave Band**: New Mobile Frequency Band

1 GHz
6 GHz
30 GHz
100 GHz

AM/FM Radio – TV
WiFi
Fixed Wireless – Satellite

Macro Cells
Macro and Small Cells
Small Cell Densification/Enhanced Capacity
## Global 5G Frequency Bands

<table>
<thead>
<tr>
<th>Region</th>
<th>Band 1</th>
<th>Band 2</th>
<th>Band 3</th>
<th>Band 4</th>
<th>Band 5</th>
<th>Band 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U.S.</strong></td>
<td>600 MHz (2x35 MHz)</td>
<td>2.5 GHz (LTE B41)</td>
<td>3.55-3.7 GHz</td>
<td>3.7-4.2 GHz</td>
<td>5.9-7.1 GHz</td>
<td>24.25-24.45 GHz</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td>700 MHz (2x30 MHz)</td>
<td>3.4-3.8 GHz</td>
<td>5.9-6.4 GHz</td>
<td>24.5-27.5 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>China</strong></td>
<td>3.3-3.6 GHz</td>
<td>4.8-5 GHz</td>
<td>24.5-27.5 GHz</td>
<td>37.5-42.5 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S.Korea</strong></td>
<td>3.4-3.8 GHz</td>
<td>26.5-29.5 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td>3.6-4.2 GHz</td>
<td>4.4-4.9 GHz</td>
<td>27.5-29.5 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Around the world, these bands have been allocated or targeted. Source: everythingrf.com*
Mixers and Multipliers

Expect high-performance signal conversion with Pasternack's ready-to-ship RF mixers and multipliers for 5G applications.

- Coaxial packaged mixers and multipliers covering select frequency bands from DC to 46 GHz, available in double-balanced, triple-balanced and IQ designs, with LO drive levels ranging from 10 to 19 dBm
- Waveguide converter mixers covering mmWave bands up to 110 GHz, available in both up and down converter models, with DC to 18 GHz IF frequency bands
- Additional features include field-replaceable coaxial connectors, active LO drives, and integrated waveguide ports
- Ideal for 5G communication systems and test instrumentation

<table>
<thead>
<tr>
<th>Mixers &amp; Multipliers</th>
<th>Design</th>
<th>Max. RF Frequency (GHz)</th>
<th>Max. IF Frequency (GHz)</th>
<th>Conversion Loss, Typical (dB)</th>
<th>RF to LO Isolation, Typical (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-6 GHz Mixers</strong></td>
<td>Double Balanced</td>
<td>6</td>
<td>3.5</td>
<td>6.8-9.8</td>
<td>14-45</td>
</tr>
<tr>
<td><strong>mmWave Mixers</strong></td>
<td>Double Balanced, IQ</td>
<td>43</td>
<td>18</td>
<td>9-11</td>
<td>35-42</td>
</tr>
<tr>
<td><strong>Waveguide Converter Mixers</strong></td>
<td>Down Converter, Up Converter</td>
<td>75</td>
<td>18</td>
<td>6-8</td>
<td>20</td>
</tr>
<tr>
<td><strong>Multipliers</strong></td>
<td>2x</td>
<td>46</td>
<td>–</td>
<td>8-13</td>
<td>Fundamental Isolation 20-30</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Mixers and Multipliers. View all online at pasternack.com.

Programmable Attenuators

Ensure reliable attenuation levels with Pasternack’s ready-to-ship RF programmable attenuators for 5G applications.

- Covering sub-6 GHz and mmWave frequency bands
- Maximum attenuation levels up to 127 dB
- Designs optimized for low insertion loss and excellent VSWR as low as 1.25:1
- Attenuation levels from 0 to 127 dB
- Low insertion loss ranging from 1.5 dB to 8.3 dB
- Full operational temperature range
- Rugged coaxial packaging and RoHS compliant

<table>
<thead>
<tr>
<th>Programmable Attenuators</th>
<th>Control Type</th>
<th>Min. Attenuation Level (dB)</th>
<th>Max. Attenuation Level (dB)</th>
<th>Max. Frequency (GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-6 GHz</strong></td>
<td>USB Controlled, TTL Controlled, Relay Controlled</td>
<td>0</td>
<td>127</td>
<td>6</td>
</tr>
<tr>
<td><strong>mmWave</strong></td>
<td>USB Controlled, TTL Controlled</td>
<td>0</td>
<td>30</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Programmable Attenuators. View all online at pasternack.com.
Limiters and Detectors

Keep control of I/O power levels with Pasternack’s ready-to-ship, broadband coaxial packaged RF limiters and detectors for 5G applications.

- Over 15 limiters and 20 detectors available for sub-6 GHz or mmWave frequency bands
- Available in compact cylindrical or drop-mountable package outlines with SMA or 2.92 mm RF connectors
- Ideal for proof-of-concept and prototyping in precision test and measurement, instrumentation, and subsystem assemblies
- Limiter applications: receiver front ends, stabilizing generator outputs, constant amplitude signals in phase-sensitive systems, amplitude variation reduction in FM detection systems
- Detector applications: power measurements, leveling pulsed signal sources, AM noise measurements, system-level performance monitoring, pulsed RF measurements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN-Schottky &amp; PIN-PIN Limiters</td>
<td>0.5</td>
<td>4</td>
<td>20</td>
<td>1</td>
<td>100-200</td>
</tr>
<tr>
<td>Sub-6 GHz High-Reliability Limiters</td>
<td>.02</td>
<td>4</td>
<td>13</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>mmWave High-Reliability Limiters</td>
<td>18</td>
<td>40</td>
<td>18</td>
<td>1</td>
<td>20-100</td>
</tr>
<tr>
<td>Sub-6 GHz Detectors</td>
<td>0.01</td>
<td>6</td>
<td>–</td>
<td>0.01-0.2</td>
<td>–</td>
</tr>
<tr>
<td>mmWave Detectors</td>
<td>16</td>
<td>40</td>
<td>–</td>
<td>0.05</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Limiters and Detectors. View all online at pasternack.com.

Noise Sources

Meet your immediate requirements for signal performance testing with Pasternack’s ready-to-ship RF coaxial packaged noise sources for 5G applications.

- Over 25 models covering sub-6 GHz and mmWave frequency bands
- Noise source design configurations include: octave band and broadband, amplified, precision-calibrated instrumentation-grade, noise sources with integral isolators
- Output ENR levels ranging from 7 dB to 35 dB
- Amplified models with output power levels from -14 dBm to +10 dBm
- Rugged metal package enclosure
- A variety of options for DC and output RF connectors
- Most models designed to meet MIL-STD-202F environmental test conditions

<table>
<thead>
<tr>
<th>Noise Sources</th>
<th>Design</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Noise Output ENR (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>Bench-Top, Module</td>
<td>0.00001</td>
<td>6</td>
<td>15-30</td>
</tr>
<tr>
<td>mmWave</td>
<td>Module</td>
<td>0.1</td>
<td>60</td>
<td>7-10</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Noise Sources. View all online at pasternack.com.
Oscillators

Count on high-performance signal generation with Pasternack’s ready-to-ship RF oscillators for 5G applications.

- Covering select bands from 10 MHz to 43 GHz
- Oscillator types include: voltage controlled (VCO), reference, phase locked, phase locked crystal, temperature compensated crystal
- Surface mount and coaxial packaged versions available
- Some models feature integrated buffering, modulated input ports, hermetic sealing, and USB GUI and serial command control functions
- All models cover full operational temperature range
- Some models are MIL-SPEC compliant with environmental test conditions for hermeticity and temperature cycle, for high-reliability applications
- Ideal for applications involving phase locked loops, frequency synthesizers, and function generators

<table>
<thead>
<tr>
<th>Oscillators</th>
<th>Frequency Range (GHz)</th>
<th>Phase Noise Range @10 kHz Offset (dBc/Hz)</th>
<th>Voltage Tuning Range (Volts)</th>
<th>Package Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Controlled</td>
<td>0.5-43.2</td>
<td>-121 to -64</td>
<td>3-20</td>
<td>Connectorized SMA, Connectorized 2.4mm, Surface Mount</td>
</tr>
<tr>
<td>Reference</td>
<td>0.01-0.1</td>
<td>-155 to -145</td>
<td>–</td>
<td>Connectorized SMA, Surface Mount</td>
</tr>
<tr>
<td>Phase Locked</td>
<td>0.5-6</td>
<td>-110 to -90</td>
<td>–</td>
<td>Connectorized SMA, Surface Mount</td>
</tr>
<tr>
<td>Phase Locked Crystal</td>
<td>0.01-0.1</td>
<td>-155 to -150</td>
<td>–</td>
<td>Connectorized SMA, Surface Mount</td>
</tr>
<tr>
<td>Temperature Compensated Crystal</td>
<td>0.01-0.02</td>
<td>-145</td>
<td>–</td>
<td>Connectorized SMA</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Oscillators. View all online at pasternack.com.

RF Passives

Power Dividers

Meet your immediate needs for 2-way and 4-way input power division with Pasternack’s ready-to-ship RF power dividers for 5G applications.

- Maximum input power of 30 W for wideband operating frequency ranges up to 6 GHz
- Maximum input power of 20 W for operating frequency ranges in the mmWave bands
- Operating temperature range of -45 to 85 degree C
- Low insertion loss, with VSWR performance as low as 1.4:1

<table>
<thead>
<tr>
<th>Power Dividers</th>
<th>Max. Frequency (GHz)</th>
<th>VSWR</th>
<th>Input Power (Watts)</th>
<th>Isolation (dB)</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>6</td>
<td>As low as 1.3:1</td>
<td>30</td>
<td>20-21</td>
<td>2-Way Connectorized SMA, 4-Way Connectorized Type-N</td>
</tr>
<tr>
<td>mmWave</td>
<td>40</td>
<td>As low as 1.3:1</td>
<td>20</td>
<td>18-20</td>
<td>2-Way Connectorized 2.92 mm, 4-Way Connectorized 2.92 mm</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Power Dividers. View all online at pasternack.com.
Fixed Attenuators

Provide reliable signal attenuation with Pasternack’s line of ready-to-ship RF fixed attenuators for 5G applications.

- Wide range of attenuation levels
- Rated up to 2 W
- Maximum operating frequencies up to 6 GHz and mmWave bands
- Durable stainless steel construction
- Available in SMA and 2.92 mm connector designs

<table>
<thead>
<tr>
<th>Fixed Attenuators</th>
<th>Max. Frequency (GHz)</th>
<th>Attenuation (dB)</th>
<th>VSWR</th>
<th>Max. Input Power (Watts)</th>
<th>Connector Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>18</td>
<td>1-40</td>
<td>As low as 1.35:1</td>
<td>2</td>
<td>SMA</td>
</tr>
<tr>
<td>mmWave</td>
<td>40</td>
<td>1-30</td>
<td>As low as 1.4:1</td>
<td>2</td>
<td>2.92 mm</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Fixed Attenuators. View all online at pasternack.com.

Terminations

Expect durable, high-performance with Pasternack’s ready-to-ship RF terminations for 5G applications.

- Rated up to 2 W
- Maximum operating frequencies up to 6 GHz, 18 GHz, or 40 GHz
- Reliable stainless steel construction
- Available in SMA, Mini SMP, Type-N, 4.3-10, and 2.92 mm connector series
- VSWR as low as 1.15:1

<table>
<thead>
<tr>
<th>Terminations</th>
<th>Max. Frequency (GHz)</th>
<th>VSWR</th>
<th>Input Power (Watts)</th>
<th>Connector Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>6</td>
<td>As low as 1.15:1</td>
<td>2</td>
<td>Type-N, SMA, 4.3-10</td>
</tr>
<tr>
<td>mmWave</td>
<td>40</td>
<td>As low as 1.2:1</td>
<td>1</td>
<td>2.92 mm, Mini SMP</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Terminations. View all online at pasternack.com.

Filters

Turn to Pasternack for your RF bandpass filter needs for 5G applications.

- Covering mid-band and mmWave band frequencies
- 4, 9, and 11 section options
- SMA connector package design
- Low insertion loss and excellent VSWR

<table>
<thead>
<tr>
<th>Filters</th>
<th>Bandpass Min. Frequency (GHz)</th>
<th>Bandpass Max. Frequency (GHz)</th>
<th>Sections</th>
<th>Impedance (Ohm)</th>
<th>Max. Insertion Loss (dB)</th>
<th>VSWR</th>
<th>Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz Bandpass</td>
<td>2</td>
<td>4</td>
<td>4, 11</td>
<td>50</td>
<td>0.75-1.5</td>
<td>1.5</td>
<td>SMA</td>
</tr>
<tr>
<td>mmWave Bandpass</td>
<td>27.5</td>
<td>31</td>
<td>9</td>
<td>50</td>
<td>2.5</td>
<td>1.5</td>
<td>SMA</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Filters. View all online at pasternack.com.
Directional Couplers
Expect high-quality signal coupling performance with Pasternack’s ready-to-ship RF directional couplers for 5G applications.
• Wide range of coupling levels available
• Maximum input power levels as high as 30 W
• Operating frequency ranges up to the mmWave bands
• Operating temperature range from -45 to 85 degree C
• Low insertion loss, with maximum VSWR levels as low as 1.5:1
• SMA and 2.92 connector designs available

| Directional Couplers | Min. Frequency (GHz) | Max. Frequency (GHz) | Coupling Value (dB) | Input Power (Watts) | VSWR  
|----------------------|----------------------|----------------------|---------------------|---------------------|-------
| Directional Couplers | 1                    | 40                   | 6-30                | 30                  | As low as 1.4:1 |

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Directional Couplers. View all online at pasternack.com.

Waveguides
Enable low loss transmission with Pasternack’s ready-to-ship, precision waveguide components for 5G applications.
• mmWave operating frequency bands
• Waveguide components include: couplers, waveguide-to-coax adapters, straights, bends, twists, and more
• Wide range of waveguide sizes
• Flange options include UG square/round cover, CMR, or CPR
• Ideal for development and test environments

<table>
<thead>
<tr>
<th>Waveguides</th>
<th>Waveguide Size</th>
<th>Flange Type</th>
<th>Length (inches)</th>
<th>Connector Design</th>
<th>Coupling Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Couplers</td>
<td>WR-22, WR-28</td>
<td>Square Cover, Round Cover</td>
<td>8-10</td>
<td>–</td>
<td>10-20</td>
</tr>
<tr>
<td>Coax Adapters</td>
<td>WR-22, WR-28</td>
<td>Square Cover, Round Cover</td>
<td>0.75-1</td>
<td>2.4 mm, 2.92 mm</td>
<td>–</td>
</tr>
<tr>
<td>Straights</td>
<td>WR-22, WR-28</td>
<td>Square Cover, Round Cover</td>
<td>3-12</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Bends</td>
<td>WR-22, WR-28</td>
<td>Square Cover, Round Cover</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Twists</td>
<td>WR-22, WR-28</td>
<td>Square Cover, Round Cover</td>
<td>1.5-2</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Waveguides. View all online at pasternack.com.
DC Blocks

Protect your bias-sensitive RF components with Pasternack’s ready-to-ship, high-grade RF DC blocks for 5G applications.

- Maximum operating frequency ranges up to the mmWave band
- Inner or outer conductor configuration options available
- 2.92 mm, SMA, Type-N, and TNC connector designs available

<table>
<thead>
<tr>
<th>DC Blocks</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Max. Voltage (Volts)</th>
<th>Connector Configuration</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>0.01</td>
<td>18</td>
<td>200-950</td>
<td>Type-N, SMA, TNC</td>
<td>Inner or Outer – Inner/Outer</td>
</tr>
<tr>
<td>mmWave</td>
<td>0.01</td>
<td>40</td>
<td>200</td>
<td>2.92 mm</td>
<td>Inner or Outer – Inner/Outer</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of DC Blocks. View all online at pasternack.com.

Bias Tees

Ensure dependable signal processing with Pasternack’s ready-to-ship RF bias tees for 5G applications.

- Maximum operating frequencies in the sub-6 GHz or mmWave frequency bands
- Maximum DC voltage rating of 100 V and current rating of 2.5 A
- SMA, Type-N, 3.5 mm, and 2.92 mm connector options available

<table>
<thead>
<tr>
<th>Bias Tees</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Max. Current (mA)</th>
<th>Max. Voltage (Volts)</th>
<th>RF Port Connector</th>
<th>DC Port Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz</td>
<td>0.01</td>
<td>6</td>
<td>2500</td>
<td>100</td>
<td>Type-N</td>
<td>Solder Pin</td>
</tr>
<tr>
<td>mmWave</td>
<td>0.0001</td>
<td>40</td>
<td>1000</td>
<td>50</td>
<td>2.92 mm, 3.5 mm</td>
<td>Pin, Solder Pin</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Bias Tees. View all online at pasternack.com.
Antennas

RF and Waveguide Antennas

Explore Pasternack’s wide selection of ready-to-ship RF and waveguide antennas for 5G applications.

- Operating in the sub-6 GHz and mmWave frequency bands
- Including coax fed antennas operating at sub-6 GHz
- Comprehensive offering of waveguide antennas including: standard gain horns, conical horns, scalar feed horns, lens horns, omni-directional with waveguide flanges
- Waveguide antennas mount directly to waveguides or can be combined with waveguide-to-coax adapters for coaxial connections

<table>
<thead>
<tr>
<th>Antennas</th>
<th>Nominal Gain (dBi)</th>
<th>Min. Frequency (GHz)</th>
<th>Max. Frequency (GHz)</th>
<th>Waveguide Size</th>
<th>Input Connector Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-6 GHz RF</td>
<td>2-7</td>
<td>0.698</td>
<td>5.9</td>
<td>-</td>
<td>Type-N</td>
</tr>
<tr>
<td>Sub-6 GHz Waveguide</td>
<td>0-20</td>
<td>1.7</td>
<td>5.85</td>
<td>WR-187, WR-229, WR-284, WR-430</td>
<td>-</td>
</tr>
<tr>
<td>mmWave Waveguide</td>
<td>10-20</td>
<td>18</td>
<td>40</td>
<td>WR-28, WR-34, WR-42</td>
<td>-</td>
</tr>
<tr>
<td>Sub-6 Waveguide w/Coax Adapters</td>
<td>10-20</td>
<td>1.7</td>
<td>5.85</td>
<td>WR-187, WR-229, WR-284, WR-430</td>
<td>SMA, Type-N</td>
</tr>
<tr>
<td>mmWave Waveguide w/Coax Adapters</td>
<td>10-20</td>
<td>18</td>
<td>40</td>
<td>WR-28, WR-34, WR-42</td>
<td>2.92 mm</td>
</tr>
<tr>
<td>Specialty Waveguide</td>
<td>11</td>
<td>1</td>
<td>18</td>
<td>Broadband</td>
<td>Type-N, SMA</td>
</tr>
</tbody>
</table>

Note: The 5G Solutions table represents only a subset of Pasternack’s complete offering of Antennas. View all online at pasternack.com.

In addition to offering the industry’s largest selection of RF components and cable assemblies for 5G innovation and testing, Pasternack has a wide variety of other parts, ranging from DC to 220 GHz, in-stock and ready to ship today!

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- Antennas
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- Cable Assemblies
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- Connectors
- Connector Accessories
- Couplers
- Filters
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- Mixers
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- Power Dividers
- Rotary Joints
- Surge Protectors
- Switches
- Terminations
- Test and Measurement
- Tools
- Waveguides

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