Solid State Broadband High Power Amplifier

2154 – BBS2E6ARR

20 – 3000 MHz / 500 Watts

The BBS2E6ARR (SKU 2154) is suitable for ultra broadband high power applications, laboratory, and RFI/EMC susceptibility testing. This dual band amplifier utilizes push-pull LDMOS devices for 20-1000MHz band and GaN devices for 1000-3000MHz band frequency. Employing advanced broadband RF matching networks and combining techniques, EMI/RFI filters, and all qualified components achieved exceptional performance, and high efficiency. The system includes a universal voltage, single phase, power supply and a built in forced air-cooling system. Empower RF’s ISO9001 Quality Assurance Program assures consistent performance and the highest reliability.

- Solid-state Class AB design
- Instantaneous ultra broadband
- Small form factor and lightweight
- 50 ohm input/output impedance
- High reliability and ruggedness
- Built-in control, monitoring and protection circuits
- Suitable for CW, AM and FM (Consult factory for other modulation types)

**ELECTRICAL SPECIFICATIONS @ 220V<sub>AC</sub>, 25°C, 50 Ω System**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency (Dual Band)</td>
<td>Low Band</td>
<td>BW₁</td>
<td>20</td>
<td>1000</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>High Band</td>
<td>BW₂</td>
<td>1000</td>
<td>3000</td>
<td>MHz</td>
</tr>
<tr>
<td>Output Power CW</td>
<td>P&lt;sub&gt;SAT1&lt;/sub&gt;</td>
<td>500</td>
<td>Watt</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P&lt;sub&gt;SAT2&lt;/sub&gt;</td>
<td>250</td>
<td>Watt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Power @ P₁dB Gain Compression</td>
<td>P₁dB₁</td>
<td>300</td>
<td>Watt</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P₁dB₂</td>
<td>120</td>
<td>Watt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Gain @ P₁dB</td>
<td>G₁dB₁</td>
<td>56</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G₁dB₂</td>
<td>54</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Power for Rated P&lt;sub&gt;SAT&lt;/sub&gt;</td>
<td>P&lt;sub&gt;IN&lt;/sub&gt;</td>
<td>0</td>
<td>dBm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Signal Gain Flatness</td>
<td>P&lt;sub&gt;IN&lt;/sub&gt;= -20dBm</td>
<td>∆G₁</td>
<td>±2.0</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P&lt;sub&gt;IN&lt;/sub&gt;= -10dBm</td>
<td>∆G₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain Adjustment Range</td>
<td>FGA</td>
<td>20</td>
<td>25</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>S₁₁</td>
<td>10</td>
<td>-10</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Noise Figure</td>
<td>NF₁</td>
<td>15</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NF₂</td>
<td>20</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third Order Intercept Point 2-Tone @ 100kHz Spacing</td>
<td>50dBm/Tone</td>
<td>IP₃₁</td>
<td>+60</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>47dBm/Tone</td>
<td>IP₃₂</td>
<td>+63</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Harmonics @ P&lt;sub&gt;OUT&lt;/sub&gt; = 300W</td>
<td>2&lt;sup&gt;ND&lt;/sup&gt; / 3&lt;sup&gt;RD&lt;/sup&gt;</td>
<td>-30/-20</td>
<td>dBC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P&lt;sub&gt;OUT&lt;/sub&gt; = 120W</td>
<td>2&lt;sup&gt;ND&lt;/sup&gt; / 3&lt;sup&gt;RD&lt;/sup&gt;</td>
<td>-20/-30</td>
<td>dBC</td>
<td></td>
</tr>
<tr>
<td>Spurious Signals</td>
<td>Spur</td>
<td>-70</td>
<td>dBC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Voltage (single phase)</td>
<td>V&lt;sub&gt;AC&lt;/sub&gt;</td>
<td>180</td>
<td>Volt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>@ 500W, CW</td>
<td>P₀₁</td>
<td>3650</td>
<td>Watt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>@ 250W, CW</td>
<td>P₀₂</td>
<td>1850</td>
<td>Watt</td>
<td></td>
</tr>
</tbody>
</table>

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www.EmpowerRF.com
Stock No. 2154
D.S. Rev. 2.52 / 05-14-2014
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2154 – BBS2E6ARR
20 – 3000 MHz / 500 Watts

MECHANICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (W x H x D)</td>
<td>19 x 19.25 x 22</td>
<td>Inch</td>
<td>Max</td>
</tr>
<tr>
<td>Weight</td>
<td>210 (Rack Slides Included)</td>
<td>lbs.</td>
<td>Max</td>
</tr>
<tr>
<td>RF Connector Input</td>
<td>Type-N female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF Connector Output</td>
<td>Type-N female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Connector</td>
<td>RJ-45 Ethernet 10/100Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O Control Connector</td>
<td>D-Sub 9-Pin, Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Power Connector</td>
<td>MIL-STD Circular Connector, Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>Built-in Forced Air Cooling System</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LCD Controller

Local: Front panel touch screen color LCD controller including FWD/REV Power indication (dBm or Watt scale), VSWR, Gain Adjustment, ALC Fast/Slow & On/Off, Standby mode, Fault indication.


ENVIRONMENTAL CHARACTERISTICS (Design to Meet)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Ambient Temperature</td>
<td>TC</td>
<td>0</td>
<td>+50</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>TSTG</td>
<td>-40</td>
<td>+85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity (non-condensing)</td>
<td>RH</td>
<td>95</td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Altitude (MIL-STD-810F Method 500.4)</td>
<td>ALT</td>
<td>30,000</td>
<td>Feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration/Shock</td>
<td>VI/SH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIMITS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input RF drive level without damage</td>
<td>+10 dBm</td>
<td>Max</td>
</tr>
<tr>
<td>Load VSWR @ P&lt;sub&gt;OUT&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Band: 300W</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>High Band: 120W</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Thermal Overload</td>
<td>85°C shutdown</td>
<td></td>
</tr>
</tbody>
</table>

I/O CONTROL CONNECTOR – D-Sub 9-Pin, Female

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Description</th>
<th>Specification</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forward Test Point</td>
<td>Analog Voltage 0-5V&lt;sub&gt;DC&lt;/sub&gt; relative to Forward Power Level</td>
<td>LCD</td>
</tr>
<tr>
<td>2</td>
<td>Reverse Test Point</td>
<td>Analog Voltage 0-5V&lt;sub&gt;DC&lt;/sub&gt; relative to Reverse Power Level</td>
<td>LCD</td>
</tr>
<tr>
<td>3</td>
<td>5V Test Point</td>
<td>+5.0V&lt;sub&gt;DC&lt;/sub&gt;, ±0.5V</td>
<td>LCD</td>
</tr>
<tr>
<td>4</td>
<td>VVA Test Point</td>
<td>VVA Gain Control +5.6V&lt;sub&gt;DC&lt;/sub&gt;, ±0.2V</td>
<td>LCD</td>
</tr>
<tr>
<td>5</td>
<td>EXT Shutdown</td>
<td>Amplifier Disable: TTL Logic High (5V)</td>
<td>LCD</td>
</tr>
<tr>
<td>6</td>
<td>12V Test Point</td>
<td>+12.0V&lt;sub&gt;DC&lt;/sub&gt;, ±1.0V</td>
<td>LCD</td>
</tr>
<tr>
<td>7</td>
<td>P/S Test Point</td>
<td>P/S Output Voltage +28.0V&lt;sub&gt;DC&lt;/sub&gt;, ±2.0V</td>
<td>LCD</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>Ground</td>
<td>LCD</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>Ground</td>
<td>LCD</td>
</tr>
</tbody>
</table>
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2154 – BBS2E6ARR

2154 – 0001 (3U)
1000–3000 MHz AMPLIFIER UNIT

2154 – 0002 (3U)
CONTROL, POWER SUPPLY UNIT

2154 – 0003 (5U)
20–1000 MHz AMPLIFIER UNIT

System Block Diagram

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System Outline Drawing
Solid State Broadband High Power Amplifier

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Performance Plots – Low Band

Plot 1 – Small Signal Gain and $P_{1\text{dB}}$
Top Curve: Small Signal Gain @ $P_{IN} = -20\text{dBm}$
Middle Curve: Power Gain @ $P_{1\text{dB}}$, $P_{IN} = -3\text{dBm}$
Bottom Curve: Input Return Loss
Reference: 0dB, 10dB/Div.

Plot 2 – Small Signal Gain and $P_{SAT}$
Top Curve: Small Signal Gain @ $P_{IN} = -20\text{dBm}$
Middle Curve: Power Gain @ $P_{SAT}$, $P_{IN} = -0.5\text{dBm}$
Bottom Curve: Input Return Loss
Reference: 0dB, 10dB/Div.

Plot 3 – Gain Adjustment Range
Top Curve: Maximum Gain @ $P_{IN} = -20\text{dBm}$
Middle Curve: VVA @ Minimum Gain
Reference: 29dB, 10dB/Div.
Bottom Curve: Input Return Loss @ Minimum Gain
Reference: 0dB, 10dB/Div.

Plot 4 – ALC Flatness
Top Curve: ALC @ 250W, $P_{IN} = 0\text{dBm}$
Bottom Curve: ALC @ 50W, $P_{IN} = 0\text{dBm}$
Reference: 51dB, 1dB/Div.
Middle Curve: Input Return Loss @ ALC = 50W
Reference: 0dB, 10dB/Div.

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Performance Plots – High Band

**Plot 5 – Small Signal Gain and $P_{1dB}$**
Top Curve: Small Signal Gain @ $P_{IN} = -10$dBm  
Middle Curve: Power Gain @ $P_{1dB}$, $P_{IN} = -5$dBm  
Reference: 57dB, 1dB/Div.

**Plot 6 – Small Signal Gain and $P_{SAT}$**
Top Curve: Small Signal Gain @ $P_{IN} = -10$dBm  
Middle Curve: Power Gain @ $P_{SAT}$, $P_{IN} = 0$dBm  
Reference: 57dB, 1dB/Div.

**Plot 7 – Gain Adjustment Range**
Top Curve: Maximum Gain @ $P_{IN} = -10$dBm  
Middle Curve: VVA @ Minimum Gain  
Reference: 27dB, 10dB/Div.

**Plot 8 – ALC Flatness**
Top Curve: ALC @ 125W, $P_{IN} = 0$dBm  
Bottom Curve: ALC @ 25W, $P_{IN} = 0$dBm  

Reference: 0dB, 10dB/Div.