6-18GHz, 21dB Gain, 1.5dB NF
Low Noise Amplifier

Features
- 16dBm $P_{\text{SAT}}$ with 1.5dB NF and 21.5dB gain typical from 6-18GHz
- Gain flatness $< +/-0.5$dB
- Input and Output matched to 50Ω
- Self biased for simple biasing, small solution size and ease of manufacture
- +24dBm maximum input power rating
- 1.1mm x 1.36mm x 0.1mm die size

Applications
- Instrumentation
- Electronic warfare
- Microwave communications

Typical Performance (CW, Typical Device, RF Probe): $T_{A}=25^\circ\text{C}, V_{D1,2}=4\text{V}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>6</td>
<td>-</td>
<td>18</td>
<td>GHz</td>
</tr>
<tr>
<td>Small Signal Gain</td>
<td>21.0</td>
<td>-</td>
<td>21.7</td>
<td>dB</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>1.5</td>
<td>1.6</td>
<td>1.8</td>
<td>dB</td>
</tr>
<tr>
<td>Output Power, $P_{1\text{dB}}$</td>
<td>14.0</td>
<td>15.0</td>
<td>15</td>
<td>dBm</td>
</tr>
<tr>
<td>Output Power $P_{\text{SAT}}$</td>
<td>15.0</td>
<td>16.0</td>
<td>17</td>
<td>dBm</td>
</tr>
<tr>
<td>Output IP3</td>
<td>26</td>
<td>29</td>
<td>31</td>
<td>dBm</td>
</tr>
<tr>
<td>Drain Current</td>
<td>105</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>
Table 1: Absolute Maximum Ratings, Not Simultaneous

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Voltage ((V_D))</td>
<td>+4.5</td>
<td>V</td>
</tr>
<tr>
<td>Input Power ((P_{in}))</td>
<td>24</td>
<td>dBm</td>
</tr>
<tr>
<td>Channel Temperature ((T_C))</td>
<td>150(^1)</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Ambient Temperature ((T_A))</td>
<td>-55 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Thermal Resistance, Channel to Die Backside</td>
<td>TBD (140 est)</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

\(^1\) MTTF @ \(T_C = 150°C > 10^7\) hours

Table 2: Specifications (CW, 100% Test): \(T_A = 25°C, V_{dd} = 4V, I_{dd} = 100mA\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Signal Gain</td>
<td>18GHz</td>
<td>18.0</td>
<td>21.0</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Output Power, (P_{1dB})</td>
<td>18GHz</td>
<td>-</td>
<td>1.8</td>
<td>2.3</td>
<td>dBm</td>
</tr>
</tbody>
</table>

RF Probe Measurement Set-Up With Reference Planes\(^2\)

\(^2\) Reference planes are the same for S-parameter files downloadable on www.microsemi.com/mmics
Typical Performance, RF Probe
$V_{DD} = 4V$, $I_{DD} = 105$, $T_A=25°C$ unless otherwise noted

**$S_{11}$ Over $V_{DD}$**

**$S_{11}$ Over Temperature, $V_{DD} = 3.3V$**

**$S_{11}$ Over Temperature, $V_{DD} = 4.0V$**

**$S_{22}$ Over $V_{DD}$**

**$S_{22}$ Over Temperature, $V_{DD} = 3.3V$**

**$S_{22}$ Over Temperature, $V_{DD} = 4.0V$**
Typical Performance, RF Probe

\(V_{DD} = 4V, I_{DD} = 105, T_A=25^\circ C\) unless otherwise noted

**S\(_{21}\) Over \(V_{DD}\)**

- **3.3V**
- **4.0V**

**S\(_{21}\) Over Temperature, \(V_{DD} = 3.3V\)**

- \(+25^\circ C\)
- \(+85^\circ C\)

**S\(_{21}\) Over Temperature, \(V_{DD} = 4.0V\)**

- \(+25^\circ C\)
- \(+85^\circ C\)

**NF Over \(V_{DD}\)**

- **3.3V**
- **4.0V**

**NF Over Temperature, \(V_{DD} = 3.3V\)**

- \(+25^\circ C\)
- \(+85^\circ C\)

**NF Over Temperature, \(V_{DD} = 4.0V\)**

- \(+25^\circ C\)
- \(+85^\circ C\)
**Typical Performance, RF Probe**

\( V_{DD} = 4V, I_{DD} = 105, T_A=25^\circ C \) unless otherwise noted

---

**P1dB Over \( V_{DD} \)**

- 3.3V
- 4.0V

---

**P3dB Over \( V_{DD} \)**

- 3.3V
- 4.0V

---

**Power Sweep, \( V_{DD} = 3.3V \)**

- 6GHz
- 8GHz
- 10GHz
- 12GHz
- 14GHz
- 16GHz
- 18GHz

---

**Power Sweep, \( V_{DD} = 4.0V \)**

- 6GHz
- 8GHz
- 10GHz
- 12GHz
- 14GHz
- 16GHz
- 18GHz

---

**OIP3 Over \( P_{OUT}/\text{tone}, V_{DD} = 3.3V \)**

- 0dBm/\text{tone}
- 3dBm/\text{tone}
- 6dBm/\text{tone}

---

**OIP3 Over \( P_{OUT}/\text{tone}, V_{DD} = 4.0V \)**

- 0dBm/\text{tone}
- 3dBm/\text{tone}
- 6dBm/\text{tone}

---

\(^3\) OIP3 over \( P_{OUT}/\text{tone} \) can be adjusted using \( V_{D1} \) and \( V_{D2} \)
Typical Performance, RF Probe

V\text{DD} = 4V, I\text{DD} = 105, T_A=25^\circ C unless otherwise noted

\begin{align*}
S_{21} & \text{ & NF, } V_{\text{DD}} = 3.3V \\
\text{Power & OIP3, } V_{\text{DD}} = 3.3V^4
\end{align*}

\begin{align*}
\text{IMD Sweep, } V_{\text{DD}} = 3.3V^4 \\
\text{IMD Sweep, } V_{\text{DD}} = 4.0V^4
\end{align*}

\text{OIP3 over } P_{\text{OUT/ tone}} \text{ can be adjusted using } V_{D1} \text{ and } V_{D2}

Connectorized Test Fixture
With 2.92mm Connectors

VD1 Feedthru
VD2 Feedthru

0.1uF  100pF  100pF  0.1uF

1.000
0.950
Typical Performance, Connectorized Test Fixture

$V_{DD} = 4V$, $I_{DD} = 105$, $T_A = 25^\circ C$ unless otherwise noted

**S\textsubscript{11} Over Temperature**

**S\textsubscript{22} Over Temperature**

**S\textsubscript{21} Over Temperature**

**NF Over Temperature**

**P\textsubscript{1dB} Over Temperature**

**P\textsubscript{3dB} Over Temperature**
Typical Performance, Connectorized Test Fixture

\( V_{DD} = 4V, \, I_{DD} = 105, \, T_A = 25^\circ C \) unless otherwise noted

\( ^5 \) OIP3 over \( P_{OUT/tone} \) can be adjusted using \( V_{D1} \) and \( V_{D2} \)
Typical Performance, Connectorized Test Fixture

\( V_{\text{DD}} = 4V, I_{\text{DD}} = 105, T_{\text{A}}=25^\circ\text{C} \) unless otherwise noted

---

IMD3 Sweep, -40°C

\[
\text{IMD3 (dBc)} = 100 \log_{10} \left( \frac{P_{\text{OUT}}}{P_{\text{TONE}}} \right)
\]

\[ P_{\text{OUT}} = 1 \text{MHz Tone Spacing} \]

---

IMD3 Sweep, +25°C

\[
\text{IMD3 (dBc)} = 100 \log_{10} \left( \frac{P_{\text{OUT}}}{P_{\text{TONE}}} \right)
\]

\[ P_{\text{OUT}} = 1 \text{MHz Tone Spacing} \]

---

IMD3 Sweep, +85°C

\[
\text{IMD3 (dBc)} = 100 \log_{10} \left( \frac{P_{\text{OUT}}}{P_{\text{TONE}}} \right)
\]

\[ P_{\text{OUT}} = 1 \text{MHz Tone Spacing} \]

---

Phase Noise, 6.5GHz

\[
\text{Phase Noise (dBc)} = 100 \log_{10} \left( \frac{P_{\text{OUT}}}{P_{\text{TONE}}} \right)
\]

\[ P_{\text{TONE}} = 6.5\text{GHz} \]

---

Phase Noise, 8.0GHz

\[
\text{Phase Noise (dBc)} = 100 \log_{10} \left( \frac{P_{\text{OUT}}}{P_{\text{TONE}}} \right)
\]

\[ P_{\text{TONE}} = 8.0\text{GHz} \]

---

Phase Noise, 9.5GHz

\[
\text{Phase Noise (dBc)} = 100 \log_{10} \left( \frac{P_{\text{OUT}}}{P_{\text{TONE}}} \right)
\]

\[ P_{\text{TONE}} = 9.5\text{GHz} \]

---

6 OIP3 over \( P_{\text{OUT}}/\text{tone} \) can be adjusted using \( V_{\text{D1}} \) and \( V_{\text{D2}} \)

7 Visit www.microsemi.com/mmics for application note on phase noise measurement at Microsemi
**Typical Performance, Connectorized Test Fixture**

\[ V_{DD} = 4V, I_{DD} = 105, T_A=25^\circ C \] unless otherwise noted

---

**Phase Noise**, 11.0GHz

![Phase Noise Graph](image1)

**Phase Noise**, 12.5GHz

![Phase Noise Graph](image2)

---

8 Visit [www.microsemi.com/mmics](http://www.microsemi.com/mmics) for application note on phase noise measurement at Microsemi
Chip layout showing pad locations.
All dimensions are in microns. Die thickness is 100 microns. Backside metal is gold, bond pad metal is gold.
Refer to Die Handling Application Note MM-APP-0001 (visit www.microsemi.com/mmics).

![Chip layout showing pad locations.](image)

Table 3: Pad Descriptions

<table>
<thead>
<tr>
<th>Pad #</th>
<th>Description</th>
<th>Pad Dimensions (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 4, 7</td>
<td>Ground</td>
<td>100 x 100</td>
</tr>
<tr>
<td>2</td>
<td>RF_{IN}, pad is AC coupled</td>
<td>100 x 150</td>
</tr>
<tr>
<td>3</td>
<td>V_{D1}</td>
<td>100 x 100</td>
</tr>
<tr>
<td>5</td>
<td>V_{D2}</td>
<td>100 x 100</td>
</tr>
<tr>
<td>6</td>
<td>RF_{OUT}, pad is AC coupled</td>
<td>100 x 150</td>
</tr>
</tbody>
</table>

Biasing
MMA004AA is a self-biased device with positive supply. Apply V_{DD} to pad 3 and 5. V_{D1} and V_{D2} should be RF isolated from each other. Bias sequence does not matter.
Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense and security, aerospace, and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs, and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world’s standard for time; voice processing devices; RF solutions; discrete components; security technologies and scalable anti-tamper products; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif. and has approximately 3,400 employees globally. Learn more at www.microsemi.com.

Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo CA 92656 USA
Within the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996

© 2014 Microsemi Corporation. All rights reserved. Microsemi and the Microsemi logo are trademarks of Microsemi Corporation. All other trademarks and service marks are the property of their respective owners.