78 GHz – 100 GHz High - Power Amplifier

Features

- Wideband operation: 78 GHz – 100 GHz
- Pout = 17 dBm (typ, Pin = 5 dBm)
- P(-1dB) = 11 dBm (typ)
- Linear Gain: 14 – 23 dB
- Linear Gain Control Range: 10 dB
- WR-10 Waveguide Interface

General Description

CI0402 is a high-power amplifier operated from 78 GHz to 100 GHz frequency range with output power up to 50 mW (typ). The MMIC is fabricated using a 0.1-µm InP HEMT process. CI0402 has WR-10 waveguide interface for the input and output.

Applications

- Astronomy
- Millimeter-wave spectrum measurement
- Millimeter-wave imaging system
- Other test equipment

Functional Diagram
### Connection Table

<table>
<thead>
<tr>
<th>No.</th>
<th>NAME</th>
<th>FUNCTION</th>
<th>No.</th>
<th>NAME</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RFin</td>
<td>RF Input (WR-10, UG-387/U)</td>
<td>6</td>
<td>NC</td>
<td>No Internal Connection</td>
</tr>
<tr>
<td>2</td>
<td>RFout</td>
<td>RF Output (WR-10, UG-387/U)</td>
<td>7</td>
<td>GND</td>
<td>Ground (0.0 V)</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground (0.0 V)</td>
<td>8</td>
<td>NC</td>
<td>No Internal Connection</td>
</tr>
<tr>
<td>4</td>
<td>Vgain</td>
<td>Gain Control (-3.0 - 0.0 V)</td>
<td>9</td>
<td>Vd</td>
<td>Power Supply (1.5 V)</td>
</tr>
<tr>
<td>5</td>
<td>Vd</td>
<td>Power Supply (1.5 V)</td>
<td>10</td>
<td>Vgain</td>
<td>Gain Control (-3.0 - 0.0 V)</td>
</tr>
</tbody>
</table>

**Note**

Normally, the pins should be grounded.

### Connection Diagram

[Diagram showing connections and heat sinks]
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>RATING</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vd</td>
<td>Power Supply Voltage</td>
<td>-0.1 to +2.0</td>
<td>V</td>
</tr>
<tr>
<td>Vgain</td>
<td>Gain Control Voltage</td>
<td>-4.0 to +0.1</td>
<td>V</td>
</tr>
<tr>
<td>Pin</td>
<td>RF Input Power</td>
<td>10</td>
<td>dBm</td>
</tr>
<tr>
<td>Tc</td>
<td>Case Temperature under Bias</td>
<td>TBD</td>
<td>°C</td>
</tr>
<tr>
<td>Tstor</td>
<td>Storage Temperature</td>
<td>TBD</td>
<td>°C</td>
</tr>
</tbody>
</table>

TBD: To Be Determined

Recommended Operating Conditions

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vd</td>
<td>Power Supply Voltage</td>
<td>TBD</td>
<td>1.5</td>
<td>TBD</td>
<td>V</td>
</tr>
<tr>
<td>Vgain</td>
<td>Gain Control Voltage</td>
<td>-3.0</td>
<td>0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Pin</td>
<td>RF Input Power</td>
<td></td>
<td>5</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Tc</td>
<td>Case Temperature under Bias</td>
<td>TBD</td>
<td>45</td>
<td></td>
<td>°C</td>
</tr>
</tbody>
</table>

TBD: To Be Determined

DC Characteristics

(Vd = 1.5V, Vgain = 0.0V, GND = 0.0 V, Tc (1) = 40 °C)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>Power Supply Current</td>
<td>2.3</td>
<td>TBD</td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

TBD: To Be Determined

Note

Tc: Temperature at package base.
AC Characteristics

\(V_d = 1.5 \text{ V}, \ V_{\text{gain}} = 0.0 \text{ V}, \ GND = 0.0 \text{ V}, \ f = 78 \text{ GHz} – 100 \text{ GHz}, \ T_c^{(1)} = 40 \text{ ºC}\)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gs</td>
<td>Linear Gain</td>
<td>TBD</td>
<td>20</td>
<td>TBD</td>
<td>dB</td>
</tr>
<tr>
<td>Pout</td>
<td>Output Power at 5 dBm Input</td>
<td>TBD</td>
<td>17</td>
<td>TBD</td>
<td>dBm</td>
</tr>
<tr>
<td>P(-1dB)</td>
<td>Output Power at 1dB Gain Compression</td>
<td>TBD</td>
<td>11</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>S_{11}</td>
<td>Maximum Input Return Loss</td>
<td>-7</td>
<td>TBD</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>S_{22}</td>
<td>Maximum Output Return Loss</td>
<td>-4</td>
<td>TBD</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>S_{12}</td>
<td>Maximum Reverse Isolation</td>
<td>-35</td>
<td>TBD</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Gc</td>
<td>Linear Gain Control Range (V_{\text{gain}} = -3.0 – 0.0 \text{ V})</td>
<td>TBD</td>
<td>10</td>
<td>TBD</td>
<td>dB</td>
</tr>
</tbody>
</table>

TBD: To Be Determined

Note

Tc: Temperature at package base.
Sample Small Signal Characteristics (75 GHz – 110 GHz)

Measurement Conditions
Vd = 1.5 V, Vgain = 0.0 V, GND = 0.0 V

Sample Input and Output Characteristics

Measurement Conditions
Vd = 1.5 V, Vgain = 0.0 V, GND = 0.0 V
Sample Output Power vs Frequency (78 GHz - 100 GHz)

Measurement Conditions
Vd = 1.5 V, Vgain = 0.0 V, GND = 0.0 V
Sample Implementation

Note: Each number corresponds to a pin or a waveguide as shown in Connection Diagram.

Power Supply Sequence

(1) Set power supply voltage $V_d$, $V_{gain}$, and GND to 0 V.

(2) Apply 1.5 V to $V_d$.

(3) Apply $-3.0 \text{ V} - 0.0 \text{ V}$ to $V_{gain}$.

(4) Supply RF Input.

Note.

(1) Use common power supply for both pin 5 and 9.

(2) Use common power supply for both pin 4 and 10.

(3) Use power supplies that do not generate over-voltages such as spikes. Many power supplies generate over-voltages when their outputs are turned on or turned off. To avoid these over-voltages, connect power supplies to $V_d$ and $V_{gain}$ after the power supply outputs are turned on and set to 0 V. Disconnect power supplies from $V_s$ and $V_{gain}$ after the power supply outputs are set to 0 V but before the outputs are turned off.

(4) Connect a power supply to $V_d$ with compliance current of less than 3.0 A.

(5) Use the module in an air velocity of 0.5 m/sec or more and do not remove the heat sinks attached on the module surfaces.
Handling Instructions

Since the IC is fabricated using InP HEMT process, users are recommended to follow the instructions below to prevent damage to the chip from electro-static discharge.

1) Use a conductive working desk connected to the ground (or, a conductive table top connected to the ground).
2) Require all handling personnel to wear a conductive bracelet or wrist-strap connected to the ground through a 1 M-ohm resistor.
3) Ground all test equipment.
4) Ground all soldering iron tops.
5) Store IC's and other devices such as chip capacitors in their conductive carriers until they are soldered.

tolerance: ±0.15
Caution

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