Features:

- Frequency Range: 12.5 – 15.5 GHz
- P1dB: 32 dBm
- IM3 Level -44dBc @Po=20dBm/tone
- Gain: 23.5 dB
- Vdd =4 to 6 V
- Ids = 1200 to 2500 mA
- Input and Output Fully Matched to 50 Ω
- Integrated RF power detector
- Surface Mount QFN 5x5mm Package

Applications:

- Communication systems
- Microwave instrumentations
- Point to Point Radios

Description:

The MMA-121633 is a GaAs MMIC linear power amplifier with 2-Watt output power and high gain over full 12.5 to 15.5GHz frequency range. This amplifier was optimally designed for high linearity applications at 5dB back-off from P-1 condition.

Absolute Maximum Ratings: \( (Ta= 25 \, ^\circ C) \)

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETERS</th>
<th>UNITS</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vds</td>
<td>Drain-Source Voltage</td>
<td>V</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Vg</td>
<td>Gate-Source Voltage</td>
<td>V</td>
<td>-2.1</td>
<td>0</td>
</tr>
<tr>
<td>Ig</td>
<td>First Gate Current</td>
<td>mA</td>
<td>-17</td>
<td>17</td>
</tr>
<tr>
<td>Pd</td>
<td>Power Dissipation</td>
<td>W</td>
<td>16.8</td>
<td></td>
</tr>
<tr>
<td>Pin max</td>
<td>RF Input Power</td>
<td>dBm</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Toper</td>
<td>Operating Temperature</td>
<td>°C</td>
<td>-40 to +85</td>
<td></td>
</tr>
<tr>
<td>Tch</td>
<td>Channel Temperature</td>
<td>°C</td>
<td>+150</td>
<td></td>
</tr>
<tr>
<td>Tstg</td>
<td>Storage Temperature</td>
<td>°C</td>
<td>-55 to +150</td>
<td></td>
</tr>
<tr>
<td>Tmax</td>
<td>Max. Assembly Temp (20 sec max)</td>
<td>°C</td>
<td>+250</td>
<td></td>
</tr>
</tbody>
</table>

*Operation of this device above any one of these parameters may cause permanent damage.
### Electrical Specifications: \( V_{ds}=6V, V_{g}=-0.9V, \ Ids=1400mA, \ Ta=25°C \ Z_0=50 \text{ ohm} \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Typical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>GHz</td>
<td>12.5 - 15.5</td>
</tr>
<tr>
<td>Gain (Typ / Min)</td>
<td>dB</td>
<td>23.5 / 22</td>
</tr>
<tr>
<td>Gain Flatness (Typ / Max)</td>
<td>+/-dB</td>
<td>1.5 / 2</td>
</tr>
<tr>
<td>Input RL(Typ/Max)</td>
<td>dB</td>
<td>10/8</td>
</tr>
<tr>
<td>Output RL(Typ/Max)</td>
<td>dB</td>
<td>10/8</td>
</tr>
<tr>
<td>Output P1dB(Typ/Min)</td>
<td>dBm</td>
<td>32/31</td>
</tr>
<tr>
<td>IM3 Level @Po=20dBm/tone</td>
<td>dBc</td>
<td>-44</td>
</tr>
<tr>
<td>Output Psat(Typ/Min)</td>
<td>dBm</td>
<td>34/33</td>
</tr>
<tr>
<td>Operating Current at P1dB (Typ/Max)</td>
<td>mA</td>
<td>2000 / 2300</td>
</tr>
<tr>
<td>Thermal Resistance</td>
<td>°C /W</td>
<td>3.8</td>
</tr>
</tbody>
</table>

(1) Output IM3 is measured with two tones at output power of 20 dBm/tone separated by 20 MHz.
Typical RF Performance: $V_{ds} = 6V$, $V_{g} = -0.9V$, $I_{ds} = 1400mA$, $Z_0 = 50\ \text{ohm}$, $T_a = 25\ ^\circ\text{C}$

- S11[dB], S21[dB], and S22[dB] vs. Frequency
- IM3 Level [dBc] vs. output power/tone [dBm]
- P-1 and Psat vs. Frequency
- Pout[dBm], and $I_{ds}[mA]$ vs. Input power [dBm]
Typical Bias dependent RF Performance: Vds=4V

- Bias dependent P1 vs. Frequency
  - @Vds=4V, Ids=1400mA
  - @Vds=4V, Ids=2000mA

- Bias dependent P-3 vs. Frequency
  - @Vds=4V, Ids=1400mA
  - @Vds=4V, Ids=2500mA

Vds=4V, Ids=1400mA
Vds=4V, Ids=2000mA
Vds=4V, Ids=2500mA
MMA-121633-R5
12.5-15.5GHz, 2W Power Amplifier
Data Sheet

Typical Bias dependent RF Performance: Vds=5V

Bias dependent P1 vs. Frequency

Bias dependent P-3 vs. Frequency

Vds=5V, Ids=1400mA

@Vds=5V, Ids=2000mA

@Vds=5V, Ids=2500mA

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Typical Bias dependent RF Performance: Vds=6V

- Bias dependent P1 vs. Frequency
- Bias dependent P-3 vs. Frequency

Vds=6V, Ids=2000mA

@Vds=6V, Idsq=1400mA

@Vds=6V, Idsq=2000mA

@Vds=6V, Idsq=2500mA
Typical Over Temperature Performance: $V_{ds}=6V$, $I_{ds}=1400mA$, $Z_0=50$ ohm, $T_a=-40$, 25, and 85 ºC

P1 over temperature

S21(dB) over temperature

P-3 over temperature

S11(dB) over temperature

S22(dB) over Voltage
Typical Power Detector Voltages: $V_{ds}=6V$, $I_{dsq}=1.4A$, Frequency=13GHz

Detector Voltages (DET_O and DET_R) vs. Output RF power

$V_{delta}$ axis is Log-scale.
Applications

The MMA-121633-R5 MMIC power amplifier is designed for use as a power stage amplifier in microwave transmitters. It is ideally suited for 12.7 to 15.4GHz band point to point radio applications requiring a flat gain response and excellent linearity performance. This amplifier is provided as a 5x5mm QFN package, and the packaged amplifier is fully compatible with industry standard high volume surface mount PCB assembly processes.

Biasing and Operation

The recommended bias conditions for best performance for the MMA-121633-R5 are VDD = 6.0V, Idsq = 1400mA. Performance improvements are possible depending on applications. The drain bias voltage range is 4 to 6V and the quiescent drain current biasing range is 1200mA to 2500mA. A single DC gate supply connected to Vg will bias all the amplifier stages. Muting can be accomplished by setting Vg to the pinch-off voltage (Vp=-2V). The gate voltage (Vg) should be applied prior to the drain voltages (Vd1, Vd2, and Vd3) during power up and removed after the drain voltages during power down. The RF input port is connected internally to the ground for ESD protection purpose; therefore, an input decoupling capacitor is needed if the preceding output stage has DC present. The RF output is DC decoupled internally. Typical DC supply connection with bi-passing capacitors for the MMA-121633-R5 is shown in following pages.

MMA-121633-R5 contains optional temperature compensated output power detectors. Typical detection voltage vs. output power is shown in previous page. To obtain over temperature compensation, a recommended differential amplifier is required.

Assembly Techniques

GaAs MMICs are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling, and assembly. MMIC ESD precautions, handling considerations, die attach and bonding methods are critical factors in successful GaAs MMIC performance and reliability.
Package Pin-out:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>RF Input</td>
</tr>
<tr>
<td>21</td>
<td>RF Output</td>
</tr>
<tr>
<td>10</td>
<td>Vg</td>
</tr>
<tr>
<td>31</td>
<td>Vd1</td>
</tr>
<tr>
<td>28</td>
<td>Vd2</td>
</tr>
<tr>
<td>15, 26</td>
<td>Vd3</td>
</tr>
<tr>
<td>18</td>
<td>DET_Reference</td>
</tr>
<tr>
<td>23</td>
<td>DET_Output</td>
</tr>
<tr>
<td>1, 3, 5, 8, 9, 16, 17, 20, 22, 24, 25, 32, 33</td>
<td>Ground</td>
</tr>
<tr>
<td>2, 6, 7, 11, 12, 13, 14, 19, 27, 29, 30</td>
<td>N/C</td>
</tr>
</tbody>
</table>
Mechanical Information:

The units are in [mm].
Application Circuit:

Note:
Vd3 pins must be biased from both sides.
Recommended Application Board Design:
Board Material is 10mil (Dielectric) thickness Rogers 4350B with 0.5oz cupper clads. 
Board is soldered on a gold plated solid cupper block and adequate heat-sinking is required for 16.8W total power dissipation.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2, C3, C4, C5</td>
<td>1uF capacitor (0603)</td>
</tr>
<tr>
<td>C6, C7, C8, C9, C10</td>
<td>0.01uF Capacitor (0402)</td>
</tr>
<tr>
<td>R1, R2, R3, R4, R5</td>
<td>10Ω Resistor (0402)</td>
</tr>
</tbody>
</table>
Recommended Application Board Design:
Board Material is 10mil (Dielectric) thickness Rogers 4350B with 0.5oz copper clads. The board material and mounting pattern, as defined in the data sheet, optimizes RF performance and is strongly recommended. An electronic drawing of the land pattern is available upon request from MwT Sales & Application Engineering.

Underneath the package must be Copper filled plated through holes.
D=0.3mm and Space=0.5mm
Total Via-holes = 7 x 7

Copper filled thru vias
D=0.3mm, Space=0.5mm
7x7

For best thermal dissipation, 3mm square Copper filled PCB is recommended.

SolderPipes 62NCLR-A
Rogers RO4350B,
T=0.25mm with 17.8um copper clads
Indium Solder 60% Sn, 40% PB
2.5mm Thk. Cu Carrier
Thermagon T2910C

Aluminium-alloy
Heat-sink

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