Features:

- Frequency Range: 28 - 31 GHz
- P1dB: +36 dBm
- IM3 Level: -35 dBc @Po=26dBm/tone
- Gain: 22 dB
- Vdd = 5 to 6V
- Idsq = 1200 to 3000mA
- Input and Output Fully Matched to 50 Ω
- Integrated power detector
- BCB coated for scratch and moisture protections

Applications:

- P2P Radio
- V-sat
- Military

Description:

The MMIC is a high power amplifier MMIC die for use in transmitters that operate at frequencies between 28GHz and 31GHz. In the operational frequency band, it provides 36dBm of output power (P-3dB) and 22dB of small-signal gain. This MMIC is also optimized for high linearity applications. This MMIC provides IM3 level of 35dBc at Po=26dBm/tone when biased under Vds=5V, Idsq=3000mA.

Absolute Maximum Ratings:  (Ta= 25 °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>-2.1</td>
<td>6.5</td>
</tr>
<tr>
<td>Vg</td>
<td>Gate-Source Voltage</td>
<td>V</td>
<td>-17</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>-17</td>
<td>24</td>
</tr>
<tr>
<td>Pin max</td>
<td>RF Input Power</td>
<td>dBm</td>
<td>-17</td>
<td>20</td>
</tr>
<tr>
<td>Tch</td>
<td>Channel Temperature</td>
<td>°C</td>
<td>-150</td>
<td>+150</td>
</tr>
<tr>
<td>Tstg</td>
<td>Storage Temperature</td>
<td>°C</td>
<td>-55</td>
<td>+150</td>
</tr>
<tr>
<td>Tmax</td>
<td>Max. Assembly Temp (20 sec max)</td>
<td>°C</td>
<td>-150</td>
<td>+250</td>
</tr>
</tbody>
</table>

*Operation of this device above any one of these parameters may cause permanent damage.
### Electrical Specifications:

<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>28-31</td>
</tr>
<tr>
<td>Gain (Typ / Min)</td>
<td>dB</td>
<td>22 / 20</td>
</tr>
<tr>
<td>Gain Flatness (Typ / Max)</td>
<td>+/-dB</td>
<td>2.5 / 3</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>35/34</td>
</tr>
<tr>
<td>Output P3dB (Typ/Min)</td>
<td>dBm</td>
<td>36/35</td>
</tr>
<tr>
<td>IM3 Level (1)</td>
<td>dBc</td>
<td>-40</td>
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<tr>
<td>Thermal Resistance</td>
<td>°C/W</td>
<td>3.8</td>
</tr>
<tr>
<td>Operating Current at P1dB (Typ / Max)</td>
<td>mA</td>
<td>2500 / 3000</td>
</tr>
</tbody>
</table>

(1) Output IP3 is measured with two tones at output power of 20 dBm/tone separated by 20 MHz.
Typical RF Performance: \( V_{ds}=6V, V_{gs}=0.85V, I_{ds}=2000mA, Z_0=50 \, \text{ohm}, T_a=25 \, ^\circ\text{C} \)

![Graph of S11, S21, and S22 vs. Frequency](image1)

![Graph of IM3 level [dBc] vs. Output power/tone [dBm]](image2)

![Graph of P-1 and P-3 vs. Frequency](image3)

![Graph of Po(dBm), and I_{ds}(mA) vs. Pin(dBm)](image4)
Typical Bias dependent RF Performance: Vds=4V

Bias dependent P1 vs. Frequency

Bias dependent P-3 vs. Frequency

@Vds=4V, Idsq=2.8A

@Vds=4V, Idsq=2.2A

@Vds=4V, Idsq=2.2A
Typical Bias dependent RF Performance: $V_{ds}=5V$

Bias dependent $P_1$ vs. Frequency

Bias dependent $P-3$ vs. Frequency

@$V_{ds}=5V$, $I_{dsq}=3A$

@$V_{ds}=5V$, $I_{dsq}=2.6A$

@$V_{ds}=5V$, $I_{dsq}=1.5A$
Typical Bias dependent RF Performance: Vds=6V

Bias dependent P1 vs. Frequency

@Vds=6V, Idsq=2.5A

Bias dependent P-3 vs. Frequency

@Vds=6V, Idsq=2A

@Vds=6V, Idsq=1.5A
Applications

The MMA28316 MMIC power amplifier is designed for use as a power stage amplifier in microwave transmitters. It is ideally suited for 28 to 31GHz band V-sat transmitter applications requiring excellent saturated output power and linearity performance. This amplifier is provided as a bare die format in a Gel-pack.

Biasing and Operation

The recommended bias conditions for best performance for high power applications the MMA28316 are VDD = 6.0V, Idsq = 2000mA. For high linearity requirement at higher output power up to 27dBm/tone, recommended bias conditions are Vdd=5V, Idsq=3000mA. Performance improvements are possible depending on applications. The drain bias voltage range is 5 to 6V and the quiescent drain current biasing range is 1200mA to 3000mA. 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=-1.8V). The gate voltage (Vg) should be applied prior to the drain voltages (Vd1, Vd2, Vd3, and Vd4) during power up and removed after the drain voltages during power down. The RF input and output ports are DC decoupled internally. Typical DC supply connection with bi-passing capacitors for the MMA28316 is shown in following pages.

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.
Mechanical Information:

The units are in [um].
Application Circuit:

```
RF IN

Vd1  Vd2  Vd3  Vd4  DET_O

1uF 10Ω  1uF  10Ω  1uF  10Ω  1uF  10Ω
0.01u 10Ω  0.01u  10Ω  0.01u

RF Output

Vg1  Vd4  DET_R

10K  1.5K  10K

Vd1  Vd2  Vd3  Vd4  DET_O

10Ω  0.01u  1uF

Note:
Vd4 bonding pads must be biased from both sides.
```
Recommended Application Module:

![Recommended Application Module Diagram](image_url)