Features
- Optimized for RF Energy Applications
- Suitable for Linear and Saturated Applications
- CW and Pulsed Operation: 300 W Output Power
- Internally Pre-Matched
- 50 V Operation
- 100% RF Tested
- RoHS* Compliant

Description
The MAGE-102425-300S00 is a GaN HEMT D-mode amplifier designed for RF Energy applications and optimized for 2.4 - 2.5 GHz CW signal operation. This device supports CW and pulsed operation with peak output power levels to 300 W (54.8 dBm) in an air cavity ceramic package.

The MAGE-102425-300S00 is ideally suited for CW applications as a highly efficient precise heat and power source. The wide range of applications includes solid state cooking, RF plasma generation, material drying, industrial heating, automotive ignition, lighting and medical.

Typical Performance:
- \( V_{DS} = 50 \text{ V}, \ I_{DQ} = 300 \text{ mA}, \ T_C = 25^\circ \text{C} \)
  Measured under pulsed load-pull at 2.5 dB compression, 100 µs pulse width, 10% duty cycle.

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Gain(^2) (dB)</th>
<th>(\eta_D) (%)</th>
<th>Output Power(^1) (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.45</td>
<td>16.7</td>
<td>75</td>
<td>55.6</td>
</tr>
</tbody>
</table>

1. Load impedance tuned for maximum output power.
2. Load impedance tuned for maximum drain efficiency.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGE-102425-300S00</td>
<td>Bulk Quantity</td>
</tr>
<tr>
<td>MAGE-102425-300ST0</td>
<td>Tape and Reel</td>
</tr>
<tr>
<td>MAGE-1D2425-300S00</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

For further information and support please visit: https://www.macom.com/support
GaN Amplifier 50 V, 300 W
2.4 - 2.5 GHz

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RF Electrical Characteristics:  \( T_C = +25°C \), \( V_{DS} = 50 \) V, \( I_{DQ} = 300 \) mA

Note: Performance in MACOM Evaluation Test Fixture, 50 Ω system

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Signal Gain</td>
<td>Pulsed(^4), 2.45 GHz</td>
<td>( G_{SS} )</td>
<td>-</td>
<td>15.0</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Power Gain</td>
<td>CW, 2.45 GHz, 2 dB Gain Compression</td>
<td>( G_{SAT} )</td>
<td>-</td>
<td>14.0</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Saturated Drain Efficiency</td>
<td>CW, 2.45 GHz, 2 dB Gain Compression</td>
<td>( \eta_{SAT} )</td>
<td>-</td>
<td>65.0</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Saturated Output Power</td>
<td>CW, 2.45 GHz, 2 dB Gain Compression</td>
<td>( P_{SAT} )</td>
<td>-</td>
<td>55.4</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Gain Variation (-40°C to +85°C)</td>
<td>Pulsed(^4), 2.45 GHz</td>
<td>( \Delta G )</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
<td>dB/C</td>
</tr>
<tr>
<td>Power Variation (-40°C to +85°C)</td>
<td>Pulsed(^4), 2.45 GHz</td>
<td>( \Delta P_{2dB} )</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
<td>dB/C</td>
</tr>
<tr>
<td>Gain</td>
<td>Pulsed(^4), 2.45 GHz, ( P_{OUT} = 54.8 ) dBm</td>
<td>( G_P )</td>
<td>-</td>
<td>15.0</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Drain Efficiency</td>
<td>Pulsed(^4), 2.45 GHz, ( P_{OUT} = 54.8 ) dBm</td>
<td>( \eta )</td>
<td>-</td>
<td>62</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Ruggedness: Output Mismatch</td>
<td>Pulsed(^4), 2.45 GHz, All phase angles</td>
<td>( \psi )</td>
<td>VSWR = 10:1, No Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruggedness: Output Mismatch</td>
<td>CW, 2.45 GHz, All phase angles</td>
<td>( \psi )</td>
<td>VSWR = 3:1, No Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Pulse details: 100 µs pulse width, 10% Duty Cycle.

RF Electrical Specifications:  \( T_A = +25°C \), \( V_{DS} = 50 \) V, \( I_{DQ} = 300 \) mA

Note: Performance in MACOM Production Test Fixture, 50 Ω system

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Gain</td>
<td>Pulsed(^4), 2.5 GHz, 2 dB Gain Compression</td>
<td>( G_{SAT} )</td>
<td>11.5</td>
<td>14.0</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Saturated Drain Efficiency</td>
<td>Pulsed(^4), 2.5 GHz, 2 dB Gain Compression</td>
<td>( \eta_{SAT} )</td>
<td>54.7</td>
<td>62.5</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Saturated Output Power</td>
<td>Pulsed(^4), 2.5 GHz, 2 dB Gain Compression</td>
<td>( P_{SAT} )</td>
<td>53.5</td>
<td>54.7</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Gain</td>
<td>Pulsed(^4), 2.5 GHz, ( P_{IN} = 41 ) dBm</td>
<td>( G_P )</td>
<td>11.2</td>
<td>13.7</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Drain Efficiency</td>
<td>Pulsed(^4), 2.5 GHz, ( P_{IN} = 41 ) dBm</td>
<td>( \eta )</td>
<td>55.1</td>
<td>62.8</td>
<td>-</td>
<td>%</td>
</tr>
</tbody>
</table>

DC Electrical Characteristics \( T_A = +25°C \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-Source Leakage Current</td>
<td>( V_{DS} = -8 ) V, ( V_{DS} = 130 ) V</td>
<td>( I_{DLK} )</td>
<td>-</td>
<td>-</td>
<td>54</td>
<td>mA</td>
</tr>
<tr>
<td>Gate-Source Leakage Current</td>
<td>( V_{GS} = -8 ) V, ( V_{DS} = 0 ) V</td>
<td>( I_{GLK} )</td>
<td>-</td>
<td>-</td>
<td>54</td>
<td>mA</td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>( V_{DS} = 50 ) V, ( I_D = 54 ) mA</td>
<td>( V_T )</td>
<td>-2.6</td>
<td>-2.1</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Gate Quiescent Voltage</td>
<td>( V_{DS} = 50 ) V, ( I_D = 300 ) mA</td>
<td>( V_{GSQ} )</td>
<td>-2.4</td>
<td>-2.0</td>
<td>-1.4</td>
<td>V</td>
</tr>
<tr>
<td>On Resistance</td>
<td>( V_{GS} = 2 ) V, ( I_D = 405 ) mA</td>
<td>( R_{ON} )</td>
<td>0.12</td>
<td>-</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>Maximum Drain Current</td>
<td>( V_{DS} = 7 ) V pulsed, pulse width 300 µs</td>
<td>( I_{D,\text{MAX}} )</td>
<td>-</td>
<td>31.5</td>
<td>-</td>
<td>A</td>
</tr>
</tbody>
</table>
GaN Amplifier 50 V, 300 W
2.4 - 2.5 GHz

Absolute Maximum Ratings\(^{5,6,7,8,9}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain Source Voltage, (V_{DS})</td>
<td>130 V</td>
</tr>
<tr>
<td>Gate Source Voltage, (V_{GS})</td>
<td>-10 to 3 V</td>
</tr>
<tr>
<td>Gate Current, (I_G)</td>
<td>54 mA</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Case Operating Temperature Range</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Channel Operating Temperature Range, (T_{CH})</td>
<td>-40°C to +225°C</td>
</tr>
<tr>
<td>Absolute Maximum Channel Temperature</td>
<td>+250°C</td>
</tr>
</tbody>
</table>

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation above maximum operating conditions.
7. Operating at drain source voltage \(V_{DS} < 55\) V will ensure MTTF > 1 x 10\(^7\) hours.
8. Operating at nominal conditions with \(T_{CH} \leq 225°C\) will ensure MTTF > 1 x 10\(^7\) hours.
9. MTTF may be estimated by the expression MTTF (hours) = \(A e^{[B + C/(T+273)]}\) where \(T\) is the channel temperature in degrees Celsius, \(A = 3.686\), \(B = -35.00\), and \(C = 25,416\).

Thermal Characteristics\(^{10}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Symbol</th>
<th>Typical</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance using Finite Element Analysis</td>
<td>(V_{DS} = 50) V, (T_C = 85°C, T_{CH} = 225°C)</td>
<td>(R_{\theta \text{FEA}})</td>
<td>0.76</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal Resistance using Infrared Measurement of Die Surface Temperature</td>
<td>(V_{DS} = 50) V, (T_C = 85°C, T_{CH} = 225°C)</td>
<td>(R_{\theta \text{IR}})</td>
<td>0.64</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

10. Case temperature measured using thermocouple embedded in heat-sink. Contact local applications support team for more details on this measurement.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1C, CDM Class C3 devices.
## GaN Amplifier 50 V, 300 W

**2.4 - 2.5 GHz**

![MACOM Logo]

**MAGE-102425-300S00**

Rev. V2

### Pulsed Load-Pull Performance

**Reference Plane at Device Leads**

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>$Z_{SOURCE}$ (Ω)</th>
<th>$Z_{LOAD}^{11}$ (Ω)</th>
<th>Gain (dB)</th>
<th>$P_{OUT}$ (dBm)</th>
<th>$P_{OUT}$ (W)</th>
<th>$\eta_D$ (%)</th>
<th>AM/PM (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.40</td>
<td>1.3 - j4.8</td>
<td>1.3 - j3.3</td>
<td>15.2</td>
<td>55.8</td>
<td>380</td>
<td>70.0</td>
<td>53</td>
</tr>
<tr>
<td>2.45</td>
<td>2.0 - j5.0</td>
<td>1.5 + j3.2</td>
<td>16.0</td>
<td>55.6</td>
<td>371</td>
<td>72.8</td>
<td>45</td>
</tr>
<tr>
<td>2.50</td>
<td>2.0 - j5.6</td>
<td>1.0 - j3.5</td>
<td>15.2</td>
<td>55.8</td>
<td>380</td>
<td>69.0</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>$Z_{SOURCE}$ (Ω)</th>
<th>$Z_{LOAD}^{12}$ (Ω)</th>
<th>Gain (dB)</th>
<th>$P_{OUT}$ (dBm)</th>
<th>$P_{OUT}$ (W)</th>
<th>$\eta_D$ (%)</th>
<th>AM/PM (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.40</td>
<td>1.3 - j4.8</td>
<td>1.95 - j3.0</td>
<td>16.5</td>
<td>54.5</td>
<td>280</td>
<td>73</td>
<td>47</td>
</tr>
<tr>
<td>2.45</td>
<td>2.0 - j5.0</td>
<td>2.1 + j2.8</td>
<td>16.7</td>
<td>54.2</td>
<td>263</td>
<td>75</td>
<td>42</td>
</tr>
<tr>
<td>2.50</td>
<td>2.0 - j5.6</td>
<td>1.9 - j2.9</td>
<td>16.6</td>
<td>54.3</td>
<td>270</td>
<td>73</td>
<td>30</td>
</tr>
</tbody>
</table>

### Impedance Reference

$Z_{SOURCE} = \text{Measured impedance presented to the input of the device at package reference plane.}$

$Z_{LOAD} = \text{Measured impedance presented to the output of the device at package reference plane.}$

11. Load Impedance for optimum output power.

12. Load Impedance for optimum efficiency.
GaN Amplifier 50 V, 300 W
2.4 - 2.5 GHz

Pulsed\textsuperscript{4} Load-Pull Performance
2.5 GHz

\textbf{P2.5dB Loadpull Output Power Contours (dBm)}

\textbf{P2.5dB Loadpull Drain Efficiency Contours (%)}

\textbf{P2.5dB Loadpull Gain Contours (dB)}

\textbf{P2.5dB Loadpull AM/PM Contours (°)}

\textbf{Gain vs. Output Power}

\textbf{Drain Efficiency vs. Output Power}

For further information and support please visit:
https://www.macom.com/support
GaN Amplifier 50 V, 300 W
2.4 - 2.5 GHz

Evaluation Test Fixture and Recommended Tuning Solution 2.4 - 2.5 GHz

Description
Parts measured on evaluation board (30-mil thick RO4350). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Bias Sequencing
Turning the device ON
1. Set \( V_{GS} \) to pinch-off (\( V_P \)).
2. Turn on \( V_{DS} \) to nominal voltage (50 V).
3. Increase \( V_{GS} \) until \( I_{DS} \) current is reached.
4. Apply RF power to desired level.

Turning the device OFF
1. Turn the RF power off.
2. Decrease \( V_{GS} \) down to \( V_P \) pinch-off.
3. Decrease \( V_{DS} \) down to 0 V.
4. Turn off \( V_{GS} \).
## Reference Designator | Value | Tolerance | Manufacturer | Part Number
--- | --- | --- | --- | ---
C1 | 8.2 pF | +/-0.25 pF | Passive Plus | 0805N8R2CW251T
C2 | 1.6 pF | +/-0.1 pF | Passive Plus | 0805N1R6CW251T
C6, C7 | 1.9 pF | +/-0.1 pF | Passive Plus | 0805N1R9CW251T
C8, C9 | 6.2 pF | +/-0.25 pF | Passive Plus | 0805N6R2CW251T
C13, C12 | 0.01 µF | +/-20% | Murata | GRM216R71H103MA01D
C14, C15 | 1 µF | +/-10% | Murata | GRM219R71A105KA12D
C16, C18 | 0.6 pF | +/-0.05 pF | Passive Plus | 0805N0R6CW251T
C17, C19 | 0.7 pF | +/-0.05 pF | Passive Plus | 0805N0R7CW251T
C27 | 10 pF | +/-0.25 pF | Passive Plus | 0708N100JW501XT
C20, C21 | 6.2 pF | +/-0.1 pF | Passive Plus | 1111N6R2BW501XT
C29, C30 | 0.1 µF | +/-15% | Murata | GRM31CR72D104K03
C22, C23, C24, C25 | 1 µF | +/-15% | Murata | GRM55DR72D105KW01
R1 | 0.01 Ω | +/-1% | Viking | CS75FTFR010
R2, R3 | 10 Ω | +/-1% | Viking | CR-05FL7---10R
R4, R5 | 1K Ω | +/-1% | Viking | CR-05FL7---1K
R7, R8, R9, R10 | 1 Ω | +/-1% | Panasonic | ERJ-14BQF1R0U
Q1 | MACOM GaN Power Amplifier | MAGE-102425-300S00
PCB | RO4350, 30 mil, 1 oz. Cu, Au Finish |
GaN Amplifier 50 V, 300 W
2.4 - 2.5 GHz

Typical Performance Curves as Measured in the 2.4 - 2.5 GHz Evaluation Test Fixture:
Pulsed⁴ 2.5 GHz, V_DS = 50 V, I_DQ = 300 mA, T_C = 25°C
Unless Otherwise Noted

Gain vs. Output Power and Frequency

Gain vs. Output Power and V_DS

Gain vs. Output Power and I_DQ

Drain Efficiency vs. Output Power and Frequency

Drain Efficiency vs. Output Power and V_DS

Drain Efficiency vs. Output Power and I_DQ

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DC-0017848
Typical Performance Curves as Measured in the 2.4 - 2.5 GHz Evaluation Test Fixture:
Pulsed at 2.5 GHz, \( V_{DS} = 50 \text{ V} \), \( I_{DQ} = 300 \text{ mA} \), \( T_C = 25^\circ \text{C} \)
Unless Otherwise Noted

**Gain vs. Output Power and Temperature**

**Drain Efficiency vs. Output Power and Temperature**

**CW, 2.0 dB Compression, Gain vs. Frequency**

**CW, 2.0 dB Compression, Drain Efficiency vs. Frequency**

**CW, 2.0 dB Compression, Output Power vs. Frequency**
GaN Amplifier 50 V, 300 W
2.4 - 2.5 GHz

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# Lead-Free AC-780S-2 Package Dimensions†

† Reference Application Note AN0004363 for lead-free solder reflow recommendations.

Meets JEDEC moisture sensitivity level 3 requirements.

Plating is Au.

---

NOTES:

1. ALL DIMENSIONS SHOWN AS IN [mm]. CONTROLLING DIMENSIONS ARE IN AND CONVERTED MN DIMENSIONS ARE NOT NECESSARILY EXACT.

2. LEAD FINISH: AU
   FLANGE FINISH: AU

3. UID SEAL EPOXY MAY FLOW A MAXIMUM OF .018 [0.46] FROM EDGE OF UID

4. UID MAY BE Mis-ALIGNED UP TO .002 [0.05] FROM PACKAGE IN ANY DIRECTION
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