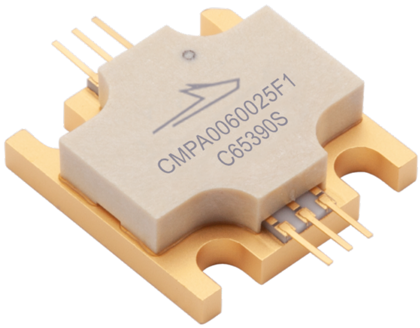
CMPA0060025F1

25 W, 20 MHz - 6.0 GHz, GaN MMIC, Power Amplifier



PN: CMPA0060025F1
Package Type: 440219

Description

Wolfspeed's CMPA0060025F1 is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) based monolithic microwave integrated circuit (MMIC). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity and higher thermal conductivity. GaN HEMTs also offer greater power density and wider bandwidths compared to Si and GaAs transistors. This MMIC enables extremely wide bandwidths to be achieved in a small footprint screw-down package

Typical Performance Over 20 MHz - 6.0 GHz (T_C = 25°C)

Parameter	20 MHz	0.5 GHz	1.0 GHz	2.0 GHz	3.0 GHz	4.0 GHz	5.0 GHz	6.0 GHz	Units
Gain	21.4	20.1	19.3	16.7	16.6	16.8	15.7	15.5	dB
Output Power @ P_{IN} = 32 dBm	26.9	30.2	26.3	23.4	24.5	24.0	20.9	18.6	W
Power Gain @ P_{IN} = 32 dBm	12.3	12.8	12.2	11.7	11.9	11.8	11.3	10.7	dB
Efficiency @ P_{IN} = 32 dBm	63	55	40	31	33	31	28	26	%

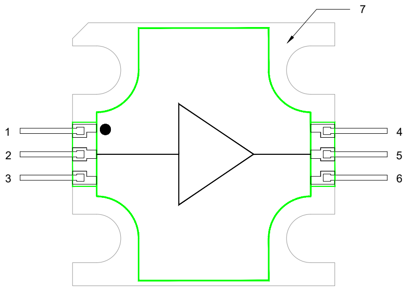
Note: V_{DD} = 50 V, I_{DQ} = 500 mA

Features

- 17 dB Small Signal Gain
- 25 W Typical P_{SAT}
- Operation up to 50 V
- High Breakdown Voltage
- High Temperature Operation
- 0.5" x 0.5" total product size

Applications

- Ultra Broadband Amplifiers
- Test Instrumentation
- EMC Amplifier Drivers



RoHS compliant

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Absolute Maximum Ratings (not simultaneous) at 25°C

<table>
<tr><th>Parameter</th><th>Symbol</th><th>Rating</th><th>Units</th></tr>
<tr><td>Drain-Source Voltage</td><td>V_{DSS}</td><td>84</td><td rowspan="2">V_{DC}</td></tr>
<tr><td>Gate-Source Voltage</td><td>V_{GS}</td><td>-10, +2</td></tr>
<tr><td>Storage Temperature</td><td>T_{STG}</td><td>-65, +150</td><td rowspan="2">°C</td></tr>
<tr><td>Operating Junction Temperature</td><td>T_J</td><td>225</td></tr>
<tr><td>Maximum Forward Gate Current</td><td>I_{GMAX}</td><td>6.3</td><td>mA</td></tr>
<tr><td>Soldering Temperature[1]</td><td>T_S</td><td>245</td><td>°C</td></tr>
<tr><td>Screw Torque</td><td>τ</td><td>40</td><td>in-oz</td></tr>
<tr><td>Thermal Resistance, Junction to Case</td><td>$R_{\theta JC}$</td><td>3.3</td><td>°C/W</td></tr>
<tr><td>Case Operating Temperature[2]</td><td>T_C</td><td>-40, +150</td><td>°C</td></tr>
</table>

Notes:
[1] Refer to the Application Note on soldering at wolfspeed.com/rf/document-library
[2] Measured for the CMPA0060025F1 at P_{IN} = 32 dBm

Electrical Characteristics (Frequency = 20 MHz to 6.0 GHz unless otherwise stated; T_C = 25°C)

<table>
<tr><th>Characteristics</th><th>Symbol</th><th>Typ.</th><th>Max.</th><th>Units</th><th>Conditions</th></tr>
<tr><td colspan="6">DC Characteristics</td></tr>
<tr><td>Gate Threshold Voltage[2]</td><td>$V_{GS(th)}$</td><td>-3.0</td><td>—</td><td>V</td><td>V_{DS} = 20 V, ΔI_D = 20 mA</td></tr>
<tr><td>Gate Quiescent Voltage</td><td>$V_{GS(Q)}$</td><td>-2.7</td><td>—</td><td>V_{DC}</td><td>V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 32 dBm</td></tr>
<tr><td>Saturated Drain Current</td><td>I_{DS}</td><td>12</td><td>—</td><td>A</td><td>V_{DS} = 12 V, V_{GS} = 2.0 V</td></tr>
<tr><td colspan="6">RF Characteristics[1]</td></tr>
<tr><td>Power Output at P_{OUT} @ 4.5 GHz</td><td rowspan="3">P_{OUT}</td><td>42.8</td><td>—</td><td rowspan="3">dBm</td><td rowspan="6">V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 32 dBm</td></tr>
<tr><td>Power Output at P_{OUT} @ 5.0 GHz</td><td>43.3</td><td>—</td></tr>
<tr><td>Power Output at P_{OUT} @ 6.0 GHz</td><td>42.9</td><td>—</td></tr>
<tr><td>Drain Efficiency at P_{OUT} @ 4.5 GHz</td><td rowspan="3">η</td><td>24.1</td><td>—</td><td rowspan="3">%</td></tr>
<tr><td>Drain Efficiency at P_{OUT} @ 5.0 GHz</td><td>28.0</td><td>—</td></tr>
<tr><td>Drain Efficiency at P_{OUT} @ 6.0 GHz</td><td>27.2</td><td>—</td></tr>
<tr><td>Output Mismatch Stress</td><td>VSWR</td><td>—</td><td>5 : 1</td><td>Ψ</td><td>No damage at all phase angles,
V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 32 dBm</td></tr>
</table>

<table>
<tr><td colspan="10">Small Signal RF Characteristics</td></tr>
<tr><th>Frequency</th><th>Min.</th><th>Typ. S21 (dB)</th><th>Max.</th><th>Min.</th><th>Typ. S11 (dB)</th><th>Max.</th><th>Min.</th><th>Typ. S22 (dB)</th><th>Conditions</th></tr>
<tr><td>0.02 GHz - 0.25 GHz</td><td rowspan="2">18</td><td>19.3</td><td>23.7</td><td>—</td><td>-4.1</td><td>-2.5</td><td>—</td><td>-8.5</td><td rowspan="6">V_{DD} = 50 V, I_{DQ} = 500 mA</td></tr>
<tr><td>0.25 GHz - 0.5 GHz</td><td>19.8</td><td rowspan="3">22</td><td>—</td><td>-6.8</td><td>-3.5</td><td>—</td><td>-8.9</td></tr>
<tr><td>0.5 GHz - 1.0 GHz</td><td rowspan="2">15.5</td><td rowspan="3">18.6</td><td>—</td><td rowspan="3">-15.3</td><td>-6.5</td><td>—</td><td rowspan="2">-6.7</td></tr>
<tr><td>1.0 GHz - 2.0 GHz</td><td>—</td><td rowspan="2">-12.5</td><td>—</td></tr>
<tr><td>2.0 GHz - 3.0 GHz</td><td rowspan="2">13</td><td rowspan="2">20</td><td>—</td><td>—</td><td>-6.0</td></tr>
<tr><td>3.0 GHz - 6.0 GHz</td><td>16.3</td><td>—</td><td>-14.2</td><td>-6.5</td><td>—</td><td>-12.0</td></tr>
</table>

Notes:
[1] P_{OUT} is defined as P_{IN} = 32 dBm
[2] The device will draw approximately 55-70 mA at pinch off due to the internal circuit structure

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Typical Performance

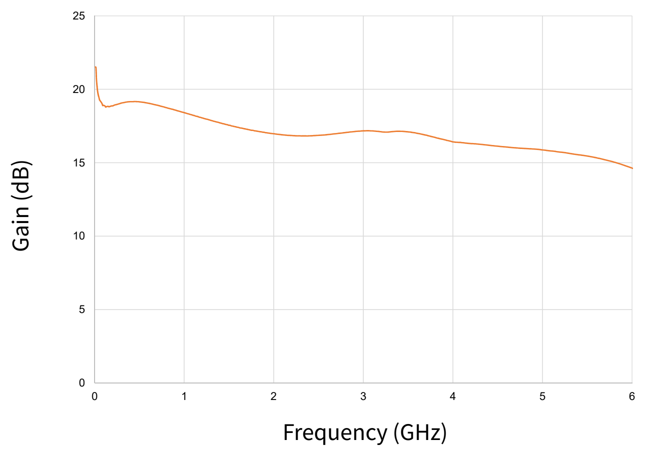

Figure 1. Small Signal Gain vs Frequency
V_{DD} = 50 V, I_{DQ} = 500 mA

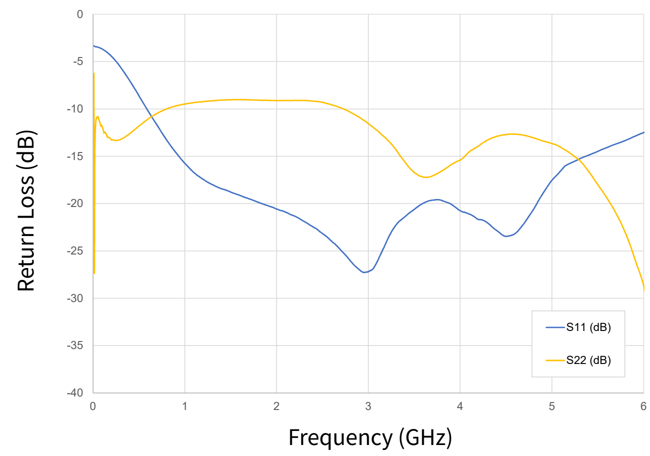

Figure 2. Input & Output Return Losses vs Frequency
V_{DD} = 50 V, I_{DQ} = 500 mA

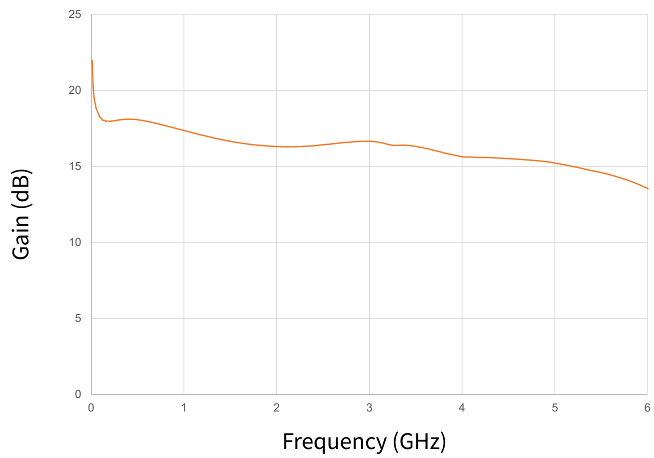

Figure 3. Small Signal Gain vs Frequency
V_{DD} = 40 V, I_{DQ} = 500 mA

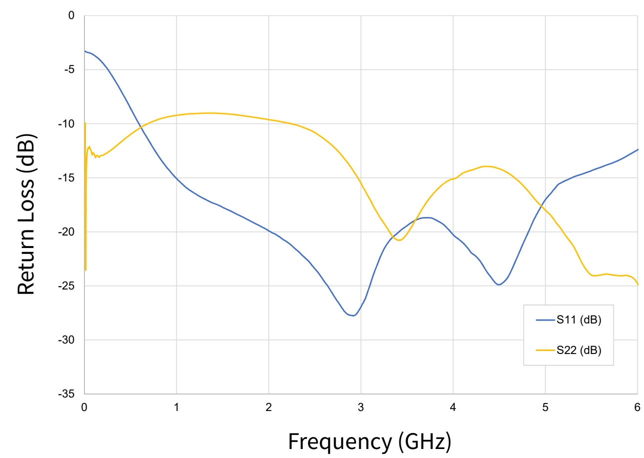

Figure 4. Small Signal Gain vs Frequency
V_{DD} = 40 V, I_{DQ} = 500 mA

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Typical Performance

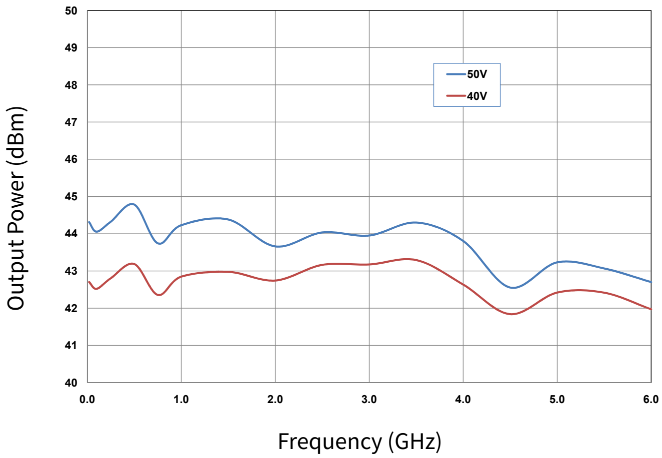

Figure 5. Output Power at P_{IN} = 32 dBm vs Frequency as a Function of Drain Voltage, I_{DQ} = 500 mA

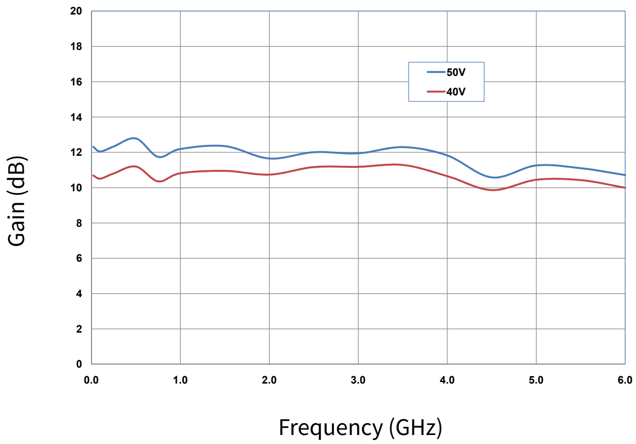

Figure 6. Power Gain at P_{IN} = 32 dBm vs Frequency as a Function of Drain Voltage, I_{DQ} = 500 mA

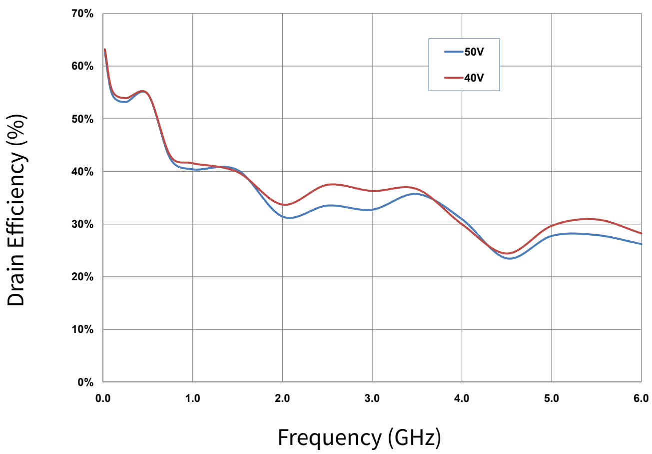

Figure 7. Drain Efficiency at P_{IN} = 32 dBm vs Frequency as a Function of Drain Voltage, I_{DQ} = 500 mA

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Typical Performance

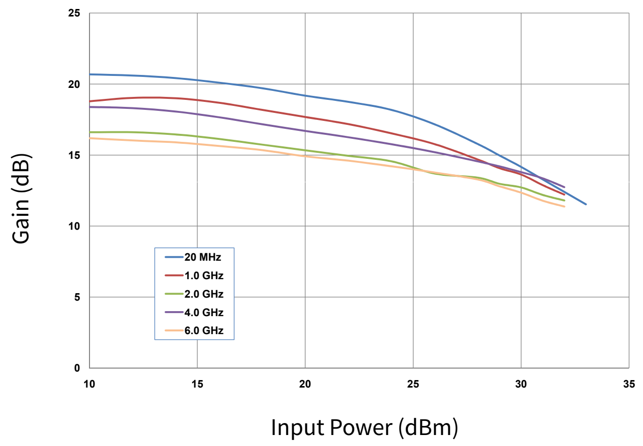

Figure 8. Gain vs Input Power at 50 V as a Function of Frequency, I_{DQ} = 500 mA

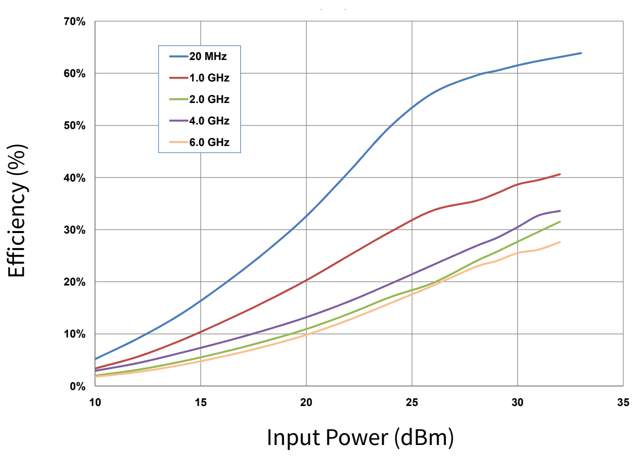

Figure 9. Efficiency vs Input Power at 50 V as a Function of Frequency, I_{DQ} = 500 mA

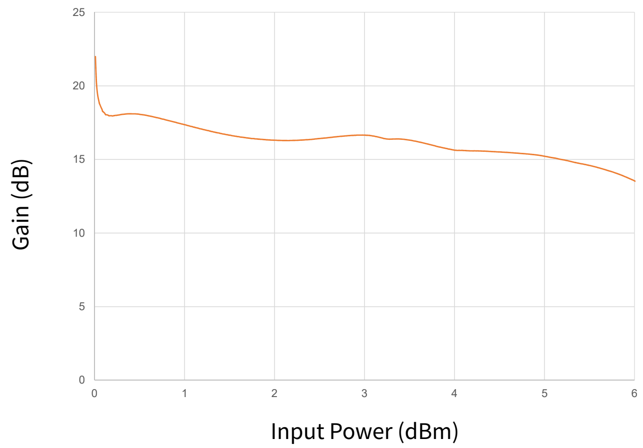

Figure 10. Gain vs Input Power at 40 V as a Function of Frequency, I_{DQ} = 500 mA

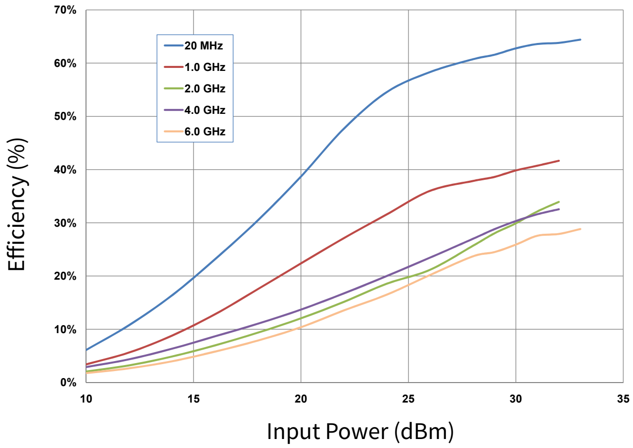

Figure 11. Efficiency vs Input Power at 40 V as a Function of Frequency, I_{DQ} = 500 mA

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General Device Information

The CMPA0060025F1 is a GaN HEMT MMIC Power Amplifier, which operates between 20 MHz - 6.0 GHz. The amplifier typically provides 17 dB of small signal gain and 25 W saturated output power with an associated power added efficiency of better than 20%. The wideband amplifier's input and output are internally matched to 50 Ohm. The amplifier requires bias from appropriate Bias-T's, through the RF input and output ports.

The CMPA0060025F1-AMP1 and the device were then measured using external Bias-T's, (TECDIA: AMP1T-H06M20 or similar), as shown in Figure 2. The Bias-T's were included in the calibration of the test system. All other losses associated with the test fixture are included in the measurements.

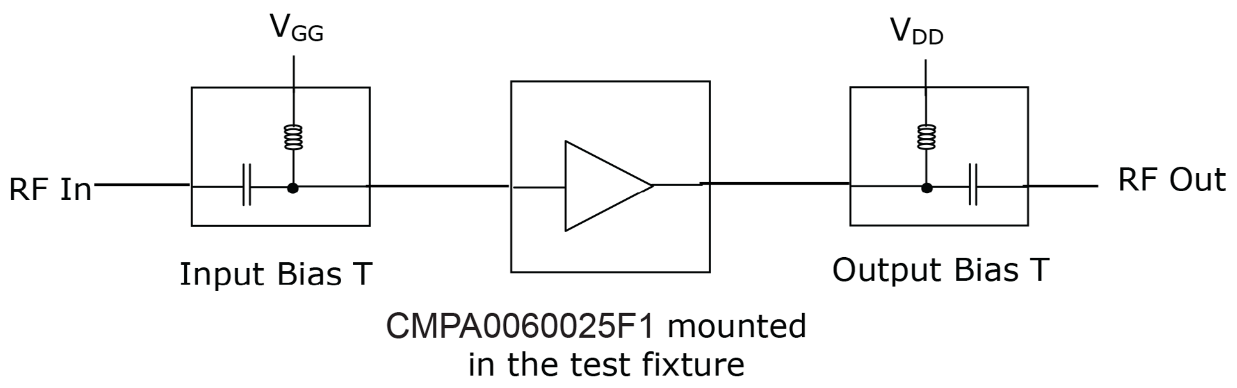

Figure 2. Typical test system setup required for measuring CMPA0060025F1-AMP1

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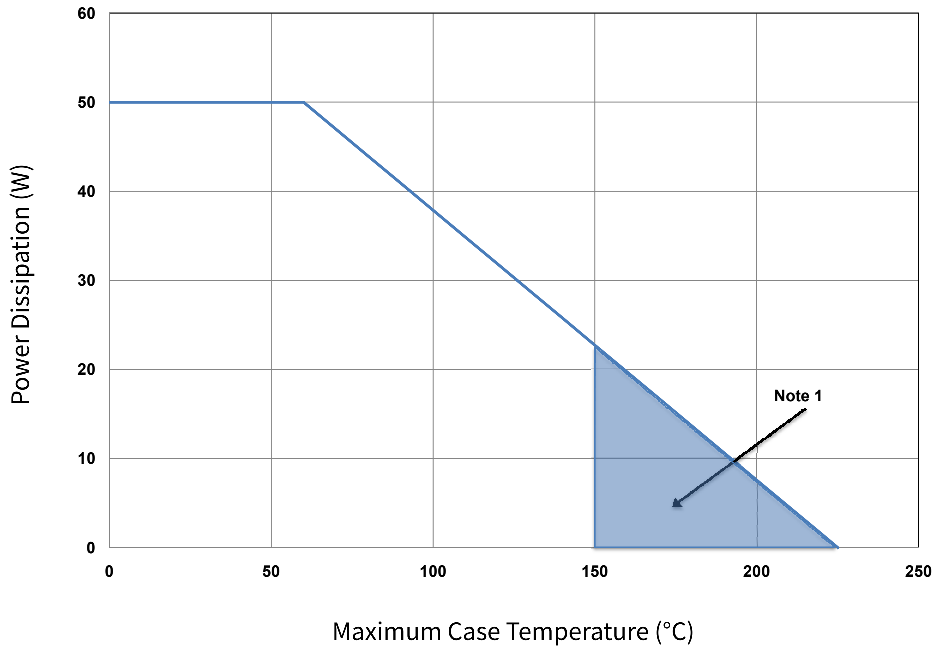
CMPA0060025F1 Power Dissipation De-rating Curve



Note: Area exceeds Maximum Case Temperature (See Page 2)

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	2	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	C3	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

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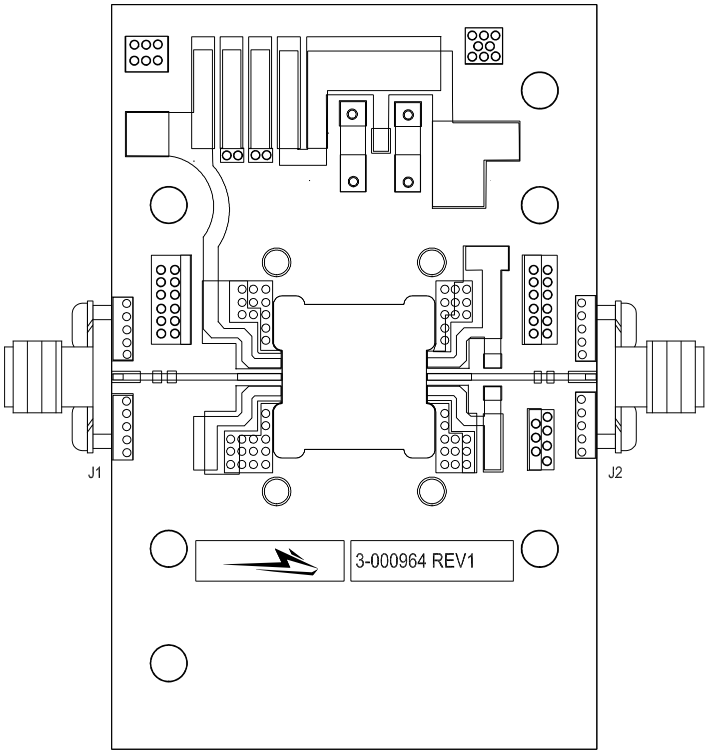
CMPA0060025F1-AMP Demonstration Amplifier Circuit Outline



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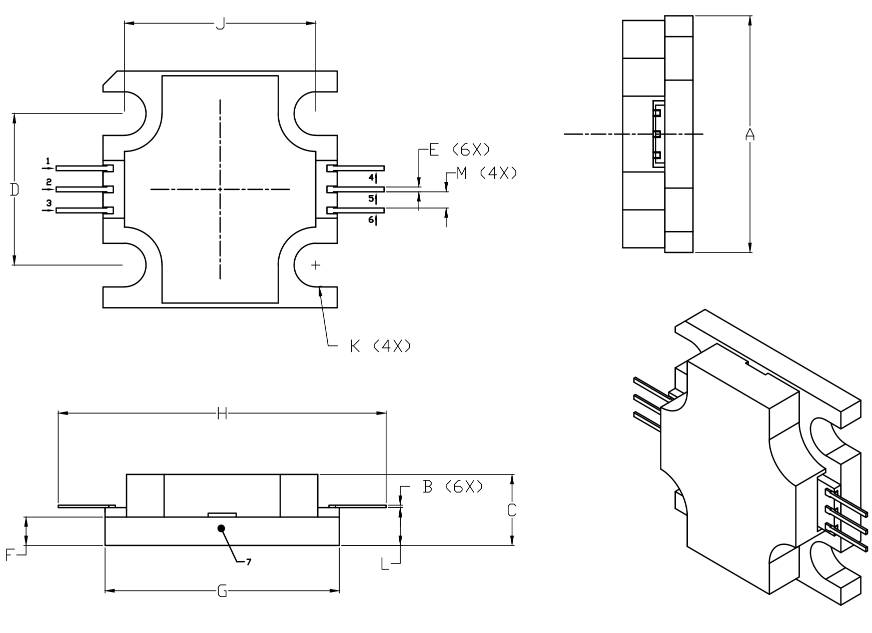
CMPA0060025F1-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
J1,J2	CONNECTOR, SMA, AMP11052901-1	2
–	PCB, TACONIC, RF-35-0100-CH/CH	1
Q1	CMPA0060025F1	1

Note: An external Bias-T is required

Product Dimensions CMPA0060025F1 (Package Type — 440219)

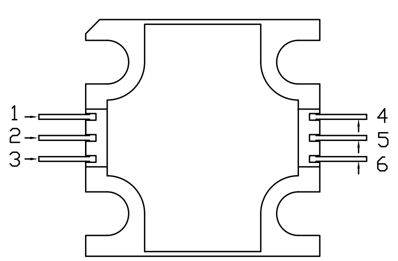


NOT TO SCALE

NOTES:

1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.495	0.505	12.57	12.82
B	0.003	0.005	0.076	0.127
C	0.140	0.160	3.56	4.06
D	0.315	0.325	8.00	8.25
E	0.008	0.012	0.204	0.304
F	0.055	0.065	1.40	1.65
G	0.495	0.505	12.57	12.82
H	0.695	0.705	17.65	17.91
J	0.403	0.413	10.24	10.49
K	ø .092		2.34	
L	0.075	0.085	1.905	2.159
M	0.032	0.040	0.82	1.02



PIN	Function
1	NC
2	Gate
3	NC
4	NC
5	Drain
6	NC
7	Source

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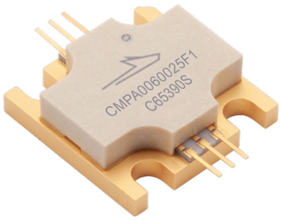
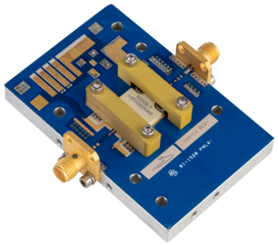
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA0060025F1	GaN HEMT	Each	
CMPA0060025F1-AMP	Test board with GaN MMIC installed	Each	

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