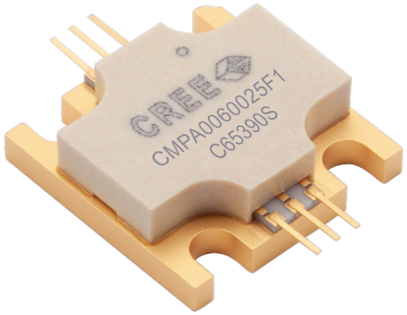
# CMPA0060025F1

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




PN: CMPA0060025F1
Package Type: 440219

### Description

Cree'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

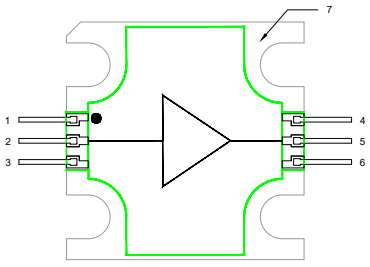



Figure 1.

RoHS COMPLIANT



4600 Silicon Drive | Durham, NC 27703 | wolfspeed.com

## Absolute Maximum Ratings (not simultaneous) at 25˚C

| Parameter | Symbol | Rating | Units |
|---|---|---|---|
| Drain-source Voltage | $V_{DSS}$ | 84 | VDC |
| Gate-source Voltage | $V_{GS}$ | -10, +2 | VDC |
| Storage Temperature | $T_{STG}$ | -65, +150 | ˚C |
| Operating Junction Temperature | $T_J$ | 225 | ˚C |
| Maximum Forward Gate Current | $I_{GMAX}$ | 6.3 | mA |
| Soldering Temperature[1] | $T_S$ | 245 | ˚C |
| Screw Torque | τ | 40 | in-oz |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 3.3 | ˚C/W |
| Case Operating Temperature[2] | $T_C$ | -40, +150 | ˚C |

Note:
[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)

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **DC Characteristics** | | | | | | |
| Gate Threshold Voltage[2] | $V_{(GS)TH}$ | – | -3.0 | – | V | $V_{DS}$ = 20 V, $\Delta I_D$ = 20 mA |
| Gate Quiescent Voltage | $V_{(GS)Q}$ | – | -2.7 | – | VDC | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Saturated Drain Current | $I_{DC}$ | – | 12 | – | A | $V_{DS}$ = 12 V, $V_{GS}$ = 2.0 V |
| **RF Characteristics[1]** | | | | | | |
| Power Output at $P_{OUT}$ @ 4.5 GHz | $P_{OUT1}$ | – | 42.8 | – | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Power Output at $P_{OUT}$ @ 5.0 GHz | $P_{OUT2}$ | – | 43.3 | – | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Power Output at $P_{OUT}$ @ 6.0 GHz | $P_{OUT3}$ | – | 42.9 | – | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Drain Efficiency at $P_{OUT}$ @ 4.5 GHz | η1 | – | 24.1 | – | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Drain Efficiency at $P_{OUT}$ @ 5.0 GHz | η2 | – | 28.0 | – | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Drain Efficiency at $P_{OUT}$ @ 6.0 GHz | η3 | – | 27.2 | – | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |
| Output Mismatch Stress | VSWR | – | – | 5 : 1 | Ψ | No damage at all phase angles, $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 32 dBm |

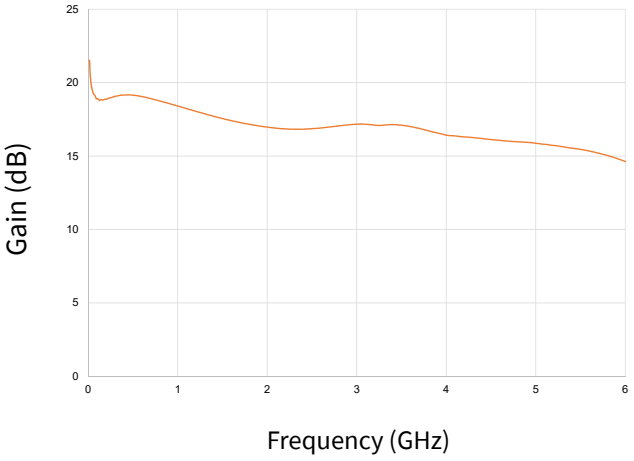
**Small Signal RF Characteristics**

| Frequency | S21 (dB) | | | S11 (dB) | | | S22 (dB) | | | Conditions |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| 0.02 GHz - 0.25 GHz | – | 19.3 | – | – | -4.1 | – | – | -8.5 | – | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |
| 0.25 GHz - 0.5 GHz | – | 19.8 | – | – | -6.8 | – | – | -8.9 | – | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |
| 0.5 GHz - 1.0 GHz | – | 18.6 | – | – | -15.3 | – | – | -6.7 | – | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |
| 1.0 GHz - 2.0 GHz | – | 18.6 | – | – | -15.3 | – | – | -6.7 | – | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |
| 2.0 GHz - 3.0 GHz | – | 18.6 | – | – | -15.3 | – | – | -6.0 | – | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |
| 3.0 GHz - 6.0 GHz | – | 16.3 | – | – | -14.2 | – | – | -12.0 | – | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |

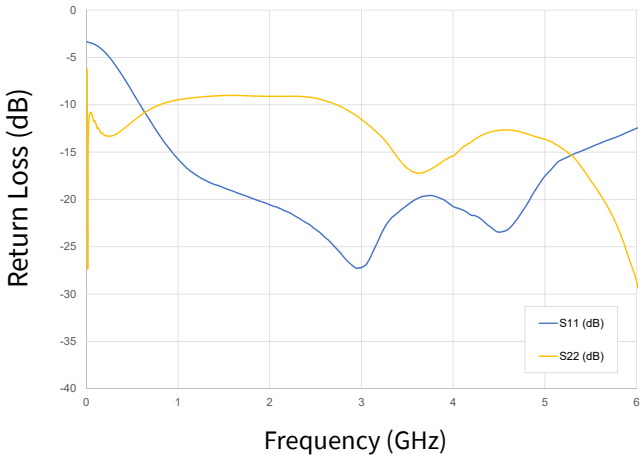
Note:
[1] $P_{OUT}$ is defined as $P_{IN}$ = 32 dBm
[2] The device will draw approximately 55-70 mA at pinch off due to the internal circuit structure

## Typical Performance

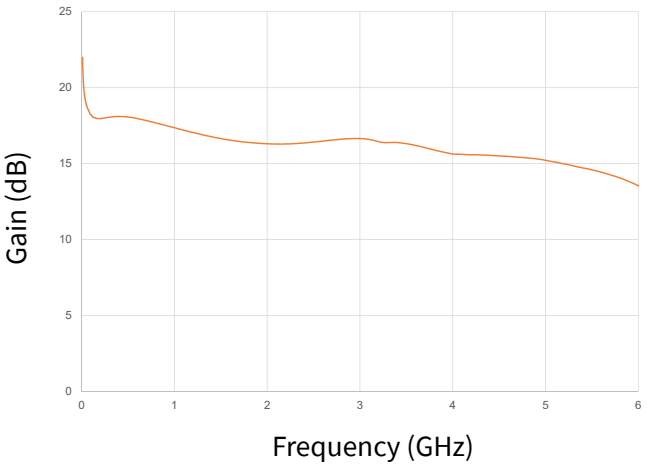
**Small Signal Gain vs Frequency**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA**



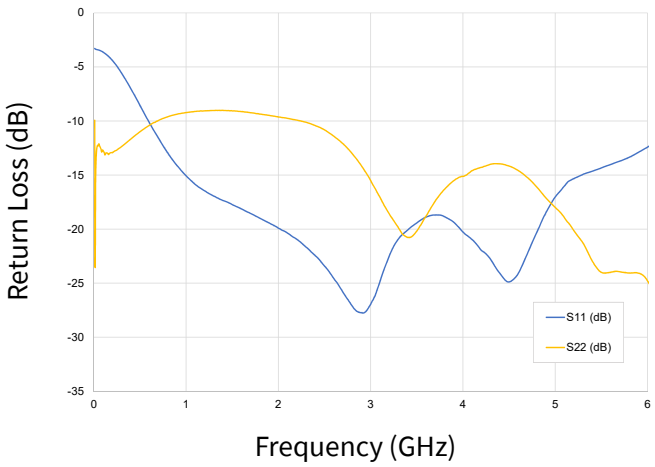

**Input & Output Return Losses vs Frequency**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA**




**Small Signal Gain vs Frequency**
**$V_{DD}$ = 40 V, $I_{DQ}$ = 500 mA**

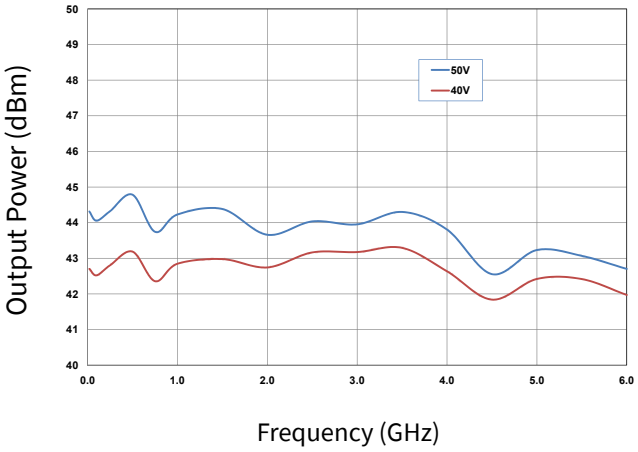



**Small Signal Gain vs Frequency**
**$V_{DD}$ = 40 V, $I_{DQ}$ = 500 mA**

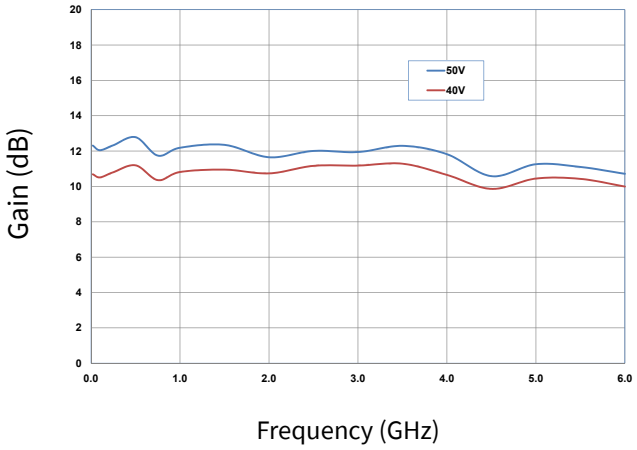


## Typical Performance

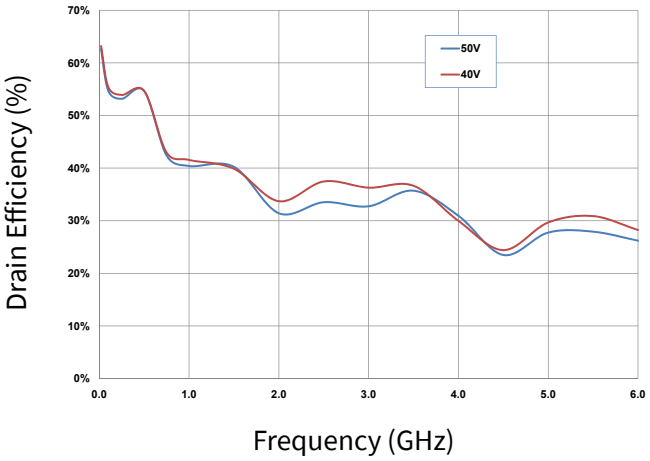
**Output Power at $P_{IN}$ = 32 dBm vs Frequency as a Function of Drain Voltage, $I_{DQ}$ = 500 mA**




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

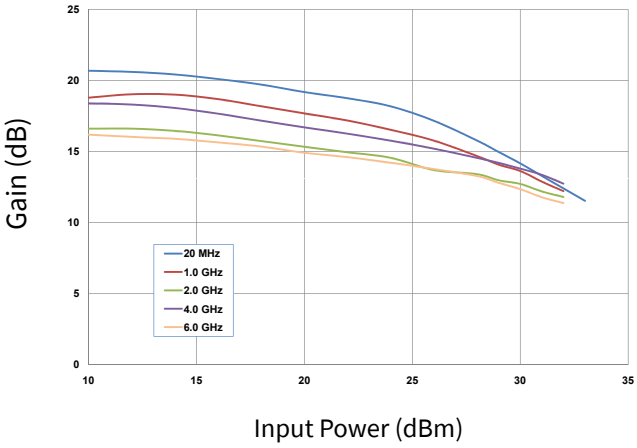



**Drain Efficiency at $P_{IN}$ = 32 dBm vs Frequency as a Function of Drain Voltage, $I_{DQ}$ = 500 mA**

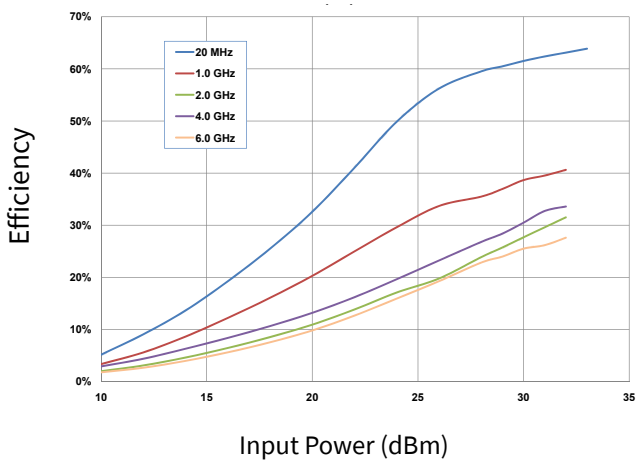


## Typical Performance

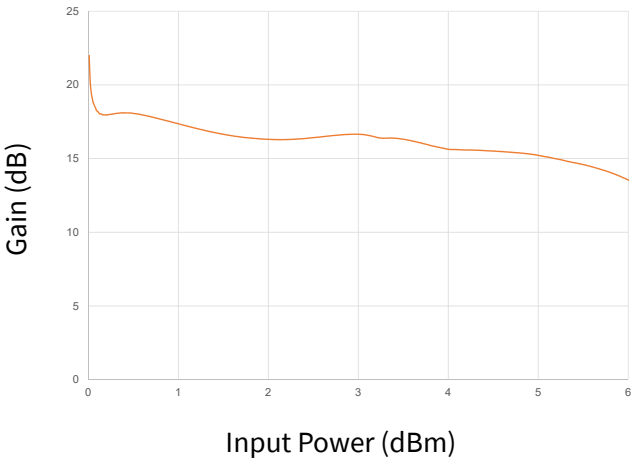
**Gain vs Input Power at 50V as a Function of Frequency, $I_{DQ}$ = 500 mA**



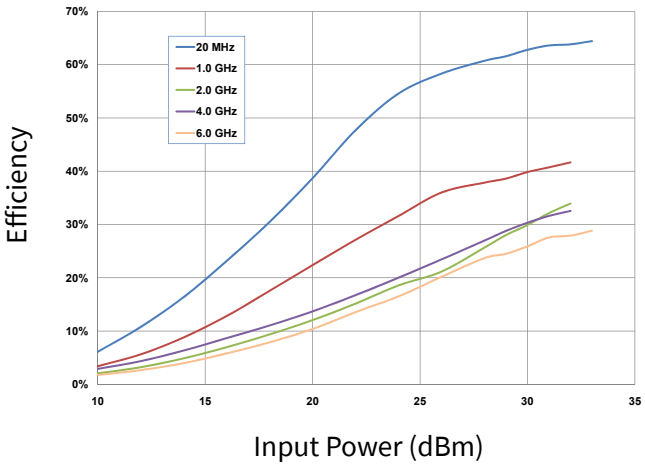

**Efficiency vs Input Power at 50 V as a Function of Frequency, $I_{DQ}$ = 500 mA**




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




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



## 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.

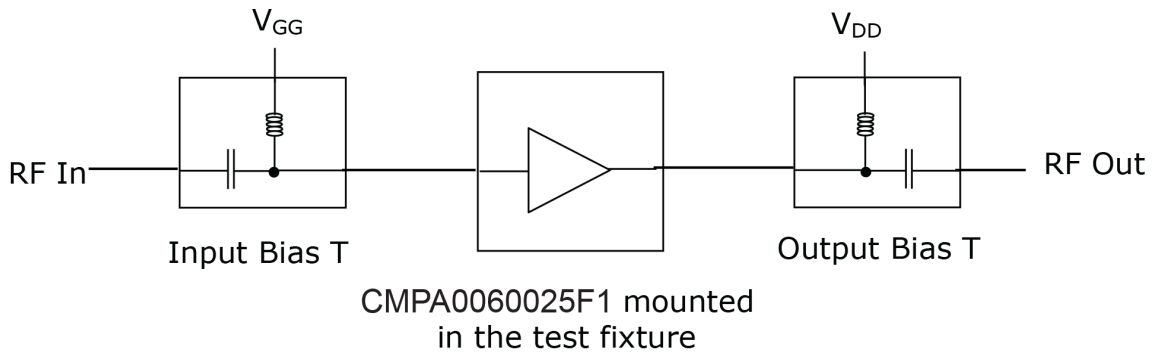
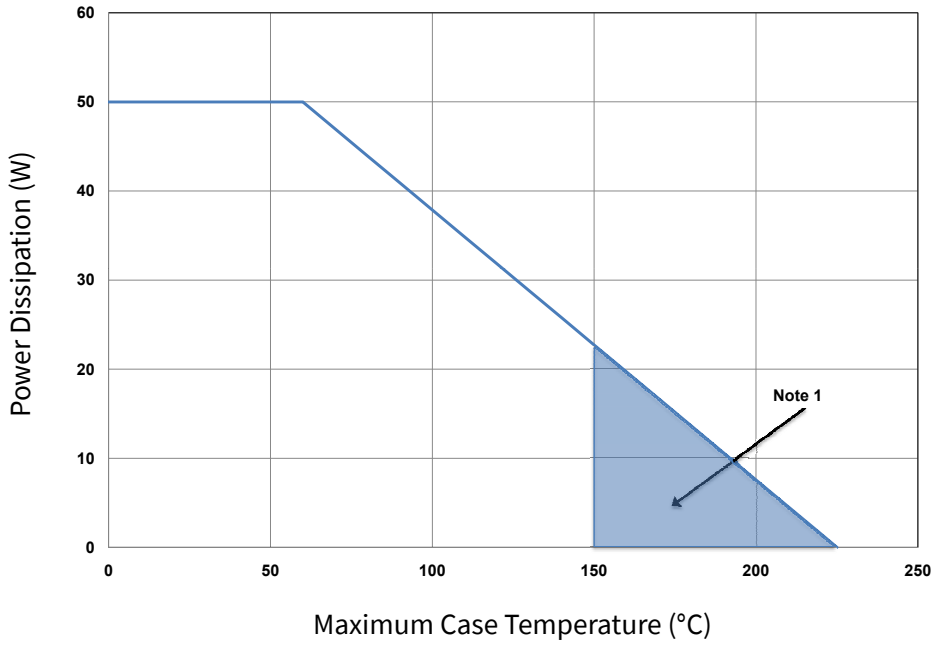



Figure 2. Typical test system setup required for measuring CMPA0060025F1-AMP1

## CMPA0060025F1 Power Dissipation De-rating Curve

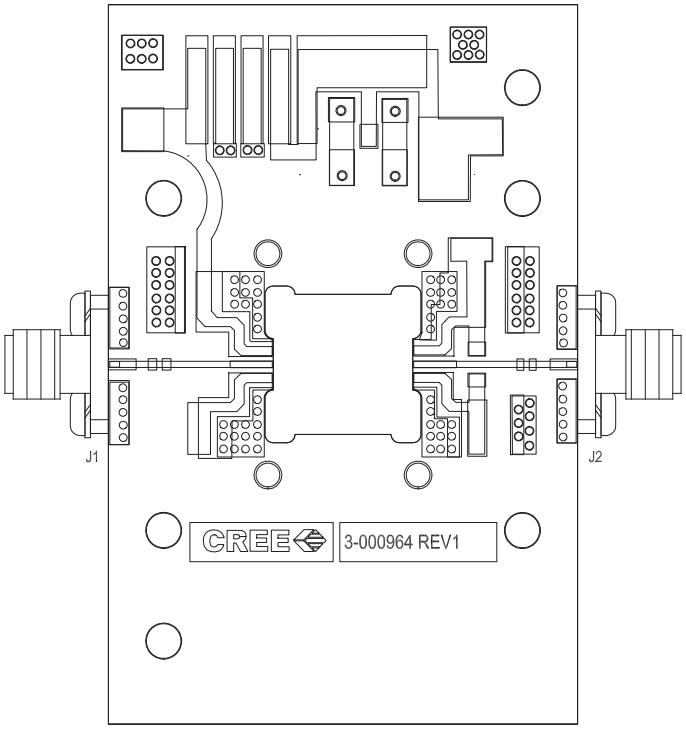



Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2)

## Electrostatic Discharge (ESD) Classifications

| Parameter | Symbol | Class | Test Methodology |
|---|---|---|---|
| Human Body Model | HBM | 1A (> 250 V) | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | II (200 < 500V) | JEDEC JESD22 C101-C |

**CMPA0060025F1-AMP Demonstration Amplifier Circuit Outline**

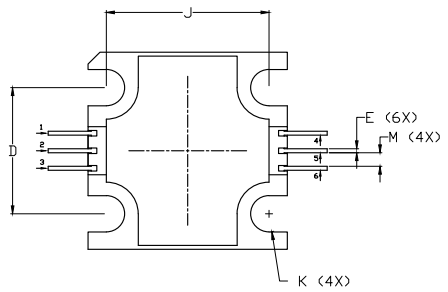


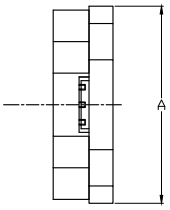
## CMPA0060025F1-AMP Demonstration Amplifier Circuit Bill of Materials

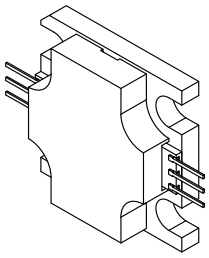
| Designator | Description | Qty |
|---|---|---|
| J1,J2 | CONNECTOR, SMA, AMP11052901-1 | 2 |
| - | PCB, TACONIC, RF-35-0100-CH/CH | 1 |
| Q1 | CMPA0060025F1 | 1 |

Note: An external bias T is required

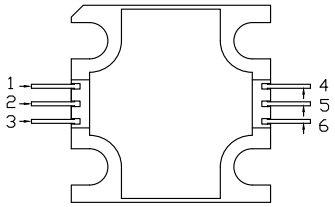
## Product Dimensions CMPA0060025F1 (Package Type — 440219)



NOT TO SCALE



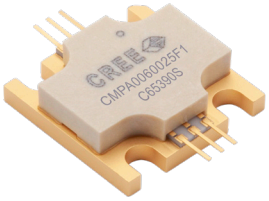
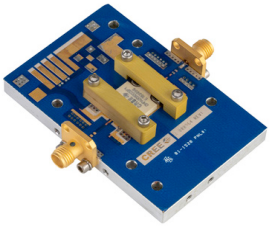

| PIN | Function |
|---|---|
| 1 | NC |
| 2 | Gate |
| 3 | NC |
| 4 | NC |
| 5 | Drain |
| 6 | NC |
| 7 | Source |

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 |

## 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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## Notes

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