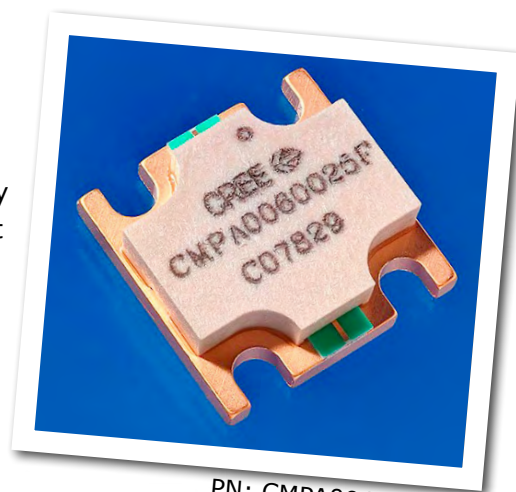


CMPA0060025F

25 W, 20 MHz-6000 MHz, GaN MMIC Power Amplifier

Cree's CMPA0060025F 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.



PN: CMPA0060025F
Package Type: 780019

Typical Performance Over 20 MHz - 6.0 GHz ($T_c = 25^\circ\text{C}$)

| 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 @ $P_{IN} = 32\text{ dBm}$ | 26.9 | 30.2 | 26.3 | 23.4 | 24.5 | 24.0 | 20.9 | 18.6 | W |
| Power Gain @ $P_{IN} = 32\text{ dBm}$ | 12.3 | 12.8 | 12.2 | 11.7 | 11.9 | 11.8 | 11.3 | 10.7 | dB |
| Efficiency @ $P_{IN} = 32\text{ dBm}$ | 63 | 55 | 40 | 31 | 33 | 31 | 28 | 26 | % |

Note¹: $V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$

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

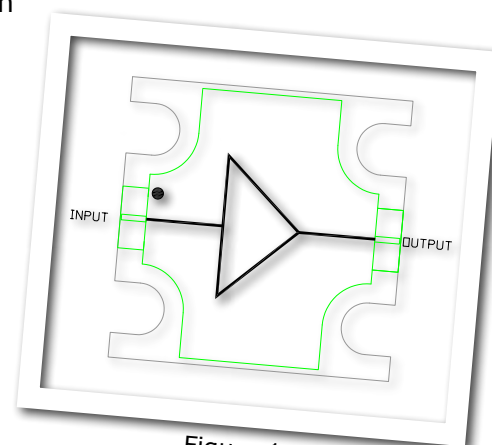


Figure 1.



Absolute Maximum Ratings (not simultaneous) at 25 °C

| Parameter | Symbol | Rating | Units |
|---|-----------------|-----------|-------|
| Drain-source Voltage | V_{DS} | 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} | 4 | 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 ^{2,3} | T_C | -40, +150 | °C |

Note:

¹ Refer to the Application Note on soldering at www.cree.com/products/wireless_apnotes.asp

² Measured for the CMPA0060025F 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} | -3.8 | -3.0 | -2.3 | V | V _{DS} = 20 V, ΔI _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} | 41.0 | 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} | 41.0 | 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} | 41.0 | 42.9 | – | dBm | V _{DD} = 50 V, I _{DQ} = 500 mA, P _{IN} = 32 dBm | | | | |
| Drain Efficiency at P _{OUT} @ 4.5 GHz | η ₁ | 18.0 | 24.1 | – | % | V _{DD} = 50 V, I _{DQ} = 500 mA, P _{IN} = 32 dBm | | | | |
| Drain Efficiency at P _{OUT} @ 5.0 GHz | η ₂ | 18.0 | 28.0 | – | % | V _{DD} = 50 V, I _{DQ} = 500 mA, P _{IN} = 32 dBm | | | | |
| Drain Efficiency at P _{OUT} @ 6.0 GHz | η ₃ | 18.0 | 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 | S ₂₁ | | | S ₁₁ | | | S ₂₂ | | | Conditions |
| | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| 0.02 GHz - 0.25 GHz | 18.0 | 19.3 | 23.7 | – | -4.1 | -2.5 | – | -8.5 | -4.5 | V _{DD} = 50 V, I _{DQ} = 500 mA |
| 0.25 GHz - 0.5 GHz | 18.0 | 19.8 | 22.0 | – | -6.8 | -3.5 | – | -8.9 | -4.5 | V _{DD} = 50 V, I _{DQ} = 500 mA |
| 0.5 GHz - 1.0 GHz | 15.5 | 18.6 | 22.0 | – | -15.3 | -6.5 | – | -6.7 | -4.5 | V _{DD} = 50 V, I _{DQ} = 500 mA |
| 1.0 GHz - 2.0 GHz | 15.5 | 18.6 | 22.0 | – | -15.3 | -12.5 | – | -6.7 | -4.5 | V _{DD} = 50 V, I _{DQ} = 500 mA |
| 2.0 GHz - 3.0 GHz | 13.0 | 18.6 | 20.0 | – | -15.3 | -12.5 | – | -6.0 | -2.5 | V _{DD} = 50 V, I _{DQ} = 500 mA |
| 3.0 GHz - 6.0 GHz | 13.0 | 16.3 | 20.0 | – | -14.2 | -6.5 | – | -5.3 | -2.5 | V _{DD} = 50 V, I _{DQ} = 500 mA |

Notes:

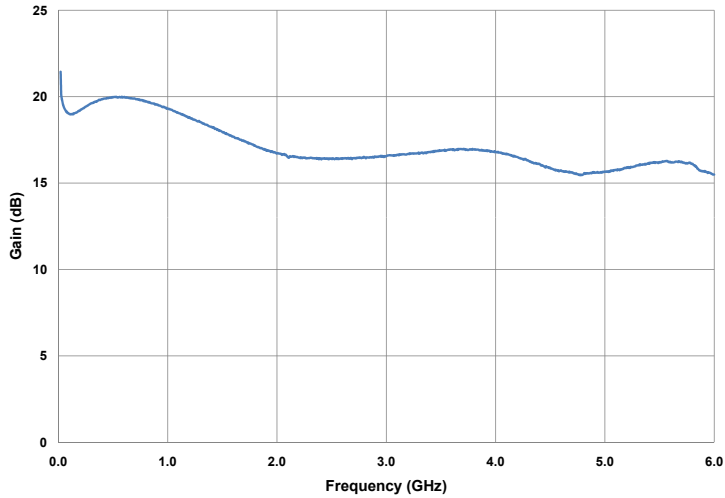
¹ P_{OUT} is defined as $P_{IN} = 32$ dBm.

² The device will draw approximately 55-70 mA at pinch off due to the internal circuit structure.

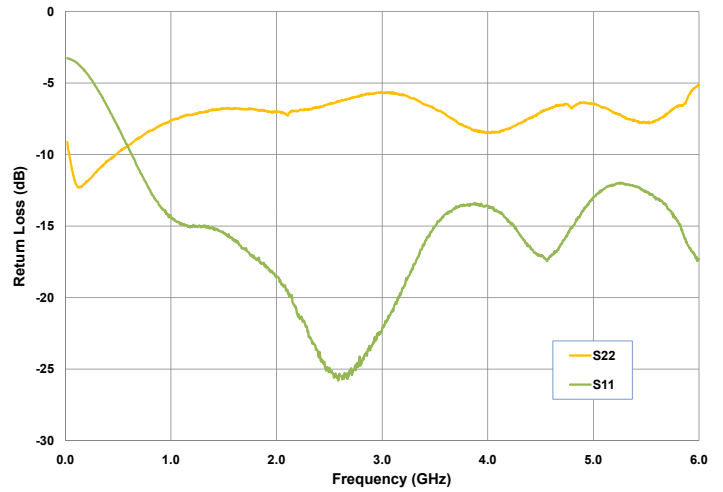


Typical Performance

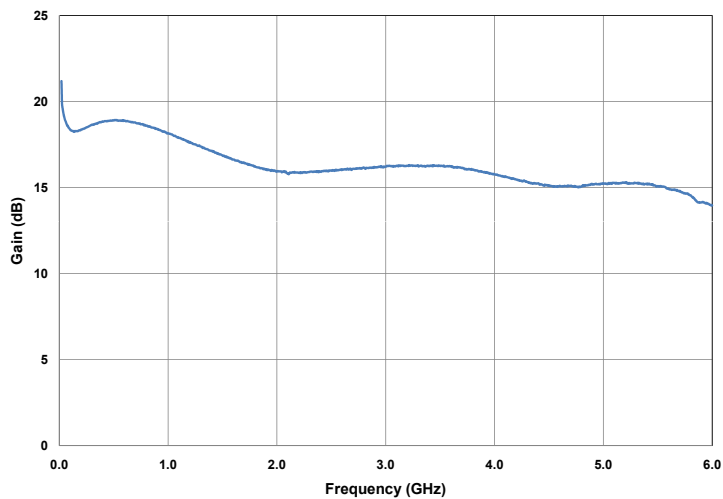
**Small Signal Gain
vs Frequency at 50 V**



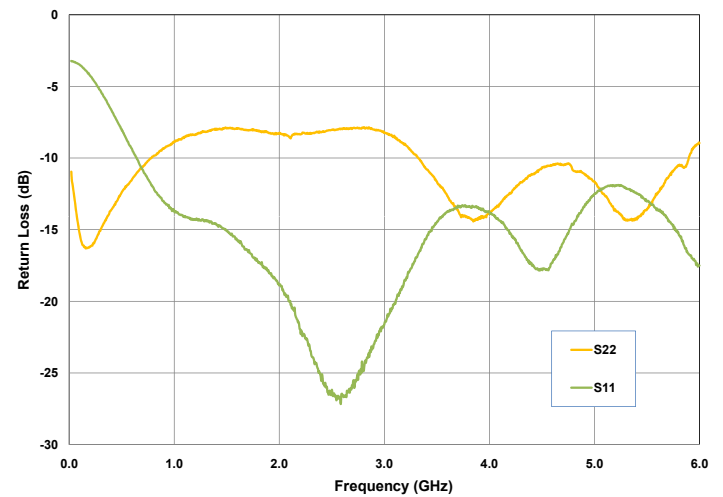
**Input & Output Return Losses
vs Frequency at 50 V**



**Small Signal Gain
vs Frequency at 40 V**



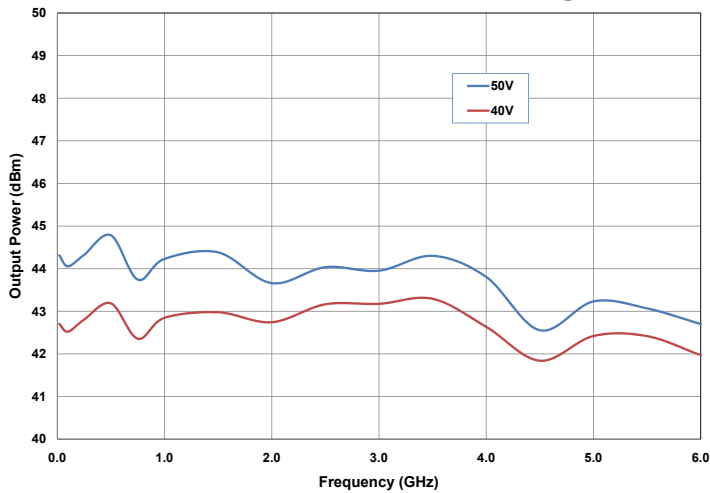
**Input & Output Return Losses
vs Frequency at 40 V**



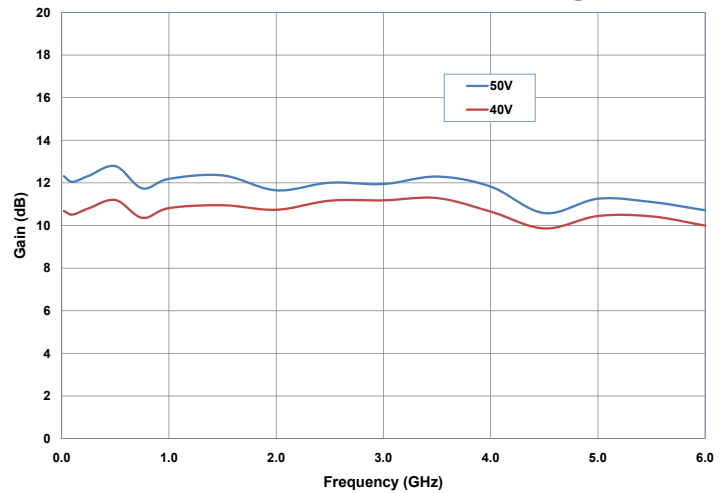


Typical Performance

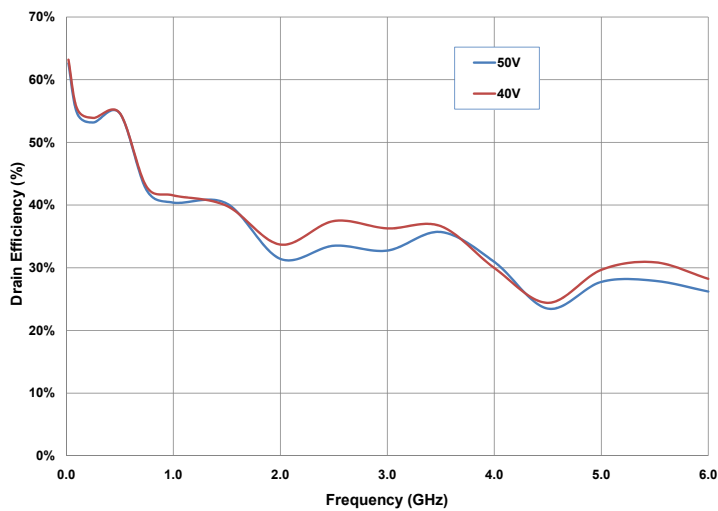
**Output Power at $P_{IN} = 32$ dBm vs Frequency
as a Function of Drain Voltage**



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



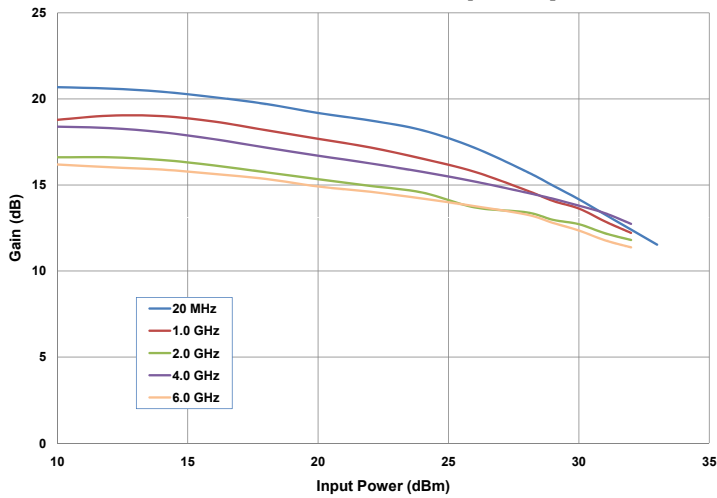
**Drain Efficiency at $P_{IN} = 32$ dBm vs Frequency
as a Function of Drain Voltage**



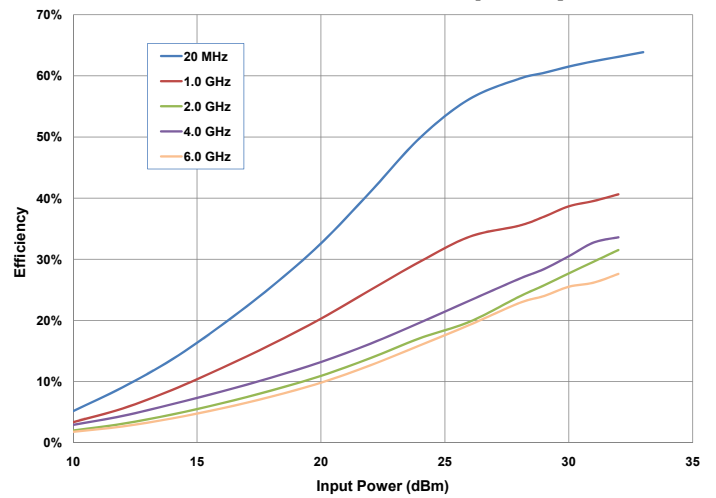


Typical Performance

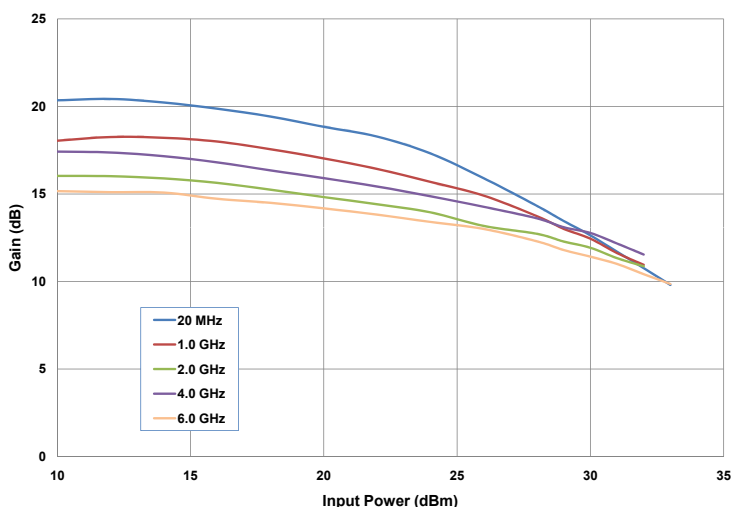
**Gain vs Input Power at 50V
as a Function of Frequency**



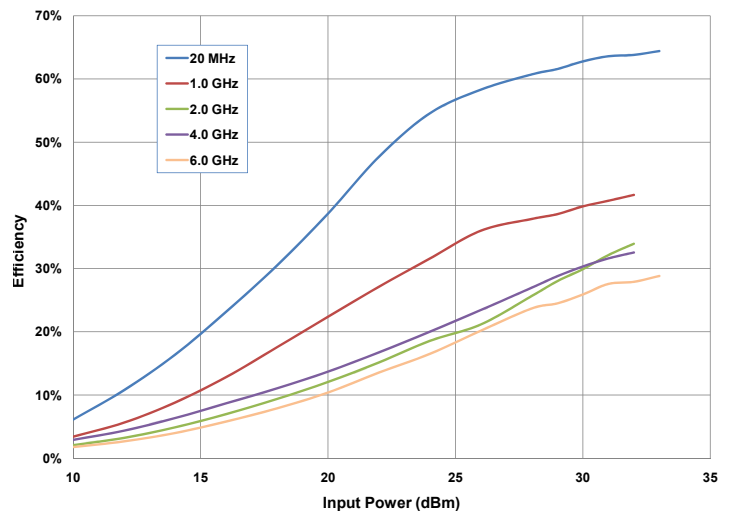
**Efficiency vs Input Power at 50 V
as a Function of Frequency**



**Gain vs Input Power at 40V
as a Function of Frequency**



**Efficiency vs Input Power at 40 V
as a Function of Frequency**



General Device Information

The CMPA0060025F 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 CMPA0060025F is provided in a flange package format. The input and output connections are gold plated to enable gold bond wire attach at the next level assembly.

The measurements in this data sheet were taken on devices wire-bonded to the test fixture with 2 mil gold bond wires. The CMPA0060025F-TB and the device were then measured using external Bias-T's, (TECDIA: TBT-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.

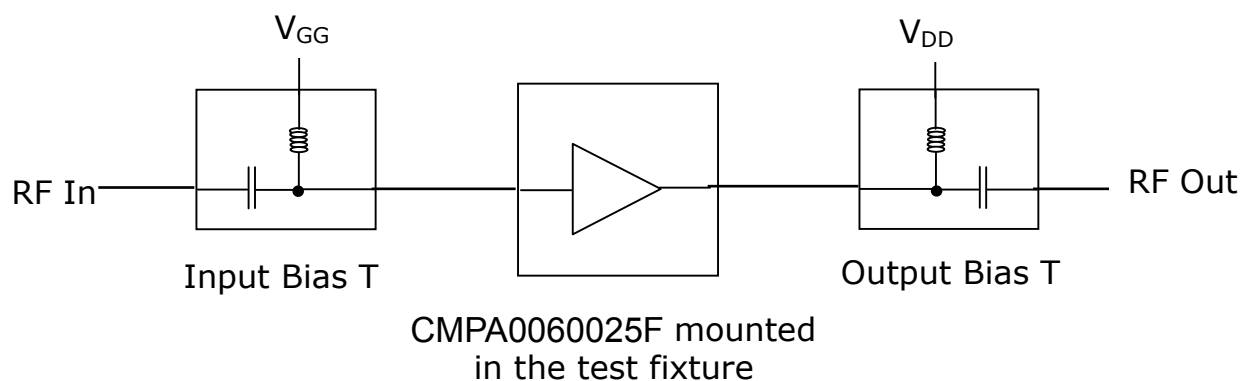
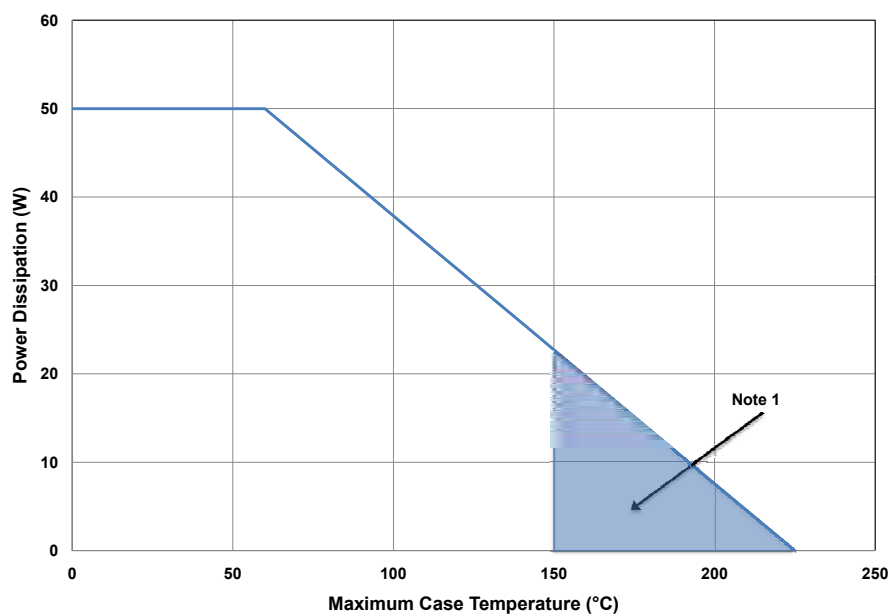


Figure 2. Typical test system setup required for measuring CMPA0060025F-TB

CMPA0060025F Power Dissipation De-rating Curve



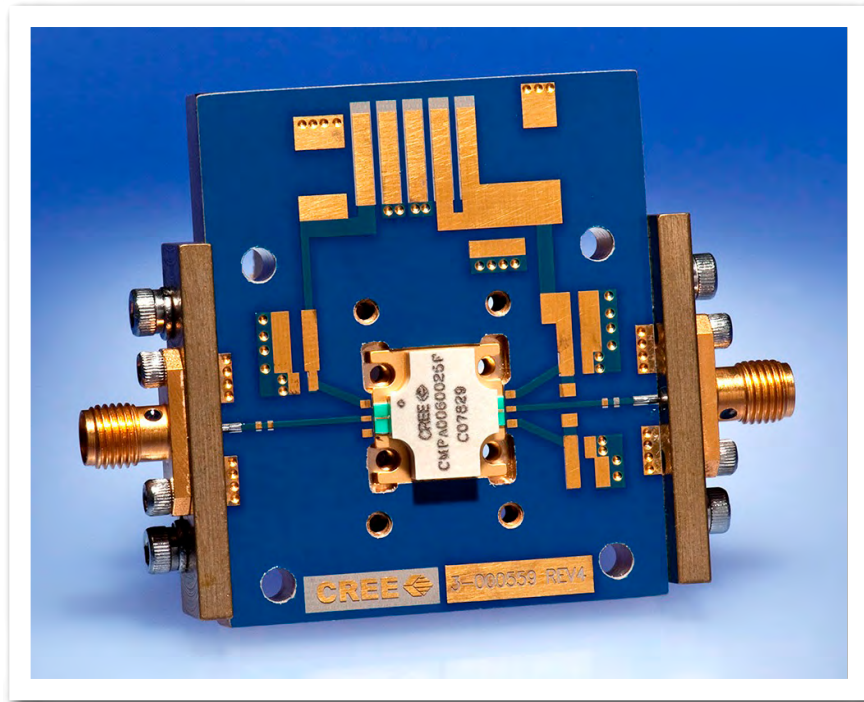
Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

Electrostatic Discharge (ESD) Classifications

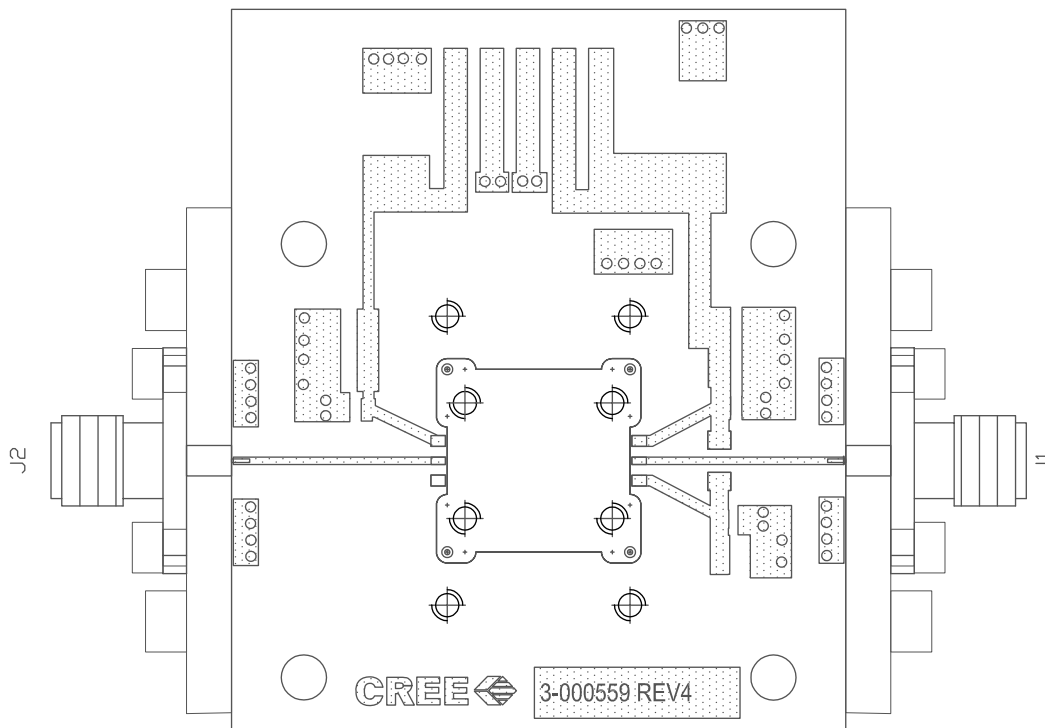
| Parameter | Symbol | Class | Test Methodology |
|---------------------|--------|------------------|---------------------|
| Human Body Model | HBM | 1A (> 250 V) | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | II (200 < 500 V) | JEDEC JESD22 C101-C |



CMPA0060025F-TB Demonstration Amplifier Circuit



CMPA0060025F-TB Demonstration Amplifier Circuit Outline



CPMA0060025F-TB Demonstration Amplifier Circuit Bill of Materials

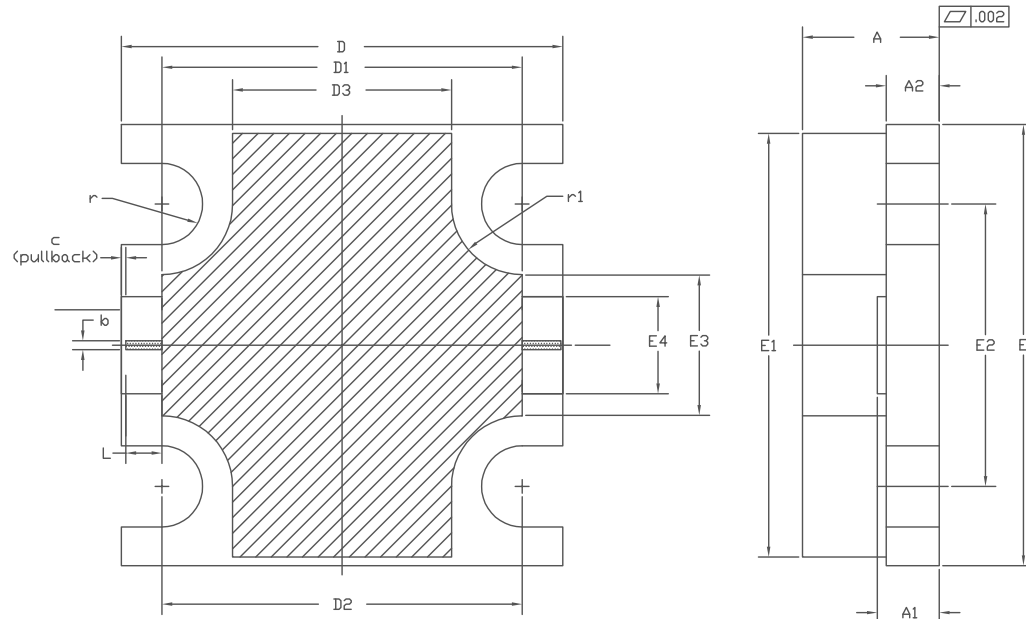
| Designator | Description | Qty |
|------------|--------------------------------|-----|
| J1,J2 | CONNECTOR, SMA, AMP1052901-1 | 2 |
| - | PCB, TACONIC, RF-35-0100-CH/CH | 1 |
| Q1 | CPMA0060025F | 1 |

Notes

¹ The CPMA0060025F is connected to the PCB with 2.0 mil Au bond wires.

² An external bias T is required.

Product Dimensions CPMA0060025F (Package Type — 780019)



NOTES:

1. DIMENSIONING AND TOLERANCING 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 | | NOTE |
|-----|--------|-------|-------------|-------|------|
| | MIN | MAX | MIN | MAX | |
| A | 0.148 | 0.162 | 3.76 | 4.12 | — |
| A1 | 0.066 | 0.076 | 1.67 | 1.93 | — |
| A2 | 0.056 | 0.064 | 1.42 | 1.63 | — |
| b | 0.009 | | 0.24 | | x2 |
| c | 0.005 | | 0.13 | | x2 |
| D | 0.495 | 0.505 | 12.57 | 12.83 | — |
| D1 | 0.403 | 0.413 | 10.23 | 10.49 | — |
| D2 | 0.408 | | 10.36 | | — |
| D3 | 0.243 | 0.253 | 6.17 | 6.43 | — |
| E | 0.495 | 0.505 | 12.57 | 12.83 | — |
| E1 | 0.475 | 0.485 | 12.06 | 12.32 | — |
| E2 | 0.320 | | 8.13 | | — |
| E3 | 0.155 | 0.165 | 3.93 | 4.19 | — |
| E4 | 0.105 | 0.115 | 2.66 | 2.92 | — |
| L | 0.041 | | 1.04 | | x2 |
| r | R0.046 | | R1.17 | | x4 |
| r1 | R0.080 | | R2.03 | | x4 |



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