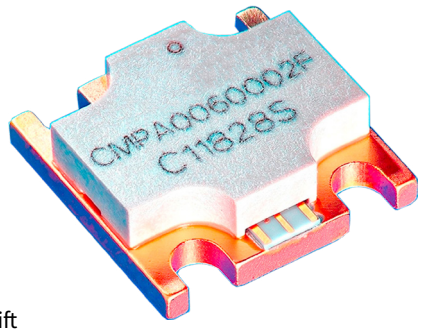
# CMPA0060002F

## 2 W, 20 MHz - 6000 MHz, GaN MMIC Power Amplifier




PN: CMPA0060002F
Package Type: 780019

### Description

The CMPA0060002F 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 employs a distributed (traveling-wave) amplifier design approach, enabling extremely wide bandwidths to be achieved in a small footprint screw-down package featuring a copper-tungsten heat sink.

### 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 | 19.9 | 18.8 | 17.8 | 16.8 | 16.8 | 17.5 | 18.5 | 16.5 | dB |
| Saturated Output Power, $P_{SAT}$[1] | 4.3 | 4.1 | 4.5 | 4.2 | 3.7 | 3.9 | 4.8 | 3.7 | W |
| Power Gain @ $P_{SAT}$[1] | 14.7 | 13.1 | 12.6 | 12.2 | 12.6 | 10.9 | 12.2 | 9.5 | dB |
| PAE @ $P_{SAT}$[1] | 34 | 28 | 29 | 28 | 24 | 26 | 33 | 20 | % |

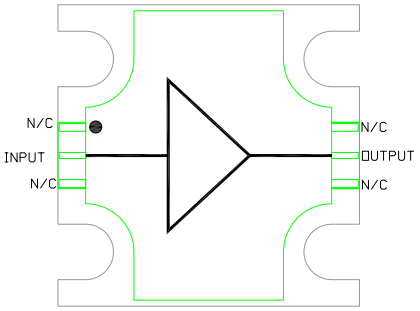
Notes:
[1] $P_{SAT}$ is defined as the RF output power where the device starts to draw positive gate current in the range of 2 - 4 mA.
[2] $V_{DD}$ = 28 V, $I_{DQ}$ = 100 mA

### Features

- 17 dB Small Signal Gain
- 3 W Typical $P_{SAT}$
- Operation up to 28 V
- High Breakdown Voltage
- High Temperature Operation
- 0.5” x 0.5” total product size

### Applications

- Ultra Broadband Amplifiers
- Fiber Drivers
- Test Instrumentation
- EMC Amplifier Drivers




RoHS compliant

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

| Parameter | Symbol | Rating | Units |
|---|---|---|---|
| Drain-source Voltage | $V_{DSS}$ | 84 | $V_{DC}$ |
| Gate-source Voltage | $V_{GS}$ | -10, +2 | |
| Storage Temperature | $T_{STG}$ | -65, +150 | °C |
| Operating Junction Temperature | $T_J$ | 225 | |
| 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 | $R_{\theta JC}$ | 4.3 | °C/W |
| Case Operating Temperature[2,3] | $T_C$ | -40, +150 | °C |

Notes:
[1] Refer to the Application Note on soldering.
[2] Measured for the CMPA0060002F at $P_{DISS}$ = 2 W.

## 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[1] | $V_{GS(th)}$ | -3.8 | -3.0 | -2.7 | V | $V_{DS}$ = 20 V, $\Delta I_D$ = 2 mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | – | -2.7 | – | $V_{DC}$ | $V_{DD}$ = 28 V, $I_{DQ}$ = 100 mA |
| Saturated Drain Current | $I_{DS}$ | – | 1.4 | – | A | $V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V |
| **RF Characteristics** | | | | | | |
| Small Signal Gain | S21 | 13.5 | 17 | 21.5 | dB | $V_{DD}$ = 28 V, $I_{DQ}$ = 100 mA |
| Input Return Loss | S11 | – | -9 | -5 | | |
| Output Return Loss | S22 | – | | | | |
| Power Output | $P_{OUT}$ | 2 | 3 | – | W | $V_{DD}$ = 28 V, $I_{DQ}$ = 100 mA, $f$ = 4.0 GHz, $P_{IN}$ = 23 dBm |
| Power Added Efficiency | PAE | – | 23 | – | % | |
| Power Gain | $G_P$ | 10 | – | – | dB | |
| Output Mismatch Stress | VSWR | – | – | 5:1 | Ψ | No damage at all phase angles, $V_{DD}$ = 28 V, $I_{DQ}$ = 100 mA, $P_{IN}$ = 23 dBm |

Note:
[1] The device will draw approximately 20 - 25 mA at pinch off due to the internal circuit structure.

## Typical Performance

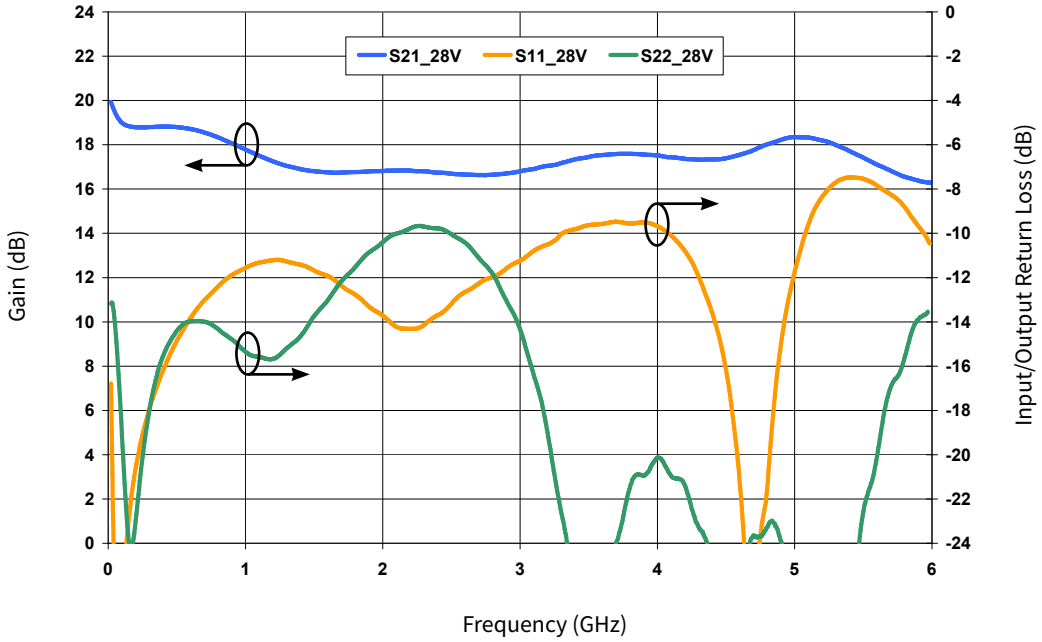



**Figure 1.** Small Signal Gain and Return Losses vs Frequency at 28 V

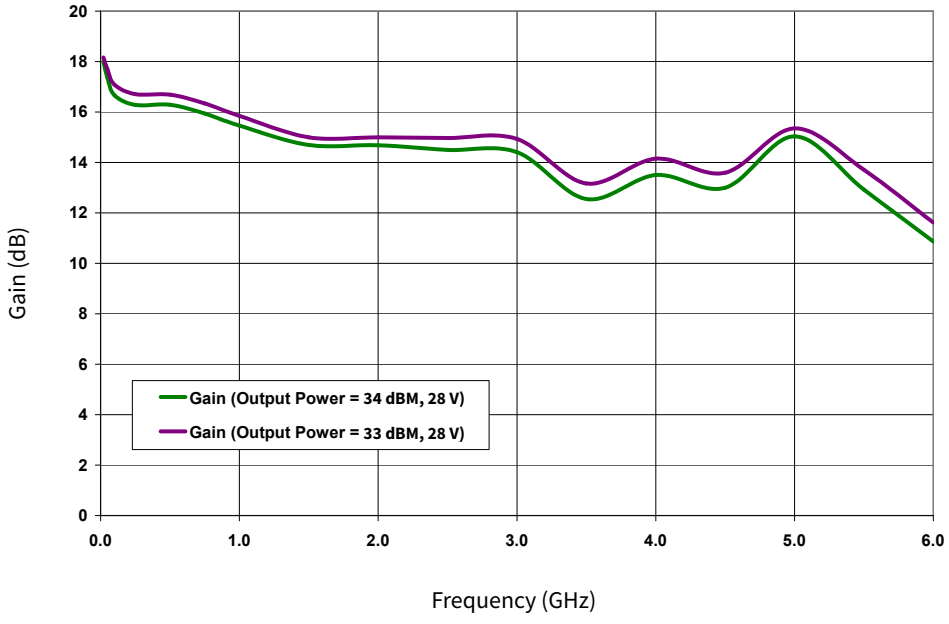



**Figure 2.** Power Gain vs Frequency at 28 V

## Typical Performance

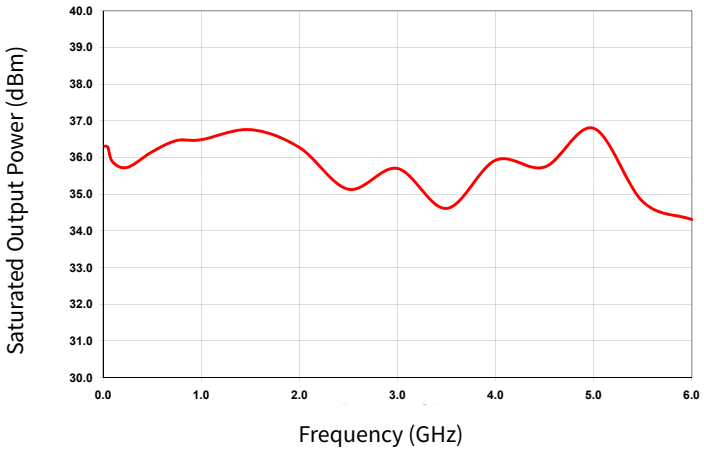



**Figure 3.** Saturated Output Power Performance ($P_{SAT}$) vs Frequency

| Frequency (GHz) | $P_{SAT}$ at 28V (dBm) | $P_{SAT}$ at 28V (W) |
|---|---|---|
| 0.02 | 36.6 | 4.3 |
| 0.5 | 36.2 | 4.1 |
| 1.0 | 36.5 | 4.5 |
| 1.5 | 36.8 | 4.7 |
| 2.0 | 36.3 | 4.2 |
| 2.5 | 35.1 | 3.3 |
| 3.0 | 35.7 | 3.7 |
| 3.5 | 34.6 | 2.9 |
| 4.0 | 35.9 | 3.9 |
| 4.5 | 35.7 | 3.8 |
| 5.0 | 36.8 | 4.8 |
| 5.5 | 34.8 | 3.0 |
| 6.0 | 34.3 | 2.7 |

Note: $P_{SAT}$ is defined as the RF output power where the device starts to draw positive gate current in the range of 2 - 4 mA.

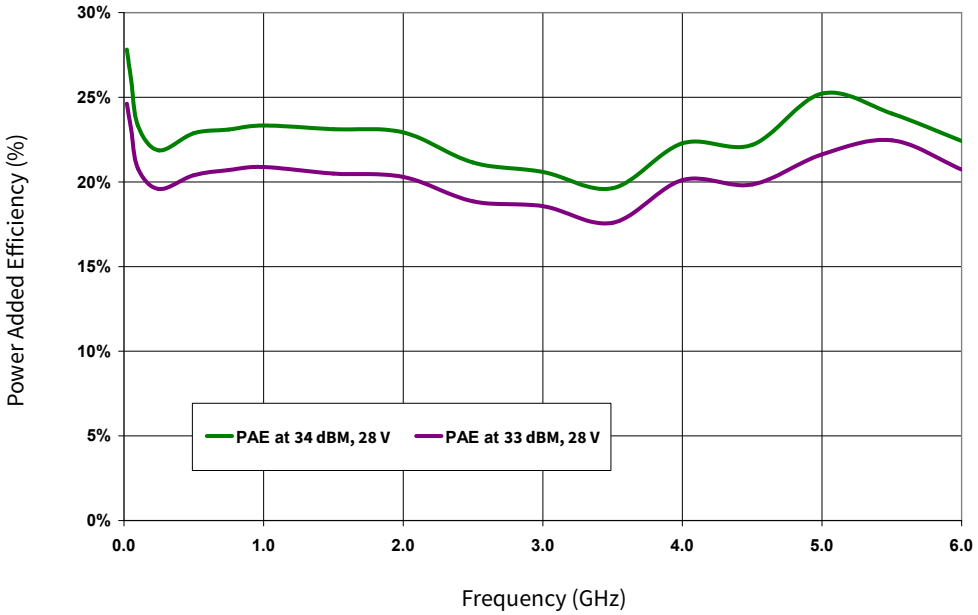



**Figure 4.** PAE at 33 & 34 dBm Output Power vs Frequency at 28 V

## General Device Information

The CMPA0060002F is a GaN HEMT MMIC Distributed Driver Amplifier, which operates between 20 MHz - 6.0 GHz. The amplifier typically provides 17 dB of small signal gain and 2 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 CMPA0060002F 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 CMPA0060002F-AMP and the device were then measured using external Bias-T's, (Aeroflex: 8800, SMF3-12; TECDIA: AMPT-06M20 or similar), as shown in Figure 5. 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.

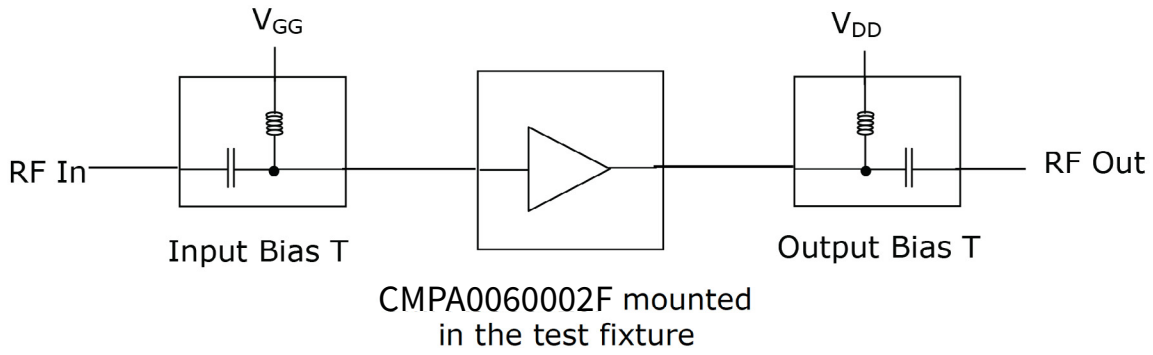
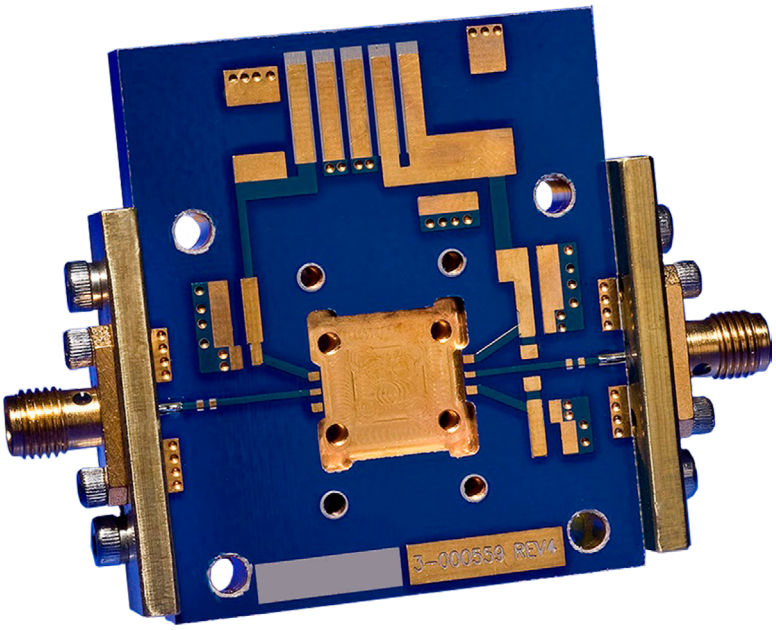



Figure 5. Typical test system setup required for measuring CMPA0060002F-AMP

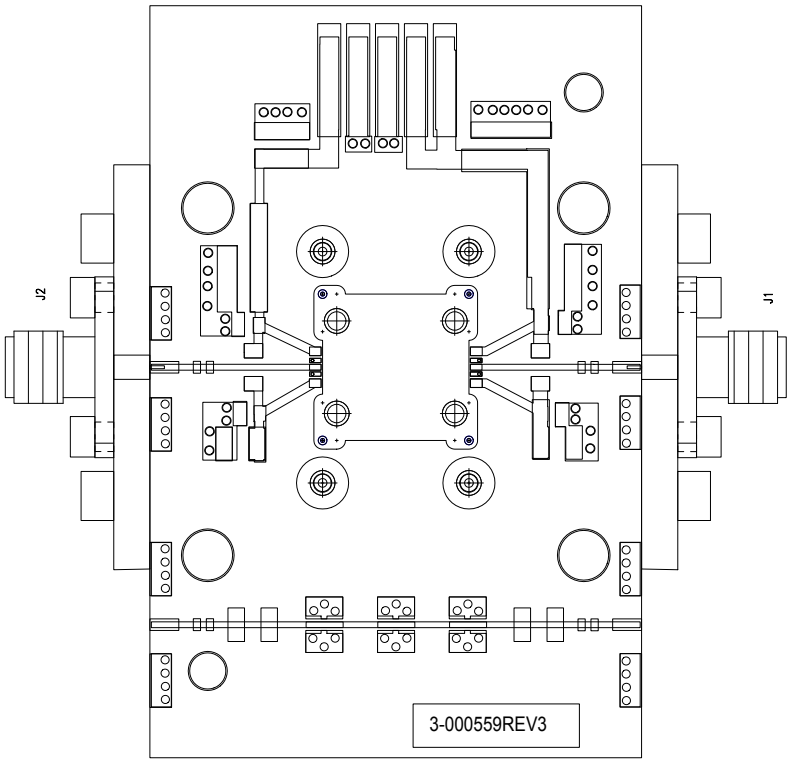
## Electrostatic Discharge (ESD) Classifications

| 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 | C2a | ANSI/ESDA/JEDEC JS-002 Table 3 | JEDEC JESD22 C101-C |

## CMPA0060002F-TB Demonstration Amplifier Circuit




## CMPA0060002F-TB Demonstration Amplifier Circuit Outline

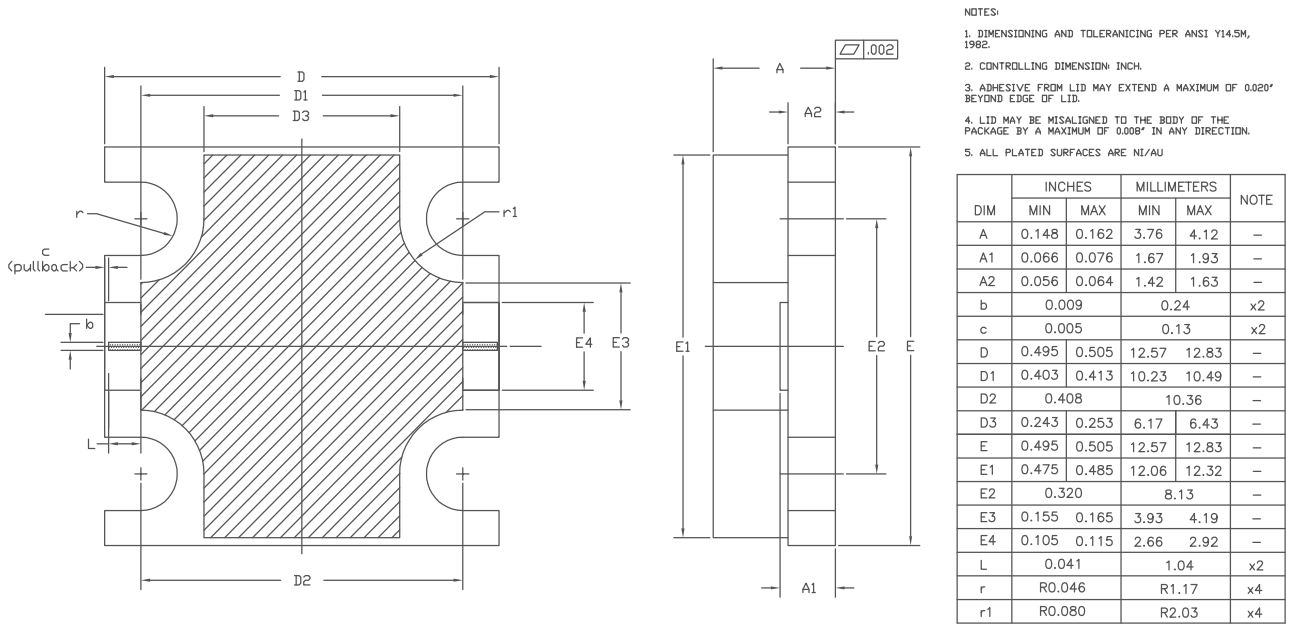


## CMPA0060002F-AMP Demonstration Amplifier Circuit Bill of Materials

| Designator | Description | Qty |
|---|---|---|
| J1,J2 | CONNECTOR, SMA, AMP11052901-1 | 2 |
| – | PCB, TACONIC, RF-35-0100-CH/CH | 1 |
| Q1 | CMPA0060002F | 1 |

Notes
[1] The CMPA0060002F is connected to the PCB with 2.0 mil Au bond wires.
[2] An external Bias-T is required.

## Product Dimensions CMPA0060002F (Package Type — 780019)

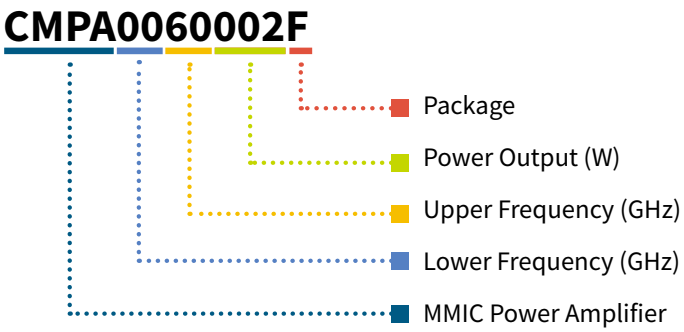



NOTES:

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 | | 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 |

## Part Number System




### Table 1.

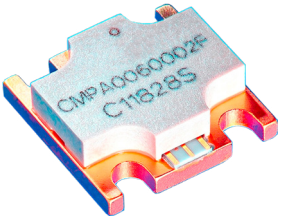
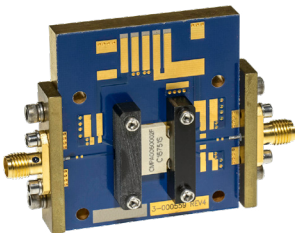
| Parameter | Value | Units |
|---|---|---|
| Lower Frequency | 20 | MHz |
| Upper Frequency | 6000 | |
| Power Output | 2 | W |
| Package | Flange | – |

Note:
[1] Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

### Table 2.

| Character Code | Code Value |
|---|---|
| A | 0 |
| B | 1 |
| C | 2 |
| D | 3 |
| E | 4 |
| F | 5 |
| G | 6 |
| H | 7 |
| J | 8 |
| K | 9 |
| Examples | 1A = 10.0 GHz<br>2H = 27.0 GHz |

## Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|---|---|---|---|
| CMPA0060002F | GaN MMIC | Each |   |
| CMPA0060002F-AMP | Test board with GaN MMIC installed | Each |  |

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