# MAMG-100227-010C0L

## 10 W 2-Stage Hybrid GaN Module
## 225 - 2600 MHz

Rev. V5

## Features

- Compact Size (14 x 18 $mm^2$)
- GaN-on-Si Technology
- Fully Matched at Input and Output
- 28 V Operation
- CW Output Power >10 W, 40% PAE and 22 dB Power Gain
- Lead-Free Package with Heat Sink
- RoHS* Compliant

## Description

The MAMG-100227-010C0L is a broadband two-stage GaN-on-Si hybrid power amplifier module in an air-cavity laminate package. A gold-plated copper heat sink is attached to the bottom side of the laminate substrate. The package can be accessed from the top or the bottom allowing for "live bug" or "dead bug" mounting.

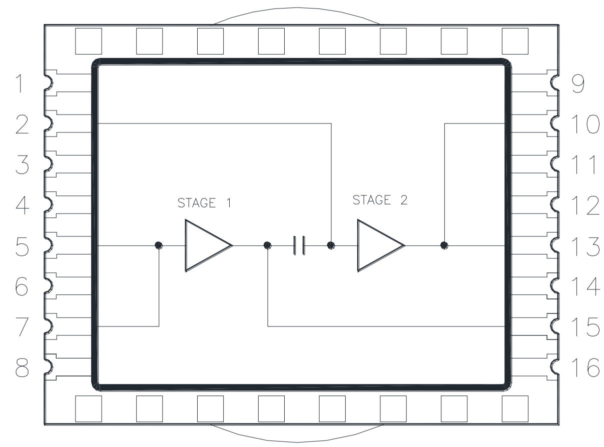
This product is ideal for use in tactical military communications, LMR, and wireless (public safety) markets.

## Ordering Information[1]

| Part Number | Package |
|---|---|
| MAMG-100227-010C0L | JEDEC tray (84 per tray) |
| MAMG-1U0227-010C0L | Sample Board |

1. All sample boards include a part soldered down to the board.

## Functional Schematic




## Pin Configuration[2,3]

| Pin # | Function | Pin # | Function |
|---|---|---|---|
| 1 | NC | 9 | GND |
| 2 | $V_{G2}$ | 10 | $V_{D2}$ |
| 3 | GND | 11 | GND |
| 4 | GND | 12 | GND |
| 5 | $RF_{IN}$ | 13 | $RF_{OUT}$ |
| 6 | GND | 14 | GND |
| 7 | $V_{G1}$ | 15 | $V_{D1}$ |
| 8 | GND | 16 | GND |

2. MACOM recommends connecting unused package pins to ground.
3. The package heat sink must be connected to RF, DC, and thermal ground.

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

## Electrical Specifications[4]:
## $T_A$ = 25°C, $Z_O$ = 50 Ω, CW RF Signal, $I_{DQ1}$ = 40 mA, $I_{DQ2}$ = 100 mA

| Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **28 V Specifications** | | | | | | |
| Output Power ($P_{OUT}$) | $P_{IN}$ = 16 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 16 dBm | 225 MHz<br>450 MHz<br>1400 MHz<br>2600 MHz | 39.5 | 41 | — | dBm |
| Power Gain ($G_P$) | $P_{IN}$ = 16 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 16 dBm | 225 MHz<br>450 MHz<br>1400 MHz<br>2600 MHz | — | 25<br>23<br>23<br>25 | — | dB |
| Drain Efficiency ($\eta_D$) | $P_{IN}$ = 16 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 16 dBm | 225 MHz<br>450 MHz<br>1400 MHz<br>2600 MHz | 46<br>39<br>30<br>33 | 50<br>43<br>37<br>38 | — | % |
| Input Return Loss ($I_{RL}$) | $P_{IN}$ = 16 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 18 dBm<br>$P_{IN}$ = 16 dBm | 225 MHz<br>450 MHz<br>1400 MHz<br>2600 MHz | — | -14<br>-15<br>-15<br>-8 | — | dB |
| 3rd Order Intermodulation Distortion (IM3) | 33.5 dBm/tone,<br>$F_2$-$F_1$ = 1.25 MHz<br>31.0 dBm/tone,<br>$F_2$-$F_1$ = 1.25 MHz | 225 MHz<br>450 MHz<br>1400 MHz<br>2600 MHz | — | -30<br>-31<br>-43<br>-36 | -26<br>-26<br>-26<br>-25 | dBc |
| Load Mismatch Tolerance ($VSWR_T$) | No Damage or Oscillations, All Phases | | — | 5:1 | — | - |
| **36 V Specifications** | | | | | | |
| Output Power ($P_{OUT}$) | $P_{IN}$ = 18 dBm | 320 MHz | 42.2 | 43 | — | dBm |
| Power Gain ($G_P$) | $P_{IN}$ = 18 dBm | 320 MHz | — | 25 | — | dB |
| Drain Efficiency ($\eta_D$) | $P_{IN}$ = 18 dBm | 320 MHz | 49 | 51 | — | % |

4. Measured in MACOM's evaluation circuit (see page 4).

## Thermal Characteristics

| Parameter | Symbol | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| Channel-to-Case Thermal Resistance[5] | $\Theta_{CH\text{-}C}$ | $T_{CASE}$ = 85 °C, RF applied, $P_{DISS}$= 22.5 W | °C/W | - | 4.35 | - |

5. The channel temperature ($T_{CH}$) is determined using Raman and simulation techniques. For more details about this measurement contact the local application team.

## Absolute Maximum Ratings[6,7]

| Parameter | Symbol | Absolute Maximum |
|---|---|---|
| Input Power | $P_{IN}$ | 27 dBm |
| Drain Supply Voltage | $V_D$ | 40 V |
| Gate Supply Voltage | $V_G$ | -4 V to 0 V |
| Supply Current | $I_{DS}$ | 1.6 A |
| Power Dissipation | $P_{DISS}$ | 32 W |
| Channel Temperature[8] | $T_{CH}$ | 250°C |
| Operating Temperature | $T_{OP}$ | -40°C to 85°C |
| Storage Temperature | TSTG | -65°C to 150°C |

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.
8. Operating at nominal conditions with $T_{CH} \leq 210°C$ will ensure MTTF > $1 \times 10^6$ hours.

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

## Biasing Sequence

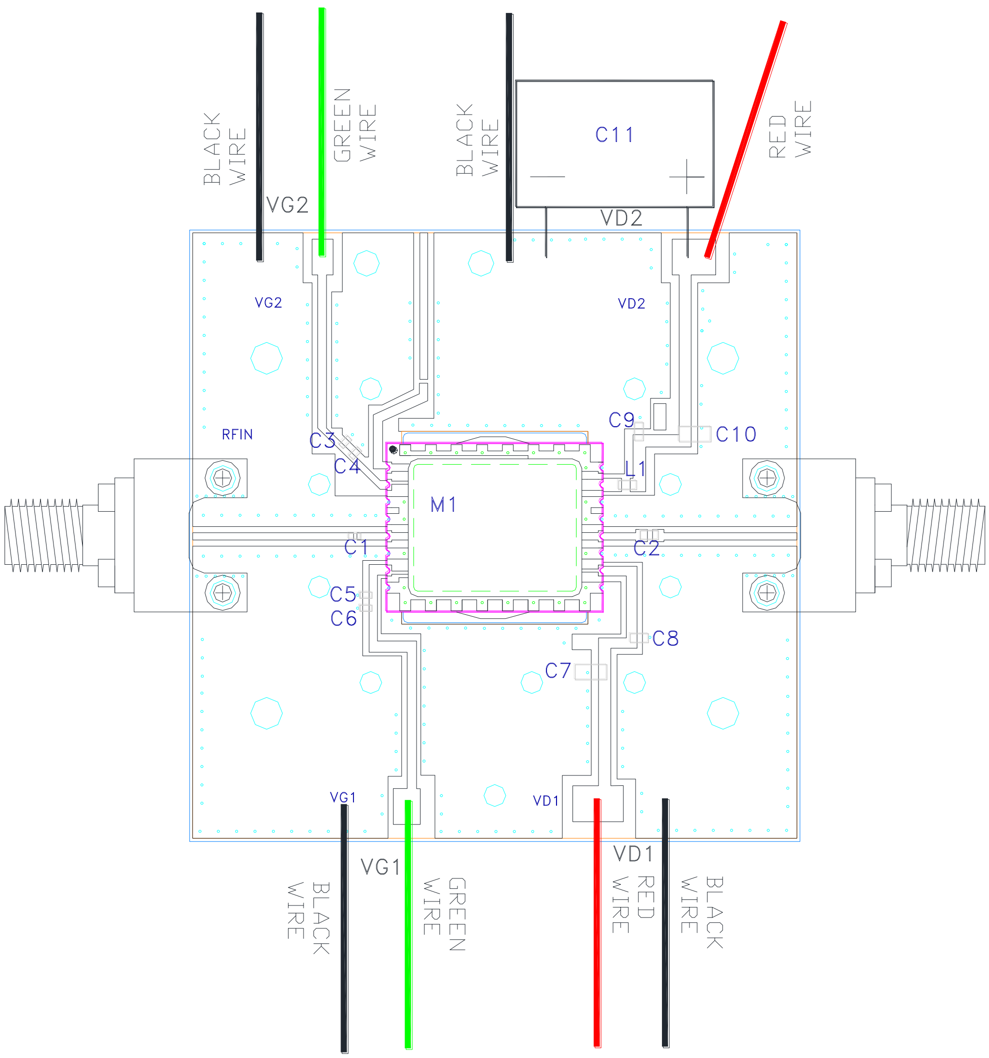
**Turning the device ON:**

1. Set $V_G$ to pinch-off ($V_P$), typically -5 V.
2. Turn on $V_D$ to nominal voltage (28 V).
3. Increase $V_G$ until the desired quiescent current $I_{DQ}$ 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 $V_P$.
3. Decrease $V_{DS}$ down to 0 V.
4. Turn off $V_{GS}$.

### Evaluation Board and Component Layout

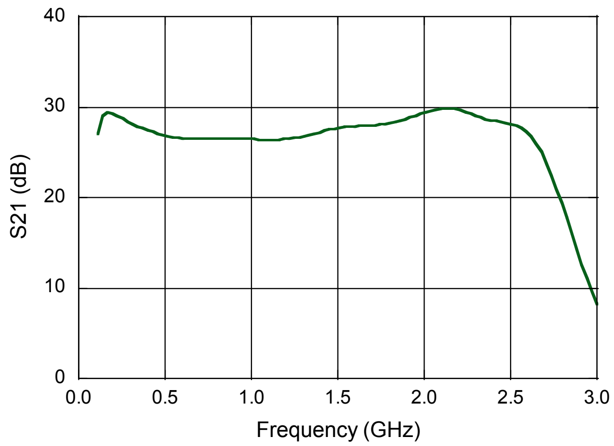



### Parts List

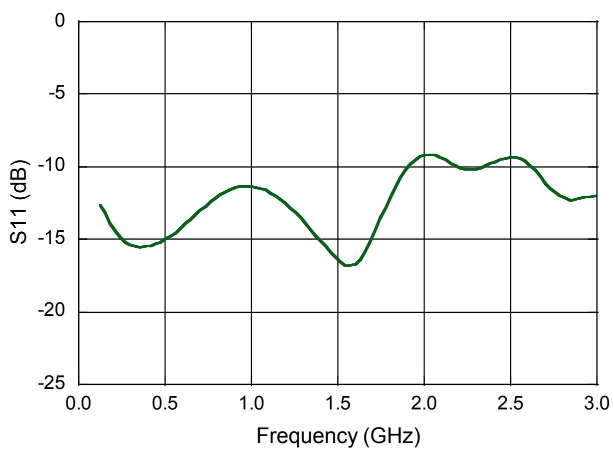
| Reference | Value | Case Style | Tolerance | Manufacturer | Part Number |
|---|---|---|---|---|---|
| L1 | 180 nH | 0603 | 5% | Coilcraft | 0603LS-181XJLC |
| C1 | 1000 pF | 0402 | 10% | Murata | GRM155R72A102KA01D |
| C2 | 1000 pF | 0603 | 10% | Murata | GRM188R72A102KA37D |
| C3,C6 | 1 µF | 0402 | 20% | TDK | C1005X5R1E105M050BC |
| C4,C5 | 10 nF | 0402 | 10% | Murata | GRM155R71H103KA88D |
| C8,C9 | 10 nF | 0603 | 10% | Murata | GCM188R72A103KA37D |
| C7,C10 | 1 µF | 1210 | 10% | KEMET | C1210C105K1RACTU |
| C11 | 100 µF | Axial | 20% | Multicomp | MCAX63V107M10X21 |

## Typical Small Signal Performance:
### $V_{DD}$ = 28 V, $I_{DQ1}$ = 40 mA, $I_{DQ2}$ = 100 mA, $T_A$ = 25°C

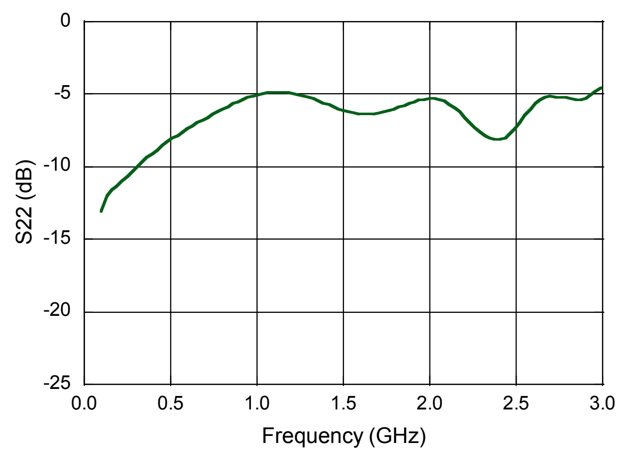
***Gain***




***Input Return Loss***



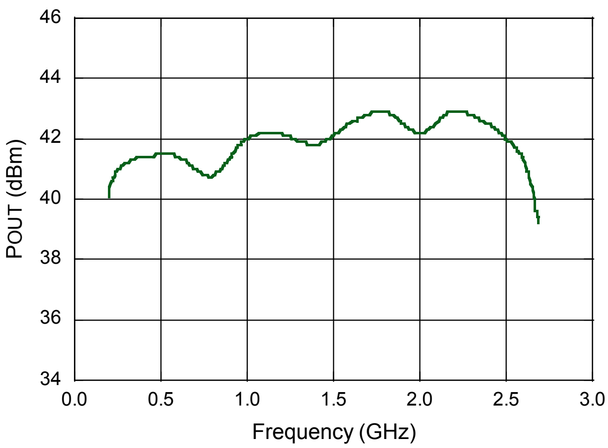

***Output Return Loss***



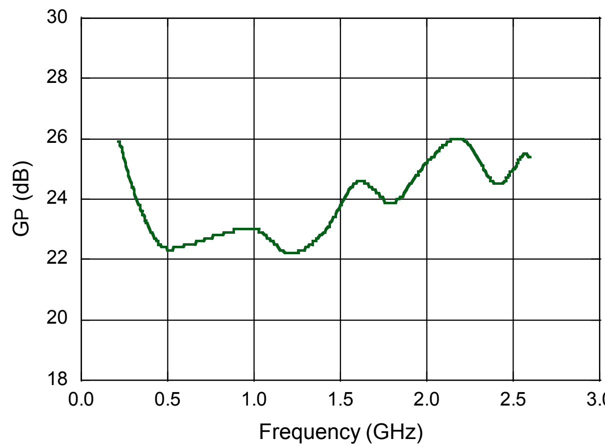
## Typical Large Signal Performance:

### $T_A$ = 25°C, $V_{DD}$ = 28 V, $I_{DQ1}$ = 40 mA, $I_{DQ2}$ = 100 mA, $P_{SAT}$, CW

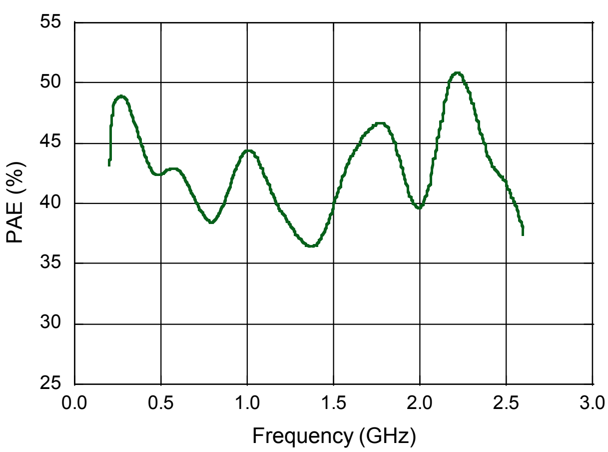
***Output Power***



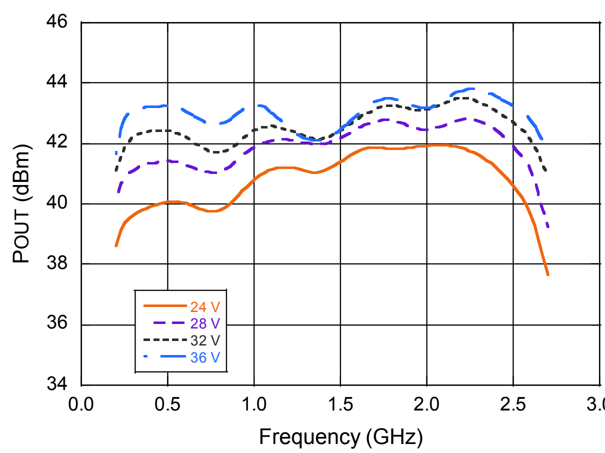

***Power Gain***




***Power Added Efficiency***

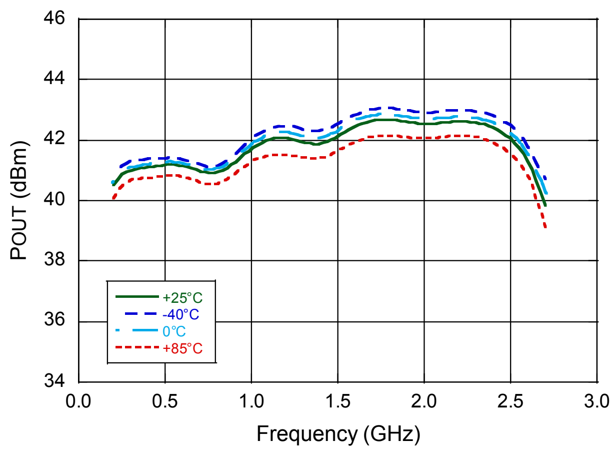



***Output Power vs. Voltage***

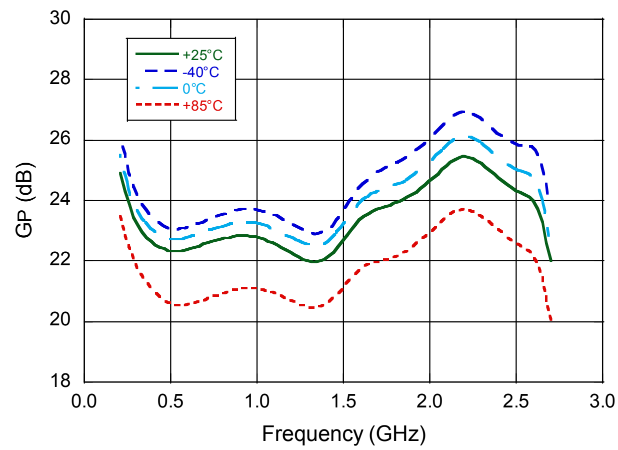


## Typical Large Signal Performance vs. Temperature:
### $V_{DD}$ = 28 V , $I_{DQ1}$ = 40 mA, $I_{DQ2}$ = 100 mA

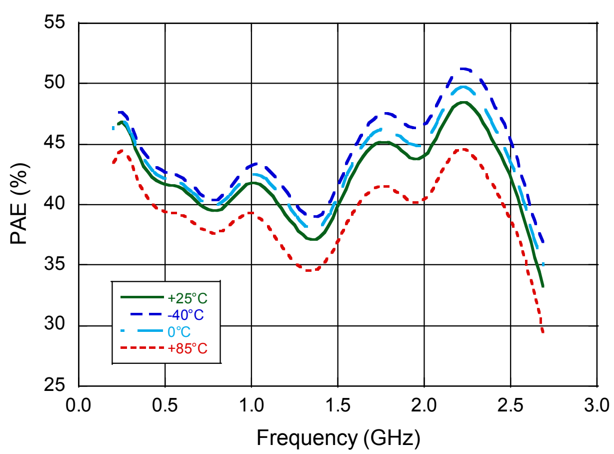
*Saturated Output Power vs. Temperature*



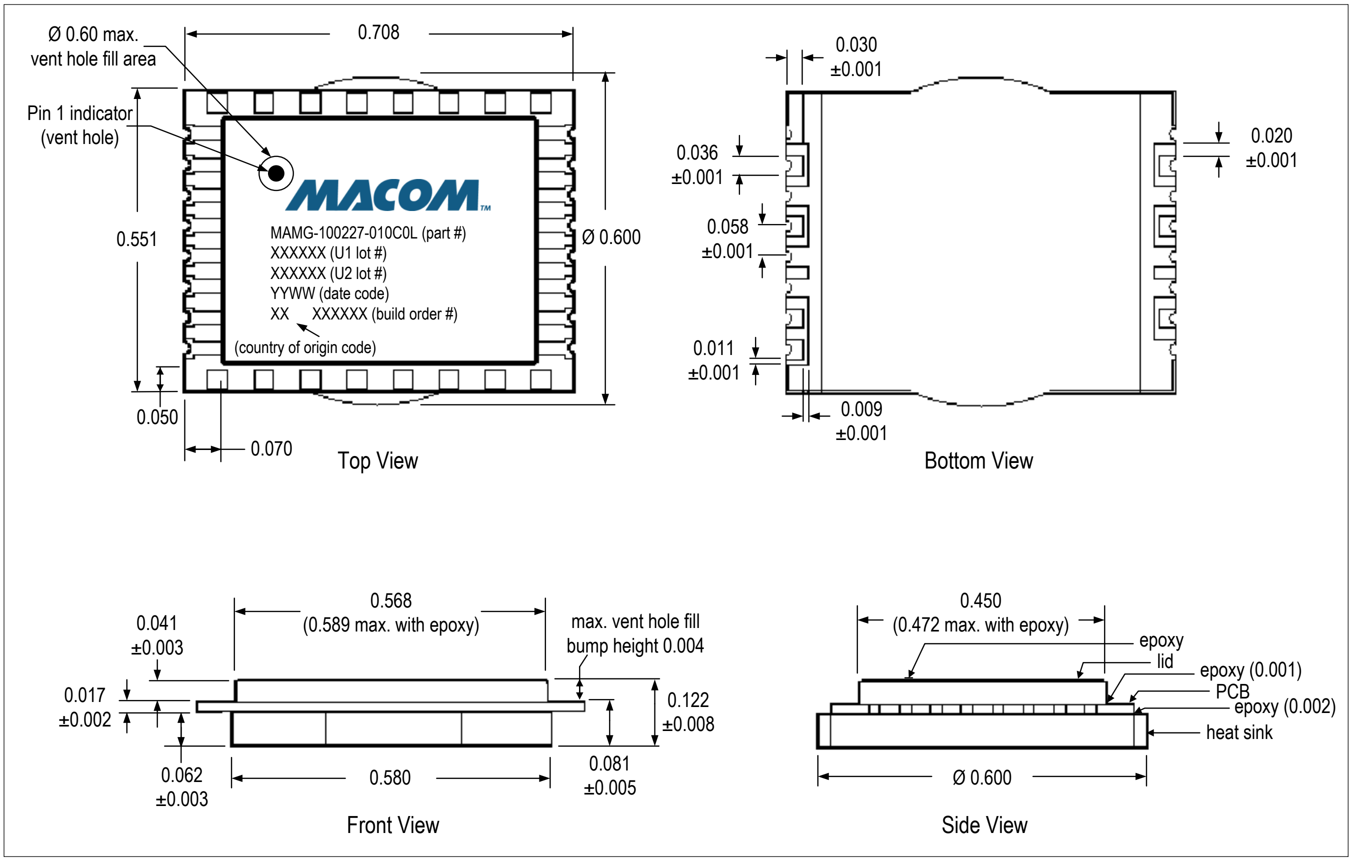

*Saturated Power Gain vs. Temperature*




*Saturated Power Added Efficiency vs. Temperature*



## Package Outline†




† All dimensions shown as inches.
Reference Application Note AN-0004016 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Gold.