

## Vector Modulator, 925 to 960 MHz

Rev. V2

### Features

- Operates 925 to 960 MHz
- Low Amplitude Ripple
- Linear Phase
- 50 Ohm Nominal Impedance
- Continuously Variable Across a Full 360 degree range
- Test Boards to be Available
- Test Boards Available
- Lead-Free 4x6 mm PQFN Package
- 100% Matte Tin Plating over Copper
- Halogen-Free "Green" Mold Compound
- 260°C Reflow Compatible
- RoHS\* Compliant Version of MAMDCC0005

### Description

M/A-COM's MAIA-007099-000100 is a Vector Modulator that significantly reduces the required board space compared to hybrid solutions. The monolithic passive elements will lead to greater repeatability lot-to-lot. Low amplitude ripple will provide superior performance. High intercept and compression points will contribute to more linear system performance. MAMDCC0005 is ideally suited for wireless infrastructure applications.

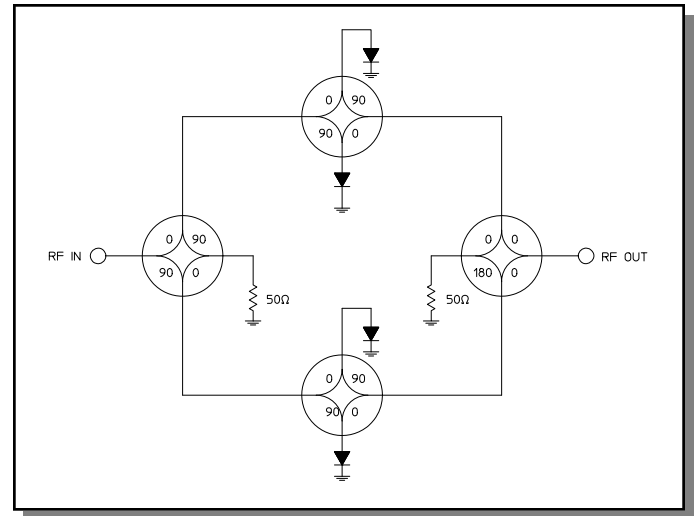
M/A-COM's MADR-007131-000100 Dual Linearizer is designed to simplify the control of Vector Modulators. See Figure 1 and App Note AN3001.

### Ordering Information

| Part Number        | Package           |
|--------------------|-------------------|
| MAIA-007099-000100 | Bulk Packaging    |
| MAIA-007099-0001TR | 1000 piece reel   |
| MAIA-007099-0001TB | Sample Test Board |

Note: Reference Application Note M513 for reel size information.

### Functional Schematic



### Pin Configuration

| Pin No. | Function | Pin No. | Function |
|---------|----------|---------|----------|
| 1       | NC       | 17      | NC       |
| 2       | NC       | 18      | NC       |
| 3       | NC       | 19      | NC       |
| 4       | NC       | 20      | NC       |
| 5       | NC       | 21      | NC       |
| 6       | NC       | 22      | NC       |
| 7       | NC       | 23      | NC       |
| 8       | NC       | 24      | BIAS 2B  |
| 9       | BIAS 1A  | 25      | NC       |
| 10      | NC       | 26      | GND      |
| 11      | GND      | 27      | RF OUT   |
| 12      | RF IN    | 28      | GND      |
| 13      | GND      | 29      | NC       |
| 14      | NC       | 30      | BIAS 1B  |
| 15      | BIAS 2A  | 31      | NC       |
| 16      | NC       | 32      | NC       |

The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)

\* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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Electrical Specifications:  $T_A = 25^\circ\text{C}$ ,  $Z_0 = 50\Omega$

| Parameter                   | Test Conditions                                            | Frequency     | Units | Min   | Typ        | Max        |
|-----------------------------|------------------------------------------------------------|---------------|-------|-------|------------|------------|
| Impedance                   | —                                                          | —             | Ohms  | —     | 50         | —          |
| Reference Loss              | $Z = 50\text{ Ohms}$                                       | 925 — 960 MHz | dB    | -14.5 | —          | -11.5      |
| Attenuation Range           | $Z = 50\text{ Ohms}$<br>Above Reference Loss               | 925 — 960 MHz | dB    | 10    | —          | —          |
| Phase Shift Range           | $Z = 50\text{ Ohms}$ , Over minimum<br>Attenuation Range   | 925 — 960 MHz | deg   | 0     | —          | 360        |
| Amplitude Ripple            | $Z = 50\text{ Ohms}$ ,<br>Ref Loss to 10 dB above Ref Loss | 925 — 960 MHz | dB    | —     | $\pm 0.05$ | $\pm 0.15$ |
| Deviation from Linear Phase | $Z = 50\text{ Ohms}$ ,<br>Ref Loss to 10 dB above Ref Loss | 925 — 960 MHz | deg   | —     | —          | $\pm 0.75$ |
| Return Loss - Input         | Ref Loss<br>5 to 10 dB above Ref Loss                      | 925 — 960 MHz | dB    | 12    | 16         | —          |
|                             |                                                            | 925 — 960 MHz | dB    | 15    | 18         | —          |
|                             |                                                            | 925 — 960 MHz | dB    | 14    | 18         | —          |
| Return Loss - Output        | Ref Loss<br>5 dB<br>10 dB                                  | 925 — 960 MHz | dB    | 8.5   | 15         | —          |
|                             |                                                            | 925 — 960 MHz | dB    | 11.5  | 18         | —          |
|                             |                                                            | 925 — 960 MHz | dB    | 14    | 18         | —          |
| Input $IP_3$                | Over 10 dB Attenuation Range                               | 925 — 960 MHz | dBm   | —     | +41        | —          |
| Input $P_{1dB}$             | Over 10 dB Attenuation Range                               | 925 — 960 MHz | dBm   | —     | +29        | —          |
| Noise Figure                | Over 10 dB Attenuation Range                               | 925 — 960 MHz | dB    | —     | —          | Note 1     |
| Switching Speed             | 50% Control to 10% / 90% RF                                | —             | ns    | —     | 1000       | —          |
| I Supply                    | —                                                          | —             | mA    | —     | —          | 25         |

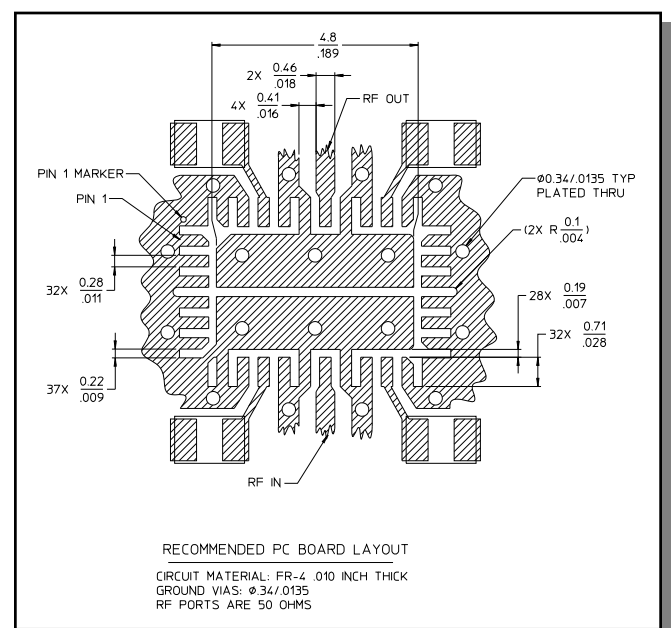
1. Noise figure is approximately equal to the absolute attenuation.

## Absolute Maximum Ratings<sup>2,3</sup>

| Parameter                                               | Absolute Maximum   |
|---------------------------------------------------------|--------------------|
| Max. Input Power<br>0.8 to 1.1 GHz<br>Other Frequencies | +30 dBm<br>+24 dBm |
| DC Voltages <sup>4</sup><br>$V_{bias1}$ or $V_{bias2}$  | +1.0V              |
| DC Current                                              | 50 mA Max per Bias |
| Operating Temperature                                   | -40°C to +85°C     |
| Storage Temperature                                     | -65°C to +125°C    |

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- M/A-COM does not recommend sustained operation near these survivability limits.
- Note that external dropping resistors are required to limit the current and voltage on the PIN diodes.

## Recommended PCB Configuration

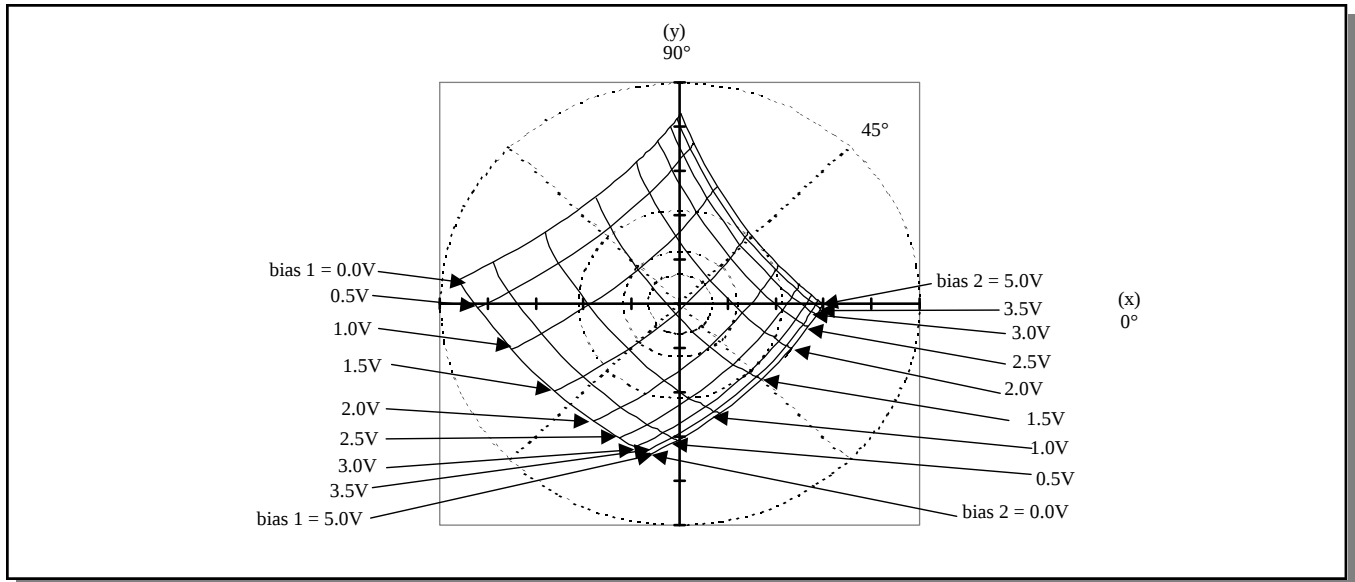


## Vector Modulator, 925 to 960 MHz

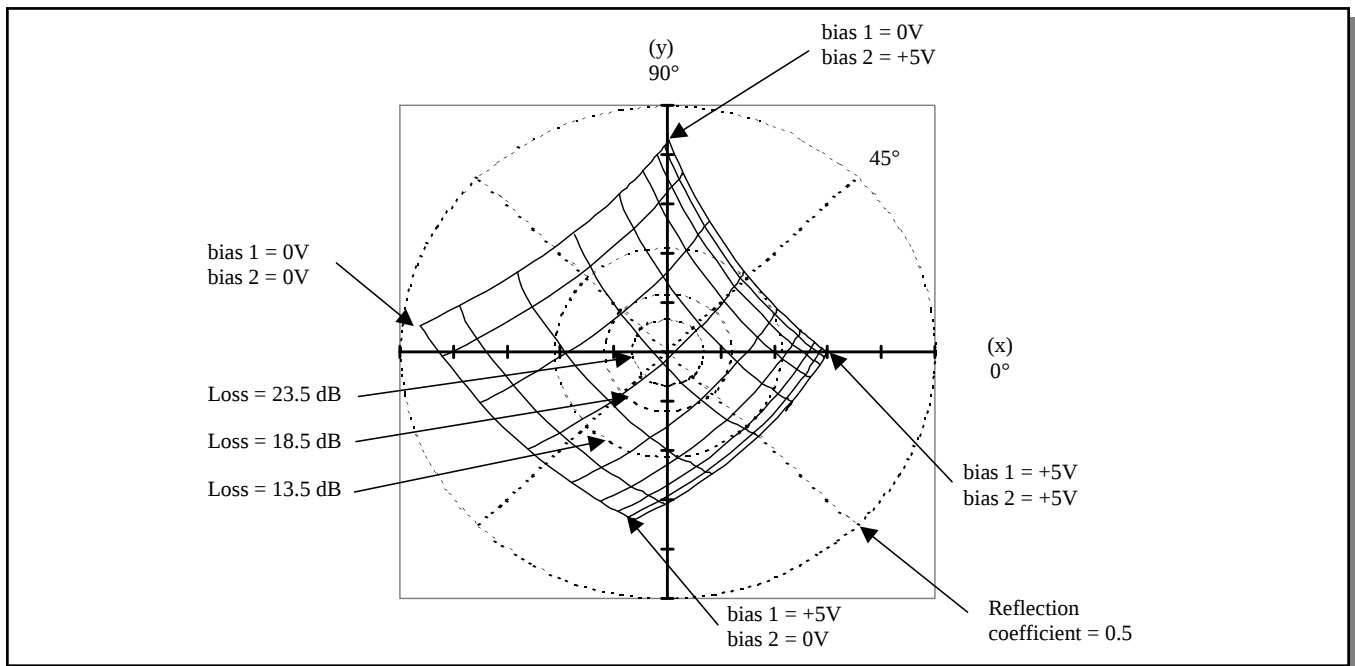
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**Phase and Attenuation of MAIA-007099-000100, Vector Modulator Linearized with  
MADR-007131-000100 Dual Linearizer<sup>5,6,7,8</sup>**

**Figure 1A**



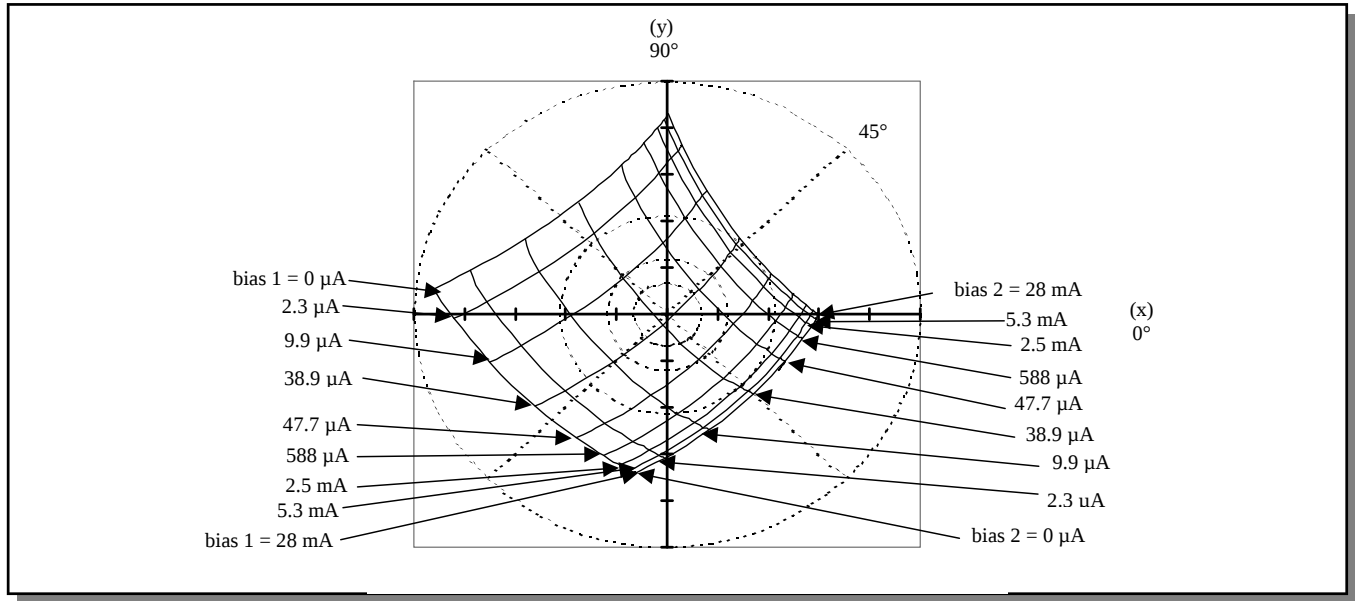
**Figure 1B**



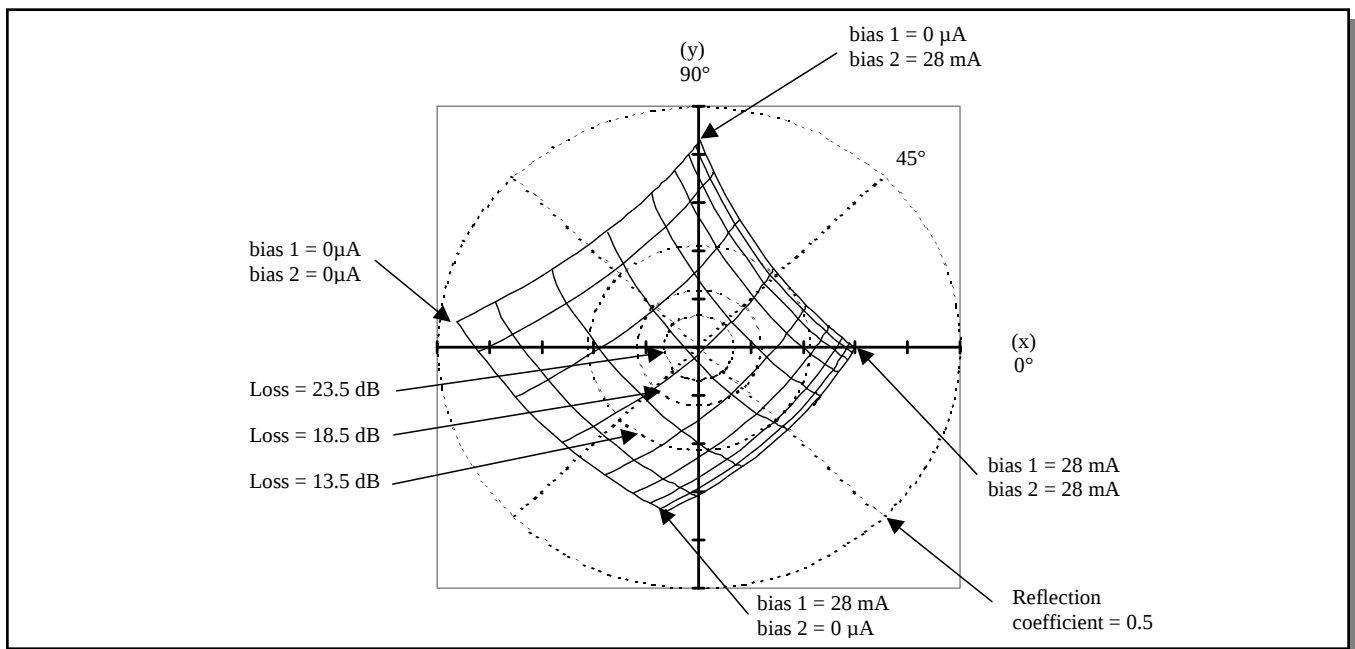
5. Tic marks on x,y axes refer to reflection coefficient in increments of 0.1V. Reflection coefficients vary from -0.5 to +0.5 on both the x and y axes.
6. Data is for vector modulators driven by linearizers. See Application Note AN3001.
7. Inputs to the linearizers vary from 0 to 5V.
8. The phase with the inputs to both linearizers set to +5V is arbitrarily called zero degrees.

**Phase and Attenuation of MAIA-007099-000100, Vector Modulator with Current Drive<sup>9,10</sup>**

**Figure 2A**



**Figure 2B**



9. Tic marks on x,y axes refer to reflection coefficient in increments of 0.1. Reflection coefficients vary from  $-0.5$  to  $+0.5$  on both the x and y axes.

10. The phase with the inputs to both linearizers set to  $+28$  mA is arbitrarily called zero degrees.

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### Handling Procedures

Please observe the following precautions to avoid damage:

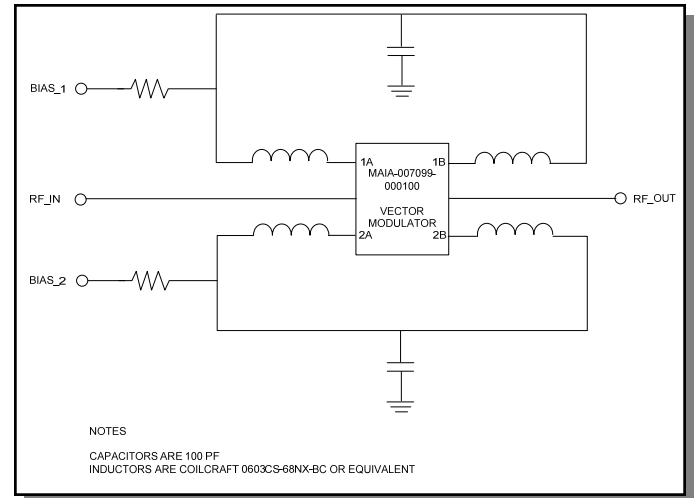
### Static Sensitivity

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

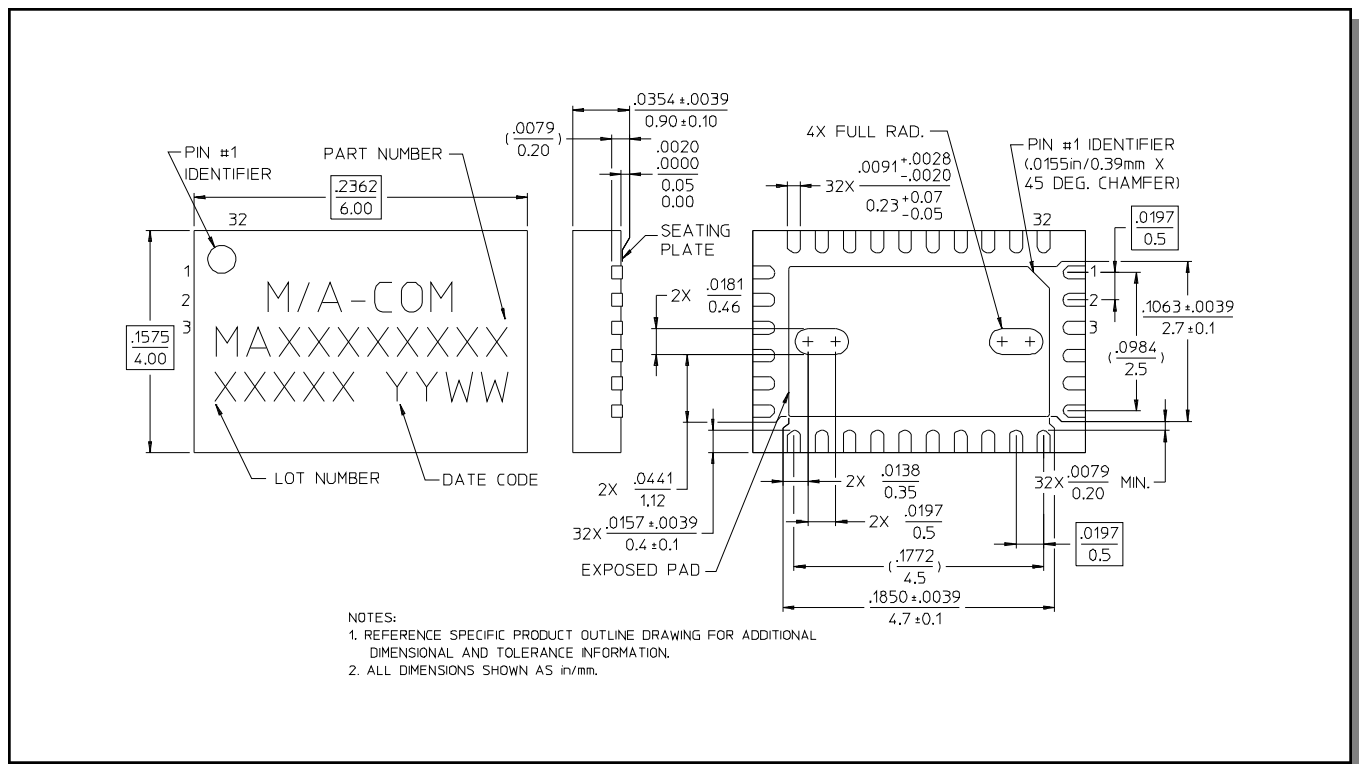
### Moisture Sensitivity

The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

### Schematic with Off-Chip Components



### CSP-6, Lead-Free, 4 x 6 mm, 32-lead, PQFN†



† Reference Application Note M538 for lead-free solder reflow recommendations.