

## Digital Attenuator 15.5 dB, 5-Bit, TTL Driver, DC-3.5 GHz

Rev. V4

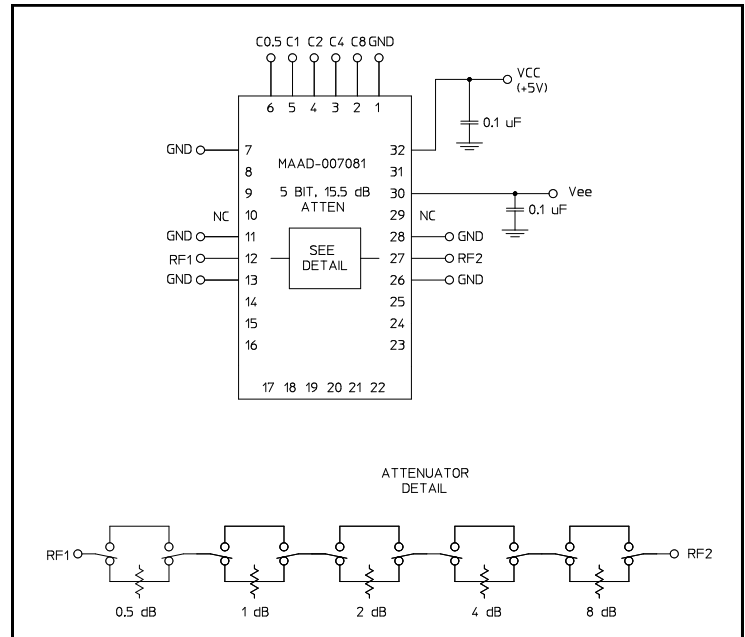
### Features

- Attenuation: 0.5 dB Steps to 15.5 dB
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 ohm Impedance
- Test Boards are Available
- Tape and Reel Packaging Available
- Lead-Free CSP-1 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free "Green" Mold Compound
- 260°C Reflow Compatible
- RoHS\* Compliant Version of AT90-0283

### Description

M/A-COM's MAAD-007081-000100 is a GaAs FET 5-bit digital attenuator with integral TTL driver. Step size is 0.5 dB providing a 15.5 dB total attenuation range. This device is in an PQFN plastic surface mount package. MAAD-007081-000100 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

### Functional Schematic



### Pin Configuration<sup>1</sup>

| Pin No. | Function        | Pin No. | Function        |
|---------|-----------------|---------|-----------------|
| 1       | GND             | 17      | NC              |
| 2       | C8              | 18      | NC              |
| 3       | C4              | 19      | NC              |
| 4       | C2              | 20      | NC              |
| 5       | C1              | 21      | NC              |
| 6       | C0.5            | 22      | NC              |
| 7       | GND             | 23      | NC              |
| 8       | NC              | 24      | NC              |
| 9       | NC              | 25      | NC              |
| 10      | NC <sup>2</sup> | 26      | GND             |
| 11      | GND             | 27      | RF2             |
| 12      | RF1             | 28      | GND             |
| 13      | GND             | 29      | NC <sup>2</sup> |
| 14      | NC              | 30      | -Vee            |
| 15      | NC              | 31      | NC              |
| 16      | NC              | 32      | +Vcc            |

### Ordering Information

| Part Number        | Package           |
|--------------------|-------------------|
| MAAD-007081-000100 | Bulk Packaging    |
| MAAD-007081-0001TR | 1000 piece reel   |
| MAAD-007081-0001TB | Sample Test Board |

Note: Reference Application Note M513 for reel size information.

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

1. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)  
2. Pins 10 & 29 must be isolated

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

| Parameter                                                           | Test Conditions                                              | Frequency     | Units              | Min  | Typ   | Max                                       |
|---------------------------------------------------------------------|--------------------------------------------------------------|---------------|--------------------|------|-------|-------------------------------------------|
| Insertion Loss                                                      | —                                                            | DC - 3.5 GHz  | dB                 | —    | 2.8   | 3.2                                       |
| Attenuation Accuracy                                                | Individual Bits 0.5-1-4-8 dB                                 | DC - 3.5 GHz  | dB                 | —    | —     | $\pm(.3 + 5\% \text{ of atten setting})$  |
|                                                                     | Individual Bit 2 dB                                          | DC - 3.5 GHz  | dB                 | —    | —     | $\pm(.4 + 10\% \text{ of atten setting})$ |
|                                                                     | Any Combination of Bits<br>1 to 15.5 dB                      | DC - 3.5 GHz  | dB                 | —    | —     | $\pm(.5 + 7\% \text{ of atten setting})$  |
| VSWR                                                                | Full Range                                                   | DC - 3.5 GHz  | Ratio              | —    | 1.6:1 | 1.8:1                                     |
| Switching Speed                                                     | 50% Cntl to 90%/10% RF<br>10% to 90% or 90% to 10%           | —             | ns                 | —    | 75    | 150                                       |
|                                                                     |                                                              | —             | ns                 | —    | 20    | 50                                        |
| 1 dB Compression                                                    | —                                                            | 50 MHz        | dBm                | —    | +21   | —                                         |
|                                                                     |                                                              | 0.5 - 3.5 GHz | dBm                | —    | +29   | —                                         |
| Input $IP_3$                                                        | Two-tone inputs up to +5 dBm                                 | 50 MHz        | dB                 | —    | +35   | —                                         |
|                                                                     |                                                              | 0.5-3.5 GHz   | dB                 | —    | +48   | —                                         |
| $V_{CC}$                                                            | —                                                            | —             | V                  | 4.75 | 5.0   | 5.25                                      |
| $V_{EE}$                                                            | —                                                            | —             | V                  | -8.0 | -5.0  | -4.75                                     |
| $V_{IL}$                                                            | LOW-level input voltage                                      | —             | V                  | 0.0  | —     | 0.8                                       |
| $V_{IH}$                                                            | HIGH-level input voltage                                     | —             | V                  | 2.0  | —     | 5.0                                       |
| $I_{in}$ (Input Leakage Current)                                    | $V_{in} = V_{CC}$ or GND                                     | —             | uA                 | -1.0 | —     | 1.0                                       |
| $I_{CC}$<br>(Quiescent Supply Current)                              | $V_{cntrl} = V_{CC}$ or GND                                  | —             | uA                 | —    | 250   | 400                                       |
| $\Delta I_{CC}$<br>(Additional Supply Current<br>Per TTL Input Pin) | $V_{CC} = \text{Max}$ , $V_{cntrl} = V_{CC} - 2.1 \text{ V}$ | —             | mA                 | —    | —     | 1.0                                       |
| $I_{EE}$                                                            | $V_{EE} \text{ min to max}$ , $V_{in} = V_{IL}$ or $V_{IH}$  | —             | mA                 | -1.0 | -0.2  | —                                         |
| Thermal Resistance $\theta_{JC}$                                    | —                                                            | —             | $^\circ\text{C/W}$ | —    | 15    | —                                         |

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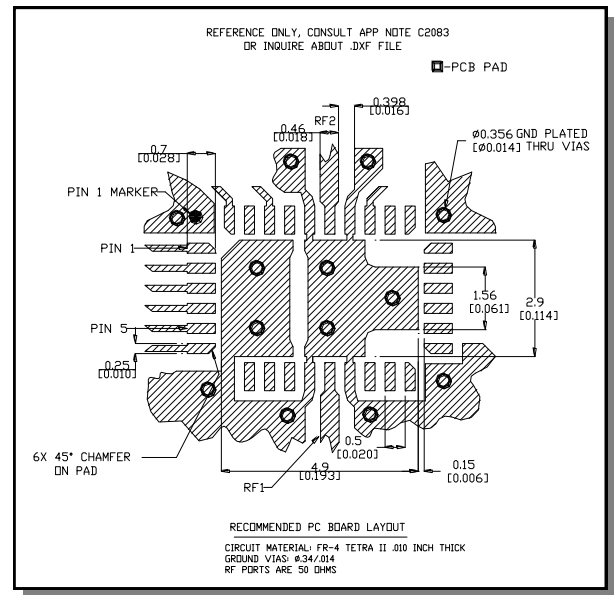
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### Absolute Maximum Ratings<sup>3,4</sup>

| Parameter                                     | Absolute Maximum                        |
|-----------------------------------------------|-----------------------------------------|
| Max. Input Power<br>0.05 GHz<br>0.5 - 3.5 GHz | +27 dBm<br>+34 dBm                      |
| $V_{CC}$                                      | $-0.5V \leq V_{CC} \leq +7.0V$          |
| $V_{EE}$                                      | $-8.5V \leq V_{EE} \leq +0.5V$          |
| $V_{CC} - V_{EE}$                             | $-0.5V \leq V_{CC} - V_{EE} \leq 14.5V$ |
| $V_{in}^5$                                    | $-0.5V \leq V_{in} \leq V_{CC} + 0.5V$  |
| Operating Temperature                         | $-40^{\circ}C$ to $+85^{\circ}C$        |
| Storage Temperature                           | $-65^{\circ}C$ to $+125^{\circ}C$       |

- 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.
- Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

### Recommended PCB Configuration<sup>6</sup>



- Application Note C2083 is available on line at [www.macom.com](http://www.macom.com)

### 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.

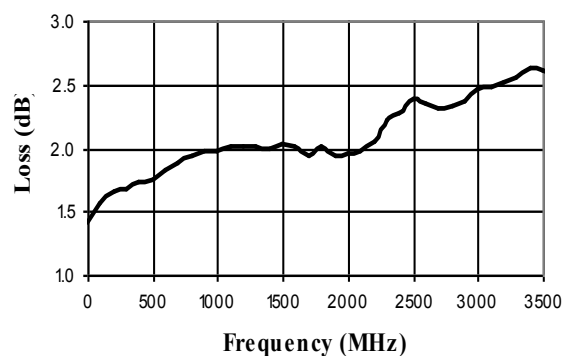
### Truth Table (Digital Attenuator)

| C8 | C4 | C2 | C1 | C0.5 | Attenuation     |
|----|----|----|----|------|-----------------|
| 0  | 0  | 0  | 0  | 0    | Loss, Reference |
| 0  | 0  | 0  | 0  | 1    | 0.5 dB          |
| 0  | 0  | 0  | 1  | 0    | 1.0 dB          |
| 0  | 0  | 1  | 0  | 0    | 2.0 dB          |
| 0  | 1  | 0  | 0  | 0    | 4.0 dB          |
| 1  | 0  | 0  | 0  | 0    | 8.0 dB          |
| 1  | 1  | 1  | 1  | 1    | 15.5 dB         |

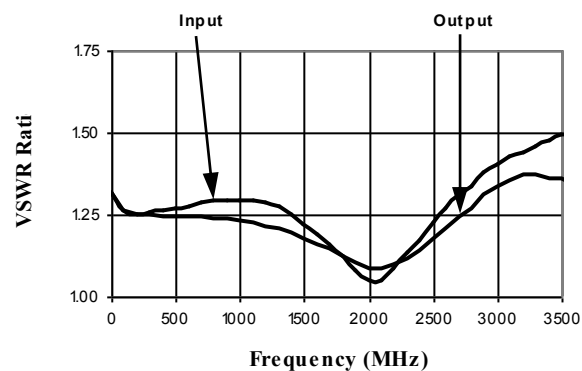
0 = TTL Low; 1 = TTL High

## Typical Performance Curves

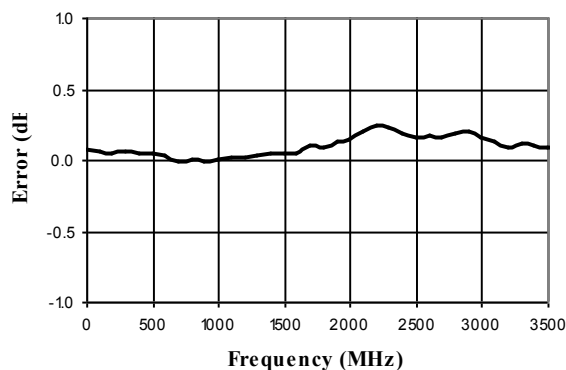
*Insertion Loss*



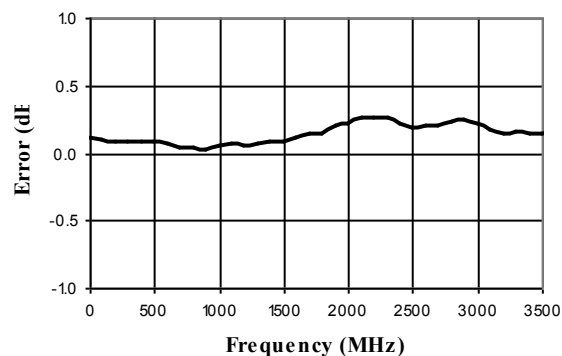
*VSWR @ Insertion Loss*



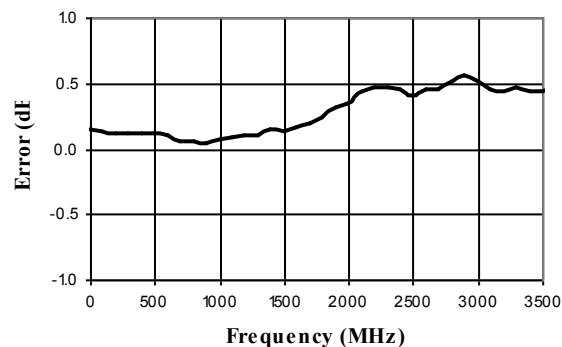
*Attenuation Error, 0.5 dB Bit*



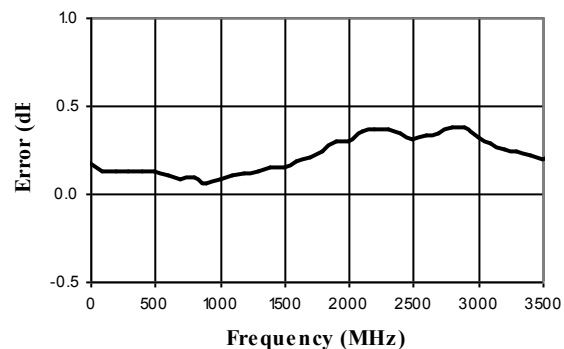
*Attenuation Error, 1 dB Bit*



*Attenuation Error, 2 dB Bit*

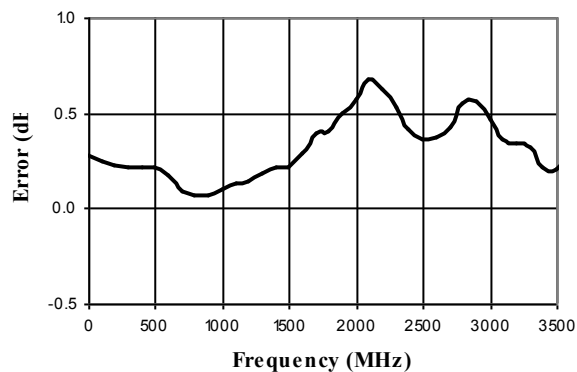


*Attenuation Error, 4 dB Bit*

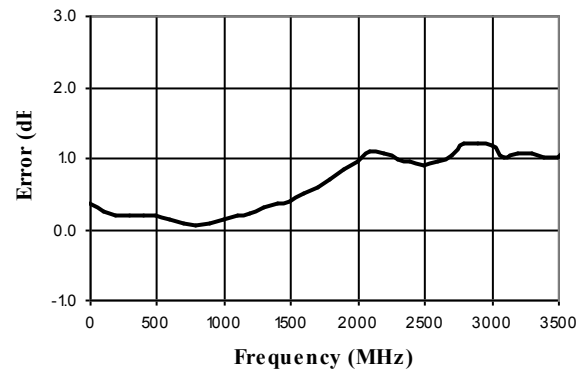


## Typical Performance Curves

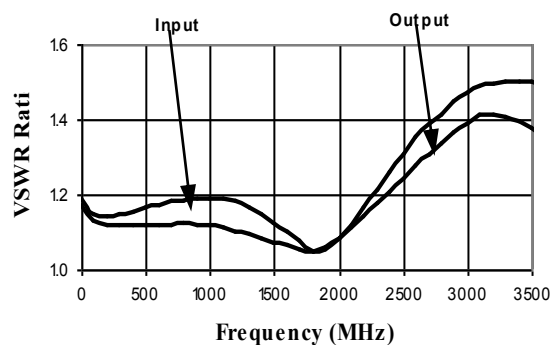
*Attenuation Error, 8 dB Bit*



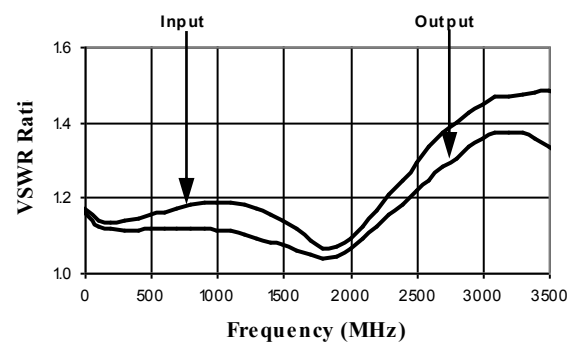
*Attenuation Error, Max. Attenuation*



*VSWR, 0.5 dB Bit*



*VSWR, 1 dB Bit*

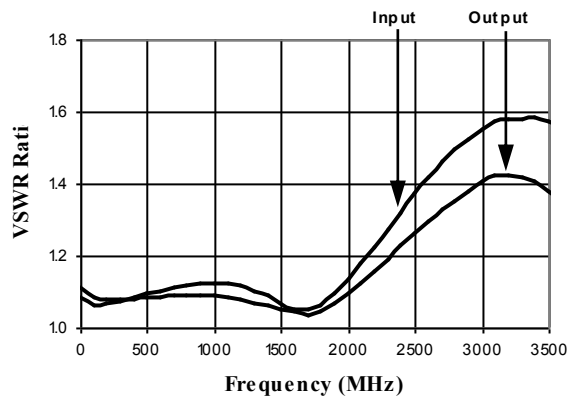


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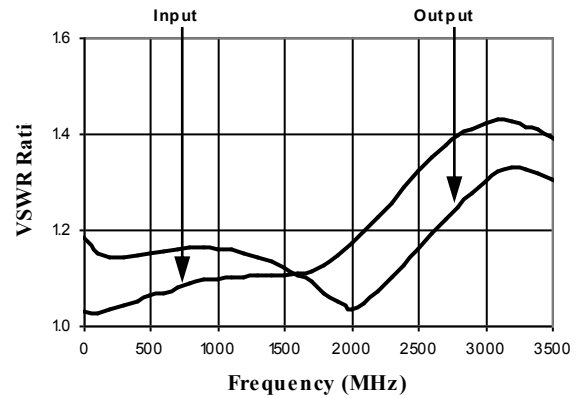
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### Typical Performance Curves

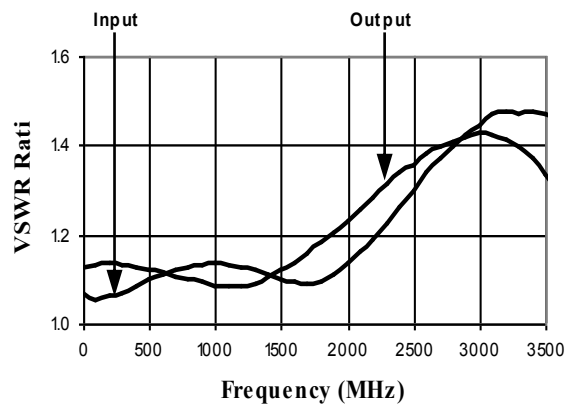
*VSWR, 2 dB Bit*



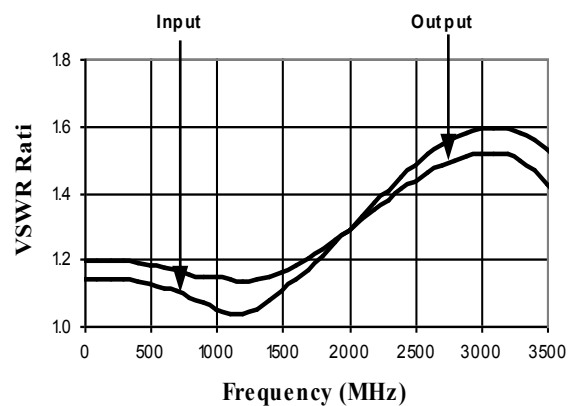
*VSWR, 4 dB Bit*



*VSWR, 8 dB Bit*



*VSWR, Maximum Attenuation*

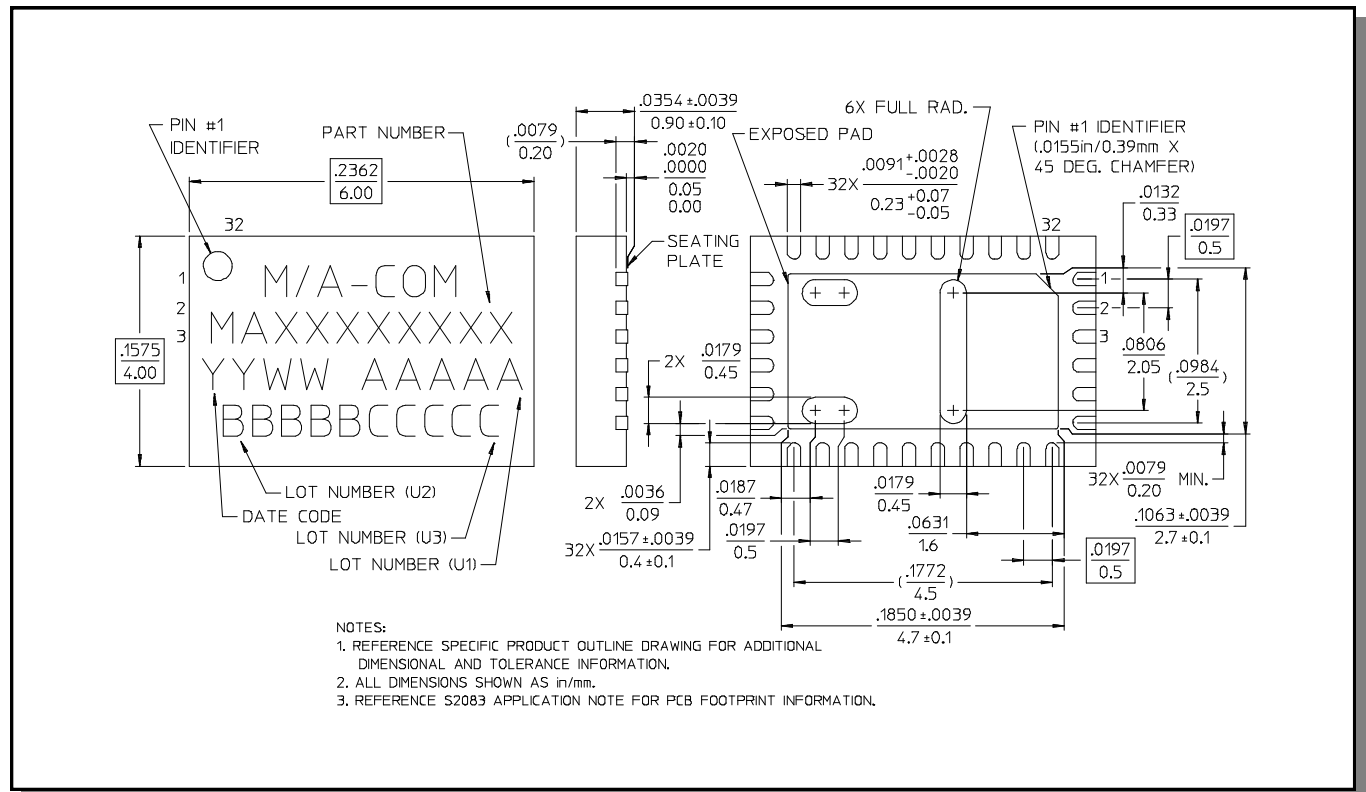


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**CSP-1, Lead-Free 4 x 6 mm, 32-lead PQFN<sup>†</sup>**



<sup>†</sup> Reference Application Note M538 for lead-free solder reflow recommendations.

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