

## Digital Attenuator 50 dB, 6-Bit, TTL Driver, DC - 2.4 GHz

Rev. V5

### Features

- Attenuation: 1 dB Steps to 50 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 AT90-0106

### Description

M/A-COM's MAAD-007082-000100 is a GaAs FET 6-bit digital attenuator with integral TTL driver. Step size is 1 dB providing a 50 dB total attenuation range. This device is in a PQFN plastic surface mount package. The MAAD-007082-000100 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

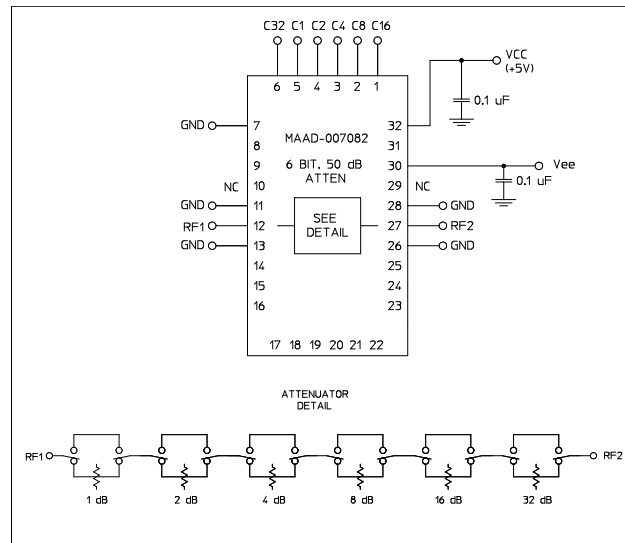
### Ordering Information

Part Number	Package
MAAD-007082-000100	Bulk Packaging
MAAD-007082-0001TR	1000 piece reel
MAAD-007082-0001TB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

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

### Functional Schematic



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

Pin No.	Function	Pin No.	Function
1	C16	17	NC
2	C8	18	NC
3	C4	19	NC
4	C2	20	NC
5	C1	21	NC
6	C32	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

1. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)
2. Pins 10 and 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 - 2.4 GHz	dB	—	5.5	6.0
Attenuation Accuracy	Individual Bits 1-2-4-8-16-32 dB Any Combination of Bits 1 to 50 dB	DC - 2.4 GHz DC - 2.4 GHz	dB dB	— —	— —	$\pm(.3 +5\%$ of atten setting) $\pm(.5 +8\%$ of atten setting)
VSWR	Full Range	DC - 2.4 GHz	Ratio	—	1.8:1	2:1
Switching Speed	50% Cntl to 90%/10% RF 10% to 90% or 90% to 10%	— —	ns ns	— —	75 20	150 50
1 dB Compression	— —	50 MHz 0.5 - 2.40 GHz	dBm dBm	— —	+21 +24	— —
Input $IP_3$	Two-tone inputs up to +5 dBm	50 MHz 0.5-2.4 GHz	dB dB	— —	+35 +48	— —
+V <sub>CC</sub> -V <sub>EE</sub>	— —	— —	V V	4.75 -8.0	5.0 -5.0	5.25 -4.75
Logic "0"	Sink Current is 20 $\mu\text{A}$ max.	—	V	0.0	—	0.8
Logic "1"	Source Current is 20 $\mu\text{A}$ max.	—	V	2.0	—	5.0
V <sub>IL</sub> V <sub>IH</sub>	LOW-level input voltage HIGH-level input voltage	— —	V V	0.0 2.0	— —	0.8 5.0
I <sub>in</sub> (Input Leakage Current)	V <sub>in</sub> = V <sub>CC</sub> or GND	—	$\mu\text{A}$	-1.0	—	1.0
I <sub>CC</sub> (Quiescent Supply Current)	V <sub>cntrl</sub> = V <sub>CC</sub> or GND	—	$\mu\text{A}$	—	250	400
$\Delta I_{CC}^3$ (Additional Supply Current Per TTL Input Pin)	V <sub>CC</sub> = Max, V <sub>cntrl</sub> = V <sub>CC</sub> - 2.1 V	—	mA	—	—	1.0
I <sub>EE</sub>	V <sub>EE</sub> min to max, V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub>	—	mA	-1.0	-0.2	—
Thermal Resistance $\theta_{jc}$	—	—	$^\circ\text{C/W}$	—	15	—

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

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 2.4 GHz	+27 dBm +34 dBm
V <sub>CC</sub>	-0.5V $\leq$ V <sub>CC</sub> $\leq$ +7.0V
V <sub>EE</sub>	-8.5V $\leq$ V <sub>EE</sub> $\leq$ +0.5V
V <sub>CC</sub> - V <sub>EE</sub>	-0.5V $\leq$ V <sub>CC</sub> - V <sub>EE</sub> $\leq$ 14.5V
V <sub>in</sub> <sup>5</sup>	-0.5V $\leq$ V <sub>in</sub> $\leq$ V <sub>CC</sub> + 0.5V
Operating Temperature	-40 $^\circ\text{C}$ to +85 $^\circ\text{C}$
Storage Temperature	-65 $^\circ\text{C}$ to +125 $^\circ\text{C}$

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM 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.

### Truth Table

C32	C16	C8	C4	C2	C1	Attenuation
0	0	0	0	0	0	Loss, Reference
0	0	0	0	0	1	1.0 dB
0	0	0	0	1	0	2.0 dB
0	0	0	1	0	0	4.0 dB
0	0	1	0	0	0	8.0 dB
0	1	0	0	0	0	16.0 dB
1	0	0	0	0	0	32.0 dB
1	1	0	0	1	0	50.0 dB

0 = TTL Low; 1 = TTL High

## Handling Procedures

Please observe the following precautions to avoid damage:

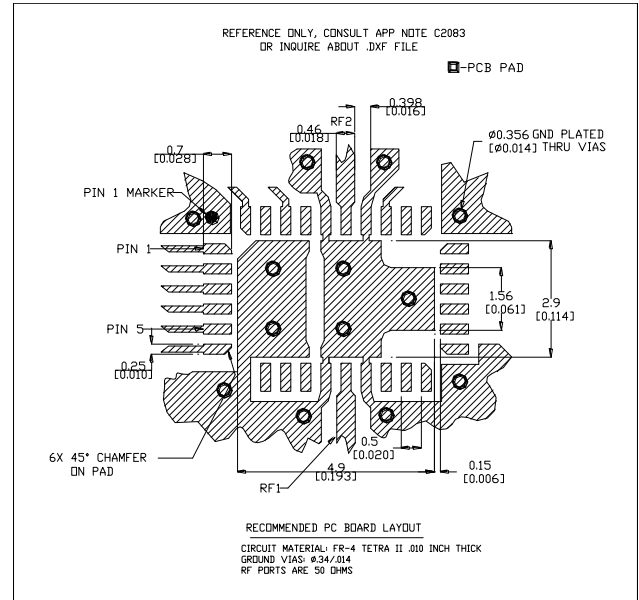
## Static Sensitivity

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.

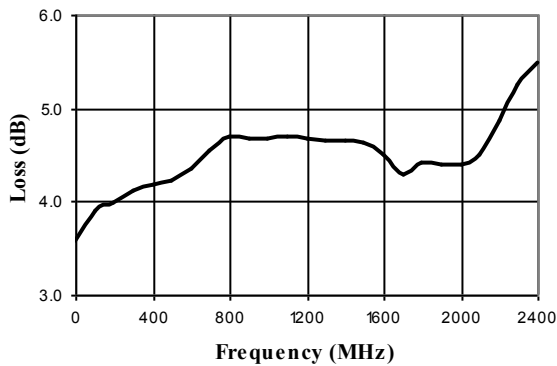
## Recommended PCB Configuration<sup>6</sup>



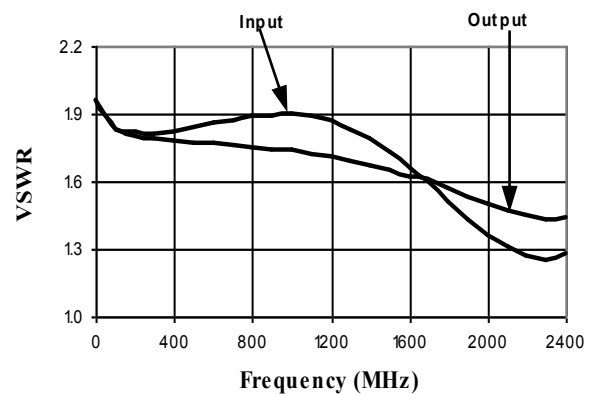
6. Application Note C2083 is available at [www.macom.com](http://www.macom.com)

## Typical Performance Curves

### Insertion Loss

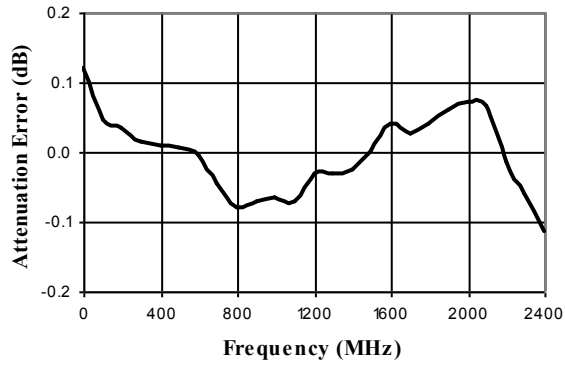


### VSWR @ Insertion Loss

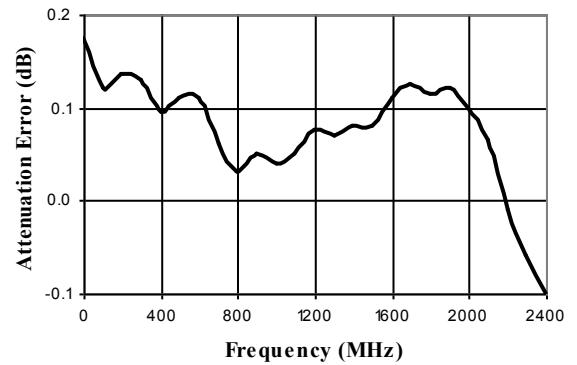


## Typical Performance Curves

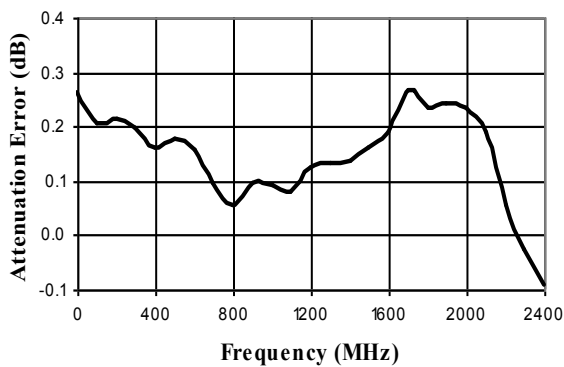
**Attenuation Error, 1 dB Bit**



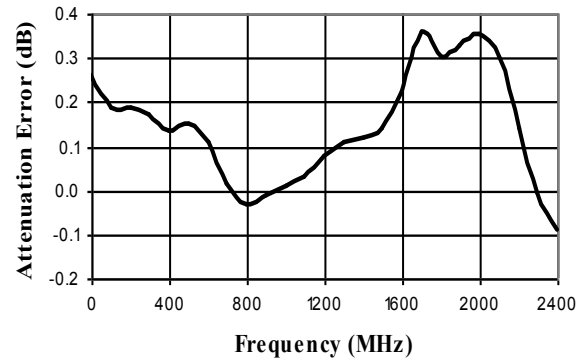
**Attenuation Error, 2 dB Bit**



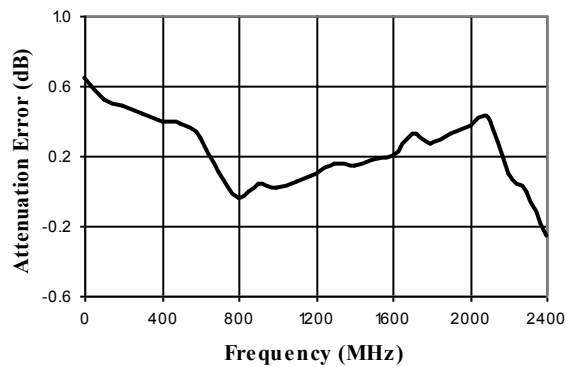
**Attenuation Error, 4 dB Bit**



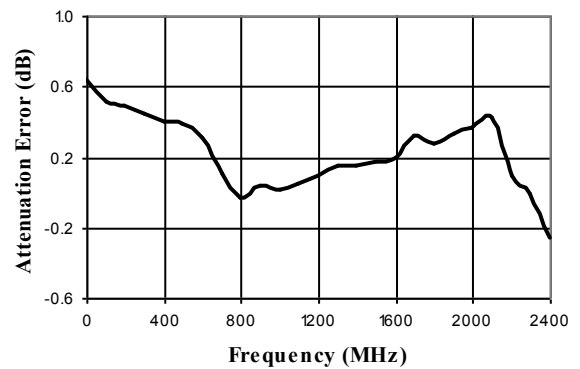
**Attenuation Error, 8 dB Bit**



**Attenuation Error, 16 dB Bit**

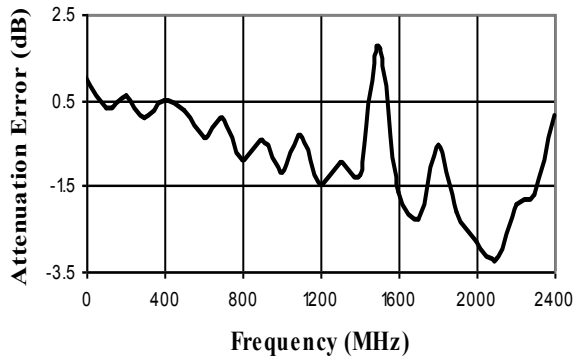


**Attenuation Error, 32 dB Bit**

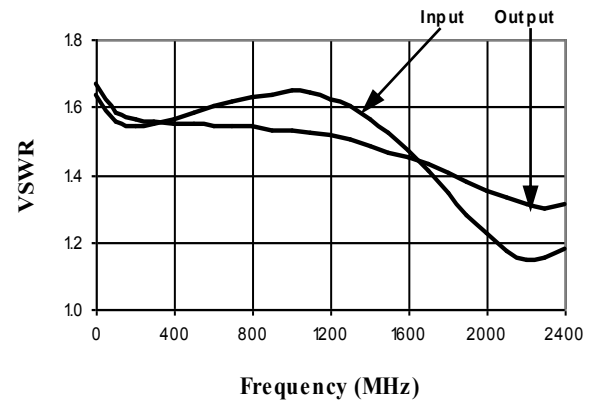


## Typical Performance Curves

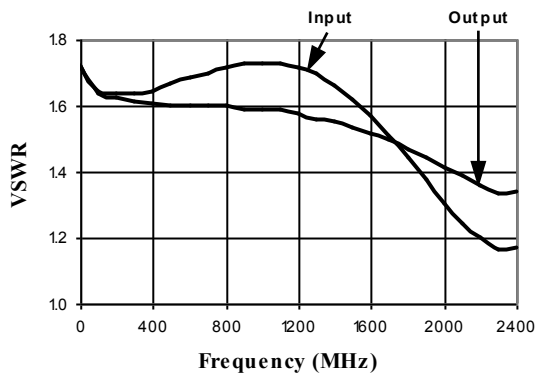
**Attenuation Error, Max. Attenuation**



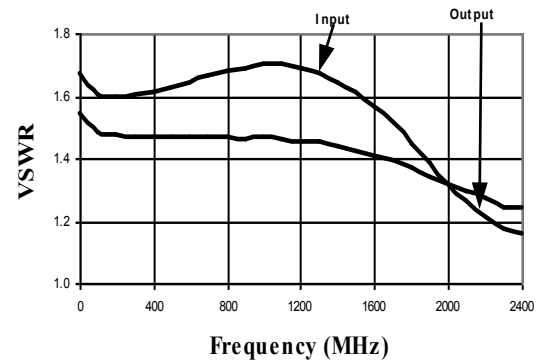
**VSWR, 1 dB Bit**



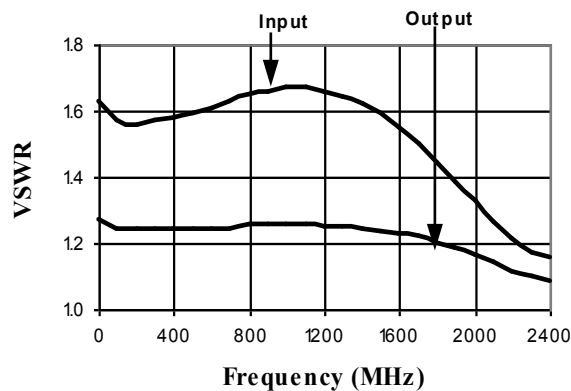
**VSWR, 2 dB Bit**



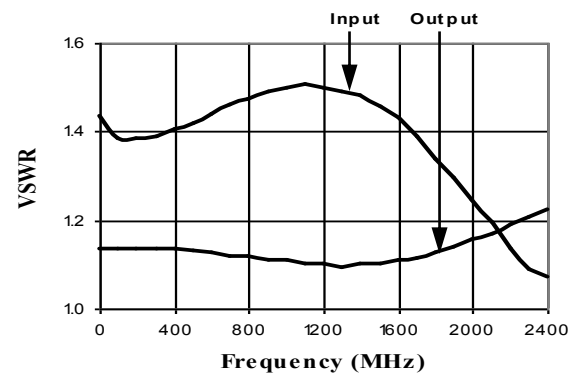
**VSWR, 4 dB Bit**



**VSWR, 8 dB Bit**

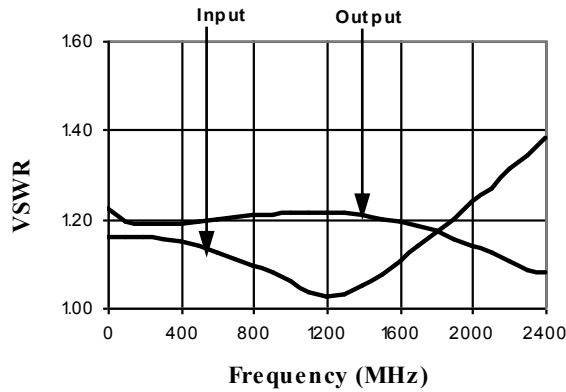


**VSWR, 16 dB Bit**

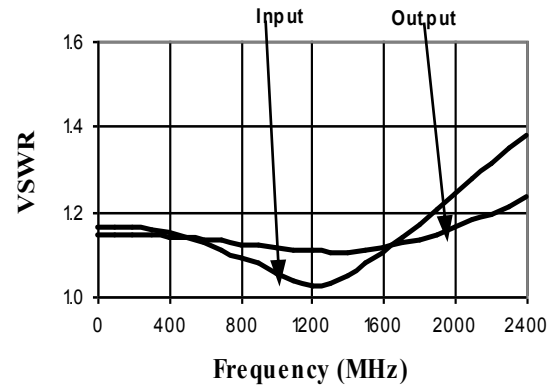


## Typical Performance Curves

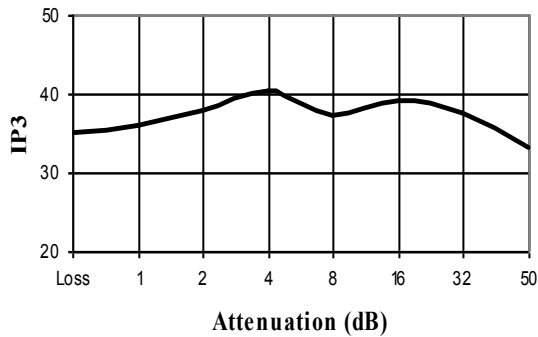
**VSWR, 32 dB Bit**



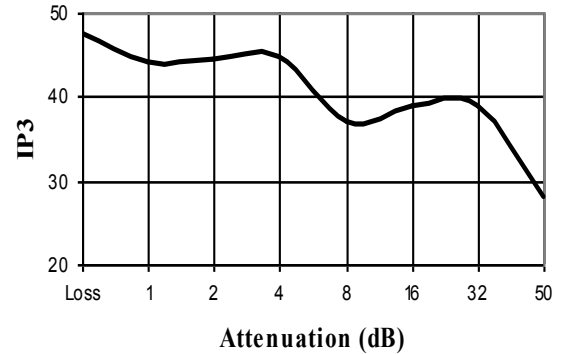
**VSWR, Maximum Attenuation**



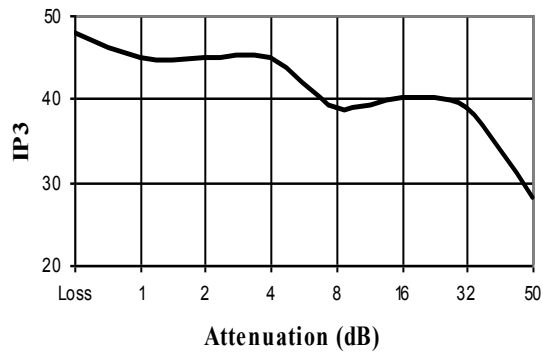
**Maximum IP3 over Temperature Range and Attenuation @ 50 MHz**



**Maximum IP3 over Temperature Range and Attenuation @ 950 MHz**



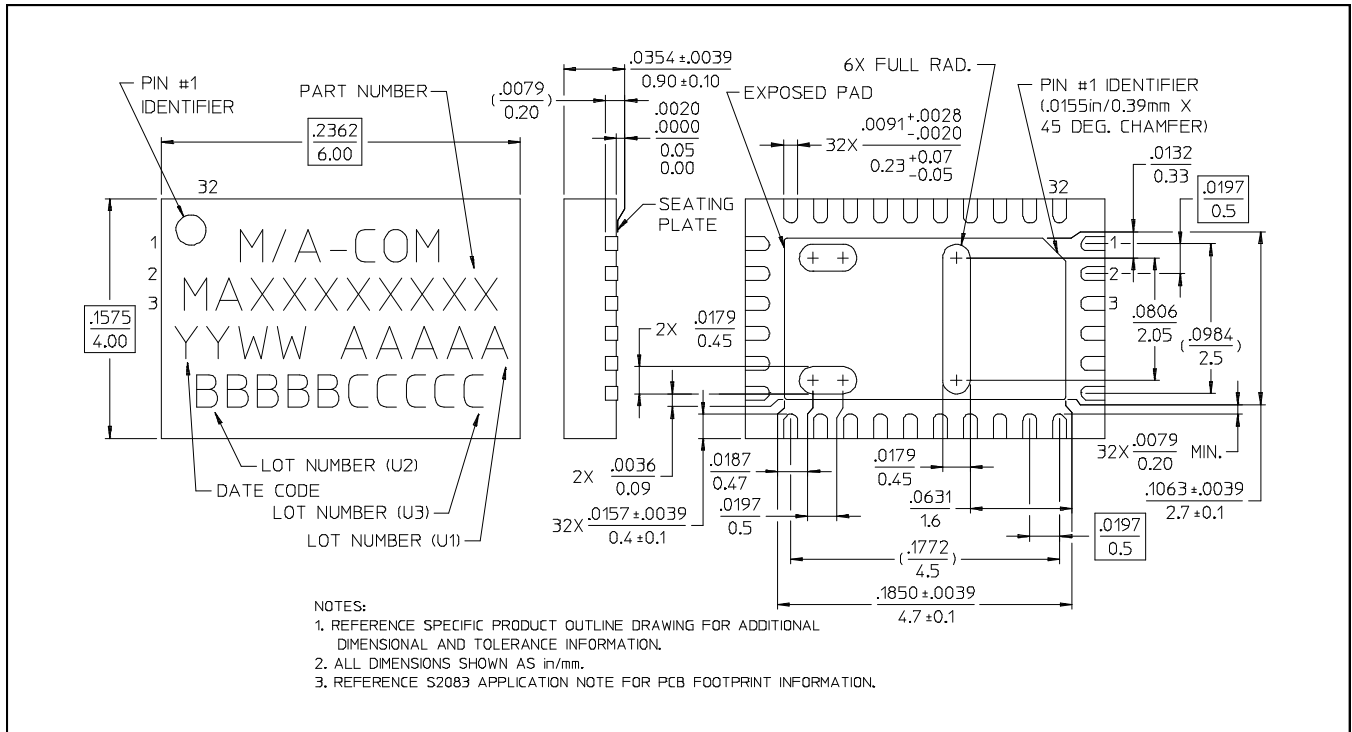
**Maximum IP3 over Temperature Range and Attenuation @ 1900 MHz**



**Digital Attenuator**  
**50 dB, 6-Bit, TTL Driver, DC - 2.4 GHz**

Rev. V5

**CSP-1, Lead-Free 4 x 6 mm, 32-lead PQFN†**



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

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