

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

**MAAD-007081-000100  
V2**

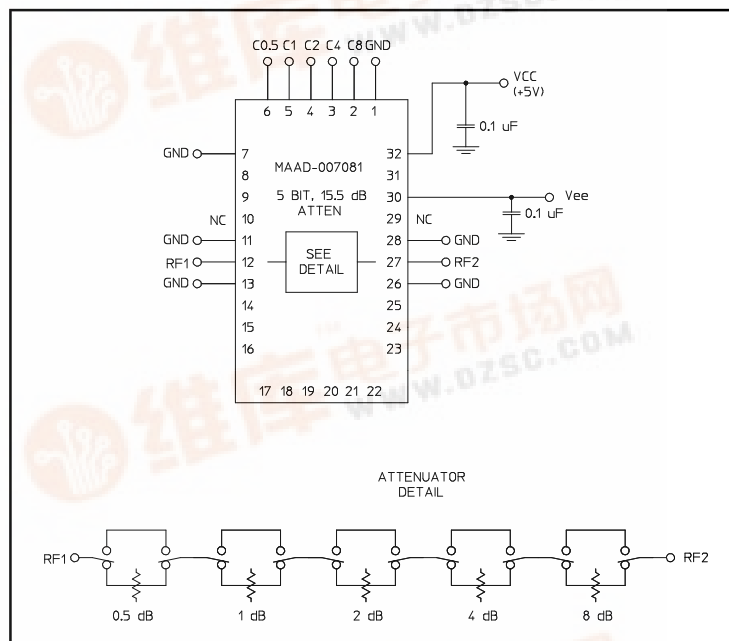
**Features**

- 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**



**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.

Note: Die quantity varies.

**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

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

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

\* 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
Insertion Loss	—	DC - 3.5 GHz	dB	—	2.8	3.2
Attenuation Accuracy	Individual Bits 0.5-1-4-8 dB Individual Bit 2 dB Any Combination of Bits 1 to 15.5 dB	DC - 3.5 GHz	dB	—	—	$\pm(.3 + 5\%$ of atten setting)
		DC - 3.5 GHz	dB	—	—	$\pm(.4 + 10\%$ of atten setting)
		DC - 3.5 GHz	dB	—	—	$\pm(.5 + 7\%$ 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 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 <sub>cc</sub>	—	—	V	4.75	5.0	5.25
V <sub>ee</sub>	—	—	V	-8.0	-5.0	-4.75
V <sub>IL</sub> V <sub>IH</sub>	LOW-level input voltage HIGH-level input voltage	—	V	0.0	—	0.8
		—	V	2.0	—	5.0
I <sub>in</sub> (Input Leakage Current)	V <sub>in</sub> = V <sub>cc</sub> or GND	—	uA	-1.0	—	1.0
I <sub>cc</sub> (Quiescent Supply Current)	V <sub>cntrl</sub> = V <sub>cc</sub> or GND	—	uA	—	250	400
$\Delta I_{cc}$ (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 $\theta_{jc}$	—	—	°C/W	—	15	—

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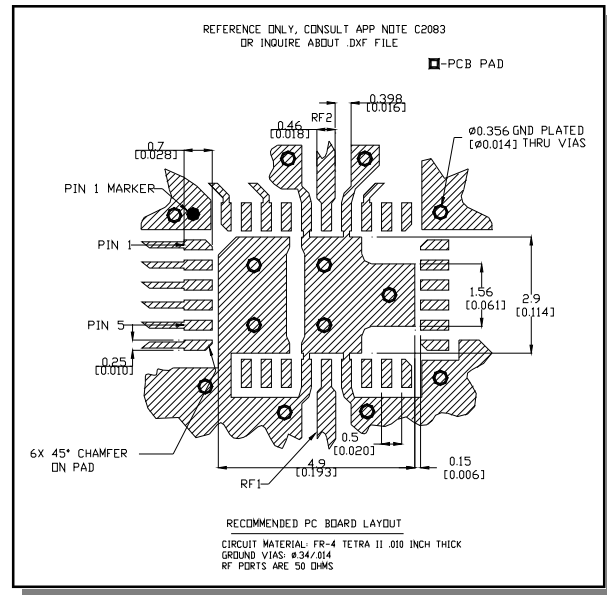
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**Absolute Maximum Ratings <sup>3,4</sup>**

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 3.5 GHz	+27 dBm +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°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.
- 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.

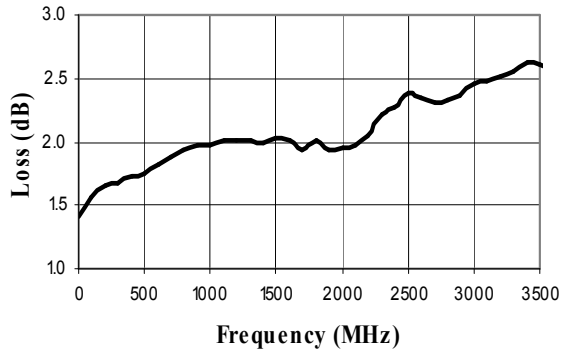
**Truth Table (Digital Attenuator)**

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

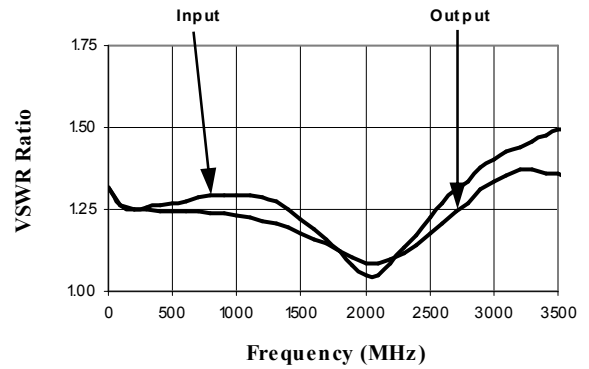
0 = TTL Low; 1 = TTL High

**Typical Performance Curves**

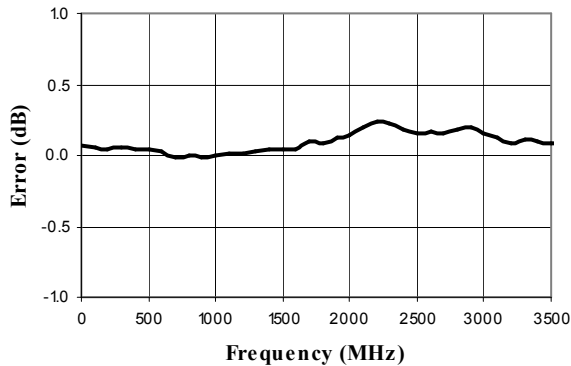
*Insertion Loss*



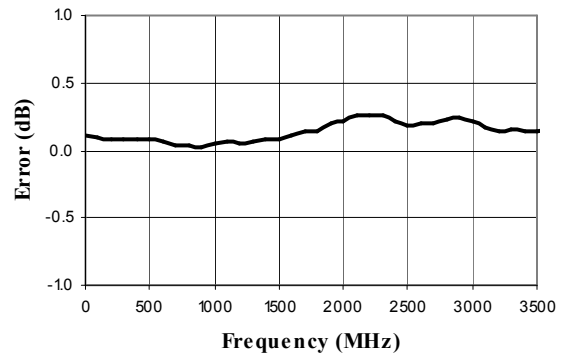
*VSWR @ Insertion Loss*



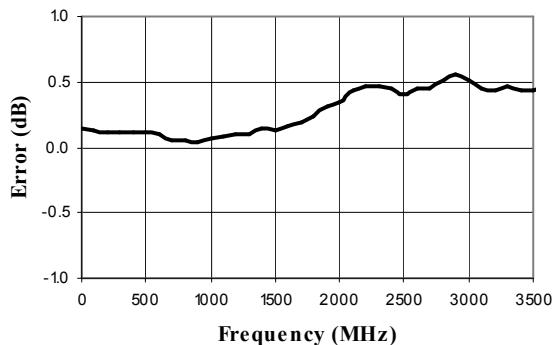
*Attenuation Error, 0.5 dB Bit*



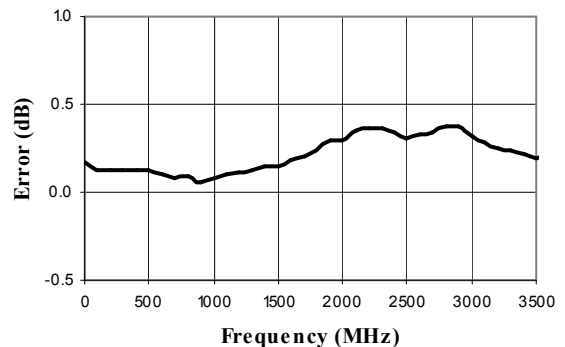
*Attenuation Error, 1 dB Bit*



*Attenuation Error, 2 dB Bit*

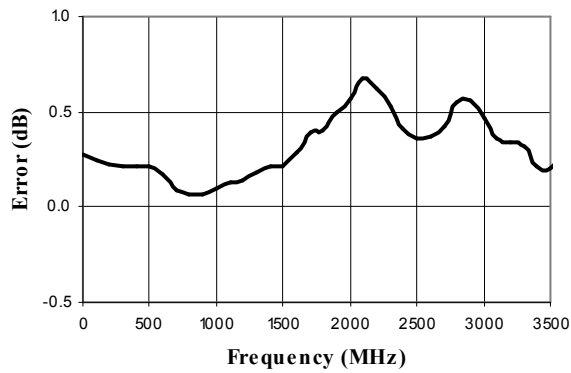


*Attenuation Error, 4 dB Bit*

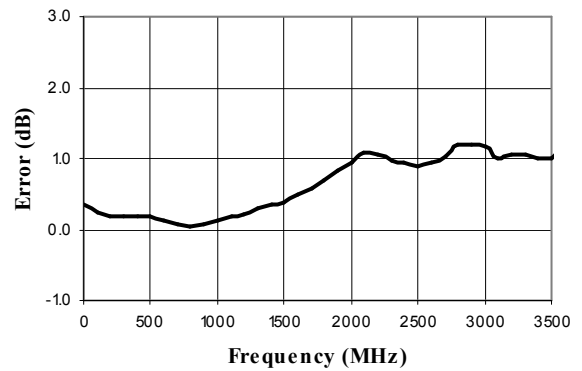


**Typical Performance Curves**

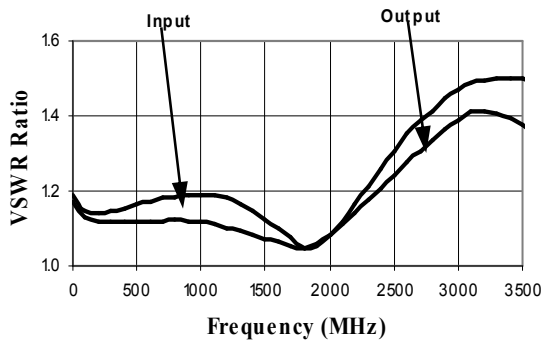
*Attenuation Error, 8 dB Bit*



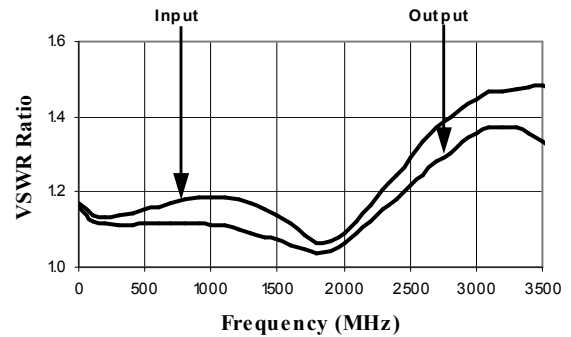
*Attenuation Error, Max. Attenuation*



*VSWR, 0.5 dB Bit*

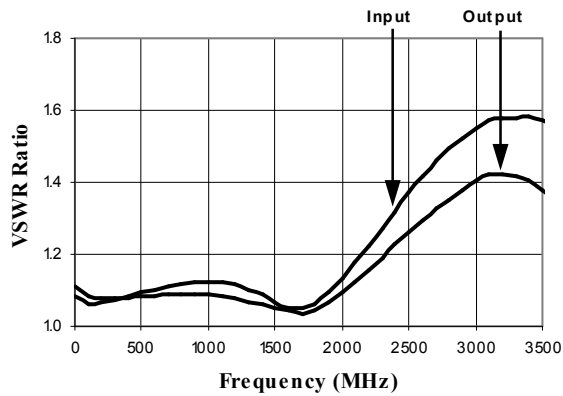


*VSWR, 1 dB Bit*

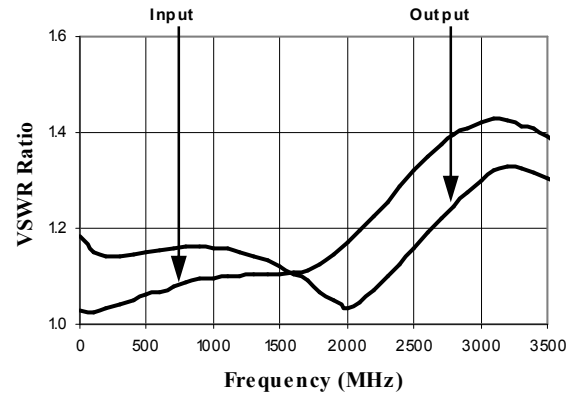


**Typical Performance Curves**

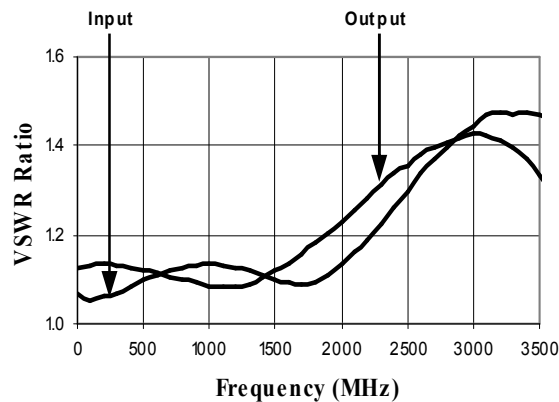
**VSWR, 2 dB Bit**



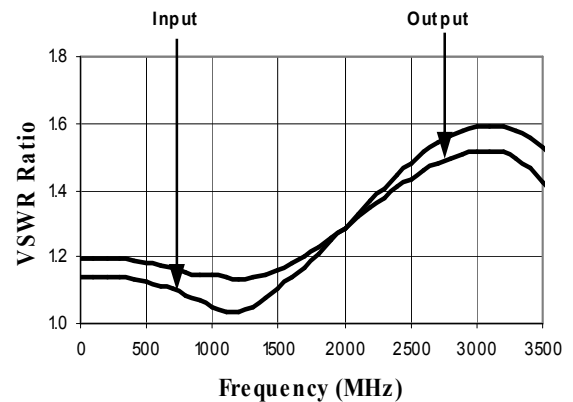
**VSWR, 4 dB Bit**



**VSWR, 8 dB Bit**



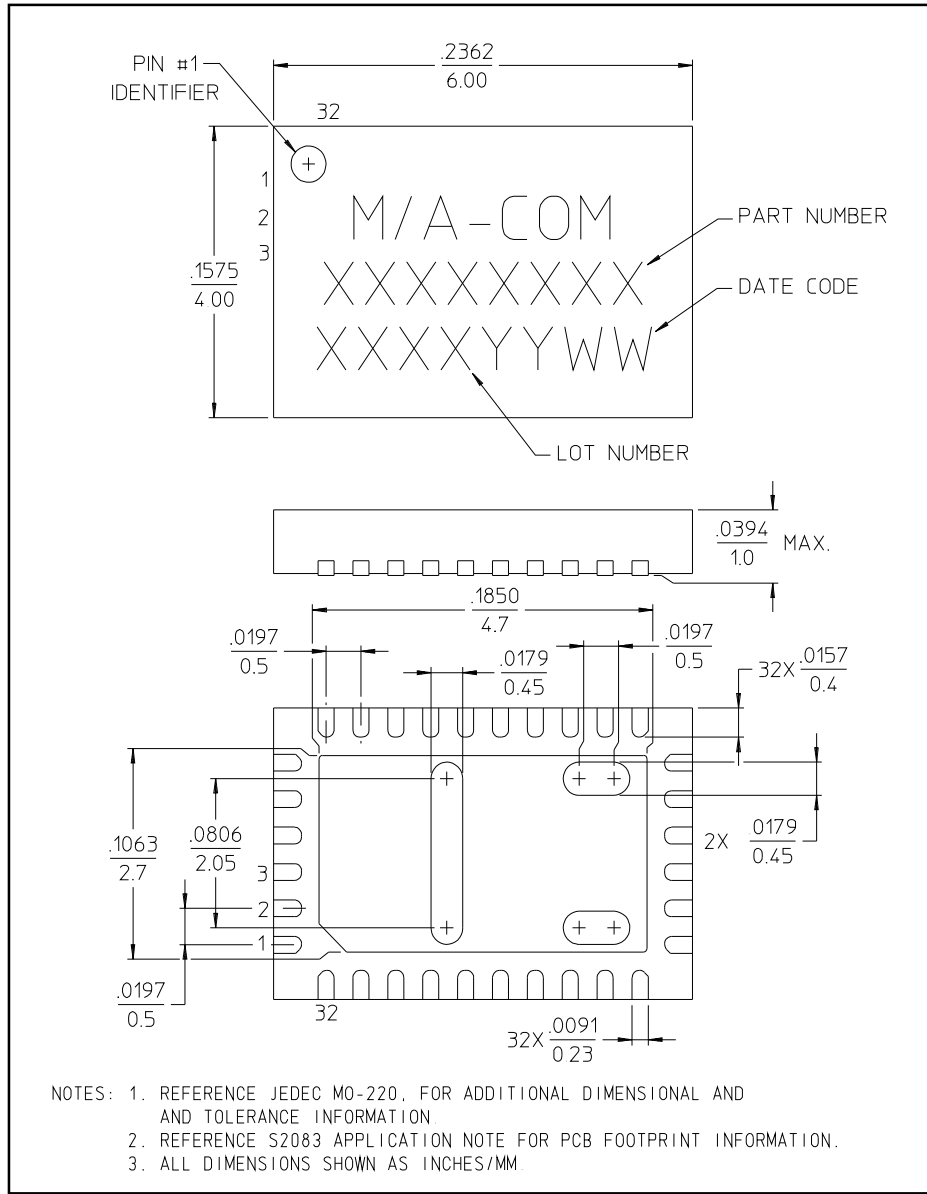
**VSWR, Maximum Attenuation**



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



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