

Rev. V4

#### **Features**

- Attenuation: 1 dB Steps to 50 dB
- Low DC Power Consumption
- Integral TTL Driver
- 50 ohm Impedance
- Test Boards are Available
- Tape and Reel Packaging Available
- Lead-Free SOW-24 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free "Green" Mold Compound
- 260°C Reflow Compatible
- RoHS\* Compliant Version of AT65-0106

#### **Description**

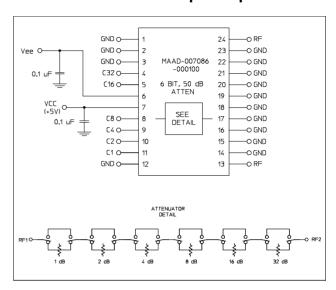
MACOM's MAAD-007086-000100 is a GaAs FET 6-bit digital attenuator with a 1 dB minimum step size and a 50 dB total attenuation range. This device is in a SOW-24, wide body plastic surface mount package. The MAAD-007086-000100 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

## **Ordering Information**

| Part Number        | Package           |  |  |  |
|--------------------|-------------------|--|--|--|
| MAAD-007086-000100 | Bulk Packaging    |  |  |  |
| MAAD-007086-0001TR | 1000 piece reel   |  |  |  |
| MAAD-007086-0001TB | Sample Test Board |  |  |  |

Note: Reference Application Note M513 for reel size information.

### **Schematic with Off-Chip Components**



## **Pin Configuration**

| Pin No. | Function        | Function |     |
|---------|-----------------|----------|-----|
| 1       | GND             | 13       | RF  |
| 2       | GND             | 14       | GND |
| 3       | GND             | 15       | GND |
| 4       | C32             | 16       | GND |
| 5       | C16             | 17       | GND |
| 6       | V <sub>EE</sub> | 18       | GND |
| 7       | V <sub>CC</sub> | 19       | GND |
| 8       | C8              | 20       | GND |
| 9       | C4              | 21       | GND |
| 10      | C2              | 22       | GND |
| 11      | C1              | 23       | GND |
| 12      | GND             | 24       | RF  |

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



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

| Parameter  | Test Conditions  | Frequency  | Units                | Min          | Тур         | Мах  |
|--|--|--|----------------------|--------------|-------------|--|
| Insertion Loss   | _  | DC - 2.0 GHz   | dB                   | _            | 4.2         | 4.7  |
| Attenuation Accuracy                                     | Individual Bits 1-2-4-8-16-32 dB<br>Any Combination of Bits 3 to 15 dB<br>Any Combination of Bits 17 to 31 dB<br>Any Combination of Bits 32 to 50 dB | DC - 2.0 GHz<br>DC - 2.0 GHz<br>DC - 2.0 GHz<br>DC - 2.0 GHz | dB<br>dB<br>dB<br>dB |              |             | ±(.3 +3% of atten setting)<br>±(.5 +5% of atten setting)<br>±(.3 +3% of atten setting)<br>±(.5 +7% of atten setting) |
| VSWR   | Full Range   | DC - 2.0 GHz   | Ratio                | _            | 1.8:1       | 2:1  |
| Switching Speed <sup>1</sup>                             | 50% Cntl to 90%/10% RF — ns — n  |  |                      |              | 75<br>20    | 150<br>50  |
| 1 dB Compression   | <u> </u>   | 50 MHz<br>0.5 - 2.0 GHz                                      | dBm<br>dBm           | _            | +21<br>+24  | _  |
| Input IP <sub>3</sub>                                    | Two-tone inputs up to +5 dBm<br>@ 0 dB Attenuation   | 50 MHz<br>0.5-2.0 GHz  | dB<br>dB             | _            | +35<br>+48  | _  |
| Vcc<br>Vee   | <u> </u>   |  | < <                  | 4.75<br>-8.0 | 5.0<br>-5.0 | 5.25<br>-4.75  |
| V <sub>IL</sub><br>V <sub>IH</sub>                       | LOW-level input voltage<br>HIGH-level input voltage  | _ V 0.0<br>_ V 2.0   |                      |              | _           | 0.8<br>5.0   |
| lin (Input Leakage Current)                              | Vin = V <sub>CC</sub> or GND   | D — uA -1.0 —  |                      | 1.0          |             |  |
| Icc<br>(Quiescent Supply Current)                        | 100 01 011   |  | uA                   | _            | 250         | 400  |
| Δlcc<br>(Additional Supply Current<br>Per TTL Input Pin) | V <sub>CC</sub> = Max, Vcntrl = V <sub>CC</sub> - 2.1 V  | _  | mA                   | _            | _           | 1.0  |
| lee  | VEE min to max, Vin = V <sub>IL</sub> or V <sub>IH</sub>   | _  | mA                   | -1.0         | -0.2        | _  |
| Thermal Resistance θ <sub>JA</sub>                       | PCB mount on FR4 material, copper trace, still air at +25°C  | _  | °C/W                 | _            | 60-80       | _  |

<sup>1.</sup> Decoupling capacitors (.01µF) are required on power supply lines.

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

| Parameter                                     | Absolute Maximum                      |  |  |
|---|---------------------------------------|--|--|
| Max. Input Power<br>0.05 GHz<br>0.5 - 2.0 GHz | +27 dBm<br>+34 dBm                    |  |  |
| V <sub>CC</sub>                               | -0.5V ≤ V <sub>CC</sub> ≤ +7.0V       |  |  |
| V <sub>EE</sub>                               | -8.5V ≤ V <sub>EE</sub> ≤ +0.5V       |  |  |
| V <sub>CC</sub> - V <sub>EE</sub>             | $-0.5V \le V_{CC} - V_{EE} \le 14.5V$ |  |  |
| Vin <sup>4</sup>                              | -0.5V ≤ Vin ≤ V <sub>CC</sub> + 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.
- 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.

## 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.



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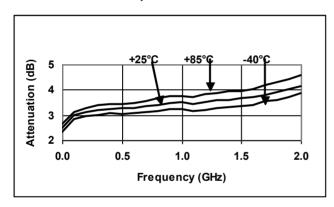
## **Truth Table (Digital Attenuator)**

| C32 | C16 | C8 | C4 | C2 | C1 | Attenuation     |
|-----|-----|----|----|----|----|-----------------|
| 0   | 0   | 0  | 0  | 0  | 0  | Loss, Reference |
| 0   | 0   | 0  | 0  | 0  | 1  | 1 dB            |
| 0   | 0   | 0  | 0  | 1  | 0  | 2 dB            |
| 0   | 0   | 0  | 1  | 0  | 0  | 4 dB            |
| 0   | 0   | 1  | 0  | 0  | 0  | 8 dB            |
| 0   | 1   | 0  | 0  | 0  | 0  | 16 dB           |
| 1   | 0   | 0  | 0  | 0  | 0  | 32 dB           |
| 1   | 1   | 0  | 0  | 1  | 0  | 50 dB           |

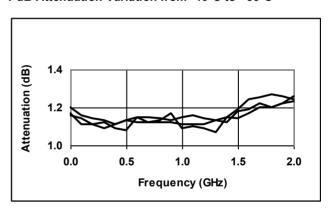
<sup>0 =</sup> TTL Low; 1 = TTL High

## **Typical Performance Curves**

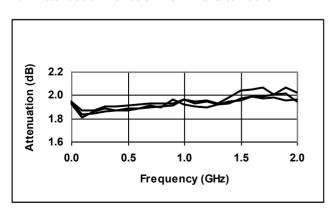
#### Insertion Loss vs. Temperature



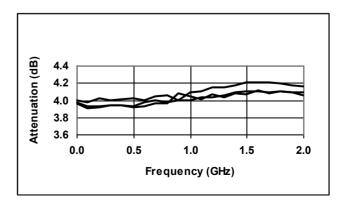
#### 1 dB Attenuation Variation from -40°C to +85°C



#### 2 dB Attenuation Variation from -40°C to +85°C



#### 4 dB Attenuation Variation from -40°C to +85°C

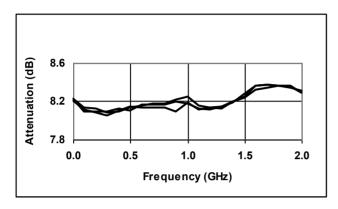




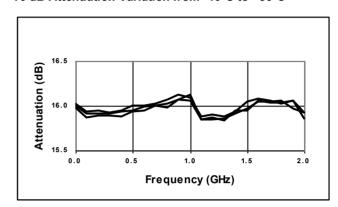
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## **Typical Performance Curves**

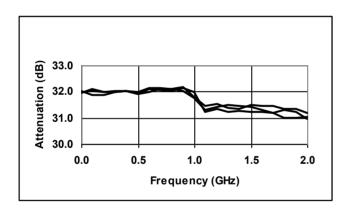
#### 8 dB Attenuation Variation from -40°C to +85°C



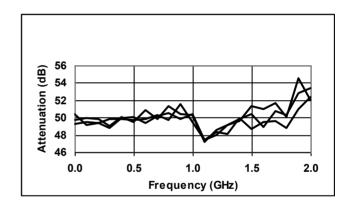
#### 16 dB Attenuation Variation from -40°C to +85°C



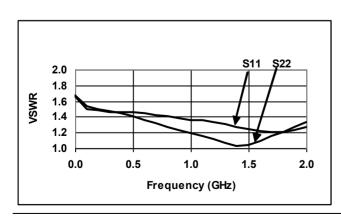
32 dB Attenuation Variation from -40°C to +85°C



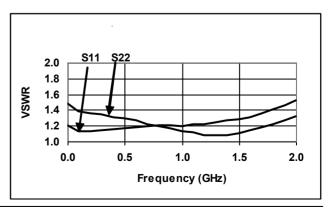
Max. Attenuation Variation from -40°C to +85°C



Reference Loss VSWR (S11, S22)



1 dB VSWR (S11, S22)



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# **MAAD-007086**

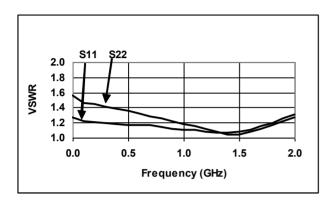


Digital Attenuator 50 dB, 6-Bit, TTL Driver, DC - 2.0 GHz

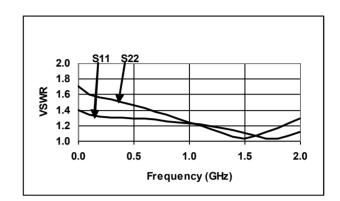
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## **Typical Performance Curves**

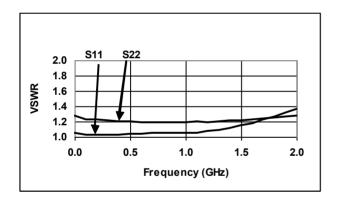
2 dB VSWR (S11, S22)



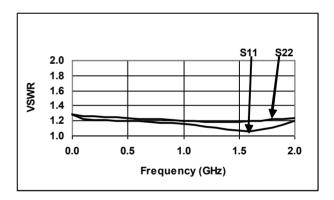
#### 4 dB VSWR (S11, S22)



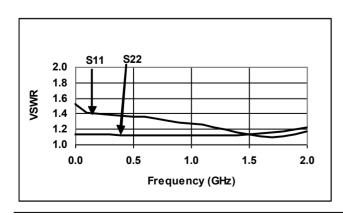
8 dB VSWR (S11, S22)



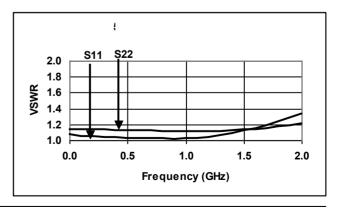
16 dB VSWR (S11, S22)



32 dB VSWR (S11, S22)



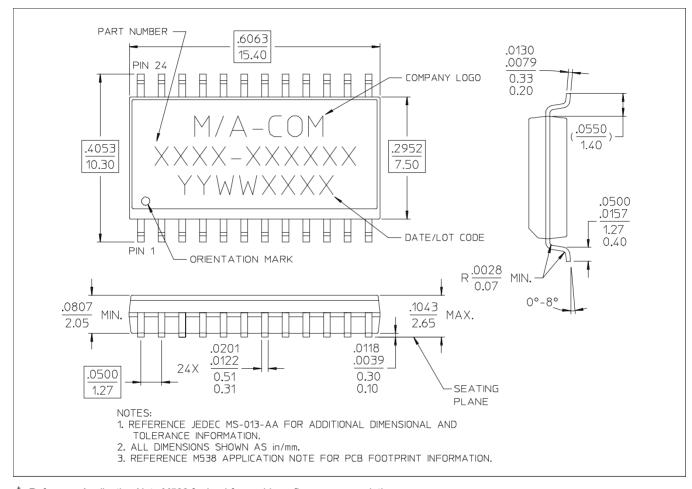
50 dB VSWR (S11, S22)





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## Lead-Free, SOW-24<sup>†</sup>



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

## MAAD-007086



Digital Attenuator 50 dB, 6-Bit, TTL Driver, DC - 2.0 GHz

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