

Digital Attenuator 31.0 dB, 5-Bit, TTL Driver, DC-3.0 GHz

Rev. V5

Features

- Attenuation: 1.0dB Steps to 31dB
- Single Positive Supply
- Contains internal DC to DC converter
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 ohm Impedance
- Lead-Free CSP-1 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of AT90-1263

Description

The MAAD-007078 is a GaAs FET 5-bit digital attenuator with integral TTL driver. Step size is 1.0 dB providing 31 dB total attenuation range. This device is in an FQFP-N plastic surface mount package. The MAAD-007078 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

For dual supply designs without DC-DC converter noise, use MAATCC0010.

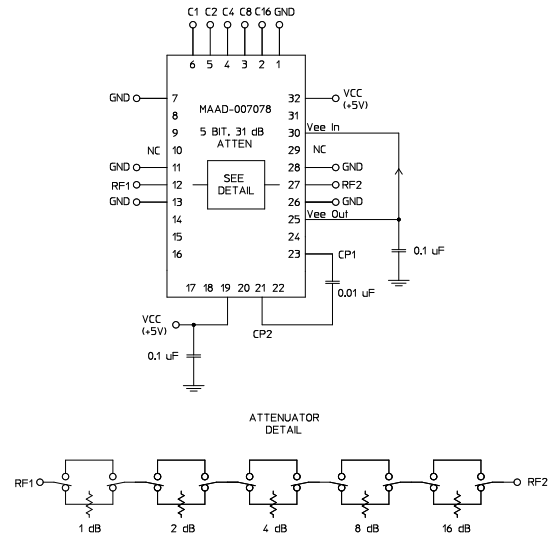
Ordering Information

| Part Number | Package |
|--------------------|-------------------|
| MAAD-007078-000100 | Bulk Packaging |
| MAAD-007078-0001TR | 1000 piece reel |
| MAAD-007078-0001TB | 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

| Pin No. | Function | Pin No. | Function |
|---------|-----------------|---------|------------------|
| 1 | GND | 17 | NC |
| 2 | C16 | 18 | NC |
| 3 | C8 | 19 | Vcc |
| 4 | C4 | 20 | NC |
| 5 | C2 | 21 | CP2 |
| 6 | C1 | 22 | NC |
| 7 | GND | 23 | CP1 |
| 8 | NC | 24 | NC |
| 9 | NC | 25 | Vee ² |
| 10 | NC ¹ | 26 | GND |
| 11 | GND | 27 | RF2 |
| 12 | RF1 | 28 | GND |
| 13 | GND | 29 | NC ¹ |
| 14 | NC | 30 | Vee ² |
| 15 | NC | 31 | NC |
| 16 | NC | 32 | Vcc |

1. Pins 10 & 29 must be isolated
2. The negative voltage Vee is produced internally and requires a 0.1µF cap to GND. Generated noise is typical of switching DC-DC Converters.
3. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)

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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 - 3.0 GHz | dB | — | 3.5 | 3.8 |
| Attenuation Accuracy | Individual Bits 1-2-4-8-16 dB Any Combination of Bits 1 to 31 dB | DC - 3.0 GHz DC - 3.0 GHz | dB | ±(.3 +5% of atten setting) ±(.5 +7% of atten setting) | | |
| VSWR | Full Range | DC - 3.0 GHz | Ratio | — | 2.0:1 | 2.2:1 |
| Switching Speed | 50% Cntl to 90%/10% RF 10% to 90% or 90% to 10% | — | ns | — | 75 20 | 150 50 |
| 1 dB Compression | — | 50 MHz 0.5 - 3.0 GHz | dBm | — | +21 +24 | — |
| Input IP_3 | Two-tone inputs up to +5 dBm | 50 MHz 0.5-3.0 GHz | dB | — | +35 +48 | — |
| V_{CC} | — | — | V | 4.75 | 5.0 | 5.25 |
| V_{IL} V_{IH} | LOW-level input voltage HIGH-level input voltage | — — | V | 0.0 2.0 | — — | 0.8 5.0 |
| I_{in} (Input Leakage Current) | $V_{in} = V_{CC}$ or GND | — | μA | -1.0 | — | 1.0 |
| I_{CC}^4 | V_{CC} min to max, Logic "0" or "1" | — | mA | — | 6 | 10 |
| Turn-on Current ⁵ | For guaranteed start-up | — | mA | — | — | 125 |
| ΔI_{CC} (Additional Supply Current Per TTL Input Pin) | $V_{CC} = \text{Max}$, $V_{ctrl} = V_{CC} - 2.1 \text{ V}$ | — | mA | — | — | 1.0 |
| Switching Noise | Generated from DC-DC Converter with recommended capacitors | 3.5 MHz | dBm | — | -93 | — |
| Thermal Resistance θ_{jc} | — | — | $^\circ\text{C/W}$ | — | 35 | — |

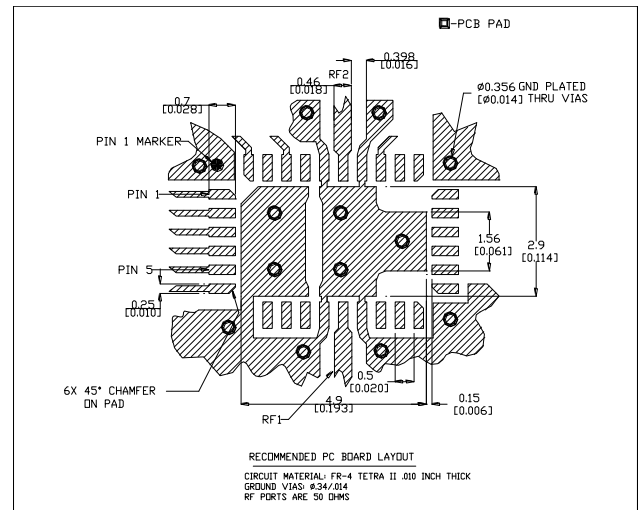
- During turn-on, the device requires an initial start up current (I_{CC}) specified as "Turn-on Current". Once operational, I_{CC} will drop to the specified levels.
- The DC-DC converter is guaranteed to start in 100 μs as long as the power supplies have the maximum turn-on current available for start up.

Absolute Maximum Ratings^{6,7}

| Parameter | Absolute Maximum |
|--|--|
| Input Power 0.05 GHz 0.5 - 3.0 GHz | +27 dBm +34 dBm |
| V_{CC} | $-0.5\text{V} \leq V_{CC} \leq +6.0\text{V}$ |
| V_{in}^8 | $-0.5\text{V} \leq V_{in} \leq V_{CC} + 0.5\text{V}$ |
| Operating Temperature | -40°C to $+85^\circ\text{C}$ |
| Storage Temperature | -65°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.

Recommended PCB Configuration⁹



9. Application Note S2083 is available on line at www.macom.com

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Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

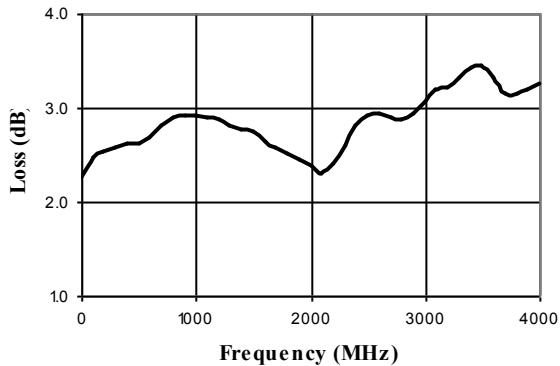
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Moisture Sensitivity

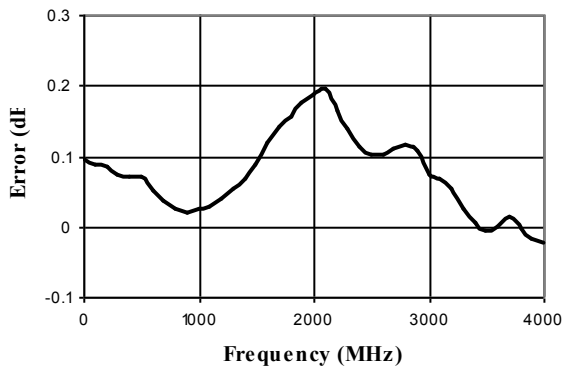
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

Typical Performance Curves

Insertion Loss



Attenuation Error, 1 dB Bit

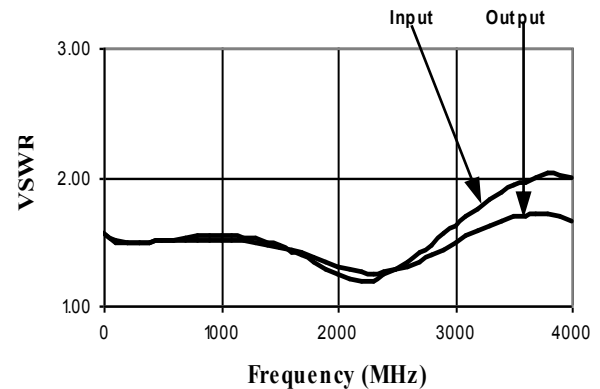


Truth Table (Digital Attenuator)

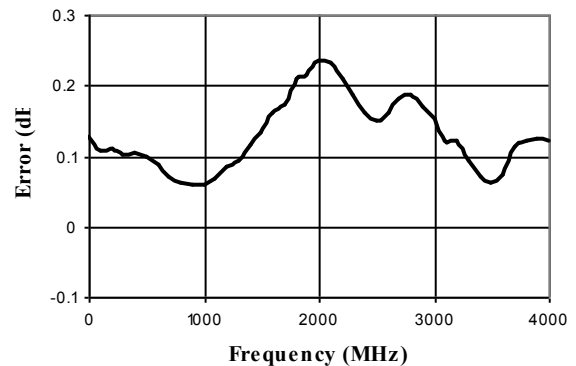
| C16 | C8 | C4 | C2 | C1 | Attenuation |
|-----|----|----|----|----|-----------------|
| 0 | 0 | 0 | 0 | 0 | Loss, Reference |
| 0 | 0 | 0 | 0 | 1 | 1.0 dB |
| 0 | 0 | 0 | 1 | 0 | 2.0 dB |
| 0 | 0 | 1 | 0 | 0 | 4.0 dB |
| 0 | 1 | 0 | 0 | 0 | 8.0 dB |
| 1 | 0 | 0 | 0 | 0 | 16.0 dB |
| 1 | 1 | 1 | 1 | 1 | 31.0 dB |

0 = TTL Low; 1 = TTL High

VSWR @ Insertion Loss

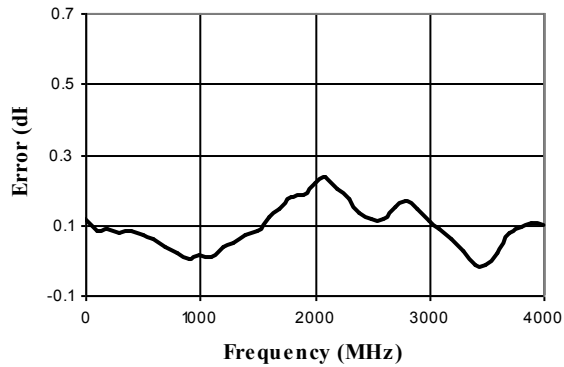


Attenuation Error, 2 dB Bit

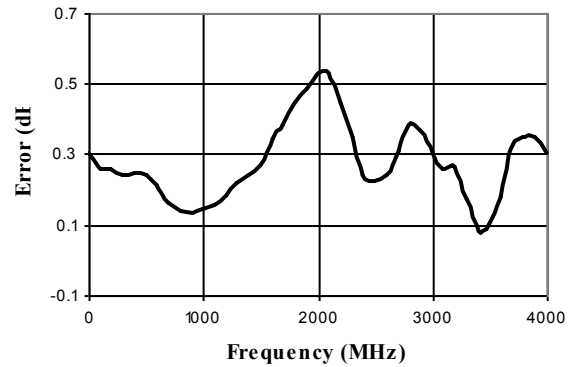


Typical Performance Curves

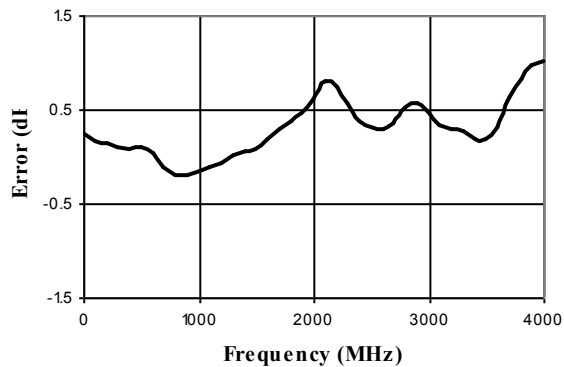
Attenuation Error, 4 dB Bit



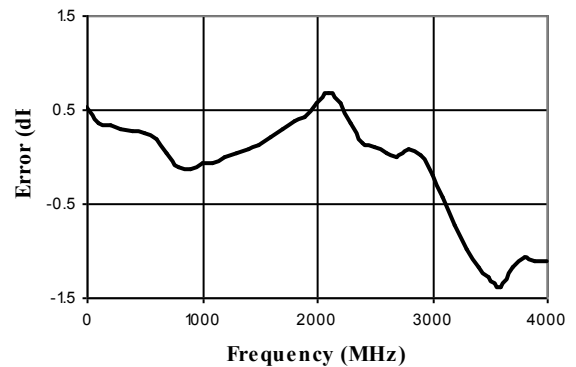
Attenuation Error, 8 dB Bit



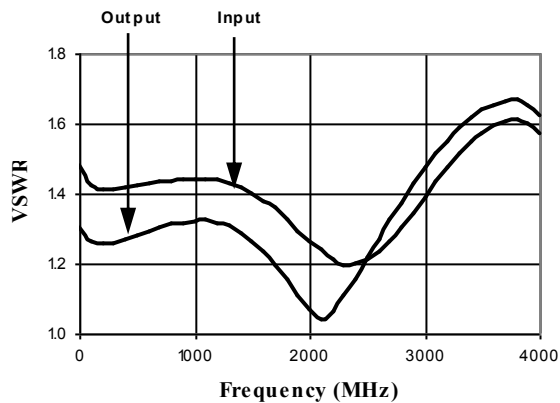
Attenuation Error, 16 dB Bit



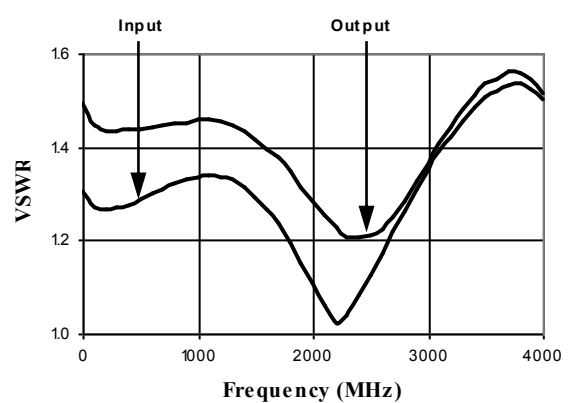
Attenuation Error, Max. Attenuation



VSWR, 1 dB Bit

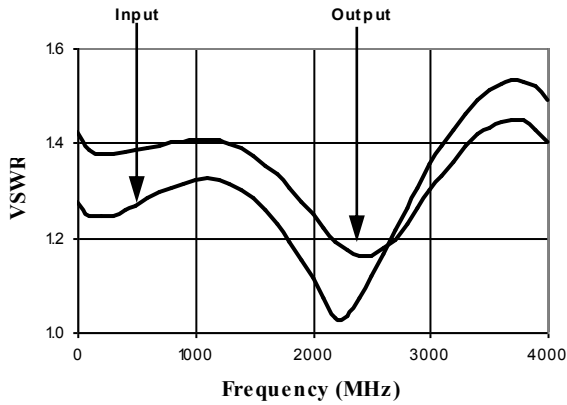


VSWR, 2 dB Bit

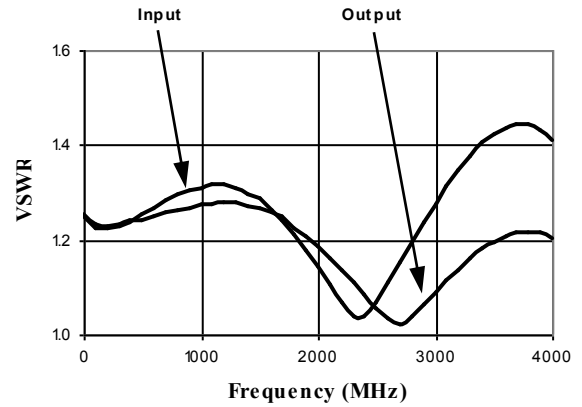


Typical Performance Curves

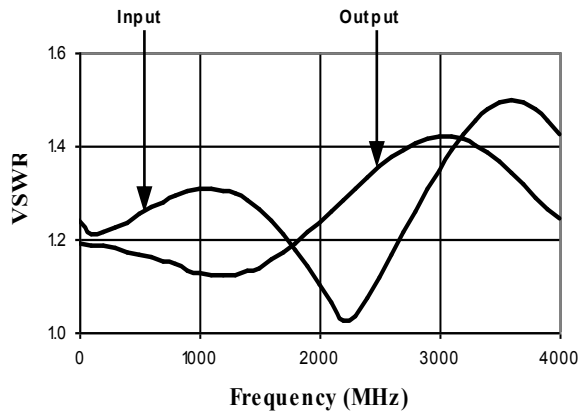
VSWR, 4 dB Bit



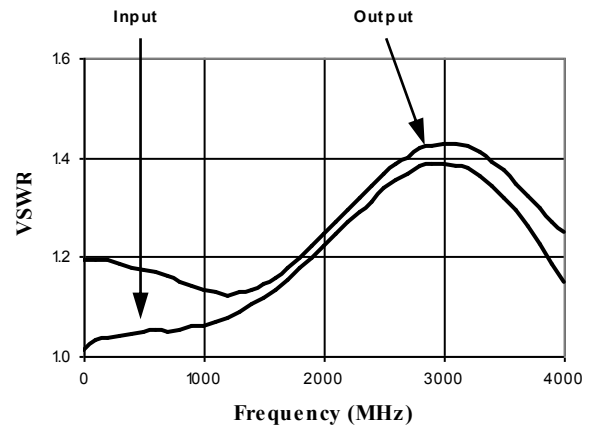
VSWR, 8 dB Bit



VSWR, 16 dB Bit



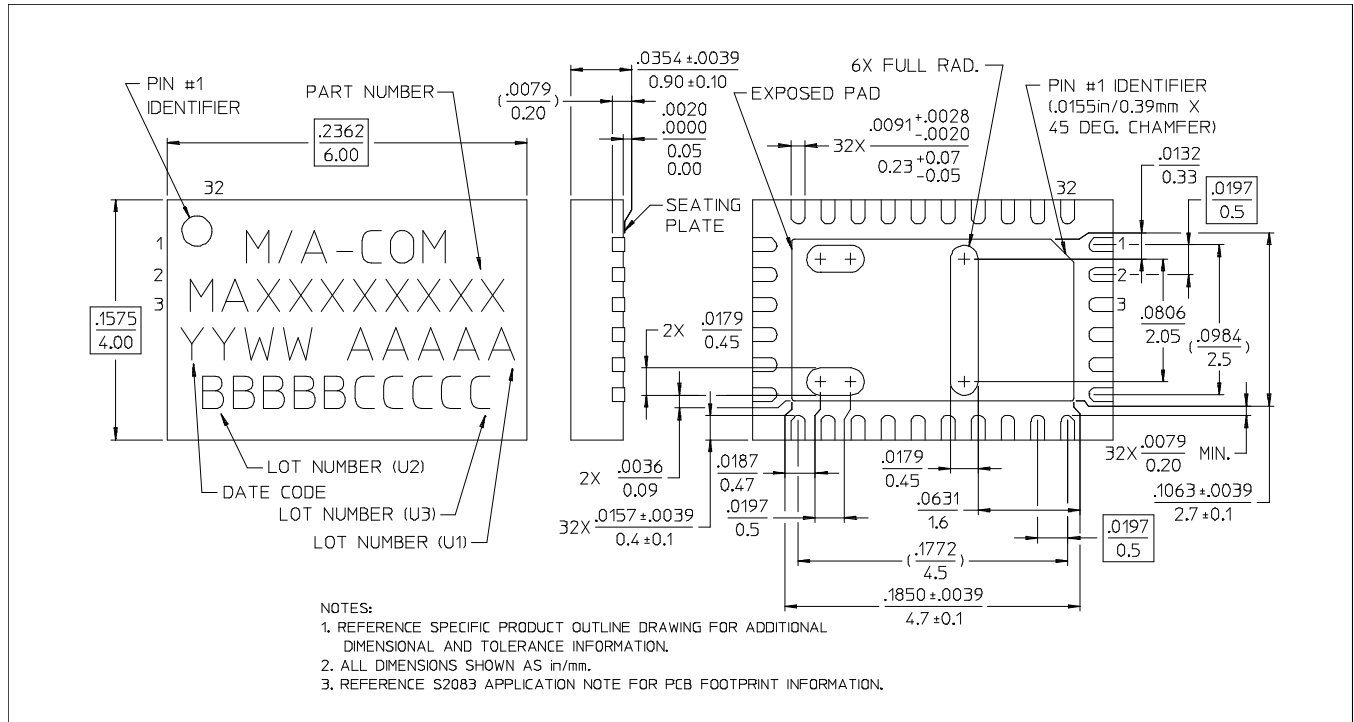
VSWR, Maximum Attenuation



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



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

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