MAAD-007078-000100

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

Rev. V4

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

M/A-COM's MAAD-007078-000100 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-007078-000100 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.

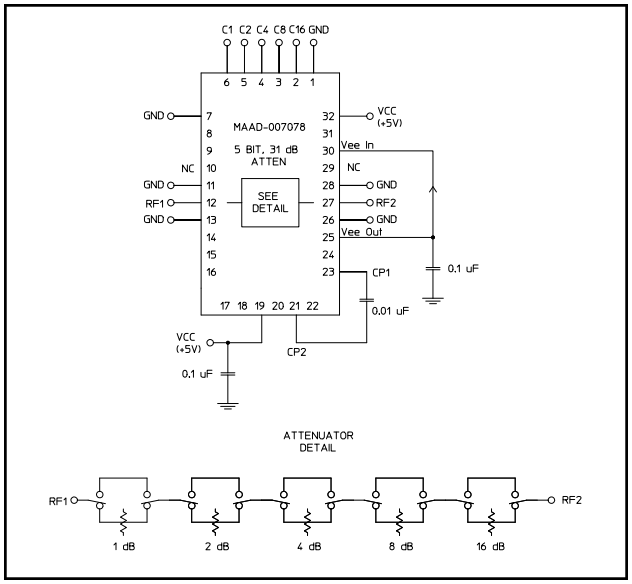
Ordering Information

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°C, Z_0 = 50Ω

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 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 ns	— —	75 20	150 50
1 dB Compression	— —	50 MHz 0.5 - 3.0 GHz	dBm dBm	— —	+21 +24	— —
Input IP_3	Two-tone inputs up to +5 dBm	50 MHz 0.5-3.0 GHz	dB dB	— —	+35 +48	— —
Vcc	—	—	V	4.75	5.0	5.25
V_{IL} V_{IH}	LOW-level input voltage HIGH-level input voltage	— —	V V	0.0 2.0	— —	0.8 5.0
Iin (Input Leakage Current)	Vin = V_{CC} or GND	—	uA	-1.0	—	1.0
Icc[4]	Vcc min to max, Logic “0” or “1”	—	mA	—	6	10
Turn-on Current[5]	For guaranteed start-up	—	mA	—	—	125
ΔIcc (Additional Supply Current Per TTL Input Pin)	V_{CC} = Max, Vcntrl = V_{CC} - 2.1 V	—	mA	—	—	1.0
Switching Noise	Generated from DC-DC Converter with recommended capacitors	3.5 MHz	dBm	—	-93	—
Thermal Resistance θjc	—	—	°C/W	—	35	—

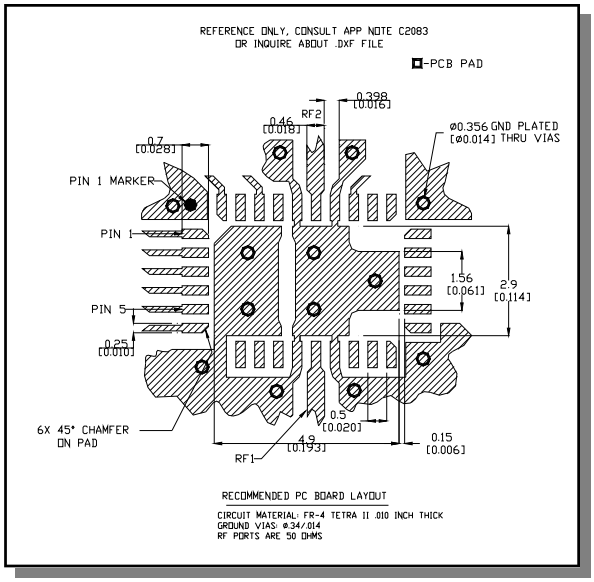
4. During turn-on, the device requires an initial start up current (Icc) specified as “Turn-on Current”. Once operational, Icc will drop to the specified levels.
5. The DC-DC converter is guaranteed to start in 100 µs as long as the power supplies have the maximum turn-on current available for start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

Absolute Maximum Ratings [6,7]

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 3.0 GHz	 +27 dBm +34 dBm
V_{CC}	-0.5V ≤ V_{CC} ≤ +6.0V
Vin[8]	-0.5V ≤ Vin ≤ V_{CC} + 0.5V
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. M/A-COM does not recommend sustained operation near these survivability limits.
8. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

Recommended PCB Configuration [9]



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.

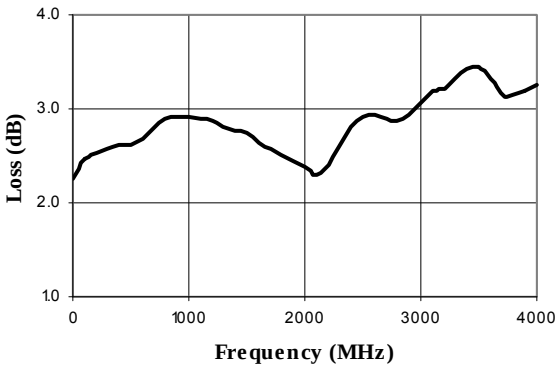
Truth Table (Digital Attenuator)

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

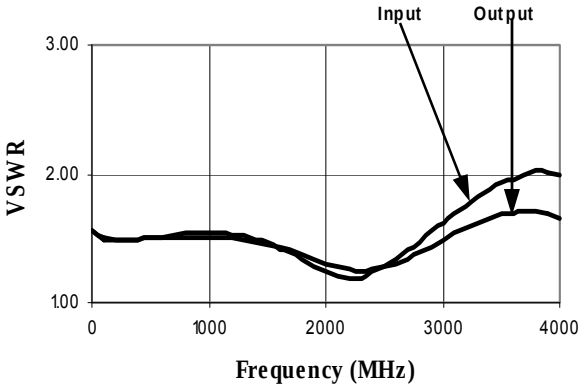
0 = TTL Low; 1 = TTL High

Typical Performance Curves

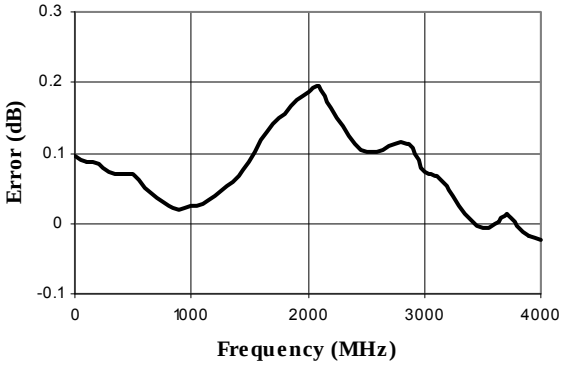
Insertion Loss



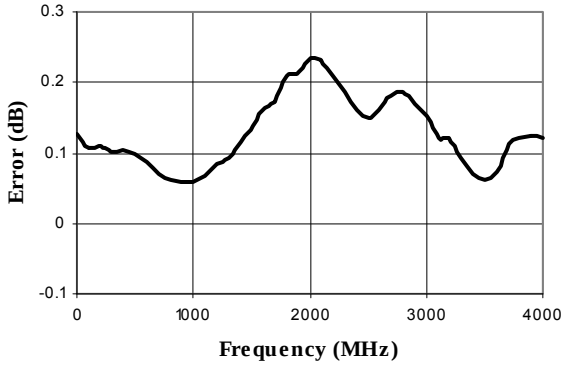
VSWR @ Insertion Loss



Attenuation Error, 1 dB Bit



Attenuation Error, 2 dB Bit



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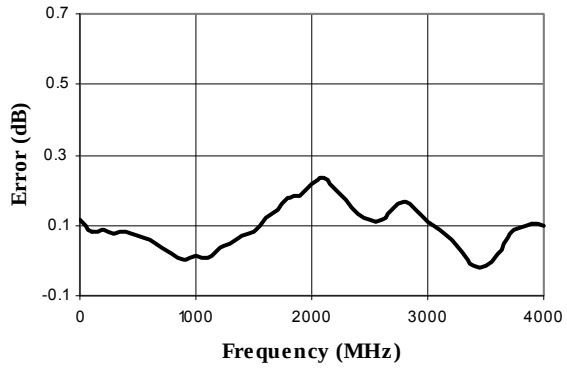
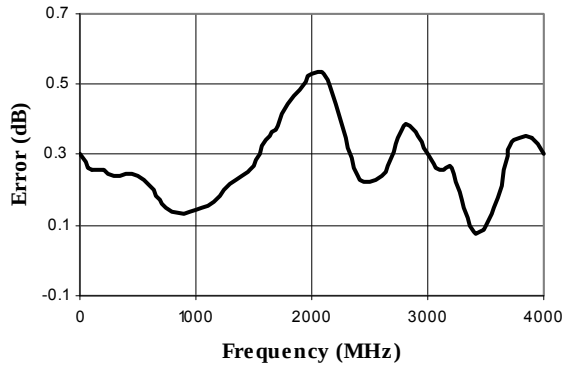
Typical Performance Curves

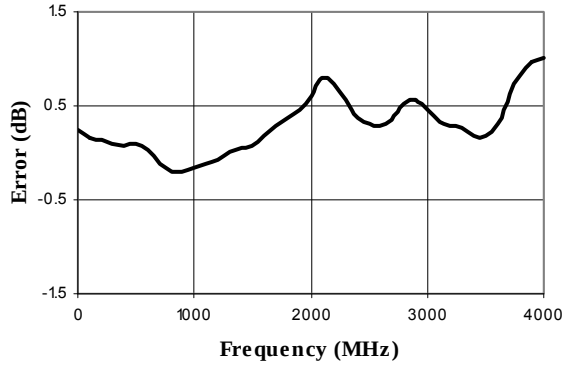
Attenuation Error, 4 dB Bit



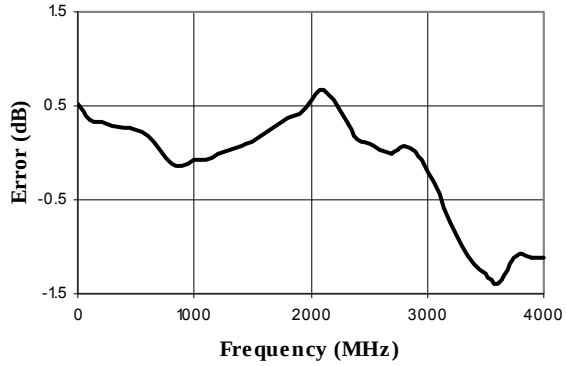
Attenuation Error, 8 dB Bit



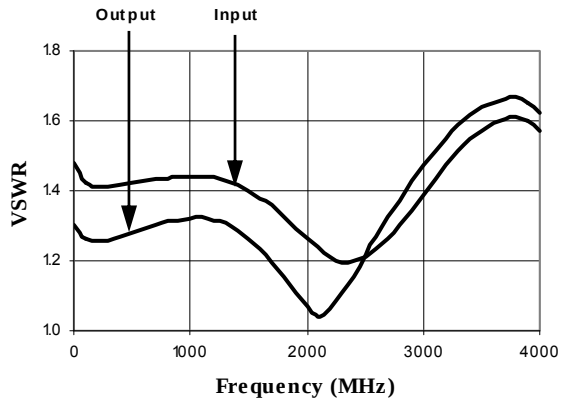
Attenuation Error, 16 dB Bit



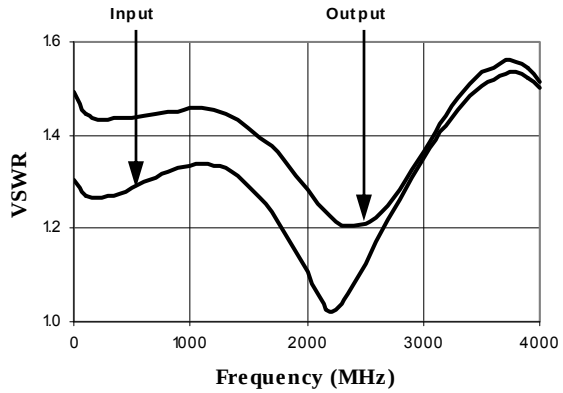
Attenuation Error, Max. Attenuation



VSWR, 1 dB Bit



VSWR, 2 dB Bit



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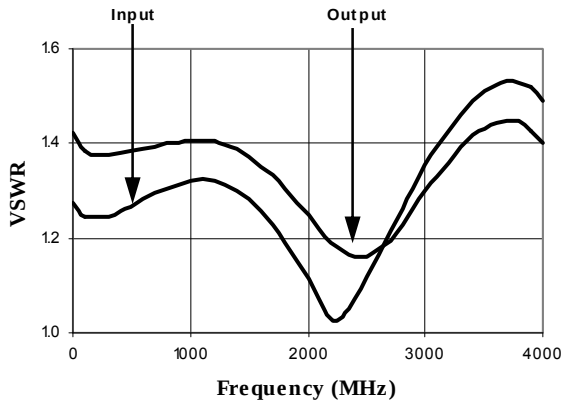
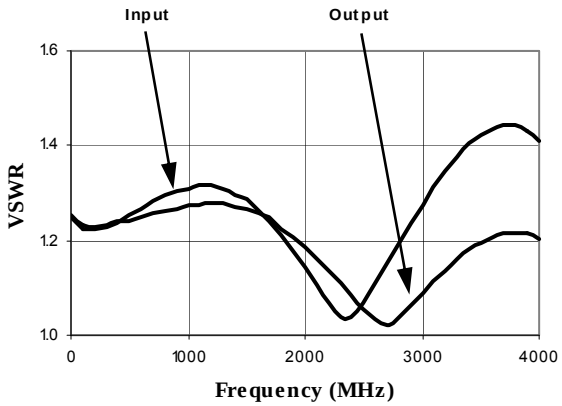
Typical Performance Curves

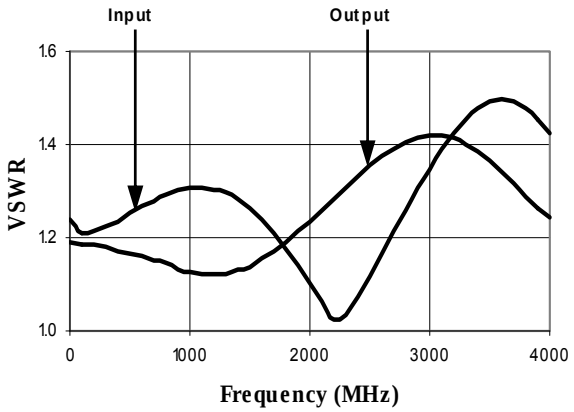
VSWR, 4 dB Bit



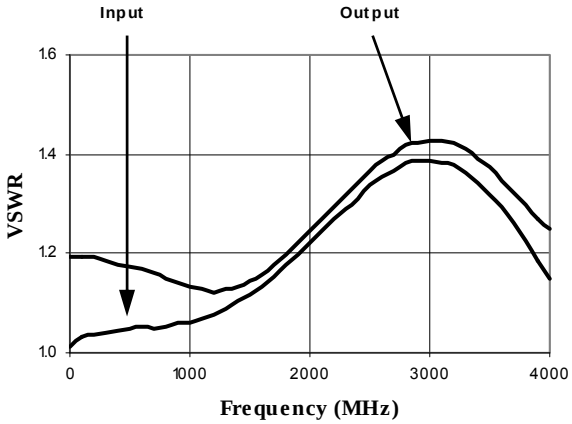
VSWR, 8 dB Bit



VSWR, 16 dB Bit



VSWR, Maximum Attenuation



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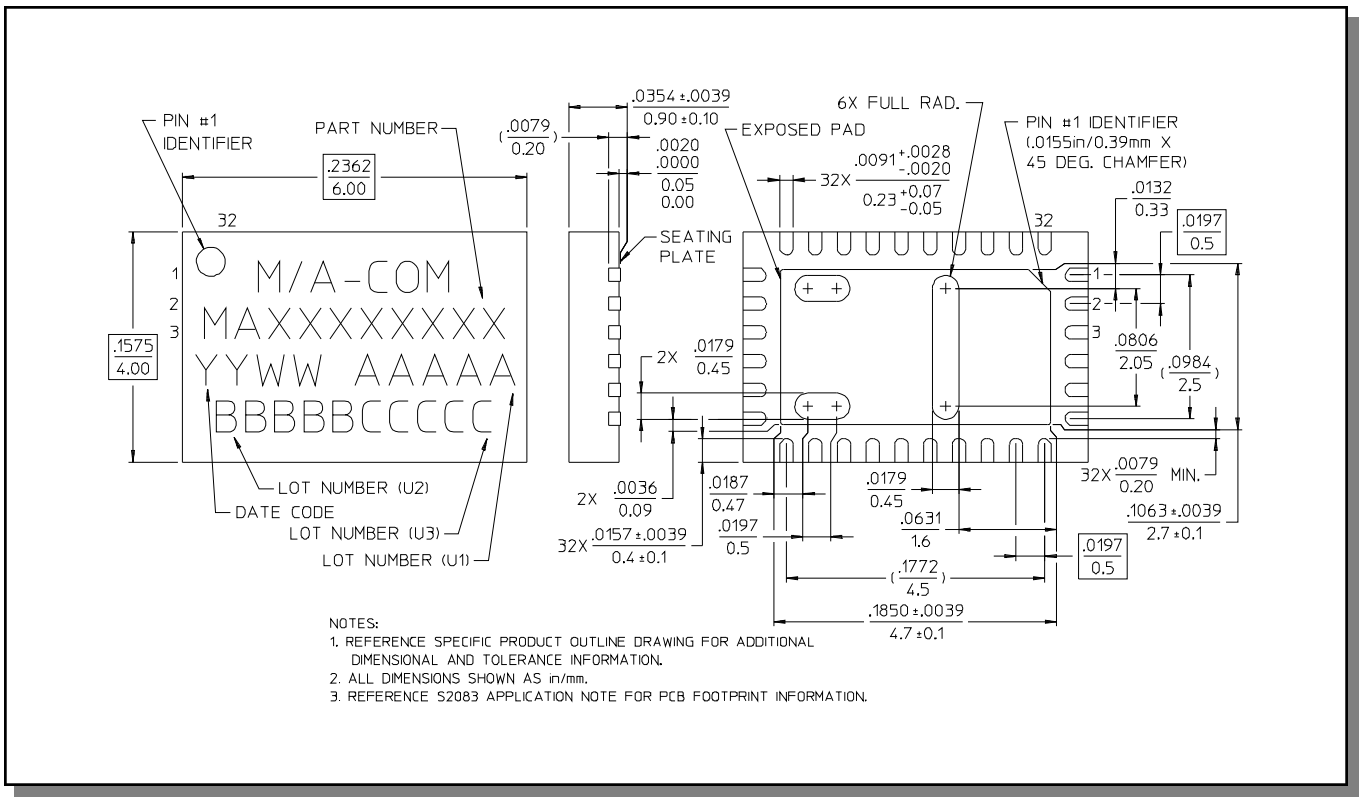
CSP-1, Lead-Free 4 x 6 mm, 32-lead PQFN†



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