MAAD-009260

Constant Phase Digital Attenuator
32 dB, 2-Bit, TTL Driver, DC - 3.0 GHz

Rev. V2

Features

- Attenuation: Two 16 dB bits
- Minimal Phase Variation over Attenuation Range
- Low DC Power Consumption
- Hermetic Surface Mount Package
- Integral TTL Driver
- 50 Ohm Nominal Impedance
- 260°C Reflow Compatible
- RoHS* Compliant

Description

MACOM's MAAD-009260-000100 is a GaAs FET 2-bit digital attenuator with two 16 dB steps and 32 dB total attenuation. The design has been optimized to minimize phase variation over the attenuation range. This attenuator and integral TTL driver is in a hermetically sealed ceramic 16-lead surface mount package.

The MAAD-009260-000100 is ideally suited for use where accuracy, fast switching, very low power consumption and low intermodulation products are required.

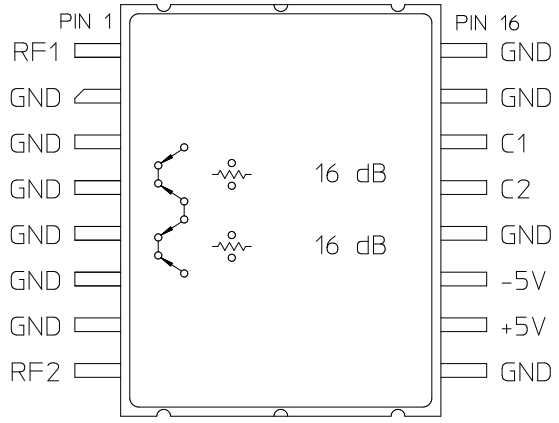
Typical applications include dynamic range setting in precision receiver circuits and other gain/leveling control circuits. Environmental screening is available. Contact the factory for information.

Ordering Information

Part Number	Package
MAAD-009260-000100	Bulk Packaging
MAAD-009260-0001TB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration [1]

Pin No.	Function	Pin No.	Function
1	RF1	9	GND
2	GND	10	+5V
3	GND	11	-5V
4	GND	12	GND
5	GND	13	C2
6	GND	14	C1
7	GND	15	GND
8	RF2	16	GND

1. The metal bottom of the case must be connected to RF and DC ground.

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

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Electrical Specifications: T_A = 25°C, Z_0 = 50 Ω, V_{CC} = +5 V, V_{EE} = -5 V

Parameter	Test Conditions	Frequency	Units	Min	Typ	Max
Operating Power [2]	—	—	dBm	—	—	+20
Reference Insertion Loss	—	DC - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 3.0 GHz	dB dB dB	— — —	— — —	1.9 2.1 2.7
Attenuation Accuracy	16 dB Bit (C1 Control) 16 dB Bit (C1 Control) 16 dB Bit (C1 Control) 32 dB Attenuation 32 dB Attenuation 32 dB Attenuation	DC - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 3.0 GHz DC - 1.0 GHz 1.0 - 2.0 GHz 2.0 - 3.0 GHz	dB dB dB dB dB dB	15.5 15.4 15.4 30.8 30.8 30.8	— — — — — —	16.7 16.8 16.8 33.5 34.2 35.0
Phase Accuracy Relative to Reference Loss State	16 dB Bit (C1 Control) 16 dB Bit (C1 Control) 32 dB Attenuation	DC - 2.0 GHz 2.0 - 3.0 GHz DC - 3.0 GHz	deg deg deg	-3 -4 -7	— — —	+3 +4 +7
VSWR	Reference Loss, 16 dB Bit (C1 Control), or 32 dB Attenuation	DC - 2.0 GHz 2.0 - 3.0 GHz	Ratio Ratio	— —	— —	1.6:1 2.2:1
Switching Speed Ton Toff Trise Tfall	 1.3 V Cntl to 90% RF 1.3 V Cntl to 10% RF 10% RF to 90% RF 90% RF to 10% RF	 — — — —	 ns ns ns ns	 — — — —	 42 30 19 16	 — — — —
1 dB Compression [3]	Reference State Reference State	0.05 GHz 0.5 - 3.0 GHz	dBm dBm	— —	>+26 >+26	— —
Input IP3	For two-tone Input Power up to +5 dBm	0.05 GHz 0.5 - 3.0 GHz	dBm dBm	— —	+42 +42	— —
Input IP2	For two-tone Input Power up to +5 dBm	0.05 GHz 0.5 - 3.0 GHz	dBm dBm	— —	+55 +77	— —
Vcc Vee	— —	— —	V V	4.5 -8.0	5.0 -5.0	5.5 -4.5
V_{IL} V_{IH}	LOW-level input voltage HIGH-level input voltage	— —	V V	0.0 2.0	0.0 5.0	0.8 5.0
Iin (Input Leakage Current)	Vin = V_{CC} or GND	—	uA	-1	—	1
Icc (Quiescent Supply Current)	Vcntrl = V_{CC} or GND	—	uA	—	250	400
ΔIcc (Additional Supply Current Per TTL Input Pin)	V_{CC} = Max Vcntrl = V_{CC} - 2.1 V	—	mA	—	—	1.5
Iee	V_{EE} min to max Vin = V_{IL} or V_{IH}	—	mA	-1.0	-0.2	—
Thermal Resistance θjc	—	—	°C/W	—	50	—

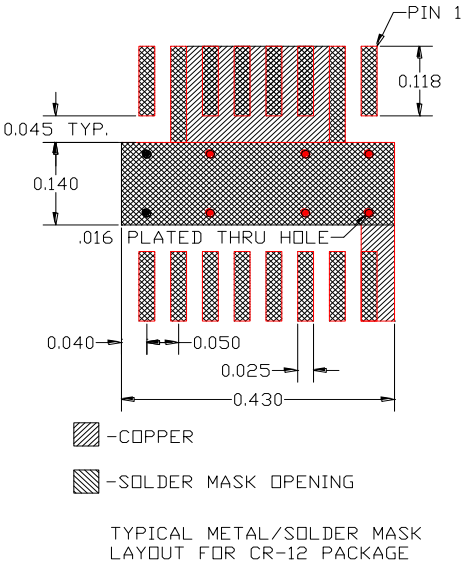
2. Maximum input power is specified with power applied to RF1. Note that C1 is the control for the 16 dB bit.
3. 1 dB Compression was measured up to +26 dBm, which is the absolute maximum rating for this device.

Absolute Maximum Ratings [4,5]

Parameter	Absolute Maximum
Max Input Power [6] DC - 3.0 GHz	+26 dBm
V_{CC}	-0.5V ≤ V_{CC} ≤ +7.0V
V_{EE}	-8.5V ≤ V_{EE} ≤ +0.5V
V_{CC} - V_{EE}	-0.5V ≤ V_{CC} - V_{EE} ≤ 14.5V
Vin [7]	-0.5V ≤ Vin ≤ V_{CC} + 0.5V
Operating Temperature	-55°C to +125°C
Storage Temperature	-65°C to +150°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Maximum input power is specified with power applied to RF1.
7. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

Recommended PCB Configuration



TYPICAL METAL/SOLDER MASK
LAYOUT FOR CR-12 PACKAGE

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) [8]

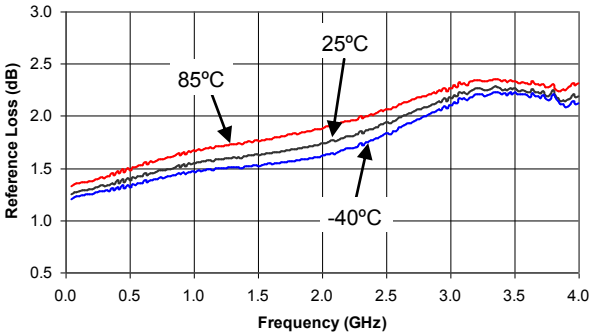
C2	C1	Attenuation
0	0	Loss, Reference
0	1	16.0 dB
1	1	32.0 dB

0 = TTL Low; 1 = TTL High

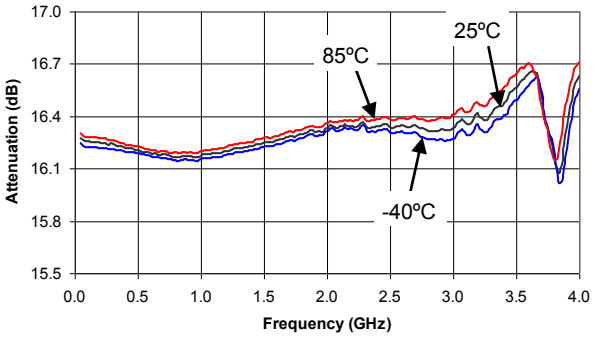
8. C1 is specified as the control for the 16 dB bit. We show data for the performance with the C2 control - note that the power handling is reduced if C2 is used for the 16 dB bit. The electrical performance of the 16 dB bit controlled by C2 is not specified.

Typical Performance Curves

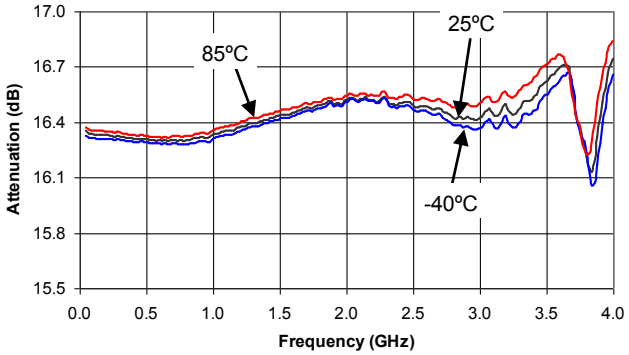
Reference Loss vs. Frequency



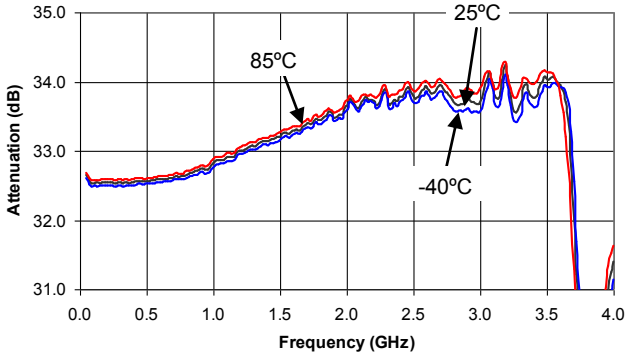
Attenuation - 16 dB Bit (C1) vs. Frequency



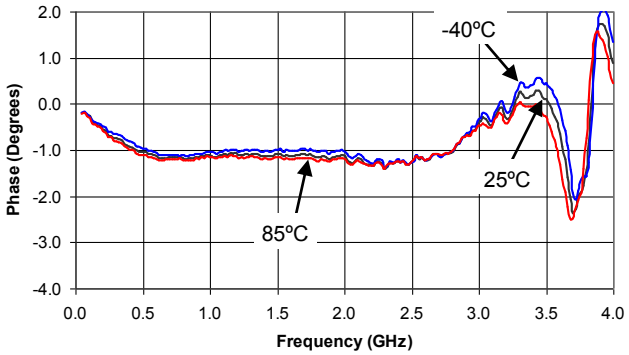
Attenuation - 16 dB Bit (C2) vs. Frequency



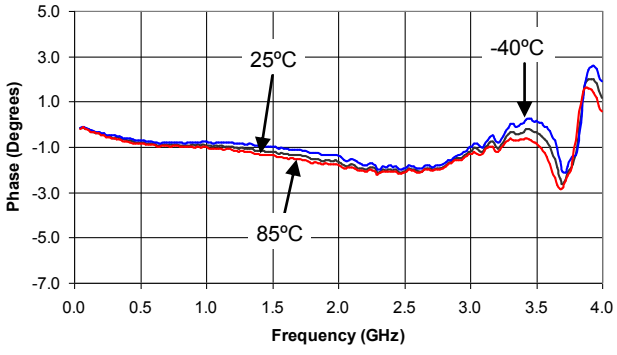
Attenuation - 32 dB Attenuation vs. Frequency



Phase - 16 dB Bit (C1) vs. Frequency
Relative to Reference Loss State

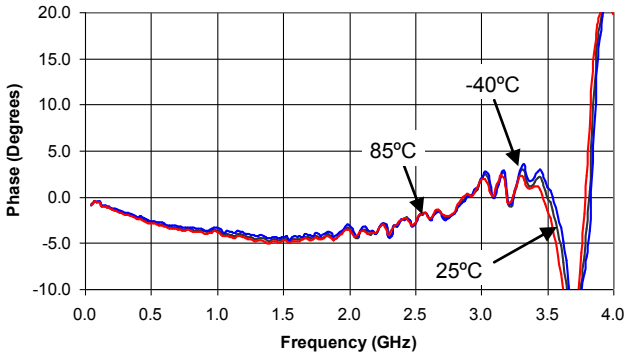


Phase - 16 dB Bit (C2) vs. Frequency
Relative to Reference Loss State

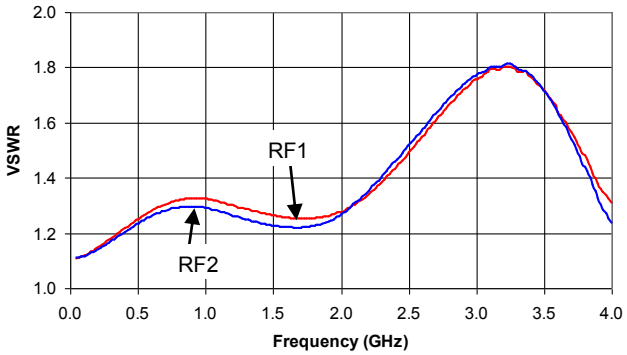


Typical Performance Curves

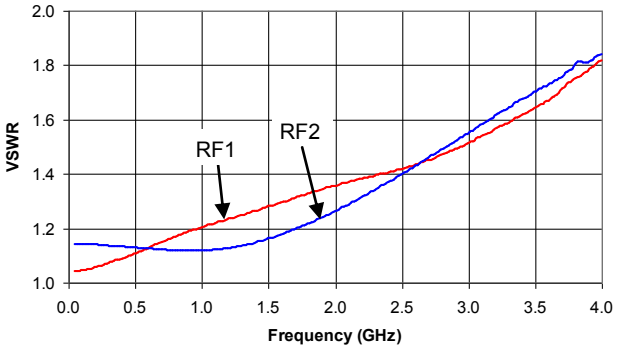
Phase - 32 dB Attenuation vs. Frequency
Relative to Reference Loss State



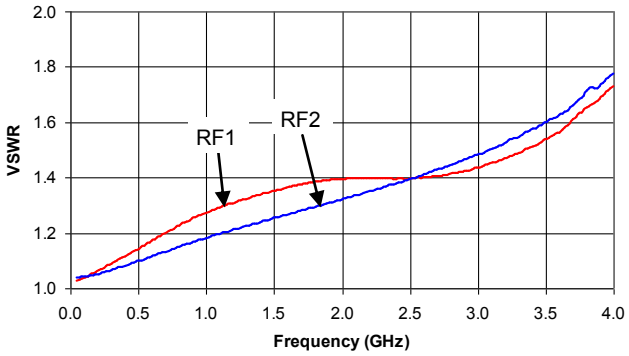
VSWR vs. Frequency
Reference Loss State



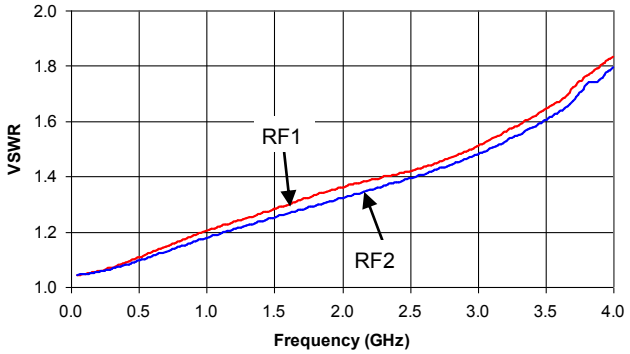
VSWR - 16 dB Bit (C1) vs. Frequency



VSWR - 16 dB Bit (C2) vs. Frequency



VSWR - 32 dB Attenuation vs. Frequency

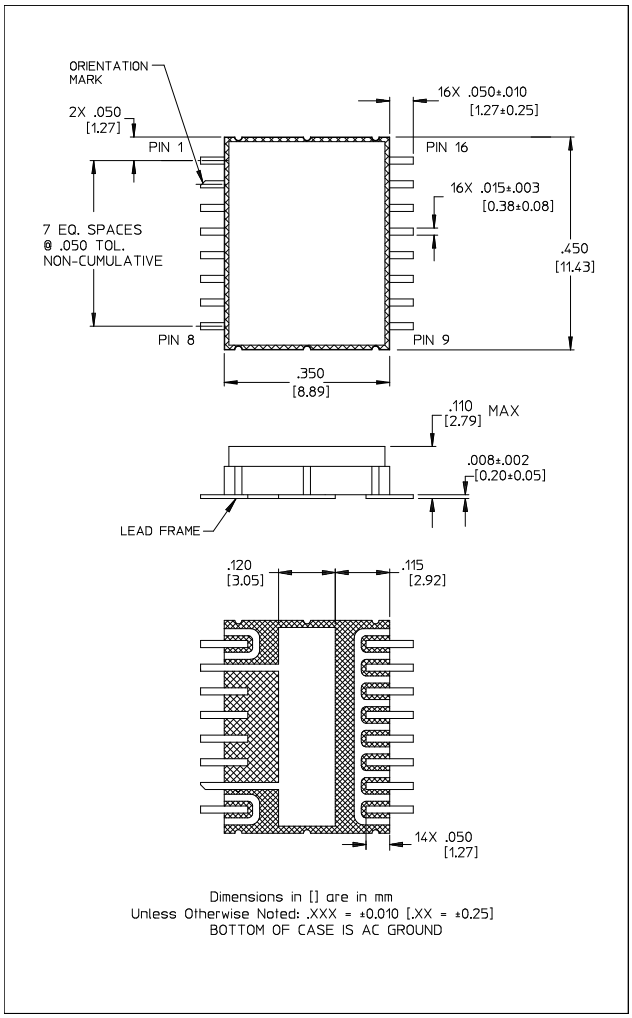


Typical Input IP2 and IP3 at Room Temperature [9]

Attenuation	IP2			IP3			Units
	50 MHz	500 MHz	2 GHz	50 MHz	500 MHz	2 GHz	
Reference State	55	77	75	42	42	43	dBm
16 dB (C1)	62	78	87	41	41	44	dBm
16 dB (C2)	57	78	77	41	41	44	dBm
32 dB	65	80	90	43	43	53	dBm

9. IP2 and IP3 are measured with two-tone inputs F1 and F2 up to +5 dBm with 1 MHz spacing.

Lead-Free, CR-12 Ceramic Package†



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