MADA2030G

5-Bit GaAs Digital Attenuator
DC- 2.0 GHz

Rev. V3

Features

- Attenuation 0.5-dB Steps to 15.5 dB
- Temperature Stability: ± 0.1 dB from –55°C to +85°C Typical
- Fast Switching Speed: 3 nS Typical to 90%
- Ultra Low DC Power Consumption

Description

M/A-COM's MADA2030G is a 5-bit, 0.5-dB step GaAs MMIC digital attenuator. The MADA2030G is ideally suited for use where high accuracy, fast switching, very low power consumption and low intermodulation products are required at a low cost.

Typical applications include radio and cellular equipment, wireless LANS, GPS equipment and other gain/level control circuits.

The MADA2030G is fabricated with a monolithic GaAs MMIC using a mature 1-micron process. The process features full chip passivation for increased performance and reliability.

Ordering Information

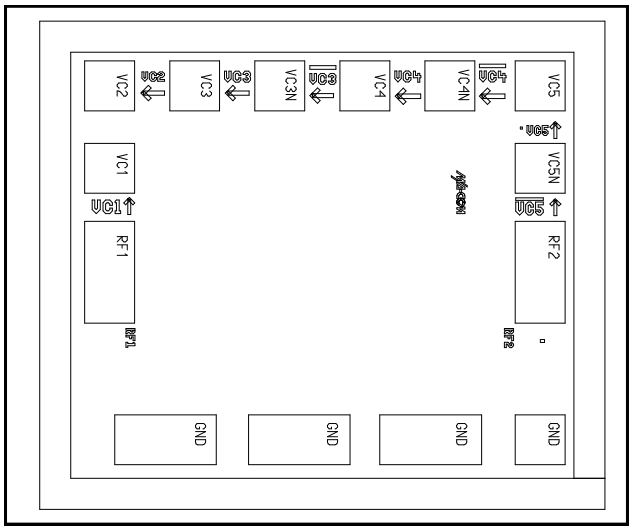
Part Number	Package
MADA2030G	DIE

Absolute Maximum Ratings [1,2]

Parameter	Absolute Maximum
Input Power 500 MHz - 2 GHz	+34 dBm
Control Voltage	-8.5 VDC
Operating Temperature	+175°C
Storage Temperature	-65°C to +175°C

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. M/A-COM does not recommend sustained operation near these survivability limits.

Die



Bond Pad Dimensions

Bond Pad	Dimension Inches (mm)
RF_{IN}, RF_{OUT}	0.004 x 0.008 (0.100 x 0.200)
VC1, VC2, VC3, $\overline{VC3}$, VC4, $\overline{VC4}$ VC5, $\overline{VC5}$	0.004 x 0.004 (0.100 x 0.100)
GND1, GND2, GND3	0.008 x 0.004 (0.200 x 0.100)
GND4	0.004 x 0.004 (0.100 x 0.100)
DIE Size	0.045 x 0.039 x 0.010 (1.14 x 0.99 x 0.25)

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Electrical Specifications: T_A = 25°C, Z_0 = 50 Ω

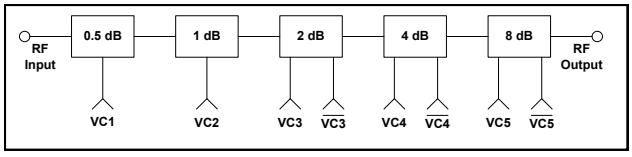
Parameter	Test Conditions	Units	Min.	Typ.	Max.
Reference Insertion Loss	DC - 1.0 GHz DC - 2.0 GHz	dB dB	— —	— —	1.9 2.3
Attenuation Accuracy	DC - 2.0 GHz	± (0.3 dB ± 3% of attenuation setting in dB) dB			
VSWR (Worst Case)	DC - 2.0 GHz	Ratio	—	—	1.6:1
Phase Balance	(For any bit or combinations of bits per unit) 500 MHz 1.0 GHz 2.0 GHz	 ° ° °	 — — —	 +1 / -2 +2 / -3 +4 / -6	 — — —
Switching Characteristics	50% Control to 90% RF, 50% Control to 10% RF Unfiltered Transients	nS mV	— —	3 7	— —
Input Power for 1 dB Compression	100 MHz Above 500 MHz	dBm dBm	— —	24 27	— —
IP2	for two-tone input power up to +5 dBm 100 MHz Above 500 MHz	 dBm dBm	 — —	 45 68	 — —
IP3	for two-tone input power up to +5 dBm 100 MHz Above 500 MHz	 dBm dBm	 — —	 40 45	 — —
Control Voltages (Complementary Logic)	V_{IN} Low, 0 to -0.2 V V_{IN} Hi, -5 V V_{IN} Hi, -8 V	µA µA µA	— — —	— 75 —	5 — 250

Truth Table[3]

VC1	VC2	VC3	$\overline{VC3}$	VC4	$\overline{VC4}$	VC5	$\overline{VC5}$	Attenuation Setting
1	1	1	0	1	0	1	0	Reference
0	1	1	0	1	0	1	0	0.5 dB
1	0	1	0	1	0	1	0	1 dB
1	1	0	1	1	0	1	0	2 dB
1	1	1	0	0	1	1	0	4 dB
1	1	1	0	1	0	0	1	8 dB
0	0	0	1	0	1	0	1	15.5 dB

3. 0 = V_{IN} Low, 0 to -0.2 V, 1 = V_{IN} Hi, -5 V to -8 V

Schematic



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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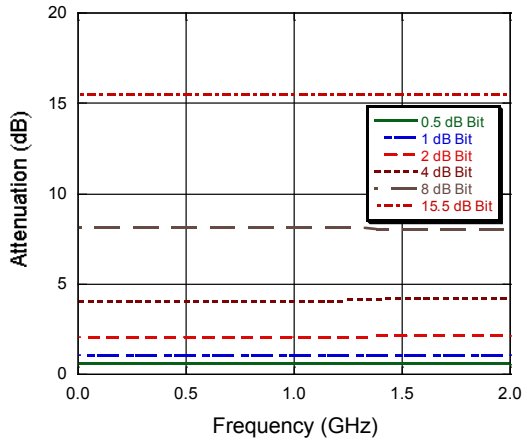
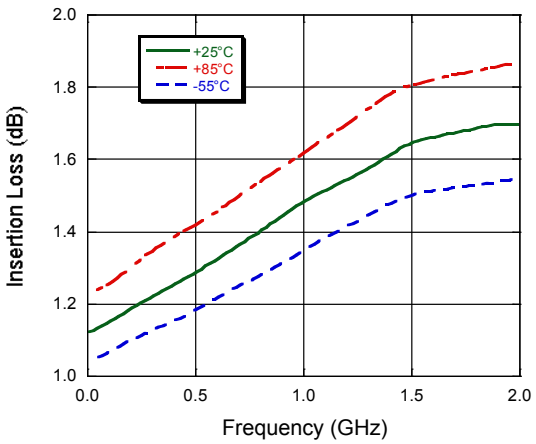
Typical Performance Curves

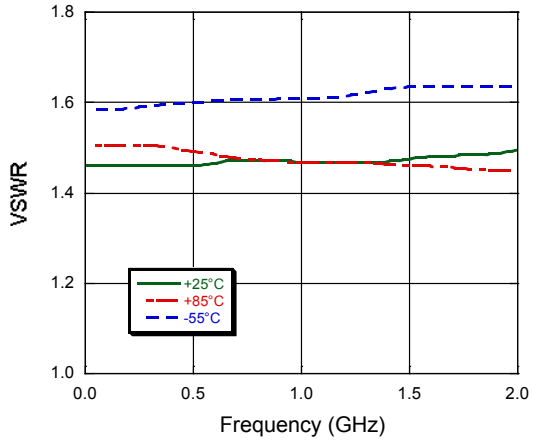
Attenuation



Insertion Loss



Worst Case VSWR



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Handling Procedures

Permanent damage to the MADA2030G may occur if the following precautions are not adhered to:

A. Cleanliness - The MADA2030G should be handled in a clean environment. DO NOT attempt to clean after the MADA2030G is installed.
B. Static Sensitivity - All die handling equipment and personnel should be DC grounded.
C. Transients - Avoid instrument and power supply transients while bias is applied to the MADA2030G. Use shielded signal and bias cables to minimize inductive pick-up.
D. Bias - Apply voltage to either complementary control ports only when the other is grounded. Neither port should be allowed to "float".
E. General Handling - It is recommended that the MADA2030G chip be handled along the long side of the die with a sharp pair of bent tweezers. DO NOT touch the surface of the chip with fingers or tweezers.

Mounting

The MADA2030G is back-metallized with Pd/Ni/Au (100/1,000/10,000Å) metallization. It can be die-mounted using Au/Sn eutectic preforms or a thermally conductive epoxy. The package surface should be clean and flat before attachment.

Eutectic Die Attach:

A. An 80/20 Au/Sn preform is recommended with a work surface temperature of approximately 255°C and a tool temperature of 265°C. When hot 90/10 nitrogen/hydrogen gas is applied, tool tip temperature should be approximately 290°C.
B. DO NOT expose the MADA2030G to a temperature greater than 320°C for more than 20 seconds. No more than 3 seconds of scrubbing should be required for attachment.

Epoxy Die Attach:

B Apply a minimum amount of epoxy and place the MADA2030G into position. A thin epoxy fillet should be visible around the perimeter of the die.
C Cure epoxy per manufacturer's recommended schedule.
D Electrically conductive epoxy may be used but is not required.

Wire Bonding

A. Ball or wedge bond with 1.0 mil diameter pure gold wire. Thermosonic wire bonding with a nominal stage temperature of 150°C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Ultrasonic energy and time should be adjusted to the minimum levels to achieve reliable wirebonds.
B. Wirebonds should be started on the chip and terminated on the package. GND bonds should be as short as possible; at least three and no more than four bond wires from ground pads to package are recommended.

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