HMC424AG16

v00.0416

0.5dB LSB GaAs MMIC 6-BIT DIGITAL ATTENUATOR, DC - 3 GHz

Typical Applications

The HMC424AG16 is ideal for:

- Telecom Infrastructure
- Military Radios, Radar & ECM
- Space Applications
- Test Instrumentation

Features

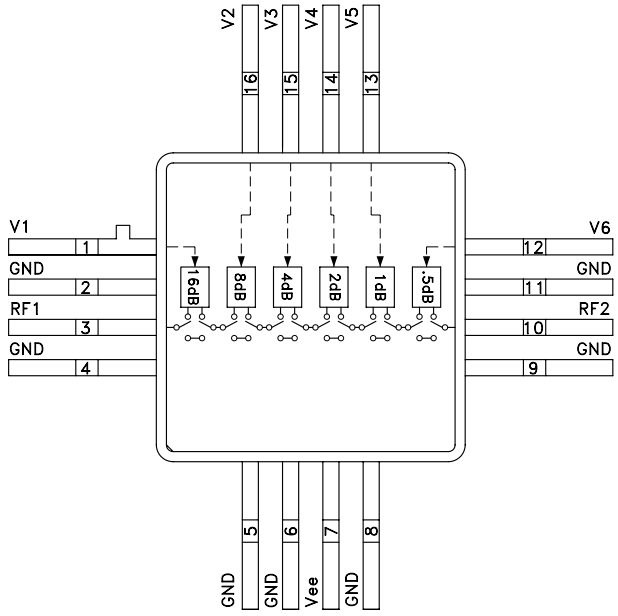
0.5 dB LSB Steps to 31.5 dB

Single Control Line Per Bit

±0.5 to ±0.8 dB Typical Bit Error

16 Lead Hermetic SMT Package

Functional Diagram



General Description

The HMC424AG16 is a broadband 6-bit GaAs IC digital attenuator in a 16 lead glass/metal (hermetic) surface mount package. Covering DC to 3 GHz, the insertion loss is less than 3 dB typical. The attenuator bit values are 0.5 (LSB), 1, 2, 4, 8, and 16 dB for a total attenuation of 31.5 dB. Attenuation accuracy is excellent at ±0.5 dB typical step error with an IIP3 of +34 dBm. Six control voltage inputs, toggled between 0 and -5V, are used to select each attenuation state at less than 70 µA each. A single Vee bias of -5V allows operation at frequencies down to DC.

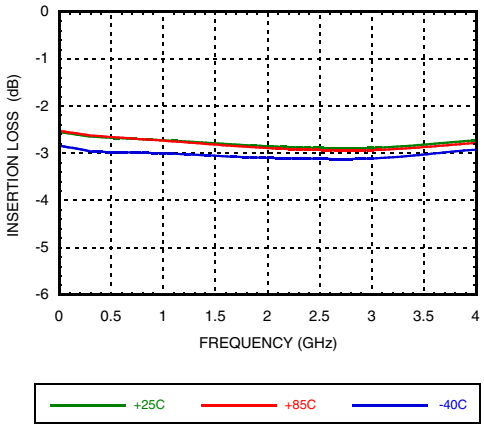
Electrical Specifications, T_A = +25° C, With Vee = -5V & Vctl = 0/-5V

Parameter		Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss		DC - 3 GHz		3.0	3.6	dB
Attenuation Range		DC - 3 GHz		31.5		dB
Return Loss (RF1 & RF2, All Atten. States)		DC - 3 GHz		12		dB
Attenuation Accuracy: (Referenced to Insertion Loss)						
	All States	DC - 2.0 GHz	± 0.4 + 4% of Atten. Setting Max			dB
	All States	2.0 - 3.0 GHz	± 0.5 + 5% of Atten. Setting Max			dB
Input Power for 0.1 dB Compression		1.0 - 3.0 GHz		27		dBm
Input Third Order Intercept Point	REF State	1.0 - 3.0 GHz		46		dBm
(Two-Tone Input Power= 0 dBm Each Tone)	All Other States			34		dBm
Switching Characteristics		DC - 3 GHz				
tRISE, tFALL (10/90% RF)				30		ns
tON/tOFF (50% CTL to 10/90% RF)				50		ns

For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106
Phone: 781-329-4700 • Order online at www.analog.com
Application Support: Phone: 1-800-ANALOG-D

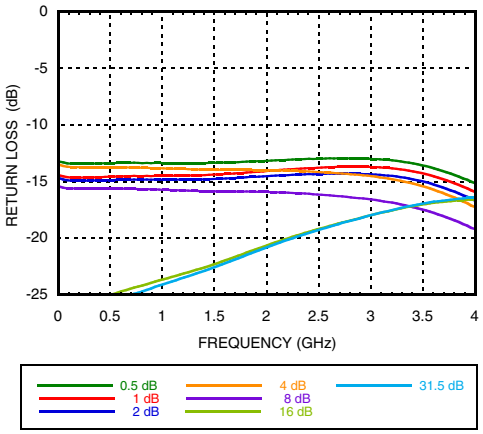
0.5dB LSB GaAs MMIC 6-BIT DIGITAL ATTENUATOR, DC - 3 GHz

Insertion Loss



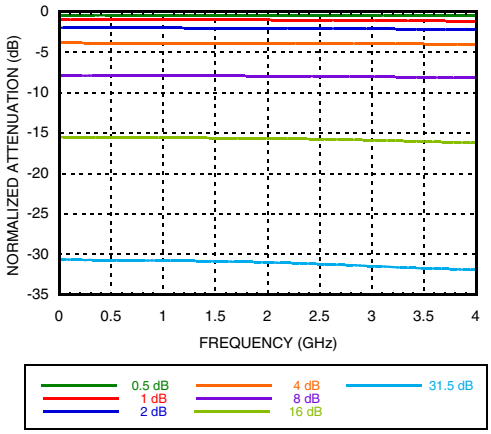
Return Loss RF1, RF2

(Only Major States are Shown)

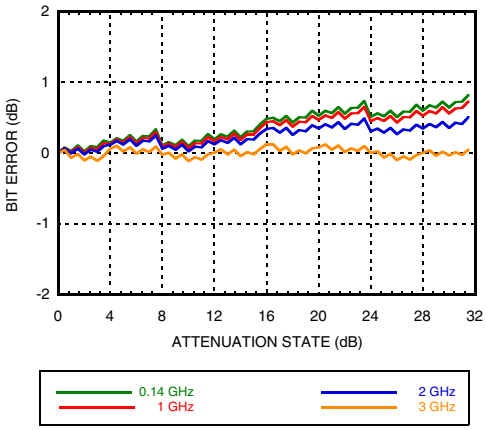


Normalized Attenuation

(Only Major States are Shown)

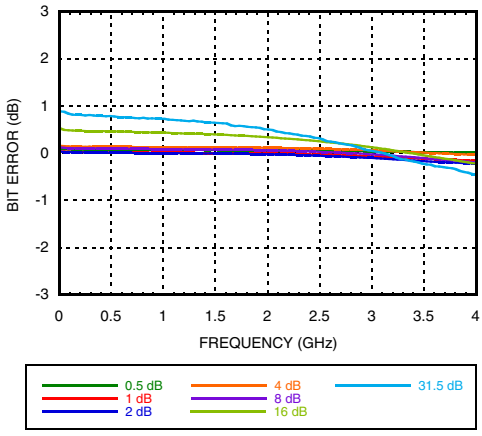


Bit Error vs. Attenuation State



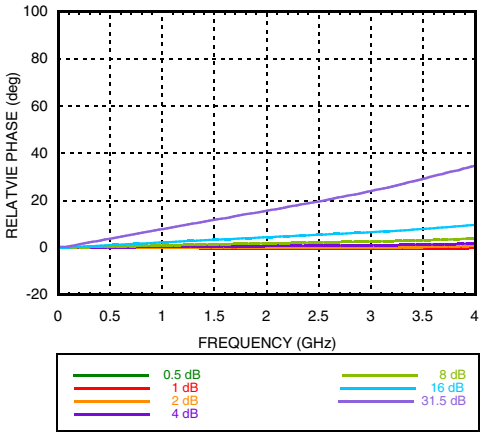
Bit Error vs. Frequency

(Only Major States are Shown)

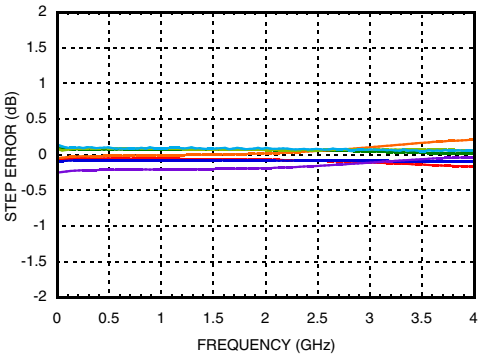


Relative Phase vs. Frequency

(Only Major States are Shown)



Step Error vs Frequency (Major States)



Bias Voltage & Current

Vee Range= -5 Vdc ± 10%		
Vee (VDC)	Iee (Typ.) (mA)	Iee (Max.) (mA)
-5	2.2	5

Control Voltage

State	Bias Condition
Low	0 to -3V @ 35 µA Typ.
High	-5 to -4.2V < 1 µA Typ.

Truth Table

Control Voltage Input						Attenuation State RF1 - RF2
V1 16 dB	V2 8 dB	V3 4 dB	V4 2 dB	V5 1 dB	V6 0.5 dB	
Low	Low	Low	Low	Low	Low	Reference I.L.
Low	Low	Low	Low	Low	High	0.5 dB
Low	Low	Low	Low	High	Low	1 dB
Low	Low	Low	High	Low	Low	2 dB
Low	Low	High	Low	Low	Low	4 dB
Low	High	Low	Low	Low	Low	8 dB
High	Low	Low	Low	Low	Low	16 dB
High	High	High	High	High	High	31.5 dB
Any Combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.						

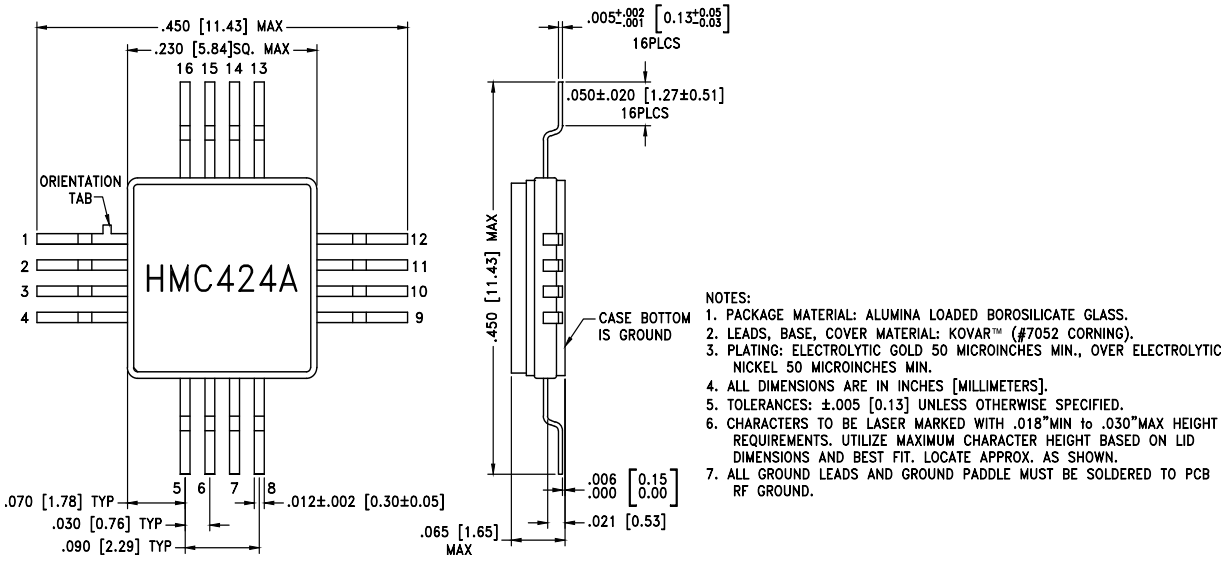
0.5dB LSB GaAs MMIC 6-BIT DIGITAL ATTENUATOR, DC - 3 GHz

Absolute Maximum Ratings

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Max RF Power Input (0.5 - 13 GHz)	+ 24.5 dBm
Bias Voltage (Vdd)	-7 Vdc
Digital Inputs	Vee-0.5V
Channel Temperature	150 °C
Continuos Pdiss (T=85 °C)	0.180 W
Thermal Resistance(+85 base, 23dBm Pin, @ max atten.)	107 °C/W
Thermal Resistance (+85 base, @ 4 dB atten.)	415.3 °C/W
Storage Temperature	-65 to 150 °C
Operating Temperature	-40 to +85 °C
ESD Sensitivity (HBM)	Class 1A
ESD Sensitivity (HBM)	Class 1A

Outline Drawing



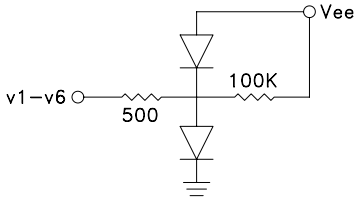
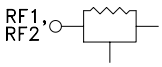
NOTES:
1. PACKAGE MATERIAL: ALUMINA LOADED BOROSILICATE GLASS.
2. LEADS, BASE, COVER MATERIAL: KOVAR™ (#7052 CORNING).
3. PLATING: ELECTROLYTIC GOLD 50 MICROINCHES MIN., OVER ELECTROLYTIC NICKEL 50 MICROINCHES MIN.
4. ALL DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. TOLERANCES: ±.005 [0.13] UNLESS OTHERWISE SPECIFIED.
6. CHARACTERS TO BE LASER MARKED WITH .018"MIN to .030"MAX HEIGHT REQUIREMENTS. UTILIZE MAXIMUM CHARACTER HEIGHT BASED ON LID DIMENSIONS AND BEST FIT. LOCATE APPROX. AS SHOWN.
7. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.

Package Information

Part Number	Package Body Material	Package Marking
HMC424AG16	ALUMINA LOADED BOROSILICATE GLASS	HMC424A

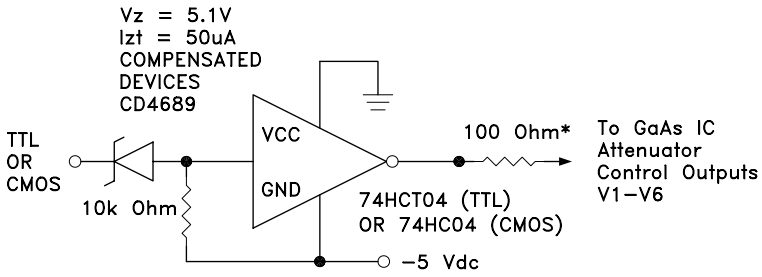
Max peak reflow temperature of 260°C

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 12-16	V1 - V6	See truth table and control voltage table.	
2, 4-6, 8, 9, 11	GND	Package bottom must also be connected to RF/DC ground.	
3, 10	RF1, RF2	These pins are DC coupled and matched to 50 Ohm. Blocking capacitors are required if RF line is not equal to 0V.	
7	Vee	Supply Voltage -5V ±10%	

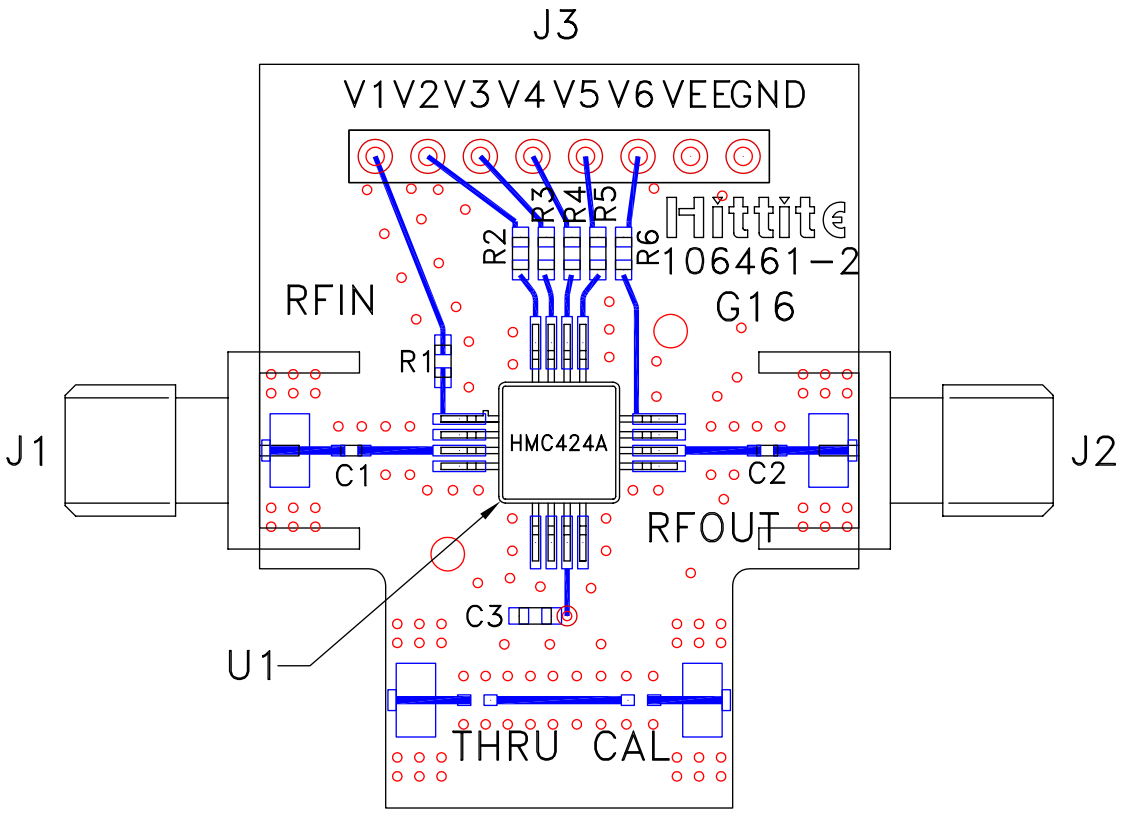
Suggested Driver Circuit

(One Circuit Required Per Bit Control Input)



*Simple driver using inexpensive standard logic ICs provides fast switching using minimum DC current. * Recommended value to suppress unwanted RF signals at V1 - V6 control lines.*

Evaluation PCB



List of Materials for Evaluation PCB EV1HMC424AG16 [1]

Item	Description
J1 - J2	PCB Mount SMA Connector
J3	8 Pin DC Connector
C1	0.01 µF Capacitor, 0603 Pkg.
C2, C3	100 pF Capacitor, 0402 Pkg.
R1 - R6	100 Ohm Resistor, 0603 Pkg.
U1	HMC424AG16 Digital Attenuator
PCB [2]	106461 Evaluation PCB

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and package bottom should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board shown is available from Analog Devices upon request.