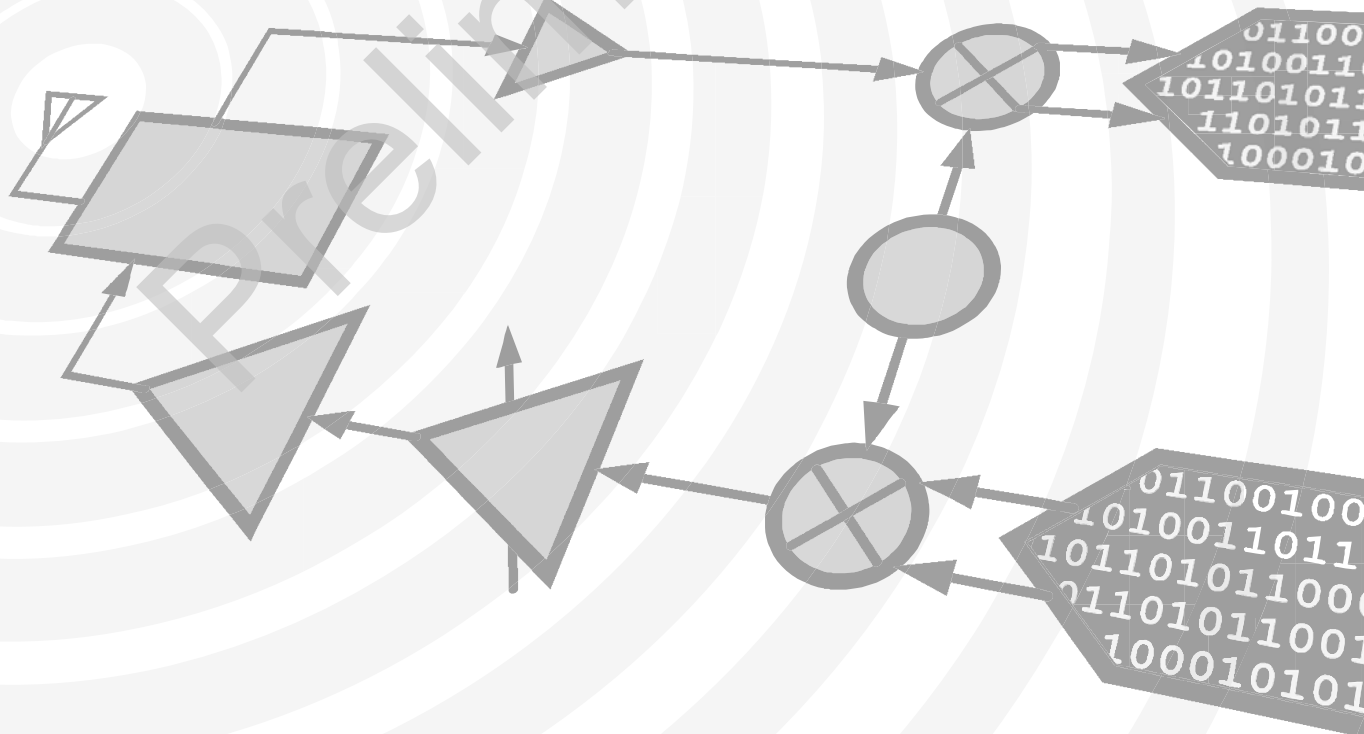


# Analog Devices Welcomes Hittite Microwave Corporation



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Preliminary

## 1.0 dB LSB GaAs MMIC 5-BIT DIGITAL ATTENUATOR, 0.1 - 33 GHz

### Typical Applications

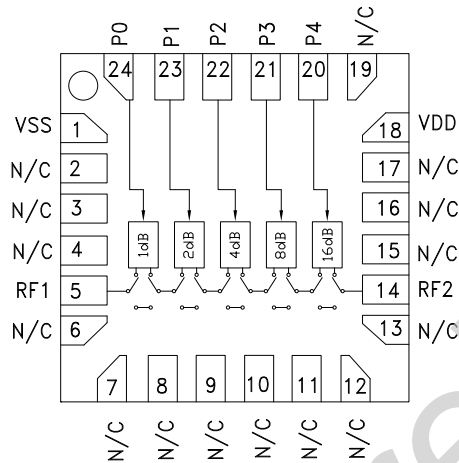
The HMC939ALP4 / HMC939ALP4E is ideal for:

- Fiber Optics & Broadband Telecom
- Microwave Radio & VSAT
- Military Radios, Radar & ECM
- Space Applications
- Sensors
- Test & Measurement Equipment

### Features

- 1.0 dB LSB Steps to 31 dB
- Single Positive Control Line Per Bit
- ±1.0 dB Typical Bit Error
- High Input IP3: +43 dBm
- 16mm<sup>2</sup> Leadless SMT Plastic Package

### Functional Diagram



### General Description

The HMC939ALP4 & HMC939ALP4E are broadband 5-bit GaAs IC digital attenuators in low cost leadless surface mount packages. Covering 0.1 to 33.0 GHz, the insertion loss is less than 5 dB typical. The attenuator bit values are 1.0 (LSB), 2, 4, 8, 16 for a total attenuation of 31 dB. Attenuation accuracy is excellent at ±0.4 dB typical step error with an IIP3 of +43 dBm. Five control voltage inputs, toggled between +5V and 0V, are used to select each attenuation state.

### Electrical Specifications, $T_A = +25^\circ C$ , With $V_{dd} = +5V$ , $V_{ss} = -5V$ , $P_0 - P_4 = 0 / +5V$

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss	0.1 - 18.0 GHz		4.0	5.5	dB
	18.0 - 26.5 GHz		5.5	7.0	dB
	26.5 - 33.0 GHz		6.5	8.5	dB
Attenuation Range	0.1 - 33.0 GHz		31		dB
Return Loss (RF1 & RF2, All Atten. States)	0.1 - 33.0 GHz		12		dB
Attenuation Accuracy: (Referenced to Insertion Loss)	1.0 - 15 dB States	0.1 - 33.0 GHz	± (0.5 + 5%) of Atten. Setting Max		dB
	16 - 31 dB States	0.1 - 20.0 GHz	± (0.5 + 5%) of Atten. Setting Max		dB
	16 - 31 dB States	20.0 - 33.0 GHz	± (0.6 + 8%) of Atten. Setting Max		dB
Input Power for 0.1 dB Compression	0.1 - 0.5 GHz		20		dBm
	0.5 - 33.0 GHz		25		dBm
Input Third Order Intercept Point (Two-Tone Input Power= 0 dBm Each Tone)	0.1 - 0.5 GHz		40		dBm
	0.5 - 33.0 GHz		43		dBm
Switching Characteristics	0.1 - 33.0 GHz	tRISE, tFALL (10/90% RF)	60		ns
		tON/tOFF (50% CTL to 10/90% RF)	90		ns
I <sub>dd</sub>	0.1 - 33.0 GHz	2.5	4.5	6.5	mA
I <sub>ss</sub>	0.1 - 33.0 GHz	-7.0	-5.0	-3.0	mA

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## 1.0 dB LSB GaAs MMIC 5-BIT DIGITAL ATTENUATOR, 0.1 - 33 GHz

### Absolute Maximum Ratings

RF Input Power (0.1 to 33.0 GHz)	+25 dBm
Control Voltage (P0 to P4)	Vdd + 0.5V
Vdd	+7 Vdc
Vss	-7 Vdc
Channel Temperature	150 °C
Continuous Pdiss (T = 85 °C) (derate 6.8 mW/°C above 85 °C)	0.451 W
Thermal Resistance	144 °C/W
Storage Temperature	-65 to + 150 °C
Operating Temperature	-40 to +85 °C
ESD Sensitivity (HBM)	Class 1A



**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**

### Bias Voltages & Currents

Vdd	+5V @ 4.5 mA
Vss	-5V @ 5 mA

### Control Voltage

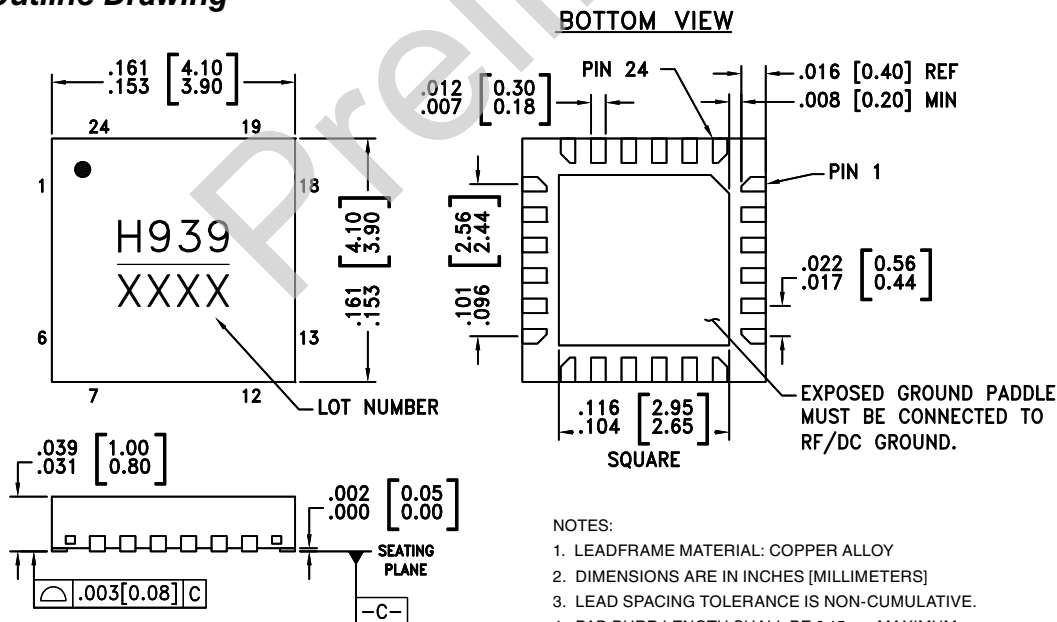
State	Bias Condition
Low	0 to 0.8V @ 1 µA
High	2 to 5V @ 1 µA

### Truth Table

Control Voltage Input					Attenuation State RF1 - RF2
P4 16 dB	P3 8 dB	P2 4 dB	P1 2 dB	P0 1 dB	
High	High	High	High	High	Reference I.L.
High	High	High	High	Low	1 dB
High	High	High	Low	High	2 dB
High	High	Low	High	High	4 dB
High	Low	High	High	High	8 dB
Low	High	High	High	High	16 dB
Low	Low	Low	Low	Low	31 dB

Any Combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

### Outline Drawing



#### NOTES:

- LEADFRAME MATERIAL: COPPER ALLOY
- DIMENSIONS ARE IN INCHES [MILLIMETERS]
- LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.  
PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
- PACKAGE WARP SHALL NOT EXCEED 0.05mm.
- ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.