

# GaAs IC 5 Bit Digital Attenuator With Serial-to-Parallel Driver 0.5–2.5 GHz



AA109-310

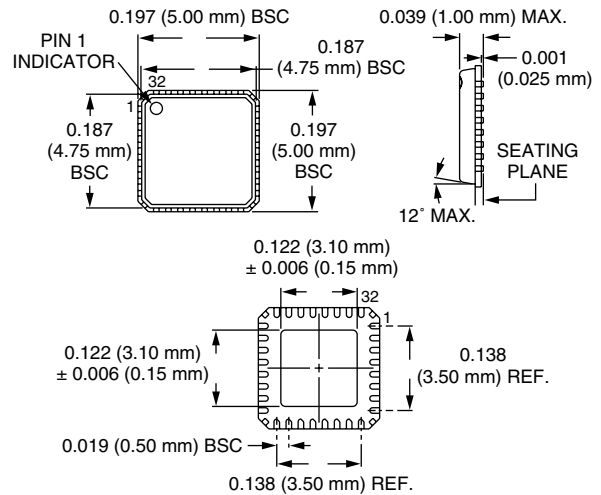
## Features

- Positive Voltage Operation (+5 V)
- QFN 5 x 5 mm Leadless Package
- Integrated Silicon Serial-to-Parallel Driver
- Attenuation 1 dB Steps to 31 dB

## Description

The AA109-310 is a GaAs FET IC 5 bit digital attenuator with a serial-to-parallel driver packaged in a 32 leadless exposed pad plastic package. It is particularly suited where high attenuation accuracy, low insertion loss and low intermodulation products are required. Typical applications include base station, wireless and wireless local loop gain control circuits.

## QFN 5 x 5 (-310)



## Electrical Specifications at 25°C (V<sub>CC</sub> = +5 V)

Parameter <sup>1</sup>	Condition	Frequency	Min.	Typ.	Max.	Unit
Insertion Loss <sup>2</sup>		0.5–1.0 GHz		2.0	2.4	dB
		1.0–2.0 GHz		2.7	3.1	dB
		2.0–2.5 GHz		3.1	3.6	dB
Attenuation Range <sup>3, 4</sup>				15.5		dB
Attenuation Accuracy <sup>3, 4</sup>		0.5–1.0 GHz	± (0.2 + 3% of Attenuation Setting in dB)			dB
		1.0–2.0 GHz	± (0.3 + 5% of Attenuation Setting in dB)			dB
		2.0–2.5 GHz	± (0.3 + 6% of Attenuation Setting in dB)			dB
VSWR (I/O)		0.5–2.5 GHz		1.5:1	2.2:1	
Switching Characteristics <sup>5</sup>	Rise, Fall (10/90% or 90/10% RF) On, Off (50% CTL to 90/10% RF) Video Feedthru			100		μs
				300		μs
				70		mV
Input Power for 1 dB Compression	V <sub>S</sub> = +3 V	0.9–2.5 GHz		+21		dBm
	V <sub>S</sub> = +5 V	0.9–2.5 GHz		+27		dBm
Intermodulation Intercept Point (IP3)	For Two-tone Input Power +5 dBm V <sub>S</sub> = +3 V V <sub>S</sub> = +5 V	0.9–2.5 GHz		+41		dBm
		0.9–2.5 GHz		+45		dBm

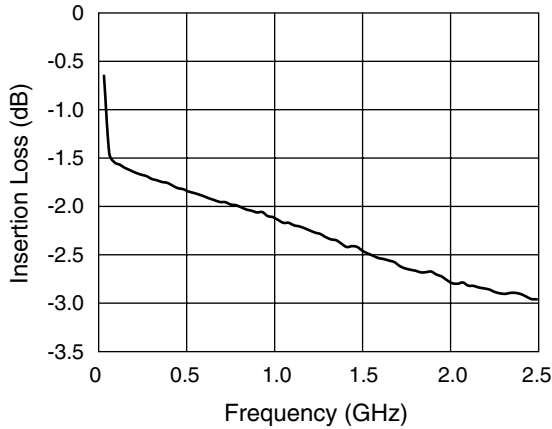
## DC Electrical Characteristics at 25°C (0, +5 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage High	V <sub>IH</sub> (1)		3.5	5.0	V
Input Voltage Low	V <sub>IL</sub> (0)	0	0.5		V
Input Leakage Current	I <sub>L</sub>		±0.5		μA
Quiescent Current	I <sub>CC</sub>		500		μA
Supply Voltages	V <sub>CC</sub>		5.0		V

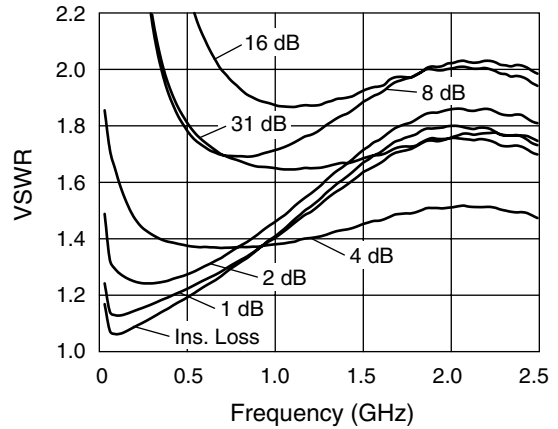
1. All measurements made in a 50 Ω system, unless otherwise specified.
2. Insertion loss changes by 0.003 dB/°C.
3. Attenuation value referenced above insertion loss.

4. Exposed pad must be connected to RF ground to obtain specified attenuation.
5. Video feedthru measured with 1 ns risetime pulse and 500 MHz bandwidth.

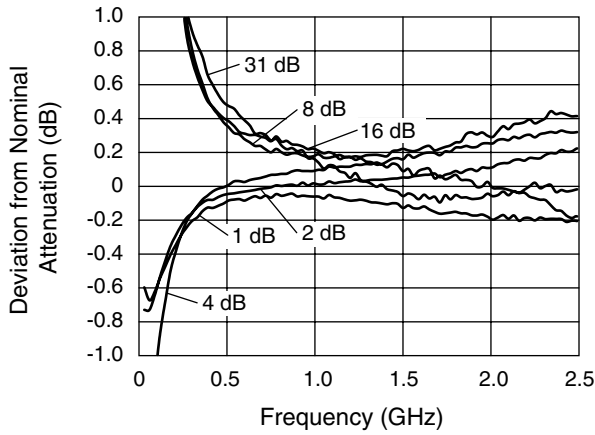
**Typical Performance Data ( $V_{CC} = +5 V$ )**



**Insertion Loss vs. Frequency**



**VSWR vs. Frequency**



**Attenuation Accuracy vs. Frequency**

**Absolute Maximum Ratings**

Characteristic	Value
Supply Voltage ( $V_{CC}$ )	-0.5 to +6 V
Input Voltage ( $V_I$ )	-0.5 – $V_{CC}$ + 0.5 V
Power Dissipation ( $P_D$ )	500 mW
Storage Temperature ( $T_{ST}$ )	-65°C to +125°C
Operating Temperature ( $T_{OP}$ )	-40°C to +85°C

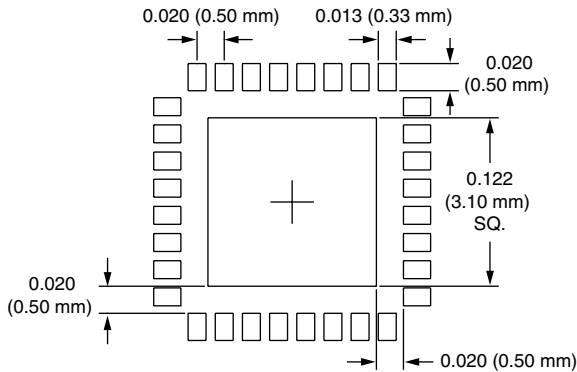
**Truth Table**

Reset	Serial Data Input					$J_1$ – $J_2$ Attenuation
	1 dB	2 dB	4 dB	8 dB	16 dB	
1	1	1	1	1	1	Insertion Loss
1	0	1	1	1	1	1 dB
1	1	0	1	1	1	2 dB
1	1	1	0	1	1	4 dB
1	1	1	1	0	1	8 dB
1	1	1	1	1	0	16 dB
1	0	0	0	0	0	31 dB
0	X	X	X	X	X	31 dB

$V_{IL}(0) = 0$  to 0.5 V.  
 $V_{IH}(1) = 3.5$  to 5 V.  
 X = Don't Care.

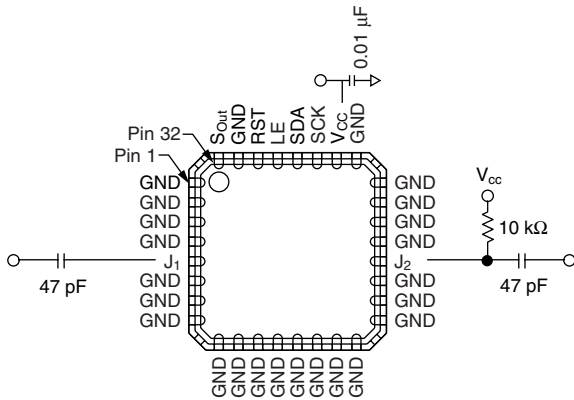
**Surface Mount Land Pattern**

5 x 5 mm QFN 32 Lead



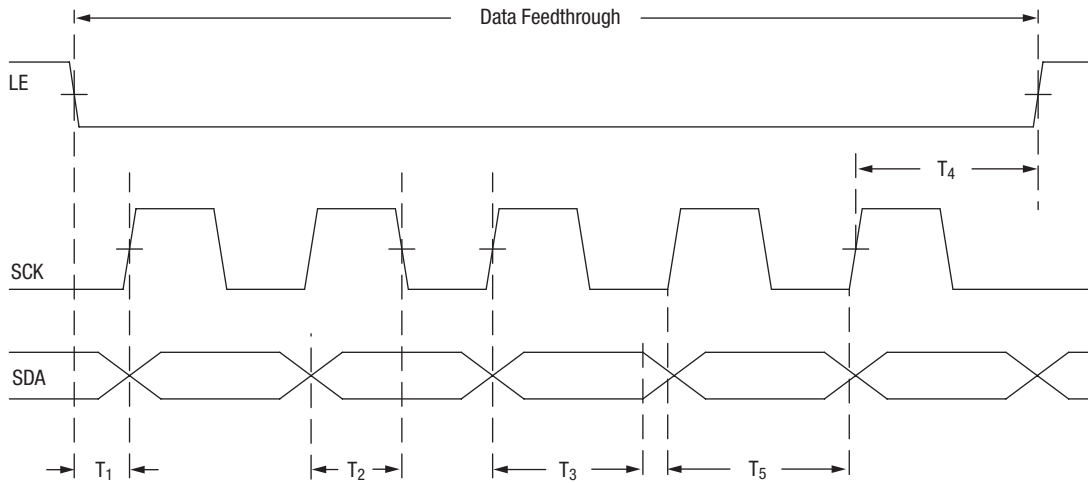
Dimensions in inches (mm).

**Pin Out**



Pin	Symbol	Function
1–4	GND	Ground
5	J <sub>1</sub>	RF Input/Output
6–19	GND	Ground
20	J <sub>2</sub>	RF Input/Output
21–25	GND	Ground
26	V <sub>CC</sub>	Supply Voltage
27	SCK	Serial Clock Input
28	SDA	Serial Data Input
29	LE	Latch Enable
30	RST	Reset
31	GND	Ground
32	S <sub>Out</sub>	Serial Data Output

**Timing Diagram**



Parameter	Symbol	Min.	Typ.	Max.	Unit
LE Setup Time	T <sub>1</sub>	5	15		ns
SDA Setup Time	T <sub>2</sub>	5	15		ns
SDA Hold Time	T <sub>3</sub>	5	10		ns
LE Hold Time	T <sub>4</sub>	5	10		ns
Clock Frequency	f <sub>CLK</sub>		16	100	MHz
Clock Period	T <sub>5</sub>		1/f <sub>CLK</sub>		

Serial data is shifted into the register on the rising edge of the clock (SCK), MSB first. The rising edge of the LE signal will be the clock for the transfer of shifted data, causing the attenuator to change states.

Power-up sequence:

1. Connect ground
2. Apply V<sub>CC</sub>
3. Set all inputs (SCK, SDA, LE)

Power-down sequence should be the reverse of above.