

SKYWORKS®

DATA SHEET

AA109-310, AA109-310LF: GaAs IC 5-Bit Digital Attenuator With Serial-to-Parallel Driver 0.5–2.5 GHz

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
- Available lead (Pb)-free and RoHS-compliant MSL-1 @ 260 °C per JEDEC J-STD-020

Description

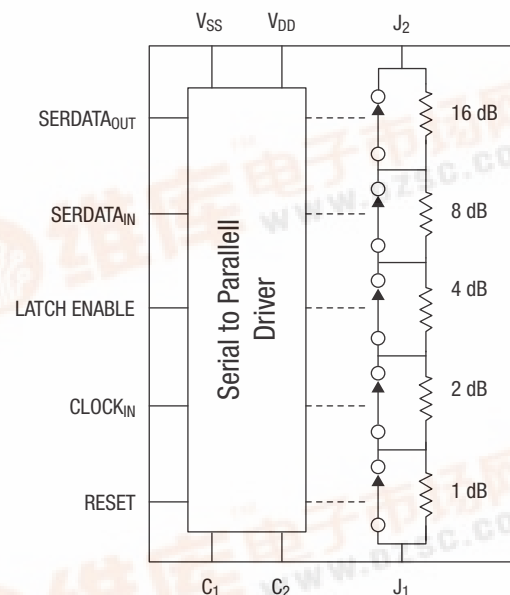
The AA109-310 is a GaAs FET IC 5-bit digital attenuator with a serial-to-parallel driver packaged in a 32-leadless exposed pad plastic package. It is particularly suited where high attenuation accuracy, low insertion loss, and low intermodulation products are required. Typical applications include base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

NEW

Skyworks offers lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant packaging.



Simplified Schematic



Electrical Specifications at 25 °C**V_{DD} = 5 V, Z₀ = 50 Ω, unless otherwise specified**

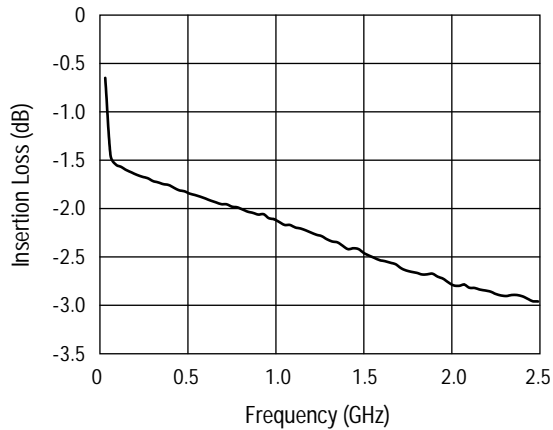
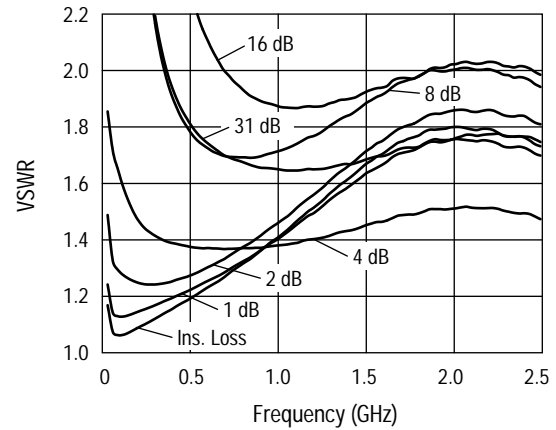
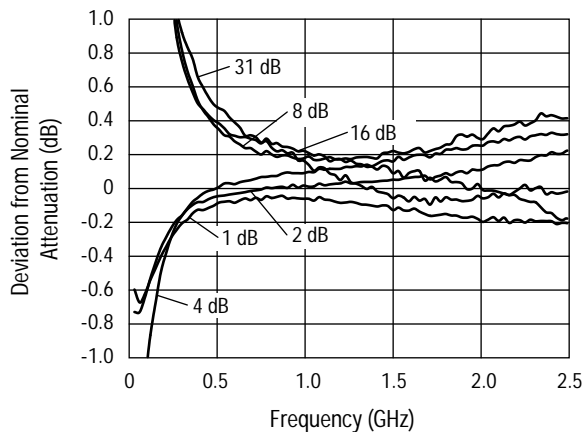
Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Insertion loss		0.5–1.0 GHz		2.0	2.4	dB
		1.0–2.0 GHz		2.7	3.1	dB
		2.0–2.5 GHz		3.1	3.6	dB
Attenuation range ^(1, 2)				31		dB
Attenuation accuracy ^(1, 2)		0.5–1.0 GHz	± (0.2 + 3% of attenuation setting in dB)			dB
		1.0–2.0 GHz	± (0.3 + 5% of attenuation 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						
Rise, fall	10/90% or 90/10% RF			100		μs
On, off	50% CTL to 90/10% RF			300		μs
Video feedthru	T _{RISE} = 1 ns, BW = 500 MHz			70		mV
Input power for 1 dB compression	V _S = 3 V	0.9–2.5 GHz		21		dBm
	V _S = 5 V	0.9–2.5 GHz		27		dBm
Intermodulation intercept point (IP3)	For two-tone input power +5 dBm					
	V _S = 3 V	0.9–2.5 GHz		41		dBm
	V _S = 5 V	0.9–2.5 GHz		45		dBm

1. Attenuation value referenced above insertion loss.

2. Exposed pad must be connected to RF ground to obtain specified attenuation.

DC Electrical Characteristics at 25 °C (V_{DD} = 5 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage high	V _{IH} (1)		3.5	5	V
Input voltage low	V _{IL} (0)	0	0.5		V
Input leakage current	I _L		±0.5		μA
Quiescent current	I _{DD}		500		μA
Supply voltages	V _{DD}		5		V

Typical Performance Data ($V_{DD} = 5\text{ V}$, $Z_0 = 50\ \Omega$)**Insertion Loss vs. Frequency****VSWR vs. Frequency****Attenuation Accuracy vs. Frequency****Absolute Maximum Ratings**

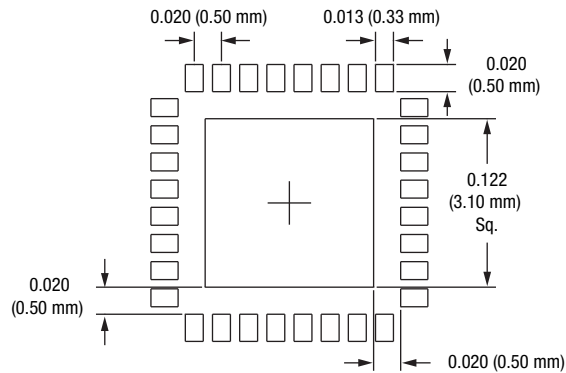
Characteristic	Value
Supply voltage (V_{DD})	-0.5 to +6 V
Input voltage (V_i)	-0.5 – V_{CC} + 0.5 V
Power dissipation (P_D)	500 mW
Storage temperature (T_{ST})	-65 °C to +150 °C
Operating temperature (T_{OP})	-40 °C to +85 °C

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

CAUTION: Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions must be employed at all times.

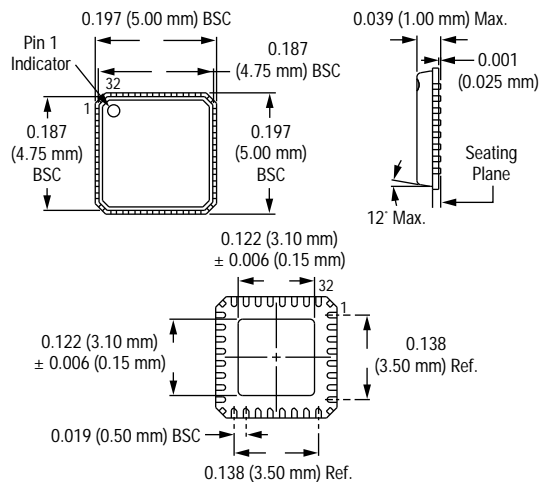
Surface Mount Land Pattern

5 x 5 mm QFN 32-Lead



Dimensions in inches (mm).

QFN 5 x 5 (-310)



Recommended Solder Reflow Profiles

Refer to the [“Recommended Solder Reflow Profile”](#) Application Note.

Tape and Reel Information

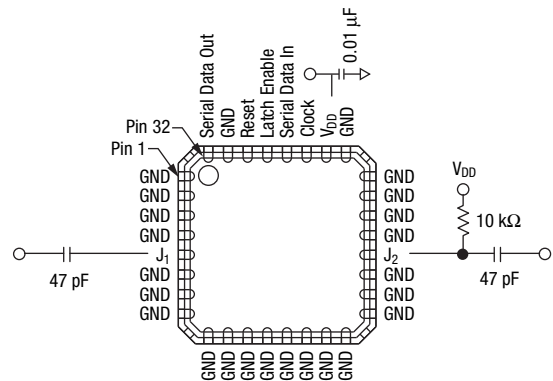
Refer to the [“Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation”](#) Application Note.

Truth Table

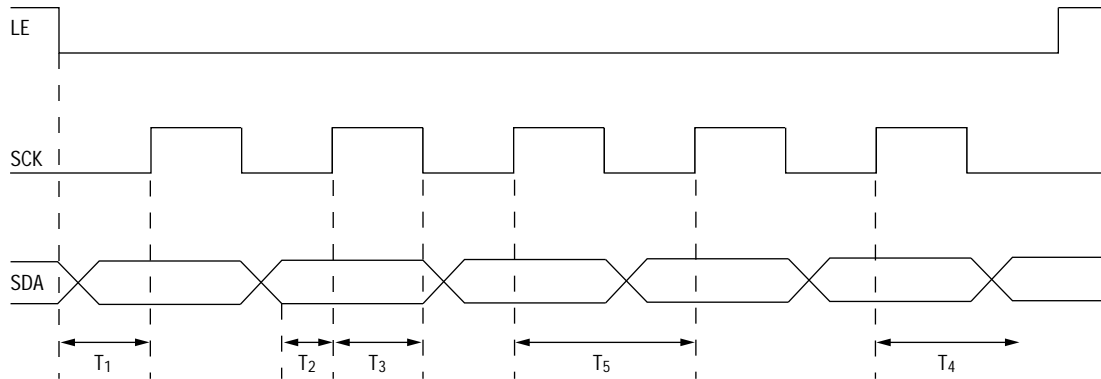
Reset	Serial Data Input					J ₁ –J ₂ Attenuation
	1 dB	2 dB	4 dB	8 dB	16 dB	
1	1	1	1	1	1	Insertion Loss
1	0	1	1	1	1	1 dB
1	1	0	1	1	1	2 dB
1	1	1	0	1	1	4 dB
1	1	1	1	0	1	8 dB
1	1	1	1	1	0	16 dB
1	0	0	0	0	0	31 dB
0	X	X	X	X	X	31 dB

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

Pin Out



Pin	Symbol	Function
1–4	GND	Ground
5	J ₁	RF input/output
6–19	GND	Ground
20	J ₂	RF input/output
21–25	GND	Ground
26	V _{DD}	Supply voltage
27	Clock In	Serial clock input
28	Serial data in	Serial data input
29	LE	Latch enable
30	Reset	Reset
31	GND	Ground
32	Serial data out	Serial data output

Timing Diagram

Parameter	Symbol	Min.	Typ.	Max.	Unit
LE setup time	T_1	5	15		ns
SDA setup time	T_2	5	15		ns
SDA hold time	T_3	5	10		ns
LE hold time	T_4	5	10		ns
Clock frequency	f_{CLK}		16	100	MHz
Clock period	T_5		$1/f_{CLK}$		

Serial data (SDA) is shifted into the register on the rising edge of the clock (SCK), most significant bit (MSB) first. The attenuator will change states on the rising edge of the latch enable (LE) signal, according to the most recent 5 bits of shifted data accepted since the previous falling edge of the LE signal.

Power-up sequence:

0. Connect ground
1. Apply VDD
2. Set all inputs (SCK, SDA, LE)

Power-down sequence should be the reverse of above.

DATA SHEET • AA109-310, AA109-310LF

Copyright © 2002, 2003, 2004, 2005, 2006, 2007, Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.