



## DATA SHEET

# AA104-73, AA104-73LF: GaAs IC 1-Bit Digital Attenuator, 32 dB 300 kHz–2.5 GHz

## Features

- 1-bit attenuation of 32 dB 300 kHz–1 GHz, 27 dB 1–2 GHz, 24 dB 2–2.5 dB
- Combine with AA260-85 or AA101-80 for 63 dB 6-bit solution
- Tune with one capacitor and/or resistor to desired operating frequency and attenuation
- Ideal for both IF and RF applications including cable, GSM, PCS, EDGE, 3G and ISM
- Available lead (Pb)-free and RoHS-compliant MSL-1 @ 260 °C per JEDEC J-STD-020

## Description

The AA104-73 is a 1-bit, GaAs IC FET digital attenuator in a low-cost SOT-6 package. This attenuator has up to 32 dB total attenuation. The attenuator requires two lines of voltage control. The AA104-73 is particularly suited where high attenuation accuracy, low insertion loss, and low intermodulation products are required. Typical application is as a sixth bit value for the AA260-85 and AA101-80. A total attenuation of 63 dB in 1 dB steps can be obtained by combining the two attenuators.

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



## Electrical Specifications at -40 °C to +85 °C (0, 3 V), (0, 5 V)

Parameter <sup>(1)</sup>	Frequency <sup>(2)</sup>	Min.	Typ.	Max.	Unit
Insertion loss	300 kHz–1.0 GHz 1.0–2.0 GHz 2.0–2.5 GHz		0.8 0.9 1.0	1.0 1.2 1.3	dB
Attenuation range	300 kHz–1.0 GHz 1.0–2.0 GHz 2.0–2.5 GHz 2.3–2.5 GHz		32 27 24 23		dB
Attenuation accuracy <sup>(3, 4)</sup>	300 kHz–0.5 GHz 0.85–0.95 GHz 1.7–2.0 GHz 2.0–2.5 GHz 2.3–2.5 GHz		± (0.4 + 10% of attenuation setting in dB) ± (0.4 + 5% of attenuation setting in dB) ± (0.5 + 6% of attenuation setting in dB) ± (0.6 + 7% of attenuation setting in dB) ± (0.7 + 7% of attenuation setting in dB)		dB
VSWR (insertion loss state) <sup>(5)</sup>	300 kHz–2.5 GHz		1.2:1	1.5:1	
VSWR (attenuation state) <sup>(5)</sup>	300 kHz–2.5 GHz		1.5:1	2.0:1	

<sup>1</sup> All measurements made in a 50 Ω system, unless otherwise specified.

<sup>2</sup> Operates to 300 kHz when controlled with negative voltage, C<sub>BP</sub> not required.

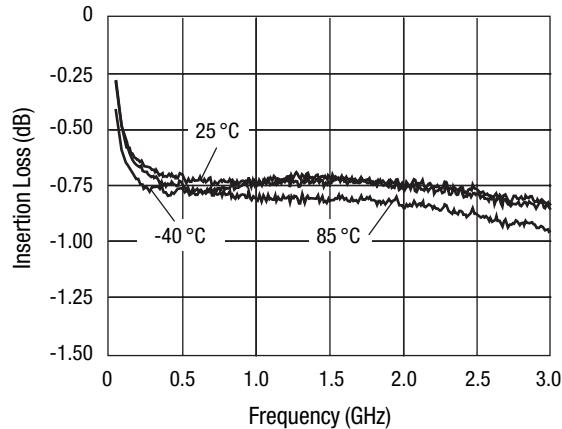
<sup>3</sup> Attenuation value set by C<sub>BP</sub>.

<sup>4</sup> Attenuation referenced to insertion loss.

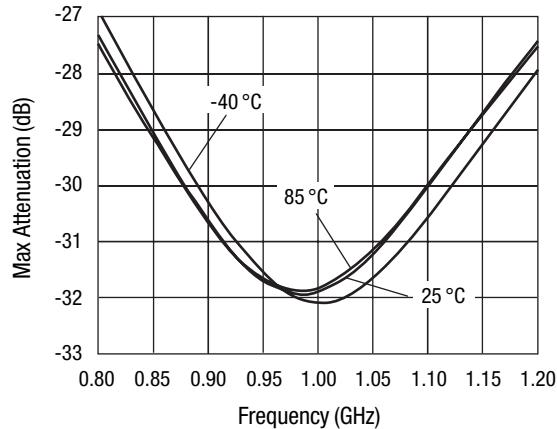
<sup>5</sup> Input/output. In band.

**Electrical Specifications at -40 °C to +85 °C (0, 3 V), (0, 5 V)**

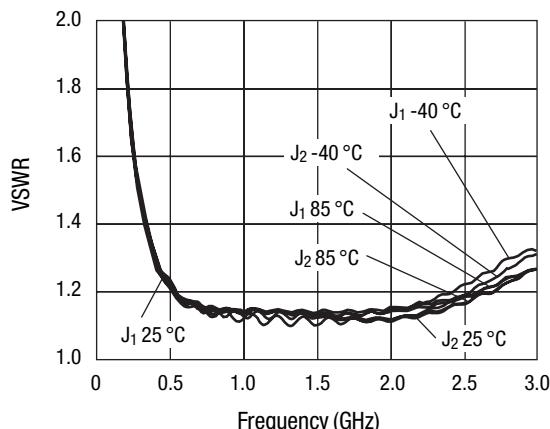
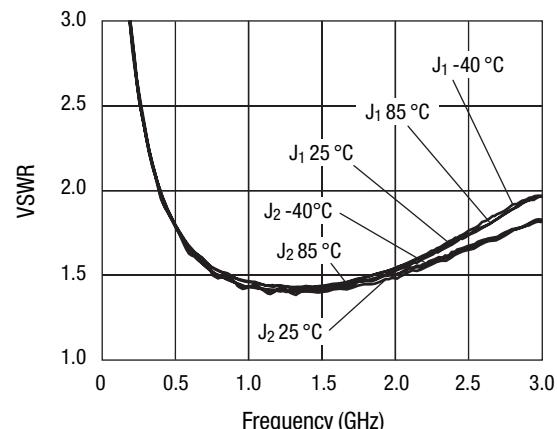
Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Switching characteristics						
Rise, fall	10/90% or 90/10% RF			50		ns
On, off	50% CTL to 90/10% RF			100		ns
Video feedthru	$T_{RISE} = 1$ ns, BW = 500 MHz			25		mV
Input Power for 1 dB compression	$V_S = 3$ V	0.5–2.5 GHz	14	21		dBm
	$V_S = 5$ V	0.5–2.5 GHz	18	23		dBm
Intermodulation intercept point (IP3)	For two-tone input power +10 dBm	0.5–2.5 GHz	36	41		dBm
	$V_S = 3$ V	0.5–2.5 GHz	38	44		dBm
$V_S = 5$ V						
Control voltages	$V_{LOW} = 0$ to 0.2 V @ 20 $\mu$ A max.					
	$V_{HIGH} = 3$ V @ 100 $\mu$ A max. to 5 V @ 200 $\mu$ A max.					

**Typical Performance Data at -40 °C to +85 °C (0, 5 V)  $C_{BP} = 12$  pF,  $C_{BL} = 47$  pF**

Insertion Loss vs. Frequency



32 dB State vs. Frequency

VSWR vs. Frequency  
Insertion Loss StateVSWR vs. Frequency  
32 dB State

**Compression Point vs. Voltage and Temperature**

Control voltage (V)	Temperature (°C)	1 dB Compression insertion loss state (dBm)	1 dB Compression 32 dB state (dBm)
3	-40	21	16.5
3	25	21	15
3	85	21	14
5	-40	22	22.5
5	25	22	22.5
5	85	22	22.5

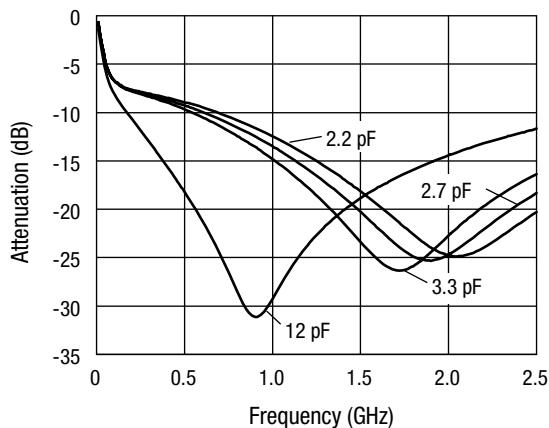
Frequency: 500 MHz.

**IP3 vs. Voltage and Temperature**

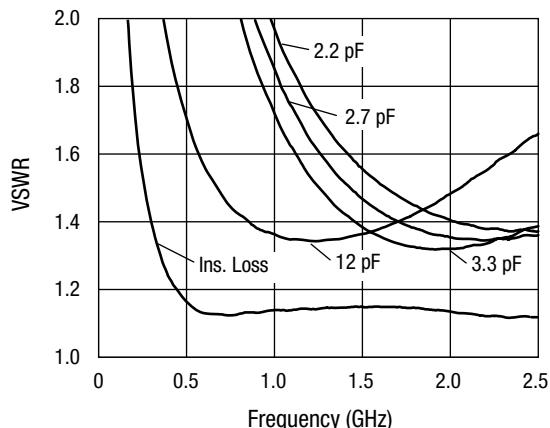
Control Voltage (V)	Temperature (°C)	IP3 @ 10 dBm each tone (dBm)
3	-40	41
3	25	42
3	85	40
5	-40	43
5	25	44
5	85	42

Two-tone input power: 10 dBm each tone.

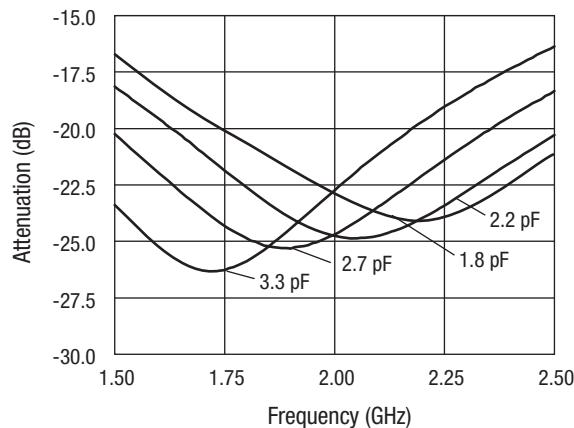
Tone frequencies: 500 and 501 MHz.



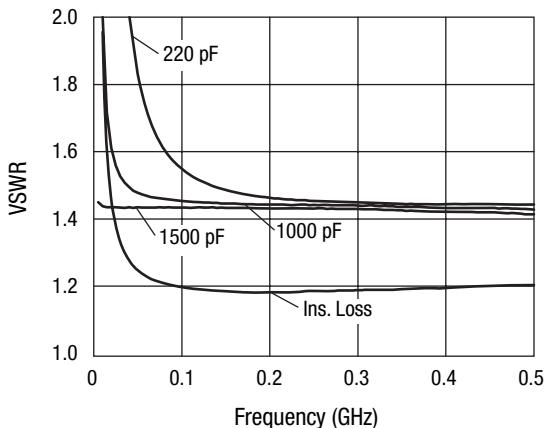
**Attenuation vs. Frequency DC-2.5 GHz**  
 **$C_{BP} = 2.2, 2.7, 3.3$  and  $12 \text{ pF}$**



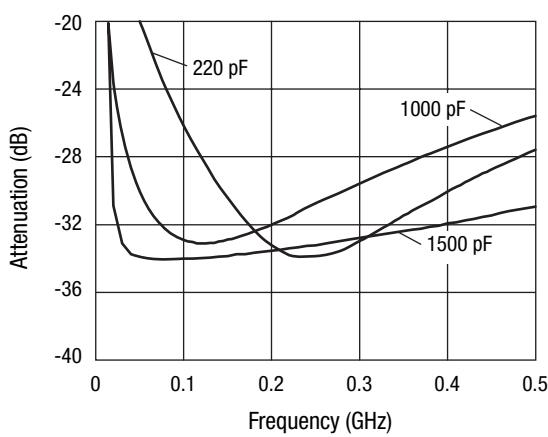
**VSWR vs. Frequency DC-2.5 GHz**  
 **$C_{BP} = 2.2, 2.7, 3.3$  and  $12 \text{ pF}$**



**Attenuation vs. Frequency 1.5-2.5 GHz**  
 **$C_{BP} = 2.2, 2.7,$  and  $3.3 \text{ pF}$**



**VSWR vs. Frequency DC-0.5 GHz**  
 **$C_{BP} = 220, 1000, 1500 \text{ pF}$**



**Attenuation vs. Frequency DC–0.5 GHz**  
 $C_{BP} = 220, 1000, 1500 \text{ pF}$

## Truth Table

### Positive Control

$V_1$	$V_2$	Attenuation $J_1-J_2$
$V_{HIGH}$	0	Reference I.L.
0	$V_{HIGH}$	32 dB

All other conditions not recommended.  
 $V_{HIGH} = 3$  to  $5 \text{ V}$ .

## 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.

$C_{BL} (\text{pF})$	$C_{BP} (\text{pF})$	Operating Frequency (GHz)
47	1.8	2.3–2.5
47	2.2	2–2.3
47	2.7	1.8–2
47	3.3	1.6–1.8
47	12	0.9–1.05
47	15	0.8–0.9
330	220	0.2–0.35
1500	1000	0.07–0.2
10000	1500	0.015–0.25

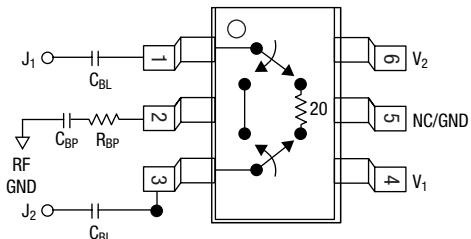
## Absolute Maximum Ratings

Characteristic	Value
RF input power	1 W > 500 MHz 0/8 V 0.5 W @ 50 MHz 0/8 V
Supply voltage	8 V
Control voltage	-0.2 V, +8 V
Operating temperature	-40 °C to +85 °C
Storage temperature	-65 °C to +150 °C

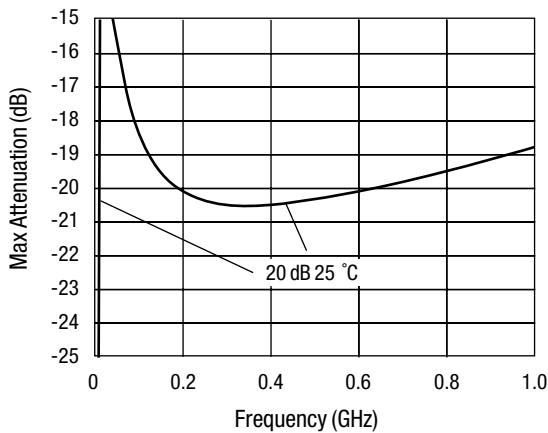
Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void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

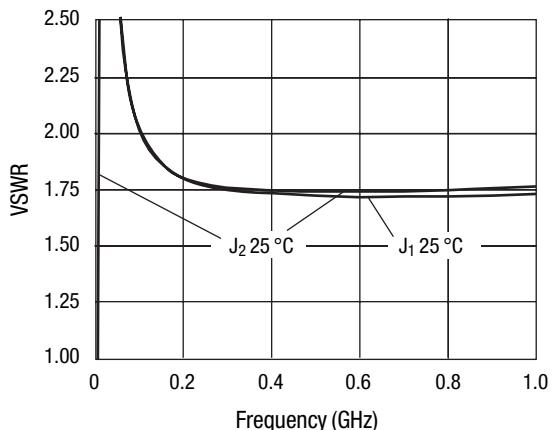
## Application: AA104-73 Used as 1-Bit 20 dB Attenuator 25 °C (0, 5 V)



$C_{BL} = 220 \text{ pF}$ ,  $C_{BP} = 100 \text{ pF}$ ,  $R_{BP} = 15 \Omega$ ,  $f_C = 400 \text{ MHz}$  with select values of  $C_{BP}$  and  $R_{BP}$ , center frequency and attenuation value respectively can be varied.

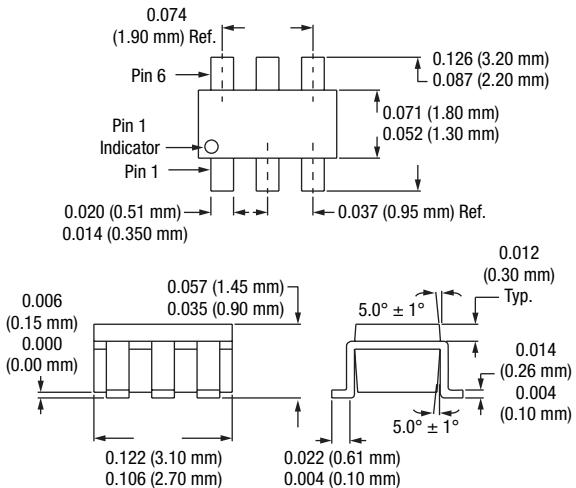


### 20 dB State vs. Frequency



## VSWR vs. Frequency 20 dB State

**SOT-6**



**PRELIMINARY DATA SHEET • AA104-73, AA104-73LF**

Copyright © 2002, 2003, 2004, 2005, 2006, 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](http://www.skyworksinc.com), are incorporated by reference.