

GaAs IC 1 Bit Digital Attenuator

32 dB DC–2.5 GHz



AA104-73

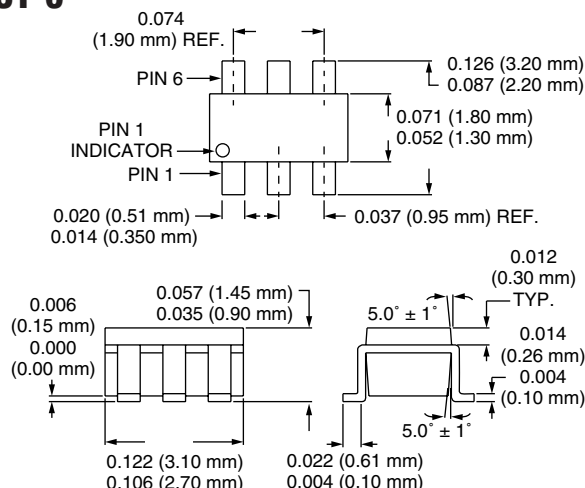
Features

- 1 Bit Attenuation of 32 dB DC–1 GHz, 27 dB 1–2 GHz, 24 dB 2–2.5 GHz
- 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

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

SOT-6



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.

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

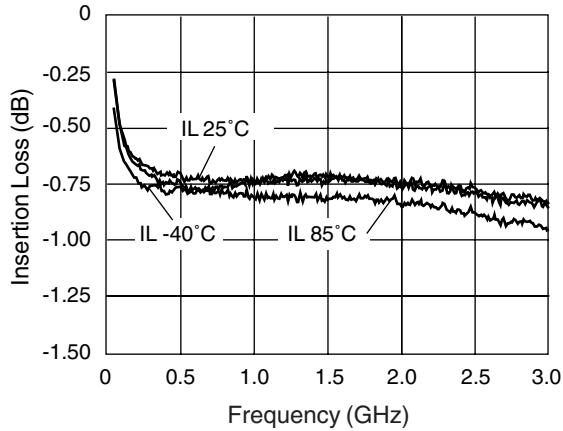
Parameter ¹	Frequency ^{2,7}	Min.	Typ.	Max.	Unit
Insertion Loss	DC–1.0 GHz		0.8	1.0	dB
	1.0–2.0 GHz		0.9	1.2	dB
	2.0–2.5 GHz		1.0	1.3	dB
Attenuation Range	DC–1.0 GHz		32		dB
	1.0–2.0 GHz		27		dB
	2.0–2.5 GHz		24		dB
Attenuation Accuracy ^{3, 4}	DC–0.5 GHz	± (0.4 + 10% of Attenuation Setting in dB)			dB
	0.85–0.95 GHz	± (0.4 + 5% of Attenuation Setting in dB)			dB
	1.7–2.0 GHz	± (0.5 + 6% of Attenuation Setting in dB)			dB
	2.0–2.5 GHz	± (0.6 + 7% of Attenuation Setting in dB)			dB
VSWR (Insertion Loss State) ⁵	DC–2.5 GHz		1.2:1	1.5:1	
VSWR (Attenuation State) ⁵	DC–2.5 GHz		1.5:1	2.0:1	

Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Switching Characteristics ⁶	Rise, Fall (10/90% or 90/10% RF)			50		ns
	On, Off (50% CTL to 90/10% RF)			100		ns
	Video Feedthru			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					
	V _S = +3 V	0.5–2.5 GHz	36	+41		dBm
	V _S = +5 V	0.5–2.5 GHz	38	+44		dBm
Control Voltages	V _{Low} = 0 to 0.2 V @ 20 µA Max. V _{High} = +3 V @ 100 µA Max. to +5 V @ 200 µA Max.					

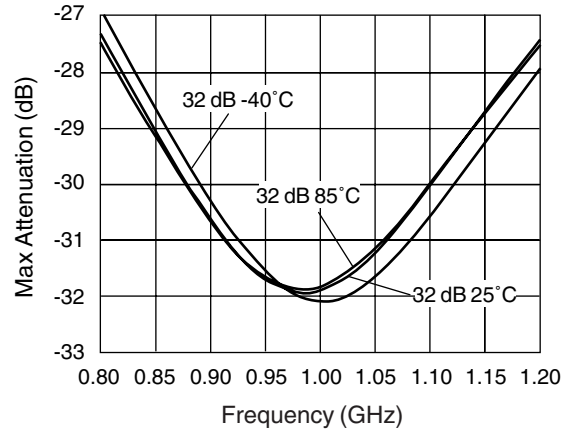
1. All measurements made in a 50 Ω system, unless otherwise specified.
2. Operates to DC when controlled with negative voltage, C_{BP} not required.
3. Attenuation value set by C_{BP}.
4. Attenuation referenced to insertion loss.

5. Input/output. In band.
6. Video feedthru measured with 1 ns risetime pulse and 500 MHz bandwidth.
7. DC = 30 KHz.

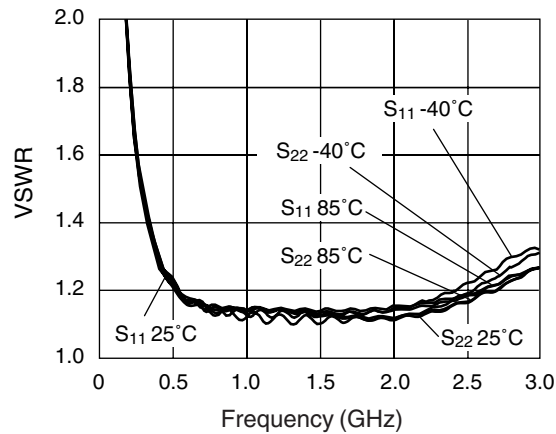
Typical Performance Data at -40 to 85°C (0, +5 V) $C_{BP} = 12$ pF, $C_{BL} = 47$ pF



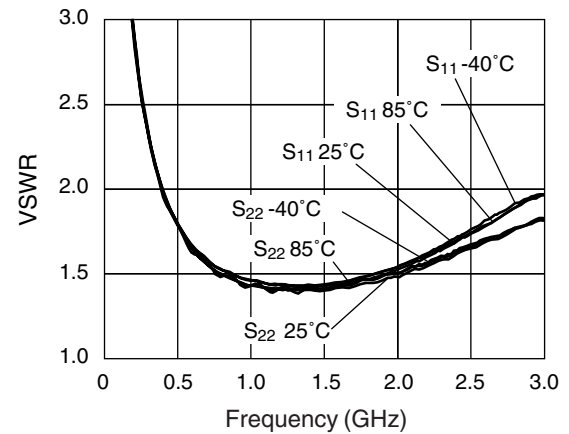
Insertion Loss vs. Frequency



32 dB State vs. Frequency



VSWR vs. Frequency
Insertion Loss State



VSWR vs. Frequency
32 dB State

Compression Point vs. Voltage and Temperature

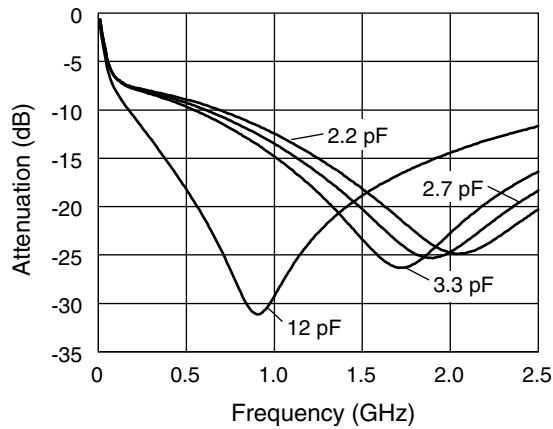
Control Voltage (V)	Temperature (°C)	1 dB Compression Insertion Loss State (dBm)	1 dB Compression 32 dB State (dBm)
3	-40	21	16.5
3	25	21	15.0
3	85	21	14.0
5	-40	22	22.5
5	25	22	22.5
5	85	22	22.5

Frequency: 500 MHz.

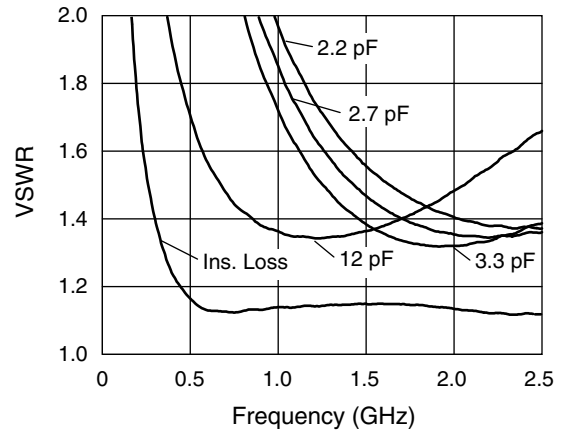
IP3 vs. Voltage and Temperature

Control Voltage (V)	Temperature (°C)	IP3 @ +10 dBm Each T one (dBm)
3	-40	41
3	25	42
3	85	40
5	-40	43
5	25	44
5	85	42

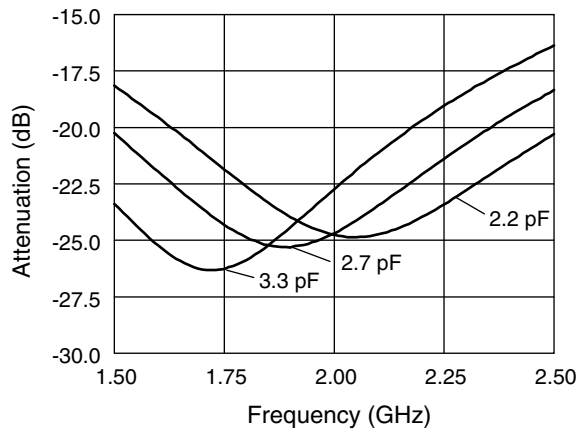
Two tone input power: +10 dBm each tone.
Tone frequencies: 500 and 501 MHz.



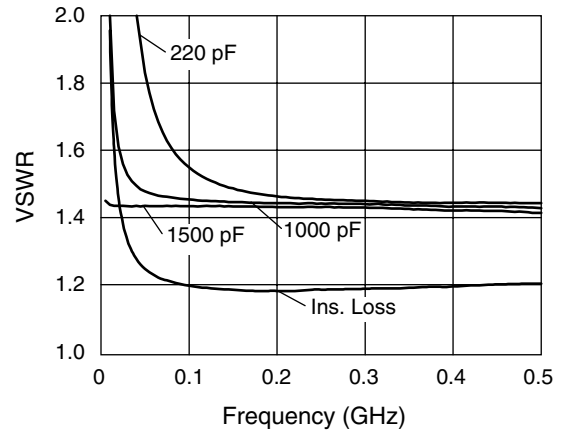
Attenuation vs. Frequency DC–2.5 GHz
C_{BP} = 2.2, 2.7, 3.3 and 12 pF



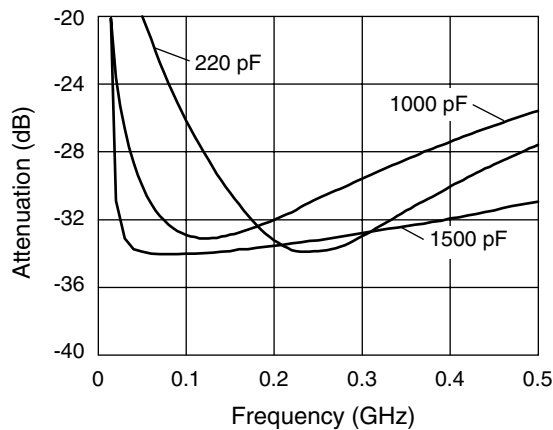
VSWR vs. Frequency DC–2.5 GHz
C_{BP} = 2.2, 2.7, 3.3 and 12 pF



Attenuation vs. Frequency 1.5–2.5 GHz
C_{BP} = 2.2, 2.7, and 3.3 pF



VSWR vs. Frequency DC–0.5 GHz
C_{BP} = 220, 1000, 1500 pF

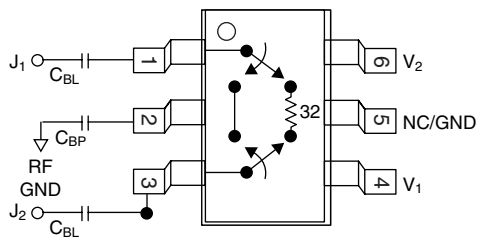


Attenuation vs. Frequency DC–0.5 GHz
C_{BP} = 220, 1000, 1500 pF

C _{BL} (pF)	C _{BP} (pF)	Operating Frequency (GHz)
47	2.2	2.00–2.30
47	2.7	1.80–2.00
47	3.3	1.60–1.80
47	12	0.90–1.05
47	15	0.80–0.90
330	220	0.20–0.35
1500	1000	0.07–0.20
10000	1500	0.015–0.25

Pin Out

Positive Voltage



C_{BL} = 47 pF for frequencies >500 MHz. See Table on previous page for C_{BP} value.
See application notes APN2013 and APN2014 for 6 bit attenuator requirements.

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

Note: Exceeding these parameters may cause irreversible damage.

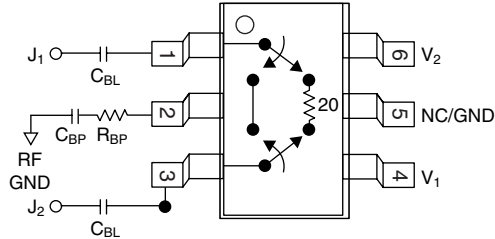
Truth Table

Positive Control

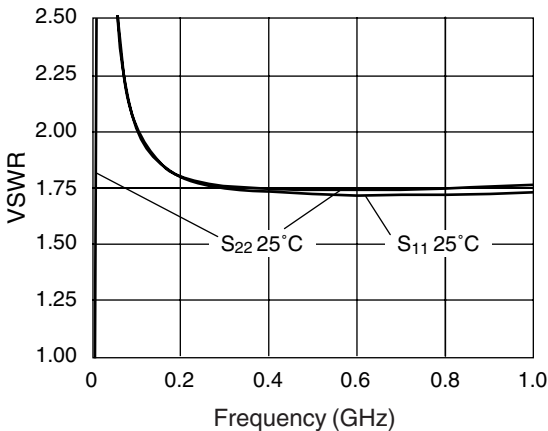
V ₁	V ₂	Attenuation J ₁ –J ₂
V _{High}	0	Reference I.L.
0	V _{High}	32 dB

V_{High} = +3 to +5 V.

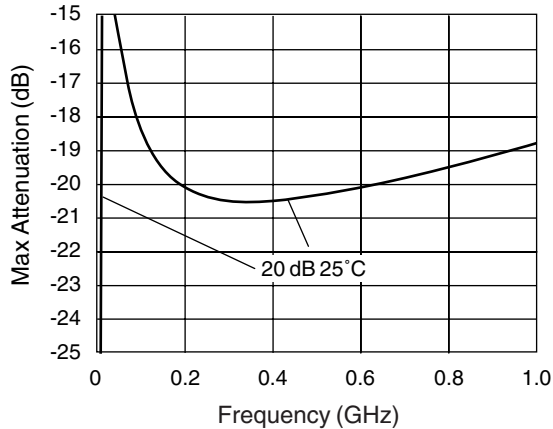
Application: AA104-73 Used as 1 Bit 20 dB Attenuator 25°C (0, +5 V)



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



VSWR vs. Frequency
20 dB State



20 dB State vs. Frequency
C_{BP} = 100 pF, C_{BL} = 220 pF, R_{BP} = 15 Ω