

# GaAs IC 5 Bit Digital Attenuator with Driver 1 dB LSB Positive Control DC–2 GHz



AA117-85

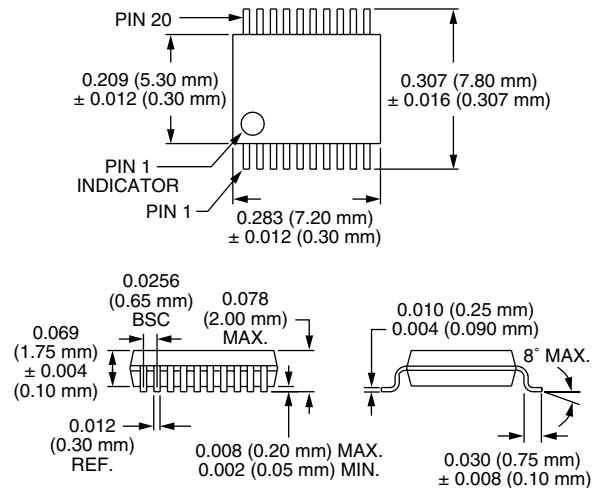
## Features

- Attenuation 1 dB Steps to 31 dB With High Accuracy
- Single Positive Control (+3 V or +5 V) for Each Bit
- Low DC Power Consumption
- CMOS Integrated Silicon Driver, Positive and Negative Supplies Required
- Designed for Use at IF Frequencies
- High Noise Linearity @  $P_{IN} < -10$  dBm

## Description

The AA117-85 is a 5 bit, single positive control GaAs IC FET digital attenuator with driver. It is particularly suited at IF frequencies where high attenuation accuracy, low insertion loss and low intermodulation products are required. Typical applications include base station, wireless data, broadband and wireless local loop gain control circuits. For single supply design and higher input signal levels, see AA110-85.

## SSOP-20



**Electrical Specifications at -40°C to +85°C ( $V_{CC} = +5\text{ V}$ ,  $V_{SS} = -3\text{ V}$ )**

Parameter <sup>1</sup>	Condition	Frequency	Min.	Typ.	Max.	Unit
Insertion Loss <sup>2</sup>		DC–0.5 GHz		1.4	1.7	dB
		DC–1.0 GHz		1.7	2.1	dB
		DC–2.0 GHz		2.2	2.6	dB
Attenuation Range				31		dB
Attenuation Accuracy <sup>3</sup>		DC–0.5 GHz	± (0.2 + 2% of Attenuation Setting in dB)			dB
		DC–1.0 GHz	± (0.25 + 3% of Attenuation Setting in dB)			dB
		DC–2.0 GHz	± (0.4 + 6% of Attenuation Setting in dB)			dB
VSWR (I/O) <sup>4</sup>		DC–2.0 GHz		1.5:1	1.8:1	
Switching Characteristics <sup>5</sup>	Rise, Fall (10/90% or 90/10% RF) On, Off (50% CTL to 90/10% RF) Video Feedthru			15		ns
				50		ns
				50		mV
Input Power for 1 dB Compression	$V_{CC} = +5\text{ V}$ , $V_{SS} = -3\text{ V}$	0.5–2.0 GHz 0.05 GHz	+22 +16	+27 +20		dBm dBm
Intermodulation Intercept Point (IP3)	For Two-tone Input Power +5 dBm $V_{CC} = +5\text{ V}$	0.5–2.0 GHz 0.05 GHz	+40 +28	+46 +34		dBm dBm
Supply Voltages <sup>6</sup>	$V_{CC}$		2.5	3.0	5.0	V
	$V_{SS}$		-2.5	-3.0	-3.5	V
Supply Currents	$V_{CC} = 5\text{ V}$ , $V_{SS} = -3\text{ V}$			1.5		mA
	$V_{CC} = 3\text{ V}$ , $V_{SS} = -3\text{ V}$			1.0		mA
Control Voltages <sup>7</sup>	$V_{CC} = 5\text{ V}$ , $V_{SS} = -3\text{ V}$ CTL1, CTL2, CTL4, CTL8, CTL16 = Logic 0		0		0.8	V
	CTL1, CTL2, CTL4, CTL8, CTL16 = Logic 1		2.5	3.0	5.0	V

1. All measurements made in a 50  $\Omega$  system, unless otherwise specified.

2. Insertion loss changes by 0.003 dB/°C.

3. Attenuation referenced to insertion loss.

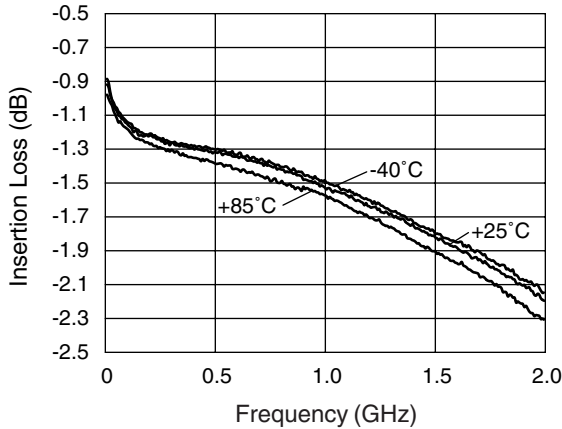
4. Input/output.

5. Video feedthru measured with 1 ns risetime pulse and 500 MHz bandwidth.

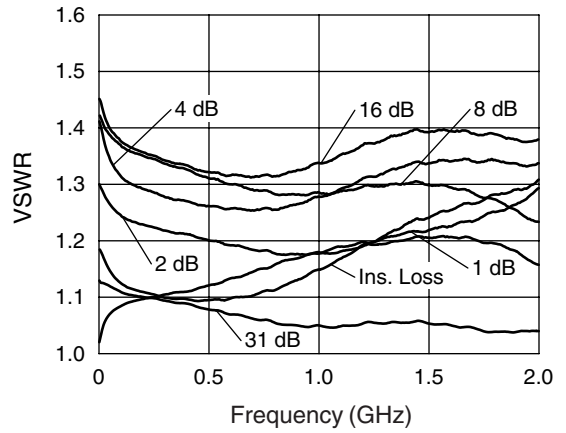
6.  $V_{CC}$  must be supplied prior to  $V_{SS}$ .

7. Control voltage must not exceed  $V_{CC}$ .

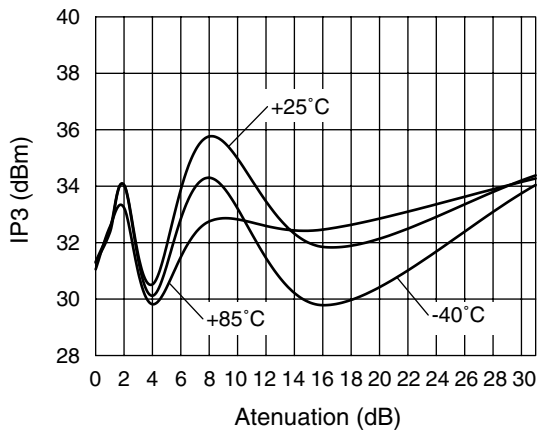
**Typical Performance Data ( $V_{CC} = +5 V$ )**



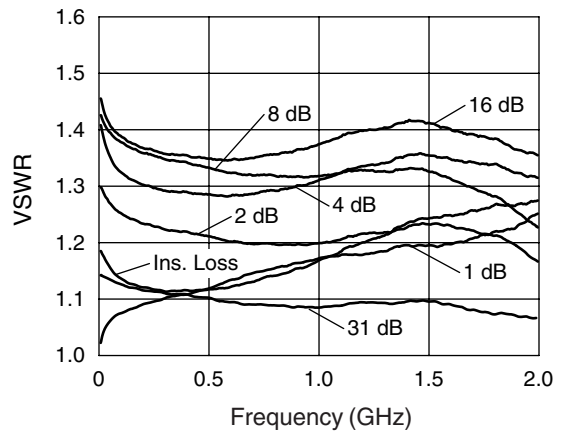
**Insertion Loss vs. Frequency**



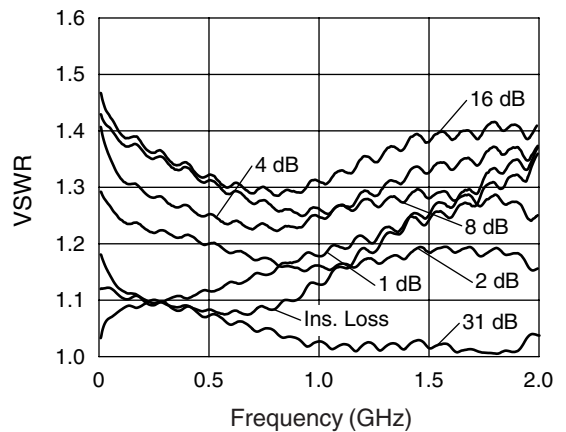
**VSWR vs. Frequency (25°C)**



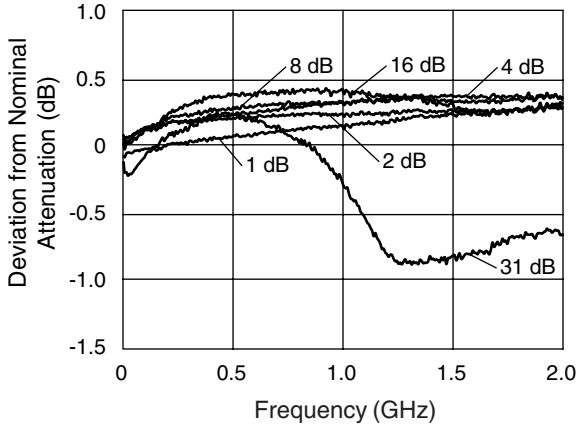
**IP3 vs. Attenuation and Temperature, Main Bits (50 MHz)  $V_{CC} = +5 V$**



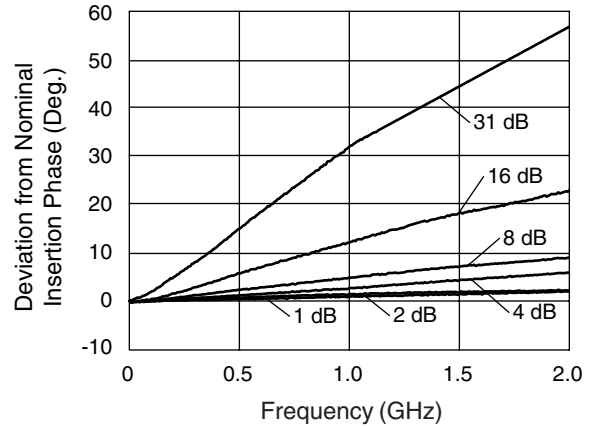
**VSWR vs. Frequency (85°C)**



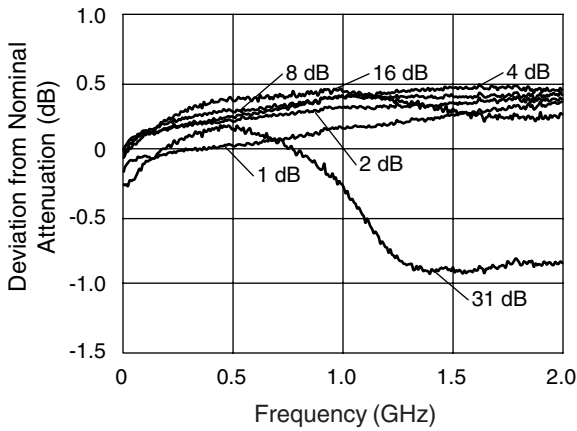
**VSWR vs. Frequency (-40°C)**



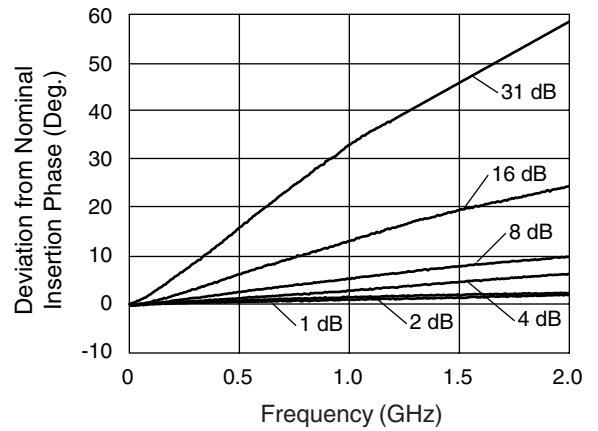
**Attenuation Accuracy vs. Frequency (25°C)**



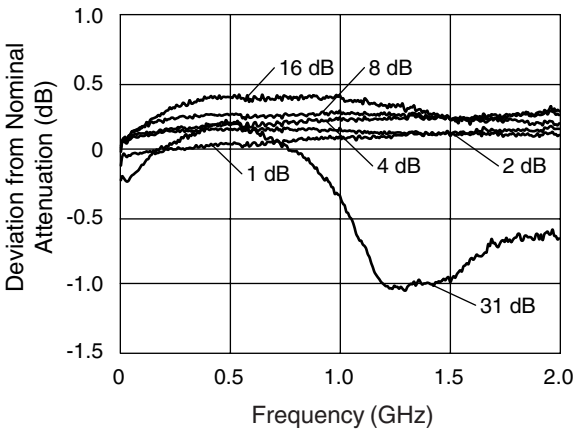
**Attenuation Phase Accuracy vs. Frequency (25°C)**



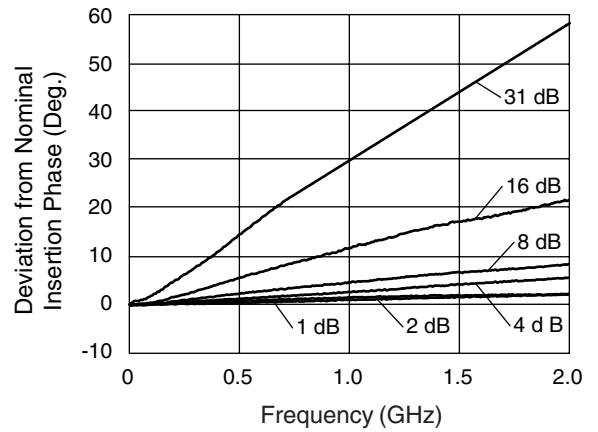
**Attenuation Accuracy vs. Frequency (85°C)**



**Attenuation Phase Accuracy vs. Frequency (85°C)**

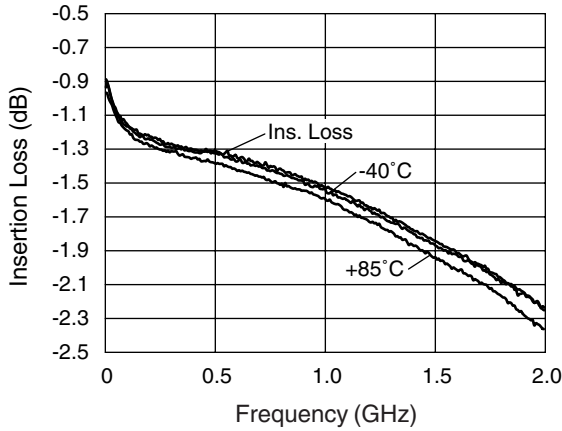


**Attenuation Accuracy vs. Frequency (-40°C)**

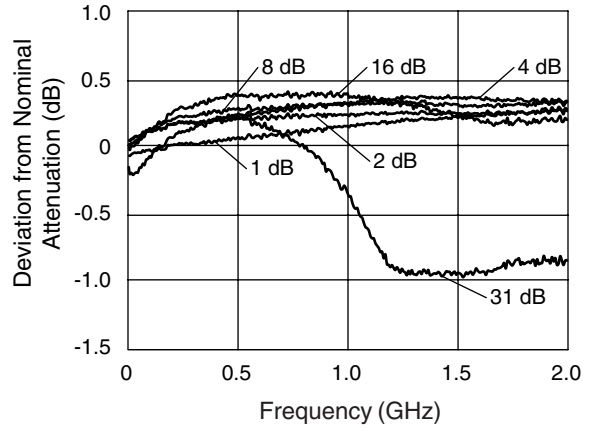


**Attenuation Phase Accuracy vs. Frequency (-40°C)**

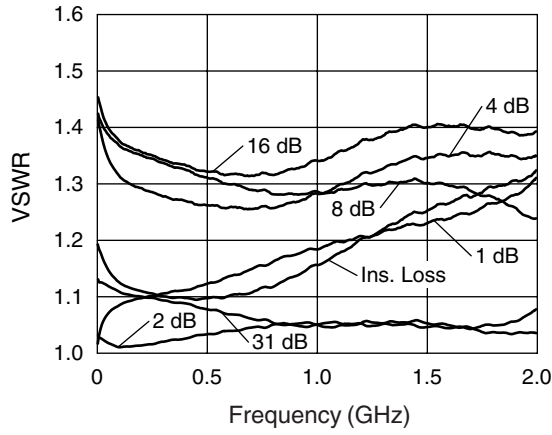
**Typical Performance Data ( $V_{CC} = +3\text{ V}$ )**



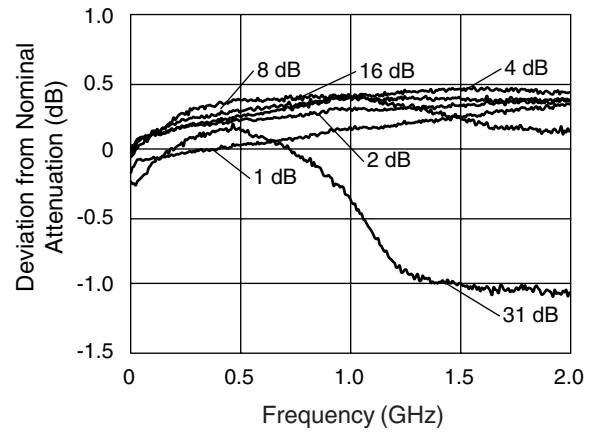
**Insertion Loss vs. Frequency**



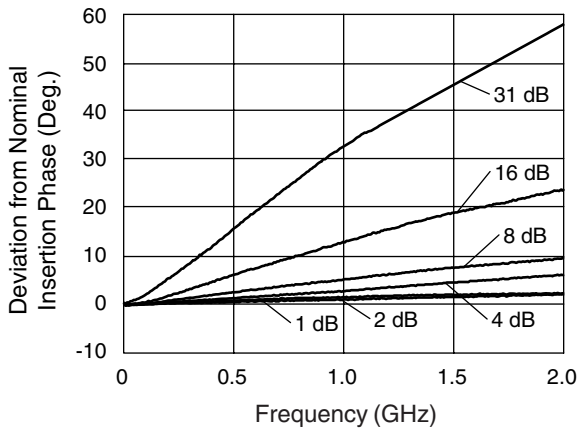
**Attenuation Accuracy vs. Frequency (25°C)**



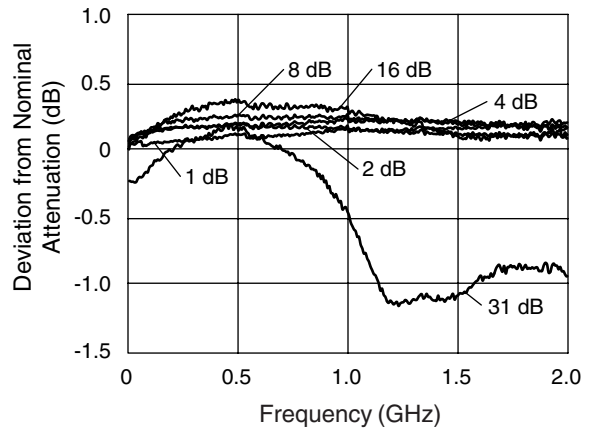
**VSWR vs. Frequency (25°C)**



**Attenuation Accuracy vs. Frequency (85°C)**



**Attenuation Phase Accuracy vs. Frequency (25°C)**



**Attenuation Accuracy vs. Frequency (-40°C)**

## Compression Point vs. Attenuation, Voltage, and Temperature

Attenuation State	V <sub>SS</sub> Voltage (V)	Input Power @ 1 dB Compression		
		+25°C (dBm)	+85°C (dBm)	-40°C (dBm)
Ins. Loss	-3	16.6	16.6	16.5
1 dB	-3	17.5	17.5	17.5
2 dB	-3	18.9	19	18.8
4 dB	-3	16.3	16.6	16.3
8 dB	-3	20.6	21.1	21.8
16 dB	-3	15.5	15.1	16.2
31 dB	-3	20.2	19.9	20.1

Frequency = 50 MHz.

## Absolute Maximum Ratings

Characteristic	Value
RF Input Power	2 W > 500 MHz, 0/6 V 0.5 W > 50 MHz, 0/6 V
Supply Voltage	6 V
Control Voltage <sup>1</sup>	-0.2 V, +6 V
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
θ <sub>JC</sub>	85°C/W

Note: Exceeding these ratings may cause irreversible damage.

1. Control voltage must not exceed supply voltage.

## Truth Table

CTL1	CTL2	CTL4	CTL8	CTL16	Attenuation J <sub>1</sub> -J <sub>2</sub>
0	0	0	0	0	Ins. Loss
1	0	0	0	0	1 dB
0	1	0	0	0	2 dB
0	0	1	0	0	4 dB
0	0	0	1	0	8 dB
0	0	0	0	1	16 dB
1	1	1	1	1	31 dB

## Pin Out

