

**DATA SHEET**

# SKY12323-303LF: GaAs Digital Attenuator

## 500 MHz–3 GHz 5 Bits, 1 dB LSB

### Features

- Broadband: 500 MHz–3 GHz
- Attenuation range: 31 dB
- Least significant bit attenuation: 1 dB
- Low insertion loss: 1.4 dB @ 900 MHz
- Single positive control voltage: 2.7–5.5 V
- Low current consumption: <100  $\mu$ A @ 3 V
- Small MSOP-10 package with exposed paddle
- Available lead (Pb)-free and RoHS-compliant MSL-1 @ 260 °C per JEDEC J-STD-020

### Applications

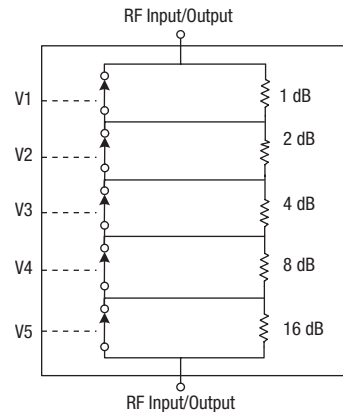
- Transceiver transmit automatic level control or receive automatic gain control in GSM, CDMA, WCDMA, WLAN, Bluetooth®, Zigbee®, land mobile radio base stations or terminal equipment
- General purpose signal attenuation in telecommunications and instrumentation applications

### Description

The SKY12323-303LF is a monolithic GaAs, binary-weighted, 5-bit, single positive control voltage digital attenuator which operates from 500 MHz–3 GHz. The attenuator has a least significant bit (LSB) of 1 dB and total attenuation of 31 dB. The two RF ports are bilateral; each can be used as the RF input or the RF output. This attenuator requires an external supply voltage of 2.7–5.5 V

The SKY12323-303LF is comprised of five fixed attenuators in cascade, each of which having a shunt bypass switch. Beginning at the LSB, which is 1 dB, each succeeding fixed attenuator produces twice the attenuation of the preceding stage. The state of each

### Functional Block Diagram




bypass switch is controlled by the logic level voltage applied to the associated control voltage input; a logic high voltage closes the associated switch, thereby bypassing that fixed attenuator stage, and a logic low opens the switch to force the input signal to that stage through the associated attenuator.

DC power consumption is very low, 100  $\mu$ A maximum with control voltage and supply voltage of 3 V. The switch can operate over the temperature range of -40 C to +85 C.

An evaluation board is available upon request.

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



### Electrical Specifications at 25°C

**V<sub>CTL</sub> = 0 V/3V, T = 25 °C, P<sub>INPUT</sub> = 0 dBm, Z<sub>0</sub> = 50 Ω, unless otherwise noted**

Parameter	Frequency	Min.	Typ.	Max.	Unit
Insertion loss	500 MHz–1 GHz		1.4	2.0	dB
	1–2 GHz		1.5	2.5	dB
	2–3 GHz		2.3	3.0	dB
Attenuation range <sup>(1)</sup>			31		dB
Attenuation accuracy <sup>(1)</sup>	500 MHz–3 GHz	± (0.3 + 5% of attenuation setting in dB)			dB
Return loss	500 MHz–3 GHz	7			dB

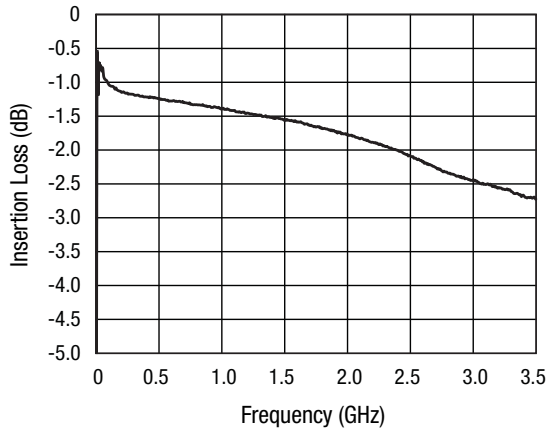
1. Attenuation referenced to insertion loss.

### Operating Characteristics at 25°C

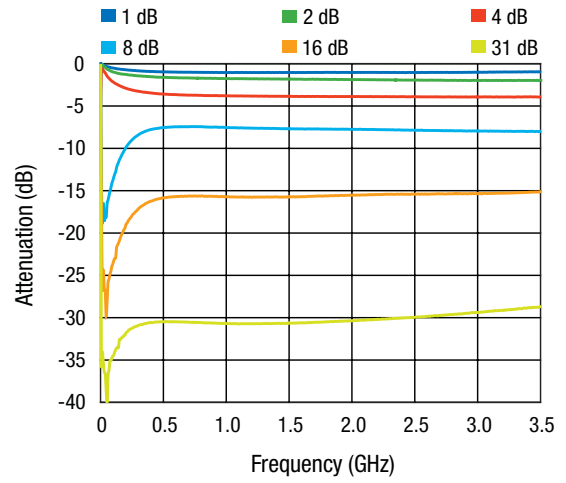
**V<sub>CTL</sub> = 0 V/3V, T = 25 °C, P<sub>INPUT</sub> = 0 dBm, Z<sub>0</sub> = 50 Ω, unless otherwise noted**

Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Switching characteristics						
Rise, fall	10/90% or 90/10% RF			150		ns
On, off	50% CTL to 90/10% RF			300		ns
Video feedthru	T <sub>RISE</sub> = 1 ns, BW = 500 MHz			70		mV
Input power for 1 dB compression	V <sub>LOW</sub> = 0 V, V <sub>HIGH</sub> = 3 V	0.9–2.4 GHz		30		dBm
	V <sub>LOW</sub> = 0 V, V <sub>HIGH</sub> = 5 V	0.9–2.4 GHz		33		dBm
Intermodulation intercept point (IP3)	For two-tone input power 5 dBm, Δf = 1 MHz					
	V <sub>LOW</sub> = 0 V, V <sub>HIGH</sub> = 3 V	0.9–2.4 GHz		41		dBm
	V <sub>LOW</sub> = 0 V, V <sub>HIGH</sub> = 5 V	0.9–2.4 GHz		45		dBm
Thermal resistance				25		°C/W
Supply voltage (V <sub>S</sub> )			V <sub>HIGH</sub> - 0.2		V <sub>HIGH</sub> + 0.2	V
Control voltages	V <sub>LOW</sub> = 0 V @ 20 μA max. V <sub>HIGH</sub> = 3 V @ 100 μA max. to 5 V @ 200 μA max. V <sub>HIGH</sub> = 0.2 ≤ V <sub>S</sub> ≤ V <sub>HIGH</sub> + 0.2 V					

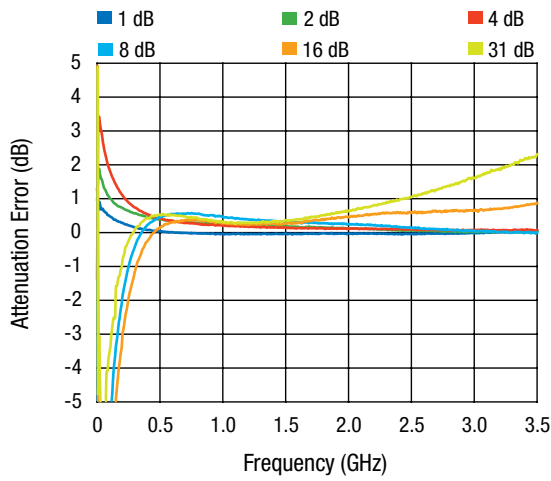
**Typical Performance Data**



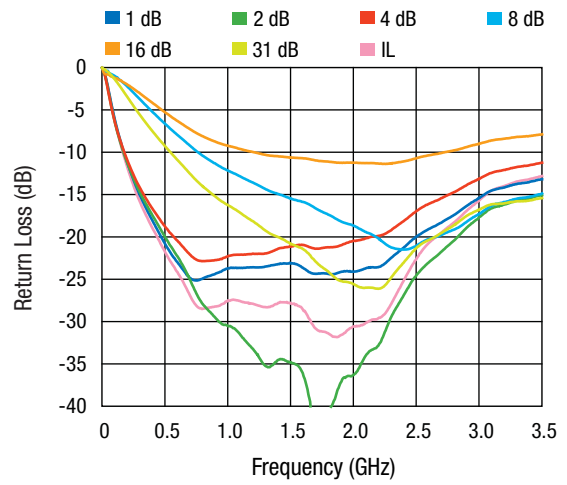
**Insertion Loss vs. Frequency**



**Attenuation vs. Frequency, Normalized to Insertion Loss**



**Attenuation Accuracy vs. Frequency**



**Return Loss vs. Frequency**

### Absolute Maximum Ratings

Characteristic	Value
RF input power	35 dBm for $f > 500$ MHz, $V_{CTL} = 0/8$ V 30 dBm for $f < 500$ MHz, $V_{CTL} = 0/8$ V
Supply voltage	$V_{HIGH} \pm 0.2$ V
Control voltage	$-0.2$ V $\leq V_C \leq 8$ 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.

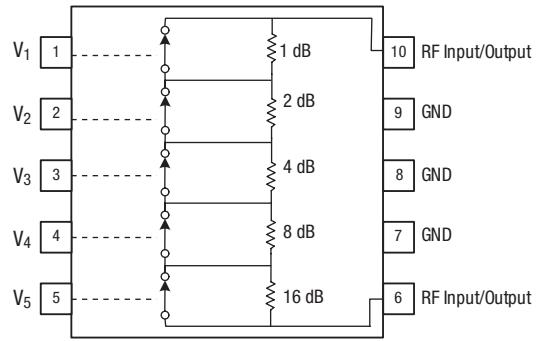
**CAUTION:** Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without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

### Truth Table

V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>	J <sub>1</sub> -J <sub>2</sub>
V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	Reference I.L.
V <sub>LOW</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	1 dB
V <sub>HIGH</sub>	V <sub>LOW</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	2 dB
V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>LOW</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	4 dB
V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>LOW</sub>	V <sub>HIGH</sub>	8 dB
V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>HIGH</sub>	V <sub>LOW</sub>	16 dB
V <sub>LOW</sub>	V <sub>LOW</sub>	V <sub>LOW</sub>	V <sub>LOW</sub>	V <sub>LOW</sub>	31 dB

$3$  V  $\leq V_{HIGH} \leq 5$  V,  $V_S = V_{HIGH} \pm 0.2$  V,  $0 \leq V_{LOW} \leq 0.2$  V.

### Pin Out



### Pin Descriptions

Pin Number	Pin Name	Description
1	V <sub>1</sub>	Control Voltage – High Impedance control voltage input for 1 dB weighted bit (LSB)
2	V <sub>2</sub>	Control Voltage – High Impedance control voltage input for 2 dB weighted bit
3	V <sub>3</sub>	Control Voltage – High Impedance control voltage input for 4 dB weighted bit
4	V <sub>4</sub>	Control Voltage – High Impedance control voltage input for 8 dB weighted bit
5	V <sub>5</sub>	Control Voltage – High Impedance control voltage input for 16 dB weighted bit (MSB)
6	J <sub>2</sub>	RF Input/Output – RF input or output port, supply voltage input if not supplied to pin 10
7, 8, 9	GND	Equipotential Point – Equipotential points for control voltages and RF circuits. Must be connected to pcb ground via lowest possible impedance
10	J <sub>1</sub>	RF Input/Output – RF input or output port. Supplied voltage input if not supplied to pin 6

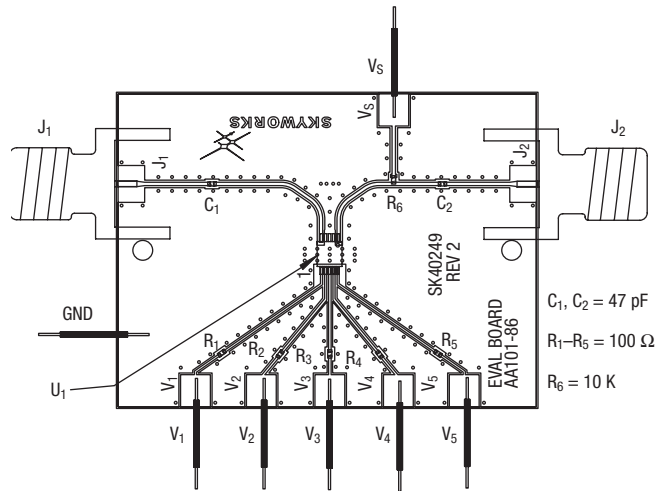
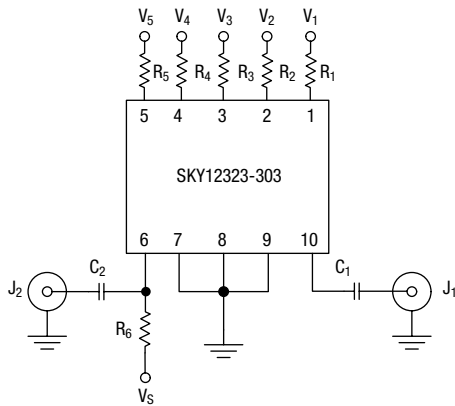
### Evaluation Board

The evaluation board for SKY12323-303LF allows the part to be fully exercised. The RF signal may be applied to J<sub>1</sub> or to J<sub>2</sub> without change in performance. The supply voltage (V<sub>S</sub>) is applied to pin 6 via R<sub>6</sub>. DC blocking capacitors (C<sub>1</sub> and C<sub>2</sub>) are required at the RF ports. The values of R<sub>6</sub>, C<sub>1</sub> and C<sub>2</sub> are shown in the Evaluation Board Components table.

The attenuation produced by the SKY12323-303LF is determined by the voltages applied to the high impedance control voltage ports

V<sub>1</sub> through V<sub>5</sub>. Each control voltage port determines whether its associated attenuation bit, as listed in the Truth Table, is switched into or out of the RF signal path. Each of these control voltage ports must be held at 0 V (V<sub>LOW</sub>) or at V<sub>S</sub> ± 0.2 V (V<sub>HIGH</sub>). The supply voltage must be within 0.2 V of V<sub>HIGH</sub> or damage may result. Any combination of V<sub>HIGH</sub> and V<sub>LOW</sub> may be applied to ports V<sub>1</sub> through V<sub>5</sub>. For example, if the desired attenuation value is 7 dB, V<sub>LOW</sub> is applied to the 1 dB, 2 dB and 4 dB voltage control ports, which are V<sub>1</sub>, V<sub>2</sub> and V<sub>3</sub>, respectively. V<sub>HIGH</sub> is applied to the remaining voltage control ports to ensure that their attenuation bits are not switched in to the RF signal path.

### Evaluation Circuit PCB



### Evaluation Board Components

Component	Description	Default
C <sub>1</sub> , C <sub>2</sub>	DC blocking capacitor	47 pF, size 0402
R <sub>6</sub>	RF block	10k Ω, size 0402
U <sub>1</sub>	GaAs digital attenuator	
J <sub>1</sub> , J <sub>2</sub>	SMA connectors	

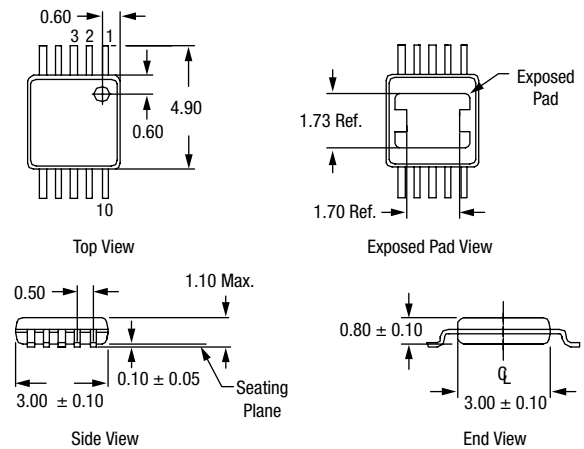
### Recommended Solder Reflow Profiles

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.

### Outline Drawing



All dimensions in mm.

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