DATA SHEET

SKY12322-86LF: GaAs Digital Attenuator 500 MHz–4 GHz 5 Bits, 0.5 dB LSB

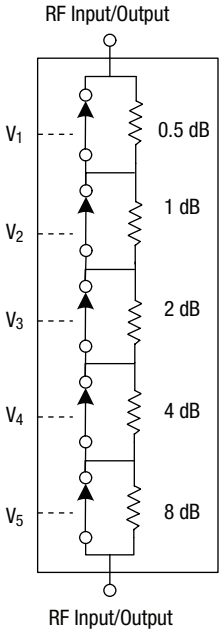
Features

- Broadband: 500 MHz–4 GHz
- Single positive control voltage: 2.7–5.5 V
- Low current consumption: <100 µA @ 3 V
- Small MSOP-10 package
- Least significant bit attenuation: 0.5 dB
- Attenuation range: 15.5 dB
- High Input IP3: 45 dBm
- 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

Functional Block Diagram



Description

The SKY12322-86LF is a monolithic GaAs, binary-weighted, 5-bit, single-positive-control voltage digital attenuator which operates from 500 MHz to 4 GHz. The attenuator has a least significant bit (LSB) of 0.5 dB and total attenuation of 15.5 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 SKY12322-86LF is comprised of 5 fixed attenuators in cascade, each of which having a shunt bypass switch. Beginning at the LSB, which is 0.5 dB, each succeeding fixed attenuator produces twice the attenuation of the preceding stage. The state of each 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 µA 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.

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Now available for purchase online.

Electrical Specifications at 25°C

V_{CTL} = 0 V/3 V, T = 25 °C, P_{INPUT} = 0 dBm, Z_0 = 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
	3–4 GHz		3.0	3.5	dB
Attenuation range[1]			15.5		dB
Attenuation accuracy[1]	500 MHz–1 GHz		± (0.2 + 3% of attenuation setting in dB)		dB
	1–3 GHz		± (0.3 + 5% of attenuation setting in dB)		dB
	3–4 GHz		± (0.5 + 5% of attenuation setting in dB)		dB
Return loss	500 MHz–4 GHz	10	20		dB

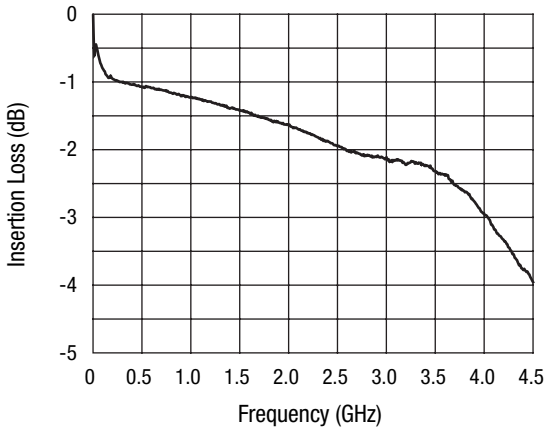
1. Attenuation referenced to insertion loss.

Operating Characteristics at 25°C

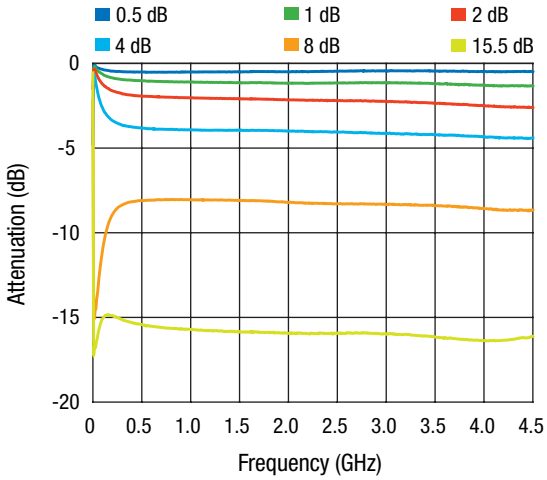
V_{CTL} = 0 V/3 V, T = 25 °C, P_{INPUT} = 0 dBm, Z_0 = 50 Ω, unless otherwise noted

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_{RISE} = 1 ns, BW = 500 MHz			70		mV
Input power for 1 dB compression	V_{LOW} = 0 V, V_{HIGH} = 3 V	0.9–4.0 GHz		21		dBm
	V_{LOW} = 0 V, V_{HIGH} = 5 V	0.9–4.0 GHz		27		dBm
Intermodulation intercept point (IP3)	For two-tone input power 5 dBm, Δf = 1 MHz					
	V_{LOW} = 0 V, V_{HIGH} = 3 V	0.9–4.0 GHz		45		dBm
	V_{LOW} = 0 V, V_{HIGH} = 5 V	0.9–4.0 GHz		45		dBm
Thermal resistance				25		°C/W
Supply voltage			V_{HIGH} - 0.2		V_{HIGH} + 0.2	V
Control voltages	V_{LOW} = 0 V @ 20 µA max. V_{HIGH} = 3 V @ 100 µA max. to 5 V @ 200 µA max. V_{HIGH} = 0.2 ≤ V_S ≤ V_{HIGH} + 0.2 V					

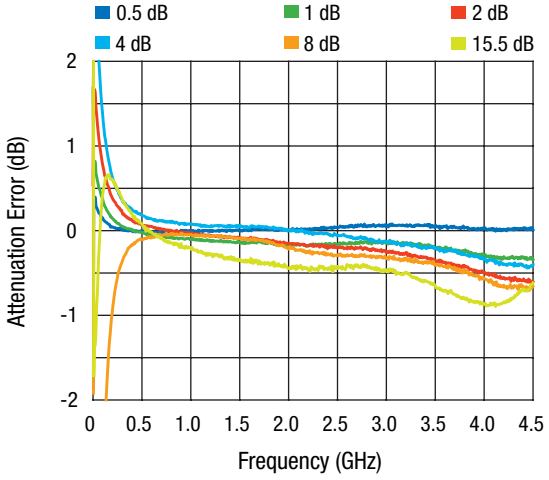
Typical Performance Data



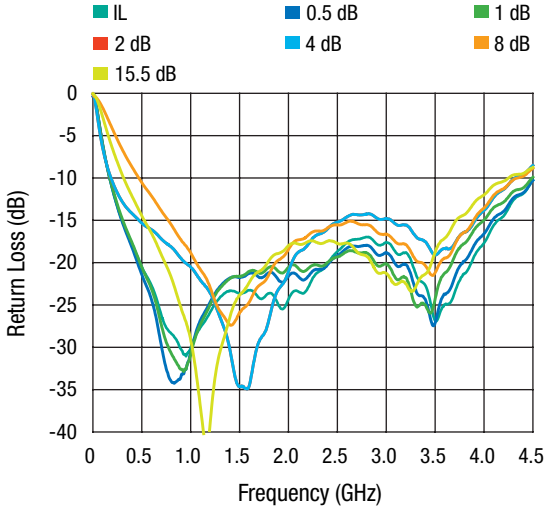
Insertion Loss vs. Frequency



Attenuation vs. Frequency, Normalized to Insertion Loss



Attenuation vs. Frequency, Normalized to Insertion Loss



Insertion Loss vs. Frequency

Absolute Maximum Ratings

Characteristic	Value
RF input power	1 W for f > 500 MHz, V_{CTL} = 0/8 V 0.5 W for f < 500 MHz, V_{CTL} = 0/8 V
Supply voltage	V_{HIGH} ± 0.2 V
Control voltage	-0.2 V ≤ V_C ≤ 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.

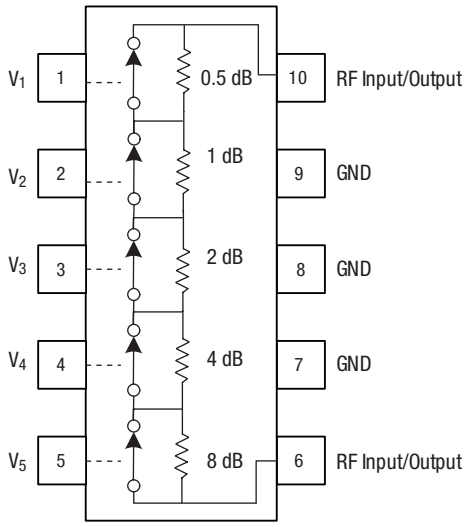
CAUTION: *Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without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

Truth Table

V_1	V_2	V_3	V_4	V_5	Nominal Attenuation
V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	Reference I.L.
V_{LOW}	V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	0.5 dB
V_{HIGH}	V_{LOW}	V_{HIGH}	V_{HIGH}	V_{HIGH}	1 dB
V_{HIGH}	V_{HIGH}	V_{LOW}	V_{HIGH}	V_{HIGH}	2 dB
V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{LOW}	V_{HIGH}	4 dB
V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{LOW}	8 dB
V_{LOW}	V_{LOW}	V_{LOW}	V_{LOW}	V_{LOW}	15.5 dB

3 V ≤ V_{HIGH} ≤ 5 V, V_S = V_{HIGH} ± 0.2 V, 0 ≤ V_{LOW} ≤ 0.2 V.

Pin Out



Pin Descriptions

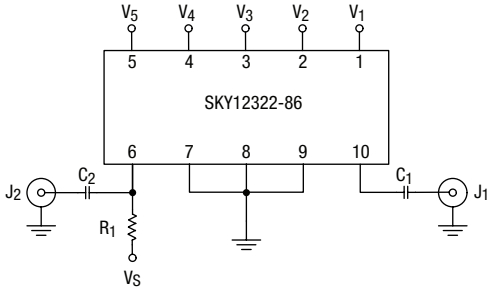
Pin Number	Pin Name	Description
1	V_1	Control Voltage – High Impedance control voltage input for 0.5 dB weighted bit (LSB)
2	V_2	Control Voltage – High Impedance control voltage input for 1 dB weighted bit
3	V_3	Control Voltage – High Impedance control voltage input for 2 dB weighted bit
4	V_5	Control Voltage – High Impedance control voltage input for 4 dB weighted bit
5	V_5	Control Voltage – High Impedance control voltage input for 8 dB weighted bit (MSB)
6	J_2	RF Input/Output – RF input or output port, supply voltage input
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_1	RF Input/Output – RF input or output port

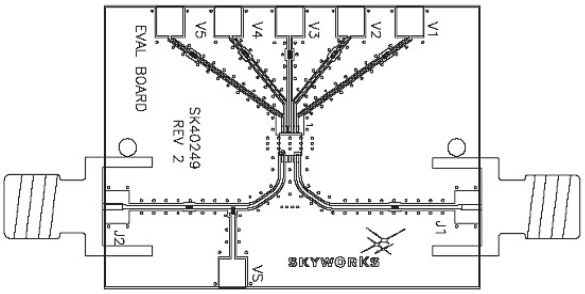
Evaluation Board

The evaluation board for SKY12322-86 allows the part to be fully exercised. The RF signal may be applied to J_1 or to J_2 without change in performance. The supply voltage (V_S) is applied to pin 6 via R_1. DC blocking capacitors (C_1 and C_2) are required at the RF ports. The values of R_1, C_1 and C_2 are shown in Evaluation Board Components Table.

The attenuation produced by the SKY12322-86 is determined by the voltages applied to the high impedance control voltage ports V_1 through V_5. 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_{LOW}) or at V_S ± 0.2 V (V_{HIGH}). The supply voltage must be within 0.2 V of V_{HIGH} or damage may result. Any combination of V_{HIGH} and V_{LOW} may be applied to ports V_1 through V_5. For example, if the desired attenuation value is 5.5 dB, V_{LOW} is applied to the 0.5 dB, 1 dB and 4 dB voltage control ports, which are V_1, V_2 and V_4, respectively. V_{HIGH} 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

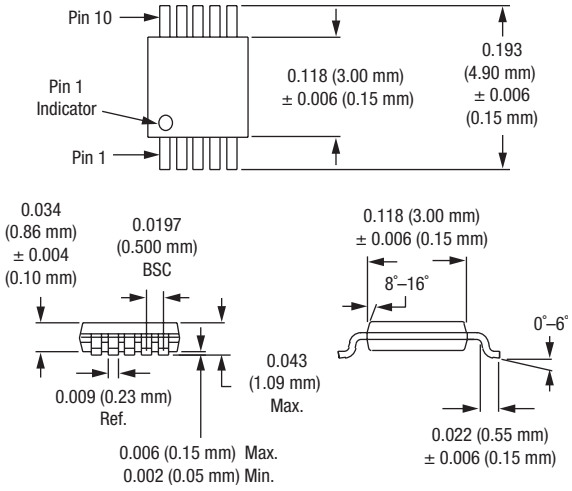




Evaluation Board Components

Component	Description	Default
C_1, C_2	DC blocking capacitor	47 pF, size 0402
R_1	RF block	10k Ω, size 0402
U_1	GaAs digital attenuator	
J_1, J_2	SMA connectors	

MSOP-10



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.

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