DATA SHEET

SKY12329-350LF: GaAs Digital Attenuator 5-Bit, 1 dB LSB 400 MHz–4 GHz

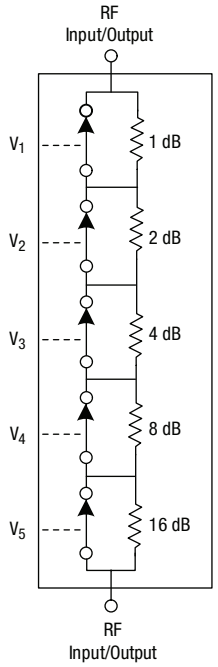
Applications

- Transceiver transmit automatic level control or receive automatic gain control in WiMAX, GSM, CDMA, WCDMA, WLAN, Bluetooth®, Zigbee®, Land Mobile Radio Base stations or Terminal Equipment
- General purpose signal attenuation in telecommunications and instrumentation applications

Features

- Broadband: 400 MHz–4 GHz
- Attenuation range: 31 dB
- Least significant bit attenuation: 1 dB
- Low insertion loss: 1.2 dB @ 900 MHz
- Single positive control voltage: 2.7–5.5 V
- Low current consumption: <100 µA @ 5 V
- Small QFN-16 3 x 3 mm package with exposed paddle
- Lead (Pb)-free and RoHS-compliant MSL-1 @ 260 °C per JEDEC J-STD-020

Functional Block Diagram



Description

The SKY12329-350LF is a monolithic GaAs, binary-weighted, 5-bit, single positive control voltage digital attenuator which operates from 400 MHz–4 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 SKY12329-350LF is comprised of 5 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 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 5 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

V_{CTL} = 0 V/5 V, T = 25 °C, P_{INPUT} = 0 dBm, Z_O = 50 Ω, unless otherwise noted

Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Insertion loss		0.4–1.0 GHz 1.0–2.0 GHz 2.0–3.0 GHz 3.0–4.0 GHz		1.2 1.5 1.8 2.7	1.6 1.9 2.2 3.1	dB dB dB dB
Attenuation range				31		dB
Attenuation accuracy	Attenuation referred to insertion loss. All attenuation states All attenuation states 1–15 dB attenuation states 16–31 dB attenuation states	 0.4–1.0 GHz 1.0–3.0 GHz 3.0–4.0 GHz 3.0–4.0 GHz	 ± (0.35 + 3% of attenuation setting in dB) ± (0.3 + 3% of attenuation setting in dB) ± (0.5 + 5% of attenuation setting in dB) ± (0.6 + 6% of attenuation setting in dB)			 dB dB dB dB
Return loss		0.4–1.0 GHz 1.0–4.0 GHz		7 10		dB dB

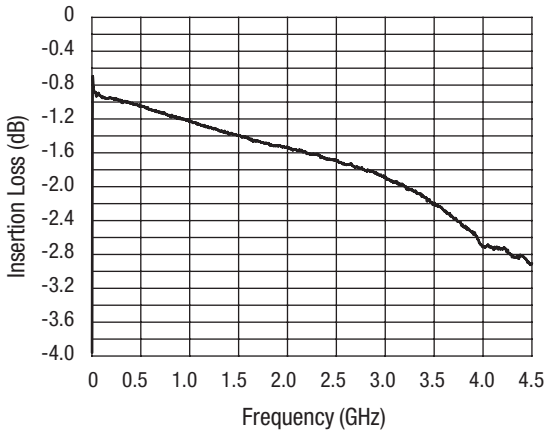
Operating Characteristics

V_{CTL} = 0 V/5 V, T = 25 °C, P_{INPUT} = 0 dBm, Z_O = 50 Ω, unless otherwise noted

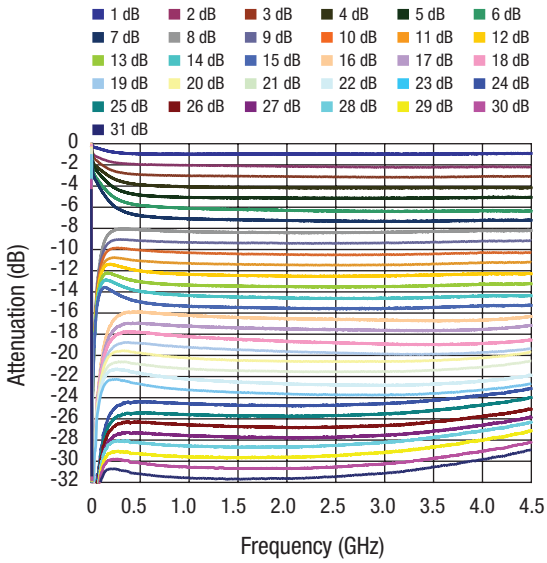
Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Switching characteristics On/rise time Off/fall time	 50/90% or 10/90% RF 50/10% or 90/10% RF			 150 500		 ns ns
Input power for 1 dB compression	V_{LOW} = 0 V, V_{HIGH} = 3 V V_{LOW} = 0 V, V_{HIGH} = 5 V	900 MHz 900 MHz		29 31		dBm dBm
Input third order intermodulation intercept	For two input tones. +5 dBm each tone V_{LOW} = 0 V, V_{HIGH} = 3 V V_{LOW} = 0 V, V_{HIGH} = 5 V	 1–4 GHz 1–4 GHz		 39 41		 dBm dBm
Thermal resistance	Junction to package terminal			45		°C/W
Supply voltage			V_{HIGH} - 0.2		V_{HIGH} + 0.2	V
Control voltage	High Low		2.7 -0.2		5.5 0.2	V V
Control port current	V_{CTL} = V_{HIGH} V_{CTL} = V_{LOW}			15 5	100 20	µA µA

Typical Performance Data

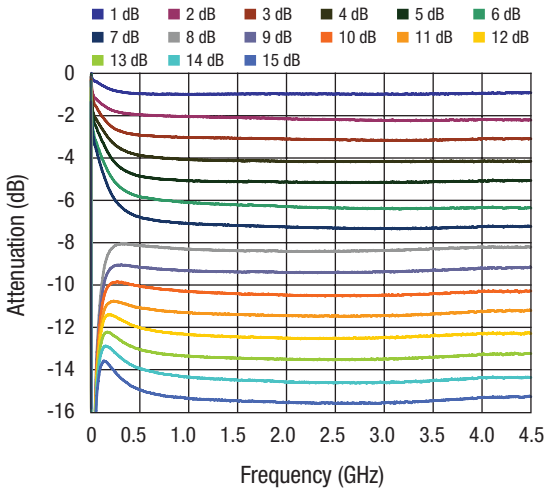
V_{CTL} = 0 V/5 V, T = 25 °C, P_{INPUT} = 0 dBm, Z_O = 50 Ω, unless otherwise noted



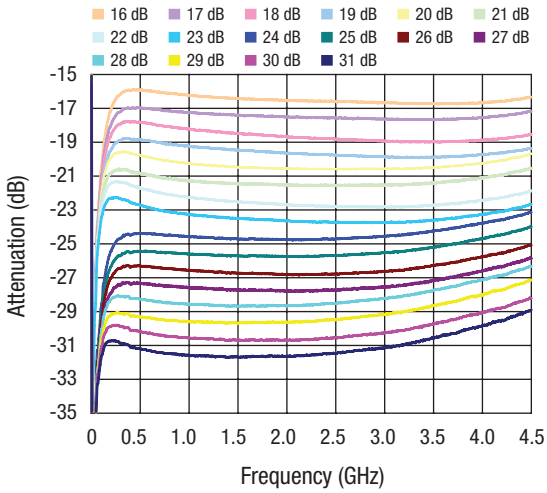
Insertion Loss vs. Frequency



Attenuation vs. Frequency[1]

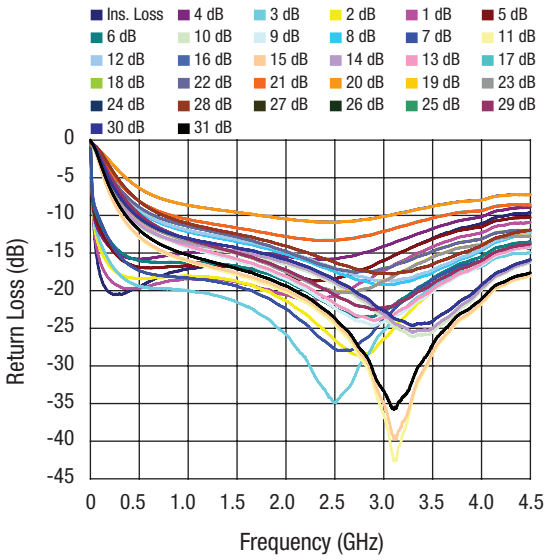


Attenuation vs. Frequency[1]
1–15 dB

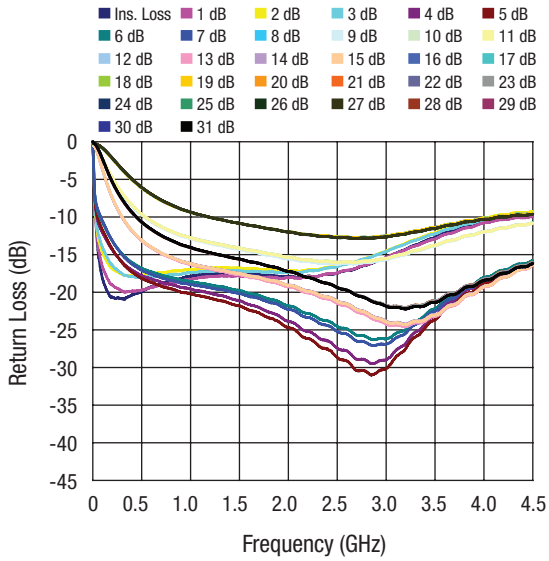


Attenuation vs. Frequency[1]
16–31 dB

1. Attenuation normalized to insertion loss



Input Return Loss vs. Frequency



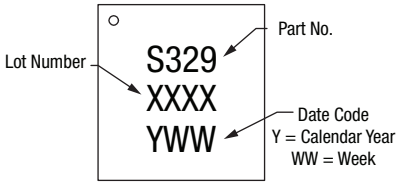
Output Return Loss vs. Frequency

Truth Table

V_1	V_2	V_3	V_4	V_5	Attenuation
V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	Reference insertion loss
V_{LOW}	V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	1 dB
V_{HIGH}	V_{LOW}	V_{HIGH}	V_{HIGH}	V_{HIGH}	2 dB
V_{HIGH}	V_{HIGH}	V_{LOW}	V_{HIGH}	V_{HIGH}	4 dB
V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{LOW}	V_{HIGH}	8 dB
V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{HIGH}	V_{LOW}	16 dB
V_{LOW}	V_{LOW}	V_{LOW}	V_{LOW}	V_{LOW}	31 dB

$2.7\ V \leq V_{HIGH} \leq 5.5\ V$, $V_S = V_{HIGH} \pm 0.2\ V$, $0 \leq V_{LOW} \leq 0.2\ V$.

Part Marking



Absolute Maximum Ratings

Characteristic	Value
RF input power	33 dBm for f > 400 MHz, V_{CTL} = 0/8 V
Control voltage range	$-0.2 \leq V_C \leq 8$ V
Operating temperature range	-40 °C to +85 °C
Storage temperature range	-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.*

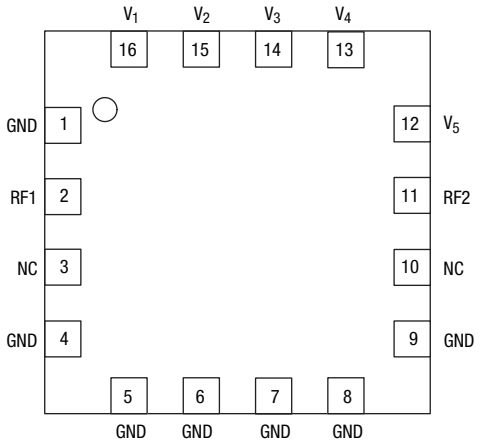
Recommended Solder Reflow Profiles

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.

Pin Out



Pin Descriptions

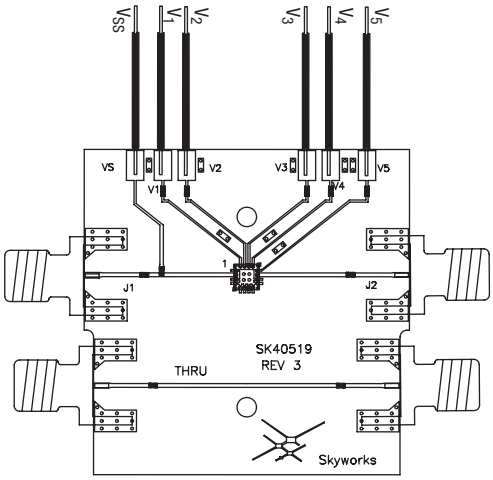
Pin Number	Pin Name	Description
1, 4–9	GND	Equipotential Point—Equipotential points for control voltages and RF circuits. Must be connected to PCB ground via lowest possible
2	RF1	RF Input/Output—RF input or output port. A DC block is required for this port.
3, 10	N/C	No connection
11	RF2	RF Input/Output—RF input or output port. A DC block is required for this port.
12	V_5	Control Voltage—Control voltage input for 16 dB weighted bit (MSB)
13	V_4	Control Voltage—Control voltage input for 8 dB weighted bit
14	V_3	Control Voltage—Control voltage input for 4 dB weighted bit
15	V_2	Control Voltage—Control voltage input for 2 dB weighted bit
16	V_1	Control Voltage—Control voltage input for 1 dB weighted bit (LSB)

Evaluation Board

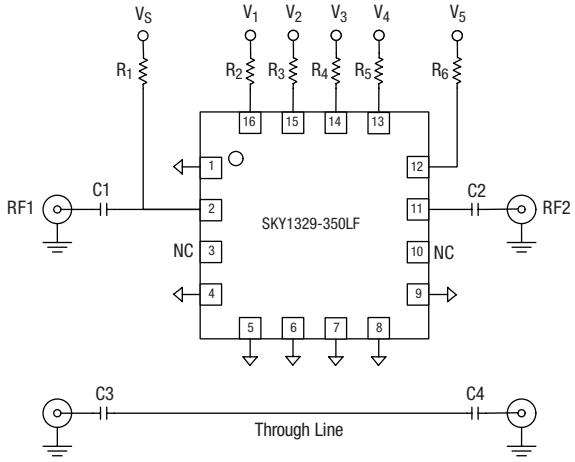
The evaluation board for SKY12329-350LF allows the part to be fully exercised. The insertion loss of the transmission lines between J_1–U_1 and U_1–J_2 can be determined by measuring the performance of the calibration through line, which contains two DC block capacitors (560 pF) in identical positions to the DC blocks present in the main circuit.

The state of the SKY12329-350LF is controlled by applying the appropriate logic level voltages to ports V_1 through V_5, per the Truth Table

SKY12329-350LF Evaluation Circuit PCB



SKY12329-350LF Evaluation Circuit

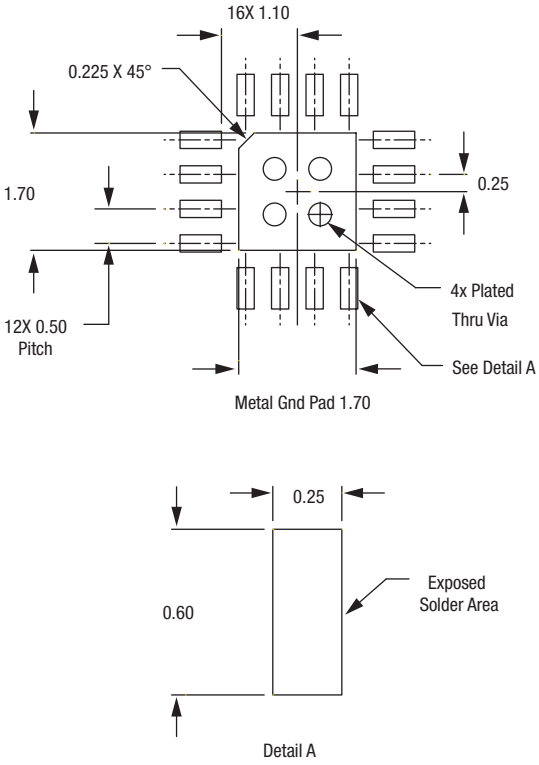


Evaluation Board Components

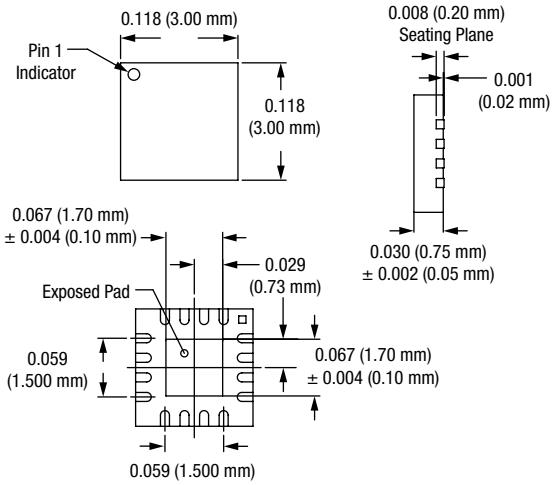
Component	Description	Default
C_1–C_4	DC blocking capacitor	560 pF, size 0402
R_1	RF block	10k Ω, size 0402
R_2–R_6	Current limiting	100 Ω
U_1	SKY12329-350LF GaAs digital attenuator	
J_1, J_2	SMA connectors	

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Land Pattern



-350 (QFN 3 x 3)



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