

DATA SHEET

SKY12325-350LF: 0.5-6.0 GHz Three-Bit Digital Attenuator (1 dB LSB)

Applications

- Cellular Bluetooth® systems
- General-purpose level control

Features

- Broadband operation: 0.5 to 6.0 GHz
- Attenuation: 7 dB
- Positive control voltage
- Resolution: 1 dB
- Miniature QFN (16-pin, 3 x 3 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

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


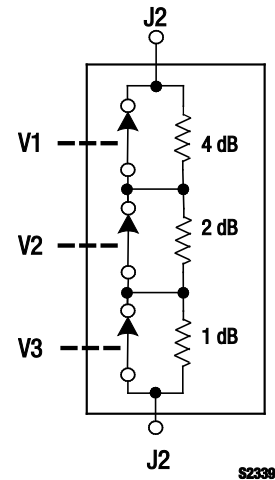



Figure 1. SKY12325-350LF Block Diagram

Description

The SKY12325-350LF is a three-bit digital attenuator. The attenuation bits are binary weighted, with the Least Significant Bit (LSB) equal to 1 dB. States are selected by three positive voltage control inputs (pins V1, V2, and V3). DC blocking capacitors are required at each RF port. Both RF ports are absorptive.

The SKY12325-350LF is provided in a miniature 3 x 3 mm, 16-pin exposed pad plastic Quad Flat No-Lead (QFN) package. A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

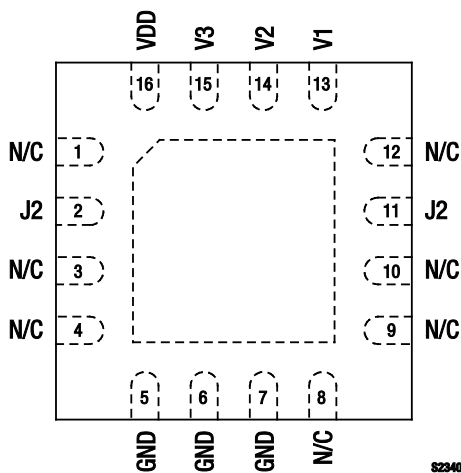


Figure 2. SKY12325-350LF Pinout – 16-Pin QFN (Top View)

Table 1. SKY12325-350LF Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	N/C	No connection	9	N/C	No connection
2	J2	RF input or output port, and supply voltage input. An external DC blocking capacitor is required.	10	N/C	No connection
3	N/C	No connection	11	J2	RF input or output port, and supply voltage input. An external DC blocking capacitor is required.
4	N/C	No connection	12	N/C	No connection
5	GND	Ground	13	V1	High impedance control voltage input for 4 dB weighted bit (MSB)
6	GND	Ground	14	V2	High impedance control voltage input for 2 dB weighted bit
7	GND	Ground	15	V3	High impedance control voltage input for 1 dB weighted bit (LSB)
8	N/C	No connection	16	VDD	Supply voltage

Note: Exposed paddle must be grounded.

Table 2. SKY12325-350LF Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
RF input power	P _{IN}		+30	dBm
Supply voltage	V _S		+6	V
Control voltage	V _{CTL}	0	+6	V
Operating temperature	T _{OP}	-40	+85	°C
Storage temperature	T _{STG}	-65	+150	°C

Note: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

CAUTION: Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) 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 should be used at all times.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY12325-350LF are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the SKY12325-350LF are illustrated in Figures 3 through 6.

The state of the SKY12325-350LF is determined by the logic provided in Table 4.

Table 3. SKY12325-350LF Electrical Specifications (Note 1)**($V_{CTL} = 0/5\text{ V}$, $T_{OP} = +25\text{ }^{\circ}\text{C}$, $P_{IN} = 0\text{ dBm}$, Characteristic Impedance [Z_0] = $50\text{ }\Omega$, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Insertion loss	IL	0.5 to 3.0 GHz		0.7	0.9	dB
		3.0 to 4.5 GHz		0.9	1.1	dB
		4.5 to 6.0 GHz		1.3	1.5	dB
Attenuation	ATTN				7	dB
Attenuation accuracy		0.5 to 4.0 GHz	$\pm(0.2 + 3\%$ of attenuation setting)			dB
		4.0 to 6.0 GHz	$\pm(0.3 + 3\%$ of attenuation setting)			dB
Return loss	RL	0.5 to 3.5 GHz		15		dB
		3.5 to 6.0 GHz		15		dB
1 dB Input Compression Point	IP1dB	0.5 to 6.0 GHz $V_{DD} = 3\text{ V}$ $V_{DD} = 5\text{ V}$		+24		dBm
				+27		dBm
3 rd Order Input Intercept Point	IIP3	0.5 to 6.0 GHz, for two-tone input power, +5 dBm/tone, $\Delta f = 1\text{ MHz}$ $V_{LOW} = 0\text{ V}$, $V_{HIGH} = 3\text{ V}$ $V_{LOW} = 0\text{ V}$, $V_{HIGH} = 5\text{ V}$		+44		dBm
				+47		dBm
Control voltage: High Low	V_{CTL_H}		$V_{DD} - 0.2$		$V_{DD} + 0.2$	V
	V_{CTL_L}		0		0.8	V
Control port current	I_{CTL}	V_{CTL_L}			50	μA
		V_{CTL_H}			50	μA
Supply voltage	V_S		2.7		5.5	V

Note 1: Performance is guaranteed only under the conditions listed in this Table.

Typical Performance Characteristics

($V_{DD} = 5\text{ V}$, $T_{OP} = +25\text{ }^{\circ}\text{C}$, Characteristic Impedance [Z_0] = $50\ \Omega$, , Unless Otherwise Noted)

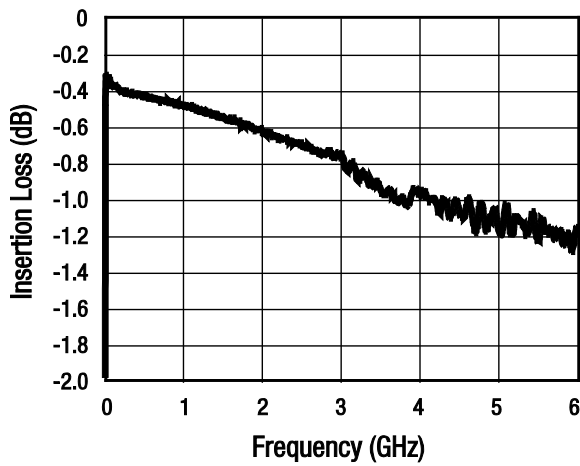


Figure 3. Insertion Loss vs Frequency

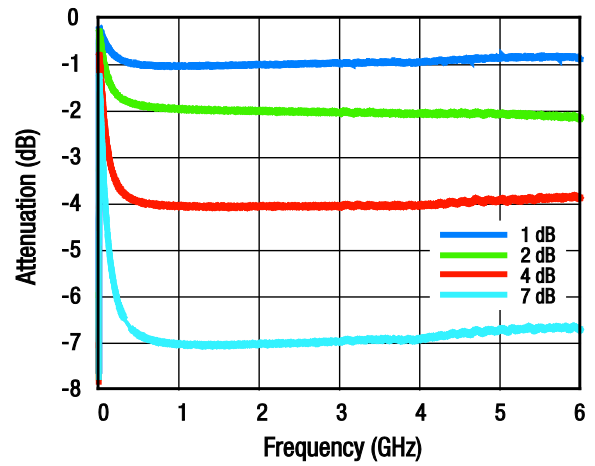


Figure 4. Attenuation vs Frequency (Normalized to Insertion Loss)

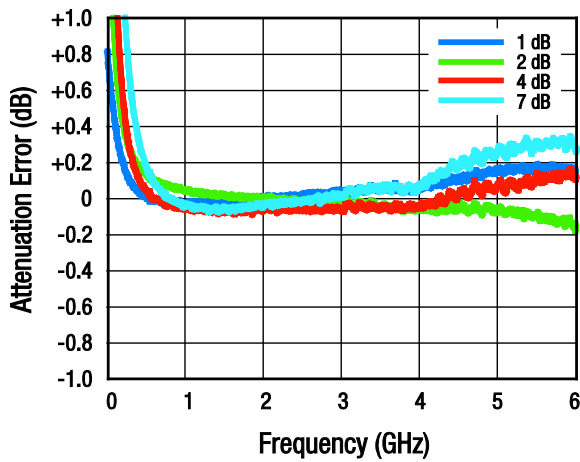


Figure 5. Attenuation Error vs Frequency

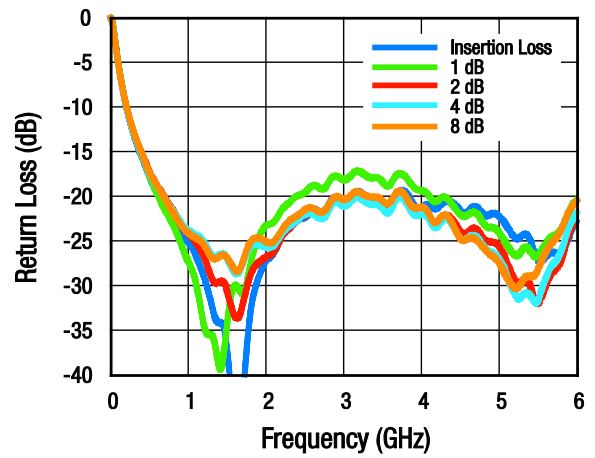


Figure 6. Return Loss vs Frequency

Table 4. SKY12325-350LF Truth Table

Attenuation (Note 1) (dB)	V1 (Pin 13)	V2 (Pin 14)	V3 (Pin 15)
7	Low	Low	Low
6	Low	Low	High
5	Low	High	Low
4	Low	High	High
3	High	Low	Low
2	High	Low	High
1	High	High	Low
0	High	High	High

Note 1: Attenuation normalized to insertion loss.

Note 2: High = +2.7 V to 5.5 V. "Low" = -0.2 V to +0.2 V.

Package Dimensions

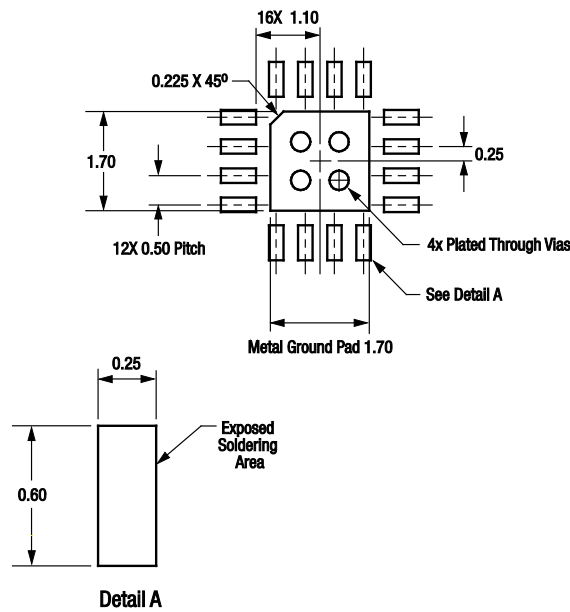
The PCB layout footprint for the SKY12325-350LF is shown in Figure 7. Typical case markings are noted in Figure 8. Package dimensions for the 16-pin QFN are shown in Figure 9, and tape and reel dimensions are provided in Figure 10.

THE SKY12325-350LF is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.



All dimensions are in millimeters

S1691

Figure 7. SKY12325-350LF PCB Layout Footprint

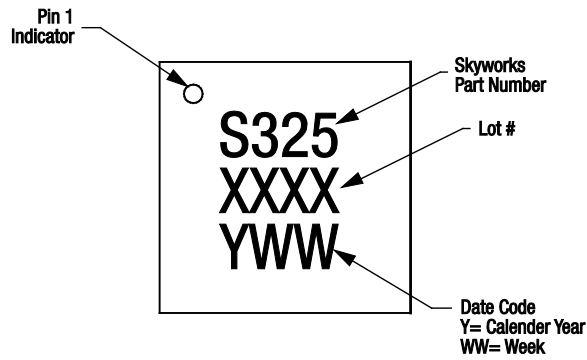
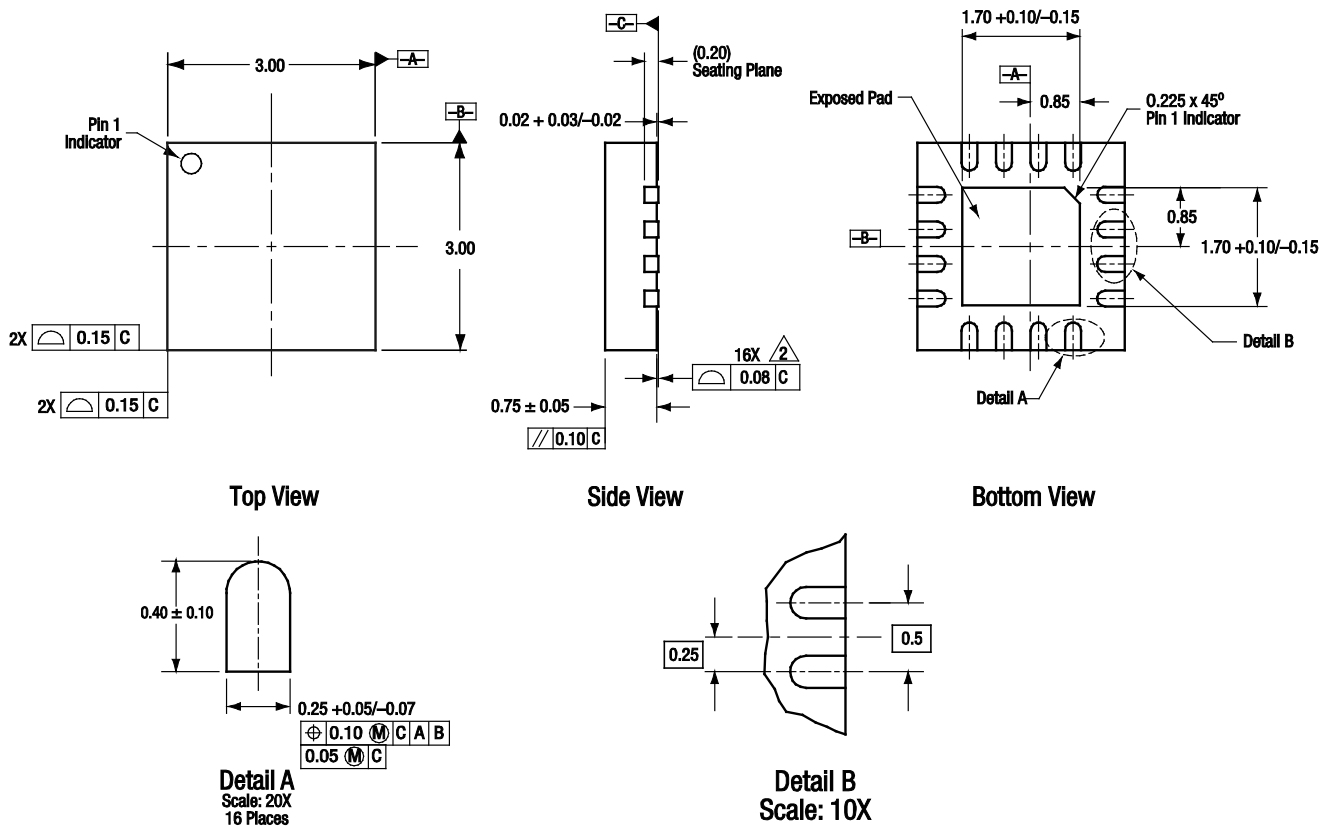


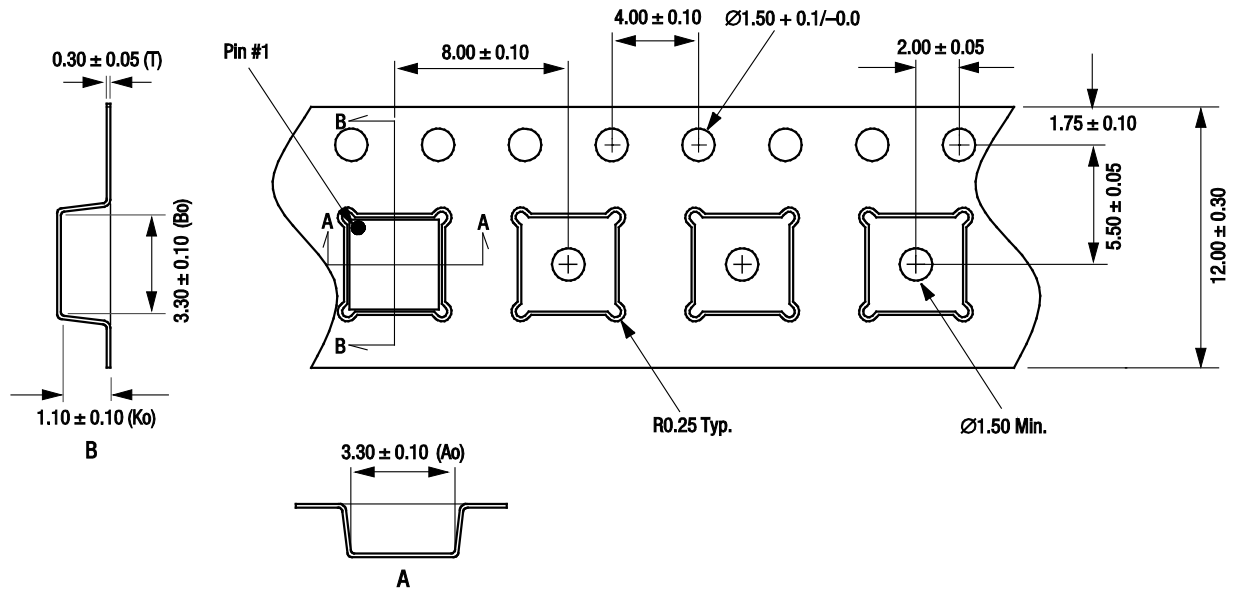
Figure 8. Typical Part Markings



All measurements are in millimeters.
 Dimensioning and tolerancing according to ASME Y14.5M-1994.
 Coplanarity applies to the exposed heat sink slug as well as the terminals.
 Plating requirement per source control drawing (SCD) 2504.

S1692

Figure 9. SKY12325-350LF 16-Pin QFN Package Dimensions



Notes:

1. Carrier tape: black conductive polystyrene, non-bakeable material.
2. Cover tape material: transparent conductive HSA.
3. Cover tape size: 9.20 mm width.
4. All measurements are in millimeters.

S1698

Figure 10. SKY12325-350LF Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Numbers
SKY12325-350LF Digital Attenuator	SKY12325-350LF	SKY12325-350LF-EVB

Copyright © 2006, 2011 Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.