



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts,Customers Priority,Honest Operation,and Considerate Service",our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



**DATA SHEET**

# SKY12332-310LF: 6-Bit Digital Attenuator with Driver

## LF–1 GHz, 0.5 dB LSB, 31.5 dB Range

**Features**

- Attenuation range: 31.5 dB
- LSB: 0.5 dB
- On-board low noise CMOS driver
- Excellent RF noise floor
- Single 5 V supply
- Very low DC power consumption
- Single positive control for each bit
- Small 5 x 5 mm QFN-32 package
- Lead (Pb)-free and RoHS-compliant MSL-1 @ 260 °C per JEDEC J-STD-020

**Description**

The Skyworks SKY12332-310LF is 6-bit digital GaAs attenuator with an on-board low-noise CMOS driver. This attenuator offers excellent performance from low frequency through 1 GHz, making it ideal for IF and RF level control applications. It contains an on-board CMOS driver circuit which accepts CMOS logic levels at the 6 control inputs and produces a negative supply voltage to control the GaAs attenuator.


The SKY12332-310LF has excellent linearity for compatibility with non-constant envelope signals, such as W-CDMA and OFDM. The 6 attenuation bits are binary weighted, with an LSB of 0.5 dB and a total nominal attenuation range of 31.5 dB. It also has excellent attenuation accuracy and is monotonic. The low-noise CMOS driver enables a very low RF noise floor, typically -100 dBm.

Typical applications for this attenuator include level control in cellular base stations, wireless data transceivers, broadband systems, etc.

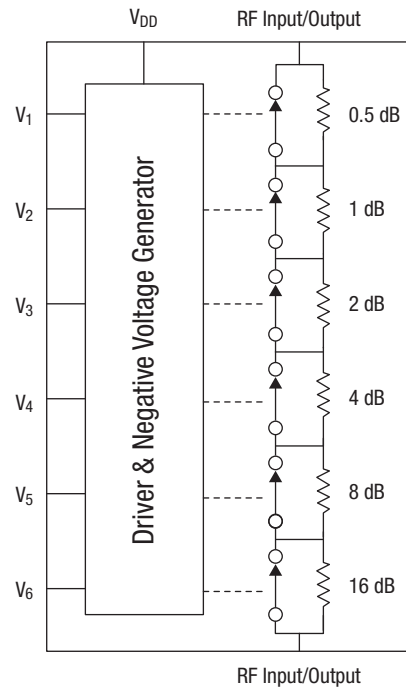
The required supply voltage for SKY12332-310LF is 5V. This part can operate over the temperature range of -40 °C to 85 °C.

An evaluation board is available upon request.

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



**Functional Block Diagram**



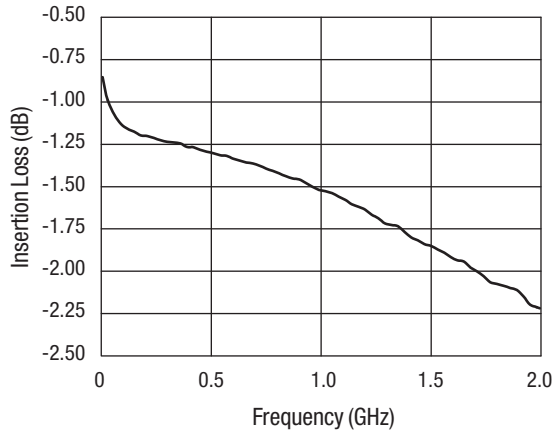
## Electrical Specifications

**V<sub>DD</sub> = 5 V, T = 25 °C, Z<sub>0</sub> = 50 Ω, unless otherwise noted**

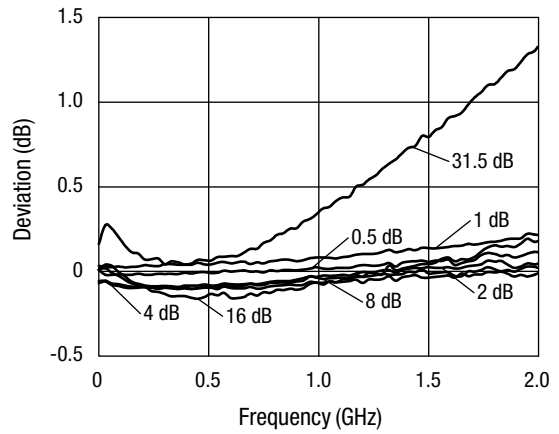
| Parameter   | Symbol                             | Condition   | Frequency       | Min.                                       | Typ.  | Max.            | Unit |
|---|------------------------------------|---|-----------------|--|-------|-----------------|------|
| Insertion loss                                    | IL                                 |   | LF–500 MHz      |  | 1.5   | 1.8             | dB   |
|   |                                    |   | LF–1.0 GHz      |  | 1.8   | 2.2             | dB   |
| Attenuation range                                 |                                    |   |                 |  | 31.5  |                 | dB   |
| Attenuation accuracy                              |                                    | Attenuation referred to insertion loss                                      | LF–500 MHz      | ± (0.20 + 2% of attenuation setting in dB) |       |                 | dB   |
|   |                                    |   | LF–1.0 GHz      | ± (0.25 + 3% of attenuation setting in dB) |       |                 | dB   |
| RF input/RF output VSWR                           |                                    | Non-driven port terminated in Z <sub>0</sub>                                | LF–1.0 GHz      |  | 1.4:1 | 1.6:1           |      |
| Control voltage                                   | V <sub>CTL</sub>                   | V <sub>CTL</sub> = V <sub>LOW</sub><br>V <sub>CTL</sub> = V <sub>HIGH</sub> |                 | 0  |       | 0.8             | V    |
|   |                                    |   |                 | 2.7  |       | V <sub>DD</sub> | V    |
| Control port current                              | I <sub>CTL</sub>                   | V <sub>CTL</sub> = V <sub>LOW</sub><br>V <sub>CTL</sub> = V <sub>HIGH</sub> |                 |  | 20    |                 | μA   |
|   |                                    |   |                 |  | 20    |                 | μA   |
| Switching characteristics                         |                                    |   |                 |  |       |                 |      |
| Rise, fall time                                   | t <sub>r</sub> , t <sub>f</sub>    | 10%/90% or 90%/10% of RF  |                 |  | 30    |                 | ns   |
| On, off time                                      | t <sub>on</sub> , t <sub>off</sub> | 50% V <sub>CTL</sub> to 90%/10% of RF                                       |                 |  | 50    |                 | ns   |
| Video feedthrough                                 |                                    | T <sub>RISE</sub> = 1 ns, BW = 500 MHz                                      |                 |  | 50    |                 | mV   |
| Input power for 1 dB compression                  | IP <sub>1</sub> dB                 |   | 50 MHz          |  | 22    |                 | dBm  |
|   |                                    |   | 500 MHz–1.0 GHz |  | 29    |                 | dBm  |
| Input third order intermodulation intercept point | IIP3                               | 2 input tones, 5 dBm each tone  | 50 MHz          |  | 36    |                 | dBm  |
|   |                                    |   | 500 MHz–1.0 GHz |  | 48    |                 | dBm  |
| DC supply voltage                                 | V <sub>DD</sub>                    |   |                 | 4.75                                       | 5     | 5.25            | V    |
| DC supply current                                 | I <sub>DD</sub>                    |   |                 |  | 700   |                 | μA   |

### Typical Performance Data

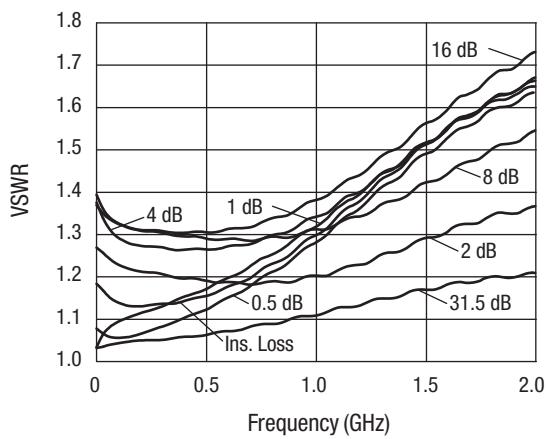
$V_{DD} = 5\text{ V}$ ,  $T = 25\text{ }^{\circ}\text{C}$ ,  $Z_0 = 50\text{ }\Omega$ , unless otherwise noted



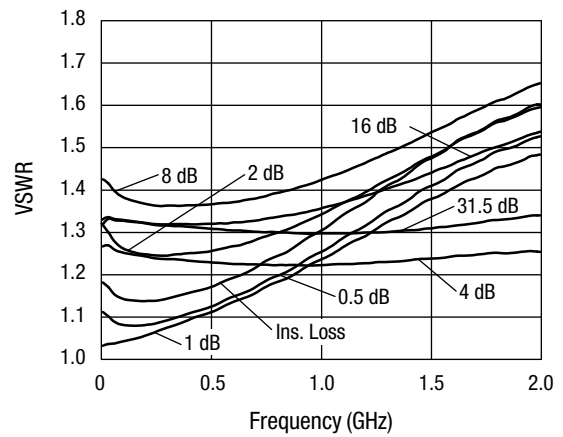
**Insertion Loss vs. Frequency**



**Attenuation Accuracy vs. Frequency**



**Input VSWR vs. Frequency**



**Output VSWR vs. Frequency**



### Absolute Maximum Ratings

| Characteristic        | Value   |
|-----------------------|---|
| RF input power        | 2 W for $f > 500$ MHz<br>0.5 W for $50 \text{ MHz} \leq f \leq 500 \text{ MHz}$ |
| Supply voltage        | 6 V   |
| Supply current        | 2 mA  |
| 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.

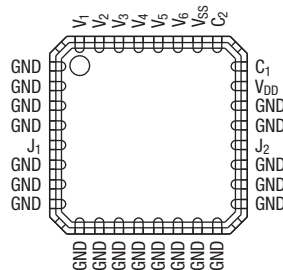
**CAUTION:** Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without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

### Truth Table

| V <sub>6</sub> | V <sub>5</sub> | V <sub>4</sub> | V <sub>3</sub> | V <sub>2</sub> | V <sub>1</sub> | Attenuation<br>J <sub>1</sub> -J <sub>2</sub> |
|----------------|----------------|----------------|----------------|----------------|----------------|---|
| 16 dB          | 8 dB           | 4 dB           | 2 dB           | 1 dB           | 0.5 dB         |   |
| 0              | 0              | 0              | 0              | 0              | 0              | Ins. loss                                     |
| 0              | 0              | 0              | 0              | 0              | 1              | 0.5 dB  |
| 0              | 0              | 0              | 0              | 1              | 0              | 1 dB  |
| 0              | 0              | 0              | 1              | 0              | 0              | 2 dB  |
| 0              | 0              | 1              | 0              | 0              | 0              | 4 dB  |
| 0              | 1              | 0              | 0              | 0              | 0              | 8 dB  |
| 1              | 0              | 0              | 0              | 0              | 0              | 16 dB   |
| 1              | 1              | 1              | 1              | 1              | 1              | 31.5 dB                                       |

"0" = V<sub>LOW</sub>  
"1" = V<sub>HIGH</sub>

### Pin Out



### Pin Description

| Pin              | Symbol                          | Function   |
|------------------|---------------------------------|--|
| 1-4, 6-19, 21-22 | GND                             | Connect to system ground via lowest possible impedance   |
| 5                | J <sub>1</sub>                  | RF input/output  |
| 20               | J <sub>2</sub>                  | RF output/input  |
| 23               | V <sub>DD</sub>                 | Positive supply voltage input. Bypass this pin to ground via a 10 nF or larger capacitor             |
| 24, 25           | C <sub>1</sub> , C <sub>2</sub> | Connect charge pump capacitor, 25 nF typical, between these pins                                     |
| 26               | V <sub>SS</sub>                 | Negative supply voltage filter capacitor. Bypass this pin to ground via a 10 nF or larger capacitor. |
| 27               | V <sub>6</sub>                  | Control voltage input for 16 dB bit, MSB   |
| 28               | V <sub>5</sub>                  | Control voltage input for 8 dB bit   |
| 29               | V <sub>4</sub>                  | Control voltage input for 4 dB bit   |
| 30               | V <sub>3</sub>                  | Control voltage input for 2 dB bit   |
| 31               | V <sub>2</sub>                  | Control voltage input for 1 dB bit   |
| 32               | V <sub>1</sub>                  | Control voltage input for 0.5 dB bit, LSB  |
| Paddle           |                                 | Connect to system ground via lowest possible electrical and thermal impedance                        |

### Circuit Description

The SKY12332-301LF is comprised of a Si CMOS die and a GaAs digital attenuator die, packaged in a 5 x 5 mm, 32-pin QFN surface mount package.

The CMOS die performs the following functions: it contains a charge pump circuit that generates a negative voltage,  $V_{SS}$ , from the positive supply voltage,  $V_{DD}$ ; it decodes the 6-bit control word applied to ports  $V_1$  through  $V_6$ ; and, it drives the corresponding switching FETs on the GaAs attenuator die. This circuit was optimized to produce the lowest possible noise in the RF signal path.

The GaAs attenuator die is comprised of 6 resistive, fixed attenuator sections with nominal input and output impedance of 50  $\Omega$ . The attenuation of these sections is binary weighted, ranging from 0.5 dB nominal up to 16 dB nominal. These attenuator sections are either switched into or out of the main signal path, between ports  $J_1$  and  $J_2$ , according to the 6-bit control word applied to ports  $V_1$  through  $V_6$ . This die is also utilized in AA113-310.

The switching is performed by depletion mode MESFETs on the attenuator die. The charge pump circuit on the CMOS die generates the negative voltage  $V_{SS}$ , nominally -3.75 V, required to enable reverse bias of the gate-source of the MESFETs that must be switched to high drain-source impedance to properly select or bypass the fixed resistive attenuator sections.

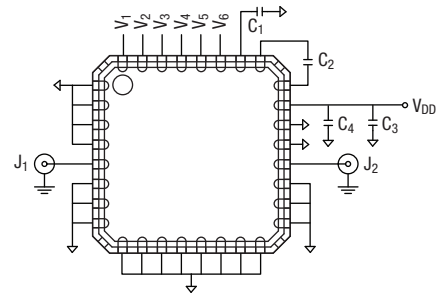
### Recommended Solder Reflow Profiles

Refer to the [“Recommended Solder Reflow Profile”](#) Application Note.

### Tape and Reel Information

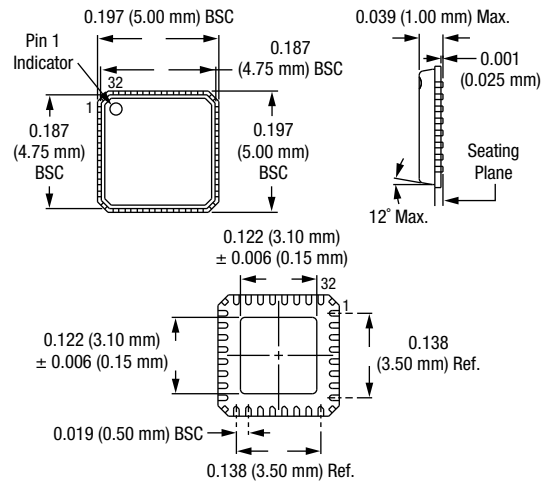
Refer to the [“Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation”](#) Application Note.

### Suggested Circuit



| Component  | Suggested Value     |
|------------|---------------------|
| $C_1, C_3$ | 0.01 $\mu\text{F}$  |
| $C_2$      | 0.025 $\mu\text{F}$ |
| $C_4$      | 100 pF              |

### QFN 5 x 5 (-310)



Copyright © 2002, 2003, 2004, 2005, 2006, 2007, 2008, 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](http://www.skyworksinc.com), are incorporated by reference.