

**DATA SHEET**

# SKY13405-490LF: 0.1 to 3.0 GHz Ultra High Linearity SP2T Switch

## Applications

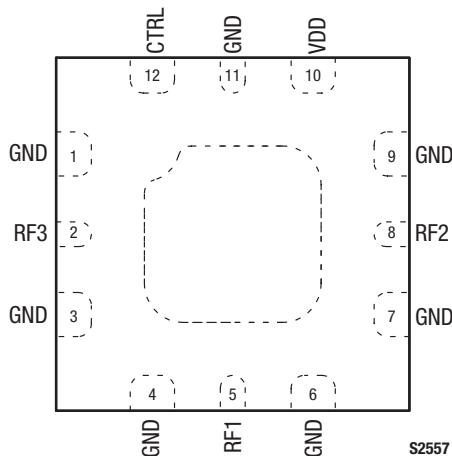
- Simultaneous voice and LTE data

## Features

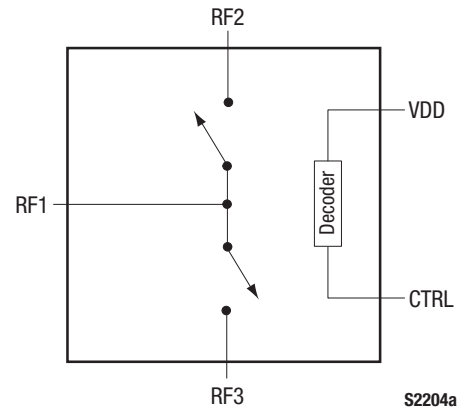
- Ultra high linearity performance
- IMD3: < -100 dBm for SVLTE data
- Low insertion loss: 0.3 dB @ 1.0 GHz
- High IP0.1dB: +38 dBm
- No external DC blocking capacitors required
- DC supply voltage: 2.5 V to 4.8 V
- Small, QFN (12-pin, 2 x 2 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.



**Figure 2. SKY13405-490LF Pinout – 12-Pin QFN (Top View)**



**Figure 1. SKY13405-490LF Block Diagram**

## Description

The SKY13405-490LF is a CMOS, Silicon-On-Insulator (SOI) Single-Pole, Double-Throw (SP2T) switch. The high linearity and low insertion loss of the SKY13405-490LF will meet the most stringent requirements of CDMA Simultaneous Voice and LTE (SVLTE) data applications.

The switch is a “reflective short” on the isolated port.

The SKY13405-490LF SP2T switch is provided in a compact Quad Flat No-Lead (QFN) 2 x 2 mm 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.

**Table 1. SKY13405-490LF Signal Descriptions**

| Pin # | Name | Description | Pin # | Name | Description                  |
|-------|------|-------------|-------|------|------------------------------|
| 1     | GND  | Ground      | 7     | GND  | Ground                       |
| 2     | RF3  | RF port 3   | 8     | RF2  | RF port 2                    |
| 3     | GND  | Ground      | 9     | GND  | Ground                       |
| 4     | GND  | Ground      | 10    | VDD  | DC power supply              |
| 5     | RF1  | RF port 1   | 11    | GND  | Ground                       |
| 6     | GND  | Ground      | 12    | CTRL | DC control pin. See Table 4. |

**Note:** Exposed pad must be properly grounded using a low impedance path.

**Table 2. SKY13405-490LF Absolute Maximum Ratings (Note 1)**

| Parameter                           | Symbol            | Minimum | Maximum | Units |
|-------------------------------------|-------------------|---------|---------|-------|
| Supply voltage                      | V <sub>BATT</sub> |         | 5       | V     |
| Control voltage                     | V <sub>CTL</sub>  |         | 3       | V     |
| Input power                         | P <sub>IN</sub>   |         | +40     | dBm   |
| Storage temperature                 | T <sub>STG</sub>  | −40     | +125    | °C    |
| Operating temperature               | T <sub>OP</sub>   | −40     | +85     | °C    |
| Electrostatic Discharge:            | ESD               |         |         |       |
| Charged Device Model (CDM), Class 4 |                   |         | 1000    | V     |
| Human Body Model (HBM), Class 1B    |                   |         | 500     | V     |
| Machine Model (MM), Class A         |                   |         | 150     | V     |

**Note 1:** 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.

## Functional Description

The SKY13405-490LF is designed for high linearity LTE/CDMA handset and data card switching applications. The device can also be used in a variety of other applications that require high performance RF switching.

The high linearity and low insertion loss combined with an advanced proprietary fabrication process enable the switch to be used in CDMA and LTE applications. An internal negative voltage generator and decoder eliminate the need for external DC blocking capacitors on the RF ports.

Switching is controlled by one voltage input (CTRL). Depending on the logic voltage level applied to the control pin, the RF1 pin is connected to one of two switched RF outputs (RF2 or RF3) using a low insertion loss path, while the path between the RF1 pin and the other RF output pin is in a high isolation state.

An internal decoder is used to provide the correct logic to the switch.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13405-490LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13405-490LF is determined by the logic provided in Table 4.

Typical performance characteristics of the SKY13405-490LF are illustrated in Figures 3 through 6.

**Table 3. SKY13405-490LF Electrical Specifications (Note 1)****(V<sub>BATT</sub> = 2.5 V to 4.8 V, CTRL = 1.65 V to 2.70 V, T<sub>OP</sub> = +25 °C, P<sub>IN</sub> = 0 dBm, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

| Parameter                                        | Symbol                                        | Test Condition                                                                                  | Min            | Typical              | Max                  | Units          |
|--------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------|----------------|----------------------|----------------------|----------------|
| <b>RF Specifications</b>                         |                                               |                                                                                                 |                |                      |                      |                |
| Insertion loss                                   | IL                                            | RF1 to RF2/RF3:<br>0.1 to 1.0 GHz<br>1.0 to 2.2 GHz<br>2.2 to 3.0 GHz                           |                | 0.30<br>0.35<br>0.40 | 0.35<br>0.40<br>0.50 | dB<br>dB<br>dB |
| Isolation                                        | Iso                                           | RF1 to RF2/RF3:<br>0.1 to 1.0 GHz<br>1.0 to 2.2 GHz<br>2.2 to 3.0 GHz                           | 35<br>28<br>25 | 37<br>30<br>27       |                      | dB<br>dB<br>dB |
| Return loss                                      | IS11I                                         | RF1 to RF2/RF3,<br>0.1 to 3.0 GHz                                                               |                | 20                   |                      | dB             |
| 0.1 dB Input Compression Point                   | IP0.1dB                                       | RF1 to RF2/RF3,<br>0.8 to 3.0 GHz                                                               |                | +38                  |                      | dBm            |
| B13 2 <sup>nd</sup> harmonic                     | B13 2fo                                       | P <sub>IN</sub> = +25 dBm,<br>f = 787 MHz, RF2, RF3                                             |                | −81                  |                      | dBm            |
| 3 <sup>rd</sup> Order Intermodulation Distortion | BCO IMD3<br>(voice)                           | f1 = 827 MHz,<br>f2 = 782 MHz,<br>F <sub>IMD3</sub> = 872 MHz,<br>P1 = +14 dBm,<br>P2 = +23 dBm |                | −100                 |                      | dBm            |
|                                                  | B13 IMD3<br>(LTE data)                        | f1 = 825 MHz,<br>f2 = 786 MHz,<br>F <sub>IMD3</sub> = 747 MHz,<br>P1 = +14 dBm,<br>P2 = +23 dBm |                | −95                  |                      | dBm            |
| Switching speed                                  |                                               | 50% V <sub>CTL</sub> to 10/90% RF<br>“on” time                                                  |                | 2.3                  |                      | μs             |
|                                                  |                                               | 50% V <sub>CTL</sub> to 90/10% RF<br>“off” time                                                 |                | 2.0                  |                      | μs             |
|                                                  |                                               | 10/90% RF rise time                                                                             |                | 1.1                  |                      | μs             |
|                                                  |                                               | 90/10% RF fall time                                                                             |                | 1.8                  |                      | μs             |
| Startup time                                     |                                               |                                                                                                 |                | 2                    |                      | μs             |
| <b>DC Specifications</b>                         |                                               |                                                                                                 |                |                      |                      |                |
| Control voltage:<br>high<br>low                  | V <sub>CTL_HIGH</sub><br>V <sub>CTL_LOW</sub> |                                                                                                 | 1.65<br>0      |                      | 2.70<br>0.4          | V<br>V         |
| Supply voltage                                   | V <sub>BATT</sub>                             |                                                                                                 | 2.5            |                      | 4.8                  | V              |
| Supply current                                   | I <sub>BATT</sub>                             | V <sub>BATT</sub> = 2.5 to 4.8 V                                                                |                | 50                   |                      | μA             |
| Control current                                  | I <sub>CTRL</sub>                             | CTRL = 1.8 V                                                                                    |                | 0.5                  |                      | μA             |

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

**Table 4. SKY13405-490LF Truth Table**

| CTRL<br>(Pin 12) | Mode       |
|------------------|------------|
| 0                | RF1 to RF2 |
| 1                | RF1 to RF3 |

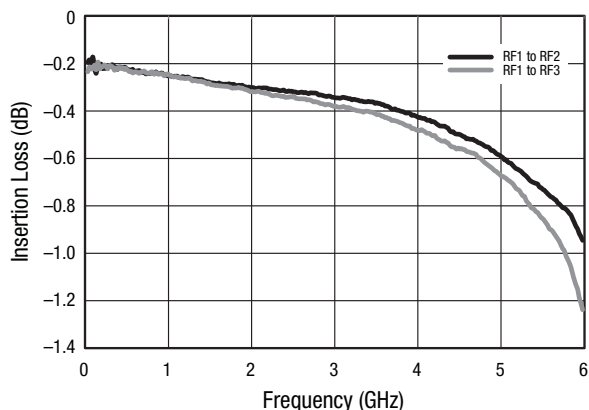
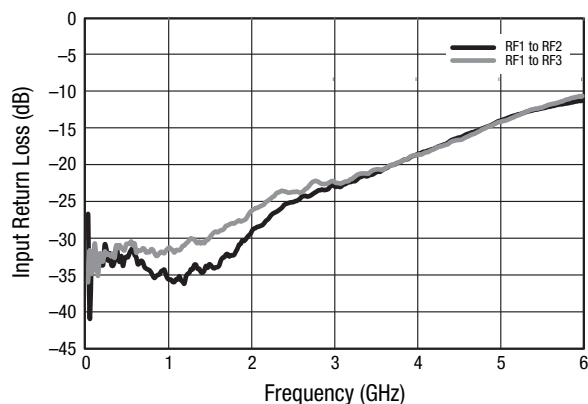
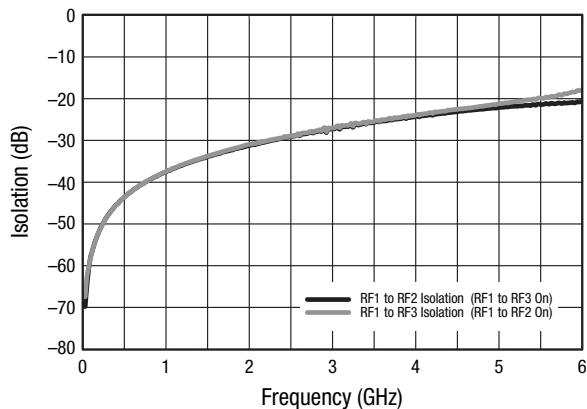
Note: 1 = 1.65 to 2.70 V

0 = -0 to 0.4 V

Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.

## Typical Performance Characteristics

( $V_{BATT} = 2.5\text{ V to }4.8\text{ V}$ , CTRL = 1.65 V to 2.70 V,  $T_{OP} = +25\text{ }^{\circ}\text{C}$ ,  $P_{IN} = 0\text{ dBm}$ , Characteristic Impedance [ $Z_0$ ] = 50  $\Omega$ , Unless Otherwise Noted)

**Figure 3. Insertion Loss vs Frequency****Figure 4. Input Return Loss vs Frequency****Figure 5. Input to Output Isolation vs Frequency**

## Evaluation Board Description

The SKY13405-490LF Evaluation Board is used to test the performance of the SKY13405-490LF SP2T Switch.

An Evaluation Board schematic diagram is provided in Figure 6. An assembly drawing for the Evaluation Board is shown in Figure 7.

## Package Dimensions

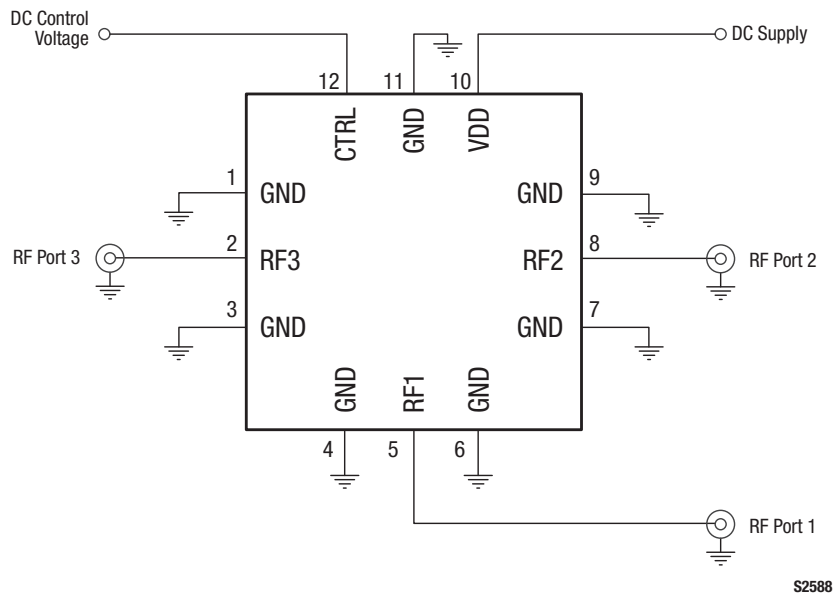
The PCB layout footprint for the SKY13405-490LF is provided in Figure 8. Typical case markings are shown in Figure 9. Package dimensions for the 12-pin QFN are shown in Figure 10, and tape and reel dimensions are provided in Figure 11.

## Package and Handling Information

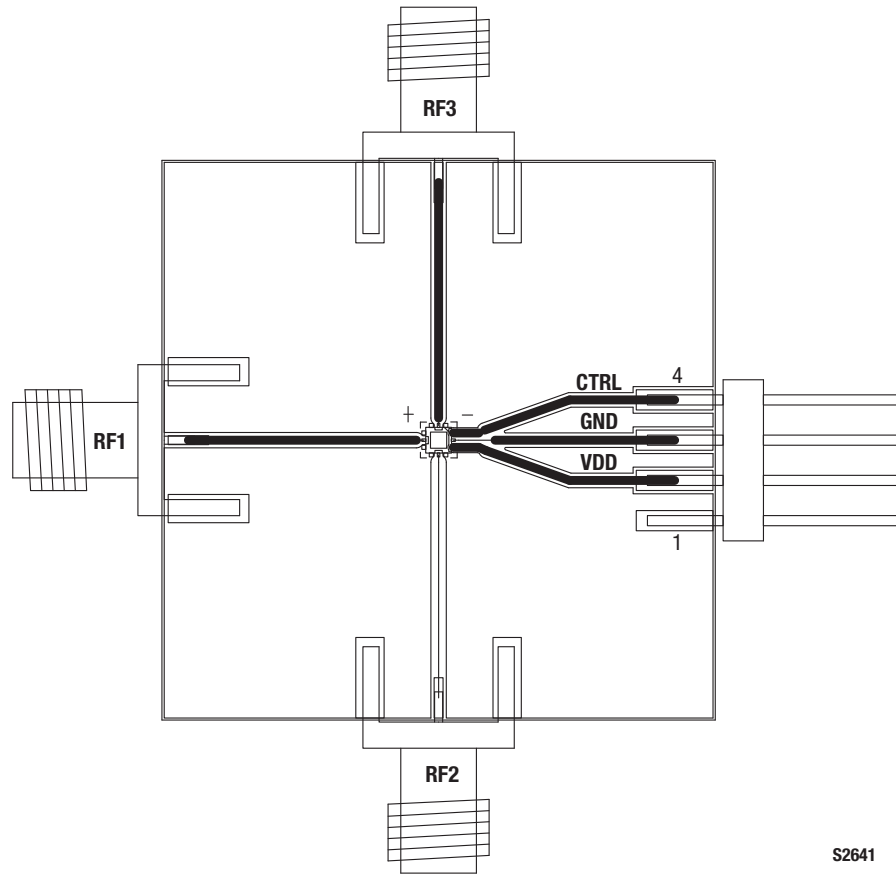
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

THE SKY13405-490LF 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.

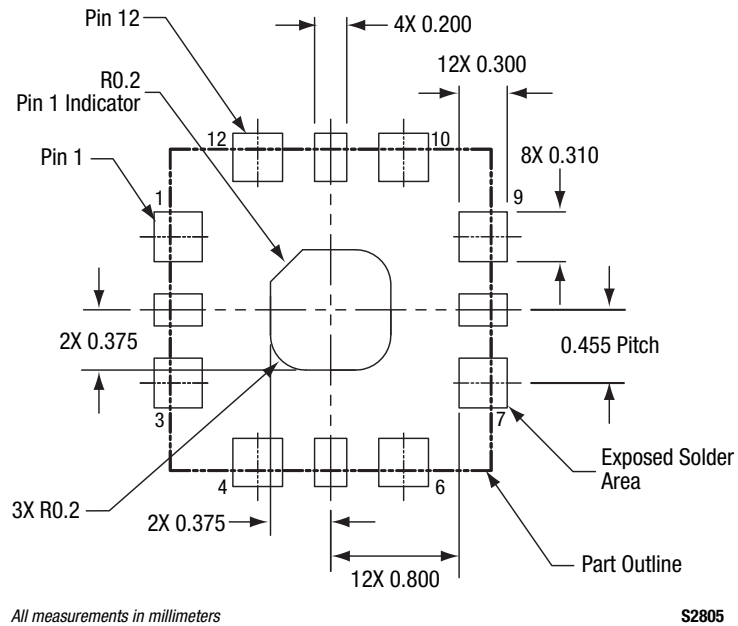


**Figure 6. SKY13405-490LF Evaluation Board Schematic**

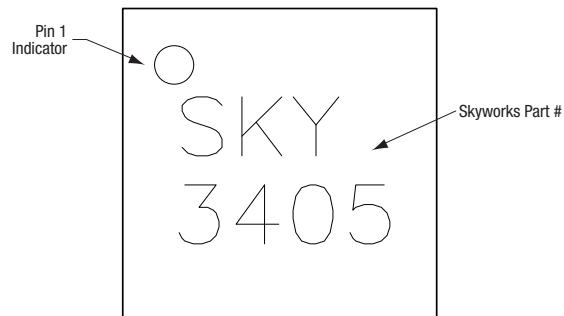


S2641

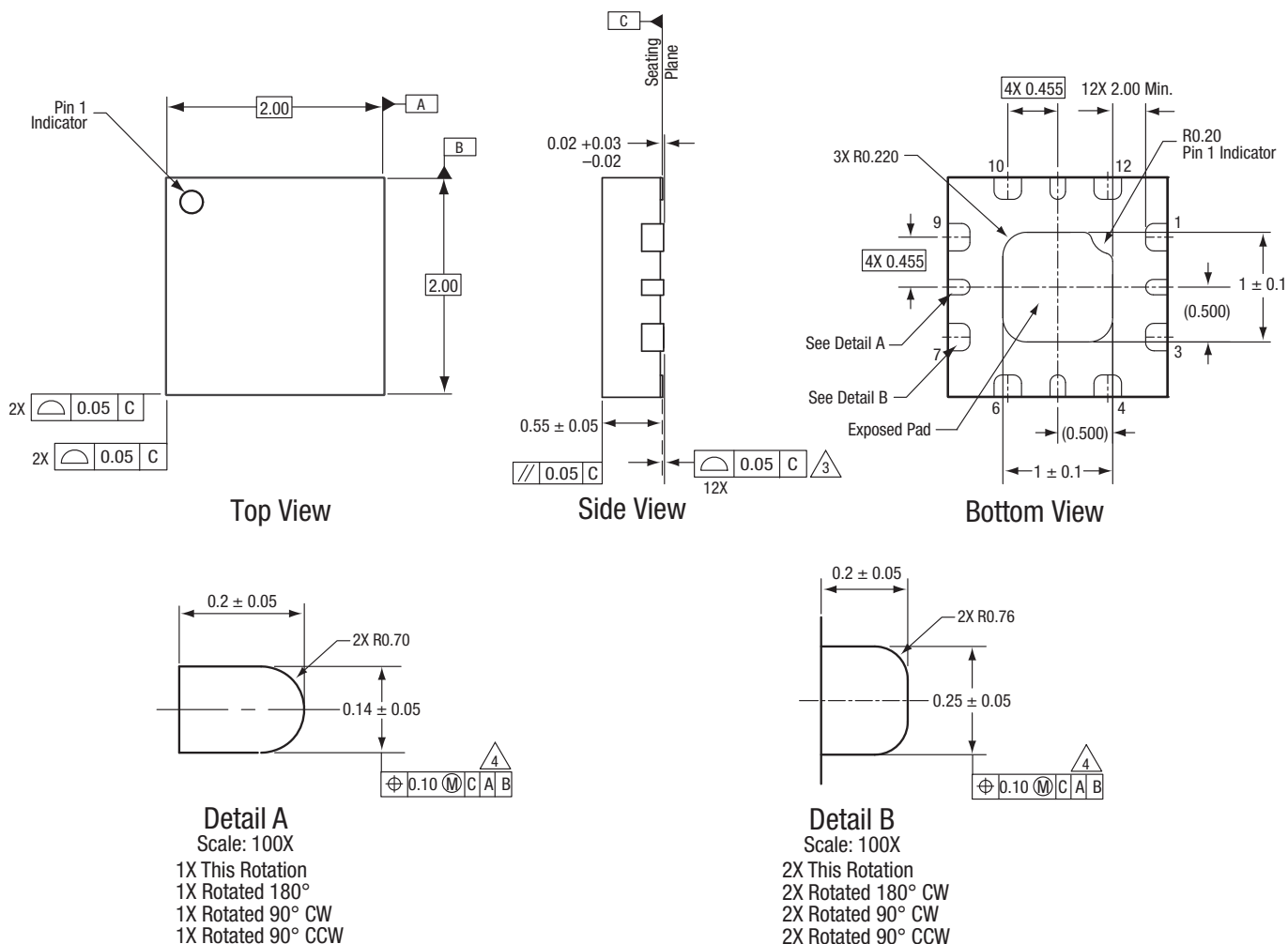
**Figure 7. SKY13405-490LF Evaluation Board Assembly Diagram**



**Figure 8. SKY13405-490LF PCB Layout Footprint (Top View)**



**Figure 9. Typical Case Markings  
(Top View)**



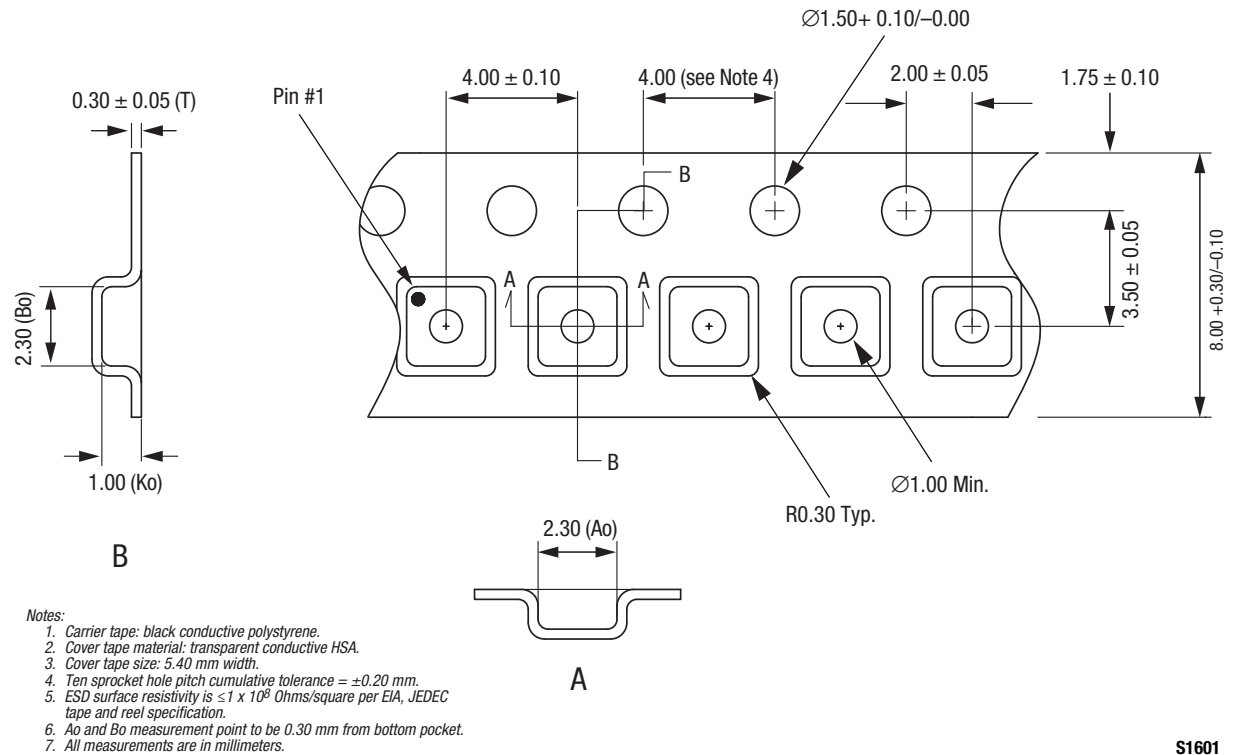
**Notes:**

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Coplanarity applies to the terminals and all other bottom surface metalization.
4. Dimension applies to metalized terminal. If the terminal has a radius on its end, the width dimension should not be measured in that radius area.

S2677

**Figure 10. SKY13405-490LF 12-Pin QFN Package Dimensions**





### Figure 11. SKY13405-490LF Tape and Reel Dimensions

## Ordering Information

| Model Name                 | Manufacturing Part Number | Evaluation Board Part Number |
|----------------------------|---------------------------|------------------------------|
| SKY13405-490LF SP2T Switch | SKY13405-490LF            | SKY13405-490LF-EVB           |

Copyright © 2011-2013 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.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Skyworks:](#)

[SKY13405-490LF](#)