

**DATA SHEET**

# SKY13330-397LF: 0.1-6.0 GHz SP2T Switch

## Applications

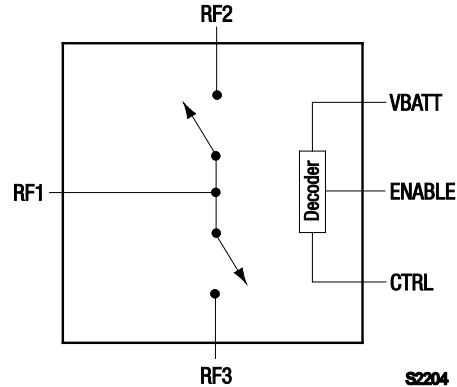
- WCDMA band and mode switching
- Antenna switch for multimode systems

## Features

- Broadband frequency range: 0.1 GHz to 6.0 GHz
- Low insertion loss:
  - 0.35 dB @ 2.2 GHz
  - 0.60 dB @ 6 GHz
- High IP1dB: +39 dBm
- No external DC blocking capacitors required
- Positive low control voltage range: 1.65 V to 2.70 V
- DC supply voltage: 2.3 V to 4.8 V
- Small, QFN (12-pin, 2 x 2 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



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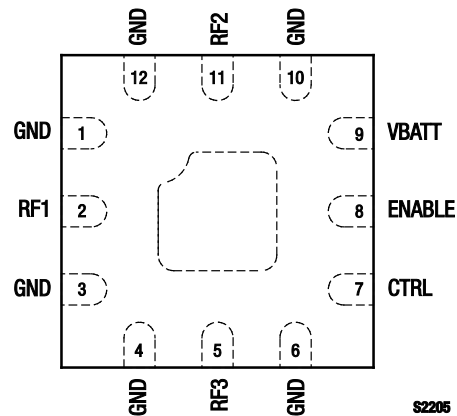
**Figure 1. SKY13330-397LF Block Diagram**

## Description

The SKY13330-397LF is a CMOS, Silicon-On-Insulator (SOI) Single-Pole, Double-Throw (SP2T) switch. The high linearity and low insertion loss of the SKY13330-397LF make it an ideal choice for WCDMA handset and data card applications.

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

The SKY13330-397LF 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.



**Figure 2. SKY13330-397LF Pinout – 12-Pin QFN (Top View)**

**Table 1. SKY13330-397LF Signal Descriptions**

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

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

**Table 2. SKY13330-397LF Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	B <sub>ATT</sub>		5.0	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

**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.

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**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.

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## Functional Description

The SKY13330-397LF is designed for medium to high power WCDMA handset and data card switching applications. The device can also be used in a variety of other applications that require high performance RF switching such as WLANs (a/b/g/n).

An internal negative voltage generator and decoder eliminate the need for external DC blocking capacitors on the RF ports unless VDC is externally applied.

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.

Shutdown mode is enabled by connecting the ENABLE pin to logic low. Shutdown mode reduces the overall current consumption of the device to 7 µA, typical.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13330-397LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13330-397LF is determined by the logic provided in Table 4.

Typical performance characteristics of the SKY13330-397LF are illustrated in Figures 3 through 5.

**Table 3. SKY13330-397LF Electrical Specifications (Note 1)****( $V_{BATT} = 2.3\text{ V}$  to  $4.8\text{ V}$ ,  $CTRL = 0/1.65\text{ V}$  to  $2.70\text{ V}$ ,  $T_{OP} = +25\text{ }^{\circ}\text{C}$ ,  $P_{IN} = 0\text{ dBm}$ , Characteristic Impedance [ $Z_0$ ] =  $50\text{ }\Omega$ , Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
<b>RF Specifications</b>						
Insertion loss	IL	RF1 to RF2/RF3:				
		0.1 to 1.0 GHz		0.30	0.35	dB
		1.0 to 2.2 GHz		0.35	0.50	dB
		2.2 to 2.5 GHz		0.35	0.50	dB
		2.5 to 5.0 GHz		0.45	0.65	dB
5.0 to 6.0 GHz		0.60	0.80	dB		
Isolation	Iso	RF1 to RF2/RF3:				
		0.1 to 1.0 GHz	40	42	dB	
		1.0 to 2.2 GHz	30	34	dB	
		2.2 to 2.5 GHz	30	33	dB	
		2.5 to 5.0 GHz	22	24	dB	
5.0 to 6.0 GHz	18	21	dB			
Return loss	IS111	RF1 to RF2/RF3, 0.1 to 6.0 GHz		20		dB
0.1 dB Input Compression Point	IP0.1dB	RF1 to RF2/RF3, 0.8 to 2.5 GHz		+38.5		dBm
3 <sup>rd</sup> Order Intermodulation Distortion	IMD3	$f_{ND} = 1950\text{ MHz}$ @ +20 dBm, $f_{BLK} = 1760\text{ MHz}$ @ -15 dBm		-110	-105	dBm
Switching speed		50% $V_{CTL}$ to 10/90% RF "on" time		1.70		$\mu\text{s}$
		50% $V_{CTL}$ to 90/10% RF "off" time		1.24		$\mu\text{s}$
		10/90% RF rise time		0.50		$\mu\text{s}$
		90/10% RF fall time		1.00		$\mu\text{s}$
Startup time (Note 2)		Shutdown state to any RF switch state		2		$\mu\text{s}$
<b>DC Specifications</b>						
Control voltage: high low	$V_{CTL\_HIGH}$		1.65		2.7	V
	$V_{CTL\_LOW}$		0		0.4	V
Supply voltage	$V_{BATT}$		2.3		4.8	V
Supply current	$I_{BATT}$	$V_{BATT} = 2.3\text{ to }4.8\text{ V}$		37		$\mu\text{A}$
Control current	$I_{CTRL}$	$CTRL = 1.8\text{ V}$		1		$\mu\text{A}$
Shutdown mode supply current	$I_{OFF}$	$ENABLE = 0\text{ V}$ , $V_{BATT} = 2.3\text{ V to }4.8\text{ V}$		7		$\mu\text{A}$

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.**Note 2:** Startup time refers to the amount of time it takes for the switch to be fully operational when coming out of shutdown mode ( $EN = 0$ ).

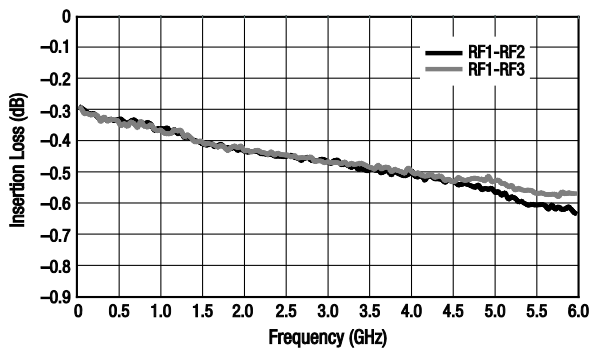
**Table 4. SKY13330-397LF Truth Table**

CTRL	ENABLE	Mode
1	1	RF1 to RF2
0	1	RF1 to RF3
X	0	Shutdown

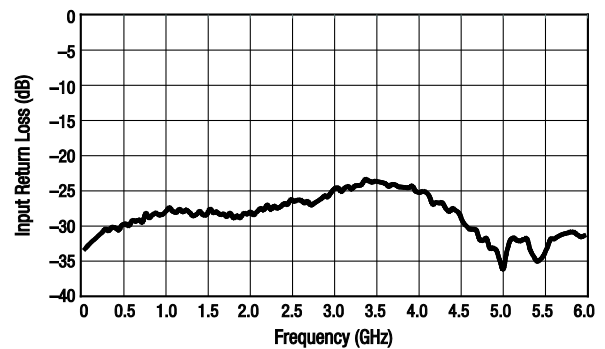
**Note:** 1 = 1.65 to 2.70 V  
 0 = -0 to 0.4 V (control voltage must be  $\leq V_{DD}$  at all times)  
 X = don't care  
 Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.

**Typical Performance Characteristics**

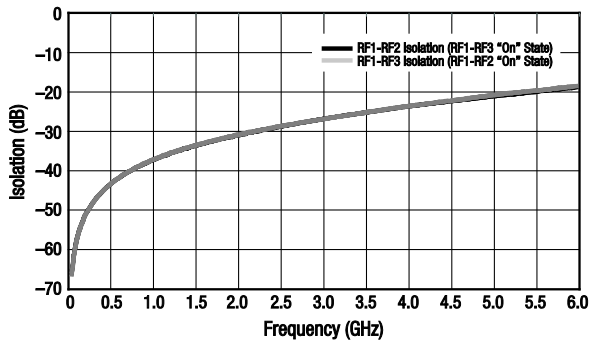
( $V_{BATT} = 2.3 \text{ V to } 4.8 \text{ V}$ ,  $CTRL = 0/1.65 \text{ V to } 2.70 \text{ V}$ ,  $T_{OP} = +25 \text{ }^\circ\text{C}$ ,  $P_{IN} = 0 \text{ dBm}$ , **Characteristic Impedance [ $Z_0$ ] = 50  $\Omega$ , Unless Otherwise Noted**)



**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 SKY13330-397LF Evaluation Board is used to test the performance of the SKY13330-397LF 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**

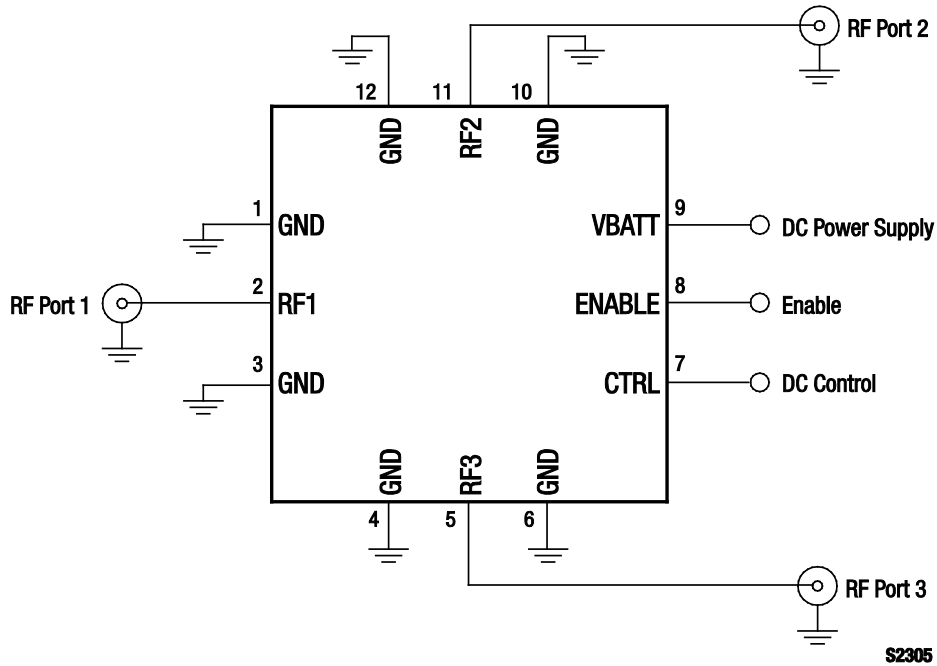
The PCB layout footprint for the SKY13330-397LF is provided in Figure 8. Typical case markings are shown in Figure 9. Package dimensions for the 12-pin QFN are shown in Figure 10, and tape and reel dimensions are provided in Figure 11.

**Package and Handling Information**

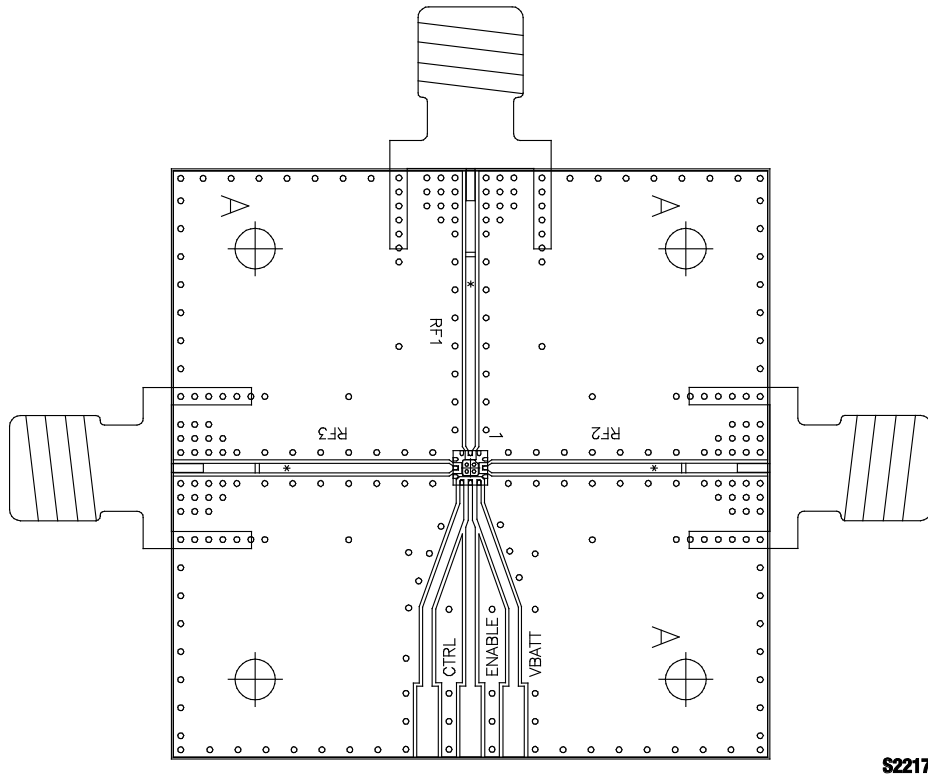
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

THE SKY13330-397LF 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.

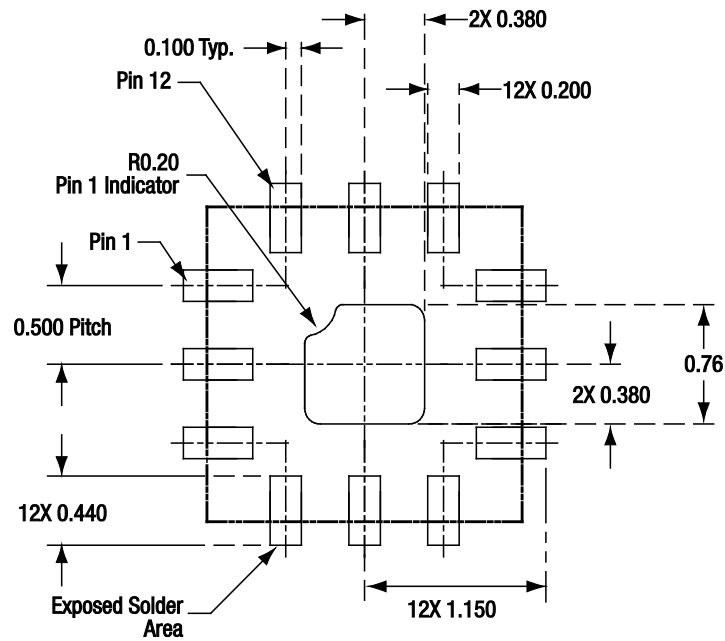


**Figure 6. SKY13330-397LF Evaluation Board Schematic**



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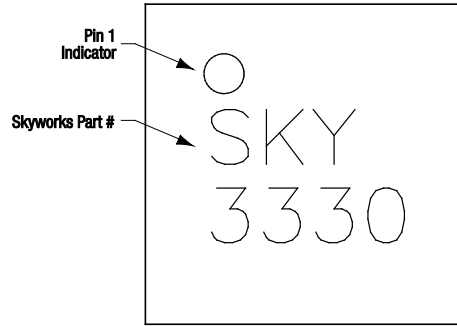
Figure 7. SKY13330-397LF Evaluation Board Assembly Diagram



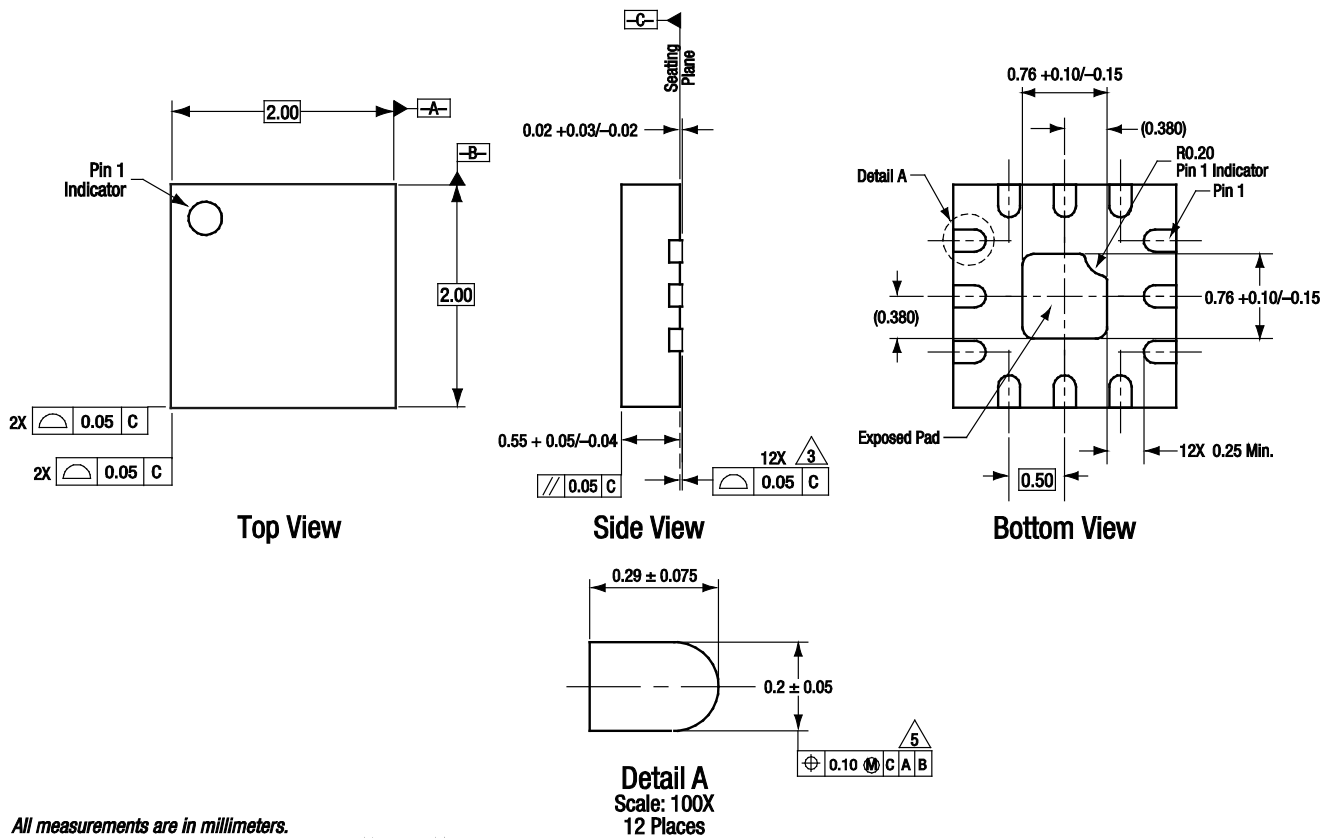
All measurements in millimeters

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Figure 8. SKY13330-397LF PCB Layout Footprint (Top View)



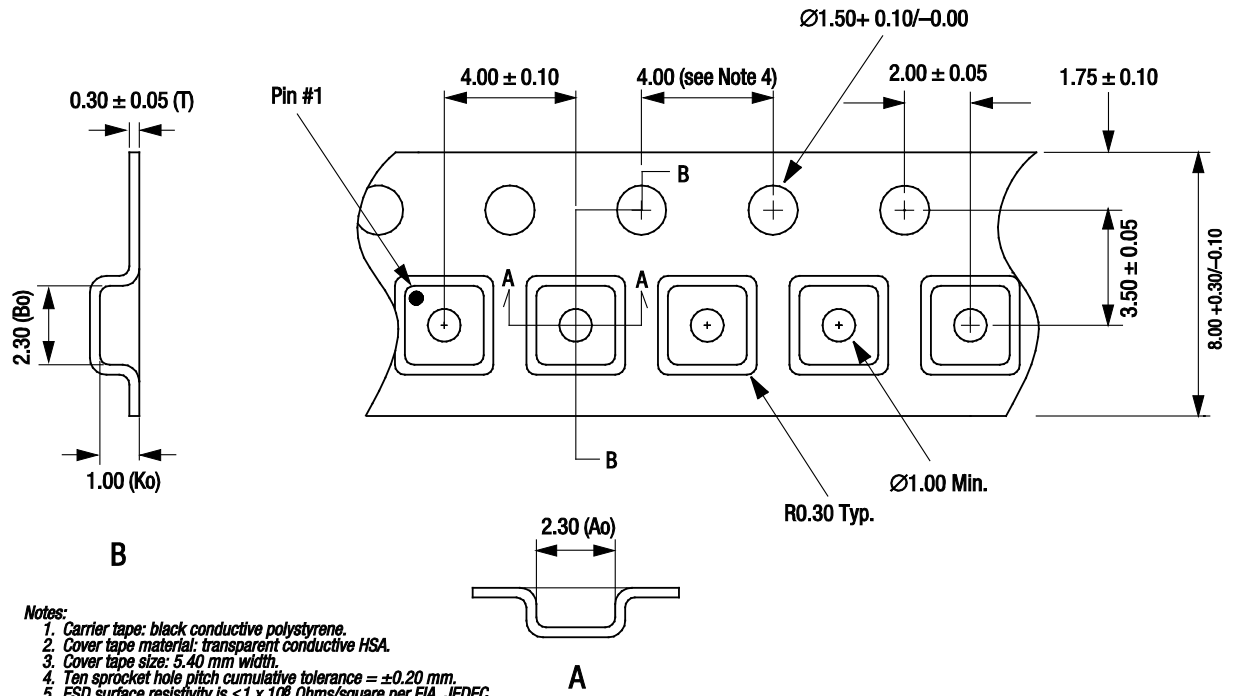
**Figure 9. Typical Case Markings (Top View)**



All measurements are in millimeters.  
 Dimensioning and tolerancing according to ASME Y14.5M-1994.  
 Coplanarity applies to the terminals and all other bottom surface metalization.  
 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.  
 Contact areas are NiPdAu.

S2512

**Figure 10. SKY13330-397LF 12-Pin QFN Package Dimensions**



- Notes:
1. Carrier tape: black conductive polystyrene.
  2. Cover tape material: transparent conductive HSA.
  3. Cover tape size: 5.40 mm width.
  4. Ten sprocket hole pitch cumulative tolerance =  $\pm 0.20$  mm.
  5. ESD surface resistivity is  $\leq 1 \times 10^8$  Ohms/square per EIA, JEDEC tape and reel specification.
  6.  $A_0$  and  $B_0$  measurement point to be 0.30 mm from bottom pocket.
  7. All measurements are in millimeters.

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Figure 11. SKY13330-397LF Tape and Reel Dimensions



**Ordering Information**

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13330-397LF SP2T Switch	SKY13330-397LF	SKY13330-397LF-EVB

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