

## DATA SHEET

# SKY13321-360LF: 0.1-3.0 GHz GaAs SPDT Switch

## Applications

- Higher power applications with excellent linearity performance
- WiMAX systems

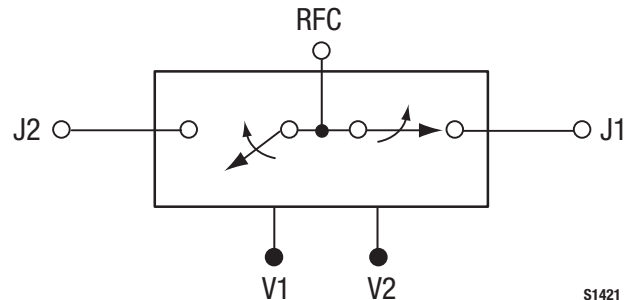
## Features

- Positive voltage control (0 to 1.8 V)
- High isolation, 26 dB typical @ 1 GHz
- Low loss, 0.4 dB typical @ 1 GHz
- Excellent linearity performance, P-0.1dB insertion point @ +39 dBm
- Small, QFN (8-pin, 2 x 2 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

### NEW



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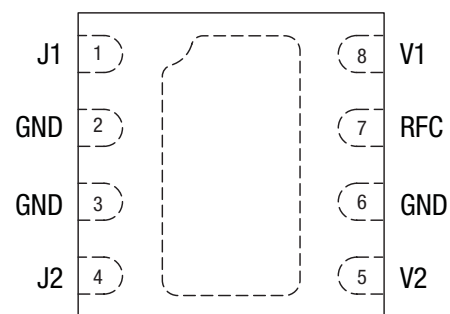
**Figure 1. SKY13321-360LF Block Diagram**

## Description

The SKY13321-360LF is a pHEMT GaAs FET I/C switch. The switch may be used in transmit/receive applications by connecting the RF common port (RFC, pin 7) to either the J1 or J2 port (pin 1 or 4, respectively) using a low loss path (i.e., a positive voltage applied to either V1 or V2 pins).

The switch is manufactured in a compact, 2 x 2 mm, 8-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.



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**Figure 2. SKY13321-360LF Pinout – 8-Pin QFN (Top View)**

**Table 1. SKY13321-360LF Signal Descriptions**

| Pin # | Name | Description | Pin # | Name | Description        |
|-------|------|-------------|-------|------|--------------------|
| 1     | J1   | RF port     | 5     | V2   | DC control voltage |
| 2     | GND  | Ground      | 6     | GND  | Ground             |
| 3     | GND  | Ground      | 7     | RFC  | RF port            |
| 4     | J2   | RF port     | 8     | V1   | DC control voltage |

**Table 2. SKY13321-360LF Absolute Maximum Ratings**

| Parameter                                       | Symbol           | Minimum | Typical | Maximum    | Units      |
|---|------------------|---------|---------|------------|------------|
| Input power<br>@ 900 MHz, 5 V<br>@ 130 MHz, 5 V | P <sub>IN</sub>  |         |         | +40<br>+39 | dBm<br>dBm |
| Storage temperature                             | T <sub>STG</sub> | −65     |         | +150       | °C         |
| Operating temperature                           | T <sub>OP</sub>  | −40     |         | +85        | °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.

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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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**Table 3. SKY13321-360LF Recommended Operating Conditions**

| Parameter                       | Symbol                                   | Minimum  | Typical | Maximum    | Units  |
|---------------------------------|--|----------|---------|------------|--------|
| Frequency                       | f  | 0.1      |         | 3.0        | GHz    |
| Control voltage:<br>low<br>high | V <sub>CTL_L</sub><br>V <sub>CTL_H</sub> | 0<br>1.8 |         | 0.2<br>5.0 | V<br>V |

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13321-360LF are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Typical performance characteristics of the SKY13321-360LF are illustrated in Figures 3 through 8.

The state of the SKY13321-360LF is determined by the logic provided in Table 5.

**Table 4. SKY13321-360LF Electrical Specifications (Note 1)****( $V_{CTL} = 0\text{ V}$  and  $+3\text{ V}$ ,  $T_{OP} = +25\text{ }^{\circ}\text{C}$ ,  $P_{IN} = 0\text{ dBm}$ , Characteristic Impedance  $[Z_0] = 50\text{ }\Omega$ , Unless Otherwise Noted)**

| Parameter                                    | Symbol       | Test Condition   | Min | Typical | Max  | Units         |
|--|--------------|--|-----|---------|------|---------------|
| Frequency                                    | f            |  | 0.1 |         | 3.0  | GHz           |
| Insertion loss                               |              | 0.1-1.0 GHz  |     | 0.40    | 0.50 | dB            |
|  |              | 1.0-2.0 GHz  |     | 0.50    | 0.60 | dB            |
|  |              | 2.0-2.5 GHz  |     | 0.55    | 0.70 | dB            |
|  |              | 2.5-3.0 GHz  |     | 0.60    | 0.80 | dB            |
| Isolation                                    |              | 0.1-1.0 GHz  | 23  | 26      |      | dB            |
|  |              | 1.0-2.0 GHz  | 17  | 20      |      | dB            |
|  |              | 2.0-2.5 GHz  | 15  | 18      |      | dB            |
|  |              | 2.5-3.0 GHz  | 13  | 16      |      | dB            |
| Return loss (insertion loss state)           |              | 0.1-3.0 GHz  |     | 25      |      | dB            |
| Switching characteristics:<br>Rise/fall time |              | 10/90% or 90/10% RF  |     | 650     |      | ns            |
|  |              | 50% $V_{CTL}$ to 90/10% RF   |     | 800     |      | ns            |
| Input power for 0.1 dB compression           |              | 130 MHz  |     | +39     |      | dBm           |
|  |              | 900 MHz  |     | +39     |      | dBm           |
|  |              | 2450 MHz   |     | +39     |      | dBm           |
| Second harmonic                              | 2fo          | $P_{IN} = +34.5\text{ dBm}$ ,<br>f = 900 MHz   |     | -75     |      | dBc           |
|  |              | $P_{IN} = +32.0\text{ dBm}$ ,<br>f = 1800 MHz  |     | -70     |      | dBc           |
|  |              | $P_{IN} = +36\text{ dBm}$ ,<br>f = 350 to 470 MHz (UHF band),                                  |     | -80     |      | dBc           |
| Third harmonic                               | 3fo          | $P_{IN} = +34.5\text{ dBm}$ ,<br>f = 900 MHz   |     | -75     |      | dBc           |
|  |              | $P_{IN} = +32.0\text{ dBm}$ ,<br>f = 1800 MHz  |     | -70     |      | dBc           |
|  |              | $P_{IN} = +36\text{ dBm}$ ,<br>f = 350 to 470 MHz (UHF band)                                   |     | -85     |      | dBc           |
| Blocker performance                          |              | Tone 1 = 1950 MHz @<br>+20 dBm,<br>Tone 2 = 1760 MHz @<br>-15 dBm, IMD3 measured<br>@ 2140 MHz |     | -105    |      | dBm           |
| Control voltage:<br>Low<br>High              | $V_{CTL\_L}$ |  | 0   |         | 0.2  | V             |
|  | $V_{CTL\_H}$ |  | 1.8 |         | 5.0  | V             |
| Control current                              | $I_{CC}$     | $V_{CTL\_H} = 5\text{ V}$  |     | 100     |      | $\mu\text{A}$ |

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

## Typical Performance Characteristics

( $V_{CTL} = 0\text{ V}$  and  $+3\text{ V}$ ,  $T_{OP} = +25\text{ }^{\circ}\text{C}$ ,  $P_{IN} = 0\text{ dBm}$ , Characteristic Impedance [ $Z_0$ ] =  $50\text{ }\Omega$ , Blocking Capacitors =  $100\text{ pF}$ , Bypass Capacitors =  $33\text{ pF}$ , Unless Otherwise Noted)

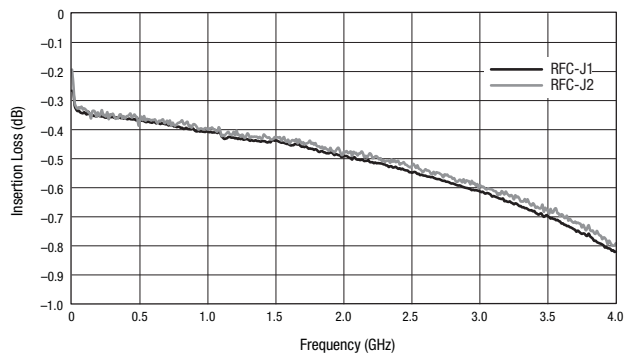


Figure 3. Typical Insertion Loss

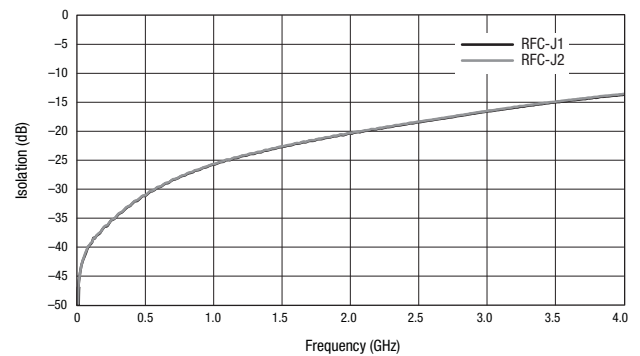


Figure 4. Typical Isolation

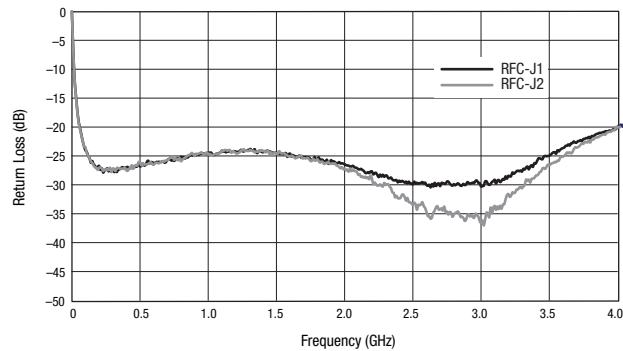


Figure 5. Typical Return Loss

## Typical Performance Characteristics

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

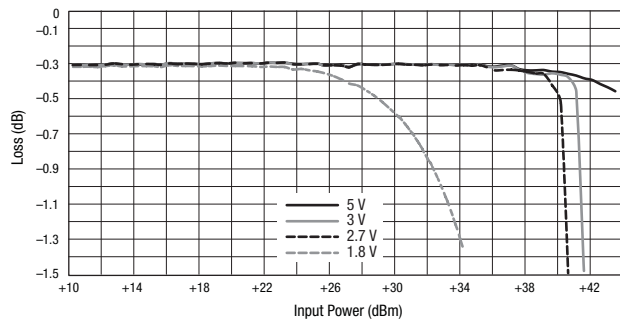


Figure 6. Typical 130 MHz Compression

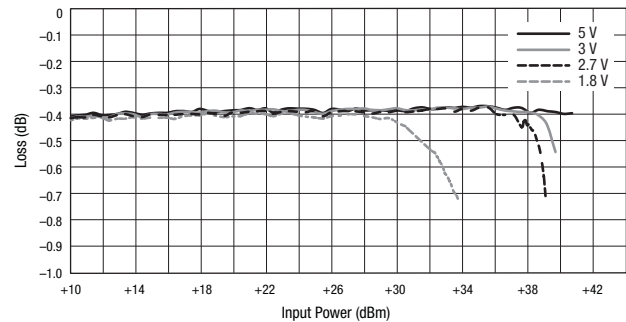


Figure 7. Typical 900 MHz Compression

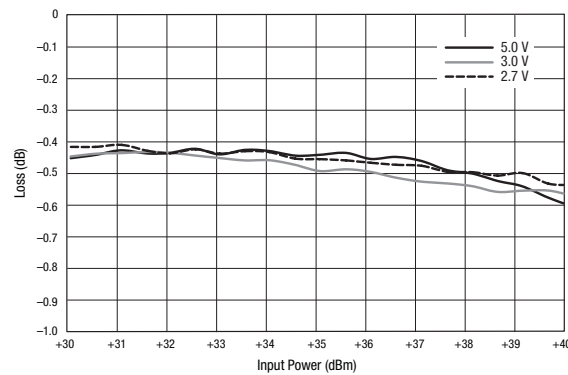


Figure 8. Typical 2450 MHz Compression

Table 5. SKY13321-360LF Truth Table

| V1 (Pin 8) | V2 (Pin 5) | RFC to J1 Path | RFC to J2 Path |
|------------|------------|----------------|----------------|
| 1          | 0          | Insertion loss | Isolation      |
| 0          | 1          | Isolation      | Insertion loss |

Note: "1" = +1.8 V to +5 V. "0" = 0 V. Any state other than described in this Table places the switch into an undefined state.

## Evaluation Board Description

The SKY13321-360LF Evaluation Board is used to test the performance of the SKY13321-360LF SPDT Switch. An assembly drawing for the Evaluation Board is shown in Figure 9.

## Package Dimensions

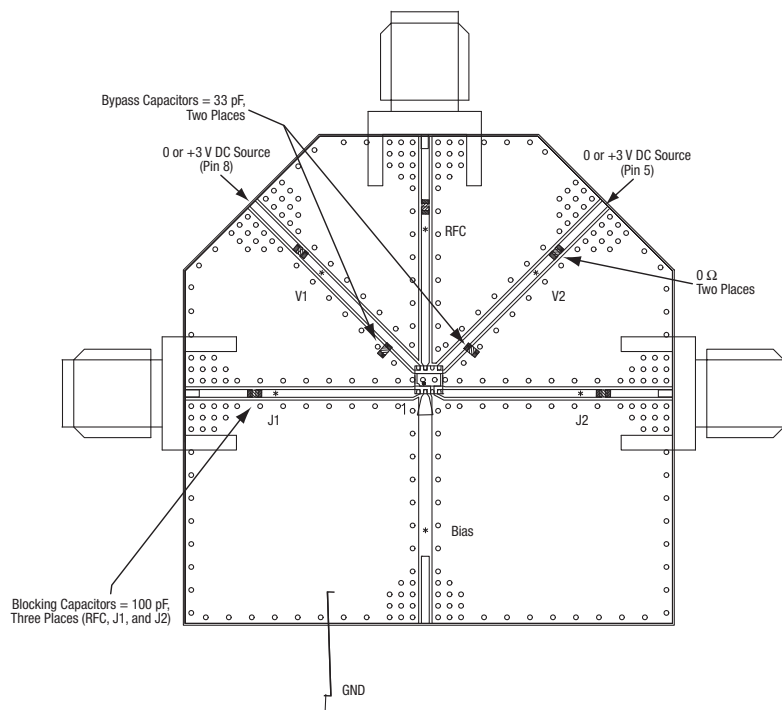
The PCB layout footprint for the SKY13321-360LF is provided in Figure 10. Typical case markings are shown in Figure 11. Package dimensions for the 4-pin QFN are shown in Figure 12, and tape and reel dimensions are provided in Figure 13.

## 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 SKY13321-360LF is rated to Moisture Sensitivity Level 1 (MSL1) at 260  $^{\circ}\text{C}$ . It can be used for lead or lead-free soldering.

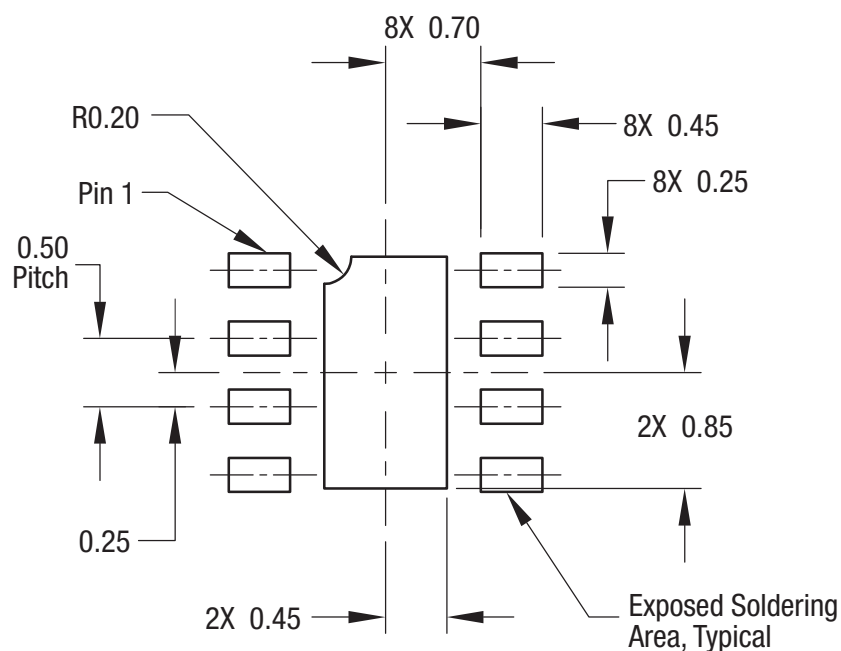
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



NOTE: A semi-universal Evaluation Board is used to test the SKY13321-360LF. Some RF lines are used to apply DC bias and have 0  $\Omega$  resistors installed. There are two RF bypass capacitors added to the DC control lines. The RF paths -- RFC, J1, and J2 -- have DC blocking capacitors installed.

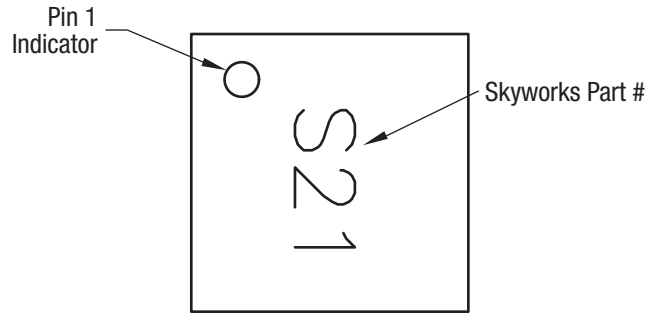
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**Figure 9. SKY13321-360LF Evaluation Board Assembly Diagram**

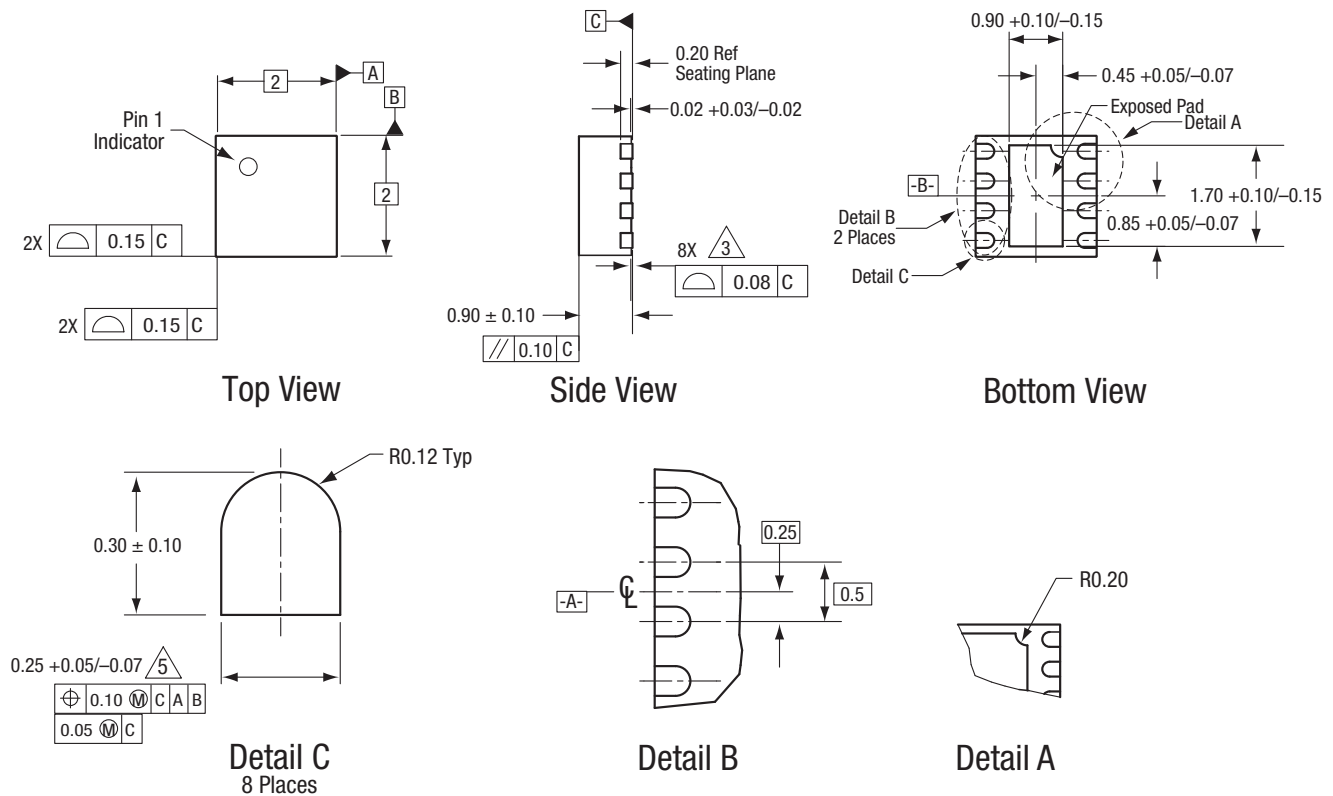


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**Figure 10. SKY13321-360LF PCB Layout Footprint**



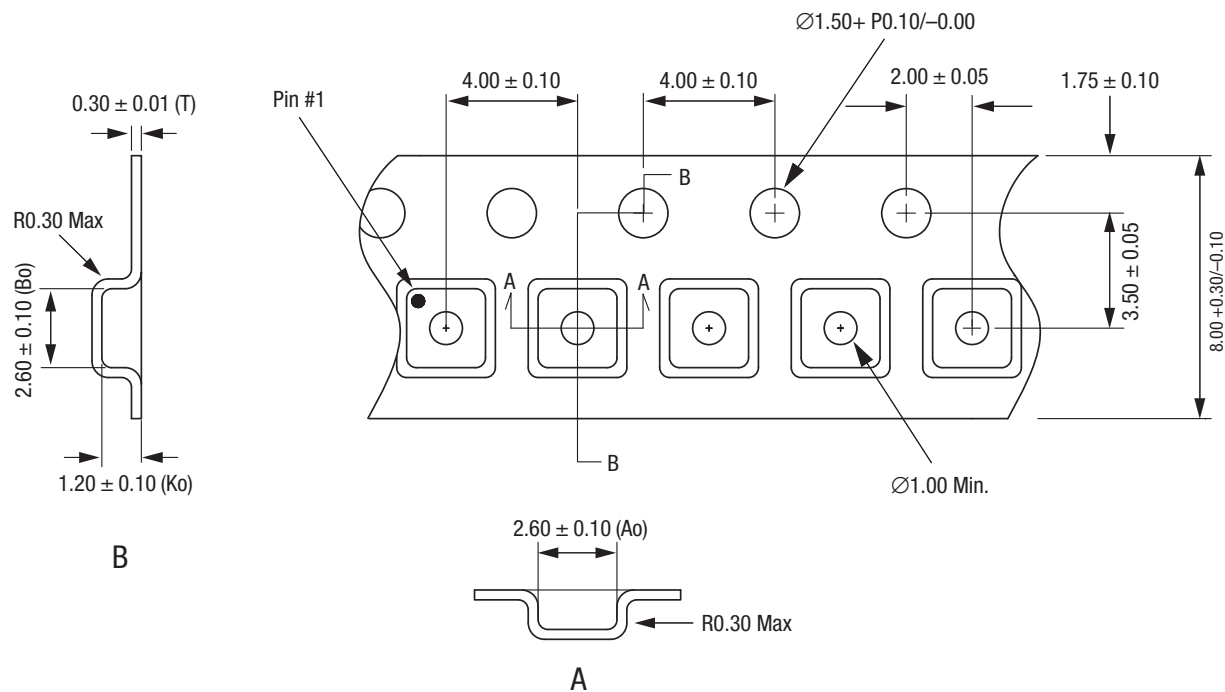
**Figure 11. Typical Case Markings (Top View)**



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.  
 Dimension applies to metallized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

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**Figure 12. SKY13321-360LF 8-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. All measurements are in millimeters.

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**Figure 13. SKY13321-360LF Tape and Reel Dimensions**



## Ordering Information

| Model Name                 | Manufacturing Part Number | Evaluation Kit Part Number |
|----------------------------|---------------------------|----------------------------|
| SKY13321-360LF SPDT Switch | SKY13321-360LF            | SK40709-1, Rev. 3          |

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