

DATA SHEET

# SKY13547-490LF: 5 to 1800 MHz Ultra-High Linearity SPDT 75 Ω Switch

## Applications

- Cable modem
- Set-top box
- Filter band switching
- Relay replacement to switch between DOCSIS 3.0 and DOCSIS 3.1 configurations

## Features

- Ultra-high linearity performance
- IMD2, IMD3:
  - < -110 dBc typ @ P<sub>IN</sub> = +68 dBmV F<sub>IN</sub> = 880 MHz
  - < -80 dBc typ @ P<sub>IN</sub> = +68 dBmV F<sub>IN</sub> = 40 MHz
- 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.

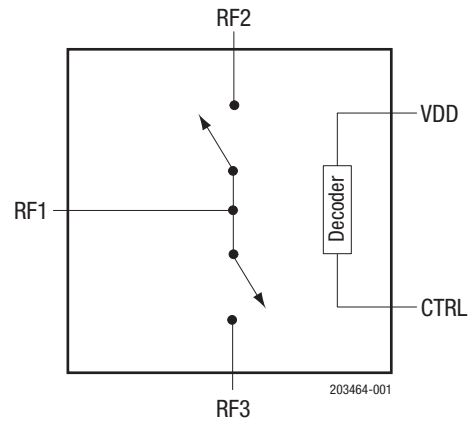


Figure 1. SKY13547-490LF Block Diagram

## Description

The SKY13547-490LF is a single-pole, double-throw (SPDT) 75 Ω switch. The high linearity and low insertion loss of the SKY13547-490LF meet the most stringent requirements of DOCSIS 3.1 applications.

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

The SKY13547-490LF 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.

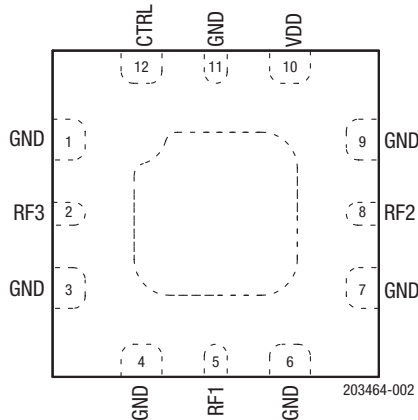


Figure 2. SKY13547-490LF Pinout (Top View)

**Table 1. SKY13547-490LF Signal Descriptions<sup>1</sup>**

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.

<sup>1</sup> Exposed pad must be properly grounded using a low impedance path.

### Functional Description

The high linearity, very low insertion loss SKY13547-490LF SPDT 75 Ω switch has been developed using an advanced proprietary fabrication process that enables the switch to be used in cable applications including DOCSIS 3.0 and DOCSIS 3.1 cable modems and set-top boxes. 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 SKY13547-490LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13547-490LF is determined by the logic provided in Table 4.

Typical performance characteristics of the SKY13547-490LF are illustrated in Figures 3 through 5.

**Table 2. SKY13547-490LF Absolute Maximum Ratings<sup>1,2</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V <sub>DD</sub>		5	V
Control voltage	V <sub>CTL</sub>		3	V
Input power	P <sub>IN</sub>		+87	dBmV
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

<sup>1</sup> 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.

<sup>2</sup> 100% duty cycle, 75 Ω.

**ESD HANDLING:** 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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

**Table 3. SKY13547-490LF Electrical Specifications<sup>1</sup> (1 of 2)**

(V<sub>DD</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> = +68 dBmV, Characteristic Impedance [Z<sub>0</sub>] = 75 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>RF Specifications</b>						
Insertion loss	IL	RF1 to RF2/RF3:				
		5 to 200 MHz		0.20		dB
		0.2 to 1.0 GHz		0.30		dB
		1.0 to 1.8 GHz		0.35		dB
Isolation	Iso	RF1 to RF2/RF3:				
		5 to 200 MHz		50		dB
		0.2 to 1.0 GHz		37		dB
		1.0 to 1.8 GHz		30		dB
Return loss	IS111	RF1 to RF2/RF3, 5 MHz to 1.8 GHz		20		dB
0.1 dB input compression point	IP0.1dB	RF1 to RF2/RF3:				
		5 to 10 MHz		+82		dBmV
		10 to 100 MHz		+85		dBmV
		100 to 1200 MHz		+88		dBmV
2 <sup>nd</sup> and 3 <sup>rd</sup> harmonics	2fo, 3fo	P <sub>IN</sub> = +68 dBmV		-110 @ F <sub>IN</sub> = 880 MHz -80 @ F <sub>IN</sub> = 40 MHz		dBc dBc
Composite triple beat	CTB	159 channels, +42 dBmV per channel output power		-103		dBc
Composite second order	CSO	159 channels, +42 dBmV per channel output power		-103		dBc
Switching speed		50% V <sub>CTL</sub> to 10/90% RF "on" time		2.3		ns
		50% V <sub>CTL</sub> to 90/10% RF "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

**Table 3. SKY13547-490LF Electrical Specifications<sup>1</sup> (2 of 2)**

(V<sub>DD</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> = +68 dBmV, Characteristic Impedance [Z<sub>0</sub>] = 75 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>DC Specifications</b>						
Control voltage: High	V <sub>CTL_HIGH</sub>		1.65		2.70	V
Low	V <sub>CTL_LOW</sub>		0		0.4	V
Supply voltage	V <sub>DD</sub>		2.5		4.8	V
Supply current	I <sub>DD</sub>	V <sub>DD</sub> = 2.5 to 4.8 V		50		μA
Control current	I <sub>CTRL</sub>	CTRL = 1.8 V		0.5		μA

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

**Table 4. SKY13547-490LF Truth Table<sup>1</sup>**

CTRL (Pin 12)	Mode
0	RF1 to RF2
1	RF1 to RF3

<sup>1</sup> 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

(VDD = 2.5 V to 4.8 V, CTRL = 1.65 V to 2.70 V, TOP = +25 °C, PIN = +68 dBmV, Characteristic Impedance [Zo] = 75 Ω, Unless Otherwise Noted)

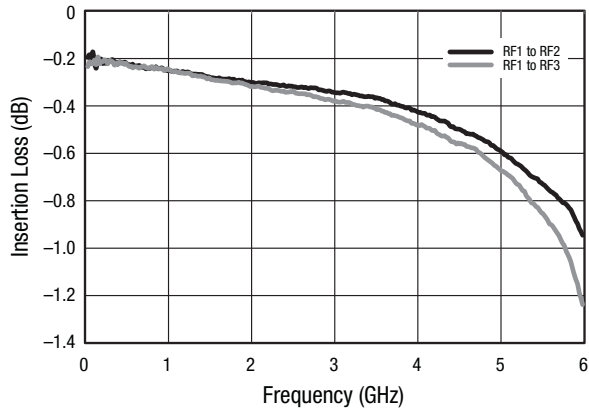


Figure 3. Insertion Loss vs Frequency

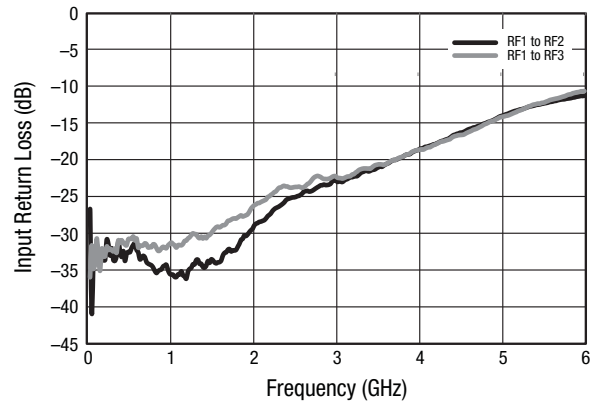


Figure 4. Input Return Loss vs Frequency

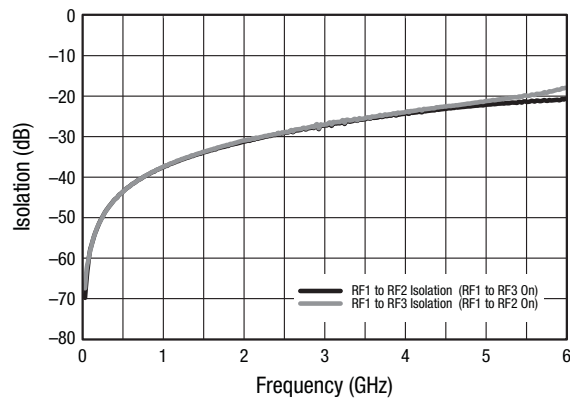
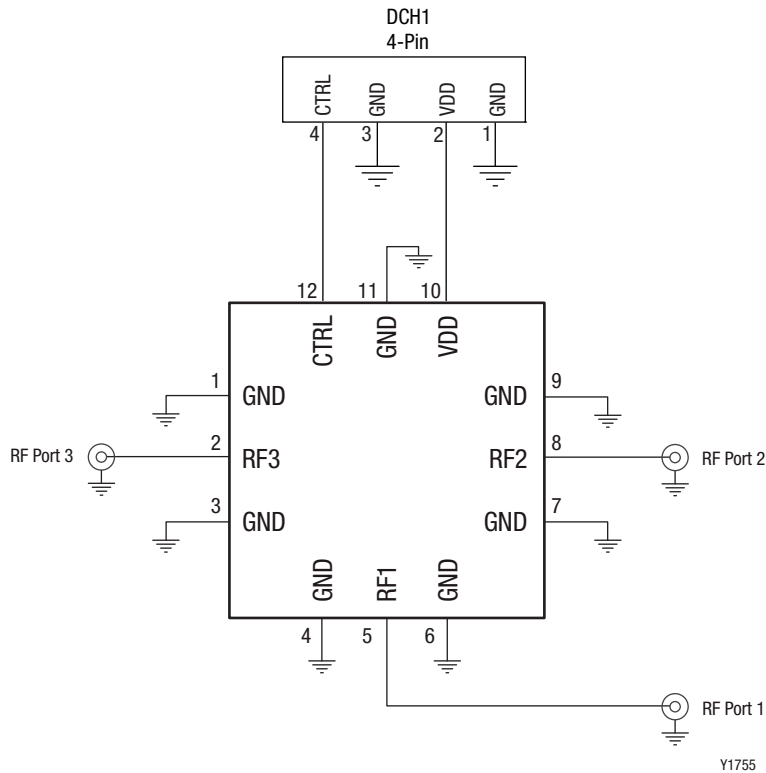


Figure 5. Input to Output Isolation vs Frequency

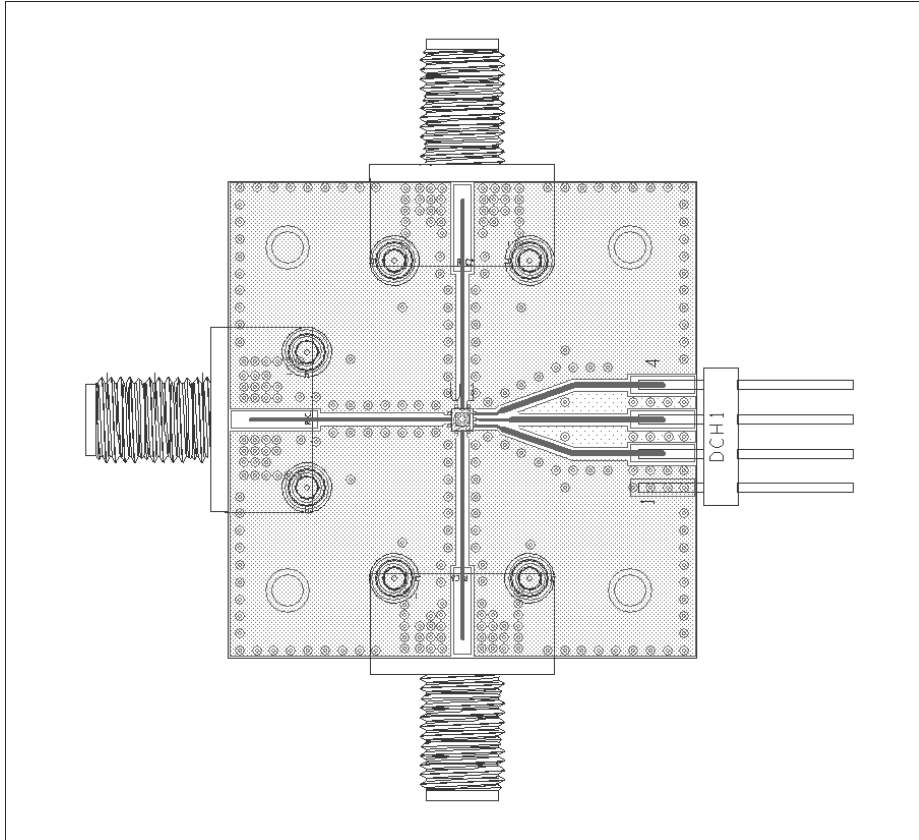
### Evaluation Board Description

The SKY13547-490LF Evaluation Board is used to test the performance of the SKY13547-490LF SP2T Switch.

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



**Figure 6. SKY13547-490LF Evaluation Board Schematic**



**Figure 7. SKY13547-490LF Evaluation Board Assembly Diagram**

### Package Dimensions

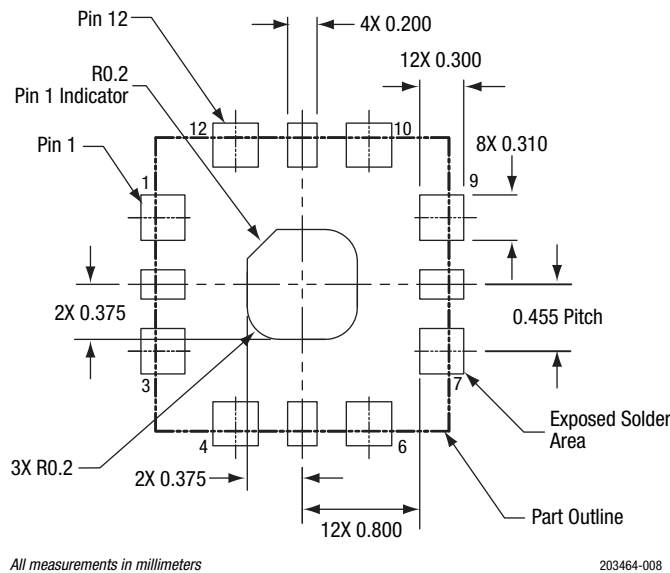
The PCB layout footprint for the SKY13547-490LF is provided in Figure 8. Typical part markings are shown in Figure 9. Package dimensions are shown in Figure 10, and tape and reel dimensions are provided in Figure 11.

### Package and Handling Information

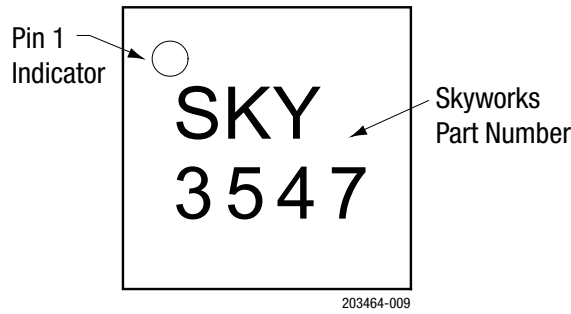
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY13547-490LF 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.

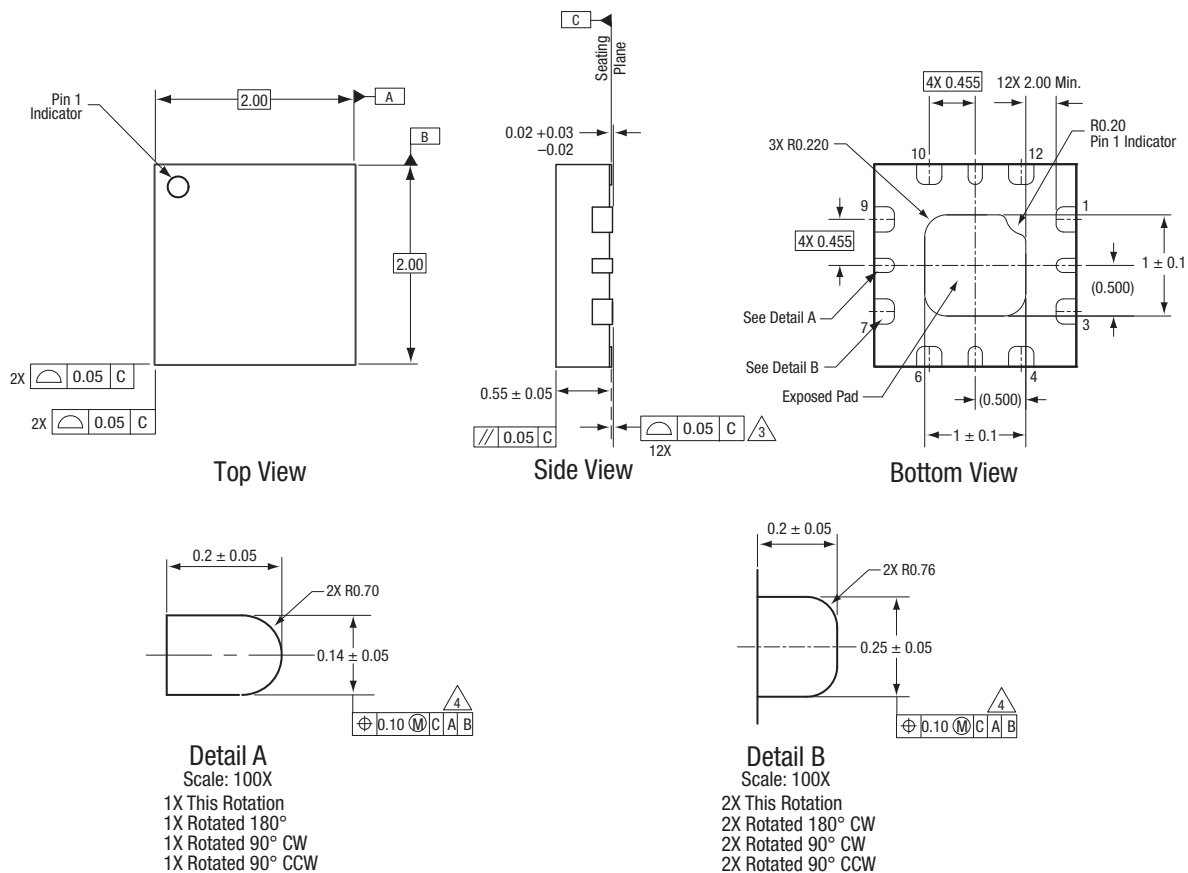
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



**Figure 8. SKY13547-490LF PCB Layout Footprint (Top View)**



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

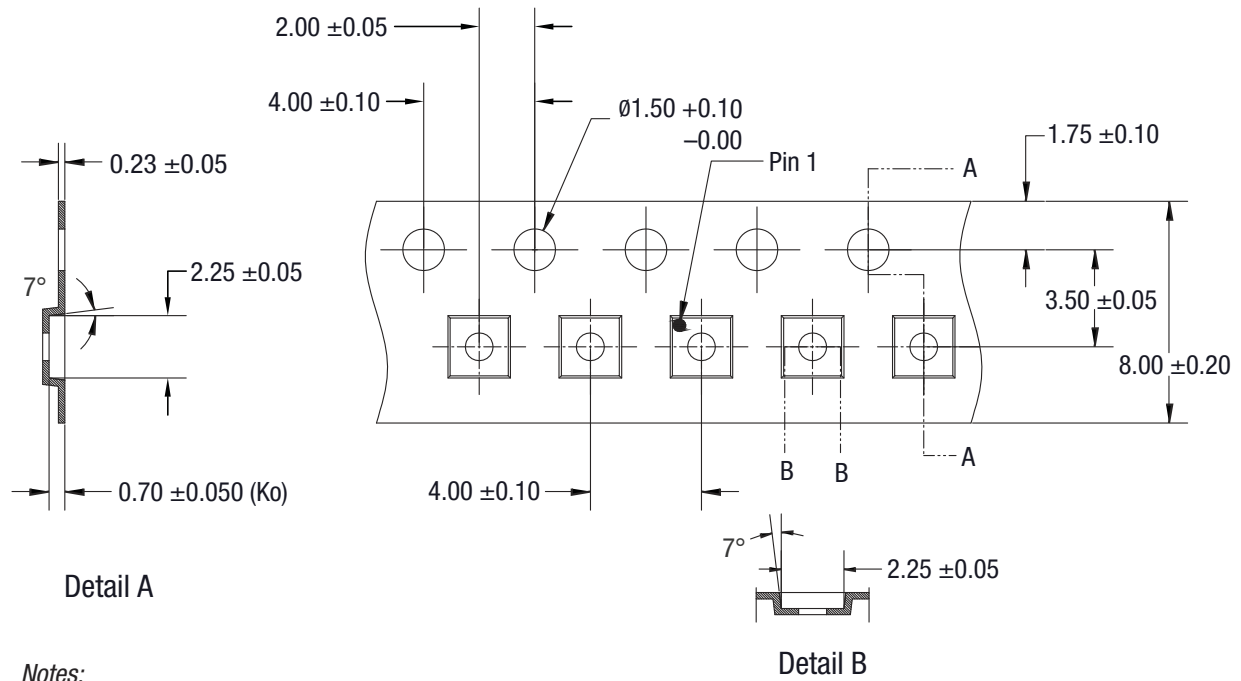


**Notes:**

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.

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**Figure 10. SKY13547-490LF Package Dimensions**



Notes:

1. Carrier tape must meet all requirements of Skyworks GP01-D232 procurement spec for tape and reel shipping.
2. Carrier tape material: black conductive polycarbonate bakeable material at 125 °C.
3. Cover tape material: transparent conductive material with 5.40 mm width.
4. ESD surface resistivity must meet all ESD requirements of Skyworks as specified on GP01-D232.
5. All dimensions are in millimeters.

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**Figure 11. SKY13547-490LF Tape and Reel Dimensions**

## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13547-490LF: SPDT SPDT 75 Ω Switch	SKY13547-490LF	SKY13547-490LF-EVB

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