



DATA SHEET

SKY13477-001A: 3P4T Transmit/Receive LTE Switch in a WLCSP Package

Applications

- Receive and Transmit WCDMA FDD and TDD Band 7 systems
- Mode switching for cellular, tablet, and embedded modules

Features

- 400 micron WLCSP suitable for direct board attachment
- Low insertion loss optimized for high TDD band applications and FDD Band 7 applications
- No external DC blocking capacitors required
- Four GPIO control lines with V_{DD} voltage regulator:
 - V_{CTL} = 1.8 V
 - V_{DD} = 2.45 to 3.00 V
- Small, 15-bump WLCSP, 200 μm diameter, 400 μm pitch (1.942 x 1.142 x 0.420 mm maximum) package (MSL1, 260 °C per JEDEC J-STD-020)

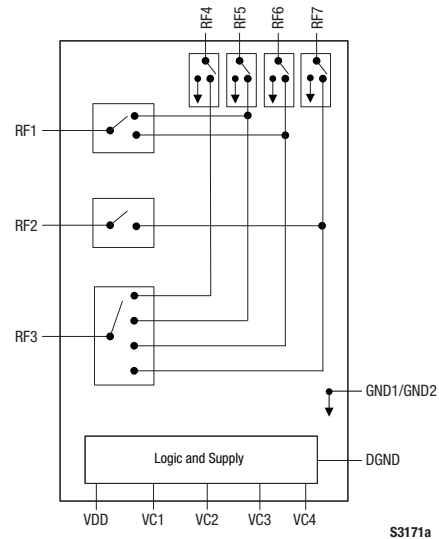


Figure 1. SKY13477-001A Block Diagram



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Description

The SKY13477-001A is a three-pole, four-throw (3P4T) switch. Switching is controlled by an integrated GPIO interface with four control pins. Depending on the logic voltage level applied to the control pins, the following switched outputs are possible:

- RF1 port can be connected to the RF6 or RF5 port.
- RF2 port can be connected to the RF7 port.
- RF3 port can be connected to the RF4, RF5, RF6, or RF7 port.

No external DC blocking capacitors are required as long as no DC voltage is applied on any RF path. The internal voltage regulator allows the V_{DD} supply value to be within 2.45 V to 3.00 V. Logic control is 1.8 V nominal.

The SKY13477-001A is provided in a compact 15-bump, 1.942 x 1.142 x 0.420 mm (maximum) Wafer Level Chip Scale Package (WLCSP) that meets requirements for board-level assembly. Bump and Under-Bump Metallization (UBM) diameters are 200 microns.

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.

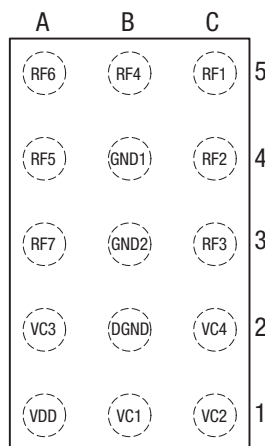


Figure 2. SKY13477-001A Pinout (Top View, Bumps Facing Down)

Table 1. SKY13477-001A Signal Descriptions

Pin	Name	Description	Pin	Name	Description
A1	VDD	Supply voltage	C3	RF3	RFIO, pole 3
B1	VC1	Control line 1	A4	RF5	RFIO, throw 2
C1	VC2	Control line 2	B4	GND1	RF ground 1
A2	VC3	Control line 3	C4	RF2	RFIO, pole 2
B2	DGND	Digital ground	A5	RF6	RFIO, throw 3
C2	VC4	Control line 4	B5	RF4	RFIO, throw 1
A3	RF7	RFIO, throw 4	C5	RF1	RFIO, pole 1
B3	GND2	RF ground 2			

Table 2. SKY13477-001A Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage (@ TA = 25 °C)	VDD		+4.8	V
Digital control voltage (@ TA = 25 °C)	VCTL	-0.5	+3.1	V
RF input power (@ TA = 25 °C) burst LTE signal	Pin		+30	dBm
Supply ripple	VPP		20	mVpp
Operating temperature	TOP	-35	+90	°C
Storage temperature	TSTG	-55	+150	°C
Electrostatic discharge:	ESD			
Charged Device Model (CDM), Class 3			500	V
Human Body Model (HBM), Class 1B			500	V
Machine Model (MM), Class A			100	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.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13477-001A are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13477-001A is determined by the logic provided in Table 4.

A timing diagram is provided in Figure 3 that shows the status and sequence of control lines, VDD, and the RF signal for power on and switching time specifications.

Table 3. SKY13477-001A Electrical Specifications (1 of 2) (Note 1)
(V_{DD} = 2.65 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
DC Specifications						
Supply voltage	V _{DD}		2.45	2.65	3.00	V
Control voltage: Low High	V _{CTL_L} V _{CTL_H}	P _{IN} = +26 dBm	0 1.35	1.80	0.45 2.70	V V
Current on VC1 pin	I _{CTL}				10	μA
Supply current	I _{DD}	V _{DD} = 3.0 V, VC1 = V _{CTL_H}		30	50	μA
DC supply turn-on/turn-off time	t _{ON}	Measured from 50% of final V _{DD} supply voltage to final RF power ± 1 dB, P _{IN} = +26 dBm, T _A = -20 °C to +85 °C		10	20	μs
RF path switching time	t _{SW}	From one active state to another active state transition, measured from 50% of final control voltage to final RF input power ± 1 dB, P _{IN} = +26 dBm, T _A = -20 °C to +85 °C		1.5	2.0	μs
RF Specifications						
Insertion loss (RF1 to RF5 pin)	IL	2496 to 2690 MHz		0.39	0.45	dB
Insertion loss (RF1 to RF6 pin)	IL	2570 to 2620 MHz		0.38	0.55	dB
Insertion loss (RF2 to RF7 pin)	IL	2300 to 2400 MHz		0.35	0.46	dB
Insertion loss (RF3 to RF5 pin)	IL	2496 to 2690 MHz		0.52	0.57	dB
Insertion loss (RF3 to RF6 pin)	IL	2570 to 2620 MHz		0.66	0.74	dB
Insertion loss (RF3 to RF7 pin)	IL	2300 to 2400 MHz		0.64	0.73	dB
Insertion loss (RF3 to RF4 pin)	IL	2500 to 2570 MHz		0.42	0.49	dB
Isolation between any active RF port and any unused port	Iso	2300 to 2690 MHz (NTC) 2300 to 2690 MHz (ETC)	23	30		dB dB
Isolation between any active RF port and any unused port except the following: RF3 to RF4 "on," isolation RF4 to RF1 RF3 to RF4 "on," isolation RF4 to RF6 RF3 to RF5 "on," isolation RF5 to RF6 RF3 to RF5 "on," isolation RF5 to RF7 RF3 to RF7 "on," isolation RF3 to RF2 RF3 to RF7 "on," isolation RF7 to RF2 RF3 to RF7 "on," isolation RF7 to RF5	Iso	2300 to 2690 MHz (ETC)	20 20 20 20 15 15 20			dB dB dB dB dB dB dB

Table 3. SKY13477-001A Electrical Specifications (2 of 2) (Note 1)
(V_{DD} = 2.65 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
RF Specifications (continued)						
Isolation between any RF port in an “all isolation” state	Iso	2300 to 2690 MHz (NTC) 2300 to 2690 MHz (ETC)	23	30		dB dB
Isolation between any RF port in an “all isolation” state except the following: RF6 to RF1 RF6 to RF4 RF6 to RF5 RF7 to RF5 RF7 to RF2 RF7 to RF3	Iso	2300 to 2690 MHz (ETC)	20 15 15 20 20 20			dB dB dB dB dB db
Voltage Standing Wave Ratio: RF1 to RF5 RF1 to RF6 RF2 to RF7 RF3 to RF4 RF3 to RF5 RF3 to RF6 RF3 to RF7	VSWR	Referenced to 50 Ω: 2496 MHz to 2690 MHz 2570 MHz to 2620 MHz 2300 MHz to 2400 MHz 2500 MHz to 2570 MHz 2496 MHz to 2690 MHz 2570 MHz to 2620 MHz 2300 MHz to 2400 MHz		1.05:1 1.09:1 1.17:1 1.05:1 1.20:1 1.32:1 1.22:1	1.45:1 1.45:1 1.45:1 1.45:1 1.45:1 1.45:1 1.45:1	– – – – – – –
Harmonics		P _{IN} = +28 dBm, load VSWR = 2.5:1, all harmonics up to 12.75 GHz: RF1 to RF5 or RF1 to RF6, f _o = 2300 to 2400 MHz RF2 to RF7, f _o = 2570 to 2620 MHz		–70 –70	–55 –55	dBm dbm

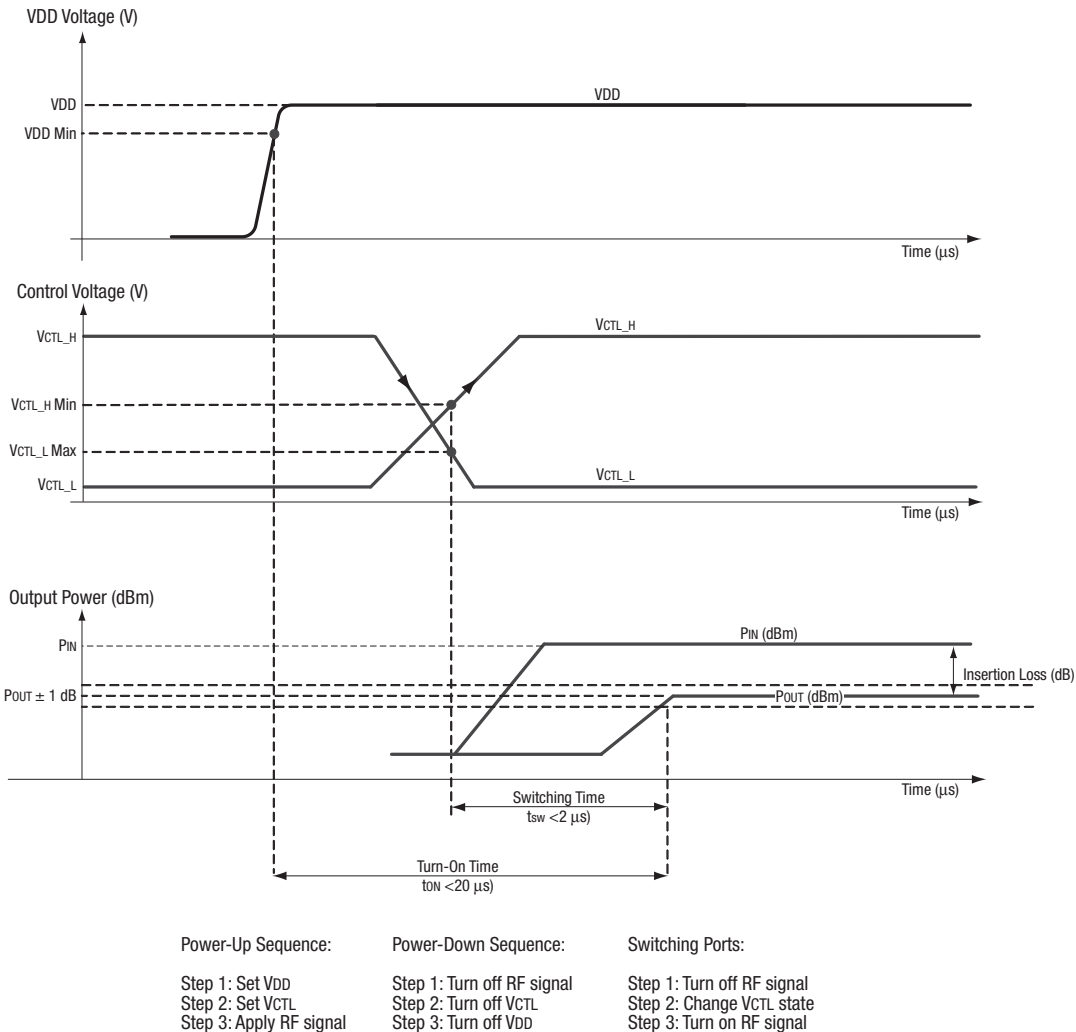
Note 1: Performance is guaranteed only under the conditions listed in this table.

Note 2: ETC = Extreme Test Conditions (V_{DD} = 2.45 V to 3.00 V and T_{OP} = –10 °C to +85 °C)

Table 4. SKY13477-001A Truth Table

State	VC1	VC2	VC3	VC4	Active Path
0	0	0	0	0	All isolation
1	1	1	0	1	RF1 to RF5
2	1	0	0	1	RF1 to RF6
3	0	0	0	1	RF2 to RF7
4	0	1	0	1	RF3 to RF4
5	0	1	1	1	RF3 to RF5
6	0	0	1	1	RF3 to RF6
7	0	0	1	0	RF3 to RF7

Note: "1" = 1.35 V to 2.70 V. "0" = -0 V to +0.45 V. Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.



S3483

Figure 3. SKY13477-001A Timing Diagram

Evaluation Board Description

The SKY13477-001A Evaluation Board is used to test the performance of the SKY13477-001A 3P4T Switch. An Evaluation Board schematic diagram is provided in Figure 4. An assembly drawing for the Evaluation Board is shown in Figure 5.

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 SKY13477-001A 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, *Wafer Level Chip Scale Packages: SMT Process Guidelines and Handling Considerations*, document number 201676.

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.

Package Dimensions

Package dimensions for the SKY13477-001A die are shown in Figure 6, and tape and reel dimensions are provided in Figure 7.

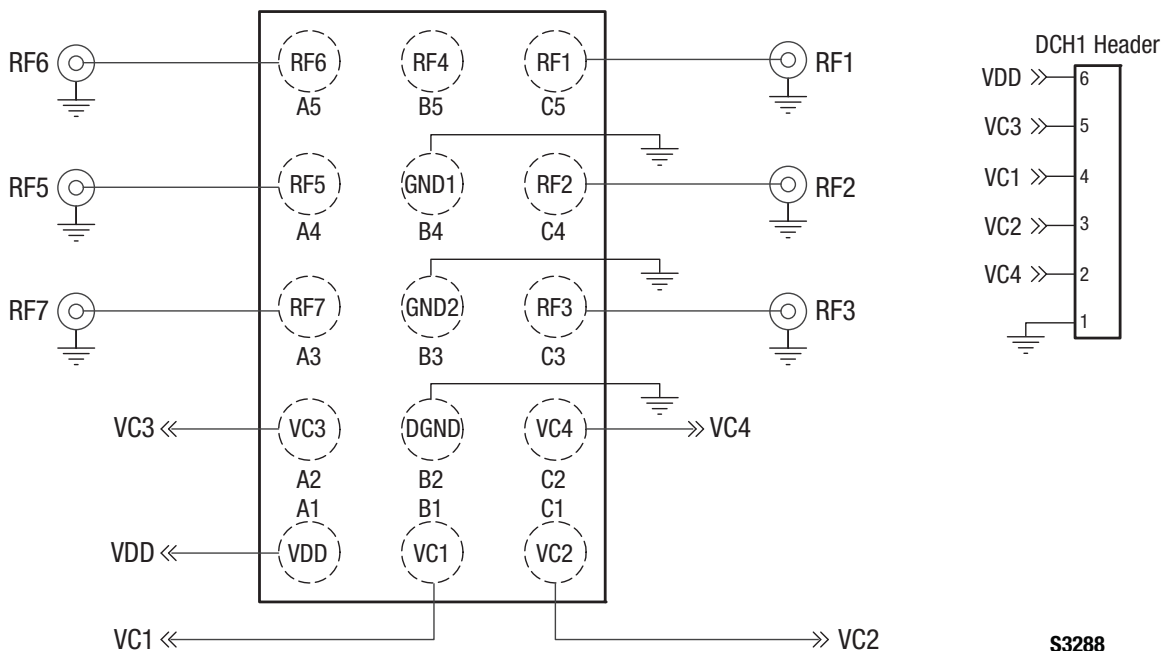


Figure 4. SKY13477-001A Evaluation Board Schematic

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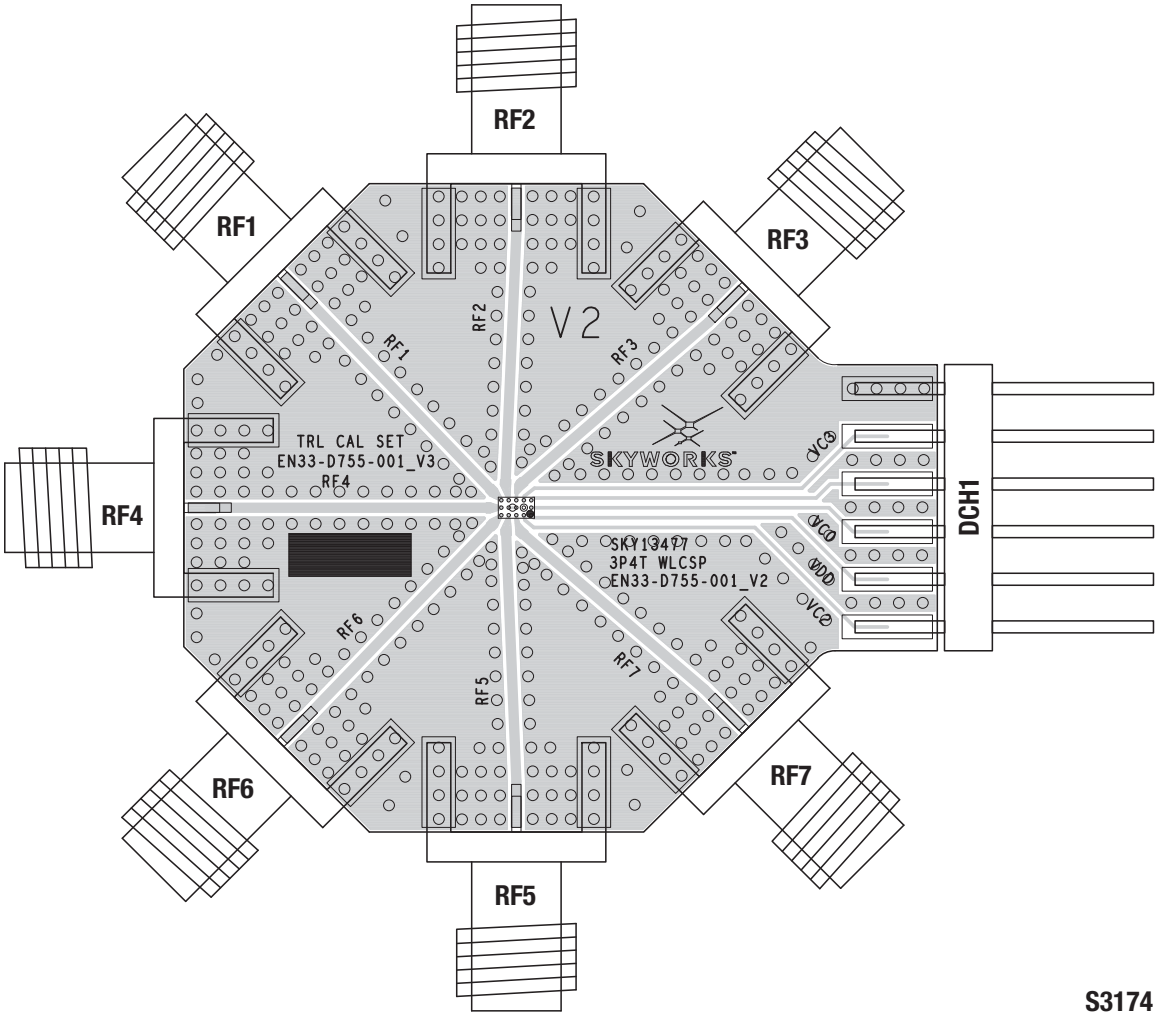
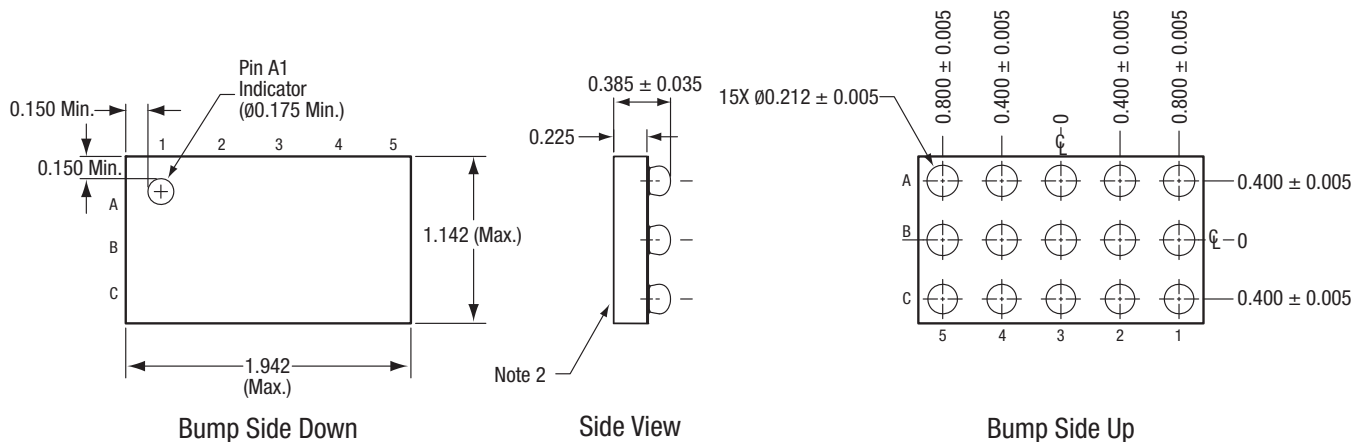


Figure 5. SKY13477-001A Evaluation Board Assembly Diagram

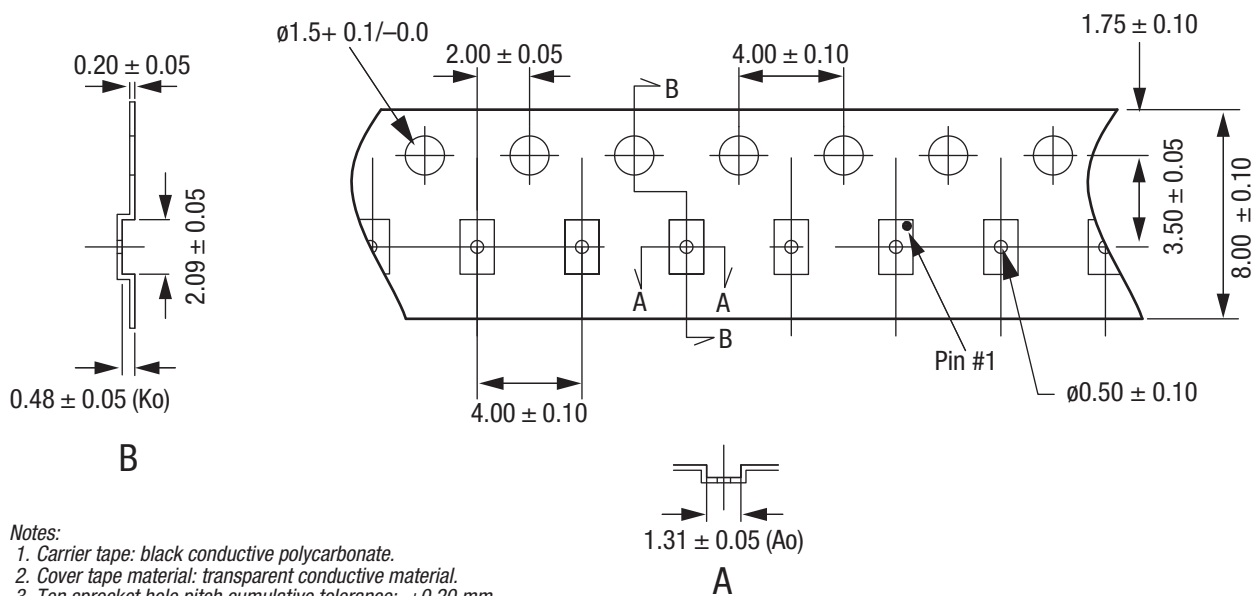
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- Notes:
1. All measurements are in millimeters.
 2. Includes wafer backside coating.
 3. Marking shown is for package orientation reference only.

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Figure 6. SKY13477-001A Package Dimensions



- Notes:
1. Carrier tape: black conductive polycarbonate.
 2. Cover tape material: transparent conductive material.
 3. Ten sprocket hole pitch cumulative tolerance: ±0.20 mm.
 4. Ao and Bo measured on plane 0.30 mm above the bottom of the pocket.
 5. All measurements are in millimeters.

S3289

Figure 7. SKY13477-001A Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13477-001A: 3P4T Switch in a WLCSP Package	SKY13477-001A	SKY13477-001A-EVB

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