

DATA SHEET

# SKY13587-378LF: 20 MHz to 6.0 GHz GaAs SPDT Switch

## Applications

- WLAN 802.11 a/b/g/n networks
- Low power transmit/receive systems
- Industrial IoT
- Lighting
- Smart energy
- Connected home

## Features

- Positive voltage control (0 and 1.8 V to 0 and 5.0 V)
- Broadband frequency range: 20 MHz to 6.0 GHz
- Very low insertion loss: 0.35 dB typical @ 2.45 GHz
- High isolation: 24 dB typical @ 2.45 GHz
- Excellent linearity performance:  $IP0.5dB = +30$  dBm
- Operating temperature range:  $-40$  °C to  $+105$  °C
- Ultra-miniature, MLPD (6-pin,  $1 \times 1 \times 0.5$  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.

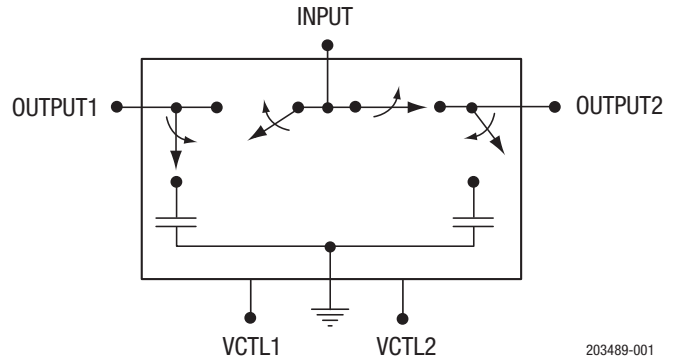


Figure 1. SKY13587-378LF Block Diagram

## Description

The SKY13587-378LF is a pHEMT GaAs FET I/C switch. The switch can be used in transmit/receive applications by connecting the RF common port (INPUT, pin 5) to either the OUTPUT1 or OUTPUT2 port (pin 1 or 3, respectively) using a low-loss path (i.e., a positive voltage applied to either VCTL1 or VCTL2 pins). The switch is “reflective short” on the isolated port.

The switch is manufactured in a compact,  $1 \times 1 \times 0.5$  mm, 6-pin exposed pad plastic Micro Lead-frame Package Dual (MLPD) 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.

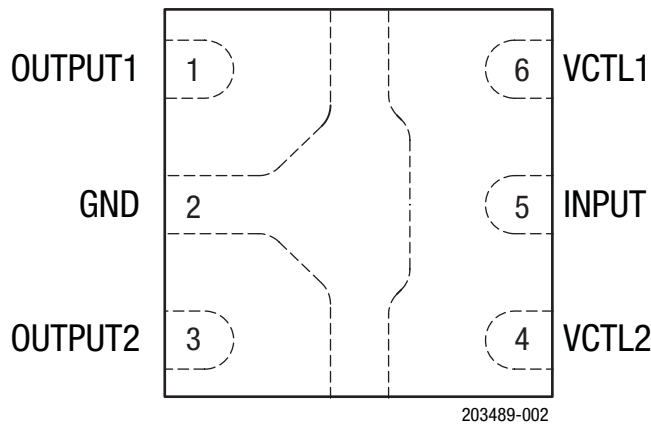


Figure 2. SKY13587-378LF Pinout (Top View)

**Table 1. SKY13587-378LF Signal Descriptions**

Pin	Name	Description	Pin	Name	Description
1	OUTPUT1	RF port (must be DC blocked)	4	VCTL2	DC control voltage
2	GND	Ground	5	INPUT	RF port (must be DC blocked)
3	OUTPUT2	RF port (must be DC blocked)	6	VCTL1	DC control voltage

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13587-378LF 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 SKY13587-378LF are illustrated in Figures 3 through 9.

The state of the SKY13587-378LF is determined by the logic provided in Table 5.

**Table 2. SKY13587-378LF Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Input power:	PIN			
>500 MHz, 5 V, CW			+32	dBm
>500 MHz, 2.7 V, CW			+31	dBm
802.11g, 54 Mbps, 64 QAM, 2.4 to 2.5 GHz			+26	dBm
802.11g, 54 Mbps, 64 QAM, 5.2 to 5.8 GHz			+25	dBm
Storage temperature	TSTG	-65	+150	°C
Operating temperature	TOP	-40	+105	°C

<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.

**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. SKY13587-378LF Recommended Operating Conditions**

Parameter	Symbol	Min	Typ	Max	Units
Frequency	f	0.02		6.0	GHz
Control voltage:					
low	VCTL_L	0		0.2	V
high	VCTL_H	1.8		5.0	V
Operating temperature	TOP		+25		°C

**Table 4. SKY13587-378LF Electrical Specifications<sup>1</sup>****(V<sub>CTL</sub> = 0 V and +2.7 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	Typ	Max	Units
Frequency	f		0.02		6.0	GHz
Insertion loss	IL	0.02 to 3.0 GHz		0.35	0.50	dB
		3.0 to 6.0 GHz		0.50	0.65	dB
Isolation	ISO	0.02 to 3.0 GHz	22	24		dB
		3.0 to 6.0 GHz	22	26		dB
Return loss (insertion loss state)		0.02 to 3.0 GHz		25		dB
		3.0 to 6.0 GHz		15		dB
Switching characteristics: Rise/fall time		10/90% or 90/10% RF 50% V <sub>CTL</sub> to 90/10% RF		40		ns
				100		ns
Video feedthrough				25		mV
0.5 dB input compression point	IP0.5dB	V <sub>CTL</sub> = 0 and 1.8 V @ 2.45 GHz	+21	+22		dBm
		V <sub>CTL</sub> = 0 and 2.7 V @ 2.45 GHz	+29	+30		dBm
		V <sub>CTL</sub> = 0 and 2.7 V @ 48 MHz		+26		dBm
Input IP3	IIP3	P <sub>IN</sub> = +20 dBm/tone:  V <sub>CTL</sub> = 0 and 1.8 V 2.45 GHz V <sub>CTL</sub> = 0 and 2.7 V @ 2.45 GHz V <sub>CTL</sub> = 1.8 V @ 5.8 GHz V <sub>CTL</sub> = 2.7 V @ 5.8 GHz	+30	+32		dBm
			+46	+50		dBm
				+30		dBm
				+46		dBm
Error vector magnitude	EVM	802.11a, 54 Mbps, P <sub>IN</sub> = <+24 dBm, V <sub>CTL</sub> = 2.7 V		2.5		%
		802.11g, 54 Mbps, P <sub>IN</sub> = <+25.5 dBm, V <sub>CTL</sub> = 2.7 V		2.5		%
Control voltage: Low High	V <sub>CTL_L</sub>		0		0.2	V
	V <sub>CTL_H</sub>		1.8	2.7	5.0	V
Supply current	I <sub>CC</sub>	V <sub>CTL_L</sub> = 0 V		5		μA
		V <sub>CTL_H</sub> = 5 V		5		μA

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

### Typical Performance Characteristics

(VCTL = 0 V and +2.7 V, TOP = +25 °C, PIN = 0 dBm, Characteristic Impedance [Zo] = 50 Ω, Blocking Capacitors = 100 pF, Bypass Capacitors = 33 pF, Unless Otherwise Noted)

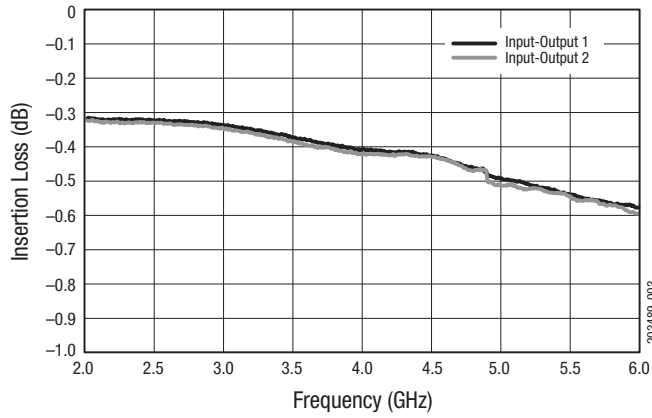


Figure 3. Typical Insertion Loss

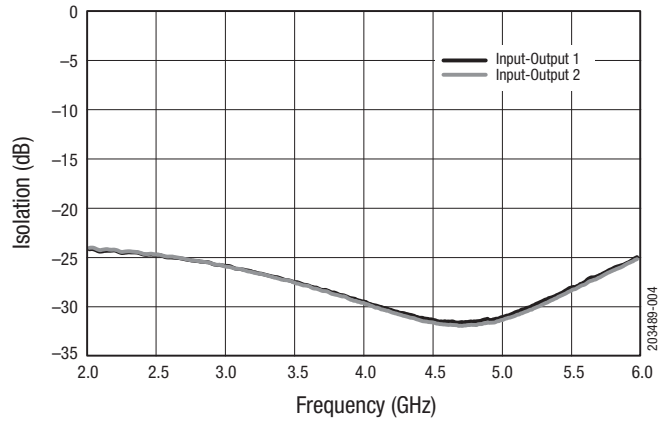


Figure 4. Typical Isolation

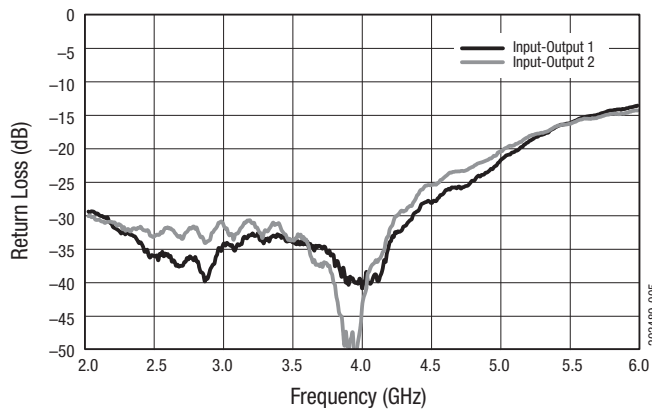


Figure 5. Typical Return Loss

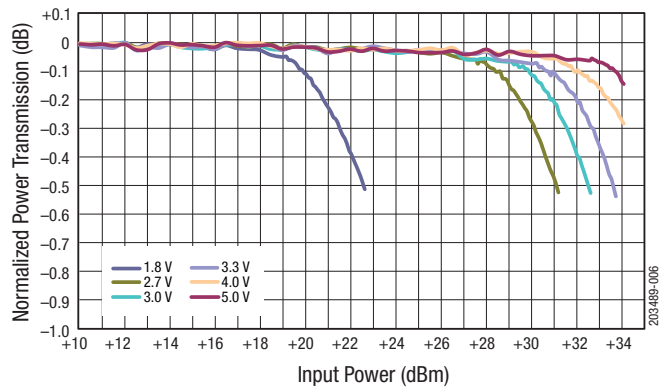


Figure 6. Compression vs Control Voltage (2450 MHz)

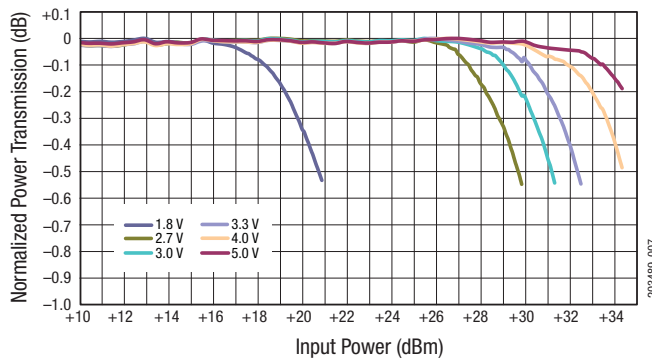


Figure 7. Compression vs Control Voltage (5.2 to 5.8 GHz)

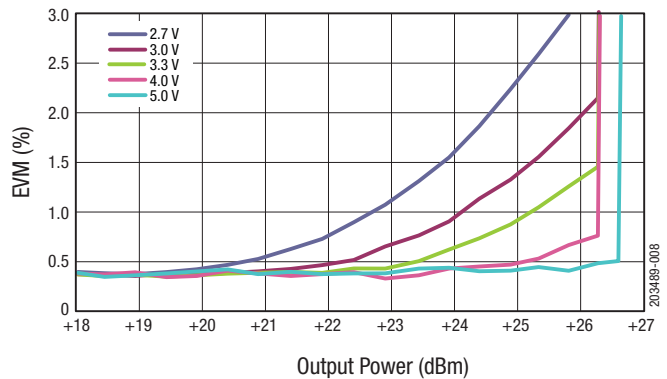


Figure 8. 802.11g EVM vs Output Power @ 2.45 GHz, 54 Mbps

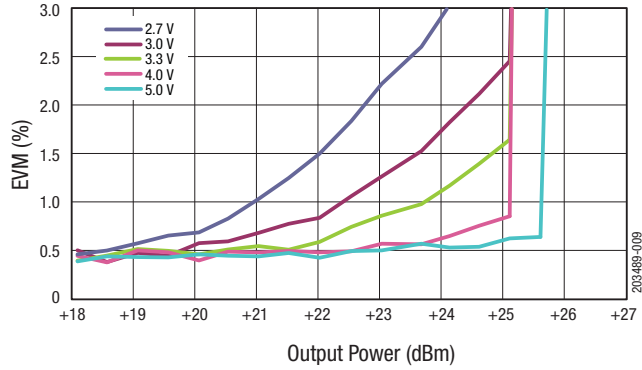


Figure 9. 802.11a EVM vs Output Power, 5.2-5.8 GHz, 54 Mbps

Table 5. SKY13587-378LF Truth Table<sup>1</sup>

VCTL1 (Pin 6)	VCTL2 (Pin 4)	INPUT to OUTPUT1 Path	INPUT to OUTPUT2 Path
1	0	Isolation	Insertion loss
0	1	Insertion loss	Isolation

<sup>1</sup> "1" = +1.8 V to +5 V.  
 "0" = 0 V to +0.2 V.

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

### Evaluation Board Description

The SKY13587-378LF Evaluation Board is used to test the performance of the SKY13587-378LF SPDT Switch. An Evaluation Board schematic diagram is provided in Figure 10. An assembly drawing for the Evaluation Board is shown in Figure 11.

### Package Dimensions

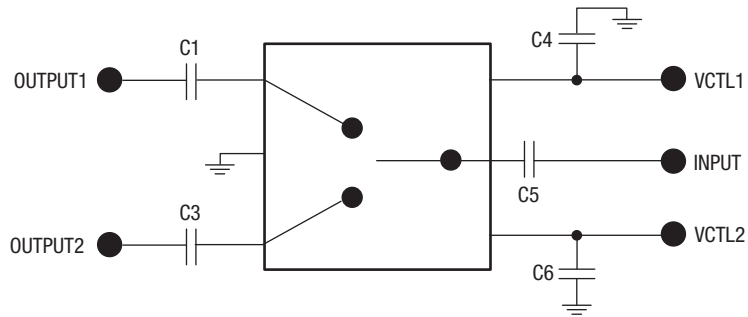
The PCB layout footprint for the SKY13587-378LF is provided in Figure 12. Typical part markings are shown in Figure 13. Package dimensions are shown in Figure 14, and tape and reel dimensions are provided in Figure 15.

### 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 SKY13587-378LF 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.

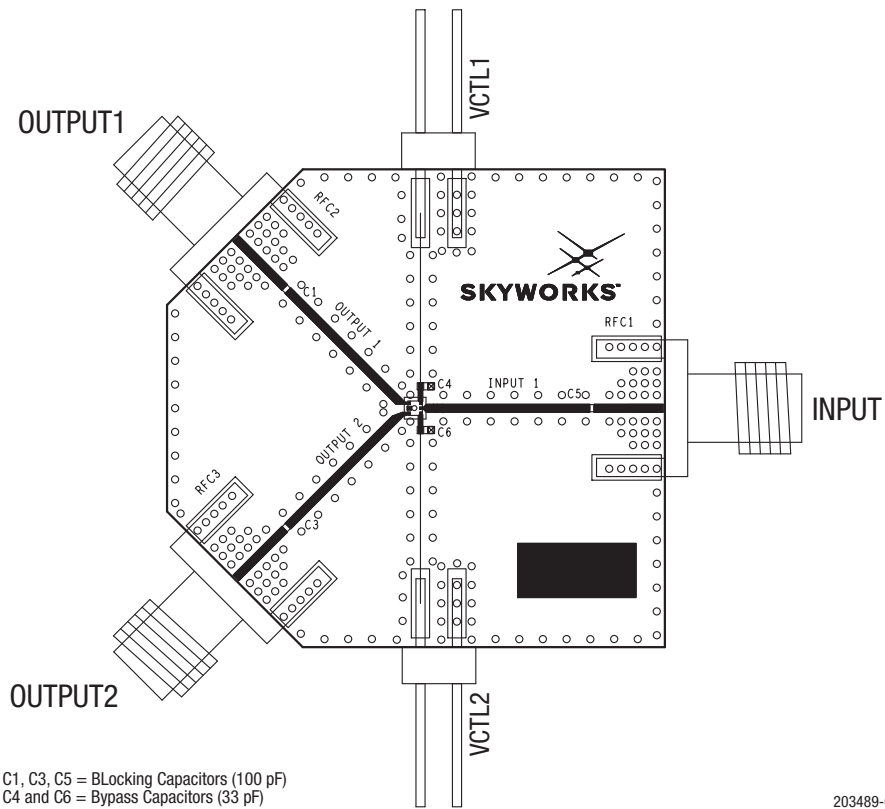


C1, C3, and C5 are DC blocking capacitors (100 pF)  
 C4 and C6 are bypass capacitors (33 pF)

Use 10 nF DC blocking capacitors (C1, C3, and C5)  
 for <50 MHz operation.

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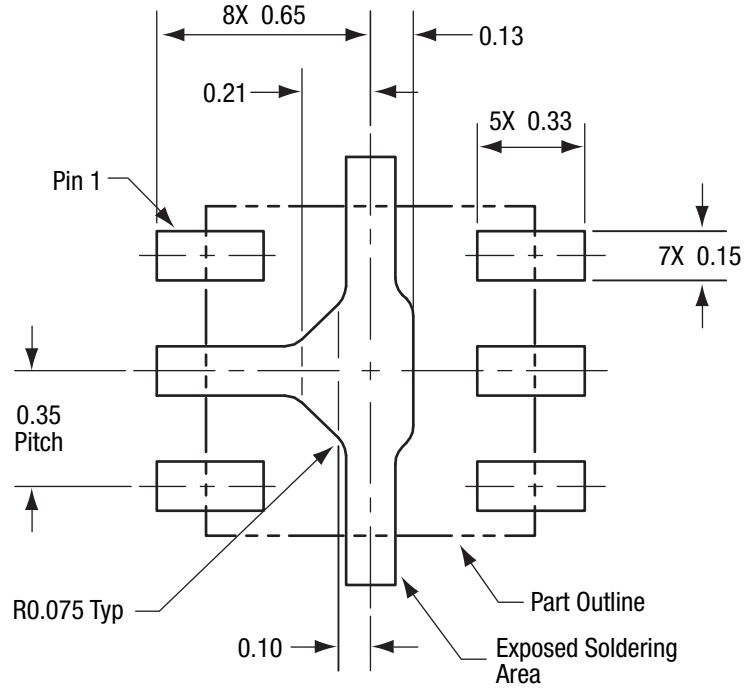
**Figure 10. SKY13587-378LF Evaluation Board Schematic**



C1, C3, C5 = Blocking Capacitors (100 pF)  
 C4 and C6 = Bypass Capacitors (33 pF)

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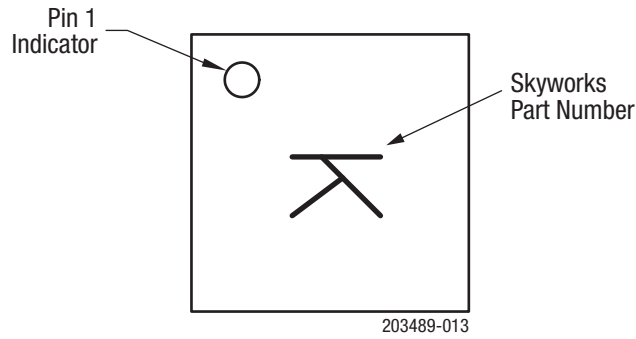
**Figure 11. SKY13587-378LF Evaluation Board Assembly Diagram**



All measurements in millimeters

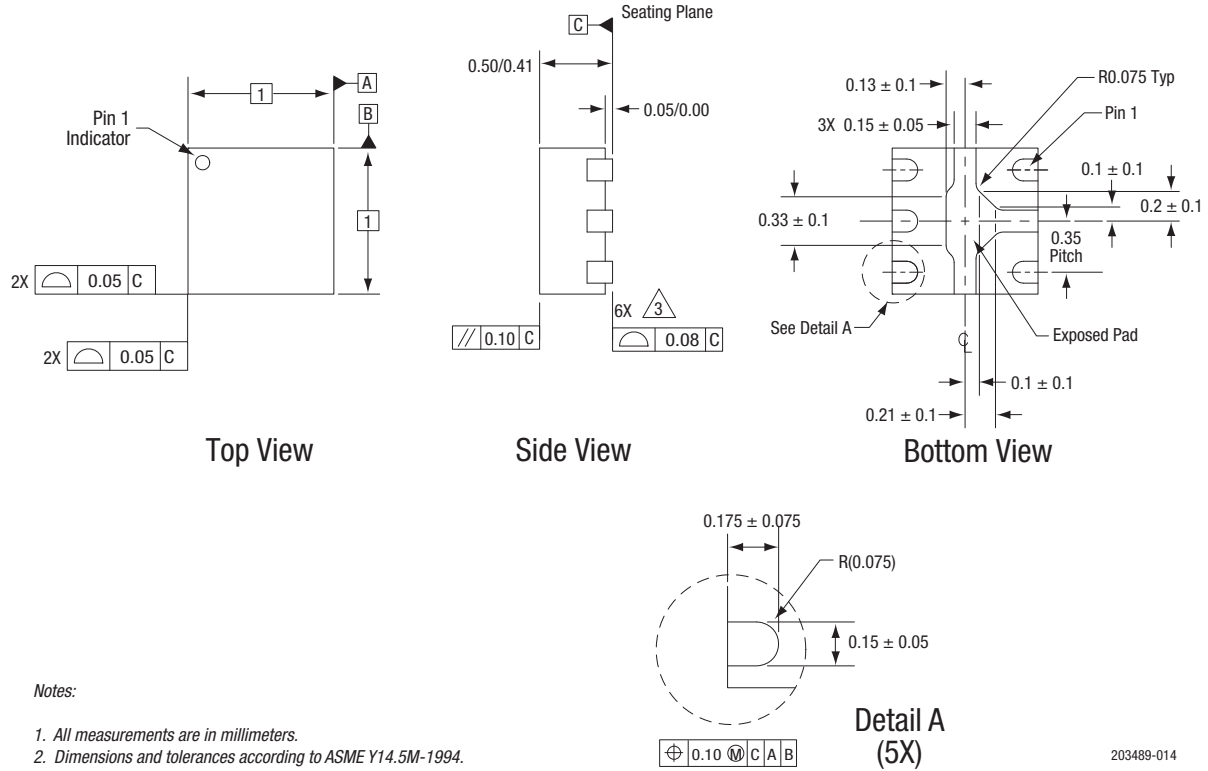
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**Figure 12. SKY13587-378LF PCB Layout Footprint (Top View)**



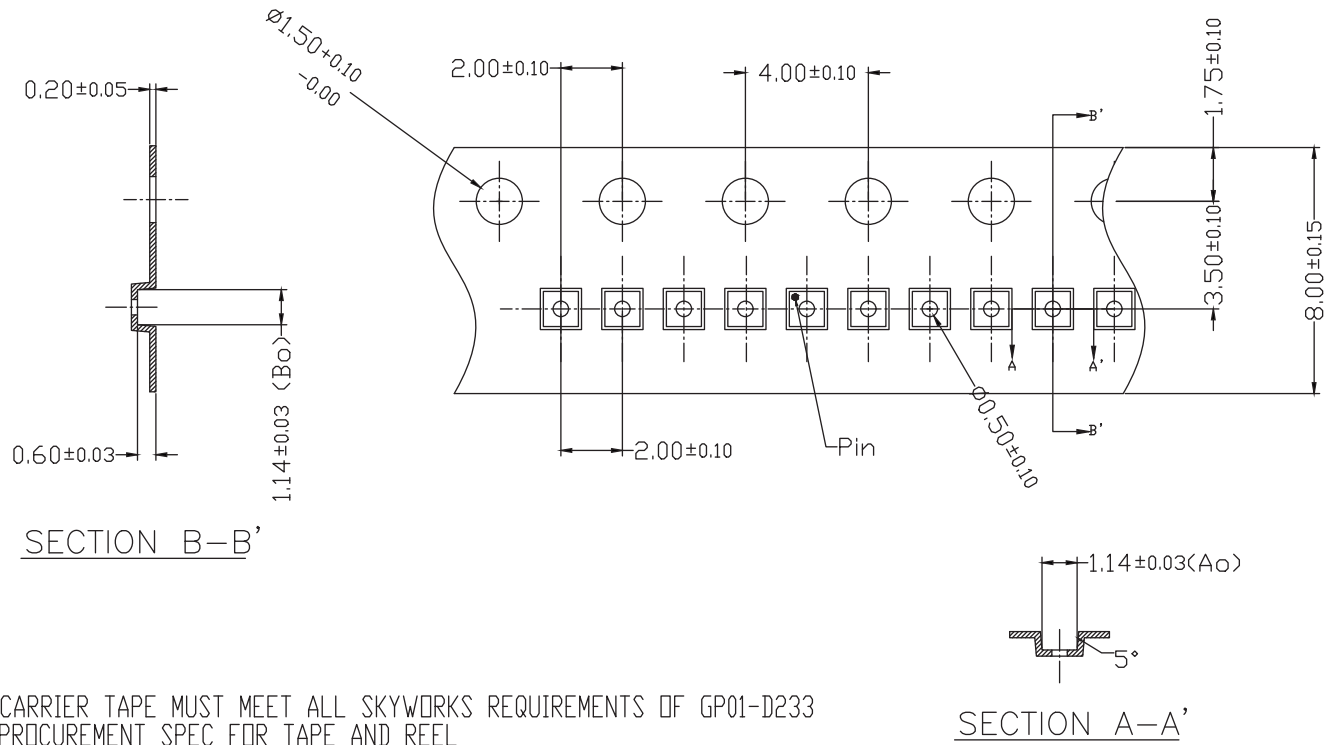
**Figure 13. Typical Part Markings (Top View)**

**DATA SHEET • SKY13587-378LF: SPDT SWITCH**



**Figure 14. SKY13587-378LF Package Dimensions**





1. CARRIER TAPE MUST MEET ALL SKYWORKS REQUIREMENTS OF GP01-D233 PROCUREMENT SPEC FOR TAPE AND REEL
2. CARRIER TAPE SHALL BE BLACK CONDUCTIVE POLYCARBONATE.
3. COVER TAPE SHALL BE TRANSPARENT CONDUCTIVE MATERIAL
4. ESD-SURFACE RESISTIVITY SHALL MEET GP01-D233
5. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE :  $\pm 0.20\text{mm}$
6.  $A_o$  &  $B_o$  MEASURED ON PLANE  $0.30\text{mm}$  ABOVE THE BOTTOM OF THE POCKET.
7. ALL DIMENSIONS ARE IN MILLIMETERS.

SECTION A-A'

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**Figure 15. SKY13587-378LF Tape and Reel Dimensions**