

## DATA SHEET

# SKY13418-485LF: 0.1 to 3.8 GHz SP8T Antenna Switch

## Applications

- Any 2G/3G/4G antenna diversity or LTE (TDD/FDD) transmit/receive system for which GSM transmit is not required

## Features

- Broadband frequency range: 0.1 to 3.8 GHz
- Low insertion loss: 0.7 dB typical @ 2.7 GHz
- High isolation: >20 dB @ 2.7 GHz
- Integrated logic
- Small QFN (14-pin, 2.0 x 2.0 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



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## Description

The SKY13418-485LF is a single-pole, eight-throw (SP8T) antenna switch. The high linearity performance and low insertion loss achieved by the SKY13418-485LF make it an ideal choice for main/diversity switching commonly used in LTE-based handsets, data cards, and tablets that use antenna diversity solutions.

The SKY13418-485LF is part of a scalable family of products that covers SP4T through SP8T switches that allow up to eight bands of WCDMA/LTE.

- SKY13414-485LF SP4T Antenna Switch (Data Sheet #201689)
- SKY13415-485LF SP5T Antenna Switch (Data Sheet #201704)
- SKY13416-485LF SP6T Antenna Switch (Data Sheet #201679)
- SKY13417-485LF SP7T Antenna Switch (Data Sheet #201661)
- SKY13418-485LF SP8T Antenna Switch (this Data Sheet)

The symmetric port designs provide flexibility in signal routing for both receive diversity and higher power TD-SCDMA/TDD-LTE, WCDMA/FDD, and LTE transmit/receive applications.

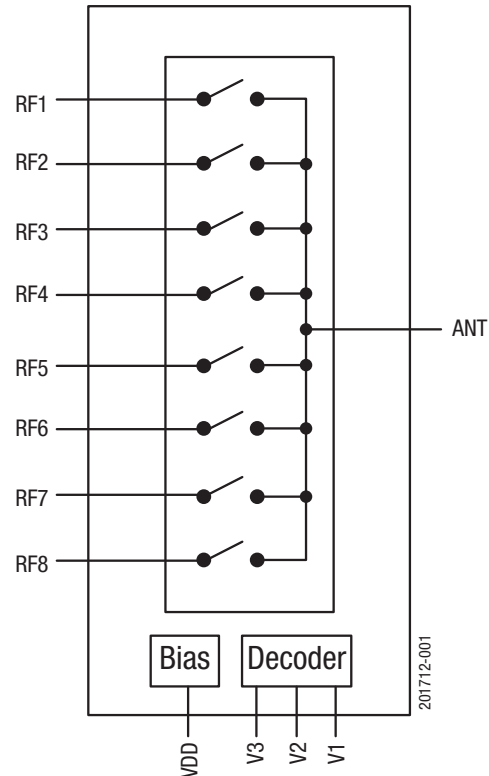
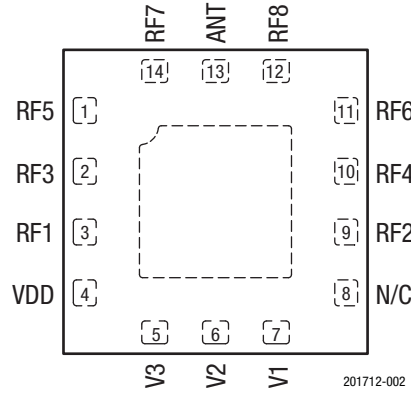


Figure 1. SKY13418-485LF Block Diagram

Switching is controlled by three CMOS/TTL-compatible control voltage inputs (V1, V2, and V3). Depending on the logic voltage level applied to the control pins, the ANT pin is connected to one of eight switched RF input/output (I/O) ports (RF1 to RF8) using a low insertion loss path, while the paths between the ANT pin and the other RF pins are in a high isolation state. No external blocking capacitors are required on the RF paths unless  $V_{DC}$  is applied externally.

The SKY13418-485LF is manufactured in a compact, 14-pin 2.0 x 2.0 mm, 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.



**Figure 2. SKY13418-485LF Pinout (Top View)**

**Table 1. SKY13418-485LF Signal Descriptions<sup>1</sup>**

Pin	Name	Description	Pin	Name	Description
1	RF5	RF I/O path 5	8	N/C	Not connected
2	RF3	RF I/O path 3	9	RF2	RF I/O path 2
3	RF1	RF I/O path 1	10	RF4	RF I/O path 4
4	VDD	DC power supply	11	RF6	RF I/O path 6
5	V3	DC control voltage 3	12	RF8	RF I/O path 8
6	V2	DC control voltage 2	13	ANT	Antenna port
7	V1	DC control voltage 1	14	RF7	RF I/O path 7

<sup>1</sup> Bottom ground paddles must be connected to ground.

## Functional Description

The SKY13418-485LF includes an internal negative voltage generator and decoder that eliminate the need for external DC blocking capacitors on the RF ports. No external components are required for proper operation. DC decoupling capacitors may be added on the VDD and control lines if necessary.

Switching is controlled by three control voltage inputs, V1, V2, and V3. Depending on the logic voltage level applied to the control pins, the antenna pin is connected to one of eight switched RF outputs.

The recommended startup sequence is:

1. Apply VDD
2. Apply V1, V2, and V3 voltages
3. Apply RF input

The device must be turned off in reverse order.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13418-485LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13418-485LF is determined by the logic shown in Table 4.

The isolation matrix shown in Table 5 provides the port-to-port isolation for all available RF states at four different frequencies: 1.0 GHz, 2.0 GHz, 2.7 GHz, and 3.8 GHz.

**Table 2. SKY13418-485LF Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V <sub>DD</sub>	2.5	5.0	V
Control voltage (V1, V2, and V3)	V <sub>CTL</sub>	-0.5	+3.0	V
RF input power:	P <sub>IN</sub>			
0.1 to 3 GHz (RF1 to RF8)			+37.5	dBm
3.4 to 3.8 GHz (RF3 to RF8)			+34.5	dBm
Operating temperature	T <sub>OP</sub>	-40	+90	°C
Storage temperature	T <sub>STG</sub>	-55	+150	°C
Electrostatic Discharge, Human Body Model (HBM), Class 1C	ESD		1000	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.

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**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.*

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**Table 3. SKY13418-485LF General Electrical Specifications<sup>1</sup>**  
**(V<sub>DD</sub> = 2.6 V, V<sub>1</sub> = V<sub>2</sub> = V<sub>3</sub> = 0/1.8 V, P<sub>IN</sub> = 0 dBm, T<sub>OP</sub> = +25 °C, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>DC Specifications</b>						
Supply voltage	V <sub>DD</sub>		2.5	3.0	4.8	V
Supply current	I <sub>DD</sub>			40	50	μA
Control voltage: High Low	V <sub>CTL_H</sub> V <sub>CTL_L</sub>		1.35	1.80	2.70 0.3	V V
Control current	I <sub>CTL</sub>	V <sub>CTL</sub> = 1.8 V		0.5	1.0	μA
Turn-on switching time	t <sub>ON</sub>	50% of final control voltage to 90% of final RF power, switching between RF1/2/3/4/5/6/7/8		1.5	2.2	μs
<b>RF Specifications</b>						
Insertion loss (ANT pin to RF1/2/3/4/5/6 pins)	IL	0.1 to 1.0 GHz 1.0 to 2.0 GHz 2.0 to 2.7 GHz 3.4 to 3.8 GHz		0.45 0.60 0.70 1.00	0.60 0.80 0.95 1.30	dB
Insertion loss (ANT pin to RF7/8 pins)	IL	0.1 to 1.0 GHz 1.0 to 2.0 GHz 2.0 to 2.7 GHz 3.4 to 3.8 GHz		0.45 0.65 0.85 1.30	0.60 0.85 1.15 1.65	dB
Isolation (ANT pin to RF1/2/3/4/5/6 pins)	I <sub>SO</sub>	0.1 to 1.0 GHz 1.0 to 2.0 GHz 2.0 to 2.7 GHz 3.4 to 3.8 GHz	32 28 24 19	37 31 27 23		dB
Isolation (ANT pin to RF7/8 pins)	I <sub>SO</sub>	0.1 to 1.0 GHz 1.0 to 2.0 GHz 2.0 to 2.7 GHz 3.4 to 3.8 GHz	29 23 19 14	31 24 21 18		dB
Input return loss (ANT pin to RF1/2/3/4/5/6 pins)	RL	0.1 to 1.0 GHz 1.0 to 2.0 GHz 2.0 to 2.7 GHz 3.4 to 3.8 GHz	24 23 15 10	27 25 18 15		dB
Input return loss (ANT pin to RF7/8 pins)	RL	0.1 to 1.0 GHz 1.0 to 2.0 GHz 2.0 to 2.7 GHz 3.4 to 3.8 GHz	21 15 11 7	24 18 13 11		dB
Second harmonics (ANT pin to RF1/2/3/4/5/6/7/8 pins)	2f <sub>o</sub>	P <sub>IN</sub> = +26 dBm, 0.1 to 3.0 GHz		+90		dBc
Third harmonics (ANT pin to RF1/2/3/4/5/6/7/8 pins)	3f <sub>o</sub>	P <sub>IN</sub> = +26 dBm, 0.1 to 3.0 GHz		+93		dBc
Harmonics (ANT pin to RF3,4,5,6,7,8 pins)	2f <sub>o</sub> 3f <sub>o</sub> 2f <sub>o</sub> 3f <sub>o</sub>	3.4 to 3.8 GHz, P <sub>IN</sub> = +26 dBm: VSWR = 1:1 VSWR = 1:1 VSWR = 5:1 VSWR = 5:1		-50 -60 -47 -60		dBm
0.1 dB compression point: ANT pin to RF1/2/3/4/5/6/7/8 pins ANT pin to RF3/4/5/6/7/8 pins)	P <sub>0.1dB</sub>	0.8 GHz to 3.0 GHz 3.4 GHz to 3.8 GHz		+37.5 +36		dBm
Third order input intercept point	IIP3	@ 2.0 GHz, P <sub>IN</sub> = +26 dBm, Δf = 1 MHz		+66		dBm

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

**Table 4. SKY13418-485LF Control Logic<sup>1</sup>**

Control Pins			Switched RF I/O							
V1 (Pin 7)	V2 (Pin 6)	V3 (Pin 5)	RF1 (Pin 3)	RF2 (Pin 9)	RF3 (Pin 2)	RF4 (Pin 10)	RF5 (Pin 1)	RF6 (Pin 11)	RF7 (Pin 14)	RF8 (Pin 12)
0	0	0	<b>Insertion Loss</b>	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
0	0	1	Isolation	<b>Insertion Loss</b>	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation
0	1	0	Isolation	Isolation	<b>Insertion Loss</b>	Isolation	Isolation	Isolation	Isolation	Isolation
0	1	1	Isolation	Isolation	Isolation	<b>Insertion Loss</b>	Isolation	Isolation	Isolation	Isolation
1	0	0	Isolation	Isolation	Isolation	Isolation	<b>Insertion Loss</b>	Isolation	Isolation	Isolation
1	0	1	Isolation	Isolation	Isolation	Isolation	Isolation	<b>Insertion Loss</b>	Isolation	Isolation
1	1	0	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	<b>Insertion Loss</b>	Isolation
1	1	1	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	<b>Insertion Loss</b>

<sup>1</sup> "High" = 1.8 V; "Low" = 0 V. Any state other than that described in this Table places the switch into an undefined state. An undefined state will not damage the device.

**Table 5. Isolation Matrix (1 of 2)**

"On" Port	Frequency (GHz)	Isolation (dB)							
		RF1	RF2	RF3	RF4	RF5	RF6	RF7	RF8
<i>Antenna-to-Port</i>									
RF1	1.0	-	-50	-39	-43	-40	-38	-31	-32
RF1	2.0	-	-42	-32	-37	-31	-32	-24	-25
RF1	2.7	-	-38	-29	-33	-27	-29	-21	-22
RF1	3.8	-	-33	-25	-29	-22	-25	-17	-19
RF2	1.0	-46	-	-41	-40	-37	-40	-31	-31
RF2	2.0	-40	-	-35	-32	-31	-32	-25	-24
RF2	2.7	-36	-	-32	-29	-28	-28	-22	-21
RF2	3.8	-31	-	-28	-26	-24	-23	-18	-17
RF3	1.0	-39	-48	-	-43	-42	-39	-32	-32
RF3	2.0	-32	-40	-	-36	-31	-32	-25	-26
RF3	2.7	-29	-37	-	-33	-27	-29	-21	-22
RF3	3.8	-25	-33	-	-29	-23	-25	-17	-19
RF4	1.0	-45	-39	-41	-	-37	-43	-31	-32
RF4	2.0	-38	-32	-35	-	-31	-32	-25	-24
RF4	2.7	-35	-29	-32	-	-28	-28	-22	-21
RF4	3.8	-30	-26	-28	-	-24	-23	-18	-17
RF5	1.0	-47	-48	-38	-44	-	-40	-35	-33
RF5	2.0	-36	-40	-31	-37	-	-32	-26	-26
RF5	2.7	-31	-37	-28	-33	-	-29	-22	-23
RF5	3.8	-26	-32	-24	-29	-	-25	-17	-19
RF6	1.0	-46	-48	-42	-39	-38	-	-32	-35
RF6	2.0	-38	-36	-35	-32	-31	-	-25	-26
RF6	2.7	-35	-32	-32	-29	-28	-	-22	-22
RF6	3.8	-30	-27	-28	-25	-24	-	-18	-17
RF7	1.0	-45	-49	-46	-45	-41	-41	-	-34
RF7	2.0	-35	-40	-35	-37	-32	-33	-	-27
RF7	2.7	-31	-37	-30	-33	-27	-29	-	-23
RF7	3.8	-26	-32	-25	-29	-22	-25	-	-18
RF8	1.0	-47	-45	-43	-47	-40	-42	-33	-
RF8	2.0	-39	-36	-36	-36	-32	-32	-26	-
RF8	2.7	-35	-32	-32	-31	-28	-28	-22	-
RF8	3.8	-30	-27	-27	-26	-24	-23	-18	-

**Table 5. Isolation Matrix (2 of 2)**

"On" Port	Frequency (GHz)	Isolation (dB)							
		RF1	RF2	RF3	RF4	RF5	RF6	RF7	RF8
<i>Port-to-Port</i>									
RF1	1.0	-	-51	-31	-50	-41	-43	-38	-35
RF1	2.0	-	-40	-24	-41	-32	-37	-31	-29
RF1	2.7	-	-37	-21	-37	-28	-34	-28	-27
RF1	3.8	-	-31	-17	-33	-23	-32	-25	-26
RF2	1.0	-52	-	-47	-31	-40	-42	-34	-38
RF2	2.0	-41	-	-40	-24	-35	-32	-28	-31
RF2	2.7	-37	-	-36	-21	-32	-28	-26	-28
RF2	3.8	-31	-	-33	-17	-31	-23	-24	-25
RF3	1.0	-31	-53	-	-51	-32	-43	-41	-36
RF3	2.0	-24	-42	-	-42	-25	-37	-32	-30
RF3	2.7	-21	-38	-	-38	-21	-34	-27	-28
RF3	3.8	-17	-33	-	-34	-17	-32	-23	-25
RF4	1.0	-52	-31	-47	-	-41	-33	-34	-40
RF4	2.0	-42	-24	-40	-	-35	-25	-29	-32
RF4	2.7	-38	-21	-37	-	-33	-21	-27	-28
RF4	3.8	-33	-17	-34	-	-31	-17	-24	-24
RF5	1.0	-37	-53	-31	-52	-	-45	-38	-37
RF5	2.0	-30	-42	-24	-41	-	-38	-28	-31
RF5	2.7	-26	-38	-21	-37	-	-34	-23	-28
RF5	3.8	-22	-33	-17	-33	-	-31	-18	-25
RF6	1.0	-53	-37	-49	-31	-43	-	-36	-38
RF6	2.0	-42	-30	-40	-24	-36	-	-30	-28
RF6	2.7	-38	-27	-37	-21	-33	-	-27	-23
RF6	3.8	-33	-23	-33	-17	-30	-	-24	-19
RF7	1.0	-40	-53	-37	-52	-32	-48	-	-40
RF7	2.0	-33	-42	-30	-41	-25	-38	-	-32
RF7	2.7	-29	-38	-26	-36	-22	-33	-	-28
RF7	3.8	-24	-32	-22	-32	-17	-29	-	-24
RF8	1.0	-53	-41	-51	-38	-45	-33	-38	-
RF8	2.0	-42	-33	-40	-31	-37	-25	-31	-
RF8	2.7	-38	-30	-36	-27	-33	-22	-27	-
RF8	3.8	-32	-25	-31	-23	-29	-17	-24	-

### Evaluation Board Description

The SKY13418-485LF Evaluation Board is used to test the performance of the SKY13418-485LF SP8T Switch. An Evaluation Board schematic diagram is provided in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4.

### Package Dimensions

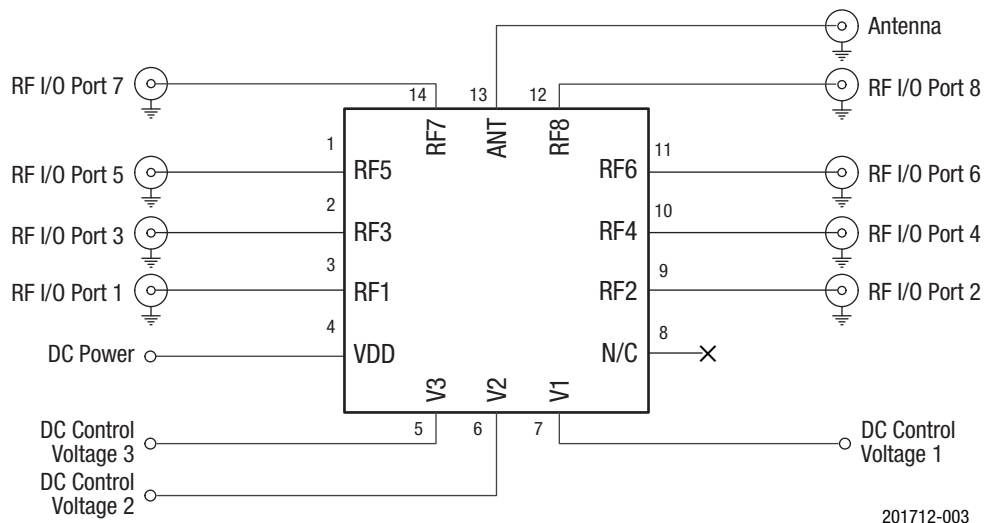
The PCB layout footprint for the SKY13418-485LF is provided in Figure 5. Typical part markings are shown in Figure 6. Package dimensions are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

### 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 SKY13418-485LF 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, *PCB Design & SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

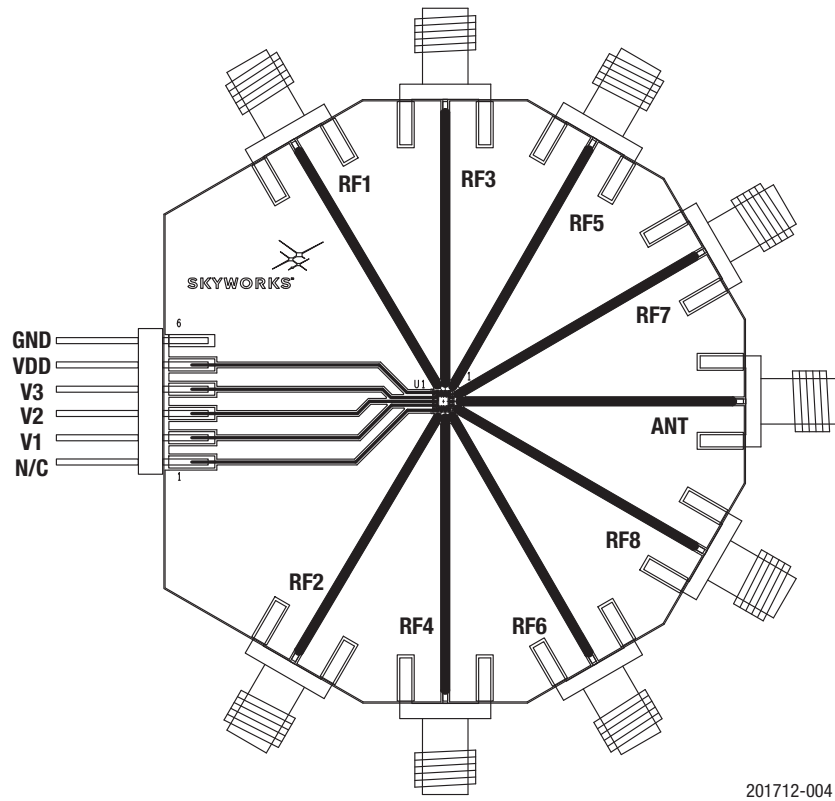
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



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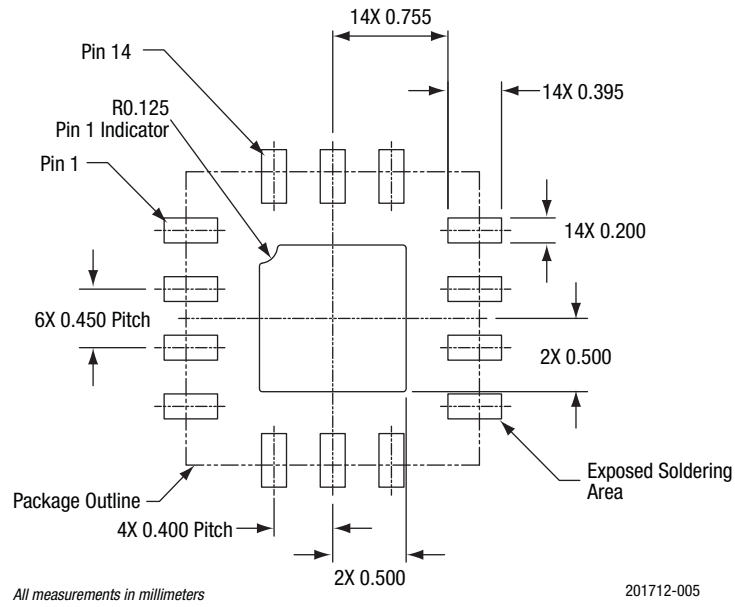
Figure 3. SKY13418-485LF Evaluation Board Schematic



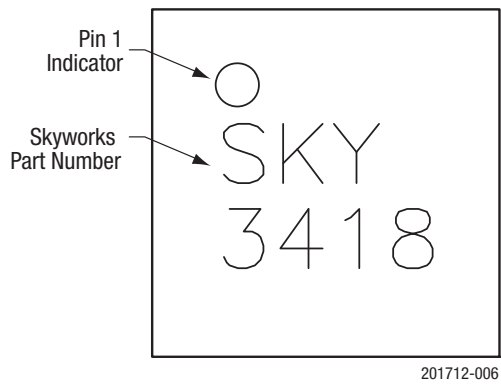


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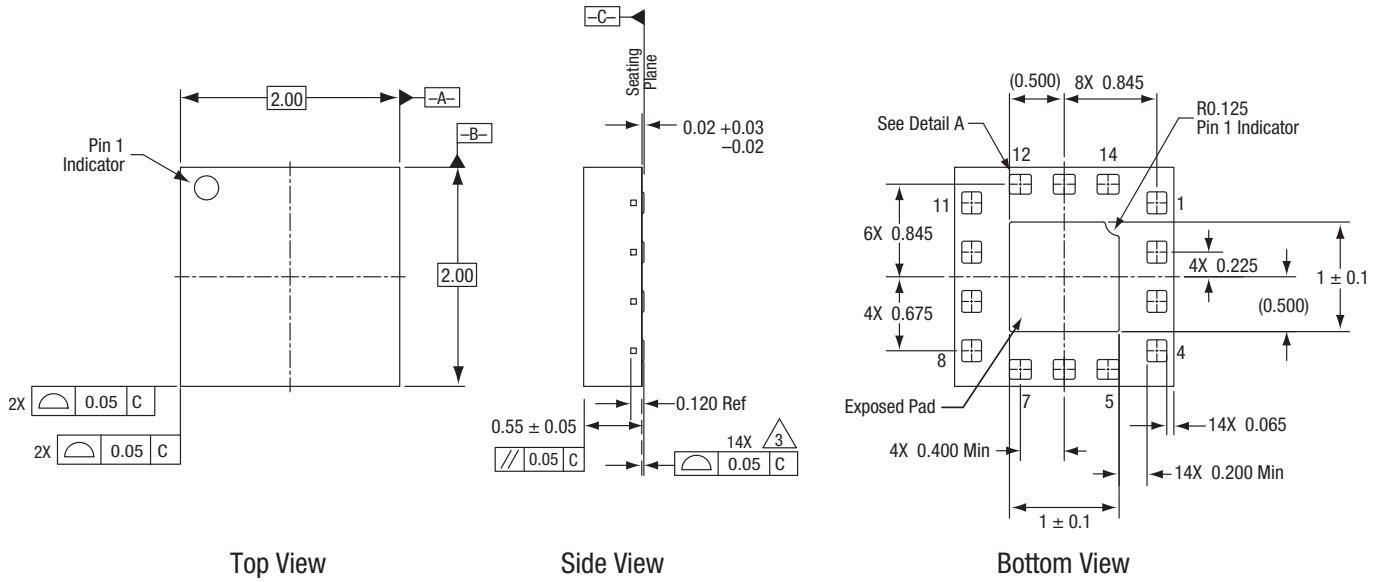
Figure 4. SKY13418-485LF Evaluation Board Assembly Diagram



**Figure 5. SKY13418-485LF PCB Layout Footprint (Top View)**

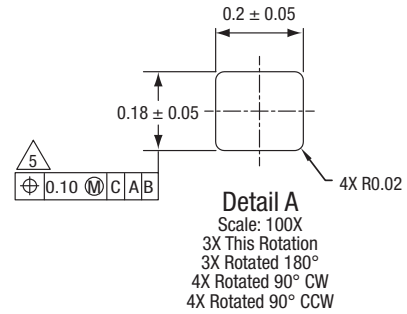


**Figure 6. Typical Part Markings (Top View)**



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 metallization.
4. Dimension applies to metallized 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 7. SKY13418-485LF Package Dimensions

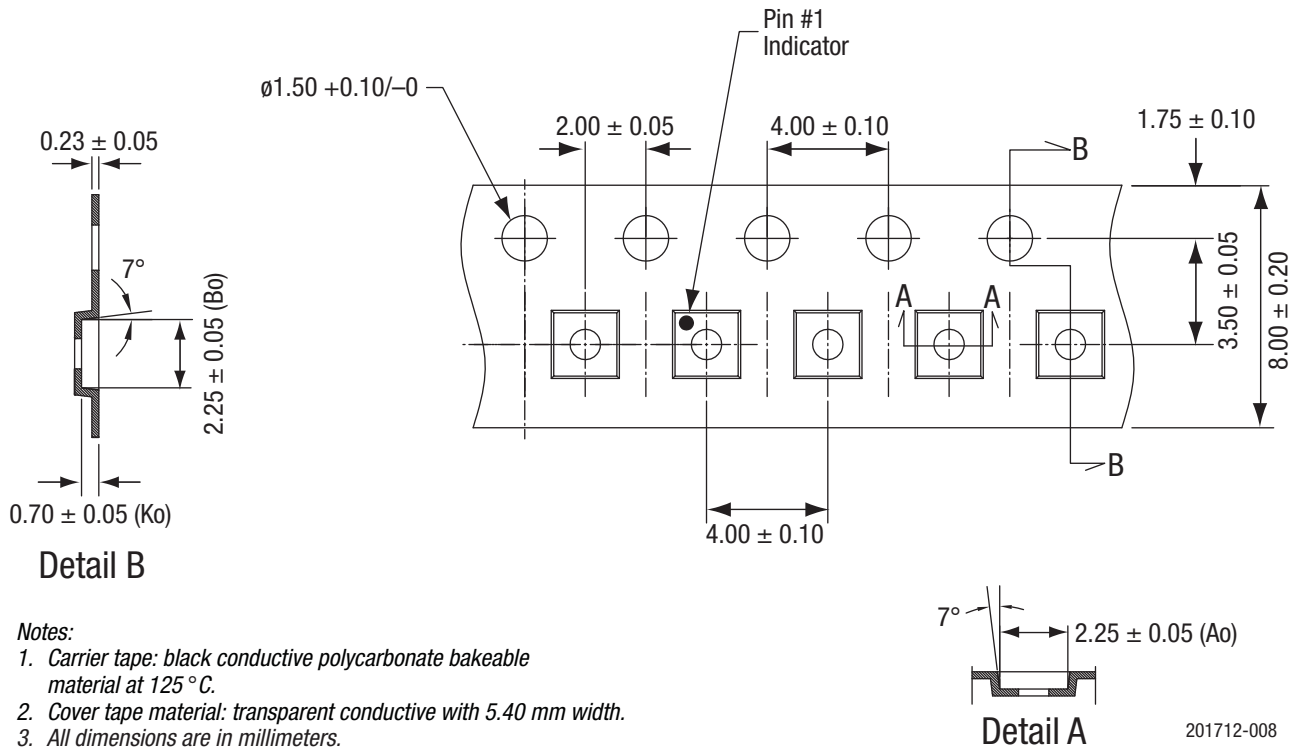


Figure 8. SKY13418-485LF Tape and Reel Dimensions

**Ordering Information**

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13418-485LF: 0.1 to 3.8 GHz SP8T Antenna Switch	SKY13418-485LF	SKY13418-485LF-EVB