WINSOURCE ELECTRONICS

THE DATASHEET OF

SKY5A5109

DATA SHEET

SKY5A5109: 0.8 to 8 GHz SP3T Switch

Applications

- 2G, 3G, 4G, 5G band and mode switching
- Antenna switch for multi-mode systems
- 802.11a/b/g/n WLANs
- Wi-Fi® 6E systems

Features

- AEC-Q100 Grade 2
- Broadband frequency range: 0.8 to 8 GHz
- Low insertion loss: 0.55 dB @ 2.5 GHz, 0.75 dB @ 7.125 GHz
- High isolation: 30 dB up to 2.5 GHz
- No external DC blocking capacitors required
- Positive low voltage control: V_{CTL} = 1.65 to 3.00 V, V_{DD} = 2.5 to 4.8 V
- Small (12-pin, 2 x 2 mm) QFN package (MSL1, 260 °C per JEDEC J-STD-020)

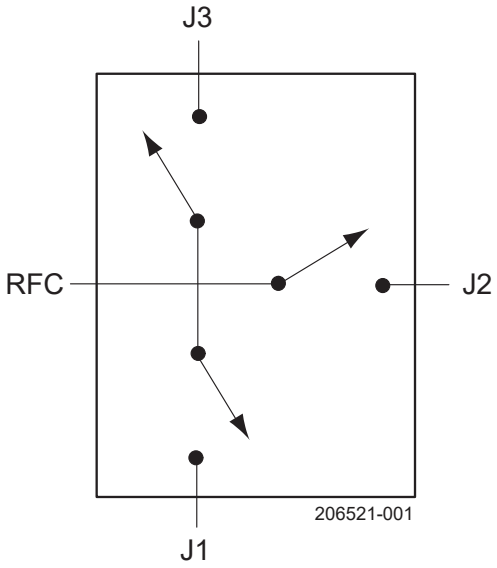


Figure 1. Block Diagram

Description

The SKY5A5109 is a CMOS silicon-on-insulator (SOI), single-pole, triple-throw (SP3T) switch.

The AEC-Q100 Grade 2 qualification, in addition to the high linearity performance and low insertion loss, make the device ideal for WCDMA handset, data card, and automotive applications.

The SKY5A5109 SP3T 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.

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.

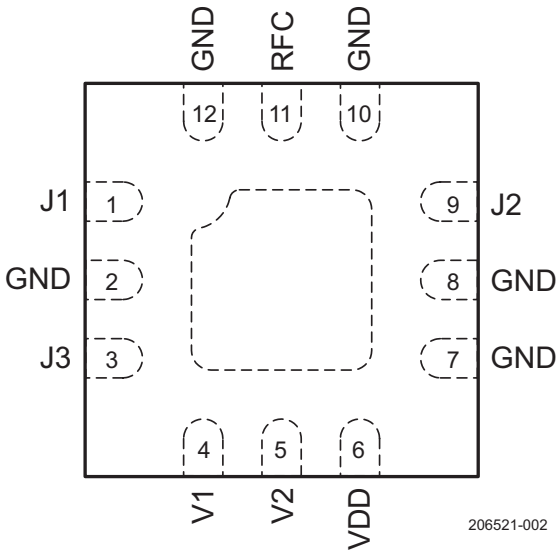


Figure 2. Pinout (Top View)

Table 1. Signal Descriptions[1]

Pin	Name	Description
1	J1	RF port 1
2	GND	Ground
3	J3	RF port 3
4	V1	DC control voltage 1 (See Table 4)
5	V2	DC control voltage 2 (See Table 4)
6	VDD	DC power supply
7	GND	Ground
8	GND	Ground
9	J2	RF port 2
10	GND	Ground
11	RFC	RF common (antenna) port
12	GND	Ground

1. Exposed pad must be grounded.

Technical Description

The SKY5A5109 includes an internal negative voltage generator and decoder that eliminates external DC blocking capacitors on the RF ports, unless a DC voltage is present. 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 two control voltage inputs, V1 and V2. Refer to the Control Logic Table below. The RF common (RFC) pin is connected to one of three switched RF outputs (J1, J2, or J3) through a low insertion path while the paths between the RFC pin and the other RF pins are in a high isolation state.

Shutdown mode is enabled by connecting all control pins to logic low. This mode reduces the overall current consumption to 5 µA, typical. To prevent the switch from accidentally entering shutdown mode during switching, all states must be set to logic low for at least 20 µs.

Table 2. Control Logic [1]

V1 (Pin 4)	V2 (Pin 5)	State
0	0	Shutdown
1	0	RFC to J2
0	1	RFC to J1
1	1	RFC to J3

1. Control voltage: High: 1.65 to 3.0 V. Low: 0 to 0.4 V. Control voltage must not exceed supply voltage.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY5A5109 are provided in Table 2, followed by recommended operating conditions, electrical specifications, and a logic table.

Table 3. Absolute Maximum Ratings[1]

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V_{DD}	2.5	5	V
Control voltage[2]	V_{CTL}	1.35	3.3	V
Input power	P_{IN}		+39	dBm
Storage temperature	T_{STG}	–65	+150	°C
Operating temperature	T_{OP}	–40	+105	°C
Electrostatic discharge Charged-Device Model (CDM), Class C3 Human Body Model (HBM), Class 1C			 1000 1000	 V V

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.
2. Any bias voltage applied to the V1 or V2 pins may damage the device if there is no bias voltage also present on the VDD pin. Maximum control voltage cannot exceed V_{DD}.

ESD Handling: *Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.*

Table 4. Recommended Operating Conditions[1]

Parameter	Symbol	Min	Typ	Max	Units
Operating temperature	T_{OP}	–40	25	105	°C
Supply voltage	V_{DD}	2.5	2.7	4.8	V
Control voltage[2] High Low	 V_{CTL_HIGH} V_{CTL_LOW}	 1.65 0	 1.8 0	 3.0 0.4	 V V

1. Performance is guaranteed only under the conditions listed in this table.
2. Control voltage must not exceed supply voltage.

Table 5. RF Specifications, +25 °C[1]

(VDD = 2.5 V to 4.8 V, V1/V2 = 0 /1.8 V, TOP = +25 °C, PIN = 0 dBm, Characteristic Impedance [ZO] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Insertion loss	IL	0.8 to 1 GHz		0.45	0.55	dB
		1 to 2.2 GHz		0.53	0.65	
		2.2 to 3 GHz		0.6	0.7	
		3 to 4.9 GHz		0.6	1.0	
		4.9 to 6 GHz		0.6	1.0	
		6 to 7 GHz		0.8	1.1	
		7 to 8 GHz		0.8	1.3	
Isolation	ISO	0.8 to 1 GHz	35	41		dB
		1 to 2.2 GHz	28	34		
		2.2 to 3 GHz	25	31		
		3 to 4.9 GHz	20	23		
		4.9 to 6 GHz	18	24		
		6 to 7 GHz	17	21		
		7 to 8 GHz	14	16		
Return loss	|S11|	0.8 to 8 GHz		12		dB
Third order input intercept point	IIP3	0.8 to 3.0 GHz, Δf = 1 MHz, P_{IN} = +20 dBm/tone	56	65		dBm
Input 0.1 dB compression point	P0.1dB	0.8 to 8 GHz, RFC to J1, J2, and J3		39		dBm
2nd harmonic	2fo	0.8 to 8 GHz, P_{IN} = +20 dBm		85		dBc
3rd harmonic	3fo	0.8 to 8 GHz, P_{IN} = +20 dBm		85		dBc
Switching on time		50% V_{CTL} to 10/90% RF		1700		ns
Switching off time		50% V_{CTL} to 90/10% RF		2400		ns
Startup time		Shutdown state to any RF switch state		20		us
Supply current	IDD	VDD = 3.5 V		40	55	uA
Leakage current	IOFF	VDD = 3.5 V, V1 = V2 = 0 V		8	15	uA
Control current	I1/I2	V1/V2 = 1.8 V		2		uA

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

Table 6. RF Specifications, –40 °C[1]

(VDD = 2.5 V to 4.8 V, V1/V2 = 0/1.8 V, TOP = –40 °C, PIN = 0 dBm, Characteristic Impedance [ZO] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Insertion loss	IL	0.8 to 1 GHz		0.37	0.5	dB
		1 to 2.2 GHz		0.43	0.55	
		2.2 to 3 GHz		0.5	0.6	
		3 to 4.9 GHz		0.5	0.65	
		4.9 to 6 GHz		0.5	0.9	
		6 to 7 GHz		0.7	0.9	
		7 to 8 GHz		0.7	1.3	
Isolation	ISO	0.8 to 1 GHz	34	40		dB
		1 to 2.2 GHz	27	33		
		2.2 to 3 GHz	28	31		
		3 to 4.9 GHz	21	23		
		4.9 to 6 GHz	17	22		
		6 to 7 GHz	16	19		
		7 to 8 GHz	13	15		
Return loss	|S11|	0.8 to 8 GHz		12		dB
Third order input intercept point	IIP3	0.8 to 3 GHz, Δf = 1 MHz, P_{IN} = +20 dBm/tone	54	63		dBm
Input 0.1 dB compression point	P0.1dB	0.8 to 8 GHz, RFC to J1, J2, and J3		39		dBm
2nd harmonic	2fo	0.8 to 8 GHz, P_{IN} = +20 dBm		85		dBc
3rd harmonic	3fo	0.8 to 8 GHz, P_{IN} = +20 dBm		85		dBc
Switching on time		50% V_{CTL} to 10/90% RF		1750		ns
Switching off time		50% V_{CTL} to 90/10% RF		1900		ns
Startup time		Shutdown state to any RF switch state		20		us
Supply current	IDD	VDD = 3.5 V		38	50	uA
Leakage current	IOFF	VDD = 3.5 V, V1 = V2 = 0 V		5	10	uA
Control current	I1/I2	V1/V2 = 1.8 V		2		uA

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

Table 7. RF Specifications, +105 °C[1]

(VDD = 2.5 V to 4.8 V, V1/V2 = 0/1.8 V, TOP = +105 °C, PIN = 0 dBm, Characteristic Impedance [ZO] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Insertion loss	IL	0.8 to 1 GHz		0.5	0.6	dB
		1 to 2.2 GHz		0.6	0.75	
		2.2 to 3 GHz		0.7	0.8	
		3 to 4.9 GHz		0.7	1.1	
		4.9 to 6 GHz		0.7	1.1	
		6 to 7 GHz		1	1.2	
		7 to 8 GHz		1	1.3	
Isolation	ISO	0.8 to 1 GHz	36	48		dB
		1 to 2.2 GHz	29	40		
		2.2 to 3 GHz	26	31		
		3 to 4.9 GHz	21	23		
		4.9 to 6 GHz	19	22		
		6 to 7 GHz	17	20		
		7 to 8 GHz	15	17		
Return loss	|S11|	0.8 to 8 GHz		12		dB
Third order input intercept point	IIP3	0.8 to 3 GHz, Δf = 1 MHz, PIN = +20 dBm/tone	48	62		dBm
Input 0.1 dB compression point	P0.1dB	0.8 to 8 GHz, RFC to J1, J2, and J3		39		dBm
2nd harmonic	2fo	0.8 to 8 GHz, PIN = +20 dBm		85		dBc
3rd harmonic	3fo	0.8 to 8 GHz, PIN = +20 dBm		85		dBc
Switching on time		50% VCTL to 10/90% RF		1700		ns
Switching off time		50% VCTL to 90/10% RF		3400		ns
Startup time		Shutdown state to any RF switch state		20		us
Supply current	IDD	VDD = 3.5 V		45	60	uA
Leakage current	IOFF	VDD = 3.5 V, V1 = V2 = 0 V		11	20	uA
Control current	I1/I2	V1/V2 = 1.8 V		2		uA

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

Evaluation Board Description

The SKY5A5109 Evaluation Board is used to test the performance of the SKY5A5109 SP3T switch. An Evaluation Board schematic diagram is shown below.

The board is made from a two-layer construction with 1/2-oz. copper cladding on top and bottom. The first layer material is 12-mil Rogers 4003C. The second layer material is 49-mil of FR4 for a total board thickness of about 62 mils. The impedance of all RF traces is 50 Ω.

Package Dimensions

The PCB layout footprint for the SKY5A5109 is provided in Figure 5. Typical part markings are shown in Figure 6. Package dimensions are shown in Figure 7, followed by tape and reel information.

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 SKY5A5109 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.

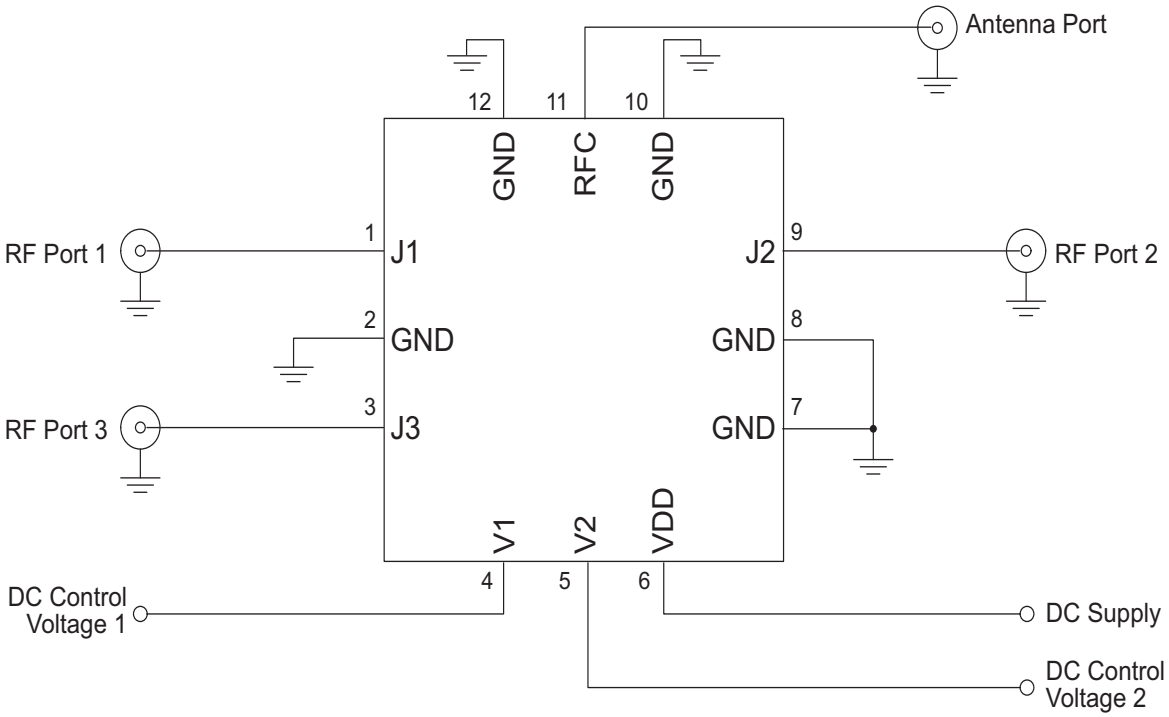


Figure 3. Evaluation Board Schematic

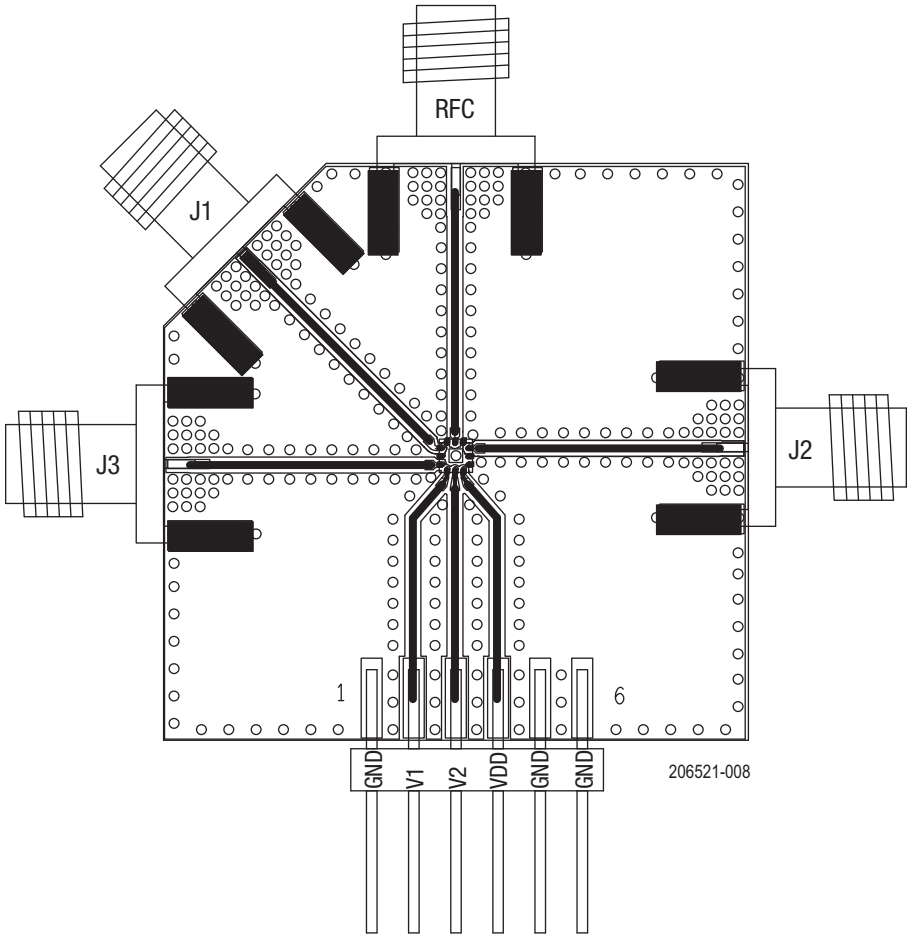


Figure 4. Evaluation Board Assembly Diagram

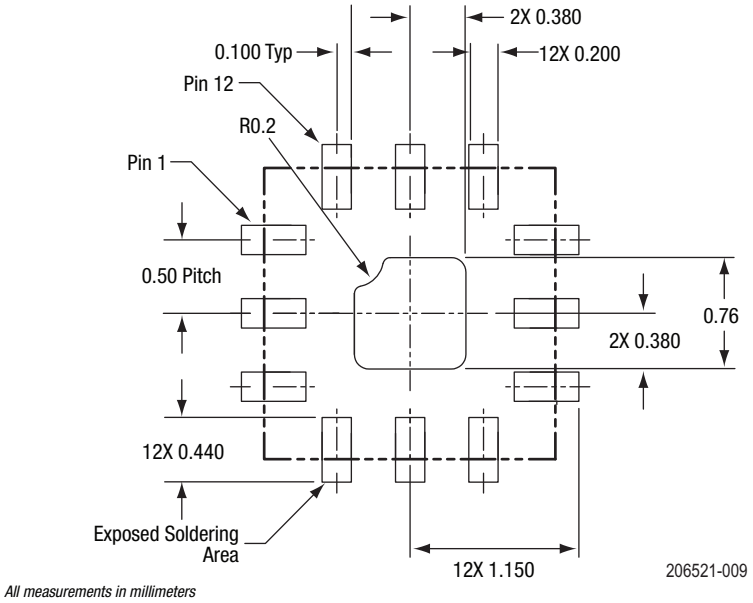


Figure 5. PCB Layout Footprint (Top View)

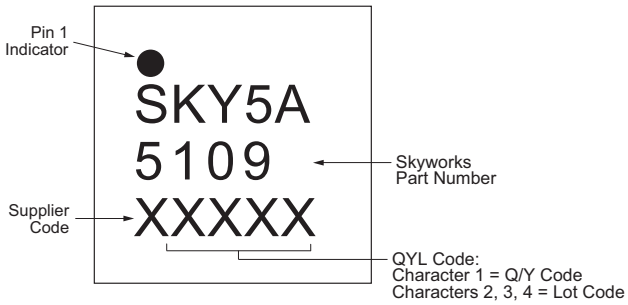
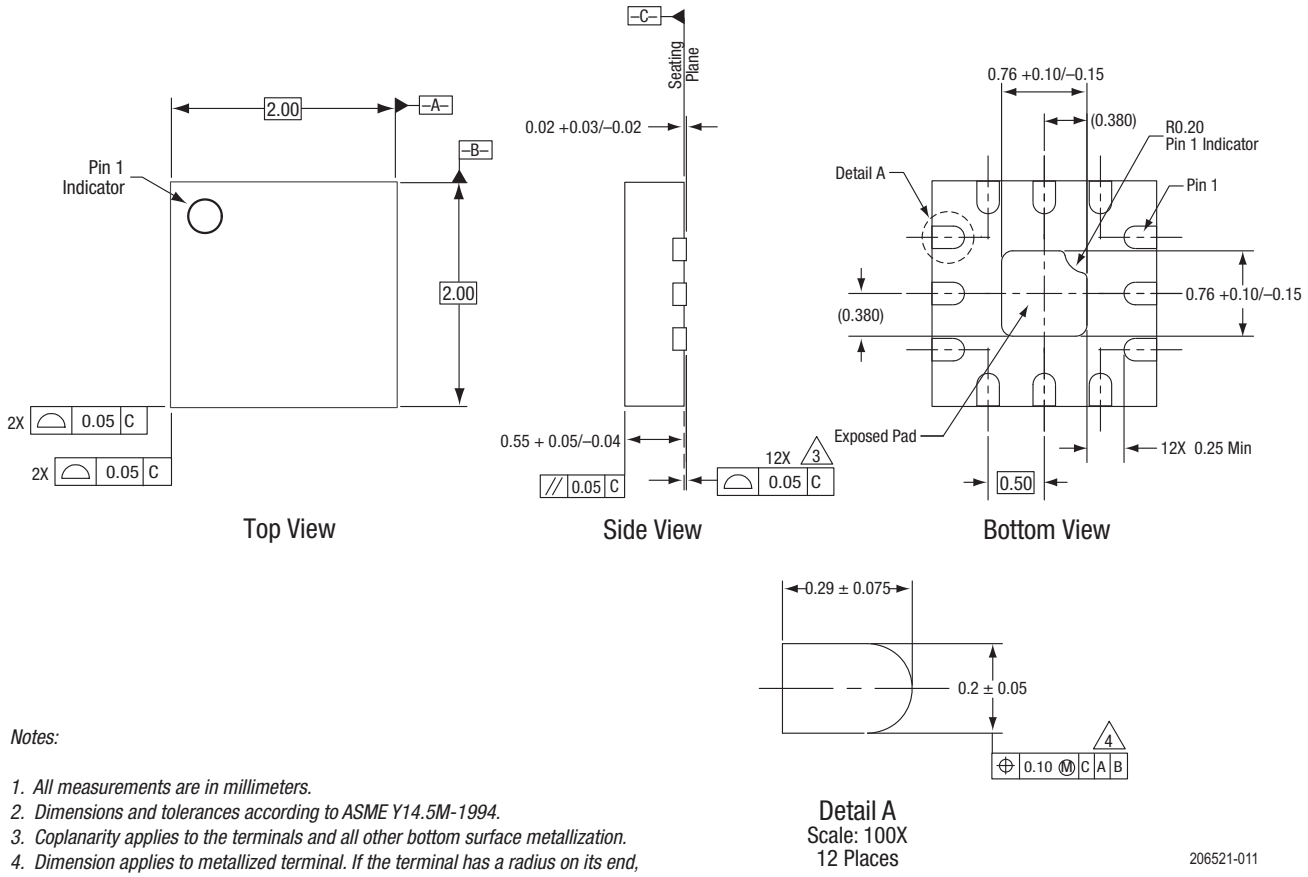


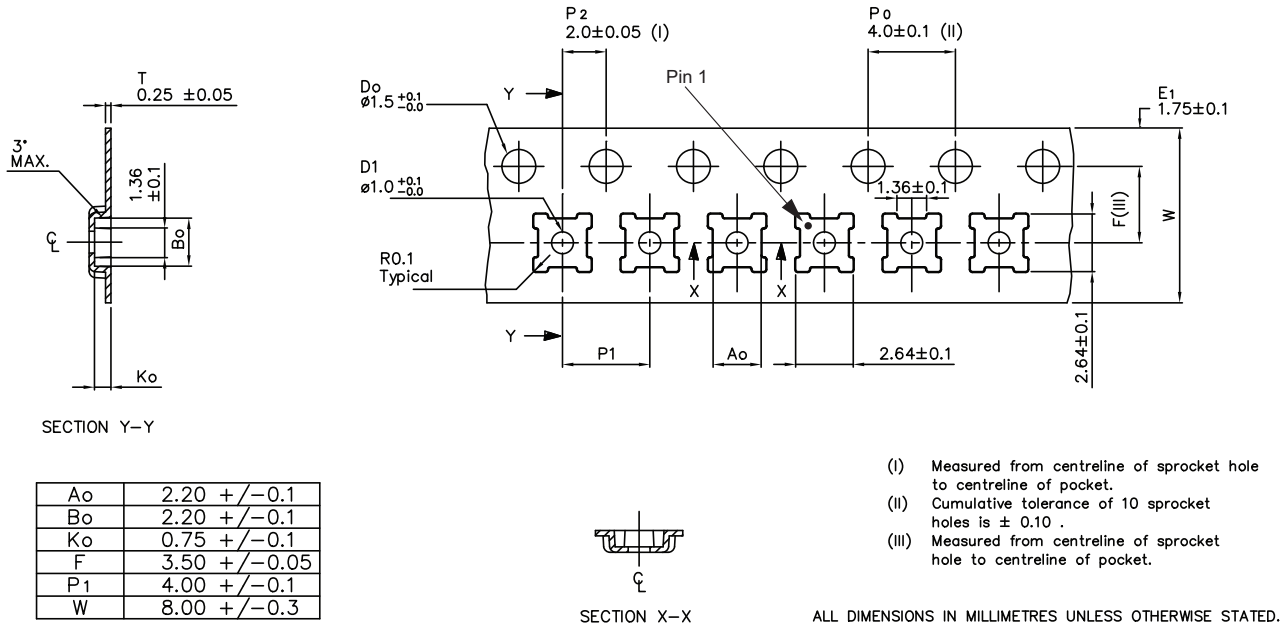
Figure 6. Typical Part Markings



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.*

Figure 7. Package Dimensions



Ao	2.20 +/−0.1
Bo	2.20 +/−0.1
Ko	0.75 +/−0.1
F	3.50 +/−0.05
P1	4.00 +/−0.1
W	8.00 +/−0.3

Figure 8. Tape and Reel Dimensions

Ordering Information

Part Number	Part Description	Evaluation Board Part Number
SKY5A5109	SP3T Switch	SKY5A5109-EK1

Copyright © 2023-2024, Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks' Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of Skyworks' published specifications or parameters.

Skyworks, the Skyworks symbol, Sky5®, SkyOne®, SkyBlue™, Skyworks Green™, ClockBuilder®, DSPLL®, ISOmodem®, ProSLIC®, SiPHY®, and RFeIC® are trademarks or registered trademarks of Skyworks Solutions, Inc. or its subsidiaries in the United States and other countries. Third-party brands and names are for identification purposes only and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- View SKY5A5109 on WIN SOURCE
- Skyworks Solutions Inc. Information

Optimize Your Supply Chain with WIN SOURCE Solutions

- Global Sourcing Solution
- Obsolete Management
- Cost Control Management
- Shortage Management
- Alternative Solution
- Excess Inventory Management