DATA SHEET

SKY5A5110: 0.4 to 3.8 GHz SP4T High Power Switch

Applications

- Cellular systems
- 2G/3G/4G/5G systems
- Pre- and post-PA switching

Features

- Broad frequency range, 0.4 ~ 3.8 GHz
- Low insertion loss, <0.6 dB typ. across frequency
- Excellent linearity, –110 dBm typ. B1 and B3
- High isolation: 25 dB at 2.7 GHz, typ.
- Integrated GPIO interface, 1.8 V control
- No DC blocking capacitors required
- Lead (Pb)-free and RoHS-compliant
- AEC-Q100 Grade 2 qualification, –40 °C ~ +105 °C
- Robust ESD protection, 2 kV HBM, 1 kV CDM
- Compact QFN-10 (1.1 x 1.5 mm) MSL1 package

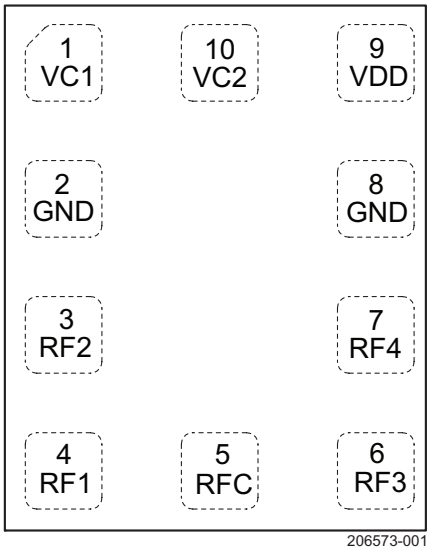


Figure 1. Pinout (Top View)

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.

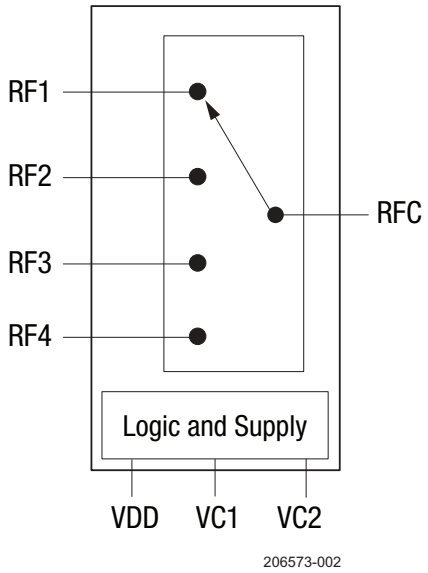


Figure 2. Block Diagram

Description

The SKY5A5110 is a single-pole, four-throw (SP4T) switch. No external DC blocking capacitors are required on the RF paths as long as there is no DC voltage on the RF line. The switch can operate over the temperature range of –40 °C to +105 °C.

Switching is controlled by two CMOS/TTL compatible control voltage inputs (VC1 and VC2). Depending on the logic voltage level applied to the control pin, the RFC pin is connected to one of four switched RF outputs (RF1, RF2, RF3, or RF4) by using a low insertion loss path, while the paths between the RFC pin and the other RF pins are in isolation.

The SKY5A5110 is provided in a small 10-pin 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 descriptions are provided in Table 1.

Table 1. Pin Descriptions[1]

Pin	Name	Description	Pin	Name	Description
1	VC1	Control voltage 1	6	RF3	RF input/output port 3
2	GND	Ground	7	RF4	RF input/output port 4
3	RF2	RF input/output port 2	8	GND	Ground
4	RF1	RF input/output port 1	9	VDD	Supply voltage
5	RFC	RF common port	10	VC2	Control voltage 2

1. Exposed pads must be grounded.

Electrical and Mechanical Specifications

Table 2. Absolute Maximum Ratings[1]

Parameter	Symbol	Condition	Min	Max	Units
Supply voltage	VDD		–0.5	5.5	V
Control voltage	VC1, VC2		–0.3	3.0[2]	V
RF input power	RFIN	Peak power at RFC port, 50 Ω		+38	dBm
Operating case temperature	Tcasemax		–40	+105	°C
Storage temperature	TSTG		–55	+150	°C
Electrostatic discharge Human Body Model (HBM), Class 2 Charged-Device Model (CDM), Class C3	ESD			 2000 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. VDD or 3.0 V, whichever is lower.

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

Table 3. Recommended Operating Conditions[1]

Parameter	Symbol	Min	Typ	Max	Units
Operating temperature	TOP	–40	25	105	C
Supply voltage	VDD	2.45	2.8	4.8	V
Control voltage high[2]	VC1, VC2	1.65	1.8	2.8	V
Control voltage low	VC1, VC2		0	0.45	V

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

Table 4. Electrical Specifications[1]

(VDD = 2.8 V, VC1/VC2 = 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
Small Signal						
Insertion loss (RFC to RF1-RF4)[2]	IL	400 to 960 MHz		0.2	0.4	dB
		1710 to 2170 MHz		0.4	0.7	
		2170 to 2690 MHz		0.5	0.8	
		3400 to 3800 MHz		0.6	1.0	
Isolation (RFC to RF1-RF4)	ISO	400 to 960 MHz	30	43		dB
		1710 to 2170 MHz	25	27		
		2170 to 2690 MHz	23	25		
		3400 to 3800 MHz	18	20		
Return loss (RFC, RF1 to RF4)	RL	400 to 2690 MHz		12		dB
		3400 to 3800 MHz		10		
Large Signal						
GSM low-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 824, 915 MHz, P_{IN} = +35 dBm VSWR 1:1		–64	–47	dBm
	3fo			–51	–48	
	2fo	fo = 824, 915 MHz, P_{IN} = +35 dBm VSWR 6:1		–51	–47	dBm
	3fo			–41	–36	
GSM high-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 1710, 1910 MHz, P_{IN} = +33 dBm VSWR 1:1		–61	–50	dBm
	3fo			–50	–46	
	2fo	fo = 1710, 1910 MHz, P_{IN} = +33 dBm VSWR 6:1		–58	–51	dBm
	3fo			–47	–40	
LTE/WCDMA low-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 400 to 960 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 1:1		–76	–69	dBm
	3fo			–71	–65	
	2fo	fo = 400 to 960 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 6:1		–69	–64	dBm
	3fo			–63	–52	
LTE/WCDMA mid-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 1710 to 1910 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 1:1		–68	–62	dBm
	3fo			–65	–60	
	2fo	fo = 1710 to 1910 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 6:1		–61	–56	dBm
	3fo			–54	–49	
LTE/WCDMA high-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 2690 MHz, P_{IN} = +26 dBm VSWR 1:1		–68	–62	dBm
	3fo			–69	–66	
	2fo	fo = 2690 MHz, P_{IN} = +26 dBm VSWR 6:1		–57	–51	dBm
	3fo			–57	–54	
Band 17 3rd harmonic RF1, RF2, RF3, or RF4 to ANT	B17 3fo	fo = 710 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 1:1		–73	–70	dBm
		fo = 710 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 5:1		–63	–55	
Band 13 2nd harmonic RF1, RF2, RF3, or RF4 to ANT	B13 2fo	fo = 787 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 1:1		–76	–68	dBm
		fo = 787 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 5:1		–72	–66	
Second order intermodulation distortion	IMD2	Bands 1 and 5: P_{TX} = +20 dBm, $P_{BLOCKER}$ = –15 dBm		–105	–100	dBm

Table 4. Electrical Specifications[1] (Continued)

(VDD = 2.8 V, VC1/VC2 = 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
Third order intermodulation distortion	IMD3	Bands 1 and 5: P_{TX} = +20 dBm, $P_{BLOCKER}$ = –15 dBm		–110	–105	dBm
Input compression point	IP0.1dB	f = 400, 3800 MHz		40		dBm
Timing						
DC supply turn-on/turn-off time	T_{ON}	Measured from 50% of final V_{DD} supply voltage to final RF power ± 1 dB		2	3	µs
RF path switching time	T_{SW}	One active state to another active state transition: Measured from 50% of final $V_{C1/C2}$ voltage to final RF power ± 1 dB		2	3	
DC Operating						
Supply current	I_{DD}			50	100	µA
Control current	$I_{C1/C2}$			0.1	0.5	

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.
2. IL specifications are taken without matching.

Table 5. Electrical Specifications[1]

(VDD = 2.8 V, VC1/VC2 = 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
Small Signal						
Insertion loss (RFC to RF1-RF4)[2]	IL	400 to 960 MHz		0.2	0.4	dB
		1710 to 2170 MHz		0.4	0.7	
		2170 to 2690 MHz		0.5	0.8	
		3400 to 3800 MHz		0.6	1.0	
Isolation (RFC to RF1-RF4)	ISO	400 to 960 MHz	35	44		dB
		1710 to 2170 MHz	25	27		
		2170 to 2690 MHz	23	25		
		3400 to 3800 MHz	18	20		
Return loss (RFC, RF1 to RF4)	RL	400 to 2690 MHz		12		dB
		3400 to 3800 MHz		10		
Large Signal						
GSM low-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 824, 915 MHz, P_{IN} = +35 dBm VSWR 1:1		–64	–58	dBm
	3fo			–51	–48	
	2fo	fo = 824, 915 MHz, P_{IN} = +35 dBm VSWR 6:1		–51	–47	dBm
	3fo			–42	–36	
GSM high-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 1710, 1910 MHz, P_{IN} = +33 dBm VSWR 1:1		–63	–57	dBm
	3fo			–49	–46	
	2fo	fo = 1710, 1910 MHz, P_{IN} = +33 dBm VSWR 6:1		–59	–52	dBm
	3fo			–47	–41	
LTE/WCDMA low-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 400 to 960 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 1:1		–79	–73	dBm
	3fo			–71	–65	
	2fo	fo = 400 to 960 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 6:1		–68	–62	dBm
	3fo			–62	–56	
LTE/WCDMA mid-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 1710 to 1910 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 1:1		–69	–62	dBm
	3fo			–63	–58	
	2fo	fo = 1710 to 1910 MHz, P_{IN} = +26 dBm LTE_1x 20 MHz VSWR = 6:1		–61	–56	dBm
	3fo			–53	–48	
LTE/WCDMA high-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 2690 MHz, P_{IN} = +26 dBm VSWR 1:1		–68	–62	dBm
	3fo			–67	–64	
	2fo	fo = 2690 MHz, P_{IN} = +26 dBm VSWR 6:1		–57	–51	dBm
	3fo			**–56**	**–52**	
Band 17 3rd harmonic RF1, RF2, RF3, or RF4 to ANT	B17 3fo	fo = 710 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 1:1		–74	–69	dBm
		fo = 710 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 5:1		–64	–54	
Band 13 2nd harmonic RF1, RF2, RF3, or RF4 to ANT	B13 2fo	fo = 787 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 1:1		–80	–71	dBm
		fo = 787 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 5:1		–74	–67	
Second order intermodulation distortion	IMD2	Bands 1 and 5: P_{TX} = +20 dBm, $P_{BLOCKER}$ = –15 dBm		–105	–100	dBm

Table 5. Electrical Specifications[1] (Continued)

(VDD = 2.8 V, VC1/VC2 = 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
Third order intermodulation distortion	IMD3	Bands 1 and 5: P_{TX} = +20 dBm, $P_{BLOCKER}$ = –15 dBm		–110	–105	dBm
Input compression point	IP0.1dB	f = 400, 3800 MHz		40		dBm
Timing						
DC supply turn-on/turn-off time	T_{ON}	Measured from 50% of final V_{DD} supply voltage to final RF power ± 1 dB		2	3	µs
RF path switching time	T_{SW}	one active state to another active state transition: Measured from 50% of final $V_{C1/C2}$ voltage to final RF power ± 1 dB		2	3	
DC Operating						
Supply current	I_{DD}			50	100	µA
Control current	$I_{C1/C2}$			0.1	0.5	

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.
2. IL specifications are taken without matching.

Table 6. Electrical Specifications[1]

(VDD = 2.8 V, VC1/VC2 = 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
Small Signal						
Insertion loss (RFC to RF1-RF4)[2]	IL	400 to 960 MHz		0.3	0.4	dB
		1710 to 2170 MHz		0.5	0.7	
		2170 to 2690 MHz		0.6	0.8	
		3400 to 3800 MHz		0.7	1.0	
Isolation (RFC to RF1-RF4)	ISO	400 to 960 MHz	37	40		dB
		1710 to 2170 MHz	24	26		
		2170 to 2690 MHz	23	25		
		3400 to 3800 MHz	18	20		
Return loss (RFC, RF1 to RF4)	RL	400 to 2690 MHz		12		dB
		3400 to 3800 MHz		10		
Large Signal						
GSM low-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 824, 915 MHz, P_{IN} = +35 dBm VSWR 1:1		–57	–53	dBm
	3fo			–51	–48	
	2fo	fo = 824, 915 MHz, P_{IN} = +35 dBm VSWR 6:1		–51	–48	dBm
	3fo			–38	–34	
GSM high–band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 1710, 1910 MHz, P_{IN} = +33 dBm VSWR 1:1		–63	–55	dBm
	3fo			–51	–48	
	2fo	fo = 1710, 1910 MHz, P_{IN} = +33 dBm VSWR 6:1		–58	–40	dBm
	3fo			–46	–35	
LTE/WCDMA low-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 400 to 960 MHz, P_{IN} = +26 dBm LTE_1x20MHz VSWR = 1:1		–71	–67	dBm
	3fo			–69	–64	
	2fo	fo = 400 to 960 MHz, P_{IN} = +26 dBm LTE_1x20MHz VSWR = 6:1		–69	–64	dBm
	3fo			–61	–56	
LTE/WCDMA mid-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 1710 to 1910 MHz, P_{IN} = +26 dBm LTE_1x20MHz VSWR = 1:1		–67	–62	dBm
	3fo			–66	–61	
	2fo	fo = 1710 to 1910 MHz, P_{IN} = +26 dBm LTE_1x20MHz VSWR = 6:1		–61	–56	dBm
	3fo			–55	–49	
LTE/WCDMA high-band harmonic RF1, RF2, RF3, or RF4 to ANT	2fo	fo = 2690 MHz, P_{IN} = +26 dBm VSWR 1:1		–68	–63	dBm
	3fo			–71	–68	
	2fo	fo = 2690 MHz, P_{IN} = +26 dBm VSWR 6:1		–58	–52	dBm
	3fo			–58	–55	
Band 17 3rd harmonic RF1, RF2, RF3, or RF4 to ANT	B17 3fo	fo = 710 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 1:1		–73	–60	dBm
		fo = 710 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 5:1		–61	–55	
Band 13 2nd harmonic RF1, RF2, RF3, or RF4 to ANT	B13 2fo	fo = 787 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 1:1		–72	–68	dBm
		fo = 787 MHz, P_{IN} = +25 dBm LTE_1x 20 MHz VSWR = 5:1		–74	–67	
Second order intermodulation distortion	IMD2	Bands 1 and 5: P_{TX} = +20 dBm, $P_{BLOCKER}$ = –15 dBm		–105	–100	dBm

Table 6. Electrical Specifications[1] (Continued)

(VDD = 2.8 V, VC1/VC2 = 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
Third order intermodulation distortion	IMD3	Bands 1 and 5: P_{TX} = +20dBm, $P_{BLOCKER}$ = –15 dBm		–110	–104	dBm
Input compression point	IP0.1dB	f = 400, 3800 MHz		40		dBm
Timing						
DC supply turn-on/turn-off time	T_{ON}	Measured from 50% of final V_{DD} supply voltage to final RF power ± 1 dB		2	3	µs
RF path switching time	T_{SW}	One active state to another active state transition: Measured from 50% of final $V_{C1/C2}$ voltage to final RF power ± 1 dB		2	3	
DC Operating						
Supply current	I_{DD}			50	100	µA
Control current	$I_{C1/C2}$			0.1	0.5	

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.
2. IL specifications are taken without matching.

Table 7. Control Logic[1]

Path	VC1	VC2
RFC to RF1	1	0
RFC to RF2	1	1
RFC to RF3	0	1
RFC to RF4	0	0

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

Evaluation Board Description

The SKY5A5110-EK1 Evaluation Board is used to test the performance of the SKY5A5110 SP4T switch. An Evaluation Board schematic diagram is provided in Figure 3. An Evaluation Board assembly diagram in shown in Figure 4.

Package Dimensions

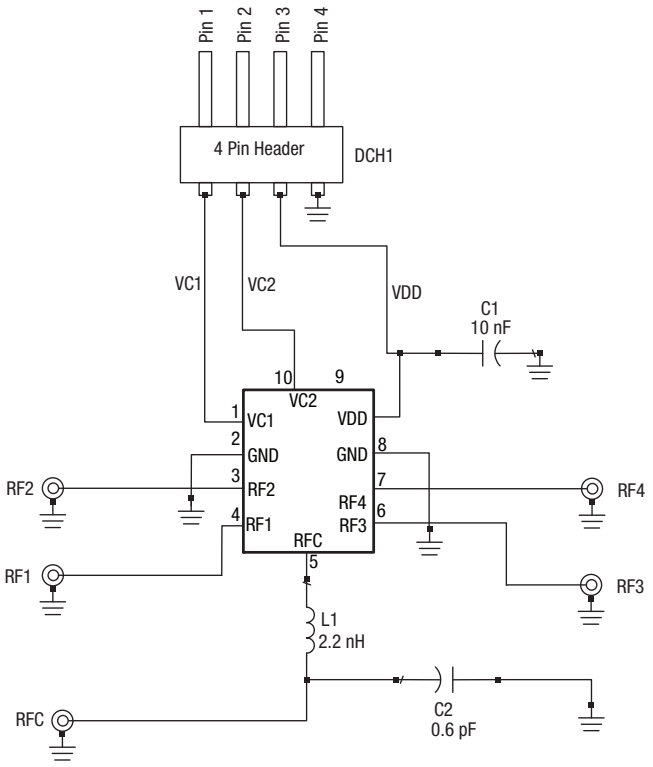
The PCB layout footprint for the SKY5A5110 is provided in Figure 9. Typical part markings are shown in Figure 10. Package dimensions are shown in Figure 11, and tape and reel dimensions are provided in Figure 12.

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 SKY5A5110 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.



Note: IL can be improved 0.3 to 0.4 dB from 2.7 GHz to 3.8 GHz with a series L and a shunt C at the RFC port.

206573-003

Figure 3. Evaluation Board Schematic

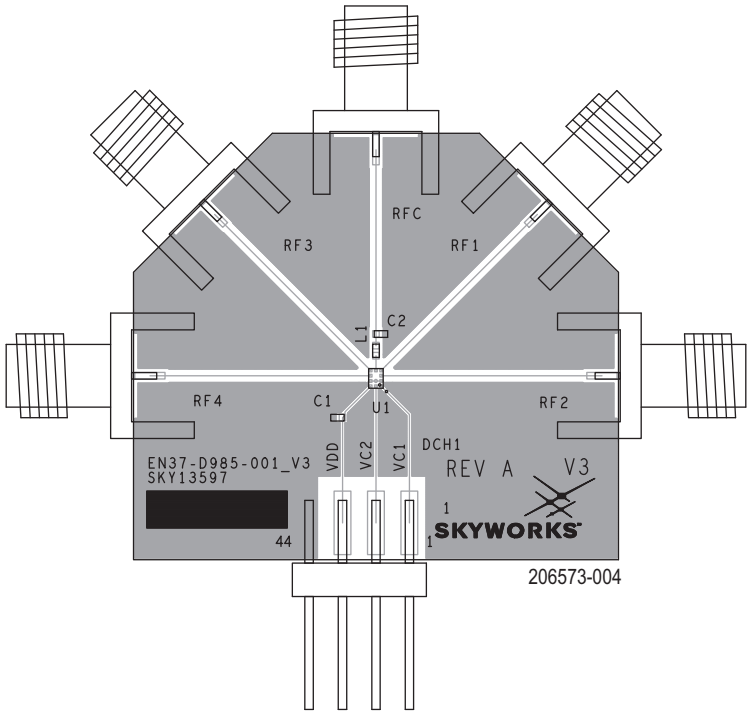


Figure 4. Evaluation Board Assembly Diagram

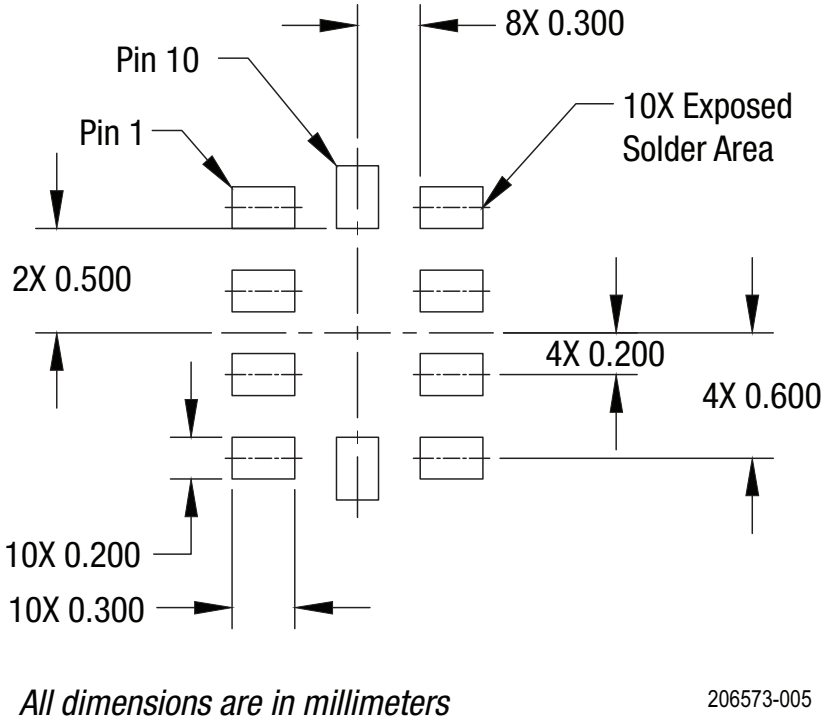


Figure 5. PCB Layout Footprint (Top View)

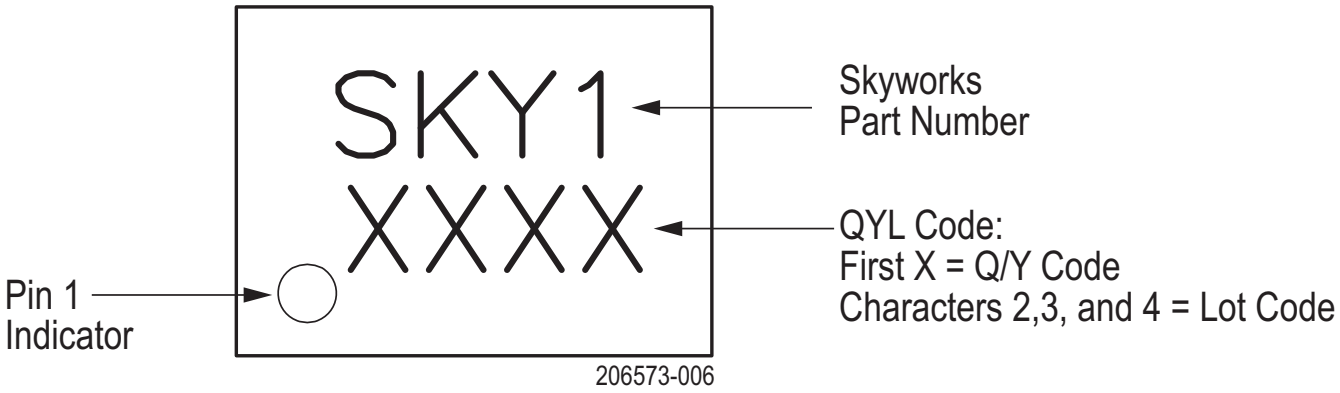
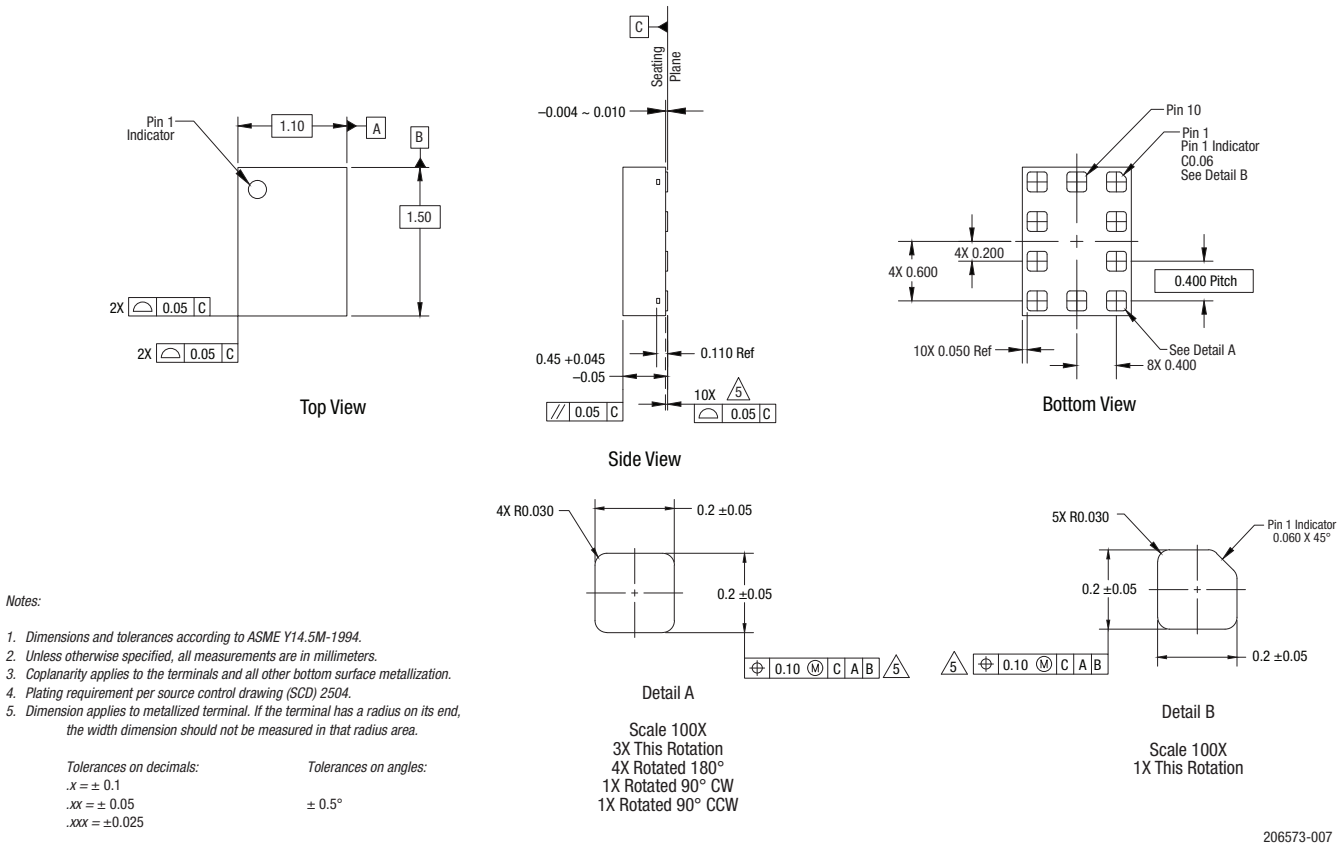


Figure 6. Typical Part Markings

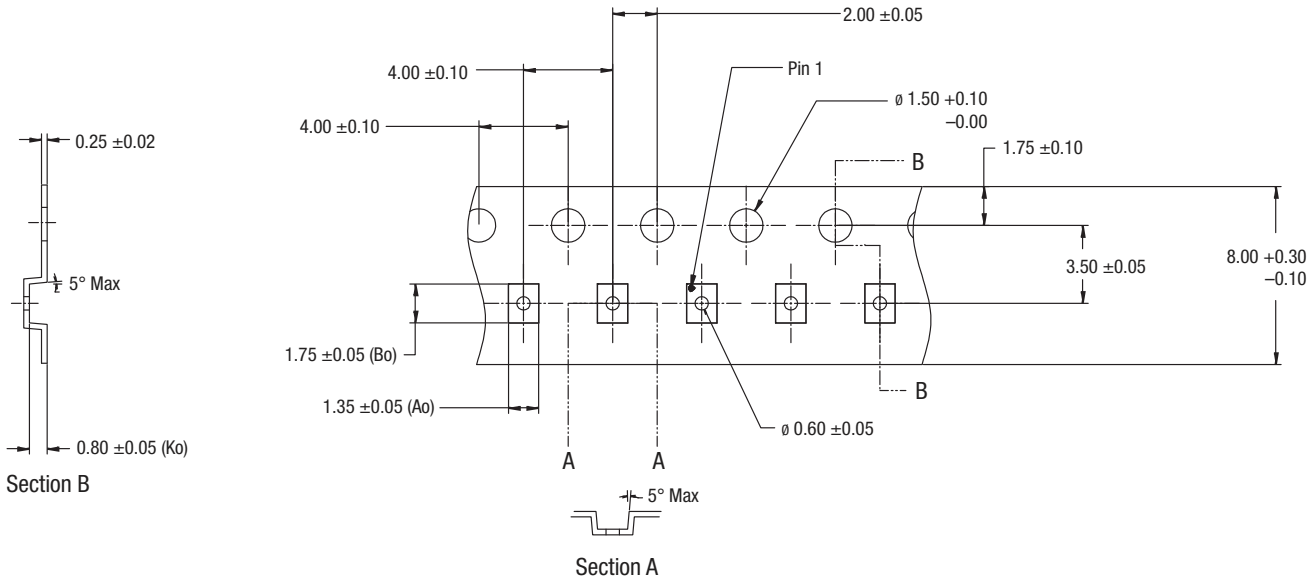


Notes:

1. *Dimensions and tolerances according to ASME Y14.5M-1994.*
2. *Unless otherwise specified, all measurements are in millimeters.*
3. *Coplanarity applies to the terminals and all other bottom surface metallization.*
4. *Plating requirement per source control drawing (SCD) 2504.*
5. *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.*

Tolerances on decimals:	*Tolerances on angles:*
.x = ± 0.1	
.xx = ± 0.05	± 0.5°
.xxx = ±0.025	

Figure 7. Package Dimensions



Notes:

1. *Carrier tape must meet all requirements of Skyworks GP01-D233 procurement spec for tape and reel shipping.*
2. *Carrier tape: black conductive polycarbonate.*
3. *Cover tape: transparent conductive material.*
4. *ESD surface resistivity shall meet GP01-D233.*
5. *10-sprocket hole pitch cumulative tolerance: ±0.20 mm.*
6. *Pocket position relative to sprocket hole measured as true position of pocket.*
7. *Ao and Bo measured on a plane 0.30 mm above the bottom of the pocket.*
8. *All dimensions are in millimeters.*

206573-008

Figure 8. Tape and Reel Dimensions

Ordering Information

Part Number	Part Description	Evaluation Board Part Number
SKY5A5110	0.4 to 3.8 GHz SP4T High Power Switch	SKY5A5110-EK1

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