

DATA SHEET

SKYA21029: 0.1 to 3.8 GHz SP4T Antenna Switch

Applications

- 2G/3G/4G/4G LTE, 4G LTE-A
- Embedded cellular telematics modules
- OBD-II cellular modems

Features

- Broadband frequency range: 0.1 to 3.8 GHz
- Low insertion loss: 0.45 dB typical @ 2.7 GHz
- High isolation: >31 dB @ 2.7 GHz
- Internal 50 Ω port to control diversity antenna impedance when device is not in use
- Integrated logic
- Automotive Level-3 PPAP available upon request
- IMDS material declaration available at production release
- Extended production life to support automotive requirements
- Independent BOM management to minimize PCN risk
- 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 SKYA21029 is a single-pole, four-throw (SP4T) antenna switch with an internal 50 Ω termination. The high-linearity performance and low insertion loss achieved by the SKYA21029 make it an ideal choice for embedded cellular telematics modules and OBD-II cellular modems.

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.

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 four switched RF outputs (RF1 to RF4) using a low insertion loss path, while the paths between the ANT pin and the other RF pins are in a high isolation state.

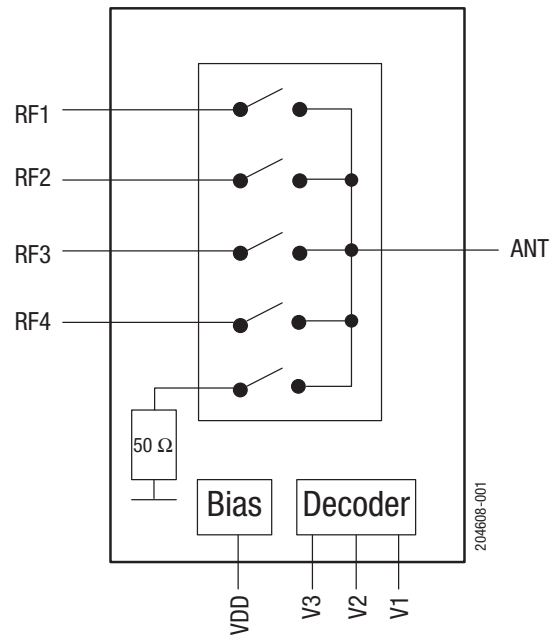


Figure 1. SKYA21029 Block Diagram

The antenna path can also be closed on a 50 Ω load when it needs to be terminated. The 50 Ω load is internally grounded. No external blocking capacitors are required on the RF paths unless VDC is externally applied.

The SKYA21029 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.

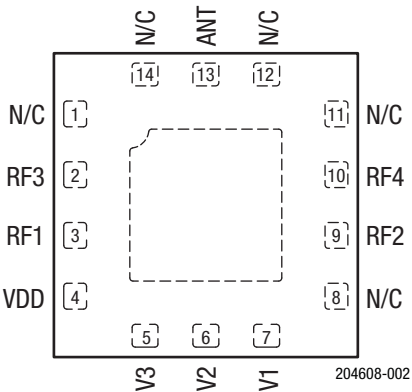


Figure 2. SKYA21029 Pinout (Top View)

Table 1. SKYA21029 Signal Descriptions¹

Pin	Name	Description	Pin	Name	Description
1	N/C	Not connected	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	N/C	Not connected
5	V3	DC control voltage 3	12	N/C	Not connected
6	V2	DC control voltage 2	13	ANT	Antenna port
7	V1	DC control voltage 1	14	N/C	Not connected

¹ Bottom ground paddles must be connected to ground.

Functional Description

The SKYA21029 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 four switched RF outputs or a 50 Ω termination.

Shutdown mode is enabled by connecting all three control pins (V1, V2, and V3) to logic high. This mode reduces the overall current consumption of the device to 5 μ A typical.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKYA21029 are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKYA21029 is determined by the logic shown in Table 4.

The isolation matrix shown in Table 5 provides the port-to-port and antenna-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. SKYA21029 Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V _{DD}	2.5	5.0	V
Control voltage (V1, V2, and V3)	V _{CTL}	-0.5	+3.0	V
RF power applied to “on” arm (RF1 to RF4) or ANT port: 0.1 to 2.7 GHz (RF1 to RF4 arm) 3.4 to 3.8 GHz (RF2 to RF4 arm)	P _{IN}		+37.5 +35	dBm dBm
RF power applied to “off” arm (RF1 to RF4)	P _{IN}		+33	dBm
RF power applied to antenna in the 50 Ω switched RF output state	P _{IN}		+27	dBm
Operating temperature	T _{OP}	-40	+85	°C
Storage temperature	T _{STG}	-55	+150	°C
Electrostatic discharge: Human Body Model (HBM)	ESD		500	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.

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. SKYA21029 General Electrical Specifications¹**(V_{DD} = 2.6 V, V₁ = V₂ = V₃ = 0/1.8 V, P_{IN} = 0 dBm, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition ²	Min	Typ	Max	Units
DC Specifications						
Supply voltage	V _{DD}		2.5	2.6	4.8	V
Supply current	I _{DD}	V _{DD} = 2.6 V		40	50	μA
Control voltage: High Low	V _{CTL_H} V _{CTL_L}		1.35	1.80	2.70 0.4	V V
Control current	I _{CTL}	V _{CTL} = 1.8 V		0.5	1.0	μA
Shutdown mode supply current	I _{OFF}	V _{1/2/3} = 1.8 V, V _{DD} = 2.6 V		5	10	μA
Turn-on switching time	t _{ON}	50% of control voltage to 90% of final RF power, switching between RF1/2/3/4		1.75	2.20	μs
RF Specifications						
Insertion loss (ANT pin to RF1/2/3/4 pins)	IL	0.1 to 1.0 GHz		0.40	0.50	dB
		1.0 to 2.0 GHz		0.40	0.50	dB
		2.0 to 2.7 GHz		0.45	0.60	dB
		3.4 to 3.8 GHz		0.6	0.8	dB
Isolation (ANT pin to RF1/2/3/4 pins)	Iso	0.1 to 1.0 GHz	38	42		dB
		1.0 to 2.0 GHz	32	35		dB
		2.0 to 2.7 GHz	27	31		dB
		3.4 to 3.8 GHz	20	26		dB
Input return loss (ANT pin to RF1/2/3/4 pins)	RL	0.1 to 1.0 GHz	21	24		dB
		1.0 to 2.0 GHz	23	25		dB
		2.0 to 2.7 GHz	15	18		dB
		3.4 to 3.8 GHz	12	15		dB
Second harmonics (ANT pin to RF1/2/3/4 pins)	2f ₀	P _{IN} = +26 dBm, 0.1 to 3.0 GHz		+99		dBc
Third harmonics (ANT pin to RF1/2/3/4 pins)	3f ₀	P _{IN} = +26 dBm, 0.1 to 3.0 GHz		+105		dBc
Harmonics (ANT to RF2, 3, 4)	2f ₀	P _{IN} = +26 dBm, 3.4 to 3.8 GHz, VSWR = 1:1		-55		dBm
Harmonics (ANT to RF2, 3, 4)	3f ₀	P _{IN} = +26 dBm, 3.4 to 3.8 GHz, VSWR = 1:1		-65		dBm
Harmonics (ANT to RF2, 3, 4)	2f ₀	P _{IN} = +26 dBm, 3.4 to 3.8 GHz, VSWR = 5:1		-50		dBm
Harmonics (ANT to RF2, 3, 4)	3f ₀	P _{IN} = +26 dBm, 3.4 to 3.8 GHz, VSWR = 5:1		-60		dBm
0.1 dB compression point (ANT pin to RF2/3/4 pins)	P _{0.1dB}	0.8 GHz to 3.0 GHz 3.4 to 3.8 GHz		+37.5 +37		dBm dBm
Third order input intercept point	IIP ₃	@ 2.0 GHz, P _{IN} = +26 dBm, Δf = 1 MHz		+70		dBm
50 Ω power handling		@ 0.1 to 3.8 GHz			+27	dBm

Table 4. SKYA21029 Control Logic¹

Control Pins			Switched RF Outputs				
V1 (Pin 7)	V2 (Pin 6)	V3 (Pin 5)	RF1 (Pin 3)	RF2 (Pin 9)	RF3 (Pin 2)	RF4 (Pin 10)	50 Ω
0	0	0	Insertion Loss	Isolation	Isolation	Isolation	Isolation
0	0	1	Isolation	Insertion Loss	Isolation	Isolation	Isolation
0	1	0	Isolation	Isolation	Insertion Loss	Isolation	Isolation
0	1	1	Isolation	Isolation	Isolation	Insertion Loss	Isolation
1	0	0	Isolation	Isolation	Isolation	Isolation	Isolation
1	0	1	Isolation	Isolation	Isolation	Isolation	50 Ω
1	1	1	Shutdown mode				

¹ "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
Antenna-to-Port					
RF1	1.0	-	-47	-40	-42
RF1	2.0	-	-39	-31	-35
RF1	2.7	-	-36	-27	-32
RF1	3.8	-	-31	-22	-27
RF2	1.0	-46	-	-40	-40
RF2	2.0	-38	-	-34	-32
RF2	2.7	-35	-	-31	-28
RF2	3.8	-30	-	-26	-23
RF3	1.0	-38	-46	-	-42
RF3	2.0	-30	-39	-	-35
RF3	2.7	-27	-36	-	-32
RF3	3.8	-23	-31	-	-27
RF4	1.0	-45	-38	-41	-
RF4	2.0	-38	-31	-34	-
RF4	2.7	-34	-28	-31	-
RF4	3.8	-30	-24	-26	-

Table 5. Isolation Matrix (2 of 2)

“On” Port	Frequency (GHz)	Isolation (dB)			
		RF1	RF2	RF3	RF4
Port-to-Port					
RF1	1.0	-	-54	-31	-52
RF1	2.0	-	-43	-25	-43
RF1	2.7	-	-39	-22	-39
RF1	3.8	-	-32	-17	-34
RF2	1.0	-55	-	-48	-31
RF2	2.0	-43	-	-41	-24
RF2	2.7	-38	-	-37	-21
RF2	3.8	-32	-	-33	-17
RF3	1.0	-30	-56	-	-52
RF3	2.0	-24	-45	-	-43
RF3	2.7	-21	-40	-	-39
RF3	3.8	-17	-34	-	-34
RF4	1.0	-56	-30	-48	-
RF4	2.0	-44	-24	-41	-
RF4	2.7	-39	-21	-37	-
RF4	3.8	-32	-17	-32	-

Evaluation Board Description

The SKYA21029 Evaluation Board is used to test the performance of the SKYA21029 SP4T 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 SKYA21029 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 SKYA21029 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.

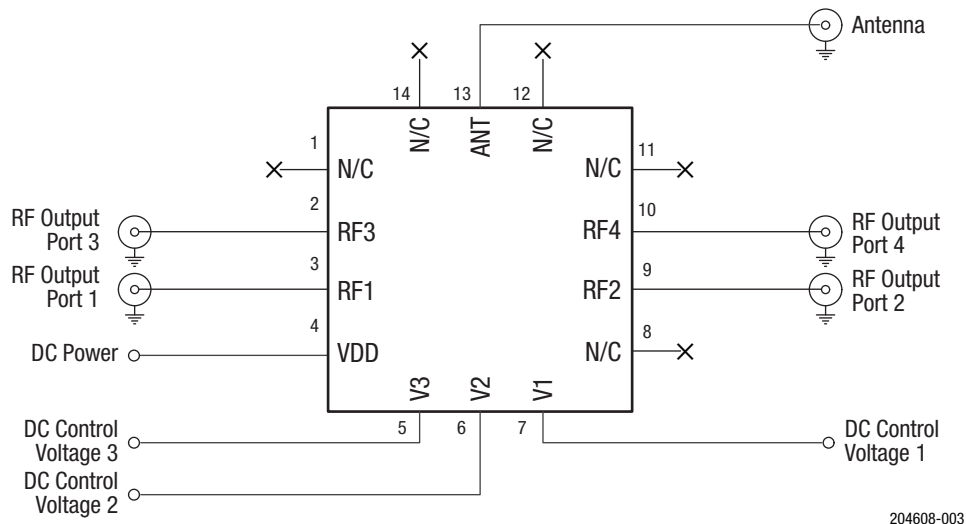


Figure 3. SKYA21029 Evaluation Board Schematic

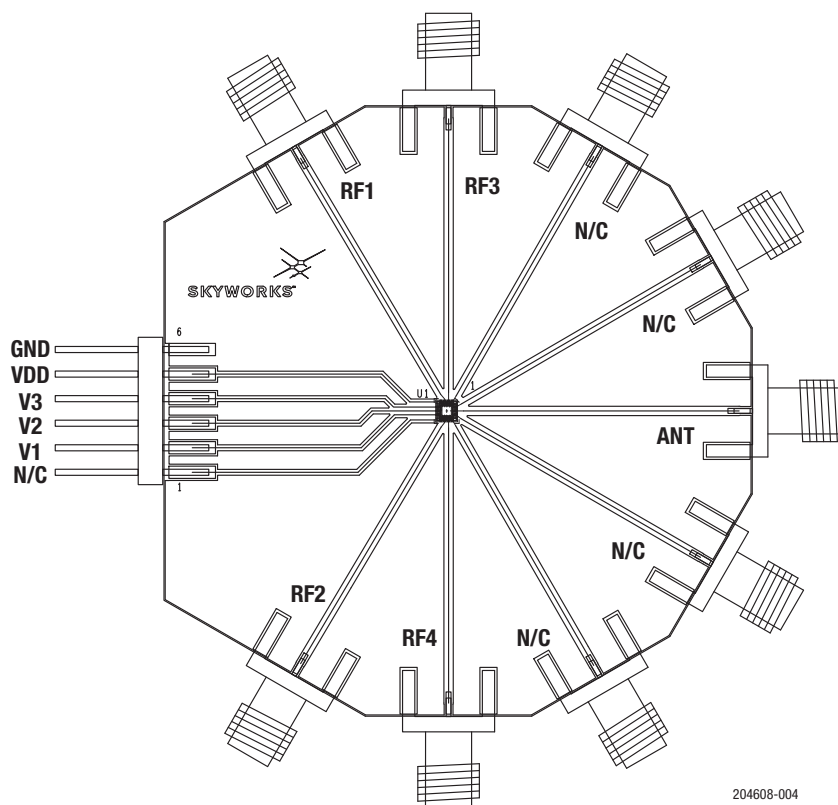


Figure 4. SKYA21029 Evaluation Board Assembly Diagram

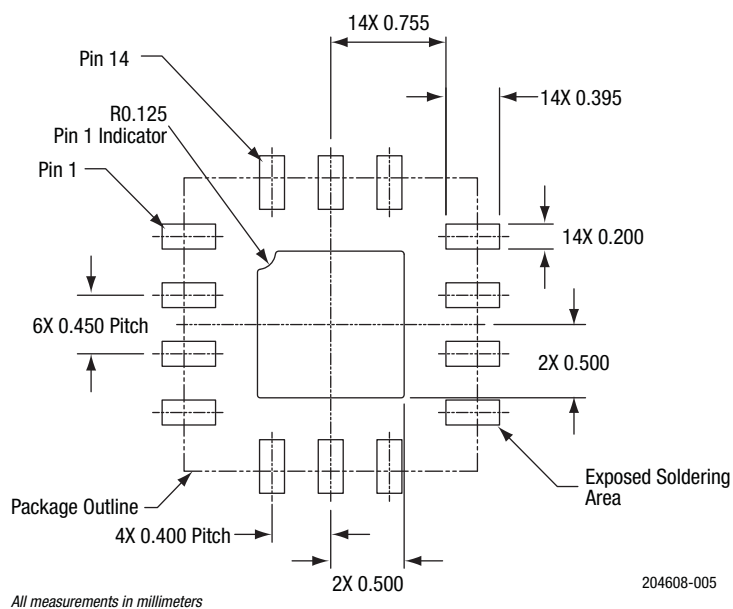


Figure 5. SKYA21029 PCB Layout Footprint (Top View)

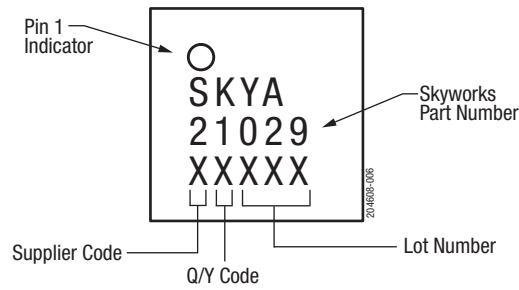


Figure 6. Typical Part Markings (Top View)

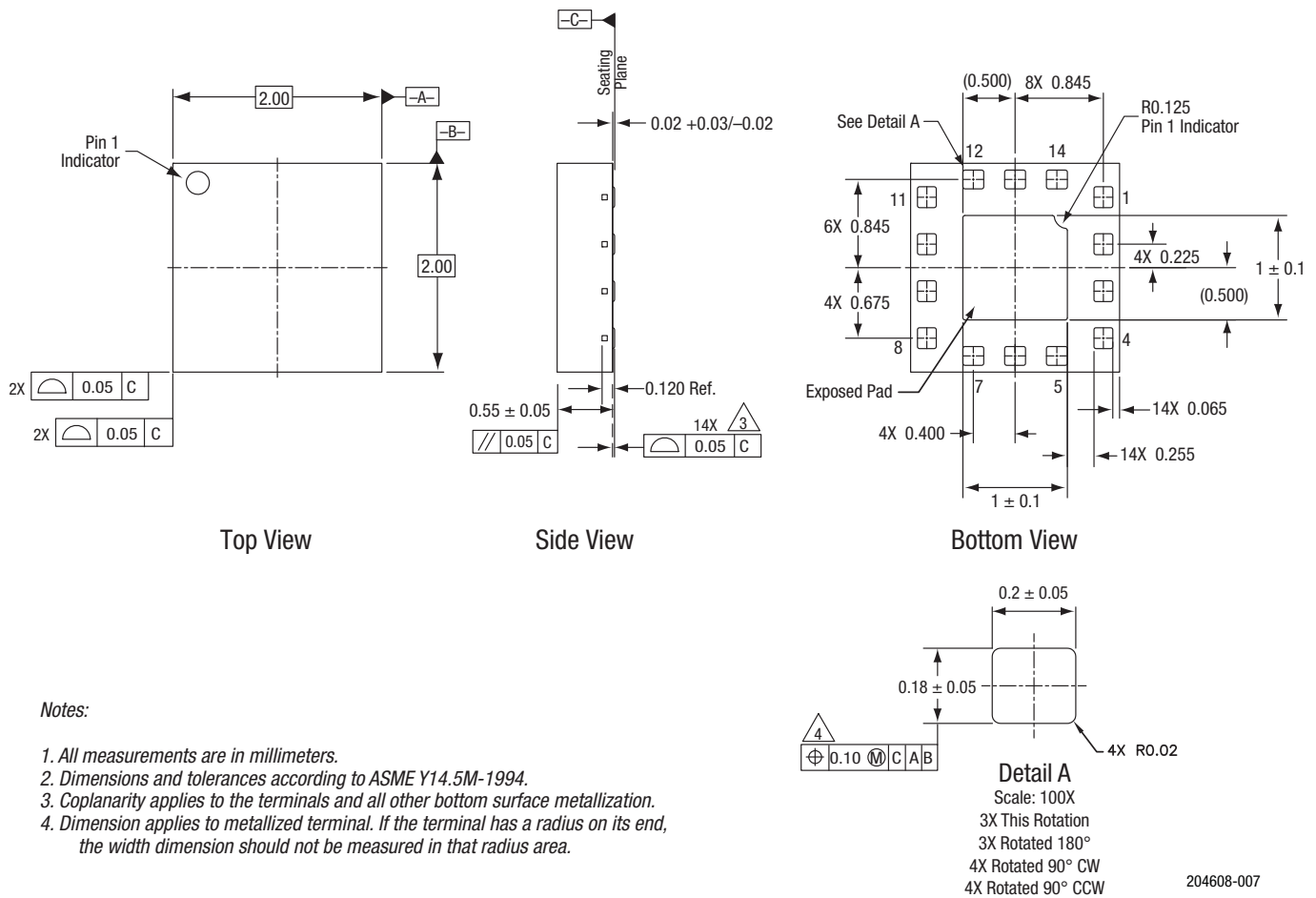
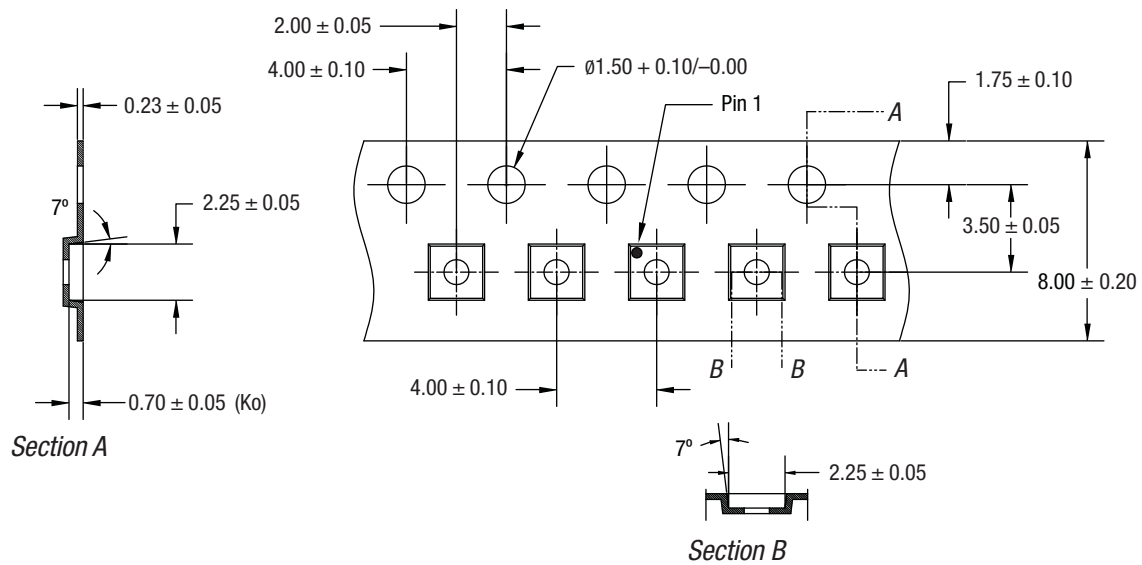


Figure 7. SKYA21029 Package Dimensions



Notes:

1. Carrier tape must meet all requirements of Skyworks GP01-D232 procurement spec for tape and reel shipping.
2. Carrier tape shall be black conductive polycarbonate bakeable material at 125 °C temperature.
3. Cover tape shall be transparent conductive with 5.40 mm width.
4. ESD-surface resistivity must meet all ESD requirements of Skyworks specified on GP01-D232.
5. All measurements are in millimeters.

204608-008

Figure 8. SKYA21029 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKYA21029: 0.1 to 3.8 GHz SP4T Antenna Switch	SKYA21029	SKYA21029-EK1

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