PRELIMINARY DATA SHEET

SKY85610-11: 4.9 to 5.9 GHz SPDT Switch with Low-Noise Amplifier

Applications

- 802.11a/n WLANs
- 5 GHz ISM radios
- Smartphones
- Notebooks, netbooks, and tablets
- Routers, access points, and gateways
- Wireless video systems

Features

- Low noise figure: 2.5 dB
- Frequency range: 4.9 to 5.9 GHz
- High IIP3: +6 dBm
- High gain: 12 dB
- Bypass mode with –8 dB insertion loss
- High transmit to receive isolation for high power applications
- Small QFN (16-pin, 2.5 x 2.5 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.

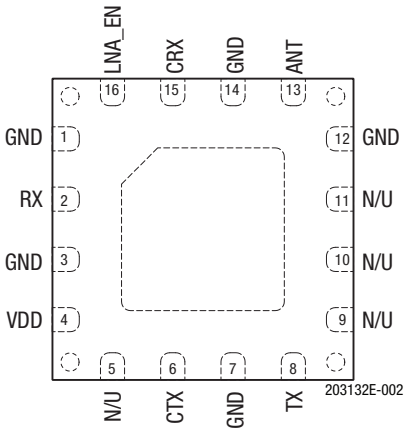


Figure 2. SKY85610-11 Pinout (Top View)

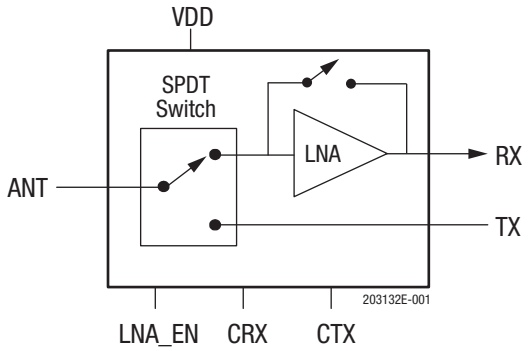


Figure 1. SKY85610-11 Block Diagram

Description

The SKY85610-11 is an integrated, single-pole, double-throw (SPDT) switch with a low-noise amplifier (LNA) intended for wireless applications. The device has a low noise figure (NF) with high linearity in the transmit mode.

The SKY85610-11 can operate at 3.3 V or 5 V and draws 12 mA of current. In the transmit mode, a shutdown function saves power when the device is inactive. This device requires five external components.

This device is manufactured in a compact, 2.5 x 2.5 mm, 16-pin Quad Flat No-Lead (QFN) package. The small footprint provides the industry's smallest PCB area needed to implement an integrated broadband SPDT switch with LNA functionality.

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.

Table 1. SKY85610-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	GND	Ground	9	N/U	Not used. Pin is open circuit in package.
2	RX	5 GHz LNA output signal	10	N/U	Not used. Pin is open circuit in package.
3	GND	Ground	11	N/U	Not used. Pin is open circuit in package.
4	VDD	Supply voltage	12	GND	Ground
5	N/U	Not used. Pin is open circuit in package.	13	ANT	5 GHz antenna output
6	CTX	Switch control voltage, TX path	14	GND	Ground
7	GND	Ground	15	CRX	Switch control voltage, RX path
8	TX	5 GHz transmit input signal	16	LNA_EN	LNA enable

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY85610-11 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Tables 4, 5, and 6.

Typical performance characteristics of the SKY85610-11 are illustrated in Figure 3.

Control logic for the SKY85610-11 SPDT switch is provided in Table 7.

Table 2. SKY85610-11 Absolute Maximum Ratings[1]

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V_{DD}	3.0	6.0	V
LNA power (receive mode)	P_{RX}		+3	dBm
Transmit input power (ANT terminated in 50 Ω match, OFDM signal modulated at MCS9 or less)	P_{TXIN}		+27	dBm
Switch logic control	C0, C1	0	3.6	V
Storage temperature	T_{STG}	–40	+125	°C

[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.

***CAUTION**: 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. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.*

Table 3. SKY85610-11 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage: LNA, bias, and driver stage	V_{DD}	3.0	3.3 or 5.0[1]	5.5	V
Operating temperature	T_A	–40	+25	+85	°C

[1] During production testing, devices will be tested at 5 V.

Table 4. SKY85610-11 Electrical Specifications: Control Logic Characteristics[1]
(T_A = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Supply current, receive mode	$I_{CC\_802.11A}$	State 2		12	15	mA
		State 3		0.02		mA
Supply current, off	I_{OFF}	No RF, State 1, measured on VDD pin		20	70	µA
Control voltage:						
High	V_{IH}		1.6		3.6	V
Low	V_{IL}		–0.3		+0.3	V
Control line current:						
High	I_{CC_H}			2	10	µA
Low	I_{CC_L}				1	µA

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

Table 5. SKY85610-11 Electrical Specifications: Receive AC Characteristics[1]
(T_A = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		4.90		5.85	GHz
Insertion loss	IL	State 3		–8		dB
Receive gain		High gain mode	9	12	16	dB
Noise figure	NF	High gain mode		2.5		dB
TX to RX port isolation	Iso	State 1		40		dB
Input return loss	S11	State 2	6			dB
		State 3	10			dB
Output return loss	S22	@ RX output		8		dB
1 dB input compression point	IP1dB	@ ANT port:				
		State 2		–5		dBm
		State 3		+10		dBm
Interferer amplitude (maximum 2.4 GHz)		1 dB degradation of IP1dB			0	dBm
Transmit/receive switching speed	t_{ON}, t_{OFF}	LNA_EN and CRX (50%) to RF output (10% or 90%)			200	ns

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

Table 6. SKY85610-11 Electrical Specifications: Transmit AC Characteristics[1]
(State 1, T_A = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		4.90		5.85	GHz
Insertion loss	I_L			–0.75		dB
Input return loss	S_{11}	@ TX input port		–15		dB
Output return loss	S_{22}	@ ANT port		–15		dB
Maximum input power	P_{IN}	Harmonic contribution from switch or LNA < –50 dBm/MHz OFDM, MCS9 or better		+27		dBm

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

Typical Performance Characteristics

(TA = +25 °C, Unless Otherwise Noted)

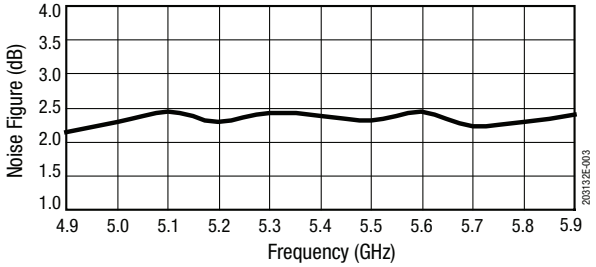


Figure 3. Noise Figure vs Frequency

Table 7. SKY85610-11 Switch Control Logic

State	Mode	CRX	CTX	LNA_EN
	All off	0	0	0
1	TX	0	1	0
2	RX (LNA on)	1	0	1
3	RX (LNA bypass)	1	0	0
	All other states	Not supported		

Note: "Off" = 0 V. "On" = +3.3 V.

Evaluation Board Description

The SKY85610-11 Evaluation Board is used to test the performance of the SKY85610-11 SPDT Switch. An Evaluation Board schematic diagram is provided in Figure 4. Table 8 lists the Bill of Materials (BOM). A photograph of the Evaluation Board is shown in Figure 5.

Evaluation Board Setup Procedure

1. Connect system ground to pin 2 of connector J4.
2. Apply 3.3 V or 5 V to pin 5 of connector J4.
3. Test the RF paths as described by the control logic in Table 7.

Evaluation Board Losses

The board losses from the RF connectors of the Evaluation Board to the pins of the SKY85610-11 are shown in the table:

Signal	Loss (dB)		
	4.9 GHz	5.4 GHz	5.9 GHz
TX	0.28	0.25	0.37
RX	0.15	0.19	0.20
ANT	0.15	0.19	0.20

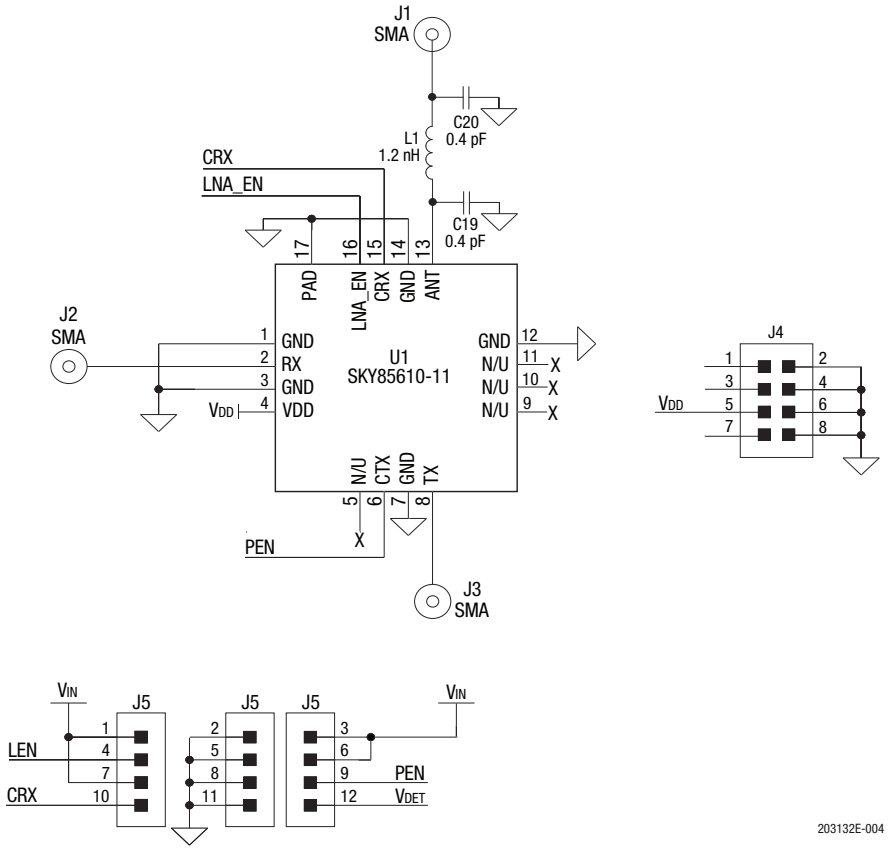


Figure 4. SKY85610-11 Evaluation Board Schematic

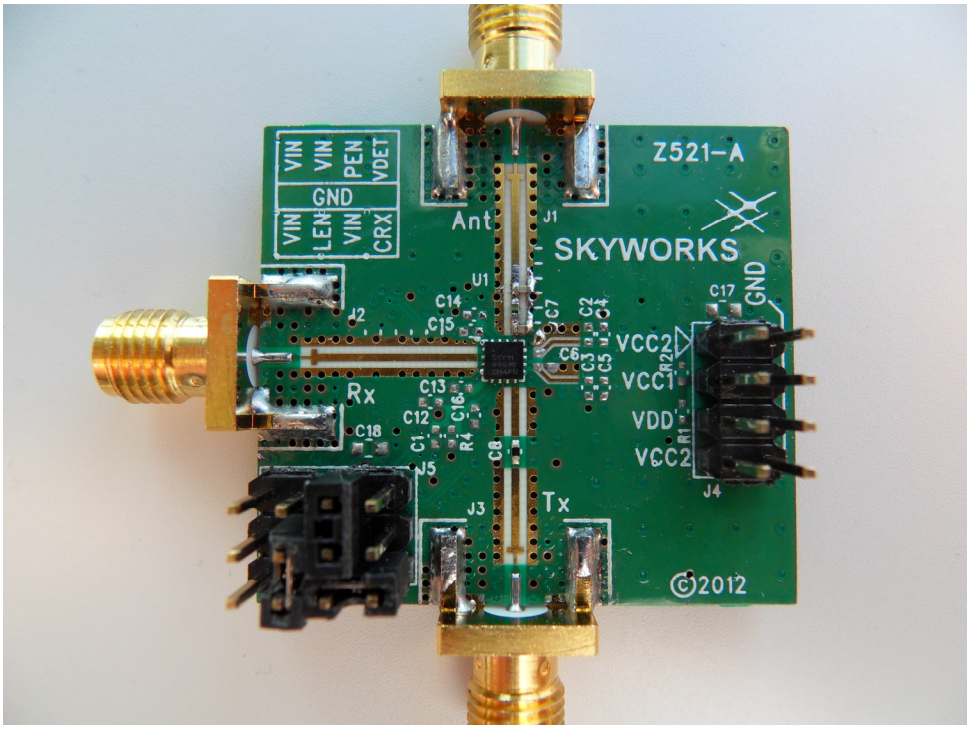


Figure 5. SKY85610-11 Evaluation Board

Table 8. SKY85610-11 Evaluation Board Bill of Materials

Component	Value	Vendor	Part Number	Package	Description
C19, C20	0.4 pF	Murata	GJM1555C1HR40BB01	0402	
L1	1.2 nH	Murata	LQG15HN1N2S02D	0402	

Package Dimensions

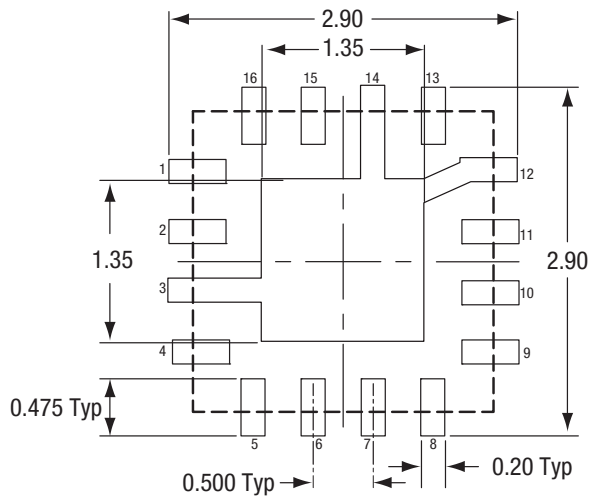
The PCB layout footprint for the SKY85610-11 is provided in Figure 6. Typical part markings are shown in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

Package and Handling Information

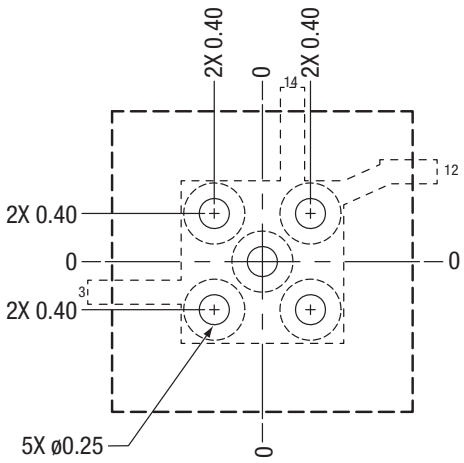
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY85610-11 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.

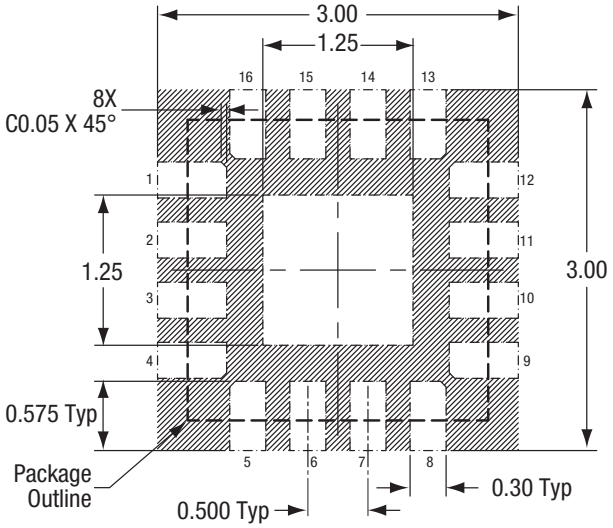
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



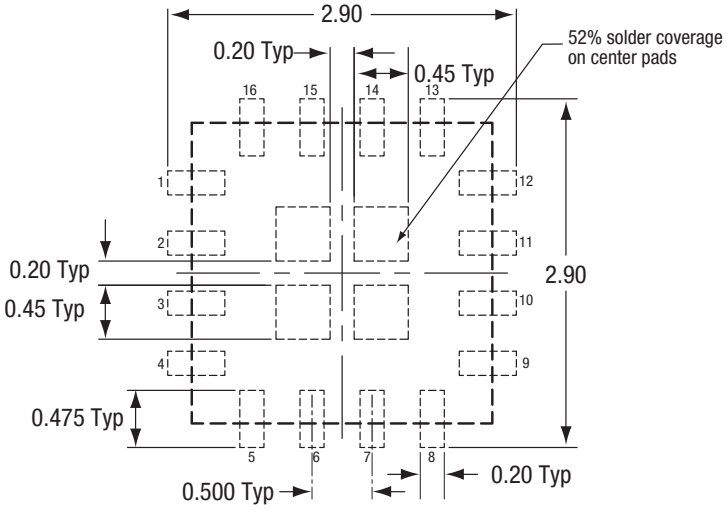
Board Metal



Via Pattern
(Note 4)



Solder Mask Pattern
(Note 6)



Stencil Pattern
(Note 5)

Notes:

1. *All dimensions are in millimeters*
2. *Dimensions and tolerances according to ASME Y14.5M-1994*
3. *Unless specified, dimensions are symmetrical about center lines.*
4. *Via hole recommendations: 0.025 mm Cu via wall plating (minimum), solder mask on the far side should tent or plug via holes.*
5. *Stencil recommendations: 0.10 mm stencil thickness, laser cut apertures, trapezoidal walls and rounded corners offer better paste release.*
6. *Solder mask recommendations: contact board fabricator for recommended solder mask offset and tolerance.*

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Figure 6. SKY85610-11 PCB Layout Footprint

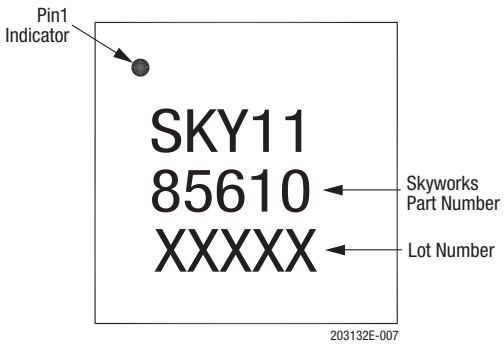
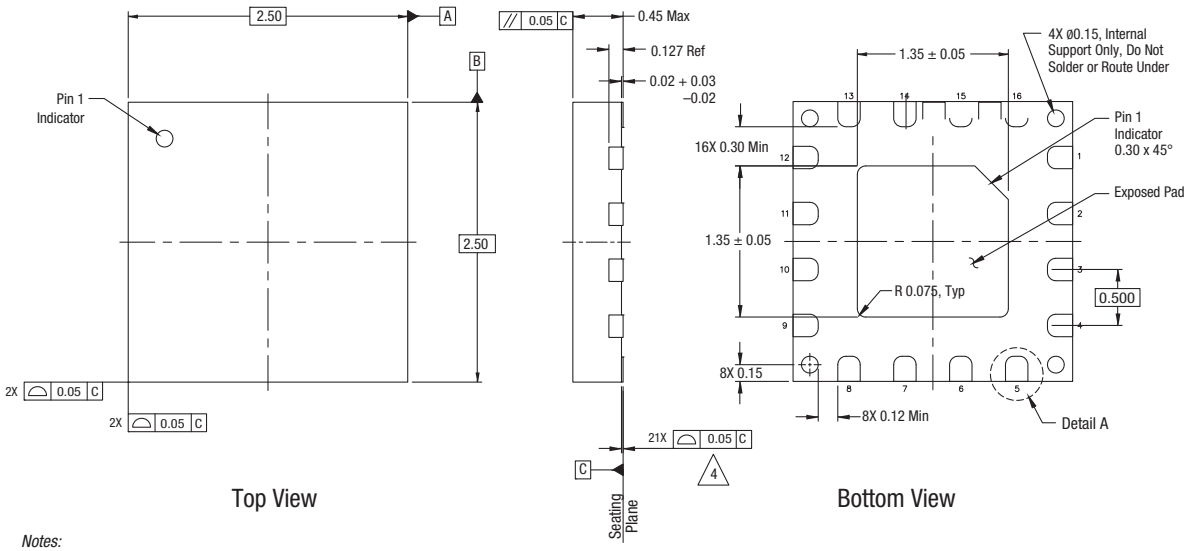


Figure 7. Typical Part Markings (Top View)



Notes:

1. *Dimensions and tolerances according to ASME Y14.5M-1994.*
2. *All measurements are in millimeters.*
3. *Unless otherwise specified, the following values apply:*

   Decimal Tolerance: *Angular Tolerance:*

   X.X (1 place) ± 0.1 mm *± 0.5°*

   X.XX (2 places) ± 0.05 mm

   X.XXX (3 places) ± 0.025 mm
4. *Coplanarity applies to the terminals as well as all other bottom surface metallization.*
5. *Dimension applies to metallized terminal. If terminal tip has a radius, dimension should not be measured in that radius area.*
6. *Unless specified, dimensions are symmetrical about center lines.*

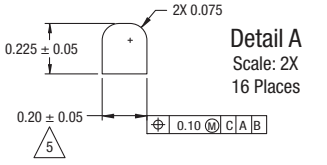
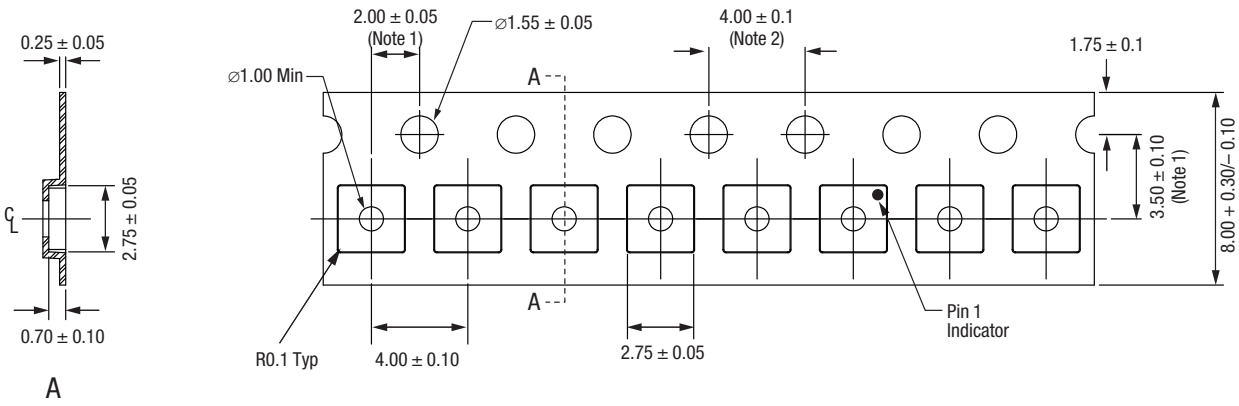


Figure 8. SKY85610-11 Package Dimensions



Notes:

1. Measured from center line of sprocket hole to center line of pocket.
2. Cumulative tolerance of 10 sprocket holes: ±0.20 mm.
3. All measurements are in millimeters.

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Figure 9. SKY85610-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY85610-11: SPDT Switch with LNA	SKY85610-11	SKY85610-11-EK1