

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.

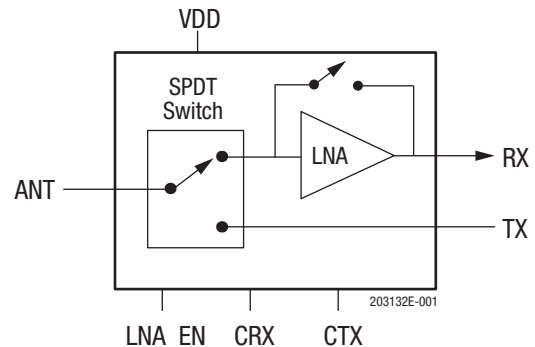


Figure 1. SKY85610-11 Block Diagram

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.

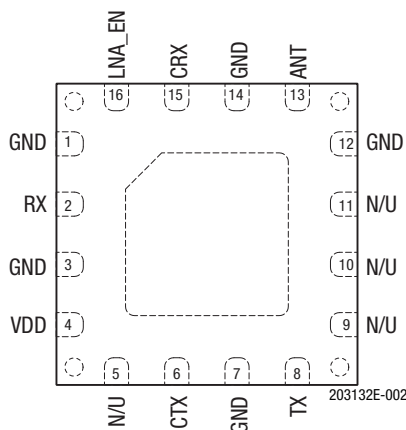


Figure 2. SKY85610-11 Pinout (Top View)

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 Ratings¹

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 Characteristics¹
(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 Low	V _{IH}		1.6		3.6	V
	V _{IL}		-0.3		+0.3	V
Control line current: High Low	I _{CC_H}			2	10	μA
	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 Characteristics¹
(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	I _{SO}	State 1		40		dB
Input return loss	S ₁₁	State 2	6			dB
		State 3	10			dB
Output return loss	S ₂₂	@ 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 Characteristics¹
(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	IL			-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)

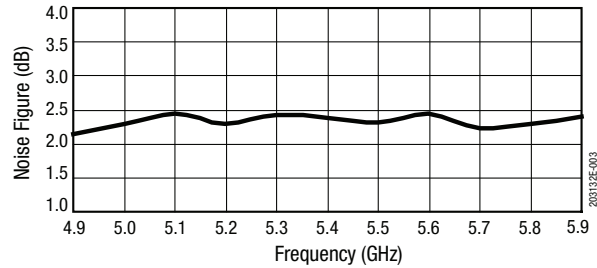


Figure 3. Noise Figure vs Frequency

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

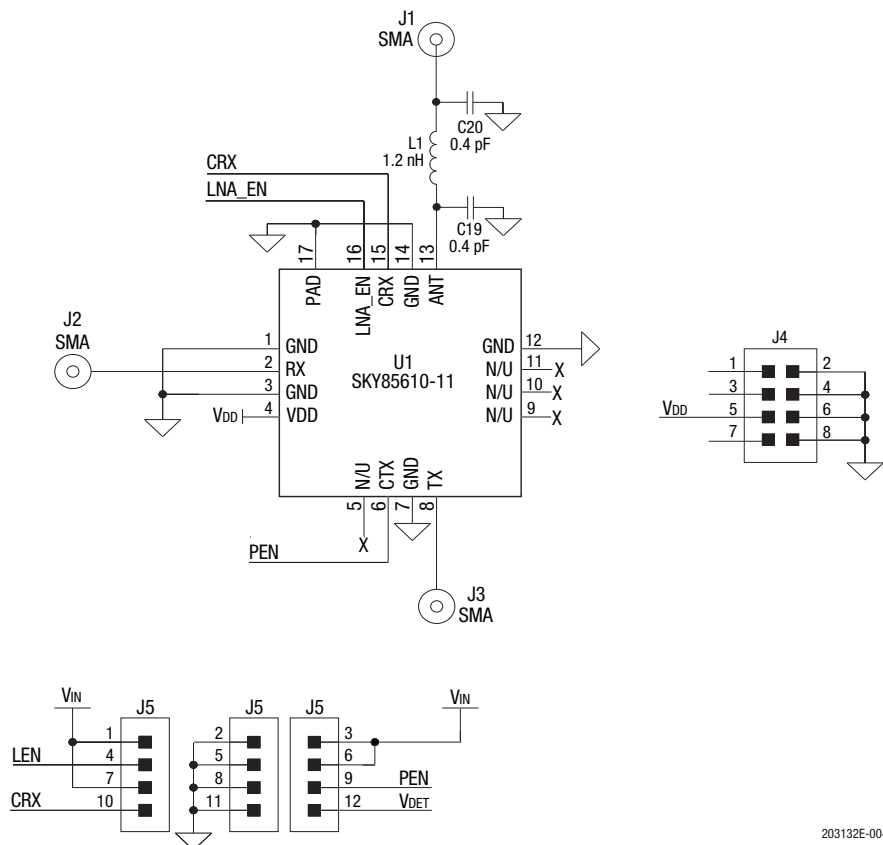


Figure 4. SKY85610-11 Evaluation Board Schematic

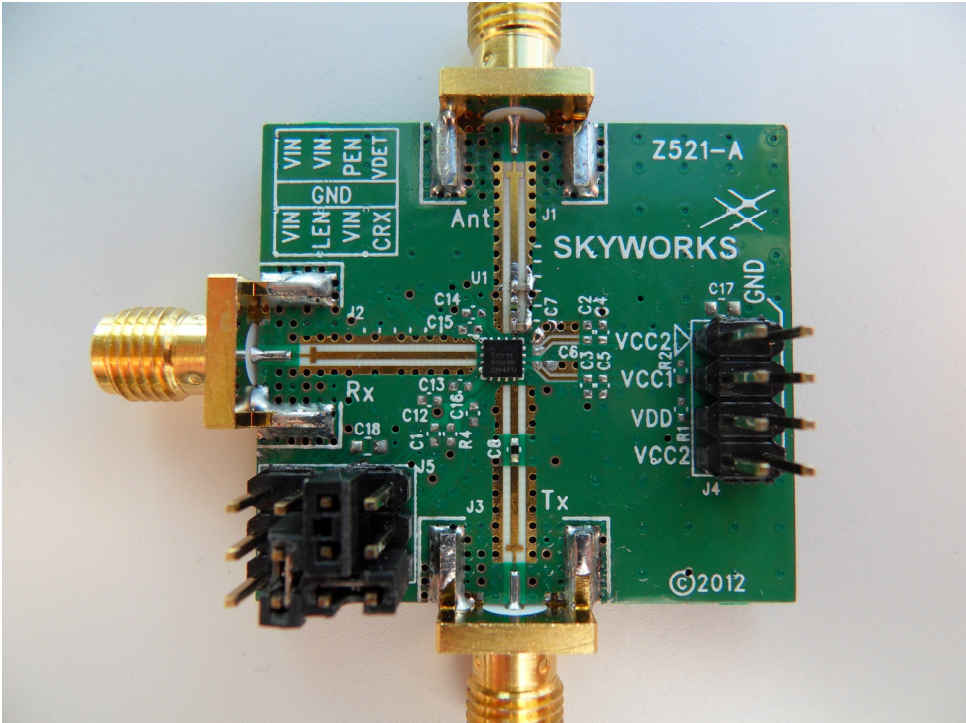


Figure 5. SKY85610-11 Evaluation Board

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.

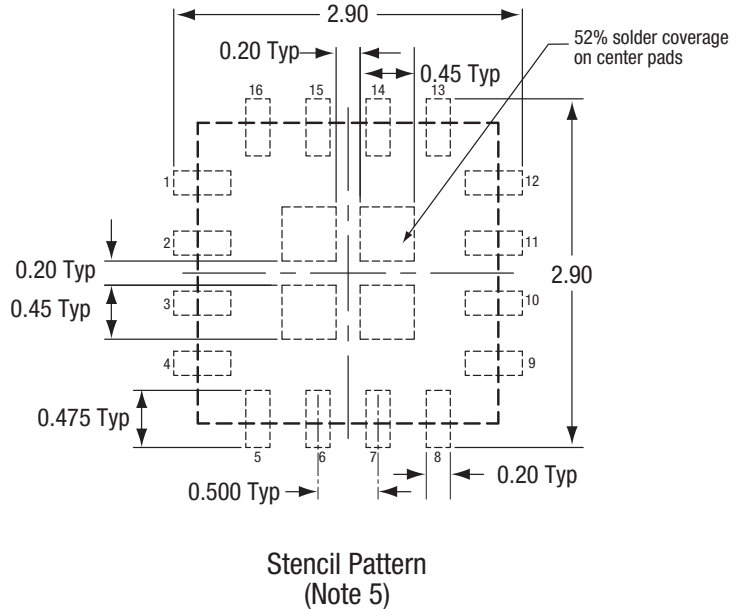
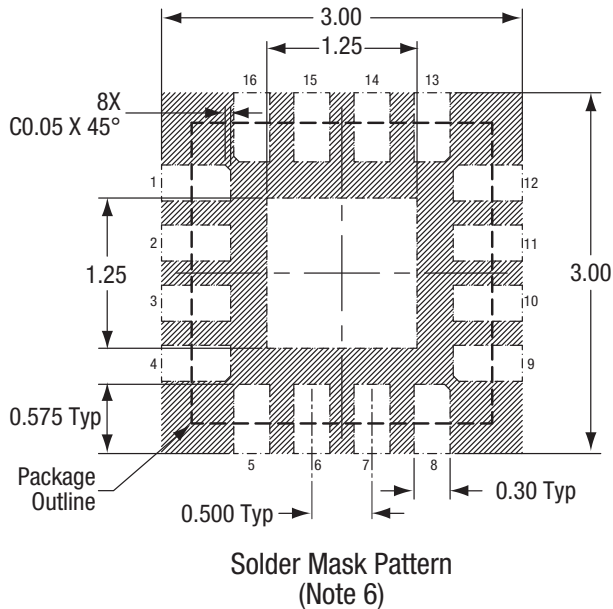
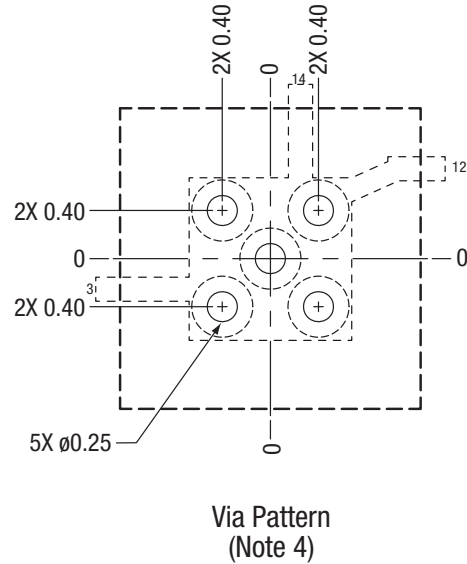
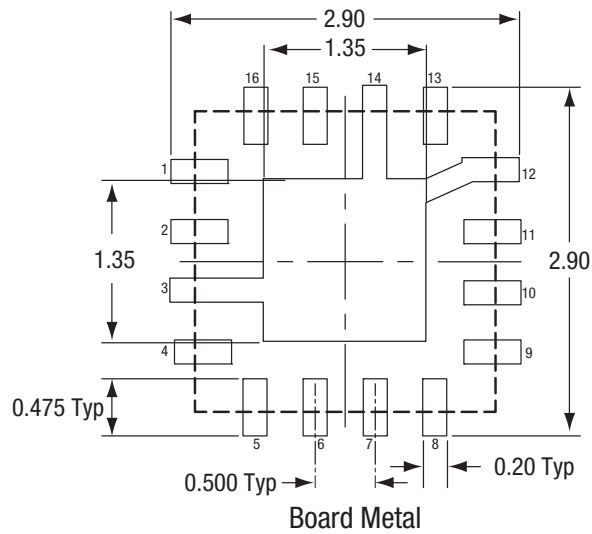
Package and Handling Information

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.



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.

203132E-006

Figure 6. SKY85610-11 PCB Layout Footprint

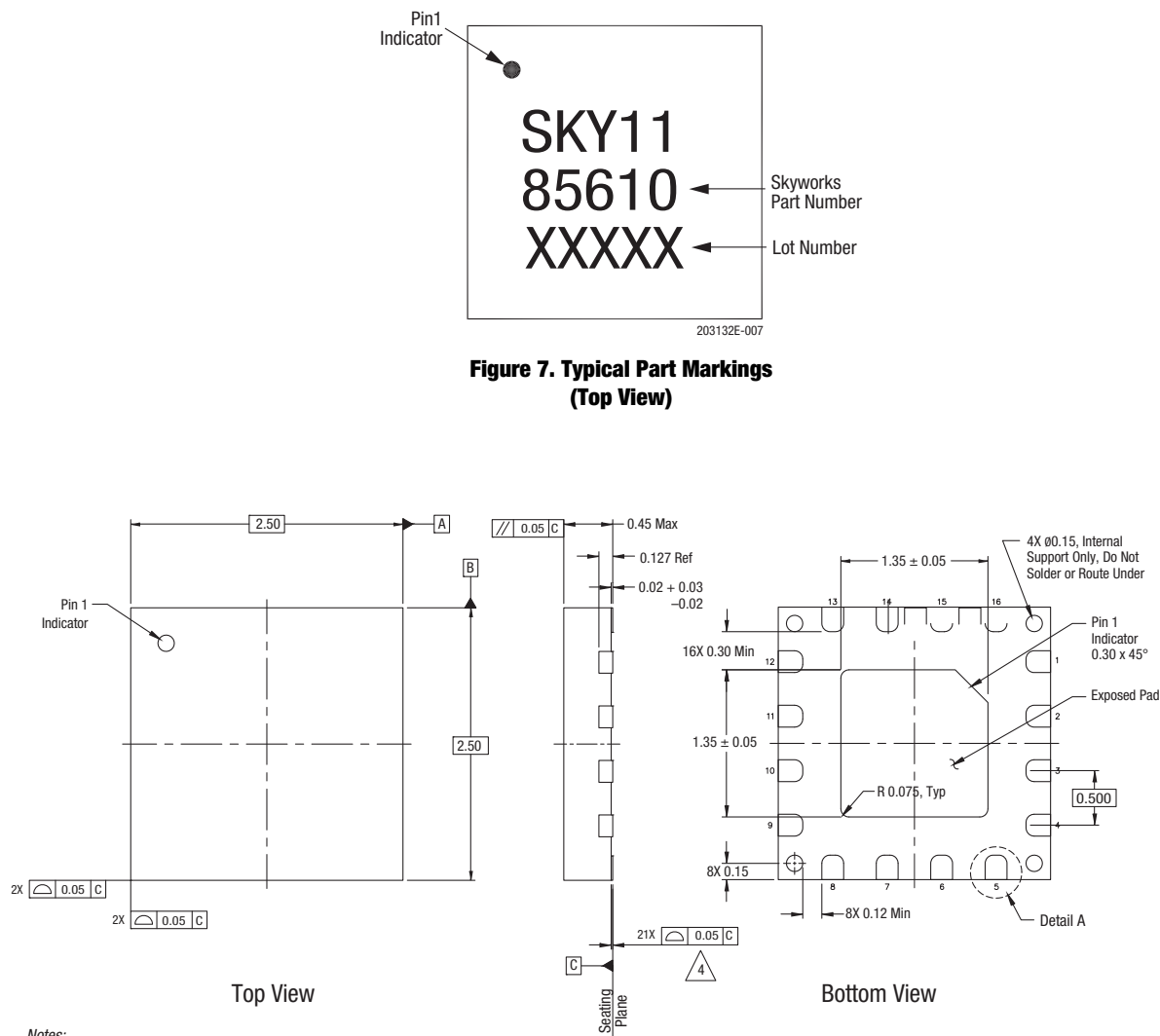
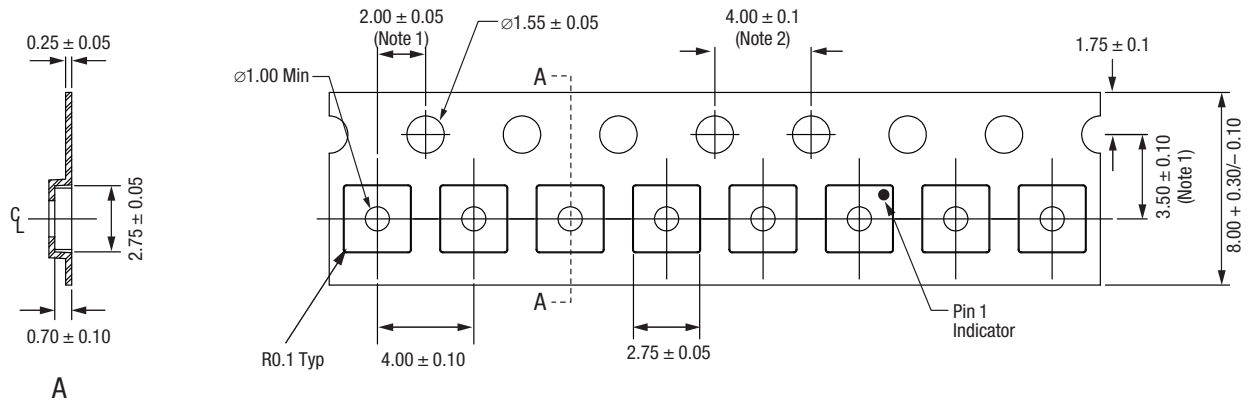


Figure 8. SKY85610-11 Package Dimensions



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.

203132E-009

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

Copyright © 2014-2016 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 stated published specifications or parameters.

Skyworks and the Skyworks symbol are trademarks or registered trademarks of Skyworks Solutions, Inc., 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.