DATA SHEET

SKY65971-11: 2 GHz, 256 QAM Low-Noise Amplifier

Applications

- 256 QAM, 802.11g/n WLANs
- 2 GHz ISM radios
- Smart phones
- Notebooks, netbooks, tablets
- Access points, routers, gateways
- Wireless video systems

Features

- Ultra-low Noise Figure
- 2.4 GHz to 2.5 GHz operation
- Enable/disable/bypass modes
- High IIP3
- High gain
- 2.8 V to 3.6 V single-supply operation
- QFN (6-pin, 1.5 x 1.5 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

Skyworks Pb-free products are compliant with all applicable legislation. For additional information, refer to *Skyworks Definition of Lead (Pb)-Free*, document number SQ04-0073.

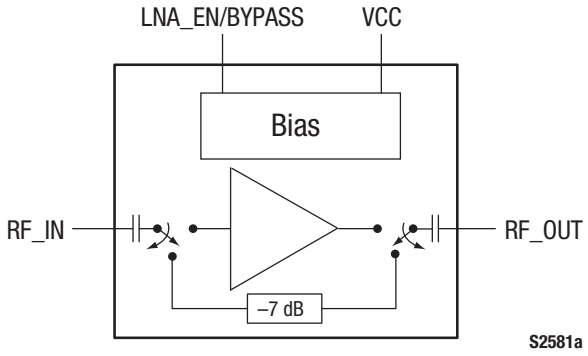


Figure 1. SKY65971-11 LNA Block Diagram

Description

The SKY65971-11 is an ultra Low-Noise Amplifier (LNA) intended for 2 GHz, 256 Quadrature Amplitude Modulation (QAM) wireless receiver applications. Its industry-leading Noise Figure (NF), together with high linearity, make it ideal as a first-stage LNA in 256 QAM Wireless Local Area Network (WLAN) radios.

Operating with a single supply voltage, the SKY65971-11 consumes only 13 mA of current. The device includes a bypass mode for near field applications and to save power when the receiver is inactive.

The tiny package footprint of the SKY65971-11, requiring only four external components, enables the industry's smallest PCB area needed to implement a 2 GHz LNA.

A block diagram of the SKY65971-11 is shown in Figure 1. The device package and pinout for the 6-pin Quad Flat No-Lead (QFN) are shown in Figure 2.

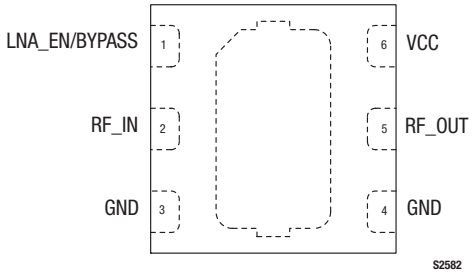


Figure 2. SKY65971-11 Pinout – 6-Pin QFN Package (Top View)

Technical Description

The SKY65971-11 is fully matched at 50 Ω and requires only a simple bypass circuit on pin 6 (VCC). The bypass/shutdown mode is achieved by switching the LNA_EN signal (pin 1) to 0 V.

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 SKY65971-11 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.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SKY65971-11 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Performance characteristics for the SKY65971-11 are illustrated in Figures 3 through 8.

An application schematic diagram for the SKY65971-11 is shown in Figure 9. The PCB footprint drawing for the SKY65971-11 is provided in Figure 10. Typical part markings are shown in Figure 11. The package dimensions for the 6-pin QFN are shown in Figure 12, and the tape and reel dimensions are provided in Figure 13.

Table 1. SKY65971-11 Pin Assignments and Signal Descriptions

Pin	Name	Description
1	LNA_EN/BYPASS	LNA enable (when pulled high) or bypass (when pulled low) control input
2	RF_IN	LNA RF input
3	GND	Ground
4	GND	Ground
5	RF_OUT	LNA RF output
6	VCC	Supply voltage for LNA

Table 2. Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VCC	0	3.6	V
DC voltage at control ports	V_{ENABLE}	0	3.6	V
Power into LNA inputs	P_{IN}, LNA		+10	dBm
Receive power (ANT terminated in 50 Ω match, OFDM, V_{CC} = 3.45 V)	P_{IN}		+5	dBm
Operating temperature	T_A	–40	+85	°C
Storage temperature	T_{STG}	–40	+125	°C
Electrostatic Discharge, Human Body Model (HBM), Class 1C	ESD		1000	V

Note 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 values. 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. Recommended Operating Conditions (@ +25 °C, VCC = 3.3 V)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	VCC	0		3.6	V
RF frequency range	f	2.4		2.5	GHz
Operating temperature range	T_A	–40		+85	°C
DC voltage at control port: High Low	 V_{ENABLE_H} V_{ENABLE_L}	 1.8 0		 3.6 0.2	 V V

Table 4. Electrical Characteristics (Note 1)
(V_{CC} = 3.3 V, T_A = +25 °C, f = 2.4 to 2.5 GHz, V_{ENABLE} = 3.3 V, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units
Enable Mode (LNA_EN = 3.3 V)						
Gain	|S21|		13.0	14.5		dB
Gain flatness across band	|S21|			0.3		
Out of band gain @ 5.18 GHz	S21_5.18			–8		dB
Noise Figure	NF			1.3	1.5	dB
3rd Order Input Intercept Point	IIP3			+7		dBm
In-band 1 dB compression point at input	IP1dB			–1.5		dBm
Out-of-band (5.18 GHz injected signal) 1 dB Input Compression Point	IP1dB			+4		dBm
Input return loss	|S11|	$Z_{S/L}$ = 50 Ω	9			dB
Output return loss	|S22|	$Z_{S/L}$ = 50 Ω	12			dB
Reverse isolation	S12			–20		dB
Maximum RF input (compliant)				–10		dBm
Maximum RF input (no damage)				+10		dBm
Drain current				13.0	17.5	mA
Control enable current	I_{EN}				100	µA
Bypass Mode (LNA_EN = 0 V)						
Gain	S21			–7		dB
Gain flatness across 80 MHz	|S21|			0.5		dB
Noise Figure	NF			7		dB
1 dB Input Compression Point	IP1dB			+15.3		dBm
Input return loss	|S11|		9			dB
Output return loss	|S22|		12			dB
Maximum RF input with harmonic < –50 dBm/MHz (Note 2)				+6		dBm
Switching speed: LNA to bypass mode and bypass mode to LNA	t_S				300	ns

Note 1: Performance is guaranteed only under the conditions listed in this Table.

Note 2: Harmonic leakage is measured at the RF_IN port.

Typical Performance Characteristics

(V_{CC} = 3.3 V, T_A = +25 °C, f = 2.4 to 2.5 GHz, V_{ENABLE} = 3.3 V, Unless Otherwise Noted)

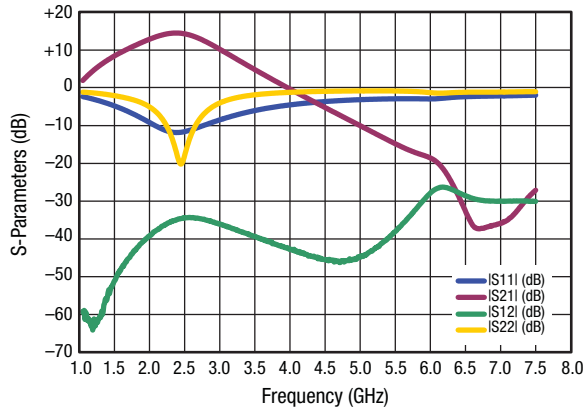


Figure 3. Broadband S-Parameters vs Frequency ("On" State)

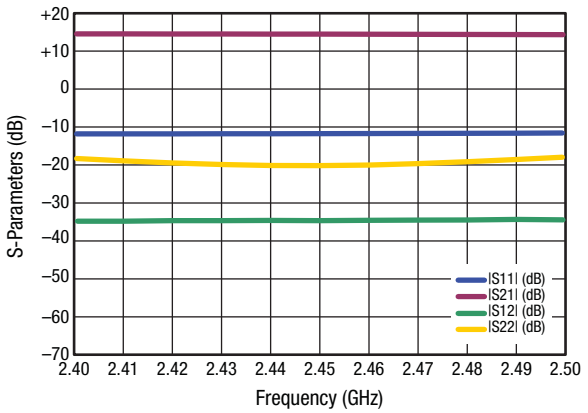


Figure 4. Narrow Band S-Parameters vs Frequency ("On" State)

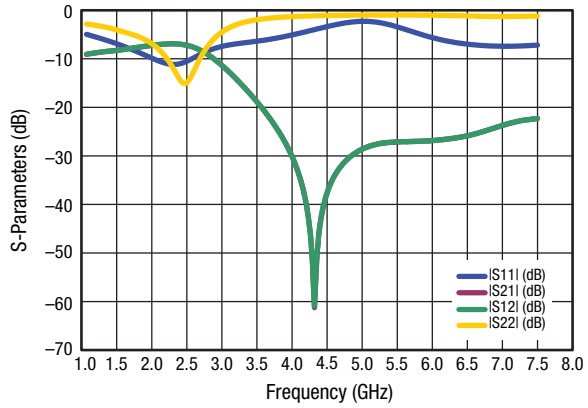


Figure 5. Broadband S-Parameters vs Frequency ("Off" State)

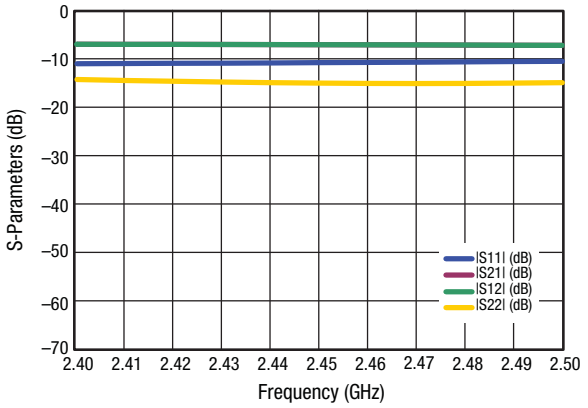


Figure 6. Narrow Band S-Parameters vs Frequency ("Off" State)

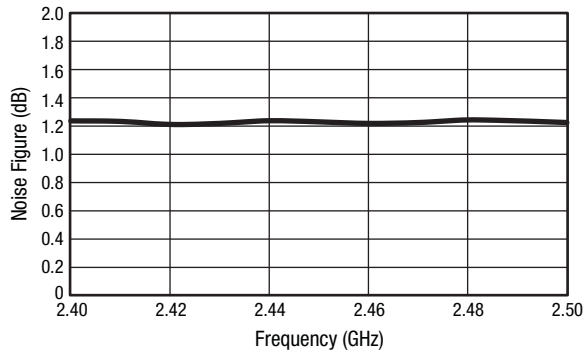


Figure 7. Noise Figure vs Frequency

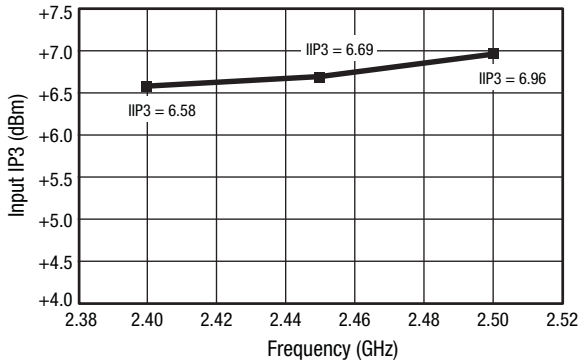


Figure 8. IIP3 vs Frequency

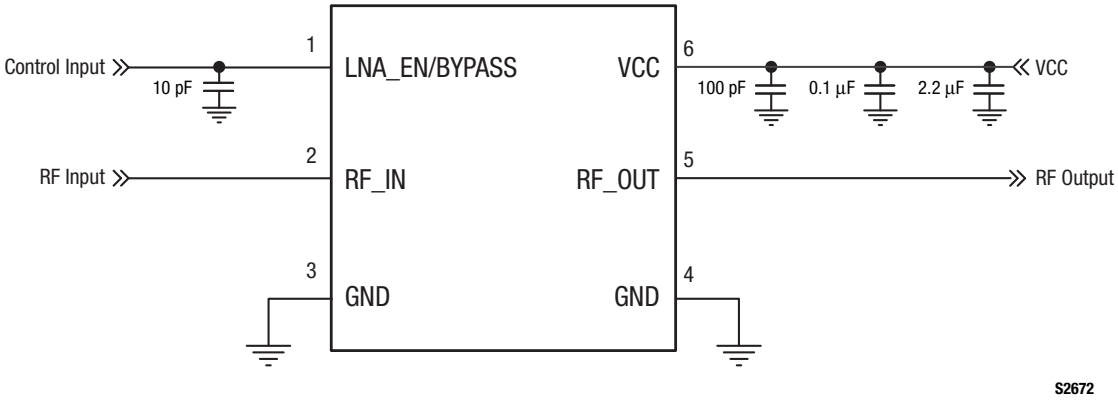
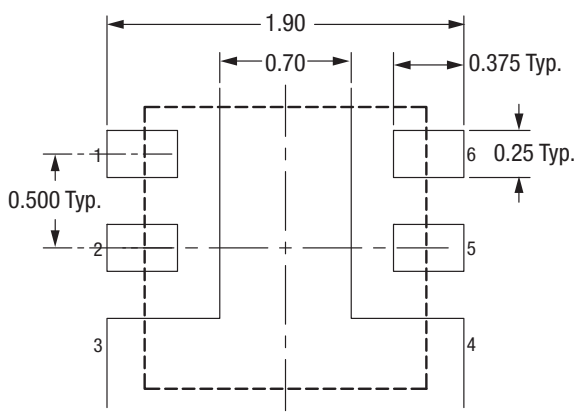
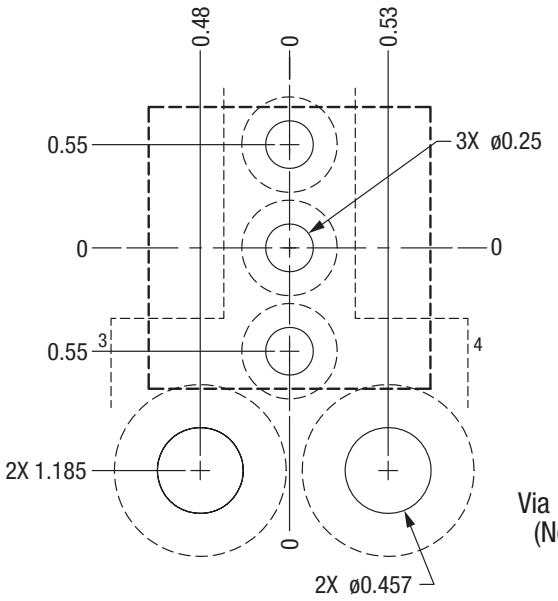


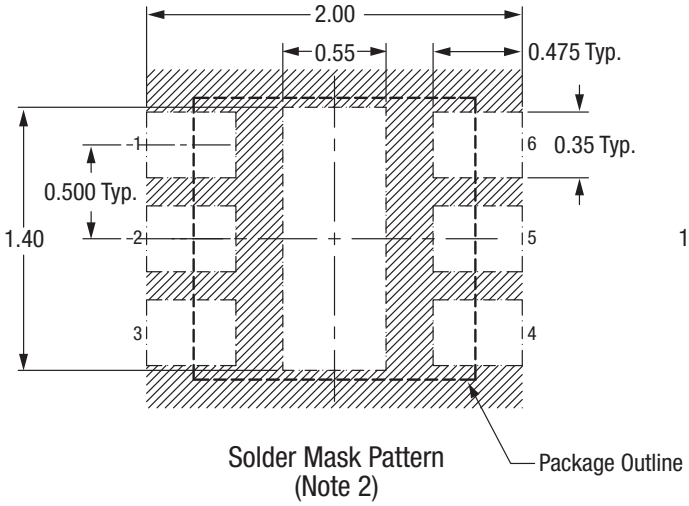
Figure 9. SKY65971-11 Schematic Diagram



Board Metal

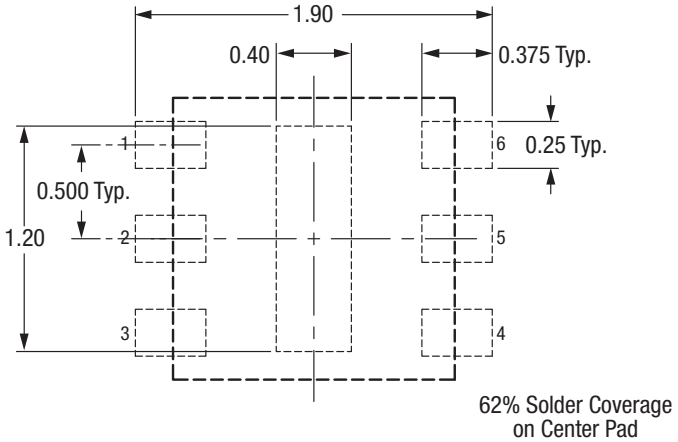


Via Pattern
(Note 1)



Solder Mask Pattern
(Note 2)

Package Outline



62% Solder Coverage
on Center Pad

Stencil Pattern
(Note 3)

NOTES:

1. *Via hole recommendations:*
   0.025 mm Cu via wall plating (minimum), via holes to be plated shut or plugged and capped, both sides.
2. *Soldermask recommendations:*
   Contact board fabricator for recommended soldermask offset and tolerance.
3. *Stencil recommendations:*
   0.10 mm stencil thickness, laser cut apertures, trapezoidal walls and rounded corners offer better paste release.

Dimension and tolerancing according to ASME Y14.5M-1994.
Unless specified, dimensions are symmetrical about center lines.
All dimensions are in millimeters.

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Figure 10. SKY65971-11 PCB Layout Footprint
(Top View)

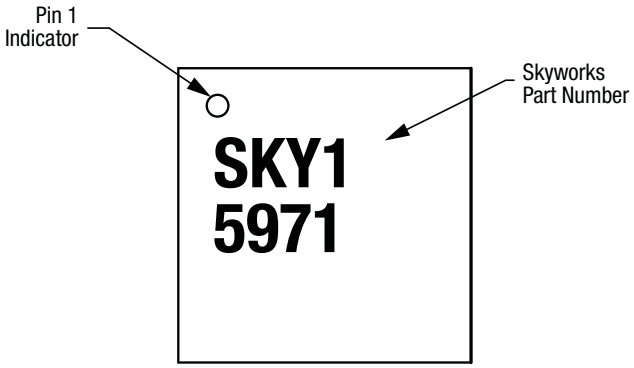
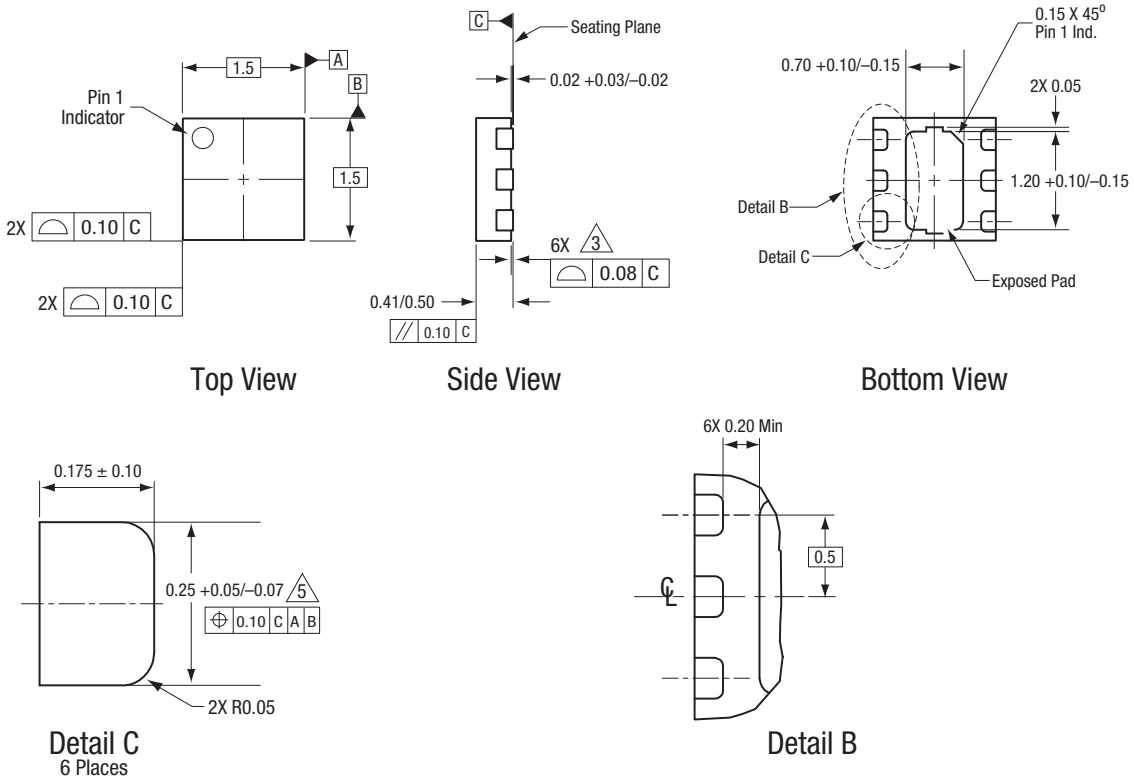


Figure 11. Typical Part Markings (Top View)



All measurements are in millimeters.
Dimensioning and tolerancing according to ASME Y14.5M-1994.
Coplanarity applies to the exposed heat sink slug as well as the terminals..
Plating requirement per source control drawing (SCD) 2504.
Dimension applies to metalized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

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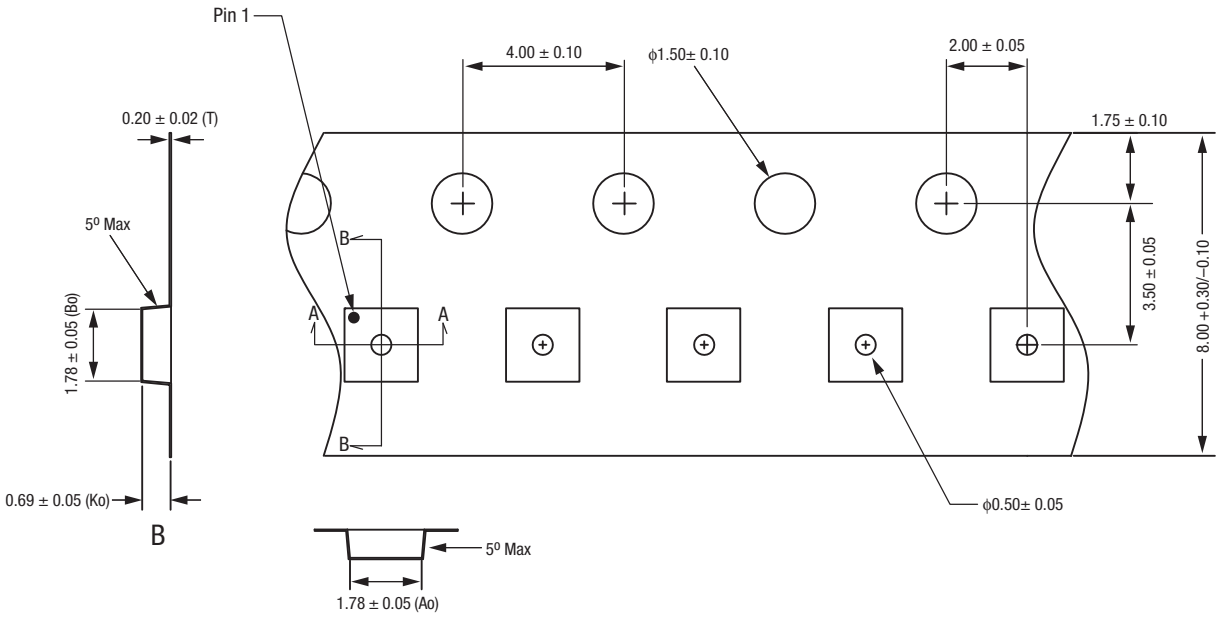
Figure 12. SKY65971-11 6-Pin QFN Package Dimensions



Notes:
1. *Carrier tape: black conductive polycarbonate or polystyrene.*
2. *Cover tape material: transparent conductive PSA.*
3. *Cover tape size: 5.4 mm width.*
4. *All measurements are in millimeters.*

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Figure 13. SKY65971-11 Tape and Reel Dimensions