

PRELIMINARY DATA SHEET

SKY85202-11: 2.4 GHz, 802.11ac Switch/Low-Noise Amplifier Front-End

Applications

- WiFi-enabled handsets, tablets, and mobile systems
- System-in-Package (SiP) modules for embedded systems
- 802.11n/ac smartphones and tablets

Features

- Integrates an SP3T switch and LNA with bypass mode
- Receive gain: 14 dB
- Noise Figure: 2 dB
- Transmit/Bluetooth® path loss: 0.7 dB
- Small WLCSP (15-bump, 1.04 x 1.04 mm) package (MSL1, 260 °C per JEDEC-J-STD-020)



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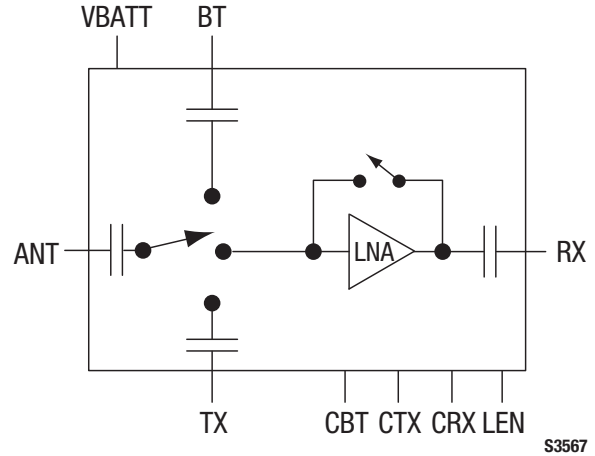
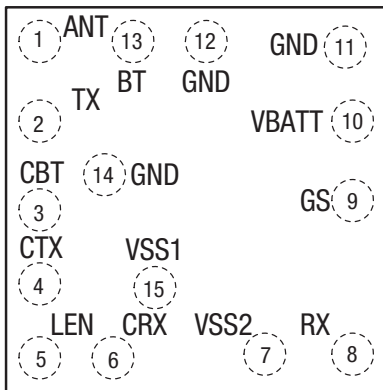


Figure 1. SKY85202-11 Block Diagram

Description

The SKY85202-11 integrates a Single-Pole, Triple-Throw (SP3T) switch and Low-Noise Amplifier (LNA) with a bypass mode in an ultra-compact package. The device is capable of switching between WLAN receive and WLAN transmit.

The SKY85202-11 is provided in a small, 15-bump, 1.04 x 1.04 mm Wafer Level Chip Scale Package (WLCSP). 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.



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Figure 2. SKY85202-11 Pinout – 15-Bump WLCSP (Top View, Bumps Down)

Table 1. SKY85202-11 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	ANT	Antenna port	9	GS	Ground
2	TX	Transmit input	10	VBATT	Supply voltage
3	CBT	Control signal	11	GND	Ground
4	CTX	Control signal	12	GND	Ground
5	LEN	Control signal	13	BT	Bluetooth port
6	CRX	Control signal	14	GND	Ground
7	VSS2	Ground	15	VSS1	Ground
8	RX	LNA output			

Table 2. SKY85202-11 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VBAT, VCC	-0.3	+5.5	V
DC input on control pins	VIN	-0.3	+3.6	V
LNA input power (RXOUT terminated in 50 Ω match)	PIN	+5		dBm
Operating temperature	TA	-40	+85	°C
Storage temperature	TSTG	-40	+140	°C

Note: 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. Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage relative to ground (= 0 V)	VDD	2.7	3.6	5.0	V
Control voltage:					
High	V _{IH}	1.6		3.6	V
Low	V _{IL}	0		0.4	V
Control current:					
High	I _{IH}			5	μA
Low	I _{IL}			1	μA
Operating temperature	TA	-40	+25	+85	°C

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY85202-11 are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4 to 7.

The state of the SKY85202-11 is determined by the logic provided in Table 8.

Table 4. SKY85202-11 Electrical Specifications: DC Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Supply current	I _{CC}	LNA enabled		9		mA
		Transmit mode		8		μA
		Bypass mode		8		μA
		All off		8		μA

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

Table 5. SKY85202-11 Electrical Specifications: Transmit (ANT to TX) Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		2400		2500	MHz
Insertion loss	TX _{IL}	Insertion loss from TX input to ANT port		0.6		dB
1 dB Input Compression Point (TX port)	IP1dB			+30		dBm
Transmit input return loss (TX port)	S ₁₁			20		dB
Output return loss (ANT port)	S ₂₂			20		dB
ANT to RX isolation, bypass (loopback) mode				40		dB

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

Table 6. SKY85202-11 Electrical Specifications: Transmit (ANT to BT) Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		2400		2500	MHz
Insertion loss	BT _{IL}	Insertion loss from BT input to ANT port		0.6		dB
1 dB Input Compression Point (BT port)	IP1dB			+30		dBm
Transmit input return loss (BT port)	S ₁₁			20		dB
Output return loss (ANT port)	S ₂₂			20		dB

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

Table 7. SKY85202-11 Electrical Specifications: Receive (ANT to RX Port) Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		2400		2500	MHz
Small signal gain	S21	LNA enabled		+14		dB
		Bypass mode		-7		dB
LNA gain step	Gain_STEP	Gain step change between LNA normal and LNA bypass modes		21		dB
Gain flatness		Over 20 MHz			±0.25	dB
		Full band			±1.00	dB
Noise Figure	NF	LNA enabled		2		dB
		Bypass mode		7		dB
Third Order Input Intercept Point	IIP3	LNA enabled	0	+5		dBm
		Bypass mode	+23			dBm
Receive input return loss	S11			12		dB
Receive output return loss	S22			12		dB
Receive to transmit (or BT) switching time	t _{RX-TX(BT)}	10% to 90%			500	ns
Transmit (or BT) to receive switching time	t _{TX(BT)-RX}	10% to 90%			500	nS
LNA turn-on time	t _{OFF – t_{ON}}	10% to 90%			400	nS
LNA turn-off time	t _{ON – t_{OFF}}	90% to 10%			200	nS

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

Table 8. SKY85202-11 Control Logic

Mode	CBT (Bump 3)	CTX (Bump 4)	LEN (Bump 5)	CRX (Bump 6)
All off	0	0	0	0
WLAN receive LNA	0	0	1	1
WLAN receive bypass	0	0	0	1
Bluetooth	1	0	0	0
WLAN transmit	0	1	0	0

Note: "0" = 0 V to +0.4 V. "1" = +1.6 V to +3.6 V. Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.

Evaluation Board Description

The SKY85202-11 Evaluation Board is used to test the performance of the SKY85202-11 LNA FEM. An Evaluation Board schematic diagram is provided in Figure 3. A photograph of the Evaluation Board is shown in Figure 4.

Evaluation Board Procedure

1. Connect the system ground to pin 1 of connector J5.
2. Apply 3.3 V to VBAT pin 20 of connector J5.
3. Refer to the Control Logic Table in Table 9 to set the device in the desired mode of operation.
4. Transmit performance is monitored by applying an RF signal to connector J3 (TX) and measuring the output power at the antenna port connector J2 (ANT).

Receive performance in either high gain or bypass mode is monitored by applying an RF signal to the antenna port connector J2 (ANT) and measuring the output power at the receive port connector J1 (RX).

Bluetooth performance is monitored by applying an RF signal to the J4 connector (BT) and measuring the output power at the antenna port connector J2 (ANT).

Evaluation Board Losses

The total track losses from the RF connectors of the Evaluation Board to the CSP bumps of the SKY85202 are:

ANT:	0.12 dB
TX:	0.11 dB
BT:	0.08 dB
RX:	0.08 dB

Package Dimensions

The PCB layout footprint for the SKY85202-11 is provided in Figure 5. The typical part marking is shown in Figure 6. Package dimensions for the 15-bump WLCSP 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 SKY85202-11 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, *PCB Design and SMT Assembly Guidelines for Wafer Level Chip Scale Packages*, document number 201676.

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.

Underfill Requirements

The assembly of a WLCSP onto an electrical substrate requires special handling and normally needs an underfill liquid epoxy mold compound. When fully cured, the underfill material forms a rigid, low-stress seal that dissipates stress on solder joints and extends thermal cycling performance. Skyworks recommends the use of Loctite Hysol 4549 as an underfill material, which should be cured for 30 minutes at +165 °C.

If the WLCSP is attached without an underfill, the circuit is more susceptible to mechanical damage. Damage can even occur if components in close proximity to the WLCSP are soldered or unsoldered on the substrate without evenly preheating the entire board and die. Mechanical damage to the solder joint between the board and die could result, which may impact electrical connectivity.

Pad Coordinates

The SKY85202-11 pad coordinates are provided in Table 9 (also refer to the pinout diagram in Figure 2). The origin of the coordinates (i.e., X = 0, Y = 0) is located at the center of the SKY85202-11 package. Sense is top view through package (PCB footprint).

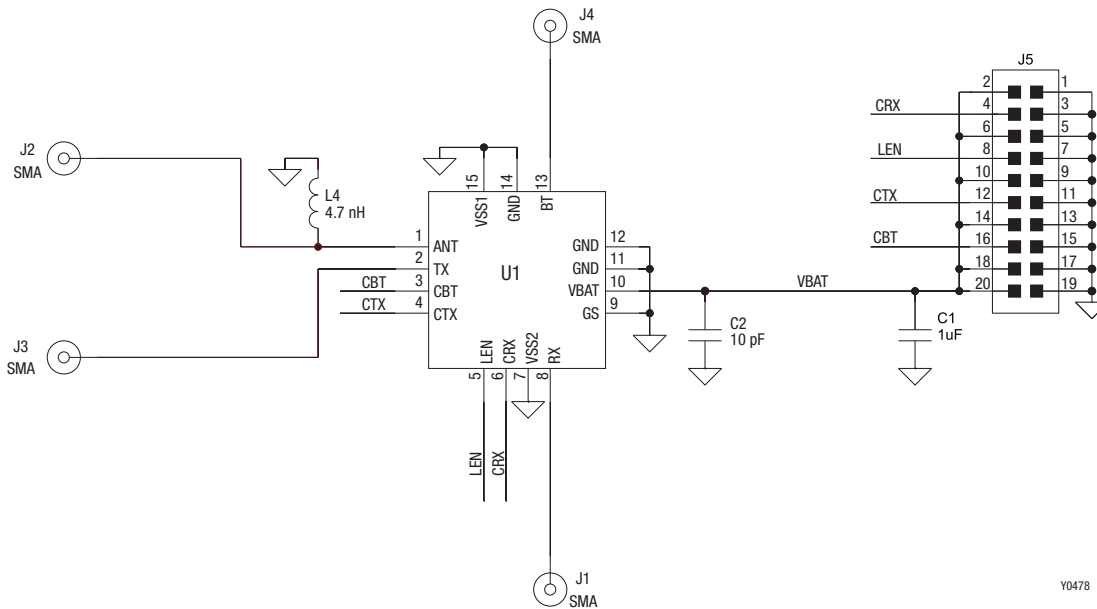
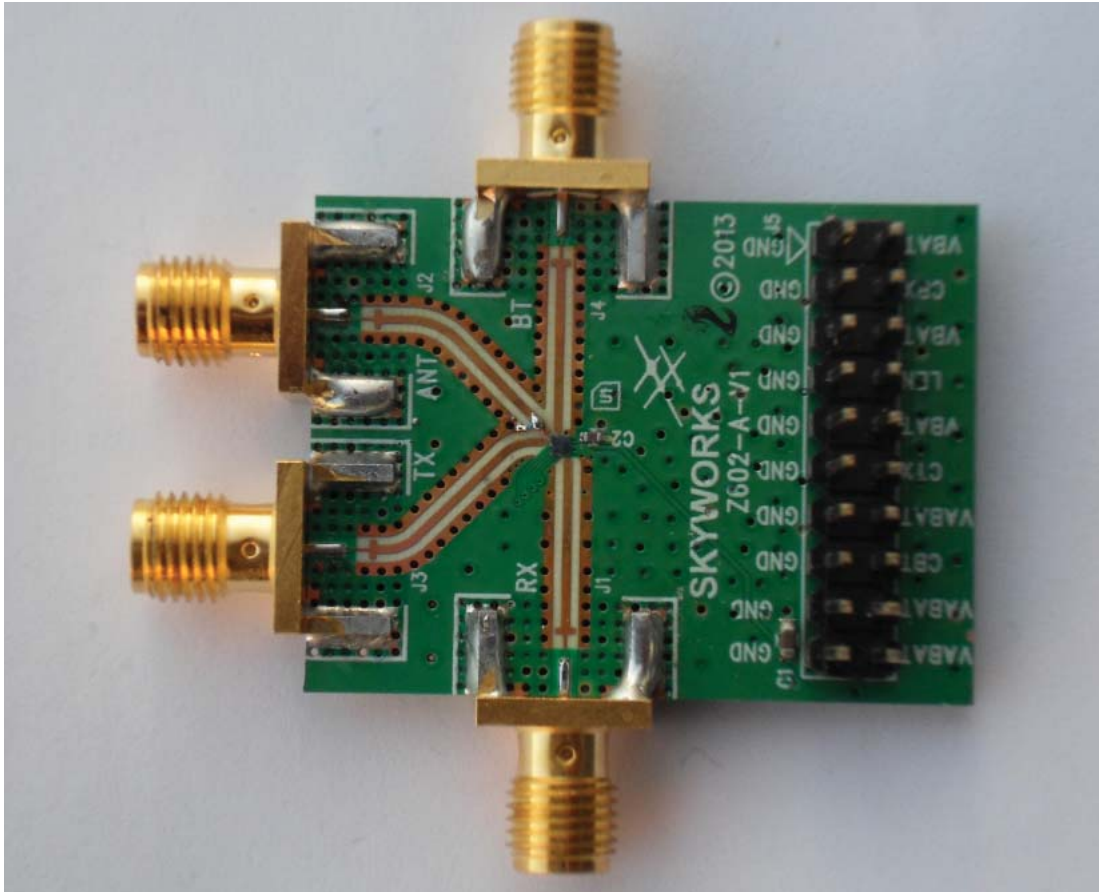


Figure 3. SKY85202-11 Evaluation Board Schematic

Table 8. SKY85202-11 Bump Pad Coordinates

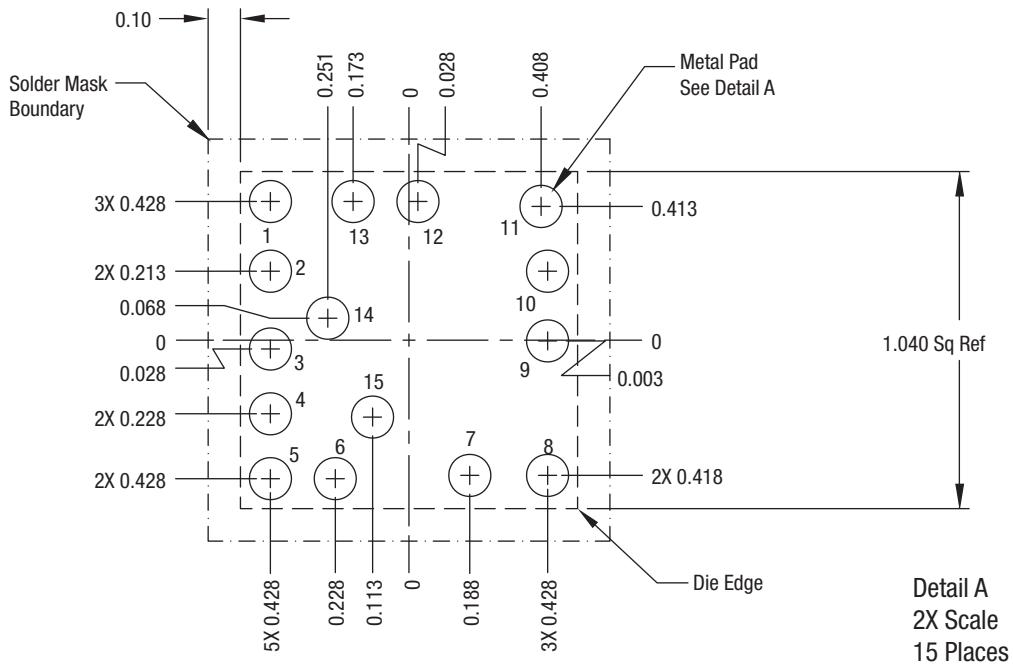
Bump Number	Signal	Bump Coordinates (Top View)	
		X (μm)	Y (μm)
1	ANT	-428	+428
2	TX	-428	+213
3	CBT	-428	-28
4	CTX	-428	-228
5	LEN	-428	-428
6	CRX	-228	-428
7	VSS2	+188	-418
8	RX	+428	-418
9	GS	+428	-3
10	VBATT	+428	+213
11	GND	+408	+413
12	GND	+28	+428
13	BT	-173	+428
14	GND	-251	+68
15	VSS1	-113	-238



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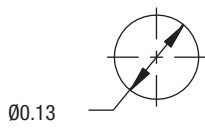
Figure 4. SKY85202-11 Evaluation Board

PRELIMINARY DATA SHEET • SKY85202-11 WLAN SWITCH/LNA FEM



Notes:

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Unless specified, dimensions are symmetrical about center lines.
4. Unless otherwise specified, the following values apply:
 Decimal Tolerance: Angular Tolerance:
 X.X (1 place) ± 0.1 mm ±1/2°
 X.XX (2 places) ± 0.05 mm
 X.XXX (3 places) ± 0.025 mm

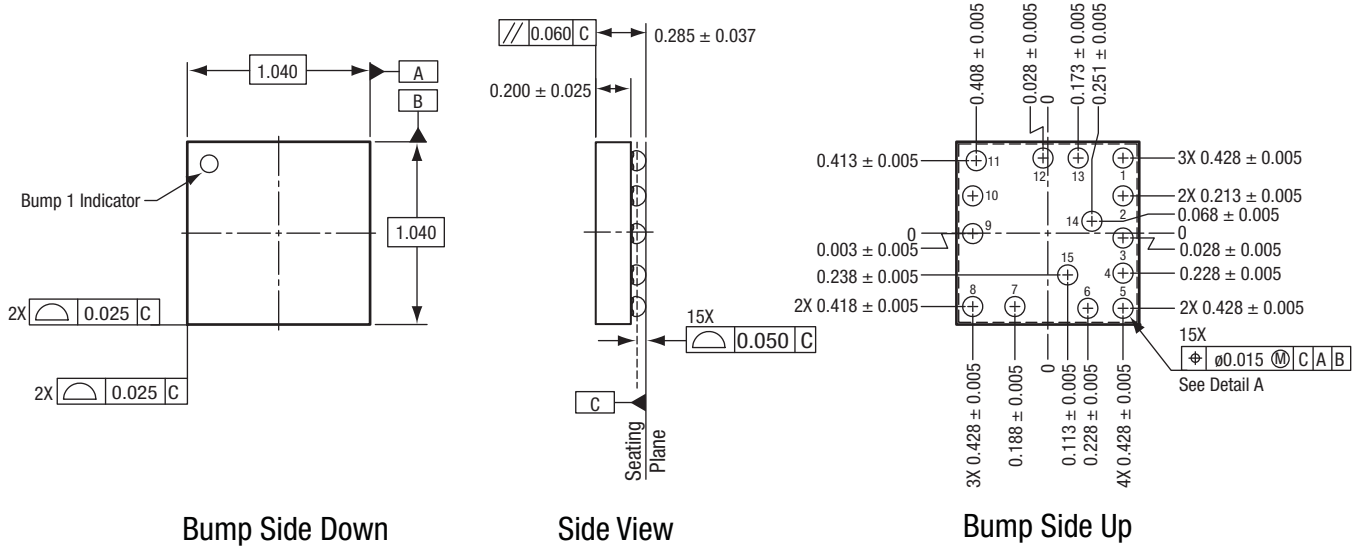


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Figure 5. SKY85202-11 PCB Footprint

*** TBD ***

Figure 6. Typical Part Marking



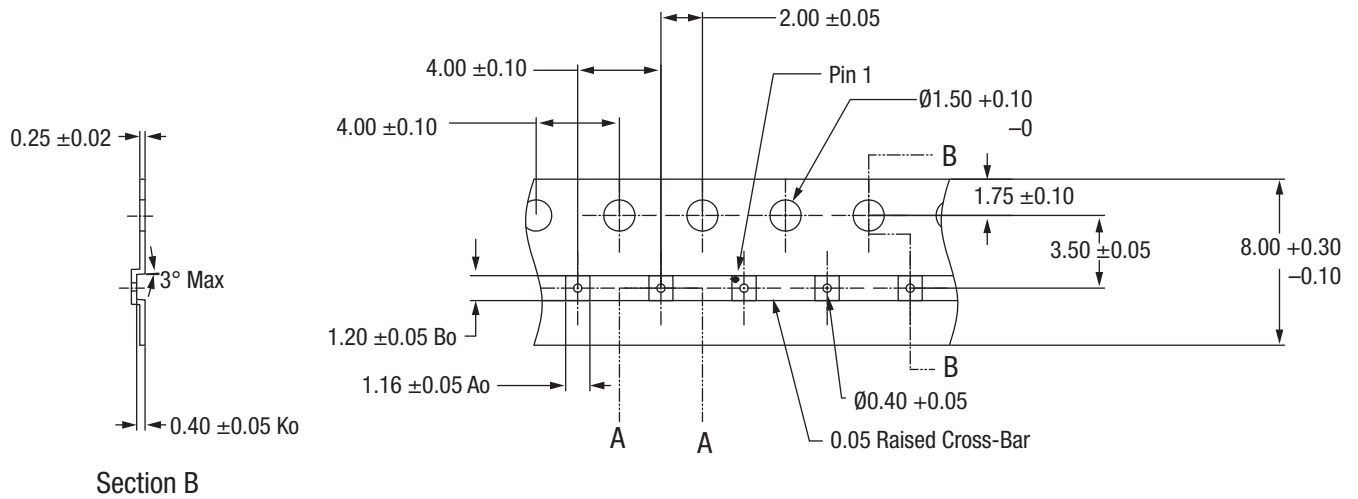
NOTES:

1. All measurements are in millimeters.
2. Dimensioning and tolerancing according to ASME Y14.5M-1994.
 Unless otherwise specified the following values apply:
 Decimal Tolerance: Angular Tolerance:
 X.X (1 place) ± 0.1 mm ±1/2°
 X.XX (2 places) ± 0.05 mm
 X.XXX (3 places) ± 0.025 mm
3. Unless specified, dimensions are symmetrical about center lines.

Detail A
 Scale: 4X
 15 Places

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Figure 7. SKY85202-11 15-Bump WLCSP Package Dimensions



Notes:

1. Carrier tape: black conductive polycarbonate.
2. Cover tape material: transparent conductive.
3. All dimensions are in millimeters.
4. 10-sprocket hole pitch cumulative tolerance on tape: ± 0.20 mm.
5. Ao and Bo measurement point to be 0.30 mm from bottom of pocket.
6. Pocket position relative to sprocket hole measured as true position of pocket.

Tolerances:

Decimals: $.x = \pm 0.15$ Angles: $\pm 1^\circ$
 .xx = ± 0.10



Section A

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Figure 8. SKY85202-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY85202-11 2.4 GHz, 802.11ac Switch/LNA Front-End	SKY85202-11	SKY85202-11-EVB

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