

Figure 2. Pinout (Top View, Solder Bumps Down)

Table 1. Signal Descriptions

Pin	Name	Description	Pin	Name	Description
A1	VCC2	Positive power supply for switch and PA	B3	CRX	Receive mode control input
A2	GND	Ground	C1	ANT	Connect to 50 Ω antenna
A3	T/R	Connect to 50 Ω transceiver	C2	GND	Ground
B1	CTX	Transmit mode control input	C3	VCC1	Positive power supply for LNA
B2	GND	Ground			

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66415-11 are provided in Table 2. The recommended operating conditions are specified in Table 3. Electrical specifications are provided in Tables 4 and 5. The state is determined by the logic in Table 6.

Table 2. Absolute Maximum Ratings¹

Parameter	Symbol	Min	Max	Units
Supply voltage	VCC1	-0.3	+2.4	V
	VCC2	-0.3	+2.4	
Control pin voltages	CTX, CRX	-0.3	VCC2	V
Transmit input power at T/R port	PIN_TX		+8	dBm
Receive input power at ANT ports ²	PIN_RX		+15	dBm
Bypass input power at ANT ports ²	PIN_BYP		+15	dBm
Voltage standing wave ratio	VSWR		10:1	
Operating temperature	TA	-40	+85	°C
Storage temperature	TSTG	-40	+125	°C
Electrostatic discharge: Human Body Model (HBM)	ESD		2000	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.
2. CW test signal.

ESD Handling: Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.

Table 3. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Supply voltage on VCC1 pin	VCC1	1.1	1.2	2	V
Supply voltage on VCC2 pin	VCC2	1.7	1.8	2.0	V
Operating temperature	TA	-40	+25	+85	°C

Table 4. DC Electrical Specifications¹

(VCC1 = 1.2 V, VCC2 = 1.8 V, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
DC Characteristics						
Transmit operating current	I _{CC_TX}	P _{OUT} = 11 dBm		17.5		mA
Transmit quiescent current	I _{CCQ_TX}			4		mA
Receive mode current	I _{CC_RX}			2.5		mA
Bypass mode current	I _{CC_BYP}			4		μA
Sleep mode current	I _{CC_SLEEP}	No RF		0.1	1	μA
Logic Characteristics						
Control voltage CTX, CRX High Low	V _{IH} V _{IL}		1.05 0		VCC2 0.3	V
Control current CTX control pin current CRX control pin current	I _{CTX} I _{CRX}			1 1		μA

1. Performance is assured only under the conditions listed in this Table and is not invariant over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Table 5. AC Electrical Specifications¹

(VCC1 = 1.2 V, VCC2 = 1.8 V, TA = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Transmit Characteristics						
Frequency range	f		2400		2483.5	MHz
Output power at ANT port	P _{OUT}	P _{IN} = 0 dBm		11		dBm
Power added efficiency	PAE	P _{OUT} = 11 dBm, BDR-DH1, duty cycle = 100%	38	40		%
Output 1 dB compression point	OP1dB			12		dBm
Gain variation	ΔG		-0.5		0.5	dB
Input return loss	S11_TX	T/R port, P _{IN} = 0 dBm		-12		dB
Second harmonic	2fo	P _{OUT} = 11 dBm		-35		dBm
Third harmonic	3fo	P _{OUT} = 11 dBm		-35		dBm
ACLR (1 to 1.5 MHz)	ACLR	P _{OUT} = 11 dBm, f = 2440 MHz, BDR-DH1		-32	-29	dBc
ACLR (1.5 to 2.5 MHz)	ACLR	P _{OUT} = 11 dBm, f = 2440 MHz, BDR-DH1		-26	-23	dBm
ACLR (> 2.5 MHz)	ACLR	P _{OUT} = 11 dBm, f = 2440 MHz, BDR-DH1		-46	-43	dBm
Switching time (BYP/RX to TX) ²	T _{BYS_TX_RX}	50% control value(s) to 90% RF		1	2	μs
Turn-on time (SLEEP to TX) ²	T _{SLEEP_TX}	50% control value(s) to 90% RF		1	2	μs
Stability ²	STAB	CW, 0 GHz to 20 GHz, load VSWR = 6:1, P _{IN} = 0 dBm (all non-harmonically related outputs)		-45	-42	dBm/ MHz

Table 5. AC Electrical Specifications¹ (Continued)

(VCC1 = 1.2 V, VCC2 = 1.8 V, TA = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Ruggedness ²	RUG	CW, load VSWR = 10:1 P _{IN} = 4 dBm, 10 seconds	No permanent damage			
Receive Characteristics						
Frequency range	f		2400		2483.5	MHz
Receive gain	S21_RX	P _{IN} = -30 dBm	10.8	12.3		dB
Receive noise figure	NF			2.2		dB
Third order input intercept point	IIP3	P _{IN} = -30 dBm, Δf = 3 MHz, f = 2440 MHz		-10		dBm
1 dB input compression point	IP1dB	f = 2440 MHz	-23	-20		dBm
Input return loss	S11_RX	P _{IN} = -30 dBm		-12		dB
Output return loss	S22_RX	P _{IN} = -30 dBm		-14	-10	dB
Switching time (BYP/TX to RX) ²	T _{BYS_TX_RX}	50% control value(s) to 90% RF		1	2	μs
Turn-on time (SLEEP to RX) ²	T _{SLEEP_TX}	50% control value(s) to 90% RF		1	2	μs
Bypass Characteristics						
Frequency range	f		2400		2483.5	MHz
Bypass insertion loss	S21_BYP	P _{IN} = 0 dBm		-1.7		dB
Input return loss	S11_BYP	P _{IN} = 0 dBm		-20		dB
Output return loss	S22_BYP	P _{IN} = 0 dBm		-14	-10	dB
Switching time (TX/RX to BYS) ²	T _{BYS_TX_RX}	50% control value(s) to 90% RF		1	2	μs
Turn-on time (SLEEP to BYP) ²	T _{SLEEP_TX}	50% control value(s) to 90% RF		1	2	μs

1. Performance is assured only under the conditions listed in this table and is not invariant over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.
2. Not tested in production. Fully characterized and assured by design.

Table 6. Mode Control Logic

State	CTX	CRX
Sleep	0	0
TX	1	0
RX	0	1
BYP	1	1

Evaluation Board Description

An evaluation board schematic diagram is shown in Figure 3, a photograph of the evaluation board is shown in Figure 4.

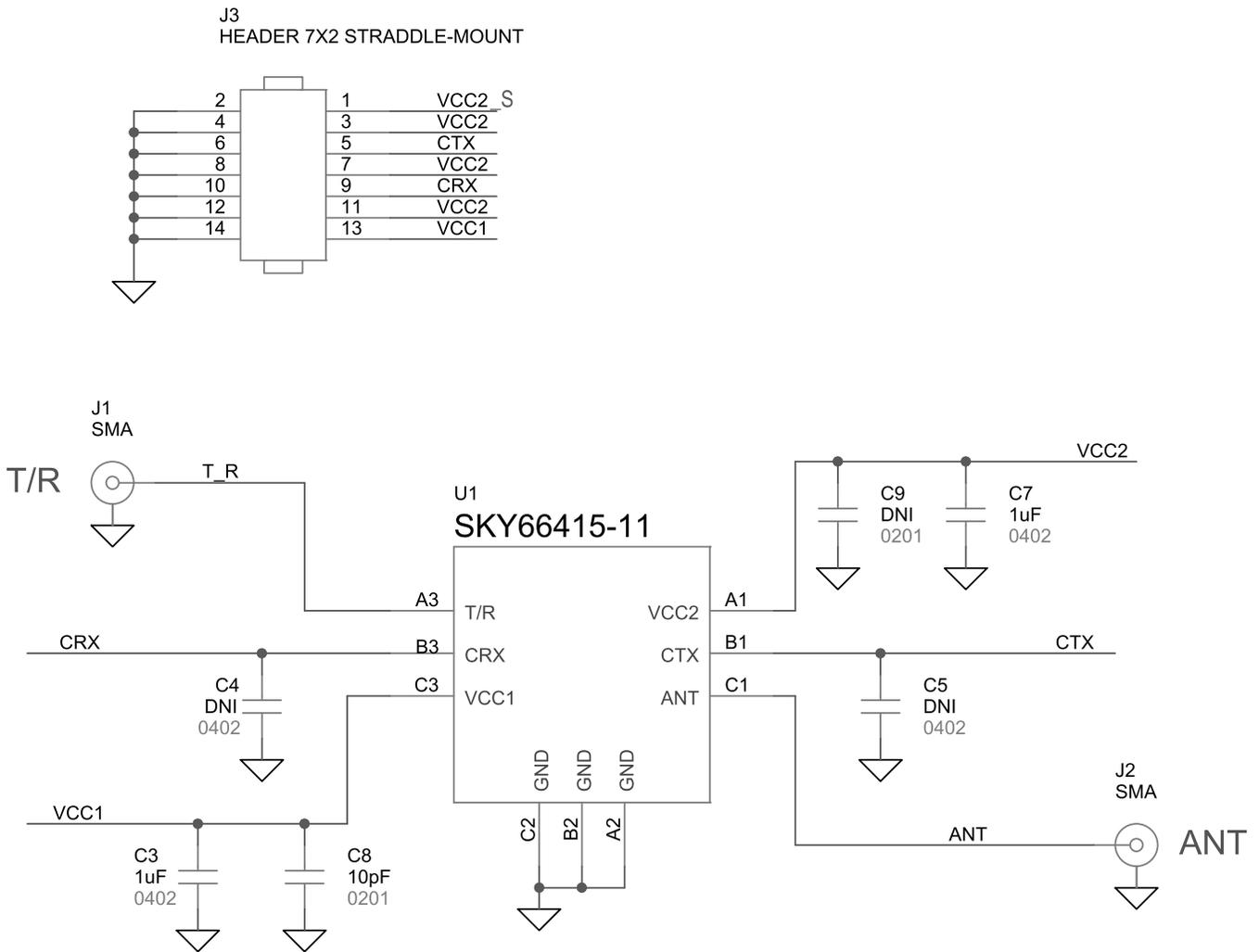


Figure 3. Evaluation Board Schematic Diagram

Table 7. Evaluation Board Bill of Materials

Item	Quantity	Reference	Value	Manufacturer	Part Number	Package	Description
1	2	C3, C7	1 μ F	Murata Electronics	GCM155C71A105KE38D	0402	Capacitor, ceramic, 1 μ F 10 V X7S
2	2	C4, C5	DNI				
3	1	C8	10 pF	Murata Electronics	GRM0335C1E100JD01	0201	Capacitor, ceramic, 10 pF 25 V COG/NP0
4	1	C9	DNI				
5	2	J1, J2	SMA	Multicomp/SPC	615R54-021 R19-070-18-0032210MM	SMA	SMA end-launch straight jack
6	1	J3	Header	Samtec Inc.	TSW-107-07-G-D		Vertical, 14 position, 7 x 2, 2.54 mm
7	1	PCB1	Z1824-A	Skyworks	Z1824-A		PCB
8	1	U1	SKY66415-11	Skyworks	SKY66415-11	WLCSP	Front-end module

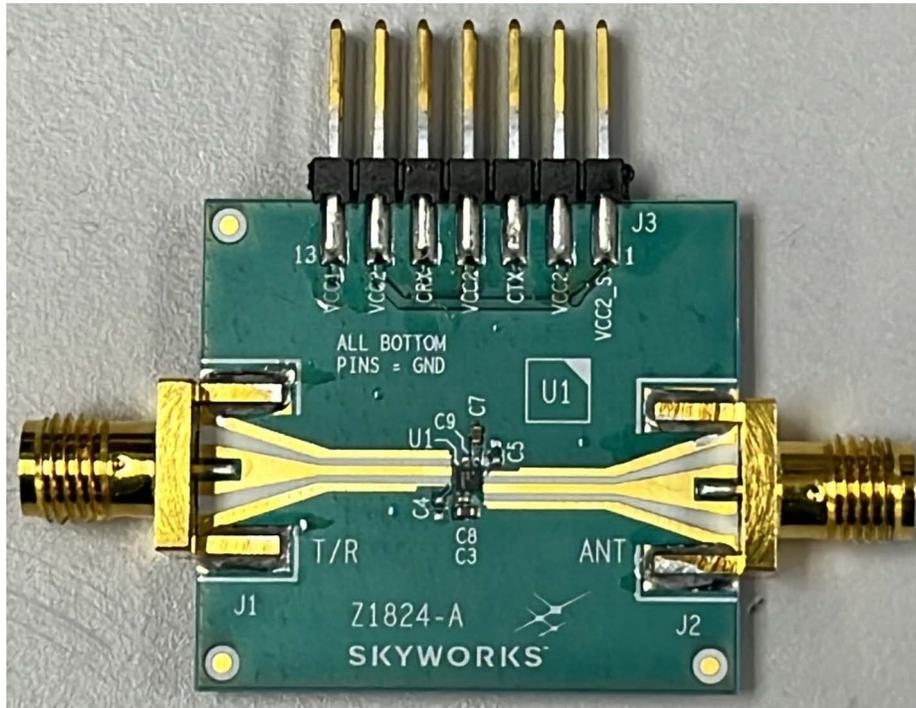


Figure 4. Evaluation Board Photograph

Package and Handling Information

The SKY66415-11 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.

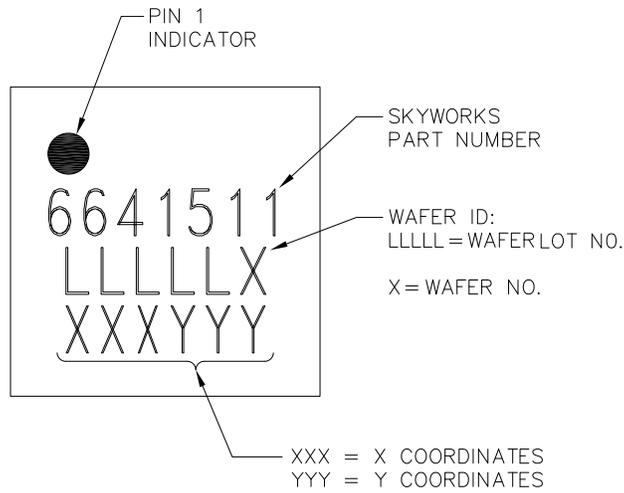
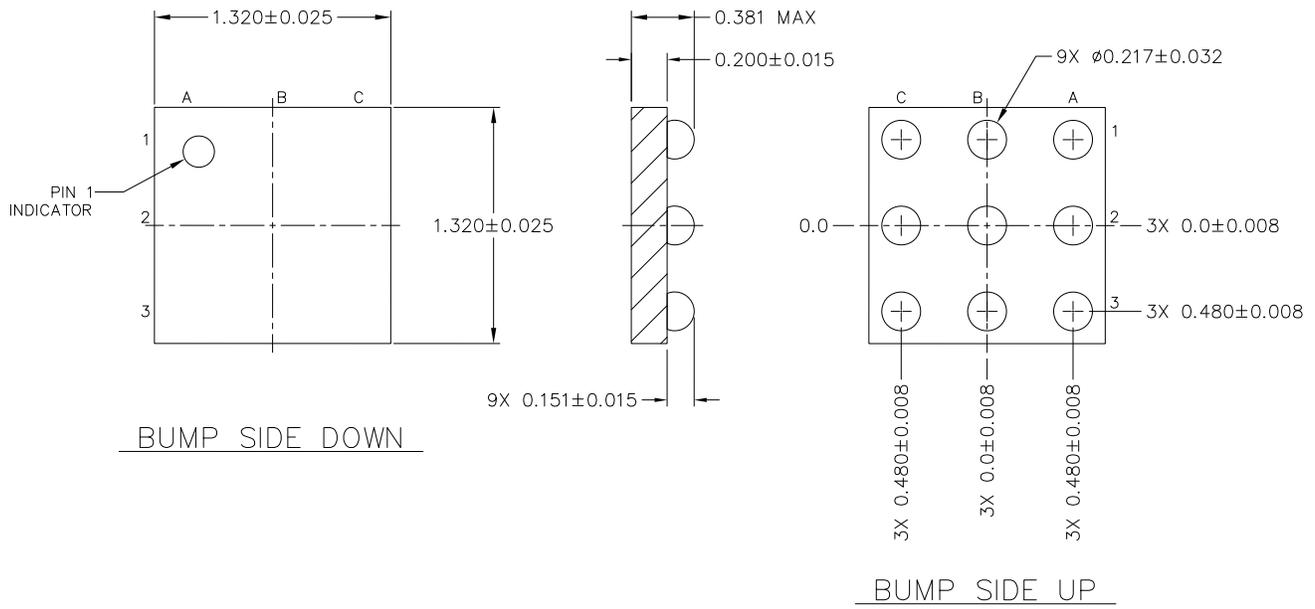


Figure 5. Typical Part Marking



NOTES

1. DIMENSIONS ARE IN MILLIMETERS.

2. TOLERANCING (UNLESS OTHERWISE SPECIFIED).

DECIMAL TOLERANCE

ANGULAR TOLERANCE

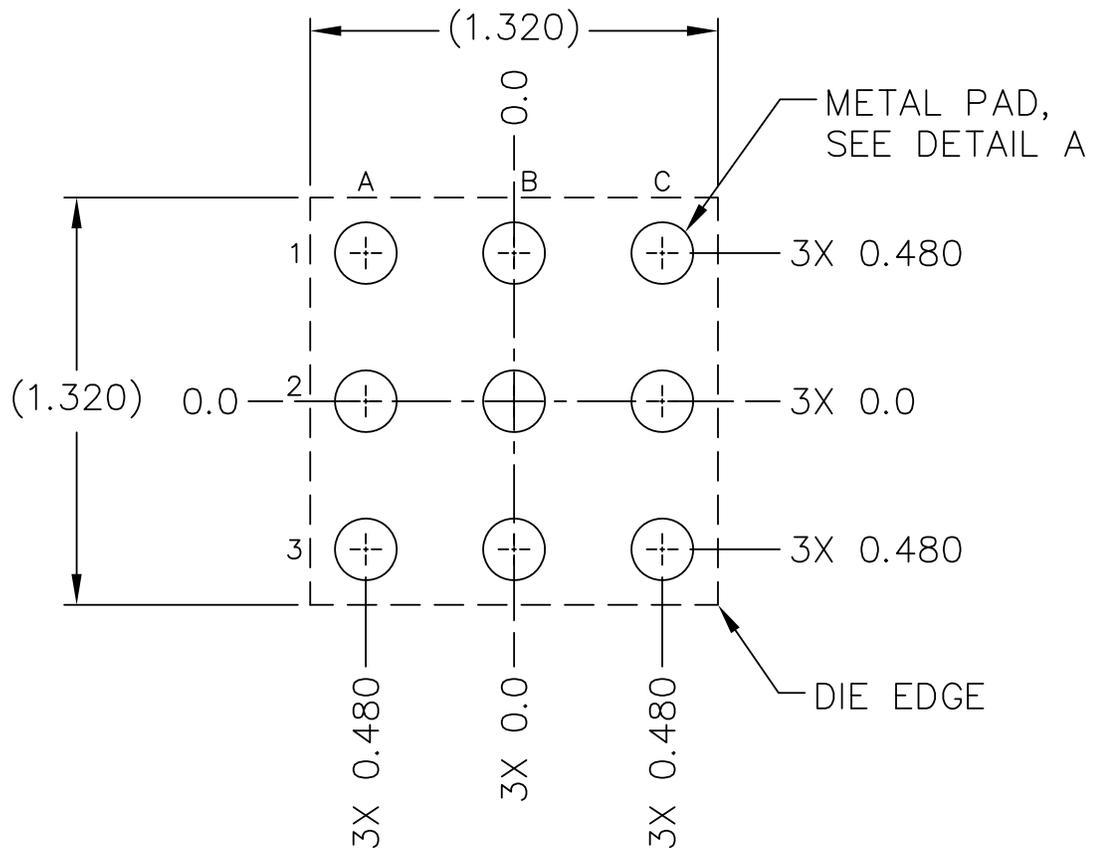
X.X (1 PLC) ± 0.1mm

± 1/2

X.XX (2 PLC) ± 0.05mm

X.XXX (3 PLC) ± 0.025mm

Figure 6. Package Dimensions



TOP VIEW

(THRU WLCSP DIE, BUMP SIDE DOWN)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES.
4. TOLERANCING (UNLESS OTHERWISE SPECIFIED).

DECIMAL TOLERANCE:

- X.X (1 PLC) ± 0.1mm
- X.XX (2 PLC) ± 0.05mm
- X.XXX (3 PLC) ± 0.025mm

ANGULAR TOLERANCE:

± 1/2°

DETAIL A

(2X SCALE)
9 PLCS

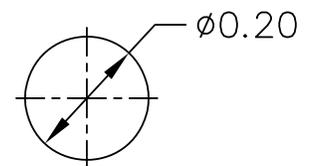


Figure 7. PCB Layout Footprint

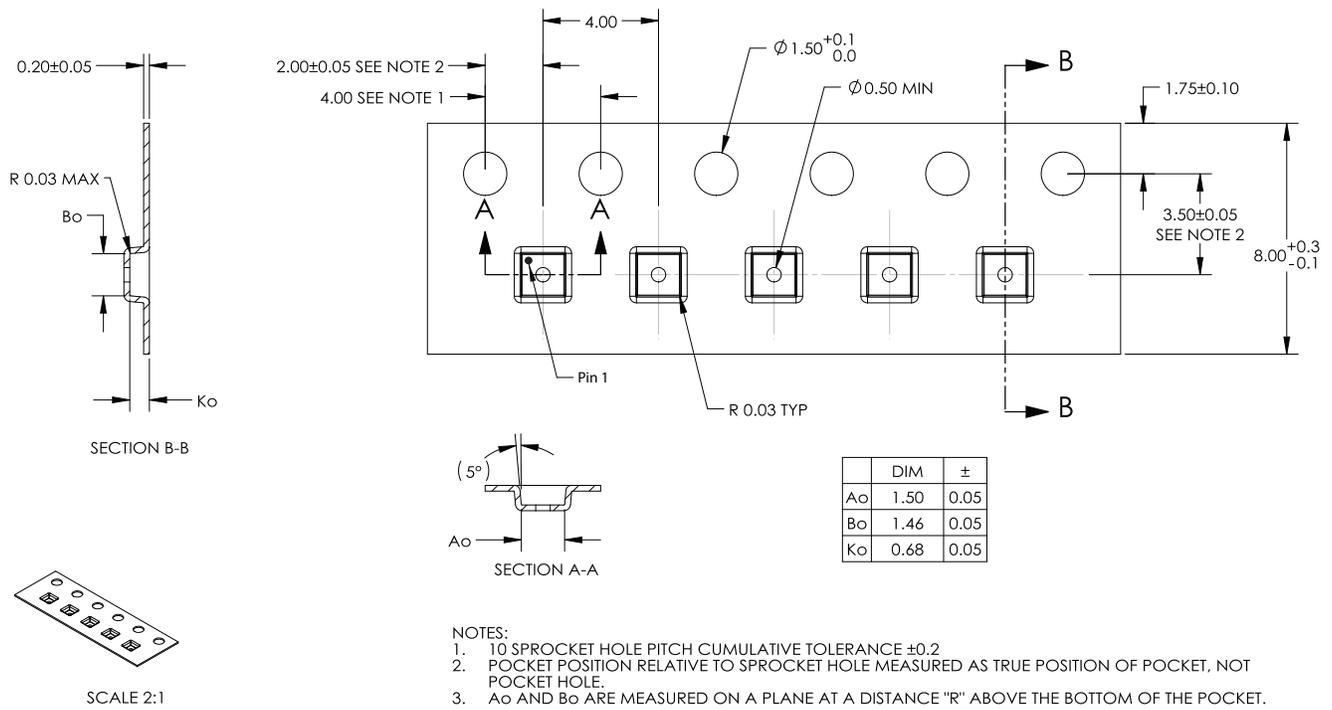


Figure 8. Tape and Reel Information

Ordering Information

Part Number	Description	Evaluation Board Part Number
SKY66415-11	2.4 GHz Front-End Module for Bluetooth®/Zigbee®/Thread Applications	SKY66415-11EK3

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