DATA SHEET

SKY66424-11: 922 to 928 MHz Transmit/Receive RF Front-End Module for Wi-SUN® and LoRaWAN® Applications

Applications

- LP-WAN devices
- Internet of Things (IoT)
- Smart meters
- Industrial applications

Features

- Integrated SAW filter for out-of-band interference rejection
- Japan region: Association of Radio Industries and Businesses (ARIB), 922 to 928 MHz
- Low insertion loss antenna switch paths
- RF power detector voltage output
- Integrated LNA with high IIP3 of +2 dBm, typical
- Integrated low pass filter for SoC harmonic suppression
- Integrated power limiter for high-power interference protection
- Supply voltage: 3.0 to 5.0 V
- 20-pin, 2.8 x 2.8 x 0.765 mm LGA package (MSL3, 260 °C per JEDEC J-STD-020)
- For RoHS and other product compliance information, see Skyworks Certificate of Conformance.

Description

The SKY66424-11 is a high-performance, highly integrated RF front-end module designed for Wi-SUN® and mesh network devices and applications operating in the 922 to 928 MHz frequency range.

The SKY66424-11 is designed for ease of use and maximum flexibility with fully matched 50 Ω TX and RX inputs and antenna outputs, and digital controls. The RF blocks operate over a supply voltage range allowing the SKY66424-11 to be used in battery power applications over a wide spectrum of the battery discharge curve.

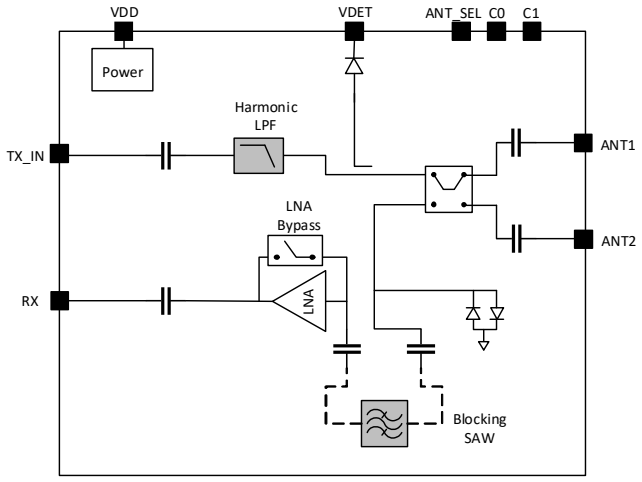


Figure 1. Block Diagram

A functional block diagram of the SKY66424-11 is shown above. Figure 2 shows the pinout for the SKY66424-11. Table 1 lists the pin assignments and signal descriptions.

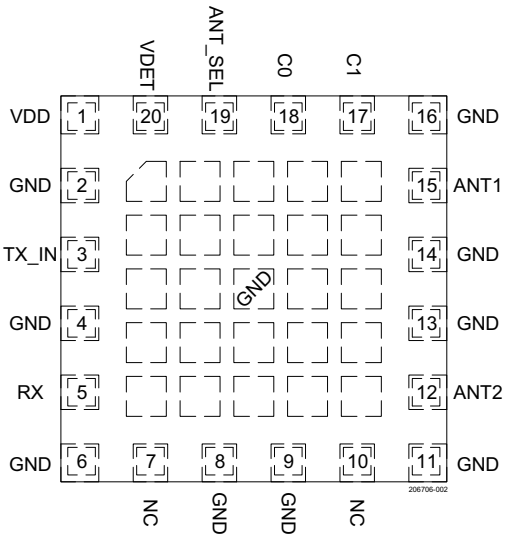


Figure 2. Pinout (Top View)

Table 1. Signal Descriptions

Pin	Name	Description
1	VDD	General voltage supply
2	GND	Ground
3	TX_IN	Transmit mode RF input
4	GND	Ground
5	RX	Receive mode RF output
6	GND	Ground
7	NC	No connect
8	GND	Ground
9	GND	Ground
10	NC	No connect
11	GND	Ground
12	ANT2	Antenna 2 RF input/output
13	GND	Ground
14	GND	Ground
15	ANT1	Antenna 1 RF input/output
16	GND	Ground
17	C1	C1 control pin
18	C0	C0 control pin
19	ANT_SEL	Antenna select control pin
20	VDET	Power detector voltage output

Technical Description

The SKY66424-11 is a TRX FEM supporting operation for Wi-SUN, LoRa®, and other mesh network devices. An integrated low insertion loss DPDT antenna switch enables system architectures with dual antennas.

All RF ports are internally dc-blocked, facilitating implementation. The module includes a high input IP3 LNA with a bypass feature, integrated SAW filter, and limiter for high-power interference protection.

The transmit path features a low pass filter for SoC harmonic suppression.

Three digital input control pins (C0, C1, and ANT_SEL) are used to select between eight modes listed in the Control Mode Logic Table.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66424-11 are provided in Table 2. The recommended operating conditions are specified in Table 3, followed by other electrical specifications and control logic.

Table 2. Absolute Maximum Ratings[1]

Parameter	Symbol	Min	Max	Units
General supply voltage (no RF)	VDD	–0.3	+5.5	V
Storage temperature	TS	–40	150	°C
TX RF input power at TX ports	PIN_TX_MAX		+25	dBm
RX RF input power at ANT ports	PIN_RX_MAX		+15	dBm
Control voltage absolute maximum[2]	V_CTL_MAX		3.6[2]	V
Control voltage absolute minimum	V_CTL_MIN	–0.3		V

1. Exposure to maximum rating conditions for extended periods may reduce device reliability. Exceeding any of the limits listed here may result in permanent damage to the device.
2. VDD or 3.6 V, whichever is lower.

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
Operating general supply voltage	VDD	3.0	3.6	5.0	V
Ambient temperature	TA	–40	25	85	°C
Voltage control level high	VIH	1.5		VDD	V
Voltage control level low	VIL	0		0.5	V

Table 4. DC Specifications[1]

(VDD = 3.6 V, f = 922 to 928 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Min	Typ	Max	Units
RX current consumption, LNA active	RX_IDD		6		mA
RX current consumption, LNA bypass	LNA_BYP_IDD		100		uA
TX current consumption	TX_IDD		1.5		mA
Sleep current consumption	SLEEP_IDD		1		uA

1. Performance is assured only under the conditions listed in the table.

Table 5. RF Coupler and Detector Voltage Output Specifications[1]

(VDD = 3.6 V, f = 922 to 928 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
VDET power detector voltage output	VDET_VOUT	f = 925 MHz P_OUT = 0 dBm P_OUT = +20 dBm		0.4 2.4		V
VDET output impedance	VDET_OUT_IMPEDANCE			1200		Ω

1. Performance is assured only under the conditions listed in the table.

Table 6. RX Specifications[1]

(VDD = 3.6 V, f = 922 to 928 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Compression point	IP1dB_BP_ANT1_RX IP1dB_BP_ANT2_RX	LNA bypass: ANT1 to RX LNA bypass: ANT2 to RX 1 dB compression point, f = 925 MHz	5	10		dBm
Noise figure	LNA_NF_ANT1_RX LNA_NF_ANT2_RX	LNA active: ANT1 to RX LNA active: ANT2 to RX		3		dB
Input compression point	LNA_IP1dB_ANT1 LNA_IP1dB_ANT2	LNA active: ANT1 to RX LNA active: ANT2 to RX 1 dB compression point, f = 925 MHz	–15	–10		dBm
IIP3	LNA_IIP3_ANT1 LNA_IIP3_ANT2	LNA active: ANT1 to RX, f = 925 MHz LNA active: ANT2 to RX, f = 925 MHz	–2	2		dBm
Input return loss	S11_ANT1 S11_ANT2	RX: ANT1 to RX RX: ANT2 to RX		10		dB
Input return loss	S11_ANT1_BYP S11_ANT2_BYP	LNA bypass: ANT1 to RX LNA bypass: ANT2 to RX		10		dB
Small signal gain	LNA_GAIN_ANT1 LNA_GAIN_ANT2	LNA active: ANT1 to RX LNA active: ANT2 to RX		14.5		dB

1. Performance is assured only under the conditions listed in the table.

Table 7. TX Filter (TX Mode) and SAW Filter (LNA Bypass Mode) Specifications[1]

(VDD = 3.6 V, f = 922 to 928 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
RX filter rejection	FILT_REJ	RX: 100 to 815 MHz		54		dB
		RX: 815 to 875 MHz		59		dB
		RX: 875 to 900 MHz		55		dB
		RX: 900 to 915 MHz		19		dB
		RX: 945 to 960 MHz		26		dB
		RX: 960 to 990 MHz		39		dB
		RX: 990 to 1150 MHz		54		dB
		RX: 1150 to 1856 MHz		50		dB
		RX: 1856 to 2500 MHz		45		dB
RX insertion loss	FILT_IL	RX: ANT1/ANT2 to RX		3		dB
RX in-band ripple	IBR_SAW_ANT1 IBR_SAW_ANT2	RX: ANT1 to RX RX: ANT2 to RX		0.5	1.1	dBpp
TX in-band ripple	TX_ANT1_LPF_IBR TX_ANT2_LPF_IBR	TX		0.1		dB
TX filter rejection	TX_ANT1_LPF_REJ_H2 TX_ANT2_LPF_REJ_H2	TX: 1850 MHz		29		dB
	TX_ANT1_LPF_REJ_H3 TX_ANT2_LPF_REJ_H3	TX: 2745 MHz		45		dB

1. Performance is assured only under the conditions listed in the table.

Table 8. TX/RX/ANT Specifications[1]

(VDD = 3.6 V, f = 922 to 928 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Insertion loss	IL_TX_ANT1 IL_TX_ANT2	TX to ANT1 TX to ANT2		1.4		dB
Insertion loss	IL_RX_ANT1 IL_RX_ANT2	LNA bypass to ANT1 LNA bypass to ANT2		3		dB
Isolation	ISO_ANT1_ANT2	RX: ANT1 to ANT2		25		dB
Isolation	ISO_TX_RX	TX/RX: TX_IN to RX		30		dB
Return loss	RL_TX_IN_ANT1 RL_TX_IN_ANT2	TX to ANT1: TX_IN return loss TX to ANT2: TX_IN return loss		15		dB
Return loss	RL_ANT1_TX_IN RL_ANT2_TX_IN	TX to ANT1: ANT1 return loss TX to ANT2: ANT2 return loss		15		dB
Return loss	RL_RX_ANT1 RL_RX_ANT2	LNA bypass to ANT1: RX return loss LNA bypass to ANT2: RX return loss		15		dB
Return loss	RL_ANT1_RX RL_ANT2_RX	LNA bypass to ANT1: ANT1 return loss LNA bypass to ANT2: ANT2 return loss		15		dB
Compression point	IP0.1dB_TX_ANT1 IP0.1dB_TX_ANT2	TX to ANT1: 0.1 dB compression point f = 925 MHz TX to ANT2: 0.1 dB compression point f = 925 MHz		25		dBm

1. Performance is assured only under the conditions listed in the table.

Table 9. Timing Specifications[1]

(VDD = 3.6 V, f = 922 to 928 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Turn-on time	T_ON_RX	SLEEP to RX, f = 925 MHz		4		µs
Turn-on time	T_ON_RX_BYP	SLEEP to RX bypass, f = 925 MHz		2		µs
Turn-on time	T_ON_TX	SLEEP to TX, f = 925 MHz		2		µs
RX mode switching time	T_RX_RX_BYP T_RX_BYP_RX	RX to RX bypass, f = 925 MHz RX bypass to RX, f = 925 MHz		2		µs
TX/RX switching time	T_RX_TX T_TX_RX	RX to TX, f = 925 MHz TX to RX, f = 925 MHz		2		µs
Antenna switching time	T_SW	ANT1 to ANT2/ANT2 to ANT1, f = 925 MHz		2		µs

1. Performance is assured only under the conditions listed in the table.

Table 10. Mode Control Logic

Mode	ANT_SEL	C0	C1
Sleep	0	0	0
TX to ANT1	0	0	1
ANT1 to RX LNA bypass	0	1	0
ANT1 to RX LNA active	0	1	1
Reserved	1	0	0
TX to ANT2	1	0	1
ANT2 to RX LNA bypass	1	1	0
ANT2 to RX LNA active	1	1	1

Evaluation Board Description

The SKY66424-11EK1 evaluation board is designed to demonstrate the performance of the SKY66424-11.

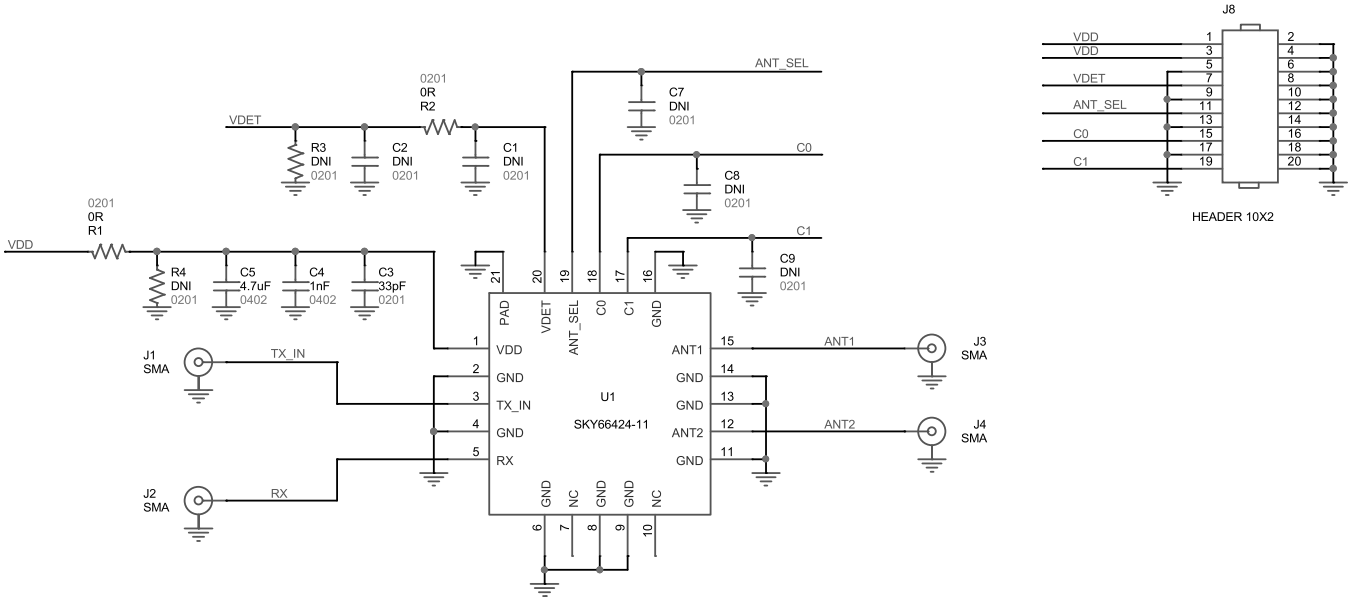


Figure 3. SKY66424-11EK1 Evaluation Board Schematic

Table 11. Evaluation Board Bill of Materials

Item	Qty	Reference	Value	Manufacturer	Part Number	Package	Description
1	7	C1, C2, R3, R4, C7, C8, C9	DNI			0201	
2	1	C3	33 pF	Murata	GRM0335C1H330JA01	0201	Capacitor, ceramic, 50 V, C0G/NP0
3	1	C4	1 nF	Murata	GRM155R71H102KA01	0402	Capacitor, ceramic, 50 V, X7R
4	1	C5	4.7 µF	Murata	GRM155R61A475MEAAD	0402	Capacitor, ceramic, 10 V, X5R
5	4	J1, J2, J3, J4	SMA	SPC/Multicomp	R19-070-18-0032210MM	SMA	SMA end-launch
6	1	J8	Header 10 x 2	Samtec	TSW-110-07-G-D	100mil	Header 10 x 2 100 mil
7	1	PCB1	Z1668-A	Skyworks Solutions Inc.	Z1668-A	1500	Printed circuit board
8	2	R1, R2	0R	Panasonic	ERJ-1GN0R00C	0201	RES SMD 0 Ω jumper 1/20 W
9	1	U1	SKY66424-11	Skyworks Solutions Inc.	SKY66424-11	2.8X2.8	Transmit/receive RF front-end module

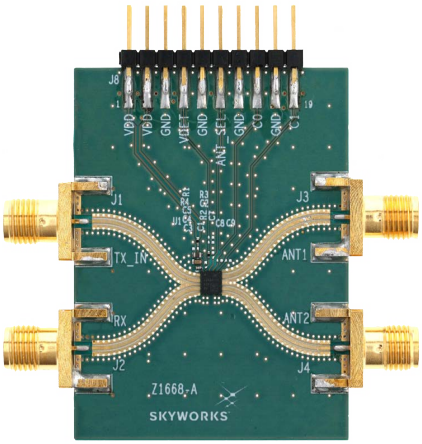


Figure 4. Evaluation Board

PCB Recommendations

- Bottom layer: Minimize or eliminate traces on the bottom.
- Avoid using thermal relief pads for component ground connections and the shield case. Always place vias close to each shunt connection.
- Spread ground vias equally to stitch the grounds together.
- Metal layer 1: RF traces (microstrip or co-planar waveguide) and control lines. Core thickness between top RF layer and ground plane is critical.
- Metal layer 2: Solid ground plane. No trace routings.
- Metal layer 3: Control lines and VCC traces. No VCC plane.
- Metal layer 4: Solid ground plane under the shield case area.
- Pour copper on each layer connected to the ground plane.

Package and Handling Information

Since the device is sensitive to moisture absorption, it is baked and vacuum packed before shipping. 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 SKY66424-11 is rated to Moisture Sensitivity Level 3 (MSL3) 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.

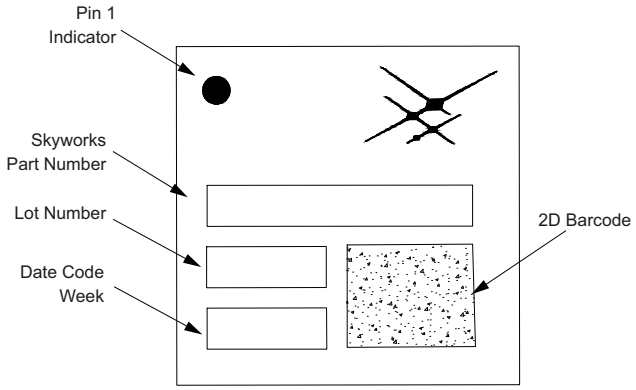
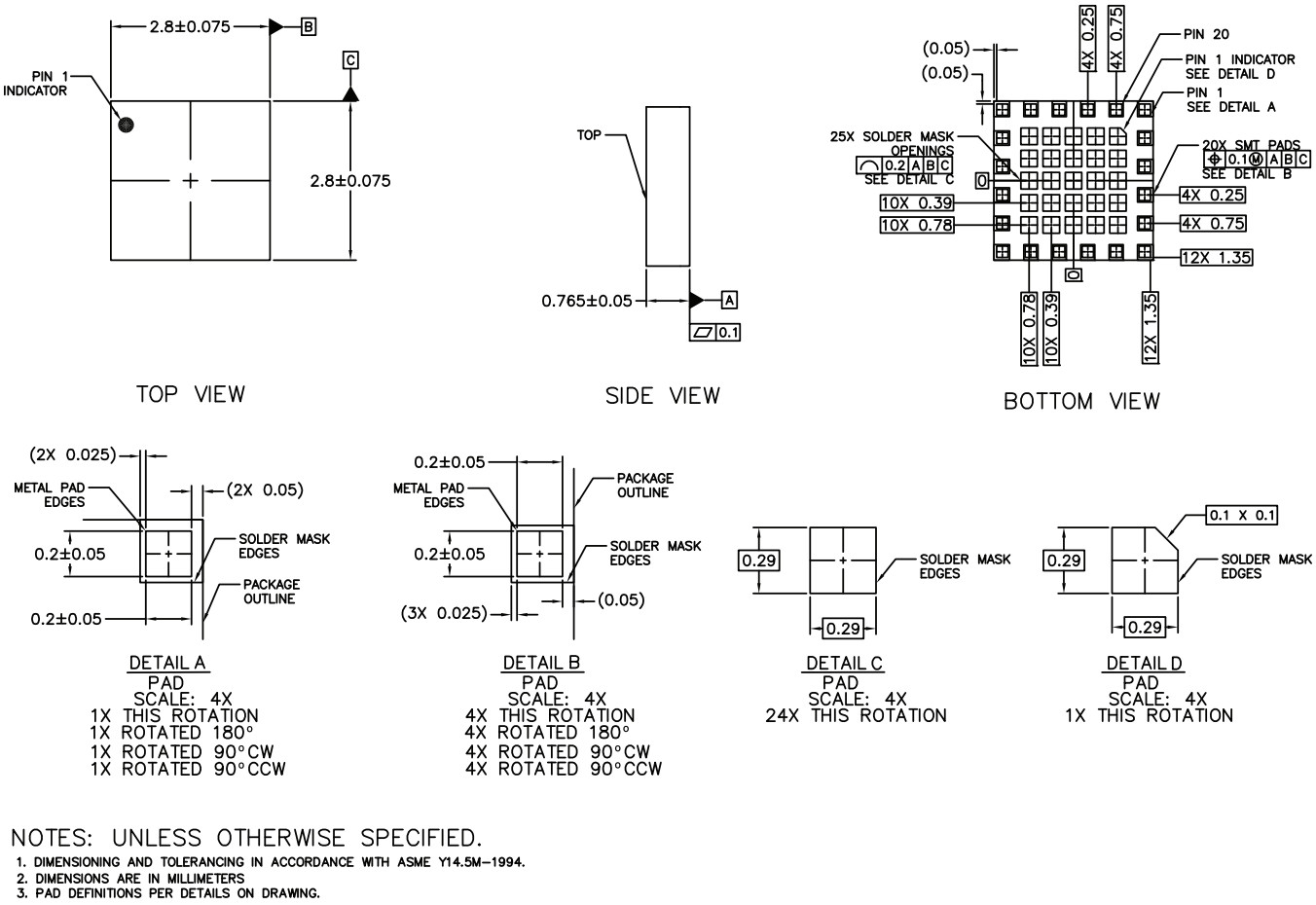


Figure 5. Typical Part Marking



NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M–1994.
2. DIMENSIONS ARE IN MILLIMETERS
3. PAD DEFINITIONS PER DETAILS ON DRAWING.

Figure 6. Package Dimensions

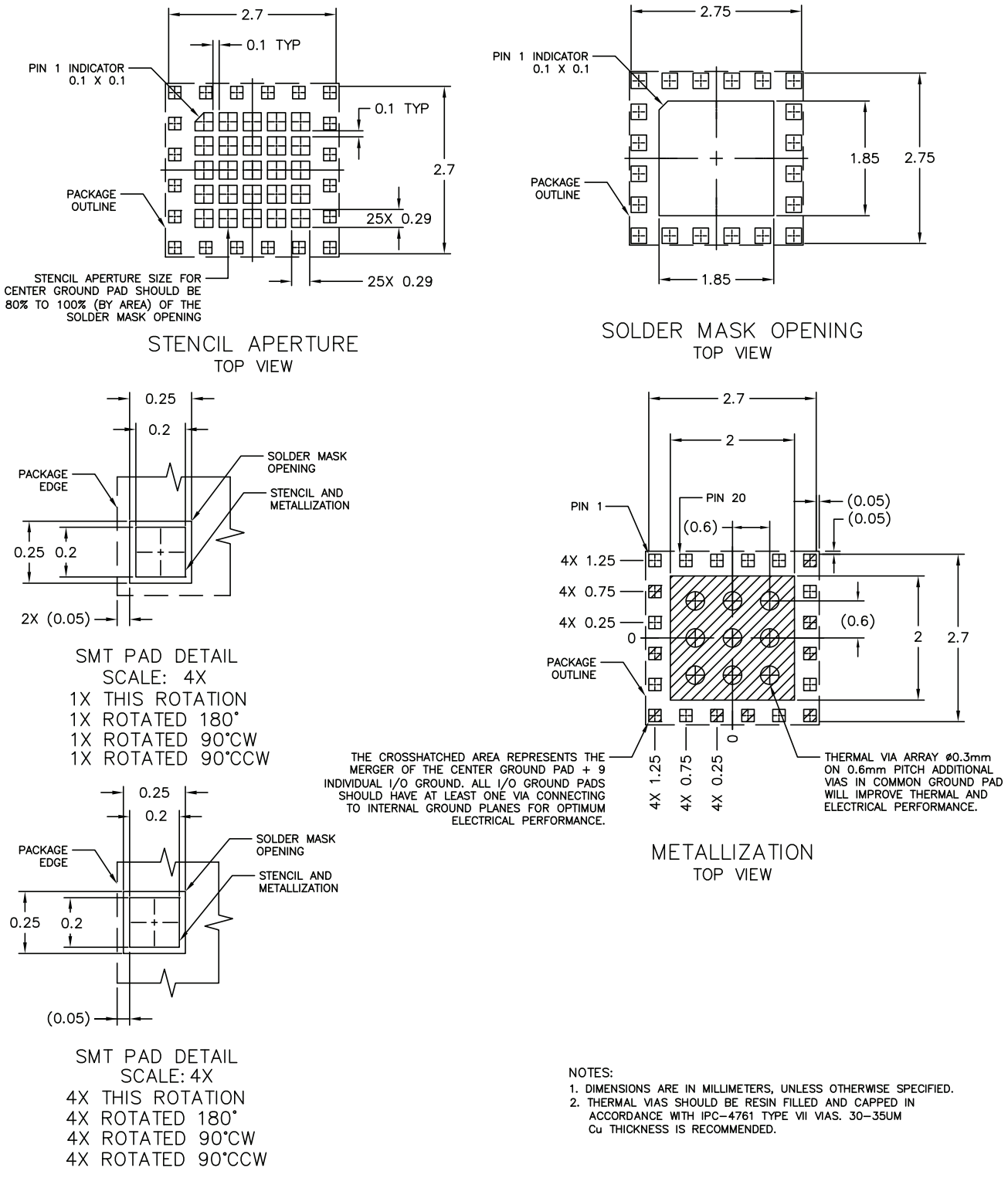
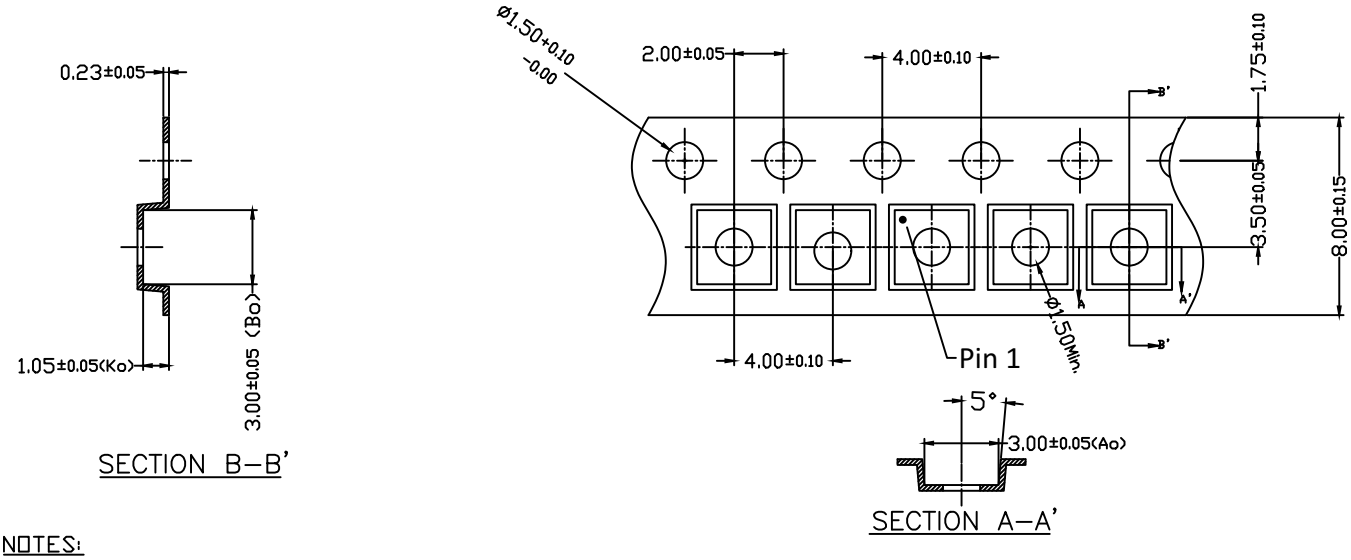


Figure 7. PCB Layout Footprint



NOTES:

10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE : ±0.20mm
Ao & Bo MEASURED ON PLANE 0.30mm ABOVE THE BOTTOM OF THE POCKET.
ALL DIMENSIONS ARE IN MILLIMETERS.

Figure 8. Tape and Reel Information

Ordering Information

Part Number	Description	Evaluation Board Part Number
SKY66424-11	Transmit/Receive RF Front-End Module for Wi-SUN® and LoRaWAN® Applications	SKY66424-11EK1