

DATA SHEET

SKY66421-11: 860 to 930 MHz RF Front-End Module

Applications

- LP-WAN devices
- Internet of Things
- Smart meters
- Industrial applications
- Range extender

Features

- Integrated PA with +27 dBm output power
- Integrated receive bypass path
- Alternate TX input simplifies connection to any SoC
- Very low RX bypass insertion loss: 0.6 dB typical
- Single-ended 50 Ω transmit/receive RF interface
- Fast turn-on/turn-off time: < 1 μsec
- Supply voltage: 2.0 to 4.8 V
- Low gain power amplifier
- Sleep mode current: < 1 μA
- MCM (16-pin, 3.0 x 3.0 x 0.75 mm) NiPdAu plated package (MSL3, 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.

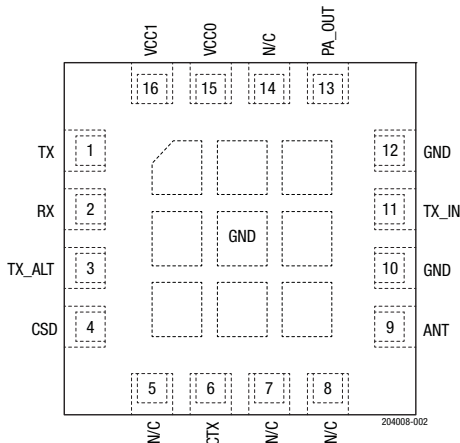


Figure 2. SKY66421-11 Pinout (Top View)

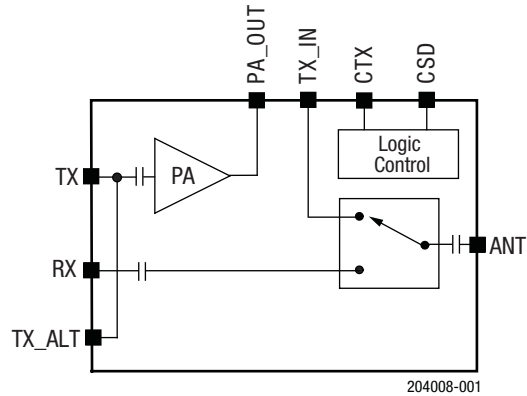


Figure 1. SKY66421-11 Block Diagram

Description

The SKY66421-11 is a high-performance, highly integrated RF front-end module designed for high-power Industrial, Scientific, Medical (ISM) band applications operating in the 860 to 930 MHz frequency range.

The SKY66421-11 is designed for ease of use and maximum flexibility with fully matched 50 Ω TX (or TX_ALT) and RX inputs and antenna outputs, and digital controls compatible with 1.6 to 3.6 V CMOS levels.

The RF blocks operate over a wide supply voltage range from 2.0 to 4.8 V allowing the SKY66421-11 to be used in battery powered applications over a wide spectrum of the battery discharge curve.

The SKY66421-11 is packaged in a 16-pin, 3.0 x 3.0 x 0.75 mm Multi-Chip Module (MCM) package.

A functional block diagram of the SKY66421-11 is provided in Figure 1. Figure 2 shows the pinout for the SKY66421-11. Table 1 lists the pin assignments and signal descriptions.

Table 1. SKY66421-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	TX	Transmit mode RF input	10	GND	Connect to PCB ground
2	RX	Receive mode RF output	11	TX_IN	TX input signal to antenna (from OMN)
3	TX_ALT	TX_ALT Transmit mode RF input (alternate pin)	12	GND	Connect to PCB ground
4	CSD	Shutdown control input	13	PA_OUT	PA output and positive power supply
5	N/C	Not connected internally to the device	14	N/C	Not connected internally to the device
6	CTX	Transmit mode select input	15	VCC0	Positive power supply
7	N/C	Not connected internally to the device	16	VCC1	Positive power supply
8	N/C	Not connected internally to the device	Paddle	GND	Exposed die paddle; electrical and thermal ground (connect to PCB ground)
9	ANT	Connect to 50 Ω antenna filter			

Electrical and Mechanical Specifications

Table 2 provides the absolute maximum ratings, and Table 3 shows the recommended operating conditions. Electrical specifications are provided in Tables 4 through 6.

The state of the SKY66421-11 is determined by the control logic shown in Tables 7 and 8.

Table 2. SKY66421-11 Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage on VCC0 (no RF)	V _{CC0}	-0.3	5.5	V
Supply voltage on VCC1 and VCC2 (no RF)	V _{CC12}	-0.3	5.5	V
Operating temperature	T _A	-40	85	°C
Storage temperature	T _{STG}	-40	125	°C
Tx input power at TX port	P _{IN_TX_MAX}		+17	dBm
Rx input power at ANT port	P _{IN_RX_MAX}		+10	dBm
Electrostatic discharge: Human Body Model (HBM), Class 1C	ESD		1000	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.

ESD HANDLING: *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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

Table 3. SKY66421-11 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage on VCC0	V _{CC0}	2.0	3.3	4.8	V
Supply voltage on VCC1 and PA_OUT	V _{CC}	2.0	3.3	4.8	V
Ambient temperature	T _A	-40	+25	+85	°C

Table 4. SKY66421-11 DC Electrical Specifications¹
(Vcc0 = Vcc12 = 3.3 V, f = 915 MHz, TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Total supply current, transmit mode	Icc_TX27	POUT = +27 dBm		280		mA
Quiescent current	IcQ_RX			200		μA
	IcQ_TX	No RF		50		mA
Sleep supply current	Icc_OFF	No RF			1.00	μA

¹ Performance is guaranteed only under the conditions listed in this table.

Table 5. SKY66421-11 AC Electrical Specifications: Transmit Mode
(Vcc0 = Vcc12 = 3.3 V, TA = +25 °C, All Unused Ports Terminated at 50 Ω, Unless Otherwise Noted. Input Port TX, Output Port ANT, Matching Network Connected between PA_OUT and TX_IN)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency range	f		860		930	MHz
Output power at ANT port ^{1, 2}	POUT_915	f = 915 MHz		+27		dBm
	POUT_868	f = 868 MHz		+27		dBm
Small signal gain ^{1, 2}	S21_915	f = 915 MHz		16		dB
	S21_868	f = 868 MHz		16		dB
Small signal gain variation ^{1, 2}	ΔS21	Peak to peak gain variation across frequency band			1	dB
Input return loss	S11	Into 50 Ω (TX port)		-10		dB
Output return loss ^{1, 2}	S22	Into 50 Ω (ANT port)		-10		dB
2 nd harmonic ³	2fo	POUT = +27 dBm			+7	dBm
3 rd to 10 th harmonic ³	3fo to 10fo	POUT = +27 dBm			-42	dBm
Turn-on time ⁴	ton			1	2	μs
Turn-off time ⁵	toff				1	μs
Stability	STAB	CW, PIN = +14 dBm 0.1 GHz to 20 GHz load VSWR = 6:1	All non-harmonically related outputs less than -42 dBm			
Ruggedness	RU	CW, POUT = +27 dBm into 50 Ω, load VSWR = 10:1	No permanent damage			

¹ 900 to 930 MHz with specified matching network on the Evaluation Board.

² 860 to 870 MHz with specified matching network on the Evaluation Board.

³ Measured with continuous wave signal.

⁴ From 50% of CTX edge to 90% of final RF output power.

⁵ From 50% of CTX edge to 10% of initial RF output power.

Table 6. SKY66421-11 AC Electrical Specifications: Receive Mode
(Vcc0 = Vcc12 = 3.3 V, TA = +25 °C, All Unused Ports Terminated at 50 Ω, Unless Otherwise Noted. Input Port ANT and Output Port RX)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency range	f _{IN}		860		930	MHz
Receive insertion loss	RX_S21			0.6		dB
Antenna port return loss	S11 _{ANT}	Into 50 Ω (ANT port)		-15		dB
RX port return loss	S22 _{RX}	Into 50 Ω (RX port)		-15		dB
Turn-on time ¹	t _{ON}			1	2	μs
Turn-off time ²	t _{OFF}				1	μs

¹ From 50% of CTX edge to 90% of final RF output power.

² From 50% of CTX edge to 10% of initial RF output power.

Table 7. SKY66421-11 Electrical Specifications: Control Logic Characteristics¹
(TA = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Control voltage: High	V _{IH}		1.6 ²		VCC0	V
Low	V _{IL}		0		0.3 ²	V
Input current: High	I _{IH}				1	μA
Low	I _{IL}				1	μA

¹ Performance is guaranteed only under the conditions listed in this table.

² Logic inputs must be VCC0 or GND to achieve specified sleep currents.

Table 8. SKY66421-11 Electrical Specifications: Mode Control Logic (TA = +25)

Mode	GSD	CTX
Sleep (all off)	0	0
Receive mode	1	0
Transmit mode	1	1

Evaluation Board Description

The SKY66421-11-EK1 Evaluation Board is designed to demonstrate the performance of the SKY66421-11 RF Front-End Module. It is optimized for evaluation, experimentation, and investigation, using CW (continuous wave) signals.

Figure 3 shows the Evaluation Board. The Evaluation Board schematic diagram for 915 MHz application (EK1) is provided in Figure 4. The Bill of Materials (BOM) for the SKY66421-11 Evaluation Board for 915 MHz application (EK1) is listed in Table 9.

The Evaluation Board schematic diagram for 868 MHz (EK3) is provided in Figure 5. The Bill of Materials (BOM) for the SKY66423-11 Evaluation Board for 868 MHz application (EK3) is listed in Table 10.

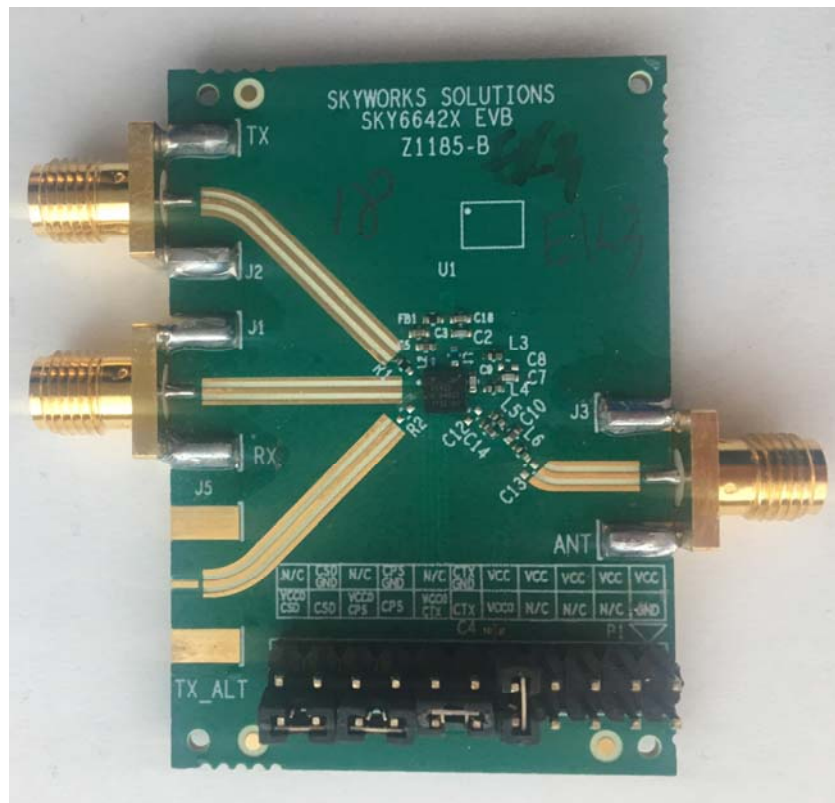
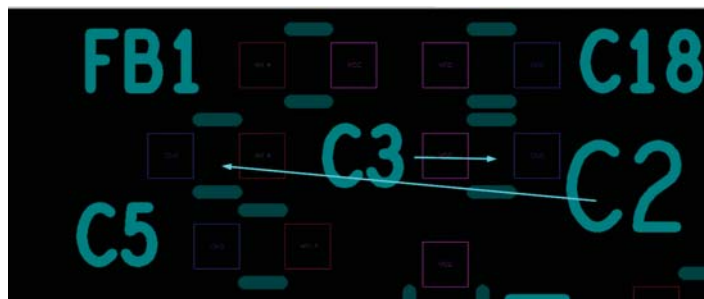


Figure 3. SKY66421-11 Evaluation Board

Note: The placement of the capacitors is correct. Only the designator markings on the Evaluation Board will be changed.



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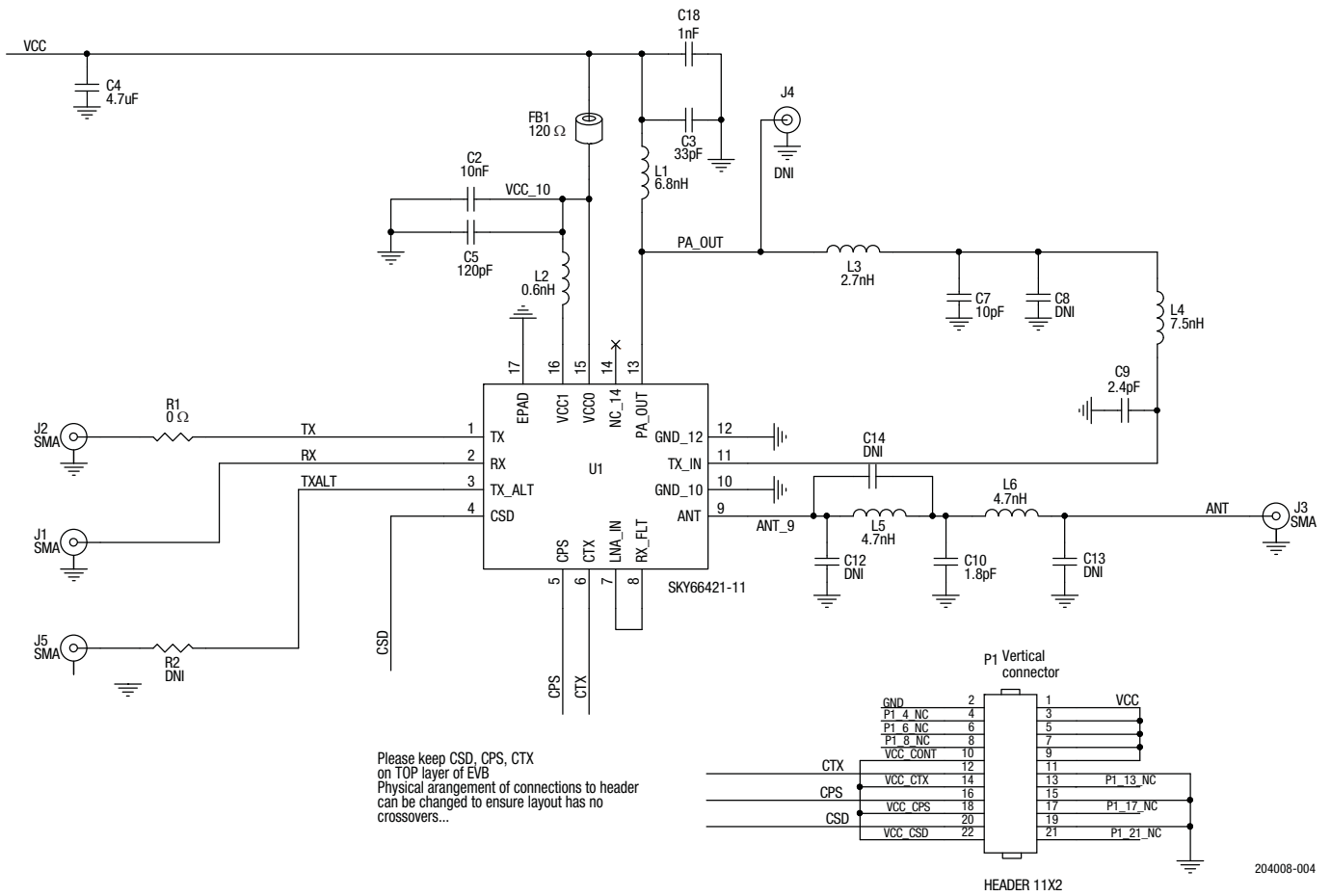


Figure 4. SKY66421-11 Evaluation Board Schematic for 915 MHz Application (EK1)

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Table 9. SKY66421-11 Evaluation Board Bill of Materials for 915 MHz Application¹ (EK1)

Component	Value	Manufacturer	Mfr Part Number	Size	Description
C2	10 nF	Murata	GRM155R71H103KA88	0402	Ceramic capacitor 10000 pF 50 V x7r
C3	33 pF	Murata	GRM1555C1H330JA01	0402	Ceramic capacitor 33 pF 50 V c0g/np0
C4	4.7 uF	Murata	GRM155R61A475MEAA	0402	Ceramic capacitor 4.7uF 10 V x5r
C5	120 pF	Murata	GRM1555C1H121GA01	0402	Ceramic capacitor 120 pF 50 V c0g/np0
C7	10 pF	Murata	GRM1555C1E100JA01D	0402	Ceramic capacitor 10 pF 25 V c0g/np0
R2,C8,C14	DNI			0402	
C9	2.4 pF	Murata	GRM1555C1H2R4CA01	0402	Ceramic capacitor 2.4 pF 50 V c0g/np0
C10	1.8 pF	Murata	GRM1555C1H1R8BA01D	0402	Ceramic capacitor 1.8 pF 50 V c0g/np0
C12,C13	DNI	Murata		0402	
C18	1 nF	Murata	GRM155R71H102KA01	0402	Ceramic capacitor 1000 pF 50 V x7r
FB1	120 Ω	Taiyo Yuden	BK1005HM121	0402	Ferrite bead 120 Ω 0402 1In
J1,J2,J3,J5	SMA	Johnson Components	142-0701-851	End launch	Small end launch straight jack receptacle
J4	DNI	Amphenol		Amphenol_132134	Conn SMA jack straight 50 Ω PCB
L1	6.8 nH	Murata	LQW15AN6N8J00D	0402	Fixed inductor 6.8 nH 600 mA 290 MΩ
L2	0.6 nH	Murata	LQP03TN0N6B02D	0201	Fixed inductor 0.6 nH 850 mA 70 MΩ
L3	2.7 nH	Murata	LQG15WZ2N7S02D	0402	Fixed inductor 2.7 nH 900 mA 70 MΩ
L4	7.5 nH	Murata	LQG15HN7N5J02	0402	Fixed inductor 7.5 nH 500 mA 310 MΩ
L5,L6	4.7 nH	Murata	LQG15HN4N7S02	0402	Fixed inductor 4.7 nH 700 mA 230 MΩ
PCB1	Z1185-B2	Skyworks	Z1185-B2		EVB
P1	HEADER 11X2	Molex	10-89-1221	11X2	Header 11x2
R1	0 Ω	Panasonic	ERJ2GE0R00	0402	Res SMD 0 Ω jumper 1/10w 0402
U1	SKY66421-11				

¹ Schematic and BOM have been designed to optimize performance with CW signals, 100% duty cycle.

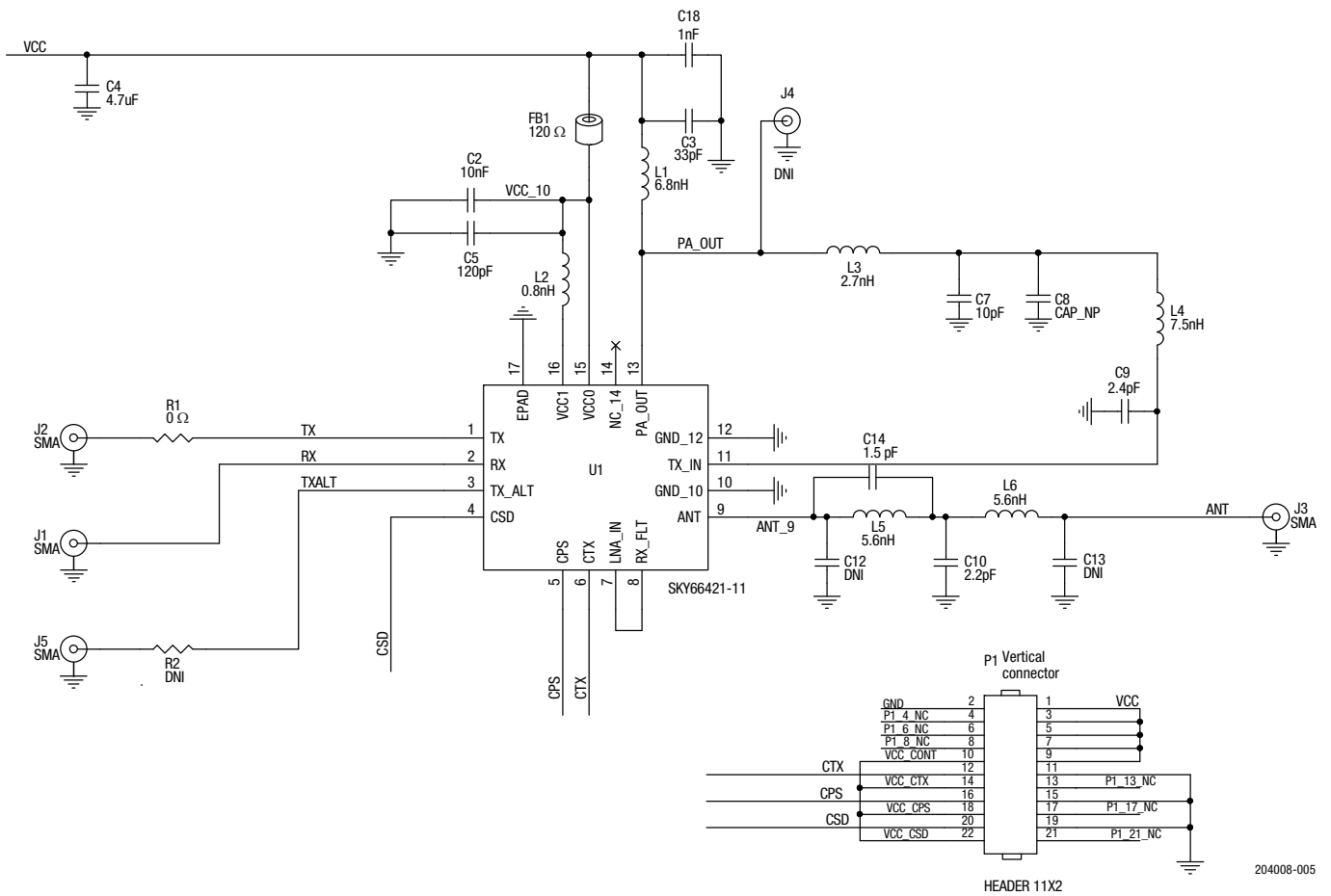


Figure 5. SKY66421-11 Evaluation Board Schematic for 868 MHz Application (EK3)

Table 10. SKY66421-11 Evaluation Board Bill of Materials for 868 MHz Application¹ (EK3)

Component	Value	Manufacturer	Mfr Part Number	Size	Description
C2	10 nF	Murata	GRM155R71H103KA88	0402	Ceramic capacitor 10000 pF 50 V x7r
C3	33 pF	Murata	GRM1555C1H330JA01	0402	Ceramic capacitor 33 pF 50 V COG/NP0
C4	4.7 uF	Murata	GRM155R61A475MEAA	0402	Ceramic capacitor 4.7uF 10 V X5R
C5	120 pF	Murata	GRM1555C1H121GA01	0402	Ceramic capacitor 120 pF 50 V COG/NP0
R2, C7	DNI				
C8	10 pF	Murata	GRM1555C1H100JA01	0402	Ceramic capacitor 10 pF 50 V X7R
C9	2.4 pF	Murata	GRM1555C1H2R4CA01	0402	Ceramic capacitor 2.4 pF 50 V COG/NP0
C10	2.2 pF	Murata	GRM1555C1H2R2CA01	0402	Ceramic capacitor 2.2 pF 50 V COG/NP0
C12,C13	DNI	Murata		0402	
C14	1.5 pF	Murata	GRM1555C1H1R5CA01		Ceramic capacitor 1.5 pF 50 V COG/NP0
C18	1 nF	Murata	GRM155R71H102KA01	0402	Ceramic capacitor 1000 pF 50 V X7R
FB1	120 Ω	Taiyo Yuden	BK1005HM121	0402	Ferrite bead 120 Ω 0402 1LN
J1,J2,J3,J5	SMA	Johnson Components	142-0701-851	End launch	Small end launch straight jack receptacle
J4	DNI	Amphenol		Amphenol_132134	Conn SMA jack straight 50 Ω PCB
L1	6.8 nH	Murata	LQW15AN6N8J00D	0402	Fixed inductor 6.8 nH 600 mA 290 MΩ
L2	0.8 nH	Murata	LQP03TN0N6B02D	0201	Fixed inductor 0.8 nH 850 mA 70 MΩ
L3	2.4 nH	Murata	LQG15WZ2N7S02D	0402	Fixed inductor 2.4 nH 800 mA 160 MΩ
L4	7.5 nH	Murata	LQG15HN7N5J02	0402	Fixed inductor 7.5 nH 500 mA 310 MΩ
L5,L6	5.6 nH	Murata	LQG15HN5N6S02D	0402	Fixed inductor 5.6 nH 600 mA 260 MΩ
PCB1	Z1185-B2	Skyworks	Z1185-B		EVB
P1	HEADER 11X2	Molex	10-89-1221	11X2	Header 11x2
R1	0 Ω	Panasonic	ERJ2GE0R00	0402	Res SMD 0 Ω jumper 1/10w
U1	SKY66421-11				

¹ Schematic and BOM have been designed to optimize performance with CW signals, 100% duty cycle.

Package Dimensions

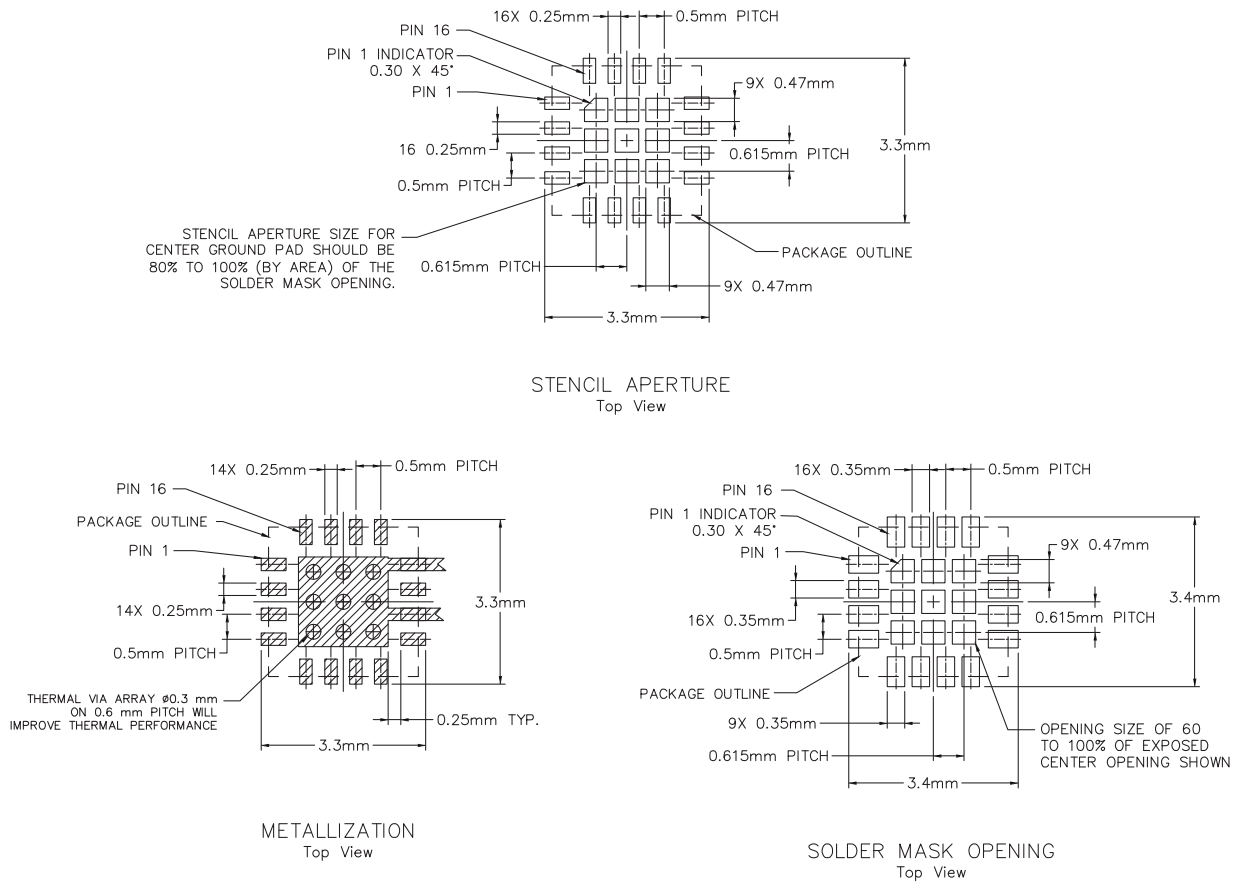
The layout footprint for the SKY66421-11 is provided in Figure 6. Typical part markings are shown in Figure 7. Package dimensions for the SKY66421-11 are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

Package and Handling Information

Since the device package 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 SKY66421-11 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.



NOTE: THERMAL VIAS SHOULD BE RESIN FILLED AND CAPPED IN ACCORDANCE WITH IPC-4761 TYPE VII VIAS. 30-35UM Cu THICKNESS IS RECOMMENDED.

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Figure 6. SKY66421-11 Recommended Footprint (Top View)

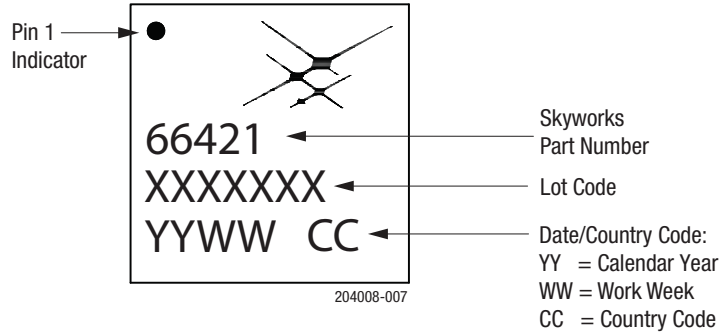
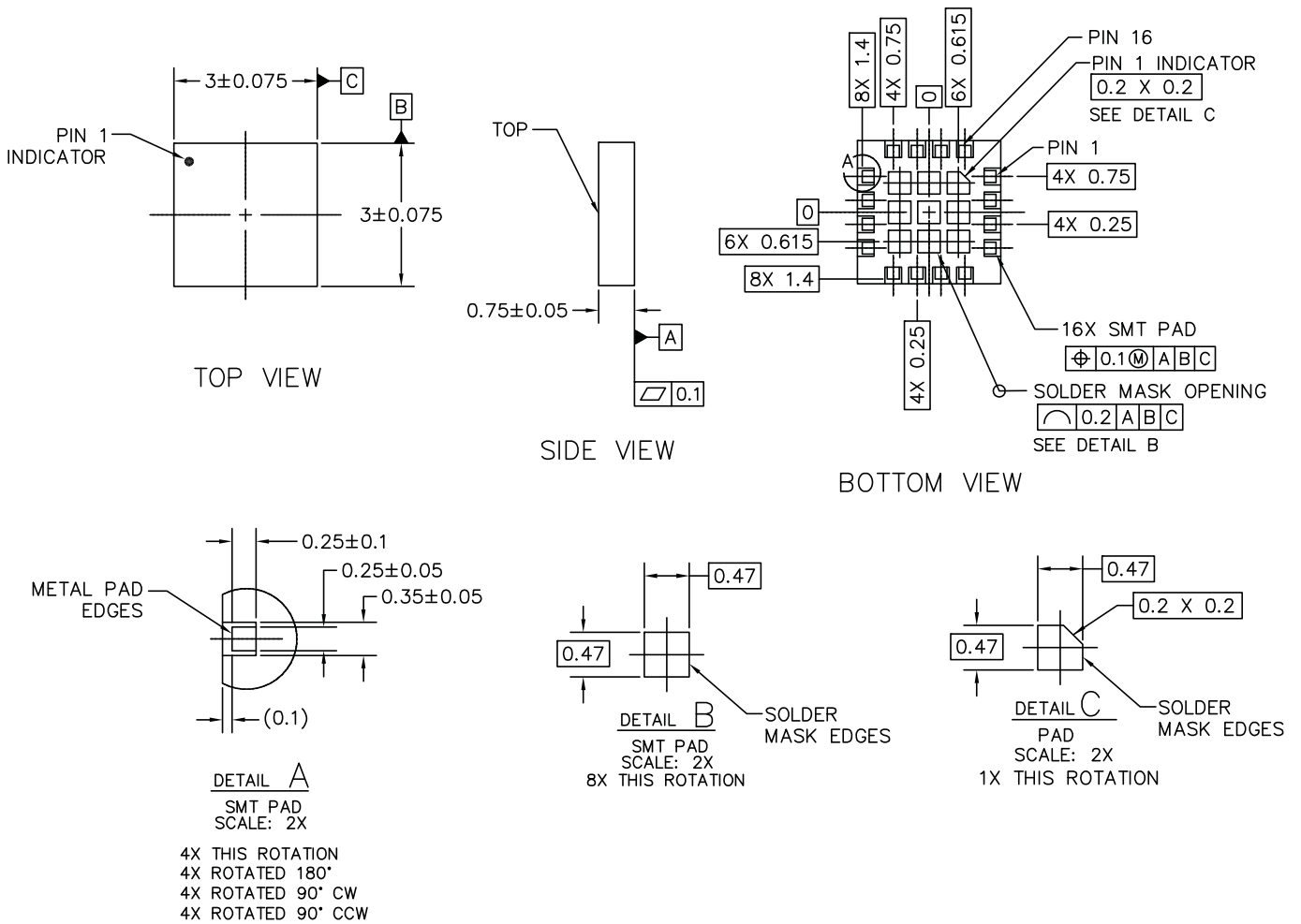


Figure 7. Typical Part Markings (Top View)



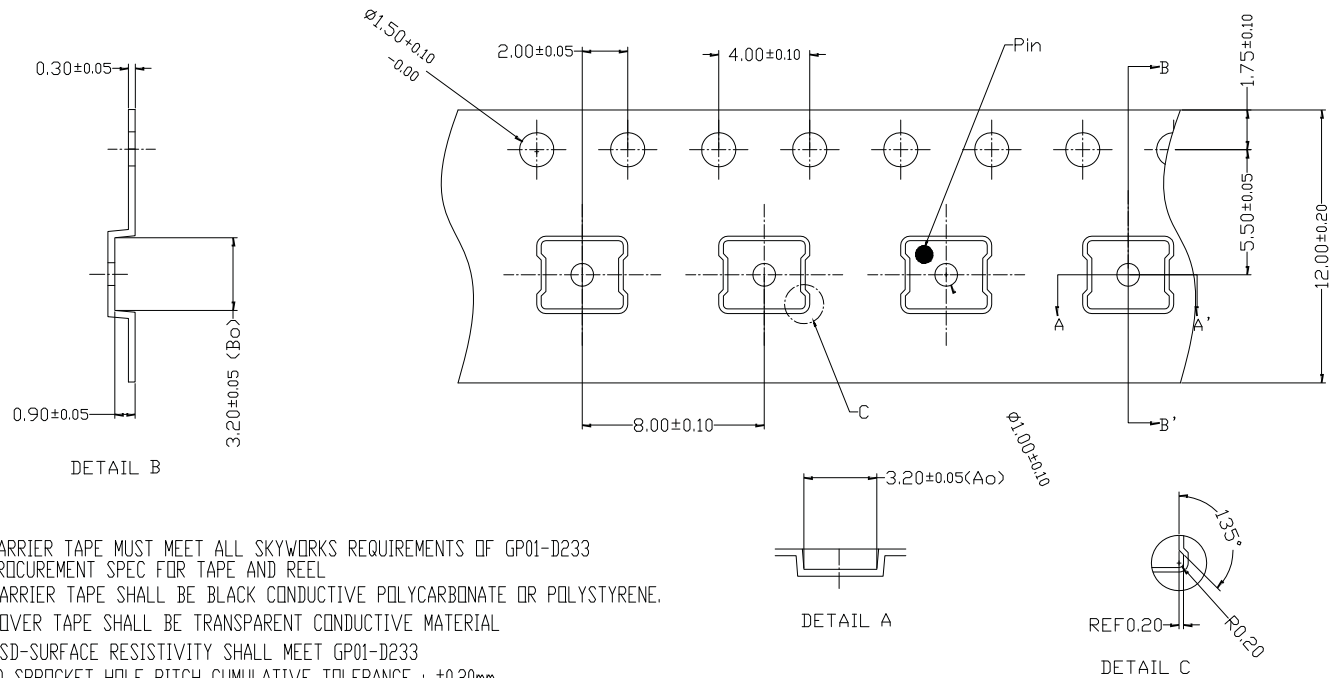
NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M-1994.
2. DIMENSIONS ARE IN MILLIMETERS

204008-008

Figure 8. SKY66421-11 Package Dimensions

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1. CARRIER TAPE MUST MEET ALL SKYWORKS REQUIREMENTS OF GP01-D233 PROCUREMENT SPEC FOR TAPE AND REEL
2. CARRIER TAPE SHALL BE BLACK CONDUCTIVE POLYCARBONATE OR POLYSTYRENE.
3. COVER TAPE SHALL BE TRANSPARENT CONDUCTIVE MATERIAL
4. ESD-SURFACE RESISTIVITY SHALL MEET GP01-D233
5. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE : ±0.20mm
6. Ao & Bo MEASURED ON PLANE 0.30mm ABOVE THE BOTTOM OF THE POCKET.
7. ALL DIMENSIONS ARE IN MILLIMETERS.

Figure 9. SKY66421-11 Tape and Reel Dimensions

204008-009

Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY66421-11	RF Front-End Module 915 MHz	SKY66421-11-EK1
SKY66421-11	RF Front-End Module 868 MHz	SKY66421-11-EK3

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