DATA SHEET

SKY66105-11: 902 to 931 MHz High-Power RF Front-End Module

Applications

- Smart meters
- ISM communications
- Smart thermostats
- Range extender

Features

- Integrated PA with up to +30 dBm output power
- Receive pass-through
- Diversity antenna switching
- Single-ended, 50 Ω transmit/receive RF interfaces
- Fast turn-on/turn-off time: 1 to 2 µs
- Supply operation: 2.0 V to 4.8 V
- Sleep mode current: < 10 µA
- Small footprint shielded MCM (12-pin, 8.00 x 6.00 x 1.05 mm) 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.

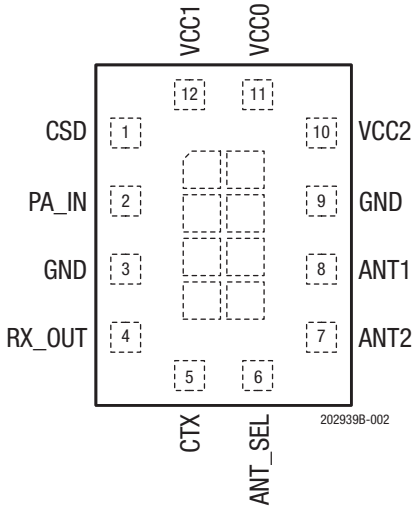


Figure 2. SKY66105-11 Pinout (Top View)

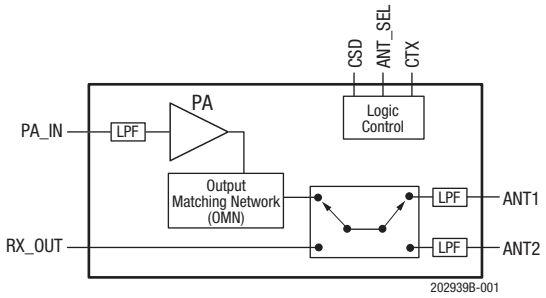


Figure 1. SKY66105-11 FEM Block Diagram

Description

The SKY66105-11 is a high-performance, highly integrated RF front-end module (FEM) designed for high-power Industrial, Scientific, and Medical (ISM) applications operating in the 902 MHz to 931 MHz frequency band.

The SKY66105-11 is designed for ease of use and maximum flexibility, with fully matched 50 Ω inputs and outputs, and digital controls compatible with 1.8 V to 3.6 V CMOS levels.

The RF blocks operate over a wide supply voltage range from 2.0 V to 4.8 V, which allows the SKY66105-11 to be used in battery powered applications over a wide spectrum of the battery discharge curve.

The SKY66105-11 is packaged in a 12-pin, 8 x 6 mm Multi-Chip Module (MCM) with exposed ground paddle and surrounding shielding.

A functional block diagram of the SKY66105-11 is shown in Figure 1. The 12-pin MCM package and pinout are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

Table 1. SKY66105-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	CSD	Control input, shutdown (PA disable)	7	ANT2	Antenna 2 port
2	PA_IN	PA input	8	ANT1	Antenna 1 port
3	GND	Ground	9	GND	Ground
4	RX_OUT	Receive output (receive signal to transceiver or application)	10	VCC2	Stage 2 PA supply
5	CTX	Control input, transmit/receive switch	11	VCC0	Logic supply
6	ANT_SEL	Control input, antenna 1 / antenna 2 switch	12	VCC1	Stage 1 PA supply

Technical Description

The SKY66105-11 contains all of the needed RF matching and DC biasing circuits. The PA is a two-stage amplifier, capable of over +30 dBm and optimized for power efficiency. This makes the device suitable for battery-powered applications where PA power consumption is of critical importance.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66105-11 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Tables 4 through 6.

The state of the SKY66105-11 is determined by the logic provided in Table 7. Mode control configurations are noted in Tables 8 and 9.

Table 2. SKY66105-11 Absolute Maximum Ratings[1]

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage (VCC0, VCC1, VCC2)	V_{CC}	-0.3	+5.5	V
Logic control voltages	V_{IH}, V_{IL}	-0.3	+3.0	V
Transmit RF input power (at PA_IN port)	P_{IN_TX}		+10	dBm
Receive RF input power (at ANT1 or ANT2 ports)	P_{IN_RX}		+13	dBm
Thermal resistance	θ_{JC}		16.3	°C/W
Operating case temperature	T_C	-40	+85	°C
Storage temperature	T_{STG}	-40	+150	°C
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 typical value as provided in Tables 3, 4, and 5. 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. SKY66105-11 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Operating case temperature	T_C	-40	+25	+85	°C
RF supply voltage[1]	V_{CC0}, V_{CC1}, V_{CC2}	2.0	3.6	4.8	V

[1] Power supply pins VCC0, VCC1, and VCC2 are independent supplies and are not internally tied together.

Table 4. SKY66105-11 DC Electrical Specifications[1]
(VCC0/1/2 = +3.6 V, T_C = +25 °C, P_{IN} = 0 dBm, as Measured on the SKY66105-11 Evaluation Board (De-Embedded to Device), Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Total supply current in Transmit Mode	$I_{CC_TX}29$	P_{OUT} = +29 dBm, VCC1/2 = 3.6 V		450		mA
	$I_{CC_TX}27$[2]	P_{OUT} = +27 dBm, VCC1/2 = 3.6 V		360		mA
Quiescent current in Transmit Mode	I_{CQ_TX}	No RF		50		mA
Total supply current in Receive Bypass Mode	$I_{CC_RXBYPASS}$			280	300	µA
Total supply current in Sleep Mode[3]	I_{CC_OFF}			3.7	10	µA

[1] Performance is guaranteed only under the conditions listed in this table. Logic levels are compliant with the logic described in Table 7.

[2] Not tested in production. Fully characterized and guaranteed by design.

[3] All controls must be at 0 V to achieve the specified sleep current.

Table 5. SKY66105-11 Transmit Mode Electrical Specifications[1]
(VCC0/1/2 = +3.6 V, T_C = +25 °C, Transmit Mode, as Measured on the SKY66105-11 Evaluation Board (De-Embedded to Device), All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency range	f		902		931	MHz
Output power at ANT1/2 ports	$P_{OUT_TX}48V$[2]	VCC1/2 = 4.8 V		+31.5		dBm
	$P_{OUT_TX}40V$[2]	VCC1/2 = 4.0 V		+30		dBm
	$P_{OUT_TX}29$	VCC1/2 = 3.6 V		+29		dBm
	$P_{OUT_TX}30V$[2]	VCC1/2 = 3.0 V		+27.5		dBm
PA power-added efficiency	PAE	P_{OUT} = +29 dBm at PA_OUT port, at 915 MHz		45		%
Small signal gain[2]	S21		26	29		dB
Saturated gain	$S21_{SAT}$	P_{OUT} = +29 dBm	26	29		dB
Gain variation	ΔS21	P_{OUT} = +29 dBm, 902 to 931 MHz		0.5	1	dBp-p
Input return loss	S11			-15	-6	dB
Output return loss	$S22_{ANT1/2}$	ANT1/2 ports, into 50 Ω		-10	-6	dB
2nd harmonic	HD2	P_{OUT} = +29 dBm, CW			-22	dBc
3rd to 10th harmonics[2]	HD3 to HD10	P_{OUT} = +29 dBm, CW			-72	dBc
Turn-on time[2]	t_{ON}	From 50% of CTX edge to 90% of final RF output power		2		µs
Turn-off time[2]	t_{OFF}	From 50% of CTX edge to 10% of final RF output power		1		µs
Antenna select switching time[2]	$t_{ANT_SW_TX}$	From 50% of ANT_SEL edge		2		µs
Stability[2]	Stab	P_{IN} = +6 dBm, CW f = 0.1 GHz to 20 GHz, load VSWR = 6:1	All non-harmonically related outputs < -42 dBm/MHz			
Ruggedness[2]	RU	P_{IN} = +6 dBm into 50 Ω, CW, load VSWR = 10:1	No permanent damage			

[1] Performance is guaranteed only under the conditions listed in this table. Production testing is performed at 915 MHz.

[2] Not tested in production. Fully characterized and guaranteed by design.

Table 6. SKY66105-11 Receive Mode Electrical Specifications[1]
(VCC0/1/2 = +3.6 V, T_C = +25 °C, Receive Mode, as Measured on the SKY66105-11 Evaluation Board (De-Embedded to Device), All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency range	f		902		931	MHz
ANT1/2 port input return loss[2]	$S11_{ANT1/2}$	Into 50 Ω, ANT1/2 ports		-20	-10	dB
RX port return loss	$S22_{RX}$	Into 50 Ω, RX port		-20	-10	dB
Turn-on time[2]	t_{ON}	From 50% of CTX edge		2		µs
Turn-off time[2]	t_{OFF}			1		µs
Antenna select switching time[2]	$t_{ANT_SW_RX}$	From 50% of ANT_SEL edge		2		µs
Gain in Receive Bypass Mode	$G_{_BP}$			-0.7		dB
1 dB input compression point[2]	IP1dB			+30		dBm

[1] Performance is guaranteed only under the conditions listed in this table. Production testing is performed at 915 MHz.
[2] Not tested in production. Fully characterized and guaranteed by design.

Table 7. SKY66105-11 Electrical Specifications: Control Logic Characteristics[1]
(T_C = +25 °C, as Measured on the SKY66105-11 Evaluation Board (De-Embedded to Device), Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Control voltage:						
High	V_{IH}		1.8		3.0	V
Low	V_{IL}		0		0.3	V
Input current:						
High	I_{IH}				50	µA
Low	I_{IL}				50	µA

[1] Performance is guaranteed only under the conditions listed in this table. Control logic input signals are: CSD and CTX. Not tested in production. Fully characterized and guaranteed by design.

Table 8. SKY66105-11 Mode Control Logic[1]

Mode	CSD (Pin 1)	CTX (Pin 5)	ICC Total
Sleep (all off)	0	0	3.7 µA
Receive Bypass	1	0	280 µA
Transmit	1	1	50 mA
Not a legal state	0	1	6.2 mA

[1] Logic levels "0" and "1" are compliant with V_{IL} and V_{IH}, respectively, as specified in Table 7.

Table 9. SKY66105-11 Mode Control Logic: Antenna Select[1]

Mode	ANT_SEL (Pin 6)
Antenna 1 active (ANT1)	1
Antenna 2 active (ANT2)	0

[1] Logic levels "0" and "1" are compliant with V_{IL} and V_{IH}, respectively, as specified in Table 7.

Evaluation Board Description

The SKY66105-11 Evaluation Board is used to test the performance of the SKY66105-11 FEM. A typical application schematic diagram is provided in Figure 3. An Evaluation Board schematic is shown in Figure 4. An assembly drawing for the Evaluation Board is shown in Figure 5, and the layer detail is provided in Figure 6.

Package Dimensions

Typical part markings are shown in Figure 7. The PCB layout footprint for the SKY66105-11 is provided in Figure 8. Figure 9 shows the package dimensions, and Figure 10 provides the tape and reel dimensions.

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 SKY66105-11 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, *PCB Design and SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

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.

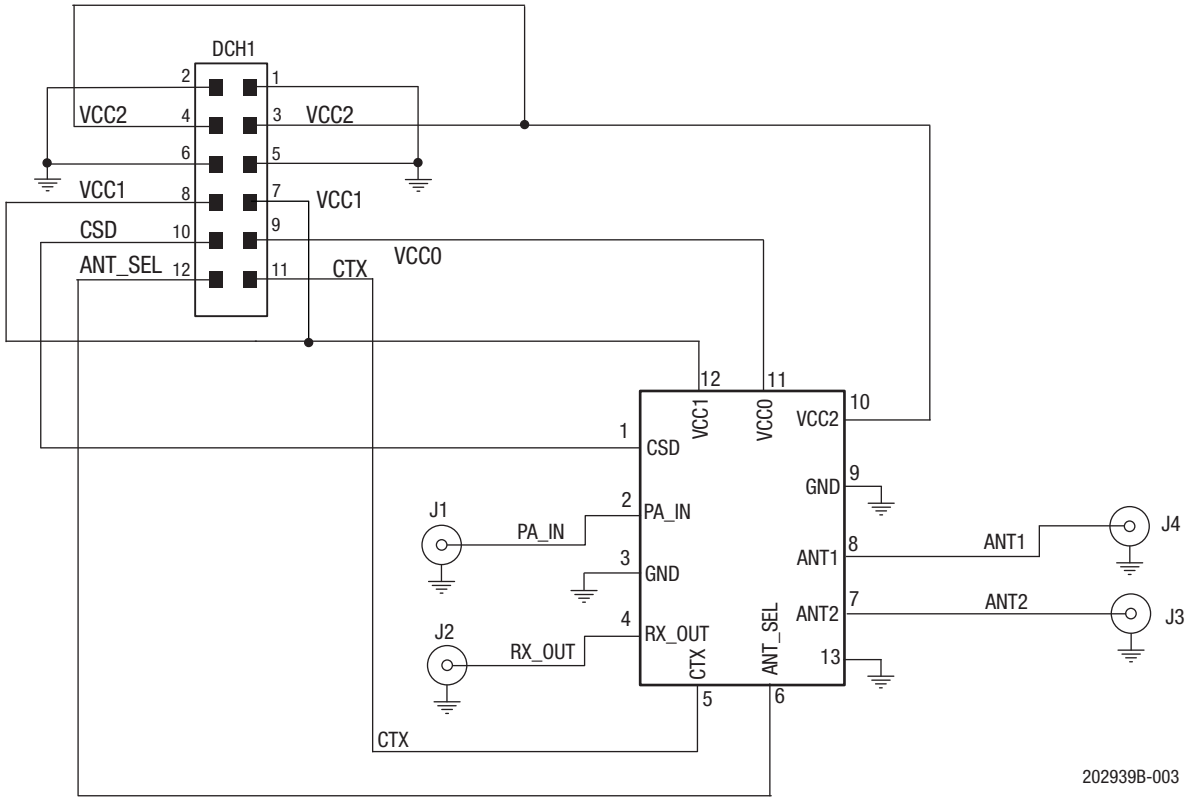


Figure 3. SKY66105-11 Typical Application Schematic

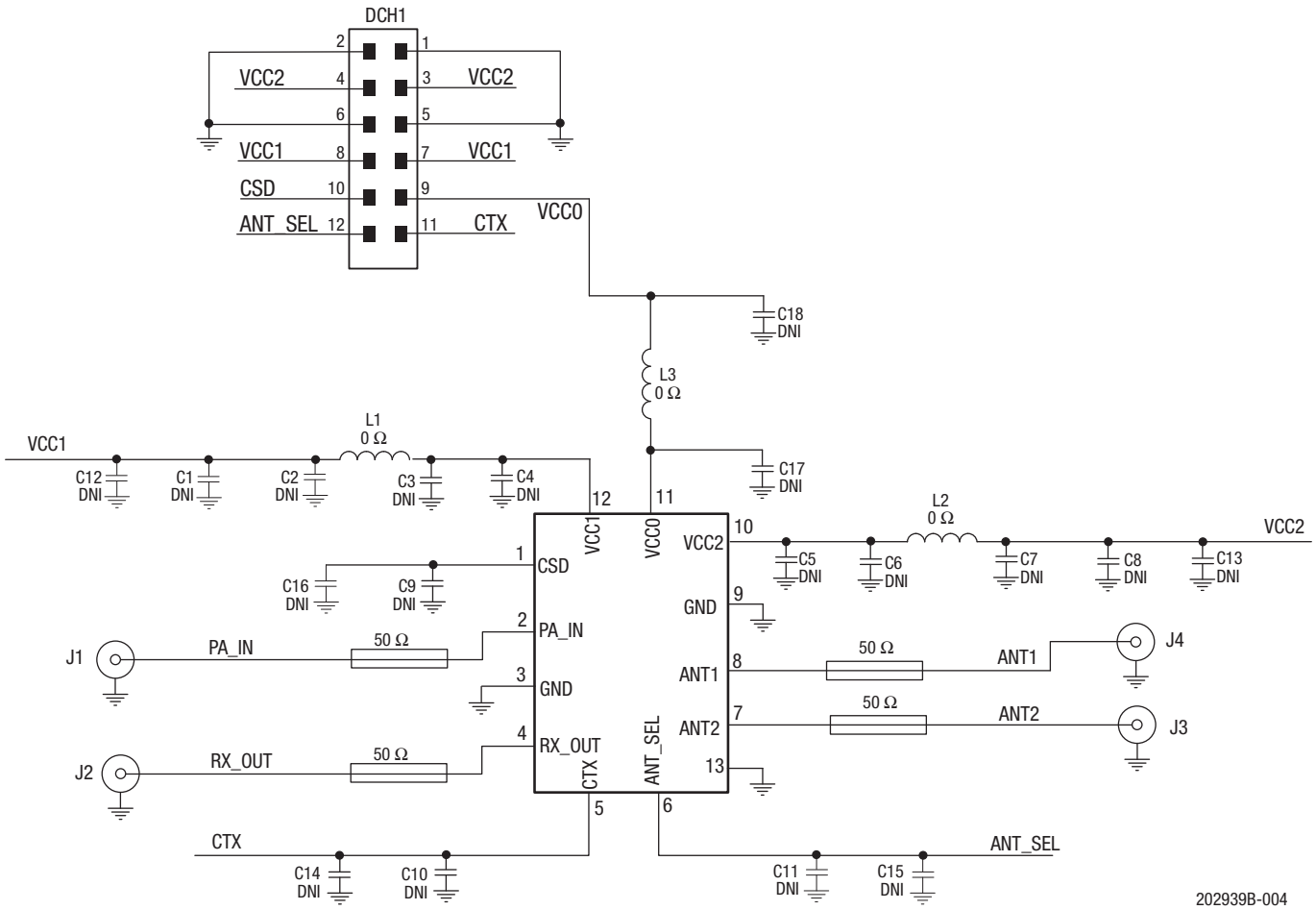


Figure 4. SKY66105-11 Evaluation Board Schematic

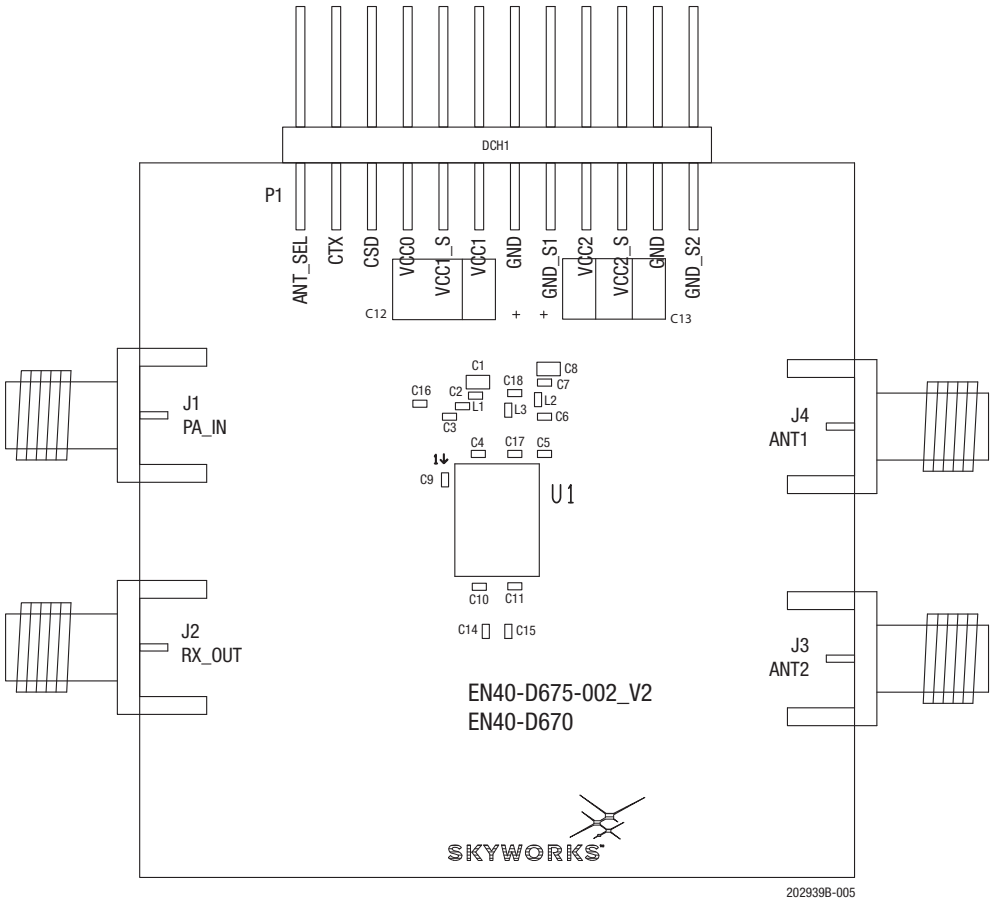


Figure 5. SKY66105-11 Evaluation Board Assembly Drawing

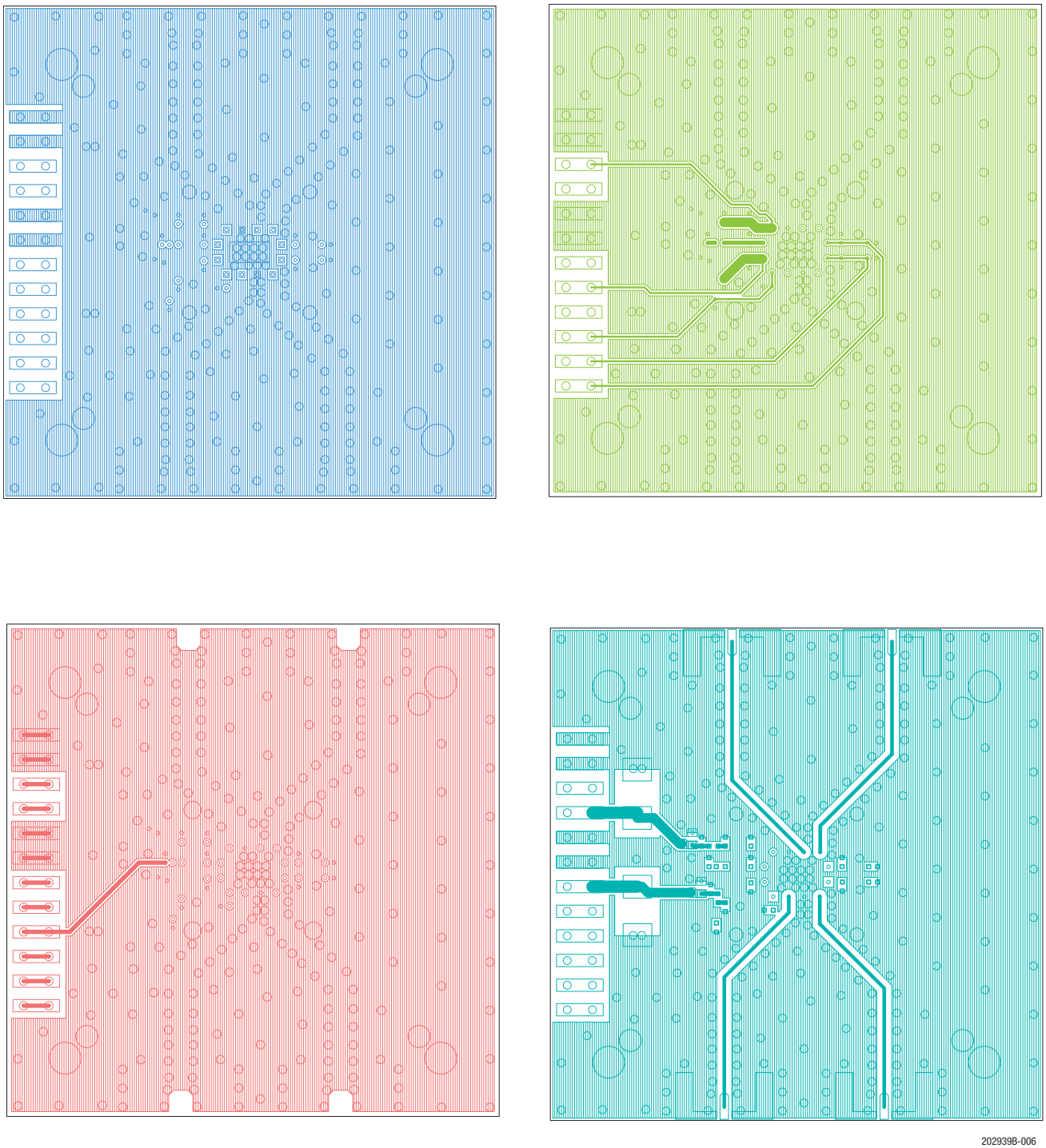


Figure 6. SKY66105-11 Evaluation Board Layer Detail

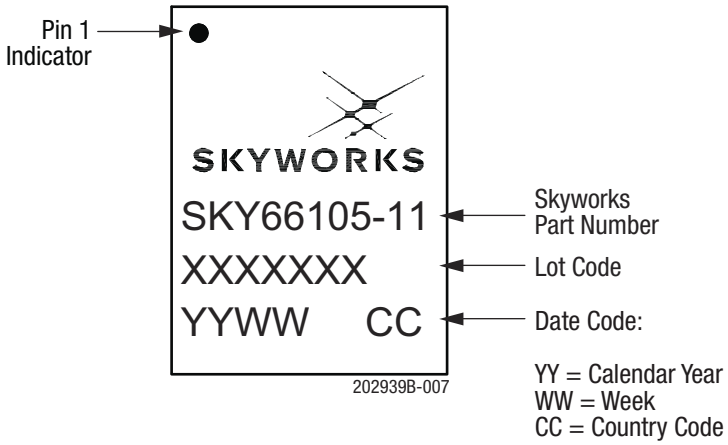


Figure 7. SKY66105-11 Typical Part Markings (Top View)

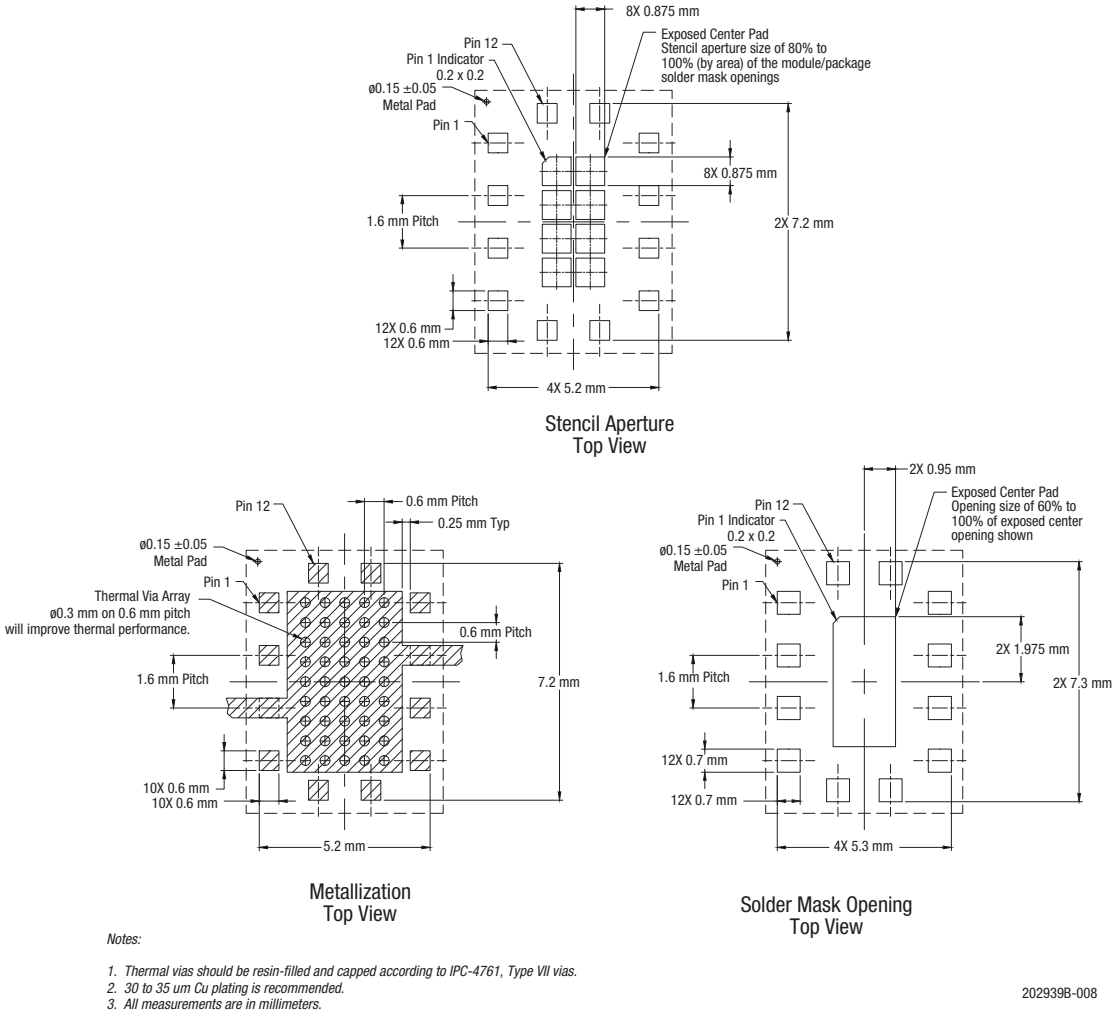
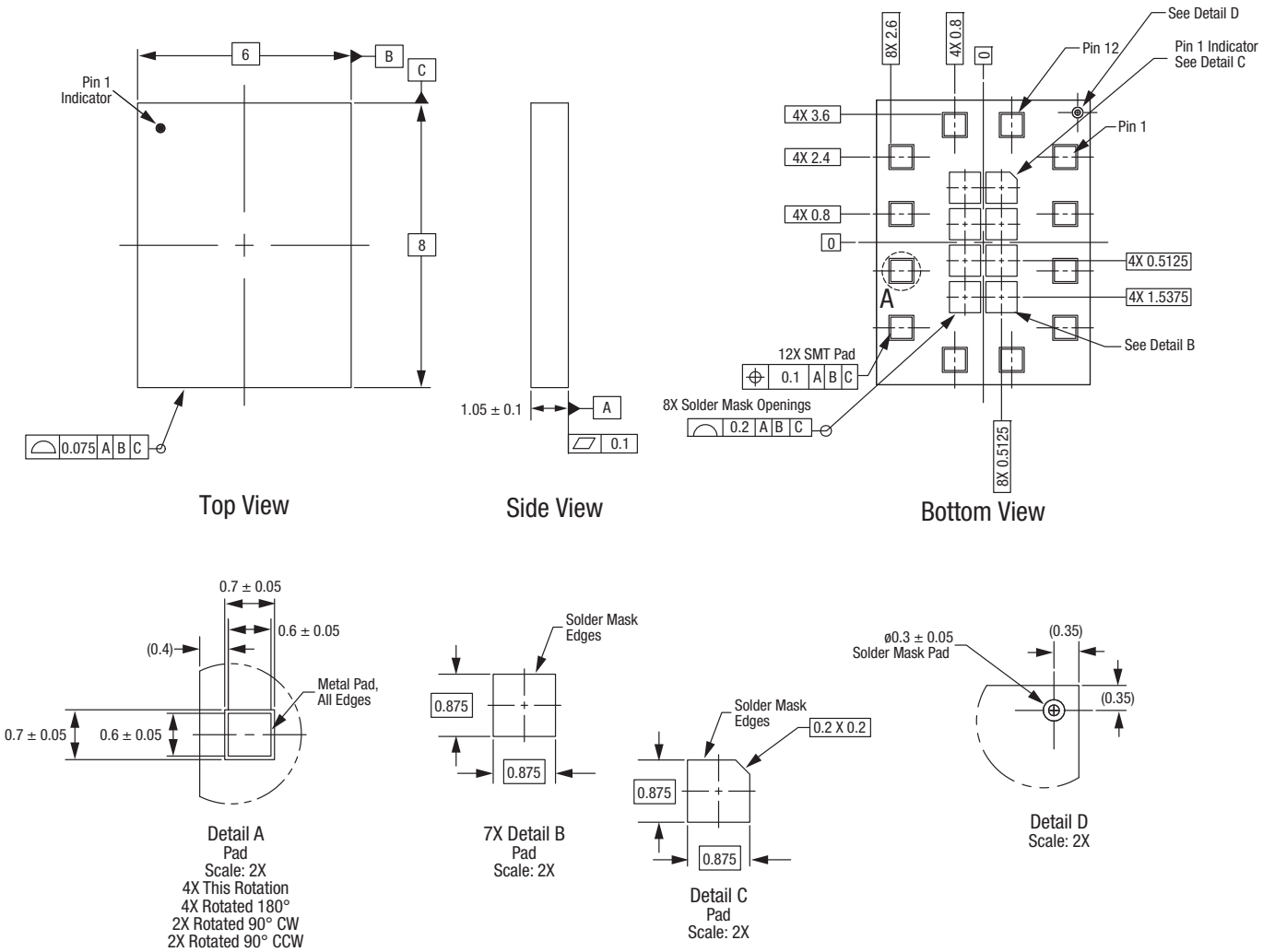


Figure 8. SKY66105-11 PCB Layout Footprint

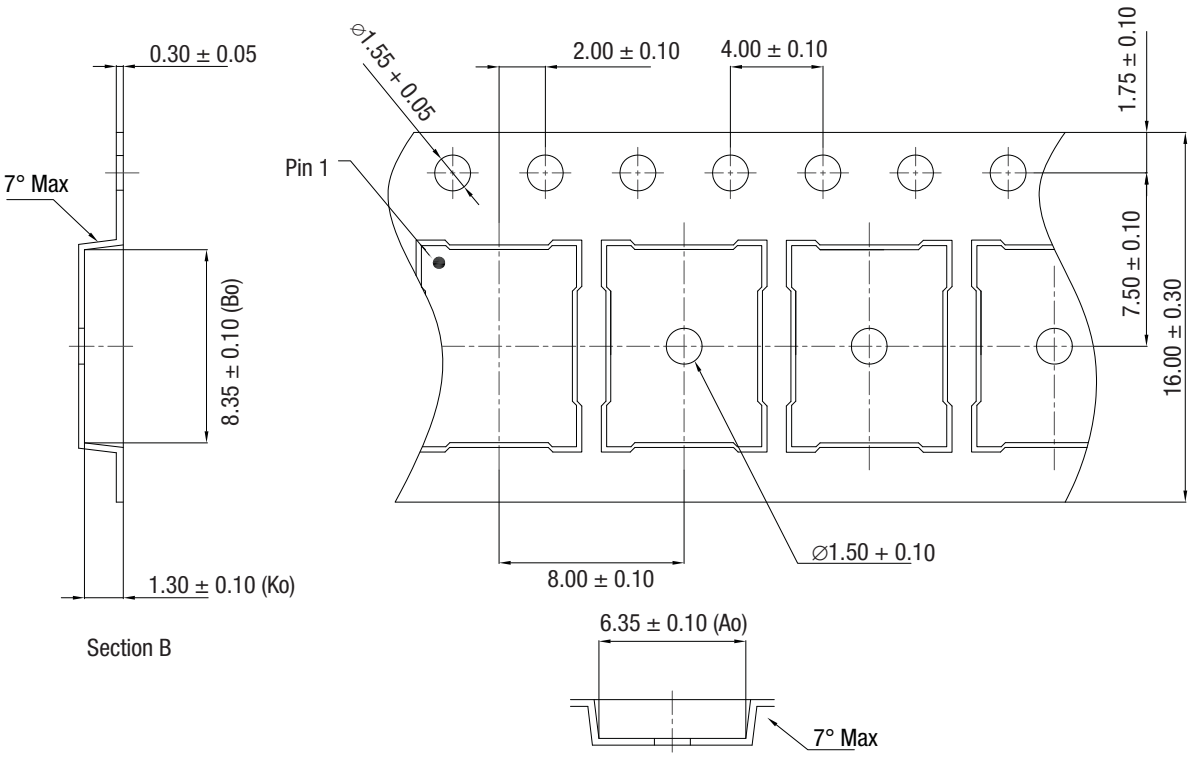


Notes:

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Pad definitions per details on drawing.

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Figure 9. SKY66105-11 Package Dimensions



Notes:

1. *Carrier tape must meet all requirements of Skyworks GP01-D232 procurement spec for tape and reel shipping.*
2. *Carrier tape: black conductive polystyrene.*
3. *Cover tape material: transparent conductive.*
4. *ESD-surface resistivity shall meet GP01-D232.*
5. *10-sprocket hole pitch cumulative tolerance: ±0.20 mm.*
6. *Ao and Bo are measured on plane 0.30 mm above the bottom of the pocket.*
7. *All dimensions are in millimeters.*

202939B-010

Figure 10. SKY66105-11 Tape and Reel Dimensions

Ordering Information

Product Description	Product Part Number	Evaluation Board Part Number
SKY66105-11: 902 to 931 MHz High-Power RF Front-End Module	SKY66105-11	SKY66105-11-EVB

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