SKY65374-11: 1850-1915 MHz High Linearity, Active Bias Low-Noise Variable Gain Amplifier

Applications

- LTE, WCDMA, GSM wireless infrastructure
- Low noise, high linearity systems
- Macro base stations
- Small cells

Features

- Fully integrated low-noise front end
- High gain: 35 dB
- Excellent return loss: >20 dB
- High linearity gain control > 35 dB
- Low NF: 1.0 dB
- Switchable high/low gain state modes
- Temperature and process stable active bias
- Small MCM (16-pin, 8 x 8 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.
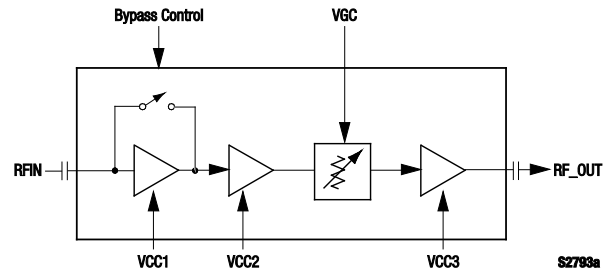

Figure 1. SKY65374-11 Block Diagram

Description

The SKY65374-11 is variable gain Low-Noise Amplifier (LNA) with an active bias and high linearity performance. The first stage of the device is comprised of an LNA with a bypass switch that is followed by a high linearity driver amplifier, a variable voltage attenuator, and a high linearity power amplifier. This module architecture provides excellent return loss, low noise, and high linearity performance.

The internal active bias circuitry ensures repeatable performance over temperature. The device is fully integrated and requires minimal external components.

The SKY65374-11 is manufactured in a compact, 8 x 8 mm, 16-pin Multi-Chip Module (MCM) package. 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.
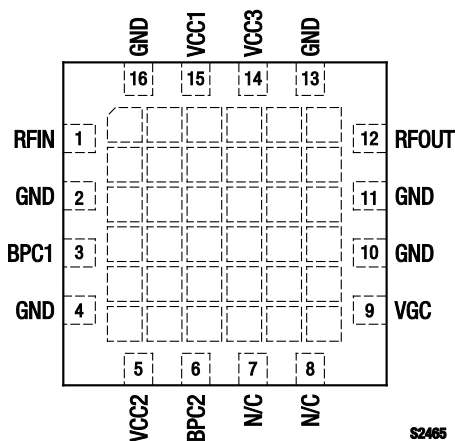

Figure 2. SKY65374-11 Pinout – 16-Pin MCM (Top View)

Table 1. SKY65374-11 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	RFIN	RF input	9	VGC	Gain control, 0 V (maximum gain) to +3.3 V (minimum gain)
2	GND	Ground	10	GND	Ground
3	BPC1	Bypass switch for high/low gain state, terminal 1. See Table 8.	11	GND	Ground
4	GND	Ground	12	RFOUT	RF output
5	VCC2	Second state amplifier bias. Connect to +5 V, 120 mA minimum DC supply.	13	GND	Ground
6	BPC2	Bypass switch for high/low gain state, terminal 2. See Table 8.	14	VCC3	Third stage amplifier bias. Connect to +5 V, 120 mA minimum DC supply.
7	N/C	No connection. Can be left open or grounded.	15	VCC1	First stage amplifier bias. Connect to +5 V, 120 mA minimum DC supply.
8	N/C	No connection. Can be left open or grounded.	16	GND	Ground

Table 2. SKY65374-11 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V_{CC}		5.5	V
RF input power	P_{IN}		+15	dBm
Storage temperature	T_{STG}	−55	+150	°C
Operating temperature	T_C	−40	+100	°C
Junction temperature	T_J		+150	°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.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65374-11 are provided in Table 2. The recommended operating conditions are specified in Table 3. Electrical specifications are provided in Tables 4 through 7. The gain control logic is shown in Table 8.

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Table 3. SKY65374-11 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
RF input power	P_{IN}		−25		dBm
Frequency range	f	1850		1915	MHz
Supply voltage	V_{CC}	4.75	5.00	5.25	V
Gain control voltage	V_{GC}	0		+3.3	V
Bypass control voltage: 　High 　Low	 V_{BPC1} V_{BPC2}	 2.7 0	 3.0 	 3.3 0.6	 V V
Quiescent current	I_{CQ}		350	430	mA
Operating case temperature	T_C	−40		+85	°C

Table 4. SKY65374-11 Electrical Specifications (Note 1)
(V_{DD} = 5.0 V @ Maximum Gain [V_{GC} = V_{BPC1} = 0 V, V_{BPC2} = 3.3 V], T_C = +25 °C, P_{IN} = −25 dBm, f = 1880 MHz,
Characteristic Impedance [Z_0] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
RF Specifications						
Frequency range	f		1850		1915	MHz
Noise Figure (Note 2)	NF	Gain = +35 dB		0.9		dB
Small signal gain	$|S21|$	P_{IN} = −25 dBm		35	39	dB
Gain variation over frequency		P_{IN} = −25 dBm		0.8		dB
Gain control range: 　High (BPC1 = 0, BPC2 = 1) 　Low (BPC1 = 1, BPC2 = 0)		P_{IN} = −25 dBm	 18 3		 35 17	 dB dB
Input return loss	$|S11|$	P_{IN} = −25 dBm		20		dB
Output return loss	$|S22|$	P_{IN} = −25 dBm		16		dB
Reverse isolation	$|S12|$	P_{IN} = −25 dBm		60		dB
3rd Order Input Intercept Point (Note 3)	IIP3	Δf = 1 MHz, P_{IN} = −25 dBm/tone, gain = +35 dB		+1		dBm
1 dB Input Compression Point (Note 4)	IP1dB	Gain = +35 dB		−8		dBm

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

Note 2 Loss from the input SMA connector and Evaluation Board up to pin 1 has been de-embedded from the NF measurement. See Table 4 for full specifcation.

Note 3: See Table 5 for full specification.

Note 4: See Table 6 for full specification.

Table 5. SKY65374-11 Electrical Specifications: Noise Figure (Note 1)
(V$_{DD}$ = 5.0 V, T$_C$ = +25 °C, P$_{IN}$ = −25 dBm, f = 1880 MHz, Characteristic Impedance [Z$_0$] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Noise Figure	NF	Low gain mode:				
		Gain = 3 to 6 dB			22.80	dB
		Gain = 7 to 8 dB			20.80	dB
		Gain = 9 to 10 dB			18.80	dB
		Gain = 11 to 12 dB			16.80	dB
		Gain = 13 to 14 dB			14.80	dB
		Gain = 15 to 16 dB			12.80	dB
		Gain = 17 dB			10.80	dB
		High gain mode:				
		Gain = 18 dB			10.80	dB
		Gain = 19 to 20 dB			1.80	dB
		Gain = 21 to 22 dB			7.30	dB
		Gain = 23 to 24 dB			5.30	dB
		Gain = 25 to 26 dB			3.50	dB
		Gain = 27 to 28 dB			2.40	dB
		Gain = 29 to 30 dB			2.10	dB
		Gain = 31 to 32 dB			1.60	dB
		Gain = 33 to 34 dB			1.35	dB
		Gain = 35 dB			1.25	dB

Note 1: Verified by characterization.

Table 6. SKY65374-11 Electrical Specifications: IIP3 (Note 1)
(V$_{DD}$ = 5.0 V, T$_C$ = +25 °C, P$_{IN}$ = −25 dBm, f = 1880 MHz, Characteristic Impedance [Z$_0$] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
3rd Order Input Intercept Point	IIP3	Low gain mode:				
		Gain = 3 to 11 dB	+18			dBm
		Gain = 12 to 17 dB	+14			dBm
		High gain mode:				
		Gain = 18 to 29 dB	+3			dBm
		Gain = 30 to 35 dB	+1			dBm

Note 1: Verified by characterization.

Table 7. SKY65374-11 Electrical Specifications: IP1dB (Note 1)
(V$_{DD}$ = 5.0 V, T$_C$ = +25 °C, P$_{IN}$ = −25 dBm, f = 1880 MHz, Characteristic Impedance [Z$_0$] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
1 dB Input Compression Point	IP1dB	Low gain mode:				
		Gain = 3 to 5 dB	+10.5			dBm
		Gain = 5 to 11 dB	+8.0			dBm
		Gain = 12 to 17 dB	+4.0			
		High gain mode:				dBm
		Gain = 18 to 29 dB	−7.0			dBm
		Gain = 30 to 35 dB	−14.0			dBm

Note 1: Verified by characterization.

Table 8. Gain Control Logic

	BPC1 (Pin 3)	BPC2 (Pin 6)
High gain	0	1
Low gain	1	0

Note: "1" = 3.0 V, "0" = 0 V.

Evaluation Board Description

The SKY65374-11 Evaluation Board is used to test the performance of the SKY65374-11 LNA. An assembly drawing for the Evaluation Board is shown in Figure 3 and the layer detail is provided in Figure 4. The layer detail physical characteristics are noted in Figure 5.

An Evaluation Board schematic diagram is provided in Figure 6. Table 9 provides the Bill of Materials (BOM) list for Evaluation Board components.

Package Dimensions

The PCB layout footprint for the SKY65374-11 is provided in Figure 7. Package dimensions for the 16-pin MCM 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 SKY65374-11is 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 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.
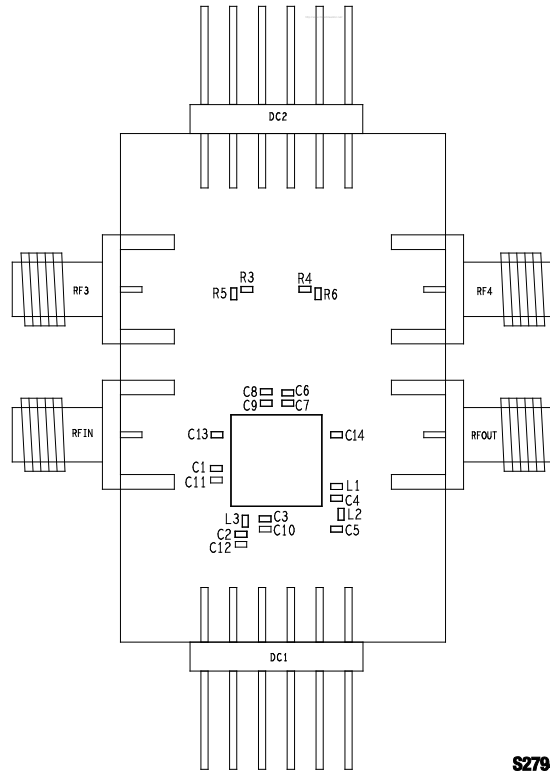
Figure 3. SKY65374-11 Evaluation Board Assembly Diagram
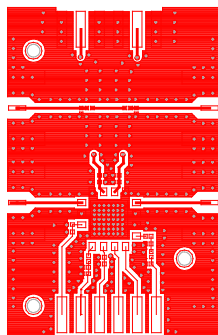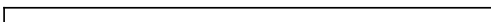
Layer 1: Top – Metal
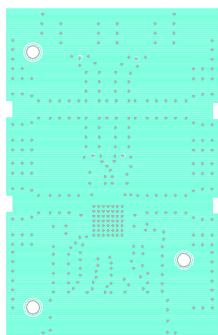
Layer 2: Ground
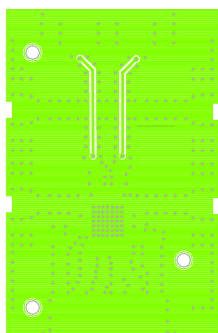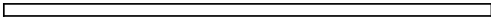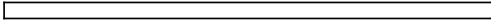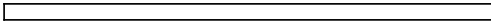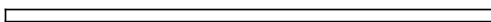
Layer 3: Signal
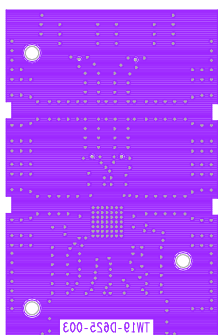
Layer 4: Solid Ground Plane

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Figure 4. SKY65374-11 Evaluation Board Layer Detail

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Cross Section

Name	Thickness (mm)	Material
Tmask	0.010	Solder Resist
L1	0.035	Cu – 1 oz
Dielectric	0.250	RO4350
L2	0.035	Cu – 1 oz
Dielectric	0.900	FR4
L3	0.035	Cu – 1 oz
Dielectric	0.250	FR4
L4	0.200	Cu – 1 oz
Bmask	0.010	Solder Resist

S2796

Figure 5. Layer Detail Physical Characteristics
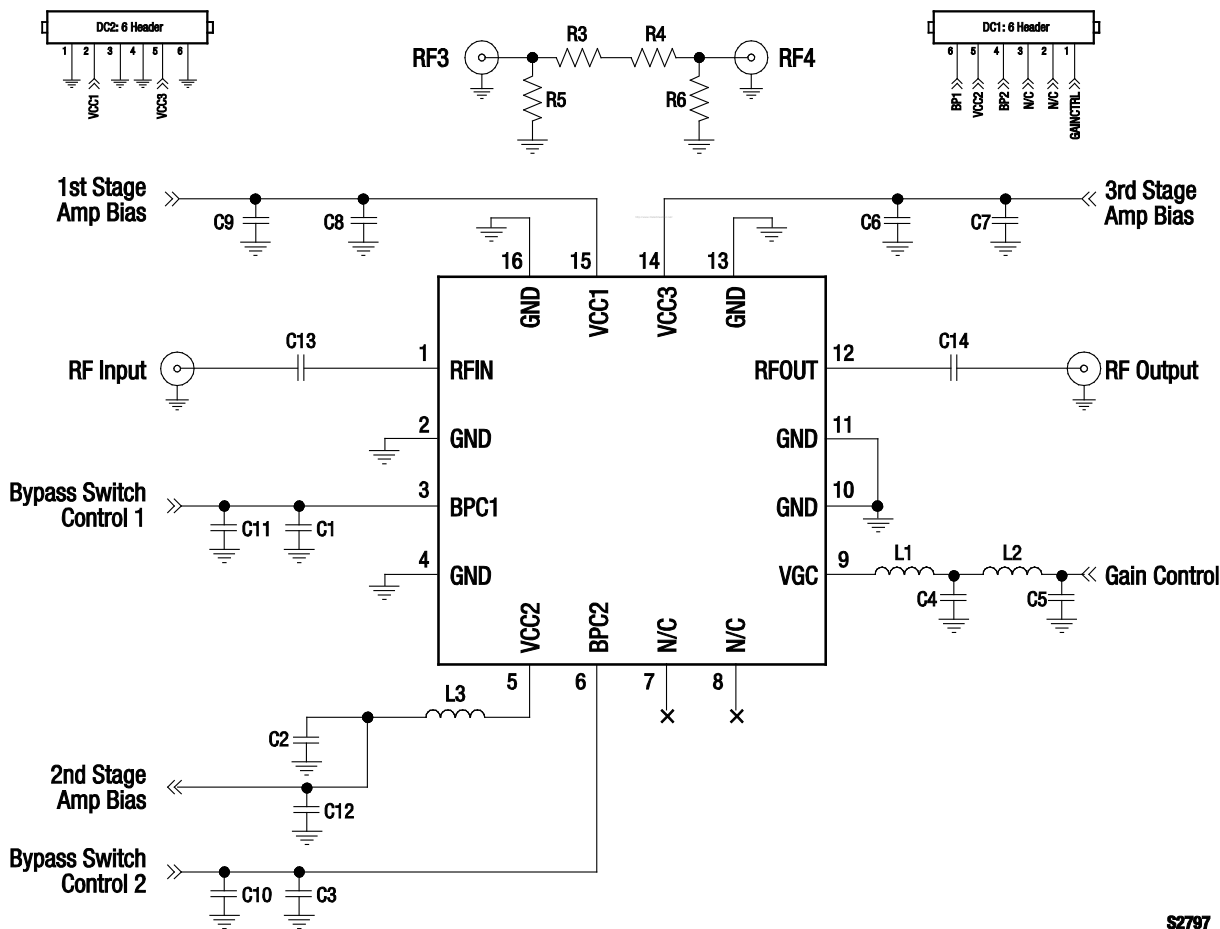
Figure 6. SKY65374-11 Evaluation Board Schematic

Table 9. SKY65374-11 Evaluation Board Bill of Materials

Component	Size	Value	Vendor	Part Number
*** TBD ***				

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Figure 7. SKY65374-11 PCB Layout Footprint
(Top View)
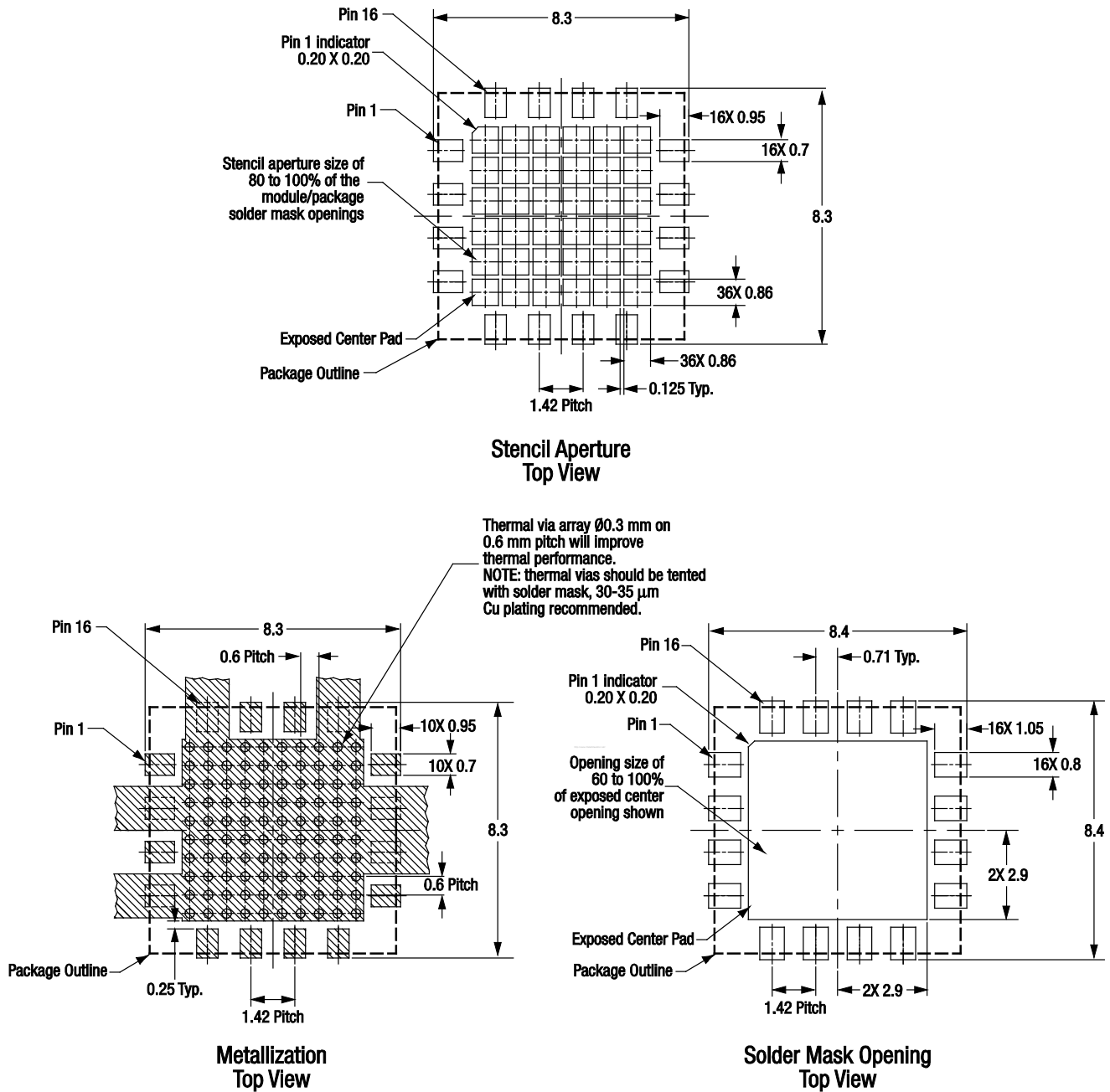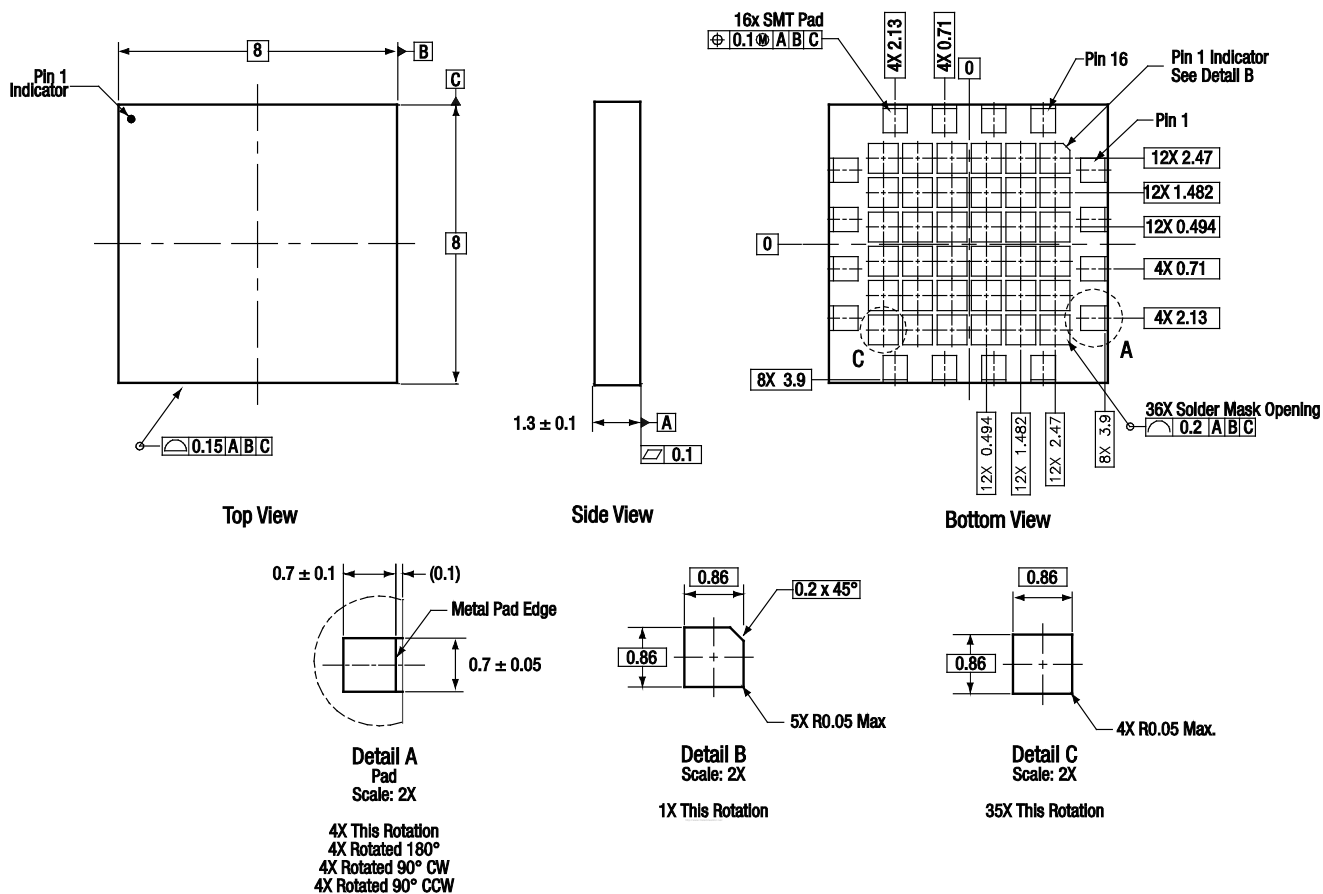
All dimensions are in millimeters

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Figure 8. SKY65374-11 16-Pin MCM Package Dimensions

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Notes:
1. *Carrier tape: black conductive polycarbonate.*
2. *Cover tape material: transparent conductive PSA.*
3. *Cover tape size: 21.3 mm width.*
4. *All dimensions are in millimeters.*
5. *ESD-surface resistivity is ≤1 x 10^{10} Ohms/square per EIA, JEDEC TNR Specification.*
6. *Po/P1 10 pitches cumulative tolerance on tape: ±0.20 mm.*
7. *Ao & Bo measurement point to be 0.30 mm from bottom pocket.*
8. *Pin 1 orientation is in top left corner for the following Skyworks products:*

   SKY77506-XX
   SKY77512-XX
   SKY77526-XX
   SKY77343-XX

   For all other 8 x 8 mm MCM/RFLGA products, pin 1 orientation is in top right corner.

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Figure 9. SKY65374-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY65374-11 LNA	SKY65374-11	TW19-D620

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