

**DATA SHEET**

# SKY66184-11: 2110 to 2170 MHz Linear Power Amplifier

## Applications

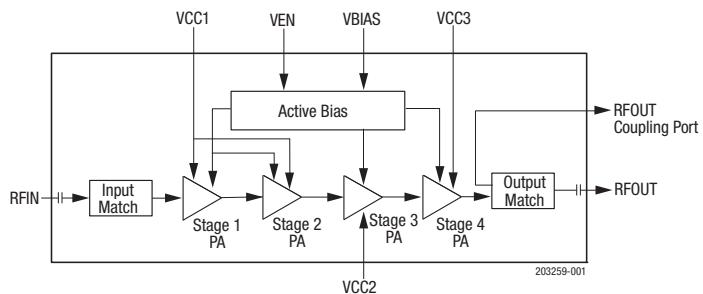
- 3G/4G LTE Band 1, 4, and 10 small cell
- Active distributed antenna system
- Cellular repeaters
- Driver amplifier

## Features

- High gain: 39.0 dB (unconditionally stable)
- High linearity: +23 dBm with  $-50$  dBc ACLR @ 85°C (WCDMA Test Model 1 with 64 DPCH)
- RF input and output internally matched to  $50\ \Omega$
- Excellent output return loss:  $< -17$  dB
- Integrated active bias: performance compensated over temp
- PA On/Off function: 2.5  $\mu$ s switching time
- Integrated coupler for output power monitoring
- Single supply voltage: 3.3 V
- Minimal external components
- Pin-to-pin compatible PA family supporting all 3GPP bands
- Small 5 x 5 mm, 28-pin package (MSL3, 260 °C per JEDEC J-STD-020)



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**Figure 1. SKY66184-11 Linear PA Block Diagram**

## Description

SKY66184-11 is a high-linearity power amplifier (PA) with fully matched input/output and high gain. The compact 5 x 5 mm PA is designed for FDD 3G/4G LTE small cell base stations operating from 2100 to 2200 MHz. The active biasing circuitry is integrated to compensate PA performance over temperature, voltage, and process variation as well as an internal coupler for power monitoring.

The SKY66184-11 requires minimal external components and is part of a high-linearity, pin-to-pin compatible PA family supporting all 3GPP bands.

A block diagram of the SKY66184-11 is shown in Figure 1. The device package and pinout for the 28-pin device are shown in Figure 2. Table 1 lists the pin-to-pin compatible parts in the PA family.

**Table 1. Pin-to-Pin Compatible PA Family**

Part Number	Frequency (MHz)	LTE Band
SKY66180-11	790 to 821	20
SKY66181-11	1805 to 1880	3
SKY66182-11	2300 to 2400	30, 40
SKY66183-11	3400 to 3600	22, 42
SKY66184-11	2110 to 2170	1, 4, and 10
SKY66185-11	851 to 894	5, 6, 18, 19, 26, and 27
SKY66186-11	728 to 768	12, 13, 14, and 17
SKY66187-11	2620 to 2690	7
SKY66188-11	758 to 803	28
SKY66189-11	1930 to 1995	2, 25

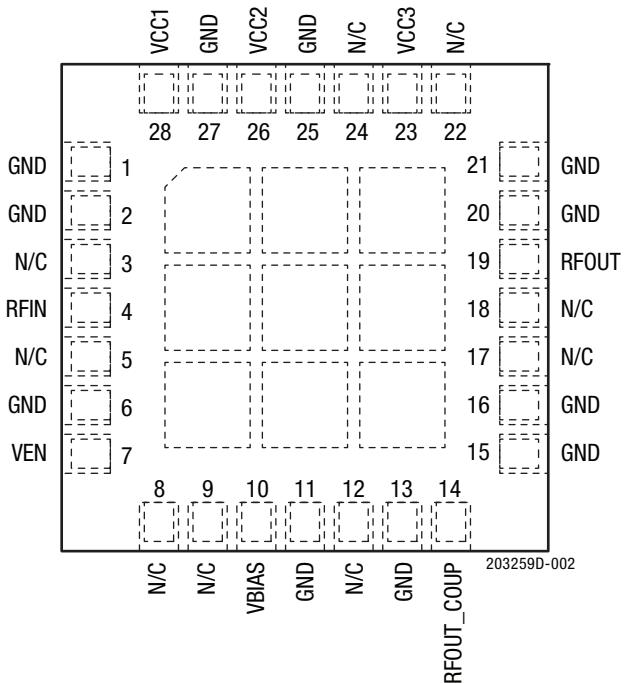


Figure 2. SKY66184-11 Pinout (Top View)

Table 2. SKY66184-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	GND	Ground	15	GND	Ground
2	GND	Ground	16	GND	Ground
3	N/C	No internal connection	17	N/C	No internal connection
4	RFIN	RF input	18	N/C	No internal connection
5	N/C	No internal connection	19	RFOUT	RF output
6	GND	Ground	20	GND	Ground
7	VEN	Enable (active low)	21	GND	Ground
8	N/C	No internal connection	22	N/C	No internal connection
9	N/C	No internal connection	23	VCC3	Output stage supply voltage
10	VBIAS	Bias voltage	24	N/C	No internal connection
11	GND	Ground	25	GND	Ground
12	N/C	No internal connection	26	VCC2	Stage 2 PA supply voltage
13	GND	Ground	27	GND	Ground
14	RFOUT_COUP	RF output coupling port	28	VCC1	Input stage supply voltage

## Technical Description

The SKY66184-11 PA contains all of the needed RF matching and DC biasing circuits. This three-stage device is optimized for high linearity and power efficiency. These features make the device suitable for wideband applications where PA linearity and power consumption are of critical importance (e.g., small cell and infrastructure applications).

The device is designed for standard WCDMA and LTE modulated signals. Under these stringent test conditions, the device exhibits excellent spectral purity and power efficiency.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66184-11 are provided in Table 3. The recommended operating conditions are specified in Table 4, and electrical specifications are provided in Table 5.

Typical performance characteristics are shown in Figures 3 through 6.

**Table 3. SKY66184-11 Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage (VCC)	VCC	0	+4.0	V
Total supply current	I <sub>CC</sub>		1400	mA
Logic control input voltage (V <sub>EN</sub> )	V <sub>EN</sub>	-0.5	3.6	V
Case operating temperature <sup>2</sup>	T <sub>C</sub>	-40	+98	°C
Storage temperature	T <sub>TSG</sub>	-55	+150	°C
Junction temperature	T <sub>J</sub>		+150	°C
Thermal resistance	θ <sub>JC</sub>		23	°C/W
Power dissipation	P <sub>D</sub>		4.6	W
Electrostatic discharge:	ESD			
Charged Device Model (CDM)			500	V
Human Body Model (HBM)			150	V

<sup>1</sup> 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.

<sup>2</sup> Case operating temperature (T<sub>C</sub>) refers to the temperature of the bottom ground pad.

**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 4. SKY66184-11 Recommended Operating Conditions**

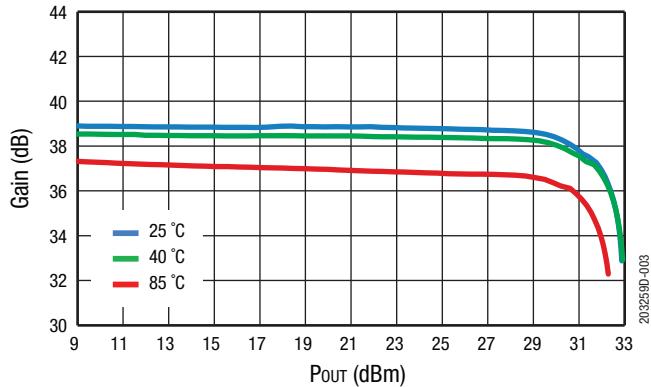
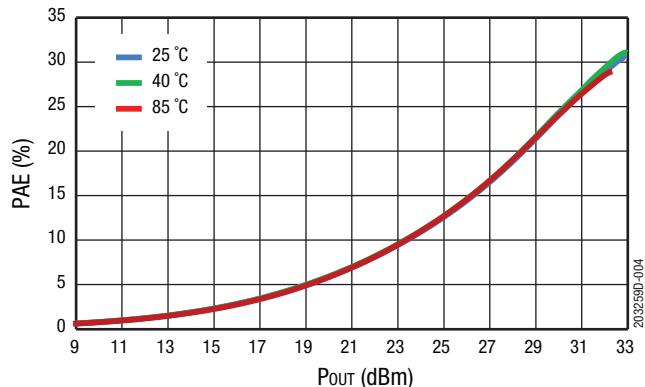
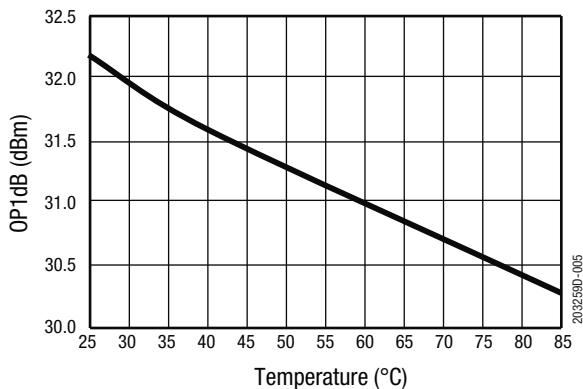
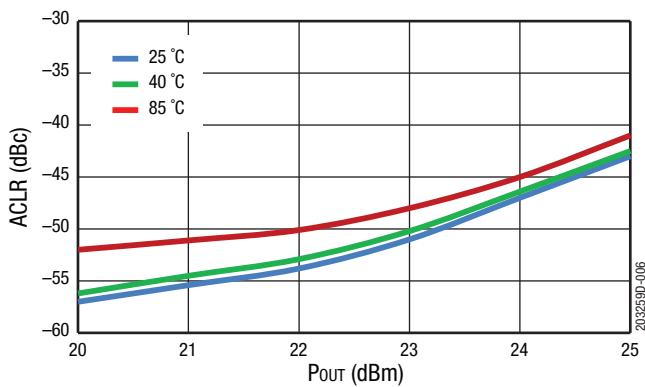
Parameter	Symbol	Minimum	Typical	Maximum	Units
Frequency range	f	2110		2170	MHz
Supply voltage (VCC1, VCC2, VCC3) <sup>1</sup>	V <sub>CC</sub>	3.0	3.3	3.6	V
PA enable control voltage (active low):					
Disable	V <sub>ENH</sub>	2.5		3.6	V
Enable	V <sub>ENL</sub>	0		0.6	V
PA enable current (@ PAEN = 3.6 V)	I <sub>EN</sub>			3.0	mA
Case operating temperature	T <sub>C</sub>	+25	+40	+85	°C

<sup>1</sup> Voltage levels measured at the pads of the package. The Evaluation Board supply voltage levels may be different.

**Table 5. SKY66184-11 Electrical Specifications<sup>1</sup>**( $V_{CC} = +3.3$  V,  $T_c = +25$  °C,  $f = 2140$  MHz, Characteristic Impedance  $[Z_0] = 50$  Ω,  $V_{EN} = 0$  V, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Gain	$G @ 23$ dBm	CW, $P_{OUT} = +23$ dBm	38.0	39.0		dB
Input return loss	$ S_{11} $	CW, $P_{IN} = -30$ dBm	8	10		dB
Output return loss: In-band Out-of-band	$ S_{22} $	CW, $P_{IN} = -30$ dBm: In-band frequency: 2.11 and 2.17 GHz Out-of-band frequency: 2.03 and 2.25 GHz	12 10	17.5 14		dB dB
Quiescent current	$I_{CQ}$	No RF		400	460	mA
Operating current	$I_{CC}$	CW, $P_{OUT} = +23$ dBm		650	730	mA
Power-down current	$I_{PD}$	$V_{EN} = 2.5$ V		1.5	2.5	mA
Adjacent channel leakage ratio	ACLR	5 MHz offset, WCDMA test model 1, with 64 DPCH, 8.5 dB PAR, $P_{OUT} = +23$ dBm		-50	-47	dBc
Output 1 dB compression point	$OP_{1dB}$	CW (Gain compression less than 1dB reference to $G@23$ dBm)	+30.3	+31		dBm
Power added efficiency	PAE	CW @ $P_{OUT} = +23$ dBm	7.5	9.5		%
Output coupling factor	$CPL_{OUT}$	$P_{OUT} = +23$ dBm, CW	19	21	23	dB

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

**Typical Performance Characteristics**(V<sub>CC</sub> = +3.3 V, T<sub>C</sub> = +25 °C, f = 2140 MHz, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, V<sub>EN</sub> = 0 V, Unless Otherwise Noted)**Figure 3. Gain vs Output Power****Figure 4. PAE vs Output Power****Figure 5. OP1dB vs Temperature****Figure 6. ACLR vs Output Power**

## Evaluation Board Description

The SKY66184-11 Evaluation Board is used to test the performance of the SKY66184-11 PA. A typical application schematic diagram is shown in Figure 7. A Bill of Materials for the SKY66184-11 Evaluation Board is listed in Table 6. An assembly drawing for the Evaluation Board is shown in Figure 8. The board layer detail is shown in Figure 9. The layer detail physical characteristics are shown in Figure 10.

## Application Circuit Notes

**Center Ground.** It is extremely important to sufficiently ground the bottom ground pad of the device for both thermal and stability reasons. Multiple small vias are acceptable and work well under the device if solder migration is an issue.

**GND (pins 1, 2, 6, 11, 13, 15, 16, 20, 21, 25, and 27).** Attach all ground pins to the RF ground plane with the largest diameter and lowest inductance via that the layout allows. Multiple small vias are acceptable and work well under the device if solder migration is an issue.

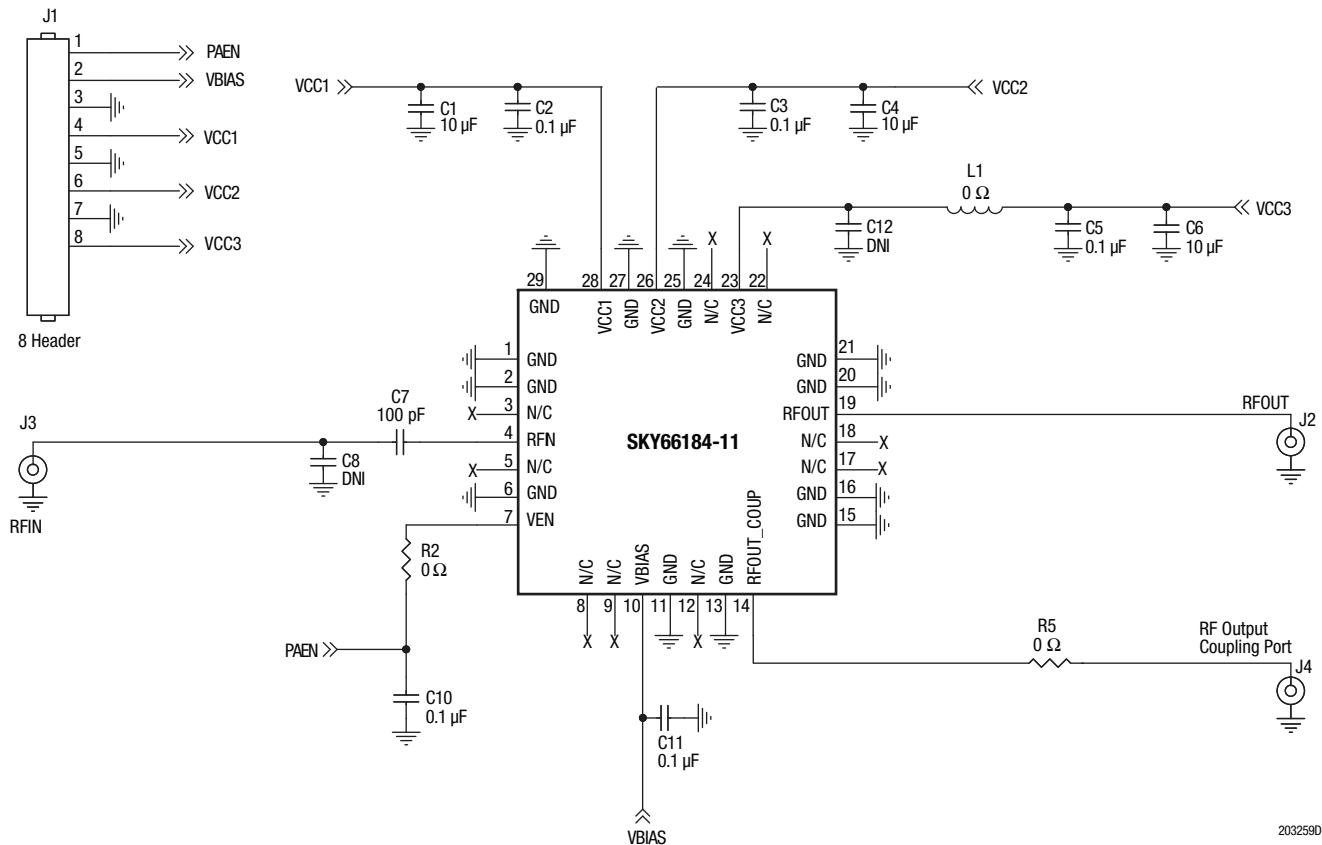
**VBIAS (pin 10).** The bias supply voltage for each stage, nominally set to +3.3 V.

**RFOUT (pin 19).** Amplifier RF output pin ( $Z_0 = 50 \Omega$ ). The module includes an onboard internal DC blocking capacitor. All impedance matching is provided internal to the module.

**VCC1, VCC2, and VCC3 (pins 28, 26, and 23, respectively).**

Supply voltage for each stage collector bias is nominally set to 3.3 V. Bypass and decoupling capacitors C1, C2, C3, C4, C5, and C6 should be placed in the approximate location shown on the evaluation board assembly drawing, although exact placement is not critical.

**RFIN (pin 4).** Amplifier RF input pin ( $Z_0 = 50 \Omega$ ). The module includes an onboard internal DC blocking capacitor. All impedance matching is provided internal to the module.

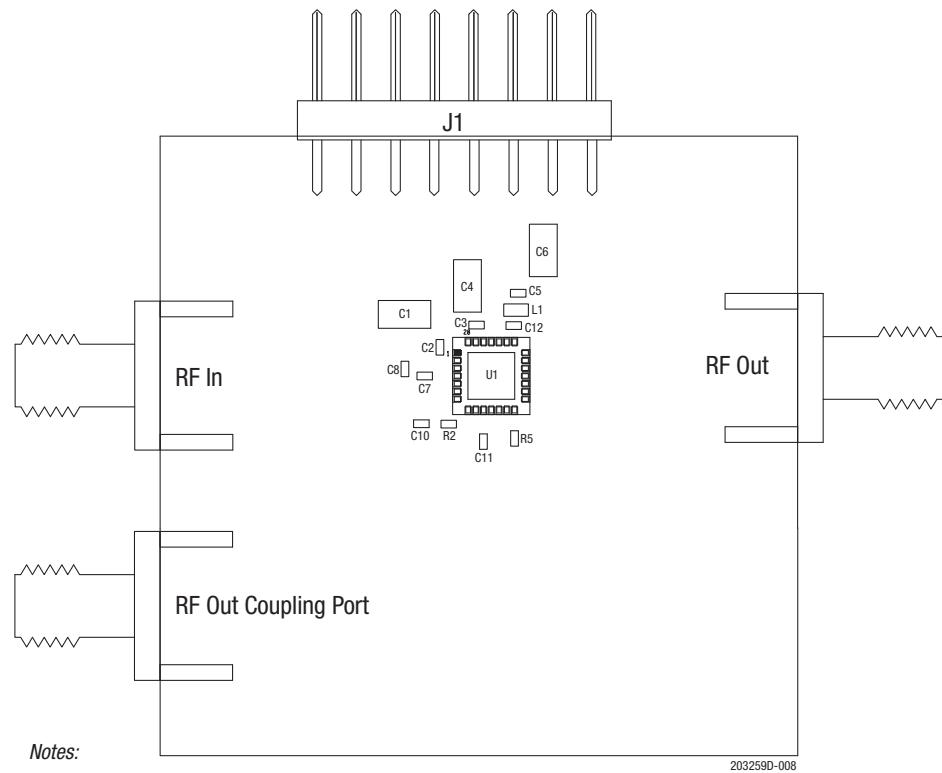


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Figure 7. SKY66184-11 Application Schematic

Table 6. SKY66184-11 Evaluation Board Bill of Materials (BOM)

Quantity	Component	Size	Part Number	Description
3	C1, C4, C6	1206	C1206X7R160-106KNE	Capacitor, 10 µF, 16 V, ±10%, X7R
5	C2, C3, C5, C10, C11	0402	GRM155R71C104KA88	Ceramic capacitor, 0.1 µF, 10%, X7R, 16 V
1	C7	0402	GRM1555C1H101JZ01J	Capacitor, 100 pF, 50 V, 5%, COG/NPO
2	C8, C12		DNI	DNI
1	L1	0603	RM73ZLJ000	Resistor, 0 Ω, 5%
2	R2, R5	0402	ERJ2GE0R00	Resistor, 0 Ω, jumper, 0.063 W



**Figure 8. SKY66184-11 Evaluation Board Assembly Diagram**

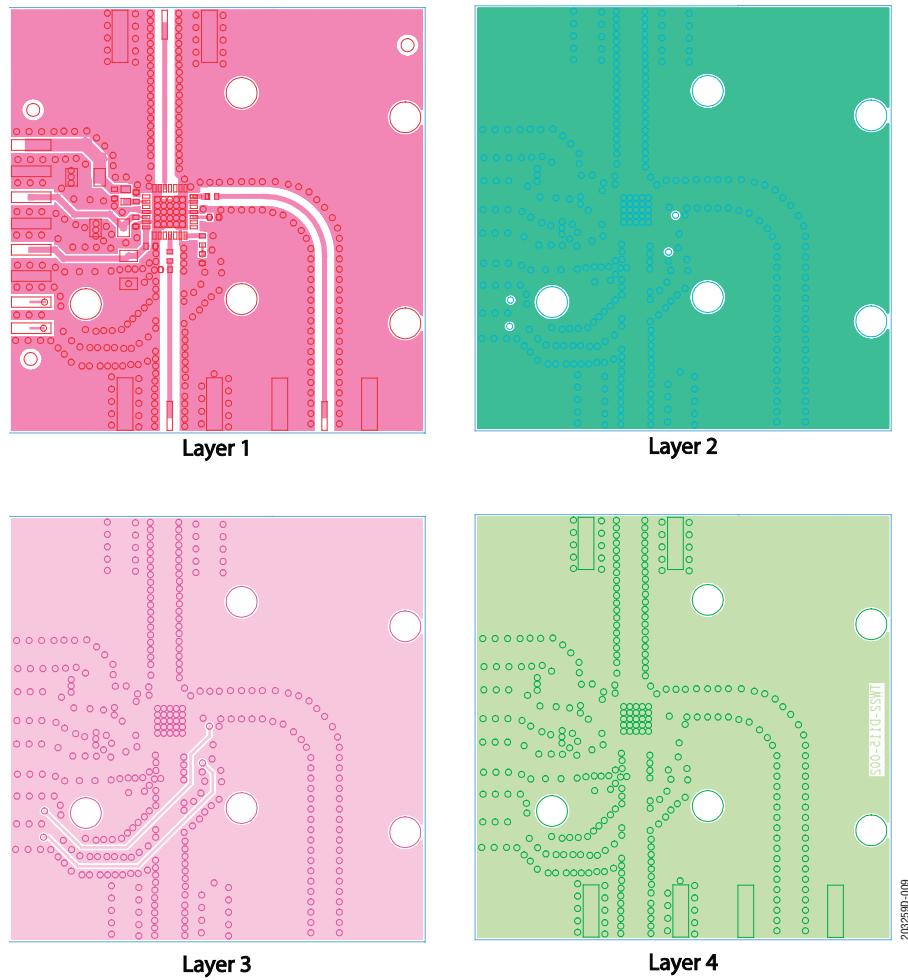


Figure 9. SKY66184-11 Board Layer Detail

Cross Section	Name	Thickness (mm)	Material
Solid line	Top Solder Mask	0.010	Solder Resist
Line with cross-hatch	L1	0.035	Cu – 1 oz
Line with diagonal hatching	Dielectric	0.250	Rogers R04350B
Line with cross-hatch	L2	0.035	Cu – 1 oz
Line with diagonal hatching	Dielectric	0.500	FR4
Line with cross-hatch	L3	0.035	Cu – 1 oz
Line with diagonal hatching	Dielectric	0.250	FR4
Line with cross-hatch	L4	0.035	Cu – 1 oz
Solid line	Bottom Solder Mask	0.010	Solder Resist

203259D-010

Figure 10. SKY66184-11 Layer Detail Physical Characteristics

## Package Dimensions

The typical part marking is shown in Figure 11. Figure 12 shows the PCB layout footprint. Figure 13 shows the package dimensions, and Figure 14 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 SKY66184-11 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.

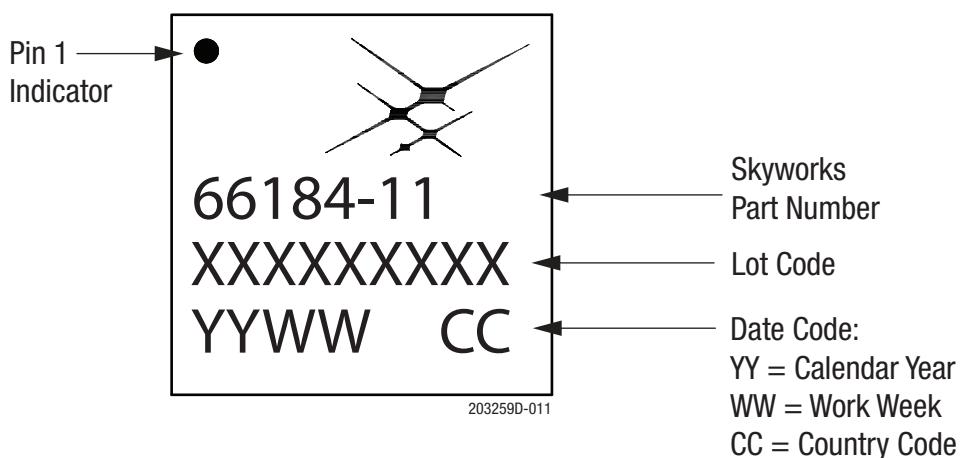


Figure 11. Typical Part Marking

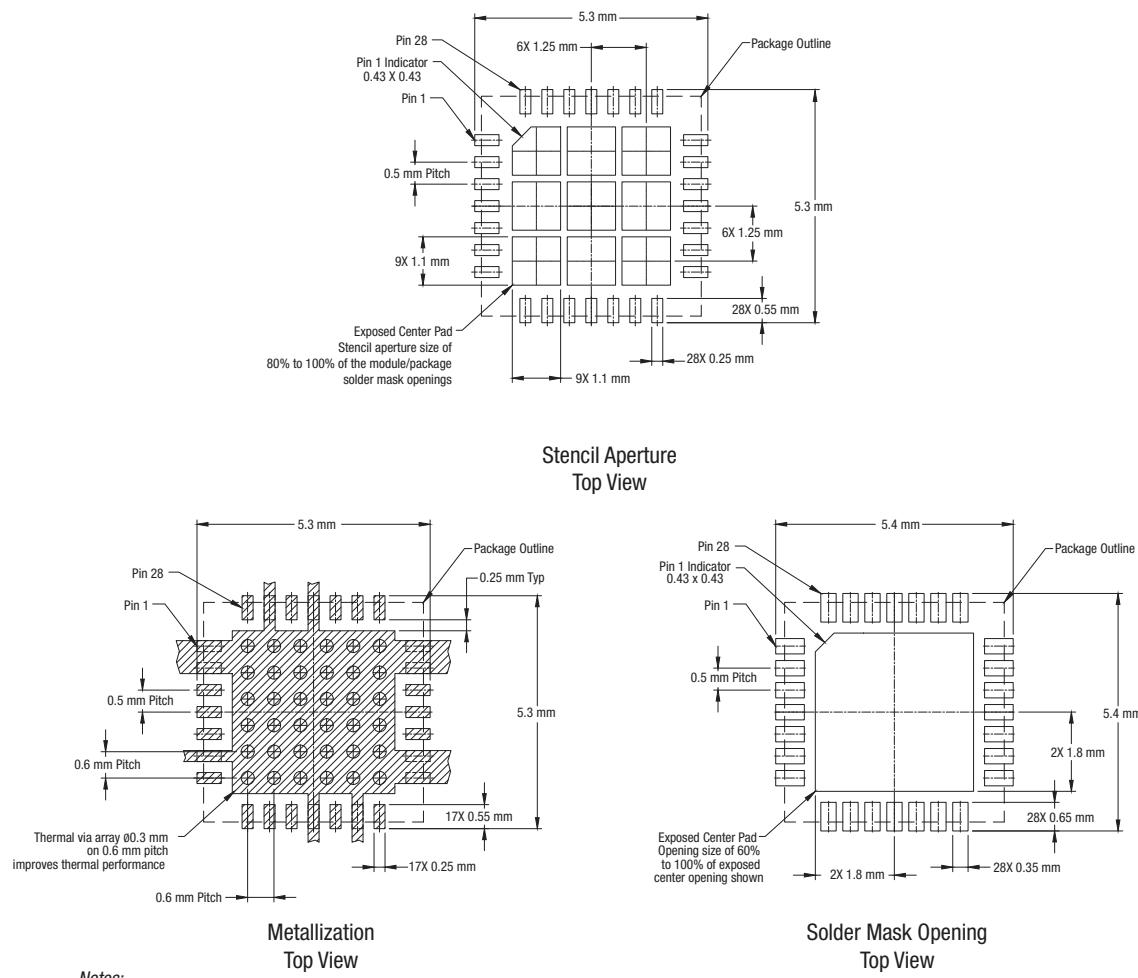
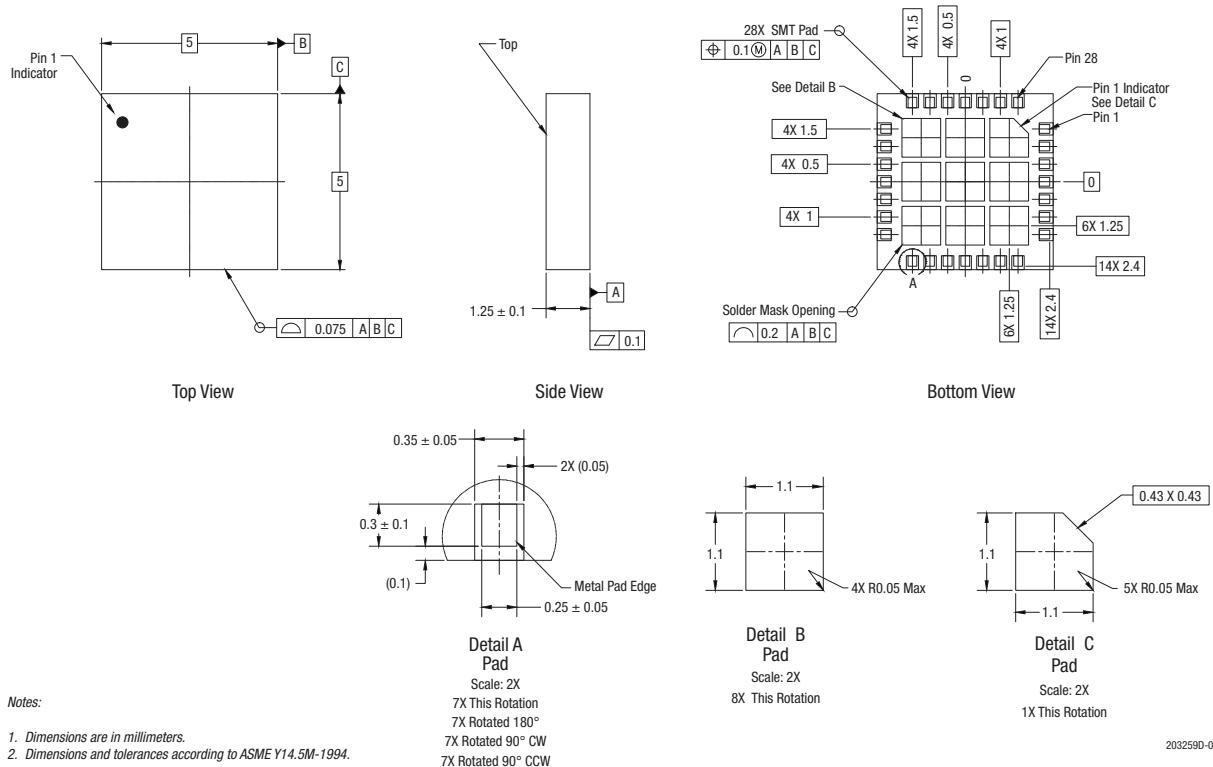


Figure 12. SKY66184-11 PCB Layout Footprint

## Notes:

1. Thermal vias should be resin filled and capped in accordance with IPC-4761 type VII vias.
2. Recommended Cu thickness is 30 to 35  $\mu$ m.

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**Figure 13. SKY66184-11 Package Dimensions**

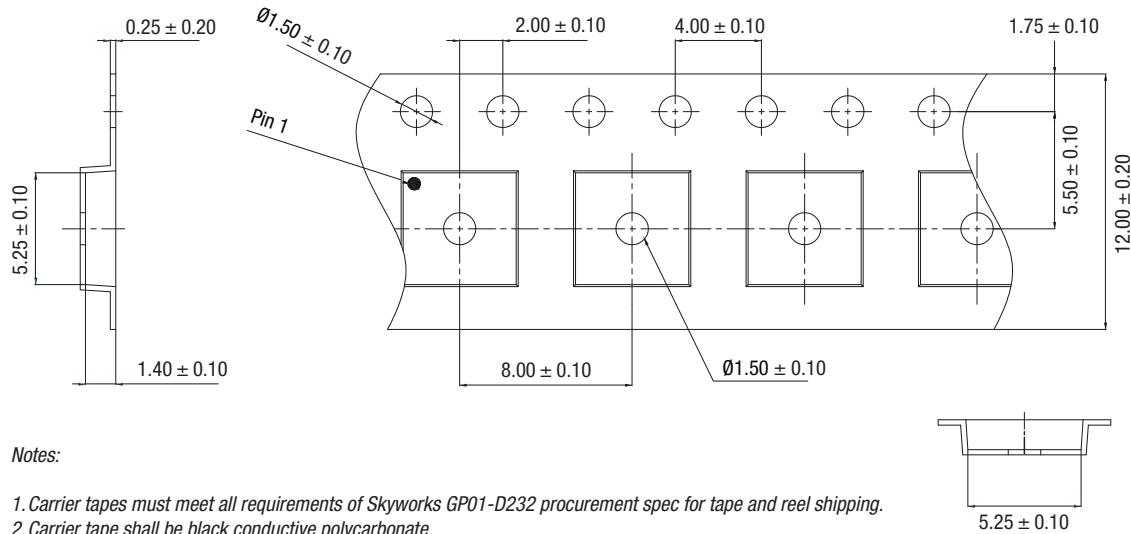


Figure 14. SKY66184-11 Tape and Reel Dimensions

## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY66184-11: Linear PA	SKY66184-11	TW22-D110

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