

DATA SHEET

# SKY67154-396LF: 0.7 to 3.8 GHz Ultra-Low-Noise Amplifier

## Applications

- LTE, GSM, WCDMA, HSDPA macro-base and micro-base stations
- L and S band ultra-low-noise receivers
- Cellular repeaters, DAS, and RRH/RRUs
- High-temperature transceiver applications to +105 °C

## Features

- Ultra-low Evaluation Board NF:
  - 0.45 dB @ 849 MHz
  - 0.55 dB @ 1850 MHz
  - 0.65 dB @ 2500 MHz
  - 0.9 dB @ 3600 MHz
- High OIP3 performance: >+38 dBm over 700 to 3800 MHz
- Adjustable supply current from 30 to 100 mA
- Flexible bias voltage: 3 to 5 V
- Temperature and process-stable active bias
- Miniature DFN (8-pin, 2 x 2 mm) package (MSL1 @ 260 °C per JEDEC J-STD-020)



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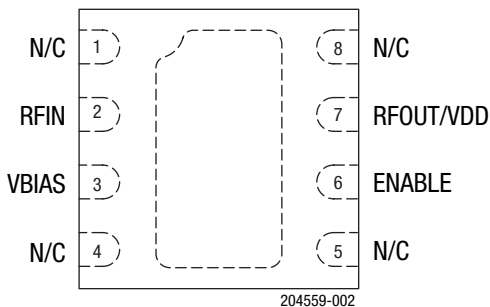


Figure 2. SKY67154-396LF Pinout (Top View)

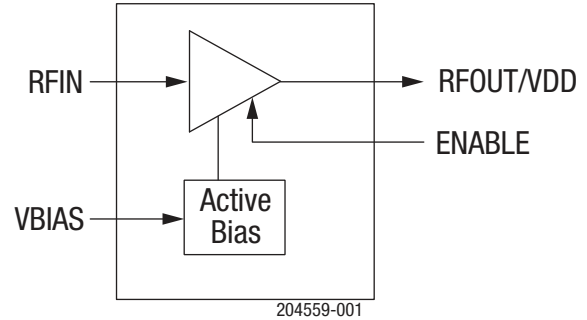


Figure 1. SKY67154-396LF Block Diagram

## Description

The SKY67154-396LF is GaAs, pHEMT low-noise amplifier (LNA) with an active bias, high linearity, superior gain, and industry-leading noise figure (NF) performance from 700 to 3800 MHz. The device features Skyworks advanced, pHEMT enhancement mode process in a compact 2 x 2 mm, 8-pin Dual Flat No-Lead (DFN) package.

The internal active bias circuitry provides stable performance over temperature and process variation. The device offers the ability to externally adjust supply current. Supply voltage is applied to the RFOUT/VDD pin through an RF choke inductor. The RFIN and RFOUT/VDD pins should be DC blocked to ensure proper operation.

The SKY67154-396LF operates in the frequency range of 0.7 to 3.8 GHz using a common layout and band-specific tunes.

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.

**Table 1. SKY67154-396LF Signal Descriptions**

Pin	Name	Description	Pin	Name	Description
1	N/C	No connection. May be connected to ground with no change in performance.	5	N/C	No connection. May be connected to ground with no change in performance.
2	RFIN	RF input. DC blocking capacitor required.	6	ENABLE	Enable pin. Active low = amplifier “on” state
3	VBIAS	Bias voltage for input gate. External resistor sets current consumption.	7	RFOUT/VDD	RF output. Apply VDD through RF choke inductor. DC blocking capacitor required.
4	N/C	No connection. May be connected to ground with no change in performance.	8	N/C	No connection. May be connected to ground with no change in performance.

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY67154-396LF are provided in Table 2.

Electrical specifications are provided in Tables 3 and 4.

**Table 2. SKY67154-396LF Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V <sub>DD</sub>		5.5	V
Quiescent supply current	I <sub>DQ</sub>		120	mA
RF input power	P <sub>IN</sub>		+21	dBm
Storage temperature	T <sub>STG</sub>	-40	+150	°C
Operating temperature	T <sub>A</sub>	-40	+105	°C
Junction temperature	T <sub>J</sub>		+150	°C
Electrostatic discharge:	ESD			
Charged Device Model (CDM), Class C3			1000	V
Human Body Model (HBM), Class 1B			500	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.

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**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.*

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**Table 3. SKY67154-396LF Electrical Specifications: Thermal Data<sup>1</sup>****(V<sub>DD</sub> = 5 V, T<sub>A</sub> = +25 °C, P<sub>IN</sub> = -25 dBm, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Thermal resistance	Θ <sub>JC</sub>			45		°C/W
Channel temperature @ +85 °C reference (package heat slug)		V <sub>DD</sub> = 5 V, I <sub>DQ</sub> = 70 mA, no RF applied, dissipated power = 0.35 W		101		°C

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.**Table 4. SKY67154-396LF Electrical Specifications: 2300 to 2700 MHz Optimized Tuning<sup>1</sup>****(V<sub>DD</sub> = 5 V, T<sub>A</sub> = +25 °C, P<sub>IN</sub> = -20 dBm, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>RF Specifications</b>						
Noise figure	NF	@ 2500 MHz, includes Evaluation Board loss		0.55	0.7	dB
Small signal gain	IS21I	@ 2500 MHz	17.5	19	20	dB
Input return loss	IS11I	@ 2500 MHz		9		dB
Output return loss	IS22I	@ 2500 MHz		15		dB
Reverse isolation	IS12I	@ 2500 MHz		27		dB
Third order input intercept point	IIP3	@ 2500 MHz, Δf = 1 MHz, P <sub>IN</sub> = -20 dBm/tone	+14	+17		dBm
Third order output intercept point	OIP3	@ 2500 MHz, Δf = 1 MHz, P <sub>IN</sub> = -20 dBm/tone	+33	+38		dBm
1 dB input compression point	IP1dB	@ 2500 MHz	0	+3		dBm
1 dB output compression point	OP1dB	@ 2500 MHz	+19	+21		dBm
<b>DC Specifications</b>						
Supply voltage	V <sub>DD</sub>			5		V
Quiescent supply current	I <sub>DQ</sub>	Set with external resistor	58	72	86	mA
Bias current	I <sub>BIAS</sub>			500		μA
Enable voltage:	V <sub>ENABLE</sub>					
Gain mode			0		0.2	V
Power-down mode			1.5		5.5	V
Enable rise time <sup>2</sup>	T <sub>R</sub>	@ 2500 MHz		250		ns
Enable fall time <sup>2</sup>	T <sub>F</sub>	@ 2500 MHz		250		ns

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.<sup>2</sup> Tested with a 100 kHz square wave, 1000 pF capacitance-to-ground on the ENABLE pin. Switching time can be improved by reducing the value of, or eliminating, the 1000 pF capacitor on pin 6 (component M17 in Figure 5).

### Evaluation Board Description

The SKY67154-396LF Evaluation Board is used to test the performance of the SKY67154-396LF LNA.

An assembly drawing for the Evaluation Board is shown in Figure 3.

The layer detail is provided in Figure 4. An Evaluation Board schematic diagram is provided in Figure 5. Table 5 lists the Bill of Materials (BOM) for the Evaluation Board.

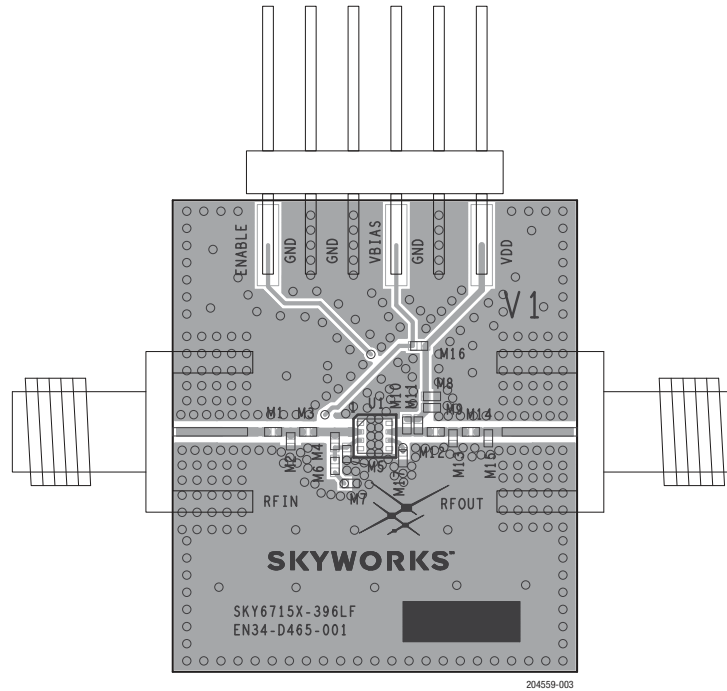


Figure 3. SKY67154-396LF Evaluation Board Assembly Diagram

Cross Section	Name	Thickness (mm)	Material
	MSK-NS		
	TRA-NS	0.03556	Cu foil
	Laminate	0.254 ± 0.152	Rogers 4350B
	TRA-2	0.0178	Cu foil
	Laminate	0.889 nom.	FR4 Prepreg (Note 1)
	TRA-3	0.0178	Cu foil
	Laminate	0.254 ± 0.152	FR4 Core
	TRA-FS	0.0178	Cu foil
	MSK-PS		

Note 1: Adjust this thickness to meet total thickness goal.

General Notes:

- Material: Rogers R04350,  $\epsilon_r = 3.66$
- Layer 1 thickness: 0.254 mm
- Overall board thickness: 1.575 mm
- 50  $\Omega$  transmission line width: 0.522 mm
- Coplanar ground spacing: 0.394 mm
- Via diameter: 0.254 mm

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Figure 4. Layer Detail Physical Characteristics

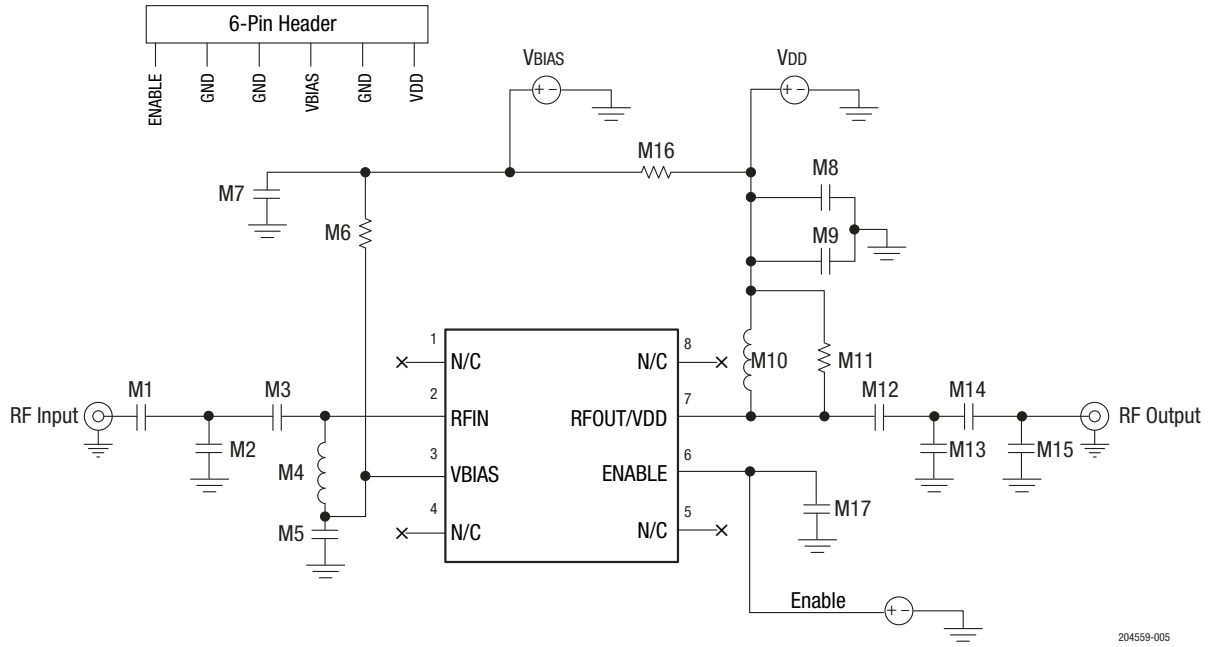


Figure 5. SKY67154-396LF Evaluation Board Schematic

Table 5. SKY67154-396LF Evaluation Board Bill of Materials (BOM) for 2300 to 2700 MHz Optimized Tuning

Component	Description	Value	Size	Manufacturer	Mfr Part Number
M1	Capacitor	20 pF	0402	Murata	GJM1555C1H200JB01
M2	Capacitor	1.2 pF	0402	Murata	GJM1555C1H1R2CB01
M3	Inductor	1 nH	0402	Coilcraft	0402HP-1NOXJL
M4	Inductor	12 nH	0402	Coilcraft	0402HP-12NX_L
M5	Capacitor	56 pF	0402	Murata	GRM1555C1H560JZ01
M6	Resistor	9.1 kΩ	0402	Kamaya	RMC1/16S-0912JTH
M7	Capacitor	10000 pF	0402	Murata	GRM155R71H103KA88
M8	Capacitor	1000 pF	0402	Murata	GRM155R71H102KA01
M9	Capacitor	22 pF	0402	Murata	GRM1555C1H220JZ01
M10	Inductor	2.7 nH	0402	Murata	LQG15HS2N7S02
M11	Resistor	2 kΩ	0402	Kamaya	RMC1/16S-202JTH
M12	Capacitor	3.9 pF	0402	Murata	GRM1555C1H3R9CZ01
M13		DNP			
M14	Resistor	0 Ω	0402	Kamaya	RMC1/16SJPTH
M15		DNP			
M16	Resistor	0 Ω	0402	Kamaya	RMC1/16SJPTH
M17	Capacitor	1000 pF	0402	Murata	GRM155R71H102KA01

### Package Dimensions

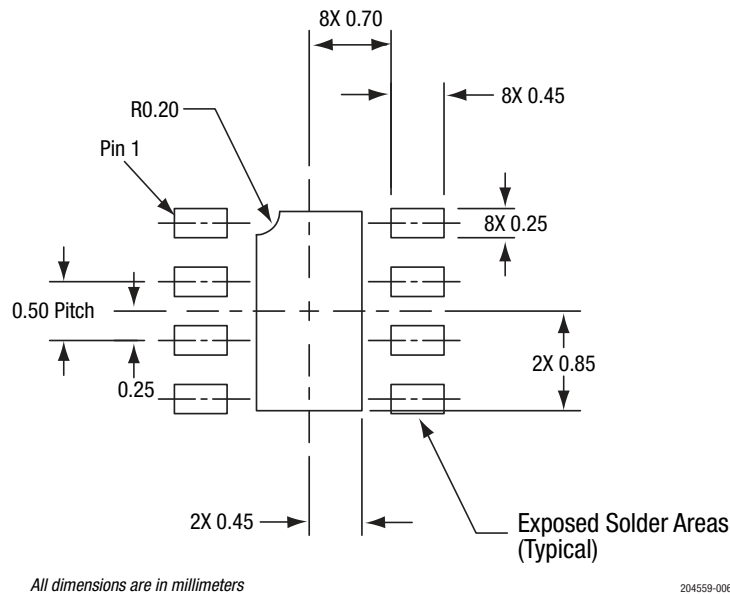
The PCB layout footprint for the SKY67154-396LF is provided in Figure 6. Typical part markings are shown in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

### Package and Handling Information

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 SKY67154-396LF is rated to Moisture Sensitivity Level 1 (MSL1) 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 6. SKY67154-396LF PCB Layout Footprint (Top View)**

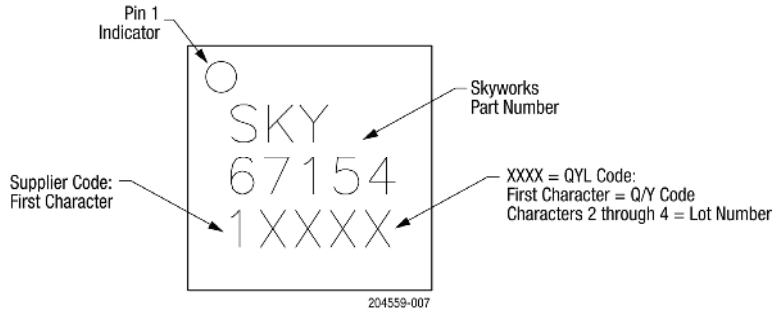
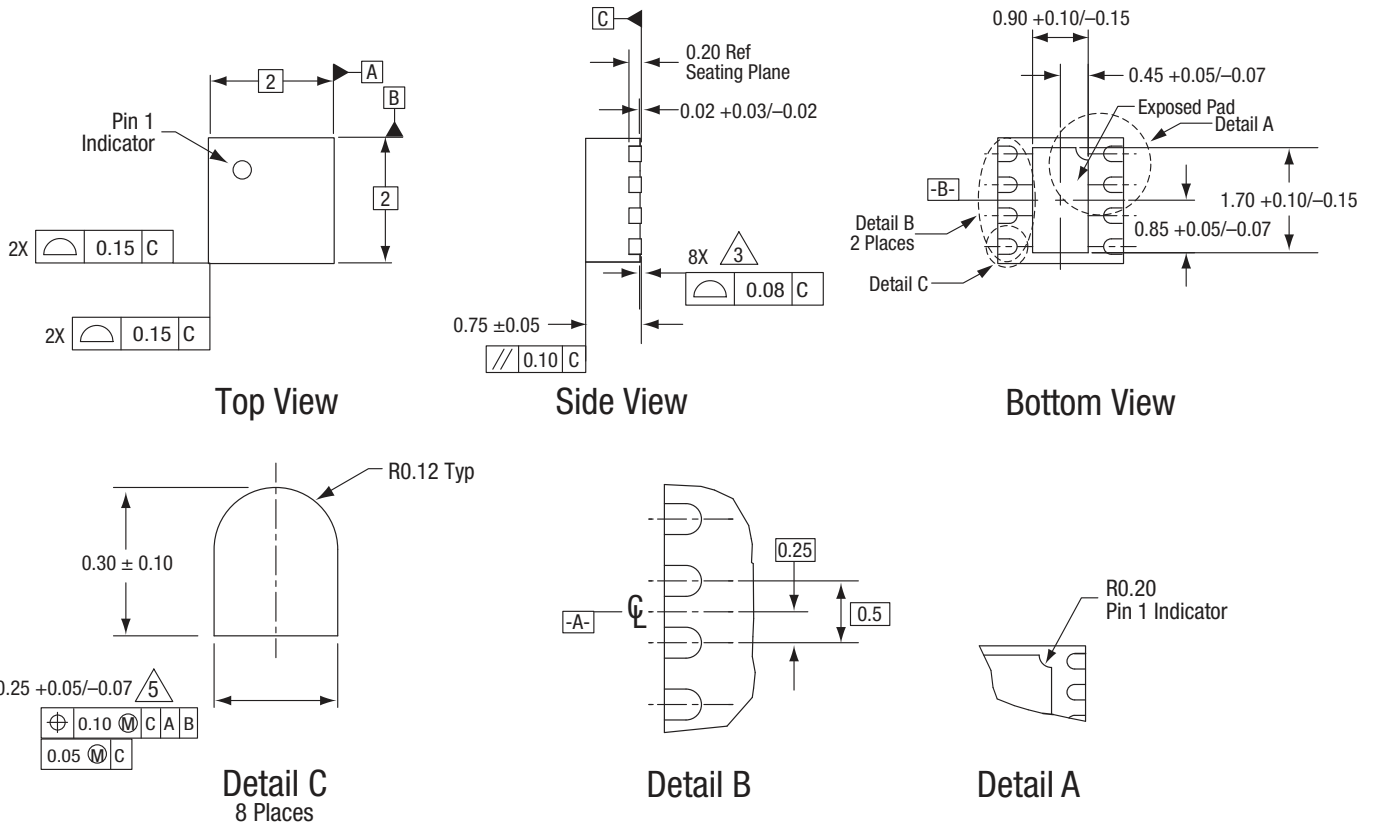


Figure 7. Typical Part Markings (Top View)

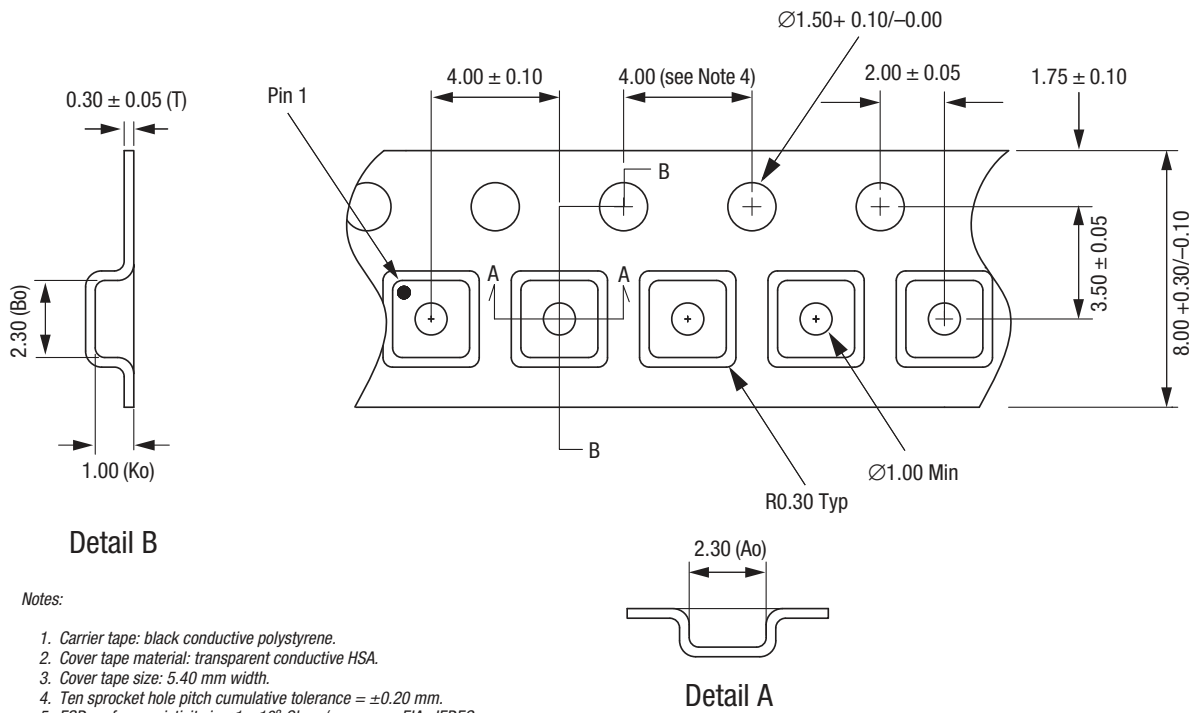


Notes:

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Coplanarity applies to the exposed heat sink ground pad as well as the terminals.
4. Plating requirement per source control drawing (SCD) 2504.
5. Dimension applies to metallized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

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Figure 8. SKY67154-396LF Package Dimensions



Notes:

1. Carrier tape: black conductive polystyrene.
2. Cover tape material: transparent conductive HSA.
3. Cover tape size: 5.40 mm width.
4. Ten sprocket hole pitch cumulative tolerance = ±0.20 mm.
5. ESD surface resistivity is  $\leq 1 \times 10^9$  Ohms/square per EIA, JEDEC tape and reel specification.
6. Ao and Bo measurement point to be 0.30 mm from bottom pocket.
7. All measurements are in millimeters.

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Figure 9. SKY67154-396LF Tape and Reel Dimensions



## Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY67154-396L	0.7 to 3.8 GHz Ultra-Low-Noise Amplifier	SKY67154-396LF-EVB

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