

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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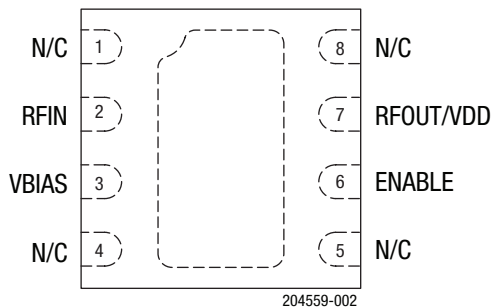


Figure 2. SKY67154-396LF Pinout (Top View)

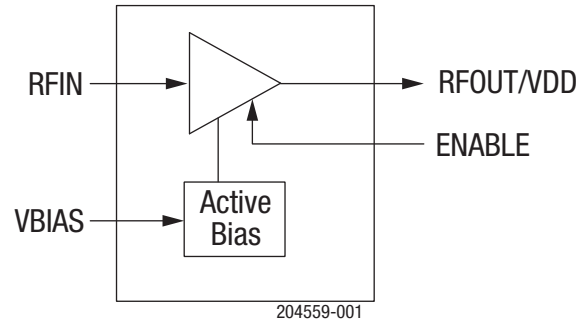


Figure 1. SKY67154-396LF Block Diagram

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 Ratings¹

| Parameter | Symbol | Minimum | Maximum | Units |
|--------------------------------------|------------------|---------|---------|-------|
| Supply voltage | V _{DD} | | 5.5 | V |
| Quiescent supply current | I _{DQ} | | 120 | mA |
| RF input power | P _{IN} | | +21 | dBm |
| Storage temperature | T _{STG} | -40 | +150 | °C |
| Operating temperature | T _A | -40 | +105 | °C |
| Junction temperature | T _J | | +150 | °C |
| Electrostatic discharge: | ESD | | | |
| Charged Device Model (CDM), Class C3 | | | 1000 | V |
| Human Body Model (HBM), Class 1B | | | 500 | 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: Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.

Table 3. SKY67154-396LF Electrical Specifications: Thermal Data¹**(V_{DD} = 5 V, T_A = +25 °C, P_{IN} = -25 dBm, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

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

¹ Performance is guaranteed only under the conditions listed in this table.**Table 4. SKY67154-396LF Electrical Specifications: 2300 to 2700 MHz Optimized Tuning¹****(V_{DD} = 5 V, T_A = +25 °C, P_{IN} = -20 dBm, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|------------------------------------|---------------------|--|------|------|-----|-------|
| RF Specifications | | | | | | |
| 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 _{IN} = -20 dBm/tone | +14 | +17 | | dBm |
| Third order output intercept point | OIP3 | @ 2500 MHz, Δf = 1 MHz, P _{IN} = -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 |
| DC Specifications | | | | | | |
| Supply voltage | V _{DD} | | | 5 | | V |
| Quiescent supply current | I _{DQ} | Set with external resistor | 58 | 72 | 86 | mA |
| Bias current | I _{BIAS} | | | 500 | | μA |
| Enable voltage: | V _{ENABLE} | | | | | |
| Gain mode | | | 0 | | 0.2 | V |
| Power-down mode | | | 1.5 | | 5.5 | V |
| Enable rise time ² | T _R | @ 2500 MHz | | 250 | | ns |
| Enable fall time ² | T _F | @ 2500 MHz | | 250 | | ns |

¹ Performance is guaranteed only under the conditions listed in this table.² 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.

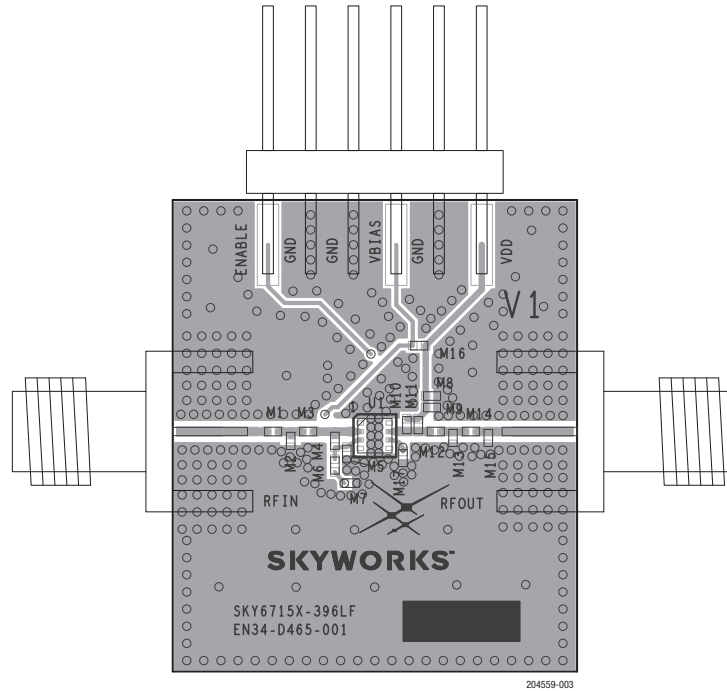


Figure 3. SKY67154-396LF Evaluation Board Assembly Diagram

| 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 | | |

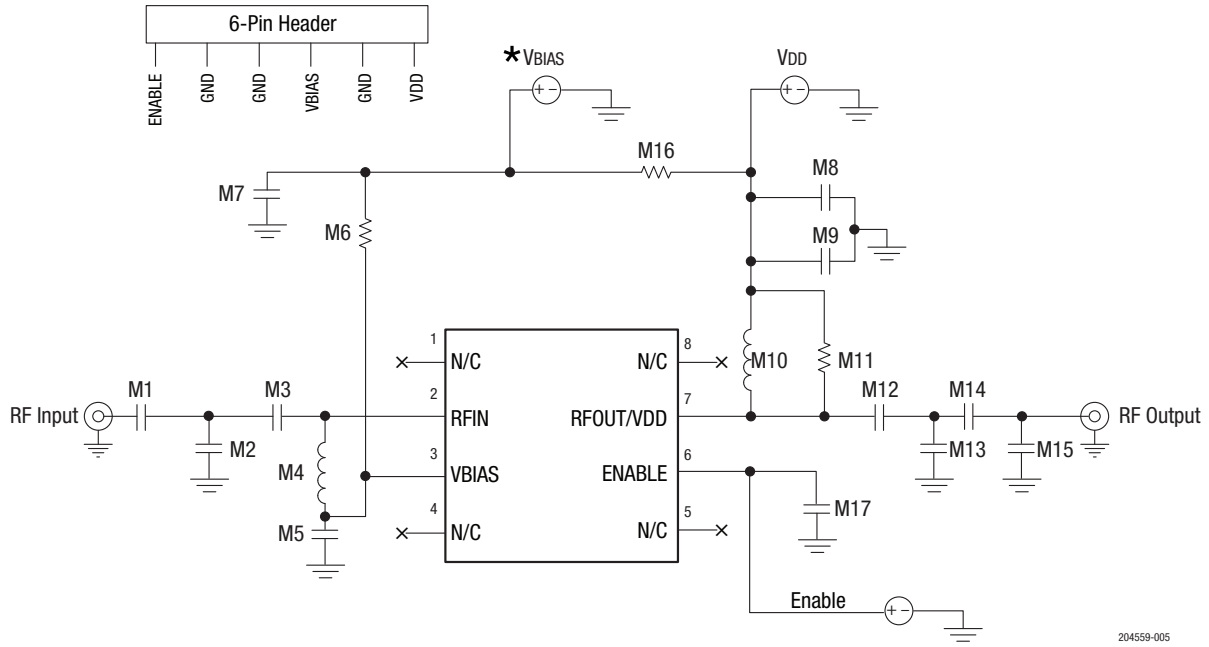
Note 1: Adjust this thickness to meet total thickness goal.

General Notes:

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

204559-004

Figure 4. Layer Detail Physical Characteristics



204559-005

*VBIAS can be used with VDD through M16 (0Ω) as a common connection

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.

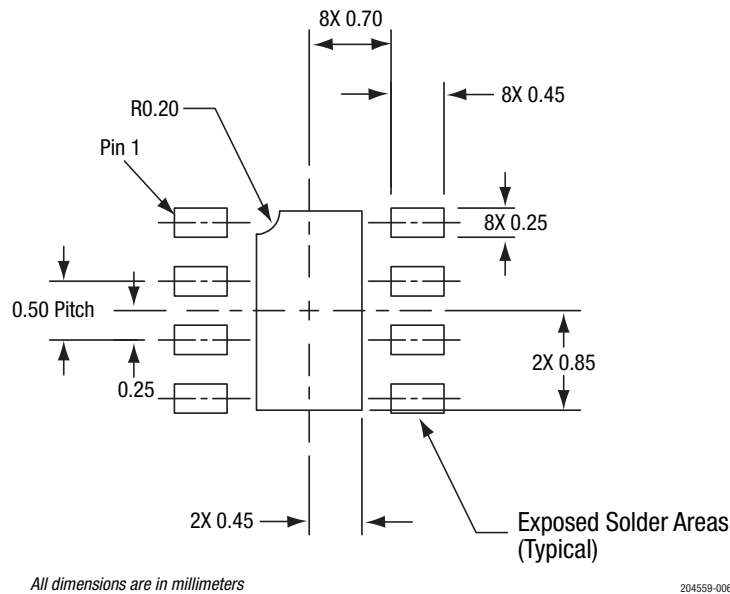


Figure 6. SKY67154-396LF PCB Layout Footprint (Top View)

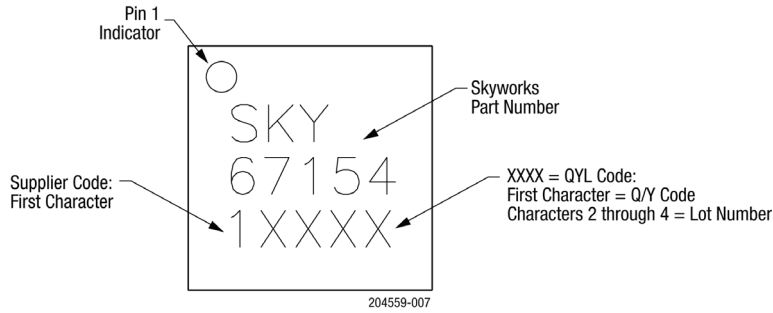
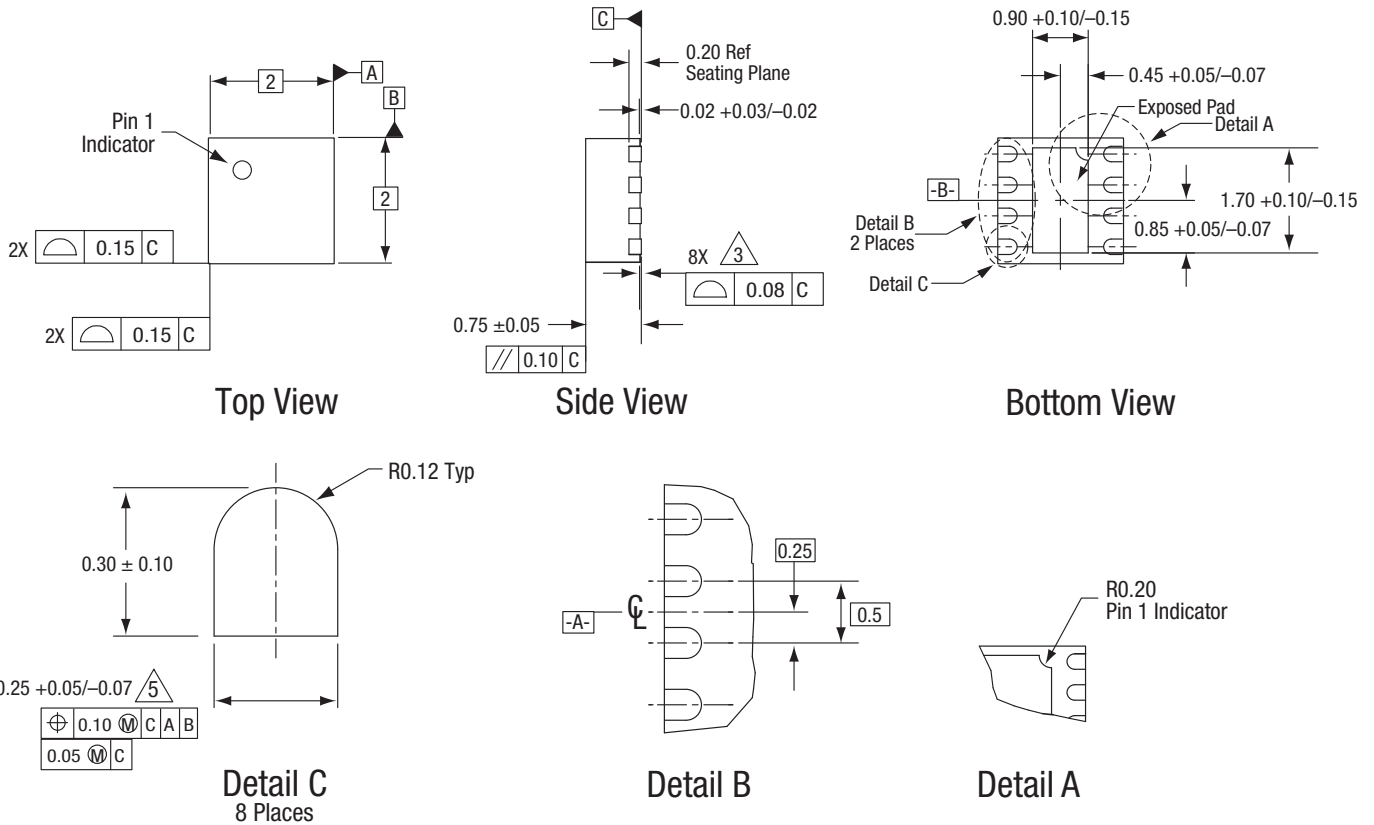


Figure 7. Typical Part Markings (Top View)

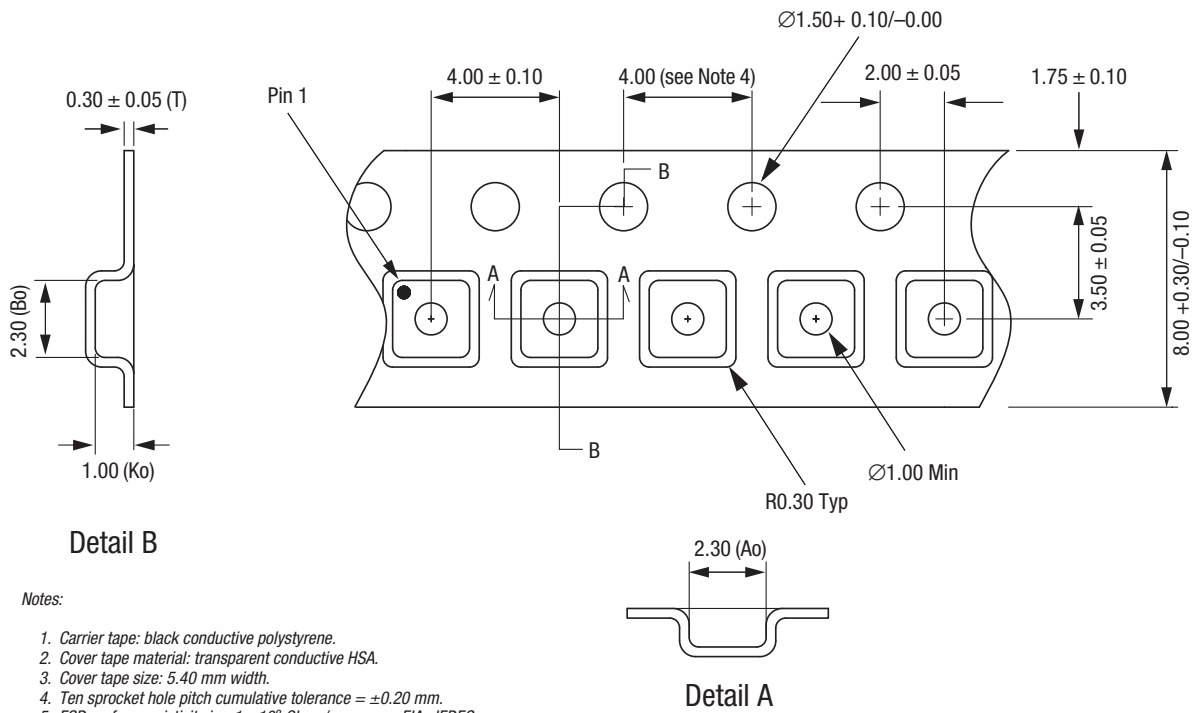


Notes:

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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