DATA SHEET

SKY67102-396LF: 2.0 to 3.0 GHz High Linearity, Active Bias Low-Noise Amplifier

Applications

- CDMA, WCDMA, TD-SCDMA, WiMAX, and LTE cellular infrastructure
- Ultra-low-noise systems

Features

- Ultra-low-noise figure: 0.8 dB @ 2.6 GHz
- Input and output return loss > 18 dB @ 2.6 GHz
- High IIP3 performance: +16.7 dBm @ 2.6 GHz
- Adjustable supply current and gain
- Temperature and process-stable active bias
- Miniature DFN (8-pin, 2 x 2 mm) package (MSL1 @ 260 °C per JEDEC J-STD-020)
- For RoHS and other product compliance information, see the Skyworks Certificate of Conformance.

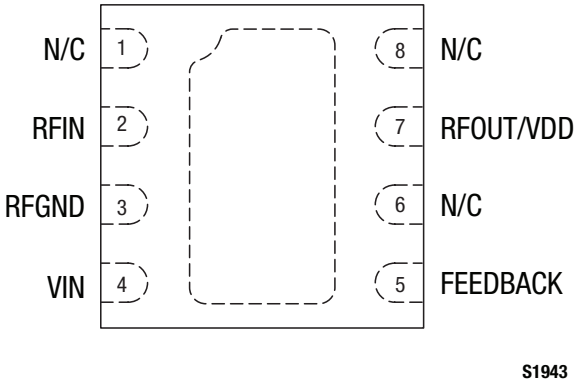


Figure 2. SKY67102-396LF Pinout – 8-Pin DFN (Top View)

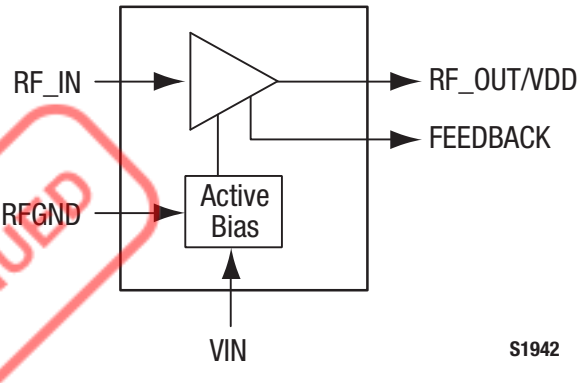


Figure 1. SKY67102-396LF Block Diagram

Description

The SKY67102-396LF is GaAs, pHEMT low-noise amplifier (LNA) with an active bias and high linearity performance. The advanced GaAs pHEMT enhancement mode process provides excellent return loss, low noise, and high linearity performance.

The internal active bias circuitry provides stable performance over temperature and process variation. The device offers the ability to externally adjust supply current and gain. Supply voltage is applied to the RFOUT/VDD pin through an RF choke inductor. Pin 4 (VIN) should be connected to RFOUT/VDD through an external resistor to control the supply current. The RFIN and RFOUT/VDD pins should be DC blocked to ensure proper operation. Pin 5 (FEEDBACK) is connected through an RC network to externally adjust the gain of the device without affecting the noise figure (NF) of the LNA.

The SKY67102-396LF operates in the frequency range of 2.0 to 3.0 GHz with proper tuning. For lower frequency operation, the pin-compatible SKY67100-396LF or SKY67101-396LF should be used.

The LNA is manufactured in a compact, 2 x 2 mm, 8-pin Dual Flat No-Lead (DFN) 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.

Table 1. SKY67102-396LF Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	N/C	No connection. May be connected to ground with no change in performance.	5	FEEDBACK	LNA external gain control. Connect to RFOUT using a series RD network.
2	RFIN	RF input. DC blocking capacitor required.	6	N/C	No connection. May be connected to ground with no change in performance.
3	RFGND	RF ground. Connect to ground through a capacitor.	7	RFOUT/VDD	RF output. Apply VDD through RF choke inductor. DC blocking capacitor required.
4	VIN	LNA supply current. Connect through series resistor to VDD.	8	N/C	No connection. May be connected to ground with no change in performance.

Table 2. SKY67102-396LF Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	V_{DD}			5.5	V
Supply current	I_{DD}			100	mA
RF input power	P_{IN}			+20	dBm
Storage temperature	T_{STG}	–65	+25	+125	°C
Operating temperature	T_A	–40	+25	+85	°C
Junction temperature	T_J			+150	°C
Electrostatic discharge: Human Body Model (HBM), Class 1A	ESD			250	V

Note 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.

Thermal resistance = 83 °C/W @ 4 V bias.

***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 SKY67102-396LF are provided in Table 2. Electrical specifications are provided in Tables 3 and 4.

Typical performance characteristics of the SKY67102-396LF are illustrated in Figures 3 through 13.

Table 3. SKY67102-396LF Electrical Specifications (Note 1)
(V_{DD} = 4.0 V, I_{DD} = 50 mA, T_A = +25 °C, P_{IN} = –20 dBm, Characteristic Impedance [Z_O] = 50 Ω, Refer to Table 5 [4.0 V, 50 mA BOM])

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
RF Specifications						
Noise figure (Note 2)	NF	@ 2.0 GHz @ 2.6 GHz @ 3.0 GHz		1.10 0.80 1.10	0.95	dB dB dB
Small signal gain	|S21|	@ 2.0 GHz @ 2.6 GHz @ 3.0 GHz	16.2	18.2 17.2 1.12	18.2	dB dB dB
Input return loss	|S11|	@ 2.0 GHz @ 2.6 GHz @ 3.0 GHz	15	10 18 12		dB dB dB
Output return loss	|S22|	@ 2.0 GHz @ 2.6 GHz @ 3.0 GHz	14	9 17 13		dB dB dB
Reverse isolation	|S12|	@ 2.0 GHz @ 2.6 GHz @ 3.0 GHz	34	37 37 38		dB dB dB
3rd Order Input Intercept Point	IIP3	@ 2.6 GHz, Δf = 1 MHz, P_{IN} = –18 dBm/tone		+16.7		dBm
3rd Order Output Intercept Point	OIP3	@ 2.6 GHz, Δf = 1 MHz, P_{IN} = –18 dBm/tone	+32.0	+33.8		dBm
1 dB Input Compression Point	IP1dB	@ 2.6 GHz		–1		dBm
1 dB Output Compression Point	OP1dB	@ 2.6 GHz		+15.1		dBm
Stability	μ1, μ2	Up to 18 GHz, –40 °C to +85 °C		>1		
DC Specifications						
Supply voltage	V_{DD}		3.3	4.0	5.0	V
Quiescent supply current	I_{DD}	Set with external resistor	15	50	90	mA

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 component C1 has been de-embedded from the NF measurement by 0.05 dB.

Typical Performance Characteristics

(V_{DD} = 4.0 V, I_{DD} = 50 mA, T_A = +25 °C, P_{IN} = –20 dBm, Characteristic Impedance [Z_O] = 50 Ω, Unless Otherwise Noted)

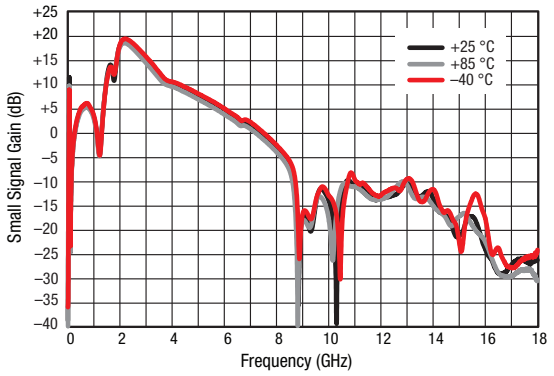


Figure 3. Broadband Gain Response vs Frequency Over Temperature

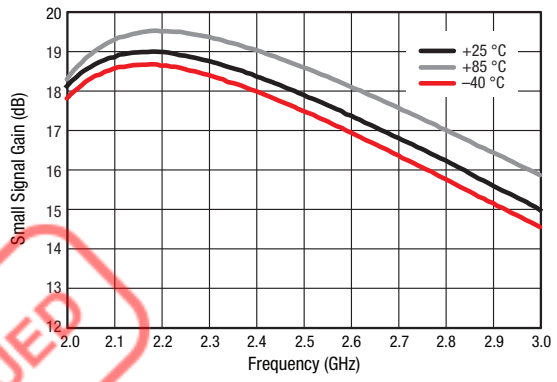


Figure 4. Narrowband Gain Response vs Frequency Over Temperature

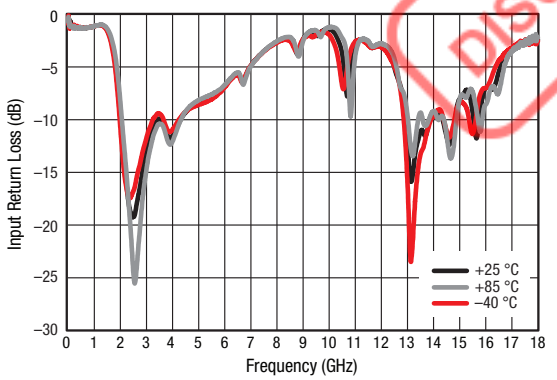


Figure 5. Broadband Input Return Loss vs Frequency Over Temperature

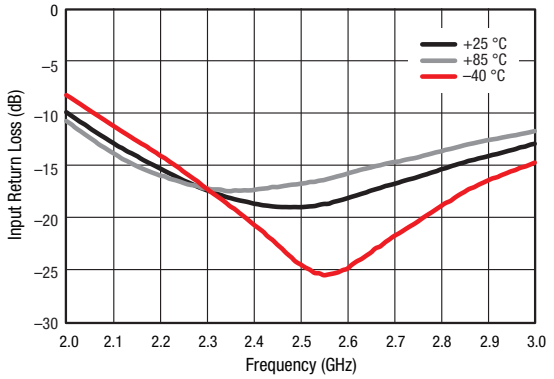


Figure 6. Narrowband Input Return Loss vs Frequency Over Temperature

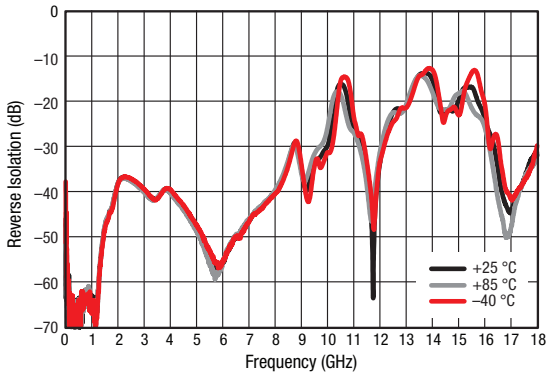


Figure 7. Broadband Reverse Isolation vs Frequency Over Temperature

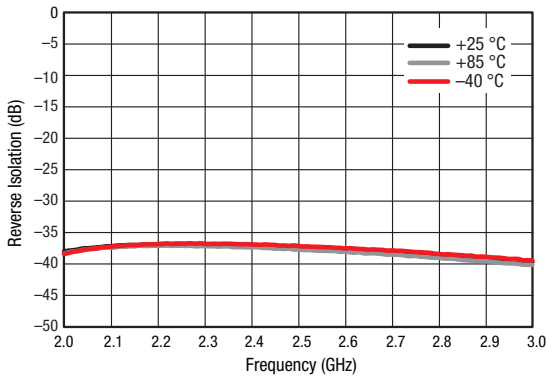


Figure 8. Narrowband Reverse Isolation vs Frequency Over Temperature

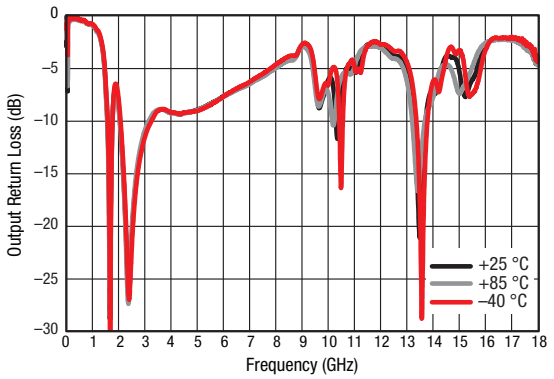


Figure 9. Broadband Output Return Loss vs Frequency Over Temperature

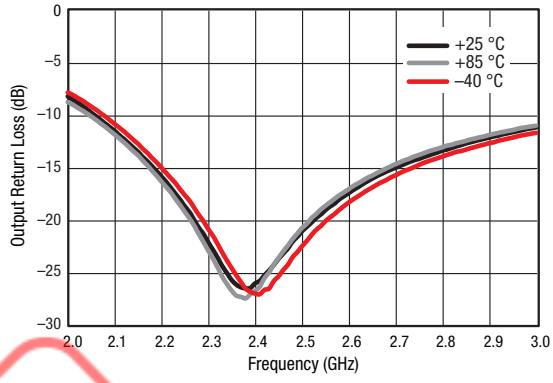


Figure 10. Narrowband Output Return Loss vs Frequency Over Temperature

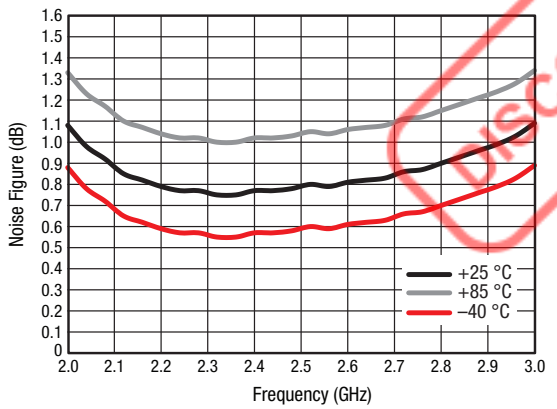


Figure 11. Noise Figure vs Frequency Over Temperature

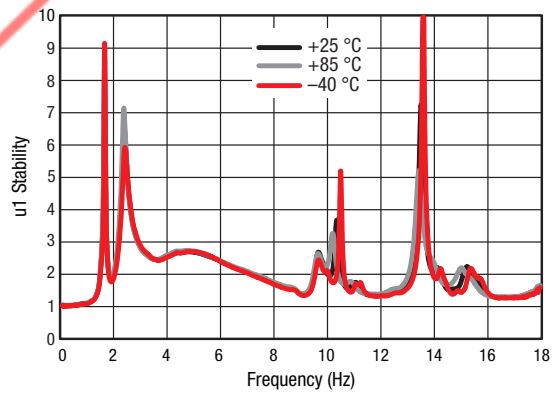


Figure 12. µ1 Stability vs Frequency Over Temperature @ 4 V

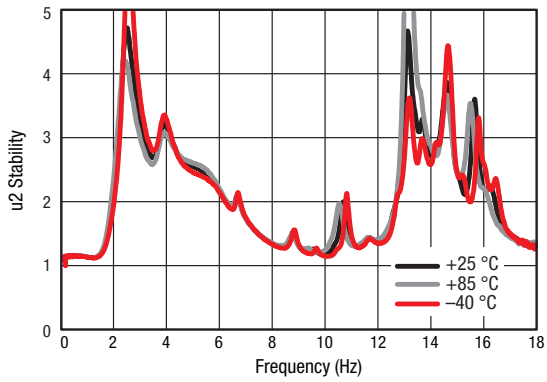


Figure 13. µ2 Stability vs Frequency Over Temperature @ 4 V

Table 4. SKY67102-396LF Electrical Specifications (Note 1)
(V_{DD} = 3.3 V, I_{DD} = 40 mA, T_A = +25 °C, P_{IN} = –20 dBm, Characteristic Impedance [Z_O] = 50 Ω, Refer to Table 6 [3.3 V, 40 mA BOM])

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
RF Specifications						
Noise figure (Note 2)	NF	@ 2.55 GHz		0.85		dB
Small signal gain	|S21|	@ 2.55 GHz		17.2		dB
Input return loss	|S11|	@ 2.55 GHz		18.0		dB
Output return loss	|S22|	@ 2.55 GHz		12.7		dB
Reverse isolation	|S12|	@ 2.55 GHz		37.0		dB
3rd Order Input Intercept Point	IIP3	ΔF = 1 MHz, P_{IN} = –20 dBm/tone 2550 MHz		15.9		dBm
3rd Order Output Intercept Point	OIP3	ΔF = 1 MHz, P_{IN}= –20 dBm/tone 2550 MHz		32.9		dBm
1 dB Input Compression Point	IP1dB	@ 2.55 GHz		-0.5		dBm
1 dB Output Compression Point	OP1dB	@ 2.55 GHz		16.0		dBm
Stability	μ1, μ2			>1		-
DC Specifications						
Supply voltage	V_{DD}			3.30		V
Quiescent supply current	I_{DD}			40.00		mA

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 component C1 has been de-embedded from the NF measurement by 0.05 dB.

Evaluation Board Description

The SKY67102-396LF Evaluation Board is used to test the performance of the SKY67102-396LF LNA. An assembly drawing for the Evaluation Board is shown in Figure 14. An Evaluation Board schematic diagram is provided in Figure 15. Table 5 provides the Bill of Materials (BOM) list for Evaluation Board components at 4.0 V, 50 mA operation. Table 6 provides the BOM for 3.3 V, 40 mA operation.

The test board uses a 10 mil Rogers 4350B substrate on a 50 mil FR4 supporting substrate. The Rogers 4350B material was selected for the RF circuit because of its low dielectric constant (ε_r) and low ε_r variation over temperature for the best possible noise performance.

Package Dimensions

The PCB layout footprint for the SKY67102-396LF is provided in Figure 16. Typical case markings are shown in Figure 17. Package dimensions for the 8-pin DFN are shown in Figure 18, and tape and reel dimensions are provided in Figure 19.

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 SKY67102-396LF 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.

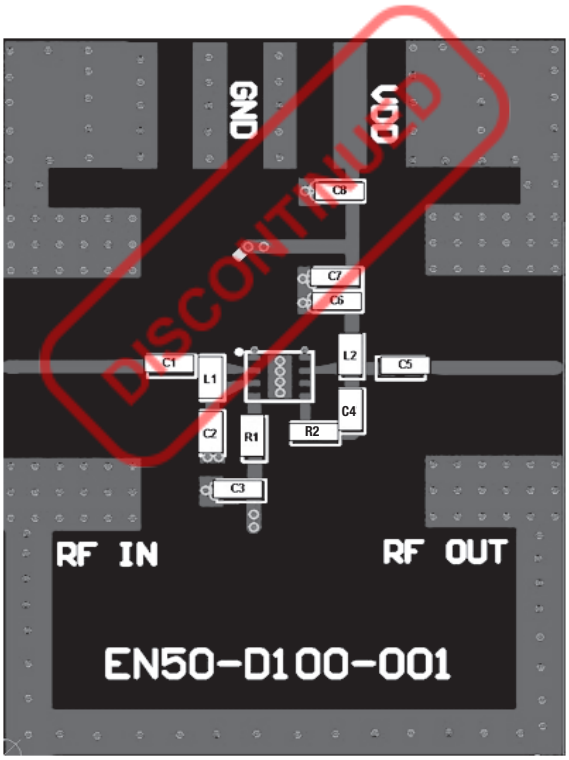


Figure 14. SKY67102-396LF Evaluation Board Assembly Diagram

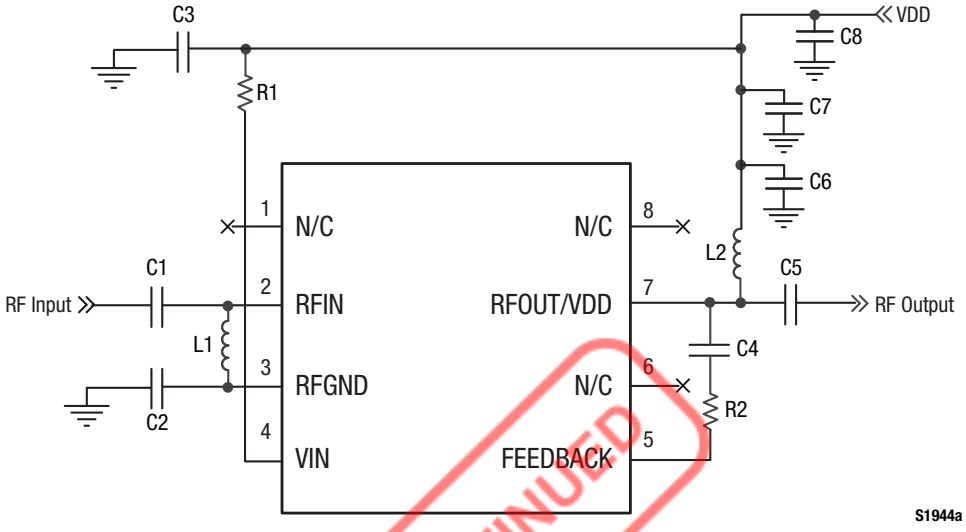


Figure 15. SKY67102-396LF Evaluation Board Schematic

Table 5. SKY67102-396LF Evaluation Board Bill of Materials
(V_{DD} = 4.0 V, I_{DD} = 50 mA)

Component	Description	Value	Size	Manufacturer	Mfr Part Number
C1	Capacitor	10 pF	0402	Murata GJM	GJM1555C1H100JB01
C2	Capacitor	3.6 pF	0402	Murata GJM	GJM1555C1H3R6CB01
C3	Capacitor	0.1 uF	0402	Murata GRM	GRM155R71H104KA01
C4		DNI	0402		
C5	Capacitor	100 pF	0402	Murata GRM	GRM1555C1H101JZ01
C6	Capacitor	10 pF	0402	Murata GRM	GRM1555C1H100JZ01
C7	Capacitor	1000 pF	0402	Murata GRM	GRM155R71H102KA01
C8	Capacitor	DNI			
L1	Inductor	3.3 nH		Coilcraft HP	0402HP-3N3XJL
L2	Inductor	2.4 nH	0402	TDK	MLG1005S2N4S
R1	Inductor	3.6 K	0402	Panasonic	ERJ2GEJ362X
R2		DNI			

Table 6. SKY67102-396LF Evaluation Board Bill of Materials
(V_{DD} = 3.3 V, I_{DD} = 40 mA)

Component	Description	Value	Size	Manufacturer	Mfr Part Number
C1	Capacitor	10 pF	0402	Murata GJM	GJM1555C1H100JB01
C2	Capacitor	3.6 pF	0402	Murata GJM	GJM1555C1H3R6CB01
C3	Capacitor	0.1 uF	0402	Murata GRM	GRM155R71H104KA01
C4		DNI	0402		
C5	Capacitor	100 pF	0402	Murata GRM	GRM1555C1H101JZ01
C6	Capacitor	10 pF	0402	Murata GRM	GRM1555C1H100JZ01
C7	Capacitor	1000 pF	0402	Murata GRM	GRM155R71H102KA01
C8	Capacitor	DNI			
L1	Inductor	3.3 nH		Coilcraft HP	0402HP-3N3XJL
L2	Inductor	3.9 nH	0402	TDK	MLG1005S3N9S
R1	Inductor	3.3 K	0402	Panasonic	ERJ2GEJ332X
R2		DNI			

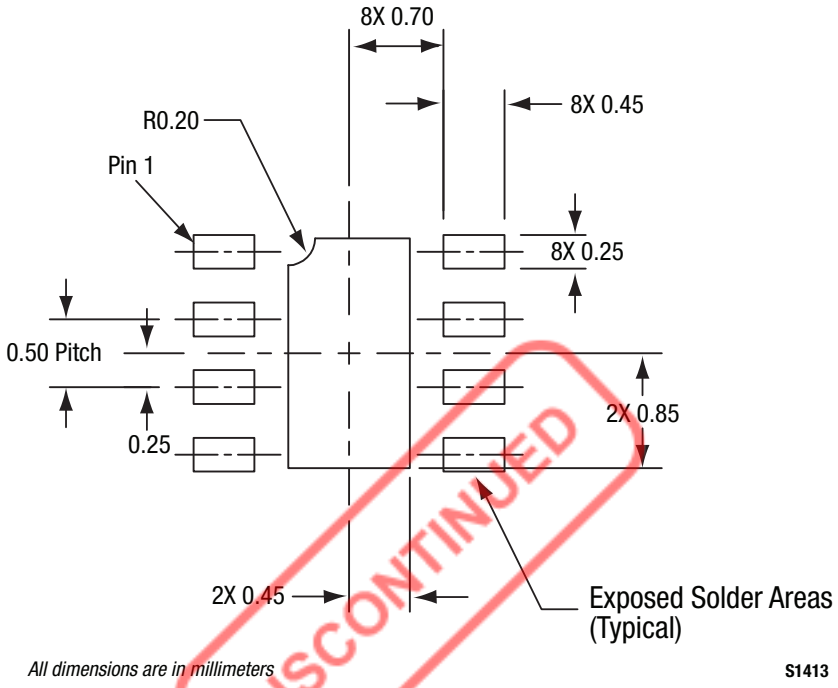


Figure 16. SKY67102-396LF PCB Layout Footprint
(Top View)

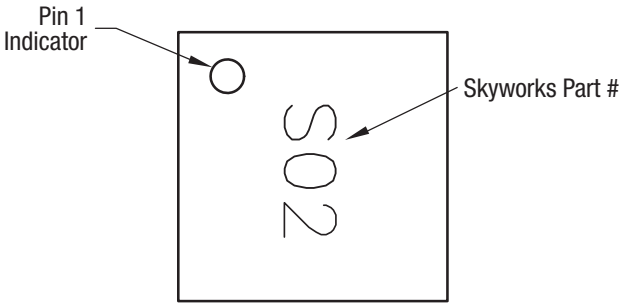
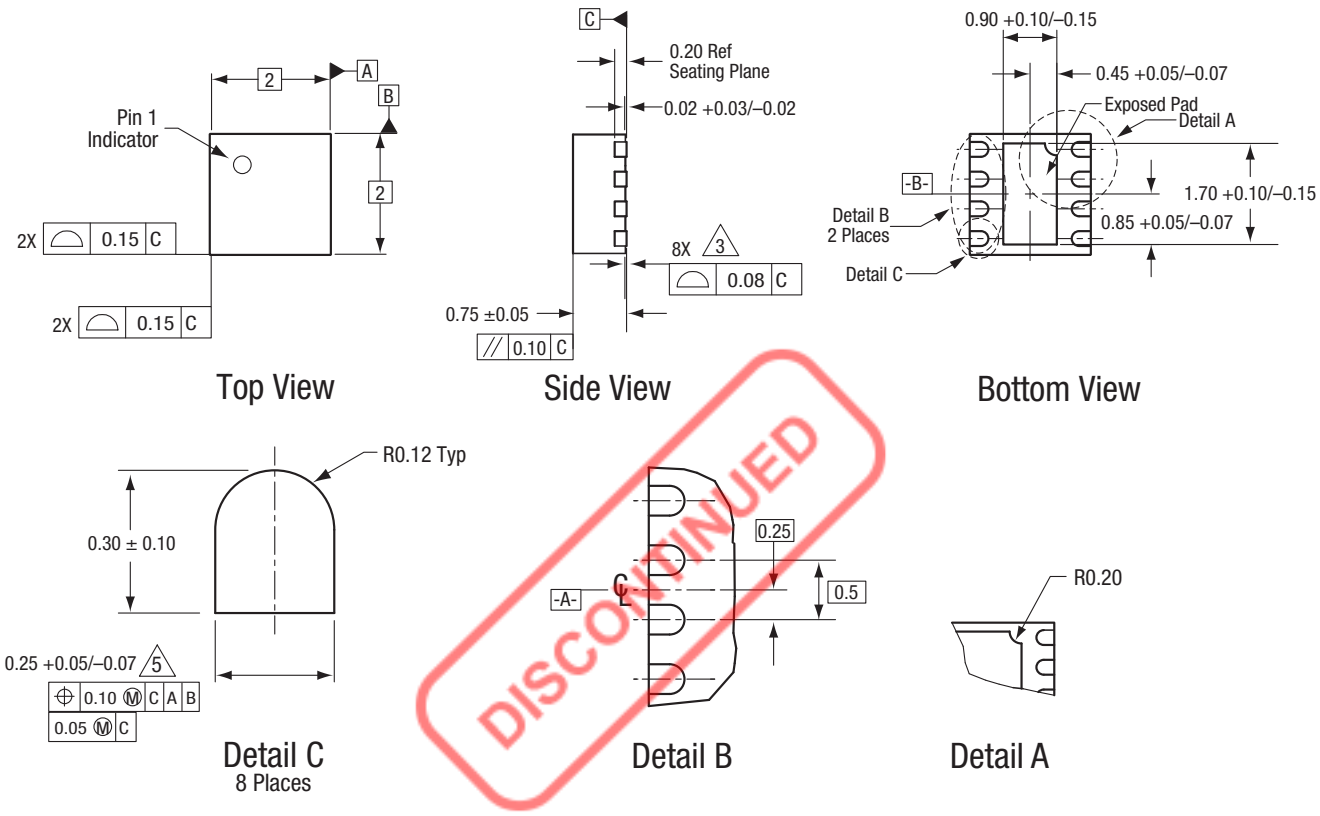


Figure 17. Typical Case Markings
(Top View)



All measurements are in millimeters.
Dimensioning and tolerancing according to ASME Y14.5M-1994.
Coplanarity applies to the exposed heat sink slug as well as the terminals..
Plating requirement per source control drawing (SCD) 2504.
Dimension applies to metalized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

S1945

Figure 18. SKY67102-396LF 8-Pin DFN Package Dimensions

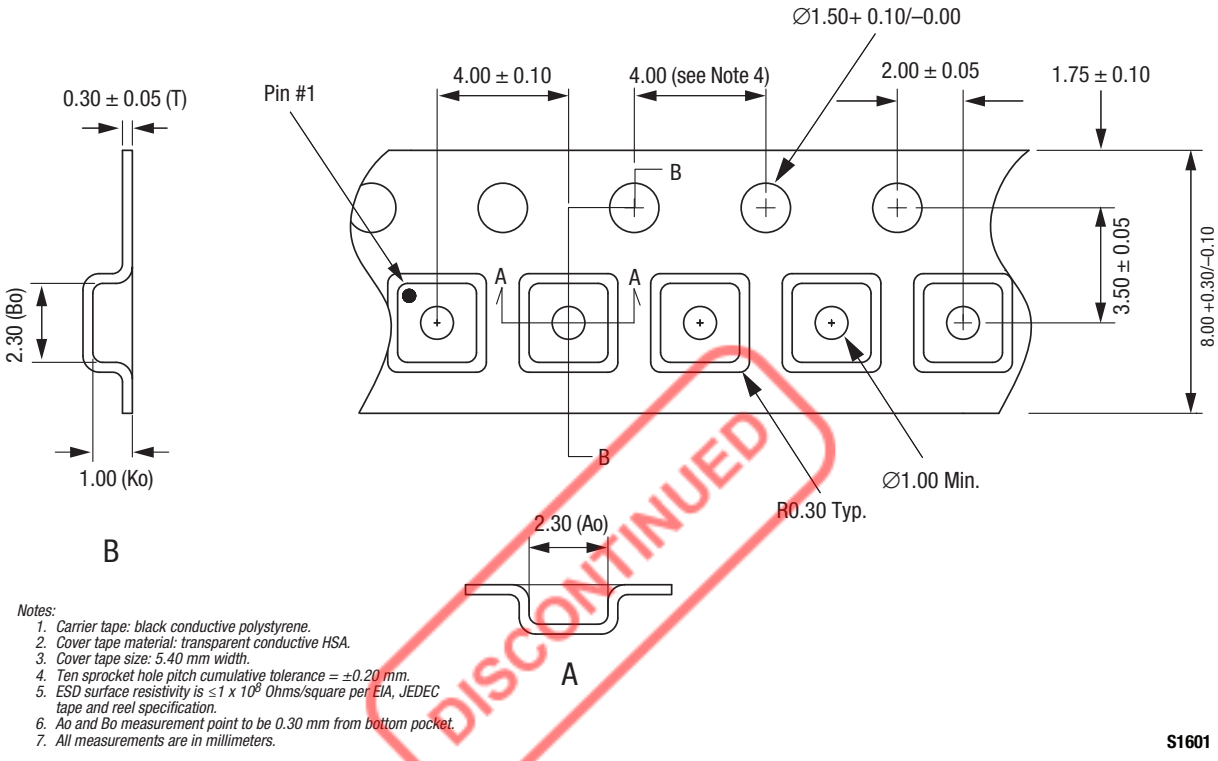


Figure 19. SKY67102-396LF Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY67102-396LF LNA	SKY67102-396LF	SKY67102-396LF-EVB