

SKYWORKS®

## DATA SHEET

# SKY67103-396LF: 0.5 to 4.0 GHz High Linearity, Active Bias Low-Noise Amplifier

## Applications

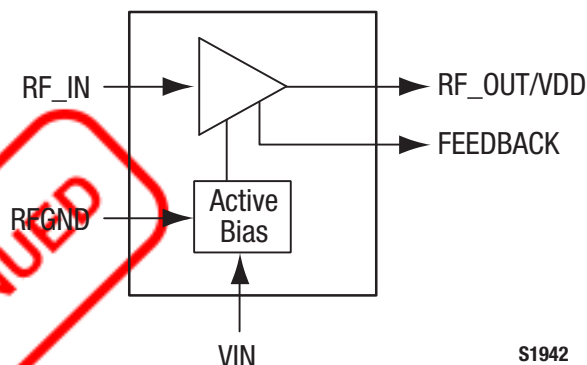
- LTE, GSM, WCDMA, HSDPA macro base stations
- Small cells
- Cellular repeaters, DAS, and RRH/RRUs
- 0.5 to 4.0 GHz low-noise receivers
- High-temperature receiver applications to +105 °C
- Improved high-frequency performance and footprint compatible with several industry standard low-noise amplifiers

## Features

- High gain:
  - 25 dB @ 0.85 GHz
  - 20 dB @ 1.85 GHz
  - 18.2 dB @ 2.6 GHz
  - 16.5 dB @ 3.6 GHz
- Low noise figure:
  - 0.5 dB @ 0.85 GHz
  - 0.6 dB @ 1.85 GHz
  - 0.65 dB @ 2.6 GHz
  - 0.7 dB @ 3.6 GHz
- High IIP3 performance: +17.8 dBm @ 3.6 GHz
- Return loss > 17.5 dB @ 3.6 GHz
- Adjustable supply current and gain
- Flexible bias voltage: 3 to 5 V
- Adjustable supply current from 30 mA to 100 mA
- Temperature and process-stable active bias
- Miniature DFN (8-pin, 2 x 2 mm) package (MSL1 @ 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.



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Figure 1. SKY67103-396LF Block Diagram

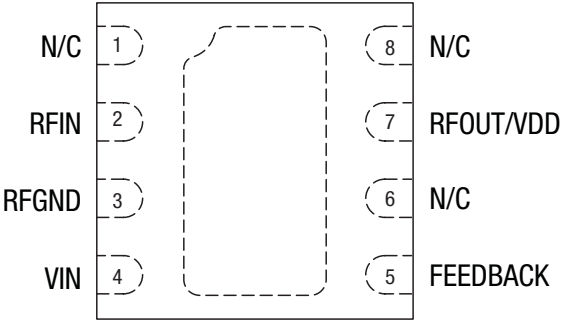
## Description

The SKY67103-396LF low-noise amplifier (LNA) with an active bias offers 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 SKY67103-396LF operates in the frequency range of 0.5 to 4.0 GHz with appropriate tuning. The SKY67103-396LF is an improved higher frequency version of the SKY67102-396LF. The SKY67103-396LF is pin-compatible with the SKY67100-396LF and SKY67101-396LF series of low-noise devices.

The LNA is available 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.



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Figure 2. SKY67103-396LF Pinout – 8-Pin DFN (Top View)

Table 1. SKY67103-396LF 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 RC 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.        |

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY67103-396LF are provided in Table 2. Thermal performance data are provided in Table 3.

Typical performance characteristics of the SKY67103-396LF for broadband operation are illustrated in Figures 3 through 13.

Electrical specifications for broadband operation are provided in Table 4.

Electrical specifications for narrowband operation are provided in Tables 5, 6, and 7. Table 8 provides data for noise parameters versus frequency.

**Table 2. SKY67103-396LF Absolute Maximum Ratings (Note 1)**

| 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    |
| Electrostatic discharge:            | ESD              |         |         |       |
| Charged Device Model (CDM), Class 4 |                  |         | 1000    | V     |
| Human Body Model (HBM), Class 1A    |                  |         | 250     | V     |
| Machine Model (MM), Class A         |                  |         | 30      | V     |

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

**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.

**Table 3. SKY67103-396LF: Thermal Performance Data (Note 1)**

(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 | Typical | 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    |

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

**Table 4. SKY67103-396LF Electrical Specifications for Operation at 3.6 GHz (Note 1)**  
**(V<sub>DD</sub> = 5.0 V, I<sub>DD</sub> = 78 mA, T<sub>A</sub> = +25 °C, P<sub>IN</sub> = -20 dBm, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

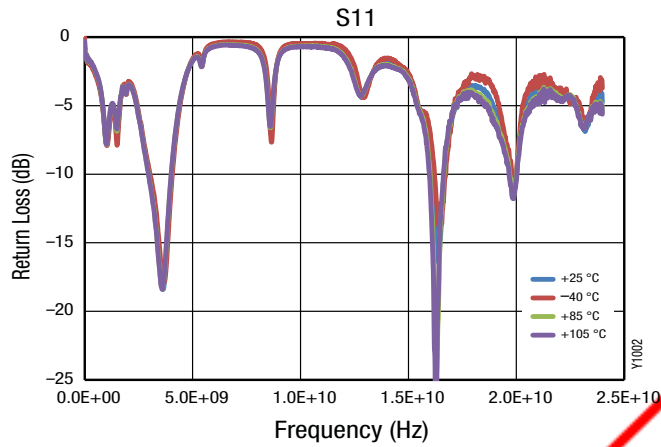
| Parameter                                    | Symbol             | Test Condition                                           | Min                  | Typical              | Max                  | Units          |
|----------------------------------------------|--------------------|----------------------------------------------------------|----------------------|----------------------|----------------------|----------------|
| <b>RF Specifications</b>                     |                    |                                                          |                      |                      |                      |                |
| Noise figure (Note 2)                        | NF                 | @ 3.4 GHz<br>@ 3.6 GHz<br>@ 3.8 GHz                      |                      | 0.65<br>0.70<br>0.76 | 0.85<br>0.90<br>0.96 | dB<br>dB<br>dB |
| Small signal gain                            | IS <sub>21</sub> I | @ 3.4 GHz<br>@ 3.6 GHz<br>@ 3.8 GHz                      | 15.3<br>15.0<br>14.6 | 16.8<br>16.5<br>16.1 |                      | dB<br>dB<br>dB |
| Input return loss                            | IS <sub>11</sub> I | @ 3.4 GHz<br>@ 3.6 GHz<br>@ 3.8 GHz                      |                      | 14.5<br>17.5<br>16.0 |                      | dB<br>dB<br>dB |
| Output return loss                           | IS <sub>22</sub> I | @ 3.4 GHz<br>@ 3.6 GHz<br>@ 3.8 GHz                      |                      | 18<br>17<br>17       |                      | dB<br>dB<br>dB |
| Reverse isolation                            | IS <sub>12</sub> I | @ 3.4 GHz<br>@ 3.6 GHz<br>@ 3.8 GHz                      |                      | 27.0<br>26.4<br>27.0 |                      | dB<br>dB<br>dB |
| 3 <sup>rd</sup> Order input intercept point  | IIP3               | @ 3.6 GHz, Δf = 1 MHz,<br>P <sub>IN</sub> = -20 dBm/tone |                      | +17.8                |                      | dBm            |
| 3 <sup>rd</sup> Order output intercept point | OIP3               | @ 3.6 GHz, Δf = 1 MHz,<br>P <sub>IN</sub> = -20 dBm/tone |                      | +34.3                |                      | dBm            |
| 1 dB input compression point                 | IP1dB              | @ 3.6 GHz                                                |                      | +1.9                 |                      | dBm            |
| 1 dB output compression point                | OP1dB              | @ 3.6 GHz                                                |                      | +17.4                |                      | dBm            |
| Stability                                    | μ1, μ2             | Up to 18 GHz,<br>-40 °C to +105 °C                       |                      | >1                   |                      | –              |
| <b>DC Specifications</b>                     |                    |                                                          |                      |                      |                      |                |
| Supply voltage                               | V <sub>DD</sub>    |                                                          |                      | 5.0                  |                      | V              |
| Supply current                               | I <sub>DD</sub>    | Set with external resistor                               |                      | 78                   |                      | mA             |

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

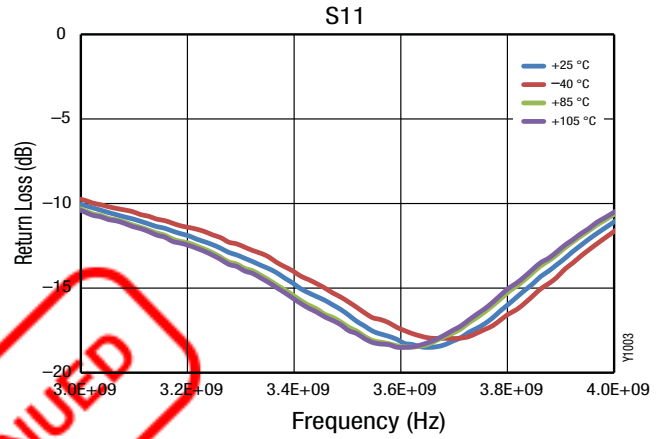
**Note 2:** Loss from the input SMA connector and Evaluation Board up to component C1 has been de-embedded from the NF measurement by 0.05 dB.

## Typical Performance Characteristics

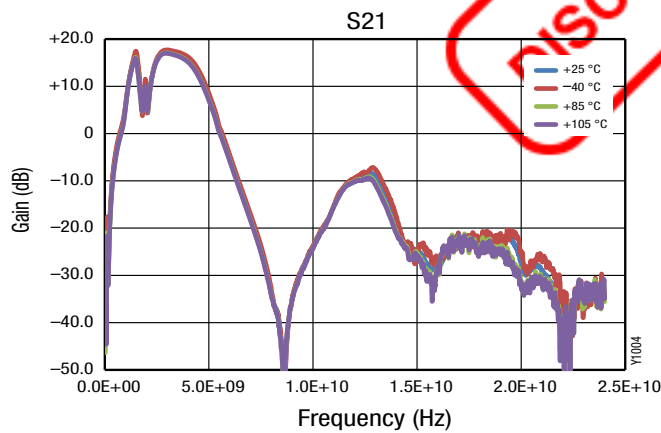
( $V_{DD} = 77 \text{ mA}$ ,  $P_{IN} = -20 \text{ dBm}$ , Characteristic Impedance [ $Z_0$ ] =  $50 \Omega$ , Unless Otherwise Noted)



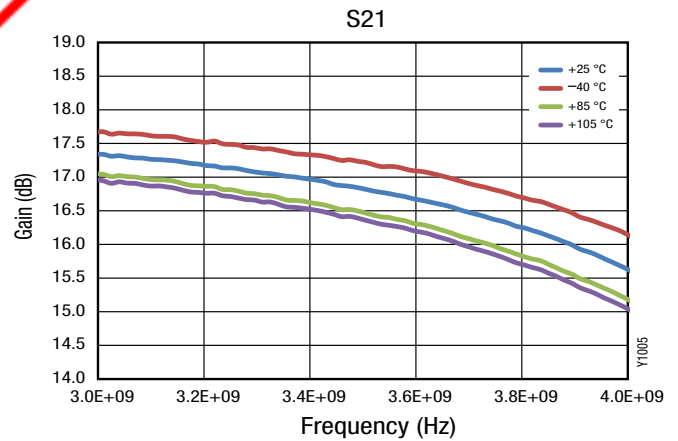
**Figure 3. Broadband Input Return Loss vs Frequency and Temperature**



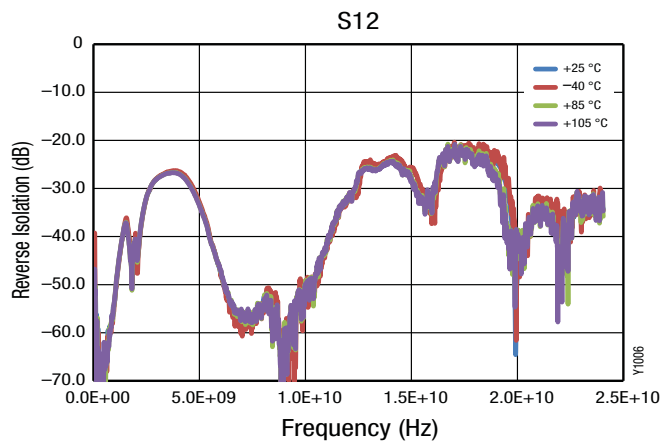
**Figure 4. Narrowband Input Return Loss vs Frequency and Temperature**



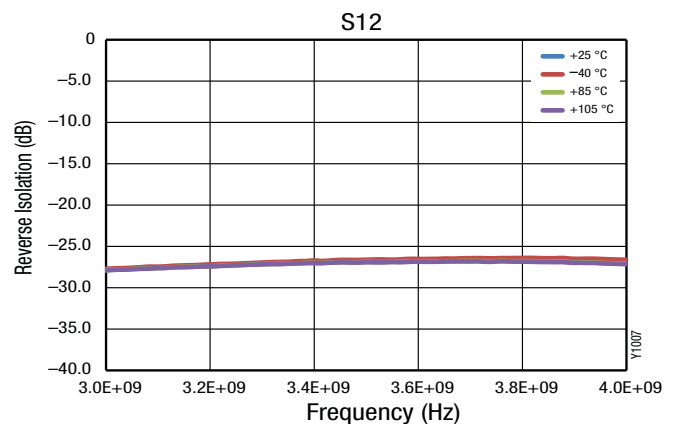
**Figure 5. Broadband Gain vs Frequency and Temperature**



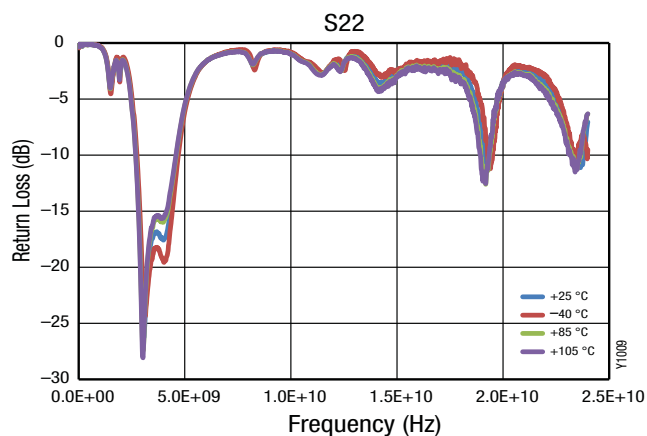
**Figure 6. Narrowband Gain vs Frequency and Temperature**



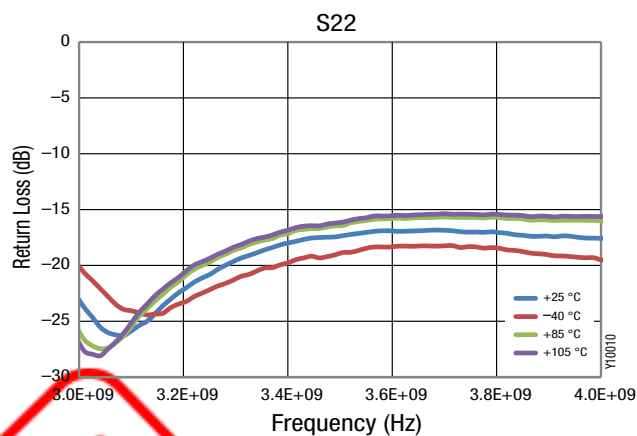
**Figure 7. Broadband Reverse Isolation vs Frequency and Temperature**



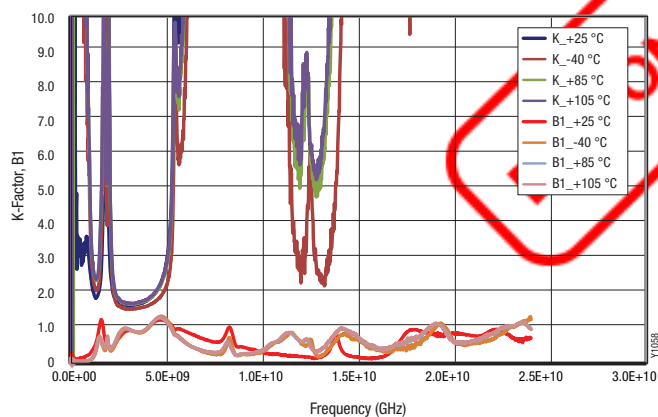
**Figure 8. Narrowband Reverse Isolation vs Frequency and Temperature**



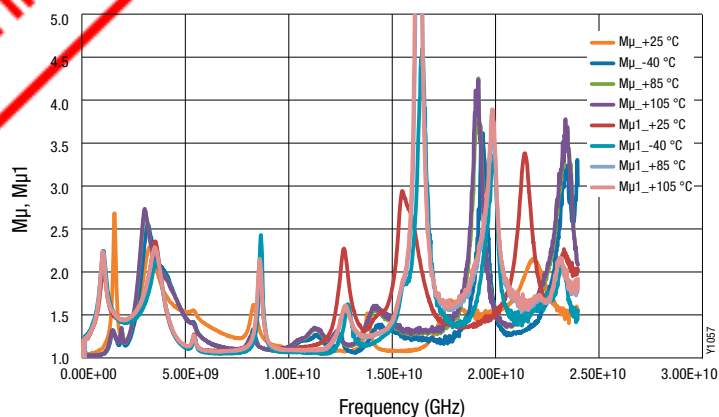
**Figure 9. Broadband Output Return Loss vs Frequency and Temperature**



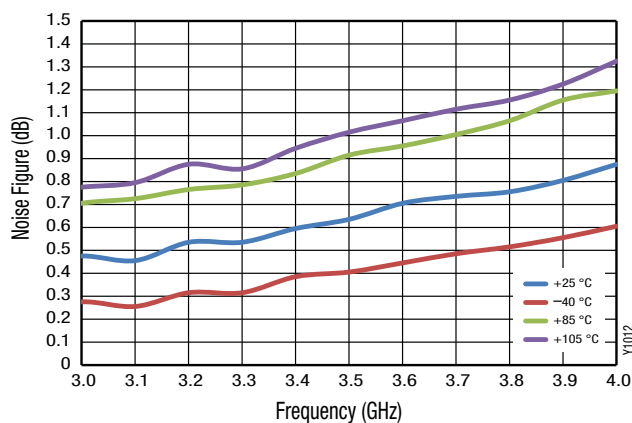
**Figure 10. Narrowband Output Return Loss vs Frequency and Temperature**



**Figure 11. Stability Factor K, B1 vs Frequency and Temperature**



**Figure 12. Stability Factor  $M\mu$ ,  $M\mu_1$  vs Frequency and Temperature**



**Figure 13. Noise Figure vs Frequency and Temperature**

**Table 5. SKY67103-396LF Electrical Specifications for Operation at 850 MHz (Note 1)**  
**(V<sub>DD</sub> = 5.0 V, I<sub>DD</sub> = 78 mA, 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 | Typical | Max | Units |
|------------------------------------|--------------|----------------------------------------------------|-----|---------|-----|-------|
| Noise figure (Note 2)              | NF           | @ 850 MHz                                          |     | 0.50    |     | dB    |
| Small signal gain                  | IS21I        | @ 850 MHz                                          |     | 25.0    |     | dB    |
| Input return loss                  | IS11I        | @ 850 MHz                                          |     | 16.0    |     | dB    |
| Output return loss                 | IS22I        | @ 850 MHz                                          |     | 15.0    |     | dB    |
| Reverse isolation                  | IS12I        | @ 850 MHz                                          |     | 32.0    |     | dB    |
| Input third order intercept point  | IIP3         | ΔF=1 MHz, P <sub>IN</sub> =-20 dBm/Tone<br>850 MHz |     | +7.5    |     | dBm   |
| Output third order intercept point | OIP3         | ΔF=1 MHz, P <sub>IN</sub> =-20 dBm/Tone<br>850 MHz |     | +34.5   |     | dBm   |
| Input 1 dB compression point       | IP1dB        | @ 850 MHz                                          |     | -5.0    |     | dBm   |
| Output 1 dB compression point      | OP1dB        | @ 850 MHz                                          |     | +21.0   |     | dBm   |
| Stability                          | μ1, μ2, K, B |                                                    |     | >1      |     |       |
| <b>DC Specifications</b>           |              |                                                    |     |         |     |       |
| Supply voltage                     | VDD          |                                                    |     | 5.0     |     | V     |
| Quiescent supply current           | IDD          |                                                    |     | 76.0    |     | mA    |

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

**Note 2:** No correction for evaluation board and connector has been taken in the measurement.

**Table 6. SKY67103-396LF Electrical Specifications for Operation at 1.85 GHz (Note 1)**  
**(V<sub>DD</sub> = 5.0 V, I<sub>DD</sub> = 78 mA, 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 | Typical | Max | Units |
|------------------------------------|----------------------|-------------------------------------------------------------|-----|---------|-----|-------|
| Noise figure (Note 2)              | NF                   | @ 1.85 GHz                                                  |     | 0.60    |     | dB    |
| Small signal gain                  | IS21I                | @ 1.85 GHz                                                  |     | 20.0    |     | dB    |
| Input return loss                  | IS11I                | @ 1.85 GHz                                                  |     | 16.0    |     | dB    |
| Output return loss                 | IS22I                | @ 1.85 GHz                                                  |     | 15.0    |     | dB    |
| Reverse isolation                  | IS12I                | @ 1.85 GHz                                                  |     | 28.0    |     | dB    |
| Input third order intercept point  | IIP3                 | $\Delta F=1$ MHz, P <sub>IN</sub> =-20 dBm/Tone<br>1850 MHz |     | +15.5   |     | dBm   |
| Output third order intercept point | OIP3                 | $\Delta F=1$ MHz, P <sub>IN</sub> =-20 dBm/Tone<br>1850 MHz |     | +35.5   |     | dBm   |
| Input 1 dB compression point       | IP1dB                | @ 1.85 GHz                                                  |     | +1.0    |     | dBm   |
| Output 1 dB compression point      | OP1dB                | @ 1.85 GHz                                                  |     | +20.0   |     | dBm   |
| Stability                          | $\mu_1, \mu_2, K, B$ |                                                             |     | >1      |     | -     |
| <b>DC Specifications</b>           |                      |                                                             |     |         |     |       |
| Supply voltage                     | VDD                  |                                                             |     | 5.0     |     | V     |
| Quiescent supply current           | IDD                  |                                                             |     | 76.0    |     | mA    |

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

**Note 2:** No correction for evaluation board and connector has been taken in the measurement.

**Table 7. SKY67103-396LF Electrical Specifications for Operation at 2.6 GHz (Note 1)**  
**(V<sub>DD</sub> = 5.0 V, I<sub>DD</sub> = 78 mA, 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 | Typical | Max | Units |
|------------------------------------|-----------------|------------------------------------------------------|-----|---------|-----|-------|
| Noise figure (Note 2)              | NF              | @ 2.6 GHz                                            |     | 0.65    |     | dB    |
| Small signal gain                  | S <sub>21</sub> | @ 2.5 GHz                                            |     | 18.4    |     | dB    |
|                                    |                 | @ 2.6 GHz                                            |     | 18.2    |     | dB    |
|                                    |                 | @ 2.7 GHz                                            |     | 17.9    |     | dB    |
| Input return loss                  | S <sub>11</sub> | @ 2.5 GHz                                            |     | 14.2    |     | dB    |
|                                    |                 | @ 2.6 GHz                                            |     | 16.4    |     | dB    |
|                                    |                 | @ 2.7 GHz                                            |     | 18.7    |     | dB    |
| Output return loss                 | S <sub>22</sub> | @ 2.5 GHz                                            |     | 24.9    |     | dB    |
|                                    |                 | @ 2.6 GHz                                            |     | 19.6    |     | dB    |
|                                    |                 | @ 2.7 GHz                                            |     | 17.5    |     | dB    |
| Reverse isolation                  | S <sub>12</sub> | @ 2.5 GHz                                            |     | 28.2    |     | dB    |
|                                    |                 | @ 2.6 GHz                                            |     | 27.9    |     | dB    |
|                                    |                 | @ 2.7 GHz                                            |     | 27.7    |     | dB    |
| Input third order intercept point  | IIP3            | ΔF=1 MHz, P <sub>IN</sub> = -20 dBm/Tone<br>2600 MHz |     | +17.5   |     | dBm   |
| Output third order intercept point | OIP3            | ΔF=1 MHz, P <sub>IN</sub> = -20 dBm/Tone<br>2600 MHz |     | +35.8   |     | dBm   |
| Input 1 dB compression point       | IP1dB           | @ 2600 MHz                                           |     | +1.6    |     | dBm   |
| Output 1 dB compression point      | OP1dB           | @ 2600 MHz                                           |     | +18.9   |     | dBm   |
| Stability                          | μ1, μ2, K, B    |                                                      |     | >1      |     |       |
| <b>DC Specifications</b>           |                 |                                                      |     |         |     |       |
| Supply voltage                     | VDD             |                                                      |     | 5       |     | V     |
| Quiescent supply current           | IDD             |                                                      |     | 76      |     | mA    |

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

**Note 2:** No correction for evaluation board and connector has been taken in the measurement.

**Table 8. Noise Parameters vs Frequency (@ +25 °C, 5 V, 78 mA) (1 of 3)**

| Frequency (MHz) | FMIN (dB) | Gamma opt (Mag) | Gamma opt (Phase) | Noise Resistance (RN) (Ω) | Associated Gain (dB) | Maximum Gain (GMAX) (dB) |
|-----------------|-----------|-----------------|-------------------|---------------------------|----------------------|--------------------------|
| 400             | 0.33      | 0.40            | 7.69              | 0.06                      | 29.58                | 31.69                    |
| 450             | 0.31      | 0.37            | 13.49             | 0.06                      | 29.19                | 31.12                    |
| 500             | 0.30      | 0.35            | 19.08             | 0.05                      | 28.81                | 30.58                    |
| 550             | 0.29      | 0.33            | 24.47             | 0.05                      | 28.44                | 30.05                    |
| 600             | 0.28      | 0.31            | 29.66             | 0.05                      | 28.07                | 29.55                    |
| 650             | 0.27      | 0.29            | 34.66             | 0.05                      | 27.72                | 29.06                    |
| 700             | 0.26      | 0.27            | 39.48             | 0.05                      | 27.38                | 28.60                    |
| 750             | 0.25      | 0.26            | 44.13             | 0.04                      | 27.04                | 28.16                    |
| 800             | 0.25      | 0.25            | 48.60             | 0.04                      | 26.72                | 27.73                    |
| 850             | 0.24      | 0.23            | 52.92             | 0.04                      | 26.40                | 27.32                    |
| 900             | 0.24      | 0.22            | 57.08             | 0.04                      | 26.09                | 26.93                    |
| 950             | 0.23      | 0.21            | 61.09             | 0.04                      | 25.79                | 26.55                    |
| 1000            | 0.23      | 0.20            | 64.96             | 0.04                      | 25.50                | 26.19                    |
| 1050            | 0.23      | 0.20            | 68.69             | 0.04                      | 25.22                | 25.84                    |
| 1100            | 0.23      | 0.19            | 72.29             | 0.03                      | 24.94                | 25.51                    |
| 1150            | 0.23      | 0.19            | 75.77             | 0.03                      | 24.67                | 25.19                    |
| 1200            | 0.23      | 0.18            | 79.12             | 0.03                      | 24.41                | 24.89                    |
| 1250            | 0.23      | 0.18            | 82.37             | 0.03                      | 24.16                | 24.60                    |
| 1300            | 0.24      | 0.18            | 85.51             | 0.03                      | 23.91                | 24.32                    |
| 1350            | 0.24      | 0.17            | 88.54             | 0.03                      | 23.67                | 24.05                    |
| 1400            | 0.24      | 0.17            | 91.48             | 0.03                      | 23.43                | 23.79                    |
| 1450            | 0.25      | 0.17            | 94.33             | 0.03                      | 23.21                | 23.55                    |
| 1500            | 0.25      | 0.17            | 97.09             | 0.03                      | 22.98                | 23.31                    |
| 1550            | 0.25      | 0.17            | 99.76             | 0.03                      | 22.77                | 23.08                    |
| 1600            | 0.26      | 0.18            | 102.36            | 0.03                      | 22.56                | 22.87                    |
| 1650            | 0.27      | 0.18            | 104.89            | 0.03                      | 22.35                | 22.66                    |
| 1700            | 0.27      | 0.18            | 107.35            | 0.03                      | 22.15                | 22.46                    |
| 1750            | 0.28      | 0.19            | 109.74            | 0.03                      | 21.96                | 22.27                    |
| 1800            | 0.28      | 0.19            | 112.08            | 0.03                      | 21.77                | 22.08                    |
| 1850            | 0.29      | 0.19            | 114.36            | 0.03                      | 21.59                | 21.90                    |
| 1900            | 0.30      | 0.20            | 116.58            | 0.03                      | 21.41                | 21.73                    |
| 1950            | 0.31      | 0.20            | 118.76            | 0.03                      | 21.23                | 21.57                    |
| 2000            | 0.31      | 0.21            | 120.89            | 0.03                      | 21.06                | 21.41                    |
| 2050            | 0.32      | 0.22            | 122.99            | 0.03                      | 20.90                | 21.26                    |
| 2100            | 0.33      | 0.22            | 125.04            | 0.03                      | 20.74                | 21.11                    |
| 2150            | 0.34      | 0.23            | 127.06            | 0.03                      | 20.58                | 20.97                    |
| 2200            | 0.35      | 0.24            | 129.05            | 0.03                      | 20.42                | 20.83                    |
| 2250            | 0.36      | 0.24            | 131.00            | 0.03                      | 20.27                | 20.69                    |

**Table 8. Noise Parameters vs Frequency (@ +25 °C, 5 V, 78 mA) (2 of 3)**

| Frequency (MHz) | FMIN (dB) | Gamma opt (Mag) | Gamma opt (Phase) | Noise Resistance (RN) (Ω) | Associated Gain (dB) | Maximum Gain (GMAX) (dB) |
|-----------------|-----------|-----------------|-------------------|---------------------------|----------------------|--------------------------|
| 2300            | 0.37      | 0.25            | 132.94            | 0.03                      | 20.13                | 20.56                    |
| 2350            | 0.37      | 0.26            | 134.85            | 0.03                      | 19.99                | 20.44                    |
| 2400            | 0.38      | 0.26            | 136.74            | 0.03                      | 19.85                | 20.31                    |
| 2450            | 0.39      | 0.27            | 138.61            | 0.03                      | 19.71                | 20.19                    |
| 2500            | 0.40      | 0.28            | 140.46            | 0.03                      | 19.58                | 20.07                    |
| 2550            | 0.41      | 0.29            | 142.31            | 0.03                      | 19.45                | 19.96                    |
| 2600            | 0.42      | 0.29            | 144.14            | 0.03                      | 19.32                | 19.85                    |
| 2650            | 0.43      | 0.30            | 145.96            | 0.03                      | 19.19                | 19.74                    |
| 2700            | 0.44      | 0.31            | 147.77            | 0.03                      | 19.07                | 19.63                    |
| 2750            | 0.45      | 0.32            | 149.57            | 0.03                      | 18.95                | 19.52                    |
| 2800            | 0.45      | 0.32            | 151.37            | 0.03                      | 18.84                | 19.42                    |
| 2850            | 0.46      | 0.33            | 153.17            | 0.03                      | 18.72                | 19.32                    |
| 2900            | 0.47      | 0.34            | 154.97            | 0.03                      | 18.61                | 19.21                    |
| 2950            | 0.48      | 0.34            | 156.76            | 0.03                      | 18.50                | 19.11                    |
| 3000            | 0.49      | 0.35            | 158.55            | 0.03                      | 18.39                | 19.02                    |
| 3050            | 0.50      | 0.36            | 160.35            | 0.03                      | 18.29                | 18.92                    |
| 3100            | 0.51      | 0.36            | 162.14            | 0.03                      | 18.18                | 18.82                    |
| 3150            | 0.51      | 0.37            | 163.94            | 0.04                      | 18.08                | 18.72                    |
| 3200            | 0.52      | 0.38            | 165.74            | 0.04                      | 17.98                | 18.63                    |
| 3250            | 0.53      | 0.38            | 167.54            | 0.04                      | 17.89                | 18.53                    |
| 3300            | 0.54      | 0.39            | 169.35            | 0.04                      | 17.79                | 18.44                    |
| 3350            | 0.55      | 0.39            | 171.16            | 0.04                      | 17.69                | 18.34                    |
| 3400            | 0.55      | 0.40            | 172.97            | 0.04                      | 17.60                | 18.25                    |
| 3450            | 0.56      | 0.41            | 174.78            | 0.04                      | 17.51                | 18.15                    |
| 3500            | 0.57      | 0.41            | 176.59            | 0.04                      | 17.42                | 18.06                    |
| 3550            | 0.58      | 0.42            | 178.41            | 0.04                      | 17.33                | 17.97                    |
| 3600            | 0.58      | 0.42            | -179.77           | 0.04                      | 17.24                | 17.87                    |
| 3650            | 0.59      | 0.43            | -177.96           | 0.04                      | 17.16                | 17.78                    |
| 3700            | 0.60      | 0.43            | -176.14           | 0.04                      | 17.07                | 17.69                    |
| 3750            | 0.60      | 0.43            | -174.33           | 0.04                      | 16.99                | 17.60                    |
| 3800            | 0.61      | 0.44            | -172.52           | 0.04                      | 16.91                | 17.51                    |
| 3850            | 0.62      | 0.44            | -170.71           | 0.04                      | 16.83                | 17.42                    |
| 3900            | 0.62      | 0.45            | -168.91           | 0.04                      | 16.75                | 17.33                    |
| 3950            | 0.63      | 0.45            | -167.11           | 0.04                      | 16.67                | 17.25                    |
| 4000            | 0.64      | 0.45            | -165.33           | 0.04                      | 16.59                | 17.16                    |
| 4050            | 0.64      | 0.46            | -163.55           | 0.04                      | 16.52                | 17.07                    |
| 4100            | 0.65      | 0.46            | -161.79           | 0.04                      | 16.44                | 16.99                    |
| 4150            | 0.66      | 0.46            | -160.05           | 0.04                      | 16.37                | 16.91                    |

**Table 8. Noise Parameters vs Frequency (@ +25 °C, 5 V, 78 mA) (3 of 3)**

| Frequency (MHz) | FMIN (dB) | Gamma opt (Mag) | Gamma opt (Phase) | Noise Resistance (RN) (Ω) | Associated Gain (dB) | Maximum Gain (GMAX) (dB) |
|-----------------|-----------|-----------------|-------------------|---------------------------|----------------------|--------------------------|
| 4200            | 0.66      | 0.46            | -158.32           | 0.04                      | 16.30                | 16.83                    |
| 4250            | 0.67      | 0.47            | -156.61           | 0.04                      | 16.23                | 16.75                    |
| 4300            | 0.68      | 0.47            | -154.92           | 0.04                      | 16.15                | 16.67                    |
| 4350            | 0.68      | 0.47            | -153.26           | 0.04                      | 16.09                | 16.60                    |
| 4400            | 0.69      | 0.47            | -151.62           | 0.04                      | 16.02                | 16.52                    |
| 4450            | 0.70      | 0.47            | -150.02           | 0.04                      | 15.95                | 16.45                    |
| 4500            | 0.70      | 0.48            | -148.45           | 0.04                      | 15.89                | 16.39                    |
| 4550            | 0.71      | 0.48            | -146.91           | 0.04                      | 15.82                | 16.32                    |
| 4600            | 0.72      | 0.48            | -145.42           | 0.04                      | 15.76                | 16.26                    |
| 4650            | 0.72      | 0.48            | -143.96           | 0.04                      | 15.70                | 16.20                    |
| 4700            | 0.73      | 0.48            | -142.56           | 0.04                      | 15.64                | 16.15                    |
| 4750            | 0.74      | 0.49            | -141.21           | 0.04                      | 15.58                | 16.10                    |
| 4800            | 0.74      | 0.49            | -139.91           | 0.05                      | 15.52                | 16.06                    |
| 4850            | 0.75      | 0.49            | -138.66           | 0.05                      | 15.46                | 16.02                    |
| 4900            | 0.76      | 0.49            | -137.48           | 0.05                      | 15.41                | 15.98                    |
| 4950            | 0.77      | 0.49            | -136.37           | 0.05                      | 15.35                | 15.95                    |
| 5000            | 0.78      | 0.50            | -135.33           | 0.05                      | 15.30                | 15.93                    |
| 5050            | 0.79      | 0.50            | -134.36           | 0.05                      | 15.25                | 15.91                    |
| 5100            | 0.80      | 0.50            | -133.48           | 0.05                      | 15.20                | 15.90                    |
| 5150            | 0.81      | 0.51            | -132.68           | 0.06                      | 15.15                | 15.90                    |
| 5200            | 0.82      | 0.51            | -131.97           | 0.06                      | 15.11                | 15.90                    |
| 5250            | 0.83      | 0.51            | -131.35           | 0.06                      | 15.06                | 15.92                    |
| 5300            | 0.84      | 0.52            | -130.83           | 0.06                      | 15.02                | 15.94                    |
| 5350            | 0.85      | 0.52            | -130.42           | 0.06                      | 14.98                | 15.97                    |
| 5400            | 0.86      | 0.53            | -130.12           | 0.07                      | 14.94                | 16.00                    |
| 5450            | 0.88      | 0.53            | -129.94           | 0.07                      | 14.91                | 16.05                    |
| 5500            | 0.89      | 0.54            | -129.88           | 0.07                      | 14.87                | 16.11                    |
| 5550            | 0.90      | 0.54            | -129.95           | 0.07                      | 14.84                | 16.18                    |
| 5600            | 0.92      | 0.55            | -130.15           | 0.08                      | 14.81                | 16.25                    |
| 5650            | 0.93      | 0.56            | -130.49           | 0.08                      | 14.79                | 16.35                    |
| 5700            | 0.95      | 0.56            | -130.97           | 0.08                      | 14.76                | 16.45                    |
| 5750            | 0.97      | 0.57            | -131.61           | 0.09                      | 14.74                | 16.56                    |
| 5800            | 0.99      | 0.58            | -132.41           | 0.09                      | 14.72                | 16.69                    |
| 5850            | 1.01      | 0.59            | -133.37           | 0.10                      | 14.71                | 16.83                    |
| 5900            | 1.03      | 0.60            | -134.51           | 0.10                      | 14.70                | 16.99                    |
| 5950            | 1.05      | 0.61            | -135.82           | 0.11                      | 14.69                | 17.16                    |
| 6000            | 1.07      | 0.62            | -137.33           | 0.11                      | 14.68                | 17.35                    |

## Evaluation Board Description

The SKY67103-396LF Evaluation Board is used to test the performance of the SKY67103-396LF LNA. An assembly drawing for the Evaluation Board is shown in Figure 14. An Evaluation Board schematic diagram is provided in Figure 15. Table 9 provides the Bill of Materials (BOM) list for Evaluation Board components at 3600 MHz.

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 ( $\epsilon_r$ ) and low  $\epsilon_r$  variation over temperature for the best possible noise performance.

## Package Dimensions

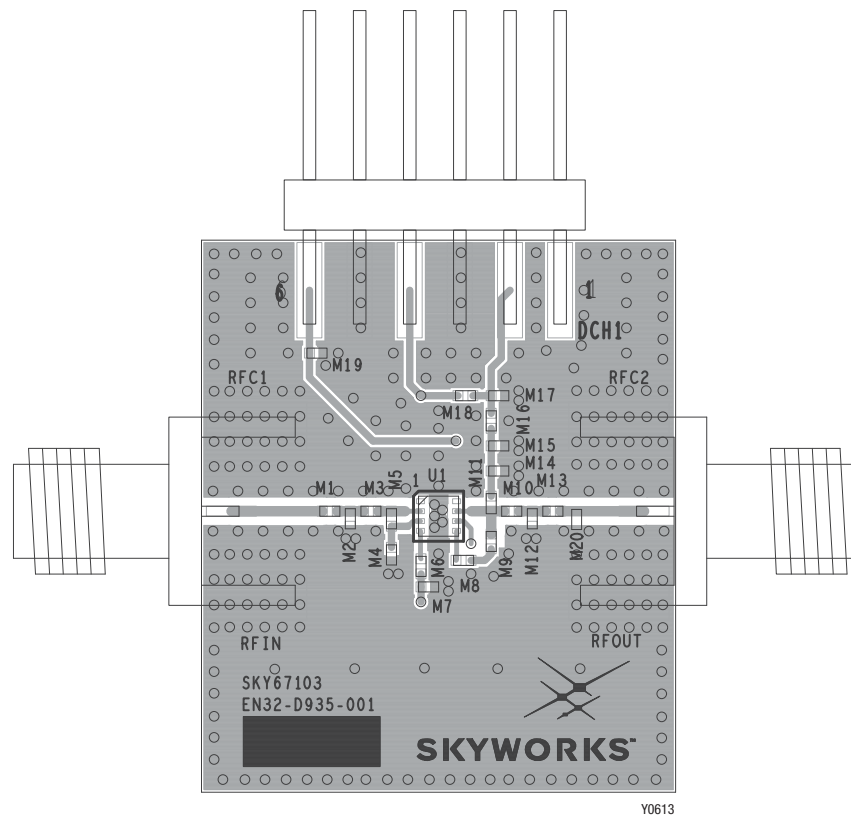
The PCB layout footprint for the SKY67103-396LF is provided in Figure 16. Typical case markings are shown in Figure 17. Package dimensions for the 8-pin DFN are shown in Figure 18, and tape and reel dimensions are provided in Figure 19.

## 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 SKY67103-396LF 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. SKY67103-396LF Evaluation Board Assembly Diagram**

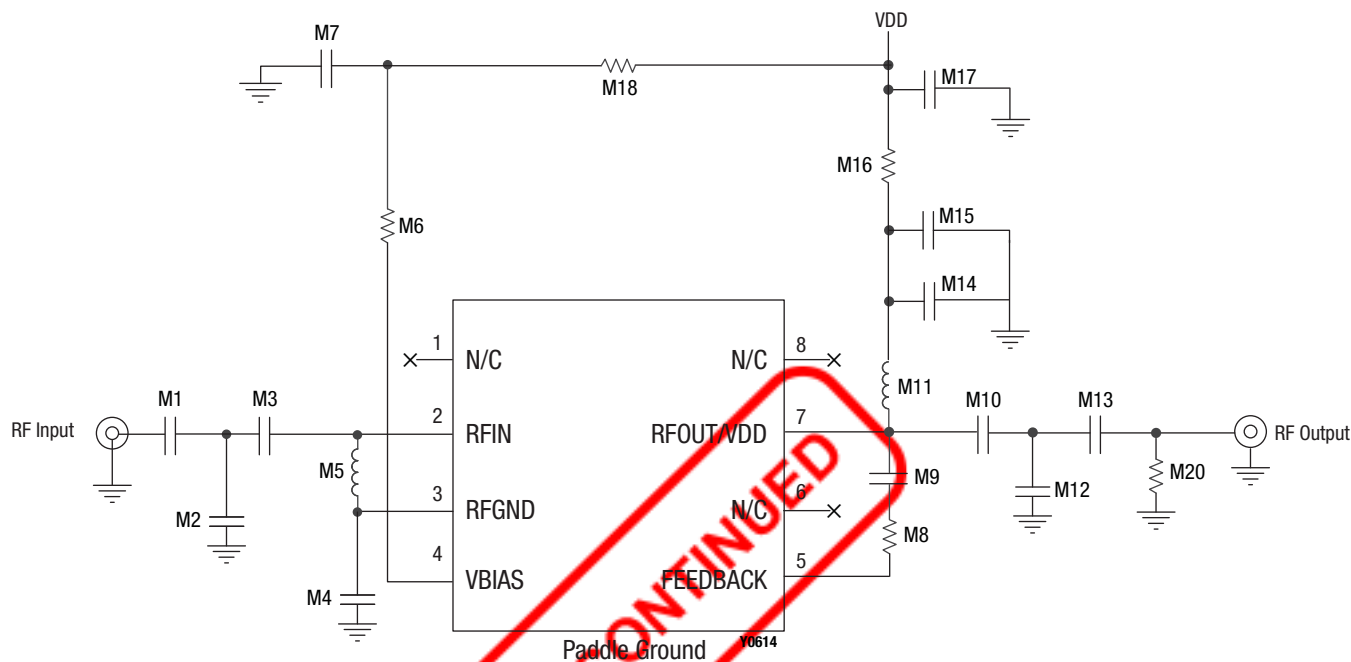


Figure 15. SKY67103-396LF Evaluation Board Schematic

Table 9. SKY67103-396LF Evaluation Board Bill of Materials (3 GHz to 4 GHz)

| Component | Description | Value      | Size | Manufacturer     | Mfr Part Number   |
|-----------|-------------|------------|------|------------------|-------------------|
| M1        | Capacitor   | 15 pF      | 0402 | Murata GJM       | GJM1555C1H150JB01 |
| M2        | Capacitor   | 1 pF       | 0402 | Murata GJM       | GJM1555C1H1R0CB01 |
| M3        | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M4        |             | DNP        |      |                  |                   |
| M5        | Inductor    | 15 nH      | 0402 | Coilcraft HP     | 0402HP-15N0XJL    |
| M6        | Resistor    | 10.2k      | 0402 | Kamaya RMC 1/16S | RMC1/16SK1022FTH  |
| M7        | Capacitor   | 1000 pF    | 0402 | Murata GRM       | GRM155R71H102KA01 |
| M8        |             | DNP        |      |                  |                   |
| M9        |             | DNP        |      |                  |                   |
| M10       | Inductor    | 1 nH       | 0402 | Coilcraft HP     | 0402HP-1N0XJL     |
| M11       | Inductor    | 1 nH       | 0402 | Coilcraft HP     | 0402HP-1N0XJL     |
| M12       |             | DNP        |      |                  |                   |
| M13       | Capacitor   | 1.1 pF     | 0402 | Murata GJM       | GJM1555C1H1R1CB01 |
| M14       | Capacitor   | 10 pF      | 0402 | Murata GJM       | GJM1555C1H100JB01 |
| M15       | Capacitor   | 1000 pF    | 0402 | Murata GRM       | GRM155R71H102KA01 |
| M16       | Resistor    | 0 Ohm      | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M17       |             | DNP        |      |                  |                   |
| M18       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M19       |             | DNP        |      |                  |                   |
| M20       | Resistor    | 5.1k       | 0402 | Kamaya RMC 1/16S | RMC1/16SK511FTH   |

**Table 10. SKY67103-396LF Evaluation Board Bill of Materials (850 MHz)**

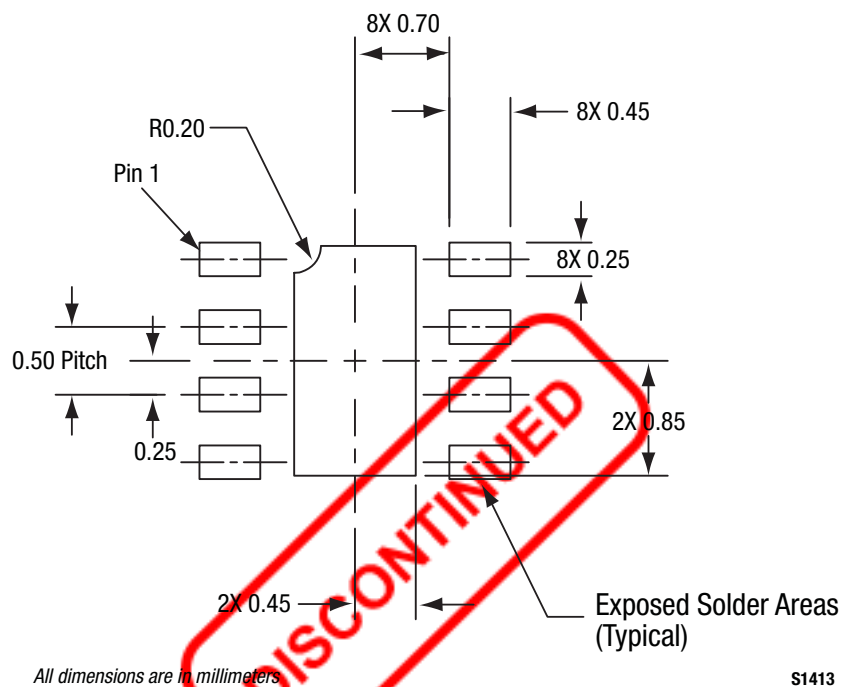
| Component | Description | Value      | Size | Manufacturer     | Mfr Part Number   |
|-----------|-------------|------------|------|------------------|-------------------|
| M1        | Inductor    | 2.2 nH     | 0402 | Coilcraft        | 0402HP-2N2XJL     |
| M2        | DNI         |            |      |                  |                   |
| M3        | Capacitor   | 20 pF      | 0402 | Murata GJM       | GJM1555C1H200JB01 |
| M4        | Capacitor   | 68 pF      | 0402 | Murata GRM       | GRM1555C1H680JZ01 |
| M5        | Inductor    | 15 nH      | 0402 | Coilcraft HP     | 0402HP-15N0XJL    |
| M6        | Resistor    | 10.2k      | 0402 | Kamaya RMC 1/16S | RMC1/16SK1022FTH  |
| M7        | Capacitor   | 1000 pF    | 0402 | Murata GRM       | GRM155R71H102KA01 |
| M8        |             | DNP        |      |                  |                   |
| M9        |             | DNP        |      |                  |                   |
| M10       | Capacitor   | 100 pF     | 0402 | Murata GJM       | GRM1555C1H101JZ01 |
| M11       | Inductor    | 8.2 nH     | 0402 | Murata           | LQG15HS8N2J02     |
| M12       | Capacitor   | 1.8 pF     | 0402 | Murata GJM       | GRM1555C1H1R8CB01 |
| M14       | Capacitor   | 100 pF     | 0402 | Murata GJM       | GRM1555C1H101JZ01 |
| M14       | Capacitor   | 100 pF     | 0402 | Murata GJM       | GRM1555C1H101JZ01 |
| M15       | Capacitor   | 10000 pF   | 0402 | Murata GRM       | GRM155R71H103KA01 |
| M16       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M17       |             | DNP        |      |                  |                   |
| M18       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M19       |             | DNP        |      |                  |                   |
| M20       | Resistor    | 5.1k       | 0402 | Kamaya RMC 1/16S | RMC1/16SK511FTH   |

**Table 11. SKY67103-396LF Evaluation Board Bill of Materials (1.85 GHz)**

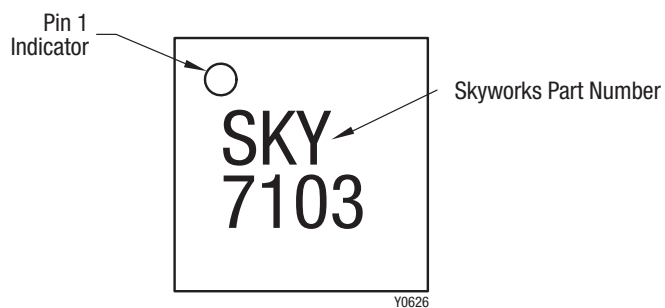
| Component | Description | Value      | Size | Manufacturer     | Mfr Part Number   |
|-----------|-------------|------------|------|------------------|-------------------|
| M1        | Capacitor   | 20 pF      | 0402 | Murata GJM       | GJM1555C1H200JB01 |
| M2        | Capacitor   | 1 pF       | 0402 | Murata GJM       | GJM1555C1H1R0CB01 |
| M3        | Inductor    | 2 nH       | 0402 | Coilcraft HP     | 0402HP-2N0XJL     |
| M4        | Capacitor   | 8.2 pF     | 0402 | Murata GRM       | GJM1555C1H8R2DB01 |
| M5        | Inductor    | 10 nH      | 0402 | Coilcraft HP     | 0402HP-10N0XJL    |
| M6        | Resistor    | 10.2 K     | 0402 | Kamaya RMC 1/16S | RMC1/16SK1022FTH  |
| M7        | Capacitor   | 10000 pF   | 0402 | Murata GRM       | GRM155R71H103KA01 |
| M8        |             | DNP        |      |                  |                   |
| M9        |             | DNP        |      |                  |                   |
| M10       | Capacitor   | 3.6 pF     | 0402 | Murata GJM       | GRM1555C1H3R6CB01 |
| M11       | Inductor    | 3.6 nH     | 0402 | Murata           | LQG15HS3N6S02     |
| M12       | Resistor    | 2.0 K      | 0402 | Kamaya RMC 1/16S | RMC1/16S-202JTH   |
| M13       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M14       | Capacitor   | 22 pF      | 0402 | Murata GRM       | GRM1555C1H220JZ01 |
| M15       | Capacitor   | 1000 pF    | 0402 | Murata GRM       | GRM155R71H102KA01 |
| M16       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M17       |             | DNP        |      |                  |                   |
| M18       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M19       |             | DNP        |      |                  |                   |
| M20       | Resistor    | 5.1k       | 0402 | Kamaya RMC 1/16S | RMC1/16SK511FTH   |

**Table 12. SKY67103-396LF Evaluation Board Bill of Materials (2.6 GHz)**

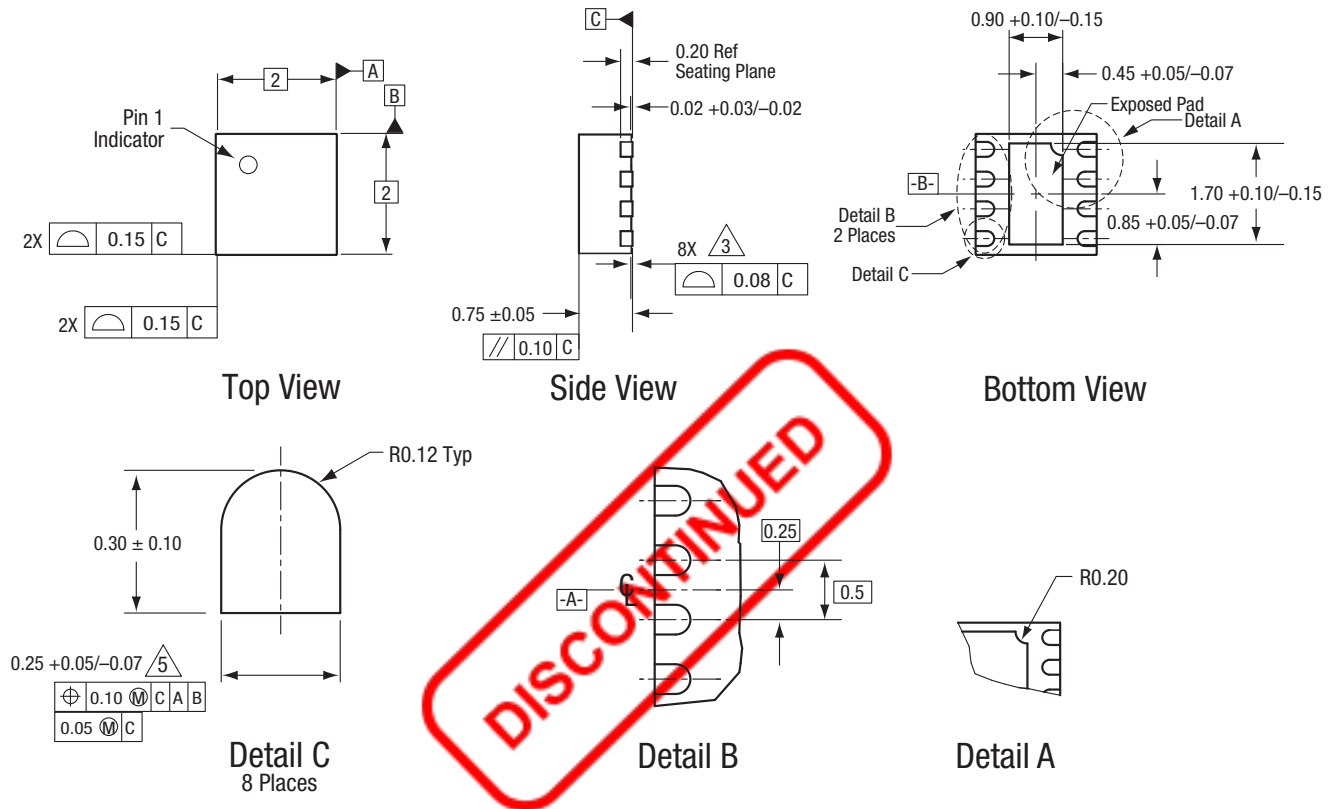
| Component | Description | Value      | Size | Manufacturer     | Mfr Part Number   |
|-----------|-------------|------------|------|------------------|-------------------|
| M1        | Capacitor   | 20 pF      | 0402 | Murata GJM       | GJM1555C1H200JB01 |
| M2        | Capacitor   | 1 pF       | 0402 | Murata GJM       | GJM1555C1H1R0CB01 |
| M3        | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M4        | Capacitor   | 56 pF      | 0402 | Murata GRM       | GRM1555C1H560JZ01 |
| M5        | Inductor    | 12 nH      | 0402 | Coilcraft HP     | 0402HP-12N0XJL    |
| M6        | Resistor    | 10.2 K     | 0402 | Kamaya RMC 1/16S | RMC1/16SK1022FTH  |
| M7        | Capacitor   | 10000 pF   | 0402 | Murata GRM       | GRM155R71H103KA01 |
| M8        |             | DNP        |      |                  |                   |
| M9        |             | DNP        |      |                  |                   |
| M10       | Capacitor   | 3.9 pF     | 0402 | Murata GJM       | GRM1555C1H3R9CZ01 |
| M11       | Inductor    | 2.7 nH     | 0402 | Murata           | LQG15HS2N7S02     |
| M12       | Resistor    | 2.0 K      | 0402 | Kamaya RMC 1/16S | RMC1/16S-202JTH   |
| M13       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M14       | Capacitor   | 22 pF      | 0402 | Murata GRM       | GRM1555C1H220JZ01 |
| M15       | Capacitor   | 1000 pF    | 0402 | Murata GRM       | GRM155R71H102KA01 |
| M16       | Resistor    | 0 Ohm      | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M17       |             | DNP        |      |                  |                   |
| M18       | Resistor    | 0 $\Omega$ | 0402 | Kamaya RMC 1/16S | RMC1/16SJPTH      |
| M19       |             | DNP        |      |                  |                   |
| M20       | Resistor    | 5.1k       | 0402 | Kamaya RMC 1/16S | RMC1/16SK511FTH   |



**Figure 15. SKY67103-396LF PCB Layout Footprint (Top View)**



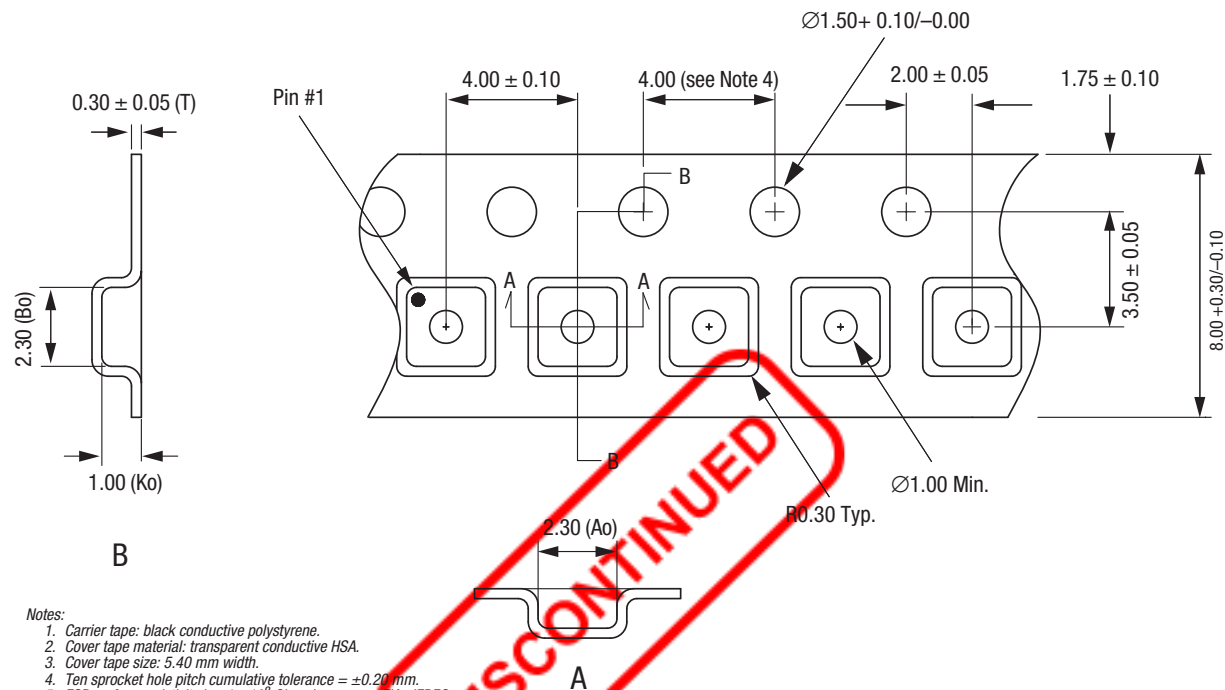
**Figure 16. Typical Case Markings (Top View)**



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 metallized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

S1945

**Figure 17. SKY67103-396LF 8-Pin DFN Package Dimensions**



S1601

Figure 18. SKY67103-396LF Tape and Reel Dimensions

## Ordering Information

| Model Name         | Manufacturing Part Number | Evaluation Board Part Number |
|--------------------|---------------------------|------------------------------|
| SKY67103-396LF LNA | SKY67103-396LF            | SKY67103-396LF-EVB           |



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