

DATA SHEET

SKY74092-11: Dual-Band LNA for CDMA, Femtocell, and PCS Mobile Handset Applications

Applications

- Femtocell systems
- Dual-band cellular handsets
- CDMA and PCS phones

Features

- Wide voltage range for both digital and analog supply voltages, 2.7 V to 3.3 V
- Cellular band IS95/IS2000 LNA with four gain steps and programmable current
- Four-step gain control for CDMA and PCS bands
- PCS band IS95/IS2000 LNA with four gain steps and programmable current
- Three-wire serial bus for device programming
- LGA (16-pin, 3 x 3 x 1 mm) package (MSL3, 260 °C per JEDEC J-STD-020)

NEW

Skyworks offers lead (Pb)-free RoHS (Restriction of Hazardous Substances) compliant packaging.



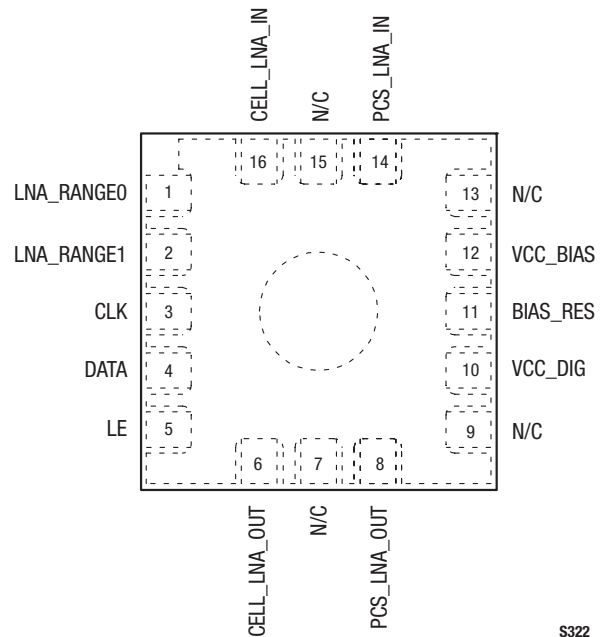
Description

The SKY74092-11 is a dual-band Low Noise Amplifier (LNA) intended for use in Code Division Multiple Access (CDMA) portable phones in both cellular and Personal Communications Service (PCS) bands. The device provides low noise amplification with high linearity to achieve high dynamic range.

Together with Skyworks SKY74100 direct conversion receiver, the SKY74092-11 offers a cost effective, high performance RF-to-baseband radio solution. By cascading the SKY74092-11 with the SKY74100 DCR™, Printed Circuit Board (PCB) layout can easily be optimized for small areas and easy routing.

Different modes, currents, and gain steps of low noise amplification are controlled by a serial three-wire bus interface. The device requires external supply filtering capacitors, one bias resistor, and various external components to match input and output impedance to 50 Ω. The SKY74092-11 is provided in a 3 x 3 mm Land Grid Array (LGA) package.

The device package and pinout for the 16-pin LGA are shown in Figure 1 and a block diagram of the SKY74092-11 is shown in Figure 2.



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Figure 1. SKY74092-11 Pinout – 16-Pin LGA Package (Top View)

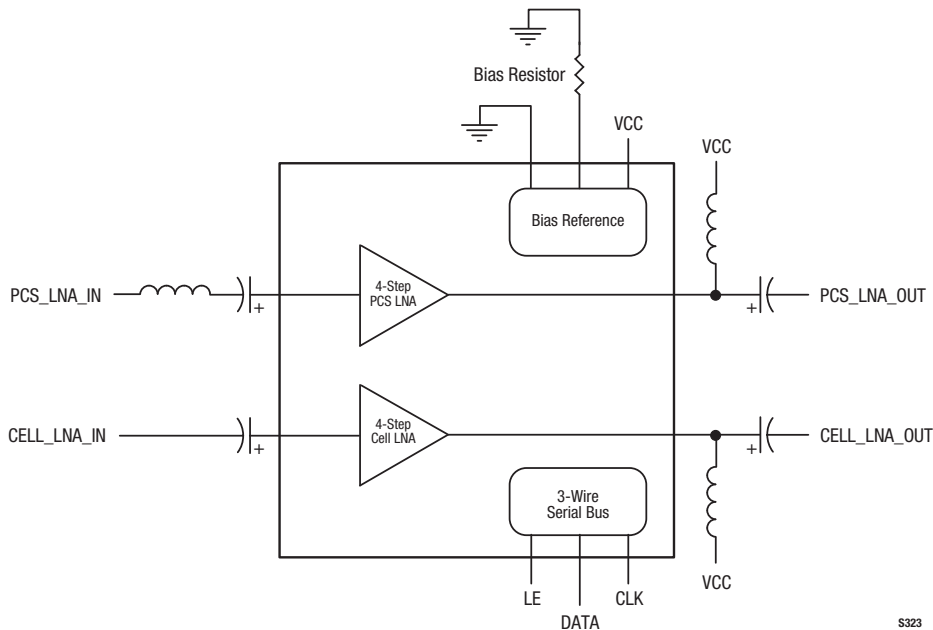


Figure 2. SKY74092-11 LNA Block Diagram

Technical Description

Bias Reference

LNA bias currents are derived from an on-chip bandgap voltage reference. The voltage reference requires a 10 kΩ external resistor.

Cellular Band LNA

The cellular band LNA requires an off-chip matching network at input and output terminals. The LNA is designed to provide a low Noise Figure (NF) and high 3rd order Input Intercept Point (IIP3) to achieve the maximum dynamic range.

The cellular LNA has four gain steps to optimize gain, linearity, and noise at various input signal levels: high gain, mid-gain, bypass, and high attenuation.

PCS Band LNA

The PCS band LNA requires an off-chip matching network at input and output terminals. The PCS LNA is designed to provide a low NF and high IIP3 to achieve the maximum dynamic range.

The PCS LNA has four gain steps to optimize gain, linearity, and noise at various input signal levels: high gain, mid-gain, bypass, and high attenuation.

Serial Interface

A three-wire serial bus is used to control the operation mode, gain, and current of the LNAs. The CLK, DATA, and LE signals

(pins 3, 4, and 5, respectively) provide the control inputs. The SKY74092-11 provides the following control and test registers:

- Mode Selection
- Gain Control
- Current Selection

The SKY74092-11 supports two types of fixed-length data transfers: 9-bit and 27-bit. Data is latched starting from the second high-to-low transition on the CLK signal after LE goes low. The first high-to-low transition of the CLK signal is ignored.

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY74100 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *PCB Design & SMT Assembly/Rework Guidelines for RFLGA Packages*, document number 103147.

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.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SKY74092-11 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Tables 4 and 5. Tables 6 through 8 provide the control logic for the SKY74092-11.

An application schematic diagram for the SKY74092-11 is shown in Figure 3. The package dimensions for the 16-pin LGA are shown in Figure 4, and the tape and reel dimensions are provided in Figure 5.

Table 1. SKY74092-11 Pin Assignments and Signal Descriptions

| Pin # | Name | Description |
|-------|--------------|--|
| 1 | LNA_RANGE0 | LNA gain control input (bit 0). Hardware control disabled. Needs to be grounded with software control. |
| 2 | LNA_RANGE1 | LNA gain control input (bit 1). Hardware control disabled. Needs to be grounded with software control. |
| 3 | CLK | Clock for the three-wire bus |
| 4 | DATA | Data for the three-wire bus |
| 5 | LE | Latch enable for the three-wire bus |
| 6 | CELL_LNA_OUT | Externally matched cellular LNA output |
| 7 | N/C | No connection |
| 8 | PCS_LNA_OUT | Externally matched PCS LNA output |
| 9 | N/C | No connection |
| 10 | VCC_DIG | Supply voltage for digital circuitry |
| 11 | BIAS_RES | External 10 k Ω bias resistor |
| 12 | VCC_BIAS | Supply voltage for bias circuitry |
| 13 | N/C | No connection |
| 14 | PCS_LNA_IN | Externally matched PCS LNA input |
| 15 | N/C | No connection |
| 16 | CELL_LNA_IN | Externally matched cellular LNA input |

Table 2. Absolute Maximum Ratings

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|-----------------------------|----------------------|---------|---------|-----------|-------|
| Supply voltage | VDD | 0 | | 5.0 | V |
| DC voltage at control ports | V _{CNTL} | 0 | | 0.3 + VDD | V |
| Power into LNA inputs | P _{IN, LNA} | | | -5.0 | dBm |
| Operating temperature | T _A | -30 | | +85 | °C |
| Storage temperature | T _{STG} | -40 | | +125 | °C |

Note: 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 values.

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. With the exception of the input pins, the SKY74092-11 ESD threshold level, with respect to ground, is ± 2.0 kV using Human Body Model (HBM) testing. The HBM ESD withstand threshold value for input pins is 900 V.

Table 3. Recommended Operating Conditions (@ +25 °C, VCC = 2.85 V)

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|------------------------------------|--------|---------|---------|---------|-------|
| Supply voltage | | 2.7 | 2.85 | 3.3 | V |
| RF frequency range (cellular band) | | 869 | | 894 | MHz |
| RF frequency range (PCS) | | 1930 | | 1990 | MHz |
| Operating temperature range | | -30 | +25 | +85 | °C |

Table 4. Electrical Characteristics: Cellular LNA Mode Settings (869-894 MHz) (Note 1)
(TA = +25 °C, VCC = 2.85 V, Unless Otherwise Noted)

| Parameter | Symbol | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------------------------------|-------------|-----------------|---------|---------|---------|-------|
| LNA High Gain | | | | | | |
| Gain | | | 15 | 16 | 16.8 | dB |
| Noise Figure | | | | 1.2 | 1.5 | dB |
| IIP3 | | | 7.5 | 9.0 | | dBm |
| 1 dB compression point at input | | | -8 | -7 | | dBm |
| Input/output return loss (Note 2) | Zs/L = 50 Ω | | | -12 | -10 | dB |
| Reverse isolation | | | 20 | 21 | | dB |
| Current | | | 8 | 9 | 12 | mA |
| LNA Mid-Gain | | | | | | |
| Gain | | | 6.5 | 7.5 | 8.5 | dB |
| Noise Figure | | | | 4.2 | 5.2 | dB |
| IIP3 | | | 9.5 | 11 | | dBm |
| 1 dB compression point at input | | | -2 | -1 | | dBm |
| Input/output return loss (Note 2) | Zs/L = 50 Ω | | | -10 | -8 | dB |
| Reverse isolation | | | 15 | 16 | | dB |
| Current | | | 6 | 8 | 10 | mA |
| LNA Bypass | | | | | | |
| Gain | | | -4 | -3 | -2 | dB |
| Noise Figure | | | | 3 | 4 | dB |
| IIP3 | | | 18.5 | 20.0 | | dBm |
| 1 dB compression point at input | | | 2.5 | 3.5 | | dBm |
| Input/output return loss (Note 2) | Zs/L = 50 Ω | | | -8 | -7 | dB |
| Reverse isolation | | | 2 | 3 | | dB |
| Current | | | | 200 | 240 | μA |
| LNA High Attenuation | | | | | | |
| Gain | | | -18 | -17 | -16 | dB |
| Noise Figure | | | | 17 | 18 | dB |
| IIP3 | | | 20.5 | 22.0 | | dBm |
| 1 dB compression point at input | | | 4 | 5 | | dBm |
| Input/output return loss (Note 2) | Zs/L = 50 Ω | | | -12 | -10 | dB |
| Reverse isolation | | | 16 | 17 | | dB |
| Current | | | | 200 | 240 | μA |

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

Note 2: Input and output externally matched to 50 Ω.

Table 5. Electrical Characteristics: PCS LNA Mode Settings (1930-1990 MHz) (Note 1)
(T_A = +25 °C, V_{CC} = 2.85 V, Unless Otherwise Noted)

| Parameter | Symbol | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------------------------------|-------------------------|-----------------|---------|---------|---------|-------|
| LNA High Gain | | | | | | |
| Gain | | | 15 | 16 | 16.8 | dB |
| Noise Figure | | | | 1.3 | 1.6 | dB |
| IIP3 | | | 7.0 | 8.5 | | dBm |
| 1 dB compression point at input | | | -12.0 | -10.5 | | dBm |
| Input/output return loss (Note 2) | Z _{s/L} = 50 Ω | | | -11.5 | -10.0 | dB |
| Reverse isolation | | | 20.0 | 21.5 | | dB |
| Current | | | 9.0 | 11.1 | 13.0 | mA |
| LNA Mid-Gain | | | | | | |
| Gain | | | 6.0 | 7.0 | 7.8 | dB |
| Noise Figure | | | | 4.3 | 5.3 | dB |
| IIP3 | | | 7.5 | 9.0 | | dBm |
| 1 dB compression point at input | | | -4.5 | -3.0 | | dBm |
| Input/output return loss (Note 2) | Z _{s/L} = 50 Ω | | | -7 | -6 | dB |
| Reverse isolation | | | 14.0 | 15.5 | | dB |
| Current | | | 7.0 | 8.5 | 11 | mA |
| LNA Bypass | | | | | | |
| Gain | | | -5 | -4 | -3 | dB |
| Noise Figure | | | | 4 | 5 | dB |
| IIP3 | | | 20.5 | 22.0 | | dBm |
| 1 dB compression point at input | | | 3.0 | 4.5 | | dBm |
| Input/output return loss (Note 2) | Z _{s/L} = 50 Ω | | | -10 | -8 | dB |
| Reverse isolation | | | 3 | 4 | | |
| Current | | | | 200 | 240 | μA |
| LNA High Attenuation | | | | | | |
| Gain | | | -18 | -17 | -16 | dB |
| Noise Figure | | | | 17 | 18 | dB |
| IIP3 | | | 23.5 | 25.0 | | dBm |
| 1 dB compression point at input | | | 4 | 5 | | dBm |
| Input/output return loss (Note 2) | Z _{s/L} = 50 Ω | | | -9 | -7 | dB |
| Reverse isolation | | | 16 | 17 | | dB |
| Current | | | | 200 | 240 | μA |

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

Note 2: Input and output externally matched to 50 Ω.

Table 6. Mode Selection Register

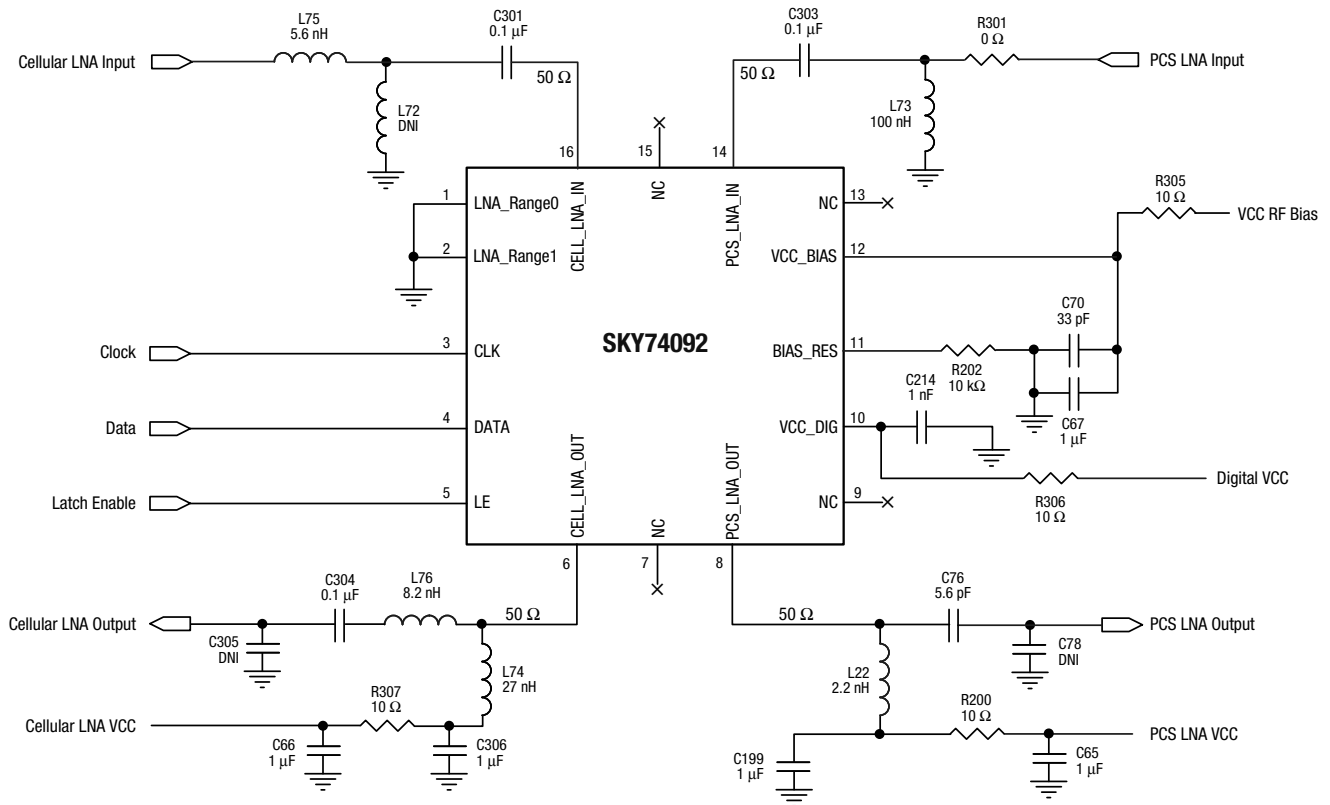
| Bit Range | Description |
|-----------|---|
| [2:0] | Bits [2:0]: Not configurable – must be set to 1 1 1 |
| [4:3] | Bits [4:3]: LNA mode control 0 0 = Cellular mode 0 1 = Not used 1 0 = Not used 1 1 = PCS mode |
| [7:5] | Bits [7:5]: Not configurable – must be set to 1 0 0 |
| [8] | Bit [8]: LNA enable 0 = LNA off 1 = LNA on |
| [26:9] | Bits [26:9]: Not configurable – must be set to 0 1 0 0 0 1 0 1 1 0 0 0 0 0 1 0 0 |

Table 7. Gain Control Register

| Bit Range | Description |
|-----------|--|
| [3:0] | Bits [3:0]: Not configurable – must be set to 0 0 0 0 |
| [5:4] | Bits [5:4]: LNA gain control: 0 0 = High gain 0 1 = Mid-gain 1 0 = Bypass 1 1 = High attenuation |
| [8:6] | Bits [8:6]: Not configurable – must be set to 0 0 1 |

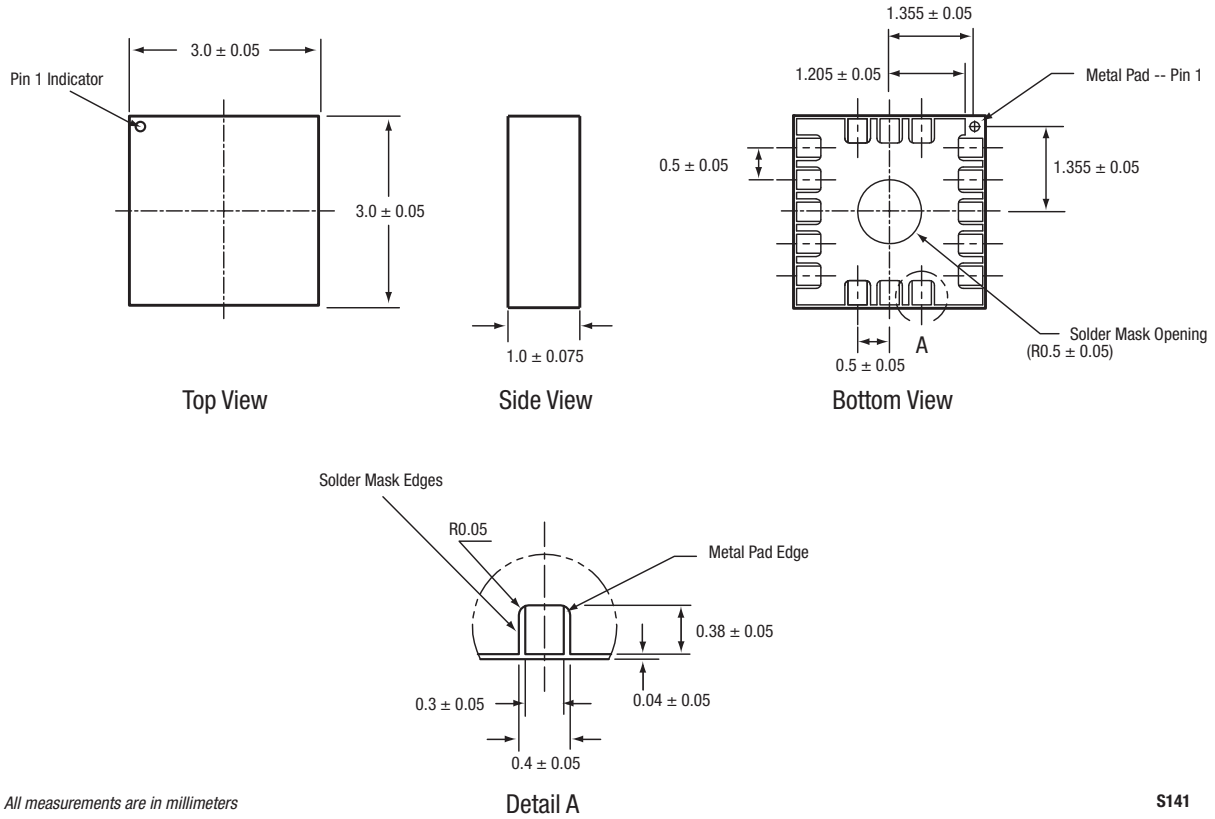
Table 8. Current Selection Register

| Bit Range | Description |
|-----------|--|
| [0] | Bit [0]: Not configurable – must be set to 1 |
| [3:1] | Bits [3:1]: CDMA LNA current selection (high gain setting only) 0 0 0 = 5.862 mA 1 0 0 = 10.944 mA 0 0 1 = 7.159 mA 1 0 1 = 12.246 mA 0 1 0 = 8.427 mA 1 1 0 = 13.503 mA 0 1 1 = 9.735 mA 1 1 1 = 14.795 mA Note that the current can also be adjusted with the external bias resistor. |
| [6:4] | Bits [6:4]: PCS LNA current selection (high gain setting only) 0 0 0 = 5.590 mA 1 0 0 = 11.030 mA 0 0 1 = 6.990 mA 1 0 1 = 12.146 mA 0 1 0 = 8.360 mA 1 1 0 = 12.749 mA 0 1 1 = 9.736 mA 1 1 1 = 13.098 mA Note that the current can also be adjusted with the external bias resistor. |
| [26:7] | Bits [26:7]: Not configurable – must be set to 0 1 0 0 0 1 0 1 1 0 0 0 0 0 1 0 1 0 0 1 |



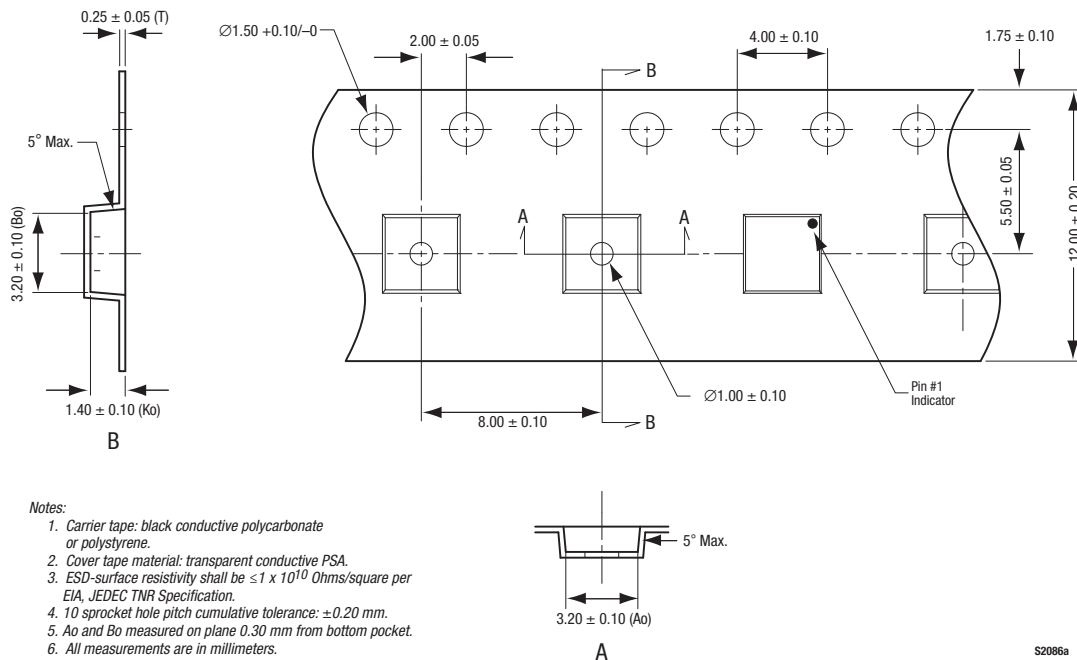
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Figure 3. SKY74092-11 Schematic Diagram



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Figure 4. SKY74092-11 16-Pin LGA Package Dimensions



S2086a

Figure 5. SKY74092-11 Tape and Reel Dimensions

Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Board Part Number |
|-----------------|---------------------------|------------------------------|
| SKY74092-11 LNA | SKY74092-11 | *** TBD *** |

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