SKY73001

2-3500 MHz Direct Conversion Mixer

Skyworks' SKY73001 direct conversion mixer is an integrated, high-dynamic range, zero Intermediate Frequency (IF) architecture down-converter for use in wireless communication applications. High second and third order intercept points (IIP2 and IIP3, respectively) allow seamless integration into high performance systems. The SKY73001 has a wide RF and Local Oscillator (LO) frequency range of 2 to 3500 MHz.

Figure 1 shows a functional block diagram for the SKY73001. The device package and pinout for the 32-pin Radio Frequency Land Grid Array (RFLGA™) are shown in Figure 2.

Distinguishing Features

- High second and third order Input Intercept Points (IIP2 and IIP3)
- Wideband RF and LO input frequency range (2 to 3500 MHz)
- Single +3.0 V supply
- –40 °C to +85 °C operating temperature range
- Zero IF architecture eliminates need for image rejection filter
- Differential IF output supports direct interface to A/D circuitry
- AM demodulation immunity
- Low power consumption
- 32-pin RFLGA package

Applications

- Personal Communications Systems (PCS)
- Digital Communications Systems (DCS)
- Global System for Mobile Communications (GSM)
- Third Generation (3G) wireless communications
- Mobile base stations
- Wireless Local Loops (WLLs)
- Wireless Local Area Networks (WLANs)
- Direct conversion receivers

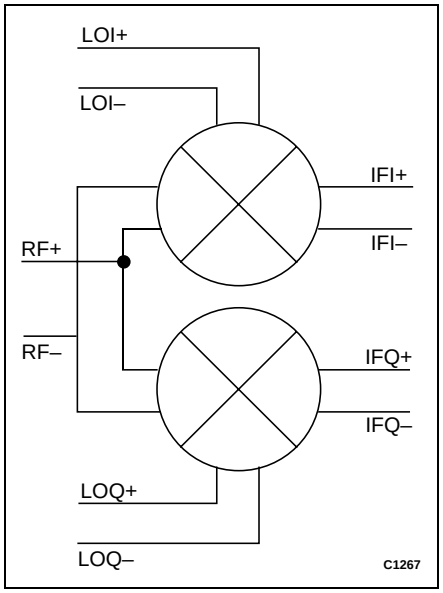

Figure 1. SKY73001 Functional Block Diagram

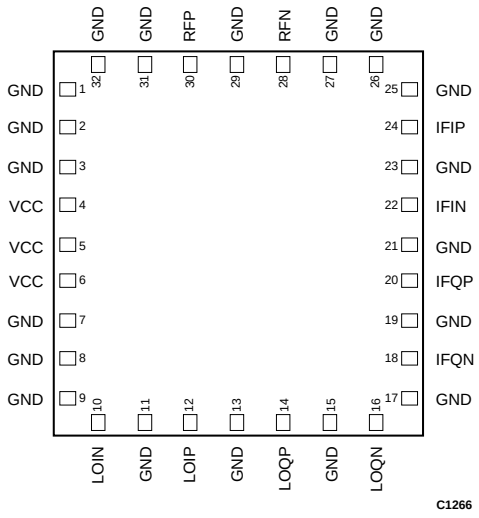

Figure 2. SKY73001 Pinout– 32-Pin RFLGA Package (Top View)

Electrical and Mechanical Specifications

The signal pin assignments and functions are described in Table 1. The absolute maximum ratings of the SKY73001 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Typical performance characteristics of the SKY73001 with respect to varying conditions are illustrated in Figures 3, 4, 5, 6, and 7.

Table 1. SKY73001 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	GND	Ground	17	GND	Ground
2	GND	Ground	18	IFQN	Negative quadrature IF output
3	GND	Ground	19	GND	Ground
4	VCC	+3 VDC supply	20	IFQP	Positive quadrature IF output
5	VCC	+3 VDC supply	21	GND	Ground
6	VCC	+3 VDC supply	22	IFIN	Negative in-phase IF output
7	GND	Ground	23	GND	Ground
8	GND	Ground	24	IFIP	Positive in-phase IF output
9	GND	Ground	25	GND	Ground
10	LOIN	Negative LO input	26	GND	Ground
11	GND	Ground	27	GND	Ground
12	LOIP	Positive LO input	28	RFN	Negative RF input
13	GND	Ground	29	GND	Ground
14	LOQP	Positive quadrature LO input	30	RFP	Positive RF input
15	GND	Ground	31	GND	Ground
16	LOQN	Negative quadrature LO input	32	GND	Ground

Table 2. SKY73001 Absolute Maximum Ratings
(T_A = +25 °C, unless otherwise noted)

Parameter	Symbol	Min	Typical	Max	Units
+3 V supply voltage	VCC	2.7		3.6	V
Power dissipation			140	230	mW
RF input power				+20	dBm
LO input power				+3	dBm
Thermal resistance	θjc		36		°C/W
Operating case temperature		–40		+85	°C
Storage case temperature		–40	0	+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.

Table 3. SKY73001 Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units
+3 V supply voltage	VCC	2.7	3.0	3.3	V
Operating case temperature		–40		+85	°C

Table 4. SKY73001 Electrical Characteristics
(IF = 10 MHz, LO input power = 0 dBm, Tc = 25 °C unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Units
RF input frequency range			2		3500	MHz
LO input frequency range			2		3500	MHz
IF frequency range			DC		100	MHz
I/Q amplitude imbalance			–0.3		+0.3	dB
I/Q phase error				1		deg
Image rejection (Note 1)						dB
IF output impedance				500		Ω
RF Input (900 MHz)						
Voltage conversion gain			–3	–1		dBV
SSB Noise Figure				16	19	dB
IIP2				67		dBm
IIP3			23	26		dBm
–1 dB compression point			13	15		dBm
RF input impedance				1.5:1	2.0:1	VSWR
LO input impedance				1.5:1	2.0:1	VSWR
RF Input (1900 MHz)						
Voltage conversion gain			–3.5	–1.5		dBV
SSB Noise Figure				17.5	20.5	dB
IIP2				70		dBm
IIP3			22	25		dBm
–1 dB compression point			12	14		dBm
RF input impedance				1.5:1	2.0:1	VSWR
LO input impedance				1.5:1	2.0:1	VSWR

Note 1: Image rejection is determined using the following equation:

$$IR = 10\ log\left(\frac{1+A^2+2A[\cos\theta]}{1+A^2-2A[\cos\theta]}\right)\ where\ \ A = 10^{-\left(\frac{amplitude\ \ error}{20}\right)}\ in\ dB.$$

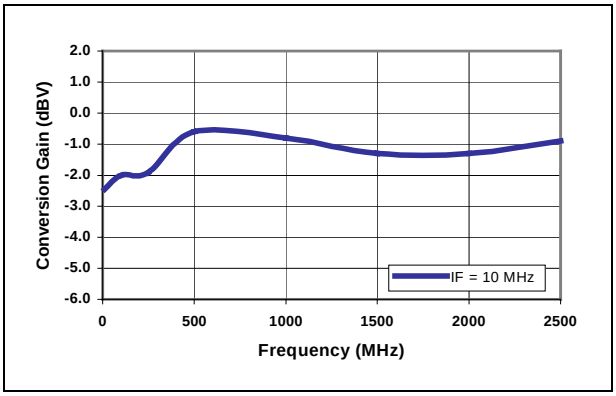

Figure 3. Voltage Conversion Gain vs Frequency

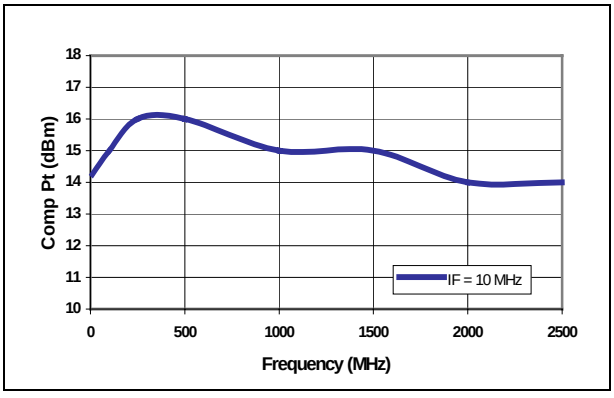

Figure 4. 1 dB Compression Point vs Frequency

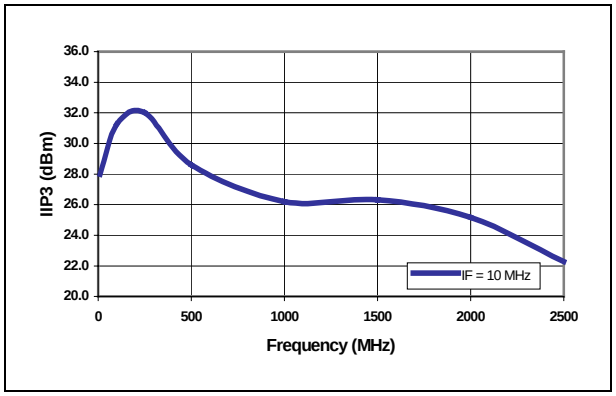

Figure 5. IIP3 vs Frequency (100 kHz Tone Spacing)

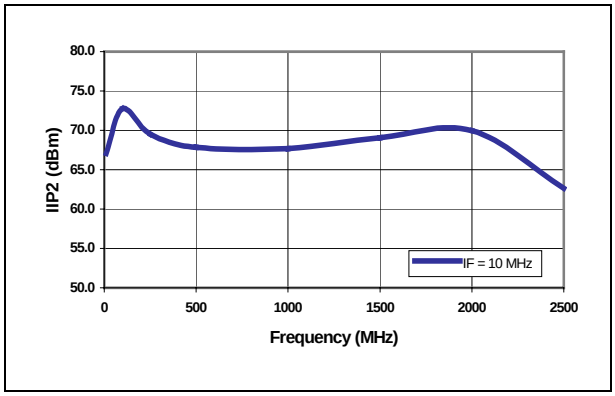

Figure 6. IIP2 vs Frequency

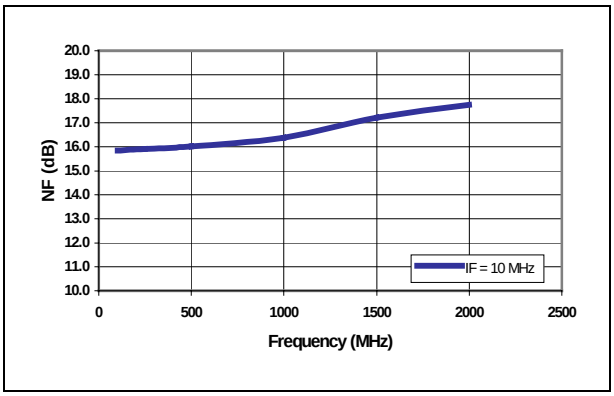

Figure 7. Noise Figure vs Frequency (IF = 10 MHz)

Evaluation Board Description

Skyworks' SKY73001 Evaluation Board is used to test the SKY73001 mixer's performance. The SKY73001 Evaluation Board schematic diagram is shown in Figure 8. Figure 9 provides the Evaluation Board assembly diagram.

Circuit Design Considerations

The following design considerations are general in nature and must be followed regardless of final use or configuration:

1. Paths to ground should be made as short as possible.
2. The ground pad of the SKY73001 direct conversion mixer has special electrical and thermal grounding requirements. This pad is the main thermal conduit for heat dissipation. Since the circuit board acts as the heat sink, it must shunt as much heat as possible from the mixer. As such, design the connection to the ground pad to dissipate the maximum wattage produced to the circuit board. Multiple vias to the grounding layer are required.
3. Two external output bypass capacitors are required on the VCC pin. The values of these capacitors will change with respect to the desired RF frequency. One capacitor should be used for low frequency bypassing and the other capacitor for high frequency bypassing. Special attention should be given so that the smaller value capacitor does not go into self-resonance at the desired RF frequency. See Figure 8 for a detailed diagram.
4. Wire wound balanced transformers (baluns) were used during the test and characterization of the SKY73001. Ceramic baluns can be used to create the differential input signals (i.e., RF and LO). However, their performance will limit the overall system performance of the SKY73001.

Testing Procedure

Use the following procedure to set up the SKY73001 Evaluation Board for testing. Refer to Figure 10 for guidance:

1. Connect the SKY73001 Evaluation Board to a +3.0 VDC power supply using an insulated supply cable. If available, enable the current limiting function of the power supply to 100 mA for the +3 VDC supply current.
2. Connect a signal generator to the RF signal input port. Set it to the desired RF frequency at a power level of 0 dBm but do NOT enable.

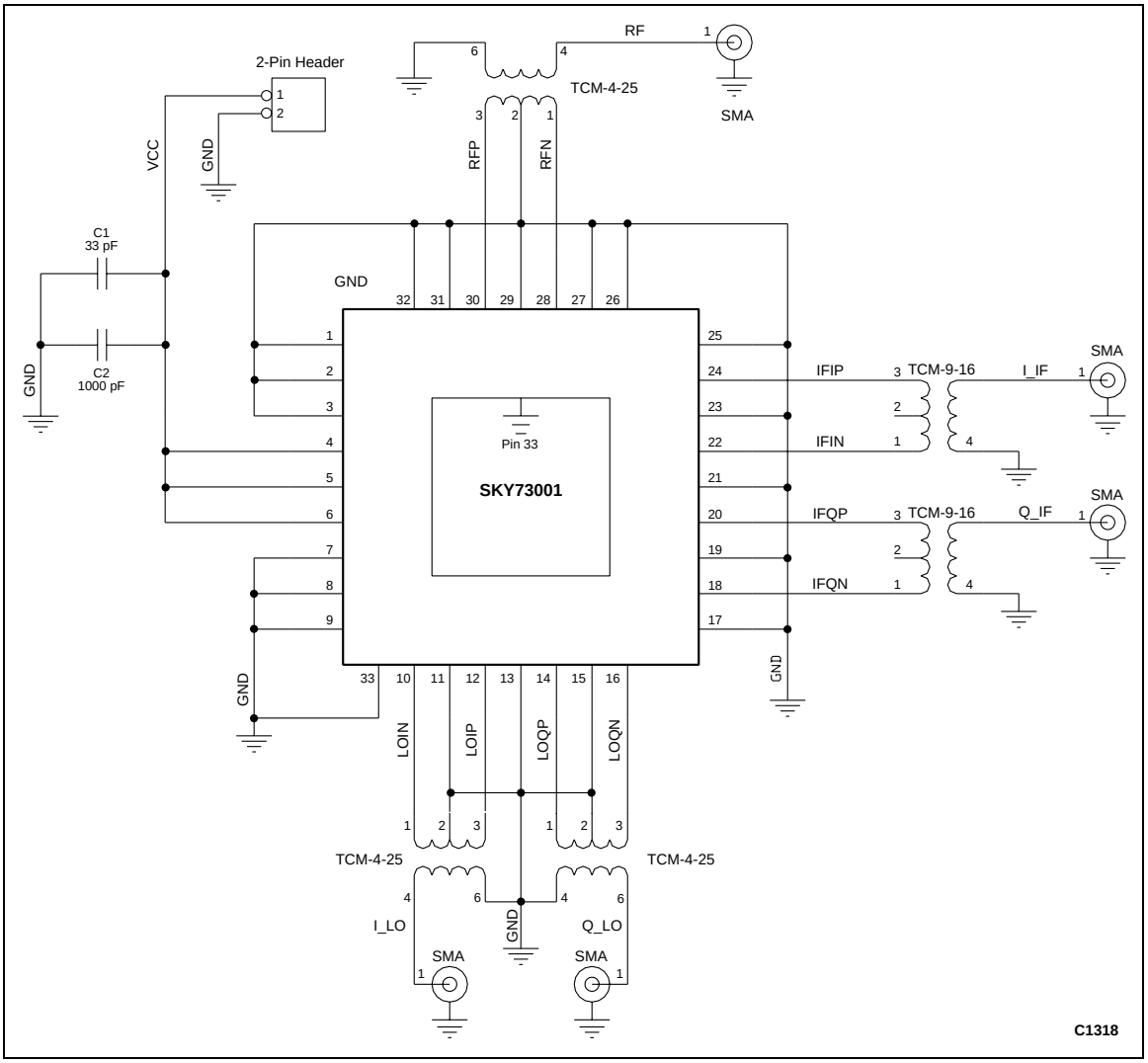

Figure 8. SKY73001 Evaluation Board Schematic

3. Connect a signal generator to the LOQ signal input port. Set to the desired LO frequency at a power level of 0 dBm, but do not enable.
4. Connect a spectrum analyzer to the IFQ signal output port and terminate the IFI signal input port in 50 Ω.
5. Enable the power supply.
6. Enable the LO input signal.
7. Enable the RF signal.
8. Take measurements and repeat these steps for channel I.

***Caution**: If any of the input signals exceed the rated maximum values, the SKY73001 Evaluation Board can be permanently damaged.*

Package Dimensions

Figure 11 shows the package dimensions for the 32-pin SKY73001 RFLGA and Figure 12 provides the tape and reel dimensions.

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.

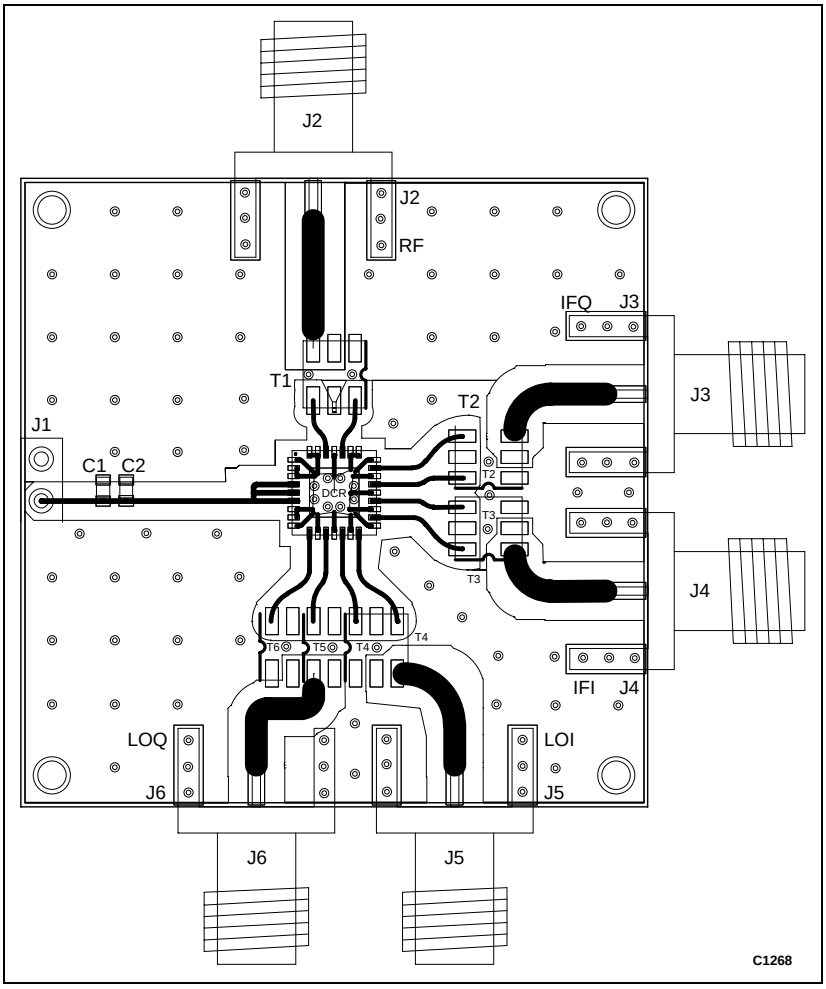

Figure 9. SKY73001 Evaluation Board Assembly Diagram (Top View)

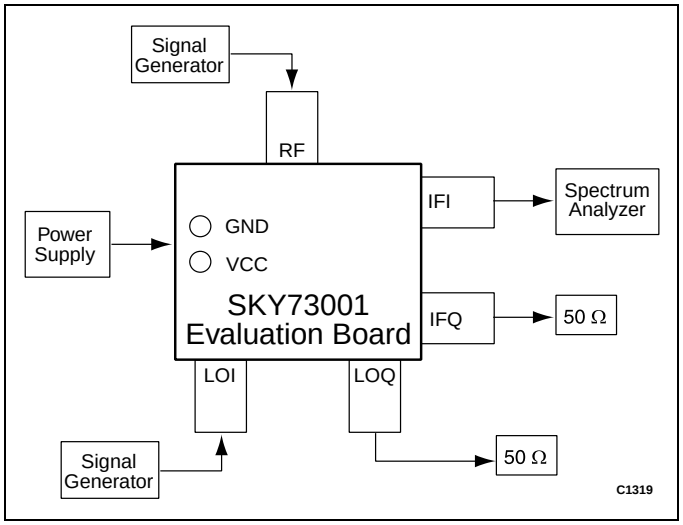

Figure 10. SKY73001 Evaluation Board Testing Configuration

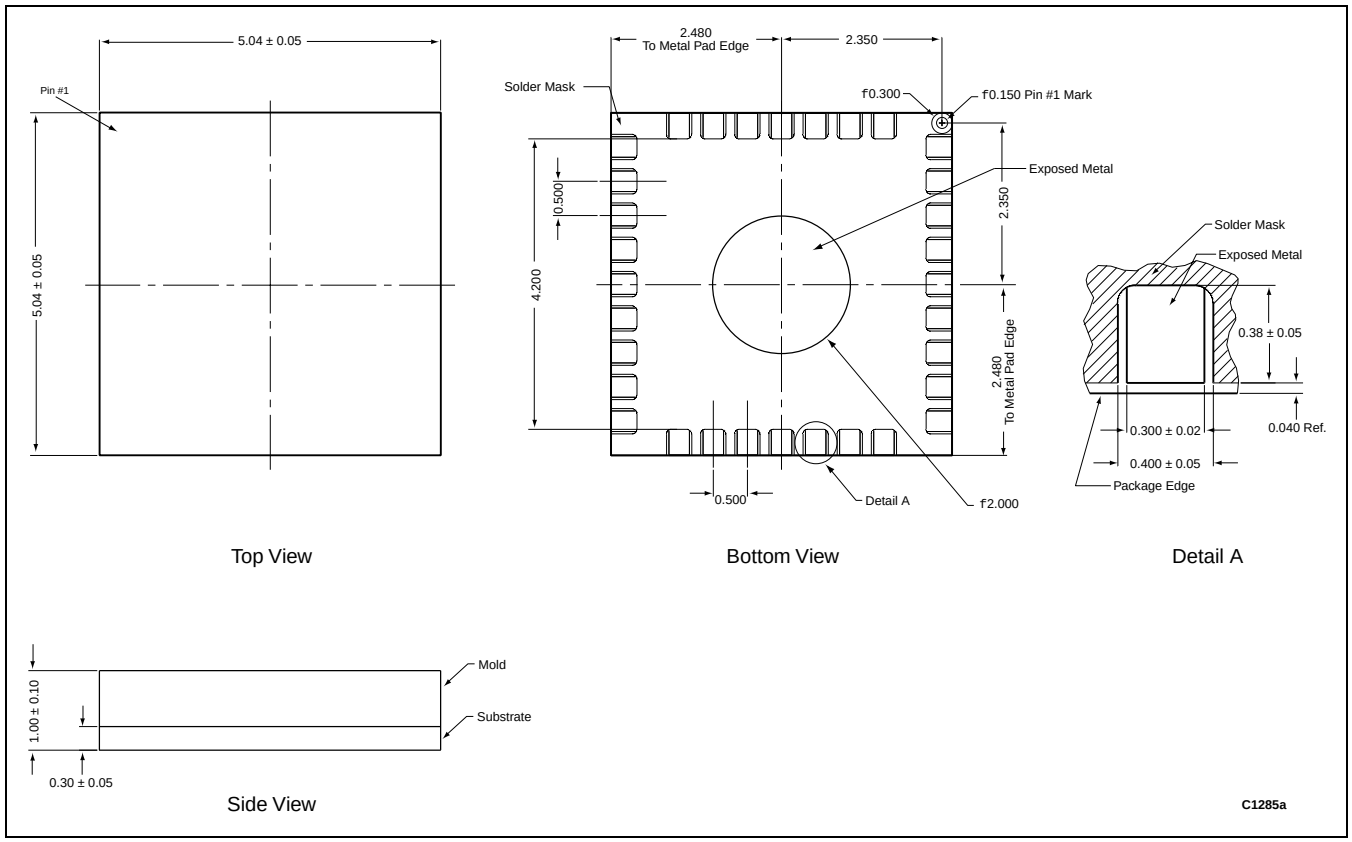

Figure 11. SKY73001 32-Pin RFLGA Package Dimension Drawing

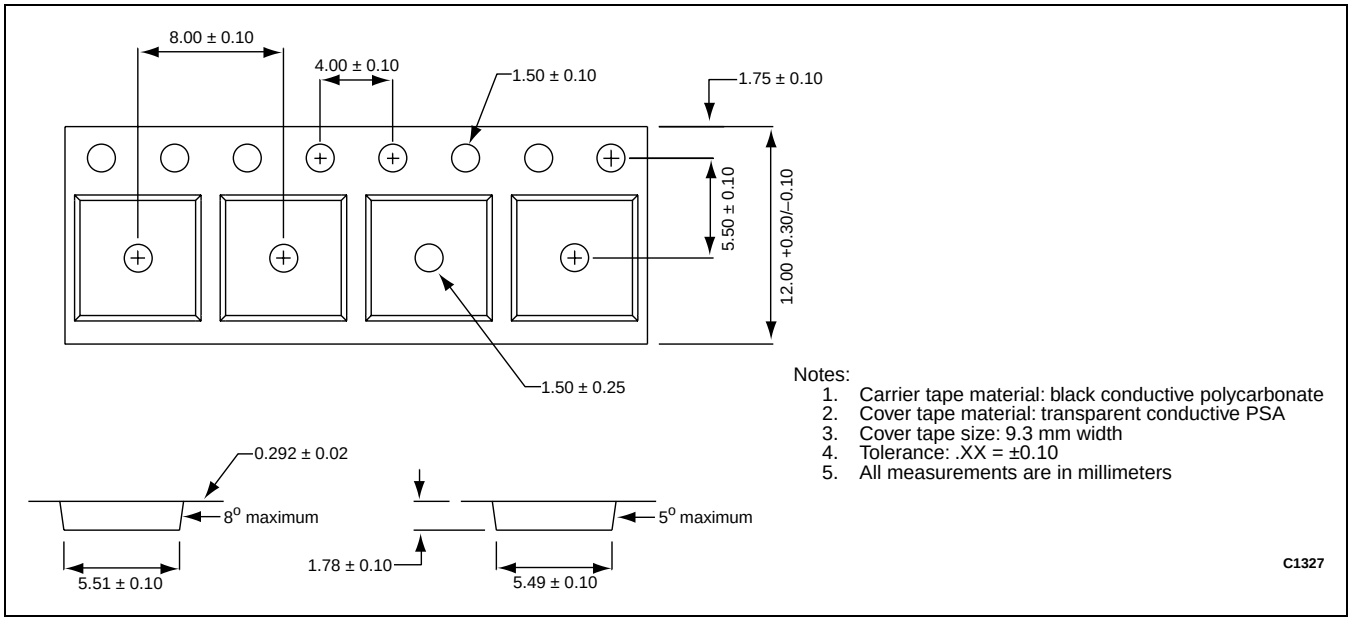

Figure 12. SKY73001 32-Pin RFLGA Tape and Reel Dimensions

If the part is attached in a reflow oven, the temperature ramp rate should not exceed 10 °C per second. Maximum temperature should not exceed 225 °C and the time spent at a temperature that exceeds 210 °C should be limited to less than 10 seconds. If the part is manually attached, precaution should be taken to ensure that the part is not subjected to a temperature that exceeds 300 °C for more than 10 seconds.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. For additional details on both attachment techniques, precautions, and recommended handling procedures, refer to the Skyworks document *Solder Reflow Application Note*, document number 101536.

Production quantities of this product are shipped in a standard tape and reel format. For packaging details, refer to the Skyworks document *Tape and Reel Information Application Note*, document number 101568.

Electrostatic Discharge (ESD) Sensitivity

The SKY73001 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

Ordering Information

Model Name	Ordering Part Number	Evaluation Kit Part Number
SKY73001 2-3500 MHz Direct Conversion Mixer	SKY73001-11	TW10-D912

General Information:

Skyworks Solutions, Inc.
4311 Jamboree Rd.
Newport Beach, CA 92660-3007

www.skyworksinc.com