

PRELIMINARY DATA SHEET

# SKY73069: 700 – 1000 MHz High Linearity, Single Up/Downconversion Mixer

## Applications

- 2G/3G base station transceivers:
  - GSM/EDGE, CDMA, UMTS/WCDMA
- Wi-Fi (802.11)
- WiMAX (802.16)
- 3GPP Long-Term Evolution
- Wireless Local Loop
- High performance radio links
- Land mobile radio
- Private mobile radio

## Features

- Operating frequency range: 700 to 1000 MHz
- IF frequency range: 50 to 300 MHz
- Insertion loss: 7 dB
- Input IP3: +31 dBm
- Noise Figure: 7 dB
- Integrated LO driver
- Integrated low loss RF balun
- On-chip SPDT LO switch (greater than 40 dB LO-to-LO isolation)
- Small, MCM (20-pin, 5 x 5 mm) Pb-free package (MSL3, 260 °C per JEDEC J-STD-020)

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



## Description

The SKY73069 is a fully integrated up/downconversion mixer that includes a Local Oscillator (LO) driver, an LO switch, and a high linearity mixer. A low loss RF balun has also been included to reduce design complications and lower system cost.

The SKY73069 features an input IP3 of +31 dBm and an insertion loss of 7 dB, making the device an ideal solution for high dynamic range systems such as 2G/3G base station receivers. The LO switch provides more than 40 dB of isolation between LO inputs and supports the switching time required for GSM/EDGE base stations.

The SKY73069 is manufactured using a robust silicon BiCMOS process and has been designed for optimum long-term reliability. The SKY73069 single up/downconversion mixer is provided in a compact, 20-pin 5 x 5 mm Multi-Chip Module (MCM). 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.

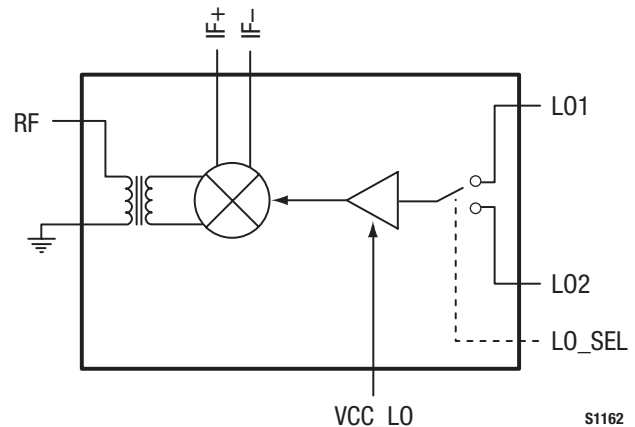
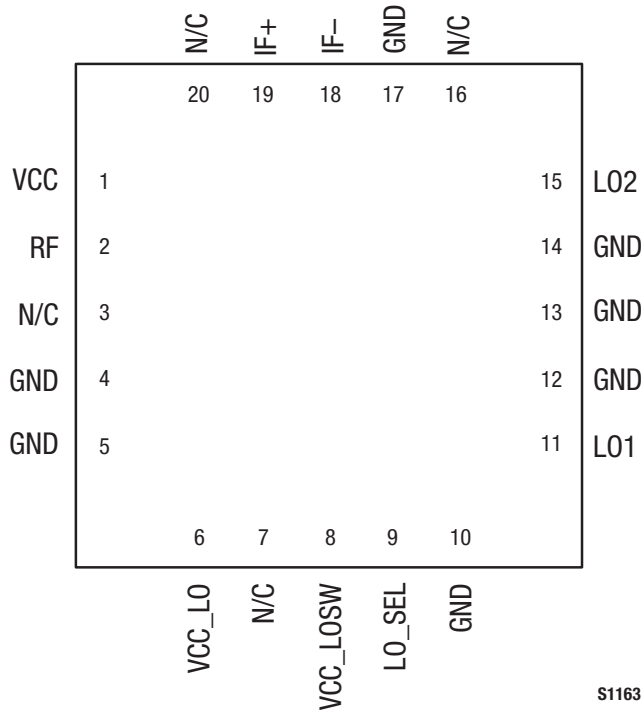


Figure 1. SKY73069 Block Diagram



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Figure 2. SKY73069 Pinout – 20-Pin MCM

Table 1. SKY73069 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	VCC	DC supply, +5V	11	LO1	LO1 input
2	RF	RF input	12	GND	Ground
3	N/C	No connection	13	GND	Ground
4	GND	Ground	14	GND	Ground
5	GND	Ground	15	LO2	LO2 input
6	VCC_LO	LO DC supply, +5V	16	N/C	No connection
7	N/C	No connection	17	GND	Ground
8	VCC_LOSW	LO switch DC supply, +5V	18	IF-	Negative IF output
9	LO_SEL	LO select switch control	19	IF+	Positive IF output
10	GND	Ground	20	N/C	No connection

### Functional Description

The SKY73069 is a high linearity, single up/downconversion mixer, optimized for base station receiver applications. The device consists of a low loss RF balun and high linearity passive mixer.

An LO amplifier is also included that allow the SKY73069 to connect directly to the output of a Voltage Controlled Oscillator (VCO). This eliminates the extra gain stages needed by most discrete passive mixers. A Single Pole, Double Throw (SPDT) switch has been included to select between two different LO inputs (LO1 and LO2) for frequency hopping applications such as GSM.

### RF Balun and Passive Mixer

The RF balun provides a single ended input, which can easily be matched to 50 Ω using a simple external matching circuit. The balun offers very low loss, and excellent amplitude and phase balance.

The high linearity SKY73069 is a passive, double-balanced mixer that provides a very low conversion loss, and excellent 3<sup>rd</sup> Order Input Insertion Point (IIP3).

Additionally, the balanced nature of the mixer provides for high port-to-port isolation.

### LO Buffer and SPDT LO Switch

The LO buffer allows the input power of the SKY73069 to be in the range of ±6 dBm. The LO section is optimized for low-side LO injection. However, each of the two LOs can be driven over a wide frequency range with some degradation in performance.

A high isolation SPDT switch allows the SKY73069 to be used for frequency hopping applications. This switch provides greater than 40 dB of LO1 to LO2 isolation:

LO_SEL Input	LO Path Selected
High	LO1 (pin 11) enabled
Low	LO2 (pin 15) enabled

For applications that do not require frequency hopping, LO\_SEL is fixed to one state and the appropriate LO input is used. An internal pull-down resistor enables the LO2 input.

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY73069 are provided in Table 2 and the recommended operating conditions in Table 3. Electrical characteristics for the SKY73069 are provided in Table 4.

**Table 2. SKY73069 Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage, +5 V	VCC	4.5	5.5	V
Supply current	I <sub>CC</sub>		100	mA
RF input power	P <sub>RF</sub>		+20	dBm
IF input power	P <sub>IF</sub>		+20	dBm
LO input power	P <sub>LO</sub>		+20	dBm
Operating case temperature	T <sub>C</sub>	-40	+85	°C
Junction temperature	T <sub>J</sub>		+150	°C
Storage case temperature	T <sub>STG</sub>	-40	+125	°C

**Notes:** 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.

**Table 3. SKY73069 Recommended Operating Conditions**

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage, +5 V	VCC	4.75	5.00	5.25	V
Supply current	I <sub>CC</sub>		70		mA
LO input power	P <sub>LO</sub>	-6	0	+6	dBm
LO select input: high low	LO_SEL <sub>H</sub> LO_SEL <sub>L</sub>	2.2		0.8	V V
Operating case temperature	T <sub>C</sub>	-40		+85	°C
RF frequency range	F <sub>RF</sub>	700		1000	MHz
LO frequency range (Note 1)	F <sub>LO</sub>	400		950	MHz
IF frequency range	F <sub>IF</sub>	50		300	MHz

**Note 1:** The SKY73069 has been optimized for low-side LO injection. However, the LO can be used outside of the specified frequency range with degraded performance.

**Table 4. SKY73069 Electrical Specifications (1 of 2)**

**(Voltage Supply = +5 V, T<sub>C</sub> = +25 °C, LO = 0 dBm, RF Frequency = 900 MHz, IF Frequency = 90 MHz, LO Frequency = 810 MHz, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Downconversion insertion loss	I <sub>LDOWN</sub>	RF input to IF output, F <sub>RF</sub> = 900 MHz, P <sub>RF</sub> = 0 dBm		7		dB
Upconversion insertion loss	I <sub>LUP</sub>	IF input to RF output, F <sub>IF</sub> = 90 MHz, P <sub>IF</sub> = 0 dBm		7.5		dB
Noise Figure	NF			7		dB
Noise Figure with a blocker signal	NF <sub>BLK</sub>	Blocking signal input power = +8 dBm			25	dB
Downconversion third order input intercept point	IIP3 <sub>down</sub>	RF input, F <sub>RF</sub> = 900 MHz and 900.8 MHz, P <sub>RF</sub> = 0 dBm/each tone		+31		dBm
Upconversion third order input intercept point	IIP3 <sub>up</sub>	IF input, F <sub>IF</sub> = 90 MHz and 90.8 MHz, P <sub>IF</sub> = 0 dBm/each tone		+30.5		dBm
2RF – 2LO	2x2	Downconversion, P <sub>RF</sub> = -10 dBm		-65		dBc
3RF – 3LO	3x3	Downconversion, P <sub>RF</sub> = -10 dBm		-80		dBc
Input 1 dB compression point	IP1dB	Downconversion		+20.9		dBm
L01-to-L02 isolation				54		dB
RF to IF isolation			30			dB
LO leakage: @ RF port @ IF port				-27 -25		dBm dBm
LO_SEL input			-20	+150	+250	μA
LO switching time					0.5	μs

**Table 4. SKY73069 Electrical Specifications (2 of 2)**

(Voltage Supply = +5 V, T<sub>c</sub> = +25 °C, LO = 0 dBm, RF Frequency = 900 MHz, IF Frequency = 90 MHz, LO Frequency = 810 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
RF port input return loss	Z <sub>IN_RF</sub>	With external matching components	14			dB
LO port input return loss	Z <sub>IN_LO</sub>	With external matching components	14			dB
IF port input return loss	Z <sub>OUT_IF</sub>	With external matching components	14			dB

**Evaluation Board Description**

The SKY73069 Evaluation Board is used to test the performance of the SKY73069 downconversion mixer. An assembly drawing for the Evaluation Board is shown in Figure 3 and the layer detail is provided in Figure 4.

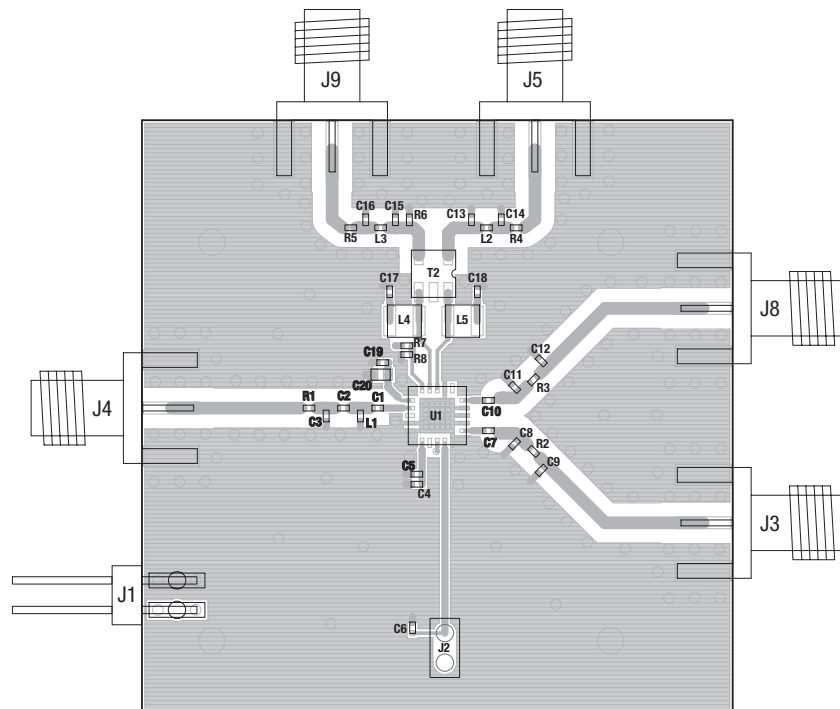
**Circuit Design Configurations**

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

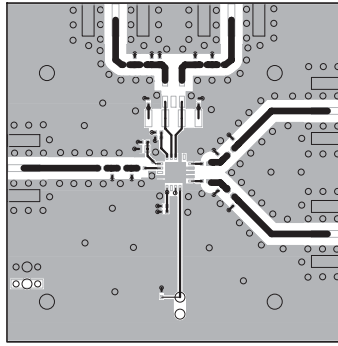
1. Paths to ground should be made as short and as low impedance as possible.

2. The ground pad of the SKY73069 provides critical electrical and thermal functionality. The connection to the ground pad should be designed to provide the best ground for the mixer. For more information on soldering the SKY73069, refer to the Package and Handling Information section of this Data Sheet.
3. Skyworks recommends including external bypass capacitors on the VCC voltage inputs of the device.

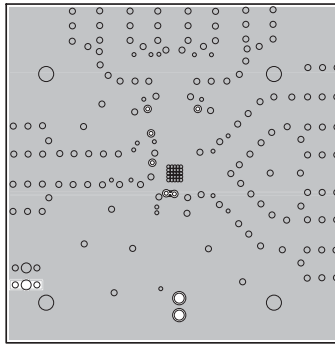
A schematic diagram for the SKY73069 Evaluation Board is shown in Figure 5.



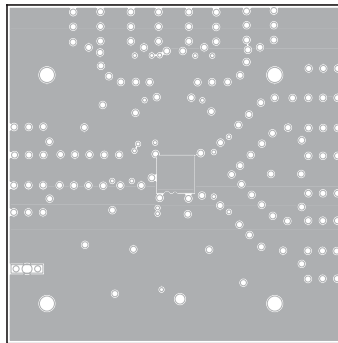
**Figure 3. SKY73069 Evaluation Board Assembly Diagram**



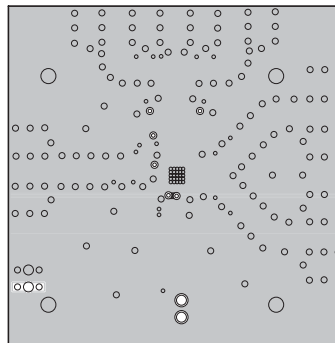
Layer 1: Top – Metal



Layer 2: Ground



Layer 3: Power Plane



Layer 4: Solid Ground Plane

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**Figure 4. SKY73069 Evaluation Board Layer Detail**



### Package Dimensions

Figure 6 shows the package dimensions for the 20-pin MCM, and Figure 7 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.

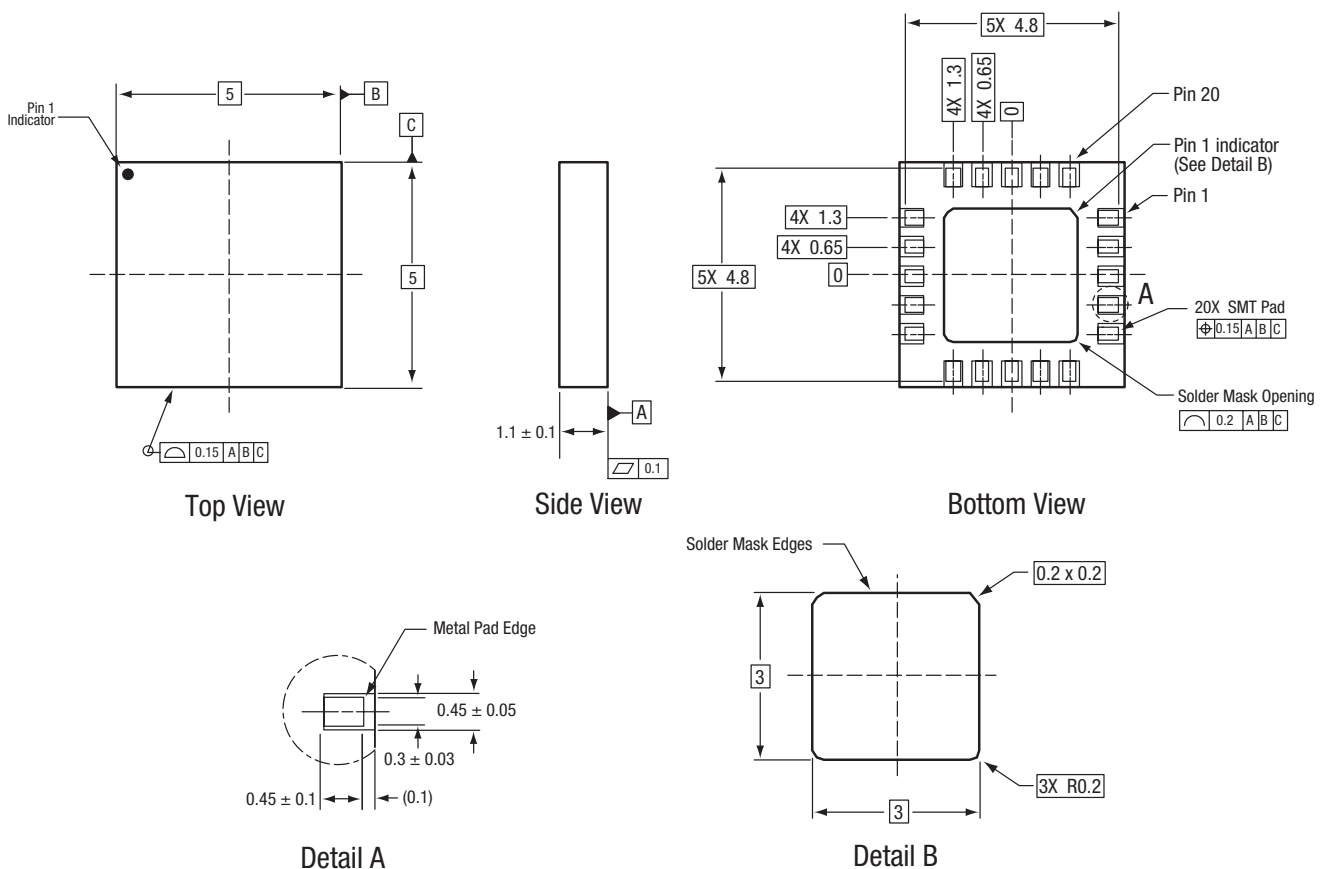
THE SKY73069 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note,

*PCB Design & SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

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. For packaging details, refer to the Skyworks Application Note, *Tape and Reel*, document number 101568.

### Electrostatic Discharge (ESD) Sensitivity

The SKY73069 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.



All measurements are in millimeters.  
Dimensioning and tolerancing according to ASME Y14.5M-1994.

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**Figure 6. SKY73069 20-Pin MCM Package Dimensions**



## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY73069 700-1000 MHz Up/Downconversion Mixer	SKY73069-11 (Pb-free package)	*** TBD ***

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