PRELIMINARY DATA SHEET

SKY73069-11: 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: 6.8 dB
- Input IP3: +31.5 dBm
- Noise Figure: 6.8 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) package (MSL3, 260 °C per JEDEC J-STD-020)

Description

The SKY73069-11 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 SKY73069-11 features an input IP3 of +31.5 dBm and an insertion loss of 6.8 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 SKY73069-11 is manufactured using a robust silicon BiCMOS process and has been designed for optimum long-term reliability. The SKY73069-11 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 2. SKY73069-11 Pinout – 20-Pin MCM (Top View)

Table 1. SKY73069-11 Signal Descriptions

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Name</th>
<th>Description</th>
<th>Pin #</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td>DC supply, +5V</td>
<td>11</td>
<td>LO1</td>
<td>LO1 input</td>
</tr>
<tr>
<td>2</td>
<td>RF</td>
<td>RF input</td>
<td>12</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>N/C</td>
<td>No connection</td>
<td>13</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
<td>14</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground</td>
<td>15</td>
<td>LO2</td>
<td>LO2 input</td>
</tr>
<tr>
<td>6</td>
<td>VCC_LO</td>
<td>LO DC supply, +5V</td>
<td>16</td>
<td>N/C</td>
<td>No connection</td>
</tr>
<tr>
<td>7</td>
<td>N/C</td>
<td>No connection</td>
<td>17</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>8</td>
<td>VCC_GAIN</td>
<td>LO gain DC supply, +5V</td>
<td>18</td>
<td>IF–</td>
<td>Negative IF output</td>
</tr>
<tr>
<td>9</td>
<td>LO_SEL</td>
<td>LO select switch control</td>
<td>19</td>
<td>IF+</td>
<td>Positive IF output</td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
<td>Ground</td>
<td>20</td>
<td>N/C</td>
<td>No connection</td>
</tr>
</tbody>
</table>
**Functional Description**

The SKY73069-11 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 SKY73069-11 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 SKY73069-11 is a passive, double-balanced mixer that provides a very low conversion loss, and excellent 3rd 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 SKY73069-11 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 SKY73069-11 to be used for frequency hopping applications. This switch provides greater than 40 dB of LO1 to LO2 isolation:

<table>
<thead>
<tr>
<th>LO_SEL Input</th>
<th>LO Path Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>LO1 (pin 11) enabled</td>
</tr>
<tr>
<td>Low</td>
<td>LO2 (pin 15) enabled</td>
</tr>
</tbody>
</table>

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 SKY73069-11 are provided in Table 2 and the recommended operating conditions in Table 3. Electrical characteristics for the SKY73069-11 are provided in Table 4.

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**Table 2. SKY73069-11 Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage, +5 V</td>
<td>VCC</td>
<td>4.5</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Supply current Icc</td>
<td>Icc</td>
<td>100</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>RF input power P RF</td>
<td>P RF</td>
<td>20</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>IF input power P F</td>
<td>P F</td>
<td>20</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>LO input power P LO</td>
<td>P LO</td>
<td>20</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Operating case temperature T C</td>
<td>T C</td>
<td>–40</td>
<td>85</td>
<td>°C</td>
</tr>
<tr>
<td>Junction temperature T J</td>
<td>T J</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage case temperature T STG</td>
<td>T STG</td>
<td>–40</td>
<td>125</td>
<td>°C</td>
</tr>
</tbody>
</table>

**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. Exceeding any of the limits listed here may result in permanent damage to the device.

**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. SKY73069-11 Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage, +5 V</td>
<td>VCC</td>
<td>4.75</td>
<td>5.00</td>
<td>5.25</td>
<td>V</td>
</tr>
<tr>
<td>Supply current</td>
<td>ICC</td>
<td>74</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>LO input power</td>
<td>PLO</td>
<td>−6</td>
<td>0</td>
<td>+6</td>
<td>dBm</td>
</tr>
<tr>
<td>LO select input:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high</td>
<td>LO_SELH</td>
<td>2.2</td>
<td></td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td>low</td>
<td>LO_SELL</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Operating case temperature</td>
<td>TC</td>
<td>−40</td>
<td></td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>RF frequency range</td>
<td>F RF</td>
<td>700</td>
<td></td>
<td>1000</td>
<td>MHz</td>
</tr>
<tr>
<td>LO frequency range (Note 1)</td>
<td>F LO</td>
<td>400</td>
<td></td>
<td>950</td>
<td>MHz</td>
</tr>
<tr>
<td>IF frequency range</td>
<td>F IF</td>
<td>50</td>
<td></td>
<td>300</td>
<td>MHz</td>
</tr>
</tbody>
</table>

**Note 1:** The SKY73069-11 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. SKY73069-11 Electrical Specifications (Note 1) (1 of 2)

(Voltage Supply = +5 V, TC = +25 °C, LO = 0 dBm, RF Frequency = 900 MHz, IF Frequency = 90 MHz, LO Frequency = 810 MHz, Unless Otherwise Noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downconversion insertion loss</td>
<td>IL DOWN</td>
<td>RF input to IF output, F RF = 900 MHz, P RF = 0 dBm</td>
<td>6.8</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Upconversion insertion loss</td>
<td>IL UP</td>
<td>IF input to RF output, F IF = 90 MHz, P IF = 0 dBm</td>
<td>7.4</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>NF</td>
<td></td>
<td>6.8</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Noise Figure with a blocker signal</td>
<td>NF BLK</td>
<td>Blocking signal input power = +8 dBm</td>
<td></td>
<td>25</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Downconversion third order input intercept point</td>
<td>IIP3 down</td>
<td>RF input, F RF = 900 MHz and 900.8 MHz, P RF = 0 dBm/each tone</td>
<td>+31.5</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Upconversion third order input intercept point</td>
<td>IIP3 up</td>
<td>IF input, F IF = 90 MHz and 90.8 MHz, P IF = 0 dBm/each tone</td>
<td>+26.5</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>2RF – 2LO</td>
<td>2x2</td>
<td>Downconversion, P RF = 0 dBm</td>
<td>−51.6</td>
<td></td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td>3RF – 3LO</td>
<td>3x3</td>
<td>Downconversion, P IF = 0 dBm</td>
<td>−61.7</td>
<td></td>
<td></td>
<td>dBC</td>
</tr>
<tr>
<td>Input 1 dB compression point</td>
<td>IP1 dB</td>
<td>Downconversion</td>
<td>+20.9</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>LO1-to-LO2 isolation</td>
<td></td>
<td></td>
<td>54</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>RF to IF isolation</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>LO leakage:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ RF port</td>
<td></td>
<td>−27</td>
<td>−25</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>@ IF port</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>LO_SEL input</td>
<td></td>
<td>−20</td>
<td>150</td>
<td>+250</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>LO switching time</td>
<td></td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
<td>μs</td>
</tr>
</tbody>
</table>
Table 4. SKY73069-11 Electrical Specifications (Note 1) (2 of 2)
(Voltage Supply = +5 V, Tc = +25 °C, LO = 0 dBm, RF Frequency = 900 MHz, IF Frequency = 90 MHz, LO Frequency = 810 MHz, Unless Otherwise Noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF port input return loss</td>
<td>ZIN_RF</td>
<td>With external matching components</td>
<td>14</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>LO port input return loss</td>
<td>ZIN_LO</td>
<td>With external matching components</td>
<td>14</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>IF port input return loss</td>
<td>ZOUT_IF</td>
<td>With external matching components</td>
<td>14</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
</tbody>
</table>

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

Evaluation Board Description
The SKY73069-11 Evaluation Board is used to test the performance of the SKY73069-11 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 SKY73069-11 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 SKY73069-11, 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 SKY73069-11 Evaluation Board is shown in Figure 5.
Figure 4. SKY73069-11 Evaluation Board Layer Detail
Notes: Values for all components are subject to change for matching purposes.
Some component labels may be different than the corresponding component symbol shown here.
Component values, however, are accurate as of the date of this Data Sheet.

Figure 5. SKY73069-11 Evaluation Board Schematic
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 SKY73069-11 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 SKY73069-11 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

Figure 6. SKY73069-11 20-Pin MCM Package Dimensions
Notes:
1. Carrier tape: black conductive polystyrene
2. Cover tape material: transparent conductive PSA
3. Cover tape size: 9.3 mm width
4. ESD surface resistivity is ≤1 x 10^10 Ω/square according to EIA, JEDIC TNR specification.
5. P0/P1 10 pitches cumulative tolerance on tape: ±0.20 mm
6. A and B measurement points are 0.30 mm from bottom pocket.
7. All dimensions are in millimeters

Figure 7. SKY73069-11 Tape and Reel Dimensions
Ordering Information

<table>
<thead>
<tr>
<th>Model Name</th>
<th>Manufacturing Part Number</th>
<th>Evaluation Kit Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKY73069-11 700-1000 MHz Up/Downconversion Mixer</td>
<td>SKY73069-11 (Pb-free package)</td>
<td>TW18-D490</td>
</tr>
</tbody>
</table>