

PRELIMINARY DATA SHEET

# SKY65112-84LF: Linear Power Amplifier Driver, 0.5 W 400–2300 MHz

## Features

- Wideband: 400–2300 MHz
- High linearity: OIP3 > 39 dBm; P<sub>1 dB</sub> > 27 dBm @ 940 MHz
- High gain > 18 dB
- Single DC supply: 5 V
- Low-cost SMT, lead (Pb)-free package, RoHS-compliant

## Applications

- UHF TV broadcast
- TETRA radio
- GSM/CDMA/EDGE 450/750/850/900MHz bands
- DCS, PCS, W-CDMA, UMTS

## Description

Skyworks SKY65112 is a high performance power amplifier with superior linearity and output power. The device is fabricated using Skyworks high-reliability Heterojunction Bipolar Transistor (HBT) technology. The device utilizes low-cost, industry-standard, thermally enhanced SOIC-8 lead (Pb)-free, RoHS-compliant packaging.

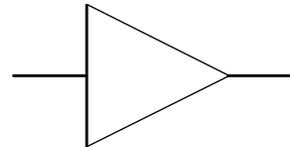
The SKY65112 incorporates on-chip active bias which achieves excellent gain tracking over temperature and voltage variations.

The SKY65112 is designed for ultrahigh linearity and wideband operation, making it a cost effective building block for many transceiver applications.

The SKY65112 is rated for operation from -40 to +85 °C. It operates from a 5 V power supply voltage.

An evaluation board is available upon request.

## Functional Block Diagram



**NEW**

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



**Electrical Specifications****T<sub>A</sub> = 25 °C, V<sub>CC</sub> = 5 V, I<sub>CCQ</sub> = 260 mA, Z<sub>0</sub> = 50 Ω, as measured in the evaluation board, unless otherwise noted**

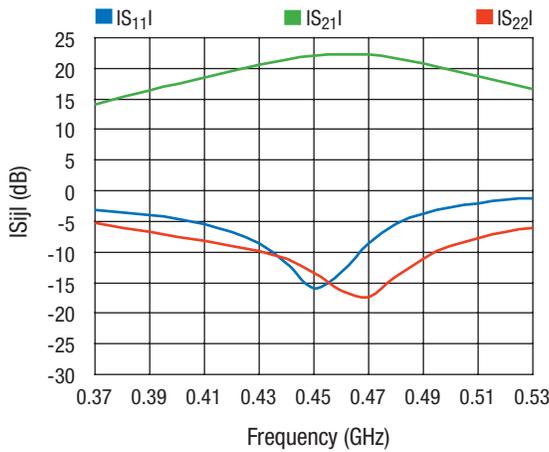
| Parameter                    | Symbol             | Conditions                                     | Min. | Typ. | Max. | Unit |
|------------------------------|--------------------|--|------|------|------|------|
| Operational bandwidth        |                    |  | 440  |      | 460  | MHz  |
| Total power-added efficiency | PAE                | @ P <sub>1</sub> dB                            |      | 27   |      | %    |
| Gain                         | S <sub>21</sub>    |  |      | 22   |      | dB   |
| Output P <sub>1</sub> dB     | OP <sub>1</sub> dB |  | 26.5 |      |      | dBm  |
| Output IP3                   | OIP3               | @ 14 dBm P <sub>OUT</sub> /Tone, 1 MHz Spacing |      | 34   |      | dBm  |
| Second harmonic              |                    | P <sub>OUT</sub> @ 450 MHz = 10 dBm            |      | -40  |      | dBc  |
| Third harmonic               |                    | P <sub>OUT</sub> @ 450 MHz = 10 dBm            |      | -86  |      | dBc  |
| Supply current               | I <sub>CCQ</sub>   |  |      | 260  |      | mA   |
| Reference current            | I <sub>REF</sub>   |  |      | 2    |      | mA   |
| Operational bandwidth        |                    |  | 920  |      | 960  | MHz  |
| Total power-added efficiency | PAE                | @ P <sub>1</sub> dB                            |      | 22   |      | %    |
| Gain                         | S <sub>21</sub>    |  |      | 18   |      | dB   |
| Output P <sub>1</sub> dB     | OP <sub>1</sub> dB |  |      | 27.2 |      | dBm  |
| Output IP3                   | OIP3               | @ 14 dBm P <sub>OUT</sub> /Tone, 1 MHz Spacing |      | 39   |      | dBm  |
| Second harmonic              |                    | P <sub>OUT</sub> @ 940 MHz = 10 dBm            |      | -65  |      | dBc  |
| Third harmonic               |                    | P <sub>OUT</sub> @ 940 MHz = 10 dBm            |      | -90  |      | dBc  |
| Supply current               | I <sub>CCQ</sub>   |  |      | 260  |      | mA   |
| Reference current            | I <sub>REF</sub>   |  |      | 2    |      | mA   |
| Operational bandwidth        |                    |  | 1930 |      | 1990 | MHz  |
| Total power-added efficiency | PAE                | @ P <sub>1</sub> dB                            |      | 38   |      | %    |
| Gain                         | S <sub>21</sub>    |  |      | 15.1 |      | dB   |
| Output P <sub>1</sub> dB     | OP <sub>1</sub> dB |  |      | 30   |      | dBm  |
| Output IP3                   | OIP3               | @ 14 dBm P <sub>OUT</sub> /Tone, 1 MHz Spacing |      | 39   |      | dBm  |
| Second harmonic              |                    | P <sub>OUT</sub> @ 1.96 GHz = 10 dBm           |      | -58  |      | dBc  |
| Third harmonic               |                    | P <sub>OUT</sub> @ 1.96 GHz = 10 dBm           |      | -79  |      | dBc  |
| CDMA (IS95) channel power    |                    | @ -50 dBc ACPR, 1960 MHz                       |      | 22   |      | dBm  |
| Supply current               | I <sub>CCQ</sub>   |  |      | 260  |      | mA   |
| Reference current            | I <sub>REF</sub>   |  |      | 2    |      | mA   |
| Operational bandwidth        |                    |  | 2110 |      | 2170 | MHz  |
| Total power-added efficiency | PAE                | @ P <sub>1</sub> dB                            |      | 38   |      | %    |
| Gain                         | S <sub>21</sub>    |  |      | 15.5 |      | dB   |
| Output P <sub>1</sub> dB     | OP <sub>1</sub> dB |  |      | 29   |      | dBm  |
| Output IP3                   | OIP3               | @ 14 dBm P <sub>OUT</sub> /Tone, 1 MHz Spacing |      | 37   |      | dBm  |
| Second harmonic              |                    | P <sub>OUT</sub> @ 2.14 GHz = 10 dBm           |      | -55  |      | dBc  |
| Third harmonic               |                    | P <sub>OUT</sub> @ 2.14 GHz = 10 dBm           |      | -72  |      | dBc  |
| W-CDMA channel power         |                    | @ -45 dBc ACLR, 2140 MHz                       |      | 20   |      | dBm  |
| Supply current               | I <sub>CCQ</sub>   |  |      | 260  |      | mA   |
| Reference current            | I <sub>REF</sub>   |  |      | 2    |      | mA   |

### Recommended Operating Conditions

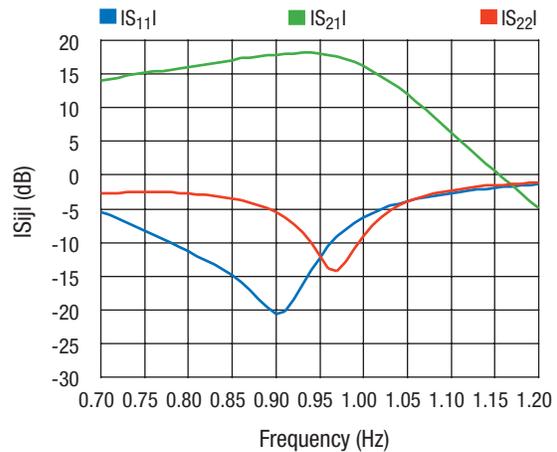
| Parameter            | Symbol    | Min. | Typ. | Max. | Unit |
|----------------------|-----------|------|------|------|------|
| Supply voltage       | $V_{CC}$  |      | 5    |      | V    |
| Reference current    | $I_{REF}$ |      | 2    |      | mA   |
| Reference voltage    | $V_{REF}$ |      | 5    |      | V    |
| Operating frequency  |           | 400  |      | 2300 | MHz  |
| Supply current       | $I_{CCQ}$ |      | 260  |      | mA   |
| Junction temperature | $T_J$     |      |      | 150  | °C   |

### Typical Performance Data

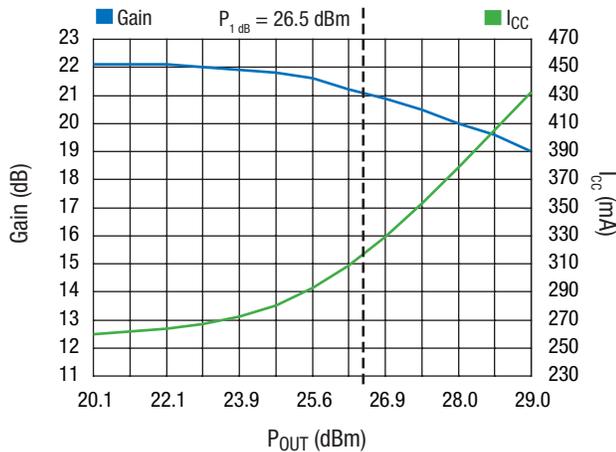
$T_A = 25\text{ °C}$ ,  $V_{CC} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $Z_0 = 50\text{ }\Omega$ , unless otherwise noted



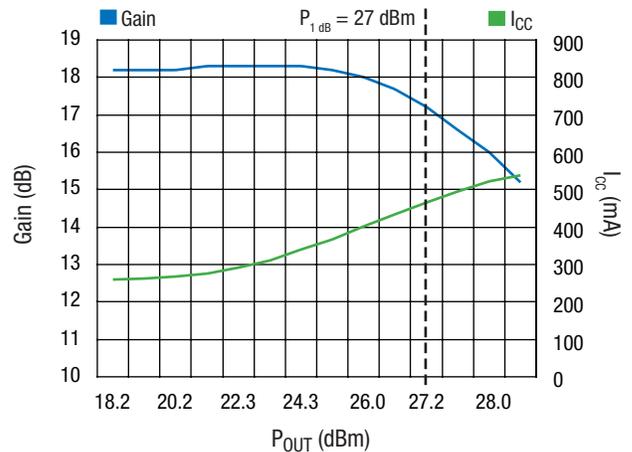
**SKY65112 Tuned for 450 MHz**  
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$



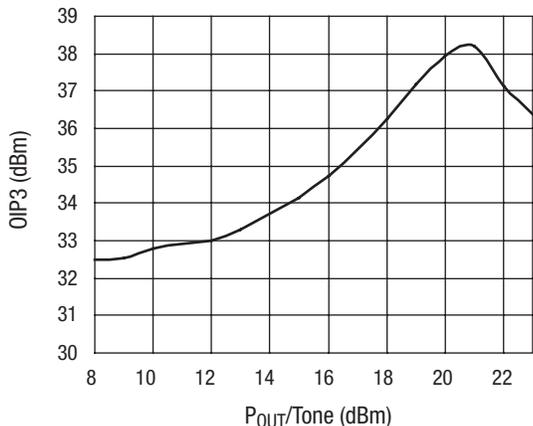
**SKY65112 Tuned for 940 MHz**  
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$



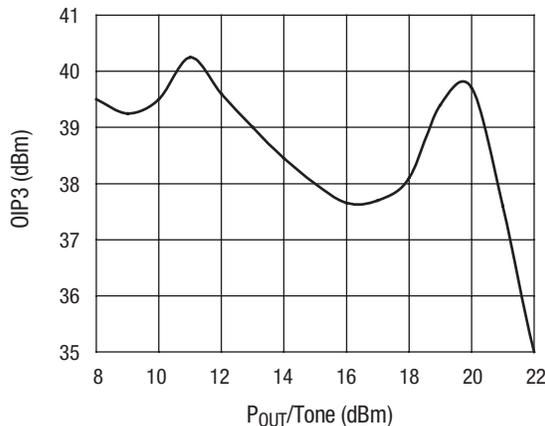
**SKY65112 Gain,  $I_{CC}$  vs.  $P_{OUT}$**   
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 450\text{ mA}$ ,  $F = 450\text{ MHz}$



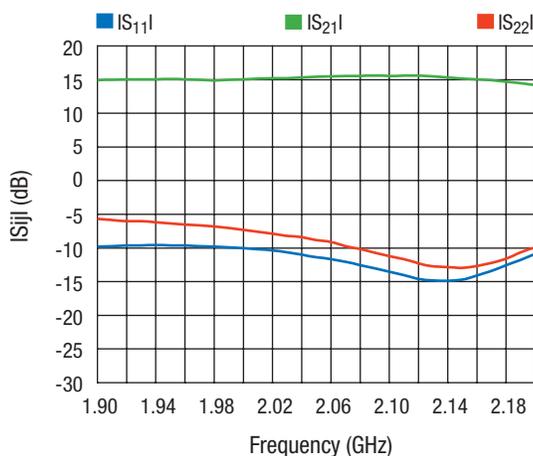
**SKY65112 Gain,  $I_{CC}$  vs.  $P_{OUT}$**   
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5.1\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $F = 940\text{ MHz}$



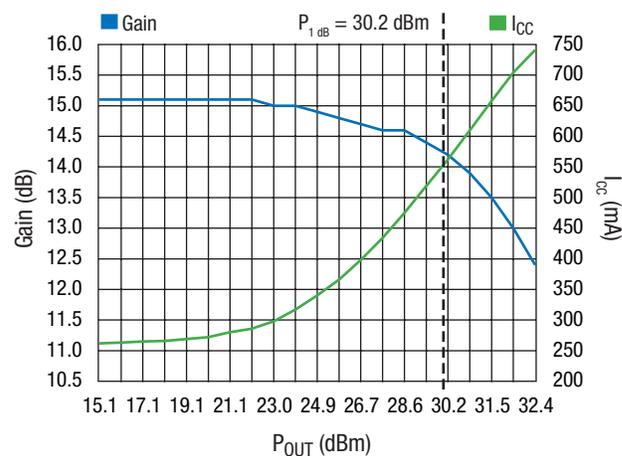
**SKY65112 OIP3,  $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $F = 450\text{ MHz}$ , Tone Spacing = 1 MHz**



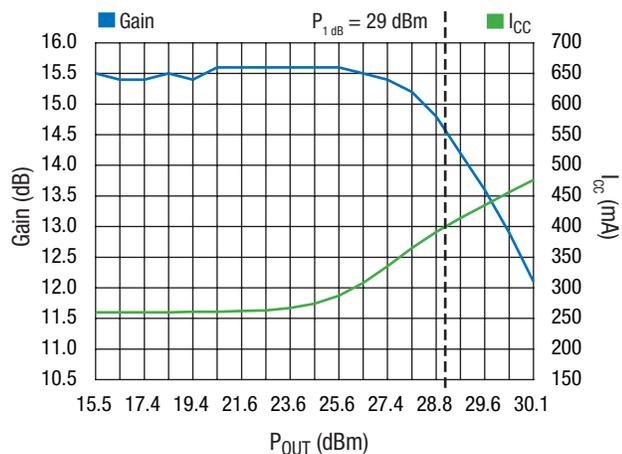
**SKY65112 OIP3,  $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $F = 940\text{ MHz}$ , Tone Spacing = 1 MHz**



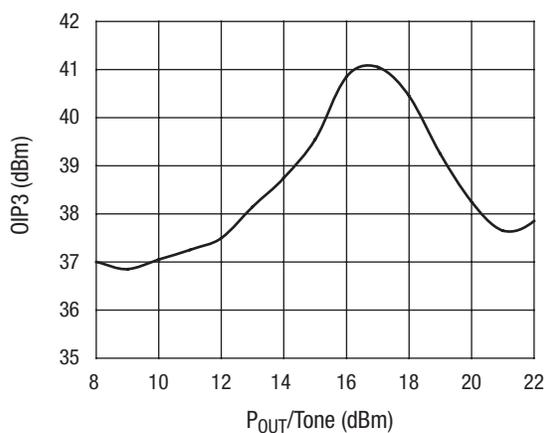
**SKY65112 Tuned for 1960–2140 MHz  
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$**



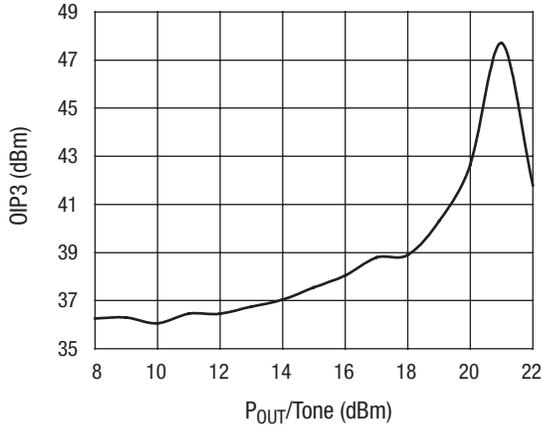
**SKY65112 Gain,  $I_{CC}$  vs.  $P_{OUT}$   
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $F = 1960\text{ MHz}$**



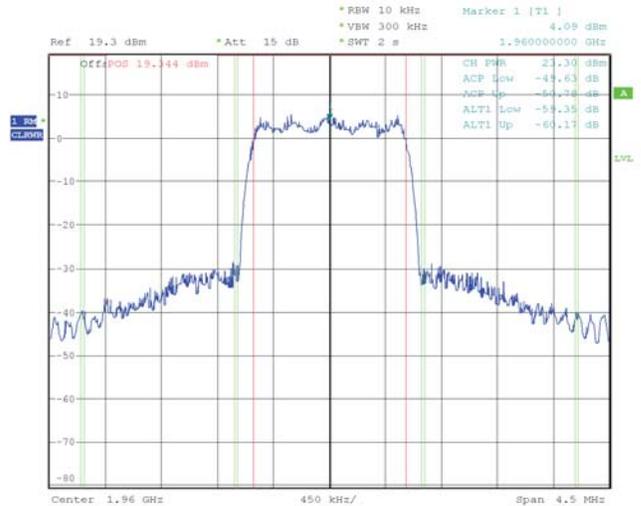
**SKY65112 Gain,  $I_{CC}$  vs.  $P_{OUT}$   
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $F = 2140\text{ MHz}$**



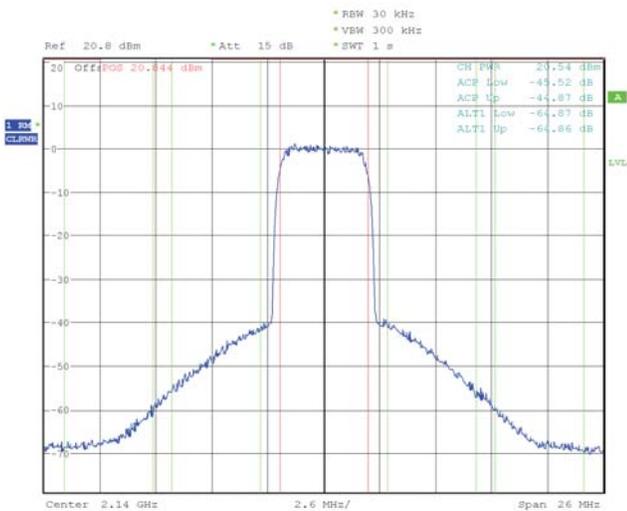
**SKY65112 OIP3,  $V_{CC} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  $V_{REF} = 5\text{ V}$ ,  $F = 1960\text{ MHz}$ , Tone Spacing = 1 MHz**



**SKY65112 OIP3,  $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  
 $I_{CCQ} = 260\text{ mA}$ ,  $F = 2140\text{ MHz}$ , Tone Spacing = 1 MHz**



**SKY65112 IS-95,  $F = 1960\text{ MHz}$   
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,  
 Clock freq 9.8304 MHz**



**SKY65112 3GPP WCDMA,  $F = 2140\text{ MHz}$   
 QPSK 45° Offset, Filter Root Cosine,  
 Roll-off Factor 0.22, Symbol Rate 3.84 Msym/s  
 $V_{CC} = 5\text{ V}$ ,  $V_{REF} = 5\text{ V}$ ,  $I_{CCQ} = 260\text{ mA}$ ,**

### Absolute Maximum Ratings

| Characteristic                                      | Value          |
|---|----------------|
| RF input power ( $P_{IN}$ )                         | 22 dBm         |
| Supply voltage ( $V_{CC}$ )                         | 8 V            |
| Reference current ( $I_{REF}$ )                     | 10 mA          |
| Total supply current ( $I_{CC} + I_{REF}$ )         | 500 mA         |
| Power dissipation ( $P_{DISS}$ )                    | 2 W            |
| Case operating temperature <sup>(1)</sup> ( $T_C$ ) | -40 to +85 °C  |
| Storage temperature ( $T_{ST}$ )                    | -50 to +150 °C |
| Junction temperature ( $T_J$ )                      | -50 to +150 °C |
| Thermal resistance ( $\theta_{JC}$ )                | 42 °C/W        |

1. Case temperature is defined as the temperature of the surface of the exposed paddle where it is soldered to the printed circuit board ground. This surface must be connected via the lowest possible thermal impedance to an adequate heatsink.

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

**CAUTION:** Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) 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 must be employed at all times.

### Technical Description

The SKY65112 is a single stage linear amplifier. The device should be externally matched for optimum gain and linearity using external passive components on the input and on the output ports. These external components allow the amplifier to be optimized for the desired operating frequency.

The RF input is internally connected to pins 2, 3 and 4 via different lengths of bond wire. The inductances produced by these bond wires can be utilized in the impedance matching circuit on the amplifier’s input port.

The RF output is internally connected to pins 6 and 7 for current sharing. Both of these pins should be connected externally to the same printed circuit board trace.

The SKY65112 contains a bias circuit for optimum temperature tracking performance. An external resistor is used to set the bias current level. The value of this resistor can be selected to set the amplifier operational mode to Class A, B, or AB, allowing for optimization of linearity and efficiency.

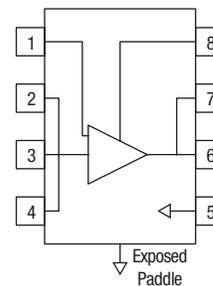
### Package and Handling Information

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.

Please refer to Skyworks solder reflow application note, available at [www.skyworksinc.com](http://www.skyworksinc.com), for instructions on mounting the SKY65112 to a printed circuit board.

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.

### Pin Out



### Pin Descriptions

| Pin No.  | Name      | Descriptions                  |
|----------|-----------|-------------------------------|
| 1        | $V_{REF}$ | Reference voltage input       |
| 2, 3, 4  | RF_In     | RF input                      |
| 5        | GND       | Ground                        |
| 6, 7     | RF_Out    | RF output                     |
| 8        | $V_{CC}$  | Supply voltage                |
| Backside | GND       | Exposed paddle package ground |

## Evaluation Board

The SKY65112 Evaluation Board is used to test the performance of the SKY65112 power amplifier driver. Schematic diagrams for evaluation circuits, optimized for output third order intercept (OIP3) are shown below. Evaluation board schematics and bills of materials are shown for GSM operation at 940 MHz and also for DCS/UMTS/CDMA operation near 2 GHz. The mounting footprint for the SKY65112 is shown in the mounting footprint schematic.

The evaluation board also contains a probe fixture section which makes it possible to conveniently measure scattering parameters with ground-signal-ground probes and a vector network analyzer, directly at the input and output pins of the package. Scattering parameters measured in this fixture are available upon request.

## 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 as possible.
2. The exposed paddle ground pad of the SKY65112 power amplifier has special electrical and thermal grounding requirements. This paddle 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 amplifier. As such, design the connection to the ground pad to dissipate the maximum power produced to the circuit board. Multiple vias to the grounding layer are required.

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**NOTE:** Junction temperature ( $T_j$ ) of the device increases with a poor connection to the exposed paddle and ground. This reduces the lifetime of the device.

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3. External bypass capacitors are required on the  $V_{CC}$  line and on pins 1.
4. Bias resistors  $R_2$  and  $R_4$  and the voltage applied to  $V_{REF}$  determine the reference current,  $I_{REF}$ , into pin 1. This current controls the supply current through the amplifier stage.

A suggested matching circuit is shown in the evaluation board schematic.

## Test Procedure

Use the following procedure to set up the SKY65112 Evaluation Board for testing. Refer to the mounting footprint schematic for guidance:

1. Connect a 5 V supply to  $V_{CC}$ . If available, enable the current limiting function of the power supply to 520 mA.
2. Connect a positive supply to  $V_{REF}$ .
3. Connect a signal generator to the RF signal input port. Set it to the desired RF frequency at a power level of -15 dBm or less to the evaluation board, but do not enable the RF signal.
4. Connect a spectrum analyzer to the RF signal output port.
5. Enable the power supply.
6. Adjust  $V_{REF}$  to set supply current ( $I_{CCQ}$ ) to 260 mA
7. Enable the RF signal.
8. Take measurements.

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**CAUTION:** If any of the input signals exceed the rated maximum values, the SKY65112 Evaluation Board can be permanently damaged.

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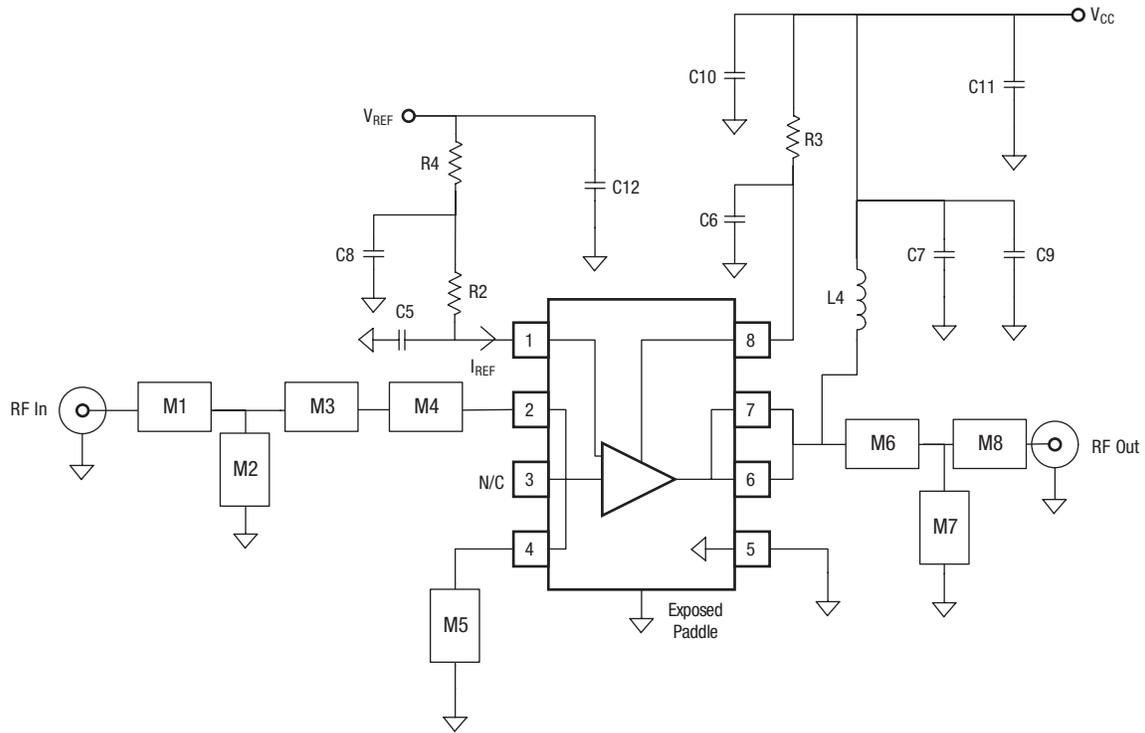
## Recommended Solder Reflow Profiles

Refer to the [“Recommended Solder Reflow Profile”](#) Application Note.

## Tape and Reel Information

Refer to the [“Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation”](#) Application Note.

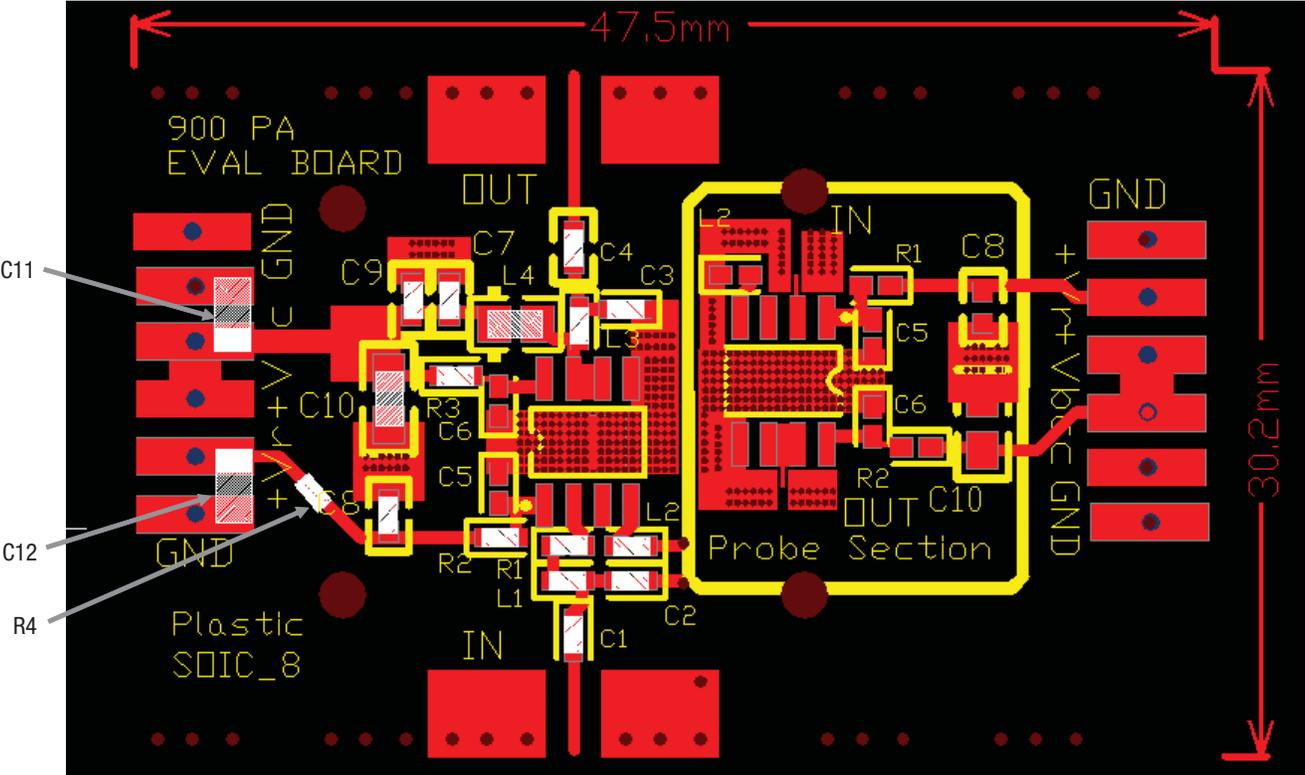
### Evaluation Board Schematic



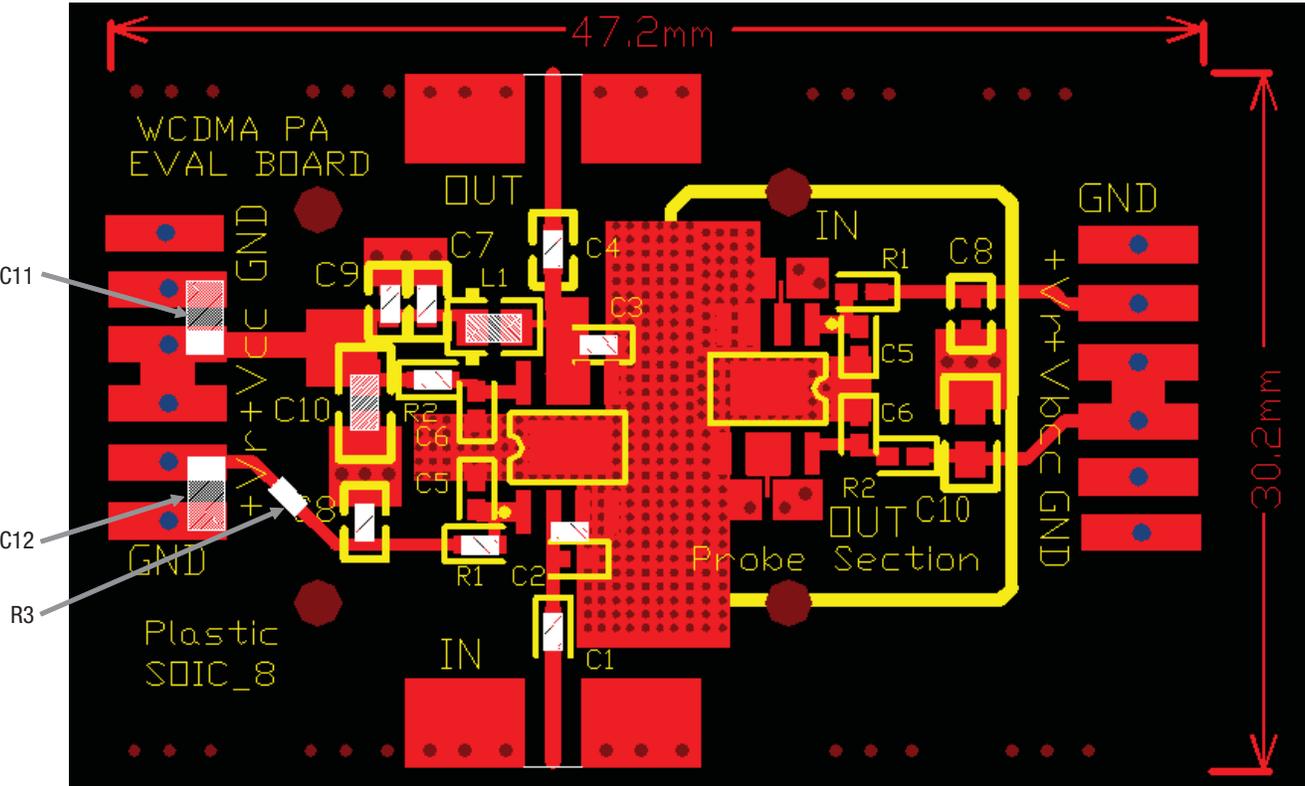
### Evaluation Board Component Values vs. Frequency

| Component | 450 MHz      | 940 MHz      | 1960 MHz     | 2140 MHz     |
|-----------|--------------|--------------|--------------|--------------|
| R1        | NA           | NA           | 51 Ω         | 51 Ω         |
| R2        | 51 Ω         | 51 Ω         | 51 Ω         | 51 Ω         |
| R3        | 51 Ω         | 51 Ω         | 1.2 kΩ       | 1.2 kΩ       |
| R4        | 1.2 kΩ       | 1.2 kΩ       | NA           | NA           |
| L4        | 82 nH (0805) | 82 nH (0805) | 47 nH (0603) | 47 nH (0603) |
| C5        | NA           | NA           | NA           | NA           |
| C6        | NA           | NA           | NA           | NA           |
| C7        | 100 pF       | 22 pF        | 10 pF        | 10 pF        |
| C8        | 2.2 μF       | 0.1 μF       | 0.1 μF       | 0.1 μF       |
| C9        | 2.2 μF       | 0.1 μF       | 0.1 μF       | 0.1 μF       |
| C10       | 10 μF        | 2.2 μF       | 2.2 μF       | 2.2 μF       |
| C11       | 10 μF        | 4 μF         | 4 μF         | 4 μF         |
| C12       | 10 μF        | 4 μF         | 4 μF         | 4 μF         |
| M1        | 33 nH        | 10 nH        | 100 pF       | 100 pF       |
| M2        | 4.7 pF       | 2.2 pF       | 2.2 pF       | 2.2 pF       |
| M3        | 10 nH        | 15 nH        | NA           | NA           |
| M4        | 10 Ω         | 0 Ω          | NA           | NA           |
| M5        | 5.6 nH       | 1 nH         | NA           | NA           |
| M6        | 27 pF        | 1.5 nH       | NA           | NA           |
| M7        | 5.6 nH       | 10 pF        | 3.9 pF       | 3.9 pF       |
| M8        | 1000 pF      | 100 pF       | 100 pF       | 100 pF       |

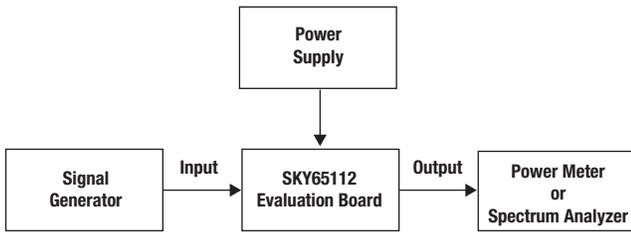
**Test Board Assembly 450, 940 MHz**



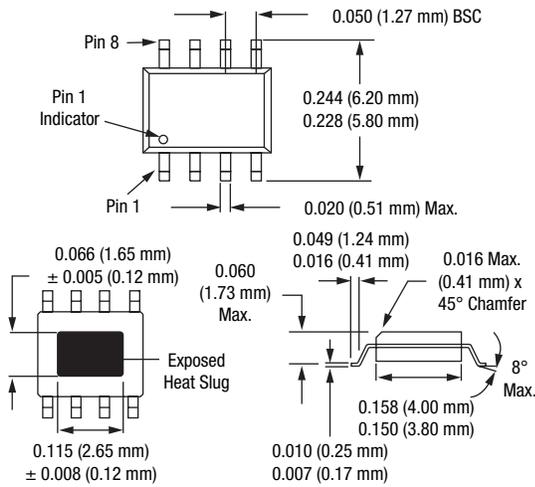
**Test Board Assembly 1960, 2140 MHz**



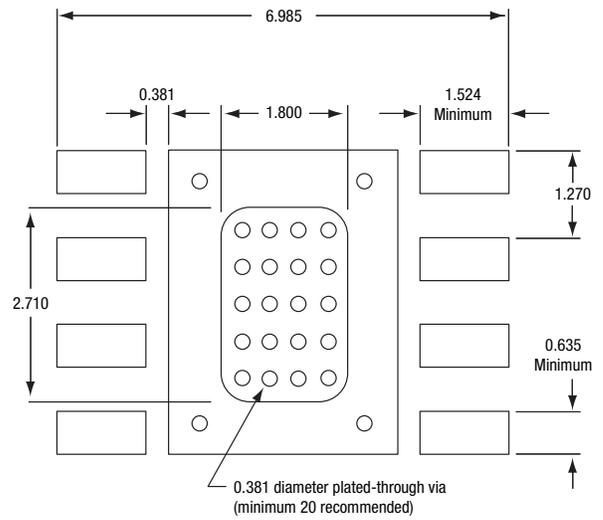
### Evaluation Board Test Configuration



### SOIC-8



### Mounting Footprint



Dimensions in mm.

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