

**DATA SHEET**

# SKY65028-70LF: 450 MHz–2.5 GHz Linear Power Amplifier Driver

## Applications

- UHF TV broadcasts
- TETRA radios
- GSM450, GSM480, GSM750 basestations
- AMPS, PCS, DCS, 2.5G, 3G basestations
- ISM band transmitters
- WCS fixed wireless
- 802.11b/g WLANs

## Features

- Wideband frequency range: 450 MHz–2.5 GHz
- High linearity: OIP3 > 40 dBm and P<sub>1 dB</sub> > 24 dBm
- High efficiency: PAE 48%
- High gain: 20 dB
- Single DC supply, 3 V or 5 V
- Available lead (Pb)-free, RoHS-compliant, and Green MSL-1 @ 260 °C per JEDEC J-STD-020

## Description

Skyworks SKY65028-70LF is a high performance, ultra-wideband linear amplifier with superior output power, linearity, and efficiency. The device is fabricated using Skyworks high reliability Aluminum Gallium Arsenide (AlGaAs) Heterojunction Bipolar Transistor (HBT) technology.

The SKY65028-70LF achieves a high linearity and superior Adjacent Channel Power Rejection/Adjacent Channel Leakage Ratio (ACPR/ACLR) performance. This makes it ideal for use in the driver stage of infrastructure transmit chains for Trans-European Trunked Radio (TETRA) transceivers, multi-band (GSM, AMPS, PCS, DCS) handsets, and many other wireless applications.

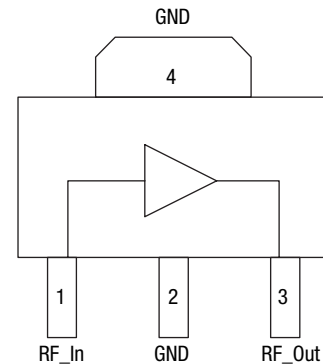
The SKY65028-70LF is a lead (Pb)-free and Green SOT-89 industry standard package.

**NEW**

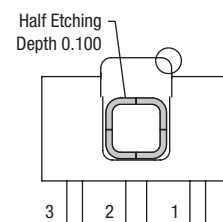
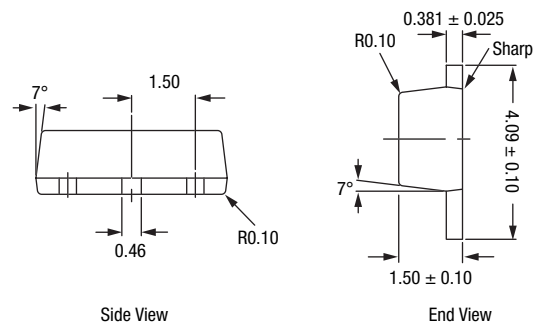


Skyworks Green products are lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, and are free from antimony trioxide and brominated flame retardants.

## Pin Out — 4-Pin SOT-89 Package (Top View)



## SOT-89 (-70)



### 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.

For details on attachment techniques, precautions, and handling procedures recommended by Skyworks, please refer to Skyworks Application Note, PCB Design and SMT Assembly/ Rework Guidelines for MCM-L Packages, document number 101752. Additional information on standard SMT reflow profiles can also be found in the JEDEC Standard J-STD-020.

### Electrostatic Discharge (ESD) Sensitivity

The SKY65028-70LF is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

### Pin Descriptions

Pin #	Name	Description
1	RF_In	RF input
2	GND	Ground
3	RF_Out	RF output
4	GND	Ground

### Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V <sub>CC</sub>		5		V
Frequency range	F	250		2700	MHz
Junction temperature	T <sub>J</sub>			140	°C

### Absolute Maximum Ratings

Characteristic	Value
RF input power (P <sub>IN</sub> )	15 dBm max.
RF output power (P <sub>OUT</sub> )	27 dBm
Supply voltage (V <sub>CC</sub> )	6 V
Supply current (I <sub>CC</sub> )	160 mA
Power dissipation (P <sub>D</sub> )	1.2 W
Operating case temperature (T <sub>C</sub> )	-40 °C to +85 °C
Storage temperature (T <sub>ST</sub> )	-55 °C to +125 °C
Junction temperature (T <sub>J</sub> )	150 °C

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. 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.

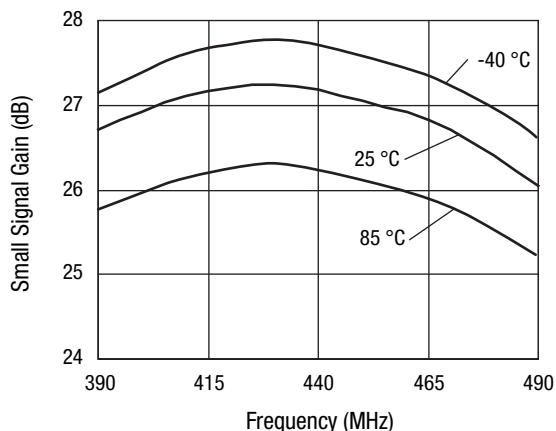
**CAUTION:** *Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions must be employed at all times.*

## Electrical Characteristics

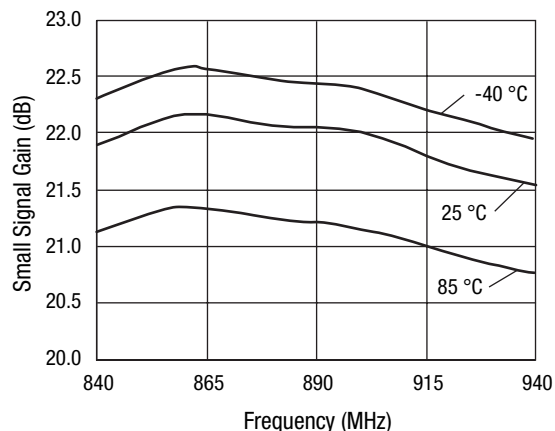
**V<sub>CC</sub> = 5 V, T<sub>C</sub> = 25 °C unless otherwise noted**

Parameter <sup>(1)</sup>	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Test Frequency = 450 MHz</b>						
Small signal gain	G	CW		27		dB
Output power @ 1 dB compression	P <sub>1 dB</sub>	CW		24		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		42		dBm
<b>Test Frequency = 900 MHz</b>						
Small signal gain	G	CW		22		dB
Output power @ 1 dB compression	P <sub>1 dB</sub>	CW		24		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		42		dBm
Noise figure	NF			4		dB
Output power @ ACPR = -45 dBc, 750 kHz offset	P <sub>OUT</sub>	IS-95. Nine forward channels		18		dBm
<b>Test Frequency = 1960 MHz</b>						
Small signal gain	G	CW	14.5	16		dB
Output power @ 1 dB compression	P <sub>1 dB</sub>	CW	23	25		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power	39	42		dBm
Noise figure	NF			5.5	6.5	dB
Power added efficiency	PAE	CW @ P <sub>OUT</sub> = P <sub>1 dB</sub>	42	48		%
Supply current	I <sub>S</sub>			125	145	mA
Output power @ ACPR = -45 dBc, 885 kHz offset	P <sub>OUT</sub>	IS-95. Nine forward channels	17	19		dBm
<b>Test Frequency = 2140 MHz</b>						
Small signal gain	G	CW		15		dB
Output power @ 1 dB compression	P <sub>1 dB</sub>	CW		25		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		42		dBm
Output power @ ACLR = -45 dBc, 5 MHz offset	P <sub>OUT</sub>	WCDMA. Test model #1; 64 DPCH		17		dBm
<b>Test Frequency = 2450 MHz</b>						
Small signal gain	G	CW		14.5		dB
Output power @ 1 dB compression	P <sub>1 dB</sub>	CW		25		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		42		dBm
Noise figure	NF			5		dB
Power added efficiency	PAE	CW, P <sub>OUT</sub> = 26 dBm		50		%
<b>Test Frequency = 2600 MHz</b>						
Small signal gain	G	CW		14		dB
Output power @ 1 dB compression	P <sub>1 dB</sub>	CW		25		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		41		dBm

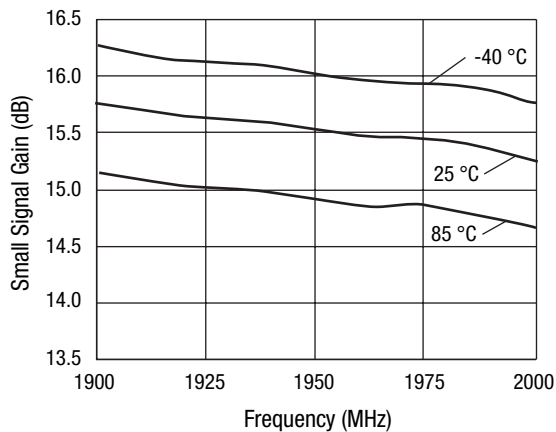
**Typical Performance Data**



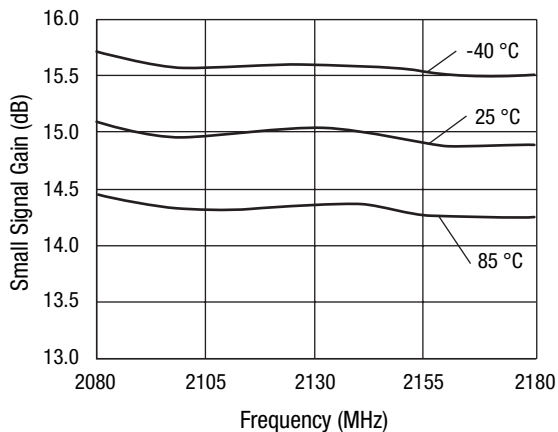
**Typical Small Signal Gain  
From 390–490 MHz Over Temperature**



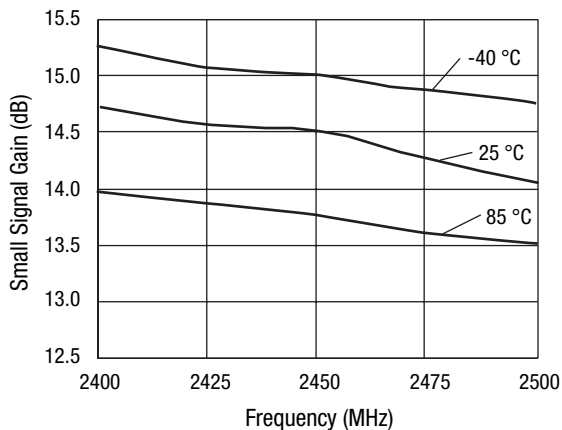
**Typical Small Signal Gain  
From 840–940 MHz Over Temperature**



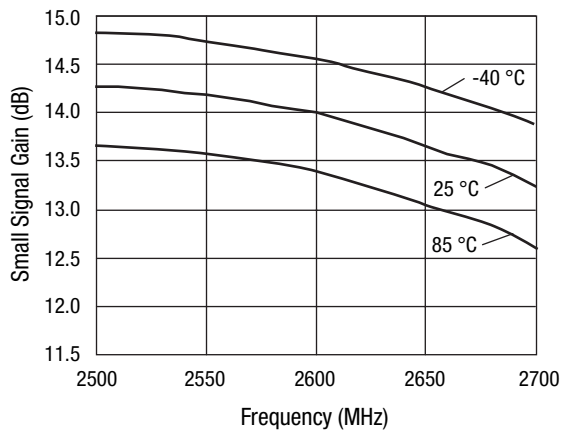
**Typical Small Signal Gain  
From 1900–2000 MHz Over Temperature**



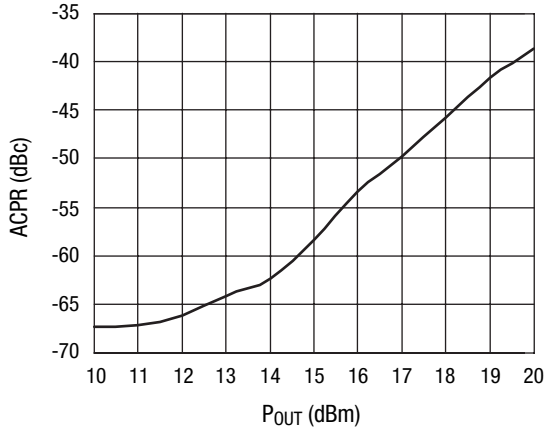
**Typical Small Signal Gain  
From 2080–2180 MHz Over Temperature**



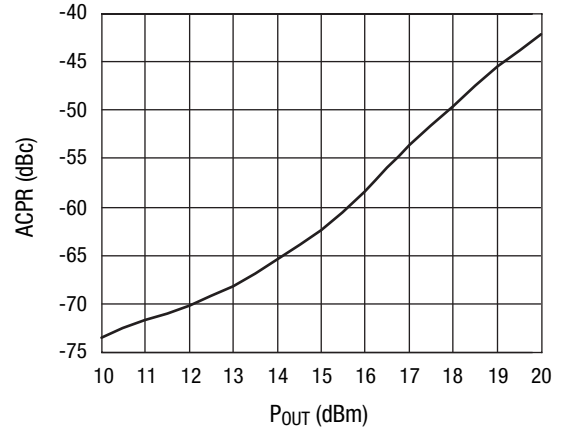
**Typical Small Signal Gain  
From 2400–2500 MHz Over Temperature**



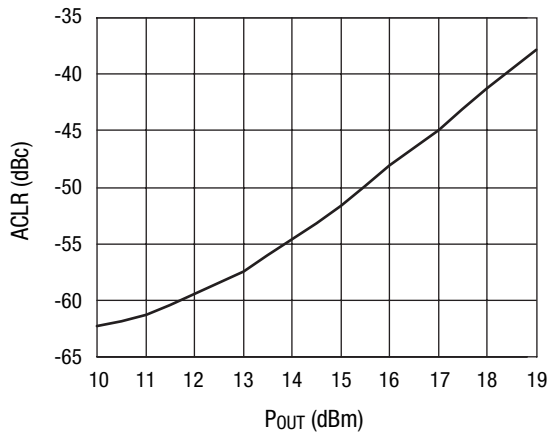
**Typical Small Signal Gain  
From 2500–2700 MHz Over Temperature**



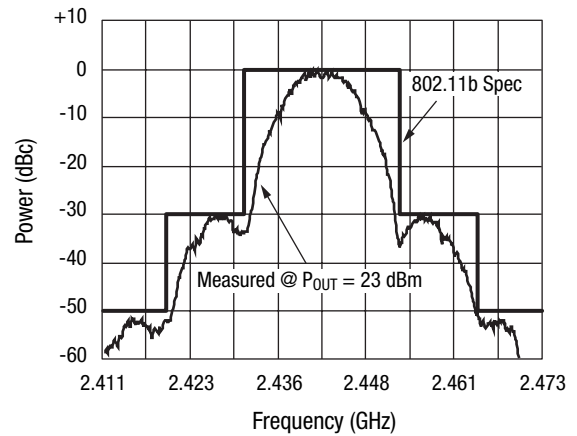
**Typical ACPR vs P<sub>OUT</sub> @ 900 MHz,  
750 kHz Offset and 25 °C**



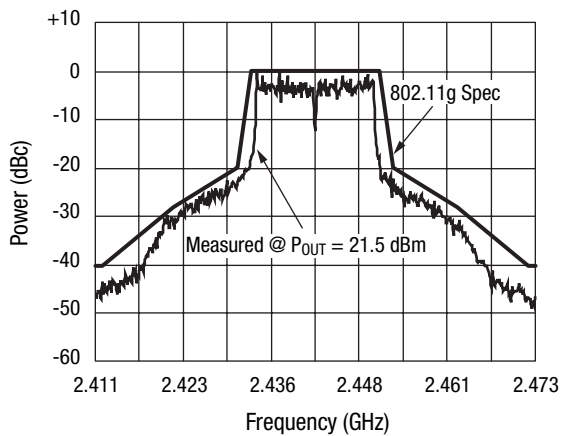
**Typical ACPR vs P<sub>OUT</sub> @ 1960 MHz,  
885 kHz Offset and 25 °C**



**Typical ACLR vs P<sub>OUT</sub> @ 2140 MHz,  
5 MHz Offset and 25 °C**



**Spectral Response with 802.11b Signal  
(CCK @ 11 Mbps, V<sub>CC</sub> = 3.3 V)**



**Spectral Response with 802.11g Signal  
(64 QAM @ 54 Mbps, V<sub>CC</sub> = 3.3 V)**

### Evaluation Board Description

The Skyworks SKY65028-70LF Evaluation Board is used to test the performance of the SKY65028-70LF power amplifier driver.

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 SKY65028-70LF power amplifier 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 amplifier. 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.

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

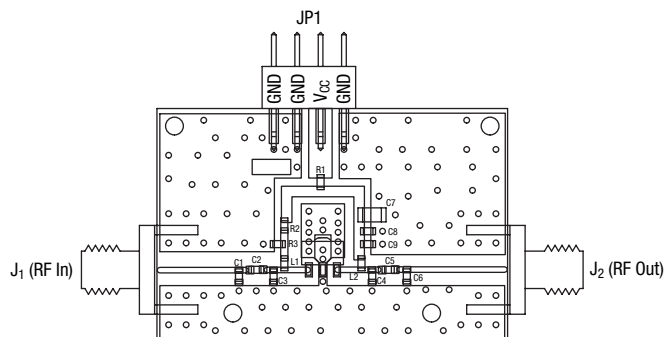
### Testing Procedure

Use the following procedure to set up the SKY65028-70LF Evaluation Board for testing:

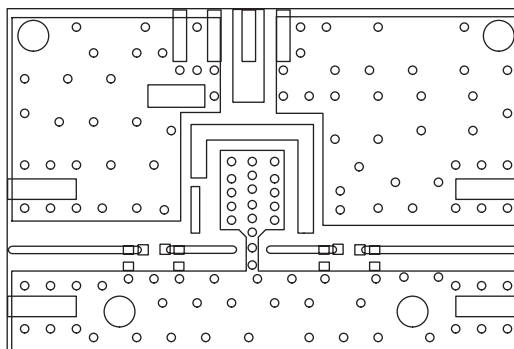
1. Connect a 5.0 V supply to  $V_{CC}$ . If available, enable the current limiting function of the power supply to 240 mA.
2. Connect a signal generator to the RF signal input port. Set it to the desired RF frequency at a power level of -15 dBm or less to the evaluation board but do NOT enable the RF signal.
3. Connect a spectrum analyzer to the RF signal output port.
4. Enable the power supply.
5. Enable the RF signal.
6. Take measurements.

**CAUTION:** If any of the output signals exceed the rated maximum values, the SKY65028-70LF evaluation board can be permanently damaged.

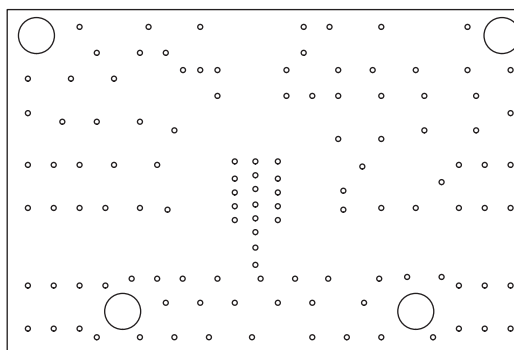
### Evaluation Board Assembly



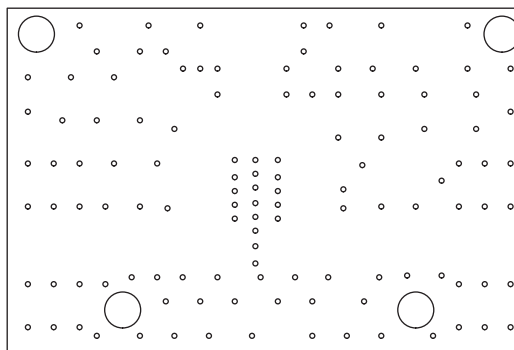
### Evaluation Board Layer Detail



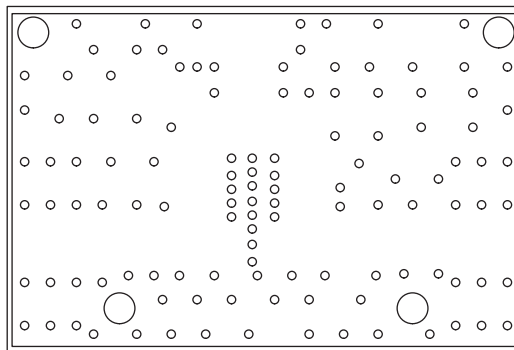
Layer 1: Top - Metal



Layer 2: Ground

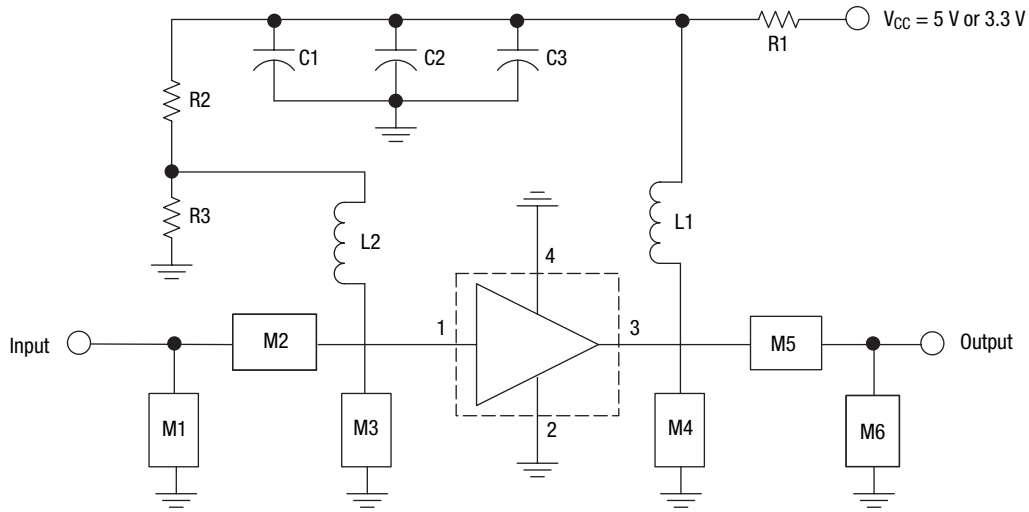


Layer 3: Ground



Layer 4: Solid Ground Plane

### Evaluation Board Schematic



Refer to Evaluation Board Component Values vs. Frequency Table for component values.

### Evaluation Board Component Values vs. Frequency

Component	Evaluation Board Frequency (MHz)						
	450	900	1960	2140	2450	2450	2600
	VCC = 5 V					VCC = 3.3 V	VCC = 5 V
R1	0 Ω	0 Ω	0	0 Ω	0 Ω	0 Ω	0 Ω
R2	390 Ω	390 Ω	390	390 Ω	390 Ω	220 Ω	390 Ω
R3	180 Ω	180 Ω	180	180 Ω	180 Ω	200 Ω	180 Ω
C1	0.1 μF	0.1 μF	0.1 μF	0.1 μF	0.1 μF	0.1 μF	0.1 μF
C2	1000 pF	1000 pF	1000 pF	1000 pF	1000 pF	1000 pF	1000 pF
C3	68 pF	68 pF	18 pF	18 pF	18 pF	18 pF	18 pF
L1	39 nH	39 nH	27 nH	27 nH	27 nH	27 nH	22 nH
L2	39 nH	39 nH	27 nH	27 nH	27 nH	27 nH	22 nH
M1	6.8 nH	6.8 nH	15 nH	6.8 nH	6.8 nH	1 pF	1 pF
M2	15 pF	6.8 pF	12 pF	1 pF	1.5 pF	1.5 pF	1.2 pF
M3	DNI	10 pF	1.5 pF	1 pF	DNI	DNI	DNI
M4	DNI	DNI	DNI	2.2 pF	DNI	DNI	DNI
M5	22 pF	10 pF	2.2 pF	3.3 pF	20 pF	20 pF	20 pF
M6	0.5 pF	8.2 nH	3.9 nH	2.2 nH	0.5 pF	0.5 pF	0.5 pF

DNI: Do Not Install.

Copyright © 2002, 2003, 2004, 2005, 2006, Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at [www.skyworksinc.com](http://www.skyworksinc.com), are incorporated by reference.