

DATA SHEET

SKY65028-70LF: 250–2700 MHz 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: 250–2700 MHz
- High linearity: OIP3 > 40 dBm and P_{1 dB} > 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.

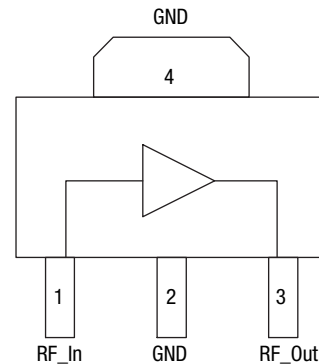
The SKY65028-70LF is a lead (Pb)-free and Green™ SOT-89 industry standard package.

NEW

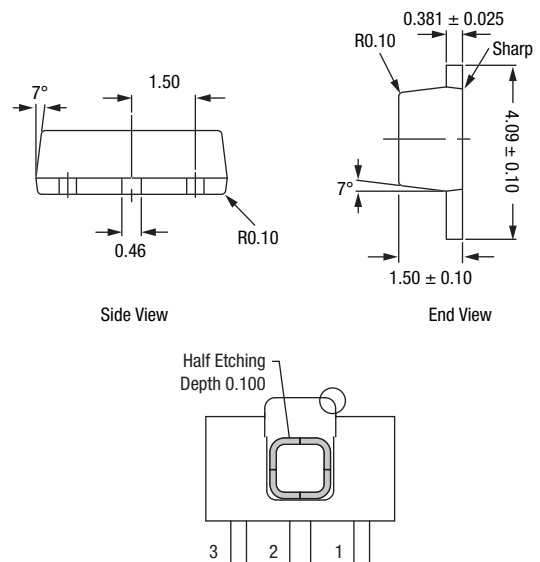


Skyworks Green™ products are lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, and are free from antimony trioxide and brominated flame retardants.

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



SOT-89 (-70)



Electrical Characteristics

V_{CC} = 5 V, T_C = 25 °C, unless otherwise noted

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Test Frequency = 450 MHz						
Small signal gain	G	CW		27		dB
Output power @ 1 dB compression	P _{1 dB}	CW		24		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		42		dBm
Test Frequency = 900 MHz						
Small signal gain	G	CW		22		dB
Output power @ 1 dB compression	P _{1 dB}	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 _{OUT}	IS-95. Nine forward channels		18		dBm
Test Frequency = 1960 MHz						
Small signal gain	G	CW	14.5	16		dB
Output power @ 1 dB compression	P _{1 dB}	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 _{OUT} = P _{1 dB}	42	48		%
Supply current	I _S			125	145	mA
Output power @ ACPR = -45 dBc, 885 kHz offset	P _{OUT}	IS-95. Nine forward channels	17	19		dBm
Test Frequency = 2140 MHz						
Small signal gain	G	CW		15		dB
Output power @ 1 dB compression	P _{1 dB}	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 _{OUT}	WCDMA. Test model #1; 64 DPCH		17		dBm
Test Frequency = 2450 MHz						
Small signal gain	G	CW		14.5		dB
Output power @ 1 dB compression	P _{1 dB}	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 _{OUT} = 26 dBm		50		%
Test Frequency = 2600 MHz						
Small signal gain	G	CW		14		dB
Output power @ 1 dB compression	P _{1 dB}	CW		25		dBm
Output 3rd order intercept point	OIP3	Two tones, each @ 7 dBm output power		41		dBm

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_{CC}		5		V
Frequency range	F	250		2700	MHz
Junction temperature	T_J			140	°C
Thermal resistance	Θ_{JC}		36		°C/W

Theory of Operation

The SKY65028-70LF is comprised of a single amplifier stage. All matching structures are external to the amplifier to accommodate a wide frequency range of tuning over the 250–2700 MHz band. The part has excellent linearity at low power levels and high efficiency at $P_{1\text{ dB}}$. Utilizing the matching and bias circuits shown the evaluation board schematic, the part can be tuned for a specific frequency band and operate single positive supply voltage of typically 3–5 V.

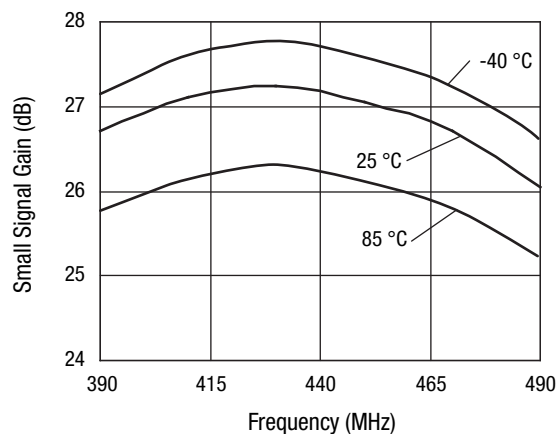
Absolute Maximum Ratings

Characteristic	Value
RF input power (P_{IN})	15 dBm max.
RF output power (P_{OUT})	27 dBm
Supply voltage (V_{CC})	6 V
Supply current (I_{CC})	160 mA
Power dissipation (P_D)	1.2 W
Operating case temperature (T_C)	-40 °C to +85 °C
Storage temperature (T_{ST})	-55 °C to +125 °C
Junction temperature (T_J)	150 °C

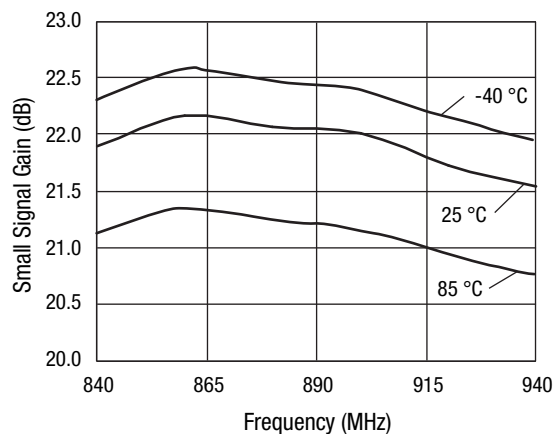
Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty. Each absolute maximum rating listed is an individual parameter. Biasing and driving the amplifier with more than one absolute maximum rating listed may result in permanent damage to the device. Exposure to maximum rating conditions for extended periods may reduce device reliability.

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.*

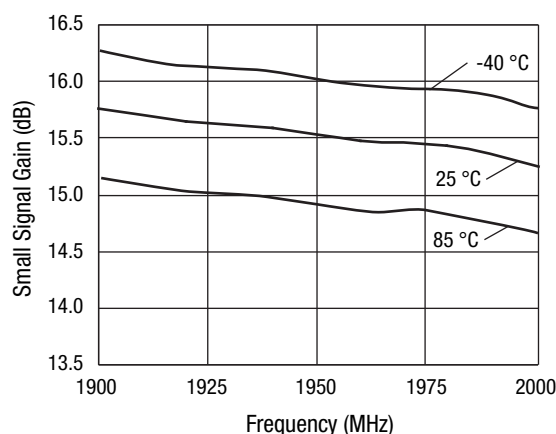
The amplifier collector voltage is supplied through an RF choke to the output. The reference voltage is supplied through a separate RF choke to the amplifier input. A voltage divider (R_2/R_3) sets the proper bias level to the input. Capacitors C_7 , C_8 and C_9 provide DC bias decoupling for V_{CC} . In some applications, if a series DC blocking cap is not part of the input or output RF matching circuits, a blocking cap of 100 pF, should be included to provide DC blocking to the RF ports.

Typical Performance Data **$V_{CC} = 5\text{ V}$, $T_C = 25\text{ }^{\circ}\text{C}$, unless otherwise noted**

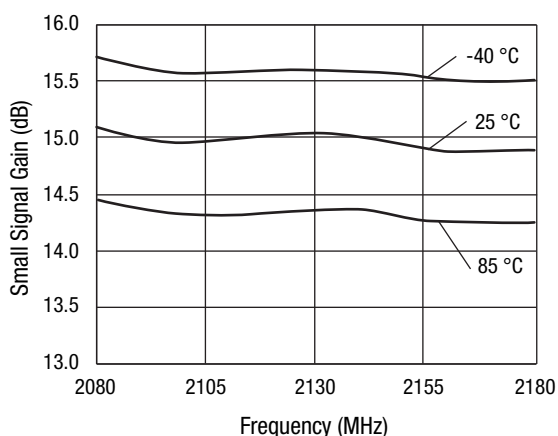
**Typical Small Signal Gain
From 390–490 MHz Over Temperature**



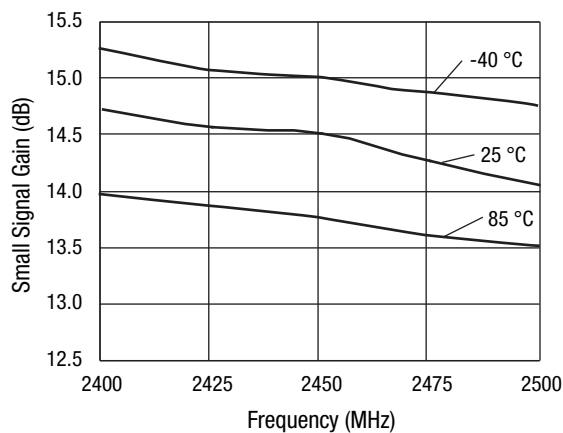
**Typical Small Signal Gain
From 840–940 MHz Over Temperature**



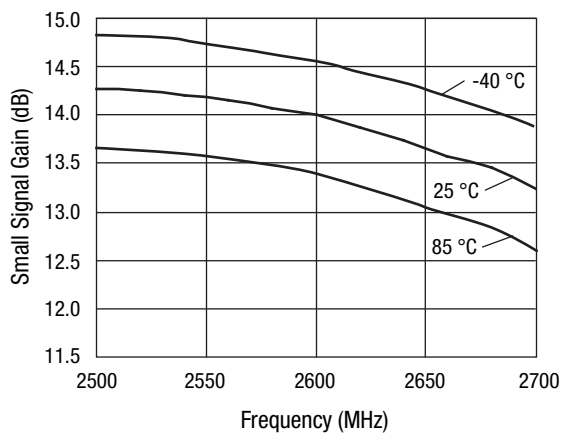
**Typical Small Signal Gain
From 1900–2000 MHz Over Temperature**



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



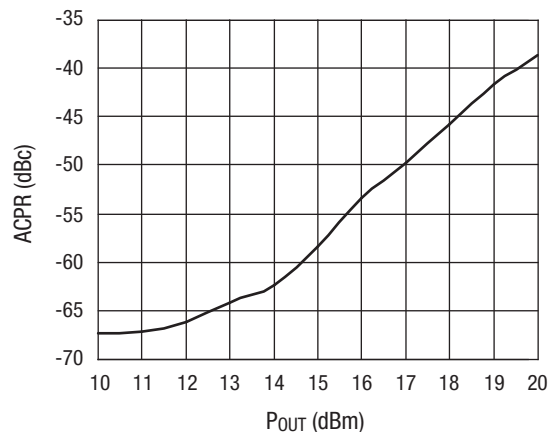
**Typical Small Signal Gain
From 2400–2500 MHz Over Temperature**



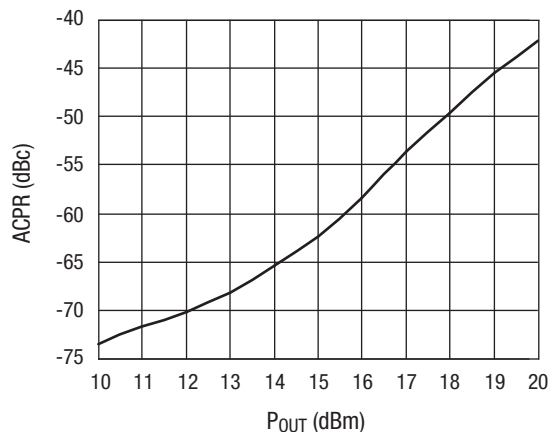
**Typical Small Signal Gain
From 2500–2700 MHz Over Temperature**

Typical Performance Data

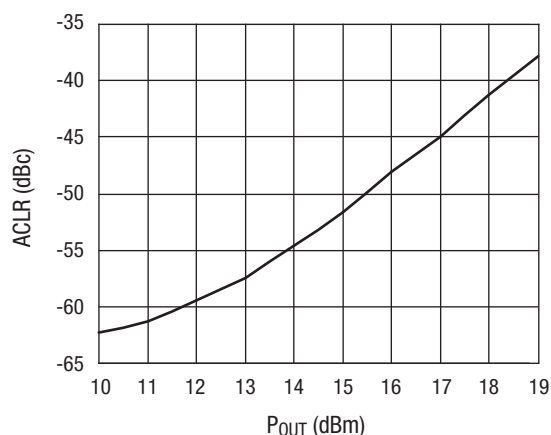
$V_{CC} = 5\text{ V}$, $T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted



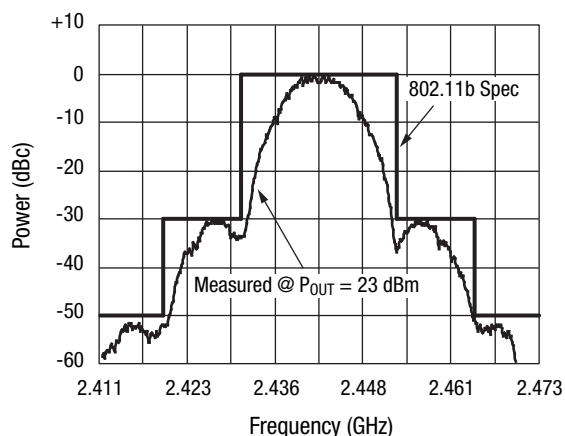
**Typical ACPR vs. P_{OUT} @ 900 MHz,
750 kHz Offset, IS-95**



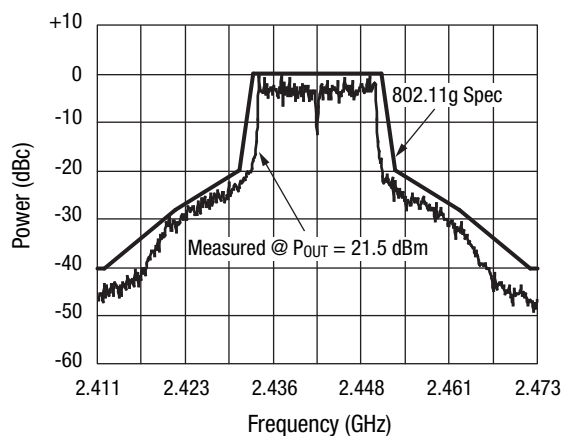
**Typical ACPR vs. P_{OUT} @ 1960 MHz,
885 kHz Offset, IS-95**



**Typical ACPR vs. P_{OUT} @ 2140 MHz,
5 MHz Offset, WCDMA**



**Spectral Response with 802.11b Signal
(CCK @ 11 Mbps, $V_{CC} = 3.3\text{ V}$)**



**Spectral Response with 802.11g Signal
(64 QAM @ 54 Mbps, $V_{CC} = 3.3\text{ V}$)**

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.

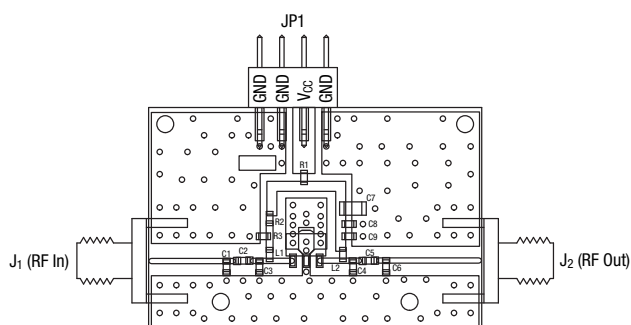
Testing Procedure

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

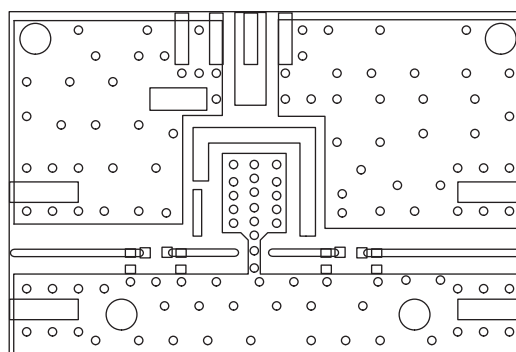
1. Connect a 5.0 V supply to V_{CC} . If available, enable the current limiting function of the power supply to 240 mA.
2. Connect a signal generator to the RF signal input port. Set it to the desired RF frequency at a power level of -15 dBm or less to the evaluation board but do NOT enable the RF signal.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

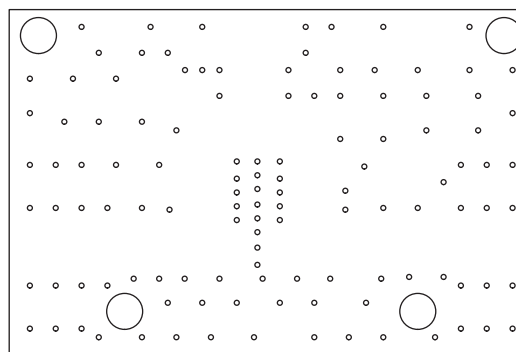
Evaluation Board Assembly



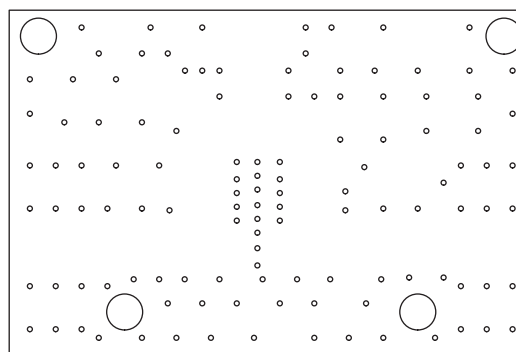
Evaluation Board Layer Detail



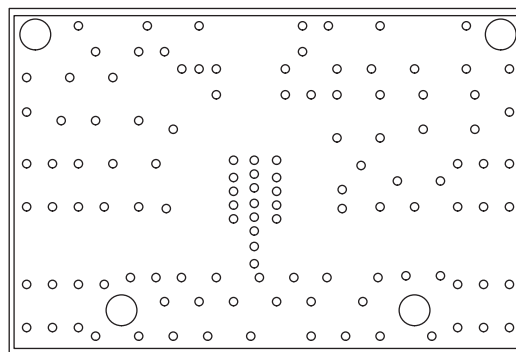
Layer 1: Top - Metal



Layer 2: Ground



Layer 3: Ground

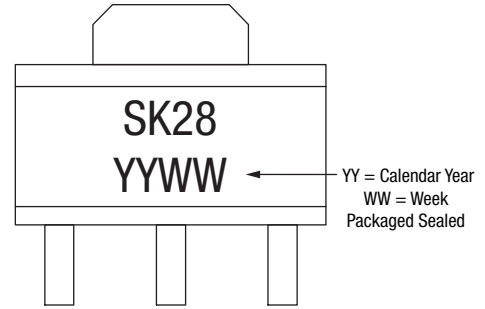


Layer 4: Solid Ground Plane

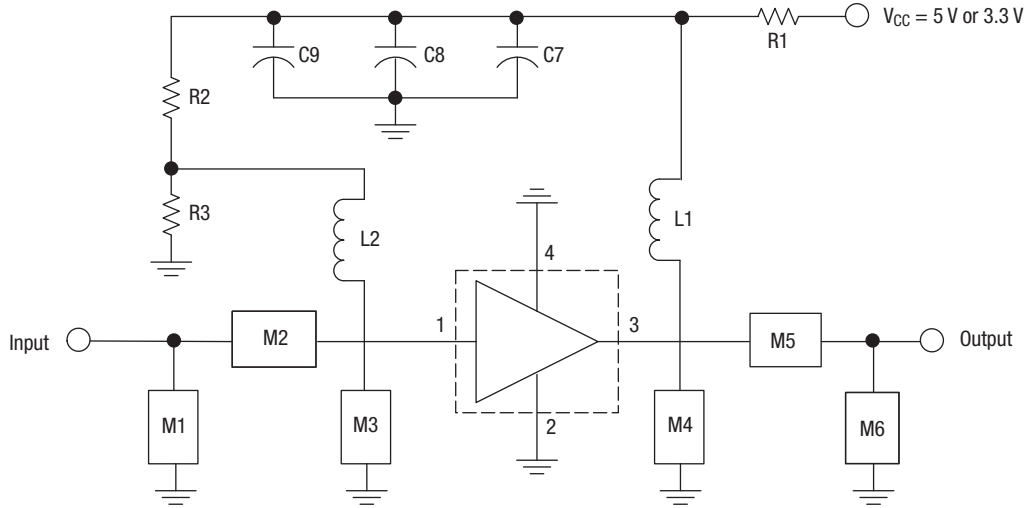
Evaluation Board Stack-Up

Cross Section	Name	Thickness (mils)	Material	ϵ_r
	L1	1.4	Cu	—
	Lam1	12	Rogers 4003-12	3.38
	L2_GND	1.4	Cu, 1 oz.	—
	Lam2	4	FR4-4	4.35
	L3_GND	1.4	Cu, 1 oz.	—
	Lam3	12	FR4-12	4.35
	L4	1.4	Cu, 1 oz.	—

Branding Specifications



Evaluation Board Schematic



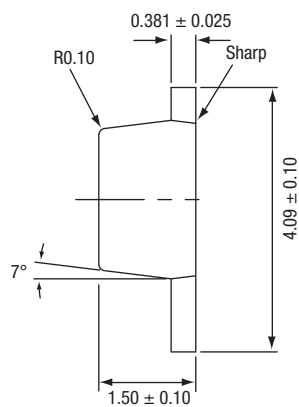
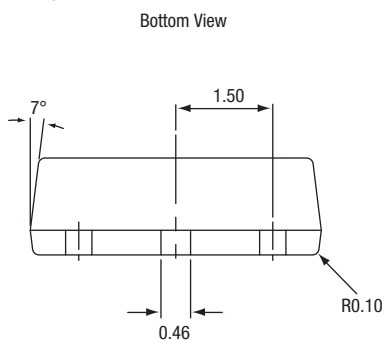
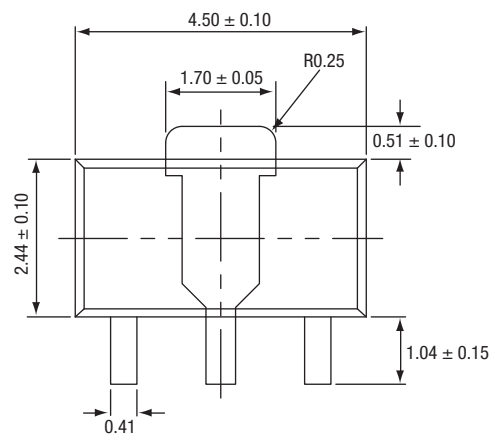
Refer to Evaluation Board Component Values vs. Frequency Table for component values.

Evaluation Board Component Values vs. Frequency

Component	Evaluation Board Frequency (MHz)						
	450	900	1960	2140	2450	2450	2600
	$V_{CC} = 5\text{ V}$					$V_{CC} = 3.3\text{ V}$	$V_{CC} = 5\text{ V}$
R1	0 Ω	0 Ω	0 Ω	0 Ω	0 Ω	0 Ω	0 Ω
R2	390 Ω	390 Ω	390 Ω	390 Ω	390 Ω	220 Ω	390 Ω
R3	180 Ω	180 Ω	180 Ω	180 Ω	180 Ω	200 Ω	180 Ω
C7	0.1 μF	0.1 μF	0.1 μF	0.1 μF	0.1 μF	0.1 μF	0.1 μF
C8	1000 pF	1000 pF	1000 pF	1000 pF	1000 pF	1000 pF	1000 pF
C9	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	1 pF	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	39 pF	10 pF	2.2 pF	3.3 pF	20 pF	20 pF	20 pF
M6	33 nH	8.2 nH	3.9 nH	2.2 nH	0.5 pF	0.5 pF	0.5 pF

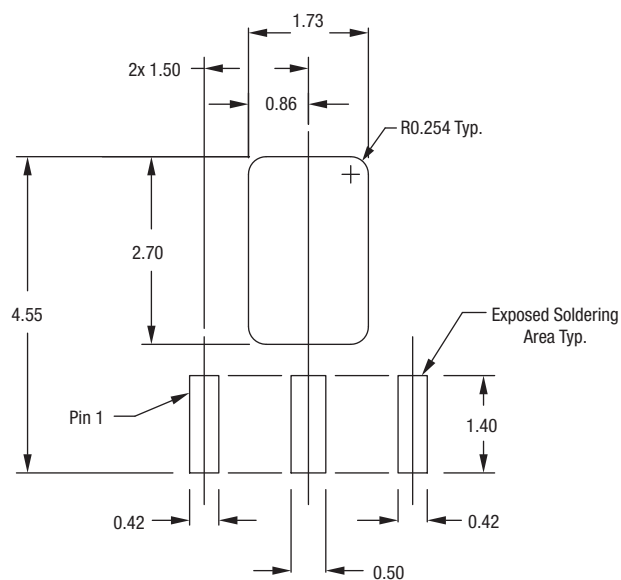
DNI: Do Not Install.

Package Dimensions

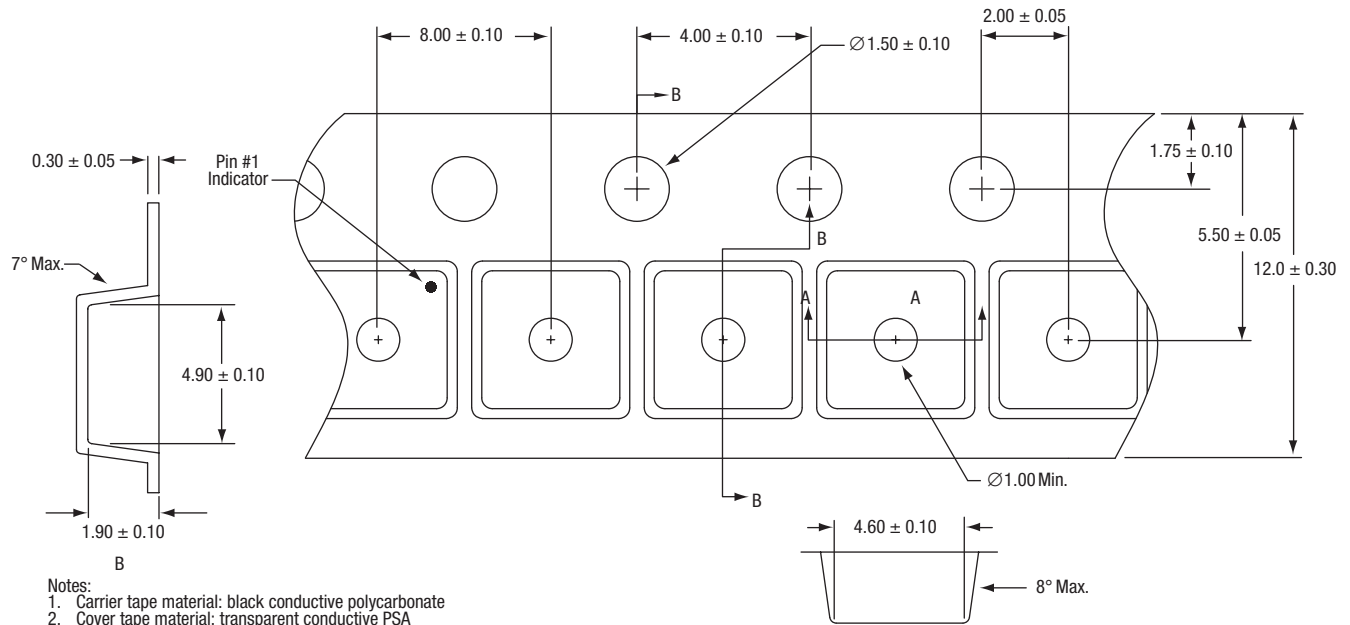


All measurements are in millimeters

Recommended Footprint



Tape and Reel Dimensions



Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY65028-70LF: 250–2700 MHz Linear Power Amplifier Driver	SKY65028-70LF (Pb-free and Green package)	TW11-D631 (900 MHz)
		TW11-D632 (1960 MHz)
		TW11-D633 (2140 MHz)
		TW11-D634 (450 MHz)
		TW11-D636 (2450 MHz, $V_{CC} = 5\text{ V}$)
		TW11-D638 (2450 MHz, $V_{CC} = 3.3\text{ V}$)
		TW11-D637 (2600 MHz)

Copyright © 2002, 2003, 2004, 2005, 2006, 2007, 2008, 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.skyworksin.com, are incorporated by reference.