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**DATA SHEET**

# SKY65162-70LF: 400 to 3800 MHz Linear Power Amplifier

## Applications

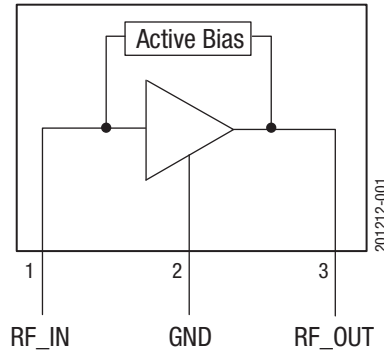
- UHF television
- TETRA radios
- PCS, DCS, 2.5G, 3G, 4G handsets and infrastructure systems
- ISM band transmitters
- WCS fixed wireless
- 802.16 WiMAX
- 3GPP LTE

## Features

- Wideband frequency range: 400 to 3800 MHz
- Low noise figure: 3.6 dB
- High OIP3
- OP1dB = +29.5 dBm @ 1960 MHz
- High gain: 24 dB
- On-chip bias circuit
- SOT-89 (4-pin, 2.4 x 4.5 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

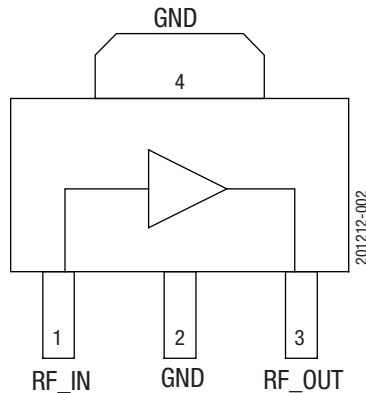


**Figure 1. SKY65162-70LF Functional Block Diagram**

## Description

Skyworks SKY65162-70LF is a high-performance, ultra-wideband power amplifier (PA) with superior output power, low noise, high linearity, and high efficiency. The device provides excellent linearity with a 1 dB output compression point (OP1dB) of +29.5 dBm at 1960 MHz, making the SKY65162-70LF ideal for use in the driver stage of infrastructure transmit chains.

The SKY65162-70LF uses low-cost surface-mount technology (SMT) in the form of a 4-pin, 2.4 x 4.5 mm small outline transistor (SOT-89) package. A functional block diagram is provided in Figure 1. The device package and pinout are shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.



**Figure 2. SKY65162-70LF Pinout Package (Top View)**

**Table 1. SKY65162-70LF Signal Descriptions**

Pin	Name	Description
1	RF_IN	RF input
2	GND	Ground
3	RF_OUT	RF output
4	GND	Ground

### Technical Description

The SKY65162-70LF is a single-stage, linear PA that operates with a single 5 V power supply connected through an RF choke (inductor L2) to the output signal (pin 3). The bias current is set by the on-chip active bias composed of current mirror and reference voltage transistors, which allow excellent gain tracking over temperature and voltage variations. The device is externally RF matched using surface-mount components to facilitate operation over a frequency range of 400 to 3800 MHz.

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65162-70LF are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Tables 4 through 10.

Typical performance characteristics of the SKY65162-70LF are illustrated in Figures 3 through 17 (915 MHz), Figures 18 through 34 (1960 MHz), Figures 35 through 49 (2100 MHz), Figures 50 through 67 (2400 MHz), Figures 68 through 71 (2600 MHz), and Figures 72 through 82 (3600 MHz).

**Table 2. SKY65162-70LF Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VCC		6	V
RF output power	P <sub>OUT</sub>		+30	dBm
Supply current	I <sub>CC</sub>		400	mA
Operating case temperature	T <sub>C</sub>	-40	+85	°C
Storage temperature	T <sub>ST</sub>	-55	+125	°C
Junction temperature	T <sub>J</sub>		+150	°C
Thermal resistance	Θ <sub>JC</sub>		29	°C/W

<sup>1</sup> 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. Exceeding any of the limits listed here may result in permanent damage to the device.

**ESD HANDLING:** 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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

**Table 3. SKY65162-70LF Recommended Operating Conditions**

Parameter	Symbol	Min	Typ	Max	Units
Supply voltage	VCC	4.75	5.0	5.5	V
Operating frequency	f	400		3800	MHz
Operating case temperature	T <sub>J</sub>	-40	+25	+85	°C

**Table 4. SKY65162-70LF Electrical Characteristics<sup>1</sup>  
(VCC = +5 V, T<sub>C</sub> = 25 °C, f = 430 MHz, Unless Otherwise Noted)**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		400		470	MHz
Small signal gain	IS21I	Small signal	23.0	23.5		dB
Input return loss	IS11I	Small signal	14	17		dB
Output return loss	IS22I	Small signal	16	24		dB
Third order output intercept point	OIP3	P <sub>OUT</sub> = +10 dBm	+37	+40		dBm
Noise figure	NF			10	12	dB
1 dB output compression point	OP1dB	CW	+28	+29		dBm
Adjacent channel power ratio	ACPR1	@ P <sub>OUT</sub> = +14 dBm (CDMA 2000)		-61	-60	dBc
Quiescent current	I <sub>CC</sub>	No RF		188		mA

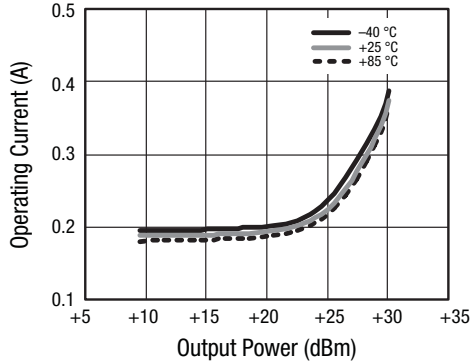
<sup>1</sup> Performance shown in this table is verified by characterization and is not guaranteed by production test.

**Table 5. SKY65162-70LF Electrical Characteristics<sup>1</sup>**  
**(VCC = +5 V, Tc = 25 °C, f = 915 MHz, Unless Otherwise Noted)**

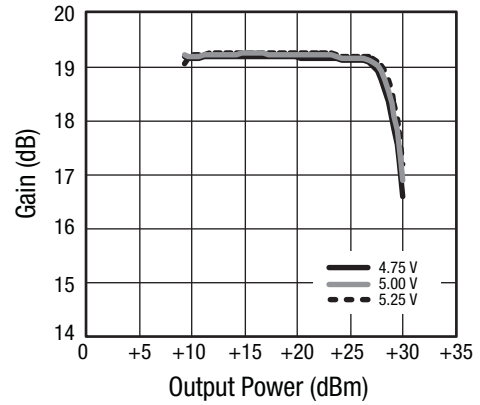
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		869		960	MHz
Small signal gain	IS21I	Small signal	19.5	20.0		dB
Input return loss	IS11I	Small signal	21	29		dB
Output return loss	IS22I	Small signal	9	10		dB
Third order output intercept point	OIP3	POUT = +10 dBm	+40	+42		dBm
Noise figure	NF			4.0	4.5	dB
1 dB output compression point	OP1dB	CW	+28.0	+28.5		dBm
Saturated output power	PSAT	VCC = 5 V		+30.5		dBm
		VCC = 4 V		+29.0		dBm
Operational current	IOP	@ P1dB = +28.8 dBm		306		mA
Quiescent current	ICQ	No RF		188		mA

<sup>1</sup> Performance shown in this table is verified by characterization and is not guaranteed by production test.

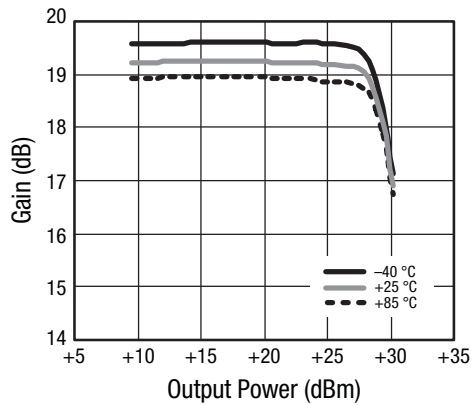
**Typical Performance Characteristics**  
 (VCC = +5 V, Tc = 25 °C, f = 915 MHz, Unless Otherwise Noted)



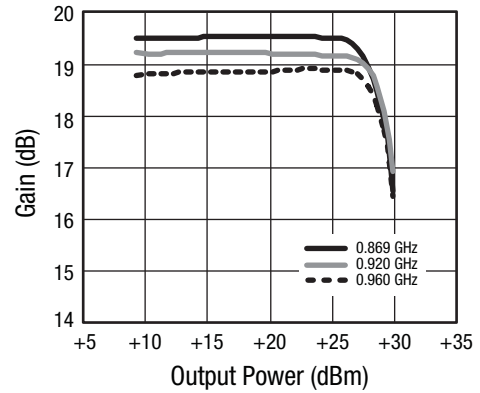
**Figure 3. Operating Current vs Output Power Over Temperature**



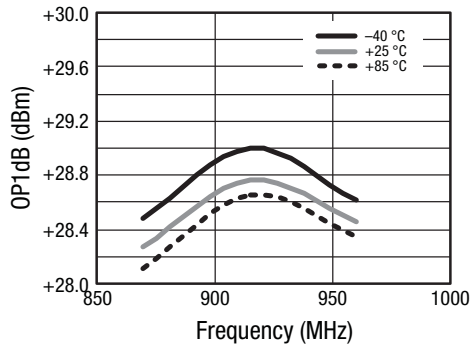
**Figure 4. Gain vs Output Power Over Voltage**



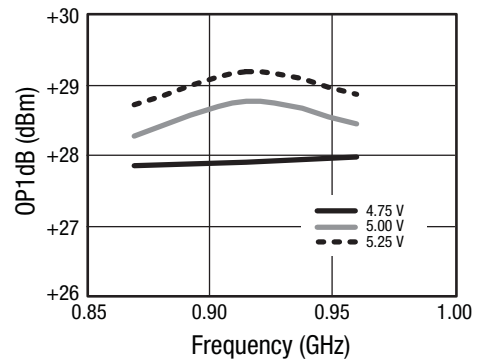
**Figure 5. Gain vs Output Power Over Temperature**



**Figure 6. Gain vs Output Power Over Frequency**



**Figure 7. OP1dB vs Frequency Over Temperature**



**Figure 8. OP1dB vs Frequency Over Voltage**

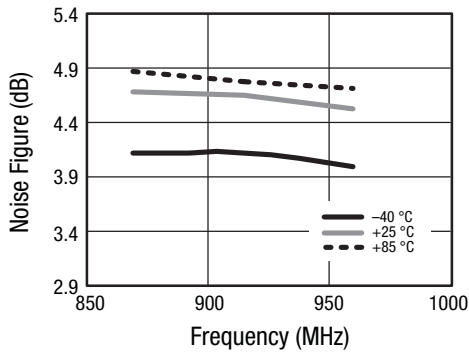


Figure 9. Noise Figure vs Frequency Over Temperature

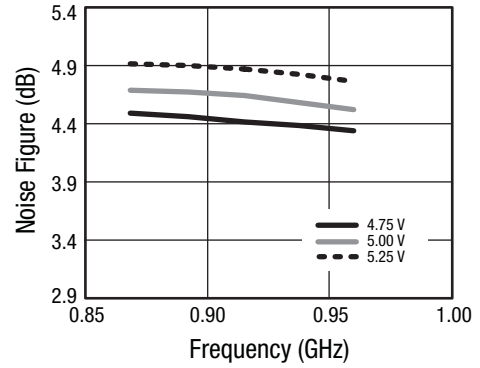


Figure 10. Noise Figure vs Frequency Over Voltage

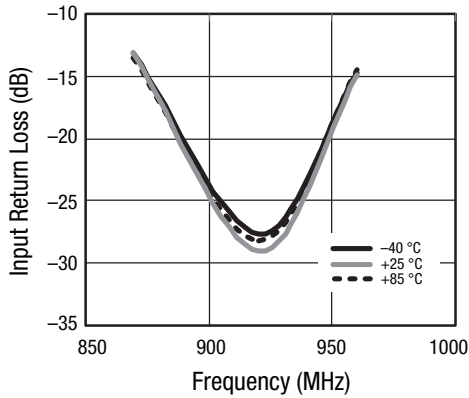


Figure 11. Input Return Loss vs Frequency Over Temperature

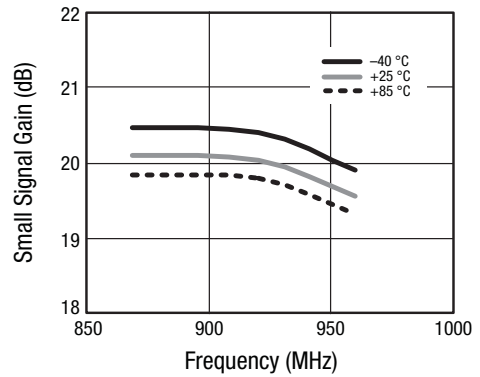


Figure 12. Small Signal Gain vs Frequency Over Temperature

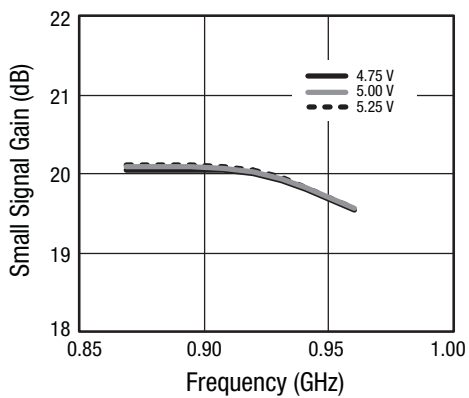


Figure 13. Small Signal Gain vs Frequency Over Voltage

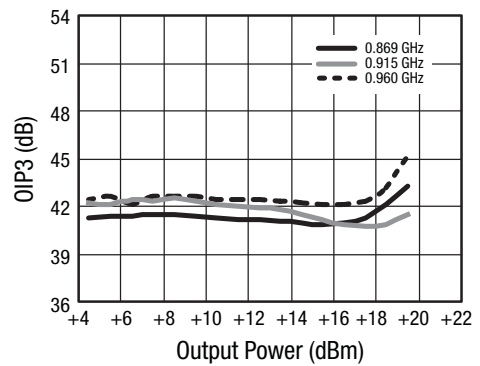


Figure 14. OIP3 vs Output Power Over Frequency

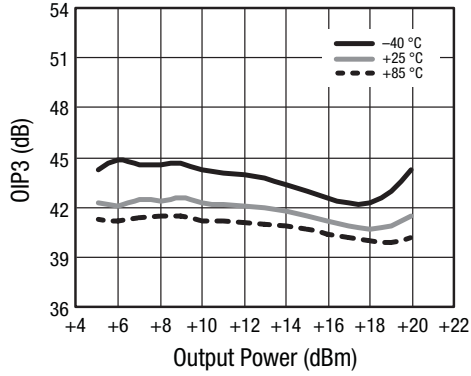


Figure 15. OIP3 vs Output Power Over Temperature

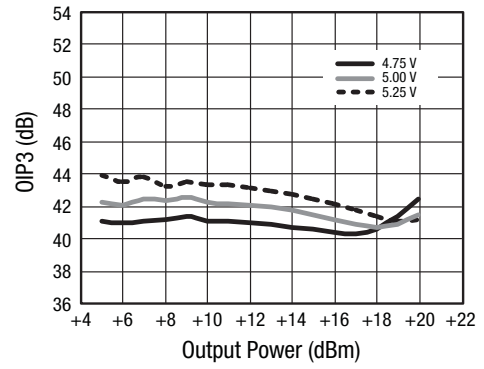


Figure 16. OIP3 vs Output Power Over Voltage

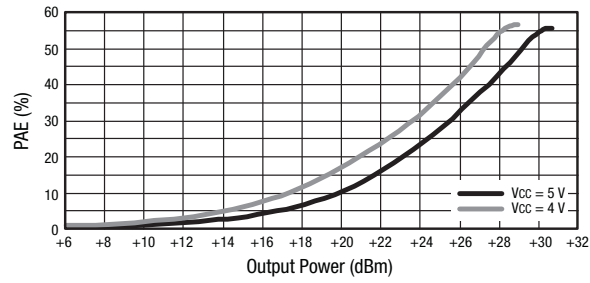


Figure 17. Output Power vs PAE Over Voltage



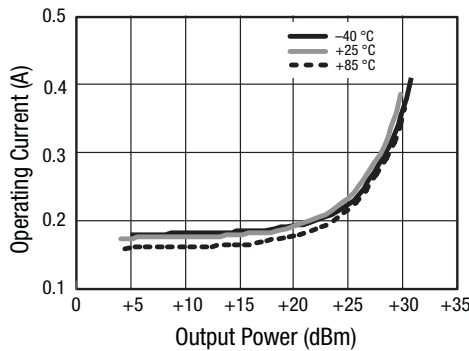
**Table 6. SKY65162-70LF Electrical Characteristics<sup>1</sup>**  
**(VCC = +5 V, Tc = 25 °C, f = 1960 MHz, Unless Otherwise Noted)**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		1930		1990	MHz
Small signal gain	IS21I	Small signal	14.5	15.0		dB
Input return loss <sup>2</sup>	IS11I	Small signal	15	20		dB
Output return loss <sup>2</sup>	IS22I	Small signal	15	20		dB
1 dB output compression point	OP1dB	CW	+28.0	+29.5		dBm
Third order output intercept point	OIP3	P <sub>IN</sub> = -5 dBm/tone	+40.0	+43.0		dBm
Noise figure	NF			3.8	4.5	dB
Operating current	I <sub>OP</sub>	@ P1dB		340	400	mA
Quiescent current	I <sub>CO</sub>	No RF		180	210	mA

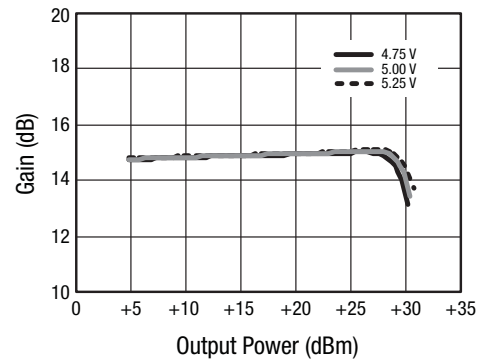
<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

<sup>2</sup> Verified by characterization; not tested in production.

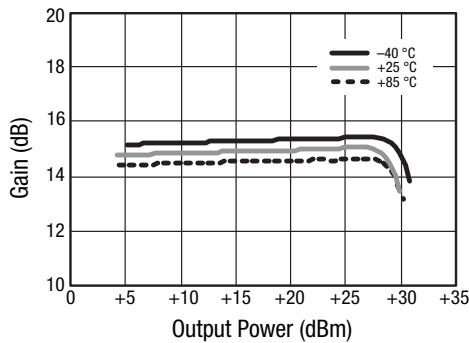
**Typical Performance Characteristics**  
**(VCC = +5 V, Tc = 25 °C, f = 1960 MHz, Unless Otherwise Noted)**



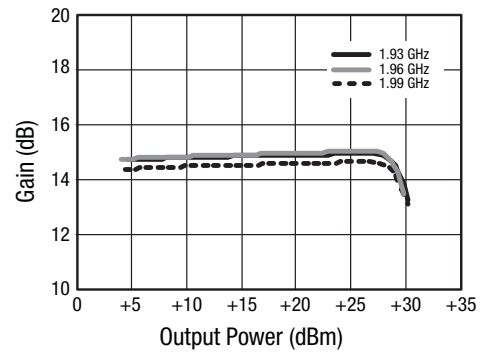
**Figure 18. Operating Current vs Output Power Over Temperature**



**Figure 19. Gain vs Output Power Over Voltage**



**Figure 20. Gain vs Output Power Over Temperature**



**Figure 21. Gain vs Output Power Over Frequency**

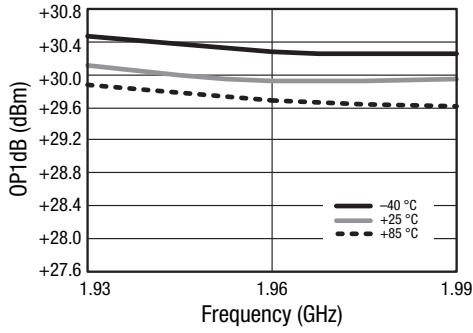


Figure 22. OP1dB vs Frequency Over Temperature

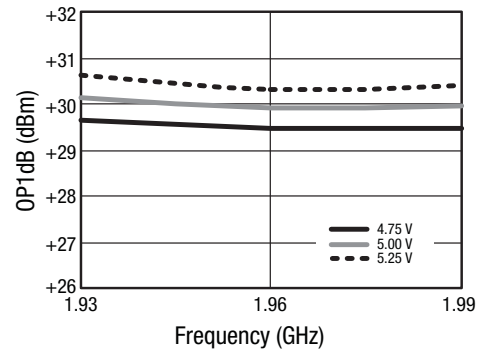


Figure 23. OP1dB vs Frequency Over Voltage

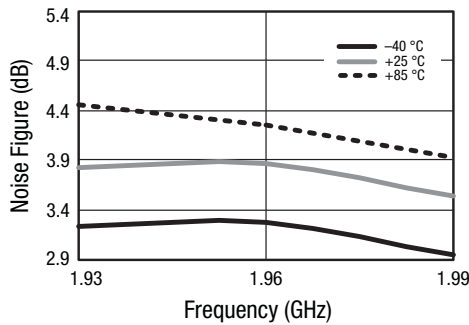


Figure 24. Noise Figure vs Frequency Over Temperature

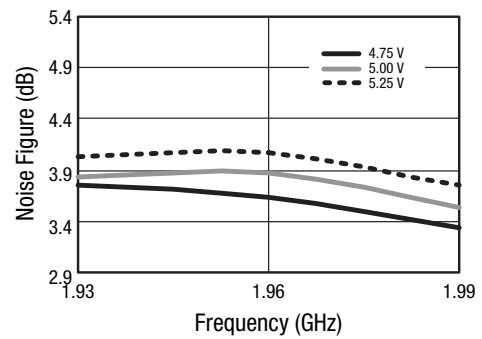


Figure 25. Noise Figure vs Frequency Over Voltage

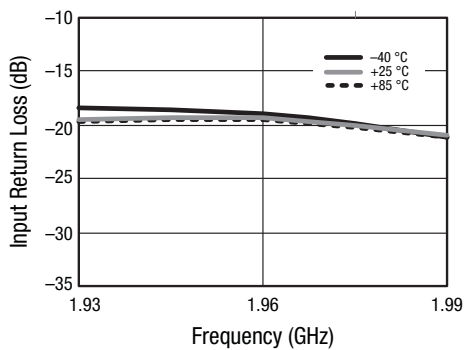


Figure 26. Input Return Loss vs Frequency Over Temperature

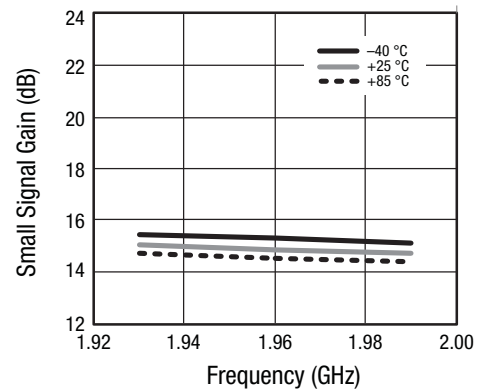


Figure 27. Small Signal Gain vs Frequency Over Temperature

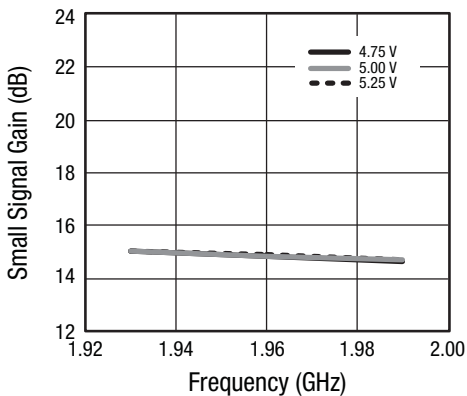


Figure 28. Small Signal Gain vs Frequency Over Voltage

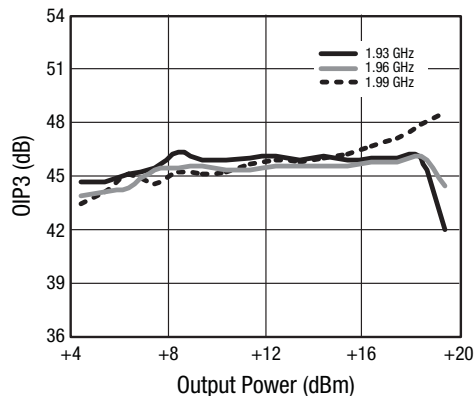


Figure 29. OIP3 vs Output Power Over Frequency

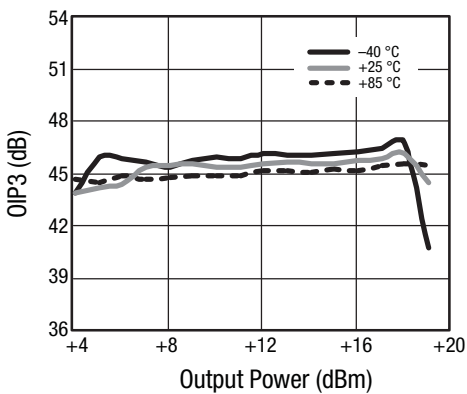


Figure 30. OIP3 vs Output Power Over Temperature

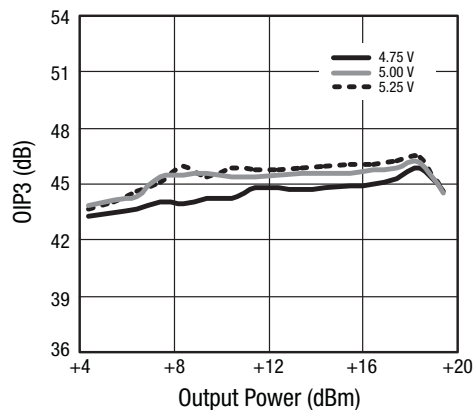


Figure 31. OIP3 vs Output Power Over Voltage

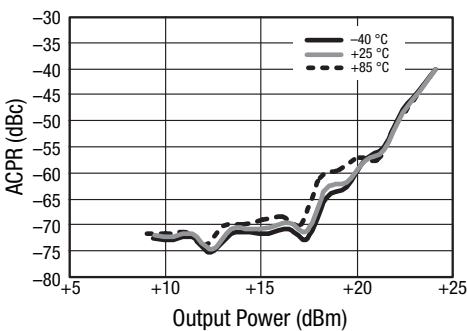


Figure 32. ACPR vs Output Power Over Temperature

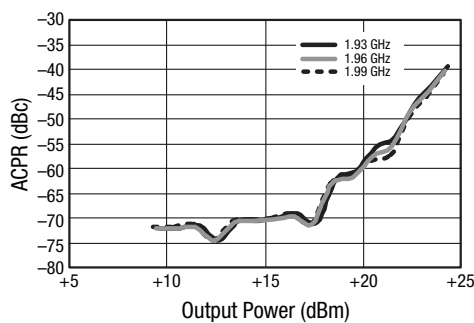
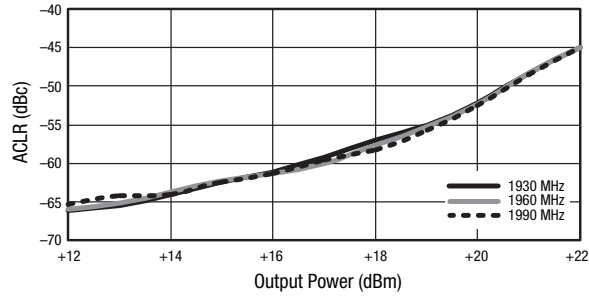


Figure 33. ACPR vs Output Power Over Frequency



**Figure 34. ACLR vs Output Power Over Frequency (WCDMA 3GPP, Test Model 1, 64 DPCH)**

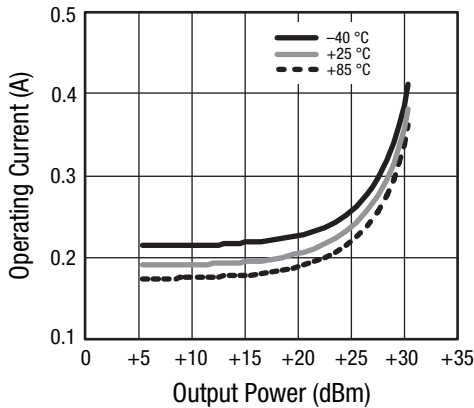
**Table 7. SKY65162-70LF Electrical Characteristics<sup>1</sup>**  
(VCC = +5 V, Tc = 25 °C, f = 2100 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		2110		2170	MHz
Small signal gain	IS211	Small signal	14.0	14.3		dB
Input return loss	IS111	Small signal	10	17		dB
Output return loss	IS221	Small signal	10	20		dB
1 dB output compression point	OP1dB	CW	+28.5	+29.0		dBm
Third order output intercept point	OIP3	P <sub>OUT</sub> = +10 dBm	+42.0	+43.5		dBm
Noise figure	NF			4.6	5.0	dB
Operational current	I <sub>OP</sub>	@ P1dB = +29.5 dBm		375	400	mA
Quiescent current	I <sub>CO</sub>	No RF		188		mA

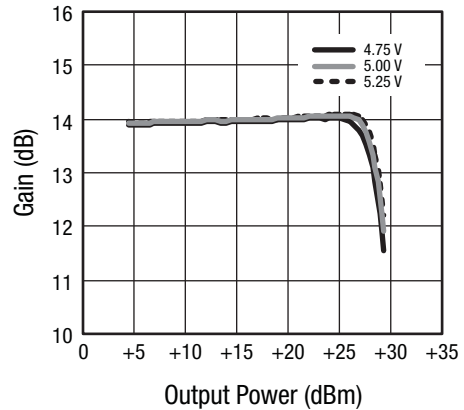
<sup>1</sup> Performance shown in this table is verified by characterization and is not guaranteed by production test.

### Typical Performance Characteristics

(VCC = +5 V, Tc = 25 °C, f = 2100 MHz, Unless Otherwise Noted)



**Figure 35. Operating Current vs Output Power Over Temperature**



**Figure 36. Gain vs Output Power Over Voltage**

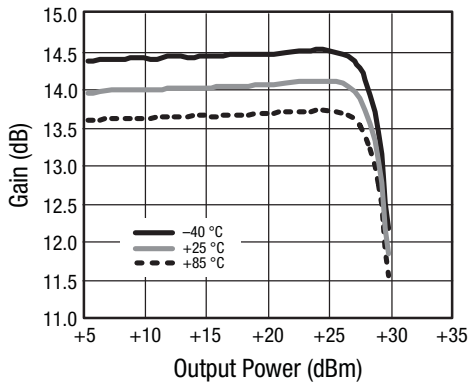


Figure 37. Gain vs Output Power Over Temperature

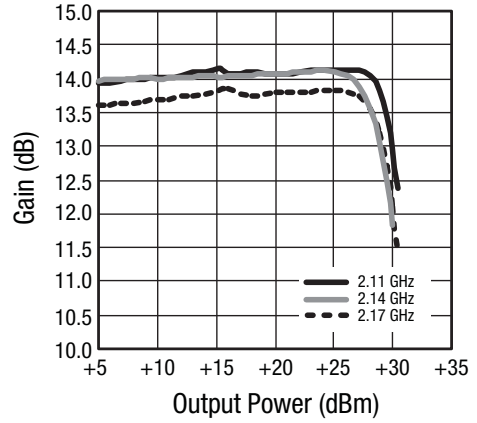


Figure 38. Gain vs Output Power Over Frequency

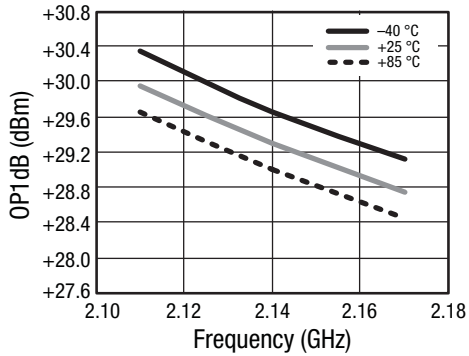


Figure 39. OP1dB vs Frequency Over Temperature

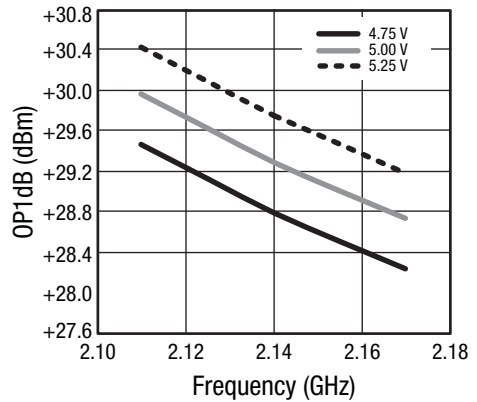


Figure 40. OP1dB vs Frequency Over Voltage

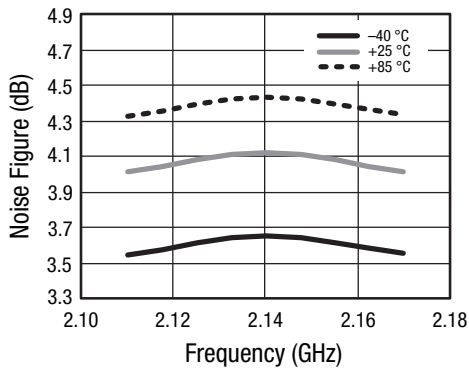


Figure 41. Noise Figure vs Frequency Over Temperature

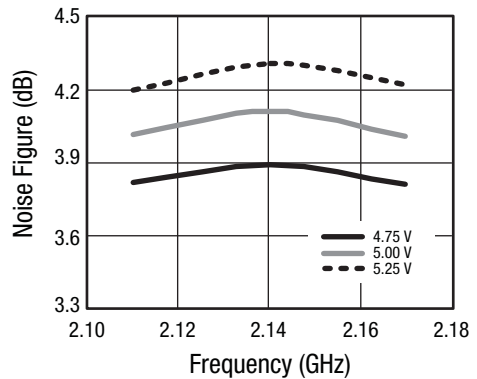


Figure 42. Noise Figure vs Frequency Over Voltage

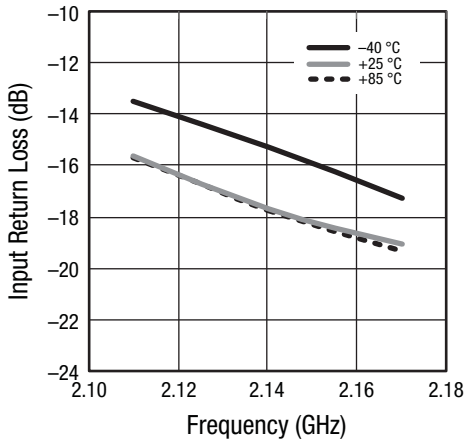


Figure 43. Input Return Loss vs Frequency Over Temperature

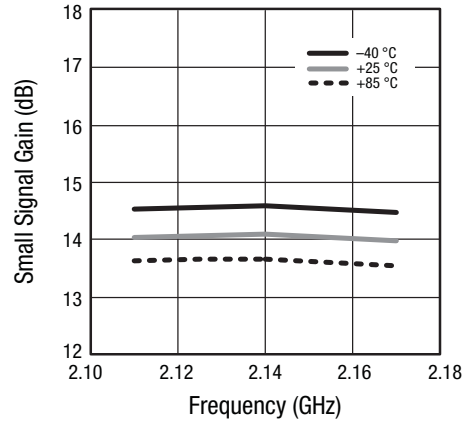


Figure 44. Small Signal Gain vs Frequency Over Temperature

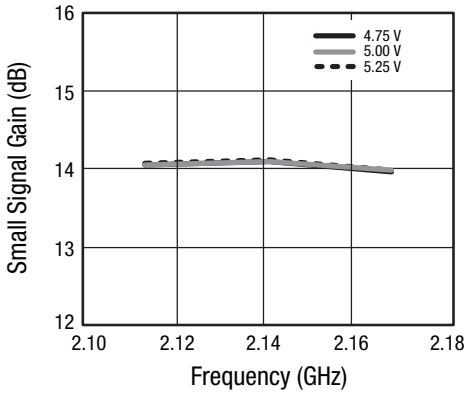


Figure 45. Small Signal Gain vs Frequency Over Voltage

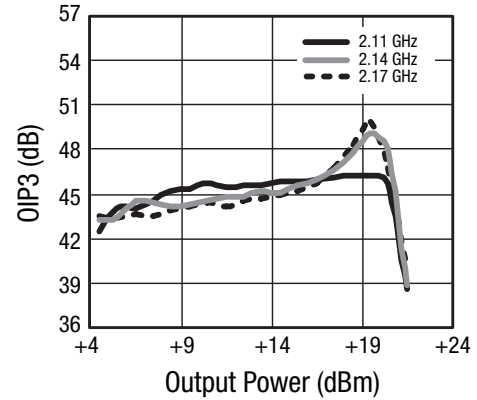


Figure 46. OIP3 vs Output Power Over Frequency

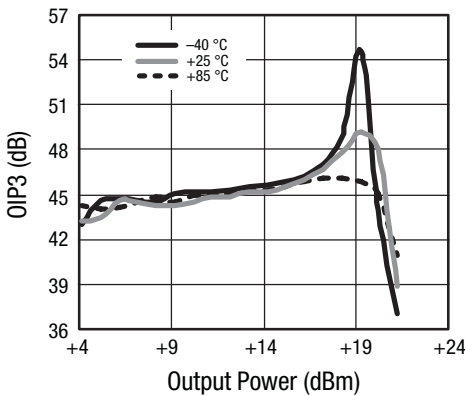


Figure 47. OIP3 vs Output Power Over Temperature

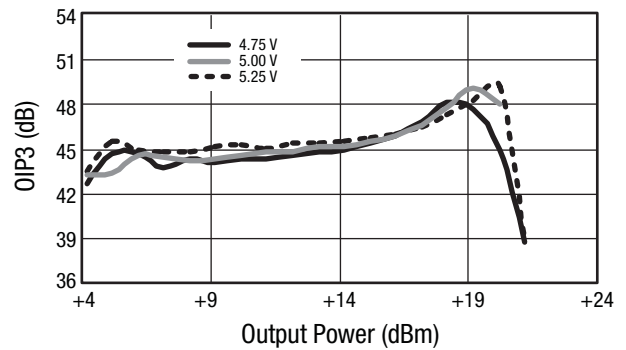


Figure 48. OIP3 vs Output Power Over Voltage

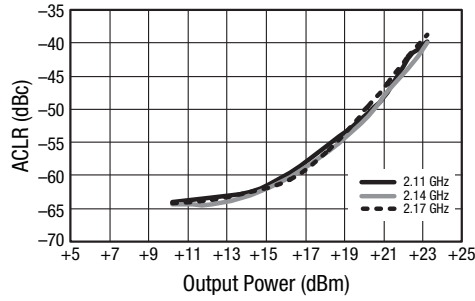


Figure 49. ACLR vs Output Power Over Frequency

Table 8. SKY65162-70LF Electrical Characteristics<sup>1</sup>  
(VCC = +5 V, Tc = 25 °C, f = 2400 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		2300		2500	MHz
Small signal gain	IS21	Small signal	12.5	13.0		dB
Input return loss	IS11	Small signal	17	20		dB
Output return loss	IS22	Small signal	15	20		dB
Reverse transmission loss	IS12	Small signal	17	21		dB
1 dB output compression point	OP1dB	CW	+29.0	+29.5		dBm
Third order output intercept point	OIP3		+44	+45		dBm
Output power	POUT	802.11g, 64 QAM, 54 Mbps, 3% EVM		+22		dBm
Noise figure	NF			4.4	5.0	dB
Operational current	IOP	@ P1dB = +30 dBm		401	480	mA
Quiescent current	ICQ	No RF		188		mA

<sup>1</sup> Performance shown in this table is verified by characterization and is not guaranteed by production test.

**Typical Performance Characteristics**  
(VCC = +5 V, Tc = 25 °C, f = 2400 MHz, Unless Otherwise Noted)

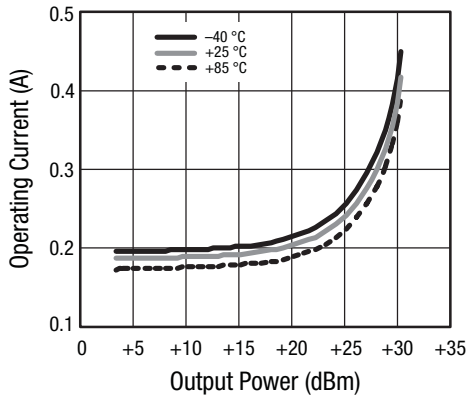


Figure 50. Operating Current vs Output Power Over Temperature

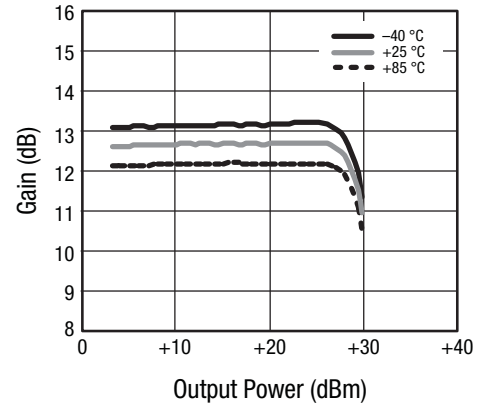


Figure 51. Gain vs Output Power Over Temperature

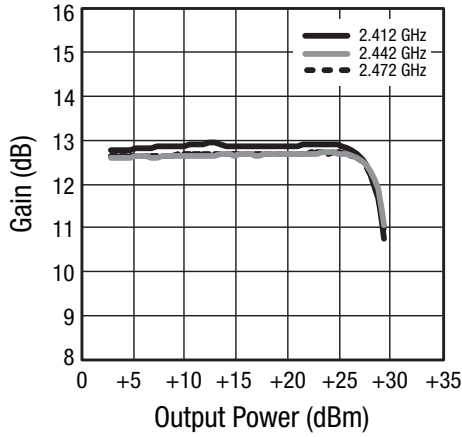


Figure 52. Gain vs Output Power Over Frequency

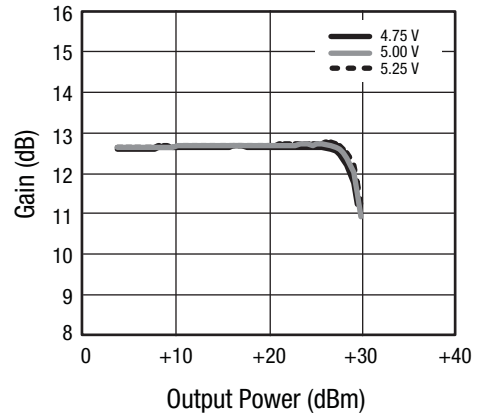


Figure 53. Gain vs Output Power Over Voltage

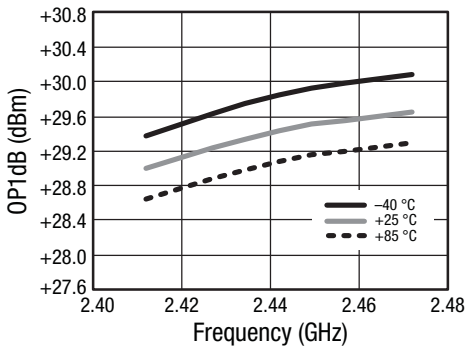


Figure 54. OP1dB vs Frequency Over Temperature

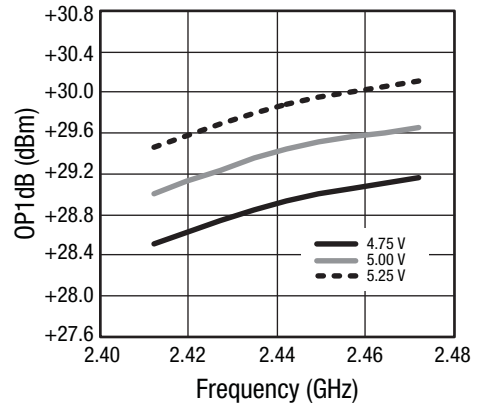


Figure 55. OP1dB vs Frequency Over Voltage

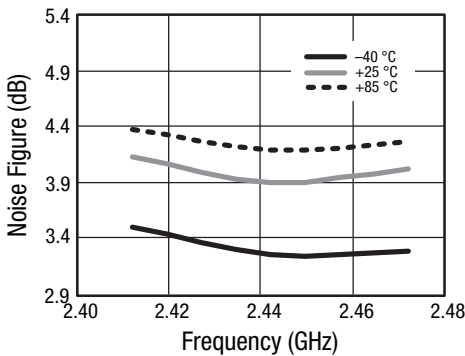


Figure 56. Noise Figure vs Frequency Over Temperature

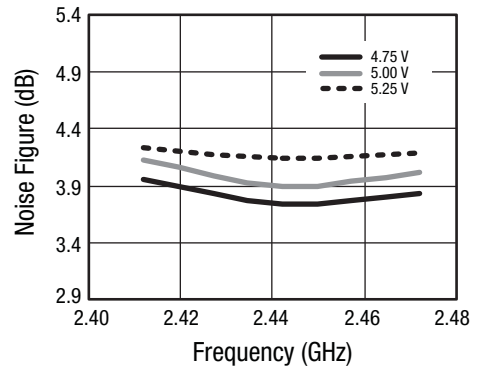


Figure 57. Noise Figure vs Frequency Over Voltage



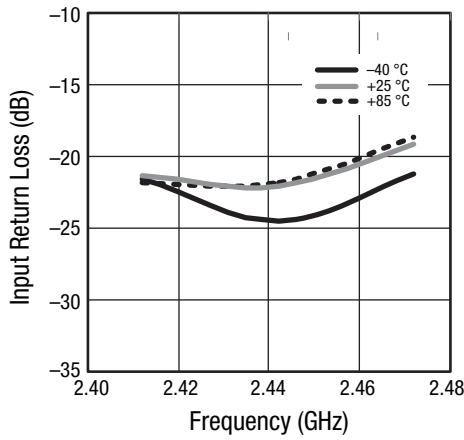


Figure 58. Input Return Loss vs Frequency Over Temperature

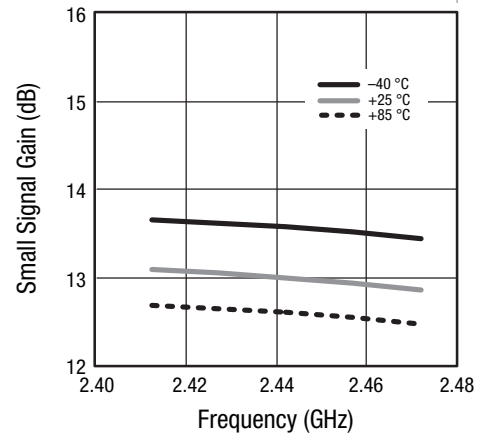


Figure 59. Small Signal Gain vs Frequency Over Temperature

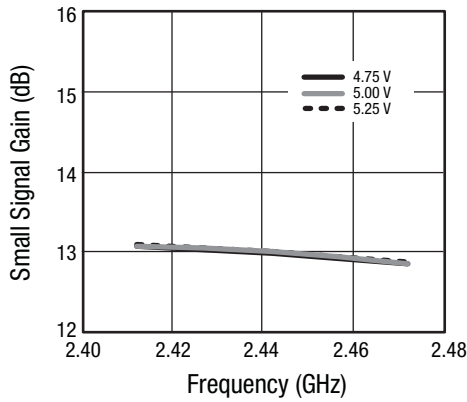


Figure 60. Small Signal Gain vs Frequency Over Voltage

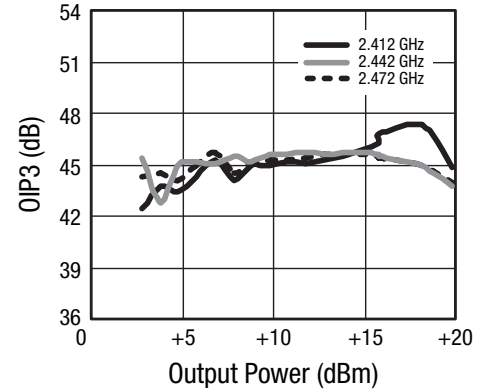


Figure 61. OIP3 vs Output Power Over Frequency

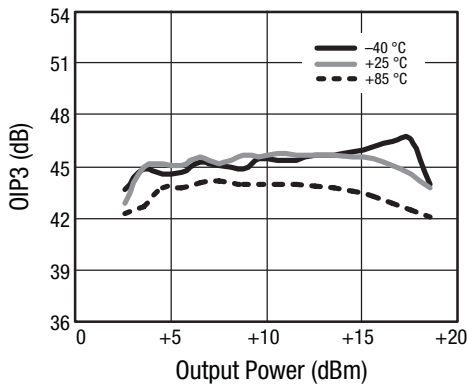


Figure 62. OIP3 vs Output Power Over Temperature

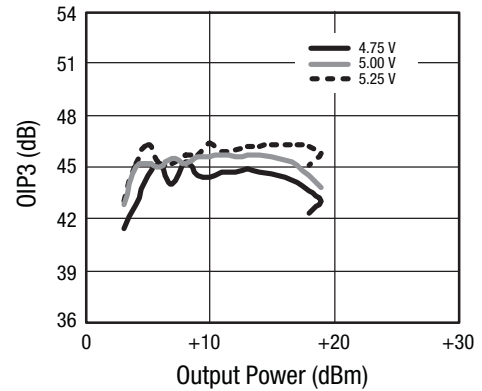
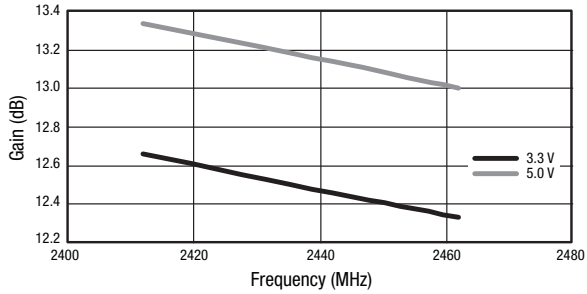
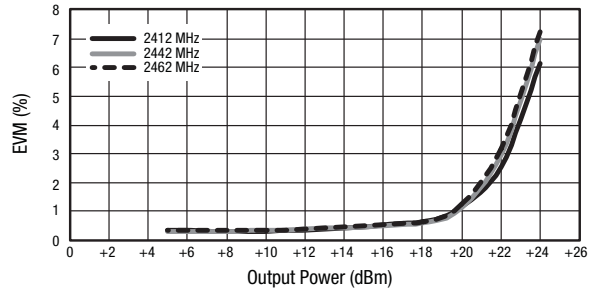


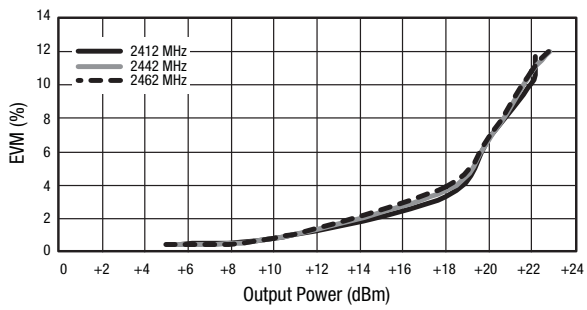
Figure 63. OIP3 vs Output Power Over Voltage



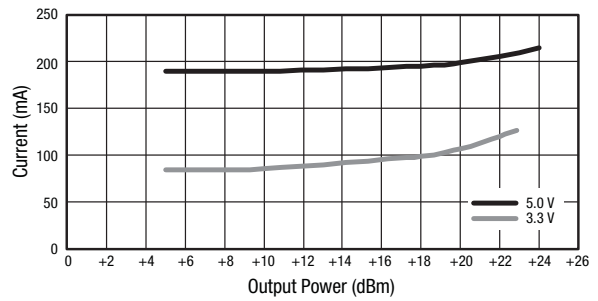
**Figure 64. Gain vs Frequency Over Voltage (802.11g, 64 QAM, 54 Mbps, OFDM)**



**Figure 65. EVM vs Output Power Over Frequency (802.11g, 64 QAM, 54 Mbps, OFDM)**



**Figure 66. EVM vs Output Power Over Frequency (802.11g, 64 QAM, 54 Mbps, OFDM, Vcc = 3.3 V)**



**Figure 67. Operating Current vs Output Power Over Voltage (802.11g, 64 QAM, 54 Mbps, OFDM)**

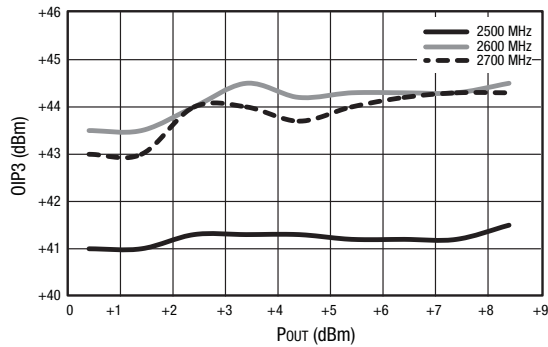
**Table 9. SKY65162-70LF Electrical Characteristics<sup>1</sup>**  
**(VCC = +5 V, Tc = 25 °C, f = 2600 MHz, Unless Otherwise Noted)**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		2500	2600	2700	MHz
Small signal gain	S21	Small signal		12.7		dB
Input return loss	S11	Small signal		17		dB
Output return loss	S22	Small signal		22		dB
Reverse transmission loss	S12	Small signal		25		dB
1 dB output compression point	OP1dB	CW		+29.6		dBm
Saturated output power	PSAT			+30.4		dBm
Saturation current	ISAT	@ PSAT = +30.4 dBm		428		mA
Third order output intercept point	OIP3	POUT = +5 dBm		+44		dBm
Noise figure	NF			3.8		dB
Operating current	IOP	@ P1 dB = +29.6 dBm		330		mA
Quiescent current	ICQ	No RF		188		mA

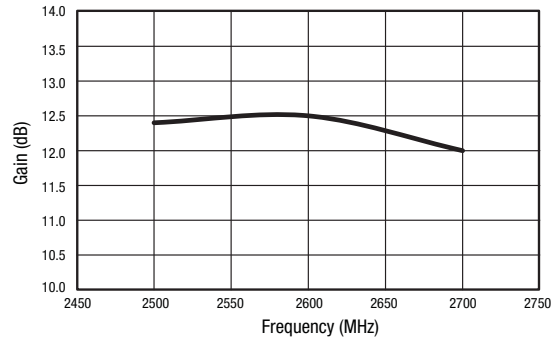
<sup>1</sup> Performance shown in this table is verified by characterization and is not guaranteed by production test.

### Typical Performance Characteristics

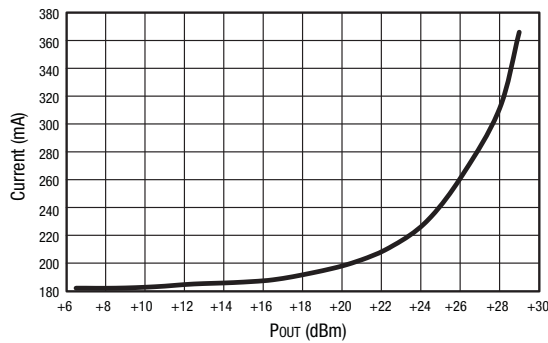
(VCC = +5 V, Tc = 25 °C, f = 2600 MHz, Unless Otherwise Noted)



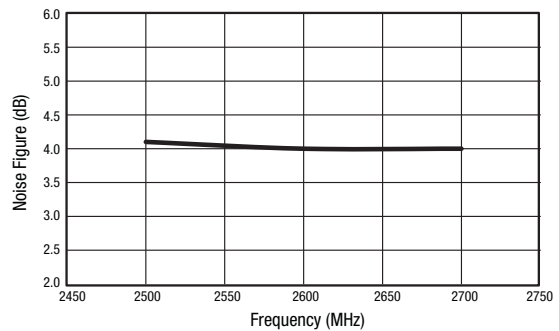
**Figure 68. OIP3 vs Pout @ 2700 MHz**



**Figure 69. Gain vs Frequency @ 2600 MHz**



**Figure 70. Current vs Pout @ 2600 MHz**



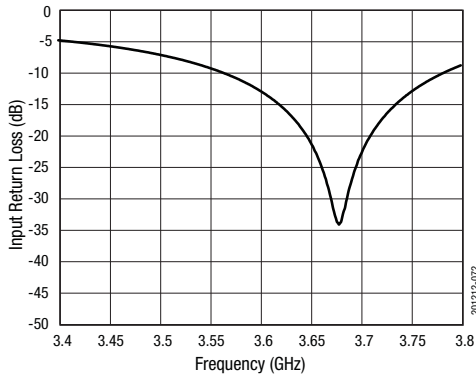
**Figure 71. Noise Figure vs Frequency @ 2600 MHz**

**Table 10. SKY65162-70LF Electrical Characteristics<sup>1</sup>**  
**(VCC = +5.5 V, Tc = 25 °C, f = 3600 MHz, Unless Otherwise Noted)**

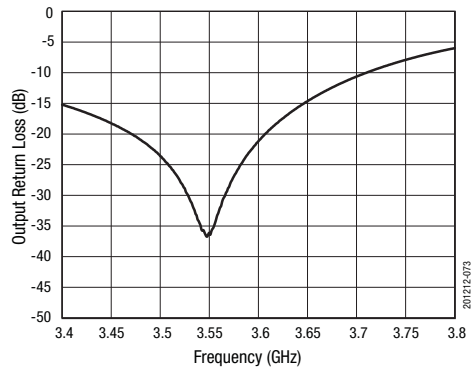
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		3400	3600	3800	MHz
Small signal gain	S21	Small signal		9.5		dB
Input return loss	S11	Small signal		12		dB
Output return loss	S22	Small signal		18		dB
Reverse transmission loss	S12	Small signal		23		dB
1 dB output compression point	OP1dB	CW		+28.7		dBm
Saturated output power	PSAT			+31.0		dBm
Saturation current	ISAT	@ PSAT = +31.0 dBm		720		mA
Third order output intercept point	OIP3	POUT = +10 dBm		+42		dBm
Noise figure	NF			5.0		dB
Operating current	IOP	@ P1dB = +28.7 dBm		425		mA
Quiescent current	ICQ	No RF (VCC = 5.5 V)		200		mA

<sup>1</sup> Performance shown in this table is verified by characterization and is not guaranteed by production test.

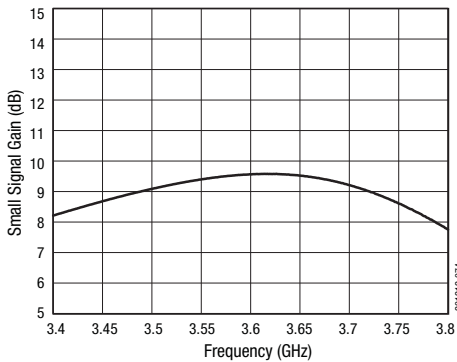
**Typical Performance Characteristics**  
**(VCC = +5.5 V, Tc = 25 °C, f = 3600 MHz, Unless Otherwise Noted)**



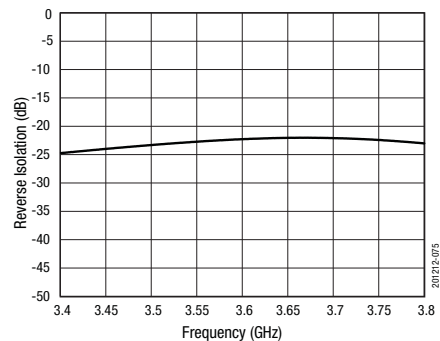
**Figure 72. Input Return Loss vs Frequency**



**Figure 73. Output Return Loss vs Frequency**



**Figure 74. Small Signal Gain vs Frequency**



**Figure 75. Reverse Isolation vs Frequency**

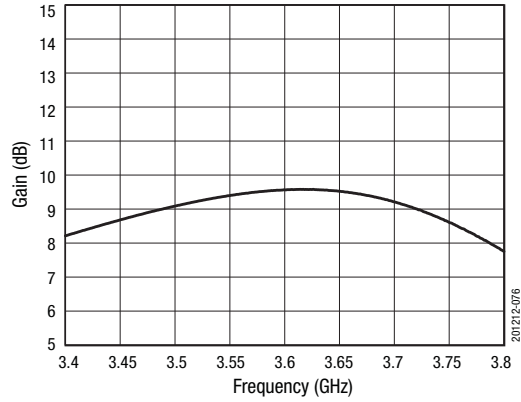


Figure 76. Gain vs Frequency

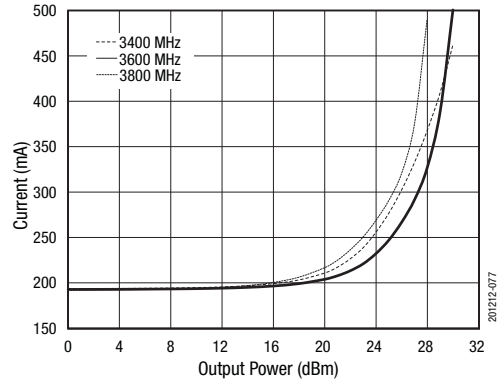


Figure 77. Current vs Output Power

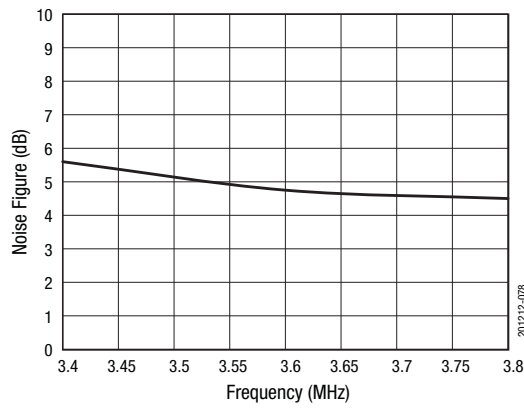


Figure 78. Noise Figure vs Frequency

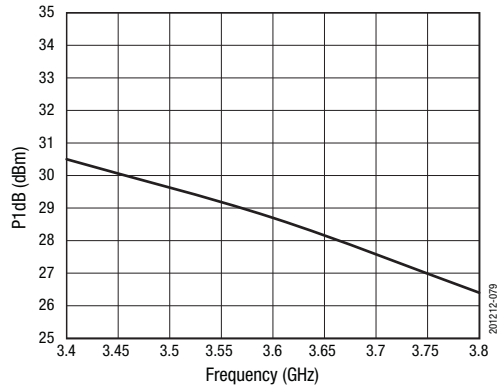


Figure 79. P1dB vs Frequency

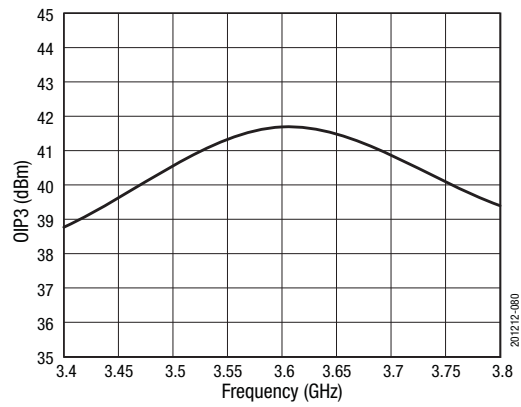


Figure 80. OIP3 vs Frequency  
( $P_{out} = +10$  dBm/tone)

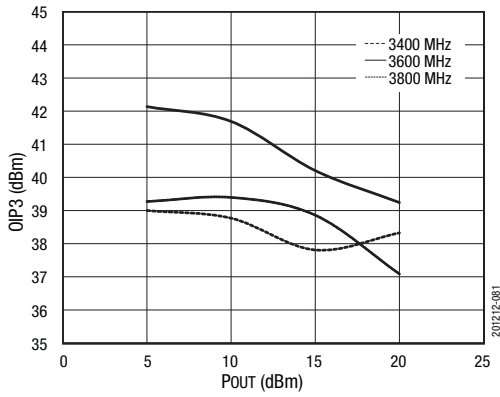


Figure 81. OIP3 vs Pout

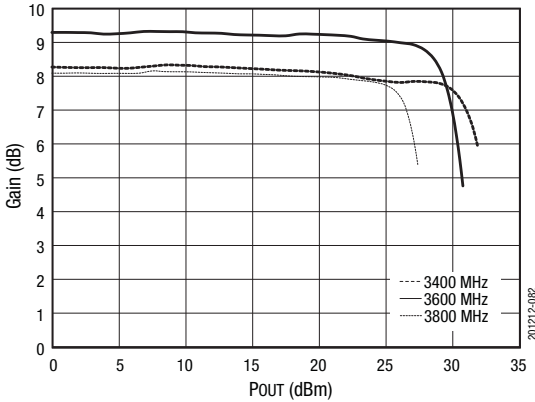


Figure 82. Gain vs Pout

## Evaluation Board Description

The Skyworks SKY65162-70LF Evaluation Board is used to test the performance of the SKY65162-70LF PA driver. An assembly drawing for the Evaluation Board is shown in Figure 83 and the layer detail is provided in Figure 84. The layer detail physical characteristics are noted in Figure 85.

Capacitors C7, C8, and C9 provide DC bias decoupling for VCC. Pins 1 and 3 are the RF input and output signals, respectively. External DC blocking is required on the input and output, but can be implemented as part of the RF matching circuit. Pin 2 and the package backside metal, pin 4, are ground pins that provide the DC and RF ground, respectively.

## Testing Procedure

Use the following procedure to set up the SKY65162-70LF Evaluation Board for testing:

1. Connect a 5.0 V supply to VCC. If available, enable the current limiting function of the power supply to 400 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.

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**CAUTION:** *If any of the output signals exceed the rated maximum values, the SKY65162-70LF Evaluation Board can be permanently damaged.*

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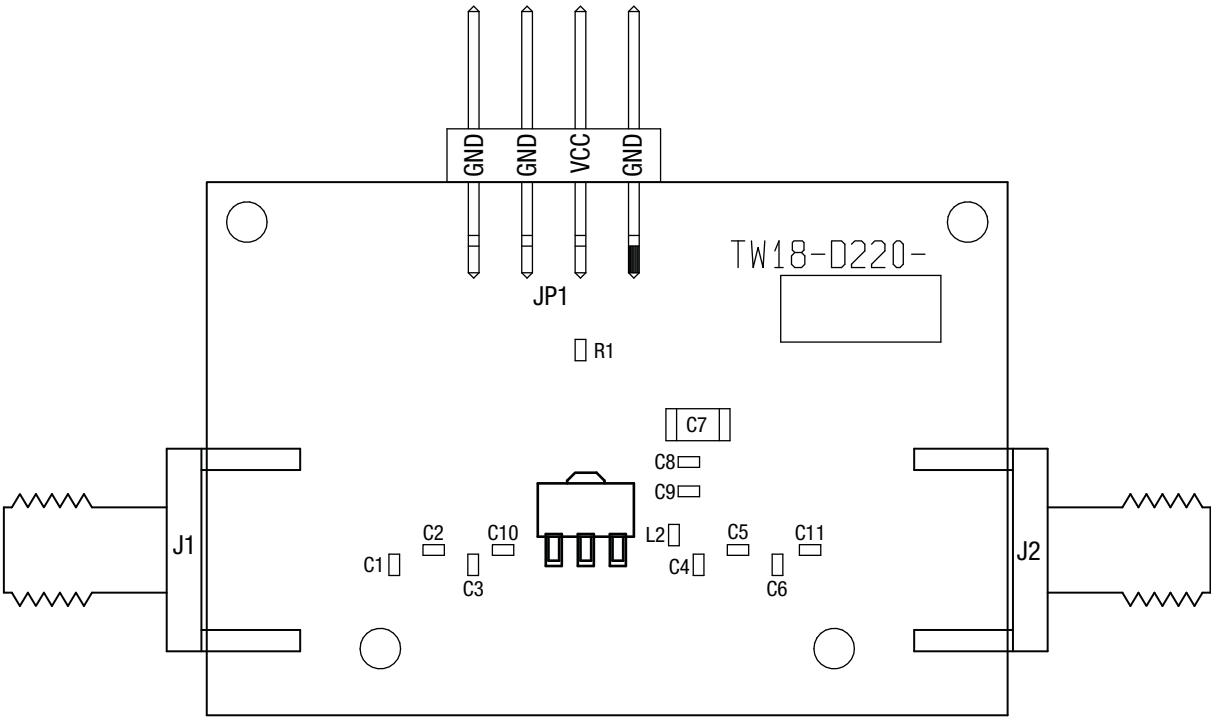
## Circuit Design Configurations

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 ground pad of the SKY65162-70LF 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.*

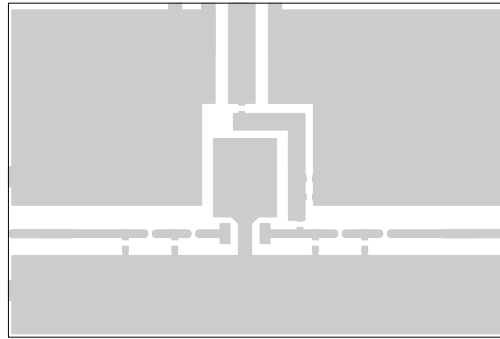
A suggested matching circuit is shown in Figure 86. Component values for the SKY65162-70LF Evaluation Board are shown in Table 11.



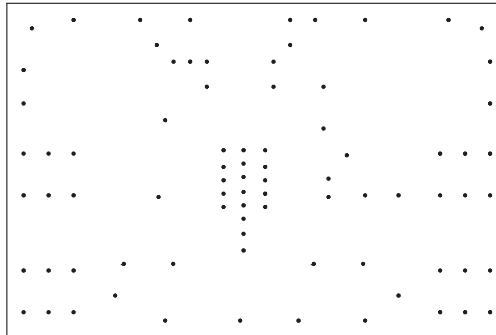
S1886

Figure 83. Evaluation Board Assembly Drawing

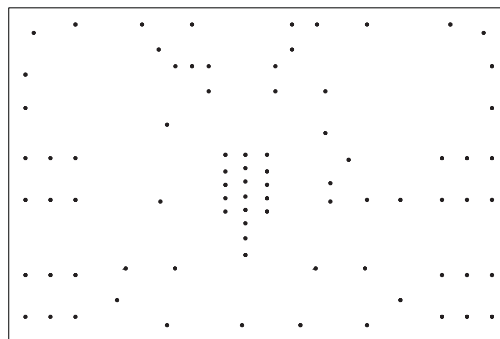




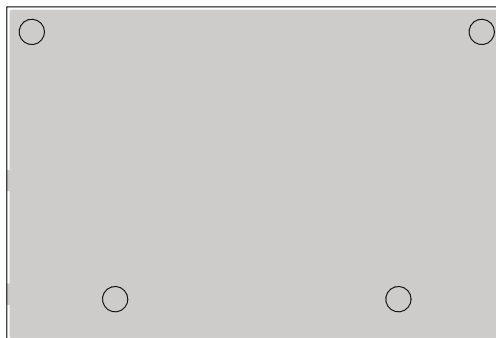
Layer 1: Top – Metal



Layer 2: Ground



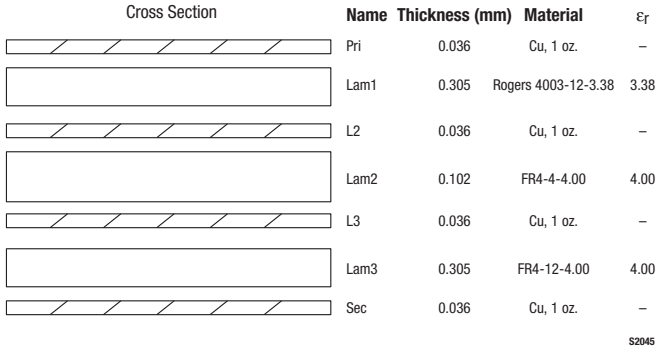
Layer 3: Ground



Layer 4: Solid Ground Plane

S2056

**Figure 84. Evaluation Board Layer Detail**



**Figure 85. Layer Detail Physical Characteristics**