

PRELIMINARY DATA SHEET

SKY65238: Power Amplifier Module With Integrated BAW Filter for WLAN Applications


Applications

- IEEE802.11 b/g/n WLAN
 - Access points and routers
 - Set top boxes, gaming consoles, and other home entertainment devices (including video, voice, and data “triple play” devices)

Features

- High gain of 30 dB
- EVM (64 QAM OFDM): 3% @ +25 dBm
- Supply voltage: 5 V
- Integrated output power detector with ± 0.5 dB accuracy
- Output power detector with 20 dB dynamic range
- Sharp rejection near bandwidth edges meets FCC restricted band emissions
- Internal RF match and bias circuits
- Superior gain flatness
- Small footprint, MCM (20-pin, 6 x 6 mm) Pb-free (MSL3, 250 °C per JEDEC J-STD-020) SMT package

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

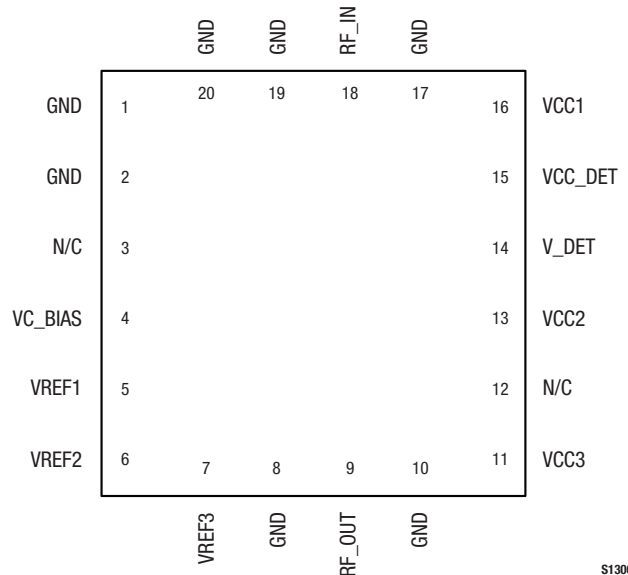


Description

Skyworks SKY65238 is a Power Amplifier Module (PAM) with integrated Bulk Acoustic Wave (BAW) filtering technology. The device provides high output power, linearity, and gain across the entire bandwidth. These features make the SKY65238 ideal for 802.11 b/g/n Wireless Local Area Networks (WLANs) transmitting video, voice, and data.

The device is fabricated using Skyworks highly reliable Indium Gallium Phosphide (InGaP) Heterojunction Bipolar Transistor (HBT) technology. The PAM integrates three-stage power amplifiers, a BAW filter, and a power detector into a small, 20-pin, 6 x 6 mm Multi-Chip Module (MCM).

The device package and pinout for the 20-pin MCM are shown in Figure 1. A block diagram of the SKY65238 is shown in Figure 2.



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Figure 1. SKY65238 Pinout – 20-Pin MCM (Top View)

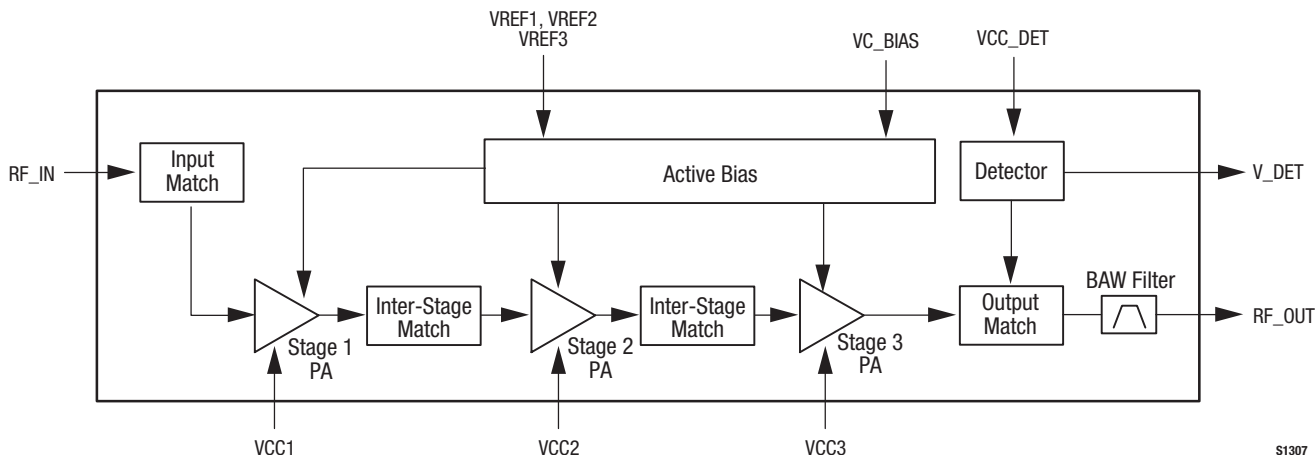


Figure 2. SKY65238 Block Diagram

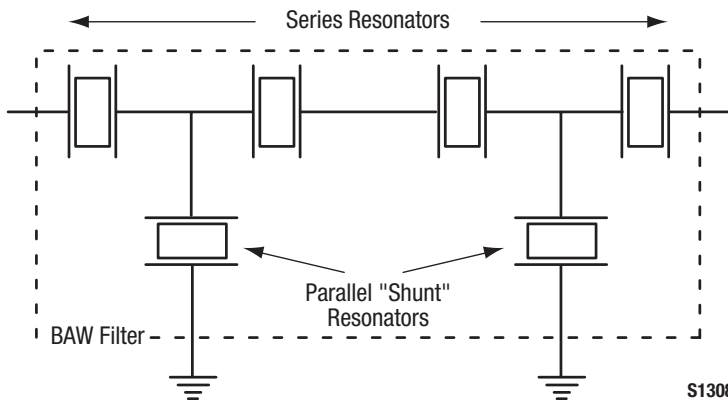


Figure 3. Typical BAW Filter "Ladder" Network

Technical Description

The SKY65238 PAM contains all of the needed RF matching, BAW filtering, and DC biasing circuits. The device also provides an output power detector voltage.

The SKY65238 is a three-stage, HBT InGaP device optimized for high linearity and power efficiency. These features make the device suitable for WLAN applications where power amplifier linearity and power consumption are of critical importance.

BAW Filter

The BAW filter uses very low loss electromechanical resonators to perform highly selective RF filtering. A BAW filter is formed by cascading both series and shunt resonators in a ladder configuration as shown in Figure 3.

The series and shunt resonators have slightly different resonant frequencies. Together, they form a bandpass with steep near-band roll off. The impedance, band shape, insertion loss, and the

out of band rejection of the filter are determined by optimizing the properties of the various resonators.

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY65238 is rated to Moisture Sensitivity Level 3 (MSL3) at 250 °C. It can be used for lead or lead-free soldering. For additional information, refer to Skyworks Application Note, *PCB Design and SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format. For packaging details, refer to the Skyworks Application Note, *Tape and Reel*, document number 101568.

Figure 13 provides a typical evaluation board schematic. An assembly drawing for the Evaluation Board is shown in Figure 14 and the layer detail is provided in Figure 15. Package dimensions for the 20-pin MCM are shown in Figure 16, and tape and reel dimensions are provided in Figure 17.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SKY65238 are provided in Table 2. Electrical specifications are provided in Table 3. Typical performance characteristics are illustrated in Figures 4 through 12.

Electrostatic Discharge (ESD) Sensitivity

The SKY65238 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

Table 1. SKY65238 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	GND	Ground	11	VCC3	Stage 3 collector voltage
2	GND	Ground	12	N/C	No connection
3	N/C	No connection	13	VCC2	Stage 2 collector voltage
4	VC_BIAS	Bias voltage	14	V_DET	Detector output signal
5	VREF1	Bias reference voltage 1	15	VCC_DET	Detector supply voltage
6	VREF2	Bias reference voltage 2	16	VCC1	Stage 1 collector voltage
7	VREF3	Bias reference voltage 3	17	GND	Ground
8	GND	Ground	18	RF_IN	RF input
9	RF_OUT	RF output	19	GND	Ground
10	GND	Ground	20	GND	Ground

Table 2. SKY65238 Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
RF output power	P _{OUT}		27	dBm
Supply voltage, measured at pin of package (Note 2)	VREF1, VREF2, VREF3, and VCC_DET		4	V
Collector and bias voltage	VCC1, VCC2, VCC3, and VC_BIAS		6	V
Total supply current (I _{CC} + I _{BIAS} + I _{REF})	I _{CC_TOTAL}		800	mA
Power dissipation			3.0	W
Case operating temperature	T _C	-40	+85	°C
Storage temperature	T _{ST}	-55	+125	°C
Junction temperature (Note 3)	T _J		+150	°C

Note 1: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value.

Note 2: Evaluation Board supply voltage levels can be different. Refer to the Evaluation Board schematic diagram in Figure 12.

Note 3: Thermal resistance (junction to center ground pad) is 20 °C/W minimum and 23 °C/W maximum.

Table 3. SKY65238 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
RF input power	P _{IN}			-6	dBm
Supply voltage, measured at pin of package	VREF1, VREF2, and VREF3	2.3	2.5	2.7	V
	VCC_DET	3.3	3.6	3.9	V
	VCC1, VCC2, VCC3, and VC_BIAS	4.5	5.0	5.5	V
Case operating temperature	T _C	-40		+85	°C
Storage temperature	T _{ST}	-55		+125	°C

Table 4. SKY65238 Electrical Specifications (1 of 2)
(VCC1, VCC2, VCC3, VREF1, VREF2, VREF3, VCC_DET, and VC_BIAS = 5 V at the Evaluation Board Terminals, T_C = +25 °C, Test Frequency = 2.442 GHz Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Using IEEE802.11b Complimentary Code Keying Input Signal, Data Rate = 11 Mbps						
Total supply current	I _{CC_TOTAL}			1150		mA
Output power (Note 1)	P _{OUT}			+27		dBm
Power added efficiency (Note 2)	PAE			25		%
Ramp-up/ramp-down (Note 3)	T _S			<0.5		µs
Using IEEE802.11g Orthogonal Frequency Division Multiplexing Input Signal, Data Rate = 54 Mbps						
Total supply current	I _{CC_TOTAL}			1050		mA
Output power (Note 4)	P _{OUT}			+27		dBm
Output power @ EVM = 3%	P _{OUT_EVM}			+22		dBm
Power added efficiency (Note 2)	PAE			22		%
Error Vector Magnitude	EVM	All power levels between +13 dBm and +22 dBm per IEEE802.11g @ 54 Mbps OFDM			3	%
Using Continuous Wave Input Signals						
Small signal gain	G	P _{IN} = -25 dBm		30		dB
Gain flatness over band		From 2.4 GHz to 2.5 GHz		±2		dB
Gain flatness over channel (16.25 MHz)		Over any 20 MHz within band		±1		dB
Output IP3	OIP3	P _{TONE} = +25 dBm, Delta_freq = 5 MHz		+40		dBm
Quiescent Current	I _Q	No RF input		420	460	mA
Noise Figure	NF			5	7	dB
Power detector dynamic range				20		dB
Power detector accuracy		Over temperature		±0.5		dB

Table 4. SKY65238 Electrical Specifications (2 of 2)
 (VCC1, VCC2, VCC3, VREF1, VREF2, VREF3, VCC_DET, and VC_BIAS = 5 V at the Evaluation Board Terminals, Tc = +25 °C,
 Test Frequency = 2.442 GHz Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
<i>Using Continuous Wave Input Signals (continued)</i>						
Lower passband frequency				2402		MHz
Upper passband frequency	F2			2472		MHz
Lower stopband attenuation		@ 2.39 GHz	10			dB
Upper stopband attenuation		@ 2.4835 GHz	10			dB
Second harmonic attenuation band			40			dB

Note 1: Defined as the maximum power level for which the IEEE802.11b transmit mask requirements are met.

Note 2: Measured at the specified average output RF power and modulation type.

Note 3: Ramp-up and ramp-down times are defined from the 10% to 90% power points.

Note 4: Defined as the maximum power level for which the IEEE802.11g transmit mask requirements are met.

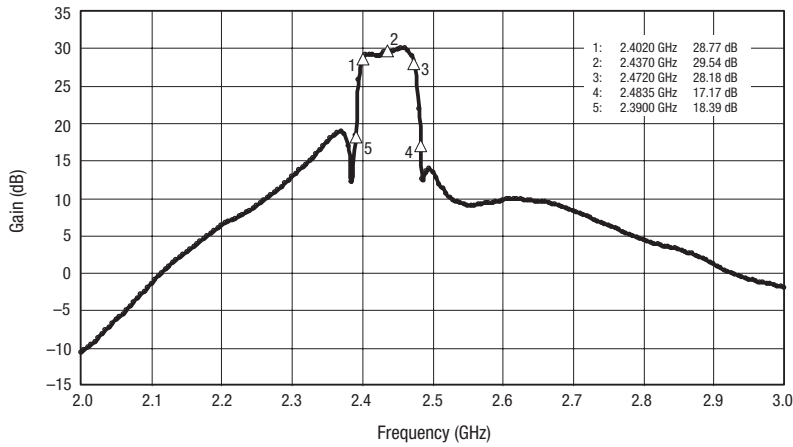


Figure 4. Gain Response

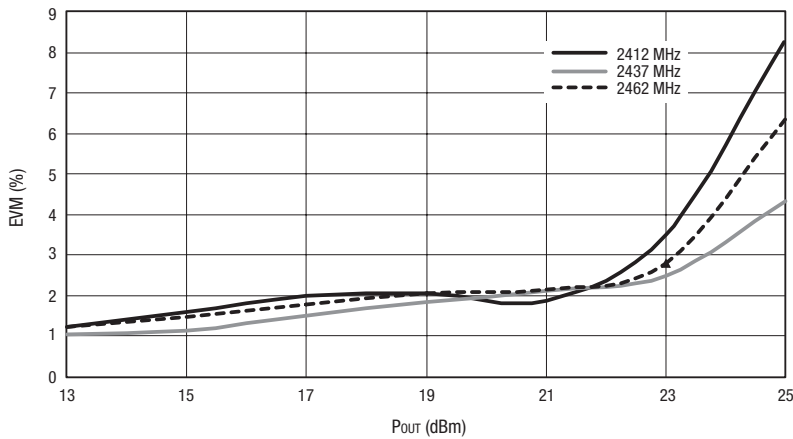


Figure 5. EVM vs Output Power Over Frequency

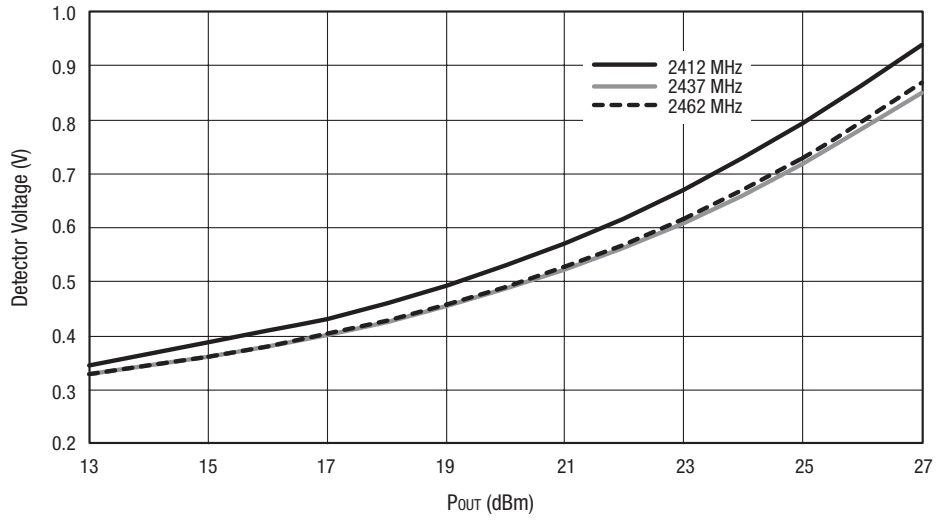


Figure 6. Detector Voltage vs Output Power Over Frequency

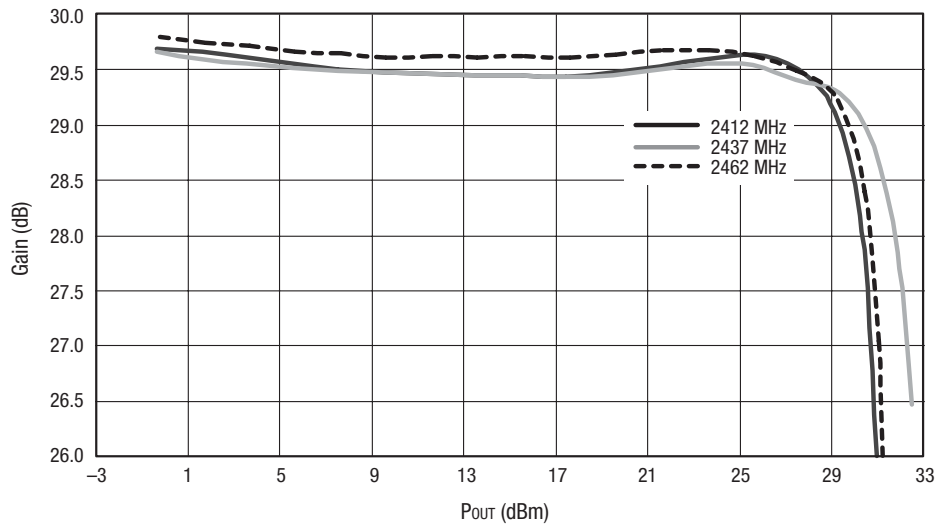


Figure 7. Typical Gain vs Output Power

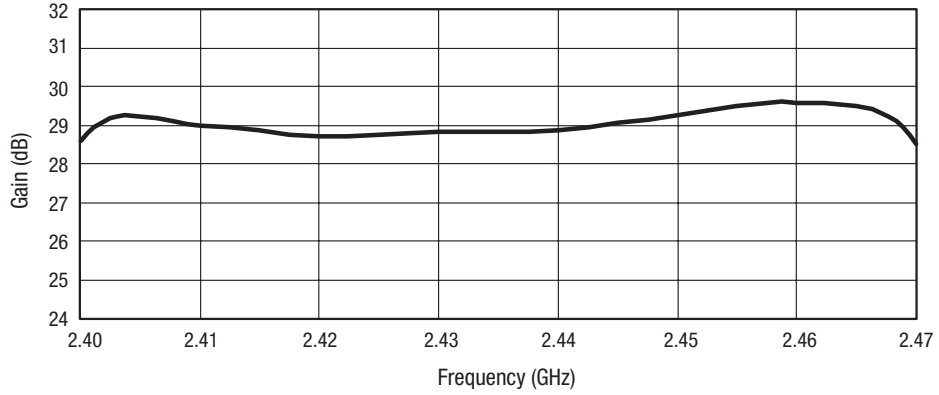


Figure 8. Gain vs Frequency

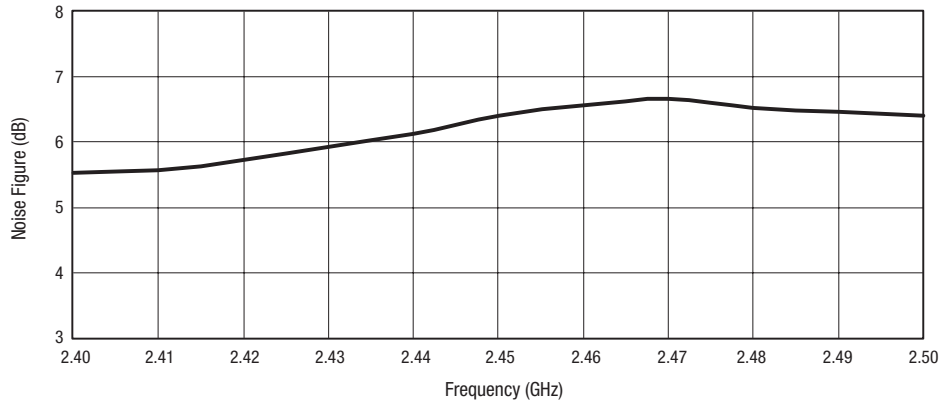


Figure 9. Typical Noise Figure vs Frequency

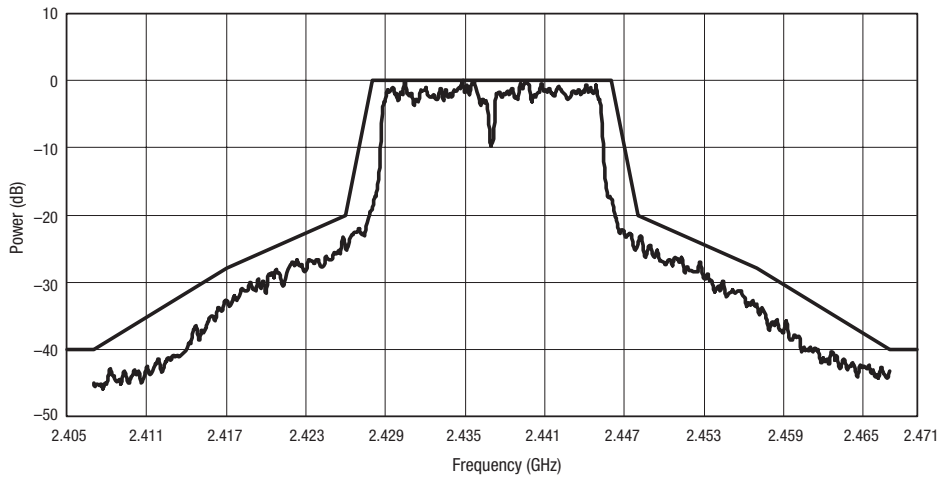


Figure 10. Output Spectrum Response for 802.11g Signal
(P_{out} = + 28 dBm)

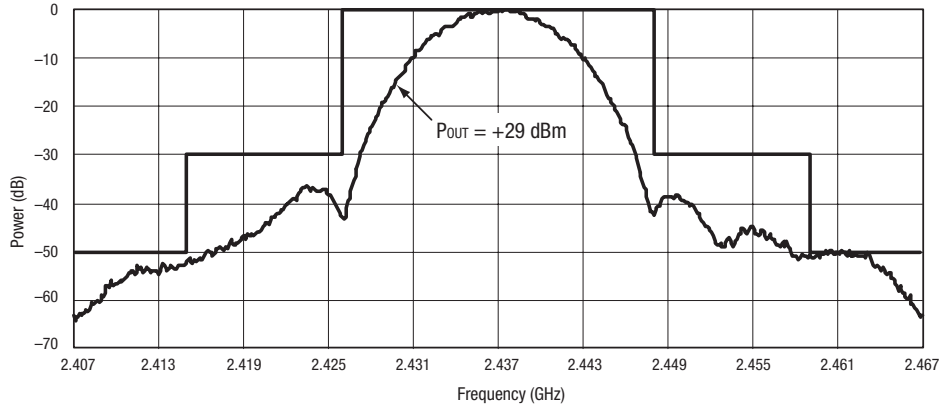


Figure 11. Output Spectrum Response for 802.11b CCK-Coded Signal (Pout = +29 dBm)

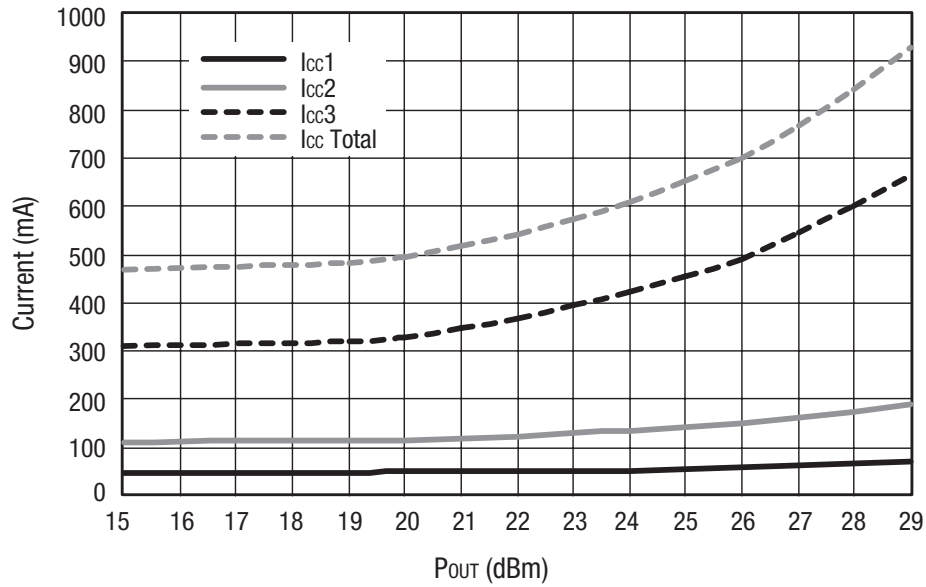
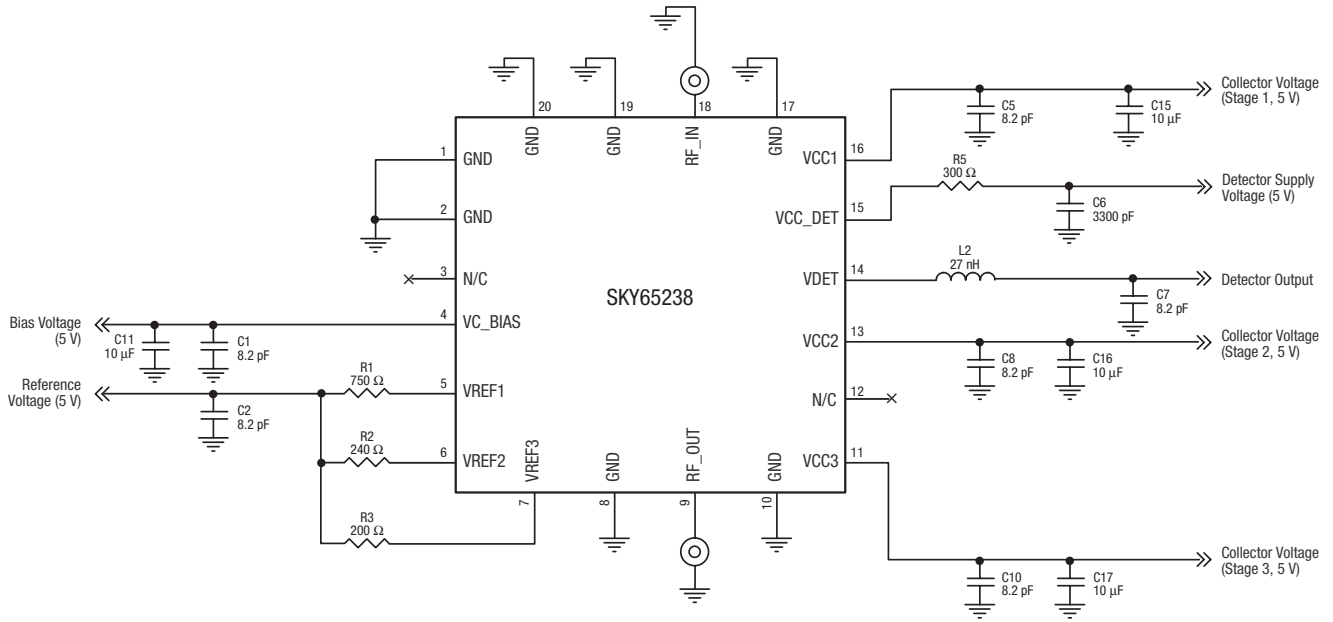


Figure 12. Individual Stage Currents and Total Current vs. RF Output Power

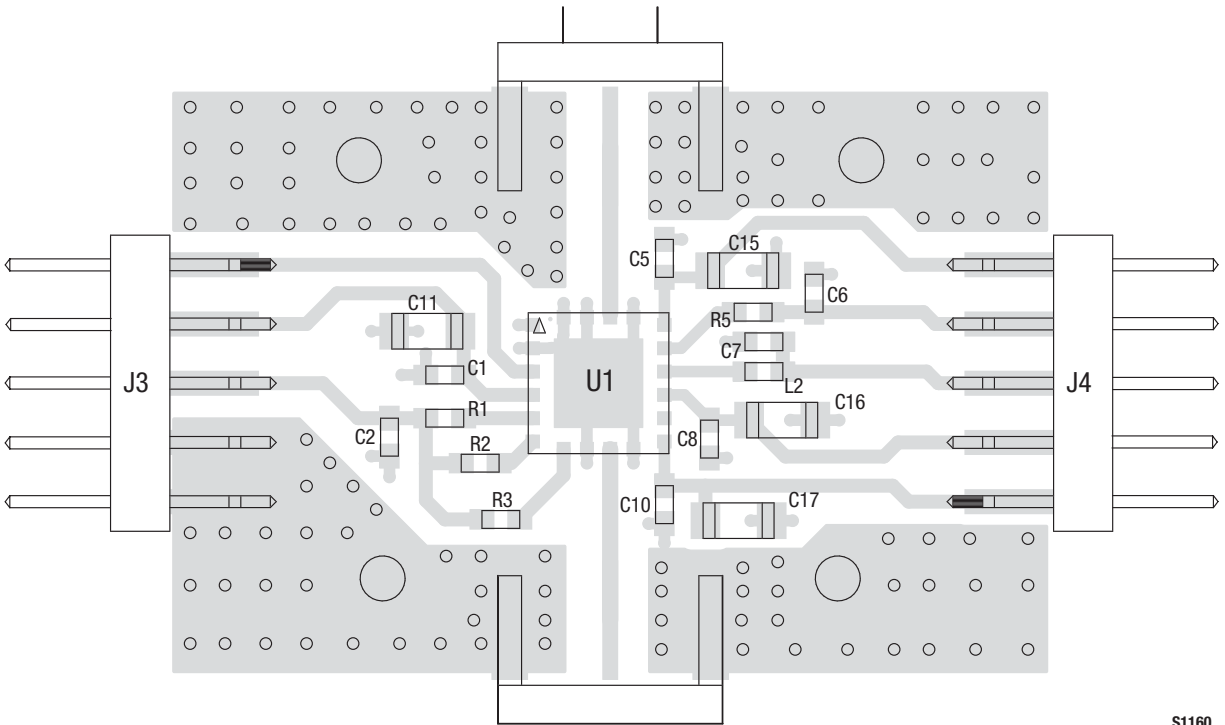


Note: Evaluation Board material: four-layer Rogers 4003-12, $\epsilon_r = 3.38$.

Some component labels may be different than the corresponding component symbol shown here. Component values, however, are accurate as of the date of this Data Sheet.

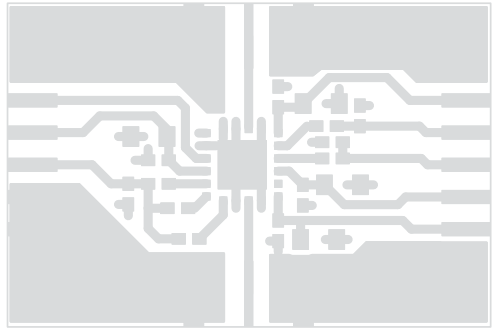
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Figure 13. SKY65238 Evaluation Board Schematic

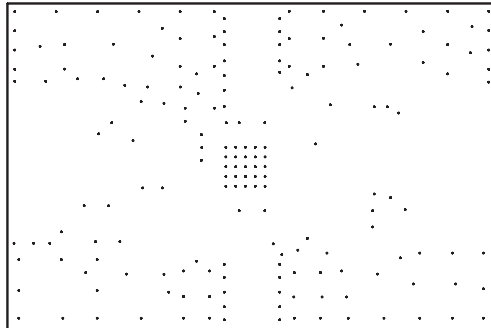


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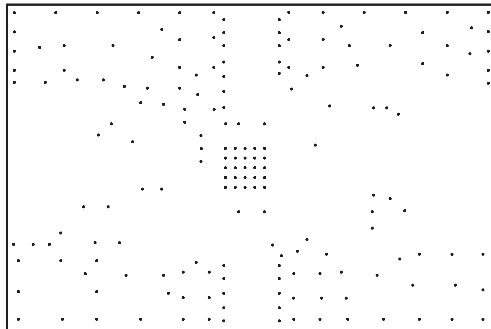
Figure 14. Evaluation Board Assembly Drawing



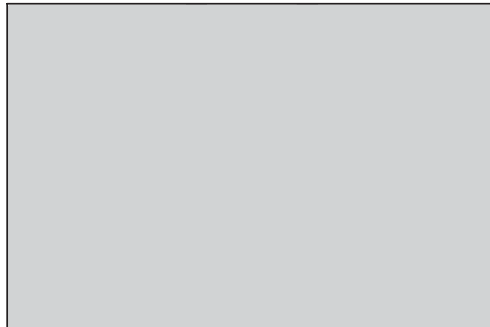
Layer 1: Top Metal



Layer 2: Ground



Layer 3: Inner Traces

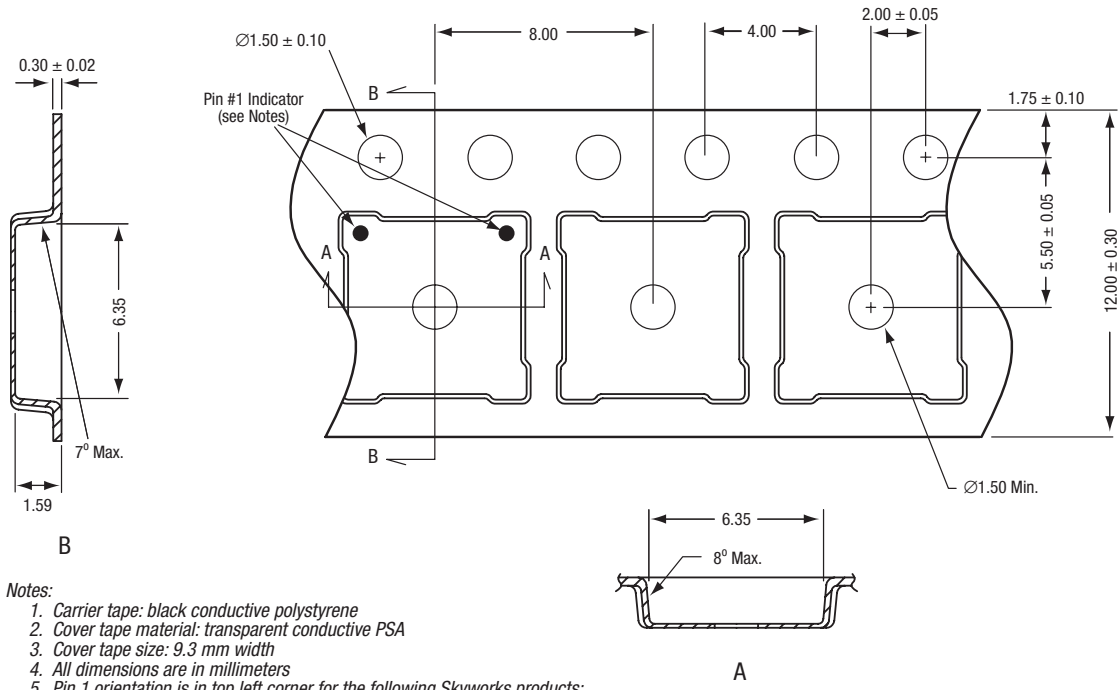


Layer 4: Ground

S1159

Figure 15. Evaluation Board Layer Detail

PRELIMINARY DATA SHEET • SKY65238 WLAN PAM WITH BAW FILTER



- Notes:
1. Carrier tape: black conductive polystyrene
 2. Cover tape material: transparent conductive PSA
 3. Cover tape size: 9.3 mm width
 4. All dimensions are in millimeters
 5. Pin 1 orientation is in top left corner for the following Skyworks products:

SKY73022-21, -31
SKY73023-21, -31

For all other 6 x 6 mm MCM/RFLGA products, pin 1 orientation is in top right corner.

S1183

Figure 17. SKY65238 20-Pin MCM Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY65238 WLAN Power Amplifier with BAW Filter	SKY65238-21 (Pb-free package)	TW16-D281

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