DATA SHEET

SKY77149 PA Module for CDMA / PCS (1850–1910 MHz)

Applications

- Personal Communications Services (PCS)
- Wireless Local Loop (WLL)

Features

- Low voltage positive bias supply
  - 3.2 V to 4.2 V
- Low VREF
  - 2.85 V, nominal
- Low IREF
  - less than 1 mA
- Good linearity
- High efficiency
- Large dynamic range
- 8-pin package
  - 3 x 3 x 1.2 mm
- Power down control
- Dynamic bias control
- InGaP
- IS95/CDMA2000/EVDO
- Full U.S. PCS coverage

NEW Skyworks offers lead (Pb)-free "environmentally friendly" packaging that is RoHS compliant (European Parliament for the Restriction of Hazardous Substances).

The SKY77149 System Smart™ Power Amplifier Module (PAM) is a fully matched 8-pin surface mount module developed for Code Division Multiple Access (CDMA) / Personal Communications Service (PCS) and Wireless Local Loop (WLL) applications. This small and efficient module packs full 1850–1910 MHz bandwidth coverage into a single compact package. The SKY77149 meets the stringent spectral linearity requirements of Code Division Multiple Access (CDMA) PCS transmission, with high power added efficiency for power output of up to 28 dBm. A low current pin (VCONT) is provided to improve efficiency for the low RF power range of operation.

The single Gallium Arsenide (GaAs) Microwave Monolithic Integrated Circuit (MMIC) contains all active circuitry in the module. The MMIC contains on-board bias circuitry, as well as input and interstage matching circuits. The output match is realized off-chip within the module package to optimize efficiency and power performance into a 50-ohm load. This device is manufactured with Skyworks' GaAs Heterojunction Bipolar Transistor (HBT) process that provides for all positive voltage DC supply operation while maintaining high efficiency and good linearity. Primary bias to the SKY77149 is supplied directly from a three-cell Ni-Cd, a single-cell Li-Ion, or other suitable battery with an output in the 3.2 to 4.2 volt range. Power down is accomplished by setting the voltage on the low current reference pin to zero volts. No external supply side switch is needed as typical "off" leakage is a few microamperes with full primary voltage supplied from the battery.

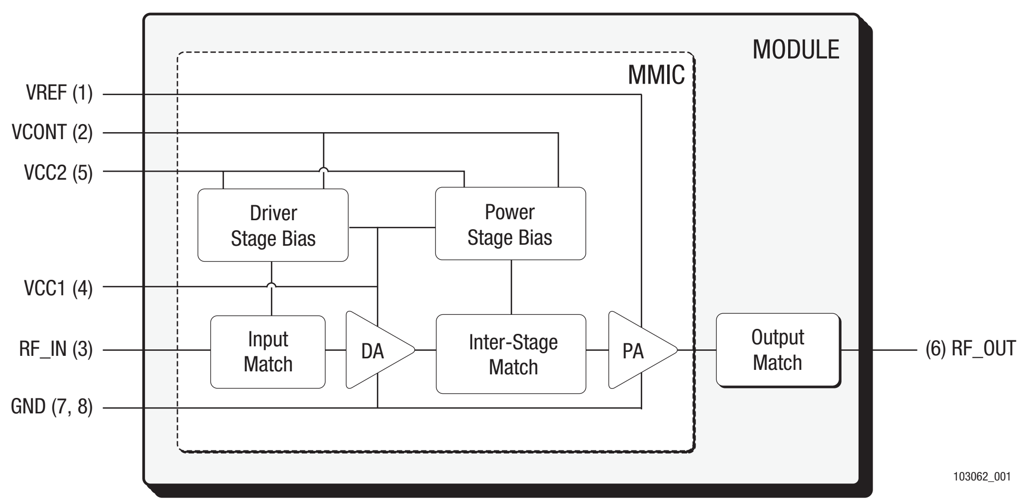


Figure 1. Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77149 Power Amplifier. Table 1 lists the absolute maximum ratings, while Table 2 shows the recommended operating conditions to achieve the performance characteristics listed in Table 4. Table 3 presents a truth table for the power settings.

Table 1. Absolute Maximum Ratings [1]

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
RF Input Power		P_{IN}	—	0	5	dBm
Supply Voltage		V_{CC}	—	3.4	6.0	Volts
Reference Voltage		V_{REF}	—	2.85	3.0	Volts
Control Voltage		V_{CONT}	—	1.25	3.0	Volts
Case Temperature [2]	Operating	T_C	–30	25	+110	°C
	Storage	T_{STG}	–55	—	+125	°C

[1] No damage assuming only one parameter is set at limit at a time with all other parameters set at nominal value.

[2] Case Operating Temperature refers to the temperature of the GROUND PAD at the underside of the package.

Table 2. Recommended Operating Conditions

Parameter	Symbol	Minimum	Nominal	Maximum	Unit
Power Output	P_O	—	—	28.0	dBm
Operating Frequency	F_O	1850.0	1880.0	1910.0	MHz
Supply Voltage	VCC	3.2	3.4	4.2	Volts
Reference Voltage	V_{REF}	2.75	2.85	2.95	Volts
Control voltage	V_{CONT}	1.0	1.25	2.0	Volts
Case Operating Temperature	T_C	–30	+25	+85	°C

Table 3. Power Range Truth Table [1]

Power Setting	V_{REF}	V_{CONT}	Output Power
High Power	2.85 V	2.0 V	28 dBm
Low Power	2.85 V	< 1.3 V	≤ 0 dBm
Shut Down	0.0 V	0.0 V	—

[1] In the output power range between –10 dBm and +28 dBm, VCONT can be continuously adjusted to minimize current consumption while meeting required linearity specification.

Table 4. Electrical Specifications for CDMA Nominal Operating Conditions [1]

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Gain conditions		G_{LOW}	$V_{CONT} \leq 1.3$ V $P_O < 0$ dBm	19	22	23	dB
		G_{MID}	1.3 V $\leq V_{CONT} < 2.0$ V $P_O = 16$ dBm	23	26	28	
		G_{HIGH}	$V_{CONT} = 2.0$ V $P_O = 28$ dBm	26	28	30	
Gain Sensitivity		G_{SEN}	All conditions fixed, except V_{CONT}	5	8	15	dB/Volt
Power Added Efficiency for Optimal VCONT Setting (VCC = 3.4 V)		PAE_{LOW}	$P_O = 0$ dBm	0.5	0.7		%
		PAE_{HIGH}	$P_O = 28$ dBm	37.0	40.0		
Total Supply current for Optimal VCONT Setting		I_{CC_LOW}	$P_O = 0$ dBm		40	60	mA
		I_{CC_HIGH}	$P_O = 28$ dBm		450	500	
Quiescent current		I_{Q_LOW}	$V_{CONT} = 1.25$ V	15	35	47	mA
		I_{Q_HIGH}	$V_{CONT} = 2.0$ V	65	95	130	
Reference Current		I_{REF}			0.5	1.5	mA
Control Current		I_{CTRL}	$V_{CONT} = 2.0$ V		100	250	µA
Total Supply current in Power-down Mode		I_{PD}	$V_{CC} = 3.4$ V $V_{REF} = 0$ V		2.0	5.0	µA
Adjacent Channel Power for Optimal VCONT Setting [2,3]	1.25 MHz offset	$ACP1_{\_LOW}$	$V_{CONT} \leq 1.3$ V $P_O \leq 0$ dBm		–63.0	–50.0	dBc
		$ACP1_{\_HIGH}$	$P_O \leq 28$ dBm		–50.0	–48.0	
	1.98 MHz offset	$ACP2_{\_LOW}$	$V_{CONT} \leq 1.3$ V $P_O \leq 0$ dBm		–80.0	–60.0	
		$ACP2_{\_HIGH}$	$P_O \leq 28$ dBm		–55.0	–53.5	
Harmonic Suppression	Second	F_O2	$P_O \leq 28$ dBm		–56.0	–35.0	dBc
	Third	F_O3			–45.0	–40.0	
Noise Power in RX Band 1930-1990 MHz		RxBN	$P_O \leq 28$ dBm		–138.0		dBm/Hz
Noise Figure		NF	—		4.0		dB
Input Voltage Standing Wave Ratio (VSWR)		VSWR	—		—	2.5:1	—
Stability (Spurious output)		S	5:1 VSWR All phases		—	–70.0	dBc
Ruggedness [4]		Ru	$P_O \leq 28$ dBm	10:1	—		VSWR
			$P_O = 29$ dBm	5:1	—	—	
Turn On Time [5]	DC	$T_{ON}DC$			40		µs
	RF	$T_{ON}RF$			5		
Turn Off Time [5]	DC	$T_{OFF}DC$			40		µs
	RF	$T_{OFF}RF$			5		

1 Per Table 2 over dynamic range up to 28 dBm output power, unless otherwise specified

2 ACP is specified per IS95 as the ratio of the total in-band power (1.23 MHz BW) to adjacent power in a 30 kHz BW.

3 For CDMA2000 test configured as [PCH @ –3.75 dB, DCCH–9600 bps @ 0 dB; SCHO–9600 bps @ 0 dB] and other test configurations that yield a peak-to-average up to 4.5 dB for CCDF = 1%, up to 1. dB power back off from the maximum listed for IS95 may be required to meet specified maximum ACP performance under worst-case conditions.

4 All phases, time = 10 seconds; V_{CC} = 4.2 V; Freq. = 1850 MHz, 1880 MHz, 1910 MHz; T_{CASE} = –30 °C, +25 °C, +85 °C; P_O set using 50 Ω load, P_{IN} held constant during mismatch.

5 TONDC is time required to reach stable quiescent bias (±10%) after VREF is switched high.
TOFFDC is time required for battery to decrease to < 100 µA after VREF is switched low.
After ICQ is stable, The TONRF is time to reach final output power (±1 dB) once RF input is applied.
TOFFRF is time required for PO to drop 30 dB once RF input is removed.

Characterization Data

The following graphs illustrate the characteristics of a typical SKY77149 power amplifier designed for operation in the cellular frequency band (824–849 MHz). This amplifier was selected by characterizing a group of devices and then selecting a part with average electrical performance for both nominal and the full range of recommended operating conditions, including worst case limits. Figure 2 through 8 illustrate the digital signal characteristics of the SKY77149. Shown are power sweep characteristics for key performance parameters, over temperature and frequency, up to 28.5 dBm output power. The data was taken up to and including 8 dBm output power with the bias mode control pad setting of VCONT = 1.25 volts and from 10 dBm to 16 dBm output power with the bias mode control pad setting of VCONT = 1.55 V. Beyond 16 dBm output power, VCONT was set to 2.0 V.

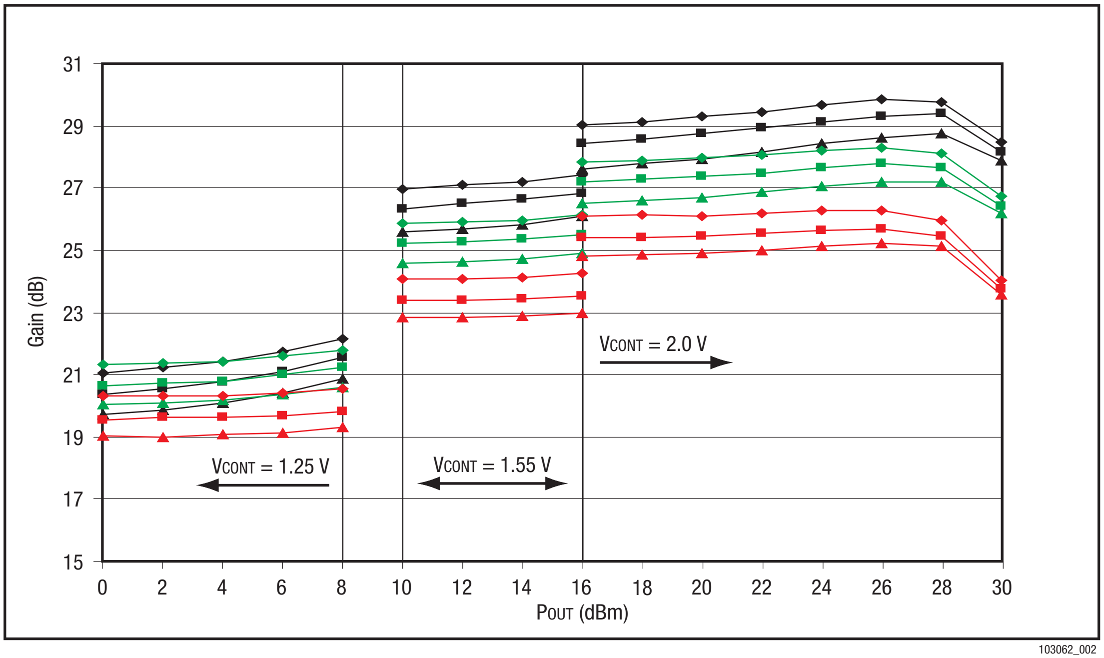
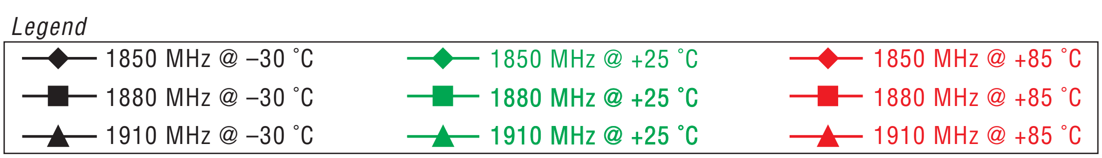


Figure 2. Gain vs. Output Power



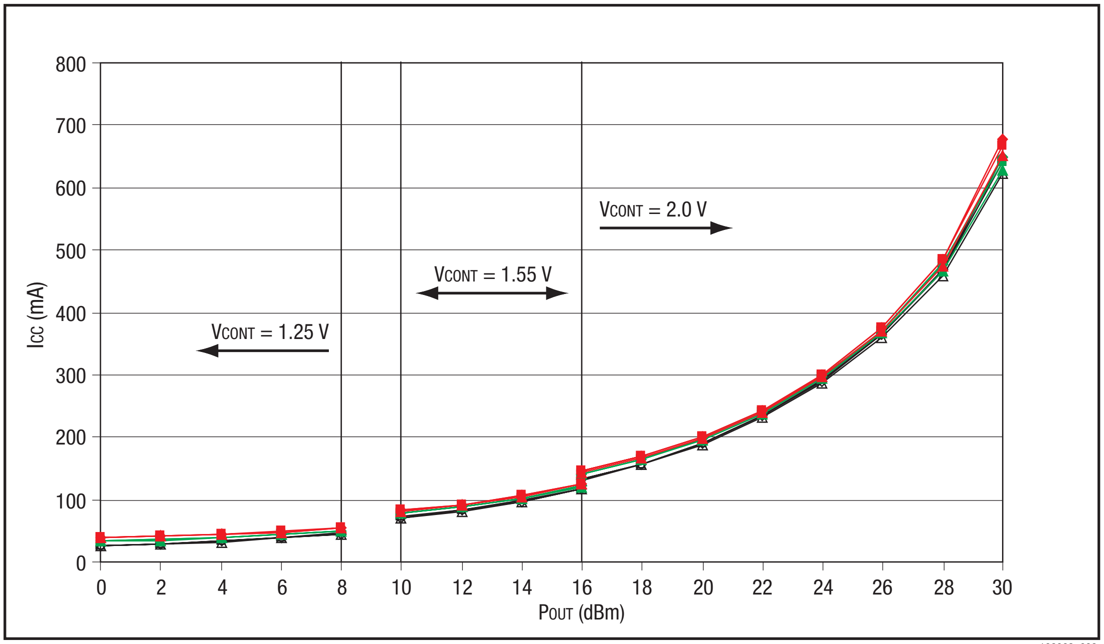


Figure 3. Supply Current vs. Output Power

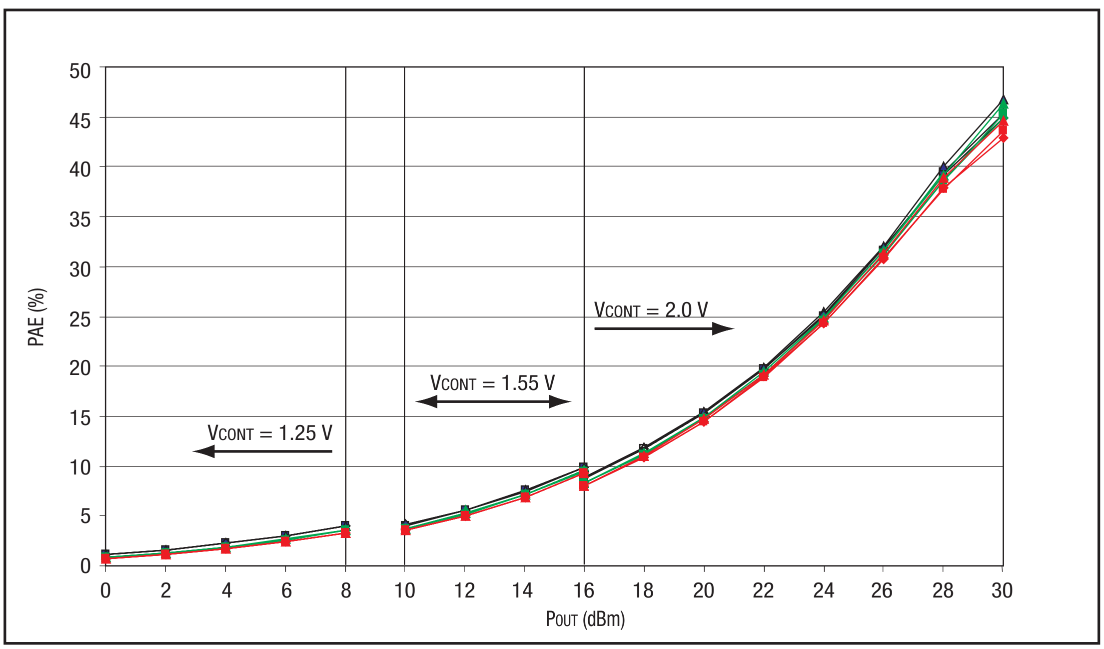
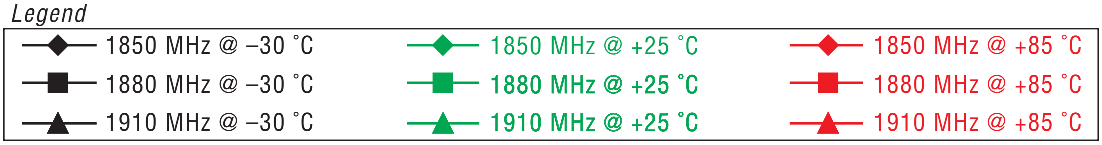


Figure 4. Power Added Efficiency vs. Output Power

Legend



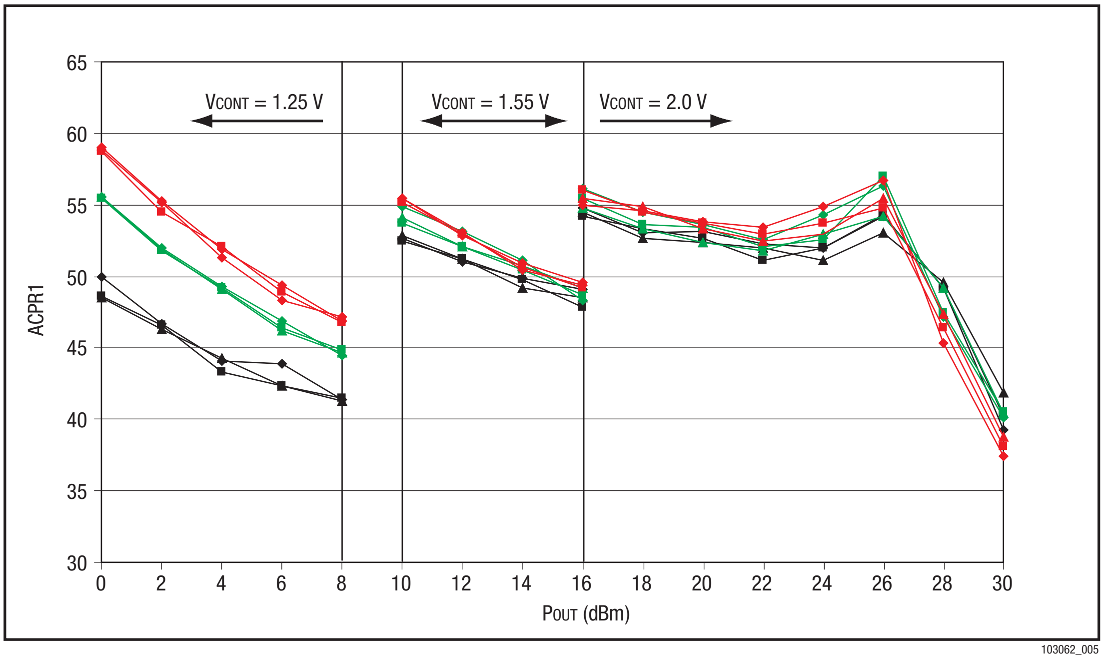


Figure 5. Adjacent Channel Power Ratio 1 vs. Output Power

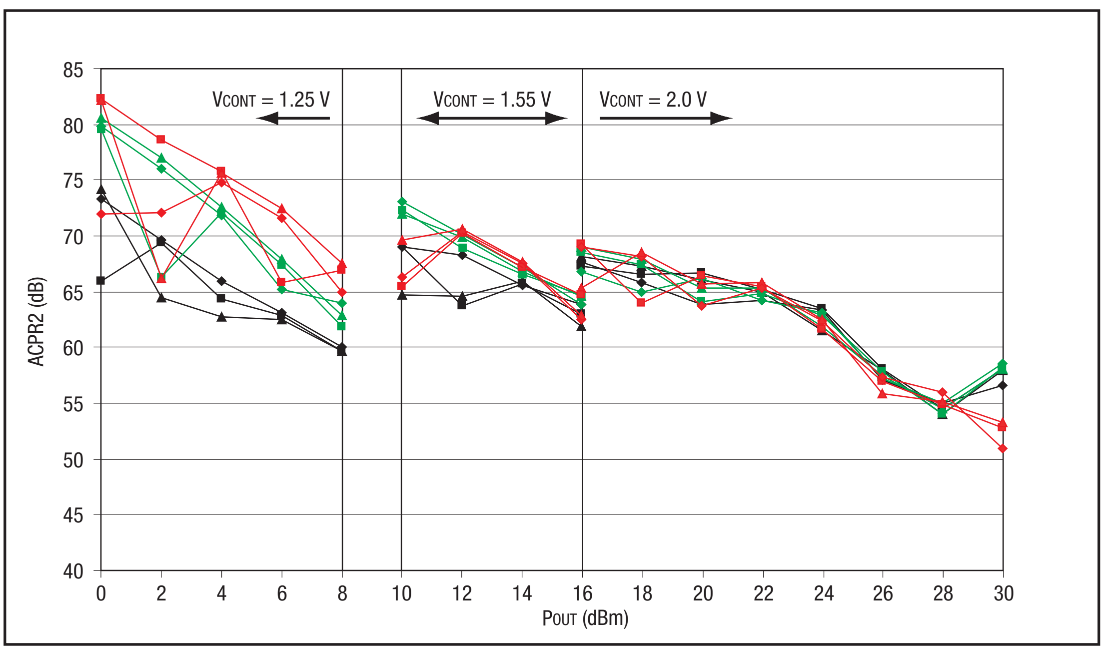
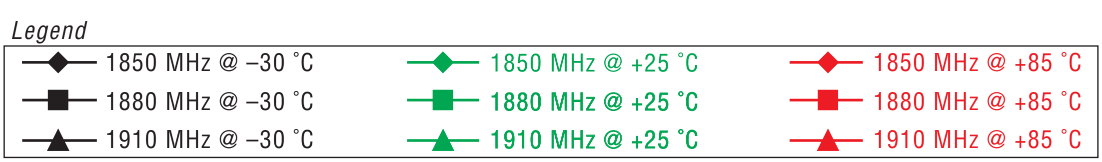


Figure 6. Adjacent Channel Power Ratio 2 vs. Output Power



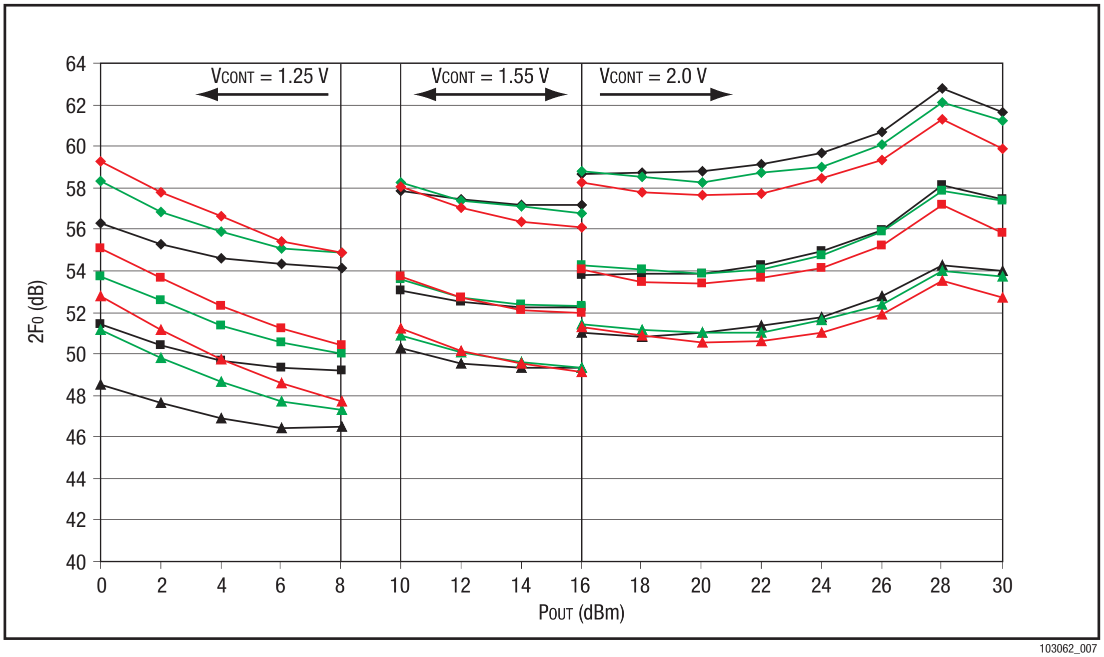


Figure 7. Second Harmonic vs. Output Power

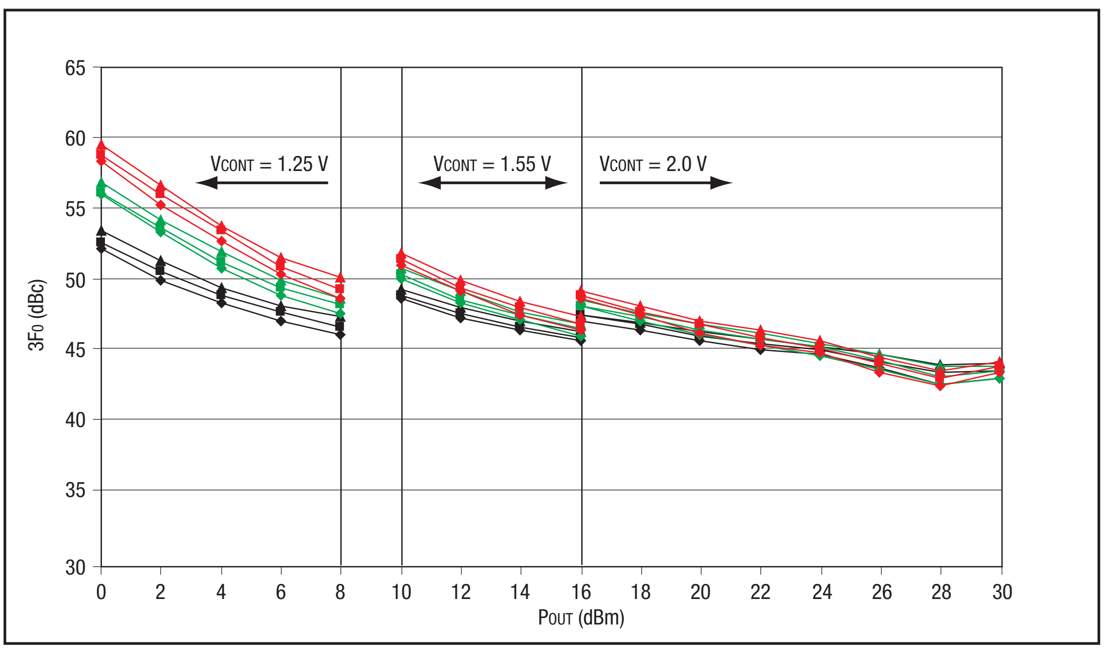
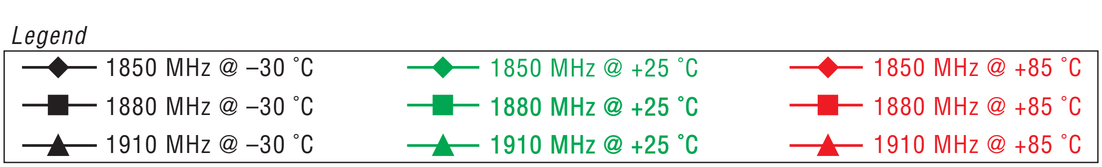


Figure 8. Third Harmonic vs. Output Power



Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77149, the evaluation board schematic and diagrams are included for preliminary analysis and design. Figure 9 shows the basic schematic of the board for the 1850 MHz to 1910 MHz range.

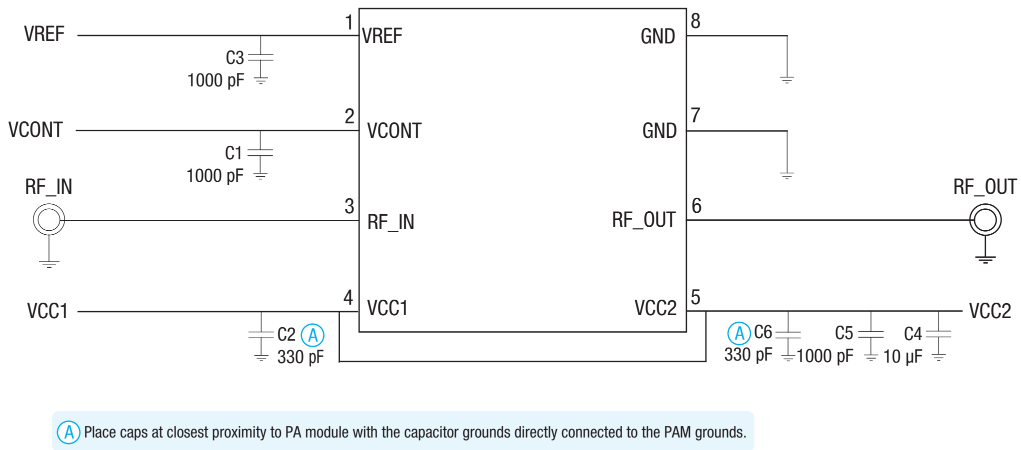
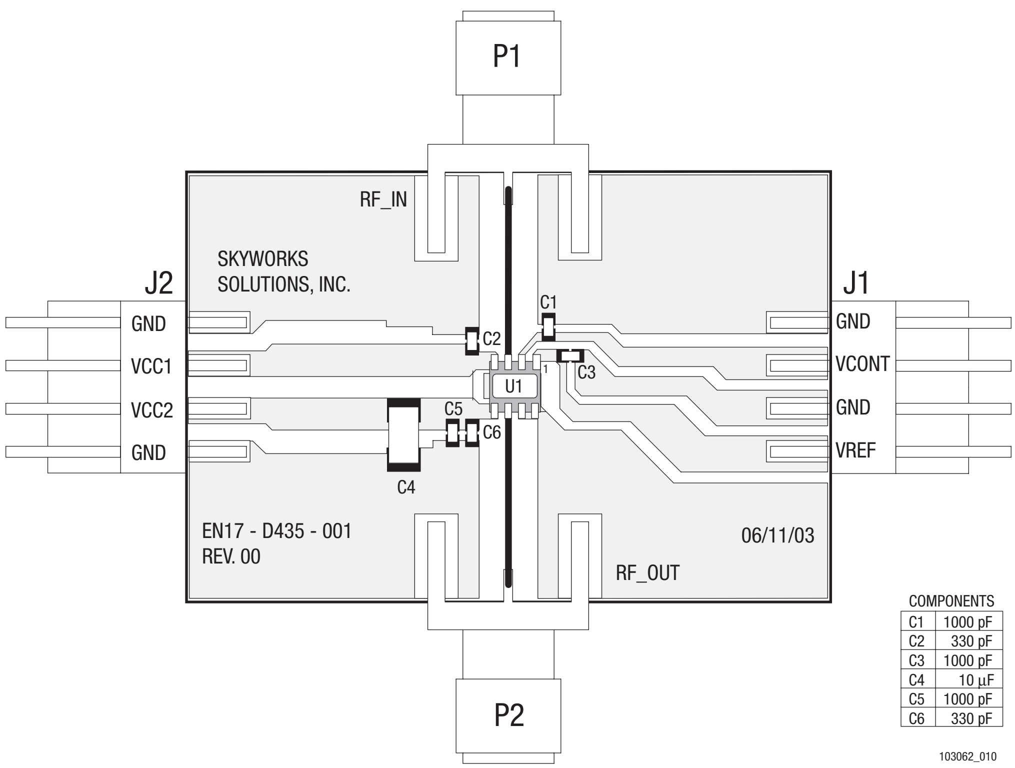


Figure 9. Evaluation Board Schematic



COMPONENTS	
C1	1000 pF
C2	330 pF
C3	1000 pF
C4	10 µF
C5	1000 pF
C6	330 pF

Figure 10. Evaluation Board Assembly Diagram

Package Dimensions and Pin Descriptions

The SKY77149 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 11 is a mechanical drawing of the pad layout for this package and Figure 12 is a PCB Symbol diagram of the 3x3 mm SKY77149. Figure 13 shows the pin names and the pin numbering convention, which starts with pin 1 in the upper left and increments counter-clockwise around the package. Figure 14 illustrates typical case markings.

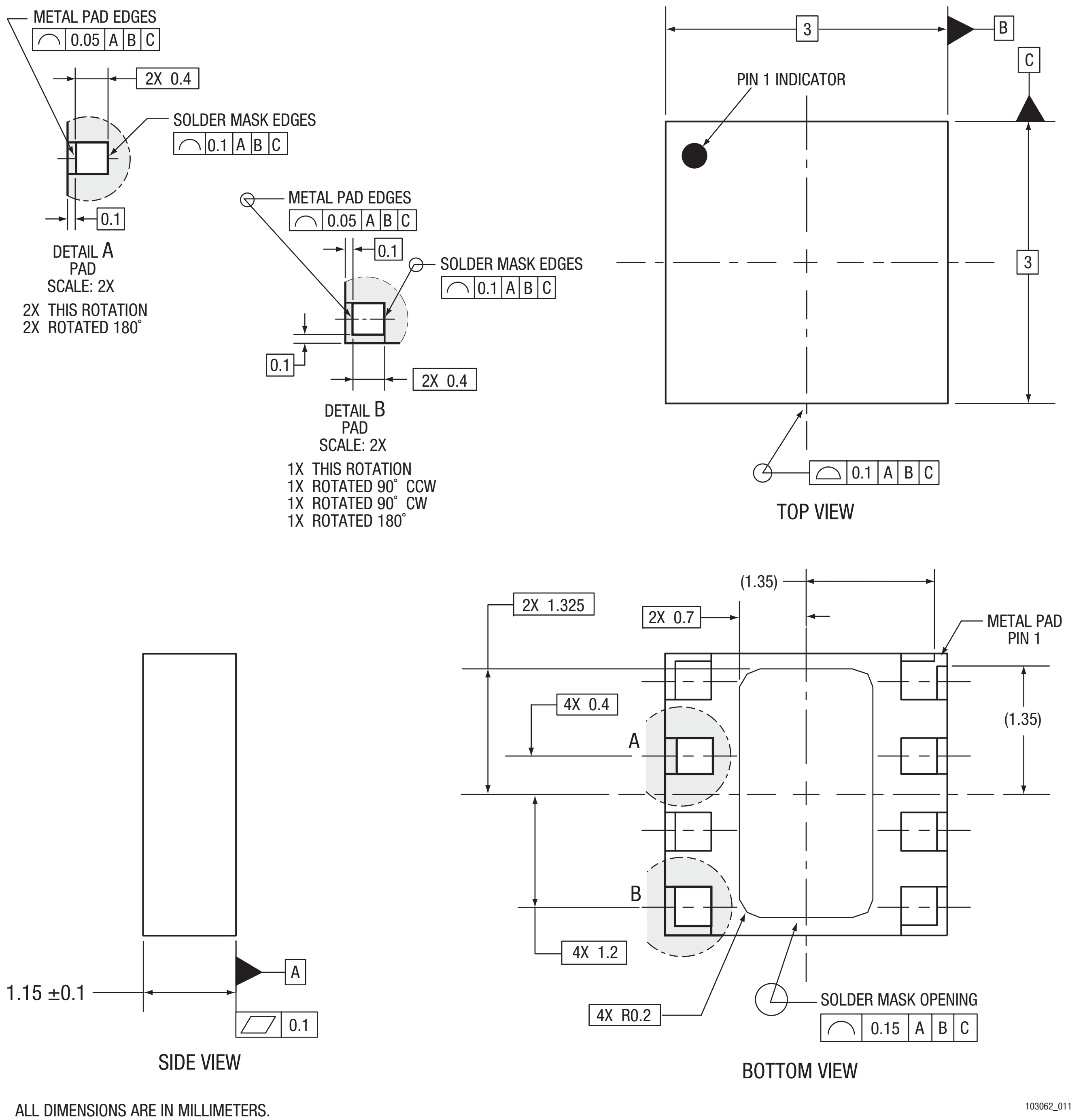


Figure 11. SKY77149 Package Drawing

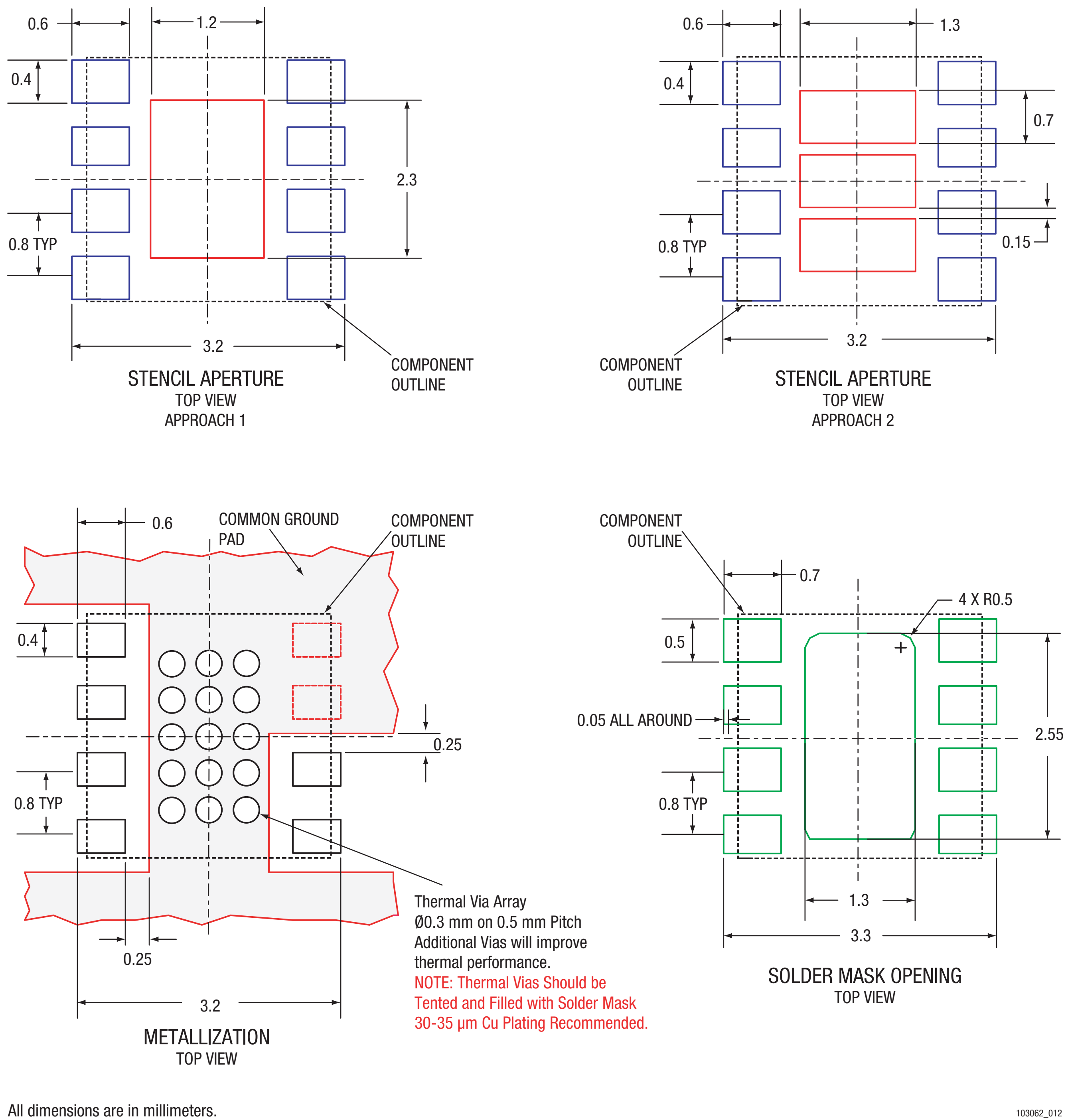


Figure 12. Phone PCB Layout Footprint Diagram for 3 x 3 mm, 8-Pin Package – SKY77149

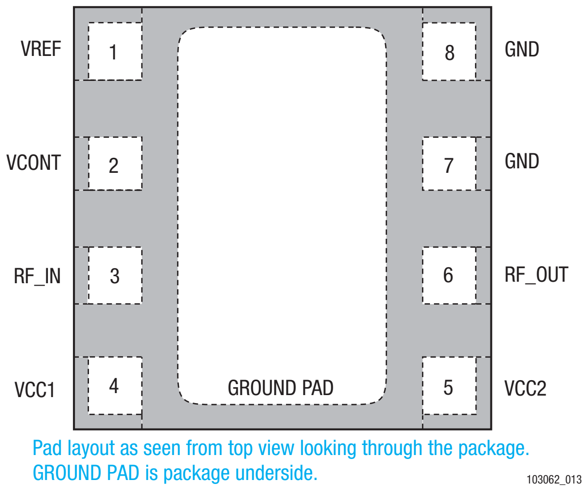


Figure 13. SKY77149 Pin Names and Configuration (Top View)

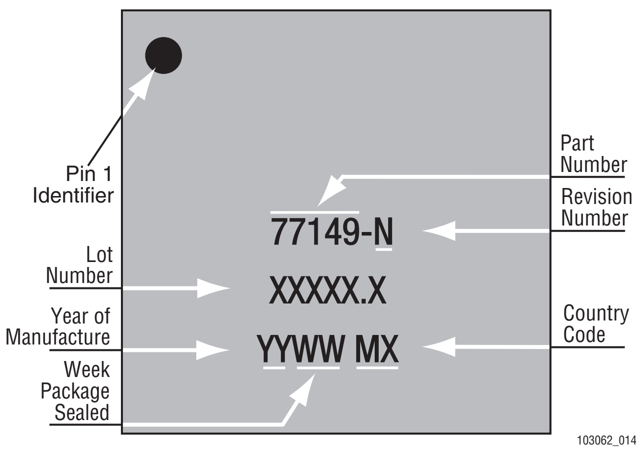


Figure 14. Typical Case Markings

Package and Handling Information

Because of its sensitivity to moisture absorption, this device package is baked and vacuum-packed prior to shipment. Instructions on the shipping container label must be followed regarding exposure to moisture after the container seal is broken, otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY77149 is capable of withstanding an MSL3/250 °C solder reflow. Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. If the part is attached in a reflow oven, the temperature ramp rate should not exceed 3 °C per second; maximum temperature should not exceed 250 °C. If the part is manually attached, precaution should be taken to insure that the part is not subjected to temperatures exceeding 250 °C for more than 10 seconds. For details on attachment techniques, precautions, and handling procedures recommended by Skyworks, please refer to Skyworks Application Note: *PCB Design and SMT Assembly/Rework,* Document Number 101752. Additional information on standard SMT reflow profiles can also be found in the JEDEC Standard J-STD–020.

Production quantities of this product are shipped in the standard tape-and-reel format. For packaging details, refer to Skyworks Application Note: *Tape and Reel Information – RF Modules,* Document Number 101568.

Electrostatic Discharge Sensitivity

The SKY77149 is a Class 2 device. Figure 15 lists the Electrostatic Discharge (ESD) immunity level for each non-ground pin of the SKY77149 product. The numbers in Figure 15 specify the ESD threshold level for each pin where the I-V curve between the pin and ground starts to show degradation.

The ESD testing was performed in compliance with MIL-STD-883E Method 3015.7 using the Human Body Model. If ESD damage threshold magnitude is found to consistently exceed 2000 volts on a given pin, this so is indicated. If ESD damage threshold below 2000 volts is measured for either polarity, numbers are indicated that represent worst case values observed in product characterization.

Various failure criteria can be utilized when performing ESD testing. Many vendors employ relaxed ESD failure standards, which fail devices only after “the pin fails the electrical specification limits” or “the pin becomes completely non-functional”. Skyworks employs most stringent criteria and fails devices as soon as the pin begins to show any degradation on a curve tracer.

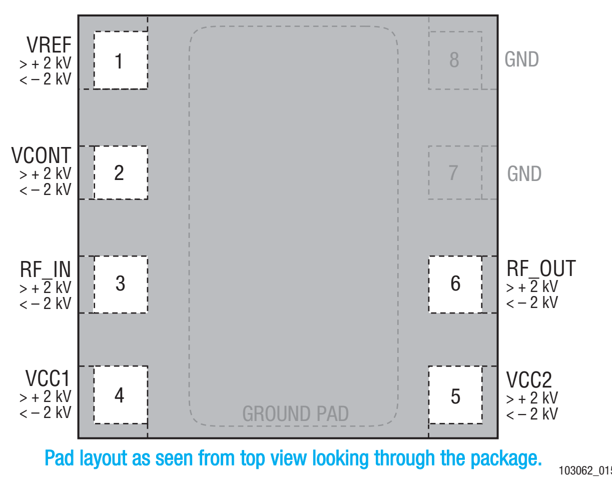


Figure 15. ESD Sensitivity Areas (Top View)

To avoid ESD damage, both latent and visible, it is very important that the product assembly and test areas follow the Class-1 ESD handling precautions listed below.

- Personnel Grounding
  - Wrist Straps
  - Conductive Smocks, Gloves and Finger Cots
  - Antistatic ID Badges
- Protective Workstation
  - Dissipative Table Top
  - Protective Test Equipment (Properly Grounded)
  - Grounded Tip Soldering Irons
  - Solder Conductive Suckers
  - Static Sensors
- Facility
  - Relative Humidity Control and Air Ionizers
  - Dissipative Floors (less than $10^9\ \Omega$ to GND)
- Protective Packaging and Transportation
  - Bags and Pouches (Faraday Shield)
  - Protective Tote Boxes (Conductive Static Shielding)
  - Protective Trays
  - Grounded Carts
  - Protective Work Order Holders

Ordering Information

Model Number	Manufacturing Part Number	Product Revision	Package	Operating Temperature
SKY77149	SKY77149		3x3LM–10	–30 °C to +85 °C

Revision History

Revision	Level	Date	Description
A		May 8, 2006	Initial Release
B		November 6, 2006	Revise: Table 4

References

Application Note: PCB Design and SMT Assembly/Rework, Document Number 101752.

Application Note: Tape and Reel Information – RF Modules, Document Number 101568

Standard SMT Reflow Profiles: JEDEC Standard J–STD–020