DATA SHEET

SKY77154 System Smart® PA Module for CDMA / AMPS (824–849 MHz)

Applications

- Digital cellular (CDMA)
- Analog cellular (AMPS)
- Wireless local loop (WLL)

Features

- Low voltage positive bias supply
  - 3.2 V to 4.2 V
- Low V_{REF}
  - 2.85 V, nominal
- Low I_{REF}
  - 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

NEW

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

Description

The SKY77154 System Smart® Power Amplifier Module (PAM) is a fully matched, 8-pin surface mount module developed for Code Division Multiple Access (CDMA) / Advanced Mobile Phone Service (AMPS) and Wireless Local Loop (WLL) applications. This small and efficient module packs a full 824–849 MHz bandwidth coverage into a single compact package. The device meets the stringent IS95 CDMA linearity requirements to and exceeding 28 dBm output power, and can be driven to levels beyond 31 dBm for high efficiency in FM mode operation. A low current pin (VCONT) provides improved 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 and 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 SKY77154 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.

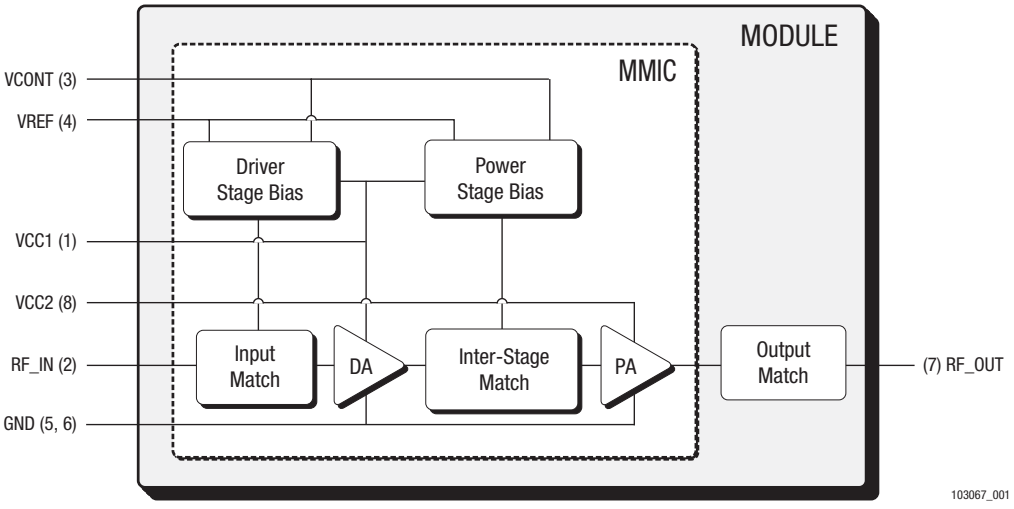


Figure 1. Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77154 Power Amplifier. Table 1 lists the absolute maximum ratings, while Table 2 lists the recommended operating conditions for achieving the electrical performance 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	CDMA	P_{IN_D}	—	–1.0	8.0	dBm
	AMPS	P_{IN_A}	—	3.0	8.0	
Supply Voltage		V_{CC}	—	3.4	6.0	Volts
Reference Voltage		V_{REF}	—	2.85	3.0	Volts
Control Voltage		V_{CONT}	—	TBD	3.0	Volts
Case Temperature [2]	Operating	T_{CASE}	–30	25	+110	°C
	Storage	T_{STG}	–55	—	+125	

[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
Output Power	CDMA	P_{O_D}	—	—	28	dBm
	AMPS	P_{O_A}	—	—	31	
Operating Frequency		F_O	824.0	836.5	849.0	MHz
Supply Voltage		V_{CC}	3.2	3.4	4.2	Volts
Reference Voltage		V_{REF}	2.75	2.85	2.95	Volts
Control voltage		V_{CONT}	1.0	TBD	2.0	Volts
Case Operating Temperature		T_O	–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, V_{CONT} can be continuously adjusted to minimize current consumption while meeting required linearity specification.

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

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Gain Conditions	Digital Mode	G_{LOW}	$V_{CONT} \leq 1.3$ V $P_{O_D} \leq 0$ dBm	21.5	23.0	24.5	dB
		G_{MID}	$V_{CONT} = 1.55$ V $P_{O_D} = 16$ dBm	24.5	26.0	27.5	
		G_{HIGH}	$V_{CONT} = 1.8$ V $P_{O_D} = 28$ dBm	28.0	29.0	31.0	
	Analog Mode	G_P	$V_{CONT} = 2.08$ V $P_{O_A} = 31$ dBm	28.0	29.0	31.0	
Gain Flatness [2]		G_F	$V_{CONT} \leq 2.08$ V $P_O \leq 31$ dBm	—	—	0.75	dB
Power Added Efficiency	Digital Mode	PAE_{D_LOW}	$V_{CONT} = 1.3$ V $P_{O_D} = 0$ dBm	0.60	0.75	—	%
		PAE_{D_HIGH}	$V_{CONT} = 1.8$ V $P_{O_D} = 28$ dBm	37.0	39.0	—	
	Analog Mode	PAE_a	$V_{CONT} = 1.8$ V $P_{O_A} = 31$ dBm	48.0	54.0	—	
Total Supply Current		I_{CC_LOW}	$V_{CONT} = 1.3$ V $P_{O_D} = 0$ dBm	—	37	50	mA
		I_{CC_HIGH}	$P_{O_D} = 28$ dBm	—	475	500	
Quiescent Current		I_{CQ_LOW}	$V_{CONT} = 1.3$ V	25	35	50	mA
		I_{CQ_HIGH}	$V_{CONT} \geq 1.8$ V	55	72	95	
Reference Current		I_{REF}		0.2	1.0	2.0	mA
Control Current		I_{CTRL}	$V_{CONT} = 1.8$ V	100	120	150	µA
Adjacent Channel Power [3,4]	885 kHz offset	$ACP1_{LOW}$	$V_{CONT} \leq 1.3$ v $P_{O_D} \leq 0$ dBm	—	–58	–50	dBc
		$ACP1_{HIGH}$	$V_{CONT} \geq 1.8$ V $P_{O_D} \leq 28$ dBm	—	–49	–48	
	1.98 MHz offset	$ACP2_{LOW}$	$V_{CONT} \leq 1.3$ v $P_{O_D} \leq 0$ dBm	—	–60	–56	
		$ACP2_{HIGH}$	$V_{CONT} \geq 1.8$ V $P_{O_D} \leq 28$ dBm	—	–58	–56	
Harmonic Suppression	Second	F_O2	$P_{O_D} \leq 31$ dBm	—	–40	–30	dBc
	Third	F_O3		—	–52	–45	
Noise Power in RX Band 869-894 MHz		RxBN	$P_{O_D} \leq 28$ dBm	—	–137	–136	dBm/Hz
Noise Figure		NF		—	4.6	5.0	dB
Input Voltage Standing Wave Ratio		VSWR		—	2.0:1	2.3:1	
Stability (Spurious output)		S	5:1 VSWR all phases	—	—	–62.0	dBc
Ruggedness—No damage [5]		Ru	$P_{O_D} \leq 28$ dBm	10:1	—	—	VSWR
			$P_{O_D} = 29$ dBm	5:1	—	—	
Turn On Time [6]	DC	$T_{ON}DC$		—	40	—	µs
	RF	$T_{ON}RF$		—	5	—	
Turn Off Time [6]	DC	$T_{OFF}DC$		—	40	—	µs
	RF	$T_{OFF}RF$		—	5	—	

[1] $V_{CC} = 3.4$ V, $V_{REF} = 2.85$ V, Freq. = 836.5 MHz, $T_{CASE} = +25$ °C.

[2] Over operating frequency range

[3] 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.

[4] 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.

[5] All phases, time = 10 seconds; $V_{CC} = 4.2$ V; Freq. = 824 MHz, 836.5 MHz, 849 MHz; $T_{CASE} = –30$ °C, +25 °C, +85 °C; P_O set using 50 Ω load, P_{IN} held constant during mismatch.

[6] $T_{ON}DC$ is time required to reach stable quiescent bias (±10%) after V_{REF} is switched high.
$T_{OFF}DC$ is time required for battery to decrease to < 100 µA after V_{REF} is switched low.
After I_{CQ} is stable, The $T_{ON}RF$ is time to reach final output power (±1 dB) once RF input is applied.
$T_{OFF}RF$ is time required for P_O to drop 30 dB once RF input is removed.

Characterization Data

Figure 2 through Figure 7 illustrate the characteristics of a typical SKY77154 power amplifier designed for operation in the CDMA frequency band (824–849 MHz). Shown are power sweep characteristics for key performance parameters up to 28 dBm output power.

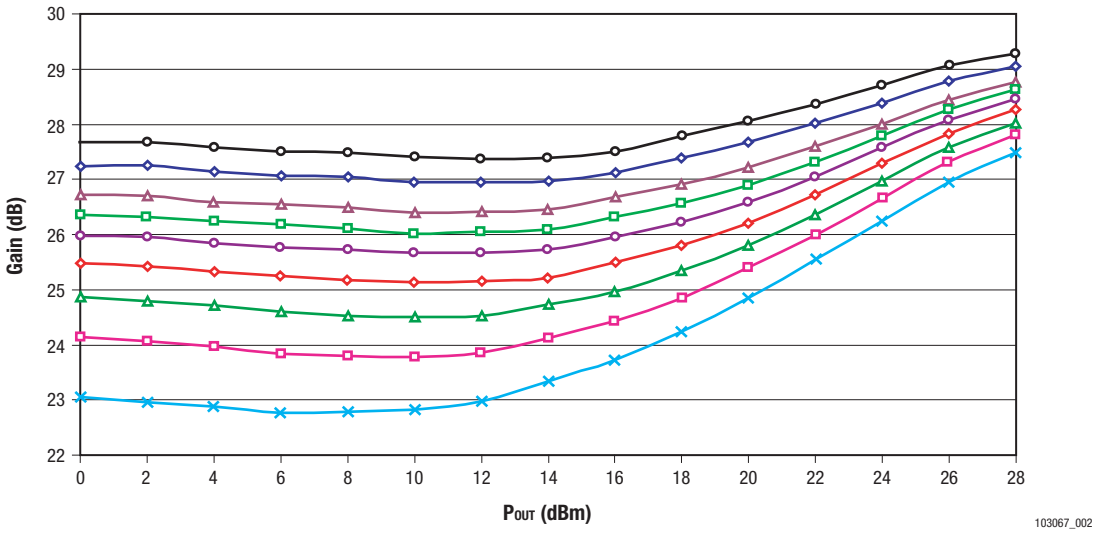


Figure 2. Gain vs. VCONT

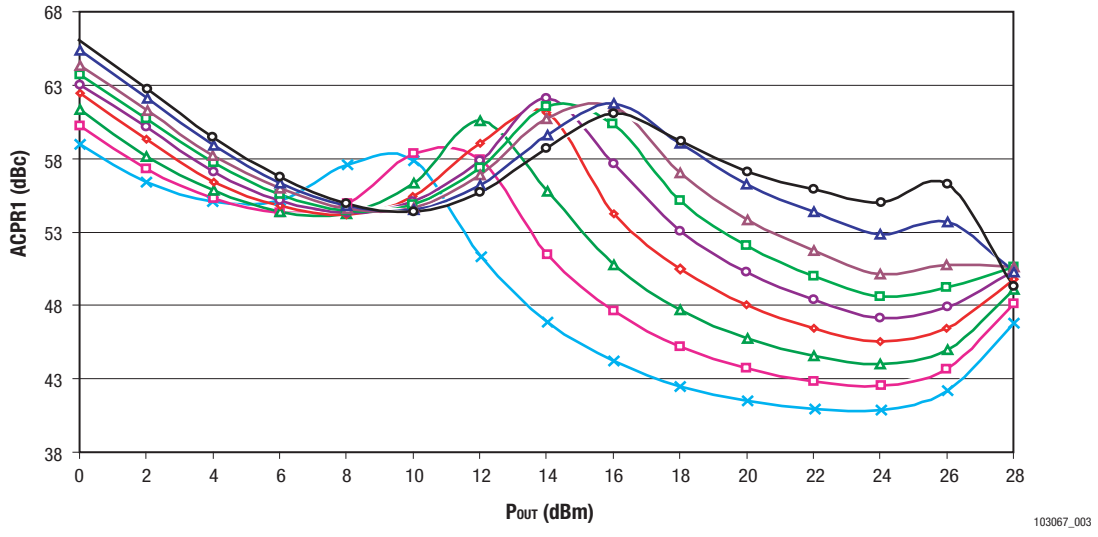


Figure 3. ACPR1 vs. VCONT



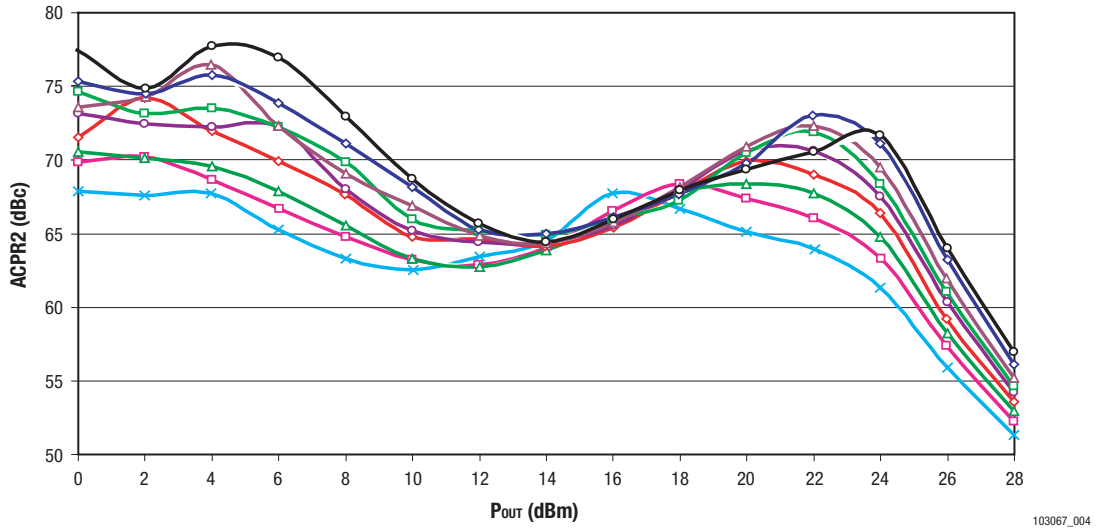


Figure 4. ACPR2 vs. V_{CONT3}

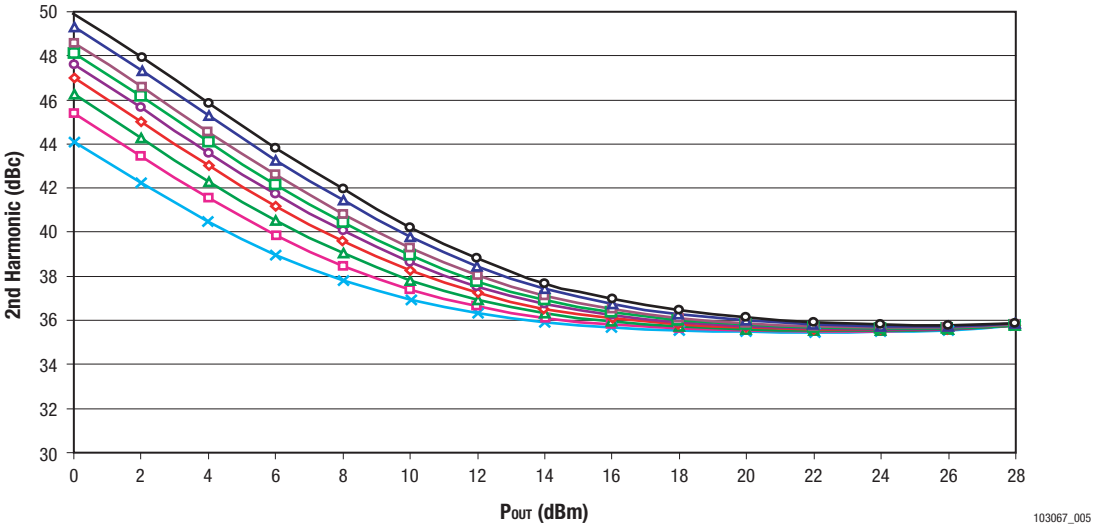


Figure 5. 2 x f0 vs. V_{CONT}



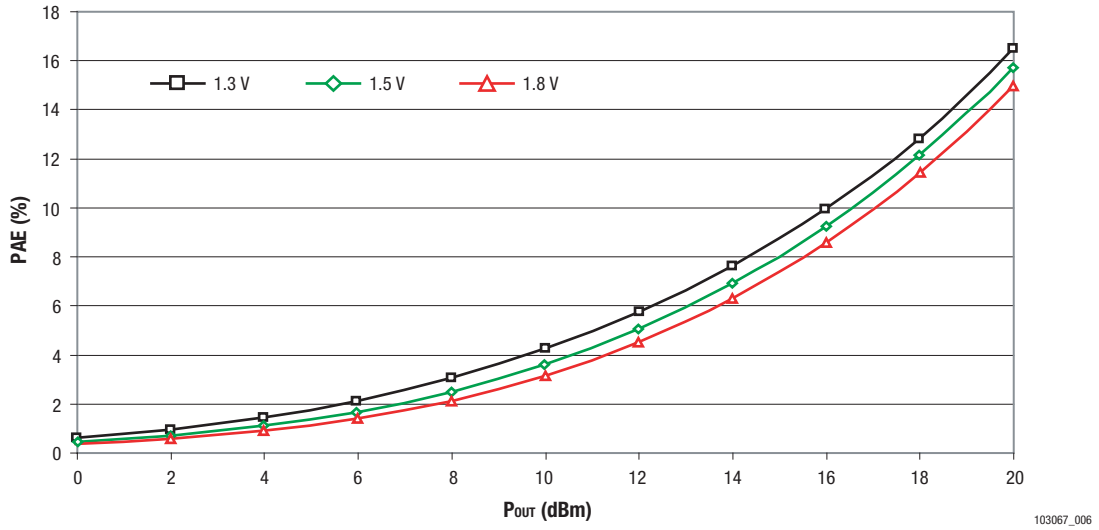


Figure 6. PAE vs. VCONT

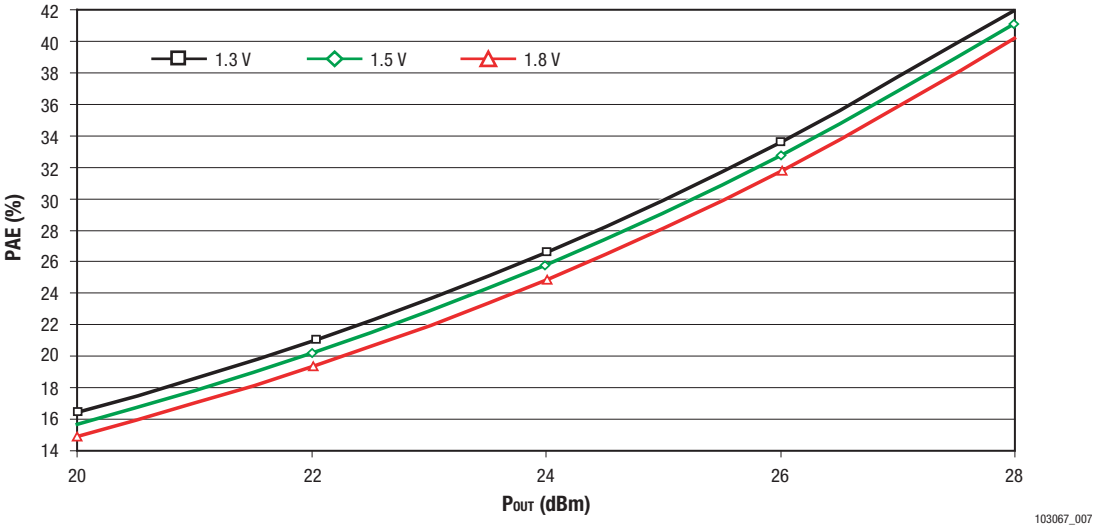


Figure 7. PAE vs. VCONT

Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77154, the evaluation board schematic and evaluation board assembly diagram are included for preliminary analysis and design. Figure 8 shows the basic schematic of the evaluation board for the 824 MHz to 849 MHz range.

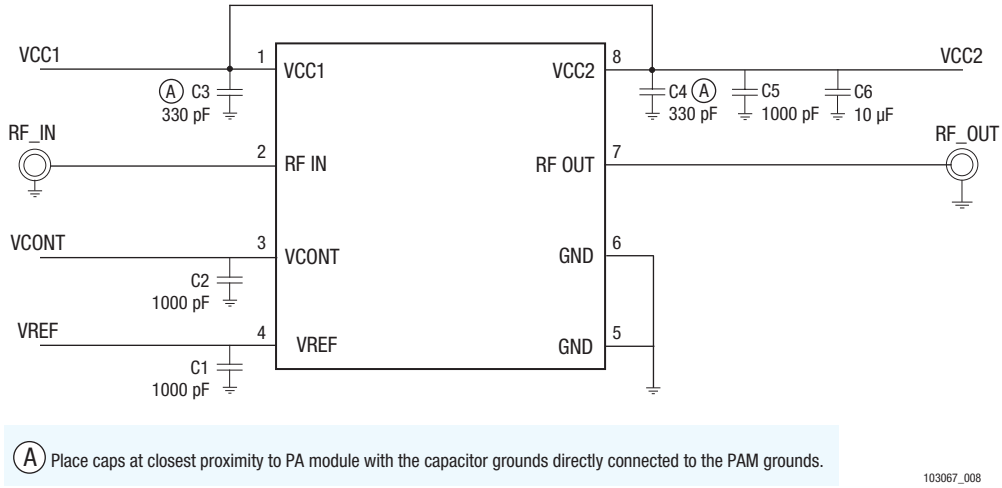


Figure 8. Evaluation Board Schematic

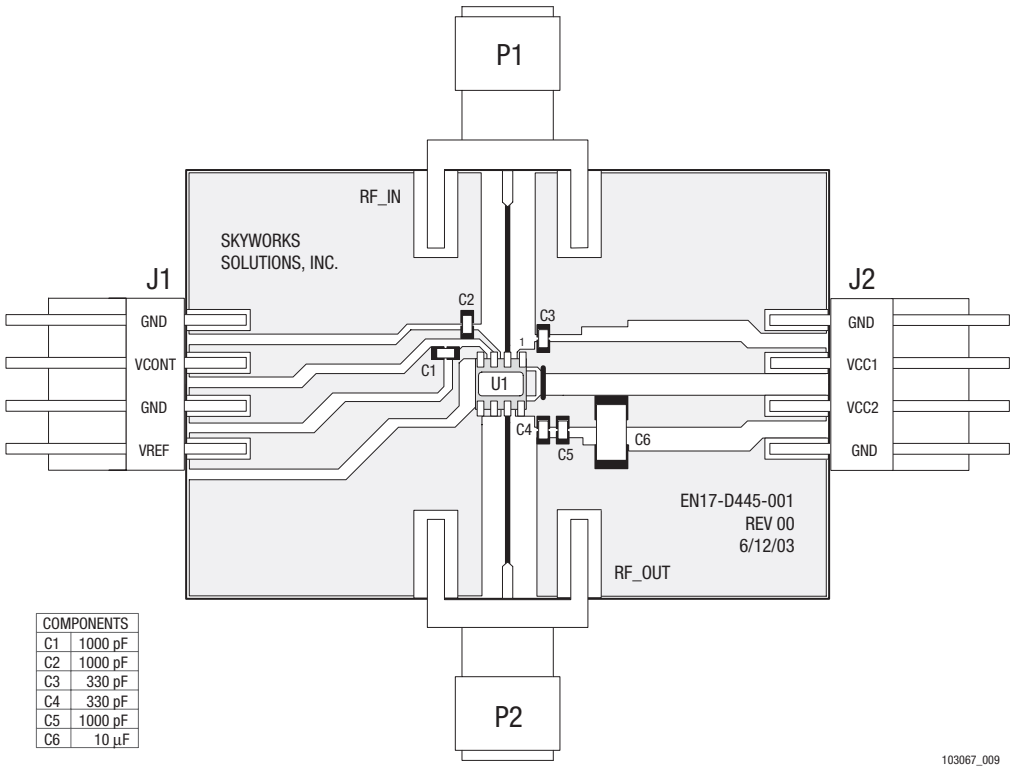
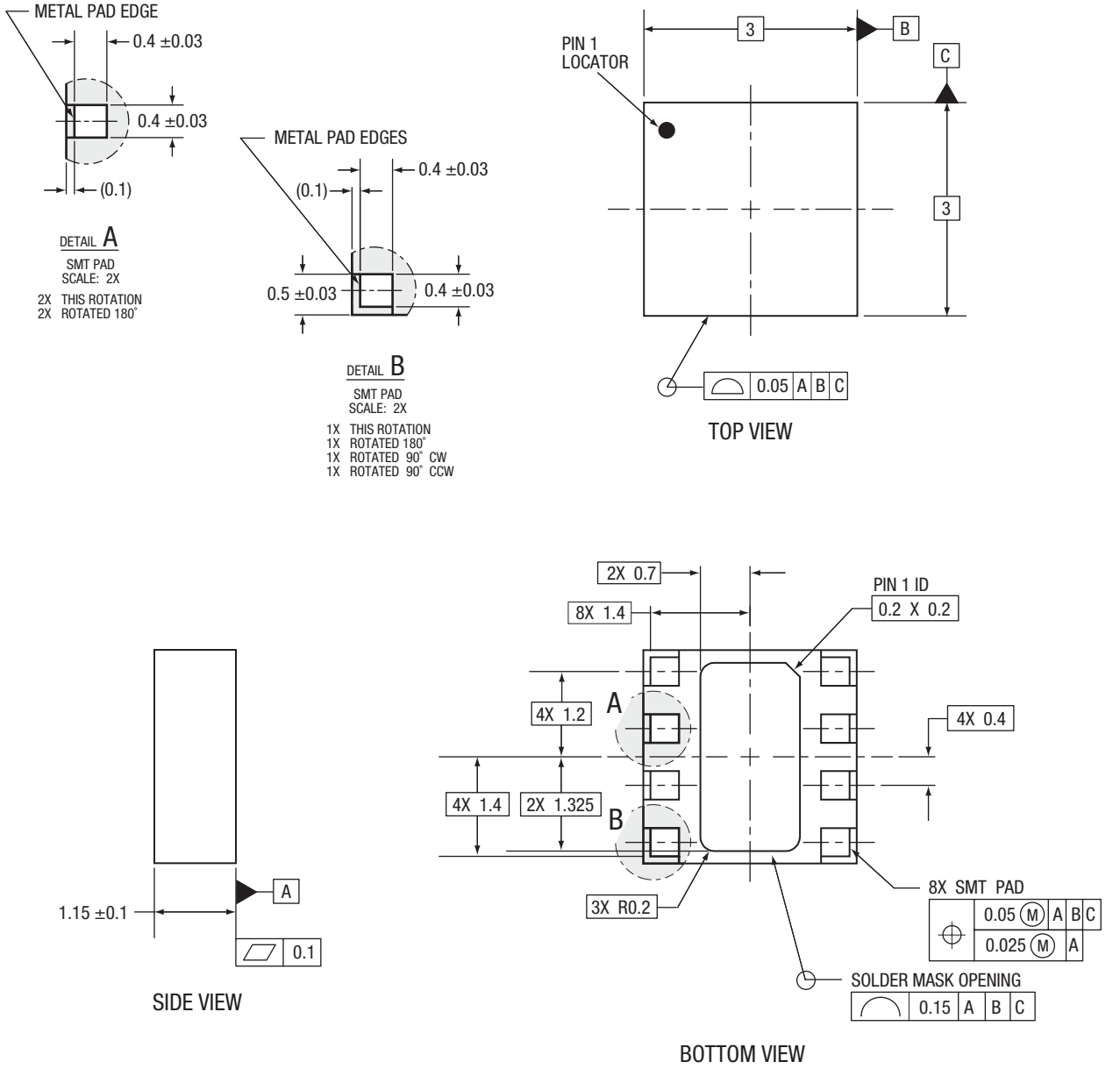


Figure 9. Evaluation Board Assembly Diagram

Package Dimensions and Pin Descriptions

The SKY77154 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 10 is a mechanical drawing of the pad layout for this package. Figure 12 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 13 illustrates typical case markings.



NOTES: Unless otherwise specified
1. DIMENSIONING AND TOLERANCES IN ACCORDANCE WITH ASME Y14.5M–1994.
2. SEE APPLICABLE BONDING DIAGRAM AND DEVICE ASSEMBLY DRAWING FOR DIE AND COMPONENT PLACEMENT.
3. PADS ARE SOLDER MASK DEFINED ON ALL INSIDE EDGES.
4. ALL DIMENSIONS ARE IN MILLIMETERS.

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Figure 10. SKY77154 Package Dimensional Drawing (All Views)

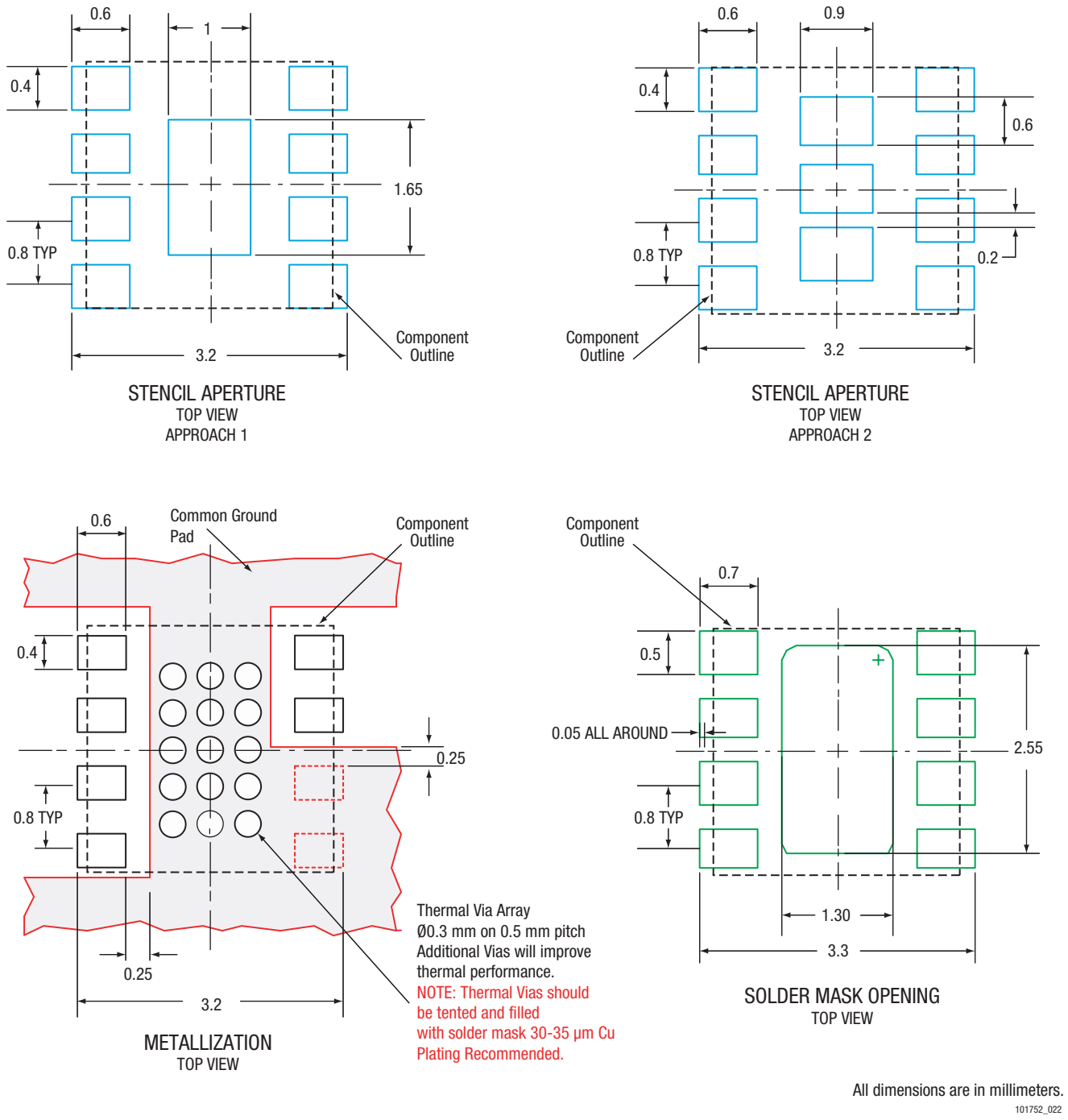


Figure 11. Phone PCB Layout Footprint for 3 x 3 mm, 8-Pin Package – SKY77154

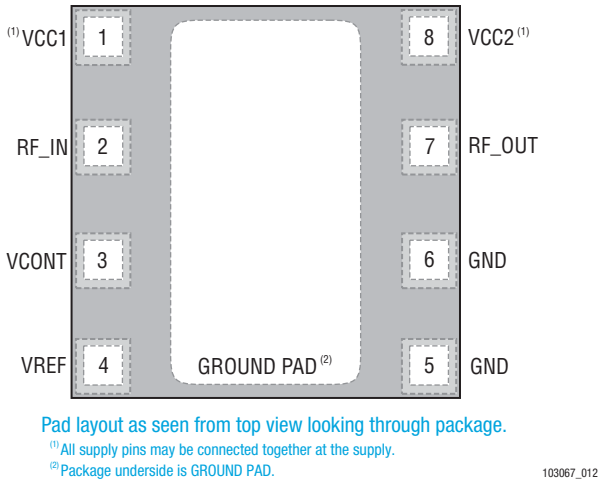


Figure 12. SKY77154 Pin Configuration and Pin Names (Top View)

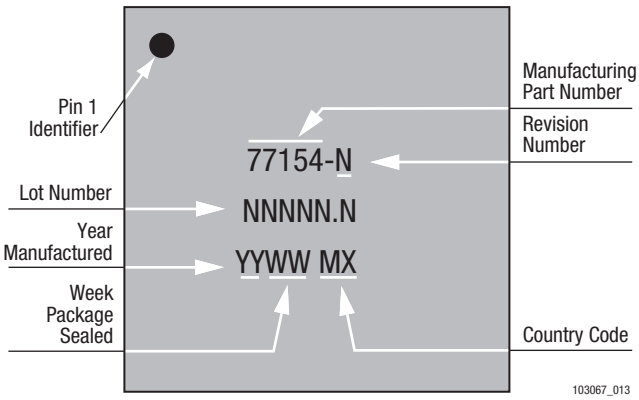


Figure 13. Typical Case Markings

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 SKY77154 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 both 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,* Document Number 101568.

Electrostatic Discharge Sensitivity

The SKY77154 is a Class 2 device. Figure 14 lists the Electrostatic Discharge (ESD) immunity level for each pin of the SKY77154 product. The numbers in Figure 14 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.

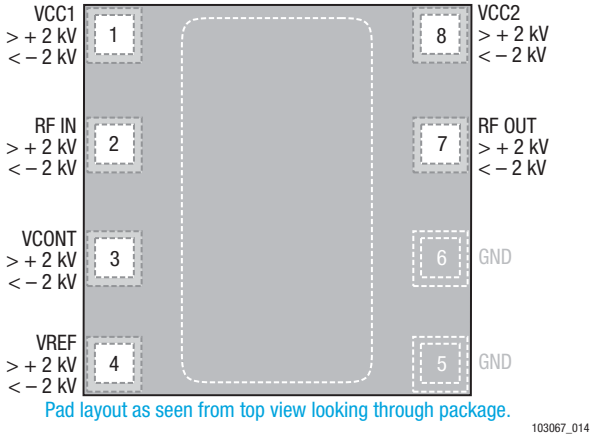


Figure 14. ESD Sensitivity Areas (Top View)

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 109 Ω 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
SKY77154	SKY77154			–30 °C to +85 °C

Revision History

Revision	Level	Date	Description
A		November 3, 2006	Initial Release

References

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

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

JEDEC Standard J–STD–020

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