

**ADVANCE DATA SHEET**

# SKY77166 Power Amplifier Module for CDMA2000 (450-460 MHz)

**Applications**

- Digital cellular (CDMA2000)
- Wireless Local Loop (WLL)

**Features**

- Low voltage positive bias supply: 3.2 V to 4.2 V
- Good linearity
- High efficiency across wide dynamic range
- Dual-mode operation
- 10-pad package:  
4 x 4 x 1.15 mm
- Power down control
- Low power state control
- CDMA2000

**Description**

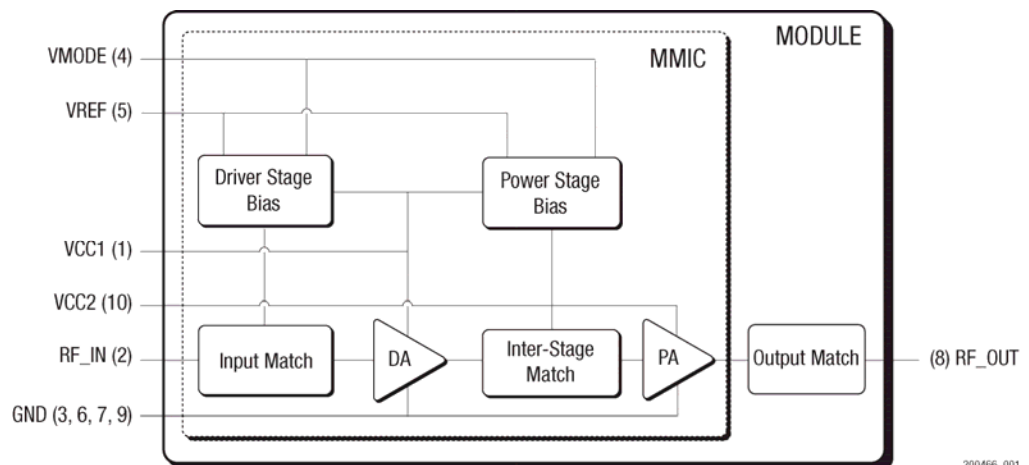
The SKY77166 Power Amplifier Module (PAM) is a fully matched 10-pad surface mount module developed for Code Division Multiple Access (CDMA2000) handsets and Wireless Local Loop applications. This small and efficient module packs full coverage of the 450–460 MHz bandwidth into a single compact package. The SKY77166 meets the stringent CDMA2000 linearity requirements to and exceeding 29 dBm output power.

The single Gallium Arsenide (GaAs) Microwave Monolithic Integrated Circuit (MMIC) contains all active circuitry within the module, which includes onboard bias circuitry as well as input and interstage matching circuits. Output match into a 50-ohm load is realized off-chip within the module package to optimize efficiency and power performance. 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 SKY77166 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.

**NEW**

Skyworks offers lead (Pb)-free, RoHS (European Parliament for the Restriction of Hazardous Substances) -compliant packaging.



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**Figure 1. Functional Block Diagram**

**Electrical Target Specifications**

The following tables list the electrical characteristics of the SKY77166 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 Rating <sup>1</sup>**

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	
RF Input Power	P <sub>IN</sub>	—	0.0	6.0	dBm	
Supply Voltage	V <sub>CC</sub>	—	3.4	6.0	Volts	
Reference Voltage	V <sub>REF</sub>	—	2.85	2.95	Volts	
Case Temperature <sup>2</sup>	Operating	T <sub>C</sub>	-30	+25	+110	°C
	Storage	T <sub>STG</sub>	-55	—	+125	

<sup>1</sup> No damage assuming only one parameter is set at limit at a time with all other parameters set at nominal value.

<sup>2</sup> Case Temperature refers to the temperature of the case measured at the GROUND PAD at the underside of the package.

**Table 2. Recommended Operating Conditions**

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	
Supply Voltage	V <sub>CC</sub>	3.2	3.4	4.2	Volt	
Reference Voltage	V <sub>REF</sub>	2.80	2.85	2.95	Volts	
Control voltage	V <sub>CONT</sub>	HIGH	2.5	—	3.0	Volt
		LOW	0.0	—	0.5	
Operating Frequency	F <sub>O</sub>	450.0	455.0	460.0	MHz	
Case Temperature <sup>1</sup>	T <sub>C</sub>	-30	+25	+85	°C	

<sup>1</sup> Case Temperature (TC) refers to the temperature of the case measured at the GROUND PAD at the underside of the package.

**Table 3. Power Range Truth Table**

Power Mode	V <sub>REF</sub>	V <sub>CONT</sub>	Range
High Power	2.85 V	0.0 V – 0.5 V	16 dBm – 29 dBm
Low Power	2.85 V	2.5 V – 3.0 V	≤ 16 dBm
Shut Down	0.0 V	0.0 V	—

**Table 4. Electrical Specifications for CDMA2000 Nominal Operating Conditions <sup>1</sup>**

Characteristics	Symbol	Condition	Minimum	Typical	Maximum	Unit	
Gain conditions	G <sub>LOW</sub>	V <sub>CONT</sub> ≥ 2.5 V P <sub>0</sub> = 16 dBm	24.5	26.5	28.2	dB	
	G <sub>HIGH</sub>	V <sub>CONT</sub> ≤ 0.5 V P <sub>0</sub> = 29 dBm	29.0	30.0	32.0		
Power Added Efficiency	PAE <sub>LOW</sub>	V <sub>CONT</sub> ≥ 2.5 V P <sub>0</sub> = 16 dBm	6.5	7.0	—	%	
	PAE <sub>HIGH</sub>	V <sub>CONT</sub> ≤ 0.5 V P <sub>0</sub> = 29 dBm	33.0	37.0	—		
Total Supply current	I <sub>CC_LOW</sub>	P <sub>0</sub> = 16 dBm	—	165	180	mA	
	I <sub>CC_HIGH</sub>	P <sub>0</sub> = 29 dBm	—	630	695		
Quiescent current	I <sub>Q_LOW</sub>	V <sub>CONT</sub> ≥ 2.5 V	—	75	—	mA	
	I <sub>Q_HIGH</sub>	V <sub>CONT</sub> ≤ 0.5 V	—	95	—		
Reference current	I <sub>REF</sub>	—	—	0.75	1.0	mA	
Control current	I <sub>CONT</sub>	V <sub>CONT</sub> = 2.5 V	—	0.95	1.2	mA	
Total Supply current in Power-down Mode	I <sub>PD</sub>	V <sub>CC</sub> = 3.4 V V <sub>REF</sub> = 0 V	—	2.0	4.5	µA	
Adjacent Channel Power <sup>2,3,4</sup>	885 kHz offset	ACP1	P <sub>0</sub> ≤ 29 dBm	—	-50.0	-47.5	dBc
	1.98 MHz offset	ACP2		—	-61.0	-60.0	
Harmonic Suppression	Second	f <sub>02</sub>	P <sub>0</sub> ≤ 29 dBm	—	-50.0	-45.0	dBc
	Third	f <sub>03</sub>		—	-60.0	-55.0	
Noise Power in RX Band 460-470 MHz	RXBN	P <sub>0</sub> ≤ 29 dBm	—	-130	-128	dBm/Hz	
Noise Figure	NF	—	—	4.0	5.5	dB	
Input Voltage Standing Wave Ratio (VSWR)	VSWR	—	—	1.6:1	1.8:1	—	
Stability (Spurious output)	S	5:1 VSWR All phases	—	—	-70	dBc	
Ruggedness <sup>5</sup>	Ru	P <sub>0</sub> ≤ 29 dBm	10:1	—	—	VSWR	

<sup>1</sup> Unless specified otherwise:

V<sub>CC</sub> = +3.4 V  
V<sub>REF</sub> = +2.85 V  
Temp = +25 °C

<sup>2</sup> ACP is specified per CDMA2000 as the ratio of the total in-band power (1.23 MHz) to adjacent power in a 30 kHz BW.

<sup>3</sup> CDMA2000 is configured as FCH = 9600 or PCH = -3.75 dB, DCCH = 9600, -7.0 dB, SCH = 9600, SCH = 9600, -5.36 dB, and Peak-to-Average Ratio (CCDF = 1%) = 4.5 dB.

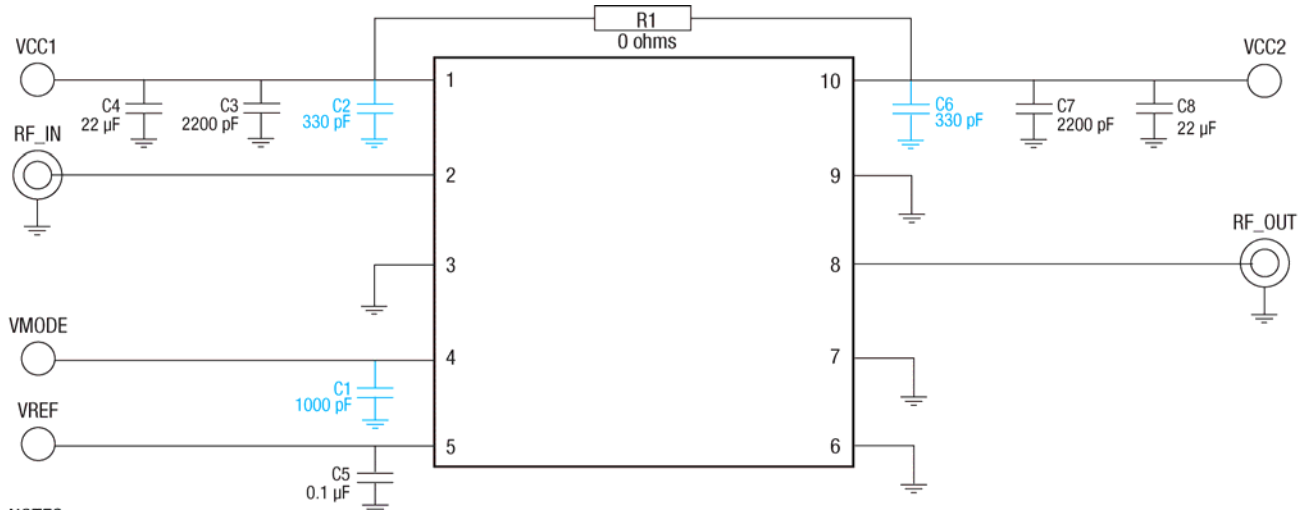
<sup>4</sup> For operation at V<sub>CC</sub> = 3.2 V, P<sub>OUT</sub> is derated by 0.25 dB

<sup>5</sup> All phases, time = 10 seconds.

### Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77166, the evaluation board schematic and diagram are

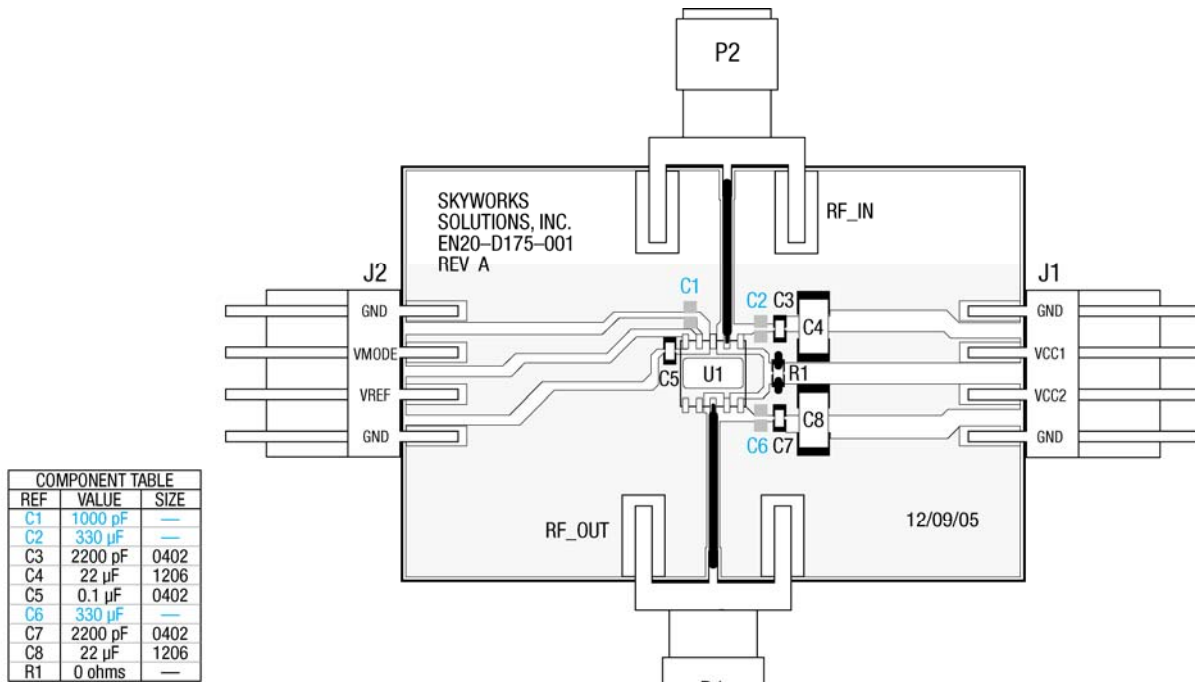
included for preliminary analysis and design. Figure 2 shows the basic schematic of the board for the 450 MHz to 460 MHz range and Figure 3 is the assembly diagram.



- NOTES:
1. C1, C2, C6 are optional and not placed on the evaluation board.
  2. When placing C2 or C6, locate at closest possible proximity to U1.

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Figure 2. Evaluation Board Schematic



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1. C1, C2, C6 are optional and not placed on the evaluation board.
  2. When placing C2 or C6, locate at closest possible proximity to U1.

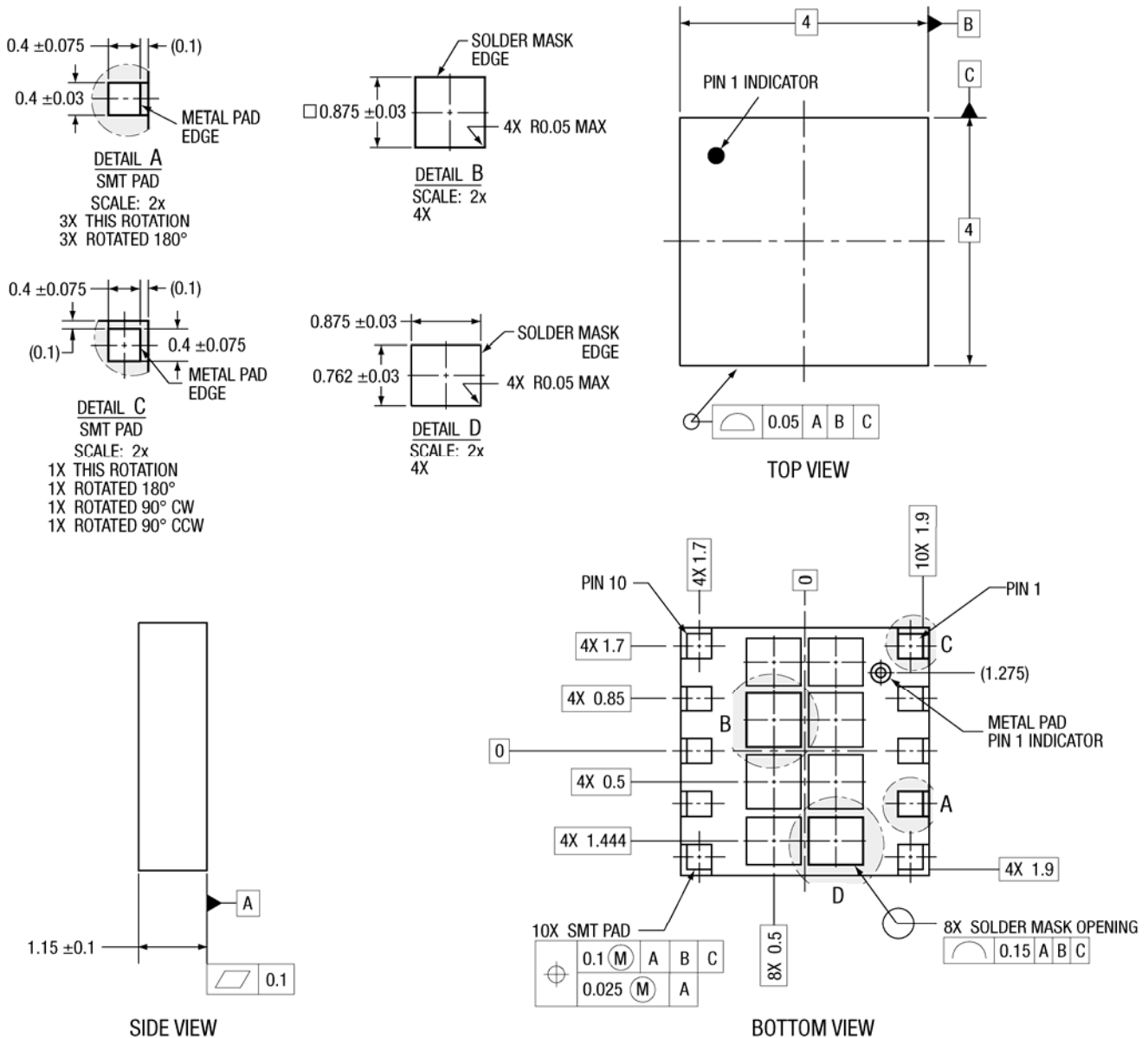
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Figure 3. Evaluation Board Assembly Diagram

**Package Dimensions and Pad Descriptions**

The SKY77166 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 4 is a mechanical drawing of the pad layout for this package. Figure 6 shows each

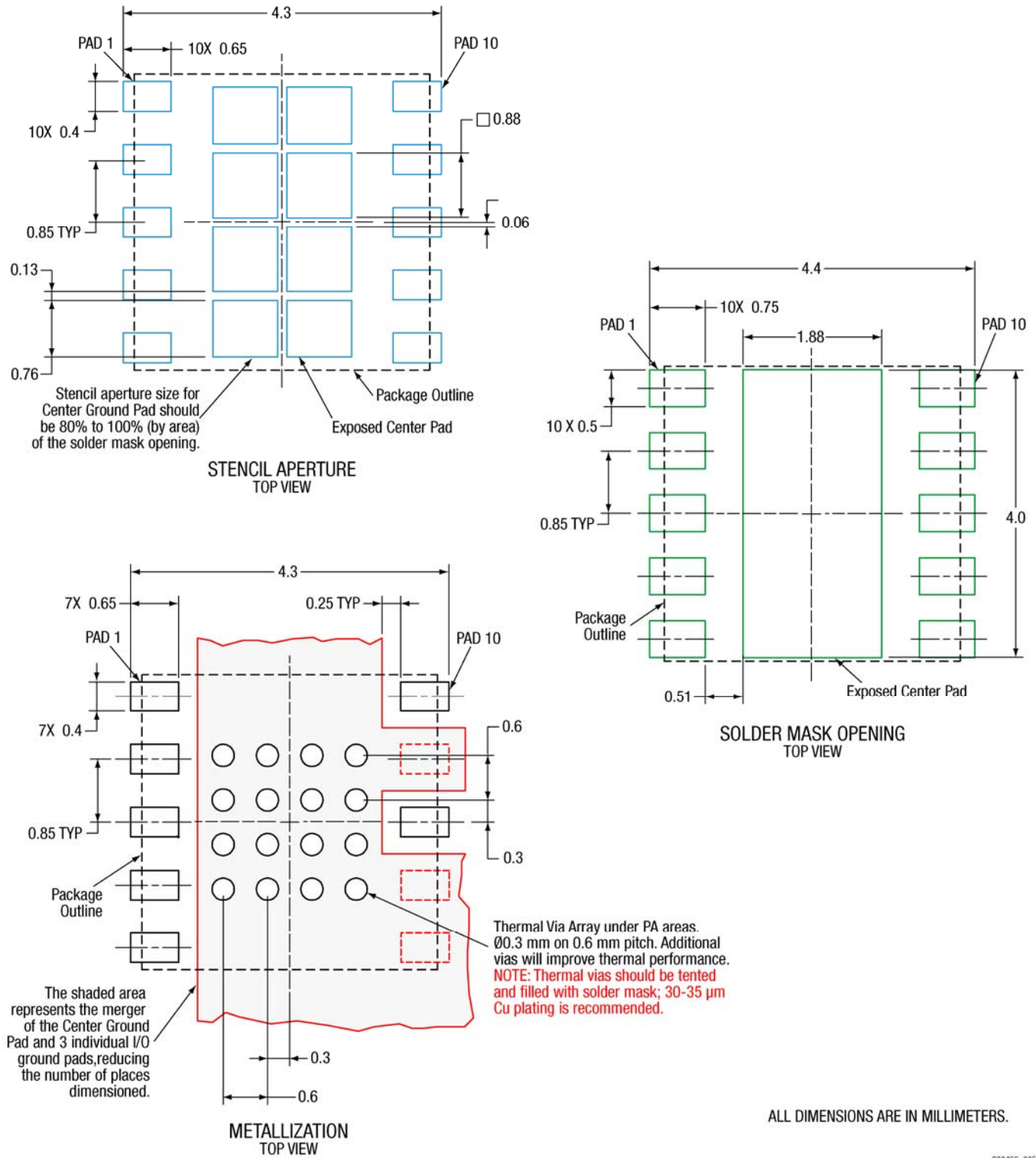
pad function and the pad numbering convention, which starts with pad 1 in the upper left and increments counter-clockwise around the package. Figure 7 illustrates typical case markings.



- NOTES: UNLESS OTHERWISE SPECIFIED
1. Dimensioning and Tolerancing in accordance with ASME Y14.5M-1994.
  2. All dimensions are in millimeters.
  3. Pads are solder mask defined on 3 edges and metal defined on 1 edge.

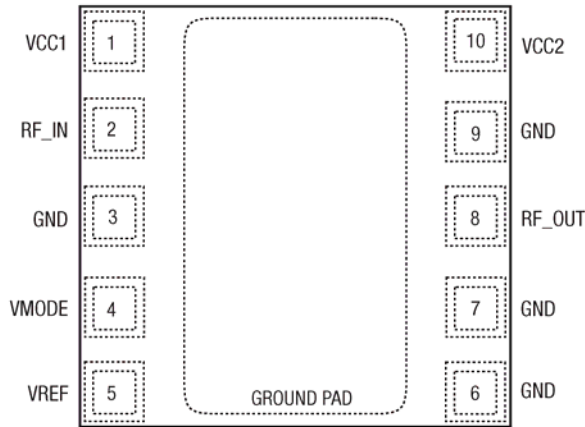
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**Figure 4. Dimensional Drawing – 4 x 4 x 1.15 mm, 10-Pad Package – SKY77166**



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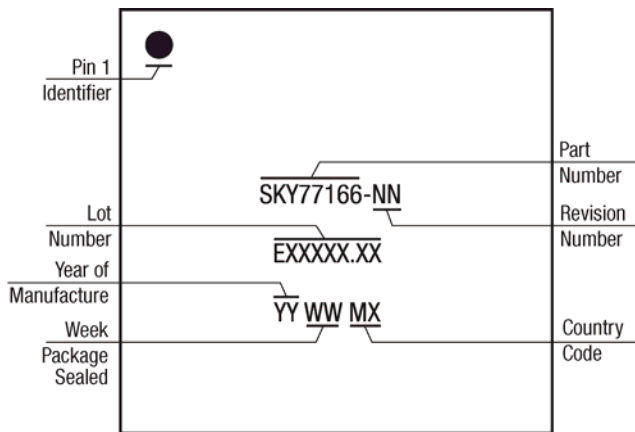
Figure 5. Phone PCB Layout Footprint for 4 x 4 mm, 10-Pad Package – SKY77166 Specific



Pad layout as seen from top view looking through package. Package underside is GROUND PAD.

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Figure 6. Pad Names and Configuration (Top View)



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Figure 7. Typical Case Markings – 4 x 4 mm Package

**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 SKY77166 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*.

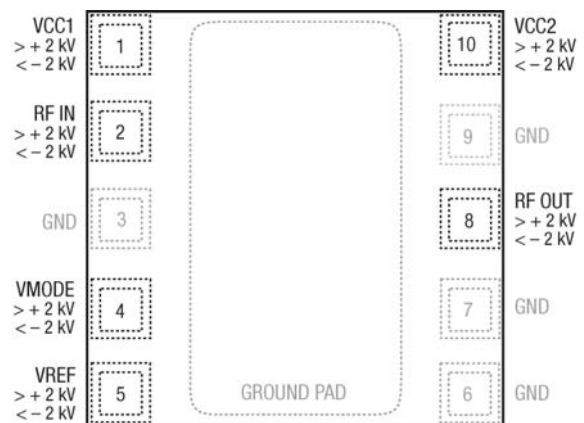
Production quantities of this product are shipped in the standard tape-and-reel format. For packaging details, refer to Skyworks Application Note: *Tape and Reel Information – RF Modules*, Document Number 101568.

**Electrostatic Discharge Sensitivity**

The SKY77166 is a Class 2 device. Figure 8 lists the Electrostatic Discharge (ESD) immunity level for each non-ground pad of the SKY77166 product. The numbers in Figure 8 specify the ESD threshold level for each pad where the I-V curve between the pad 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 pad, 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 pad fails the electrical specification limits” or “the pad becomes completely non-functional”. Skyworks employs most stringent criteria and fails devices as soon as the pad begins to show any degradation on a curve tracer.



Pad layout as seen from top view looking through package.

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Figure 8. ESD Sensitivity of Non-Ground Pads (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
SKY77166	SKY77166		MCM 4x4	-30 °C to +85 °C

## Revision History

Revision	Level	Date	Description
P1		September 22, 2006	Advance Information
A		February 15, 2007	Revise: Change data sheet Revision suffix from P1 to A (Advance data sheet status continues); Table 4
B		December 6, 2007	Revise: Figures 1, 2, 3, 6–8; 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 (current revision).

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