ADVANCE DATA SHEET

SKY77185 Power Amplifier Module for WCDMA / HSDPA (1920–1980 MHz)

Applications

- WCDMA handsets
- HSDPA

Features

- Low voltage positive bias supply
  - 3.2 V to 4.2 V
- Good linearity
- High efficiency
  - 40% @ 26.5 dBm
- Large dynamic range
- 10-pad package
  - 3 x 3 x 0.85 mm
- Power down control
- InGaP
- Supports low collector voltage operation
- Digital Enable
- No V_{REF} required
- CMOS compatible control signals

NEW

Skyworks Green™ products are lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, and are free from antimony trioxide and brominated flame retardants.

The SKY77185 Power Amplifier Module (PAM) is a fully matched 10-pad surface mount module developed for Wideband Code Division Multiple Access (WCDMA) applications. This small and efficient module packs full 1920–1980 MHz bandwidth coverage into a single compact package. Because of high efficiencies attained throughout the entire power range, the SKY77185 delivers unsurpassed talk-time advantages. The SKY77185 meets the stringent spectral linearity requirements of High Speed Downlink Packet Access (HSDPA) data transmission with high power added efficiency. A directional coupler is integrated into the module thus eliminating the need for any external coupler.

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. Output match into a 50-ohm load is realized off-chip within the module package to optimize efficiency and power performance.

The SKY77185 PAM is manufactured with Skyworks' InGaP GaAs Heterojunction Bipolar Transistor (HBT) BiFET process that provides for all positive voltage DC supply operation while maintaining high efficiency and good linearity. Primary bias to the SKY77185 is supplied directly from any 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. No VREF voltage is required. Power down is accomplished by setting the voltage on VENABLE 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.

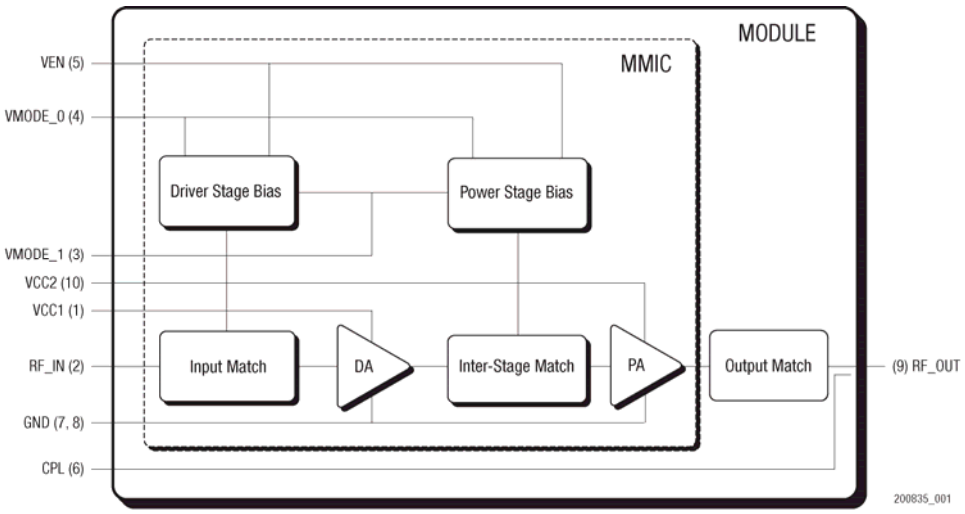


Figure 1. Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77185 Power Amplifier. Table 1 lists the absolute maximum ratings, while Table 2 shows the recommended operating conditions to achieve WCDMA and HSDPA 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	10	dBm
Supply Voltage		V_{CC1}, V_{CC2}	—	3.4	6.0	Volts
Control Voltage		V_{EN} V_{MODE_0} V_{MODE_1}	—	1.8	4.2	Volts
Case Temperature [2]	Operating	T_C	–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 (T_C) 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
Linear Power Output		P_O	—	—	26.5	dBm
Maximum Power Output		P_O	—	—	28.0	
Operating Frequency		F_O	1920.0	1950.0	1980.0	MHz
Supply Voltage		V_{CC1}, V_{CC2}	3.2 [1]	3.4	4.2	Volts
Enable Control Voltage	Low	V_{EN_L}	0.0	—	0.5	Volts
	High	V_{EN_H}	1.35	—	3.1	
Control Voltage	Low	V_{MODE_0} V_{MODE_1}	0.0	—	0.5	Volts
	High	V_{MODE_0} V_{MODE_1}	1.35	—	3.1	
Case Operating Temperature		T_C	–30	+25	+85	°C

1 Recommended minimum V_{CC} for maximum power output is indicated. V_{CC2} down to 0.5 V may be used for backed-off power when using DC/DC converter to conserve battery current.

Table 3. Modes of Operation

Power Setting	ENABLE	VMODE_0	VMODE_1	VCC
Power Down	Low	Low	Low	On
Standby Mode	Low	X	X	On
High-Power Mode (17.0 dBm ≤ P_{OUT} ≤ 26.5 dBm	High	Low	Low	On
Medium-Power Mode (7.0 dBm ≤ P_{OUT} ≤ 17.0 dBm)	High	High	Low	On
Low-Power Mode (P_{OUT} ≤ 7.0 dBm)	High	High	High	On
Optional Lower VCC in Low-Power Mode (P_{OUT} ≤ 7.0 dBm)	High	Low	Low	1.5 V

Note: Two pads are available for PA control that allow for a total of four states.

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

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Gain Conditions		G_{LOW}	P_O = 0 dBm	—	TBD	—	dB
		G_{MID}	P_O = 17.0 dBm	—	20	—	
		G_{HIGH}	P_O = 26.5 dBm	—	27	—	
Power Added Efficiency		PAE_{LOW}	P_O = 0 dBm	—	TBD	—	%
		PAE_{MID}	P_O = 17.0 dBm	—	20	—	
		PAE_{HIGH}	P_O = 26.5 dBm	—	40	—	
Total Supply Current		I_{CC_LOW}	P_O = 0 dBm	—	TBD	—	mA
		I_{CC_MID}	P_O = 17.0 dBm	—	55	—	
		I_{CC_HIGH}	P_O = 26.5 dBm	—	330	—	
Quiescent Current		I_{Q_MID}	Medium Power Mode	—	25	—	mA
		I_{Q_HIGH}	High Power Mode	—	90	—	
Enable Current		I_{EN}	—	—	—	1.0	mA
Total Supply Current in Power-down Mode		I_{PD}	V_{CC} = 3.4 V V_{EN} = Low	—	—	20	µA
Adjacent Channel Leakage power Ratio [2]	5 MHz offset	ACLR5	P_O = 0 dBm	—	–42	–34	dBc
			P_O = 17.0 dBm	—	–46	–34	
			P_O = 26.5 dBm	—	–40	–34	
	10 MHz offset	ACLR10	P_O = 0 dBm	—	–65	–44	
			P_O = 17.0 dBm	—	–60	–44	
			P_O = 26.5 dBm	—	–55	–44	
Harmonic Suppression	Second	fo2	$P_O \leq$ 26.5 dBm	—	–45	–30	dBc
	Third	fo3		—	–35	–30	
Noise Power in RX Band 2110-2170 MHz		RxBN	$P_O \leq$ 26.5 dBm	—	–140	–138	dBm/Hz
Input Voltage Standing Wave Ratio (VSWR)		VSWR	—	—	1.5:1	2.5:1	—
Coupling Factor		P_CPL	P_O = 26.5 dBm	—	17	—	dB
Stability (Spurious output)		S	5:1 VSWR All phases	—	—	–70	dBc
Ruggedness [3]		Ru	$P_O \leq$ 28.0 dBm	10:1	—	—	VSWR

1 Unless specified otherwise: V_{CC} = +3.4 V, Temp = +25 °C; Freq. = 1950 MHz for Voice and HSDPA.

2 ACLR is expressed as a ratio of total adjacent power to WCDMA modulated in-band, both measured in 3.84 MHz bandwidth at specified offsets.

3 All phases, time = 10 seconds.

Table 5. Modulation

STC1 = General Test Conditions (Voice)	
Modulation	HPSK modulated carrier in 3.8 MHz BW UL ref. meas. Chan. (12.2 kbps) from 3GPP TS 25.101 Annex A sec. A.2.1. 1 DPCCH @ 15 ksps, Spread Code = 0, Relative Power = –6.547 dB 1 DPDCH @ 60 ksps, Spread Code = 16, Relative Power = –1.087 dB.
Pulse Rate	CW testing (not pulsed).
Input Power	Adjusted to meet output power requirement.
STC2 = General Test Conditions (HSDPA)	
Modulation	HPSK modulated carrier in 3.8 MHz BW 1 DPCCH @ 15 ksps, Spread Code = 0, Relative Power = –7.095 dB 1 DPCCH @ 60 ksps, Spread Code = 16 Relative Power = –5.157 dB 1 DPDCH @ 15 ksps, Spread Code = 64, Relative Power = –3.012 dB.
Pulse Rate	CW testing (not pulsed).
Input Power	Adjusted to meet output power requirement.

NOTES:

Measure the power in the 99% bandwidth channel for the ULTRA/FDD UL reference with a root-raised cosine (RRC) filter response of alpha 0.22 and a bandwidth of 3.84 MHz.

Measure emission power at ±X MHz offset, P±x MHz, in a Y kHz bandwidth with a root-raised cosine (RRC) filter response of alpha 0.22 and a bandwidth of 3.84 MHz.

Efficiency and idle current numbers include current consumption of any control voltages like VEN, V_{MODE_0} and V_{MODE_1}.

Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77185, the evaluation board schematic and assembly diagrams are included for preliminary analysis and design. Figure 2 shows the basic schematic of the board for the 1920 MHz to 1980 MHz range.

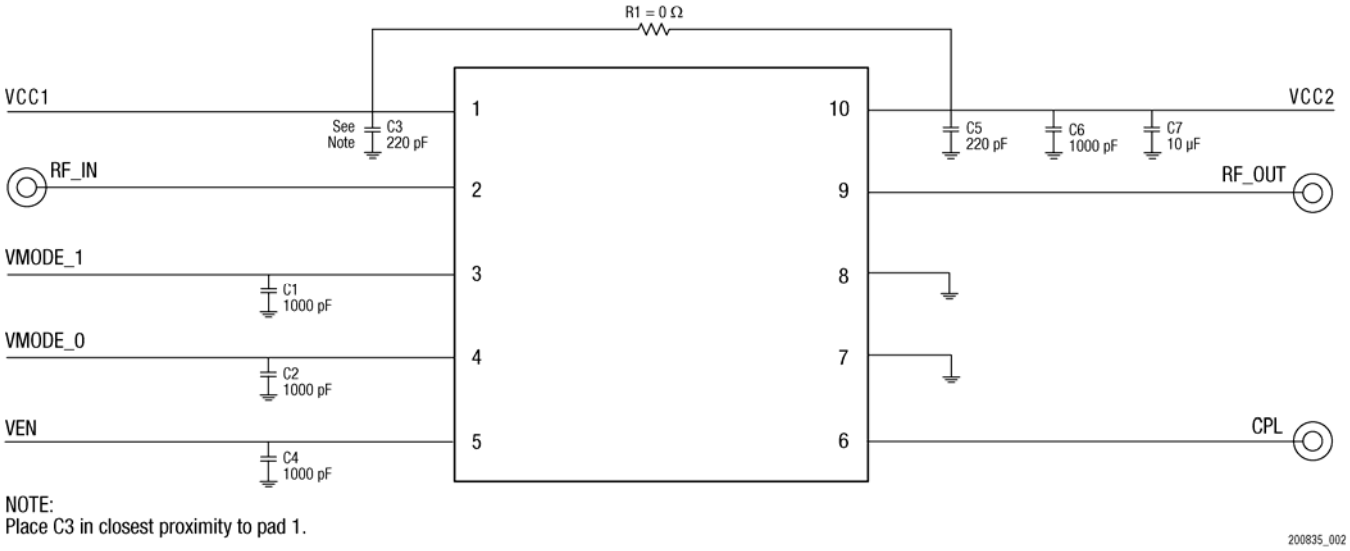
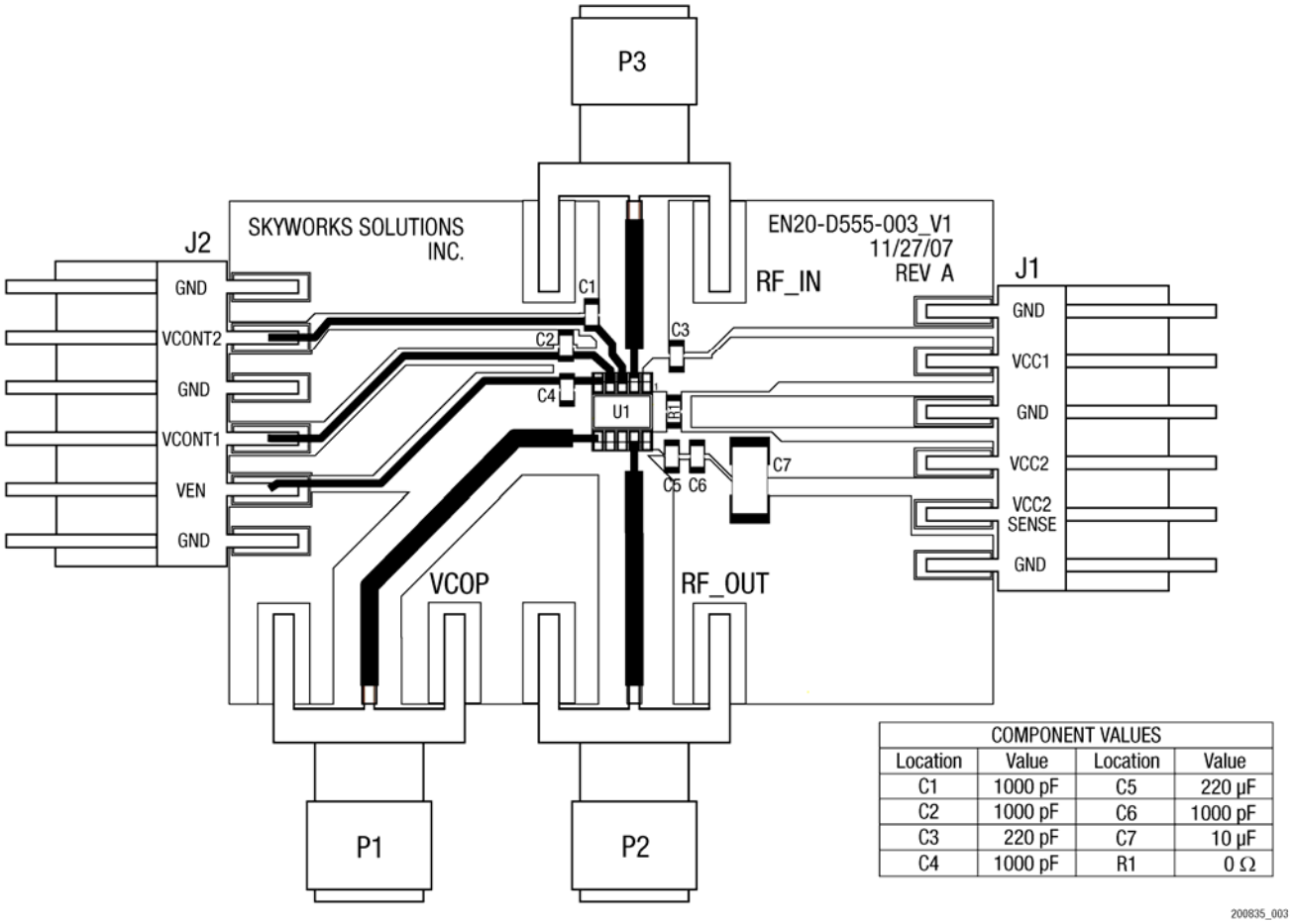


Figure 2. Evaluation Board Schematic

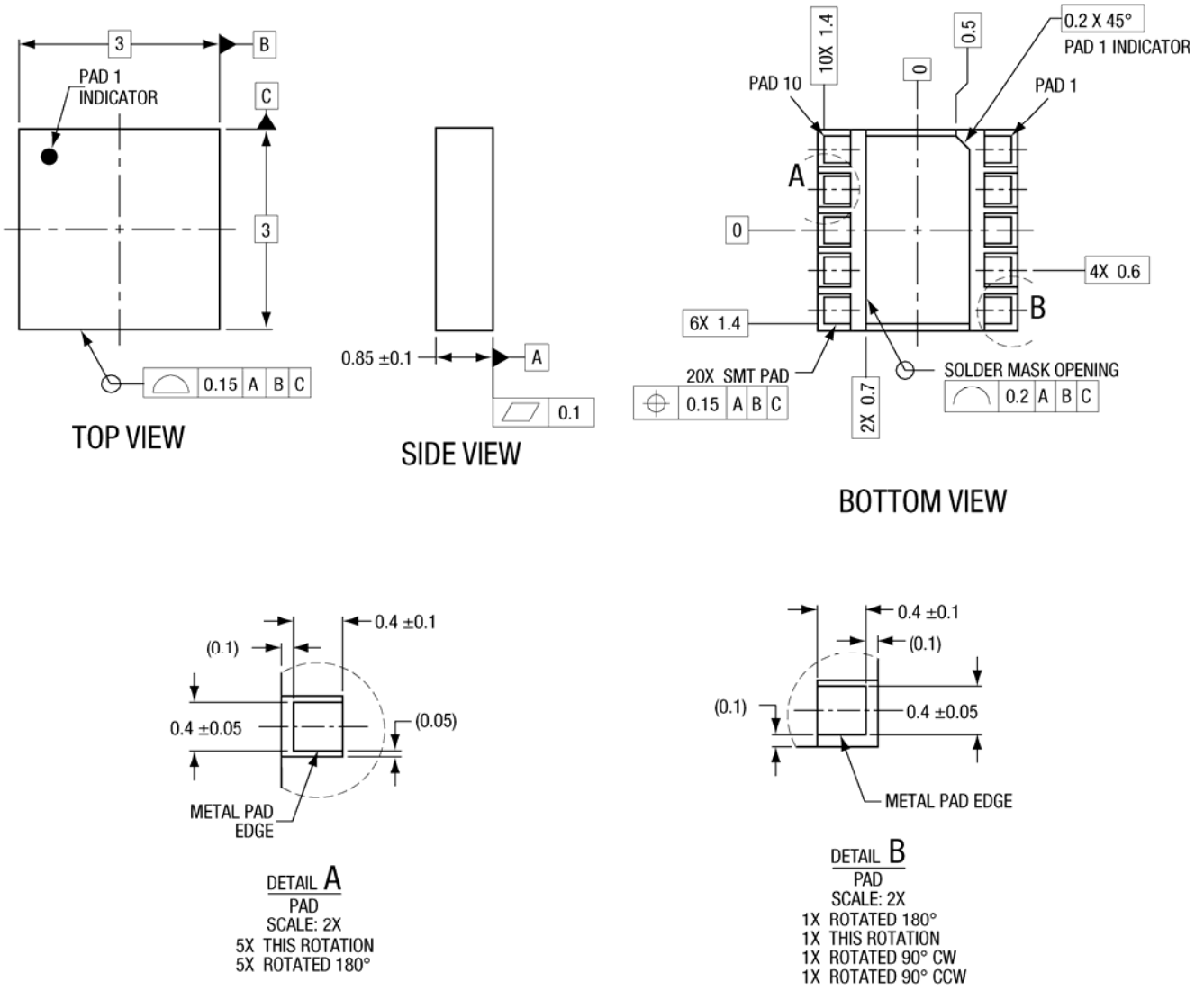


COMPONENT VALUES			
Location	Value	Location	Value
C1	1000 pF	C5	220 µF
C2	1000 pF	C6	1000 pF
C3	220 pF	C7	10 µF
C4	1000 pF	R1	0 Ω

Figure 3. Evaluation Board Assembly Diagram

Package Dimensions

The SKY77185 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 5 provides a recommended phone board layout footprint for the PAM to help the designer attain optimum thermal conductivity, good grounding, and minimum RF discontinuity for the 50-ohm terminals.



NOTES: Unless otherwise specified.
1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5 – 1994
2. SEE APPLICABLE DIAGRAM AND DEVICE ASSEMBLY DRAWING FOR DIE AND COMPONENT PLACEMENT.
3. PAD DEFINITIONS PER DETAILS ON DRAWING.
4. PCB TYPE 4L PPG TEV MCM (100).

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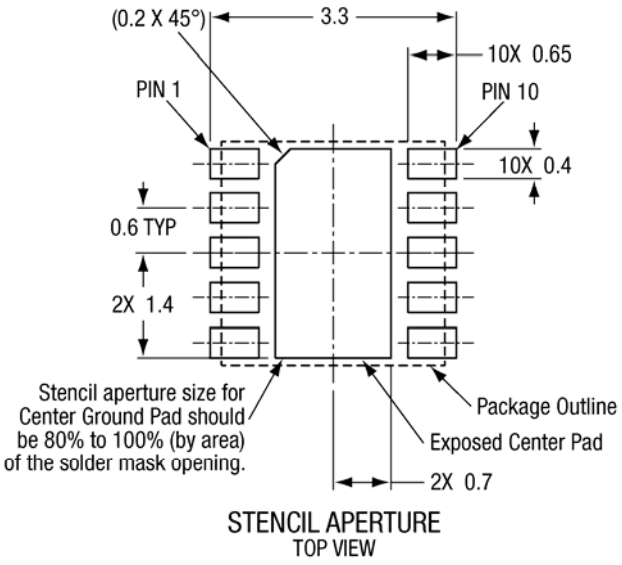
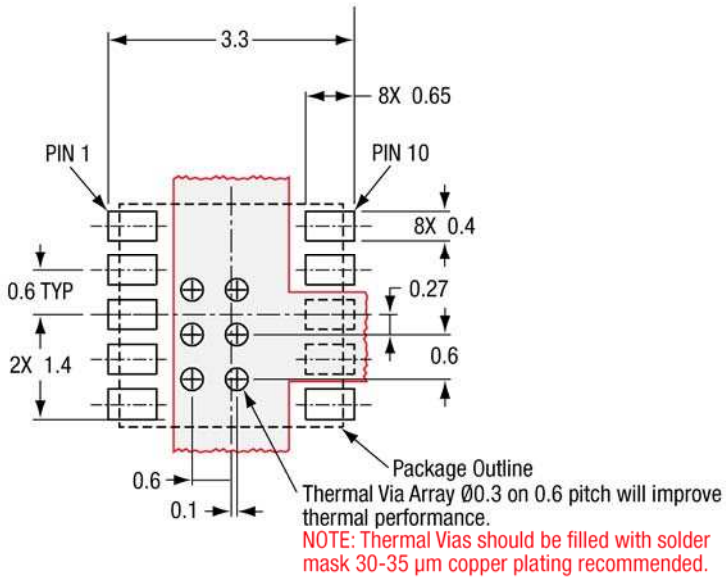
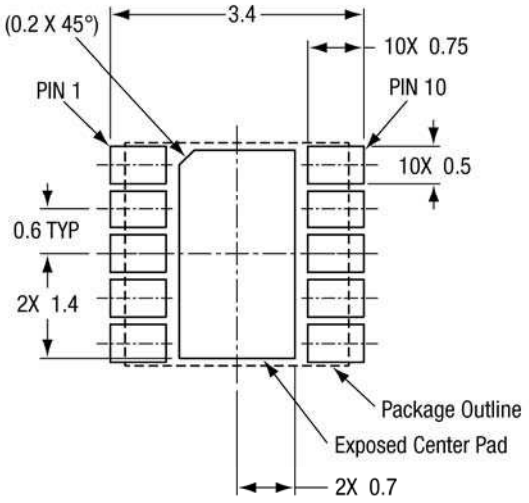
Figure 4. Dimensional Diagram for 3 mm x 3 mm x 0.85 mm Package – SKY77185



STENCIL APERTURE
TOP VIEW



METALLIZATION
TOP VIEW



SOLDER MASK OPENING
TOP VIEW

200835_005

Figure 5. Phone PCB Layout Diagram – 3 mm x 3 mm x 0.85 mm Package – SKY77185

Package Description

Figure 6 shows the pad functions and the pad numbering convention, which starts with pad 1 in the upper left and increments counter-clockwise around the package. Typical case markings are illustrated in Figure 7.

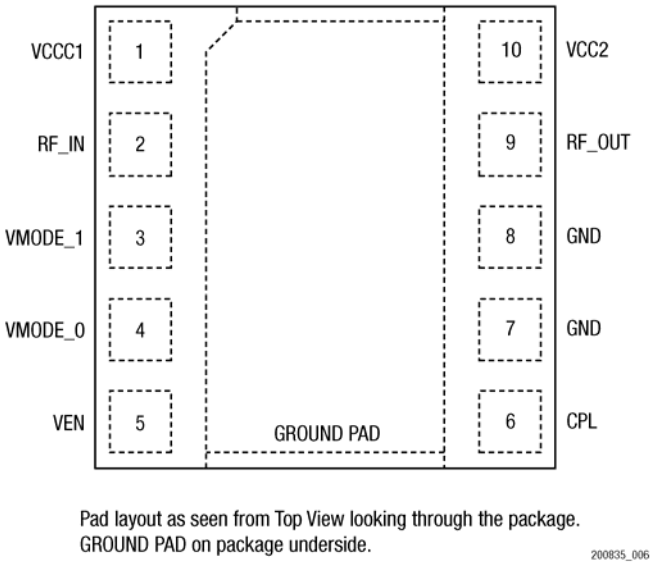


Figure 6. SKY77185 Pad Names and Configuration (Top View)

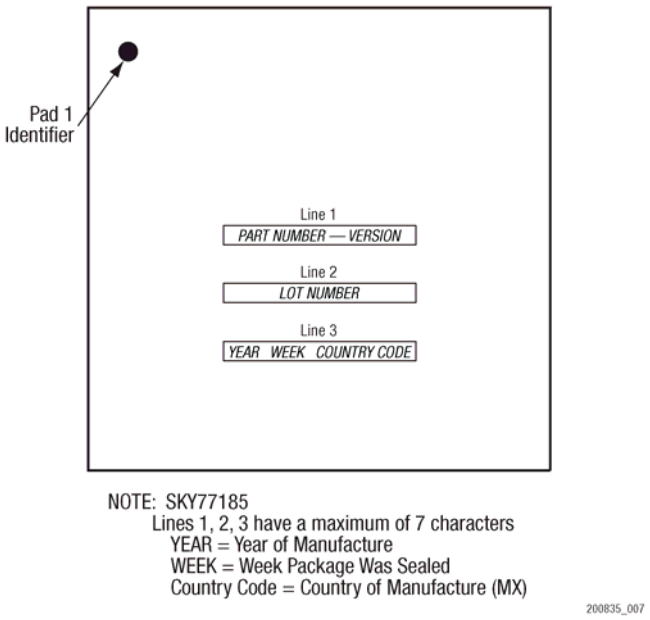


Figure 7. Typical Case Markings

Package 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 SKY77185 is capable of withstanding an MSL3/260 °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 260 °C. If the part is manually attached, precaution should be taken to insure that the part is not subjected to temperatures exceeding 260 °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 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.

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 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
SKY77185	SKY77185		MCM 3 x 3 x 0.85 mm	–30 °C to +85 °C

Revision History

Revision	Date	Description
A	February 28, 2008	Initial Release – Preliminary Information
B	May 19, 2008	Revise: Tables 1–5; Figures 1–6 Add: Skyworks Green tag (p1)

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