

ADVANCE DATA SHEET

SKY77189 Power Amplifier Module for WCDMA / HSDPA Band VIII (880–915 MHz)

Applications

- WCDMA handsets
- HSDPA

Features

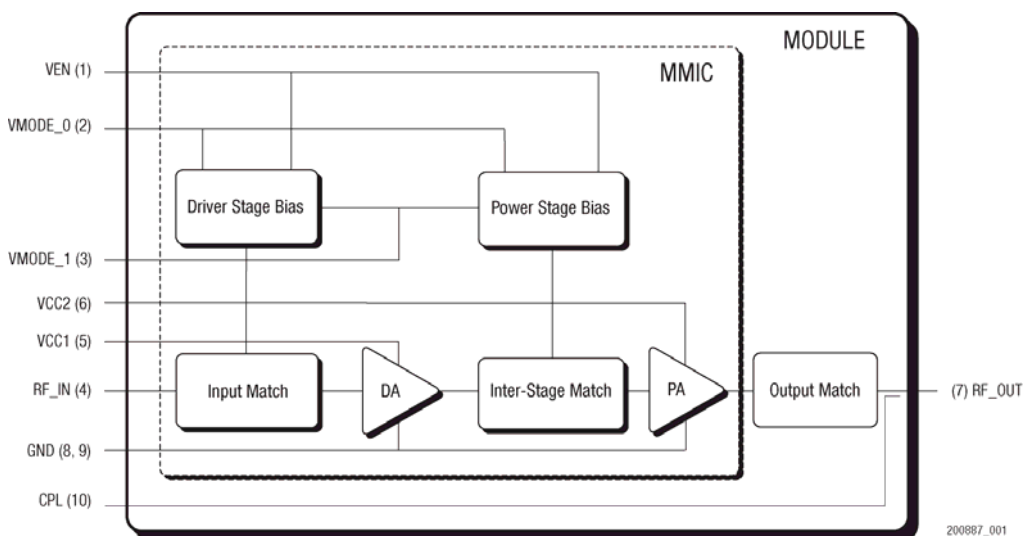
- Low voltage positive bias supply
3.2 V to 4.2 V
- Good linearity
- High efficiency
- 40% @ 28.75 dBm
- Large dynamic range
- 10-pad package
- 3 x 3 x 0.85 mm
- Power down control
- InGaP
- Supports low collector voltage operation
- Digital Enable
- No V_{REF} required
- CMOS compatible control signals
- Integrated Directional Coupler

The SKY77189 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 880–915 MHz bandwidth coverage into a single compact package. Because of high efficiencies attained throughout the entire power range, the SKY77189 delivers unsurpassed talk-time advantages. The SKY77189 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 SKY77189 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 SKY77189 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 V_{REF} voltage is required. Power down is accomplished by setting the voltage on V_{ENABLE} 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 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.

**Figure 1. Functional Block Diagram**

Electrical Specifications

The following tables list the electrical characteristics of the SKY77189 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 5](#) and [Table 6](#) provide the standard test configurations for WCDMA (STC1) and HSDPA (STC2), respectively.

Table 1. Absolute Maximum Ratings¹

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
Enable Control Voltage	V _{EN}	—	1.8	4.2	Volts
Mode Control Voltage	V _{MODE_0}	—	1.8	4.2	Volts
	V _{MODE_1}	—	1.8	4.2	
Case Temperature ²	Operating	T _{CASE}	–30	25	°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_{CASE}) 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
RF Output Power ¹	WCDMA	P _{O_MAX}	—	28.75	dBm
	HSDPA	P _{O_MAX}	—	27.75	
Operating Frequency	F ₀	880.0	897.5	915.0	MHz
Supply Voltage	V _{CC1} , V _{CC2}	3.2 ²	3.4	4.2	Volts
Enable Control Voltage	Low	V _{EN_L}	0.0	0.0	Volts
	High	V _{EN_H}	1.35	1.8	
Mode Control Voltage	Low	V _{MODE_0}	1.35	1.8	Volts
		V _{MODE_1}	1.35	1.8	
	Medium	V _{MODE_0}	1.35	1.8	
		V _{MODE_1}	0.0	0.0	
	High	V _{MODE_0}	0.0	0.0	
		V _{MODE_1}	0.0	0.0	
Case Operating Temperature	T _{CASE}	–20	+25	+85	°C

¹ For V_{CC} < 3.4 V, output power back-off = 0.5 dB.

² 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	V _{MODE_0}	V _{MODE_1}	V _{CC}
Power Down Mode	Low	Low	Low	0n
Standby Mode	Low	—	—	0n
High Power Mode (17.0 dBm ≤ P _{OUT} ≤ 28.75 dBm)	High	Low	Low	0n
Medium Power Mode (7.0 dBm ≤ P _{OUT} ≤ 17.0 dBm)	High	High	Low	0n
Low Power Mode (P _{OUT} ≤ 7.0 dBm)	High	High	High	0n
Optional Lower V _{CC} Mode (P _{OUT} ≤ 7.0 dBm)	High	Low	Low	1.5 V

BAND VIII (880–915 MHz)

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Table 4. Electrical Specifications for Nominal Operating Conditions ¹

Characteristics	Symbol	Condition	Minimum	Typical	Maximum	Unit
Gain	G _{LOW}	P ₀ = 7.0 dBm	8.0	12.0	16.0	dB
	G _{MID}	P ₀ = 17.0 dBm	13.0	18.0	24.0	
	G _{HIGH}	P ₀ = 28.75 dBm	24.5	27.0	29.5	
Rx Band Gain	RxG	—	—	—	−0.5	dB
	RxG_GPS	—	—	−14.0	−3.0	
	RxG_ISM	—	—	−20.0	−6.0	
Power Added Efficiency	PAE _{LOW}	P ₀ = 7.0 dBm	—	9.0	—	%
	PAE _{MID}	P ₀ = 17.0 dBm	—	16.5	—	
	PAE _{HIGH}	P ₀ = 28.75 dBm	40.0	—	—	
Total Supply Current	I _{CC_LOW}	P ₀ = 7.0 dBm	—	7.5	—	mA
	I _{CC_MID}	P ₀ = 17.0 dBm	—	40.0	—	
	I _{CC_HIGH}	P ₀ = 28.75 dBm	—	—	550	
Quiescent Current	I _{Q_LOW}	Low Power Mode	—	2.5	—	mA
	I _{Q_MED}	Medium Power Mode	—	10.0	—	
Enable Control Current	I _{EN}	—	—	0.01	0.1	mA
Mode Control Current	I _{MODE_0}	—	—	0.05	0.1	mA
	I _{MODE_1}	—	—	0.05	0.1	
Total Supply Current in Power Down Mode	I _{PD}	V _{CC} = 3.4 V V _{EN} = Low V _{MODE_0} = Low V _{MODE_1} = Low	—	—	10	μA
Adjacent Channel Leakage power Ratio ²	5 MHz offset	ACLR5	P ₀ = 7.0 dBm	—	−42	dBc
			P ₀ = 17.0 dBm	—	−46	
			P ₀ = 28.75 dBm	—	−40	
	10 MHz offset	ACLR10	P ₀ = 7.0 dBm	—	−65	
			P ₀ = 17.0 dBm	—	−60	
			P ₀ = 28.75 dBm	—	−55	
Harmonic Suppression	Second	f ₀₂	P ₀ ≤ 28.75 dBm	—	−45	dBc
	Third	f ₀₃		—	−50	
Tx Noise in Rx Bands	Rx		925 MHz–960 MHz	—	−138	dBm/Hz
	GPS Rx		1574 MHz–1577 MHz	—	−142	
	ISM Rx		2400 MHz–2483.5 MHz	—	−145	
Input Voltage Standing Wave Ratio	VSWR	—	—	1.5:1	1.8:1	—
EVM	EVM1	P ₀ = P _{MAX}	—	—	3.35	%
	EVM2	P ₀ = P _{MAX} − 3	—	—	2.50	
Rise / Fall Time	DC	T _{ONDC}	—	—	20	μs
		T _{OFFDC}	—	—	20	
	RF	T _{ONRF}	—	—	6	
		T _{OFFRF}	—	—	6	
Coupling Factor	CPL	P ₀ = 28.75 dBm	—	−18	—	dB
Stability (Spurious output)	S	5:1 VSWR All phases	—	—	−70	dBc
Ruggedness – no damage ³	Ru	P ₀ ≤ 28.75 dBm	10:1	—	—	VSWR

¹ Per Table 2 over dynamic range up to 28.75 dBm output power, unless specified otherwise.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. Standard Test Configuration – STC1 WCDMA Mode

Parameter	Level	Spread Code	Spread Factor	I/Q	β_c	β_d	β_{hs}	β_{ec}	β_{ed}	Relative Power (dB)
DPCCH	15 kbps	0	256	Q	8/15	—	—	—	—	-6.547
DPDCH	60 kbps	16	64	I	—	15/15	—	—	—	-1.087

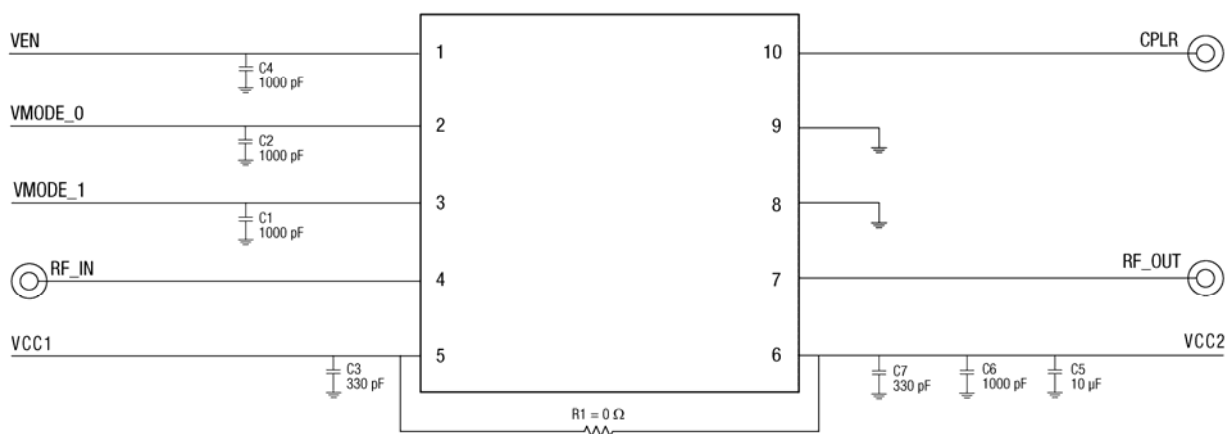
Table 6. Standard Test Configuration – STC2 HSDPA Mode

Parameter	Level	Spread Code	Spread Factor	I/Q	β_c	β_d	β_{hs}	β_{ec}	β_{ed}	Relative Power (dB)
DPCCH	15 kbps	0	256	Q	12/15	—	—	—	—	-7.095
DPDCH	60 kbps	16	64	I	—	15/15	—	—	—	-5.157
HS-DPCCH	15 kbps	64	256	Q	—	—	24/15	—	—	-3.012

Evaluation Board Description

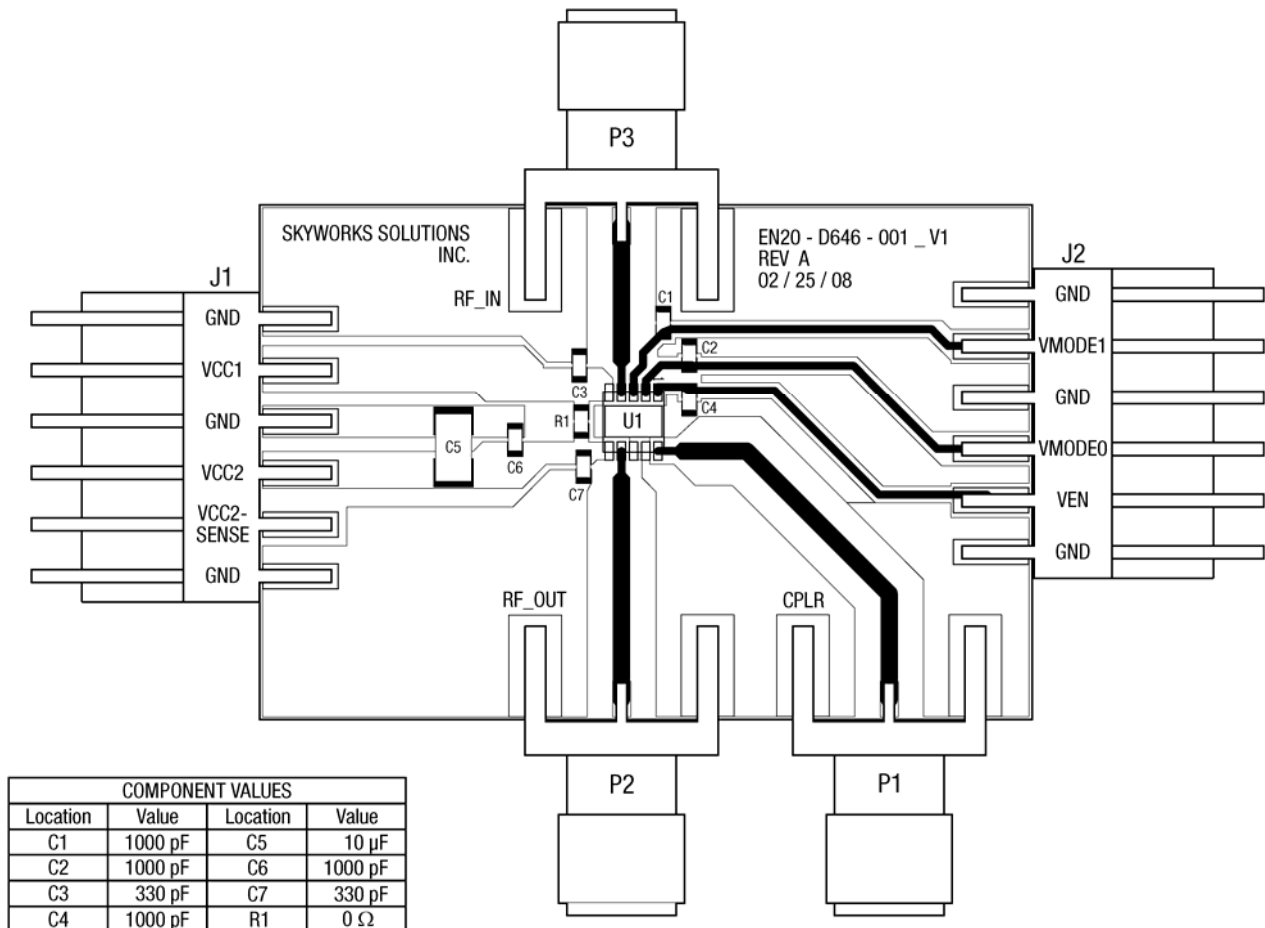
The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77189, the evaluation board schematic and assembly

diagrams are included for preliminary analysis and design. [Figure 2](#) shows the basic schematic of the board for the 880 MHz to 915MHz range.



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Figure 2. Evaluation Board Schematic



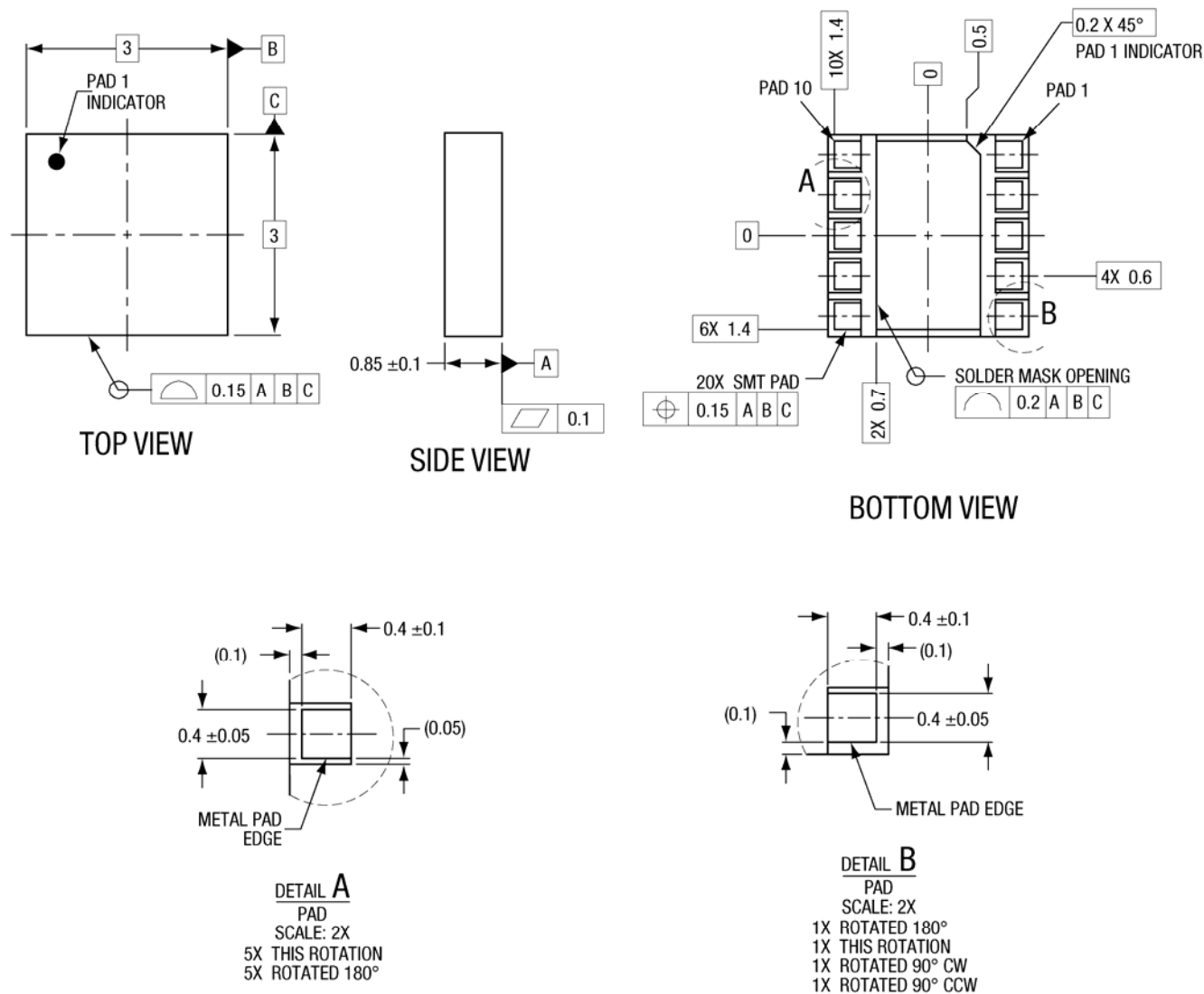
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Figure 3. Evaluation Board Assembly Diagram

Package Dimensions

The SKY77189 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.

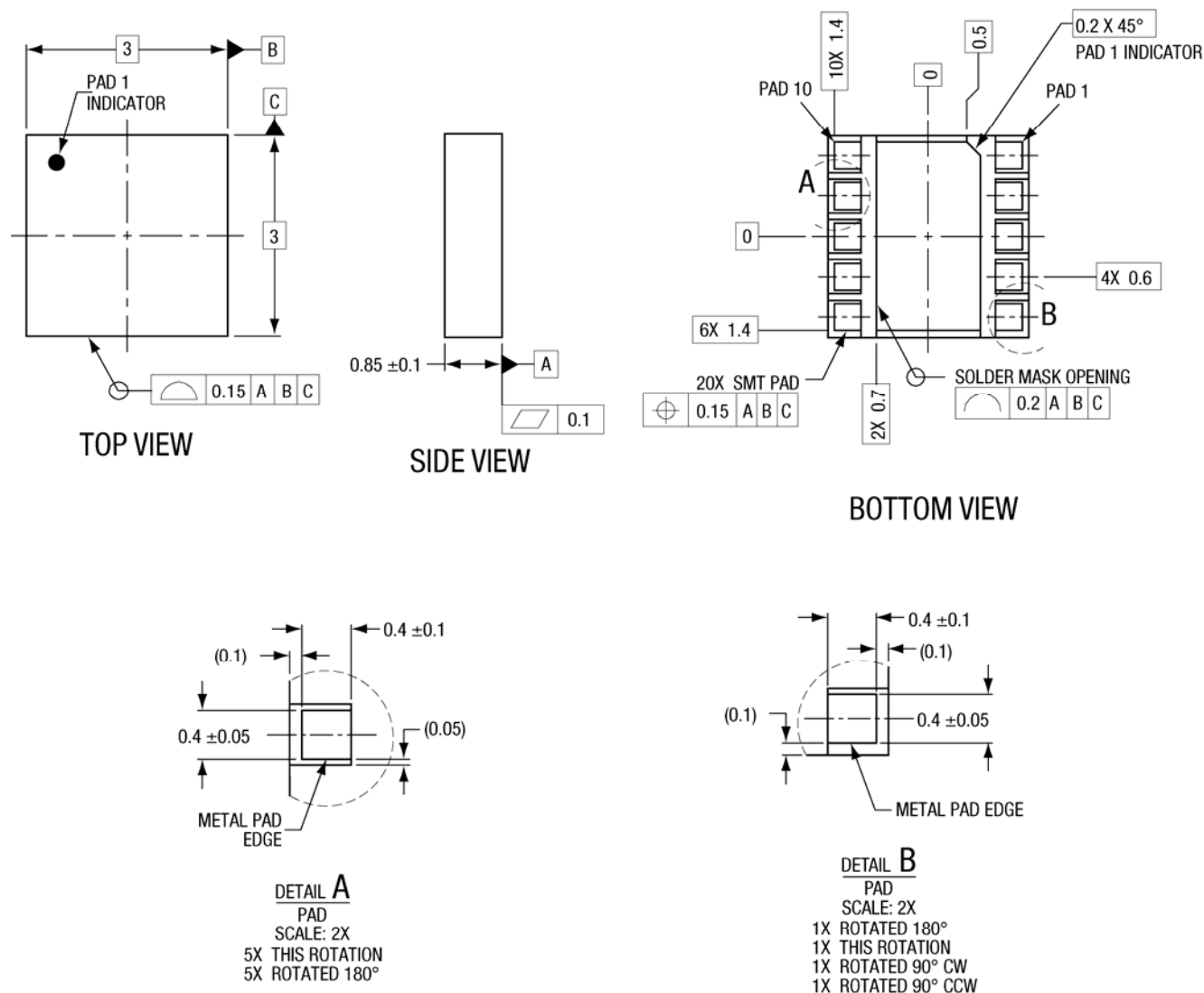


NOTES: Unless otherwise specified.

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 – SKY77189 Specific



NOTES: Unless otherwise specified.

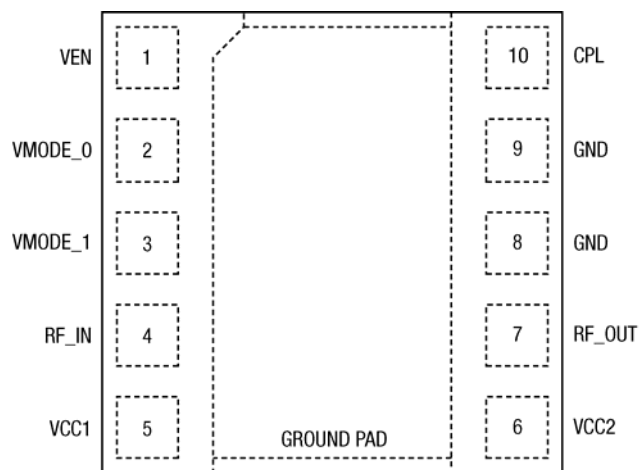
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4. PCB TYPE 4L PPG TEV MCM (100).

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Figure 5. Phone PCB Layout Diagram – 3 mm x 3 mm, 10-Pad Package – SKY77189

Package Description

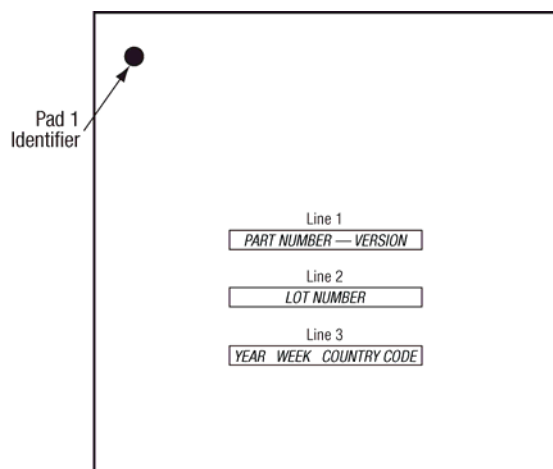
Figure 6 shows the pad functions and the pad numbering convention, which starts with pad 1 in the upper left and increments counter-clockwise around the package. Typical case markings are illustrated in Figure 7.



Pad layout as seen from Top View looking through the package.
GROUND PAD is package underside.

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Figure 6. SKY77189 Pad Names and Configuration (Top View)



NOTE: SKY77189
Lines 1, 2, 3 have a maximum of 7 characters
YEAR = Year of Manufacture
WEEK = Week Package Was Sealed
Country Code = Country of Manufacture (MX)

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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 SKY77189 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 (ESD)

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
SKY77189	SKY77189		MCM 3 x 3 x 0.85 mm	-20 °C to +85 °C

Revision History

Revision	Date	Description
A	April 4, 2008	Initial Release – Advance Information
B	April 23, 2008	Revise: Tables 1–4; Figures 1–3, 6; Tx freq. to 880–915; Rx freq. to 925–960
C	May 20, 2008	Revise: Features list (p1); Tables 1, 2, 4, 5; Figures 2–5; Add: Skyworks Green tag (p1)
D	November 13, 2008	Revise: Features list (p1); Figure 3; Tables 1–4; ESD section Add: Tables 5, 6
E	February 3, 2009	Revise: Order Information table, Package column

References

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

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

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

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