ADVANCE DATA SHEET

SKY77446 LIPA® Module for WCDMA / HSDPA / HSUPA / HSPA+ Band I (1920–1980 MHz)

Applications

- WCDMA handsets

Features

- Low voltage positive bias supply
  - 3.0 V to 4.6 V
- Good linearity
- High efficiency at all power levels
  - 18.5% @ 15 dBm
- Large dynamic range
- Small low profile package
  - 4 mm x 3 mm x 0.9 mm
  - 10-pad configuration
- Power down control
- InGaP
- Supports low collector voltage operation
- Digital V_{EN}
- No V_{REF} required
- Digital or analog control
- Integrated Directional Coupler

NEW Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain < 1,000 ppm antimony trioxide in polymeric materials.

The SKY77446 Load-Insensitive Power Amplifier (LIPA®) module 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 SKY77446 delivers unsurpassed talk-time advantages. The SKY77446 meets the stringent spectral linearity requirements of High Speed Downlink Packet Access (HSDPA) data transmission with high power added efficiency. A directional coupler integrated into the module eliminates 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 SKY77446 operates as a load-insensitive power amplifier providing high linearity in the presence of high RF mismatch up to 3:1 VSWR. The module 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. No VREF voltage is required. Power down is accomplished by setting the voltage on VEN 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.

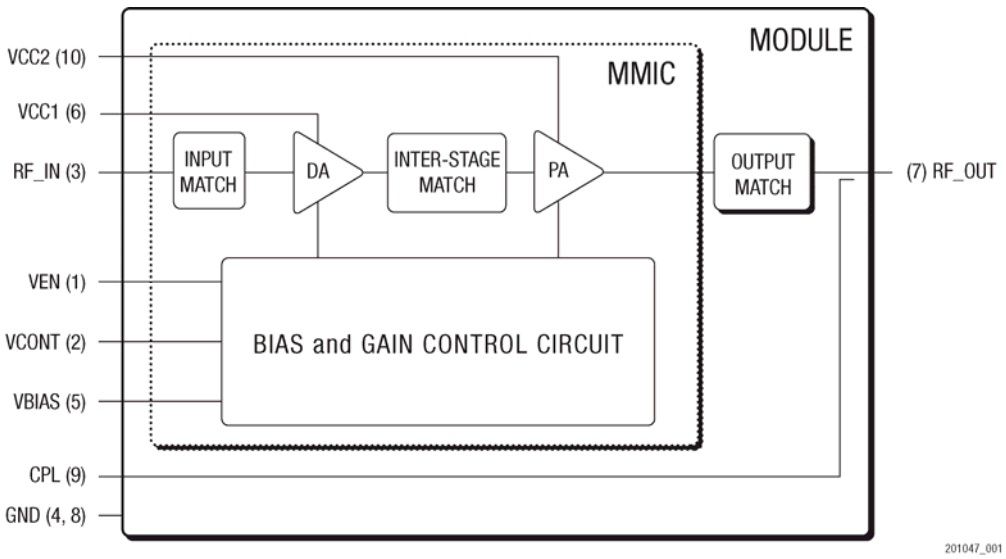


Figure 1. SKY77446 Functional Block Diagram

Electrical Specifications

The following tables list the electrical parameters of the SKY77446 Power Amplifier. Table 1 lists the absolute maximum ratings, while Table 2 shows the recommended operating conditions to achieve WCDMA and HSDPA performance parameters listed in Table 3. Standard test configurations for WCDMA (Mode_0) and HSDPA (Mode_1) are shown in Table 4 and Table 5, respectively.

Table 1. SKY77446 Absolute Maximum Ratings[1]

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
RF Input Power		P_{IN}	—	0	5	dBm
Supply Voltage	No RF	V_{CC1} V_{CC2} V_{BIAS}	—	—	7.0[2]	Volts
	With RF		—	—	4.6	
Enable Control Voltage		V_{EN}	—	—	3	Volts
Bias Control Voltage		V_{CONT}	—	—	1.9	Volts
Case Temperature[3]	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 At <7 V for <1 µs and <4.7 V after 1 µs.

3 Case Operating Temperature (T_{CASE}) refers to the temperature of the GROUND PAD at the underside of the package.

Table 2. SKY77446 Recommended Operating Conditions

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
RF Output Power[1]	Mode_0	P_{OUT_MAX}	—	—	26.8	dBm
	Mode_1	P_{OUT_MAX}	—	—	26.8	
Operating Frequency		f_O	1920	1950	1980	MHz
Supply Voltage		V_{CC1}, V_{CC2}	3.0[1]	3.4	4.6	Volts
		V_{BIAS}	3.0	3.3	4.6	
Enable Control Voltage	Low	V_{EN_L}	0.0	0.0	0.1	Volts
	High	V_{EN_H}	1.6	1.8	1.9	
Bias Control Voltage		V_{CONT}	0.6	1.5	1.9	Volts
Case Operating Temperature		T_{CASE}	–20	+25	+85	°C

1 Recommended minimum VCC1 and VCC2 for maximum output power is indicated. VCC1 and V_{CC2} down to 1.1 V may be used for backed-off power when using DC/DC converter to conserve battery current.

Table 3. SKY77446 Electrical Specifications for Nominal Operating Conditions[1]

Parameter	Symbol	Condition	Minimum	Typical	Maximum	Unit
Gain	G_{LOW}	V_{CC} = 1.1 V V_{CONT} = 1.2 V P_{OUT} = 15 dBm	—	16.5	—	dB
	G_{HIGH}	V_{CONT} = 1.5 V P_{OUT} = P_{OUT_MAX}	—	28.0	—	
Out of Band Gain	G_LOWFREQ	470 MHz to 770 MHz	—	—	23	dB
	G_BAND_V_Rx	869 MHz to 894 MHz	—	—	24	
	G_GPS_Rx	1570 MHz to 1580 MHz	—	—	31	
	G_BAND_III_Rx	1805 MHz to 1880 MHz	—	—	31	
	G_PHS	1884.5 MHz to 1919.6 MHz	—	—	33	
	G_BAND_I_Rx	2110 MHz to 2170 MHz	—	—	31	
	G_BT	2402 MHz to 2480 MHz	—	—	28	
	G_B_2Rx	2620 MHz to 2690 MHz	—	—	28	
	G_2f_0	3840 MHZ to 3960 MHz	—	—	8	
	G_nf_0	5760 MHz to 11880 MHz	—	—	3	
Power Added Efficiency	PAE_{LOW}	V_{CC} = 1.1 V V_{CONT} = 1.2 V P_{OUT} = 15 dBm	—	18.5	—	%
	PAE_{HIGH}	V_{CONT} = 1.5 V P_{OUT} = P_{OUT_MAX}	—	31.0	—	
Total Supply Current	I_{CC_LOW}	V_{CC} = 1.1 V V_{CONT} = 1.2 V P_{OUT} = 15 dBm	—	135	—	mA
	I_{CC_HIGH}	V_{CONT} = 1.5 V P_{OUT} = P_{OUT_MAX}	—	515	—	
Quiescent Current	I_{Q_LOW}		—	35	—	mA
	I_{Q_HIGH}		—	120	—	
Digital Enable Control Current	I_{EN}	—	—	1	—	µA
Leakage Current	I_{LAEK}	V_{CC} = 4.5 V V_{CONT} = 0 V V_{EN} = 0 V	—	3	11	µA
Adjacent Channel Leakage power Ratio[2]	ACLR5	V_{CONT} = 1.5 V P_{OUT} = P_{OUT_MAX}	—	–41	—	dBc
		V_{CC} = 1.1 V V_{CONT} = 1.2 V P_{OUT} = 15 dBm	—	–46	—	
	ACLR10	V_{CONT} = 1.5 V P_{OUT} = P_{OUT_MAX}	—	–54	—	
		V_{CC} = 1.1 V V_{CONT} = 1.2 V P_{OUT} = 15 dBm	—	–60	—	
Harmonic Suppression	$f_0$2	$P_{OUT} \le P_{OUT\_MAX}$	—	—	–11	dBm
	$f_0$3		—	—	–16	

[continued] **Table 3. SKY77446 Electrical Specifications for Nominal Operating Conditions [1]**

Parameter	Symbol	Condition	Minimum	Typical	Maximum	Unit
Tx Noise Power in Rx Band	PN_LOWFREQ	POUT = POUT_MAX 470 MHz to 770 MHz RBW = 30 kHz	—	—	–89	dBm
	PN_BAND_V_Rx	POUT = POUT_MAX 869 MHz to 894 MHz RBW = 30 kHz	—	—	–92	
	PN_GPS_Rx	POUT = 15 dBm 1570 MHz to 1580 MHz RBW = 30 kHz	—	—	–87	
	PN_BAND_III_Rx	POUT = POUT_MAX 1805 MHz to 1880 MHz RBW = 30 kHz	—	—	–80	
	PN_BAND_IX_Rx	POUT = POUT_MAX 1884.9 MHz to 1879.9 MHz RBW = 30 kHz	—	—	–82	
	PN_PHS	POUT = POUT_MAX 1884.5 MHz to 1919.6 MHz RBW = 30 kHz	—	—	–53	
	PN_BAND_I_Rx	POUT = POUT_MAX 2110 MHz to 2170 MHz RBW = 30 kHz	—	—	–90	
	PN_BT	POUT = POUT_MAX 2402 MHz to 2480 MHz RBW = 30 kHz	—	—	–85	
	PN_2.6	POUT = POUT_MAX 2620 MHz to 2680 MHz RBW = 30 kHz	—	—	–80	
Input Voltage Standing Wave Ratio	VSWR	—	—	—	1.8:1	—
Error Vector Magnitude	EVM1	POUT = POUT_MAX	—	3	5	%
Coupling Factor	CPL	POUT = POUT_MAX	—	21	—	dB
Stability (Spurious output)	S	6:1 VSWR All phases	—	—	–46	dBm
Ruggedness - no damage [3]	Ru	POUT ≤ POUT_MAX	10:1	—	—	VSWR

1 Per Table 2 over dynamic range up to 26.8 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 4. Standard Test Configuration – Mode_0 (WCDMA Mode)

Parameter	Level	Spread Code	Spread Factor	I/Q	βc	βd	βhs	βec	βed	Relative Power (dB)
DPCCH	15 kbps	0	256	Q	8/15	—	—	—	—	–6.547
DPDCH	60 kbps	16	64	I	—	15/15	—	—	—	–1.087

Table 5. Standard Test Configuration – Mode_1 (HSDPA Mode)

Parameter	Level	Spread Code	Spread Factor	I/Q	βc	βd	βhs	βec	βed	Relative Power (dB)
DPCCH	15 kbps	0	256	Q	12/15	—	—	—	—	–8.17
DPDCH	60 kbps	16	64	I	—	15/15	—	—	—	–6.23
HS-DPCCH	15 kbps	64	256	Q	—	—	24/15	—	—	–2.15

Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77446, 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.

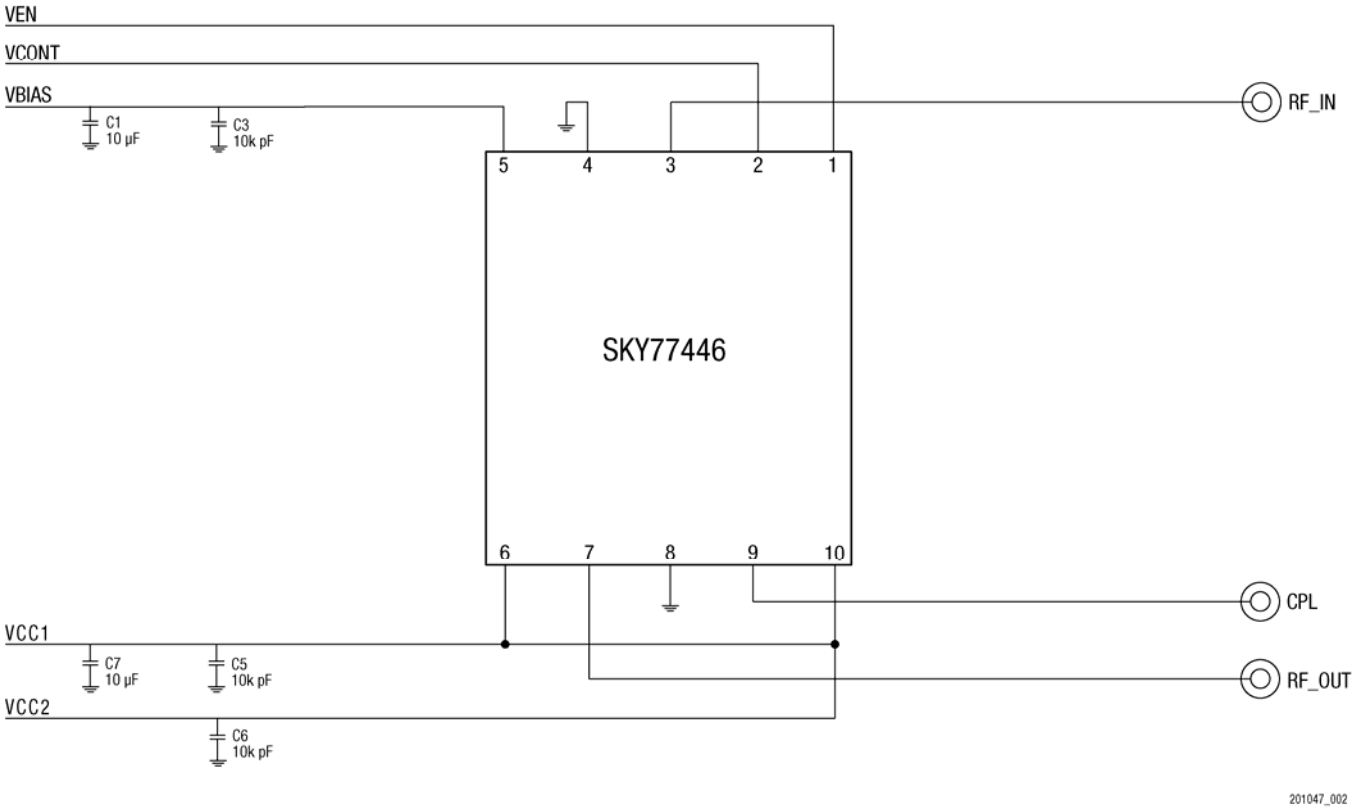
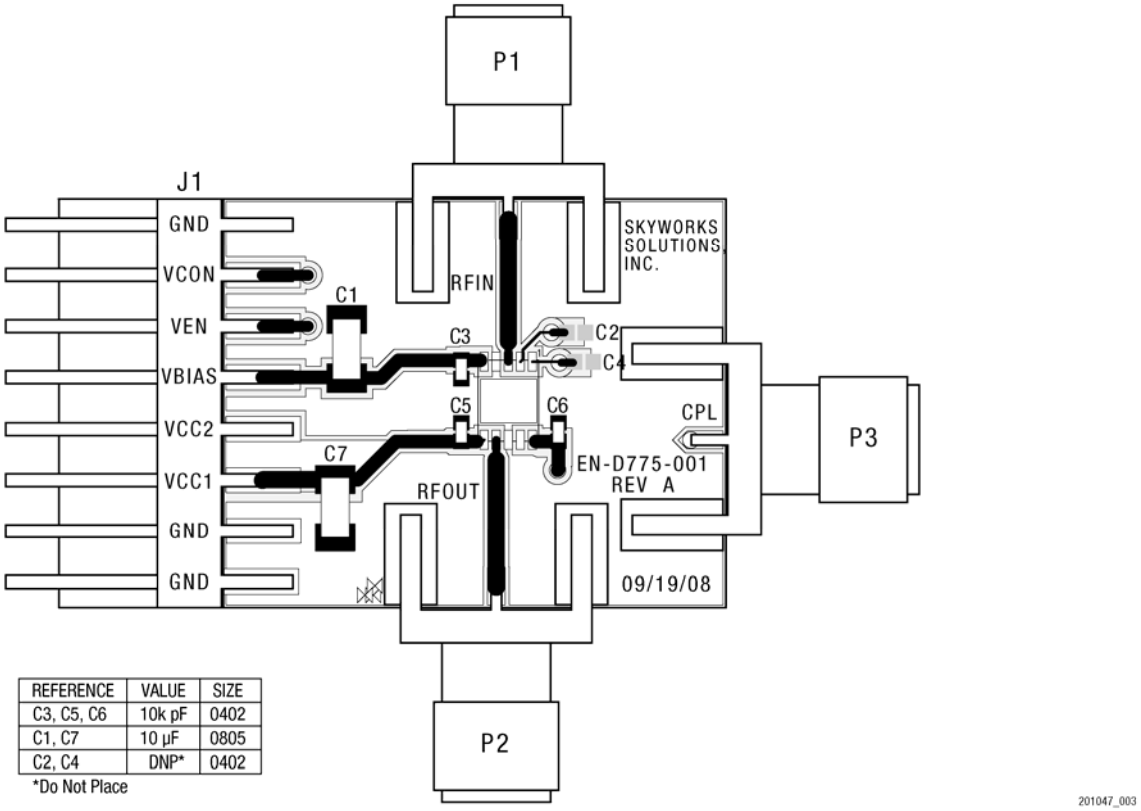


Figure 2. Evaluation Board Schematic



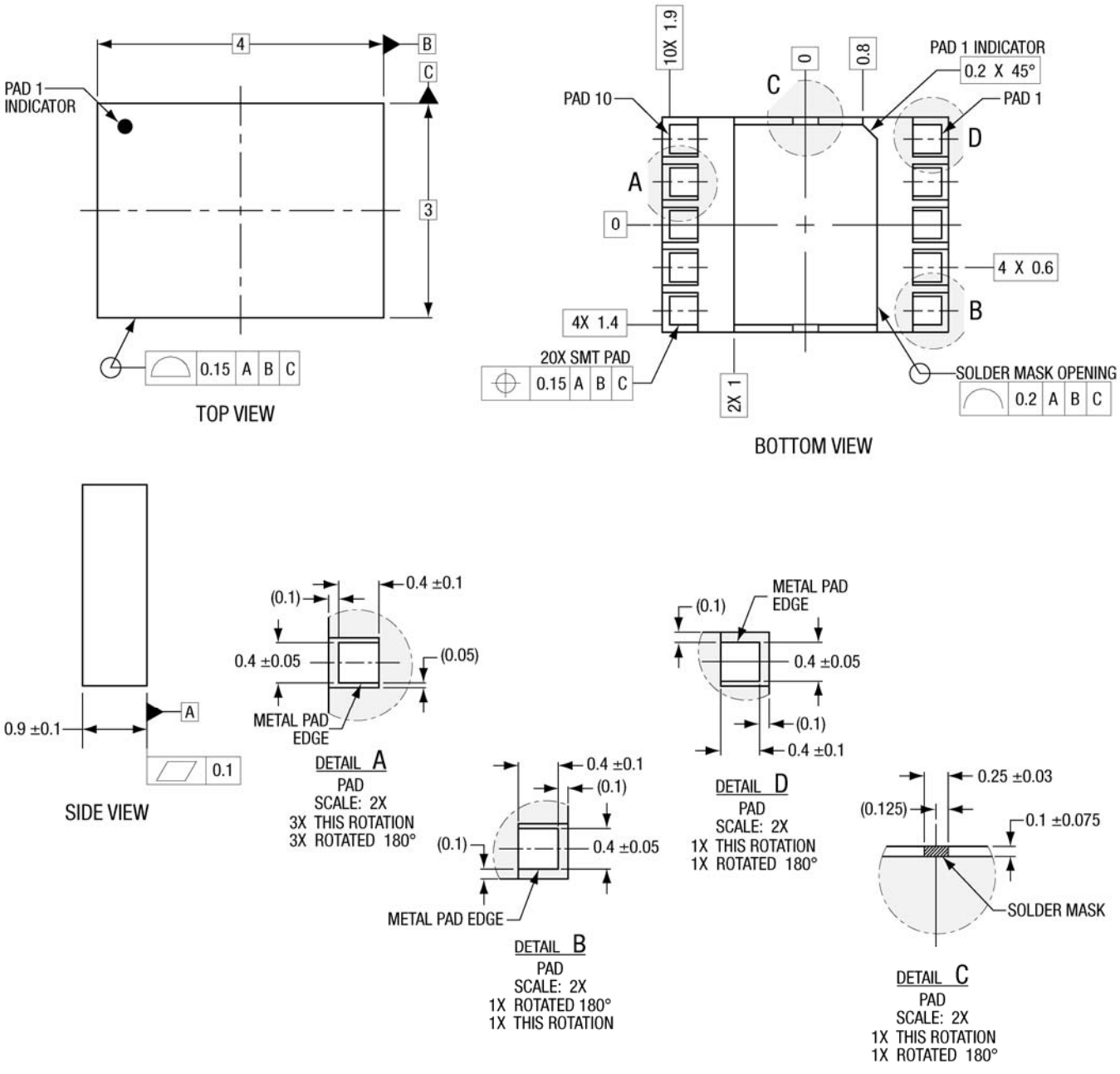
REFERENCE	VALUE	SIZE
C3, C5, C6	10k pF	0402
C1, C7	10 µF	0805
C2, C4	DNP*	0402

*Do Not Place

Figure 3. Evaluation Board Assembly Diagram

Package Dimensions

The SKY77446 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 Y14.5M–1994
2. All dimensions are in millimeters.

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Figure 4. Dimensional Diagram for 4 mm x 3 mm x 0.9 mm Package – SKY77446 Specific

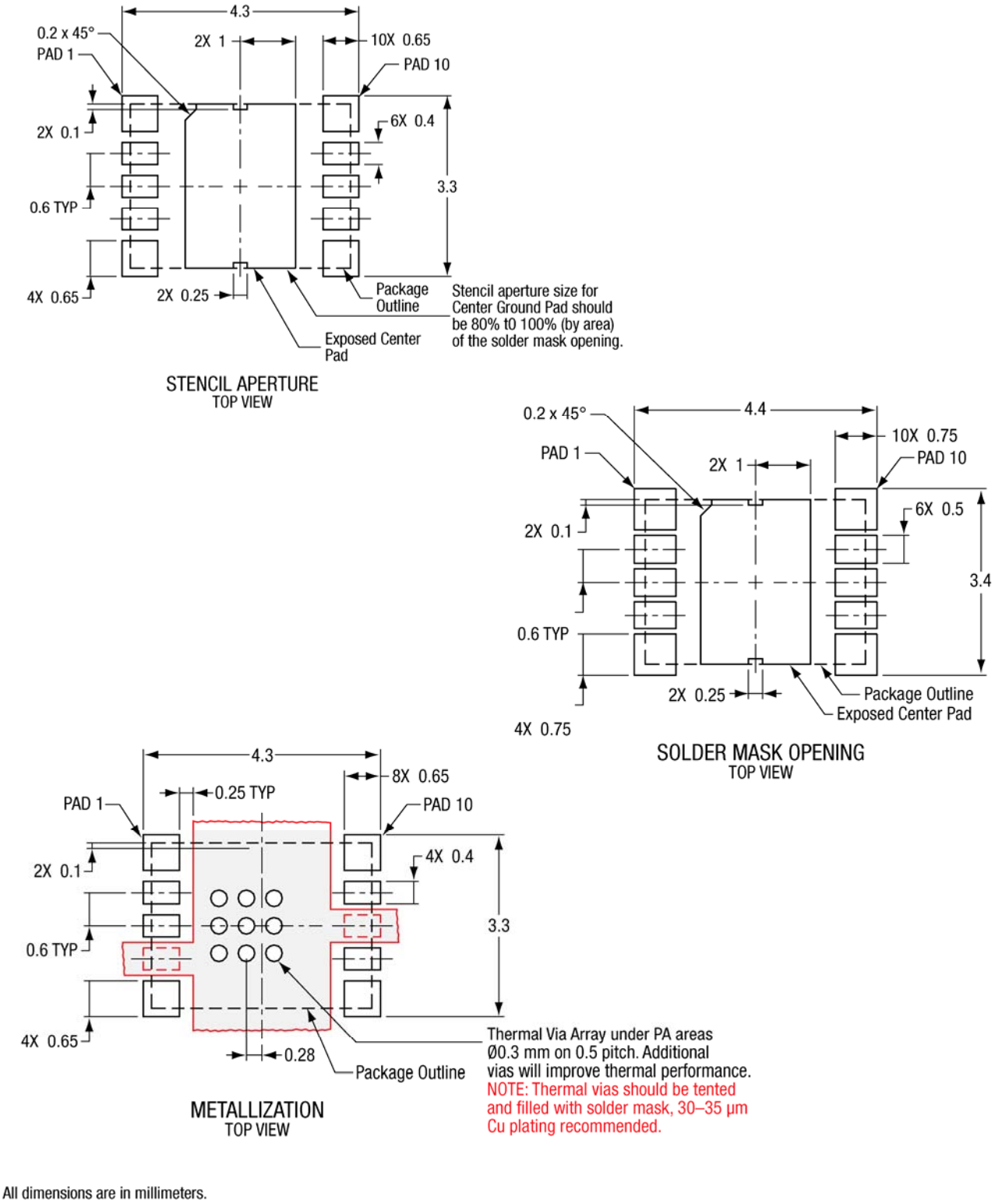
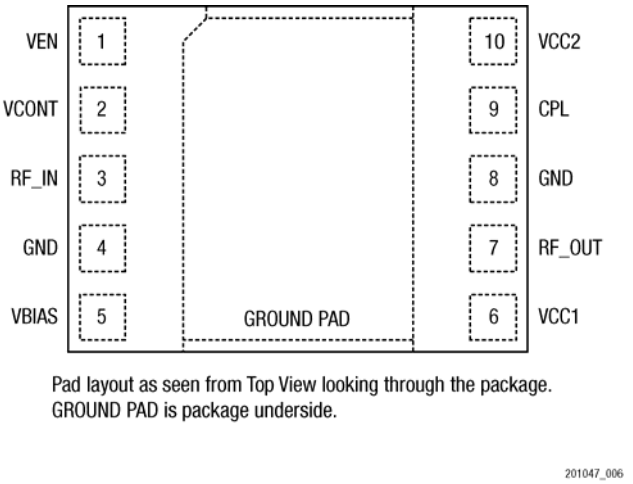


Figure 5. Phone PCB Layout Drawing for 4 mm x 3 mm Package – SKY77446 Specific

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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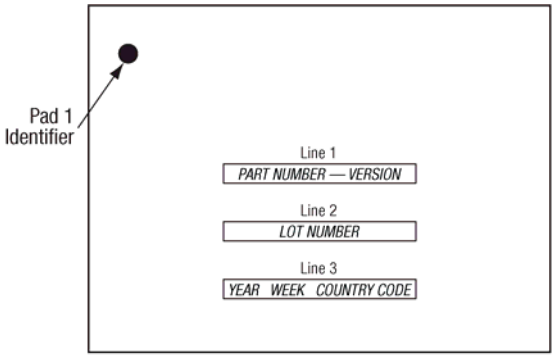
Figure 6. SKY77446 Pad Names and Configuration (Top View)



NOTE: Lines 1, 2, 3 have a maximum of 13 characters
Line 1 = Part Number and Version
Line 2 = Lot Number
Line 3 = Year–Week–Country Code (MX)

201047_007

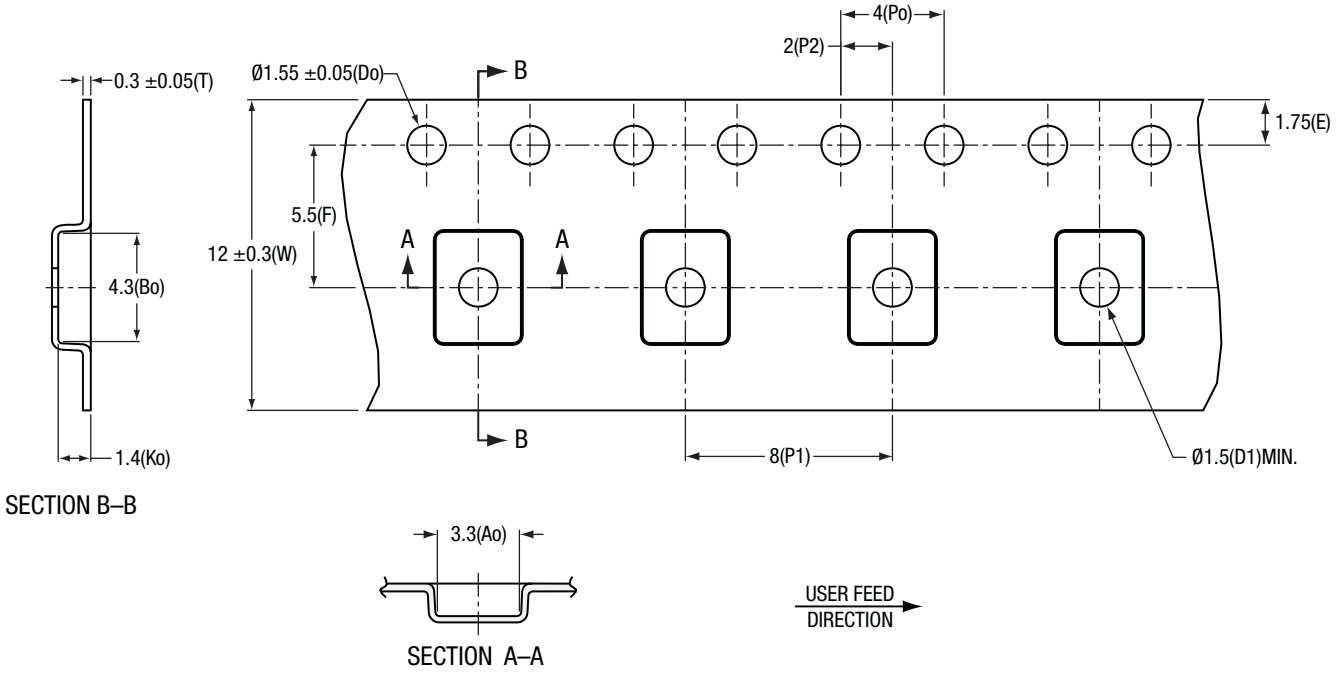
Figure 7. Typical Case Markings

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 SKY77446 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 (Figure 8).



NOTES:
1. CARRIER TAPES MUST MEET ALL REQUIREMENTS OF SKYWORKS GP01–D232 PROCUREMENT SPEC FOR TAPE AND REEL SHIPPING.
2. CARRIER TAPE SHALL BE BLACK CONDUCTIVE POLYCARBONATE OR POLYSTYRENE.
3. COVER TAPE SHALL BE TRANSPARENT CONDUCTIVE PRESSURE-SENSITIVE ADHESIVE (PSA) MATERIAL W/ 9.3 mm WIDTH.
4. ESD-SURFACE RESISTIVITY SHALL BE ≤ 1 X 10^{10} OHMS/SQUARE PER EIA, JEDEC TNR SPECIFICATION.
5. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE: ±0.2 mm
6. Ao & Bo MEASURED ON PLANE 0.3 mm ABOVE THE BOTTOM OF THE POCKET.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PART NO.: eCA1411 REV. 00 (PLEASE INDICATE ON PURCHASE ORDER).
9. NUMBER OF PARTS per 13 inch (DIAMETER) x 12 mm REEL: 2500/4500.

ePAK CARRIER TAPE

CARRIER TAPE OVERMOLD MCM / RFLGA 3 x 4 x 1.4 mm BODY SIZE GP01-D232-219A

Figure 8. Dimensional Diagram for Carrier Tape Body Size 3 mm x 4 mm – MCM

Electrostatic Discharge (ESD) Sensitivity

SKY77446 meets Class 1B per JESD22-A114 Human Body Model (HBM), Class M1 per JESD-A115 Machine Model (MM), and Class C3 per JESD-C101 Charged Device Model (CDM) for electrostatic discharge classifications.

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
SKY77446	SKY77446		MCM 4 mm x 3 mm x 0.9 mm	–20 °C to +85 °C

Revision History

Revision	Date	Description
A	March 19, 2009	Initial Release – Advance Information
B	June 17, 2009	Re-Release
C	August 5, 2009	Revise: Features list (p1); Description (p1); Figures 2, 3; Tables 1, 2, 3 Add: Figure 8
D	November 12, 2009	Revise: Figures 1–6; Tables 2, 3

References

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

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

Electrostatic Discharge Sensitivity (ESD) Testing: JEDEC Standard, JESD22-A114 Human Body Model (HBM)

Electrostatic Discharge Sensitivity (ESD) Testing: JEDEC Standard, JESD22-A115 Machine Model (MM)

Electrostatic Discharge Sensitivity (ESD) Testing: JEDEC Standard, JESD22-C101 Charged Device Model (CDM).