

ADVANCE DATA SHEET

SKY77436 Front-End Module for WCDMA / HSDPA / HSUPA Band V (Tx 824-849 MHz), (Rx 869-894 MHz)

Applications

- Digital cellular (WCDMA) handsets

Features

- High Speed Downlink Packet Access (HSDPA)
- High Speed Uplink Packet Access (HSUPA)
- Low quiescent current - 16 mA
- Low current consumption - 450 mA
- Integrated Power Detector
- 16-pad package
- Small package - 7 mm x 4 mm
- Low profile - 1.15 mm, Max.
- Low voltage - 3.1 V to 4.45 V
- Digital enable pad
- Highly integrated, user friendly solution
- InGaP HBT
- Integrated interstage filter and duplexer
- Requires few external components

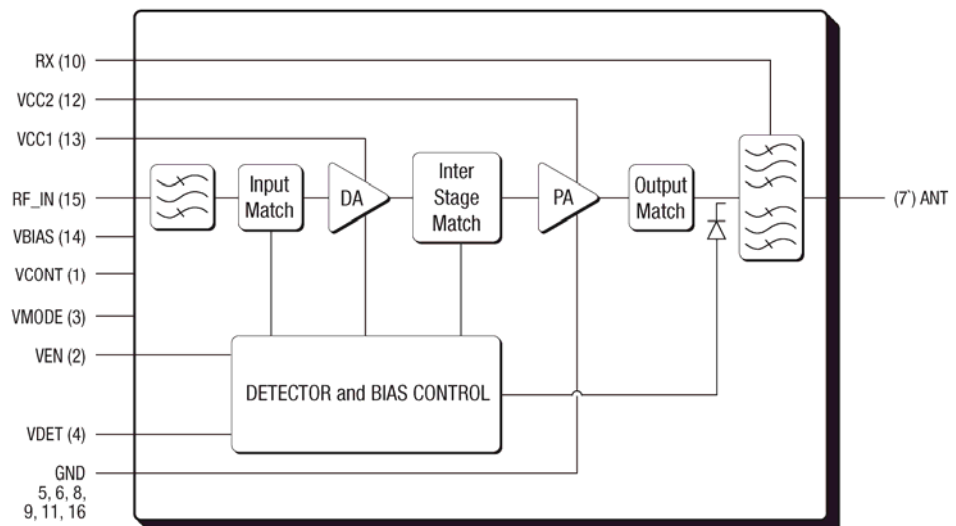
Description

The SKY77436 Front-End Module (FEM) is a fully matched, 16-pad surface mount module developed for WCDMA applications. Small and efficient, this WCDMA FEM integrates the interstage filter, the input matching, the power amplifier, the output matching, the power detection, and the duplexer into a single 7 mm x 4 mm x 1.15 mm package.

The SKY77436 meets the stringent spectral requirements of WCDMA standards up to 25.0 dBm output power. The FEM incorporates an InGaP HBT PA and contains circuitry to optimize power detector performance. Different control pads are available to enhance the performance of the FEM at different power levels.

Integration of the RF front-end greatly simplifies the design of the handset radio as all critical matching between the interstage filter, PA, power detection, and duplexer is optimized within the module. By optimizing the efficiency of the InGaP HBT PA MMIC and reducing the RF loss between the integrated components, this FEM achieves current as low as 410 mA at maximum output power (25.0 dBm) that significantly improves the talk time of the WCDMA handset. This small package uses Skyworks' low cost, multi-laminate substrate technology and is approximately half the size of individually-packaged component solutions. The SKY77436 front-end module can save handset designers significant board space and design-cycle time.

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.

200597_001

Figure 1. Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77436 Front-End Module for WCDMA. Table 1 lists the absolute maximum ratings and Table 2 specifies the recommended operating conditions necessary to achieve the electrical performance listed in Table 3. Table 4 through Table 7 defines the standard test configurations for WCDMA, HSDPA, and

HSUPA modes. Table 8 lists the parameters specific to power detection performance over the recommended operating conditions, including mismatch at the module antenna port up to a VSWR of 2.5:1 for all phase angles. Table 9 presents nominal duplexer performance data.

Table 1. Absolute Maximum Ratings¹

| Parameter | Symbol | Minimum | Nominal | Maximum | Unit | |
|------------------------|-------------------|---|---------|---------|-------|------|
| RF Input Power | P _{IN} | — | — | 10.0 | dBm | |
| Supply Voltages | No RF | V _{CC1} , V _{CC2} , V _{BIAS} | — | 3.4 | 6.0 | Volt |
| | With RF | | — | 3.4 | 4.7 | Volt |
| Bias Control Voltage | V _{CONT} | — | — | 2.7 | Volt | |
| Mode Control Voltage | V _{MODE} | — | — | 3.0 | Volts | |
| Enable Control Voltage | V _{EN} | — | — | 3.0 | Volt | |
| Temperatures | Operating | T _{CASE} | -20 | +25 | +110 | °C |
| | Storage | T _{STG} | -55 | — | +125 | |

¹ No damage assuming only one parameter at a time is set to limit with all other parameters set at nominal values.

Table 2. Recommended Operating Conditions

| Parameter | Symbol | Minimum | Nominal | Maximum | Unit | |
|-----------------------------|---|---------------------|---------|---------|------|------|
| Tx Channel Center Frequency | F _{TX} | 826.4 | 836.5 | 846.6 | MHz | |
| Rx Channel Center Frequency | F _{RX} = F _{TRX} + 45 MHz | 871.4 | 881.5 | 891.6 | MHz | |
| Supply Voltages | V _{CC1} , V _{CC2} | 3.1 ¹ | 3.4 | 4.45 | Volt | |
| | V _{BIAS} | 3.1 | 3.4 | 4.45 | | |
| Bias Control Voltage | V _{CONT} | 0.5 | — | 1.9 | Volt | |
| Mode Control | Low Power Mode (LPM) | V _{MODE_L} | 1.5 | 1.8 | 2.86 | Volt |
| | High Power Mode (HPM) | V _{MODE_H} | 0.0 | 0.0 | 0.56 | |
| Enable Control Setting | Disabled | V _{EN_L} | 0.0 | 0.0 | 0.56 | Volt |
| | Enabled | V _{EN_H} | 1.5 | 1.8 | 2.86 | |
| Operating Temperature | T _{CASE} | -20 | +25 | +85 | °C | |

¹ For V_{CC} < 3.4 V, maximum output power = P_{MAX2}

Table 3. Electrical Specifications for Nominal Operating Conditions ¹

| WCDMA (Wide Band Code Division Multiple Access) | | | | | | | |
|---|------------|--------------------------------|---|---------|---------|---------|------|
| Characteristic | | Symbol | Conditions | Minimum | Typical | Maximum | Unit |
| Linear Output Power | | P _{MID} | V _{CC} ≥ 3.1 V HPM, LPM | 10.0 | — | — | dBm |
| | | P _{MAX2} ² | V _{CC} ≥ 3.1 V HPM | 24.2 | — | — | |
| | | P _{MAX1} ² | HPM | 25.0 | — | — | |
| Gain | Mid Power | G _{MID} | LPM P _{MID} | 13.0 | — | 23.0 | dB |
| | High Power | G _{HIGH} | P _{MAX1} | 21.5 | — | 30.0 | |
| Gain Flatness Over Frequency | | ΔGPWR | Each Tx Frequency | -2.5 | — | 2.5 | dB |
| Current Consumption | Mid Power | I _{CC} | LPM P _{MID} | — | — | 50 | mA |
| | High Power | | P _{MAX1} | — | — | 450 | |
| Power Added Efficiency | Mid Power | PAE _{MID} | LPM P _{MID} | 5.5 | — | — | % |
| | High Power | PAE _{HIGH} | P _{MAX1} | 22.5 | — | — | |
| Error Vector Magnitude | | EVM | — | | | 5 | % |
| Adjacent Channel Leakage Ratio ³ | 5 MHz | ACL1 | — | — | -40 | — | dBc |
| | 10 MHz | ACL2 | | — | -54 | — | |
| Harmonic Suppression | Second | f _{H2} | P _{MAX1} | — | — | -33 | dBm |
| | Third | f _{H3} | | — | — | -33 | |
| Tx Noise Power in Rx Band | | NRX | RBW = 3.84 MHz | — | — | -114 | dBm |
| Input Voltage Standing Wave Ratio | | VSWR | — | — | — | 2.5:1 | |
| Quiescent Current | | I _Q | — | — | — | 16 | mA |
| Control Current | | I _{CONT} | — | — | — | 1 | mA |
| Enable Current | | I _{EN} | — | — | — | 1 | mA |
| Leakage Current | | I _{LEAK} | V _{CC1} , V _{CC2} , V _{BIAS} = 4.45 V V _{CONT} = 0 V V _{EN} = 0 V V _{MODE} = 0 V | — | — | 20 | μA |
| Stability (spurious output) | | S | 8:1 VSWR, all phases | — | — | -65 | dBc |
| Ruggedness ⁴ | | Ru | — | 10:1 | — | — | — |

¹ Unless otherwise specified: V_{CC} = 3.4 V, Temp. = 25 °C.

² For STC1 WCDMA, STC2 HSDPA, and STC3 HSUPA modes test conditions. For STC4 HSUPA, power backoff = 2.6 dB.

³ ACLR is specified per 3GPP as the ratio of in-band power to adjacent power, both measured in 3.84 MHz bandwidth at specified offsets.

⁴ All phases, time = 10 seconds, continuous WCDMA / HSDPA modulated signal.

Table 4. 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 5. 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 |

Table 6. Standard Test Configuration – STC3 HSUPA 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 | — | — | — | — | -19.391 |
| DPDCH | 960 kbps | 1 | 4 | I | — | 15/15 | — | — | — | -13.931 |
| HS- DPCCH | 15 kbps | 64 | 256 | Q | — | — | 8/15 | — | — | -19.391 |
| E-DPCCH | 15 kbps | 1 | 256 | I | — | — | — | 10/15 | — | -17.338 |
| E-DPDCH | 960 kbps | 2 | 4 | I | — | — | — | — | 71.5/15 | -0.371 |

Table 7. Standard Test Configuration – STC4 HSUPA 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 | 6/15 | — | — | — | — | -12.499 |
| DPDCH | 960 kbps | 1 | 4 | I | — | 15/15 | — | — | — | -4.540 |
| HS- DPCCH | 15 kbps | 64 | 256 | Q | — | — | 2/15 | — | — | -22.041 |
| E-DPCCH | 15 kbps | 1 | 256 | I | — | — | — | 12/15 | — | -6.478 |
| E-DPDCH | 960 kbps | 2 | 4 | I | — | — | — | — | 15/15 | -4.425 |

Table 8. Electrical Specifications for Power Detector

| Tx Power Detection | | | | | | |
|-----------------------|------------------|---------------------------------|-----------|---------|-------------|------|
| Characteristic | Symbol | Conditions | Minimum | Typical | Maximum | Unit |
| Power Detect Range | P _{DET} | | 0.0 | — | 26.0 | dBm |
| Detector Output Range | V _{DET} | 3 dBm ≤ P ₀ ≤ 26 dBm | 400 (rms) | — | 1800 (peak) | mV |

Table 9. Nominal Duplexer Performance

| Antenna to Rx Parameter | | | | | | |
|-------------------------|------------------|---|----------------------|---------|---------|------|
| Characteristic | Symbol | Conditions | Minimum | Typical | Maximum | Unit |
| Insertion Loss | IL _{Rx} | 869 MHz to 894 MHz | — | — | 3.5 | dB |
| Ripple | | Each Rx Frequency | -0.5 | — | 0.5 | dB |
| Attenuation | | DC to 12750 MHz | 20 | — | — | dB |
| | | A _{Rx1} | 35 MHz to 55 MHz | 40 | — | |
| | | A _{Rx2} | 289 MHz to 298 MHz | 25 | — | |
| | | A _{Rx3} | 434 MHz to 447 MHz | 45 | — | |
| | | A _{Rx4} | 779 MHz to 804 MHz | 30 | — | |
| | Tx Band | A _{Rx5} | 824 MHz to 849 MHz | 50 | — | |
| | | A _{Rx6} | 849 MHz to 869 MHz | 2 | — | |
| | | A _{Rx7} | 914 MHz to 1693 MHz | 15 | — | |
| | | A _{Rx8} | 1693 MHz to 1743 MHz | 35 | — | |
| | A _{Rx9} | 2517 MHz to 2592 MHz | 35 | — | | |
| VSWR | | — | — | — | 2.0:1 | — |
| Input | | — | — | — | 15 | dBm |
| Tx Power @ Rx Port | | 826.4 MHz to 846.6 MHz P _{MAX1} | — | — | -25 | dBm |

Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77436, the evaluation board schematic and assembly

diagrams are included for preliminary analysis and design. The basic schematic is shown in Figure 2 for the board assembly in Figure 3.

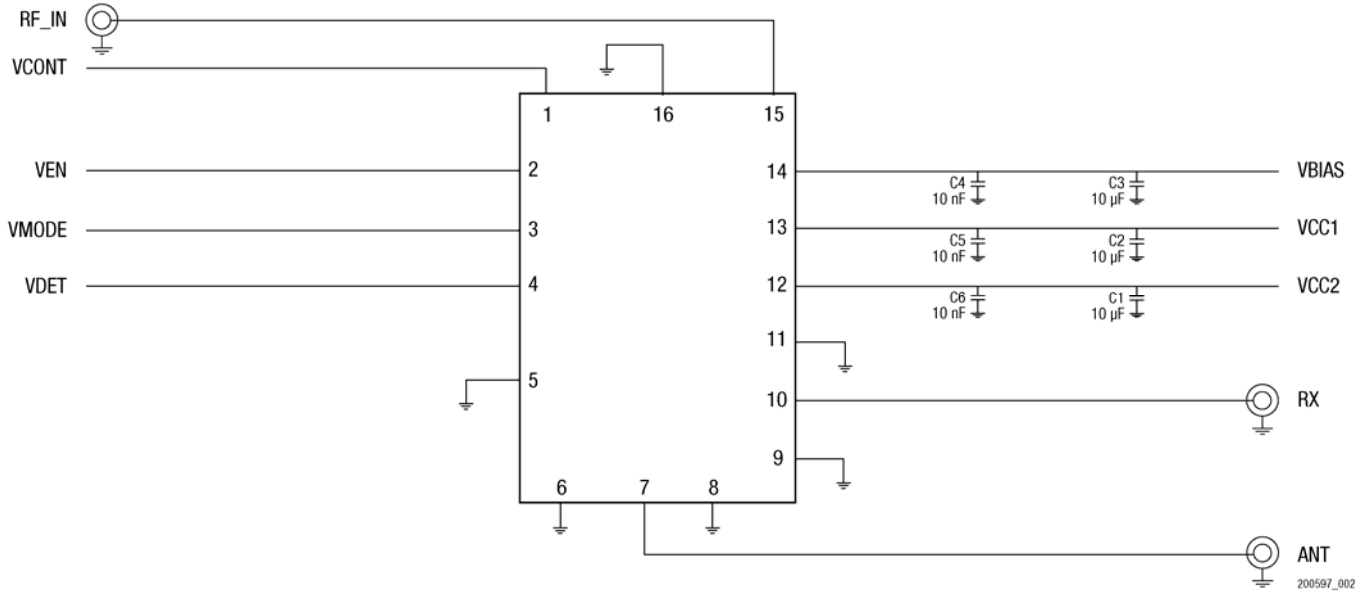


Figure 2. Evaluation Board Schematic Diagram

| SKY77436 COMPONENT TABLE | | |
|--------------------------|-------|------|
| REF | VALUE | SIZE |
| C1 | 10 uF | 1206 |
| C2 | 10 uF | 1206 |
| C3 | 10 uF | 1206 |
| C4 | 10 nF | 0402 |
| C5 | 10 nF | 0402 |
| C6 | 10 nF | 0402 |

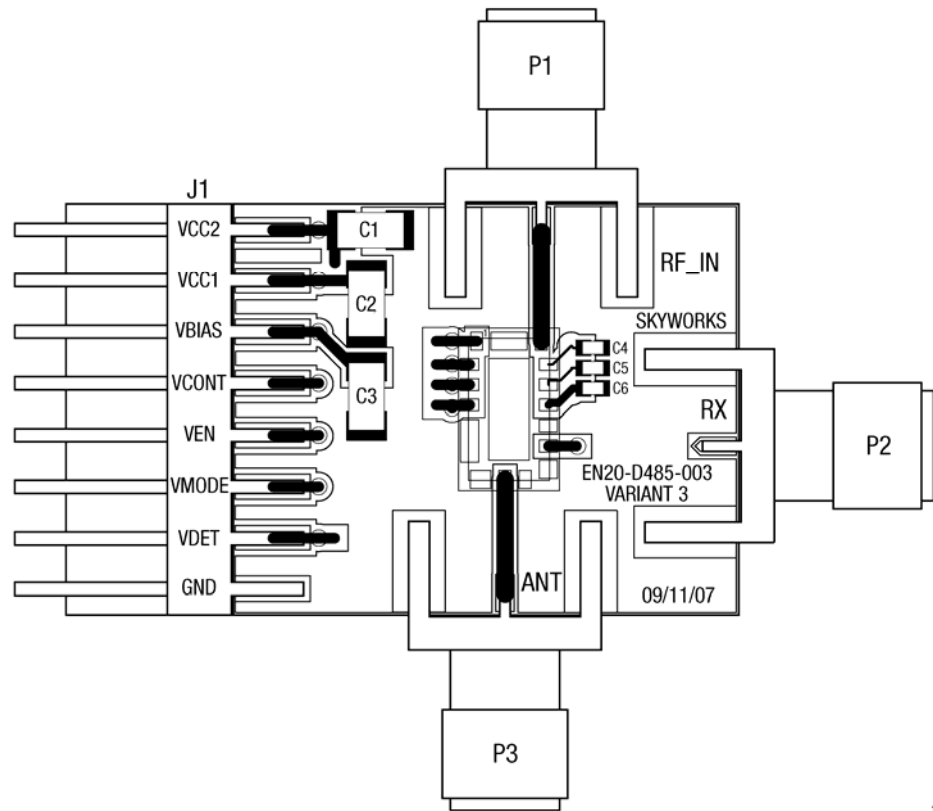
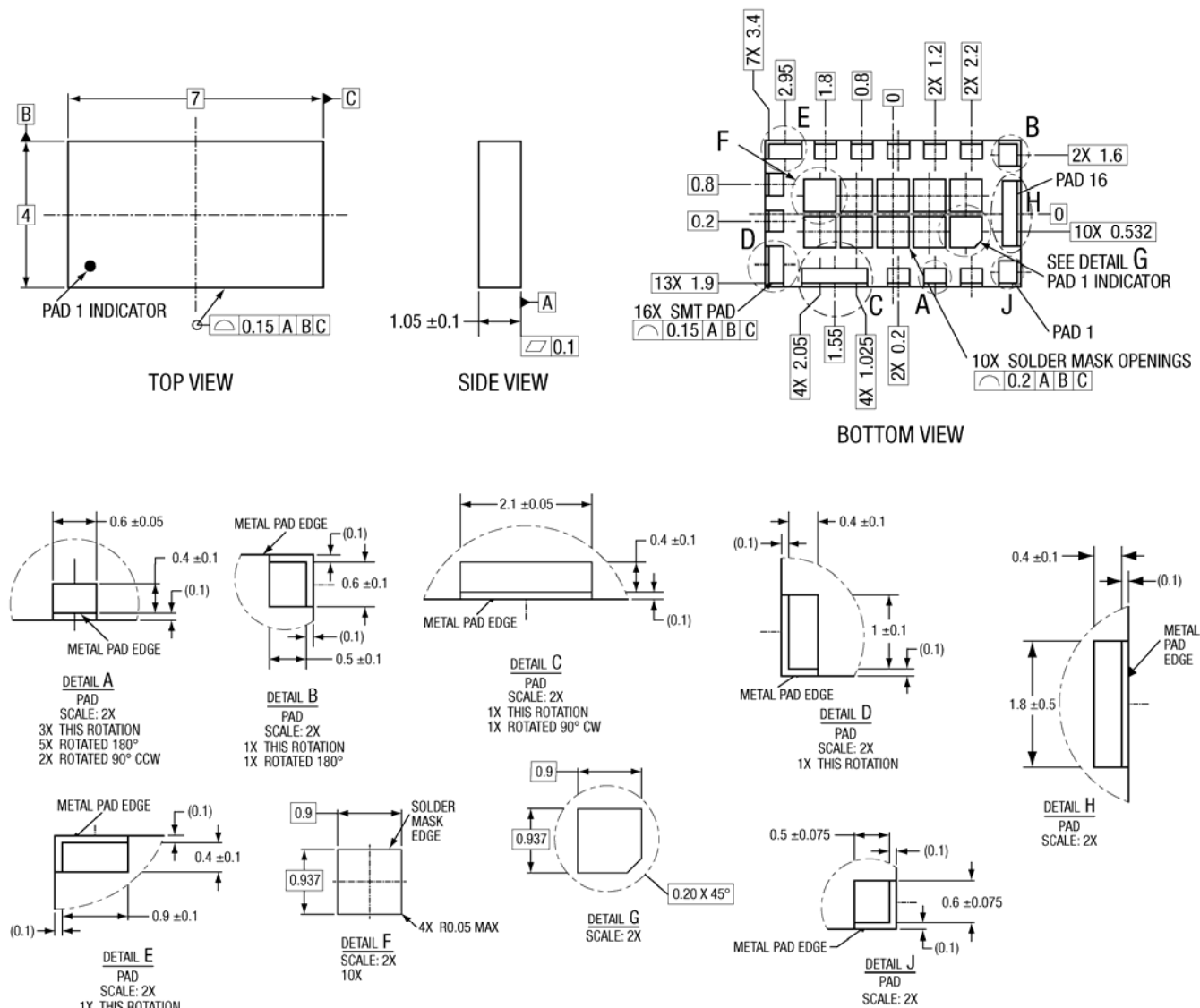


Figure 3. Evaluation Board Assembly Diagram

Package Dimensions

The SKY77436 is a multi-layer laminate base, overmold encapsulated modular package designed for surface-mounted 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 FEM to help the designer attain optimum thermal conductivity, good grounding, and minimum RF discontinuity for the 50-ohm terminals.

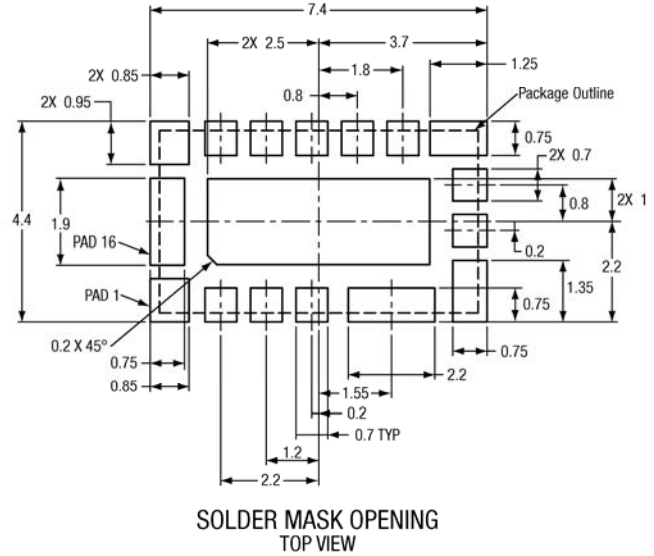
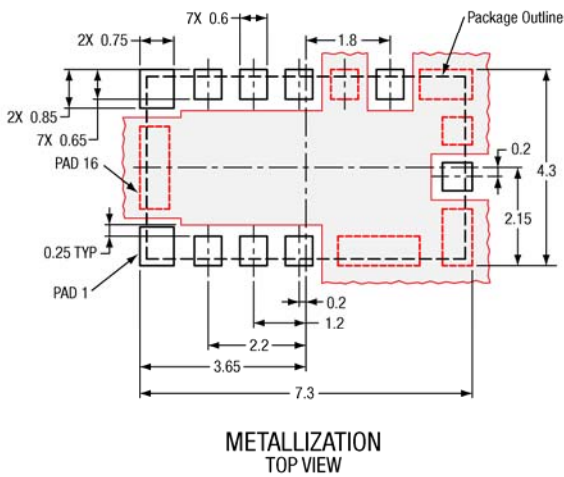
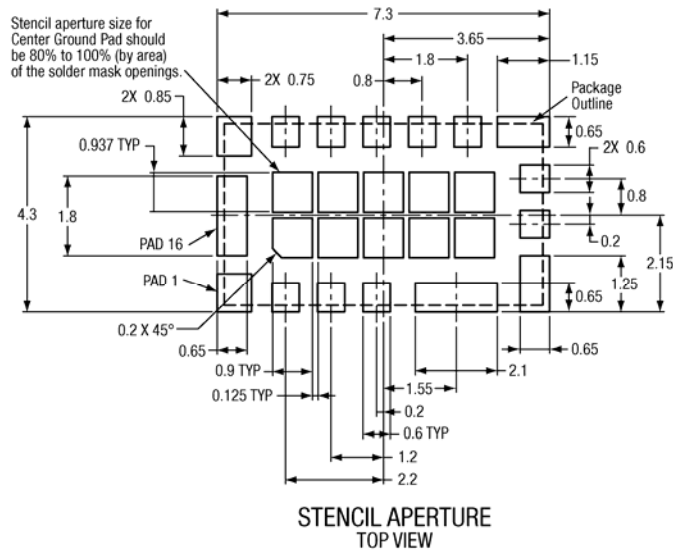


NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. PADS ARE SOLDER MASK DEFINED ON 3 EDGES & METAL DEFINED ON 1 EDGE.

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Figure 4. Dimensional Diagram for 7 x 4 x 1.05 mm, 16-Pad Package (All Views) – SKY77436



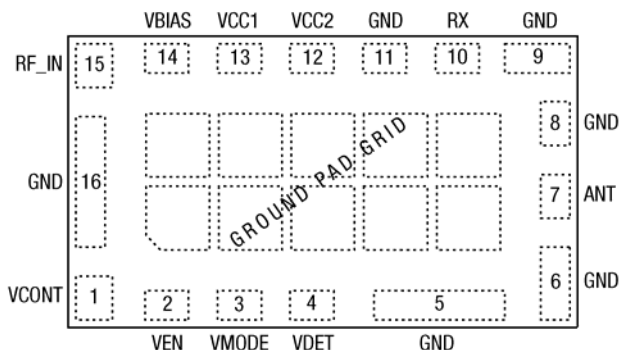
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 2. ALL DIMENSIONS ARE IN MILLIMETERS.

DS00089-2 REV. 1
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Figure 5. Phone PCB Layout Footprint for 7 x 4 mm, 16-pad Package – SKY77436

Package Description

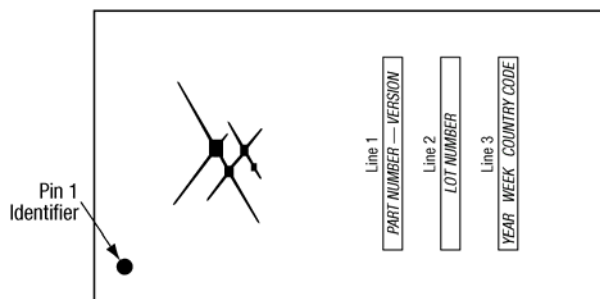
Figure 6 shows each pad name and the pad numbering convention, which starts with pad 1 in the lower left, as indicated, and increments counter-clockwise around the package. Figure 7 illustrates typical case markings.



Pad layout as seen from Top View looking through package.

200597_006

Figure 6. SKY77436 16-pad Configuration – (Top View)



NOTE: SKY77436
Lines 1, 2, 3 have a maximum of 11 characters
YEAR = Year of Manufacture
WEEK = Week Package Was Sealed
Country Code = Country of Manufacture (MX)

200597_006

Figure 7. Typical Case Markings (Top View)

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 SKY77436 is currently qualified for MSL3/260 °C. 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 – RF Modules*, Document Number 101568.

Electrostatic Discharge (ESD) Sensitivity

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 |
|--------------|---------------------------|------------------|---------------------|-----------------------|
| SKY77436 | SKY77436 | | MCM 4 x 7 x 1.05 mm | -20 °C to +85 °C |

Revision History

| Revision | Date | Description |
|----------|-------------------|---------------------------------------|
| A | October 15, 2008 | Initial Release – Advance Information |
| B | November 18, 2008 | Revise: Figure 3 |
| C | December 8, 2008 | Revise: Table 8 |

References

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

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

JEDEC Standard JESD22-A114 Human Body Model (HBM)

JEDEC Standard JESD22-A115 Machine Model (MM)

JEDEC Standard JESD22-C101 Charged Device Model (CDM)

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