

DATA SHEET
SE2603L: 2.4 GHz High Efficiency Wireless LAN Front-End
Preliminary

Applications

- IEEE802.11b DSSS WLAN
- IEEE802.11g,n OFDM WLAN
- Access Points, PCMCIA, PC cards

Features

- Dual Mode IEEE802.11b, IEEE802.11g, IEEE802.11n
- Integrated PA, TX Filter, Diversity switch
- Integrated Positive Slope Power Detector
- 20 dBm Output Power, 802.11b, 11 Mbps
- 17 dBm @ 3.0 % EVM, 802.11g, 3.3V
- Lead free, halogen free and RoHS compliant
- Small plated package, 3 mm x 4 mm x 0.9 mm, MSL 1

Ordering Information

| Part No. | Package | Remark |
|-------------|------------|----------------|
| SE2603L | 24 pin QFN | Samples |
| SE2603L-R | 24 pin QFN | Tape & Reel |
| SE2603L-EK1 | N/A | Evaluation kit |

Product Description

The SE2603L is a complete 802.11bgn WLAN RF front-end module providing all the functionality of the power amplifier, power detector, diversity switch and 50 ohm matching on all RF ports in an ultra compact form factor.

The SE2603L is designed for ease of use, with all the critical matching and harmonic filtering and integrated transmit/receive DPDT switch providing a 50 Ω interface to the antenna. The SE2603L also includes a transmitter power detector with 20 dB of dynamic range and a digital enable control for transmitter power ramp on/off control. The power ramp rise/fall time is 0.5 μs typical.



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Functional Block Diagram

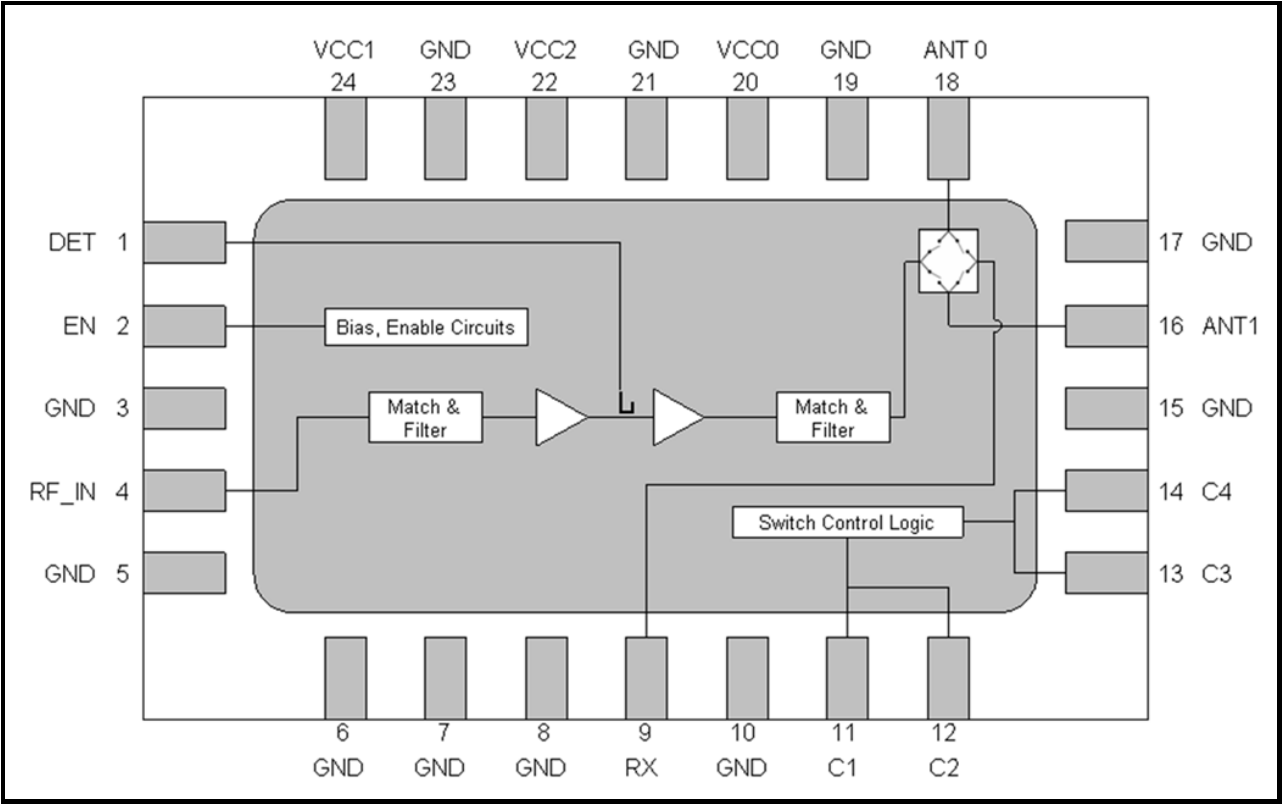


Figure 1: Functional Block Diagram

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Pin Out Diagram

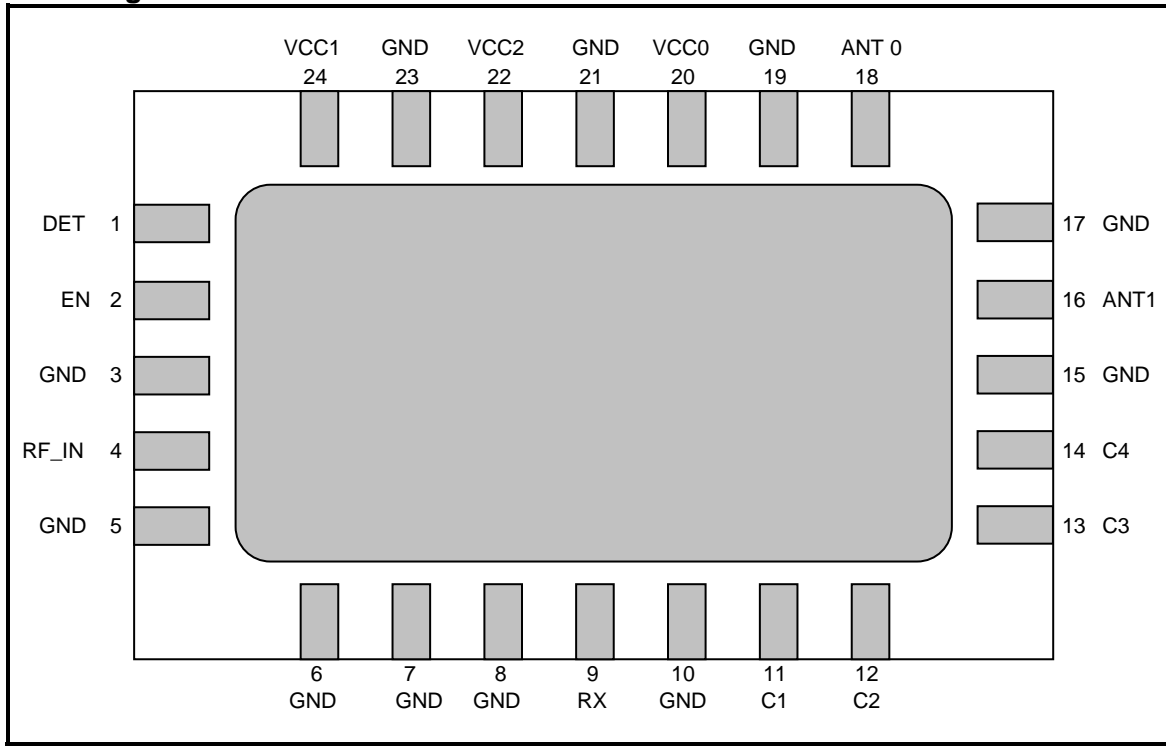


Figure 2: SE2603L Pin Out (Top View Through Package)

Pin Out Description

| Pin No. | Name | Description |
|---------|-------|------------------------|
| 1 | Det | Power Detector Output |
| 2 | EN | Power Amplifier Enable |
| 3 | GND | Ground |
| 4 | RF_IN | Transmit RF Input |
| 5 | GND | Ground |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 8 | GND | Ground |
| 9 | RX | Receive RF Output |
| 10 | GND | Ground |
| 11 | C1 | Switch Control Logic |
| 12 | C2 | Switch Control Logic |
| 13 | C3 | Switch Control Logic |

| Pin No. | Name | Description |
|---------|------|----------------------|
| 14 | C4 | Switch Control Logic |
| 15 | GND | Ground |
| 16 | ANT1 | Antenna 1 |
| 17 | GND | Ground |
| 18 | ANT0 | Antenna 0 |
| 19 | GND | Ground |
| 20 | VCC0 | Supply Voltage |
| 21 | GND | Ground |
| 22 | VCC2 | Supply Voltage |
| 23 | GND | Ground |
| 24 | VCC1 | Supply Voltage |
| | | |
| Paddle | GND | Ground |

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Absolute Maximum Ratings

These are stress ratings only. Exposure to stresses beyond these maximum ratings may cause permanent damage to, or affect the reliability of the device. Avoid operating the device outside the recommended operating conditions defined below. This device is ESD sensitive. Handling and assembly of this device should be at ESD protected workstations.

| Symbol | Definition | Min. | Max. | Unit |
|------------------|---|------|------|------|
| VCC | Supply Voltage on VCC | -0.3 | 3.6 | V |
| V _{IN} | DC input on EN, C1, C2, C3, C4 | -0.3 | 3.6 | V |
| TX | RF Input Power. ANT0 and ANT1 terminated in 50Ω match | - | 12.0 | dBm |
| T _A | Operating Temperature Range | 0 | 85 | °C |
| T _{STG} | Storage Temperature Range | -40 | 150 | °C |

Recommended Operating Conditions

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|----------------|---------------------------------|------|------|------|------|
| T _A | Ambient temperature | -30 | 25 | 85 | °C |
| VCC | VCC0, VCC1, VCC2 supply voltage | 3.0 | 3.3 | 3.6 | V |

DC Electrical Characteristics

Conditions: VCC = EN = 3.3 V, T_A = 25 °C, as measured on Skyworks Solutions' SE2603L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---------------------|------------------------|--|------|------|------|------|
| I _{CC-G} | Total Supply Current | P _{OUT} = 17 dBm, 54 Mbps OFDM signal, 64QAM | - | 145 | - | mA |
| I _{CC-B} | Total Supply Current | P _{OUT} = 19 dBm, 11 Mbps CCK signal, BT = 0.45 | - | 180 | - | mA |
| I _{CQ} | Total Supply Current | No RF | - | 90 | - | mA |
| I _{cntl} | Control Line Current | C1, C2, C3 or C4 = 3.3V | - | 1 | 10 | μA |
| I _{CC0} | Supply Current on VCC0 | No RF, VCC0 = 3.3V | - | 70 | 100 | μA |
| I _{CC-OFF} | Total Supply Current | No RF Applied, EN = R0 = T0 = T1 = R1 = VCC0 = 0 V | - | 1 | 10 | μA |
| | | No RF Applied, EN = R0 = T0 = T1 = R1 = 0 V; VCC0 = 3.3V | - | 71 | 110 | μA |

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PA Logic Characteristics

Conditions: $V_{CC} = EN = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on Skyworks Solutions' SE2603L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------|----------------------------------|------------|------|------|------|---------------|
| V_{ENH} | Logic High Voltage (Module On) | - | 1.8 | 3.3 | 3.6 | V |
| V_{ENL} | Logic Low Voltage (Module Off) | - | 0 | - | 0.4 | V |
| I_{ENH} | Input Current Logic High Voltage | - | - | 2 | 10 | μA |
| I_{ENL} | Input Current Logic Low Voltage | - | - | 2 | 10 | μA |

Switch Logic Characteristics

Conditions: $V_{CC} = EN = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on Skyworks Solutions' SE2603L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|----------------|----------------------------------|---|------|------|------|------|
| V_{CTL_ON} | Control Voltage (On State) | - | 3.0 | - | 3.6 | V |
| V_{CTL_OFF} | Control Voltage (OFF State) | - | 0.0 | - | 0.2 | V |
| ON | Low Loss Switch Control Voltage | High State = $V_{CTL_ON} - V_{CTL_OFF}$ | 2.7 | - | 3.6 | V |
| OFF | High Loss Switch Control Voltage | Low State = $V_{CTL_OFF} - V_{CTL_OFF}$ | 0 | - | 0.3 | V |
| C_{CTL} | Control Input Capacitance | - | - | - | 100 | pF |



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Switch Control Logic Table

| Switch Logic | | | | Operational Mode | | | |
|--------------------------|-----|-----|-----|-------------------------|-----------|-----------|-----------|
| C1 | C2 | C3 | C4 | TX – ANT0 | TX – ANT1 | RX – ANT0 | RX – ANT1 |
| ON | ON | ON | ON | ON | OFF | OFF | OFF |
| OFF | ON | ON | ON | OFF | OFF | ON | OFF |
| ON | ON | ON | OFF | OFF | ON | OFF | OFF |
| OFF | ON | ON | OFF | OFF | OFF | OFF | ON |
| ON | OFF | OFF | OFF | ON | OFF | OFF | OFF |
| OFF | ON | OFF | OFF | OFF | OFF | OFF | ON |
| OFF | OFF | ON | OFF | OFF | ON | OFF | OFF |
| OFF | OFF | OFF | ON | OFF | OFF | ON | OFF |
| ON | ON | OFF | OFF | ON | OFF | OFF | ON |
| OFF | OFF | ON | ON | OFF | ON | ON | OFF |
| All other configurations | | | | All switches set to OFF | | | |

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AC Electrical Characteristics

802.11g/n Transmit Characteristics

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on Skyworks Solutions' SE2603L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|------------------|--|--|--|------------|------|---------------|
| F_{IN} | Frequency Range | - | 2400 | - | 2500 | MHz |
| P_{OUT} | Output Power | 54 Mbps OFDM signal, 64 QAM, 3% EVM | - | 17 | - | dBm |
| ACPR, IEEE Mask | Spectral Mask | $P_{OUT} = 20\text{ dBm}$, 11 Mbps CCK, BT = 0.45 11 – 22 MHz 22 – 33 MHz | - | -35 -55 | - | dBc |
| P_{1dB} | P1dB | - | - | 23.0 | - | dBm |
| S_{21} | Small Signal Gain | - | 24 | 27 | 30 | dB |
| ΔS_{21} | Small Signal Gain Variation | Gain variation over single 40MHz channel Gain Variation over band | - | 0.5 | 1.0 | dB |
| $S_{213.2}$ | Gain @ limit at Ref-vco spur frequency | 3206 to 3312 MHz | - | - | 15 | dB |
| 2f | Harmonics | $P_{OUT} = 19\text{ dBm}$, 1 Mbps, CCK | - | -50 | -45 | dBm/MHz |
| 3f | | | - | -50 | -45 | dBm/MHz |
| t_{dr}, t_{df} | Delay and rise/fall Time | 50 % of V_{EN} edge and 90/10 % of final output power level | - | 0.7 | - | μs |
| S_{11} | Input Return Loss | - | 10 | 14 | - | dB |
| STAB | Stability | CW, $P_{OUT} = 20\text{ dBm}$ 0.1 GHz – 20 GHz Load VSWR = 6:1 | All non-harmonically related outputs less than -42 dBm/MHz | | | |
| RU | Ruggedness | $P_{IN} = 12\text{ dBm}$, Load VSWR = 6:1 | No permanent damage | | | |

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Receive Characteristics

Conditions: VCC = 3.3 V, EN = 0 V, TA = 25 °C, as measured on Skyworks Solutions' SE2603L-EK1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|----------------------|---------------------------------|--|------|------|------|------|
| F _{OUT} | Frequency Range | - | 2400 | - | 2500 | MHz |
| RX _{IL} | Insertion Loss | - | - | 0.9 | 1.2 | dB |
| RX _{RL} | Return Loss | - | 10 | 15 | - | dB |
| Delta Rx | Delta between Rx paths | ANT0 to RX or ANT1 to RX | - | - | 0.5 | dB |
| T _{on/off} | T/R on/off switching speed | Switching speed between T/R modes. V _{CC0} =3.3V. | | 100 | 250 | nSec |
| TR _{iso} | Tx to Rx Leakage | Device transmitting (EN = 3.3 V) with 17.0 dBm. @ ANT0 or ANT1, Power measured @ RX TX ↔ ANT0 or ANT1 = ON, RX ↔ ANT0 or ANT1 = OFF | - | -3 | 0 | dBm |
| ANTR _{ISOL} | Isolation between ANT0 and ANT1 | Difference in transmitted signal level on ANT1 or ANT0 while transmitting from ANT0 or ANT1. TX ↔ ANT0 or ANT1 = ON, Rx and opposite ANT port terminated in 50ohm. | 18 | 25 | - | dB |

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Power Detector Characteristics

Conditions: $V_{CC} = EN = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on Skyworks Solutions' SE2603L-EK1 evaluation board, unless otherwise noted.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--|------------------------------|------|------|------|------|
| F _{OUT} | Frequency Range | - | 2400 | - | 2500 | MHz |
| PDR | Power detect range, CW | Measured at ANT0 or ANT1 | 0 | - | 21 | dBm |
| PDZ _{src} | DC source impedance on PD_OUT | - | - | 1 | - | kΩ |
| PDV _{NoRF} | Output Voltage, P _{OUT} = No RF | Measured into 1MΩ | - | 0.12 | - | V |
| PDV _{p18} | Output Voltage, P _{OUT} = 17 dBm CW | Measured into 1MΩ | - | 0.45 | - | V |
| PDV _{p21} | Output Voltage, P _{OUT} = 21 dBm CW | Measured into 1MΩ | - | 0.75 | - | V |
| LPF _{-3dB} | Power detect low pass filter -3dB corner frequency | PDC _{LOAD} = 390 pF | 270 | 290 | 400 | kHz |

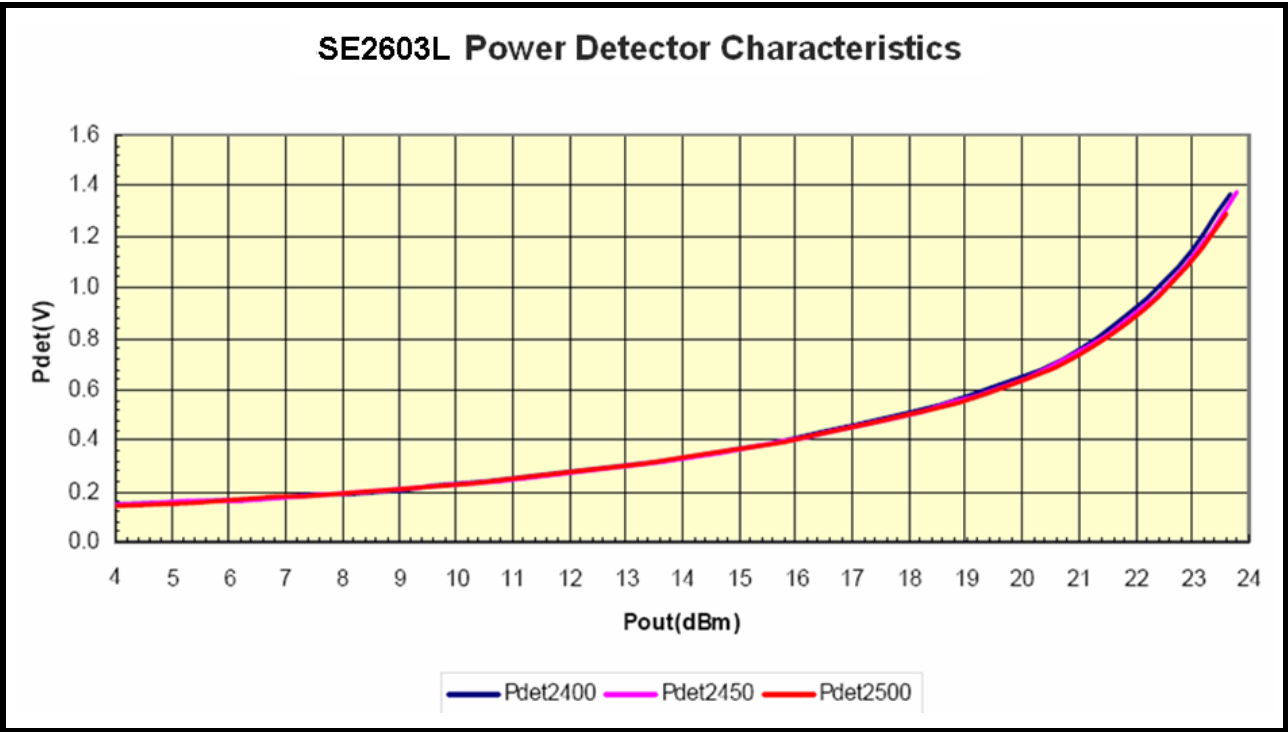


Figure 3: SE2603L Power Detector Characteristics

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Package Diagram

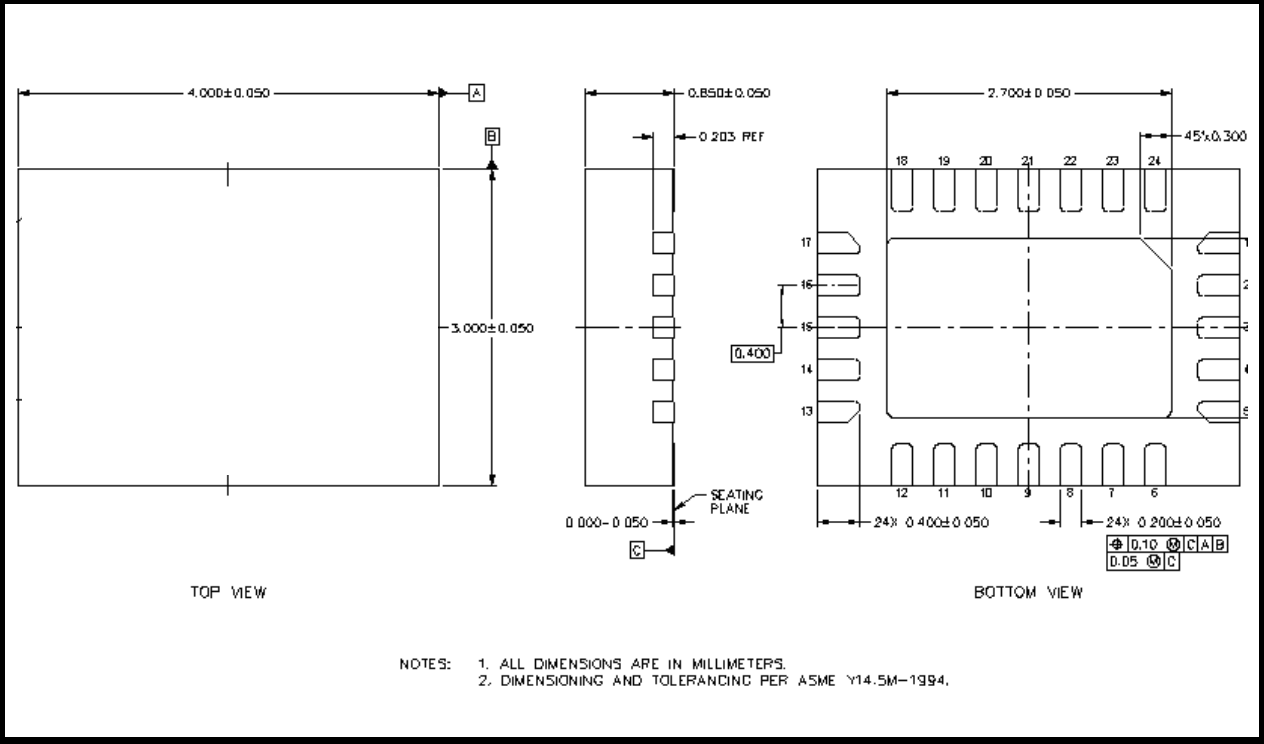


Figure 4: SE2603L Package Outline Drawing



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Recommended Land and Solder Patterns

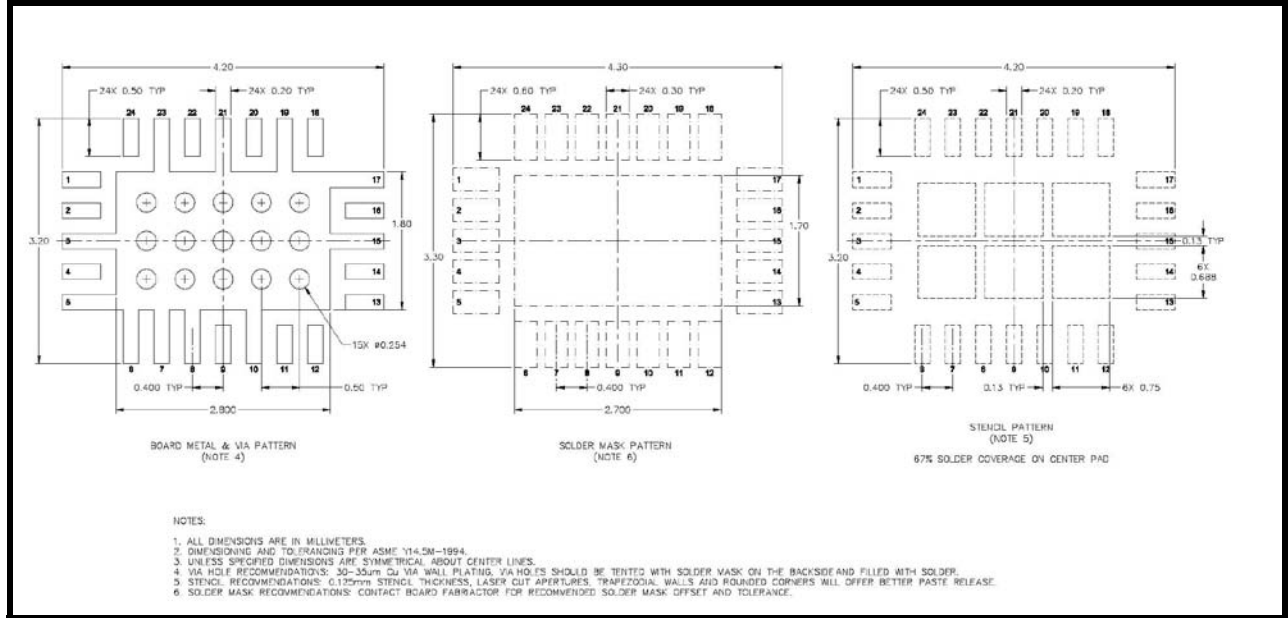


Figure 5: Recommended Land and Solder Patterns

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Package Handling Information

Because of its sensitivity to moisture absorption, 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 SE2603L is capable of withstanding a Pb free 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 manually attached, precaution should be taken to insure that the device is not subjected to temperatures above its rated peak temperature for an extended period of time. For details on both attachment techniques, precautions, and handling procedures recommended, please refer to:

- “Quad Flat No-Lead Module Solder Reflow & Rework Information”, *Document Number QAD-00045*
- “Handling, Packing, Shipping and Use of Moisture Sensitive QFN”, *Document Number QAD-00044*
- SiGe’s Application Note: “Class 0 ESD Device Handling”, *Document Number QAD-00163*



Caution! Class 0 ESD sensitive device

Branding Information

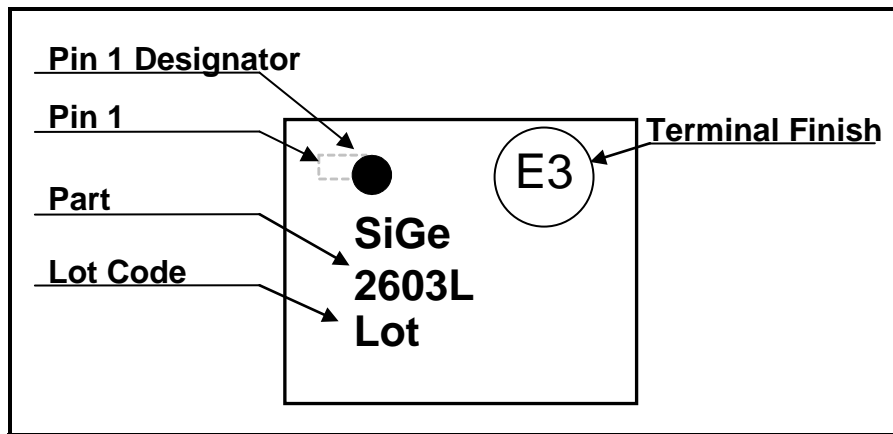


Figure 6: SE2603L Branding and Pin 1 Location

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Tape and Reel Information

| Parameter | Value |
|------------------|----------------|
| Devices Per Reel | 3000 |
| Reel Diameter | 13 inches |
| Tape Width | 12 millimeters |

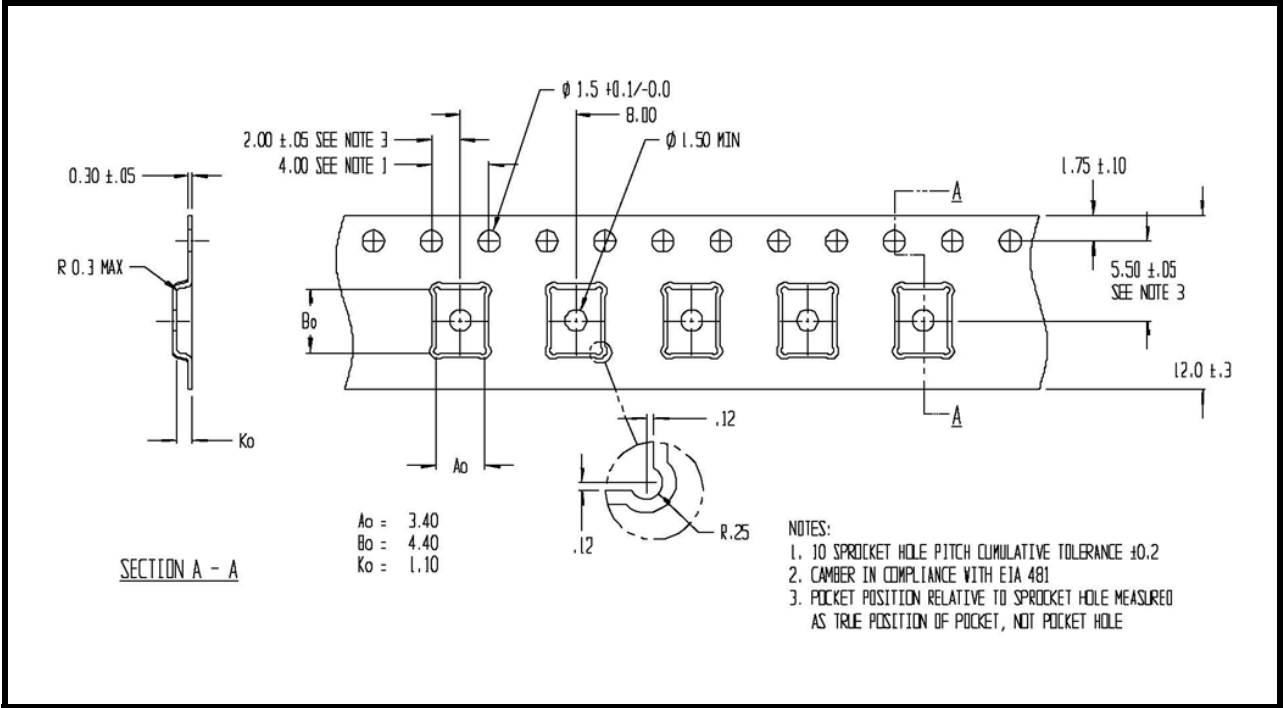


Figure 7: SE2603L-R Tape and Reel Information



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Document Change History

| Revision | Date | Notes |
|----------|--------------|--|
| 1.0 | Sep 18, 2009 | Created |
| 1.1 | Sep 23, 2009 | Corrected operating voltage, Updated current consumption |
| 1.2 | Sep 29, 2009 | Remove reference to pull down resistor. Updated leakage current. |
| 1.3 | Oct 12, 2009 | Updated package outline drawing |
| 1.4 | Jan 20, 2010 | Updated for ESD |
| 1.5 | Jan 29, 2010 | Removed reference to the incorrect part number |
| 1.6 | Jun 9, 2010 | Updated MSL rating to MSL 1 |
| 1.7 | Apr 10, 2012 | Updated with Skyworks logo and disclaimer statement |

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[RFFM4293TR7](#) [RFFM4203TR7](#) [RFFM5765QTR7](#)