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**DATA SHEET**  
**SE2604L: 2.4 GHz High Power Wireless LAN Power Amplifier**

**Applications**

- IEEE802.11b DSSS WLAN
- IEEE802.11g,n OFDM WLAN
- High Power Wireless Networking Products

**Features**

- Dual Mode IEEE802.11b, IEEE802.11g, IEEE802.11n
- 23 dBm, EVM = 3%, 802.11g, OFDM 54 Mbps
- 26 dBm, ACPR < -32 dBc, 802.11b
- Integrated PA, Input Match, 2.8V reference voltage generator
- Integrated Temperature Compensated, Positive Slope Power Detector
- Pb-free, RoHS compliant and Halogen-free
- 3 mm x 3 mm x 0.6 mm QFN, MSL 3

**Product Description**

The SE2604L is a high power 802.11bgn WLAN power amplifier module providing the functionality of the power amplifier, power detector, reference voltage generator and input match.

The SE2604L is designed for ease of use and maximum flexibility, with an integrated input match, and external output match to adjust the load line for either 3.3V, 23dBm operation.

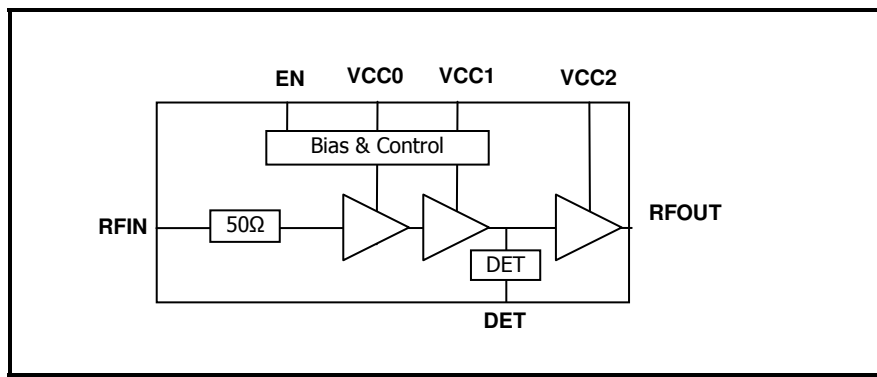
The SE2604L includes a temperature compensated transmit power detector with over 20 dB of dynamic range and <1.2dB variation under 3:1 mismatch at the antenna.

The SE2604L includes a digital enable control due to an integrated reference voltage generator. The power ramp rise/fall time is 0.5  $\mu$ s typical.

**Ordering Information**

| Part No.    | Package    | Remark         |
|-------------|------------|----------------|
| SE2604L     | 16 pin QFN | Samples        |
| SE2604L-R   | 16 pin QFN | Tape & Reel    |
| SE2604L-EK1 | N/A        | Evaluation kit |

**Functional Block Diagram**



**Figure 1: Functional Block Diagram**

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**Pin Out Diagram**

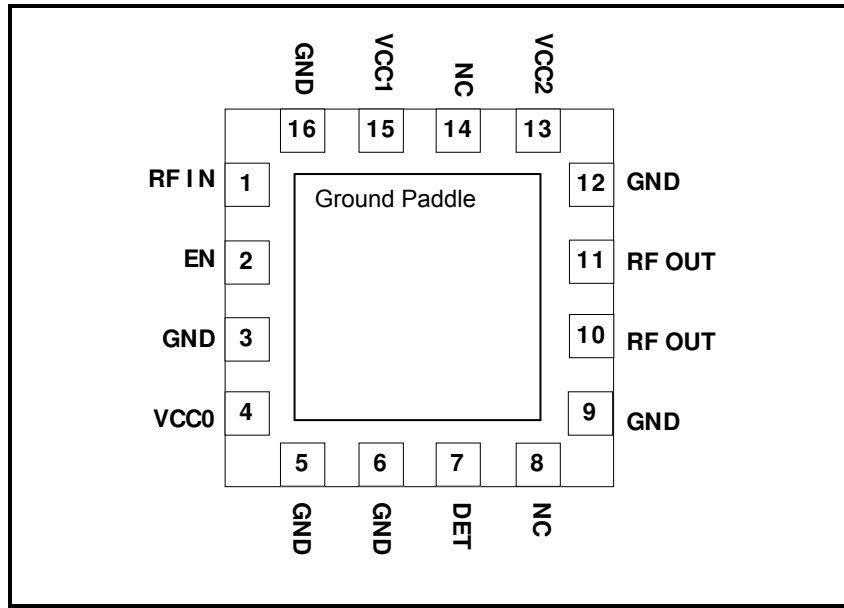


Figure 2: SE2604L Pin Out (Top View Through Package)

**Pin Out Description**

| Pin No.    | Name   | Description                                   |
|------------|--------|---|
| 1          | RF IN  | RF Input                                      |
| 2          | EN     | Power Amplifier Enable                        |
| 3          | GND    | Ground  |
| 4          | VCC0   | Power Supply for Bias Circuit                 |
| 5          | GND    | Ground  |
| 6          | GND    | Ground  |
| 7          | DET    | Power Detector Output                         |
| 8          | NC     | No Connect. May be left floating or grounded. |
| 9          | GND    | Ground  |
| 10         | RF OUT | RF Output                                     |
| 11         | RF OUT | RF Output                                     |
| 12         | GND    | Ground  |
| 13         | VCC2   | Power Supply for 2 <sup>nd</sup> Stage        |
| 14         | NC     | No Connect. May be left floating or grounded. |
| 15         | VCC1   | Power Supply driver stages                    |
| 16         | GND    | Ground  |
| Die 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 | 4.0   | V    |
| V <sub>IN</sub>    | DC input on EN                               | -0.3 | 3.6   | V    |
| TX                 | RF Input Power with RF Out terminated in 50Ω | -    | 12.0  | dBm  |
| T <sub>A</sub>     | Operating Temperature Range                  | -40  | 85    | °C   |
| T <sub>STG</sub>   | Storage Temperature Range                    | -40  | 150   | °C   |
| ESD <sub>HBM</sub> | JEDEC JESD22-A114<br>all pins                | -    | 1,000 | V    |

**Recommended Operating Conditions**

| Symbol         | Parameter                             | Min. | Typ. | Max. | Unit |
|----------------|---------------------------------------|------|------|------|------|
| T <sub>A</sub> | Ambient temperature                   | -40  | 25   | 85   | °C   |
| VCC            | Supply voltage, relative to GND = 0 V | 2.9  | 3.3  | 3.6  | V    |

**DC Electrical Characteristics**

Conditions: VCC = EN = 3.3 V, T<sub>A</sub> = 25 °C, as measured on Skyworks Solutions' SE2604L-EV1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted

| Symbol              | Parameter            | Conditions   | Min. | Typ. | Max. | Unit |
|---------------------|----------------------|--|------|------|------|------|
| I <sub>CC-G</sub>   | Total Supply Current | P <sub>OUT</sub> = 23 dBm, 54 Mbps OFDM signal, 64QAM    | 300  | 410  | 460  | mA   |
| I <sub>CC-B</sub>   | Total Supply Current | P <sub>OUT</sub> = 26 dBm, 11 Mbps CCK signal, BT = 0.45 | 400  | 450  | 560  | mA   |
| I <sub>CC-OFF</sub> | Total Supply Current | EN = 0 V, No RF Applied                                  | -    | 10   | 100  | μA   |

**Logic Characteristics**

Conditions: VCC = EN = 3.3 V, T<sub>A</sub> = 25 °C, as measured on Skyworks Solutions' SE2604L-EV1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted.

| Symbol           | Parameter                        | Conditions              | Min. | Typ. | Max.            | Unit |
|------------------|----------------------------------|-------------------------|------|------|-----------------|------|
| V <sub>ENH</sub> | Logic High Voltage (Module On)   | -                       | 1.8  | -    | V <sub>CC</sub> | V    |
| V <sub>ENL</sub> | Logic Low Voltage (Module Off)   | -                       | 0    | -    | 0.4             | V    |
| I <sub>ENH</sub> | Input Current Logic High Voltage | -                       | -    | 300  | -               | μA   |
| I <sub>ENL</sub> | Input Current Logic Low Voltage  | V <sub>ENL</sub> = 0.4V | -    | 1    | 50              | μA   |

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| Symbol          | Parameter                  | Conditions        | Min. | Typ. | Max. | Unit |
|-----------------|----------------------------|-------------------|------|------|------|------|
| Z <sub>EN</sub> | Enable pin input impedance | Passive Pull Down |      | 10   |      | kΩ   |

**AC Electrical Characteristics**

**802.11g/n Transmit Characteristics**

Conditions: V<sub>CC</sub> = EN = 3.3 V, T<sub>A</sub> = 25 °C, as measured on Skyworks Solutions' SE2604L-EV1 evaluation board (de-embedded to device), all unused ports terminated with 50 ohms, unless otherwise noted.

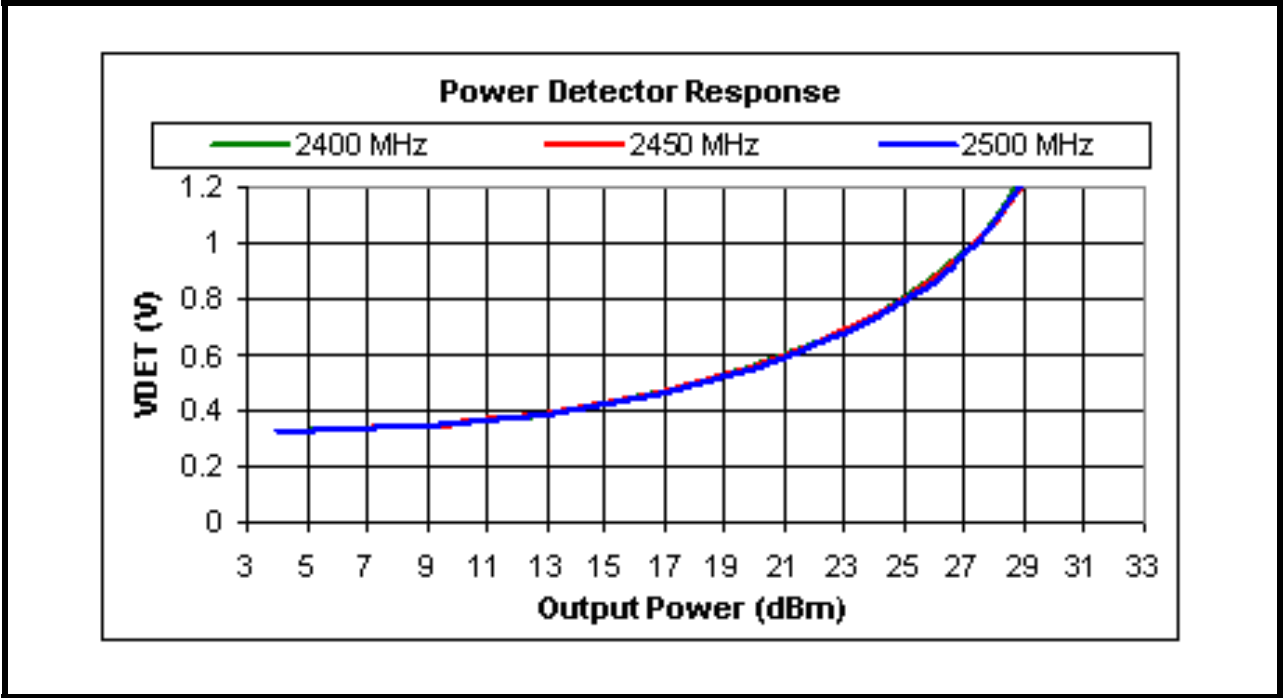
| Symbol                            | Parameter                   | Condition  | Min.   | Typ. | Max. | Unit    |
|-----------------------------------|-----------------------------|--|--|------|------|---------|
| F <sub>IN</sub>                   | Frequency Range             | -  | 2400   | -    | 2500 | MHz     |
| P <sub>OUT</sub>                  | Output Power                | 54 Mbps OFDM signal, 64 QAM, 3% EVM                                  | 21.5   | 23   | -    | dBm     |
|                                   |                             | 11Mbps CCK signal, BT = 0.045, Mask                                  | 24.5   | 26   | -    |         |
|                                   |                             | 802.11n, HT20, all data rates, Mask                                  | 26   | 27   | -    |         |
|                                   |                             | 802.11n, HT40, All data rates, Mask                                  | 23   | 24   | -    |         |
| P <sub>1dB</sub>                  | P1dB                        | -  | 27   | 30   | -    | dBm     |
| S <sub>21</sub>                   | Small Signal Gain           | -  | 30   | 32   | 35   | dB      |
| ΔS <sub>21</sub>                  | Small Signal Gain Variation | Gain variation over single 40MHz channel                             | -  | 0.5  | 0.6  | dB      |
|                                   |                             | Gain Variation over band   | -  | 1.0  | 1.75 |         |
| 2f                                | Harmonics                   | P <sub>OUT</sub> = 26 dBm, 1 Mbps, 802.11b                           | -  | -50  | -45  | dBm/MHz |
| 3f                                |                             |  | -  | -50  | -45  | dBm/MHz |
| t <sub>dr</sub> , t <sub>df</sub> | Delay and rise/fall Time    | 50 % of V <sub>EN</sub> edge and 90/10 % of final output power level | -  | 0.5  | -    | μs      |
| S <sub>11</sub>                   | Input Return Loss           | -  | 10   | 15   | -    | dB      |
| STAB                              | Stability                   | CW, P <sub>OUT</sub> = 26 dBm<br>0.1 GHz – 20 GHz<br>Load VSWR = 6:1 | All non-harmonically related outputs less than -42 dBm/MHz |      |      |         |
| RU                                | Ruggedness                  | CW, P <sub>IN</sub> = +12dBm, Load VSWR = 6:1                        | No permanent damage.                                       |      |      |         |

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**Power Detector Characteristics**

Conditions: VCC = EN = 3.3 V, TA = 25 °C, as measured on Skyworks Solutions' SE2604L-EV1 evaluation board, unless otherwise noted.

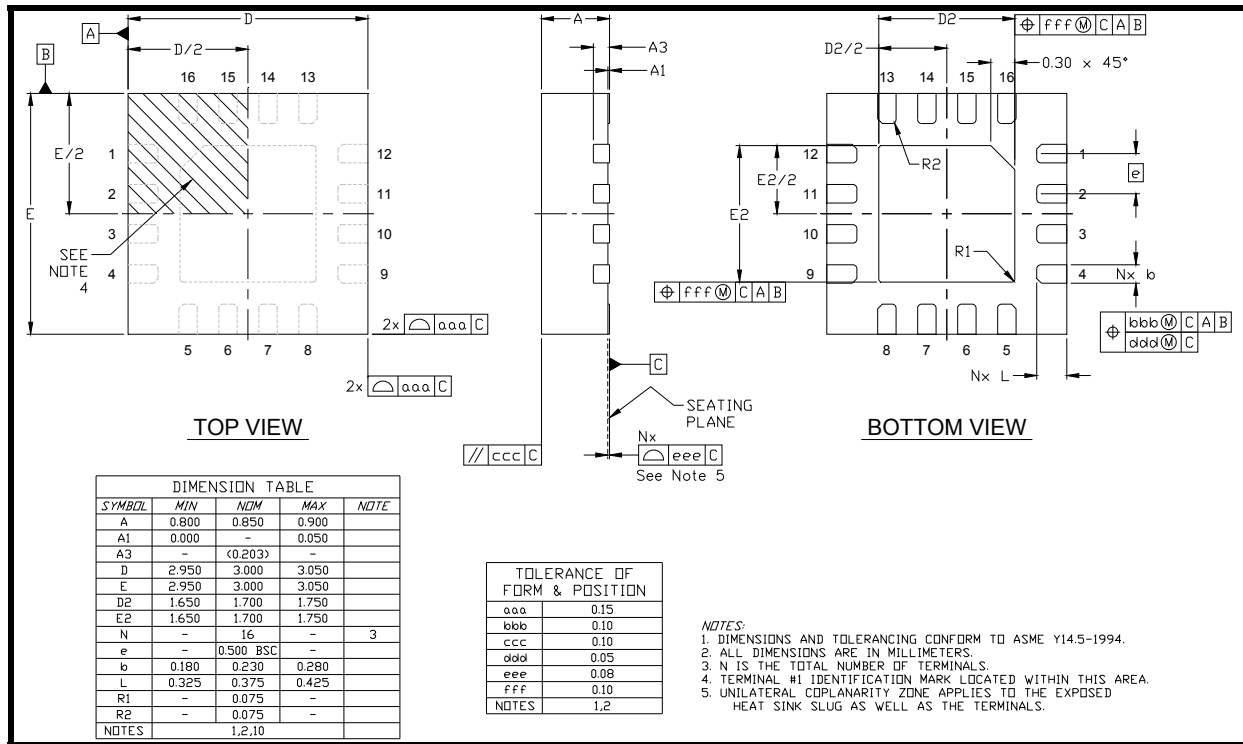
| Symbol              | Parameter  | Condition            | Min. | Typ. | Max. | Unit |
|---------------------|--|----------------------|------|------|------|------|
| F <sub>OUT</sub>    | Frequency Range                                    | -                    | 2400 | -    | 2500 | MHz  |
| PDR                 | Power detect range, CW                             | Measured at RF out   | 0    | -    | 26   | dBm  |
| PDZ <sub>src</sub>  | DC source impedance on PD_OUT                      | -                    | -    | 2.3  | -    | KΩ   |
| PDZ <sub>LOAD</sub> | DC load impedance                                  | -                    | -    | 26.5 | -    | KΩ   |
| PDV <sub>NoRF</sub> | Output Voltage, P <sub>OUT</sub> = 5dBm            | Measured into 26.5KΩ | 0.27 | 0.33 | 0.38 | V    |
| PDV <sub>p23</sub>  | Output Voltage, P <sub>OUT</sub> = 23 dBm CW       | Measured into 26.5KΩ | 0.70 | 0.79 | 0.89 | V    |
| PDV <sub>p27</sub>  | Output Voltage, P <sub>OUT</sub> = 27 dBm CW       | Measured into 26.5KΩ | 0.9  | 1.0  | 1.1  | V    |
| LPF <sub>-3dB</sub> | Power detect low pass filter -3dB corner frequency | Measured into 26.5KΩ | -    | 2.0  | -    | MHz  |



**Figure 3: SE2604L Detector Characteristics**

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**Package Diagram**



**Figure 4: SE2604L Package Diagram**



# DATA SHEET SE2604L: 2.4 GHz High Power Wireless LAN Power Amplifier

## Recommended Land and Solder Patterns

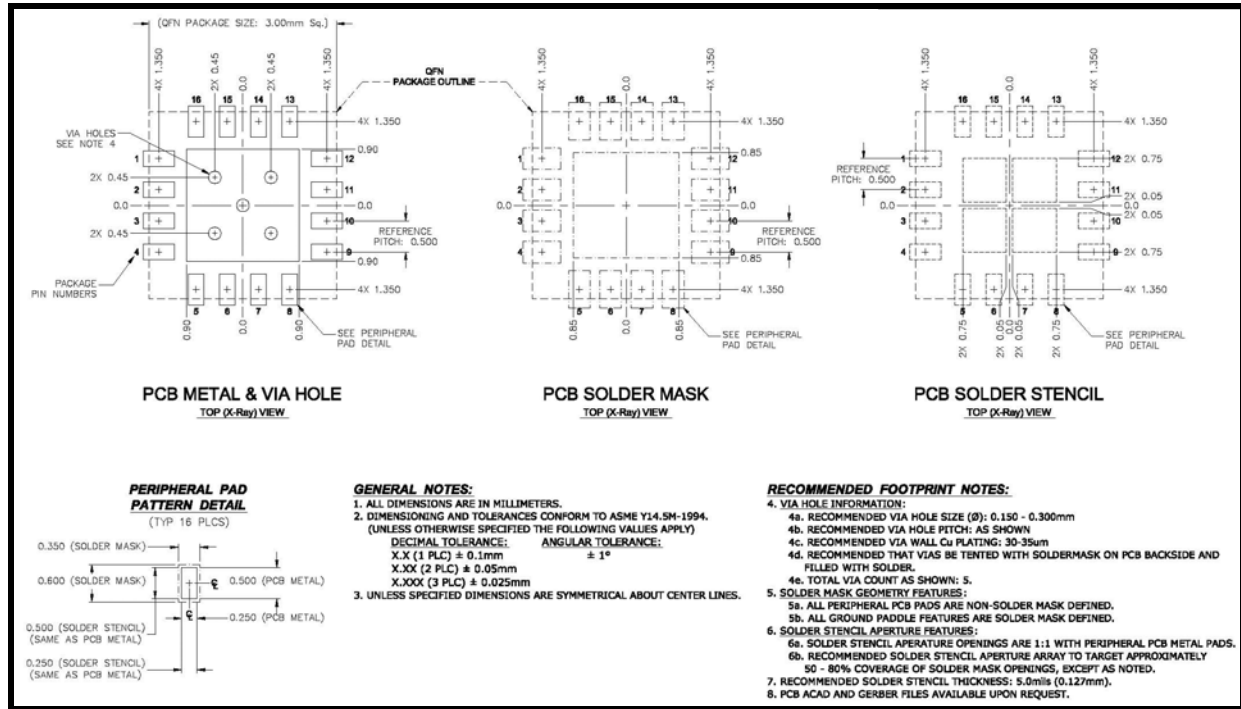


Figure 5: SE2604L Recommended Land and Solder Pattern

## 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 SE2604L 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*

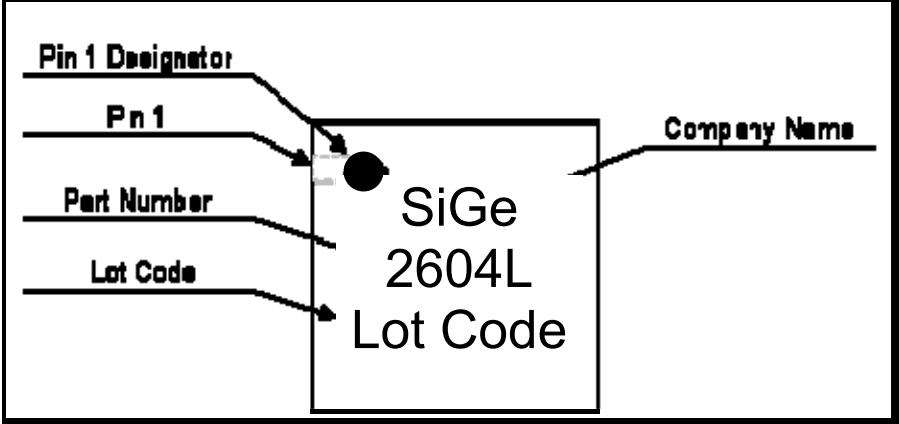


Caution! Class 1C ESD sensitive device



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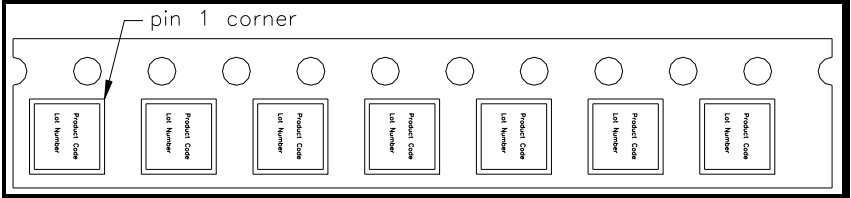
**Branding Information**



**Figure 6: SE2604L Branding**

**Tape and Reel Information**

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



**Figure 7: SE2604L-R Tape and Reel Information**



# DATA SHEET

## SE2604L: 2.4 GHz High Power Wireless LAN Power Amplifier

### Document Change History

| Revision | Date         | Notes   |
|----------|--------------|---|
| 1.0      | Oct 15, 2009 | Created   |
| 1.1      | Jan 26, 2010 | Updated for Off-State Leakage                       |
| 1.2      | Dec 18, 2010 | Updated ESD Rating<br>Added OFDM Mask Compliance    |
| 1.3      | Sep 11, 2011 | Updated recommended operating temperature           |
| 1.4      | Apr 11, 2012 | Updated with Skyworks logo and disclaimer statement |

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