

**DATA SHEET**

# SE2623L: 2.4 GHz High Power Wireless LAN Power Amplifier

## Applications

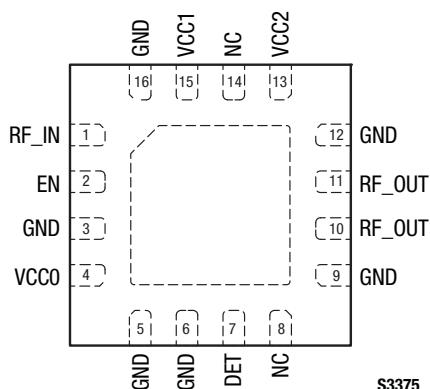
- DSSS 2.4 GHz WLAN (IEEE 802.11b)
- OFDM 2.4 GHz WLANs:  
IEEE 802.11b/g/n  
256 QAM IEEE 802.11ac
- Access points
- PCMCIA cards
- PC cards

## Features

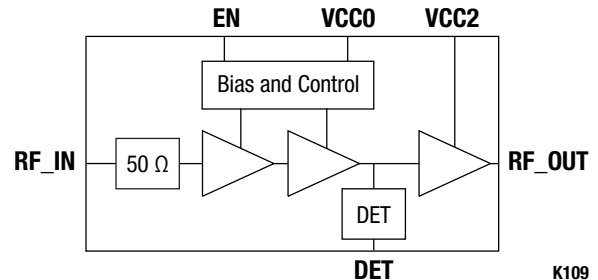
- Single 5 V supply operation:  
+23 dBm, EVM = 1.8 %, MCS8  
+26 dBm, EVM = 3 %, 802.11g, OFDM 54 Mbps  
+26 dBm, ACPR < -32 dBc, 802.11b
- +33 dB gain
- Integrated temperature-compensated power detector
- Digital power amplifier enable pin ( $V_{EN}$ )
- Small QFN (16-pin, 3.0 x 3.0 x 0.9 mm) package (MSL3, 260 °C per JEDEC J-STD-020)



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.



**Figure 2. SE2623L Pinout—16-Pin QFN (Top View)**



**Notes:**

- $RF\_IN$  is DC-short to Ground within the package. Skyworks recommends an external blocking capacitor.
- $RF\_OUT$  is DC-short to VCC within the package. The output match should include the blocking capacitor.

**Figure 1. SE2623L Block Diagram**

## Description

The SE2623L is a 2.4 GHz Power Amplifier (PA) designed for use in the 2.4 GHz Industrial, Scientific, Medical (ISM) band for wireless Local Area Network (LAN) applications. The SE2623L device incorporates a power detector for closed loop monitoring of the output power.

The SE2623L includes a digital enable control for device on/off control.

The SE2623L temperature-compensated power detector is highly immune to mismatch at its output, with less than +1.5 dB of variation with a 2:1 mismatch.

A block diagram of the SE2623L is shown in Figure 1. The device package and pinout for the 16-pin QFN are shown in Figure 2.

## Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SE2623L are provided in Table 2.

The recommended operating conditions are specified in Table 3. The electrical specifications are provided in Tables 4 through 7. The typical performance characteristics of the SE2623L are illustrated in Figure 3.

**Table 1. SE2623L Signal Descriptions**

| Pin | Name  | Description                                 | Pin | Name   | Description                                 |
|-----|-------|---------------------------------------------|-----|--------|---------------------------------------------|
| 1   | RF_IN | RF input                                    | 9   | GND    | Ground                                      |
| 2   | EN    | PA enable                                   | 10  | RF_OUT | RF output                                   |
| 3   | GND   | Ground                                      | 11  | RF_OUT | RF output                                   |
| 4   | VCC0  | Power supply for bias circuit               | 12  | GND    | Ground                                      |
| 5   | GND   | Ground                                      | 13  | VCC2   | Power supply for second stage               |
| 6   | GND   | Ground                                      | 14  | NC     | No Connect—may be left floating or grounded |
| 7   | DET   | Power detector output                       | 15  | VCC1   | Power supply driver stages                  |
| 8   | NC    | No Connect—may be left floating or grounded | 16  | GND    | Ground                                      |

**Table 2. SE2623L Absolute Maximum Ratings (Note 1)**

| Parameter                                                               | Symbol                   | Minimum | Maximum | Units |
|-------------------------------------------------------------------------|--------------------------|---------|---------|-------|
| Supply voltage                                                          | VCC0, VCC1, VCC2, RF_OUT | −0.3    | +5.5    | V     |
| DC input on EN                                                          | V <sub>IN</sub>          | −0.3    | +3.6    | V     |
| RF input power—RF out terminated in 50 Ω                                | P <sub>IN</sub>          |         | +12.0   | dBm   |
| Operating temperature range                                             | T <sub>A</sub>           | −40     | +85     | °C    |
| Junction temperature                                                    | T <sub>J</sub>           |         | +150    | °C    |
| Storage temperature range                                               | T <sub>STG</sub>         | −40     | +150    | °C    |
| Electrostatic discharge:<br>Human Body Model (HBM), Class 1C (all pins) | ESD                      |         | 1000    | V     |

**Note 1:** Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

**CAUTION:** Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

**Table 3. SE2623L Recommended Operating Conditions**

| Parameter                             | Symbol          | Minimum | Typical | Maximum | Units |
|---------------------------------------|-----------------|---------|---------|---------|-------|
| Ambient temperature                   | T <sub>A</sub>  | −40     | +25     | +85     | °C    |
| Supply voltage, relative to GND = 0 V | V <sub>CC</sub> | 4.5     | 5.0     | 5.5     | V     |

**Table 4. SE2623L Electrical Specifications: DC Characteristics (Note 1)****(V<sub>CC</sub> = 5 V, EN = V<sub>ENH</sub>, T<sub>A</sub> = 25 °C as Measured on the Evaluation Board (De-embedded to the Device), All Unused Ports are Terminated with 50 Ω, Unless Otherwise Noted)**

| Parameter                      | Symbol      | Test Condition                                                                     | Minimum | Typical | Maximum | Units |
|--------------------------------|-------------|------------------------------------------------------------------------------------|---------|---------|---------|-------|
| Supply current—Sum of all VCCs | ICC-802.11b | P <sub>OUT</sub> = +29 dBm, 11 Mbps CCK signal, BT = 0.45, V <sub>CC</sub> = 5.0 V |         | 600     | 700     | mA    |
|                                | ICC-802.11g | P <sub>OUT</sub> = +26 dBm, 54 Mbps OFDM signal, 64 QAM, V <sub>CC</sub> = 5V      |         | 480     | 535     | mA    |
|                                | ICQ         | No RF                                                                              |         | 320     |         | mA    |
| Supply current                 | ICC         | V <sub>EN</sub> = 0 V, No RF                                                       |         |         | 100     | μA    |

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.**Table 5. SE2623L Electrical Specifications: AC Characteristics—802.11g/n/ac Transmit Characteristics (Note 1)****(V<sub>CC</sub> = 5.0 V, EN = 3.3 V, T<sub>A</sub> = 25 °C as Measured on the Evaluation Board (De-embedded to the Device), All Unused Ports are Terminated with 50 Ω, Unless Otherwise Noted)**

| Parameter                      | Symbol                          | Test Condition                                                     | Minimum                                            | Typical | Maximum | Units   |
|--------------------------------|---------------------------------|--------------------------------------------------------------------|----------------------------------------------------|---------|---------|---------|
| Frequency range                | f <sub>L-U</sub>                |                                                                    | 2400                                               |         | 2500    | MHz     |
| Output power                   | P <sub>OUT</sub>                | MCS8, HT40, 1.8% EVM                                               | +21                                                | +23     |         | dBm     |
|                                |                                 | MCS8, HT40, 1.25% EVM                                              |                                                    | +18     |         | dBm     |
|                                |                                 | MCS7, HT20, 3% EVM                                                 | +24                                                | +26     |         | dBm     |
|                                |                                 | CCK signal, BT = 0.045, mask                                       | +28                                                | +29     |         | dBm     |
|                                |                                 | MCS0, HT20, mask                                                   | +28                                                | +29     |         | dBm     |
|                                |                                 | MCS0, HT40, mask                                                   | +27                                                | +28     |         | dBm     |
| +1 dB output compression point | OP <sub>1dB</sub>               | No modulation                                                      | +29                                                | +31     |         | dBm     |
| Input return loss              | S <sub>11</sub>                 |                                                                    | 10                                                 | 15      |         | dB      |
| Small signal gain              | S <sub>21</sub>                 | P <sub>IN</sub> = -25 dBm                                          | 30                                                 | 33      |         | dB      |
| Gain variation over band       | ΔS <sub>21</sub>                | P <sub>IN</sub> = -25 dBm, f <sub>IN</sub> = 2400 to 2500 MHz      |                                                    | 1       |         | dB      |
| Harmonics                      | 2f                              | P <sub>OUT</sub> = 29 dBm, 802.11b, 1 Mbps                         |                                                    | -50     | -45     | dBm/MHz |
|                                | 3f                              |                                                                    |                                                    | -50     | -45     | dBm/MHz |
| Rise and fall time             | t <sub>R</sub> , t <sub>F</sub> |                                                                    |                                                    | 0.50    | 0.75    | μs      |
| Stability                      | STAB                            | CW, P <sub>OUT</sub> = +29 dBm, 0.1 GHz to 20 GHz, Load VSWR = 4:1 | All non-harmonically related outputs < -42 dBm/MHz |         |         |         |
| Ruggedness                     | RU                              | CW, 50% duty cycle, P <sub>IN</sub> = +12 dBm, Load VSWR = 6:1     | No damage                                          |         |         |         |

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.

**Table 6. SE2623L Electrical Specifications: Logic Characteristics (Note 1)****(V<sub>CC</sub> = 5 V, EN = V<sub>ENH</sub>, T<sub>A</sub> = 25 °C as Measured on the Evaluation Board (De-embedded to the Device), All Unused Ports are Terminated with 50 Ω, Unless Otherwise Noted)**

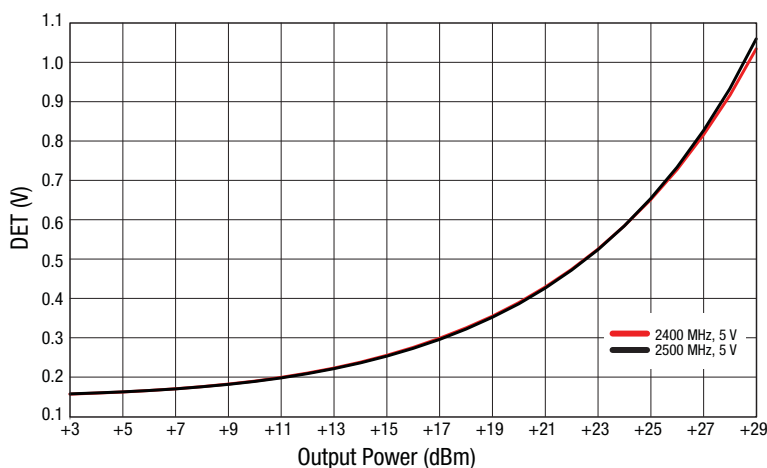
| Parameter                    | Symbol           | Test Condition          | Minimum | Typical | Maximum | Units |
|------------------------------|------------------|-------------------------|---------|---------|---------|-------|
| Logic voltage:               |                  |                         |         |         |         |       |
| High (module on)             | V <sub>ENH</sub> |                         | 1.8     |         | 3.6     | V     |
| Low (module off)             | V <sub>ENL</sub> |                         | 0       |         | 0.4     |       |
| Input current logic voltage: |                  |                         |         |         |         |       |
| High                         | I <sub>ENH</sub> |                         |         |         | 250     | μA    |
| Low                          | I <sub>ENL</sub> | V <sub>EN</sub> = 0.4 V |         | 1       | 20      |       |
| Enable pin input impedance   | Z <sub>EN</sub>  | Passive pull-down       |         | 20      |         | kΩ    |

**Table 7. SE2623L Electrical Specifications: Power Detector Characteristics (Note 1)****(V<sub>CC</sub> = 5 V, EN = V<sub>ENH</sub>, T<sub>A</sub> = 25 °C as Measured on the Evaluation Board, Unless Otherwise Noted)**

| Parameter                                            | Symbol             | Test Condition                  | Minimum | Typical | Maximum | Units |
|------------------------------------------------------|--------------------|---------------------------------|---------|---------|---------|-------|
| Frequency range                                      | f                  |                                 | 2400    |         | 2500    | MHz   |
| Power detect range                                   | PDR                | CW, measured at RF_OUT          | +5      |         | +30     | dBm   |
| DC source impedance on DET                           | PDZSRC             |                                 |         | 2.0     |         | kΩ    |
| DC load impedance                                    | PDZLOAD            |                                 |         | 26.5    |         | kΩ    |
| Output voltage                                       | PDV <sub>DC</sub>  | Measured into 26.5 kΩ:<br>No RF | 0.120   | 0.150   | 0.200   | V     |
|                                                      | PDV <sub>P5</sub>  | P <sub>OUT</sub> = +5 dBm CW    | 0.300   | 0.400   | 0.500   |       |
|                                                      | PDV <sub>P26</sub> | P <sub>OUT</sub> = +26 dBm CW   | 0.575   | 0.700   | 0.875   |       |
|                                                      | PDV <sub>P29</sub> | P <sub>OUT</sub> = +29 dBm CW   | 0.900   | 0.950   | 1.100   |       |
| Power detect low-pass filter, -3 dB corner frequency | LPF-3DB            | Measured into 26.5 kΩ           |         | 2       |         | MHz   |

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.

## Typical Performance Characteristics

**Figure 3. SE2623L Detector Characteristics**

## Evaluation Board Description

The SE2623L-EK1 Evaluation Board is used to test the performance of the SE2623L-R PA. A typical application schematic diagram is provided in Figure 4. Table 8 provides the Bill of Materials (BOM) list for Evaluation Board components. A photograph of the Evaluation Board is shown in Figure 5.

## Circuit Design Considerations

The following design considerations are general in nature and must be followed regardless of final use or configuration:

- Paths to ground should be made as short as possible.
- The ground pad of the SE2623L-R1 has special electrical and thermal grounding requirements. This pad is the main thermal conduit for heat dissipation. Since the circuit board acts as the heat sink, it must shunt as much heat as possible from the device.

Therefore, design the connection to the ground pad to dissipate the maximum wattage produced by the circuit board. Multiple vias to the grounding layer are required.

For further information, refer to the Skyworks Application Note, *PCB Design Guidelines for High Power Dissipation Packages*, document number 201211.

- Bypass capacitors should be used on the DC supply lines. An RF inductor is required on the VCC supply line to block RF signals from the DC supply. Refer to the schematic drawing in Figure 4 for further details.
- The RF lines should be well separated from each other with solid ground in between traces to maximize input-to-output isolation.

## Evaluation Board Test Procedure

1. Connect GND to all ground pins.
2. Connect a power supply to the VCC1, VCC2, and the two RF\_OUT pins.
3. If desired, connect a voltage meter to the VDET pin.
4. Connect a +3.3 V supply to EN pin.
5. Connect a signal generator to the RF signal input port. Set it to the desired RF frequency at a power level of –30 dBm or less to the Evaluation Board. DO NOT enable the RF signal.
6. Connect a spectrum analyzer to the RF signal output port.
7. Enable the power supply.
8. Enable the RF signal.
9. Take measurements.

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**CAUTION:** If the input signal exceeds the rated power, the Evaluation Board can be permanently damaged.

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**NOTE:** It is important to adjust the VCC voltage source so that the target supply voltage (+5) is measured at the board. The high collector currents will drop the collector voltage significantly if long leads are used. Adjust the bias voltage to compensate.

## Package Dimensions

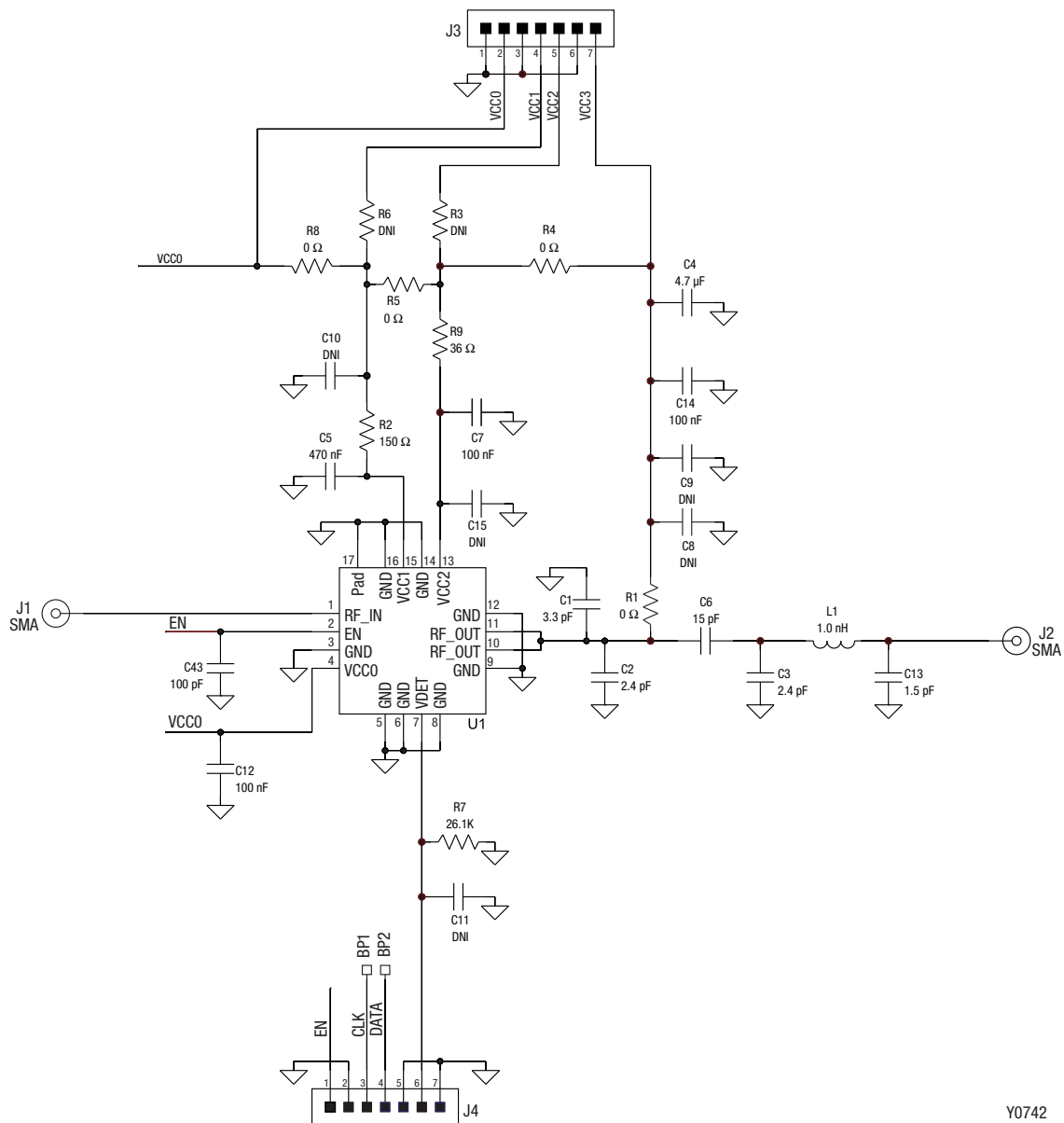
Typical part markings for the SE2623L are shown in Figure 6. The PCB layout footprint for the SE2623L is provided in Figure 7. Package dimensions for the 16-pin QFN are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

## Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SE2623L is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C, and can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information* (Document Number 200164).

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

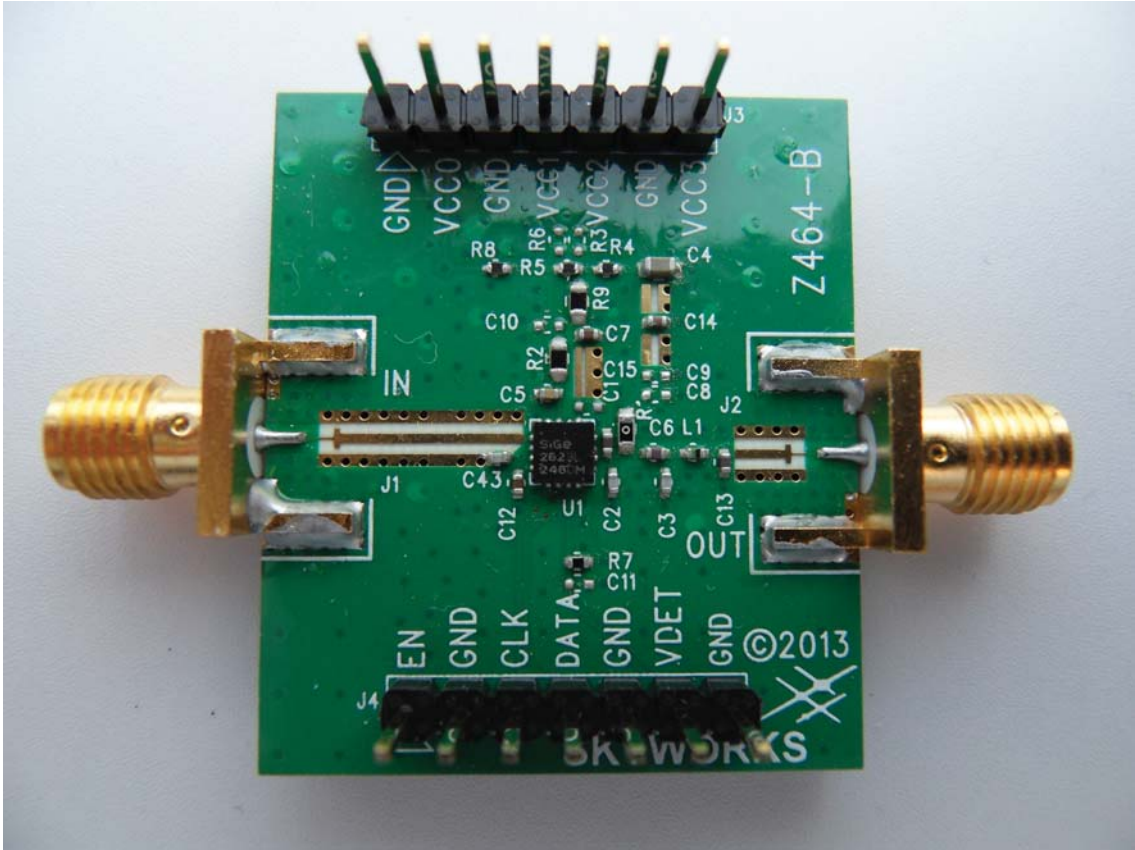


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**Figure 4. SE2623L Evaluation Board Schematic Diagram**

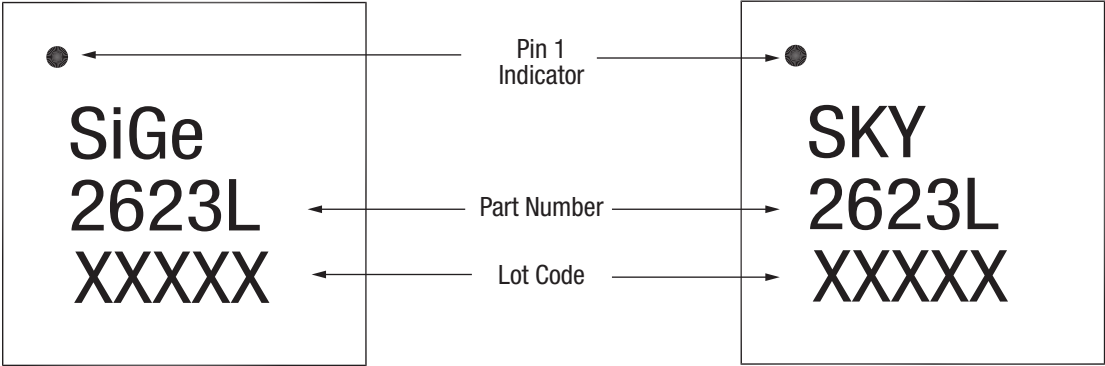
**Table 8. SE2623L Evaluation Board Bill of Materials**

| Quantity | Component             | Value        | Manufacturer       | Mfr Part Number   | Package         | Description                                           |
|----------|-----------------------|--------------|--------------------|-------------------|-----------------|-------------------------------------------------------|
| 1        | R1                    | 0 $\Omega$   | Panasonic          | ERJ3GEJ0R0        | 0603            | Thick film chip resistor                              |
| 1        | L1                    | 1.0 nH       | Murata             | LQG15HN1N0S02D    | 0402            |                                                       |
| 1        | C13                   | 1.5 pF       | Murata             | GRM1555C1H1R5CZ01 | 0402            | Multilayer ceramic                                    |
| 1        | C1                    | 3.3 pF       | Murata             | GRM1555C1H3R3CZ01 | 0402            | Multilayer ceramic                                    |
| 1        | C4                    | 4.7 $\mu$ F  | Murata             | GRM188R60J475KE19 | 0603            | Multilayer ceramic                                    |
| 1        | C6                    | 15 pF        | Murata             | GRM1555C1H150JZ01 | 0402            | Multilayer ceramic                                    |
| 1        | R7                    | 26.1K        | Panasonic          | ERJ2RKF2612       | 0402            | Thick film chip resistor                              |
| 1        | R9                    | 36 $\Omega$  | Panasonic          | ERJ3GEYJ360       | 0603            | Thick film chip resistor                              |
| 1        | C43                   | 100 pF       | Murata             | GRM1555C1H101JZ01 | 0402            | Multilayer ceramic                                    |
| 1        | R2                    | 150 $\Omega$ | Panasonic          | ERJ3GEYJ151       | 0603            | Thick film chip resistor                              |
| 1        | C5                    | 470 nF       | Murata             | GRM155R60J474KE19 | 0402            | Multilayer ceramic                                    |
| 1        | U1                    | SE2623L      | Skyworks Solutions | SE2623L           | QFN 300 X 300   | 802.11g/n High Power PA                               |
| 1        | PCB1                  | Z464-B       | Skyworks Solutions | Z464-B            |                 | PCB                                                   |
| 2        | C2, C3                | 2.4 pF       | Murata             | GRM1555C1H2R4CZ01 | 0402            | Multilayer ceramic                                    |
| 2        | J3, J4                | 7X1          | Samtec             | TSW-107-07-G-S    | 100 mil         | 100 mil header                                        |
| 2        | R3, R6                | DNI          |                    |                   | 0402            | Do Not Install                                        |
| 2        | J1, J2                | SMA          | Johnson Components | 142-0701-851      | end launch      | SMA end launch straight jack receptacle - tab contact |
| 2        | BP1, BP2              | Value        | Skyworks Solutions | printed element   | 0.25mm X 0.25mm | Bonding pad                                           |
| 3        | R4, R5, R8            | 0 $\Omega$   | Panasonic          | ERJ2GEJ0R0        | 0402            | Thick film chip resistor                              |
| 3        | C7, C12, C14          | 100 nF       | Murata             | GRM155R61A104KA01 | 0402            | Multilayer ceramic                                    |
| 5        | C8, C9, C10, C11, C15 | DNI          | -                  | -                 | 0402            | -                                                     |



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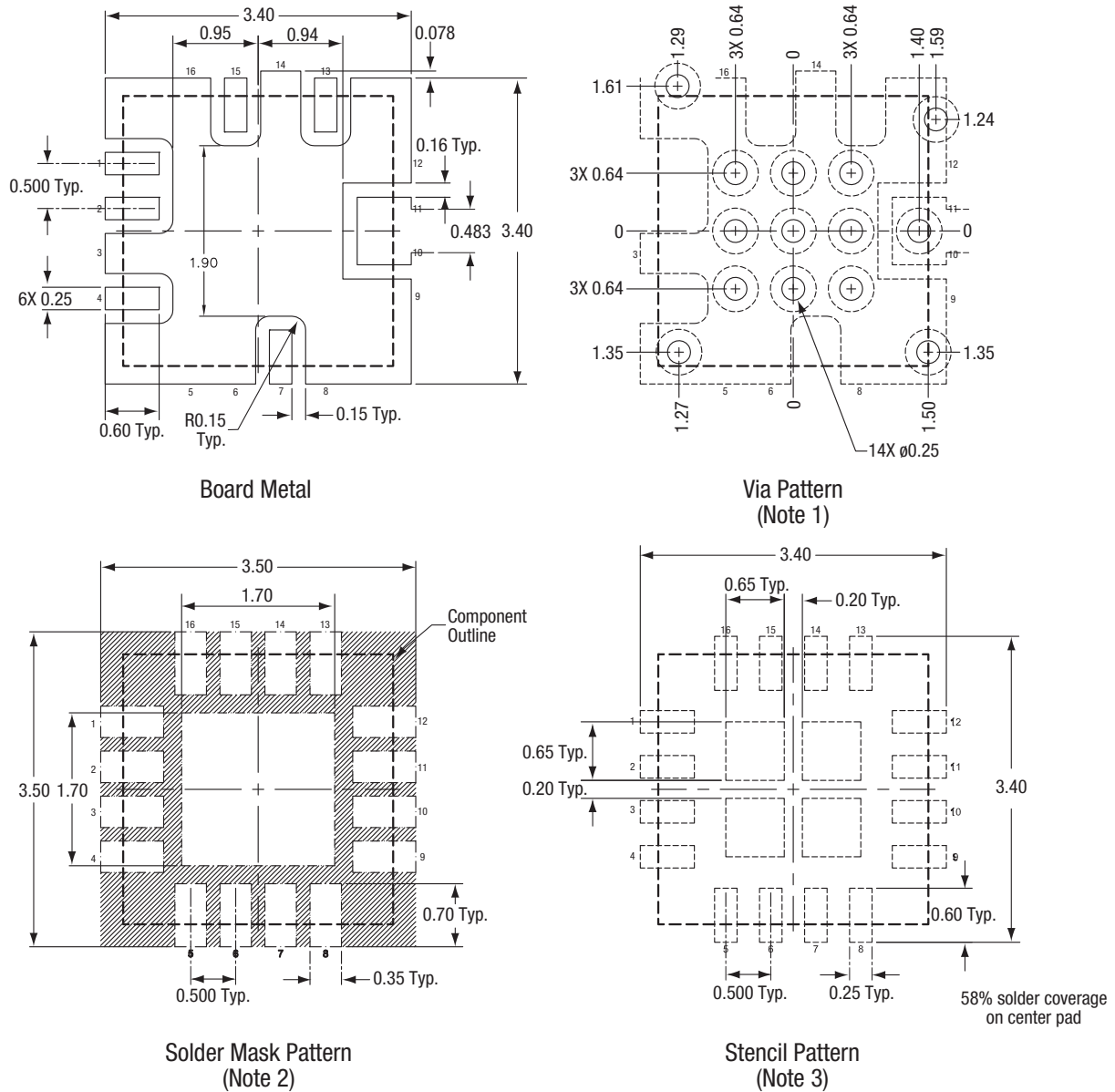
Figure 5. SE2623L Evaluation Board



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Figure 6. SE2623L Typical Part Markings (Top View)



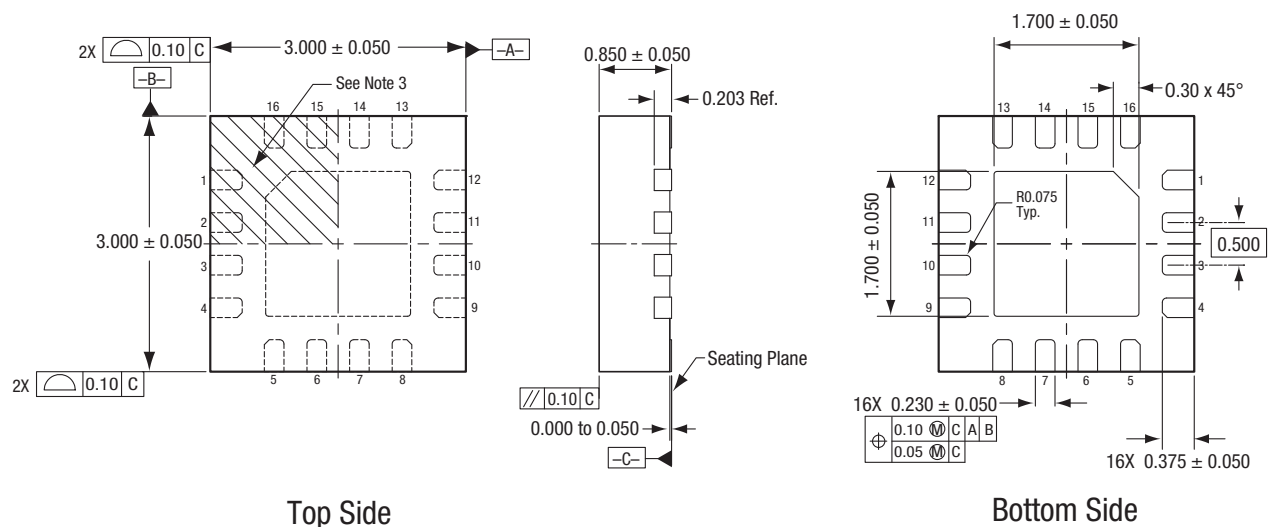


**Notes:**

1. Via hole recommendations:  
0.025 mm Cu via wall plating (minimum), via holes to be plated shut or plugged and capped, both sides.
2. Solder mask recommendations:  
Contact board fabricator for recommended solder mask offset and tolerance.
3. Stencil recommendations:  
0.125 mm stencil thickness, laser cut apertures, trapezoidal walls and rounded corners offer better paste release.
4. Dimensions and tolerances according to ASME Y14.5M-1994.
5. Unless specified, dimensions are symmetrical about center lines.
6. All dimensions are in millimeters.

S3376

**Figure 7. SE2623L PCB Layout Footprint**

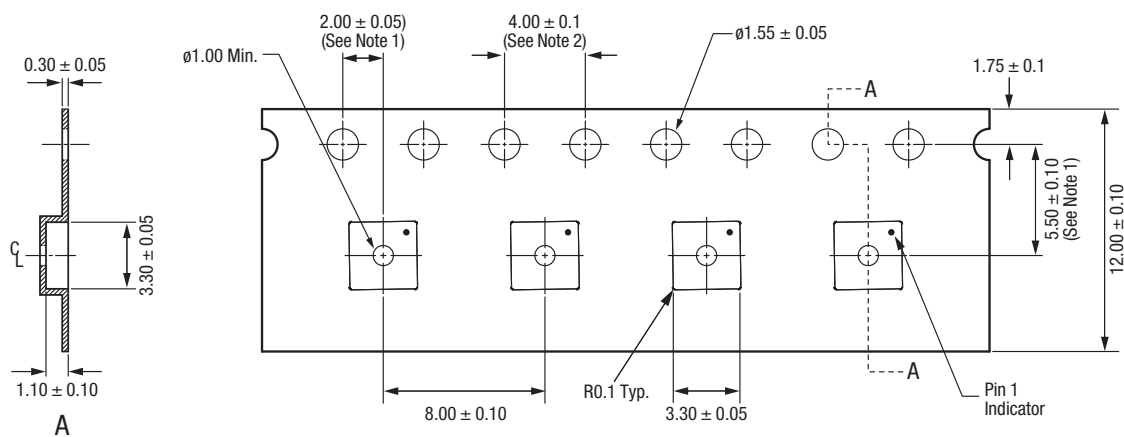


**Notes:**

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.  
Unless otherwise specified, the following values apply:  
Decimal Tolerance:      Angular Tolerance:  
X.X (1 place) ± 0.1 mm      ±1°  
X.XX (2 places) ± 0.05 mm  
X.XXX (3 places) ± 0.025 mm
3. Terminal #1 identification mark located within marked area.
4. Unless specified, dimensions are symmetrical about center lines.

S3374

**Figure 8. SE2623L 16-Pin QFN Package Dimensions**



S3377

**Figure 9. SE2623L 16-Pin QFN Tape and Reel Dimensions**

## Ordering Information

| Model Name                                 | Manufacturing Part Number | Evaluation Board Part Number |
|--------------------------------------------|---------------------------|------------------------------|
| SE2623L 2.4 GHz High Power Wireless LAN PA | SE2623L                   | SE2623L-EK1                  |

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