

DATA SHEET

# SE2623L-R: 2.4 GHz High Power Wireless LAN Power Amplifier

## Applications

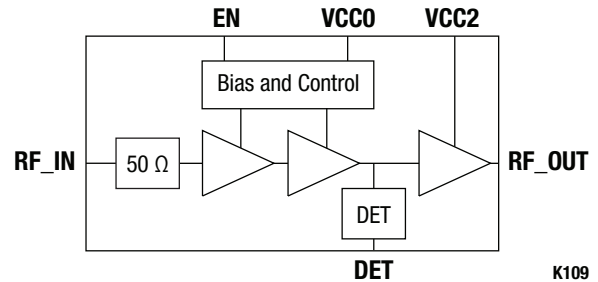
- DSSS 2.4 GHz WLAN (IEEE 802.11b)
- OFDM 2.4 GHz WLANs:
  - IEEE 802.11b/g/n
  - 256 QAM IEEE 802.11ac
- Access points
- PCMCIA cards
- PC cards

## 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<sub>EN</sub>)
- 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.



Notes:

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

Figure 1. SE2623L-R Block Diagram

## Description

The SE2623L-R 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-R device incorporates a power detector for closed loop monitoring of the output power.

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

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

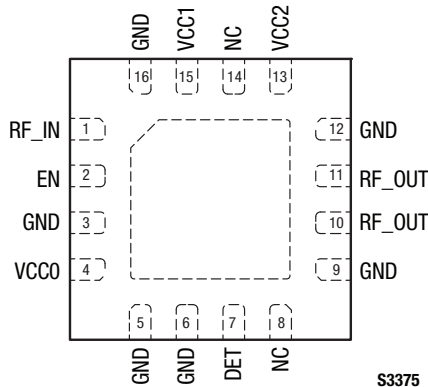


Figure 2. SE2623L-R Pinout—16-Pin QFN (Top View)

### Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SE2623L-R 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-R are illustrated in Figure 3.

**Table 1. SE2623L-R 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-R Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VCC0, VCC1, VCC2, RF_OUT	-0.3	+5.5	V
DC input on EN	VIN	-0.3	+3.6	V
RF input power—RF out terminated in 50 Ω	PIN		+12.0	dBm
Operating temperature range	TA	-40	+85	°C
Junction temperature	TJ		+150	°C
Storage temperature range	TSTG	-40	+150	°C
Electrostatic discharge: Human Body Model (HBM), Class 1C (all pins)	ESD		1000	V

<sup>1</sup> 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.

**ESD HANDLING:** *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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

**Table 3. SE2623L-R Recommended Operating Conditions**

Parameter	Symbol	Min	Typ	Max	Units
Ambient temperature	TA	-40	+25	+85	°C
Supply voltage, relative to GND = 0 V	Vcc	4.5	5.0	5.5	V

**Table 4. SE2623L-R Electrical Specifications: DC Characteristics<sup>1</sup>**

**(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	Min	Typ	Max	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
	I <sub>CQ</sub>	No RF		280		mA
Supply current	ICC	V <sub>EN</sub> = 0 V, No RF			150	μA
Thermal conductivity	θ <sub>JC</sub>				13	°C/W

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

**Table 5. SE2623L-R Electrical Specifications: AC Characteristics: 802.11g/n/ac Transmit Characteristics<sup>1</sup>**

**(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	Min	Typ	Max	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			

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

**Table 6. SE2623L-R Electrical Specifications: Logic Characteristics<sup>1</sup>**

(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	Min	Typ	Max	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

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

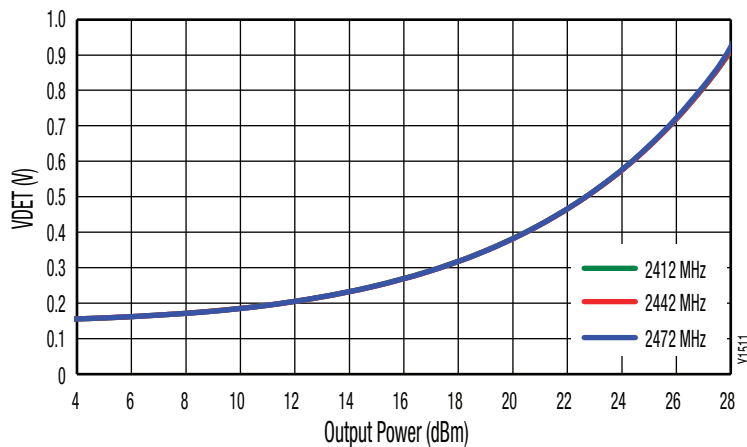
**Table 7. SE2623L-R Electrical Specifications: Power Detector Characteristics<sup>1</sup>**

(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	Min	Typ	Max	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	P <sub>VDc</sub> P <sub>VDp5</sub> P <sub>VDp26</sub> P <sub>VDp29</sub>	Measured into 26.5 kΩ: No RF P <sub>OUT</sub> = +5 dBm CW P <sub>OUT</sub> = +26 dBm CW P <sub>OUT</sub> = +29 dBm CW	0.120 0.120 0.575 0.900	0.150 0.180 0.700 1.000	0.200 0.230 0.875 1.100	V
Power detect low-pass filter, -3 dB corner frequency	LPF-3DB	Measured into 26.5 kΩ		2		MHz

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

### Typical Performance Characteristics



**Figure 3. SE2623L-R Detector Characteristics**

## Evaluation Board Description

The SE2623L-R-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.

### 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.*

### 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-R 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.

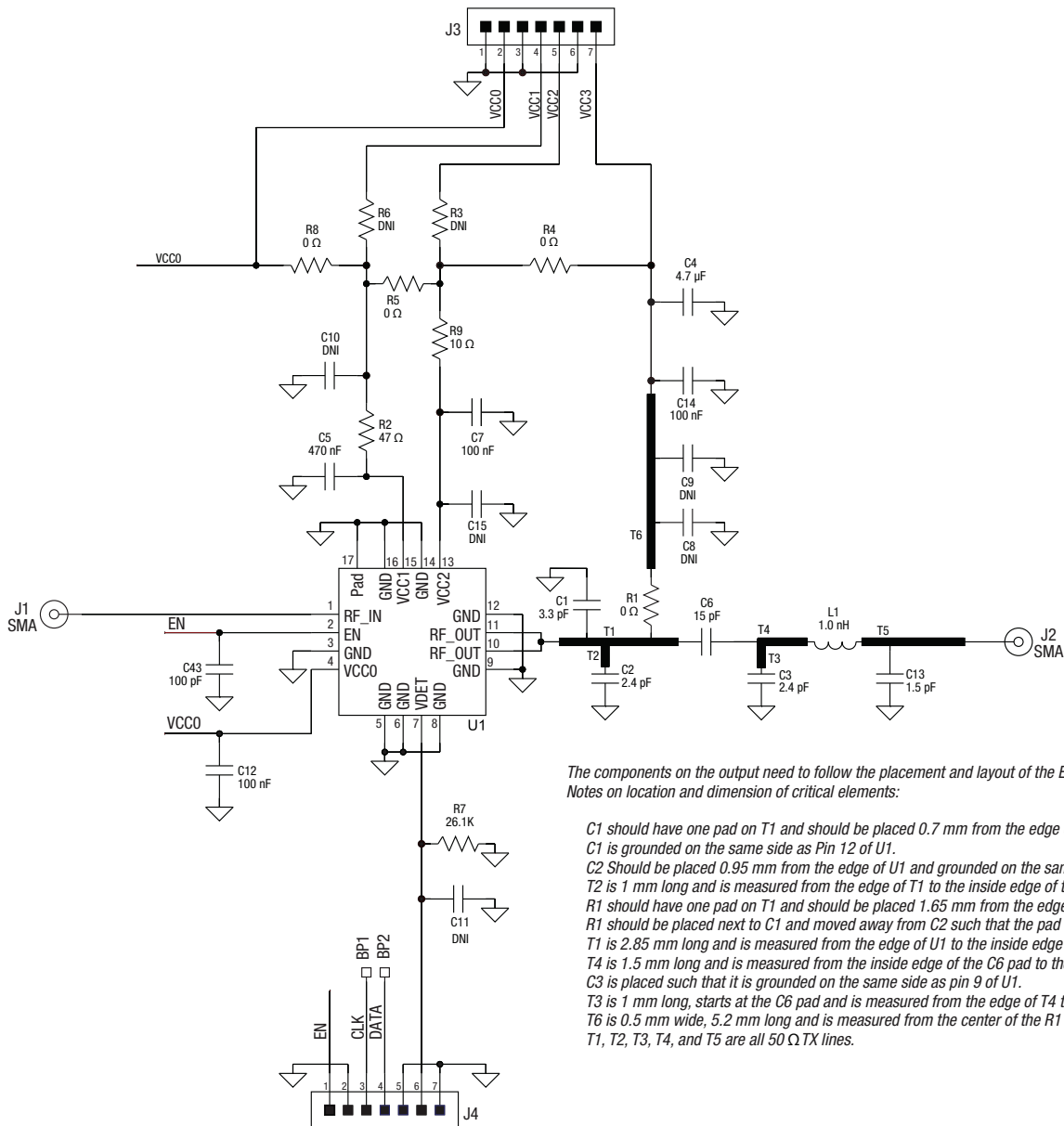
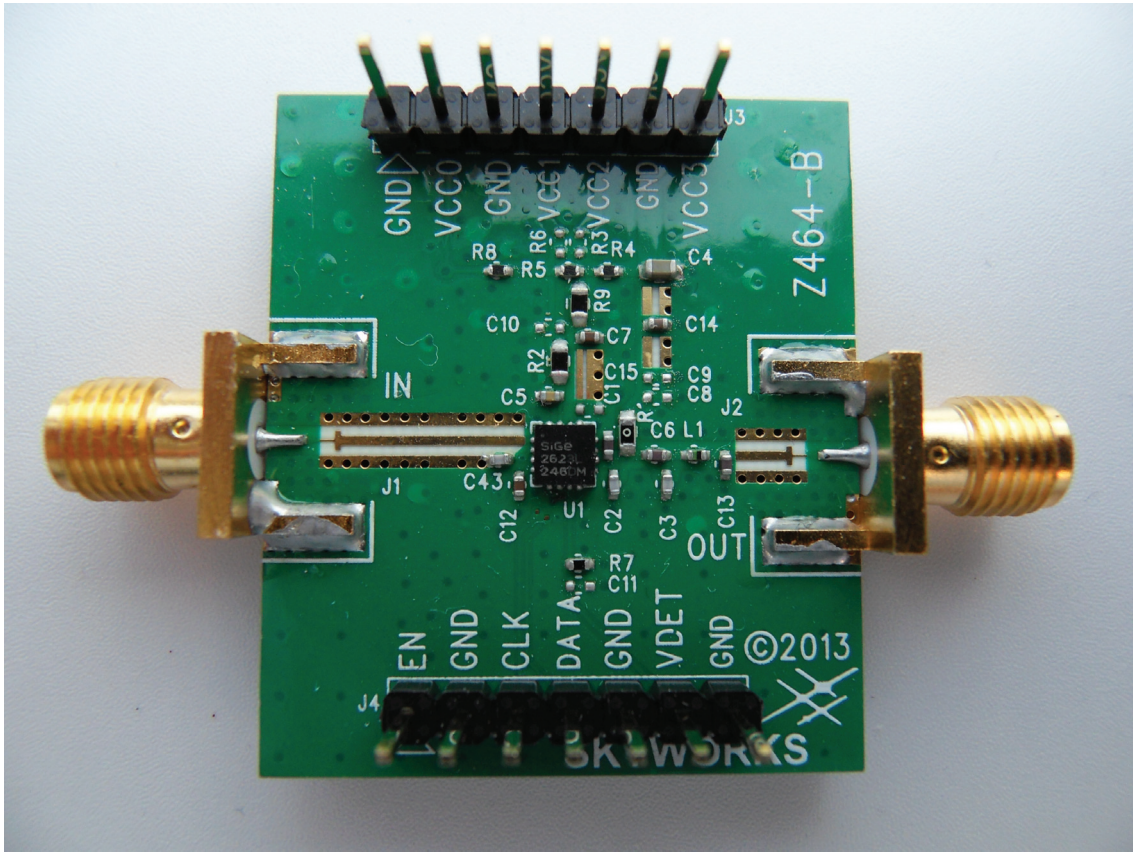


Figure 4. SE2623L-R Evaluation Board Schematic Diagram

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

Quantity	Component	Value	Manufacturer	Mfr Part Number	Package	Description
1	R1	0 Ω	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 uF	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	10 Ω	Panasonic	ERJ3GEYJ100	0603	Thick film chip resistor
1	C43	100 pF	muRata	GRM1555C1H101JZ01	0402	Multilayer ceramic
1	R2	47 Ω	Panasonic	ERJ3GEYJ470	0603	Thick film chip resistor
1	C5	470 nF	muRata	GRM155R60J474KE19	0402	Multilayer ceramic
1	U1	SE2623L-R	Skyworks Solutions	SE2623L-R	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 Ω	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-R Evaluation Board



**Package Dimensions**

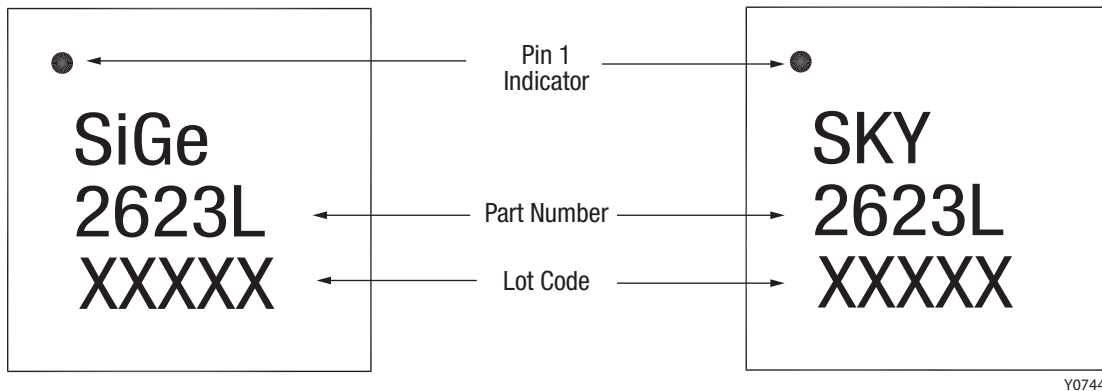
Typical part markings for the SE2623L-R are shown in Figure 6. The PCB layout footprint for the SE2623L-R is provided in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

**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-R 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.



**Figure 6. SE2623L-R Typical Part Markings (Top View)**





## Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SE2623L-R	2.4 GHz High Power Wireless LAN PA	SE2623L-R-EK1

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