

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 μ s typical.



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Functional Block Diagram

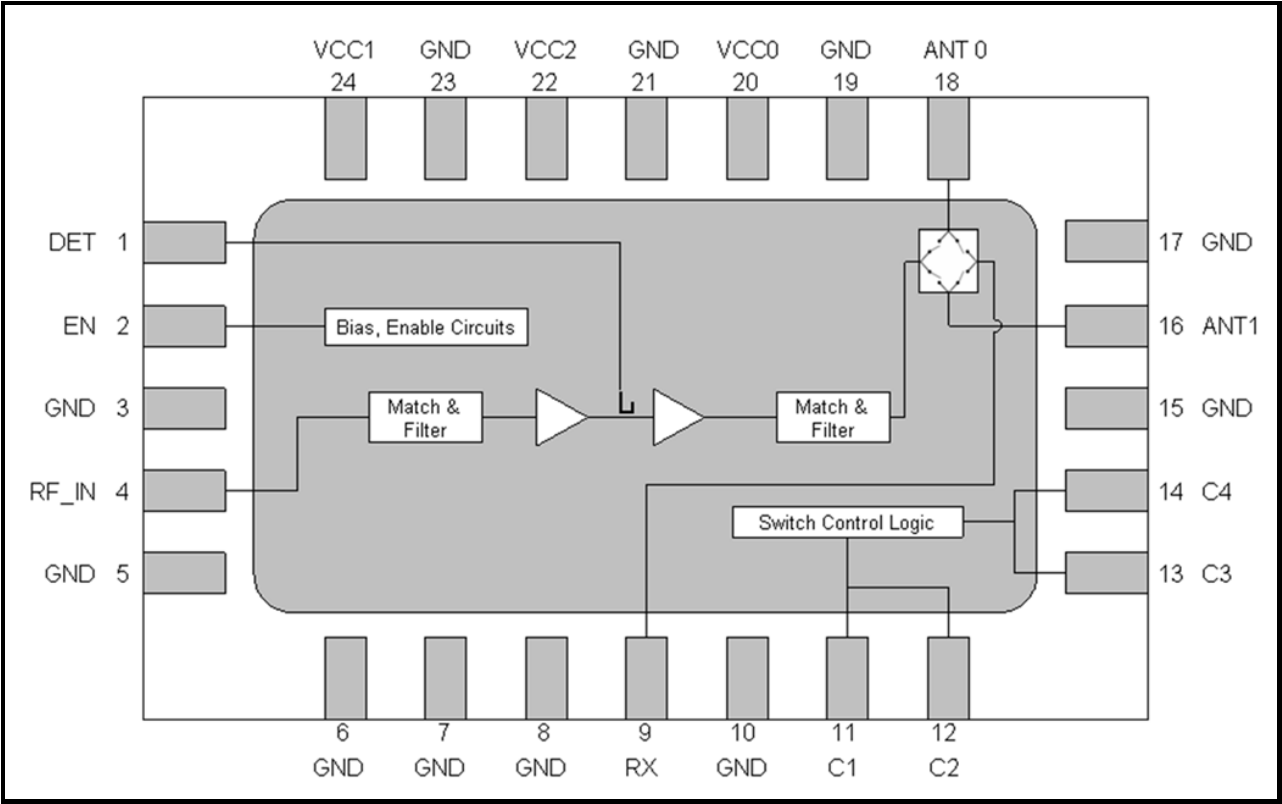


Figure 1: Functional Block Diagram

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Pin Out Diagram

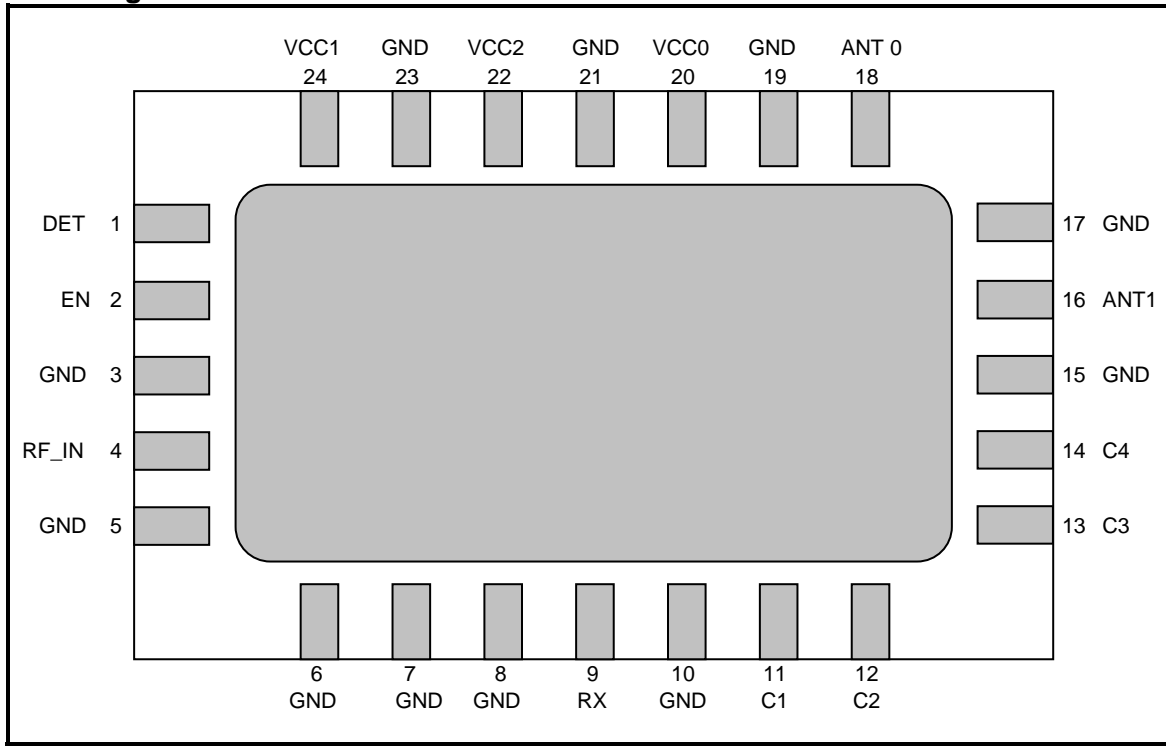


Figure 2: SE2603L Pin Out (Top View Through Package)

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

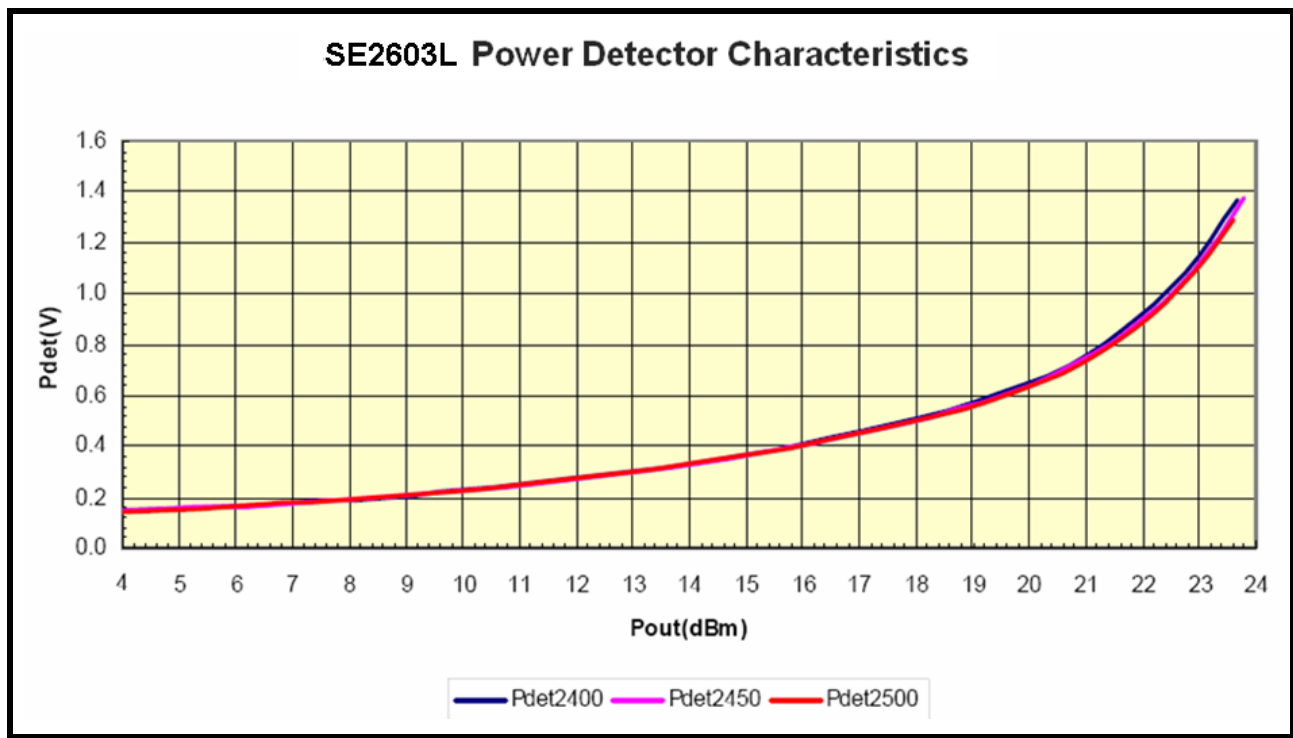


Figure 3: SE2603L Power Detector Characteristics

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Package Diagram

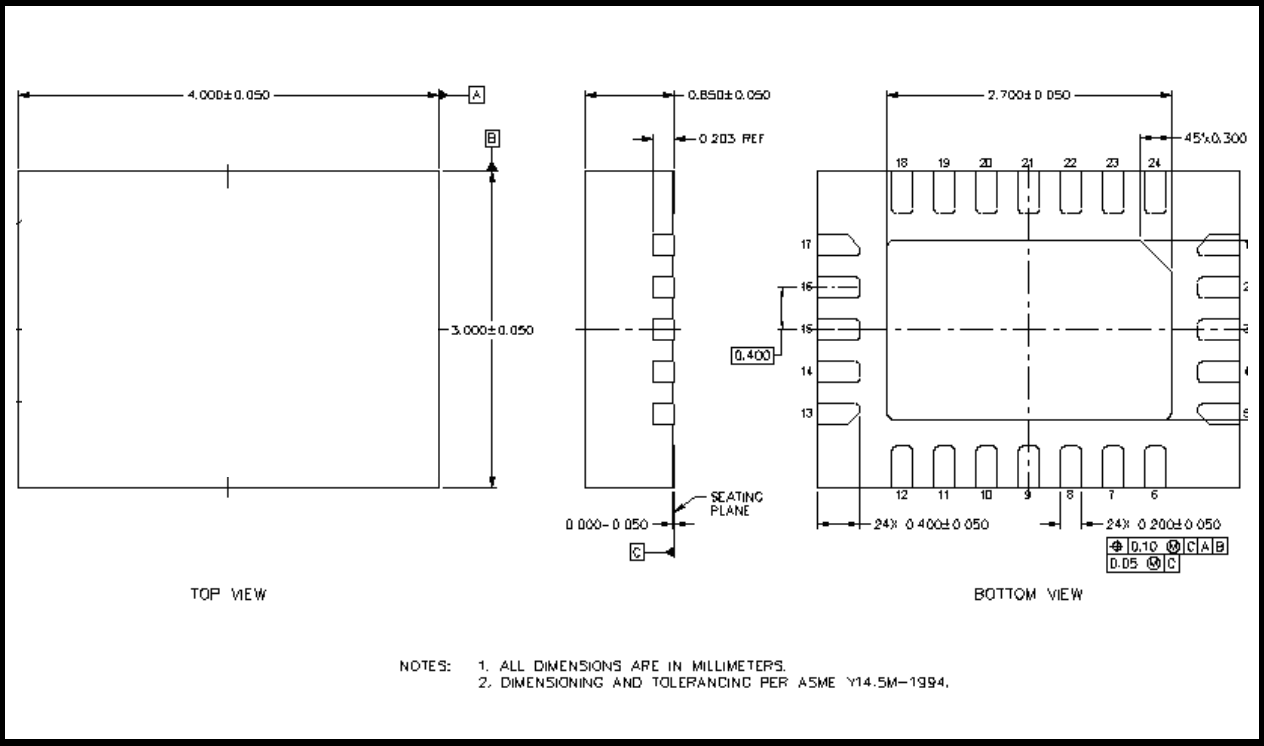


Figure 4: SE2603L Package Outline Drawing



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Recommended Land and Solder Patterns

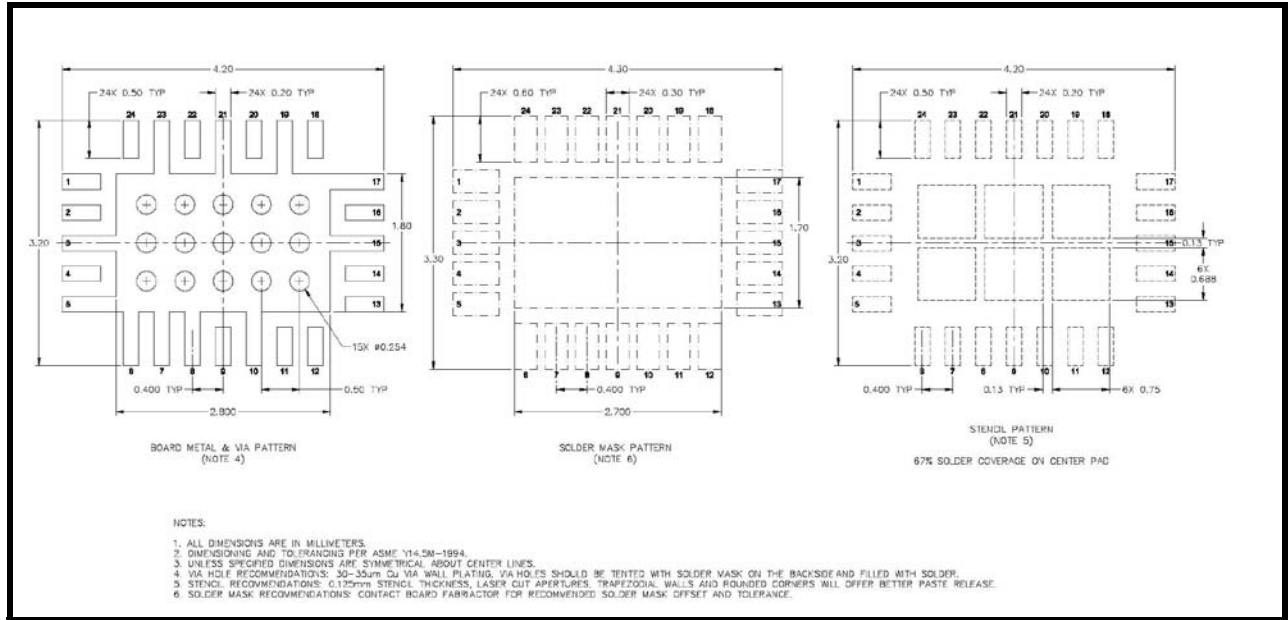


Figure 5: Recommended Land and Solder Patterns

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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

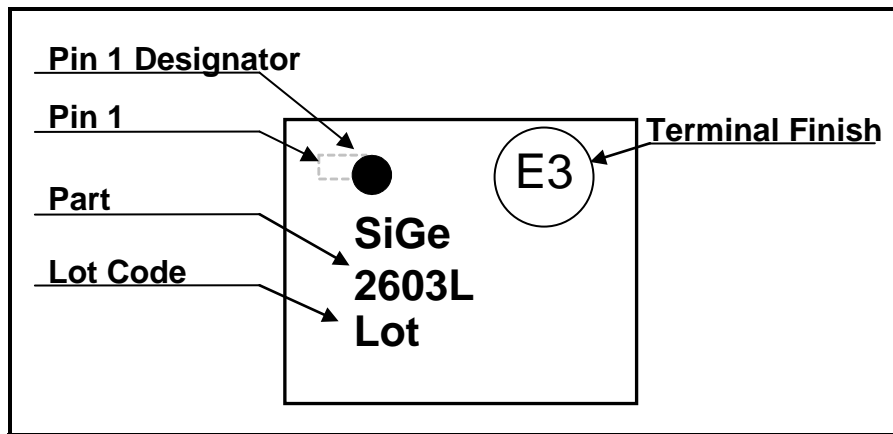


Figure 6: SE2603L Branding and Pin 1 Location

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Tape and Reel Information

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

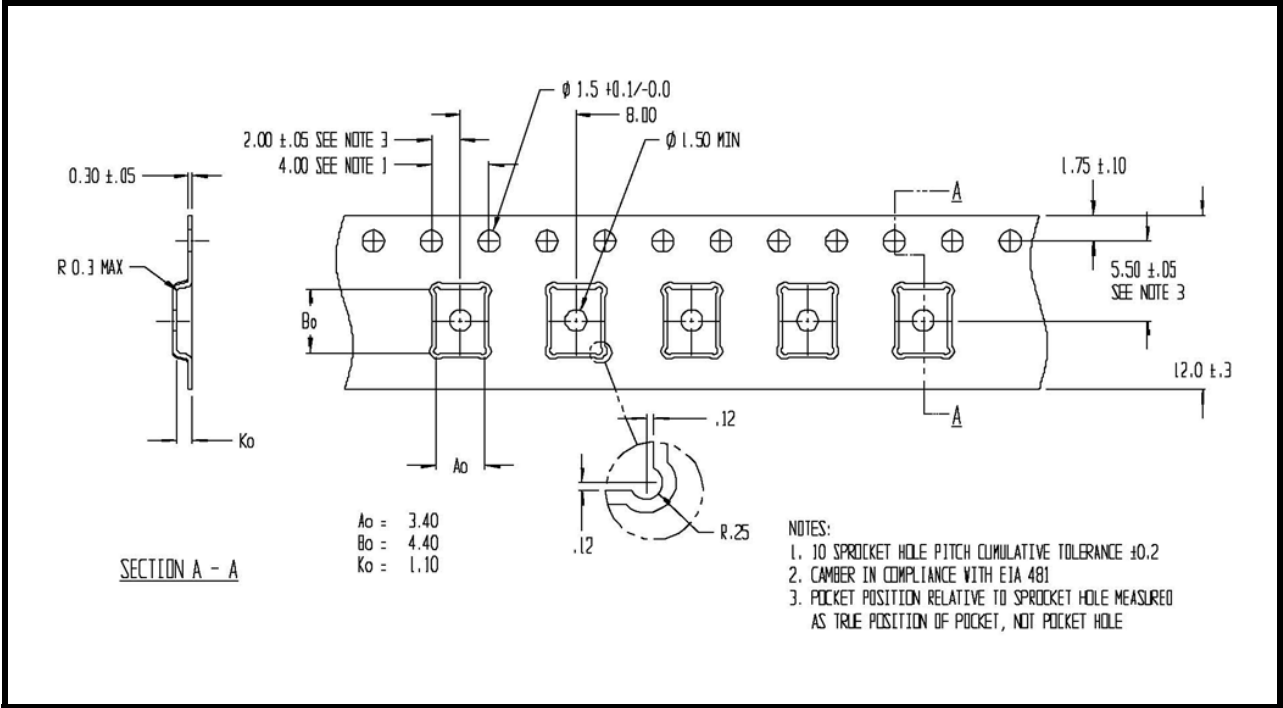


Figure 7: SE2603L-R Tape and Reel Information



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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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