

**DATA SHEET**  
**SE5004L: 5 GHz, 26dBm Power Amplifier with Power Detector**

**Applications**

- DSSS 5 GHz WLAN (IEEE802.11a)
- DSSS 5 GHz WLAN (IEEE802.11n)
- Access Points, PCMCIA, PC cards

**Features**

- High output power amplifier
  - 26dBm at 5V
- External Analog Reference Voltage ( $V_{REF}$ ) for maximum flexibility
- Buffered, temperature compensated power detector
- 3% EVM, @26dBm, 64 QAM, 54 Mbps
- 32 dB Gain
- Lead Free, RoHS compliant, halogen free MSL3 package
- 20 pin 4 mm x 4 mm x 0.9 mm QFN

**Product Description**

The SE5004L is a 5GHz power amplifier offering high linear power for wireless LAN applications. The SE5004L incorporates a power detector for closed loop monitoring and control of the output power.

The SE5004L offers high integration for a simplified design, providing quicker time to market and higher application board production yield. The device integrates the input match, the inter-stage match, the output match, the power detector with 15dB of dynamic range and a 3.8GHz notch filter. Only 6 external decoupling capacitors are required to complete the design.

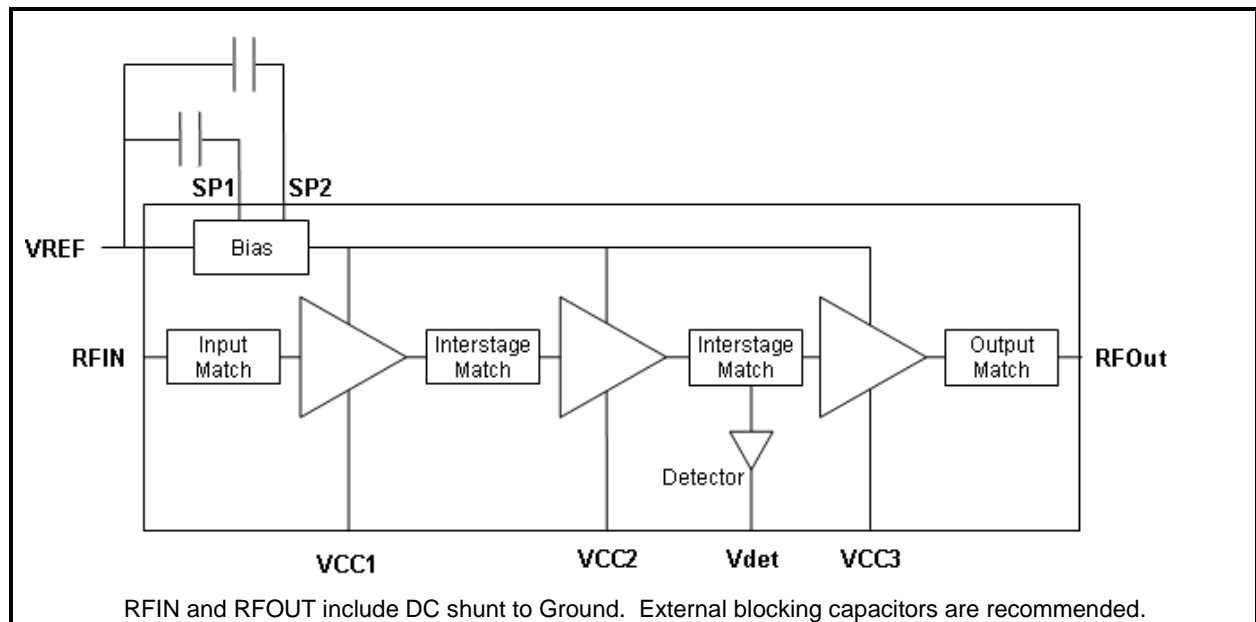
For wireless LAN applications, the device meets the requirements of IEEE802.11a & 802.11n, and delivers approximately 26dBm of linear output power at 5V.

The SE5004L integrates temperature compensated bias voltage generators. A 2.85V reference voltage on VREF is all that is required to enable or disable the power amplifier.

**Ordering Information**

Part Number	Package	Remark
SE5004L	20 Pin QFN	Samples
SE5004L-R	20 Pin QFN	Tape and Reel
SE5004L-EK1	Evaluation Kit	Standard

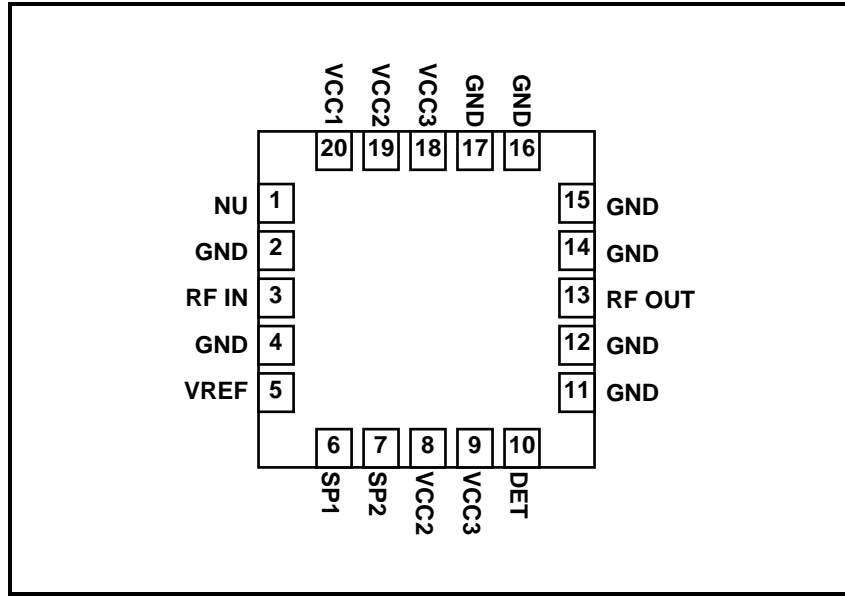
**Functional Block Diagram**



**Figure 1: Functional Block Diagram**

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**Pin Out Diagram**



**Figure 2: SE5004L Pin Out (Top View Through Package)**

**Pin Out Description**

Pin No.	Name	Description
1	NU	Pin is not used, and is open circuit in the package
2	GND	Ground
3	RFin	Power Amplifier RF input, DC block required
4	GND	Ground
5	V <sub>REF</sub>	Reference Voltage
6	SP1	Port for optional capacitor to improve dynamic EVM
7	SP2	Port for optional capacitor to improve dynamic EVM
8	VCC2	Second Stage Supply Voltage
9	VCC3	Third Stage Supply Voltage
10	DET	Analog Power Detector Output
11,12	GND	Ground
13	RF OUT	Power Amplifier RF Output
14-17	GND	Ground
18	VCC3	Third Stage Supply Voltage
19	VCC2	Second Stage Supply Voltage
20	VCC1	First Stage Supply Voltage

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**Absolute Maximum Ratings**

These are stress ratings only. Exposure to stresses beyond these maximum ratings for a long period of time 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
V <sub>CC</sub>	Supply Voltage on pins VCC3	-0.3	+6	V
	Supply Voltage on pins VCC1, VCC2	-0.3	VCC3	
V <sub>REF</sub>	Power Amplifier Enable and Reference Voltage	-0.3	3.6	V
R <sub>FIN</sub>	RF Input Power, R <sub>Fout</sub> into 50Ω match, T <sub>CASE_MAX</sub> = 85C	-	6	dBm
T <sub>STG</sub>	Storage Temperature Range	-40	160	°C
T <sub>j</sub>	Maximum Junction Temperature	-	160	°C
ESD <sub>HBM</sub>	JEDEC JESD22-A114 all pins	-	500	V

**Recommended Operating Conditions**

Symbol	Parameter	Min.	Max.	Unit
V <sub>CC</sub>	Supply Voltage VCC3	3.0	5.5	V
	Supply Voltage VCC1, VCC2	3.0	VCC3	
T <sub>CASE_MAX</sub>	Maximum Case Temperature	-40	85	°C
V <sub>REF</sub>	Reference Voltage	2.8	2.9	V

**DC Electrical Characteristics**

Conditions: V<sub>CC</sub> = 5.0V, V<sub>REF</sub> = 2.85 V, T<sub>A</sub> = 25 °C, as measured on Skyworks Solutions' SE5004L-EK1 evaluation board, unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>CC-802.11a</sub>	Supply Current	P <sub>OUT</sub> = 26 dBm, 54 Mbps, 64 QAM	-	600	800	mA
I <sub>QC</sub>	Quiescent Current	No RF	-	300	-	mA
I <sub>OFF</sub>	Supply Current	V <sub>REF</sub> = 0 V, No RF	-	0.5	10	μA
I <sub>EN</sub>	Bias Control Current	V <sub>REF</sub> = V <sub>REF H</sub> Internal 2KΩ pull down resistor	-	10	-	mA
V <sub>REF H</sub>	Reference Voltage Enabled	-	2.80	2.85	2.9	V
V <sub>REF L</sub>	Reference Voltage Disabled	-	0	-	0.5	V

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**AC Electrical Characteristics**

**802.11a AC Electrical Characteristics**

Conditions:  $V_{CC} = 5.0\text{ V}$ ,  $V_{REF} = 2.85\text{ V}$ ,  $f = 5.4\text{ GHz}$ ,  $T_A = 25\text{ }^\circ\text{C}$ , as measured on Skyworks Solutions' SE5004L-EK1 evaluation board, unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$f_{L-U}$	Frequency Range	-	5.15	-	5.85	GHz
$P_{OUT}$	Output Power	802.11a, 54Mbps, 64 QAM, 3% EVM	25.5	26	-	dBm
		802.11a, 54Mbps, 64 QAM, 2.5% EVM	24.5	25	-	
		802.11n, MCS0, Mask Compliant	-	29	-	
$P_{1dB}$	Output 1dB compression point	No modulation	30	34	-	dBm
$S_{21}$	Small Signal Gain	$P_{IN} = -25\text{ dBm}$	30	32	-	dB
$\Delta S_{21}$	Gain Variation	Within each UNII Band	-	3	-	dB
$\Delta S_{21\ 3.8}$	Gain at 3.8GHz	$P_{IN} = -25\text{ dBm}$	-	-	0	dB
2f	Harmonic	$P_{OUT} = 26\text{ dBm}$ , 5V	-	-	-45	dBm/MHz
3f						
$t_r, t_f$	Rise and Fall Time	-	-	0.15	0.3	us
STAB	Stability	$P_{OUT} = 26\text{ dBm}$ , $V_{CC} = 5V$ , 54 Mbps, 64 QAM, VSWR = 6:1, all phases	All non-harmonically related outputs less than -50 dBc/100 kHz			
Rugged	Tolerance to constant input power into a mismatch load	$P_{IN} = -10\text{ dBm}$ , CW, VSWR = 6:1, all phases	No damage			

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**Power Detector**

Conditions:  $V_{CC} = 5.0\text{ V}$ ,  $V_{REF} = 2.85\text{ V}$ ,  $f = 5.4\text{ GHz}$ ,  $T_A = 25\text{ }^\circ\text{C}$ , as measured on Skyworks Solutions' SE5004L-EK1 evaluation board, unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
PDR	$P_{OUT}$ detect range	-	0	-	$P_{1dB}$	dBm
VDET	Detector voltage	$P_{OUT} = 27\text{ dBm}$	-	1.000	-	V
		$P_{OUT} = \text{NO RF}$	-	0.325	-	V
ERR <sub>DET</sub>	Detector Accuracy	$\Delta P_{OUT}$ at constant $V_{DET}$ , 5.15 GHz – 5.70 GHz	-0.5	-	+0.5	dB
		5.70 GHz – 5.85 GHz	-0.5	-	+0.5	dB
		$\Delta P_{OUT}$ at constant $V_{DET}$ , VSWR = 3:1	-1.5		+1.5	dB
PDZ <sub>OUT</sub>	Output Impedance	-	-	0.7	-	K $\Omega$
PDZ <sub>LOAD</sub>	DC load impedance	-	-	26.5	-	K $\Omega$

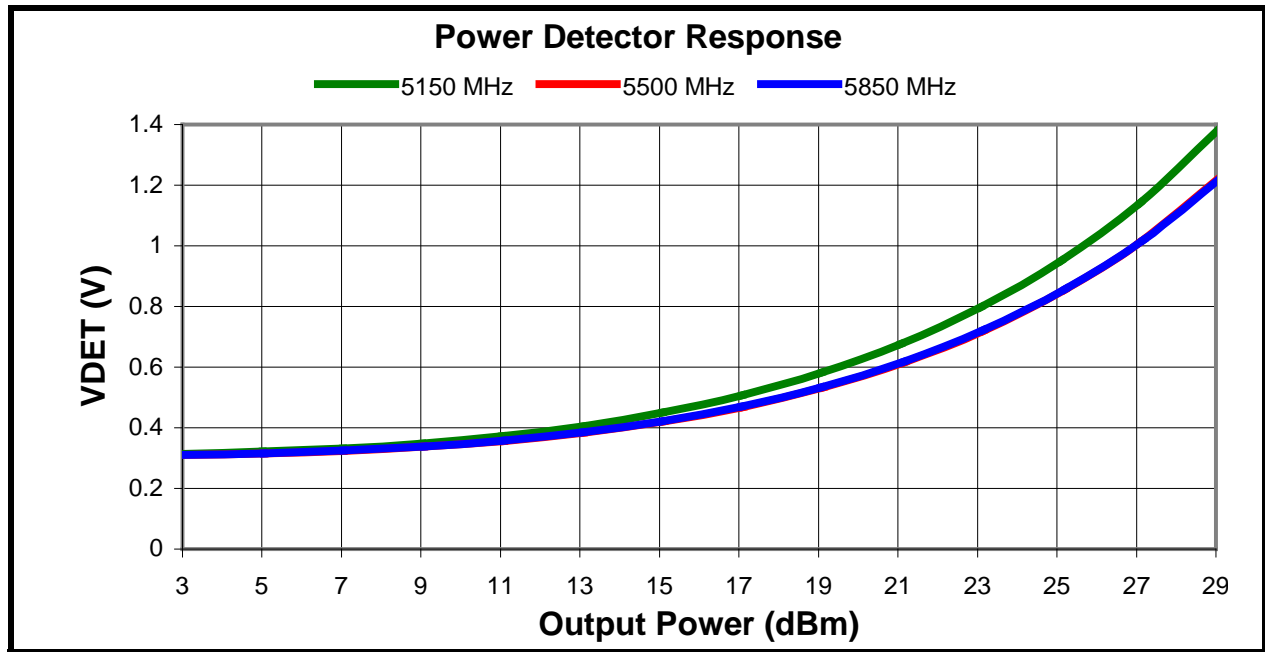
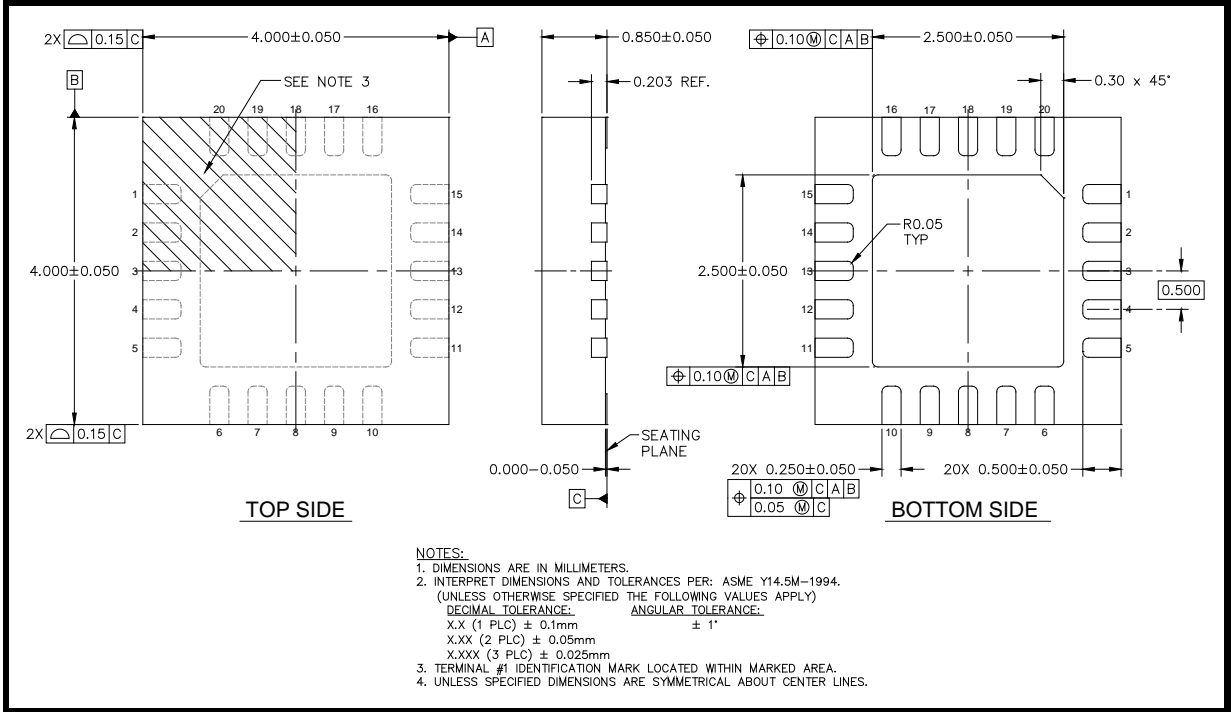


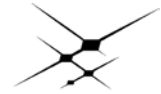
Figure 3: SE5004L Power Detector Characteristic over Frequency

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**Package Diagram**



**Figure 4: SE5004L Package Information**



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Recommended Land and Solder Pattern

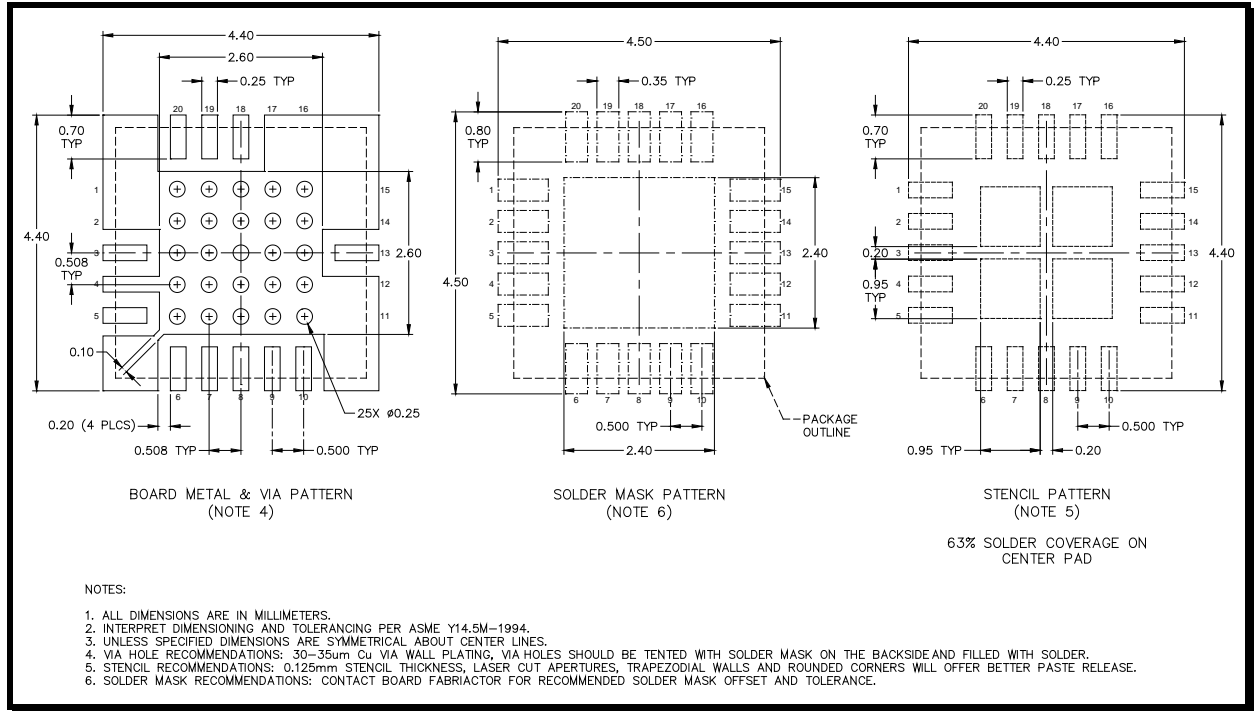


Figure 5: SE5004L Recommended Land Pattern

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 SE5004L 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:

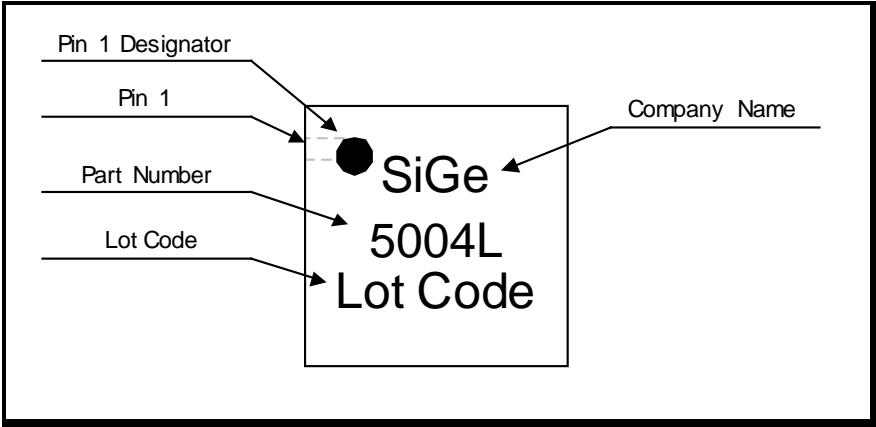
- “Quad Flat No-Lead Module Solder Reflow & Rework Information”, *Document Number QAD-00045*
- “Handling, Packing, Shipping and Use of Moisture Sensitive QFN”, *Document Number QAD-00044*



Caution! Class 1B ESD sensitive device

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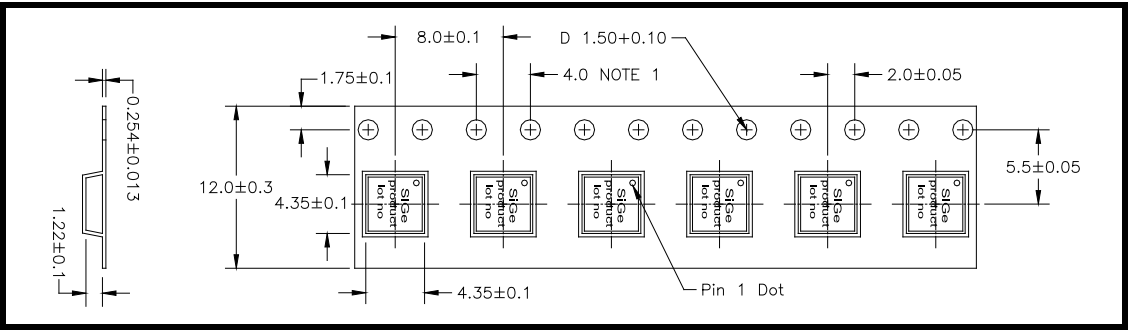
**Branding Information**



**Figure 6: SE5004L Branding Information**

**Tape and Reel Information**

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



**Figure 7: SE5004L-R Tape and Reel Information**



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**Document Change History**

Revision	Date	Notes
1.0	Aug 18, 2009	Created
1.1	Jan 14, 2010	Updated Pinout
1.2	May 4, 2010	Updated harmonic specification
1.3	May 7, 2010	Update $T_{RISE}$ and $T_{FALL}$ time Added MSL rating
1.4	May 20, 2010	Update Recommended Land and Solder Pattern Update detector plot.
1.5	Jul 20, 2010	Extended operating temperature range to -40C to +85C Updated absolute maximum ratings for VCC1 and VCC2 Updated EN pull down resistor value
1.6	Nov 20, 2010	Update Maximum Junction Temperature Updated ESD rating
1.7	Feb 25, 2011	Added Mask compliance Added Vref min/max limits to recommended operating conditions
1.8	Apr 02, 2012	Updated with Skyworks logo and disclaimer statement
1.9	Apr 12, 2012	Added min/max limits to Gain, P1dB, EVM, ICC

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