DATA SHEET
SE5012T: 5 GHz Front End Module with Power Detector

Applications

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

Features

- 5GHz Front End Module with PA, LNA and T/R Switch
- Integrated power amplifier enable pin (V_{EN})
- Buffered, temperature compensated power detector
- High and Low-Linearity mode
- 5V or Direct-to-Battery operation
- 3% EVM, 64 QAM, 54 Mbps: 17dBm @3.3V or 21dBm @5V
- 30 dB Typical Gain
- Lead Free and RoHS compliant, halogen free package
- 16 pin 3 mm x 3 mm x 0.6 mm QFN, MSL1

Product Description

The SE5012T is a 5GHz front end module offering high linear power for wireless LAN applications. It incorporates a power detector for control of the output power.

The SE5012T offers a high level of integration for a simplified design, providing quicker time to market and higher application board production yield. The device integrates the input match, inter-stage match, a temperature compensated, load insensitive power detector with 20dB of dynamic range, a 3.8GHz notch filter, a T/R switch and LNA.

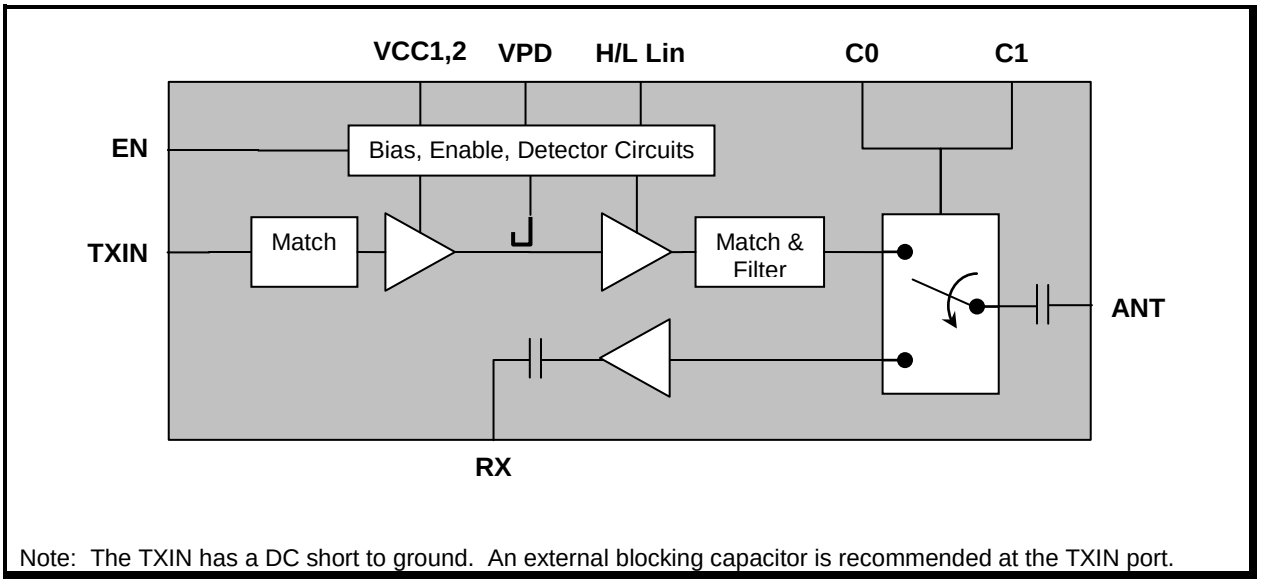
For wireless LAN applications, the device meets the requirements of IEEE802.11a and delivers approximately 17dBm of linear output power at VCC=3.3V or 21dBm at VCC=5.0V. It also features a low linearity mode control to reduce current consumption at low power modes.

The SE5012T integrates the reference voltage generator, allowing for a true 1.8V CMOS compatible digital EN (enable) function to turn the power amplifier on and off.

Ordering Information

Part Number	Package	Remark
SE5012T	16 Pin QFN	Samples
SE5012T-R	16 Pin QFN	Tape and Reel
SE5012T-EK1	Evaluation Kit	Standard

Functional Block Diagram



Note: The TXIN has a DC short to ground. An external blocking capacitor is recommended at the TXIN port.

Figure 1: Functional Block Diagram

Pin Out Diagram

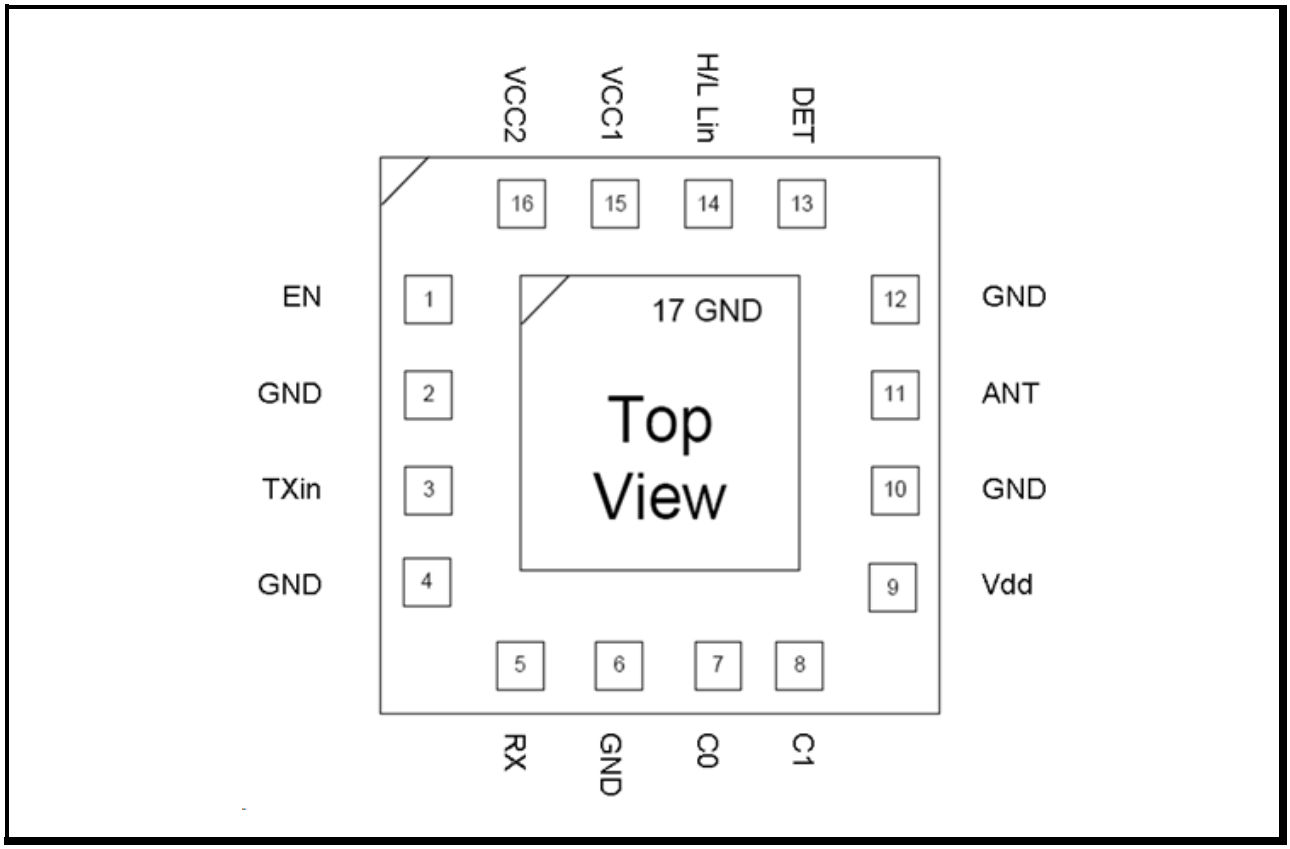


Figure 2: SE5012T Pin-Out Diagram

Pin Out Description

Pin No.	Name	Description
1	EN	PA Enable
2	GND	Ground
3	TXIN	5GHz TX RF Input Signal
4	GND	Ground
5	RX	5GHz LNA Output Signal
6	GND	Ground
7	C0	Switch Control Logic 1
8	C1	Switch Control Logic 2

Pin No.	Name	Description
9	VDD	LNA Supply Voltage
10	GND	Ground
11	ANT	5GHz Antenna output
12	GND	Ground
13	DET	Power Detector Output
14	H/L Lin	High-Low linearity Control
15	VCC1	Power Amplifier Supply Voltage
16	VCC2	Power Stage Supply Voltage

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_{CC}	Supply Voltage on pins VCC1, VCC2	-0.3	5.5	V
V_{DD}	Supply Voltage on pin VDD	-0.3	3.6	V
EN	DC input on Enable	-0.3	3.6	V
TXIN	RF Input Power, RFout into 50Ω match	-	12	dBm
T_{STG}	Storage Temperature Range	-40	150	°C
ESD $_{HBM}$	JEDEC JESD22-A114 all pins	-	500	V

Recommended Operating Conditions

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply Voltage on pins VCC1, VCC2	3.0	5.5	V
V_{DD}	Supply Voltage on pin VDD	3.0	3.6	V
T_A	Ambient Temperature	-40	85	°C

Control Logic Characteristics

Conditions: V_{CC} = 5.0 V; V_{DD} = V_{EN} = 3.3 V, T_A = 25 °C, as measured on Skyworks Solutions' SE5012T-EV1 evaluation board, unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{CC}-802.11a	Supply Current, Transmit Mode	P_{OUT} = 21 dBm, 54 Mbps, 64 QAM, VCC = 5.0V, H/L Lin = 3.3V (High Linearity)	-	270	-	mA
		P_{OUT} = 17 dBm, 54 Mbps, 64 QAM, VCC = 3.3V, H/L Lin = 3.3V (High Linearity)	-	195	-	
		P_{OUT} = 13 dBm, 54 Mbps, 64 QAM, VCC = 3.3V, H/L Lin = 0V (Low Linearity)	-	165	-	
I_{DD}	LNA Supply Current	V_{EN} = C0 = 0V; C1 = 3.3V		13		
I_{OFF}	Supply Current	V_{EN} = 0 V, No RF, C0=C1=0 V Measured on VCC, VDD pins	-	20	50	µA
V_{ENH}	Logic High Voltage	-	2.8	-	3.6	V
V_{ENL}	Logic Low Voltage	-	-0.3	-	0.3	V
I_{ENH}	Input Current Logic High Voltage	10Kohm on chip pull down resistor	-	330	400	µA
I_{ENL}	Input Current Logic Low Voltage	-	-	<1	-	µA

Switch Logic Characteristics

Conditions: V_{CC} = 3.0 V to 5.5 V, V_{DD} = V_{EN} = 3.3 V, T_A = 25 °C, as measured on Skyworks Solutions' SE5012T-EK1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
ON	Low Loss Switch Control Voltage	High State = V_{CTL_ON} - V_{CTL_OFF}	2.8	-	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
I_{CTL}	Control Line Current	V_{CTL} = V_{CTL_ON}	-	2	10	uA

Switch Control Logic Table

C0	C1	EN	Hi/L Lin	ANT
ON	OFF	**ON**	OFF	**TX Low Linearity**
ON	OFF	**ON**	**ON**	**TX High Linearity**
OFF	OFF	OFF	D/C	**Rx Bypass**
OFF	**ON**	OFF	D/C	**Rx LNA ON**
ON	**ON**	Un-supported state		

Note: D/C = don't care

AC Electrical Characteristics

Transmit Characteristics

Conditions: V_{CC} = 5.0V, V_{DD} = V_{EN} = C0 = H/L Lin = 3.3V, C1 = 0V, T_A = 25 °C, as measured on Skyworks Solutions' SE5012T-EV1 evaluation board, unless otherwise noted

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Unit
f_{L-U}	Frequency Range		-	5.15	-	5.85	GHz
POUT	Output Power OFDM Signal, 64QAM, EVM = 3%	High Linearity Mode H/L Lin = 3.3V	VCC = 5.0 V	-	21	-	dBm
			VCC = 3.3 V	-	17	-	
		Low Linearity Mode H/L Lin = 0V	VCC = 5.0 V	-	17	-	
			VCC = 3.3 V	-	13	-	
P_{1dB}	Output 1dB compression point, No Modulation		VCC = 5.0V	-	27	-	dBm
			VCC = 3.3V	-	23	-	
S_{11}	Input Return Loss		P_{IN} = -25 dBm	-	12	-	dB
S_{21}	Small Signal Gain, P_{IN} = -25dBm		5V, High or Low Linearity Mode	29	-	35	dB
			3.3V, High or Low Linearity Mode	28	-	33	
ΔS_{21}	Small Signal Gain Variation		Gain variation over single 40MHz channel	-	-	0.5	dB
			Gain Variation over band	-	3.5	-	
$S_{21\_3.8}$	Out of Band Gain		Gain at 3.8GHz	-	-	15	dB
2f	Harmonic		P_{OUT} = 17 dBm, OFDM	-	-50	-45.2	dBm/MHz
3f				-	-50	-45.2	
t_r, t_f	Rise and Fall Time		-	-	0.5	-	us
STAB	Stability		P_{OUT} = 17 dBm, 54 Mbps, 64 QAM, VSWR = 6:1, all phases	All non-harmonically related outputs less than -50 dBc/100 kHz			
Rugged-ness	Tolerance to output load mismatching		Constant P_{IN} equal to P_{OUT} = 21 dBm at 50ohms, 54 Mbps, 64 QAM, VCC = 5.5V, VSWR = 6:1, all phases	No damage			
Robust	Robustness to input power		P_{IN} = 12dBm, CW, VSWR = 6:1, all phases	No damage			

Receive Characteristics

Conditions: V_{CC} = 3.0 V to 5.5 V, V_{DD} = C1 = 3.3V, V_{EN} = C0 = 0V, T_A = 25 °C, as measured on Skyworks Solutions' SE5012T-EK1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{OUT}	Frequency Range	-	5.15	-	5.85	GHz
RX	Insertion Loss	Bypass Mode: C0 = C1 = 0V	-	-5	-	dB
	RX Gain	High Gain Mode	11	12	-	
NF	Noise Figure	High Gain Mode	-	2.5	-	dB
RX_{RL}	Input Return Loss	At the Antenna port	-	-11	-	dB
	Output Return Loss	At RX RF output	-	-8	-	
RxIP1DB	Input P1DB	Measured at ANT Port; High Gain Mode	-	-5	-	dBm
		LNA Bypass Mode	-	10	-	
Rx_2.4int	Max 2.4Ghz interferer power	1 dB degradation of IP1DB	-	-	0	dBm
TX_{LEAK}	Transmit Power at RX Output	V_{EN} = C0 = H/L Lin = 3.3V, C1 = 0V 24dBm at the ANT port	-	-13	-	dBm
$T_{on/off}$	T/R on/off switching speed	C0, C1 (50%) to RF output (10% or 90%)	-	300	-	nSec

Power Detector Characteristics

Conditions: V_{CC} = 3.0 V to 5.5 V, V_{DD} = V_{EN} = C0 = 3.3V, C1 = 0V, f = 5.4 GHz, T_A = 25 °C, as measured on Skyworks Solutions' SE5012T-EV1 evaluation board, unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
PDR	P_{OUT} detect range	-	0	-	P_{1dB}	dBm
$VDET_{22}$	Detector voltage	P_{OUT} = 22 dBm	0.7	-	0.9	V
$VDET_{16}$	Detector voltage	P_{OUT} = 16 dBm	0.50	-	0.60	V
$VDET_{2}$	Detector voltage	P_{OUT} = 2 dBm	0.25	-	0.35	V
PDZ_{OUT}	Output Impedance	-	-	5	-	KΩ

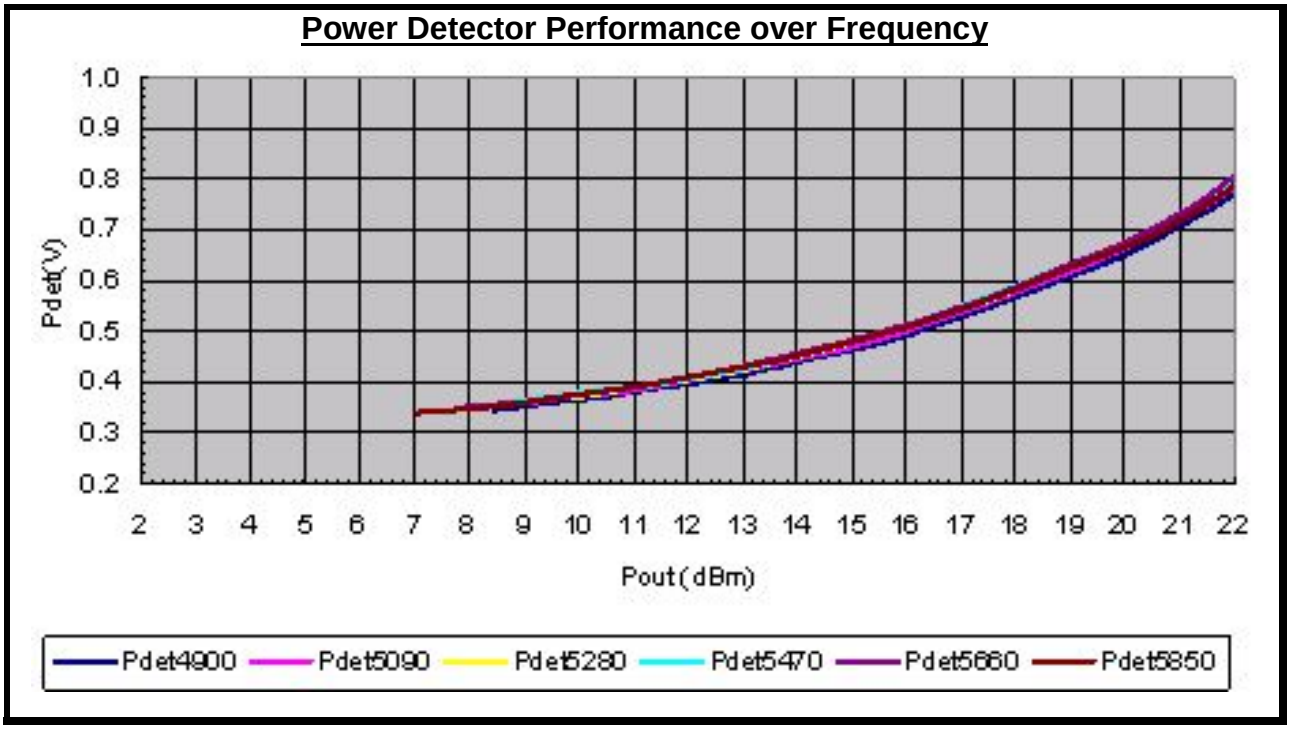


Figure 3: SE5012T Power Detector Characteristic

Package Diagram

This package is Pb free and RoHS compliant. The product is rated MSL1.

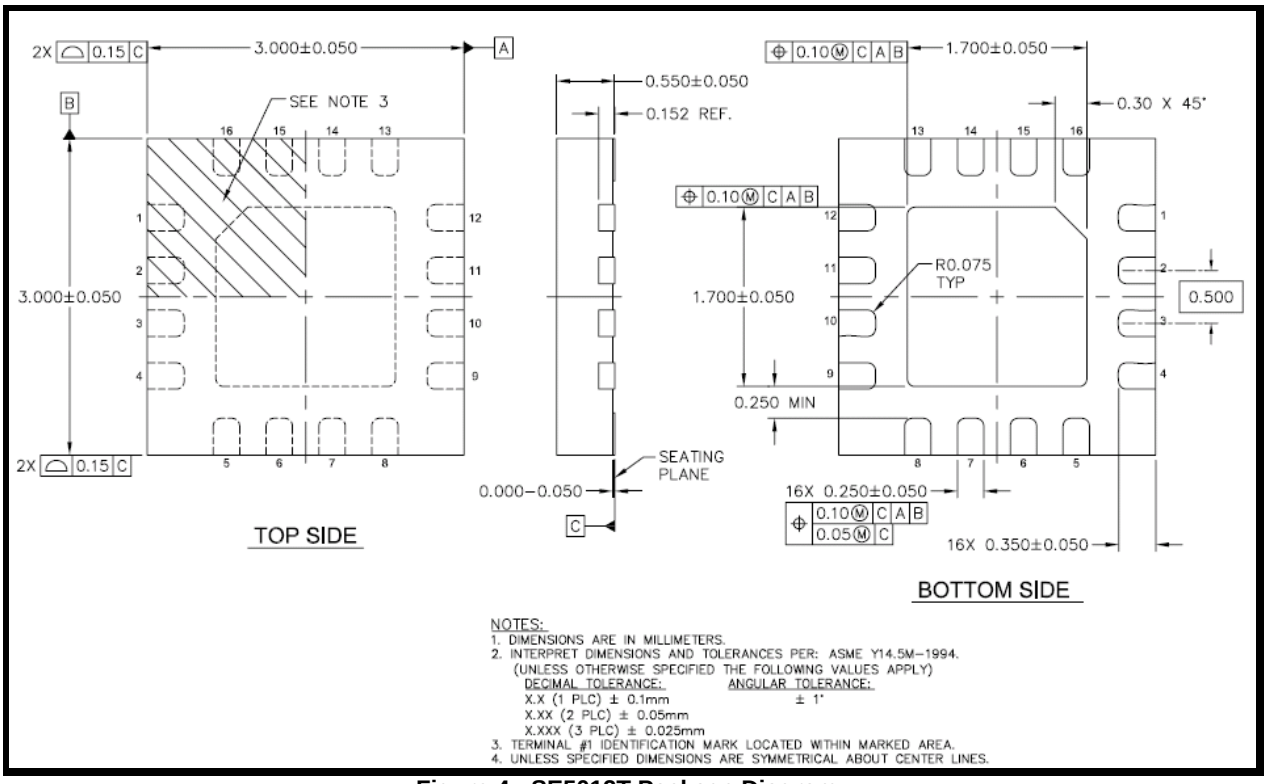


Figure 4: SE5012T Package Diagram

Recommended Land and Solder Patterns

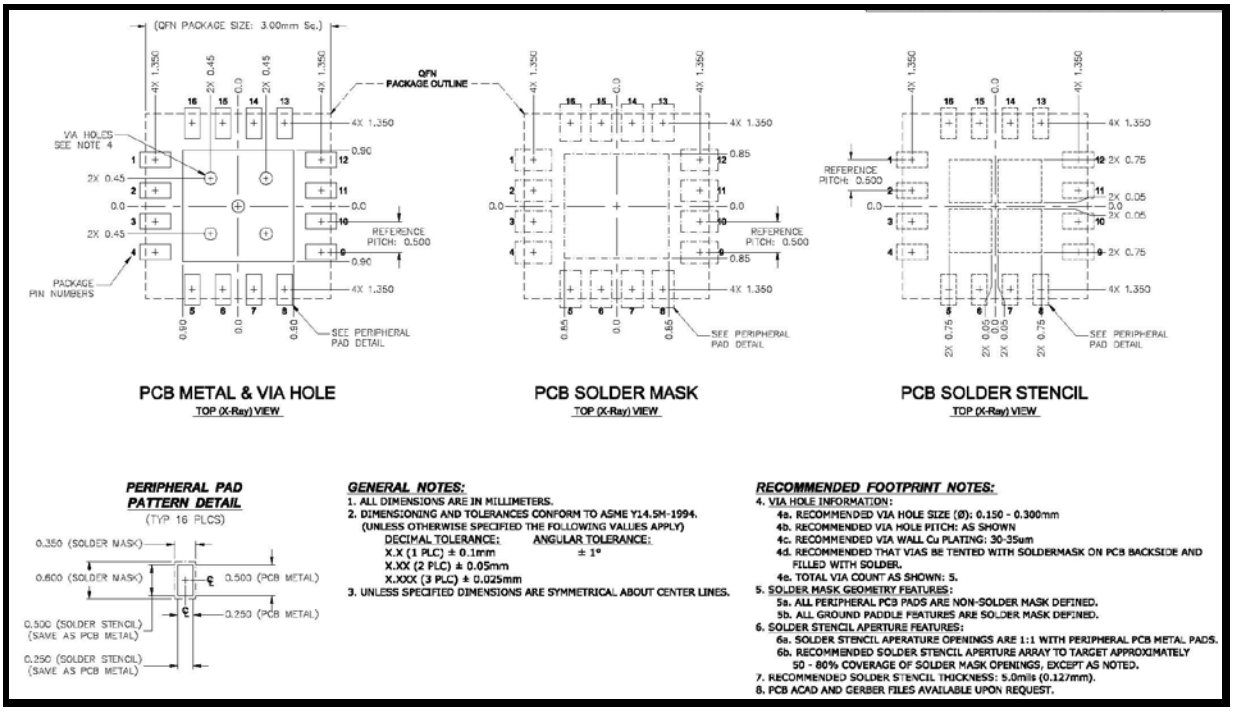


Figure 5: SE5012T Recommended Land and Solder Pattern

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 SE5012T 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

Branding Information

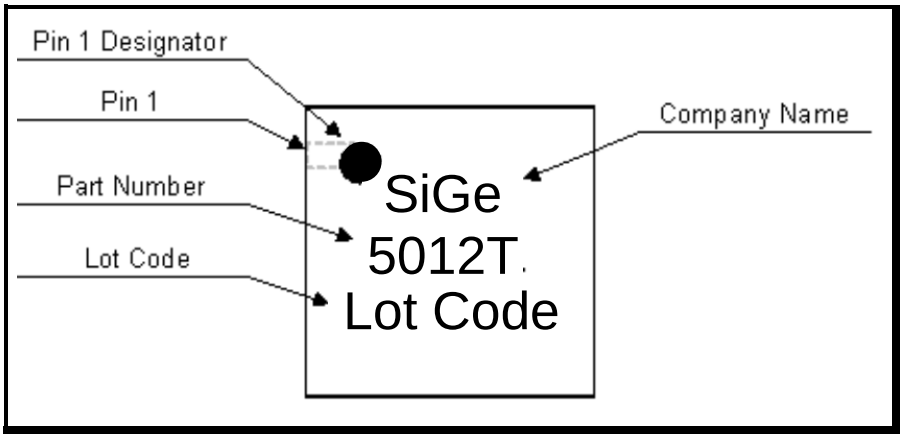


Figure 6: SE5012T Branding

Tape and Reel Information

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

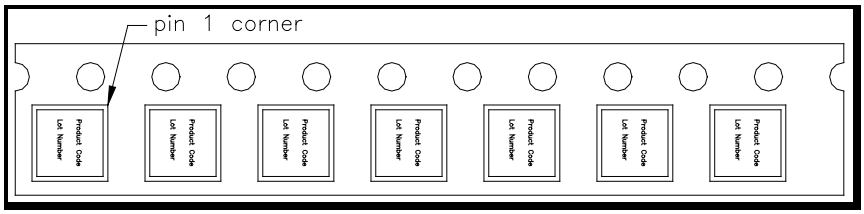


Figure 7: SE5012T-R Tape and Reel Information

Document Change History

Revision	Date	Notes
1.0	Nov 05, 2010	Created
1.1	Nov 14, 2011	Updated package outline drawing Updated Max 2.5Ghz interferer power specification for LNA Add TX leakage at RX output port Update operating frequency Update TX gain slope
1.2	Jan 31, 2012	Updated current at 13dBm RX S11, S22
1.3	Apr 03, 2012	Updated with Skyworks logo and disclaimer statement
1.4	Jun 14, 2012	Updated LNA gain

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