Applications

- IEEE802.11b DSSS WLAN
- IEEE802.11g OFDM WLAN
- IEEE802.11a OFDM WLAN
- IEEE802.11n WLAN
- Access Points, PCMCIA, PC cards

Features

- All RF ports matched to 50 Ω
- Integrated 2.4 GHz PA, 5 GHz PA, TX Filter, T/R switches and diplexers
- Integrated Power Detector for each TX Chain
- 21 dBm O/P Power, 802.11b, 11 Mbits, ACPR = 35 dBc
- 18 dBm @ 3.0 % EVM, 802.11g, 54 Mbits
- 16 dBm @ 3.0 % EVM, 802.11a, 54 Mbits
- Single supply voltage: 3.3 V ± 10 %
- Lead free, Halogen free, RoHS compliant, MSL 3
- 4mm x 4mm x 1.0mm, LGA Package

Ordering Information

Part No.	Package	Remark
SE5503A	24 pin LGA	Samples
SE5503A-R	24 pin LGA	Tape & Reel
SE5503A-EK1	N/A	Evaluation kit

Product Description

The SE5503A is a complete 802.11a/b/g/n WLAN RF front-end module providing all the functionality of the power amplifiers, filtering, power detector, T/R switch, diplexers and associated matching. The SE5503A provides a complete 2.4 GHz and 5 GHz WLAN RF solution from the output of the transceiver to the antenna in an ultra compact form factor.

Designed for ease of use, all RF ports are matched to 50 Ω to simplify PCB layout and the interface to the transceiver RFIC. The SE5503A also includes a transmitter power detector with 20 dB of dynamic range for each transmit chain. Each power amplifier has a separate digital enable control for transmitter on/off control. The power ramp rise/fall time is less than 0.7 µsec.

The device also provides a notch filter from 3.260-3.267 GHz and 3.28-3.89 GHz prior to the input of each 2.4 GHz and 5 GHz power amplifiers, respectively.

The SE5503A packaged in 4mm x 4mm x 1.0mm, Halogen free, Lead free, ROHS compliant, MSL 3 LGA package.

Functional Block Diagram

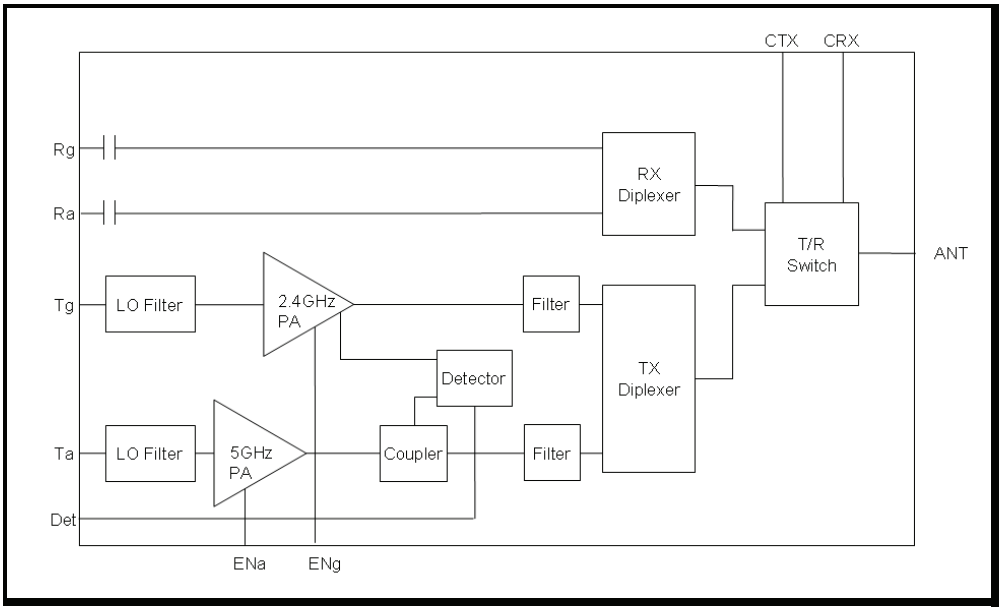


Figure 1: SE5503A Functional Block Diagram

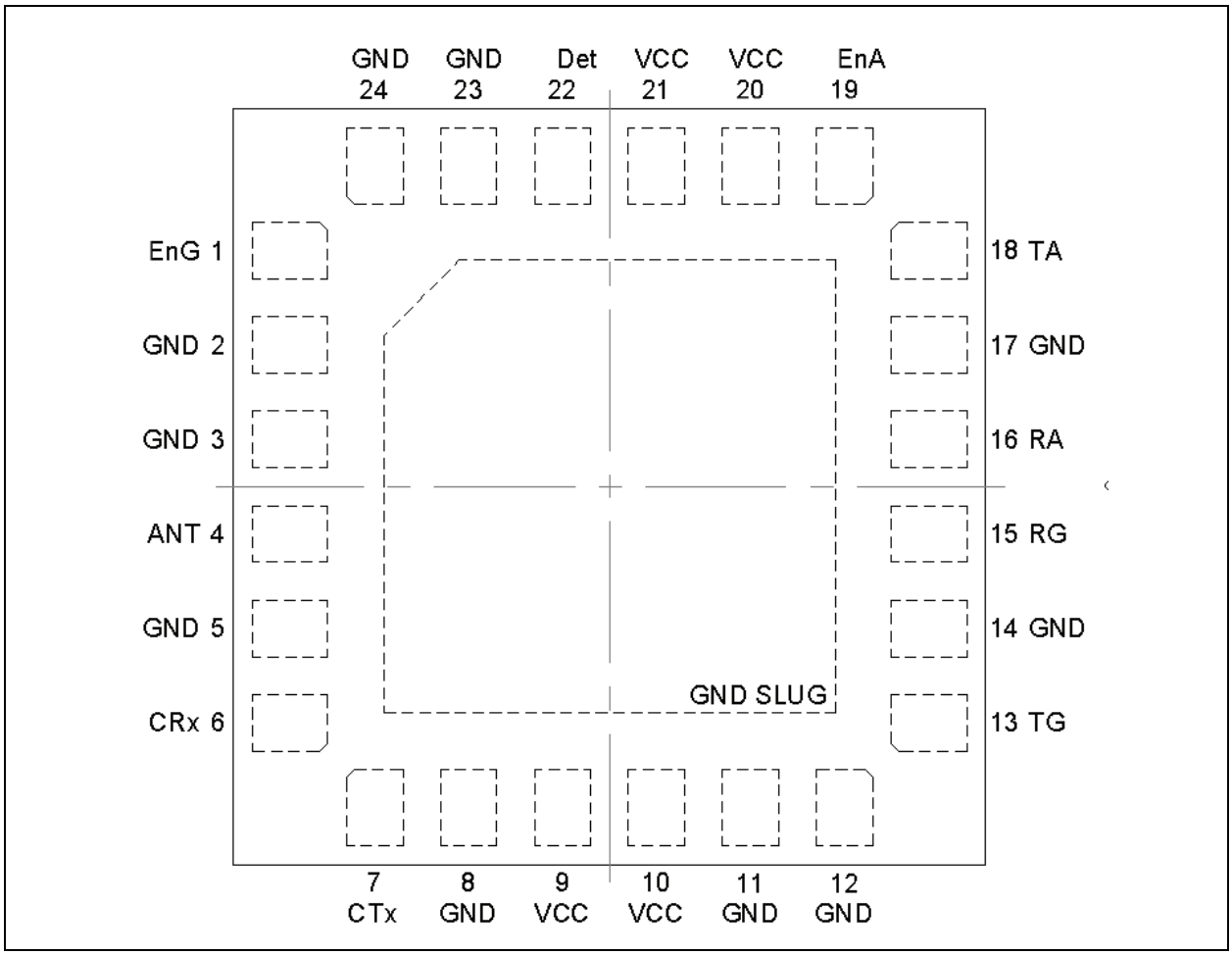


Figure 2: SE5503A Pin Out (Top View Through Package)

Pin Out Description

Pin No.	Name	Description
1	ENg	2.4 GHz Power Amplifier Enable
2	GND	Ground
3	GND	Ground
4	Ant	Antenna
5	GND	Ground
6	CRx	Switch Control for RX Path
7	CTx	Switch Control for TX Path
8	GND	Ground
9	VCC	Supply Voltage
10	VCC	Supply Voltage
11	GND	Ground
12	GND	Ground

Pin No.	Name	Description
13	Tg	2GHz Transmit RF Input
14	GND	Ground
15	Rg	2GHz Receive RF Output
16	Ra	5GHz Receive RF Output
17	GND	Ground
18	Ta	5GHz Transmit RF Input
19	ENa	5GHz Power Amplifier Enable
20	VCC	Supply Voltage
21	VCC	Supply Voltage
22	DET	2/5GHz Power Detector Output
23	GND	Ground
24	GND	Ground

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
V_{CC}	Supply Voltage	-0.3	3.6	V
PU	ENa, ENg	-0.3	3.6	V
TX_{RF}	Ta, Tg, ANT terminated in 6:1 load or better	-	12.0	dBm
T_A	Operating Temperature Range	-10	85	°C
T_{STG}	Storage Temperature Range	-40	150	°C
ESD_{HBM}	JEDEC JESD22-A114 all pins	-	250	V

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply Voltage	3.0	3.3	3.6	V
T_A	Ambient Temperature	-10	25	85	°C

DC Electrical Characteristics

Conditions: V_{CC} = 3.3 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 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 802.11g Transmit Supply Current	P_{OUT} = 18 dBm, 54 Mbps OFDM signal, 64 QAM ENg = 3.3 V, ENa = 0 V	-	150	180	mA
I_{CC-B}	Total 802.11b Transmit Supply Current	P_{OUT} = 21 dBm, 11 Mbps CCK signal, BT = 0.45, ENg = 3.3 V, ENa = 0 V	-	190	200	mA
I_{CC-A}	Total 802.11a Transmit Supply Current	P_{OUT} = 16 dBm, 54 Mbps OFDM signal, 64 QAM, ENa = 3.3 V, ENg = 0 V	-	220	250	mA
I_{CC_OFF}	Total Supply Current	No RF, ENg = ENa = 0 V	-	65	200	µA

Logic Characteristics

Conditions: V_{CC} = 3.3 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 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 for ENg, ENa (Module On)	-	1.8	-	V_{CC}	V
V_{ENL}	Logic Low Voltage ENg, ENa (Module Off)	-	0	-	0.5	V
I_{ENH}	Input Current Logic High Voltage (ENg, ENa)	-	-	350	400	µA
I_{ENL}	Input Current Logic Low Voltage (ENg, ENa)	-	-	0.2	-	µA

Switch Characteristics

Conditions: V_{CC} = V_{EN} = 3.3 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 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
SW_{ON}	Low Loss Switch Control Voltage	High State = V_{CTL_ON} - V_{CTL_OFF}	2.8	-	V_{CC}	V
SW_{OFF}	High Loss Switch Control Voltage	Low State = V_{CTL_OFF} - V_{CTL_OFF}	0	-	0.3	V
I_{CTL_ON}	Switch Control Bias Current (RF Applied)	On pin (CTx, CRx) being driven high. RF Applied	-	-	100	µA
I_{CTL_ON}	Switch Control Bias Current (No RF)	On pin (CTx, CRx) being driven high. No RF	-	-	30	µA
C_{CTL}	Control Input Capacitance	-	-	-	100	pF

Switch Control Logic Table

CTx	CRx	Tg, Ta – ANT	Rg, Ra – ANT
SW_{ON}	SW_{OFF}	**ON**	OFF
SW_{OFF}	**SW_{ON}**	OFF	**ON**
SW_{OFF}	SW_{OFF}	OFF	OFF
All Other States		Unsupported Switch State	

2.4 GHz AC Electrical Characteristics

2.4 GHz Transmit Characteristics

Conditions: V_{CC} = 3.3 V, ENg = CTx = 3.3 V, ENa = CRx = 0 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{IN}	Frequency Range	-	2400	-	2500	MHz
$P_{802.11g}$	Output power	54 Mbps OFDM signal, 64QAM, EVM = 3.0 %, input signal EVM < 1%	17.25	18	-	dBm
$P_{802.11b}$	Output power	11 Mbps CCK signal, BT = 0.45 ACPR(± 11MHz offset) < -35 ACPR(± 22MHz offset) < -56	-	21	-	dBm
P_{1dB}	P1dB	-	24	24.5	-	dBm
S_{21}	Small Signal Gain	-	25	-	30	dB
ΔS_{21}	Small Signal Gain Variation Over Band	-	-	1.0	2.0	dB
$S_{21}1.6$	Gain at ½Ref-VCO	1640.00 to 1942.00 MHz	-	12	20	dB
$S_{21}3.2$	Gain at Ref-VCO	3216.00 to 3312.00 MHz	-	-	0	dB
2f,3f	Harmonics	Pout ≤ 21 dBm, 1Mbps, CCK	-	-	-45.2	dBm/MHz
t_{dr}, t_{df}	Delay and rise/fall Time	50 % of V_{EN} edge and 90/10 % of final output power level	-	0.25	0.4	µs
S_{11}	Input Return Loss	-	8	10	-	dB
STAB	Stability	CW, P_{OUT} = 21 dBm 0.1 GHz – 21 GHz Load VSWR = 6:1	All non-harmonically related outputs less than -42 dBm/MHz			
Ru	Ruggedness	Tg = 12dBm, ANT load varies over 6:1 VSWR	No Irreversible damage			

2.4 GHz Receive Characteristics

Conditions: V_{CC} = 3.3 V, CRx = 3.3 V, ENg = ENa = CTx = 0 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 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	-	-	1.5	-	dB
RX_{RL}	Return Loss	-	10	15	-	dB
TR_{ISOL-2}	Rx Leakage	CTx = SWON, CRx = SWOFF, Device transmitting (TXEN = 3.3 V) 18.0 dBm @ ANT, Power measured @ RX_OUT	-	-	-3	dBm
$ANTR_{ISOL}$	Antenna to Rx isolation	Small signal input into ANT, Device not transmitting, Power measured @ RX_{RF}, CTx (Ant to Rx Iso) = SWON, CRx = SWOFF	20	-	33	dB

5 GHz AC Electrical Characteristics

5 GHz Transmit Characteristics

Conditions: V_{CC} = 3.3 V, ENa and CTx = 3.3 V, ENg = CRx = 0 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{IN}	Frequency Range	-	4900	-	5900	MHz
$P_{802.11a}$	Nominal Output Power	54 Mbps OFDM signal, 64 QAM, EVM = 3.0 %, input signal EVM < 1%	15.0	16.0	-	dBm
P_{1dB}	P1dB	-	21	22.5	-	dBm
S_{21}	Small Signal Gain	-	23	-	30	dB
ΔS_{21}	Small Signal Gain Variation Over 40 MHz Channel		-	-	0.5	dB
	Small Signal Gain Variation Over sub-bands	4.9 – 5.18 GHz 5.18 – 5.50 GHz 5.50 – 5.90 GHz	-	1	3	dB
$S_{21}3.2$	Gain at Ref-VCO	3280 to 3885 MHz	-	2	5.5	dB
2f,3f	Harmonics @16dBm, 54Mbps, 802.11a	4900 – 5900 MHz	-	-	-48.2	dBm/MHz
t_{dr}, t_{df}	Delay and rise/fall Time	50 % of V_{EN} edge and 90/10 % of final output power level	-	0.25	0.4	µs
S_{11}	Input Return Loss	-	9	15	-	dB
STAB	Stability	64 QAM, P_{OUT} = 16 dBm 0.1 GHz – 21 GHz Load VSWR = 6:1	All non-harmonically related outputs less than -42 dBm/MHz			
Ru	Ruggedness	TXa = 12dBm, ANT load varies over 6:1 VSWR	No Irreversible damage			

5 GHz Receive Characteristics

Conditions: V_{CC} = 3.3 V, CRx = 3.3 V, ENg = ENa = CTx = 0 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 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	-	4900	-	5900	MHz
RX_{IL}	Insertion Loss	-	-	1.8	-	dB
RX_{RL}	Return Loss	-	10	15	-	dB
TA_{LEAK}	Tx Power Leakage	Pout = 16 dBm, ENa = 3.3 V, CTx = 3.3 V, CRx = 0 V	-	-	-3	dBm
ATTa	Antenna to Rx isolation	Small signal input into ANT, Device not transmitting, Power measured @ RX_{RF}, CTx (Ant to Rx Iso) = SWON, CRx = SWOFF	19	-	33	dB

2.4 GHz Power Detector Characteristic

Conditions: V_{CC} = ENg = CTx = 3.3 V, ENa = CRx = 0 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 evaluation board (de-embedded to device), all unused ports terminated with 50 Ω, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{OUT}	Frequency Range	-	2400	-	2500	MHz
PDR	Power detect range, peak power	Measured at ANT	0	-	22	dBm
PDZ_{OUT}	DC Output impedance	-	-	2.3	-	KΩ
PDV_{P21}	Output Voltage, P_{OUT} = 21dBm	Measured into 26.5KΩ	0.75	0.85	1.0	V
PDV_{p18}	Output Voltage, P_{OUT} = 18dBm	Measured into 26.5KΩ	0.56	0.63	0.73	V
PDV_{pnoRF}	Output Voltage, P_{OUT} = No RF	Measured into 26.5KΩ	0.29	0.31	0.33	V
LPF_{-3dB}	Power detect low pass filter -3dB corner frequency	Measured into 26.5KΩ	-	2.0	-	MHz

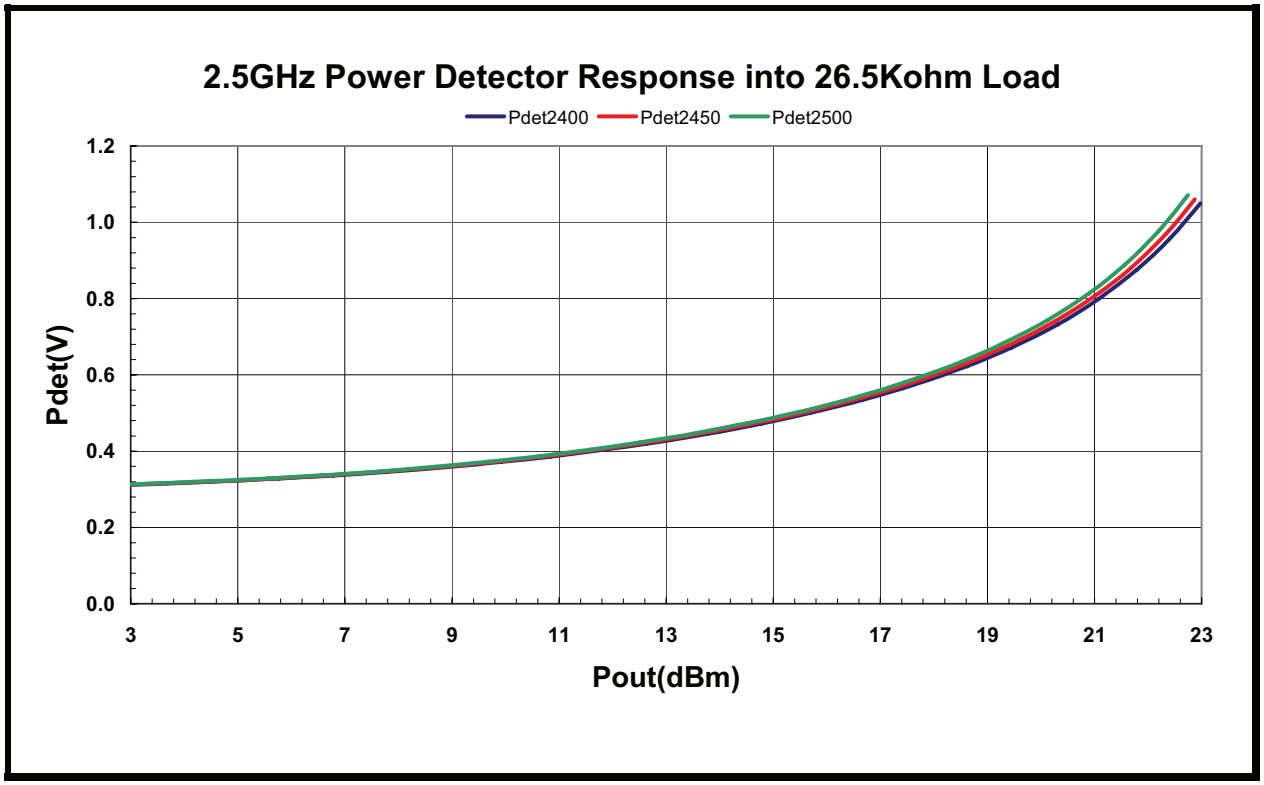


Figure 3: SE5503A Power Detector vs. Output Power over Frequency (CW Signal)

5 GHz Power Detector Characteristic

Conditions: V_{CC} = ENa = CTx = 3.3 V, ENg = CRx = 0 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE5503A-EV1 evaluation board (de-embedded to device), all unused ports terminated with 50 Ω, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{OUT}	Frequency Range	-	4900	-	5900	MHz
PDR	Power detect range, peak power	Measured at ANT	0	-	21	dBm
PDZ_{OUT}	DC Output impedance	-	-	26.5	-	KΩ
PDV_{p18}	Output Voltage, P_{OUT} = 18dBm	Measured into 26.5KΩ	0.6	0.75	0.9	V
PDV_{p16}	Output Voltage, P_{OUT} = 16dBm	Measured into 26.5KΩ	0.5	0.65	0.85	V
PDV_{NoRF}	Output Voltage, P_{OUT} = No RF	Measured into 26.5KΩ	0.29	0.31	0.33	V
LPF_{-3dB}	Power detect low pass filter -3dB corner frequency	Measured into 26.5KΩ	-	2.0	-	MHz

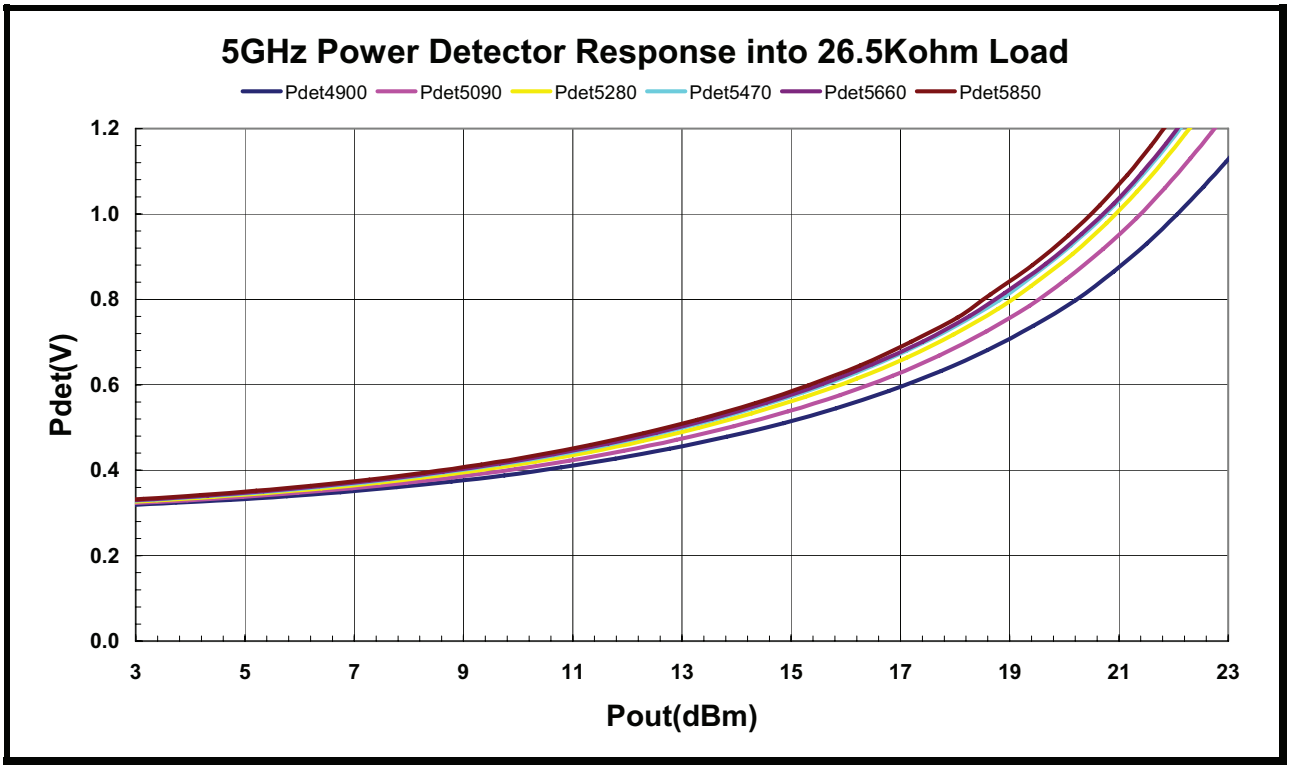
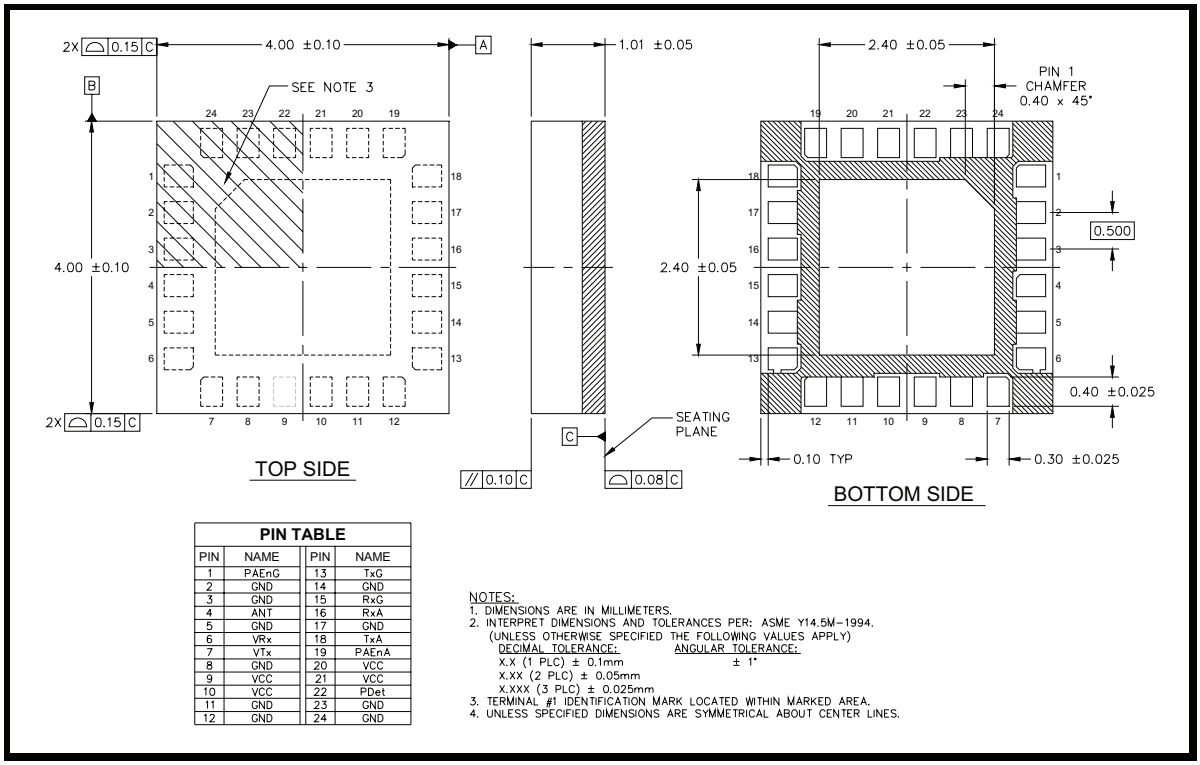


Figure 4: Preliminary SE5503A Power Detector vs. Output Power over Frequency (CW Signal)

Package Drawing

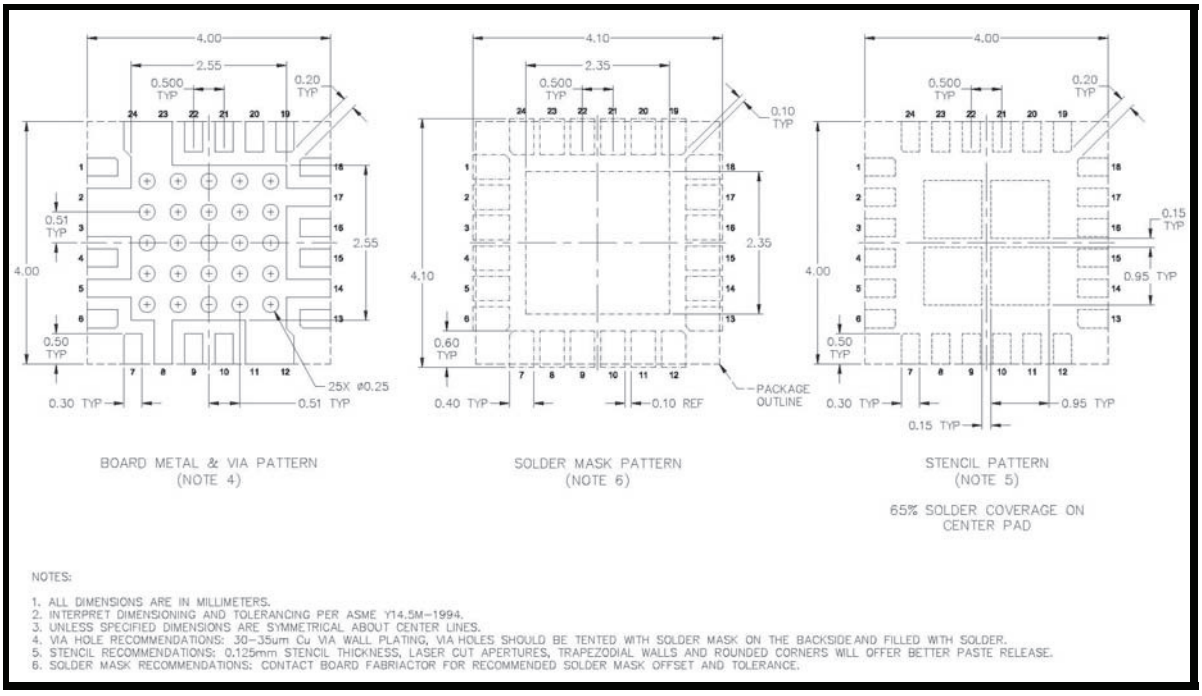


PIN TABLE			
PIN	NAME	PIN	NAME
1	PAEnG	13	TxG
2	GND	14	GND
3	GND	15	RxG
4	ANT	16	RxA
5	GND	17	GND
6	VRx	18	TxA
7	VTx	19	PAEnA
8	GND	20	VCC
9	VCC	21	VCC
10	VCC	22	PDet
11	GND	23	GND
12	GND	24	GND

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER: ASME Y14.5M–1994.
   (UNLESS OTHERWISE SPECIFIED THE FOLLOWING VALUES APPLY)
   DECIMAL TOLERANCE: ANGULAR TOLERANCE:
   X.X (1 PLC) ± 0.1mm ± 1°
   X.XX (2 PLC) ± 0.05mm
   X.XXX (3 PLC) ± 0.025mm
3. TERMINAL #1 IDENTIFICATION MARK LOCATED WITHIN MARKED AREA.
4. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES.

Figure 5: Package Drawing: Topside

Recommended Land and Solder Patterns



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
3. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES.
4. VIA HOLE RECOMMENDATIONS: 30–35um Cu VIA WALL PLATING, VIA HOLES SHOULD BE TENTED WITH SOLDER MASK ON THE BACKSIDE AND FILLED WITH SOLDER.
5. STENCIL RECOMMENDATIONS: 0.125mm STENCIL THICKNESS, LASER CUT APERTURES, TRAPEZODIAL WALLS AND ROUNDED CORNERS WILL OFFER BETTER PASTE RELEASE.
6. SOLDER MASK RECOMMENDATIONS: CONTACT BOARD FABRIACTOR FOR RECOMMENDED SOLDER MASK OFFSET AND TOLERANCE.

Figure 6: Recommended Land and Solder Patterns

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 SE5503A 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 by SiGe, please refer to:

- SiGe's Application Note: "Land Grid Array Module Solder Reflow & Rework Information", *Document Number QAD-00046.*
- SiGe's Application Note: "Handling, Packing, Shipping and Use of Moisture Sensitive LGA", *Document Number QAD-00047*.

Caution! Class 1A ESD sensitive device

Product Branding

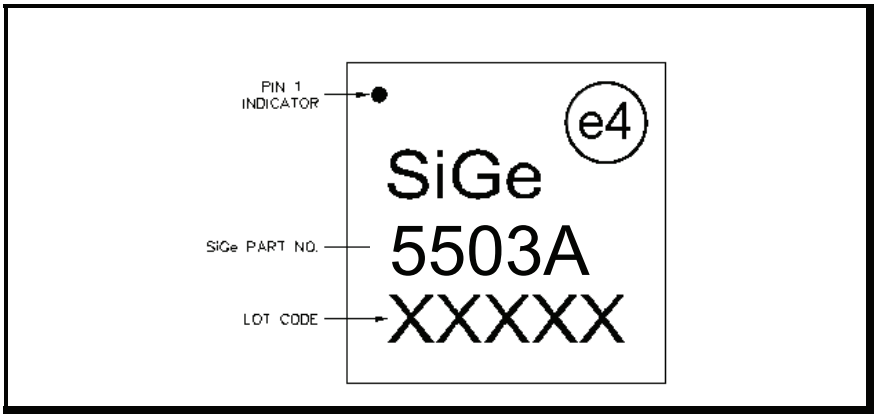


Figure 7: SE5503A Branding Information

Tape and Reel Information

Production quantities of this product are shipped in a standard tape-and-reel format. Specific tape and reel dimensions and sizing is shown in Table 1and Figure .

Parameter	Value
Devices Per Reel	3000
Reel Diameter	13 inches

Table 1: Tape and Reel Dimensions

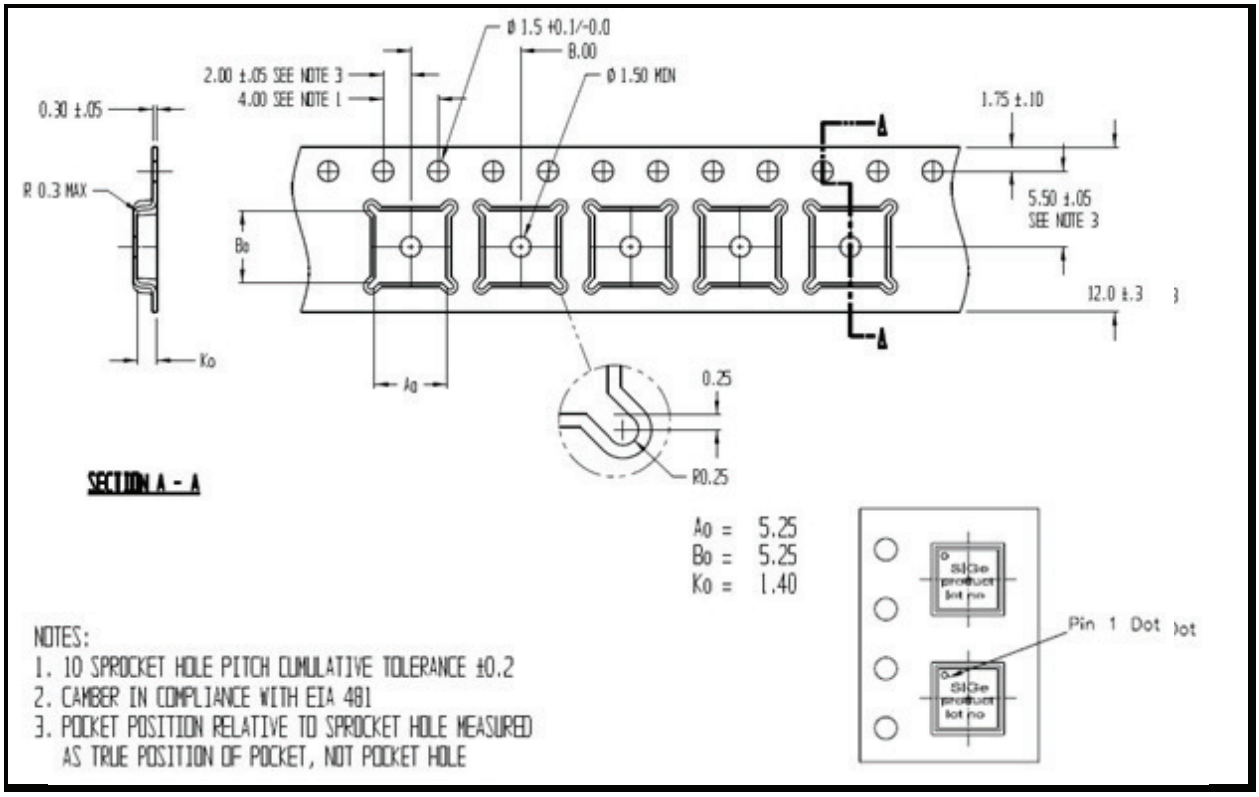


Figure 8: Detailed Tape and Reel Information (All diminensions in Millimeters)

Document Change History

Revision	Date	Notes
1.0	Sep-01-2009	Created
1.1	Sep-18-2009	Added Recommended Land Pattern
1.2	Sep-22-2009	Updated recommended land pattern
1.3	Nov-13-2009	Updated ICC, S_{21}, RX_{IL}, RX_{RL}, ICC.
1.4	Dec-1-2009	Updated operating temp, rise-fall time, and 5GHz sub-bands.
1.5	Mar-23-2010	Updated 5GHz harmonic compliance, absolute max operating temp, off-state leakage current
1.6	Oct-27-2010	Updated Package Marking Diagram
1.7	Feb-9-2011	Updated ESD rating Added min/max limits

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Product Preview
The datasheet contains information from the product concept specification. SiGe Semiconductor, Inc. reserves the right to change information at any time without notification.

Preliminary Information
The datasheet contains information from the design target specification. SiGe Semiconductor, Inc. reserves the right to change information at any time without notification.

Production testing may not include testing of all parameters.

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