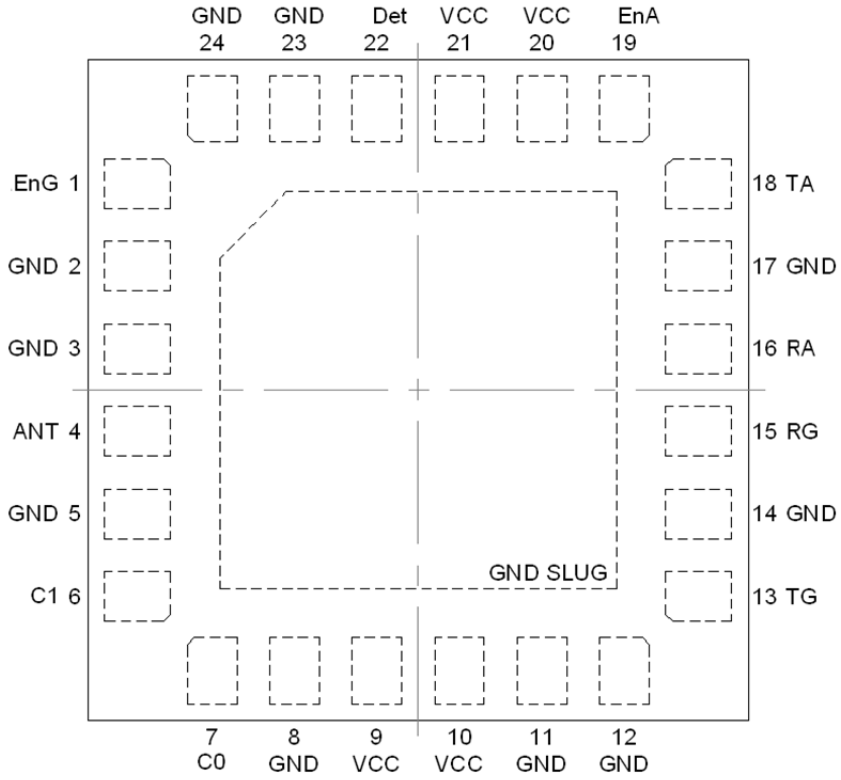


Figure 2: SE5516A Pin Out (Top View Through Package)

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	C1	Switch Control
7	C0	Switch Control
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	PA Enable pins: ENa, ENg	-0.3	3.6	V
TX_{RF}	Max power input to Ta, Tg, with ANT terminated in 6:1 load or better	-	12.0	dBm
T_A	Operating Temperature Range	-40	85	°C
T_{STG}	Storage Temperature Range	-40	150	°C
ESD_{ANT}	JEDEC JESD22-A114 ANT pin zap to ground		1.5	KV
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	-40	25	85	°C

DC Electrical Characteristics

Conditions: V_{CC} = 3.3 V, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{CQ-A}	Total 802.11a Transmit Supply Current	No RF	-	170	-	mA
I_{CQ-G}	Total 802.11g Transmit Supply Current	No RF	-	140	-	mA
I_{CC-G}	Total 802.11g Transmit Supply Current	P_{OUT} = 18 dBm, 54 Mbps OFDM signal, 64 QAM	-	185	200	mA
I_{CC-B}	Total 802.11b Transmit Supply Current	P_{OUT} = 21 dBm, 11 Mbps CCK signal, BT = 0.45,	-	205	220	mA
I_{CC-A}	Total 802.11a Transmit Supply Current	P_{OUT} = 16 dBm, 54 Mbps OFDM signal, 64 QAM,	-	220	250	mA
$I_{CC-AC2G}$	Total 802.11ac Transmit Supply Current 2G	P_{OUT} = 16 dBm, 256 QAM,MCS9, 40Mhz	-	155	165	mA
$I_{CC-AC5G}$	Total 802.11ac Transmit Supply Current 5G	P_{OUT} = 13 dBm, 256 QAM,MCS9, 80Mhz	-	190	210	mA
I_{CC-RX2}	Total Receive Supply Current 2G	Eng=Ena=0V, LNA on Switch condition 1	-	-	12	mA
I_{CC-RX5}	Total Receive Supply Current 5G	Eng=Ena=0V, LNA on Switch condition 4	-	-	12	mA
I_{CC_OFF}	Total Supply Current	No RF, ENg = ENa = 0 V Switch condition 3 or 6	-	65	200	µA

Logic Characteristics

Conditions: V_{CC} = 3.3 V, T_A = 25 °C, as measured on Skyworks' SE5516A-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 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 Skyworks' SE5516A-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
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 (C0, C1) being driven high. RF Applied	-	-	100	µA
I_{CTL_ON}	Switch Control Bias Current (No RF)	On pin (C0, C1) being driven high. No RF	-	-	30	µA
C_{CTL}	Control Input Capacitance	-	-	-	100	pF

Switch Control Logic Table

Condition	Logic				State		
	C0	C1	ENa	Eng	SP3T	LNA	Bypass
1	0	1	0	0	RXg	RXg_EN	Open
2	0	0	0	1	TX	RXg_OFF	RXg_Bypass
3	0	0	0	0	RXg	RXg_OFF	RXg_Bypass
4	1	1	0	0	RXa	RXa_EN	Open
5	1	0	1	0	TX	RXa_OFF	RXa_Bypass
6	1	0	0	0	RXa	RXa_OFF	RXa_Bypass

2.4 GHz AC Electrical Characteristics

2.4 GHz Transmit Characteristics

Conditions: V_{CC} = 3.3 V, ENg = C0 = 3.3 V, ENa = C1 = 0 V, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 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, DEVM = 3.0 %, input signal EVM < 1% 802.11g mask compliant	-	18	-	dBm
$P_{802.11n}$	Output power	OFDM signal, MCS7, HT40, DEVM = 3% 802.11n mask compliant ± 11MHz offset, RBW=100KHz, VBW=30KHz	-	18	-	dBm
		DEVM = 2%	-	17	-	
$P_{802.11ac}$	Output power	40 MHz 256 QAM, MCS9 DEVM= 1.8% ac mask compliant	-	16	-	dBm
		DEVM = 1.2%	-	15	-	
$P_{802.11b}$	Output power	11 Mbps CCK signal, BT = 0.45 ACPR(± 11MHz offset) < -35 ACPR(± 22MHz offset) < -56	21	22	-	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
		Pout ≤ 18 dBm, 802.11gn, all data rates	-	-	-50.0	
t_{dr}, t_{df}	Delay and rise/fall Time	50 % of V_{EN} edge and 90/10 % of final output power level	-	0.2	0.4	µs
S_{11}	Input Return Loss	-	9	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, Switch Condition 1, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{OUT}	Frequency Range	-	2400	-	2500	MHz
S_{21}	Receive Gain, LNA Enabled.	2400 – 2485 MHz Switch Condition 1	10	14	16	dB
	Receive Gain, Bypass mode	LNA bypassed Switch Condition 3	-12	-	-10	
	High Band Gain @5150-5850MHz	Switch Condition 1	-	-10	-	
ΔS_{21}	Gain Variation	2400 – 2485 MHz, Over any 40MHz band	-	0.25	0.5	dB
NF	Noise Figure	De-embedded to device	-	2.5	2.8	dB
S_{11}	Input Return Loss	-	5	10	-	dB
S_{22}	Output Return Loss	-	8	10	-	dB
IP1dB	Input P1dB	LNA enabled Switch Condition 1	-	-7	-	dBm
IP1dB	Input P1dB	LNA bypassed Switch Condition 3	-	8	-	dBm
LB	Loop Back Isolation (ANT – RXg)	Switch Condition 2, Pout = Psat	Psat+10	40	-	dB
T_{EN}	Enable Time	RXg LNA_ON ⇄ LNA_Bypass	-	-	0.2	usec
	From C0 = 50% to RX RF power to 90% of transition	TX ⇄ RXg, RXa ⇄ RXg	-	0.6	1.0	

5 GHz AC Electrical Characteristics

5 GHz Transmit Characteristics

Conditions: V_{CC} = 3.3 V, ENa = C0 = 3.3 V, ENg = C1 = 0 V, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 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
$P_{802.11n}$	Output Power	OFDM signal, MCS7, HT40, DEVM = 3% 802.11n mask compliant ± 11MHz offset, RBW=100KHz, VBW=30KHz	-	16	-	dBm
		DEVM = 2.0%	-	15	-	
$P_{802.11ac}$	Output Power	80Mhz , 256 QAM, MCS9 DEVM = 1.8 % Input signal EVM < 0.6% 802.1111ac mask compliant	-	13	-	dBm
		DEVM = 1.2%	-	12	-	
P_{1dB}	P1dB	-	21	22.5	-	dBm
S_{21}	Small Signal Gain	In Band	23	-	30	dB
		1.9GHz	-	-	-20	
		3.9GHz	-	-	4	
ΔS_{21}	Small Signal Gain Variation Over 80 MHz Channel		-1	-	1	dB
	Small Signal Gain Variation Over sub-bands	4.9 – 5.18 GHz 5.18 – 5.50 GHz 5.50 – 5.90 GHz	-	2	3	dB
S_{12}	-	Switch State 5, 4.9 – 5.9 GHz	-	-	-45	dB
2f,3f	Harmonics @16dBm, 54Mbps, 802.11a		-	-	-50	dBm/MHz
t_{dr}, t_{df}	Delay and rise/fall Time	50 % of V_{EN} edge and 90/10 % of final output power level	-	0.2	0.4	µs
S_{11}	Input Return Loss	-	-	10	-	dB
S_{22}	Output Return Loss	-	-	10	-	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, Switch Condition 4, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_{OUT}	Frequency Range	-	4900	-	5850	MHz
S_{21}	Receive Gain	4900 – 5850 MHz Switch Condition 4	10	12	14	dB
	Receive Gain, Bypass mode	LNA bypassed Switch Condition 6	-14	-	-10	
	Low Band Gain @2400-2500MHz	Switch Condition 4	-	-10	-	
ΔS_{21}	Gain Variation	4900 – 5850 MHz, Over any 80MHz band	-0.5	-	0.5	dB
		Over Entire band	-TBD	-	TBD	
NF	Noise Figure	De-embedded to device	-	2.8	3.0	dB
S_{11}	Input Return Loss	-	8	10	-	dB
S_{22}	Output Return Loss	-	6	10	-	dB
IP1dB	Input P1dB	LNA enabled Switch Condition 4	-6	-	-	dBm
IP1dB	Input P1dB	LNA bypassed Switch Condition 6	6	-	-	dBm
LB	Loop Back Isolation (TXa – RXa)	Switch Condition 5, Pout = Psat	-	-40	-	dB
T_{EN}	Enable Time	10% to 90% of RX RF power, from time that C0 is at 50%	-	-	0.2	usec

2.4 GHz Power Detector Characteristic

Conditions: V_{CC} = 3.3 V, Switch Condition 2, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 evaluation board, 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	-	0.80	-	V
PDV_{p18}	Output Voltage, P_{OUT} = 18dBm	Measured into 26.5KΩ	-	0.60	-	V
PDV_{pnoRF}	Output Voltage, P_{OUT} = No RF	Measured into 26.5KΩ	-	0.20	-	V
LPF_{-3dB}	Power detect low pass filter -3dB corner frequency	Measured into 26.5KΩ	-	10	-	MHz
$PDet_{acc}$	Power Detector Accuracy	Measured into 3:1 load at ANT port	-1	-	1	dB

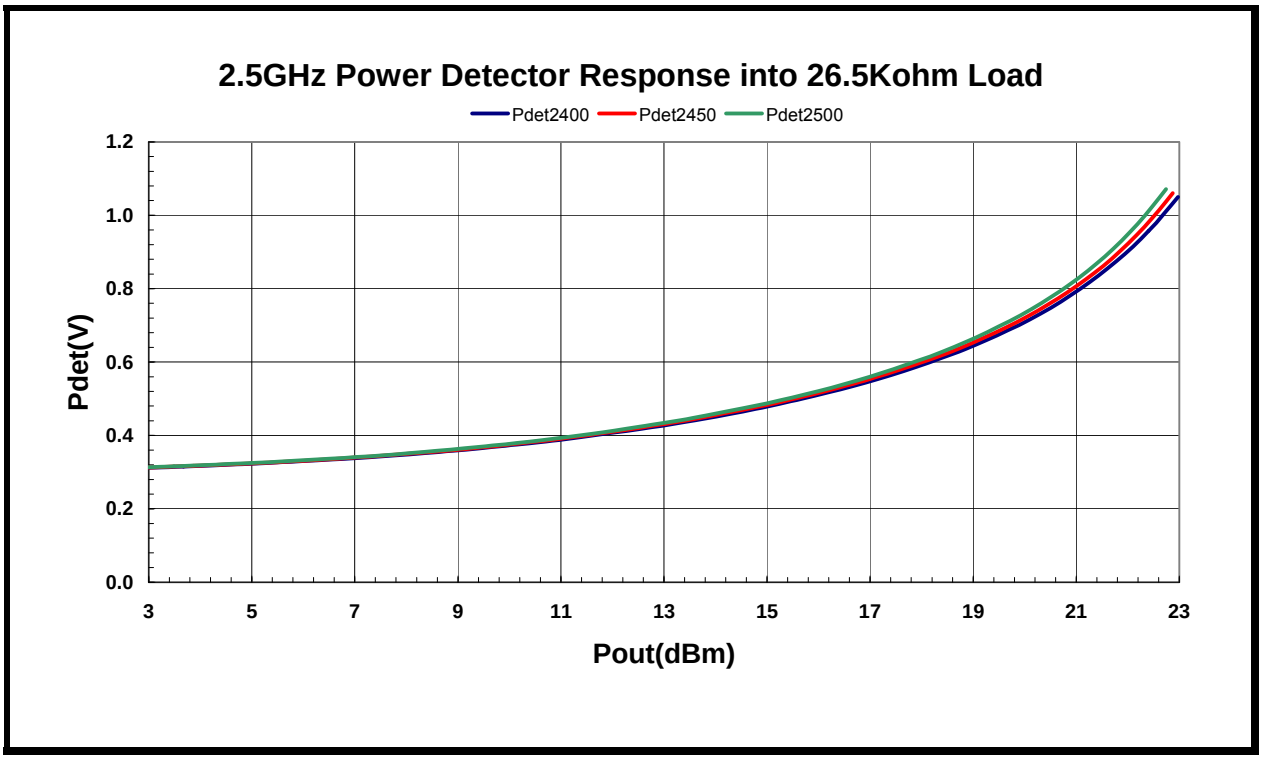


Figure 3: SE5516A Power Detector vs. Output Power over Frequency (CW Signal)

5 GHz Power Detector Characteristic

Conditions: V_{CC} = 3.3 V, Switch Condition 5, T_A = 25 °C, as measured on Skyworks' SE5516A-EK1 evaluation board, 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	-	0.70	-	V
PDV_{p16}	Output Voltage, P_{OUT} = 16dBm	Measured into 26.5KΩ	-	0.6	-	V
PDV_{NoRF}	Output Voltage, P_{OUT} = No RF	Measured into 26.5KΩ	-	0.20	-	V
LPF_{-3dB}	Power detect low pass filter -3dB corner frequency	Measured into 26.5KΩ	-	10	-	MHz
$PDet_{acc}$	Power Detector Accuracy	Measured into 3:1 load at ANT port	-1.5	-	1.5	dB

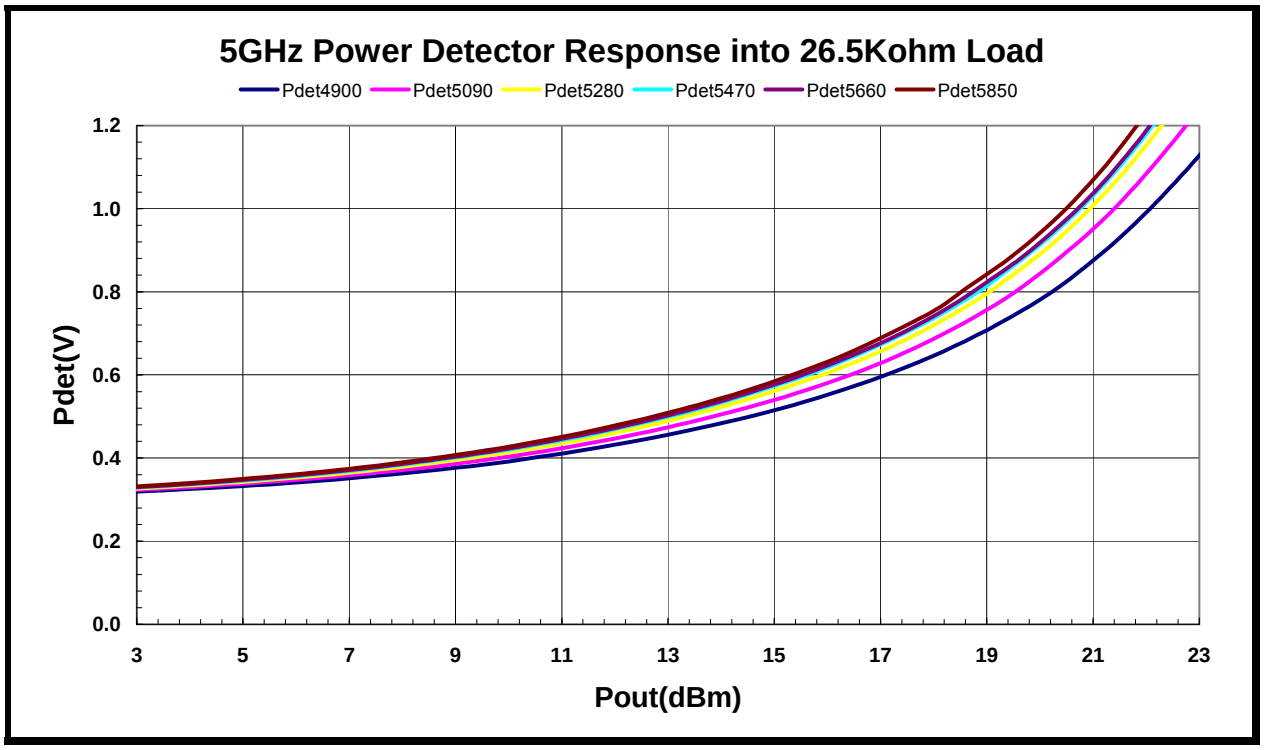
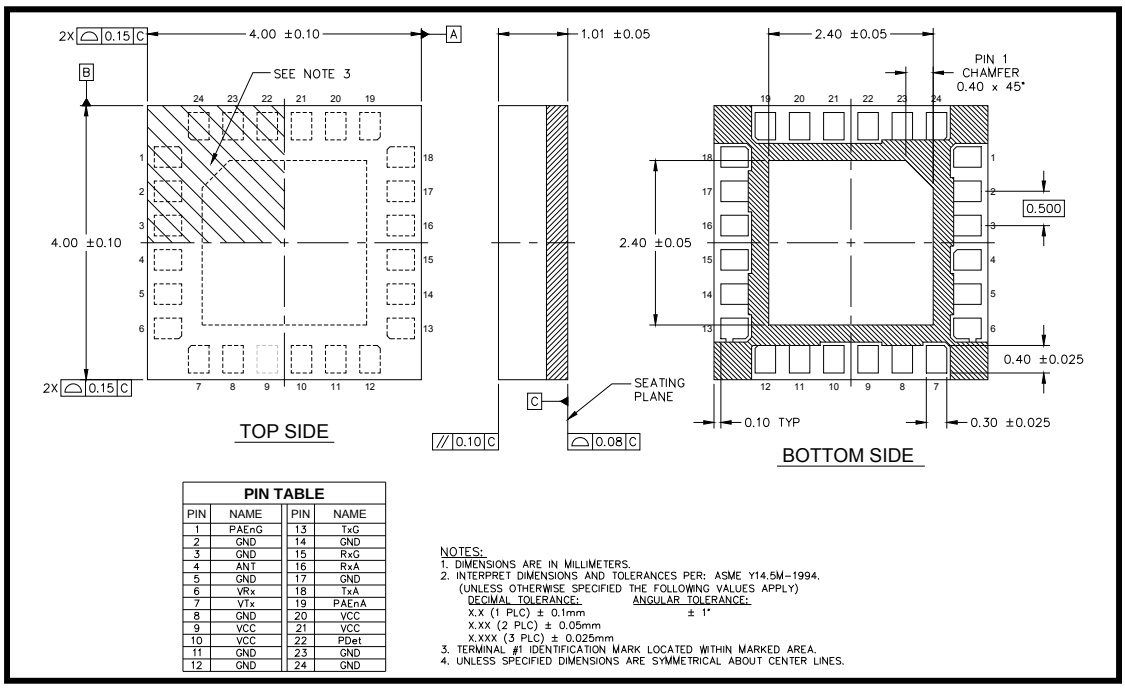


Figure 4: Preliminary SE5516A Power Detector vs. Output Power over Frequency (CW Signal)

Package Drawing

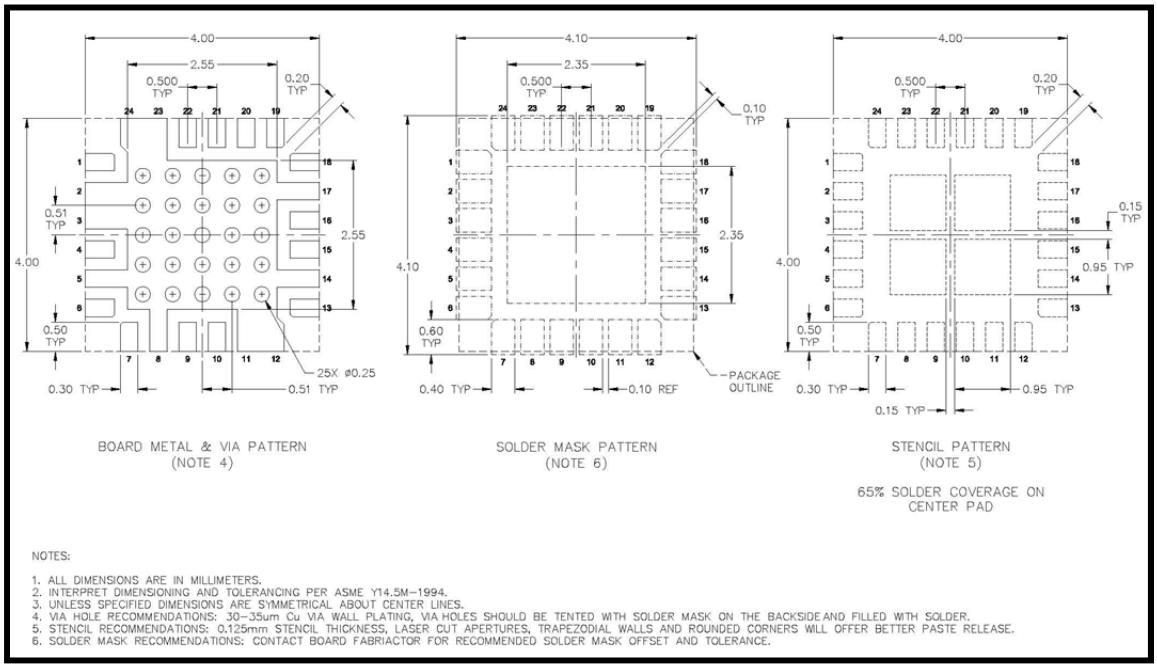


PIN TABLE			
PIN	NAME	PIN	NAME
1	PAEnG	13	TxG
2	GND	14	GND
3	GND	15	RxG
4	ANT	16	RxA
5	GND	17	GND
6	VRx	18	TxA
7	VTx	19	PAEnA
8	GND	20	VCC
9	VCC	21	VCC
10	VCC	22	PDet
11	GND	23	GND
12	GND	24	GND

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 SE5516A 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 Skyworks, please refer to:

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

Caution! Class 1A ESD sensitive device

Product Branding

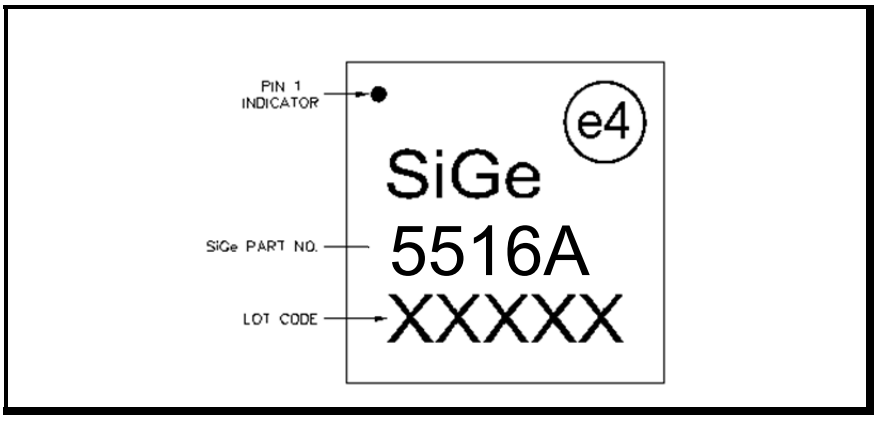


Figure 7: SE5516A Branding Information

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 1 and Figure .

Parameter	Value
Devices Per Reel	3000
Reel Diameter	13 inches

Table 1: Tape and Reel Dimensions

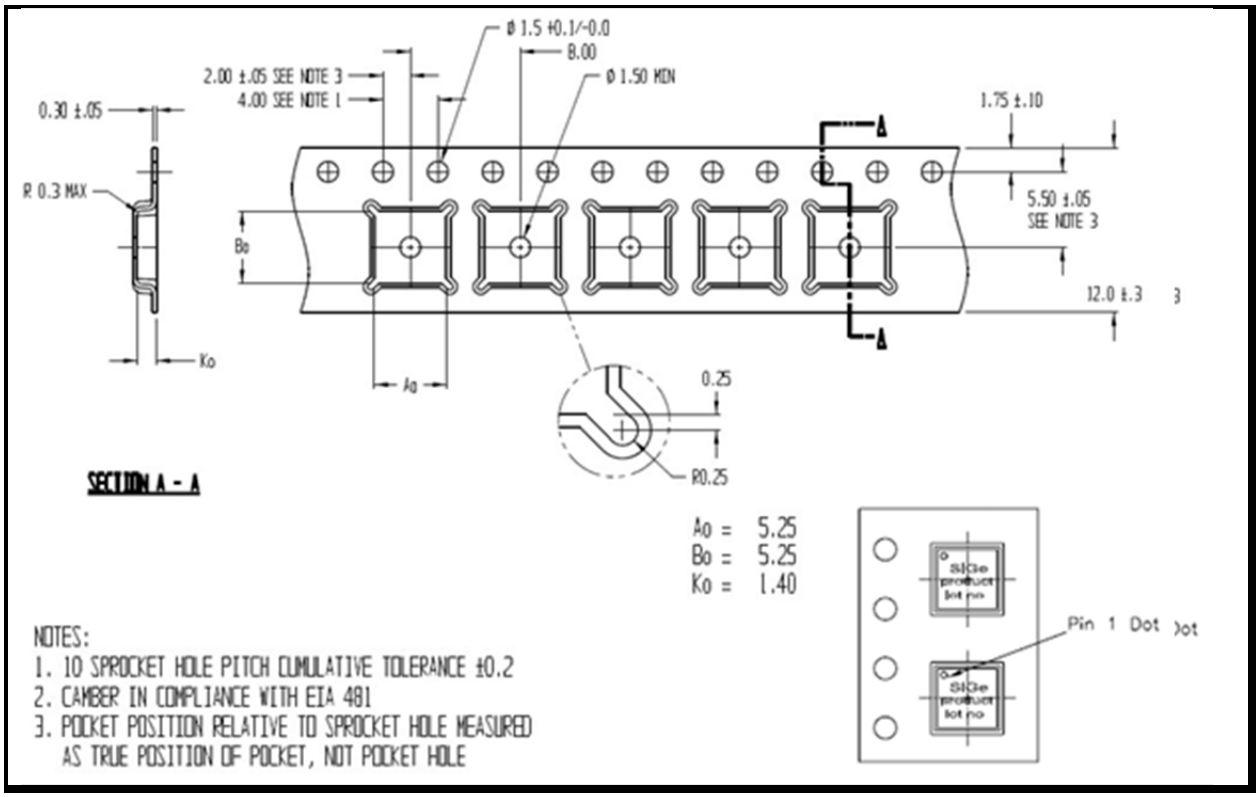


Figure 8: Detailed Tape and Reel Information (All diminensions in Millimeters)

Document Change History

Revision	Date	Notes
1.0	Mar-29-2011	Created
1.1	Apr-20-2011	Numerous updates to performance limits
1.2	Apr-26-2011	Update RX loop-back limits Update detector bandwidth
1.3	Apr-30-2011	Updated RX Gain in Active and Bypass modes, both bands
1.4	Nov-22-2011	Update to DEVM Update LNA gain at the opposite band (both bands) Update Harmonics Update loopback mode isolation (both bands)
1.5	May 15, 2012	Update to change header and footer to Skyworks. Update current consumption, 2GHz TX gain, 2GHx RX EN time, detector characteristics