

## DATA SHEET

### SE5007BT: 5 GHz Front-End Module with Power Detector

#### Applications

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

#### 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
- 3% EVM, @17dBm, 64 QAM, 54 Mbps
- 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 SE5007BT 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 SE5007BT offers a high level of integration for a simplified design, providing quicker time to market and higher application board production yield. The device integrates 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 an Rx LNA.

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

The SE5007BT 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        |
|--------------|----------------|---------------|
| SE5007BT     | 16 Pin QFN     | Samples       |
| SE5007BT-R   | 16 Pin QFN     | Tape and Reel |
| SE5007BT-EK1 | Evaluation Kit | Standard      |

#### Functional Block Diagram

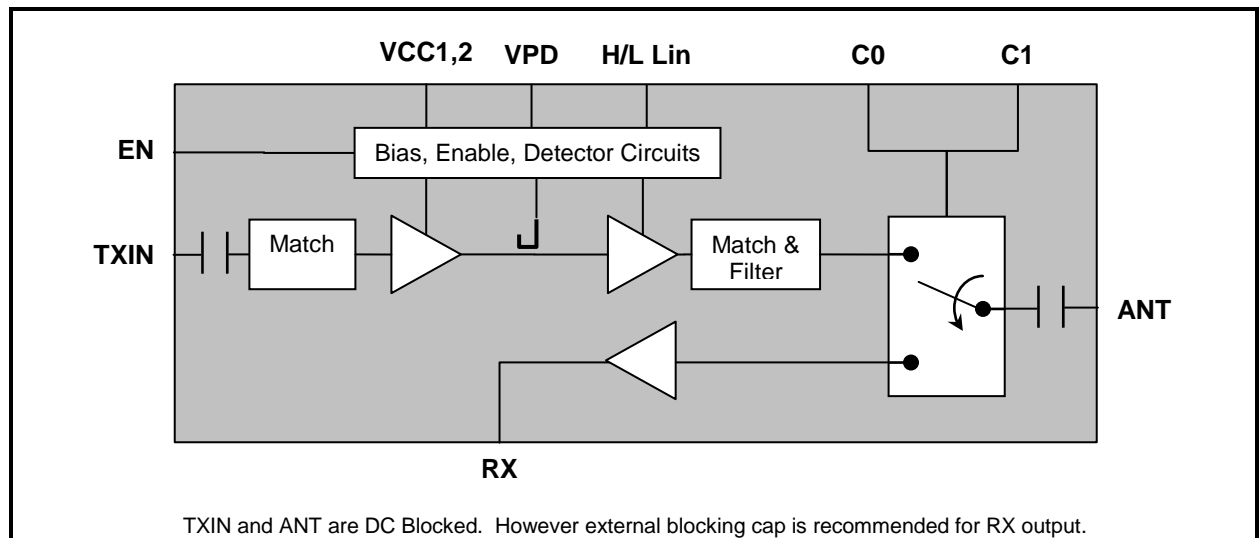
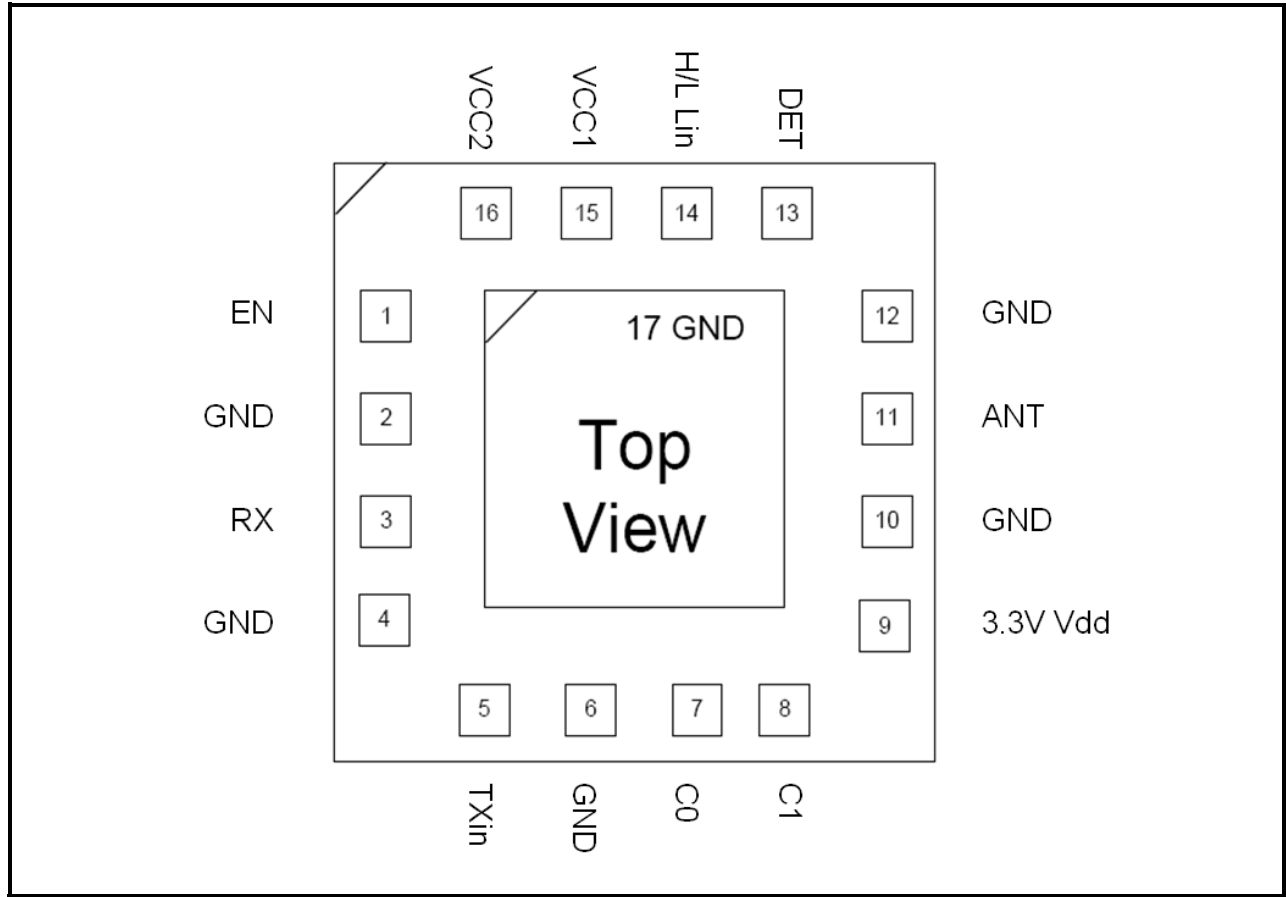


Figure 1: Functional Block Diagram

**DATA SHEET**  
**SE5007BT: 5 GHz Front-End Module with Power Detector**

**Pin Out Diagram**



**Figure 2: SE5007BT Pin-Out Diagram**

**Pin Out Description**

| Pin No. | Name | Description             |
|---------|------|-------------------------|
| 1       | EN   | PA Enable               |
| 2       | GND  | Ground                  |
| 3       | RX   | 5GHz LNA Output Signal  |
| 4       | GND  | Ground                  |
| 5       | TXIN | 5GHz TX RF Input 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 (3.3V+/-10% only) |
| 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 Stage Supply Voltage           |
| 16      | VCC2    | Bias, Driver Stage Supply Voltage    |

**DATA SHEET**
**SE5007BT: 5 GHz Front-End Module with Power Detector**
**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>CC1</sub>                   | Supply Voltage on pin 15 (VCC1)          |                | -0.3 | 4.8  | V    |
| V <sub>DD</sub> , V <sub>CC2</sub> | Supply Voltage on pins 9, 16 (VDD, VCC2) |                | -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 <sub>STG</sub>                   | Storage Temperature Range                |                | -40  | 150  | °C   |
| ESD <sub>HBM</sub>                 | JEDEC JESD22-A114<br>all pins            | Antenna Pin    | -    | 1000 | V    |
|                                    |  | All Other Pins | -    | 350  |      |

**Recommended Operating Conditions**

| Symbol                             | Parameter                                | Min. | Max. | Unit |
|------------------------------------|--|------|------|------|
| V <sub>CC1</sub>                   | Supply Voltage on pin 15 (VCC1)          | 3.0  | 4.5  | V    |
| V <sub>DD</sub> , V <sub>CC2</sub> | Supply Voltage on pins 9, 16 (VDD, VCC2) | 3.0  | 3.6  | V    |
| T <sub>A</sub>                     | Ambient Temperature                      | -40  | 85   | °C   |

**Control Logic Characteristics**

Conditions: V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>DD</sub> = V<sub>PAON</sub> = V<sub>EN</sub> = 3.3 V, T<sub>A</sub> = 25 °C, as measured on Skyworks Solutions' SE5007T-EV1 evaluation board, unless otherwise noted.

| Symbol                  | Parameter                     | Conditions   | Min. | Typ. | Max.            | Unit |
|-------------------------|-------------------------------|--|------|------|-----------------|------|
| I <sub>CC-802.11a</sub> | Supply Current, Transmit Mode | P <sub>OUT</sub> = 17 dBm, 54 Mbps, 64 QAM, H/L Lin = 3.3V (High Linearity Mode) | -    | 195  | -               | mA   |
|                         |                               | P <sub>OUT</sub> = 13 dBm, 54 Mbps, 64 QAM, H/L Lin = 0V (Low Linearity Mode)    | -    | 140  | -               |      |
|                         |                               | P <sub>OUT</sub> = 5 dBm, 54 Mbps, 64 QAM, H/L Lin = 0V (Low Linearity Mode)     | -    | 105  | -               |      |
|                         |                               | P <sub>OUT</sub> = 19 dBm, 54 Mbps, 64 QAM, H/L Lin = 3.3V, VCC1 = 4.0V          |      | 220  |                 |      |
|                         | Supply Current, Receive Mode  | V <sub>EN</sub> = C0 = 0V; C1 = 3.3V   |      | 15   |                 |      |
|                         |                               | V <sub>EN</sub> = C0 = C1 = 0V   |      | 0.02 |                 |      |
| I <sub>OFF</sub>        | Supply Current                | V <sub>EN</sub> = 0 V, No RF, C0=C1=0 V<br>Measured on VCC, VDD pins             | -    | 20   | 50              | μA   |
| V <sub>ENH</sub>        | Logic High Voltage            | -  | 1.6  | -    | V <sub>CC</sub> | V    |

**DATA SHEET**
**SE5007BT: 5 GHz Front-End Module with Power Detector**

| Symbol           | Parameter                        | Conditions | Min. | Typ. | Max. | Unit |
|------------------|----------------------------------|------------|------|------|------|------|
| V <sub>ENL</sub> | Logic Low Voltage                | -          | -0.3 | -    | 0.3  | V    |
| I <sub>ENH</sub> | Input Current Logic High Voltage | -          | -    | 330  | 400  | μA   |
| I <sub>ENL</sub> | Input Current Logic Low Voltage  | -          | -    | <1   | -    | μA   |

**Switch Logic Characteristics**

Conditions: V<sub>CC</sub> = V<sub>DD</sub> V<sub>EN</sub> = 3.3 V, T<sub>A</sub> = 25 °C, as measured on Skyworks Solutions' SE5007BT-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 <sub>CTL_ON</sub> - V <sub>CTL_OFF</sub> | 2.8  | -    | 3.6  | V    |
| OFF              | High Loss Switch Control Voltage | Low State = V <sub>CTL_OFF</sub> - V <sub>CTL_OFF</sub> | 0    | -    | 0.3  | V    |
| C <sub>CTL</sub> | Control Input Capacitance        | -   | -    | -    | 100  | pF   |
| I <sub>CTL</sub> | Control Line Current             | V <sub>CTL</sub> = V <sub>CTL_ON</sub>                  | -    | 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 |          |                   |

**DATA SHEET**
**SE5007BT: 5 GHz Front-End Module with Power Detector**
**AC Electrical Characteristics**
**Transmit Characteristics**

Conditions:  $V_{CC1} = V_{CC2} = V_{DD} = V_{EN} = C0 = H/L \text{ Lin} = 3.3V$ ,  $C1 = 0V$ ,  $T_A = 25^\circ C$ , as measured on Skyworks Solutions' SE5007T-EV1 evaluation board, unless otherwise noted

| Symbol                          | Parameter   | Conditions   | Min.   | Typ. | Max. | Unit    |
|---------------------------------|---|--|--|------|------|---------|
| $f_{L-U}$                       | Frequency Range   | -  | 4.90   | -    | 5.85 | GHz     |
| P <sub>OUT</sub>                | Output Power, High Linearity Mode<br>H/L Lin = 3.3V<br>OFDM | 802.11a, 64 QAM  | EVM = 3%   | -    | 17   | -       |
|                                 |   |  | EVM = 2%   | -    | 15   | -       |
|                                 |   | VCC1 = 4.0V, 3% EVM  | EVM = 3%   | -    | 19   | -       |
|                                 |   | MCS0, HT20, mask compliant   |  | -    | 21   | -       |
|                                 |   | MCS0, HT40, mask compliant   |  | -    | 20   | -       |
|                                 | Output Power, Low Linearity Mode<br>H/L Lin = 0V<br>OFDM    | 802.11a, 64 QAM, EVM = 3%  |  | -    | 13   | -       |
|                                 |   | MCS0, HT20, mask compliant   |  | -    | 17   | -       |
|                                 |   | MCS0, HT40, mask compliant   |  | -    | 16   | -       |
| P <sub>1dB</sub>                | Output 1dB compression point                                | No modulation  | -  | 24   | -    | dBm     |
| S <sub>11</sub>                 | Input Return Loss   | P <sub>IN</sub> = -25 dBm  | -  | 14   | -    | dB      |
| S <sub>21</sub>                 | Small Signal Gain, P <sub>IN</sub> = -25dBm                 | High Linearity Mode  | 28   | 31   | -    | dB      |
|                                 |   | Low Linearity Mode   | 26   | 30   | -    |         |
| $\Delta S_{21}$                 | Small Signal Gain Variation                                 | Gain variation over single 40MHz channel   | -  | -    | 0.5  | dB      |
|                                 |   | Gain Variation over band   | -1.5   | -    | 1.5  |         |
| S <sub>21_3.8</sub>             | Out of Band Gain  | Gain at 3.8GHz   | -  | -    | 15   | dB      |
| 2f                              | Harmonic  | P <sub>OUT</sub> = 17 dBm, OFDM  | -  | -50  | -42  | dBm/MHz |
| 3f                              |   |  | -  | -50  | -42  |         |
| t <sub>r</sub> , t <sub>f</sub> | Rise and Fall Time  | -  | -  | 0.5  | -    | us      |
| STAB                            | Stability   | P <sub>OUT</sub> = 17 dBm, 54 Mbps, 64 QAM, VSWR = 6:1, all phases   | All non-harmonically related outputs less than -50 dBc/100 kHz |      |      |         |
| Ruggedness                      | Tolerance to output load mismatching                        | Constant P <sub>IN</sub> equal to P <sub>OUT</sub> = 17 dBm at 50ohms, 54 Mbps, 64 QAM, VSWR = 6:1, all phases | No damage  |      |      |         |
| Robust                          | Robustness to input power                                   | P <sub>IN</sub> = 12dBm, CW, VSWR = 6:1, all phases  | No damage  |      |      |         |

**DATA SHEET**
**SE5007BT: 5 GHz Front-End Module with Power Detector**
**Receive Characteristics**

Conditions:  $V_{CC} = C1 = V_{DD} = 3.3V$ ,  $V_{EN} = C0 = 0V$ ,  $T_A = 25\text{ }^{\circ}\text{C}$ , as measured on Skyworks Solutions' SE5007BT-EK1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

| Symbol              | Parameter                       | Condition                              | Min. | Typ. | Max. | Unit |
|---------------------|---------------------------------|--|------|------|------|------|
| F <sub>OUT</sub>    | Frequency Range                 | -                                      | 4.9  | -    | 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 <sub>RL</sub>    | Input Return Loss               | At the Antenna port                    | -    | 12   | -    | 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 Amplitude | 1 dB degradation of IP1DB              | -    | -10  | -7   | dBm  |
| T <sub>on/off</sub> | T/R on/off switching speed      | C0, C1 (50%) to RF output (10% or 90%) | -    | 300  | -    | nSec |

**DATA SHEET**
**SE5007BT: 5 GHz Front-End Module with Power Detector**
**Power Detector Characteristics**

Conditions:  $V_{CC} = V_{EN} = C_0 = V_{DD} = 3.3V$ ,  $C_1 = 0V$ ,  $f = 5.4\text{ GHz}$ ,  $T_A = 25\text{ }^{\circ}\text{C}$ , as measured on Skyworks Solutions' SE5007BT-EV1 evaluation board, unless otherwise noted

| Symbol      | Parameter              | Conditions                | Min. | Typ. | Max.      | Unit       |
|-------------|------------------------|---------------------------|------|------|-----------|------------|
| PDR         | $P_{OUT}$ detect range | -                         | 0    | -    | $P_{1dB}$ | dBm        |
| $V_{DET22}$ | Detector voltage       | $P_{OUT} = 22\text{ dBm}$ | 0.7  | -    | 0.9       | V          |
| $V_{DET16}$ | Detector voltage       | $P_{OUT} = 16\text{ dBm}$ | 0.50 | -    | 0.60      | V          |
| $V_{DET2}$  | Detector voltage       | $P_{OUT} = 2\text{ dBm}$  | 0.25 | -    | 0.35      | V          |
| $PDZ_{OUT}$ | Output Impedance       | -                         | -    | 5    | -         | K $\Omega$ |

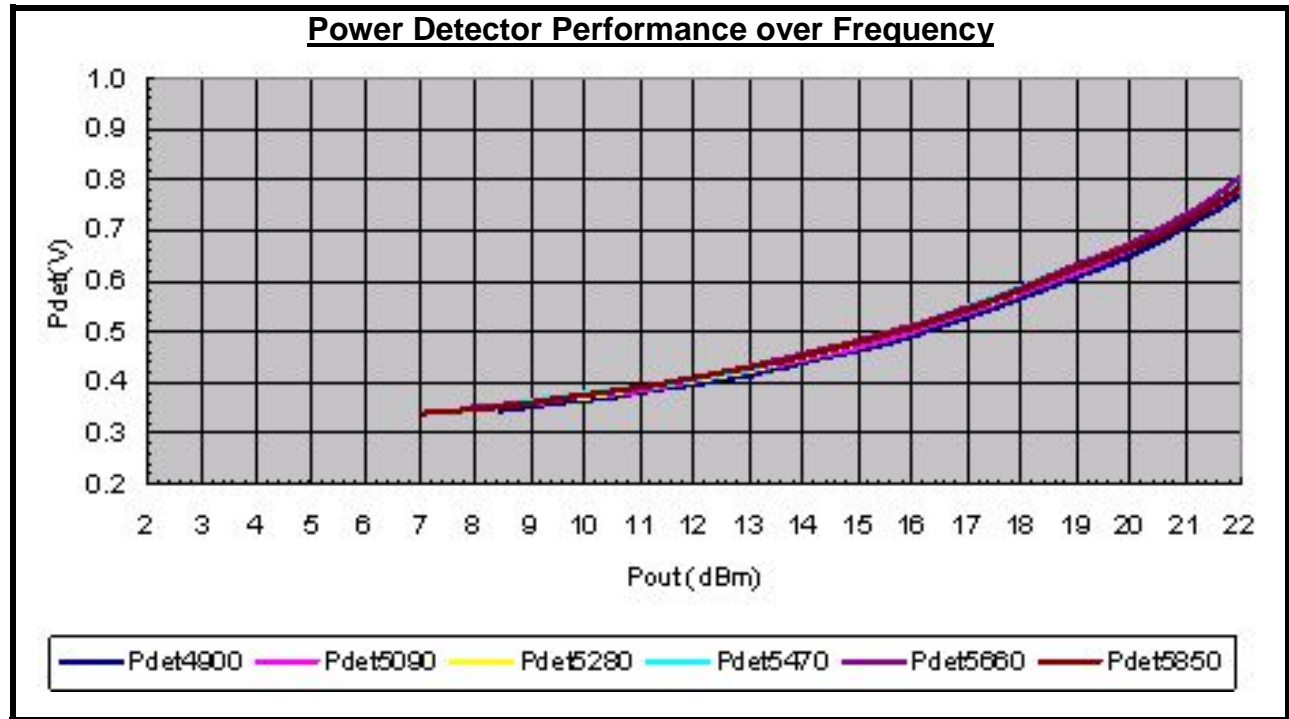


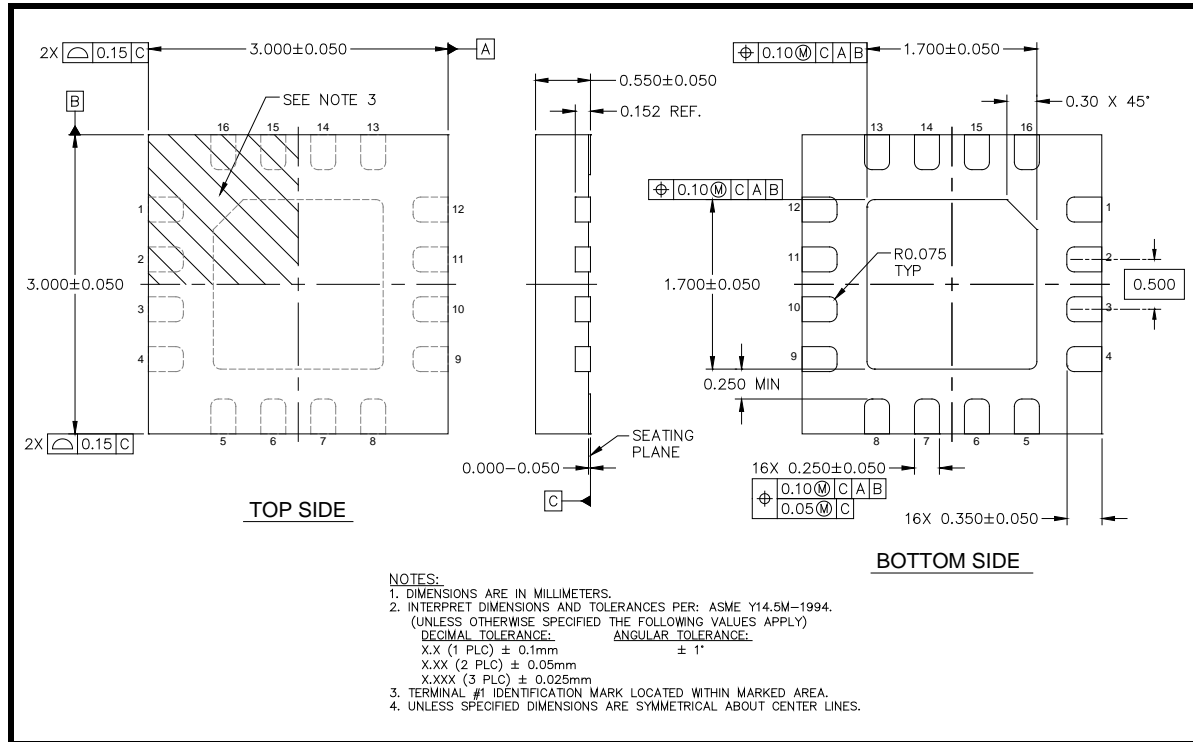
Figure 3: SE5007BT Power Detector Characteristic

## DATA SHEET

## SE5007BT: 5 GHz Front-End Module with Power Detector

## Package Diagram

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



### Figure 4: SE5007BT Package Diagram



## DATA SHEET

### SE5007BT: 5 GHz Front-End Module with Power Detector

## Recommended Land and Solder Patterns

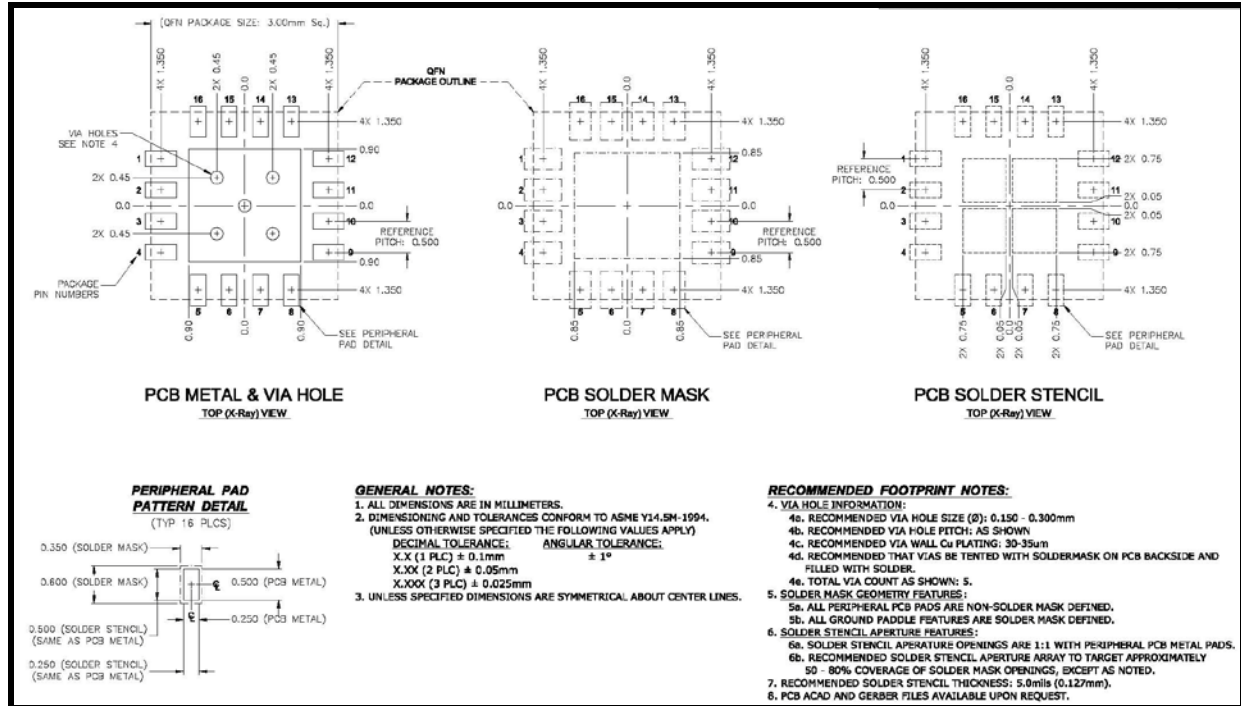


Figure 5: SE5007BT Recommended Land and Solder Pattern

## 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 SE5007BT 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:

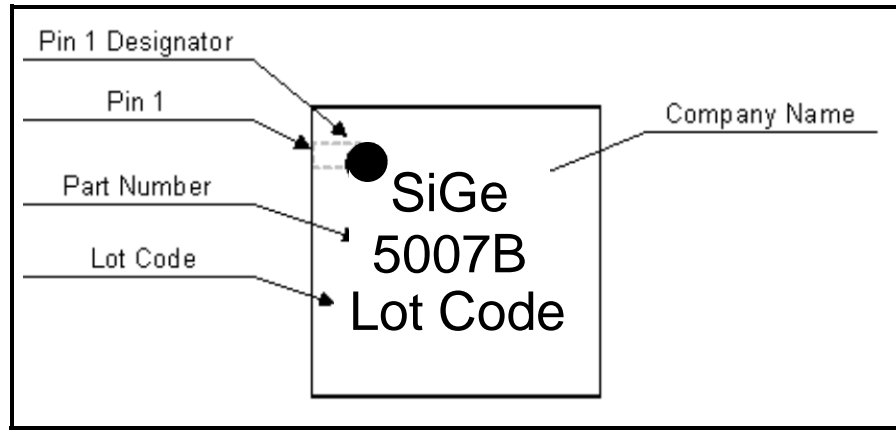
- "Quad Flat No-Lead Module Solder Reflow & Rework Information", *Document Number QAD-00045*
- "Handling, Packing, Shipping and Use of Moisture Sensitive QFN", *Document Number QAD-00044*



Caution! Class 1A ESD sensitive device

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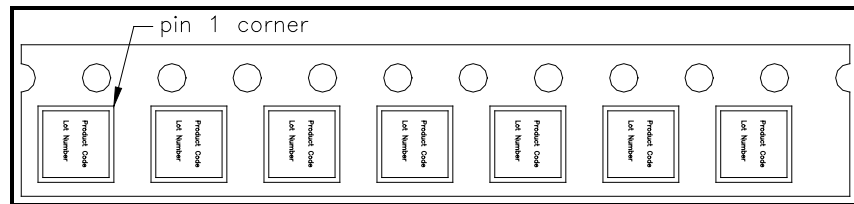
**Branding Information**



**Figure 6: SE5007BT Branding**

**Tape and Reel Information**

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



**Figure 7: SE5007BT-R Tape and Reel Information**

**Document Change History**

| Revision | Date         | Notes   |
|----------|--------------|---|
| 1.0      | Nov 03, 2010 | Created   |
| 1.1      | Nov 22, 2010 | Updated Supply voltage specs  |
| 1.2      | Dec 20, 2010 | Corrected RX Conditions in Control Logic table  |
| 1.3      | Jan 03, 2011 | Updated recommended storage temperature   |
| 1.4      | Feb 8, 2011  | Added 4V operation, Mask Performance,<br>Added reference to blocked RF ports on the block diagram             |
| 1.5      | Apr 25, 2011 | Update V <sub>ENH</sub> (min) from 2.8V to 1.6V<br>Corrected product description – removed reference to Balun |
| 1.6      | Apr 11, 2012 | Updated with Skyworks logo and disclaimer statement   |



## DATA SHEET

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