

Applications

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

Features

- Pin for pin compatible to SiGe's SE2521A34 but providing 2 dB extra output power
- Dual Mode IEEE802.11b & IEEE802.11g
- All RF ports matched to 50 Ω
- Integrated PA, TX Filter, DPDT T/R and Diversity switches
- Integrated Power Detector
- 23 dBm O/P Power, 802.11b, 11 Mbits, ACPR <- 35 dBc
- 18 dBm @ 2.0 %, 802.11g, 54 Mbits
- Single supply voltage: 3.3 V ± 10 %
- Lead free and RoHS compliant
- Small lead free plated package, 8 mm x 7 mm x 1.1 mm, MSL 3

Product Description

The SE2521A60 is a complete 802.11 b/g WLAN RF front-end module providing all the functionality of the power amplifier, power detector, T/R switch, diversity switch and associated matching. The SE2521A60 provides a complete 2.4 GHz WLAN RF solution from the output of the transceiver to the antennas 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 SE2521A60 also includes a transmitter power detector with 20 dB of dynamic range and a digital enable control for transmitter power ramp on/off control. The power ramp rise/fall time is 1 μsec typical.

The device also provides a notch filter from 3.2-3.3 GHz prior to the input of the power amplifier.

The SE2521A60 is footprint compatible to SiGe's SE2521A34 and can be placed directly into existing SE2521A34 designs easily providing higher output power solutions

Ordering Information

| Part No. | Package | Remark |
|---------------|------------|----------------|
| SE2521A60 | 24 pin LGA | Samples |
| SE2521A60-R | 24 pin LGA | Tape and Reel |
| SE2521A60-EK1 | N/A | Evaluation kit |

Functional Block Diagram

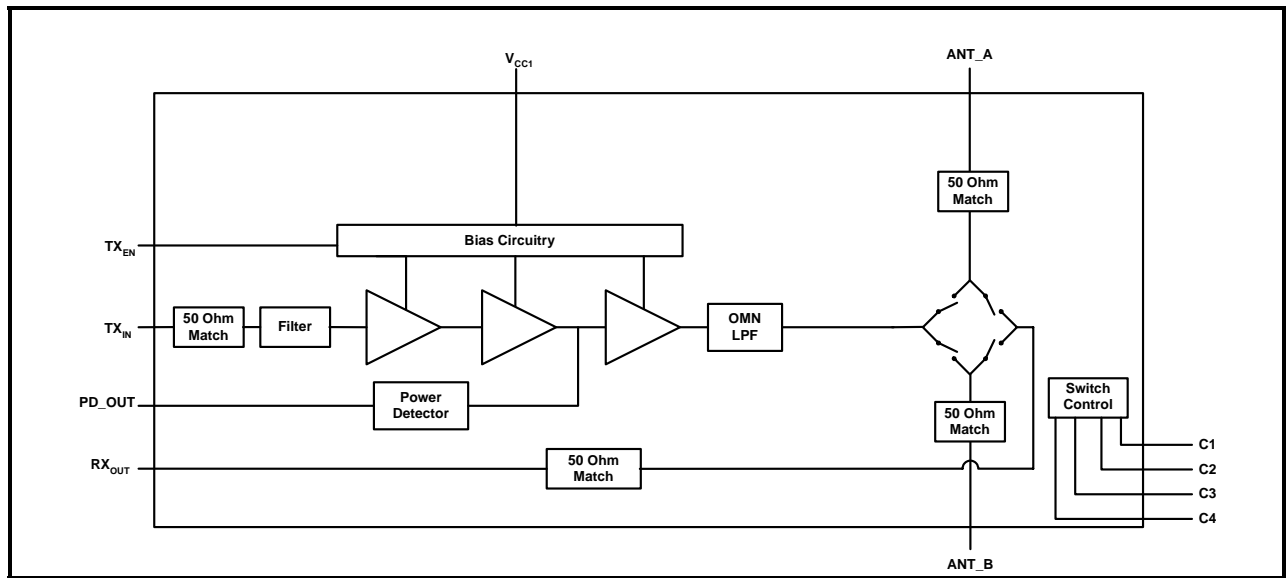


Figure 1: Functional Block Diagram

Pin Out Diagram

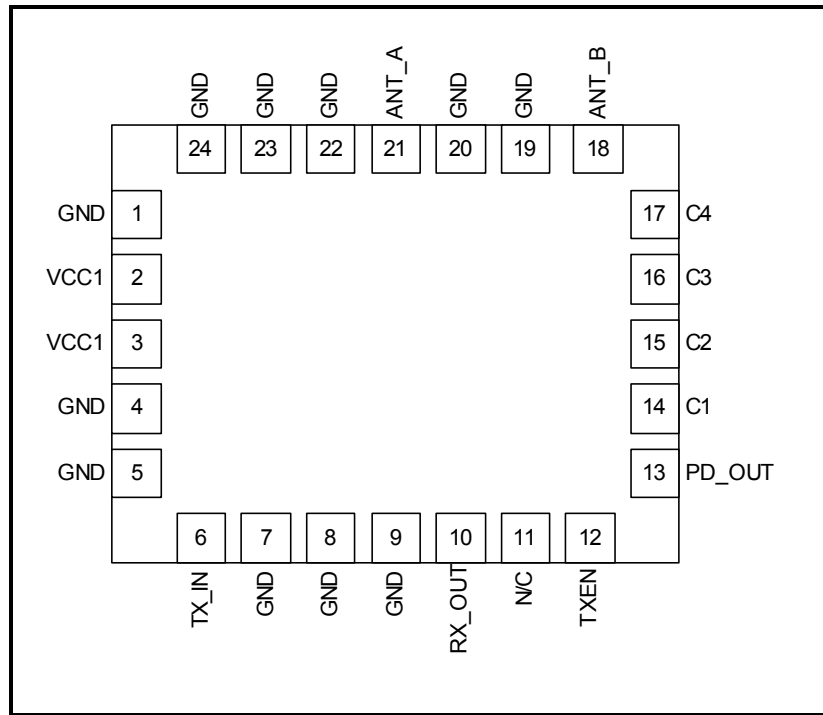


Figure 2: SE2521A60 Pin Out (Top View Through Package)

Pin Out Description

| Pin No. | Name | Description |
|----------|--------|--------------------|
| 1 | GND | Ground |
| 2 | VCC1 | +3.3 V DC |
| 3 | VCC1 | +3.3 V DC |
| 4,5 | GND | Ground |
| 6 | TX_IN | Transmit Input |
| 7,8,9 | GND | Ground |
| 10 | RX_OUT | Receive Output |
| 11 | N/C | No Connect |
| 12 | TXEN | Transmit Enable |
| 13 | PD_OUT | Power Detector |
| 14 | C1 | Control 1 Input |
| 15 | C2 | Control 2 Input |
| 16 | C3 | Control 3 Input |
| 17 | C4 | Control 4 Input |
| 18 | ANT_B | Antenna B (50 ohm) |
| 19,20 | GND | Ground |
| 21 | ANT_A | Antenna A (50 ohm) |
| 22,23,24 | 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 on V _{CC} | -0.3 | 4.0 | V |
| TX _{EN} | Power Amplifier Enable | -0.3 | 4.0 | V |
| TX _{RF} | RF Input Power | - | 2.0 | dBm |
| T _A | Operating Temperature Range | -20 | 85 | °C |
| T _{STG} | Storage Temperature Range | -40 | 150 | °C |

Recommended Operating Conditions

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-----------------|---------------------|------|------|------|------|
| V _{CC} | Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| T _A | Ambient Temperature | 0 | 25 | 85 | °C |

DC Electrical Characteristics

Conditions: V_{CC} = V_{EN} = 3.3 V, T_A = 25 °C, as measured on SiGe Semiconductor's SE2521A60-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 Supply Current | P _{OUT} = 18 dBm, 54 Mbps OFDM signal, 64QAM | 165 | 180 | 230 | mA |
| | | P _{OUT} = 15 dBm, 54 Mbps OFDM signal, 64QAM | 110 | 150 | 215 | mA |
| I _{CC-B} | Total Supply Current | P _{OUT} = 20 dBm, 11 Mbps CCK signal, BT = 0.45 | 175 | 205 | 275 | mA |
| I _{CC-OFF} | Total Supply Current | V _{EN} = 0 V, No RF Applied, C1 = C2 = C3 = C4 = 0 V | - | 2 | 10 | μA |

Logic Characteristics

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on SiGe Semiconductor's SE2521A60-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 (Module On) | - | 2.0 | - | V_{CC} | V |
| V_{ENL} | Logic Low Voltage (Module Off) | - | 0 | - | 0.5 | V |
| I_{ENH} | Input Current Logic High Voltage | - | -1 | - | 200 | μA |
| I_{ENL} | Input Current Logic Low Voltage | - | -1 | - | 1 | μA |

Switch Characteristics

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on SiGe Semiconductor's SE2521A60-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 (C1,C2,C3,C4) being driven high. RF Applied | - | - | 100 | μA |
| I_{CTL_ON} | Switch Control Bias Current (No RF) | On pin (C1,C2,C3,C4) being driven high. No RF | - | - | 30 | μA |
| C_{CTL} | Control Input Capacitance | - | - | - | 100 | pF |

Switch Control Logic Table

| Switch Logic | | | | Operational Mode | | | |
|-------------------|-------------------|-------------------|-------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| C1 | C4 | C2 | C3 | TX _{RF} – ANTA | TX _{RF} – ANTB | RX _{RF} – ANTA | RX _{RF} – ANTB |
| SW _{ON} | SW _{OFF} | SW _{OFF} | SW _{OFF} | ON | OFF | OFF | OFF |
| SW _{OFF} | SW _{ON} | SW _{OFF} | SW _{OFF} | OFF | ON | OFF | OFF |
| SW _{OFF} | SW _{OFF} | SW _{ON} | SW _{OFF} | OFF | OFF | ON | OFF |
| SW _{OFF} | SW _{OFF} | SW _{OFF} | SW _{ON} | OFF | OFF | OFF | ON |

AC Electrical Characteristics

802.11g Transmit Characteristics

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on SiGe Semiconductor's SE2521A60-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_{IN} | Frequency Range | - | 2400 | - | 2500 | MHz |
| $P_{802.11g}$ | Output power | 54 Mbps OFDM signal, 64QAM, EVM = 2.0 % | - | 18 | - | dBm |
| $P_{802.11b}$ | Output power | 11 Mbps CCK signal, BT = 0.45 ACPR(Adj) < -32 ACPR(Alt) < -52 | - | 23 | - | dBm |
| P_{1dB} | P1dB | - | 22.5 | 25.5 | - | dBm |
| S_{21} | Small Signal Gain | - | 25 | - | 33 | dB |
| ΔS_{21} | Small Signal Gain Variation Over Band | - | - | 1.0 | 3.0 | dB |
| $S_{213.2}$ | Gain @ 3.2 to 3.3 GHz | - | - | 0 | 7 | dB |
| 2f,3f | Harmonics | Pout = 19 dBm, 2 Mbps, 802.11b CCK | - | -49 | -42 | dBm/MHz |
| IM3 | 3 rd Order Inter-modulation | f1 and f2 at $F_c \pm 312.5$ kHz, P = 15 dBm | - | -40 | -33 | dBc |
| IM5 | 5 th Order Inter-modulation | f1 and f2 at $F_c \pm 312.5$ kHz, P = 15 dBm | - | -55 | -47 | dBc |
| t_r | Rise Time | 10 % to 90% of final output power level | - | 0.12 | 0.5 | μs |
| t_{dr}, t_{df} | Delay and rise/fall Time | 50 % of V_{EN} edge and 90/10 % of final output power level | - | - | 1.0 | μs |
| S_{11} | Input Return Loss | - | 4.5 | 6.5 | - | dB |
| STAB | Stability | $P_{IN} \leq -2\text{ dBm}$ Load VSWR = 6:1 | All non-harmonically related outputs less than -50 dBc/1MHz | | | |

Receive Characteristics

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on SiGe Semiconductor's SE2521A60-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 | - | - | 0.8 | 1.2 | dB |
| RX _{RL} | Return Loss | - | - | -15 | -10 | dB |
| Delta Rx | Delta between Rx paths | ANT_A to RX_OUT or ANT_B to RX_OUT | - | - | 0.5 | dB |
| TR _{ISOL-2} | Rx Leakage | C1 or C4 = SWON, C2 = C3 = SWOFF, Device transmitting 15 dBm @ ANTA or ANTB, Power measured @ RX_OUT | -9 | - | 3 | dBm |
| ANTR _{ISOL} | Isolation between ANT_A and ANT_B to RX_OUT | Small signal input into ANT_A or ANT_B, Device not transmitting, Power measured @ RX_OUT, C1 AND C4 = SWON, C2 and C3 = SWOFF | 14 | - | 24 | dB |

Power Detector Characteristics

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, as measured on SiGe Semiconductor's SE2521A60-EV1 evaluation board (de-embedded to device), 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_A or ANT_B | 0 | - | 20 | dBm |
| PDZ _{LOAD} | DC load impedance | - | 1 | - | - | Mohm |
| PDV _{NoRF} | Output Voltage, P _{OUT} = No RF | - | 0.90 | - | 1.02 | V |
| PDV _{p18} | Output Voltage, P _{OUT} = 18dBm | - | 0.44 | - | 0.66 | V |
| PDV _{p20} | Output Voltage, P _{OUT} = 20dBm | - | 0.28 | - | 0.51 | V |
| LPF _{-3dB} | Power detect low pass filter -3dB corner frequency | PDZ _{LOAD} = >1 Mohm, PDC _{LOAD} = 180 pF | 270 | 330 | 400 | KHz |

Note: Power detector internal impedance is 2.7 KOhm

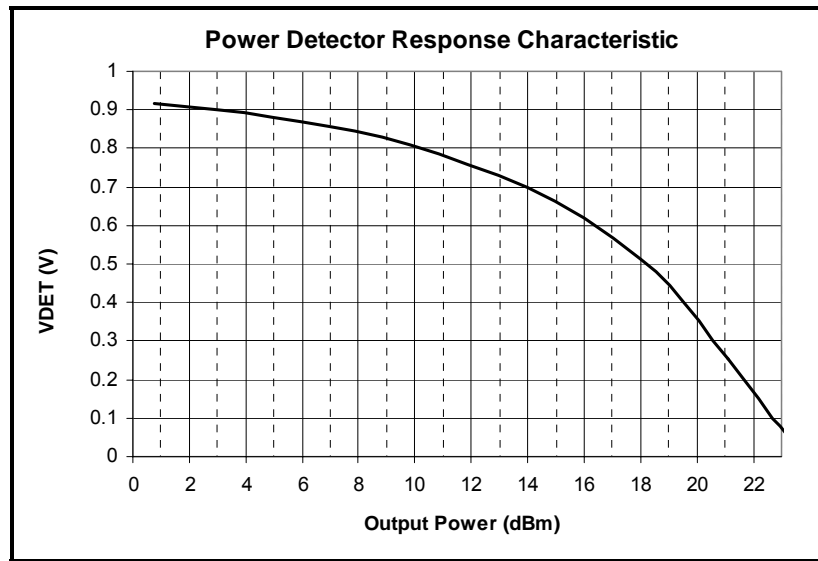


Figure 3: SE2521A60 Power Detector Performance Curve

Typical Performance Data (Ambient Temperature)

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, Frequency = 2450 MHz, $T_A = 25\text{ }^\circ\text{C}$, as measured on SiGe Semiconductor's SE2521A60-EV1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

802.11g Typical Performance

Conditions: 54Mbps 802.11g OFDM Signal

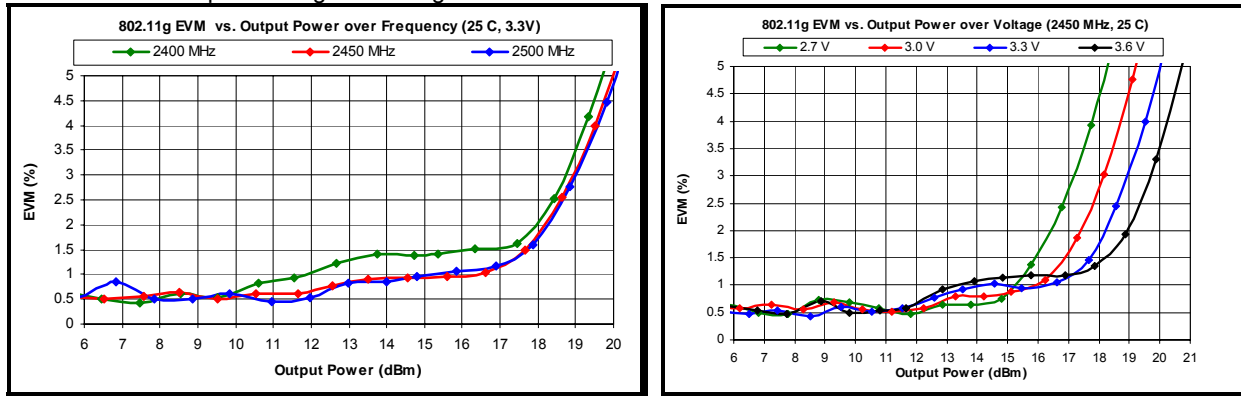


Figure 4: 802.11g Typical EVM Performance: (a) Over Frequency, (b) Over Voltage

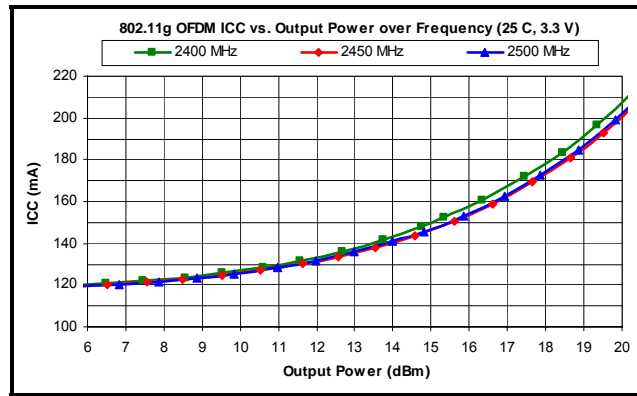


Figure 5: 802.11g Typical Current Consumption (ICC) Performance over Frequency

802.11b Typical Performance

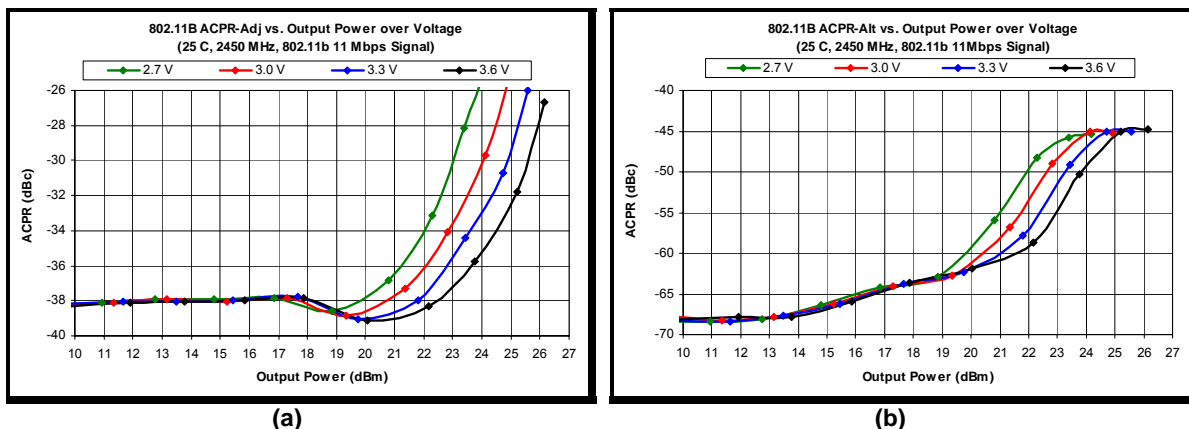


Figure 6: 802.11b Typical ACPR Performance (11 Mbps, CCK, BT = 0.45) (a) 802.11b ACPR-ADJ vs. POUT over Voltage and (b) 802.11b ACPR-ALT vs. POUT over Voltage

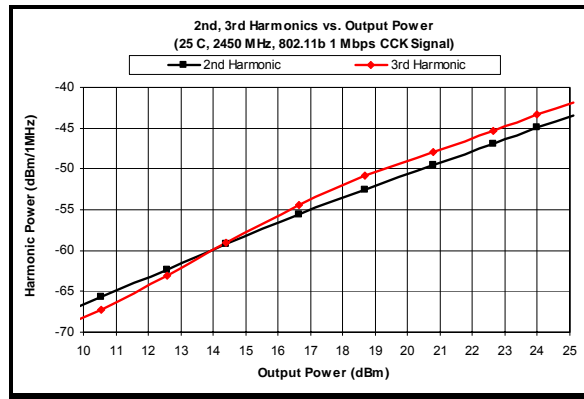
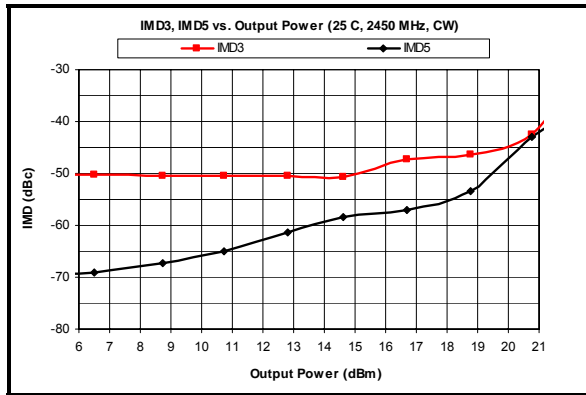
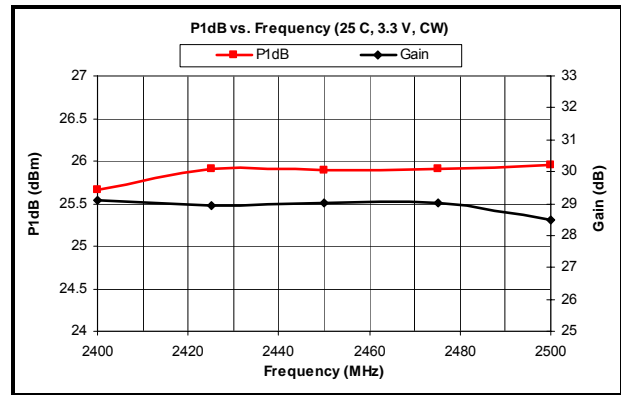


Figure 7: 802.11b Typical Harmonic Performance (1 Mbps, CCK)

CW Typical Performance



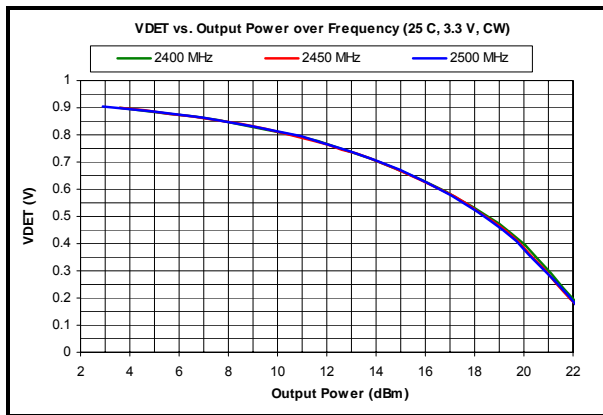
(a)



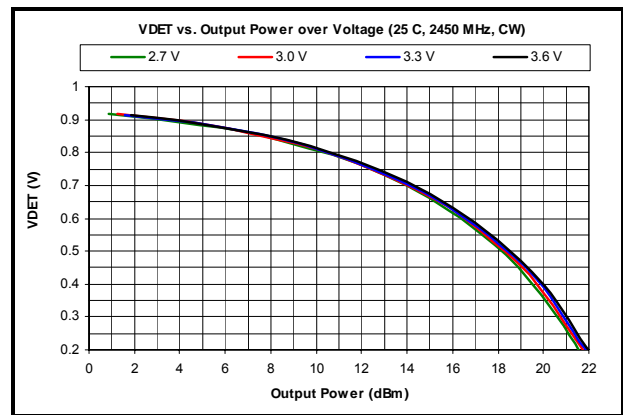
(b)

Figure 8: Typical CW Performance (a) IMD3, IMD5 vs. Output Power, (b) P1dB, Gain vs. Frequency

Detector Performance



(a)



(b)

Figure 9: Typical Power Detector Response: (a) Over Frequency, (b) Over Voltage

Typical Performance Data (Over Temperature: -40 C, 25 C, 85 C)

Conditions: $V_{CC} = V_{EN} = 3.3\text{ V}$, Frequency = 2450 MHz, as measured on SiGe Semiconductor's SE2521A60-EV1 evaluation board, all unused ports terminated with 50 ohms, unless otherwise noted.

802.11g Typical Performance

Conditions: 54Mbps 802.11g OFDM Signal

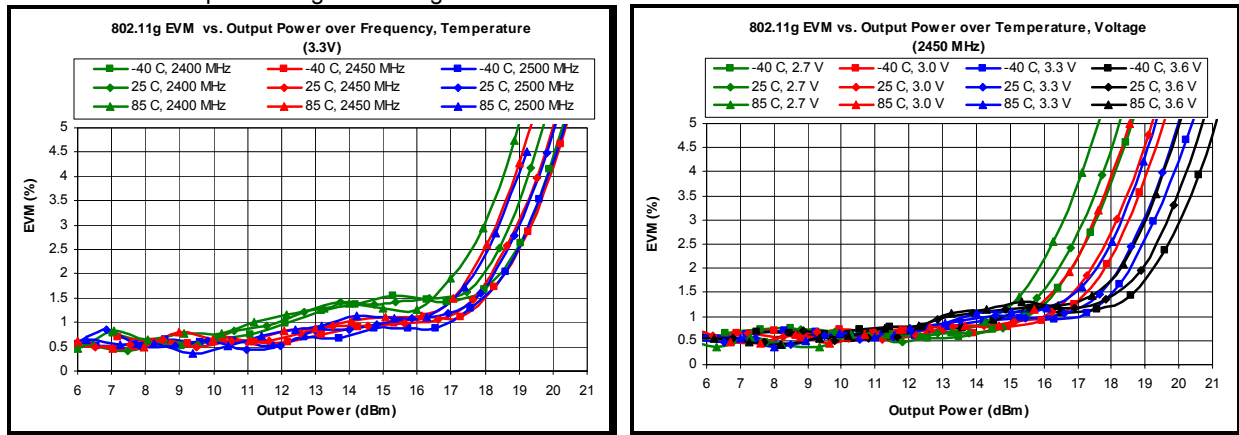


Figure 10: 802.11g Typical EVM Performance: (a) Over Frequency and Temperature, (b) Over Voltage and Temperature

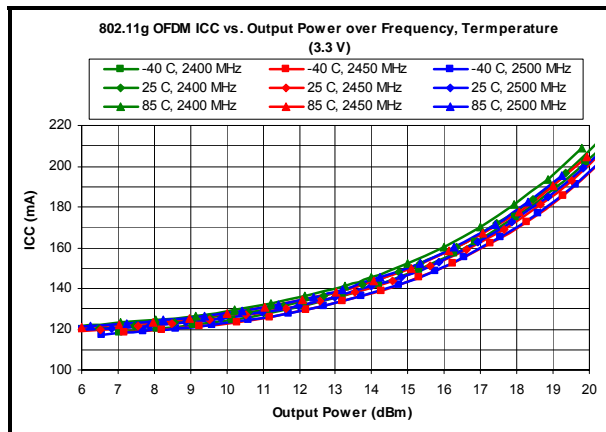


Figure 11: 802.11g Typical Current Consumption (ICC) Performance over Frequency and Temperature

802.11b Typical Performance

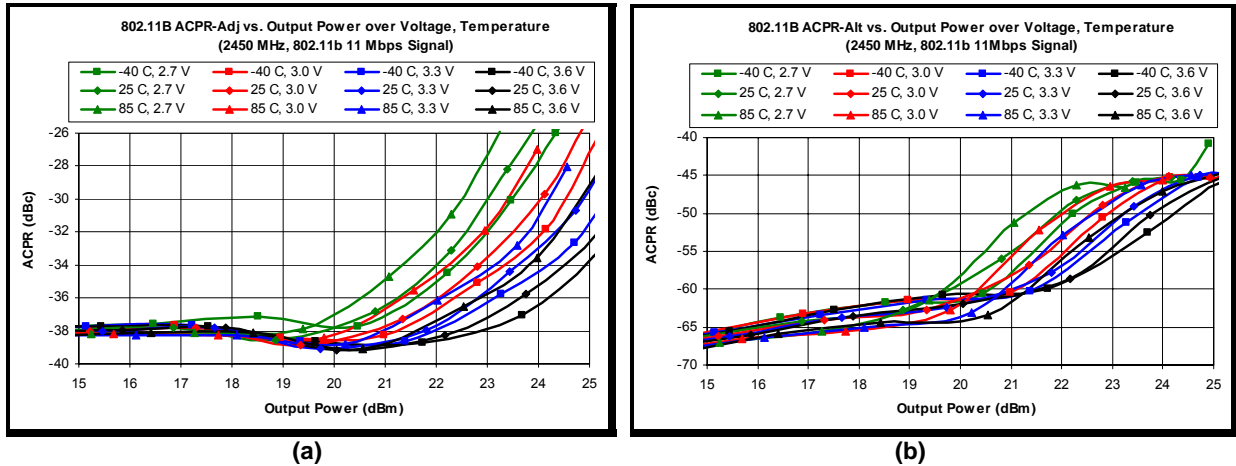


Figure 12: 802.11b Typical ACPR Performance over Voltage and Temperature (11 Mbps, CCK, BT = 0.45) (a) 802.11b ACPR-ADJ vs. POUT and (b) 802.11b ACPR-ALT vs. POUT

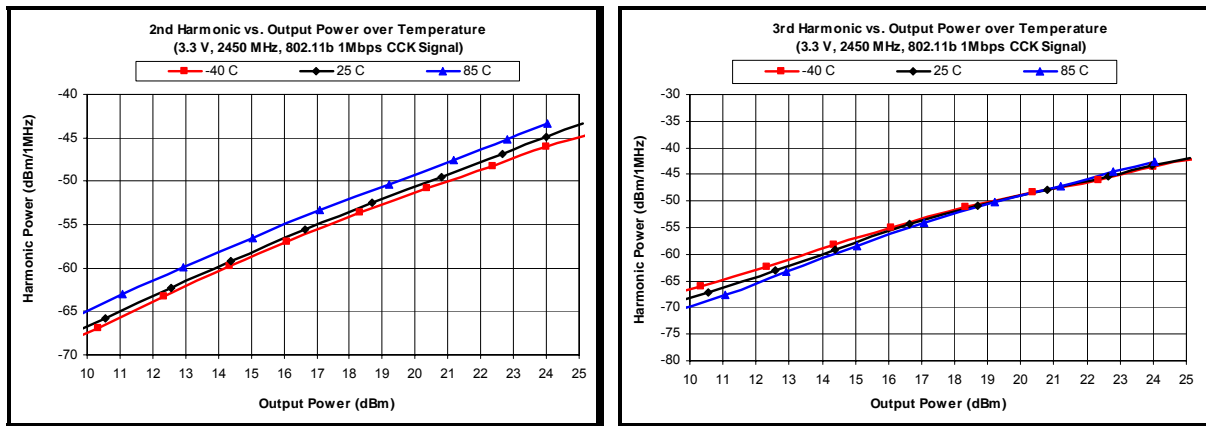


Figure 13: 802.11b Typical Harmonic Performance over Temperature (1 Mbps, CCK) (a) 2nd Harmonic (b) 3rd Harmonic

CW Typical Performance

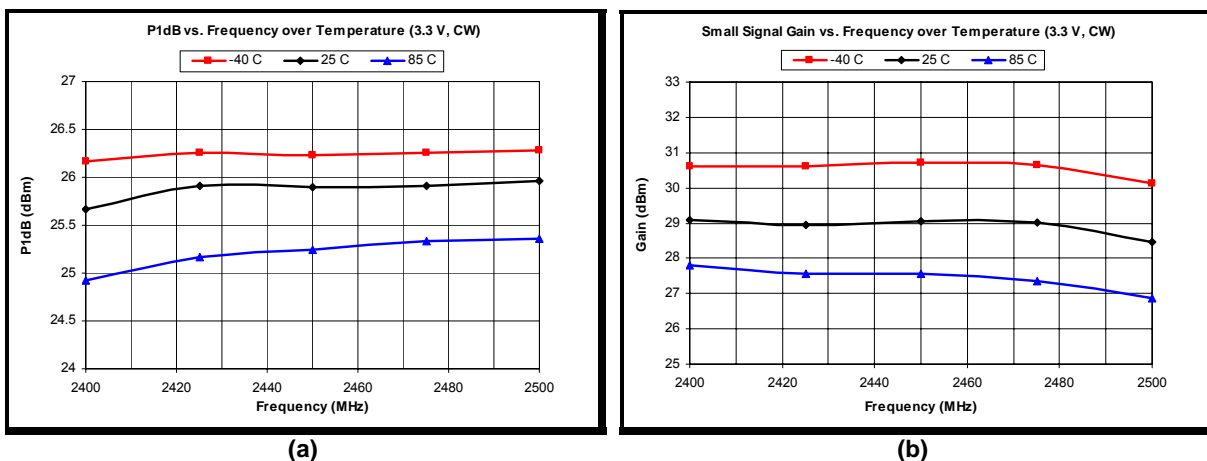


Figure 14: Typical CW Performance over Temperature (a) P1dB vs. Frequency, (b) Gain vs. Frequency

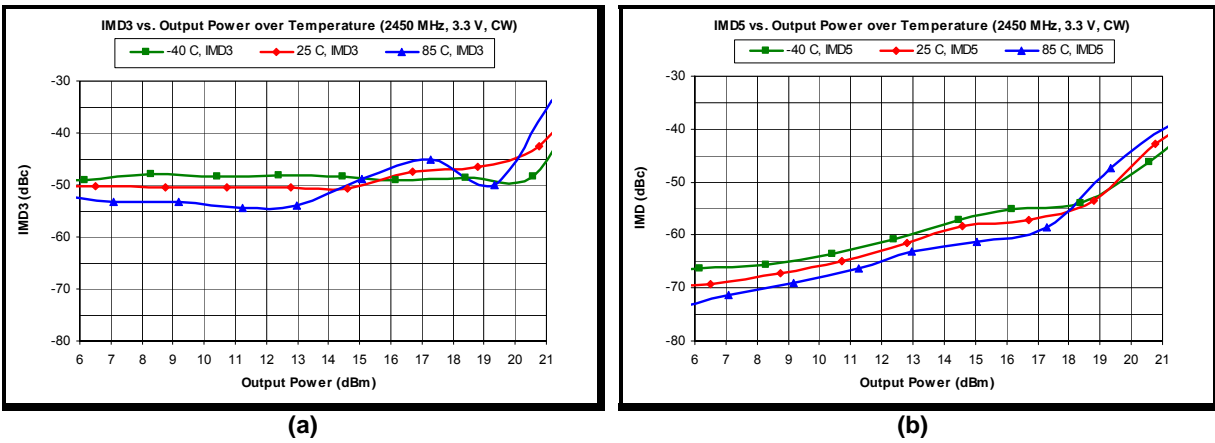


Figure 15: Typical CW Performance over Temperature (a) IMD3 vs. Output Power, (b) P1dB vs. Frequency

Typical Power Detector Performance

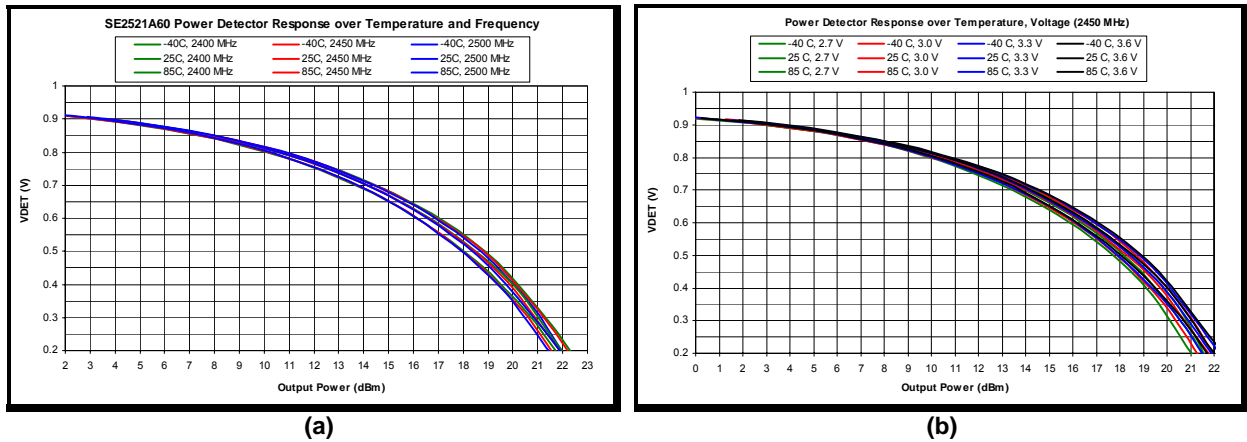


Figure 16: Typical Power Detector Response: (a) Over Frequency and Temperature, (b) Over Voltage and Temperature

Package Information

Figure 17 shows the detailed device package diagram. The pads on the SiGe RF modules are plated with gold over nickel, with a gold thickness of approx. 0.75 to 1.0 um. The modules can be reflowed onto FR4 based material using eutectic Pb based or common tin based Pb free solder pastes.

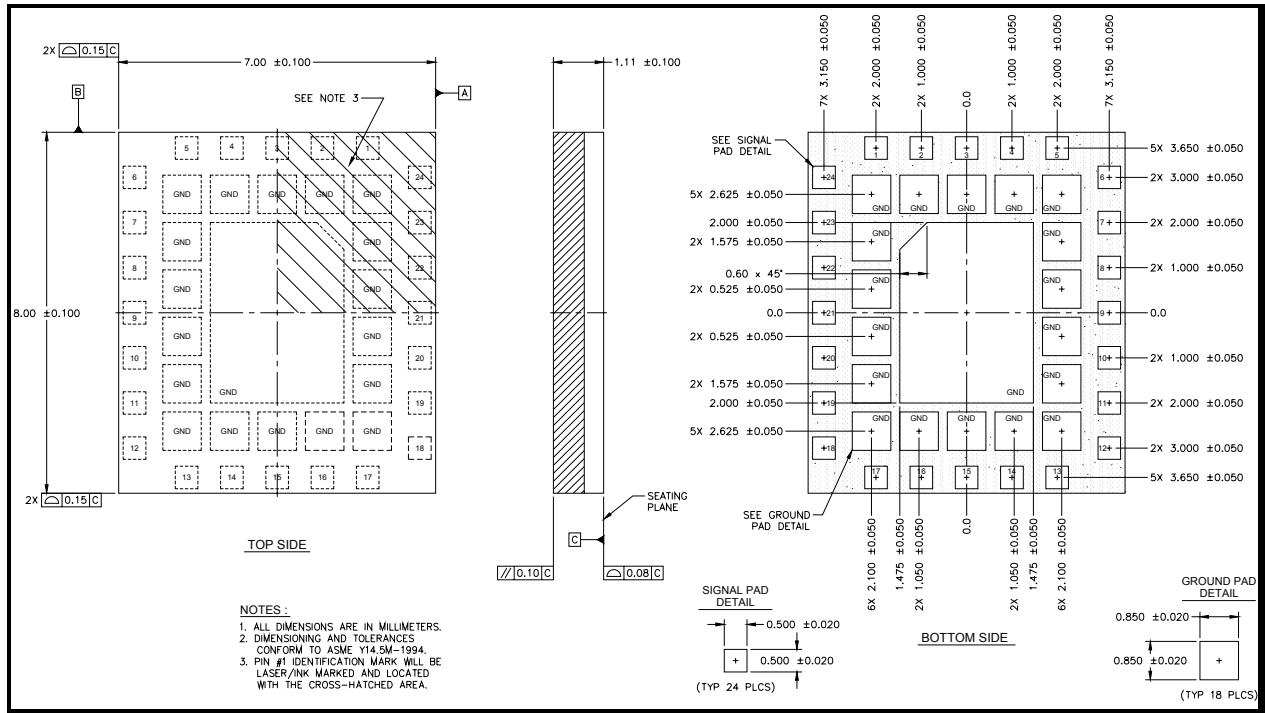


Figure 17: SE2521A60 Package Diagram

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 SE2521A60 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 69-APP-01*.
- SiGe's Application Note: "Handling, Packing, Shipping and Use of Moisture Sensitive LGA", *Document Number 69-APP-02*.

Recommended PCB Footprint

Figure 18 shows the recommended PCB footprint for the SE2521A60.

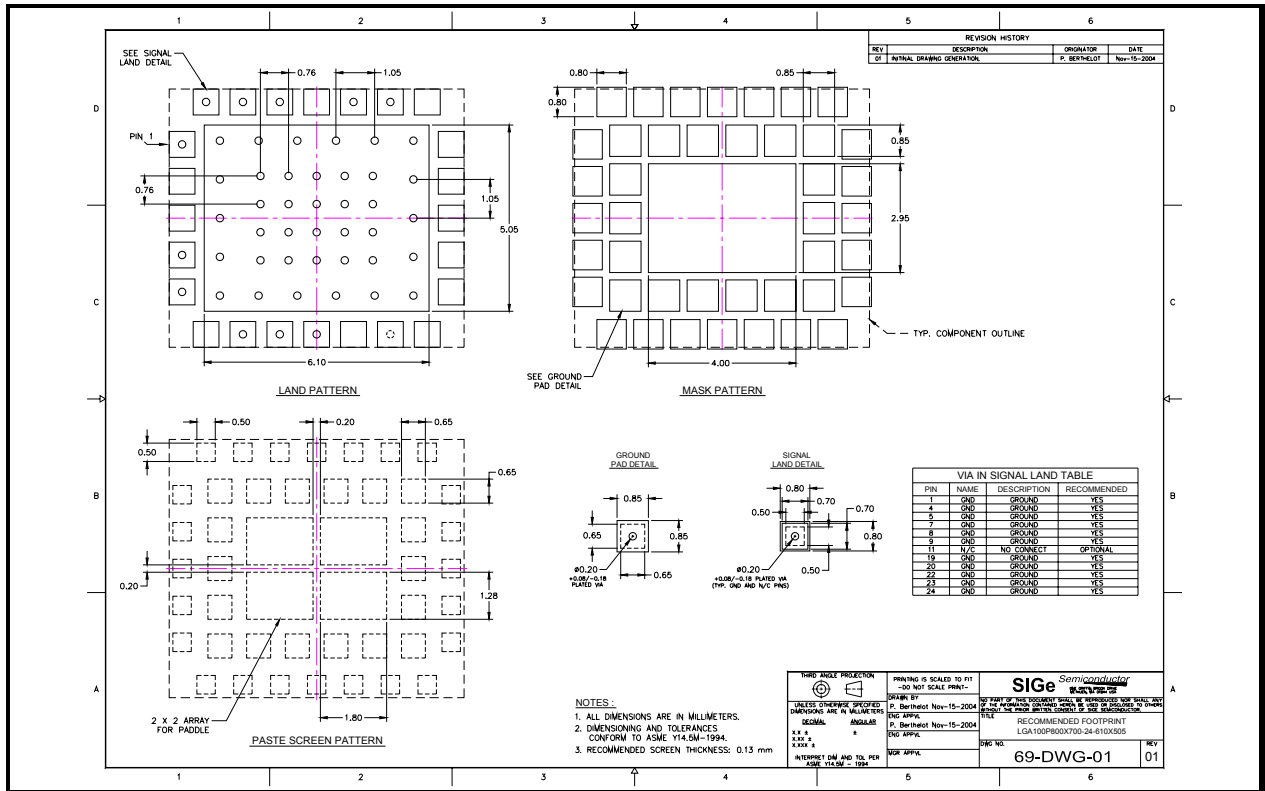


Figure 18: SE2521A60 Recommended PCB Footprint

Branding Information

The device branding is shown in Figure 19.

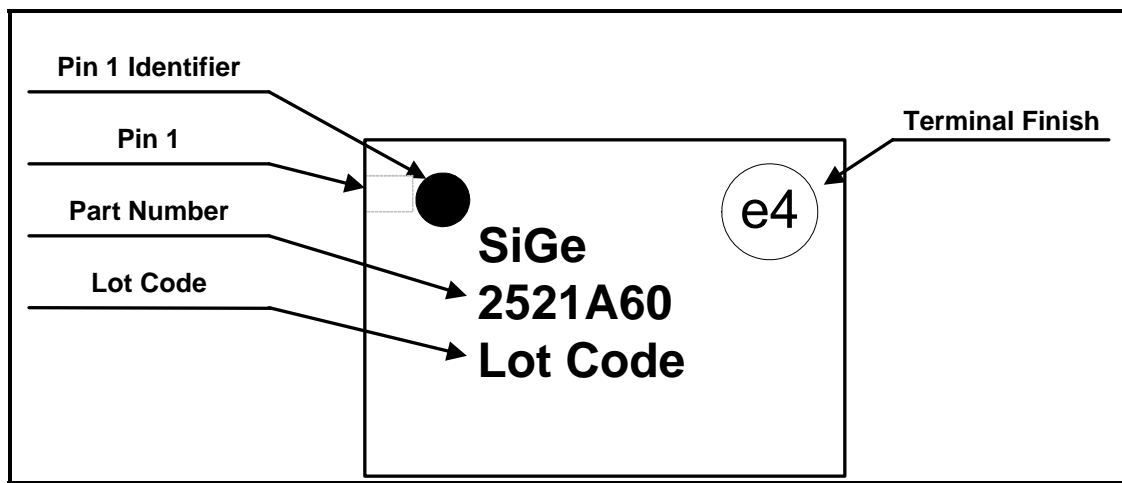


Figure 19: SE2521A60 Branding and Pin 1 Location

Tape and Reel

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 20.

| Parameter | Value |
|------------------|-----------|
| Devices Per Reel | 2500 |
| Reel Diameter | 13 inches |

Table 1: Tape and Reel Dimensions

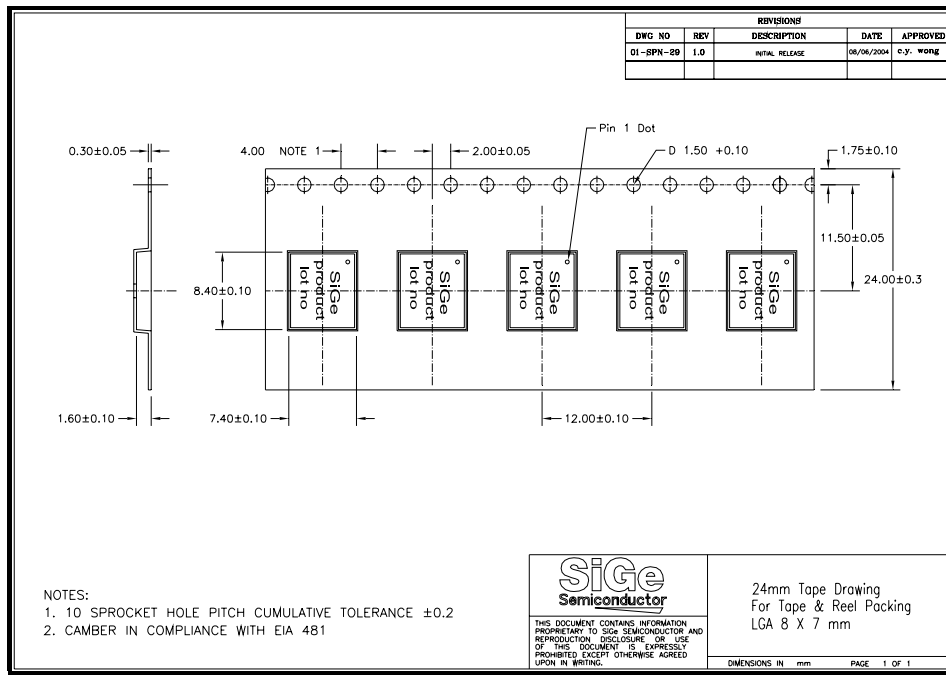


Figure 20: SE2521A60 Tape and Reel Information

<http://www.sige.com>

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Customer Service Locations:

North America:
1050 Morrison Drive, Suite 100
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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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