DATA SHEET

# SE2568U: 2.4 GHz High Efficiency Wireless LAN PA

## Applications

- IEEE802.11b DSSS WLAN
- IEEE802.11g/n OFDM WLAN
- General applications

## Features

- Dual mode IEEE802.11b & IEEE802.11g
- Integrated PA, digital bias control, 50 Ω input and output match, 3.2 GHz TX filter
- Integrated harmonic filter
- Integrated load insensitive power detector, with < 1 dB error at 2 : 1 mismatch
- 20 dBm, 802.11b, 11 Mbps, ACPR < –30 dBc, 3.3 V
- 18 dBm, 802.11g, @ 3.0 % EVM, 54 Mbps, 3.3 V
- 20.5 dBm, 802.11g @ 3.0 % EVM, 54 Mbps, 5.0 V
- Lead free, halogen free, ROHS compliant QFN (8-pin, 2 × 2 × 0.5 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

## Description

The SE2568U is a complete 802.11 b/g WLAN discrete power amplifier. The device provides all the functionality of the power amplifier, power detector, filter, associated input, inter-stage and output matching in an ultra-compact 2 mm × 2 mm × 0.5 mm form factor.

The SE2568U is designed for ease of use, with all the critical input and output matching integrated. The SE2568U includes a transmitter power detector with 20 dB of dynamic range and a digital Enable for power on/off control. Harmonic filters and an input 3.2 GHz LO rejection filter are integrated on-chip. The power ramp rise/fall time is 0.7 μs typical.

The device package and pinout for the 8-pin QFN are shown in Figure 1. A block diagram of the SE2568U is shown in Figure 2.

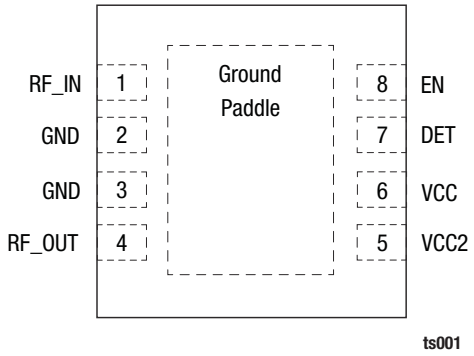



**Figure 1. SE2568U Pinout – 8-Pin QFN (Top View)**

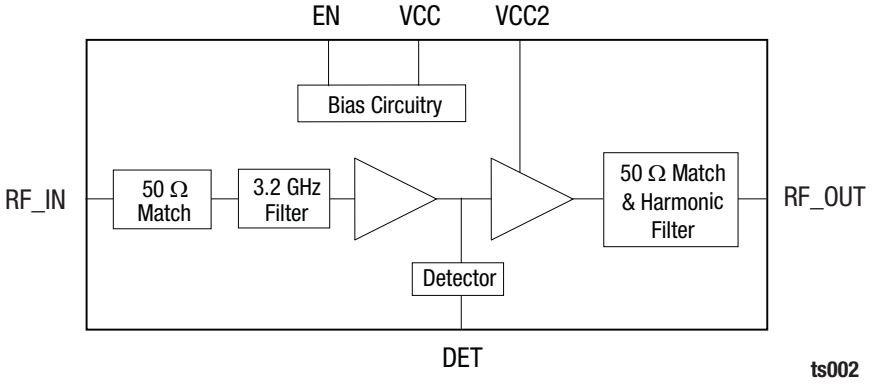



**Figure 2. SE2568U Block Diagram**

## Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SE2568U are provided in Table 2. Recommended operating conditions are specified in Table 3. Electrical specifications are provided in Tables 4 through 6, and Figure 3.

**Table 1. SE2568U Signal Descriptions**

| Pin | Name | Description |
|---|---|---|
| 1 | RF_IN | RF input (no DC voltage on the pin, but DC short to ground) |
| 2 | GND | Ground |
| 3 | GND | Ground |
| 4 | RF_OUT | RF output (no DC voltage on the pin, DC open to ground) |
| 5 | VCC2 | Final stage supply voltage (may attach directly to battery) |
| 6 | VCC | First stage supply voltage (may attach directly to battery) |
| 7 | DET | Power detector output |
| 8 | EN | Power amplifier enable |
| Die paddle | GND | Ground |

**Table 2. SE2568U Absolute Maximum Ratings (Note 1)**

| Parameter | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|
| Supply voltage on VCC | VCC | –0.3 | +5.5 | V |
| DC input on EN | EN | –0.3 | +4.0 | V |
| RF input power. ANT terminated in 50 Ω match | TX | | 12.0 | dBm |
| Operating temperature range | $T_A$ | –40 | +85 | °C |
| Storage temperature range | $T_{STG}$ | –40 | +150 | °C |
| Electrostatic discharge:<br>Human Body Model (HBM), Class 1B | ESD | | <br>500 | <br>V |

**Note 1:** Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

***CAUTION**: Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.*

**Table 3. SE2568U Recommended Operating Conditions**

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Ambient temperature | $T_A$ | –40 | 25 | 85 | °C |
| Supply voltage, nominal operation | $V_{CC}$ | 3.0 | 3.3 | 5.0 | V |
| Supply voltage, output power reduced by 2 dB typ. | | 2.3 | 3.0 | | V |

**Table 4. SE2568U Electrical Specifications: DC Characteristics (Note 1)**
**($V_{CC}$ = 3.3 V (default) or $V_{CC}$ = 5.0 V (as noted), EN = 3.3 V, $T_A$ = +25 °C as Measured on the SE2568U-EK1 Evaluation Board, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Total supply current | $I_{CC\_G}$ | 54 Mbps OFDM signal, 64QAM<br>18 dBm, $V_{CC}$ = 3.3 V<br>20.5 dBm, $V_{CC}$ = 5.0 V | | <br>135<br>150 | | mA |
| Total supply current | $I_{CC\_N}$ | 802.11n, MCS7<br>17 dBm, $V_{CC}$ = 3.3 V<br>19 dBm, $V_{CC}$ = 5.0 V | | <br>115<br>130 | | mA |
| Total supply current | $I_{CC\_B}$ | 11 Mbps CCK signal, BT = 0.45<br>20 dBm, $V_{CC}$ = 3.3 V<br>22 dBm, $V_{CC}$ = 5.0 V | | <br>160<br>175 | | mA |
| Total supply current | $I_{CQ}$ | No RF.<br>$V_{CC}$ = 3.3 V<br>$V_{CC}$ = 5.0 V | | <br>90<br>100 | | mA |
| Total supply current | $I_{CC\_OFF}$ | EN = 0 V, no RF applied | | 1 | 10 | µA |

**Note 1:** Performance is guaranteed only under the conditions listed in this table.

**Table 5. SE2568U Electrical Specifications: AC Characteristics (802.11g/n Transmit) (Note 1)**
**($V_{CC}$ = 3.3 V (default) or $V_{CC}$ = 5.0 V (as noted), EN = 3.3 V, $T_A$ = +25 °C as Measured on the SE2568U-EK1 Evaluation Board, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Frequency range | $f_{IN}$ | | 2400 | | 2500 | MHz |
| Output power, 3.3 V | $P_{OUT}$ | 54 Mbps OFDM, 64 QAM, EVM = 3% | | 18 | | dBm |
| | | 11 Mbps CCK, BT = 0.45, Mask | | 20 | | dBm |
| | | 802.11n, HT20, all data rates, Mask | | 22 | | dBm |
| | | 802.11n, HT40, all data rates, Mask | | 20 | | dBm |
| Output power, 5.0 V | | 54 Mbps OFDM, 64 QAM, EVM = 3% | | 20.5 | | dBm |
| | | 11 Mbps CCK, BT = 0.45, Mask | | 22 | | dBm |
| | | 802.11n, HT20, all data rates, Mask | | 24 | | dBm |
| | | 802.11n, HT40, all data rates, Mask | | 22 | | dBm |
| 1 dB output compression point | $P1_{DB}$ | $V_{CC}$ = 3.3 V | | 25.0 | | dBm |
| Small signal gain | $\|S21\|$ | | 25 | 28 | 29 | dB |
| Small signal gain variation | $\Delta S21$ | Gain variation over single 20 MHz channel | | 0.5 | | dB |
| | | Gain variation over band | | | 1.1 | dB |
| Gain @ limit at Ref-VCO spur frequency | $S_{21,3.2}$ | 3206 to 3312 MHz | | | 15 | dB |
| 2nd harmonics | $2f_0$ | 1 Mbps, BPSK, 20 dBm, 3.3 V, 22 dBm, 5.0 V | | –50 | –45 | dBm/MHz |
| 3rd harmonics | $3f_0$ | 1 Mbps, BPSK,<br>20 dBm, 3.3 V,<br>22 dBm, 5.0 V | | <br>–50<br>–48 | <br>–45<br>–43 | <br>dBm/MHz<br>dBm/MHz |
| Delay and rise/fall time | $t_R$, $t_F$ | 50 % of $V_{EN}$ edge and 90/10 % of final output power level | | 0.7 | | µs |
| Input return loss | $\|S11\|$ | | 7 | 10 | | dB |
| Stability | STAB | CW, $P_{OUT}$ = 20 dBm, $V_{CC}$ = 3.3 V,<br>0.1 GHz ~ 20 GHz, load VSWR = 10:1 | All non-harmonically rel©ated outputs less than –42 dBm/MHz | | | |
| Ruggedness | Ru | $P_{IN}$ = 12 dBm, $V_{CC}$ = 3.3 V, Load VSWR = 10:1 | No permanent damage | | | |

**Note 1:** Performance is guaranteed only under the conditions listed in this table.

**Table 6. SE2568U Electrical Specifications: Power Detector Characteristics (Note 1)**
**(VCC = 3.3 V, EN = 3.3 V, TA = +25 °C as Measured on the SE2568U-EK1 evaluation board, all unused ports terminated with 50 Ω, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | VCC = 3.3 V | | | VCC = 5.0 V | | | Units |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Typ | Max | |
| Frequency range | fOUT | | 2400 | | 2500 | 2400 | | 2500 | MHz |
| Power detect range, CW | PDR | Measured at ANT | 0 | | 23 | 0 | | 23 | dBm |
| DC source impedance on PD_OUT | PDZSRC | | | 1 | | | 1 | | kΩ |
| Output voltage, POUT = No RF | PDVNORF | Measured into 1 MΩ | | 0.12 | | | 0.12 | | V |
| Output voltage, POUT = 18 dBm CW | PDVP18 | Measured into 1 MΩ | | 0.60 | | | 0.55 | | V |
| Output voltage, POUT = 20 dBm CW | PDVP20 | Measured into 1 MΩ | | 0.75 | | | 0.70 | | V |
| Output voltage, POUT = 23 dBm CW | PDVP23 | Measured into 1 MΩ | | NA | | | 1.00 | | V |
| Power detect low-pass filter –3dB corner frequency | LPF–3dB | Measured into 1 MΩ | 260 | 290 | 400 | 270 | 290 | 400 | kHz |

**Note 1:** Performance is guaranteed only under the conditions listed in this table.

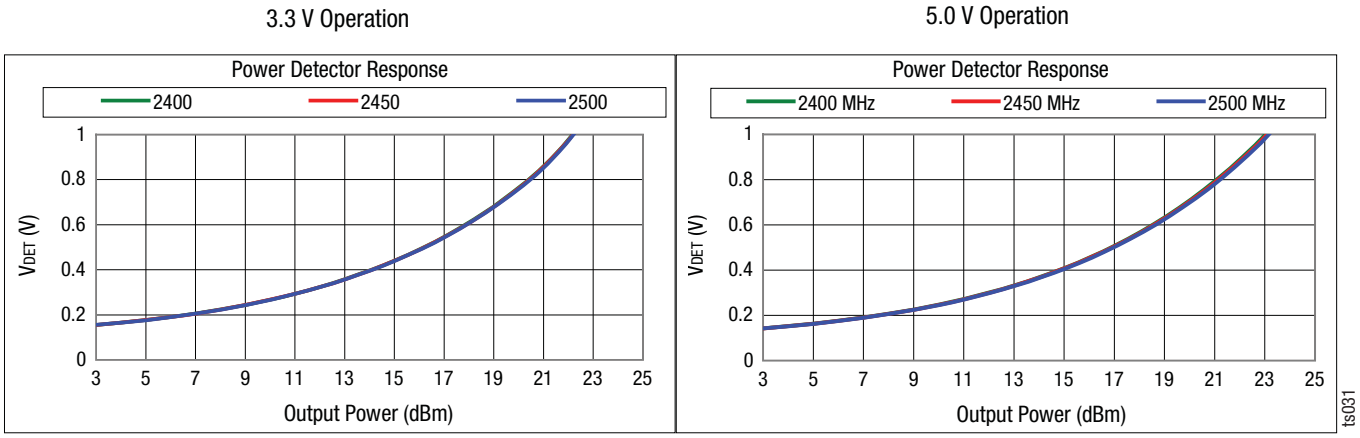



**Figure 3. SE2568U Power Detector Characteristics**

## Package Dimensions

The PCB layout footprint for the SE2568U is provided in Figure 4. Typical case markings are shown in Figure 5. Package dimensions for the 8-pin QFN are shown in Figure 6, and carrier tape dimensions are provided in Figure 7.

## Package and Handling Information

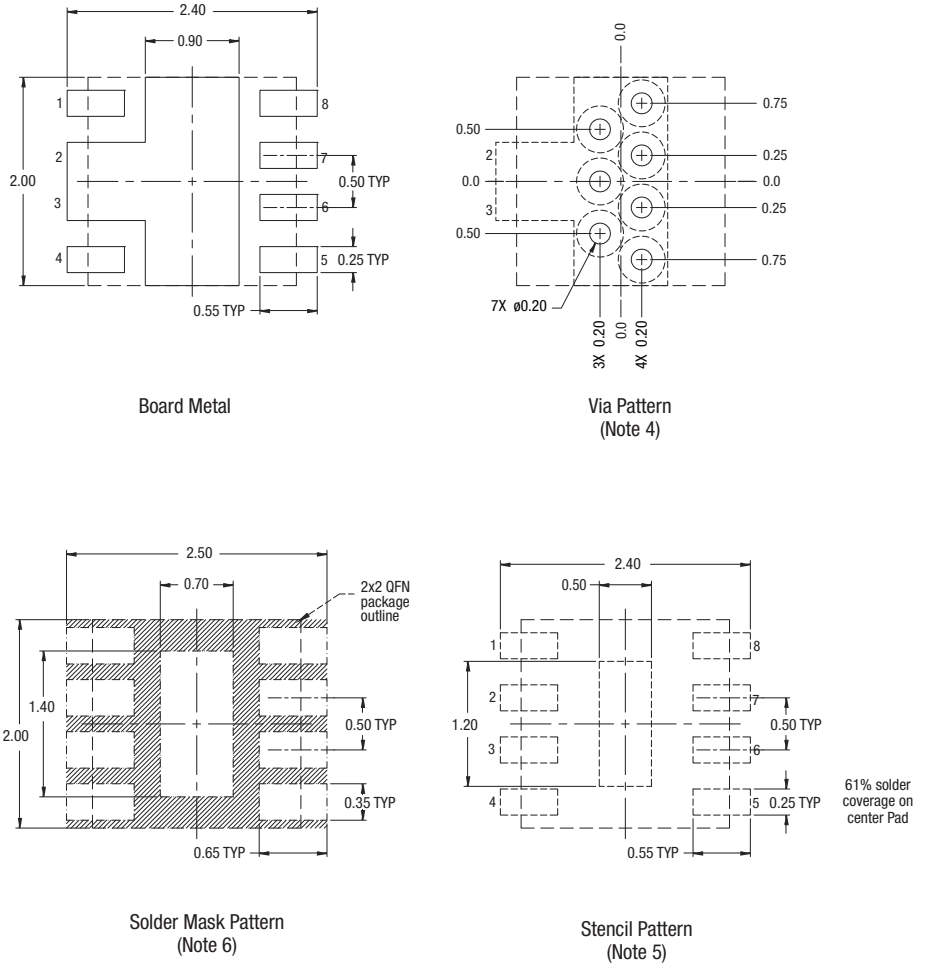
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SE2568U is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

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: *QFN Solder Reflow and Rework Information Application Note*, Document Number QAD-00045.
- Skyworks Application Note: *Handling, Packing, Shipping and Use of Moisture Sensitive QFN Application Note*, Document Number QAD-00044.

Production quantities of this product are shipped in a standard tape and reel format.




*Notes:*
*1. All dimensions are in millimeters.*
*2. Dimensions and tolerances per ASME Y14.5M-1994.*
*3. Unless specified, dimensions are symmetrical about center lines.*
*4. Via hole recommendations: 0.025 mm Cu via wall plating (minimum). Via holes to be filled with conductive paste and plated over.*
*5. Stencil recommendations: 0.125 mm stencil thickness., laser cut apertures, trapezoidal walls and rounded corners offer better paste release.*
*6. Solder mask recommendations: contact board fabricator for recommended solder mask offset and tolerance.*

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**Figure 6. PCB Layout Footprint for the SE2568U**

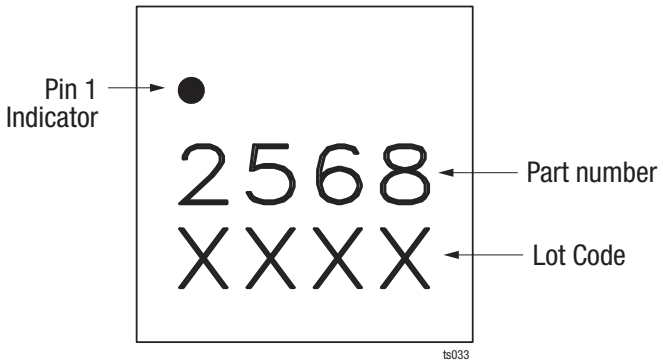
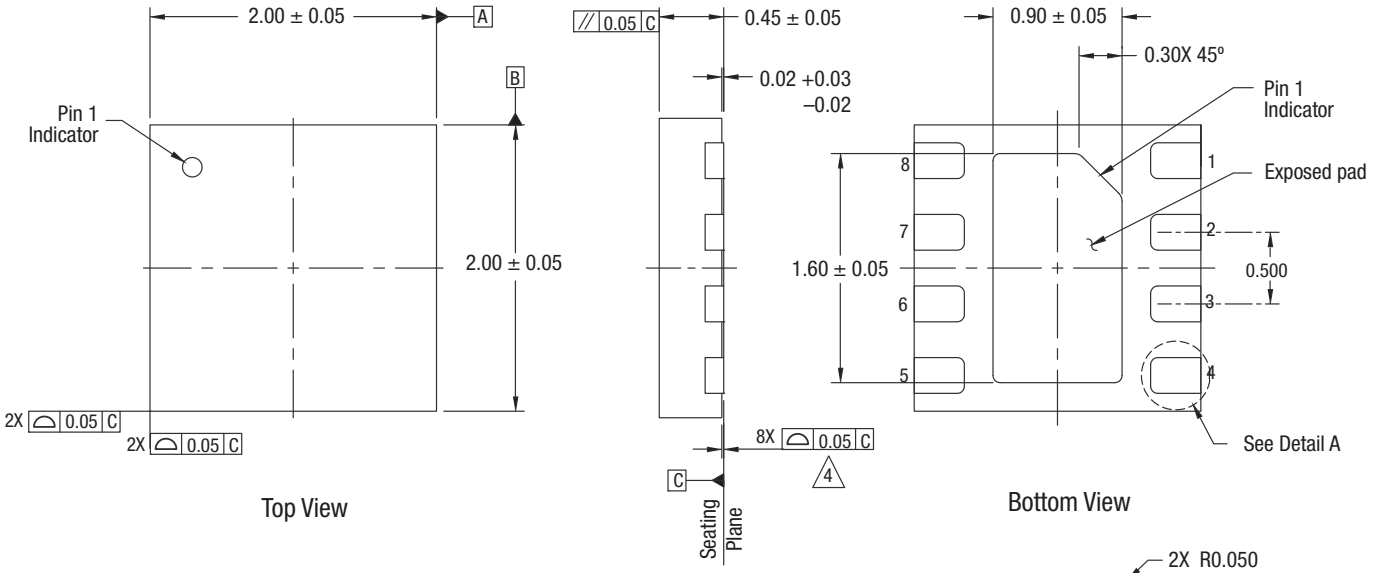



**Figure 7. Typical Case Markings (Top View)**




*Notes:*

*1. All dimensions are in millimeters.*
*2. Dimensions and tolerances per ASME Y14.5M-1994.*
*3. Tolerances (unless otherwise specified)*

| *Decimal Tolerance:* | *Angular Tolerance:* |
|---|---|
| *X. X (1 plc) ± 0.1 mm* | *± 1/2º* |
| *X. XX (2 plc) ± 0.05 mm* | |
| *X. XXX (3 plc) ± 0.025 mm* | |

*4. Coplanarity applies to the terminal as well as all other bottom surface metallization.*
*5. Dimension applies to metallized terminal. If terminal tip has a radius, dimension should not be measured in that radius area.*
*6. Plating requirements per source control drawing (SCD) 2504.*
*7. Unless otherwise specified, dimensions are symmetrical about center lines.*

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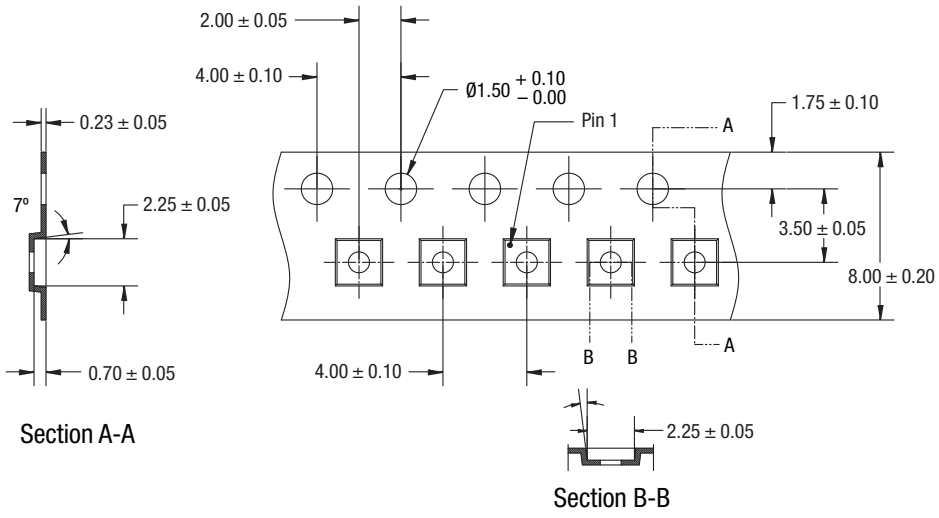
**Figure 8. SE2568U 8-Pin QFN Package Dimensions**




*All measurements are in millimeters unless otherwise stated.*

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**Figure 9. SE2568U 8-Pin QFN Carrier Tape Dimensions**

## Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Board Part Number |
|---|---|---|
| SE2568U: 2.4 GHz high efficiency wireless LAN PA | SE2568U | SE2568U-EK1 |

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