

## DATA SHEET

# SE2600S: 2.4 GHz WLAN Switch/Low-Noise Amplifier Front-End

## Applications

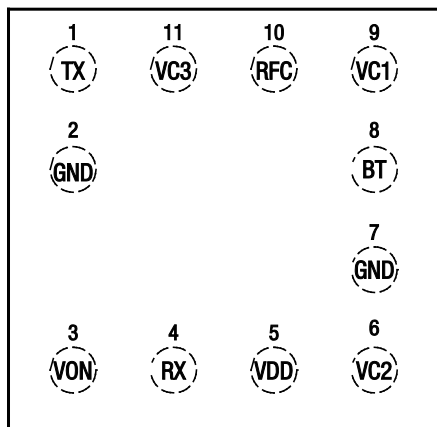
- IEEE802.11b DSSS WLAN
- IEEE802.11g/n OFDM WLAN
- Embedded systems

## Features

- Integrates an SP3T switch and LNA with bypass mode
- Gain: 12 dB
- Noise Figure: 1.8 dB
- Bluetooth® path loss: 0.5 dB
- Small WLCSP (11-bump, 1.07 x 1.05 x 0.38 mm) 250  $\mu$ m ball pitch package (MSL1, 260 °C per JEDEC-J-STD-020)

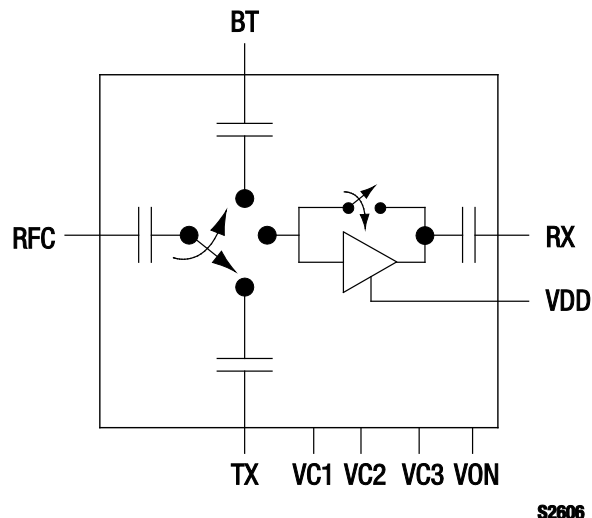


Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.



S2608

**Figure 2. SE2600S Pinout – 11-Bump CSP (Top View, Bumps Down)**



**Figure 1. SE2600S Block Diagram**

## Description

The SE2600S is an integrated Front-End Module (FEM) with a Bluetooth port to complement WLAN chipsets with an integrated Power Amplifier (PA).

The SE2600S integrates a Single-Pole, Triple-Throw (SP3T) switch and Low-Noise Amplifier (LNA) with a bypass mode in an ultra-compact package. The device is capable of switching between WLAN receive, WLAN transmit, and Bluetooth.

The SE2600S is provided in a small, 11-bump, 1.07 x 1.05 mm Wafer Level Chip Scale Package (WLCSP). A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

**Table 1. SE2600S Signal Descriptions**

Pin #	Name	Description	Pin #	Name	Description
1	TX	WLAN transmit port	7	GND	Ground
2	GND	Ground	8	BT	Bluetooth port
3	VON	LNA control signal	9	VC1	BT switch control pin
4	RX	WLAN receive port	10	RFC	RF common port (antenna)
5	VDD	Positive power supply voltage	11	VC3	Transmit switch control pin
6	VC2	Receive switch control pin			

**Table 2. SE2600S Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V <sub>DD</sub>	0	3.6	V
DC input on control pins		−0.5	V <sub>DD</sub> + 0.5	V
Transmit input power, RFC terminated in 50 Ω match	P <sub>IN</sub>		+27	dBm
Operating temperature	T <sub>A</sub>	−40	+85	°C
Storage temperature	T <sub>STG</sub>	−40	+150	°C

**Note:** 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. The SE2600S ESD threshold level is 1000 VDC using Human Body Model (HBM) testing.

**Table 3. Recommended Operating Conditions**

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	V <sub>DD</sub>	2.7	3.3	3.6	V
Control voltage (relative to GND = 0 V)	V <sub>CTL</sub>	0		V <sub>DD</sub>	V
Operating temperature	T <sub>A</sub>	−40	+25	+85	°C

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SE2600S are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Tables 4 through 7.

The state of the SE2600S is determined by the logic provided in Table 8.

**Table 4. SE2600S Electrical Specifications: DC Characteristics (Note 1)**  
**(V<sub>DD</sub> = 3.3 V, T<sub>A</sub> = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
LNA current	I <sub>DD</sub>	High gain mode		10	13	mA
		Bypass mode			60	μA
LNA control current	I <sub>CTL</sub>				20	μA
BT port control current	I <sub>C1</sub>				20	μA
TX port control current	I <sub>C3</sub>				20	μA
Control voltage:						
High	V <sub>IH</sub>		2.7		3.6	V
Low	V <sub>IL</sub>		0		0.3	V

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

**Table 5. SE2600S Electrical Specifications: AC Characteristics, Transmit (RFC to TX Port) (Note 1)**  
**(V<sub>C1</sub> = V<sub>C2</sub> = V<sub>ON</sub> = 0 V, V<sub>DD</sub> = 3.3 V, T<sub>A</sub> = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		2.4		2.5	GHz
Insertion loss	IL			0.5	0.7	dB
Input return loss	S <sub>11</sub>			-16	-14	dB
Output return loss	S <sub>22</sub>			-16	-14	dB
Switch isolation	I <sub>SO</sub>	V <sub>C3</sub> = 0 V	23			dB
1 dB Input Compression Point	IP1dB		+31			dBm
Turn-on/turn-off time	T <sub>ON</sub> , T <sub>OFF</sub>	90/10% of final output power level			400	ns

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

**Table 6. SE2600S Electrical Specifications: AC Characteristics, Bluetooth (RFC to BT Port) (Note 1)**  
**(V<sub>C2</sub> = V<sub>C3</sub> = V<sub>ON</sub> = 0 V, V<sub>DD</sub> = 3.3 V, T<sub>A</sub> = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		2.4		2.5	GHz
Insertion loss	IL			0.5	0.7	dB
Input return loss, BT port	S <sub>11</sub>			-16	-14	dB
Output return loss, BT port	S <sub>22</sub>			-16	-14	dB
Switch isolation	I <sub>SO</sub>	V <sub>C1</sub> = 0 V	25			dB
1 dB Input Compression Point	IP1dB		+31			dBm
Turn-on/turn-off time	T <sub>ON</sub> , T <sub>OFF</sub>	90/10% of final output power level			400	ns

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

**Table 7. SE2600S Electrical Specifications: Receive Characteristics (RFC to RX Port) (Note 1)**  
**(VC1 = VC3 = 0 V, VDD = 3.3 V, TA = +25 °C, All Unused Ports Terminated With 50  $\Omega$ , Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		2.4		2.5	GHz
Receive gain, LNA enabled	S21		+11	+12	+13	dB
Receive gain, LNA bypassed	S21_BYP		−4	−3		dB
Input return loss	S11			−10	−8	dB
Output return loss	S22			−10	−8	dB
Noise Figure	NF			1.8	2.0	dB
1 dB Input Compression Point	IP1dB		−6	−5		dBm
Turn-on/turn-off time	T <sub>ON</sub> , T <sub>OFF</sub>	90/10% of final output power level			400	ns

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

**Table 8. SE2600S Control Logic**

Mode	Path	VC1 (Pin 9)	VC2 (Pin 6)	VC3 (Pin 11)	VON (Pin 3)
All off	N/A	0	0	0	0
Transmit	TX to RFC	0	0	1	0
Bluetooth	RFC to BT	1	0	0	0
High gain (receive)	RFC to RX	0	1	0	1
Bypass (receive)	RFC to RX	0	1	0	0

**Note:** “0” = 0 V to +0.3 V. “1” = +2.7 V to +3.6 V. Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.

## Evaluation Board Description

The SE2600S Evaluation Board is used to test the performance of the SE2600S LNA FEM. An Evaluation Board schematic diagram is provided in Figure 3. Table 9 provides the Bill of Materials (BOM) list for Evaluation Board components. An assembly drawing for the Evaluation Board is shown in Figure 4.

## Evaluation Board Setup Procedure

- Step 1: Connect system ground to pin 1 of the J14 header.
- Step 2: Apply 3.3 V to pin 14 of the J14 header.
- Step 3: Select a path/mode according to the information in Table 8. For the J14 header pinout, refer to the Evaluation Board silkscreen and schematic in Figure 3.

**NOTE:** In case only three controls are available from the application, (transmit, receive, and Bluetooth), connect the VC2 and VON signals together. In this configuration, the LNA is always “on” in receive mode (corresponding to high gain mode in Table 8). The LNA 3<sup>rd</sup> Order Input Intercept Point (IIP3) is > +5 dBm.

## Evaluation Board Losses

The board losses from the RF connectors of the Evaluation Board to the pins of the SE2600S are:

RFC: 0.175 dB  
 TX: 0.165 dB  
 RX: 0.175 dB  
 BT: 0.21 dB

## Package Dimensions

The PCB layout footprint for the SE2600S is provided in Figure 5. Typical case markings are shown in Figure 6. Package dimensions for the 11-bump WLCSP are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

## 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 SE2600S 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, *PCB Design and SMT Assembly Guidelines for Wafer Level Chip Scale Packages*, document number 201676.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

## Underfill Requirements

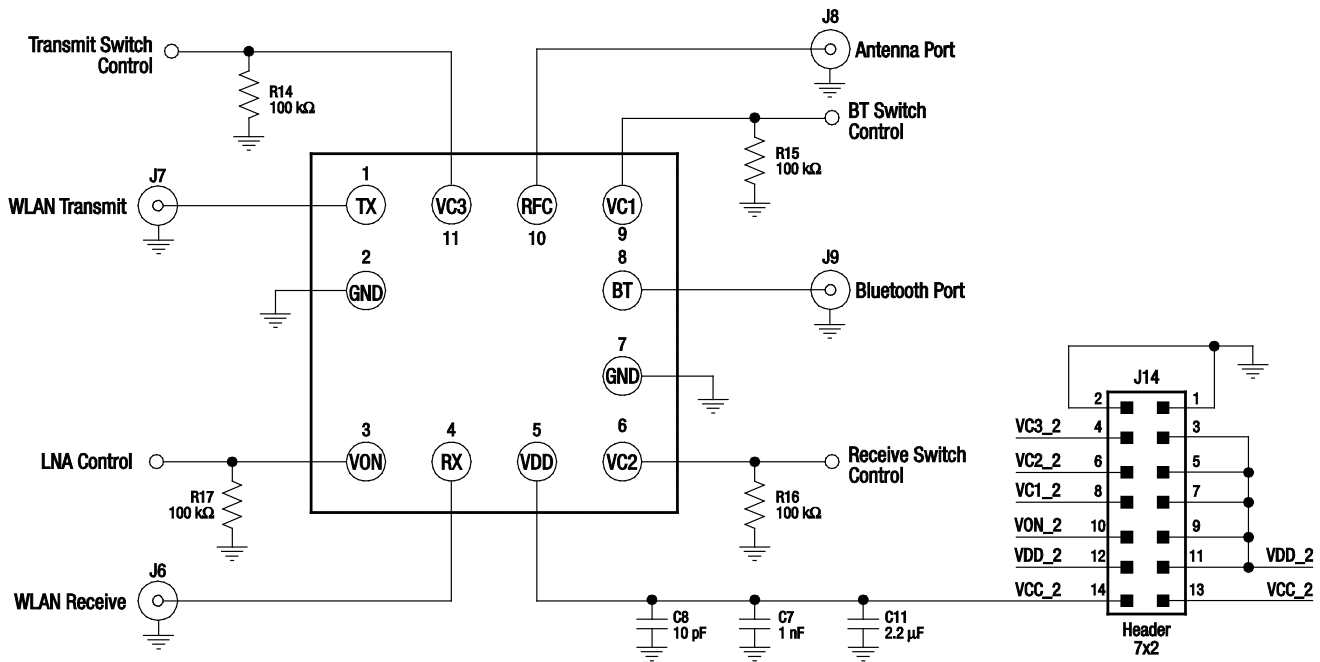
The assembly of a WLCSP onto an electrical substrate requires special handling and normally needs an underfill liquid epoxy mold compound. When fully cured, the underfill material forms a rigid,

low-stress seal that dissipates stress on solder joints and extends thermal cycling performance. Skyworks recommends the use of Loctite Hysol 4549 as an underfill material, which should be cured for 30 minutes at +165 °C.

If the WLCSP is attached without an underfill, the circuit is more susceptible to mechanical damage. Damage can even occur if components in close proximity to the WLCSP are soldered or unsoldered on the substrate without evenly preheating the entire board and die. Mechanical damage to the solder joint between the board and die could result, which may impact electrical connectivity.

## Pad Coordinates

The SE2600S pad coordinates are provided in Table 10 (also refer to the pinout diagram in Figure 2). The origin of the coordinates (i.e., X = 0, Y = 0) is located at the center of the SE2600S package. Sense is top view through package (PCB footprint).



Note: The PCB contains series 0 Ω resistors and footprints for non-populated components that are not shown on this schematic.

S2610

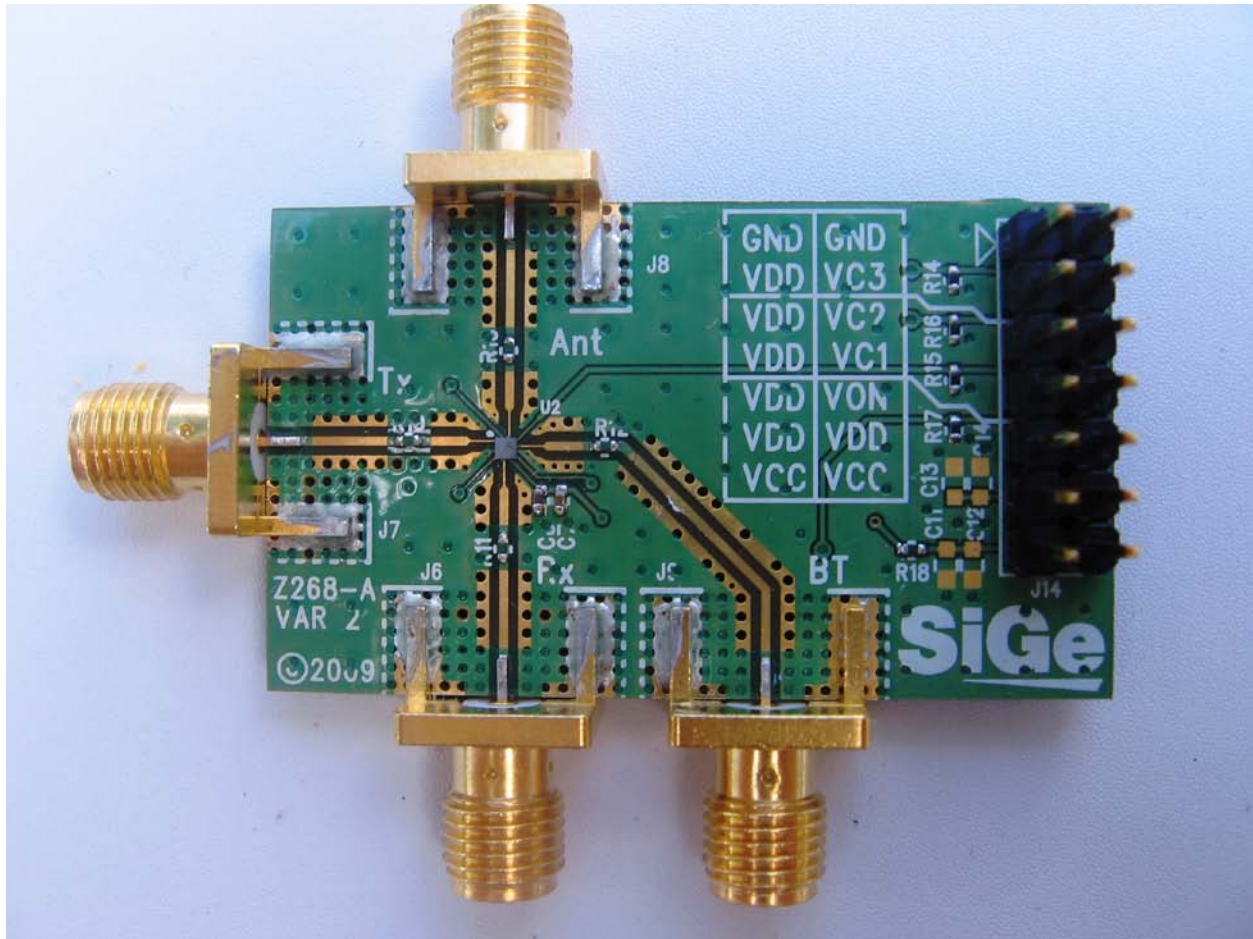
Figure 3. SE2600S Evaluation Board Schematic

**Table 9. SE2600S Evaluation Board Bill of Materials (BOM)**

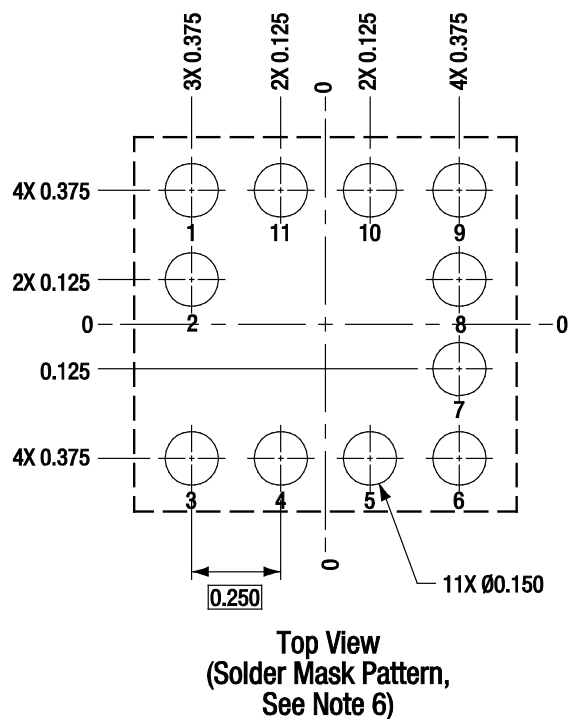
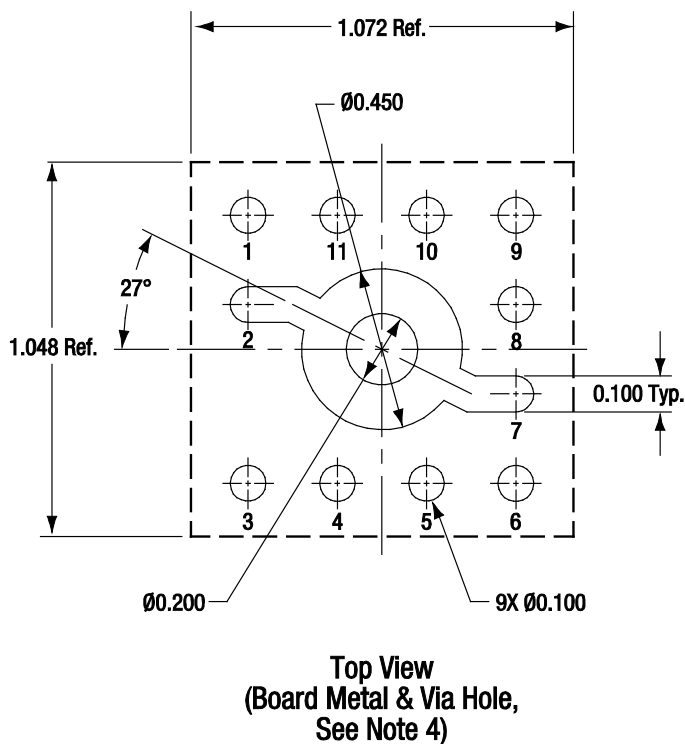
Component	Value	Size	Manufacturer	Manufacturer's Part #	Characteristics
C7	1 nF	0402	Murata	GRM155R71H102KA01	Multi-layer ceramic
C8	10 pF	0402	Murata	GRM1555C1H100JZ01	Multi-layer ceramic
C11	2.2 $\mu$ F	0603	Murata	GRM188R71A225KE15D	Monolithic ceramic
J14	–	100 mil	Samtec	TSW-107-07-G-D	7x2 100 mil pin header
R14, R15, R16, R17	100 k $\Omega$	0402	Panasonic	ERJ2GEJ104	Thick film chip resistor

**Table 10. SE2600S Bump Pad Coordinates**

Bump Number	Bump Label	Bump Coordinates	
		X ( $\mu$ m)	Y ( $\mu$ m)
1	TX	–375	+375
2	GND	–375	+125
3	VON	–375	–375
4	RX	–125	–375
5	VDD	+125	–375
6	VC2	+375	–375
7	GND	+375	–125
8	BT	+375	+125
9	VC1	+375	+375
10	RFC	+125	+375
11	VC3	–125	+375



**Figure 4. SE2600S Evaluation Board Assembly Diagram**



1. All dimensions are in millimeters
2. Dimensioning and tolerancing per ASME Y14.5M-1994.
3. Unless specified, dimensions are symmetrical about center lines.
4. Via hole recommendations: 30-35  $\mu\text{m}$  Cu via wall plating, via holes should be tented with solder mask on the backside and filled with solder.
5. Solder stencil recommendations: no stencil recommended.
6. Solder mask recommendations: contact board fabricator for recommended solder mask offset and tolerance.

S2609

Figure 5. SE2600S PCB Layout Footprint

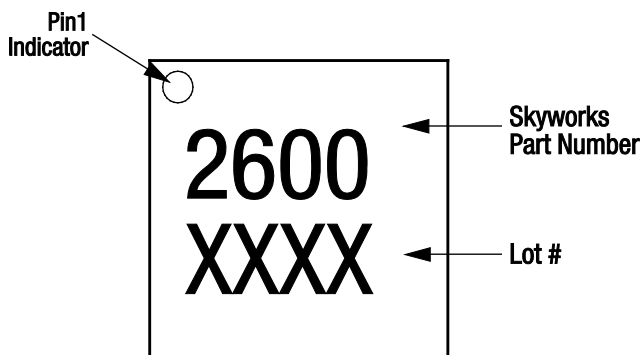
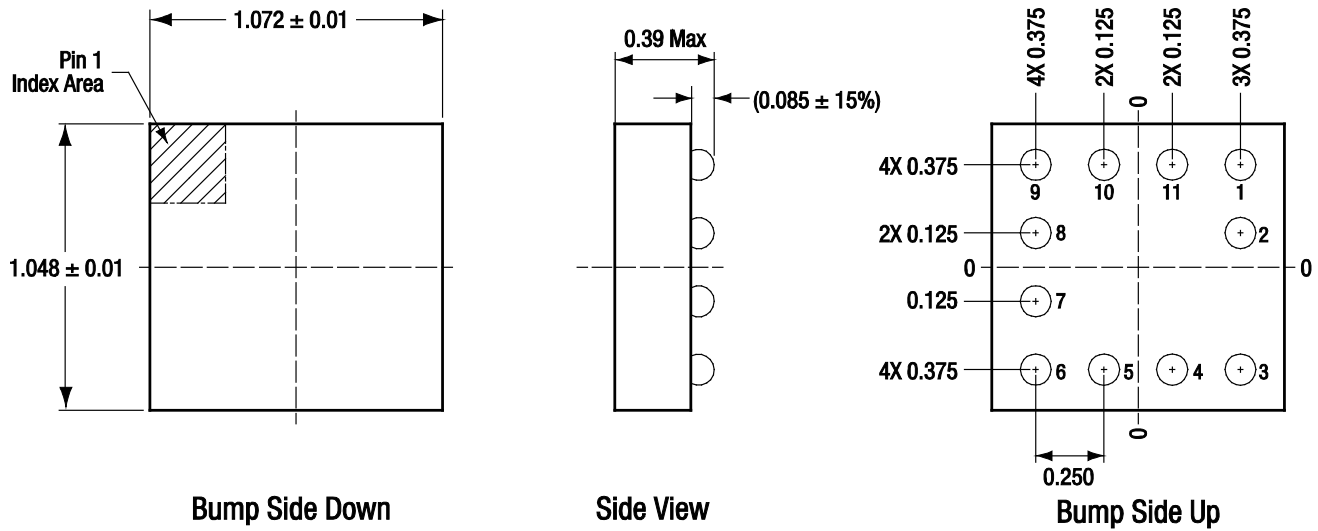


Figure 6. Typical Case Markings

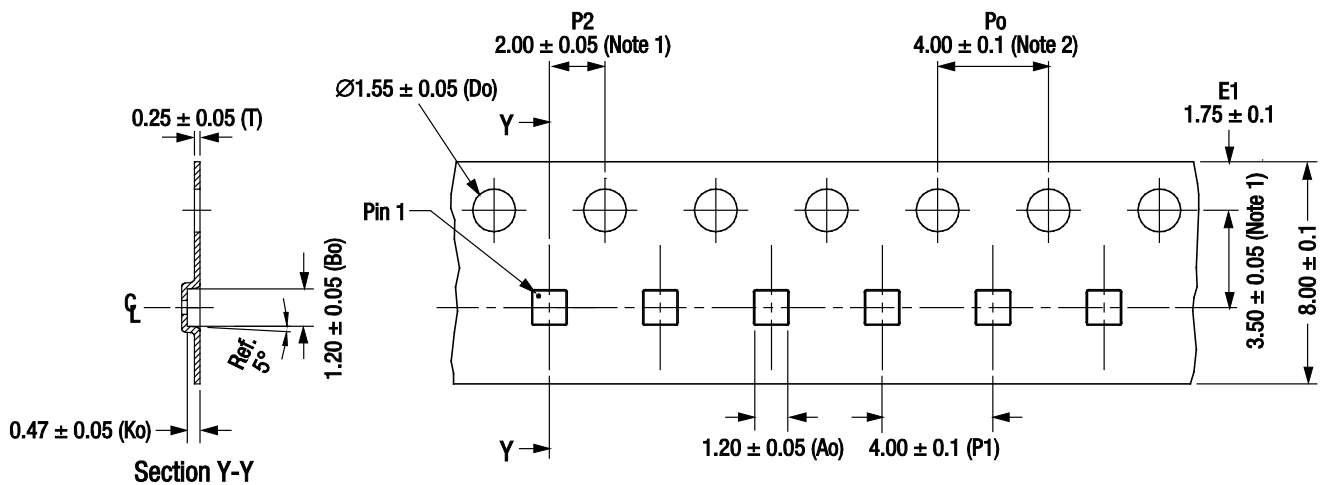




All measurements are in millimeters.  
 Bump material: lead-free solder  
 Bump pitch: 0.250 mm  
 Solder bump diameter: 0.114 mm ± 15%.  
 Wafer background thickness: 0.279 mm.

S2607

Figure 7. SE2600S 11-Bump WLCSP Package Dimensions

**Notes:**

1. Measured from center line of sprocket hole to center line of pocket.
2. Cumulative tolerance of 10 sprocket holes is ± 0.20 mm.
3. Other material available.

All measurements are in millimeters.

S2618

Figure 8. SE2600S Tape and Reel Dimensions

## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SE2600S LNA Front-End	SE2600S-R	SE2600S-EK1

Copyright © 2011 Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at [www.skyworksinc.com](http://www.skyworksinc.com), are incorporated by reference.

# AMEYA360

Components Supply Platform

Authorized Distribution Brand :



Website :

Welcome to visit [www.ameya360.com](http://www.ameya360.com)

Contact Us :

➤ Address :

401 Building No.5, JiuGe Business Center, Lane 2301, Yishan Rd  
Minhang District, Shanghai , China

➤ Sales :

Direct     +86 (21) 6401-6692  
  
Email       amall@ameya360.com  
  
QQ         800077892  
  
Skype       ameyasales1 ameyasales2

➤ Customer Service :

Email       service@ameya360.com

➤ Partnership :

Tel         +86 (21) 64016692-8333  
  
Email       mkt@ameya360.com