2.4 GHz High-Efficiency Amplifier
SST12LP14E

SST12LP14E is a high-efficiency, ultra-compact power amplifier (PA) based on the highly-reliable InGaP/GaAs HBT technology. Designed to operate over the 2.4 - 2.5 GHz frequency band, SST12LP14E typically provides 23.5 dB gain with 32% power-added efficiency. This power amplifier has excellent linearity while meeting 802.11g spectrum mask requirements up to 22 dBm. The device typically consumes only 95 mA total current at 18 dBm output power, with linear 54 Mbps 802.11g modulation. This efficiency is desirable in embedded applications such as in hand-held units. The SST12LP14E also features easy, board-level usage along with high-speed power-up/-down control through a single combined reference voltage pin and is offered in both 6- and 8-contact XSON packages.

Features

• Excellent RF Stability with Moderate Gain:
  – Typically 23.5 dB gain across 2.4 – 2.5 GHz

• High Linear Output Power:
  – >24 dBm P1dB
  – Please refer to “Absolute Maximum Stress Ratings” on page 6
  – Meets 802.11g OFDM ACPR requirement up to 22 dBm
  – ~2.5% added EVM up to 18 dBm for
    54 Mbps 802.11g signal
  – Meets 802.11b ACPR requirement up to 22 dBm

• High Power-added Efficiency/Low Operating Current for 802.11b/g/n Applications
  – ~33%/145 mA @ POUT = 22 dBm for 802.11g

• Single-pin Low IREF Power-up/-down Control
  – IREF <2 mA

• Low Idle Current
  – ~45 mA IcQ

• High-speed Power-up/-down
  – Turn on/off time (10%- 90%) <100 ns
  – Typical power-up/down delay <200 ns

• High Temperature Stability
  – 2 dB gain variation between -40°C to +85°C
  – 1 dB power variation between 0°C to +85°C

• Low Shut-down Current: <2.5 µA (typical)

• Excellent On-chip Power Detection
  – <+/- 0.3dB variation between 0°C to +85°C
  – <+/- 0.4dB variation with 2:1 VSWR mismatch
  – <+/- 0.3dB variation Ch1 through Ch14

• Greater than 15 dB Dynamic Range On-chip Power Detection

• Simple input/output matching

• Packages Available
  – 6-contact XSON – 1.5mm x 1.5mm
  – 8-contact XSON – 2mm x 2mm

• All Non-Pb (lead-free) Devices are RoHS Compliant

Applications

• WLAN (IEEE 802.11b/g/n)
• Home RF
• Cordless phones
• 2.4 GHz ISM wireless equipment
Product Description

SST12LP14E is a high-efficiency, ultra-compact power amplifier (PA) based on the highly-reliable InGaP/GaAs HBT technology.

Designed to operate over the 2.4 – 2.5 GHz frequency band, SST12LP14E typically provides 23.5 dB gain with 33% power-added efficiency (PAE) @ $P_{\text{OUT}} = 22$ dBm for 802.11g.

This power amplifier has excellent linearity, typically ~2.5% added EVM at 18 dBm output power, which is essential for 54 Mbps 802.11g operation while meeting 802.11g spectrum mask requirements up to 22 dBm. Due to its high efficiency, the device typically consumes only 95 mA total current at 18 dBm output power, with linear 54 Mbps 802.11g modulation. This efficiency is desirable in embedded applications such as in hand-held units.

The SST12LP14E also features easy, board-level usage along with high-speed power-up/-down control through a single combined reference voltage pin. Ultra-low reference current (total $I_{\text{REF}}$ ~2 mA) makes the SST12LP14E controllable by an on/off switching signal directly from the baseband chip. These features, coupled with low operating current, make the SST12LP14E ideal for the final stage power amplification in battery-powered 802.11b/g/n WLAN transmitter applications.

The SST12LP14E has an excellent on-chip, single-ended power detector, which features a >15 dB range good linearity and high stability over temperature (< +/-0.3 dB 0°C to +85°C), frequency (< +/-0.3 dB across Channels 1 through 14), and output load (< +/-0.4 dB with 2:1 output VSWR all phases). The excellent on-chip power detector provides a reliable solution to board-level power control.

The SST12LP14E is offered in both 6- and 8-contact XSON packages. See Figure 3 for pin assignments and Tables 1 and 2 for pin descriptions.
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Functional Blocks

**Figure 1:** Functional Block Diagram, 6-contact XSON (QX6)

![Functional Block Diagram, 6-contact XSON (QX6)](image)

**Figure 2:** Functional Block Diagram, 8-contact XSON (QX8)

![Functional Block Diagram, 8-contact XSON (QX8)](image)
Pin Assignments

Figure 3: Pin Assignments

6-Contact XSON

8-Contact XSON
Pin Descriptions

Table 1: Pin Description, 6-contact XSON (QX6)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>0</td>
<td>Ground</td>
<td></td>
<td>Low inductance GND pad</td>
</tr>
<tr>
<td>VCC1</td>
<td>1</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Power supply, 1st stage</td>
</tr>
<tr>
<td>RFIN</td>
<td>2</td>
<td>I RF input, DC decoupled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCCb</td>
<td>3</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Supply voltage for bias circuit</td>
</tr>
<tr>
<td>VREF</td>
<td>4</td>
<td>PWR 1st and 2nd stage idle current control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Det</td>
<td>5</td>
<td>O On-chip power detector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCC2/RFOUT</td>
<td>6</td>
<td>Power Supply</td>
<td>PWR/O</td>
<td>Power supply, 2nd stage/RF Output</td>
</tr>
</tbody>
</table>

T1.0 75037

1. I=Input, O=Output

Table 2: Pin Description, 8-contact XSON (QX8)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND</td>
<td>0</td>
<td>Ground</td>
<td></td>
<td>Low inductance GND pad</td>
</tr>
<tr>
<td>VCC1</td>
<td>1</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Power supply, 1st stage</td>
</tr>
<tr>
<td>RFIN</td>
<td>2</td>
<td>I RF input, DC decoupled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCCb</td>
<td>3</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Supply voltage for bias circuit</td>
</tr>
<tr>
<td>VREF</td>
<td>4</td>
<td>PWR 1st and 2nd stage idle current control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Det</td>
<td>5</td>
<td>O On-chip power detector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFOUT</td>
<td>6</td>
<td>O RF output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFOUT</td>
<td>7</td>
<td>O RF output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCC2</td>
<td>8</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Power supply, 2nd stage</td>
</tr>
</tbody>
</table>

T2.0 75037

1. I=Input, O=Output
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Electrical Specifications

The AC and DC specifications for the power amplifier are specified for the conditions shown. Refer to Table 4 for the DC voltage and current specifications. Refer to Figures 4 through 19 for the RF performance.

**Absolute Maximum Stress Ratings** (Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.)

- Input power to pins 2 (PIN) ................................................... +5 dBm
- Average output power (POUT)1 ............................................. +26 dBm
- Supply Voltage at pins 1, 3, and 6 (VCC) for 6-contact XSON ............... -0.3V to +5.0V
- Supply Voltage at pins 1, 3, and 8 (VCC) for 8-contact XSON ............... -0.3V to +5.0V
- Reference voltage to pin 4 (VREF) ....................................... -0.3V to +3.3V
- DC supply current (ICC) .................................................. 400 mA
- Operating Temperature (TA) ........................................... -40ºC to +85ºC
- Storage Temperature (TSTG) .......................................... -40ºC to +120ºC
- Maximum Junction Temperature (TJ) ..................................... +150ºC
- Surface Mount Solder Reflow Temperature ................................... 260ºC for 10 seconds

1. Never measure with CW source. Pulsed single-tone source with <50% duty cycle is recommended. Exceeding the maximum rating of average output power could cause permanent damage to the device.

**Table 3: Operating Range**

<table>
<thead>
<tr>
<th>Range</th>
<th>Ambient Temp</th>
<th>VDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>-40ºC to +85ºC</td>
<td>3.3V</td>
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**Table 4: DC Electrical Characteristics @ 25ºC**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>VCC</td>
<td>Supply Voltage at pins 1, 3, and 6 for 6-contact XSON (QX6)</td>
<td>3.0</td>
<td>3.3</td>
<td>4.2</td>
<td>V</td>
</tr>
<tr>
<td>VCC</td>
<td>Supply Voltage at pins 1, 3, and 8 for 8-contact XSON (QX8)</td>
<td>3.0</td>
<td>3.3</td>
<td>4.2</td>
<td>V</td>
</tr>
<tr>
<td>ICC</td>
<td>Supply Current for 802.11g, 22 dBm</td>
<td>145</td>
<td></td>
<td>4.2</td>
<td>mA</td>
</tr>
<tr>
<td>ICQ</td>
<td>Idle current for 802.11g to meet added EVM &lt; 2.5% @ dBm</td>
<td>45</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>IOFF</td>
<td>Shut down current</td>
<td>2.0</td>
<td></td>
<td>2.95</td>
<td>µA</td>
</tr>
<tr>
<td>VREG</td>
<td>Reference Voltage for, with 360Ω resistor</td>
<td>2.75</td>
<td>2.8</td>
<td>2.95</td>
<td>V</td>
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T3.1 75037

T4.3 75037
Table 5: AC Electrical Characteristics for Configuration (@25°C)

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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<tr>
<td>FL-U</td>
<td>Frequency range</td>
<td>2400</td>
<td>2500</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Small signal gain</td>
<td>22.5</td>
<td>23.5</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>G\text{VAR1}</td>
<td>Gain variation over band (2400~2485 MHz)</td>
<td></td>
<td>±0.5</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>G\text{VAR2}</td>
<td>Gain ripple over channel (20 MHz)</td>
<td>0.2</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>ACPR</td>
<td>Meet 11b spectrum mask</td>
<td></td>
<td>22</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meet 11g OFDM 54 Mbps spectrum mask</td>
<td>21</td>
<td>22</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Added EVM</td>
<td>&lt; 18 dBm output with 11g OFDM 54 Mbps signal</td>
<td></td>
<td>2.5</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>2f, 3f, 4f, 5f</td>
<td>Harmonics at 22 dBm, without external filters</td>
<td></td>
<td>-30</td>
<td>dBc</td>
<td></td>
</tr>
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</table>
Typical Performance Characteristics
Test Conditions: $V_{CC} = 3.3V$, $T_A = 25^\circ C$, unless otherwise specified

Figure 4: S-Parameters
Typical Performance Characteristics

Test Conditions: \( V_{CC} = 3.3V, T_A = 25^\circ C, 54 \text{ Mbps} \) 802.11g OFDM signal

Figure 5: EVM versus Output Power measured using equalizer training with sequence only

Figure 6: Power Gain versus Output Power
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Figure 7: Total Current Consumption for 802.11g operation versus Output Power

Figure 8: PAE versus Output Power
2.4 GHz High-Efficiency Power Amplifier
SST12LP14E

Figure 9: 802.11g Spectrum Mask at 22 dBm

Figure 10: CH1 Detector Characteristics Over Temperature with 2:1 Output VSWR All Phases
Figure 11: CH7 Detector Characteristics Over Temperature with 2:1 Output VSWR All Phases

Figure 12: CH14 Detector Characteristics Over Temperature with 2:1 Output VSWR All Phases
Figure 13: Detector Characteristics Over Temperature and Over Frequency with 2:1 Output VSWR All Phases
Typical Performance Characteristics

Test Conditions: \( V_{CC} = 3.3\text{V}, T_A = 25^\circ\text{C}, 1\text{ Mbps} \) 802.11b CCK signal

**Figure 14:** 802.11b Spectrum Mask at 22 dBm

**Figure 15:** Total Current Consumption for 802.11b Operation versus Output Power
2.4 GHz High-Efficiency Power Amplifier
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**Figure 16:** CH1 Detector Characteristics Over Temperature

**Figure 17:** CH7 Detector Characteristics Over Temperature
Typical Performance Characteristics
Test Conditions: $V_{CC} = 3.3V$, $T_A=25^\circ C$, 1 Mbps 802.11b CCK signal

**Figure 18:** CH14 Detector Characteristics Over Temperature

**Figure 19:** Detector Characteristics Over Temperature and Frequency
2.4 GHz High-Efficiency Power Amplifier
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Figure 20: Typical Schematic for 6-contact XSON (QX6)

Figure 21: Typical Schematic for 8-contact XSON (QX8)

*Standard evaluation board has a series SMT capacitor. However, 12LP14E has a DC block on chip. The input capacitor is optional.
## Product Ordering Information

**SST 12 LP 14E - QX8E**

### Environmental Attribute
- E¹ = non-Pb contact (lead) finish

### Package Modifier
- 6 = 6 contact
- 8 = 8 contact

### Package Type
- QX = XSON

### Version

### Product Identifier

### Product Type
- P = Power Amplifier

### Voltage
- L = 3.0-3.6V

### Frequency of Operation
- 2 = 2.4 GHz

### Product Line
- 1 = RF Product

### Valid combinations for SST12LP14E
- SST12LP14E-QX6E
- SST12LP14E-QX8E

### SST12LP14E Evaluation Kits
- SST12LP14E-QX6E-K
- SST12LP14E-QX8E-K

**Note:** Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.

1. Environmental suffix “E” denotes non-Pb solder. SST non-Pb solder devices are “RoHS Compliant”
Packaging Diagrams

Figure 22: 6-contact Extra-thin Quad Flat No-lead (XSON)
SST Package Code: QX6

Note: 1. Similar to JEDEC JEP95 XQFN/XSON variants, though number of contacts and some dimensions are different.
2. From the bottom view, the pin #1 indicator may be either a curved indent or a 45-degree chamfer.
3. The external paddle is electrically connected to the die back-side and to VSS. This paddle must be soldered to the PC board; it is required to connect this paddle to the VSS of the unit. Connection of this paddle to any other voltage potential will result in shorts and electrical malfunction of the device.
4. Untoleranced dimensions are nominal target dimensions.
5. All linear dimensions are in millimeters (max/min).
Figure 23: 8-contact Extra-thin Quad Flat No-lead (XSON) SST Package Code: QX8

Note:  
1. Similar to JEDEC JEP95 XQFN/XSON variants, though number of contacts and some dimensions are different. 
2. The topside pin #1 indicator is laser engraved; its approximate shape and location is as shown. 
3. From the bottom view, the pin #1 indicator may be either a curved indent or a 45-degree chamfer. 
4. The external paddle is electrically connected to the die back-side and to VSS. This paddle must be soldered to the PCB board; it is required to connect this paddle to the VSS of the unit. Connection of this paddle to any other voltage potential will result in shorts and electrical malfunction of the device. 
5. Untoleranced dimensions are nominal target dimensions. 
6. All linear dimensions are in millimeters (max/min).
Table 6: Revision History

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<th>Revision</th>
<th>Description</th>
<th>Date</th>
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<tr>
<td>00</td>
<td>Initial release of data sheet</td>
<td>Oct 2007</td>
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<tr>
<td>01</td>
<td>Changed environmental attribute from “F” to “E” and updated “Product</td>
<td>Mar 2008</td>
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<td>Ordering Information” on page 18 to reflect that change.</td>
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<tr>
<td>02</td>
<td>Updated “Features” on page 1</td>
<td>May 2008</td>
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<td>Revised Table 4 on page 6</td>
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<td>Added “@25°C” to Table 5 title</td>
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<tr>
<td>03</td>
<td>Revised Table 4 on page 6 and Table 5 on page 7</td>
<td>Mar 2009</td>
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<tr>
<td>04</td>
<td>Added package QX6 including updates to “Product Description”, “Functional</td>
<td>May 2009</td>
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<td>Blocks”, “Pin Assignments”, and “Electrical Specifications”</td>
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<tr>
<td>A</td>
<td>Applied new document format</td>
<td>Nov 2011</td>
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<td>Released document under letter revision system</td>
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<td>Updated spec number from S71369 to DS75037</td>
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<tr>
<td>B</td>
<td>Updated Figure 23 on page 20 to reflect new Pin1 indicator</td>
<td>Jun 2012</td>
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<td>Made a slight modification to the “High Temperature Stability” feature</td>
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