2.4 GHz High-Efficiency, High-Gain Power Amplifier Module

SST12LP17E is a 2.4 GHz high-efficiency, fully-matched power amplifier module based on the highly-reliable InGaP/GaAs HBT technology. It is designed in compliance with IEEE 802.11b/g/n applications and typically provides 28 dB gain with 28% power-added efficiency at 21dBm. SST12LP17E has excellent linearity, providing 3% EVM at typically 18 dBm, while meeting 802.11g spectrum mask at 21.5 dBm. This power amplifier requires no external RF matching, and only requires one external DC-bias capacitor to meet the specified performance. It offers high-speed power-up/-down control through a single reference voltage pin and includes a temperature-stable, VSWR insensitive power detector voltage output. SST12LP17E is offered in a super-thin (0.4mm maximum) 8-contact X2SON package and a 8-contact USON package.

Features

- Input/Output ports internally matched to 50Ω and DC decoupled
- High gain:
  - Typically 28 dB gain across 2.4–2.5 GHz
- High linear output power:
  - >24 dBm P1dB
  - Single-tone measurement. Please refer to “Absolute Maximum Stress Ratings” on page 5
  - Meets 802.11g OFDM ACPR requirement up to 21.5 dBm
  - ~3% 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 both 802.11b/g/n applications
  - ~28%/138 mA @ POUT = 21.5 dBm for 802.11g
  - ~33%/155 mA @ POUT = 22.5 dBm for 802.11b
- Single-pin low IREF power-up/down control
  - IREF <2 mA
- Low idle current
  - ~60 mA ICQ
- High-speed power-up/down
  - Turn on/off time (10%- 90%) <100 ns
  - Typical power-up/down delay with driver delay included <200 ns
- Low shut-down current (~2 µA)
- Stable performance over temperature
  - ~2 dB gain variation between -40°C to +85°C
  - ~1 dB power variation between -40°C to +85°C
- Excellent on-chip power detection
  - >15 dB dynamic range, dB-wise linear
  - VSWR insensitive, temperature stable
- Packages available
  - 8-contact X2SON – 2mm x 2mm x 0.4mm
  - 8-contact USON – 2mm x 2mm x 0.6mm
- Non-Pb (lead-free), RoHS compliant, and Halogen free

Applications

- WLAN (IEEE 802.11b/g/n)
- Home RF
- Cordless phones
- 2.4 GHz ISM wireless equipment
2.4 GHz High-Efficiency, High-Gain Power Amplifier Module
SST12LP17E

Product Description

The SST12LP17E is a versatile power amplifier based on the highly-reliable InGaP/GaAs HBT technology. The input/output RF ports are fully matched to 50 Ohm internally. These RF ports are DC decoupled and require no DC-blocking capacitors or matching components. This helps reduce the system board’s Bill of Materials (BOM) cost.

The SST12LP17E is a 2.4 GHz fully-integrated, high-efficiency Power Amplifier module designed in compliance with IEEE 802.11b/g/n applications. It typically provides 28 dB gain with 28% power-added efficiency (PAE) @ POUT = 21.5 dBm for 802.11g and 33% PAE @ POUT = 22 dBm for 802.11b.

The SST12LP17E has excellent linearity, typically ~3% added EVM at 18 dBm output power which is essential for 54 Mbps 802.11g/n operation while meeting 802.11g spectrum mask at 21.5 dBm and 802.11b spectrum mask at 22.5 dBm.

The SST12LP17E 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 IREF ~2 mA) makes the SST12LP17E controllable by an on/off switching signal directly from the baseband chip. These features, coupled with low operating current, make the SST12LP17E ideal for the final stage power amplification in battery-powered 802.11b/g/n WLAN transmitter applications.

The SST12LP17E has an excellent on-chip, single-ended power detector, which features wide dynamic-range, >15 dB, with dB-wise linear performance. The excellent on-chip power detector provides a reliable solution to board-level power control.

The SST12LP17E is offered in both 8-contact X2SON and 8-contact USON packages. See Figure 2 for pin assignments and Table 1 for pin descriptions.
Functional Blocks

Figure 1: Functional Block Diagram
Pin Assignments

![Pin Assignments for 8-contact X2SON and 8-contact USON](image)

**Figure 2:** Pin Assignments for 8-contact X2SON and 8-contact USON

Pin Descriptions

**Table 1: Pin Description**

<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 ground pad</td>
</tr>
<tr>
<td>VCC2</td>
<td>1</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Power supply, 2nd stage</td>
</tr>
<tr>
<td>VCC1</td>
<td>2</td>
<td>Power Supply</td>
<td>PWR</td>
<td>Power supply, 1st stage</td>
</tr>
<tr>
<td>RFIN</td>
<td>3</td>
<td></td>
<td>I</td>
<td>RF input, DC decoupled</td>
</tr>
<tr>
<td>VREF</td>
<td>4</td>
<td></td>
<td>PWR</td>
<td>1st and 2nd stage idle current control</td>
</tr>
<tr>
<td>DET</td>
<td>5</td>
<td></td>
<td>O</td>
<td>On-chip power detector</td>
</tr>
<tr>
<td>RFOUT</td>
<td>6</td>
<td></td>
<td>O</td>
<td>RF output, DC decoupled</td>
</tr>
<tr>
<td>DNU</td>
<td>7</td>
<td>Do Not Use</td>
<td></td>
<td>Do not use or connect</td>
</tr>
<tr>
<td>DNU</td>
<td>8</td>
<td>Do Not Use</td>
<td></td>
<td>Do not use or connect</td>
</tr>
</tbody>
</table>

1. I=Input, O=Output
Electrical Specifications

The DC and RF specifications for the power amplifier are specified below. Refer to Table 3 for the DC voltage and current specifications. Refer to Figures 3 through 8 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 beyond absolute maximum stress rating conditions may affect device reliability.)

Input power to pin 3 (P\text{IN}) .......................................................................................... +5 dBm
Average output power from Pin 6 (P\text{OUT}) \(^1\) .................................................. +25.5 dBm
Supply Voltage at pins 1 and 2 (V\text{CC}) \(^2\) ............................................................... -0.3V to +6.0V
Reference voltage to pin 4 (V\text{REF}) ................................................................. -0.3V to +3.3V
DC supply current (I\text{CC}) \(^3\) ........................................................................... 300 mA
Operating Temperature (T\text{A}) ............................................................................... -40ºC to +85ºC
Storage Temperature (T\text{STG}) ............................................................................. -40ºC to +120ºC
Maximum Junction Temperature (T\text{J}) ..................................................................... +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.
2. V\text{CC} maximum rating of 6.0V for RF output power levels up to 10 dBm.
3. Measured with 100% duty cycle 54 Mbps 802.11g OFDM Signal

**Table 2: Operating Range**

<table>
<thead>
<tr>
<th>Range</th>
<th>Ambient Temp</th>
<th>V\text{CC}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>-40ºC to +85ºC</td>
<td>3.0V to 4.6V</td>
</tr>
</tbody>
</table>

**Table 3: DC Electrical Characteristics at 25ºC**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V\text{CC}</td>
<td>Supply Voltage at pins 1 and 2</td>
<td>3.0</td>
<td>3.3</td>
<td>4.6</td>
<td>V</td>
</tr>
<tr>
<td>I\text{CQ}</td>
<td>Idle current to meet EVM ~3% @ 18 dBm Output Power, 802.11g OFDM 54 Mbps signal</td>
<td>60</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V\text{REG}</td>
<td>Reference Voltage for pin 4</td>
<td>2.9</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I\text{CC}</td>
<td>Current consumption to meet 802.11g OFDM 54 Mbps spectrum mask @ 21.5 dBm</td>
<td>138</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Current consumption to meet 802.11b DSSS 54 Mbps spectrum mask @ 22 dBm</td>
<td>155</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Current consumption to meet EVM ~3% @ 18 dBm Output Power with 802.11g OFDM 54 Mbps signal</td>
<td>105</td>
<td>mA</td>
<td></td>
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</table>
### Table 4: RF Characteristics at 25°C

<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>FL-U</td>
<td>Frequency range</td>
<td>2412</td>
<td>2484</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>G</td>
<td>Small signal gain</td>
<td>27</td>
<td>28</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>GVAR1</td>
<td>Gain variation over band (2412–2484 MHz)</td>
<td></td>
<td>±0.5</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>GVAR2</td>
<td>Gain ripple over channel (20 MHz)</td>
<td>0.2</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>2f, 3f, 4f, 5f</td>
<td>Harmonics at 23 dBM, without external filters</td>
<td></td>
<td>-40</td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td>EVM</td>
<td>Added EVM @ 18 dBM output with 802.11g OFDM 54 Mbps signal</td>
<td>3</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>POUT</td>
<td>Output Power to meet 802.11g OFDM 54 Mbps spectrum mask</td>
<td>20.5</td>
<td>21.5</td>
<td></td>
<td>dBM</td>
</tr>
<tr>
<td></td>
<td>Output Power to meet 802.11b DSSS 1 Mbps spectrum mask</td>
<td>21</td>
<td>22</td>
<td></td>
<td>dBM</td>
</tr>
</tbody>
</table>
Typical Performance Characteristics

Test Conditions: \( V_{CC} = 3.3V, \ T_A = 25^\circ C \), unless otherwise specified

Figure 3: S-Parameters
Typical Performance Characteristics

Test Conditions: \( V_{CC} = 3.3V, \ T_A = 25^\circ\text{C}, \ 54 \text{ Mbps} \ 802.11g \text{ OFDM Signal} \)
Equalizer Training Setting using Channel Estimation Sequence only

**Figure 4:** EVM versus Output Power

**Figure 5:** Power Gain versus Output Power
2.4 GHz High-Efficiency, High-Gain Power Amplifier Module
SST12LP17E

Data Sheet

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

Figure 7: PAE versus Output Power
Figure 8: Detector Characteristics versus Output Power

Figure 9: Typical Schematic for High-Efficiency 802.11b/g/n Applications

* Place VCC capacitor close to Pin #1 and allow 1mm trace to Pin #2.
2.4 GHz High-Efficiency, High-Gain Power Amplifier Module
SST12LP17E

Product Ordering Information

<table>
<thead>
<tr>
<th>SST</th>
<th>12</th>
<th>LP</th>
<th>17E</th>
<th>XX8E</th>
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<tr>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
<td>XXX</td>
<td>XXXX</td>
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</tbody>
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Environmental Attribute
E$^1$ = non-Pb contact (lead) finish

Package Modifier
8 = 8 contact

Package Type
XX = X2SON
QU = USON

Product Family Identifier

Product Type
P = Power Amplifier

Voltage
L = 3.0-3.6V

Frequency of Operation
2 = 2.4 GHz

Product Line
1 = RF Products

Valid combinations for SST12LP17E

SST12LP17E-XX8E SST12LP17E-QU8E

SST12LP17E Evaluation Kits

SST12LP17E-XX8E-K SST12LP17E-QU8E-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”.

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DC-75004E 07/12

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Packaging Diagrams

Figure 10: 8-Contact Super-thin Small Outline No-lead (X2SON)
SST Package Code: XX8
2.4 GHz High-Efficiency, High-Gain Power Amplifier Module
SST12LP17E

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Figure 11: 8-Contact Ultra-thin Small Outline No-lead (USON)
SST Package Code: QU8

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 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.
5. Untoleranceed dimensions are nominal target dimensions.
6. All linear dimensions are in millimeters (max/min).
## Table 5: Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description</th>
<th>Date</th>
</tr>
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<tr>
<td>00</td>
<td>Initial release of data sheet</td>
<td>Apr 2010</td>
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<tr>
<td>A</td>
<td>Modified “Features”, “Product Description” on page 2, Table 1 on page 4, Table 3 on page 5, Table 4 on page 6, Figure 1 on page 3, and Figure 9 on page 10.</td>
<td>Apr 2011</td>
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<tr>
<td></td>
<td>Replaced Figures 3-8.</td>
<td></td>
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<td>B</td>
<td>Updated document type to “Data Sheet”</td>
<td>Oct 2011</td>
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<tr>
<td></td>
<td>Changed supply voltage in “Electrical Specifications” on page 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Revised VCC values in Table 3 on page 5</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Updated package to 8-contact X2SON (XX8)</td>
<td>Feb 2012</td>
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<tr>
<td></td>
<td>Revised performance information to reflect new package type including Tables 2, 3, and 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Revised Supply Voltage on page 5.</td>
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</tr>
<tr>
<td>D</td>
<td>Added QU8 package information</td>
<td>Mar 2012</td>
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<td></td>
<td>Updated maximum supply voltage from 5.5V to 6.0V in “Absolute Maximum Stress Ratings” on page 5</td>
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<tr>
<td></td>
<td>Updated Supply Voltage from 4.2 to 4.6 in Table 3 on page 5</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Updated Figures 10 and 11 to reflect new Pin 1 indicator</td>
<td>Jul 2012</td>
</tr>
</tbody>
</table>
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Microchip:
SST12LP17E-QU8E