

# 2.4 GHz High-Power, High-Gain Power Amplifier

## SST12LP15



Data Sheet

### FEATURES:

- **High Gain:**
  - Typically 35 dB gain across 2.4~2.5 GHz over temperature 0°C to +80°C
- **High linear output power:**
  - >29 dBm P1dB (Exceeding maximum rating of average output power, never measure with CW source! Pulsed single-tone source with <50% duty cycle is recommended.)
  - Meets 802.11g OFDM ACPR requirement up to 25 dBm
  - Added EVM~4% up to 23.5 dBm for 54 Mbps 802.11g signal
  - Meets 802.11b ACPR requirement up to 25 dBm
- **High power-added efficiency/Low operating current for both 802.11g/b applications**
  - ~26%/290 mA @  $P_{OUT} = 24$  dBm for 802.11g
  - ~29%/340 mA @  $P_{OUT} = 25$  dBm for 802.11b
- **Built-in Ultra-low  $I_{REF}$  power-up/down control**
  - $I_{REF} < 2$  mA
- **Low idle current**
  - ~50 mA  $I_{CQ}$
- **High-speed power-up/down**
  - Turn on/off time (10%~90%) <100 ns
  - Typical power-up/down delay with driver delay included <200 ns
- **High temperature stability**
  - ~1 dB gain/power variation between 0°C to +80°C
  - ~1 dB detector variation over 0°C to +80°C
- **Low shut-down current (< 0.1  $\mu$ A)**
- **On-chip power detection**
- **25 dB dynamic range on-chip power detection**
- **Simple input/output matching**
- **Packages available**
  - 16-contact VQFN (3mm x 3mm)
  - Non-Pb (lead-free) packages available

### APPLICATIONS:

- WLAN (IEEE 802.11g/b)
- Home RF
- Cordless phones
- 2.4 GHz ISM wireless equipment

### PRODUCT DESCRIPTION

The SST12LP15 is a high-power, high-gain power amplifier based on the highly-reliable InGaP/GaAs HBT technology.

The SST12LP15 can be easily configured for high-power, high-efficiency applications with superb power-added efficiency while operating over the 2.4~2.5 GHz frequency band. It typically provides 35 dB gain with 26% power-added efficiency @  $P_{OUT} = 24$  dBm for 802.11g and 29% power-added efficiency @  $P_{OUT} = 25$  dBm for 802.11b.

The SST12LP15 has excellent linearity, typically ~4% added EVM at 23.5 dBm output power which is essential for 54 Mbps 802.11g operation while meeting 802.11g spectrum mask at 24+ dBm. SST12LP15 also has wide-range (>25 dB), temperature-stable (~1 dB over 80°C), single-ended/differential power detectors which lower users' cost on power control.

The power amplifier IC also features easy board-level usage along with high-speed power-up/down control. Ultra-low reference current (total  $I_{REF} < 2$  mA) makes the SST12LP15 controllable by an on/off switching signal directly from the baseband chip. These features coupled with low operating current make the SST12LP15 ideal for the final stage power amplification in battery-powered 802.11g/b WLAN transmitter applications.

The SST12LP15 is offered in 16-contact VQFN package. See Figure 2 for pin assignments and Table 1 for pin descriptions.



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## FUNCTIONAL BLOCKS

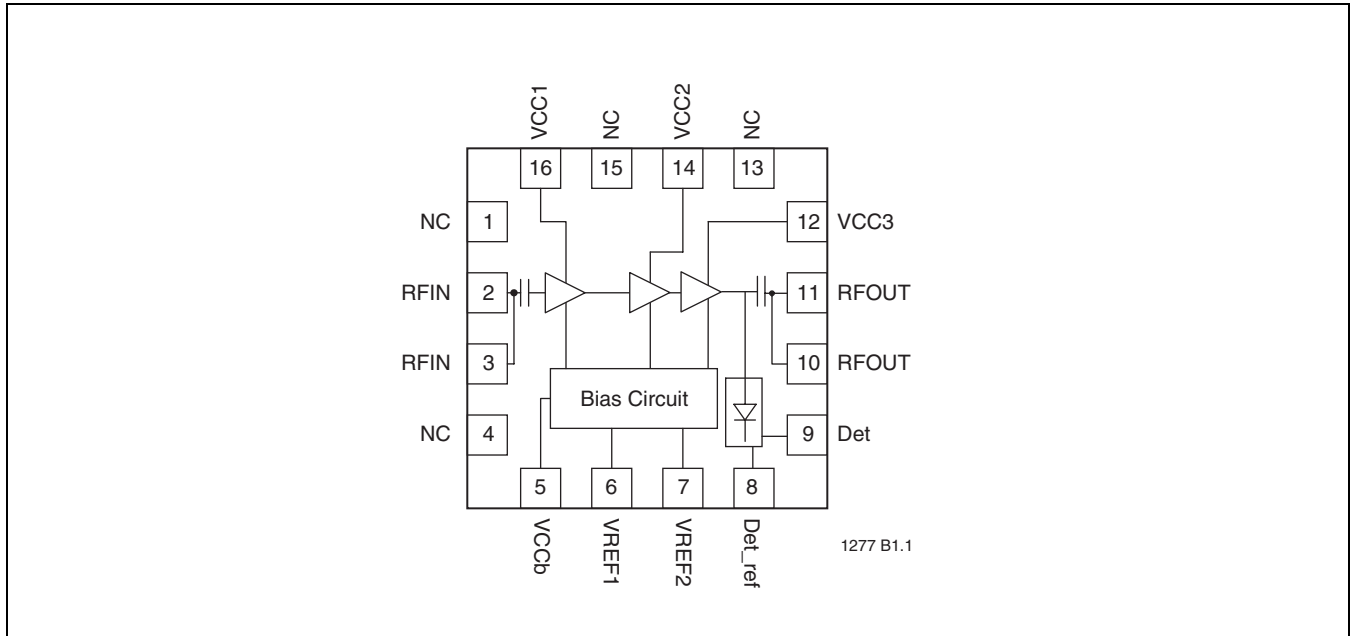


FIGURE 1: Functional Block Diagram

### PIN ASSIGNMENTS

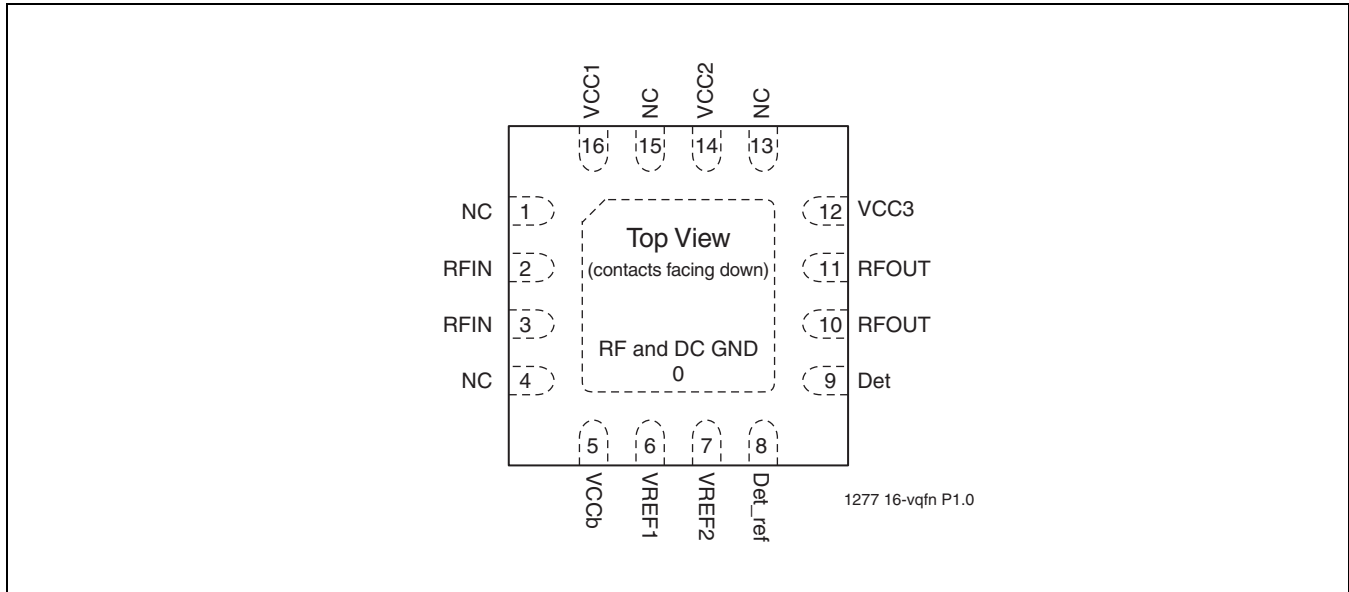


FIGURE 2: Pin Assignments for 16-contact VQFN

### PIN DESCRIPTIONS

TABLE 1: Pin Description

Symbol	Pin No.	Pin Name	Type <sup>1</sup>	Function
GND	0	Ground		The center pad should be connected to RF ground with several low inductance, low resistance vias.
NC	1	No Connection		Unconnected pins.
RFIN	2		I	RF input, DC decoupled
RFIN	3		I	RF input, DC decoupled
NC	4	No Connection		Unconnected pins.
VCCb	5	Power Supply	PWR	Supply voltage for bias circuit
VREF1	6		PWR	1st and 2nd stage idle current control
VREF2	7		PWR	3rd stage idle current control
Det_ref	8		O	On-chip power detector reference
Det	9		O	On-chip power detector
RFOUT	10		O	RF output
RFOUT	11		O	RF output
VCC3	12	Power Supply	PWR	Power supply, 3rd stage
NC	13	No Connection		Unconnected pins.
VCC2	14	Power Supply	PWR	Power supply, 2nd stage
NC	15	No Connection		Unconnected pins.
VCC1	16	Power Supply	PWR	Power supply, 1st stage

1. I=Input, O=Output



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### ELECTRICAL SPECIFICATIONS

The AC and DC specifications for the power amplifier interface signals. Refer to Table 2 for the DC voltage and current specifications. Refer to Figures 3 through 11 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 and 3 ( $P_{IN}$ )	+5 dBm
Average output power ( $P_{OUT}$ )	+28 dBm
Supply Voltage at pins 5, 12, 14, 16 ( $V_{CC}$ )	-0.3V to +4.6V
Reference voltage to pins 6 ( $V_{REF1}$ ) and pin 7 ( $V_{REF2}$ )	-0.3V to +3.6V
DC supply current ( $I_{CC}$ )	500 mA
Operating Temperature ( $T_A$ )	-40°C to +85°C
Storage Temperature ( $T_{STG}$ )	-40°C to +120°C
Maximum Junction Temperature ( $T_J$ )	+150°C
Surface Mount Solder Reflow Temperature:	“with-Pb” units <sup>1</sup> : 240°C for 3 seconds
	“non-Pb” units: 260°C for 3 seconds

1. Certain “with-Pb” package types are capable of 260°C for 3 seconds; please consult the factory for the latest information.

### Operating Range

Range	Ambient Temp	V <sub>CC</sub>
Industrial	-40°C to +85°C	3.3V

**TABLE 2: DC Electrical Characteristics**

Symbol	Parameter	Min.	Typ	Max.	Unit	Test Conditions
$V_{CC}$	Supply Voltage at pins 5, 12, 14, 16	3.0	3.3	4.2	V	
$I_{CC}$	Supply Current					
	for 802.11g, 24 dBm			290	mA	
	for 802.11g, 25 dBm			340	mA	
$I_{CQ}$	Idle current for 802.11g to meet EVM<4% @ 23dBm		50		mA	
$I_{OFF}$	Shut down current			0.1	μA	
$V_{REG1}$	Reference Voltage for 1st Stage, with 110Ω resistor	2.75	2.8	2.85	V	
$V_{REG2}$	Reference Voltage for 2nd Stage, with 270Ω resistor	2.75	2.8	2.85	V	

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**TABLE 3: AC Electrical Characteristics for Configuration**

Symbol	Parameter	Min.	Typ	Max.	Unit
F <sub>L-U</sub>	Frequency range	2400		2485	MHz
P <sub>OUT</sub>	Output power @ PIN = -10 dBm 11b signals @ PIN = -11 dBm 11g signals	25	24		 dBm dBm
G	Small signal gain	35	36		dB
G <sub>VAR1</sub>	Gain variation over band (2400~2485 MHz)			±0.5	dB
G <sub>VAR2</sub>	Gain ripple over channel (20 MHz)		0.2		dB
Stability	Spurious output@ 25.5 dBm 54 Mbps OFDM signal when VSWR=6:1 all angle			-60	dBc
Output VSWR Ruggedness	Survivable time@ 25.5 dBm (to 50Ω) 54 Mbps OFDM signal when VSWR=10:1 all angle	10			second
ACPR	Meet 11b spectrum mask Meet 11g OFDM 54 MBPS spectrum mask	24 24	25		 dBm dBm
Added EVM	@ 23.5 dBm output with 11g OFDM 54 MBPS signal		4		%
2f, 3f, 4f, 5f	Harmonics at 22 dBm, without trapping capacitors			-40	dBc

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## TYPICAL PERFORMANCE CHARACTERISTICS

TEST CONDITIONS:  $V_{CC} = 3.3V$ ,  $T_A = 25^\circ C$

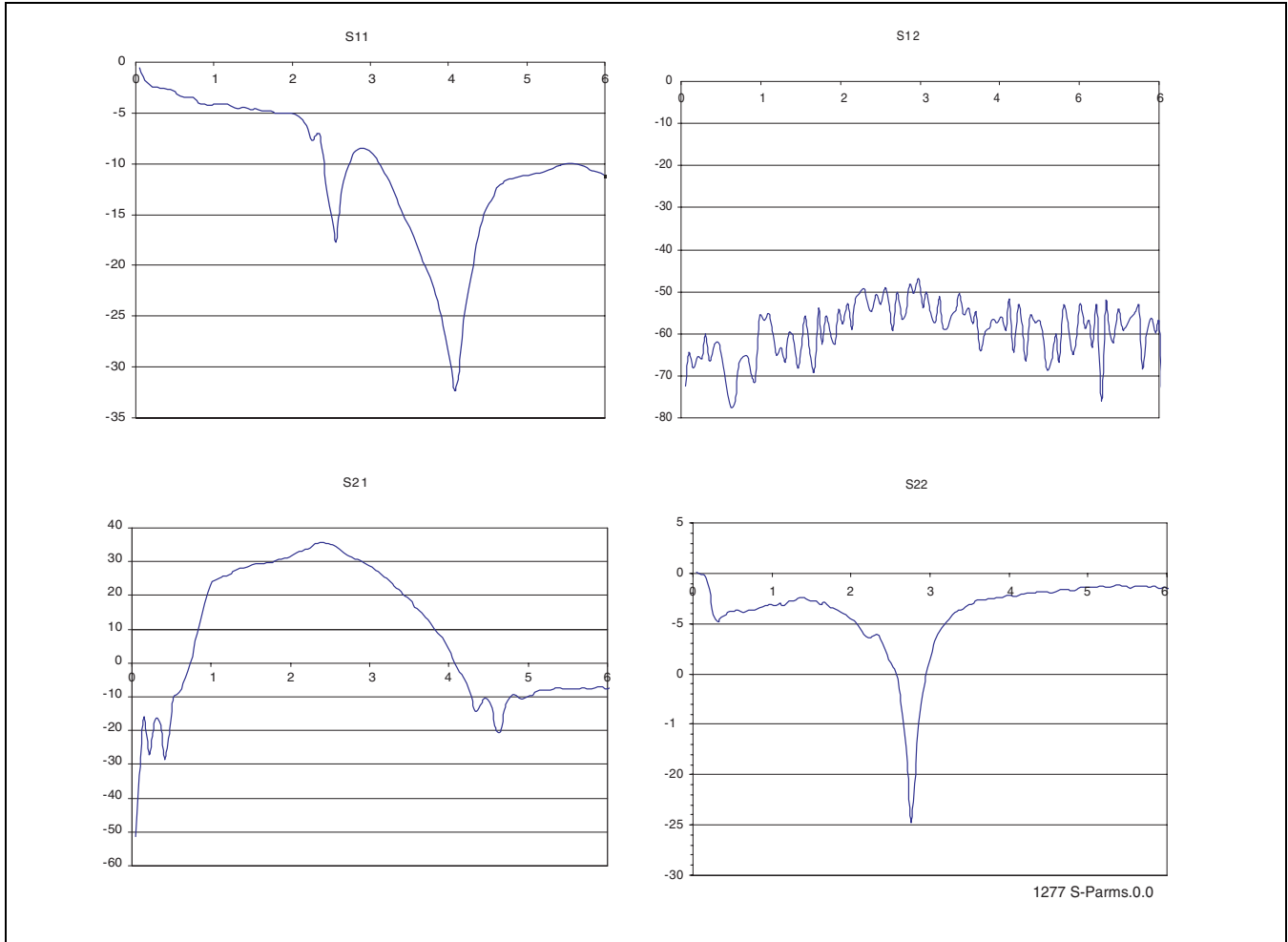


FIGURE 3: S-Parameters

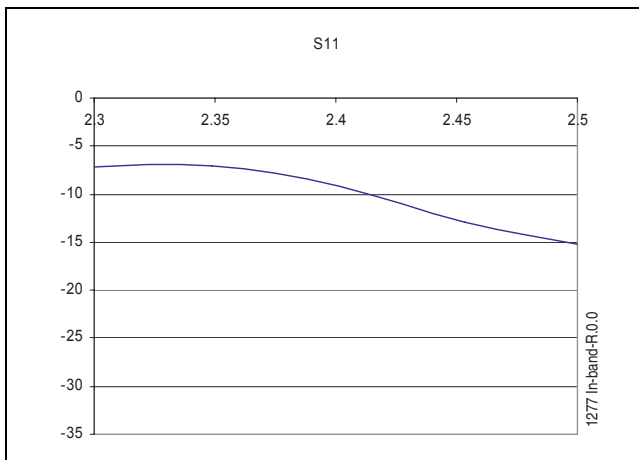


FIGURE 4: In-band Return Loss

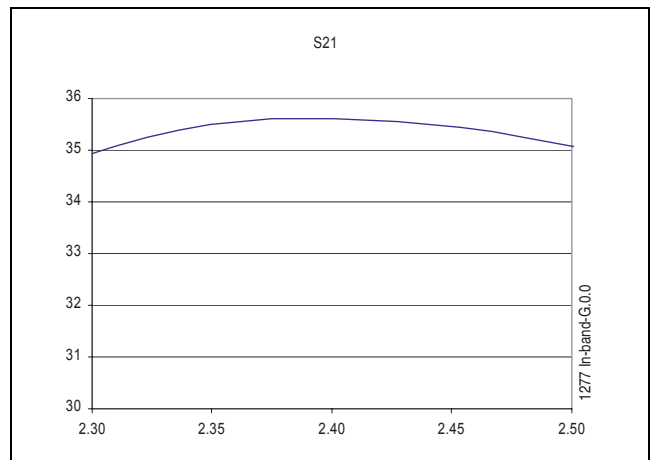


FIGURE 5: In-band Gain Flatness

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## TYPICAL PERFORMANCE CHARACTERISTICS TEST CONDITIONS: F1 = 2.45 GHz, F2 = 2.451 GHz

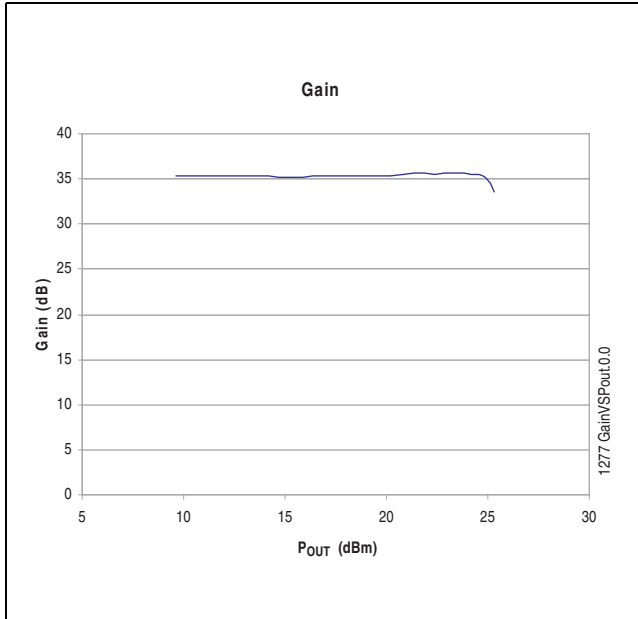


FIGURE 6: Gain vs. Pout

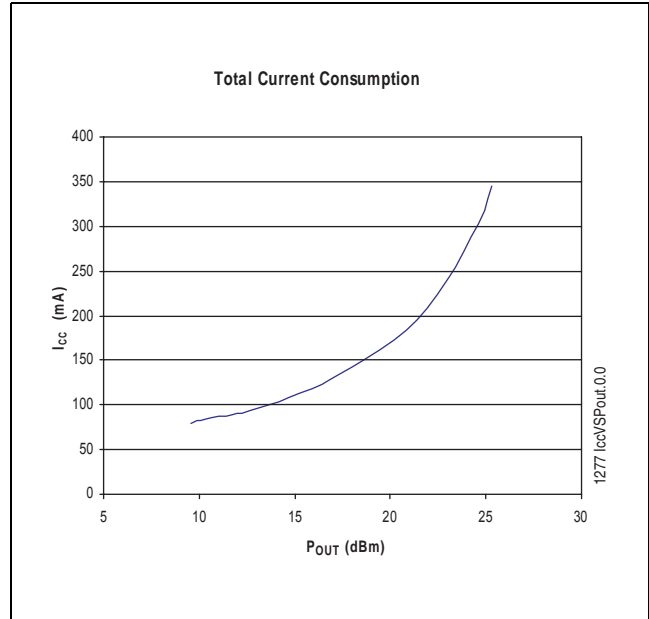


FIGURE 8: Icc vs. Pout

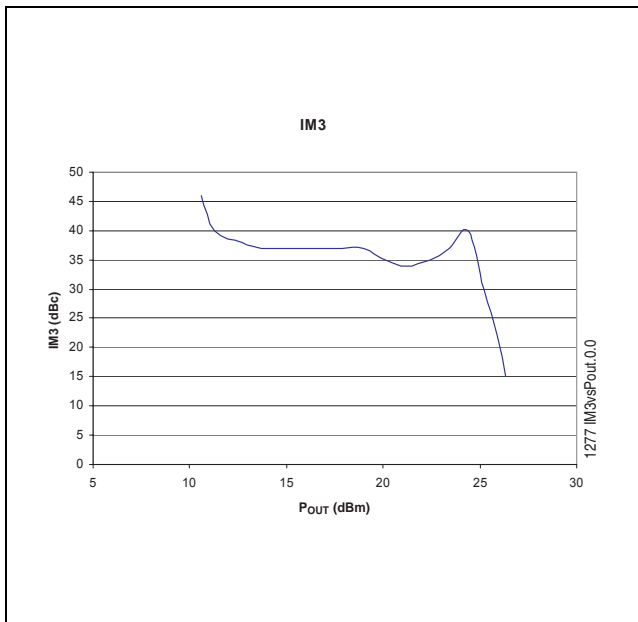


FIGURE 7: IM3 vs. Pout

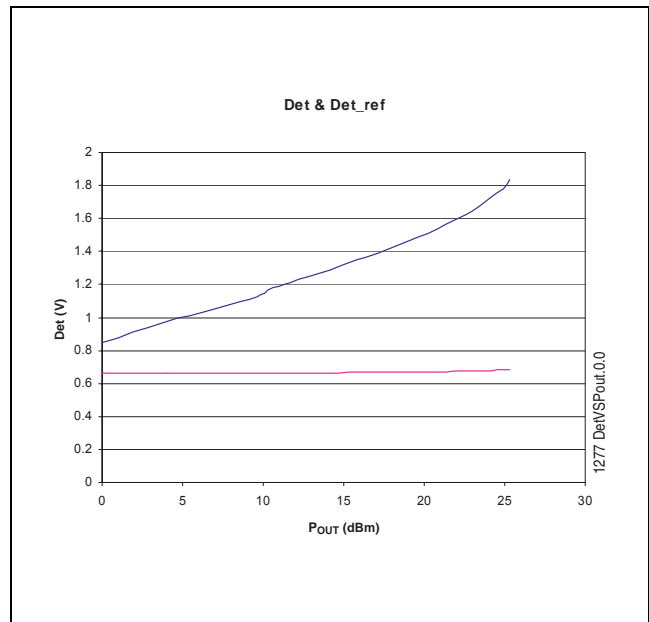


FIGURE 9: Detectors vs. Pout



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## TYPICAL PERFORMANCE CHARACTERISTICS

TEST CONDITIONS:  $V_{CC} = 3.3V$ ,  $T_A = 25^\circ C$ ,  $F = 2.45 GHz$ , 54 MBPS 802.11G OFDM SIGNAL

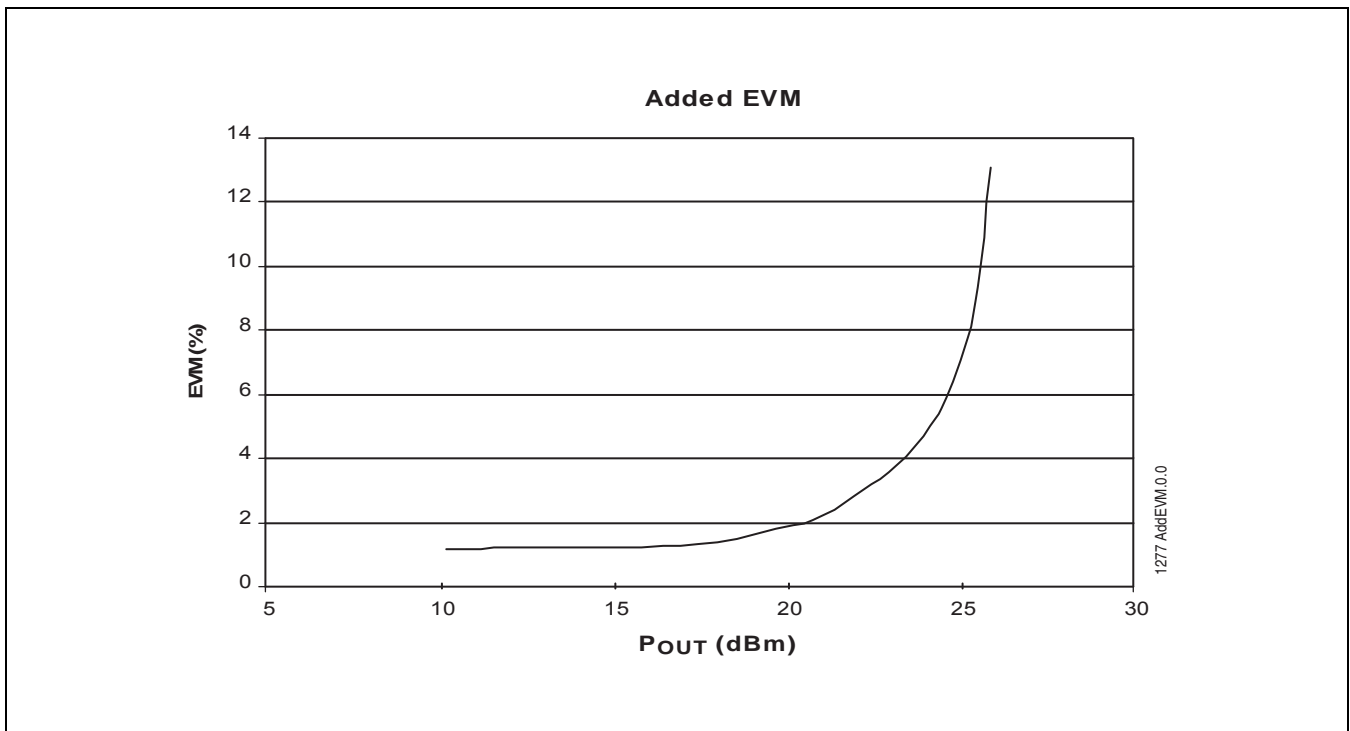
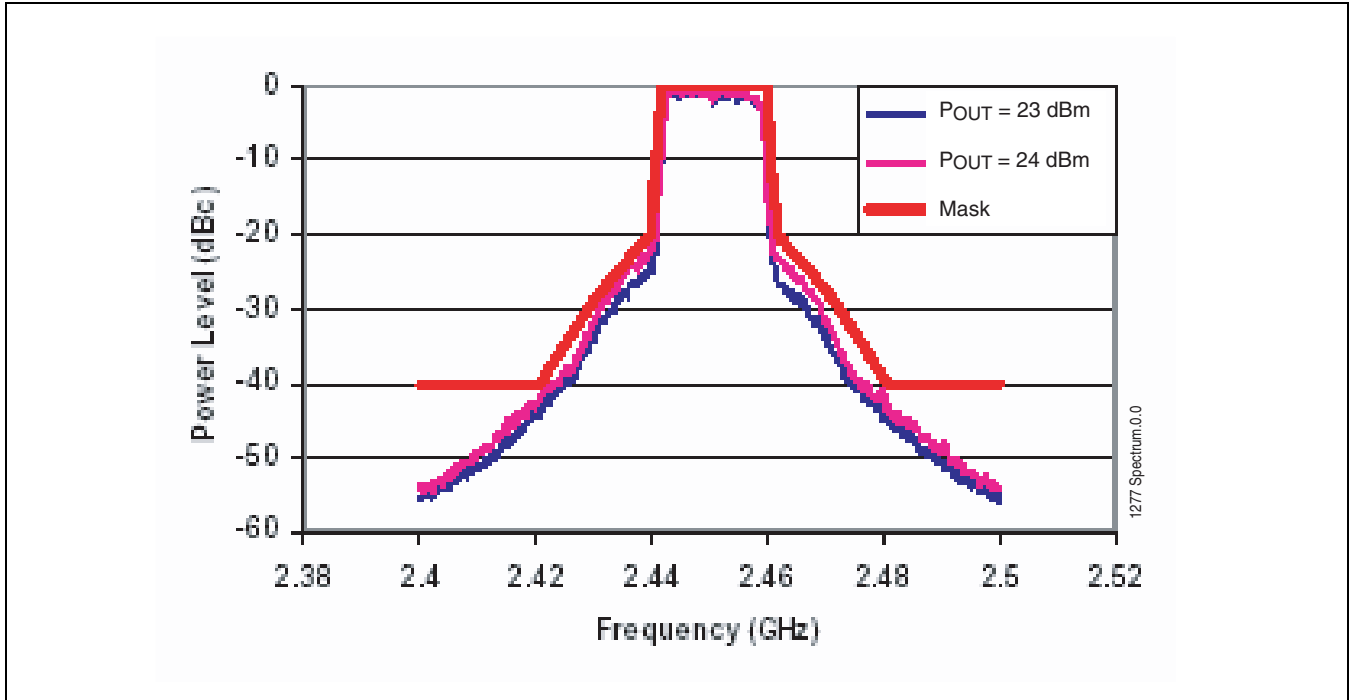


FIGURE 10: 802.11g Spectrum at 23/24 dBm, DC current 240/290 mA



### TYPICAL PERFORMANCE CHARACTERISTICS

TEST CONDITIONS:  $V_{CC} = 3.3V$ ,  $T_A = 25^\circ C$ , 1 MBPS 802.11B CCK SIGNAL

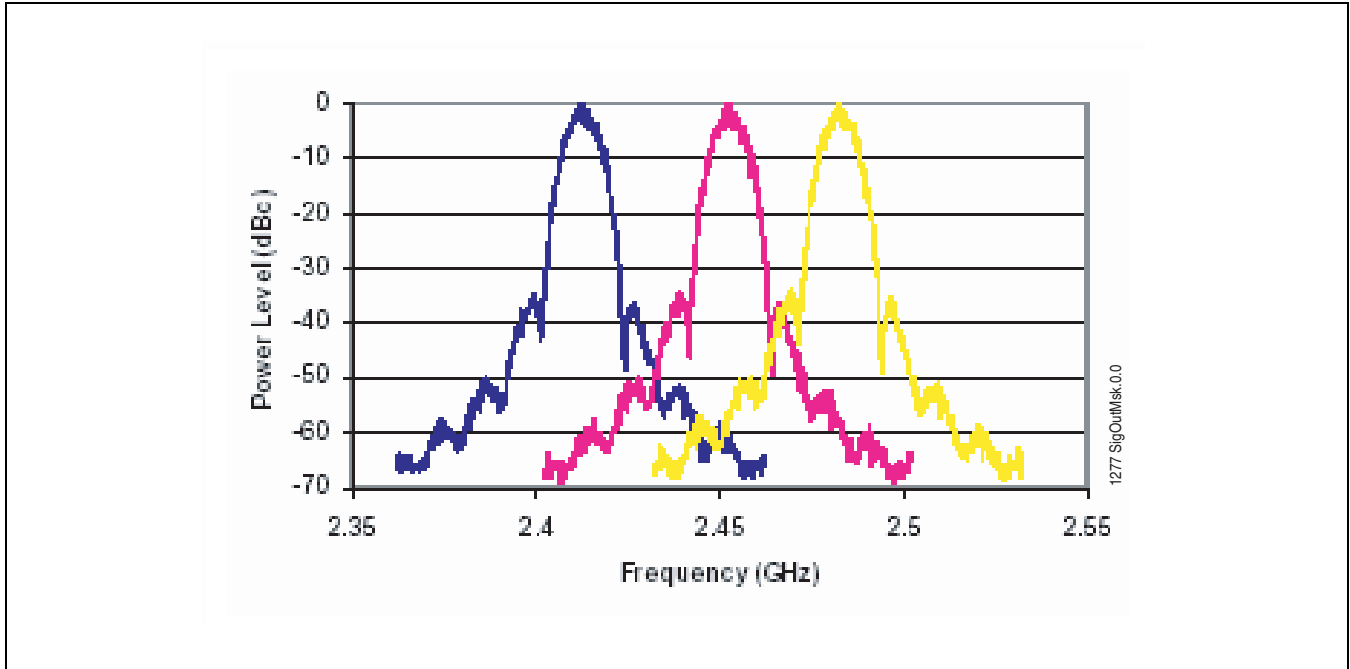


FIGURE 11: 802.11B Signal Output Mask at 25 dBm, DC current 340 mA

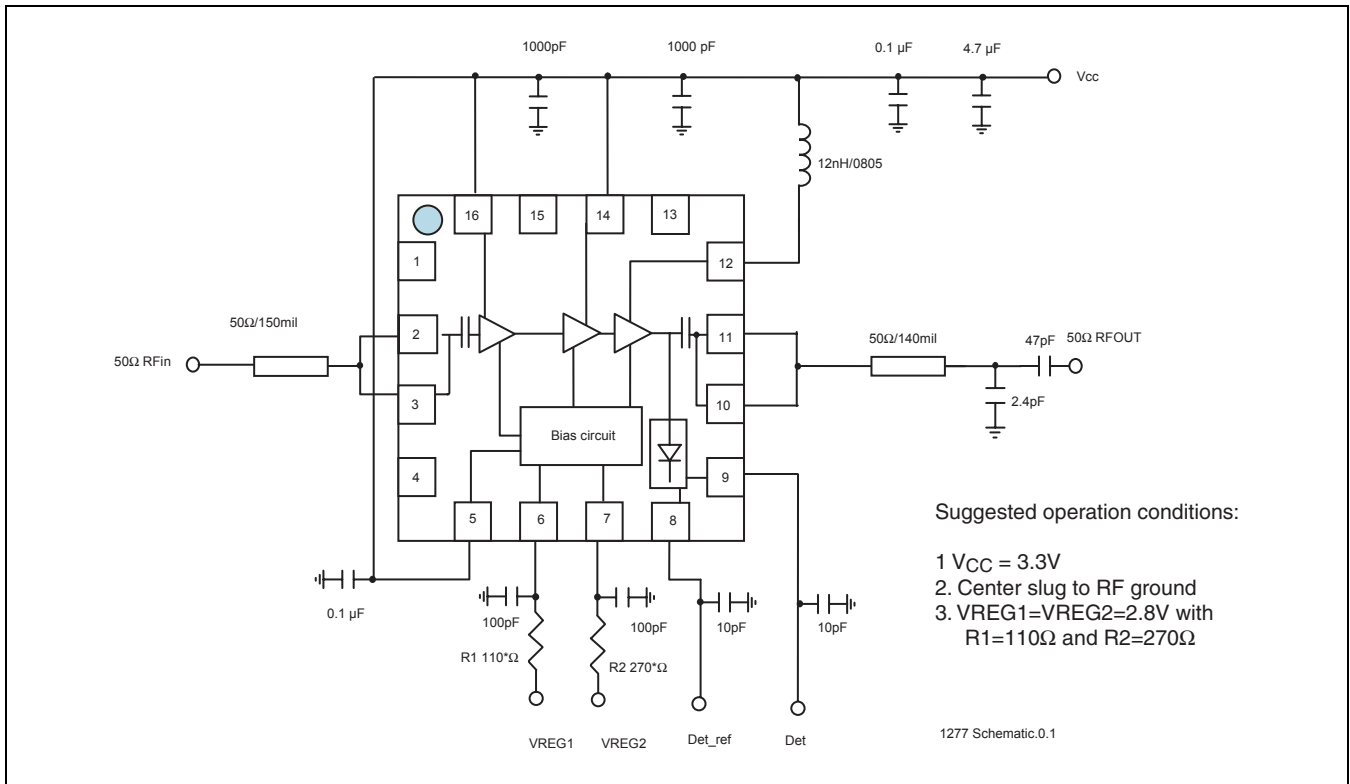
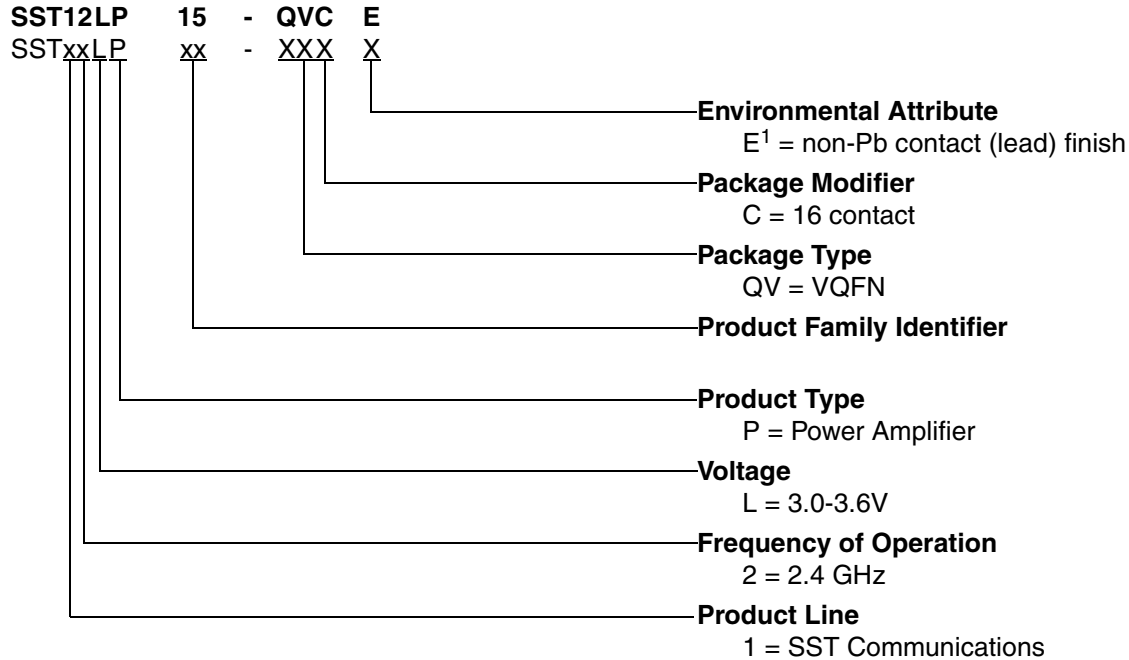


FIGURE 12: Typical Schematic for High-Power, High-Efficiency 802.11b/g Applications



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## PRODUCT ORDERING INFORMATION



1. Environmental suffix "E" denotes non-Pb solder.  
SST non-Pb solder devices are "RoHS Compliant".

### Valid combinations for SST12LP15

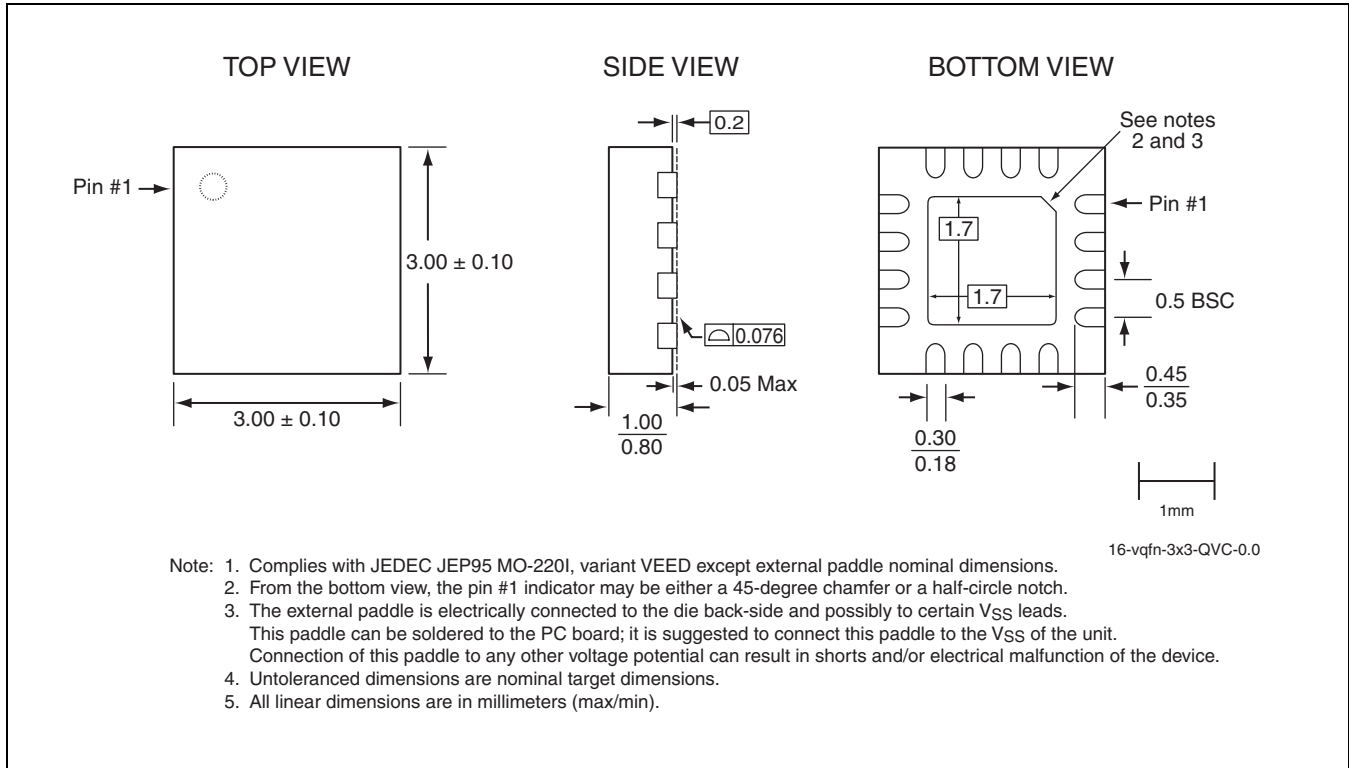
SST12LP15-QVC  
SST12LP15-QVCE

### SST12LP15 Evaluation Kits

SST12LP15-QVC-K  
SST12LP15-QVCE-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.

### PACKAGING DIAGRAMS



**FIGURE 13: 16-Contact Very-thin Quad Flat No-lead (VQFN)**  
**SST Package Code: QVC**

**TABLE 4: Revision History**

Revision	Description	Date
00	• S71277: SST conversion of data sheet GP1215	Jan 2005
01	• Updated document status from Preliminary Specification to Data Sheet	Apr 2008
02	• Updated "Contact Information" on page 12.	Feb 2009



## 2.4 GHz High-Power, High-Gain Power Amplifier SST12LP15

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