2.4 GHz High-Power, High-Gain Power Amplifier
SST12LP15B

Data Sheet

The SST12LP15B is a versatile power amplifier based on the highly-reliable InGaP/GaAs HBT technology. Easily configured for high-power applications with excellent power-added efficiency while operating over the 2.4- 2.5 GHz frequency band, it typically provides 32 dB gain with 34% power-added efficiency. The SST12LP15B has excellent linearity while meeting 802.11g spectrum mask at 24 dBm. This power amplifier also features easy board-level usage along with high-speed power-up/down control through the reference voltage pins. The SST12LP15B is offered in both a 3mm x 3mm, 16-contact VQFN package and a 2mm x 2mm, 12-contact XQFN package.

Features

- **High Gain:**
  - More than 32 dB gain across 2.4–2.5 GHz over temperature -40°C to +85°C
- **High linear output power:**
  - >29 dBm P1dB
  - Meets 802.11g OFDM ACPR requirement up to 26 dBm
  - ~3% added EVM up to 23 dBm for 54 Mbps 802.11g signal
  - Meets 802.11b ACPR requirement up to 25.5 dBm
- **High power-added efficiency/Low operating current for 802.11b/g/n applications**
- **Single-pin low I_{REF} power-up/down control**
  - I_{REF} <2 mA
- **Low idle current**
- **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 (~2µA)**
- **High temperature stability**
  - ~1 dB gain/power variation between 0°C to +85°C
- **Excellent On-chip power detection**
- **More than 20 dB dynamic range on-chip power detection**
- **Simple input/output matching**
- **Packages available**
  - 16-contact VQFN – 3mm x 3mm
  - 12-contact XQFN – 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

SST12LP15B is a versatile power amplifier based on the highly-reliable InGaP/GaAs HBT technology.

This power amplifier can be easily configured for high-power applications with very low EVM for improved power-added efficiency (PAE) while operating over the 2.4- 2.5 GHz frequency band. There are two application circuits provided to show this versatility.

SST12LP15B provides more than 32 dB gain. The device has excellent linearity—typically it meets 3% added EVM up to 23 dBm output power for 54 Mbps 802.11g operation. This power amplifier also meets spectral mask compliance output power up to 26 dBm for 802.11g and up to 25.5 dBm for 802.11b operation.

This device also features easy board-level usage along with high-speed power-up/down control through the reference voltage pins. Ultra-low reference current (total I_{REF} ~2 mA) makes the SST12LP15B controllable by an on/off switching signal directly from the baseband chip. These features coupled with low operating current make SST12LP15B ideal for the final stage power amplification in battery-powered 802.11b/g/n WLAN transmitter applications.

The power amplifier has an excellent, wide dynamic range (>20 dB), dB-wise linear on-chip power detector. The excellent on-chip power detector provides a reliable solution to board-level power control.

The SST12LP15B is offered in both 16-contact VQFN (3mm x 3mm) and 12-contact XQFN (2mm x 2mm) packages. See Figures 3 and 4 for pin assignments and Tables 1 and 2 for pin descriptions.

Functional Blocks

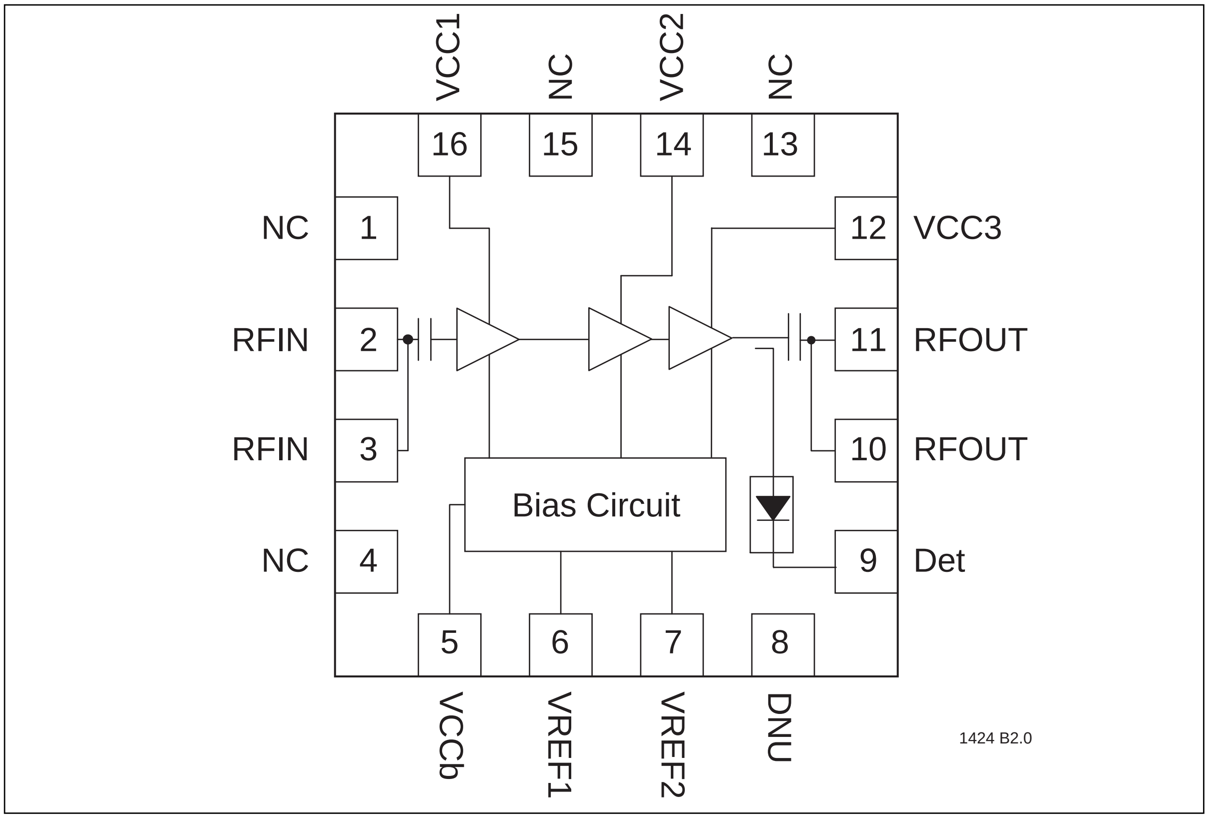


Figure 1: Functional Block Diagram for 3mm x 3mm, 16-contact VQFN (QVC)

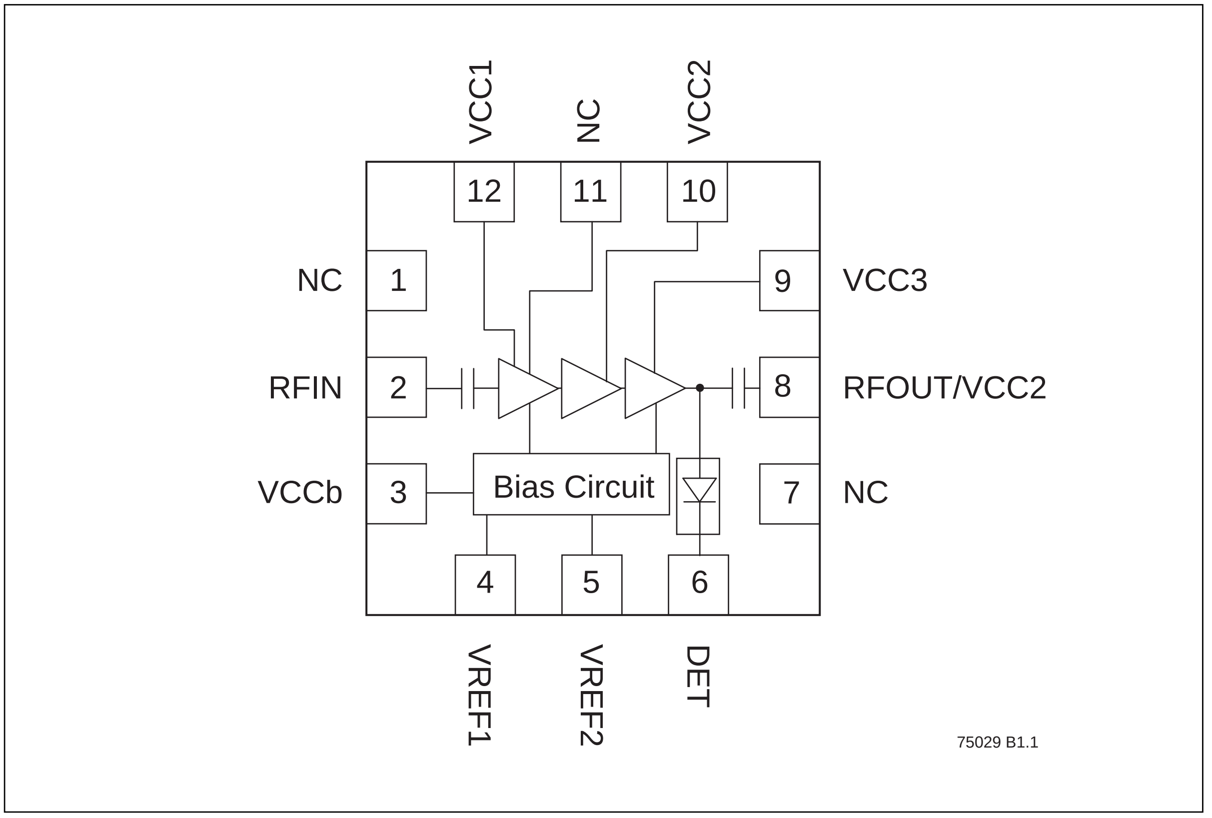


Figure 2: Functional Block Diagram for 2mm x 2mm, 12-contact XQFN (QXB)

Pin Assignments and Pin Descriptions

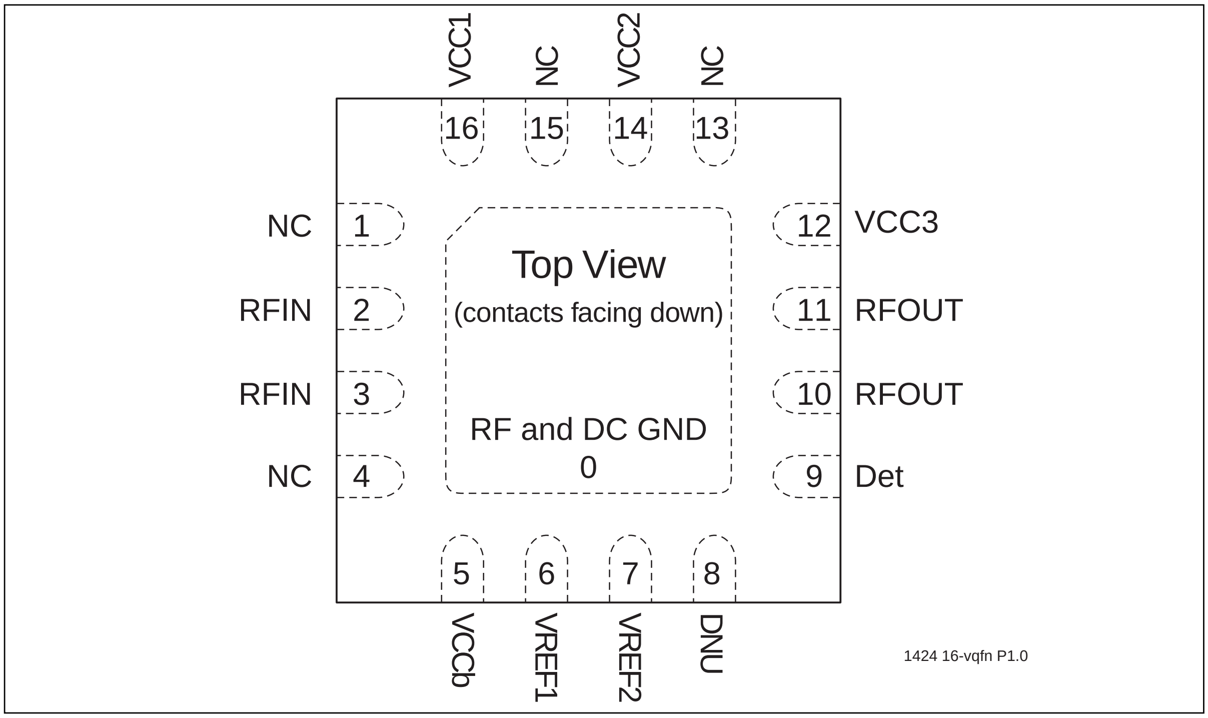


Figure 3: Pin Assignments for 3mm x 3mm, 16-contact VQFN (QVC)

Table 1: Pin Description for 3mm x 3mm,16-contact VQFN

Symbol	Pin No.	Pin Name	Type[1]	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
DNU	8	Do Not Use		Do not use or connect
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

T1.0 75029

1. I=Input, O=Output

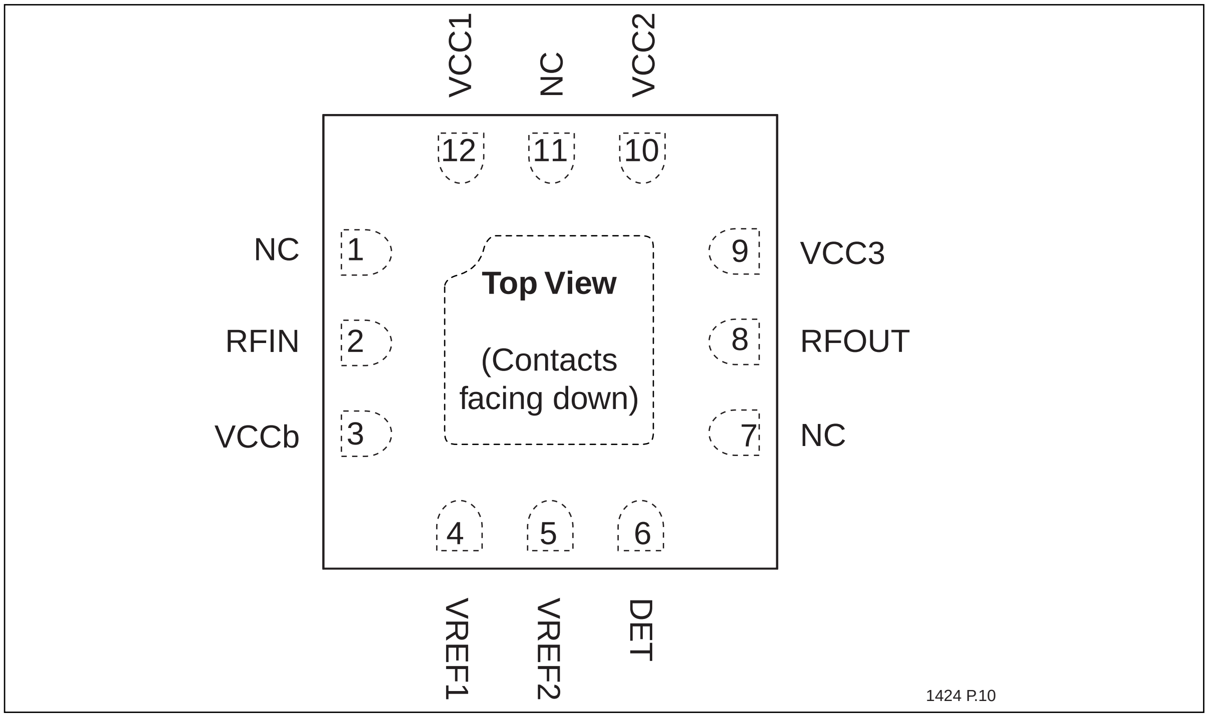


Figure 4: Pin Assignments for 2mm x 2mm, 12-contact XQFN (QXB)

Table 2: Pin Description for 2mm x 2mm,12-contact XQFN

Symbol	Pin No.	Pin Name	Type[1]	Function
GND	0	Ground		Low-inductance ground pad
NC	1	No Connection		Unconnected pin
RFIN	2		I	RF input, DC decoupled
VCCb	3	Power Supply	PWR	Supply voltage for bias circuit
VREF1	4		PWR	1st and 2nd stage idle current control
VREF2	5		PWR	3rd stage idle current control
DET	6		O	On-chip power detector
NC	7	No Connection		Unconnected pin
RFOUT	8		O	RF output, DC decoupled
VCC3	9	Power Supply	PWR	Power supply, 3rd stage
VCC2	10	Power Supply	PWR	Power supply, 2nd stage
NC	11	No Connection		Unconnected pin
VCC1	12	Power Supply	PWR	Power supply, 1st stage

T2.0 75029

1. I=Input, O=Output

Electrical Specifications

The DC and RF specifications for the power amplifier are specified below.

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.)

Average Input power (P_{IN})[1] . . . . +5 dBm
Average output power (P_{OUT})[1]. . . . . +28 dBm
Supply Voltage at pins 5, 12, 14, and 16 (V_{CC}) for 16-contact VQFN . . . . -0.3V to +5.0V[2]
Reference voltage to pin 6 and 7(V_{REF}) for 16-contact VQFN. -0.3V to +3.3V
DC supply current (I_{CC})[3] . . . . 500 mA
Operating Temperature (T_A) . . . . -40ºC to +85ºC
Storage Temperature (T_{STG}) . . . . -40ºC to +120ºC
Maximum Junction Temperature (T_J) . . . . +150ºC
Surface Mount Solder Reflow Temperature . . . . 260°C 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. Output power must be limited to 20 dBm at 5V V_{CC}.
3. Measured with 100% duty cycle 54 Mbps 802.11g OFDM Signal

Table 6 shows the DC and RF characteristics for the configuration that achieves high linear power, with good

Table 3: Operating Range

Range	Ambient Temp	V_{CC}
Industrial	-40°C to +85°C	3.3V

T3.1 75029

PAE. The associated schematic is shown in Figure 22, at 25°C for 16-contact VQFN package. The RF performance is shown in figures 17 through 21.

Table 4 shows the DC and RF characteristics for the configuration that achieves high spectrum mask compliant output power. The associated schematic is shown in Figure 16, at 25°C for 16-contact VQFN package. The RF performance is shown in figures 11 through 15.

3mm x 3mm, 16-contact VQFN High-Linearity Configuration

Typical Performance Characteristics for High Spectrum Mask Compliant Output Power Configuration for 16-contact VQFN package (Schematic in Figure 16)

Table 4: DC and RF Characteristics for High-Spectrum Mask Compliant Output Power Performance at 25°C, for 16-contact VQFN (Schematic in Figure 16)

Symbol	Parameter	Min.	Typ	Max.	Unit
V_{CC}	Supply Voltage at pins 5, 12, 14, and 16	3.0	3.3	4.2	V
I_{CQ}	Idle current to meet EVM ~3.5% @ 23 dBm Output Power with 802.11g OFDM 54 Mbps signal		175		mA
V_{REG1}	Reference Voltage for pin 6, with 51Ω resistor	2.75	2.85	2.95	V
V_{REG2}	Reference Voltage for pin 7, with 91Ω resistor	2.75	2.85	2.95	V
I_{CC}	Current Consumption to meet 802.11g OFDM 6 Mbps Spectrum mask @ 25.5 dBm Output Power		370		mA
	Current Consumption to meet 802.11b DSSS 1 Mbps Spectrum mask @ 25.5 dBm Output Power		370		mA
F_{L-U}	Frequency range	2412		2484	MHz
G	Small signal gain	32	33		dB
G_{VAR1}	Gain variation over band (2412–2484 MHz)			±0.5	dB
G_{VAR2}	Gain ripple over channel (20 MHz)		0.2		dB
2f	Harmonics at 25 dBm, without external filters		-43		dBm/ MHz
3f			-25		
4f			-30		
5f			-30		
EVM	Added EVM @ 22 dBm Output Power with 802.11g OFDM 54 Mbps signal		3		%
P_{OUT}	Output Power to meet 802.11g OFDM 6 Mbps spectrum mask	24.5	25.5		dBm
	Output Power to meet 802.11b DSSS 1 Mbps spectrum mask	24.5	25.5		dBm

T4.1 75029

3mm x 3mm, 16-contact VQFN High-Linearity Configuration (continued)

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, unless otherwise specified

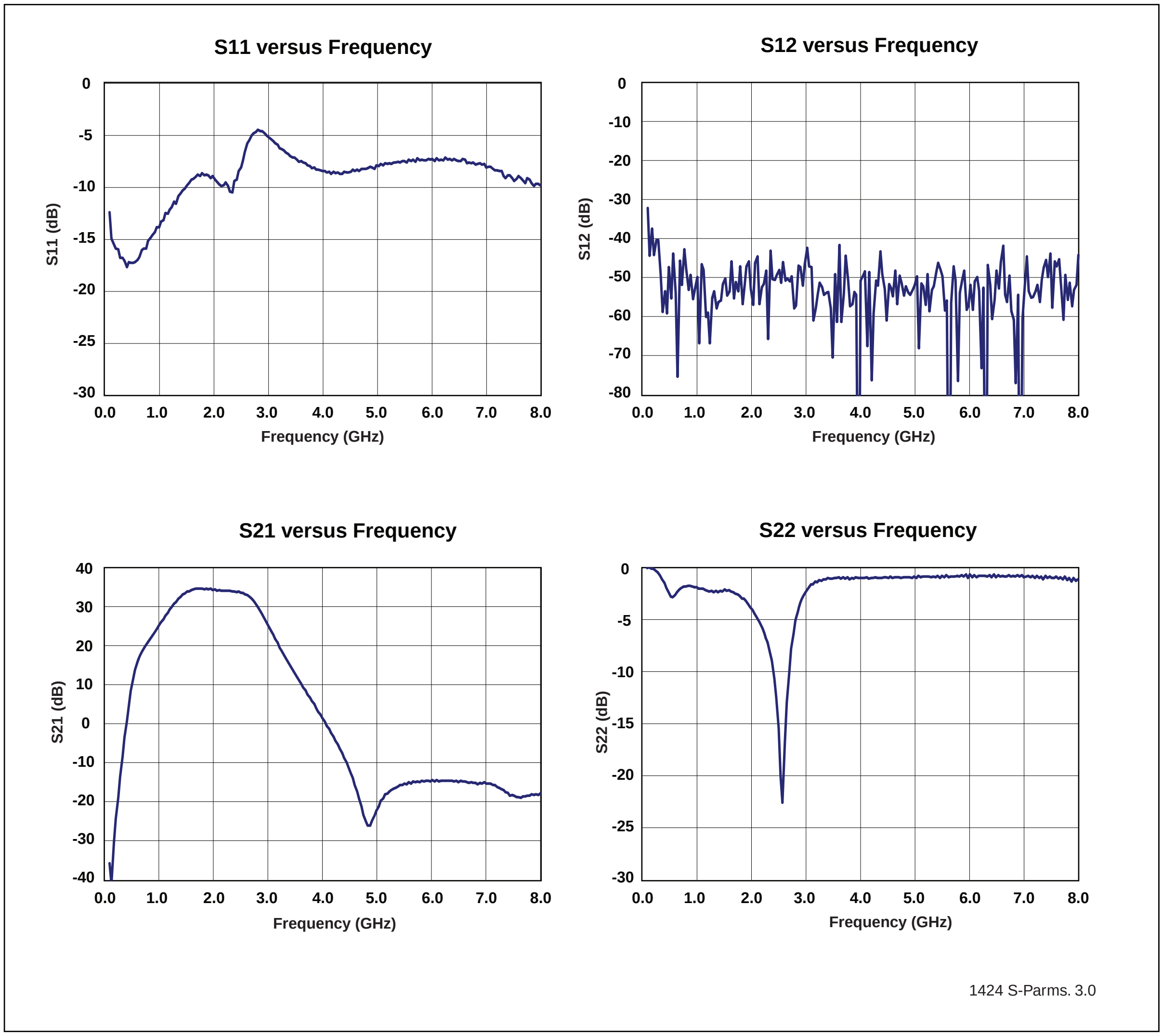


Figure 5: S-Parameters

3mm x 3mm, 16-contact VQFN High-Linearity Configuration (continued)

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, 54 Mbps 802.11g OFDM Signal

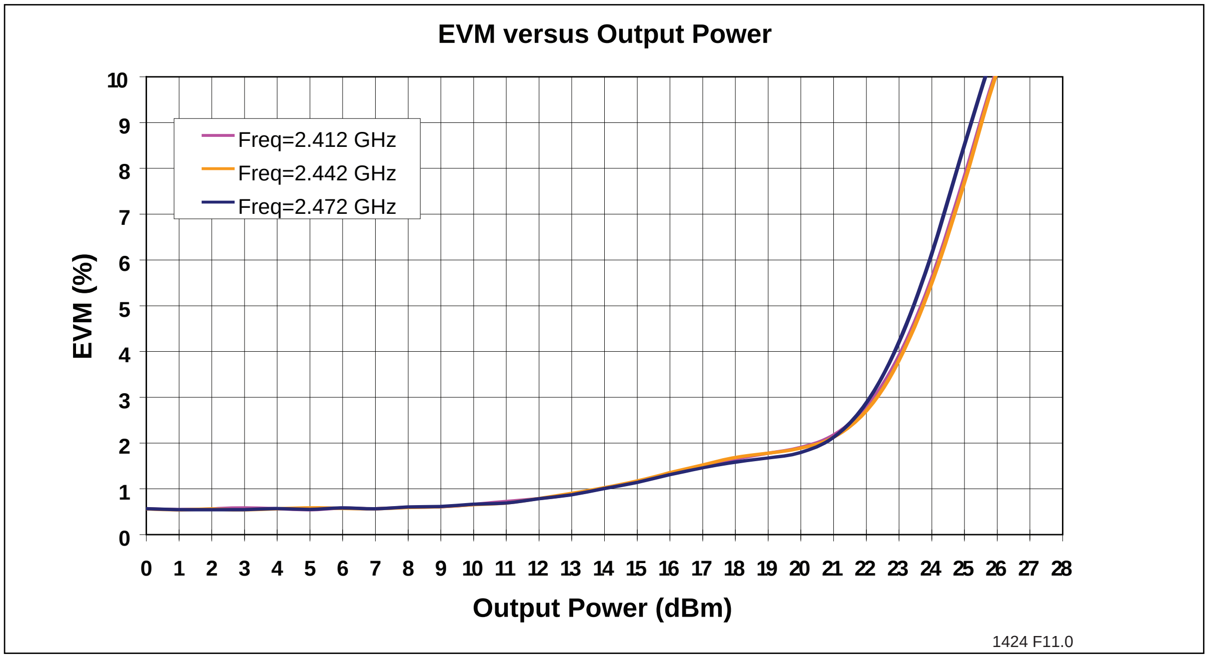


Figure 6: EVM versus Output Power measured with equalizer training set to sequence only

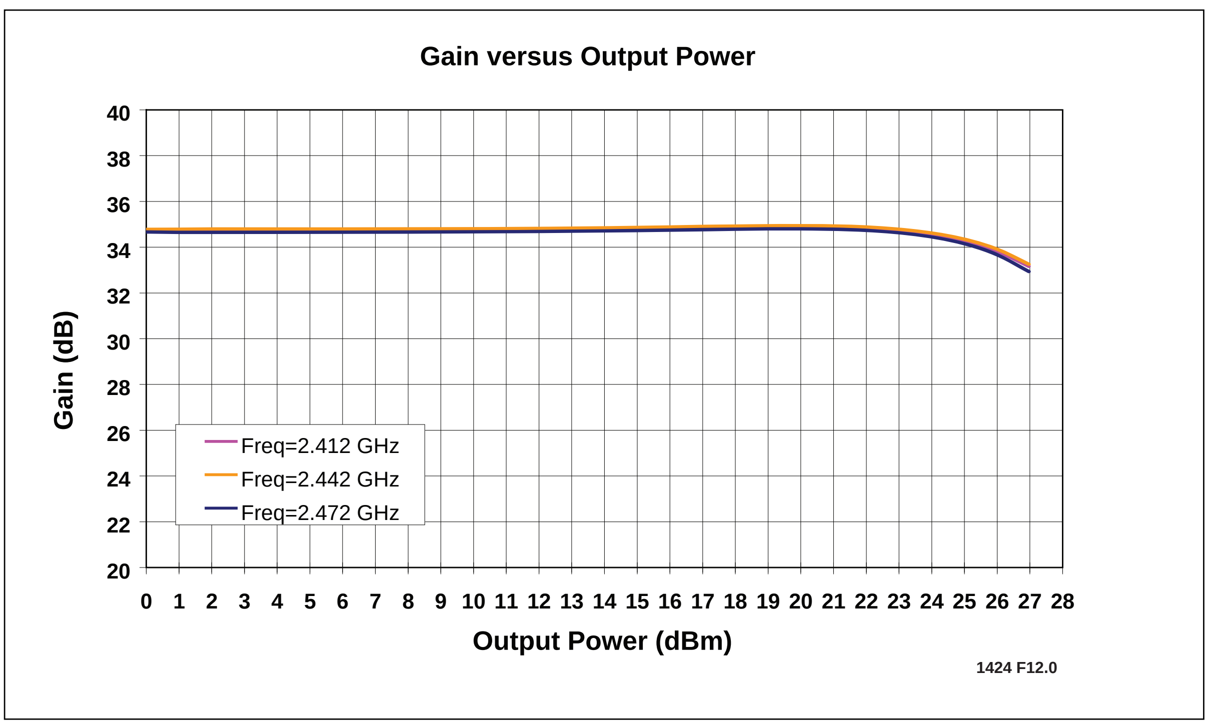


Figure 7: Gain versus Output Power

3mm x 3mm, 16-contact VQFN High-Linearity Configuration (continued)

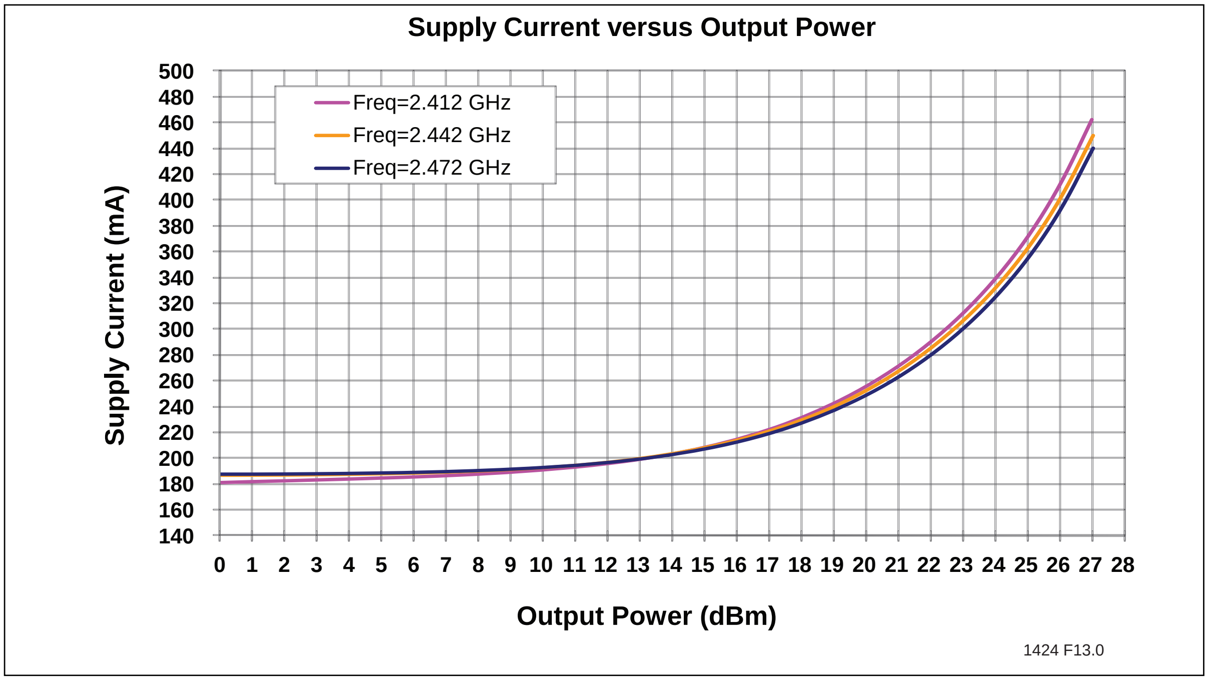


Figure 8: Total Current Consumption for 802.11g operation versus Output Power

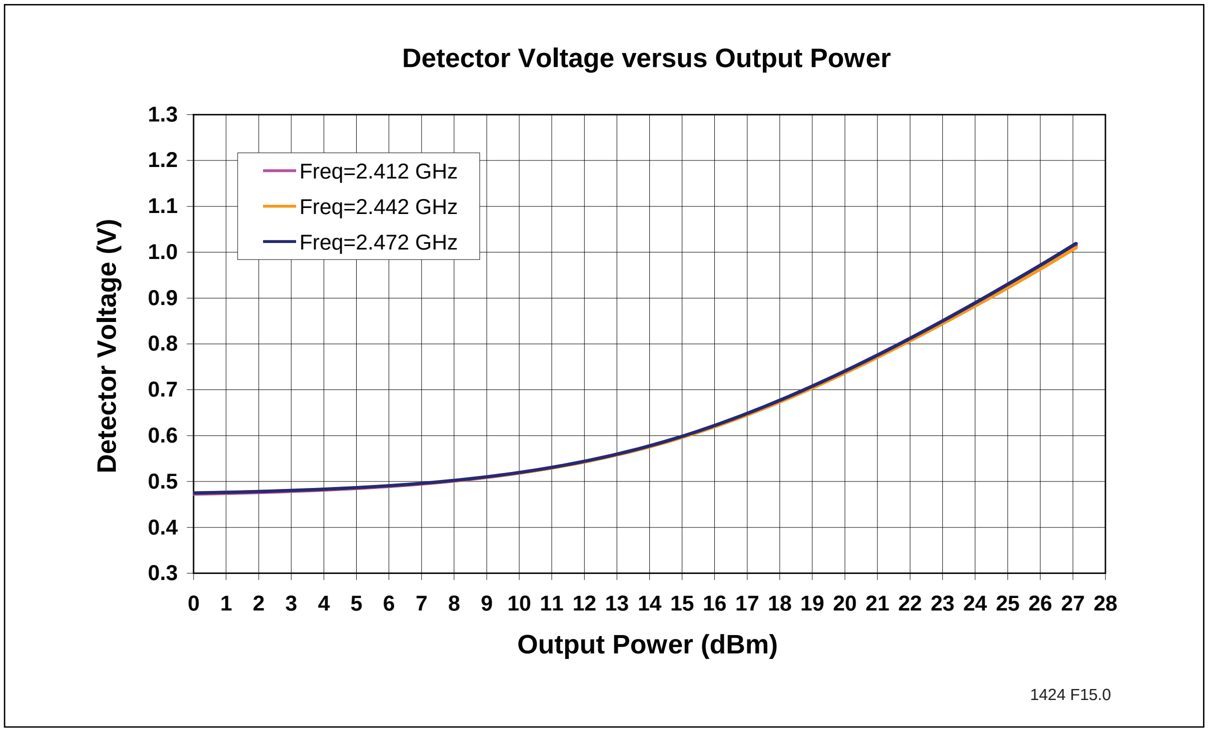


Figure 9: Detector Characteristics versus Output Power

3mm x 3mm, 16-contact VQFN High-Linearity Configuration (continued)

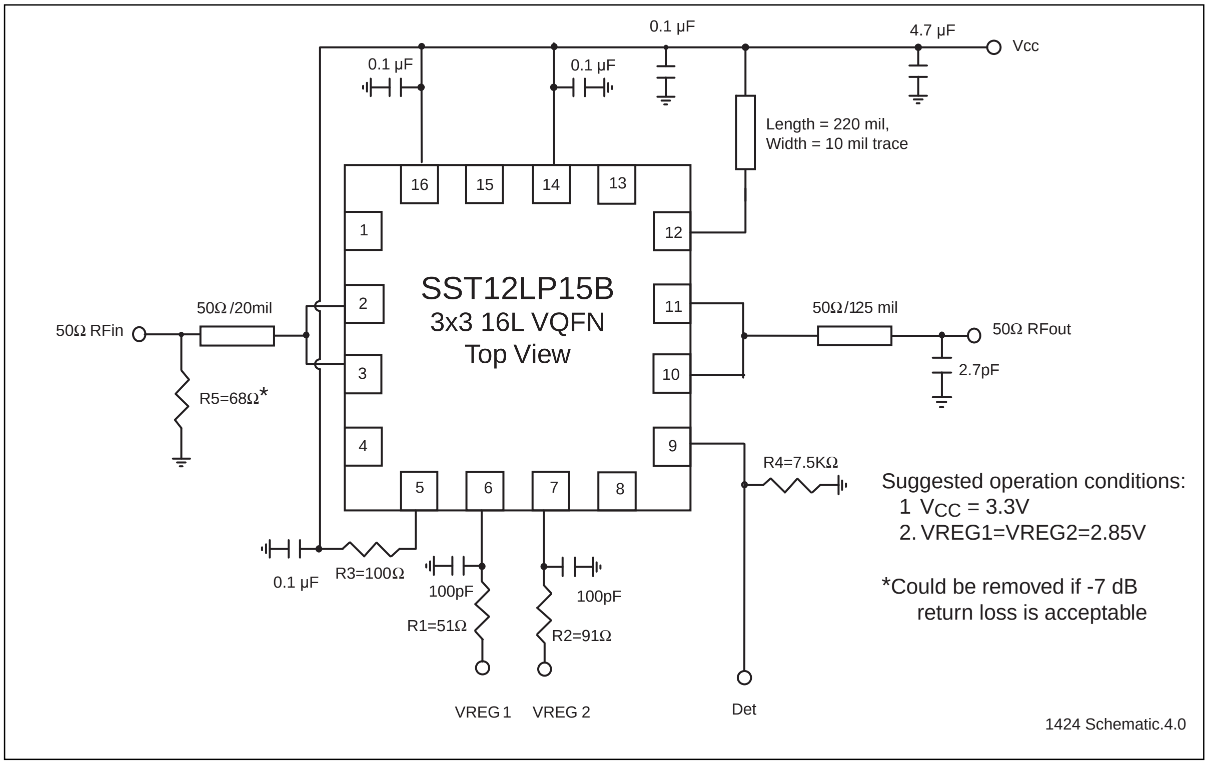


Figure 10: Typical Schematic for High Spectrum Mask Compliant Output Power 802.11b/g/n Applications for 16-contact VQFN

2mm x 2mm, 12-contact XQFN High-Linearity Configuration

Typical Performance Characteristics for High Spectrum Mask Compliant Output Power Configuration for 12-contact XQFN package (Schematic in Figure 16)

Table 5: DC and RF Characteristics for High Linear Power, with Good PAE Performance at 25°C, for 12-contact XQFN (Schematic in Figure 16)

Symbol	Parameter	Min.	Typ	Max.	Unit
V_{CC}	Supply Voltage at pins 3, 9, 10, and 12	3.0	3.3	4.2	V
I_{CQ}	Idle current to meet EVM ~3.5% @ 23 dBm Output Power with 802.11g OFDM 54 Mbps signal		190		mA
V_{REG1}	Reference Voltage for pin 4, with 562Ω resistor	2.75	2.85	2.95	V
V_{REG2}	Reference Voltage for pin 5, with 294Ω resistor	2.75	2.85	2.95	V
I_{CC}	Current Consumption to meet 802.11g OFDM 6 Mbps Spectrum mask @ 26 dBm Output Power		395		mA
	Current Consumption to meet 802.11b DSSS 1 Mbps Spectrum mask @ 24 dBm Output Power		325		mA
F_{L-U}	Frequency range	2412		2484	MHz
G	Small signal gain	31	32		dB
G_{VAR1}	Gain variation over band (2412–2484 MHz)			±0.5	dB
G_{VAR2}	Gain ripple over channel (20 MHz)		0.2		dB
2f	Harmonics at 25 dBm, without external filters		-43		dBm / MHz
3f			-25		
4f			-30		
5f			-30		
EVM	Added EVM @ 23 dBm Output Power with 802.11g OFDM 54 Mbps signal		3.0		%
P_{OUT}	Output Power to meet 802.11g OFDM 6 Mbps spectrum mask	24.5	25.5		dBm
	Output Power to meet 802.11b DSSS 1 Mbps spectrum mask	24.5	25.5		dBm

T5.1 75029

2mm x 2mm, 12-contact XQFN High-Linearity Configuration (continued)

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, unless otherwise specified

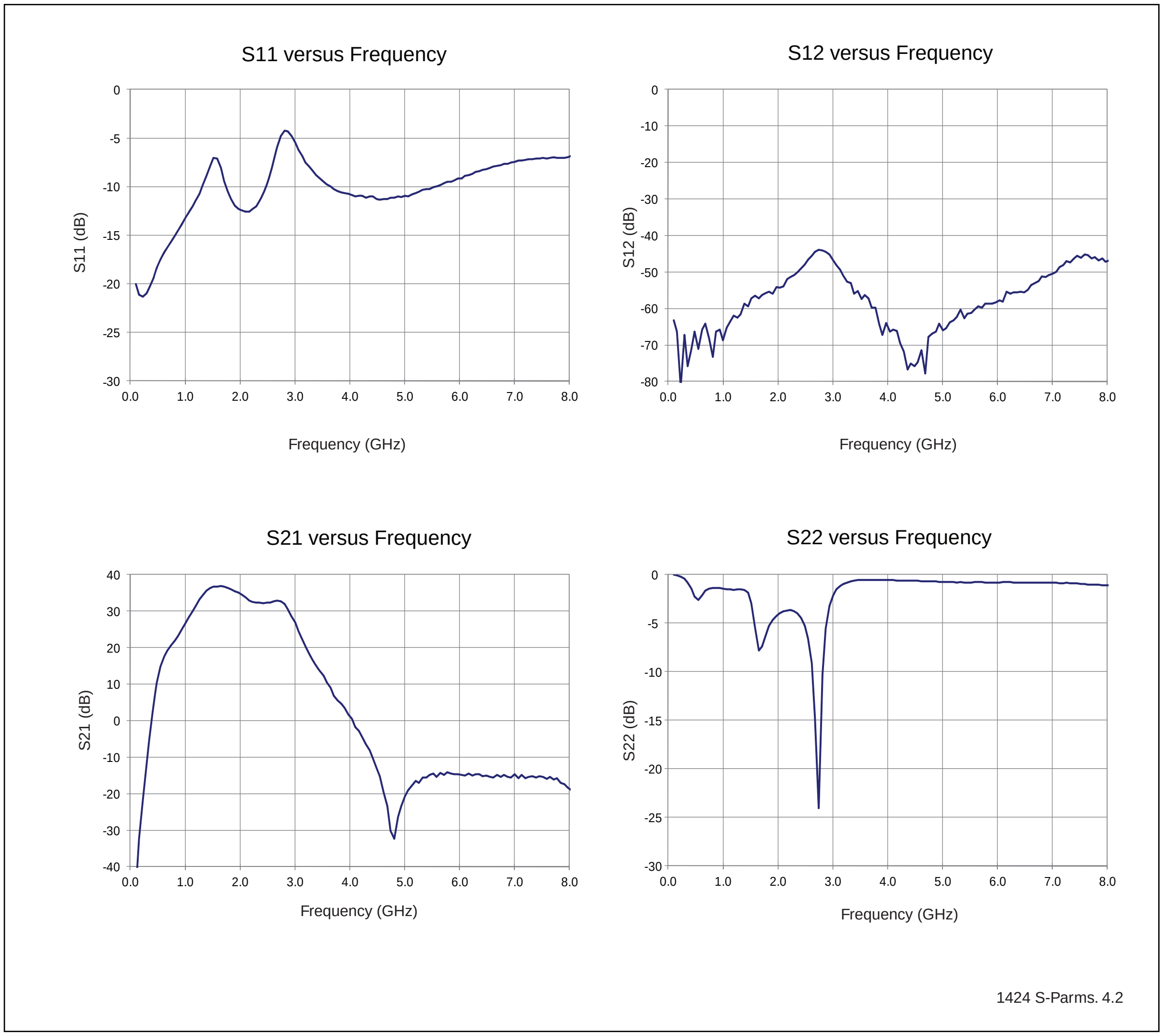


Figure 11: S-Parameters

2mm x 2mm, 12-contact XQFN High-Linearity Configuration (continued)

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, 54 Mbps 802.11g OFDM Signal

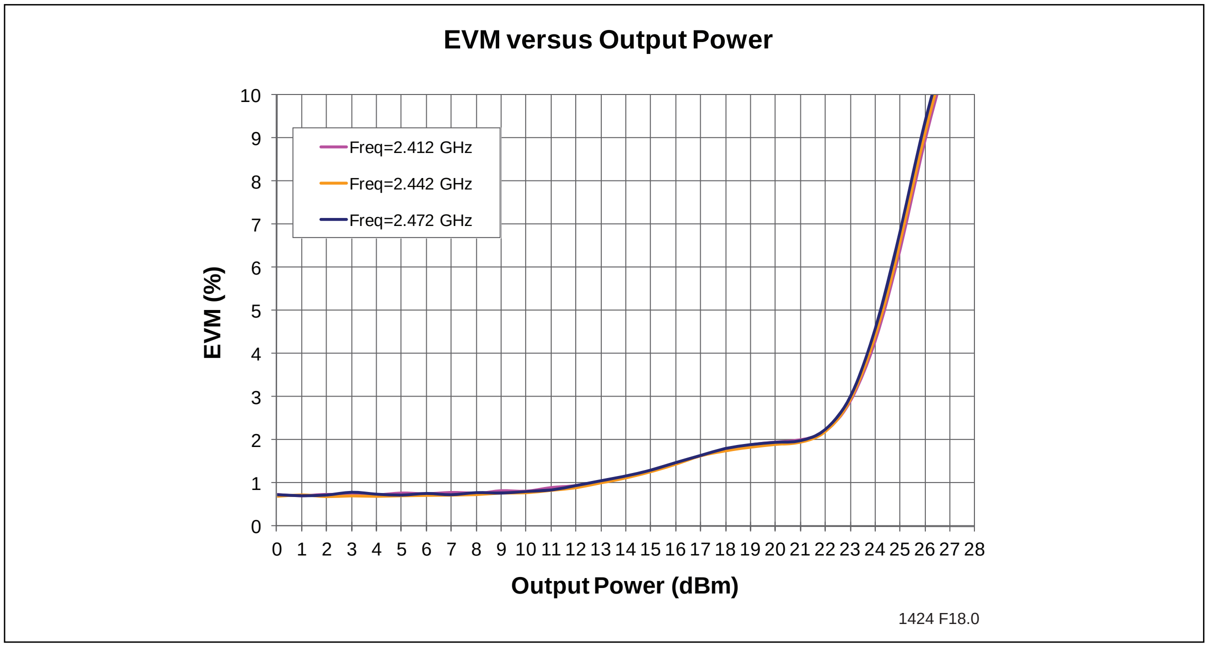


Figure 12: EVM versus Output Power measured with equalizer training set to sequence only

2mm x 2mm, 12-contact XQFN High-Linearity Configuration (continued)

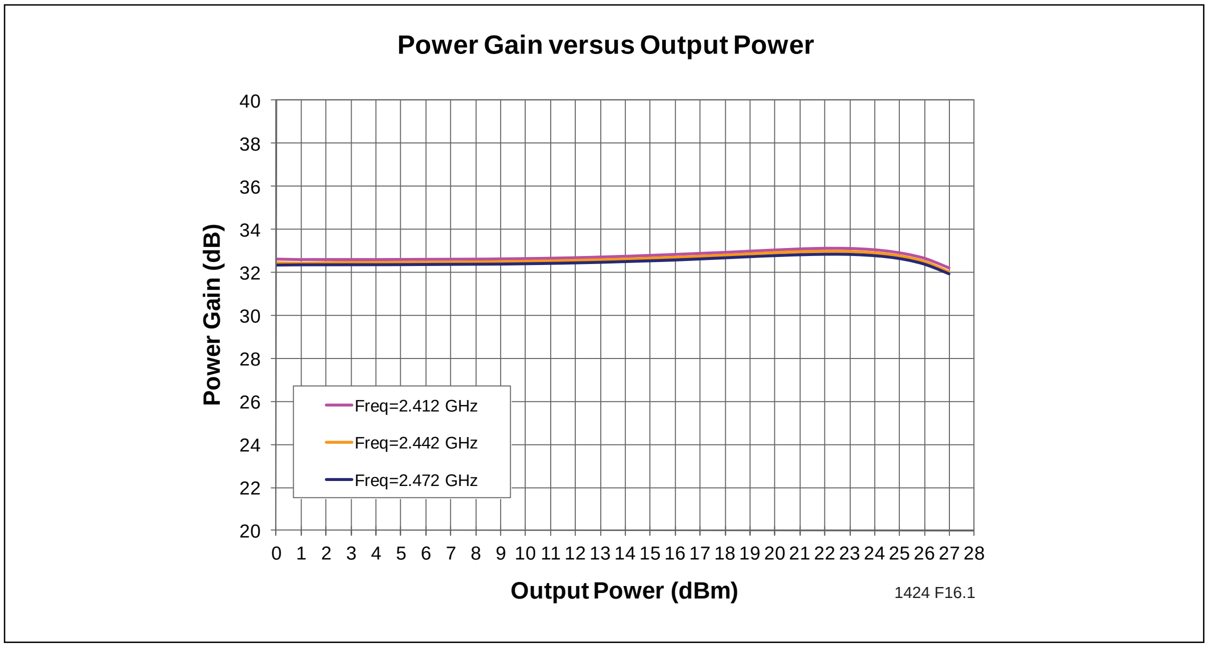


Figure 13: Gain versus Output Power

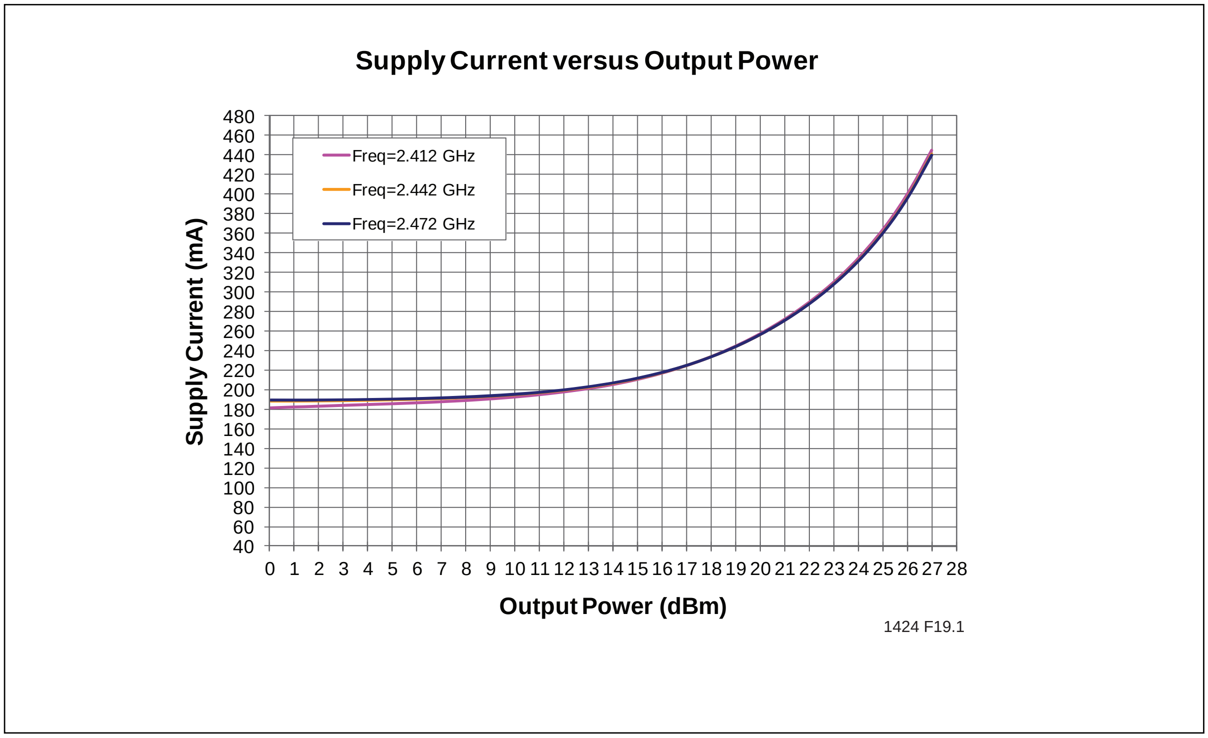


Figure 14: Total Current Consumption for 802.11g operation versus Output Power

2mm x 2mm, 12-contact XQFN High-Linearity Configuration (continued)

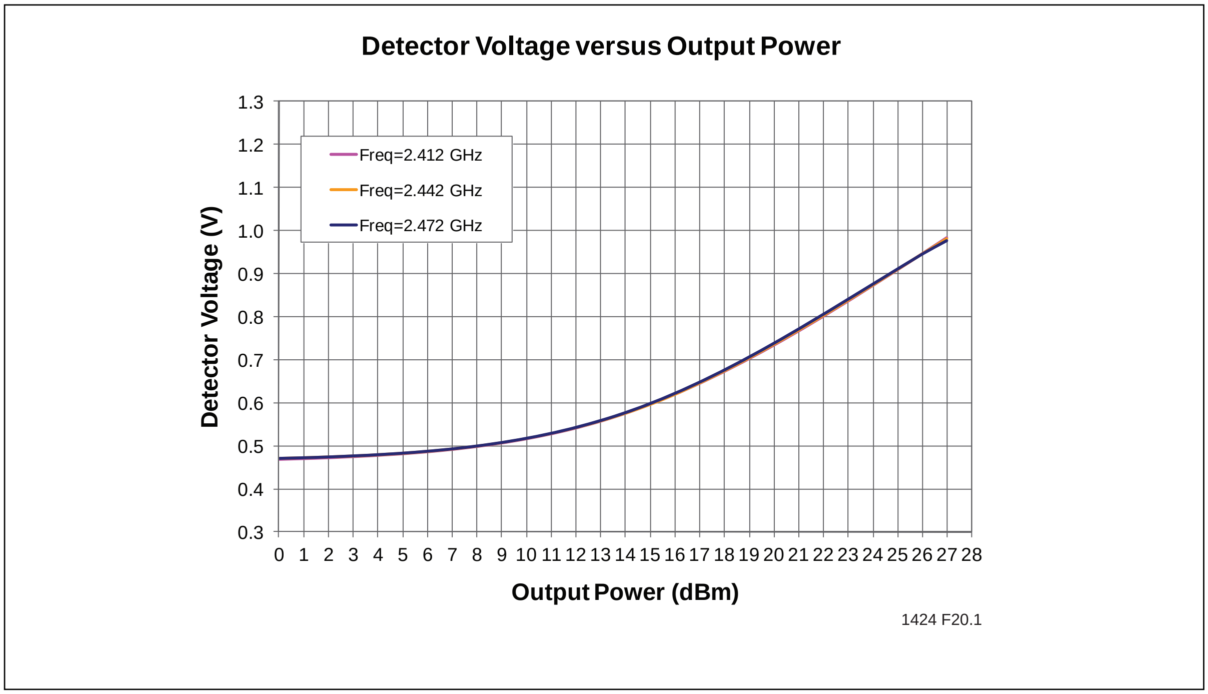


Figure 15: Detector Characteristics versus Output Power

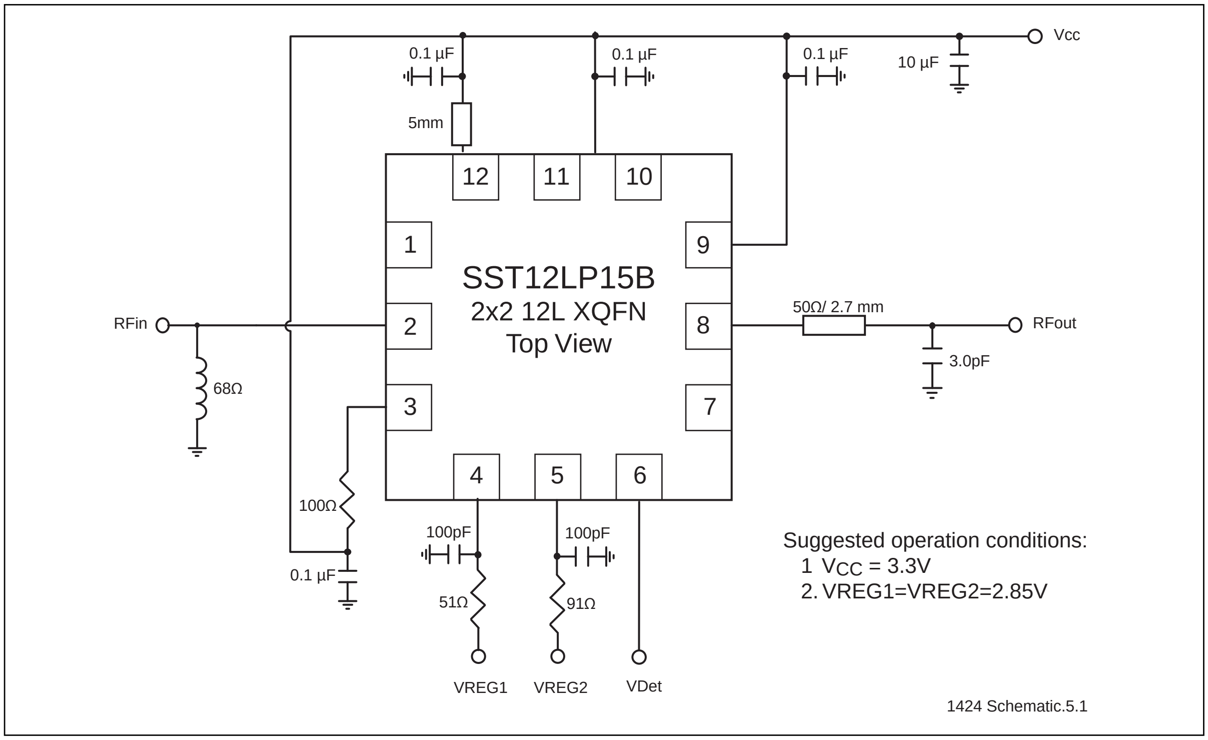


Figure 16: Typical Schematic for 802.11b/g/n Applications for 12-contact XQFN

3mm x 3mm, 16-contact VQFN High-Efficiency Configuration

Typical Performance Characteristics for High Linear Power, with Good PAE Configuration, for 16-contact VQFN package (Schematic in Figure 22)

Table 6: DC and RF Characteristics for High Linear Power, with Good PAE Performance at 25°C, for 16-contact VQFN (Schematic in Figure 22)

Symbol	Parameter	Min.	Typ	Max.	Unit
V_{CC}	Supply Voltage at pins 5, 12, 14, and 16	3.0	3.3	4.2	V
I_{CQ}	Idle current to meet EVM ~3.5% @ 23 dBm Output Power with 802.11g OFDM 54 Mbps signal		80		mA
V_{REG1}	Reference Voltage for pin 6, with 806Ω resistor	2.75	2.85	2.95	V
V_{REG2}	Reference Voltage for pin 7, with 806Ω resistor	2.75	2.85	2.95	V
I_{CC}	Current Consumption to meet 802.11g OFDM 6 Mbps Spectrum mask @ 25 dBm Output Power		330		mA
	Current Consumption to meet 802.11b DSSS 1 Mbps Spectrum mask @ 24 dBm Output Power		310		mA
F_{L-U}	Frequency range	2412		2484	MHz
G	Small signal gain	35	36		dB
G_{VAR1}	Gain variation over band (2412–2484 MHz)			±0.5	dB
G_{VAR2}	Gain ripple over channel (20 MHz)		0.2		dB
2f	Harmonics at 25 dBm, without external filters		-43		dBm/MHz
3f			-25		
4f			-30		
5f			-30		
EVM	Added EVM @ 23 dBm Output Power with 802.11g OFDM 54 Mbps signal		3.5		%
P_{OUT}	Output Power to meet 802.11g OFDM 6 Mbps spectrum mask	24	25		dBm
	Output Power to meet 802.11b DSSS 1 Mbps spectrum mask	23	24		dBm

T6.1 75029

3mm x 3mm, 16-contact VQFN High-Efficiency Configuration (continued)

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, unless otherwise specified

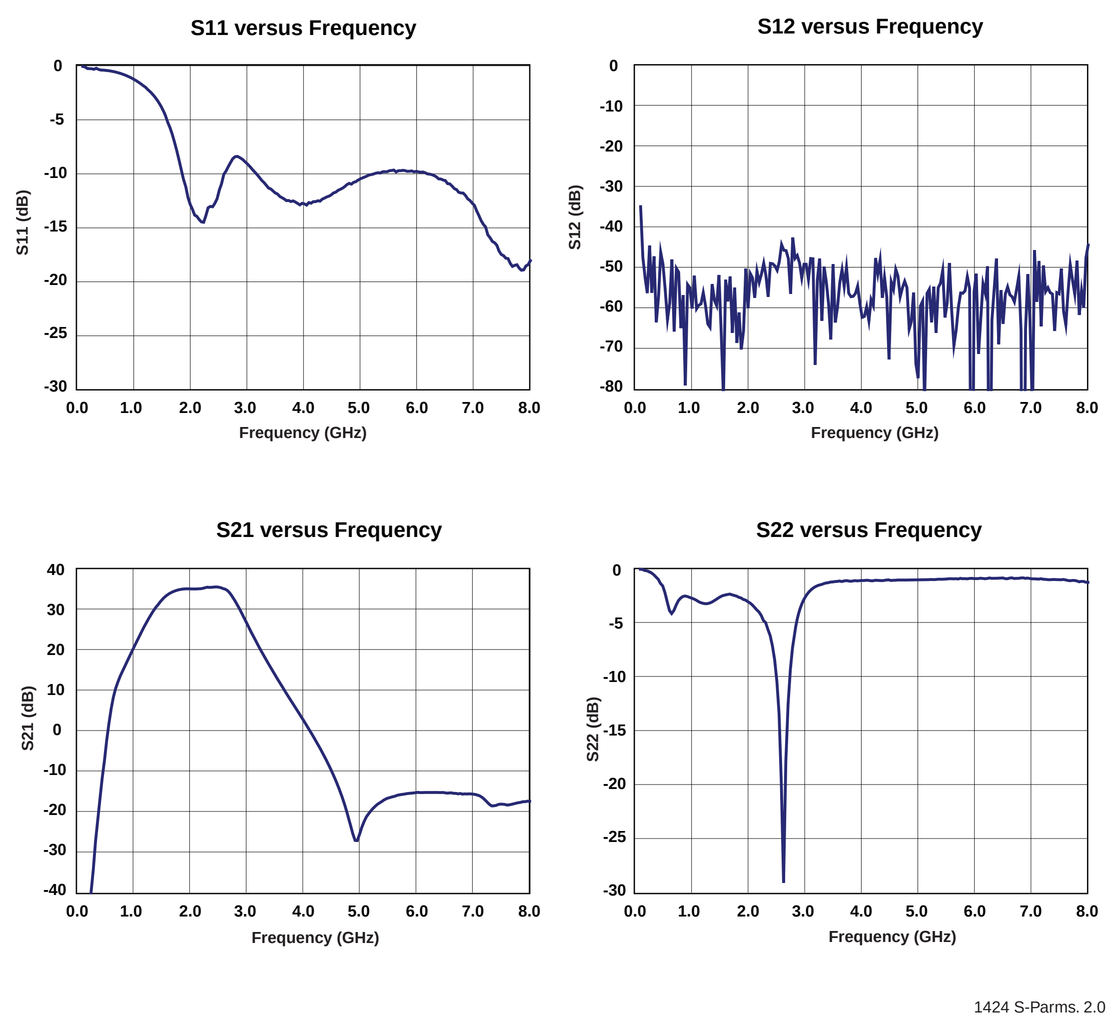


Figure 17: S-Parameters

3mm x 3mm, 16-contact VQFN High-Efficiency Configuration (continued)

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, 54 Mbps 802.11g OFDM Signal

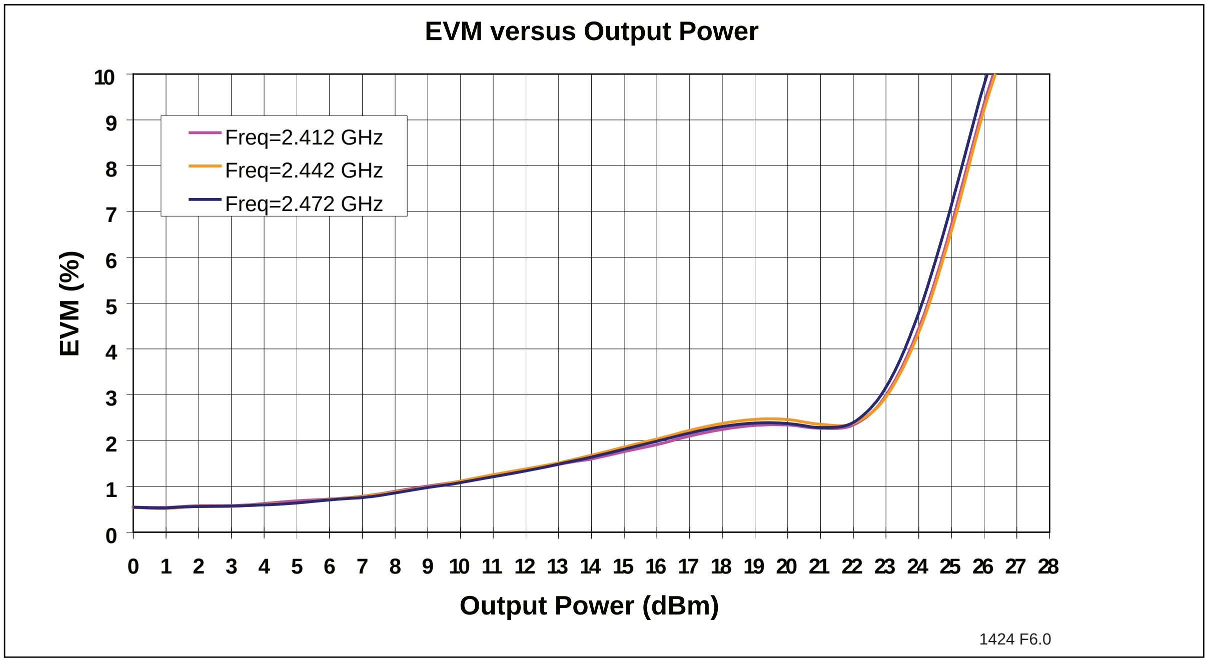


Figure 18: EVM versus Output Power measured with equalizer training set to sequence only

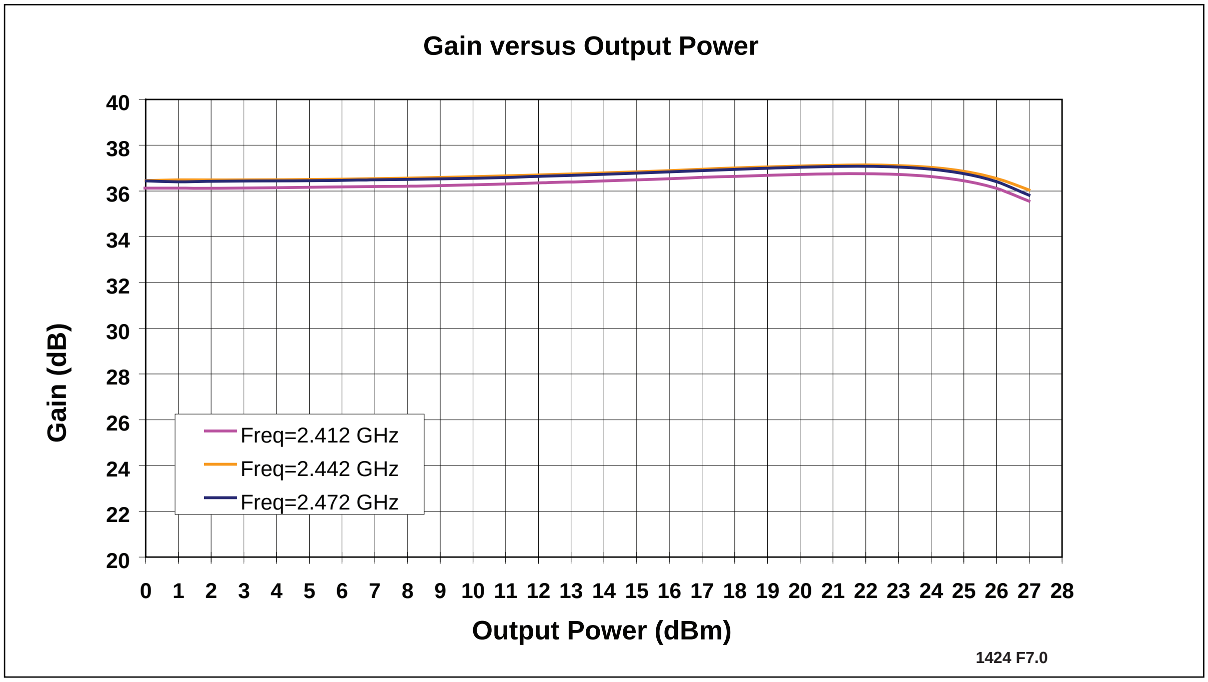


Figure 19: Gain versus Output Power

3mm x 3mm, 16-contact VQFN High-Efficiency Configuration (continued)

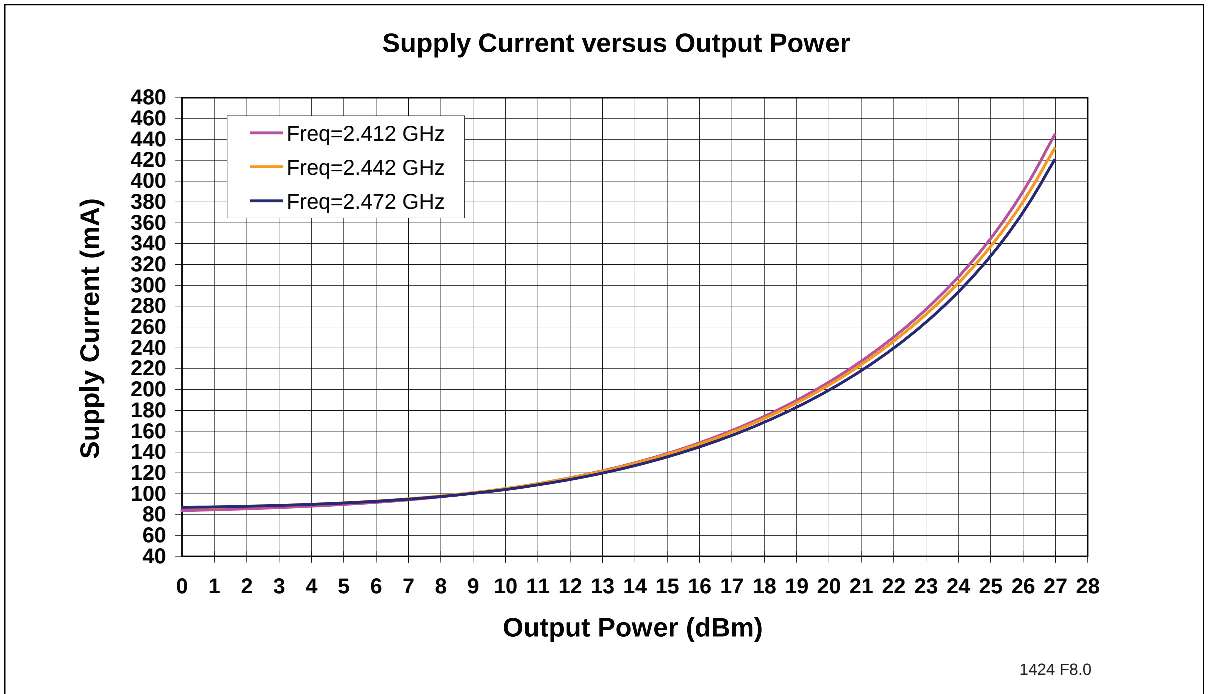


Figure 20: Total Current Consumption for 802.11g operation versus Output Power

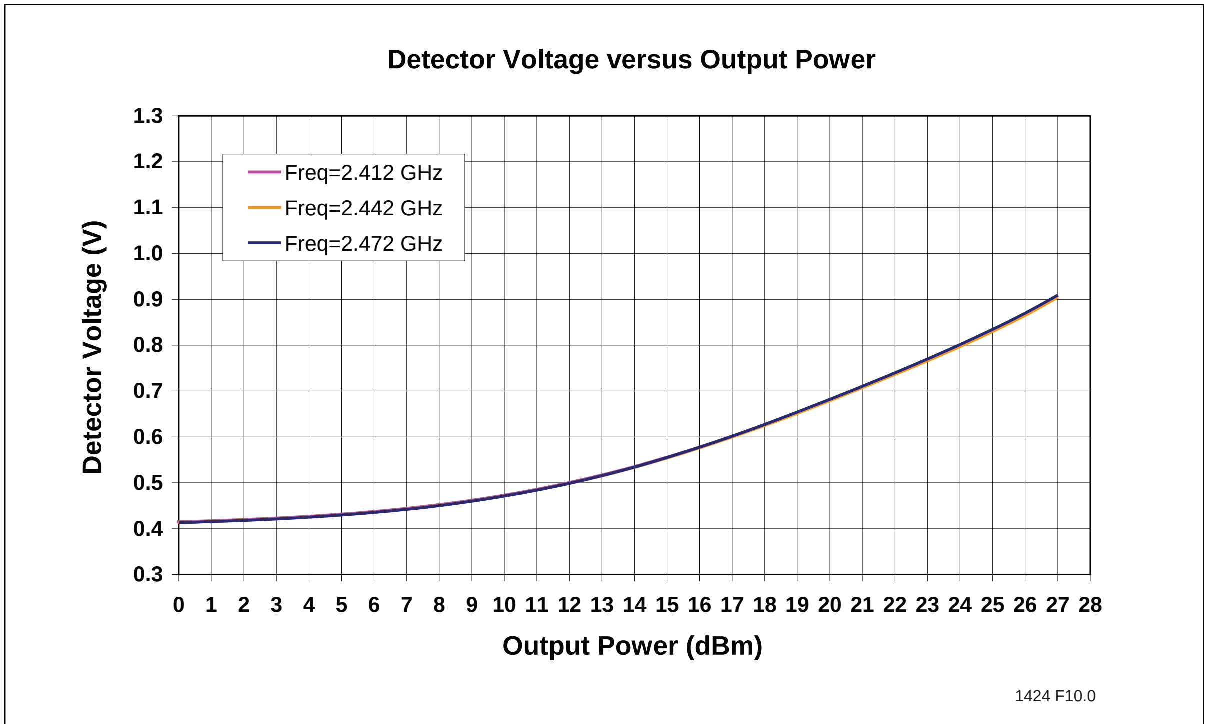


Figure 21: Detector Characteristics versus Output Power

3mm x 3mm, 16-contact VQFN High-Efficiency Configuration (continued)

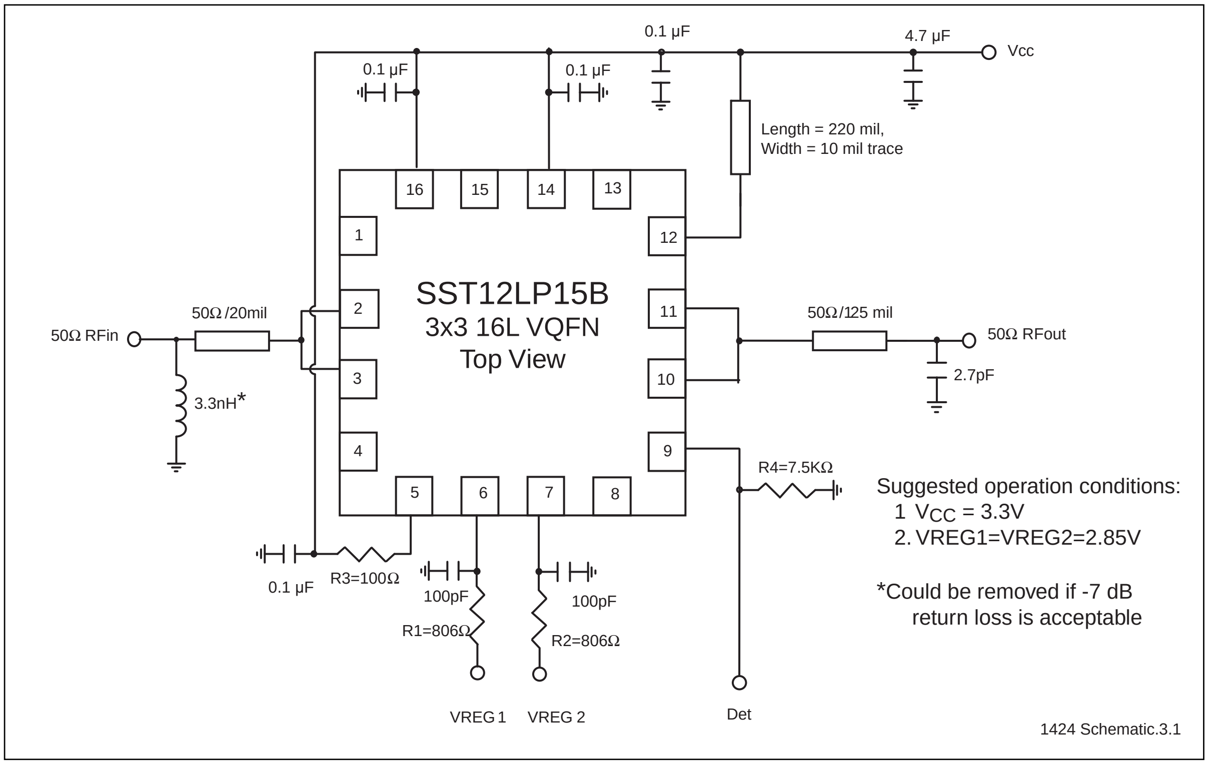


Figure 22: Typical Schematic for High-Linearity 802.11b/g/n Applications for 16-contact VQFN

Product Ordering Information

SST 12 LP 15B - QVCE

XX XX XXX - XXXX

Environmental Attribute
E[1] = non-Pb contact (lead) finish

Package Modifier
C = 16 contact
B = 12 contact

Package Type
QV = VQFN (3mm x 3mm)
QX = XQFN (2mm x 2mm)

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

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

Valid combinations for SST12LP15B

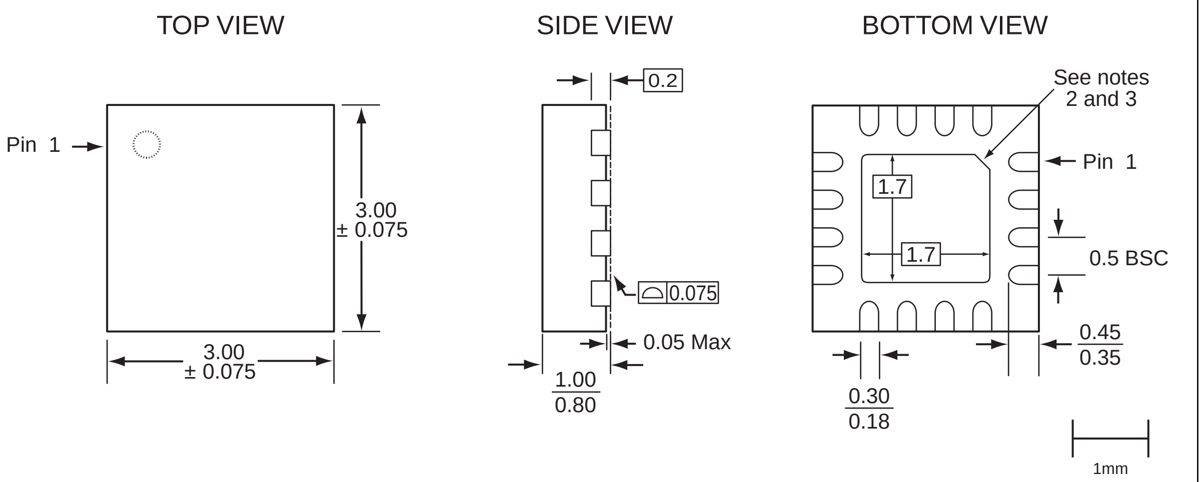
SST12LP15B-QVCE SST12LP15B-QXBE

SST12LP15B Evaluation Kits

SST12LP15B-QVCE-K SST12LP15B-QXBE-K

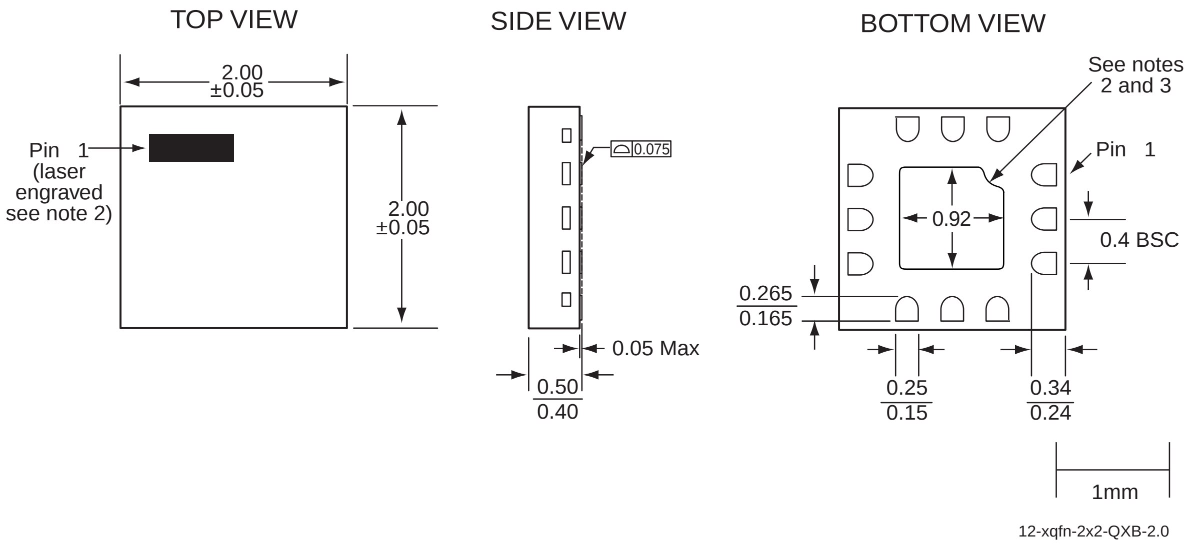
Note: Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.

Packaging Diagrams



Note: 1. Complies with JEDEC JEP95 MO-220J, variant VEED-4 except external paddle nominal dimensions.
2. From the bottom view, the pin 1 indicator ma y be either a 45-degree chamfer or a half-circle notch.
3. The external paddle is electrically connected to the die back-side and possibly to certain V_{SS} leads. This paddle can be soldered to the PC board; it is suggested to connect this paddle to the V_{SS} of the unit. Connection of this paddle to any other voltage potential can result in shorts and/or electrical malfunction of the device.
4. Untoleranced dimensions are nominal target dimensions.
5. All linear dimensions are in millimeters (max/min).

Figure 23: 16-contact Very-thin Quad Flat No-lead (VQFN)
SST Package Code: QVC



Note: 1. Complies with JEDEC JEP95 MO-220J, variant VEED-4 except external paddle nominal dimensions and pull-back of terminals from body edge.
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.
3. The external paddle is electrically connected to the die back-side and possibly to certain V_{SS} leads. This paddle **must** be soldered to the PC board; it is required to connect this paddle to the V_{SS} 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 24: 12-contact Extremely-thin Quad Flat No-lead (XQFN)
SST Package Code: QXB

Table 7: Revision History

Revision	Description	Date
00	• Initial release of data sheet	Mar 2010
01	• Added QVC package to the data sheet. This required changes throughout the document and the addition of the following: Figures 1, 3, 17-22, and 24; Tables 1, 6, and 8. • Changed document status from “Data Sheet” to “Preliminary Specification”	Oct 2010
02	• Added Figures 11 - 16 and Tables 4 and 7	Jan 2011
03	• Updated document status from “Preliminary Specification” to “Data Sheet”	Feb 2011
A	• Applied new document format • Released document under letter revision system • Updated spec number S71424 to DS75029 • Updated XQFN information in Figures 11- 16 • Added package dimensions throughout.	Oct 2012

ISBN:978-1-62076-617-0

Silicon Storage Technology, Inc.
A Microchip Technology Company
www.microchip.com