A Microchip Technology Company

2.4 GHz High-Efficiency Amplifier
SST12LP14E

Data Sheet

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 @ P_{OUT} = 22 dBm for 802.11g
- **Single-pin Low I_{REF} Power-up/-down Control**
  - – I_{REF} <2 mA
- **Low Idle Current**
  - – ~45 mA I_{CQ}
- **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_{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_{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.

Functional Blocks

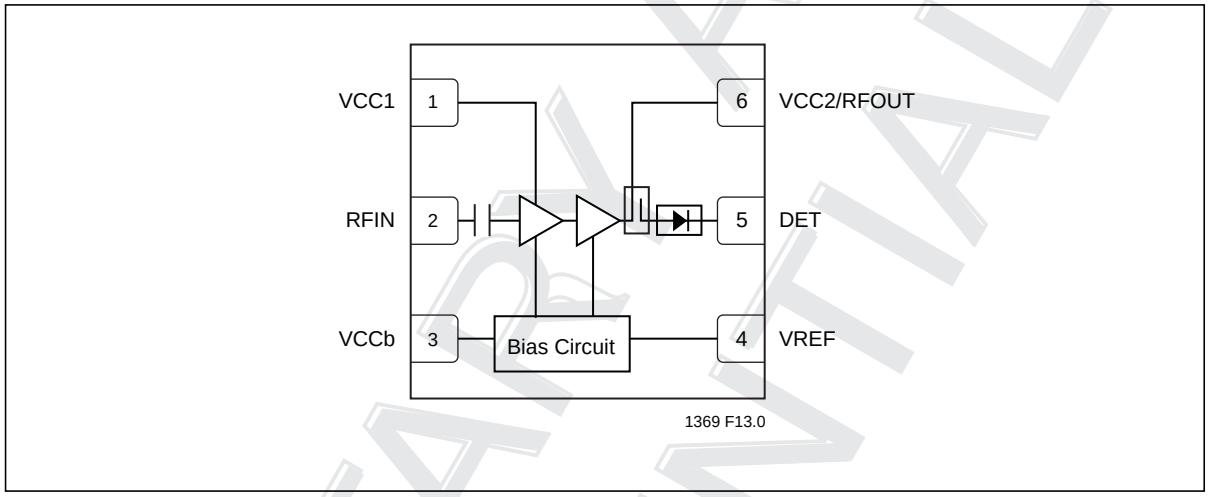

Figure 1: Functional Block Diagram, 6-contact XSON (QX6)

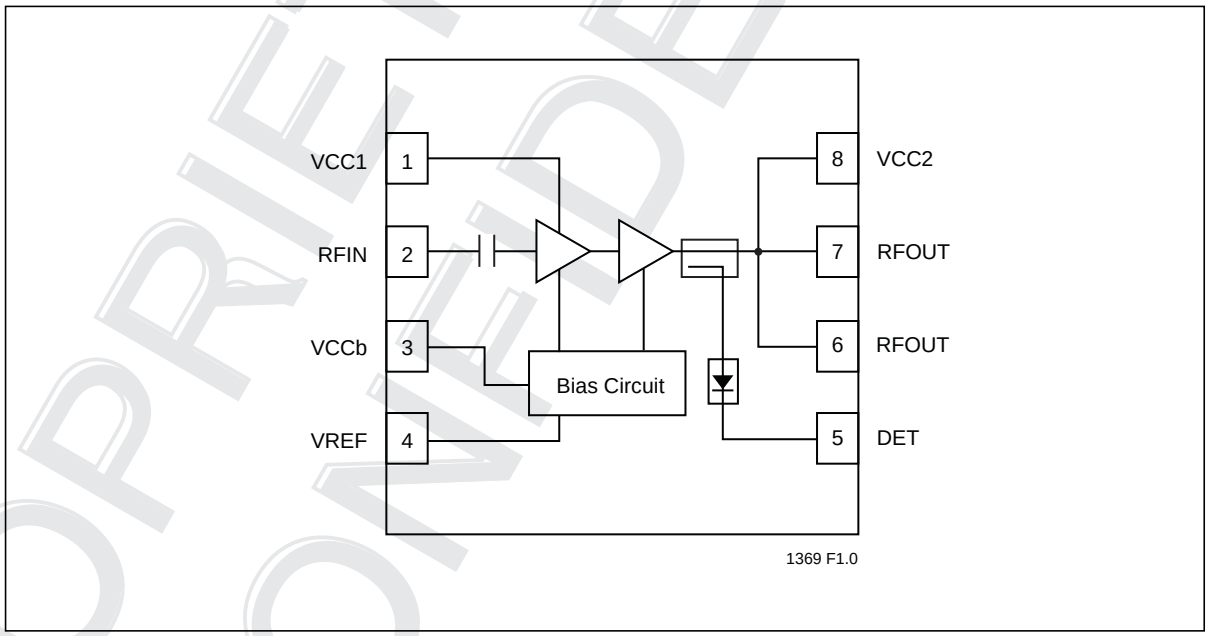

Figure 2: Functional Block Diagram, 8-contact XSON (QX8)

Pin Assignments

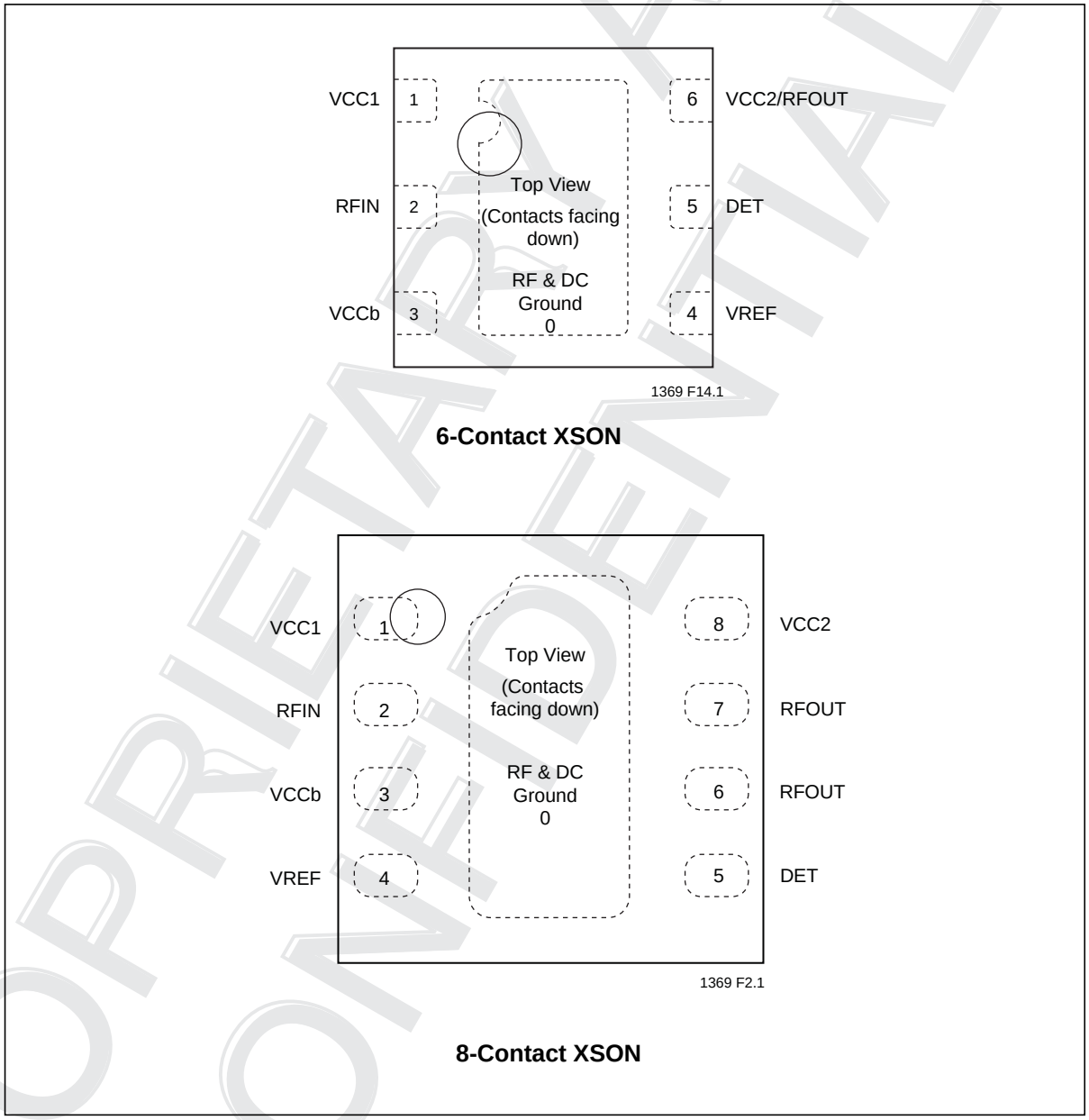

Figure 3: Pin Assignments

Pin Descriptions

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

Symbol	Pin No.	Pin Name	Type[1]	Function
GND	0	Ground		Low inductance GND pad
V_{CC1}	1	Power Supply	PWR	Power supply, 1st stage
RF_{IN}	2		I	RF input, DC decoupled
V_{CCb}	3	Power Supply	PWR	Supply voltage for bias circuit
VREF	4		PWR	1st and 2nd stage idle current control
Det	5		O	On-chip power detector
V_{CC2}/ RFOUT	6	Power Supply	PWR/O	Power supply, 2nd stage/ RF Output

T1.0 75037

1. I=Input, O=Output

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

Symbol	Pin No.	Pin Name	Type[1]	Function
GND	0	Ground		Low inductance GND pad
V_{CC1}	1	Power Supply	PWR	Power supply, 1st stage
RF_{IN}	2		I	RF input, DC decoupled
V_{CCb}	3	Power Supply	PWR	Supply voltage for bias circuit
VREF	4		PWR	1st and 2nd stage idle current control
Det	5		O	On-chip power detector
RFOUT	6		O	RF output
RFOUT	7		O	RF output
V_{CC2}	8	Power Supply	PWR	Power supply, 2nd stage

T2.0 75037

1. I=Input, O=Output

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 (P_{IN}) . . . . . +5 dBm
Average output power (P_{OUT})[1] . . . . . +26 dBm
Supply Voltage at pins 1, 3, and 6 (V_{CC}) for 6-contact XSON . . . . . -0.3V to +5.0V
Supply Voltage at pins 1, 3, and 8 (V_{CC}) for 8-contact XSON . . . . . -0.3V to +5.0V
Reference voltage to pin 4 (V_{REF}) . . . . . -0.3V to +3.3V
DC supply current (I_{CC}) . . . . . 400 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.

Table 3: Operating Range

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

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Table 4: DC Electrical Characteristics @ 25ºC

Symbol	Parameter	Min.	Typ	Max.	Unit	Test Conditions
V_{CC}	Supply Voltage at pins 1,3, and 6 for 6-contact XSON (QX6)	3.0	3.3	4.2	V	
V_{CC}	Supply Voltage at pins 1,3, and 8 for 8-contact XSON (QX8)	3.0	3.3	4.2	V	
I_{CC}	Supply Current for 802.11g, 22 dBm		145		mA	
I_{CQ}	Idle current for 802.11g to meet added EVM < 2.5% @ dBm		45		mA	
I_{OFF}	Shut down current		2.0		µA	
V_{REG}	Reference Voltage for, with 360Ω resistor	2.75	2.85	2.95	V	

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Table 5: AC Electrical Characteristics for Configuration (@25°C)

Symbol	Parameter	Min.	Typ	Max.	Unit
F_{L-U}	Frequency range	2400		2500	MHz
G	Small signal gain	22.5	23.5		dB
G_{VAR1}	Gain variation over band (2400~2485 MHz)			±0.5	dB
G_{VAR2}	Gain ripple over channel (20 MHz)		0.2		dB
ACPR	Meet 11b spectrum mask	21	22		dBm
	Meet 11g OFDM 54 Mbps spectrum mask	21	22		dBm
Added EVM	< 18 dBm output with 11g OFDM 54 Mbps signal			2.5	%
2f, 3f, 4f, 5f	Harmonics at 22 dBm, without external filters		-30		dBc

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Typical Performance Characteristics

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

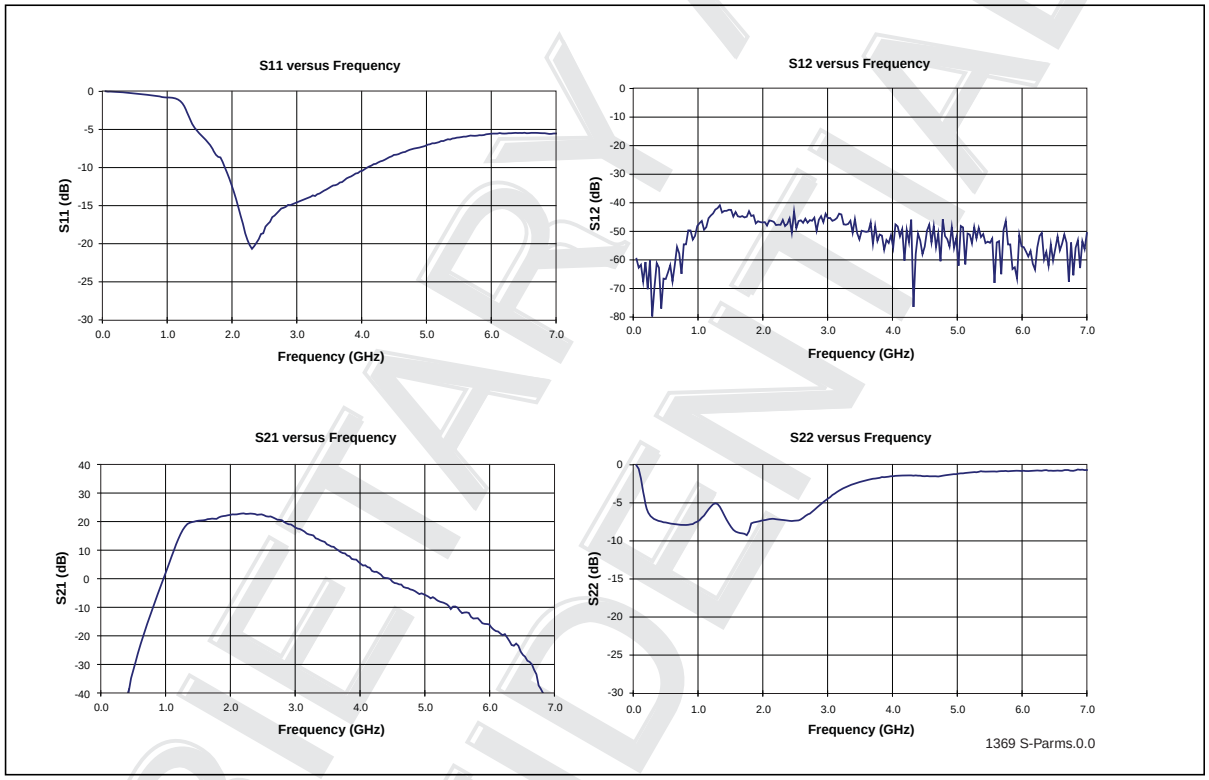


Figure 4: S-Parameters

Typical Performance Characteristics

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

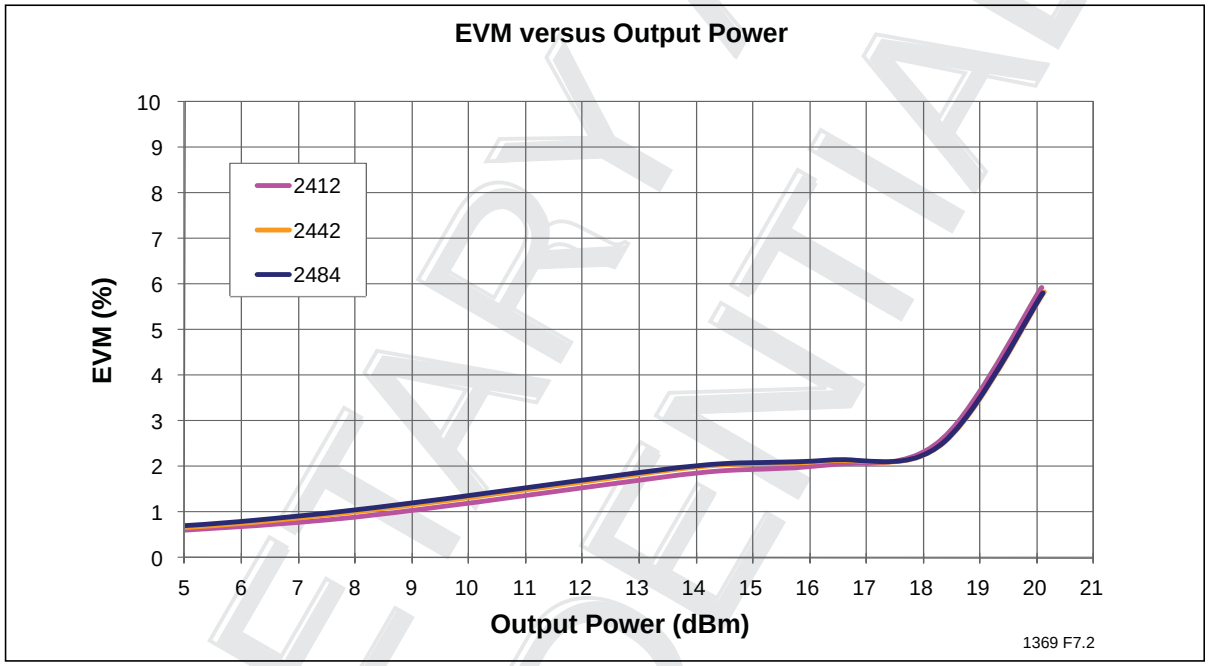


Figure 5: EVM versus Output Power measured using equalizer training with sequence only

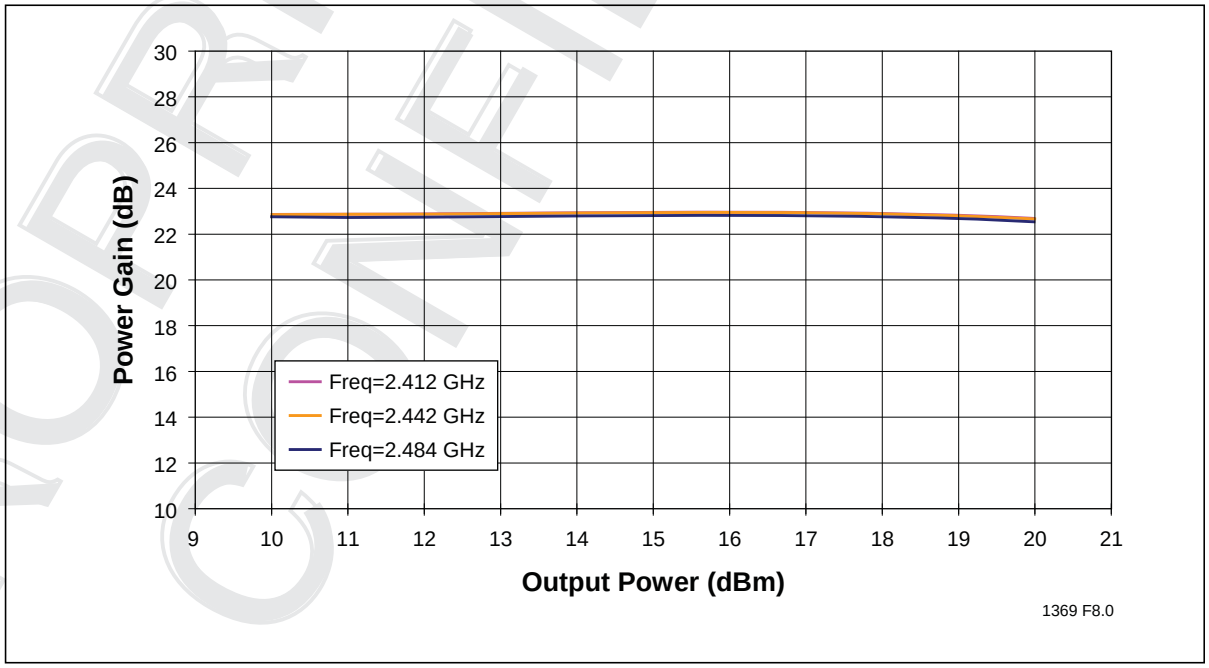


Figure 6: Power Gain versus Output Power

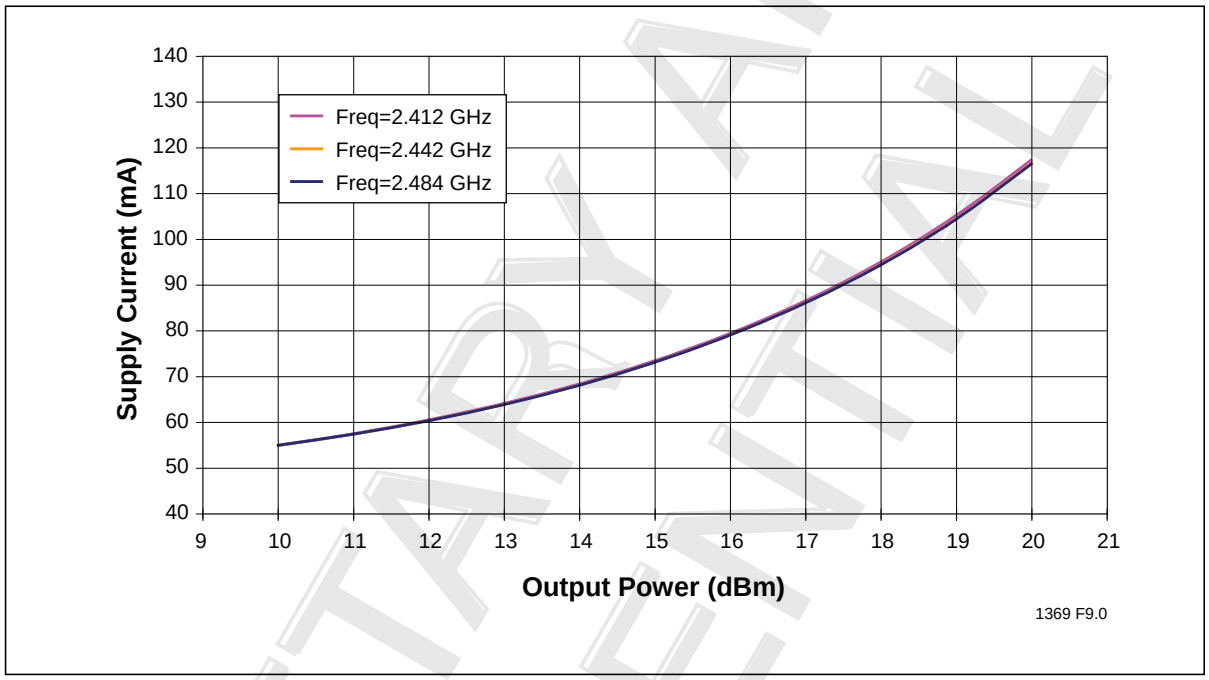


Figure 7: Total Current Consumption for 802.11g operation versus Output Power

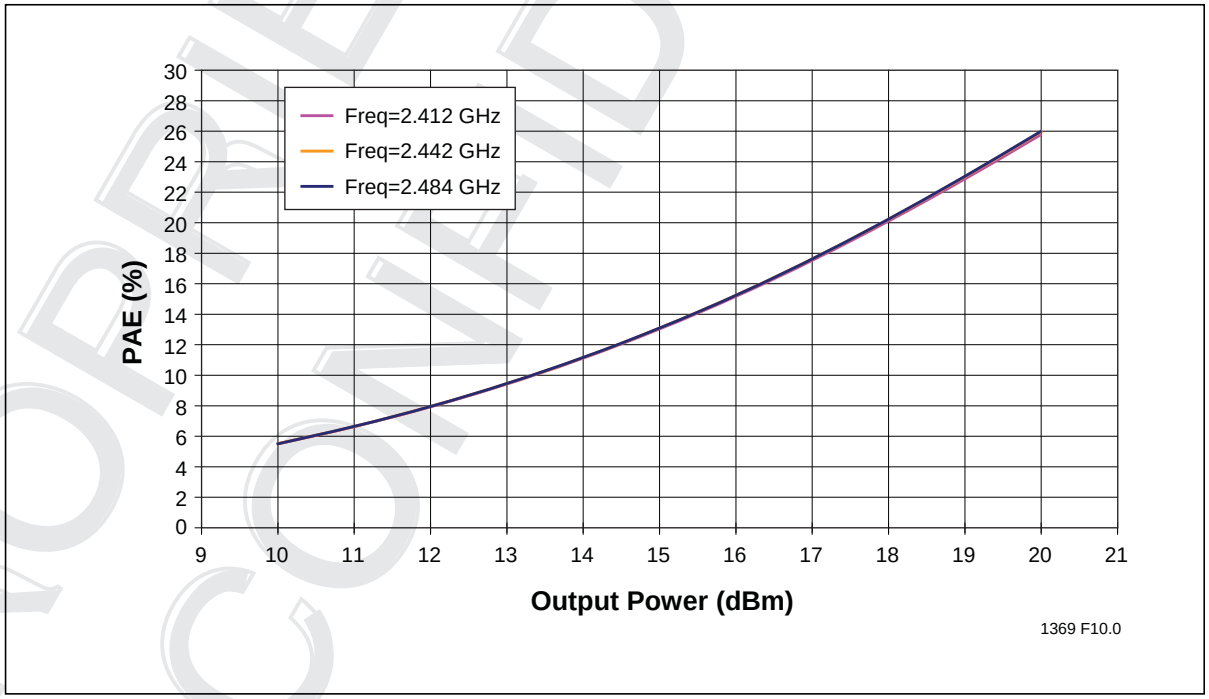


Figure 8: PAE versus Output Power

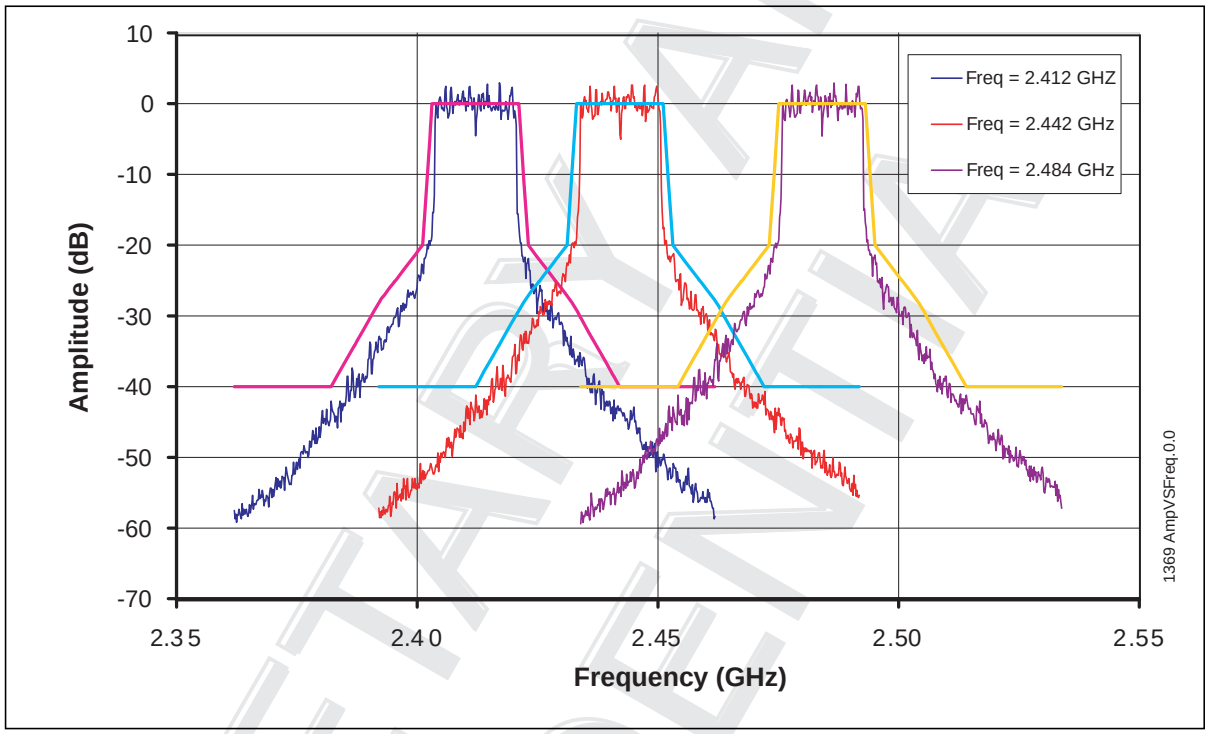


Figure 9: 802.11g Spectrum Mask at 22 dBm

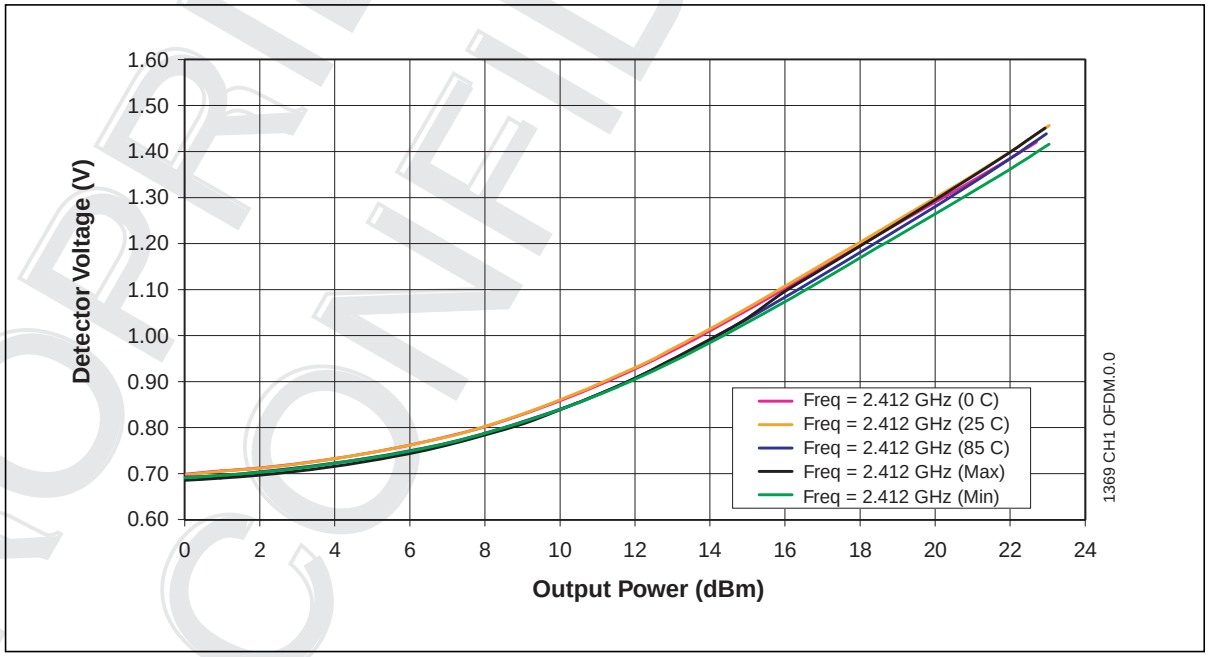


Figure 10: CH1 Detector Characteristics Over Temperature with 2:1 Output VSWR All Phases

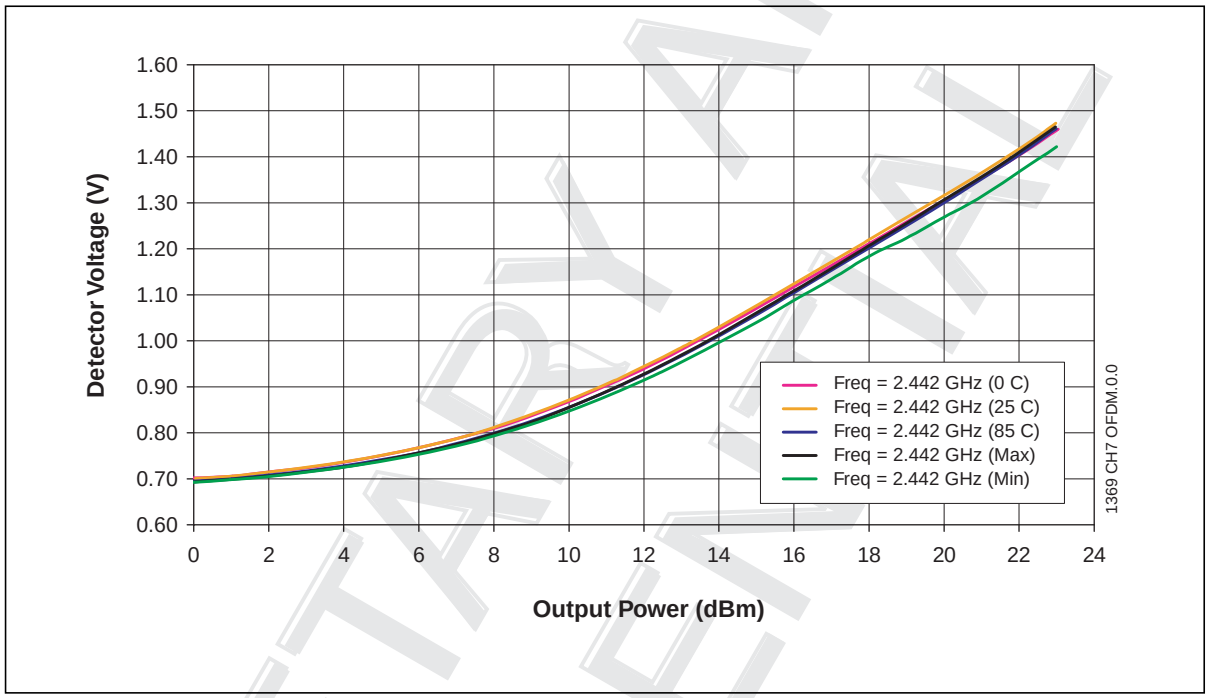


Figure 11: CH7 Detector Characteristics Over Temperature with 2:1 Output VSWR All Phases

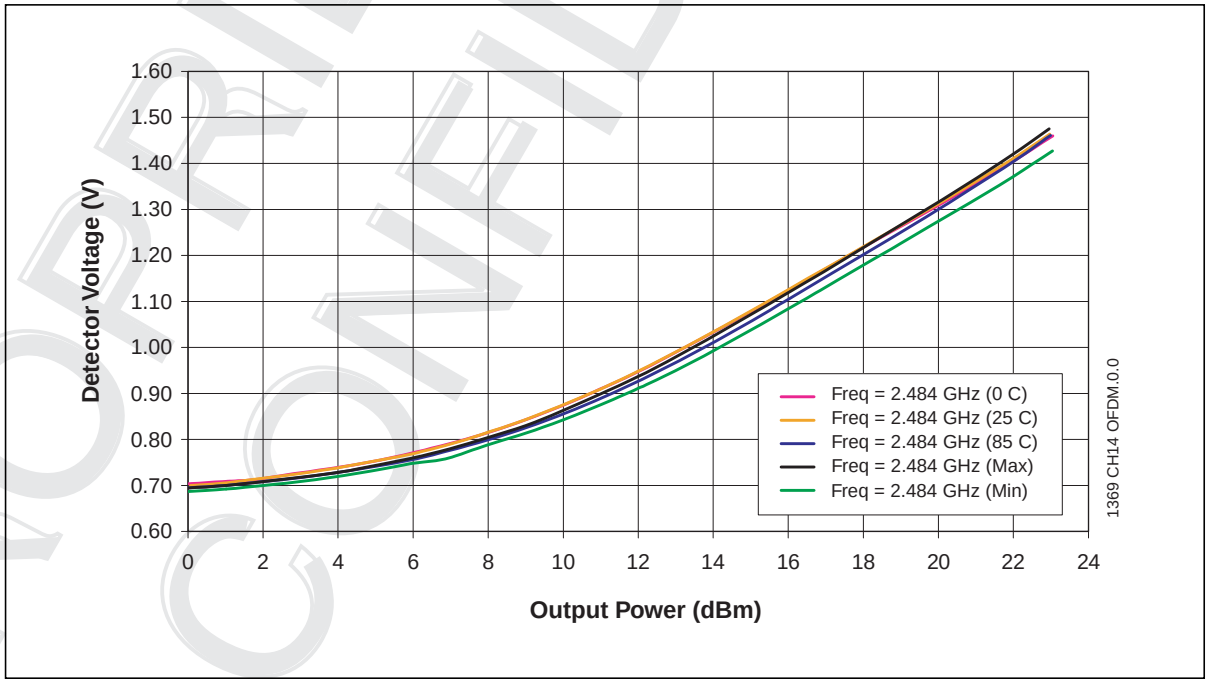


Figure 12: CH14 Detector Characteristics Over Temperature with 2:1 Output VSWR All Phases

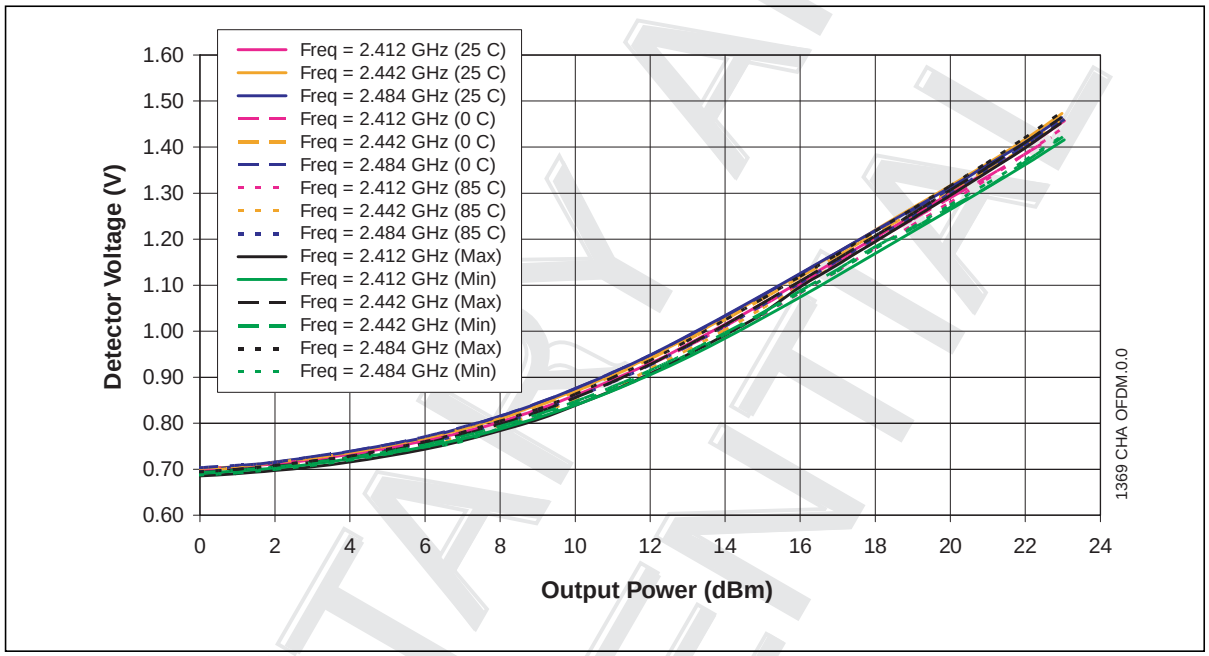


Figure 13: Detector Characteristics Over Temperature and Over Frequency with 2:1 Output VSWR All Phases

Typical Performance Characteristics

Test Conditions: V_{CC} = 3.3V, T_A = 25°C, 1 Mbps 802.11b CCK signal

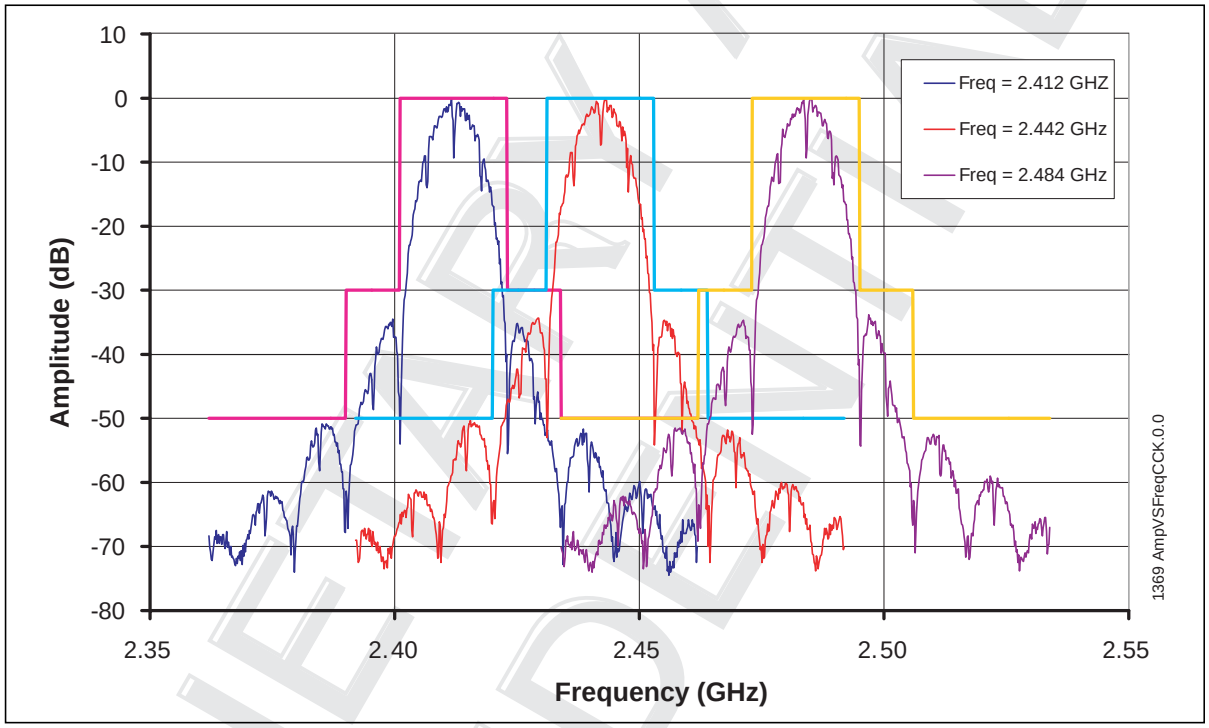


Figure 14: 802.11b Spectrum Mask at 22 dBm

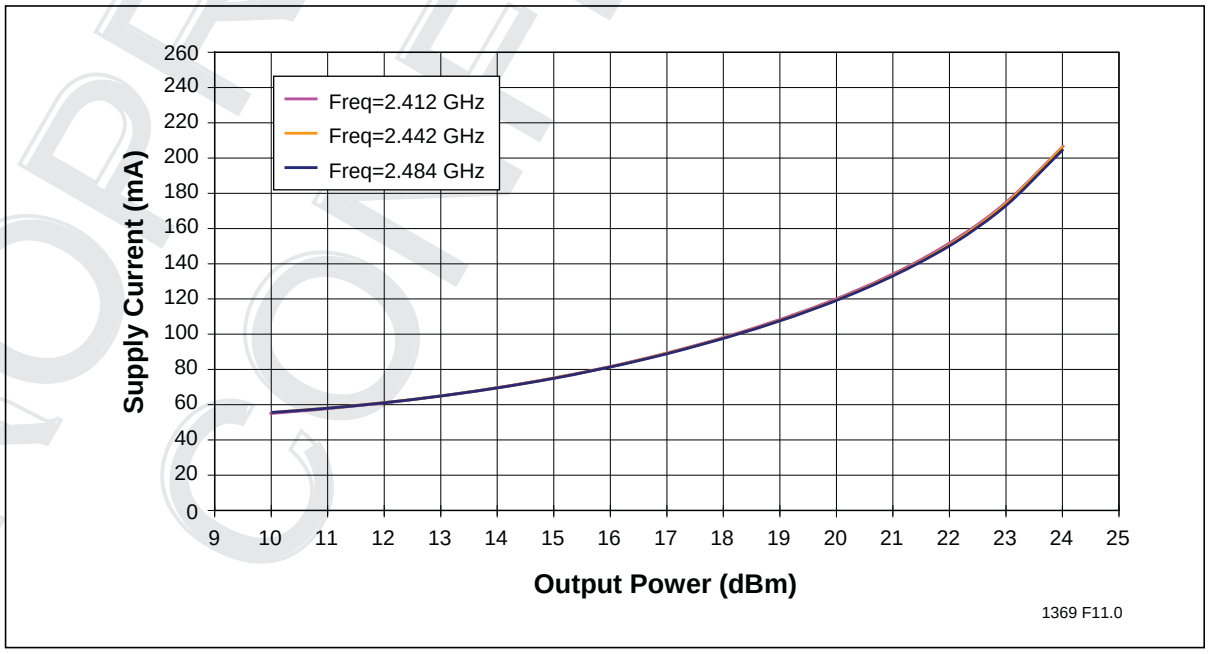


Figure 15: Total Current Consumption for 802.11b Operation versus Output Power

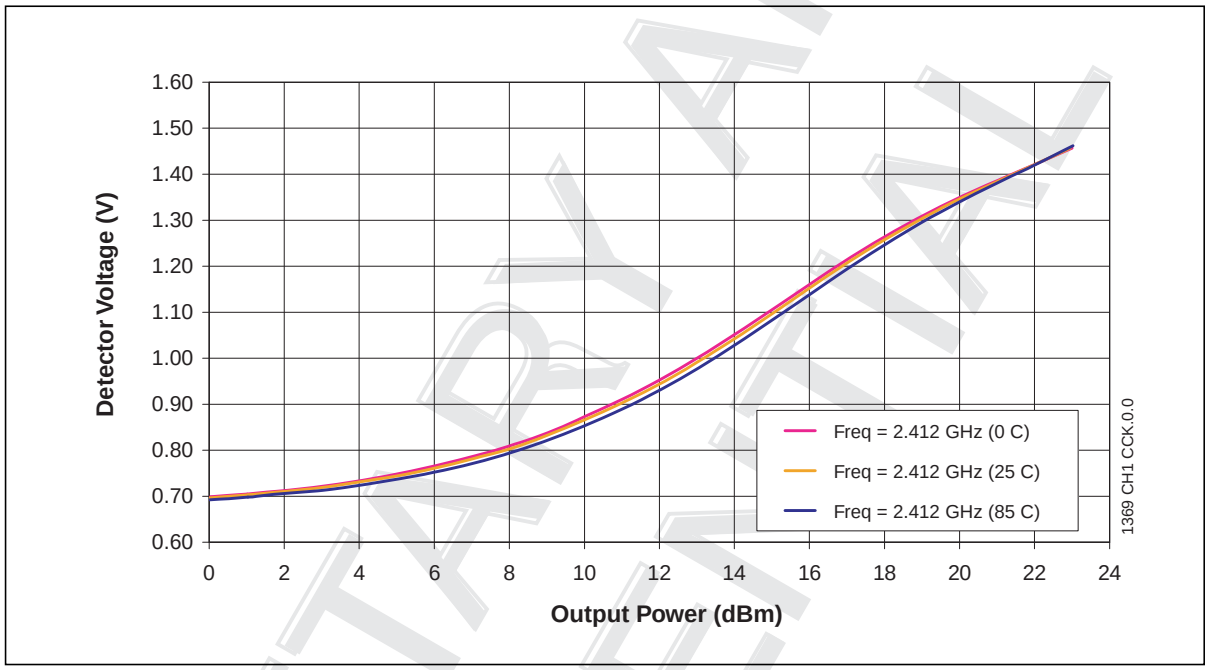


Figure 16: CH1 Detector Characteristics Over Temperature

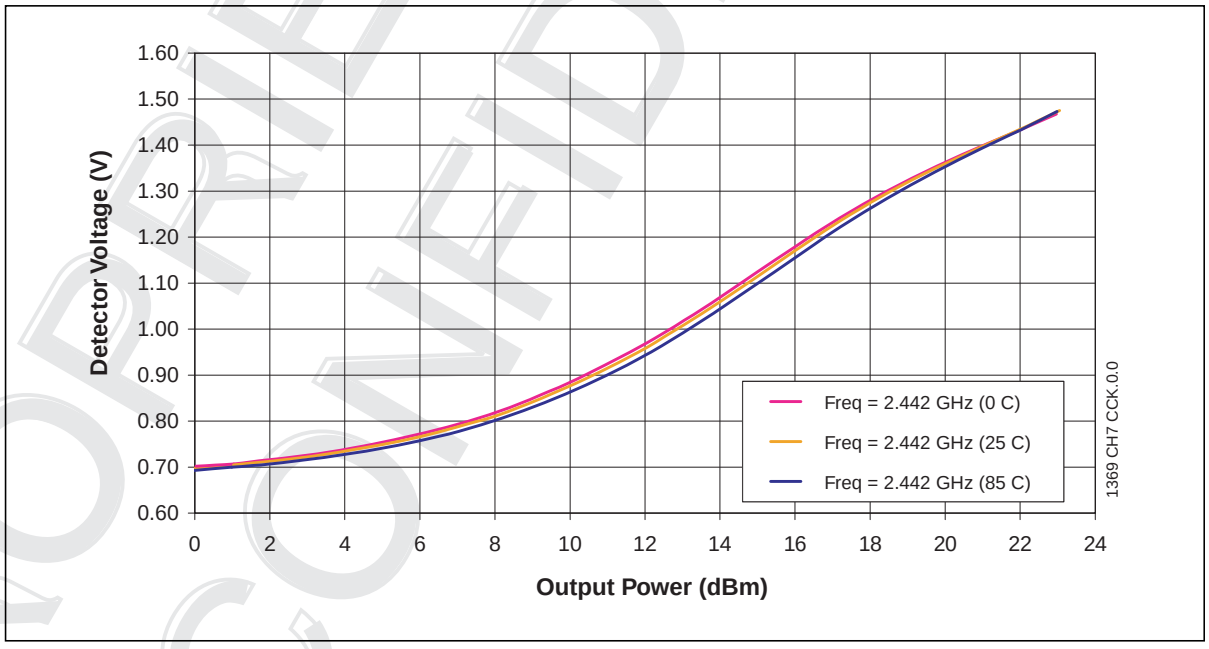


Figure 17: CH7 Detector Characteristics Over Temperature

Typical Performance Characteristics

Test Conditions: V_{CC} = 3.3V, T_A=25°C, 1 Mbps 802.11b CCK signal

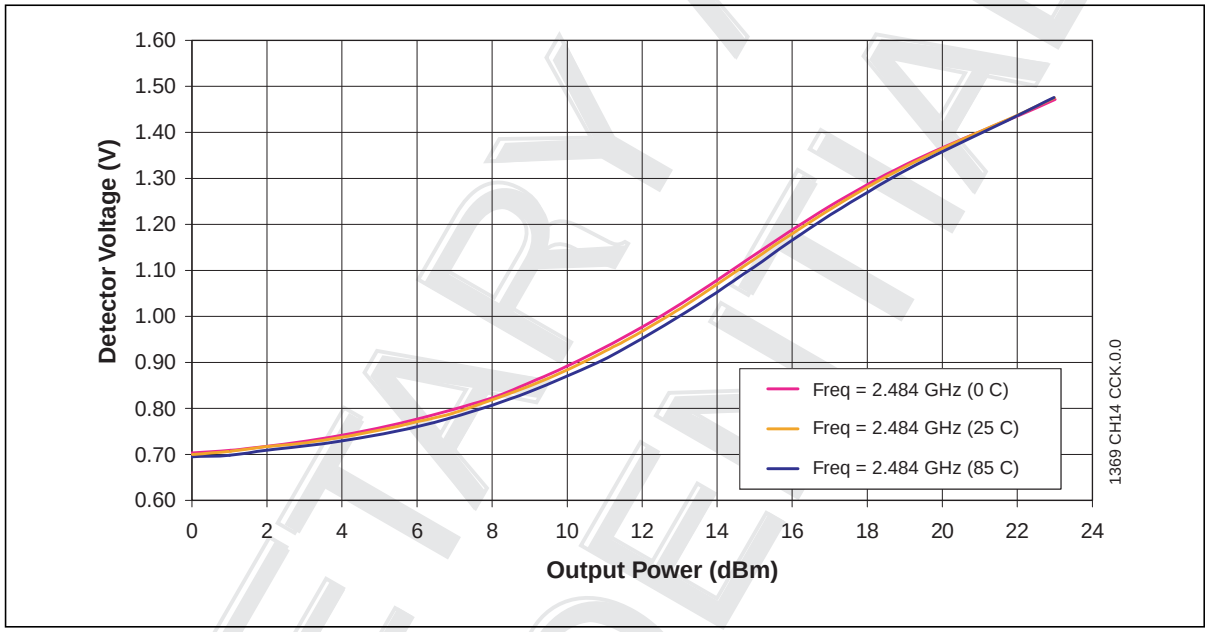


Figure 18: CH14 Detector Characteristics Over Temperature

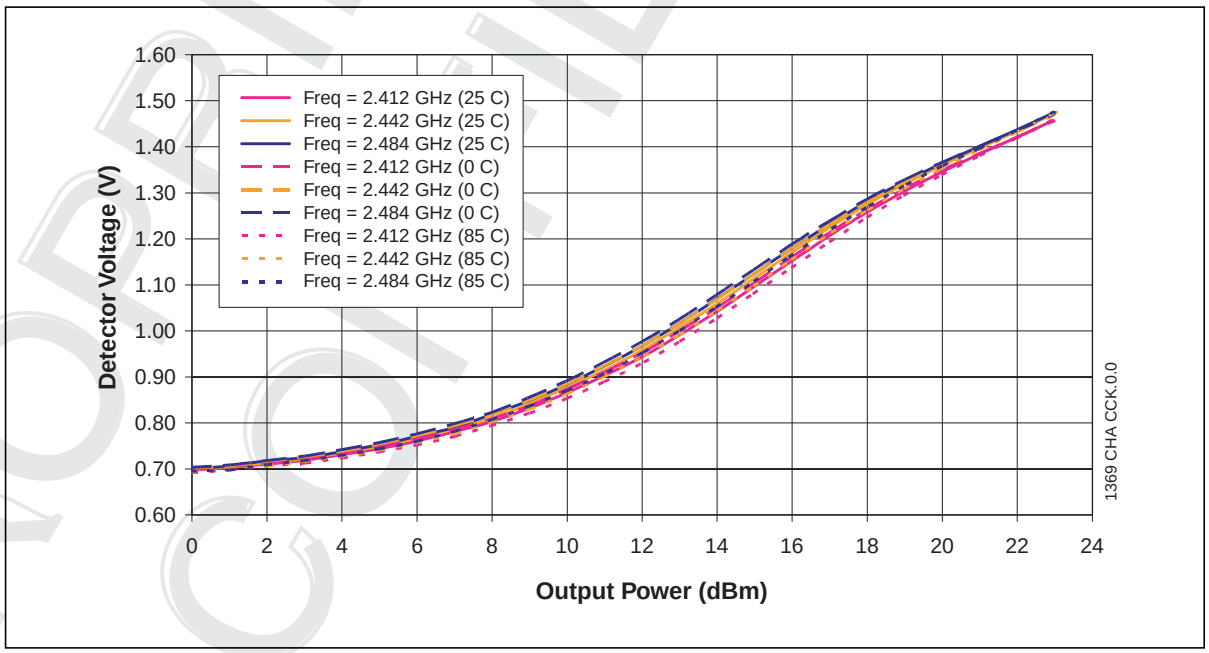


Figure 19: Detector Characteristics Over Temperature and Frequency

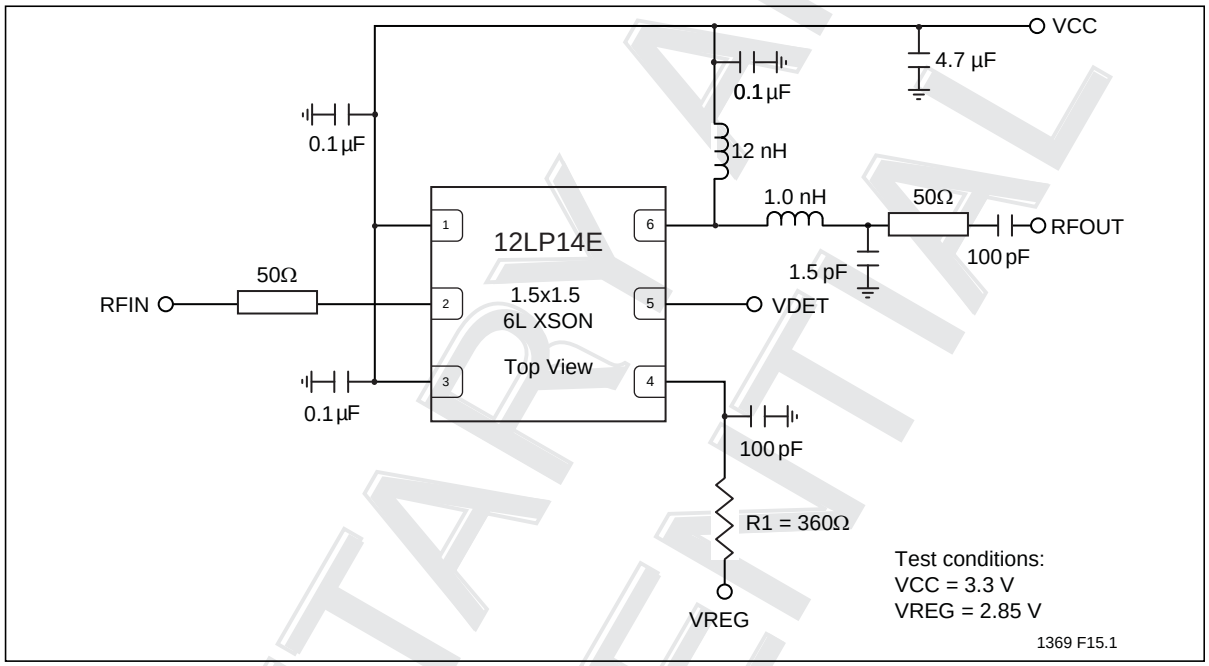


Figure 20: Typical Schematic for 6-contact XSON (QX6)

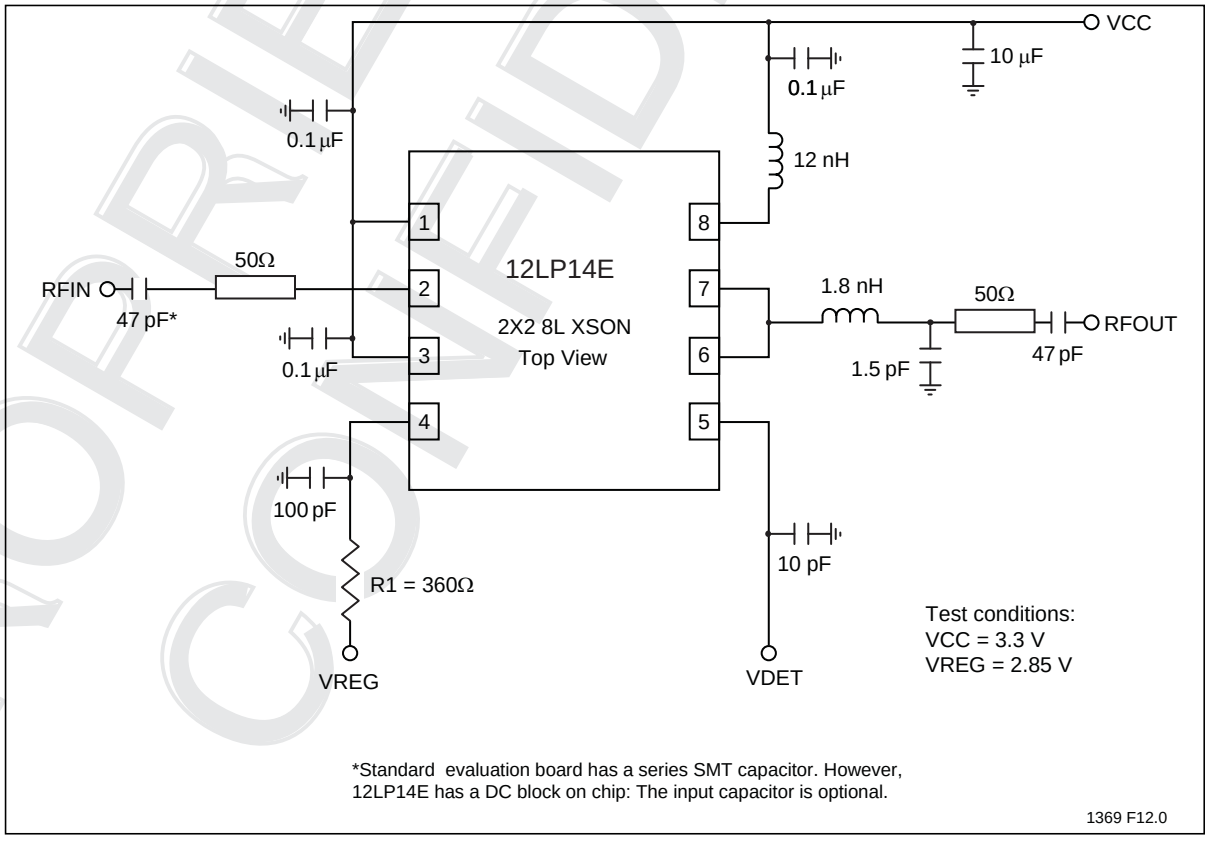
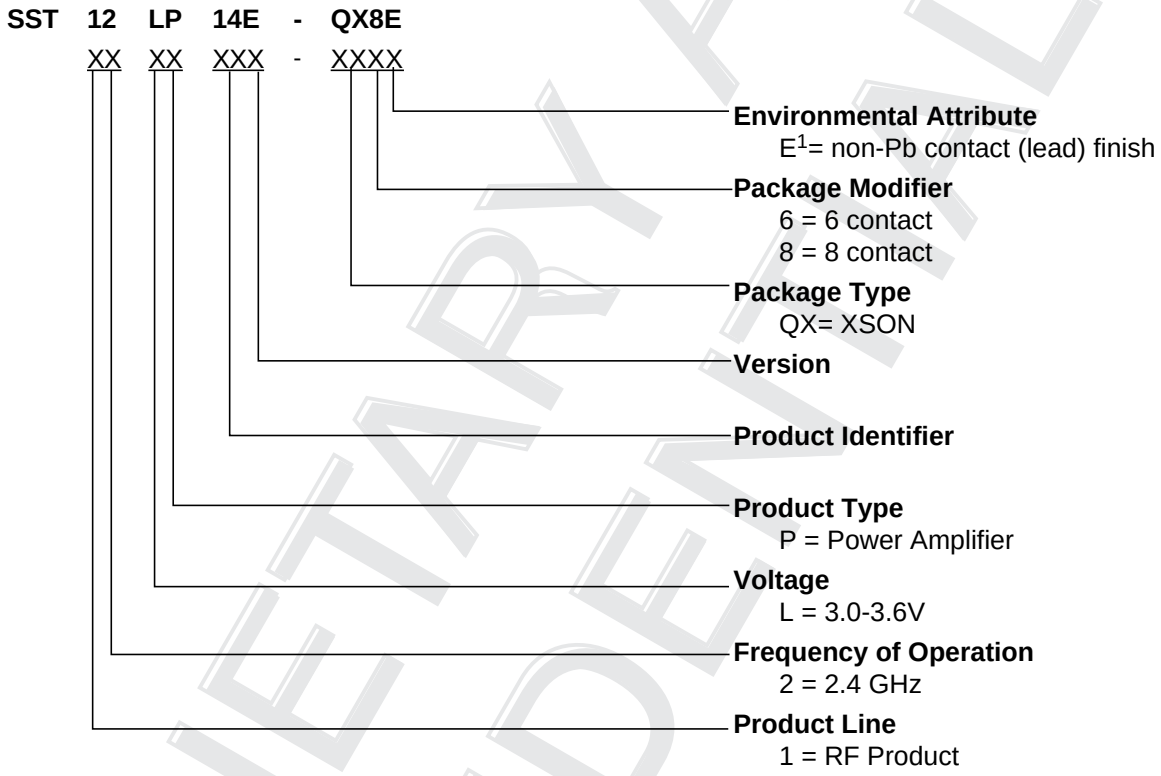


Figure 21: Typical Schematic for 8-contact XSON (QX8)

Product Ordering Information



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

Valid combinations for SST12LP14E

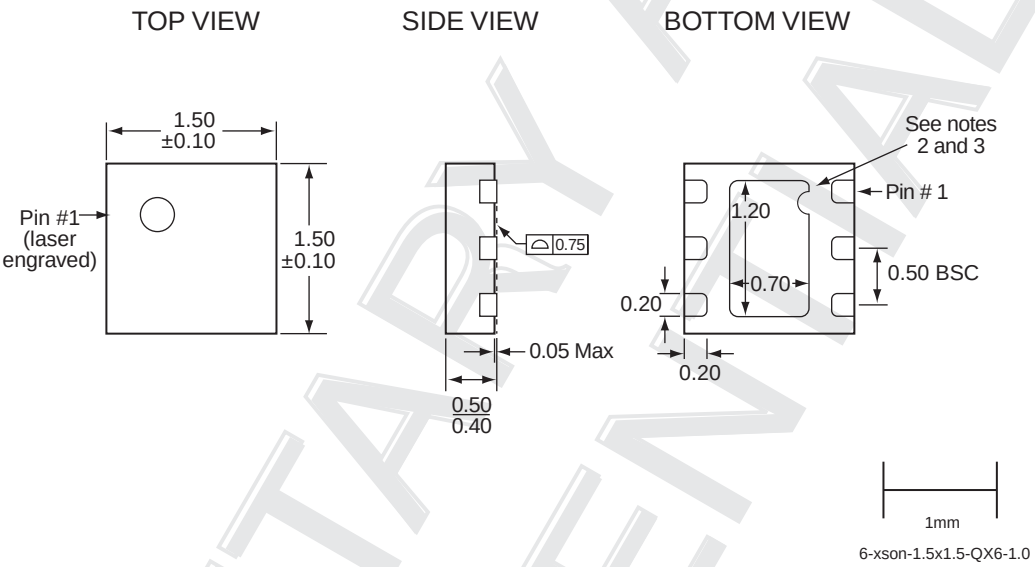
SST12LP14E-QX6E SST12LP14E-QX8E

SST12LP14E Evaluation Kits

SST12LP14E-QX6E-K SST12LP14E-QX8E-K

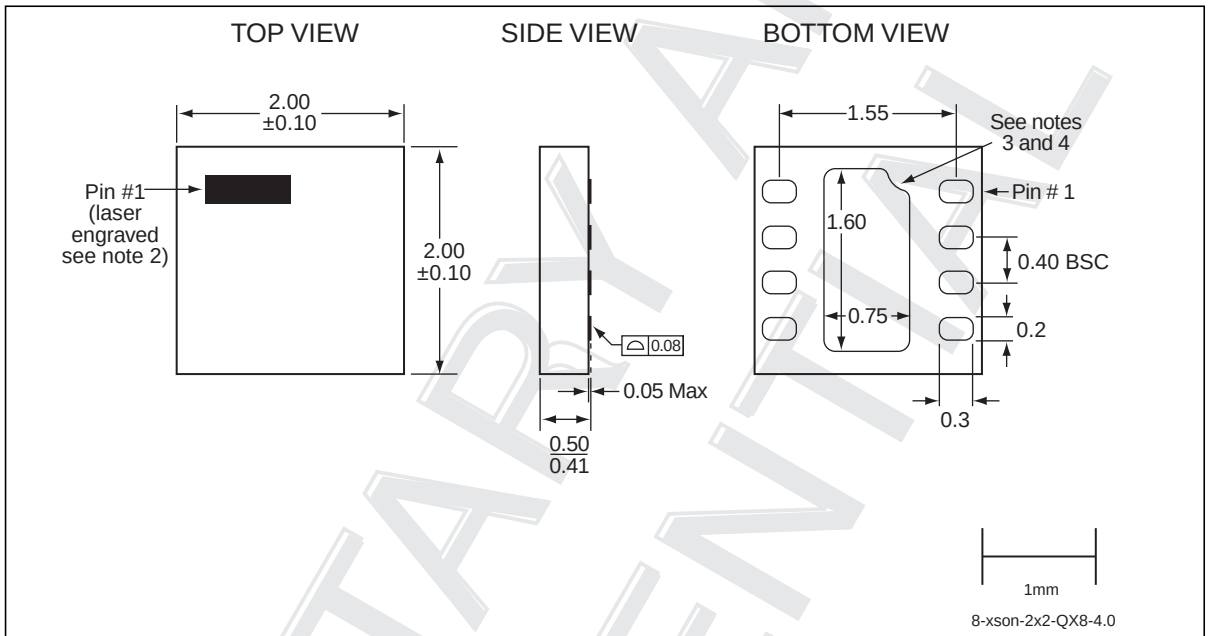
Note: Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.

Packaging Diagrams



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 V_{SS}.
   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 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. 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 V_{SS}.
   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.
5. Untoleranced dimensions are nominal target dimensions.
6. All linear dimensions are in millimeters (max/min).

Figure 23: 8-contact Extra-thin Quad Flat No-lead (XSON)
SST Package Code: QX8

Table 6: Revision History

Revision	Description	Date
00	• Initial release of data sheet	Oct 2007
01	• Changed environmental attribute from “F” to “E” and updated “Product Ordering Information” on page 18 to reflect that change.	Mar 2008
02	• Updated “Features” on page 1 • Revised Table 4 on page 6 • Added “@25°C” to Table 5 title • Updated document status from Preliminary Specification to Data Sheet	May 2008
03	• Revised Table 4 on page 6 and Table 5 on page 7 • Updated “Features” and “Product Description” on page 2 • Updated “Contact Information” on page 20.	Mar 2009
04	• Added package QX6 including updates to “Product Description”, “Functional Blocks”, “Pin Assignments”, and “Electrical Specifications”	May 2009
A	• Applied new document format • Released document under letter revision system • Updated spec number from S71369 to DS75037	Nov 2011
B	• Updated Figure 23 on page 20 to reflect new Pin1 indicator • Made a slight modification to the “High Temperature Stability” feature bullet on page 1 • Updated Figure 5 on page 9	Jun 2012

ISBN:978-1-62076-349-0

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