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## 2.4 GHz High-Gain, High-Efficiency Front-end Module

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### FEATURES

- Input/output ports internally matched to 50Ω and DC decoupled
- Package available
  - 16-contact XQFN – 2.5mm x 2.5mm x 0.4mm
- All non-Pb (lead-free) devices are RoHS compliant

### Transmitter Chain

- Gain:
  - Typically 24 dB gain
- Dynamic linear output power:
  - Meets 802.11g OFDM ACPR requirement up to 21 dBm
  - 3% EVM up to 17 dBm for 802.11g, 54 Mbps
  - 1.75% dynamic EVM up to 15 dBm for 256 QAM, 40 MHz bandwidth
- Operating current for 802.11g/n applications
  - 170mA @  $P_{OUT} = 17$  dBm for 802.11g
  - 130 mA @  $P_{OUT} = 15$  dBm for 802.11n
- PA Control current,  $I_{PEN} < 2$ mA
- Idle current,  $I_{CQ} : 105$ mA
- Low shut-down current: ~2 μA
- Power-up/down control
  - Turn on/off time (10%–90%) <400 ns
- Limited variation over temperature
  - ~1 dB gain/power variation between -40°C to +85°C
- Linear on-chip power detection
  - Load and temperature insensitive
  - >20 dB dynamic range on-chip power detection

### Receiver Chain

- Gain: Typically 13 dB gain
- Noise figure: Typically 2.5 dB
- Receiver input P1dB: Typically -6 dBm
- LNA bypass loss: Typically 9 dB

### Bluetooth® Chain

- Loss: 1.0 dB
- Output P1dB: >25 dBm

### APPLICATIONS

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

### 1.0 PRODUCT DESCRIPTION

SST12LF09 is a 2.4 GHz Front-end Module (FEM) designed in compliance with IEEE 802.11b/g/n applications. Based on GaAs pHEMT/HBT technology, it combines a high-performance Power Amplifier (PA), a low-noise amplifier (LNA) and an antenna Tx/Rx switch (SW). The input/output RF ports are single-ended and internally matched to 50 Ω. These RF ports are DC decoupled, and require no DC-blocking capacitors or matching components. This helps reduce the system board Bill of Materials (BOM) cost.

There are two components to the FEM: the Transmitter (TX) chain and the Receiver (RX) chain.

The TX chain includes a high-efficiency PA based on the InGaP/GaAs HBT technology. The transmitter is optimized for high linearity, 802.11n and 256 QAM operation—typically providing 15 dBm with 1.75% dynamic EVM for 256 QAM, 40 MHz operation and 17 dBm at 3% for 802.11g, 54 Mbps operation.

SST12LF09 has an excellent transmitter on-chip, single-ended power detector that is stable over temperature and insensitive to output VSWR. It features a wide dynamic-range (20 dB) with dB-wise linear operation. The on-chip power detector provides a reliable solution to board-level power control.

The Rx chain provides typically 13 dB gain with 2.5 dB noise figure. With the LNA bypassed, the receiver loss is typically 9 dB. SST12LF09 also features a Bluetooth® path with typically 1.0 dB loss.

SST12LF09 is offered in a 16-contact X2QFN package. See [Figure 3-1](#) for pin assignments and [Table 4-1](#) for pin descriptions.



### 3.0 PIN ASSIGNMENTS

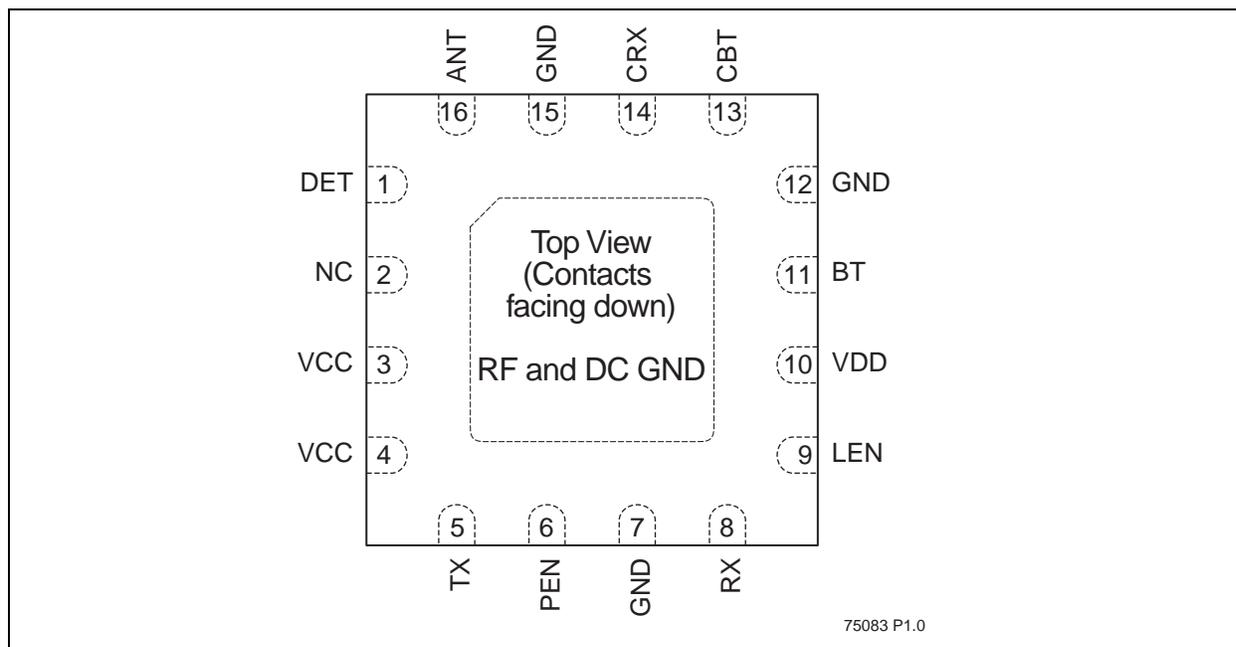


FIGURE 3-1: PIN ASSIGNMENTS FOR 16-CONTACT X2QFN

### 4.0 PIN DESCRIPTIONS

TABLE 4-1: PIN DESCRIPTION

Symbol	Pin No.	Pin Name	Type <sup>1</sup>	Function
DET	1		O	Detector output voltage ground
NC	2			No connect
VCC	3	Power Supply	PWR	Supply voltage PA
VCC	4	Power Supply	PWR	Supply voltage PA
TX	5		I	RF transmit input
PEN	6		I	PA enable
GND	7	Ground		Ground pad
RX	8		O	Rx output
LEN	9			LNA enable
VDD	10		PWR	Supply voltage LNA
BT	11			Bluetooth RF port
GND	12	Ground		Ground pad
CBT	13			Bluetooth switch control
CRX	14			Receiver switch control voltage
GND	15	Ground		Ground Pad
ANT	16		I/O	Antenna

1. I=Input, O=Output

## 5.0 ELECTRICAL SPECIFICATIONS

The DC and RF specifications for the power amplifier are specified below. Refer to [Table 5-2](#) for the DC voltage and current specifications.

**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.)

Tx input power to pin 5 (TX)	+5 dBm
Rx input power to pin 16 (ANT with LNA ON)	+5 dBm
Average Tx output power from pin 16 (ANT) <sup>1</sup>	+26 dBm
Supply Voltage at pins 3 and 4 (V <sub>CC</sub> )	-0.3V to +5.5V
Supply Voltage at pin 10 (V <sub>DD</sub> )	-0.3V to +5.5V
PA Enable Voltage to pin 6 (PEN)	-0.3V to +3.6V
DC supply current (I <sub>CC</sub> ) <sup>2</sup>	400 mA
DC supply current (I <sub>DD</sub> ) <sup>2</sup>	400 mA
Operating Temperature (T <sub>A</sub> )	-40°C to +85°C
Storage Temperature (T <sub>STG</sub> )	-40°C to +120°C
Maximum Junction Temperature (T <sub>J</sub> )	+150°C
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. Measured with 100% duty cycle 54 Mbps 802.11g OFDM Signal

**TABLE 5-1: OPERATING RANGE**

Range	Ambient Temp	V <sub>CC</sub>
Extended	-40°C to +85°C	3.0-5.0V

**TABLE 5-2: DC ELECTRICAL CHARACTERISTICS AT 25°C FOR TX CHAIN**

Symbol	Parameter	Min.	Typ	Max.	Unit
V <sub>CC</sub>	Supply Voltage at pins 3 and 4	3.0	3.6	5.0	V
V <sub>DD</sub>	Supply Voltage at pin 10	3.0	3.6	5.0	V
I <sub>CQ</sub>	Tx Idle current for 802.11g to meet EVM ~3% @ 17 dBm		105		mA
V <sub>PEN</sub>	Tx Enable Voltage	3.05	3.10	3.15	V
I <sub>CC</sub>	Tx Supply Current for 11g OFDM 54 Mbps signal, P <sub>OUT</sub> = 17 dBm		170		mA
I <sub>DD</sub>	Rx Supply Current (with LNA ON)		9		mA

TABLE 5-3: TX CHAIN RF CHARACTERISTICS AT 25°C

Symbol	Parameter	Min.	Typ	Max.	Unit
F <sub>L-U</sub>	Frequency range	2.4		2.5	GHz
Linearity,	Output Power with <3% EVM, 802.11g @ 54 Mbps OFDM		17		dBm
	Output Power level 1.75% Dynamic EVM, 256 QAM, 40 MHz		15		dBm
	Output Power level 2.5% Dynamic EVM, 802.11n, HT40		16		dBm
G	Gain	22	24		dB
RL <sub>IN</sub>	Input return loss at TX port		14		dB
V <sub>DET</sub>	Power detector output voltage 5<P <sub>OUT</sub> <22 dBm	0.4		0.95	V
2f, 3f, 4f, 5f	Harmonics at 17 dBm			-30	dBm/ MHz

TABLE 5-4: RX CHAIN RF CHARACTERISTICS AT 25°C

Symbol	Parameter	Min.	Typ	Max.	Unit
F <sub>L-U</sub>	Frequency range	2.4		2.5	GHz
G	Gain, with LNA ON		13		dB
NF	Noise figure, with LNA ON		2.5		dB
IP1dB	Input P1dB, with LNA ON		-6		dBm
Loss	LNA bypassed		9		dB
RL <sub>IN</sub>	Input return loss at Antenna port with LNA		12		dB

TABLE 5-5: BLUETOOTH CHAIN RF CHARACTERISTICS AT 25°C

Symbol	Parameter	Min.	Typ	Max.	Unit
F <sub>L-U</sub>	Frequency range	2.4		2.5	GHz
L	Loss		1.0		dB
RL	Return Loss		12		dB

TABLE 5-6: CONTROL VOLTAGES<sup>1</sup>

Function	PEN	CRX	LEN	CBT
Transmit mode	3.1V	0	0	0
Bluetooth	0	0	0	3
Receive mode, LNA on	0	3	3	0
Receive mode, LNA bypass	0	3	0	0
OFF	0	0	0	0

1. No other operating modes are allowed

6.0 TYPICAL PERFORMANCE CHARACTERISTICS

Transmitter

Test Conditions:  $V_{CC} = 3.6V$ ,  $PEN = 3.10V$ ,  $LEN = 0V$ ,  $CRX = 0V$ ,  $CBT = 0V$ ,  $T_A = 25^\circ C$ , unless otherwise specified

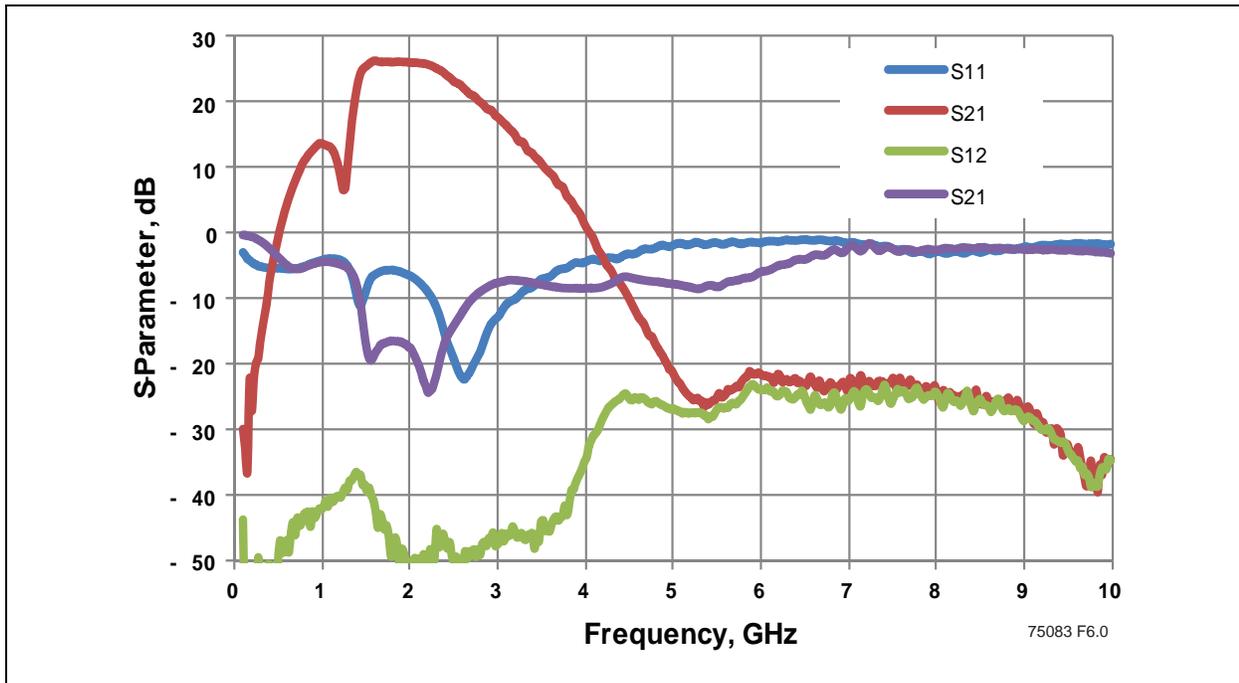


FIGURE 6-1: S-PARAMETERS

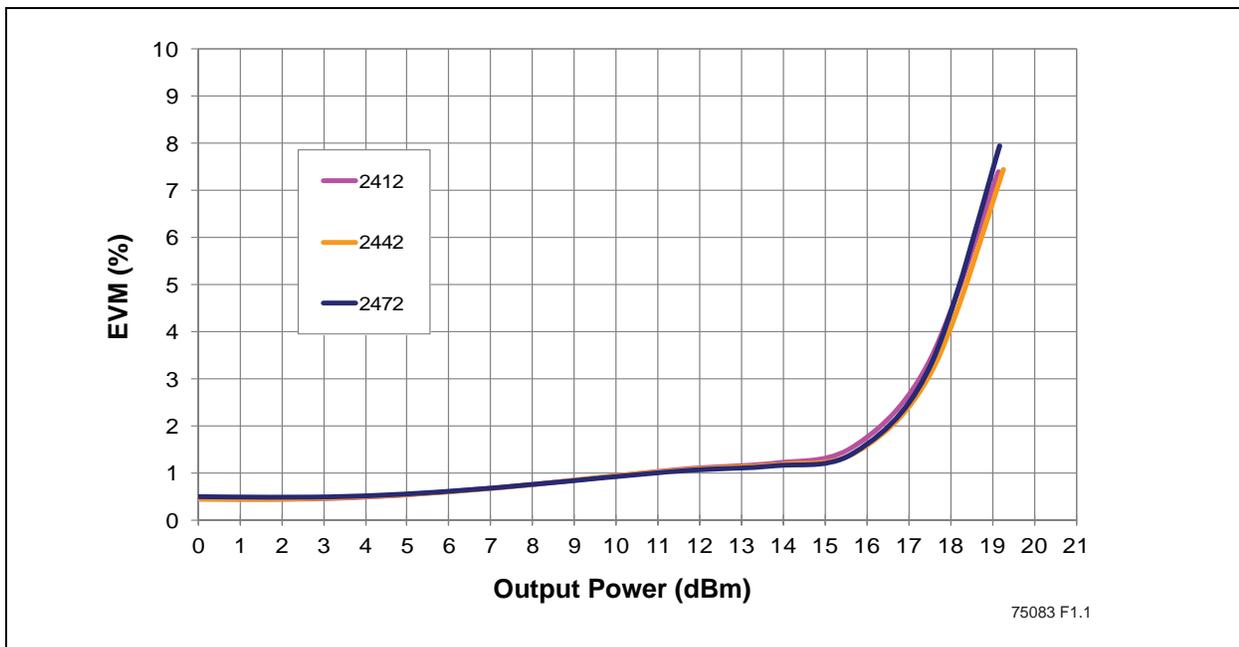
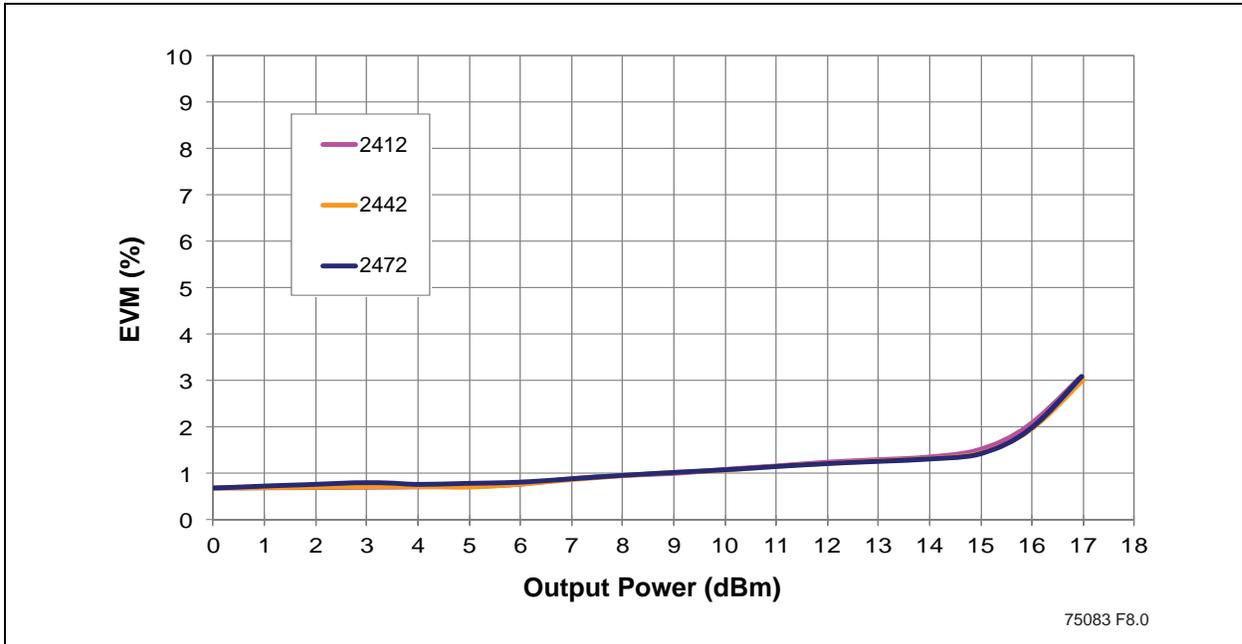
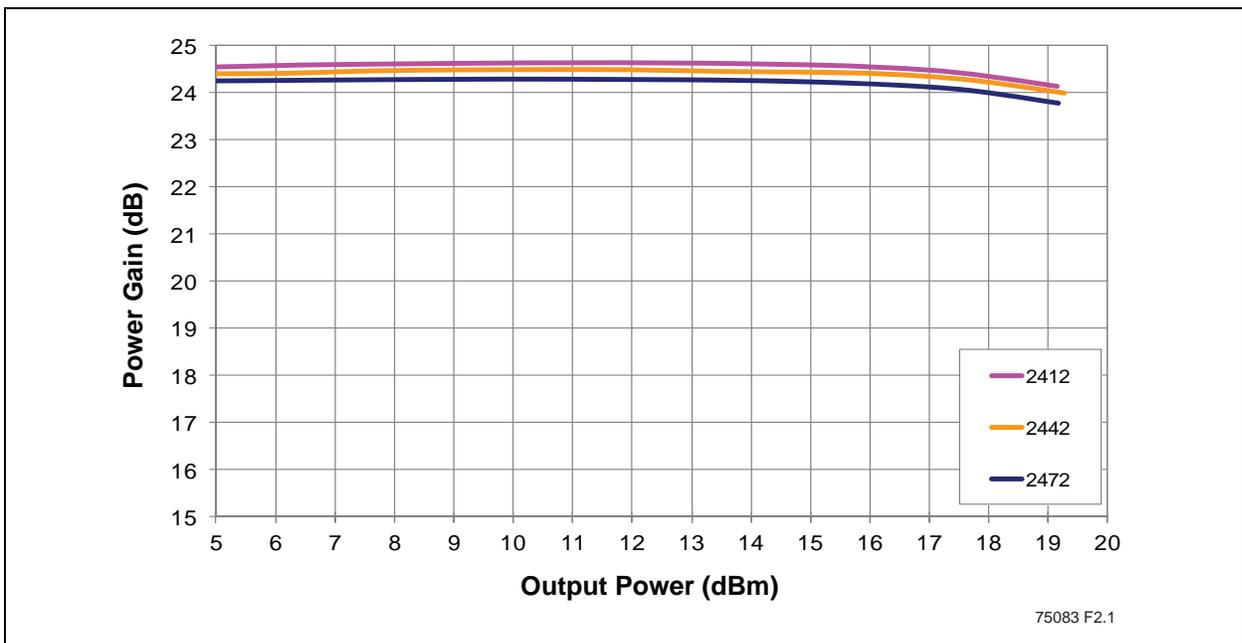


FIGURE 6-2: TRANSMITTER EVM VERSUS OUTPUT POWER MEASURED USING 802.11G WITH EQUALIZER TRAINING USING SEQUENCE ONLY



**FIGURE 6-3: TRANSMITTER DYNAMIC EVM VERSUS OUTPUT POWER MEASURED USING 256 QAM, 40 MHZ BANDWIDTH WITH EQUALIZER TRAINING USING SEQUENCE ONLY**



**FIGURE 6-4: GAIN VERSUS OUTPUT POWER**

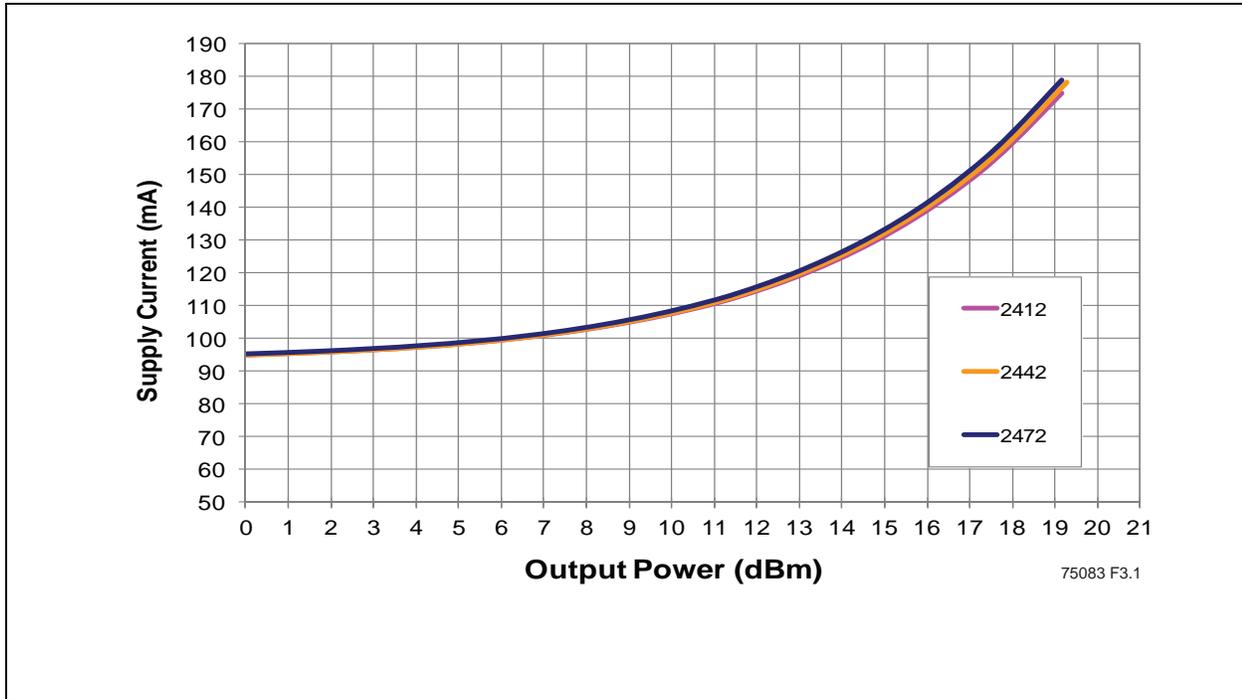


FIGURE 6-5: TRANSMITTER DC CURRENT VERSUS OUTPUT POWER

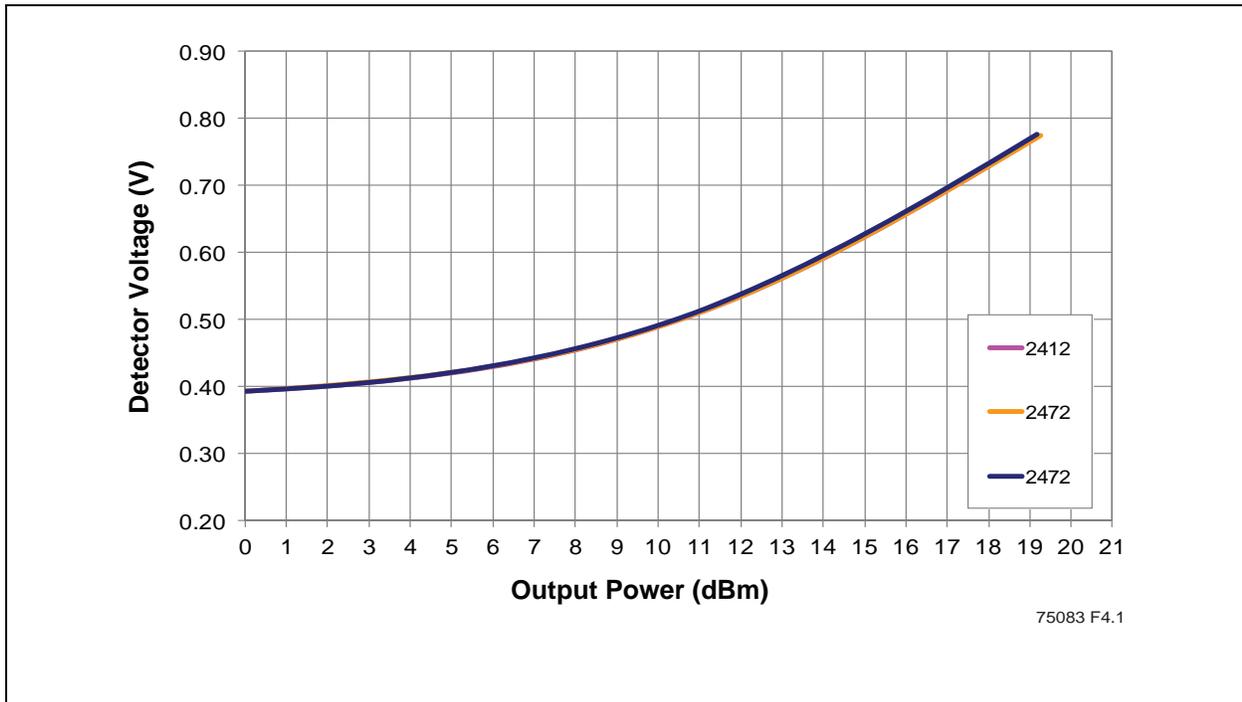


FIGURE 6-6: DETECTOR VOLTAGE VERSUS OUTPUT POWER

## Receiver

Test Conditions:  $V_{CC} = 3.6V$ ,  $LEN = 3.3V$ ,  $CRX = 3.3V$ ,  $PEN = 0V$ ,  $CBT = 0V$ ,  
 $T_A = 25^\circ C$ , unless otherwise specified

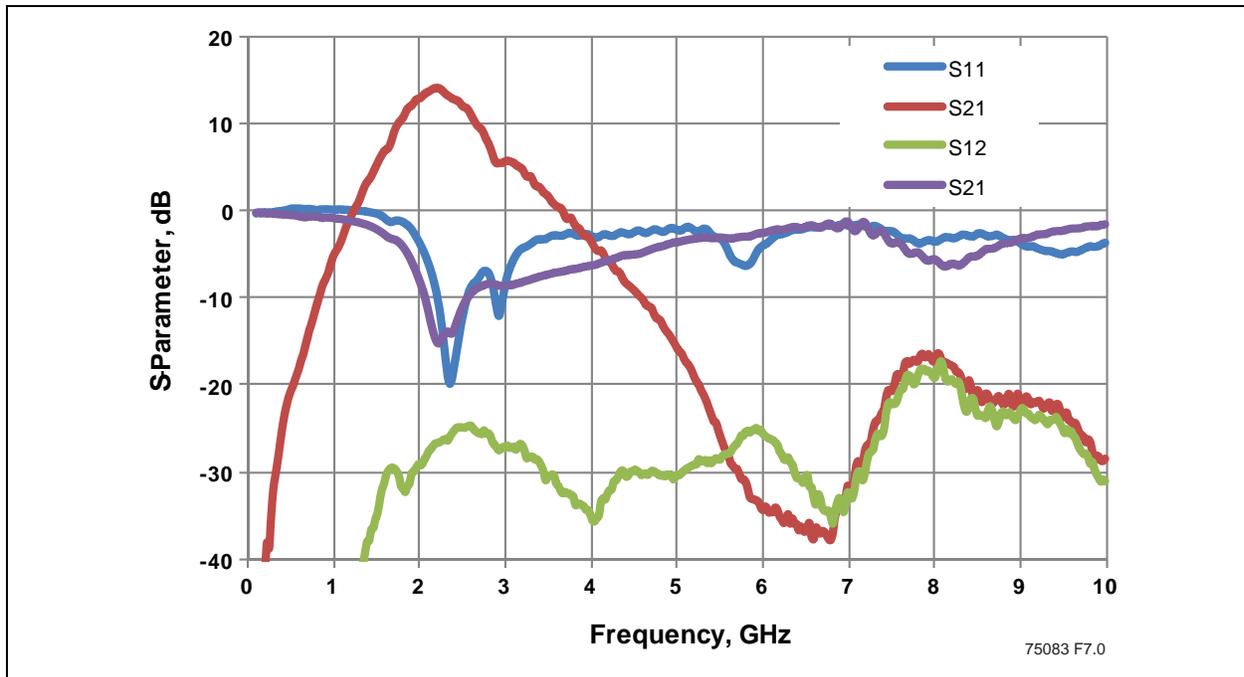


FIGURE 6-7: RECEIVER S-PARAMETER

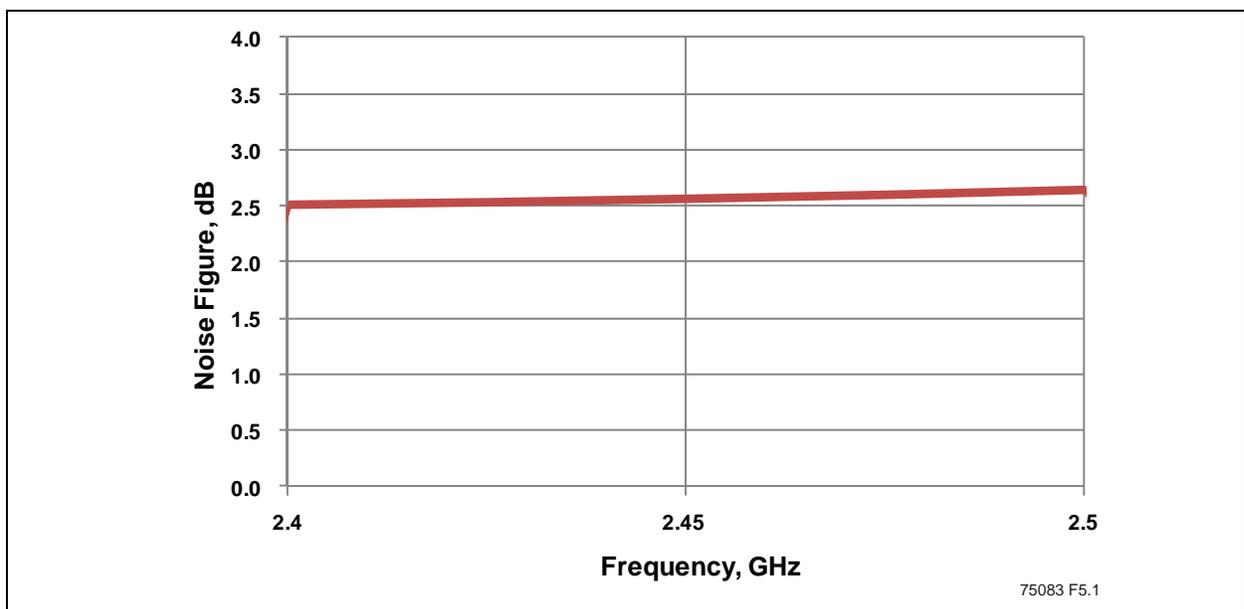


FIGURE 6-8: RECEIVER NOISE FIGURE

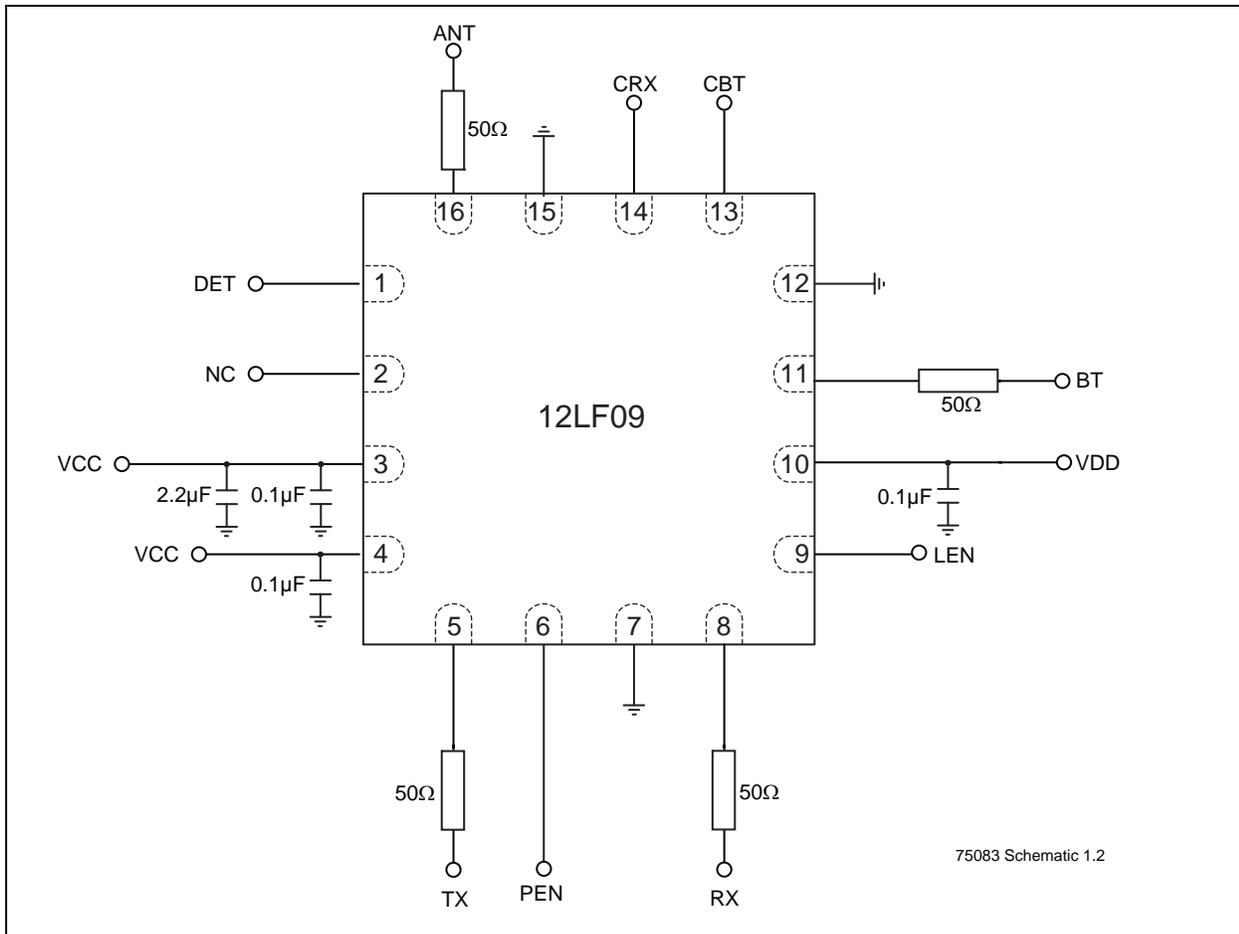


FIGURE 6-9: TYPICAL SCHEMATIC

## 7.0 PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<b>PART NO.</b>		<b>XXX</b>
<b>Device</b>		<b>Package</b>
Device:	SST12LF09	= 2.4 GHz High-Gain, High-Efficiency Front-end Module
Package:	Q3CE	= X2QFN (2.5mm x 2.5mm), 0.4 max thickness 16-contact
Evaluation Kit Flag	K	= Evaluation Kit

**Valid Combinations:**  
 SST12LF09-Q3CE  
 SST12LF09-Q3CE-K

8.0 PACKAGING DIAGRAMS

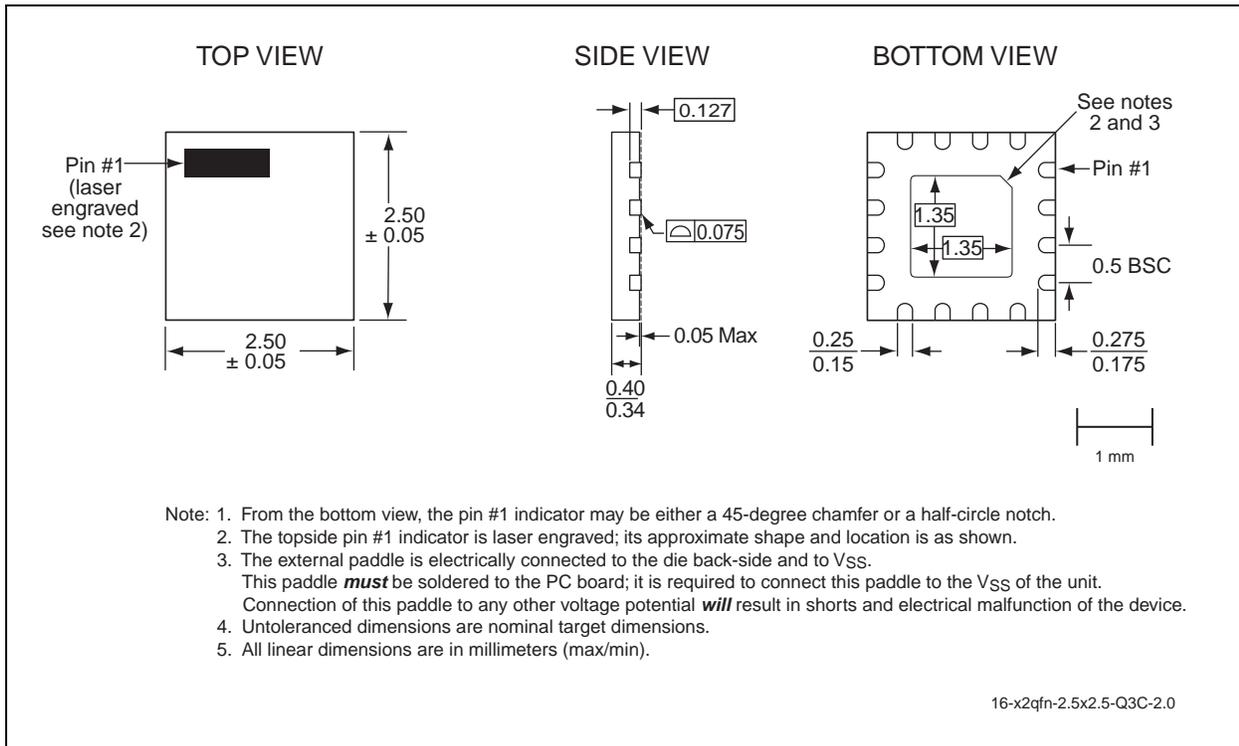


FIGURE 8-1: 16-CONTACT SUPER-THIN QUAL FLAT NO-LEAD (XQFN)  
 PACKAGE CODE: Q3C

TABLE 8-1: REVISION HISTORY

Revision	Description	Date
A	• Initial release of data sheet	May 2013

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