



The SST12LF03 is a fully integrated Front-End Module (FEM) for WLAN 802.11b/g/n and Bluetooth® systems. The SST12LF03 RF module includes a PA, a LNA, and an antenna switch, making it ideal for WLAN/BT embedded applications where small size and high performance are required. Designed in compliance with IEEE 802.11 b/g/n applications and based on GaAs PHEMT/HBT technology, the SST12LF03 operates within the frequency range of 2.4- 2.5 GHz with a very low DC-current consumption. The Transmitter chain has excellent linearity, typically 3% added EVM up to 19 dBm output power for 54 Mbps 802.11g operation, while meeting 802.11b spectrum mask at 22 dBm. The receiver chain provides a low noise amplifier and has options for simultaneous WLAN and Bluetooth operation. The SST12LF03 is offered in a 20-contact UQFN package.

## Features

- **Input/output ports are matched to 50Ω internally and DC decoupled.**
- **Packages available**
  - 20-contact UQFN – 3mm x 3mm x 0.55mm
- **All non-Pb (lead-free) devices are RoHS compliant**

### Transmitter Chain:

- **High gain:**
  - Typically 28 dB gain across 2.4–2.5 GHz over temperature -20°C to +85°C for Transmitter.
- **High linear output power:**
  - Meets 802.11g OFDM ACPR requirement up to 21 dBm
  - 3% added EVM up to 19 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**
  - ~25% @ P<sub>OUT</sub> = 22 dBm for 802.11b/g
- **Low I<sub>REF</sub> power-up/down control**
  - I<sub>REF</sub> <2 mA
- **Low quiescent current**
  - ~55 mA I<sub>Q</sub>
- **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)**
- **Limited variation over temperature**
  - ~1 dB power variation between -20°C to +85°C
  - ~2 dB gain variation between -20°C to +85°C

- **Temperature and load insensitive on-chip power detector**

- >20 dB dynamic range, temperature-stable, on-chip power detection

### Receiver Chain:

- **LNA ON:**
  - Typically 12 dB gain
  - 3.1 dB noise figure
  - >5dB P1dB

### Bluetooth Path:

- **Typically 2.5 dB loss**
- **Simultaneous BT/WLAN Rx mode:**
  - 8 dB gain
  - 3.1 dB noise figure

## Applications

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



## Product Description

The SST12LF03 is a 2.4 GHz Front-end Module (FEM) designed in compliance with IEEE 802.11b/g/n applications. It combines a high-performance Power Amplifier (PA), a low-noise amplifier, and an antenna switch. The single-pole, three-throw, antenna switch provides WLAN transmit and receive capability as well as Bluetooth® connectivity. The receive path also allow for simultaneous WLAN and Bluetooth operation.

The TX chain includes a high-efficiency PA based on the InGaP/GaAs HBT technology. This chain typically provides 28 dB gain with 25% power-added efficiency (PAE) @ POUT = 22 dBm for 802.11g and 802.11b operation.

The TX chain has excellent linearity, typically 3% added EVM at 19 dBm output power for 54 Mbps 802.11g operation, while meeting 802.11g spectrum mask at 22 dBm.

The SST12LF03 also features easy board-level usage along with high-speed power-up/down controls. Ultra-low reference current (total I<sub>REF</sub> ~2 mA) makes the SST12LF03 controllable directly from the baseband chip. These features, coupled with low operating current, make the SST12LF03 ideal for the final stage power amplification in battery-powered 802.11b/g/n WLAN transmitter applications.

The SST12LF03 transmitter has a linear on-chip, single-ended power detector, which is temperature stable, load insensitive, and has a linear dynamic range greater than 20 dB. The excellent on-chip power detector provides a reliable solution to board-level power control. In addition, the receiver path includes an LNA, has the option for simultaneous WLAN and Bluetooth operation, and an optional low-loss LNA bypass path. In WLAN operating mode, the receiver provides typically 12 dB gain and only 3.1 dB noise figure and >5 dB P1dB. Operating with simultaneous WLAN/BT, the receiver will provide both the WLAN and Bluetooth ports with 8 dB gain and 3.1 dB noise figure.

All input/output RF ports are single-ended, DC blocked, and internally matched to 50 Ω. No external DC-blocking capacitors or matching components are necessary. This helps reduce the system board Bill of Materials (BOM) cost.

The SST12LF03 is offered in a 20-contact UQFN package. See Figure 2 for pin assignments and Table 1 for pin descriptions.



### Functional Blocks

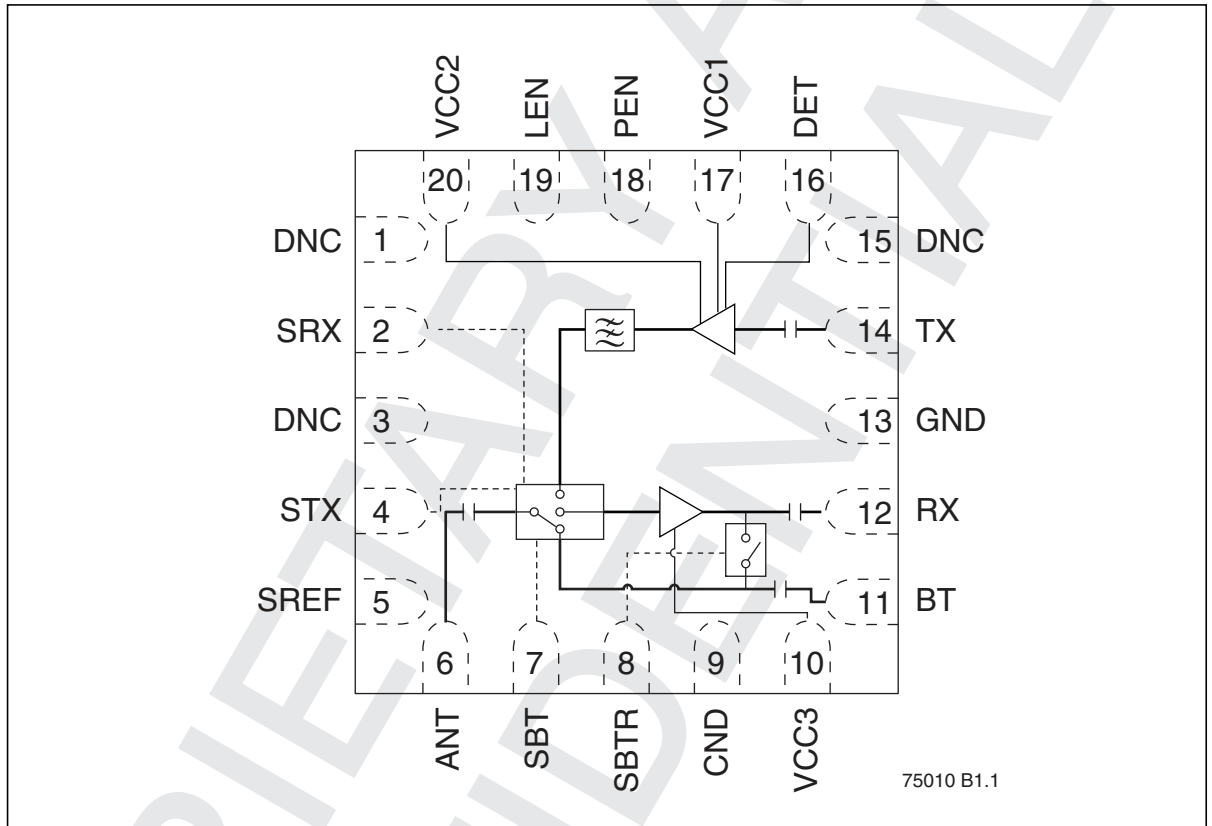
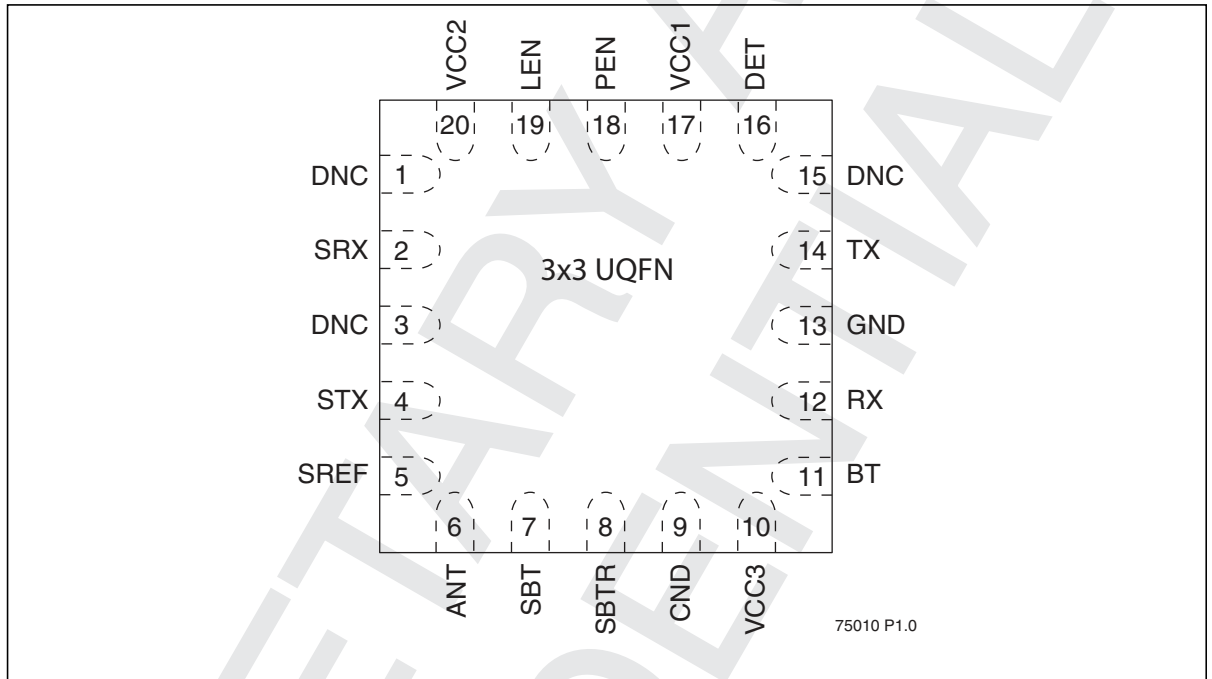


Figure 1: Functional Block Diagram



### Pin Assignments



**Figure 2:** Pin Assignments for 20-contact UQFN



### Pin Descriptions

**Table 1:** Pin Description

Symbol	Pin No.	Pin Name	Type <sup>1</sup>	Function
DNC	1	Do Not Connect		Do not connect to this pin
SRX	2			WLAN Receive Antenna Switch control
DNC	3	Do Not Connect		Do not connect to this pin
STX	4	STX		WLAN Transmit Antenna Switch control
SREF	5	C <sub>REF</sub>		Control pin reference high-level input
ANT	6	Antenna	I/O	Antenna port, AC coupled
SBT	7	SBT		BT antenna switch control
SBTR	8	SBTR		Switch control for simultaneous BT/RX
GND	9	Ground		Ground pin
VCC3	10	V <sub>CC3</sub>	PWR	LNA power supply
BT	11			BT port, AC coupled
RX	12	R <sub>X</sub>	I	WLAN receive port, AC coupled
GND	13	Ground		Ground pin
TX	14	T <sub>X</sub>	O	WLAN transmit port, AC coupled
DNC	15	Do Not Connect		Do not connect to this pin
DET	16			WLAN transmit power detector
VCC1	17	V <sub>CC1</sub>		WLAN power amplifier power supply #1
PEN	18			WLAN PA enable
LEN	19			LNA enable
VCC2	20	V <sub>CC2</sub>	PWR	WLAN power amplifier power supply #2
Center	GND	Ground		Ground pin

1. I=Input, O=Output

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### 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 9 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 pin 3 ( $P_{IN}$ )	+5 dBm
Average output power from pin 11 ( $P_{OUT}$ ) <sup>1</sup>	+26 dBm
Supply Voltage at pins 6 and 9 ( $V_{CC}$ )	-0.3V to +4.2V
Reference voltage to pin 4 ( $V_{REF}$ )	-0.3V to +3.3V
DC supply current ( $I_{CC}$ ) <sup>2</sup>	400 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	260°C for 10 seconds

- 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.
- Measured with 100% duty cycle 54 Mbps 802.11g OFDM Signal

**Table 2: Operating Range**

Range	Ambient Temp	$V_{CC}$
Extended	-20°C to +85°C	3.3V

**Table 3: DC Electrical Characteristics**

Symbol	Parameter	Min.	Typ	Max.	Unit
$V_{CC}$	TX Supply Voltage at pins 6 and 9	3.0	3.3	4.2	V
$I_{CQ}$	TX Idle current for 802.11g to meet EVM ~3% @ 19 dBm		55		mA
$V_{REG}$	TX Reference Voltage	2.75	2.80	2.95	V
PEN	PA Enabled; PA Off			2.0	V
$I_{CC}$	TX Supply Current for 11g OFDM 54 Mbps signal, $P_{OUT} = 22$ dBm for 11b DSSS 1 Mbps signal, $P_{OUT} = 22$ dBm		175 185		mA mA
$V_{DD}$	LNA Supply Voltage at pin 10	3.0	3.3	4.2	V
$I_{DD}$	LNA Supply Current		15		mA
$V_{CNTL}$	Control Voltage logic high, SRX, STX, SBT, LEN	2.8	3.3	$V_{CC}$	V
	Control Voltage logic low	0		1.5	V

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

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**Table 4:** TX Chain WLAN RF Characteristics

Symbol	Parameter	Min.	Typ	Max.	Unit	Test Condition
F <sub>L-U</sub>	Frequency range	2412		2484	MHz	
G	Small signal gain	26	29		dB	TX and PA On
G <sub>VAR1</sub>	Gain variation over band (2412–2484 MHz)			±0.5	dB	TX and PA On
G <sub>VAR2</sub>	Gain ripple over channel (20 MHz)		0.2		dB	TX and PA On
P <sub>OUT</sub>	Output power meets 11g OFDM 6 Mbps spectrum mask	20	22		dBm	TX and PA On
	Output power meets 11b DSSS 1 Mbps spectrum mask	20	22		dBm	TX and PA On
Added EVM	@ 19 dBm output power with 11g OFDM 54 Mbps signal		3		%	TX and PA On
2f, 3f, 4f, 5f	Harmonics at 22 dBm, without external filters			-35	dBc	TX and PA On
ISO1	Isolation (TX to RX)		-12		dB	TX and PA On
ISO2	Isolation (TX to BT)		-10		dB	TX and PA On
ISO3	Isolation (RX to TX)		-30		dB	TX and PA On
ISO4	Isolation (BT to TX)		-50		dB	TX and PA On

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**Table 5:** RX Chain WLAN RF Characteristics

Symbol	Parameter	Min.	Typ	Max.	Unit	Test Condition
F <sub>L-U</sub>	Frequency range	2412		2484	MHz	
G <sub>ON</sub>	Gain with LNA on	10	12		dB	LEN=SRX=High PEN=STX=SBT=SBTR=Low
P1dB	Receiver 1 dB compression		5		dBm	LEN=SRX=High PEN=STX=SBT=SBTR=Low
G <sub>ONS</sub>	Gain with LNA on and simultaneous BT	7	8		dB	LEN=SRX=High PEN=STX=SBT=Low
IL <sub>S</sub>	Insertion loss with LNA bypassed to BT and RX simultaneous		4.8		dB	SBT=SBTR=High PEN=STX=SRX=LEN=Low
NF <sub>ON</sub>	Noise figure with LNA on		3.1		dB	LEN=SRX=High PEN=STX=SBT=SBTR=Low
NF <sub>ONS</sub>	Noise figure with LNA on and simultaneous BT		3.1		dB	LEN=SRX=High PEN=STX=SBT=Low
I <sub>DD</sub>	Receiver supply current with LNA on		15		mA	LEN=High
ISO <sub>BT-RX</sub>	Isolation BT to RX		17		dB	LEN=SRX=High PEN=STX=SBT=SBTR=Low
ISO <sub>BT-TX</sub>	Isolation TX to RX with TX on		25		dB	LEN=SRX=High PEN=STX=SBT=SBTR=Low
RL <sub>ANT</sub>	Receiver input return loss at the antenna with LNA on		12		dB	LEN=SRX=High PEN=STX=SBT=SBTR=Low
RL <sub>RX</sub>	Receiver output return loss with WLAN only		12		dB	LEN=SRX=High PEN=STX=SBT=SBTR=Low
RX <sub>RXS</sub>	Receiver output return loss with simultaneous WLAN/BT		10		dB	LEN=SRX=High PEN=STX=SBT=Low

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**Table 6:** Bluetooth Chain RF Characteristics

Symbol	Parameter	Min.	Typ	Max.	Unit	Test Condition
F <sub>LU</sub>	Frequency range	2412		2484	MHz	
IL	Loss: antenna to BT		2.5		dB	SBT=High LEN=PEN=STX=SRX=SBTR=Low
G <sub>ONS</sub>	Gain with LNA on and simultaneous BT	7	8		dB	LEN=SRX=SBTR=High PEN=STX=SBT=Low
NF <sub>ONS</sub>	Noise figure with LNA on and simultaneous BT		3.1		dB	LEN=SRX=SBTR=High PEN=STX=SBT=Low
RL <sub>ANT</sub>	Receiver input return loss at the antenna with LNA on		12		dB	SBT=High PEN=STX=SBTR=LEN=SRX=Low
BT <sub>RX</sub>	Receiver output return loss		12		dB	SBT=High PEN=STX=SBTR=LEN=SRX=Low
RX <sub>RXS</sub>	Receiver output return loss with simultaneous WLAN/BT		8		dB	SBT=SBTR=High PEN=STX=LEN=SRX=Low

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**Table 7:** Switch Control Logic

Mode	STX	SRX	SBT	SBTR	PEN	LEN
All Off (not supported)	L	L	L	L	L	L
Bluetooth On	L	L	H	L	L	H
WLAN TX On	H	L	L	L	H	L
WLAN RX On	L	H	L	L	L	H
Simultaneous WLAN/BT RX On	L	H	L	H	L	H

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### Typical WLAN Transmitter Performance Characteristics

Test Conditions:  $V_{CC} = 3.3V$ ,  $PEN=2.80V$ ,  $STX=High$ ,  $SRX=SBT=SBTR=Low$ ,  $T_A = 25^{\circ}C$ , unless otherwise specified

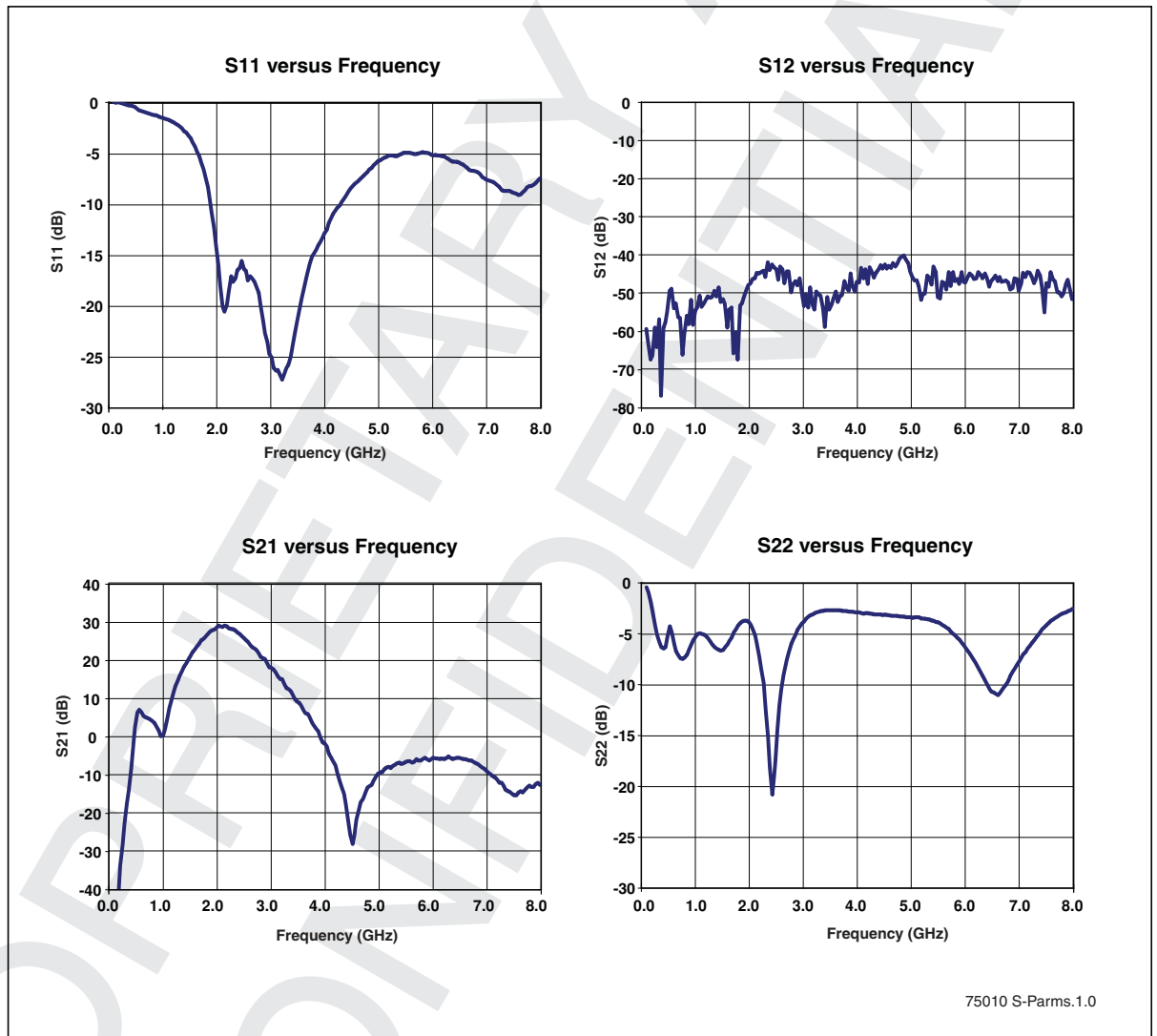


Figure 3: S-Parameters for WLAN Transmitter



### Typical WLAN Transmitter Performance Characteristics

Test Conditions:  $V_{CC} = 3.3V$ ,  $PEN=2.80V$ ,  $STX=High$ ,  $SRX=SBT=SBT=Low$ ,  
 $T_A = 25^{\circ}C$ , 54 Mbps 802.11g OFDM Signal  
Equalizer Training Setting using Channel Estimation Sequence and Data

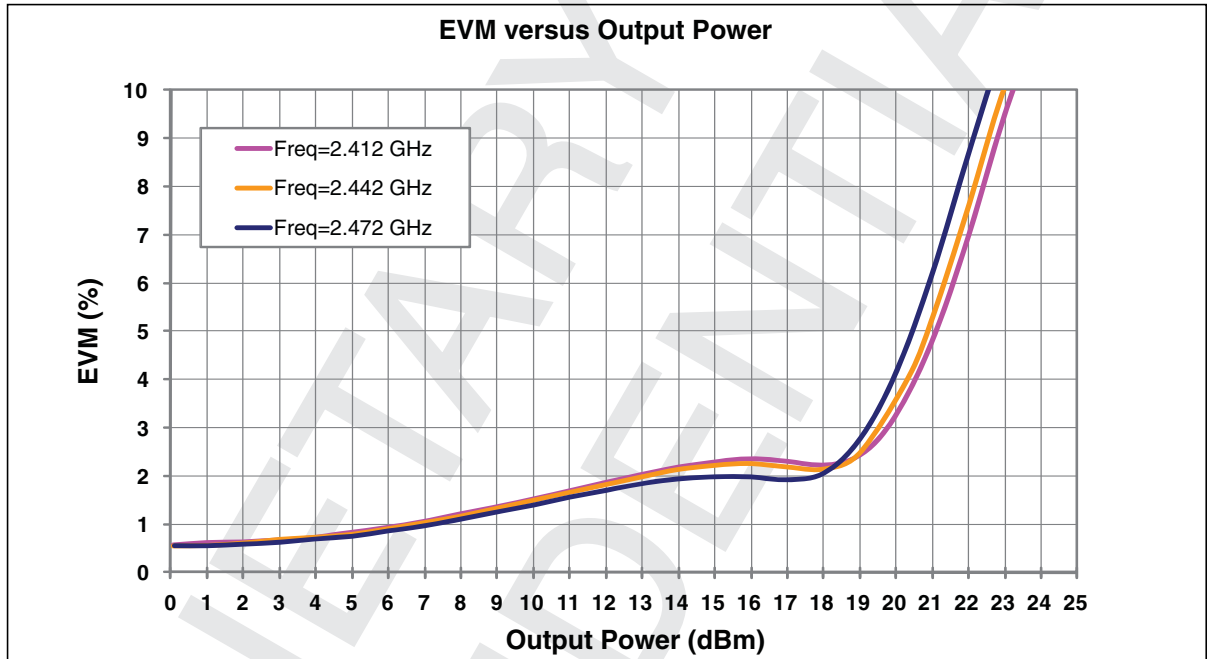


Figure 4: WLAN Tx EVM with 802.11g OFDM 54 Mbps

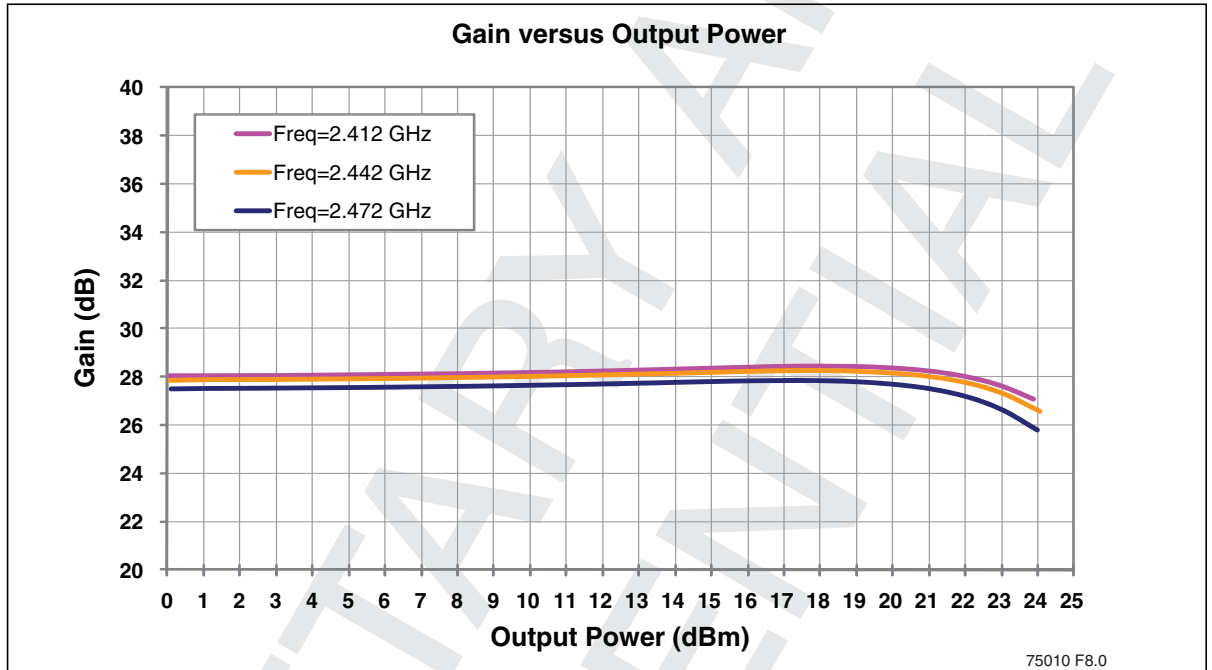


Figure 5: WLAN Tx Gain with 802.11g OFDM 54 Mbps

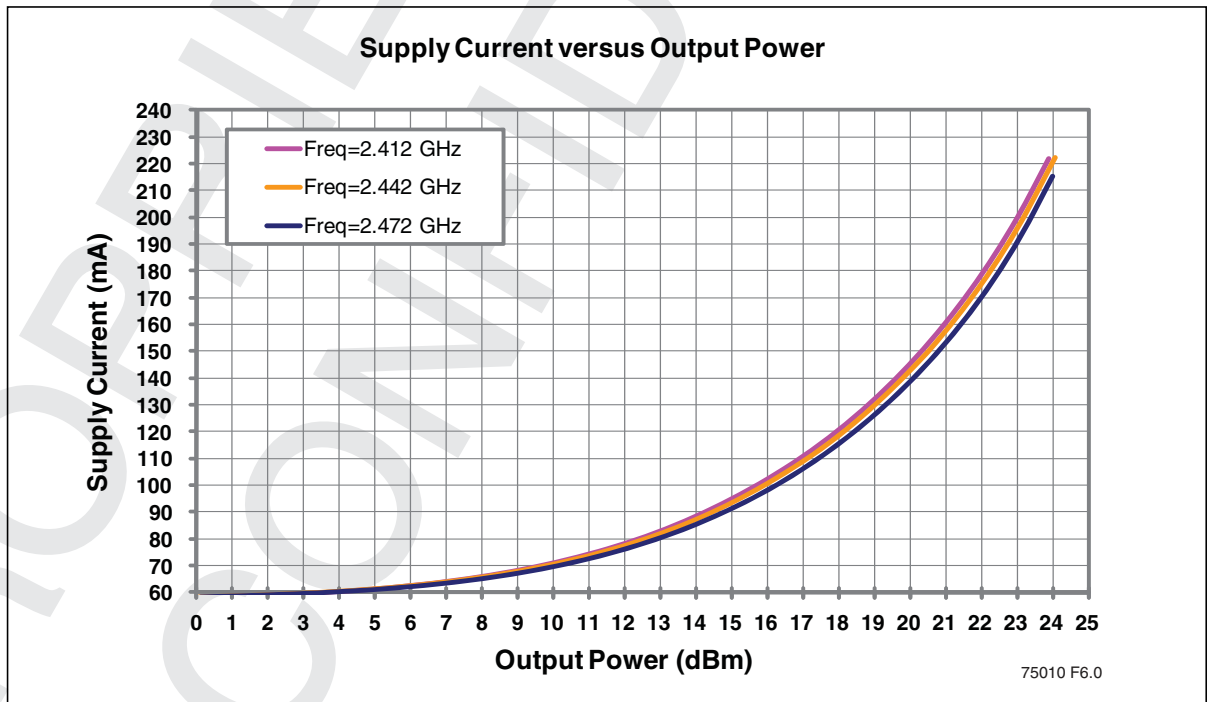


Figure 6: WLAN Tx Supply Current with 802.11g OFDM 54 Mbps

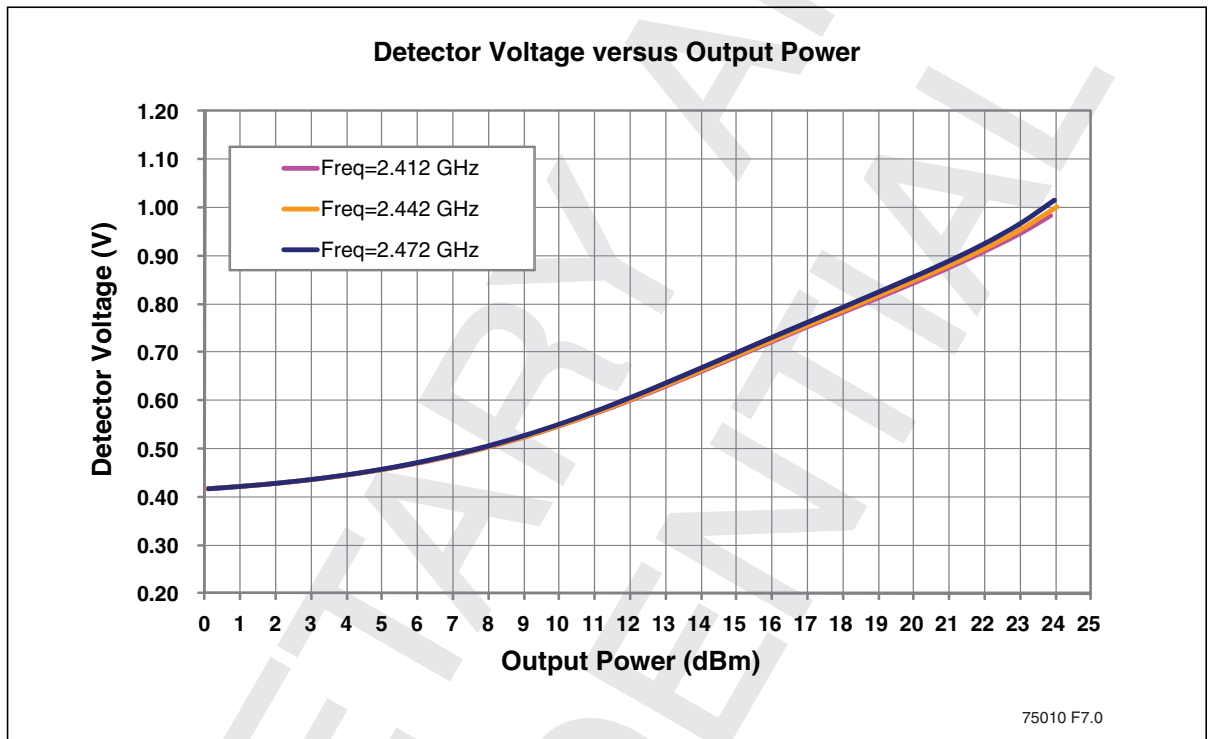


Figure 7: WLAN Tx Detector Voltage with 802.11g OFDM 54 Mbps



### Typical WLAN Receiver Performance Characteristics

Test Conditions:  $V_{DD} = 3.3V$ ,  $SRX=LEN=High$ ,  $STX = SBT=SBTR=Low$ ,  $T_A = 25^{\circ}C$ , unless otherwise specified

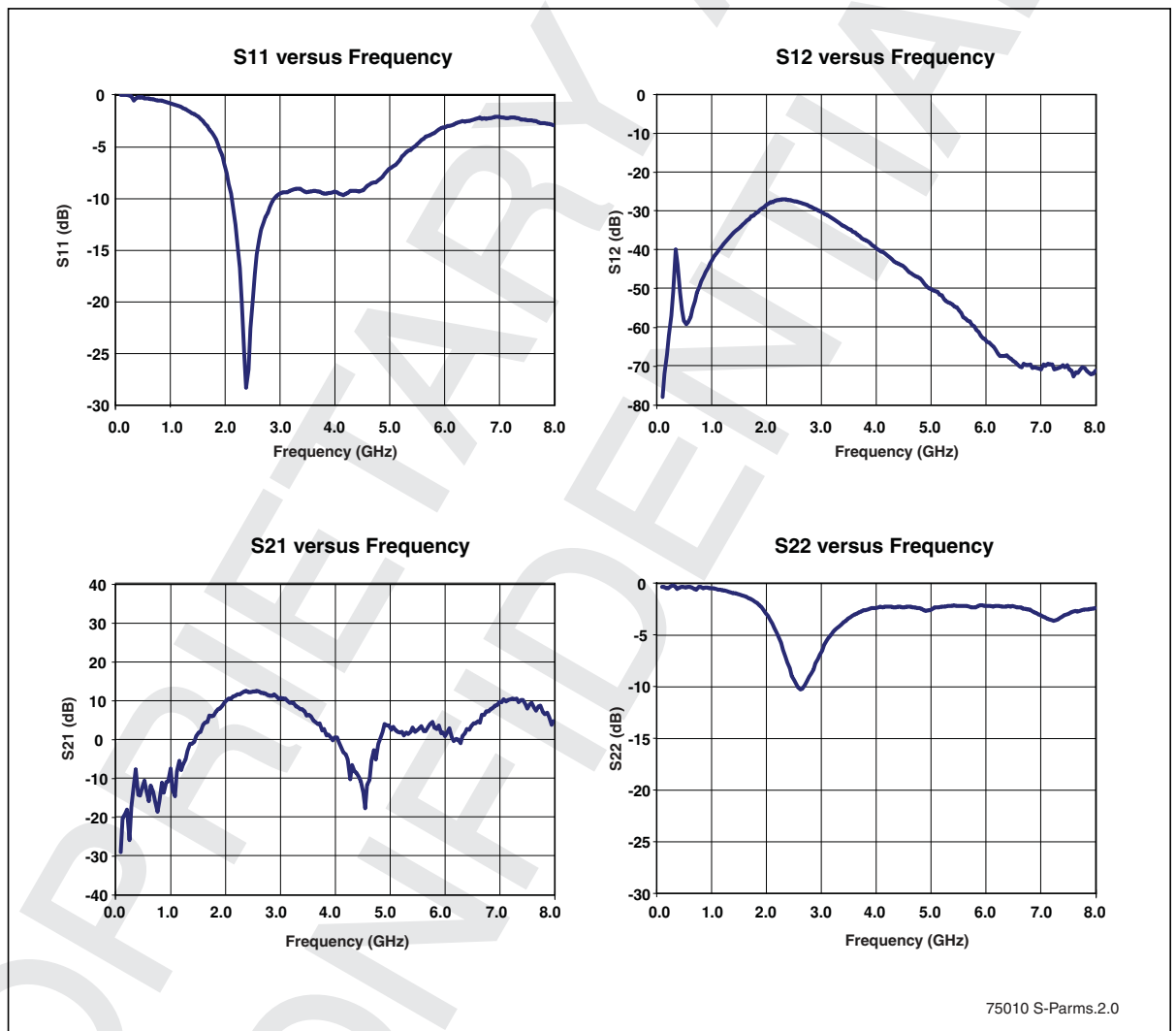


Figure 8: WLAN Receiver Gain

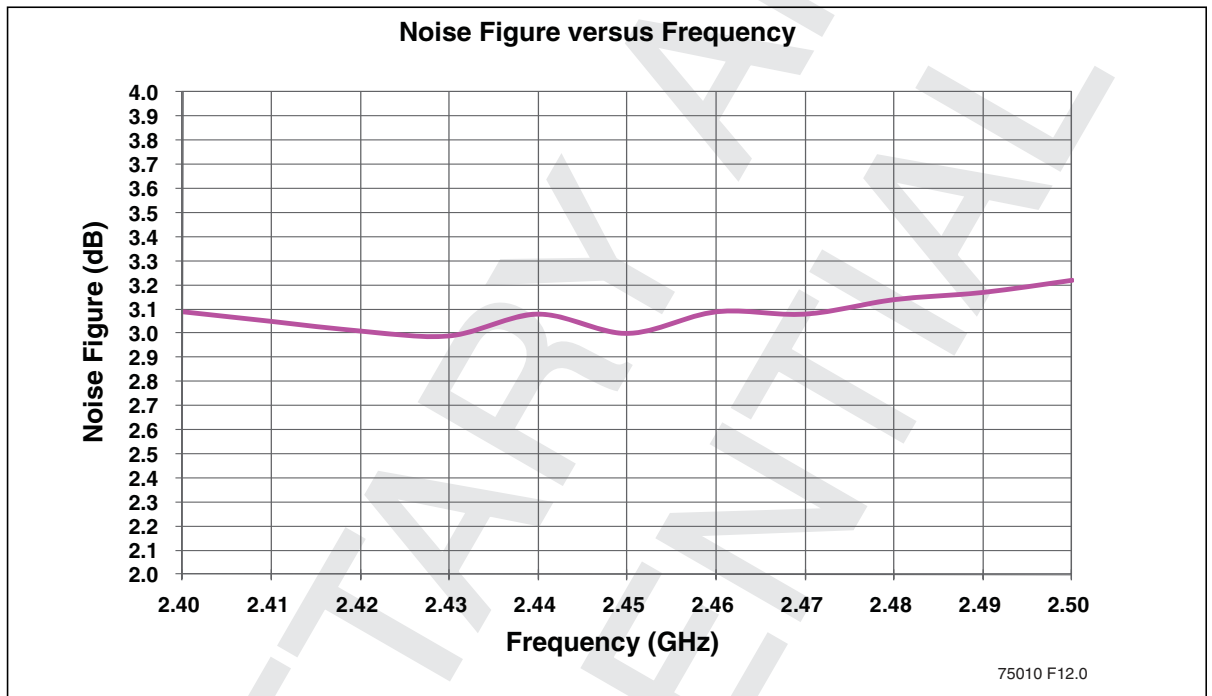


Figure 9: WLAN Rx Noise Figure

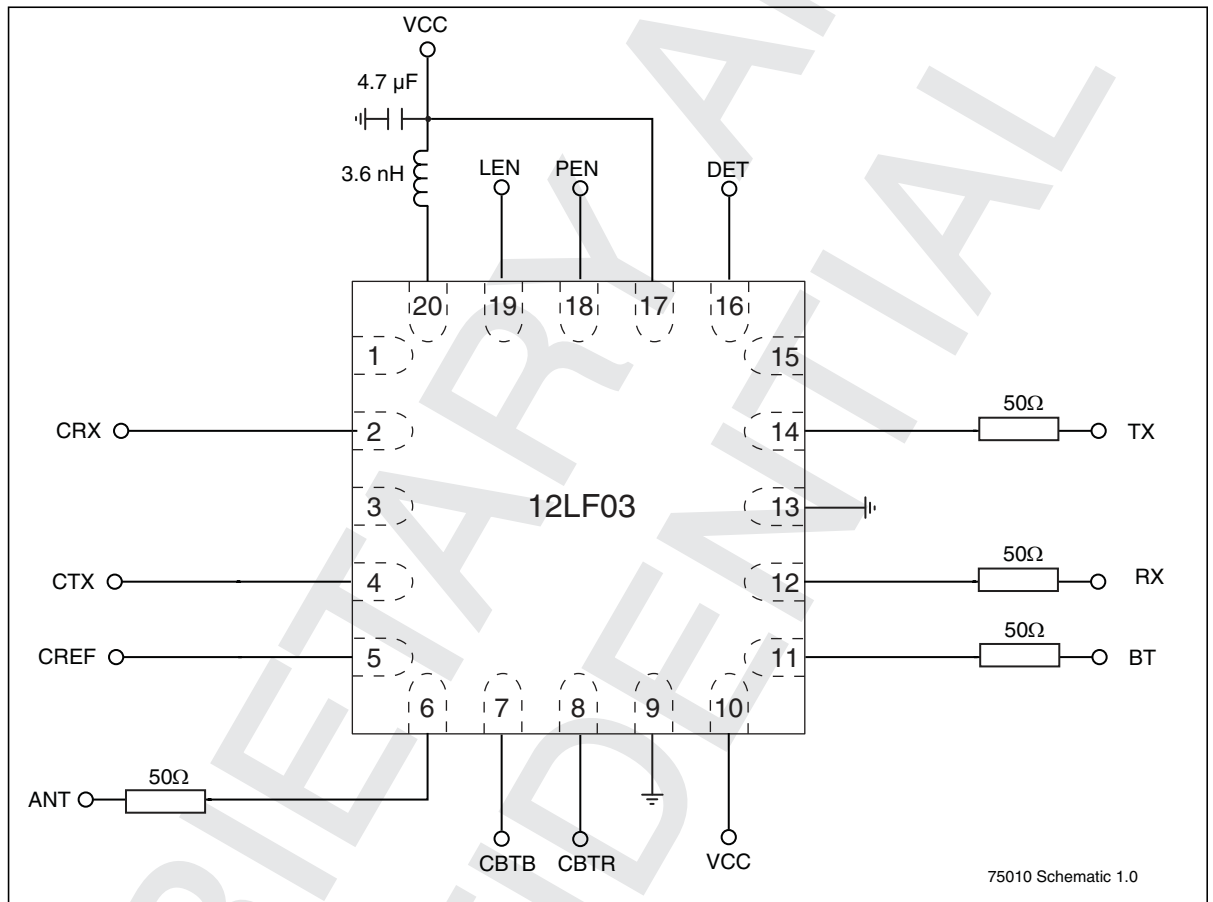


# 2.4 GHz High-Gain, High-Efficiency Front-end Module

## SST12LF03

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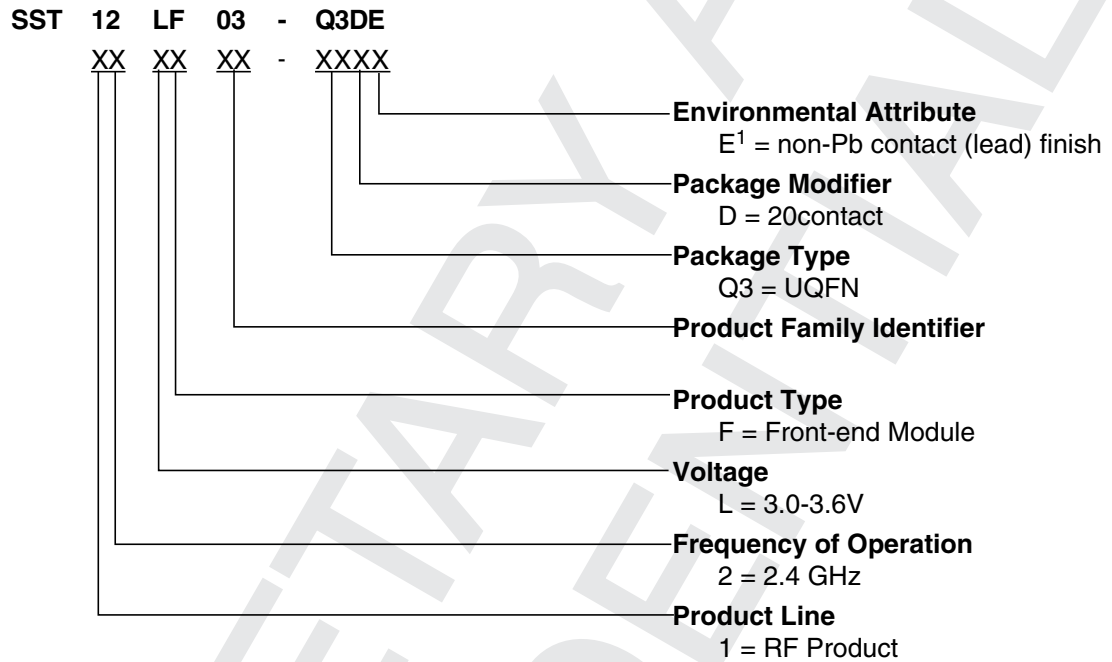
Data Sheet



**Figure 10:** Typical Schematic for High-Efficiency 802.11b/g/n Applications



### Product Ordering Information




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

#### Valid combinations for SST12LF03

SST12LF03-Q3DE

#### SST12LF03 Evaluation Kits

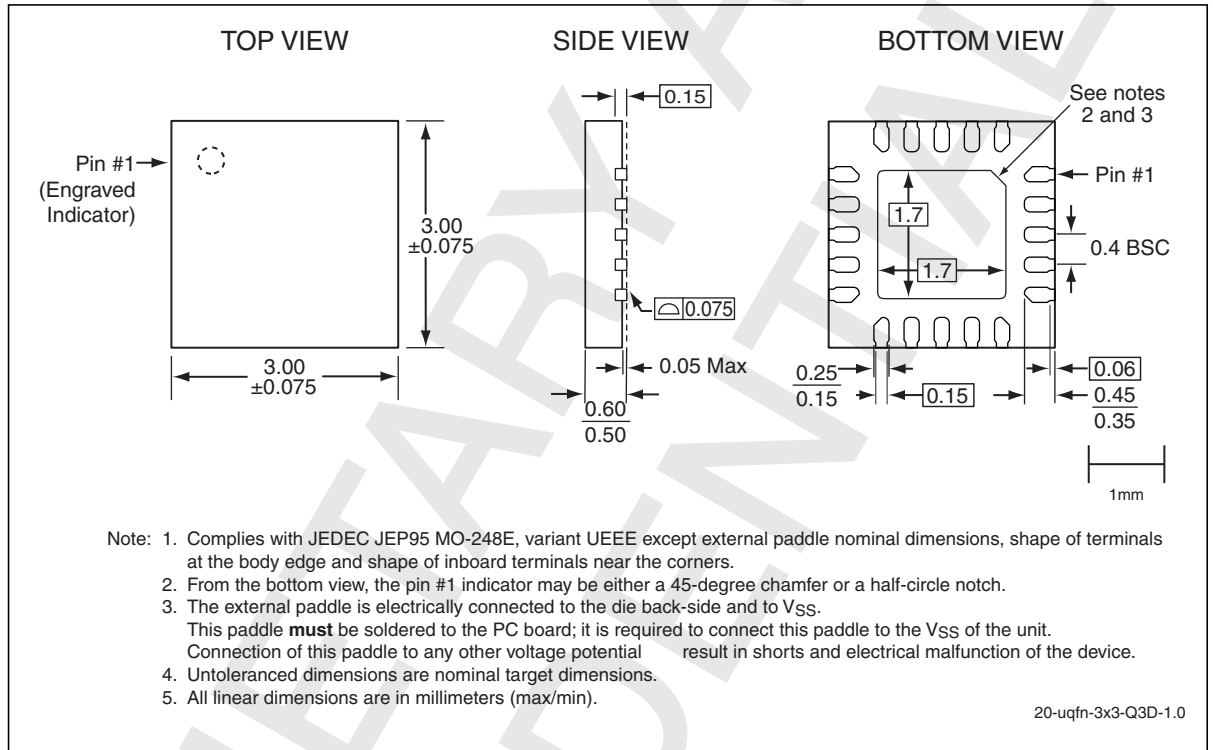
SST12LF03-Q3DE-K

**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 11:20-Contact Ultra-thin Qual Flat No-lead (UQFN)**  
SST Package Code: Q3D



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**Table 8:** Revision History

Revision	Description	Date
A	<ul style="list-style-type: none"> <li>Initial release of data sheet</li> </ul>	Jun 2011
B	<ul style="list-style-type: none"> <li>Various updates in Features and Product Description</li> <li>Updated pin names in Figure 1 on page 3, Figure 2 on page 4, and Table 1 on page 5</li> <li>Revised values in Table 3 on page 6, Table 5 on page 7, Table 6 on page 8, and Table 7 on page 8</li> <li>Minor change in “Product Ordering Information” on page 16</li> </ul>	Sep 2011

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