Product Technical Specification

BC188

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate the Sierra Wireless modem in areas where blasting is in progress, where explosive atmospheres may be present, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. The Sierra Wireless modem can transmit signals that could interfere with this equipment.

Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE POWERED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

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Contact Information

Sales information and technical support, including warranty and returns	Web: sierrawireless.com/company/contact-us/ Global toll-free number: 1-877-687-7795 6:00 am to 6:00 pm PST
Corporate and product information	Web: sierrawireless.com

Revision History

Revision number	Release date	Changes
1	March 20, 2017	Initial conversion to SWI template.

Contents

1: Introduction

BC188 is a highly flexible, low power, small form factor self contained Wi-Fi module. It comes preloaded with Sierra Wireless Melody-Wi-Fi software, and is ideal for developers who want to quickly and cost effectively integrate Wi-Fi functionality into their products.

Figure 1-1: BC188

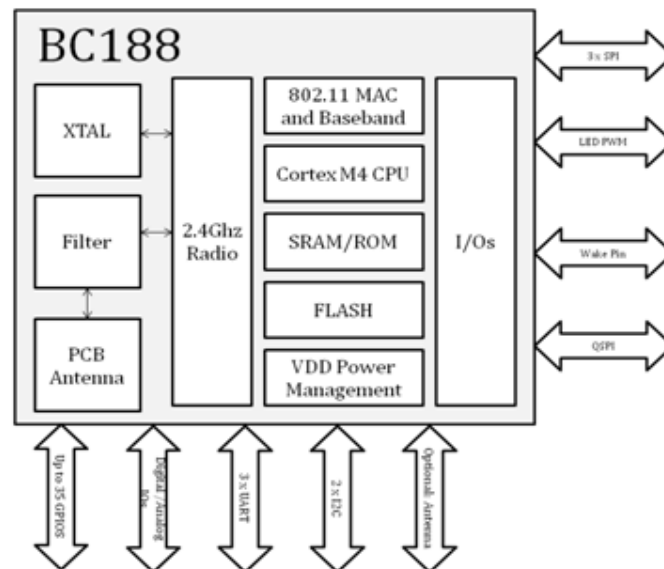*Note: this is an example image and does not represent the label used on commercial shipments.*

Figure 1-2: BC188 Flow Diagram

Applications

- White Goods/Appliances
- Consumer Devices and Accessories
- Home Automation
- Personal Health Devices
- IoT and Wearables
- Commercial and Industrial

Key Specifications

- Low Power Wi-Fi module with Microcontroller and Antenna
- Cortex-M4F CPU with integrated 512KB SRAM, 320KB ROM, 8Mbit Flash
- Ultra Low Power modes (Deep Sleep, Standby)
- IEE 802.11n/g/b, 1x1 SISO, 2.4 GHz and HT20
- Antenna Diversity
- Embedded Stack and TCP/IP, Simple UART interface
- 3xI2S, 3xSPI, 2xI2C, 3xUART, QSPI, Up to 35 GPIOS, 2 x Wake
- 2 Step ADC with PGA, 2 Channel or 1 Diff channel DAC
- Small form factor (22mm x 15.5mm x 1.5mm)

General Specifications

Table 1-1: General Specifications

Specification	Description
Wi-Fi	802.11 b.g.n.d.e.h.i.k.r.w
Interfaces	UART, AIO, GPIO, SPI, PCM, I2S, SPDIF, I2C
Size	22mm x 15.5mm x 1.5mm
Weight	0.9g

Wi-Fi Specifications

Table 1-2: Wi-Fi Specifications

Specification	Description
Encryption	WEP 64 and 128 bit encryption (WPA), AES-CCMP, WAPI
Frequency Range	2400 to 2500 MHz
Maximum Data Rate	72.2Mbps, 20 MHz channels
Tx output saturation	26dBm

Table 1-2: Wi-Fi Specifications

Specification	Description
Rx input IP3	-15dBm
Phase Noise	-103dBc/Hz

Audio Specifications

Table 1-3: Audio Specifications

Specifications	Description
DAC Output Range	0.12V to 1.6V
Common ADC Input	0.9V (Typical)

Electric Specifications

Table 1-4: Electrical Specifications

Specification	Description
Supply Voltage	3.0V to 3.6 V DC (Supports Li Ion battery voltage range)
Typical Current (Sleep)	36µA
Typical Current (PowerSave)	0.4mA
Operating Temperature	-40°C to 85°C

2: Physical Characteristics

Module Footprint
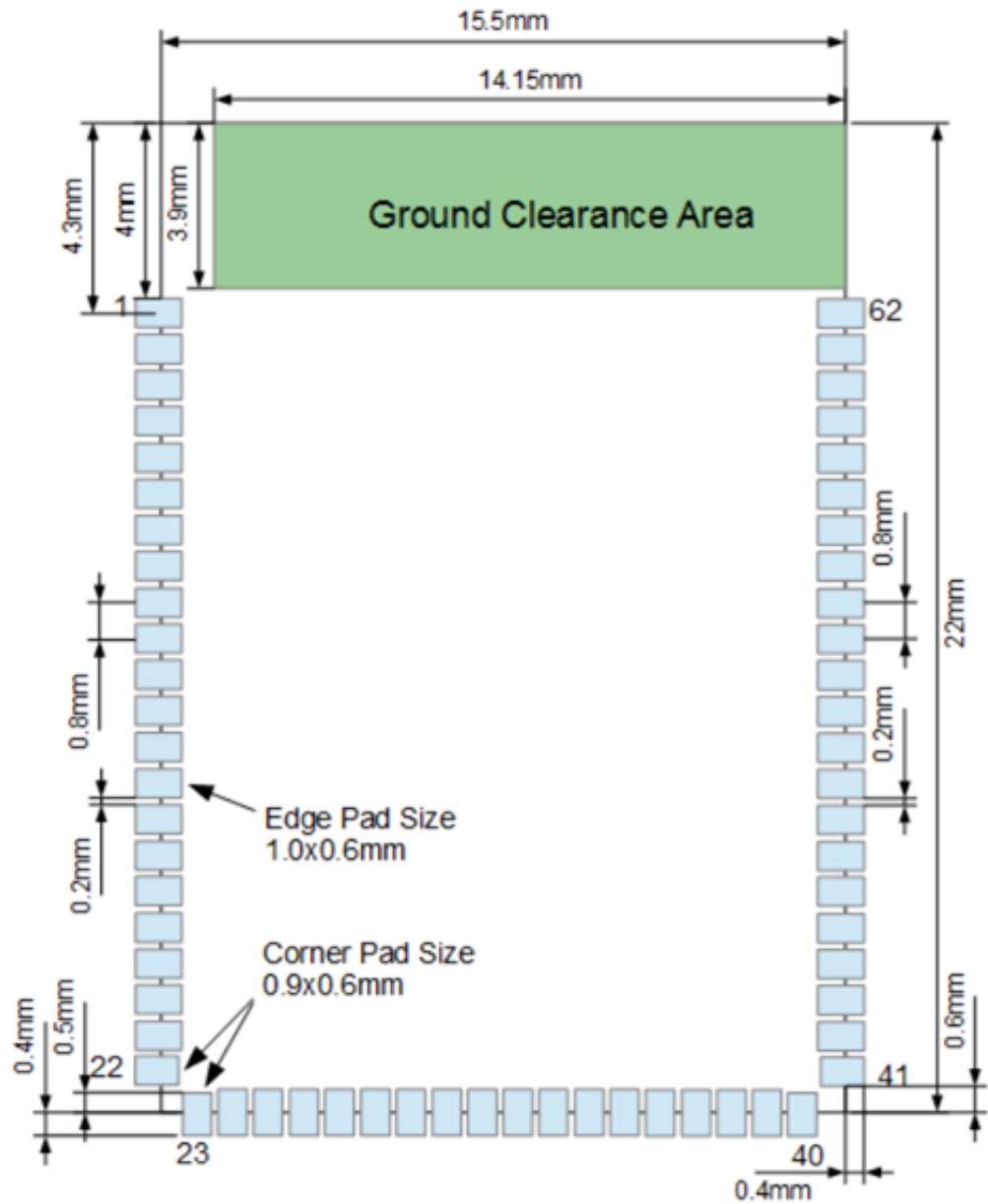
Figure 2-1: Module Footprint

PIN Descriptions

Table 2-1: Pin Descriptions

No	Pin Name	Pin Type	Pin Description
1	GND	GND	GND
2	ANT_CTRL1	Output ANT_CTRL1	General Purpose IO44
3	ANT_CTRL0	Output ANT_CTRL0	General Purpose IO45
4	GND	GND	GND
5	RF_EXT	External RF Connection	NA
6	GND	GND	GND
7	UART_CTS/ GPIO_0	UART Clear To Send via USB<>UART Converter	GPIO_0
8	UART_RTS/ GPIO_1	UART Ready To Send via USB<>UART Converter	GPIO_1
9	UART_TX/ GPIO_2	UART Transmit via USB<>UART Converter	GPIO_2
10	UART_RX/ GPIO_3	UART Receive via USB<>UART Converter	GPIO_3
11	VDDIO_0	Supply input for GPIOs	NA
12	VDDIO_1	Supply input for GPIO16	NA
13	GND	GND	GND
14	GND	GND	GND
15	GND	GND	GND
16	GPIO_16	General Purpose IO 16	CON5 Configuration Pin 5
17	GND	GND	GND
18	GND	GND	GND
19	GPIO23	General Purpose IO 23	Wake Up 1
20	GPIO22	General Purpose IO 22	Wake Up 0
21	GPIO24	General Purpose IO 24	General Purpose Timer 1 Channel 5

Table 2-1: Pin Descriptions

No	Pin Name	Pin Type	Pin Description
22	GND	GND	GND
23	GND	GND	GND
24	GND	GND	GND
25	VBAT	Battery Supply Input	NA
26	RST#	Module Reset (Active Low)	NA
27	GPIO25	XTAL_32k CLK IN (Sourced Internally DNC)	GPIO25
28	GPIO26	XTAL_32k CLK OUT (Sourced Internally DNC)	GPIO26
29	GND	GND	GND
30	QSPI_D1/ GPIO31	Flash SPI Data I/O 1	GPIO31
31	QSPI_CLK/ GPIO29	Flash SPI Clock	GPIO29
32	VDDIO_2	Supply input for QSPI I/O	NA
33	GND	GND	GND
34	QSPI_D2/ GPIO32	Flash SPI Data I/O 2	GPIO32
35	QSPI_D3/ GPIO33	Flash SPI Data I/O 3	GPIO33
36	QSPI_D0/ GPIO30	Flash SPI Data I/O 0	GPIO30
37	QSPI_SSN/ GPIO28	Flash SPI Chip Select	GPIO28
38	GPIO27	General Purpose IO 27	CON4 Configuration Pin 4
39	GND	GND	GND
40	GND	GND	GND
41	GND	GND	GND
42	GND	GND	GND
43	VDDIO_3	Supply input for GPIO [49:26], 27	NA
44	GPIO40	General Purpose IO 40	NA

Table 2-1: Pin Descriptions

No	Pin Name	Pin Type	Pin Description
45	GPIO39	General Purpose IO 39	General Purpose Timer 3 Clock Input
46	GND	GND	GND
47	GPIO41	General Purpose IO 41	NA
48	GPIO42	General Purpose IO 42	NA
49	GPIO43	General Purpose IO 43	NA
50	GPIO46	General Purpose IO 46	NA
51	GPIO47	General Purpose IO 47	NA
52	GPIO48	General Purpose IO 48	NA
53	GPIO49	General Purpose IO 49	NA
54	GPIO7	General Purpose IO 7	JTAG Test Clock
55	GPIO6	General Purpose IO 6	JTAG Test Data Output
56	GPIO5	General Purpose IO 5	I2C0_SCL
57	GPIO4	General Purpose IO 4	I2C0_SDA
58	GPIO8	General Purpose IO 8	JTAG Test Mode State
59	GPIO9	General Purpose IO 9	JTAG Test Data Input
60	GPIO10	General Purpose IO 10	JTAG Test Reset (Active Low)
61	3V3	3V3 Supply Input	NA
62	GND	GND	GND

3: Hardware Design Guideline

Application Schematic
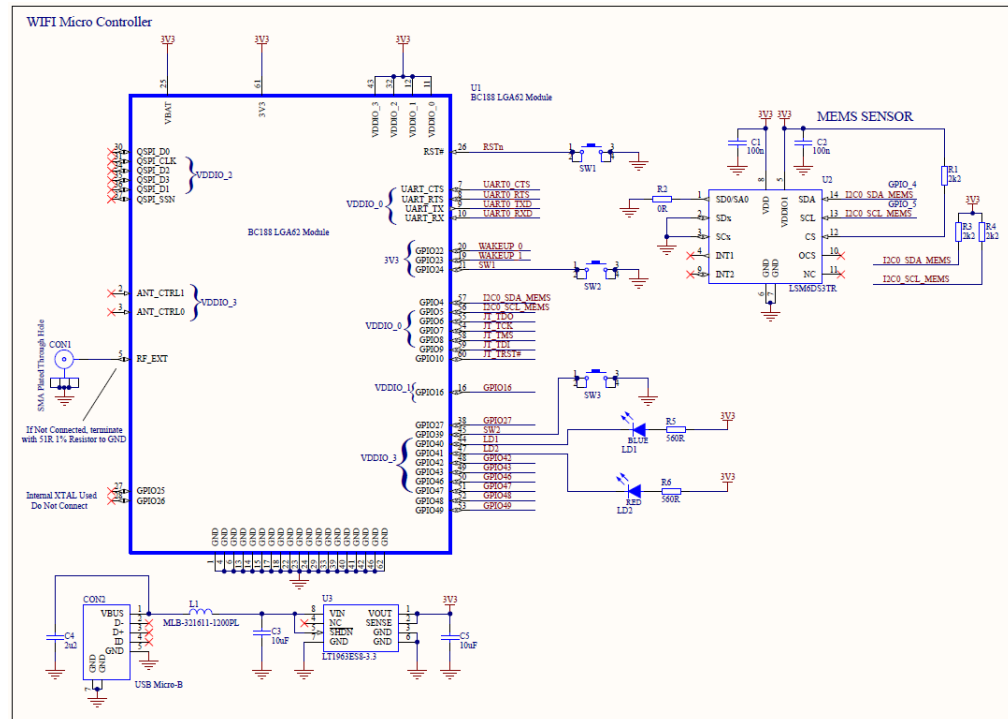
Figure 3-1: Application Schematic

Table 3-1: Voltages

Net	Minimum	Typical	Maximum	Absolute Maximum[a]
VBAT	3.0V[b]	3.3V	3.60V	3.63V
3V3	2.97V	3.3V	3.63V	4.00V
VDDIO_0	2.97V	3.3V	3.60V	3.63V
VDDIO_1	2.97V	3.3V	3.60V	4.00V
VDDIO_2	2.97V	3.3V	3.60V	4.00V
VDDIO_3	2.97V	3.3V	3.60V	3.63V

a. Operation above this level of voltage may damage the device.
b. This is the minimum voltage allowed to enable the module in the boot modes described below.

Boot Modes

All supplies (VBAT Pin 25, 3V3 Pin 61 and VDDIO Pins 11,12, 32 & 43) should be applied simultaneously. No digital pins (GPIO, UART, I2C etc.) should be powered externally without first applying VDDIO_X.

The entire module is in a reset state during power on when the internal PMU detection circuit detects the voltage rising on VBAT.

RESET Mode

The module is reset by applying a minimum of a 80us active low pulse to RST# (Pin26). An internal PMU detection circuit detects when RST# is pulled low and powers on when RST# >1.25V. Pulling RST# low resets the entire module.

Power Down Modes

Several power down modes are supported

GPIOs

Unused PIOs should be left floating.

UART

The BC188 is controlled by GPIOs. This can be configured. If GPIO control is not used, these GPIOs should be left floating. The UART by default does not use RTS/CTS flow control. If the users do not expect to use it, these lines should be left floating.

EXT_RF

If the External RF Port is not used, terminate with a 51Ohm 1% resistor to ground.

The external RF port is internally DC Blocked and can be used as a external RF connection for test purposes or as an additional antenna where higher gain or range is required than that supported by the internal antenna on the module.

Digital Pin States on RESET or after Power Up

Table 3-2 shows the Digital Pin States on RESET or after power up.

Table 3-2: Digital Pin States on RESET or after Power up

Pin Name/Group	I/O Type	State After Power Up or RESET
UART_RX	Digital bi-directional with PU	Strong PU
UART_TX	Digital bi-directional with PU	Weak PU
UART_CTS	Digital bi-directional with PD	Weak PD
UART_RTS	Digital bi-directional with PU	Weak PU
GPIOX	Digital bi-directional with PU	Weak PU
RST#	Digital input with PU	Strong PU

PD=Pull Down, PU=Pull Up

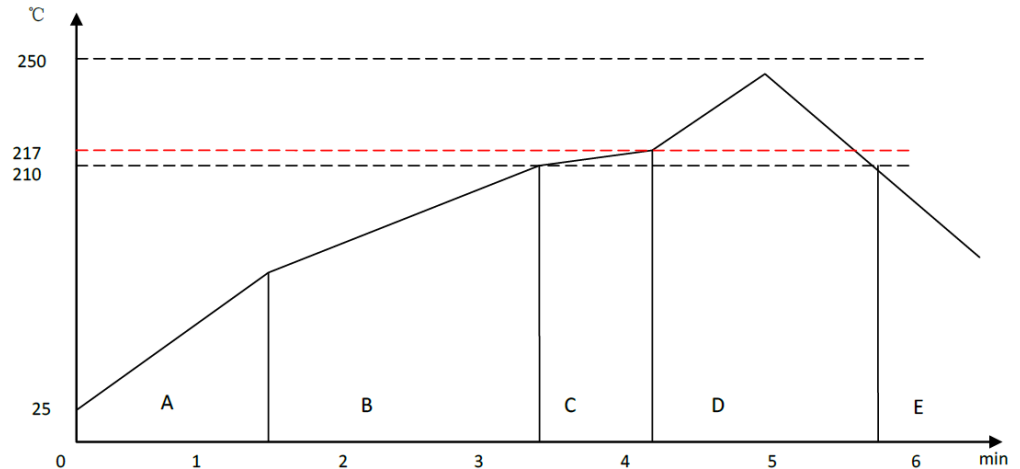# 4: Solder Reflow Profile

The solder profile is described below.

Figure 4-1: Solder Profile

Zone A: Preheat: This raises the temperature at a controlled rate, typically 0.5 - 2C/s. This will preheat the component to 120°C to 150°C to distribute the heat uniformly to the PCB.

Zone B: Equilibrium1: In this zone, the flux becomes soft and uniformly spreads solder particles over the PCB board, preventing re-oxidisation. The recommended temperature for this zone is 150°C to 200°C for 60s to 120s.

Zone C: Equilibrium2: This is optional and in order to resolve the upright component issue. Temperature is 210°C to 217°C for 20s to 30s.

Zone D: Reflow zone: The temperature should be high enough to avoid wetting but low enough to avoid component deterioration. The recommended peak temperature is 230°C to 250°C. The soldering time should be 30s to 90s when the temperature is above 217°C.

Zone E: Cooling: The cooling rate should be fast to keep the solder grains small which will give a longer lasting joint. A typical cooling rate is 4°C/s.

A: Regulatory Certifications

> **Caution:** *Unauthorized modifications or changes not expressly approved by Sierra Wireless could void compliance with regulatory rules, and thereby your authority to use this equipment.*

The BC188 module is designed to meet, and upon commercial release, will meet the requirements of the following regulatory bodies and regulations, where applicable:
• Federal Communications Commission (FCC) of the United States

Upon commercial release, the following industry certification will have been obtained, where applicable:
• Bluetooth SIG

Additional certifications and details on specific country approvals may be obtained upon customer request — contact your Sierra Wireless account representative for details.

Additional testing and certification may be required for the end product with an embedded BC188 module and are the responsibility of the OEM. Sierra Wireless offers professional services-based assistance to OEMs with the testing and certification process, if required.

United States - FCC

The BC188 module, upon commercial release, will have been granted modular approval by the FCC. Integrators may use the BC188 module in their end products without additional FCC certification if the following conditions are met.
• At least 20 cm separation distance between the antenna and the user's body must be maintained at all times.
• The BC188 module must not be collocated with any other transmitter within a host device.
• The regulatory label on the end product must include the text "Contains FCC ID: SSSBC188-X" and the following compliance statement:

> *This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

A user manual with the end product must clearly indicate the operating requirements and conditions to ensure compliance with current FCC RF exposure guidelines.

The end product with an embedded BC188 module may also need to meet the FCC Part 15 unintentional emission requirements and be properly authorized per FCC Part 15 Subpart B.

>> B: WLAN

Overview

The BC188 integrates a highly integrated, single-band (2.4 GHz) IEEE 802.11n 1x1 WLAN subsystem, specifically designed to support next generation, high throughput data rates.

The subsystem provides the combined functions of CPU, memory, Medium Access Controller (MAC), Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency Division Multiplexing (OFDM) baseband modulation, direct conversion WLAN RF radio, and encryption. For security, the 802.11i security is supported through several protocols.

Features

- 1x1 SISO, 2.4 GHz, HT20 operation
- Antenna diversity
- CMOS and low-swing sine wave input clock
- Low power with deep sleep and standby modes
- Pre-regulated supplies
- Integrated T/R switch, PA, and LNA
- Optional 802.11n features
- One Time Programmable (OTP) memory to eliminate need for external EEPROM

WLAN MAC

- Simultaneous peer-to-peer and infrastructure modes
- RTS/CTS for operation under DCF
- Hardware filtering of 32 multicast addresses
- On-chip Tx and Rx FIFO for maximum throughput
- Open System and Shared Key Authentication services
- A-MPDU Rx (de-aggregation) and Tx (aggregation)
- Reduced Inter-Frame Spacing (RIFS) receive
- Management information base counters
- Radio resource measurement counters
- Quality of service queues
- Block acknowledgment extension
- Multiple-BSSID and Multiple-Station operation
- Transmit rate adaptation
- Transmit power control
- Long and short preamble generation on a frame-by-frame basis for 802.11b frames

WLAN Baseband

- 802.11n 1x1 SISO
- Backward compatibility with legacy 802.11g/b technology

- PHY data rates up to 72.2 Mbps
- 20 MHz bandwidth/channel
- Modulation and Coding Scheme (MCS)-MCS 0~7
- Radio resource measurement
- Optional 802.11n SISO features
  - One spatial stream STBC reception and transmission
  - Short guard interval
  - RIFS on receive path 802.11n packets
  - 802.11n greenfield Tx/Rx
- Power save features

WLAN Radio

The BC188 direct conversion WLAN RF radio integrates all the necessary functions for transmit and receive operation.

Features Include:
- Integrated direct-conversion radio
- 20 MHz channel bandwidth
- Integrated T/R switch, PA, and LNA

WLAN Rx Path

- Direct conversion architecture eliminates need for external SAW filter
- On-chip gain selectable LNA with optimized noise figure and power consumption
- High dynamic range AGC function in receive mode

WLAN Tx Path

- Integrated power amplifier with power control
- Optimized Tx gain distribution for linearity and noise performance

WLAN Local Oscillator

- Fractional-N for multiple reference clock support
- Fine channel step

Channel Frequencies Supported

Table 2-1: Channel Frequencies Supported

20 MHz Channel	Frequency (GHz)
1	2.412
2	2.417
3	2.422
4	2.427
5	2.432
6	2.437
7	2.442
8	2.447
9	2.452
10	2.457
11	2.462
12	2.467
13	2.472

WLAN Encryption

- WEP 64- and 128-bit encryption with hardware TKIP processing (WPA)
- AES-CCMP hardware implementation as part of 802.11i security standard (WPA2)
- Enhanced AES engine performance
- AES-Cipher-Based Message Authentication Code (CMAC) as part of the 802.11w security standard
- WLAN Authentication and Privacy Infrastructure (WAPI)