

# User Manual of WSSFM20R4(Rev1.0)

## 1. Introduction

The WSSFM20R4 module is a quad mode module supporting Sigfox, BLE, WiFi and GPS.

This Module able to transmit and receive messages using the SIGFOX network.

The typical applications can be used as a low power tracking device.

The application use WIFI or GPS to determine location. It will then transmit the location information via SIGFOX. It also will transmit other information like temperature, accelerometer, and so on.

## 2. Hardware Architecture:

### 2.1 Main Chipset Information

Item	Vendor	Part Number
SigFox BLE WIFI GPS(GLONASS)	ON semiconductor NORDIC semiconductor ESPRESSIF UBLOX	AX-SFUS-1-01 nRF52832 ESP8285 UBX-G8020

### 2.2 Circuit Block Diagram

The major internal and external block diagram of WSSFM20R4 is illustrated in Figure 1-1.

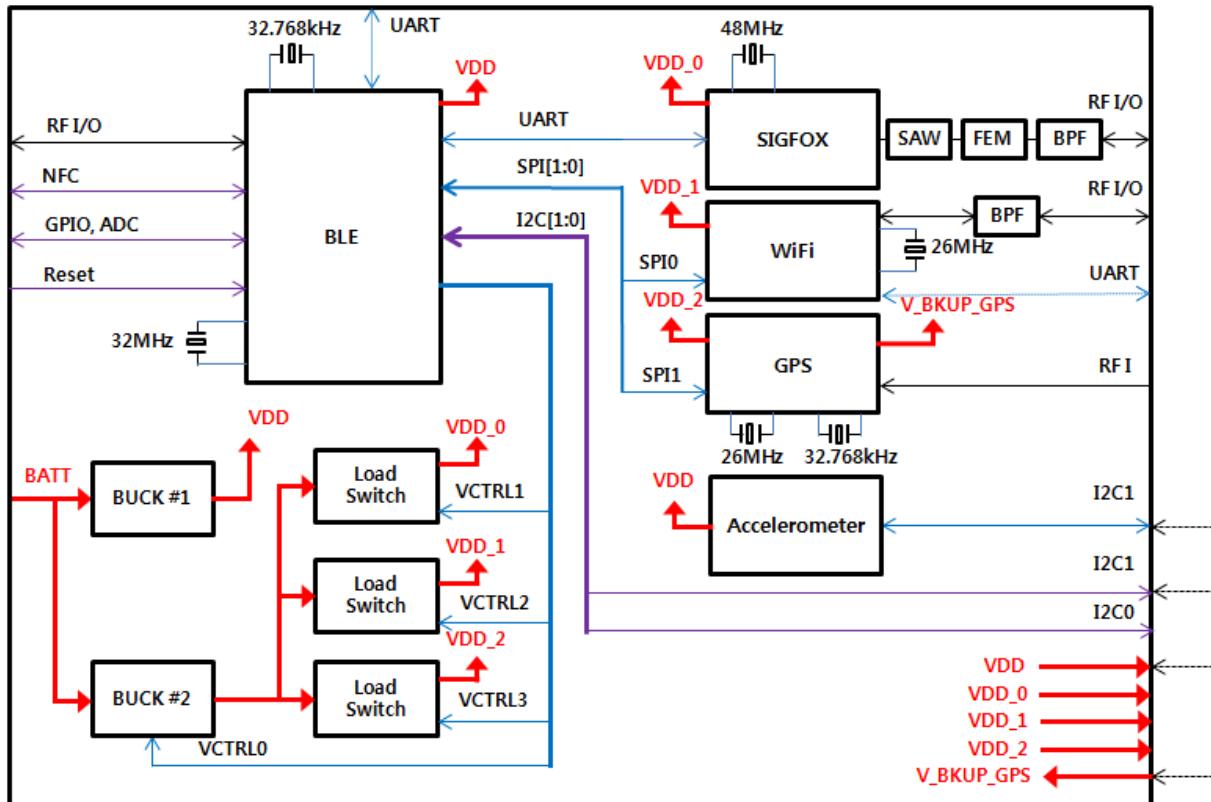


Figure 1-1 WSSFM20R4 block diagram and System Interface

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### 3. Operational Description

#### -SIGFOX

SIGFOX able to transmit and receive messages using the SIGFOX network.

This module address the RCZ4(Australia, new Zealand).

#### -BLE

Bluetooth 4.2 optimized for low-power applications.

The RADIO contains a 2.4 GHz radio receiver and a 2.4 GHz radio transmitter that is compatible with Nordic's proprietary 1 Mbps and 2 Mbps radio modes in addition to 1 Mbps *Bluetooth®* low energy mode.

#### -WIFI

ESP8285 implements TCP/IP, the full 802.11 b/g/n/e/i WLAN MAC protocol and Wi-Fi

Direct specification. It supports not only basic service set (BSS) operations under the distributed control function (DCF) but also P2P group operation compliant with the latest Wi-Fi P2P protocol. Low level protocol functions are handled automatically by ESP8285.

- RTS/CTS
- acknowledgement
- fragmentation and defragmentation
- aggregation
- frame encapsulation (802.11h/RFC 1042)
- automatic beacon monitoring / scanning, and
- P2P Wi-Fi direct

Passive or active scanning, as well as P2P discovery procedure is performed autonomously once initiated by the appropriate command. Power management is handled with minimum interaction with host to minimize active duty period.

#### -GPS (GLONASS)

The application use GPS(GLONASS) to determine location. It will then transmit the location information via SIGFOX. It also will transmit other information like temperature, accelerometer, and so on.

#### 3.1 Features

##### - SIGFOX

- > Sigfox up-link and down-link functionality controlled by AT commands
- > Temperature sensor
- > Ultra-low power consumption

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> High performance narrow-band Sigfox

- BLE

> Based on Nordic Semiconductor nRF52832 Bluetooth Smart Soc  
(ARM Cortex –M4F, 512KB flash, and 64KB RAM embedded)

> Ultra-low power multiprotocol support

> BLE Wireless application

> Bluetooth specification Version 4.2 (LE single mode) compliant

> External interface: 32 GPIO pins for NFC(tag), SPI, TWI, UART, Crystal (32.768 KHz) and ADC

-WIFI

> 2.4 GHz receiver

> 2.4 GHz transmitter

> High speed clock generators and crystal oscillator

> Real-Time Clock

> Bias and regulators

> Power management

-GPS (GLONASS)

blox 8 position engine featuring: ver 2 million effective correlators

> down to 1 s acquisition time

> up to 18 Hz navigation update rate in single GNSS mode

> Supports GPS and GLONASS as well as SBAS and QZSS

> Supports u-blox's AssistNow Online / AssistNow Offline A-GNSS services and is OMA SUPL 1.0 compliant

> Supports u-blox's AssistNow Autonomous (no connectivity required)

> Supports crystal oscillator and TCXO

> Supports a built-in DC/DC converter and an intelligent, user configurable power management

> Supports data logging, odometer, geo-fencing, spoofing detection, and message integrity protection.

### **3.2 Time base of the RF frequency**

-SIGFOX

For Sigfox RF frequency, a TCXO(48MHz) is a clock reference.

-BLE

Using external 32.768 kHz crystal for RTC.

The 64 MHz crystal oscillator (HFXO) is controlled by a 32 MHz external crystal.

-WIFI

The high frequency clock on ESP8285 is used to drive both transmit and receive mixers.

This clock is generated from internal crystal oscillator and external crystal. The crystal frequency is 26 MHz.

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#### -GPS(GLONASS)

The RTC is driven internally by a 32.768 Hz oscillator, which makes use of an external RTC crystal.

For GPS(GLONASS) RF frequency, a TCXO(26MHz) is a clock reference.

### 3.3 Transmission

#### -SIGFOX

The Tx path produces a DBPSK-modulated signal. modulate RF signal generated by the synthesizer. The modulated RF signal is fed to the integrated RX/TX switch and antenna interface and then out of the AX-SFUS-1-01.

#### -BLE

The RADIO contains a 2.4 GHz radio receiver and a 2.4 GHz radio transmitter that is compatible with Nordic's proprietary 1 Mbps and 2 Mbps radio modes in addition to 1 Mbps *Bluetooth®* low energy mode.

#### -WIFI

The 2.4 GHz transmitter up-converts the quadrature baseband signals to 2.4 GHz, and drives the antenna with a high-power CMOS power amplifier. The function of digital calibration further improves the linearity of the power amplifier, enabling a state of art performance of delivering +19.5 dBm average power for 802.11b transmission and +16dBm for 802.11n transmission.

Additional calibrations are integrated to offset any imperfections of the radio, such as:

- Carrier leakage
- I/Q phase matching
- Baseband nonlinearities

These built-in calibration functions reduce the product test time and make the test equipment unnecessary.

### 3.4 Receiver

#### -SIGFOX

The Rx path is able to receive 922.3MHz signal and the noise amplifier is built in the inside of the chip, it amplifies the received signal by the low noise amplifier according to the receiving intensity, and the amplified signal is converted into the digital signal through the ADC, Packets will be interpreted.

#### -BLE

The RADIO contains a 2.4 GHz radio receiver and a 2.4 GHz radio transmitter that is compatible with Nordic's proprietary 1 Mbps and 2 Mbps radio modes in addition to 1 Mbps *Bluetooth®* low energy mode.

#### -WIFI

The 2.4-GHz receiver down-converts the RF signals to quadrature baseband signals and converts them to the digital domain with 2 high resolution high speed ADCs. To adapt to varying signal channel conditions, RF filters, automatic gain control (AGC), DC offset cancelation circuits and baseband filters are integrated within ESP8285.

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### -GPS(GLONASS)

u-blox 8 GNSS chips are single GNSS receivers which can receive and track either GPS or GLONASS signals. By default the u-blox 8 receivers are configured for GPS, including SBAS and QZSS reception. If power consumption is a key factor, then QZSS and SBAS should be disabled.

## 3.5 Product Details

### -SIGFOX

> Data Modulation

- TX : DBPSK
- RX : 2GFSK

> Frequency :

Sigfox zone	Uplink(TX)	Downlink(RX)
RCZ4 (Australia, new Zealand)	920.8MHz	922.3MHz

### -BLE

> Data Modulation : GFSK

> Frequency : 2402-2480MHz

### -WIFI

> Data Modulation :

- DSSS:CCK,BPSK,QPSK for 802.11b
- OFDM:BPSK,QPSK,16QAM,64QAM for 802.11g,n (HT20)

> Frequency Range : 2412-2484MHz

### -GPS(GLONASS)

> Data Modulation : BPSK

> Frequency :

- GPS : 1575.42MHz
- GLONASS : Around 1602MHz

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## 3.6 Output Power tolerance

- SIGFOX Output power : +/- 1.5dB
- BLE Output power : +/- 4.0dB
- WIFI Output power : +/- 2.5dB

## 3.7 WSSFM20R4 Category of signal

### 1) Categorization as Correlated or Completely Uncorrelated

For the purposes of this guidance, transmitter output signals are considered *correlated* if any of the following are true:

- The same digital data are transmitted from two or more antennas in a given symbol period, even with different coding or phase shifts; or,
- Correlation between two transmitted signals exists at any frequency and time delay; or,
- Multiple transmitter outputs serve to focus energy in a given direction or to a given receiver; or,
- The operating mode combines correlated techniques with uncorrelated techniques.

Otherwise, the output signals are considered *completely uncorrelated*.

## 3.8 Simultaneous transmission

	B LE	SIGFOX	2.4GHz WiFi	GPS
B LE		O	O	O
SIGFOX	O		N/A	N/A
2.4GHz WiFi	O	N/A		N/A
GPS	O	N/A	N/A	

## 4. Installation Guide

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### - Installation Figure

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## 5. N.B.

### Distance Precautions

1. The power density level at 20 cm is 0.0731 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 0.613 mW/cm<sup>2</sup> at Sigfox.
2. The power density level at 20 cm is 0.0031 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.0 mW/cm<sup>2</sup> at Bluetooth LE.
3. The power density level at 20 cm is 0.0876 mW/cm<sup>2</sup>, which is below the uncontrolled exposure limit of 1.0 mW/cm<sup>2</sup> at WLAN.

### FCC Precautions

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.