

Operation Description of SFM60R2(Rev1.0)

1. Introduction

The SFM60R2 is a quad mode module supporting Sigfox, BLE 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 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	ON semiconductor	AX-SFUS-1-01
BLE	NORDIC semiconductor	nRF52832
GPS(GLONASS)	UBLOX	UBX-G8020

2.2 Circuit Block Diagram

The major internal and external block diagram of SFM60R2 is illustrated in Figure 1-1.

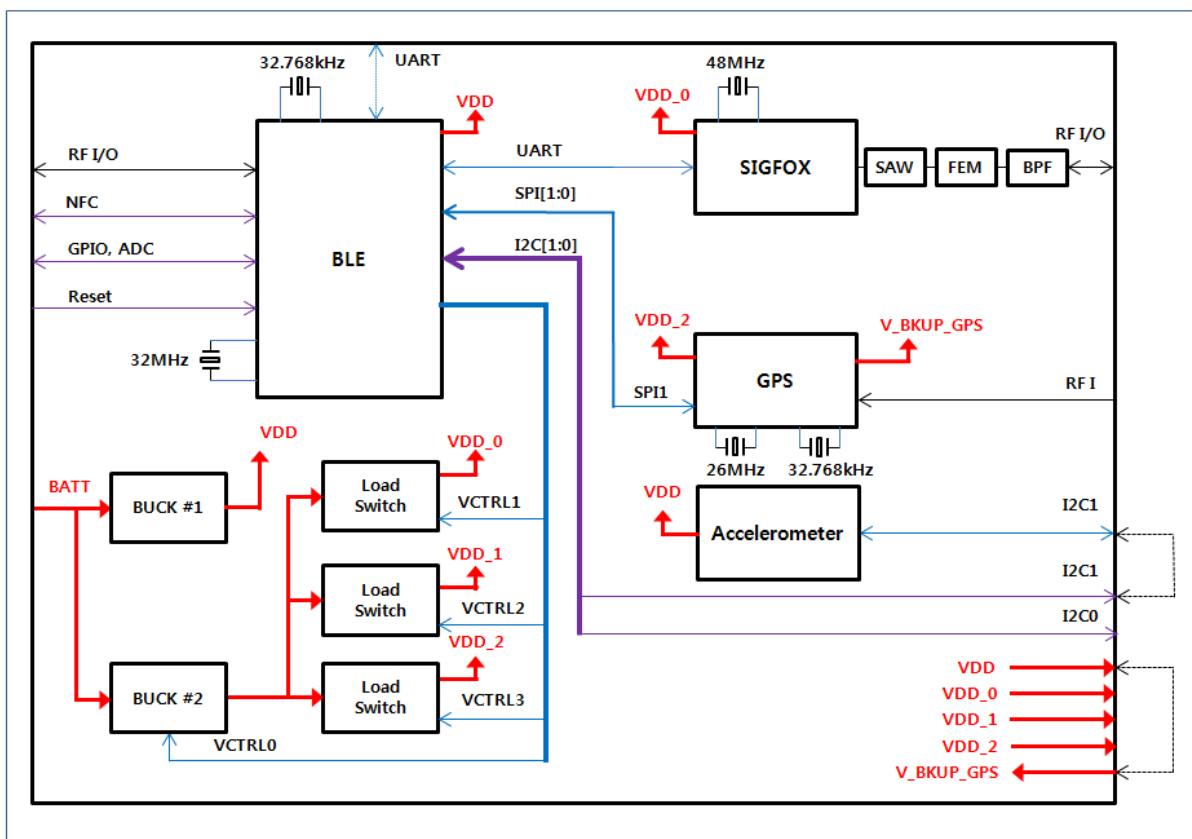


Figure 1-1 SFM60R2 block diagram and System Interface

3. Operational Description

-SIGFOX

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

This module address the RC2(North America).

-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.

-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.

-NFC

Type 2 near field communication (NFC-A) tag with wakeup-on-field and touchto-pair capabilities

3.1 Features

- SIGFOX

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

-GPS (GLONASS)

- > 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.

-NFC

- > Wake-on-field low power field detection (SENSE) mode
- > Frame assemble and disassemble for the NFC-A frames specified by the NFC Forum
- > Programmable frame timing controller
- > Integrated automatic collision resolution, CRC and parity functions

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.

-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.

3.4 Receiver

-SIGFOX

The Rx path is able to receive 905.2MHz 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.

-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.

-NFC

The NFCT peripheral (referred to as the 'NFC peripheral' from now on) supports communication signal interface type A and 106 kbps bit rate from the NFC Forum.

3.5 Product Details

-SIGFOX

> Data Modulation

TX : DBPSK

RX : 2GFSK

> Frequency :

Sigfox zone	Uplink(TX)	Downlink(RX)
RC2(North America)	920.1375 ~ 922.6625 MHz	905.2MHz

-BLE

> Data Modulation : GFSK

> Frequency : 2402-2480MHz

-GPS(GLONASS)

> Data Modulation : BPSK

> Frequency :

GPS : 1575.42MHz

GLONASS : Around 1602MHz

-NFC

> NFC-A listen mode operation

13.56 MHz input frequency

Bit rate 106 kbps

3.6 Output Power tolerance

- SIGFOX Output power : 22 +/- 1.5dBm

- BLE Output power : 4 +/- 2.0dB

3.7 SFM60R2 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

	BLE	SIGFOX
BLE		O
SIGFOX	O	

4. Installation Guide

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<Warning Statements>

FCC Part 15.19 / RSS-GEN Sec.8.4 Statements:

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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

FCC Part 15.21 statement

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

RF Exposure Statement

The antenna(s) must be installed such that a minimum separation distance of at least 20 cm is maintained between the radiator (antenna) and all persons at all times. This device must not be co-located or operating in conjunction with any other antenna or transmitter.

l'exposition aux RF L'antenne (ou les antennes) doit être installée de façon à maintenir à tout instant une distance minimum de au moins 20 cm entre la source de radiation (l'antenne) et toute personne physique.

End Product Labeling

The module is labeled with its own FCC ID. If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

"Contains FCC ID: 2ABA2SFM60R2

" Contains IC: 11534A-SFM60R2

Étiquetage du produit final Le module BT111 est étiqueté avec sa propre identification FCC et son propre numéro de certification IC. Si l'identification FCC et le numéro de certification IC ne sont pas visibles lorsque le module est installé à l'intérieur d'un autre dispositif, la partie externe du dispositif dans lequel le module est installé devra également présenter une étiquette faisant référence au module inclus. Dans ce cas, le produit final devra être étiqueté sur une zone visible avec les informations suivantes :

« Contient module émetteur identification FCC ID : 2ABA2SFM60R2

« Contient module émetteur IC : 11534A-SFM60R2

OEM Responsibilities to comply with FCC Regulations

The module has been certified for integration into products only by OEM integrators under the following condition:

- The antenna(s) must be installed such that a minimum separation distance of at least 20 cm is maintained between the radiator (antenna) and all persons at all times.
- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures.

As long as the two condition above is met, further transmitter testing may not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE: In the event that these conditions can ' t be met (for certain configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can't be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module or change RF related parameters in the user manual of the end product.

RSS-GEN, Sec. 8.3

This radio transmitter (IC: 11534A-SFM60R2, Model: SFM60R2) has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

- List of approved antennas

- 1) For Sigfox antenna, INNO-EL9SWS-149 or similar part manufactured by Inno-Link. Co., Ltd. (Highest permitted antenna gain: 2.01 dBi)
- 3) For BT LE antenna, INNO-EL9SWS-151 or similar part manufactured by Inno-Link. Co., Ltd. (Highest permitted antenna gain: 4.44 dBi)

Le présent émetteur radio (IC: 11534A-SFM60R2, Model: SFM60R2) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

- Liste des antennes approuvées

1) Pour l'antenne Sigfox, INNO-EL9SWS-149 ou une pièce similaire fabriquée par Inno-Link. Co., Ltd. (Plus haut gain d'antenne autorisé: 2,01 dBi)

2) Pour l'antenne BT LE, INNO-EL9SWS-151 ou une pièce similaire fabriquée par Inno-Link. Co., Ltd. (Plus haut gain d'antenne autorisé: 4.44 dBi)

Antenna Installation Requirement

The host manufacturer must meet the antenna requirements stated in operational description and must not give to access to antenna connector to user when you install this module into devices to be compliance with FCC section 15.203.