



WISOL / SFM20R

Rev 0.0

# Product design guide for RF regulatory certification

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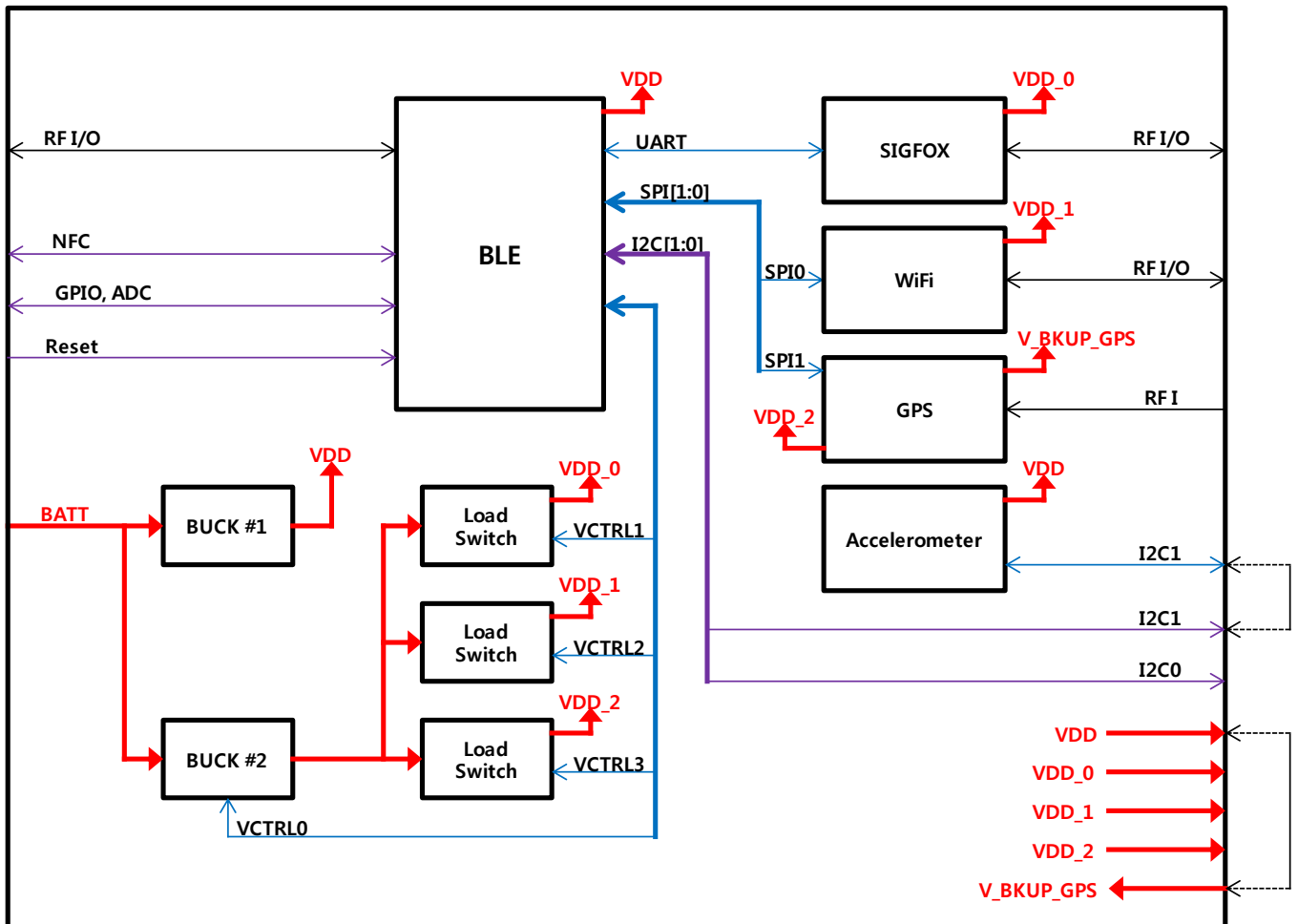
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## 1. Scope

SFM20R is a module that supports Quad mode.(Sigfox, WIFI, BLE, GPS, NFC)

This document describes what should be considered when designing the product for RF regulatory certification of each RF block.

## 2. Block Diagram



< Block diagram of SFM20R model >

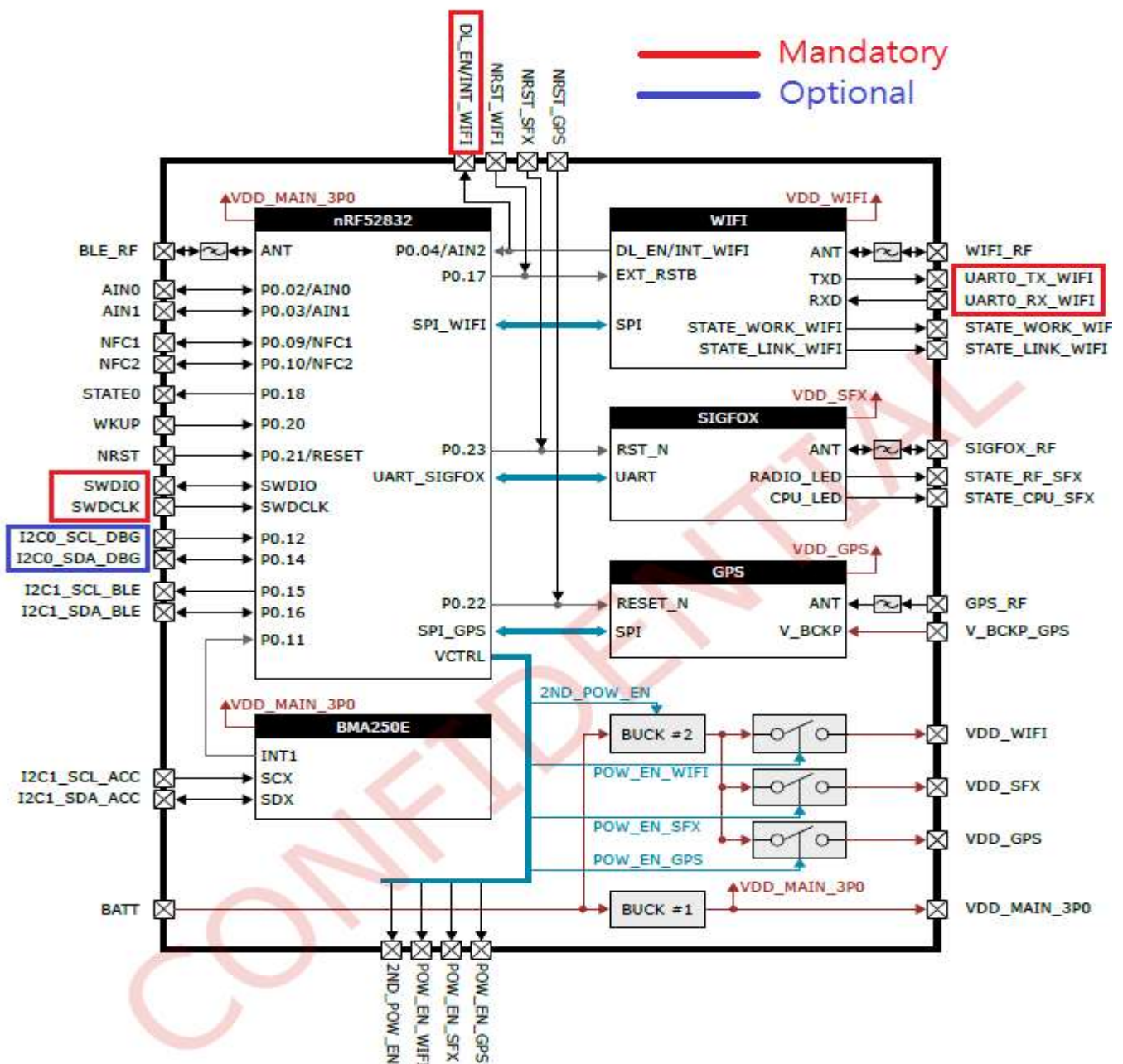
BLE chip (nRF52832/ARM Cortex M4) is host MCU.

For RF regulatory certification, each RF block must be set to Test mode.

In case of WIFI, WIFI UART and WIFI download enable pin should be connected to the outside.

(UART0\_TX\_WIFI, UART0\_RX\_WIFI, DL\_EN/INT\_WIFI)

### 3. Pin Map Overview



\* External connection pin.

**Mandatory : 5 pins (Test conducted with J-Link equipment)**

- . SWD (2 pins : SWDCLK, SWDIO) : use J-Link connect
- . WIFI UART(2 pins : UART0\_TX\_WIFI, UART0\_RX\_WIFI) : WIFI RF Test, download for WIFI firmware
- . DL\_EN/INT\_WIFI : boot for WIFI firmware download mode (Active Low)

\* SWD(use RTT) : BLE, Sigfox, GPS, Dedicated UART : WIFI

**Optional : 2 pins (Can be tested with UART when using, "USB to UART converter" required)**

- . I2C\_DBG (I2C0\_SCL\_DBG, I2C0\_SDA\_DBG) : Used as UART in "RF regulatory certification" test**

## 4. Test Mode Overview

### . Kind of boot mode

Normal mode : 0 (default, The mode setting is possible with SWD)

Sigfox test mode : 6 (via SWD), 7(via UART)

WIFI test mode : 1 (via WIFI UART), \*WIFI download mode -> DL\_EN/INT\_WIFI to GND

BLE test mode : 3 (via SWD and via UART)

GPS test mode : 4 (via SWD and via UART)

\* How to setting test mode : SEND "CMx" to RTT in Normal mode. ("x" is boot mode)

\* How to go back to normal mode : SEND "CF" (0x4346) to RTT, it is initialized to normal mode.

### . RF Testable Interface

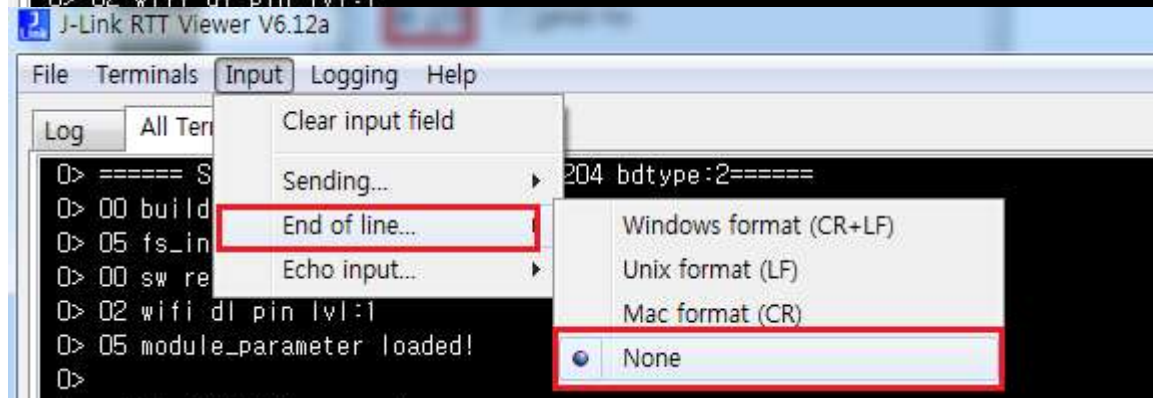
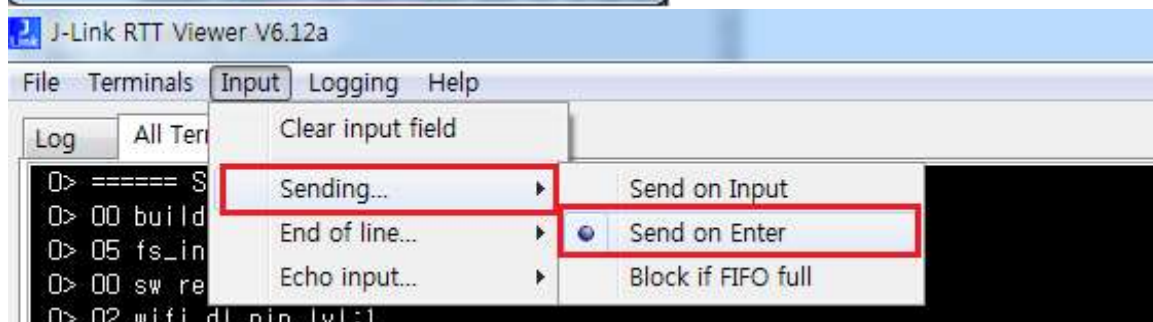
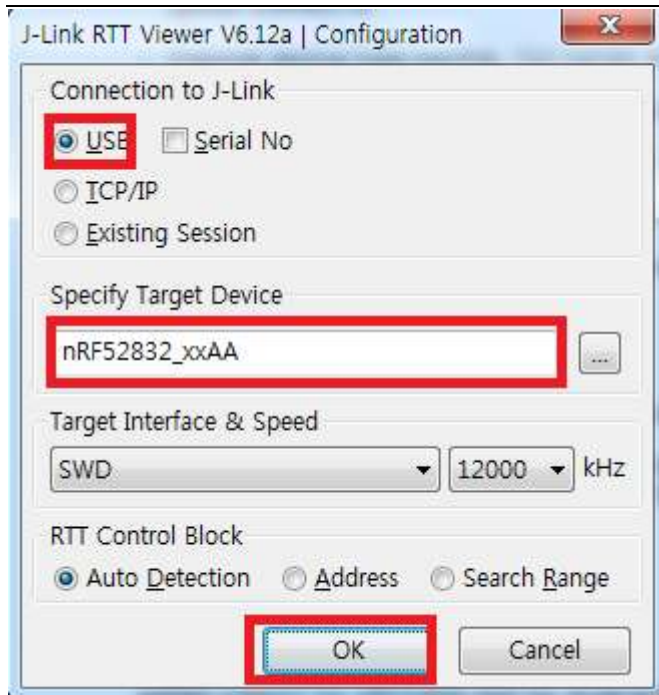
Interface pins			
	SWD pins (Use RTT)	WIFI_UART pins	Use <b>I2C_DBG</b> pins as uart (I2C0_SCL_DBG <- TXD, I2C0_SDA_DBG -> RXD)
<b>SIGFOX</b>	O (mode:6)	X	O (mode:7)
			Baud rate : 9600
<b>WIFI</b>	X	O (mode:1)	X
<b>BLE</b>	O (mode:3)	X	O (mode:3)
			Baud rate : 19200
<b>GPS</b>	O (mode:4)	X	O (mode:4)
			Baud rate : 9600
	j-Link	USB to Uart	USB to Uart

## 5. How to use common tools

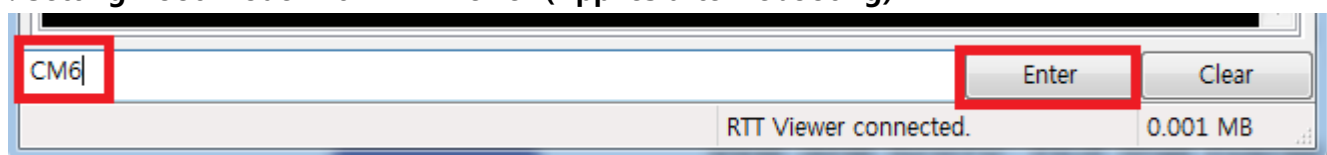
### . Use RTT tools

Tools for RTT communication with J-link equipment via SWD

<https://www.nordicsemi.com/eng/nordic/Products/nRF51822/nRF5x-Command-Line-Tools-Win32/33444>

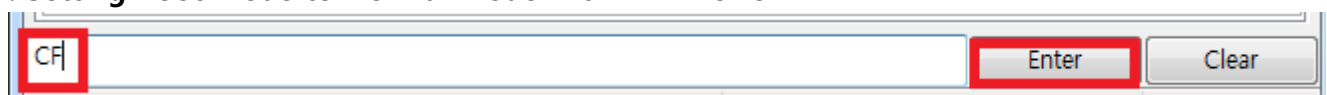


### . Setting Boot Mode with RTT Viewer (Applies after rebooting)



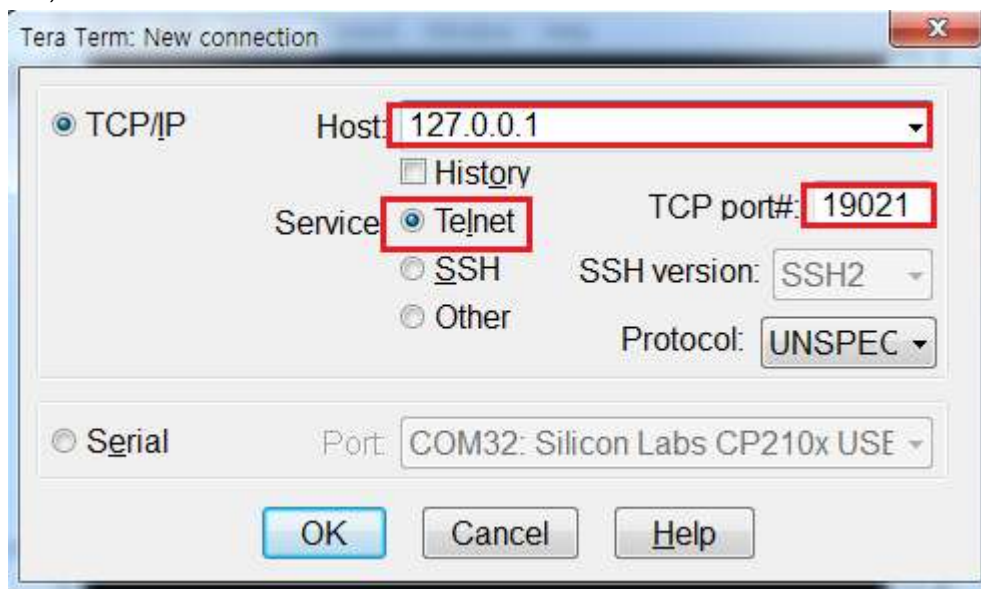
\*6 is boot mode value (sigfox), [ref. boot mode value](#)

### . Setting Boot Mode to Normal mode with RTT Viewer



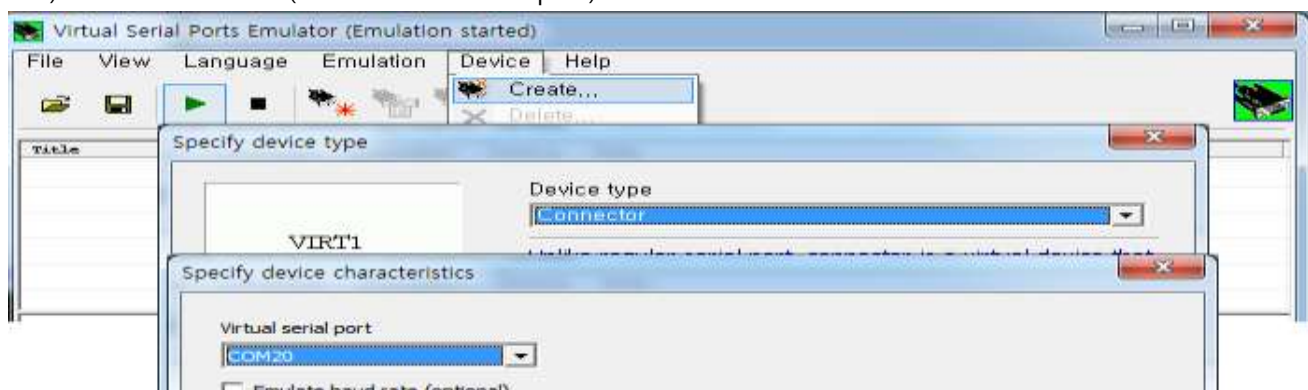
## . Connect RTT by Terminal tool (eg. Tera Term)

- 1) Run RTT Viewer (It acts as a telnet server)
- 2) Connect terminal tool

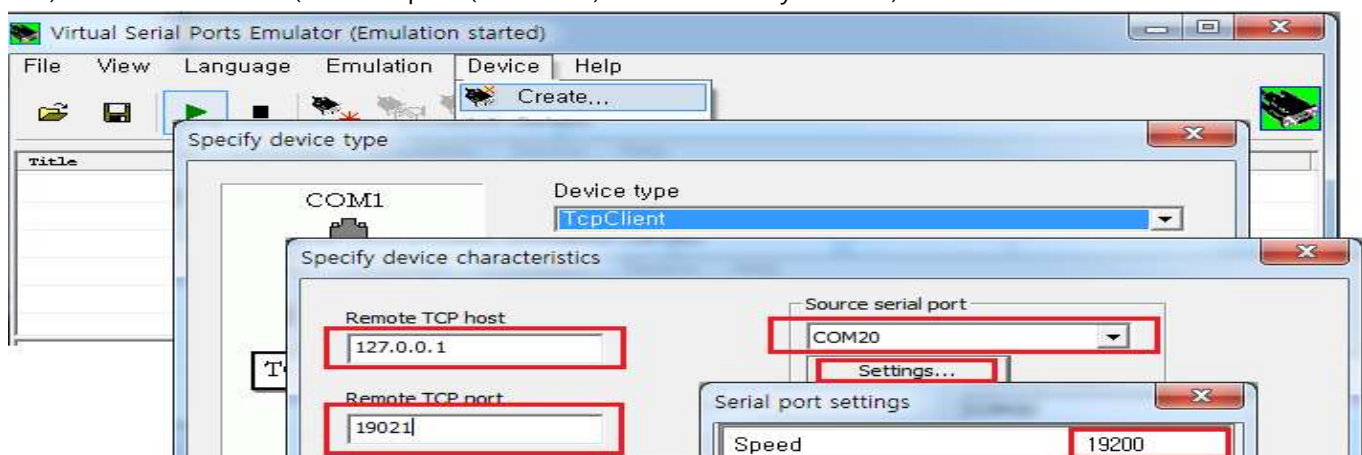


## . How to create a virtual com port via RTT (For tools that use the com port)

- 1) Run RTT Viewer (It acts as a telnet server)
- 2) Run VSPE (<http://www.eterlogic.com/Products.VSPE.html>)
- 3) Create Connector (Set to unused com port)



- 4) Create TCP Client. (Set the speed(baud rate) baud rate for your tool)







4) Com port is available

## 6. Product Design Guide for Sigfox RF Certification

"Sigfox RF Certification" available with UART or SWD

Set the test mode to 6(RTT) or 7(UART).

You must provide "J-Link" when using "SWD" or provide "USB to serial converter board" when using "UART".

In case of RF Certification, it is recommended to use a shielded cable because there is a possibility of problems due to noise emitted through the cable.

### [set test mode]

RTT

CM6	Enter	Clear
-----	-------	-------

UART

CM7	Enter	Clear
-----	-------	-------

### [test tool]

Test with AT command using terminal tools (RTT or UART)

### [Serial Config]

Baud rate : 9600, Data bits : 8, parity : None, Stop bits : 1

### [Test Cmd]

AT\$CW=868130000,1,15<CR><LF>	CwEuON
AT\$CW=868130000,0,15<CR><LF>	CwEuOFF
AT\$CW=902200000,1,24<CR><LF>	CwUsON
AT\$CW=902200000,0,24<CR><LF>	CwUsOFF
AT\$CW=920800000,1,24<CR><LF>	CwRcz4ON
AT\$CW=902200000,0,24<CR><LF>	CwRcz4OFF

ref. <https://www.onsemi.com/pub/Collateral/AX-SIGFOX-D.PDF>

## 7. Product Design Guide for WIFI RF Certification

When WIFI RF Certification test, it must be able to control the DL\_EN / INT\_WIFI pin and the WIFI UART (UART0\_TX\_WIFI, UART0\_RX\_WIFI) pins.

To conduct WiFi Certification, It use Test Binary, which is provided for separate Certification.

Because of this, WIFI downloads may be required. (WIFI download mode -> DL\_EN/INT\_WIFI to low)

Set the test mode to 1 and using the WIFI UART port.

You must provide "USB to serial convertor board" when using "UART".

In case of RF Certification, it is recommended to use a shielded cable because there is a possibility of problems



due to noise emitted through the cable.

#### [set test mode]

CM1	Enter	Clear
-----	-------	-------

#### [test tool]

using terminal tools (UART)

#### [Serial Config]

Baud rate : 115200, Data bits : 8, parity : None, Stop bits : 1

#### [ Test firmwares]

\* WIFI download mode -> DL\_EN/INT\_WIFI to low and booting

#### . FCC

Tx Command : [ESP8285\\_RF\\_TEST\\_20171018.bin](#)

#### . CE

Tx and Rx Command : [ESP8285\\_RF\\_TEST\\_20171018.bin](#)

Adaptivity Test : [ESP8285\\_CE\\_Adaptivity\\_20171018.bin](#)

#### . TELEC

Tx and Rx Command : [ESP8285\\_RF\\_TEST\\_20171018.bin](#)

Occupied Bandwidth and Spread-spectrum Bandwidth / Factor(14Channel) : [ESP8266\\_TELEC\\_20171018.bin](#)

\*\*Using EMC mode for Tx/Rx Command

\*\*Using SRRC mode for TELEC Occupied Bandwidth and Spread-spectrum Bandwidth / Factor(14Channel)

#### [how to write firmware]

Booting for WIFI download mode (DL\_EN/INT\_WIFI to low)

. [ESP8285\\_RF\\_TEST\\_20171018.bin](#)

run development\sigfox\_cfg2\tools\wifitools\Certification\_Test\_write\_RF\_TEST.cmd

. [ESP8285\\_CE\\_Adaptivity\\_20171018.bin](#)

run development\sigfox\_cfg2\tools\wifitools\Certification\_Test\_write\_CE\_Adaptivity.cmd

. [ESP8266\\_TELEC\\_20171018.bin](#)

run development\sigfox\_cfg2\tools\wifitools\Certification\_Test\_write\_TELEC.cmd

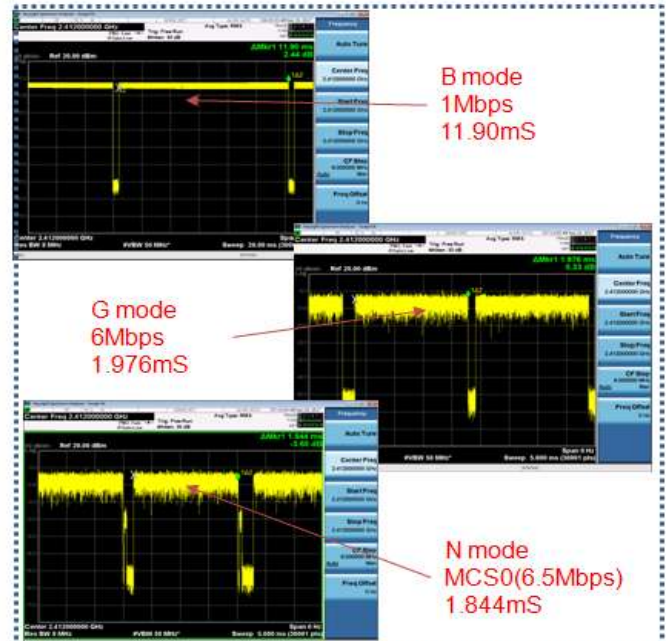
### [CE : Adaptivity Test]

- Using **ESP8285\_CE\_Adaptivity\_20171018.bin**
- Baudrate : 74880(with Both NL & CR)
- Interference Level : -47 dBm @ 60 sec
- Occupancy time : less than 12.8ms
  - 11.90ms @ B mode / 1Mbps
  - 1.976ms @ G mode / 6Mbps
  - 1.844ms @ N mode / MCS0(6.5Mbps)

#### Test Command

```

•op -S -o 1
•sleep -S -t 0
•dhcp -E
•ip -S -i 192.168.1.30 -m 255.255.255.0 -g 192.168.1.2
•sta -C -s ap_2g_ht20 -p
•phy -R -e 1 -f 1(1: 1M; 2: 6M; 3: 6.5M)
•soc -B -t UDP -i 192.168.1.30
•soc -C -s 0 -i 192.168.1.9 -p 5001
•soc -S -s 0 -i 192.168.1.9 -p 5001 -l 1400 -n 1000000 -j 1
  
```



### [TELEC : Occupied Bandwidth and Spread-spectrum Bandwidth / Factor(14Channel)]

#### • Condition

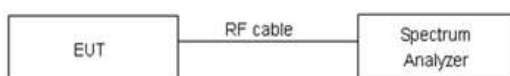
- Using **ESP8266\_TELEC\_20171018.bin**
- 14 Channel, Spread Factor > 10
  - 1Mbps, 2Mbps > 10Mhz
  - 5.5Mbps, 11Mbps > 13.75Mhz

#### Test Command

```

- certfc_mode_sel 2 (SRRC mode)
- wifitxout 14 0x0 8 (8 : Tx Power = 16dBm)
  
```

Attenuation	8
1M	14.465
2M	14.226
5.5M	14.099
11M	14.145



**[Test Command : Tx]**

- Using **ESP8285\_RF\_TEST\_20171018.bin**
- **Baudrate : 115200(with Both NL & CR)**
- **Certification Command**
  - **certific\_mode\_sel 1**
    - Ex) **certific\_mode\_sel=1**
    - Print) **EMC Certification start!!!**
- **Tx Start Command**
  - **wifitxout <Parameter1> <Parameter2> <Parameter3>**
    - <Parameter1>: Select the **Tx** channel from 1 ~ 14
    - <Parameter2>: Select the **Tx** data rate according to Table 1
    - <Parameter3>: It is an 8-bit signed operand that indicates **Tx** power attenuation. The unit is 0.25 dB. Value 4 means an attenuation of 1 dB, and 252 means a gain of 1 dB
      - Ex) **Wifitxout 1 0x0 0**
      - Print) **wifi tx** out: channel is 1, data rate is 11b 1.0Mb/s, bk=0,dl=0,len=4095
        - » Send the packets via channel 1 (2412 MHz) with the data rate of 1 Mbps
- **Tx Stop Command**
  - **cmdstop**
    - Ex) **cmdstop**
    - Print) **Tx Over**

11b		11g		11n	
Parameter	Data rate	Parameter	Data rate	Parameter	Data rate
0x0	1 Mbps	0xb	6 Mbps	0x10	6.5 Mbps / MCS0
0x1	2 Mbps	0xf	9 Mbps	0x11	13 Mbps / MCS1
0x2	5.5 Mbps	0xa	12 Mbps	0x12	19.5 Mbps / MCS2
0x3	11 Mbps	0xe	18 Mbps	0x13	26 Mbps / MCS3
-	-	0x9	24 Mbps	0x14	39 Mbps / MCS4
-	-	0xd	36 Mbps	0x15	52 Mbps / MCS5
-	-	0x8	48 Mbps	0x16	58.5 Mbps / MCS6
-	-	0xc	54 Mbps	0x17	65 Mbps / MCS7

Table 1

**[Test Command : Rx]**

- **Rx Start Command**
  - **esp\_rx <Parameter1> <Parameter2>**
    - <Parameter1>: Select the Rx channel from 1 ~ 14
    - <Parameter2>: Select the Rx data rate according to Table 1
      - Ex) **esp\_rx 1 0x0**
      - Print) **wifi rx** start: channel is 1, rate is 0x0
        - » Receive the packets via channel 1 (2412 MHz) with a data rate of 1 Mbps
- **Rx Stop Command**
  - **cmdstop**
    - Ex) **cmdstop**
    - Print) **Correct: 0 Desired: 0 RSSI: 0**

**7. Product Design Guide for BLE RF Certification**

" BLE RF Certification" available with UART or SWD

You must provide "J-Link" when using "SWD" or provide "USB to serial convertor board" when using "UART".

In case of RF Certification, it is recommended to use a shielded cable because there is a possibility of problems due to noise emitted through the cable.

**[set test mode]**

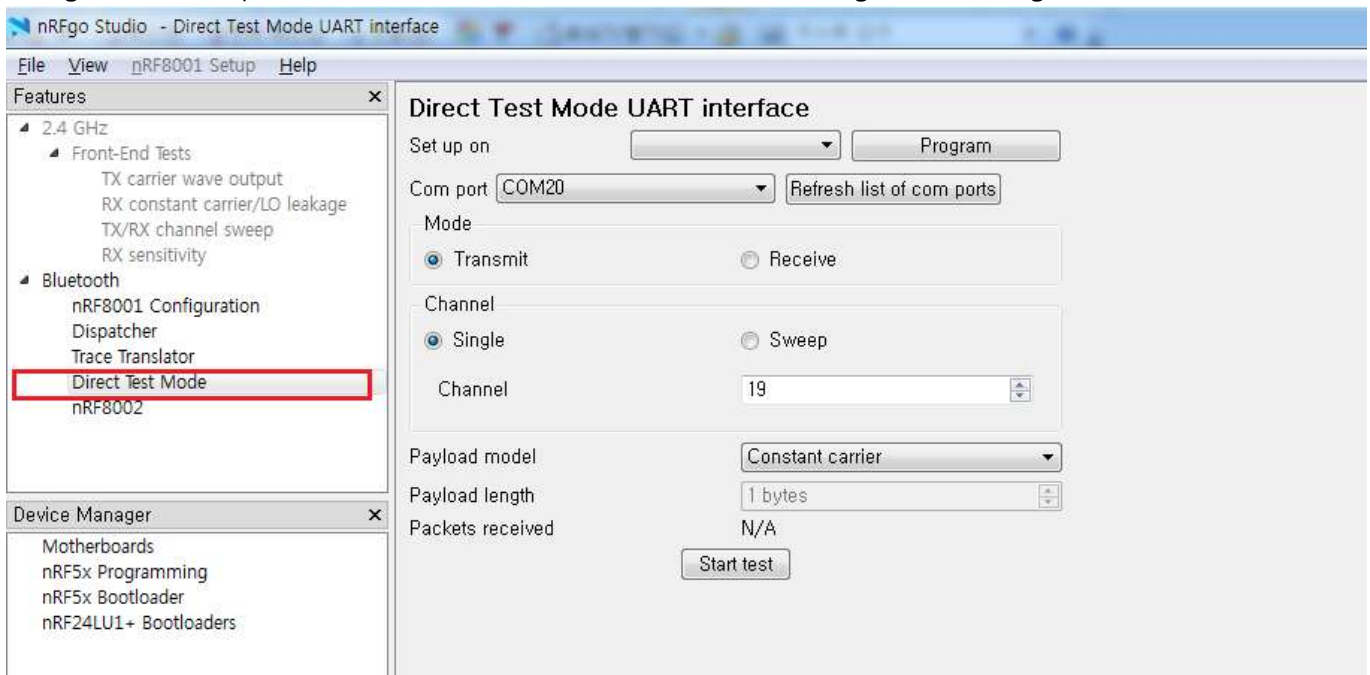
CM3	Enter	Clear
-----	-------	-------

**[Serial Config]**

Baud rate : 19200, Data bits : 8, parity : None, Stop bits : 1

**[test tool]**

nRFgo Studio : <https://www.nordicsemi.com/kor/nordic/Products/nRFgo-Studio/nRFgo-Studio-Win64/14964>



\* Other tools using the com port are also available.

**8. Product Design Guide for GPS RF Certification**

"GPS Certification" available with UART or SWD

You must provide "J-Link" when using "SWD" or provide "USB to serial convertor board" when using "UART".

In case of RF Certification, it is recommended to use a shielded cable because there is a possibility of problems due to noise emitted through the cable.

**[set test mode]**

CM4	Enter	Clear
-----	-------	-------

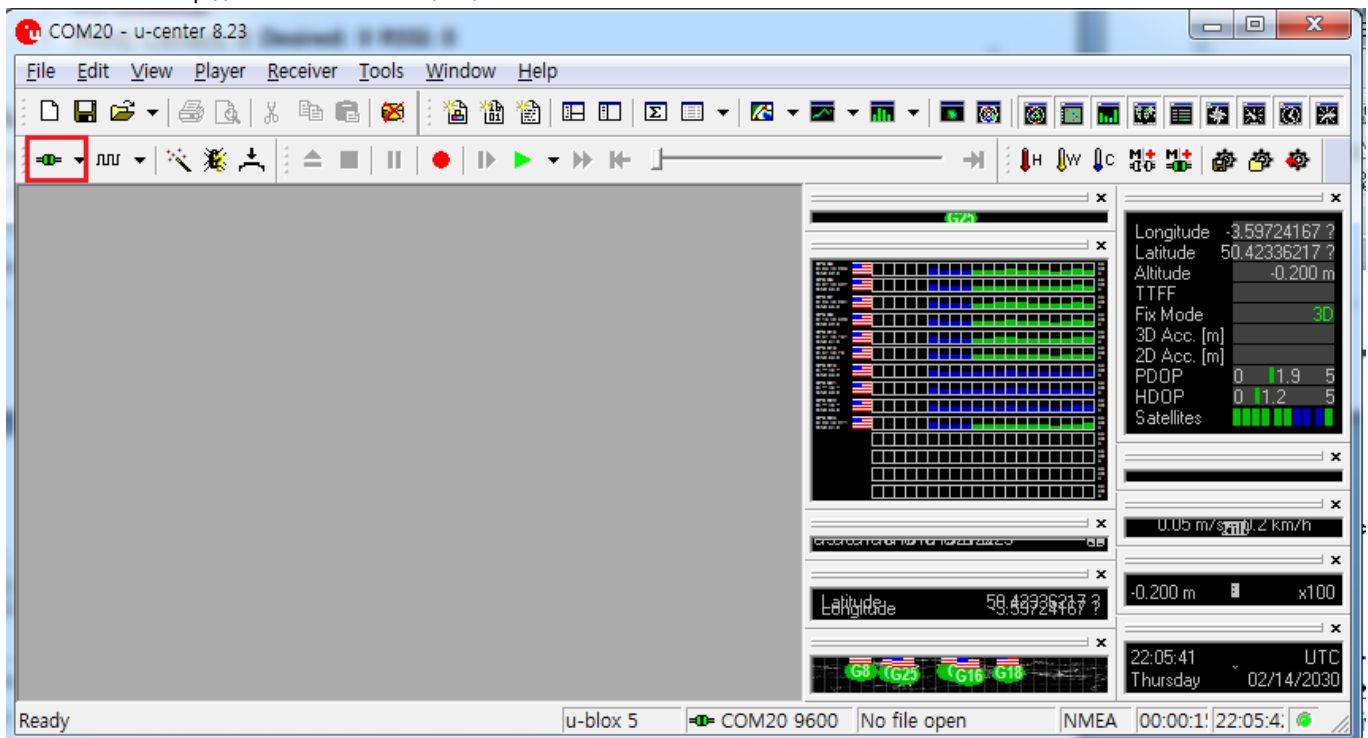
**[Serial Config]**

Baud rate : 9600, Data bits : 8, parity : None, Stop bits : 1

**[Use test tool]**



u-center : <http://www.u-blox.com/en/u-center-download-windows>



## 9. Product Design Guide for NFC RF Certification

CE (RED) certification must also proceed with NFC certification.

Certification should be carried out at the product end including the NFC antenna.