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WIRELESS PRODUCTS & SOLUTIONS

SIGFOX RTU Module

By Adeunis

User Guide Version 1.0

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Information

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Table of contents

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Technical Support

Website
Our website contains much useful information: modules and stand-alone products information, user guides, configuration software and technical documents which can be accessed 24 hours a day.

Email
If you have technical problems or cannot find the required information in the provided documents, contact our Technical Support by email. Use our dedicated email address (arf@adeunis.com) rather than any personal email address of our staff. This makes sure that your request is processed as soon as possible.

Helpful Information when Contacting Technical Support
When contacting Technical Support please have the following information ready:

- Product type (e.g. Wireless M-Bus),
- Firmware version (e.g. V3.03)
- Clear description of your question or the problem
- A short description of the application
- Your complete contact details

Environmental recommendations

All superfluous packaging materials have been eliminated. We have done everything possible to make it easy to separate the packaging into three types of materials: cardboard (box), expanded polystyrene (filler material) and polyethylene (packets, foam protective sheets). Your device is composed of materials that can be recycled and reused if it is dismantled by a specialist company. Please observe local regulations concerning the manner in which waste packaging material, used batteries and your obsolete equipment are disposed of.

Warnings
Valid for the following product:
ARF8119A

Read the instructions in the manual

The safety of this product is only guaranteed when it is used in accordance with its purpose. Maintenance should only be carried out by qualified persons.

Please note, do not install the equipment close to a heat source or in damp conditions.

Warning: Do not open the product, risk of electric shock.

Please note: for you own safety, you must ensure that equipment is switched off before carrying out any work on it.

Recommendations regarding use

- Before using the system, check that the power supply voltage shown in the user manual corresponds to your supply. If it doesn't, please consult your supplier.
- Place the device against a flat, firm and stable surface.
- The device must be installed in a location that is sufficiently ventilated so that there is no risk of internal heating and it must not be covered with objects such as newspapers, cloths, curtains, etc.
- The device's aerial must be free and at least 10 cm away from any conducting material.
- The device must never be exposed to heat sources such as heating equipment.
- Do not place the device close to objects with naked flames such as lit candles, blowtorches, etc.
- The device must not be exposed to aggressive chemical agents or solvents likely to damage the plastic or corrode the metal parts.
- Install your device close to its DC power supply.

COMPLIANCE TO FCC US/CAN

Important regulary information

FCC ID : U3Z-ARF8119

• This device complies with part 15 of the FCC rules and Industry Canada licence-exempt RSS standard(s). 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 ofthe device.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radiocommunication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off
and on, the user is encouraged to try to correct the interference by one or more of the following measures :
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
• CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY ADEUNIS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lower) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (e.i.r.p.) is not superior than necessary for successful communication.

WARNING !
FOR MOBILE DEVICE USAGE

.
This radiation element complies with FCC RF radiation exposure limits set forth for general population.
This radiation element must be installed to provide a separation distance of at least 20cm from all
persons and must not be co-located or operating in conjunction with any other antenna or
transmitter.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication."

This device has been designed to operate with the antennas listed below, and having a maximum gain of 6 dBi. Antennas not included in this list or having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms."

MobileMark	PSKN3-925S	3 dBi gain	dipole (see Annex1 for technical detail)
Adeunis		0 dBi+/-2dBgain	PCB Antenna (see Annex1 for technical detail)

OEM Installation and Compliance Labeling

The ARF8119A module is labeled with its own FCC ID number, and, 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 transmitter module.

This exterior label can use wording such as the following:

"Contains Transmitter Module "Contains FCC ID: U3Z-ARF8119"

Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application forequipment authorization.

Ce dispositif est conforme aux règles de la FCC part 15 and à la norme CNR-210 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Cet équipement a été testé et déclaré conforme aux limites d'un appareil numérique de classe B, conformément à la partie 15 des règles de la FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences nuisibles dans une installation résidentielle. Cet équipement génère, utilise et peut émettre de l'énergie radiofréquence et, s'il n'est pas installé et utilisé conformément aux instructions, peut causer des interférences nuisibles aux radiocommunications. Il est cependant toujours possible que des interférences se produisent dans le cadre d'une installation particulière.
Si cet appareil produit des interférences nuisibles à la réception des programmes de radio et de télévision –détectables lors de la mise hors tension ou en tension de l'appareil-l'utilisateur est encouragé à mettre en œuvre une ou plusieurs des mesures suivantes pour remédier à ces interférences :
•Réorienter ou déplacer l'antenne de réception.
•Augmenter la distance entre l'équipement et le récepteur.
•Branchez le matériel à une sortie sur un circuit différent de celui auquel le récepteur est branché.
•Prendre conseil auprès du commerçant ou d'un technicien de radio/TV expérimenté.
Tout changement ou modification non expressément approuvé par la partie responsable des mesures de conformité peut amener l'utilisateur à se voir interdire l'usage de l'appareil.
Cet appareil est limité à l'exploitation des fréquences autorisées Partie 15, et ne peut pas être configuré par des utilisateurs finaux ou des installateurs professionnels à fonctionner en dehors des bandes autorisées.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

ATTENTION !
POUR UTILISATION DE DISPOSITIF MOBILE
.
l'élément radio est conforme aux limites d'exposition aux rayonnements RF de la FCC établies pour la population générale. l'élément radio doit être installé de manière à assurer une distance de séparation d'au moins 20 cm de tout personnes et ne doivent pas être co-localisés ou fonctionner en conjonction avec toute autre antenne ou émetteur.

Pour réduire le brouillage radioélectrique potentiel causé aux autres utilisateurs, le type d'antenne et son gain doivent être choisis de manière à ce que la puissance rayonnée isotropiquement équivalente (par exemple) ne soit pas supérieure à celle autorisée pour une communication réussie. "

Cet appareil a été conçu pour fonctionner avec les antennes répertoriées ci-dessous et avec un gain maximal de 6 dBi. Les antennes ne figurant pas dans cette liste ou ayant un gain supérieur à 6 dBi sont strictement interdites d'utilisation avec cet appareil. L'impédance d'antenne requise est de 50 ohms. "

 MobileMark PSKN3-925S Dipole à gain de 3 dBi (voir détails en annexe1)
Antenne PCB Adeunis 0 dBi +/- 2dBgain (voir détails en annexe1)

I   installation OEM et étiquetage de conformité
Le module ARF8119A est étiqueté avec son propre numéro d'identification FCC. Si l'ID FCC n'est pas visible lorsque le module est installé dans un autre périphérique, l'extérieur du périphérique sur lequel il est installé doit également afficher une étiquette faisant référence au module.

Cette étiquette extérieure peut utiliser les libellés suivants:

"Contains Transmitter Module" Contient le FCC ID: U3Z-ARF8119 "

Toute formulation similaire exprimant le même sens peut être utilisée. Le bénéficiaire peut soit fournir une telle étiquette, dont un exemple doit être inclus dans la demande d'autorisation d'équipement, soit fournir des instructions adéquates ainsi

que le module qui explique cette exigence. Dans ce dernier cas, une copie de ces instructions doit être incluse dans la demande d'autorisation d'équipement

Identification :
• FCC ID : U3Z-ARF8119

Product reference: USA/CANADA: ARF8119A

Technical specifications

ARF8119A – RC2(US) / RC4(AUS/NZ) module

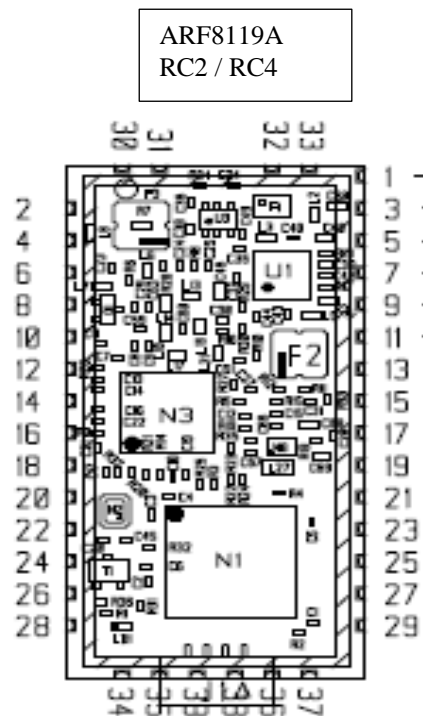| Technical specifications	
Communication	SIGFOX protocol & SIGFOX DBPSK
Module configuration	Through AT commands
Radio data rate	600bps
UART configuration	115.2 kbps/N/8/1
Frequency channels	ISM band 902-928MHz (US)- ISM band 915-928MHz(AUS/NZ)
RF output power	23dBm (200mW)
Sensitivity	down to -126dBm
Operating range (Line Of Sight)	Up to 15km
Operating temperature	-30°C / +70°C
Dimensions	TBD
Standard compliance	FCC - Title 47 CFR Part 15, RSS - 247 Issue 2

Device Overview

Device Description

The SIGFOX RTU module by Adeunis is a SIGFOX Class 0 compliant device. It is NOT a point-to-point device and cannot be operated in such a way. It is meant to be paired to an operated network.

The **SIGFOX RTU module by ADEUNIS RF** is a ready to use system, which provides connection to any operated network using the SIGFOX protocol. It allows transmitting, receiving and instantly viewing the radio frames on the used network.

RTU module pining

1 – GND	21 – Uplink trigger
2 – GND	22 – TP1
3 – ANTENA	23 – Downlink trigger
4 – VCC	24 – NC
5 – GND	25 – NC
6 – NC	26 – RTU READY
7 – /RESET	27 – TP2
8 – NC	28 – GND
9 – BOOT	29 – TP3
10 – UART TX	30 – GND
11 – NC	31 – GND
12 – UART RX	32 – GND
13 – NC	33 – GND
14 – NC	34 – GND
15 – NC	35 – GND
16 – NC	36 – GND
17 – NC	37 – GND
18 – GND	38 – SWCLK
19 – GND	39 – SWDIO
20 – VCC	

1 RTU module hardware interface

1.1 Hardware interface

1.1.1 RTU interface

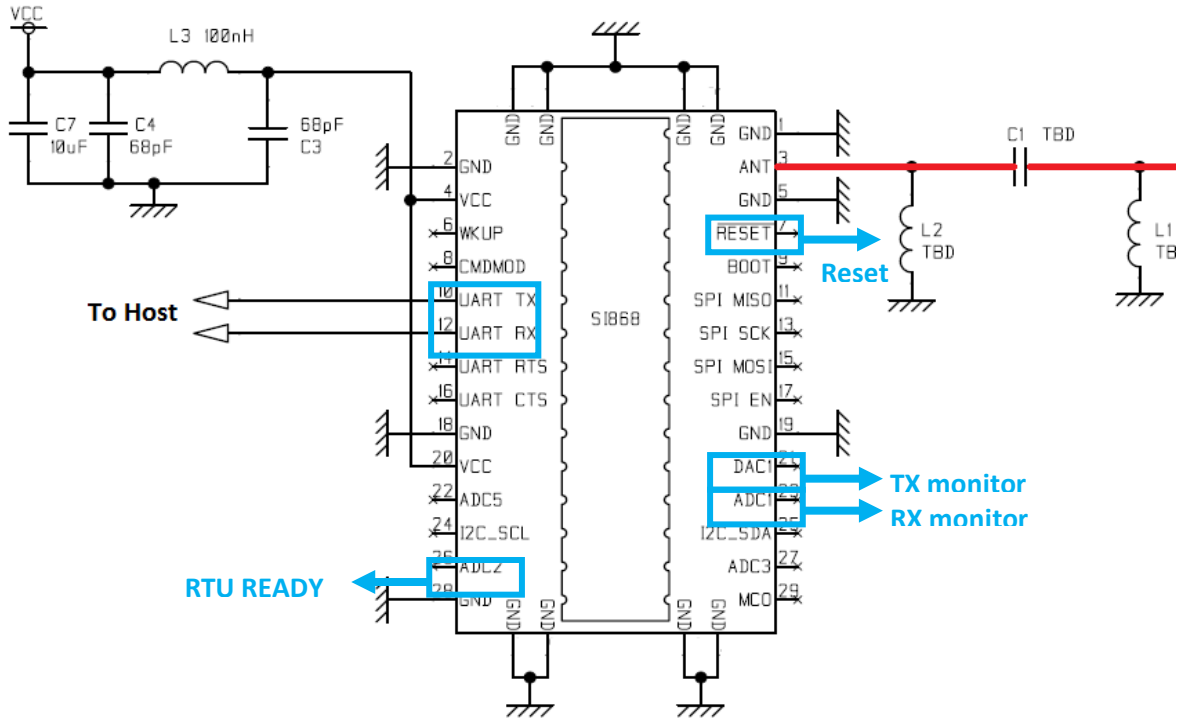The radio module is based on ADEUNIS's form factor and for SIGFOX module:

Figure 1: Radio module

Pin	Function	description
7	Reset	Pulled up to VCC Steady state = 1 1 = do nothing 0 = reset module
10	UART TX	/
12	UART RX	/
21	TX-Uplink monitor Signal that indicates if an UL is in progress	READ ONLY Steady state = 0 1 = uplink in progress 0 = no uplink in progress
23	RX – downlink monitor Signal that indicates if an DL is in progress	READ ONLY Steady state = 0 1 = Rx window opened 0 = Rx window closed
26	RTU READY Indicate if module is ready to receive commands on UART	READ ONLY Steady state = 1 1 = RTU ready 0 = RTU busy

UART Configuration:
- Data rate: 115.2 kbps,
- Data size : 8 bits
- Parity : None
- Stop bit : 1 bit

In exploitation mode, UART is in charge of exchanging data to transmit (UPLINK), data to receive (DOWNLINK), + some other internal data and traces (DEBUG, etc..)
Before exchanging UART frame, one or several WakeUp character could be emitted by the RTU module. This number of wake up character is configurable (Register S2xx)

1.1.2 RTU signal description

1.1.2.1 Reset signal
The reset signal allows a complete reset of the RTU module.

1.1.2.1 RTU ready signal
This signal is used to indicate to the host microcontroller if RTU module is ready for reception of new command. When the signal is low, data sent on the UART of the module are ignored. Each time a new command is transmitted to the RTU, this signal goes low until the end of the command processing. After an Uplink command request, RTU Ready stays low for the complete IoT cycle. In that case, the duration may be very long (many seconds).

1.1.2.1 TX Uplink / RX Downlink signals
These two signals are signals frame activated at uplink (RF transmission) and downlink (RF reception) during IoT cycle.

1.1.2.1 UART Tx an UART Rx signals
These two signals allow UART communication to support the serial interface protocol. UART TX is an output of the RTU module, UART Rx is an input.

1.2 Serial interface protocol

This protocol will be used on exchnge from apllication to RTU module and vice&versa.

1.2.1 Command format

Frame format little endian ➔ LSByte first

1.2.1.1 Command
[WKUP] / SOF / LENGTH / CMD / [OPTIONS] / [DATAS] / [CRC]

WKUP: wakeup characters (optional)
- N bytes '0xFF'

SOF: Start Of Frame: 2 bytes = 0x01FF (LSB First)
LENGTH: indicates size of frame including CMD, OPTIONS and DATAS, excluding CRC
- 1 byte: (0x01 to 0xFF) = f(CMD)

CMD: Command
- 1 octet

OPTIONS: depends on CMD (optional)
DATAS: depends on CMD (optional)
CRC: 4 bytes depends on CMD (optional)

1.2.1.2 Acknowledge - Command answer

Acknowledge is always sent after receiving an application command ➔ Application commands:
APPLICATION (RTU
Acknowledge is always expected after transmitting an application firmware upgrade command ➔ F4 / AF1 /
AF2 – Application µc firmware upgrade

[WKUP] / SOF / LENGTH / CMD / ACK / [DATA] / [CRC]

WKUP: wakeup characters (optional)
- N bytes '0xFF'

SOF: Start Of Frame: 2 bytes = 0x01FF (LSB First)
LENGTH: following frame bytes number: 1 bytes = 0x02 to 0xFF
CMD: 1 byte: 0xFF if unknown command else received CMD
ACK: Acknowledge: 1 byte
  o 0x06 ➔ ACK
  o 0x15 ➔ NACK
DATA: [OPTIONNEL] only if ACK
CRC: 4 bytes depends on CMD (optional)

Command Uplink
Initiate a Uplink.

SOF / LENGTH / CMD / OPTIONS / DATA

CMD : Command
- 0x04

OPTIONS
- SIGFOX OPTIONS ➔ CTRL/TEMP
  o CTRL
    ▪ Bit 0 ➔ bidir cycle if 1
    ▪ Bit 1 ➔ frame OOB
    ▪ Bit<3 :2> ➔ Nb of transmission (0 : valeur du registre, 1 à 3 : Nb of transmission
  o TEMP : Temperature expressed in tenths of degrees, signed in addition to 2 (2 octets – LSB
    First)

Command : Vbat Application
To inform the module about the supply voltage of the application.
SOF / LENGTH / CMD / Vbat

LENGTH : 0x03

CMD : Command
- 0x05

VBAT : Application battery voltage in mV - 2 octets, LSB First

Command : Vbat Module RTU
Lets you know the supply voltage of the module.
SOF / LENGTH / CMD / Vbat

LENGTH : 0x01

CMD : Command
- 0x06

Answer :
- ACK ➔ SOF / 0x03 / 0x06 / 0x06 / VBAT (mV, 2 octets LSB First)
- NACK ➔ SOF / 0x02 / 0x06 / 0x15

Command ATReg Read
Allows you to read AT registers

SOF/ LENGTH / CMD / DATA

LENGTH : 0x03 (1 register) à 0x7F (63 registers)

CMD : Command
- 0xFC

DATA: [REG1][REG2]….. [REG63]
- [REGx]: n° du registre à lire, 2 octets (LSB First)

Answer :
- ACK ➔ SOF / 0x06 / 0xFC / 0x06 / [REG1_VAL][REG2_VAL]…..[REG63_VAL]
- NACK ➔ SOF / 0x02 / 0xFC / 0x15 / N°_REG

REGx_VAL: register value : 4 octets (LSB First)
N°_REG:
- 0 if problem on the format of the frame: Length error, number of data (except CMD) % 2 !=0
- 1 to 63 register index in the DATA field that caused the NACK
-

Command ATReg Write
Allows writing AT registers

SOF/ LENGTH / CMD / DATA

LENGTH : 0x07 (1 register) à 0xFD (42 registers)

CMD : Command
- 0xFD

DATA: [REG1][VALUE1] [REG2][VALUE2]….. [REG42][VALUE42],
- [REGx]: number of the register to modify, 2 octets (LSB First)
- [VALUEx]: value of the register to modify, 4 octets (LSB First)

Answer :
- ACK ➔ SOF / 0x06 / 0xFD / 0x06
- NACK ➔ SOF / 0x02 / 0xFD / 0x15 / N°_REG

N°_REG:
- 0 if problem on the format of the frame: Length error, number of data (except CMD) % 6 !=0
- 1 a 42 register index in the DATA field that caused the NACK

Command Enter Command Mode
Enter command mode.
SOF/ LENGTH / CMD

LENGTH : 0x01

CMD : Command
- 0xFE

Anwser :
- ACK ➔ SOF / 0x06 / 0xFE / 0x06 / 'C' / 'M' / 0x0D / 0x0A
- NACK ➔ SOF / 0x02 / 0xFE / 0x15

Emission orders or informational commands : RTU ➔ APPLICATION

These commands inform the application about the behavior of the RTU module.
Command Downlink

SOF / LENGTH / CMD / OPTIONS / DATA

LENGTH: length bytes to follow in bytes - always 8 for SIGFOX

CMD : Command
- 0x00

OPTIONS
- SIGFOX : OPTIONS ➔ RXWIN/Freq/ RSSI
    - RXWIN : fenêtre de réception durant laquelle les données ont été reçues
        - 0x00 ➔ RX1
    - Freq : fréquence exprimée en Hz (4 octets – LSB First)
    - RSSI : niveau de réception de la trame de downlink (1 octet / signé)

DATA : downlink

Command Encapsulation trace

Necessary encapsulation of the trace frames so that the application can redirect them to external UART / USB
SOF / LENGTH / CMD / TRACE_DATA

LENGTH : lenght TRACE_DATA + 1 octets

CMD : Command
- 0x01

TRACE_DATA :

1.2.1.2.1 Command Uplink Cfg

Sent before each Uplink broadcast.

SOF / LENGTH / CMD / OPTIONS
LENGTH: 0x0C (sigfox)

CMD : Command
- 0x02

OPTIONS
- SIFGFOX : OPTIONS ➔ FREQ / BAND / TXPOWER / TXTIMEONAIR / SEQ /ULNUM
  - FREQ : frequency expressed in Hz (4 octets – LSB First)
  - BAND : frequency band (1 octet)
  - TXPOWER: transmission power in dBm (1 octet)
  - TXTIMEONAIR: transmission time of the frame expressed in ms (2 octets – LSB First)
  - SEQ : Sequence number (2 octets), LSB First
  - ULNUM : Up Link Number (1 byte) (1 = First date UL, 2 = Second date UL, 3 = third date UL, 0 = OOB UL)

Command Power Fail

Sent in the event of a power failure, the supply voltage is lower than the minimum voltage (AT register S260), once the command has been sent, the module automatically switches to STOP mode.
SOF / LENGTH / CMD

LENGTH: 0x01

CMD : Command
- 0x03

Command RxWindowOpening

This command is issued when a reception window is opened
SOF / LENGTH / CMD / OPTION

LENGTH: 0x02

CMD : Command
- 0x05

SIGFOX: OPTIONS ➔ RX_SLOT
  - RX_SLOT :
    - 0x00 ➔ Rx slot 1
  - Rx FREQ : frequency expressed in Hz (4 octets – LSB First)

Command Init Done

This command is issued as soon as the module is initialized.
SOF / LENGTH / CMD

LENGTH: 0x01

CMD : Command
- 0xFE

1.2.2 Implemented commands

Command code	Description	Type	Acknowledgement	CRC
Application to RTU Commands (Application command)				
0x00	Reset RTU module	Sigfox	Yes	No
0x01	Start RTU module	Sigfox	Yes	No
0x02	Stop RTU module	Sigfox	Yes	No
0x04	Uplink request	Sigfox	Yes	No
0x05	Application power supply voltage	Sigfox	Yes	No
0x06	RTU module power supply voltage	Sigfox	Yes	No
0xFE	Enter command mode	Sigfox	Yes	No
0x09-0xFD	RFU			
RTU to Application Commands (Indication command)				
0x00	Downlink message	Sigfox	No	No
0x01	Trace message	Sigfox	No	No
0x02	Uplink configuration message	Sigfox	No	No
0x03	Power fail message	Sigfox	No	No
0x05	Reception window opening	Sigfox	No	No
0x07	New Cycle Allowed	Sigfox	No	No
0x08-0xFC	RFU			
0xFE	Init Done	Sigfox	No	No
0xFF	RFU			

1.2.3 Command execution time of RTU module

This chapter is only for APPLICATION module command sent to RTU module with Acknowledgment mechanism.
The command execution time will be indicated through pin RTU_READY maintained in low state position during the time of command execution. This time depends on the command to execute.

2 RTU features mode description

2.1 RTU State Machine
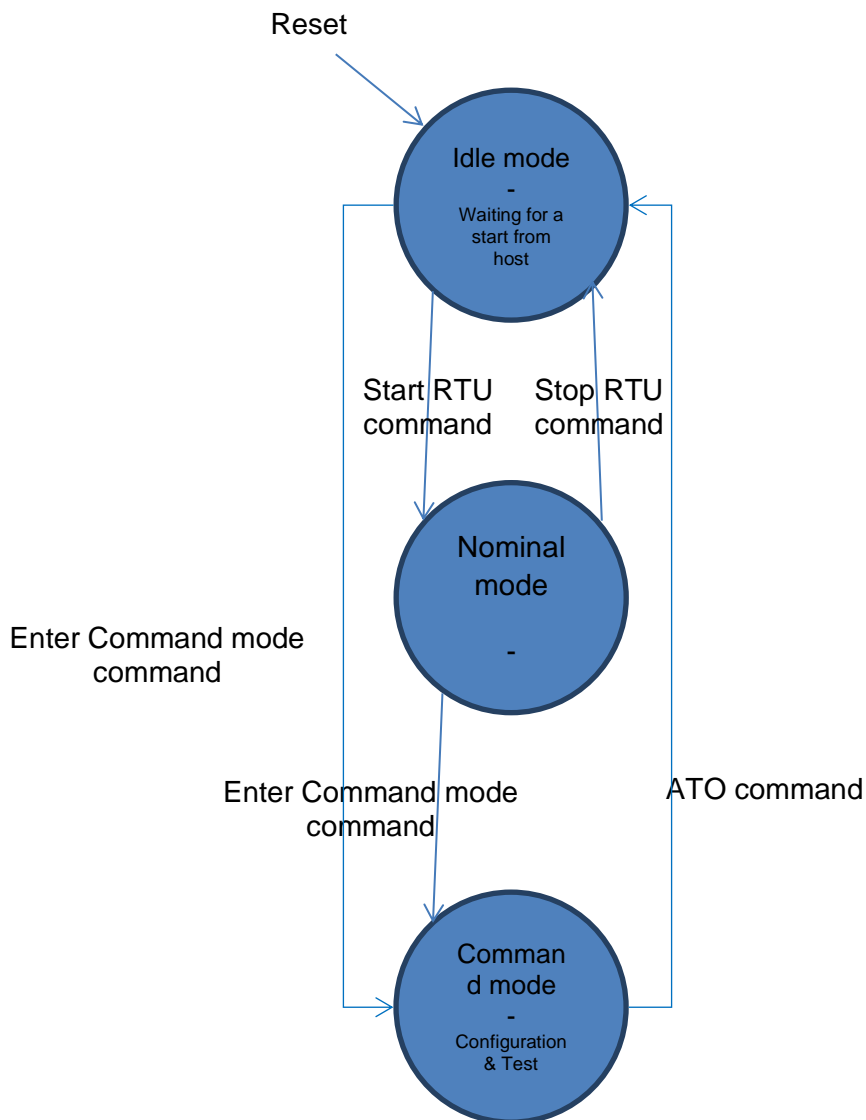
2.1.1 State diagram

Figure 9: RTU state diagram

2.1.2 Idle and Nominal mode

At powerup or after a reset or the module enter idle mode. To allow IoT communication, the host controller must send the Start RTU command (command code 0x01). In these states, the module reaches ultra low power consumption while there is not command processing. The module is automatically wakeup by the char received on its UART and returns to standby mode after the processing.

2.1.3 Command mode

Command mode is the configuration and test command state of the RTU module. Command mode may be entered from Idle mode or Nominal mode by sending the Enter Command Mode command (command code 0xFE). In this mode, the RTU is not standby so there is no power saving while the module stays in this state. The command format is based on AT style command which is an ASCII oriented format.

2.2 RTU Application interface in Command mode

2.2.1 AT commands
2.2.1.1 Change command execution level
This command must be called before using ATT10 or ATT24 command to change the execution level of the module.

Command format:
'ATT63 ROOT'<CR>
Command answer:
'O'<CR><LF> for OK if command succeeds, 'E'<CR><LF> for error if command is rejected

2.2.1.2 RF carrier command
This command places the RF in carrier wave mode.

Command format:
'ATT10'<CR>
Command answer:
'O'<CR><LF> for OK if command succeeds, 'E'<CR><LF> for error if command is rejected

This test is exited on reception of an <ESC> char on UART. The module response is 'O'<CR><LF> on <ESC> reception.

RF carrier command

This command places the RF in modulated carrier mode.

Command format:
'ATT14'<CR>
Command answer:
'O'<CR><LF> for OK if command succeeds, 'E'<CR><LF> for error if command is rejected

This test is exited on reception of an <ESC> char on UART. The module response is 'O'<CR><LF> on <ESC> reception.

2.2.1.3 RF reception command
This command places the RF in reception mode.

Command format:
'ATT24'<CR>
Command answer:
'O'<CR><LF> for OK if command succeeds, 'E'<CR><LF> for error if command is rejected.

This test is exited on reception of an <ESC> char on UART. The module response is 'O'<CR><LF> on <ESC> reception.
Char received during this mode (which may correspond to RF data) must be discarded by the host controller.

2.2.1.4 Exit command mode command
This command places the RF in reception mode.

Command format:
'ATO'<CR>
Command answer:
'O'<CR><LF> for OK if command succeeds, 'E'<CR><LF> for error if command is rejected.

The module backs to Idle mode. The AT command interpreter is stopped and the module gets its lowest power consumption.

2.3 RTU Application interface in Nominal mode

This feature allows application to transmit/receive data from IOT network.
RTU module provides run time information to application.

2.3.1 Application commands: APPLICATION ➔ RTU

2.3.1.1 Reset command

Reset RTU module

SOF/ LENGTH / CMD

LENGTH: 0x01
CMD: 0x00

2.3.1.2 Start command

Allows to start up RTU module if power supply level is OK

SOF/ LENGTH / CMD

LENGTH: 0x01
CMD: 0x01

Expected answer:
- ACK ➔ SOF / 0x03 / 0x01 / 0x06 / POWERFAIL (1 octet)
    - POWERFAIL != 0 ➔ POWER FAIL, power supply voltage is less than minimum power supply voltage AT register 260 + 200 mV, le module repasse de lui-même en mode STOP (low power)
    - POWERFAIL = 0 ➔ POWER GOOD, le module passe en mode START
- NACK ➔ SOF / 0x02 / 0x01 / 0x15

2.3.1.3 Stop command

Stop module.

SOF/ LENGTH / CMD

LENGTH: 0x01
CMD: 0x02

SIGFOX test modes

SIGFOX library has embedded test modes with the following format:

Command	Description	Comment
AT$TM=<mode>,<loop><CR>	Mode : test to execute Loop : number of test iterations to execute	

Specific PRIVATE keys & IDs are used for P1 verification:

- ID = 0xFEDCBA98
- KEY = 0x0123456789ABCDEF0123456789ABCDEF

Private and public keys can be switched through register 202.

Value of mode	Test	Description
0	SFX_TEST_MODE_TX_BPSK	Send only BPSK with Synchro Bit + Synchro frame + PN sequence : no hopping centered on the TX_frequency
1	SFX_TEST_MODE_TX_PROTOCOL	with full protocol with internal SIGFOX key : send all SIGFOX protocol frames available with hopping
2	SFX_TEST_MODE_RX_PROTOCOL	with full protocol with SIGFOX key: send SIGFOX protocol frames with initiate downlink flag = SFX_TRUE
3	SFX_TEST_MODE_RX_GFSK	RX mode with known pattern with SB + SF + Pattern on RX_Frequency (internaly comparison with received frame <=> known pattern= **AA AA B2 27 1F 20 41 84 32 68 C5 BA 53 AE 79 E7 F6 DD 9B)**
4	SFX_TEST_MODE_RX_SENSI	Do uplink + downlink frame with SIGFOX key with specific timings
5	SFX_TEST_MODE_TX_BPSK	Do 1 uplink frame on each sigfox channel to measure frequency synthesis step

Other test modes are available:

SEE *Ultra Narrow Band Transceiver Product requirements specifications for AT CMD* **document from SIGFOX for more details on how to use these test modes**

Command	Description	Comment
AT$SB	Send bit	
AT$SF	Send frame	
AT$IF	TX central frequency	
AT$DR	RX central frequency	
AT$CW	Carrier wave	
AT$TR	Number of repetitions	

3   Annex 1

Dipole Antenna

Device Antennas, Halfwave, LTE 3G/4G Dual-band, 694-2750 MHz

PSKN Series in Straight Position

PSN in fixed straight position

PSNRA in fixed right angle position

- Sleek profile with adjustable elbow for straight or angled operation

- Compact design, ground plane independent with high performance

- Can be configured as fixed straight or fixed right angle (prefix PSN or PSNRA)

The PSKN Dual band antennas offer excellent performance and are available for a number of dualband and broadband wireless data applications.

Three different series are available; a model for US Cellular 3G, a model for EU GSM, and a wideband model for US Cellular including GSM/CDMA, LTE & AWS/UMTS.

The EU GSM 925 MHz lower band also covers with the ISM 915 band (902-928 MHz), without any sacrifice in performance. Additionally, a model is available with reverse polarity SMA connector, for use in ISM 915.

The broadband options, PSKN3-700/2100S and PSKN3-700/2700S, cover traditional cellular frequencies as well as the new LTE 700 MHz band and the UMTS bands.

This PSKN series is a "blade" style antenna with an adjustable right angle elbow. Overall length is 7.75" (20 cm) in a straight position, and 6.75 " (17.2 cm) in a right angle position. Peak gain on all bands is 3 dBi.

The halfwave design means the antennas are ground-plane independent; the antennas can be used on plastic or metal without concern for proper ground size.

The radome material is a semi-flex polyurethane, providing some give when stressed but maintaining long term durability.

The antennas pass a number of industrial and military shock & vibration stantards, and have been rated IPx5 for water ingress. The PSN models are rated IP67.
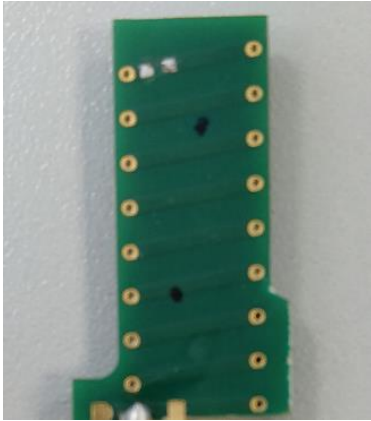
The antennas are available with SMA, TNC or Reverse Polarity SMA (for 902-928 ISM applications).

Model #	Frequency (MHz)	Connector
US CDMA/GSM/Data		
PSKN3-900/1900T	824-894 & 1850-1990	TNC Plug
PSKN3-900/1900S	824-894 & 1850-1990	SMA Plug
EU GSM & ISM 915		
PSKN3-925/1800S	870-960 & 1710-1880	SMA Plug
PSKN3-925/1800T	870-960 & 1710-1880	TNC Plug
EU GSM & ISM 915 with Rev Pol SMA		
PSKN3-925/1800RS	870-960 & 1710-1880	Rev SMA Plug
Wideband with SMA		
PSKN3-700/2100S	694-960 & 1710-2170	MA Plug
PSKN3-700/2700S	694-960 & 1710-2750	SMA Plug

All Knuckle-Swivel Models (PSKN) Available in Fixed Position:
PSN - Straight Fixed Position. PSNRA - Right Angle Fixed Position.

Specifications			
Frequency ranges:		Whip Length:	6.75" (17.2 cm) at 90° angle, 7.75" (19.7 cm) when straight
900/1900	824-894 & 1850-1990 MHz		
925/1800	870-960 & 1710-1880 MHz	Radome Material:	Polyurethane, with black matt finish, and knurled connector.
700/2100	694-960 & 1710-2170 MHz		
700/2700	694-960 & 1710-2750 MHz	Shock & Vibration:	EN 61373, IEEE 1478, MIL-810G, TIA-329.2-C
Gain:	3 dBi peak		
VSWR:	2:1 max over range	Water Ingress:	IP67 (PSN series) IPx5 (others)
Impedance:	50 Ohm nominal	Style:	
Maximum Power:	5 Watt	PSKN	Adjustable Straight, Right Angle
Operating Temp:	-40°C to +85°C		
Connector:	SMA Plug (Male), TNC Plug (Male), or Reverse Pol SMA	PSN	Fixed Straight
		PSNRA	Fixed Right Angle

15   Specifications subject to change without notice (9/2018)
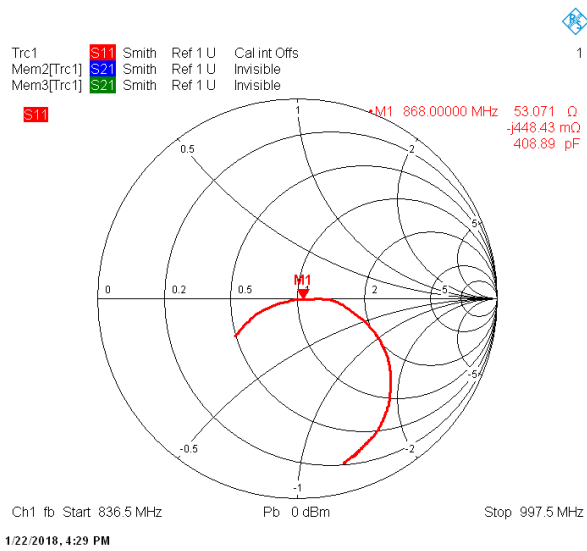
PCB ANTENNA

Polarization : Vertical

Gain : 0dB +/-2dB

Realized Gain (gain + efficient): 0dB +/-2dB

Parametre S:

****** END OF DOCUMENT ******