AN01678

RHF76-052AM Configuration and Usage Guide

V1.0

Document information

Info	Content
Keywords	*LoRaWAN, IoT, Point to Point, full-duplex, RHF76-52AM*
Abstract	This document shows customer how to configure and use RHF76-052AM (V2.0.0 AT modem).

Content

1 Preface

This document shows user how to make quick test RisingHF UART LoRAWAN AT modem RHF76-052AM. It will covers these topics, include how to configure the modem, detailed explanation of key parameters, how to add node to server, how to add device to server etc.

RHF76-052AM modem is designed for long range and long battery life application. Include below key features:

+ LoRaWAN certificated; Link
+ Configurable ABP or OTAA mode
+ Configurable LoRaWAN standard frequency plan (EU868, EU434, US915, AU920)
+ Intelligent ultra-low power mode (less than1.5uA)
+ Full Sub-1GHz band supported
+ Flexible AT command interface
+ Point to point communication

Note: The document is for user to quick start only, detailed command usage is defined in PS01509 V3.1+.

2 Quick Start

2.1 UART Parameter

Interface: Pin22-PB6 (TX) / Pin23-PB7 (RX)
Baud Rate: 9600
Data Bits: 8
Stop Bits: 1
Parity: None

2.2 LoRaWAN Basics

LoRaWAN defines two ways to participate in a LoRaWAN network ABP (Activation By Personalization) and OTAA (Over-The-Air Activation)

Refer the table below about relationship of key, ID, EUI and mode:

Mode	ID/EUI	Key
ABP	DevAddr	NwkSKey, AppSKey
OTAA	AppEUI, DevEUI	AppKey

Table 2-1 ABP and OTAA mode ID/EUI/Key

For ABP mode, AppEUI and DevEUI are not mandatory, but to register an ABP device you will need AppEUI and DevEUI. Although AppEUI and DevEUI information are never used during communication of ABP mode, server uses them to identify the application type and the device itself.

2.3 Check Configuration

Before to register device, first check firmware version and channel definitions. Make sure the setting is what is expected, or need to configure correctly.

Command:

```
AT+VER
AT+CH
AT+RXWIN1
AT+RXWIN2
AT+DR
```

Step by step:

```
AT+VER
  +VER: 2.0.8
AT+CH
  +CH: 3; 0,868100000,DR0,DR5; 1,868300000,DR0,DR5; 2,868500000,DR0,DR5;
AT+RXWIN1
  +RXWIN1: OFF[1]; 3; 0,868100000; 1,868300000; 2,868500000;
AT+RXWIN2
  +RXWIN2: 869525000,DR0
AT+DR
  +DR: DR0
  +DR: EU868 DR0  SF12 BW125K
```

[1] RXWIN1 OFF means customized RXWIN1 is not enabled

2.4 ABP Mode

Before start ABP mode, please make sure channel configuration and data rate scheme are correct. Refer to chapter 3 Configure Modem to configure RHF76-052AM.

```
AT+ID
  +ID: DevAddr, 00:ac:bb:b3
  +ID: DevEui, 47:f6:34:bc:00:36:00:24
  +ID: AppEui, 52:69:73:69:6e:67:48:46
```

Keys are not readable. Default NWKSKEY, APPSKEY, APPKEY is **2B7E151628AED2A6ABF7158809CF4F3C**, all is the same.

2.4.1 Set new key and new ID

This chapter is optional, if user could accept to use default keys and IDs.
But for security reasons, it is recommend to overwrite the default 128bits keys.

```
AT+KEY=NwkSKey,"xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"
AT+KEY=AppSKey,"xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"
AT+KEY=AppKey,"xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"
```

DevAddr, DevEui and AppEui are also changeable if user has special demand on these parameters, use below replace it with specific ones.

```
AT+ID=DevAddr, "xxxxxxxx"
AT+ID=AppEui, "xxxxxxxxxxxxxxxx"
AT+ID=DevEui, "xxxxxxxxxxxxxxxx"
```

2.4.2 Register

DevAddr, NwkSKey, AppSKey are necessary items to register RHF76-052AM to a LoRaWAN network as an ABP end device. AppEui and DevEui are optional.

2.4.3 Communication

Either MSG/CMSG/MSGHEX/CMSGHEX could be used to send message to server. For example.

```
AT+CMSGHEX=AA
  +CMSGHEX: Start
  +CMSGHEX: TX "AA"
  +CMSGHEX: Wait ACK
  +CMSGHEX: ACK Received
  +CMSGHEX: PORT: 12; RX: "11 22 33 44 55 66 77 88 99 00"
  +CMSGHEX: RXWIN1, RSSI -82, SNR 10.25
  +CMSGHEX: Done
```

2.5 OTAA Mode

Key and ID could be set or get through “AT+KEY” and “AT+ID” command.

2.5.1 Register

AppEui, DevEui, AppKey are necessary items to register RHF76-052AM to a LoRaWAN network as an OTAA end device. According to the LoRaWAN server you are using to register the device.

2.5.1 Communication

When registered, JOIN command need to be used to join the specific LoRaWAN network.

Start to join the network

```
AT+JOIN
  +JOIN: Starting
  +JOIN: NORMAL, count 1, 0s, 0s
  +JOIN: Network joined
  +JOIN: NetID 000024 DevAddr 48:00:00:01
  +JOIN: Done
```

Transmit one packet

```
AT+CMSGHEX=AA
  +CMSGHEX: Start
  +CMSGHEX: TX "AA"
  +CMSGHEX: Wait ACK
  +CMSGHEX: ACK Received
  +CMSGHEX: PORT: 12; RX: "11 22 33 44 55 66 77 88 99 00"
  +CMSGHEX: RXWIN1, RSSI -82, SNR 10.25
  +CMSGHEX: Done
```

2.6 Downlink

LoRaWAN modem is bidirectional communication device. In LoRaWAN Class A mode, two receive windows will be opened to receive downlink from server, however LoRaWAN Class C device could receive downlink from server at almost any time. Following example shows how modem reports received downlink message.

Example: *(CMSG)*

```
+CMSG: Start LoRaWAN transaction
+CMSG: TX "RisingHF"
+CMSG: Wait ACK
+CMSG: ACK Received
+CMSG: PORT: 5; RX: "14 54 54"
+CMSG: RXWIN2, RSSI -88, SNR 13.5
+CMSG: Done
```

Example: *(Class C)*

```
+CMSG: ACK Received
+CMSG: PORT: 5; RX: "14 54 54"
+CMSG: RXWIN2, RSSI -88, SNR 13.5
```

Class C downlink will use last message command (MSG/CMSG/MSGHEX/CMSGHEX) as its prompt symbol. Could be any of below cases.

```
+MSG: PORT: 5; RX: "14 54 54"
+CMSG: PORT: 5; RX: "14 54 54"
+MSGHEX: PORT: 5; RX: "14 54 54"
+CMSGHEX: PORT: 5; RX: "14 54 54"
```

3 Configure Modem

"AT+FDEFAULT=RISINGHF" will reset modem to below status summary.

Item	Value
Mode	LWABP
Data Rate	DR0
Data Rate Scheme	EU868
Power	14dBm
Key	2B7E151628AED2A6ABF7158809CF4F3C
ADR	ON
Port	8
RXWIN2	869.525MHz/DR0

Note: Customized ID and KEY should be set after RHF76-052AM is configured, as FDEFAULT will erase them.

3.1 EU868

```
AT+FDEFAULT=RISINGHF
```

3.2 US915

```
AT+FDEFAULT=RISINGHF
AT+DR=US915
AT+RXWIN2=923.3,DR8
```

Note: All LoRaWAN predefined 72 channels will be enabled by default.

3.3 AU920

```
AT+FDEFAULT=RISINGHF
AT+DR=AU920
AT+RXWIN2=923.3,DR8
```

Note: All LoRaWAN predefined 72 channels will be enabled by default.

3.4 Customized

3.4.1 Loriot CN433

Loriot CN433 reuse EU868 data rate scheme

```
AT+FDEFAULT=RISINGHF
AT+CH=0, 434.100, DR0, DR5
AT+CH=1, 434.300, DR0, DR5
AT+CH=2, 434.500, DR0, DR5
AT+CH=3, 434.700, DR0, DR5
AT+CH=4, 433.300, DR0, DR5
AT+CH=5, 433.500, DR0, DR5
AT+CH=6, 433.700, DR0, DR5
AT+CH=7, 433.900, DR0, DR5
```

```
AT+RXWIN2=434.9, DR3
```

3.4.2 Loriot CN470

Loriot CN470 reuse EU868 data rate scheme

```
AT+FDEFAULT=RISINGHF
AT+CH=0, 471.500, DR0, DR5
AT+CH=1, 471.700, DR0, DR5
AT+CH=2, 471.900, DR0, DR5
AT+CH=3, 472.100, DR0, DR5
AT+CH=4, 472.300, DR0, DR5
AT+CH=5, 472.500, DR0, DR5
AT+CH=6, 472.700, DR0, DR5
AT+CH=7, 472.900, DR0, DR5
AT+RXWIN2=471.3, DR3
```

3.4.3 Semtech EU868

```
AT+FDEFAULT=RISINGHF
AT+CH3=867.1,DR0,DR5
AT+CH4=867.3,DR0,DR5
AT+CH5=867.5,DR0,DR5
AT+CH6=867.7,DR0,DR5
AT+CH7=867.9,DR0,DR5
```

4 Others Useful Commands

4.1 Set LoRaWAN CLASS A/C

Enable Class A mode, this is the default configuration when power on in the first time

```
AT+CLASS=A
  +CLASS: A
```

Enable Class C mode

```
AT+CLASS=C
  +CLASS: C
```

Note: After Class C mode is enabled, at least one message needs to be transmitted to make LoRaWAN stack open extra RX window (RXWIN2)!!!

4.2 Set Sleep Mode

Low power manual mode

```
AT+LOWPOWER
  +LOWPOWER: SLEEP
```

Wake up when in manual low power mode

```
AT
  U+LOWPOWER: WAKEUP
```

Low power auto mode

```
AT+LOWPOWER=AUTOON
  +LOWPOWER: AUTOON
```

Exit low power auto mode, command is in hex format

```
FFFFFFFF61742B6C6F77706F7765723D6175746F6F66660D0A
  U+LOWPOWER: WAKEUP
  +LOWPOWER: AUTOOFF
```

4.3 Help Information

a) System help information

```
AT+HELP
  +HELP: OK
           AT -- AT Ping
              ...
              ...
        DELAY -- RX window delay
```

b) Test mode help information

```
AT+MODE=TEST
  +MODE: TEST
AT+TEST=HELP
  +TEST: HELP
         STOP -- AT+TEST=STOP
         HELP -- AT+TSET=HELP
         TXCW -- AT+TEST=TXCW
      TXCLORA -- AT+TEST=TXCLORA
        RFCFG -- AT+TEST=RFCFG,[F],[SF],[BW],[TXPR],[RXPR],[POW]
      RXLRPKT -- AT+TEST=RXLRPKT
      TXLRPKT -- AT+TEST=TXLRPKT,"HEX"
      TXLRSTR -- AT+TEST=TXLRSTR,"TEXT"
         RSSI -- AT+TEST=RSSI,F,[CNT]
         LWDL -- AT+TEST=LWDL,TYPE,DevAddr,"HEX",[FCNT],[FPORT],[FCTRL]
```

4.4 Customized Data Rate

Except LoRaWAN standard data rate scheme, RisingHF modem also supports custom data rate scheme. This need customer know deeply in LoRa and LoRaWAN before define a custom data rate scheme.

Example to define EU868 data rate:

```
AT+DR=CUSTOM
AT+DR=CUSTOM,DR0,SF12,125
AT+DR=CUSTOM,DR1,SF11,125
AT+DR=CUSTOM,DR2,SF10,125
AT+DR=CUSTOM,DR3,SF9,125
AT+DR=CUSTOM,DR4,SF8,125
AT+DR=CUSTOM,DR5,SF7,125
AT+DR=CUSTOM,DR6,SF7,250
AT+DR=CUSTOM,DR7,FSK
AT+DR=CUSTOM,DR8,RFU
AT+DR=CUSTOM,DR9,RFU
AT+DR=CUSTOM,DR10,RFU
AT+DR=CUSTOM,DR11,RFU
AT+DR=CUSTOM,DR12,RFU
AT+DR=CUSTOM,DR13,RFU
AT+DR=CUSTOM,DR14,RFU
AT+DR=CUSTOM,DR15,RFU
AT+LW=CDR,0,7,0,7                // Set TX and RX DR range
```

Example to define US915 customized data rate:

```
AT+DR=CUSTOM
AT+DR=SCHEME
AT+DR=CUSTOM,DR0,SF10,125
AT+DR=CUSTOM,DR1,SF9,125
AT+DR=CUSTOM,DR2,SF8,125
AT+DR=CUSTOM,DR3,SF7,125
AT+DR=CUSTOM,DR4,SF8,500
AT+DR=CUSTOM,DR5,RFU
AT+DR=CUSTOM,DR6,RFU
AT+DR=CUSTOM,DR7,RFU
AT+DR=CUSTOM,DR8,SF12,500
AT+DR=CUSTOM,DR9,SF11,500
AT+DR=CUSTOM,DR10,SF10,500
AT+DR=CUSTOM,DR11,SF9,500
AT+DR=CUSTOM,DR12,SF8,500
AT+DR=CUSTOM,DR13,SF7,500
AT+DR=CUSTOM,DR14,RFU
AT+DR=CUSTOM,DR15,RFU
AT+LW=CDR,0,4,8,13               // Set TX and RX DR range
```

Check DR scheme:

```
AT+DR=SCHEME
```

4.5 Set to Factory Default Configuration

Reset LoRaWAN AT modem to factory default configuration.

```
AT+FDEFAULT=RisingHF
  +FDEFAULT: OK
```

Note: This command would reset all the configurations to factory default.

4.6 Firmware upgrade

User either “AT+DFU=ON” or Bootloader enable pin (Pin14 PA15) to enter bootloader mode. Refer to UM01518 for more details.

5 Full-duplex Gateway Application Support

RHF76-052AM supports customized RXWIN1 and RXWIN2 channels, which could be used to support full-duplex system. Full-duplex system uplink and downlink use different channels normally to avoid TX/RX collisions and make the RF system efficient.

Set uplink channels:

```
AT+CH=0,471.5,DR0,DR5
AT+CH=1,471.7,DR0,DR5
AT+CH=2,471.9,DR0,DR5
AT+CH=3,472.1,DR0,DR5
AT+CH=4,472.3,DR0,DR5
AT+CH=5,472.5,DR0,DR5
AT+CH=6,472.7,DR0,DR5
AT+CH=7,472.9,DR0,DR5
```

Set downlink channels

```
AT+RXWIN1=ON
AT+RXWIN1=0,481.5
AT+RXWIN1=1,481.7
AT+RXWIN1=2,481.9
AT+RXWIN1=3,482.1
AT+RXWIN1=4,482.3
AT+RXWIN1=5,482.5
AT+RXWIN1=6,482.7
AT+RXWIN1=7,482.9
```

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+ Creation

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