DS01810

RHF0M010 LoRaWAN module

V1.2

Document information

Info	Content
Keywords	*RisingHF, LoRaWAN, Module, AT command*
Abstract	This document is a datasheet of RHF0M010 LoRaWAN module.

Content

Figures

Tables

RHF0M010 LoRaWAN Module

Low Power Small Size High integrated LoRaWAN Module

General description

RHF0M010 LoRaWAN Module is a low cost, low power and small size module, embedded with Semtech's LoRa propriety chip SX127x and ST's ultra-low power MCU STM32L07x.

The module designed by RisingHF (Shenzhen) is targeted to application in sensor network and others IOT devices powered by battery which need low power consumption to extend the battery lifetime.

This datasheet will give some details of description of the module, including HW design information, performance validation, and application information.

Applications

The RHF0M010 LoRaWAN Module is designed for end device which need long range and low power consumption, such as metering, sensor network, and others IOT application.

Key features

- Low power consumption: 2.0uA sleep current
- Small size: 20mm X 20.4mm
  18 pins SMT package
- High performance:
  RHF0M010-LF20:
  TXOP=18.5dBm@434MHz/470MHz
  RHF0M010-HF20:
  TXOP=18.5dBm@868MHz/915MHz
  160dB link budget, suitable for long range
- User-friendly interface
  USART;
  I2C;
  LPUART;
  ADC;
  GPIOs
- LoRaWAN embedded with AT command:
- Support global LoRaWAN protocol
  EU868;
  US915 and US915 Hybrid;
  CN779;
  EU433;
  AU915;
  CN470 and CN470 Prequel;
  AS923;
  KR920;
  IN865;

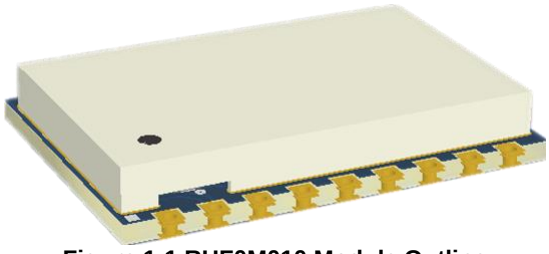

Figure 1-1 RHF0M010 Module Outline

This product datasheet contains a detailed description of the RHF0M010 performance and functionality. Please consult with RisingHF for the latest updates, Firmware or errata.

1 General description

The RHF0M010 incorporates SX127x and STM32L07x, and is well suited for node in the networking of IOT.

Based on the powerful functions and performance of SX127x, the RHF0M010 could operates in both (G)FSK and LoRa. In LoRa mode, BW with 62.5kHz, 125kHz, 250kHz and 500kHz could be used.

And with the STM32L07x MCU, the module could provide LPUART, UART, I2C, ADC and some others GPIOs for customer to extend their application. Two wire interface (SWIM) is suggested to be used for programming.

RHF0M010 series include two pin to pin part numbers, RHF0M010-LF20 and RHF0M010-HF20. RHF0M010-LF20 support 18.5dBm@LF band (434MHz/470MHz), RHF0M010-HF20 support 18.5dBm@HF band (868MHz/915MHz).

1.1 Simplified Block Diagram

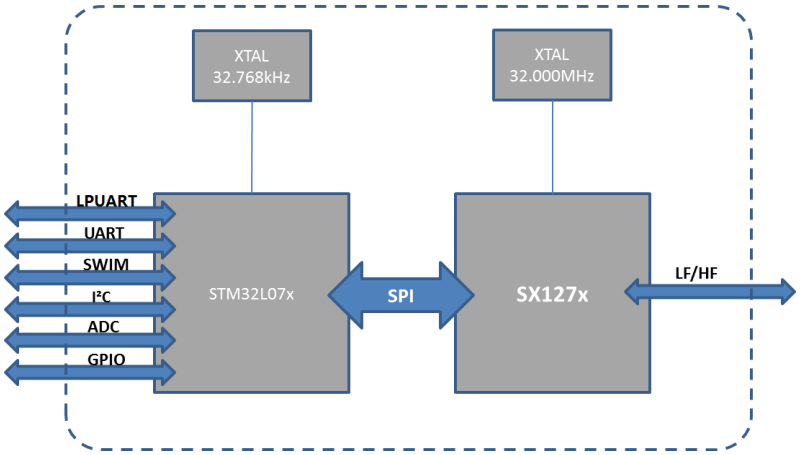

Figure 1-1 Block Diagram of RHF0M010

1.2 Pin description

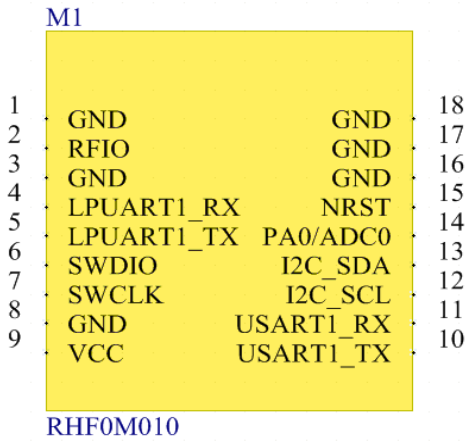

Figure 1-2 schematic of RHF0M010

Table 1-1 pin description

Number	Name	Type	Description
1	GND	-	Ground
2	RFIO	-	RF input/output
3	GND	-	Ground
4	LPUART1_RX	I/O	Low power USART_RX from MCU; or GPIO from MCU, PB11
5	LPUART_TX	I/O	Low power USART_TX from MCU; or GPIO from MCU, PB10
6	SWDIO	I/O	SWDIO of SWIM for program download
7	SWCLK	I/O	SWCLK of SWIM for program download
8	GND	-	Ground
9	VCC	-	Supply voltage for the module
10	USART1_TX	I/O	USART1_TX from MCU; or GPIO from MCU, PB6
11	USART1_RX	I/O	USART1_RX from MCU; or GPIO from MCU, PB7
12	I2C_SCL	I/O	SCL of I2C from MCU; or GPIO from MCU, PB8
13	I2C_SDA	I/O	SDA of I2C from MCU; or GPIO from MCU, PB9
14	PA0/ADC0	I/O	GPIO from MCU, PA0;or ADC_IN0
15	NRST	I	Reset trigger input for MCU
16	GND	-	Ground
17	GND	-	Ground
18	GND	-	Ground

2 Electrical Characteristics

2.1 Absolute Maximum Ratings

As stated that the values listed below may cause permanent device failure. Exposure to absolute maximum ratings for extended periods may affect device reliability.

Table 2-1 Absolute Maximum Ratings

Item	Description	min	max	unit
VCCmr	Supply voltage	-0.3	+3.9	V
Tmr	Temperature	-55	+115	℃
Pmr	RF input level	-	+10	dBm

2.2 Operating Range

Table 2-2 Operating Range

Item	Description	min	max	unit
VCCop	Supply voltage	+1.8	+3.6	V

Top	Temperature	-40	+85	℃
Pop	RF input level	-	+10	dBm

2.3 Module Specifications

Table 2-3 Module Specifications

ITEMs	Parameter	Specifications	Unit
Structure	Size	20(W) X 20.4(L) X 2.8(H)	mm
	Package	18 pins, SMT	
Electrical Characteristics	power supply	3.3V type	V
	Sleep current	2.0uA	uA
	Operation current (Transmitter+MCU)	120mA @18.5dBm in 434MHz/470MHz type	mA
		122mA @18.5dBm in 868MHz/915MHz type	mA
	Operation current (Receiver+MCU)	19mA @BW125kHz, 434MHz/470MHz type	mA
		18mA @BW125kHz, 868MHz/915MHz type	mA
	Output power	18.5dBm max @434MHz/470MHz	dBm
		18.5dBm max @868MHz/915MHz	dBm
	Sensitivity	-139dBm @SF12, BW125kHz, 434MHz/470MHz	dBm
		-137dBm @SF12, BW125kHz, 868MHz/915MHz	dBm
	Harmonics (LF Output)	<-42dBm below 1GHz	dBm
		<-35dBm above 1GHz	dBm
	Harmonics (HF output)	<-40dBm above 1GHz	dBm
Interface	RFIO	RF port	
	USART	2 group of USART, include 2pins	
	I2C	1 group of I2C, include 2 pins	
	ADC	1 ADC Input, include 1 pins, reuse with GPIO port	
	NRST	Manual reset pin input	

3 Typical Performance Characteristics Measurement

3.1 RHF0M010-LF20 measurement

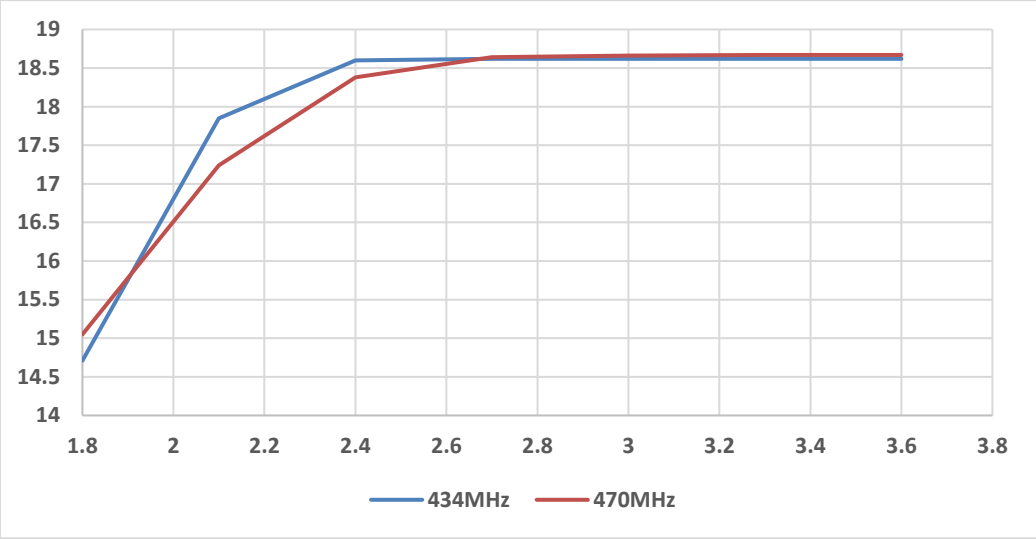

Figure 3-1 TXOP vs Supply voltage

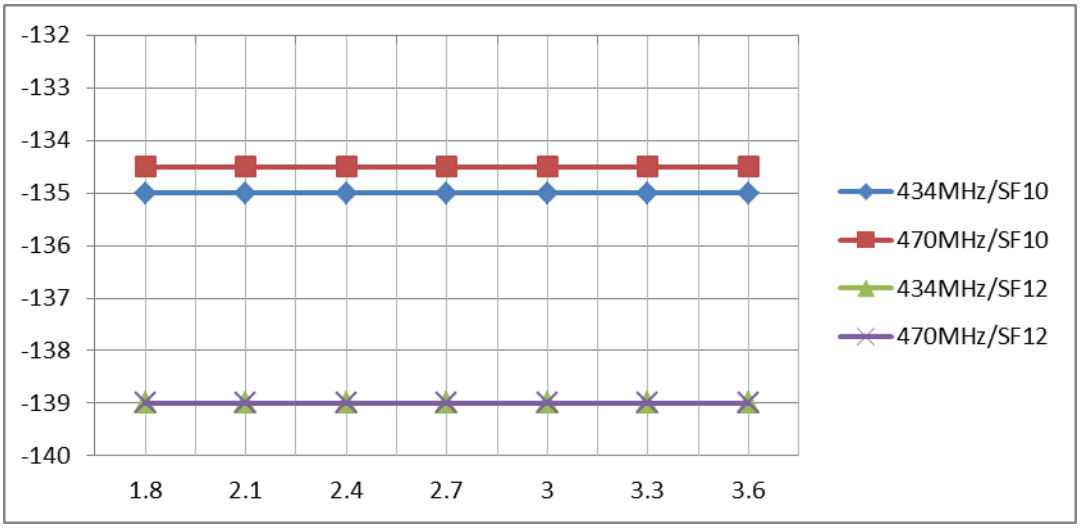

Figure 3-2 Sensitivity (SF10/SF12,125kHz) vs Supply voltage

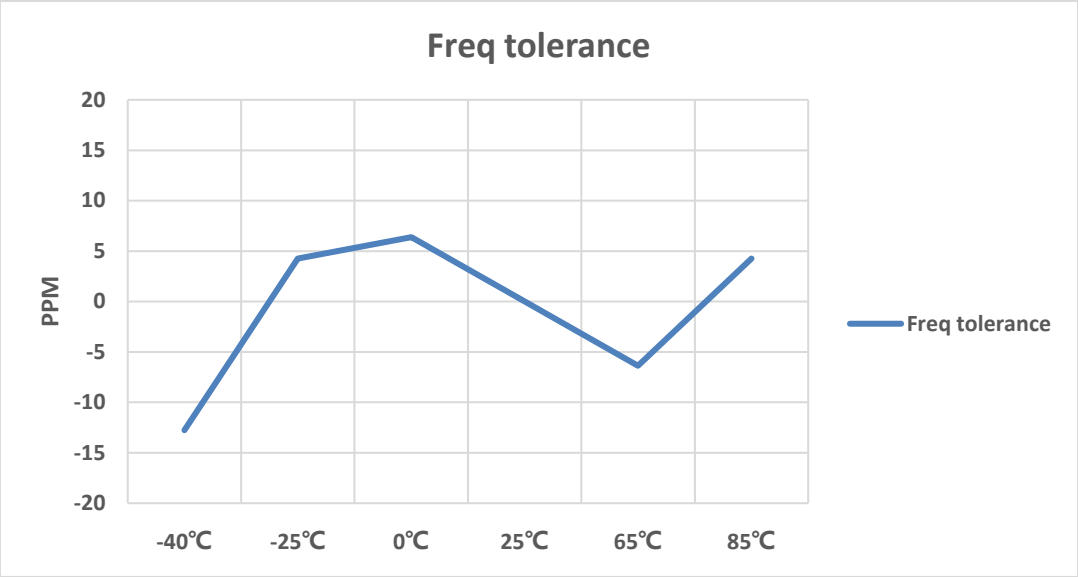

Figure 3-3 Frequency Tolerance vs Temperature

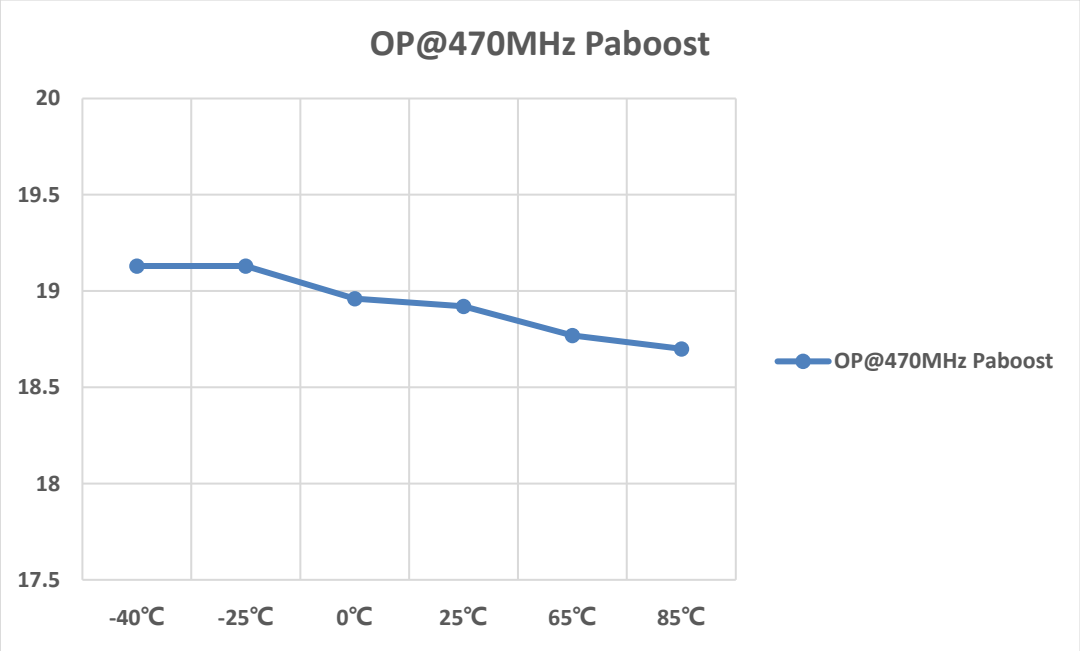

Figure 3-4 TXOP vs Temperature

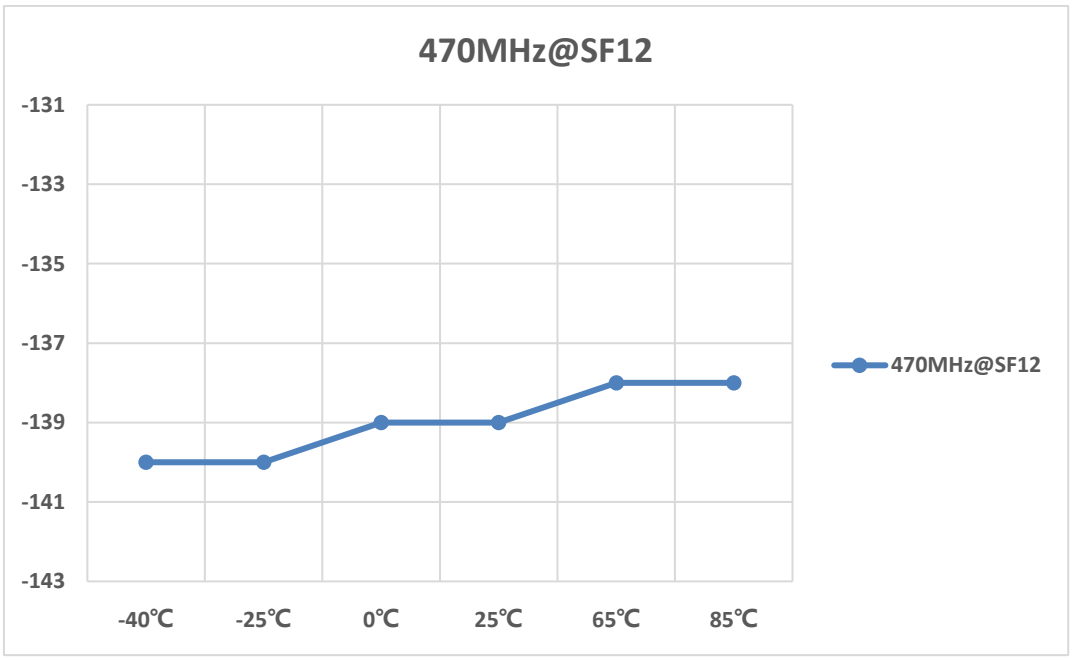

Figure 3-5 Sensitivity (SF12,125kHz) vs temperature

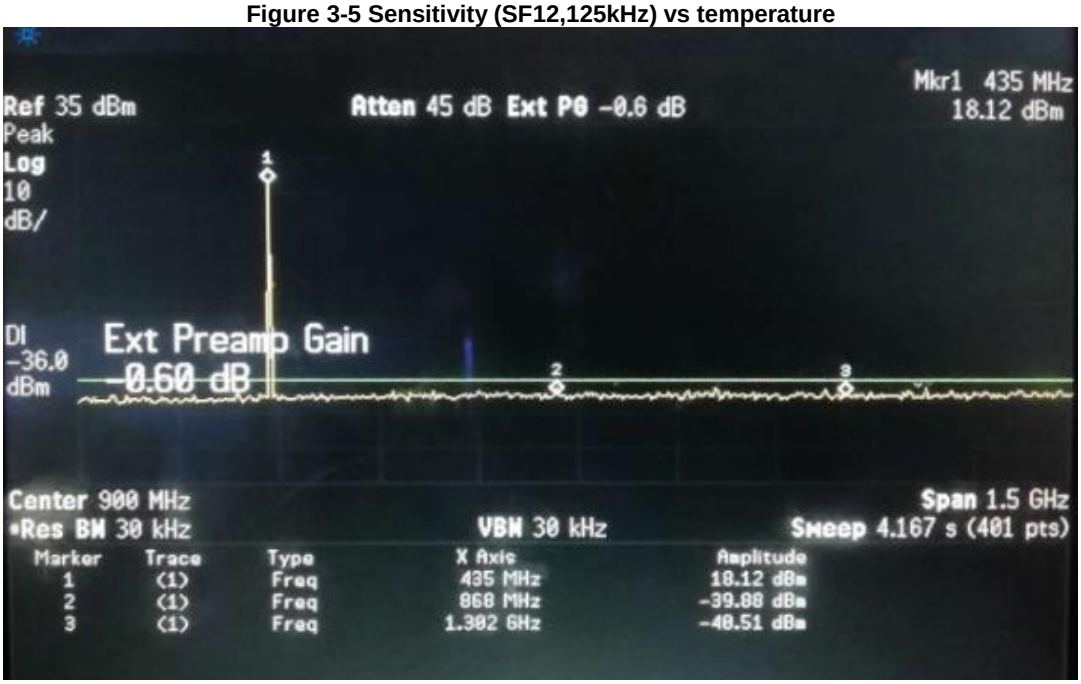

Figure 3-6 Harmonics measurement @Frf=434MHz, TXOP=20dBm

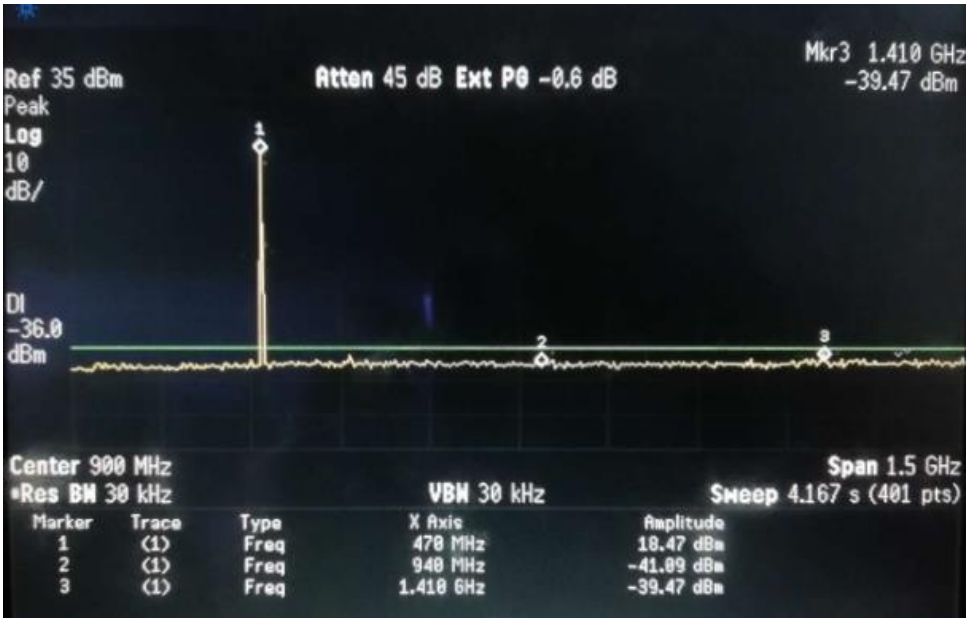

Figure 3-7 Harmonics measurement @Frf=470MHz, TXOP=20dBm

3.2 RHF0M010-HF20 measurement

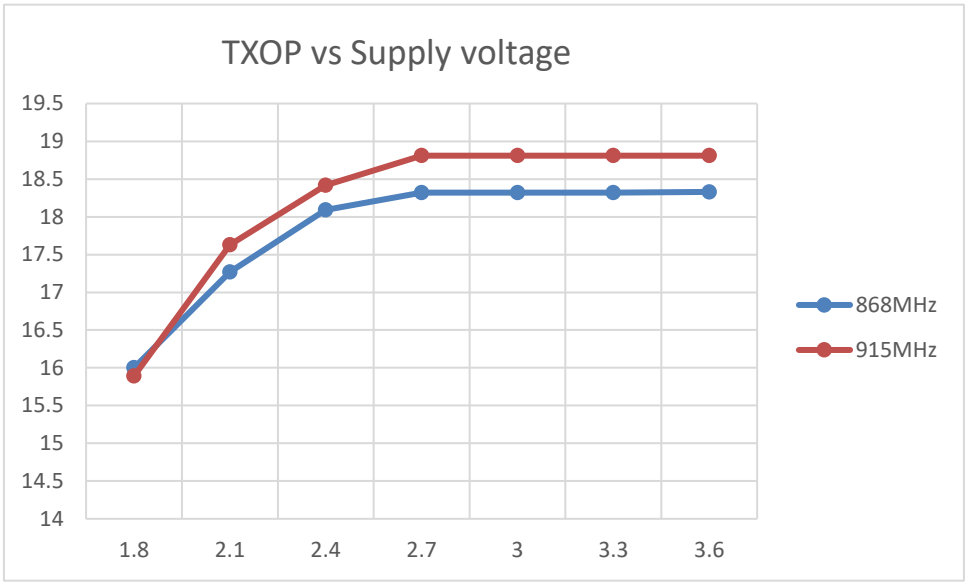

Figure 3-8 TXOP vs Supply voltage

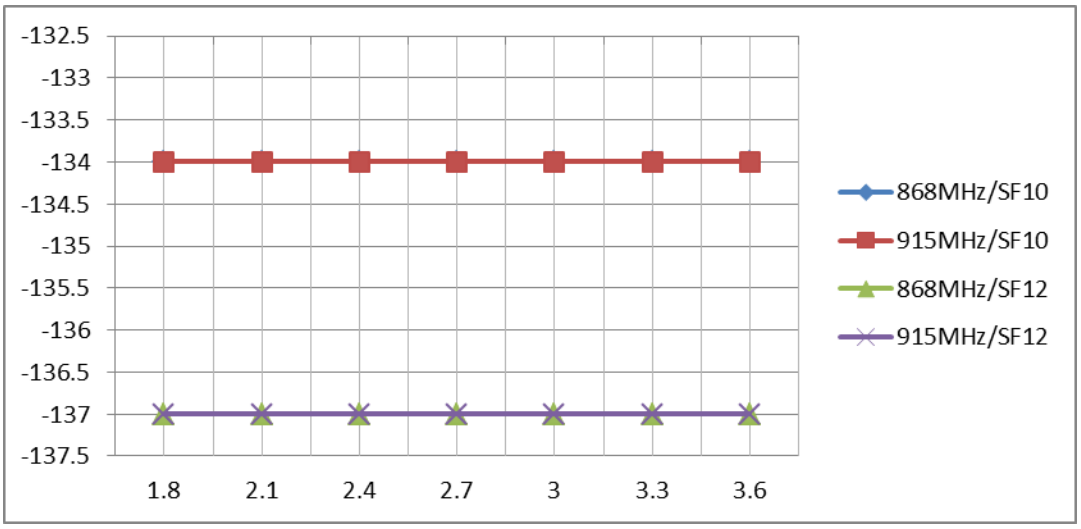

Figure 3-9 Sensitivity (SF10/SF12,125kHz) vs Supply voltage

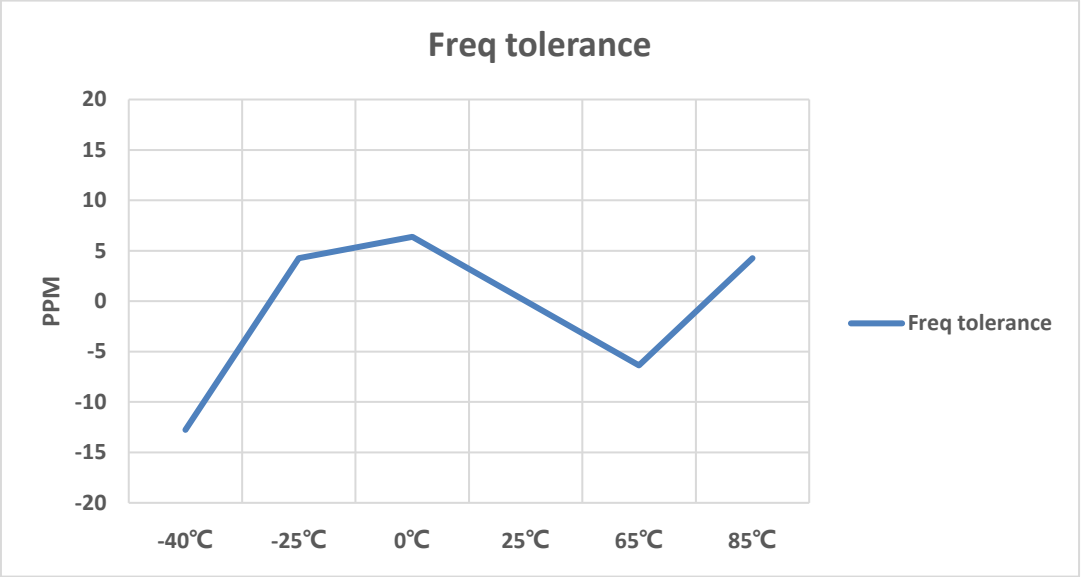

Figure 3-10 Frequency Tolerance vs Temperature

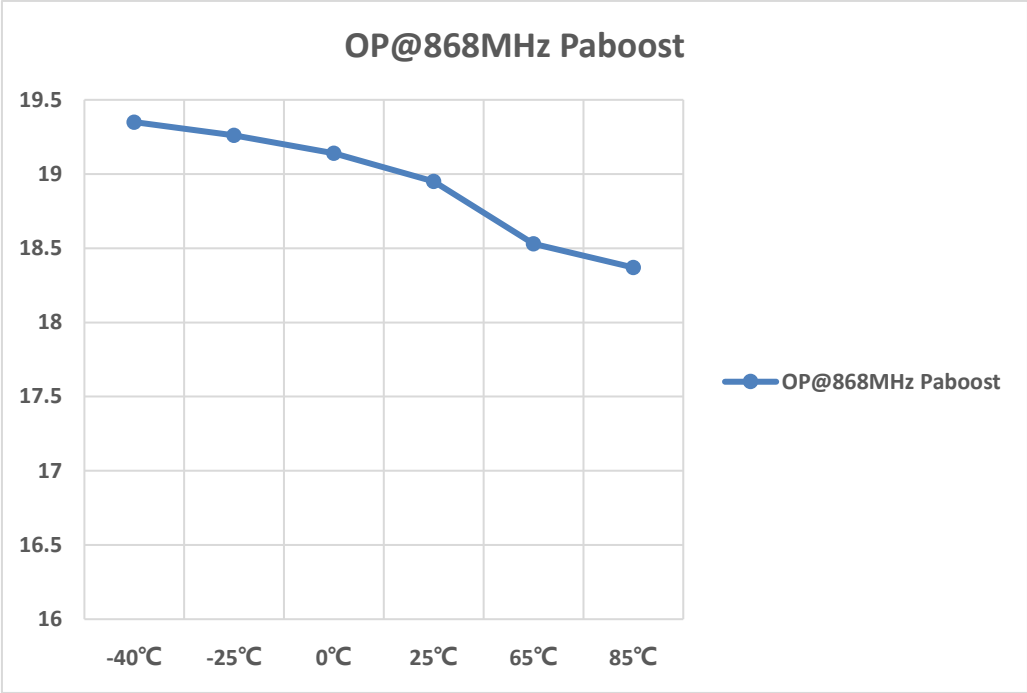

Figure 3-11 TXOP vs Temperature

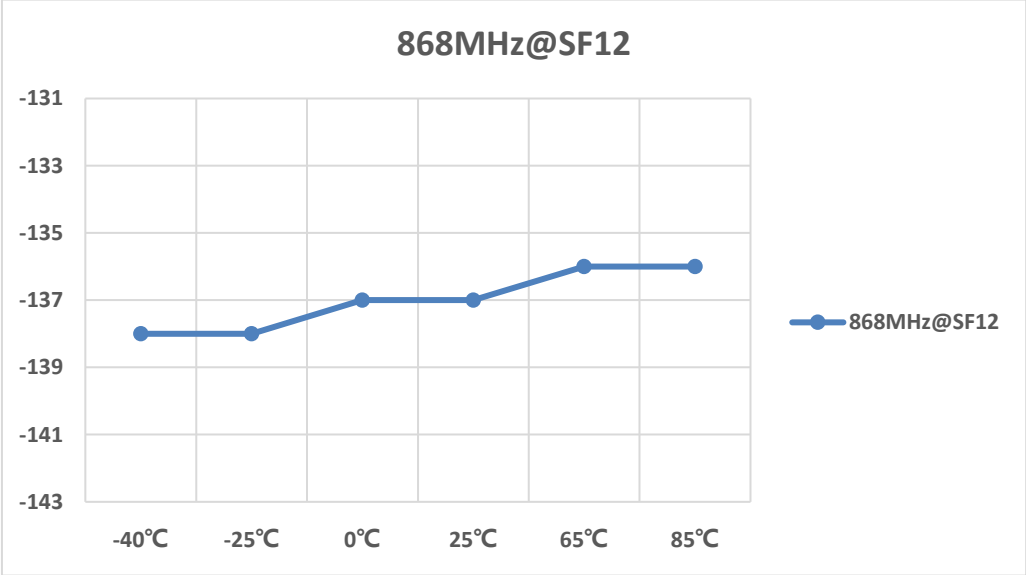

Figure 3-12 Sensitivity (SF12,125kHz) vs temperature

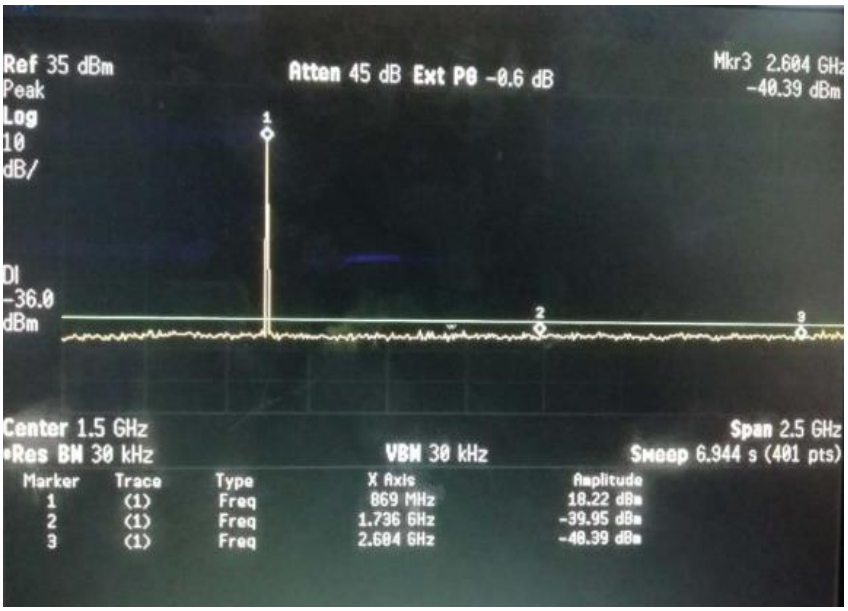

Figure 3-13 Harmonics measurement @Frf=868MHz, TXOP=20dBm

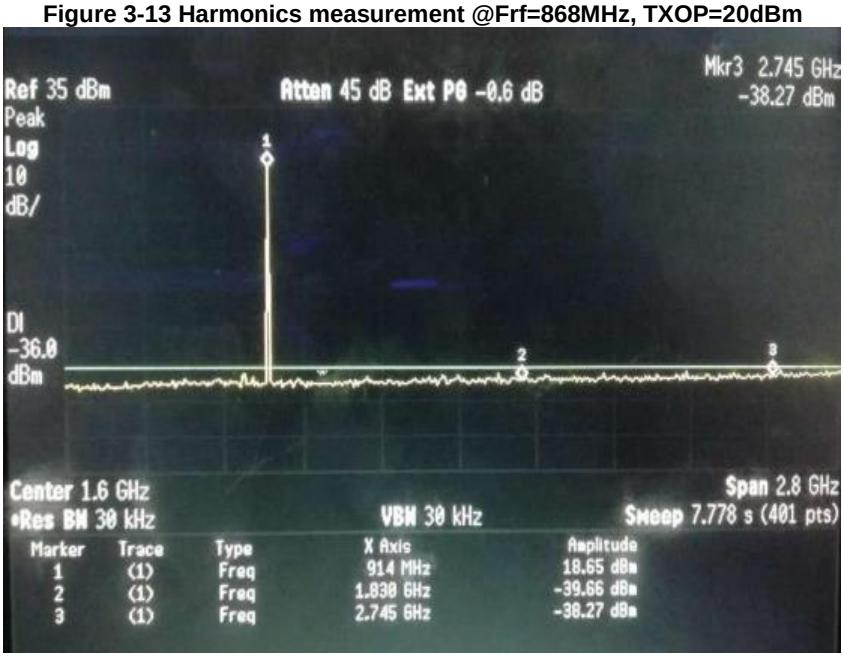

Figure 3-14 Harmonics measurement @Frf=915MHz, TXOP=20dBm

4 Application Information

4.1 Package Information

The RHF0M010 is available in a 18-lead SMD package as shown below:

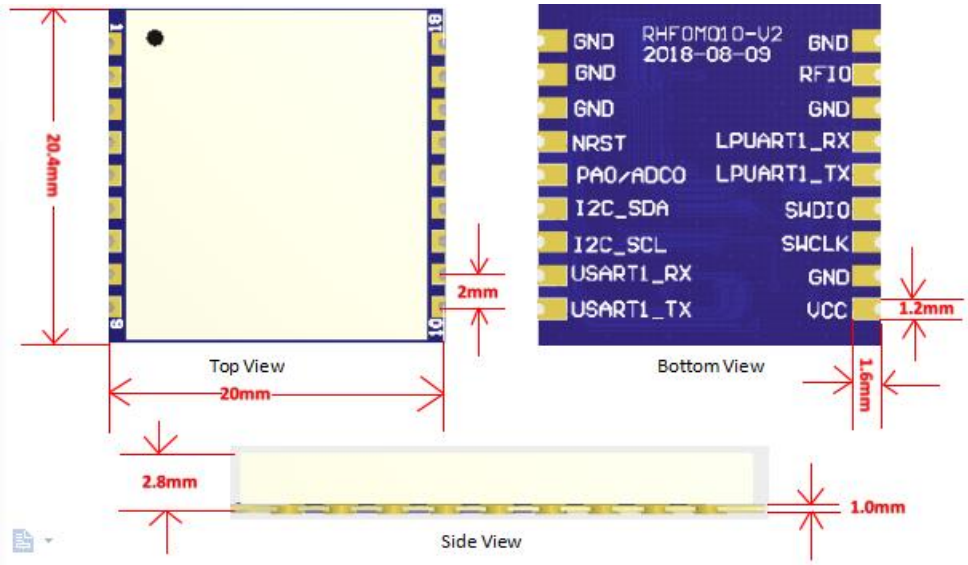

Figure 4-1 package outline drawing

Figure 4-2 show the recommended land pattern for layout.

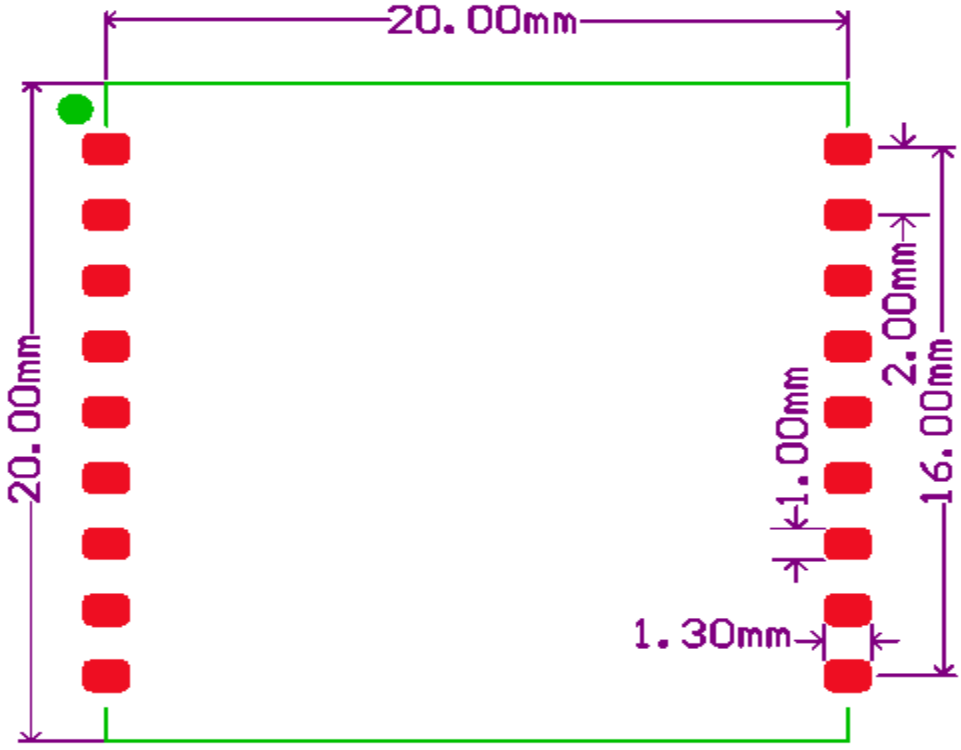

Figure 4-2 Recommended land pattern

4.2 Internal connection

Table 4-1 and Table 4-2 provides the internal connection which could help customers who would design their own firmware instead of using RisingHF AT command mode.

Table 4-1 Internal IO connection between MCU(STM32L07x) and Radio(SX127x)

Chip	SX127x		STM32L07x	
Item	Pin Num	Description	Pin Num	Description
IO connection Between SX127x and STM32L07x	Pin7	NRESET_SX	Pin40	PB4
	Pin8	DIO0_SX	Pin33	PA12
	Pin9	DIO1_SX	Pin18	PB0
	Pin10	DIO2_SX	Pin20	PB2
	Pin11	DIO3_SX	Pin19	PB1
	Pin12	DIO4_SX	NC	NC
	Pin13	DIO5_SX	Pin5	PH0
	Pin16	SCK_SX	Pin15	PA5
	Pin17	MISO_SX	Pin16	PA6
	Pin18	MOSI_SX	Pin17	PA7
	Pin19	NSS_SX	Pin14	PA4

Table 4-2 RF control logic

	Pin Num/MCU	Description	Definition	Logic	Status
RF Switch Control	Pin25	PB12	Switch_CTL	1	TX ON
	Pin26	PB13		0	
	Pin25	PB12	Switch_CTL	0	RX_ON
	PIN26	PB13		1	
	PIN25	PB12	Switch_CTL	0	Sleep
	PIN26	PB13		0	

4.3 Interface of Module

Except that several essential GPIOs and one group of SPI would be used for internal transceiver control, part others GPIOs and interface of the MCU would be connected to external pins of the module, which includes USART, I2C, LPUART, ADC and so on.

4.4 Reference design with RHF0M010 Module

RHF0M010 is integrated with LoRaWAN protocol and AT command. LoRaWAN node design with RHF0M010 is very simple. Just connect the USART and NRST to their host MCU and send AT command.

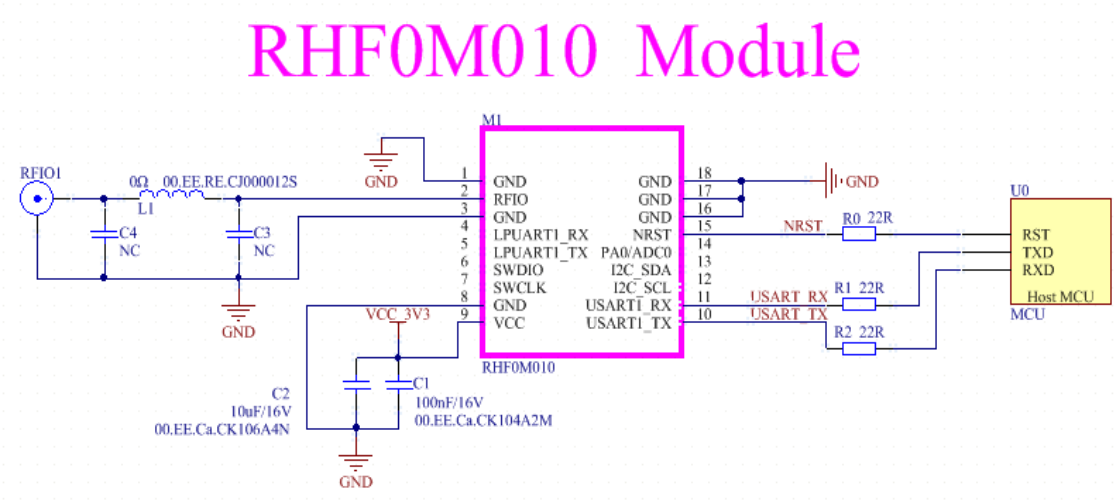

Figure 4-3 Reference design with RHF0M010

5 Application in LoRaWAN

5.1 LoRaWAN

LoRaWAN networks typically are laid out in a star-of-stars topology in which gateways relay messages between end-devices and a central network server at the backend. Gateways are connected to the network server via standard IP connections while end devices use single-hop LoRa™ or FSK communication to one or many gateways. All communication is generally bi-directional, although uplink communication from an end device to the network server is expected to be the predominant traffic. Communication between end-devices and gateways is spread out on different frequency channels and data rates. The selection of the data rate is a trade-off between communication range and message duration, communications with different data rates do not interfere with each other. LoRa data rates range from 0.3 kbps to 50 kbps, with different Band Width and Spreading Factor. To maximize both battery life of the end-devices and overall network capacity, the LoRa network infrastructure can manage the data rate and RF output for each end-device individually by means of an adaptive data rate (ADR) scheme.

End-devices may transmit on any channel available at any time, using any available data rate, as long as the following rules are respected:

1) The end-device changes channel in a pseudo-random fashion for every transmission. The resulting frequency diversity makes the system more robust to interferences.

2) The end-device respects the maximum transmit duty cycle relative to the sub-band used and local regulations.

The RHF0M010 Module incorporates Semtech's LoRa Chip SX1276 and ST's ultra-low power MCU. With only 2.0uA sleep current , the module is really very suitable for LoRaWAN application.

5.2 LoRaWAN sensor with RHF0M010

RHF0M010 is AT command LoRaWAN modem, which is LoRaWAN protocol embedded. Customer just need use a simple host mcu with application to control the modem via UART that a LoRaWAN sensor could be designed easily. This will help customer to promote their sensor devices to market quickly.

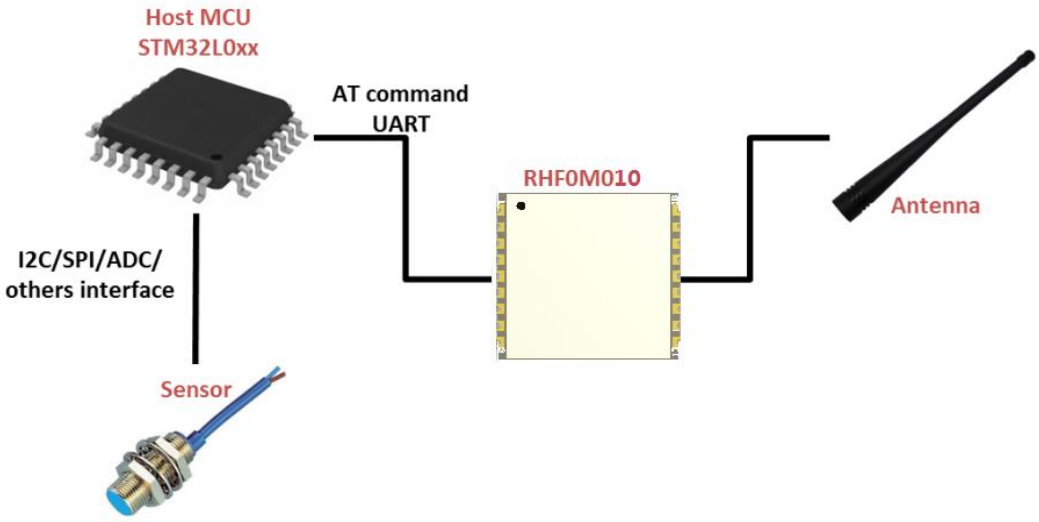

Figure 5-1 LoRaWAN sensor with RHF0M010

6 Ordering information

Technical Support: Support@RisingHF.com
Business:
China: Salescn@RisngHF.com
Others: Salesww@RisingHF.com

Table 6-1 Ordering information

Part Number	MCU	TX Power (dBm)	AT Modem
RHF0M010-LF20	ROM 128KB / RAM 20KB	18.5@LF (434/470MHz)	Yes
RHF0M010-HF20	ROM 128KB / RAM 20KB	18.5@HF (868/915MHz)	Yes

Revision

V1.1 2018-08-28

+ Draft Creation

V1.2 2018-10-29

+ Delete RHF0M010-HF14

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.
(2) This device must accept any interference received, including interference that may cause undesired operation.

NOTE: 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 instructions, may cause harmful interference to radio communications. 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

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integrationinto devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states:

"Contains transmitter module FCC ID: 2AJUZ0M010. Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and

(2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

Professional installation:

This module need to be installed under professional guidance, if there is any questions, please contact us.

Host device: RHF4T010

Antenna information：Gain: 2.67dBi; Type: Dipole antenna; Impedance: 50Ω

The module can work on the host device, it means the driver is matched, different host devices have the different drives.

The host manufacturer can not get the module drive authorization to remain compliant, until the host device compliance with the requirements.

Note: The module has the antenna schematics, so the host device just provide the antenna connector for this device. The antenna port and connector is designed by OEM, it need to compliance with the 15.203 requirement, and it is not designed for use with high-gain directional antennas.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end-use operational conditions, including simultaneous transmission operations.

When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application.

When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is limited modular approval, it is limited to OEM installation ONLY.

Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product includ the integrated Module.

Additional measurements (15B) and/or equipment authorizations (e.g Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user of the final host device.

Please Read Carefully:

Information in this document is provided solely in connection with RisingHF products. RisingHF reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All RisingHF products are sold pursuant to RisingHF's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the RisingHF products and services described herein, and RisingHF assumes no liability whatsoever relating to the choice, selection or use of the RisingHF products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by RisingHF for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN RISINGHF'S TERMS AND CONDITIONS OF SALE RisingHF DISCLAIMS ANY EXPRESS OR IMPLIEDWARRANTY WITH RESPECT TO THE USE AND/OR SALE OF RisingHF PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIEDWARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWSOF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

RISINGHF PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE RISINGHF PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF RISINGHF HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY RISINGHF AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO RISINGHF PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of RisingHF products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by RisingHF for the RisingHF product or service described herein and shall not create or extend in any manner whatsoever, any liability of RisingHF.

http://www.risinghf.com