DS119180

RHF0M0E5 模块技术规格书

V1.4

Document information

Info	Content
Keywords	RisingHF, LoRaWAN®, 模块, 超小尺寸, AT 指令
Abstract	本文档是 RHF0M0E5 模块技术规格书

Content

1 介绍

RHF0M0E5 是瑞兴恒方网络(深圳)有限公司设计的低成本，超低功耗，超小尺寸的 LoRaWAN®模组，模块采用 ST 系统级芯片 STM32WLE5JC, 内部集成高性能 LoRa® SX126X IP 和超低功耗 MCU.该模块的目标应用是无线传感网络和其他物联网设备，尤其是有电池供电要求低功耗和远距离的场合。

本规格书主要描述模块的硬件信息、硬件性能和应用信息。

RHF0M0E5 LoRaWAN®模块主要适用于远距离，超低功耗的应用，比如无线抄表，传感网络和其他低功耗广域物联网场景。

1.1 主要特点

- 超低功耗：低至 2.1uA 睡眠电流 (WOR 模式)
- 低成本
- 小尺寸: 12mm X 12mm *2.5mm 28 pins SMT
- 高性能：

  RHF0M0E5-LF22:
  - ✓ TXOP=10dBm@434MHz
  - ✓ TXOP=22dBm@470MHz

  RHF0M0E5-HF22:
  - ✓ TXOP=22dBm@868/915MHz
  - ✓ -136.5dBm sensitivity for SF12 with 125KHz BW
  - ✓ 158dB 链路预算, 适合长距离的需要
- 灵活的接口
  - ✓ USART
  - ✓ I2C
  - ✓ SWD
  - ✓ ADC
- 内嵌 LoRaWAN®协议，AT 指令，支持全球 LoRaWAN®频率计划
  - ✓ EU868
  - ✓ US915 and US915 Hybrid
  - ✓ CN779
  - ✓ AU915
  - ✓ CN470 and CN470 Prequel
  - ✓ AS923
  - ✓ KR920
  - ✓ IN865

本产品规格书包括 RHF0M0E5 模块性能和功能的详细描述。获取最新的固件，产品更新或勘误表等请与瑞兴恒方联系。

2 总体描述

RHF0M0E5 内嵌高性能 MCU STM32WLE5JC，非常适合于各种物联网节点的设计。

RHF0M0E5 模块支持(G)FSK 模式 和 LoRa®。LoRa®模式下可以使用 62.5kHz, 125kHz, 250kHz 和 500kHz 带宽。

基于 STM32WLE5JC 的强大功能和丰富的外设, 模块提供 UART, I2C, SPI，ADC 和 GPIOs 供用户根据应用选用。 如果需要对内置的 AT 指令固件进行升级，请使用两线接口 (UART) 基于 boot 模式完成烧录；而客户基于模组内部 MCU 自主开发软件，则可以通过 SWD 完成程序擦除和烧录。

RHF0M0E5 目前包含两个子型号，RHF0M0E5-LF22(单核 STM32WLE5JC 集成 SX126X IP)和 RHF0M0E5-HF22(单核 STM32WLE5JC 集成 SX126X IP)，RHF0M0E5-LF22 支持 22dBm@LF band (470MHz)；10dBm@LF band (434MHz)；RHF0M0E5-HF22 支持 22dBm@HF band (868/915MHz)。

原理框图：

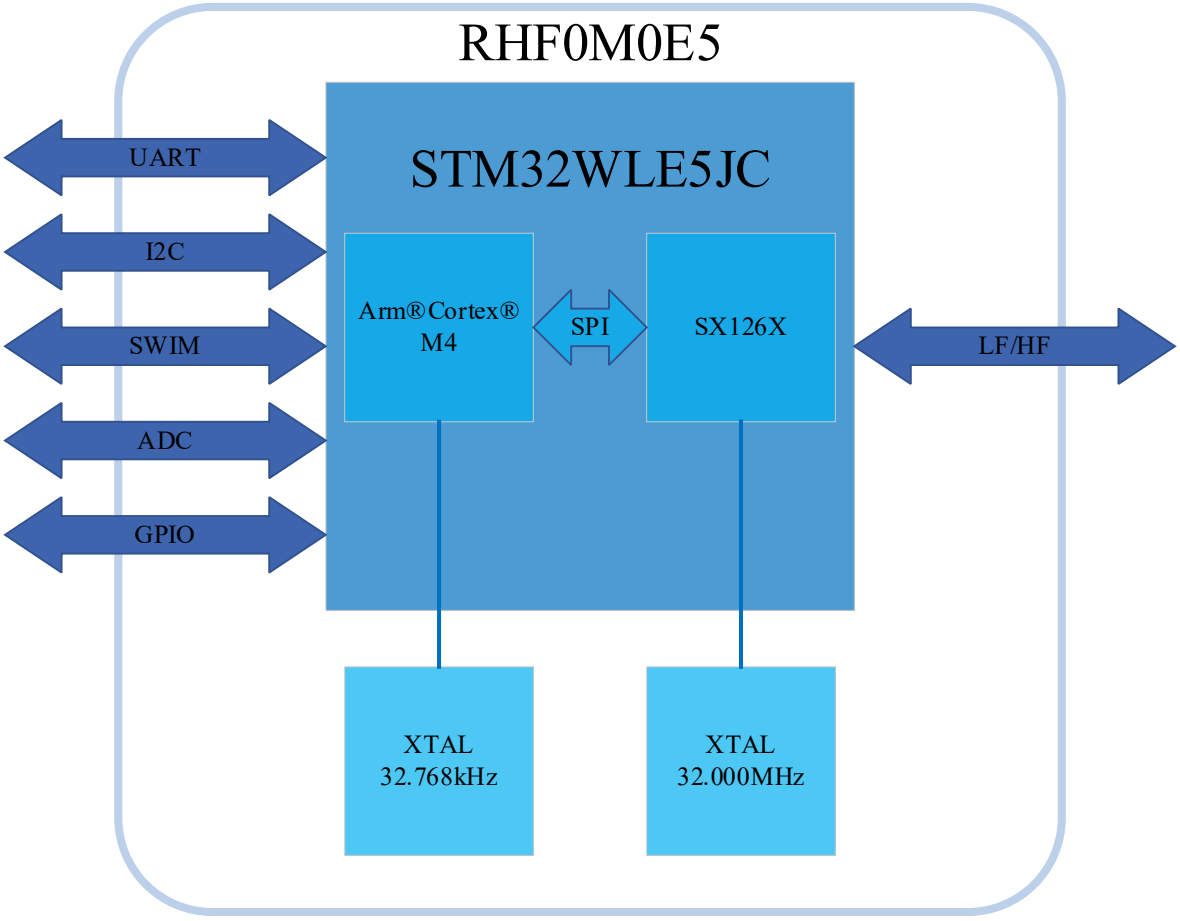

Figure 1 RHF0M0E5 Schematic diagram

2.1 管脚定义

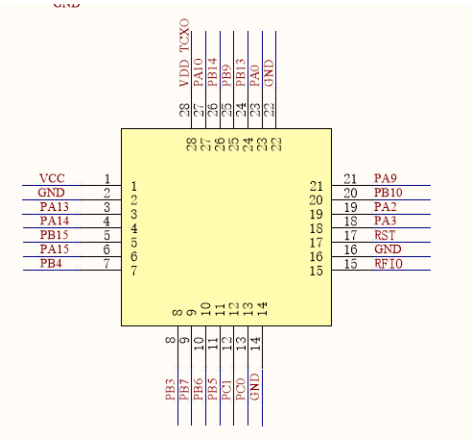

Figure 2 RHF0M0E5 Pin arrangement

Table 1 RHF0M0E5 pinout

Number	Name	Type	Description
1	VCC	-	Supply voltage for the module
2	GND	-	Ground
3	PA13	I	SWDIO of SWIM for program download
4	PA14	I/O	SWCLK of SWIM for program download
5	PB15	I/O	SCL of I2C2 from MCU
6	PA15	I/O	SDA of I2C2 from MCU
7	PB4	I/O	MCU GPIO
8	PB3	I/O	MCU GPIO
9	PB7	I/O	UART1_RX from MCU
10	PB6	I/O	UART1_TX from MCU
11	PB5	I/O	MCU GPIO
12	PC1	I/O	MCU GPIO；LPUART1_TX from MCU
13	PC0	I/O	MCU GPIO；LPUART1_RX from MCU
14	GND	-	Ground
15	RFIO	I/O	RF input/output
16	GND	-	Ground
17	RST	I/O	Reset trigger input for MCU
18	PA3	I/O	MCU GPIO；USART2_RX from MCU
19	PA2	I/O	MCU GPIO；USART2_TX from MCU
20	PB10	I/O	MCU GPIO
21	PA9	I/O	MCU GPIO
22	GND	-	Ground
23	PA0	I/O	MCU GPIO
24	PB13	I/O	SPI2_SCK from MCU; Boot pin(Active low)
25	PB9	I/O	SPI2_NSS from MCU

26	PB14	I/O	SPI2_MISO from MCU
27	PA10	I/O	SPI2_MOSI from MCU
28	PB0	I/O	Unavailable；Suspended treatment

3 电气特性

3.1 极限工作条件

达到或超过下表列出的额定最大值会导致设备损坏。

Table 2 Absolute Maximum Ratings

Item	Description	min	max	unit
VCCmr	供电电压	-0.3	+3.9	V
Tmr	环境温度	-40	+85	℃
Pmr	射频输入信号	-	+10	dBm

3.2 正常工作条件

Table 3 Recommended Operating Conditions

Item	Description	min	max	unit
VCCop	供电电压	+1.8	+3.6	V
Top	环境温度	-40	+85	℃
Pop	射频输入信号	-	+10	dBm

3.3 模块规格指标

Table 4 RHF0M0E5 features

ITEMs	Parameter	Specifications	Unit
Structure	Size	12(W) X 12(L) X 2.5(H)	mm
	Package	28 pins, SMT	
Electrical Characteristics	power supply	3.3V type	V
	Sleep current	2.1uA (WDT on);	uA
	Operation current (Transmitter+MCU)	50mA @10dBm in 434MHz type	mA
		111mA @22dBm in 470MHz type	
		111mA @22dBm in 868MHz type	

	Operation current (Receiver+MCU)	6.7mA @BW125kHz, 434MHz type				mA
		6.7mA @BW125kHz, 470MHz type				
		6.7mA @BW125kHz, 868MHz type				
	Output power	10dBm max @434MHz				dBm
		22dBm max @470MHz				
		22dBm max @868MHz				
	Sensitivity	@SF12, BW125kHz				dBm
		Fr(MHz)	min	type	max	
		434	-	-134.5	-136	
		470	-	-136.5	-137.5	
		868	-	-135	-137	
	Harmonics	<-36dBm below 1GHz				dBm
		<-40dBm above 1GHz				dBm
Interface	RFIO	RF port				
	UART	3 group of UART, include 2pins				
	I2C	1 group of I2C, include 2 pins				
	ADC	1 ADC Input, include 1pins,12-bit 1Msps				
	NRST	Manual reset pin input				
	SPI	1 group of SPI, include 4 pins				

4 典型射频性能测试

4.1 RHF0M0E5-LF22 性能测试

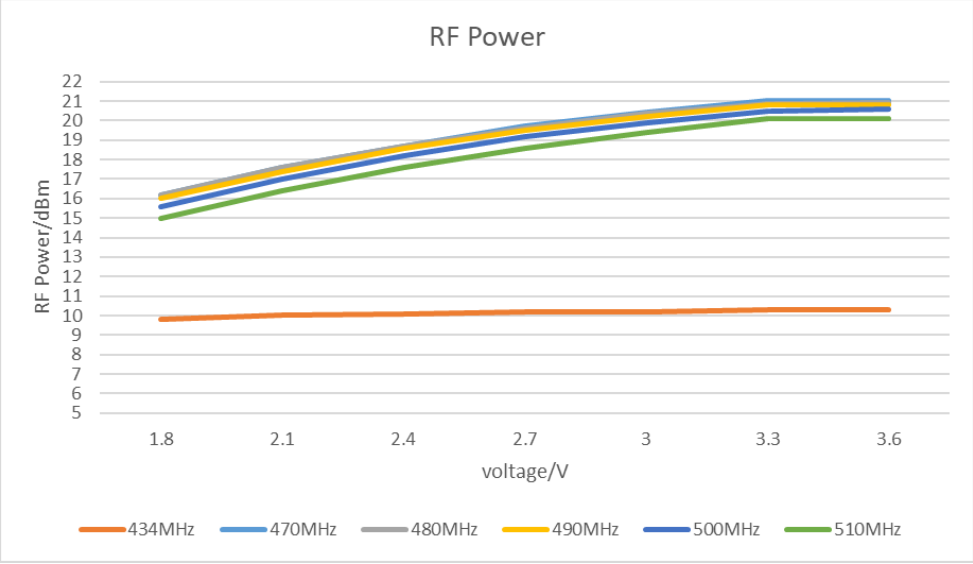

Figure 3 RF Power vs Voltage（434~510MHz）

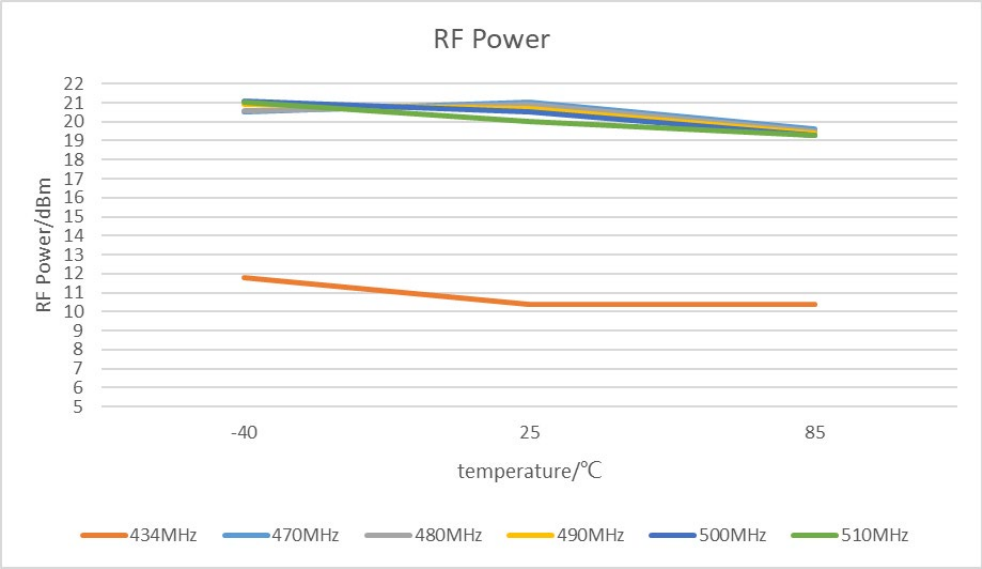

Figure 4 RF Power VS Temperature（434~510MHz）

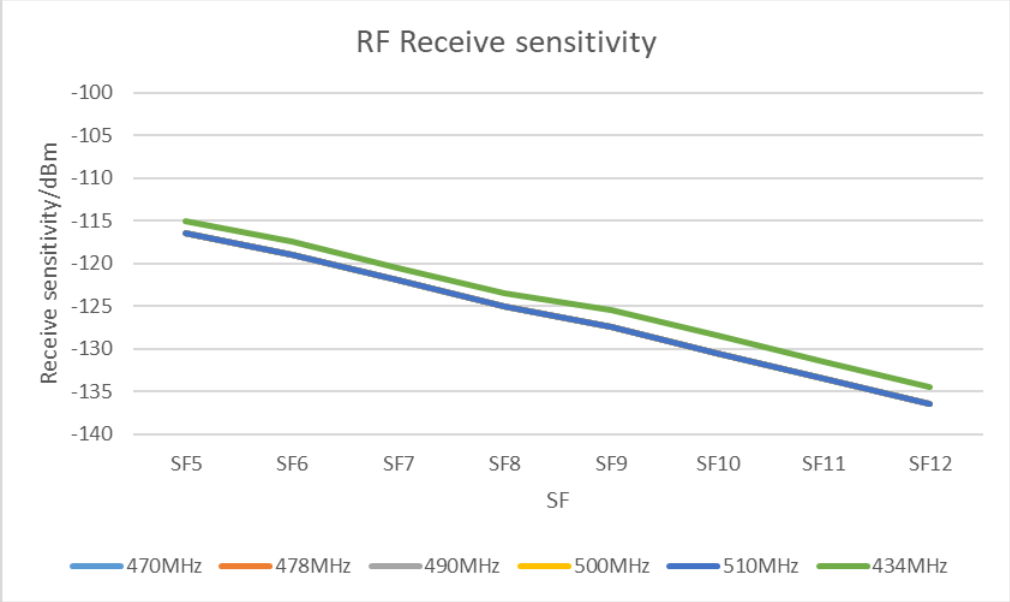

Figure 5 RF Receiver Sensitivity vs Spreading factor（434~510MHz）

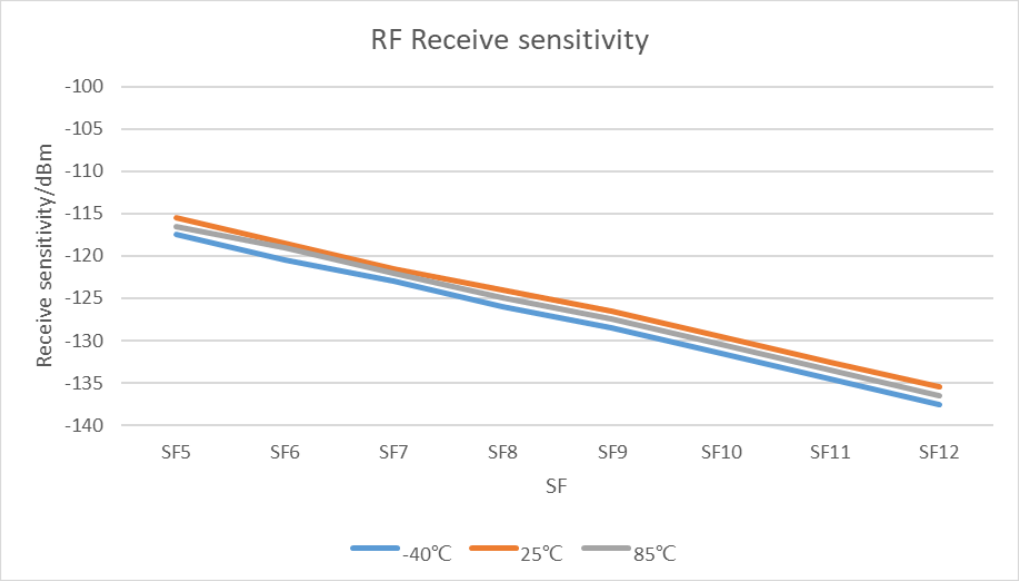

Figure 6 RF Receiver Sensitivity VS Temperature（470MHz）

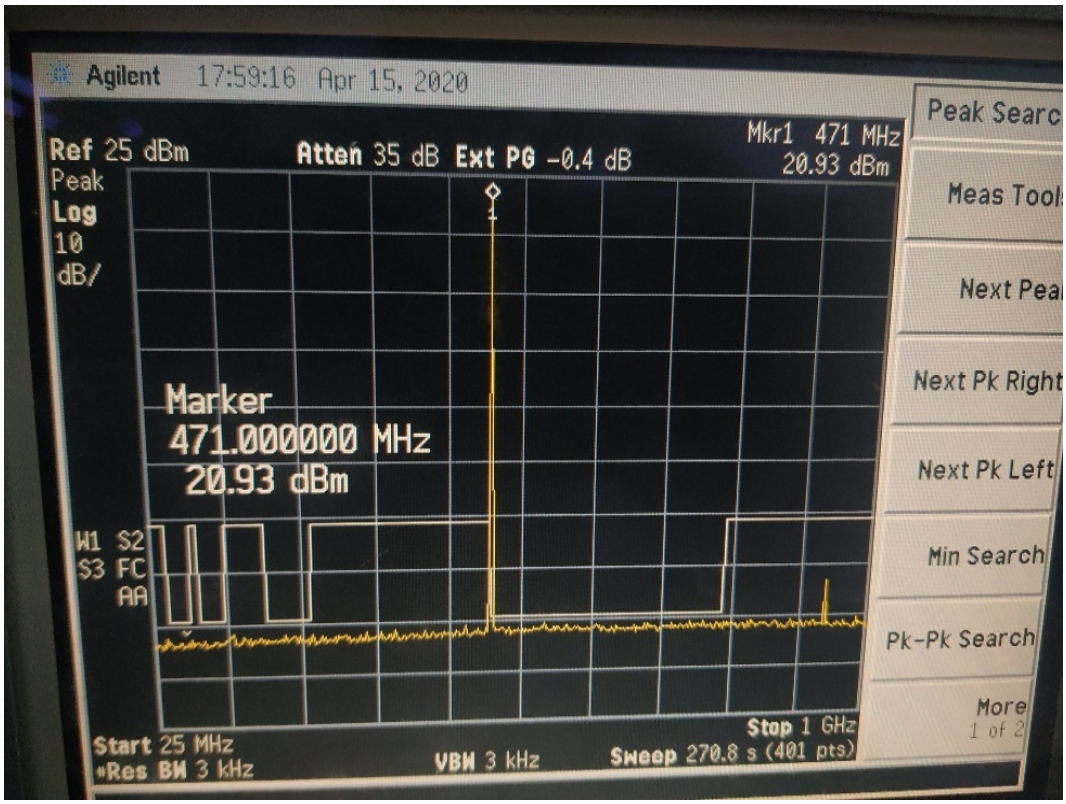

Figure 7 Harmonic(25MHz~1GHz)@Frf=470MHz, TXOP=22dBm

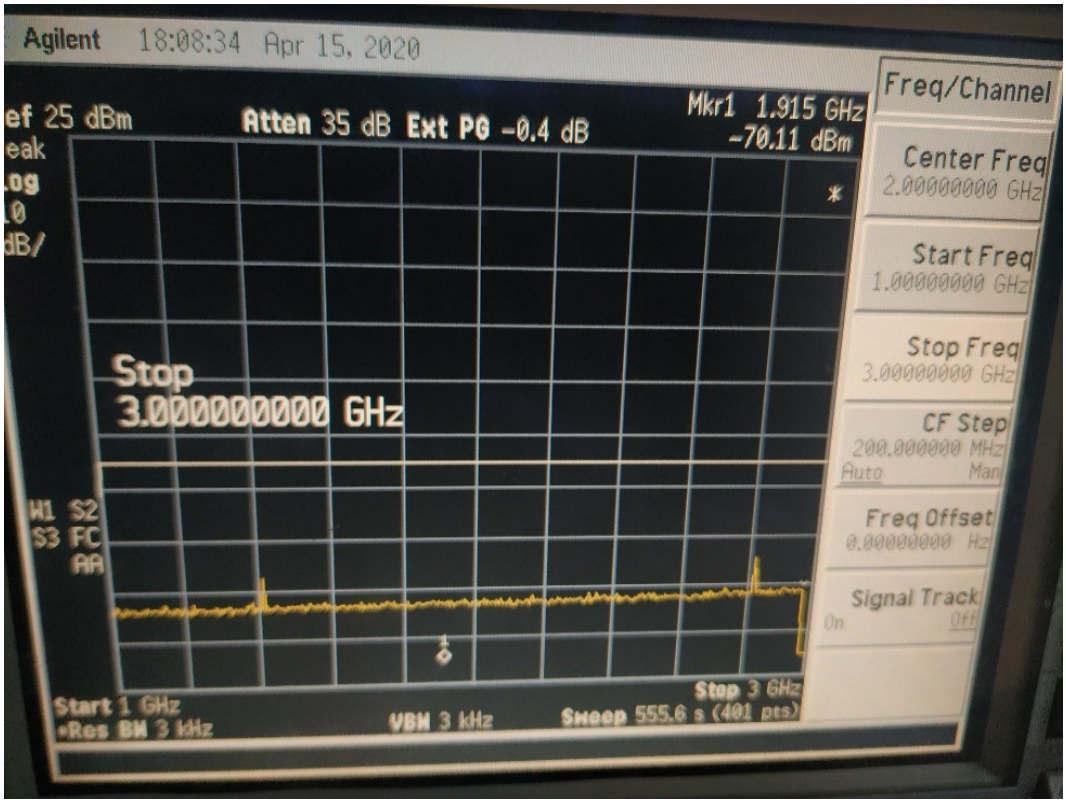

Figure 8 Harmonic(1GHz~3GHz)@Frf=470MHz, TXOP=22dBm

4.2 RHF0M0E5-HF22 性能测试

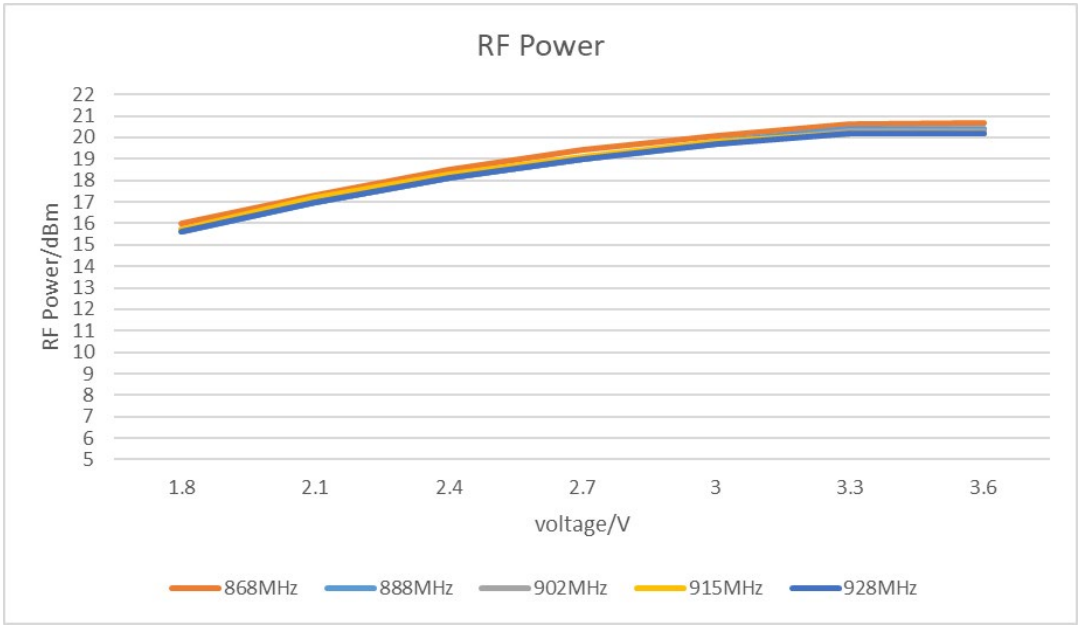

Figure 9 RF Power vs Voltage（868~928MHz）

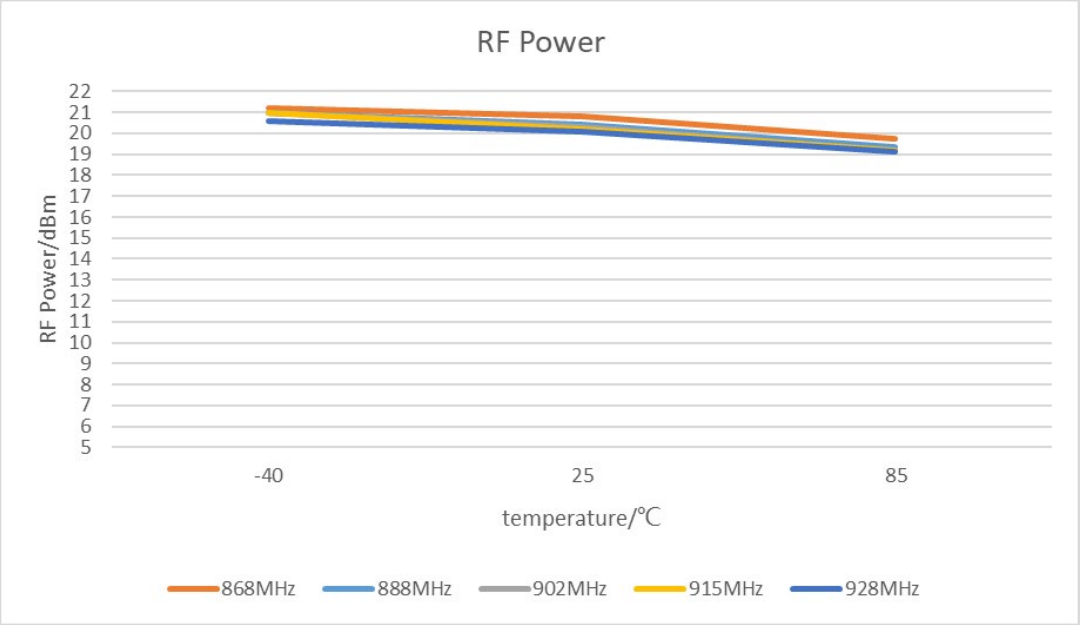

Figure 10 RF Power VS Temperature（868~928MHz）

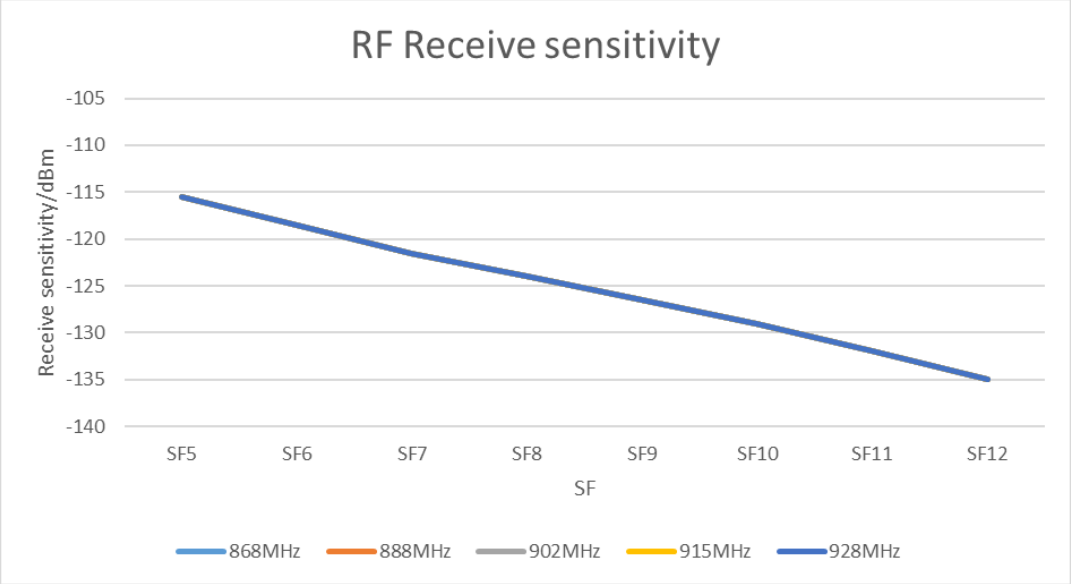

Figure 11 RF Receiver Sensitivity vs Spreading factor（868~928MHz）

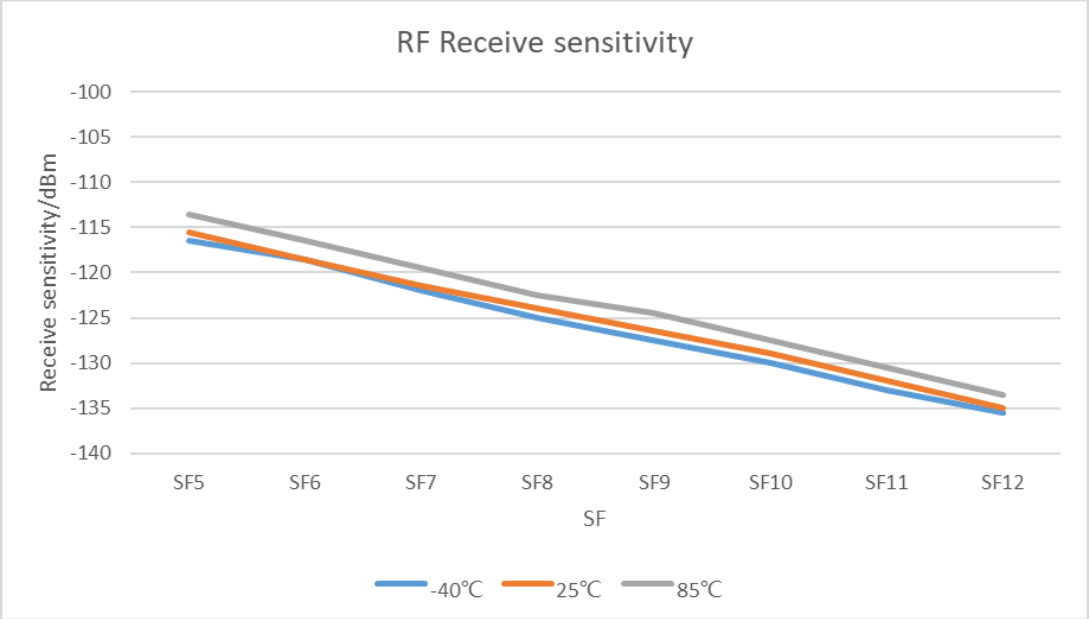

Figure 12 RF Receiver Sensitivity VS Temperature（868MHz）

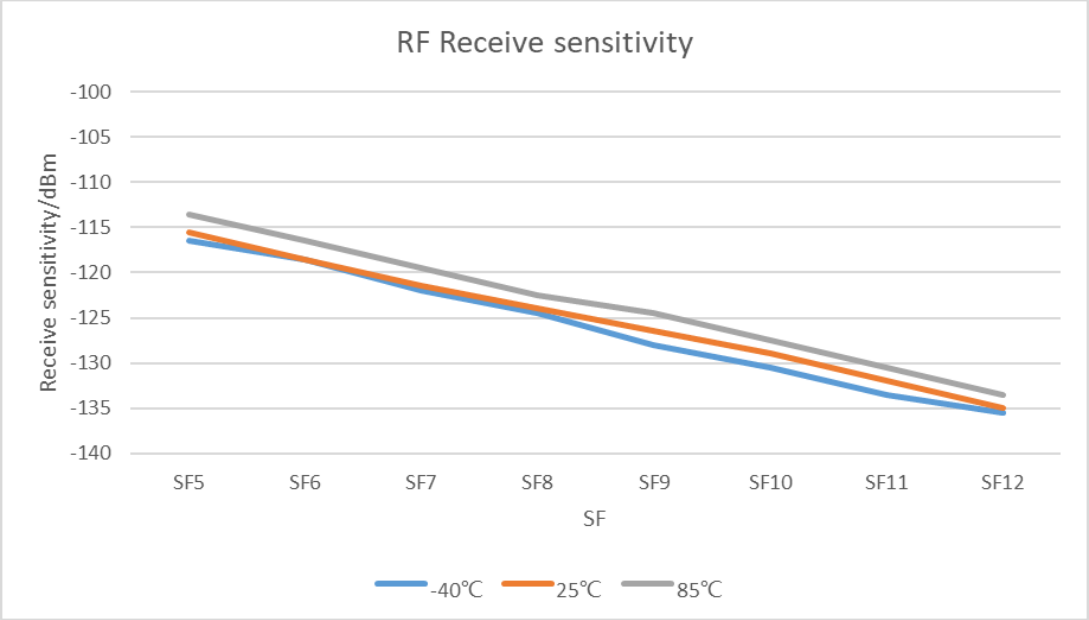

Figure 13 RF Receiver Sensitivity VS Temperature（915MHz）

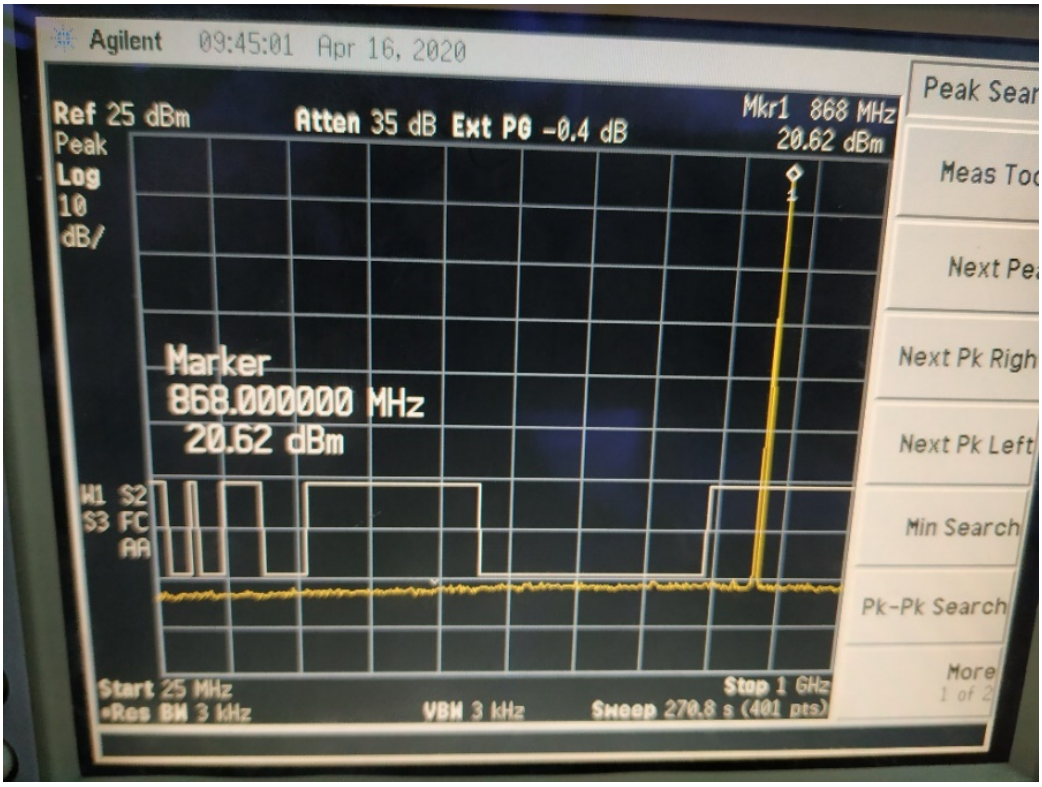

Figure 14 Harmonic(25MHz~1GHz)@Frf=868MHz, TXOP=22dBm

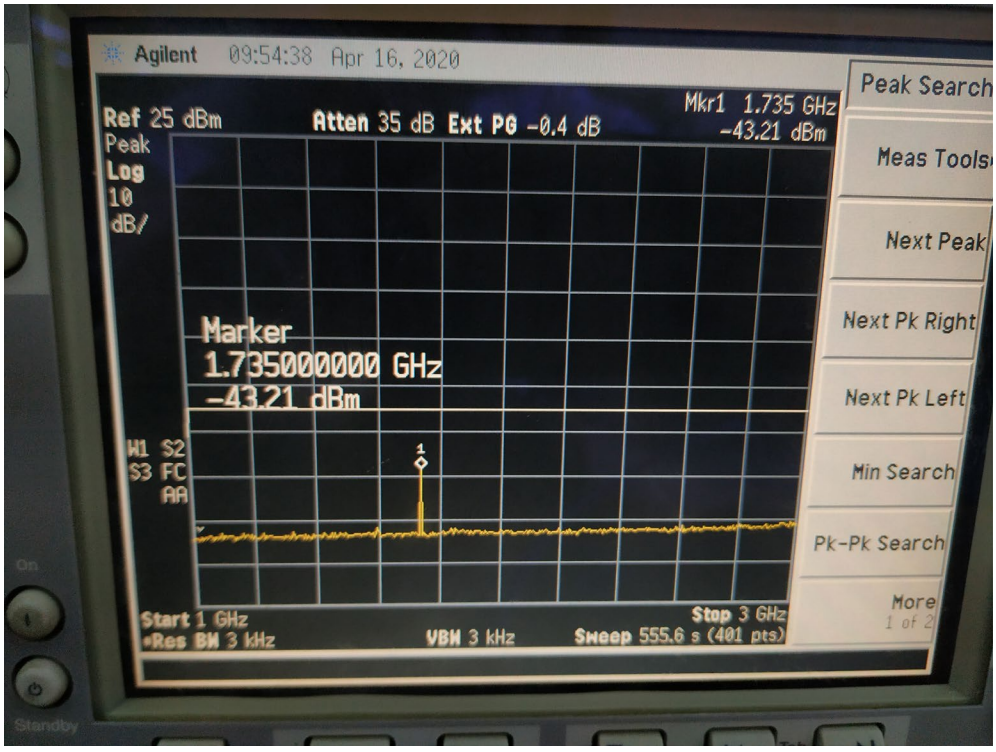

Figure 15 Harmonic(1GHz~3GHz)@Frf=868MHz, TXOP=22dBm

5 应用信息

5.1 封装信息

RHF0M0E5 具有 28pin 的贴片封装：

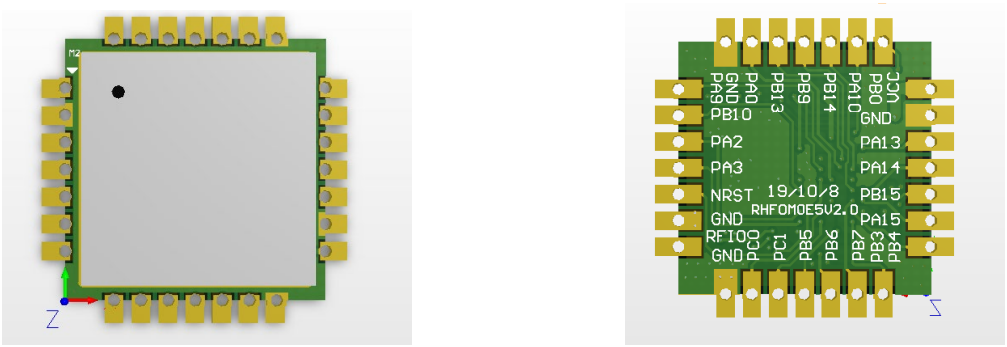

Figure 16 RHF0M0E5 Module appearance

下图给出了建议的 Layout 封装尺寸图：

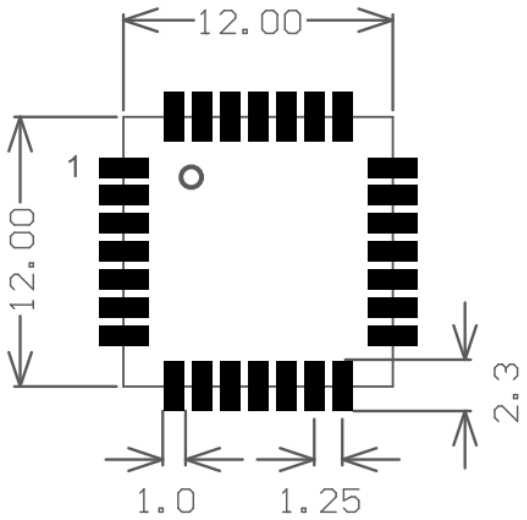

Figure 17 PCB layout

5.2 模块对外接口

除了几个必要的 GPIO 口和一组 SPI 口被用于内部射频收发机的控制外， MCU 的其他 GPIO 都已引出，包括 UART(用于 AT 指令）, I2C，ADC 等。对于那些希望在模组的片上 MCU 进行软件开发或拓展外设的用户来说，这些丰富的 GPIO 接口能满足绝大多数应用的需求。

5.3 基于 RHF0M0E5 模块的参考设计

RHF0M0E5 内嵌全球的 LoRaWAN®协议和 AT 指令集。这将使得基于该模块的 LoRaWAN®节点设计变得非常容易， 以下是使用 RHF0M0E5 快速启动 LoRaWAN®应用程序的典型参考设计。只需将 UART 和 NRST 连接到主机 MCU 并发送 AT 命令即可。

此外，模块的 Pin24 接地会使模块强制进入 Boot 升级模式。

注意：28 引脚 PB0 必须悬空处理，不允许上拉或接地。

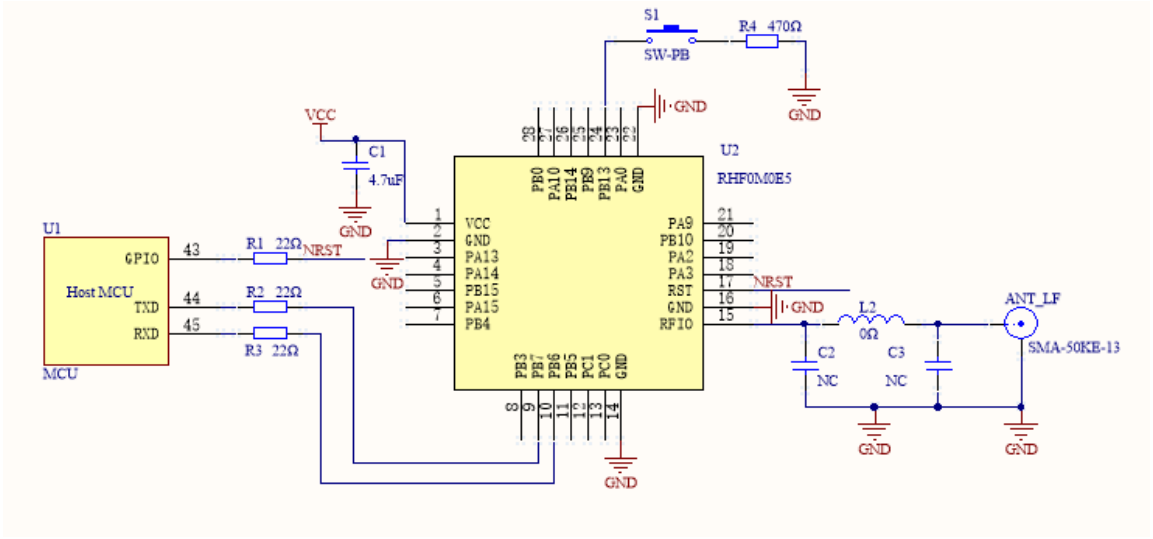

Figure 18 Reference design based on RHF0M0E5

6 LoRaWAN®应用信息

6.1 LoRaWAN®应用

LoRaWAN®网络的拓扑结构是星形网络，网关作为节点和网络服务器之间的中继。网关通过标准的 IP 链路连接到网络服务器，而节点设备使用 LoRa®或者 FSK 与一个或者多个网关通信。通信是双向的，尽管主要是从节点到网络服务器的上行通信。

节点和网关之间的通信使用不同的频率和速率，速率的选择是功耗和距离的折中，不同的速率之间互不干扰。根据不同的扩频因子和带宽，LoRa®的速率可以从 300bps 到 50Kbps。为了使电池寿命和网络容量最大化，网络服务器通过速率自适应(ADR)管理节点的速率和输出功率。

节点设备可能在任何时间，以任何速率，在随机的一个信道上发射，只要符合以下条件：

□ 1) 节点当前使用的信道是伪随机的。这使得系统抗干扰的能力更强

□ 2) 节点每次的最大传输时间(信道的驻留时间)和占空比取决于所用的频段和当地的规范

RHF0M0E5 模块集成了 ST 超低功耗 IC STM32WLE5JC. 在睡眠模式下电流仅 2.1uA, 该模块非常适合于 LoRaWAN®的各种应用。.

6.2 基于 RHF0M0E5 设计 LoRaWAN®无线传感器

RHF0M0E5 是封装了全球 LoRaWAN®标准协议的 AT 指令集。客户只需要一颗很简单的 MCU 作为主控，便可通过串口来控制 RHF0M0E5，从而轻松实现 LoRaWAN®协议。这有助于帮助客户快速地将传感器产品推向 LoRaWAN®市场。

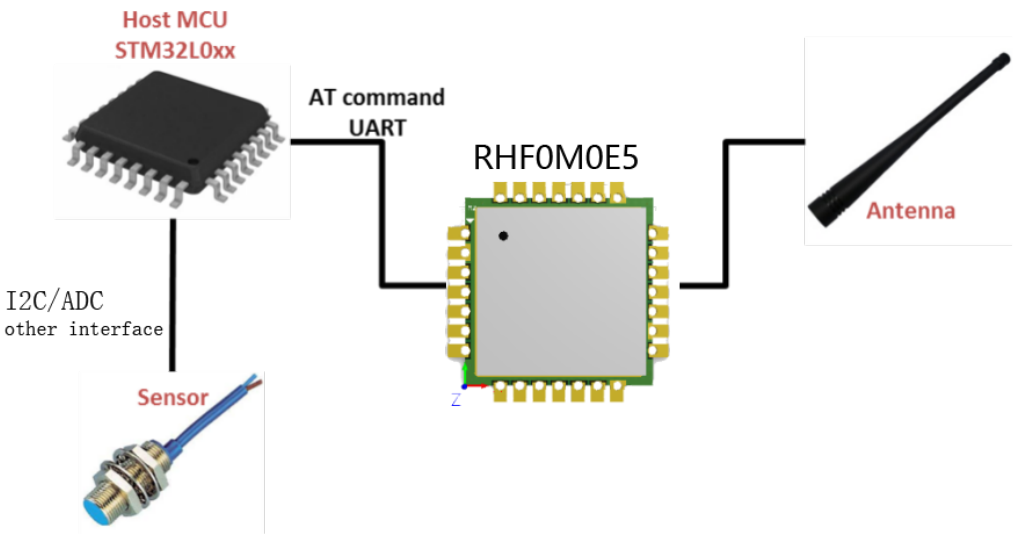

Figure 19 Design of LoRaWAN® wireless sensor based on RHF0M0E5 module

7 订购信息

技术支持： support@risinghf.com

中国销售：salescn@risnghf.com

海外销售：saleswww@risinghf.com

Table 5 Ordering Information

Part Number	MCU	TX Power (dBm)	AT Modem
RHF0M0E5-LF22	ROM 256KB / RAM 64KB	10@LF(434MHz) 22@LF (470MHz)	Yes
RHF0M0E5-HF22	ROM 256KB / RAM 64KB	22@HF (868/915MHz)	Yes

8 Revision

V1.4 2020-09-25

+ 更新 STM32WL5JC 描述
+ 更新原理框图

V1.3 2020-05-06

+ 增加 RHF0M0E5-HF22 性能参数
+ 更新 RHF0M0E5-LF22 性能参数

V1.2 2020-03-03

+ 增加 STM32WLE5JC 描述
+ 增加 Boot 升级描述

V1.1 2019-12-18

+ 初稿

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