DS117914

超小尺寸 LoRaWAN 模块 RHF0M003

V1.2

Document information

Info	Content
Keywords	*RisingHF, LoRaWAN, 模块, 超小尺寸, AT command*
Abstract	本文档是 RHF0M003/RHF78-052 LoRaWAN 模块的规格书.

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RHF0M003 超小尺寸 AT 指令控制的 LoRaWAN 模块

超低功耗超小尺寸 LoRaWAN 模块

一般描述

RHF0M003 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 模块， 模块内嵌了 Semtech 的 LoRa 芯片 SX127x 和 ST 超低功耗 MCU STM32L07x.

该模块的目标应用是无线传感网和其他物联网设备，尤其是由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，性能和应用信息。

应用

RHF0M003 LoRaWAN 模块主要适用于于远距离，超低功耗的应用，比如无线抄表，传感网和其他物联网应用。

主要特点

- 低功耗: 低至 1.45uA 睡眠电流 (WOR 模式)
- 低成本:
  SX1276/SX1278 和高性价比 MCU;
- 小尺寸: 14mm X 20mm 18 pins SMT
- 高性能:
  RHF0M003-LF20:
  TXOP=20dBm@434MHz/470MHz
  RHF0M003-HF20:
  TXOP=20dBm@868MHz/915MHz
  160dB 链路预算, 适合长距离的需要
- 灵活的接口
  SPI;
  USART;
  I2C;
  USB;
  ADC;
- 内嵌 LoRaWAN 协议，AT 指令，支持全球 LoRaWAN 频率计划
  EU868;
  US915 and US915 Hybrid;
  CN779;
  EU433;
  AU915;
  CN470 and CN470 Prequel;
  AS923;
  KR920;
  IN865;

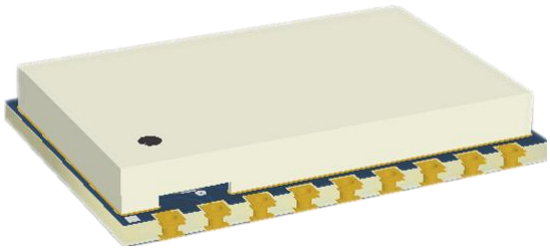

Figure 1-1 RHF0M003 Module Outline

本产品规格书包括 RHF0M003 模块性能和功能的详细描述。最新的 FW，产品更新或勘误表等请与瑞兴恒方联系。

1 总体描述

RHF0M003 内嵌 SX127x 和 STM32L07x，非常适合于各种物联网节点的设计。
基于多模高性能的 SX1276/8，RHF0M003 模块支持(G)FSK 和 LoRa 模式。LoRa 模式下可以使用 62.5kHz, 125kHz, 250kHz 和 500kHz 带宽。
基于 STM32L07x MCU, 模块提供 SPI, UART, I2C, ADC 和 GPIOs 供用户根据应用选用。 建议使用两线接口 (SWIM) 烧录。
RHF0M003 包含两个可选型号，RHF0M003-LF20 和 RHF0M003-HF20。RHF0M003-LF20 支持 20dBm@LF band (434MHz/470MHz)，而 RHF0M003-HF20 支持 20dBm@HF band (868MHz/915MHz)。

1.1 原理框图

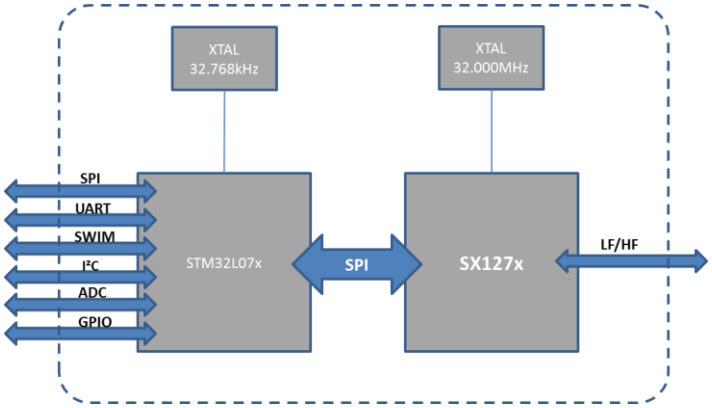

Figure 1-1 RHF0M003 原理框图

1.2 管脚定义

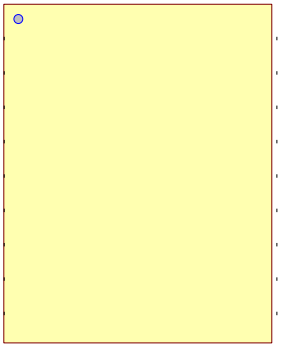

Figure 1-2 RHF0M003 管脚排列

Table 1-1 管脚定义和描述

Number	Name	Type	Description
1	GND	-	Ground
2	RFIO_HF	-	RF input/output
3	GND	-	Ground
4	BOOT0	I	BOOT0 for MCU (connected to GND via 10k internal)
5	I2C_SDA	I/O	SCL of I2C from MCU; or GPIO from MCU, PB7
6	I2C_SCL	I/O	SDA of I2C from MCU; or GPIO from MCU, PB6
7	LPUART_TX_ADC	I/O	Low power USART_TX from MCU; or GPIO from MCU, PA2
8	LPUART_RX_ADC	I/O	Low power USART_RX from MCU; or GPIO from MCU, PA3
9	GND	-	Ground
10	VCC	-	Supply voltage for the module
11	GND	-	Ground
12	PA9/USART1_TX	I/O	USART1_TX from MCU; or GPIO from MCU, PA9
13	PA10/USART1_RX	I/O	USART1_RX from MCU; or GPIO from MCU, PA10
14	PA11/USB_DM	I/O	GPIO from MCU, PA11
15	PA12/USB_DP	I/O	GPIO from MCU, PA12
16	SWDIO	I/O	SWDIO of SWIM for program download
17	SWCLK	I/O	SWCLK of SWIM for program download
18	NRST	I	Reset trigger input for MCU

2 电气特性

2.1 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无法正常工作甚至损坏。

Table 2-1 极限工作条件

Item	Description	min	max	unit
VCCmr	供电电压	-0.3	+3.9	V
Tmr	环境温度	-55	+115	℃
Pmr	射频输入信号	-	+10	dBm

2.2 正常工作条件

Table 2-2 工作范围

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

2.3 模块规格指标

Table 2-3 模块规格指标

ITEMs	Parameter	Specifications	Unit
Structure	Size	14(W) X 20(L) X 2.6(H)	mm
	Package	18 pins, SMT	
Electrical Characteristics	power supply	3.3V type	V
	Sleep current	1.45uA (WDT off)	uA
	Operation current (Transmitter+MCU)	120mA @20dBm in 434MHz/470MHz type	mA
		130mA @20dBm in 868MHz/915MHz type	mA
	Operation current (Receiver+MCU)	21mA @BW125kHz, 434MHz/470MHz type	mA
		21mA @BW125kHz, 868MHz/915MHz type	mA
	Output power	20dBm max @434MHz/470MHz	dBm
		20dBm 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	
	USB	1 group of USB, include 2 pins	
	I2C	1 group of I2C, include 2 pins	
	ADC	2 ADC Input, include 2 pins, reuse with LPUART port	
	NRST	Manual reset pin input	

3 典型射频性能测试

3.1 RHF0M003-LF20 性能测试

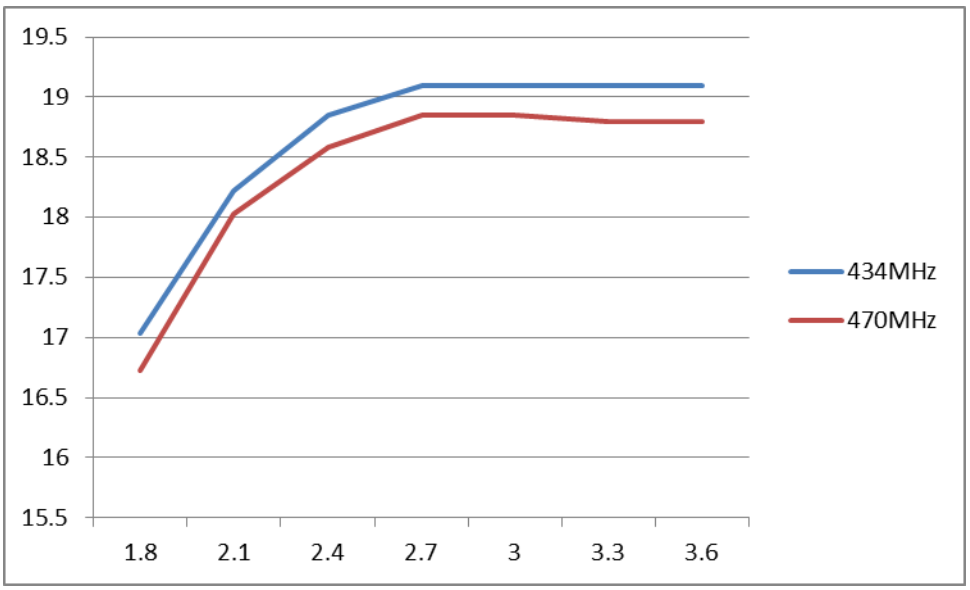

Figure 3-1 发射功率 vs 供电电压（434/470MHz）

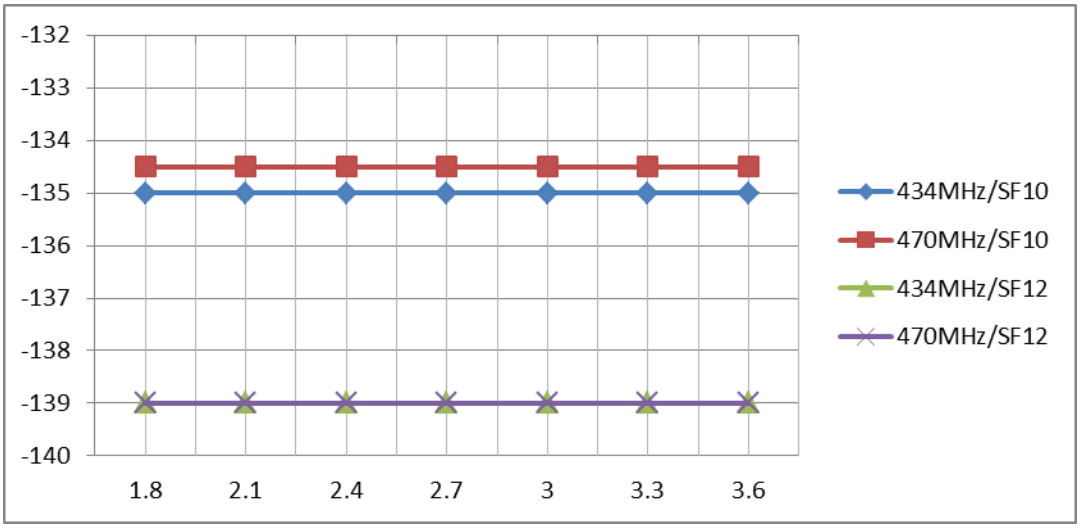

Figure 3-2 接收灵敏度(SF10/SF12,125kHz) vs 供电电压（434/470MHz）

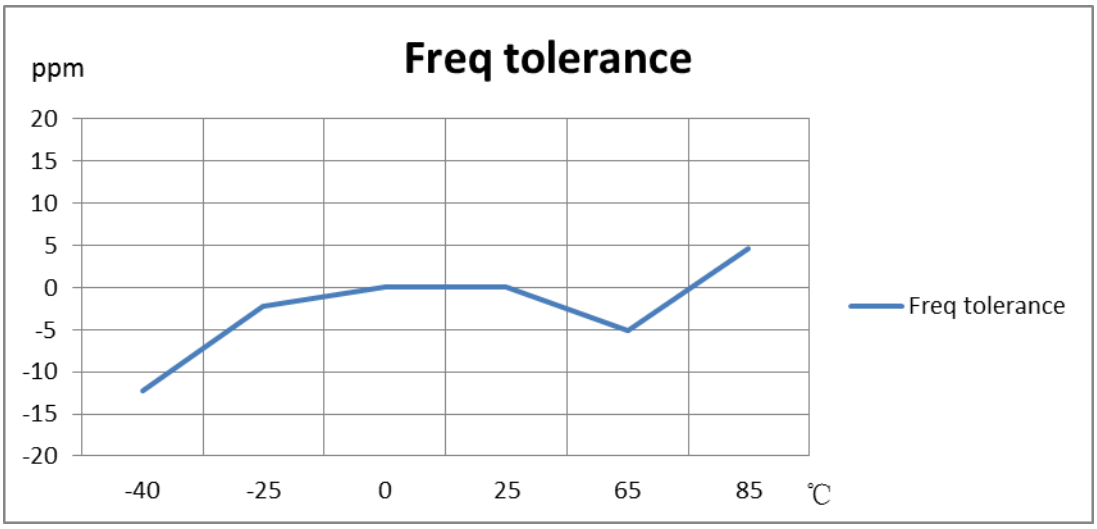

Figure 3-3 频率漂移 vs 环境温度（LF band）

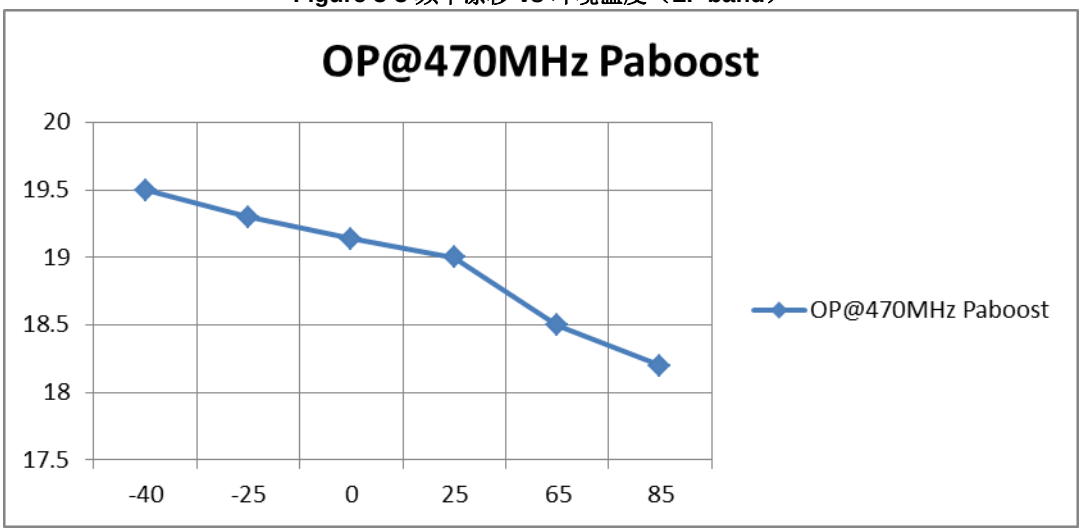

Figure 3-4 发射功率 vs 环境温度（470MHz）

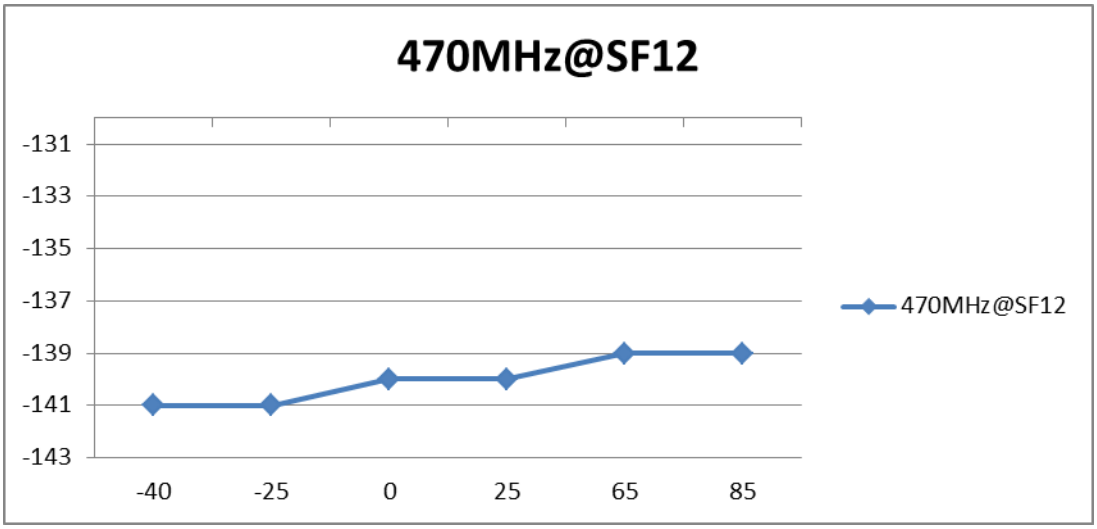

Figure 3-5 接收灵敏度 (SF12,125kHz) vs 环境温度（470MHz）

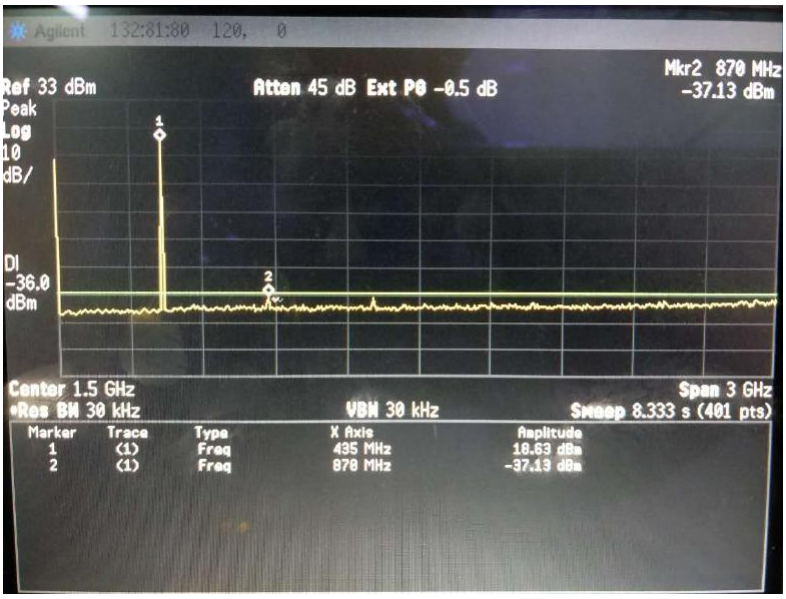

Figure 3-6 谐波 @Frf=434MHz, TXOP=20dBm（434MHz）

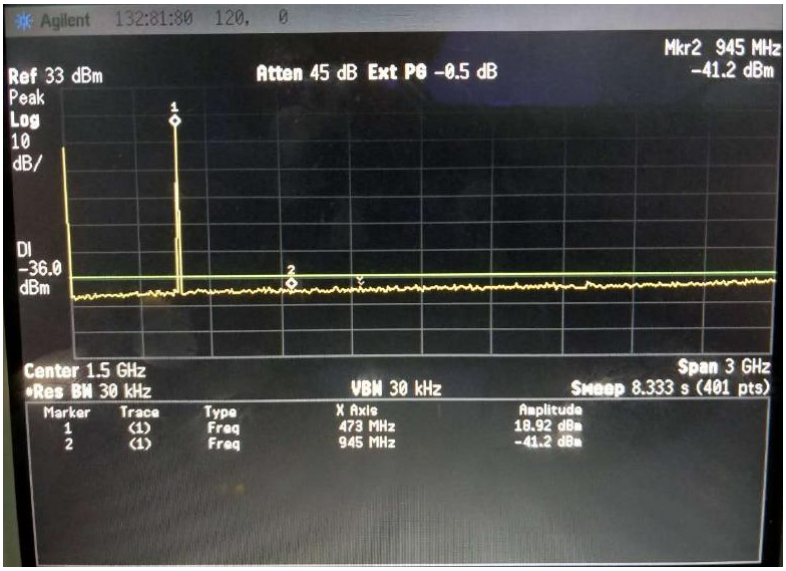

Figure 3-7 谐波 @Frf=470MHz, TXOP=20dBm（470MHz）

3.2 RHF0M003-HF20 性能测试

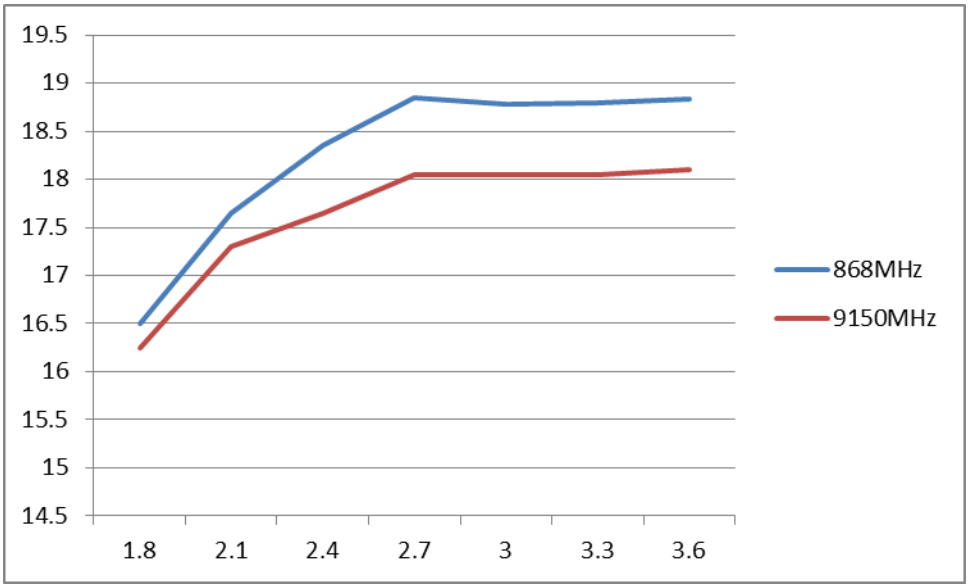

Figure 3-8 发射功率 vs 供电电压（868/915MHz）

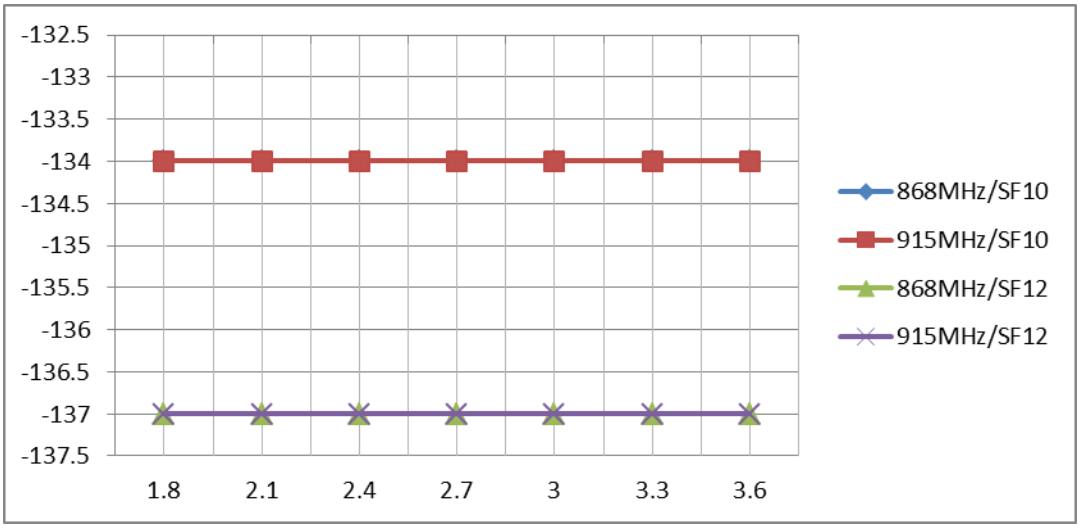

Figure 3-9 接收灵敏度 (SF10/SF12,125kHz) vs 供电电压（868/915MHz）

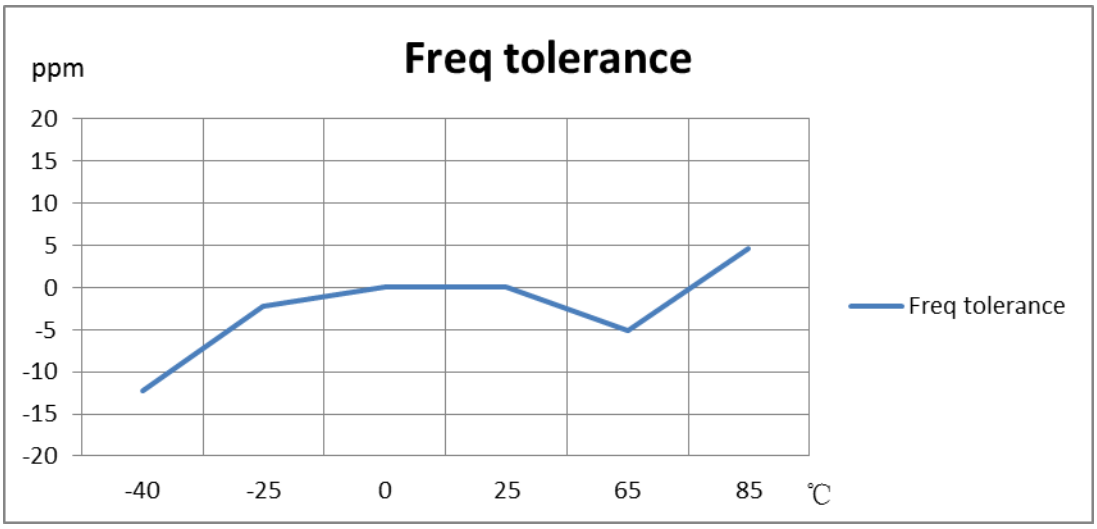

Figure 3-10 频率漂移 vs 环境温度（HF band）

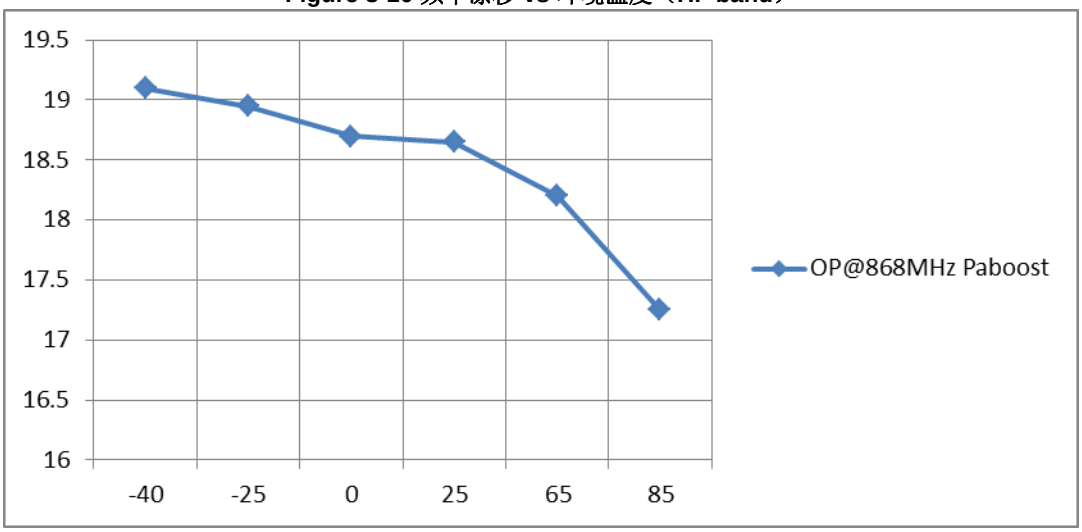

Figure 3-11 发射功率 vs 环境温度（868MHz）

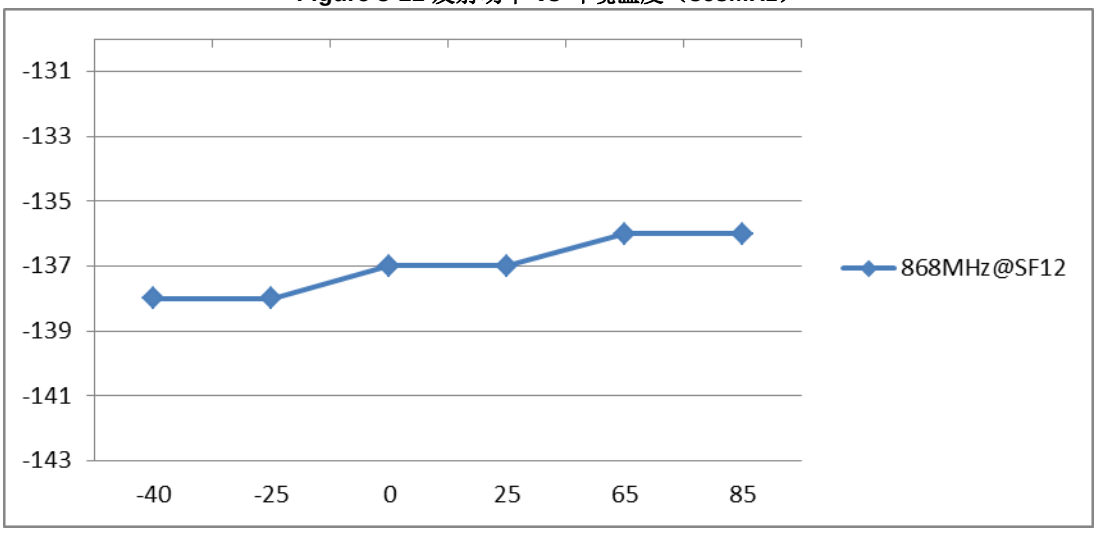

Figure 3-12 接收灵敏度 (SF12,125kHz) vs 环境温度（868MHz）

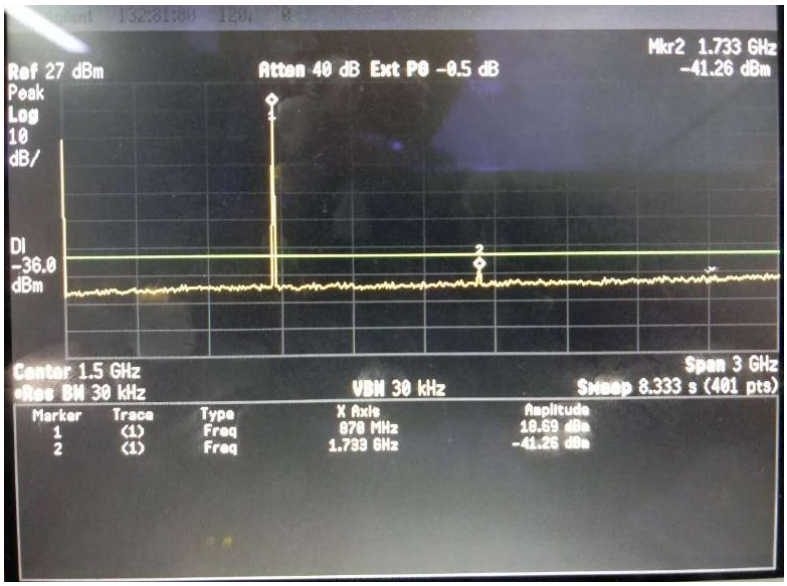

Figure 3-13 谐波 @Frf=868MHz, TXOP=20dBm

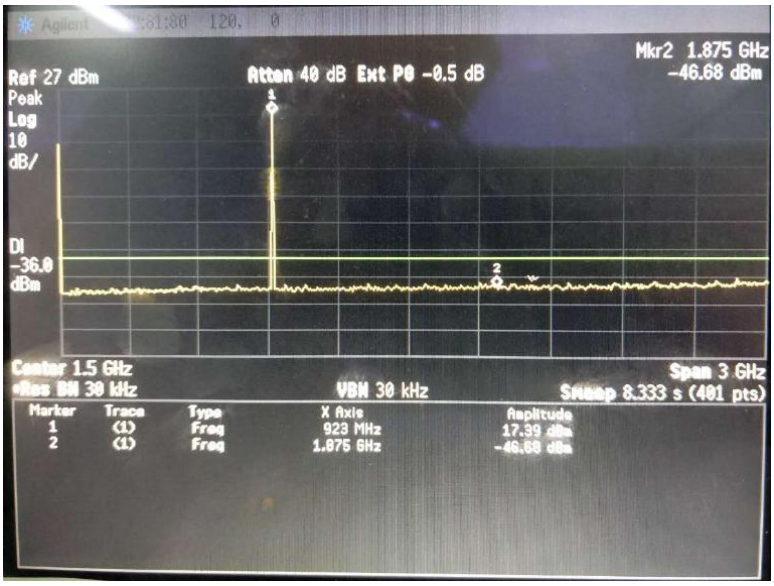

Figure 3-14 谐波 @Frf=915MHz, TXOP=20dBm

4 应用信息

4.1 封装信息

如非特别说明， 尺寸公差为±0.1mm。

RHF0M003 具有 18pin 的贴片封装:

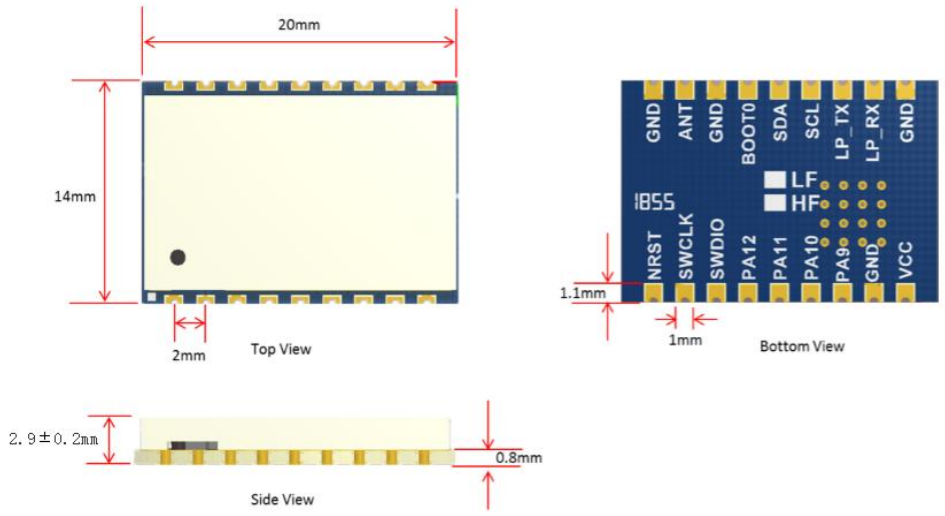

Figure 4-1 RHF0M003 模块外观尺寸

Figure 4-2 给出了建议的 Layout 封装尺寸图。

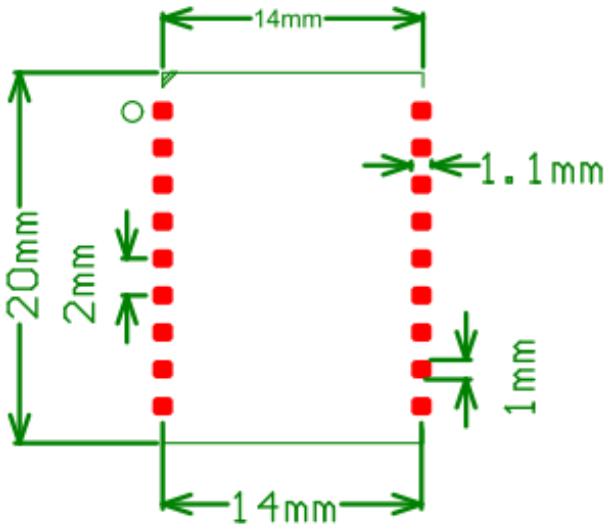

Figure 4-2 建议的 Layout 封装尺寸图

4.2 内部连接

Table 4-1 和 Table 4-2 提供了模块内部 MCU（STM32L07x）与射频收发机（SX127x）之间的 GPIO 连接和映射关系。

Table 4-1 内部的 MCU(STM32L07x) 和 Radio(SX127x)的 IO 连接映射关系

Chip	SX127x		STM32L07x	
Item	Pin Num	Description	Pin Num	Description
IO connection Between SX127x and	Pin7	NRESET_SX	Pin6	PA0
	Pin8	DIO0_SX	Pin26	PB4
	Pin9	DIO1_SX	Pin18	PA8

STM32L07x	Pin10	DIO2_SX	Pin15	PB1
	Pin11	DIO3_SX	Pin14	PB0
	Pin12	DIO4_SX	NC	NC
	Pin13	DIO5_SX	Pin7	PA1
	Pin16	SCK_SX	Pin11	PA5
	Pin17	MISO_SX	Pin12	PA6
	Pin18	MOSI_SX	Pin13	PA7
	Pin19	NSS_SX	Pin10	PA4

Table 4-2 射频收发控制逻辑

	Pin Num/MCU	Description	Definition	Logic	Status
RF Switch Control	Pin27	PB5	Switch_CTL	0	TX ON
	Pin27	PB5	Switch_CTL	1	RX ON
	Pin27	PB5	Switch_CTL	0	Sleep

4.3 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 SPI, USART, I2C, USB，ADC 等。 这些丰富的 GPIO 接口，对于需要拓展外设的用户来说非常有用。

4.4 基于 RHF0M003 模块的参考设计

RHF0M003 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。只需要将模块的串口和复位脚 NRST 连接到用户的主控 MCU 上即可。

模块 Pin7 可用于 LoRaWAN 状态指示。每次执行一次上行或者收到一次下行信号，LED1 均会闪烁一次。如果不连接 LED，则保持该管脚浮空。

模块 Pin7 可用于触发进入 boot 升级模式。请注意，该模式下升级固件，只允许使用 RisingHF 官方提供的固件。如果不连接，则保持该管脚浮空。

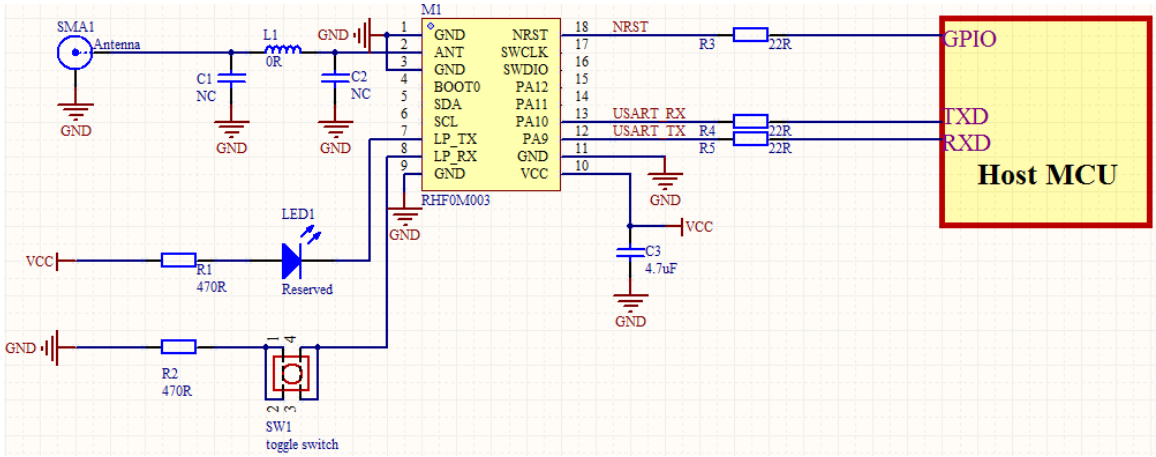

Figure 4-3 基于 RHF0M003 的参考设计

5 LoRaWAN 应用

5.1 LoRaWAN

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

RHF0M003 模块集成了 Semtech's 的 SX127x 芯片和 ST 的超低功耗 MCU. 在睡眠模式下电流仅 1.45uA, 该模块非常适合于 LoRaWAN 的各种应用.

5.2 基于 RHF0M003 设计 LoRaWAN 无线传感器

RHF0M003 是封装了全球 LoRaWAN 标准协议的 AT 指令的 Modem。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 RHF0M003，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。

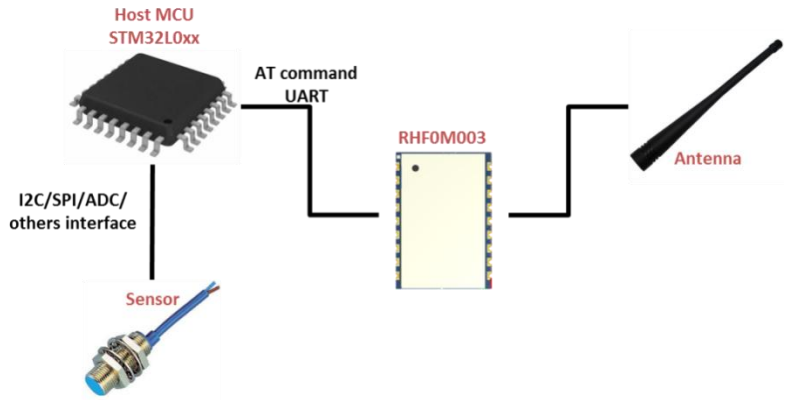

Figure 5-1 基于 RHF0M003 模块的 LoRaWAN 无线传感器设计

6 订购信息

技术支持: Support@RisingHF.com

销售:

中国: Salescn@RisngHF.com

海外: Salesww@RisingHF.com

Table 6-1 订购信息

Part Number	MCU	TX Power (dBm)	AT Modem
RHF0M003-LF20	ROM 192KB / RAM 20KB	19@LF (434/470MHz)	Yes
RHF0M003-HF20	ROM 192KB / RAM 20KB	19@HF (868/915MHz)	Yes

Revision

V1.2 2019-1-22

+ 更新封装

V1.1 2017-09-16

+ 更新测试数据

V1.0 2017-08-14

+ 初稿

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