- ## 产品简述

RHF0M084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 ,还搭载Semtach专有的2.4G长距离收发器SX1281。 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。

外观

应用领域

- LoRaWAN®节点
- 家庭自动化应用
- 智能安全
- 低功耗无线传感器网络
- 2.4GHz远程应用

功能和特点

- 低功耗：低至2uA 睡眠电流 (WOR 模式)
- 小尺寸：28mm X 23mm X 2.8mm　33 pins SMT
- 高性能：

  高发射功率：

  - TXOP=22dBm@470MHz
  - TXOP=22dBm@868/915MHz

    - TXOP=13dBm@2400MHz

  高接收灵敏度：

    - 470MHz:-134 dBm sensitivity for SF12 with 125KHz BW
    - 868MHz:-132 dBm sensitivity for SF12 with 125KHz BW
    - 2400MHz:-130 dBm sensitivity for SF12 with 125KHz BW
- 灵活的接口
    - SPI
    - USART
    - I2C
    - ADC
    - GPIO
    - SWD
- 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 Prequet
    - AS923
    - KR920
    - IN865

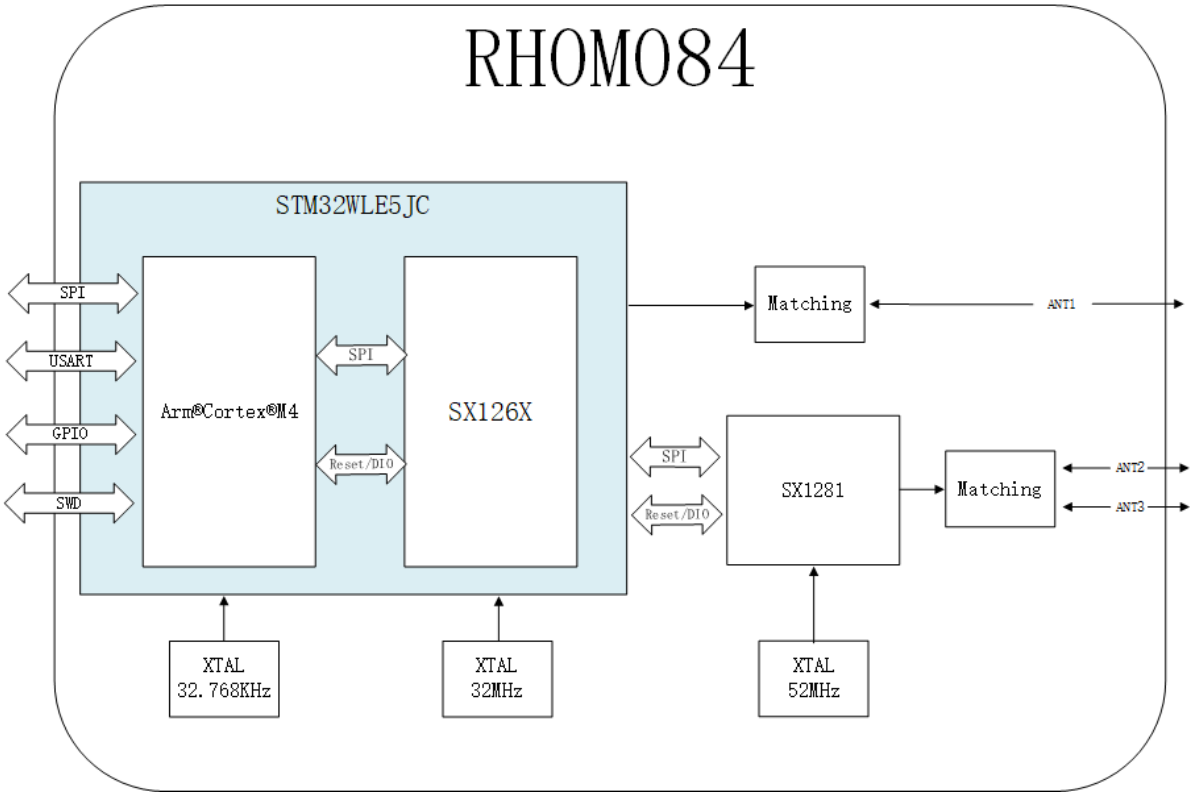
总体描述

RHF0M084内嵌 STM32WLE5JC 和 SX1281，非常适合于各种物联网节点的设计。

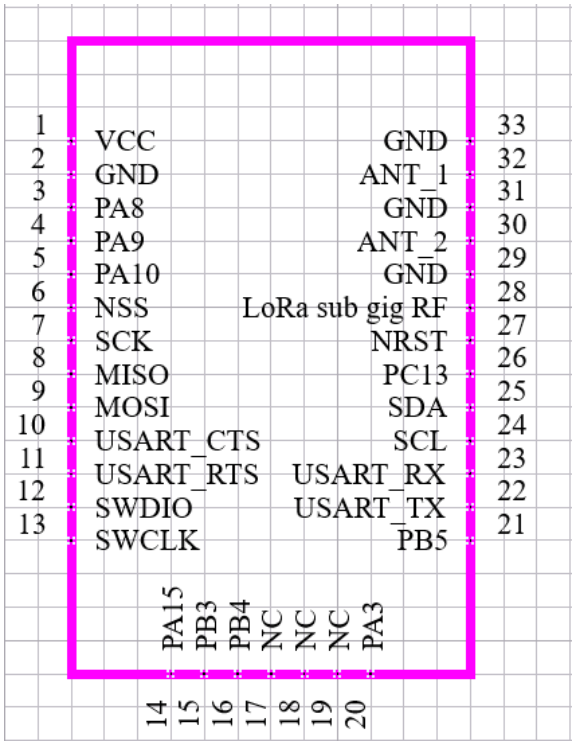
基于多模高性能的 SX126X和SX1281，RHF0M084模块支持(G)FSK 和 LoRa 模式。在 470MHz/868MHz/915MHz LoRa 模式下可以使用 62.5kHz, 125kHz, 250kHz 和 500kHz 带宽。在 2400MHz LoRa 模式下可以使用203.125KHz，406.25KHz，812.6KHz，1625KHz。

基于 STM32WLE5JC MCU, 模块提供 UART和 GPIOs 供用户根据应用选用。 建议使用两 线接口 (SWIM) 烧录。

原理框图：


RHOM084
STM32WLE5JC
SPI
USART
GPIO
SWD
Arm®Cortex®M4
SPI
Reset/DIO
SX126X
Matching
ANT1
SPI
Reset/DIO
SX1281
Matching
ANT2
ANT3
XTAL
32.768KHz
XTAL
32MHz
XTAL
52MHz

管脚定义


1 VCC
2 GND
3 PA8
4 PA9
5 PA10
6 NSS
7 SCK
8 MISO
9 MOSI
10 USART_CTS
11 USART_RTS
12 SWDIO
13 SWCLK
LoRa sub gig RF
33 GND
32 ANT_1
31 GND
30 ANT_2
29 GND
28 NRST
27 PC13
26 SDA
25 SCL
24 USART_RX
23 USART_TX
22 PB5
21
14 PA15
15 PB3
16 PB4
17 NC
18 NC
19 NC
20 PA3

Number	Name	Type	Description
1	VCC	-	Supply voltage for the module
2	GND	-	Ground
3	PA8	I/O	MCU GPIO
4	PA9	I/O	MCU GPIO
5	PA10	I/O	MCU GPIO
6	NSS	I/O	NSS of SPI from MCU or GPIO from MCU, PB12
7	SCK	I/O	SCK of SPI from MCU or GPIO from MCU, PB13
8	MISO	I/O	MISO of SPI from MCU or GPIO from MCU, PB14
9	MOSI	I/O	MOSI of SPI from MCU or GPIO from MCU, PB15
10	USART_CTS	I/O	USART1_CTS from MCU or GPIO from MCU, PA11
11	USART_RTS	I/O	USART1_RTS from MCU or GPIO from MCU, PA12
12	SWDIO	I/O	SWDIO of SWIM for program download
13	SWCLK	I/O	SWCLK of SWIM for program download
14	PA15	I/O	MCU GPIO
15	PB3	I/O	MCU GPIO
16	PB4	I/O	MCU GPIO
17	NC	-	-
18	NC	-	-
19	NC	-	-
20	PA3	I/O	MCU GPIO
21	PB5	I/O	MCU GPIO
22	USART_TX	I/O	USART1_TX from MCU or GPIO from MCU, PB6
23	USART_RX	I/O	USART1_RX from MCU or GPIO from MCU, PB7
24	SCL	I/O	SCL of I2C from MCU or GPIO from MCU, PB8
25	SDA	I/O	SDA of I2C from MCU or GPIO from MCU, PB9
26	PC13	I/O	MCU GPIO
27	NRST	I	Reset trigger input for MCU
28	LoRa sub gig RF	-	RF input/output PORT3 (470MHz/868MHz/915MHz)
29	GND	-	Ground
30	ANT_2	-	RF input/output PORT2（2400MHz）

Number	Name	Type	Description
31	GND	-	Ground
32	ANT_1	-	RF input/output PORT1 (2400MHz)
33	GND	-	Ground

备注：2400MHz天线端口批量出货默认打开ANT_1端口

电气性能

- ## 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。

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

- ## 正常工作条件

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

- ## 规格指标

ITEMs	Parameter	Specifications				Unit
Structure	Size	28(L)X 23(W) X 2.8(H)				mm
	Package	33 pins, SMT				
Electrical Characteristics	power supply	3.3V type				V
	Sleep current	2uA (WDT on);				uA
	Operation current (Transmitter+MCU)	105mA @22dBm in 470MHz type				mA
		118mA @22dBm in 868MHz type				
		111mA @22dBm in 915MHz type				
		24mA @13dBm in 2400MHz type				
	Operation current (Receiver+MCU)	6.7mA @BW125kHz, 470MHz type				mA
		6.7mA @BW125kHz, 868MHz type				
		6.7mA @BW125kHz, 915MHz type				
		6.7mA @BW125kHz, 2400MHz type				
	Output power	21dBm max @470MHz				dBm
		20dBm max @868MHz				
		19.5dBm max @915MHz				
		12dBm max @2400MHz				
	Sensitivity	@SF12, BW125kHz				dBm
		Fr(MHz)	min	type	max	
		470	-	-133	-134	
		868	-	-131	-132	
		915	-	-131	-132	
		2400	-	-128	-130	
	Harmonics	<-36dBm below 1GHz				dBm
		<-30dBm above 1GHz				dBm
Interface	RFIO	RF port				
	UART	1 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				

- **射频性能**
  - **RF Power vs Power configuration（470MHz）**

Configuration	1	2	3	4	5	6	7	8	9	10	11
Current (mA)	32.9	35.11	36.5	38.84	40.28	42.14	44.41	46.63	49.27	51.86	54.79
Output Power (dBm)	0.263	1.396	2.081	3.327	4.131	5.147	6.243	7.226	8.241	9.159	10.082
Configuration	12	13	14	15	16	17	18	19	20	21	22
Current (mA)	58.16	62.3	66.36	70.49	74.02	76.92	80.07	83.57	87.79	93.01	99.63
Output Power (dBm)	11.04	12.059	12.966	13.833	14.747	15.684	16.748	17.766	18.768	19.78	20.768

  - **RF Power vs Power configuration（490MHz）**

Configuration	1	2	3	4	5	6	7	8	9	10	11
Current (mA)	36.03	38.55	40.11	42.78	44.52	46.84	49.59	52.3	55.46	58.57	62.08
Output Power (dBm)	0.698	1.833	2.539	3.817	4.638	5.654	6.756	7.709	8.726	9.622	10.526
Configuration	12	13	14	15	16	17	18	19	20	21	22
Current (mA)	66.02	70.86	75.49	79.81	83.42	86.59	90.1	93.83	98.12	103.24	109.78
Output Power (dBm)	11.45	12.446	13.314	14.143	15.042	15.951	16.959	17.922	18.886	19.856	20.788

  - **RF Power vs Power configuration（868MHz）**

Configuration	1	2	3	4	5	6	7	8	9	10	11
Current (mA)	48.86	52.07	54.06	57.62	59.95	62.82	66.12	69.24	72.68	76	79.54
Output Power (dBm)	-0.466	0.638	1.291	2.505	3.301	4.274	5.358	6.328	7.314	8.198	9.032
Configuration	12	13	14	15	16	17	18	19	20	21	22
Current (mA)	83.62	88.45	93.08	97.76	102.15	104.86	107.77	110.92	114.43	118.35	124.41
Output Power (dBm)	9.917	10.871	11.683	12.464	13.359	14.464	15.755	16.92	17.993	18.965	20.01

  - **RF Power vs Power configuration（915MHz）**

Configuration	1	2	3	4	5	6	7	8	9	10	11
Current (mA)	48.45	51.52	53.39	56.65	58.76	61.35	64.33	67.09	70.2	73.21	76.4
Output Power (dBm)	-2.304	-1.195	-0.511	0.717	1.533	2.536	3.632	4.602	5.601	6.51	7.369
Configuration	12	13	14	15	16	17	18	19	20	21	22
Current (mA)	80.11	84.54	88.81	93.07	95.91	96.96	98.07	99.69	102.06	105.51	111.03
Output Power (dBm)	8.292	9.258	10.106	10.94	12.049	13.261	14.629	15.893	17.078	18.205	19.452

- **RF Power vs Power configuration（2400MHz）**

Configuration	-2	-1	0	1	2	3	4	5
Current（mA）				10.83	11.36	12.03	12.68	13.5
Output Power（dBm）				0.92	1.868	2.893	3.811	4.837
Configuration	6	7	8	9	10	11	12	13
Current（mA）	14.35	15.28	16.37	17.44	18.57	19.77	21.12	22.93
Output Power（dBm）	5.777	6.709	7.669	8.529	9.375	10.184	11.048	11.801

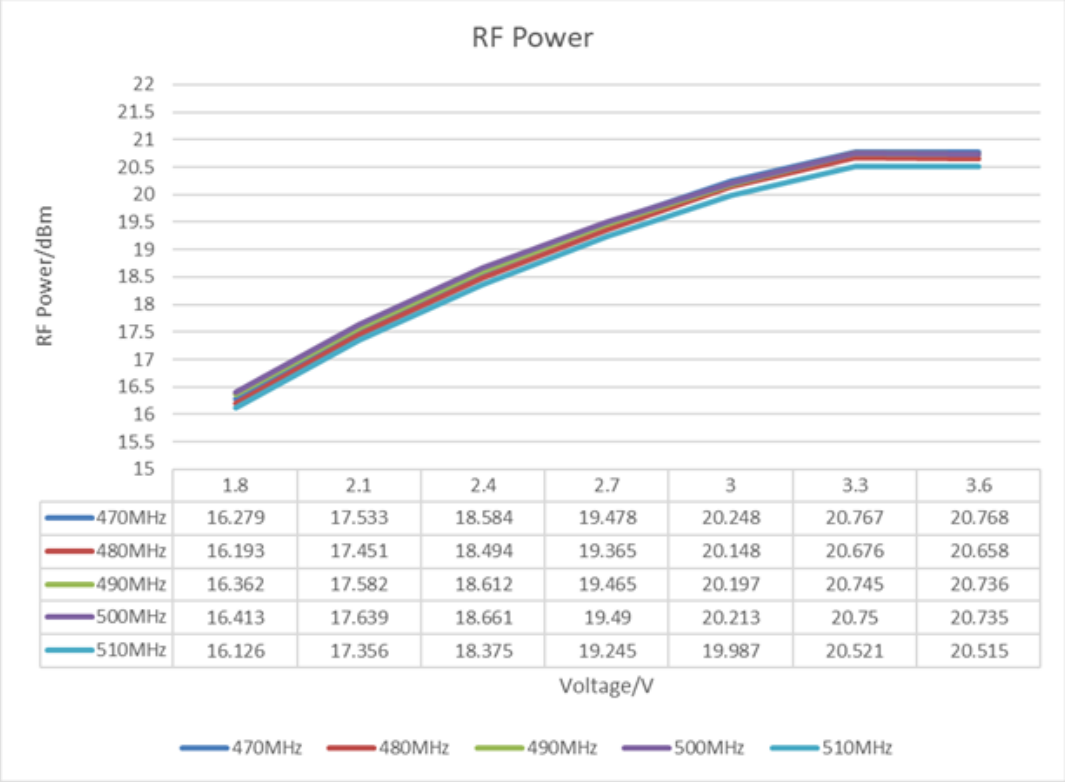
- **RF Power vs Power configuration（2460MHz）**

Configuration	-2	-1	0	1	2	3	4	5
Current（mA）				10.66	11.14	11.75	12.35	13.1
Output Power（dBm）				0.657	1.613	2.643	3.538	4.582
Configuration	6	7	8	9	10	11	12	13
Current（mA）	13.88	14.73	15.72	16.68	17.71	18.8	20.04	21.91
Output Power（dBm）	5.515	6.428	7.422	8.283	9.135	9.991	10.847	11.638

- **RF Power vs Power configuration（2500MHz）**

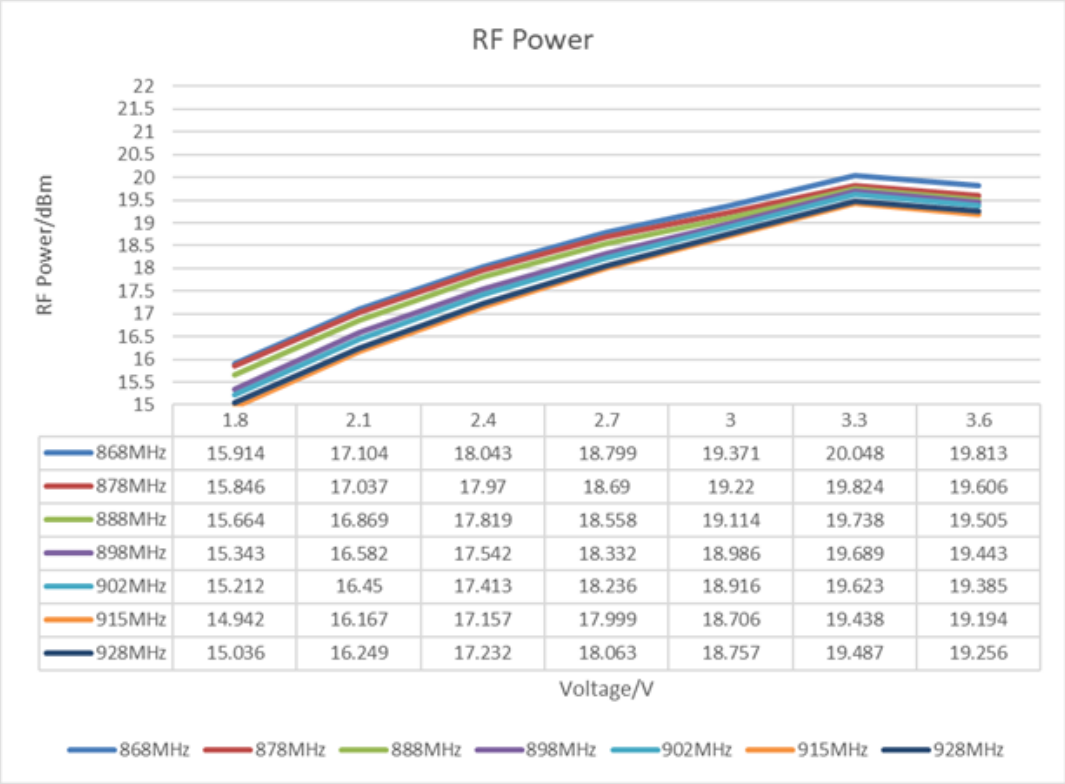
Configuration	-2	-1	0	1	2	3	4	5
Current（mA）				10.96	11.48	12.13	12.76	13.56
Output Power（dBm）				0.946	1.896	2.925	3.85	4.876
Configuration	6	7	8	9	10	11	12	13
Current（mA）	14.4	15.3	16.35	17.38	18.44	19.6	20.92	22.83
Output Power（dBm）	5.828	6.748	7.754	8.606	9.487	10.332	11.195	11.973

- **RF Power vs Voltage（470~510MHz）**



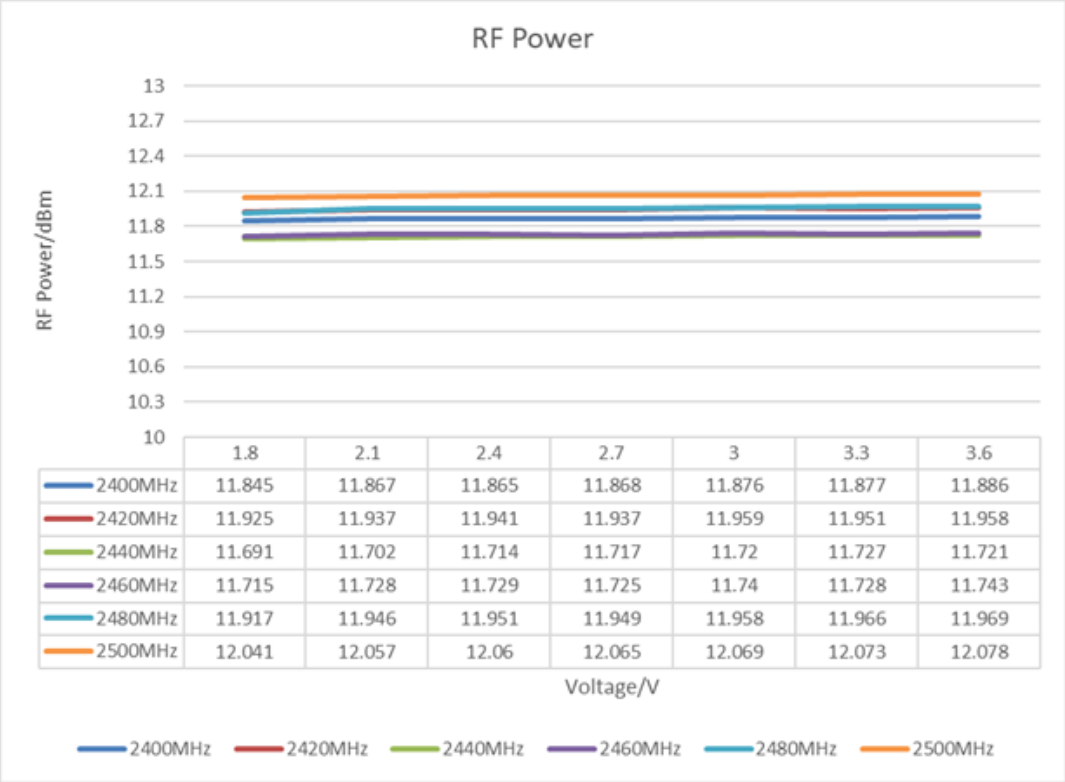
	1.8	2.1	2.4	2.7	3	3.3	3.6
470MHz	16.279	17.533	18.584	19.478	20.248	20.767	20.768
480MHz	16.193	17.451	18.494	19.365	20.148	20.676	20.658
490MHz	16.362	17.582	18.612	19.465	20.197	20.745	20.736
500MHz	16.413	17.639	18.661	19.49	20.213	20.75	20.735
510MHz	16.126	17.356	18.375	19.245	19.987	20.521	20.515

- **RF Power vs Voltage（868~915MHz）**



	1.8	2.1	2.4	2.7	3	3.3	3.6
868MHz	15.914	17.104	18.043	18.799	19.371	20.048	19.813
878MHz	15.846	17.037	17.97	18.69	19.22	19.824	19.606
888MHz	15.664	16.869	17.819	18.558	19.114	19.738	19.505
898MHz	15.343	16.582	17.542	18.332	18.986	19.689	19.443
902MHz	15.212	16.45	17.413	18.236	18.916	19.623	19.385
915MHz	14.942	16.167	17.157	17.999	18.706	19.438	19.194
928MHz	15.036	16.249	17.232	18.063	18.757	19.487	19.256

- **RF Power vs Voltage（2400~2500MHz）**

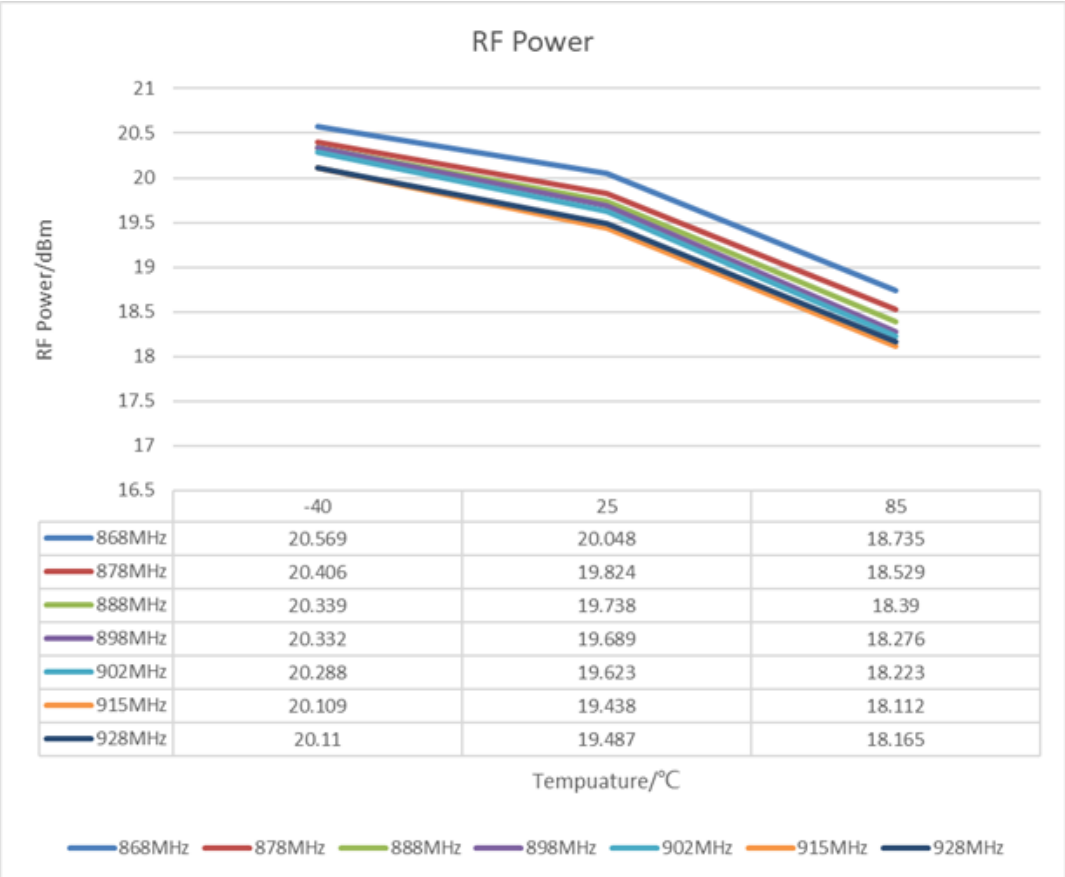


	1.8	2.1	2.4	2.7	3	3.3	3.6
2400MHz	11.845	11.867	11.865	11.868	11.876	11.877	11.886
2420MHz	11.925	11.937	11.941	11.937	11.959	11.951	11.958
2440MHz	11.691	11.702	11.714	11.717	11.72	11.727	11.721
2460MHz	11.715	11.728	11.729	11.725	11.74	11.728	11.743
2480MHz	11.917	11.946	11.951	11.949	11.958	11.966	11.969
2500MHz	12.041	12.057	12.06	12.065	12.069	12.073	12.078

- **RF Power VS Temperature（470~510MHz）**

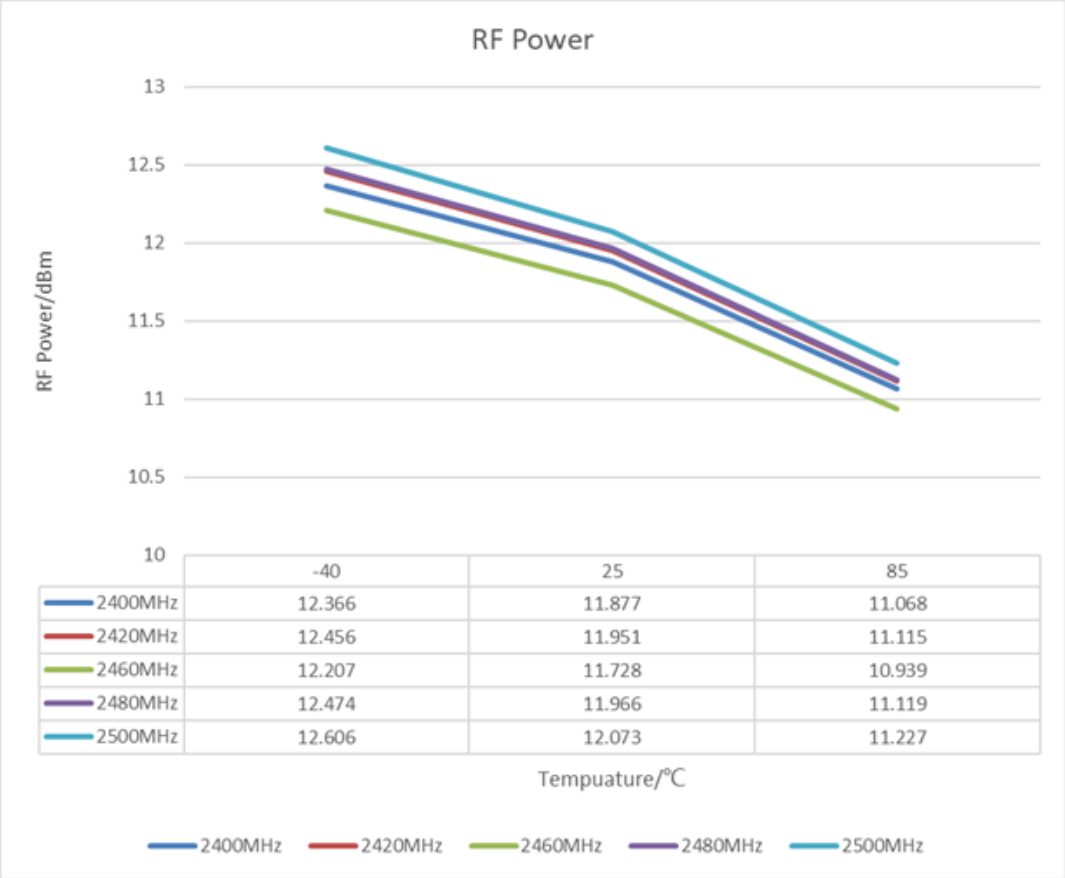
	-40	25	85
470MHz	21.174	20.767	19.809
480MHz	21.076	20.676	19.669
490MHz	21.167	20.745	19.584
500MHz	21.203	20.75	19.497
510MHz	20.996	20.521	19.308

- **RF Power VS Temperature（868~915MHz）**



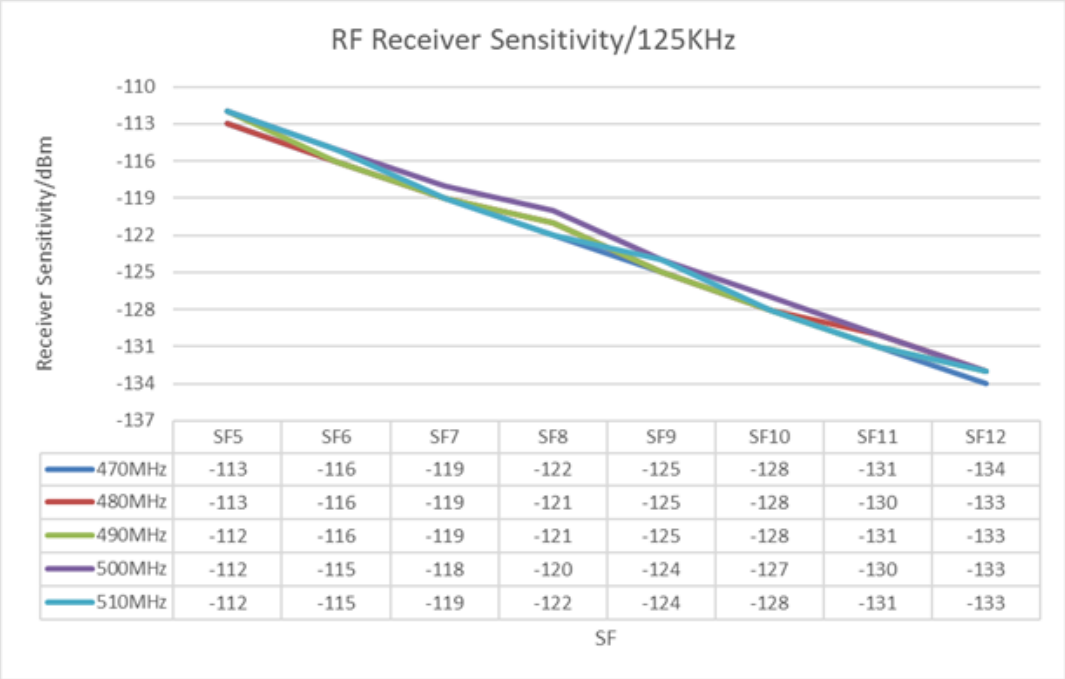
	-40	25	85
868MHz	20.569	20.048	18.735
878MHz	20.406	19.824	18.529
888MHz	20.339	19.738	18.39
898MHz	20.332	19.689	18.276
902MHz	20.288	19.623	18.223
915MHz	20.109	19.438	18.112
928MHz	20.11	19.487	18.165

- **RF Power VS Temperature（2400~2500MHz）**



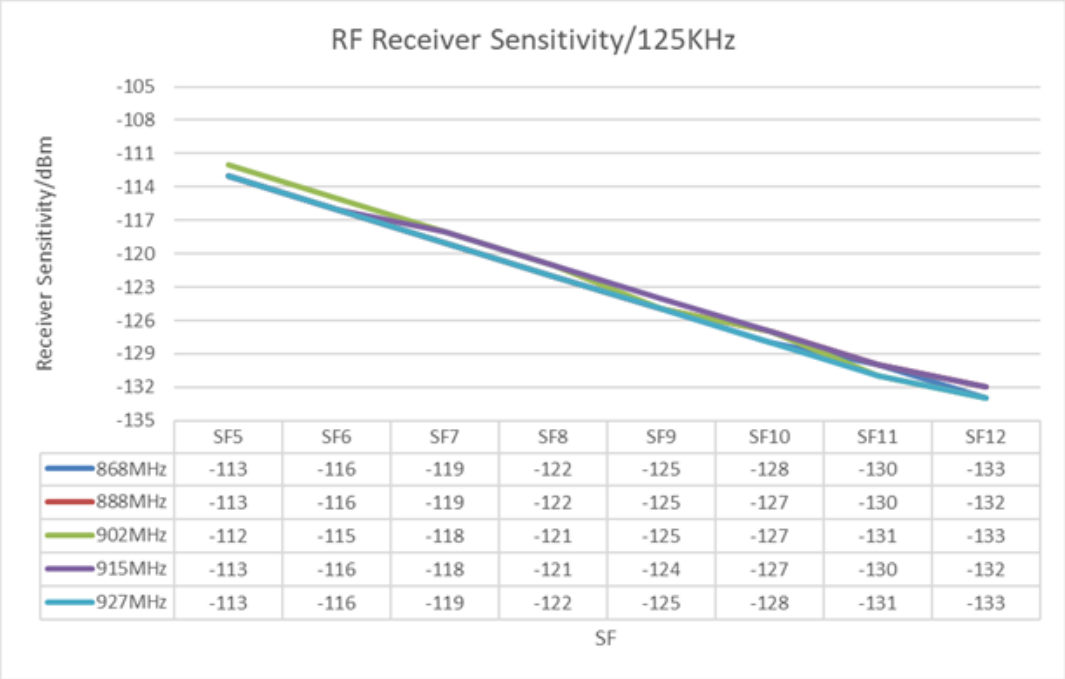
	-40	25	85
2400MHz	12.366	11.877	11.068
2420MHz	12.456	11.951	11.115
2460MHz	12.207	11.728	10.939
2480MHz	12.474	11.966	11.119
2500MHz	12.606	12.073	11.227

- **RF Receiver Sensitivity vs Spreading factor（470~510MHz）**



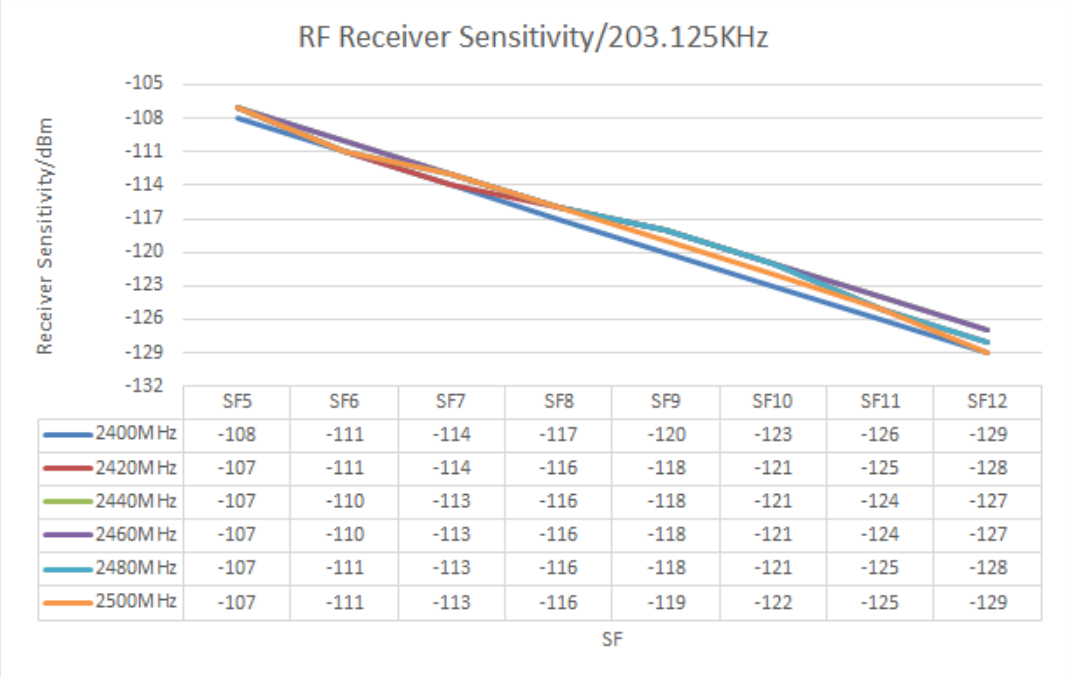
	SF5	SF6	SF7	SF8	SF9	SF10	SF11	SF12
470MHz	-113	-116	-119	-122	-125	-128	-131	-134
480MHz	-113	-116	-119	-121	-125	-128	-130	-133
490MHz	-112	-116	-119	-121	-125	-128	-131	-133
500MHz	-112	-115	-118	-120	-124	-127	-130	-133
510MHz	-112	-115	-119	-122	-124	-128	-131	-133

- **RF Receiver Sensitivity vs Spreading factor（868~915MHz）**



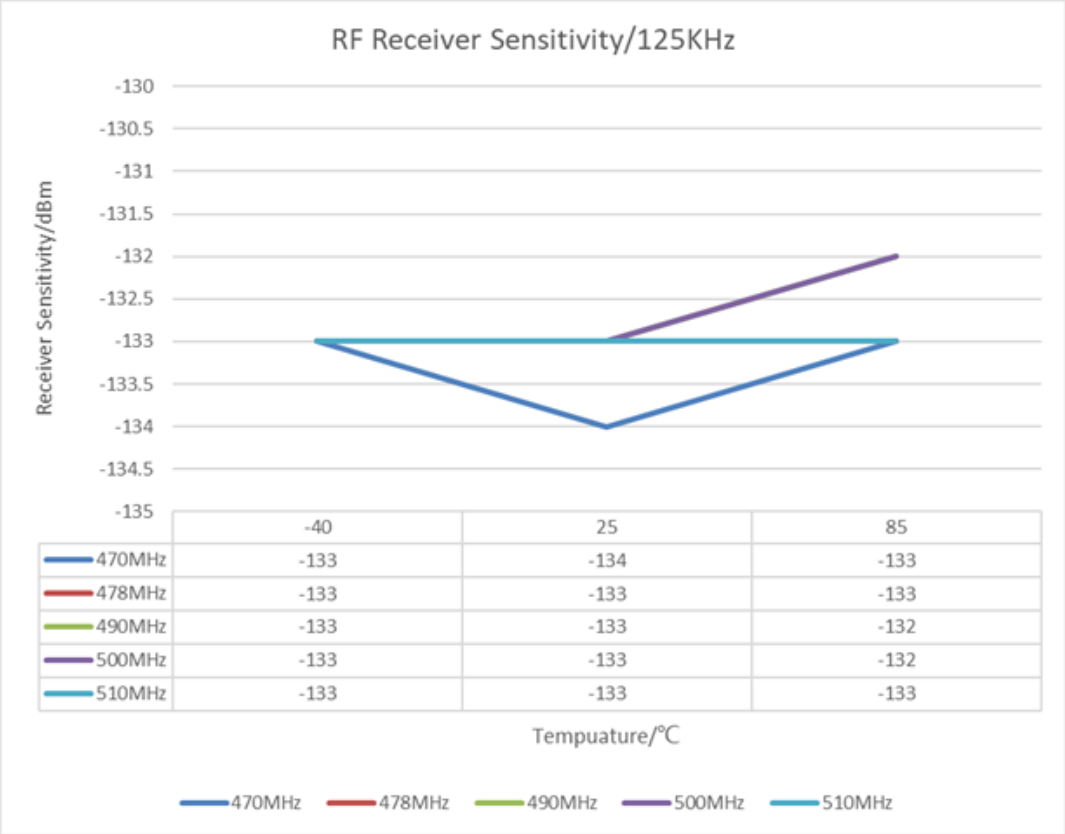
	SF5	SF6	SF7	SF8	SF9	SF10	SF11	SF12
868MHz	-113	-116	-119	-122	-125	-128	-130	-133
888MHz	-113	-116	-119	-122	-125	-127	-130	-132
902MHz	-112	-115	-118	-121	-125	-127	-131	-133
915MHz	-113	-116	-118	-121	-124	-127	-130	-132
927MHz	-113	-116	-119	-122	-125	-128	-131	-133

- **RF Receiver Sensitivity vs Spreading factor（2400~2500MHz）**

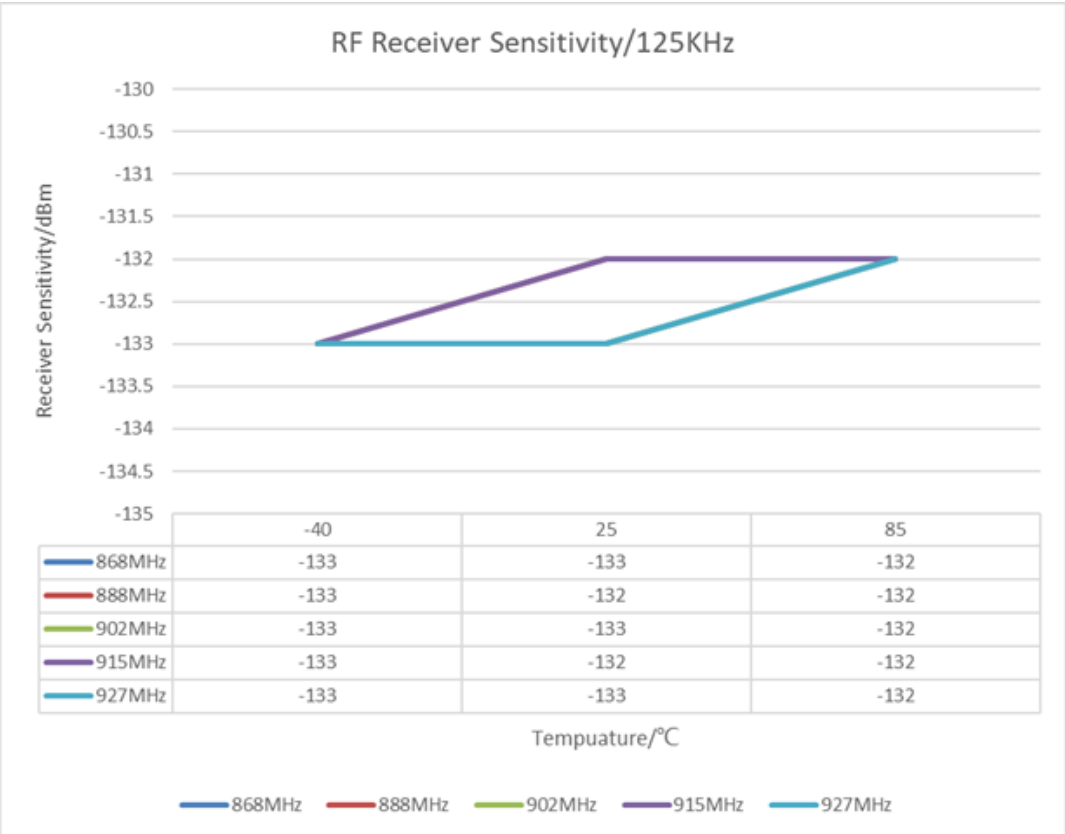


	SF5	SF6	SF7	SF8	SF9	SF10	SF11	SF12
2400MHz	-108	-111	-114	-117	-120	-123	-126	-129
2420MHz	-107	-111	-114	-116	-118	-121	-125	-128
2440MHz	-107	-110	-113	-116	-118	-121	-124	-127
2460MHz	-107	-110	-113	-116	-118	-121	-124	-127
2480MHz	-107	-111	-113	-116	-118	-121	-125	-128
2500MHz	-107	-111	-113	-116	-119	-122	-125	-129

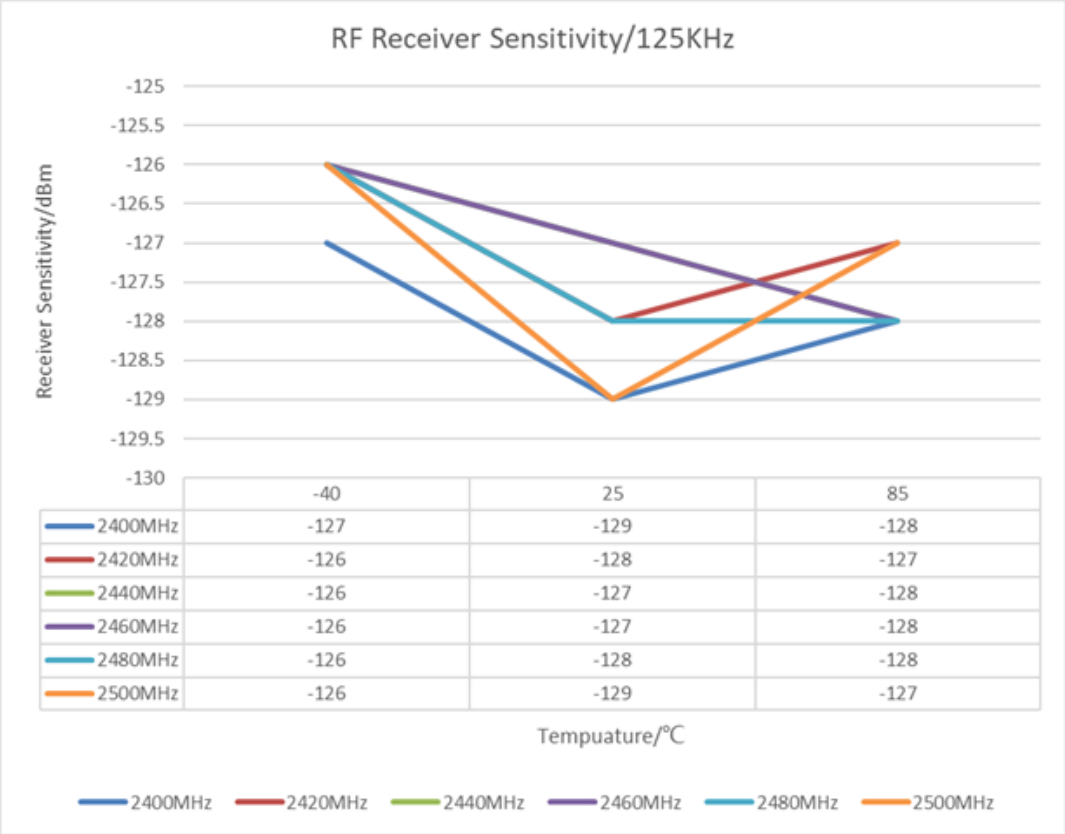
- **RF Receiver Sensitivity/SF12 VS Temperature（470~510MHz）**



- **RF Receiver Sensitivity/SF12 VS Temperature（868~915MHz)**

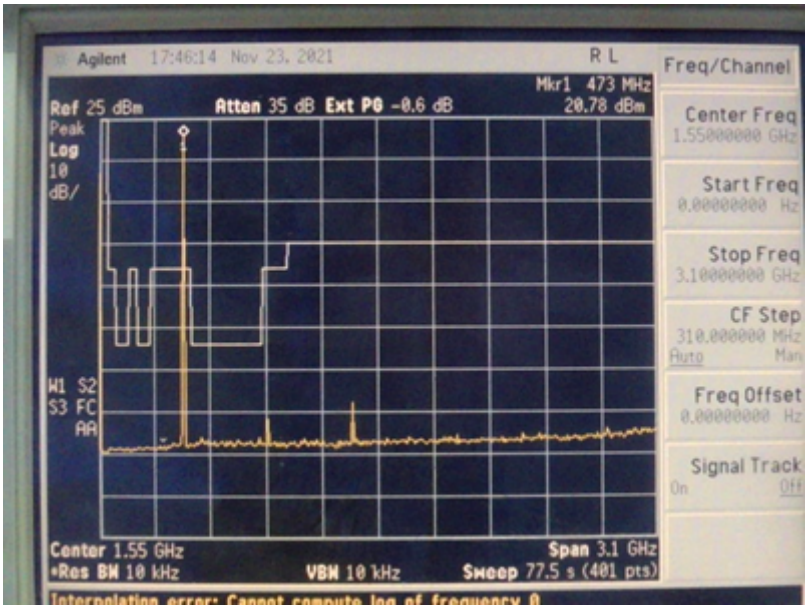


- **RF Receiver Sensitivity/SF12 VS Temperature（2400~2500MHz)**

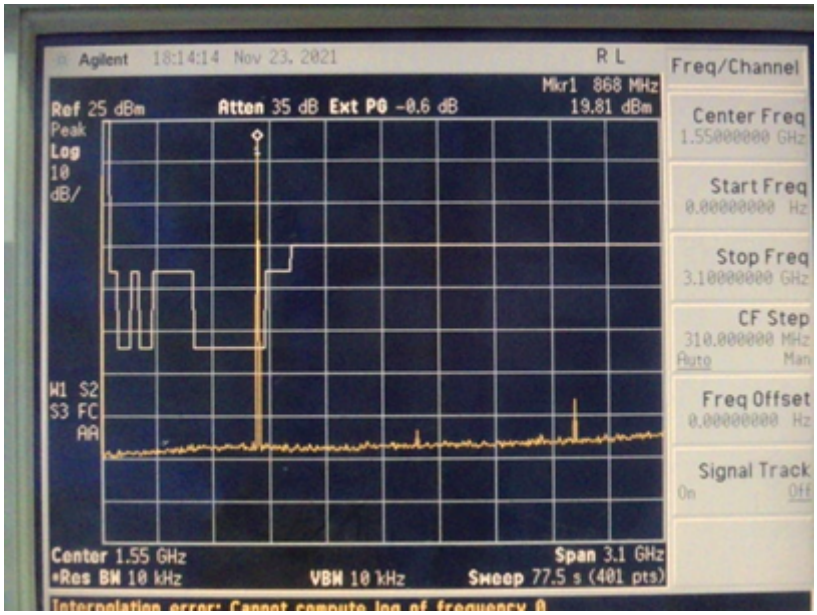


	-40	25	85
2400MHz	-127	-129	-128
2420MHz	-126	-128	-127
2440MHz	-126	-127	-128
2460MHz	-126	-127	-128
2480MHz	-126	-128	-128
2500MHz	-126	-129	-127

- **Harmonic(25MHz~3GHz)@Frf=470MHz, TXOP=22dBm**



- **Harmonic(25MHz~3GHz)@Frf=868MHz, TXOP=22dBm**

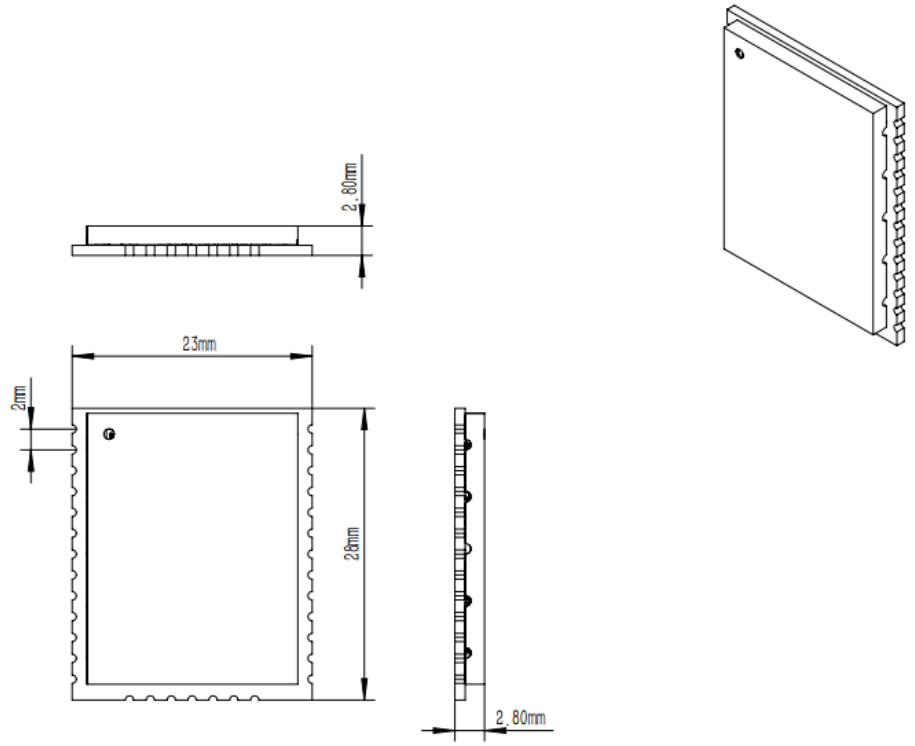


- **Harmonic(25MHz~3GHz)@Frf=2400MHz, TXOP=22dBm**

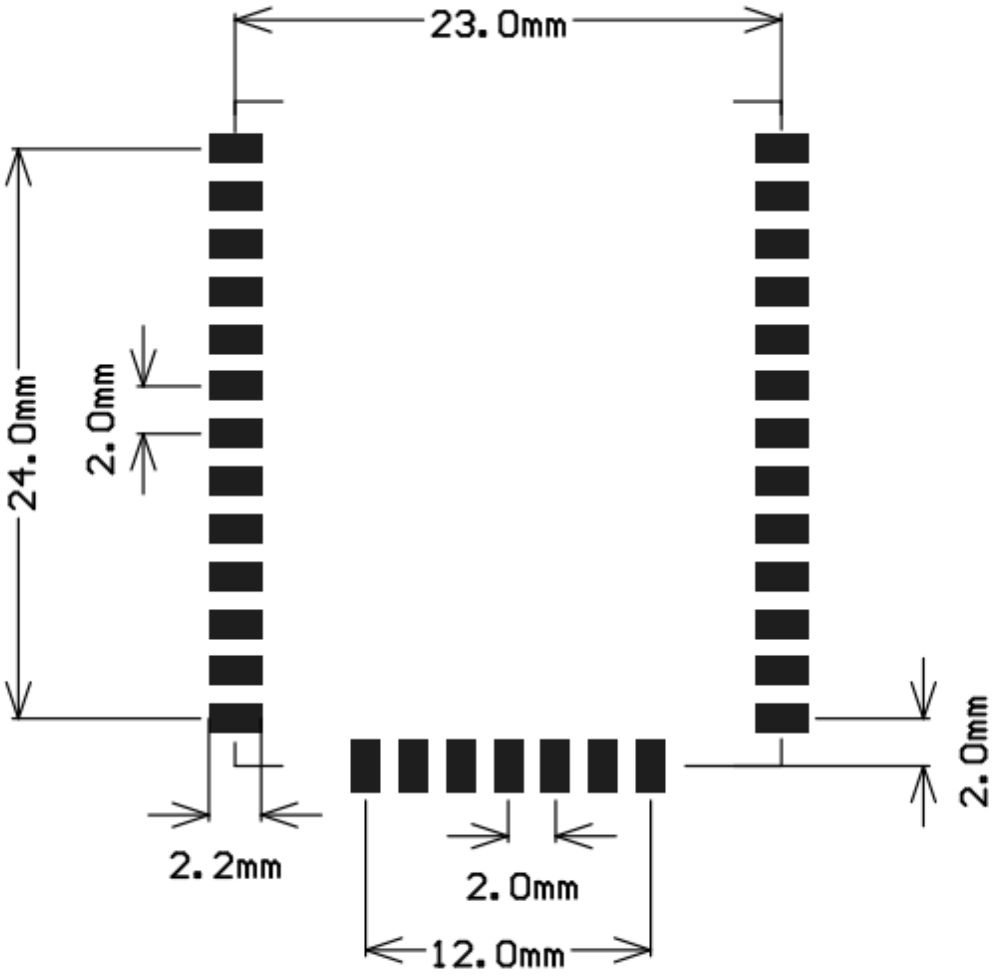
应用信息

1. **封装信息**

RHF0M084具有33pin的贴片封装：



下图给出了建议的Layout封装尺寸图：

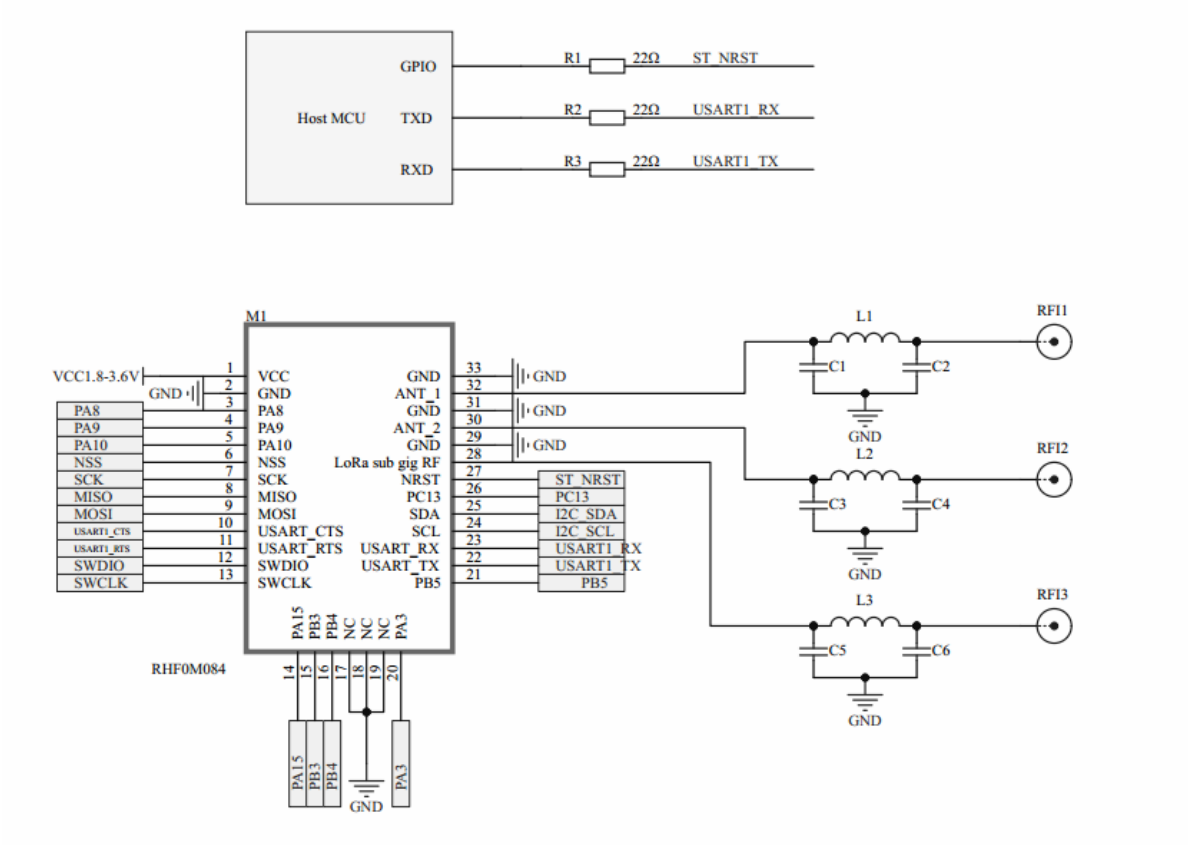


模块对外接口

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） 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。

基于RHF0M084模块的参考设计

RHF0M084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RHF0M084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。



LoRaWAN®应用信息

- ## 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。

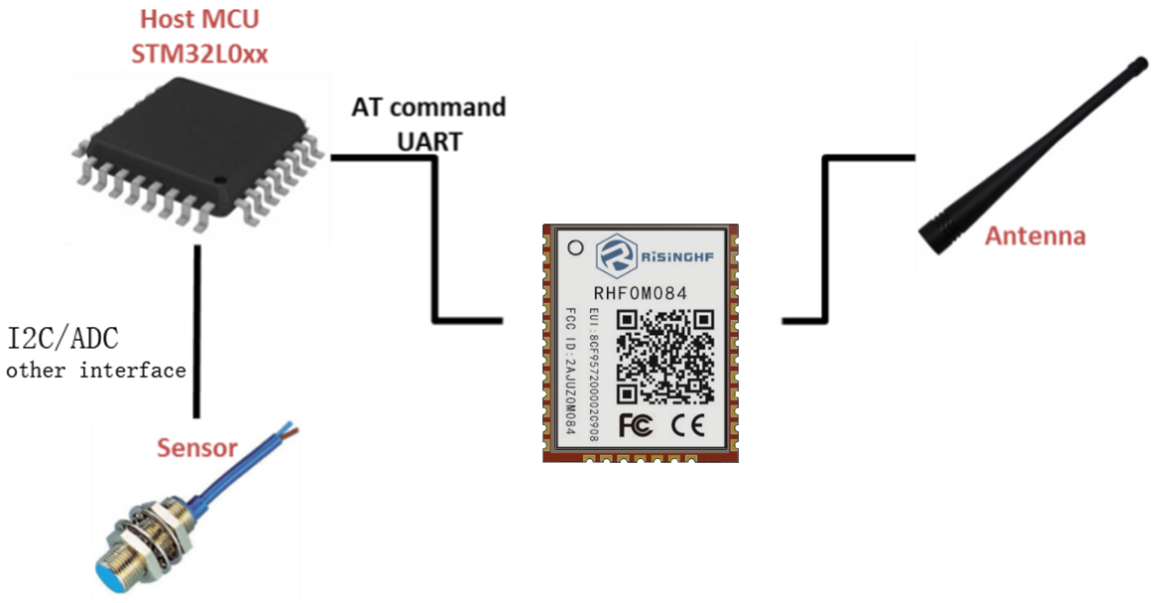
节点设备可能在任何时间，以任何速率，在随机的一个信道上发射，只要符合以下条件：

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

RHF0M084模块在睡眠模式下电流仅2uA, 该模块非常适合于LoRaWAN®的各种应用。.

- **基于RHF0M084设计LoRaWAN®无线传感器**

RHF0M084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RHF0M084，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。



订购信息

Part Number	MCU	TX Power (dBm)	AT Modem
RHF0M084	**ROM 256KB / RAM 60KB**	**22@LF (470MHz)/22dBm@(868/915MHz)/13dBm@2400MHz**	Yes

联系 salescn@risinghf.com 获取更多订购信息。