

RF-SM-1077B1

v2.0.0

RF-Star

Index

Summary.....	3
Introduction.....	4
1.Functions.....	4
2.Schematic Diagram of Working mode.....	5
3.Package Size and pin Assignments.....	5
Function Description.....	8
1.Data Transparent Transmission.....	8
2.Sensor Controller Data collection.....	8
AT Commands.....	9
1.AT commands format description.....	9
2.AT commands and parameter description.....	10
2.1 Start/exit AT commands operation mode.....	10
2.2 Serial parameter query/setup command.....	10
2.3 RF parameter query/setup command.....	10
2.4 Start/exit AD voltage acquisition command.....	11
2.5 Module software version query command.....	11
2.6 Module restart command.....	11
2.7 Module reset command.....	12
AT command list.....	12
Appendix A: Power test record.....	15
Appendix B: Version Records.....	16
Contact Us.....	17

Summary

MCU	TI-CC1310MCU (ARM Cortex®-M3 + Cortex®-M0)
	System Clock: 48MHz
	128KB Programmable FLASH
	8KB Cache
	Downloading port is JTAG
Sensor Controller	16-bit architecture
	2KB SRAM (code data storage)
Size	Module size: 18*26 (mm)、Chip Size: 7*7 (mm)
RF	Rx sensitivity: -124 dBm
	Output power: -10dBm、0 至 14dBm
	Frequency band: 868MHz、915MHz、920MHz
	Wireless protocol: IEEE® 802.15.4g
Low power consumption	Power supply: 1.8V ~ 3.8V
	Active-Mode: 48MHz clock 2.5mA (51 μA/MHz)
	Standby-Mode: RTC work 980nA
	Shutdown-Mode: 79nA
Peripheral	Module:36 Pins、30 GPIOs, Chip:48 Pins、30 GPIOs
	12-bit accuracy ADC, 200K sampling rate, support 8 analog channels
	Support UART、SPI、I2C、I2S
	AES-128 security
Tools and development environment	Sensor Controller Studio (SC program)
	SmartRF™ Studio (RF parameters setting)
	SmartRF Flash Programmer 2 (Firmware download)
	IAR Embedded Workbench® for ARM (Development environment)
	Code Composer Studio™ (Development environment)

Introduction

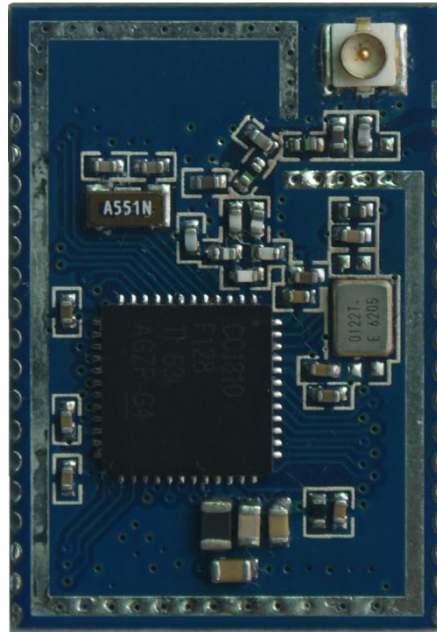


Figure 1 RF-SM-1077B1

1.Functions

Sub 1GHz module RF-SM-1077B1 is based on CC1310 from TI, which embeds ARM Cortex-M3 + ARM Cortex-M0, main MCU ARM Cortex-M3 charges application layer, ARM Cortex-M0 charges wireless data transmission, M3+M0 make CC1310 integrate low cost and low power consumption in Sub 1GHz.

RF-SM-1077B1 is designed for low power consumption and long wireless communication applications, such as instruments and meters, logistics tracking, health and medical care, building automation, motion measurement, auto electronics, toys, agricultural monitoring and so on. Users can integrate this module into their products or solutions.

RF-SM-1077B1 embeds transparent transmission firmware, the default baud rate is 115200, 8 data bits, no parity check bit, 1 stop bit. Default RF parameters are: the transmitting terminal device address: 0xAA; the receiving terminal device address: 0xAA; band parameters: 868MHz; transmitting power parameter: 14dbm; MAC rate: 50Kbps. When the module starts work, serial ports will print "Application Start\r\n", and the default start mode is transparent transmission mode, serial ports will transmit all the data except "+++".

2.Schematic Diagram of Working Mode

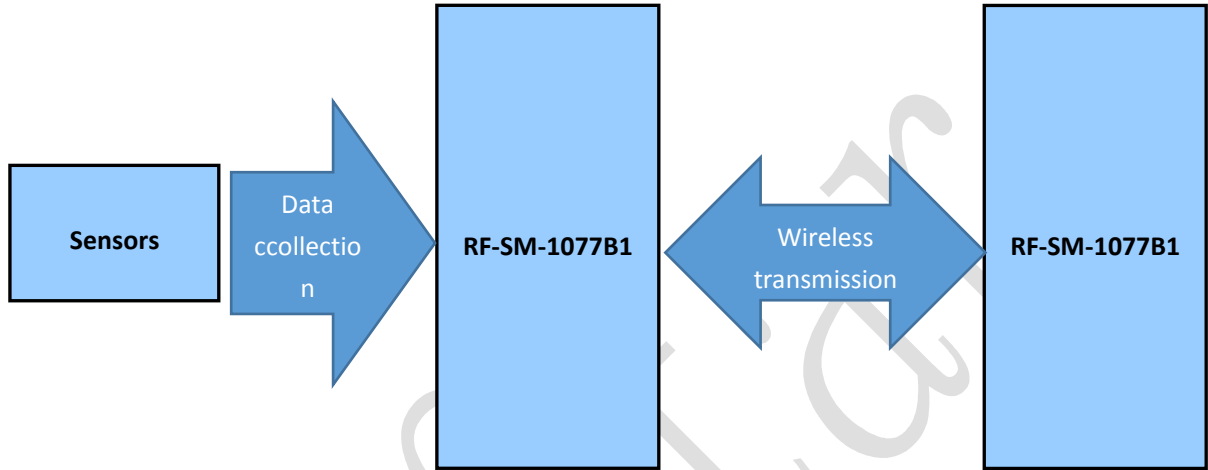


Figure 2 RF-SM-1077B1 working modes

3.Package Size and Pin Assignments

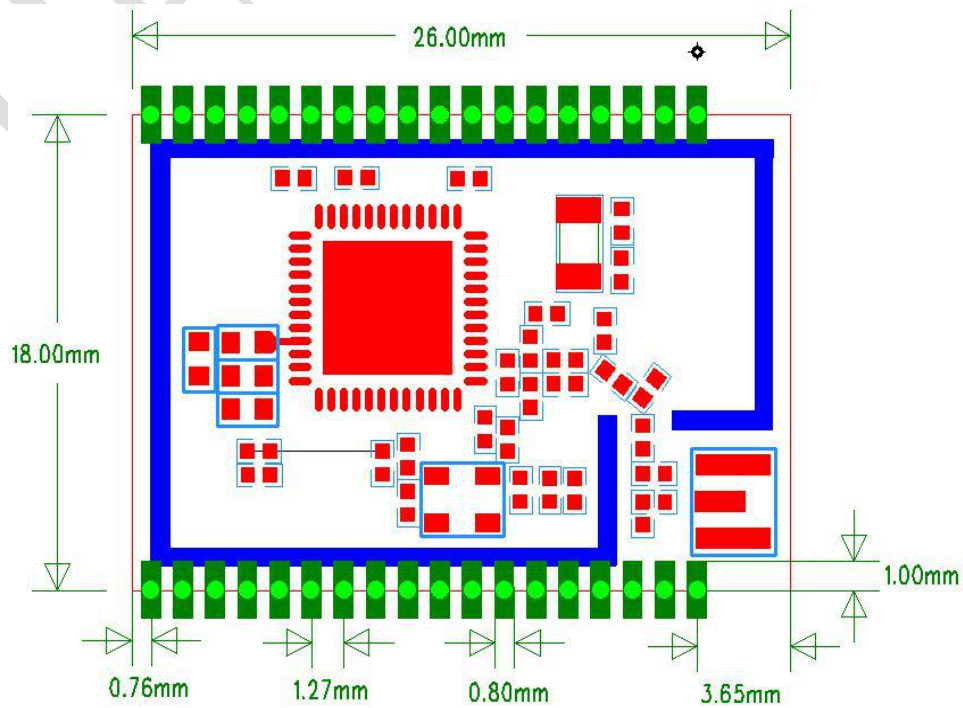


Figure 3 RF-SM-1077B1 package size

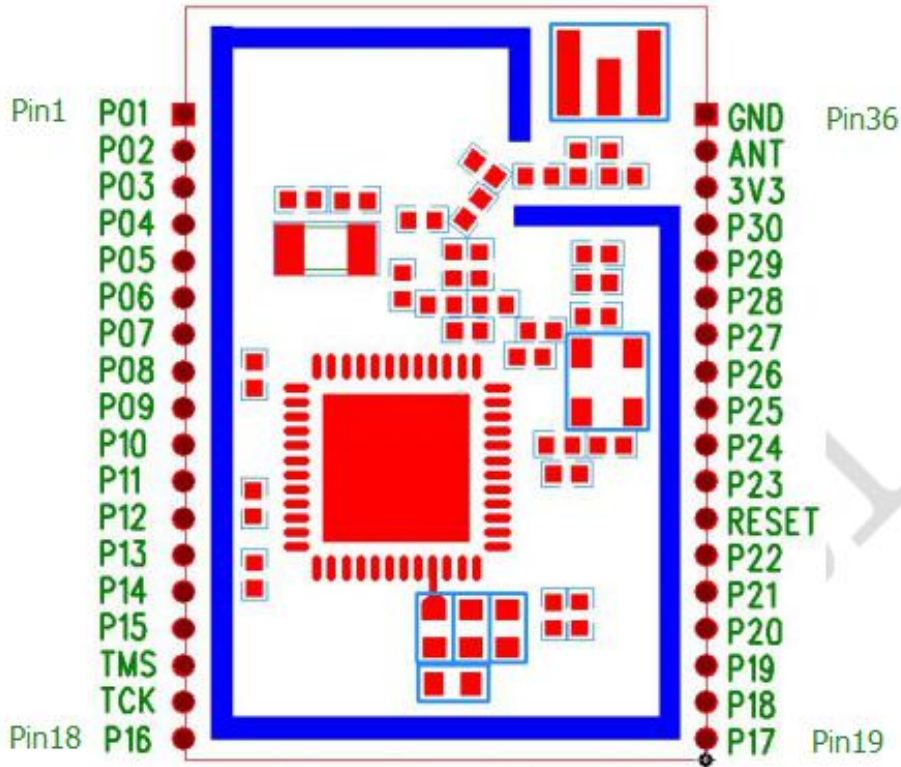


Figure 4 RF-SM-1077B1 pins

Pin No.	Module Pin Name	Chip Pin Name	I/O	Description
Pin1	P01	DIO_1	Digital I/O	GPIO, Sensor Controller
Pin2	P02	DIO_2	Digital I/O	Rx(GPIO, Sensor Controller)
Pin3	P03	DIO_3	Digital I/O	Tx(GPIO, Sensor Controller)
Pin4	P04	DIO_4	Digital I/O	GPIO, Sensor Controller
Pin5	P05	DIO_5	Digital I/O	GPIO, Sensor Controller
Pin6	P06	DIO_6	Digital I/O	GPIO, Sensor Controller
Pin7	P07	DIO_7	Digital I/O	GPIO, Sensor Controller
Pin8	P08	DIO_8	Digital I/O	GPIO
Pin9	P09	DIO_9	Digital I/O	GPIO
Pin10	P10	DIO_10	Digital I/O	GPIO
Pin11	P11	DIO_11	Digital I/O	GPIO
Pin12	P12	DIO_12	Digital I/O	GPIO
Pin13	P13	DIO_13	Digital I/O	GPIO

Pin14	P14	DIO_14	Digital I/O	GPIO
Pin15	P15	DIO_15	Digital I/O	GPIO
Pin16	TMS	JTAG_TMSC	—	JTAG TMS
Pin17	TCK	JTAG_TCKC	—	JTAG TCK
Pin18	P16	DIO_16	Digital I/O	JTAG TDO
Pin19	P17	DIO_17	Digital I/O	JTAG TDI
Pin20	P18	DIO_18	Digital I/O	GPIO
Pin21	P19	DIO_19	Digital I/O	GPIO
Pin22	P20	DIO_20	Digital I/O	GPIO
Pin23	P21	DIO_21	Digital I/O	GPIO
Pin24	P22	DIO_22	Digital I/O	GPIO
Pin25	RESET	RESET_N	—	Reset and effective at low level.
Pin26	P23/ADC0	DIO_23	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin27	P24/ADC1	DIO_24	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin28	P25	DIO_25	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin29	P26	DIO_26	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin30	P27	DIO_27	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin31	P28	DIO_28	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin32	P29	DIO_29	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin33	P30	DIO_30	Digital or analog I/O	GPIO, Sensor Controller, analog
Pin34	VCC	VCC	—	Power supply +1.8V-+3.8V
Pin35	ANT	—	—	External antenna pin
Pin36	GND	GND	—	Ground

Function Description

1.Data transparent transmission

Transparent transmission mode is the data transmitted to the device in long distance. Conditions to realize this function, 1. two or more devices in the same frequency band, 2. the addresses between devices are allowed. Users can define the frequency band according to the condition. Users can define their own devices' addresses and long distance device through AT commands to set RF parameters.

Transparent transmission rate description: the device communicates through RF band and obeys IEEE 802.15.4g. Three transmission rates **625bps, 50Kbps, 200Kbps**. Data confirmation process in transparent transmission mechanism, the mechanism involved in receiving confirmation packet timeout mechanism, project definition timeout will be adjusted according to different model parameter values in transparent transmission mode. 15ms is the timeout value of 200Kbps, 35ms is the timeout value of 50Kbps, 500ms is the timeout value of 625bps. At the same time, the defined timeout in the project including different packet sizes, 128 bytes for 200Kbps and 50Kbps, the serial number of the packet contains 2 bytes, so the actual packet can't over 126 bytes. 30 bytes for 625bps, the serial number of the packet contains 2 bytes, so the actual packet can't over 28 bytes. When the packet over the defined packet sizes, the default processing mechanism is only sending packets of the same length bytes, the left of the data will be dropped.

Module transparent transmission mechanism: devices open transparent transmission mode defaultly when power on, and the data received from the serial port will be sent out. "+" string is the of startup command of AT command, transparent transmission mode will be close when serial port receives this command, then entering AT command mode (for details please refer to the AT command section). The module will enter into transparent transmission mode after exiting AT command mode.

This module is designed for long distance transmission, we suggest users choosing transparent transmission mode when just need low transmission rate.

2.Sensor Controller Data Collection

CC1310 has a Sensor Controller inside, which supports collecting data in low power. RTC provides work timer for Sensor Controller. e.g. Sensor Controller executes operation every 100ms when RTC settled in 100ms; after the operation executed, Sensor Controller will enter into low power consumption mode. The application layer can control the sensor's collection frequency through RTC. Sensor Controller controls 7 digital I/Os (DIO1~DIO7), 8 digital/simulation I/Os (DIO23~DIO30), these I/Os, can be configured as SPI, I2C, ADC etc.

Transparent transmission firmware is configured with AD voltage acquisition function by default.

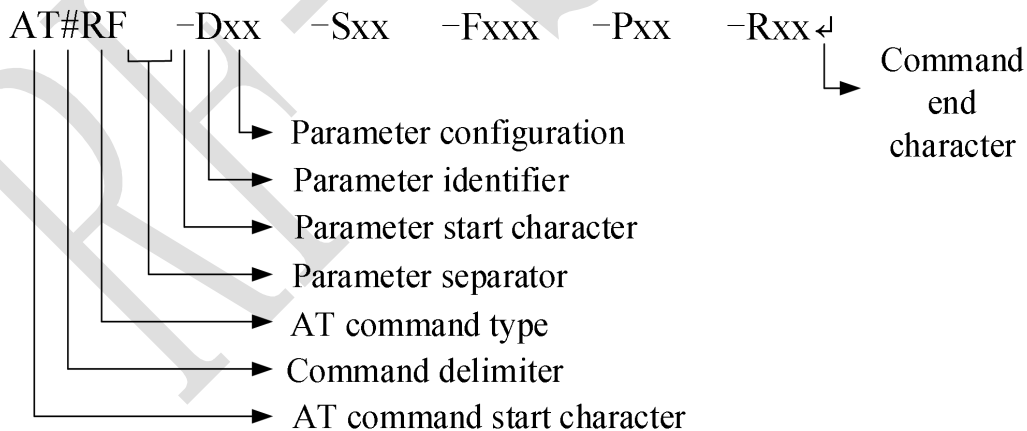
This function enables two ADC channels, channel 0 is DIO23 and channel 1 is DIO24. AD voltage acquisition range is 0 ~ 3.8V, Sensor Controller control RTC to provide the clock for AD acquisition, the default configuration for the acquisition is every second. Users can control the AD command to control the AD voltage acquisition start and shut down through AT commands, please see AT Command chapter for details.

AT Commands

The string beginning with "AT #" will be parsed and executed as an AT command and returned from the serial port as it is, and then the execution result will be output. "OK↵" means the operation is successful and "ERROR↵" means the operation error, "FAIL↵" means the operation failed.

1. AT Commands format description

AT command format: "AT # EXIT" + "Enter". The letters in AT commands are not case-sensitive unless otherwise specified. The specific format is as follows:



AT command start character: all AT commands must start with "AT" characters, can be capitalized;

Command delimiter: "AT" start character and the command type of the separator, fixed as "#" character;

AT command type: such as "RF", "UART", can be capitalized;

Parameter separator: used to separate the command type and configuration parameters or separate multiple configuration parameters, fixed to a space bar;

Parameter start character: The configuration parameter start character, which indicates the start character of the configuration parameter, is fixed to "-";

Parameter identifier: indicates the meaning of the configuration parameter, the different configuration parameters of the identifier will be different, can be capitalized, for details, please refer to the command table description of the command parameters;

Configuration parameters: configuration parameter values, different configuration parameters have different range of values, please refer to the command table description of the command parameters;

Command Ender: AT command terminator, used to indicate that the command ends, fixed to carriage return linefeed “`\r\n`”).

2. AT commands and parameters description

2.1 Start / Exit AT command operation mode

Enter the "`+++`" string into the serial debugging assistant software, the device will start the module and enter the AT command mode; when serial debugging assistant software print "`OK`", which means to start the AT command mode successfully, then the serial data will be in Command judgment processing.

Enter the "`AT # EXIT`" to the serial debugging assistant software, means exit AT command mode; if serial return "`OK`" means exit AT command mode successfully, after all the data received from serial port except "`+++`", will be sent as a transparent data.

2.2 Serial parameters query / setup command

Enter "`AT # UART?`" into the serial debugging assistant software, serial debugging assistant software print "`OK`", and return current device serial port configuration parameters, such as "`Bps: xxxx Dat: x Par: x Stp: x`", Bp is the baud rate, Dat is the data bit, Par is the parity bit, Stp is the stop bit; if the instruction format is not correct, the serial port will return "`ERROR`".

Enter "`AT # UART -Bxxxx -Dx -Px -Sx`" into the serial debugging assistant software, and the serial debugging assistant software prints "`OK`" and returns the current device serial port configuration parameters, such as "`Bps: xxxx -Dx -Px -Sx`", Bp is the baud rate, Dat is the data bit, Par is the parity bit, Stp is the stop bit; if the instruction format is not correct, the serial port will return "`ERROR`".

The default serial port baud rate is 115200, the data bit is 8 bits, no parity bit, 1 bit stop bit.

2.3 RF parameters query/setup command

Enter "`AT # RF?`" into the serial debugging assistant software, and the serial debugging assistant

software prints the "OK↵" and returns "Desxxx Src: xx Frq :: xx Pwr: xx Rat: xx↵", where Des means the location of the sender device address, Src means receiving data terminal device set address, Frq means RF transceiver data set frequency band, Pwr means radio frequency transmission data power, Rat means the bottom of the RF protocol rate.

Enter "AT # RF -Dxx -Sxx -Fxxx -Pxx-Rxx↵" into the serial debugging assistant software, and the serial debugging assistant software prints the "OK↵" to indicate that the RF parameters setted successfully. The "D" parameter indicates the address of the transmit device whose address length is 8 bits and represented by hexadecimal (0x00-0xFF); the "S" parameter indicates the address of the receiving device, the address length is 8 bits and represented by hexadecimal (0x00-0xFF). The "F" parameter indicates the frequency band. Current supported frequency bands are 868MHz, 915MHz and 920MHz. The "P" parameter indicates the RF transmit power,supports -10dbm and any value between 0 and 14dbm.The "R" parameter indicates that the set the device underlying protocol rate, supporting 625bps, 50Kbps, 200Kbps.

The default RF parameters are: Transmit Device Address: 0x55; Receiver Device Address: 0xAA; Band Parameters: 868MHz; Transmit Power Parameters: 12dbm; MAC Rate Parameters: 50Kbps.

2.4 Start / exit AD voltage acquisition command

Enter "AT # ADC -E ↵" into the serial debugging assistant software, and the serial debugging assistant software print "OK↵", means start ADC channel 0,1 voltage acquisition function successfully, and the serial port print ADC channel 0,1 data every second, otherwise the AD acquisition function failed to start; AD voltage acquisition support 0 ~ 3.8V, serial port print value in 0 ~ 3800 (mV) integer.

Enter "AT # ADC-D↵" into the serial debugging assistant software, serial debugging assistant software print "OK↵", means close the AD voltage acquisition function successfully, otherwise the operation failed.

2.5 Module software version query command

Enter "AT # SVER↵" into the serial debugging assistant software, and the serial debugging assistant software prints the "OK↵", indicating that the operation is successful and will return the version number of the software, such as "V1.0.0↵".

2.6 Module restart command

Enter "AT # RESTART↵" into the serial debugging assistant software, the serial debugging assistant software prints "OK↵", means the operation is successful, and device will automatically restart after 100ms, then the serial assistant software prints "Application Start↵" if restart successfully. If you

want to enter the AT command mode again, you need to restart the command mode (send "+ + +"), for details, please refer to the AT command table.

2.7 Module reset command

Enter "**AT # RESET**↵" into the serial debugging assistant. Software, the serial debugging assistant software prints "**OK**↵", indicating that the operation is successful and all the parameters of the device are restored to the factory settings when the device starts next time.

AT commands list

AT command	Parameters	Description
+++	No	<ul style="list-style-type: none"> "+++": The device enters into AT command mode and returns "OK" to indicate that enter into te mode successfully. Otherwise, the operation failed.
AT#EXIT	No	<ul style="list-style-type: none"> "AT # EXIT↵": Exit AT command mode, if it returns "OK" means the operation is successful, otherwise the operation failed.
AT#SVER	No	<ul style="list-style-type: none"> "AT # SVER↵": Query the software version number, if it returns "OK" means that the operation is successful and the serial software prints the software version number, otherwise the operation failed.
AT#RESTART	No	<ul style="list-style-type: none"> "AT # RESTART↵": Restart the device, if it returns "OK" means the operation is successful and the device will restart after 100ms, otherwise the operation failed.
AT#RESET	No	<ul style="list-style-type: none"> "AT # RESET↵": The device configuration parameters are restored to the factory settings. If it returns "OK" means the operation is successful and all the parameters of the device are restored to the factory settings next time when the device starts to work.

<p>AT#UART</p>	<p>-B : Baud rate parameter (default 115200bps)</p> <p>-D: Data bit parameter(default 8 bits)</p> <p>-P: Parity bit parameter(default 0)</p> <p>-S: Stop bit parameter (default 1)</p>	<ul style="list-style-type: none"> ● "AT # UART ↵ ": Query the serial port configuration parameters, if it returns "OK", which means the operation is successful and the serial port software prints the current serial port configuration parameters, otherwise the operation failed. ● "AT # UART -B11520 -D8 -P0 -S1 ↵ ": Configure the serial port parameters; baud rate parameter support: 115200,38400,57600,14400,9600,4800; data bit parameters support: 8,7,6,5; Parity bit parameter support: 0 and 1; stop bit support: 0 and 1. If it returns "OK" indicates that the operation is successful and if it returns "ERROR" indicates that the command parameter is wrong, and if it returns "FAIL" indicates that the operation failed.
<p>AT#RF</p>	<p>-D: the device address(default 0xAA)</p> <p>-S : Receiving data filtering address,only receive the data sent from the address (default 0xAA)</p> <p>-F : Frequency (default 868MHz)</p> <p>-P:Transmitpower (default 124Bm)</p> <p>-R:MAC rate parameter (default 50Kbps)</p>	<ul style="list-style-type: none"> ● "AT # RF? ↵ ": Query RF parameters, if it returns "OK" means that the operation is successful and the serial port software prints the current RF parameters, otherwise the operation failed. ● "AT # RF -DAA -SAA -F868 -P14 -R50 ↵ ": Configure RF parameters. The device address parameters (-D, -S) support: any value between 0x00 and 0xFF; frequency parameters support: 868MHz, 915MHz, 920MHz; transmit power parameter support: -10dbm and any value between 0 to 14dbm ; MAC rate parameter support : 625bps, 50Kbps. If it returns "OK" indicates that the operation is successful and "ERROR" indicates that the command parameter is wrong and "FAIL" indicates that the operation failed.

AT#ADC	-E: Enable ADC channel 0, 1 data acquisition, -D: Disnable ADC channel 0, 1 data acquisition,	<ul style="list-style-type: none"> ● "AT # ADC -E↵ ": Enable ADC channel 0, 1 data acquisition, if it returns "OK" means that the operation is successful, and the serial port software will print ADC channel 0,1 data values every second (voltage acquisition range support 0 ~ 3.8 V), otherwise the operation failed. ● "AT # ADC -D↵ ": Disable ADC channel 0,1 data acquisition, if it returns "OK" means that the operation is successful, and shuts down ADC channel 0,1 data acquisition; if not open ADC acquisition function to execute this command ,serial port software will return "FAIL".
--------	--	--

Remarks: with "●" symbol means a complete command format.

Appendix A: Power Test Record

Mode	Minimum current	Maxmum current	Average current	Number of samples
idle	1.29mA	1.32mA	1.31mA	5000
standby	68nA	69.2uA	980nA	5000
shutdown	52nA	88nA	79nA	5000

* Test conditions: battery-powered 2.88V, RIGOL DM3068 digital multimeter.

Appendix B: Version Records

Versionn	Time	By	Description
1.0.0	2017-03-13	LEVI	First version
2.0.0	2017-04-05	LEVI	1.Add new AD acquisition command 2.Modify the data transmission mechanism
2.0.0	2017-05-05	LEVI	Add device overview section

Contact Us

SHENZHEN RF STAR TECHNOLOGY CO.,LTD.

Tel: +86-755-8632 9829(Sales) +86-7755-3695 3756(FAE) Web: www.szrfstar.com

Fax: +86-7755-86329413 E-mail: sales@szrfstar.com

Add: 2F,Block8,Dist.A,Internet Industry Base,Baoyuan Road ,Baoan Dist,Shenzhen

RF-STAR