Sub-1GHz Low-power UART Transceiver Module

(Silicon Labs' EFR32FG23 SoC Based)

SPECIFICATION

Model No.: DL-EFG23-B

Version No.: V1.0

DL-EFG23-B

(433/868/915MHz)

Before using this product, please pay attention to the following important matters:

This RF module is an electrostatic sensitive product. Please operate it on an anti-static workbench during installation and testing.

This RF module requires an external antenna by default, which is intended to be embedded in your product or application. The antenna can be a wire antenna or a standard UHF antenna. You can choose a specific antenna according to the actual situation.

Metal objects and wires should be kept away from the antenna as much as possible. If the product uses a metal shell, be sure to install the antenna outside the metal shell. Otherwise, the RF signal will be seriously attenuated, which will affect the effective distance.

Disclaimer:

This specification is just for your information; all the charts and pictures used in this specification are for reference only. The actual test shall prevail for details. We do not assume any responsibility for personal injury or property loss caused by user's improper operation.

This specification is subject to change due to the continuous improvement and upgrading of the product version, and the latest version specification shall prevail. DREAMLNK reserves the right of final interpretation and modification of all contents in this specification.

Revision History

Date	Version	Formulation / Revision of Contents	Approved by
2026-01-07	V1.0	Standard Version DL-EFG23-B RF Module	Fagan Xu

1. Module Introduction

1.1 Brief Introduction

DL-EFG23-B is a high-performance Sub-1GHz RF module developed by DreamLNK based on the EFR32FG23 wireless SoC (with an integrated ARM Cortex-M33 processor) of Silicon Labs. This chip integrates an advanced RF transceiver, a low-power management unit, and a rich set of peripheral interfaces. It supports multiple frequency bands such as 433/868/915MHz, and features high output power (up to +20 dBm) and high receiving sensitivity (up to -123 dBm), offering excellent RF performance and strong anti-interference ability.

This DL-EFG23-B RF module combines an integrated RF controller (Cortex®-M33) with a powerful Arm® Cortex®-M333 processor. The main clock frequency can reach up to 78MHz, with 256K of FLASH and 32K of RAM. With its fully functional built-in AT Commands, the module support any serial baud rate from 2400 to 921600bps, which can improve communication efficiency. Through the AT commands, users can easily configure wireless network parameters. Moreover, the software internally supports obtaining RSSI (Received Signal Strength Indication) and implementing common wireless communication topologies such as point-to-point and point-to-multipoint, greatly simplifying the application development process.

Though a multi-functional firmware is pre-installed at the factory, you can also conduct secondary development based on Silicon Labs development environment if needed.

*(**Note:** these RF modules will be sold base on our standard firmware. For specific requirements, please feel free to contact us.)*

1.2 Features

Hardware Features:

- Support a wide power supply voltage range :1.7~3.8V;
- Sleep current: <1uA (EM4 mode), suitable for battery-powered remote sensors and network nodes.
- High - efficiency receiving performance (RX current: 8mA);
- TX transmission power: up to +20dbm;
- Excellent receiver sensitivity: -123dBm @ 2.4kbps; -110dBm @ 50kbps.
- Accurate signal strength indication and channel evaluation
- AES-128 or AES-256 hardware encryption support

Software Features:

- Use AT commands for configuration and saving, facilitating development and debugging;
- Support transparent transmission mode for data transfer;
- Support control of data flow in transparent transmission mode;
- Support any serial port baud rate from 2400 - 921600bps;
- Support RSSI acquisition at any time for channel idle detection;
- Support channel switching to avoid co-frequency interference;
- Can implement fixed - point transmission, broadcast and monitoring transmission modes

1.3 Typical application

- Advanced wireless meter reading architecture (water meters, electricity meters, gas meters)
- Ultra-long distance data communication
- Smart home system
- Wireless sensor networking
- Industrial automation data acquisition
- Remote control and telemetry of field data
- Various transmitters, intelligent flow meters
- Building automation and security
- Monitoring and control of mining and petroleum equipment
- Environmental, energy-saving, and temperature monitoring
- Intelligent transportation, intelligent power
- Intelligent robot
- Home and building automation
- Wireless alarm and security system
- Industrial monitoring
- Wireless M-BUS

2. Technical Parameter

Parameter	Min.	Typical	Max.	Unit	Remarks
Operating Conditions					
Working Voltage	1.7	3.3	3.8	V	To ensure maximum chip power, stable voltage should ≥ 3.0V
Communication Level Range	-0.3	3.3	3.8	V	Out range may damage the chip
Working Temperature Range	-40	25	85	℃	The larger the temperature difference, the greater the required bandwidth
Current Consumption					
Receiving Current	7.5	8	8.5	mA	@DCDC
TX Current		145		mA	@433MHz ANT 50Ω, TX power @ +20dBm
		140		mA	@868MHz/915MHz, @DCDC ANT 50Ω, TX power @ +19.7dBm
Sleep Current	0.2	5.5	7	uA	
RF Parameters					
Recommended frequency range (to ensure the best performance)	410	433/470	510	MHz	@433MHz/470MHz RF module
	830	868/915	960	MHz	@868MHz/915MHz RF module
Output Power Range		20	20	dBm	Software configurable
433MHz Receiving Sensitivity		-110		dBm	@DR=50kbps, FDEV=25kHz
868/915MHz Receiving Sensitivity		-123		dBm	@DR=2.4kbps, FDEV=1.2kHz

Table 1: Technical Parameter

3. Module Size

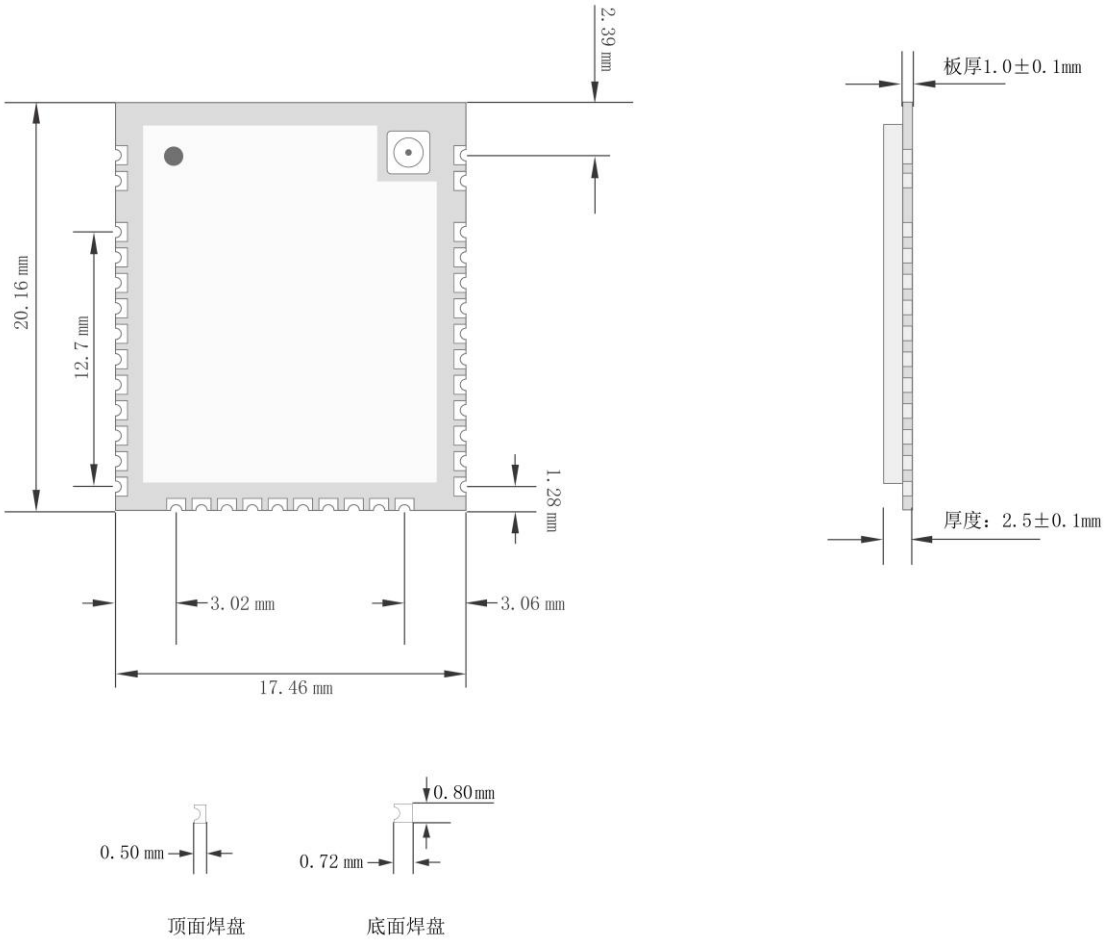


Figure 1: DL-EFG23-B RF Module Dimensions

4. Pin Definitions

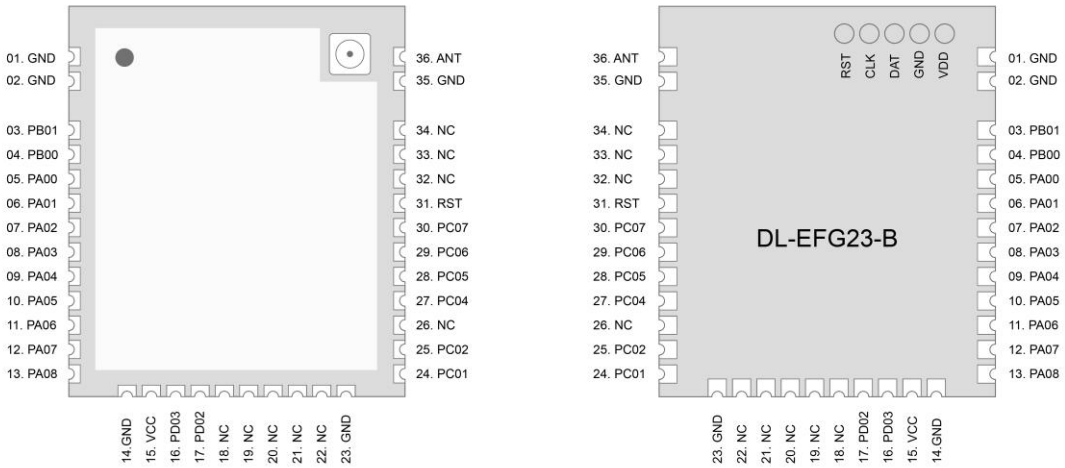


Figure 2: DL-EFG23-B Pinout Diagram

Pinout Table / Pin Definitions:

Pin No	Pin Name	Type	Description
1	ANT/NC	AI/AO	RF signal input/output port, π-matching circuit must be reserved; Adopt 50Ω impedance matching for RF routing, route the ground and add via holes around it
2	GND	PWR	Reliable grounding
3	3.3V	PWR	To maximize the chip function, ≥3.0V stable voltage is recommended
4	PB00	I/O	General I/O port, no function currently
5	PA00	I/O	General I/O port, no function currently
6	PA01/CLK	I/O	General I/O port, no function currently
7	PA02/DAT	I/O	General I/O port, no function currently
8	PA03	I	Switching between AT Command and Transparent Transmission Mode, defaulted high level 0: Transparent Transmission Mode 1: AT Command Mode
9	PA04	I	Control Module Sleep, defaulted high level 0: Sleep 1: Wake up High level can be directly connected, if low-power consumption is not a must
10	PA05	In	(UART-RX) TTL serial port input, connected to external TXD output pin
11	PA06	Out	(UART-TX) TTL serial port output, connected to external RXD input pin

12	PA07	O	(AUX) is used to indicate the working status of the module. 0: The device has completed initialization and serial communication can be carried out. 1: Initialization is not completed and serial communication cannot be carried out. **In transparent transmission mode:** 0: Idle 1: The module has received data and will output the data via the serial port after the set delay. **When transmitting data to the module:** 0: The buffer is empty (transmission is completed). 1: The buffer is not empty.
13	PA08	I/O	General I/O port, no function currently
14	GND	PWR	Reliable grounding
15	VCC	PWR	To maximize the chip function, ≥3.0V stable voltage is recommended
16	PD03	I/O	General I/O port, no function currently
17	PD02	I/O	General I/O port, no function currently
18	NC0	NA	Normally N/C
19	NC1	NA	Normally N/C
20	NC2	NA	Normally N/C
21	NC3	NA	Normally N/C
22	NC4	NA	Normally N/C
23	GND	PWR	Reliable grounding
24	PC01	I/O	General I/O port, no function currently
25	PC02	I/O	General I/O port, no function currently
26	PC03	I/O	General I/O port, no function currently
27	PC04	I/O	General I/O port, no function currently
28	PC05	I/O	General I/O port, no function currently
29	PC06	I/O	General I/O port, no function currently
30	PC07	I/O	General I/O port, no function currently
31	RST	O	Hardware reset, active low
32	NC5	NA	Normally N/C
33	NC6	NA	Normally N/C
34	NC7	NA	Normally N/C
35	GND	PWR	Reliable grounding
36	ANT	AI/AO	RF signal input/output port, π-matching circuit must be reserved; Adopt 50Ω impedance matching for RF routing, route the ground and add via holes around it

Table 2: DL-EFG23-B Pinout Table

5. Application Connection Diagram

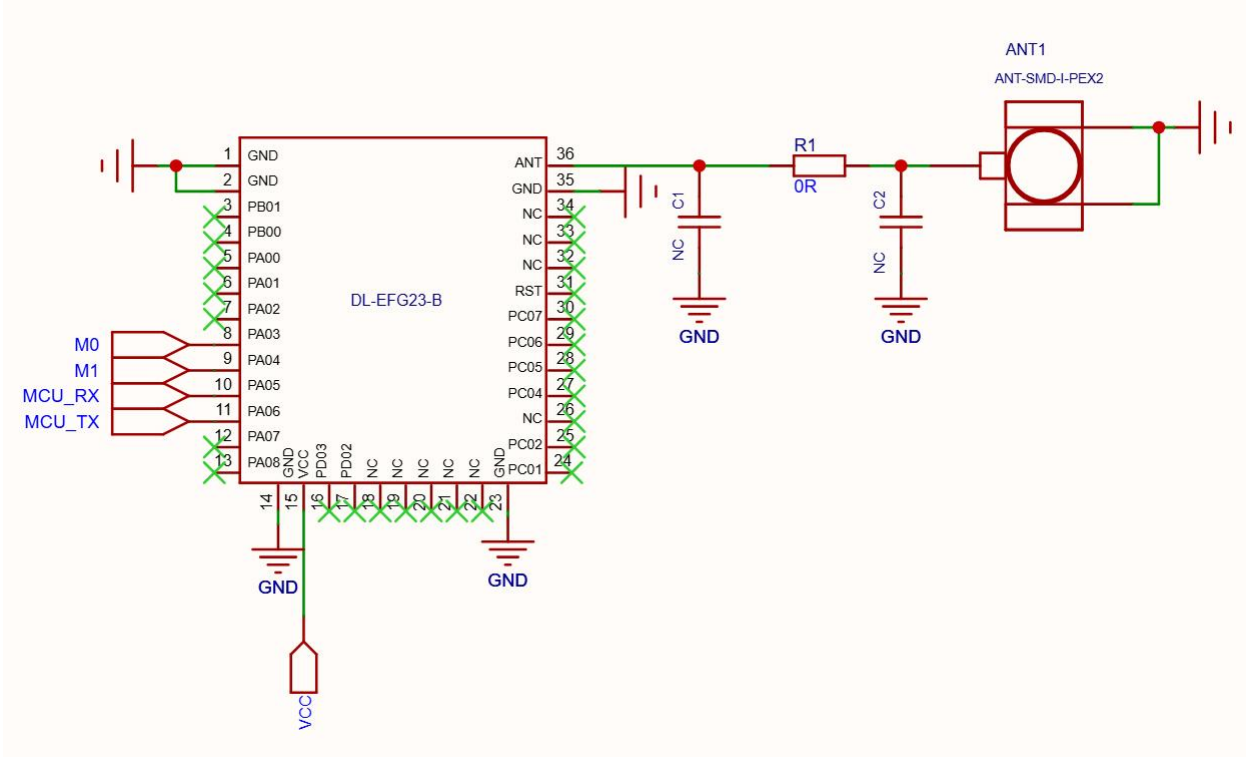


Figure 3: Application Connection Diagram

Attention for Pin Connections:

1. PA5 (RX) and PA6 (TX) are used for data transmission and should be reversely connected to the UART pins of the external MCU.
2. AUX, M0, M1, and RESET are used to control the module, and all need to be connected to the GPIO ports of the external MCU.
3. PA3 (M0) and PA4 (M1) need to be connected to a definite level. To enter sleep mode, PA3 (M0) needs to be connected to a high - level; otherwise, leakage will occur.
4. Pins that are not used, such as those marked with an "X" in the figure, can be NC (left floating).

6. Circuit Design

6.1 Power Supply Design

● Please pay attention to the power supply voltage of the device, exceeding the recommended voltage range may cause function abnormally and permanently damage;

● Try to use a DC stabilized power supply, and the power ripple coefficient should be as small as possible; the power load when transmitting the maximum power needs to be also considered;

● The RF module needs to be grounded reliably, and try to reduce the loops in PCB layout (especially the loop between ANT Pin and GND Pin should be as short as possible); a good grounding can achieve better performance and reduce the impact of RF on other sensitive devices.

6.2 RF Routing Design

● The module should be far away from RF interference sources, such as high-frequency circuit transformer, and please do not directly route at the lower layer of the RF module. Otherwise, the receiving sensitivity may be affected;

● When using the on-board antenna, the antenna needs to be clear on both sides, and the ground (copper foil) should not be too close to the antenna at the same time, otherwise it will absorb the radiated energy;

● Route 50Ω impedance line, lay the ground and add more via holes around it

● If there is enough space on your PCBA, please reserve a π-type matching circuit, and it needs to be placed as close to the chip end as possible, please make it grounded and add via holes around it. Do remember to connect it through a 0R resistor, otherwise the antenna will open circuit; SMA ANT circular through-hole requires clearance treatment

6.3 Antenna Design

● There are many types of antennas, please choose the appropriate antenna according to your needs;

● Choose a suitable position to place the antenna, according to the antenna polarity. And it is recommended to be vertically upward;

● There should be no metal objects in the antenna radiation path, otherwise the transmission distance will be affected (such as a closed metal casing).

6.4 Wireless Interference

For high-power wireless transmission, wireless interference may occur, which may affect the functions of some sensitive circuits, such as amplifiers, ADCs, RESETs, and data pins with low driving force. This situation has a significant impact on high-power transmission at 20dbm and above. The interference mainly comes from the antenna power being amplified and coupled to longer lines or devices through conduction or radiation. Therefore, when making the hardware design, the signal routing should be as short as possible; when using high power, try to use external antennas as much as possible, stay away from PCB sensitive devices, and add 100pF ground capacitance in sensitive device circuits to filter out high-frequency interference in low-speed signals to reduce wireless interference in other circuits.

7. Command format and error code

Command Format

The module uses AT commands and supports the following three types of AT commands:

1. The end of each command is "\r\n", but not separate "\r" or "\n";
2. The square brackets "<...>" are used to specify commands or parameters, but they are not needed in actual transmission;
3. The parameter separators are separated by commas "," and no spaces are allowed.

Type	Command Format	Command Echo
Execute Command	AT+<cmd> <p1>,<p2>,... (<cmd> and <p1> should be separated by a space)	OK\r\n ERROR: <erron>\r\n
Set Command	AT+<cmd>=<p1>,<p2>,...	OK\r\n ERROR: <erron>\r\n
Query Command	**AT+<cmd>?** **+<cmd>:<p1>,<p2>OK\r\n** (Parameter and "OK" should be separated by a space)	**ERROR:<erron>\r\n**

Table 3: Command Format

8. AT Commands

AT Command List

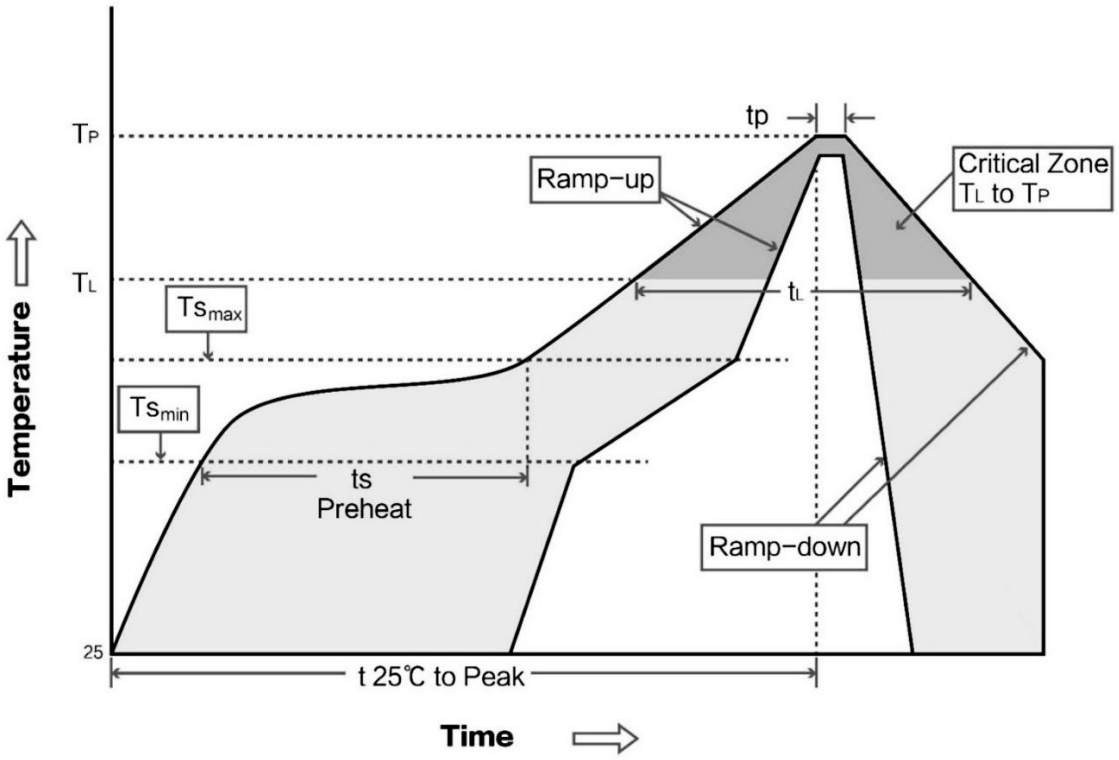
Command	Description	Command Format (Response/Default Parameters)	Savable (Y/N)
AT	Testing module response	AT\r\n OK	No

AT+DEFAULT	Restoring factory settings	AT+DEFAULT\r\n OK	No
AT+UART=	**Set/query serial port transmission properties** Default configuration: 115200,8,0,1	AT+UART=<baudrate>,<databits>,<stopbits>, <parity>\r\n	
AT+UART?	**Baud rate:** 2400~ 921600 **Data bits:** 4~16 **Parity bit:** 0：No parity 1：Even parity 2：Odd parity **Stop bits:** 0~3 0->0.5 ,1->1 ,2 ->1.5 ,3->2	+UART:115200,8,0,1 OK\r\n	Yes
AT+ENTM	**Exit AT mode** After configuring the parameters, the actual setting will be performed through this command	AT+ENTM\r\n OK\r\n	No
AT+SAVE	Save configuration parameters (power-off save)	AT+SAVE\r\n OK	
AT+AUXT=	**AUX Output Time Configuration/Query** When data is received, the time for AUX to go high in advance and go low with a delay, relative to the serial port TX. The default is 0mS. AuxPreTime: AuxDelayTime: Range: 0-100; Unit: mS	AT+AUXT=<AuxPreTime>,<AuxDelayTime>\r\n	
AT+AUXT?		+AUXT: 0,0 OK\r\n	
AT+ATE=	Enable/disable command echo. It is disabled by default. **En:** 0: Disable 1: Enable	AT+ATE=<En>\r\n	
AT+ATE?		+ATE: 0 OK\r\n	
AT+RFPOWER=	**Setting/querying the transmission power**, the power consumption can be reduced, but it will shorten the communication range. Maximum power by default **Power:** Minimum 1, Maximum 214 (corresponding to 20dBm)	AT+RFPOWER=<power>\r\n	
AT+RFPOWER?		+RFPOWER:214 OK\r\n	
AT+CHANNEL=	**Set/query the transceiver channel.** The default channel is channel 0. It can be used to switch channels to avoid co-channel interference. **Channel: 0~190**	AT+CHANNEL=<ch>\r\n	
AT+CHANNEL?		+CHANNEL:0 OK\r\n	

AT+PKTLEN=	**Set/query the wireless load length.** It can be used to adjust the wireless load length and optimize communication. Default payload length: 32Byte Pktlen: Maximum payload length 246	AT+PKTLEN=<len>\r\n	
AT+PKTLEN?		+PKTLEN:32 OK\r\n	
AT+RSS?	Querying the RSSI signal strength of the last packet; usually returns a negative number.	+RSSI:-127 OK\r\n	
AT+RFSADDR=	**Settings/Query Address, default is 255.** *255* is the broadcast address. Addr0 (Original Address): 0 - *255* Addr1 (Target Address): 0 - *255* **Addr0 (Self Address):** This is the local self - address of the module. When receiving data, the module will only perform subsequent processing on the data when the target address in the data is consistent with the locally configured value of Addr0. **Addr1 (Target Address):** This is the target address for the module to send data. It is used to specify the address of the target device to which the data needs to be sent. The module will initiate data transmission to the device corresponding to this address.	AT+RFSADDR=<Addr0>,<Addr1>\r\n	
AT+RFSADDR?		+RFSADDR:0xFF,0xFF OK	

9. Welding Operation Guidance

9.1 Reflow Soldering Curve Chart



9.2 Reflow Soldering Temperature

IPC/JEDEC J-STD-020B the condition for lead-free reflow soldering	Big size components (thickness ≥ 2.5 mm)
The ramp-up rate (Tl to Tp)	**3℃/s (max.)**
Preheat Temperature	
- Temperature Minimum (Tsmin)	150℃
- Temperature Maximum (Tsmax)	200℃
- Preheat Time (ts)	60~180s
Average ramp-up rate (Tsmax to Tp)	**3℃/s (Max.)**
- Liquidous temperature (TL)	217℃
- Time at liquidous(tL)	60~150 second
Peak Temperature (Tp)	**245+/-5℃**

10. Notice for Module Application

(1) This module is an electrostatic sensitive product. Please operate on an anti-static workbench during installation and testing;

(2) When installing the module, make sure that nearby objects keep a sufficient safe distance from the module to prevent short-circuit damage;

(3) Liquid substance is not allowed to come into contact with this module, and this module should be used in a dry environment;

(4) Please use an independent voltage stabilizing circuit to supply power to this module, and avoid sharing with other circuits. The tolerance of the power supply should not be less than 5%.

(5) The indicators of this module are accord to commonly used international standard. If special certifications needed, we can adjust certain indicators according to your needs.

11. Contact us

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