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Mesh Net Work Module DATASHEET

Description:

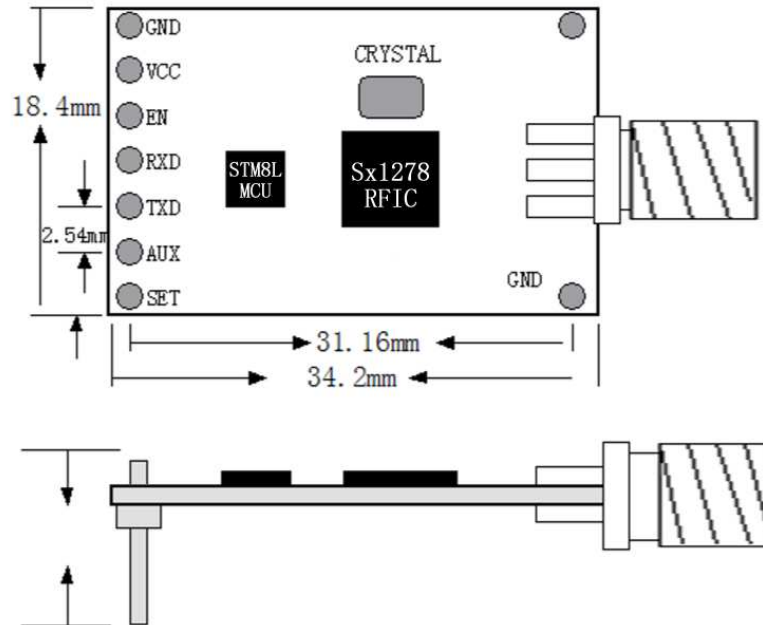
YL-800N is a high performance, low power, long-range micro-power RF module, using a distributed ad-hoc network communication mode, embedded wireless MESH MANET protocols, users do not need to do anything modified to present devices, protocols, nor need for secondary development to module, but can easily implement wireless ad hoc networks. RF chip module technology based on spread spectrum frequency hopping, spread spectrum calculations and leading internal automatic CRC error correction processing. The stability, anti-interference ability and receive sensitivity are better than other types of modules. Module also supports API mode, transparent mode and AT command mode, the user can configure our PC software, or send AT commands through the microcontroller, based on the parameters of the actual demand for flexible configuration of the module, simple operation, easy to use, strong adaptation.



Features:

- Frequency Range: 433/490MHz (Sx1278) or 868/915 MHz (Sx1276) .
- Based LoRa modulation techniques.
- Half-duplex communications, serial data transparent transmission.
- Embedded MESH distributed MANET protocols.
- each communication has multiple handshake confirmation, to ensure the stability of the data.
- Production free debugging, 3.4-5.5V voltage range can be customized 2.1-3.6V.
- Micro-power transmission, standard 100mW, 7-Level adjustable.
- Receive sensitivity up to -148dBm, the maximum transmit power + 20dBm.
- High-efficiency forward error correction coding techniques and frequency hopping mechanism, anti-interference ability, low error rate.
- Support Serial wake, ready to send and receive data, no periodic wake-up time.
- Support Air wake AUX signal given by the module, Wake user device.
- CAD detection LoRa signal, to prevent accidental wake.
- Communication protocol conversion and RF transceiver to switch automatically, without user intervention, simple to use.
- Can be flexibly set the module parameters via software or microcontroller commands.
- 2.54 standard pin interface, easy embedded installation, TTL level signals.
- Built-in watchdog to ensure long-term reliable and stable operation.
- Open ground between nodes effective communication distance up to 2-3 km.

1. Module package size(unit: mm)



2. Module Pin Definitions

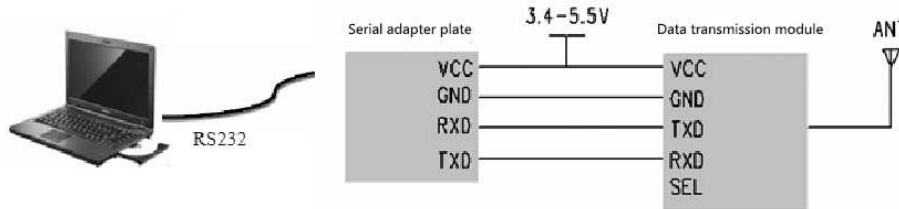
Pin No.	Pin Symbol	Description
1	GND	GND
2	VCC	Power supply(3.3v ~ 5v)
3	EN	No connection, Customized for the module
4	RXD	UART Input, CMOS 3.3v or TTL 5v
5	TXD	UART Output, CMOS 3.3v orTTL 5v
6	ACT	No connection, Customized for the module
7	SET	No connection, Customized for the module

Note: It needs a common ground when wireless modules connect to the customer's product, or modules will not work normally.

Module and client device wiring diagram(TTL Interface)

3. Parameter modifications and data transmission test

Connect YL-800N to the computer according to the typical application circuit, and plug in the power and TTL to RS-232 converter SET pin to ground.



Choose the used serial port, read software directly, so you can read or modify network ID, power, serial port baud rate, communication frequencies and other parameters on a single module. Modules can be flexibly configured freely concentrator or node module, for detailed configuration instructions, please refer to the relevant protocol.

When changing parameters, you choose a parameter you want, and write, and then read to check if the module's parameter is what you need. Module default transparent transmission mode, the concentrator module.

Data sending and receiving communications test, module opens the corresponding serial debugging assistant through TTL interface connecting to computer, and send text or character information in one or in serial debugging assistant, corresponding to the other of a serial will be received and displayed. The figure below COM3 received information from the send area COM4, COM3 receiving area received the information from COM4 Send zone.

The contents of sent and received are consistent.

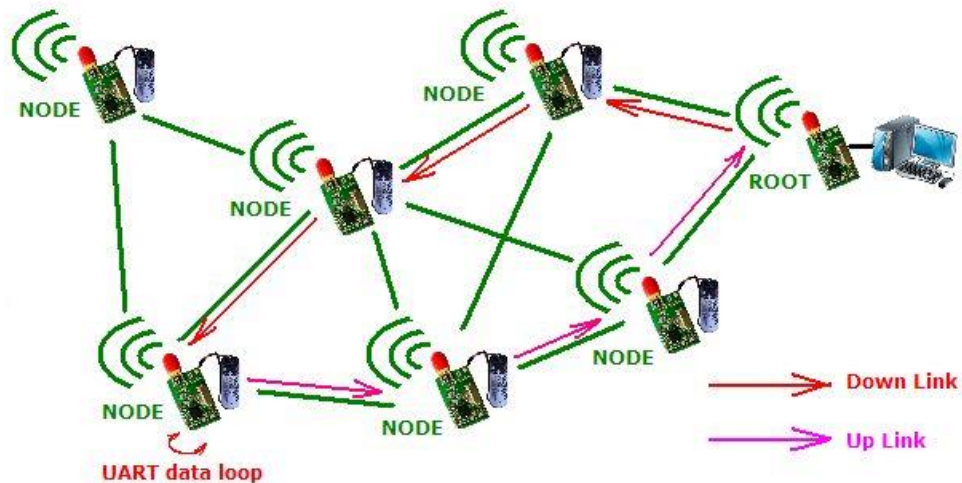
Notice:

- a) Wireless module communication need install antenna, or not able to communicate in short distance.
- b) When installing the module, the position of the antenna must not be too close to your MCU products.
- c) When the power supply, make sure the ground of module is connected to the common ground of your product!
- d) When the product is working properly, do not touch the module and the antenna part in order to achieve the best transmission results!

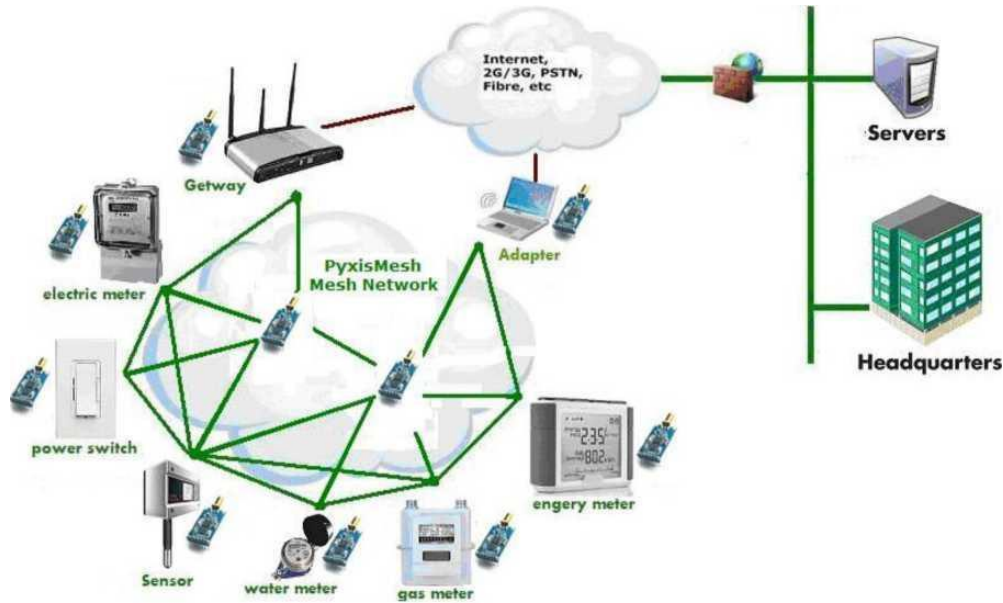


4. YL-800N MESH network typical applications:

A basic MESH network consists of multiple nodes (NODE) module and a concentrator (ROOT) module. Bi-directional data exchange between NODE and ROOT modules, multiple packets can be relayed by NODE module. Data stream from ROOT to NODE be called down, and vice versa for the uplink. Downlink data transmission for broadcasting (ROOT send data to all nodes can receive uplink data transmission mode is unicast (NODE data sent to the nearest ROOT) route selection is done automatically. Note that if you have more than one focus is ROOT, then NODE data transmission will automatically upload to the nearest communication over ROOT, other ROOT cannot receive.



Only YL-800N module can easily set up the minimum two points to hundreds of points MESH network. MESH is finished Fully Distributed symmetric network, in theory, only need a single type of device can be. But to seamless compatibility with the user's existing agreement, packet format is transparent transmission. In many applications, the user's message did not contain the flow of information and data (up or downlink), this will lead to some real problems. Therefore, MESH network defines two types of all mesh networking equipment: nodes and concentrator. Node refers to is controlled equipment such as meters, sensors, switches and the like; concentrator refers to control devices such as gateways, remote control. In this article, use nodes and concentrator instead of the device name of the specific application. A MESH network can contain multiple concentrators and a plurality of node devices. YL-800N module can both as node device may also be used as a gateway device. All mesh networking equipment with electricity will work, no network initialization process, the route will be automatically established on demand, automatically maintained, without human intervention. Its networking diagram is as follows: Ethernet.



YL-800N Network diagram

Using YL-800N module can easily set up an excellent performance, low-power distributed mature and stable MANET MESH, represents the most advanced level of MANET technology can replace the cable, and centralized multipoint networking, greatly expanded network coverage and network robustness, and can effectively reduce the cost of equipment and maintenance costs.

YL-800N module applications in areas such as low-power sensor networks ad hoc networks, wireless meter reading and other areas, with a clear technological advantage and price advantage. For example, using the YL-800N wireless meter reading program, you can free from outside interference and isolated nodes and the single-wide network. MESH wireless meter reading programs collecting success rate reached 100%.

5. MESH Distributed Routing Protocols

Mobile ad hoc networks (MANET) is a multi-hop network with a plurality of mobile nodes consisting of routing, data transmission requires multiple nodes collaborate to complete, so routing protocol is a vital part of the MANET. Compared to traditional wired networks, MANET has its own characteristics, such as distributed control, dynamically changing network topology Flutter structure, wireless transmission bandwidth and node capacity limitation, poor security, routing short survival time. Ideal MANET routing protocol should have the following characteristics:

- a) Distributed routing algorithm; distributed algorithm is more suitable for non-centric distributed control network.
- b) The adaptive ability; can adapt to rapidly changing network topology.
- c) no loops; no loop is a basic requirement for any routing protocol to avoid routing errors and wasted bandwidth.
- d) The less cost of the route calculation and maintenance of control; with minimal control overhead to achieve the most complete, most powerful feature is that all the routing protocols common goal.
- e) To adapt to large-scale networks; robustness, scalability are both good.

Single-path routing protocol does not fit MANET, for the following reasons:

- a) The wireless network node has high mobility, limited bandwidth resources, and disconnection rate, resulting in high network division opportunities. With expensive Single-path routing algorithm ,convergence is slow.
- b) The route is built through flooding technology, and when the node moves leading to the original route fails, the single-path routing maintenance also requires flooding, will occupy Network bandwidth, when a moderate number of routes need a lot of maintenance, frequent flooding of the entire network made the routing control cost controlled by routing protocols so that demand control open Pin very large.
- c) The single routing protocol does not consider the fairness, tend to source the heavy load distribute to the node of the original destination and shortest path, you can not get well and with Track the entire network topology information.
- d) The data sending of single-path routing protocol only use one path, you can not send data in parallel or concurrently, resulting in lower network transmission rate, delay increases, net. Network load imbalance, causing network congestion.

MANET from any one source node to the destination node of the path usually have extra, but with random node mobility, the entire network topology change frequently.

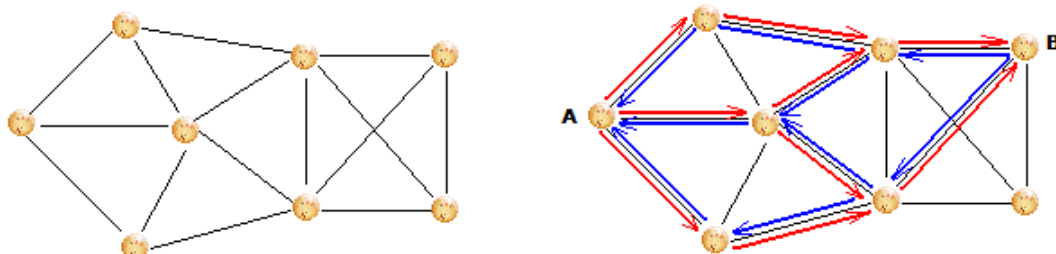
Multi-path routing protocol can overcome the single-path routing protocol insufficient, you can take full advantages of network resources, balance network load, improve communications performance, avoiding network shoc. MESH uses lightweight dynamic private demand multipath routing protocol, which is designed for the MANET of the hardware resources with harsh, adaptive to wireless network of fast moving topology ,

Topology change fast wireless network. The routing protocol routing can minimize the cost of establishing and maintaining processes, can send data in parallel in multiple paths packets

The transmission can sense changes in the network topology and update routing without flooding, seamless switching of different routes to see. The main features are: each section

maintain routing information as much as possible ; no routing loops; good routing stability, fast building speed; capable of maintaining full advantage of the wireless signal redundancy, always maintain and update routing, no overhead; routing algorithm weighs a lot of factors such as distance vector signal energy, link quality and battery voltage etc; the sensitivity to the net

Changes in network topology , dynamic routing can quickly achieve optimal; high throughput; support 255 routing, big network scale.



MESH

MESH multi-path routing diagram as shown above, network topology diagram as shown on the left, the black line represents the nodes. A and B on the right side is the established data link, the red line is the

route from point A to B, the blue line is the reverse path. A route is established by flooding, there's no closed loop between multiple routes, allowing multiple paths

Intersect. Each node will select as many nodes as possible as its next hop routing, data packets can dynamically switch between multiple paths in parallel transmission.

Routing failure detection, the new route discovery, network topology change are perceived through handshake packets between neighboring nodes listener, does not require either flooding or extra cost. all nodes including a source node need only to find their own next-hop relay node, without the need to determine the entire path, so the routing protocol overhead is very small,

Topology for fast-changing mobile network, can quickly find the best route instantly to support 255 large scale routing networks.

MESH routing protocol will be a comprehensive choice of algorithm for route selection, including distance vector, signal quality (link status) and the node remaining charge - class MMBCR

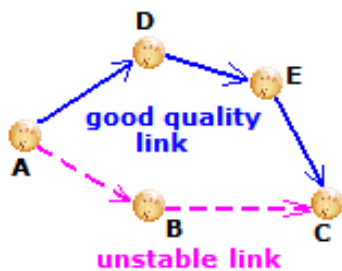
(Min-Max Battery Cost Routing). Path vector algorithm according to the distance from the destination to decide the routes, each node maintains a vector.

The best distance to each target currently known is listed in the table. Node can choose the destination node closer than itself according to this vector table as a forwarding route. You can find the nearest path between two nodes according to Distance vector algorithm, but not necessarily the best path.

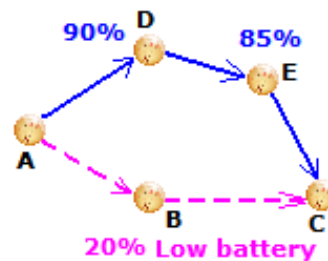
Unlike wired networks, wireless signals for MANET is susceptible to outside interference, resulting in shorter survival time data links, poor stability characteristics. Routing protocol must be able to correctly choose a good quality signal, stable link path to ensure stability, timeliness, reliability and performance of the network. MESH routing protocol

can promptly detect multiple routes' real-time link quality, and can choose the path with the best link quality in a very short time, and, to select the next most

Near path as a route when necessary. MESH link-state routing algorithm diagram is as follows, A can access to C via B that is A-B-C, but this trail is an unstable link, but there is another one path with the best link quality from A to C, A-D-E-C, although the distance is closer if choosing ABC path, but due to the Text reception success rate is very low, it will greatly increase the probability of packet retransmission and waste much time. And if you choose ADEC, it can ensure the newspaper text transmission reliability and timeliness, although the distance will be farther away.



MESH link-state routing algorithm schematic



MESH nodes remaining power routing schematic

As for low-power MANET, the routing nodes need to fully consider battery power, should avoid route nodes with low power as possible. MESH

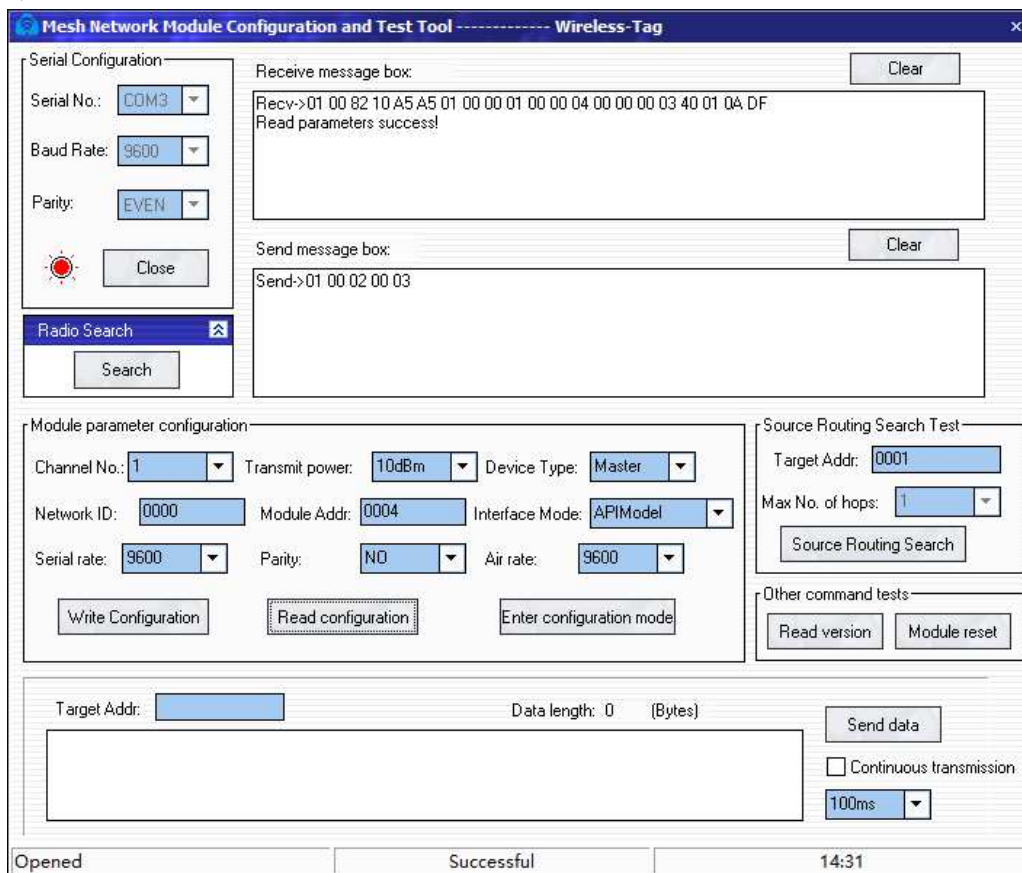
Routing protocols use category MMBCR algorithm, and automatically selects the nodes with relatively large remaining power to do routing. MESH nodes remaining power routing algorithm diagram is as follows A can access to C via B, A-B-C, but the remaining power of B nodes is low., while there is another a little

far path from A to C a little far, ADEC, with higher remaining electricity amount in the path nodes. Choosing ABC path is closer, but it will soon run out of battery B node. If you choose to ADEC, although distance will be farther, it will increase the service life of the entire network system to reduce the maintenance costs.

MESH routing protocol is ideal for MANET routing protocol design, with a distributed, robust, strong healing powers, lightweight, multi-path, loop-free, network size suitable for mobile networks and so on.

6. Parameter settings

Parameters command modify the instructions can modify parameters by modifying the software directly.



Module user interface mode is divided into three types: hex command mode, transparent mode, AT command mode;

Module device type is divided into two kinds: the main module (concentrator modules) and the slave module (node module), can be modified by AT commands

the main module in transparent mode, the data the serial port received transparently sent to all of the modules; the slave module in transparent mode, the data the serial port received transparently sent to made the main module.

In transparent mode, input "+++" will not be transparent sent, but to switch the user interface mode to AT command mode, the module is capable of responding to AT commands,

But this switch cannot be saved, it will return to the transparent mode after module resets, , the you need to use the AT in the AT command mode + USERMODE

To Command Change if want to change to the user interface mode in a long time.

It should be changed the default device type to slave module types, because the number of slave modules are usually bigger than the main modules when using.

Users can use a variety of network ways:

A. A completely non-transparent peer networking mode

There is no master-slave relationship between all parties, Absolute and pure MESH network, module type and the user interface mode are both consistent but they are non-transparent mode.

In this networking mode, all modules can use hexadecimal command or AT command to send broadcast or unicast data, it needs destination module address; transmitting broadcast data to the destination address is 0xFFFF. Modules can use hexadecimal command mode or AT command mode receives broadcast prescribed protocol format or unicast data, and learns the module source address of sending data. User device needs to send unicast data and need to manage other modules communications short address.

B. Completely transparent peer networking mode

There is no master-slave relationship among all modules, Absolute MESH network, the module type are all main module type, the user interface mode are all transparent mode.

C. Non-transparent master-slave networking mode

A module is the main module, other modules are all the slave module, the communication between master and slave modules, slave modules don't require communication, the user interface mode is consistent, but are Non-transparent mode.

This networking mode is actually the same as the first one, there is no communication between the modules among the slave modules.

D. The master-slave mode Transparent Network

A module is the slave module, other modules from the module, the communication between master and slave modules, generally do not need communications, user interface mode are consistent and are Non-transparent mode.

In this networking mode, the main module can send broadcast and send unicast data to slave modules, data to slave modules is transparently sent from the serial port, and the data received from the serial port of the slave module will be transparently unicast to the main module. The main module Received it will send it according to the protocol form of the main module serial mode Slave Users devices is passive devices and do not need to do any changes, and any information: the main users devices need to manage the communication short address of the slave modules.

E. Using a dedicated Concentrator modules automatic networking mode

In small-scale networking application, you can manage and frequency management module address manually, but in large-scale network application, this management becomes burdensome

And error-prone. Our company's dedicated concentrator module, adds a Cortex M3 core of high-performance 32-bit microprocessor outside the ordinary networking module and high capacity non-volatile memory for the group to achieve automatic network management, network management in its group work include: automatic frequency management, automated mailing address management (by the application address to correspond to

Automatically associated sites), dynamic source routing management. Dedicated concentrator module can help users easily compose a large-scale, high-performance, automated maintenance wireless network.

7. AT command set

The factory is 9600 baud module, serial port parameters: 1 stop bit, no parity; device type "slave module"; User mode is "transparent mode"; channel number is 1 channel (module supports 0-7 A total of 8 channels), to enter the AT needs to send a "+++."

Note: There must be a space between the command word and behind parameters; certainly add a enter command after entering commands and parameters, namely '\ r' and '\ n'.

Downlink command 1: Test connection command

Downlink command	Answer	Parameters
AT	OK	N/A

Downlink command 2: Discover a program version number

Downlink command	Answer	Parameters
AT+VERSION	+VERSION=< Para1>	<Para1>: The firmware version number

For example:

```
AT+VERSION\r\n
+Firmware V2.2
```

Downlink command 3 : Restore Default Settings

Downlink command	Answer	Parameters
AT+DEFAULT	Ok	N/A

Downlink 4 : Software reset / restarts

Downlink command	Answer	Parameters
AT+RESET	Ok	N/A

Downlink 5 : Query / set the baud rate

Downlink command	Answer	Parameters
AT+BAUD	+BAUD=<Para1>	<Para1>: baud rate
AT+BAUD < Para1>	1.+BAUD=<Para1> OK——Success 2.ERROR=<Error_Code>—— Failure	1---1200 2---2400 3---4800 4---9600 5---14400 6---19200 7---28800 8---38400 9---57600 A---76800 B---115200 C---230400 Default: 4---9600

Note: After the baud rate change, if is not the default 9600, or later when you need to set parameter or data communication, need to use the setting baud rate. After the baud rate changed, it won't function until resetting the module.

Downlink commands 6: Query / set the serial port communication parameters

Downlink command	Answer	Parameters
AT+UARTPARA	+ UARTPARA =<Para1>,<Para2>	<Para1>: Stop bit
AT+ UARTPARA <Para1>,<Para2>	1.+ UARTPARA =<Para1>,<Para2> OK ——Success 2.ERROR=<Error_Code>——Failure	0: 1 Stop bit 1: 2 Stop bit <Para2>:The parity bit 0: No parity 1: Odd parity 2: Even parity default: 0,0

Note: After the serial port parameters changed, the module won't function until been reset.

Downlink commands 7: Query / set a master-slave mode module APP

Downlink command	Answer	Parameters
AT+ROLE	+ROLE=<Para1>	<Para1>:
AT+ROLE < Para1>	1.+ROLE=<Para1> OK ——Success 2.ERROR=<Error_Code>—— Failure	0--- slave device 1--- master device default: 0 slave device

Downlink command 8: Query - Local module address

Downlink command	Answer	Parameters
AT+LADDR	+LADDR=<Para1>	<Para1>:Local long address of module e.g.:11:22:33:44:55:66

Note: Long address of the module is preset in the module when out of the factory ,cannot be changed.

Downlink commands 9: Query / Set eleven module communication short address

Downlink command	Answer	Parameters
AT+SADDR	+SADDR=<Para1>	<Para1>:This module communication short address
AT+SADDR < Para1>	1.+SADDR=<Para1> OK ——Success 2.ERROR=<Error_Code>—— Failure	e.g.: XXXX 2-byte hexadecimal System

Note: The communication short address of the module default is last two bytes of long addresses. Mutual communications between the modules need different short address.

Downlink commands 10: Query / set a module channel number \ channel group number

Downlink command	Answer	Parameters
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AT+CHANEL	+ CHANEL =<Para1>	<Para1>: Module's operating channel number or Channel Group number 0---32
AT+ CHANEL < Para1>	1.+ CHANEL =<Para1> OK——Success 2.ERROR=<Error_Code>—— Failure	

Downlink commands 10: Query / set a module's operating network number

Downlink command	Answer	Parameters
AT+PANID	+ PANID =<Para1>	<Para1>: Networking module network number e.g.: XXXX 2-byte hexadecimal System
AT+ PANID < Para1>	1.+ PANID =<Para1> OK——Success 2.ERROR=<Error_Code>—— Failure	

Downlink commands 11: Query / set a module user interface mode

Downlink command	Answer	Parameters
AT+USERMODE	+ USERMODE =<Para1>	<Para1>: 0: 16 Hex Command Mode 1: Transparent Mode 2: AT Command Mode
AT+ USERMODE < Para1>	1.+ USERMODE =<Para1> OK——Success 2.ERROR=<Error_Code>—— Failure	

Downlink commands 12: Send the application data

Downlink command	Answer	Parameters
AT+ SEND < Para1>,<Para2>	1.+ SEND =<Para1>,<Para2> OK——Success 2.ERROR=<Error_Code>—— Failure	<Para1>: Send short address of the destination node e.g.: XXXX 2-byte hexadecimal <Para2>: double quotes to send data "0123456789abcdef" is hexadecimal 0x01,0x23,0x45,0x67,0x89,0xab,0xcd,0xef 8 bytes data

Uplink command 12: receiving data indicating

Uplink command	Parameters
+Recv:< Para1>,<Para2>,<Para3>	<Para1>: The source node short address of received data e.g.: 0001 is a 2-byte hexadecimal 0x0001 <Para2>:The byte number of received data <Para3>: Data received 0123456789abcdef is hexadecimal: 0x01,0x23,0x45,0x67,0x89,0xab,0xcd,0xef 8 bytes data