

# RAK415 UART-WIFI Module

## Specification v2.0

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# 1. Overview

## 1.1 Module Overview

RAK415 module is an ultra-low power WIFI module that fully supports IEEE 802.11b/g/n wireless standards, with a small package and easy-to-use features. The RAK415 is a complete serial pass-through module integrated with TCP / IP protocol stack and drivers, easy to use by simply using the PC, WEB Browser, APPs tool to work individually or in bulk for parameters configuration, and then module connects the serial ports and network for normal usage.

The RAK415 module is characterized by stable performance, low power consumption and flexibility to meet the various needs of customers. It can also provide test reports, allowing customers to get started quickly, shorten the development cycle.

The RAK415 module also provides various types of customized services, such as user webpages, production and configuration tools, mobile phone APPs, etc.

## 1.2 Key Applications

- Portable products
- Home appliances and electrical appliances
- Industrial sensors
- Sales terminals
- Buildings automation
- Logistics and freight management
- Home security and automation
- Medical applications, such as patient monitoring, medical diagnostics
- Metering (stop timing, measuring instruments, meters, etc.)

## 1.3 Device Features

- Support IEEE 802.11b/g/n wireless standards
- Integrated TCP / IP protocol stack
- Support OPEN, WEP, WPA/WPA2-PSK Encryption
- Support Soft AP, Station modes
- Support TCP, UDP protocols
- Support DHCP SERVER / DHCPCLIENT
- Support AT commands and transparent transmission mode

- Support UART communication with a data flow control, maximum rate of 921600bps
- Support multiple configuration tools for one-step configuration
- Support wireless upgrade firmware
- On-board antenna or U.FL antenna connector
- Operating voltage: 3.3V
- Support 4 kinds of power operating mode, with the lowest power consumption of 1~2uA
- FCC, RoHS and CE compliant

## 1.4 RAK415 System Diagram

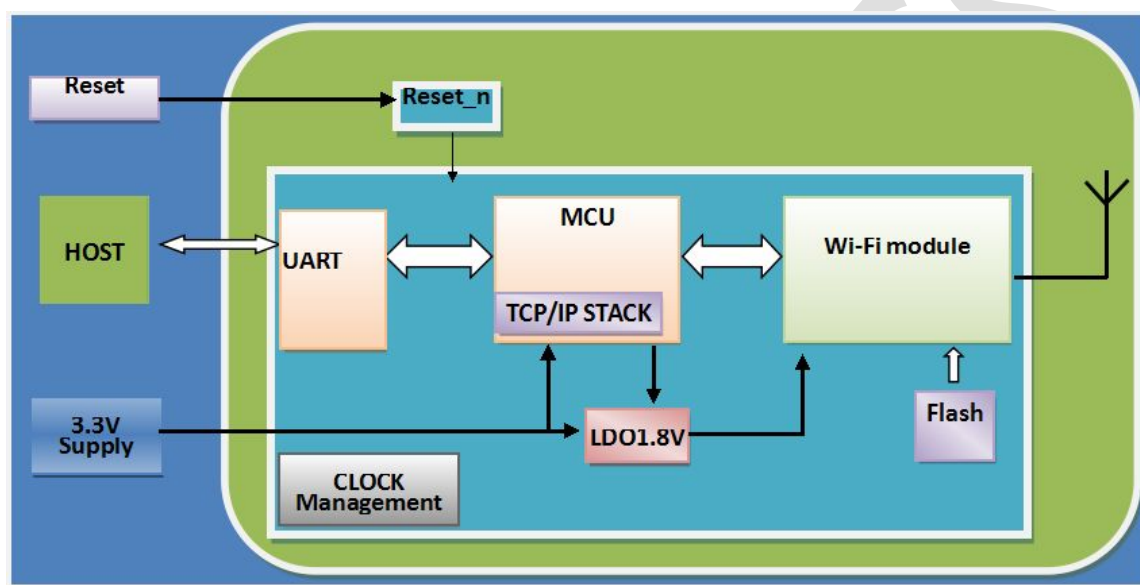


Figure 1-1 RAK415 System Diagram

## 2. Functional Description

### 2.1 HW Interface

- Rate: 9600~921600bps
- Interface actual throughput up to 600kbps
- Support hardware flow control, ensuring the reliability of data transmission
- 485 function settings

### 2.2 Wireless Driver

- Compliant with IEEE 802.11b/g/n standards
- Support AP and STA Mode
- Support WEP, WPA/WPA2-PSK encryption
- Fast networking, allowing module to be added to network within 1 sec after power up
- Support WPS and EasyConfig one-key to network connection
- Support network and socket automatic reconnection
- Support proactively identifying devices in LAN
- Support wireless configuration and firmware upgrade

### 2.3 TCP/IP

- DHCP Client and Server features
- DNS Client and Server functions
- TCP Client, TCP Server, UDP Client, UDP Server
- Dual socket transparent transmission of data (via uuid distinction)
- Support HTTP protocol
- TCPC / TCPS keep-alive time setting and TCPC reconnection

### 2.4 Power Consumption

The module supports three power consumption modes:

- Full speed working mode, with approx 80mA average power consumption, peak current less than 310mA
- Automatic power-saving mode, with approx 10mA average power consumption, peak current <310mA, DTIM = 100ms
- The stay connected mode, with approx ~ 3mA average power consumption, peak current <310mA, DTIM = 100ms (largest support to the 115200bps)
- External cable, ultra-low-power consumption mode: 1~2 uA.

## 3. Hardware Introduction

### 3.1 Top View



Figure 3-1 RAK415AS Top View

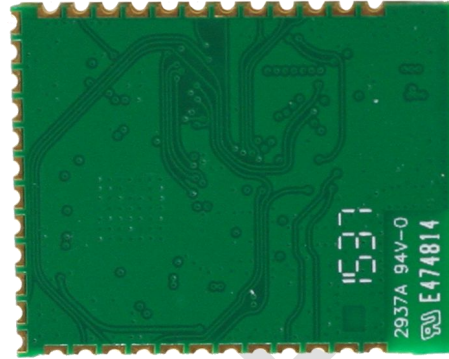


Figure 3-2 RAK415AS Bottom View

### 3.2 Pin Definition

Table 3-1: Pin Definition

Pin No.	Name	Type	Description
1,2,5,12,13,25,36	GND	Ground	All ground pins are connected to ground pad or the copper
35	VCC3V3	Power	3.3V power supply
8	MODE/WPS	I, PU	WPS function pin (default) Module reuse mode selection (by configuration switching) "0" - open assistant command mode "1" - only data pass-through mode Remain disconnected when no use
17	SLEEP	I, PU	Power Management Module Pull down and hold 2S, release - enter ultra-low-power mode Pull down, then release - normal power mode (full, save) Wake up falling edge, remain disconnected when no use
18	LINK	O, PU	Module networking indicator "0" - STA connected in AP mode, Connected to router in STA mode "1" - disconnected Remain disconnected when no use
19	RESET	I, PU	Module reset pin, low effective
24	CONFIG/Default	I, PU	Module configuration pin to achieve EasyConfig and DefaultConfig function, EasyConfig press (<3S) to enter into one-key configuration network DefaultConfig Press (>= 3S) to restore factory settings

26	STATUS	O, PU	Normal start up output pin, output low effective
31	TXD	O	Serial data communication interface send
32	RXD	I	Serial flow control pin, ready to receive, low effective
33	RTS	O	Serial flow control pin, ready to receive, low effective
34	CTS	I	Serial flow control pin, clear Send, low effective
Others	NC	NC	Remain disconnected when no use

**Note:**

- 1 . I - input O - output PU – pulling up PD - pulling down NC - not connected
- 2 . Pin in NC, remain disconnected

**Status indicator:**

- Module started properly — On (Output Low)
- Module failed to start — Off
- Module firmware is in upgrade — quick flashing
- Module is ready to enter factory mode — quick flashing
- Module Upgrade Error — slow flashing

**Link indicator :**

link\_multi parameter is 0:

module is connected to router in STA mode,

- module has STA connection under AP mode — On (Output Low) Conversely off
- EasyConfig, WPS is in one-key configuration — Quick flashing

link\_multi parameter is 1, the multi-state blinks to indicate:

- 1 . AP mode, the device is not connected. — 1s breathing lights flashing
- 2 . The module initialize successful. — off
- 3 . Scan and connect.

— off, flashing cycle 280ms, 250ms start bright and continue 30ms.

- 4 . The connection is successful, start DHCP.

— off, flashing cycle 850ms, 800ms start bright and continue 50ms.

- 5 . Single Socket, TCP Client is not connected ; double Socket, TCP Client at least one is not connected.

— off, flashing cycle 1s, 850ms start bright and flash 4 times

- 6 . AP mode, device is connected,

STA mode, if only all tcp clients have been connected. — Light



7 . easyconfig, WPS.

8 . Upgrade: transfer file.

——150ms flashes

—— 50ms flashes

### 3.3 Design Reference

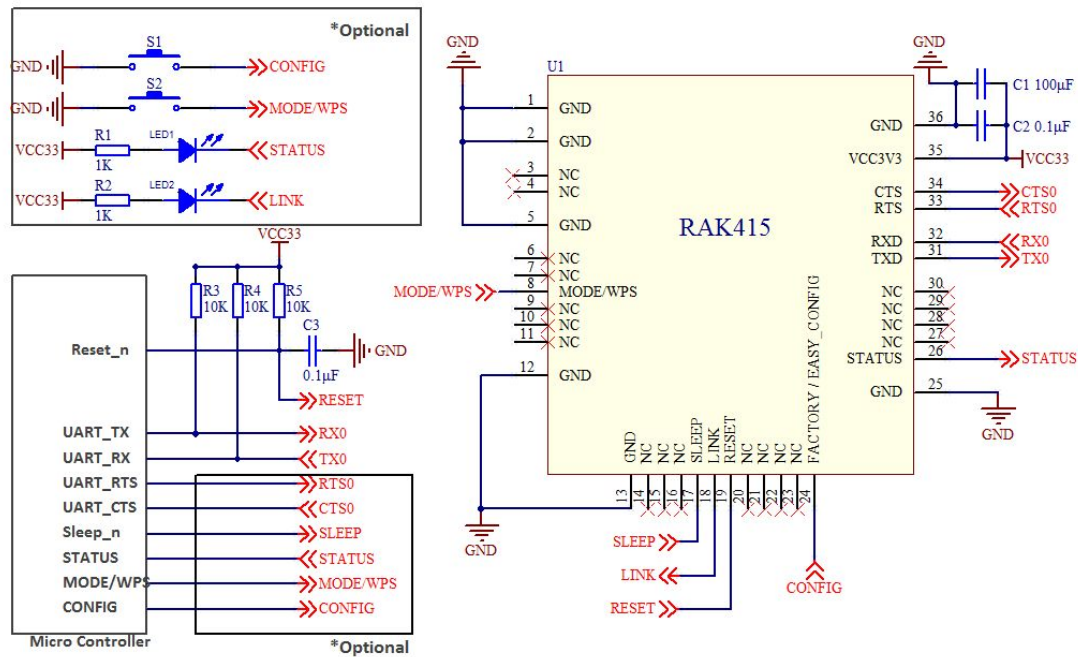


Figure 3-3 Module Typical Design Reference

#### Tips:

Customers use RAK415 module, try not to put the link pin and the MCU connection ,prevent conflicts and indicate the status of our define link pin ,affect the use and experience.

### 3.4 PCB package

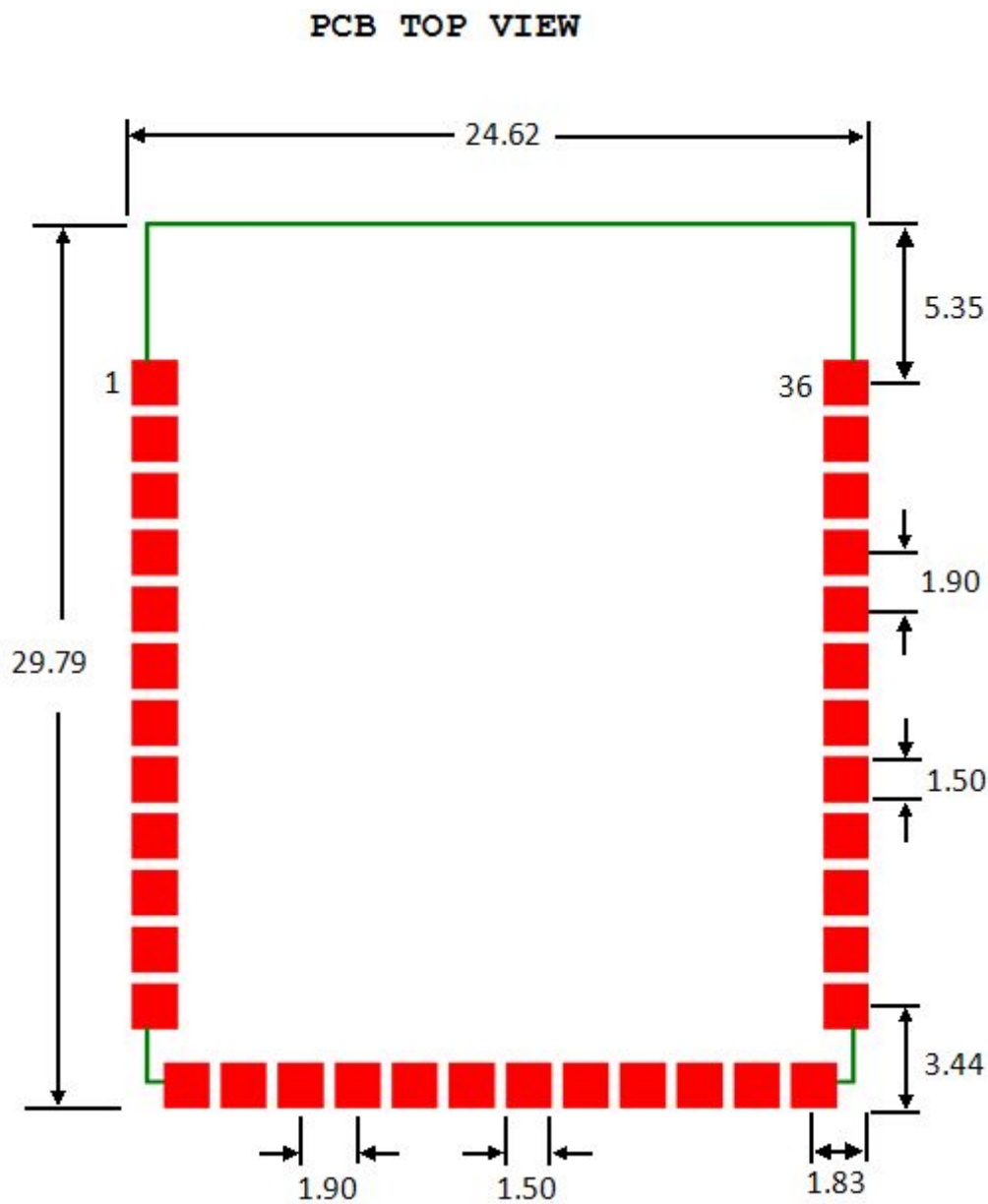


Figure3-4:PCB package (unit : mm)

### 3.5 Reflow Soldering Temperature Graph

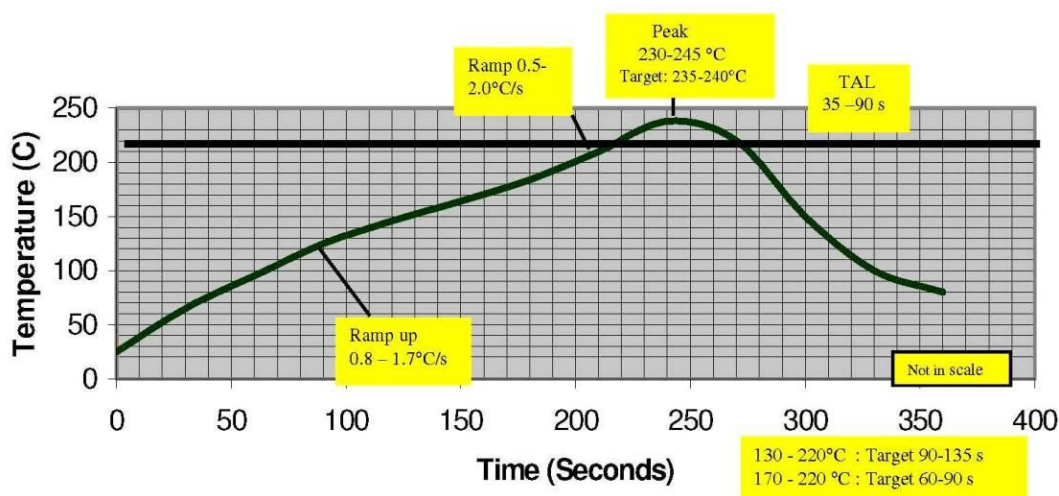


Figure 3-5: Temperature Graph

#### Note:

As shown in Figure, it is based on the SAC305 lead-free tin paste (3% silver, 0.5% copper). Alpha OM-338 lead-free cleaning-free flux is recommended. The Figure 6 is mainly used for guidance. The entire process time is subject to thermal pad number of assembly board and device Intensity.

### 3.6 Baking Instructions

The RAK415 module is very sensitive to water. Be cautious to baking the device. At ambient conditions, it is required that within 168 hours removed from the vacuum packaging, the module should be processed with the circuit board assembly by reflow soldering; Or stored in the environment with a relative humidity below 10%. If the condition is not satisfied, the RAK415 must be processed with a 9-hour baking in the environment of 125 °C before the reflow soldering.

## 4. Electrical Characteristics

### 4.1 Absolute Maximum

The following table shows the absolute maximum. Note that the module device may be damaged when exceeds the maximum. To avoid damages to the module and the device, please operate under specified conditions.

Table 4-1: Parameters and Value Range

Parameters	Symbols	Value	Unit
External supply voltage	VCC3V3	-0.3~4.0	V
Maximum RF Input (Reference: 50Ω)	RFin	+10	dBm
When voltage is 3.3V, IO Max voltage	3V3VinIOMax	VCC+0.3	V
When voltage is 3.3V, IO Min voltage	3V3VinIOMin	-0.3	V
Storage ambient temperature	Tstore	-65~+135	°C
ESD resistance	ESDHBM	2000	V

### 4.2 Recommended Operating Parameters

Table 4-2: Recommended Operating Parameter Range

Parameters	Symbols	Min Value	Typical Value	Max Value	Unit
External voltage	Vcc	3.14	3.3	3.46	V
Ambient temperature	Tambient	-40	--	+85	°C

### 4.3 RF Electrical Characteristics

- **RF Transmit Specifications**

Table 4-3: Partial RF Transmit Specifications

Symbol	Parameter	Conditions	Typical Value	Unit
Ftx	Frequency range	--	2.4	GHz
Pout	Output power	--	--	--
	802.11b	1Mbps	17	dBm
	802.11g	6Mbps	17	dBm
	802.11n, HT20	MCS0	17	dBm
	802.11g, EVM	54Mbps	14	dBm
	802.11n, HT20EVM	MCS7	10	dBm

## • RF Receiver Specifications

Table 4-4: Partial Receiver Specifications

Parameter	conditions	Test conditions	Typical Value	Unit
Receiver sensitivity	11b,1Mbps		-97	dBm
	11b,2Mbps		-92	dBm
	11b,5.5Mbps		-90	dBm
	11b,11Mbps		-88	dBm
	11g,9Mbps		-91	dBm
	11g,18Mbps		-87	dBm
	11g,36Mbps		-81	dBm
	11g,54Mbps		-75	dBm
	11n,MCS1,13Mbps		-89	dBm
	11n,MCS3,26Mbps		-82	dBm
	11n,MCS5,52Mbps		-75	dBm
	11n,MCS7,65Mbps		-72	dBm
Maximum input signal	CH7	11g,54Mbps	10	dBm
Adjacent channel suppression	6Mbps		37	dBc
	54Mbps		21	dBc
	MCS0		38	dBc
	MCS7		20	dBc

## 4.4 MCU Reset

Figure 4-1 shows the MCU reset timing diagram and reset pulse length. When power on the module or an exception occurs, the module needs to be reset. RESET pin is internally pulled up, low input is effective.

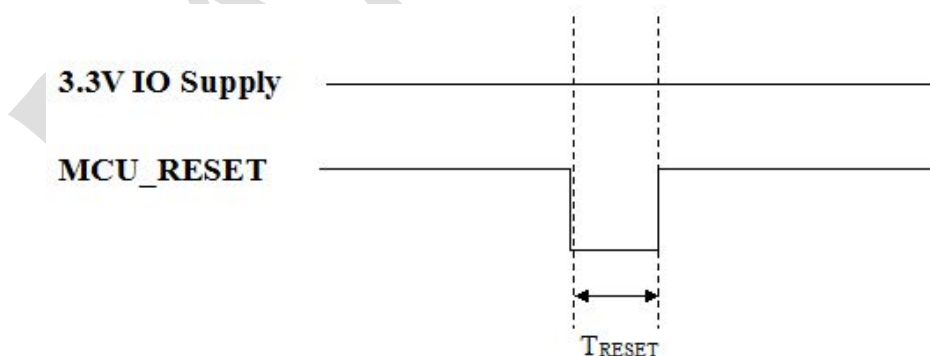


Figure 4-1: MCU Reset Timing

Symbol	Description	typical ( mS )
TRESET	MCU reset pulse length	>10

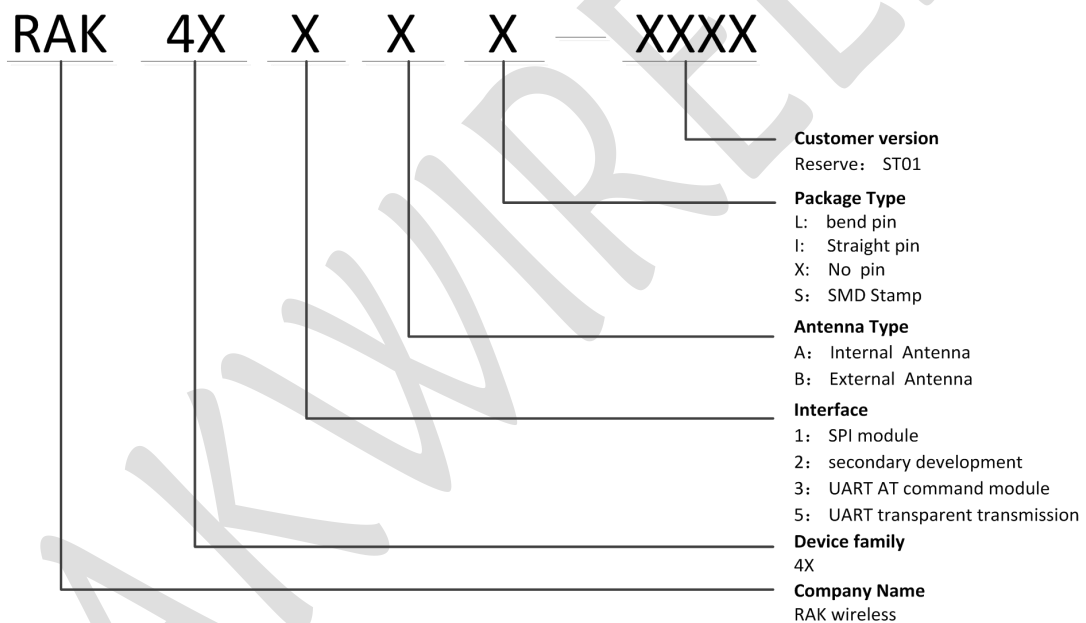
## 5. Order Information

### 5.1 Products

Table 5-1: Product Models

Product	Description	Single Tray Packing	Minimum Package	Development board corresponding model
RAK415AS-XXXX	UART interface module, with on-board antenna	32pcs/tray	320pcs	RAK415AS_EVB
RAK415BS-XXXX	UART interface module, with external antenna	32pcs/tray	320pcs	RAK415BS_EVB

### 5.2 Description



### 5.3 Size

Packaging: Hard plastic pallets

Weight: <=3.00g/pcs

Table 5-2: Module Size

Module	Length and width	Thickness (Height)	Note
RAK415 Module	28.75mm×23.14mm	2.85±0.05mm	Without shield holder
		2.95±0.05mm	With shield holder
		3.30±0.15mm	With shield

Note: In considering height design of the product, please consider your motherboard thickness error and product fit gap (recommended 0.10-0.15mm).

RAK WIRELESS

## 6. Contact information

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## 7. Revision History

Version	Author	Modification	Date
V1.0		Initial Draft	2013-12-08
V1.1		Modified Sales and Service section	2014-01-12
V1.2		Modified partial text editing	2014-02-16
V1.3		Added WPS function	2014-02-20
V1.4		Add module packet Reference design to add a reset circuit and pull up for serial port	2014-02-27
V1.5		optimize the minimum power consumption to 1-2uA	2014-03-28
V1.6		Increase to maintain the lowest power interconnection deleting PCB size chart Modify Pull into the sleep time is 2S	2014-06-09
V1.7		Update the contact way,Update the document format	2014-08-22
V1.8	Lampo	Update the Schematic and packaging(35 interface); Update Ordering Information; Correct electric current unit	2014-09-03
V1.9	Lampo	Replace back to the original 36 interface schematics and packaging; Increase the link pin tips	2014-10-09
V2.0	Lampo	Update the contact way,Update the document format.Add Link lights indicate status.Modify the module size table.	2016-02-23