Industrial Ethernet Port and Serial Port to Wireless WiFi Adapter

FS-WF485IE

User's Manual

FOURSTAR Electronic Technology Co., Ltd.

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Preface

This Manual provides guidance for users using industrial Ethernet port and serial port to WiFi adapter (model: FS-WF485IE), application methods of this product are detailed in this Manual. FS in the model is abbreviation of registered trademark of FOURSTAR Electronic Technology Co., Ltd..

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Version Information

Document name: *User's Manual for Industrial Ethernet Port and Serial Port to Wireless WiFi Adapter*

Version: V2.0

<div align="center">Revision History of Document and Product</div>

Version	Revised on	Reasons
V2.0	2013.10	Create document
	2014.02	Add pictures

Users are advised to read the following related documents:

Guidance for the Installation and Usage of Industrial Wireless Communication Products

Application Test of Industrial Ethernet Port and Serial Port to Wireless WiFi Adapter FS-WF4851E on Various PLC

General Methods for the Realization of PLC Wireless Programming Monitoring

Package Includes

1. FS-WF485IE   1PCS
2. CD   1   (including User's Manual, this product generally needs no software or device driver, but for some applications, virtual serial port software VCOMM and communication test software for Windows/IOS/Android sometimes may be required.)

1. Overview

With the rapid development and popularity of information technology represented by multi-functional mobile media, our daily life and business mode constantly change. For production and safety management of service facilities closely related with production and life, more efficient application system, and other aspects, flexible application of information technology has been paid more and more attentions.

Why wireless?

- Requirements for controlling mobile or rotary equipments;
- Requirements for signal transmission in areas where wire laying is inconvenient or dangerous;
- Communication of equipments at two sides of river, channel, road or railway, and equipments at the area with complex terrain;
- Requirements for rapid, simple installation and start-up;
- Quick access to existing control system;

FOURSTAR timely launches equipment FS-WF485IE which is able to easily convert wired port or serial port (RS232/RS485/RS422) to wireless transmission, and applications, such as remote monitoring and operation which can be realized wirelessly. To achieve transparent wireless transmission of RS232, RS485, RS422 and industrial Ethernet port, original wired transmission can be substituted through simple setting, no need of change of original communication protocol and application software.

Serial port communication of this product transparently transmit data according to UART asynchronous serial port communication protocol, applicable to RS232, RS485, RS422 communication protocols which observe UART asynchronous serial port communication protocol, such as MODBUS protocol, free port communication protocol of Siemens PLC.

As for some field buses, such as PROFIBUS, MPI, PPI, CC-Link, PC-Link, although their physical communication ports are RS485 ports, they don't observe UART asynchronous serial port communication protocol. So, they are inapplicable to this product.

FS-WF485IE adapter supports Station, AP, repeating, bridge connection, WDS and other operation modes, supports remote communication through Internet, and supports communication with handheld terminals, such as mobile phone/Pad with Windows/IOS/Android operating system. This product is designed for industry with auto reconnection function so as to ensure stable and reliable data transmission link. Power supply: 9~40VDC wide range, working temperature: -40℃~+85℃, installation: DIN35mm standard guide rail.

2. Specifications and Main Technical Parameters

Table 2-1 Basic parameters of FS-WF485IE

Category	Item	Parameters
Wireless parameters	Wireless standard	IEEE 802.11 b/g/n
	Frequency range	2.412GHz－2.484GHz
	Emitted power	802.11b: +20dBm (max.)
		802.11g: +18dBm (max.)
		802.11n: +15dBm (max.)
	Receiving sensitivity	802.11b: -89dBm
		802.11g: -81dBm
		802.11n: -71dBm
	Antenna	2.4GHz, 3dBm, SMA male collapsible, rod-like antenna
	Wireless transmission distance	100m (antennas: visible, unobstructed)
Hardware parameters	RS232/RS485/RS422 serial port	Baud rate: 300bps―230400bps
		Data bit: 8/7/6/5
		Check bit: None/Odd/Even/Mark/Space
		Stop bit: 1/2
		RS232 supports RTS/CTS stream control, RS485/422 no stream control
		RS232 max. transmission distance: 30m
		RS485/422 max. transmission distance: 1200m
	Ethernet port	10/100Mbps self-adaption, support Auto MDI/MDI-X
		Max. transmission distance: 100m
	Working voltage and power consumption	9~40VDC, 5W
	Interface isolation	Power – serial port – Ethernet port are totally isolated from each other
	Interface protection	RS485 connector, 500W, anti-lightning surge protection, RS232 and RS422 connector, 5W, surge protection, port isolated and protected
	Working temperature	-40℃~+85℃
	Dimension	85mm×49mm×100mm (L×W×H)
	Weight	200g
	Installation	Installed by DIN35mm standard guide rail
Software	Wireless network type	Station/AP/Lazy/Bridge/Repeater
	Wireless security	WEP/WPA-PSK/WPA2-PSK/WAPI
	Wireless encryption	WEP64/WEP128/TKIP/AES
	Working mode	Data transparent transmission mode

parameters	Network protocol	TCP/UDP/ DHCP/DNS/HTTP/ ARP/ICMP
	Max. Station connections	32
	Max. TCP connections	32
	Setting method for users	Web page setting

3. External Structure and Description of Parts

Figure 3-1 External structure and description of parts for FS-WF485IE

3.1 Ethernet port: Ethernet port is in line with RJ45 standard, speed: 10/100Mbps, self-adaption, support Auto MDI/MDI-X, self-adaptive to straight through cable and crossover cable, the port is internally isolated by network transformer. Please see Table 3-1 for definition of signal.

Table 3-1 Definition of Ethernet port signal
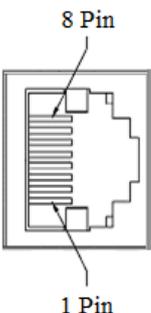
Outline	Pin	Signal name	Function	Type
	1	Tx+	Differential signal line for sending positive-phase Ethernet data	Output
	2	Tx-	Differential signal line for sending negative-phase Ethernet data	Output
	3	Rx+	Differential signal line for receiving positive-phase Ethernet data	Input
	4	Not used	Not used	-
	5	Not used	Not used	-
	6	Rx-	Differential signal line for receiving negative-phase Ethernet data	Input
	7	Not used	Not used	-
	8	Not used	Not used	-

3.2 RS232 port: RS232 port is connected by DB9M male connector, it supports RTS, CTS stream control, its signal definition is the same with computer standard RS232 port, with built-in surge protector. Please see Table 3-2 for definition of signal.

Table 3-2 Definition of RS232 port signal
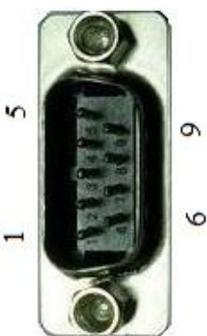
Outline	Pin	Signal name	Function	Type
	1	NC	Not used	-
	2	RXD	Receive RS232 signal	Input
	3	TXD	Send RS232 signal	Output
	4	DTR	Get terminal ready	Output
	5	GND	RS232 signal grounding	-
	6	NC	Not used	-
	7	RTS	Request for sending	Output
	8	CTS	Allow sending	Input
	9	NC	Not used	-

3.3 RS485/422 terminal and power terminal: this product's input power voltage: any DC power between 9 and 40VDC, the internal is isolated by DC/DC. So, power of this product can be supplied by any equipment, no need to consider shared grounding. The RS485/422 port is internally isolated and installed with anti-lightning surge protector. Please see Table 3-3 for

definition of signal.

Table 3-3 Definition of RS485/422 terminal and power terminal signal

Outline	Pin	Signal name	Function	Type
	1	D+	RS485 signal positive	Input/output
	2	D-	RS485 signal negative	Input/output
	3	RXD+	RS422 signal receiving positive	Input
	4	RXD-	RS422 signal receiving negative	Input
	5	TXD+	RS422 signal sending positive	Output
	6	TXD-	RS422 signal sending negative	Output
	7	SG	RS485/422 signal grounding	-
	8	FG	shielded grounding (housing grounding)	-
	9	+9-40V	Externally connect to anode of DC power	Input
	10	0V	Externally connect to cathode of DC power	Input

Please correctly install terminating resistor in accordance with RS485/422 standard:
➢ When RS485 port is used, if FS-WF485IE is at the terminal of RS485 bus, 120Ω terminating resistor shall be connected at D+, D- terminals in parallel; if FS-WF485IE is not at the terminal of bus, terminating resistor is not required to be installed in parallel.
➢ When RS422 port is used, if FS-WF485IE is at the terminal of RS422 bus, 120Ω terminating resistor shall be connected at RXD+, RXD- terminals in parallel; if FS-WF485IE is not at the terminal of bus, terminating resistor is not required to be installed in parallel.

3.4 Antenna: standard antenna configured to this product is 2.4GHz, 3db, SMA inner thread inner pin connector. Users can replace it with other high-gain antenna. If FS-WF485IE is installed inside control cabinet, sucker antenna is required to connect antenna to outside of control cabinet.

3.5 Default button: restore to factory default setting. Press this button for 3s and then release, after a while, Ready indicator is off and on again, which indicates that it is restored to factory setting and restarted. When users forget product's IP address, user name/password, or confused setting of parameters, restore factory setting and re-set parameters.

Factory default setting:
   IP address = 10.10.100.254, user name = admin, password = admin.

3.6 Indicator: there are 5 LED indicators on the panel for indicating working state, as shown in

Table 3-6.

Table 3-6 Descriptions of LED indicators

Indicator	Normally on	Blink	Off
PWR	Power is normal	Failure	Failure or power off
Ready	Successful start-up	Failure	Failure
WLink	WiFi connection	Failure	No WiFi connection
RXD	Failure	Serial port is receiving data	No data transmitted at serial port
TXD	Failure	Serial port is sending data	No data transmitted at serial port

4. Descriptions of Parameter Setting

4.1 Enter parameter setting interface:

FS-WF485IE can directly use IE web browser of Windows system to set parameters. You can enter into parameter setting interface only by inputting IP address of FS-WF485IE in address bar of browser.

● Switch on the power of FS-WF485IE, press Default button for 3s and then release, when Ready indicator is on again, the settings is restored to factory default setting, i.e. IP=10.10.100.254, user name = admin, password = admin.

● Use Ethernet cable to connect port of FS-WF485IE with port of computer (or with port of switch which is in the same LAN with computer).

● Set computer's IP address and FS-WF485IE's IP address in the same network segment, i.e. the first three items of IP address are the same, and the fourth item is different. "Open network and sharing center\Local connection\Property" on the computer, select Internet protocol version 4 (TCP/IPv4), and set computer's IP as 10.10.100.X, in which, X≠254.
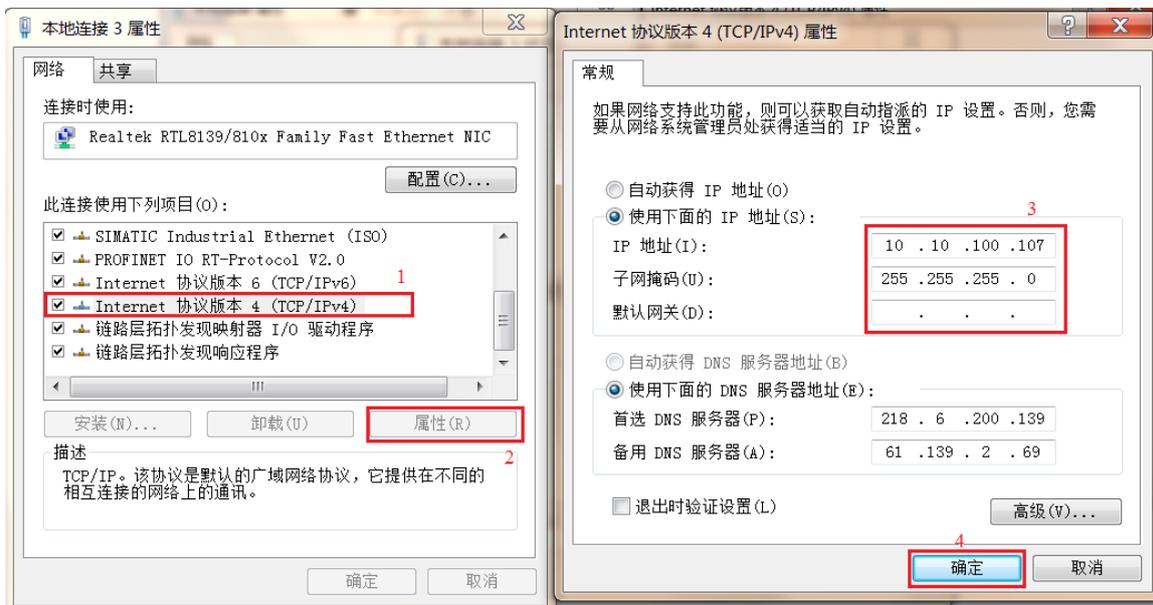
Figure 4-1 Set computer's IP address and FS-WF485IE's IP address in the same network segment

● Input FS-WF485IE's IP address in IE browser's address bar, and input user name and

_____

password in a pop-up window to enter parameter setting interface. There are Chinese and English interfaces, you can select by clicking button at the top right corner.

Figure 4-2 Web setting interface of FS-WF485IE

If you have changed FS-WF485IE's IP address, input new IP address when setting next time. For concise description, we call FS-WF485IE as module for short in the following.

4.2 Mode selection:

As shown in Figure 4-2, module can be set at AP mode or Station mode. Whether it is AP mode or Station mode, "transparent transmission mode" shall be selected in drop-down menu of data transmission mode.

AP mode: the module works as WiFi access point (AP), i.e. the module is to create WiFi wireless network for other WiFi equipments to access, such as module in Station mode, mobile phone, laptop, tablet PC.

Station mode: the module works terminal mode (Station), i.e. module is accessible to WiFi network created by AP mode. Access of mobile phone, laptop and etc to WiFi network belongs to this mode.

After completion of setting, click "OK" button. New setting is effective after restart of module as instructions.

4.3 Setting of wireless access point:

If AP mode is selected in "Mode selection", set AP's parameters in the following interface:

Figure 4-3 Setting of wireless access point AP

- ➢ Network mode: select wireless network protocols, such as IEEE 802.11b, IEEE 802.11g, and IEEE 802.11n. Different standards have different transmission rate, generally mixed mode is selected: 11b/g/n mixed mode.
- ➢ Network name (SSID): give a name for this WiFi wireless network, so as to make wireless terminal equipments able to find this network. You can input English characters as you like, but Chinese characters are not supported. If tick the check box beside "Hide", wireless terminal equipment cannot find this network.
- ➢ Module MAC address: every module has one unique MAC address which is given by manufacturers and can't be changed.
- ➢ Selection of wireless channel: 11 channels between 2.412GHz and 2.462GHz available, generally, select "Auto selection".
- ➢ Wireless distribution system (WDS): click "WDS configuration" button to select Lazy Mode, Bridge Mode, and Repeater Mode. Generally, Disable (WDS forbidden) is selected.
- ➢ Encryption mode: select wireless network's WEP/WPA-PSK/WPA2-PSK/WAPI encryption schemes and set password, wireless terminal equipments can get access to AP wireless network by inputting correct password. If Disable is selected, password is not required.
- ➢ IP address (DHCP gateway setting): module's LAN IP address, all equipments connected under a same WiFi network must have different IPs, and the first three items of these IP

must be the same and the last items are different, that is, different addresses under the same network segment.

➢ Subnet mask: it generally is 255.255.255.0, indicating in the same network segment, i.e. the first three items of IP address are same, and the last items are different.

➢ DHCP type: select as "Server", indicating it can be DHCP address pool server to automatically assign IP address for connected equipments. If "Disable" is selected, forbid assignment of IP address to equipments.

4.4 Setting of wireless terminal:

If Station mode is selected in "Mode selection", set terminal's parameters in the following interface:

Figure 4-4 Setting of wireless terminal (Station)

➢ Name of network connected to module (SSID): manually input network name of wireless AP to be connected to this terminal equipment, or click "Search" button to look for nearby wireless network and get connected. As shown in the following figure, search and select network, and click "Apply" button which will prompt you to input password of wireless network selected by you to enter into this network.
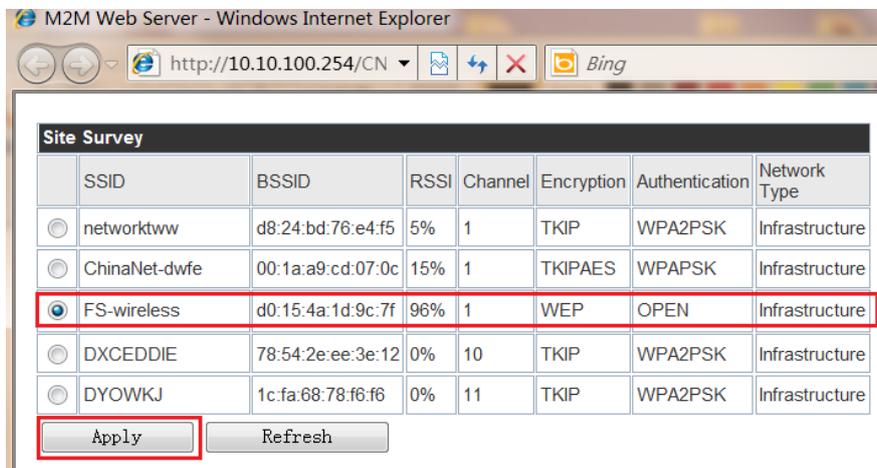
➢ MAC address (optional): input AP's MAC (BSSID) address to bind MAC address. As we know different wireless networks may have same network names (i.e. SSID), but they only have one unique MAC address. Illegal invaders can establish wireless network name with the same SSID to make Station in network connected to illegal AP; potentially information in the network may be leaked. By binding of MAC address, it can effectively prevent Station from connecting to illegal network, so as to improve security of wireless network.

4.5 Setting of serial port and others:

Regardless of AP or Station, setting of serial port and network parameters are required.

Figure 4-5 Setting of serial port and network parameters

➢ Setting of serial port parameters: parameters of serial port of module, including Baud rate, data bit, check bit, stop bit, must be set the same as parameters of serial port of equipment connected to it. Otherwise, communication can't be established normally.
In case of using RS485 and RS422 ports, select "Disable" to forbid hardware stream control (CTS/RTS).
In case of using RS232 port, it may select "Disable" to forbid hardware stream control, only use TXD, RXD, GND lines; or it may select "Enable" to allow hardware stream control, here, RTS and CTS signals at RS232 port are effective.

➢ Serial port auto framing: select "Disable" to forbid serial port auto framing.

➢ Setting of network parameters:
   ■ Server (Server mode): in TCP protocol, if the module works under TCP Server mode, it will not automatically connect to other equipments, but monitor at local port, waiting for connection by Client. Once it is connected with Client, it can conduct two-way communication with Client.
   ■ Client (Client mode): if module works under TCP Client mode, it will automatically connect with TCP Server already set in advance. In case of failure of connection, it

will continuously try to get connected. Once it is successfully connected, it can conduct two-way communication with Client.

■ Protocol: TCP or UDP network protocols can be selected.

TCP is a kind of reliable protocol based on connection. Before data transmission, two-way connection must be firstly established, and disconnected after completion of transmission. When sending data, data can be continuously sent upon confirmation of the host. In case of failure of receiving confirmation of the host or data errors, resending is required to be conducted for several times. TCP communication types include Client and Server. Client automatically gets connected to Server, and Server has to be passively connected to Client, once the connection is established, Client and Server can conduct two-way data transmission at any time.

UDP protocol is a kind of unreliable protocol without connection. In data transmission, conduct data transmission without receiving confirmation of the host. So, UDP protocol doesn't ensure that data packet sent to target host will be correctly received. In some occasions having requirement for higher reliability, ensure the data is correct by upper layer protocol. UDP is a simple communication type. It will not increase extra communication traffic. It can ensure real-time data through communication speed faster than TCP. There is no Server and Client in UDP, both communication sides are peers.

■ Port: protocol port number, port number shall not be port number retained by system. Generally, users use port numbers between 8000 and 65535. When module is under TCP Server mode, port number is the port of module; when module is under TCP Client mode, port number means port number of Server required to be connected.

■ Server address: when module is under TCP Server mode, IP address of this Server is module's IP address, i.e. IP address set under "Setting of wireless access point", and same as default IP address: 10.10.100.254. When module is under TCP Client mode, this address means Server's IP address required to be connected by Client. When module is set under UDP protocol, this address means IP address required to be connected by module.

■ Max. TCP connections: when module works as TCP Server, maximum 32 TCP Clients are allowed to be connected.

4.6 Module management:

模式选择

无线接入点设置

无线终端设置

串口及其它设置

模块管理

4.02.10.C5307

设置用户名密码，恢复出厂设置及更新软件。

管理者设置	
帐号	admin
口令	admin

确定   取消

重启模块	
重启模块	重启

恢复出厂设置	
恢复出厂设置按钮	恢复出厂设置

软件升级	
软件位置：	浏览...

确定

Figure 4-6 Module management

➢ Setting of administrator: user name and password of module can be set and changed.
➢ Restart module: after completion of parameter setting, restart module, or switch the power off and switch on again, thus, new parameters can be effective.
➢ Restore to factory setting: get all parameters of module restored to factory setting.
➢ Upgrade software: upgrade internal firmware of module.

5. Change Ethernet Port to Wireless WiF

Now, lots of industrial equipments are equipped with Ethernet port. Compared with RS232/RS485 ports, it is faster and more reliable if Ethernet is used for data exchange. Figure 5-1 shows typical network topological structure of industrial Ethernet control system. Equipments are connected by Ethernet switch for communication through Ethernet cables.
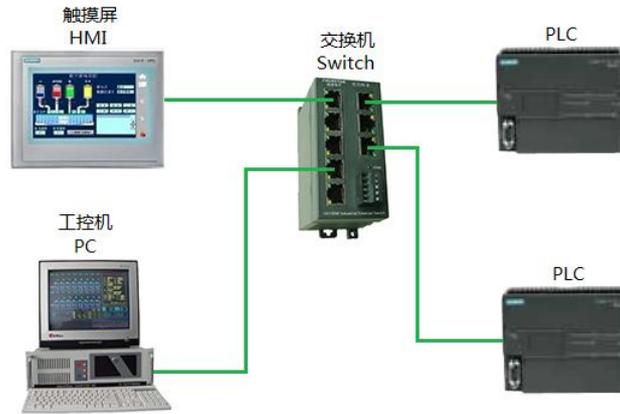
Figure 5-1 Network topology for wired connection of industrial Ethernet

In some occasions not convenient for wiring, these industrial equipments shall be connected wirelessly for data transmission with each other. It is required that any setting of original system shall not be changed, it's plug and play. FS-WF485IE's port to wireless WiFi function is especially designed for turning industrial Ethernet into wireless communication. Transparent transmission of data from Ethernet to wireless WiFi can be realized. After it is converted to wireless transmission by FS-WF485IE, all parameters, such as IP addresses, and application methods of all equipments are the same with that in wired connection, as shown in Figure 5-2.

Figure 5-2 Network topology for Ethernet to wireless WiFi

Setting is very simple:

➢ Get one computer separately connected with every module according to "4. Descriptions of parameter setting" for separate setting.

➢ Set any one of the modules as AP.

➢ Set other modules as Station (STA), and establish wireless WiFi connection with AP, no need of setting other parameters.

➢ After completion of setting, use Ethernet cable to get module's port connected to corresponding equipment port, and switch the power of equipment and modules on again.

At this time, IP addresses for every equipment (PLC, PC, HMI) still are the previous IP addresses of initial wired connection. Ports of AP module and STA module are for transparent transmission, not for address conversion. In order to avoid auto assignment of IP address to connected equipments by FS-WF485IE (if connected equipments is set as "Auto obtaining IP address"), you can forbid FS-WF485IE's DHCP Server.

6. Change RS232/RS485/RS422 Serial Port to Wireless WiFi

FS-WF485IE is able to realize transparent wireless transmission of RS232, RS485 and RS422, no need of change of original communication protocols and software, original serial port cable can be substituted by simple setting. Any serial port on FS-WF485IE adapter can be used, no need to turn on/off or select jumper. Several serial ports on FS-WF485IE can't be used simultaneously. As for RS485, RS422 ports, 120Ω terminating resistor must be correctly connected with them.

Serial port of this product transparently transmits data according to UART asynchronous serial port communication protocol, and it applicable to various RS232, RS485, RS422 communication protocols which observe UART asynchronous serial port communication protocol, such as MODBUS protocol, free port communication protocol of Siemens PLC.

Please note: as for some field buses, such as PROFIBUS, MPI, PPI, CC-Link, PC-Link, although their physical communication ports are RS485 ports, they don't observe UART asynchronous serial port communication protocol. So, they are inapplicable to this product!

Serial port to wireless WiFi can be realized by TCP or UDP protocol. There are many setting methods. The followings are common points for setting. They will not be stated again later in this document.

➢ The communication between modules which is in AP mode and module which is in Station (STA) mode can be conducted on condition that wireless WiFi connection is established.

➢ Set IP addresses of every module in the network to different addresses under same network segment, i.e. the first three items of IP are same, and the fourth item is different.

➢ Parameters of serial port of module, including Baud rate, data bit, check bit, stop bit, must be set the same with parameters of serial port of equipment connected with it. Otherwise, communication can't be conducted normally.

➢ Forbid "Serial port auto framing".

➢ Please use port number between 8000 and 65535.

6.1 Setting of TCP point-to-point connection:

As shown in Figure 6-1, module in the left is set to AP mode, WiFi network name SSID and IP address can use default setting: FS-B11_AP and 10.10.100.254, network protocol is set as TCP Server (Server), port: 8899. Module in the right is set to STA mode (Station), SSID is set to SSID (FS-B11_AP) of AP to be connected, IP address is set different from addresses of other equipments under the same network segment in the network (the first three items of IP are same, the fourth item is different), e.g. 10.10.100.100 the default is DHCP, network protocol is set as TCP Client, IP address and port to be connected are set to IP address and port of module in the left.

After start-up of Client module in the right, it will look for AP whose SSID is FS-B11_AP and establish wireless WiFi connection with it. Then, TCP Client automatically initiates the connection with TCP Server. After establishment of TCP connection, serial ports at two sides are able to transparently transmit data.
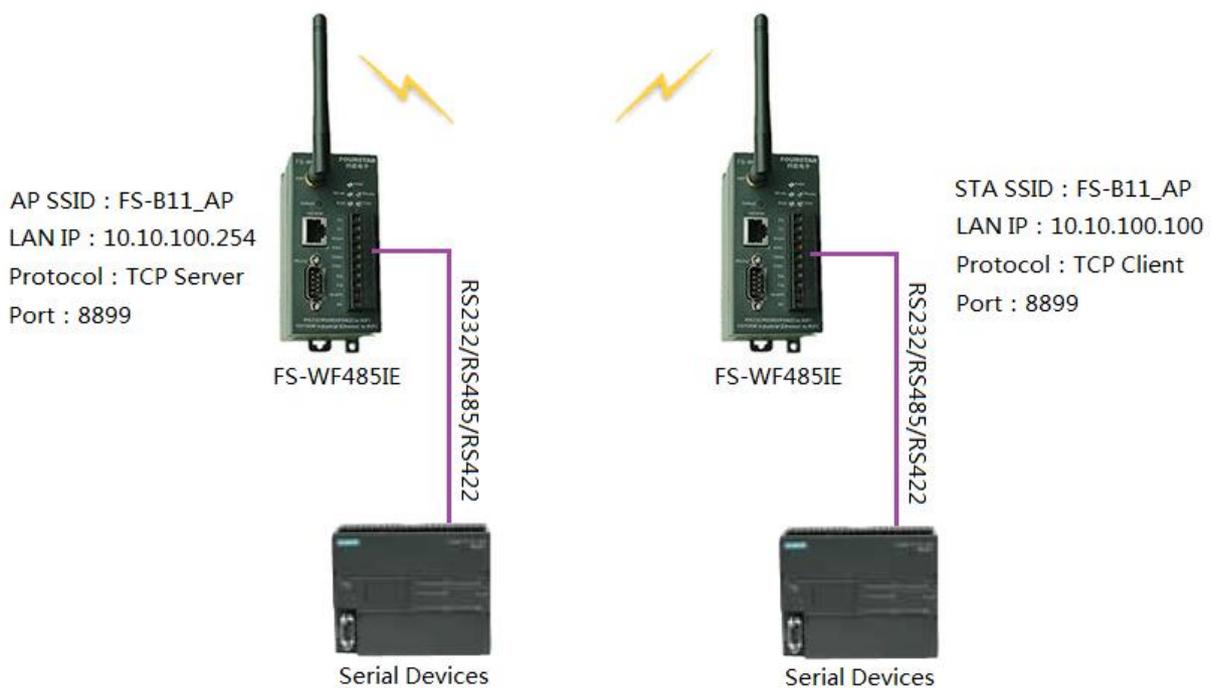
Figure 6-1 TCP point-to-point connection

6.2 Setting of TCP point-to-multipoint connection:

As shown in Figure 6-2, each STA module has established WiFi connection with AP module, every TCP Client connects to TCP Server, maximum 32 TCP Clients are allowed to connect to one TCP Server. After establishment of connection, data sent out by TCP Server can be received by every TCP Client simultaneously; data sent out by every TCP Client can be received by TCP Server; data can't be transmitted among TCP Clients. By this way, master-slave wireless communication of RS485 can be easily realized, TCP Server is RS485's master station, other TCP Clients are RS485's slave stations, master station exchanges data with every slave station by turns, and communication can't be conducted between slave stations.

AP SSID : FS-B11_AP
LAN IP : 10.10.100.254
Protocol : TCP Server
Port : 8899

STA SSID : FS-B11_AP
LAN IP : 10.10.100.100
TCP Client 10.10.100.254：8899

PC

FS-WF485IE

FS-WF485IE

Serial Devices

STA SSID : FS-B11_AP
LAN IP : 10.10.100.101
TCP Client 10.10.100.254：8899

FS-WF485IE

Serial Devices

RS485

Serial Devices

FS-WF485IE

Serial Devices

STA SSID : FS-B11_AP
LAN IP : 10.10.100.102
TCP Client 10.10.100.254：8899
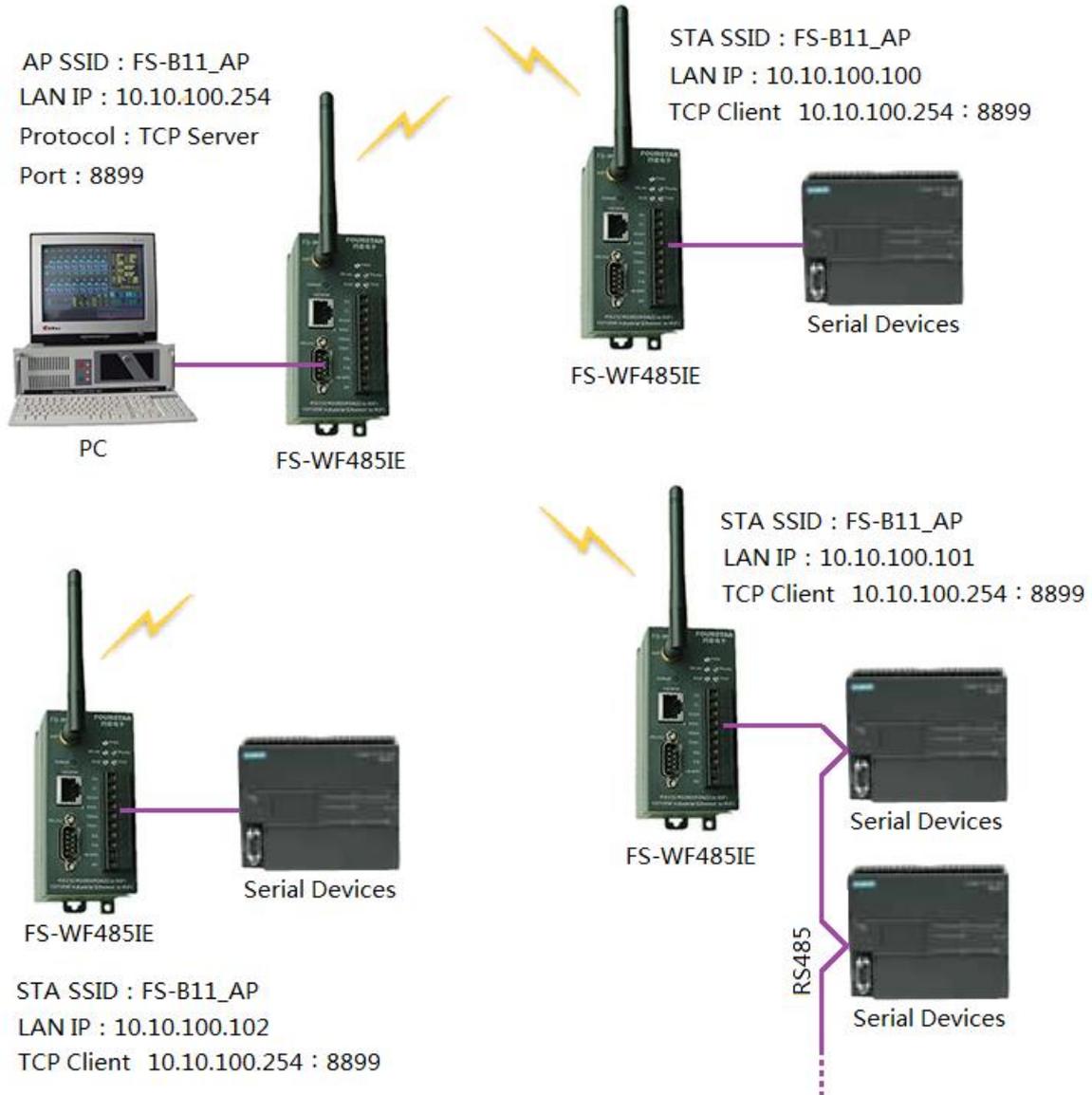
Figure 6-2 TCP point-to-multipoint connection

6.3 Setting of wireless connection to FS-WF485IE by computer:

Set FS-WF485IE as AP and TCP Server, use wireless LAN card of laptop, tablet PC, and intelligent mobile phone to make WiFi connection with it; install virtual serial port software VCOMM on the computer, set it to TCP Client mode to establish TCP connection with FS-WF485IE which is a server, and then serial port of equipment is mapped to the computer. By this way, original application software can be used to communicate with equipment.

By this way, wireless communication, programming, monitoring between computer and various PLC are easily realized, no need of connection of cables and no worry about burning-out of communication port caused by plugging and unplugging live cables. To use, plug the RS232 plug of different PLC programming cables into the RS232 port of FS-WF485IE, and get the other end plugged into corresponding PLC programming port.

Please refer to *Application Test of Industrial Ethernet Port and Serial Port to Wireless WiFi Adapter FS-WF4851E on Various PLC* and *General Methods for the Realization of PLC*

Wireless Programming Monitoring for the setting of serial port parameters and other details.
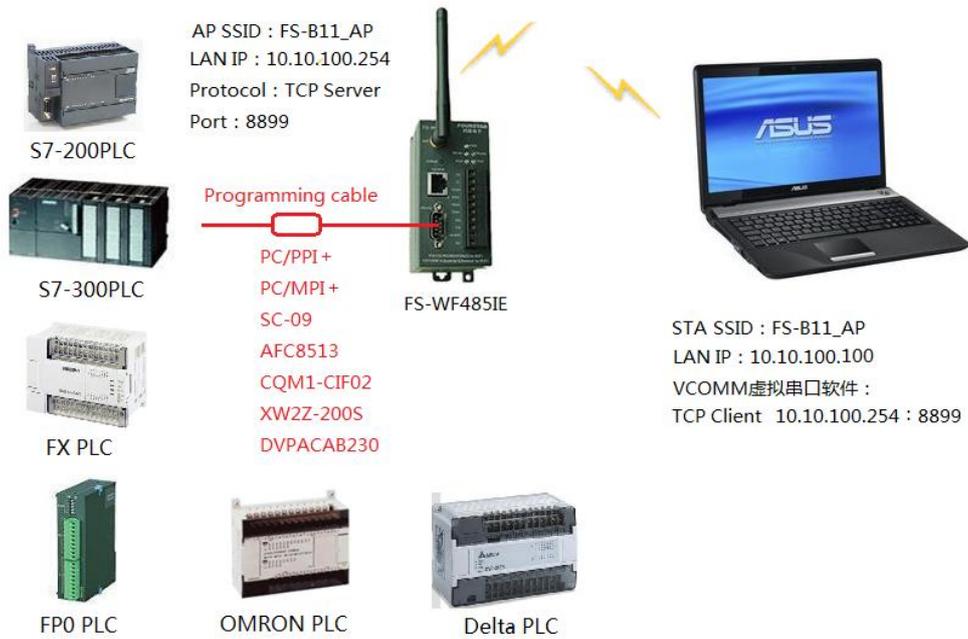
Figure 6-3 Wireless connection to FS-WF485IE by computer

6.4 Setting of unicast point-to-point connection:

As shown in Figure 6-4, one module works as AP, the other module works as SAT, establish wireless WiFi connection. Two modules are set with different LAN IP addresses under the same network segment: 10.10.100.254 and 10.10.100.100, select UDP protocol (no Server and Client in UDP protocol), two modules connect to each other's IP address and same port number 8899.

Figure 6-4 UDP unicast point-to-point connection

Please note:

Module doesn't support UDP multicast. Don't try to set UDP multicast address 224.0.0.0~239.255.255.255 for module. Otherwise, module will not be able to start.

7. Change RS232/RS485/RS422 Serial Port to Ethernet Port

Serial port to Ethernet also can be realized by FS-WF485IE, no need of using wireless WiFi function. The module can't close WiFi, so users can set all modules to AP. If certain module is set to STA and it establishes wireless WiFi connection with AP, which means that the switch's port short-circuited. Thus, address conflict will occur, which will lead to abnormal operation of whole network.

Functions and change methods of serial port to Ethernet are the same as that of "6. Change RS232/RS485/RS422 Serial Port to Wireless WiFi"; the difference is that Ethernet cable is used to get modules connected by Ethernet switch here.

7.1 Setting of TCP point-to-multipoint connection:

As shown in Figure 7-1, get every module connected to Ethernet switch though Ethernet cable, every TCP Client connects to TCP Server, and maximum 32 TCP Clients are allowed to connect to one TCP Server. After establishment of connection, data sent out by TCP Server can be received by every TCP Client simultaneously; data sent out by every TCP Client can be received by TCP Server; data can't be transmitted between TCP Clients. By this way, master-slave network of RS485 can be easily established, TCP Server is RS485's master station, other TCP Clients are RS485's slave stations, master station exchanges data with every slave stations by turns, and communication can't be conducted between slave stations.
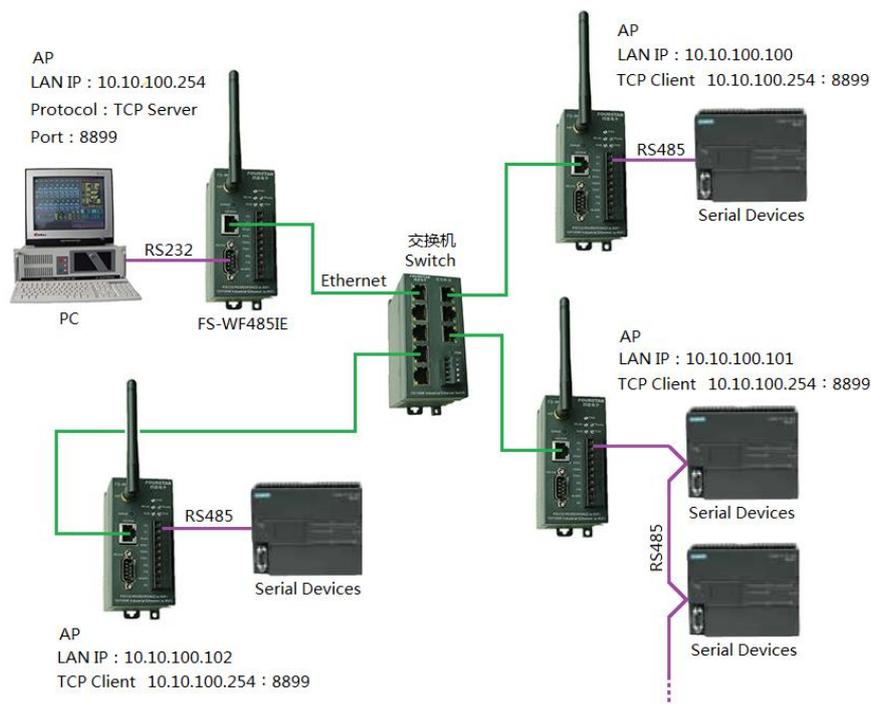
Figure 7-1 TCP point-to-multipoint connection

7.2 Setting of UDP unicast point-to-point connection:

As shown in Figure 7-2, get two modules connected to Ethernet switch via Ethernet cable or directly get them connected via Ethernet cable. Set every module with different LAN IP address to the same network segment (the first three items are same, the fourth item is

different), select UDP protocol, input IP address of the other module to be connected in "Server address" input field.

Figure 7-2 UDP unicast point-to-point connection

Please note:
The module doesn't support UDP multicast. Don't try to set UDP multicast address 224.0.0.0~239.255.255.255 for module. Otherwise, module will not be able to start.

7.3 Change Ethernet port and serial port simultaneously to wireless WiFi:
Ethernet port and serial port can be simultaneously converted to wireless WiFi by FS-WF485IE. A device can be used for several purposes without affecting each other and it saves investment for users. Ethernet port to serial port and serial port to Ethernet also can be realized. In fact, serial port, Ethernet port and WiFi are inter-connectable. Only after setting of module according to change serial port to WiFi (whether TCP protocol or UDP protocol is used), data can be transparently transmitted between the two modules' ports.
As shown in Figure 7-3, wireless WiFi communication between 1# touch screen port and 2# PLC port is established; wireless WiFi communication between 3# PLC's RS485 port and 4# PLC's RS485 port is established, and both of them don't affect each other.
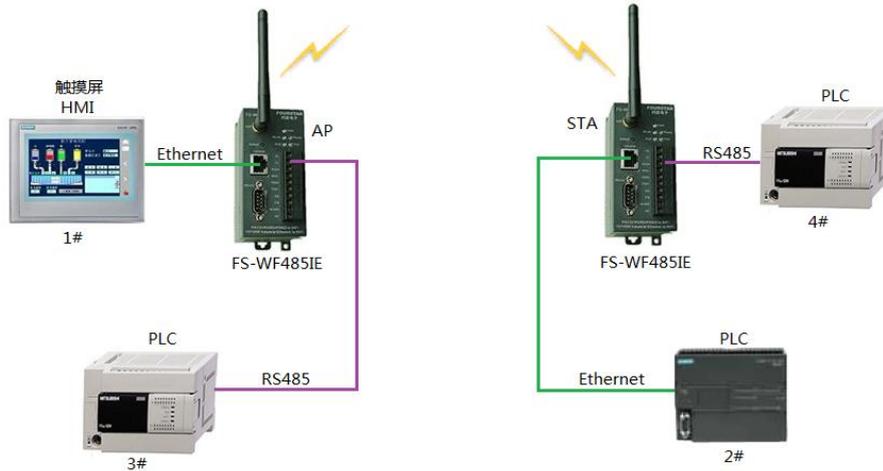
Figure 7-3 Port and serial port simultaneously to WiFi

Actually, after establishment of wireless WiFi connection among FS-WF485IE modules, data among their ports, serial ports and WiFi is inter-connected, ports, serial ports and WiFi can be connected to each other, therefore applications are flexible. In practice, users may find many interesting ways of connection and practical uses.

8. Communication with Mobile Phone and Tablet PC with ISO/Android/Win Operating System

Communication between smart phones/tablet PCs through FS-WF485IE can be realized. Currently, mobile phone operation systems, such as ISO (iPhone, iPad), Android (Samsung mobile phone, tablet PC), and Windows, are supported. Set FS-WF485IE as AP, establish connection between WiFi of mobile phone/tablet PC and such AP, and then communication can be established between these devices. There are lots of communication test softwares on the Internet. Users can enter into mobile phone application software store, such as App Store, input key words "TCP testing tools" or "Network testing tools" and download it. Users can develop suitable application software by themselves.

Figure 8-1 Communication between mobile phone and FS-WF485IE

9. Extension of Wireless WiFi Coverage

When antennas of AP and STA are connectable with each other, theoretical range (connection range) of wireless WiFi coverage (transmission distance of wireless signal) is 100m (in open area, it can reach 300m by actual measurement); in obstructed area, transmission distance of WiFi signal would greatly decreases. Optional methods in the following can be adopted to extend wireless WiFi coverage and to increase transmission distance:

➢ Replace the antenna with high-gain antenna, such as high-gain sucker antenna, omnidirectional antenna, directional antenna, planar array.

➢ Install 2.4G signal amplifier at antenna interface of FS-WF485IE.

➢ Install WiFi signal repeater or bridge.

➢ Install several APs to extend WiFi signal coverage.

FS-WF485IE can used as WiFi signal repeater and bridge, as shown in Figure 9-1. Users can enter by clicking "WDS configuration" button in "Wireless access point setting" page in webpage setting interface. **As module of repeater and bridge, the same wireless channel must be selected, "Auto selection" can't be chosen, and the module shall have the same wireless network name SSID.** Currently, only one-to-one connection, i.e. WDS1, is supported when FS-WF485IE is used as repeater or bridge.
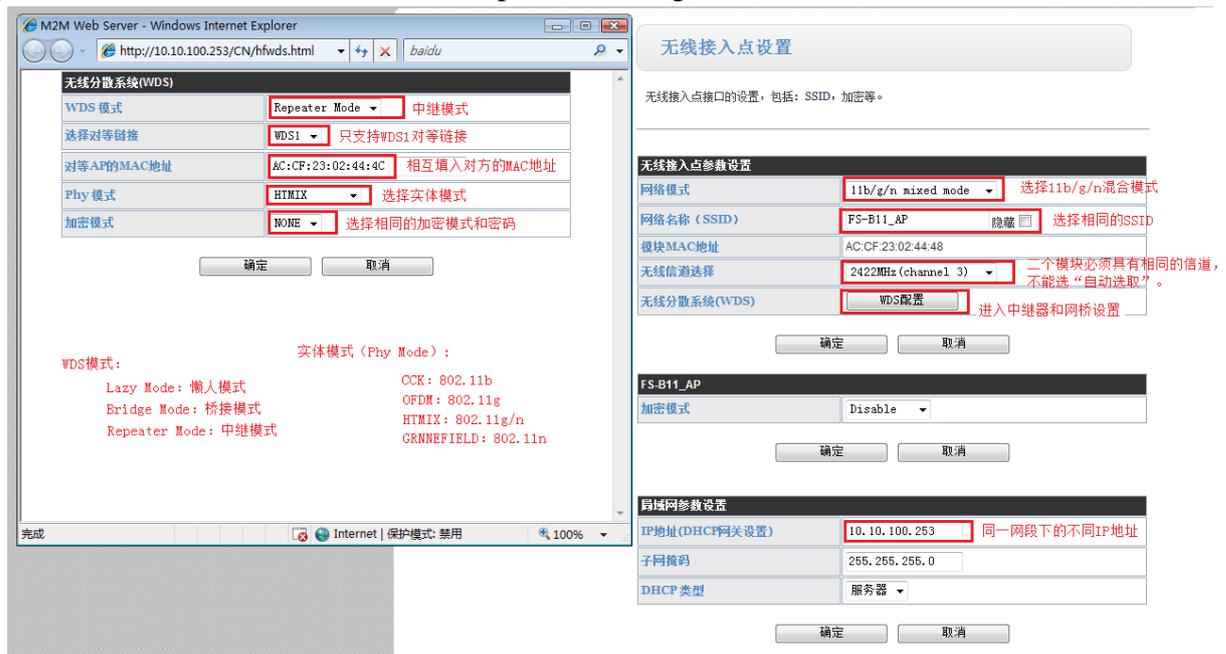
Figure 9-1 Setting interface of repeater or bridge

9.1 Set FS-WF485IE as WiFi repeater (Repeater Mode):

If it needs to set FS-WF485IE as repeater, input MAC address of AP to be connected in "MAC address of peer AP" test box, as shown in Figure 9-2. Input MAC address of AP2 in AP1, input MAC address of AP1 in AP2. Wireless WiFi signals of AP1 and AP2 are combined, and larger coverage is obtained. STAs in such coverage can use the same SSID (FS-B11_AP) and password to connect to AP in this larger coverage.
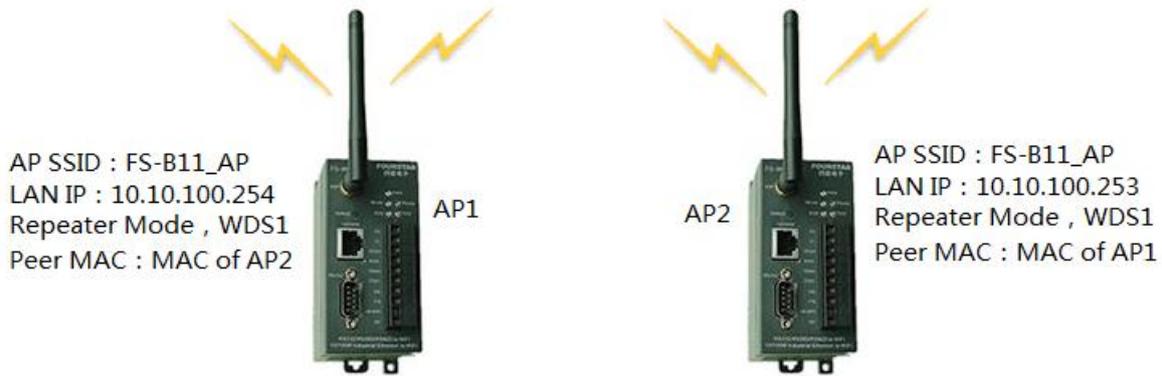
Figure 9-2 Repeater Mode

9.2 Set FS-WF485IE as WiFi Bridge (Bridge Mode):

Setting method of Bridge Mode is the same as that of Repeater Mode; the difference is AP module which works as bridge doesn't accept access of STA, only bridge modules can communicate with each other. As shown in Figure 9-3, only AP1 and AP2 can communicate with each other, STA module can't search for WiFi signals of AP1 and AP2. Wireless bridge usually is used for connection of LANs between two buildings.

Figure 9-3 Bridge mode

9.3 Set FS-WF485IE to lazy mode (Lazy Mode):

Lazy Mode is also known as self-learning mode. This mode belongs to passive mode, that is, it can identify and accept access of AP from other Repeater Mode. It doesn't actively connect to others. In Figure 9-4, AP1 is set to lazy mode, waiting for connection; AP2 is set to repeater mode, actively connecting to AP1. If AP2 is under repeater mode, it is the same with repeater mode stated in 9.1 after establishment of connection; if AP2 is under bridge mode, it is the same with bridge mode stated in 9.2 after establishment of connection.

AP SSID : FS-B11_AP
LAN IP : 10.10.100.254
Lazy Mode , WDS1
AP1

AP2
AP SSID : FS-B11_AP
LAN IP : 10.10.100.253
Repeater Mode , WDS1
Peer MAC : MAC of AP1

Figure 9-4 Lazy mode

Adopt Ethernet switch to connect several APs, so as to extend wireless WiFi coverage. Set every AP to have the same SSID (wireless WiFi network name), same encryption mode and password to realize roaming of STA. This is very helpful to mobile equipments. When STA moves from one AP coverage to the other AP coverage, it will automatically connect to AP with stronger signal, switching time is about 3s.

9.4 Solution of coverage extension by connection of several APs to switch
As shown in Figure 9-5, get several APs connected to Ethernet switch via Ethernet cable to extend WiFi signal coverage. Every STA only needs to establish wireless WiFi connection with an AP with the same SSID names and passwords. In the Figure, AP1, AP2 and AP3 are set to have the same SSID name and password. Thus, any STA can establish communication in such three AP coverage.
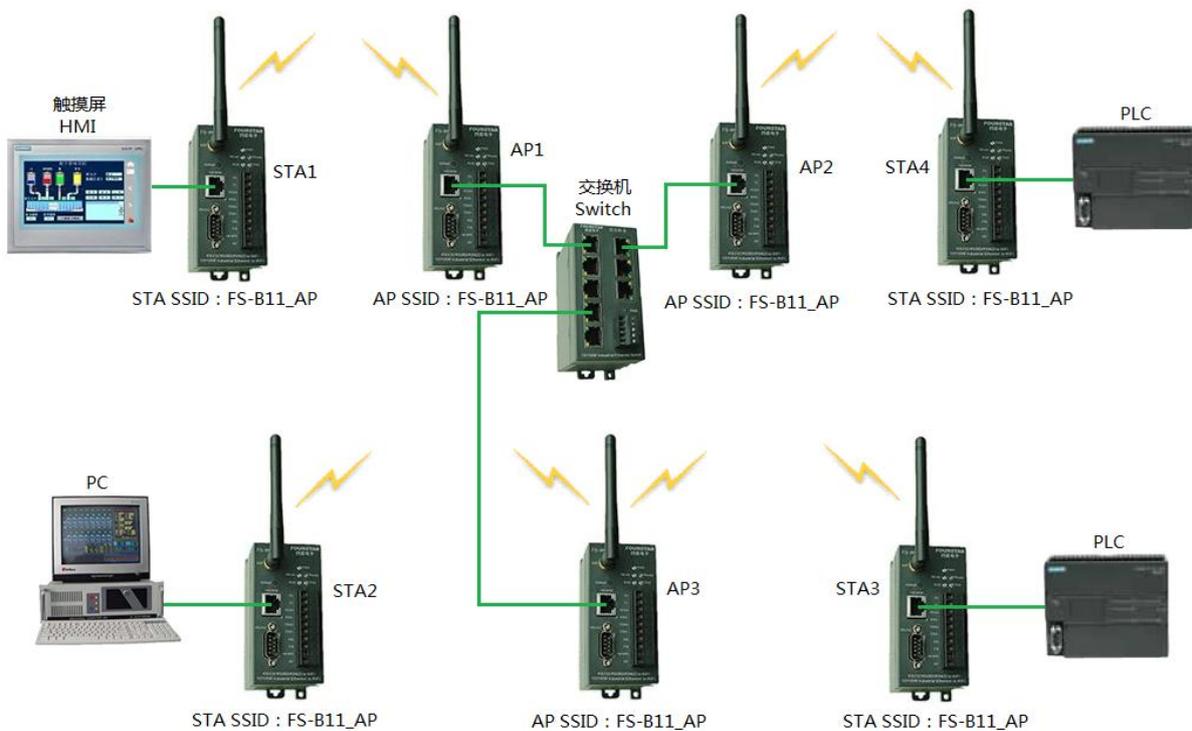
Figure 9-5 Solution of coverage extension by connection of several APs to switch

10. Remote Communication via Internet

FS-WF485IE is able to conduct remote communication by VPN (virtual private network) through Internet. Installation of a wireless router supporting VPN is required, as shown in Figure 10-1. LAN IP addresses of Ethernet equipment (such as PLC1) and FS-WF485IE using serial port are set to have different IP addresses under same network segment of router (in the Figure, PLC1 IP = 192.168.120.100, LAN IP of FS-WF485IE connected with PLC2 = 192.168.120.101), two FS-WF485IE establish wireless WiFi with router AP. After remote computer has established VPN connection with router, it can be viewed that all equipments are in the same LAN, application programs in remote computer can directly access PLC1's port or PLC2's port through virtual serial port software VCOMM. FS-WF485IE does not support mapping of router port or DMZ access.

Setting of FS-WF485IE in Figure 10-1:

➢ FS-WF485IE connected with Ethernet port equipment PLC1 only needs to set to establish wireless WiFi connection, no need of setting other parameters. Of course, PLC1's IP address is the LAN address of the same network segment under router.

➢ FS-WiF485IE connected with serial port equipment PLC2 needs to set to establish wireless WiFi connection. In addition, network protocol (TCP or UDP), LAN IP, port number, serial port parameters are required to be set. FS-WiF485IE must be set as Server, but a remote computer shall be set as Client.
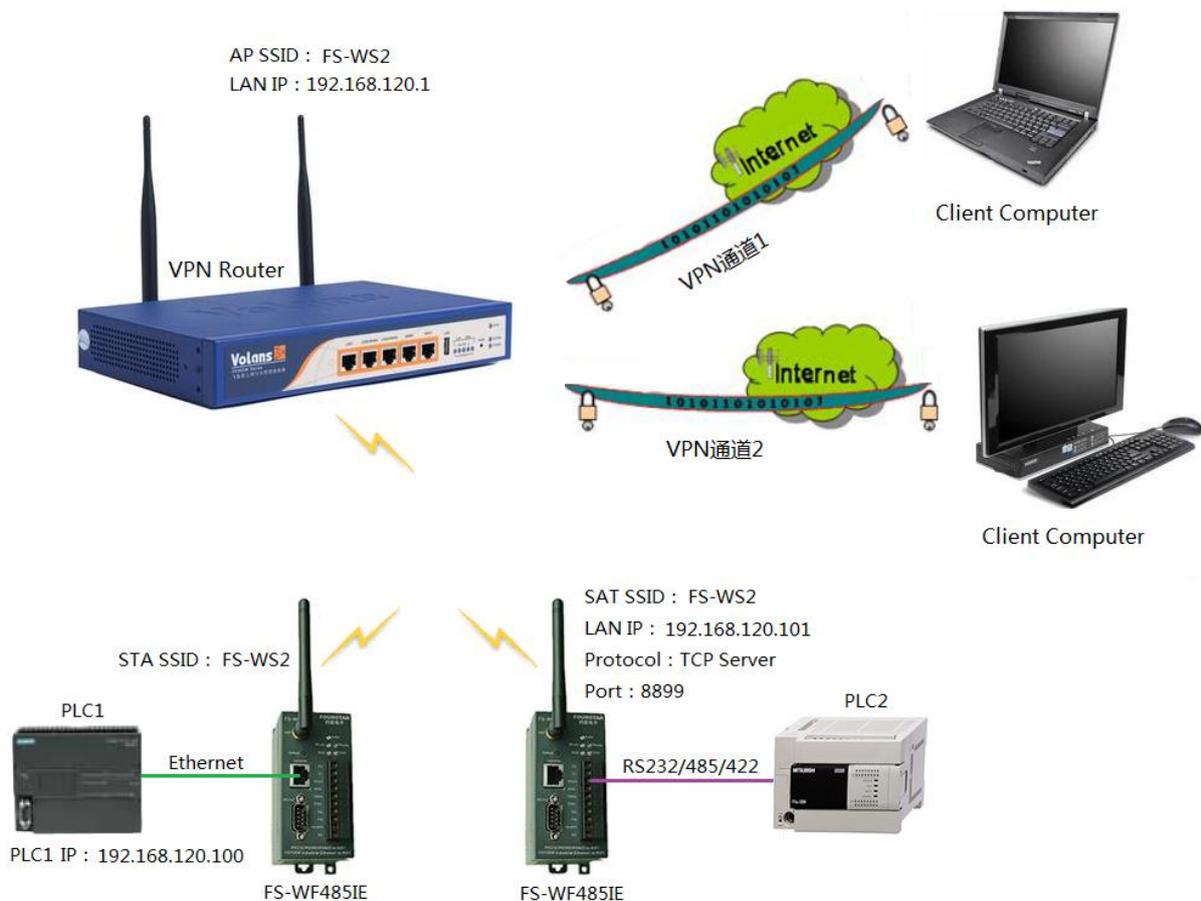
Figure 10-1 Remote communication via Internet

Take router of Tomato Firmware V1.28.0542 firmware as an example. Setting method to establish PPTP VPN for router and Client computer is briefly introduced. As for other ways to establish VNP connection, please refer to the product manual for router.

10.1 Setting of VPN router:

Connect router's LAN port to computer's Ethernet port though Ethernet cable, input router's IP address in address bar of IE, and then input user name and password according to instructions to enter router setting page.

● Set router's WAN parameters. Set WAN port parameters according to the Internet access service provided by the Internet service provider, user name, password and others provided by provider to make this router access to Internet normally.

● Set router's LAN parameters. In this example: router's IP address (gateway) = 192.168.120.1, subnet mask = 255.255.255.0. Please note: this router's IP address can't be the same IP address of router for Client (router connected with remote computer in Figure 10-1, not displayed in this Figure) (if Client gets access to Internet by router).

Figure 10-2 Set WAN port parameters and router's IP address

● Set router's wireless WiFi parameters

Figure 10-3 Set router's wireless WiFi parameters

In this example, router's IP address is 192.168.120.1. If you need to enter the router setting next time, computer's IP address is required to be changed to 192.168.120.X, and input 192.168.120.1 in address bar of IE browser.

● Set dynamic domain name. Router's external network address is different after starting router every time. This is because router is assigned with an IP address from Internet randomly when router is powered on every time. So, it causes trouble to access Internet via the router. There are two solutions to this problem:

Purchase a fixed IP address from an Internet service provider, but the cost is high.

Use domain name resolution. Apply a free or paid domain name from dynamic domain name service provider to substitute IP address with domain name. By this way, no matter how IP address changes, domain name will lead to IP address in real time after resolution of domain name, which is like the ordinary access to the Internet.

In this example, we have applied to dynamic domain name service provider 3322 for a domain name: fourstar-dy.3322.org. You can see this domain name is already under operation after inputting user name and password on the router.

Figure 10-4 Set dynamic domain name on the router

● Set VPN Server of PPTP protocol. Please note: VPN's segment address 192.168.10.X shall not be same with LAN's segment address 192.168.120.X. In PPTP user list, input Client's user name and password, and then click "Add" button to add Client's VPN user. Then remote Client computers can use this user name and password to establish VPN connection of PPTP protocol with this VPN router.

As shown in Figure 9-5, we have set six PPTP Client users: user1, user2, ……user6.
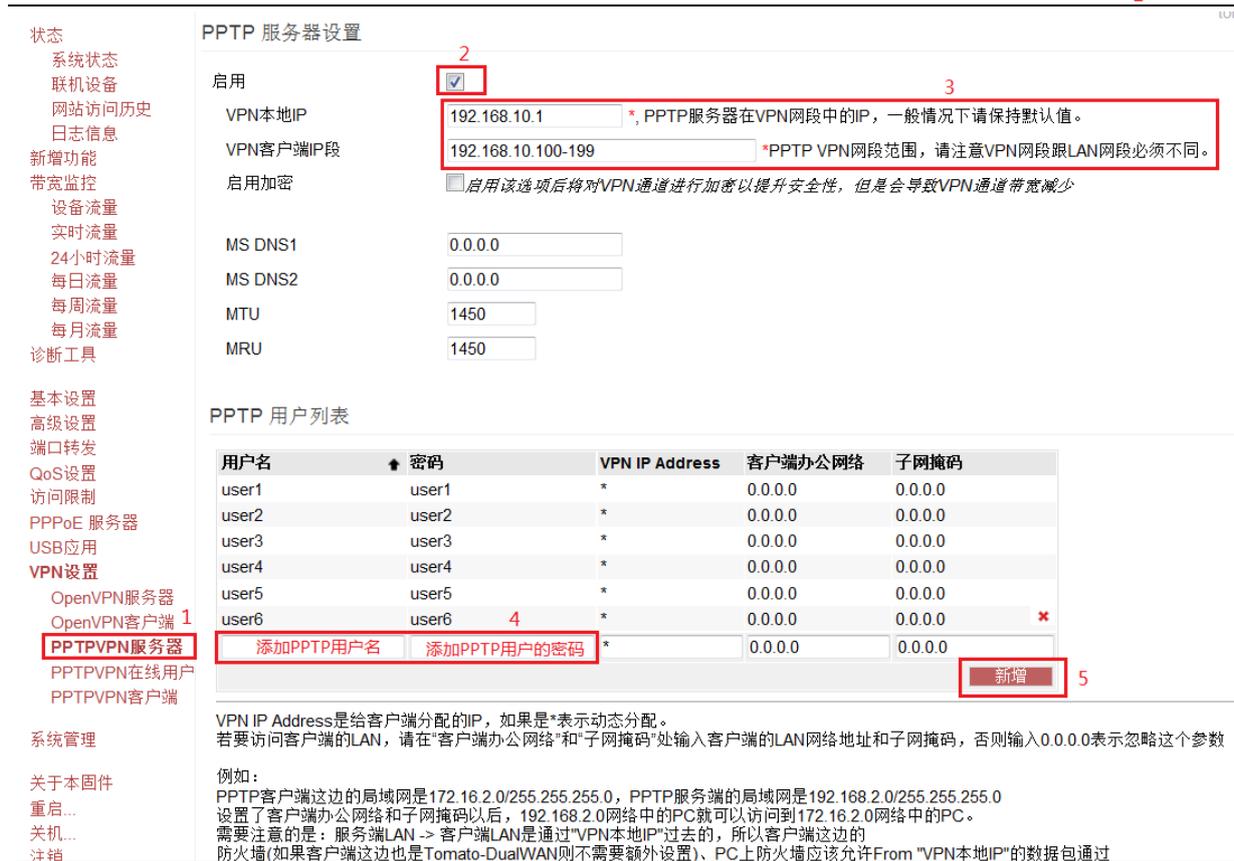
Figure 10-5 Set VPN Server of PPTP protocol and add Client PPTP user

After completion of setting in every page, don't forget clicking "Save" button to save set parameters. If necessary, restart router, and then check whether all the settings are correct, and check whether Internet is accessible by connecting computer to router.

10.2 Establish VPN connection of PPTP protocol on Client computer.

Make sure VPN router and remote Client computer are able to get access to Internet. If Client computer gets access to Internet through router, make sure IP address of router at Client side is different from IP address of VPN router at Server side. Now you can establish PPTP VPN connection on Client computer.

The interfaces for setting of VPN connection are slightly different in different operation systems. However, basic setting are the same. We take Windows 7 as an example to explain method for setting PPTP VPN connection.

● Open Windows's "Network and sharing center" -> click "Set up a new connection or network"   -> click "Connect to a Workplace".

Figure 10-6 Set VPN connection

● Select "Create new connection", input domain name which has already successfully tested on VPN router in Internet address text box, and input such connection's name named by you in Destination name text box.
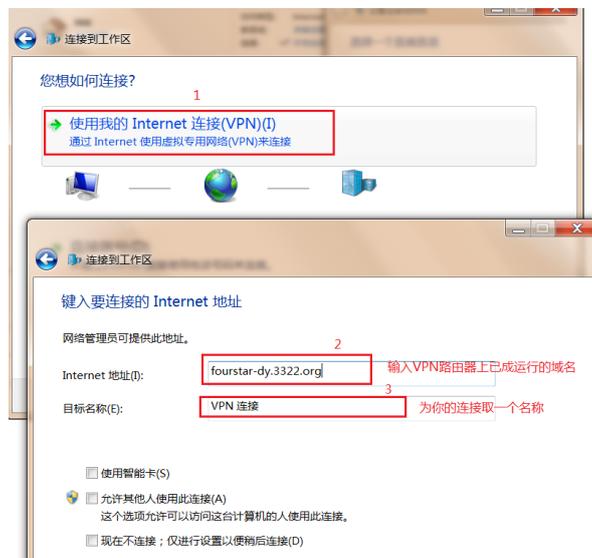
Figure 10-7 Set domain name and name connection

● Input PPTP user name and password that you successfully set on VPN router, and click "Connect" button, after a while, a window showing successful connection appears.
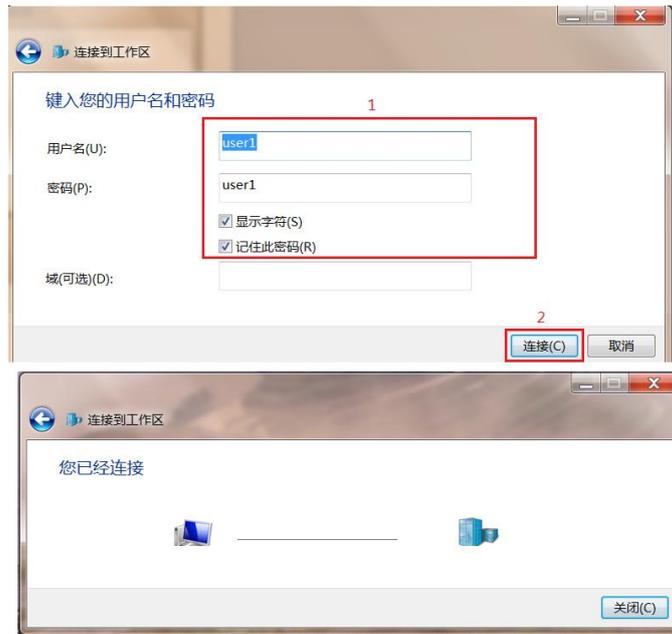
Figure 10-8 Set VPN connection

● Click connection icon in the taskbar, point mouse to the connection name you set just now and right click, select "Properties" to change property of this VPN connection, and select "Point-to-point tunneling protocol (PPTP)" in "Type of VPN" under "Security" tab. "Auto" is not recommended.

In "Data encryption" box, "Require encryption (disconnect if server declines)".
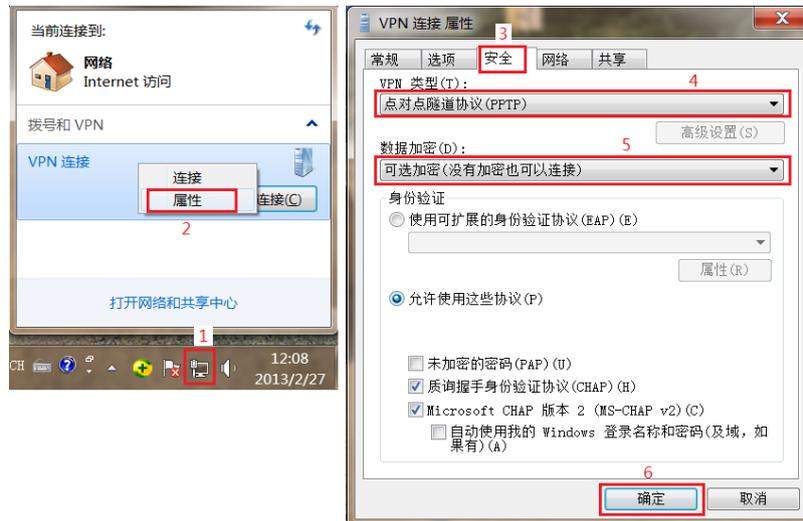
Figure 10-9 Amend VPN type as PPTP

Now, you can connect and disconnect access of PPTP VPN any time by clicking network icon in taskbar.

If a Client computer has established PPTP VPN connection with VPN router, which means that computer, PLC1, PLC2, and FS-WF485IE are in LAN where the router is in, application

software in user's computer can access PLC1 and PLC2; the setup method is the same with that in LAN, i.e. all equipments have same network segment address 192.168.120.X. But if you want to access PLC2, you have to install virtual serial port software VCOMM to get serial port of PLC2 mapped to computer, so that you can use the serial port communication software.

IP address for virtual serial port VCOMM as Client to access Server (FS-WF485IE connected with PLC2) is 192.168.120.101 in this example, rather than router's external network IP address. This is because all equipments are in the same LAN (192.168.120.X) after establishment of VPN connection.

Figure 10-10 Operation state of virtual serial port software

11. FAQ

11.1 What kind of serial port equipments are supported by serial port of serial port to WiFi adapter FS-WF485IE?

All RS232, RS485, RS422 serial ports which observe UART asynchronous serial port communication protocol, such as MODBUS protocol, free port communication protocol of Siemens PLC. As for many field buses, such as PROFIBUS, MPI, PPI, CC-Link, PC-Link, although their physical communication ports are RS485 ports, they don't transmit data under UART asynchronous serial port mode. So, they are inapplicable to this product.

11.2 Why would wireless data communication be interrupted?

Different with wired communication, wireless communication would easily be affected by environment, and would be transiently interrupted sometimes. For example, when wireless channel is interfered, WiFi connection would be transiently interrupted, then re-connect new channel. Users can set communication timeout longer in equipment's application software. As for wired communication, most equipments' communication timeout usually is 10s by default; as for wireless communication, such timeout usually is more than 30s, and reconnection link protection is set. When transmitting important data, upper equipment sends out confirmation for transmission and executes retry.

Furthermore, correctly choose wireless modules' installation locations and distances. It is better to ensure that strength of wireless signal searched by STA module is not lower than 20%. Wireless communication for control equipment in some occasions which have high requirement for real-time performance and security is not recommended. Please see *Guidance for the Installation and Usage of Industrial Wireless Communication Products* for FAQs occurring in installation and usage of wireless communication modules.

11.3 Get two FS-WF485IE adapter modules connected with LAN port of switch or router via Ethernet cable, one module is set as AP, the other module is set as STA, why is the whole network abnormal after establishment of wireless WiFi connection?

After AP has established wireless WiFi connection with STA, port in AP module is connected to port in STA module, thus, which short-circuits the two ports of switch or router. That's why the network is abnormal. Thus, we can know why abnormal situations may happen if parameters of several modules are set at the same time.

Similarly, if module is set as STA, and get it connected to wireless router's WiFi, meanwhile, get module's port connected to router's port via Ethernet cable, which also means that the two ports of router are short-circuited. Therefore, address would conflict.

11.4 Set one FS-WF485IE adapter module as STA, and get it connected to router's LAN port via Ethernet cable; the other module is set as AP, and get it connected to computer's port via Ethernet cable, why is it inaccessible to Internet? But, it is normal if directly connect computer to router via Ethernet cable.

STA module shall be connected to computer's port; AP module must be connected to router's port. By this way, it is accessible to Internet. It is like changing the router to wireless router.

11.5 How to set terminating resistor when using RS485 or RS422?

When using RS485 and RS422 ports, it is required that correctly set 120Ω terminating resistor at bus cable's beginning and end. Please refer to documents about RS485 or operation manual for various RS485 port products formulated by FOURSTAR.

11.6 What are the reasons for serial port receiving unreadable code? How to simply and rapidly check whether FS-WF485IE works normally?

The reason is that serial port parameters of FS-WF485IE, such as Baud rate, data bit, check bit, stop bit, are not compatible with serial port parameters of connected equipment. This problem can be solved by resetting to get them compatible with each other.

Following methods can be used to rapidly check FS-WF485IE:

- Press Default button to restore to factory default setting.
- Get 2 (TXD) pin and 3 (RXD) pin of RS232 port short-circuited (i.e. make it receive the data sent by itself).
- Use a computer wirelessly to search FS-WF485IE (SSID: FS-B11_AP) signal and establish wireless WiFi connection.
- Run virtual serial port software VCOMM on the computer, set TCP Client and FS-WF485IE establish TCP connection.
- Run serial port testing software on the computer, and send data to this virtual serial port. If data sent can be received, it shows that module works normally.

Figure 11-1 Screenshot of virtual serial port software and serial port testing software

If you want to test RS422 port, get TXD+ and RXD+ short-circuited, TXD- and RXD- of RS422 on the module short-circuited. If you want to test RS485 port, it is required to get computer connected to RS485 port of FS-WF485IE by a USB/RS485 converter (or

RS232/RS485 converter), run two serial port testing software on the computer to observe whether virtual serial port and RS485 can receive the data sent by each other.

11.7 If FS-WF485IE module works as STA, is it able to connect to wireless router or AP available in the market? If FS-WF485IE module works as AP, is it able to connect to STA equipment made by other manufacturer?
Of course. They are equipment in line with IEEE 802.11b/g/n standard. However, in industrial environment, industrial-grade products shall be selected so as to ensure stability and reliability of system.

11.8 I set one set of FS-WF485IE as STA, get it connected to a computer's port and establish wireless connection with wireless router. Why is it accessible to Internet if set IP address (in the same network segment of router) on the computer? Why is it inaccessible to Internet if set as "Auto obtain IP address"?
The reason is: if set to "Auto obtain IP address", the computer's IP address is assigned by FS-WF485IE module's DHCP Server, i.e. computer's IP address may be 10.10.100.X, rather than IP address assigned by wireless router. You just need to close module's DHCP Server, and the computer can be assigned with an IP address from wireless router.

11.9 If FS-WF485IE module works as AP, at most how many STA can be connected to it?
If FS-WF485IE module works as AP, it can establish wireless WiFi connection with 32 STA modules at most; if FS-WF485IE module works as TPC Server, it can connect to 32 TCP Client connections at most.

11.10 If FS-WF485IE is installed inside a metal cabinet, transmission of wireless signal is interrupted. How to solve this problem?
Change to sucker antenna (2.4GHz). Get antenna installed outside cabinet and make antennas accessible with each other.

11.11 Industrial production environment always is very complicated. How to correctly install and use FS-WF485IE adapter in different environment?
Please refer to *Guidance for the Installation and Usage of Industrial Wireless Communication Products* formulated by FOURSTAR.

11.12 Why is FS-WF485IE able to conduct communication normally on certain PLC, but unable on certain PLC?
As for many industrial equipments, such as PLC, HMI, DCS, VVVF, if their RS485/422/232 ports are in line with UART asynchronous serial port protocol, they support FS-WF485IE, such as MODBUS protocol, free port communication protocol of Siemens PLC.
If RS485 port is a special field bus port, FS-WF485IE can't be used, such as PROFIBUS, MPI, PPI, CC-Link, and PC-Link.
Users can refer to *Application Test of Industrial Ethernet Port and Serial Port to Wireless WiFi Adapter FS-WF4851E on Various PLC* formulated by FOURSTAR.

11.13 Which one has higher reliability of communication, TCP protocol or UDP protocol?

It certainly is TCP protocol. TCP is a kind of reliable protocol based on connection. UDP protocol is a kind of unreliable protocol without connection. In data transmission, conduct data transmission without receiving confirmation of the host. So, UDP protocol doesn't ensure that data packet sent to target host will be correctly received. In some occasions having requirement for higher reliability, users can ensure the data is correct by upper layer protocol.

12. Order Information

Product name: Industrial Ethernet port and serial port to wireless WiFi adapter
Product model: FS-WF485IE

Note

This Manual provides guidance for users using Industrial Ethernet port and serial port to wireless WiFi adapter (model: FS-WF485IE). We have already checked that contents provided in this Manual are in line with described hardware and software. We can't guarantee their complete consistency for errors are hard to avoid. We will always check data and contents provided in this Manual and conduct necessary updating in the subsequent versions. Product functions shall be subject to the functions on the actual device due to rapid development of new technology. FOURSTAR Electronic Technology reserves the right to revise this Manual without any prior notice.

FOURSTAR Electronic Technology Co., Ltd.

Address: 2F, Building H, No. 88 Section II, South Lushan Road, Deyang, Sichuan
Tel: +86-838-2515543   2515549
Fax: +86-838-2515546
Website: http://www.fourstar-dy.com