WF-2000 Series
Wi-Fi I/O Module

DIO User's Manual





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Document Revision

Version	Date	Description of changes
1.0	2014-01-13	First Release Revision
1.1	2014-02-25	Add WF-2042 Product Description

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1. Introduction

The WF-2000 series I/O modules have WLAN connection complies with the IEEE802.11b/g standards. With the popularity of 802.11 network infrastructure, the WF-2000 series I/O modules make an easy way to incorporate wireless connectivity into monitoring and control systems. They also support Modbus/TCP and UDP protocol and the network encryption configuration, which makes perfect integration to SCADA software and offer easy and safe access for users from anytime and anywhere.



Figure 1-1: Application architecture for the WF-2000 series

1.1 Wireless connection mode

WF-2000 series support AP and Ad-hoc wireless connection modes of WLAN.

1.2 Features

- RoHS Design
- Compatible with IEEE 802.11b/g standards
- Support infrastructure and ad hoc modes for wireless networks
- Support WEP, WPA and WPA2 wireless encryption
- Support Modbus/TCP and UDP protocols
- Support DHCP network configuration
- Wide operating temperature range
- Built-in Watchdog

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1.2.1 Features Description

The WF-2000 module offers the most comprehensive configuration to meet specific application requirements. The following list shows the features designed to simplify installation, configuration and application.

Compatible with IEEE 802.11b/g standards

WF-2000 module complied with IEEE 802.11b/g standard from 2.4~2.5GHz, and it can be used to provide up to 11Mbps for IEEE 802.11b and 54Mbps for 2.4GHz IEEE 802.11g to connect your wireless LAN.

Support infrastructure and ad hoc modes for wireless networks

Ad hoc mode lets you create a wireless network quickly by allowing wireless nodes within range (for example, the wireless devices in a room) to communicate directly with each other without the need for a wireless access point.

Infrastructure mode is the more common network configuration where all wireless hosts (clients) connect to the wireless network via a WAP (Wireless Access Point).

Support WEP, WPA and WPA2 wireless encryption

WEP and WPA are common types of security that are used to protect wireless networks. When WEP or WPA is turned on, WF-2000 module uses a special security key combination to allow only devices that know this key to connect to its wireless network. This applies to laptops, smart device, or any other wireless device.

Support Modbus/TCP and UDP protocols

The Modbus/TCP and UDP slave function on the WF-2000 module can be used to provide data to remote HMI/SCADA software built with Modbus/TCP driver. ICP DAS also provides NAPOPC_ST DA Server for Modbus/TCP to integrate WF-2000 I/O series real-time data value with OPC client enabled software.

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Built-in Multi-function I/O

Various I/O components are mixed with multiple channels in a single module, which provides the most cost effective I/O usage and enhances performance of the I/O operations.

Built-in Watchdog

Module Watchdog is a built-in hardware circuit that monitors the operating status of the module and will reset the module if a failure occurs in the hardware or the software.

1.3 Specifications

Table 1-1: System Specifications

Modules	WF-2042	WF-2051	WF-2055	WF-2060
Wi-Fi Interface				
Antenna	5 dBi (Omni-Directional)			
Output Power	8 dBm @ 11Mbps			
Receive Sensitivity	-83 dBm @ 11Mbps			
Standard Supported	IEEE 802.11b/g			
Wireless Mode	Infrastructure & Ad-hoc			
Encryption	WEP, WPA and WPA2			
UART Interface				
Connector	5-pin screw terminal connector(TxD, RxD, GND)			
COM1	RS-232			
Baud Rate (bps)	115200			
Power				
Input Voltage Range	10V ~ 30V			
Power Consumption	1.5W	1.2W	1.9W	1.6W
Mechanism				
Installation	DIN-Rail			
Dimensions (H x W x D)	120mm x 106mm x 33mm			
Environment				
Operating Temperature	-25℃ ~ +75℃			
Storage Temperature	-30℃ ~ +80℃			
Humidity	10% ~ 90%			

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Table 1-2: WF-2000 I/O Specification

Modules		WF-2042	WF-2051	WF-2055	WF-2060
Digital Input					
Channels		-	16	8	6
Input Type			Dry Contact: Source / Wet Contact: Sink, Source		
Dry Contact Level			Off Voltage Level: Open On Voltage Level: Close to GND		
Wet Contact Level			Off Voltage Level: +4V max On Voltage Level: +10 V ~ +50 V		
Counters	Channels		8		
	Max. Counts		32-bit (4294967295)		
	Max. Input Frequency		8 KHz		
Photo-Isolation			3750 VDC		
Digital Output					
Channels		16, Sink(NPN)	-	8, Sink(NPN)	-
Output Voltage		+3.5 ~ +50 V		+3.5 ~ +50 V	
Output Current		700mA/ch		700mA/ch	
Intra-module Isolation (Field to Logic)		3750 VDC		3750 VDC	
Overvoltage Protection		60 VDC		60 VDC	
Relay Output					
Channels		-			6
Output Type					Form A (SPST-NO)
Contact Rating (Resistive Load)					5A 250VAC 5A 30VDC
Operate Time					10ms (max.)
Release Time					5ms (max.)
Endurance	Mechanical				2×10^7 ops.
	Electrical				10^5 ops.

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2. Hardware

2.1 Front Panel

The WF-2000(DIO) front panel contains the antenna, I/O connectors and LEDs.

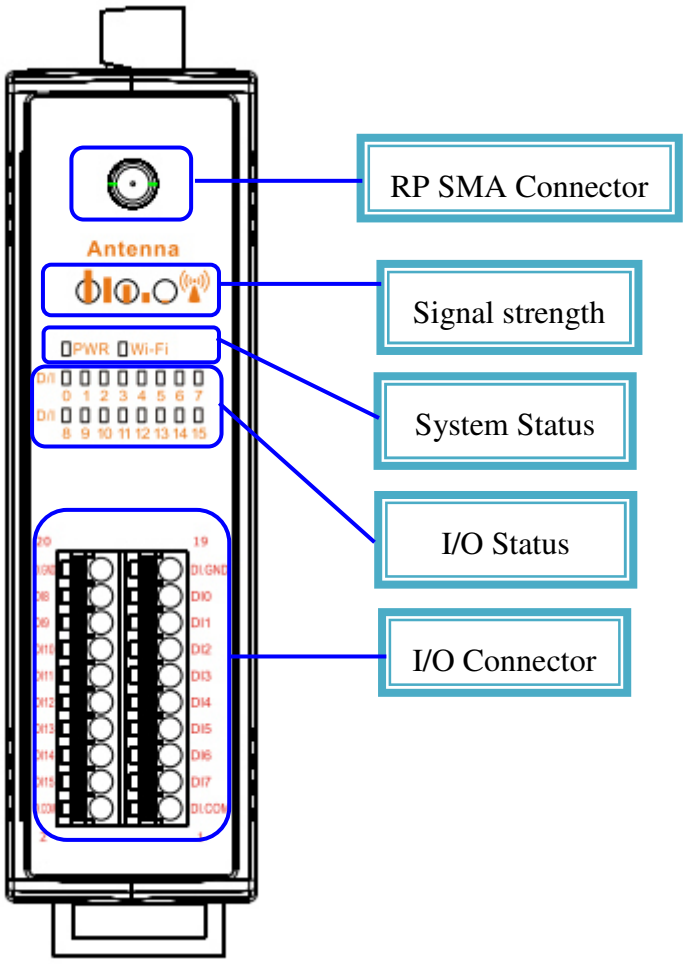


Figure 2-1: Front Panel of the WF-2000(DIO)

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2.1.1 **LED Indicator**

Table 2-1**:** System Status Indicator

System Status Indicator		
LED	**Module Status**	**LED Status**
PWR	Wi-Fi communication error	Blink per 100 ms
	Wi-Fi associate error	Every 1 second flashes twice per 100 ms
	Wi-Fi unable to connect error	Blink per 1000 ms
	Wi-Fi network configurations error	Every 1 second flashes three times per 100 ms
	Power failure	Off
Wi-Fi	Data transmission	Blink
	Bus Idle	Off

Table 2-2**:** Signal Strength LED Indicator

Signal Strength LED Indicator	
LED Status	**Signal strength**
● ● ●	High
○ ● ●	Medium
○ ○ ●	Low
○ ○ ○	Bad or No Signal

2.1.2 I/O Connector

2.1.2.1 WF-2042

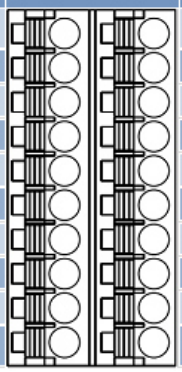
Pin Assignment Name		Terminal No.		Pin Assignment Name
EXT.GND	20		19	EXT.GND
DO8	18		17	DO0
DO9	16		15	DO1
DO10	14		13	DO2
DO11	12		11	DO3
DO12	10		9	DO4
DO13	8		7	DO5
DO14	6		5	DO6
DO15	4		3	DO7
EXT.PWR	2		1	EXT.PWR

Figure 2-2**:** I/O Connector of WF-2042

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2.1.2.2 WF-2051

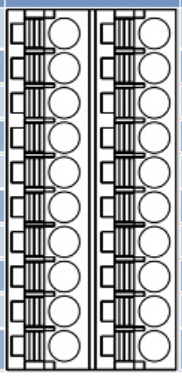
Pin Assignment Name		Terminal No.		Pin Assignment Name
DI.GND	20		19	DI.GND
DI8	18		17	DI0
DI9	16		15	DI1
DI10	14		13	DI2
DI11	12		11	DI3
DI12	10		9	DI4
DI13	8		7	DI5
DI14	6		5	DI6
DI15	4		3	DI7
DI.COM	2		1	DI.COM

Figure 2-3**:** I/O Connector of WF-2051

2.1.2.3 WF-2055

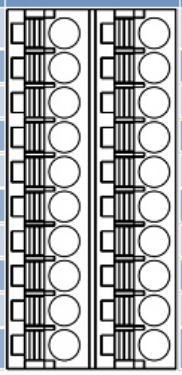
Pin Assignment Name		Terminal No.		Pin Assignment Name
EXT.GND	20		19	DI.GND
DO0	18		17	DI0
DO1	16		15	DI1
DO2	14		13	DI2
DO3	12		11	DI3
DO4	10		9	DI4
DO5	8		7	DI5
DO6	6		5	DI6
DO7	4		3	DI7
EXT.PWR	2		1	DI.COM

Figure 2-4**:** I/O Connector of WF-2055

2.1.2.4 WF-2060

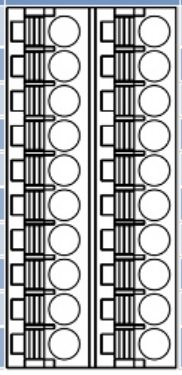
Pin Assignment Name		Terminal No.		Pin Assignment Name
RL0.NO	20		19	DI.GND
RL0.COM	18		17	DI0
RL1.NO	16		15	DI1
RL1.COM	14		13	DI2
RL2.NO	12		11	DI3
RL2.COM	10		9	DI4
RL3.NO	8		7	DI5
RL3.COM	6		5	DI.COM
RL4.NO	4		3	RL5.NO
RL4.COM	2		1	RL5.COM

Figure 2-5**:** I/O Connector of WF-2060

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2.2 Top Panel

The WF-2000 top panel contains the Power/Signal connector and operating mode Selector switch.

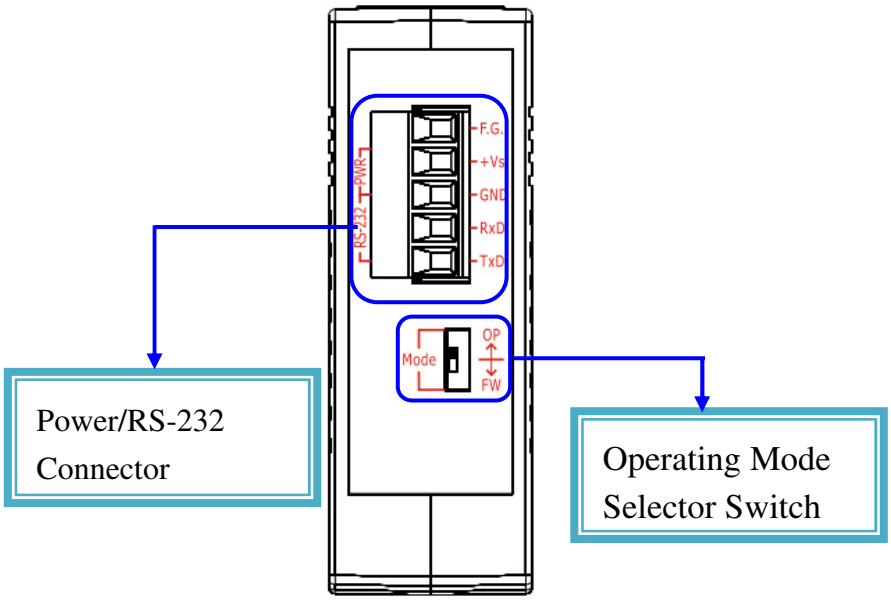


Figure 2-6: Top Panel of the WF-2000

Operating Mode Selector Switch

FW mode: Firmware update mode

Move the switch to the OP position after the upgrade is complete.

OP mode: Firmware operation mode

In the WF-2000, the switch is always in the OP position. Only when updating the WF-2000 firmware, the switch can be moved from the OP position to the FW position.

Table 2-3: Power/Signal Connector

Power/Signal connector	
Pin Assignment	**Description**
F.G	Frame Ground
+Vs	+10 ~ +30 VDC
GND	Power / RS-232 GND
RxD	RS-232 RxD
TxD	RS-232 TxD

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2.3 Dimensions

The diagrams below provide the dimensions of the WF-2000 to use in defining your enclosure specifications. All dimensions are in millimeters.

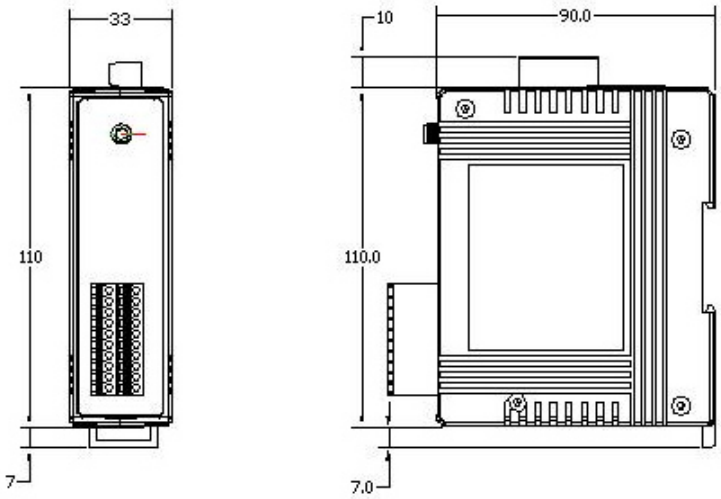


Figure 2-7**:** Front / Left Side dimension of the WF-2000

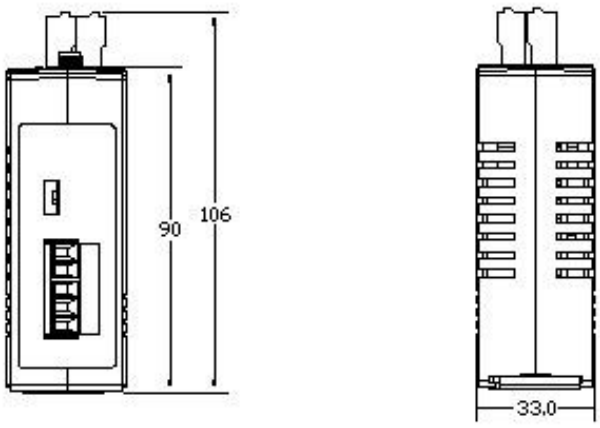


Figure 2-8**:** Top / Bottom dimension of the WF-2000

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2.4 Hardware Connection

2.4.1 Power and Serial port connection

The following figures describe the Power and the COM port to a serial device via serial network.

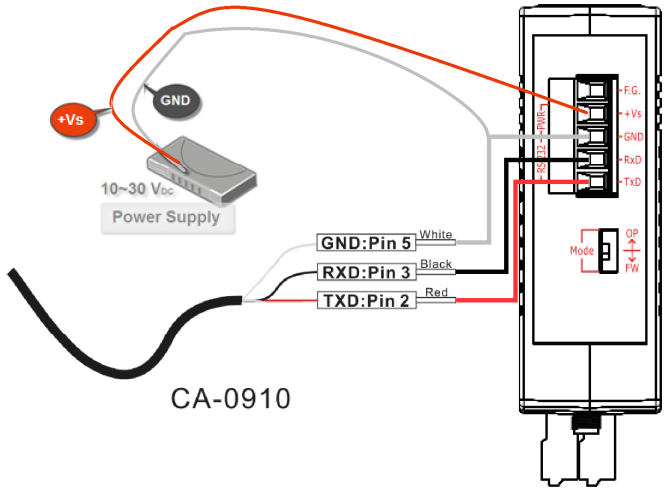


Figure 2-9**:** Power and Serial port wire connection

2.4.2 I/O connection

2.4.2.1 WF-2042

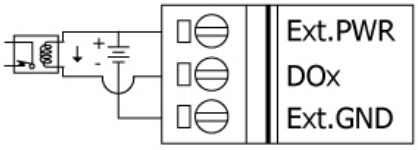
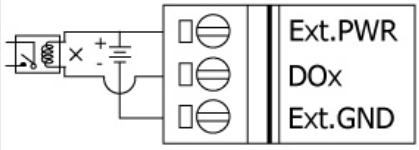
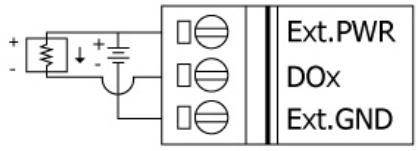
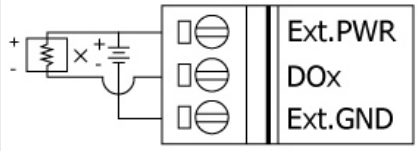
Output Type	ON State LED ON Readback as 1	OFF State LED OFF Readback as 0
Drive Relay	Relay ON	Relay OFF
		
Resistance Load		
		

Figure 2-10**:** DO wire connection of WF-2042

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2.4.2.2 WF-2051

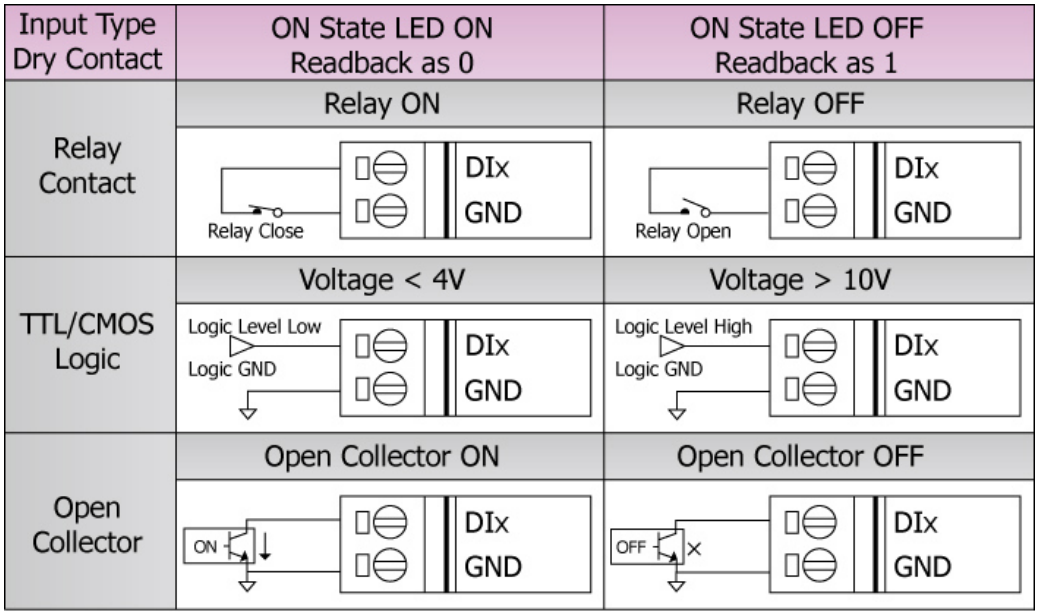


Figure 2-11**:** DI Dry contact wire connection of WF-2051

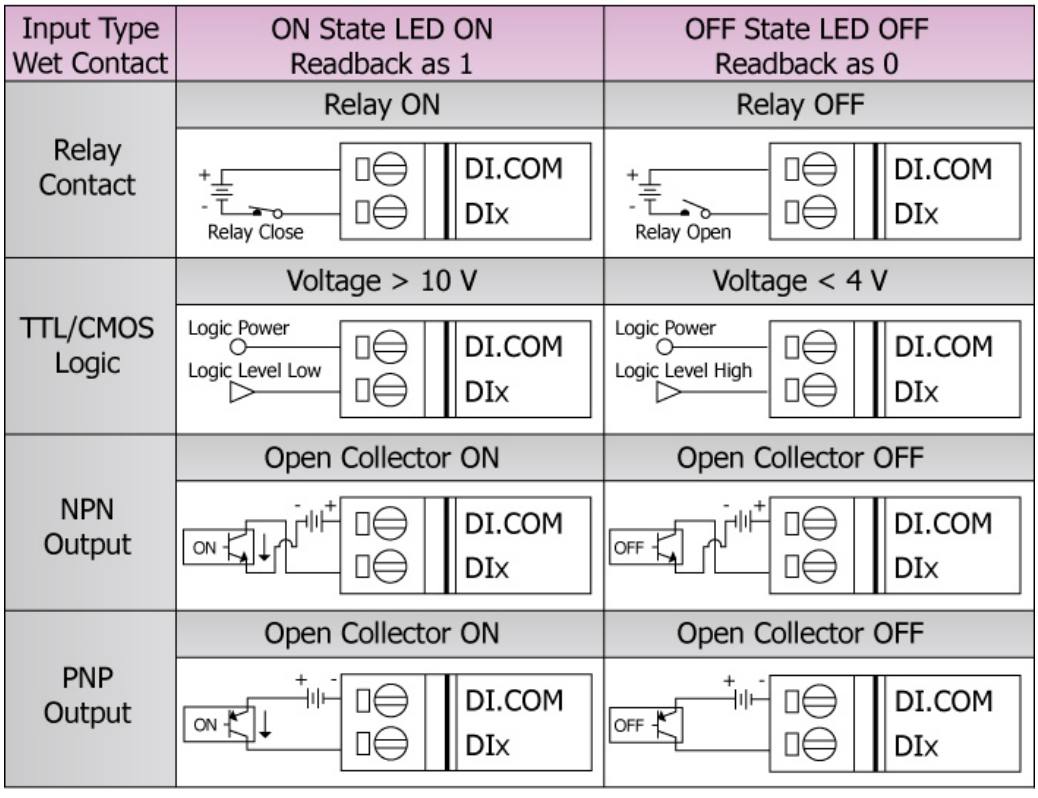


Figure 2-12**:** DI Wet contact wire connection of WF-2051

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2.4.2.3 WF-2055

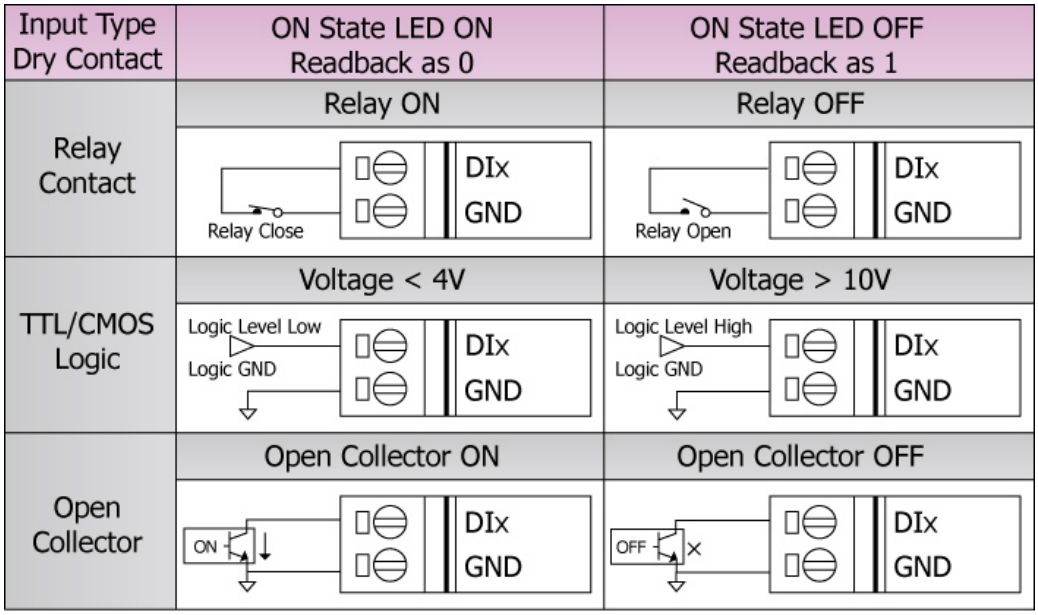


Figure 2-13**:** DI Dry contact wire connection of WF-2055

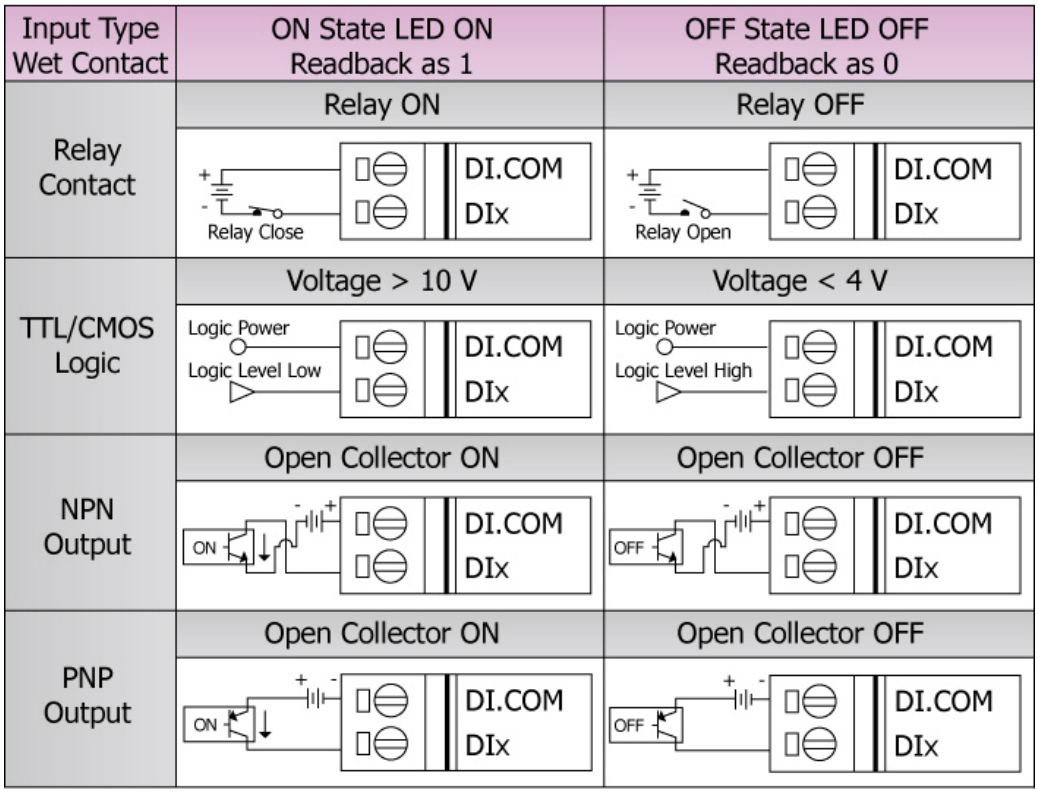


Figure 2-14**:** DI Wet contact wire connection of WF-2055

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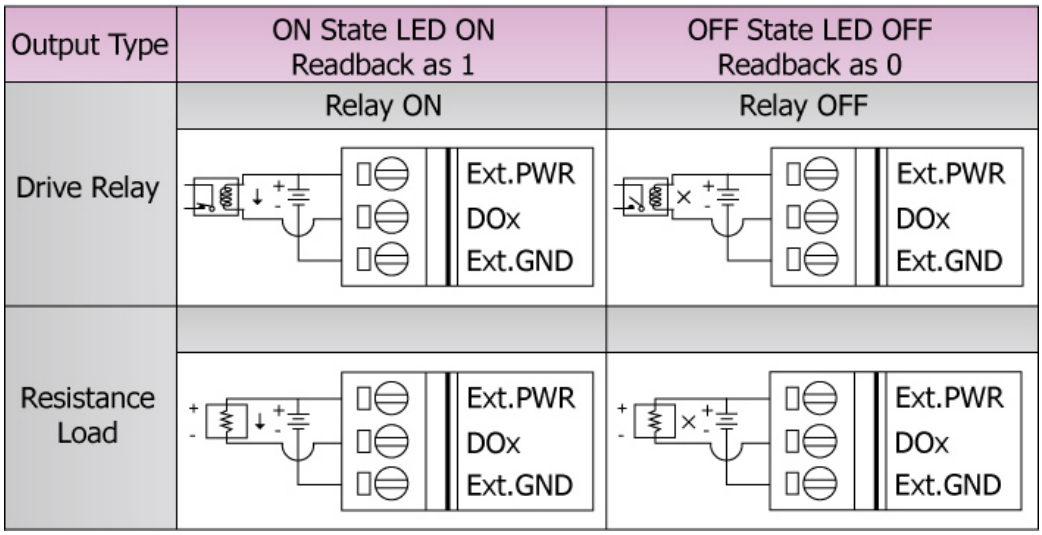


Figure 2-15**:** DO wire connection of WF-2055

2.4.2.4 WF-2060 I/O Wire Connection

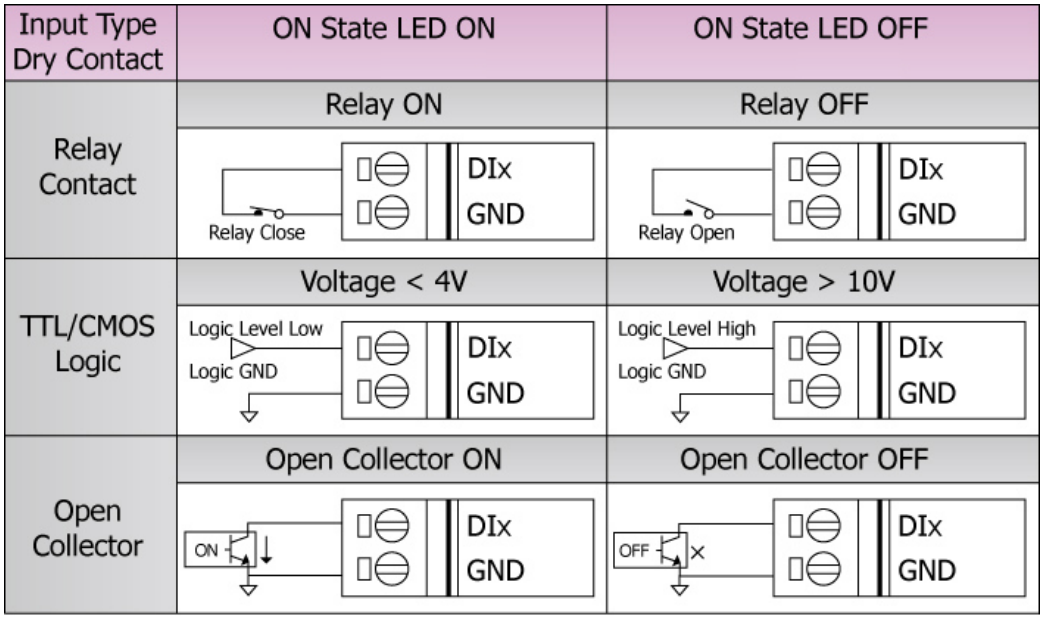


Figure 2-16**:** DI Dry contact wire connection of WF-2060

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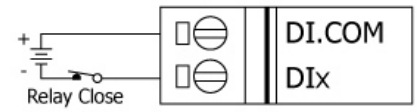
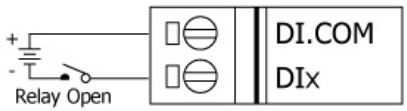
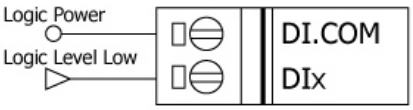
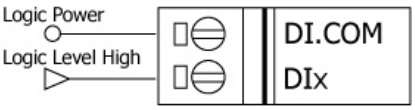
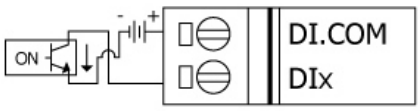
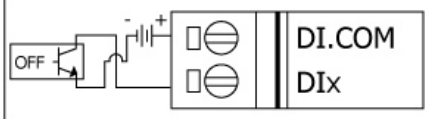
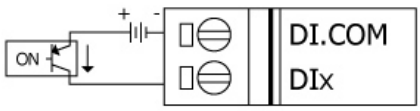
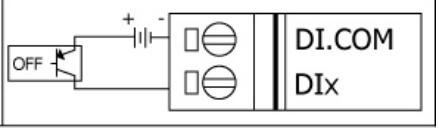
Input Type Wet Contact	ON State LED ON	OFF State LED OFF
Relay Contact	Relay ON	Relay OFF
		
TTL/CMOS Logic	Voltage > 10 V	Voltage < 4 V
		
NPN Output	Open Collector ON	Open Collector OFF
		
PNP Output	Open Collector ON	Open Collector OFF
		

Figure 2-17: DI Wet contact wire connection of WF-2060

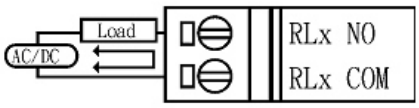
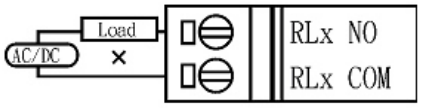
Output Type	ON State LED ON	OFF State LED OFF
Relay	Relay ON	Relay OFF
		

Figure 2-18: DO wire connection of WF-2060

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2.5 Jumper Settings

2.5.1 Watchdog Timer Settings

A watchdog timer (WDT) is a device that performs a specific operation after a certain period of time if something goes wrong and the system does not recover on its own. A watchdog timer can perform a warm boot(restarting the system) after a certain number of milliseconds.

The WF-2000 series module supplies a jumper for users to active the watchdog timer or not. If users want to use this WDT, can open the WF-2000 cover and use the Jumper to activate the WDT built in the module, as the Figure 2-13. Note that the default setting is active.

Table 2-4: WDT Jumper Position

Module	Jumper Number
WF-2042	JP1
WF-2051	
WF-2055	
WF-2060	



Figure 2-19: Watchdog timer Jumper Position

2.6 FW / OP Dip-switch

On the top of the WF-2000 series module, there is a dip-switch used for firmware operation or firmware update of the module. The following steps show how to use this dip-switch.

2.6.1 Firmware Update Mode

Please set the dip-switch to the “FW” position as Figure 2-7, and then the WF-2000 series will work in the “Firmware Update Mode” after reset the power of the module. In this mode, users can update the firmware of the WF-2000 module from computer’s RS-232 port via CA-0910 cable shown as Figure 2-22.

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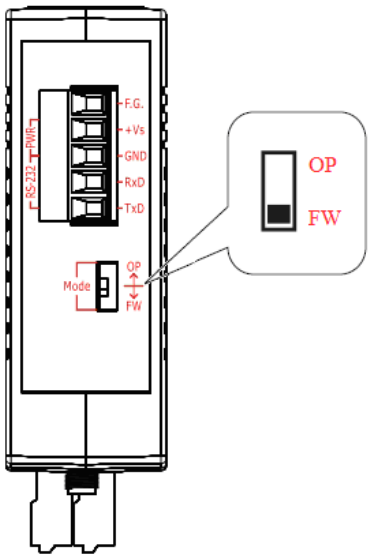


Figure 2-20: FW Position of Dip-Switch



Figure 2-21: CA-0910 Cable

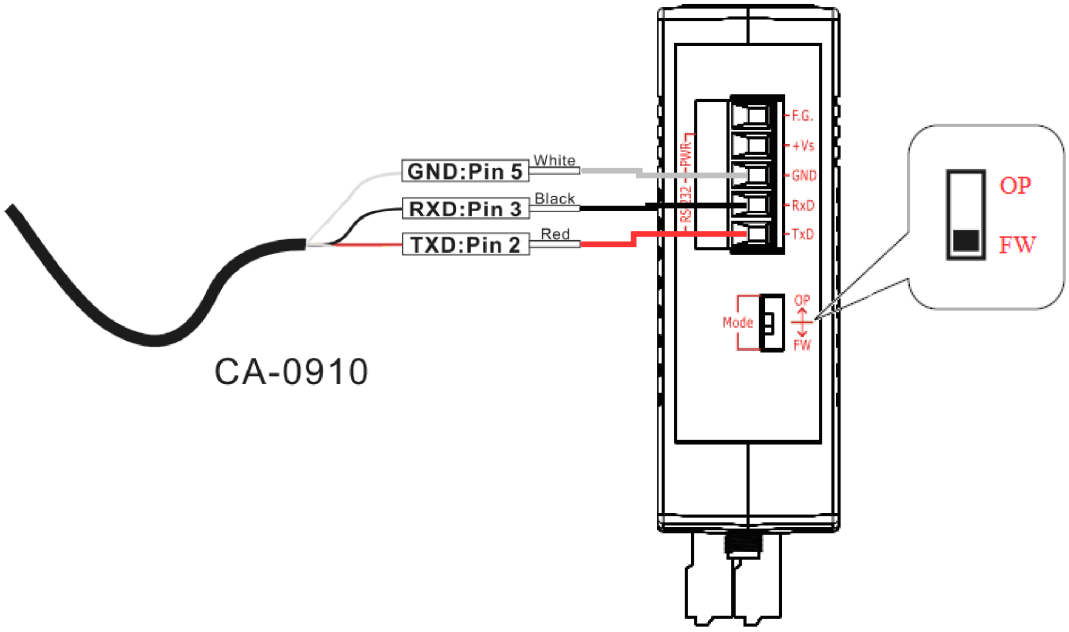


Figure 2-22: Downloads cable connection

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Users just need to execute “Firmware_Update_Tool.exe” and follow the below steps to complete the firmware updating process.

[1] Choose “**COM**” interface and “**COM Port**”.

[2] Click “**Browser**” button to choose firmware file. (e.g. **WF20xx.fw**)

[3] Click “**Firmware Update**” button to start firmware updating process.

The result will be shown in “Firmware Update” field.

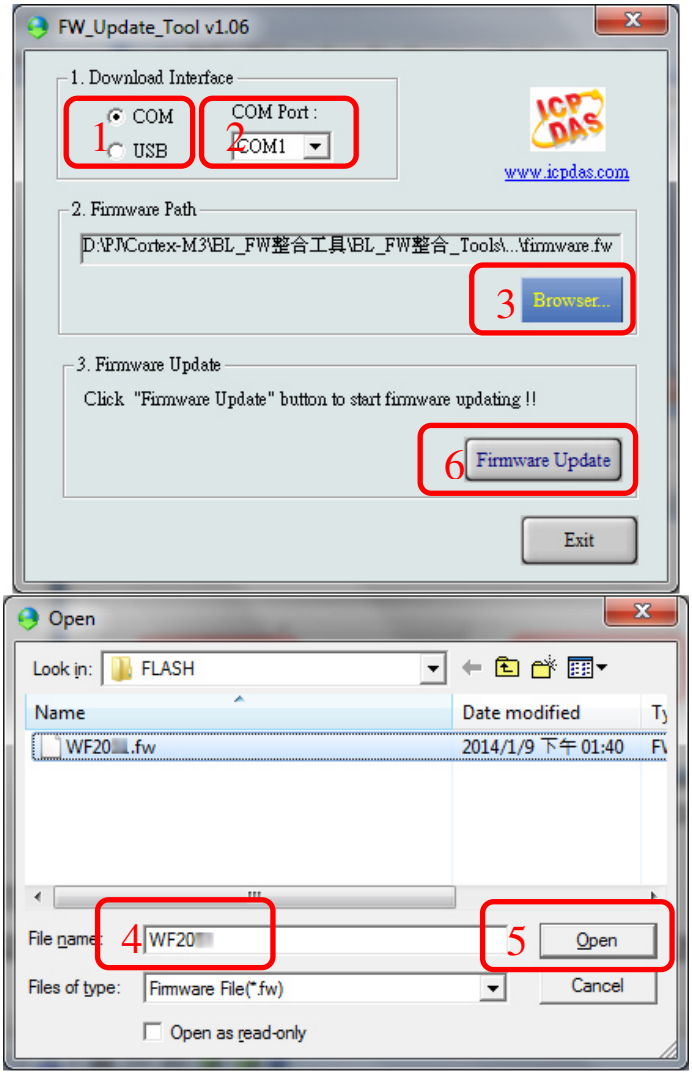


Figure 2-23**:** WF-2000 firmware update process

The WF-2000 firmware can be downloaded from ftp://ftp.icpdas.com/pub/cd/usbcd/napdos/wifi/io/wf-20xx/firmware

The Firmware_Update_Tool program can be downloaded from ftp://ftp.icpdas.com/pub/cd/usbcd/napdos/wifi/io/wf-20xx/software/tool/

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2.6.2 Firmware Operation Mode

In the operation mode, users need to set the dip-switch to the “OP” position as Figure 2-24 and reset the power, and the WF-2000 can run in the operation mode. In this mode, user can use the WF-2000 series with a computer or with another WF-2000 series module for wireless connection.

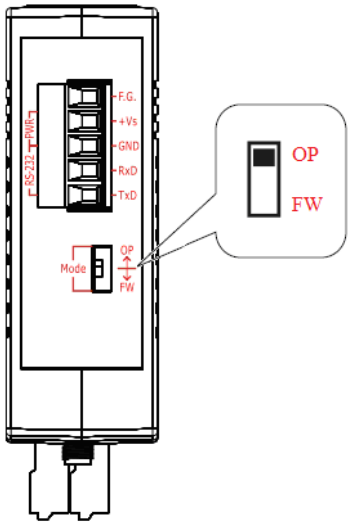


Figure 2-24**:** OP Position of Dip-Switch

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3. Software

The WF-2000 Utility provides a simple way to test and acquire data easily and instantly for all ICP DAS WF-2000 series I/O modules without programming. WF-2000 Utility can be used to configure the wireless network interface, establish a TCP connection, I/O control and I/O monitoring of WF-2000 series I/O modules.

WF-2000 I/O Utility (v2.0 or later) is a Microsoft Windows application that compatibles with Microsoft Windows XP, Vista and 7 (.NET framework 4.0 is required). You can download this program fromftp://ftp.icpdas.com/pub/cd/usbcd/napdos/wifi/io/wf-2051/software/utility/

3.1 WF-2000 I/O Utility (v2.0 or later)

The following is the main screens provided by WF-2000 I/O Utility, this utility tool can be thought as a useful tool for I/O control and monitoring on the WF-2000 series. It supplies several functions, such as UDP search, module connection and Wi-Fi configuration setting, etc.

To access the ICP DAS WF-2000 I/O module user can double click the module listed in "Device List", and then you will see the I/O page come out. In the I/O page, it is used to access I/O data and configure parameters.

3.1.1 Main Screen

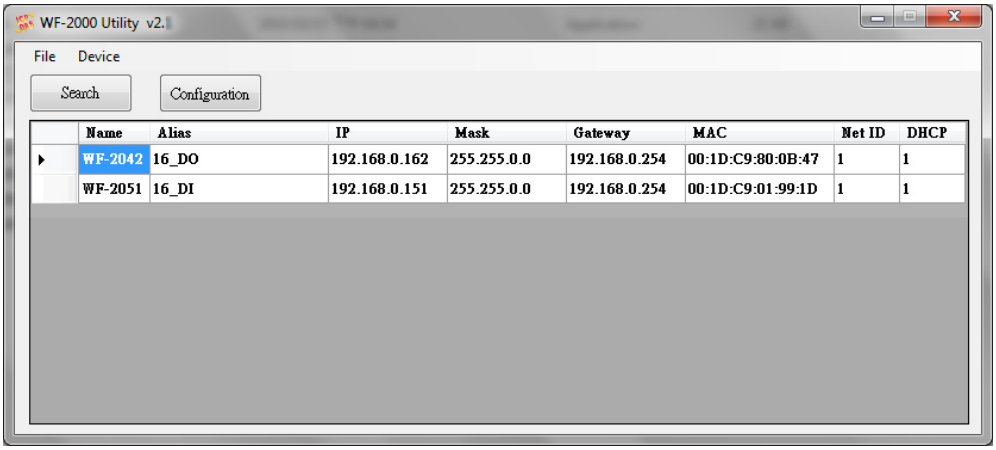


Figure 3-1**:** WF-2000 I/O Utility (v2.0 or later) main screen

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Menu Function:

[1] **File**

- Exit
  Press this button to exit WF-2000 I/O Utility.

[2] **Device**

- Search
  This function can search all of WF-2000 devices that support UDP communication.

- Configuration
  This function can enter the basic wireless configuration interface, as shown in Figure 3-2.

[3] **Search List**

Search list provides each item that scans from UDP and display the related information about the device, includes host name, alias name, IP address, Mask, Gateway, MAC address, Modbus Net ID and its DHCP state.

3.1.2 Configuration Screen

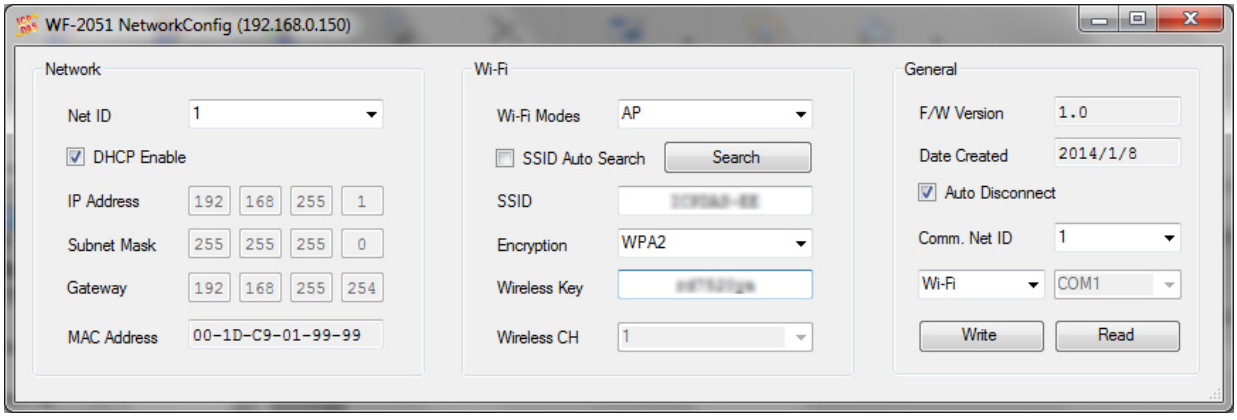


Figure 3-2**:** WF-2000 I/O Utility (v2.0 or later) configuration screen

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[1] Network

- Net ID

  The Unit Identifier in Modbus TCP/IP application data unit. (Range:1~247, Default:1)

- DHCP Enable

  If a DHCP server is present on the network, the WF-2000 will automatically obtain the network settings from the DHCP server when the DHCP function is enabled.
  (Ad Hoc mode don't support DHCP configuration)

- IP Address

  WF-2000 IP setting (Default:192.168.255.1)

- Subnet Mask

  WF-2000 Net Mask setting (Default: 255.255.255.0)

- Gateway

  WF-2000 Gateway setting (Default: 192.168.255.254)

- MAC Address

  Display WF-2000 MAC Address

[2] Wi-Fi

- SSID Auto Search

  Auto search the broadcast SSID in the air, and list SSID names in the drop-down menu.
  (It must establish a Wi-Fi connection first, and communicate with Wi-Fi Interface)

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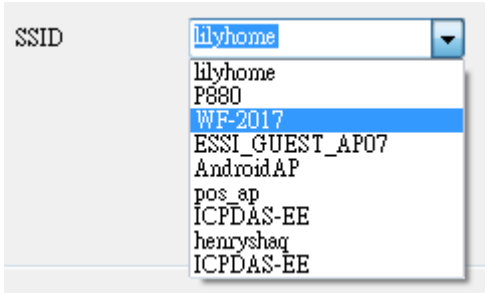


Figure 3-3: Auto search SSID list

■ Wi-Fi Configuration

Table 3-1: AP Mode

Wi-Fi Mode	AP：Use the wireless access point way for connection and transmission. (Must have Wi-Fi AP)
SSID	Service Set Identifier: Connected devices must be with the same SSID, SSID length must not exceed 20 characters.
Wireless CH	0~11：Wi-Fi transmission channel setting, connected devices must with the same channel. (In AP mode AUTO mode, the Wireless channel can be automatically selected)
Encryption	NONE / WEP64 / WEP128 / WPA / WPA2: Encryption of Wi-Fi, connected devices must with the same encryption.
Wireless Key	Key of Encryption，connected devices must with the same Key. WEP-64 ：Key length must be 10 characters. WEP-128：Key length must be 26 characters. WPA ：Key length must between 8~64 characters. WPA2 ：Key length must between 8~64 characters. Characters of key should be in range of: [0 ~ 9] or [A ~ F] or [a ~ f].

Table 3-2: AD-Hoc

Wi-Fi Mode	Ad-Hoc：Use Ad-Hoc connectivity with another WF-2000 series or Wi-Fi devices to create AD-hoc wireless network.
SSID	Service Set Identifier: Connected devices must be with the same SSID, SSID length must not exceed 20 characters.
WLCH	1~11：Wi-Fi transmission channel setting, connected devices must with the same channel.
Encryption	NONE / WEP64 / WEP128: Encryption of Wi-Fi, connected devices must with the same encryption. Not Support WPA、WPA2 encryption in Ad-Hoc mode。
Wireless Key	Key of Encryption，connected devices must with the same Key. WEP-64 ：Key length must be 10 characters. WEP-128：Key length must be 26 characters. Characters of key should be in range of: [0 ~ 9] or [A ~ F] or [a ~ f].

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[3] General

- F/W Version

  Display the firmware version of the WF-2000

- Date created

  Display the date created of the WF-2000

- Auto Disconnect

  Once the connection is established, if there is no data exchange within 60 sec the socket will be closed automatically when the this function is enabled

- Communication Net ID

  Modbus Net ID of WF-2000 module

- Parameter Transmission Interface

  The parameter transmission interface, that provides Wi-Fi and RS-232 interface for connection.

- Write Parameter

  It allows users to upload the parameters to WF-2000 series

- Read Parameter

  It allows users to download the parameters form WF-2000 series.

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3.1.3 Data Acquisition Screen

In the I/O page of the DI and DO, the real-time value and module configuration can be read or written in this page. The detail of all items in this form will be introduced in this section.

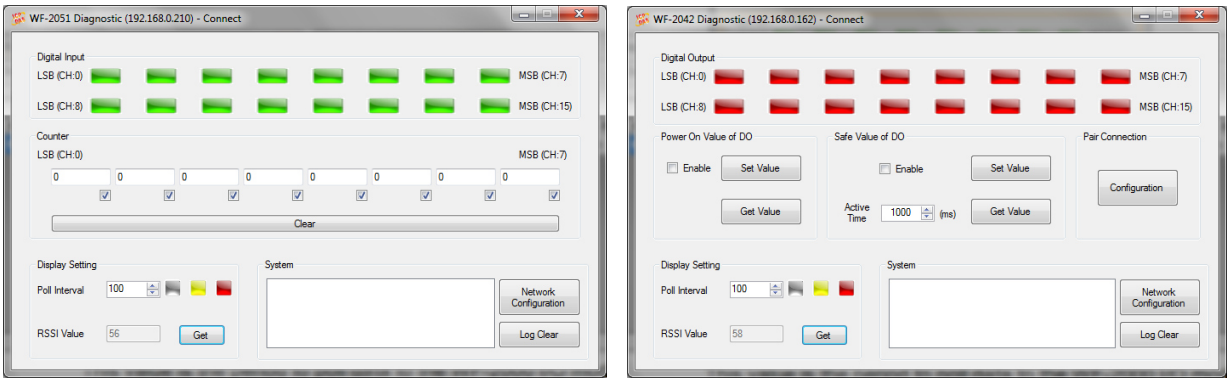


Figure 3-4**:** WF-2000 I/O Utility (v2.0 or later) DI/DO Data Monitor screen

- Digital Input Monitor Region

  The digital input value can be read in this region.

- Counter Monitor Region

  The counter value can be read or reset in this region.

- Digital Output Monitor Region

  The digital output value can be read and write in this region.

- Power On Value of DO

  The power on value of DO can be Set and Get in this region. It is loaded into the DO under 3 conditions: power on, reset by Module Watchdog, reset by reset command.

  Enable: Enabled or disable this function.
  Set Value: Set the current output status as Power On Value.
  Get Value: Get the current configuration of Power On Value.

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- Safe Value of DO

  The safe value of DO can be Set and Get in this region. When the communication timeout occurs, the "Safe Value" is loaded into the DO.

  Enable: Enabled or disable this function.
  Set Value: Set the current output status as Safe Value.
  Get Value: Get the current configuration of Safe Value.
  Active Time (ms): This function is active when the communication timeout reach this setting.

- Polling Interval

  This value is the period to poll data to the WF-2000 I/O module.
  Note: The valid value is 100 ~ 5000 ms.

- RSSI

  This area will display the signal strength information by RSSI value and LED indicator when press the "Get" button.

Table 3-3**:** Signal Strength Information Display Table

Signal Strength LED Indicator		
LED Status	**RSSI value**	**Signal strength**
	1 ~ 40	High
	41 ~ 60	Medium
	61 ~ 80	Low
	0	Bad or No Signal

- System

  This area will display information for the system connection.

- Pair Connection

  This pair connection function is a particular feature of WF-

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2000 that can enable a pair of DI-to-DO via Modbus/TCP. With pair connection function enabled, WF-2000 modules can poll the status of remote input devices using the Modbus/TCP protocol and then continuously write to its output channels in the background.

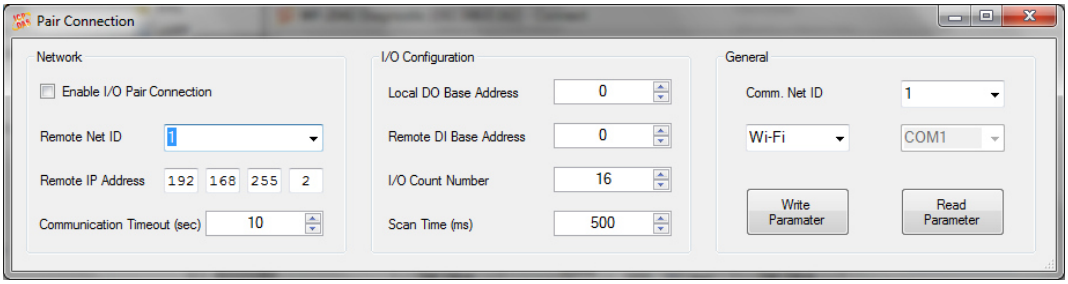


Figure 3-5: Pair connection configuration screen

Enable I/O Pair Connection: Enable/Disable I/O pair connection.

Remote Net ID: Modbus Net ID of remote device.

Remote IP Address: IP address of remote input device.

Communication Timeout (sec): The period of which the WF-2000 series is waiting for a response from the remote DI device.

Local DO Base Address: DO base address of local DO register will be mapped to remote DI device.

Remote DI Base Address: DI base address of Remote DI device that will be mapped to local DO register.

I/O Count Number: I/O count mapped from the base address.

Scan Time (ms): The frequency with the remote input device will be polled.

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4. Application Notes

Users can use a computer to communicate with the WF-2000 devices in the application. It can complete the purpose of I/O control to wireless network by this way.

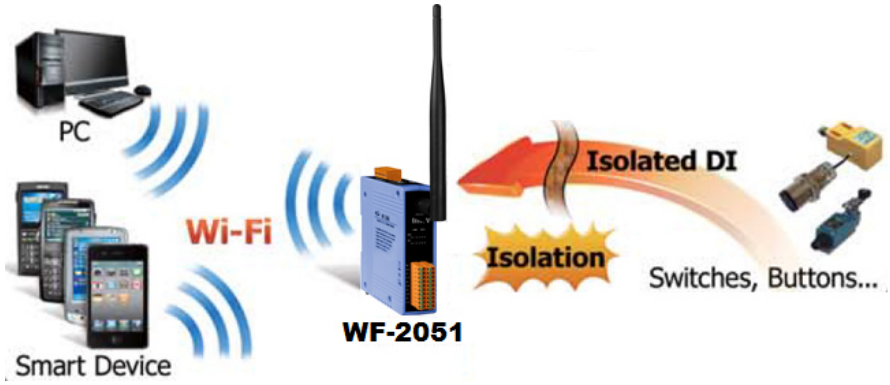


Figure 4-1**:** WF-2051 + Laptop application architecture

4.1 Hardware Installation

Before use, associated hardware configuration, the steps described as follows：

Step 1: Checking the WF-2000 series firmware operation mode

It needs to set the DIP switch to the "OP" position (operating mode), as resetting the power, WF-2000 series will be in the operation mode.

Step 2: Serial port connection

WF-2000 series supports RS-232 serial communication. The circuit configuration is as shown in Figure 2-9.

If you do not need parameter setting, this step can be omitted.

Step 3: Power connection

Connect the power supply to WF-2000 series' power terminator, as shown in Figure 2-9.

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4.2 WF-2000 series Configuration

4.2.1 **WF-2000 Series Wireless Network Configuration**

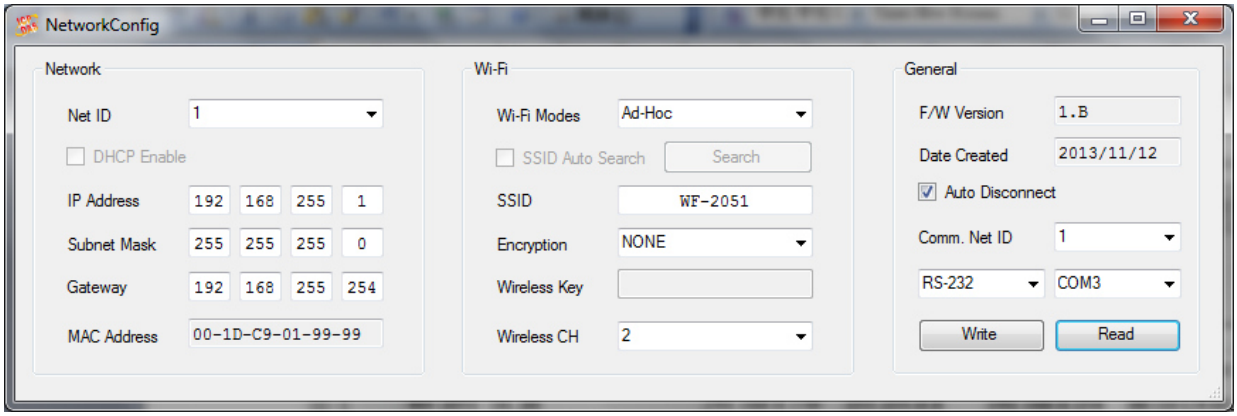


Figure 4-3**:** Configuration Interface

01、Net ID ：The Unit Identifier in Modbus TCP/IP application data unit. This case is set as "1" in Figure 4-3.

02、IP Address ：Set the local WF-2000 series' IP. Here set to "192.168.255.1".

03、Subnet Mask ：Net Mask settings. Here set to "255. 255. 255.0".

04、Gateway ：Gateway settings. Here set to "192.168.255.254".

05、Wi-Fi Mode ：Wireless network connection mode settings. Here set to "Ad-Hoc" mode. (If the mode is "AP" mode, wireless AP devices is needed.)

06、SSID ：Service set identifier. Here set to "WF-2051".

07、Wireless Key: Wireless encryption Key. Here does not have the setting.

08、Wireless CH ：Wi-Fi connection channel settings. Here set to "2".

09、Encryption : Encryption mode setting. Here set "NONE" (without encryption).

10、Upload parameters : After completing the settings above, select the "RS-232" interface, communication "Net ID" and "COM Num". Press "Write Parameter" button to upload the parameters.

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4.2.2 **PC Connection Configuration**

01、TCP/IP Setting ：

a. Open Network connections and entry the properties setting of wireless network connections.

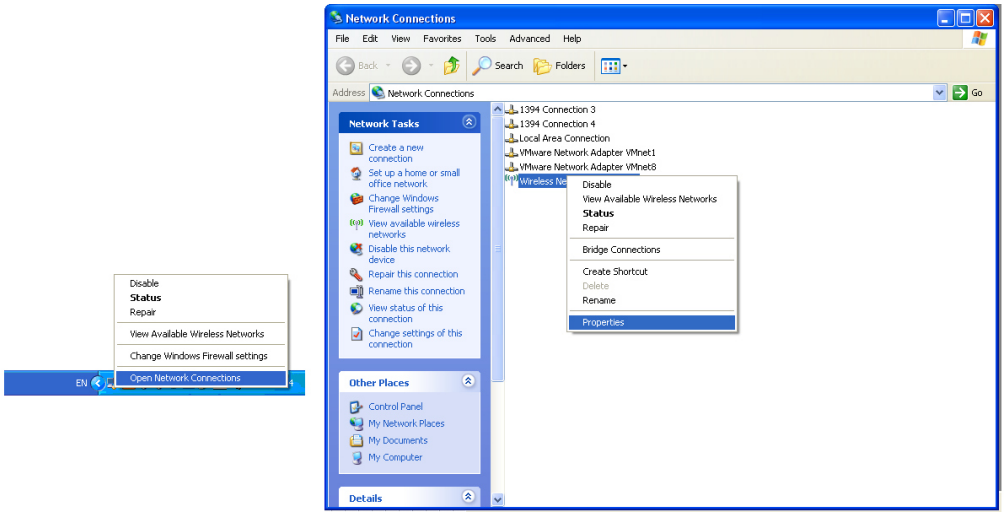


Figure 4-4**:** Properties setting of wireless network connections

b. Select the Internet Protocol (TCP/IP) and press the "Properties" button.

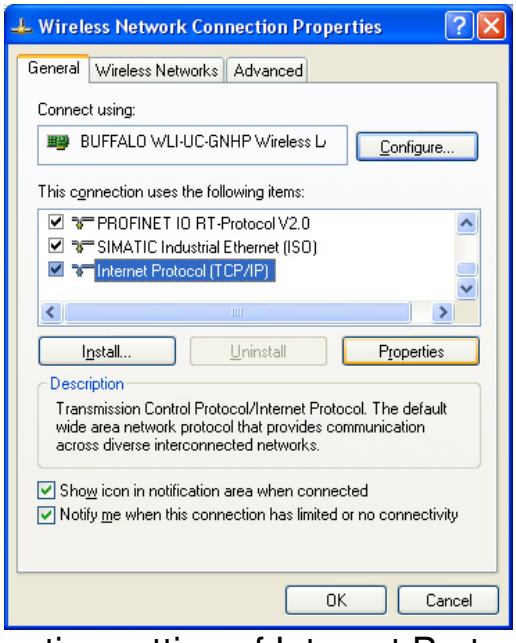


Figure 4-5**:** Properties setting of Internet Protocol (TCP/IP)

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c. Click the "Use the following IP address" and entry the **IP address** as "192.168.255.10", **Subnet mask** as "255.255.255. 0". Finally, press "OK" button.

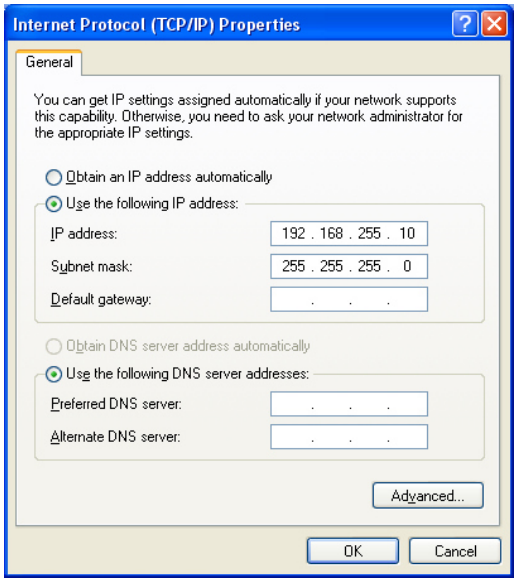


Figure 4-6**:** IP address setting interface

02、Wireless network connection ：

a. View available wireless networks and you can see the "WF-20xx" wireless network in the list.
b. Select the "WF-20xx" and press the "Connect" button.

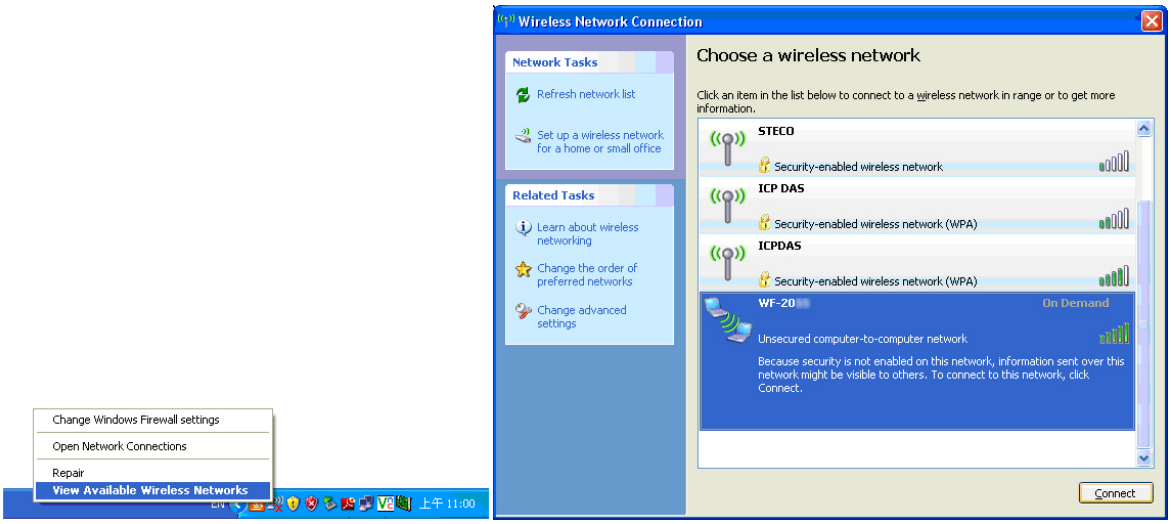


Figure 4-7**:** Wireless network connection

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c. Press the "Connect Anyway" button for the next step.



Figure 4-8**:** Connection confirm interface

d. After waiting for a while, there will appear connection success screen.

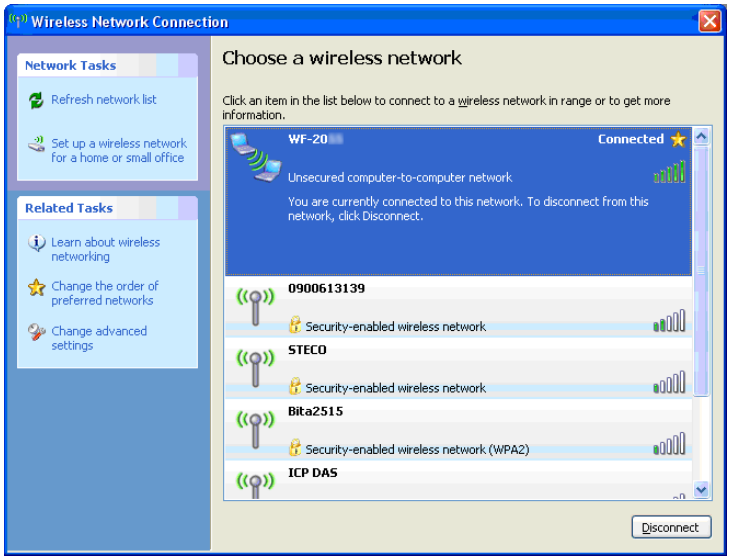


Figure 4-9**:** Connection successful interface

4.2.3 **Access I/O data**

01、**Connection with WF-2000 I/O utility (v2.0 or later)**

a. Open WF-2000 I/O utility and click the "Search" button, search list will provide each item that scan from UDP Port.
b. To access the WF-2000 I/O module user can double click the module listed in "Device List".

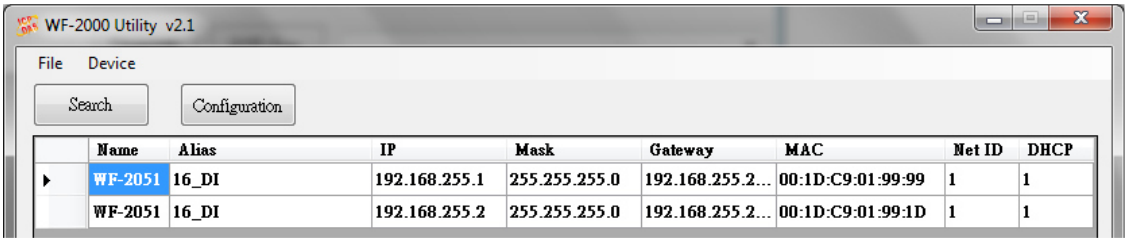


Figure 4-10**:** WF-2000 search list

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c. Then you will see the I/O page come out. In the I/O page, it is used to access I/O data and configure parameters.

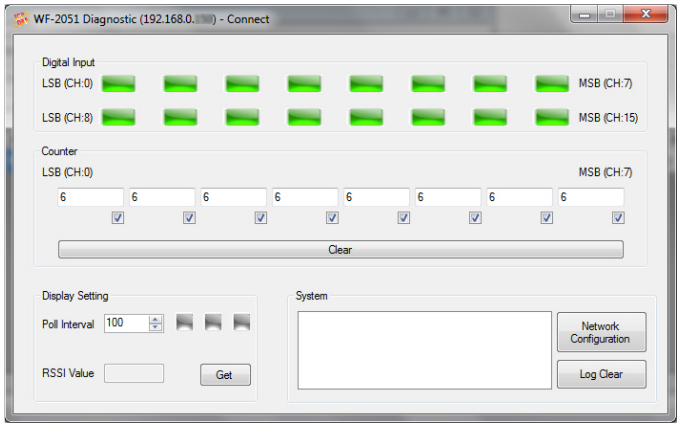


Figure 4-11: I/O page interface

02、**Connection with Modbus TCP utility**

a. Open Modbus TCP utility and key in the IP address as "192.168.255.1", Port as "502". Finally, click the "Connect" button.

b. If the network settings are correct, this will immediately establish a connection.

c. Use the function code "0x02", and set the Reference Number as "0x00", Bit Count as "0x10" to get the 16 CHs DI value.

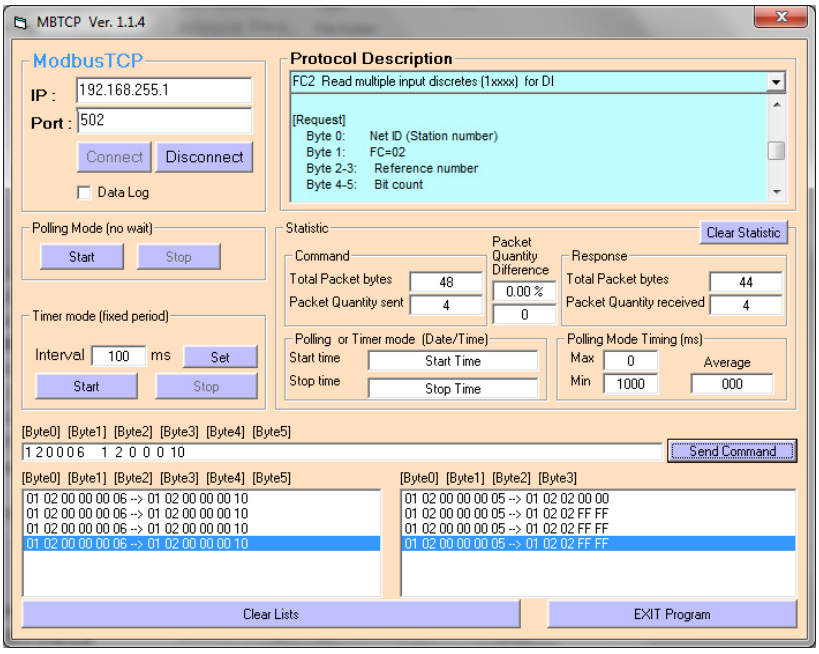


Figure 4-12: Digital Input reading screen

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d. Use the function code "0x04", and set the Reference Number as "0x32", Word Count as "0x10" to get the 8 CHs Counter value (4 bytes each counter).

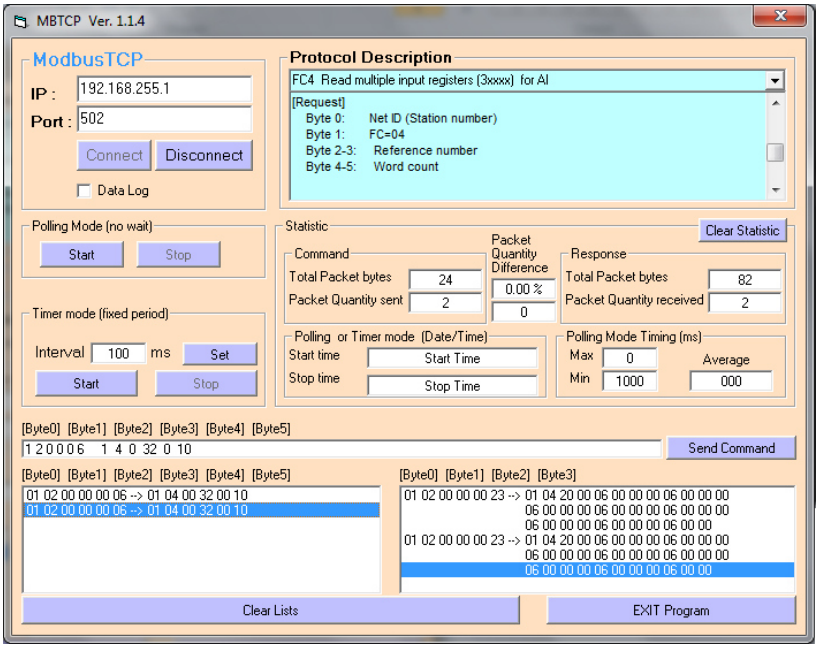


Figure 4-13: Counter reading screen

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5. Modbus Applications

The WF-2000 is a Modbus device that allows you to access terminals data via Wi-Fi and communicates using a master-slave technique in which only one device (the master) can initiate transactions (called queries). The other devices (slaves) respond by supplying the requested data to the master, or by taking the action requested in the query.

Most SCADA Supervisor Control And Data Acquisition and HMI software can easily integrate serial devices via the Modbus protocol, such as Citect, ICONICS, iFIX, InduSoft, Intouch, Entivity Studio, Entivity Live, Entivity VLC, Trace Mode, Wizcon, Wonderware, etc.

5.1 What is Modbus TCP/IP?

Modbus is a communication protocol developed by Modicon in 1979.

Different versions of Modbus used today include Modbus RTU (based on serial communication like RS485 and RS232), Modbus ASCII and Modbus TCP, which is the Modbus RTU protocol embedded into TCP packets.

Modbus TCP is an internet protocol. The protocol embeds a Modbus frame into a TCP frame so that a connection oriented approach is obtained thereby making it reliable. The master query's the slave and the slave responds with the reply. The protocol is open and hence highly scalable.

5.2 Protocol Description

The Modbus protocol defines a simple protocol data unit independent of the underlying communication layers. The mapping of Modbus protocol on network can introduce some additional fields on the application data unit.

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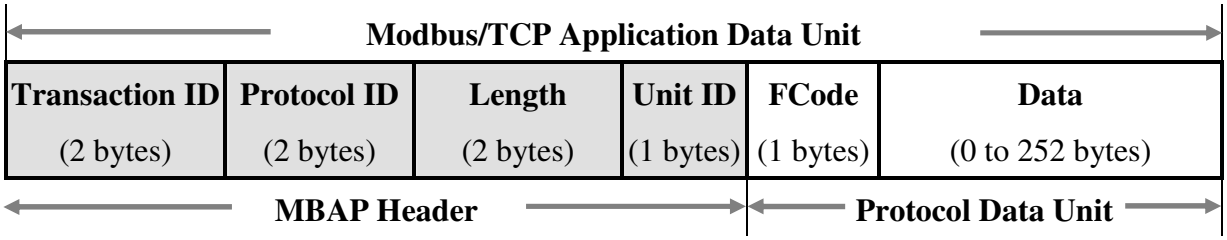


Figure 5-1**:** Modbus/TCP Application Data Unit

5.2.1 **MBAP**

The Modbus/TCP extension includes 7 additional bytes to the original Modbus protocol, which allows for transport over the TCP/IP layers.

A dedicated header is used on TCP/IP to identify the Modbus Application Data Unit. It is called the MBAP Header (MODBUS Application Protocol Header). The MBAP Header consists of 7 bytes of information:

Table 5-1: MODBUS Application Protocol Header

Fields	Length	Description
Transaction Identifier	2 bytes	Identification of Request/Response transaction – Copied from request to response
Protocol Identifier	2 bytes	0 = Modbus protocol
Length	2 bytes	Number of following bytes - Includes the Unit Identifier
Unit Identifier	1 byte	Identification of remote slave

5.2.2 **Function Code**

The function code field of a Modbus data unit is coded in one byte. Valid codes are in the range of 1 ... 255 decimal (the range 128 - 255 is reserved and used or exception responses). When a Modbus request is sent from a Modbus Client to a Server device the function code field tells the Server what kind of action to perform.

The Modbus/TCP feature of WF-2000 series module supports 7 function codes, which allows the reading and writing of data contents of

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registers.

Table 5-2: Supports Function Codes of WF-2000 series

Function Code	Descriptions
01 (0x01)	Read Coil Status
02 (0x02)	Read Input Status
03 (0x03)	Read Holding Registers
04 (0x04)	Read Input Registers
05 (0x05)	Force Single Coil
15 (0x0F)	Force Multiple Coils
16 (0x10)	Preset Multiple Registers

Any other function code request will be returned with an error response indicating the function code is not supported, as well as a request for too much data or data at a register address that not present.

5.2.3 **Data**

The data field of Modbus request sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

The data field may be nonexistent (of zero length) in certain kinds of requests; in this case the server does not require any additional information. The function code alone specifies the action.

5.2.4 **Response**

If no error occurs related to the Modbus function requested in a properly received Modbus PDU (Protocol Data Unit) the data field of a Modbus response from a server to a client contains the data requested. If an error related to the Modbus function requested occurs, the field

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contains an exception code that the server application can use to determine the next action to be taken.

For example a client can read the ON/OFF states of a group of digital input or output or it can read/write the data contents of a group of registers.

When the server responds to the client, it uses the function code field to indicate either a normal response or that some kind of error occurred (called an exception response). For a normal response, the server simply echoes to the request the original function code.

For an exception response, the server returns a code that is equivalent to the original function code from the request PDU with its most significant bit set to logic 1.

5.2.5 **Data Encoding**

Modbus uses a “big-endian” representation for address and data items. This means that when a numerical quantity larger than single byte is transmitted, the most significant byte (MSB, also called the high-order byte) is send first. The following sub-topics describe the different byte of encoding and show how the data is encoded as it is within the Modbus/TCP packet.

5.2.5.1 Binary

A binary item is represented as a single bit within a data word. All binary is packed into 16-bits data words, which are accessed using function code 01 and 02. Therefore, a single register contains 16 bits of binary data, each having a specific meaning.

Table 5-3: A single register contains 16 bits of binary data

Value	1st	2nd
0xAA55 (1010101001010101)	0xAA (10101010)	0x55 (01010101)

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5.2.5.2 16-bits Word

A 16-bits word item is transmitted with the most significant byte first. Function code 03 and 04 read 16-bits items at a time; therefore, each of these data items will fit within one register that is read.

Table 5-4: A 16-bits word item

Value	1st	2nd
0x1234	0x12	0x34

5.3 Address Mapping

5.3.1 **WF-2042 I/O Address Mapping**

Table 5-5: (0xxxx) DO address

Begin Address	Points	Descriptions	Range	Access Type
0 (0x00)	0~15	Digital Output	0=OFF, 1=ON	R/W

Table 5-6: (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
247 (0xF7)	0	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

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5.3.2 **WF-2051 I/O Address Mapping**

Table 5-7: (0xxxx) DO address

Begin Address	Points	Descriptions	Range	Access Type
10 (0x0A)	0~7	Clear Digital Counter	1=Clear	W

Table 5-8: (1xxxx) DI address

Begin Address	Points	Descriptions	Range	Access Type
0 (0x00)	0~15	Digital Input	0=OFF, 1=ON	R

Table 5-9: (3xxxx) AI address

Begin Address	Points	Descriptions	Range	Access Type
50 (0x32)	0~15 (2 points/ Each Channel)	Digital Counter	0~4294967295	R

Table 5-10: (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
247 (0xF7)	0	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

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5.3.3 **WF-2055 I/O Address Mapping**

Table 5-11: (0xxxx) DO address

Begin Address	Points	Descriptions	Range	Access Type
0 (0x00)	0~7	Digital Output	0=OFF, 1=ON	R/W
10 (0x0A)	0~7	Clear Digital Counter	1=Clear	W

Table 5-12: (1xxxx) DI address

Begin Address	Points	Descriptions	Range	Access Type
0 (0x00)	0~7	Digital Input	0=OFF, 1=ON	R

Table 5-13: (3xxxx) AI address

Begin Address	Points	Descriptions	Range	Access Type
50 (0x32)	0~15 (2 points/ Each Channel)	Digital Counter	0~4294967295	R

Table 5-14: (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
247 (0xF7)	0	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

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5.3.4 **WF-2060 I/O Address Mapping**

Table 5-15: (0xxxx) DO address

Begin Address	Points	Descriptions	Range	Access Type
0 (0x00)	0~5	Digital Output	0=OFF, 1=ON	R/W
10 (0x0A)	0~5	Clear Digital Counter	1=Clear	W

Table 5-16: (1xxxx) DI address

Begin Address	Points	Descriptions	Range	Access Type
0 (0x00)	0~5	Digital Input	0=OFF, 1=ON	R

Table 5-17: (3xxxx) AI address

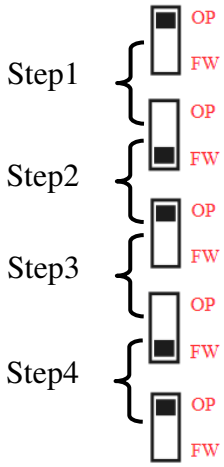
Begin Address	Points	Descriptions	Range	Access Type
50 (0x32)	0~11 (2 points/ Each Channel)	Digital Counter	0~4294967295	R

Table 5-18: (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
247 (0xF7)	0	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

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6. Troubleshooting

Item	Problem Description	Solution
1	Power Failure (PWR LED Off)	1. Please return to the ICP DAS for inspection and repair
2	WLAN connection can not be established	1. Make sure that the service set identifier device (SSID) settings are the same. 2. Make sure Wi-Fi transmission Channel settings are the same. 3. Make sure encryption is set, encryption keys are the same way 4. Make sure antenna is connected 5. Please confirm whether there are barriers on the scene. That could result in poor signal quality.
3	TCP connection can not be established	1. Make sure WLAN connection is established successfully 2. Make sure the network configuration is good (TCP / IP Port, Local IP, Net Mask)
4	How to restore factory default  	1. Power on the WF-2000 series I/O module 2. Change the Dip-Switch position of the WF-2000 series and to complete the following steps in 5 seconds. Step1. From “OP” to “FW” position. Step2. From “FW” to “OP” position. Step3. From “OP” to “FW” position. Step4. From “FW” to “OP” position. 3. When the correct implementation of the above steps, the Signal Strength LEDs and PWR/Wi-Fi LEDS of the WF-2000 series should be turn on, and that should be turn off after 500 ms later. 4. Reset the power the WF-2000 series would back to factory defaults.

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Item	Problem Description	Solution
5	Cannot execute WF-2000 Utility(v2.0 or later) with the message like the following Figure 6-1	Because the ICP DAS WF-2000 Utility(v2.0 or later) requires .NET Framework v4.0,this program will automatically detect the .NET Framework v4.0 installed as well or not. Users can install .NET Framework v4.0 in the following website. Microsoft .NET Framework 4 (Web Installer) http://www.microsoft.com/en-us/download/details.aspx?id=17851 Microsoft .NET Framework 4 (Standalone Installer) http://www.microsoft.com/en-us/download/details.aspx?id=17718

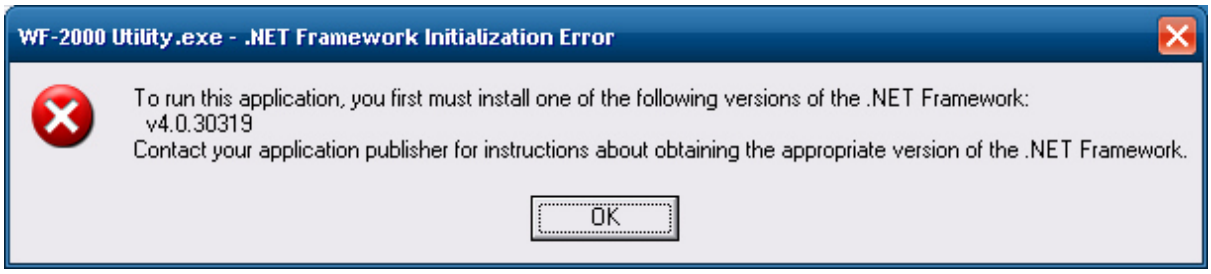


Figure 6-1: .NET Framework Initialization Error

● Technical Support

If you have problems about using the WF-2000 series I/O module, please contact ICP DAS Product Support.
Email: service@icpdas.com

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