WF-2000 Series
Wi-Fi I/O Module

AIO User Manual





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Document Revision

Version	Date	Description of changes
1.0	2013-11-27	First Release Revision
1.1	2014-03-19	Modify WF-2019 Current Input Wiring
1.2	2014-05-12	Add WF-2026 Product Description
1.3	2014-12-01	Add WF-2015 Product Description
1.4	2016-08-15	Modify RTD Input Type and Data Format Table

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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-2015	WF-2017	WF-2019	WF-2026
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	10 ~ 30 VDC			
Power Consumption	1.5 W	2.0 W	2.2 W	2.2 W
Mechanism				
Installation	DIN-Rail			
Dimensions (W x L x H)	33mm x 106mm x 120mm	33mm x 106mm x 120mm	33mm x 95mm x 120mm	33mm x 106mm x 120mm
Environment				
Operating Temperature	-25℃ ~ +75℃			
Storage Temperature	-30℃ ~ +80℃			
Humidity	10% ~ 90%			

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Table 1-2 WF-2015 I/O Specification

Modules	WF-2015
Analog Input	
Channels	6
Input Type	2/3-wire RTD
RTD Type	Pt100, Pt1000, Ni120, Cu50, Cu100, Cu1000
Resolution	16 bit
Accuracy	±0.05% of FSR
Zero Drift	0.5 μV/°C
Span Drift	20 μV/°C
Sampling Rate	12 Hz (Total)
Overvoltage Protection	120 VDC
Intra-Module Isolation, Field-to-Logic	3000 VDC
Individual Channel Configuration	Yes
Open Wire Detection	Yes
3-wire RTD Lead Resistance Elimination	Yes
Resistance Measurement	3.2 kΩ Max.

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Table 1-3 WF-2017 I/O Specification

Modules	WF-2017			
Analog Input				
Channels	8-ch Differential / 16-ch Single-ended(Note), Jumper Selectable			
Input Type	Voltage : ±150 mV, ±500 mV, ±1 V, ±5 V, ±10 V			
	Current : 0 ~ +20 mA, +4 ~ +20 mA, ±20 mA (Jumper Selectable)			
Resolution	16 bit			
Accuracy	±0.1% FSR			
Sampling Rate	10 Hz (Total)			
Zero Drift	±20 μV/°C			
Span Drift	±25 ppm/℃			
Common Mode Rejection	86 dB Min.			
Normal Mode Rejection	100 dB			
Input Impedance	Differential	> 2 MΩ	Single-ended	> 1 MΩ
Overvoltage protection		240 Vrms		150 Vrms
Intra-Module Isolation, Field-to-Logic	3000 VDC			
Individual Channel Configuration	Yes			

Note: Differential mode can be used for voltage input and current input.
Single-Ended mode can be used for voltage input only.

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Table 1-4 WF-2019 I/O Specification

Modules	WF-2019
Analog Input	
Channels	10
Input Type	Voltage : ±15 mV, ±50 mV, ±100 mV, ±500 mV, ±1 V, ±2.5 V, ±5 V, ±10 V
	Current : ±20 mA (External resistor is required)
	Thermocouple : J, K, T, E, R, S, B, N, C
Resolution	16 bit
Accuracy	±0.1% FSR
Sampling Rate	10 Hz (Total)
Zero Drift	±20 μV/°C
Span Drift	±25 ppm/℃
Common Mode Rejection	86 dB Min.
Normal Mode Rejection	100 dB
Input Impedance	Voltage Input: >400 kΩ, Current Input: 125 Ω
Intra-Module Isolation, Field-to-Logic	3000 VDC
Overvoltage protection	240 Vrms
Individual Channel Configuration	Yes
Open Wire Detection	Yes (Software programmable)

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Table 1-5 WF-2026 I/O Specification

Modules		WF-2026
Analog Input		
Channels		5
Wiring		Differential
Input Range	Voltage	±150 mVDC, ±500 mVDC, ±1 VDC, ±5 VDC, ±10 VDC
	Current	0 ~ +20 mA, +4 ~ +20 mA, ±20 mA (Jumper Selectable)
Resolution		16 bit
Accuracy		±0.1% FSR
Sampling Rate		10 Hz (Total)
Zero Drift		±20 μV/°C
Span Drift		±25 ppm/°C
Common Mode Rejection		86 dB Min.
Normal Mode Rejection		100 dB
Input Impedance	Voltage	2 MΩ
	Current	140 Ω
Common Voltage Protection		±200 V
Overvoltage Protection		240 Vrms
Overcurrent Protection		Yes, 50 mA @ 110 VDC
Virtual Channel to Channel Isolation		Yes, 400 VDC
Individual Channel Configuration		Yes
Analog Output		
Channels		2
Output Range	Voltage	+0 ~ +5 VDC, +0 ~ +10 VDC, ±5 VDC, ±10 VDC
	Current	+0 ~ +20 mA, +4 ~ +20 mA (Jumper Selectable)
Resolution		12 bit
Accuracy		±0.1% FSR
Voltage Output Capability		10 V @ 20 mA
Power-on Value		Yes, Programmable
Safe Value		Yes, Programmable

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2.Hardware

2.1 Front Panel

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

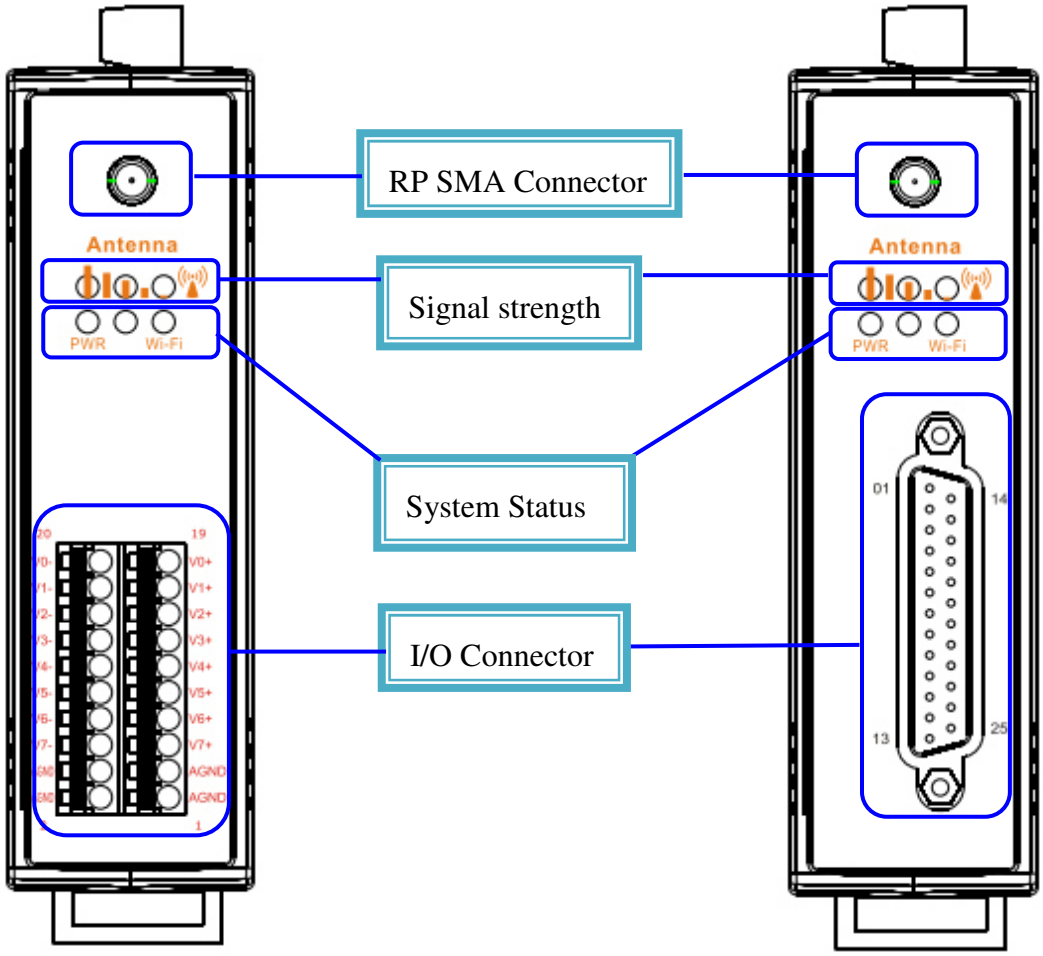


Figure 2-1 Front Panel of the WF-2000(AIO)

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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-2015

Pin Assignment Name		Terminal No.		Pin Assignment Name
A3	20		19	A0
B3	18		17	B0
/B3	16		15	/B0
A4	14		13	A1
B4	12		11	B1
/B4	10		9	/B1
A5	8		7	A2
B5	6		5	B2
/B5	4		3	/B2
N/A	2		1	N/A

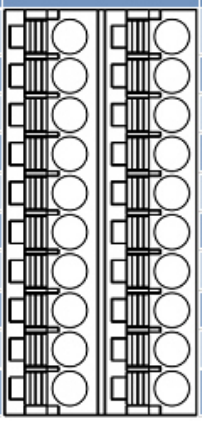


Figure 2-2 I/O Connector of WF-2015

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2.1.2.2 WF-2017

Pin Assignment Name		Terminal No.		Pin Assignment Name
V0-/V8+	20		19	V0+
V1-/V9+	18		17	V1+
V2-/V10+	16		15	V2+
V3-/V11+	14		13	V3+
V4-/V12+	12		11	V4+
V5-/V13+	10		9	V5+
V6-/V14+	8		7	V6+
V7-/V15+	6		5	V7+
AGND	4		3	AGND
AGND	2		1	AGND

Figure 2-3 I/O Connector of WF-2017

2.1.2.3 WF-2019

CON1

Pin Assignment	Terminal	No.	Pin Assignment
+5V	01		
CJC	02	14	AGND
CH 0-	03	15	CH 0+
CH 1-	04	16	CH 1+
CH 2-	05	17	CH 2+
CH 3-	06	18	CH 3+
CH 4-	07	19	CH 4+
CH 5-	08	20	CH 5+
CH 6-	09	21	CH 6+
CH 7-	10	22	CH 7+
CH 8-	11	23	CH 8+
CH 9-	12	24	CH 9+
N.C.	13	25	N.C.
		Shield	F.G.

25-pin Female D-Sub Connector

Figure 2-4 I/O Connector of WF-2019

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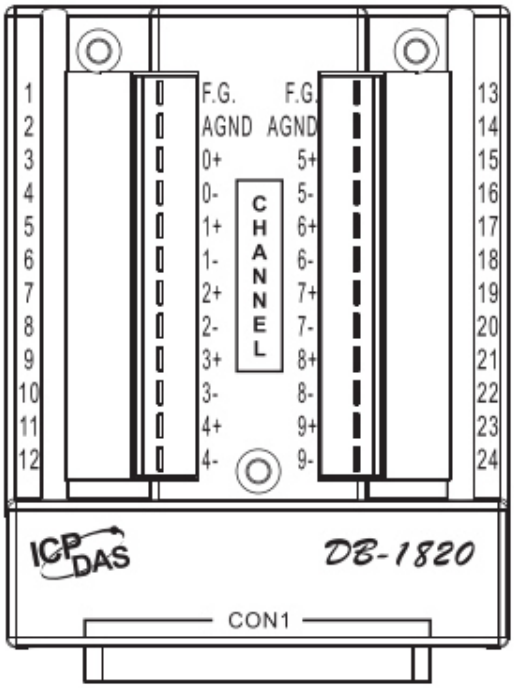


Figure 2-5 Pin Assignment of DB-1820

2.1.2.4 WF-2026

Pin Assignment Name		Terminal No.		Pin Assignment Name
VI0-	20		19	VI0+
VI1-	18		17	VI1+
VI2-	16		15	VI2+
VI3-	14		13	VI3+
VI4-	12		11	VI4+
VO0-	10		9	VO0+
VO1-	8		7	VO1+
DI0	6		5	DO0
DI1	4		3	DO1
DGND	2		1	DO2

Figure 2-6 I/O Connector of WF-2026

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2.2 Top Panel

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

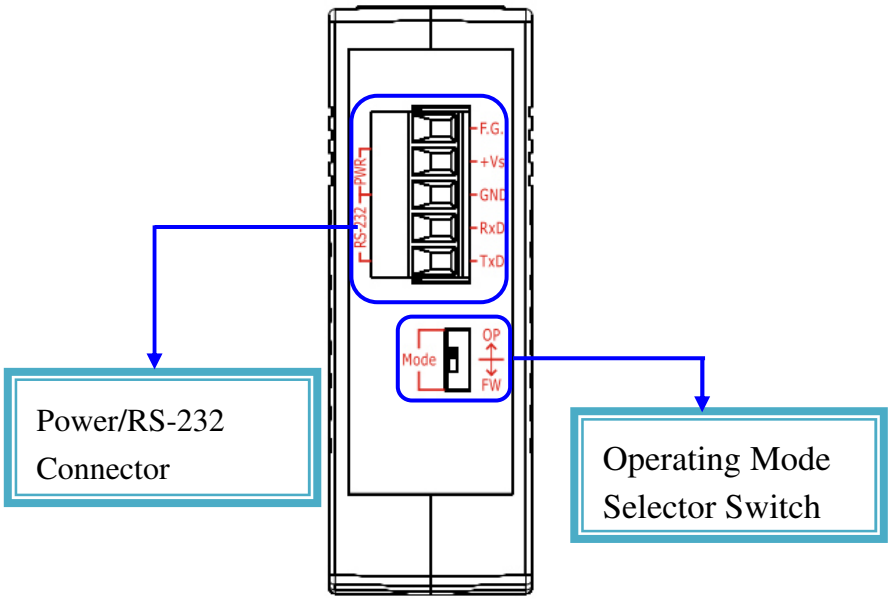


Figure 2-3 Top Panel of the WF-2000

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.

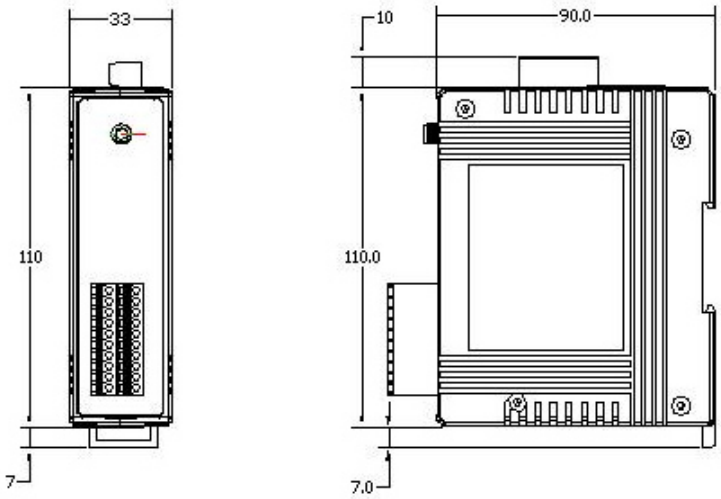


Figure 2-4 Front / Left Side dimension of the WF-2015/WF-2017/WF-2026

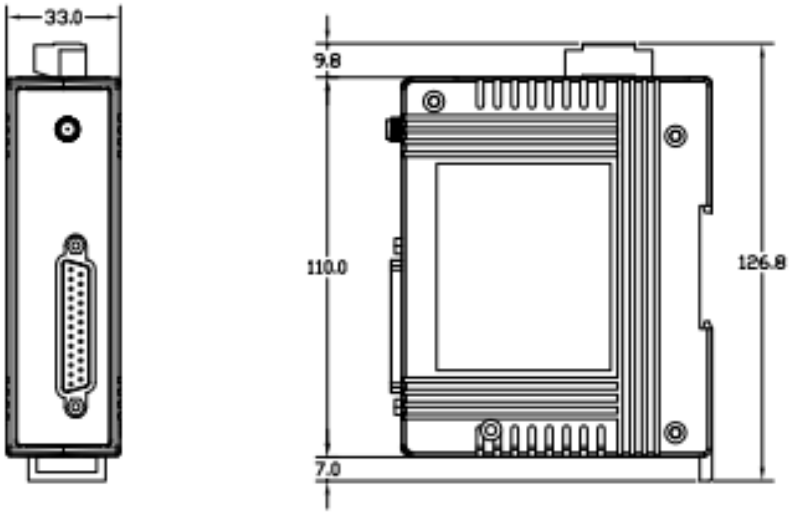


Figure 2-5 Front / Left Side dimension of the WF-2019

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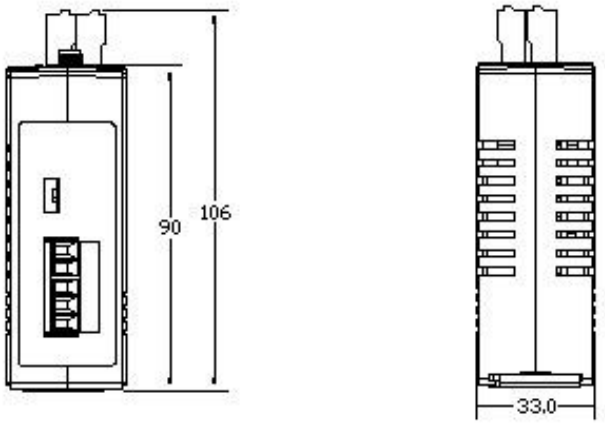


Figure 2-6 Top / Bottom dimension of the WF-2015/WF-2017/WF-2026

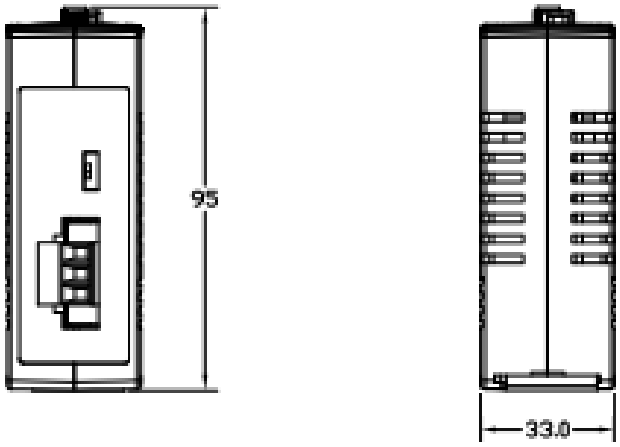


Figure 2-7 Top / Bottom dimension of the WF-2019

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.

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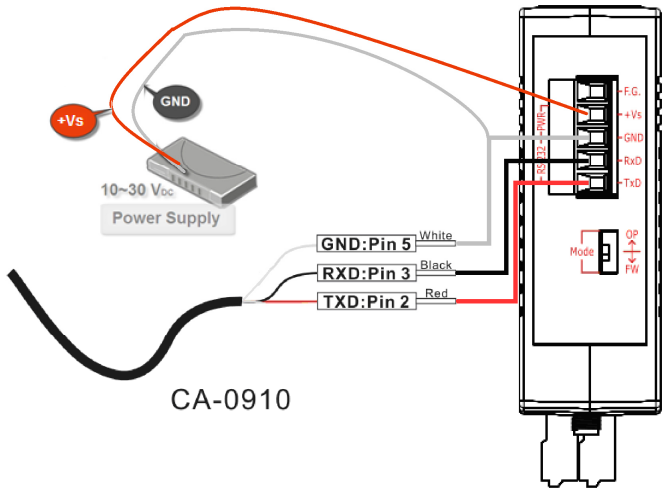


Figure 2-8 Power and Serial port wire connection

2.4.2 I/O connection

2.4.2.1 WF-2015

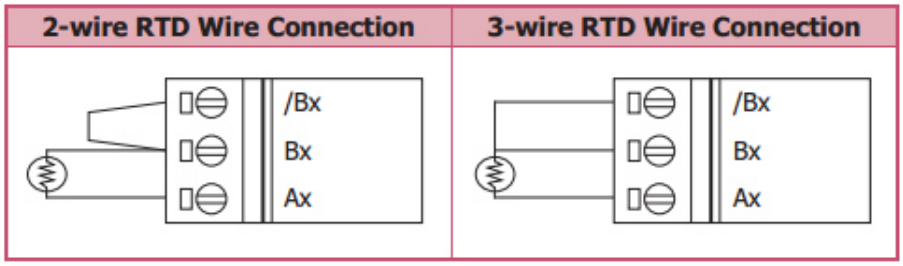


Figure 2-9 AI wire connection of WF-2015

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2.4.2.2 WF-2017

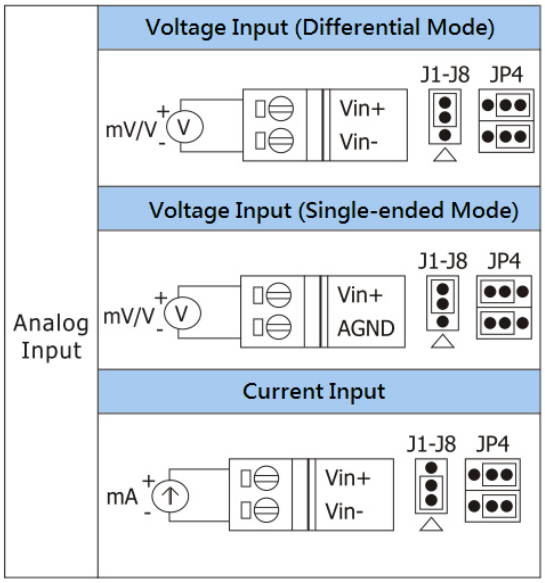


Figure 2-13 AI wire connection of WF-2017

2.4.2.3 WF-2019

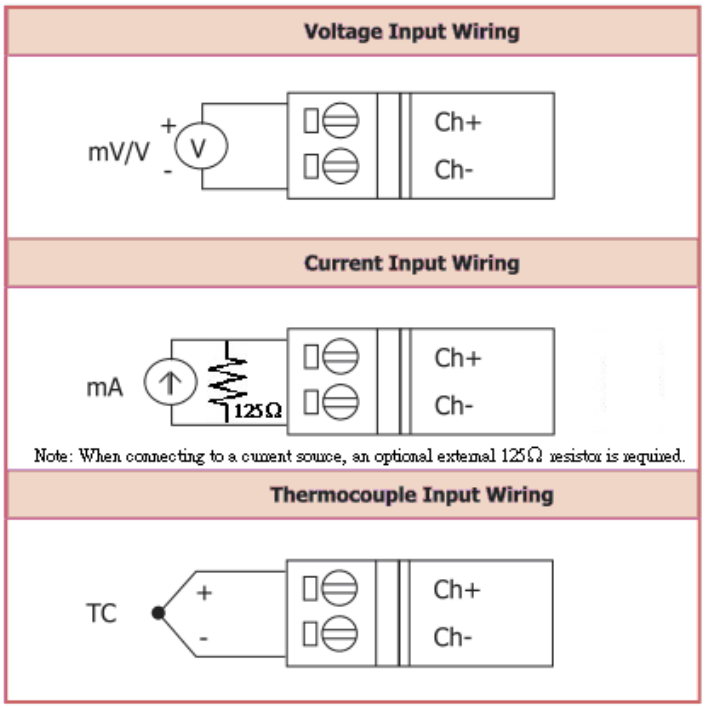


Figure 2-14 AI wire connection of WF-2019

2.4.2.4 WF-2026

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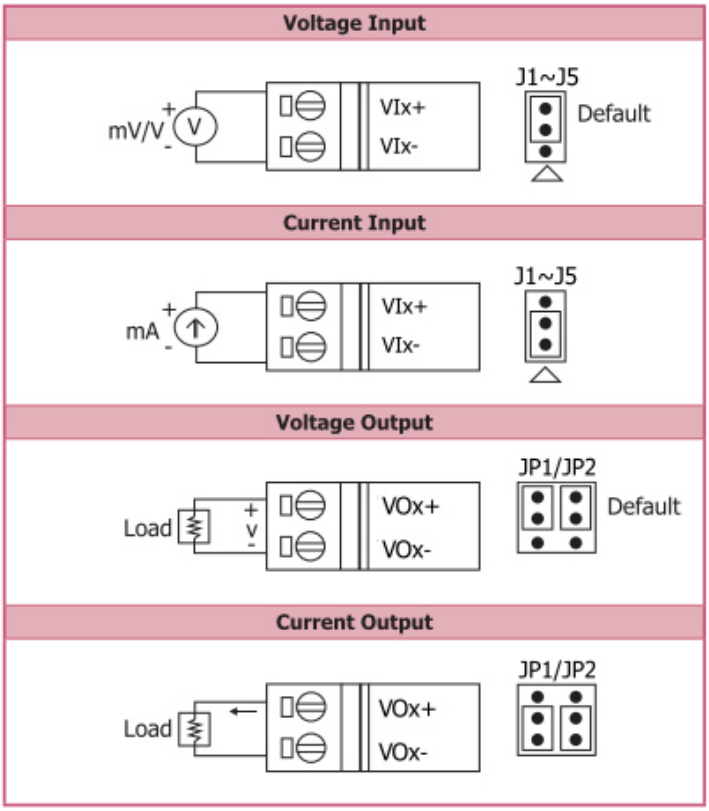


Figure 2-15 AIO wire connection of WF-2026

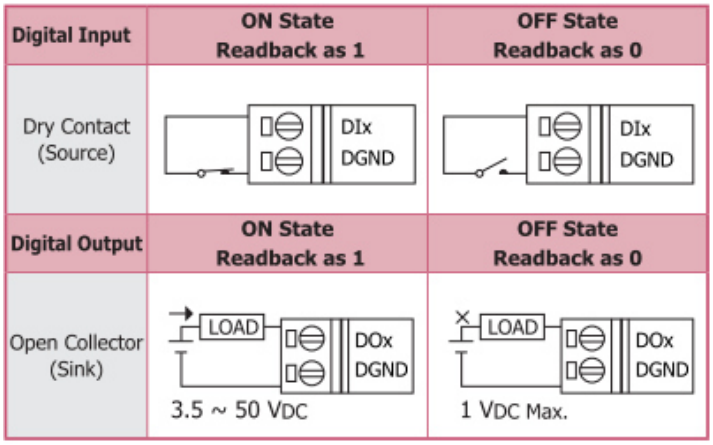


Figure 2-16 DIO wire connection of WF-2026

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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

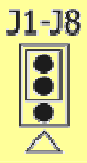
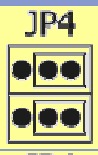
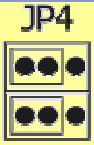
Mode	Jumper Number
WF-2015	JP2
WF-2017	JP2
WF-2019	JP1
WF-2026	JP4



Figure 2-10 Watchdog timer Jumper Position

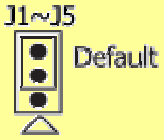
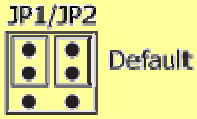
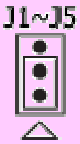
2.5.2 AI Settings

Table 2-5 WF-2017 AI Input Type/Mode Jumper configuration

Modules	Input Type	Jumper Position	Input Mode	Jumper Position
WF-2017	Voltage		Differential	
			Single-ended	
	Current		Differential	

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Table 2-6 WF-2026 Analog Input/Output Type Jumper configuration

Modules	Input Type	Jumper Position	Output Type	Jumper Position
WF-2026	Voltage		Voltage	
	Current		Current	

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 2-19.

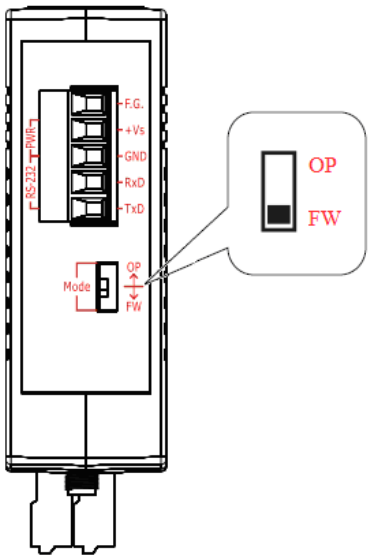


Figure 2-11 FW Position of Dip-Switch

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Figure 2-12 CA-0910 Cable

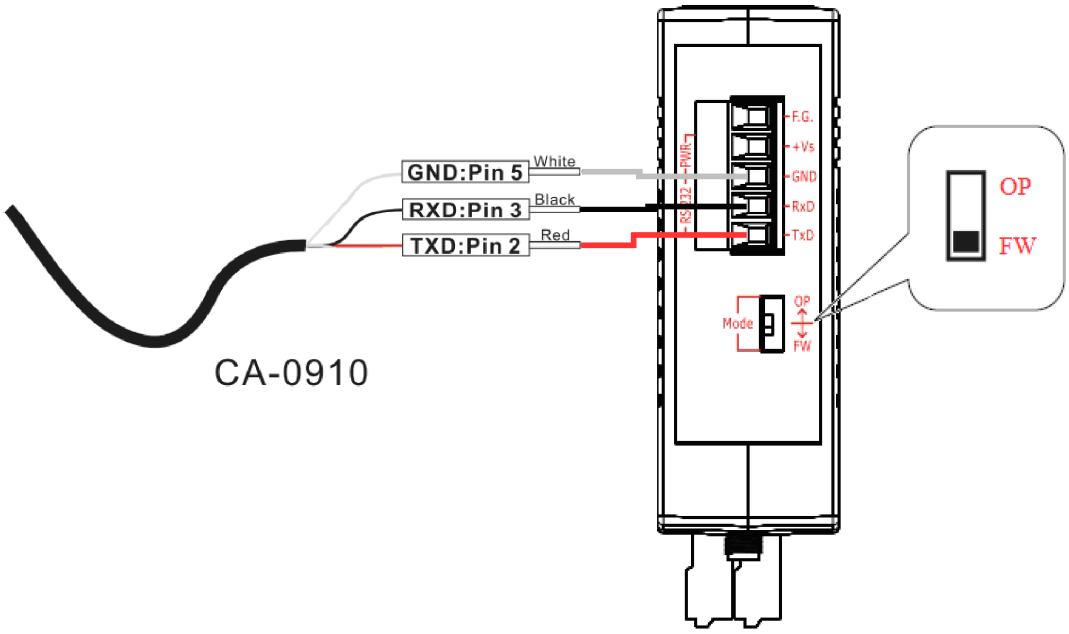


Figure 2-13 Downloads cable connection

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.

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

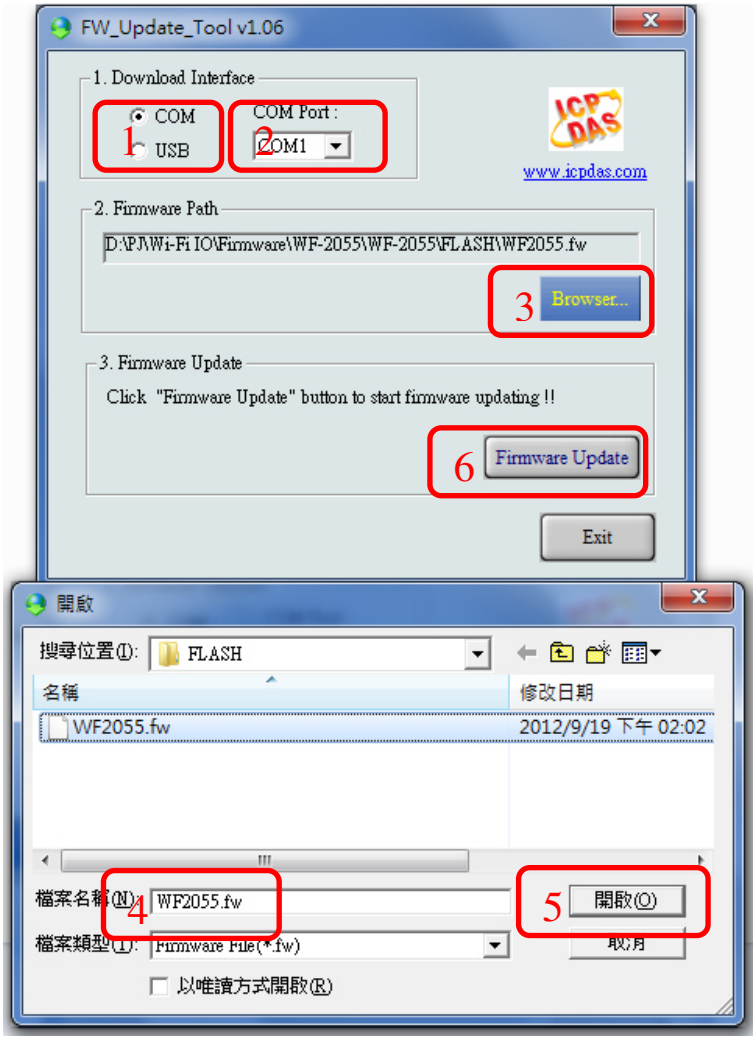


Figure 2-14 WF-2000 firmware update process

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/

2.6.2 Firmware Operation Mode

In the operation mode, users need to set the dip-switch to the “OP” position as Figure 2-22 and reset the power, and the WF-2000 can run in 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.

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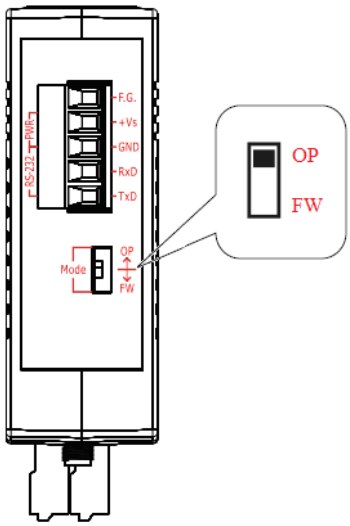


Figure 2-15 OP Position of Dip-Switch

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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-2015/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

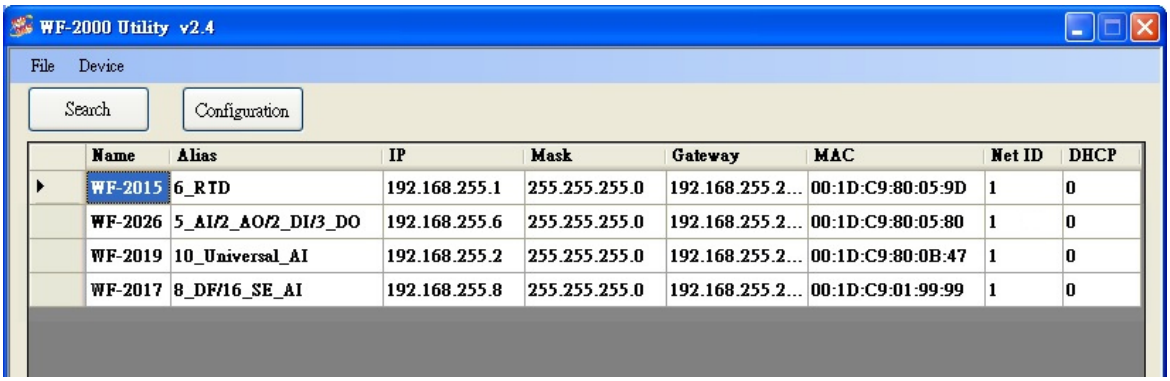


Figure 3-1 WF-2000 I/O Utility (v2.4) main screen

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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

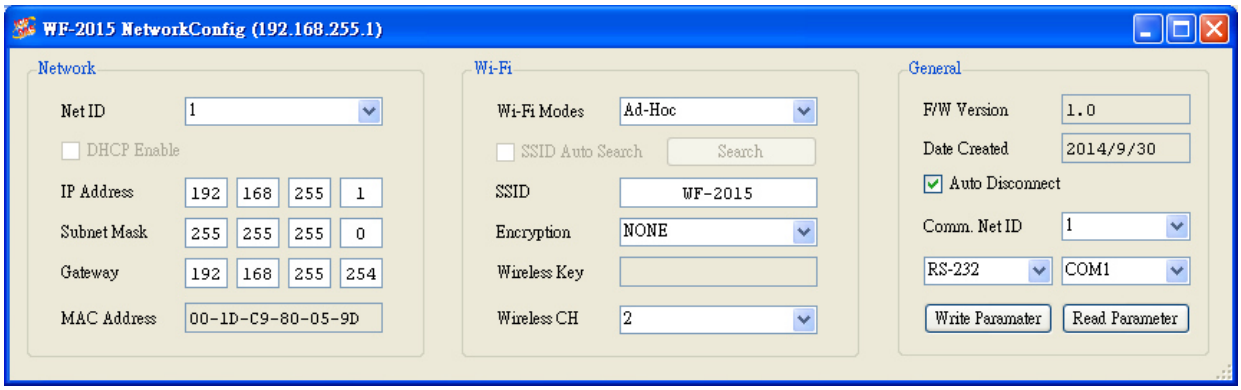


Figure 3-2 WF-2000 I/O Utility (v2.0 or later) configuration screen

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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

  WF-2000 MAC Address display

[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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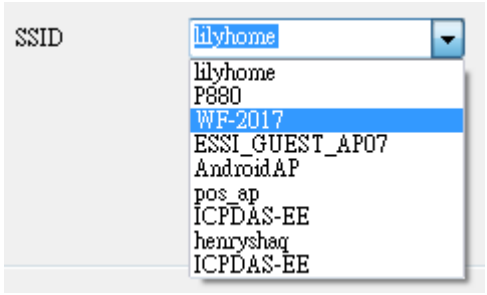


Figure 3-3 Auto search SSID list

■ Wi-Fi Modes

Table 3-1 AP Mode Configuration

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 Configuration

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: Wi-Fi Encryption of Wi-Fi, connected devices must with the same encryption. Not Support WPA、WPA2 encryption in Ad-Hoc mode。
WLK	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

- Parameter Transmission Interface

  The parameter transmission interface, that provides wireless 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 Analog Input Screen

In the I/O page of the AI, 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.

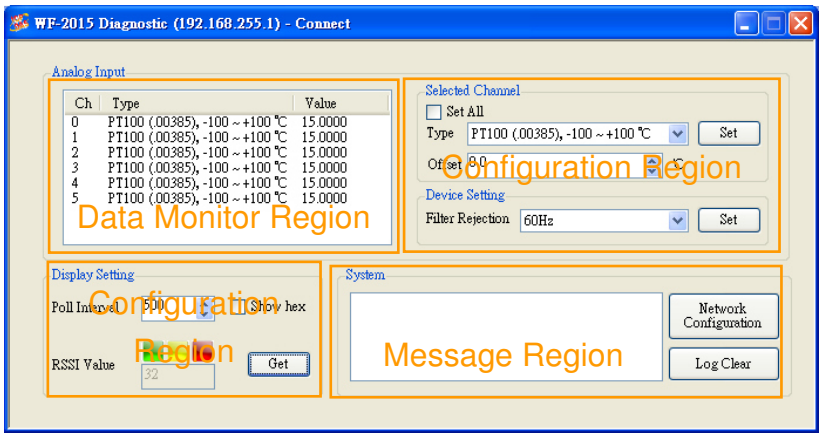


Figure 3-4 WF-2015 diagnostic screen

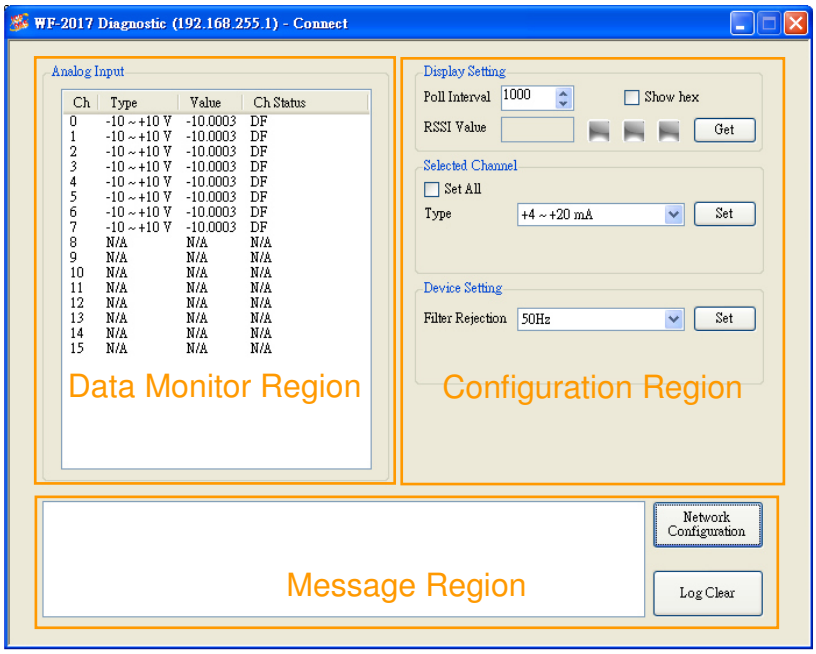


Figure 3-5 WF-2017 diagnostic screen

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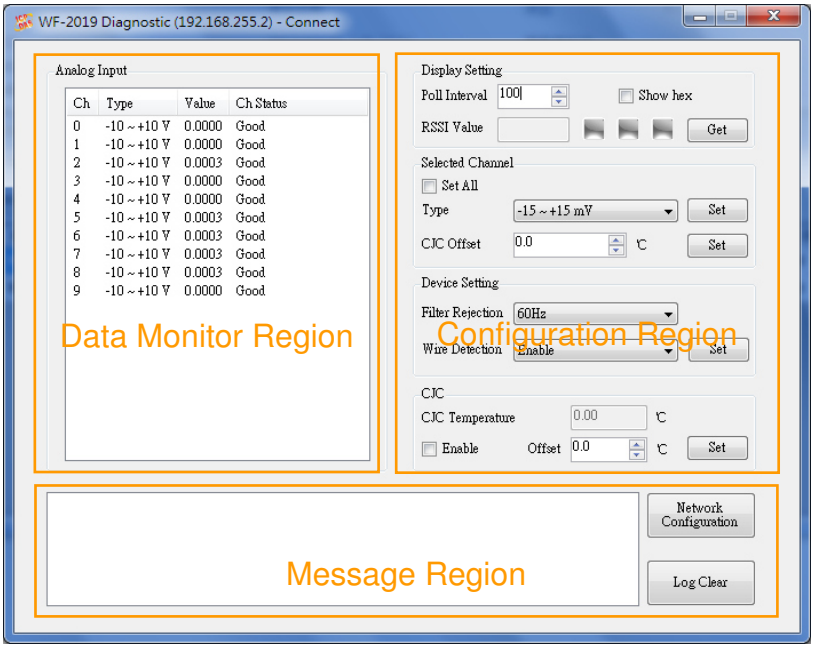


Figure 3-6 WF-2019 diagnostic screen

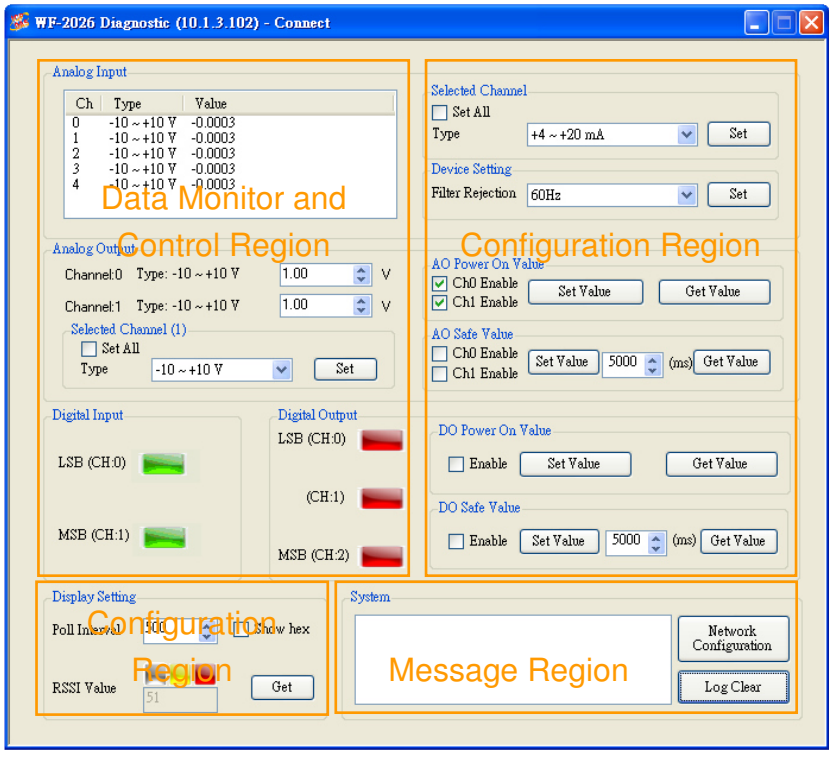


Figure 3-7 WF-2026 diagnostic screen

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- Configuration Region

  All I/O related configurations can be set in this region. This region is divided into two parts, channel and module related setting. The channel related setting is in the "Selected Channel". The rest are module related settings.

  - Set All

    All AI or AO channels related setting will follow current selection.

  - Type

    The WF-2000 series I/O modules provide programmable input type for analog input/output. Users can set different type for each analog input/output channel. For more detail for type of analog /output modules, please refer to Appendix A.

  - Channel CJC Offset

    Setting the CJC offset for the specific channel. The behavior of the setting is the same as the CJC Offset, but it only affects specific channel.

    Note: The CJC offset can be any in the range of -30.00 to +100.00 °C.

  - Filter Rejection

    In order to remove the noise from the power supply, some analog input modules feature build-in noise filter. Two filters, 50Hz and 60Hz, are provided to remove noise generated from power source.

  - Wire Detection

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Enable / Disable the open-wire detection for thermocouple.

- CJC Enable

  Enable / Disable the CJC (Cold-Junction Compensation).

- CJC Offset

  Setting the CJC offset value for all AI channels. The offset value is used to add or subtract the reading value. Changing of this value will not affect calibration, but will affect the reading value of temperature type.

  Note: The CJC offset can be any in the range of -30.00 to +100.00 °C.

- Polling Interval

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

- Show Hex

  Convert the I/O value from decimal to hexadecimal.

- 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

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- Monitor Region

  The I/O related data and configurations will be listed here. Users can select the channel to configure in the “I/O Monitor Region”. The setting of this selected channel will show in “I/O configuration region”.

- Message Region

  This area will display information for the system connection.

- Control Region

  In the controlling region, 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.

  - Digital Input Monitor Region

    The digital input value can be read in this region.
  - Digital Output Monitor and Control 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 disabled 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 disabled 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.

◆ Analog Output Monitor and Control Region

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

◆ Power On Value of AO

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

- **Enable:** Select which channel to enable or disable this function.
- **Set Value:** Set the current output value as Power on value.
- **Get Value:** Get the current configuration of Power on value.

◆ Safe Value of AO

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

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- **Enable:** Select which channel to enable or disable this function.
- **Set Value:** Set the current output value 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.

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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.

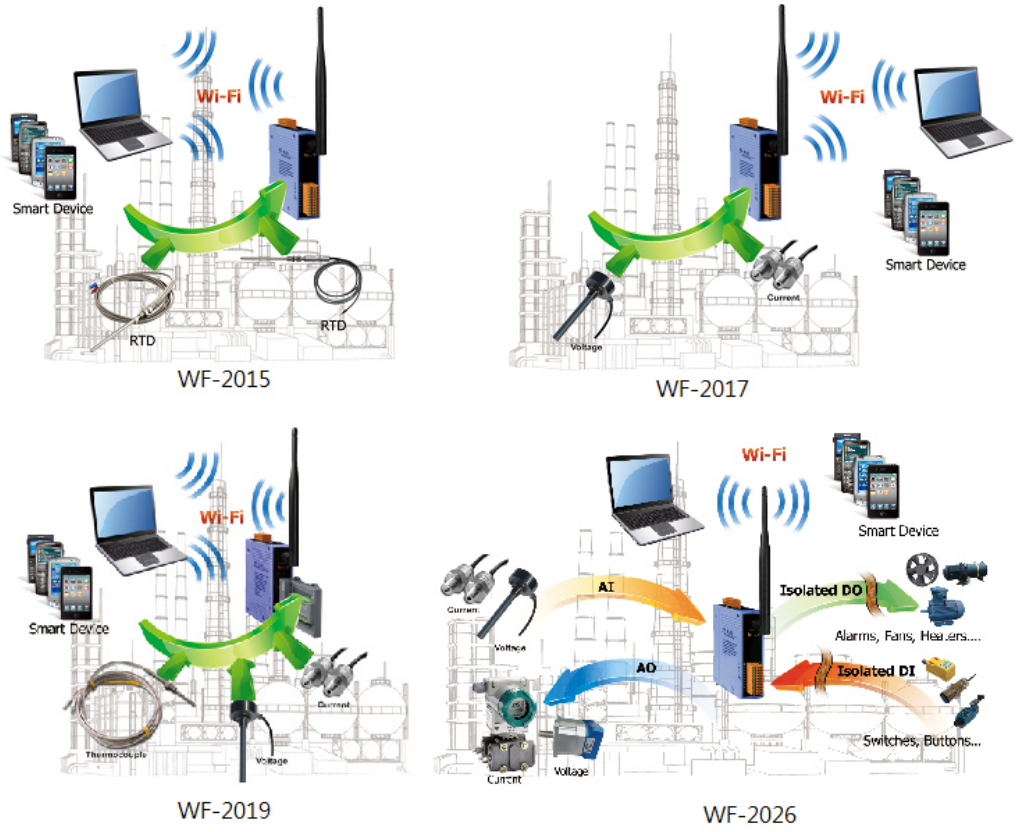


Figure 4-1 WF-2000 application architecture

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 2-19.

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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 2-5.

4.2 WF-2000 series Configuration

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

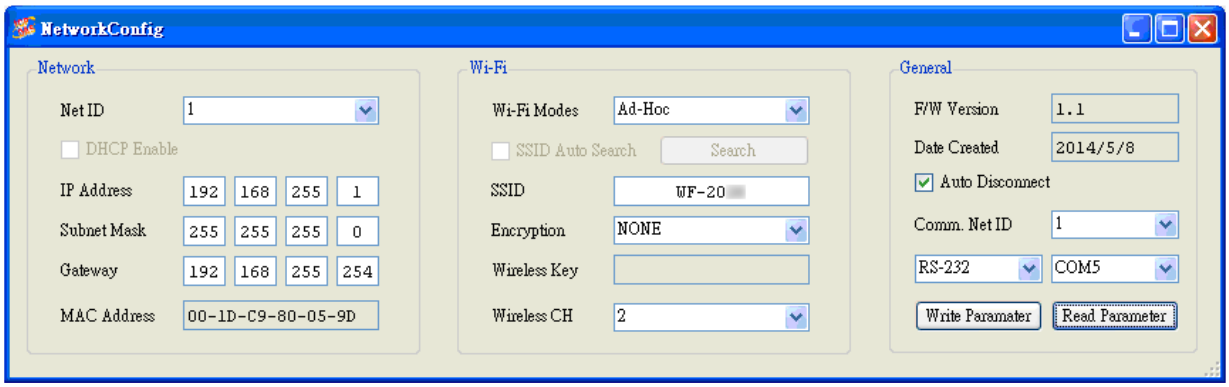


Figure 4-2 Configuration Interface

01、Net ID : The Unit Identifier in Modbus TCP/IP application data unit. This case is set as "1" in Figure 4-2.

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-20xx".

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.

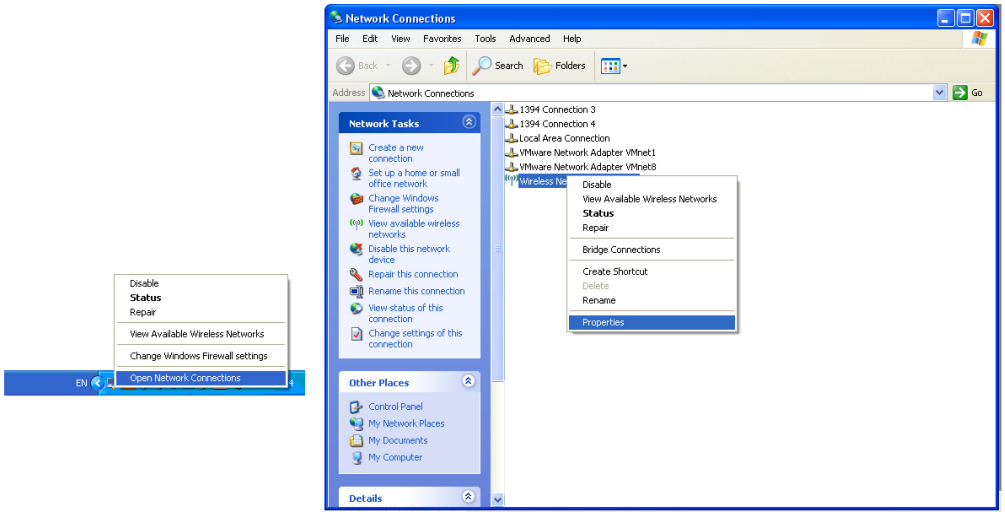


Figure 4-3 Properties setting of wireless network connections

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

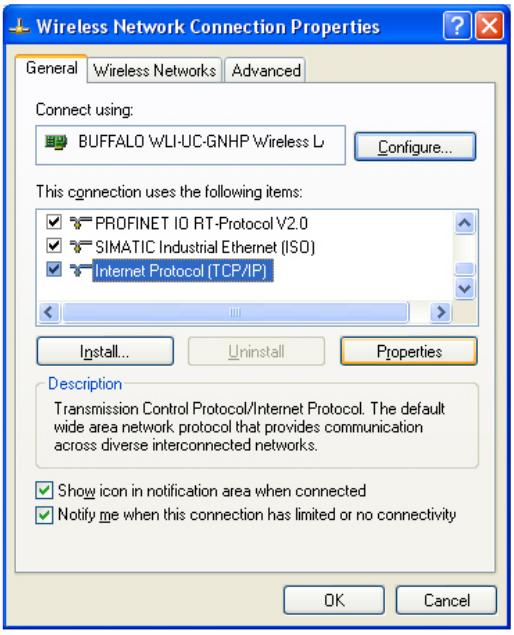


Figure 4-4 Properties setting of Internet Protocol (TCP/IP)

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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.

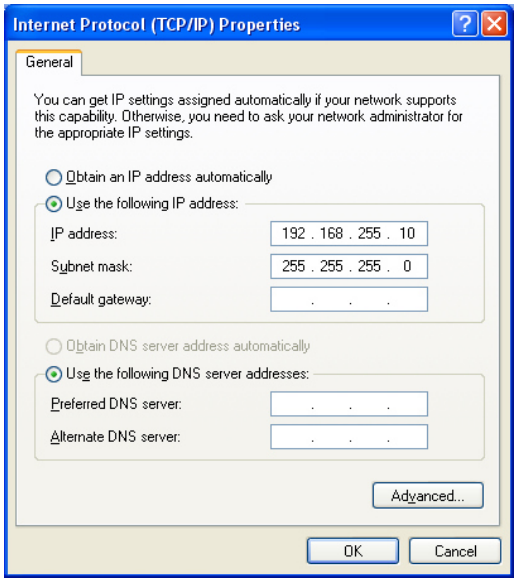


Figure 4-5 IP address setting interface

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.

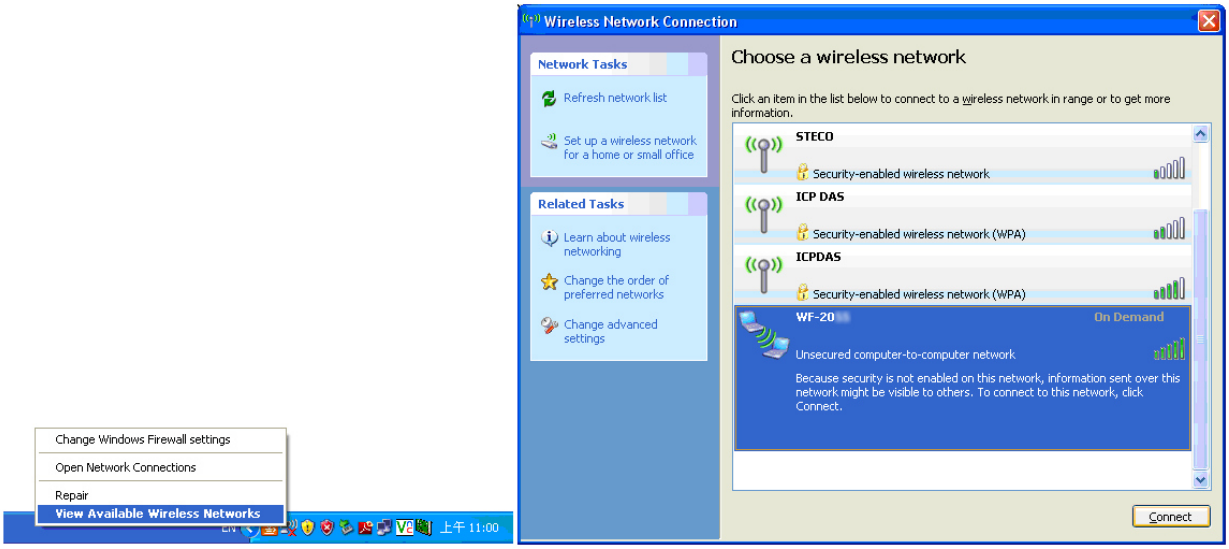


Figure 4-6 Wireless network connection

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



Figure 4-7 Connection confirm interface

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

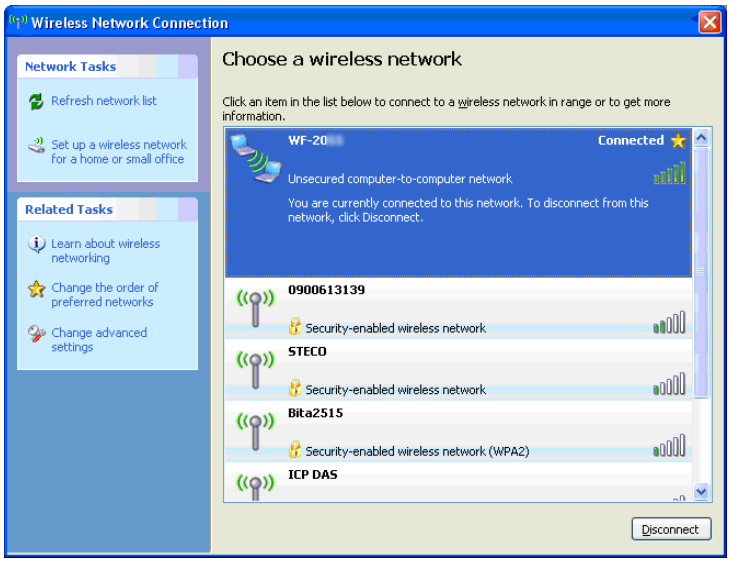


Figure 4-8 Connection successful interface

4.2.3 **Access I/O data**

01、Connection with WF-2000 I/O utility (v2.4 or later)

a. Open WF-2000 I/O utility and click the "Search" button, choose the network interface that connect with the WF-2000 device, search list will provide each item that scan from UDP Port.

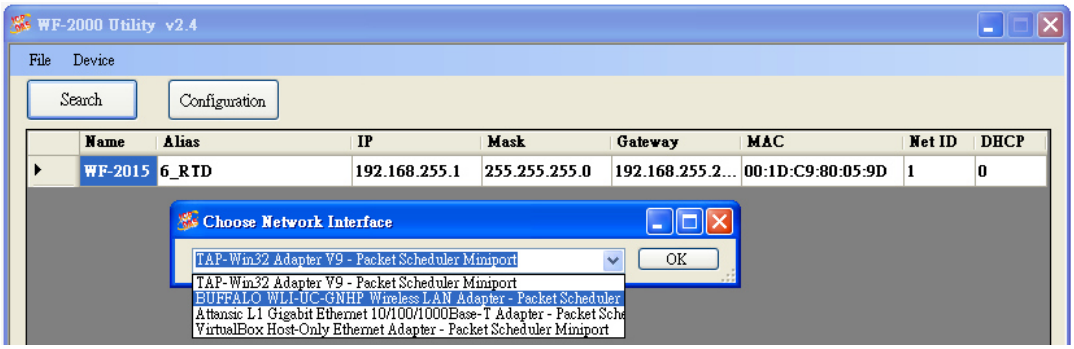


Figure 4-9 Choose Network Interface

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b. To access the WF-2000 I/O module user can double click the module listed in "Device List".

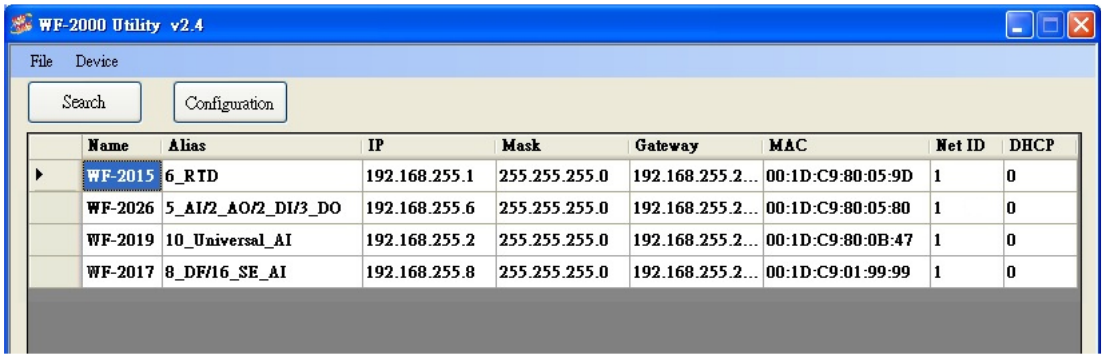


Figure 4-10 WF-2000 search list

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.

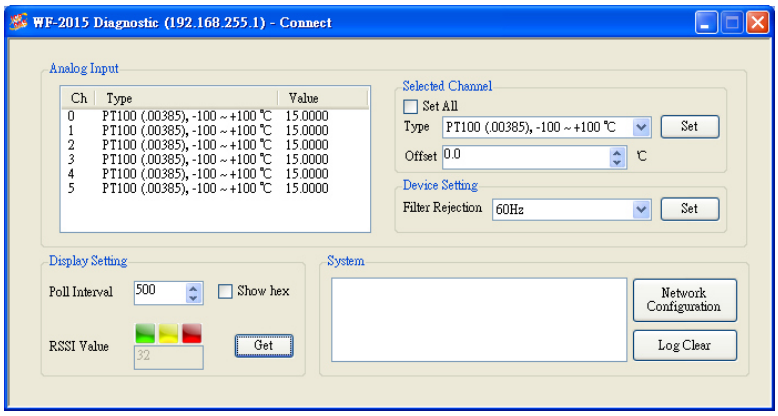


Figure 4-11 I/O page interface(WF-2015)

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.

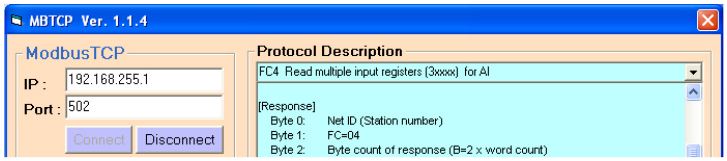


Figure 4-12 Modbus TCP utility Connection interface

c. The following Modbus command function codes are available for WF-2000 series control.

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Table 4-1 Modbus request command list

Request	FC1 Read multiple coils status (0xxxx) for DO	FC2 Read multiple input discrete (1xxxx) for DI	FC3 Read multiple registers (4xxxx) for AO	FC4 Read multiple input registers (3xxxx) for AI	FC15 Force multiple coils (0xxxx) for DO	FC16 Write multiple registers (4xxxx) for AO
Byte 0	Net ID					
Byte 1	FC=0x01	FC=0x02	FC=0x03	FC=0x04	FC=0x0F	FC=0x10
Byte 2-3	Reference number					
Byte 4-5	Bit count	Bit count	Word count	Word count	Bit count	Word count
Byte 6	N/A	N/A	N/A	N/A	Byte count (B)	Byte count (B)
Byte 7-(B+6)	N/A	N/A	N/A	N/A	Data to be written	Register values

d. Modbus TCP request command examples.

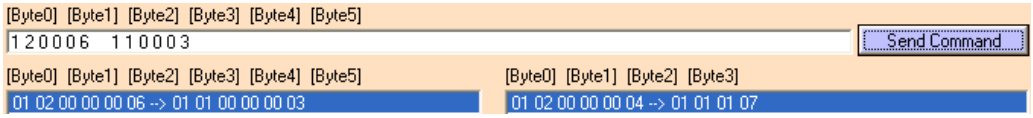


Figure 4-13 Read multiple coils status (0xxxx) for DO

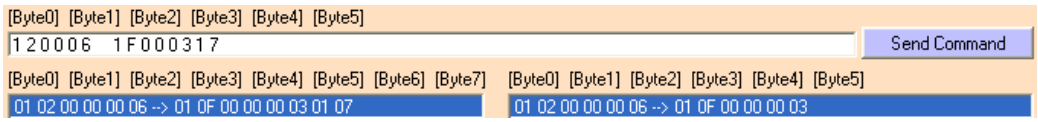


Figure 4-14 Force multiple coils (0xxxx) for DO

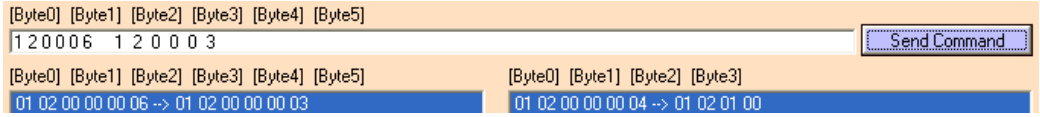


Figure 4-15 Read multiple input discretes (1xxxx) for DI

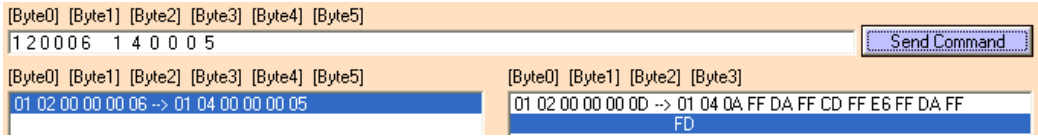


Figure 4-16 Read multiple input registers (3xxxx) for AI

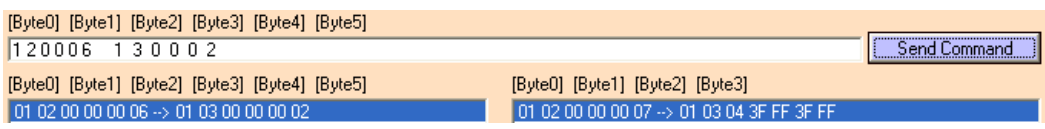


Figure 4-17 Read multiple registers (4xxxx) for AO

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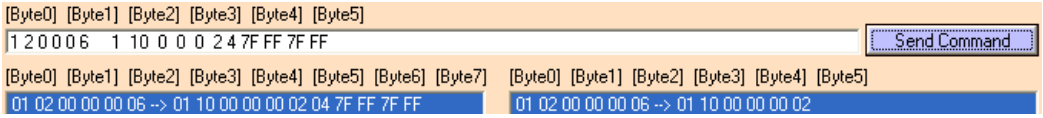


Figure 4-18 Write multiple registers (4xxxx) for AO

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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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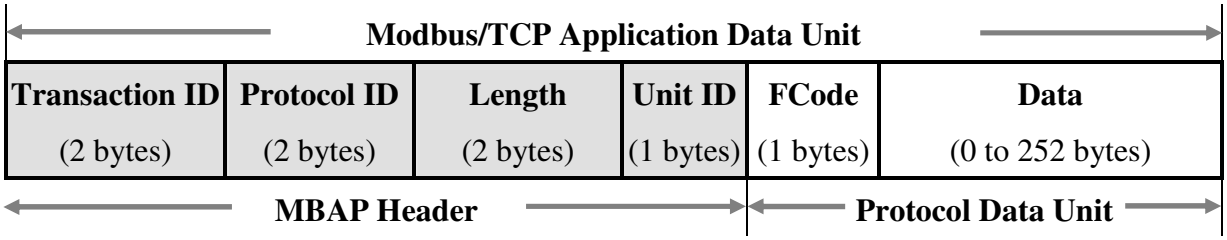


Figure 5-1 Modbus/TCP Application Data Unit

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 registers.

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

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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)

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.

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Table 5-4 A 16-bits word item

Value	1st	2nd
0x1234	0x12	0x34

5.3 Address Mapping

5.3.1 **WF-2015 I/O Address Mapping**

Table 5-5 (3xxxx) AI address

Begin Address	Points	Descriptions	Range	Access Type
30001	1~6	Analog Input	-32768 ~ +32767 (Bipolar)	R

Table 5-6 (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
40248	1	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

5.3.2 **WF-2017 I/O Address Mapping**

Table 5-7 (3xxxx) AI address

Begin Address	Points	Descriptions	Range	Access Type
30001	1~16	Analog Input	-32768 ~ +32767 (Bipolar) 0 ~ +65535 (Unipolar)	R
30017	1	AI Wire Selected	0 ~ 1 0 => Differential 1 => Single-Ended	R

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Table 5-8 (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
40248	1	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

5.3.3 **WF-2019 I/O Address Mapping**

Table 5-9 (3xxxx) AI address

Begin Address	Points	Descriptions	Range	Access Type
30001	1~10	Analog Input	-32768 ~ +32767 (Bipolar) 0 ~ +65535 (Unipolar)	R
30011	1	CJC data	-300 ~ +1000	R

Table 5-10 (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
40248	1	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

5.3.4 **WF-2026 I/O Address Mapping**

Table 5-11 (3xxxx) AI address

Begin Address	Points	Descriptions	Range	Access Type
30001	1~5	Analog Input	-32768 ~ +32767 (Bipolar) 0 ~ +65535 (Unipolar)	R

Table 5-12 (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
40001	1~2	Analog Output	-32768 ~ +32767 (Bipolar) 0 ~ +65535 (Unipolar)	R/W

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Table 5-13 (4xxxx) AO address

Begin Address	Points	Descriptions	Range	Access Type
40248	1	Reset System	1= Reset System 247= Restore to Factory Default Settings	W

Table 5-14 (0xxxx) DO address

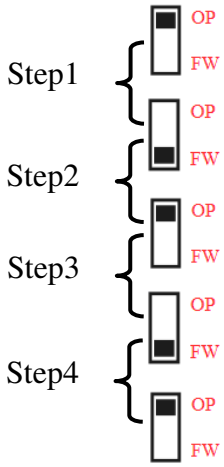
Begin Address	Points	Descriptions	Range	Access Type
00001	1~3	Digital Output	0=OFF, 1=ON	R/W

Table 5-15 (1xxxx) DI address

Begin Address	Points	Descriptions	Range	Access Type
10001	1~2	Digital Input	0=OFF, 1=ON	R

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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

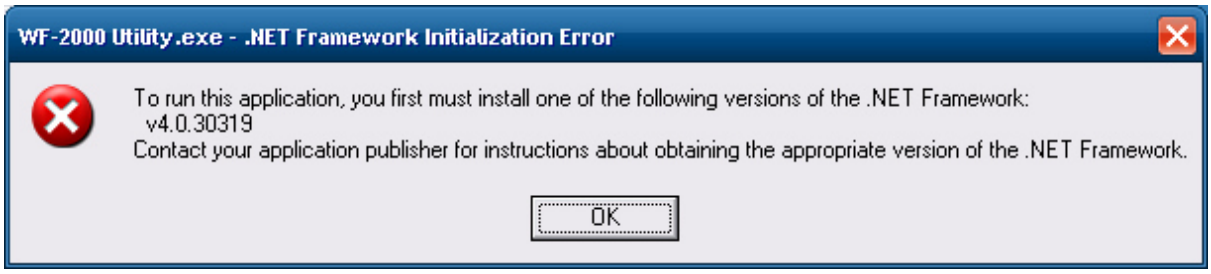


Figure 6-1 .NET Framework Initialization Error

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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Appendix A.

A.1 Analog Input Type and Data Format Table

Type Code	Input Range	Data Format	+F.S	-F.S
00h	-15 to +15 mA	Engineering Unit	+15.000	-15.000
		2's comp HEX	7FFF	8000
01h	-50 to +50 mA	Engineering Unit	+50.000	-50.000
		2's comp HEX	7FFF	8000
02h	-100 to +100 mV	Engineering Unit	+100.00	-100.00
		2's comp HEX	7FFF	8000
03h	-500 to +500 mV	Engineering Unit	+500.00	-500.00
		2's comp HEX	7FFF	8000
04h	-1 to +1 V	Engineering Unit	+1.0000	-1.0000
		2's comp HEX	7FFF	8000
05h	-2.5 to +2.5 V	Engineering Unit	+2.5.000	-2.5.000
		2's comp HEX	7FFF	8000
06h	-20 to +20 mA	Engineering Unit	+20.000	-20.000
		2's comp HEX	7FFF	8000
07h	+4 to +20 mA	Engineering Unit	+20.000	+04.000
		2's comp HEX	FFFF	0000
08h	-10 to +10 V	Engineering Unit	+10.000	-10.000
		2's comp HEX	7FFF	8000
09h	-5 to +5 V	Engineering Unit	+5.0000	-5.0000
		2's comp HEX	7FFF	8000

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Type Code	Input Range	Data Format	+F.S	-F.S
0Ah	-1 to +1 V	Engineering Unit	+1.0000	-1.0000
		2's comp HEX	7FFF	8000
0Bh	-500 to +500 mV	Engineering Unit	+500.00	-500.00
		2's comp HEX	7FFF	8000
0Ch	-150 to +150 mV	Engineering Unit	+150.00	-150.00
		2's comp HEX	7FFF	8000
0Dh	-20 to +20 mA	Engineering Unit	+20.000	-20.000
		2's comp HEX	7FFF	8000
0Eh	Type J Thermocouple -210 to 760°C	Engineering Unit	+760.00	-210.00
		2's comp HEX	7FFF	DCA2
0Fh	Type K Thermocouple -270 to 1372°C	Engineering Unit	+1372.0	-0270.0
		2's comp HEX	7FFF	E6D0
10h	Type T Thermocouple -270 to 400°C	Engineering Unit	+400.00	-270.00
		2's comp HEX	7FFF	A99A
11h	Type E Thermocouple -270 to 1000°C	Engineering Unit	1000.0	-0270.0
		2's comp HEX	7FFF	DD71
12h	Type R Thermocouple 0 to 1768°C	Engineering Unit	+1768.0	+0000.0
		2's comp HEX	7FFF	0000
13h	Type S Thermocouple 0 to 1768°C	Engineering Unit	+1768.0	+0000.0
		2's comp HEX	7FFF	0000
14h	Type B Thermocouple 0 to 1820°C	Engineering Unit	+1820.0	+0000.0
		2's comp HEX	7FFF	0000

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Type Code	Input Range	Data Format	+F.S	-F.S
15h	Type N Thermocouple -270 to 1300°C	Engineering Unit	+1300.0	-0270.0
		2's comp HEX	7FFF	E56B
16h	Type C Thermocouple 0 to 2320°C	Engineering Unit	+2320.0	+0000.0
		2's comp HEX	7FFF	0000
1Ah	0 to +20 mA	Engineering Unit	+20.000	+00.000
		2's comp HEX	FFFF	0000

Note:
Getting the 0x7FFF value in all of the thermocouple type codes, it means that the thermocouple wires are broken.

A.2 Analog Output Type and Data Format Table

Type Code	Input Range	Data Format	+F.S	-F.S
30h	0 to +20 mA	Engineering Unit	+20.000	+00.000
		2's comp HEX	FFFF	0000
31h	+4 to +20 mA	Engineering Unit	+20.000	+04.000
		2's comp HEX	FFFF	0000
32h	0 to +10 V	Engineering Unit	+10.000	+00.000
		2's comp HEX	FFFF	0000
33h	-10 to +10 V	Engineering Unit	+10.000	-10.000
		2's comp HEX	7FFF	8000
34h	0 to +5 V	Engineering Unit	+05.000	+00.000
		2's comp HEX	FFFF	0000
35h	-5 to +5 V	Engineering Unit	+05.000	-05.000
		2's comp HEX	7FFF	8000

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A.3 CJC (cold junction compensation) Definition

Type	Input Range	Data Format	+F.S	-F.S
CJC	-30 to +100 ℃	Engineering Unit	+100.00	-030.00
		2's comp HEX	03E8	FED4

A.4 RTD Input Type and Data Format Table

Type Code	Input Range	Data Format	+F.S	-F.S
20h	Platinum 100 α = 0.00385 -100 ~ 100°C	Engineering unit	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohm	+138.50	+060.25
21h	Platinum 100 α = 0.00385 0 ~ 100°C	Engineering unit	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+138.50	+100.00
22h	Platinum 100 α = 0.00385 0 ~ 200°C	Engineering unit	+200.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+175.84	+100.00
23h	Platinum 100 α = 0.00385 0 ~ 600°C	Engineering unit	+600.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+313.59	+100.00
24h	Platinum 100 α = 0.003916 -100 ~ 100°C	Engineering unit	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohm	+139.16	+059.58
25h	Platinum 100 α = 0.003916 0 ~ 100°C	Engineering unit	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+139.16	+100.00
26h	Platinum 100 α = 0.003916 0 ~ 200°C	Engineering unit	+200.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+177.13	+100.00
27h	Platinum 100, α = 0.003916 0 ~ 600°C	Engineering unit	+600.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+317.28	+100.00

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28h	Nickel 120 -80 ~ 100°C	Engineering unit	+100.00	-080.00
		2's comp HEX	7FFF	999A
		Ohm	+200.64	+066.60
29h	Nickel 120 0 ~ 100°C	Engineering unit	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+200.64	+120.60
2Ah	Platinum 1000 α = 0.00385 -200 ~ 600°C	Engineering unit	+600.00	-200.00
		2's comp HEX	7FFF	D556
		Ohm	+3137.1	+0185.2
2Bh	Cu 100 α = 0.00421 -20 ~ 150°C	Engineering unit	+150.00	-020.00
		2's comp HEX	7FFF	EEEF
		Ohm	+163.17	+091.56
2Ch	Cu 100 α = 0.00427 0 ~ 200°C	Engineering unit	+200.00	+000.00
		2's comp HEX	7FFF	0000
		Ohm	+167.75	+090.34
2Dh	Cu 1000 α = 0.00421 -20 ~ 150°C	Engineering unit	+150.00	-020.00
		2's comp HEX	7FFF	EEEF
		Ohm	+1631.7	+0915.6
2Eh	Platinum 100 α = 0.00385 -200 ~ 200°C	Engineering unit	+200.00	-200.00
		2's comp HEX	7FFF	8000
		Ohm	+175.84	+018.49
2Fh	Platinum 100 α = 0.003916 -200 ~ 200°C	Engineering unit	+200.00	-200.00
		2's comp HEX	7FFF	8000
		Ohm	+177.14	+017.14
80h	Platinum 100 α = 0.00385 -200 ~ 600°C	Engineering unit	+600.00	-200.00
		2's comp HEX	7FFF	D556
		Ohm	+313.59	+018.49
81h	Platinum 100 α = 0.003916 -200 ~ 600°C	Engineering unit	+600.00	-200.00
		2's comp HEX	7FFF	D556
		Ohm	+317.28	+017.14

Note:

Getting the 0x7FFF value in all of the RTD type codes, it means that the RTD wires are broken.

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