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Document Revision

Version	Date	Description of changes
Rev1.0	2021-03-08	First release for DL-1xxS-WF Series

Table of Contents

1. Introduction

The DL-1xxS-WF Series Data Logger devices can be used to record temperature, humidity and dew point information, including the date and time stamps for each record, with up to 650,000 downloadable records(CSV) able to be stored. Real-time data can be accessed from anywhere and at any time using the PC Utility, Android APP & Web. It includes 2-channel Photo MOS Relay Output using trigger source and range for Alarm Devices. DL-101S-WF include an LCD display, DL-111S-WF include an Illuminance sensor.

DL-1xx-WF Series have WLAN connection complies with the IEEE802.11b/g/n standards, support Modbus TCP protocol, TCP & HTML, Which makes perfect integration for monitoring or control in SCADA software, HMI Modbus & Utility.

Figure 1-1: Application architecture for the DL-1xxS-WF

1.1 Features

- Wi-Fi communication monitoring and configuration
- Compatible with IEEE 802.11b/g/n standards
- Support Access Point(AP, 1 Client) & Station(STA) modes for wireless networks
- Support WEP, WPA and WPA2 wireless encryption
- Support Modbus TCP
- Support DHCP Server(AP), DHCP Client or Static IP(STA) network configuration
- Wide power supply range
- Photo MOS Relay output
- LCD Display Shows Temperature, Relative Humidity, Dew Point, Date and Time (DL-101S-WF Only)
- Illuminance measure (DL-111S-WF Only)
- Up to 650,000 data logger records
- IP66 Protection Approval
- DIN-Rail or Wall Mounted

1.1.1 Features Description

Compatible with IEEE 802.11b/g/n standards

DL-1xxS-WF complied with IEEE 802.11b/g/n standard from 2.4~2.5 GHz, and it can be used to connect your wireless LAN.

Support Access Point(AP) & Station(STA) modes for wireless networks

AP mode lets you create a Limited AP(1 Client access allow) network with the specified SSID to communicate directly with each other without the need for a wireless access point.

STA mode is the more common network configuration where all wireless 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, DL-1xxS-WF 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 protocols

The Modbus TCP server function on the DL-1xx-WF can be used to provide data monitoring from HMI/SCADA software built with Modbus TCP driver.

Also, there is some other HMI Modbus App in Android Google Play you can use.

Data Logger up to 650,000 records

Including the date and time stamps for each record, with up to 650,000 downloadable records CSV able to be stored. Each segment file size is 64Kbyte for 5376 record.

Chart View for PC Utility & Android APP

The DL-WF Series PC Utility & DL Series Android APP, can be used to configure the module and monitor real-time data, as well as display the chart, setting alarm events, setting the schedule or free run. The utility also allows the log data to be downloaded and exported to a .CSV file analysis from any other software.

1.1.2 Application

- Transportation of food or pharmaceuticals
- Food and beverage industry
- Blood stations, pharmacies
- Building and energy management
- Museums, archives, galleries
- Warehouses

1.2 Specifications

Table 1-1: System Specifications

Device	DL-101S-WF	DL-111S-WF
Illumination Measurement		
Range	-	0 to 100,000 Lux
Resolution	-	1 Lux
Accuracy	-	±5%
Response Time	-	1 second
Temperature Measurement		
Range	-20 to +60°C (-31 to +176˚F)	
Resolution	0.1°C	
Accuracy	Typical: ± 0.4°C; refer to figure 2	
Relative Humidity Measurement		
Range	0 to 100% RH	
Resolution	0.1% RH	
Accuracy	Typical: ±3% RH @ 20 ~ 80% RH; refer to figure 1	
LCD Display		
Display Information	Date, Time, Temperature (°C and °F), Relative Humidity (RH), Dew Point	-
Digital Output		
Channels	2	
Output Type	PhotoMOS, Form A, SPST	
Max Load Current	1000 mA	
Load Voltage	100VDC	
Data Logger		
Records	650,000	
Wi-Fi Interface		
Interface	Wi-Fi 2.4G	
Standard Supported	IEEE 802.11b/g/n	
Wireless Mode	Station & AP (1 Client)	
Encryption	WEP, WPA and WPA2	
Service	TCP, Modbus TCP, HTML	

Device	DL-101S-WF	DL-111S-WF
LED Indicators		
Power/Status	2 colors LED, Blue for System status, Red for Wi-Fi connect status.	
Protection		
Waterproof Level	IP66	
ESD (IEC 61000-4-2)	±8 kV Air for Random Point	
EFT (IEC 61000-4-4)	±4 kV for Power	
Environment		
Operating Temperature	-20 ~ +60°C	
Storage Temperature	-30 ~ +80°C	
Humidity	5 to 95% RH, Non-condensing	
Mechanism		
Dimensions(WxLxH)	103mm x 135mm x 55mm	103mm x 135mm x 67mm
Installation	DIN-Rail/Wall Mount	
Power Requirements		
Input Voltage Range	+9 ~ 48 VDC with Reverse Protection (+Vs to GND)	
Consumption	0.28W(WiFi Connected Standby)	0.3W(WiFi Connected Standby)

2. Hardware

2.1 Outward Appearance

Figure 2-1: DL-101S-WF/DL-111S-WF

2.2 Reset to Default

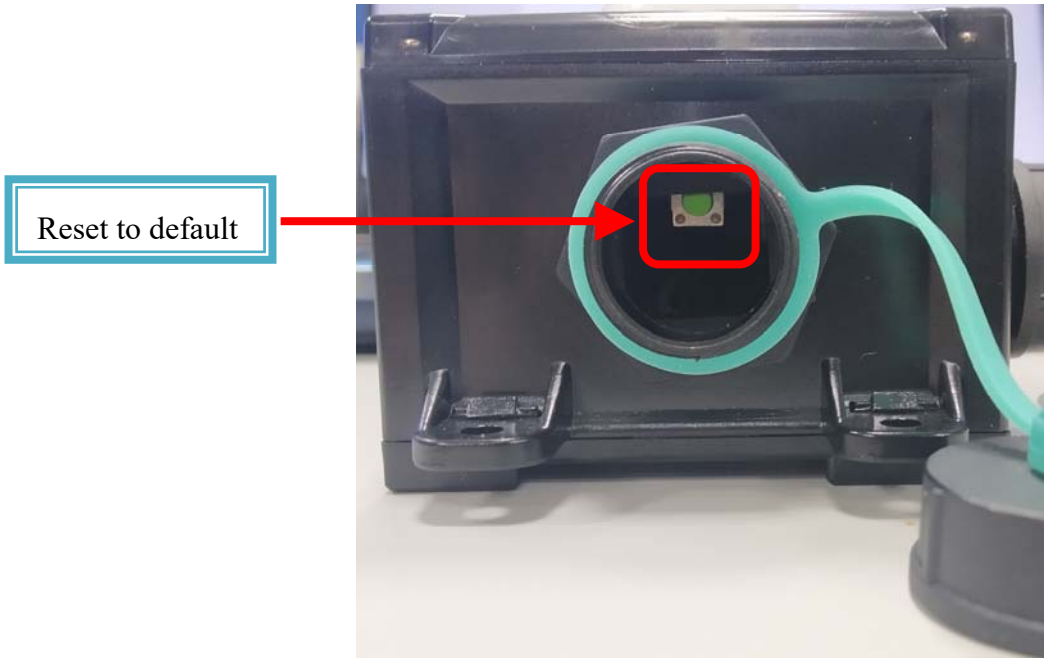


Figure 2-3: Switches inside the cover

Remove the cover on the left side(Big cover), Press & hold the Reset button on the bottom side over 6 Sec until the Red LED(Status/Alarm) quick flash then release to restore device default setting. Default is set in AP mode.

2.3 Connector & Pin Define

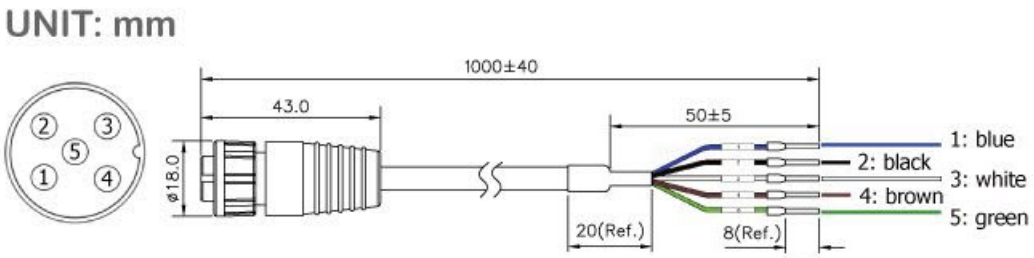
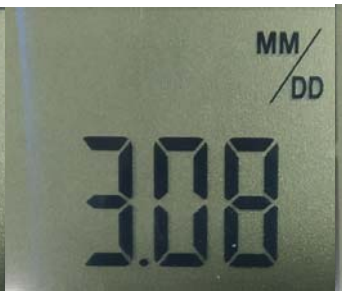


Figure 2-4: Connector for Power / Alarm Relay Output

2.4 LCD Display(Only for DL-101S-WF)

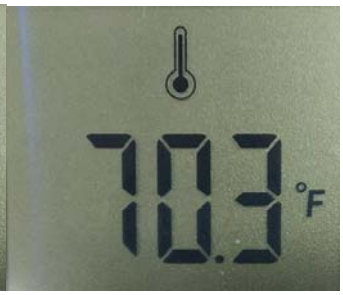
There are 6 items, Date, Time, Temperature (°C and °F), Relative Humidity (RH), Dew Point for LCD display, it can select On or Off to show on each item using utility, APP, or Web.

Time

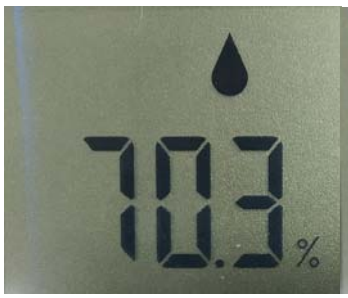


Date

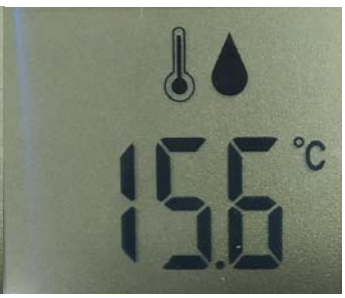
Temp °C



Temp °F



Relative Humidity



Dew Point

2.5 Dimensions

The diagrams below provide the dimensions of the DL-1xxS-WF series to use in defining your enclosure specifications. All dimensions are in millimeters.

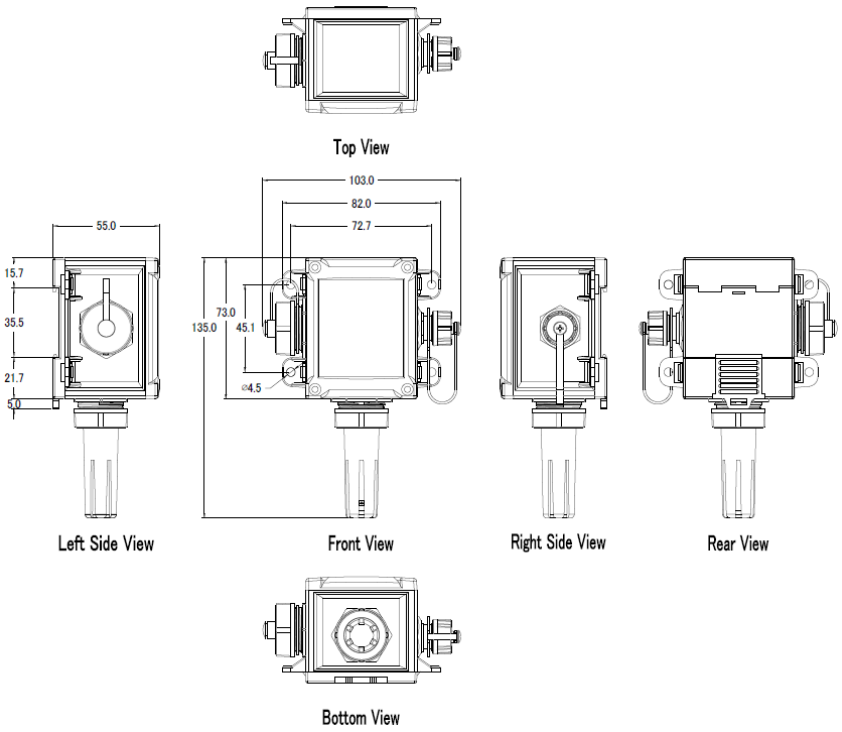


Figure 2-4: Dimension of the DL-101S-WF

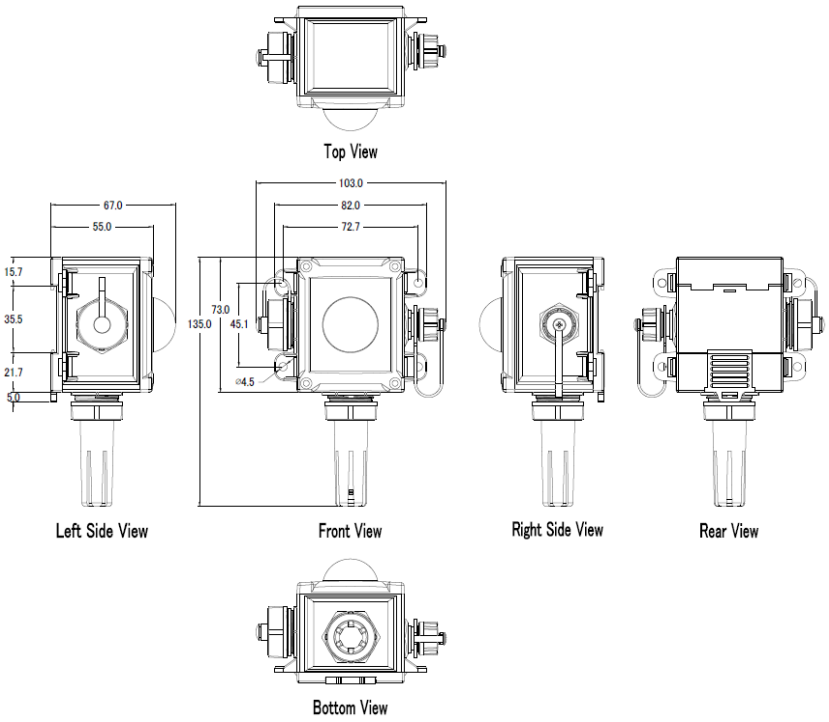


Figure 2-5: Dimension of the DL-111S-WF

2.6 Wire Connection

2.6.2 Digital Output (DO) wiring

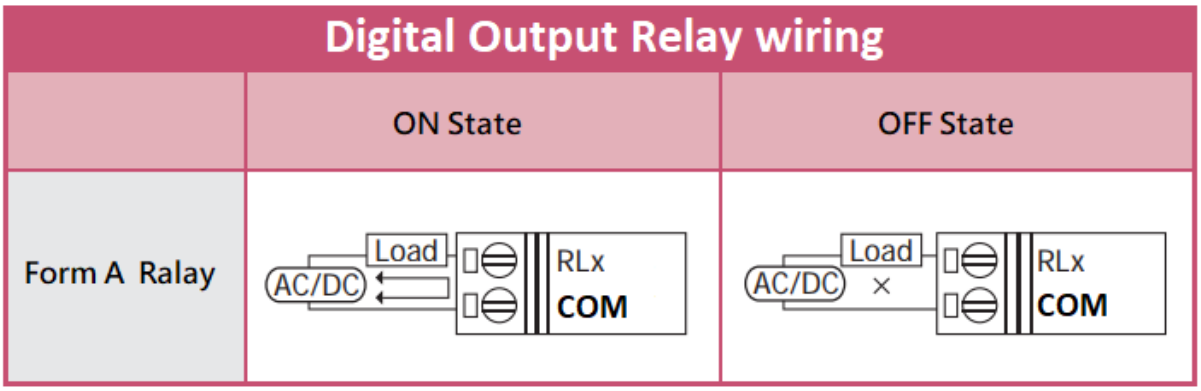


Figure 2-6: Photo MOS Output wiring

2.6.2 Power Input

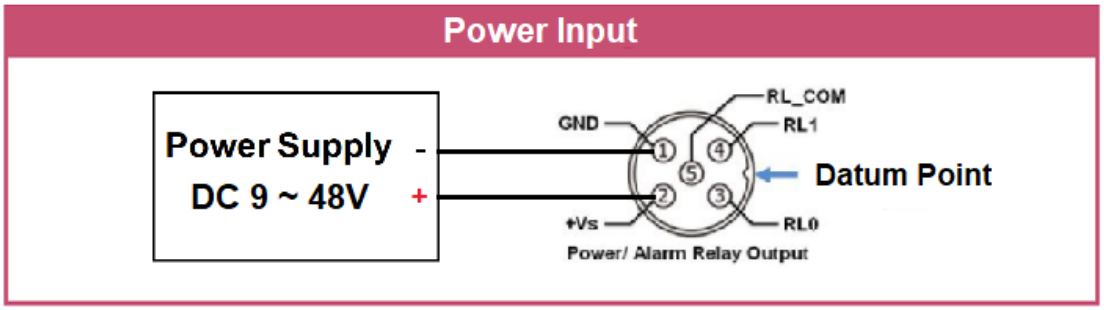


Figure 2-7: Power Input

3. Software

3.1 DL-WF PC Utility & DL Series Android APP

The Utility provides the simple way to operating and acquire status. It can use the wireless network interface to configuration. Provide AP(Access Point) & STA(Station) mode to connect the DL-1xxS-WF series. It is available on both Windows & Android application to operating and configure the DL-1xxS-WF device.

PC Utility Support Windows 7 (or later versions) and Android 5.0 (or later versions).

The following is the main screens provided by Utility, these utility tools can be thought as a useful tool for configuration and monitoring on the DL-1xxS-WF. It supplies several functions, such as Monitoring, Control, Connection, Wi-Fi setting and F/W upgrade, etc…

3.1.1 Main Screen

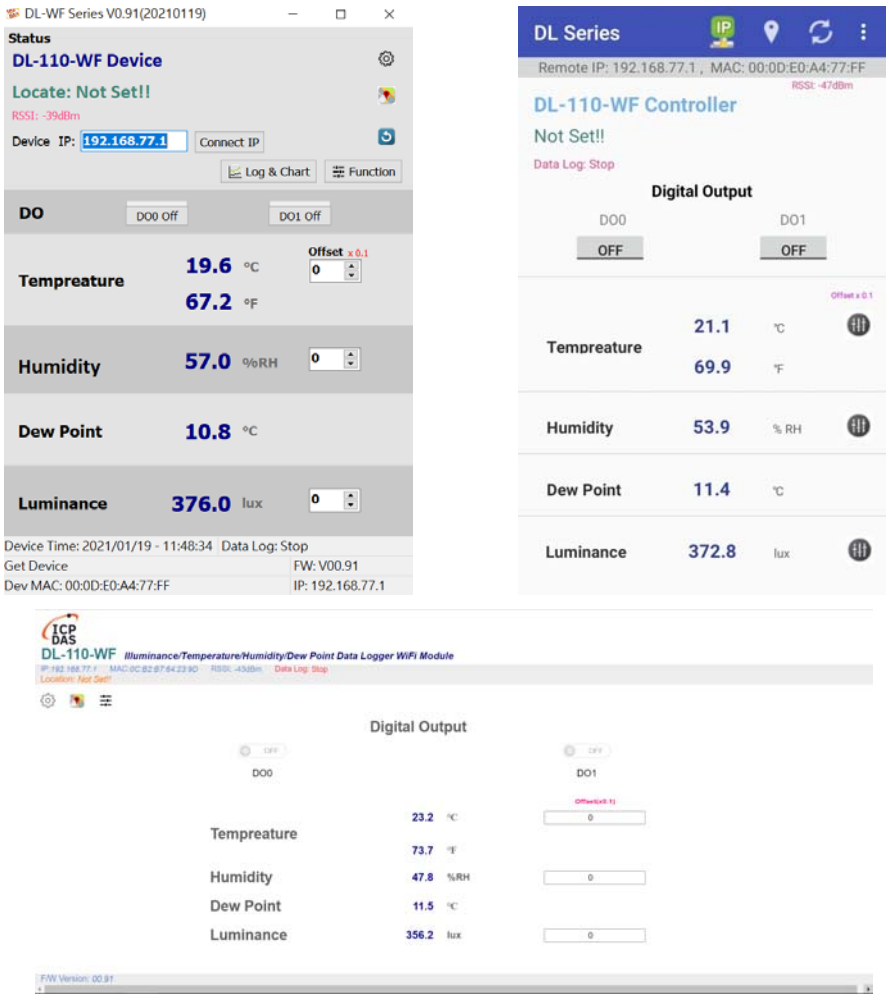
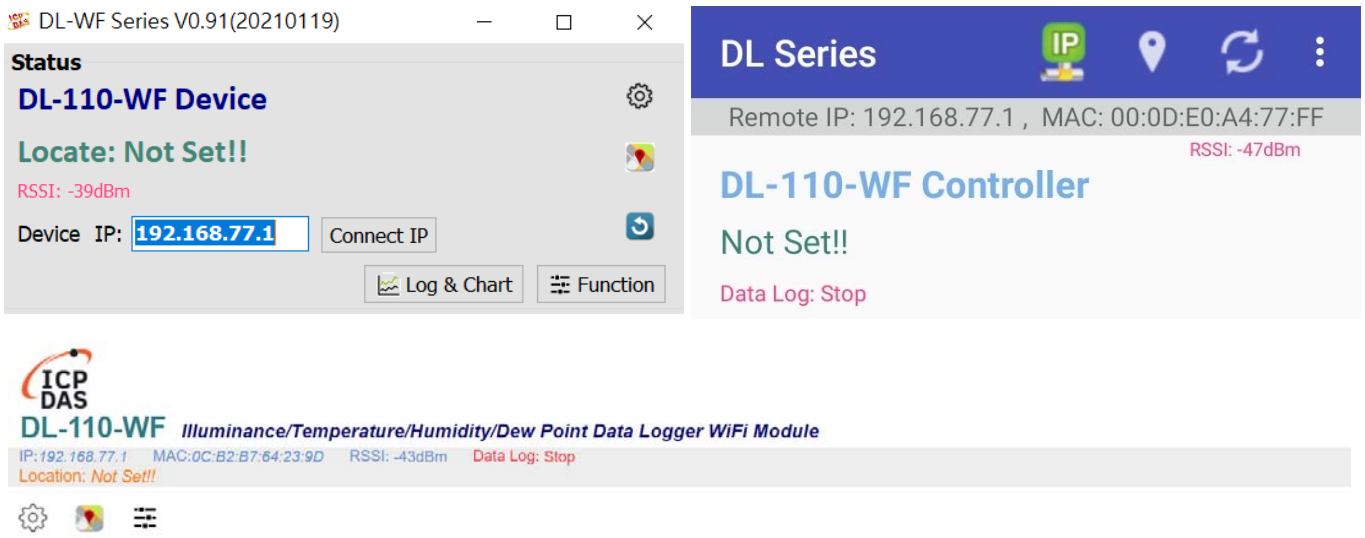


Figure 3-1: Utility main screen
(Windows Utility , Android App, WEB)

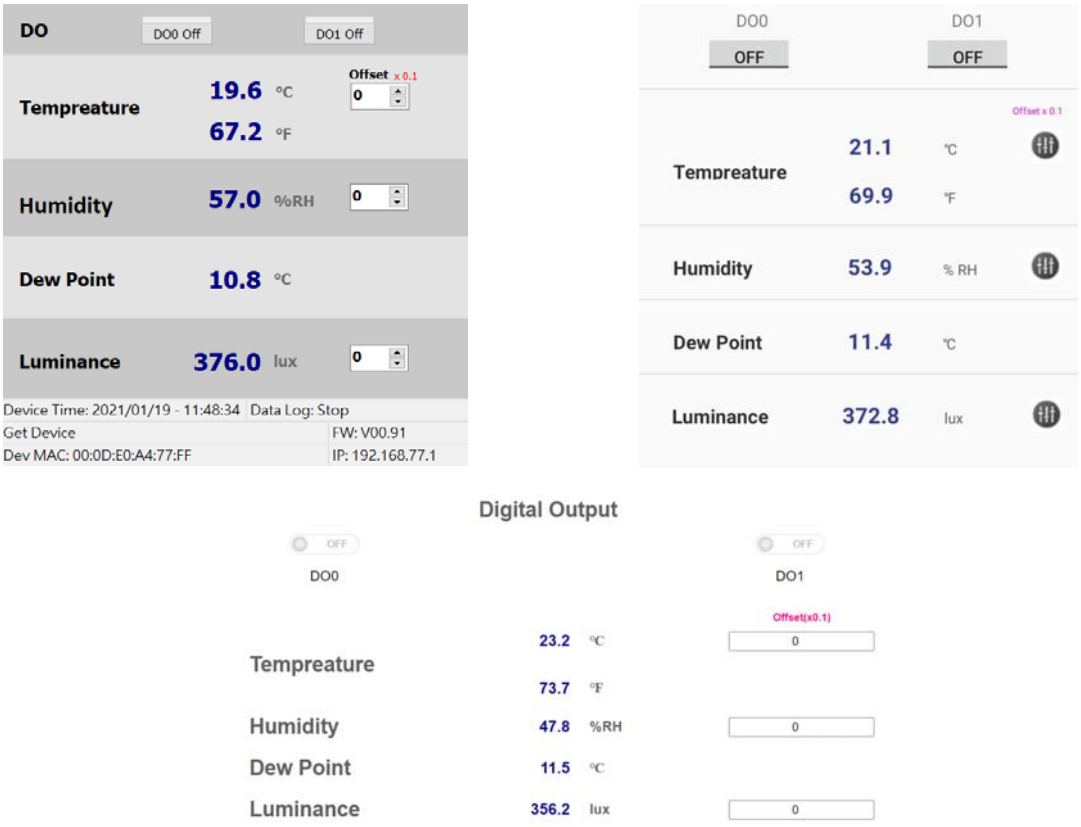
3.1.2 Device Status

Show the connected controller information, user define Locate string, RSSI strength, Device IP & Static IP button for changing device IP in STA mode.



3.1.3 Sensor & DO Output status

Show the Sensor value & DO Photo MOS output status.



3.1.4 Icon Button

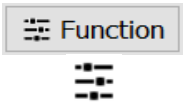
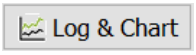
ICON	function	
	**Setup**	Open the Setup Screen (Android versions Setup function under the  icon)
	**Find Controller**	Red Led blinking, use to find the connected Controller
	**Refresh**	Refresh status
	**Function**	1. PC Utility & HTML Function button use to setup Schedule/Free run, Alarm item & range, LCD display item(Only DL-101S-WF). 2. For Android APP, Function button is including inside Menu bar.
	**Offset**	Offset adjustment only for Android APP, PC Utility & HTML is show as number box.
	**Data Log & Chart**	1. PC Utility Data Log manage & Chart view button use to download data log from device for chart view, save chart view buffer to CSV & .dlb(Data Log Binary File), load binary file to chart view. 2. For Android APP, Data Log & Chart button is including inside Menu bar. 3. HTML do not include this function.
	**Menu**	Menu list box include Setup, Function, Data Log & Chart, FW Version & About, only for Android APP.

Table 3-1: Icon Indicator

3.1.5 Configuration/Setup

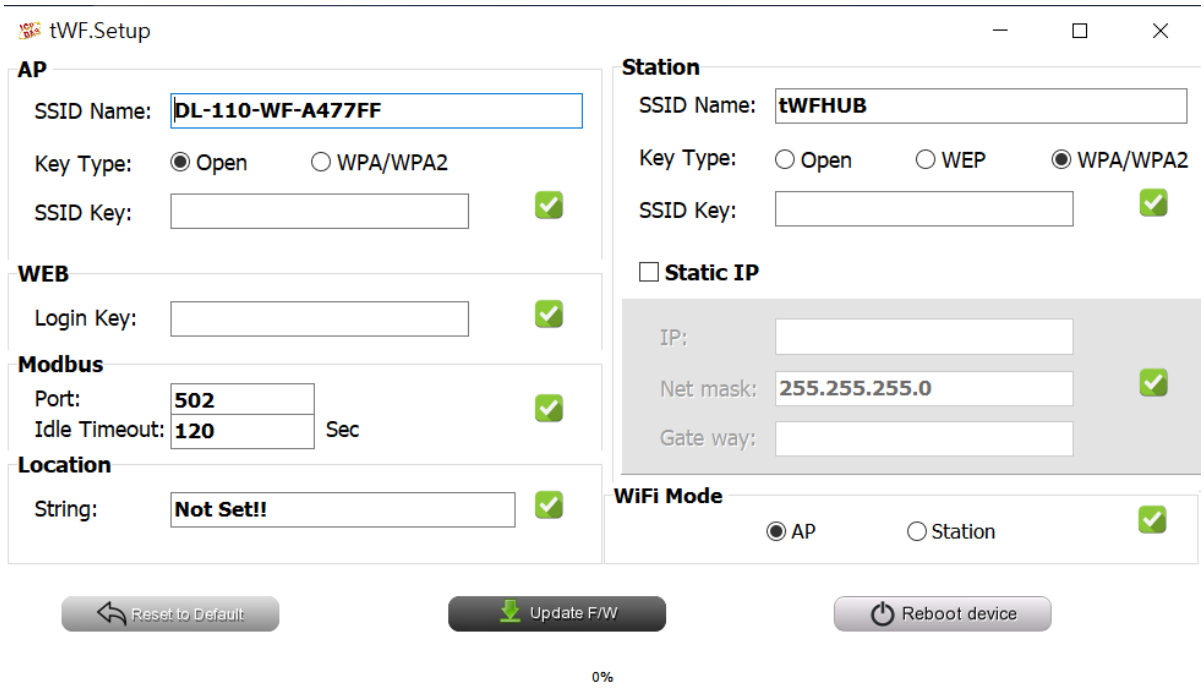


Figure 3-2: DL-WF Utility setup page

Click apply icon  to save each subject's setting, after finishing all setting click 

to make device take effect on new setting

AP：

SSID Name

1. Default Controller's SSID in Wi-Fi AP mode, will be DL-1xxS-WF-xxxxxx.
   Note: xxxxxx is the last 6 characters MAC address of your device.

Key Type

AP mode SSID Key type (default is **Open**)

SSID Key

AP mode SSID Key, (default is **None**)

STA：

SSID Name

Wi-Fi AP's SSID intent to connect (default is **tWFHUB**)

Key Type

Wi-Fi AP's SSID Key Type (default is **WPA/WPA2**)

SSID Key

Wi-Fi AP's SSID Key (default is **00000000**)

Static IP:

IP: Specific an IP that is not been used.

Mask: Default will be **255.255.255.0**.

Gateway: Basically, define in the AP you are going to connect.

SSID	Service Set Identifier: Connected devices must be the same SSID, SSID length must not exceed 31 characters.
Key Type	Key of Encryption connected devices must with the same Key. Open : No Key request. WEP(Shared) : Key length must be 15 characters. WPA/WPA2-PSK : Key length must between 8~15 characters.

Table 3-2: Station SSID & Key type configure

Wi-Fi Mode：

DL-1xxS-WF Device working mode (default is in **AP**)

AP (Access Point**)：**

PC or Android Device connect to DL Device directly through AP(Fixed IP:**192.168.77.1**), AP mode support only one connection, If Multiple devices connect at a same time, only first connected devices can access.

STA(Station**):**

DL Device will auto connect to specific Wi-Fi AP, PC or Android Device also need to connect to the same AP, then they can use those DL Device in same domain.

*. Please check specific Wi-Fi AP is active and SSID/key is same as the setting before use.

Location information:

Set the information for you to identify & locate those Controller easily, length must under 31 characters.

Modbus Port:

Modify Modbus TCP Port (default is **502**)

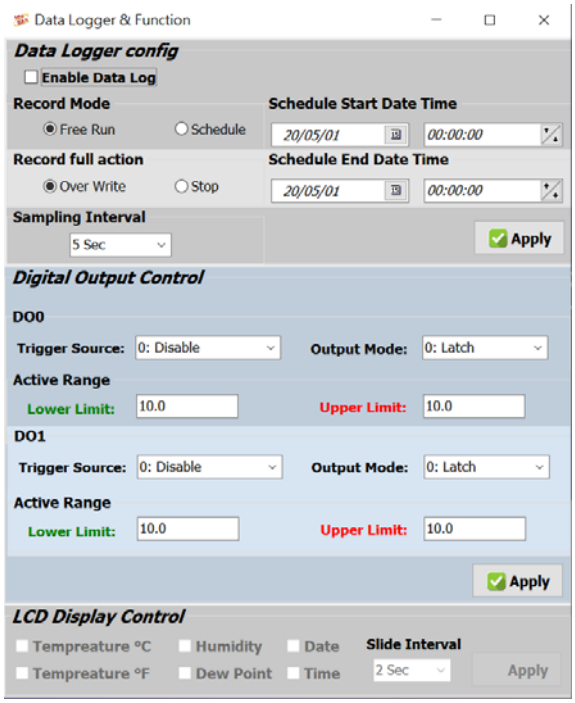
Modbus Idle Timeout:

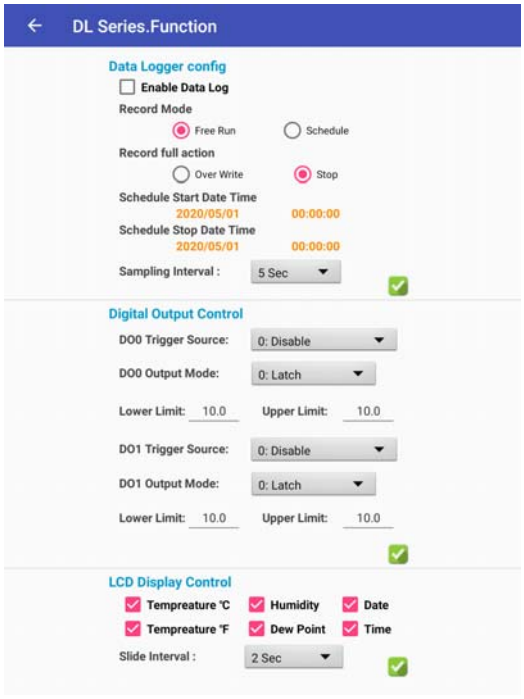
Set Idle Timeout for Modbus TCP connection (default is **120 Sec**) in STA(Station) mode, recommend 30 Sec. when device in STA mode connect to an AP, when device break connect with AP and lost connection, the device will hang in a dead connection. To prevent this happen, set a timeout, the device will close the connection and wait for next connect.

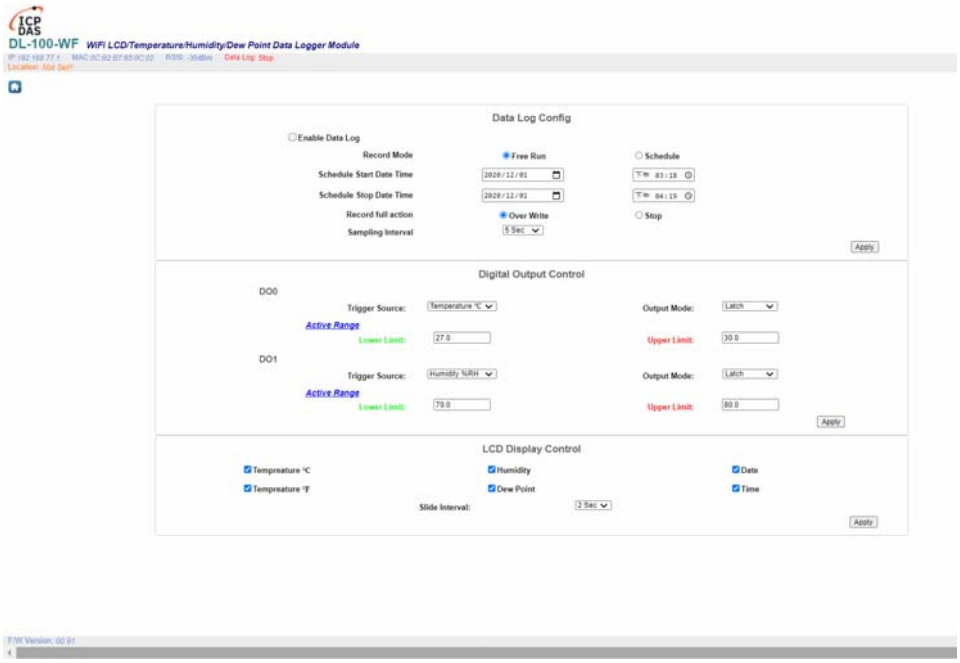
3.1.6 IP Scanner

There are lots of free IP scanner tools in both Windows & Android OS, for example "Advanced IP Scanner" for Windows, "Network Analyzer" for Android, those are high performance scanner tools on each OS.

3.2 Function page







Function page include Data Logger Config, Digital Output Control & LCD Display Control.

Data Logger Config：

Enable Data Log

Start/Stop the Data Logger & save all capture date in memory. It will start from the first record every time when enable start the Data Logger.

Record Mode

Select Data Logger running in **Schedule** or **Free Run** mode.

Record full action

Select the action roll over **Overwrite** record or **Stop** the record when Data Logger record full.

Schedule Start/Stop Date Time

To set the Start/Stop Date/Time when select Data Logger running in **Schedule** mode.

Sampling Interval

Select the interval time for sampling.(5,10,15,30Sec,1,5,10,15,30Min,1,12,24Hr)

Digital Output Control (DO0/DO1)：

Trigger Source

Select which item for trigger the DO Photo MOS active,

0: Disable
1: Temperature ℃
2: Temperature ℉
3: Humidity %RH
4: Dew Point ℃
5: Luminance lux. (Only for DL-111S-WF)

Output Mode

Select DO output mode **0: Latch** or **1: Momentary(1sec)**.

Active Range

Lower Limit/Upper Limit

Set the value active between Lower & Upper limit.

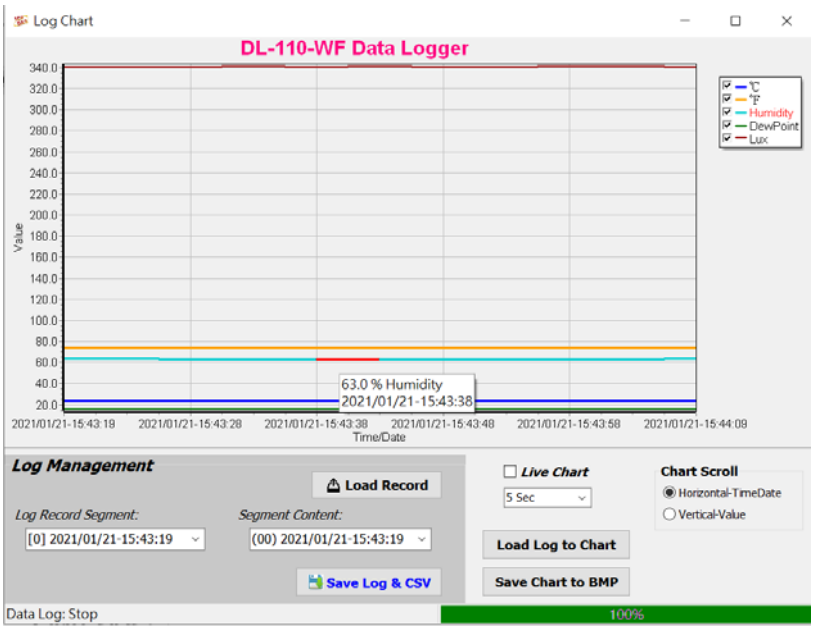
LCD Display Controller (Only for DL-101S-WF)：

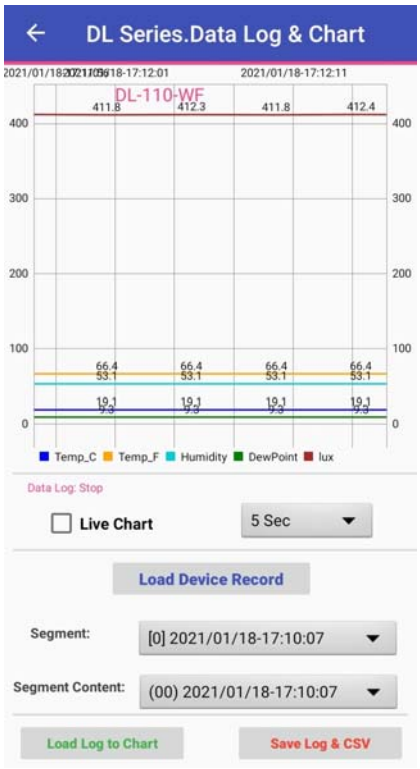
There are 6 items, Date, Time, Temperature (°C and °F), Relative Humidity (RH), Dew Point for LCD display, it can select On or Off to show on each item using utility, APP, or Web.

Slide Interval

Select a value of second for LCD switch between each item.

3.3 Log & Chart page





Log & Chart page include Chart View, Live Chart & Log Management. This page only available for PC Utility & Android APP, do not include in WEB.

Chart View：

Use mouse Left/Right/wheel to control the Chart View area zoom, shift, show hint.

Chart Scroll：

Select Horizontal(Timeline)/Vertical(Value) direction on Chart View, use mouse wheel for Zoom In or Zoom Out.

Live Chart：

Check on Live Chat & select the interval time to draw the real time chart.

Log Management：

Load record from device, it will show the segment & segment content, select the segment/content range will change the chart view data.

Save Log & CSV will save the chart to a CSV file & .dlb (Data Log Binary) file.

Load Log to Chart allow you to open a .dlb file to show on the view.

Save Chart to BMP allow you to save the view to a BMP file.

4. Modbus Protocol

4.1.2 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 DL-1xxS-WF supports 5 function codes, which allows the reading and writing of data contents of registers.

Function Code	Descriptions
01 (0x01)	Read multiple Coil Status
03 (0x03)	Read multiple Analog Output registers
04 (0x04)	Read multiple Analog Input registers
05 (0x05)	Force Single Coil
06 (0x06)	Write single Analog Output registers register

Table 4-1: Supports Function Codes of DL-1xxS-WF

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.

4.1.3 Error Response

Byte Index	Field Name	Byte count	Description
00	Address	1 Byte	1 to 247
01	Function code	1 Byte	Function code + 0x80
02	Exception code	1 Byte	01

Table 4-2: Error response of Modbus Protocol

If a CRC mismatch occurs, the module will not respond.

4.2 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 packet.

4.2.1 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.

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

Table 4-3: A single register contains 16 bits of binary data

4.2.2 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.

Value	1st	2nd
0x1234	0x12	0x34

Table 4-4: A 16-bits word item

4.3 Modbus TCP 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.

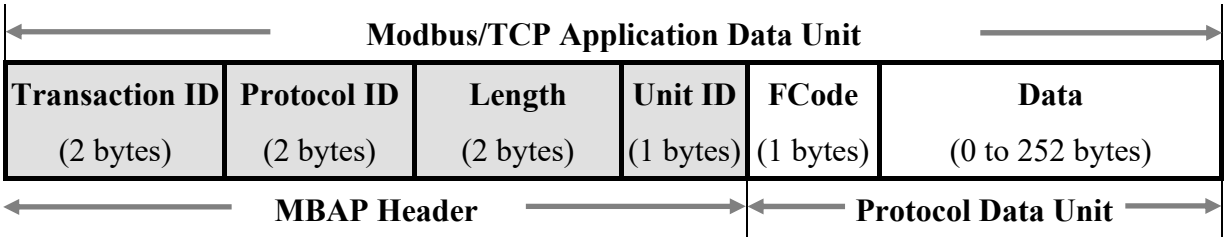


Figure 4-1: Modbus TCP Application Data Unit

4.3.1 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:

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

Table 4-5: Modbus TCP Application Protocol Header

4.4 DL-1xxS-WF Address Mapping (PLC Address Base = 1)

Address	CH	Descriptions	Range	Access Type
00001	1	DO0 output status	0=OFF, 1=ON	R
00002	2	DO1 output status	0=OFF, 1=ON	R

Table 4-6: FC01 Read DO address (0xxxx)

Address	CH/Length	Descriptions	Range/Value	Access Type
40001	1	Read Temperature ℃ offset	Int16	R
40002	2	Read Relative Humidity %RH offset	Int16	R
40003	3	Read Illumination Lux offset	Int16	R
40011	Always 1	Read Modbus Idle Timeout value	Unsigned Int16	R

Table 4-7: FC03 Read multiple AO address (4xxxx)

Note: Offset value will multiply by 0.1

E.g. Read value = 10, the offset will be 10 * 0.1 = 1.0

Address	CH	Descriptions	Range/Value	Access Type
30001	1	Read Temperature ℃ value	Int16	R
30002	2	Read Temperature ℉ value	Int16	R
30003	3	Read Relative Humidity %RH value	Int16	R
30004	4	Read Dew Point ℃ value	Int16	R
30005	5	Read Illumination Lux Hi word value	Int16	R
30006	6	Read Illumination Lux Lo word value	Int16	R

Table 4-8: FC04 Read multiple AI address (3xxxx)

Note: Value will multiply by 0.1

E.g. Read value = 198, the real value will be 198 * 0.1 = 19.8

Illumination Lux = ((Hi word * 65536) + Lo word) * 0.1

Address	CH	Descriptions	Range	Access Type
00001	1	Set DO0 Output	0x00=OFF, 0xFF=ON	W
00002	2	Set DO1 Output	0x00=OFF, 0xFF=ON	W

Table 4-9: FC05 Write DO address (0xxxx)

Address	CH	Descriptions	Range/Value	Access Type
40001	1	Write Temperature ℃ offset	Int16	W
40002	2	Write Relative Humidity %RH offset	Int16	W
40003	3	Write Illumination Lux offset	Int16	W
40011	11	Write Modbus Idle Timeout value	Unsigned Int16	W

Table 4-10: FC06 Write single AO address (4xxxx)

Note: Offset value will multiply by 0.1

E.g. Write value = 10, the offset will be 10 * 0.1 = 1.0

Technical Support

If you have problems about using the DL-1xxS-WF Series device, please contact ICP DAS Product Support.

Email: service@icpdas.com