

OPERATIONAL MANUAL

ECMv2



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Unpacking and Inspection

DO NOT REMOVE THE ECMV2 UNIT FROM THE SEALED PLASTIC BAG UNTIL TIME OF INSTALLATION

1. Verify that the following items are included in the shipping box:
 - ECMv2 device
 - Terminal Block Connector
 - Sensor pair pack
 - Necessary fitting screws
2. Make a visual inspection of the ECMv2. *Do not remove it from the sealed plastic bag for extended periods until the time of installation.* This ensures that the corrosion sensors are not exposed to air contaminants prematurely, which may shorten sensor life

Once you setup the ECMv2 and power it up, please consult your IT team to help with connecting the ECMv2 to a network and setup.

Installing and Powering the ECMv2

Although the ECMv2 is designed to withstand rigid industrial environments, the unit contains sensitive electronic circuitry; therefore, care should be taken to ensure it is not dropped or damaged during installation.

Installing the sensors

Place the copper and silver sensors at their respective positions on the ECMv2 device. Make sure the connector is fit correctly for proper connection. Fit in the screws to affix the sensors in the ECMv2.

Mechanical Mounting of the ECMv2

The ECMv2 is designed to mount on the wall via side mounting brackets as well as the mounting holes on the back to hang up on the wall. Use the screws provided and attach to the wall. There are two “keyhole-shaped” mounting holes on the rear of the ECMv2. The two mounting screws can be positioned and installed using the mounting template provided in the appendix, which should be photocopied and used for installation. The screws should be driven into the mounting surface until the bottom surface of the head of the screw is approximately 0.1 inches (2mm) from the wall. The ECMv2’s mounting holes are then placed

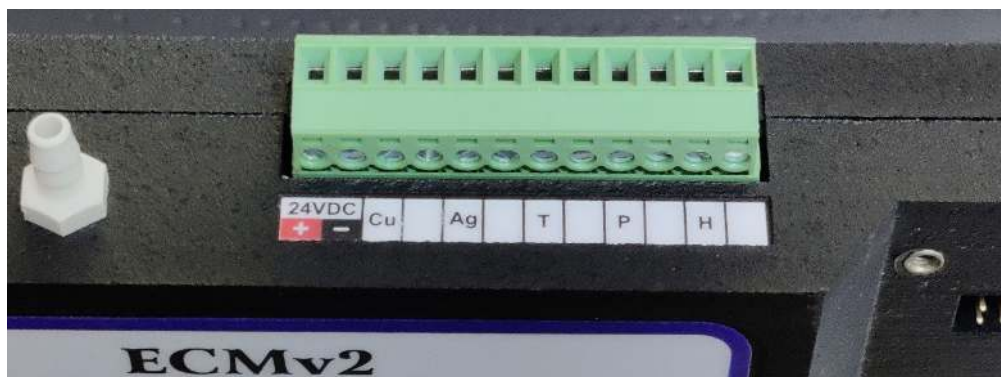
over the screws and lowered into place. Adjust the screws for a firm fit. There is also an option to affix the ECMv2 to the wall using the side tabs.

Powering up

There are two ways to provide power to the ECMv2.

External DC Power Supply

The ECMv2 can be powered by an externally supplied DC voltage of 24V_{DC}. The power source needs to be able to supply at least 1A of current. This voltage is applied to pins 1 and 2 of the 12-pin terminal block on the bottom of the ECMv2. See the terminal block drawing shown below in picture. Pin 1 is marked as + (red) and pin 2 is marked as - (black). Connect the positive lead of the power source with pin one and negative lead with pin two.



Power over Ethernet (POE)

The ECMv2 can also be powered by connecting the ECMv2 to the Ethernet through the Ethernet port on the bottom of the unit. When both of the above power sources are provided at the same time, the power will be driven from 24V_{DC}.

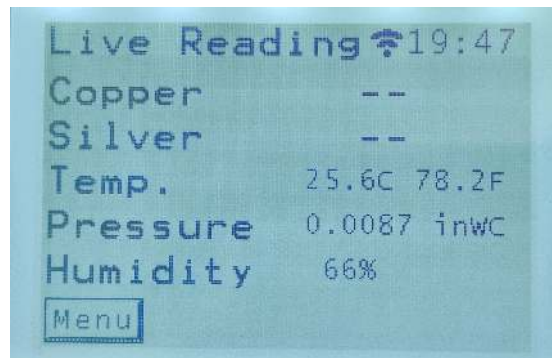
Initializing Sensors

When the ECMv2 is shipped from the factory, it is enclosed in a protective bag designed to minimize contaminant access to the corrosion sensors. The initialization process for corrosion sensors is quite simple. Once you have fixed the sensors on the device and powered it up, it will automatically detect the sensors and start initializing. On successful initialization, the device will establish the base state of the sensors and set the parameters for future operation.

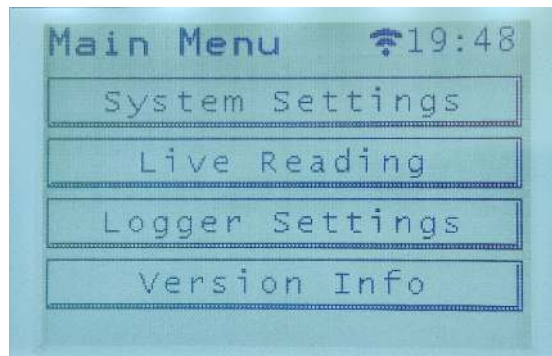
Display Interface

ECMv2 has a 3.2" display with backlight to display the corrosion parameters, sensor live data, and other settings and configurations. The display is equipped with touch interface to switch between the screens. The touch interface is operated by hand.

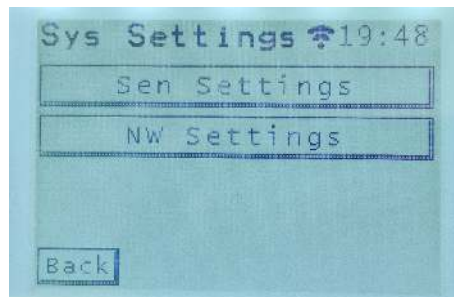
“Live Reading”: This is the default screen that appears when the device is powered up. It shows the corrosion ratings of both copper and silver QCM sensors. It also indicates if any of the two QCM sensors are faulty or missing. The live readings from temperature, pressure and humidity are also displayed on this screen.



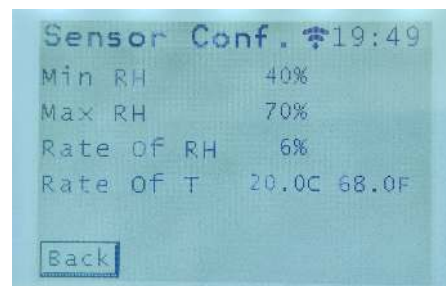
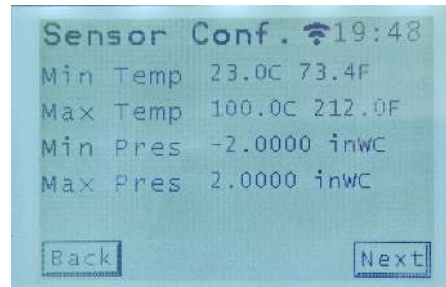
“Main Menu”: Main menu consists of four different options; “System Settings,” “Live Reading,” “Logger Setting” and “Version Info.”



“Sys Settings”: Sys (System) Settings further consists of two options – “Sen Settings” or sensor settings and “NW Settings” which is short for “Network Settings”



“Sensor Config”: Displays the minimum and maximum values of the sensors set by user via web interface. It has two screens. The second screen is accessed by tapping on “Next”



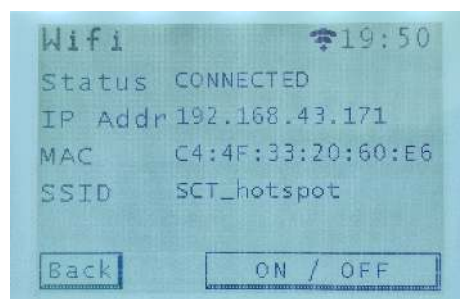
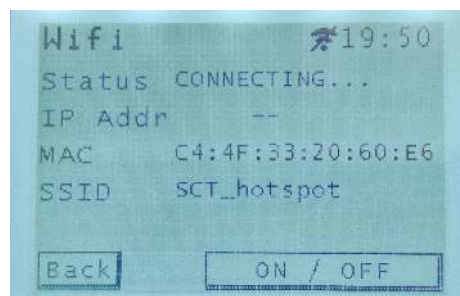
“NW Settings”: Network settings display the network configuration parameters used for communication via Ethernet and Wifi.



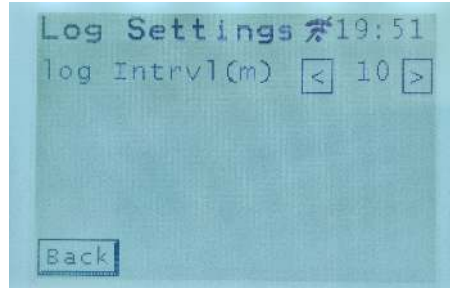
“Ethernet”: Displays the IP address and MAC address of the ECMv2 device (192.168.2.11). It also gives an option to restore the network settings of the device.



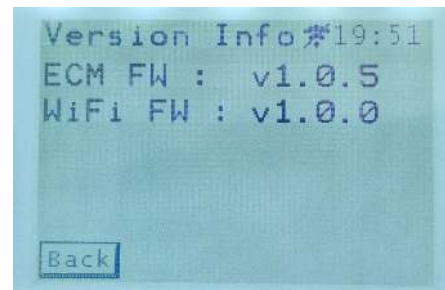
“WiFi”: Displays the connection status of WiFi along with the IP address and MAC address of the WiFi. It also displays the name of the WiFi network the ECMv2 is connected to. On this screen you can also turn the WiFi ON/OFF. The WiFi symbol at the top of the screen indicates whether the device is connected to a WiFi network or not.



“Log Settings”: Displays the data interval after which each data point will be captured for logging. Users can change the interval time at which the device captures and stores sensor parameter. This can also be changed on web interface.



“Version Info”: Displays the firmware version of main ECMv2 as well as that of WiFi.



Ethernet Communication

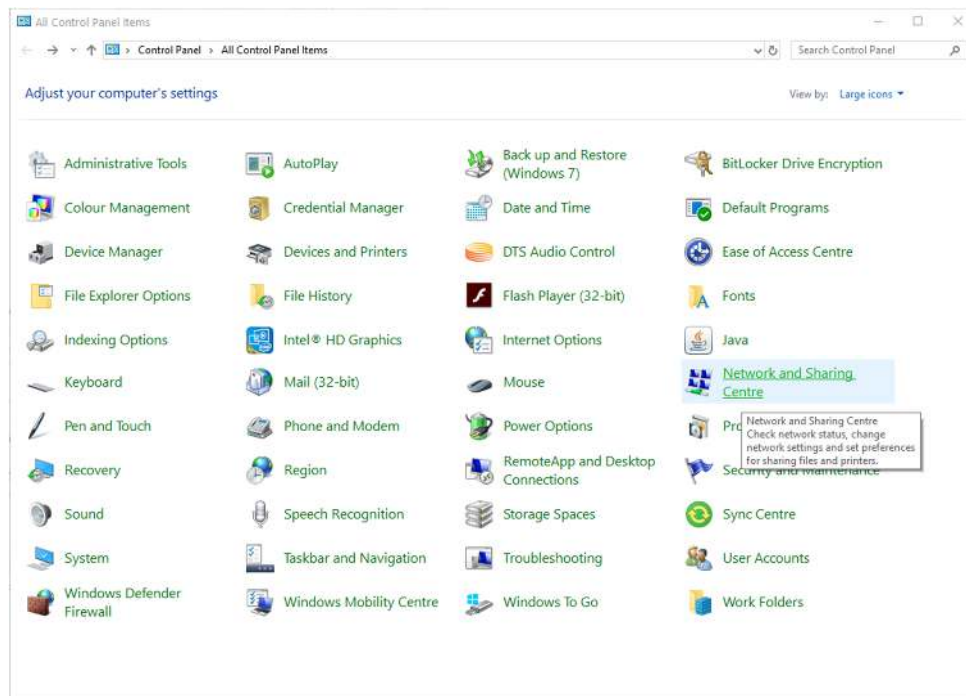
The ECMv2 is designed to communicate through an internal web interface, via the Ethernet, for setup and logging purposes. ECMv2 can communicate with the Ethernet in one of the following ways.

Direct connection (Point to Point or DHCP disabled)

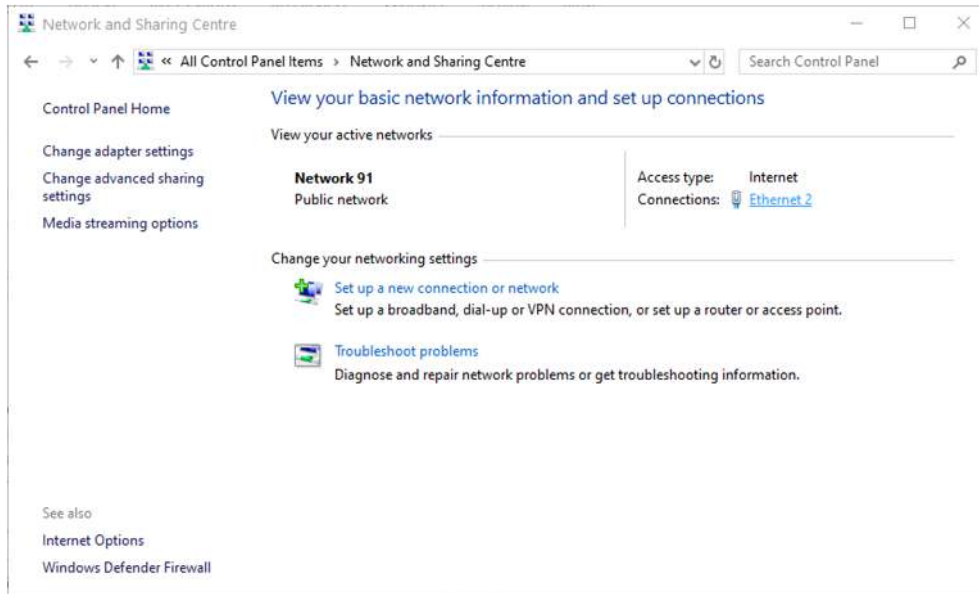
If the device is connected directly with PC, the web interface can be accessed directly from PC/MAC without a network connection. This is achieved by setting the computer's network adapter to a fixed address on 192.168.2.xx network: for example, 192.168.2.99. Below is the guide to do that:

First make sure the device is connected to the PC via Ethernet cable

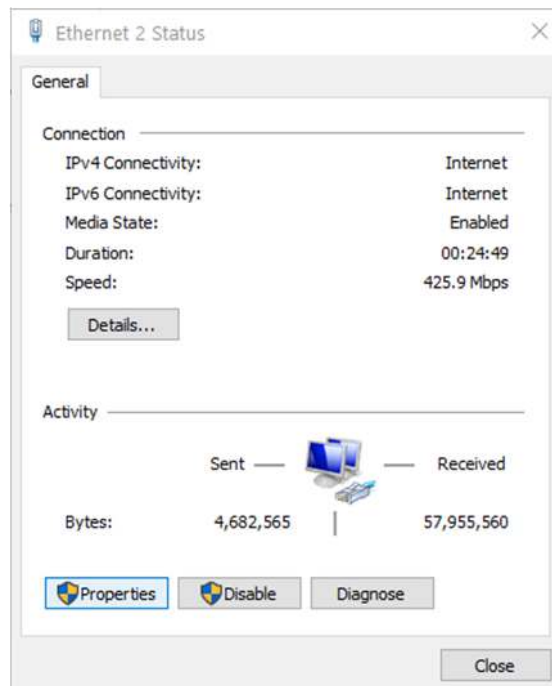
Go to **Control Panel** of your PC. Double click on "Networking and Sharing Centre"



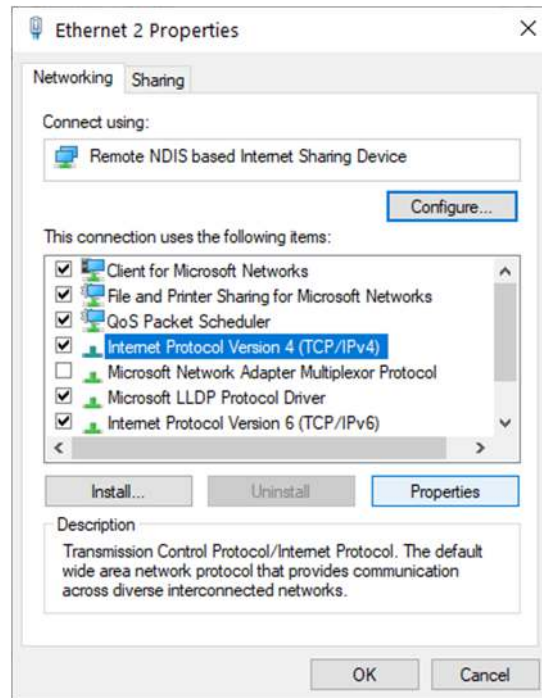
Click on Ethernet



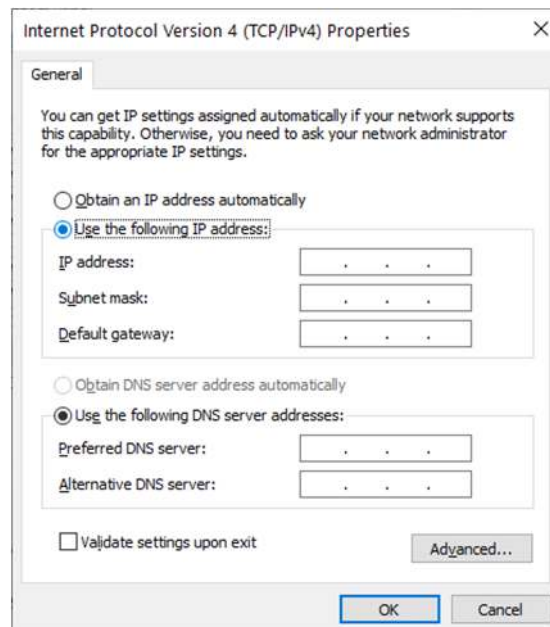
Click on properties



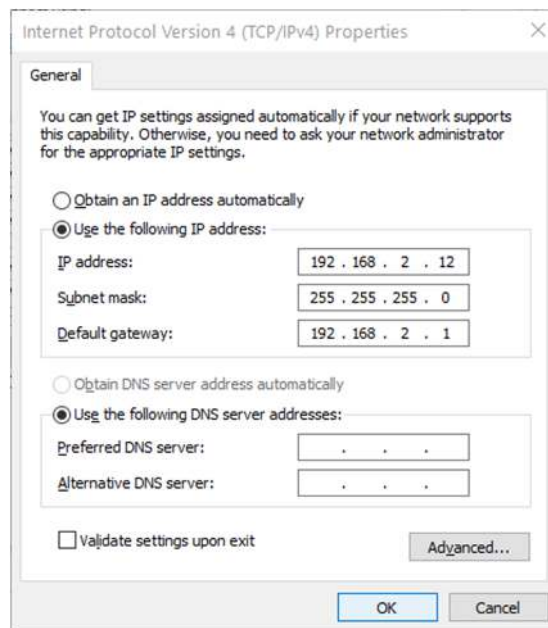
In 'Networking' tab click on Internet Protocol Version 4 (TCP/IPv4) and then click on Properties



Click 'Use the following IP address:' button. This will allow you to edit add the ip address manually.



Enter 192.168.2.12 in IP address box. Ensure firewall is turned off to set up. Click “OK.” A message asking for the “subnet mask” will pop-up. Click “OK” and the subnet mask should populate itself. Alternatively, after filling the IP address box, pressing the ‘Tab’ button on your keyboard will also auto fill the subnet mask field. Inside “Default Gateway,” enter 192.168.2.1. Click “OK” again to save the changes.



Once the configuration is complete, open the browser on your PC and enter the address 192.168.2.10 to access the ECMv2 web interface.

Local Area Network Connection (DHCP Enabled)

Note: To connect the device in LAN, it is mandatory to enable the DHCP. By default, the DHCP is disabled in the device. Check the status of DHCP on “Net Settings” option on LCD. If it is disabled, user needs to access the web interface via “Direct connection” method to enable it. In web interface go to the ‘network tab’ and check the box named ‘Enable DHCP.’

The device will get the IP address dynamically every time it is connected to the network. User can configure the router to bind the IP address to the unique MAC address of the ECMv2 device. Once user configures the router, the device will get the same IP address as it is bounded. This method is not preferred in general, and it is optional for ECMv2 device.

Web Interface

Once you have accessed the web interface by following the methods above, you can see the following tabs on your browser:

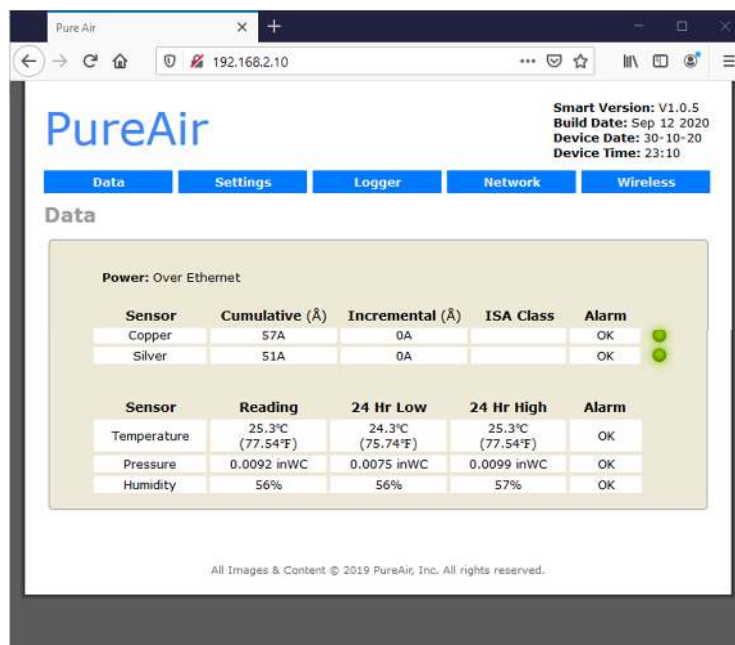
Data

The data tab provides real time readings of all the sensors.

Temperature, Pressure, and Humidity readings are shown along with 24 hour highs, 24 hour lows, and Alarm

Cumulative corrosion and incremental corrosion of Copper and Silver QCM sensors is shown along with the alarm conditions for both.

If both copper and silver QCM sensors are connected and are in working conditions, the alarm column for both will display “OK” and both the indication lights will be green.



Smart Version: V1.0.5
Build Date: Sep 12 2020
Device Date: 30-10-20
Device Time: 23:10

Data

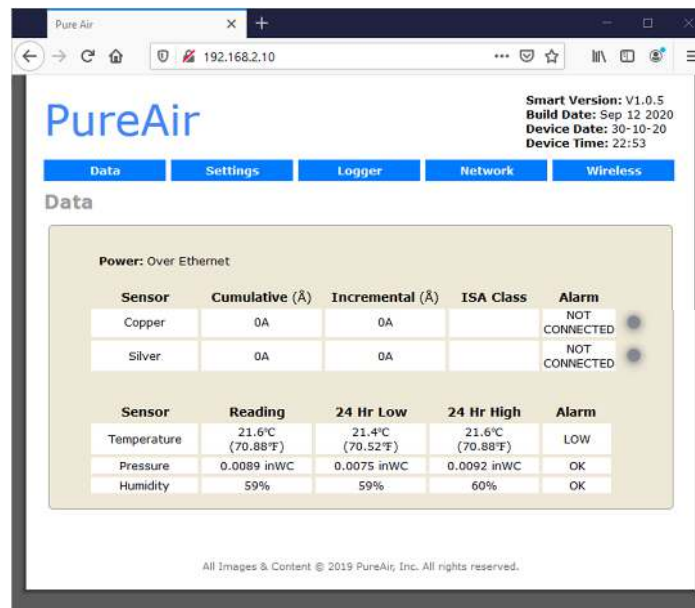
Power: Over Ethernet

| Sensor | Cumulative (Å) | Incremental (Å) | ISA Class | Alarm |
|--------|----------------|-----------------|-----------|-------|
| Copper | 57A | 0A | | OK |
| Silver | 51A | 0A | | OK |

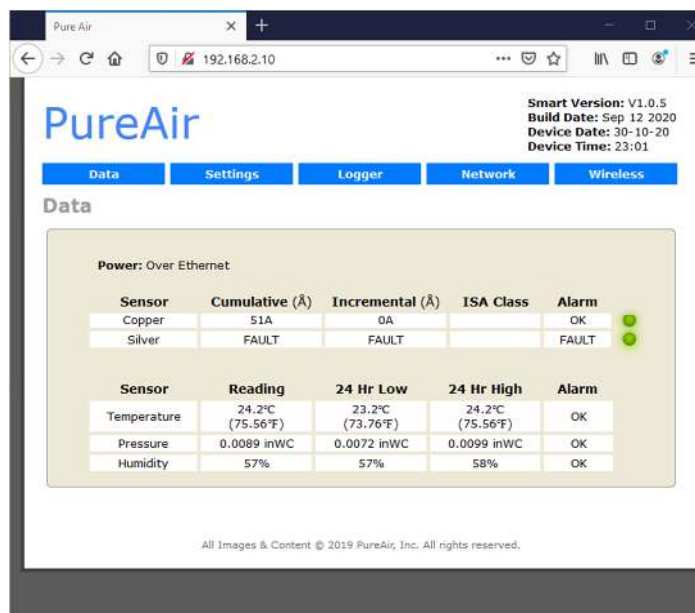
| Sensor | Reading | 24 Hr Low | 24 Hr High | Alarm |
|-------------|---------------------|---------------------|---------------------|-------|
| Temperature | 25.3°C (77.54°F) | 24.3°C (75.74°F) | 25.3°C (77.54°F) | OK |
| Pressure | 0.0092 inWC | 0.0075 inWC | 0.0099 inWC | OK |
| Humidity | 56% | 56% | 57% | OK |

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If one or both the QCM sensors are not connected, the corresponding 'Alarm' option will display 'NOT CONNECTED' and the corresponding indication light will turn grey.



If one or both the connected QCM sensors are NOT working properly or if the ISA class exceeds the maximum limit, the corresponding Alarm will display 'FAULT'



Settings

There are two options in the settings tab

'Real-Time Clock': Every time the Ethernet connection is made, and the web interface is accessed, the device automatically captures the time from the PC and stores it. However, if the user wants to set a manual time and date for the device, it can be done in this tab. There is an option of configuration, in case of automatic selection, the device will get time from the network, in the other case of manual time setting, the user can modify the date and time and the device will be configured with manually entered date and time details.

'Environment': Set the Alarm thresholds (high and low) and Rate for temperature and humidity.

'Calibration': Adjust the slope and calibration for environment sensors and adjust the corrosion coefficient of QCM sensors. For pressure there is an option to 'zero the pressure' when the external tubing is not connected. This calibrates the pressure in a more efficient way.

For QCM sensor calibration, there is an option to adjust the slope of KCC. There is also an option to reset both sensors. This action deletes all the corrosion records of the QCM sensors that have been stored by the device.

Note: please DO NOT make any changes in 'Corrosion Calibration' settings unless advised by the manufacturer.

The screenshot shows a web browser window with the URL `192.168.2.10/config_page`. The page title is "PureAir" and it includes a navigation menu with "Data", "Settings", "Logger", "Network", and "Wireless". The "Settings" page is active, displaying three main sections: "Real-Time Clock", "Environment", and "Calibration".

Real-Time Clock

Date & Time
 Configuration: Automatic
 30 - 10 - 20 (DD-MM-YY)
 23 : 11 : 08 (24-Hour Clock)
 Save

Environment

Alarm Thresholds

| Temperature | | Humidity | |
|-------------|------------|----------|----------|
| Low | 23 °C | Low | 40 % |
| High | 100 °C | High | 70 % |
| Rate | 20 °C/Hour | Rate | 6 %/Hour |

Save

Calibration

| Temperature | Pressure | Humidity | Corrosion |
|--------------------------|------------------------------------|-------------------------|--|
| Offset: 3 °C Slope: 1 | Offset: 0 inWC Slope: 1 zero | Offset: 0 % Slope: 1 | Sen 1 COF (KCC): 1.25 Sen 2 COF (KCC): 1.25 Reset Sensor 1 Reset Sensor 2 |

Save Default

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Logger

The logger has two sub tabs: Graph and Table.

Graph: In this tab, all the captured data from all the sensors is displayed in the form of a graph. The data points are captured after every interval period set in the 'Interval' option.

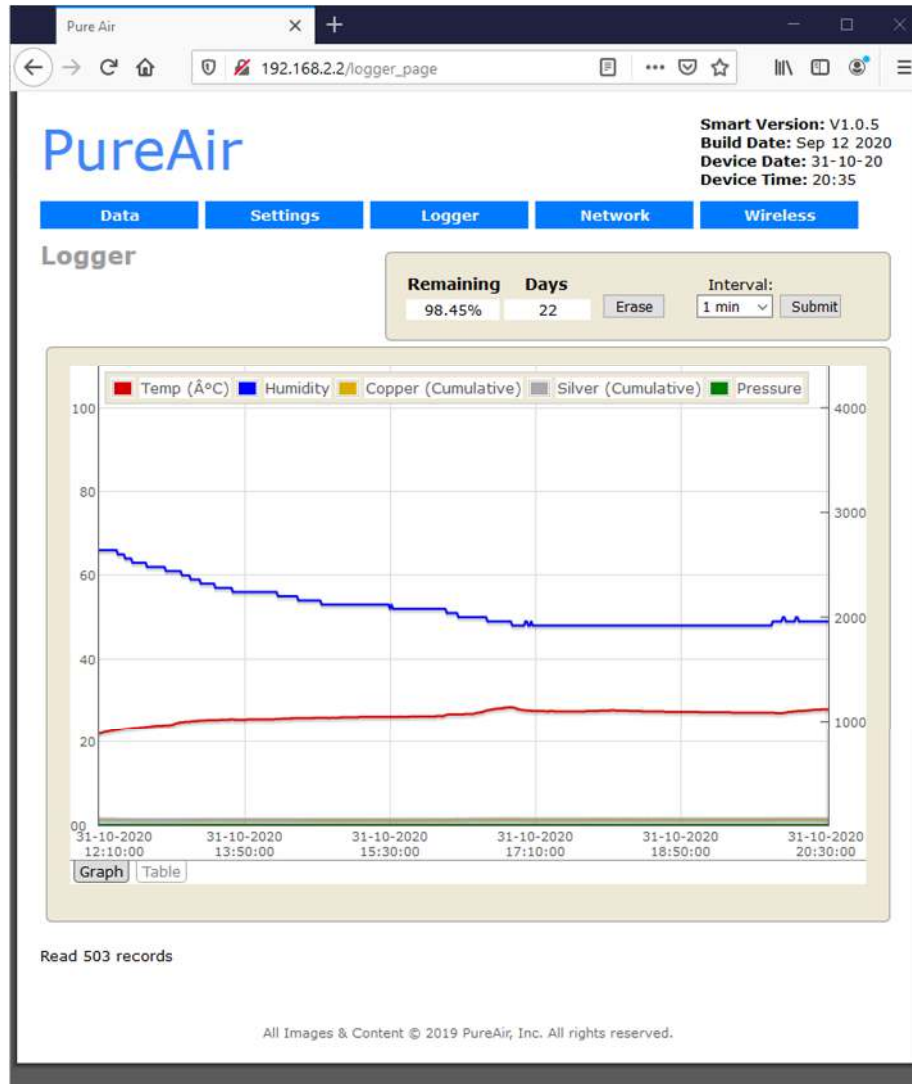
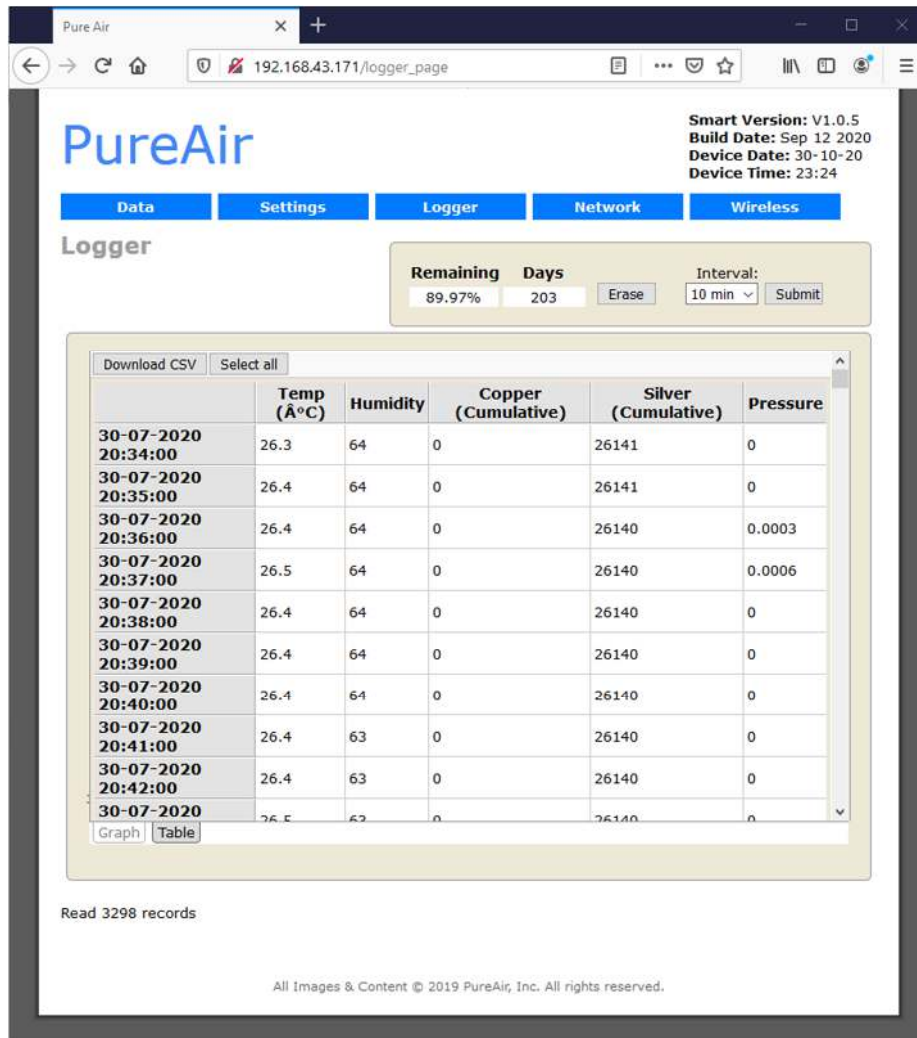


Table: In this tab the captured/stored data is shown in the form of a table and available to export as a CSV file.

Note: As of now the logger graph is only working properly with Firefox and not working with Chrome. The user should use Firefox if he wants to see the logger page correctly. Also, the Logger page should not be accessed simultaneously from different devices, browsers, or browser tabs.

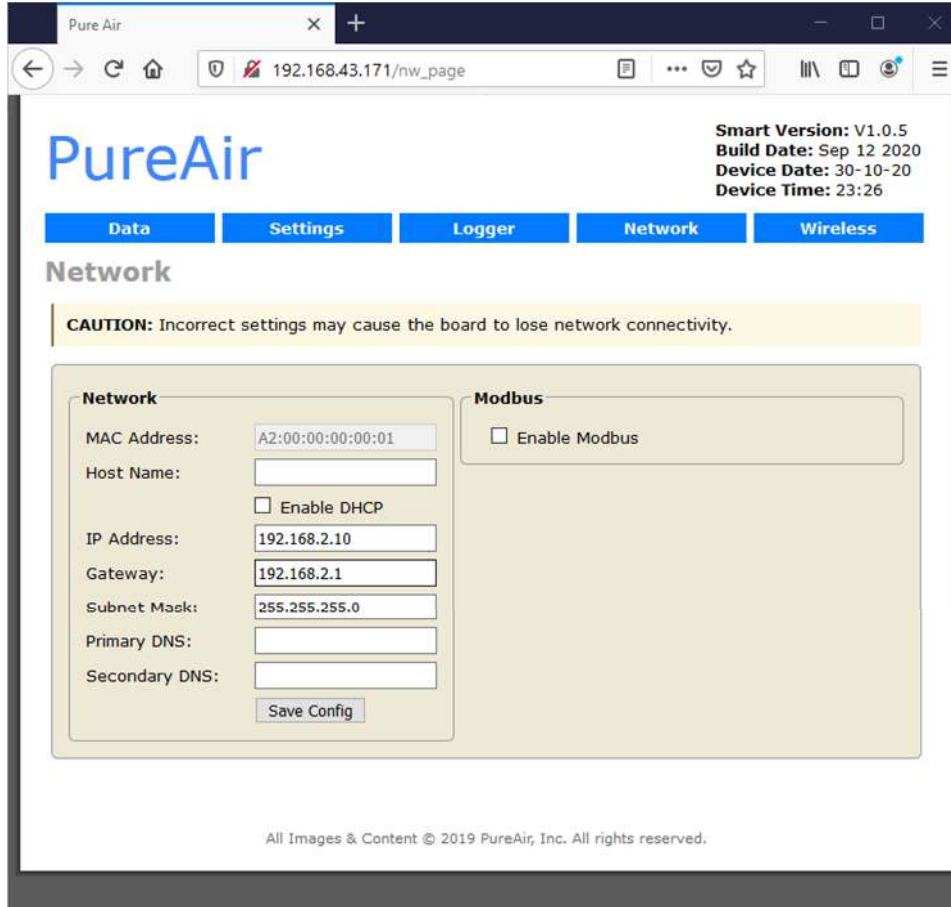


The screenshot shows the PureAir web interface. At the top right, it displays: Smart Version: V1.0.5, Build Date: Sep 12 2020, Device Date: 30-10-20, Device Time: 23:24. Below this are navigation tabs: Data, Settings, **Logger**, Network, and Wireless. The 'Logger' section includes a control panel with 'Remaining' (89.97%), 'Days' (203), and 'Interval' (10 min). Below this is a table of logged data with columns: Temp (°C), Humidity, Copper (Cumulative), Silver (Cumulative), and Pressure. The table contains 12 rows of data from 20:34:00 to 20:42:00 on 30-07-2020. At the bottom, it says 'Read 3298 records' and 'All Images & Content © 2019 PureAir, Inc. All rights reserved.'

| | Temp (°C) | Humidity | Copper (Cumulative) | Silver (Cumulative) | Pressure |
|---------------------|-----------|----------|---------------------|---------------------|----------|
| 30-07-2020 20:34:00 | 26.3 | 64 | 0 | 26141 | 0 |
| 30-07-2020 20:35:00 | 26.4 | 64 | 0 | 26141 | 0 |
| 30-07-2020 20:36:00 | 26.4 | 64 | 0 | 26140 | 0.0003 |
| 30-07-2020 20:37:00 | 26.5 | 64 | 0 | 26140 | 0.0006 |
| 30-07-2020 20:38:00 | 26.4 | 64 | 0 | 26140 | 0 |
| 30-07-2020 20:39:00 | 26.4 | 64 | 0 | 26140 | 0 |
| 30-07-2020 20:40:00 | 26.4 | 64 | 0 | 26140 | 0 |
| 30-07-2020 20:41:00 | 26.4 | 63 | 0 | 26140 | 0 |
| 30-07-2020 20:42:00 | 26.4 | 63 | 0 | 26140 | 0 |
| 30-07-2020 | 26.5 | 62 | 0 | 26140 | 0 |

Network

This tab gives the option to edit the network configuration parameters such as IP address, Gateway, etc., which are used for communication via the Ethernet. It is recommended not to modify these parameters unless asked to do so.



Pure Air

192.168.43.171/nw_page

PureAir

Smart Version: V1.0.5
Build Date: Sep 12 2020
Device Date: 30-10-20
Device Time: 23:26

Data Settings Logger Network Wireless

Network

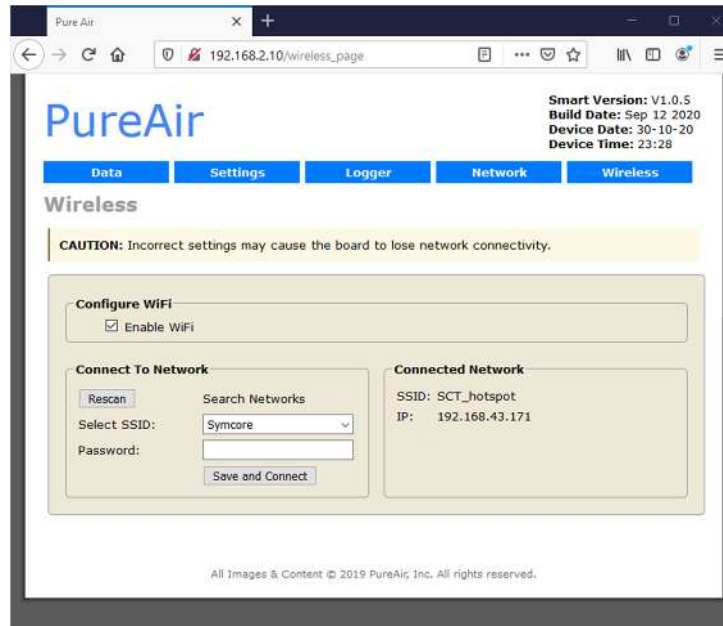
CAUTION: Incorrect settings may cause the board to lose network connectivity.

| | |
|--|--|
| Network | Modbus |
| MAC Address: A2:00:00:00:00:01 | <input type="checkbox"/> Enable Modbus |
| Host Name: | |
| <input type="checkbox"/> Enable DHCP | |
| IP Address: 192.168.2.10 | |
| Gateway: 192.168.2.1 | |
| Subnet Mask: 255.255.255.0 | |
| Primary DNS: | |
| Secondary DNS: | |
| <input type="button" value="Save Config"/> | |

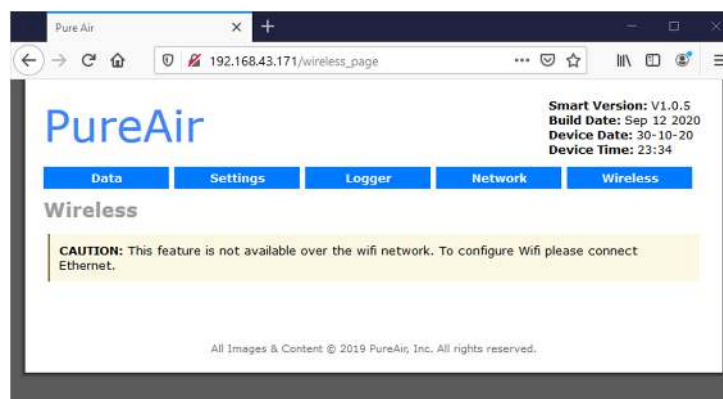
All Images & Content © 2019 PureAir, Inc. All rights reserved.

Wireless

This screen gives the option to connect the ECMv2 with a WiFi network to access it wirelessly without the Ethernet.



Please note that this page is used to configure the WiFi setting for ECMv2. You cannot access this tab if you have accessed the web interface via WiFi itself. In that case the following message will be displayed:



WiFi Communication

ECMv2 has inbuilt WiFi feature that show users how to access the Web Interface on browser wirelessly without connecting the Ethernet. Please note that to operate the ECMv2 on WiFi, it must be connected to a PC/MAC for the first time via Ethernet to configure the WiFi settings into the device. Once you access the web interface via Ethernet, go to the 'Wireless' tab. From the dropdown list, select the SSID that you want to use. Enter the password for that SSID and click on "Save and continue." This will connect the ECMv2 with the Wifi. Check the pictures shown above in "wireless" section of Web interface for reference.

Once the connection is established, the WiFi symbol on the ECMv2 LCD display gets uncrossed indicating that ECMv2 is connected by WiFi. To access the web interface through WiFi, make sure that ECMv2 and your PC/MAC are both connected to the same WiFi network. The 'Wireless' tab on web interface provides the IP address you can use to connect to the device through WiFi. Alternatively, you can also find this IP address on the WiFi slide of ECMv2 LCD display. Enter the IP address in the address bar of the browser to access the web interface.

Firmware Upgrade

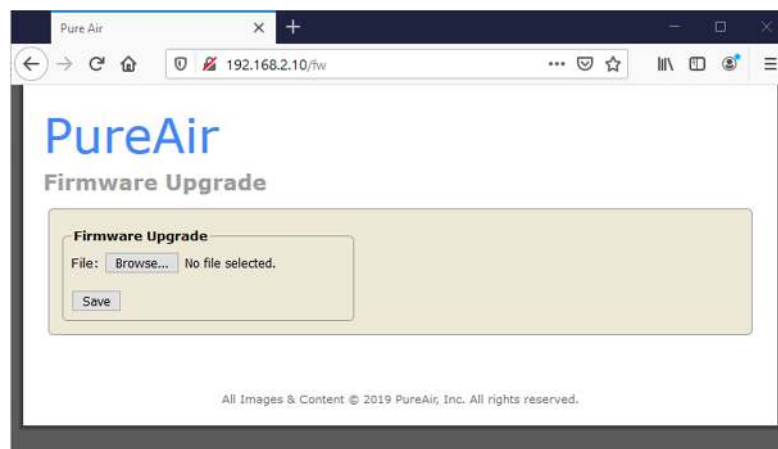
ECMv2 has a feature of upgrading its device software through Ethernet. On a rollout of new updates, customer will be informed, and the new package will be provided.

To upgrade the firmware of the device, follow the steps below:

1. Turn off the device if it is turned on already.
2. Ensure the Ethernet cable is already inserted and a direct connection with the PC is in place.
3. There is a small hole on top of the device on the right of the 12-pin connector (see the picture below) Use any thin, needle-shaped object to press and hold the button inside this hole. Keep the button pressed and turn on. Once you see 'Bootloader' on the display, release the button.

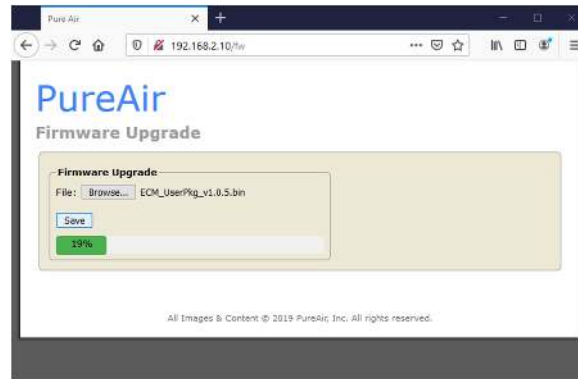


4. Insert URL shown below in screenshot on the web browser. The URL format is **<device_address>/fw**. For example, as shown in the pictures below the device URL is 192.168.2.10. Therefore the URL for firmware upgrade is 192.168.2.10/fw

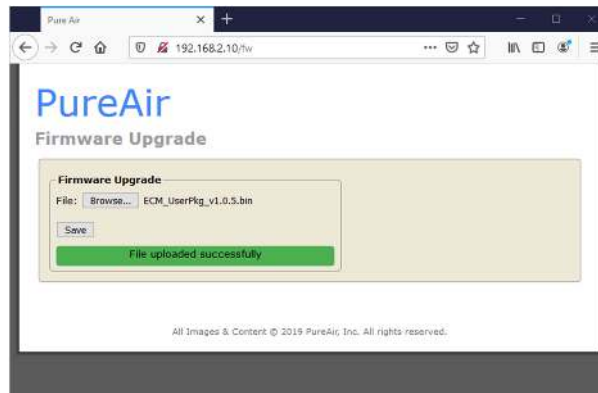


5. Browse the firmware package provided by the manufacturer in the PC and select it.
6. Once appropriate package is selected, press the save button.

The firmware upgrade will start now, a progress bar will show on the screen as scene below.



Once the upgrade is finished, the device will automatically restart and operate on the new firmware.



Please note that the firmware upgrade only works via Ethernet interface and not via WiFi interface. Also, the feature only works on Firefox web browser.

Modbus

ECMv2 can communicate with an upper-level automation system using the widely accepted Modbus automation protocol. ECMv2 supports Modbus TCP communication used in Ethernet networks. The communication type is client-server where ECMv2 acts as a Modbus TCP server. ECMv2 Modbus TCP server supports connection to one Modbus TCP client.

Modbus TCP/IP

Modbus is a communication protocol developed by Modicon Company in 1970s. It was used originally for communication in PLCs and RTU devices but later the Modbus protocol has been used in a variety of different device applications. The Ethernet based Modbus TCP/IP communication in this Device follows the specifications maintained by Modbus Organization. The Modbus communication reference guides can be downloaded from Technical Resources on www.modbus.org. ECMv2 is designed to operate with a wide range of different Modbus experts and clients. The word "client" refers to the protocol master. ECMv2 is referred to as "server" or a slave device. ECMv2 can communicate with one Modbus protocol client at a time.

Connection to client

In ECMv2, it is possible to activate one Modbus protocol server instance. Modbus TCP server is activated by setting the Modbus operation parameter to ON in the 'Network' tab of web interface.

After protocol activation, ECMv2 should be connected to the intended client. When the client makes a TCP connection, its IP address is checked. Protocol reservation is given to the client with this IP address.

TCP/IP link

ECMv2 operates as a Modbus TCP/IP server. A Modbus TCP/IP client can establish a connection to ECMv2 through the standardized TCP socket port 502.

Modbus Operation in ECMv2

ECMv2 allows read-only access of parameters through **FC04: Read Input Registers (3x)** and uses **Base-0 Addressing**. Since none of the parameters are fast changing in nature, the scan rate can be kept at 1,000 milliseconds to not unnecessarily load the device.

Modbus data is organized sequentially. This is the most efficient organization method since the expert normally scans the Modbus data in blocks.

The Modbus point list table below shows the parameters and their addresses:

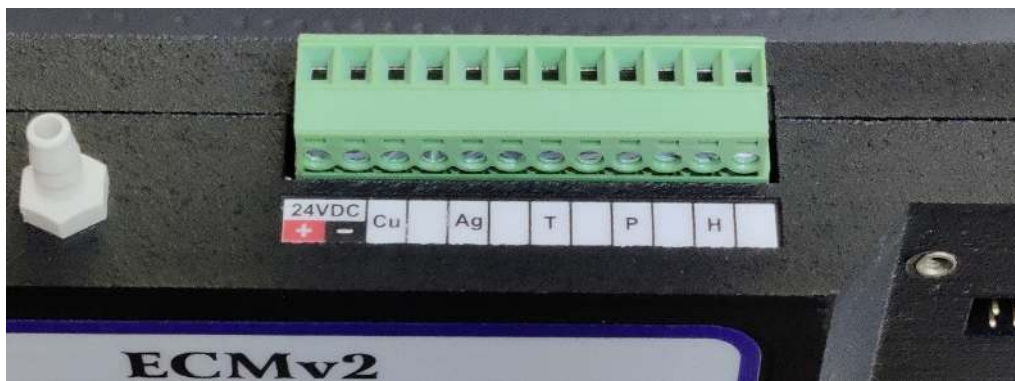
| Address | Description | Data Type | Type | Scaling | Units |
|---------|-------------|-----------|-------------------|---------|----------|
| 100 | Copper CC | u16 | Integer | 1 | Angstrom |
| 101 | Silver CC | u16 | Integer | 1 | Angstrom |
| 102 | Copper IC | u16 | Integer | 1 | Angstrom |
| 103 | Silver IC | u16 | Integer | 1 | Angstrom |
| 104 | Copper ISA | u8 | ASCII of 1,2,3, X | - | N. A |
| 105 | Silver ISA | u8 | ASCII of 1,2,3, X | - | N. A |
| 106 | Temperature | u16 | Integer | 10 | Celsius |
| 107 | Humidity | u8 | Integer | 1 | % |
| 108 | Pressure | u16 | Integer | 10000 | inWC |

Note: Since we are only using integer types, the scaling factor is to be included for Temperature and Pressure, whose actual values are in decimal format. To get the actual value, simply divide the data point by the 'Scaling' value.

Current Outputs from the Channel

The ECMv2 has five 4-20mA current outputs that correspond to Copper Cumulative, Silver Cumulative, Temperature, Relative Humidity, and Pressure. The current outputs are accessible through the large 12-pin terminal block on the bottom of the ECMv2.

Please note that Current Outputs channels are in operation only when the ECMv2 is powered using External 24VDC. When the device is powered with PoE, the channels are disabled and do not provide any current at all.



ECMv2 External Power (+24VDC), Positive Input, Pin 1

ECMv2 External Power, Negative Input, Pin 2

Channel 1, Copper Cumulative, Pin 3 (+), Pin 4 (-), 4-20mA = 0-4000 Angstroms

Channel 2, Silver Cumulative, Pin 5 (+), Pin 6 (-), 4-20mA = 0-4000 Angstroms

Channel 3, Temperature, Pin 7 (+), Pin 8 (-), 4-20mA = 0-100C

Channel 4, Relative Humidity, Pin 9 (+), Pin 10 (-), 4-20mA = 0-100%

Channel 5, Pressure, Pin 11(+), Pin 12 (-), 4-20 mA = 0-0.4 IWG

Replacement of Corrosion Sensors

When a corrosion sensor reaches its end of life, which happens when it reaches 4,000 Angstroms of corrosion accumulation, it will cease to function and must be replaced. When a replacement sensor is obtained, install it on the ECMv2 in the same place as the sensor that failed. The upper sensor location is for Copper and the lower position is for Silver.

Troubleshooting Guide

The data tab provides real time readings of all the sensors: Copper and Silver, Temperature, Pressure, and Humidity. If any of the settings are out of the established parameters, an alarm will appear that needs to be addressed immediately to ensure proper data collection. Use the touch interface capability to fix these alarms, as detailed below.

Any of the below alarms indicate a sensor is out of parameter:

- Copper or Silver Sensor **“Not Connected”**
- Copper or Silver Sensor **“Fault”**
- Copper or Silver Sensor – **Red Indication Light**
- Humidity parameter **“Low or High”**
- Temperature parameter **“Low or High”**
- Pressure parameter **“Low or High”**

Copper and Silver Sensor Alarms

“Not Connected” Copper and/or Silver Sensor Alarm

If the copper and silver QCM sensors are not connected, the alarm for both will display ‘Not Connected’. Ensure both sensors are properly affixed via their connector, then the alarm will change to show “OK”.

“Fault” Copper and/or Silver Sensor Alarm

If one or both the connected QCM sensors are NOT working properly or if the ISA class exceeds the maximum limit, the corresponding Alarm will display ‘FAULT’ To fix this alarm, click on Menu, go to System Settings, click on the sensor that is out of parameter, fix by adjusting the setting, then click Save.

“Red” Copper and/or Silver Sensor Alarm

If the sensors are out of parameter, the indication lights will show red. To fix this alarm, click on Menu, go to System Settings, click on the sensor that is out of parameter, fix by adjusting the setting, then click Save. The sensor should go back to reading “OK” with a green indication light. Repeat this process until both the copper and silver sensors read “OK” with green indication lights.

[Temperature, Pressure, and Humidity Alarms](#)

“Low or High” Alarms

To fix a low or high alarm, click Menu, go to System Settings, go to the Calibration section at the bottom of the screen, click on the setting that is out of parameter and adjust the Offset and Slope values accordingly. Users should also check the Alarm Thresholds to ensure they are within the correct parameters.

Note: please DO NOT make any changes in ‘Corrosion Calibration’ settings unless advised by the manufacturer.

Document History

| Sr. No. | Description | Release Date |
|---------|---|--------------|
| 1 | Initial Draft | |
| 2 | Added user calibration facility in v1.0.3 | 01-04-2020 |
| 3 | Added MODBUS Section | 25-08-2020 |
| 4 | Added WiFi Section | 31-10-2020 |
| 5 | Added Troubleshooting Section | 12-8-2022 |