

# Software Installation and User Manual

Universal SuperHeat Controller/Sensor (USHX)

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**GUI Version:** *DMQ USHX APP v2.0.0*

Document Revision 3.0



*Innovations that flow*<sup>®</sup>

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# 1 Before You Begin

## 1.1 About the USHX Software

The USHX software is a Microsoft Windows compatible graphical user interface (GUI) tool for DunAn Microstaq’s Universal SuperHeat Controller (USHC) and Universal SuperHeat Sensor (USHS) products used typically in HVAC and refrigeration applications. The USHX product utilizes the Modbus RTU communication protocol for user interaction. The following table shows the features of this software when used as either a USHC or USHS.

Feature	USHC	USHS
<i>Precise Superheat Control</i>	✓	-
<i>Input Desired Target Superheat Setpoint</i>	✓	-
<i>Option to Input Desired Target Air Temperature</i>	✓	-
<i>Pressure Measuring Capability</i>	✓	✓
<i>Evaporator Temperature Measuring Capability</i>	✓	✓
<i>Second Temperature Measuring Capability</i>	✓	✓
<i>Real-time Superheat Calculation</i>	✓	✓
<i>Data Collection Capability</i>	✓	✓
<i>Real-time Data Plotting</i>	✓	✓
<i>Alarm Detection with Notifications</i>	✓	✓
<i>Serial Communication Capability</i>	✓	✓
<i>Multiple USHX Network Communication Capability</i>	✓	✓
<i>Automatic Voltage Source Detection</i>	✓	✓

## 1.2 Hardware and System Requirements

The following table provides the hardware and software requirements for installing and using the USHX software.

Hardware Requirements	System Requirements
<ul style="list-style-type: none"> <li>• <i>USHX device(s)</i></li> <li>• <i>USHX wiring harness</i></li> <li>• <i>Isolated USB to RS485 adapter</i></li> <li>• <i>Power Source AC/DC</i></li> <li>• <i>Laptop or desktop PC</i></li> <li>• <i>Small flat tip screwdriver</i></li> <li>• <i>Wire stripper</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Operating System: Microsoft Windows 7, Windows 8/8.1, or Windows 10</i></li> <li>• <i>64-bit Version</i></li> </ul> <p><i>*Contact DMQ for 32-bit version</i></p>

## 1.3 Compatible Firmware

The USHX APP v2.0.0 is compatible with all USHX firmware versions shown below.

21.XX.XX.XX.XX

22.XX.XX.XX.XX

23.XX.XX.XX.XX

‘X’ can be any number starting from 0 through 9.

## 1.4 About This Manual



This manual is intended to instruct the user how to install, configure, and operate DunAn Microstaq's Universal SuperHeat Controller/Sensor software – **DMQ USHX APP v2.0.0**.

The following table shows a summary of the sections in this document and their descriptions.

Section Title	Description
<i>Before You Begin</i>	Preliminary information the user should read before proceeding through the document.
<i>Software Installation and Communications Setup</i>	This section provides information about uninstalling, installing, and setting up the software.
<i>Software Functions</i>	This section provides information about the software functions.
<i>Alarms</i>	This section provides information about alarms the user may potentially encounter and conditions under which they may appear.
<i>Appendix</i>	This section provides information about the control algorithm features provided by the USHC.

## 1.5 Document Conventions

The following table shows a list of symbols found in this document and their descriptions.

Symbol	Description
	<b>WARNINGS</b> indicate that the action you are taking could either cause injury to yourself or could harm your products and systems.
	<b>IMPORTANT NOTES</b> appear in the text to indicate additional information that should be noted.

## 1.6 Acronyms

The following table shows a list of acronyms used in this document.

Acronym	Description
DMQ	DunAn Microstaq, Inc.
F/W	Firmware
GUI	Graphical User Interface
MSEV	Modular Silicon Expansion Valve
HC-MSEV	High Capacity Modular Silicon Expansion Valve
VHC-MSEV	Very High Capacity Modular Silicon Expansion Valve
USHX	Universal SuperHeat Controller/Sensor
USHC	Universal SuperHeat Controller
USHS	Universal SuperHeat Sensor
SH	Superheat
PWM	Pulse Width Modulation Duty Cycle

## 2 Software Installation and Communications Setup

This section provides instructions for installing and setting up the USHX software.

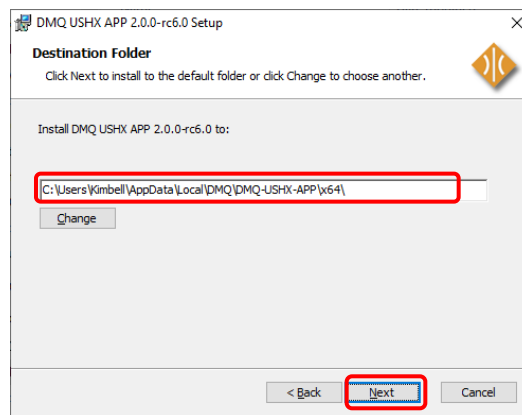
### 2.1 Installing the USHX Software

To install the USHX software, complete the following steps:

1. Double click **DMQ-USHX-APP\_vX.X.X\_Installer.msi**
2. The **DMQ-USHX-APP Setup Wizard** window appears. Click **Next**.



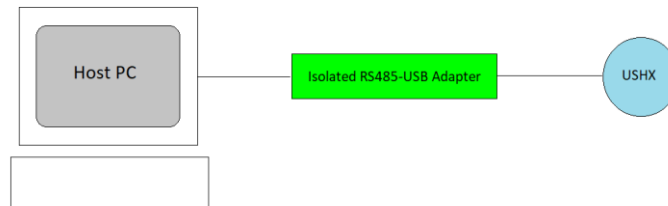
3. Read the end-user license agreement. Click **Next** to continue once the license agreement is accepted (the check box must be checked).
4. The default installation directory is the Users folder. Click **Change** to select a different installation location. Once the desired destination folder is listed, click **Next** to continue with the installation.



5. The **User Account Control** window may appear. Click **Yes** to allow the installation to continue.
6. Click **Finish** to complete the installation process. After the installation is complete, a shortcut to the application will be created on the desktop. The program may also be found through the Start Menu at **Start > All Programs > DMQ USHX APP**

## 2.2 USHX Communications Setup

The HOST PC and the USHX should be connected through an **isolated** USB-to-RS485 adapter. See the **MSEV/HC-MSEV and USHX Hardware Installation Manual** for more hardware installation details. The following diagram shows the USHX hardware and software setup.

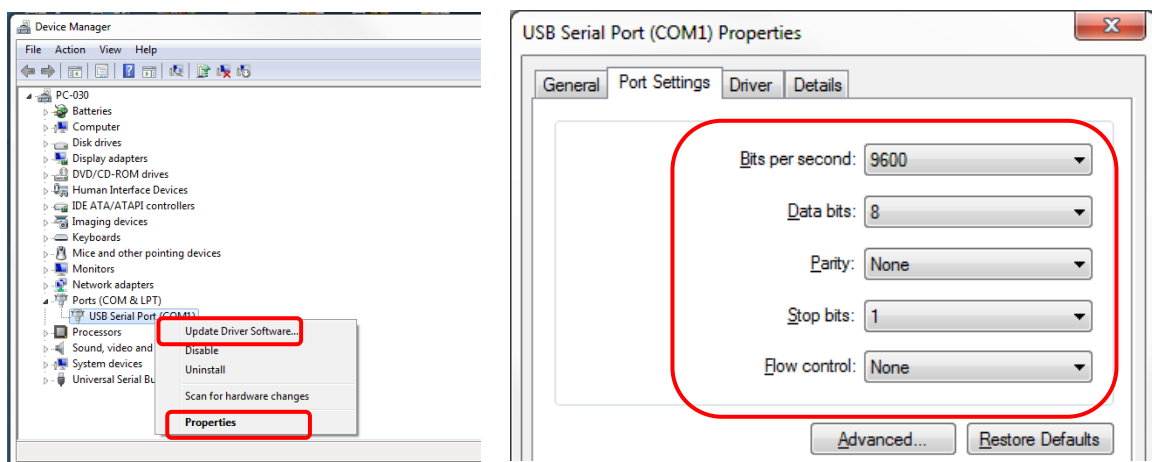


If the Isolated USB-to-RS485 adapter is being used with the associated computer for the first time, the driver(s) for the device must be downloaded and installed. USconverters (model number: U-485G) is one example of a compatible isolated USB-to-RS485 adapter. USconverters, like many manufacturers, hosts its latest drivers on its website. Link down below.

<http://www.usconverters.com/usb-rs485-isolated-converter>

To set up communications between the computer and the USHX through the adapter, complete the following steps:

1. Download the adapter driver(s) from the Internet or, if applicable, obtain them from a CD/DVD. If the driver(s) is (are) in a compressed file, extract the file(s) to a desired location.
2. Connect the adapter to the computer via a USB port.
3. When prompted for the device driver location, go to **My Computer > Right Click > Properties > Device Manager > Ports (COM & LPT)**, right click **USB Serial Port**, and select **Update Driver Software** and navigate to the driver file(s). The computer will update the driver list and install the USB adapter automatically. A new virtual COM Port with number will now be available on the computer.

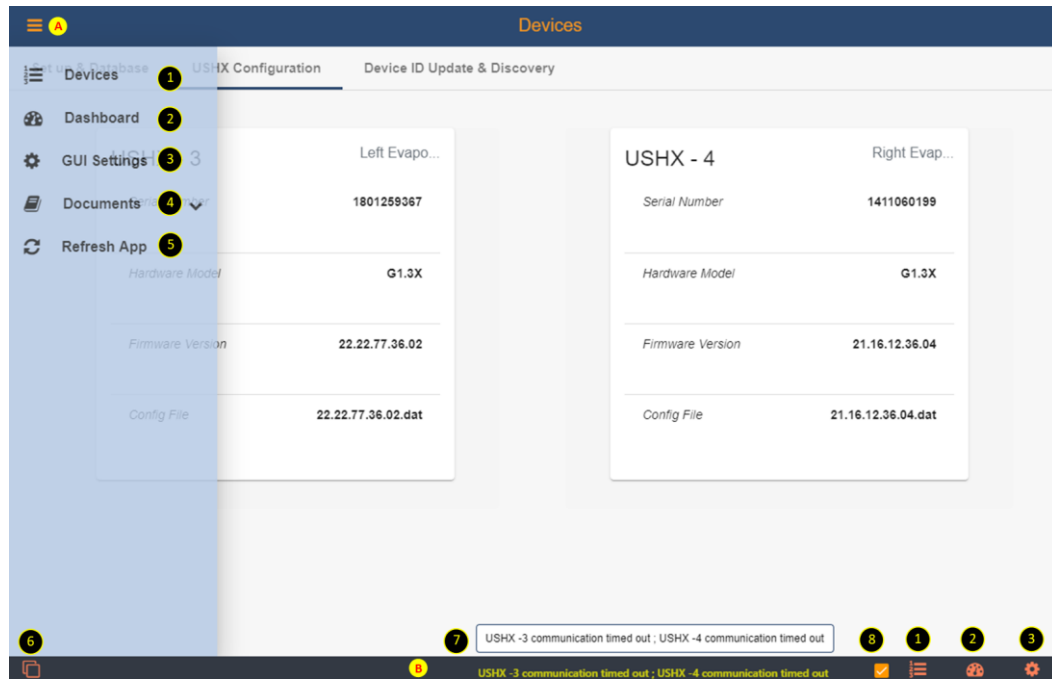


4. Make a note of COM port number and ensure the COM Port Properties are the same as in above picture

## 3 Software Functions

### 3.1 Application Basics

This section provides a quick overview of the Application (App). The features described in this section are present throughout the Application. The features in the window below are labeled as A, B, and 1 to 8 for quick identification and easy explanation.



“Dashboard” and “USHX Configuration” are disabled until USHX devices are setup

Number/ Section	Description
<b>A</b>	<b>Menu</b> – Helps user to quickly navigate through the app. Clicking the icon will pop-out shortcuts to Devices (1), Dashboard (2), GUI Settings (3), Documents (4) and to Refresh App (5).
<b>B</b>	<b>Footer</b> – Helps user to quickly navigate to Add Config File (6), Notifications (7), Tooltip (8), Devices (1), Dashboard (2) and GUI Settings (3)
①	<b>Devices</b> – Shortcut to list of Devices and Settings (Located in both section <b>A &amp; B</b> )
②	<b>Dashboard</b> – Shortcut to Dashboard (view and plot data) (Located in both section <b>A &amp; B</b> )
③	<b>GUI Settings</b> – Shortcut to Application settings (Located in both section <b>A &amp; B</b> )
④	<b>Documents</b> – Shortcut to open Software Manual and Quick Start Guide
⑤	<b>Refresh App</b> – Will automatically restart the application. Windows shortcut: “Ctrl” + “R”
⑥	<b>Add Config file</b> – The user must add a configuration file to match the firmware version or default map will be used. This action is required to show all applicable parameters for this firmware.
⑦	<b>Notifications</b> – All notifications will appear in this section. In the case that the notification is too long to be displayed, hover over this section and a pop up with all notifications will appear.
⑧	<b>Tooltip</b> – Provides brief descriptions for various features throughout the software when the mouse is hovered over a button.

## 3.2 Devices

This section of software is used primarily to Select Serial COM port, Setup Database, View, Configure Device Settings, Assign Device ID, Reassign Device ID and Device Discovery.

### 3.2.1 Set up & Database

The two primary functions of this section are to select Serial port and to Setup the database for Single USHX or Multiple USHX network.

#### 3.2.1.1 Serial Port Selection

Follow the steps below to select the Serial Port.

1. Determine the USB COM Port used by the USHX network (Refer to [Section 2.2](#))
2. Start the USHX GUI APP
3. Select the COM port being used by the USHX network (COM 3 used in the example below)
4. Select the COM settings to be 9600, no parity.
5. Refresh the App

**Serial Port Selection**

Available com ports:

COM3

Serial Port currently selected is COM3

Available com settings:

9600, no parity

19200, no parity

38400, no parity

9600, even parity

19200, even parity

38400, even parity

Serial Port Setting currently selected is 9600, no parity

At times the computer will switch the COM port used. The user should change COM port when application is unable to communicate with any USHX.



To use any other COM setting by the application, the firmware should be set to the same COM setting. Refer to the [Appendix](#) for instructions on setting the firmware to different COM setting.

#### 3.2.1.2 Database

The database is used to setup communication between the software and each individual USHX. The **factory default Device ID** of each USHX is '1'. To setup the database, complete the following steps:

1. Ensure USHX is powered and connected to the wiring harness. Secure all connections.
2. Enter the Device ID '1' for the USHX.
3. Input any notes about the device in the "Remarks" field and click Submit.



Device ID \*

1

ID has to be an integer within [1 — 247]




Remarks



Right Evaporator|

Less than 20 Characters

Cancel Submit

The following information is populated upon the successful entry of a device.













Devices						
Device ID	Serial Number	Hardware Model	Firmware Version	Remarks	Status	Monitor
1	1611283374	G1.3X	22.16.82.36.02	Right Evaporator	Online	  


Parameter	Description
Device ID	Device ID assigned to the USHX
Serial Number	Unique identification number of each USHX
Hardware Version	USHX hardware type
Firmware Version	USHX firmware version
Status	<b>Online:</b> The USHX device is communicating with the APP <b>Offline:</b> The USHX device is not communicating and is inaccessible with the APP
Monitor	<b>“ON”</b> (blue, toggled right) & <b>“OFF”</b> (grey, toggled left). Toggling ‘Monitor’ to <b>“OFF”</b> stops communication with the USHX.
	Clicking this icon allows the user to update the remarks for that device.
	Clicking this icon removes the device from the database.

### 3.2.1.3 Database Export/Import

The **Export/Import** feature allows the user to save the database of Device IDs (export the database to a comma-separated values, or CSV, file) and use it later (import the CSV file to load the database) if the database is needed again. This feature helps protect the user from the loss of the database, which could occur if the user clears the database by clicking **Trash** icon or if the computer used is changed. It eliminates the need to manually recreate a database, which can potentially be time consuming if there are multiple USHXs networked together. The steps below show how to use the **Export/Import** feature:

1. Click the vertical ellipses ( : ) next to the **Add or Edit Device** title.

ID	Serial Number	Hardware Model	Firmware Version	Remarks	Status	Monitor
3	1611281473	G1.3X	22.22.77.36.02	LowEvap RightEvap	Online	  
5	1611280006	G1.3X	22.22.77.36.02	LowTemp LeftEvap	Online	  
8	1611280248	G1.3X	22.22.77.36.02	MedTemp RightEvap	Online	  
9	1611282803	G1.3X	22.22.77.36.02	MedTemp LeftEvap	Online	  

**Add or Edit Device** 

Device ID \*

Import from CSV

Export to CSV

ID has to be an int

Remarks

Less than 20 Characters

Cancel Submit

2. Select '**Export to CSV**' to save the current database listed. In the Save CSV pop-up window, select a suitable location to save the file to, enter an appropriate **File Name**, and then click 'Save' to export and save the current database as a CSV file.
3. The user can **Import** a database of Device IDs by clicking the vertical ellipses and selecting '**Import from CSV**'.
4. In the Load CSV pop-up window, navigate to the location of the appropriate CSV file that contains the database the user wants to import.

### 3.2.2 Device ID Update & Discovery

This feature is primarily used when **Multiple USHX** are connected in network. The two functions are to 'Reassign the Device ID' and 'Device Discovery'.

#### 3.2.2.1 Reassign Device ID

The database becomes very useful when Multiple USHX are in a network. Each USHX should have a unique Device ID allowable from 1 to 247. 'Reassign Device ID' is used to change the default Device ID from 1 to any number up to 247. Follow the steps below to assign a new Device ID.



Multiple USHX should not have the same Device ID in a network. Duplicate Device IDs will cause communication issues.

1. In a Multiple USHX network, ensure only the USHX device being assigned is powered. Disconnect the wiring harness from all other USHX devices if they have the same Device ID.

2. Enter Current ID (Factory default = 1) and Enter New ID (1 to 247) and click Update. A notification will appear which states “*Device # has been reassigned to new Device #*”.
3. Complete Steps 1-2 for all USHX in the network.
4. Add each device into the database as explained in [Section 3.2.1.2](#). The picture below shows an example of a two USHX network added to the database.

Device ID	Serial Number	Hardware Model	Firmware Version	Remarks	Status	Monitor
1	1611283374	G1.3X	22.16.82.36.02		Online	<input type="checkbox"/>  
2	1611283377	G1.3X	22.16.82.36.02	Right Evaporator	Online	<input checked="" type="checkbox"/>  

### 3.2.2.2 Device Discovery

This feature allows the user to find unknown Device ID’s of a Single or Multiple USHX network.

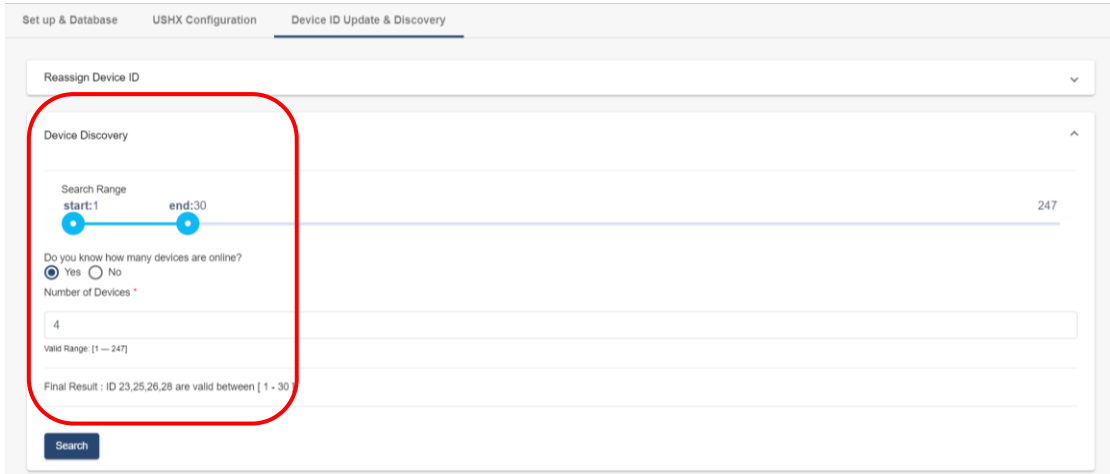


Device Discovery does not work for a multi-USHX network when two or more USHXs have the same Device ID.

To use the Device Discovery feature, complete the following steps:

1. Confirm all USHX’s are powered by securing the wiring harness to each device.
2. If the number of devices on the network is known, select ‘**Yes**’ and enter the value into ‘**Number of Devices**’. If the number is unknown, then select ‘**No**’.

3. Select the Device ID search range (default 1 – 247) and then click the ‘**Search**’ button. Once completed, all found device IDs will be listed.



### 3.2.3 USHX Configuration

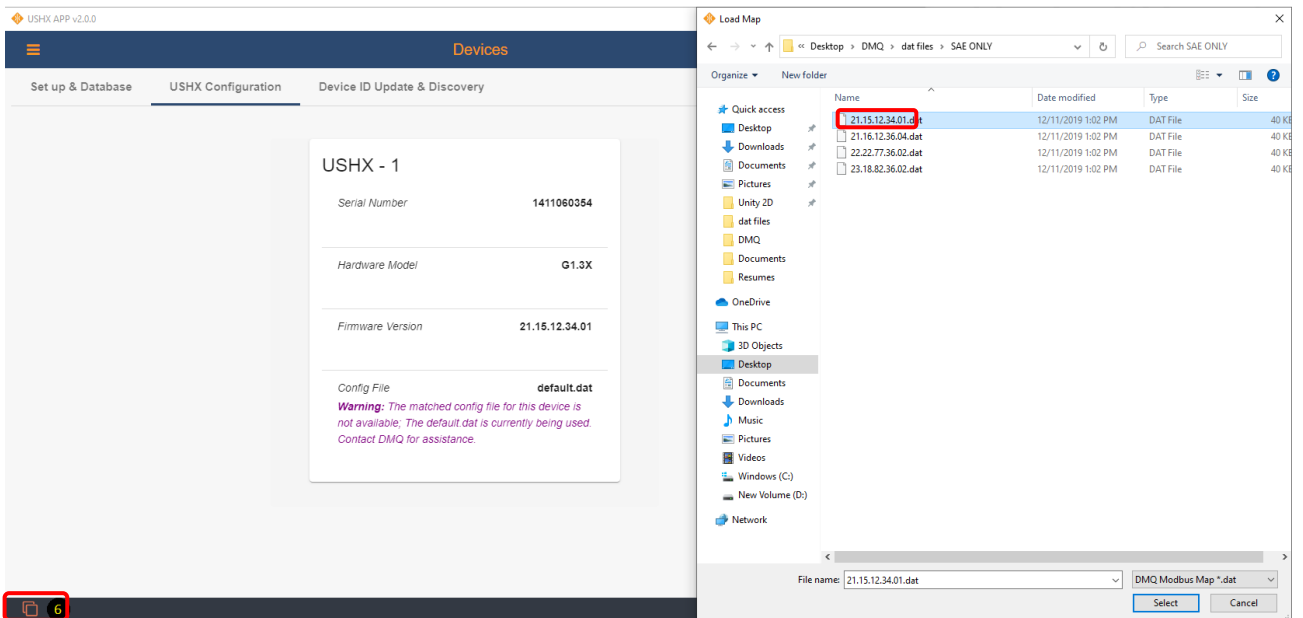
This section of the application is used to explain ‘Add Config File’ and ‘Configure USHX Settings’. It displays all the USHX(s) that are ‘Online’ and toggled to ‘Monitor’ in the database.

#### 3.2.3.1 Add Config File

Each firmware requires a specific configuration file (.dat file). The software comes with a default configuration file. When the firmware version does not match the default configuration file, it requires users to manually select the corresponding configuration file (.dat file) to match the firmware version of the USHX.



Contact DMQ to obtain the Configuration file (.dat file) if it is not provided.

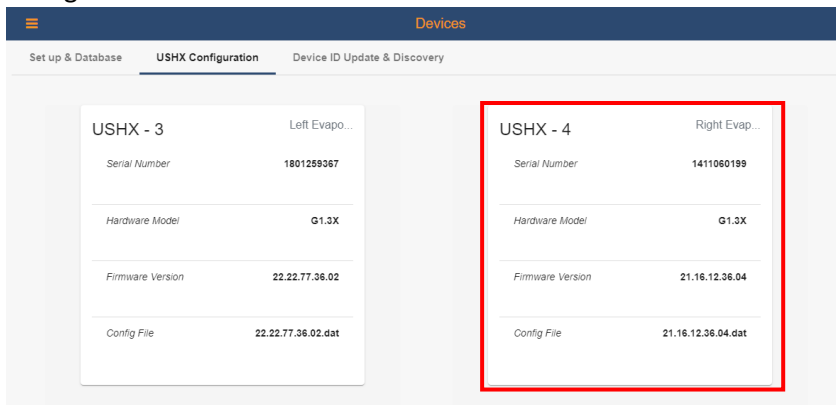


Follow the steps below to add a new Configuration file.

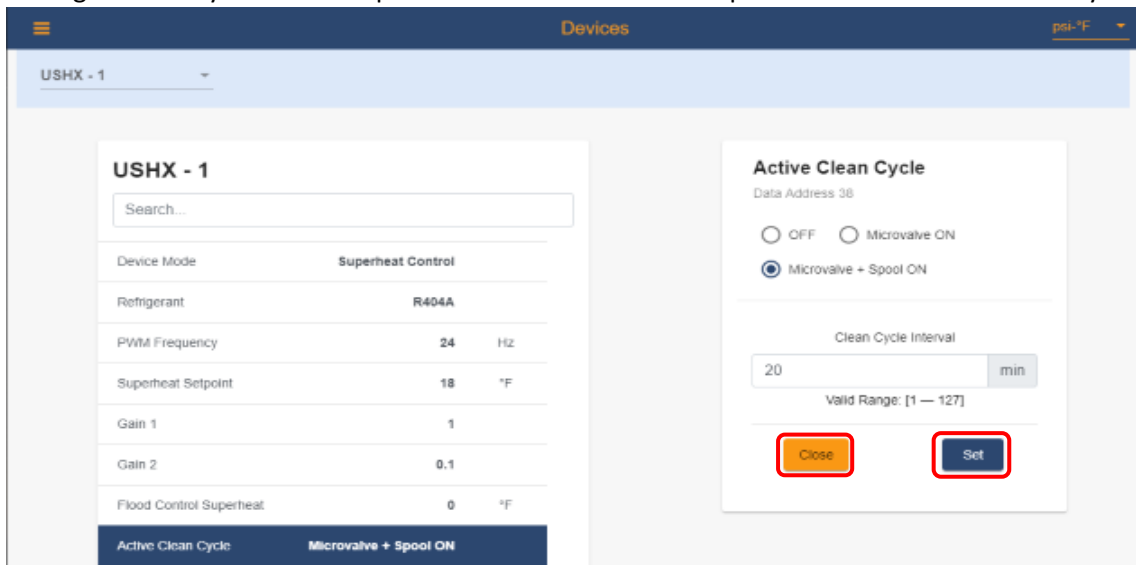
1. Click “Add Config File” button labelled “6” in the picture above.
2. A File Explorer window will appear, navigate to the .dat file on your computer
3. Select .dat file corresponding to the USHX firmware (multiple files can be selected at once)
4. Refresh the APP (shortcut “Ctrl” + “R”), and the new configuration file should be loaded
5. Verify by returning to the USHX Configuration Tab to see that the warning is no longer shown

### 3.2.3.2 View and Configure USHX Settings

This section of the APP is used to view and configure the USHX settings. Click on the USHX to view the configuration settings.



After selecting the USHX, the APP will redirect the user to configure each setting for that USHX. All USHX settings are set by numerical input or button selection. Example below is for Active Clean Cycle.



For every selected parameter there are two buttons:

- **Close** – This button will close the pop-up window.
- **Set** – This button will set all the selections and changes made by the user.

The following table describes every parameter that can be set by the user. Also, turn on the **Tooltip** (labelled ⑧ in [Section 3.1](#)) for in APP pop-up explanations.

Parameter	Description
Device Mode	<b>Superheat Control:</b> To control the superheat of the HVAC/R system. The control loop of the USHX is continuously running and the PWM will adjust automatically to achieve target superheat. <b>Superheat Sensor:</b> To manually command constant PWM to MSEV.
Refrigerant	Select the refrigerant of the system where USHX device is installed.
PWM Frequency	Changes the frequency of the PWM signal to the MSEV.
PWM Setpoint	Changes the duty cycle of the PWM signal to the MSEV in Superheat Sensor mode.
Superheat Setpoint	Changes the desired superheat setpoint of the USHX measured at the evaporator outlet.
Gain1	Gain 1 acts as a proportional gain. This determines how quickly the control loop responds to fluctuations in superheat. See the <a href="#">Appendix</a> .
Gain2	Gain 2 acts as an integral gain. This determines how quickly the control loop brings the superheat to the superheat setpoint. See the <a href="#">Appendix</a> .
Flood Control Superheat	A safety feature to prevent compressor floodback from occurring within the system. When the Calculated Superheat falls below this user-defined value, the PWM will instantly go to 5% to close the valve. The control algorithm resumes normal operation when the Calculated Superheat is above the Flood Control Superheat. See the <a href="#">Appendix</a> .
Active Clean Cycle	A safety feature to minimize the contaminant build up for either 'Microvalve' or 'Microvalve + Spool', dependent on selection. See the <a href="#">Appendix</a> .
Control Scheme	Select type of control algorithm. See the <a href="#">Appendix</a> .
Sensitivity	Used to detect sudden changes in pressure, such as, compressor ON/OFF, etc. See the <a href="#">Appendix</a> .
Passive Clean Cycle	A safety feature to minimize the stiction for both Microvalve and Spool, which operates at a frequency of every 10 seconds. See the <a href="#">Appendix</a> .
PWM Toggle	A feature to conserve power and prevent overheating of the MSEV. It is intended to occur during system OFF and defrost cycles in HVAC-R systems. See the <a href="#">Appendix</a> .
Flood Control ROC	Flood Control Rate of Change (ROC) is used in conjunction with the Flood Control Superheat. The PWM duty cycle will be updated after the USHX has exited Flood Control based off the equation: $\text{New PWM\%} = \text{Last Known PWM\%} - \text{Flood Control ROC} * \text{Elapsed Seconds}$ . See the <a href="#">Appendix</a> .
Evap-out Time Constant	Changes the effective time constant of the thermistor used to measure evaporator temperature
Impulse Delta PWM	The delta PWM value to be added or subtracted to a calculated operating PWM when a valve orifice needs to be increased or decreased respectively for a user specified duration.
Impulse PWM Frequency	A duration to hold the 'Impulse PWM' where $\text{Impulse PWM} = \text{Operating PWM} \pm \text{Impulse Delta PWM}$ . The value will be 100 milliseconds when user defines as 10Hz. Note that the Impulse PWM Frequency is independent of the operating PWM frequency.
Target Air Temp	Changes the desired target air-out temperature of the system.
Target Air Temp Upper Limit	The maximum desired target air-out temperature of the system.
Target Air Temp Lower Limit	The minimum desired target air-out temperature of the system.

### 3.2.3.3 Recommended Settings

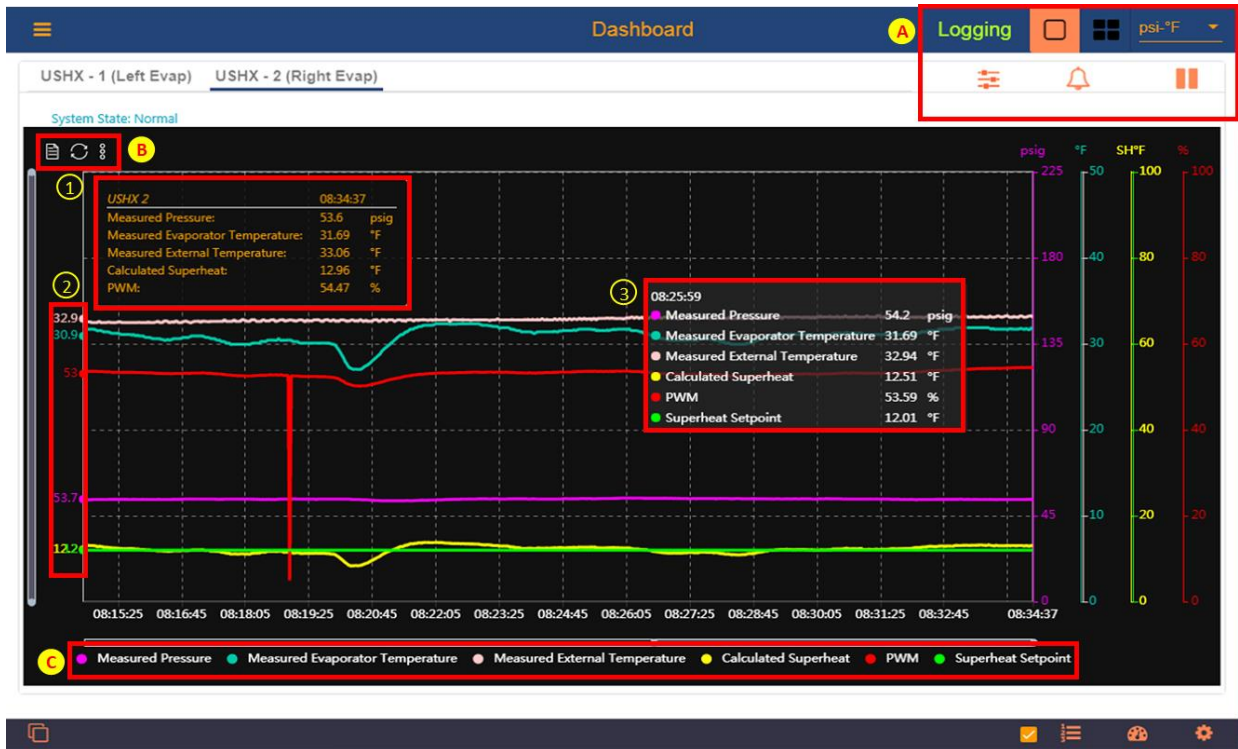
The following table describes the recommended value for each parameter. The settings highlighted in yellow are different between firmwares.

Parameter	Firmware Version 21.20.82.36.01	Firmware Version 22.22.82.36.02	Firmware Version 23.20.82.37.08
Device Mode	Superheat Control	Superheat Control	Superheat Control
Refrigerant	Per system requirement	Per system requirement	Per system requirement
PWM Frequency	24Hz	60Hz	60Hz
PWM Setpoint	N/A	N/A	N/A
Superheat Setpoint	13°F	13°F	13°F
Gain1	1	1	1
Gain2	0.1	0.05	0.05
Flood Control Superheat	1°F	1°F	1°F
Active Clean Cycle	Microvalve + Spool ON Clean cycle interval = 20 mins	Microvalve + Spool ON Clean cycle interval = 20 mins	Microvalve + Spool ON Clean cycle interval = 20 mins
Control Scheme	A	B	B
Sensitivity	30 for HVAC Systems 15 for Refrigeration Systems	30 for HVAC Systems 15 for Refrigeration Systems	30 for HVAC Systems 15 for Refrigeration Systems
Passive Clean Cycle	ON	ON	ON
PWM Toggle	Enable	Enable	Enable
Flood Control ROC	0.3%/sec	0.3%/sec	0.3%/sec
Evap-out Time Constant	1 sec	1 sec	1 sec
Impulse PWM Frequency	N/A	5Hz	5Hz
Impulse Delta PWM	N/A	10%	10%

## 3.3 Dashboard

This section enables user to view the real time plot for every USHX on the network. The data plotted varies depending upon the USHX configuration settings. See table below.

Parameter	Description	Required Configuration Settings
<i>Measured Pressure</i>	Pressure at the evaporator outlet where the USHX is installed.	Default
<i>Measured Evaporator Temperature</i>	Temperature at the evaporator outlet where the thermistor is installed.	Default
<i>Measured External Temperature</i>	Temperature where the second thermistor is installed (contact DMQ for additional thermistor)	Default
<i>Calculated Superheat</i>	Real-time calculated superheat based on pressure and temperature measurements.	Default
<i>PWM</i>	PWM duty cycle applied to the MSEV by USHX.	Default
<i>Superheat Setpoint</i>	Desired target superheat	Default
<i>Target air out temperature, Upper and Lower Limit</i>	Target air temperature features (Available only when second temperature sensor is installed)	Control scheme = E or F
<i>Floating Target Superheat</i>	Target air temperature features	Control scheme = F



Number/ Section	Description
①	<b>Current Data values</b> displays the real time value for each parameter.
②	<b>Average Data values</b> of the data on the plot. When a different section of the plot is displayed, these values will adjust accordingly. The location of the values along the Y axis depends on the average data value and the corresponding data's scale.
③	<b>Specific Point Data Hover Pop-Up.</b> When the user places the cursor over the plot, a pop-up shows parameter values at the time corresponding to the cursor location.

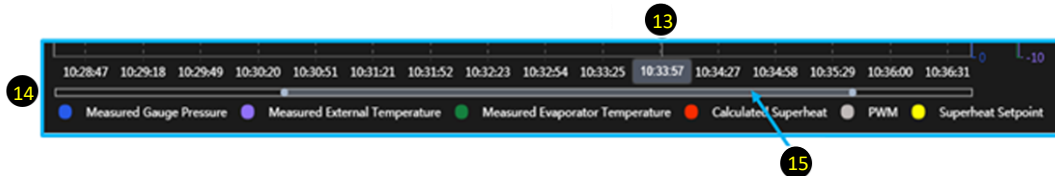


④	<b>Log Data</b> begins recording data for all monitored controllers.
⑤	<b>Single or Multi View icon</b> changes the number of plots displayed in the window.
⑥	<b>Display units</b> changes all measurement units throughout the APP <b>Note: Does not change the measurement units of the Logged Data.</b>
⑦	<b>USHX Settings icon</b> displays configured parameters for the USHX
⑧	<b>Recent Notifications icon</b> displays USHX notifications
⑨	<b>Pause/Update toggle</b> pauses and continues the plot. While paused the user can adjust both x and y axis of the viewing window. While paused the data is still being processed and recorded.





⑩	<b>Table View icon</b> shows plotted data in a table format
⑪	<b>Restore icon</b> is used to reset the plot's viewing window after it has been adjusted. This is used primarily when the plot has been paused.
⑫	<b>Chart Options</b> allows the user to turn ON and OFF grid lines and Chart Tooltip



⑬	<b>Specific Point Data Hover Pop up</b> Hovering the cursor over the plot displays the time corresponding to the cursor's location along the horizontal axis
⑭	<b>Interactive Legend</b> Allows the user to hide and unhide the parameters from plot. Click on "Measured Gauge Pressure" and it will disappear from the plot. All the data is recorded even if it is hidden from the plot.
⑮	<b>Plot's Viewing space (time axis)</b> The user may adjust the bar located below the horizontal axis to view current or historical data. The plot must be paused when using this feature.

### 3.4 Configure Settings

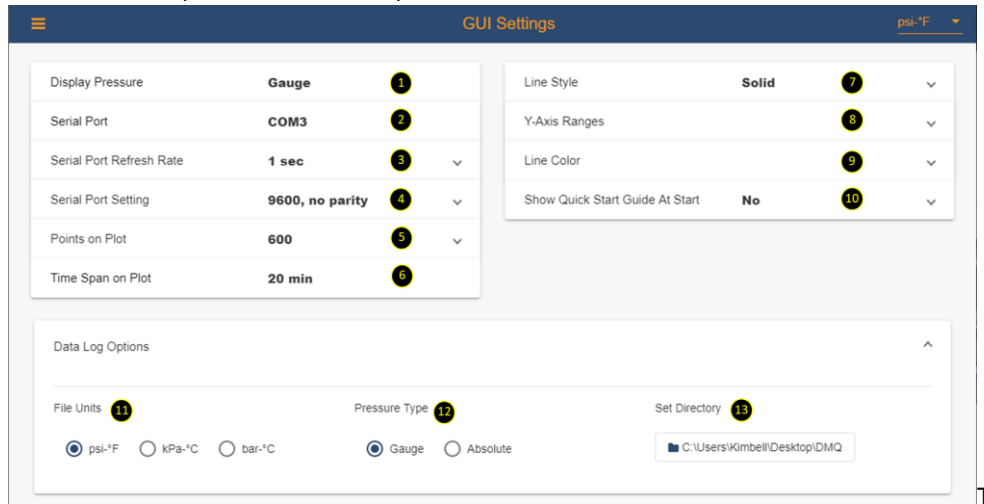
Another option to configure USHX settings without going away from the plot is by clicking ⑦ **USHX Settings icon**



Click any of the parameters and it will open a pop-up box and the settings can be adjusted.

## 3.5 GUI Settings

The GUI Settings tab allows the user to configure data logging settings and customize the plot area to the user's preference. The user has the option to save these preferences.



### 3.5.1 Display Settings

This section includes the settings which customize the way the dashboard plots are displayed.

Number/ Section	Description
①	<b>Display Pressure</b> – Indicates pressure is shown in absolute or gauge pressure
②	<b>Serial Port</b> – Indicates which COM Port is being used
③	<b>Serial Port Refresh Rate</b> – Options to change plot refresh rate and data recording rate
④	<b>Serial Port Setting</b> – Indicates the settings of the COM Port being used
⑤	<b>Points on Plot</b> – Option to select the number of data points visible in the active plot(s) <b>Note:</b> 1500 points per USHX are always saved on the APP. Adjusting this setting only affects how many of these points are shown in the dashboard
⑥	<b>Time Span on Plot</b> – Indicates the maximum time span on each active plot Time = (Serial Port Refresh rate) x (quantity of USHX being monitored) x (Points on Plot)
⑦	<b>Line Style</b> – Option to select between dotted, dashed, or solid lines
⑧	<b>Y-Axis Ranges</b> – Customizable Y axes scale; <b>Note:</b> Must click the “Update” button for each range change to take effect
⑨	<b>Line Color</b> – Customizable plot lines for each measured parameter by selecting default colors, color palette, Hex value, or RGB/HSL values
⑩	<b>Show Quick Start Guide At Start</b> – Option to display the Quick Start Guide when the App opens.

### 3.5.2 Data Log Options

The Data Log Options section only refers to the recording file(s) when logging data. Any changes to these settings will create a new file(s) if user has already logged data.

⑪	<b>File Units</b> – Select the units of measurement the data will be saved as
⑫	<b>Pressure Type</b> – Select absolute or gauge pressure for display and data being saved
⑬	<b>Set Directory</b> – Set the directory to save data; default directory is C:\Users

## 4 Alarms

The USHX software has the capability to inform the user of hazards, errors, and other information.



Multiple notifications will be displayed if multiple errors are encountered at once

### 4.1 Notifications

In the **Recent Notifications list** in the Dashboard, the software will display notifications when errors or change of states are encountered. The table below lists the notifications that the user may see and describes the conditions that trigger their appearance.

Notification	Description
<b>PWM Toggle</b>	Is triggered when the PWM is above 90% and superheat is stable for 30secs. During the PWM toggle, the PWM continuously cycles between 5 and 80%. This safety feature prevents the valve from overheating.
<b>High Input Voltage*</b>	The input voltage has exceeded the range of operation.
<b>Low Input Voltage*</b>	The input voltage has fallen below the range of operation.
<b>Primary External Temp. Not within Sensor Range*</b>	The temperature measured by the primary external sensor has exceeded or fallen below the normal operating temperature limits.
<b>Secondary External Temp. Not within Sensor Range*</b>	The temperature measured by the secondary external sensor has exceeded or fallen below the normal operating temperature limits.
<b>Internal Temp. Not within Sensor Range*</b>	The temperature measured by the internal temperature sensor has exceeded or fallen below the normal operating temperature limits.
<b>Pressure Not within Sensor Range*</b>	The input pressure has exceeded the pressure range of the pressure sensor.
<b>Temperature Difference Error</b>	Contact manufacturer if this notification is seen.

\* These notifications pertain to errors involving the operating range of the USHX. When any of these notifications are displayed, ensure that the USHX is being operated properly within its design limits as specified in the product datasheet.

### 4.2 Additional Messages

Additional messages are shown in yellow text at the footer of USHX APP. The table below lists additional messages that the user may see and describes the conditions that trigger their appearance.

Notification	Description
<b>COM [#] is currently unavailable</b>	The Serial Port is no longer available or the converter is plugged into a different serial port.
<b>USHX [#] communication timed out</b>	There is either a partial loss of data or a compatibility issue between the firmware and the USHX software interface.
<b>USHX [#] reading skipped</b>	Occurs when the user is configuring the USHX device or selecting the device to be monitored or not.
<b>Log file for USHX [#] cannot be created or appended to</b>	There is a mismatch of information of the database or the USHX is no longer available to be recorded.

## 5 Appendix

### 5.1 Common Features

#### 5.1.1 Gain 1

*Gain 1* is a proportional gain and the objective is to adjust the PWM% proportionally with the magnitude of superheat error (Superheat Setpoint – Calculated Superheat). Its effect on PWM is given:

$$\text{Gain 1} * (\text{Superheat Setpoint} - \text{Calculated Superheat})$$

With *Gain 1*, PWM adjustments will be more drastic with higher magnitude superheat error. The recommended default value is 1.

#### 5.1.2 Gain 2

*Gain 2* is an integral gain and the objective is to gradually trim down the superheat error toward zero. Its effect on PWM is given by:

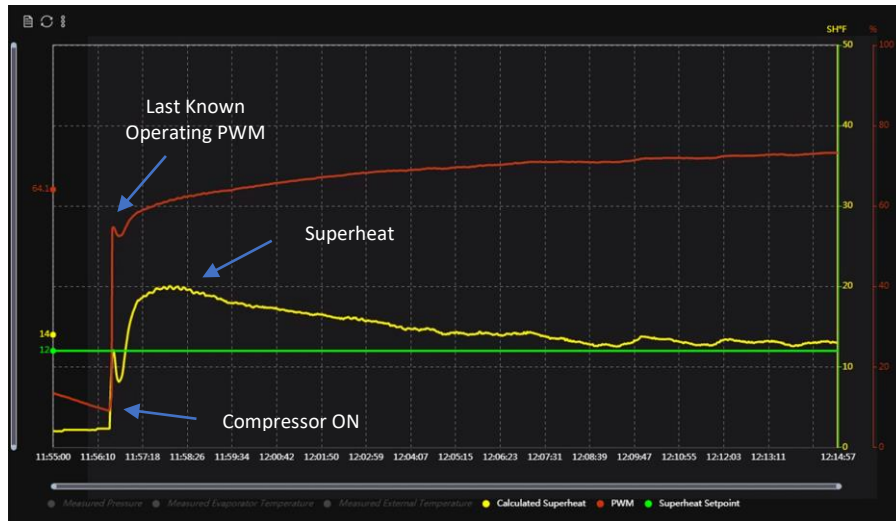
$$\text{Gain 2} * \sum (\text{Superheat Setpoint} - \text{Calculated Superheat})$$

The recommended default value is 0.1. The combination of *Gain 1* and *Gain 2* settings listed below are recommended when default gains do not provide the best results.

<i>Gain 1</i>	<i>Gain 2</i>	<i>Description</i>
1	0.1	Default
0.5	0.05	To make the PWM% adjust slower
5	0.3	To make the PWM% adjust faster

### 5.1.3 Sensitivity

*Sensitivity* is used to detect sudden changes in pressure such as compressor ON, OFF, etc. When the standard deviation of the measured pressure goes above the user-defined *Sensitivity* setting, the PWM will default to the last known operating PWM and the control algorithm will resume normal operation. The recommended *Sensitivity* settings are 15 for refrigeration systems and 30 for HVAC systems.



The plot above demonstrates the scenario of compressor ON in an HVAC system. PWM restores to its previous known good value, enhancing the superheat response time.

### 5.1.4 Flood Control SH

*Flood Control Superheat* is a safety feature to prevent compressor floodback from occurring in the system. If the system Calculated Superheat falls below this user-defined setting, the PWM will instantly go to 5% to close the valve. When Calculated Superheat goes back above the *Flood Control SH*, the control algorithm resumes normal operation. The recommended setting is 0 °F (0°C).

### 5.1.5 Passive Clean Cycle

The *Passive Clean Cycle* is a safety feature and the objective is to minimize stiction for both Microvalve and Spool. When this feature is ON, the PWM frequency is adjusted to 5Hz for 200 milliseconds every 10 seconds. This allows the MEMS microvalve to achieve full stroke and eliminate contaminant buildup for both Microvalve and Spool. It is recommended to always have this feature ON.

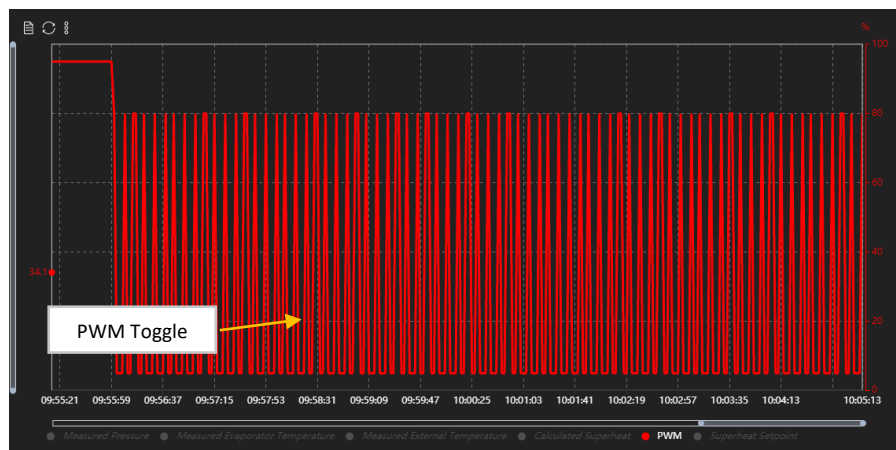
### 5.1.6 Active Clean Cycle

The *Active Clean Cycle* is a safety feature to minimize the contaminant build up for either ‘MEMS Micro Valve’ or ‘MEMS Micro Valve + Spool’ depending upon user selection. Below describes the difference between these two settings. The recommended option is ‘Micro Valve + Spool’.

Type	Function	Recommended Interval
Micro Valve	Adjust the PWM Frequency to 5 Hz for 5 seconds at a user-defined time interval.	20 minutes
Micro Valve + Spool	Adjust the PWM Frequency to 5 Hz for 5 seconds at a user-defined time interval. For the sixth second, pulse the MSEV with 80% PWM and 5% PWM in 500 ms durations.	20 minutes

### 5.1.7 PWM Toggle

The objective of *PWM Toggle* is to conserve power and prevent overheating of the MSEV. It is intended to occur when system is OFF or during defrost cycles in HVAC-R systems. It is initiated when the superheat is stable and the PWM goes above 90% for 30 seconds. The USHX will command the MSEV between 80% and 5% PWM indefinitely. PWM Toggle disables when superheat fluctuates and the control algorithm resumes normal operation. It is recommended for the PWM Toggle feature to be ON.



### 5.1.8 Flood Control ROC (Flood Control Rate of Change)

*Flood Control ROC* is a setting used in conjunction with the *Flood Control SH* parameter. If the *Flood Control* feature is triggered ([Section 5.1.4](#)), the operating PWM% automatically goes to 5%. Once the Calculated Superheat rises above the Flood Control value, the USHX control algorithm will resume normal operation but not at the last known operating PWM%. This feature avoids putting the system in the same scenario where the Flood Control feature was activated. The new PWM% value that is initialized after a Flood Control cycle is calculated by the following:

$$PWM = \text{Last known PWM} - \text{Flood Control ROC} * \text{Elapsed Seconds}$$

## 5.2 Control Scheme A

*Control Scheme A* is used to control the superheat towards a user-defined Superheat Setpoint. The Calculated Superheat is the feedback parameter for closed-loop control. The feature of this scheme is that the parameters *Gain 1* and *Gain 2* dynamically adjust to achieve precise superheat control when the calculated superheat is outside of  $\pm 2^{\circ}\text{C}$  dead band from target superheat. When the calculated superheat is within the dead band, the parameters *Gain 1* and *Gain 2* work as static gains. The initial values of *Gain 1* and *Gain 2* in the control algorithm are the values entered through the GUI. This control scheme is applicable for both HVAC and Refrigeration systems.

## 5.3 Control Scheme C

*Control Scheme C* utilizes the same control algorithm with the same control parameters as *Control Scheme A* but with *static gains*. *Gain 1* and *Gain 2* do not dynamically adjust over time. This can be advantageous if *Control Scheme A* begins to overcompensate for disturbances in the system. This control scheme is applicable for both HVAC and Refrigeration systems.

## 5.4 Control Scheme B

*Control Scheme B* utilizes both *Control Scheme A* and *Control Scheme C*. It operates as *Control Scheme A* until the Calculated Superheat intersects with Target Superheat for five times and then switches to *Control Scheme C*. The objective of this scheme is to bring the calculated superheat closer to target superheat using dynamic gains and then once the Calculated Superheat is settling to target, it will use static gains to maintain tight control. This control scheme is applicable for both HVAC and Refrigeration systems.

## 5.5 Control Scheme D

*Control Scheme D* utilizes the same control algorithm with same control parameters as *Control Scheme A* but uses the user defined dead band for static gains instead of  $\pm 2^{\circ}\text{C}$ .

## 5.6 Control Scheme E

*Control Scheme E* is used to control the Air-Out Temperature towards a user-defined Target Air-Out Temperature Setpoint. This control scheme is applicable only for Refrigeration systems. This scheme utilizes Air-Out Temperature as an additional input for control. There is one basic requirement to use *Control Scheme E*:

- ✓ *USHX must have an installed secondary external thermistor to measure Evaporator Air-Out Temperature*

*Control Scheme E and F* have the following defined parameters:

**Target Air Temp Upper Limit** - The maximum desired Air-Out Temperature

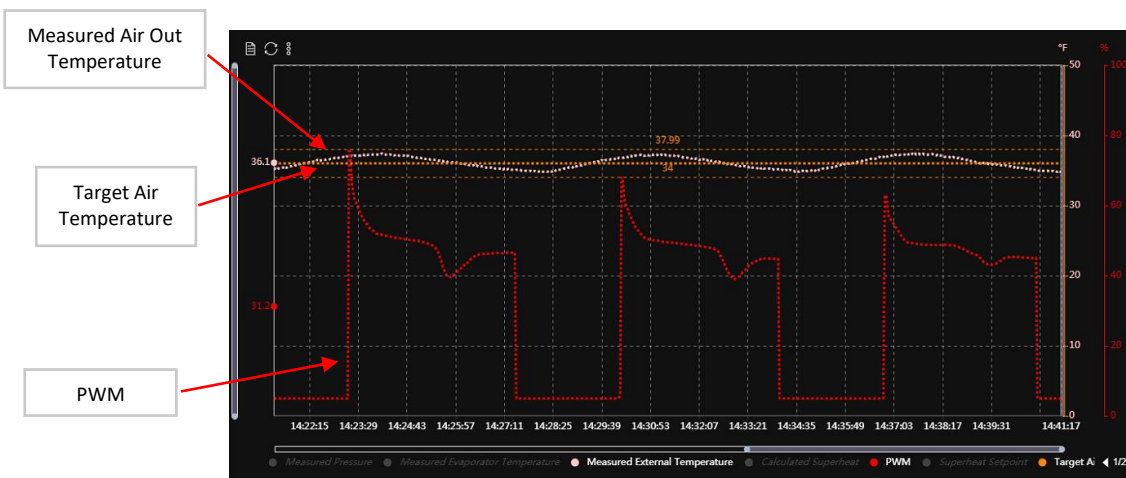
**Target Air Temp** - The desired Air-Out Temperature

**Target Air Temp Lower Limit** - The minimum desired Air-Out Temperature

The control logic for *Control Scheme E* cycles between the two conditions described below:

- Condition 1** When the measured air temperature rises above the midpoint of Target Air Temp and Target Air Temp Upper Limit, the USHX will run the standard target superheat control to cool the air temperature. It will hold Condition 1 until Condition 2 is met.
- Condition 2** When the air temperature falls below the midpoint of Target Air Temp and Target Air Temp Lower Limit, the USHX will close the MSEV (PWM = 5%) so that the air temperature rises. Hold Condition 2 until Condition 1 is met.

*Control Scheme E* will cycle between these two states indefinitely to regulate the Air-Out Temperature between the upper and lower bounds.



The plot above shows an example of *Control Scheme E*. Note as Air-Out Temperature falls below the midpoint of its target and lower limit, the PWM will fall to 5%. Similarly, when Air-Out Temperature rises above the midpoint of its target and upper limit, the PWM will begin controlling superheat as normal. These features are in place to control Air-Out Temperature at target.



## 5.7 Control Scheme F

*Control Scheme F* is used to control the Air-Out Temperature towards a user-defined Target Air-Out Temperature Setpoint. This control scheme is applicable only for Refrigeration systems. *Control Scheme F* operates similarly to *Control Scheme E*. The requirements for *Control Scheme F* are the same as for *Control Scheme E*:

- ✓ *USHX* must have an installed secondary external thermistor to measure Evaporator Air-Out Temperature
- ✓

The control logic for *Control Scheme F* cycles between the two conditions described below:

- Condition 1.** When the air temperature rises above the Target Air Temp, *USHX* to run the standard target superheat control to cool the air temperature. Hold Condition 1 until Condition 2 is met.
- Condition 2.** When the air temperature falls below the Target Air Temp, dynamically float the superheat target to control the air temperature within the target and the lower limit. Hold Condition 2 until Condition 1 is met.

*Control Scheme F* will cycle between these two states indefinitely to regulate the Air-Out Temperature between the upper and lower bounds. Note that the Floating Target Superheat parameter has a minimum and maximum threshold of *Target Superheat* minus 1 °C and 25 °C, respectively.



The plot above shows an example of *Control Scheme F*. Note that as Air-Out Temperature falls below its target, the Superheat Setpoint will float to proportionally higher values. This brings Air-Out back to target.

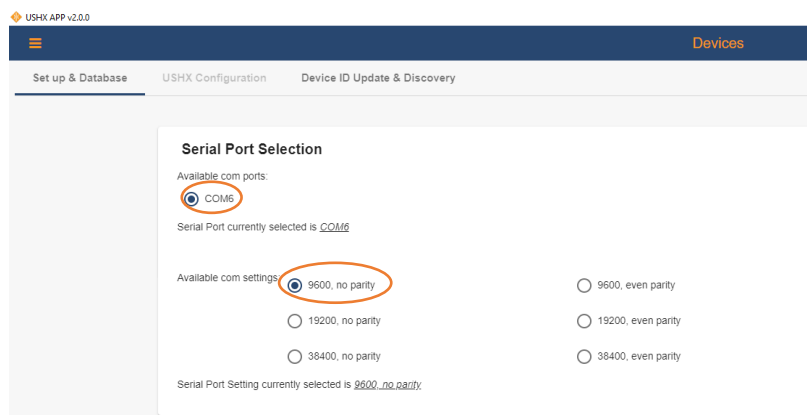
## 5.8 Change Firmware and GUI COM setting

The USHX firmware and GUI communication (COM) setting can be changed to any 4 types shown in below table. The default COM setting is '9600, no parity'.

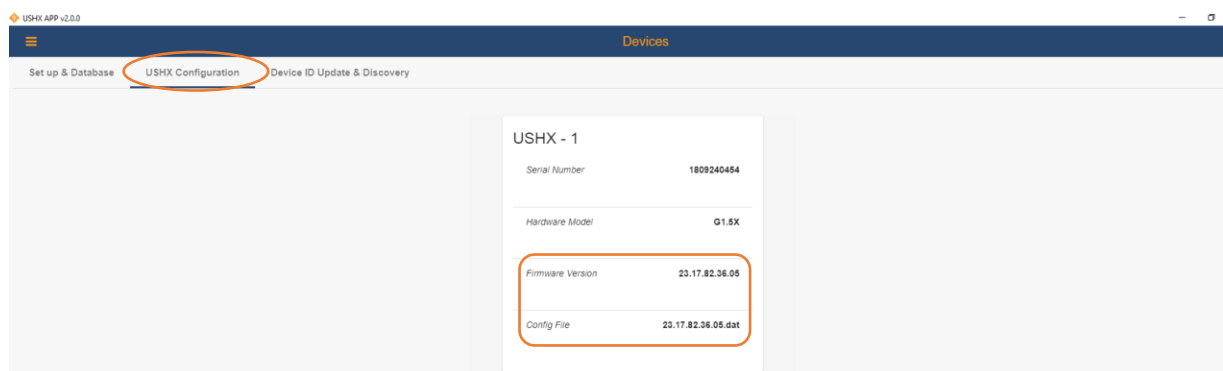
COM Setting	Baud Rate	Parity
9600, n (Default)	9600	None
9600, e	9600	Even
19200, n	19200	None
19200, e	19200	Even

The COM setting can be changed of only one USHX at any time. When multiple USHX are networked, remove power to all the other USHX except the intended USHX. Follow below steps to change the COM Setting of single USHX.

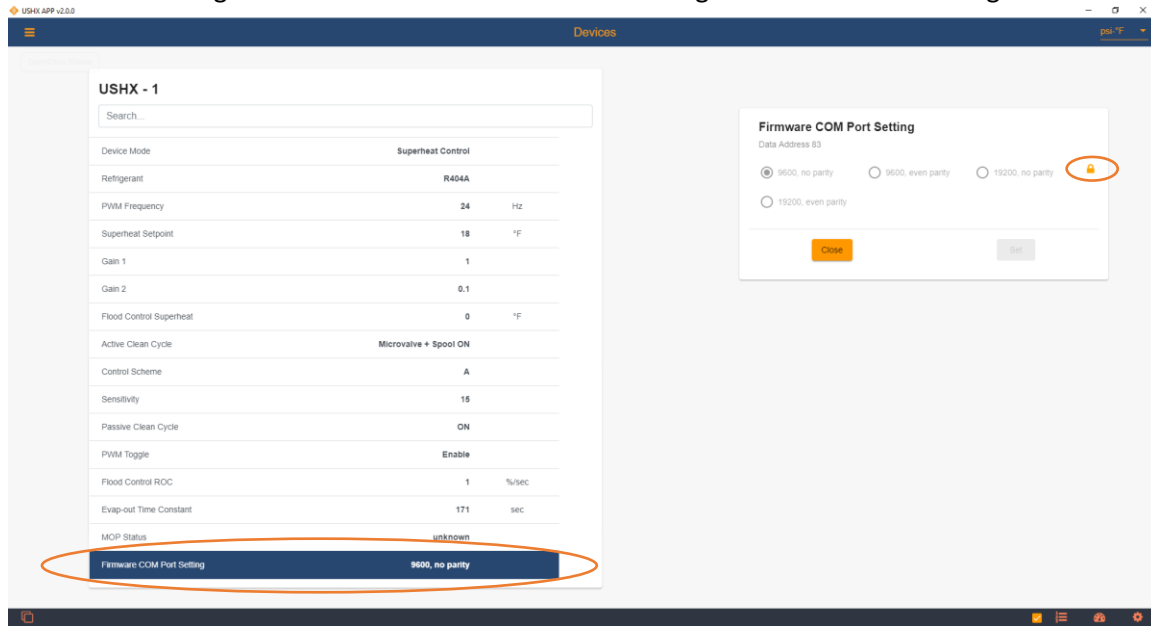
1. Open GUI v2.0.0. Select the COM port used (Device Manager -> Ports) from the 'Available com ports' and the default COM settings (9600, no parity) from the 'Available com settings'. Below figure uses '6' as an example for COM port number. The COM port selection is limited to ports **1 through 16**. If the COM port number is not within this range then change it (Device Manager -> Ports -> Properties -> Port Settings -> Advanced -> COM Port number) to any number between 1 and 16.



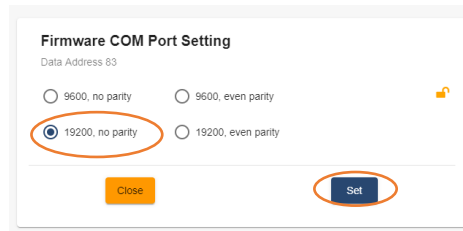
2. Go to USHX Configuration and ensure the Config file is compatible with the firmware version.



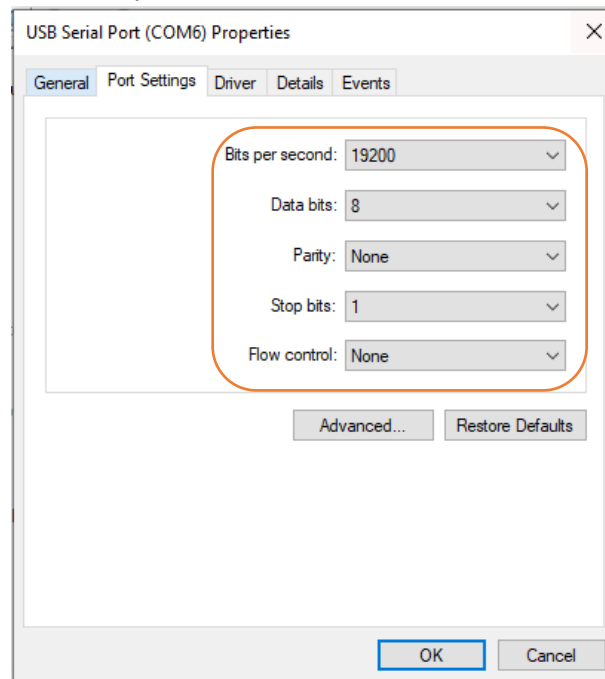
3. Go to Device settings and select 'Firmware COM Port Setting' and click unlock settings.



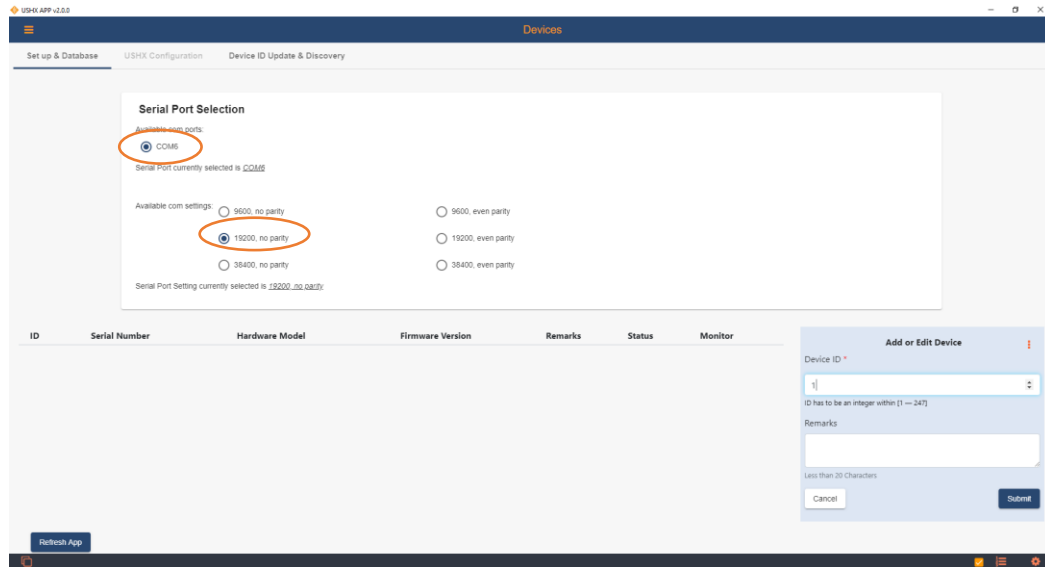
4. Select the desired setting and click 'Set'. The example below shows setting to 19200, n.



5. Ensure the COM setting of the computer is same



- Close and Open GUI v2.0.0. Select the COM port used which is '6' in above example and COM setting used which is (19200, no parity) and the default COM settings (9600, no parity). Enter '1' in device ID and click 'Submit'



- When the communication is successful the device is added to the database.

