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# Thermostat
## COMMISSIONING GUIDE

- TstatPro (9901-0010)
- TstatPro+ (9901-0020)
- AQ TstatPro+ (9901-0027)

Transforming HVAC Controls for IoT

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Version 1.0. Revision 1.0

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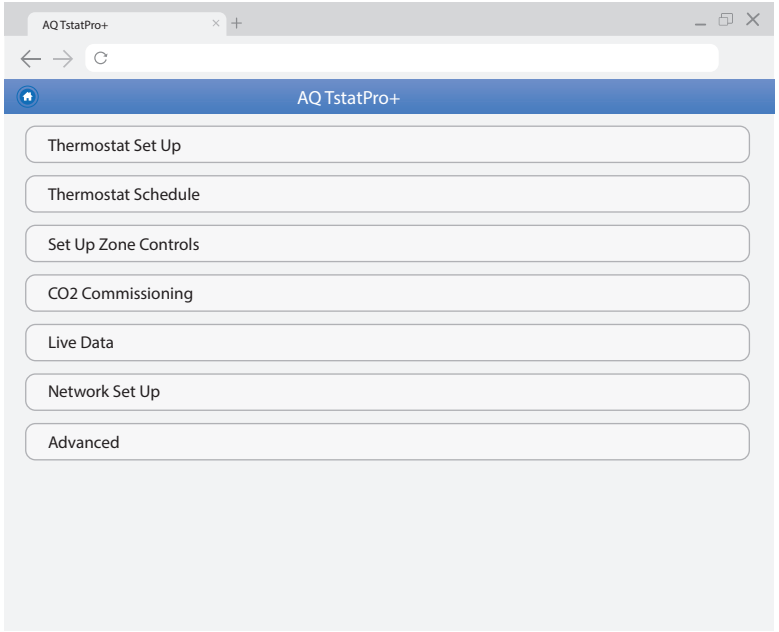
# ABOUT XCSPEC

At XCSpec, we merge the realms of building science and health to pioneer *Smart Dynamic Ventilation Controls*. Our mission is to provide affordable solutions that empower individuals to visualize, monitor, and optimize their indoor air quality, effortlessly—while also reducing energy costs.

Introducing our groundbreaking innovation, the AQ TstatPro+. Unlike conventional thermostats, ours offers advanced ventilation controls for indoor air management and additional energy savings.

At XCSpec, we're dedicated to elevating the indoor environment to promote well-being and productivity. Join us in our mission to revolutionize indoor air quality control and create healthier living and working spaces for all.

**Note:** *AQ TstatPro+ is the only model with $CO_2$.*




The **AQ TstatPro+** has an embedded web server allowing direct connection with the thermostat from a mobile device or PC over Wi-Fi. Once connected, the unit can be set up and commissioned. The thermostat must be powered and within Wi-Fi communications range.

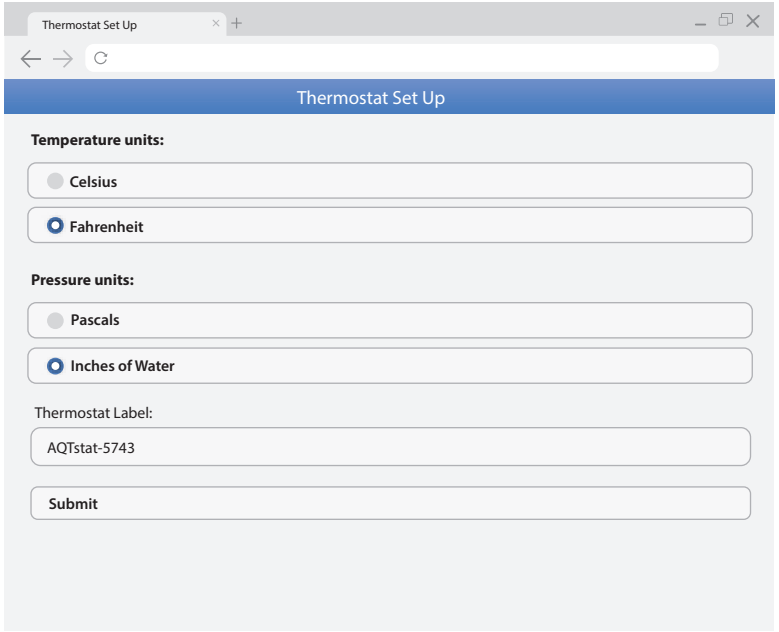
On a mobile phone or PC, pull down the list of available Wi-Fi networks. Select the Wi-Fi network named **AQ-STAT-XXXX** where the last 4 characters match the label on the box or chassis. Select this network and enter the password found on the back of the chassis. After correctly entering the password, the mobile phone or PC will indicate a successful connection.

Launch a browser and enter **192.168.10.1** into the address line. The landing page shown at the left will appear. To return to this from any other page, simply tap the home icon in the upper left corner of the web page or use the back button on your browser.

**Suggested Browsers:** Chrome, Safari, Firefox, and Edge

You must use the **Submit** button to load set up information into the thermostat.

**Note:** *AQ TstatPro+ is the only model with $CO_2$.*







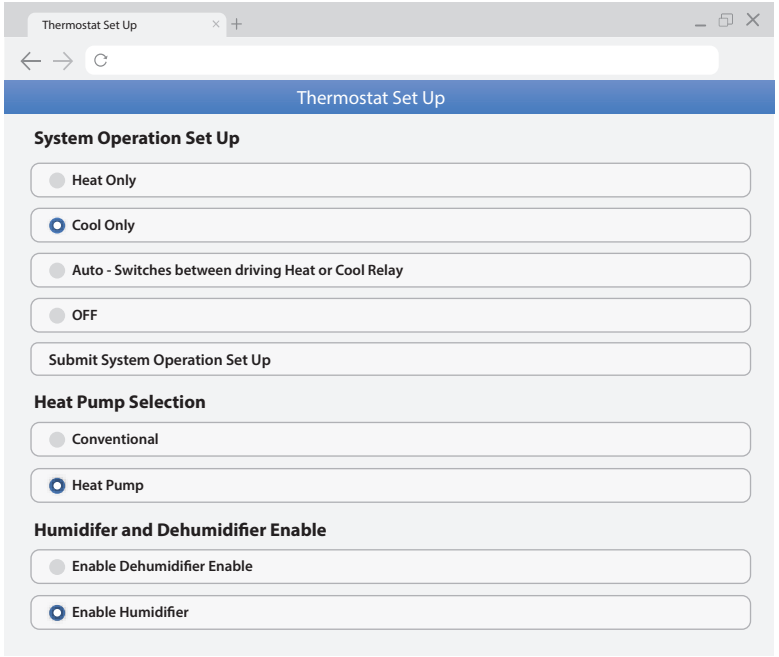

The thermostat set up page configures the AQ TstatPro+ system parameters and allows repurposing the use of either the B or the O relays.

**Celsius or Fahrenheit:** This sets the system to display temperature data is C or F. This changes the temperature displayed on the panel of the thermostat and the live data page.

**Pascals or Inches of Water:** This sets the system to display pressure in inches of water or pascals. This allows setup of pressure range based on the selected units. This is primarily used when the unit is used to display local space pressure.

**Thermostat Label:** The label field is a human-readable label associated with a particular thermostat. This label allows easy recognition of any specific unit when receiving email alerts or logging onto the **CloudBEAM** web portal. The label can be up to 54 characters long.

Use the **Submit** button to load this information into the thermostat.







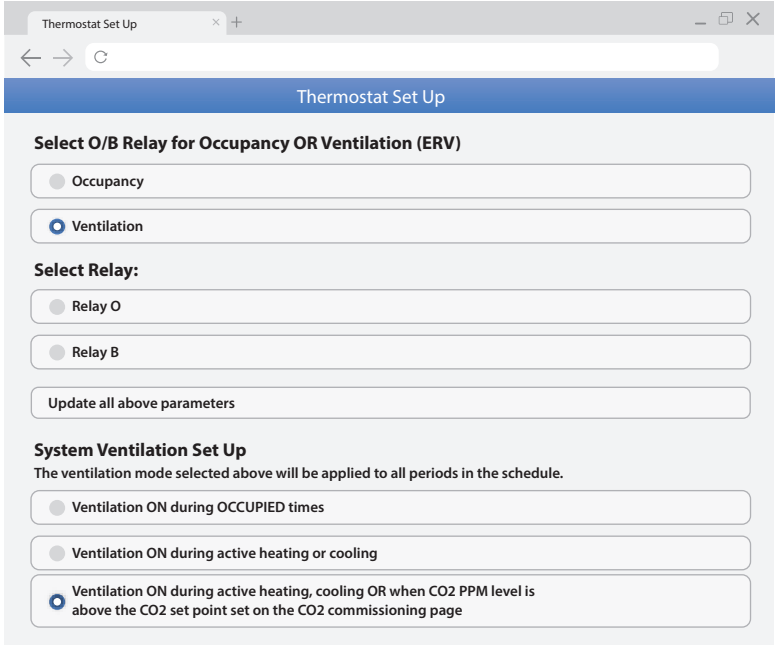

**Select Operating Mode:**
Configure the system for the particular application- heat only, cool only or auto. Auto will switch between heat or cool based on zone temperature and set points automatically.

Use the **Submit System Operation Set Up** button to load this information into the thermostat.

**Select Conventional or Heat Pump Operation:**
This section allows you to set up the for conventional operation or heat pump.

**Note:** *If using a heat pump and repurposing the B or O relay for occupancy, set the transfer option opposite the heat pump's changeover selection.*

**Enable Humidifier or Dehumidifier:**
This section allows you enable the humidifier or dehumidifier out relay.








**Thermostat Relay O/B Selection:** The O or B relay can be repurposed to drive an occupancy out relay to an economizer or signal an ERV to turn on ventilation. This page enables the function by selecting occupancy **OR** ventilation and then selecting the relay to be used.

When the thermostat is configured as a heat pump, care must be taken to make sure you configure the appropriate reversing value for the heat pump.

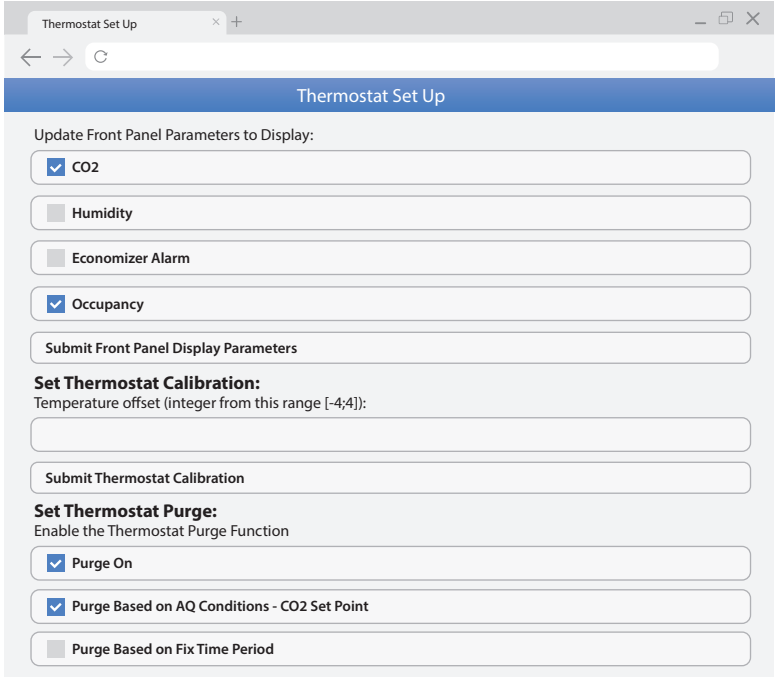
**O or B Relay Selection:** These radio buttons define which relay to re-purpose.

**Setting the Thermostat Ventilation Mode:** This section allows you to set up the thermostat's ventilation mode. This ventilation selection is applied to all days in the schedule.

**Ventilation ON:** This will run the ventilation fan during all occupied periods. Many building codes require this.

**Ventilation ON during active heating and cooling** runs the fan **ONLY** when there is a call for heating or cooling.

**AQ TstatPro+ Only: Ventilation ON during active heating or cooling or when the $CO_2$ level is above the $CO_2$ PPM High setting.** This option runs the **FAN** when there is a call for heating/cooling **OR** the measured $CO_2$ PPM is above the $CO_2$ PPM high setting. The $CO_2$ high setting is on the $CO_2$ commissioning page.








**Front Panel Display Options:** Check the boxes associated with the data to be displayed on the front panel message area. The thermostat will cycle through the different parameters.

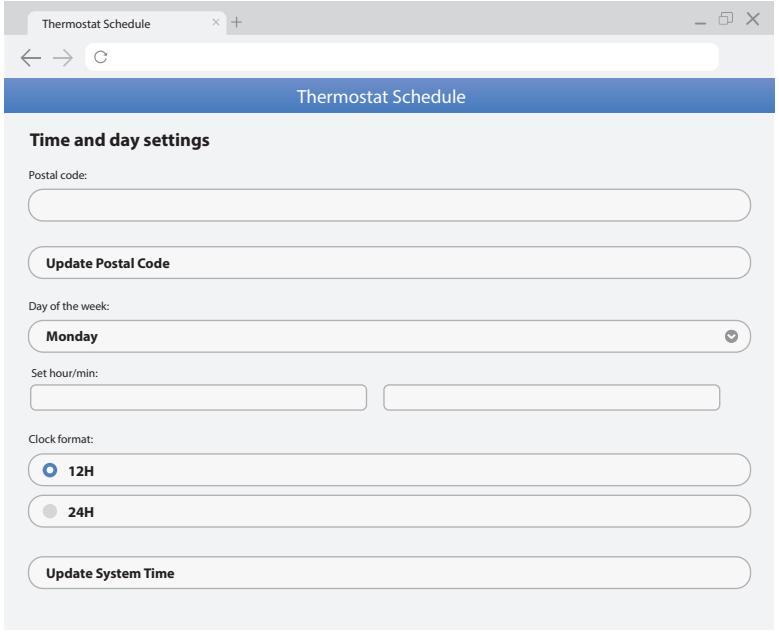
**Note:** *The economizer alarm will display on the front panel only when the economizer is in an alarmed state.*

**Thermostat Calibration:** This allows you to adjust display temperature ±4 °F (±2.2 °C).

**Note:** *The thermostat set points activate based on this displayed temperature.*

**Purge Enable:** This allows you to enable the purge function on the thermostat. Purge will occur 2 hours before the schedule occupancy.

**Purge Period:** The installer selects to purge for a fixed period or when the air quality sensors confirm acceptable air quality levels in the space. If a time period is selected, enter a time between 30 - 240 minutes in the space that appears. If AQ Is selected, then the $CO_2$ set point configured on the $CO_2$ commissioning page will be used. This feature is only available on the AQ TstatPro+.

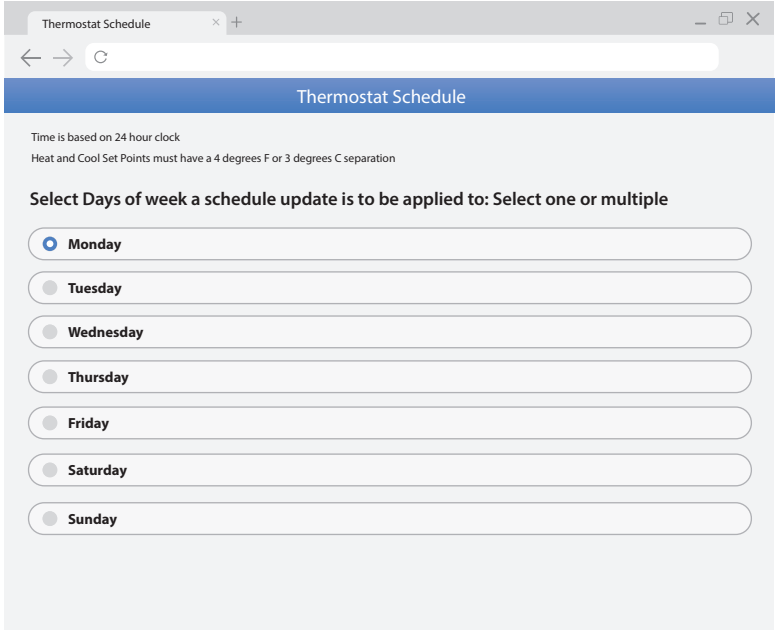







Before scheduling you will need to set the clock. Navigate to the AQ TstatPro+ home page and select thermostat schedule.

**1.** Enter the first five digits of the ZIP code where the thermostat is installed. If your thermostat is connected to the **CloudBeam**, the time will sync automatically.
**2.** Press **Update Postal Code.**
**3.** Select the current day of the week from the dropdown.
**4.** To set the time of the day enter the hour and minutes in the fields provided.
**5.** Select if you want a 12 or 24 hour clock.
**6.** Press **Update System Time.**





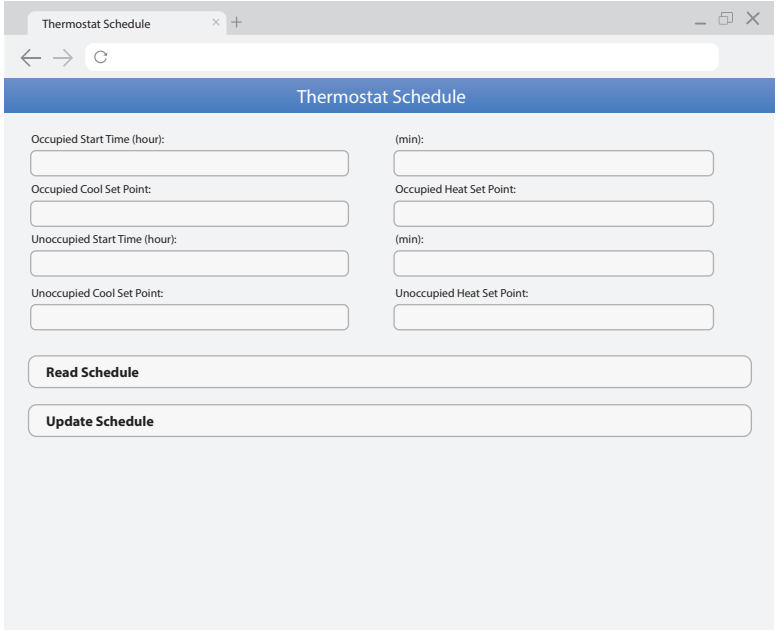



The thermostat schedule enables quick and easy scheduling. Schedules are based on 2 periods per day / 7 days per week.

**Setting a Schedule:** You can set up the heat and cool set points for one or more days at a single time.

**1.** Select the day(s) of the week the schedule will be applied to. You can select from 1 to all 7 days.

(continue to the next page)

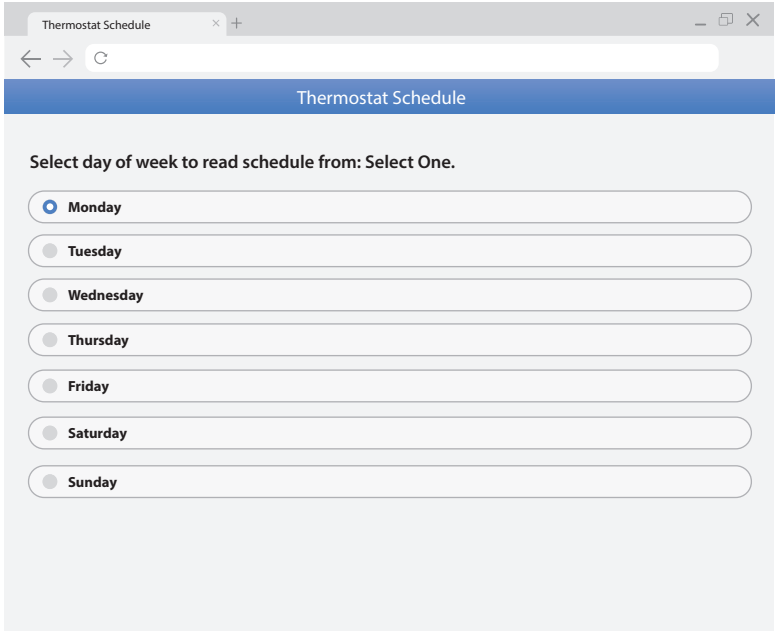







**2.** Enter occupied period start time in hours and minutes field in 15 minute increments.
**3.** Enter occupied period heat setpoint and cool setpoint in F.
**4.** Enter Unoccupied period start time in hours and minutes field.
**5.** Enter the heat and cool setpoints for the unoccupied periods.
**6.** Select **Update Schedule** to save changes. These parameters will be applied to all selected days.

**Note:** *The ventilation selection will also be applied to all selected days.*

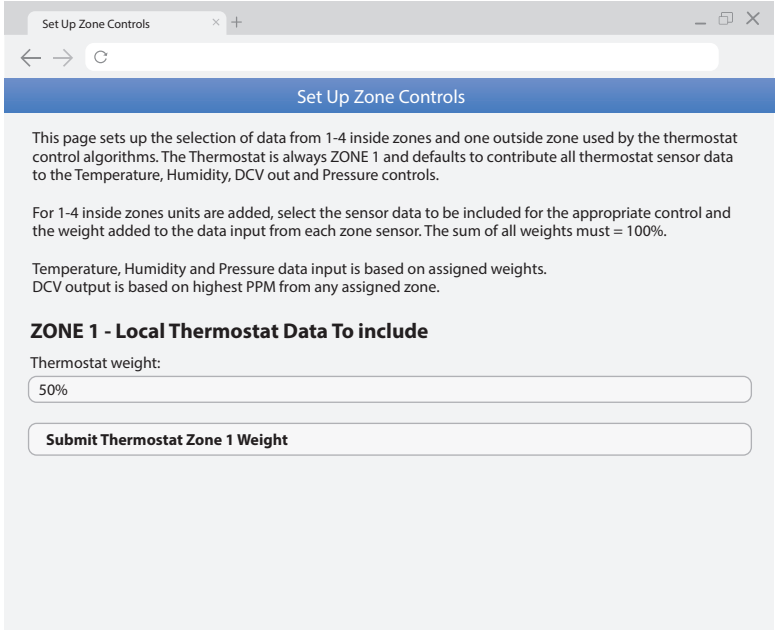







Reading a schedule: You can read the heat and cool setpoints for any specific day.

**1.** Select the day of the week you would like to read the schedule from.
**2.** Hit the "read schedule" button.
**3.** The occupied times and heat/cool set points will populate. The unoccupied time and heat/cool set points will populate. ***(not pictured)***








This page sets up the selection of data from 1-4 inside zones and one outside zone used by the thermostat control algorithms. The thermostat is always ZONE 1 and defaults to contribute all thermostat sensor data to the temperature, humidity, DCV out and pressure controls.

For 1-4 inside zones units are added, select the sensor data to be included for the appropriate control and the weight added to the data input from each zone sensor. The sum of all weights must = 100%.

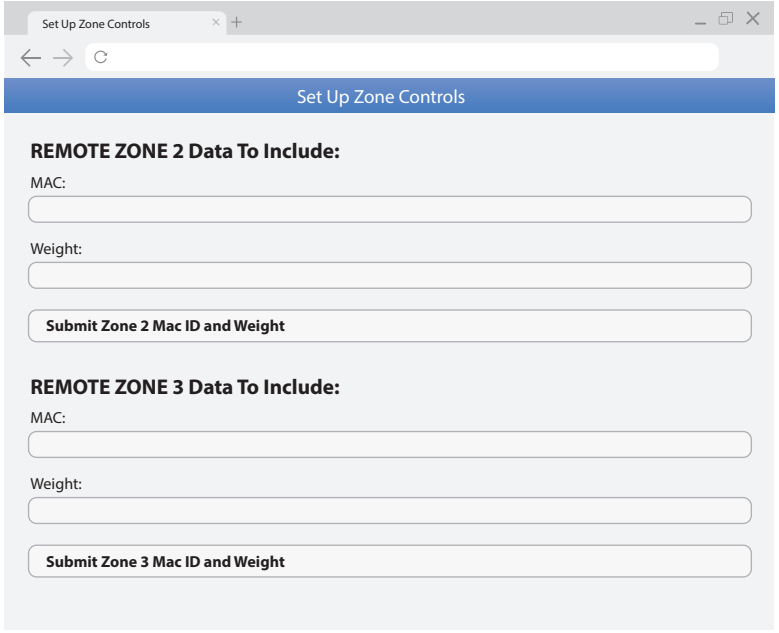
Temperature, humidity and pressure data input is based on assigned weights. DCV output is based on the highest $CO_2$ PPM among the assigned zones.

**ZONE 1 - Thermostat**

**1. Enter the Thermostat's Weight:** This is the weight value the thermostat contributes to the control output for temperature, $CO_2$ and Pressure.

**Note:** *The total weight contribution must be 100% - including the thermostat contribution.*

Use the **Submit Thermostat Zone 1 Weight** button to load this information into the thermostat any assigned zone.



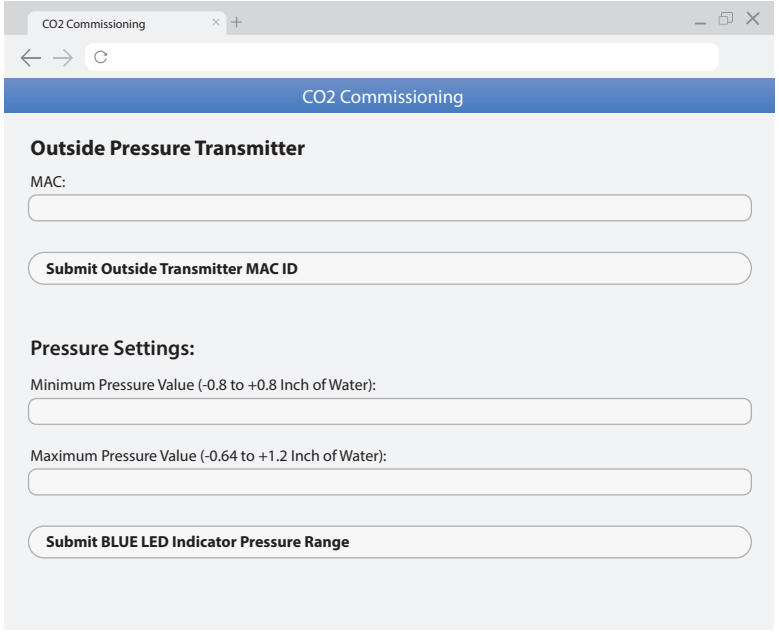





**Additional Devices (Zones 2-4).**

**1. MAC ID:** This field should be entered exactly as read from the label on the Zone device, including hyphens.
**2. Weight:** The weight value this zone should contribute to the control output and is applied evenly to $CO_2$/temperature/pressure.

Use the **Submit Zone Mac ID and Weight** button to load this information into the thermostat.







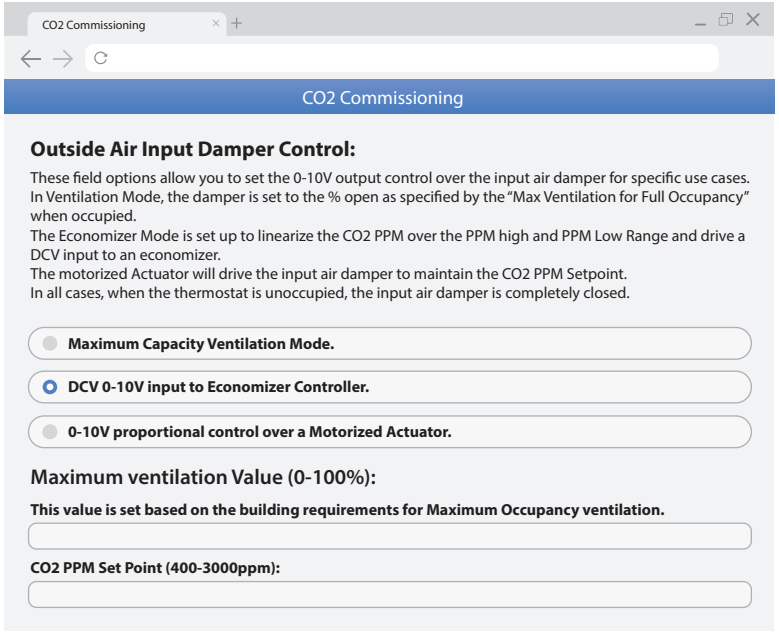

**Adding an Outside Air Transmitter to determine space pressure.**

**1. Outside Air Pressure Transmitter:** This unit provides the outside air pressure reference used by the thermostat to derive differential pressure. This derived pressure drives the blue LED on the AQ TstatPro+ indicator panel.

**2.** Enter the MAC ID and use the **Submit Outside Transmitter MAC ID** button to load this information into the thermostat.

**3. Pressure Range:** This range determines the blue LED status. If the pressure is within range defined here it is solid on. If it is outside this range, the blue LED will blink. The default is set to 0.01–0.05 in. w.c. (typical slight positive pressure).
When outside of this range, the blue LED will blink.

**4.** Use the **Submit Blue LED Indicator Pressure Range** button to load this information into the thermostat.







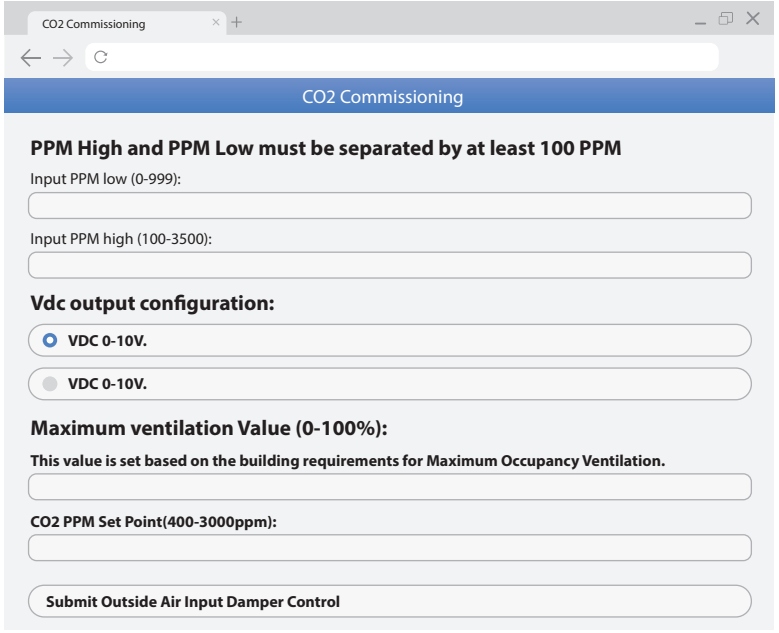

The AQ TstatPro+ supports three modes of operation over an input air damper. Depending on the mode selected – the required input parameters appear on the web page. In all modes, when the thermostat is unoccupied, it will go to the minimum ventilation position. If the $CO_2$ sensor fails, the thermostat will use the maximum ventilation setting during occupied times and the minimum ventilation setting during unoccupied times.

**OFF: This disables any voltage output on the S1 pin.**

**Ventilation mode:** In this mode the damper is set to the % open as specified by the maximum ventilation for full occupancy when occupied.

**Economizer Mode:** This mode is set up to linearize the $CO_2$ PPM over the PPM high and PPM low range and drive a DCV input to an economizer.

**Actuator Mode:** This mode drives a motorized actuator directly based on maintaining the $CO_2$ set point. This mode is used for ERV operation. If the unit $CO_2$ reporting fails, the thermostat sets the output to maximum ventilation – per Title 24 requirements.








**Input PPM Low:** The PPM low defines the range of the 0-10V signal output with PPM low being 0 volts output. This only appears if economizer mode is selected.

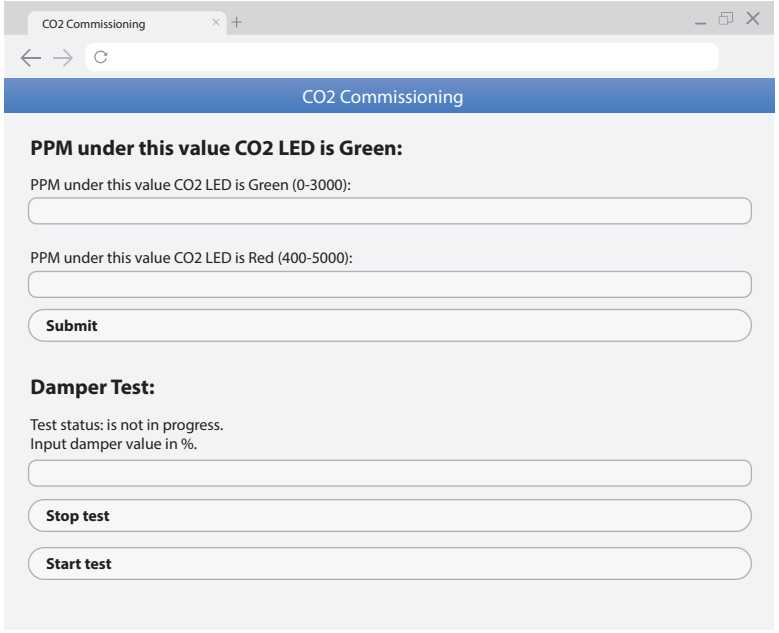
**Input PPM High:** The PPM high defines the range of the 0-10V signal output with PPM high value being 10 volts output. This only appears if economizer mode is selected.

**VDC Output Configuration:** Reference your economizer controller manual to select this option. This only appears if economizer mode is selected.

**Maximum Ventilation:** This defines the ventilation maximum output voltage the unit will drive in the event of a failure to read $CO_2$ PPM **OR** if the mode is set for ventilation. Set this according to building design requirements for maximum occupancy.

**Minimum Ventilation:** This defines the ventilation minimum output voltage the unit will drive during all unoccupied times.

**$CO_2$ Set Point:** This defines the $CO_2$ value the unit will drive the input air damper based on an internal PI algorithm. This value is also used if the ventilation mode is configured to turn the fan **ON** at or above this $CO_2$ value.







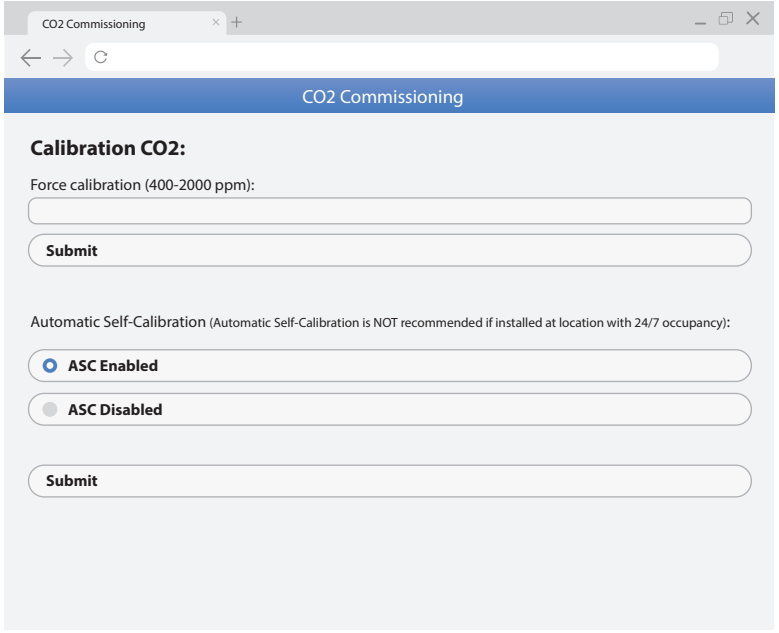

**1. PPM High/Low:** The PPM High value will drive the red LED on the indicator panel when the sensor PPM reading for $CO_2$ is at or above this value. The PPM low value drives both the green LED indicator and also turns on the ventilation fan, if this option was selected on the thermostat schedule set up page. The Indicator is green at or below this value. A PPM reading between these two values drives the amber LED.

**2. Damper Test:** The damper test allows manual confirmation that the unit is wired correctly and the DCV output is working. Setting to manual allows entry of a known value, i.e. 50%. This drives the damper to 50% open (5 volts). When satisfied, the manual test should be terminated. If not manually switched to auto, the unit switches back to auto mode after 10 minutes.

**To Run a Damper Test**

**1.** Enter in the damper % open. 50% = 5 volts.
**2.** Select **Start Test.**
**3.** Measure 0-10V output to confirm 5 volts or your setting.
**4.** Select **Stop Test.**

**Note:** *The test automatically stops after 10 minutes.*





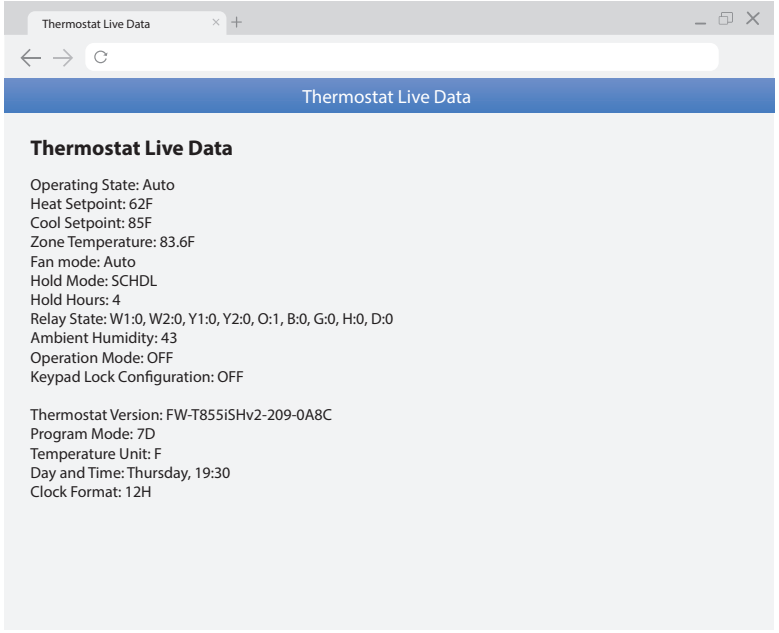



**1. Forced Calibration:** Units are shipped factory calibrated. If there is a need to recalibrate, this field allows forced calibration to a known $CO_2$ PPM value.

Use the **Submit** button to load this information into the thermostat.

**2. Automatic Self-Calibration (ASC) enable**: Enabling ASC allows the unit to self calibrate during unoccupied times. ASC is very effective to maintain calibration of the sensor. ASC is NOT recommended if the thermostat installation site operates 24/7.

Use the **Submit** button to load this information into the thermostat.



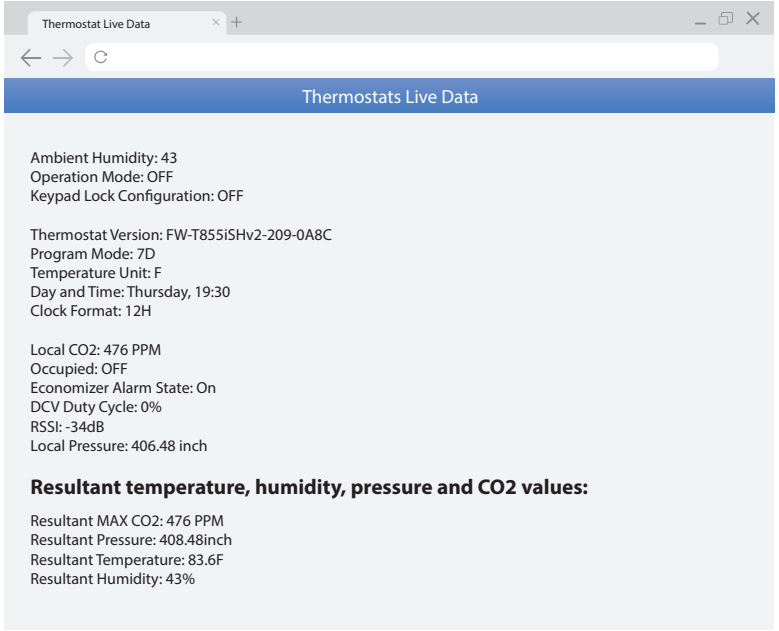





This page displays real time data from the thermostat.
Use this page to assure zone devices are attached and reporting.

**Operating State:** Indicates heating or cooling is active
**Heat/Cool Setpoints:** Active set points
**Zone Temperature:** Local temperature reading
**Fan Mode:** ON indicates G relay is energized
**Hold Mode:** Displays **SCHDL** if a schedule is running or TEMP or PERM if in a hold mode.
**Hold Hours:** displays the number of hours temporary hold is in place.
**Relay State:** State of all the relays with a 0 (not energized) or a 1 (energized) next to them.
**Ambient Humidity:** Local humidity reading
**Operation Mode:** Indicates the mode the thermostat is operating in - OFF, Cool, Heat
**Keypad Lock Configuration:** Indicates the **keypad** is locked out

**Thermostat Version:** This is the software version of the chassis code
**Program Mode:** displays the current schedule mode 5-1-1 programming or 7 day programming
**Temperature Unit:** Displays In F-Fahrenheit or C-Celsius
**Day and Time:** Day and Time set up and displayed on panel
**Clock Format:** Whether set up for a 12 or 24 hour clock format

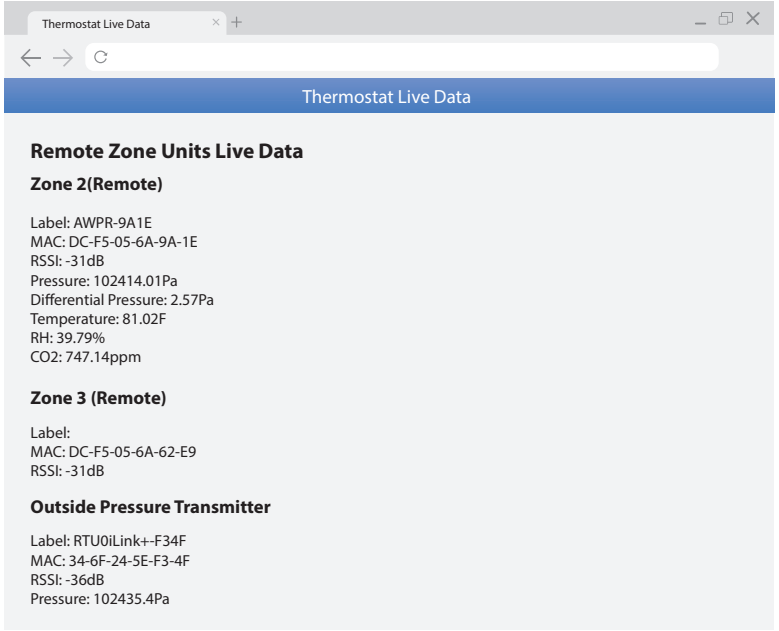







**Local CO2:** $CO_2$ ppm
**Economizer Alarm:** ON if Active
**DCV Duty Cycle:** is the % open of the S1 output.
**RSSI:** Signal strength to access point
**Local Pressure:** Local pressure reading
**Occupied:** This is the state of the thermostat based on the schedule
**Economizer Alarm:** This is the state of the alarm from the economizer received over the S2 input.

The resultant values indicate the final temperature, humidity, pressure and $CO_2$ when additional zones are included in the calculations.

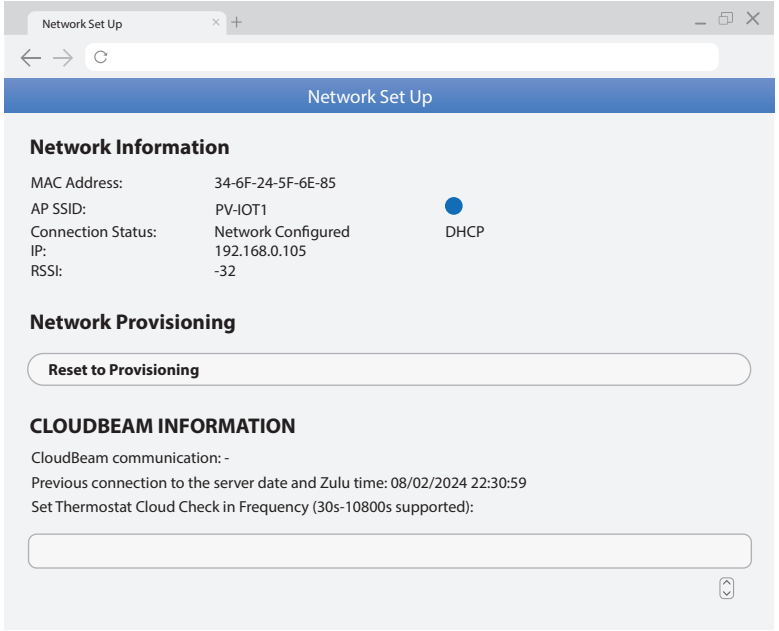







**Remote Zone Units Live Data**

**Label field:** Is a human-readable label being received from the remote devices assigned at installation time.
**MAC:** Is MAC Identifier of that zone unit.
**RSSI:** Is the relative Wi-Fi signal strength between the Thermostat and that zone device.
**Pressure:** Is the pressure reading from the zone devices, this will only display if pressure is being sent by the zone device.
**Differential Pressure:** Is the space pressure being measured by the zone device relative to outside air. This will only display if the zone device is set up to calculate local Pressure.
**Temperature:** Is the temperature in F, at the zone device being sent to the thermostat.
**RH:** Is the relative humidity, from 0-100%, at the zone device being sent to the thermostat.
**$CO_2$:** Is the in ppm measured at the zone device being sent to the thermostat.







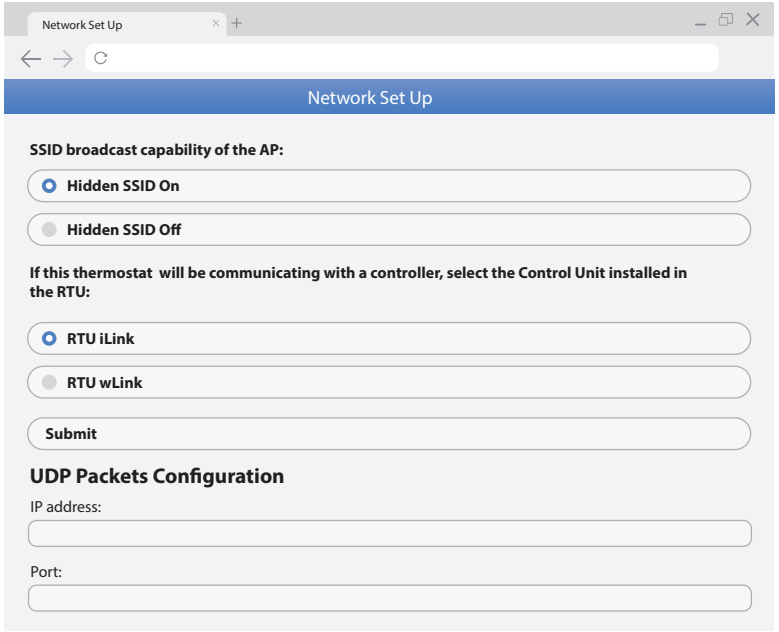

The AQ TstatPro+ is compatible with IEEE 802.11 b/g/n Wi-Fi access points (AP). To connect the thermostat to the Internet for **CloudBEAM** services or email alerts, the Wi-Fi AP must provide internet access.

The Network Set Up page connects or "provisions" the device onto Wi-Fi. When not provisioned a red dot and connection status of "unconfigured" is shown. Use the "SCAN" button to get a list of available Wi-Fi networks. Select the desired network. Enter the network password and **Submit**. The dot turns green when you have successfully connected. The network information available is shown above.

**Note:** *RSSI (Wi-Fi signal strength) should not be less than -80 dBm for a reliable connection. If the desired network is not displayed, scan again until it appears.*

If it does NOT appear after several scans, you may not be in Wi-Fi radio range of the desired network. Use "**Reset To Provisioning**" to reset and try again if the provisioning process does not go as expected.

The **CloudBEAM Engagement Transmission** (ET) period defines how often the device will check into **CloudBEAM** to send and receive information. This is defined in seconds.








**Note:** *To receive FREE email alerts or use the* **CloudBEAM** *portal for thermostat site management, the device must be connected to an internet enabled Wi-Fi network.*

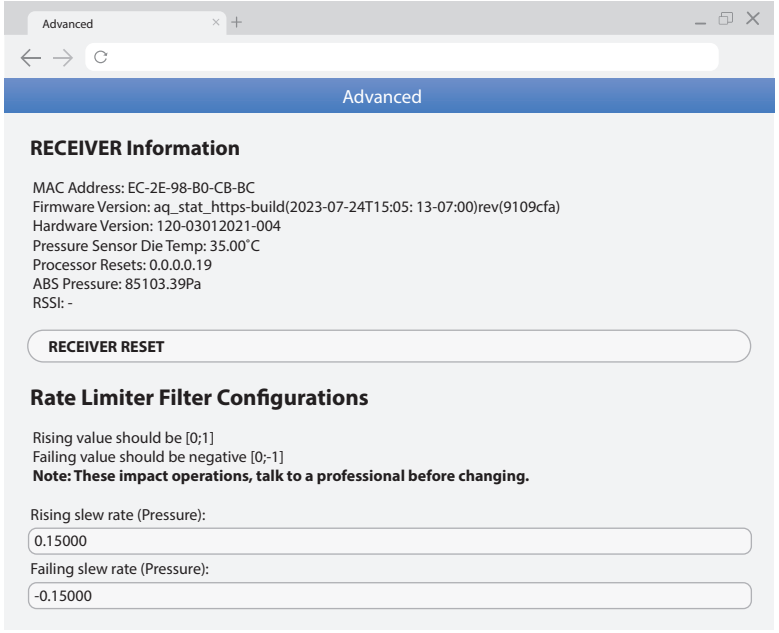
**Hidden SSID.** For security concerns, this can be used to turn off the Wi-Fi beacon of the thermostat.

If your thermostat will be communicating with an XCSpec **RTU iLink or RTU wLink** in the RTU, select the device installed in the RTU and the thermostat will use appropriate communications. The **RTU wLink** communicates over the thermostat power lines. The **RTU iLink** communicates over Wi-Fi with the thermostat - assure that signal is available from the thermostat to the RTU.

UDP packet configuration.
For more advanced users, the UDP broadcast can be sent to a particular IP and port address.

Contact ***support@xcspec.com*** for further guidance on setting this network configuration.

Use the **Submit** button to load this information into the thermostat. ***(not pictured)***





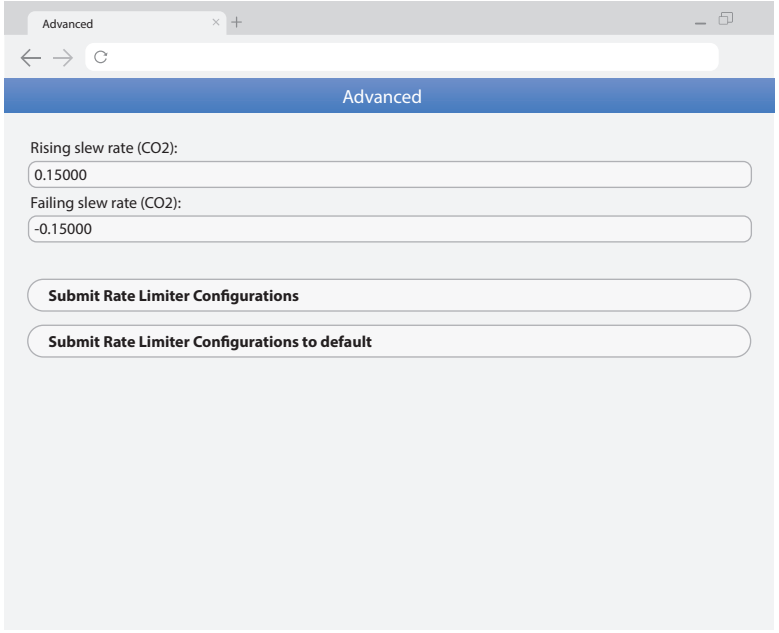



**The Advanced page is intended for use by XCSpec support and users familiar with the system.**

**Receiver Information:** Information on this page, i.e. the device firmware and other displayed information, may be requested by XCSpec support.

**Receiver Reset:** The receiver reset can be used to generate a reset to the unit. User settings will be preserved.

**Rate of Change (ROC) Limit Filters:** The rate limiter controls how quickly the 0–10 V $CO_2$ output can change to prevent hunting. The default parameters have been selected to assure that "hunting" does not occur so we control the amount of change in the 0–10V for any one cycle. Setting the limit filter to "1" will cause the 0–10V output to following the PPM range–without adding steps between each adjustment. Users familiar with ROC controls can use the slew rising and falling rates to change the control parameters. Before changing the default parameters, please reach out to support@xcspec.com. We can send information about the impact changes will have on the control output. The reset to default sets these values back to the factory condition.


Advanced
Advanced
Rising slew rate (CO2):
0.15000
Failing slew rate (CO2):
-0.15000
Submit Rate Limiter Configurations
Submit Rate Limiter Configurations to default

### Notes On Economizer Set Up

The AQ TstatPro+ is specifically designed to operate directly with economizers.

**Occupancy Out Relay:** The O/B relay can be repurposed to drive a true occupancy out based on the thermostat schedule. To configure, use the thermostat set up page to select the **Occupancy Use Algorithm**. Select the **relay O/B**. The economizer **Occupancy** input should then be wired to the selected relay.

**Input Air Damper Controller (S1):** Depending on the mode selected, the S1 output will drive the $CO_2$ input to an economizer, the $CO_2$ input to an ERV or a zone control two stage motorized damper.

**Alarm In (S2):** The alarm output from an economizer can be configured onto the S2 pin of the thermostat. When energized, an **Economizer Alarm** state will be displayed on panel.

### Notes on RTU wLink+ or RTU iLink Set Up

The AQ TstatPro+ is part of the AQ Family of products specifically designed to provide easy to install solutions for advanced ventilation and air quality solutions.

To communicate to the **RTU wLink+** or **RTU iLink+** installed in a RTU, there are two different options they can be used.





The **RTU wLink+** communicates with the thermostat directly over the existing thermostat power wires, R and C.

All Zone, DCV and powered exhaust information is communicated directly to the **RTU wLink+**.

The **RTU wLink+** will also communicate outside air conditions - pressure, PM2.5, PPM - back down to the thermostat.

Since this is a wired communications, there is no requirement for a radio link between inside the building and the roof top.

The RTU iLink+ communicates with the thermostat over a Wi-Fi link. The installer must assure that there is signal from the thermostat to the RTU iLink+ directly OR that they are both on the same WiFi network. All zone, DCV and powered exhaust information is communicated directly to the **RTU iLink+**.

The **RTU iLink+** will also communicate outside air conditions - pressure, PM2.5, PPM - back down to the thermostat.

**The AQ TstatPro+ is shipped with the following configuration:**

Schedule: 2 Periods Per Day. 7 days per week
Mon-Fri Occupied Time 8:00 - 5:00 pm
Mon-Fri Occupied Set Points: Heat: 68 Cool 72
Mon-Fri Unoccupied Set Points: Heat: 55 Cool 79
Sat & Sun Occupied Times: None
Sat & Sun Set Points: Heat: 55 Cool 79
Temperature display units - Fahrenheit
Pressure Units - Inches of Water
Pressure Range for Blue LED: 0.01- 0.05 inches of water
Network: Unprovisioned
Cloud Engagement Transmission period: 60 seconds
No Labels are Assigned
No Zone Devices are Whitelisted
DCV PPM Range 0-2000 PPM
CO2 LED: Red when > 2000 ppm; Green when < 600 ppm
DCV: Not enabled
DCV Rate Limited: Enabled
$CO_2$ Averaging Filter: Not Enabled
Front Panel to Display: Occupancy and CO2
Rate-of-Change Slew for $CO_2$ 0-10V Output: 0.15





**Caution: Electrical Hazard**

Failure to disconnect the power before beginning to install this product can cause electrical shock or equipment damage.

**Warning:**

All components of the control system and the thermostat installation must conform to Class II circuits per the NEC Code.

**Wiring**

1. If you are replacing a thermostat, make note of the terminal connections on the thermostat that is being replaced. In some cases the wiring connections will not be color coded. For example, the green wire may not be connected to the G terminal.
2. Loosen the terminal block screws. Insert wires then retighten the terminal block screws.
3. Place nonflammable insulation into the wall opening to prevent drafts.

**Installation Tip**

Do not overtighten terminal block screws, as this can damage the terminal block. A damaged terminal block can keep the thermostat from fitting on the subbase correctly or cause system operation issues.

**Max Torque = 6in-lbs.**

## Wiring Tips

**C Terminal**

This thermostat requires a 24V common wire to the C terminal.

**Wire Specifications**

Use shielded or non-shielded 18-22 gauge thermostat wire.

**Note:**

In many heat pump systems with no emergency heat relay, a jumper can be installed between E and W2 to turn thermostat into a single stage control for emergency heat operation.

**Note:**

Outdoor temperature sensor, Indoor temperature sensors, and slab sensor wiring diagrams are located in R251S manuals.





## Terminal Designations

This thermostat shipped from the factory to operate a conventional heating and cooling system. This thermostat may also be configured for a heat pump system.

| Terminal | 2 Heat 2 Cool Conventional System | 2 Heat 1 Cool Heat Pump System | 4 Heat 2 Cool Heat Pump System | 5 Heat 3 Cool Heat Pump System |
|---|---|---|---|---|
| RC | Transformer power (cooling) | Transformer power (cooling) | Transformer power (cooling) | Transformer power (cooling) |
| RH | Transformer power (heating) | Transformer power (heating) | Transformer power (heating) | Transformer power (heating) |
| C | Transformer common | Transformer common | Transformer common | Transformer common |
| B | Reversing valve /configurable terminal | Reversing valve /configurable terminal | Reversing valve /configurable terminal | Reversing valve /configurable terminal |
| O | Reversing valve /configurable terminal | Reversing valve /configurable terminal | Reversing valve /configurable terminal | Reversing valve /configurable terminal |

## Terminal Designations

This thermostat shipped from the factory to operate a conventional heating and cooling system. This thermostat may also be configured for a heat pump system.

| Terminal | 2 Heat 2 Cool Conventional System | 2 Heat 1 Cool Heat Pump System | 4 Heat 2 Cool Heat Pump System | 5 Heat 3 Cool Heat Pump System |
|---|---|---|---|---|
| G | Fan relay | Fan relay | Fan relay | Fan relay |
| W/E | First stage of heat | Emergency Heat | First stage of auxiliary heat | First stage of auxiliary heat (4th stage of heat) |
| Y | First stage of cool | First stage of heat & cool | First stage of heat & cool | First stage of heat & cool |
| Y2 | Second stage of cool | N/A | Second stage of heat & cool | Second stage of heat & cool |
| W2 | Second stage of heat | Auxiliary heat | Second stage of auxiliary heat | Second stage of auxiliary heat (5th stage of heat) |
| S1/S2 | Remote Sensor | Remote Sensor | Remote Sensor | Remote Sensor |
| H | Humidify | Humidify | Humidify | Humidify |
| D | Dehumidify | Dehumidify | Dehumidify | Dehumidify |

| | TstatPro | TstatPro+ | AQTstatPro+ |
|---|---|---|---|
| S1 | Unused | 0-10V Output Duct Actuators | 0-10V Output for DCV |
| S2 | FDD Alarm In | FDD Alarm In | FDD Alarm In |

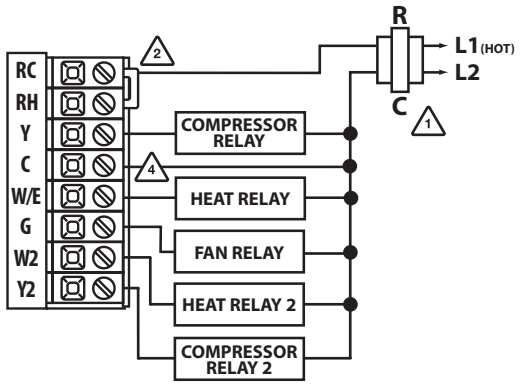




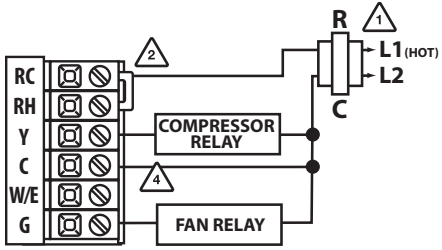
⚠1 Power supply

⚠2 Factory-installed jumper.
Remove only when installing on 2-transformer systems

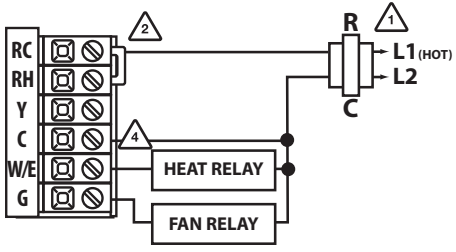
### Typical 2H/2C System: 1 Transformer



### Typical Cool-Only System With Fan




### Typical Heat Only System With Fan





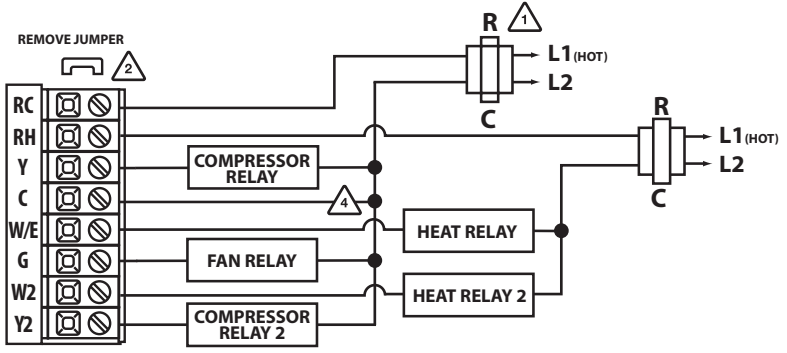



3 Use either O or B terminals for changeover valve

4 A 24 VAC common connection is required with this thermostat.

5 If DEHUM relay requires a normally energized input, set **Dehumidify** relay to NC in **Technician Setup.**

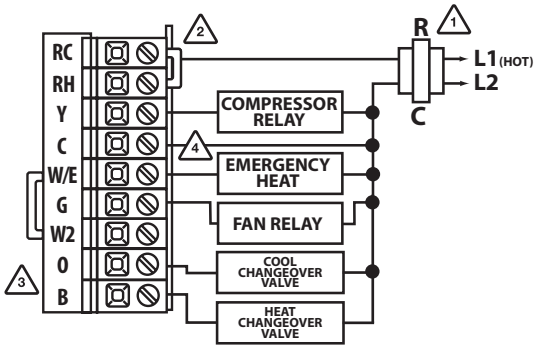
### Typical 2H/2C System: 2 Transformer




### Note:

In many systems with no emergency heat relay a jumper can be installed between **E** and **W2**.

### Typical 2H/1C Heat Pump System





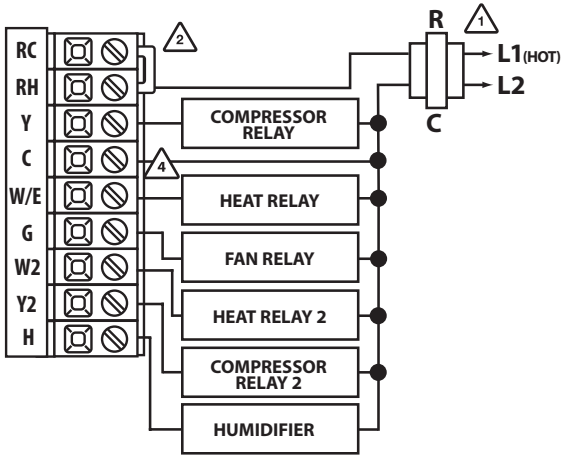



1 Power supply

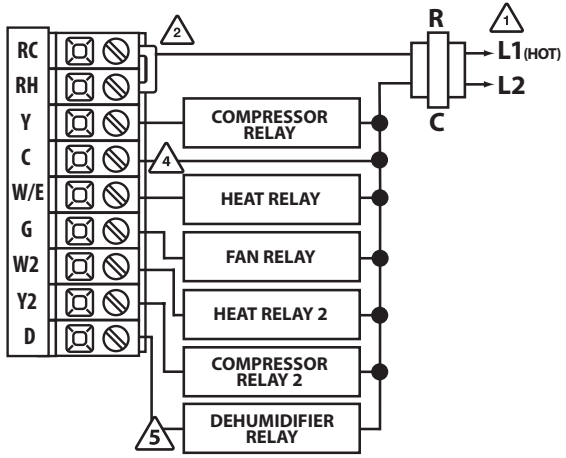
2 Factory - installed jumper. Remove only when installing on 2 transformer systems.

3 Use either O or B terminals for changeover valve.

### Typical 2H/2C System With 24 VAC Humidifier



### Typical 2H/2C System with Dehumidify Terminal



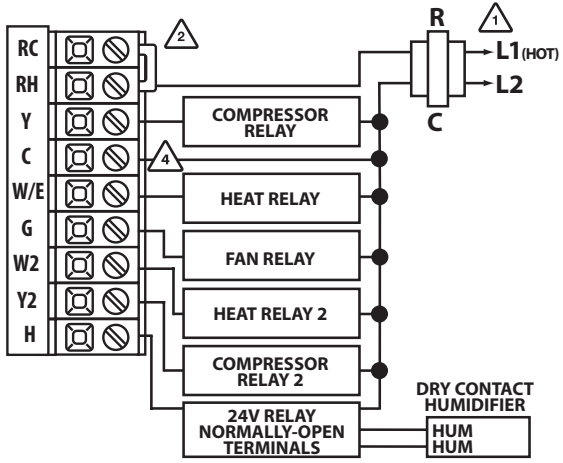




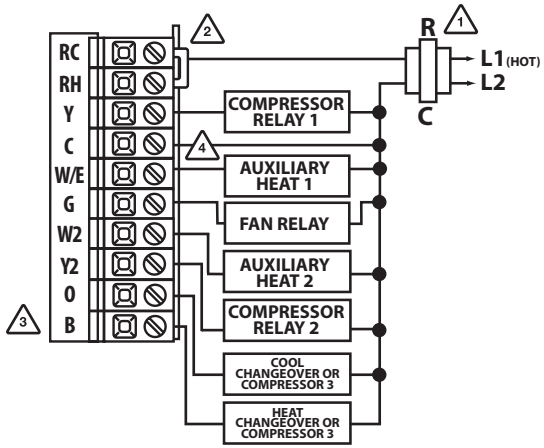

4 A 24 VAC common connection is required with this thermostat.

5 If DEHUM relay requires a normally-energized input, set **Dehumidify** relay to NC in **Technician Setup.**

### Typical 2H/2C System with Dry Contact Humidifier



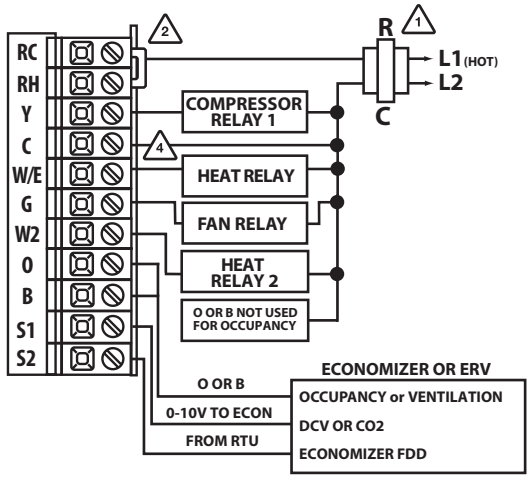
## Typical 5H/3C Heat Pump System



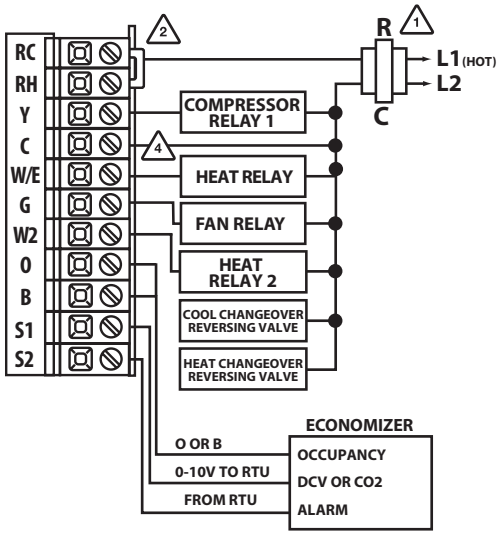





## Wiring To Economizer For Occupancy



## Wiring To Economizer For Occupancy or ERV



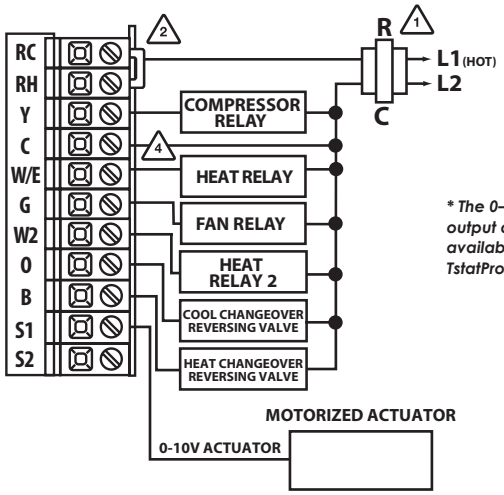

**Note:**

When wiring to an economizer—whether repurposing the O or B relays for occupancy or wiring directly to an actuator—ensure all connected devices share the same 24 V common/ground.





## Wiring To Motorized Fresh Air Actuator




** The 0–10 V output on S1 is not available on the TstatPro model.*

**Note:**

On the TstatPro model, S1 and S2 can be used for an external 100K wired temperature sensor. If a 100K sensor is used, S2 cannot also serve as the economizer alarm input.