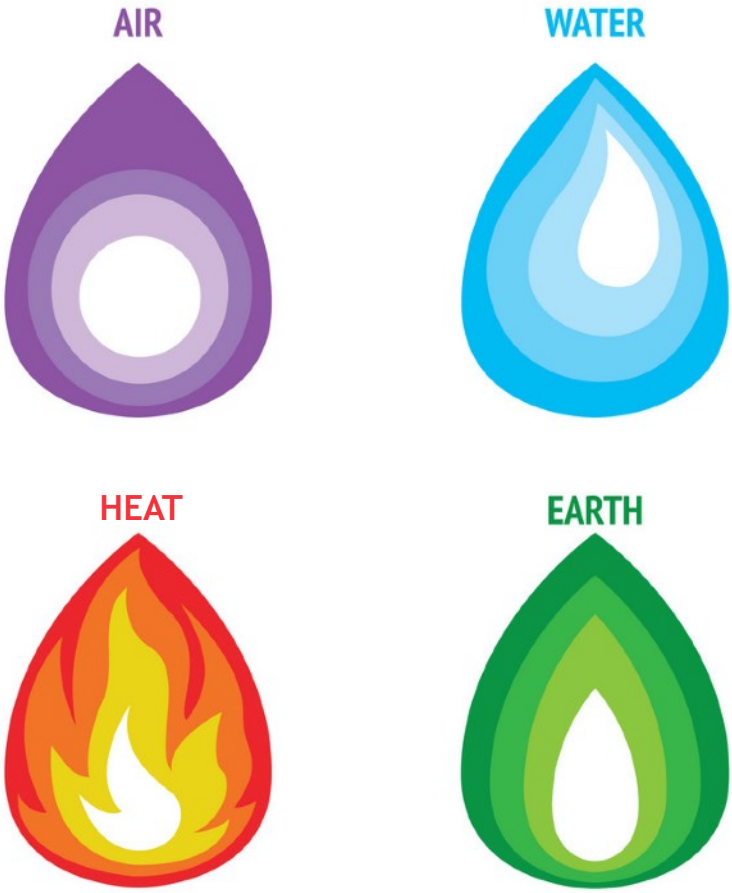
AmbientHub

The Four Elements of Comfort



Contents

1. Introduction

The AmbientHub series by HUB Manufacturing is an electronic comfort control system that modulates the flow of conditioned water to heat exchangers and the flow of conditioned air to diffusers. AmbientHub supports up to twelve thermal zones, includes a range of field level user interface options, supports connectivity for phones, tablets and personal computers and is connected to the cloud for remote diagnostics and control. The system combines the energy efficiencies of Hydronic and VAV technology to deliver the most advanced climate control package available in today's market. The AmbientHub series has been specifically designed for the large number of Australians living close to the ocean. Full stainless steel body and tough corrosion resistant heat exchangers ensure that the AmbientHub will last in the harshest environment.

- All AmbientHub systems offer the following standout features:
- Hydronic and VAV capacity demand calculation and output modulation
- Control up to twelve VAV, FCU, panel or underfloor zones
- Discreet sensors, backlit capacitive touch control panels or networked sensing in each zone
- Local Area Network connectivity for connection of all smart devices
- Voice activation for Siri, Google and Alexa
- Multiple site management through Cloud Cover for Comfort Contractors
- Home automation interface (Optional)

1.1 System Overview

The AmbientHub series is ideally suited for any structure with dynamic heat loads, particularly those where a constant temperature is required across different areas.

The conditioned space is divided into individual load segments (zones). Temperature sensors located in each area send data to the AmbientHub control system which monitors the status of each load segment and modulates the capacity of the VAV dampers, Water valves or fan speeds to match the total load (heating or cooling requirement).

2. How It Works

The operation can best be explained by separating it into the following areas:

1. Energy source capacity modulation

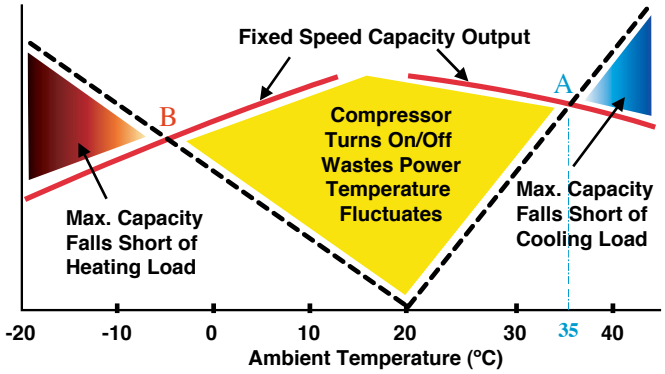
2. Hydronic modulation

3. Airflow modulation

Capacity modulation in a heating and cooling system refers to varying capacity output deliberately to better match the cooling/heating load on the system. AmbientHub is designed for use with AusGeothermal Ambient series variable speed ground or air sourced heat pumps.

To truly understand the benefits of capacity modulation, first consider the behaviour of non-modulated systems. Such systems do have a degree of capacity variance as load varies, but in an undesirable manner.

Consider the cooling case in Figure 3. A traditional AC system has a capacity output equivalent to the cooling load at point A. This is the optimum capacity for these load conditions.

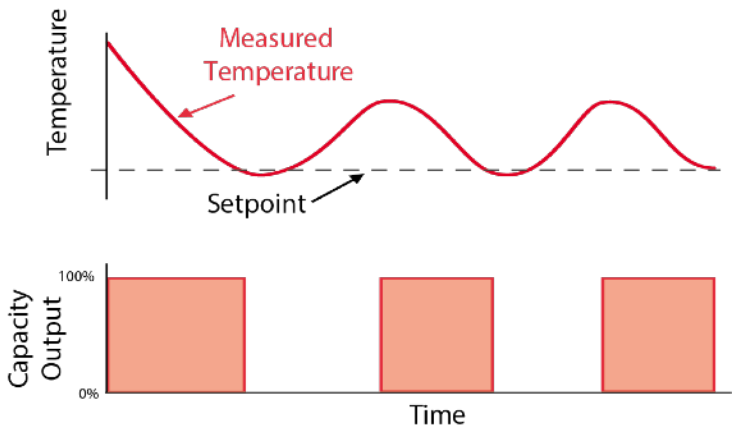


If the ambient (outdoor) temperature rises above 35 ˚C (move right from point A), the cooling load increases (indicated by the black dotted line), but the AC's capacity actually decreases (indicated by the red line). The result is a shortfall in capacity.

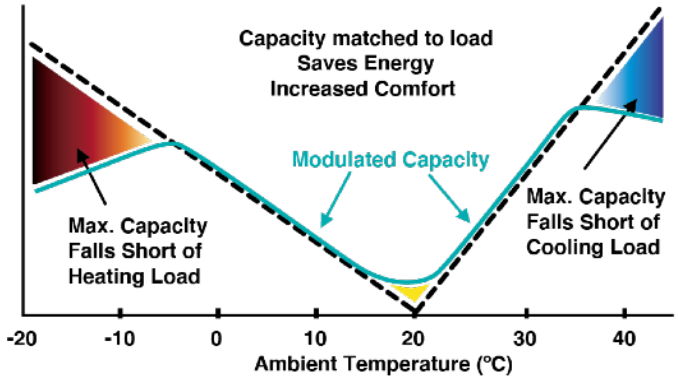
If the ambient temperature falls below 35 ˚C, the cooling load falls as well but the AC's capacity actually increases, as shown in Figure 1 moving left from point A. The resulting surplus capacity is wasted in this instance.

The same undesirable capacity changes are in effect when considering the heating case.

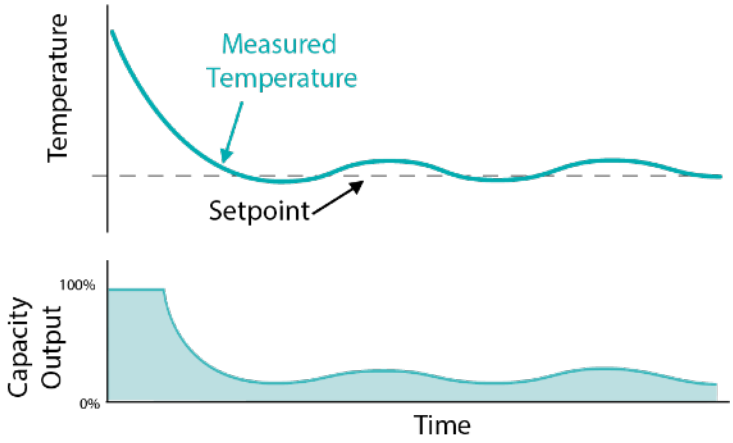
Figure 4 clearly shows the effect of excess capacity on comfort levels. As the compressor cycles inefficiently in an attempt at modulation, the temperature fluctuates.



By modulating the capacity equal to the load variation, within the design parameters, the AC capacity is always optimised. See Figure 5.



As is evident in Figure 6, optimising capacity results in more consistent temperature outcomes and greater efficiency.



In reality, it is not possible to modulate the capacity to equal the load in all conditions, nor in infinitesimal amounts of time. By incorporating capacity modulation at both individual load segment level (VAV) and system level (VRAF), the capacity output can be highly optimised, and the system can respond quickly to load variations, limiting temperature fluctuations to approximately ±0.5 oC.

2.1 VAV Capacity Modulation

VAV capacity modulation applies a layer of control at the level of individual load segments by changing the position of the damper to control the volume of conditioned air being delivered to each area.

Three variables influence the damper position for each load segment. Two of these are measured (room temperature and supply air temperature) and the third is set (target temperature or set-point). The damper to each load segment will remain in the closed position (or minimum ventilation position - if set) unless the supply air temperature is such that it will cause the room temperature to move towards the set-point. When this condition is satisfied the controller incrementally opens the damper over a 2 ˚C proportional band.

The control system also includes a minimum ventilation function. This may be set from 0% to 30% and when activated the dampers to all active load segments are modulated between the minimum ventilation setting and fully open. The dampers to any load segment that is not active will remain fully closed.

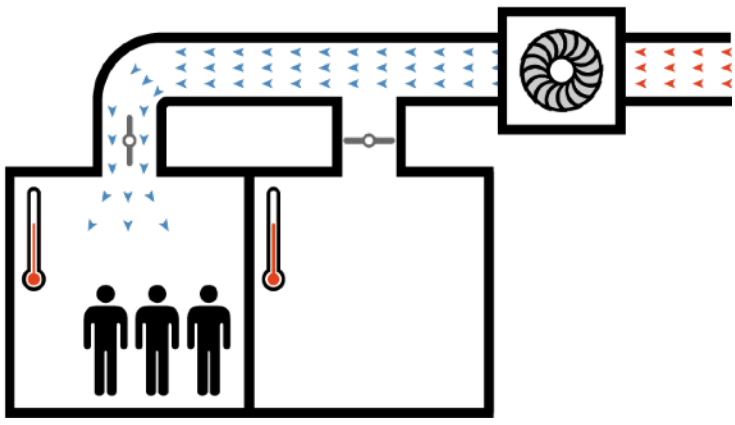
The influence of the VAV capacity modulation function on system pressure results in the requirement for a control strategy to maintain acceptable duct pressure and noise levels. This is accomplished by controlling the speed of the indoor fan to match the requirements of the conditioned space via the VAF management algorithm.

The VAF management system modulates the speed of the indoor fan based on the condition of the VAV system as a whole. The position of the VAV damper to each load segment is monitored and at any given time the status of the VAV system can be expressed as a percentage open.

Consider the following simple examples:

Example 1

A system is made up of two load segments of equal size. The VAV damper to one segment is fully closed and the damper to the other is fully open. In this instance the VAV system status is the same regardless of which VAV damper is open.

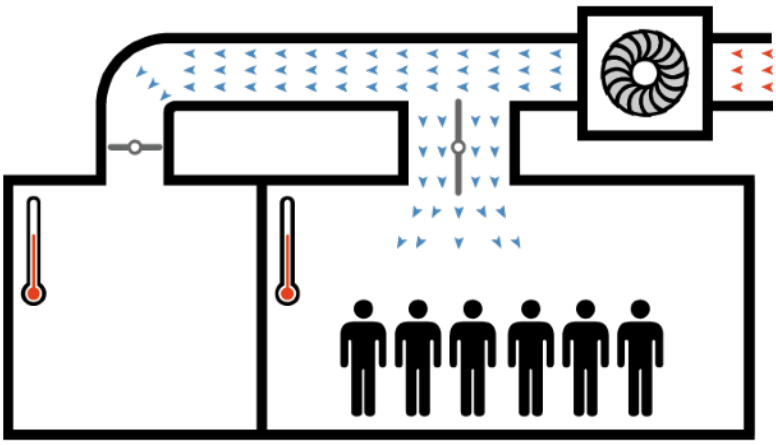


(Actual system open ≈ 50%)

Example 2

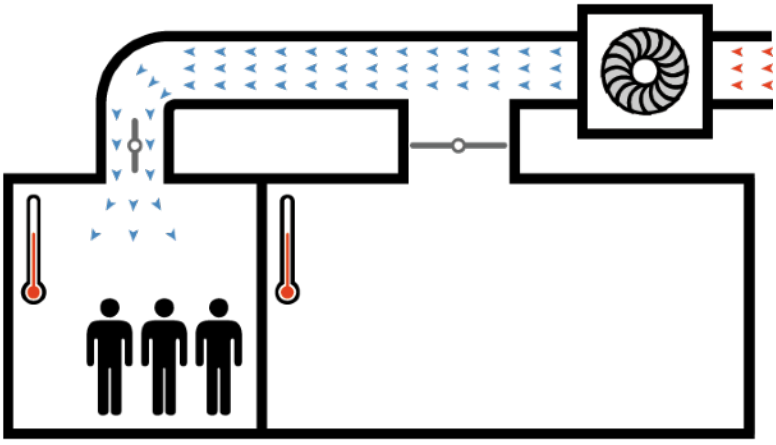
Now consider the case where one of the load segments is larger (one is twice the size of the other).

The status of the VAV system when the large load segment is fully open and the smaller one fully closed,



(Actual system open ≈ 67%)

is obviously different from when the small load segment is fully open and the large one fully closed.



(Actual system open ≈ 33%)

To ensure optimum operation of the airflow management algorithm for the case in example 2, each load segment is assigned a virtual setting called the airflow profile.

2.2 Airflow Profiles

The airflow profile represents the nominal maximum airflow for each individual load segment when the VAV damper is fully open. By adjusting the airflow profile setting for each segment, the system's airflow management algorithm may be fine tuned to compensate for variations in room and duct size when optimising the airflow.

The default value for each segment is 200 L/s. This is the minimum value and can be adjusted in increments of 10 up to the 660 L/s maximum value.

The airflow management algorithm uses the airflow profile values to determine the status of the VAV system as a whole. The VAV damper position (percentage open) for each load segment is multiplied by the airflow profile. The sum of these values is then expressed as a percentage of the sum of the airflow profiles for each segment.

In the examples on the previous page the following settings will have the desired effect.

Example 1:

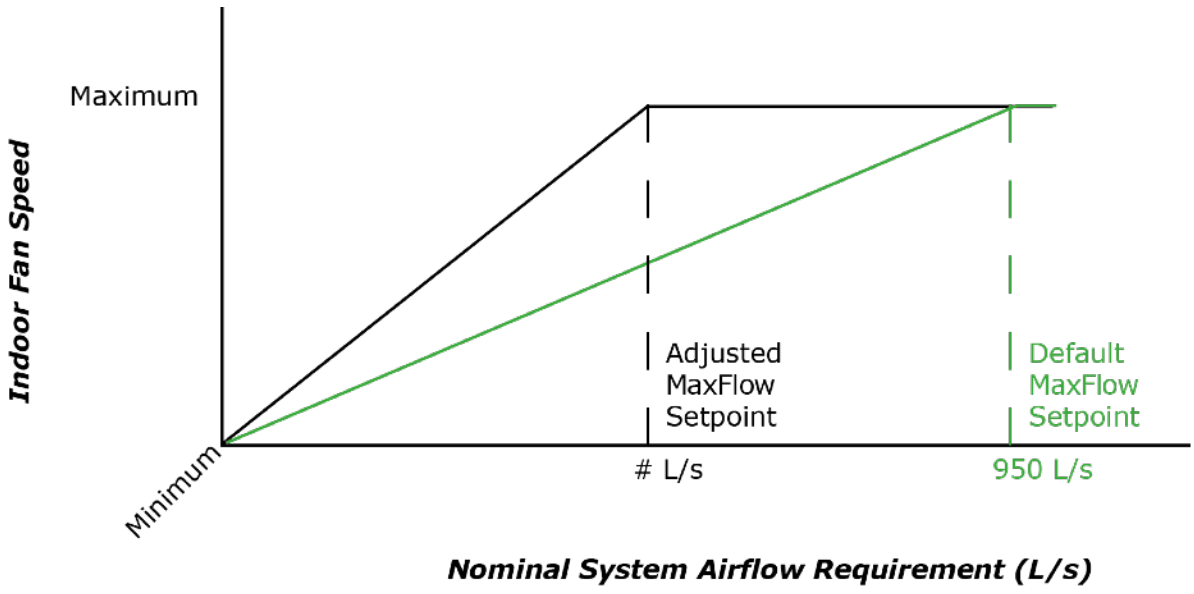
Both zones - Airflow profile = 200

Example 2:

Large zone - Airflow profile = 400 Small zone - Airflow profile = 200

2.3 Peakload Airflow

The PeakLoad Airflow determines at what point the airflow management algorithm engages maximum airflow, in relation to the total VAV system open percentage. The PeakLoad Airflow value is expressed as a percentage of the total VAV system open. The default is 95%.



The speed of the indoor fan is ramped up and down as the actual VAV system open percentage fluctuates between the minimum and PeakLoad value.

The maximum and minimum fan speeds can be adjusted via DIP switches 1 to 8 on the Indoor Unit Controller.

The following example is one way to calculate the PeakLoad setpoint:

A 12 kW system is installed with eight zones.

The total capacity required to condition all eight zones (at design conditions) is 16 kW.

Simply divide the system capacity by the total capacity required and multiply by 100 to determine the PeakLoad setpoint expressed as a percentage of the total VAV dampers open.

In this example the PeakLoad setpoint is: 12 ÷ 16 x 100 = 75%.

2.4 Underfloor and Radiator Valve Control

Water control valves operate on a 0.5℃ hysteresis. When there is a heating demand in a thermal zone and the zone temperature is lower than the target temperature (setpoint) - 0.5℃ the valve turns on. When the zone temperature is at the target temperature the valve switches off.

2.5 Pump Call

When ever a water valve or an FCU valve is open the pump call is activated. Pump calls can be system wide or attached to a group of four thermal zones.

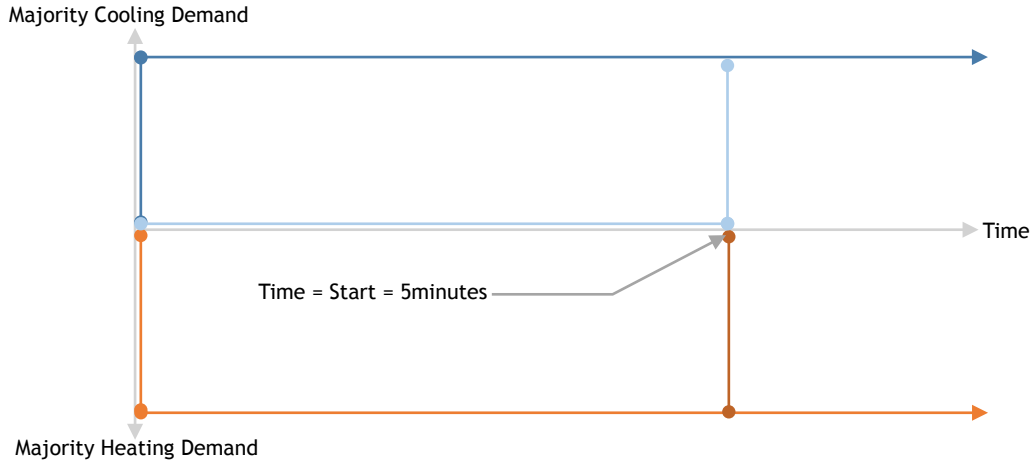
2.6 Energy Source Modulation

The total capacity requirement of the conditioned space is constantly re-evaluated by the control system. As the temperature of each load segment approaches set-point and the dampers begin to close the control system instructs the indoor fan to reduce the airflow. The reduced airflow across the indoor heat exchanger (coil) results in a temperature difference indicating excess capacity.

Energy Source management system controls the output capacity of the outdoor unit by monitoring the buffer tank and return water temperature and comparing this to the target temperature range. As the indoor heat eachanger temperature moves beyond the limits of the target temperature range the conditioning capacity of the compressor is modulated to bring the indoor heat exchanger and/or buffer tank temperature back within the optimum range.

2.7 Single Buffer Tank Control

The total capacity requirement of the conditioned space is constantly re-evaluated by the control system. Each AmbientHub has separate outputs for use with dual and single buffer tank system designs. The graphic below details the single buffer tank mode change strategy. The single buffer tank will not change mode until an alternate mode demand is continuously present for five minutes.



2.8 Dual Buffer Tank Control

When dual buffer tanks are used the system has the ability to heat and cool zones simultaneously. The control system activates a cooling or heating pump when required and the modulates individual thermal zones valves to achieve and maintain target comfort conditions. The energy source modulates its capacity to maintain the resource temperature of the cooling and heating buffer tanks.

3. Control System Components

The AmbientHub control system can be configured to suit each project using the following components:

1. AmbientHub Main Processing Module (MPM)
2. VAV Zone Expansion Module (VAV-EXP)
3. Hydronic Valve Expansion Module (H2O-EXP)
4. Fan Coil Unit Expansion Module (FCU-EXP)
5. Combination VAV/H2O Expansion Modules (VAV/H2O-EXP)

3.1 Main Processing Module

The MPM includes the following expansion ports:

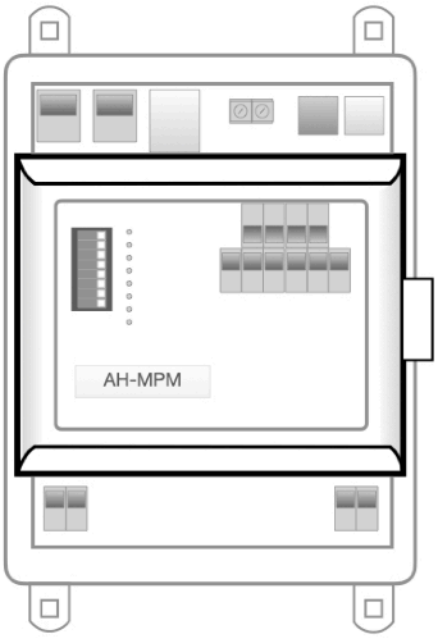
A. Expansion bus DB9 port for connecting to all AmbientHub expansion modules.

B. One wired ethernet port for connection to local TCP networks

C. One wireless ethernet port for connection to local TCP networks when a wired connection is not possible wireless connections are restricted by the structure type, a distance check is required before relying on this connection.

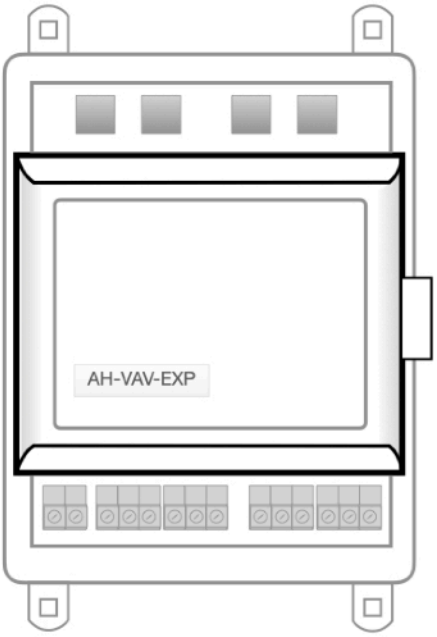
D. One WiFi connection for setup and service use

E. Two USB connections for connecting to external devices



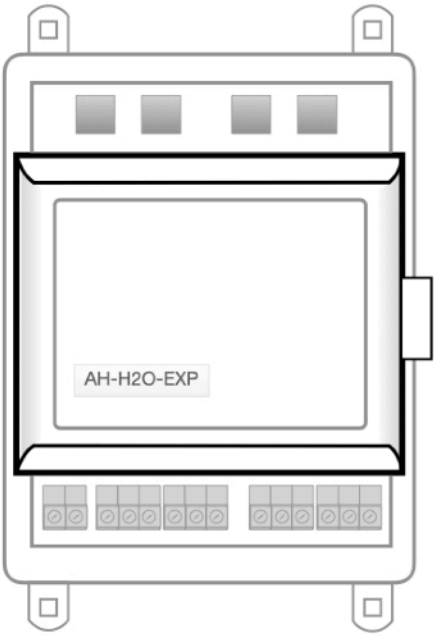
3.2 VAV Zone Module

Each VAV zone expansion module includes four auto addressing type touchpad ports (Grey RJ12, 6p6c configured for data), four motorised damper outputs and a data chain DB9 AmbientHub communication port. VAV expansion modules are available in 1~4, 5~8 and 9~12 types.



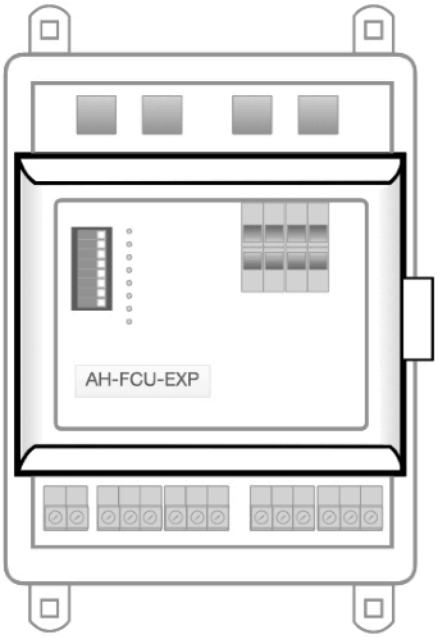
3.3 Hydronic Valve Module

Each Hydronic Valve expansion module includes four auto addressing type touchpad ports (Grey RJ12, 6p6c configured for data), four motorised damper outputs and a data chain DB9 AmbientHub communication port. Hydronic expansion modules are available in 1~4, 5~8 and 9~12 types.



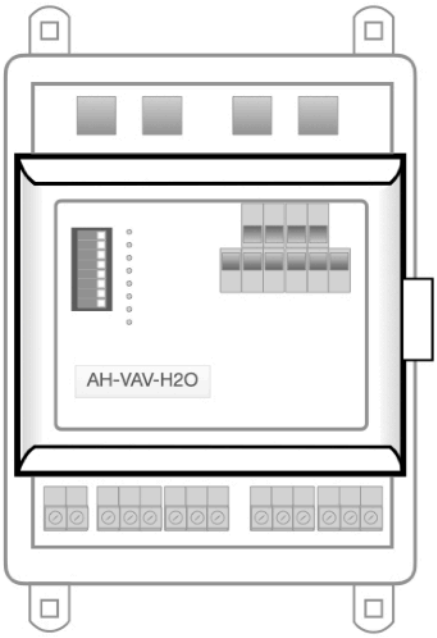
3.4 Fan Coil Unit Expansion Module

Each fan coil units expansion module include a modulating output for fan speed control that can be used for variable speed drives or to drive fan speed dating replays for permanent split capacitor type motors.



3.5 Combination VAV/H2O modules

Combination modules combine two of the available output types into a single compact form factor module.



3.7 Touchscreens, Touchpads and Room Controllers

Multiple options are available for a field level user interface in each room or system wide control.

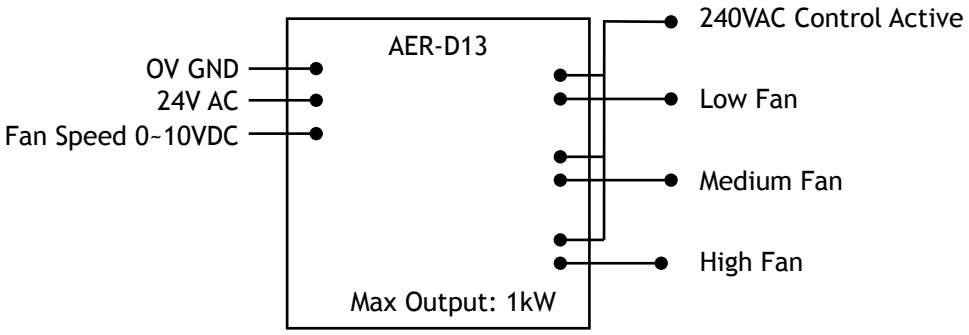
Room Touchpad

Room Controller

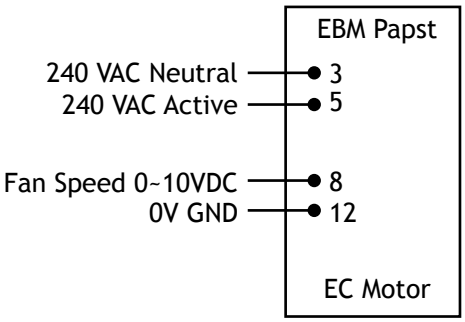
10” Touchscreen Central Controller

3.8 3 Speed Fans, EC Fans,

Fan Speed Control for Permanent Split Capacitor Fan Motors (3 Speed PSC)



Fan Speed Control for Electronically Commutated Motors (Variable Speed EC)



4. Connection Schematics

Room Controller

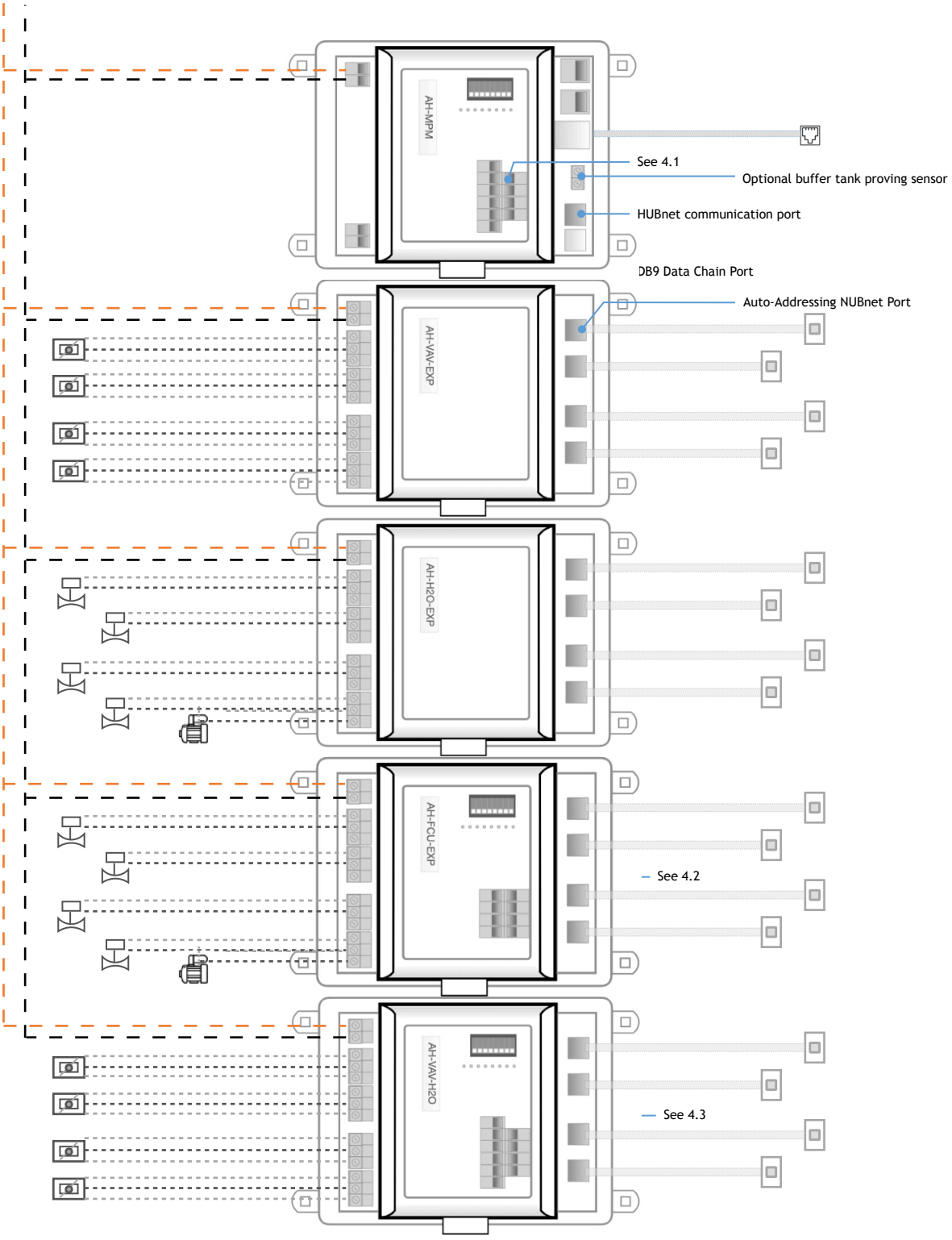
Hydronic Control Valve

Motorised Damper

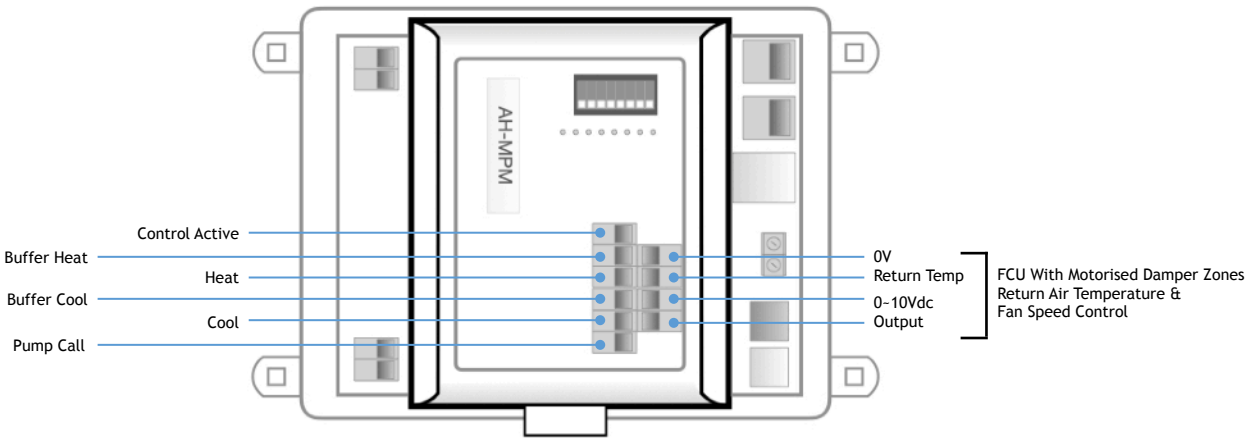
Room Touchpad

10” Tablet

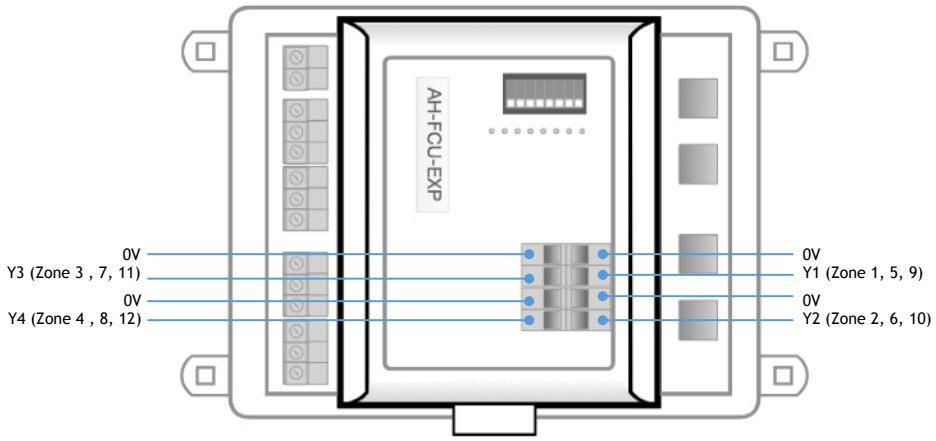
Router



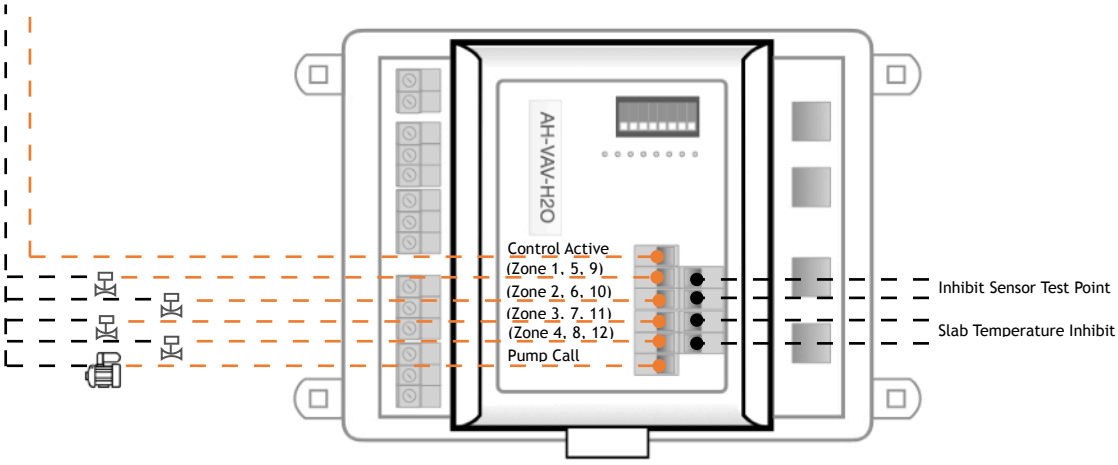
4.1 MPM Hat Connections



4.2 FCU Hat Connections



4.3 Valve Hat Connections



5. User Interface Instructions

There are multiple field and network interface options for the AmbientHub product. Field level interface options include:

1. Room Controller
2. Room Touchpad
3. Navigator Touchpad

Network level interface options include:

A. Built in web server

B. Voice activation

C. Wall mount tablet

Cloud Interface available at www.hubautomation.live (internet connection required for the cloud interface to operate).

5.1 Room Controller

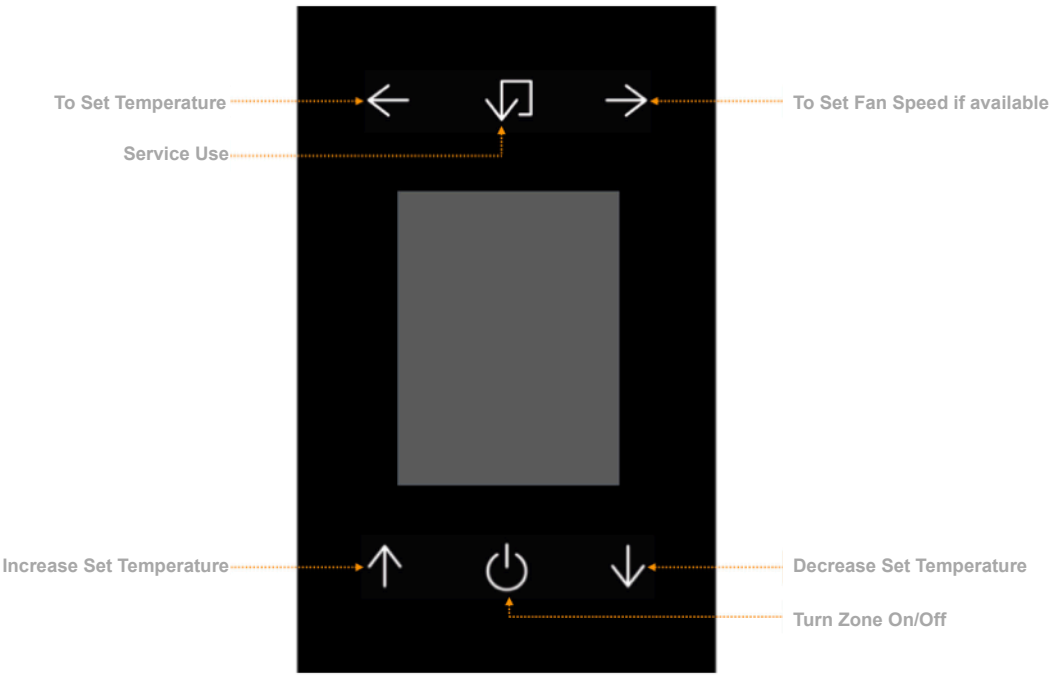
Zone / Room / is On & needs Heating

Zone / Room / is On

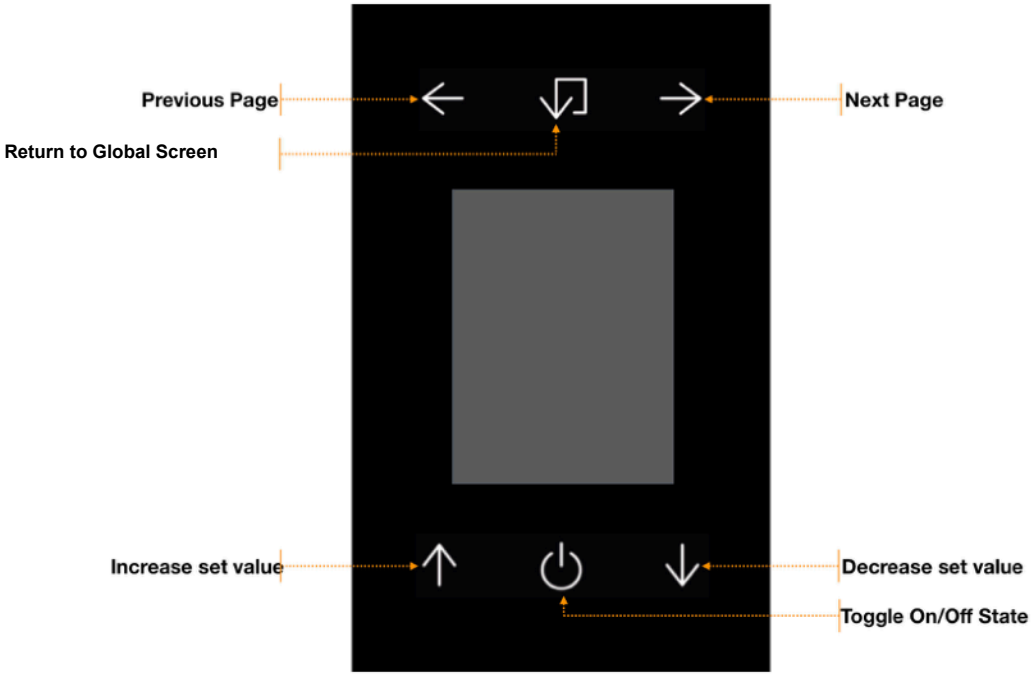
Zone / Room / is On & needs Cooling

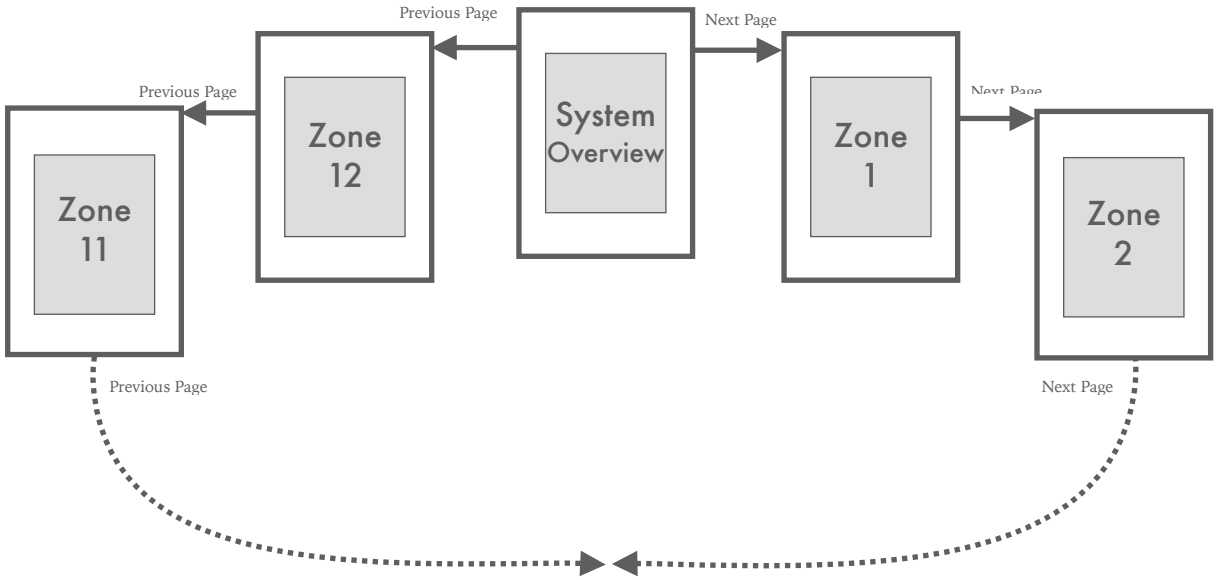
Note: The centre button is capacitive touch and switches the zone from On to Off.

5.2 Room Touchpad



5.3 Navigator Touchpad

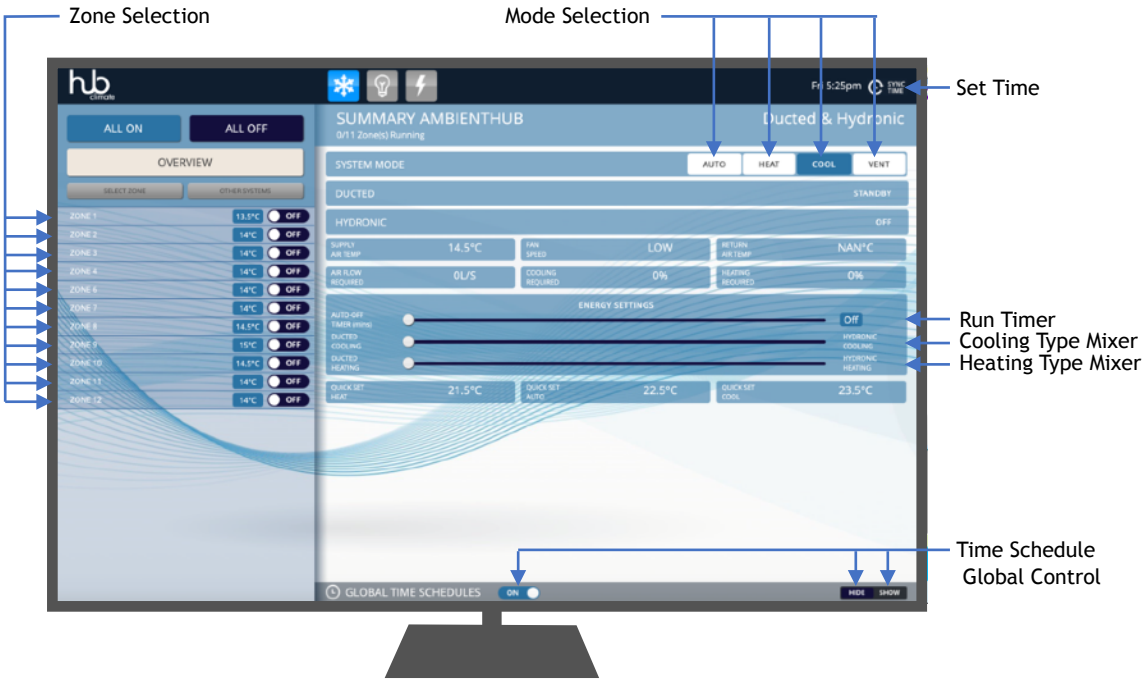




5.4 Using a Phone or Computer

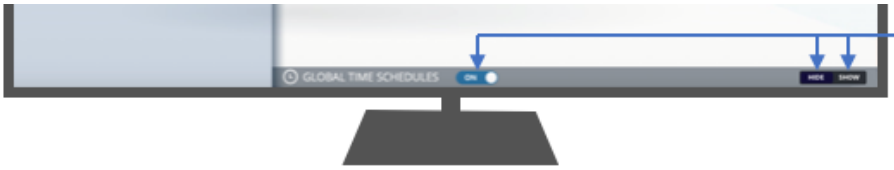
When your system is commissioned by your heating and cooling professional a home screen icon, bookmark or another link to your graphical user interface is installed on nominated smart devices. If you wish to add an additional device you will find instructions on how to achieve this in the commissioning section of this document.

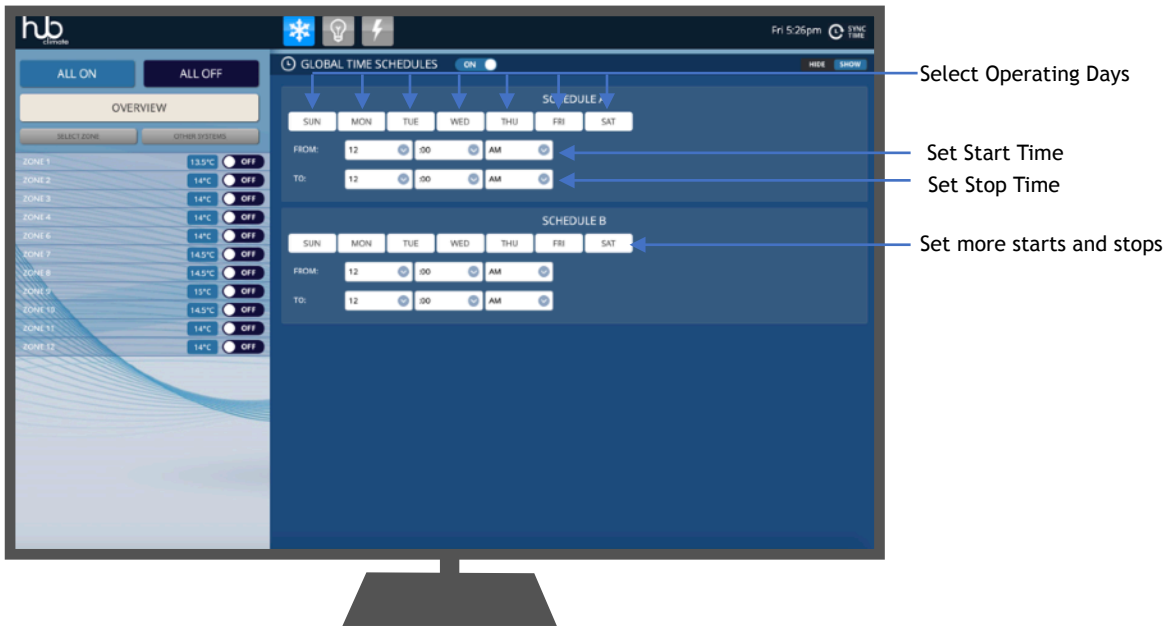
Overview , Summary or Global View Screen



Zone Screen

Global Time Schedule Setting Screen

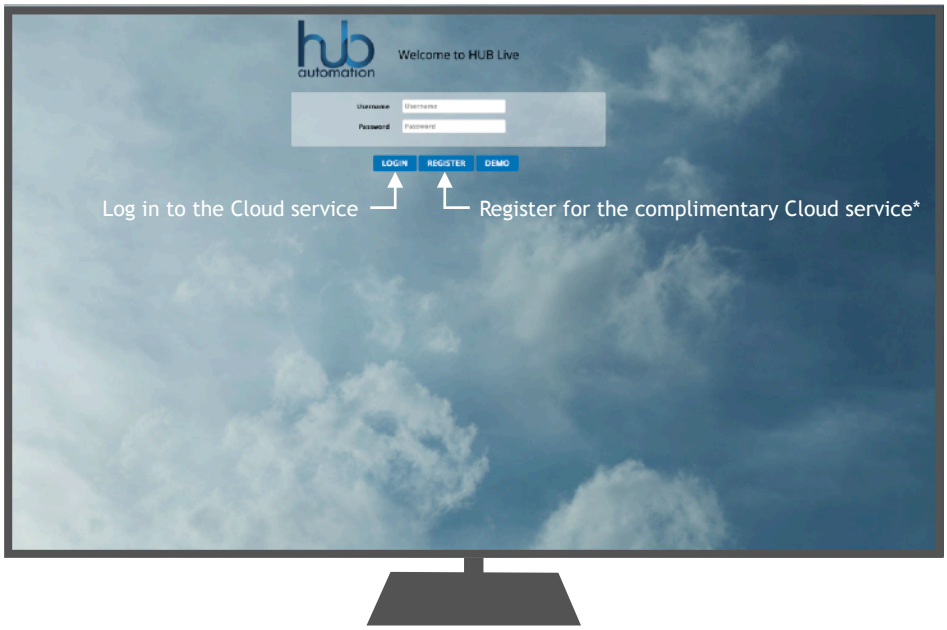




Zone Time Schedule Setting Screen

5.5 Using the Cloud Service

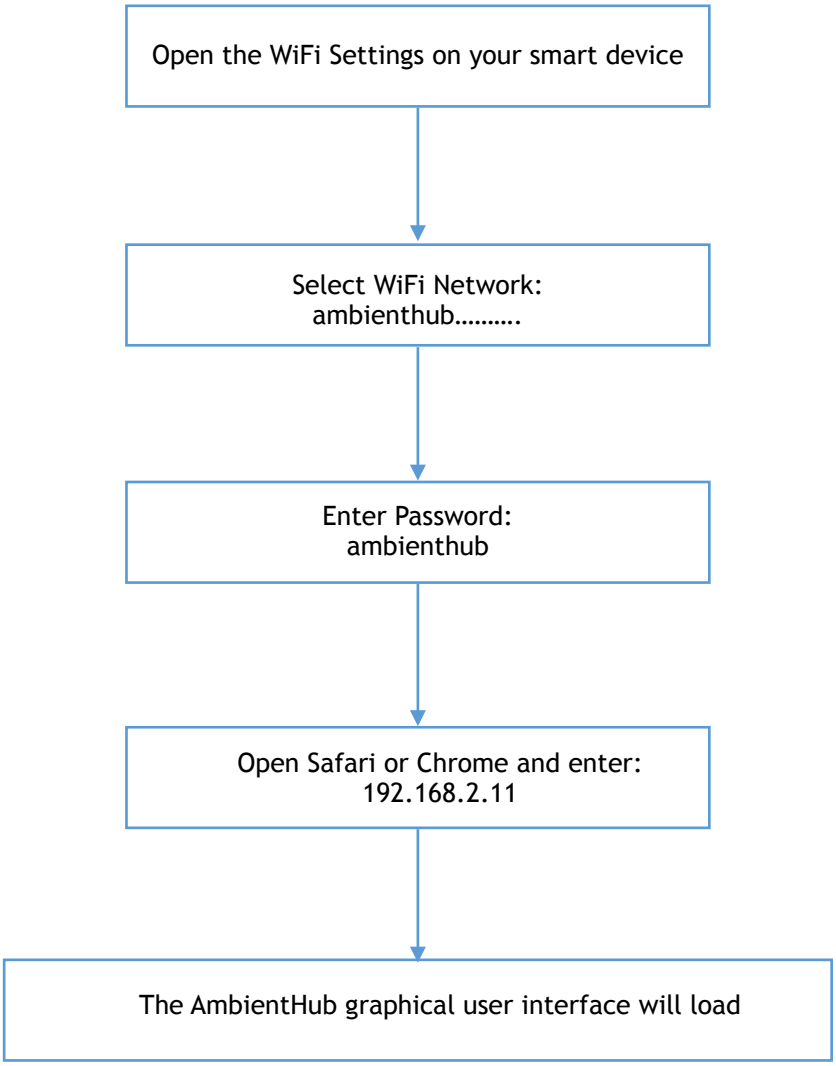
www.hubautomation.live



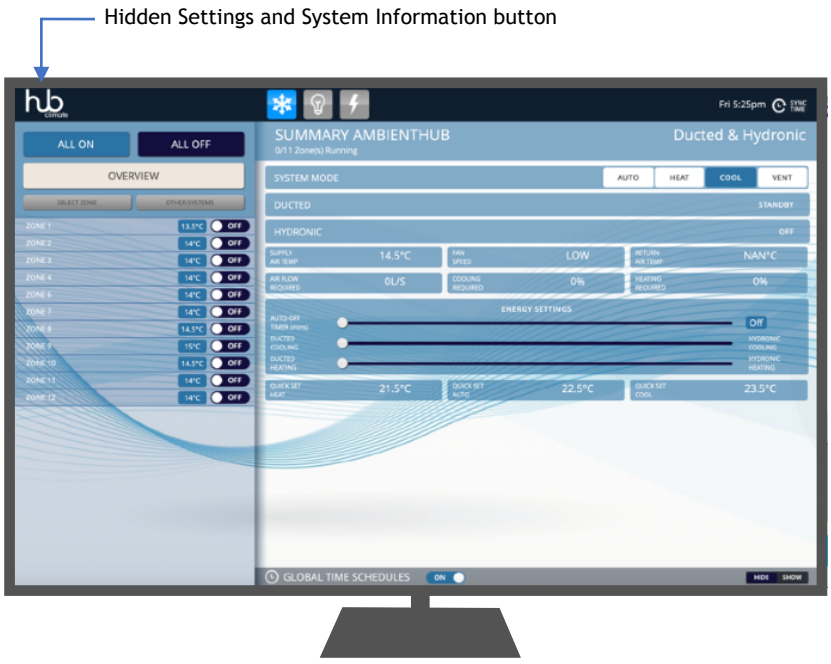
6. Commissioning and Setup

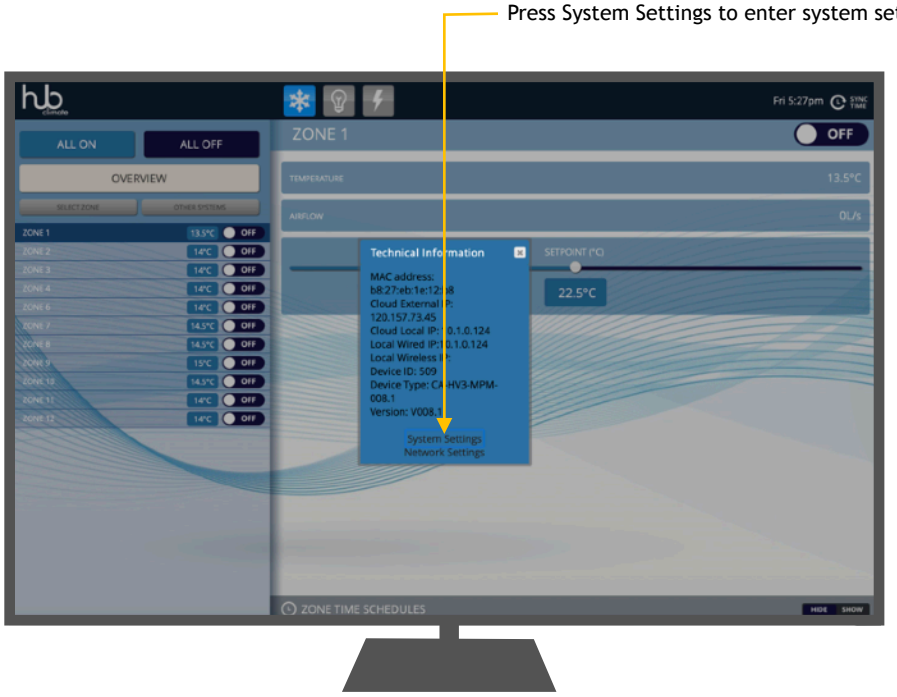
6.1 Connecting to the AmbientHub

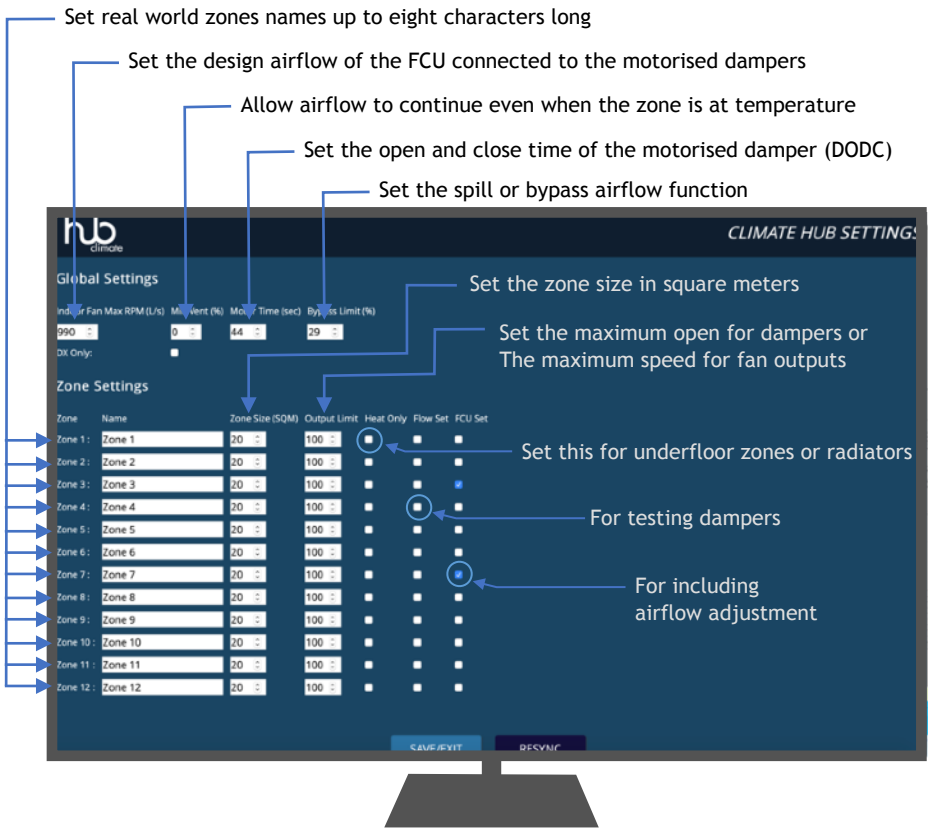
Each AmbientHub is equipped with two WiFi channels. The first step in the commissioning process is to connect to the onboard service WiFi (some heating and cooling professionals refer to this as the Service SSID). To connect to the Service SSID follow the instructions below:



6.2 Accessing System Settings

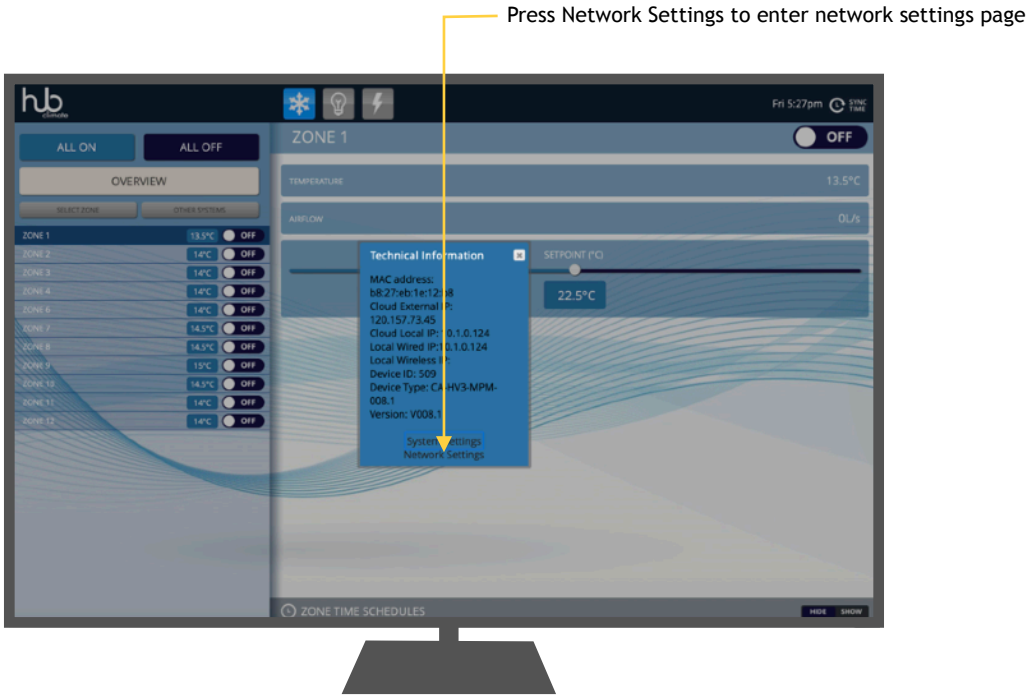






Setting Type	Notes
Fan RPM	990l/s
Min Vent	10%
Motor Time	45 seconds
Heat Only	Off
Flow Set	Off
FCU Set	Off

6.3 Accessing Network Settings



Choose connection method:
Wired or Wireless

Access network settings

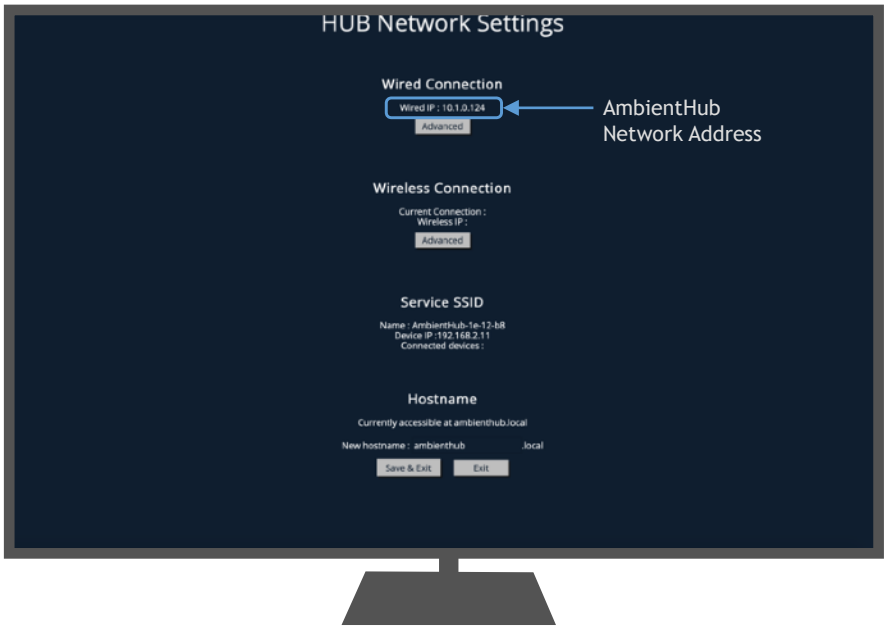
If a wired connection go to 6.4

If a wireless connection go to 6.5

6.4 Connecting to the network using an ethernet cable

A wired ethernet connection is the most reliable method of connecting to a network. The additional time taken when installing an AmbientHub to run a cat 5 or cat 6 cable will save time during the life of the system as it avoids connection issues associated with wireless ethernet (WiFi).

The first step is to run a cable from the router or switch to the AmbientHub and fit it to the RJ45 8P8C connector provided. The AmbientHub is preconfigured as DHCP and will request an IP address from the router automatically. To locate the IP address issues use the graphic below:



Join the local network with your smart device and enter the network address shown in the graphic above into the browser bar. The AmbientHub graphical user interface will load.

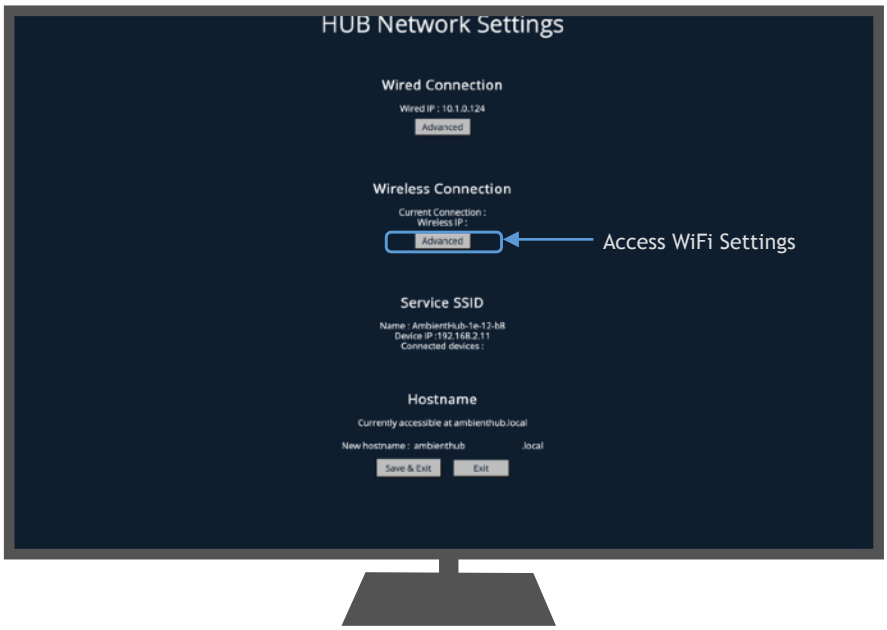
This address can be saved to the home screen of a phone or bookmarked on a personal computer.

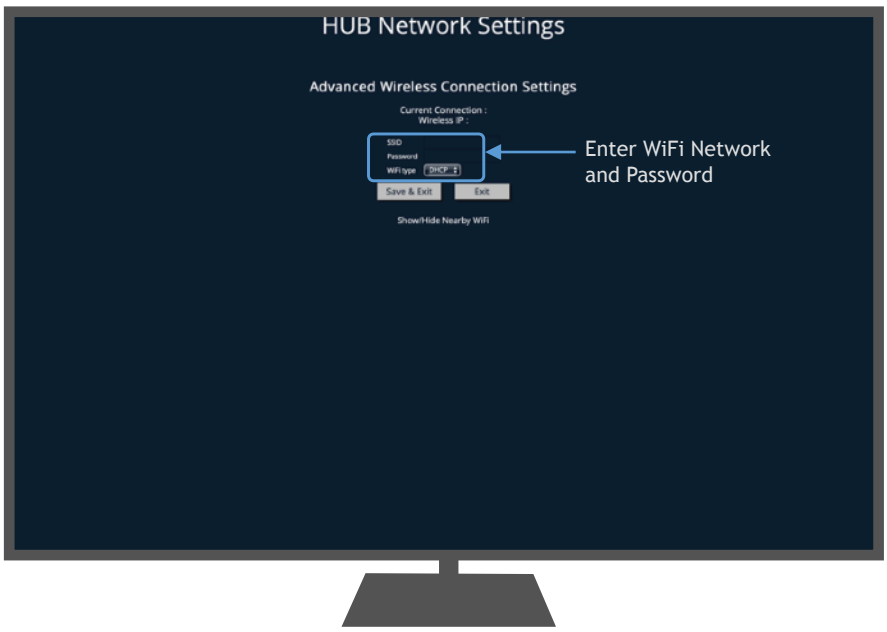
*Note: The advanced settings allows the IP address to be fixed. This will eliminate the router issuing a different address from time-to-time after a power outage. We suggest you check with the home owner or the network administrator prior to fixing the IP address.

6.5 Connecting to the network using WiFi

When connecting to a network using WiFi it is important to make sure that the distance to the router is not too far or that the congestion is not too high. Wireless connections are influenced by the local environment and physical obstacles and may perform differently in different situations.

WiFi Module	Distance	Notes
Standard	7m	Distance value are typical and will be impacted by the type of structure and the number of other networks using the same frequency in the surrounding area. *If you are not sure if the network is range is OK click the show network button to make sure the AmbientHub can detect the signal.
Extended	15m	
Max	30m	





7. Integrating with other Automation Systems

AmbientHub can integrate with most automation and building management systems. Options for integration include:

- Modbus TCP
- Serial Driver
- JSON RPC
- Cloud Control
- KNX Gateway
- Dynalite Gateway
- BACnet Gateway

For information on how to connect to AmbientHub to third part systems please contact your local distributor.

8. Service and Troubleshooting

8.1 Zones Disappearing

All thermal zones utilise auto-addressing and a keep-alive heartbeat. When the AmbientHub is started after power has been disconnected the auto addressing process takes place. This can take up to three minutes. When complete all zones that are present and operating correctly are loaded. If zones load initially and then disappear it is because the keep-alive heartbeat has been lost. Check the following:

1. Check the cable connection to that zone
2. Make sure that a smart touchpad like a Navigator or a Surface is not directing its heartbeat to the same zone.

8.2 No Zones Show Up On Boot Up

The auto zone detection runs for approximately three minutes after power is connected. It relies on the communication bus operating correctly to locate connected zones. Check the following:

1. Check that an incorrect cable crimp is not pulling the bus voltage down
2. Check that there is 24Vac at each expansion module
3. Check all wiring and connection

If the problem continues remove all touchpad, room controllers and sensors and refit one at a time remembering to power cycle between checks. The faulty connection will be located when all zones disappear after connecting.

8.3 Dampers Do Not Open

The AmbientHub features a proving sensor and a benefits test algorithm. The proving sensor confirms that the buffer tank temperature will move the zone closer to its target temperature. If the benefits test algorithm is not passed the dampers remain closed and the indoor fan runs at a low speed. Check the following:

1. Check that the proving sensor is located in a position that reflect the buffer tank temperature (the can be done by comparing the temperature shown on the graphical user interface with the temperature shown at the Heat Source).
2. Check that the buffer tank is at a suitable temperature
3. Check that the system is not locked in UnderFloor and Radiator only mode

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