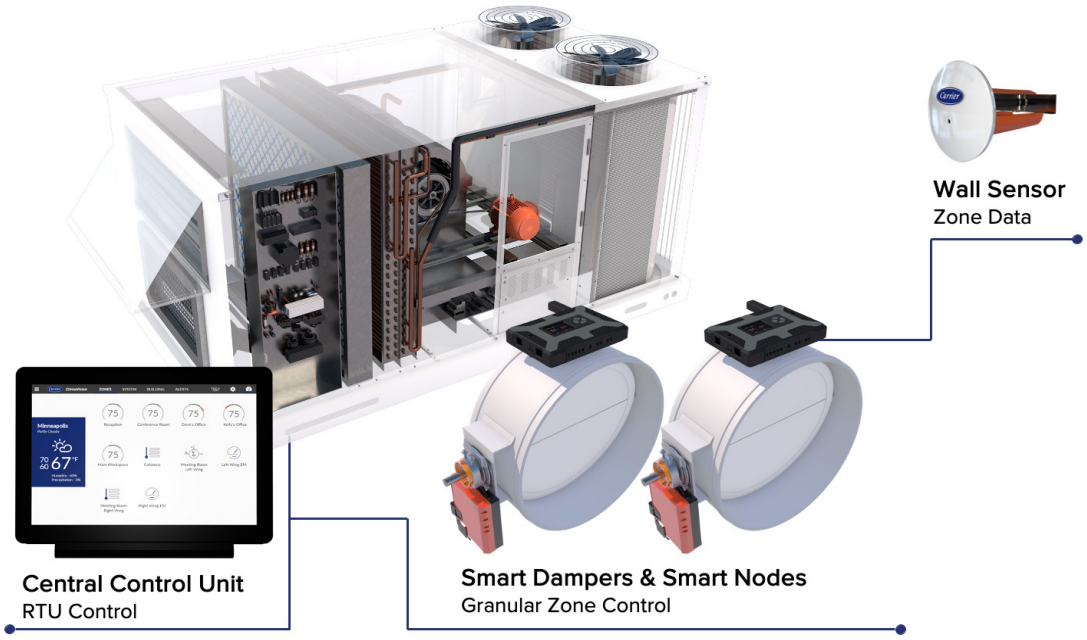
ClimaVision Dynamic Airflow Balancing

CAV and VAV Zoning Control System



APPLICATION OVERVIEW

ClimaVision Dynamic Airflow Balancing (DAB) is today's version of the familiar Carrier VVT zone control system that updates systems with remote control and monitoring for superior comfort and efficiency. Smart algorithms optimize heating and cooling capacity by redirecting conditioned air to the spaces that need it most, a strategy that multiple third-party, independent tests prove can lower utility cost by 26 to 45 percent. The DAB design is fine grained, so every space gets its own individual temperature control.

With these tools, building engineers who implement Carrier's DAB technology can expect vastly improved energy efficiency, occupant comfort, and productivity. These advantages are accessible to a wide variety of commercial buildings thanks to a full-stack solution that works out of the box, scalability across a range of central plant equipment and site footprints, and intuitive and user-friendly tuners like zone prioritization for hassle-free operation.

FEATURES

- Compatible with equipment from simple RTUs to advanced hybrid AHUs
- Indoor Air Quality (IAQ), CO_2 and occupancy control
- Dynamic Zone Priority setting
- Wireless installation and 900mHz wireless mesh network
- Integration with ClimaVision web portal and the ClimaVision Occupant App

ADVANTAGES

- Energy savings of up to 45 percent compared to traditional systems
- Enhanced IAQ Management and comfort
- Connected sensors eliminate hot and cold spots before they occur
- Easy-to-use interface with zero programming required
- Remote configuration and easy scheduling
- Out-of-the-box install, but advanced zone controls that scale

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HOW IT WORKS

Dynamic Airflow Balancing is a full-stack solution, with components that include sensors connecting to the cloud for analysis, A ClimaVision Central Control Unit (CCU) as a supervisor with built-in wall interface, ClimaVision Smart Nodes as terminal equipment controllers with wired digital sensors, dampers or third-party units in various configurations, and ClimaVision's building intelligence suite of web and mobile apps for secure remote monitoring and control. Carrier's sensor options in each zone capture at leawst temperature and humidity with CO2, occupancy, and more available. These sensors and controllers communicate via a 900 MHz wireless mesh network and the CCU to provide load conditions. Each zone is configured for parameters such as size of damper and the min/max damper positions for tracking in the algorithms. this information is combined with pre-determined zone priorities and setpoints — such as desired temperature and relative humidity — to reset the system every minute at the CCU. The CCU controls the AHU heating, cooling, and fan speeds. A 10k thermistor is added to each damper to provide Supply Air Temperature at the zone level. Carrier ClimaVision sensor options include CO2 and occupancy to provide zone-by-zone Demand Control Ventilation sequences when desired.

SEQUENCES OF OPERATION

The following sequences of operation are pre-programmed in the DAB profile:

Occupied

• Staging — Each zone contributes its Load (the difference between Desired and Current temperatures) to the CCU algorithm. The total Load of the System is the weighted average of each zone Load. Zones that experience a higher Load receive higher priority in calculation of total system Load.
• Normalization — To improve efficiency during staging, the System will normalize the damper positions to ensure that at least one damper is 100 percent open.
• Ventilation — The damper airflow sensor provides Supply Air Temperature (SAT). The zone sensor provides Current zone temperature. In ventilation, the zone algorithm is independent from the Sysem and will be a PI loop to modulate the damper to achieve the Desired temperature based on SAT.
• Priorities — The System accounts for zone priorities that can be assigned — the default is Normal. When the operator places a zone at a higher or lower priority, the weight of the zone Load is increased or decreased accordingly.

Unoccupied and Forced Occupied

Dampers will modulate to their minimum positions while unoccupied. During normally unoccupied hours, an occupant can force occupy the system by simply setting the Desired temperature using any of the means for doing so, including a wall stat, the CCU, the web UI, or a mobile app.

Auto Away and Auto Forced Occupied

When a sensor including PIR occupancy detection is present, the manager can select Auto Away and Auto Forced Occupied. During occupied hours when a zone becomes unoccupied, the Desired temperature will setback. During unoccupied hours when the zone is occupied, the Desired temperature will automatically be set. Unoccupied time, setback amounts, and forced-occupied time are adjustable tuners.

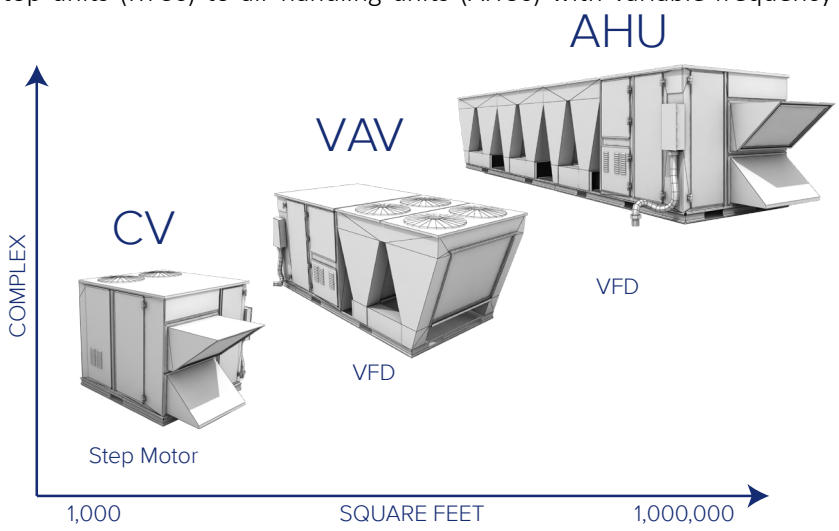
Bypass Damper

A bypass damper regulates duct static pressure. When this reaches a target value (default is 0.5" WC), the bypass will modulate towards open following a PI loop control sequence. The damper size and pressure target are designed to protect staged systems requiring minimum airflow.

ENERGY EFFICIENCY THAT SCALES

Traditional HVAC systems are balanced with manual dampers for peak cooling and peak heating loads. This causes occupant discomfort and inefficient or labor-intensive service for significant portions of the year, and requires constant adjustment in cases of partial or reduced occupancy. Instead of balancing systems twice a year, ClimaVision automatically optimizes airflow to dynamically meet current building conditions. We call this a continuous commissioning process: constantly rebalancing airflow in order to optimize both comfort and energy savings.

Dynamic Airflow Balancing scales from simple rooftop units (RTUs) to air handling units (AHUs) with variable-frequency drive (VFD) fans connected to a central plant. DAB is ideally suited for multizone AHUs and packaged RTUs where zone reheat is not available. Buildings with terminal air handling equipment with reheat capability should use ClimaVision's Variable Air Volume (VAV) application.



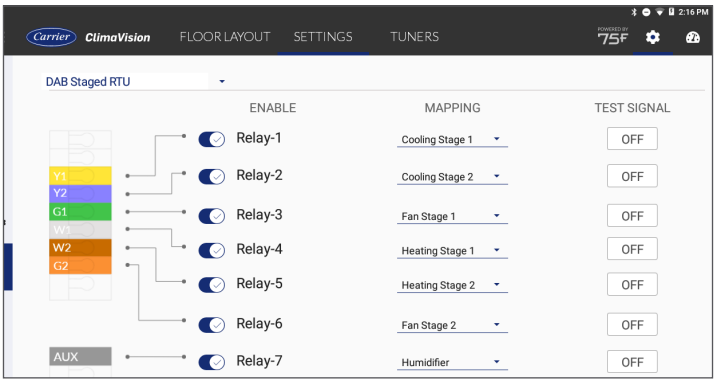
In a unitary system, DAB works out of the box to stage fan speed to airflow requirements in the system based on thermodynamic calculations and continuously redirects air. In a variable air volume system with staged heating or cooling, VFD frequencies are automatically set to best match the required stage. For built-up AHUs with chilled water and/or hot water coils and variable frequency drives, DAB resets temperature at the air handler to an optimum value for load calculations.

The following four profiles are available for pre-configured sequences of operation for common HVAC equipment types. All these profiles are compatible with the ClimaVision Outside Air Optimization (OAO) application to upgrade economizers and outside air dampers and exhaust systems.

STAGED RTU

In applications where buildings use a staged RTU, the CCU provides up to seven 24v relays that control the RTU. Relays may be mixed as required with a max of five stages for cooling, heating, or fan each. By default, the system is set up as two-stage cooling, two-stage heating, two-stage fan.

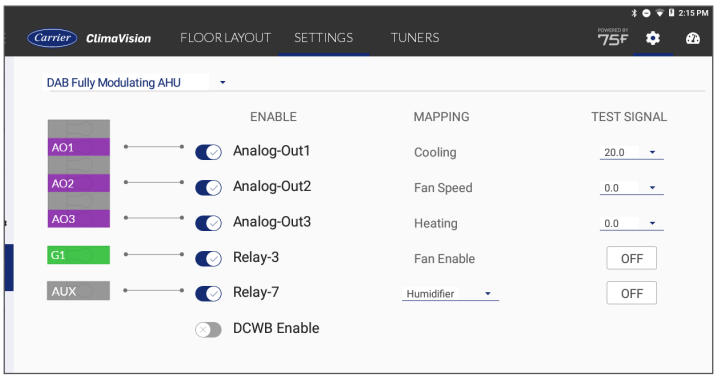
This profile is typically used for packaged RTUs and split systems with up to five stages of DX cooling.



FULLY MODULATING AHU

When applied to a fully modulating AHU, the CCU provides three separate 0-10v analog signals that control the AHU. These separate analog signals include cooling, fan speed, and heating.

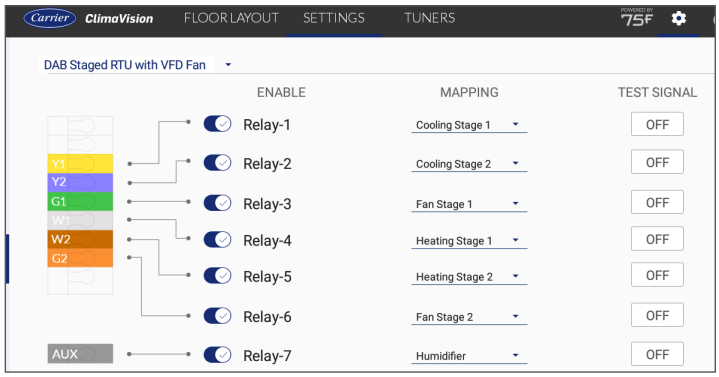
Typical application is a built-up air handler with hot water coil and valve, chill water coil and valve, and VFD fan.



STAGED RTU with VFD FAN

When applied to a staged RTU with VFD fan, the CCU provides up to seven 24v relays that control the RTU. 0-10v analog signals control the speed of the VFD driving the fan.

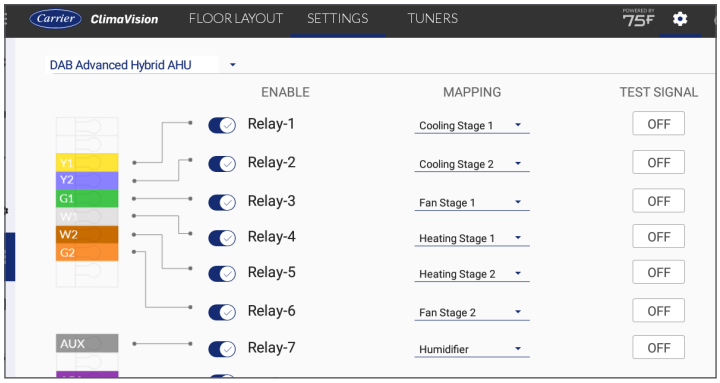
This profile is typically used when a packaged RTU has been upgraded from a step-motor to VFD. The VFD frequency is optimized for each stage of the RTU with an optional minimum fan speed selection.



ADVANCED HYBRID AHU

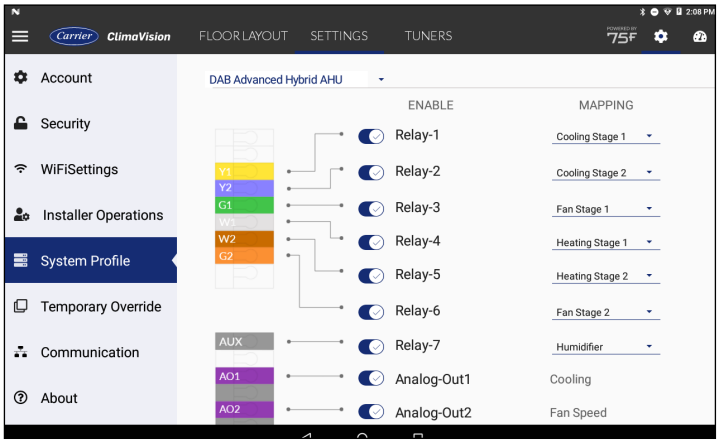
For the most advanced or hybrid AHU's, the CCU provides up to seven 24V relays that control the AHU itself. In addition, three separate 0-10V analog signals can be used to control the AHU as well. These separate analog signals include cooling, fan speed, and heating.

This profile is used anywhere where the AHU has a combination of staged equipment and modulating equipment.



TUNERS AND ADJUSTMENTS

DAB uses weighted averaging to calculate the system load. This factors the difference between a zone's current temperature and desired temperature via weightedAverageLoad which is measured as follows:



weightedAverageLoad =
((zone1CoolingLoad*zone1DynamicPriority
+ zone2CoolingLoad*zone2DynamicPriority …
) - (zone1HeatingLoad*zone1DynamicPriority
+ zone2HeatingLoad*zone2DynamicPriority …)) /
(zone1DynamicPriority + zone2DynamicPriority…)

As you can see above, the parameter of Dynamic Priority is an essential input to the DAB system. Zones may be assigned different priority levels: low, medium, high, or no priority by users, and will change dynamically in normal operation based on the how far the current temperature is from the desired temperature in the space. By default the dynamic priority will multiply by 1.3 for every multiple of zoneLoad. This is because occupants in a zone that is farther away from a desired temperature take priority otherwise and are exponentially more likely to feel uncomfortable.

Just as zones that are farthest away from a desired setpoint have more influence on the load calculation, building engineers or managers can easily influence this same calculation manually using DAB's input parameters in the tuning menu. In addition to zone priority, these inputs include adjustments to desired setpoints for heating and cooling.

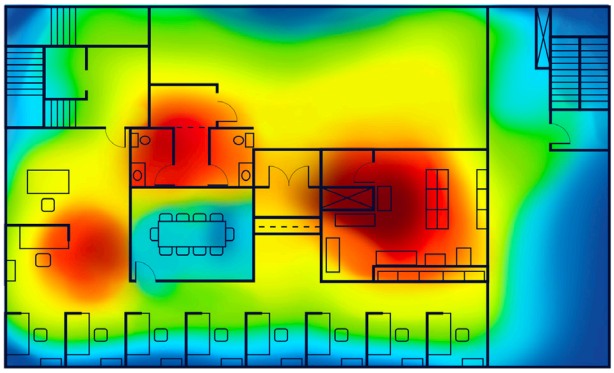
Selections can also be made to enable CO_2 and IAQ control where available. If the Smart Node is connected to a sensor delivering VOC or CO_2 values, minimum damper position will be increased whenever those levels move above a threshold.

This results in significant improvements in air quality and productivity. Similarly, if Occupancy Control is enabled and movement is detected by a sensor during a time when a zone is scheduled to be unoccupied, the system will go into a forced occupancy mode. If instead there is a lack of movement during an occupied period in any zone the system will recognize the partial occupancy or lack of occupancy in the zone or building and will move into a setback of two degrees by default unless otherwise specified.

Should temperatures in any zone surpass preset building limits at any point, an Emergency Breach function will activate and begin cooling the zone regardless of zone priority. Alerts will be sent to facility managers as well.

By adding tuners and preset functions to system load calculations, software does the work of optimizing and adjusting buildings instead of technicians on ladders. Rather than manually trying to balance rooms or zones with changing occupancy and loads throughout the day, facility managers log in from the CCU or any connected device and assign executive offices a higher zone priority than a rarely used conference room. They might enable Occupancy Control to take advantage of OPEX savings when a building is experiencing high turnover or periods of partial use. All these features work out of the box in a DAB application.

Facility managers have portfolio-wide control over all parameters remotely and can view their building performance in real time via ClimaVision's building intelligence suite of web and mobile apps.



Before

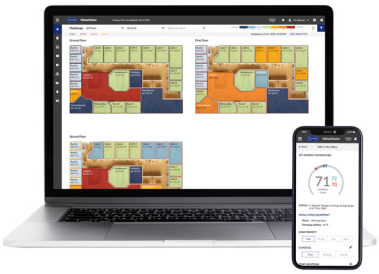
After

Dynamic Airflow Balancing from Carrier brings superior comfort and efficiency to customers and predictive and proactive control to commercial buildings in warmer climates or without simultaneous cooling and heating requirements. See Variable Air Volume from Carrier for these application types. ClimaVision's Outside Air Optimization can be added to further increase the efficiency of rooftop equipment and maximize the use of fresh outside air inside the building envelope. DAB leverages the power of the cloud as well as the benefits of remote monitoring and control to deliver a uniquely high-value, high-tech solution that is faster to install, easier to operate, and offers better energy savings, IAQ, and scheduling compared to other zone control systems.

COMPONENTS OF DAB

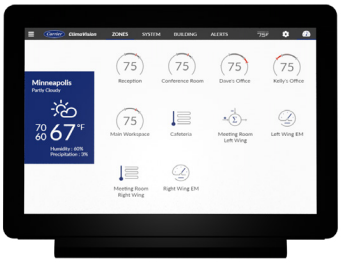
ClimaVision Dynamic Airflow Balancing includes the ClimaVision user portal & Occupant App, a ClimaVision Smart Node, and a ClimaVision Central Control Unit – plus, one ClimaVision sensor and one ClimaVision damper of your choice from the below options.

INCLUDED



ClimaVision User Portals

ClimaVision Smart Node



ClimaVision Central Control Unit

CHOOSE ONE

ClimaVision Wall Sensor

ClimaVision Multi Sensor

ClimaVision HyperSense

CHOOSE ONE

Round Damper

Rectangular Damper

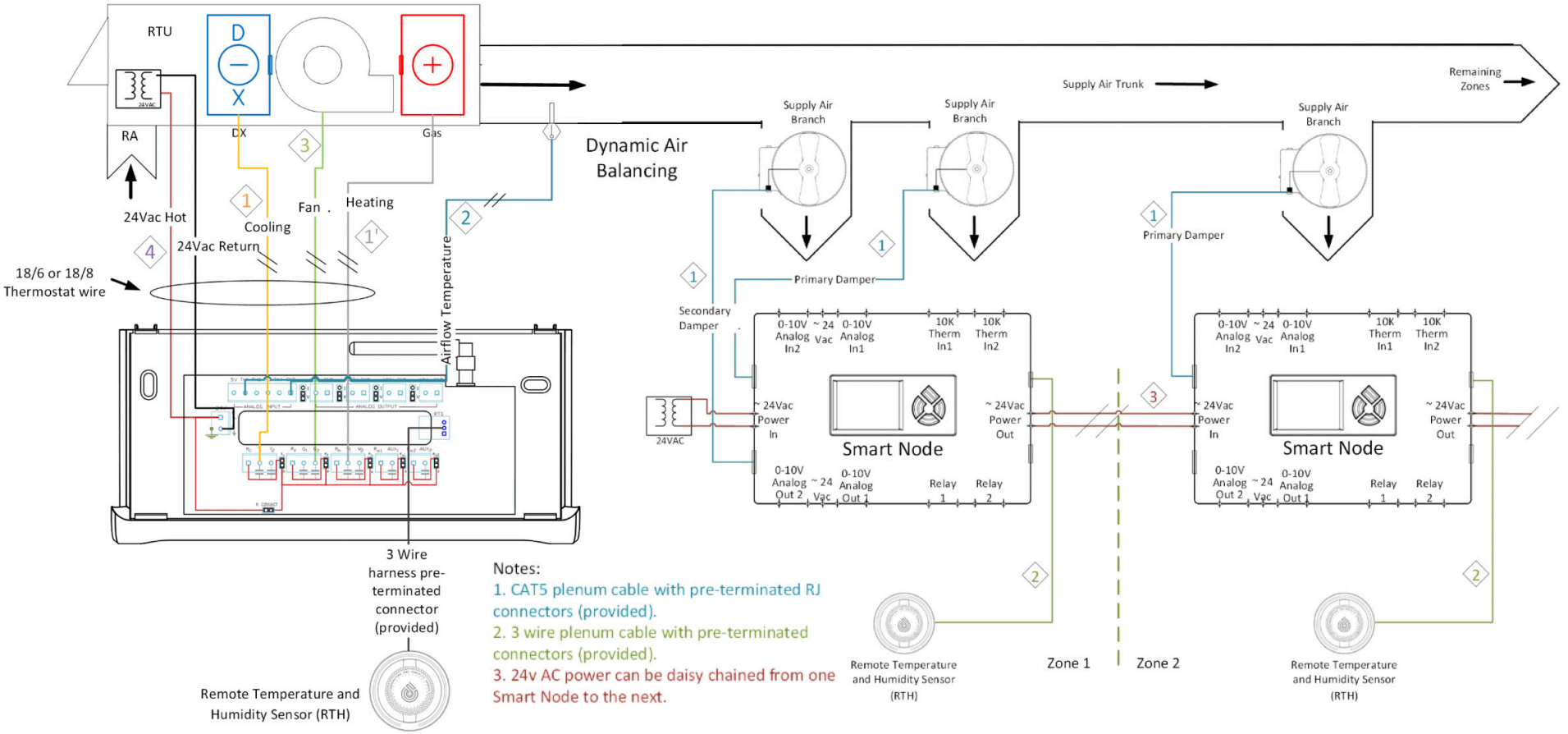
KIT OPTIONS

TYPE	PRODUCT NAME	DESCRIPTION
Standard	Smart VAV, Wall Mount	Smart Node, 30’ cable, Wall Sensor
Alternate	Smart VAV, Ceiling Mount	Smart Node, 30’ cable, Ceiling Sensor
	Smart VAV, Flush Mount	Smart Node, 30’ cable, Flush Mount Sensor
	Smart VAV, Multi Sensor	Smart Node, 30’ cable, Multi Sensor
	Smart VAV, HyperSense	Smart Node, 30’ cable, HyperSense

CONNECTIVITY

Central Control Unit (CCU) controlling Staged Rooftop Unit

Notes:
1. Cooling stage 1/2 relay as part of 18/8 wire to RTU
1' Heating stage 1/2 relay as part of 18/8 wire to RTU
2. 10k ohm bullet probe and cable (provided by 75F)
3. Fan call relay as part of 18/8 wire to RTU
4. 24v AC power as part of 18/8 wire to RTU



Notes:
1. CAT5 plenum cable with pre-terminated RJ connectors (provided).
2. 3 wire plenum cable with pre-terminated connectors (provided).
3. 24v AC power can be daisy chained from one Smart Node to the next.