BacNet DDC
VAV Controls







BacNet DDC VAV Controls

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1 INTRODUCTION

This document describes the sequence of operations for the T&B C3 DDC family of VAV controllers.

NOTE: All object values concerning Local Mode will be stored and manipulated at priority 9. If BMS control is desired, object values should be written by the BMS system at priority 8.

2 INPUT SOURCES AND TYPE

2.1 Wall Sensor

The unit continuously checks to see which type of space temperature sensor is connected. If a digital sensor is detected, Wall Sensor Type is set to STE-8XXX (no motion). Once a motion input is observed, the type may be set to STE-8XXX (Motion). If a digital wallsensor is not detected, the discrete Space Setpoint and Space Temperature inputs are checked to determine if a STE-6000 sensor is present. If a valid Space Setpoint is found, Wall Sensor Type is set to STE-6014/7. If no valid Space Setpoint is found, Space Temperature is checked for a valid reading on the temperature input also using the SENSOROFF command. If a valid Space Temperature is found, Wall Sensor Type is set to STE-6010. If no valid Space Temperature is found, Wall Sensor Type is set to None.

2.2 DAT (SAT) Sensor

The unit also continuously tests to see if a Discharge Air Temperature sensor is connected to the DAT input. If the Discharge Air Temperature is detected, DAT Sensor Present is set to Yes (ON), otherwise DAT Sensor Present is set to No (OFF).

2.3 Space Temperature

If Wall Sensor Type is set to STE-8XXX, then Space Temp Reference is mapped to the digital sensors temperature reading. If either STE-60XX type is present, Space Temp Reference is mapped to temperature input value. In the case where Wall Sensor Type is set to none, the primary damper is opened and the fan and reheat outputs are disabled. Only a Smoke Mode Control command sequence, later described, overrides the NONE Wall Sensor Type sequence.

2.4 Airflow

Primary Duct Raw Airflow is calculated by multiplying the square root of the Primary Duct Pressure Inputand the Primary Duct K-factor. Primary Duct Actual Airflow is then calculated by multiplying the Primary Duct Correction Factor Slope and the Primary Duct Raw Airflow and adding the Primary Duct Correction Factor Offset resulting in a corrected airflow reading. If the Primary Duct Actual Airflow is below the minimum of the Min Cooling Airflow and the Min Heating Airflow, then Primary Duct Actual Airflow is calculated by multiplying Primary Duct Raw Airflow and the Primary Airflow Low Flow Correction factor only.

External Duct Raw Airflow is calculated by multiplying the square root of the External Duct Pressure Input and the External Duct K-factor. External Duct Actual Airflow is then calculated by multiplying the External Duct Correction Factor Slope and the External Duct Raw Airflow and adding the External Duct Correction Factor Offset resulting in a corrected airflow reading If the External Duct Actual Airflow is below the minimum of the Min Cooling Airflow and the Min Heating Airflow, then External Duct Actual Airflow is calculated by multiplying External Duct Raw Airflow and the External Airflow Low Flow Correction factor only.

During Balancing Mode, neither Primary Duct Actual Airflow nor External Duct Actual Airflow is calculated

3 OCCUPANCY, SETPOINTS, AND MISCELLANEOUS

3.1 Occupancy States

3.1.1 Occupied

In units with no motion sensor, this mode is entered upon detection of airflow.

In units with a motion sensor, this mode is entered upon detecting motion two times within an adjustable Standby Trigger via the Motion Override Mode. Upon the second sensed motion within the trigger period, Motion Override Mode is started. Once the Motion Override Mode is initiated, the Standby Timer is retriggered any time the Motion Override Mode is active and motion is sensed. The Motion Override Mode is deactivated when no motion has been sensed for the duration of the Standby Timer.

3.1.2 Standby

For motion equipped controllers, this state is entered into after exiting the Unoccupied Mode when air is available, expiration of the Fresh Air Purge Mode, or reverted to from Occupied Mode if a motion sensor is inactive for the appropriate timeout period.

Standby mode is not valid for installations without a motion sensor, unless commanded by a BMS.

3.1.3 Fresh Air Purge

Once Fresh Air Purge Mode is initiated by the BMS, the unit remains in this mode for the duration of the Purge Timer. Upon completion of the Purge Timer, the Occupancy Mode is then set to Standby Mode if a motion sensor is present or Occupied Mode if no motion sensor is present.

3.1.4 Unoccupied

Unoccupied mode is entered any time there is no airflow available for a period of sixty seconds. During the unoccupied mode, the damper(s) will fail open.

In units configured with an analog wall sensor with pushbutton overrides (STE-6017), the Local Override state can also be entered during Unoccupied mode. The Local Override State is initiated upon sensing the override button being pushed. Once initiated, the Local Override State automatically turns OFF after the Local Override Timer expires from when the Local Override State was first initiated. This override is non-retriggering.

While in the Unoccupied Mode, upon detection of airflow with a motion sensor present, the unit will be set to the Standby Mode. If no motion sensor is present and airflow is detected, the unit will be set to Occupied Mode.

3.2 Space Setpoints

3.2.1 Setpoints

The following space setpoints are used to control the VAV operation: Active Cooling, Active Heating, Occupied Cooling, Occupied Heating, Unoccupied Cooling, Unoccupied Heating, Standby Cooling (internally calculated), Standby Heating (internally calculated). The space setpoints have default values, but may be manipulated depending on which Wall Sensor Type is connected.

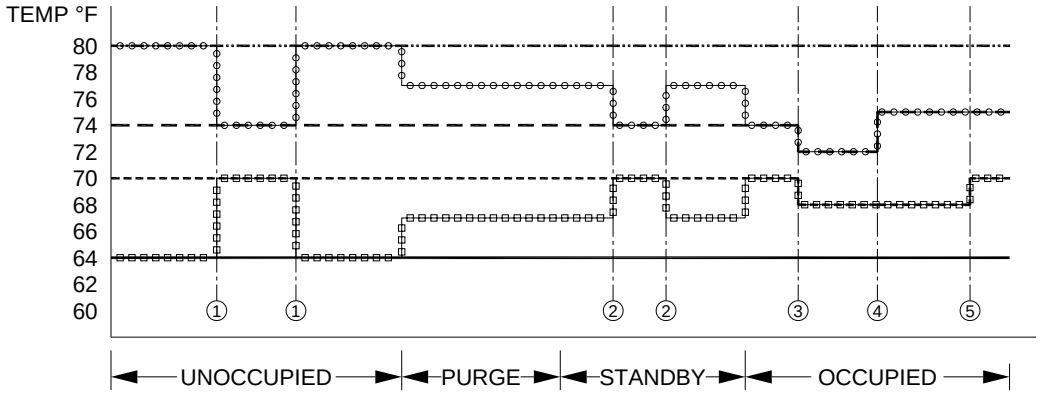
Note: When any space setpoint is manipulated, by any means, a limit is applied (at BACnet Priority 9). No cooling setpoint (Occupied, Standby or Unoccupied) shall be lower than the Min Cooling Setpoint. No heating setpoint (Occupied, Standby or Unoccupied) shall be higher than the Max Heating Setpoint.

3.2.2 Setpoint Determination

During Unoccupied Mode, Active Cooling Setpoint is set to the Unoccupied Cooling Setpoint; the Active Heating Setpoint is set to the Unoccupied Heating Setpoint.

When the unit is in either Fresh Air Purge Mode or Standby Mode, the Active Cooling Setpoint is set to the previously calculated standby cooling setpoint; the Active Heating Setpoint is set to the previously calculated standby heating setpoint.

During the Occupied Mode, the Active Cooling Setpoint is set to the Occupied Cooling Setpoint and the Active Heating Setpoint is set to the Occupied Heating Setpoint.



OCC CLG
OCC HTG
UNOCC CLG
UNOCC HTG
ACTIVE CLG
ACTIVE HTG

① LOCAL OVERRIDE TIMER
② MOTION DETECTED
③ USER ATTEMPTED ADJUSTING OCC CLG STPT TO 70°F
④ USER ADJUSTED OCC CLG STPT TO 75°F
⑤ USER ADJUSTED OCC HTG STPT TO 70°F

MIN CLG SETPOINT = 72°F
MAX HTG SETPOINT = 70°F
MIN SETPOINT DIFF = 4°F
STANDBY DIFF = 3°F

SPACE SETPOINT OPERATION

3.2.2.1 Occupied and Unoccupied

If Wall Sensor Type is set to STE-8XXX, then the cooling and heating setpoints are mapped and manipulated directly from STE-8XXX.

If Wall Sensor Type is set to STE-6014/7, Occupied Cooling Setpoint and Occupied Heating Setpoint are determined directly from the rotary setpoint dial. The reading on AI4 is mapped to Space Setpoint Reference. Occupied Cooling Setpoint is then set to the Space Temp Reference plus one half of the Minimum Setpoint Differential. Likewise the Occupied Heating Setpoint is set to the Space Temp Reference minus one half the Minimum Setpoint Differential. Unoccupied Cooling and Heating Setpoints remain their default values or those set during unit configuration.

If Wall Sensor Type is set to STE-6010, Occupied and Unoccupied Cooling and Heating Setpoints remain their default values or those set during unit commissioning.

If any setpoint is adjusted and comes within Minimum Setpoint Differential of it's corresponding opposite heating or cooling setpoint, the opposite setpoint from the one adjusted is "pushed" to maintain the Minimum Setpoint Differential between the two. For example, if Minimum Setpoint Differential is set to 4°F, the Occupied Heating Setpoint is set to 70°F and the Occupied Cooling Setpoint is lowered from 74°F to 71°F, the Occupied Heating Setpoint is reset to be 67°F.

3.2.2.2 Standby

During Standby Mode, the standby cooling setpoint is calculated by adding the Occupied Cooling Setpoint and the Standby Differential. Similarly, the standby heating setpoint is calculated by subtracting the Standby Differential from the Occupied Heating Setpoint.

3.3 Airflow Setpoints

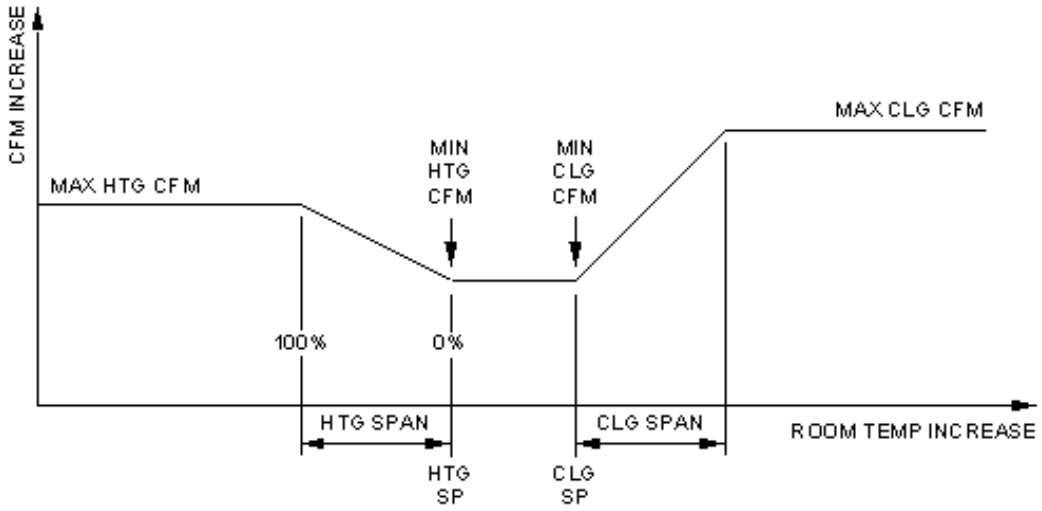
The following setpoints are used to control the operation of a single duct terminal unit: Primary Airflow, Minimum Cooling, Maximum Cooling, Minimum Heating, Maximum Heating. In dual duct applications, an External Airflow setpoint is also needed.
NOTE: External airflow point descriptions may be external, secondary, heating, fresh, or exhaust based on the sequence description. Similarly, the primary airflow descriptions be primary, cooling (or heating in single duct, mode dependant), or supply.

3.3.1 Single Duct Airflow

Airflow Setpoint is calculated based on the demand for cooling or heating depending on whether Cooling Loop or Heating Loop is presently active (greater than zero).

In the cooling mode, as the Cooling Loop increases from 0% to 100%, Primary Airflow Setpoint is proportionally calculated between Minimum Cooling Airflow and Maximum Cooling Airflow. However, if the Cooling Loop is greater then 5% and the SAT Changeover Mode is set to HEAT, then the Primary Airflow Setpoint is set to Min Cooling Airflow.

In the heating mode, as the Heating Loop increases from 0% to 100%, Primary Airflow Setpoint is proportionally calculated between Minimum Heating Airflow and Maximum Heating Airflow. However, if the Heating Loop is greater then 5% and the SAT Changeover Mode is set to COOL, then the Primary Airflow Setpoint is set to Min Heating Airflow.



SINGLE DUCT VARIABLE VOLUME AIRFLOW

While the Occupancy Mode is Fresh Air Purge, the Airflow Setpoint is set to the Max Cooling Airflow if Cooling Loop is greater than 5%. If Heating Loop is greater than 5%, the Airflow Setpoint is set to Max Heating Airflow.

3.3.2 Dual Duct Airflow (VAV and CAV)

Airflow Setpoint is calculated based on the demand for cooling or heating depending on whether Cooling Loop or Heating Loop is presently active (greater than zero).

In the cooling mode, as the Cooling Loop increases from 0% to 100%, Primary Airflow Setpoint is proportionally calculated between Dual Duct Mixing Min Airflow and Maximum Cooling Airflow.

As the Space Temp Reference drops below the Active Cooling Setpoint to the Active Heating Setpoint, the Primary Airflow Setpoint resets from the Dual Duct Mixing Min Airflow to the Min Cooling Airflow. Conversely, as the Space Temp Reference drops from the Active Cooling Setpoint to the Active Heating Setpoint, the External Airflow Setpoint is reset from Min Heating Airflow to Dual Duct Mixing Min Airflow.

As the space temp further drops below the Active Heating Setpoint, the External Airflow Setpoint continues modulating from Dual Duct Mixing Min Airflow to Max Heating Airflow.

3.3.2.1 Dual Duct Fresh Air Purge
In VAV and CAV configurations, while the Occupancy Mode is set to Fresh Air Purge, the Primary Airflow Setpoint is set to t he Max Cooling Airflow if Cooling Loop is greater than 5% and the External Airflow Setpoint is set to zero. If Heating Loop is greater than 5%, the External Airflow Setpoint is set to Max Heating Airflow and the Primary Airflow Setpoint is set to zero.

In the Supply/Exhaust Tracking configuration, the Primary Airflow Setpoint is set to Max Cooling (Sup) Airflow and the external damper is allowed to control normally.

In the Indoor Air Quality configuration, the Primary Airflow Setpoint is set to Min Cooling Airflow and the External Airflow Setpoint is set to Max Heating (Fresh) Airflow.

Tip: As the Primary Duct Actual Airflow drops below the Dual Duct Mixing Min Airflow, the External Airflow Setpoint is set to the difference between the Primary Duct Actual Airflow and the Dual Duct Mixing Min Airflow. The total airflow leaving the box thus maintains the Dual Duct Mixing Min Airflow.
Note: Generally speaking, in Variable Air Volume and Constant Air Volume Dual Duct configurations, both the Min Cooling and Min Heating Airflows are set to zero.

3.4 Changeover

The SAT Changeover Mode is used by the controller to determine the type of air that is being supplied by the AHU.
Any time the Heating Loop is inactive, the Discharge Air Temperature input is compared to the SAT Changeover Temp. If the Discharge Air Temperature is below the SAT Changeover Temp less 2 degrees, the SAT Changeover Mode is set to Cool (ON). If the Discharge Air Temperature is above the SAT Changeover Temp plus 2 degrees, the SAT Changeover Mode is set to Heat (OFF). The default changeover temperature should be 74 degrees Fahrenheit.

3.5 Fire/Smoke

Note: This control supersedes all other Damper Motor control sequences.
Upon receiving a Smoke Mode Control signal from the BMS, the unit commands both the Damper Motor and the External Damper (if applicable) to the directions commanded for the duration of the Smoke Mode Control Command. At the same time, the program commands Smoke Damper Feedback from its pre-smoke mode command state of Inactive to either Driving Primary Open or Driving Primary Closed as appropriate.

While under a Smoke Mode Control command, if the Damper Position is less than or equal to 5% open, the Smoke Damper Feedback is set to Primary Damper Closed. If the Damper Position is greater than or equal to 95% open, the Smoke Damper Feedback is set to Primary Damper Open. Once the Smoke Mode Control command returns to Inactive, Damper Motor control returns to normal operation and the Smoke Damper Feedback is set to Inactive.

For series fan powered boxes, if a smoke command is received to open the damper, the Fan Start/Stop should be active and the Fan Speed Setpoint should be set to 100%. For all other instances (closed command or parallel fan configuration) the Fan Start/Stop should be inactive and the Fan Speed Setpoint set to 0%.

Reheat should operate as normal during the smoke control sequence.
For dual duct applications, both the primary and secondary dampers should be commanded in the same direction.

3.6 Call for AHU

Call For AHU is started when either Cooling Loop or Heating Loop measures 100% for fifteen minutes and stops when both loops are less than 5%. This flag may be used by a BMS system during an unoccupied period, to know when to start an AHU to maintain the space setpoints.

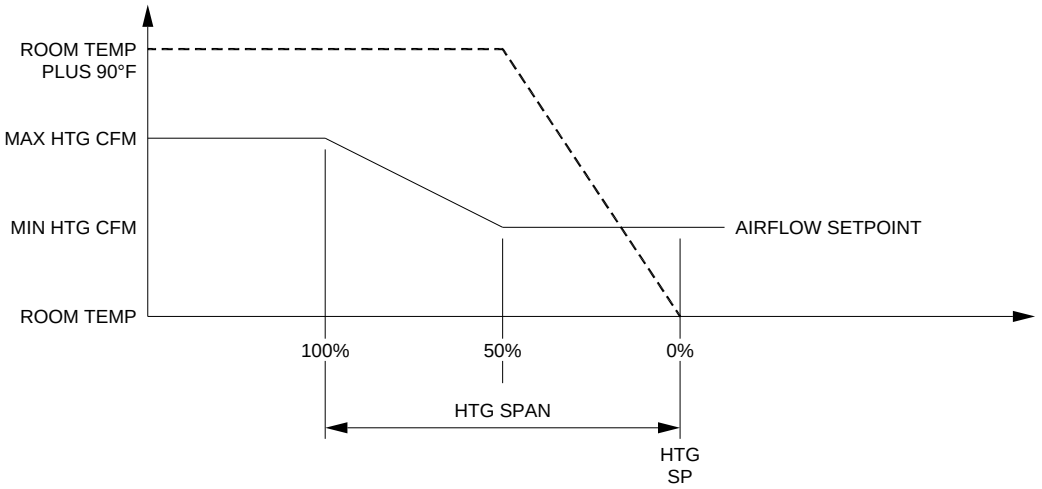
3.7 DAT Limiting

If the unit has detected a Discharge Air Temperature (DAT) sensor (DAT Sensor Present [is TRUE) and DAT Limiting is not enabled, the unit's reheat is controlled by the Heating Loop instead of DAT Loop.

If DAT Sensor Present is TRUE and the unit is configured for DAT Limiting, the VAV terminal will be controlled by the DAT Loop. The unit will also limit the Discharge Air Temperature to within 15°F of the Space Temp Reference.

If the unit is heating, the appropriate reheat operates directly controlled by the DAT Loop with the DAT Setpoint reset based on the output of the Heating Loop. As the Heating Loop increases from 0% to 50%, DAT Setpoint is proportionally calculated between Space Temp Reference and Space Temp Reference + 15°F (90°F max). This allows the reheat to control DAT over the first 50% of a call for heating and heating airflow to ramp up over the second 50%.

Discharge Air Temp Limiting does not apply during Fresh Air Purge Mode.
If the unit is configured for DAT Limiting, and the Discharge Air Temperature sensor is not present, the unit will lock out reheat from operating, control to the Active Cooling Setpoint and control normally without limiting Discharge Air Temperature. The unit will operate this way until a Discharge Air Temperature sensor is detected or until the unit is commanded to control to the Active Heating Setpoint by a supervisory BMS.



DAT LIMITING OPERATION

4 Damper, Fan, and Reheat Operation

4.1 Damper Operation

Damper movement is determined by comparing the actual airflow reading to the airflow setpoints. If the actual airflow is within 5% of the setpoint, not damper action is initiated. Once within the 5% deadband, the actual airflow must be outside a 7% deadband before damper movement is initiated.

4.2 Fan Operation

4.2.1 Non Fan Powered

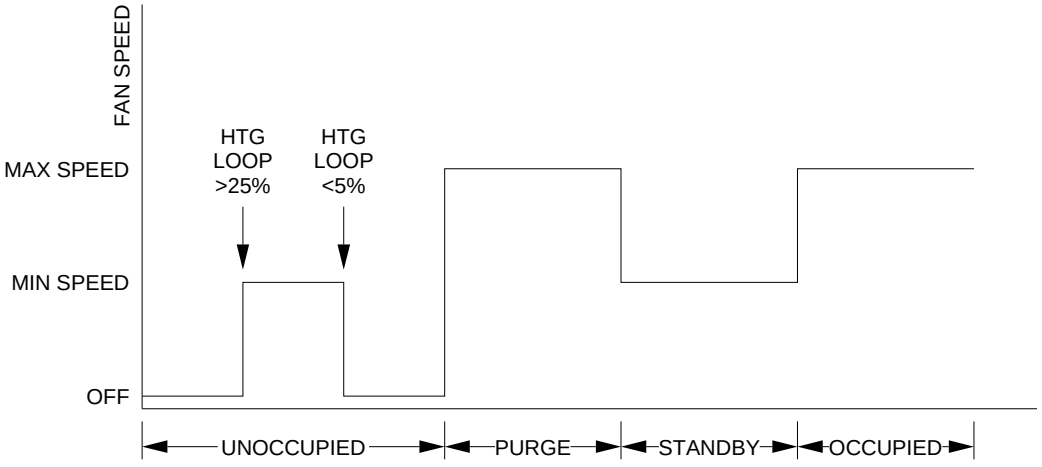
If the unit Fan Type is configured for NONE, Fan Start/Stop and Fan Speed are set to zero regardless of occupancy state.

4.4.2 Series Fan

If Fan Type is configured for SERIES (generally constant operation), any time the unit is in Occupied, Fresh Air Purge or Standby Modes, Fan Start/Stop shall be started.

When the unit is in Occupied or Fresh Air Purge Modes, Fan Speed shall be set to Max Fan Speed. When the unit is in the Standby Mode, Fan Speed shall be set to Min Fan Speed.

When the unit is in Unoccupied Mode, Fan Start/Stop is started on a call for heating only. Fan Start/Stop is started when Heating Loop is greater than 5% and stops when Heating Loop is less than 1%. Fan Speed shall be set to Min Fan Speed when Fan Start/Stop is energized and set to zero when Fan Start/Stop is off.



SERIES FAN OPERATION

4.2.3 Parallel Fan

If Fan Type is configured for PARALLEL (generally intermittent operation), any time the unit is in Occupied, Fresh Air Purge or Standby Modes, Fan Start/Stop shall be energized prior to a call for heating. Fan Start/Stop is started when Heating Loop is greater than 5% and stops when Heating Loop is less than 1%.

When the unit is in Occupied or Fresh Air Purge Modes and Fan Start/Stop is energized, Fan Speed shall be set to Max Fan Speed. When the unit is in Standby Mode and Fan Start/Stop is energized, Fan Speed shall be set to Min Fan Speed. Any time Fan Start/Stop is off, in any occupancy mode, Fan Speed is set to zero.

When the unit is in Unoccupied Mode, Fan Start/Stop is started on a call for heating only. Fan Start/Stop is started when Heating Loop is greater than 5% and stops when Heating Loop is less than 1%. Fan Speed shall be set to Min Fan Speed when Fan Start/Stop is energized and set to zero when Fan Start/Stop is off.

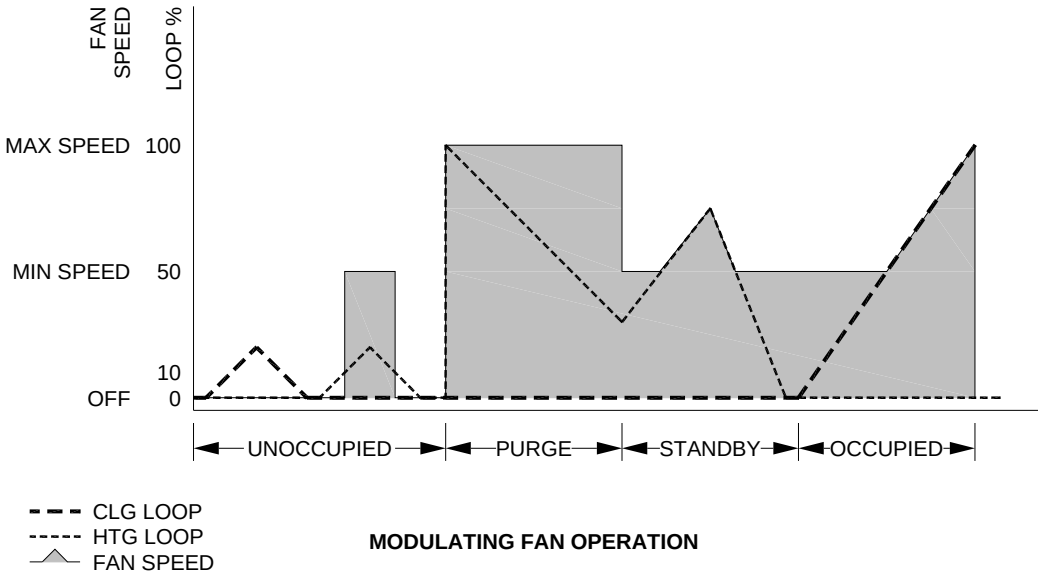
4.2.4 Modulating Fan (Preliminary)

If Fan Type is configured for MODULATING (generally constant operation), any time the unit is in Occupied, Fresh Air Purge or Standby Modes, Fan Start/Stop shall be started.

During Fresh Air Purge, Fan Speed shall be set to Max Fan Speed.
In Occupied and Standby Modes, when Cooling Loop is active (> 0), the Fan Speed output ramps from Min Fan Speed to Max Fan Speed as Cooling Loop rises from 50% to 100%. When Heating Loop is active (> 0), the Fan

Speed output ramps from Min Fan Speed to Max Fan Speed as Heating Loop rises from 50% to 100%. In Occupied and Standby Modes, when Cooling Loop and Heating Loop are both under 50%, Fan Speed output is set to Min Fan Speed.

During Unoccupied Modes, Fan Start/Stop is started on a call for heating only. Fan Start/Stop is started when Heating Loop is greater than 10 and stops when Heating Loop is less than 5. During Unoccupied Mode, when Fan Start/Stop is energized, Fan Speed output ramps from Min Fan Speed to Max Fan Speed as Heating Loop rises from 50 to 100 and Fan Speed is set to zero when Fan Start/Stop is OFF. Fan Speed is set to Min Fan Speed when Heating Loop is below 50, but Fan Start/Stop is still ON.



MODULATING FAN OPERATION

4.3 Reheat Operation

Note: These methods of reheat only apply to the Single Duct Models with Reheat, Supply/Exhaust Tracking, and Indoor Air Quality configuration. In VAV and CAV configurations, heating is controlled by the heating duct and the external duct actuator.

If Discharge Air Temp Limiting is enabled, reheat is controlled by DAT Loop. If DAT control is not operating, reheat is controlled by Heating Loop.

4.3.1 Modulating

If Reheat Type is set to Modulating, Analog Heat Output is set to the value of the appropriate loop if either Heating Loop or DAT Loop is active. If the heating loop is less than 10%, the heating output shall remain at zero.

The Analog Heat Output is set to zero if Cooling Loop is Active.

4.3.2 Staged

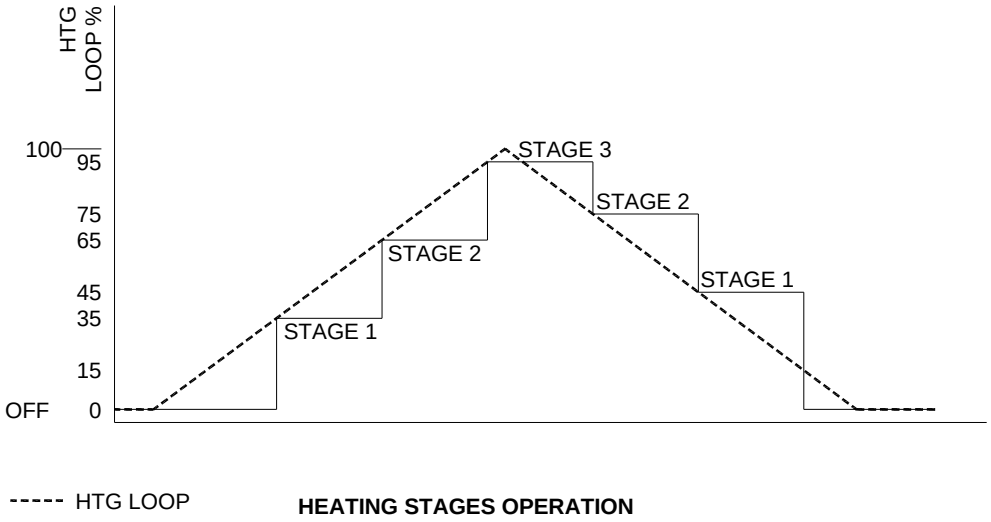
If Reheat Type is set for Staged, the reheat stages (Heating Output 1, Heating Output 2, Heating Output 3) are commanded ON when the appropriate loop rises above the ON setting and OFF when the loop drops below the OFF setting as described below.

4.3.2.1 Staging ON/OFF Trip Points

Heating Stage 1: ON – 35%, OFF – 15%

Heating Stage 2: ON – 65%, OFF – 45%

Heating Stage 3: ON – 95%, OFF – 75%



HEATING STAGES OPERATION

4.3.3 Time Proportioned

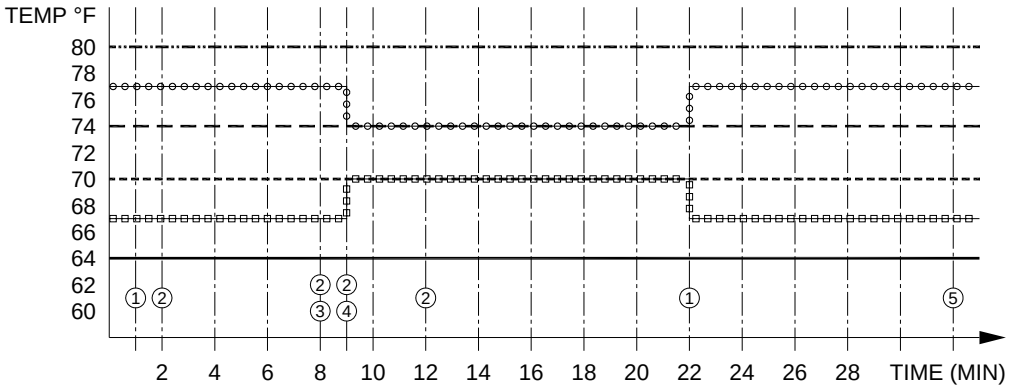
If Reheat Type is set for Time Proportioned, Heating Output 1 is controlled on a 10 second based, time-proportioned manner. Similar to the modulating reheat configuration, if the heating loop is less than 10%, the heating output shall remain at zero.

4.3.4 Floating

If Reheat Type is set for Floating, Close Valve (Heating Output 1) and Open Valve (Heating Output 2) are controlled in a manner similar to the Damper Motor. If the appropriate heating loop is less than 30%, the valve is driven closed. If the loop is greater than 70%, the valve is driven open. If the loop is in between, no valve action is taken.

5 LOCAL LIGHTING

If the unit is configured with Local Lighting Control enabled (ON), the Lighting output (Heat Binary Output three) is energized upon first detected motion when in Standby Mode. Lighting remains on while Occupancy Mode is set to Occupied and off during all other modes. If no other motion is detected during Standby Mode or the unit transitions from Occupied Mode to Standby Mode, the lighting output remains on for the delay specified in Lighting Off Delay before being de-energized.



STANDBY OPERATION

6 DUAL DUCT SPECIFIC SEQUENCES AND OPTIONS

6.1 Controller Configuration

6.1.1 VAV and CAV

The Dual Duct VAV and CAV box configurations consists of separate primary heating and cooling ducts, both with control dampers and airflow monitoring (via duct pressure). In these configurations, the VAV controller is mounted on the cooling damper and an external actuator is mounted on the heating damper.
Airflow equations for VAV and CAV are as follows:

Heating Loop Active:
Primary Flow Setpoint = MinCoolingAirflow
Secondary Flow Setpoint = (MaxHeatingAirflow – DualMixingMin) * HeatingLoop/100 + DualMixingMin

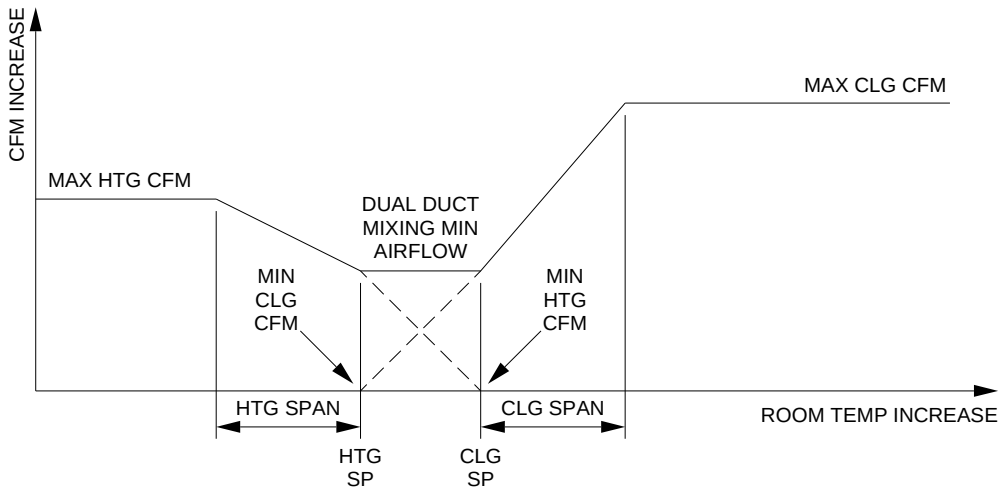
Inside Deadband:
Primary Flow Setpoint = (DualMixingMin – MinCoolingAirflow – MinHeatingAirflow) * [(RoomTemperature - ActiveCoolingSetpoint) / (ActiveCoolingSetpoint – ActiveHeatingSetpoint)] + MinCoolingAirflow

Secondary Flow Setpoint = (DualMixingMin – MinHeatingAirflow – MinCoolingAirflow) * [(ActiveHeatSetpoint - RoomTemperature) / (ActiveCoolingSetpoint – ActiveHeatingSetpoint)] + MinHeatingAirflow

Cooling Loop Active:
Primary Flow Setpoint = (MaxCoolingAirflow – DualMixingMin) * CoolingLoop/100 + DualMixingMin
Secondary Flow Setpont = MinHeatingAirflow

In the above equations, the opposite mode minimum (i.e. cooling minimum airflow when in heating) is subtracted from the airflow setpoint.

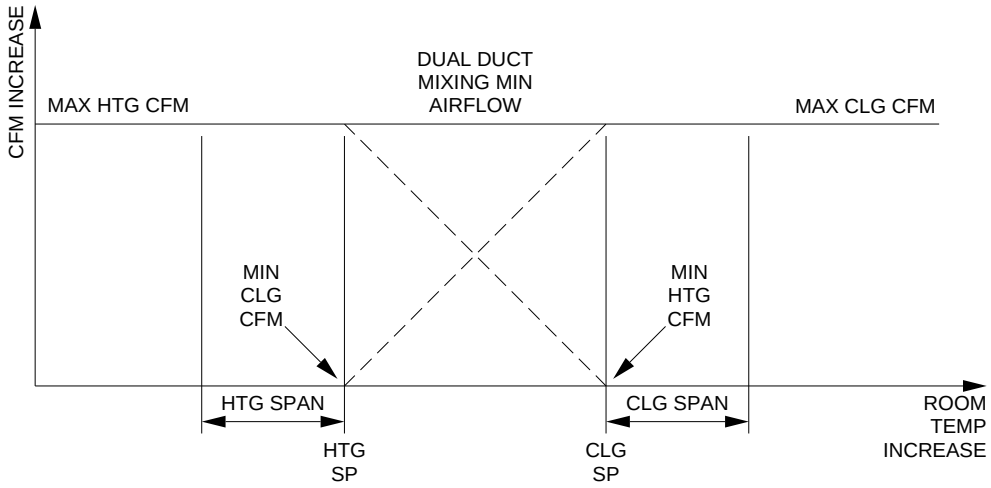
6.1.1.1 Variable Volume
In a Variable Volume Dual Duct configuration, the Dual Duct Mixing Min Airflow is set to the designed minimum mixing airflow (non-zero). The Max Cooling Airflow and Max Heating Airflows are set to their designed values and may be the same or different from each other.



DUAL DUCT VARIABLE VOLUME AIRFLOW

6.1.1.2 Constant Volume

In a Constant Volume Dual Duct configuration, the Max Cooling Airflow, Max Heating Airflow and Dual Duct Mixing Min Airflow are all set the same. This has the effect of maintaining constant airflow over the entire temperature range of the controlled space.



DUAL DUCT CONSTANT VOLUME AIRFLOW

6.1.2 Supply/Exhaust Tracking

Supply/Exhaust Dual Duct configurations typically consist of a supply box including reheat that supplies pressure independent constant air to the room and an exhaust box that controls airflow that maintains either a positive or negative pressure in the room. The VAV controller is mounted on the supply box and an external actuator is mounted on the exhaust box.

Supply/Exhaust tracking can either be configured for tracking via percent (%) offset or to a differential pressure setpoint. If the controller is configured for Supply/Exhaust Tracking via % Offset, Heating Output 1 and Heating Output 2 manipulate the external actuator to maintain the calculated secondary flow setpoint (with offset applied). External Airflow Setpoint is set to the Primary Airflow Setpoint times the Supply/Exhaust % Offset. If the controller is configured for Supply/Exhaust Tracking via differential pressure, Heating Output 1 and Heating Output 2 manipulate the external actuator to maintain the differential pressure setpoint; the External Airflow Setpoint is not used.

6.1.3 Indoor Air Quality

Dual Duct Indoor Air Quality (IAQ) box configurations consist of conditioned air supplied to one duct and tempered outdoor air supplied to the other duct as well as reheat at the unit discharge. In these configurations, the VAV controller is mounted on the primary damper and an external actuator is mounted on the fresh air damper.

If the unit is configured for Indoor Air Quality, Primary Airflow Setpoint is calculated based on the demand for cooling or heating depending on whether Cooling Loop or Heating Loop is presently active (greater than zero). The primary controller will control similar to a single duct VAV controller (as configured by the configuration variables).

The External Airflow Setpoint is based on the occupancy state. In Standby Mode, the External Airflow Setpoint will be the Minimum Ventilation Airflow. In Occupied Mode the External Airflow Setpoint will be the Maximum Ventilation Airflow.

6.1.3.1 CO2/Ventilation Control (Preliminary)

NOTE: The following CO2 (IAQ) sequence is PRELIMINARY. Initially, only a fixed airflow sequence based on occupancy state will be implemented. If a CO2 input is added, the sequence will be further defined.
Every 7 days, the lowest CO2 Level (AI8) reading from the previous 7 days is stored in CO2 Unoccupied Level.
As the CO2 Level rises from, the External Airflow Setpoint modulates from Min Ventilation Airflow to Max Ventilation Airflow as the measured CO2 level travels from 50% to 100% of the span between CO2 Unoccupied Level to CO2 Max Setpoint.

7 BALANCING

PRELIMINARY: See IOM for BAC-8000 Controllers or STE-8000 Wallsensors for a description of the balancing sequence.

NOTE: The sequence describes the necessary operation of the balancing sequence. Exact implementation may vary once the STE-8XXX is available for testing. The intent of this section should be implemented, using a STE-8XXX and Control Basic sequence(s).

To enter the balancing sequence, Balance Mode is set to ACTIVE via the STE-8XXX wall sensor. Balance mode assumes control of the terminal and locks out the unit from performing any other control routines. Once activated, the damper will modulate open in an effort to control at the higher of maximum cooling or maximum heating airflow. Once the user enters the actual measured flow, the unit will transition, modulate closed, and control to the lower of the minimum cooling or heating airflow. When a measure value is entered for the cooling minimum, the correction constants are calculated and the balance mode is ended.

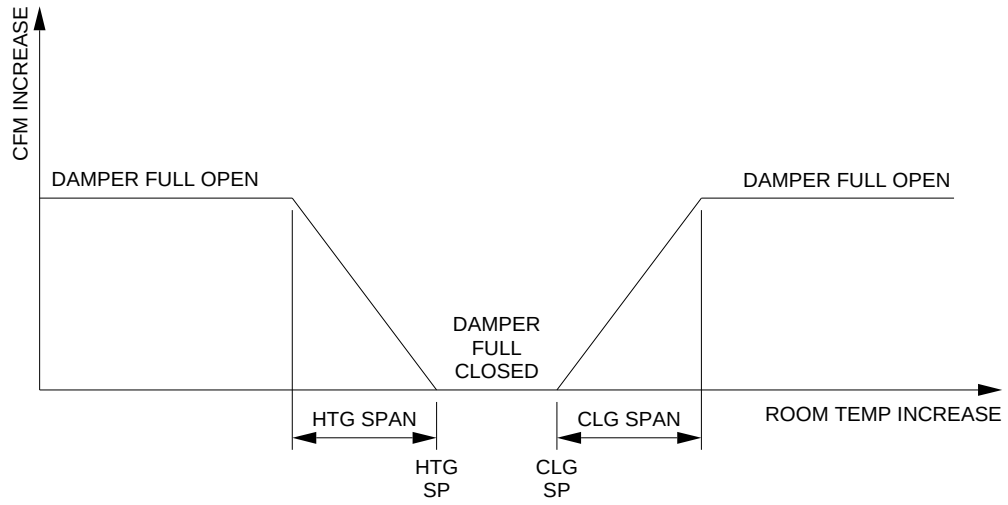
At the conclusion of the balancing sequence, or a high to low transition on the balancing binary variable, a smoke unit (BAC-820X) will stroke full open and full closed in order to measure the true span of the damper travel. The min and max values are used for positive feedback indication when a smoke command is verified.

Using the values obtained at the Minimum CFM operation, a correction factor is calculated and stored in Primary Airflow Lo Flo Corr. This value is used for correcting reading below the normal CFM operating range of the unit.

While the damper is being driven, the Primary Airflow Setpoint should be displayed on the STE-8XXX along with necessary indicators denoting the value being configured. While the unit is tuning to the appropriate airflow, the setpoint segment(s) (i.e min or max, and setpoint) shall also flash to indicate that the desired airflow setpoint has not been reached and the setpoint value should be on solid. When the unit has reached the appropriate setpoint, the airflow setpoint value should flash to denote that value is ready to accept user input and the setpoint segment(s) (i.e min or max, and setpoint) shall be on solid.

After the minimum measured airflow is configured, the device shall return to run mode and operate accordingly.

For Dual Duct models , this sequence shall be performed twice, once for the Primary Duct Airflow and once for the External (Secondary) Duct Airflow using the appropriate objects as necessary. When transitioning from the Primary Duct balance sequence to the External Duct balance sequence, the user/technician shall be able to exit the sequence if desired.



SINGLE DUCT PRESSURE DEPENDENT AIRFLOW

8 APPENDIX: OTHER CONTROL SEQUENCES

8.1 Pressure Dependant Operation

NOTE: The pressure dependant sequence is not part of the initial implementation, nor is the an appropriate hardware model available. This section is for future reference only.

If the unit is configured for Pressure Dependent control, the Damper Motor (AO7) is driven by Cooling Loop (LOOP2) or Heating Loop (LOOP3), whichever is active (> 0). Damper Motor is set to the value of the currently active loop divided by 10.