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Viconics BACnet Zoning System Engineering Guide Specification

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1.01 System Description – The Viconics BACnet Zoning System (VBZS) shall provide a simple and efficient demand based system for the operation of changeover bypass or pressure dependent type zoning systems utilizing standard 2 heat / 2 cool configurations, 2 heat / 2 cool with economizer and IAQ, analog heat/2 cool, or heat pump 3 heat/ 2cool. The system shall consist of two primary components as manufactured by Viconics: A communicating rooftop unit controller / heat pump controller (model VZ7656x1000B) and one/several communicating zone controllers (model VZ7260x5x00B). A local BACnet MS_TP communication bus between all devices shall ensure proper communication and data exchange of all required information between the zone controllers and the rooftop unit controller for proper system operation. The system shall seamlessly integrate into any 3rd party BACnet supervision system adding greater functionality without being limited to a single vendor. Controls that can only be integrated into a proprietary non-open protocol network shall not be acceptable. All system configuration tools shall be embedded within the local devices via real text configuration interface. Systems requiring external tools for commissioning or configuration shall not be acceptable.

1.02 Quality Assurance - The control system shall be manufactured within a systems certified ISO-9001 and ISO-14001. Please see the Equipment section for industry approvals and specifications.

Part 2 – Equipment

2.01 General - The VZ7656x1000B Rooftop controller shall be designed for equipment control based on heating and cooling demands from the zone controller(s) (VZ7260). The **packaged rooftop or heat pump** system controller VZ7656 shall also provide logic and required inputs/outputs to control system specific static pressure. The VZ7260F5x00B zone controllers shall be designed for local pressure dependent VAV control.

Communication Protocol – The control system shall communicate using the open-protocol BACnet MS_TP over RS485. Zone controls shall be configured directly from the local keypad to communicate with a specific Rooftop Unit controller. All zone and Rooftop Unit controllers must reside on the same network. All controllers in the network shall communicate at the same baud rate in order to properly exchange information. Baud rate for system shall be set at Rooftop/system controller (VZ7656). Zoning control controller shall feature “Auto-baud capability” allowing system baud rate configuration from Rooftop controller to be matched by zoning controller(s) thereby facilitating system configuration and commissioning.

Scalability – The system shall be fully scalable in terms of number of zone controllers and Rooftop Unit controllers used on the same BACnet MS_TP communication trunk. A segment shall be a shielded network loop run between all communicating device connections. The segment shall be no longer than 1200 meters (4000 feet). A single network segment shall be capable of installing up to 64 nodes (of either type of controller). To install more than 64 nodes or if the network wire loop is longer than 1200 meters

(4000 feet), repeaters shall be used to ensure proper communication. With repeaters and a BACnet MS_TP supervisory system, the maximum number of nodes on a single BACnet MS_TP trunk can be extended to 128 nodes (of either type of controller).

Overall system architecture shall be open-standard based upon Building Automation Control network (BACnet) standard facilitating the future replacement or addition of other system components, quickly and easily. System functionality shall be scalable to suit current and future building automation needs with simple addition of other BACnet based building controllers. System shall support supervisory functionality (supplied by others) which will support centralized scheduling, alarming and trending found commonplace amongst today's advanced automation systems.

Systems not capable of supporting supervisory BACnet workstations shall not be acceptable.

Communication Wiring and Layout – The wire shall be a balanced 22-24 AWG twisted pair with a characteristic impedance of 100-130ohms, capacitance of 17 pF/ft or lower, with a braided shield. The RS485 network requires a daisy chain configuration. A BACnet MS_TP network must be properly terminated at each end of the daisy chain with an EOL (End of line) resistor. The polarity of the network connections must be respected.

Functionality – The VBZS shall be capable of operating without external input from a supervisory system. The control system however, shall be capable of communicating with any 3rd party BACnet MS_TP compatible supervisory system, graphic user interface, charts and log software, advanced energy management software, automatic response to alarms etc.

VZ7656x1000B BACnet Rooftop or Heat Pump Controller

The Rooftop unit Controller shall be:

VZ7656R1000B: Up to two heating and two cool stages, single fan speed output, 0-10Vdc output for bypass damper or variable-frequency drive (VFD).

VZ7656F1000B: Modulating 0-10Vdc heating / 2 cooling stages, single fan speed output, 0-10Vdc output for bypass damper or variable-frequency drive (VFD).

VZ7656E1000B: Up to two heating and two cooling stages, single fan speed output, 0-10Vdc output for economizer actuator, 0-10Vdc output for bypass damper or variable frequency drive (VFD), indoor air quality sequence (IAQ)

The Heat Pump Controller shall be:

VZ7656H1000B: 2 stage compressor with reversing valve and auxiliary heat, single fan speed output, 0-10Vdc output for bypass damper or variable-frequency drive (VFD)

General VZ7656 Specifications:

- VZ7656 controller shall be capable of controlling single or multistage HVAC units with automatic changeover based on zone demands using the BACnet MS_TP communication protocol on RS485.
- The controller shall have the option of analyzing the PI heating or PI cooling demands from the zones the following ways depending on the application:
    1. **Highest:** The highest PI heating or PI cooling demand from the selected voting zones shall dictate heating or cooling operation of the Rooftop Unit controller.
    2. **Average of the three (3) highest demands:** The average of the three (3) highest PI heating or PI cooling demands from the selected voting zones will dictate heating or cooling operation of the Rooftop Unit controller.
    3. **Average of the five (5) highest demands:** The average of the five (5) highest PI heating or PI cooling demands from the selected voting zones will dictate heating or cooling operation of the Rooftop Unit controller.

- The controller shall be capable of maintaining the system static pressure set point using integrated proportional static pressure logic to modulate a bypass damper. A pressure transducer with a 0-5Vdc output shall be wired directly to the VZ7656 controller. The controller shall have an adjustable static pressure sensor range from 0-5" W.C. The control will output an analog signal from 0-10Vdc to the bypass damper. A control system requiring a separate bypass damper controller or separate sensors to display the bypass damper position is not acceptable.
- The controller shall have EEPROM memory to prevent a loss of programming due to power outage as well as a minimum of 6-hour reserve time for the internal clock.

- The controller shall be capable of operating the packaged unit even if there is a loss of communication with the zone controllers. The packaged unit will run in heating or cooling based on the return air temperature. If there is no return air sensor installed, the controller shall automatically revert to the internal temperature sensor. Control systems that cannot operate the packaged during a loss of communication with the zones are not acceptable.
- The VZ7656 controller shall be 7 day programmable with a choice of 2 or 4 events per day. Control systems that require an external time clock are not acceptable.
- The controller shall have an adjustable (from 0 to 5 minutes) minimum On/Off operation time of cooling & heating stages to prevent cycling.
- The controller shall have a connection for an outdoor air temperature sensor. The outdoor air temperature readings shall be used to lockout the system heating or cooling modes to prevent equipment cycling as well as to lockout zone auxiliary heating (duct furnace and/or perimeter heater).
- **The controller shall have a connection for a remote discharge air temperature sensor. The discharge air temperature readings shall be used for monitoring purposes and can be viewed directly on the LCD screen. The controller must have an adjustable discharge air heating high-limit range of 70°F to 150°F (21°C to 65°C) as well as a discharge air cooling low-limit range of 35 to 65°F (2.0°C to 19.0°C).**
- **The controller shall have a connection for a remote return air temperature sensor. The return air temperature readings shall be used for monitoring purposes as well as a backup to controlling the RTU in case of a loss of communication with the zone controllers. The return air temperature can be viewed directly on the LCD screen. The controller must have an adjustable return air heating high limit and return air cooling low limit.**
- The controller shall have a lockable keypad with the following three lockout levels to prevent changes to the settings from the keypad:

	Global Unocc Override	**System mode setting**	**Schedule setting**	**Clock setting**
Levels	**Override ** ….Y/N**	**Sys mode set Y/N**	**Schedule set Y/N**	**Clock set Y/N**
0	Yes access	Yes access	Yes access	Yes access
1	Yes access	No access	No access	Yes access
2	No access	No access	No access	Yes access

- The controller shall have the ability to set the programmed occupied schedule time as the time at which the desired occupied temperature setpoints will be attained at the zones. The controller shall automatically optimize the equipment start. This progressive recovery feature can be enabled or disabled.
- The controller must have a programmable digital input that can be setup for the following functions:
    1. **Service:** a backlit flashing “SERVICE” alarm will be displayed on the controller LCD screen when the input is energized.
    2. **Filter:** a backlit flashing “FILTER” alarm will be displayed on the controller LCD screen when the input is energized. The input can be tied to a differential pressure switch to monitor filter status.
    3. **Remote NSB:** Timer clock input for remote night-setback. This function shall automatically disable the internal scheduling.
    4. **Remote OVR:** Temporary occupancy remote contact. This function shall disable all override menu functions.
- The controller shall have “Smart Fan” operation to reduce energy consumption during unoccupied periods.
- The controller shall a fan delay that extends fan operation by 60 seconds after calls for heating or cooling stage operation ends (can be enabled or disabled by the local keypad).
- The controller shall have a configurable SPST output relay that can be used for lighting, exhaust fan or fresh air control.

Packaged unit controller model dependent specifications:

VZ7656R1000B: Up to two heating and two cool stages, single fan speed output, 0-10Vdc output for bypass damper or variable-frequency drive (VFD).

VZ7656F1000B: Modulating 0-10Vdc heating / 2 cooling stages, single fan speed output, 0-10Vdc output for bypass damper or variable-frequency drive (VFD).

Specifications

- The VZ7656F1000B shall have a configurable minimum supply temperature between **50 °F to 72 °F (10 °C to 22 °C)** to be maintained during occupied mode. This parameter shall only be active when the controller is in occupied mode, in heating mode and if the outdoor temperature is low enough to prevent heating stage lockout.

VZ7656E1000B: Up to two heating and two cooling stages, single fan speed output, 0-10Vdc output for economizer actuator, 0-10Vdc output for bypass damper or variable frequency drive (VFD), indoor air quality sequence (IAQ).

Specifications

- The VZ7656E1000B shall have capable of controlling the economizer for free cooling depending on the outside air temperature.
- If a fresh air station is used to measure CFM, the VZ7656E1000B shall have a 0-5 Vdc analog input for a fresh air station transmitter to enable the Min/Max CFM control logic.
- If CO2 levels must be maintained, the VZ7656E1000B can receive CO2 demands from the VZ7260x5x00B controls and control the economizer to maintain a minimum and maximum C02 range. The default minimum and maximum CO2 set points shall be 800ppm and 1200ppm respectively.

The Heat Pump Controller shall be:

VZ7656H1000B: 2 stage compressor with reversing valve and auxiliary heat, single fan speed output, 0-10Vdc output for bypass damper or variable-frequency drive (VFD)

BACnet Zone Controller

VZ7260 Zone Controller –

- The zone controller shall be capable of controlling a local VAV analog damper actuator as well as a local duct furnace and on/off or PWM perimeter heater (if necessary). The zone controller shall also be capable of auto-changeover based on the central VZ7656 controller signal.
- The zone controller shall be capable of modulating the local VAV damper using integrated damper control logic. The output signal shall be 0-10Vdc to modulate any standard analog damper actuator. The minimum damper position and maximum damper position shall be programmed directly on the controller keypad. Control systems that are mounted next to the damper or require mechanical damper stops are not acceptable.
- The zone controller shall have an output to control a duct furnace. The zone controller shall also have an output for an on/off or PWM (SSR) perimeter heater.
- The zone controller shall achieve accurate temperature control using a PI proportional-integral algorithm. Traditional differential-based controllers are not acceptable.
- The zone controller shall communicate with the Rooftop Unit controller VZ7656x1000B using the BACnet MS_TP protocol on RS485. The zone controller shall have adjustable PI heating and PI cooling weight from 0% to 100% in 25% increments to allow certain zones a higher priority versus other zones.
- The zone controller shall have a 0-10Vdc input for a CO2 transmitter for monitoring purposes or to be used in conjunction with the VZ7656E1000B economizer model for CO2 level control.
- The zone controller shall be compatible with the VI-PIR “passive infrared” occupancy sensor to enable a “Stand-by” occupancy mode for additional energy savings.
- The zone controller shall have a lockable keypad with the following three lockout levels to prevent changes to the settings from the keypad:
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Lockout	Keypad lockout levels. Default: **0 = No Lockout**		
Levels	**Occupied temperature setpoints**	**Local Override Only**	**Global Override Access**
0	Yes access	Yes access	Yes access
1	Yes access	Yes access	No access
2	Yes access	No access	No access
3	No access	No access	No access

The zone controller shall have a binary input that can be configured as follows:

BI1	Binary input no.1 configuration Default: **None**	**(None):** No function will be associated with the input. Point can still be monitored through the BACnet network. **(Motion NO):** Used in Occupied Mode only to toggle from the Occupied setpoints to the Stand-By setpoints when no motion is detected for 60 minutes at the zone. As soon as motion is detected at the zone, the Occupied setpoints resumes. Contact opened = No motion detected. Contact closed = Motion detected **(Motion NC):** Used in Occupied Mode only to toggle from the Occupied setpoints to the Stand-By setpoints when no motion is detected for 60 minutes at the zone. As soon as motion is detected at the zone, the Occupied setpoints resumes. Contact opened = Motion detected. Contact closed = No motion detected

- The zone controller shall be capable of receiving the outdoor air temperature signal from the RTU controller to lockout (if necessary) the zone's analog reheat and/or the zone's perimeter heating.
- The zone controller shall have configurable temporary or permanent local override setpoints. When the "temporary setpoints" mode is enabled, once the temporary occupancy timer expires, the setpoints will revert back to their default values.
- The zone controller shall have adjustable maximum heating and minimum cooling setpoints to prevent locking conditions at the Rooftop Unit controller by having setpoints that are not reachable.

Sequence of Operation –
The Viconics BACnet Zoning System shall operate in the following manner:

1. The VZ7656x1000B Rooftop Unit controller shall determine the mode of operation (heating / cooling) by analyzing the PI heating and PI cooling demand sent by the weighted VZ7260x5x00B zone controllers. The RTU controller shall supply heating or cooling based on the resulting analysis (highest demand, average of three highest demands or average of five highest demands). There is a mandatory two-minute delay between switchovers from heating to cooling to prevent cycling.
2. The Rooftop Unit controller shall also monitor the static pressure sensor and modulate the by-pass damper actuator accordingly to maintain the static pressure setpoint.
3. The Rooftop Unit controller shall monitor, return air temperature. If the high temperature limit or low cooling temperature limit occurs, the Rooftop Unit controller will shut off heating or cooling to prevent damage.
4. The Rooftop Unit controller shall monitor the outdoor air temperature and send the value to the zone controllers to allow outside air lockout conditions at the zone level.
5. The VZ7260 zone controller(s) shall send the actual PI heating or PI cooling value multiplied by the weight reduction factor (if necessary) to the Rooftop Unit controller.
6. The zone controllers shall modulate the local VAV damper to maintain the setpoint temperature. Using the integrated PI algorithm, the controller will determine if heating or cooling is required. If the particular zone has auxiliary reheat enabled, the auxiliary reheat (duct furnace and/or perimeter heater) will be used if necessary. If the Rooftop Unit is in cooling mode and supplying cold air and a particular zone requires cooling, the damper will modulate to supply the duct furnace enough air to heat to try and attain the heating setpoint.
7. The zone controllers will cycle (on the LCD screen) between outdoor temperature, actual Rooftop Unit occupancy and actual Rooftop Unit heating/cooling mode.
8. In case of a loss of network, the RTU unit will continue to control the Rooftop Unit based on the return air temperature.
9. The VBZS can be integrated to any BACnet MS_TP DDC central workstation.

Sequence for economizer on VZ7656E1000B only:

The fresh air damper can be controlled through more than one sequence to achieve different control strategies such as free cooling (economizer mode), minimum fresh air control and CO_2 level control.

Note: For the sequences mentioned below, the following conditions must be met in order for the sequences to be performed as stated:

- Max Pos parameter value must be greater than Min Pos Parameter value.
- Mac CO_2 parameter value must be greater than Min CO_2 Parameter value.
- Max FA parameter value must be greater than Min FA Parameter value.

Economizer Control Mode Only

If the fresh air damper is to be used only for free cooling purposes (economizer mode, without fresh air measurement station or CO_2 control), only the Min Pos parameter and the free cooling sequence will be active.

- The FA Range parameter should be set to 0 CFM. (Default Value = 0 CFM)
- Set the Chngstpt parameter to desired value which free cooling is enabled. (Default Value = 55°F)

If the outside air temperature is greater than the changeover setpoint, then normal mechanical cooling will be used. If the outside air temperature is less than or equal to the changeover setpoint, then free cooling will be enabled and mechanical cooling stages will be locked out.

Economizer Mode and Fresh Air Measurement Station

If the fresh air damper is to be used for both free cooling and minimum fresh air volume control (economizer mode and fresh air measurement station, but without CO_2 level control), only the Min FA parameter and the free cooling sequence will be active.

- The FA Range parameter should be set to a value higher than 0 CFM (0 CFM disables the fresh air control).
- Min FA (minimum fresh air) parameter should be set to the desired level.

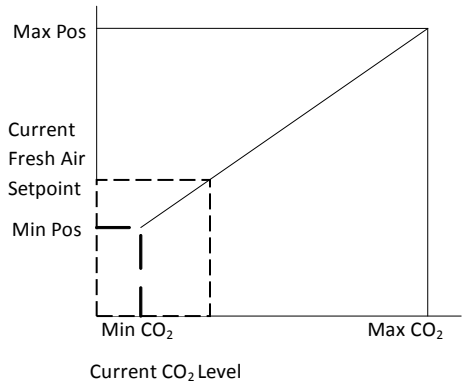
The FA Range parameter value should be set to the maximum capacity of the fresh air measurement station. Therefore the relationship between air volumes and input signals can be established. For example, if the fresh air station capacity is 10000 CFM, set FA Range to 10000.

This will set the relationship of 0 VDC = 0 CFM and 10VDC = 10000 CFM.

Economizer Mode and CO_2 Level Control

If the fresh air damper is to be used for both free cooling and CO_2level control (economizer mode and CO_2 level control, but without fresh air measurement station), only the Min Pos, Max Pos, Min $CO_2$and Max CO_2 parameters as well as the free cooling sequence will be active.

- The FA Range parameter should be set to 0 CFM.
- Set AI1 parameter to CO_2 (0 VDC = 0ppm ; 10VDC = 2000ppm)
- Min Pos, Max Pos, Min CO_2 and Max CO_2 parameters should be set according to the required setting.

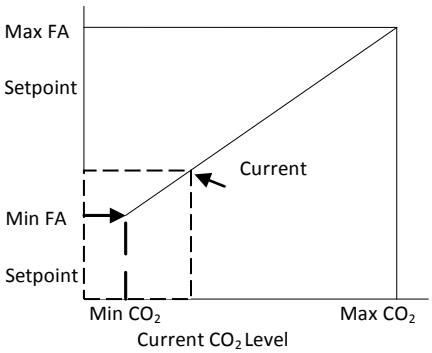


The highest value between free cooling demand output and interpolation output for the fresh air setpoint will be the output to the fresh air damper.

Economizer Mode, CO_2 Level Control and Fresh Air Measurement Station

If the fresh air damper is to be used for both free cooling and CO_2 level control with a fresh air measurement station, only the Min FA, Max FA, Min CO_2 and Max CO_2 parameters as well as the free cooling sequence will be active.

- The FA Range parameter should be set to something other than 0 CFM.
- Use an air flow transmitter to read fresh air level with AI2 input (0-5 VDC input)
- Min FA, Max FA, Min CO_2 and Max CO_2 parameters should be set according to the required setting.



The highest value between free cooling demand output and interpolation output for the fresh air setpoint based on the CO2 level will be the output to the fresh air damper