GREENHECK Vektor System Control User Guide

GREENHECK
Building Value in Air.

Vektor System Control
User Guide

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Vektor System Control

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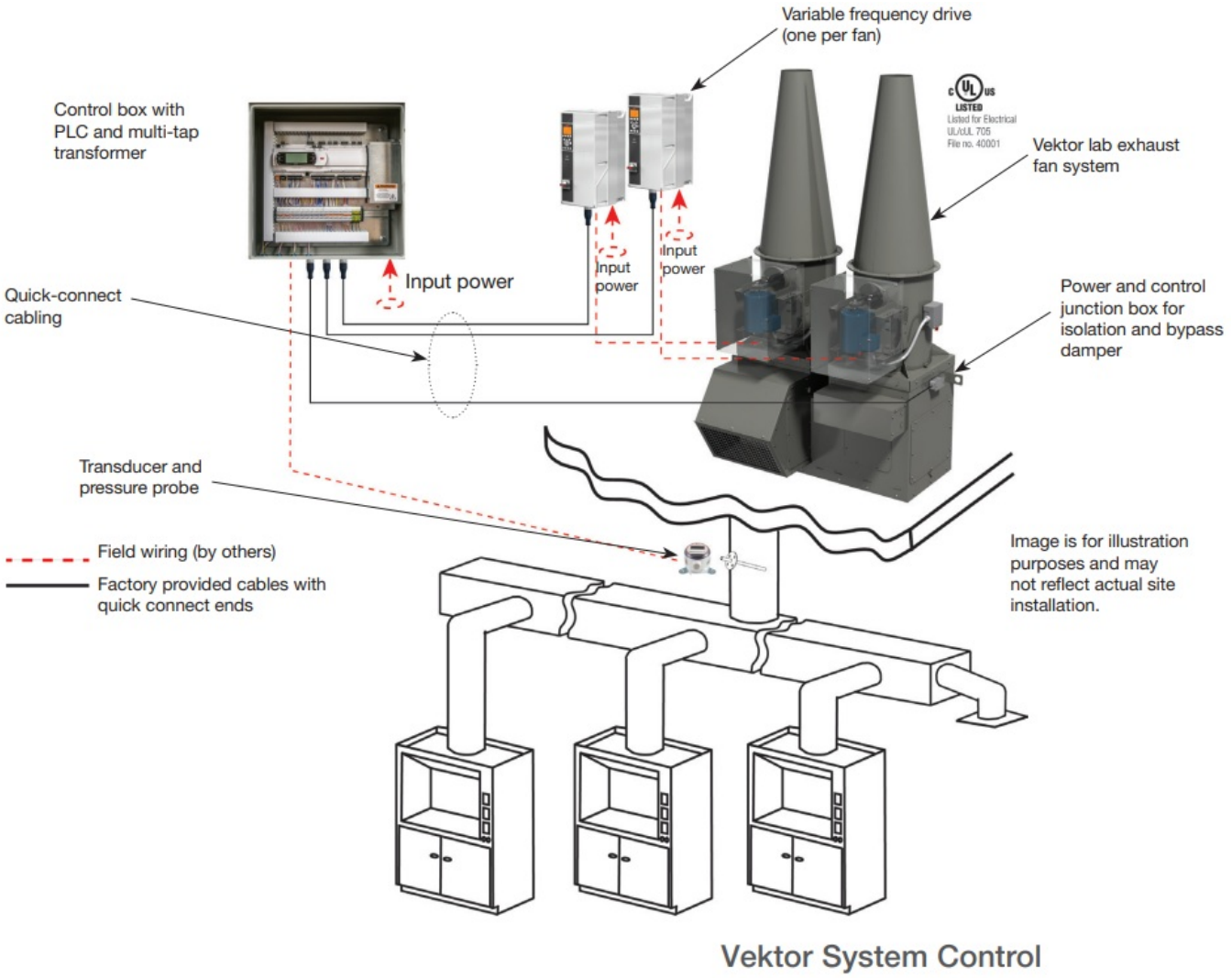
PRODUCT INFORMATION
Vektor® System Control
Comprehensive Guide
The Vektor® System Controls (VSC) package offers pre-engineered components and sequences of operation to easily integrate Greenheck Vektor exhaust fans into a variable or constant volume lab exhaust system. This system is suitable for the following options and configurations.

- Vektor models H, MH, MD, CH, CD
- 1×1 or 2×1 fan configurations (maximum of two fans & isolation dampers)
- N+1, N-1 or no redundancy
- Single or dual bypass damper applications

Duct pressure modulation, fan speed, isolation damper and bypass damper control are all handled by the Vektor System Control.



Maintain Duct Static Pressure

There are three key control loops associated with the operation of a typical variable volume lab exhaust system:

1. Maintain negative pressure in the lab area relative to adjacent hallways, offices or conference rooms.
2. Provide a safe chemical fume hood face velocity for various sash positions.
3. Ensure negative pressure in the exhaust duct for fume containment.

The Vektor exhaust fans provide a critical component in meeting these requirements by maintaining a consistent negative duct static pressure downstream of the chemical fume hoods, storage cabinets, or other lab exhaust ventilation locations. Too much duct static pressure can cause ducts to implode or ventilation equipment to fail. Too little duct static pressure can impact the operation of chemical fume hood valves and impact the speed of proper containment when chemical fume hood sashes are opened. Locating the duct static pressure probe can impact the ability to keep the lab valves in safe operation.
There are options with some more effective than others

- Measure duct static pressure at the fan system bypass plenum
  Although measuring in the plenum gives the largest pressure reading, it can have accidental variation due to the bypass damper(s) operating, along with turbulent airflow within the plenum. We do not recommend this location if the system requires very precise control. If the desired location is at the plenum, a good alternative is in the ductwork just prior to the plenum, to mitigate the effects of the bypass damper(s) and plenum.
- Measure duct static pressure 2/3 3/4 down the main duct trunk
  ASHRAE handbook suggests locating the pressure probe 2/3 3/4 down the main trunk as the ideal location. Because the location is closer to the valves, the pressure reading will measure quickly to make the system respond.
- Measure at furthest or most critical exhaust valve

Measuring at the most critical valve will ensure that the static pressure will always be maintained but can induce nuisance fluctuations if the valve frequently makes large changes.

- Care should be taken when locating probes. The preferred location is in straight duct section. Avoid placing the probes right after transition or elbows.

Vektor Exhaust System Control

There are three different VSC control strategy options available:

- Control bypass damper only (constant fan speed)
  This control theory is the most basic, as the fan is kept at a constant speed, and only the bypass damper is modulated to maintain duct static pressure. This strategy maintains a constant discharge velocity and effective plume height. The VFD component of the controls system is used for test and balance to meet design CFM and outlet velocity. The maximum and minimum fan speed is set to be the same. This is the least energy efficient control sequence but is still very common on small systems or when flow demand is constant.
- Control fan speed only (no bypass air)
  This control strategy is used primarily on small systems where outlet velocity and constant effective plume height are not an operational constraint. This allows for a more energy-efficient operation. As the fan speed changes it follows a horizontal operating line on the fan curve at the set pressure, versus a standard system resistance curve line without a set pressure. In other words, the fan stays at a constant static pressure with RPM change.
- Control fan speed and bypass air damper
  Modulating both fan speed and bypass air damper position, the system can achieve the widest operating range and highest turndown within the lab. This allows for the greatest operational cost savings as tempered make-up air is reduced. This strategy is typically not used for systems requiring a set outlet velocity or constant

effective plume height. A minimum fan speed can be programmed however to ensure operation above a defined point. The Vektor System Control utilizes a sequence that only uses the bypass damper when the fan is at minimum operating speed, field adjusted during T&B.

Use care in setting the minimum drive frequency because the potential for an unstable operation of the fan (surge area) can occur. The minimum speed is typically set to a corresponding nozzle outlet velocity or nearing surge on the fan curve.
If desired, switching between different control strategies can be accomplished in the field if the required fan system components are present.

Redundancy (Emergency Cutover) & Primary Fan Rotation

The second VSC control function deals with exhaust fan redundancy and primary fan rotation. The Vektor system in CAPS® (Greenheck's Computer Aided Product Selection program) is configurable for three different types of redundancy: None, N+1 or N-1. Redundancy choices affect system operating power, sound and equipment size.

- None

  There is no redundancy in the system. If there is a failure or shut down, then the laboratory operates at reduced or no air capacity.
- N+1 redundancy, fan on standby

  The system with N+1 redundancy includes an extra fan with 100% performance capabilities that waits on standby, unpowered. The control function in this sequence monitors and engages the redundant fan if one of the primary fan(s) fails. The redundant, standby fan is activated when a problem occurs, and the primary fan is powered off. Multi-fan systems with N+1 redundancy include an extra control loop of primary fan rotation. Primary fan rotation function allows for equal runtime of all fans. Although the concept is simple, one fan off the other fan(s) on, the sequence is more complex to maintain duct static pressure during rotation. The Greenheck VSC includes this control loop to rotate the primary and standby fan while maintaining duct static pressure. Systems with N-1 or no redundancy do not utilize this control loop.
- N-1 redundancy, excess capacity reduced normal operation power

  Think of N-1 redundancy as spare capacity. Every exhaust fan on the system is engaged during normal operation. But all the fans are capable of increased load if one of the fans fails. In this control method, the VSC increases the fan speed on the remaining operating fan(s) to maintain duct static pressure. This method reduces normal operation cost while still having 100% redundancy. This control theory is common on three-plus fan systems and can result in smaller fan sizes and lower sound during normal operation.

Vektor System Control Communication

BACnet® IP and BACnet MS/TP are all supported communication protocols to the building management system (BMS).

What Comes in the System

The electronics components within the VSC ship loose for field installation. All system control components are outdoor-rated allowing for freedom of installation location. The components ship via FedEx in multiple packages for easy handling and tracking.

Control Box
(1 per fan system)

Variable Frequency Drive (VFD)
(1 per fan)

Pressure Transducer
(1 per system)

Static Pressure Probe
(1 per fan system)

Nylon Tubing
(25 ft)

8 Pin Quick
Connect Cables
(3 per system)

5 Pin Quick
Connect Cables
(2 per fan)

Package 1: Control Box

- Control Box (with PLC)
- 8 pin quick connect cables (32 ft [10 m] each, 3 per control system)
- 5 pin quick connect cables (16 ft [5 m] each, 2 per fan)
- Duct pressure kit
    - Pressure transducer
    - Static pressure probe
    - Nylon tubing (25 ft)

Package 2: VFD, fan #1
Package 3: VFD weather shield, fan #1
Package 4: VFD, fan #2 (if two fan system)

Package 5: VFD weather shield, fan #2 (if two fan system)
Note: Orders with multiple Vektor Control Systems may ship FedEx Freight.

How to Install Vektor System Control

Physical Setup:

- Mount the control box on a suitable structure/wall within 50 ft cable length to the fan plenum.
- Connect control box to fan plenum using 8 pin cable(s). Cables can be connected end-to-end to form length required.
- Locate each VFD within 20 ft of control box.
    - Connect each VFD to the control box using supplied 5 pin cable(s). Cables can be connected end-to-end to form length required.
- Locate pressure probe in duct and transducer near probe, within 200 ft wire length to control box.
    - Wiring from pressure transducer to control box is by others.
- Power connections required by others.
    - Power to control box 120v / 1 phase or 1 leg of motor voltage (208, 230, 460 or 575 volt)
    - Power into VFD
        - Incoming voltage as selected in CAPS®
        - Power from VFD to motor/disconnect on the fan
        - Motor voltage as selected in CAPS®
- Vektor System
    - Control provides power for:
    - Isolation damper
    - Bypass damper
    - Pressure transducer

Basic Start-up/Set Points

Once all power is run and cables are connected, the system is ready to run. The system is ready to confirm each fan/ damper operation and test and balance. The system ships with duct static pressure set point of 1.0 in. wg.
Submittal Information

- Information for controls contractor
    - Communication protocols (BACnet IP, BACnet MSTP)
        - How to connect
        - VFD and PLC thru PLC
- Do not connect to VFD
- How to configure within PLC
    - What is controlled vs. what is monitored
    - Fan rotation configured by customer

Initial Start-up

- Apply power to VFD(s)

- Turn on disconnect located on VFD(s)
- Press the “Auto On” button on the VFD(s) keypad
- Apply power to the control box
- Confirm pressure transducer is powered on; the digital display on the pressure transducer will illuminate.
- Using Carel® keypad located in the control box, use up and down arrows to navigate to “On”. Press “Enter” button to turn on system.
- The control system is factory preset to start up and maintain 1 in. wg Ps; adjust this to the user desired duct static pressure set point.

Start-up Control User Interface

Unit On/Off
The Vektor system control can be turned on and off two ways; within the Carel® or by remote signal. The basic ON/OFF:

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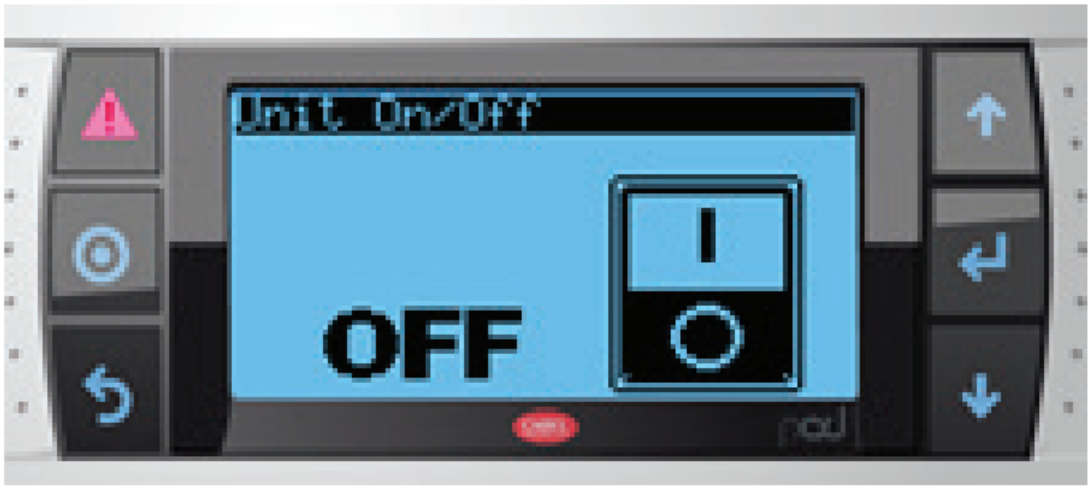
- Press 
- 

· Use  and  to turn ON and OFF. No confirmation is needed, the system will automatically start.
To change any settings:

- To enter main menu, press
- Login password 9998.

Duct Static Pressure Set Point
Factory default set to 1.0 in. wg.

- Test & Balance
- Press to enter editor.
- Use and to adjust set point on “Press 1 set point”.
- Press
- Press to return to Test & Balance menu.

Setting Minimum Fan Speed
The use of variable or constant fan speed is set using the maximum and minimum percentages.

- 

Press

- Press until fan % menu is visible.
  - 

- Press until “Min Fan %” is active.
- Use and to adjust.
- For constant fan speed set “Min Fan %” and “Max Fan %” to same value.

Configuration Redundancy
The configuration for how the Carel® maintains duct static pressure and which redundancy theory is set within the “Factory Setup”. These are set by the factory, but can be verified and adjusted, if necessary.

- If “Number Fans” = 1, and “Primary Fans” = 1
  - No redundancy is active.
- If “Number Fans” = 2, and “Primary Fans” = 1
  - I fan will be ON while the other fan will be OFF.
  - N+1 redundancy is active.
- If “Number Fans” = 2, and “Primary Fans” = 2
  - 2 fans will be ON simultaneously.
  - N-1 redundancy is active when normal operation has both fans at 50% capacity to achieve 100% of laboratory required flow.
  - No redundancy is active when normal operation requires both fans at 100% capacity to achieve 100% of laboratory required flow.

Configure Primary Fan Rotation Schedule

- Rotation type
  - Time-based based on hours runtime of the fan.
  - Schedule-based.
- Frequency
  - Weekly
    - Day of the week.
    - Hour of the day.
  - Daily
    - Hour of the day.
  - Scheduled on fan runtime.

Additional Reference Resources are available at Greenheck.com

- Sequence of Operation (SOO)
- Specification
- Installation, Operation and Maintenance Manual (IOM)
- Installation and Set-up Videos

Vektor System Control Sequence of Operation

VAV Laboratory with Constant Volume Fan Exhaust Modulating OA bypass damper and VFD to set speed

1. System Control (VSC) and building management system (BMS) able to confirm On / Off operation. VSC is On (enabled) to operate.
2. Exhaust fan(s) shall run continuously.
3. Measured duct static pressure compared to pre-set pressure set point.
   Control maintains exhaust duct static pressure set point with outdoor air (OA) bypass damper. OA bypass damper modulates to open when duct static pressure is higher than set point pressure and bypass damper will modulate to close when duct static pressure is lower than set point pressure
4. Alarm sent to BMS when exhaust duct static pressure is below set point and OA bypass damper is in maximum position.
5. Control detects fan failure through signal from VFD. Operating fan (N-1 redundancy/operation) speed is increased to maintain exhaust duct static pressure to set point. Standby fan (N+1 redundancy/operation) isolation damper is signaled to open as fan is energized to operate. Standby fan speed adjusted to maintain exhaust duct static pressure is below set point. Alarm sent to BMS of fan offline (N-1, N+1 or No redundancy).

VAV Laboratory with Variable Volume Fan Exhaust Modulating both OA bypass damper and VFD fan speed

1. System Control (VSC) and building management system (BMS) able to confirm On / Off operation. VSC is On (enabled) to operate.
2. Exhaust fan(s) shall run continuously.
3. Measured duct static pressure compared to pre-set pressure set point.
   Control maintains exhaust duct static pressure set point with outdoor air (OA) bypass damper. OA bypass damper modulates to open when duct static pressure is higher than set point pressure and bypass damper will modulate to close when duct static pressure is lower than set point pressure. At OA bypass damper full open, control adjusts fan(s) speed faster or slower through variable frequency drive (VFD) to maintain exhaust duct static pressure set point to duct static pressure.
4. Control sends alarm to BMS when exhaust duct static pressure is below set point and OA bypass damper is in maximum position and VFD at minimum fan speed setting.
5. Control detects fan failure through signal from VFD. Operating fan (N-1 redundancy/operation) speed is increased to maintain exhaust duct static pressure to set point. Standby fan (N+1 redundancy/operation) isolation damper is signaled to open as fan is energized to operate. Standby fan speed adjusted to maintain exhaust duct static pressure is below set point. Alarm sent to BMS of fan offline (N-1, N+1 or No redundancy).

For more information regarding the Greenheck Vektor System Control visit www.greenheck.com or consult your local Greenheck sales representative.

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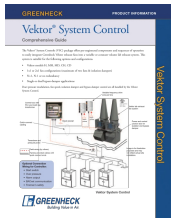
Documents / Resources

	GREENHECK Vektor System Control [pdf] User Guide Vektor System Control, Vektor System, System Control, Vektor Control

References

- Greenheck | Building Value in Air
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