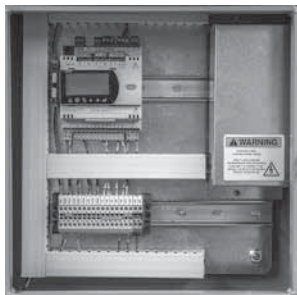


Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!



Single Fan
VGN Controller



Multiple Fan
VGN Controller

General Safety Information

Only qualified personnel should install this unit. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC), the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electrical Code (CEC) in Canada.
2. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces, or chemicals. Replace cord immediately if damaged.
3. Verify the power source is compatible with the equipment.

DANGER

Always disconnect power before working on or near a unit. Lock and tag the disconnect switch or breaker to prevent accidental power up.

CAUTION

When servicing the unit, variable frequency drives (VFD) may be hot enough to cause pain or injury. Allow motor to cool before servicing.

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Receiving

Upon receiving the product, check to ensure all items are accounted for by referencing the delivery receipt or packing list. Inspect each crate or carton for shipping damage before accepting delivery. Alert the carrier of any damage detected. The customer will make a notation of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which is countersigned by the delivering carrier. If damaged, immediately contact your Greenheck Representative. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing; report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Handling

Handle in such a manner as to keep from scratching or chipping the coating. Damaged finish may reduce ability of unit to resist corrosion.

Storage

Units are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the unit and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

INDOOR - The ideal environment for the storage of units and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain, or snow. Temperatures should be evenly maintained between 30°F (-1°C) and 110°F (43°C) (wide temperature swings may cause condensation and “sweating” of metal parts). All accessories must be stored indoors in a clean, dry atmosphere. Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid “sweating” of metal parts, allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to eliminate any moisture build up. Leave coverings loose to permit air circulation and to allow for periodic inspection. The unit should be stored at least 3½ in. (89 mm) off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

Inspection and Maintenance during Storage

While in storage, inspect equipment once per month. Keep a record of inspection and maintenance performed. If moisture or dirt accumulations are found on parts, the source should be located and eliminated.

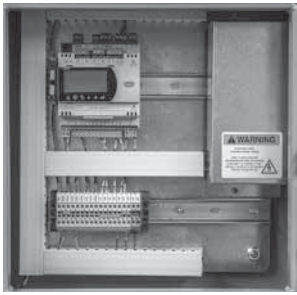
Removed From Storage

As units are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion, until the equipment goes into operation. Prior to installing the unit and system components, inspect the unit assembly to make sure it is in working order.

1. Check all fasteners, and accessories for tightness.

Variable Geometry Nozzle (VGN) Control System Components

System Components



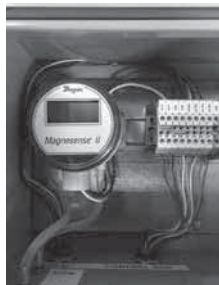
**Single Fan
VGN Controller**

The single fan nozzle controller is used to control one fan system.



**Multiple Fan
VGN Controller**

The multiple fan nozzle controller is used to control two to four fan systems.



Pressure Transducer Box
Factory-mounted on fan



5 Pin Cables, 1 per fan
Shipped in Pressure Transducer Box

8 Pin Cables, 3 per fan
Shipped in VGN Control Box



Adhesive Cable Clips and Zip Ties
Qty. 12

Customer-Supplied System Components

Quantity	Description
Varies	Wiring, conduit, miscellaneous fittings
1	Building Management System (BMS) with required communication wiring and shielding
Varies	Pressure transducer for duct pressure
1 to 4	Fan motor VFD

Quick Installation Guide

Mount VGN controller box upright with connectors *down* on structural support within 20 feet from center of fan plenum.

Connections:

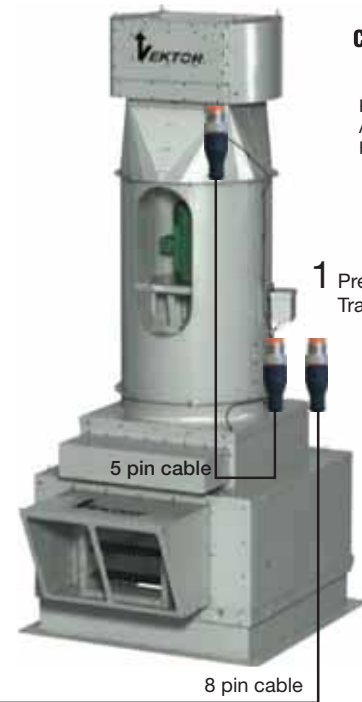
1. Connect 5 pin cable from nozzle to factory mounted pressure transducer box (repeat step for number of fans installed). Mount provided adhesive cable clips every 12 inches down fan stack and secure cable.
2. Connect 8 pin cable from pressure transducer box to VGN control box. Repeat step for number of fans installed and connect as labeled 1, 2, 3, 4 for corresponding fan. Each fan is provided with (3) 10 meter cables; use as required.
3. Run power wiring in conduit to VGN controller box.
 - 24 VAC fan run contact
 - BMS communications
 - Proper incoming power
4. All wiring by others per local codes

----- Field Wiring
 _____ GFC Provided Cables

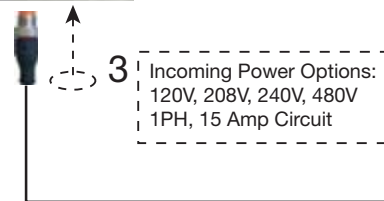
NOTE: Duct pressure modulation, fan speed, isolation damper and bypass damper control and wiring is *by others*.



2 VGN Controller Box



1 Pressure Transducer Box



3 Incoming Power Options:
 120V, 208V, 240V, 480V
 1PH, 15 Amp Circuit

VFD Connection:
 24 VAC fan run signal from VFD to **1FNRUN** and **+24V**
 NOTE: Repeat above steps for fan number 2, 3, 4 if applicable.

BMS Connection:
 Analog BMS Communications: (all hardwire connections)
Nozzle Feedback - connect to 1NZFB1 and COM, 1NZB2 and COM
Fan Flow - connect to 1SURAR and COM
 NOTE: Repeat above steps for fan number 2, 3, 4 if applicable
Alarm - connect to ALM1 and ALMCOM



Variable Geometry Nozzle (VGN) System Function Overview

The VGN system uses a variable geometry nozzle to maintain desired nozzle outlet velocities. The VGN system is controlled by a pre-programmed VGN controller. The VGN controller powers the factory mounted pressure transducer and the variable geometry nozzle. The VGN controller receives a signal from the pressure transducer and converts that signal into a fan flow. It then calculates the appropriate nozzle opening and sends a signal to the nozzle to adjust it to the proper size opening to maintain desired nozzle outlet velocity. The VGN controller does not operate the isolation or bypass damper and it does not control duct pressure; those parameters are controlled by the BMS.

Mounting of VGN Controller

Mount VGN controller upright with connectors down on structural support within 20 feet from center of fan plenum. Cables and wiring will be connected to the bottom of the box so it must have a minimum of 12 inches of clearance from any obstructions. The VGN control box is a NEMA-3R enclosure suitable to be mounted indoors or outdoors.

Nozzle to Pressure Transducer Box Quick Disconnect Wiring Instructions

Connect the factory supplied 5 pin cable (shipped in the pressure transducer box mounted on the fan) to the 5 pin threaded bulkhead on the bottom of the nozzle; connect the other end to the 5 pin threaded bulkhead on bottom of the pressure transducer box that is mounted on the fan. Mount provided adhesive cable clips every 12 inches down the fan stack and secure cable using zip ties.

NOTE: Repeat this step for fan number 2, 3, 4 if applicable.

VGN Controller to Pressure Transducer Box Quick Disconnect Wiring Instructions

Connect the factory supplied 8 pin cable (shipped in the VGN controller) to the 8 pin threaded bulkhead on bottom of the VGN controller; connect the other end to the 8 pin threaded bulkhead on bottom of the pressure transducer box that is mounted on the fan. Each fan is provided with (3) 10 meter cables that can be connected together to extend the length; use as required per fan. Based on the location of the VGN controller, each fan may require a different number of cables to reach the controller; it is not necessary to match the number of cables used on each fan.

NOTE: Repeat this step for fan number 2, 3, 4 if applicable. Make sure the numbering of the fans is consistent during the entire wiring installation; fan 1 will require wiring specific to fan 1, fan 2 will require specific wiring, along with fans 3 and 4 if applicable

Variable Geometry Nozzle (VGN) Controller to VFD and BMS Hardwiring Instructions

NOTE

All field installation and wiring of electrical equipment must be done to meet NEC, CEC and local codes.

Be sure to use appropriately sized wire for the full load amp draw.

Once the following hardwiring is complete, please refer to the BMS Communication Programming section for details on programming the BMS to communicate with the VGN controller via the hard wire connections.

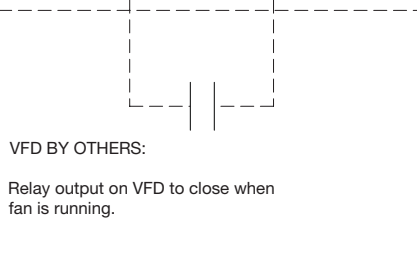
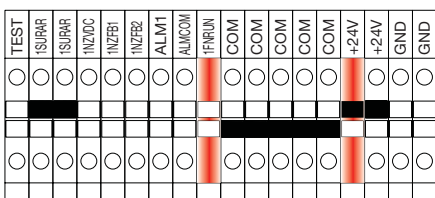
Make sure the numbering of the fans is consistent during the entire wiring installation; fan 1 will require wiring specific to fan 1, fan 2 will require specific wiring, along with fans 3 and 4 if applicable.

Fan Run Signal (hard wire connections)

The VGN controller requires a 24 VAC fan run input signal to communicate to the VGN controller that the fan is running. The VGN controller will supply the 24 VAC voltage required, but it will need to be switched on and off by the Building Management System (BMS) or Variable Frequency Drive (VFD) based on the fan run status. Use a relay contact controlled by the VFD or BMS to control the fan run signal; the contact should be closed when the fan is running. Connect the +24V terminal in the VGN controller to the input of the relay contact. Connect the normally closed (NC) switched side of the relay contact to the 1FN RUN terminal in the VGN controller. The VGN controller will not function without the 24 VAC fan run signal.

Wire Landing Points

- Fan 1: +24 V and 1FN RUN on the terminal strip
- Fan 2: +24 V and 2FN RUN on the terminal strip, *if applicable*
- Fan 3: +24 V and 3FN RUN on the terminal strip, *if applicable*
- Fan 4: +24 V and 4FN RUN on the terminal strip, *if applicable*



BMS Communication (hard wire connections)

Nozzle Feedback will report the position of the nozzle during operation. It is necessary to maintain minimum required nozzle outlet velocity. Each nozzle has two feedback outputs, one for each blade of the nozzle. Connect BMS to 1NZFB1 and COM. Connect BMS to 1NZFB2 and COM.

Wire Landing Points

- Fan 1: 1NZFB1 and COM and 1NZFB2 and COM on the terminal strip
- Fan 2: 2NZFB1 and COM and 2NZFB2 and COM on the terminal strip, *if applicable*
- Fan 3: 3NZFB1 and COM and 3NZFB2 and COM on the terminal strip, *if applicable*
- Fan 4: 4NZFB1 and COM and 4NZFB2 and COM on the terminal strip, *if applicable*

Fan Flow This feature is not required for system operation. This feature allows the BMS to record and display the CFM of the fan during operation. Connect BMS to 1SURAR and COM.

Wire Landing Points

- Fan 1: 1SURAR and COM on the terminal strip
- Fan 2: 2SURAR and COM on the terminal strip, *if applicable*
- Fan 3: 3SURAR and COM on the terminal strip, *if applicable*
- Fan 4: 4SURAR and COM on the terminal strip, *if applicable*

Alarm will notify the BMS of issues with the VGN control system by closing a dry relay contact within the VGN Carel controller. Connect BMS to ALM1 and ALMCOM.

Wire Landing Points

- Entire System: ALM1 and ALMCOM on the terminal strip

NOTE: There is only one alarm contact for the entire VGN control system regardless of the number of fans.

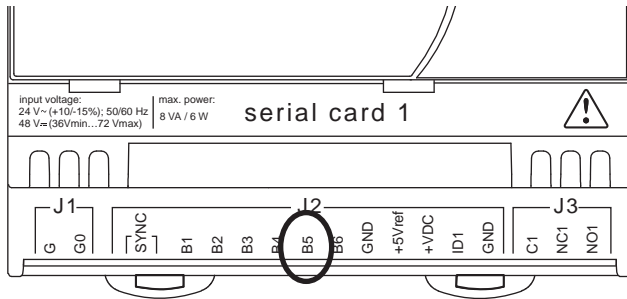
Variable Geometry Nozzle (VGN) Controller to VFD and BMS Hardwiring Instructions - *continued*

Outlet Velocity: On the Fly Unoccupied Adjustment

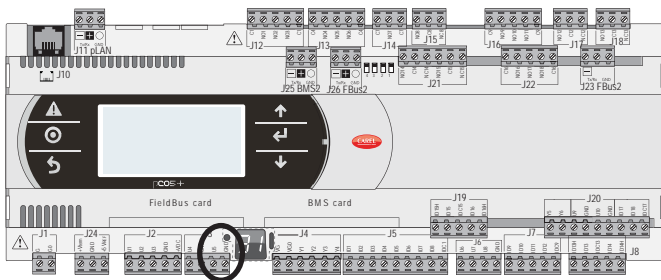
Adjustment This feature is not required for system operation. This feature allows the user to adjust the nozzle outlet velocity remotely while the fan is running with the use of a 0-10 VDC signal sent from the BMS to the VGN controller. Connect the BMS directly to the proper input (see below) on the Carel PLC unit and COM on the terminal strip.

Wire Landing Points

- Single Fan Entire System: B5 on Carel PLC and COM on the terminal strip



- Multifan Entire System: U5 on Carel PLC and GND on the Carel PLC



NOTE: There is only one on the fly unoccupied nozzle velocity adjustment for the entire VGN control system regardless of the number of fans; one BMS signal commands all the nozzles to the same outlet velocity.

VGN Controller Incoming Power Wiring Instructions

Incoming Power (hard wire connections)

The VGN controller will function on 120, 208, 240, or 480V single-phase 50/60 Hz AC. Remove the metal cover located on the right side of the VGN controller to access the terminal strip for incoming power (reference Wire Diagram for details on terminal strip landing points). Once the wiring is complete reinstall the metal cover. Each VGN controller will draw a maximum of 2 amps.

BMS Communication Programming

The VGN controller uses analog and digital communications that are hard wired to the BMS to communicate with the BMS.

Fan Run Signal can be switched by the BMS or VFD. The VGN controller requires a 24 VAC fan run input signal from BMS or VFD to communicate to the VGN controller that the fan is running. Use a switching relay contact controlled by the VFD or BMS to control the fan run signal; the contact should be closed when the fan is running. Multiple fan systems will require a separate fan run signal for each fan which corresponds to each fan number.

Nozzle Feedback will report the position of the nozzle during operation. It is necessary to maintain the minimum required nozzle outlet velocity. Each nozzle has two feedback outputs, one for each blade of the nozzle. The output from the nozzle feedback is a 2-10 VDC voltage. To properly maintain required nozzle outlet velocity the minimum allowable nozzle feedback voltage is 2.1 VDC. If the nozzle feedback drops below this voltage the fan speed must be increased to maintain the required nozzle outlet velocity. Modulation of the bypass damper may be required to maintain proper duct pressure while maintaining required nozzle outlet velocity.

Fan Flow This feature is not required for system operation; this feature allows the BMS to record and display the CFM of the fan during operation. Each fan has one 0-10 VDC output for fan flow. To calculate the fan flow and display it on the BMS use the following calculations:

$$CFM = K\text{-Factor} \cdot \sqrt{\frac{\Delta P}{\rho}}$$

- ΔP is calculated with the following equation: $((SURAIR \text{ Voltage})/10)*15$
- ρ is air density which is job site specific; a universal number to use is .075 lbm/ft³
- K-Factor is listed on a data plate located on the fan body or refer to the charts below; each fan type and size have a unique K-Factor number.

Vektor-CS (VK-C-XX)		Vektor-HS (VK-H-XX)		Vektor-MS (VK-M-XX)	
Fan Size	K-Value	Fan Size	K-Value	Fan Size	K-Value
12	296	9	248	15	526
15	431	10	202	18	787
18	542	12	296	20	955
22	805	13	351	22	1161
24	982	16	440	24	1436
27	1184	18	542	27	1729
30	1464	22	804	30	2116
33	1770	24	971	33	2581
36	2168	30	1463	36	3154
40	2630	36	2167	40	3825
44	3220				

NOTE: Repeat steps above for fan 2, 3, and 4 if applicable.

Alarm The alarm will notify the BMS of issues with the VGN control system by closing a dry relay contact within the Carel controller. There is only one alarm contact for the entire VGN control system regardless of the number of fans. The Carel controller located in the VGN control box will display the alarm history to help diagnose the issue; no alarm history will be transmitted to the BMS.

The alarm contact will close due to the following issues:

The fan run signal shows the fan running but the 0-10 VDC signal from the pressure transducer is not within the expected range. This could be due to wiring issues, failed pressure transducer, closed isolation damper, water in the pressure transducer tubes, or the fan motor is not spinning.

Outlet Velocity: On the Fly Unoccupied

Adjustment This feature is not required for system operation. This feature allows the user to adjust the nozzle outlet velocity remotely while the fan is running with the use of a 0-10 VDC signal sent from the BMS to the VGN controller. This feature is used to reduce energy costs during unoccupied or low use lab times. It can also be used with real time wind wake study data to optimize energy consumption. Lower nozzle velocity will equate to lower plume height and lower system restriction; it is the responsibility of the user to determine what nozzle velocity is required.

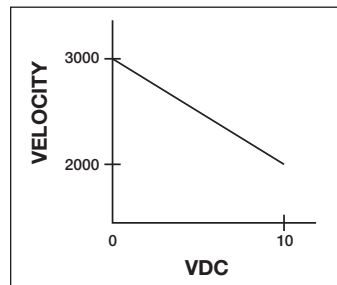
In the "User Settings" menu of the Carel menu, the user can set the nozzle outlet velocity maximum and minimum settings.

USER SETTINGS	
ELEVATION:	0 FT
MAX OUT VEL:	3000 FPM
MIN OUT VEL:	2000 FPM
ACTIVE STPT:	3000 FPM
FOR TEST/BALANCE PRESS DOWN ARROW	

Sending 0 VDC to the B5 input on single fan or U5 input on multifan of the Carel controller will default the nozzle velocity to the maximum outlet velocity set by the user.

Sending 10 VDC to the B5 input on single fan or U5 input on multifan of the Carel will adjust the nozzle velocity to the minimum outlet velocity set by the user.

Sending a DC voltage between 0 and 10 VDC will adjust the nozzle outlet velocity linearly.



DC Voltage to Velocity Relationship

Outlet Velocity: On the Fly Unoccupied Adjustment Example

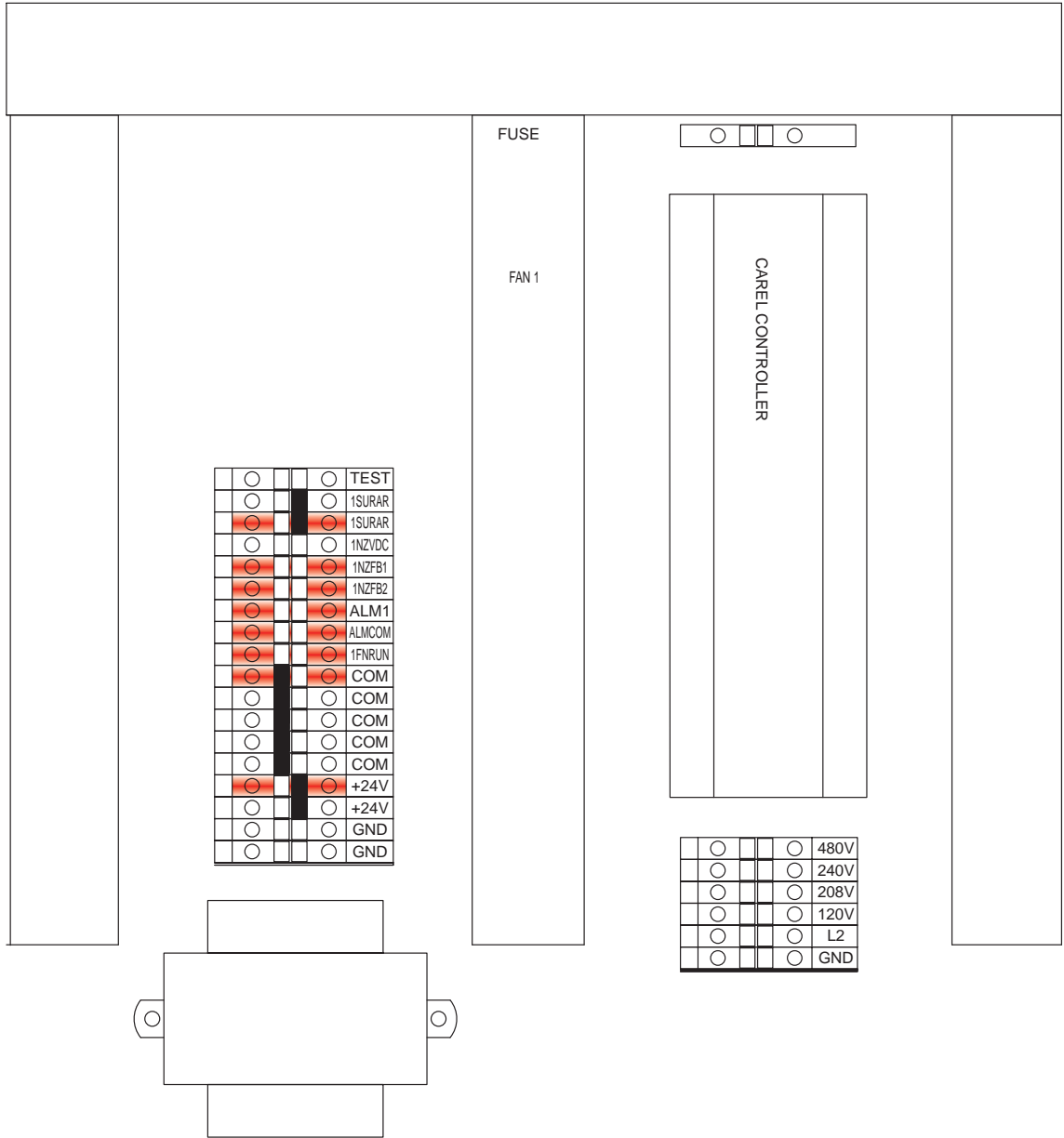
The following is an example of the user setting a 3000 FPM maximum and 2000 FPM minimum nozzle outlet velocity and then using the BMS to send a DC voltage to the Carel controller to control the nozzle outlet velocity. The user can set the maximum and minimum nozzle velocities anywhere between 2000 to 4000 FPM and use the BMS to adjust the nozzle outlet velocity.

User Set Maximum Outlet Velocity: 3000 FPM

User Set Minimum Outlet Velocity: 2000 FPM

VDC sent to Carel Controller from BMS	Nozzle Outlet Velocity
0 VDC	3000 fpm
1 VDC	2900 fpm
2 VDC	2800 fpm
3 VDC	2700 fpm
4 VDC	2600 fpm
5 VDC	2500 fpm
6 VDC	2400 fpm
7 VDC	2300 fpm
8 VDC	2200 fpm
9 VDC	2100 fpm
10 VDC	2000 fpm

Wiring Diagram - Single Fan



<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	TEST
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1SURAR
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1SURAR
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1NZVDC
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1NZFB1
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1NZFB2
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	ALM1
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	ALMCOM
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1FNRUN
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	COM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	COM
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	+24V
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	+24V
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GND
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GND

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	480V
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	240V
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	208V
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	120V
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	L2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GND

FUSE

FAN 1

CABEL CONTROLLER

Start-Up Procedure

Prior to starting and testing the VGN, it is suggested that the following check list be complete. If the fan system is not operating properly, the nozzle will not function as designed. During the testing of the VGN it will require the fan to operate within its designed CFM range; if the CFM is too low the nozzle will not actuate.

Mechanical Component System Verification

For detailed descriptions to complete these operations, see equipment Installation, Operation and Maintenance Manual (IOM).

- Fan assembly and installation completed.
- Check all fasteners for tightness, as they have loosened during shipping.
- All control enclosures and devices mounted in the appropriate locations.
- Verify fan wheel alignment.
- Complete motor pulley adjustments as required.
- All duct connections complete and sealed.
- All fume hoods installed and operational.
- All duct VAV control devices installed and operational.

Electrical Control Components System Verification

For detailed descriptions to complete these operations, see equipment Installation, Operation and Maintenance Manual, National Electrical Code and local electrical code.

- Verify fan wheel rotates the proper direction when electrical power is applied.
- Verify that the isolation damper opens when the fan is turned on.
- Verify that the by-pass damper operates properly to safeguard against pressurization damages within the system.
- Service feeder(s) to all controls completed and tested.
- Control wiring to all devices completed and tested.
- All field electrical connections complete and tested.
- Communication wiring to Building Management System completed and tested.

System Start-Up Preparation for VGN

- It is suggested that the Mechanical Component System Verification and the Electrical Component System Verification check list be complete prior to VGN start-up.
- It is very helpful to have the test and balance contractor, electrical contractor, and BMS/VFD programmer/operators on-site during VGN startup.
- During the startup procedure the fan speed will be increased, decreased, and there will be periods of time when the entire fan system will be shut down; prior arrangements must be made with the lab to accommodate these times of shut down. Opening and closing of fume hoods and dampers will be required during this start-up.
- It is useful to have multi-meter ready for diagnostics.

System Start-Up for VGN

1. Apply input electrical power to the VGN controller to turn it on.
2. Open the VGN control box and confirm that the Carel controller is powered on. The Carel controller is pre-programmed specific to each job site and fan. Test and balance adjustments are the only adjustments that may be required; refer to test and balance section of this manual for details.
3. Open the pressure transducer box mounted on the fan body to confirm that the pressure transducer display is powered on. The numbers on the display may be changing even with the fan off; this is normal operation. **The pressure transducer is very sensitive; do not attempt to adjust or zero the pressure transducer as this will void warranty.**
4. Adjust the fume hoods and dampers in the building such that the fan system can flow 100% of its designed CFM and static pressure.
5. Confirm the bypass dampers are fully functional.
6. Turn fan 1 on to 100% of its designed flow and static pressure with the VFD.
7. Confirm the nozzle blades on fan 1 move when the fan is powered up. When a fan is turned on the VGN controller will open the nozzle to 100% for 60 seconds to allow the fan to ramp up to full operating speed quickly. After the 60 second time period elapses the nozzle will adjust to the proper opening size to maintain required nozzle velocity. The nozzle blades movement can be viewed from the ground by looking at the outside edges of the nozzle.
8. Confirm that the Carel displays that "FAN1" run status is "ON". The Carel unit should also be displaying the "FLOW" and "NOZ" % which is nozzle opening percentage. If the Carel is not showing a "FAN1" run status as "ON" none of the above data will be displayed; to diagnose that issue first confirm that the fan 1 is truly running. If fan 1 is running then check that the "1FN RUN" terminal has a 24 VAC signal to it from the BMS or VFD.

Start-Up Procedure, *continued*

System Start-Up for VGN, continued

9. Reduce the fan speed to 50% of the designed CFM.
10. Confirm that the “FLOW” and “NOZ” numbers are reduced from the 100% fan speed.
11. Confirm that the nozzle blades have closed slightly from the 100% fan speed position.
NOTE: Repeat above steps for additional fans if applicable.
12. If the VGN control system operates properly the VGN system is ready for test and balance.

Test and Balance for VGN

Test and balance mode on the VGN controller allows the user to lock the nozzle in one fixed position during a test and balance of the fan system; it also allows the user to adjust the K value for the CFM displayed on the Carel to match the CFM of the fan while actively performing a test and balance procedure. Please refer to the Test and Balance section on page 16 for details on accessing the test and balance mode on the Carel.

1. Verify that the “System Start-Up for VGN” has been completed.
2. Adjust the fume hoods and or dampers to the desired positions.
3. Turn on the desired fan.
4. Use the Carel controller Test and Balance mode to lock the nozzle to 100% open; refer to the Test and Balance section on page 15 for details on accessing the test and balance mode on the Carel.
5. Perform desired test and balancing procedures.
6. Upon completing the test and balance of the fan system, turn the Test and Balance mode off in the Carel.

NOTE: Test and Balance mode will time out after 120 minutes.

Calibrating Carel CFM Display with Test and Balance Procedure

The CFM displayed by the Carel unit can be offset to match a desired test and balance procedure. It can be offset to match a CFM output by a BMS or a real-time pitot tube.

1. Verify that the “System Start-Up for VGN” has been completed.
2. Adjust the fume hoods and or dampers to the required positions to run the fan at 100% of designed CFM. Do not allow any inlet conditions to change during the remainder of this procedure.
3. Turn on the desired fan to 100% of designed CFM. Only run one fan at a time during this entire procedure.
4. Use the Carel controller Test and Balance mode to lock the nozzle to 100% open. Refer to the Test and Balance section on page 15 for details on accessing the test and balance mode on the Carel.
5. Perform desired test and balance procedure.
6. Use Test and Balance mode K Value Adjustment on the Carel to adjust the CFM displayed by the Carel to match the desire test and balance procedure.
7. Upon completing this procedure turn the Test and Balance mode off in the Carel.

NOTE: Test and Balance mode will time out after 120 minutes.

Variable Geometry Nozzle (VGN) Controller

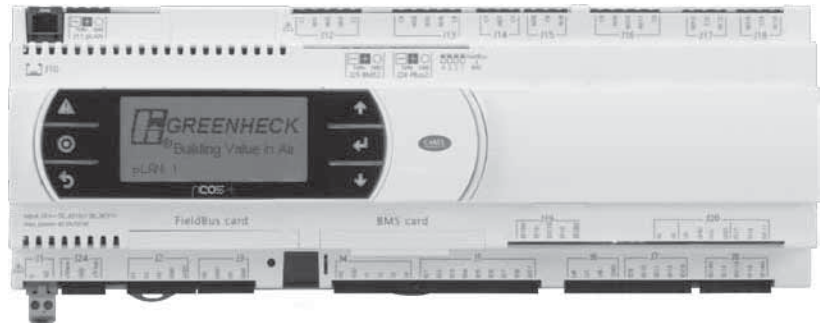
Controller Introduction and Tutorial

The VGN Controller is located in the main control panel. The controller has factory set points that can be modified to configure the system for job specific functions. The controller introduction and directions for the setup screens are shown in this section.

The face of the controller has six buttons, allowing the user to view unit conditions and alter parameters. The controller is pre-programmed with easy to use menus.



Single Fan



Multiple Fan

Operator Interface and Keypad Navigation



Single Fan



Multiple Fan

Keypad Navigation

Keypad Navigation		
	Escape	Allows the user to exit the current menu, jumping to the Main Menu.
	Up Down	The arrow buttons allow the user to scroll through different screens and adjust parameters.
	Alarm	Button will blink red, indicating an alarm condition. Press to review current alarms. To review previous alarms, access the DATA LOGGER through the main menu.
	Enter	A. In screens with adjustable parameters, pressing the Enter button moves the cursor from the upper left corner of the screen to the parameter. The arrow buttons can then be used to adjust the parameter. B. To move to the next parameter on the same screen, press the Enter button. C. To save the change, press the Enter button until the cursor moves back to the upper left corner of the screen.
	Program	Pressing the Program button allows the user to enter the Main Program Menu.

Status

10:27	05/12/16		
	RUN	FLOW	NOZ
FAN1	ON	1465CFM	47%
FAN1	ON	1465CFM	47%
FAN1	ON	1465CFM	47%
FAN1	ON	1465CFM	47%
H4-10			v0.1

FAN1 SUMMARY	
FAN RUN:	ON
FLOW:	1465 CFM
U1 INPUT:	2.7 VDC
NOZZLE POS:	47 %
NOZZLE OUT:	2.9 VDC
VEL ALARM:	NORMAL
CFM ALARM:	NORMAL

ALARM SUMMARY	
ALARM RELAY:	NORMAL

STATUS PAGE - MAIN

The main status page provides a brief summary of all fans. The number of fans displayed is dependent on the configuration, 1 through 4 fans.

Time/Date are displayed in the title bar of the screen.

Fan Status is the summarized data for each fan. This includes the run input status, fan flow and nozzle position.

Fan Type/Number/Size On the lower left corner, the fan type and number is displayed. Fan type is displayed as C, H or M and number 1 through 4. In addition the fan size will be displayed.

Version Number The major/minor software version number is displayed in the bottom corner of the screen.

STATUS PAGE - FAN 1 SUMMARY

Separate status pages are provided for each fan, 1 through 4. A fan summary screen is presented only if the fan is defined in the configuration.

Fan Run reports the on/off status of the fan run input.

Flow represents the volumetric airflow of the fan.

U1 Input is the DC voltage measured at universal input 1, associated with Fan 1.

Nozzle Position indicates the position of the variable geometry nozzle. 0% is reported at the minimum position, while 100% is reported at the maximum.

Nozzle Output is the DC voltage sent from the controller output to the nozzle actuator.

Velocity Alarm indicates the status of the alarm reported if the nozzle velocity is zero while the run input is on.

CFM Alarm indicates the status of the alarm reported if the fan flow is zero while the run input is on.

Status Page - Fan 2 Summary, Fan 3 Summary and Fan 4 Summary same as above if applicable.

STATUS PAGE - ALARM SUMMARY

Alarm Relay display the status of alarm relay (NO1). If any alarm on any fan is true, the alarm output is controlled on and the status is reported as alarm.

On/Off Unit

STATUS

END

STATUS LOOP MASK

ON/OFF UNIT

Because no content exists under the On/Off Unit menu, only the end screen is displayed.

NOTE: END LOOP screen will display anytime there is no content for menu selection.

Set Points

USER SETTINGS

ELEVATION: 0 FT
MAX OUT VEL: 3400 FPM
MIN OUT VEL: 2000 FPM
ACTIVE STPT: 3000 FPM

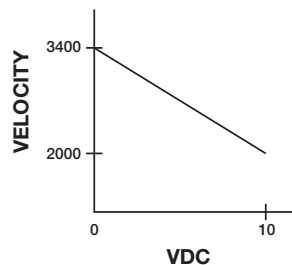
FOR TEST/BALANCE
PRESS DOWN ARROW

USER SETTINGS

Elevation allows the user to input the proper elevation for their specific region. The elevation is used to more accurately compute the density of the air, a component in determining the volumetric airflow of the fan.

Maximum Output Velocity defines the desired output velocity of the variable geometry nozzle under normal operating conditions.

Minimum Output Velocity defines an alternate (reduced) output velocity based on the hard wired 0-10 VDC input dedicated to that function. For this function, 0 VDC represents the normal output velocity setpoint while 10 VDC represents the alternate setpoint with a linear relationship between 0-10 VDC.



T&B FAN 1

FAN 1 MODE: TEST
FAN 1 FLOW: 1465 CFM
NOZZLE 1 POS: 100 PCT
K VALUE ADJ: 0

TEST AND BALANCE - FAN 1

From the **User Settings** screen, access the **Test and Balance** screen(s) by pressing the down arrow.

IMPORTANT: The fan must be ON in order to begin the test and balance procedure.

Fan 1 Mode is used to place Fan 1 into TEST mode. Press enter to advance the cursor to the fan mode, then use the arrow keys to switch modes. Press enter. Upon entering the TEST mode, the user is able to override the nozzle position for that fan and apply a K VALUE ADJUSTMENT, resulting in a modified flow reading. The fan flow reading adjustment will only update once the K VALUE ADJUSTMENT is complete (by pressing enter). The mode will automatically return to AUTO after 120 minutes. In the AUTO mode, only the fan mode and fan flow are displayed. To display/edit the nozzle position and K value, enter the TEST mode.

Fan 1 Flow represents the volumetric flow for Fan 1. The flow reading will be updated as the K VALUE ADJUSTMENT is applied.

Nozzle 1 Position is the overridden position of the nozzle during testing. The user may edit this position as needed during the test mode.

K Value Adjustment allows the user to apply an offset (+/-) to the factory K Value. The result of such an offset is a modified volumetric flow reading, intended to match the desired number from the test and balance procedure.

The displayed CFM on the control screen should match the measured CFM of the fan while actively performing Test & Balance.

Test and Balance - Fan 2, Fan 3, Fan 4 same as above if applicable.

Clock/Scheduler

Clock	
14:57:50	05/04/16
Date:	05/04/16
Hour:	14:57
Day:	Wednesday

Clock	
DST:	ENABLE
Transition time:	60min
Start:	LAST SUNDAY
in MARCH	at 2.00
End:	LAST SUNDAY
in October	at 3.00

CLOCK/SCHEDULER

Date allows the user to edit the month, day and year as needed. Press the enter key to advance the cursor. Then use the arrow keys to adjust the value. Press enter.

Hour allows the user to adjust the hour and minutes as needed. Press the enter key to advance the cursor. Then use the arrow keys to adjust the value. Press enter.

Day will be adjusted automatically based on the **Date** field.

DST allows the user to enable/disable daylight savings time. Press the enter key to advance the cursor. Then use the arrow keys to adjust the setting. Press enter.

Additional fields are provided that allow the user to enter the specifics pertaining to daylight savings time adjustment.

Inputs/Outputs

Analog Input	
Pressure1 (AIN1)	
Input 0001:	27.0

Analog Input	
VelocitySetpt (AIN5)	
Input 0005:	0.0

Digital Input	
On / Off (DIN1)	
DI 1 Status:	Closed

Relay Output	
Title (DOUT 1)	
Relay 1 Status:	OFF

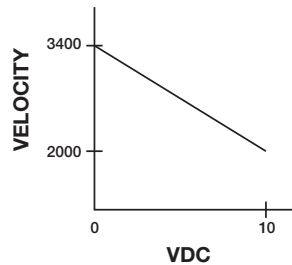
ANALOG INPUTS

AIN1 reports the status of Pressure Sensor 1 on analog input 1, 0.0 to 100.0 (0.0 to 10.0 VDC). So 27.0 equates to 2.7 VCD.

AIN2, AIN3, AIN4 same as above if applicable.

AIN5 indicates the field-provided signal for the alternate (unoccupied) nozzle velocity setpoint, 0.0 to 10.0 VDC.

For this function, 0 VDC represents the normal output velocity setpoint while 10 VDC represents the alternate setpoint with a linear relationship between 0-10 VDC.



DIGITAL INPUTS

DIN1 indicates the open/closed status of digital input 1, the run status of fan 1.

DIN2, DIN3, DIN4 same as above if applicable.

RELAY OUTPUTS

DOUT1 reports the on/off status of digital output 1, the alarm relay (off = normal, on = alarm).

Analog Output 2	
Output:	2.94vdc

Analog Output 1	
Output:	2.94vdc

Analog Output 3	
Output:	2.94vdc

Analog Output 4	
Output:	2.94vdc

ANALOG OUTPUTS

Analog Output 2 indicates the signal being sent to Nozzle 1, 0.00 to 10.00 VDC
IMPORTANT: Nozzle 1 is connected to analog output 2, while Nozzle 2 is connected to analog output 1.

Analog Output 1 indicates the signal being sent to Nozzle 2, 0.00 to 10.00 VDC
IMPORTANT: Nozzle 1 is connected to analog output 2, while Nozzle 2 is connected to analog output 1.

Analog Output 3 indicates the signal being sent to Nozzle 1, 0.00 to 10.00 VDC.

Analog Output 4 indicates the signal being sent to Nozzle 1, 0.00 to 10.00 VDC.

Alarm History

13:47:25	5/12/16
001:No CFM Fan 4	
FAN FLOW 1:	1465
FAN FLOW 1:	1511
FAN FLOW 1:	1454
FAN FLOW 1:	0

13:47:25	5/12/16
002:No CFM Fan 1	
FAN FLOW 1:	0
FAN FLOW 1:	1511
FAN FLOW 1:	1454
FAN FLOW 1:	0

ALARM HISTORY

The alarm history records and displays the alarms that have occurred. Additional information is available for each alarm. Use the arrow keys to scroll through all recorded alarms.

Time/Date is recorded and displayed for each alarm.

Alarm Number and **Description** is also provided for each alarm.

Fan Flow is recorded at the time of the alarm for each fan in this configuration.

Technician

Information

GREENHECK FAN CORP Code:	
Version:	0.1.000
Date:	09/06/15
Bios: 6.27	09/07/04
Boot: 5.00	09/07/04

Information

Board type:	pCO5+
Board size:	Medium
Total flash:	2048KB
RAM:	1024KB
Built-In type:	
Main cycle:	
9.5cycle/s	105ms

Alarm History Reset

This will clear the
Alarm history

Continue? No

TECHNICIAN INFORMATION

In rare circumstances, the factory may request additional information pertaining to the operational performance of the controller. Several screens are provided with low-level firmware information.

Information

Power Cycle Status	
Last Off Time	
5/05/16	10:54:45
Last On Time	
5/05/16	16:03:37
Length Time Off	
Days: 0 Hrs: 5 Min: 8	

USER SAVE

Alarm History Reset is used to clear the historical record of alarms. Press enter to advance the cursor. Then press the arrow buttons to toggle the no/yes state. Press enter.

NOTE: When changed to YES, the field will automatically revert to NO after a few seconds.

BMS CONFIG

Because no content exists under the BMS Configuration menu, only the end screen is displayed.

SERVICE SETTINGS

Working Hours Set

Because no content exists under the Working Hours Set menu, only the end screen is displayed.

Probe Adjustment

Because no content exists under the Probe Adjustment menu, only the end screen is displayed.

Control Loops

Because no content exists under the Control Loops menu, only the end screen is displayed.

MANUAL MANAGEMENT

Analog Inputs

Because no content exists under the Analog Inputs menu, only the end screen is displayed.

Digital Inputs

Because no content exists under the Digital Inputs menu, only the end screen is displayed.

Relay Outputs

Because no content exists under the Relay Outputs menu, only the end screen is displayed.

Analog Outputs

Because no content exists under the Analog Outputs menu, only the end screen is displayed.

Factory

Manufacturer password



Insert manufacturer
password(PWS): z000

Factory Save



Save? No
Restore? No
Auto Restore? No

Factory Delete



CLEAR ALL SAVED DATA
FACTORY+USER No

MANUFACTURER PASSWORD

In order to edit any of the factory parameters, the user must first provide the manufacturer-provided password. Contact the factory for further assistance.

INITIALIZATION

The software includes a set of default parameters to configure the controller. However, once the controller is configured for a specific fan system, it is beneficial to save the 'as shipped' configuration in case changes are made in the field.

Save is used to store the editable parameters to non-volatile memory. Press enter to advance the cursor. Then press the arrow buttons to toggle the selection to YES. Press enter. The value will automatically return to NO after a few seconds.

Restore is used to retrieve the factory settings from memory and overwrite the current configuration.

Auto Restore is not used and should remain as NO.

Though almost never used, the **Factory Delete** feature allows the current configuration to be erased. The resulting configuration is the software default configuration which **MUST** be edited to match the fan model and size.

Troubleshooting

General		
Issue	Possible Cause	Recommended Action
Fan is running but no pressure is being created in the duct.	Isolation damper not open.	Check power at isolation damper and determine if it is open.
	Bypass damper maybe open.	Verify bypass damper is closed.
Nozzle actuator is not responding to fan speed changes.	Sure-Aire transducer not reading air flow.	Inspect pressure tubing to transducer and verify voltages.
	No power at the nozzle actuator.	Verify power and signal at the actuator.
	Low CFM due to laboratory hoods being closed.	Open all laboratory hoods to verify nozzle operation.
Unstable fan conditions. Fan is not balancing the system and keeps changing speed.	BMS PID timing is incorrect.	Increase time functions in the system.
	BMS PID overlap is incorrect.	Create an increased dead band between PID for fan and bypass.
System has a positive pressure condition.	Isolation damper not open.	Check power at isolation damper and determine if it is open.
	BMS fan control not working properly.	Check BMS control and determine if condition is occurring at full speed and bypass is closed.
	Duct pressure transducer failure.	Verify power and signal at duct pressure transducer(s).
	Broken fan belt.	Check fan belt for failure.
	Bypass damper maybe open.	Verify bypass damper is closed.
	Access panel is missing on fan or bypass air plenum.	Replace missing access panels.
	Nozzle is not operating and is at minimum area.	Check actuator power and signal.
System has an unfavorable negative pressure condition.	BMS fan control not working properly.	Check BMS control and determine if condition is occurring at fan low speed and bypass full open.
	Duct pressure transducer failure.	Verify power and signal at duct pressure transducer(s).
	Bypass damper operation.	Verify bypass damper operation.
CFM reading is low or at zero even though fan is operating.	Isolation damper is not open.	Check power at isolation damper and determine if it is open.
	Sure-Aire tubing leak or blockage.	Inspect tubing and blow out tubing with air.
	Sure-Aire tube lines hooked up backwards.	Flip the high and low tube lines.
	Sure-Aire transducer for system is bad.	Test voltage with meter for 24V and output signal.
	Laboratory hoods are closed in the building	Open all laboratory hoods and verify operation.

VGN Nozzle Controller Customer-Supplied VFD		
Issue	Possible Cause	Recommended Action
Alarm contact on nozzle controller is "Active"	Velocity is below the required preset value	Fan speed is too low. Not creating enough airflow. Speed up fan.
	Fan is shown as running, but no flow is being created.	Airflow not present. Check flow station and components.

General System Failure Mode
If the 2-10 VCD signal is lost from the controls and the 24V power is still present, the nozzle actuators will move to the minimum area position.
If the 24V power is lost from the controls but the 2-10VCD signal is still present, the nozzle actuators will stay in place at the moment when 24V power was lost.

VGN Technology Maintenance

WARNING

Disconnect all electrical power and secure to the "OFF" position prior to inspection or servicing. Failure to comply with this safety precaution could result in serious injury or death.

The following list is recommended preventive maintenance of the controls system. All of these items should be done before initial power up of the system and then done on a routine maintenance schedule.

It is also recommended to follow the component manufacturer maintenance recommendations that they have stated in their IOM document(s).

Description	Action	Occurrence
Inspect System Wire	Look for cracked, frayed, bare wiring. Replace as necessary	Quarterly
Inspect System Conduit	Look loose fittings and cracked or broken down seal tight. Replace as necessary	Quarterly
Inspect Wiring Terminations	Look for loose or broken terminals. Tighten to required torque for each or replace as necessary.	Quarterly
Inspect Weather Proof Gaskets	Inspect all gaskets and look for moisture. Replace if necessary.	Quarterly
Inspect Electrical Enclosures	Inspect all enclosures and look for broken hardware. Replace as necessary	Quarterly
Inspect Nozzle Moving Components	Inspect all nozzle components. Remove any obstructions or replace any worn components.	Monthly

Finally, it is recommended to follow the fan IOM for recommended service and also routine maintenance on the mechanical components of the remaining items in the system.

VGN Technology Electrical Replacement Parts

Description	Part Number
Controller, PCO5 Compact	Consult factory
Controller, PCO5+ Medium	Consult factory
Pressure Transducer, multiple range, VDC	385394
Actuator, 2-position 24 VAC (Isolation)	Consult Factory
Actuator, modulating 2-10 VDC 24 VAC (Nozzle)	384631
Actuator, modulating 0/2-10 VDC 24 VAC (Bypass)	Consult factory
Transformer, multi-tap 120 VAC to 24 VAC	385220

Maintenance Record

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

Notes: _____

Date _____ Time _____ AM/PM

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Date _____ Time _____ AM/PM

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Date _____ Time _____ AM/PM

Notes: _____

Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Specific Greenheck product warranties are located on greenheck.com within the product area tabs and in the Library under Warranties.

Greenheck VGN Technology catalog provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at www.amca.org.

