

## Installation, Operation and Maintenance Manual

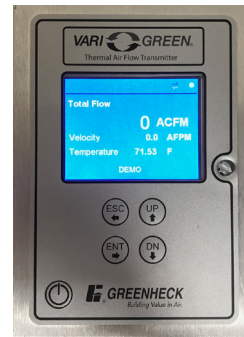
Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with these instructions will result in voiding of the product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



### Transmitter

Version 1.0X

Thermal Airflow & Temperature Measurement System



#### Regarding This Manual

- This manual should be passed on to the end user.
- Before use, read this manual thoroughly to comprehend its contents.
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- Greenheck makes no warranty of any kind with regard to this material, including, but not limited to, implied warranties of merchantability and suitability for a particular purpose.
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#### Safety Precautions

The following general safety precautions must be observed during all phases of installation, operation, service, and repair of this product. Failure to comply with these precautions or with specific WARNINGS given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Greenheck Fan Corporation assumes not liability for the customer's failure to comply with these requirements. If this product is used in a manner not specified in this manual, the protection provided by this product may be impaired.

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#### Purpose of This Manual

This manual provides information regarding the installation, operation and maintenance of your thermal airflow measurement system. This is NOT, nor is it intended to be an electrical or HVAC trade manual.

This manual is the basic reference tool for the Vari-Green® Transmitter, including its mains power connection and associated outputs. The complete system consists of the transmitter and associated probe array or stations. Refer to supplemental documents for additional information.

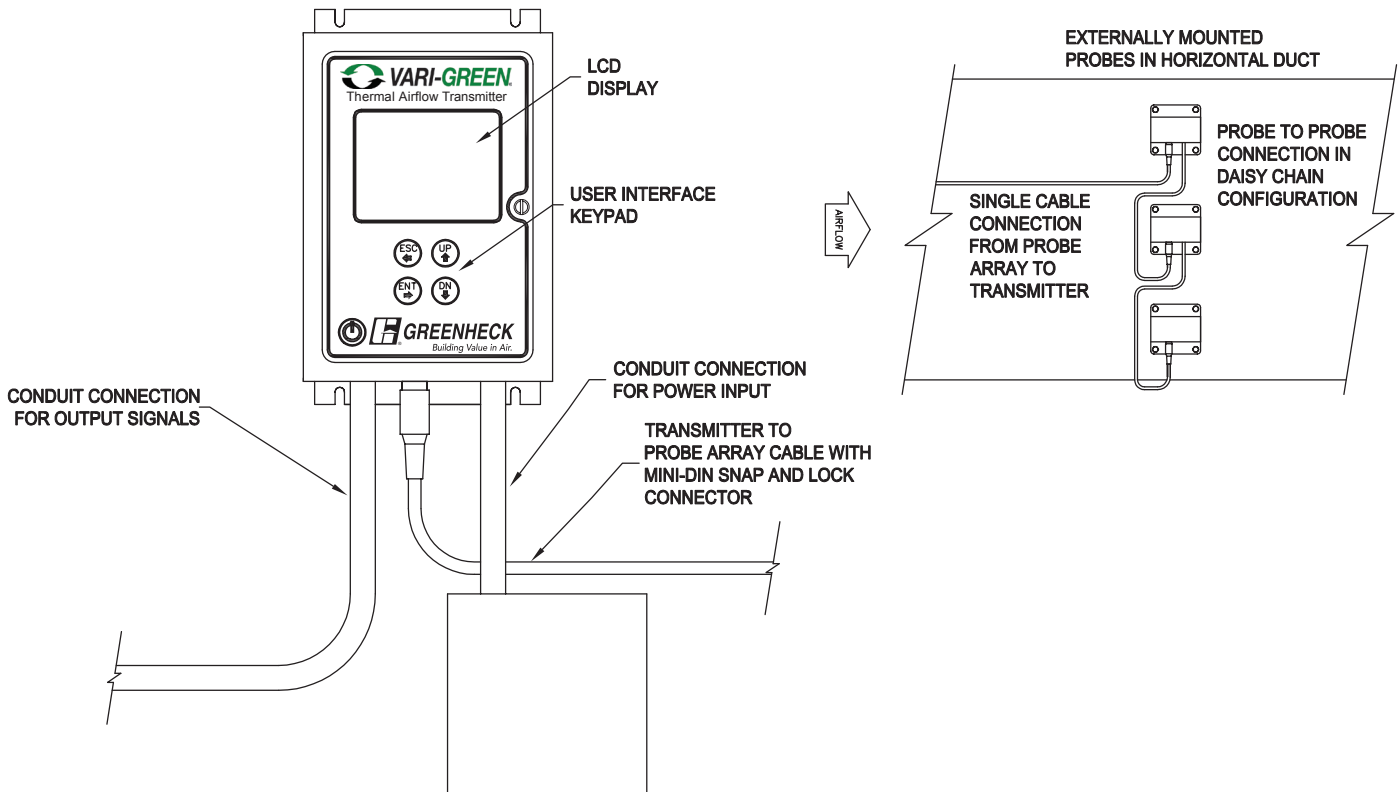
# SECTION 1.0: General Information

## 1.1 TYPICAL THERMAL AIRFLOW MEASUREMENT SYSTEM INSTALLATION

Greenheck's Vari-Green® system accurately measures the average velocity of flowing air by means of thermal dispersion at the sensor locations in the duct. Temperature is also measured via these sensors. The Vari-Green transmitter can receive up to 32 individual flow sensors measuring airflow in a single duct, and it generates the outputs, including network and analog signals, which are conveyed to a local controller or BMS.

Physical installation details for the probe array or flow stations can be found in Greenheck's Installation Instructions.

### Typical Vari-Green Installation



# SECTION 2.0: Specifications

## 2.1 PROBE ASSEMBLY

### INDIVIDUAL SENSOR ACCURACY

Velocity:  $\pm 2\%$  of reading from 0-5000 FPM

Temperature:  $\pm 0.1^\circ$  F

Multi-point NIST traceable calibration of both temperature and velocity

### SENSOR TYPE

Hermetically sealed, precision matched thermistors with laser trimmed resistive heating element mounted in flow conditioning aperture.

Max number of sensors per probe: 8

Max number of sensors per transmitter: 32

### SENSOR SIGNAL PROCESSING

Sensor signal processing at the probe with RS-485 communication to the transmitter

### MOUNTING

Insertion probe mounting via 4 in. x 4 in. aluminum plate,  $\frac{1}{4}$  in. closed cell neoprene gasket and end support stud for probes longer than 18 in.

### MATERIALS OF CONSTRUCTION

1.125 in. diameter anodized aluminum probe with aluminum probe connection box

### ELECTRICAL CONNECTIONS

Probe-to-probe connection via plenum rated cable with mini-DIN Snap & Lock connector for signal and power

Probe-to-transmitter connection via a single plenum rated cable with mini-DIN Snap & Lock connector

Cable Length: 10 ft. typical, up to 100 ft. optional (cables can be field terminated to length)

### PROBE SIZE RANGE

8 in. to 120 in. dimension length

## 2.2 VARI-GREEN® TRANSMITTER SERIES

### SENSOR DENSITY

Maximum number of sensors per transmitter is 32 total sensors per probe array or measurement station

### DISPLAY

Backlit  $\frac{1}{4}$  VGA Color TFT LCD display, 2.75" X 2.0"

Configuration Access:

Field programmable menu driven user interface accessed via four button membrane keypad. Field selectable in U.S. or S.I. units for flow, velocity and temperature.

### POWER SUPPLY

24 VAC (20-28 VAC) or 24 VDC (20-40 VDC), isolated and fused with reverse polarity protection

16-50 VA, varies based on the quantity of sensors (1-32) in the probe array or station

### OUTPUT SIGNALS PROVIDED

Dual analog outputs, field selectable via menu for 0-5 VDC, 0-10 VDC, or 4-20 mADC

Field adjustable analog output scaling of airflow velocity and temperature

Velocity Range:

0 to 5,000 FPM in Ducted Applications

Temperature Range:  $-20^\circ$  to  $140^\circ$  F

### AMBIENT CONDITIONS

Temperature Limits:  $-20^\circ$  F to  $180^\circ$  F Storage,  $-20^\circ$  to  $+140^\circ$  F Operating

Humidity: 0 to 99.9% RH, non-condensing

### ENCLOSURE

NEMA 1 aluminum with hinged cover

### APPROVALS

UL 60730 PENDING

BTL

FCC Part 15 Subpart B, Class A Device

# SECTION 3.0: Installation

## 3.1 INSPECTION

Carefully remove the Vari-Green probe(s) or station and transmitter from the shipping container and inspect for any damage.

**IMPORTANT: All Vari-Green transmitters are factory configured with the application specific duct size and flow rate information. The transmitter and probes or flow station are tagged with matching ESID and/or customer specific identification. Matching the systems as configured by the factory will reduce the installation and start-up labor required.**

Review the Factory Set-Up Information Sheet provided separately and verify that the W.O. # and serial # match those on the Vari-Green system. Verify that the configuration recorded on the Factory Set-Up Information Sheet is correct for your application. If any damage has occurred in transit or the factory set-up configuration is incorrect for your application, please contact Greenheck at 1-800-717-6540.

## 3.2 INSTALLATION LOCATION GUIDELINES

The standard version of the Vari-Green transmitter and probe connection heads have a NEMA 1 enclosure rating suitable for clean and dry indoor locations. For additional protection, an enclosure with an adequate NEMA rating may be required.

The ambient temperature of the selected mounting location must be between -20°F and 140°F. Consideration should be given to units exposed to direct sunlight.

The selected mounting location should be rigid and free of vibration.

## 3.3 TRANSMITTER PLACEMENT AND MOUNTING

For placement of transmitter, see instruction manual at [www.greenheck.com](http://www.greenheck.com), 478799 AMD-XX-TD IOM.

## 3.4 POWER and SIGNAL CONNECTIONS

**NOTE:** The Vari-Green transmitter terminal connections for power and signal wire are labeled on the board for installation convenience. Power wiring is located at terminal strip J4. Signal wiring is located at terminal strip J1.

The REMOVABLE\* terminal strips for power and signal are located in the lower portion of the transmitter and are accessible by opening the hinged cover. (See figure below for the exact location of the terminal strips.) Two conduit openings are provided in the bottom of the transmitter enclosure; one for power and one for signal wiring.

Recommended wire gauge (14 AWG is the maximum wire gauge - no more than two wires recommended per terminal):

Power wire = 14 AWG to 18 AWG

Signal wire = 14 AWG to 22 AWG

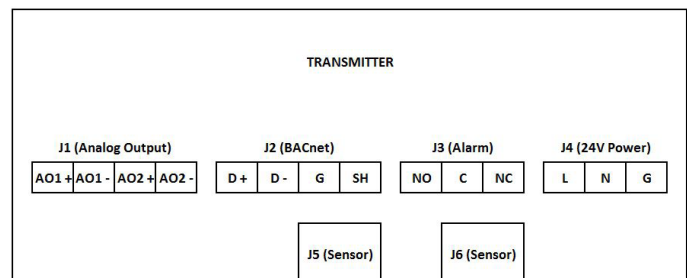
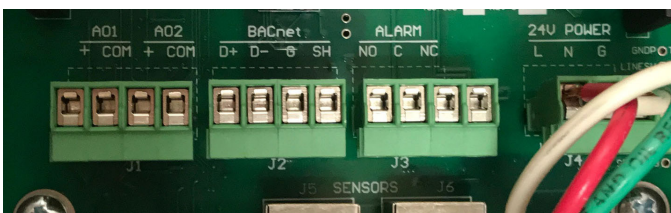
\* To aid in the wiring of both power and signal wires, J1 and J4 are removable by pulling the terminal strip straight up and off the circuit board. Once wiring has been completed, replace the terminal strip by aligning it with the receptacle and inserting firmly.

**WARNING: The Vari-Green transmitter is a low voltage device (24V AC/DC). Connecting the transmitter to high voltage power (e.g. 110 VAC) may cause damage and will void the warranty.**

**Power Connections:** Terminal J4, pin 1 for Line, pin 2 for Neutral and pin 3 for Ground. See figure below for details. The Vari-Green can be powered by either 24VAC providing 20-28VAC or 24VDC providing 20-40VDC.

**CAUTION: The earth ground is required on all Vari-Green transmitter installations. Omitting the connection to earth ground could result in poor performance and may void the warranty.**

**Analog Outputs:** Terminal J1; AO1 pins 1 and 2; AO2 pins 3 and 4. Pins 2 and 4 are for the common wire of the respective output. See figure below for details.



# Section 4.0: Configuration

## 4.1 CONFIGURATION

All device configuration is done using the four button membrane keypad on the transmitter cover. Individual key functions depend on specific menu selection. The basic key functions include:

**ENT:** Enters menu item from main or service menu; moves cursor to next item when in submenu

**ESC:** Exits current page or submenu item

**UP Arrow:** Moves cursor “up” through main and service menu; changes character in submenu items

**DOWN Arrow:** Moves cursor “down” through main and service menu; changes character in submenu items

**MAIN MENU OR SERVICE MENU:** ENT opens the highlighted submenu. UP and DOWN move the selection cursor between submenus.

**Submenu:** ENT moves selection cursor to the next item. UP and DOWN change state of item or change characters in writable fields.

MAIN MENU SELECTION	DESCRIPTION
Density Compensation	Select density compensation type for flow output (Actual or Standard CFM)
Select System of Units	Select system of units (US or SI)
Flow Configuration	Select and configure flow and application parameters
Display Configuration	Select parameters of display screen
Analog Output Configuration	Configure analog output type, value and averaging filter
Display Averaging Filter	Configure display averaging filter
Zero Lockdown	Adjust zero lockdown (below a FPM set point, drives display and output to zero)
Alarm/Alert Configuration	Configure alarm type, upper and lower limits
Network Configuration	Configure network type, baud rate and address information
Field Characterization	For information on field characterization, please see section below

SERVICE MENU SELECTION	DESCRIPTION
Password Configuration	Enable/disable and change password
Total System Scan	Displays sensor enabled/disabled status
Sensor Control	Enable or disable system sensors
Sensor Data Scan	Displays individual sensor data
Sensor Alert Scan	Displays alert codes for each sensor
Custom ID	Configure ID (tag) of unit
Restore Factory Setting	Restores display settings to original factory setup
Product Information	Displays product information (Serial number, Work Order #, etc.)

### MAIN MENU

**Density Compensation** - Density compensation can be selected to be actual flow or corrected to standard conditions. Default factory setting is for actual conditions. The Vari-Green also allows for inputting the site elevation, which will add density compensation for average atmospheric pressure based upon elevation above sea level.

**Select System of Units** - US or SI units can be selected. US units will display in CFM and degrees Fahrenheit. SI units will display in L/S and degrees Celsius.

**NOTE:** When changing between US and SI units, the flow configuration information will need to be converted and updated. This is not done by the transmitter. The user must convert and input.

## Flow Configuration

The flow configuration menu provides access to modify the application specific parameters.

**NOTE: All transmitters are factory configured for the intended application – Changes to the factory configuration should not be required. A Factory Set-Up Sheet is provided with each transmitter and provides the details for all factory configured parameters.**

The **measurement type** for all Greenheck Vari-Green applications will be selected as ducted. One transmitter accepts up to 32 sensors.

### Ducted:

Select the proper duct shape

(Rectangular, Flat Oval or Circular).

Enter the duct dimensions (inches or millimeters).

Area (cross-sectional duct area) is automatically calculated.

Enter the Max Flow (maximum airflow) in CFM or L/s.

## Display Configuration

This screen allows the user to set parameters on various lines of the display. There are four display lines on the Vari-Green.

**Line 1** - Flow (typical), Velocity or Temperature.

**Line 2** - Velocity, Flow or None.

**Line 3** - Temperature, Flow or None.

**Line 4** - Custom ID or None.

A custom ID can be entered through the Service Menu. It is typically used to describe the transmitter location in the building.

**Brightness** - Allows the user to set the brightness of the display in real time.

**Inactivity Timeout** - The time period which holds the display in menu mode. When the timer expires, the display is returned to the main display screen showing the process values.

## Analog Output Configuration

The Vari-Green transmitter is equipped with dual analog outputs. The Analog Output Configuration menu configures the analog output type, parameter and filter.

**Output Type:** 4-20 mAADC, 0-5 VDC or 0-10 VDC

**Output 1 and 2:** Flow, Velocity or Temperature

The **Filter** has a minimum setting of 0 to a maximum setting of 10. To disable the Filter, select Off.

## Display Average Filter

The Display Averaging Filter filters the data shown on the display. It affects all elements of the display. The Filter has 1-10 settings - 1 is the lightest filter, and 10 represents the heaviest filter. It also has an 'Off' setting.

### Flow Configuration

---

Measurement Type:  ▾

Shape:  ▾

Height (In):

Width (In):

Area (ft<sup>2</sup>):

Max. Flow (CFM):

ENT - Accept ESC - Leave UP/DN - Change

### Display Configuration

---

Line 1:  ▾

Line 2:  ▾

Line 3:  ▾

Line 4:  ▾

Brightness:  ▾

Inactivity Timeout:  ▾

ENT - Accept ESC - Del/Leave UP/DN - Change

### Analog Output Configuration

---

Output Type:  ▾

Output 1:  ▾

Output 2:  ▾

Filter:  ▾

ENT - Accept ESC - Leave UP/DN - Change

### Display Averaging Filter

---

Filter:  ▾

ENT - Accept ESC - Del/Leave UP/DN - Change

## Zero Lockdown

Zero Lockdown will drive the displayed flow and velocity, as well as the associated outputs to zero when the velocity is below the set point. As very low air velocities tend to be noisy and unstable, it may be best for control purposes to raise the zero lockdown velocity to an appropriate threshold above that which the velocity is steady and reliable.

## Alarm/Alert Configuration

The Alarm/Alert Configuration menu provides access to select and configure the transmitter alarm and alerts. Alarm type can be either flow or temperature with Upper and Lower limits. The transmitter alarm controls an onboard relay. Alerts are messages possibly indicating issues with sensors or the transmitter.

**Alarm Operation:** If the process value (Type) exceeds the Upper or Lower Limit, the relay will change state from the default of NO or NC and the Type will change to red. When the process value recovers to be within the Upper and Lower Limits, the relay will return to the default state and the Type will return to black. The Limits Units are shown in parentheses. These units are controlled by the System of Units and the Units of Measure. If the units are US and the flow is CFH, CFH will be the units used in Limits.

**Alert Operation:** Enable Reg. Alerts will turn ON / OFF  
Enable Global Alerts will turn ON / OFF

## Field Characterization

Field characterization (K-factoring) of a flow element is the adjustment of the flow measurement system to match a known reference measurement, (most commonly airflow traverse testing.) Field characterization is typically done when there is insufficient straight duct run or another issue that creates questionable output from the installed measurement system.

A Field Characterization can be developed from one, two or three reference flow rates – more could be used, but are not necessary. One traverse test is required for each flow rate. It is recommended that a minimum of a low and a high flow rate are used to determine a Field Characterization. If there is little to no variance in the normal flow rate, it is feasible to use a Field Characterization developed from a single flow rate test. If a high and low flow rate test are performed and it is found that these readings are substantially different, then a medium flow rate should be considered to ensure a more accurate Field Characterization. For any questions or concerns regarding Field Characterization implementation, please contact Greenheck.

### Field Characterization

**On** enables the Field Characterization and the selection of **Calculate** or **Manual**. The **Calculate** selection will display the on-board calculator that will determine the K-factor (device and reference data must be in-hand and ready to input). **Manual** displays the Exponent and Gain value forms for inputting externally determined Exponent and Gain values.

### Zero Lockdown

---

Lockdown  ▾  
Velocity (FPM):

ENT - Accept ESC - Leave UP/DN - Change

### Alarm/Alert Configuration

---

Type:  ▾  
Upper Limit (CFM):  ▾  
Lower Limit (CFM):  ▾  
Enable Reg. Alerts:  ▾  
Enable Global Alerts:  ▾

ENT - Accept ESC - Leave UP/DN - Change

### Field Characterization

---

▾

● Calculate  
○ Manual

ENT - Accept ESC - Leave UP/DN - Change

## Calculate

Number of Points is the number of flow reference points. Each point is one reference flow rate (determined by traverse testing or other) and the associated Vari-Green system flow rate. The traverse testing flow rate for these reference points is performed before entering this screen and is written down with the associated Vari-Green point (flow rate). For most applications, a minimum of two points (low and high flow rates) are recommended for an accurate Field Characterization. Three points may be required.

Electra Point refers to the flow rate measured by the transmitter, and Reference Point refers to the flow rate measured externally. Electra Point 1 and Reference Point 1 will be the flow rates for the first test, Points 2 for the second test and Points 3 for the third test. Best practice will be to go from the lowest to highest flow rates when inputting this data. Once all data has been entered and the **ENT** button is pushed for the final Reference Point, the Calculator will display the calculated gain and exponent values.

**NOTE: Whenever a system is being retested in order to determine a new Field Characterization (K-factor), the existing Field Characterization should be turned off prior to testing.**

## Manual

Selecting Manual will allow inputting of externally determined Gain (K) and Exponent (E) values, where:

$$\text{Flow (corrected)} = K \times \text{Flow (uncorrected)} \wedge E$$

**Note: A Gain (K) only Field Characterization (K-factor) can be achieved with an exponent (E) value = 1.0.**

## SERVICE MENU

### Total System Scan

Displays the current status of all of the system sensors, thus allowing the user to quickly verify all is operating properly. Expected (white) and Enabled (green) sensor values should be the same unless sensors have been intentionally Disabled (red). See below for sensor control. If Missing (yellow) is at a value other than zero, the transmitter is not communicating with the associated node.

### Sensor Control

An enabled sensor will report measurement data to the Vari-Green transmitter. This is the default condition after initially powering the system. A disabled sensor will not report measurement data to the Vari-Green transmitter. Disabled sensors may have a malfunction that causes this condition. It may also be desirable to intentionally disable a sensor for troubleshooting purposes. A known bad or suspect sensor can be disabled to remove it from the flow and temperature averages until it can be evaluated and/or repaired if necessary.

### Sensor Data Scan

Displays sensor number (Sen), power input to sensors (PWM), temperature difference between flow and temperature sensors (DELTA<sub>t</sub>), velocity (FPM), flow temperature sensor (FLOW<sub>t</sub>) and the reference temperature sensor (REF<sub>t</sub>).

This data display screen can be used to further evaluate and troubleshoot the system performance and the application characteristics; e.g., the individual sensor velocities and temperatures will provide comprehensive data regarding the flow profile measured.

## Characterization Calculator

Number of Points:  ▾  
 Electra Point 1:   
 Electra Point 2:  
 Electra Point 3:  
 Reference Point 1:   
 Reference Point 2:  
 Reference Point 3:

ENT - Accept ESC - Leave UP/DN - Change

## Total System Scan

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	32	31	32

Expected  Enabled  2  
 Missing  Disabled  0

ESC - Leave

## Sensor Control

Sensor 1: Disabled  
 Sensor 2: Enabled

ENT - Toggle ESC - Leave UP/DN - Select

## Sensor Data Scan

Sen	PWM	DELTA <sub>t</sub>	FPM	FLOW <sub>t</sub>	REF <sub>t</sub>
1	8980	31.3	885.0	104.9	73.6
2	6813	35.0	382.0	108.2	73.2
3	0	0.0	0.0	0.0	0.0
4	0	0.0	0.0	0.0	0.0
5	0	0.0	0.0	0.0	0.0
6	0	0.0	0.0	0.0	0.0
7	0	0.0	0.0	0.0	0.0
8	0	0.0	0.0	0.0	0.0
9	0	0.0	0.0	0.0	0.0
10	0	0.0	0.0	0.0	0.0

ESC - Leave UP/DN - Page Scroll

### Sensor Alert Scan

Displays alert codes for expected sensors. Sensors operating properly will display NoAlert.

Sensor Alert Scan		
SENSOR	ALERT CODE	FREQ
1	Disabled	41
2	NoAlert	

ESC - Leave UP/DN - Scroll

### Other Alert Codes

Alert Code	Type	Description	Corrective Action
Missing	ALERT	Transmitter cannot communicate with Sensor	Power cycle system and recheck.
SensA00R or SensB00R	ALERT	Sensor fault	Replace sensor. Contact Greenheck.
Delta00R	ALERT	Sensor Delta Temperature out of range	Contact Greenheck.
Temp00R	RANGE	Temperature measurement out of range (-20 to 140°F)	Verify application temperature is not outside -20 to 140°F. If Vari-Green appears to be reporting incorrectly, contact Greenheck.
Disabled	ALERT	Sensor resets abnormally	Power cycle system and recheck.
Vel00R	RANGE	Average velocity exceeds 5000 FPM for ducted and 10,000 FPM for Fan Inlet	Verify factory set-up information is correct. If application velocity exceeds 5000 FPM, contact Greenheck.

## 4.2 START-UP / OPERATION

After power and signal wiring has been verified in accordance with section 3.4, activate the external 24 VAC / 24 VDC power source.

1. Press the power button located on the bottom left corner of the front cover to turn the system ON.
2. The display will show a loading bar. After reaching 100%, the display will indicate which sensors have been discovered for approximately 2 seconds. Then the normal operating screen will be displayed.

The default normal operating screen will display Total Flow on the first process line, Velocity (average of all enabled sensors) on the second process line and Temperature (average of all enabled sensors) on the third process line. Application tagging information is at the bottom of the screen and is customer configurable.

The following icons will always be displayed at the top of the normal operating screen. Press **ENT** to enter menu screens. Follow instructions in section 4.1 to navigate.



Send/Receive arrows flashing indicates the sensor(s) and transmitter are communicating normally



Transmitter processor normal



Field Characterization has been turned on



Total Flow	
<b>520 ACFM</b>	
Velocity	417.1 AFPM
Temperature	72.71 F

### 4.3 ANALOG OUTPUT SIGNALS

**Airflow:** Available on connector J1, terminals AO1+ and AO1- or AO2+ and AO2-. The full scale output is equal to Max flow as inputted into the Vari-Green transmitter on the Flow Configuration submenu.

**Temperature:** Available on connector J1, terminals AO1+ and AO1- or AO2+ and AO2-. The temperature analog output has a fixed scale of -20° F to 140° F.

## SECTION 5.0: Maintenance / Inspections / Troubleshooting

### 5.1 MAINTENANCE / INSPECTIONS

The Vari-Green system has been designed to operate in most HVAC applications without the need for periodic maintenance or calibration. In some applications, it may be necessary to perform a visual inspection of the probe and sensors, and if necessary clean them using a soft, small brush and/or compressed air to remove any accumulated particulate or debris.

### 5.2 TROUBLESHOOTING

The Vari-Green system is intended to provide long-term, trouble-free operation. In the event there is an issue with the Vari-Green measurement system, or the BMS or the controller ceases to receive valid airflow and/or temperature signals, make certain the following have been checked and confirmed:

- The power wiring is securely connected to the proper terminals and is providing the intended 24V AC/DC power.
- The signal wiring is securely connected to the proper terminals.
- The probe-to-probe and probe-to-transmitter cables and connections are properly connected and secure.
- Power cycles the transmitter.

If after following the above troubleshooting steps, the Vari-Green system continues to operate improperly, contact Greenheck for technical assistance.

#### Technical Support:

E-mail: [dampers@greenheck.com](mailto:dampers@greenheck.com) or

Phone: 1-800-717-6540

## Our Commitment

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

Product warranties can be found online at [Greenheck.com](http://Greenheck.com), either on the specific product page or in the literature section of the website at [Greenheck.com/Resources/Library/Literature](http://Greenheck.com/Resources/Library/Literature).

