



***FVC-2000 plus*™**
Fume Hood Controller

Utilizing Sash Position
and Exhaust Flow Measurement

MODEL FVC-2600
Installation, Operation
& Maintenance Manual

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WARRANTY

Tek-Air Systems, Inc. warrants that this product, under normal use and service as described in this Operation and Service Manual, is free from defects in workmanship and material for a period of thirty-six months from the date of shipment to the customer. This limited warranty is subject to the following conditions:

With respect to any repair services rendered, Tek-Air warrants that the parts repaired or replaced will be in good working condition, under normal use, for the period of the original warranty, or for 90 days from the date of repair if the original warranty period has expired.

Unless specifically authorized by Tek-Air in writing, no warranty is made with respect to, and no liability is assumed in connection with, any goods, which are incorporated into other products or equipment by the Buyer. The foregoing is in lieu of all other warranties and is subject to the conditions and limitations stated herein. No other expressed or implied warranty of fitness for particular purpose or merchantability is made.

The exclusive remedy of the user or purchaser, and the limit of the liability of Tek-Air or any other seller for any and all losses, injuries, or damage resulting from the use of this product shall be the return of the product and the refund of the purchase price or, at the option of Tek-Air or any authorized seller, the repair or replacement of the product. In no event shall Tek-Air or any other seller be liable for any incidental or consequential damages.

Table of Contents

<u>Section Title</u>	<u>Page</u>
INTRODUCTION	1
COMPONENTS	2
MODEL CODE BREAKDOWN	4
STEPS TO STARTUP	5
UNPACKING	5
INSTALLATION	7
PVP4100 Series Combination Valve Installation	7
FVC-2000plus Controller Installation	8
FVC-2000plus Display Installation	9
SPT-2600 Sash Position Transmitter Installation	10
Vertical Sash Sensor Installation	11
Horizontal Sash Sensor Installation	16
WIRING	19
FVC2600 CONTROLLER OPERATION	21
CONFIGURATION TOOL OPERATION	25
DISPLAY OPERATION	33
STARTUP	35
TROUBLESHOOTING	40
COMMUNICATIONS	42
 APPENDIX A	
Horizontal Sash Sensor Installation Instructions for Fisher Hamilton SafeAir Combination Sash Type Fume Hood	

INTRODUCTION

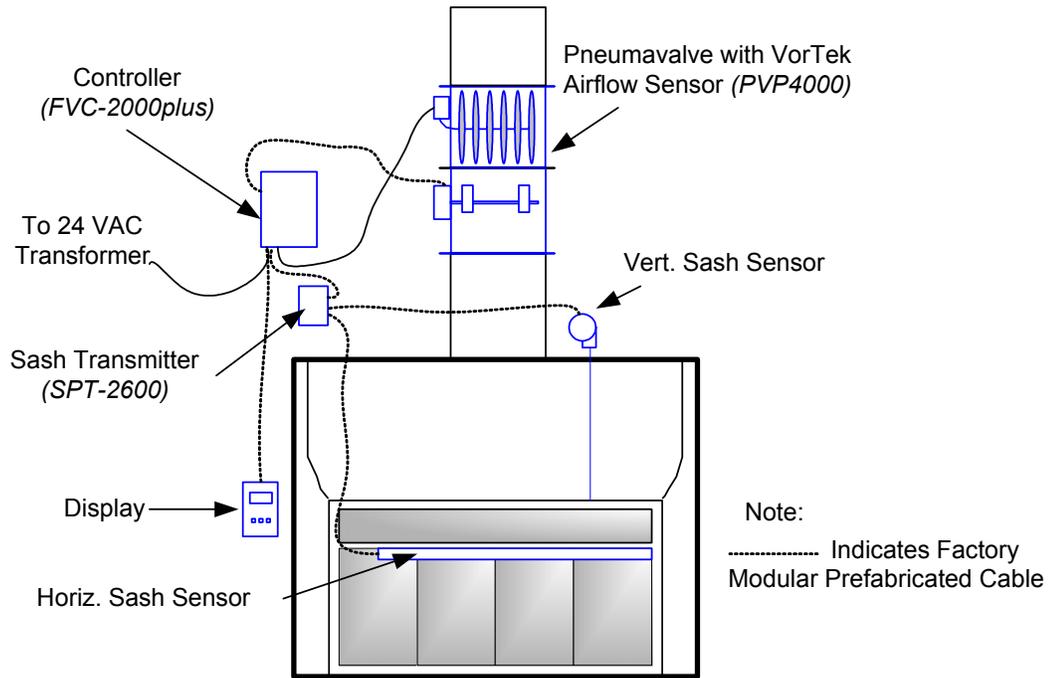
The FVC-2600 Fume Hood Controller controls face velocity by utilizing **sash area** and fume hood **exhaust airflow volume** measurements.

The open sash area is determined by the Sash Sensing System, which consists of the Sash Position Transmitter, Vertical Sash Sensors, and the Horizontal Sash Sensor. Both the Horizontal and Vertical Sash Sensors are connected to the Sash Position Transmitter via factory-supplied cables. The Sash Position Transmitter sends two 4-20mA signals to the Fume Hood Controller, one of which represents the Horizontal Area and the other Vertical Area. The Fume Hood Controller calculates the combined open area and resets the fume hood exhaust volume to maintain the desired face velocity.

The FVC-2000plus Display is typically mounted at the fume hood and can display exhaust airflow volume and set-points, face velocity, sash position, alarm conditions and set-points, and percent output to the exhaust valve. An Alarm Mute Button is provided to silence the alarm horn if a new alarm condition occurs and an Emergency Purge Button is provided to bring the exhaust airflow volume to maximum in the event of a spill.

The FVC-2600 can be programmed for remote emergency over-ride, high and low flow volume alarms, high and low face velocity alarms, and remote alarm horn mute. Output travel of the exhaust air valve can be digitally limited to both maximum opening and minimum closure points. All limits and set-points are adjustable using the FVC-2000plus Configuration Tool, which plugs into the Controller or Display.

The FVC-2600 can be used as a stand-alone device or in conjunction with other FVC2000s, or other control instruments. Communication to other instruments is accomplished via a 4-20mA Signal or an RS-485 communications link. The FVC-2600 can be operated in a lab system incorporating either ARCnet communications protocol or the Johnson Controls N2 Metasys communications protocol.



Combination Type Sash Shown

COMPONENTS

The FVC-2600 system is comprised of several components, each of which may be required for a specific hood type but not others. The components include:



FVC2000plus Mode-6 Controller



**PVP4000 Combo PRD
with VorTek Aiflow Probe**



**FVC2000plus
Face Velocity Display**



**SPT-2600
Sash Position Transmitter**



Configuration Tool

COMPONENTS



Vertical Sash Sensor and Mounting Hardware



Modular Connector and Cable for Multiple Vertical Sash Sensors



**Horizontal Sash Sensor
(Magnets and Mounting Brackets per Fume Hood Type)**



Transformer



Spring Reel for Combo Sash

MODEL CODE BREAKDOWN

T-FVC-26 -

Basic Model Includes: _____

- Controller with VorTek Input Board
- Digital Display & Display Cable
- Sash Transmitter & Transmitter Cable

Communications: _____

- 1 = ArcNET (SmartLab)
- 2 = Open/N2

Vertical Sash Configuration: _____

For multiples, all sashes are assumed to be side-by-side and each sash is assumed to be the same size. Maximum travel of sash from 100% open to 0% open is less than 40".

- 0 = No Vertical Sash
- 1 = 1 Vertical Sash
- 2 = 2 Vertical Sashes
- 3 = 3 Vertical Sashes
- 4 = 4 Vertical Sashes
- 5 = 5 Vertical Sashes
- 6 = 6 Vertical Sashes

Length of Horizontal Sensor Strip, HSS (See Example Below) _____

- 00 = No HSS Required
- 25 = 25 inches
- 33 = 33 inches
- 41 = 41 inches
- 49 = 49 inches
- 57 = 57 inches
- 65 = 65 inches
- 73 = 73 inches
- 81 = 81 inches
- 89 = 89 inches
- Other = Consult Factory

NOTE: To Determine the Length of HSS required, perform the following calculation and round the result UP to the closest size listed: $HSS\ Length = L - W + 2$

Example for Determining HSS:

L = 48" and W = 12.5"
 Calculate Minimum Strip Length Required: $48 - 12.5 + 2 = 37.5$
 Rounding up, select closest length from list: 41

Note: Horizontal sash panels are assumed to be the same size and sash track is assumed to be double only.

Magnets: The HSS requires one magnet to be mounted on each sash panel in close proximity to the HSS. Due to the wide variation in fume hood designs, the magnet size and mounting method selected is dependant on the fume hood configuration. Key to selecting proper magnet size is the distance between the HSS and the Magnet. There are five different magnet sizes available to choose from, which cover a wide range of operation, up to a maximum distance of 1 5/8". For magnet selection and HSS mounting options, consult your factory certified service representative.

Combination Type Fume Hood Sash Configuration

For the FVC2600 Controller, the combination sash must be comprised of **one** vertical sash only with the horizontal panels contained within that one vertical sash. Each horizontal panel must be the same dimension and overlap must be minimal. Consult factory for any other type of sash configuration.

STEPS TO START-UP

1. Unpack and Identify All Components.
2. Install; PRD and VorTek, Controller, Display, Sash Position Transmitter and Sash Sensors.
3. Wire All Components.
4. Familiarize Yourself With The Operation of the Controller, Configuration Tool and Display.
5. Power-Up
6. Start-Up

UNPACKING

The components of your FVC2600 are packaged as follows:



- One FVC2000plus Fume Hood Controller
- One FVC2000plus Display Module
- One 20-foot Display Cable with two 8-pin RJ-45 Jacks
- One 20-foot Cable with two 4-pin RJ-45 Jacks



- One SPT2600 Sash Position Transmitter



- Vertical Sash Sensor with Mounting Hardware
(Quantity based on Model Ordered)



- Horizontal Sash Sensor
(Quantity and Size based on Model Ordered)



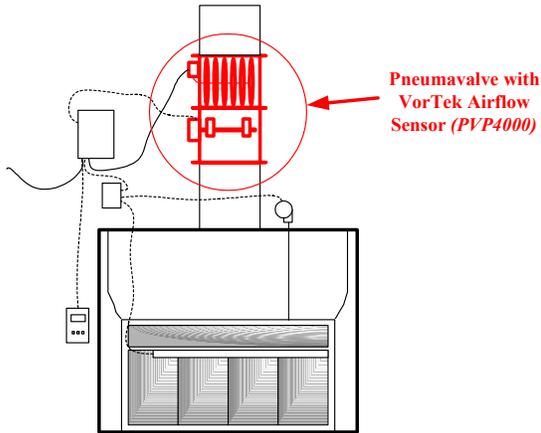
- Magnets/Mounting Hardware for Horizontal Sash Sensor
(Quantity based on Model Ordered)

If any of the components are determined to be missing, please contact your local representative or Tek-Air's Customer Service immediately at (203) 791-1400. Please have your order number and the Tek-Air Job Number available when you call.

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INSTALLATION

PVP4100 Series Combination Valve Installation



Combination Type Sash Shown

Tek-Air recommends for use with the FVC2600, the VorTek Probe and PRD Exhaust Valve be purchased as a **PVP4000 Series Combination Valve**.

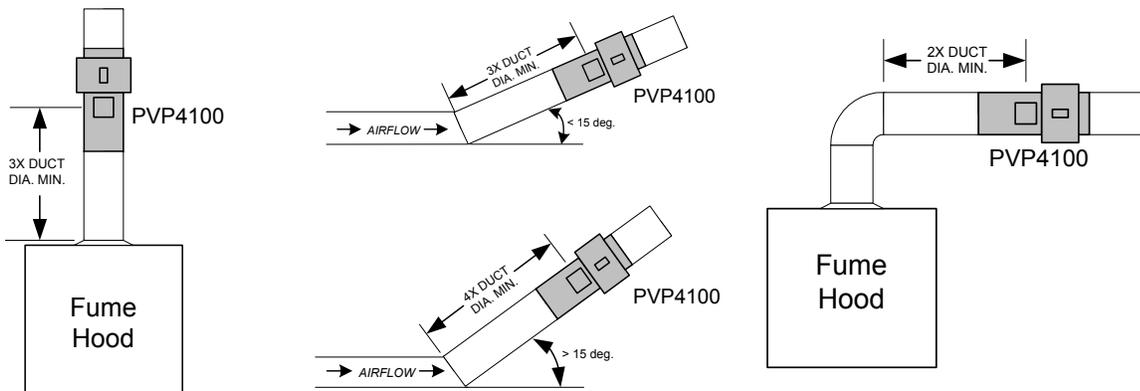
The PVP4000 Series Combination Valve is comprised of a PRD with a High Volume I/P and a VorTek 4000 Airflow Sensor.

Because most fume hood applications require circular ductwork, this manual will include mounting instructions for the PVP4100 series only.

Rectangular valves (PVP4200 Series) are also available, though unusual for fume hood applications.

Step 1: Select Mounting Location

Because the PVP4100 contains an airflow sensor, it is critical to the proper operation of the fume hood controller, that the PVP4100 be installed in a straight duct section, preferably in close proximity to the fume hood. Refer to the diagrams below for selecting a suitable mounting location. The diagrams below are **Minimum Installation Requirements**, if more space is available, the PVP4100 should be located so two-thirds of the straight duct length is upstream of the probe. **Note:** Locations other than those specified as minimums have areas with very high turbulence and reverse flow where accurate airflow measurement is not possible.

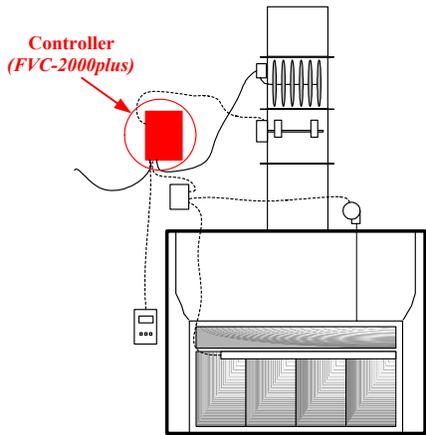


Step 2: Install into the Duct

Once you have a suitable location selected, you are now ready to mount the PVP4100 into the fume hood exhaust duct. The PVP4100 is sized to slip-into the duct for easy mounting. Identify the Inlet Side of the valve observing the airflow direction label on the valve. Carefully lift valve into place and slip into the duct. Be sure to position the valve so the I/P and VorTek Sensor are accessible. Using stainless steel sheet metal screws, secure the PVP4100 in place at both ends. **Note:** Because the I/P has been factory calibrated in the horizontal plane, recalibration of the I/P may be required if mounted in the vertical plane.

INSTALLATION

FVC-2000plus Controller Installation



Combination Type Sash Shown

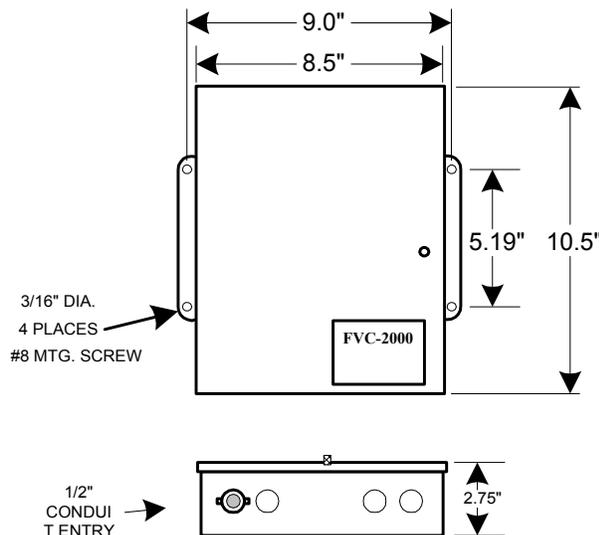
The Controller should be installed on a suitable mounting surface, usually above the ceiling, but in the general location of the fume hood.

Be sure to select a location that will allow sufficient space to open door fully, accommodate the cabling that will be entering the enclosure and allow clearance for the VorTek DIN connection on the left side of enclosure.

Also be sure to verify Sash Transmitter Cable and VorTek Cable will reach the Controller.

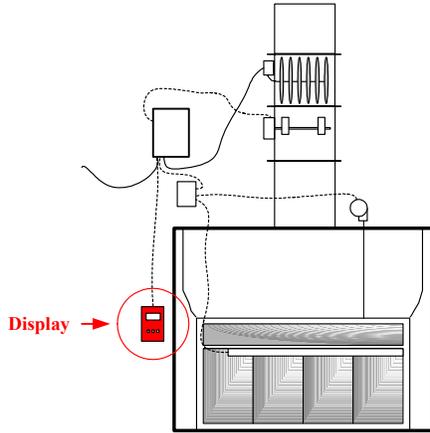
Mounting the FVC2000plus Controller

Select a suitable mounting location and install the controller using #8 screws through the 4 holes provided in the mounting flanges.



INSTALLATION

FVC-2000plus Display Installation



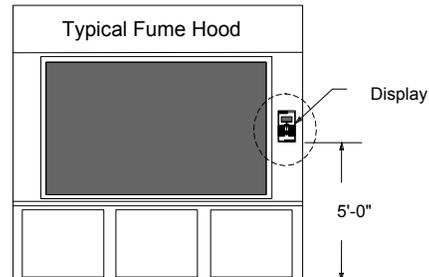
Combination Type Sash Shown

The Display should be installed on either the right or left escutcheon panel of the fume hood, in a location where the hood operator has the ability to see it while working at the hood.

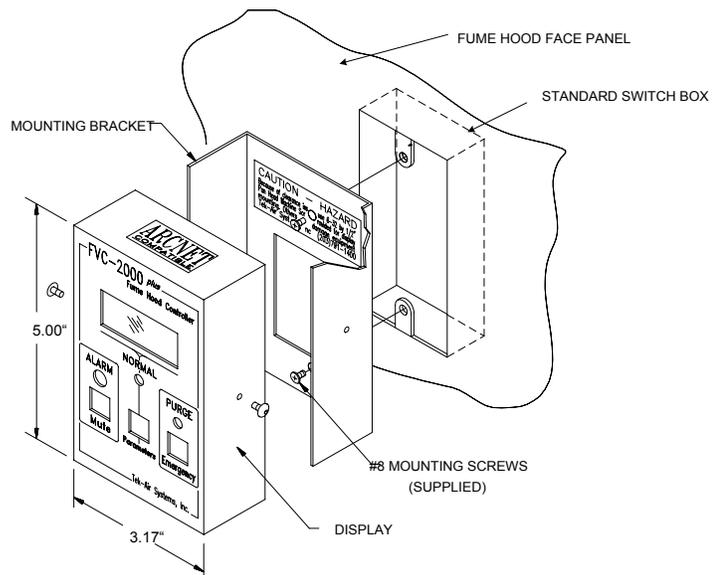
We generally recommend that the Display be located at a height five feet from the floor.

Mounting the FVC2000plus Display

- Select the mounting location for the Display. Typical mounting location is shown at the right.
- Cut a hole at this location, sized to allow for recessed mounting of a standard single gang electrical box.
- Use #6 sheet metal screws to mount the gang box to the escutcheon panel.
- Mount the bracket for the display module on the utility box **using the screws provided** with the display.



WARNING: Using any screw other than what has been provided may cause damage to the display and void your warranty.

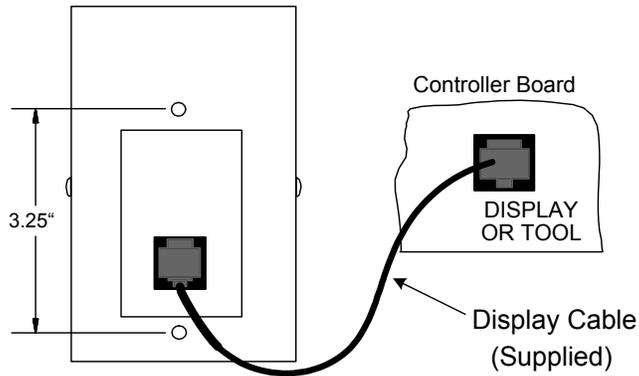


INSTALLATION

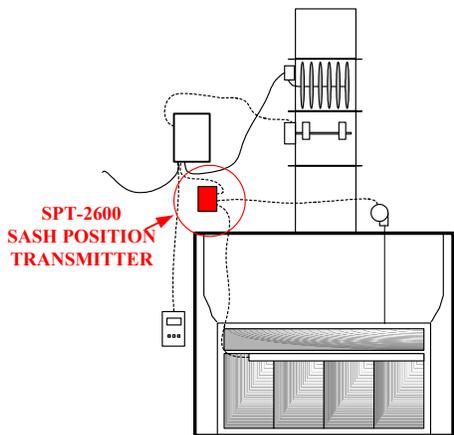
- e. Carefully pull the display cable between the utility box and the controller.

Warning: Do not use cable end for pulling or cable will be damaged. Leave a six-inch service loop at the display end of the cable to allow sufficient slack to work on display with cable plugged in.

- f. Carefully pull the cable up to the controller through the second knockout from the left in the controller enclosure. If conduit is not used, use a romex type strain relief connector.
- g. Plug the cable into the female receptacle located on the controller circuit board.



SPT-2600 Sash Transmitter Installation

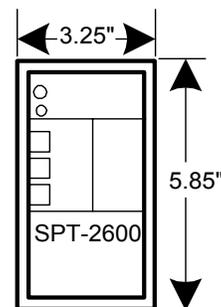


Combination Type Sash Shown

The Sash Position Transmitter must be installed in close proximity to the sash sensors, usually above the ceiling or behind the upper front panel.

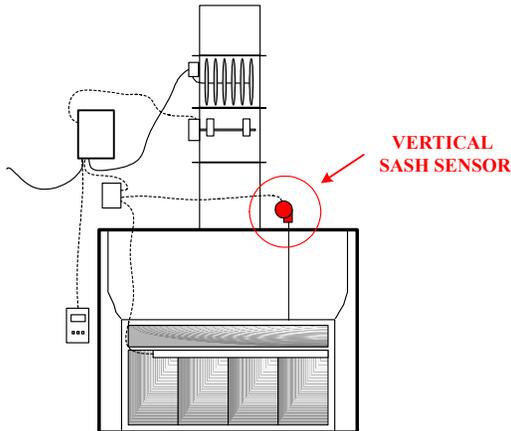
Mounting the SPT2600

- a. Select a suitable location in close proximity to sash sensors and controller. Be sure the sash sensor cables will reach the SPT-2600.
- b. Remove the wall mount plate from the back of the enclosure.
- c. Install the wall mount bracket to the mounting surface using the two screws provided.
- d. Install the SPT-2600 onto the wall bracket.



INSTALLATION

Vertical Sash Sensor Installation



Combination Type Sash Shown

The Vertical Sash Sensor cable can be mounted either directly to the sash frame or to the counter-weight cable system.

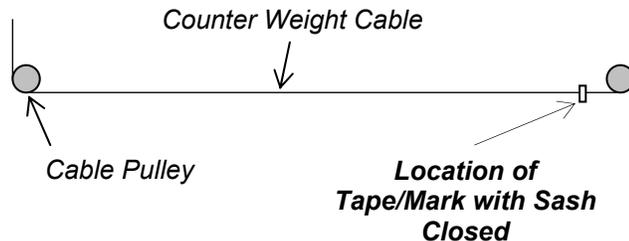
The Vertical Sash Sensor (VSS) has been factory wired so the resistance decreases as the cable is extended. If one of the vertical sash sensor wires were to break or come disconnected, the resulting failure mode would be safe, that is, the sash transmitter will respond as if the vertical sash is open.

The standard Vertical Sash Sensor (VSS) has a travel of approximately 40". Be sure the maximum sash travel does not exceed 40" or the Vertical Sash Sensor will be damaged.

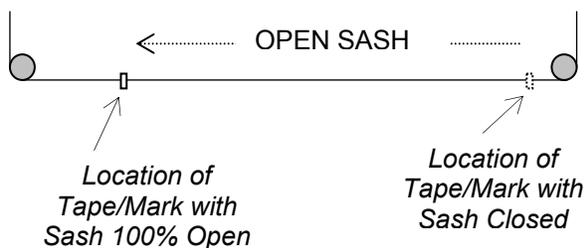
Installing the Vertical Sash Sensor to the Counter Weight Cable

Step 1: Select Suitable Cable Location.

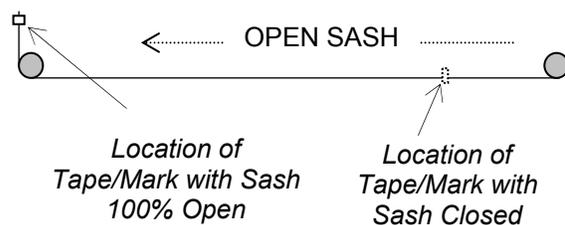
- 1a. Close the fume hood sash completely.
- 1b. Pick a straight run of cable (usually on the top of the hood) that has a distance between pulleys that is greater than the sash travel from fully closed to fully open.
- 1c. Mark the cable with a small piece of masking tape as shown to the right.
- 1d. Now open the sash while observing your tape/mark. *If the fume hood has sash-stops, be sure to release the sash-stop so you can open the sash 100%.* Your tape/mark should travel along a straight line without twisting or passing through a pulley or other obstruction as shown on the diagram marked "Acceptable" below.



Acceptable



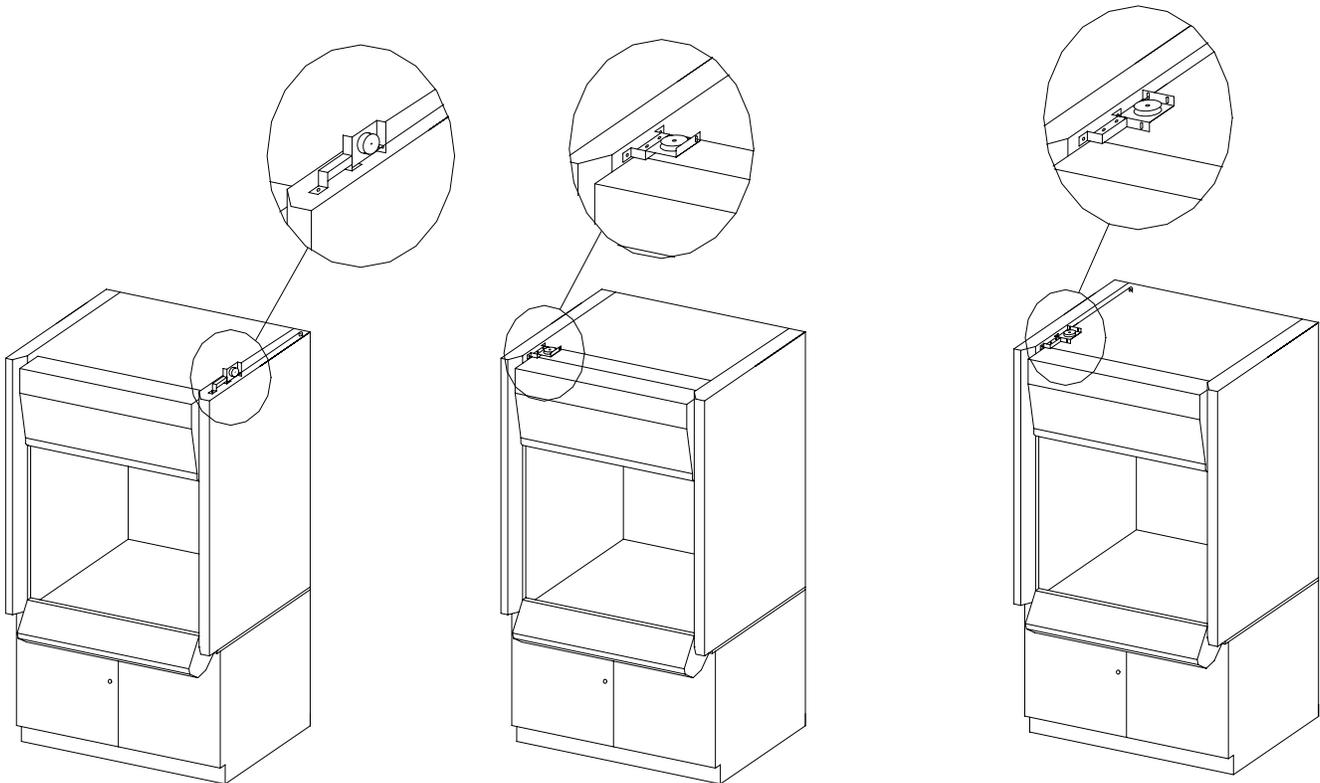
Not Acceptable



INSTALLATION

Step 2: Mount VSS to Hood.

A universal mounting bracket has been provided that will accommodate mounting the VSS to most fume hood types.



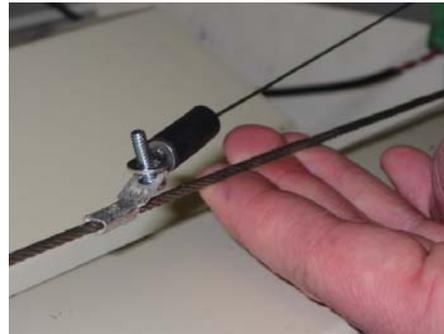
Verify that there are no obstructions that will interfere with the operation of the Vertical Sash Sensor before securing VSS and bracket. Secure in place using hardware provided.

INSTALLATION

Step 3: Connect VSS to Cable.



3a. Locate the crimp terminal onto cable at the location determined in Step 1 and crimp in place using an appropriate crimping tool. (NOTE: Channel locks or vise grips can be used also).



3b. Install the screw provided through the terminal and Vertical Sash Sensor eyelet.

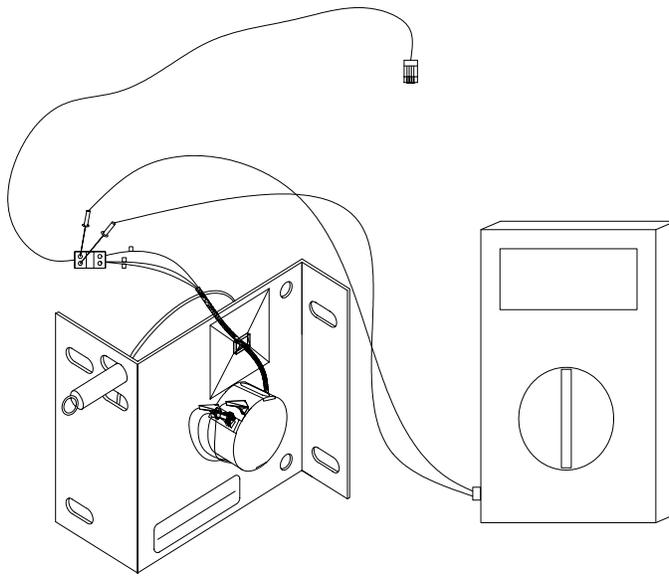


3c. Secure in place using locknut provided.

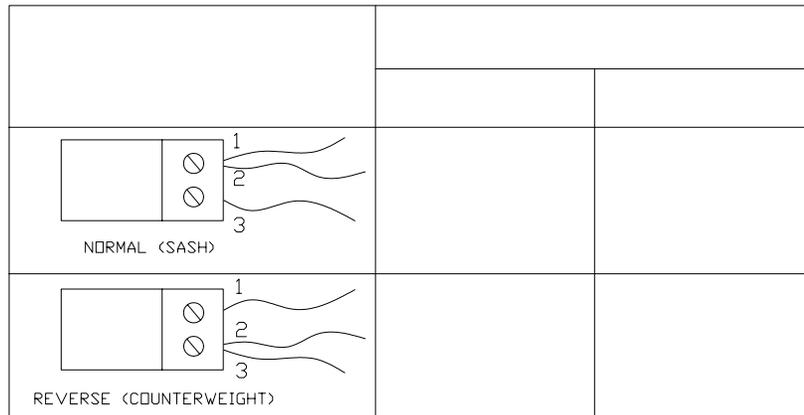
INSTALLATION

Step 4: Configure for Fail Safe Operation.

4a. For fail safe operation the VSS resistance shall increase as the fume hood sash is raised and decrease as the fume hood sash is lowered. The VSS resistance can be measured by placing an Ohm meter across the green terminal as shown below. (NOTE: When making the resistance measurement, the VSS cable shall NOT be connected to SPT2600).



4b. Raise the sash and observe the Ohm meter. If the resistance increases as the sash is raised and decreases as the sash is lowered, then no changes are required. If the resistance range decreases as the sash raised, then move wire #2 to the opposite terminal as shown below:



INSTALLATION

Installing the Vertical Sash Sensor to the Sash Frame

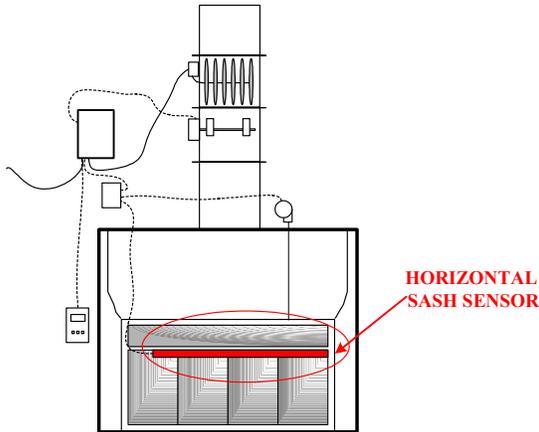
- a. Select a suitable location to mount the sash sensor cable to the sash frame. Usually the center top of the sash frame works well. Try to stay away from the right and left sides of the sash because the cables or chains can interfere with the sash sensor cable.
- b. Mark the location on the sash frame where the sash sensor cable is to be mounted.
- c. Raise the sash to 100% open and mark the upper sash pocket directly above the mark that you made on the sash frame.
- d. Verify that the area above the sash pocket where you marked is clear from any obstructions and is suitable for mounting the sash sensor.
- e. Drill a 3/8" pilot hole up through the sash pocket on your mark.
- f. Above the sash pocket, drill a 1" hole over the pilot hole.
- g. De-burr the hole and install the grommet provided into the hole to protect the sash sensor cable from coming into contact with the sharp edges.
- h. Position the sash sensor above the 1" hole and align so the sash sensor cable is directly over the center of the hole. Do not secure the sash sensor bracket with screws at this time, tape in place temporarily.
- i. Drill a pilot hole in the sash frame where you had previously marked.
- j. Carefully pull the sash sensor cable through the 1" hole and secure to the sash frame using the stainless steel sheet metal screw provided.

WARNING: DO NOT ALLOW THE SENSOR CABLE TO "SNAP BACK" INTO SENSOR ASSEMBLY. Failure to follow these instructions may cause damage to the sash sensor and will void your warranty.

- k. Slowly raise and lower the sash while observing the sash sensor cable. The cable should remain in the center of the 1" hole as the sash is raised and lowered. If not, adjust the position of the vertical sash sensor above until the correct location is found.
- l. Secure the vertical sash sensor in place using the hardware provided.

INSTALLATION

Horizontal Sash Sensor and Magnet Installation



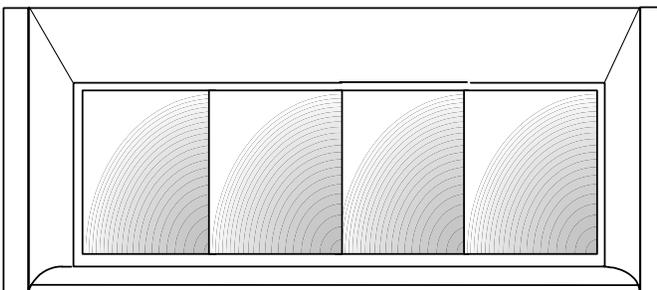
Combination Type Sash Shown

Because there are a wide variety of horizontal and combination type fume hoods on the market today, each installation can be a unique experience.

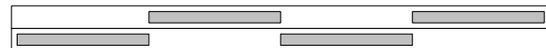
In order to simplify installation, the local Tek-Air Systems Integrator should contact the fume hood manufacturer and determine a strategy for installing the sash sensors. Custom brackets may be required to ensure proper fit-up and operation.

The following instructions are general instructions and are not specific to any one manufacturer's fume hood. If the fume hood has been ordered from the fume hood manufacturer specifically modified to accept the Tek-Air Horizontal Sash Sensor, refer to Appendices herein for installation instructions.

Horizontal Sash Fume Hood with Double Track



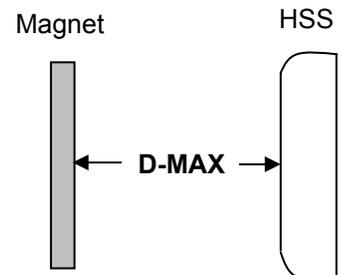
Front View



Top View

Guide for Magnet Selection

Magnet Part Number	Magnet Width (inches)	Maximum Operating Distance D-MAX (inches)
2015HDW00206A	0.125	1/4
2015HDW00206B	0.250	5/8
2015HDW00206C	0.50	1
2015HDW00206D	1.0	1 3/8
2015HDW00206E	1.5	1 5/8

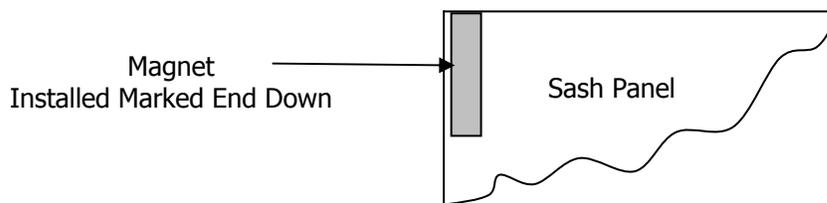


INSTALLATION

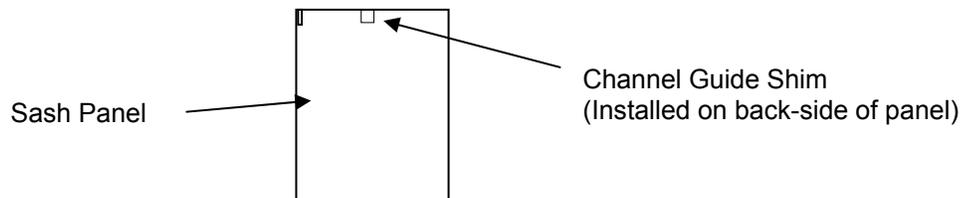
Magnet Installation

One magnet has been provided for each sash panel. The magnets come in various sizes depending on the application. The smaller magnets are to be installed on the sash panels located closest to the sensor strip (**front track**) and the larger magnets shall be installed on the sash panels located farthest from the sensor strip (**back track**). Tek-Air recommends that the magnets be installed in the upper left front corner of each sash for consistency, however any location on the upper front top edge is acceptable providing the same location is used for each sash. One end of each magnet is marked to identify the north pole. It is critical to install each magnet with the marked pole facing in the same direction. Tek-Air recommends that the marked end be located down for consistency, however the marked end may be up providing each magnet is installed the same on each sash panel.

- a. Remove the sash panels.
- b. Using the alcohol wipe provided, clean each sash panel where the magnet is going to be installed.
- c. After the glass is clean and dry, remove the paper backing from the adhesive tape on the magnet and install the magnet as shown below. Remember the small magnets go on the panels located closest to the sash sensor and the larger magnets go on the sash panels farthest from the sash sensor.



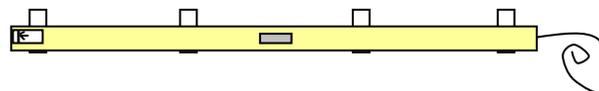
- d. Apply steady pressure to the magnet for 5-10 seconds to ensure a good bond.
- e. Replace the sash panels back into the fume hood.
- f. If there is excessive play in the sash panels that are in the rear track, it may be necessary to install a channel guide shim on the back upper edge of each rear sash as shown below. The channel guide shim will eliminate the excessive play in the panels and ensure magnetic contact between the sash and reed sensor is maintained.



Horizontal Sash Sensor Installation

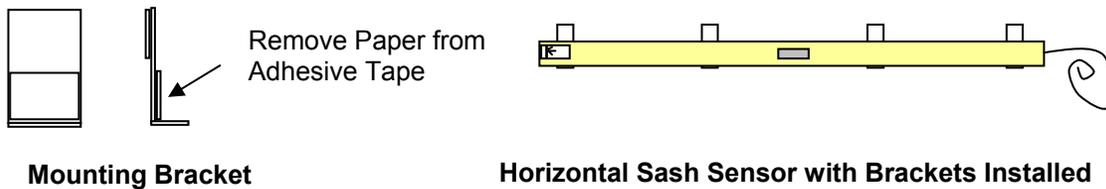
After you have successfully installed the magnets and reinstalled the sash panels, you are now ready to install the Horizontal Sash Sensor. Brackets have been provided to mount to the horizontal sash sensor. The quantity of brackets provided depends on the length of the horizontal sash sensor, one bracket per foot is typical.

- a. Remove the Horizontal Sash Sensor strip from the shipping tube. **Use extreme caution when handling the Horizontal Sash Sensor. Do not allow the Horizontal Sash Sensor to bend or flex.**
- b. Place the Horizontal Sash Sensor on clean flat surface and lay-out the brackets evenly spaced as shown below.

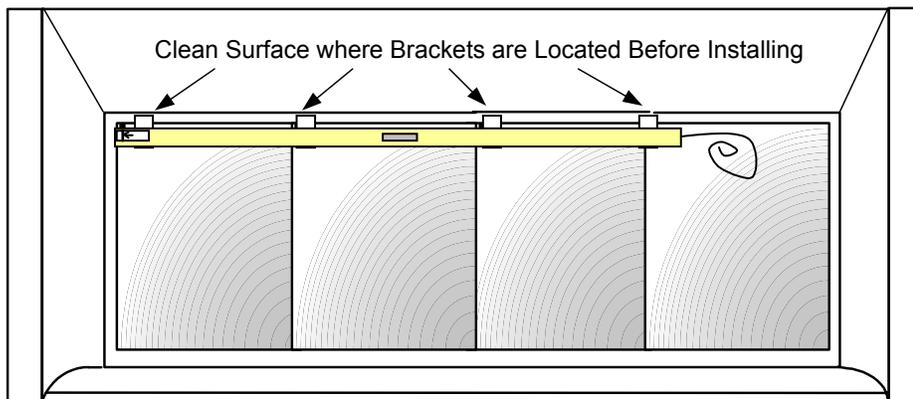


INSTALLATION

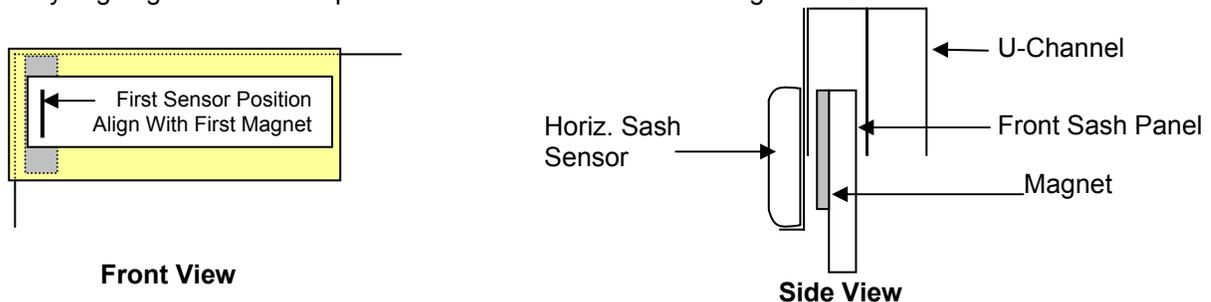
- c. Clean the backside of the Horizontal Sensor Strip where each bracket will be located using the alcohol wipe provided.
- d. Remove the paper backing from the lower piece of adhesive tape on the bracket and adhere each bracket to the backside of Horizontal Sash Sensor as shown below. Apply steady pressure to each bracket for 5-10 seconds to ensure a good bond. **Do not squeeze the sensor strip, as damage to the internal parts will result.**



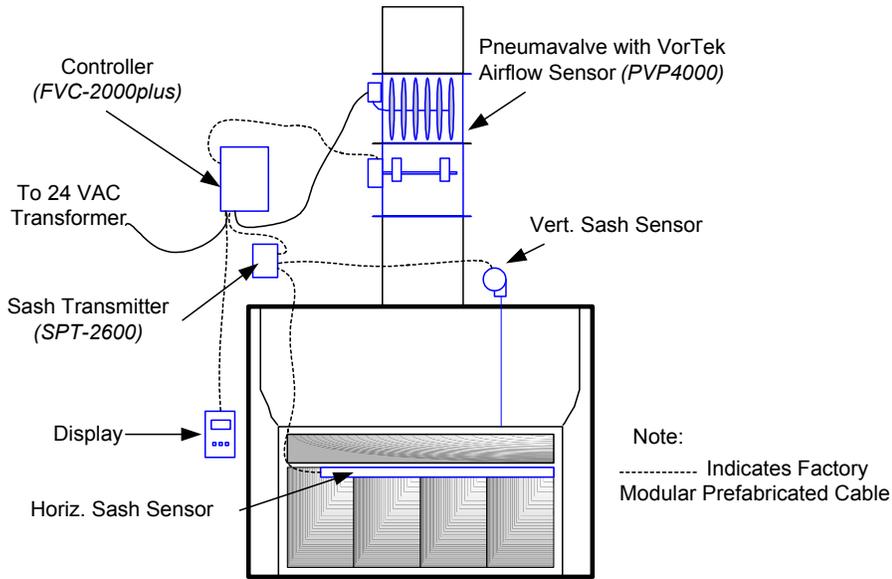
- e. Arrange the sash panels in the closed position as shown below. The horizontal sash sensor strip has an indicator label located the left side which must be aligned with the magnet located on the left-most sash. Hold the Horizontal Sash Sensor into position as shown below and note where the brackets will be adhered to the frame. Using the alcohol wipes provided or other suitable solvent, clean the area where the brackets will be adhered to the fume hood.



- f. Remove the paper backing from the adhesive tape on each mounting bracket and mount the Horizontal Sash Sensor by aligning the sensor strip indicator line with the leftmost magnet as shown below.



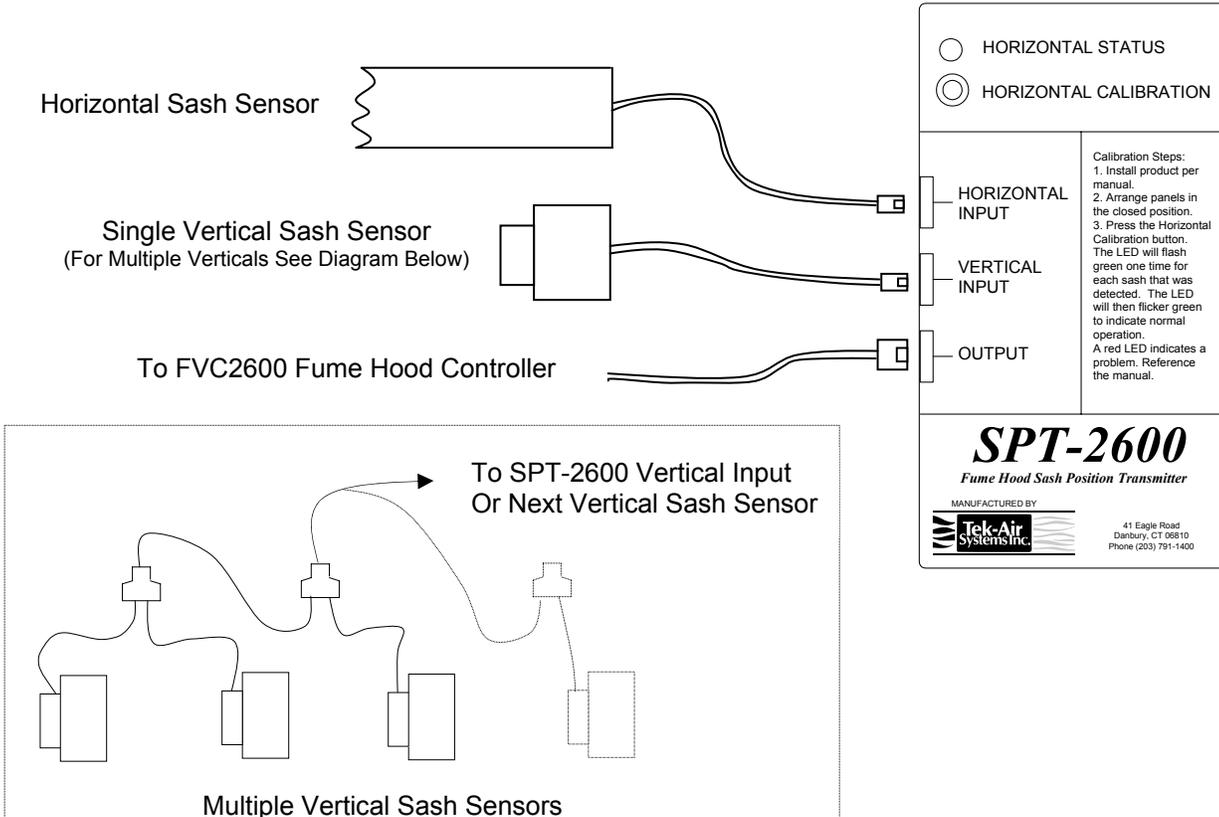
WIRING



Combination Type Sash Shown

SPT-2600 Sash Transmitter Wiring

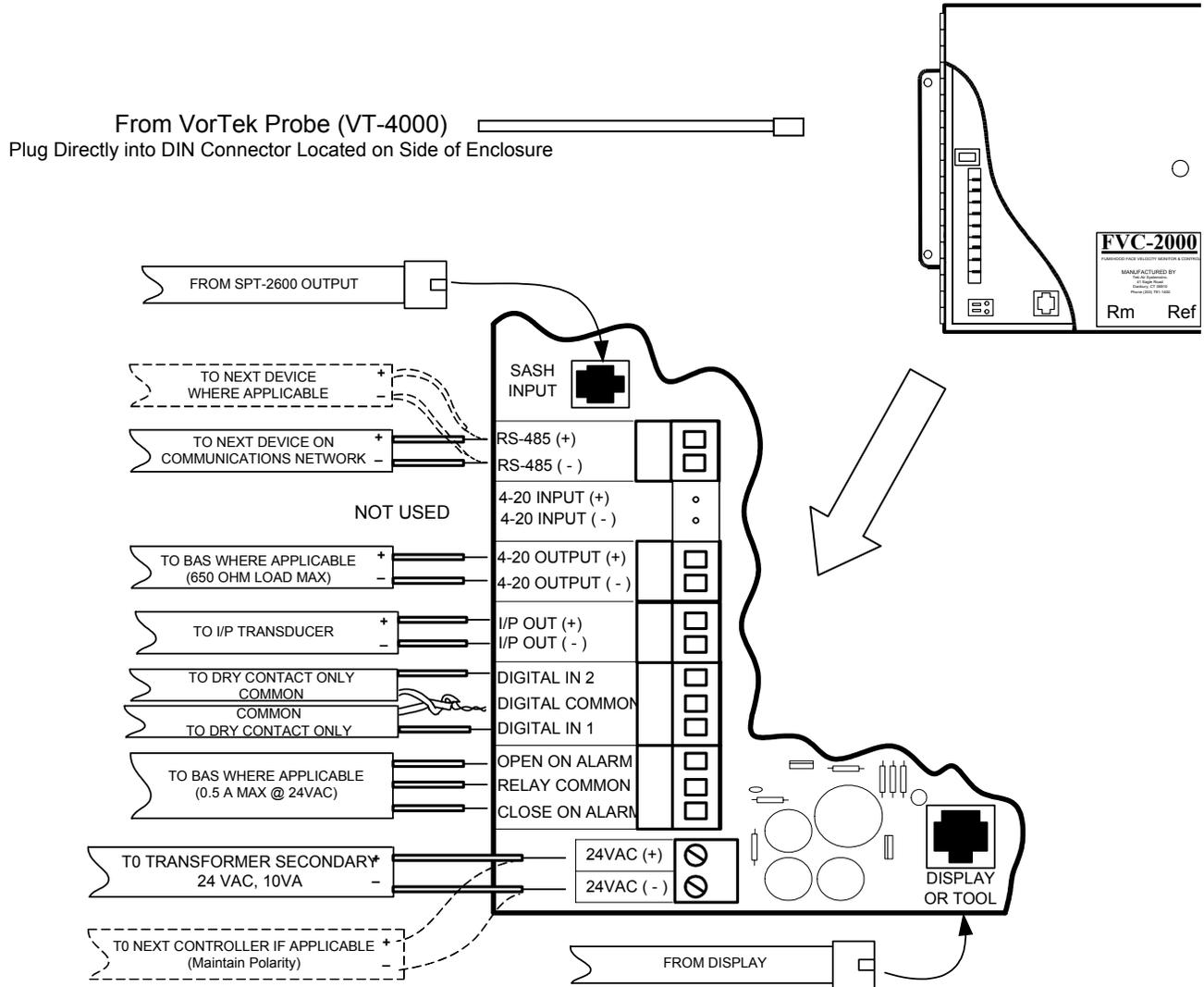
The Horizontal and Vertical Sash Sensors come from the factory pre-wired with modular connectors ready to plug directly into the SPT-2600 Sash Position Transmitter. Connect per the diagram below.



WIRING

FVC2600 Controller Wiring

Wire the FVC2600 Controller per the diagram below. The following I/O must be utilized for minimal Mode-6 Control (Sash/Volume) based control; *VorTek Input*, *Sash Input*, *I/P Output*, *Display Input* and *24 VAC Power*. The following items may or may not be used depending on the specific application; *RS-485*, *4-20mA Output*, *Digital Inputs 1 and 2*, and *Alarm Outputs*.



Notes:

1. For RS-485 Communications Wiring use only low-capacitance, 24 AWG, single twisted shielded pair for high-speed ARCnet Service (Windy City Wire Inc. # 042002 or equivalent).
2. For the Sash Input and Display Input use only Tek-Air supplied cables.

FV2600 CONTROLLER OPERATION



The FVC2600 Controller incorporates one control loop, which calculates the exhaust airflow volume set point based on sash position and exhaust airflow measurement.

Configuration, calibration, and tuning of the controller is performed using the FVC2000plus Configuration Tool, which is temporarily connected to either the display or display cable.

All of the parameters required for operation are stored in EEPROM to protect from memory loss due to a power outage.

During normal operation, an LED (D5) on-board the controller circuit board will flash at 1 Hz to show that the system is active. During RS-485 transmission periods, a separate LED (D4) will flash to show communications are taking place.

Air Flow Control Loop

The control loop calculates the airflow set point, which is based on the open sash area, and attempts to maintain the airflow set point by adjusting the valve. The control loop also calculates an indication of face velocity, which is then displayed on the FVC2000 Display.

- **Control Loop Calculations**

The volume set point is compared to the actual volume measurement, and an error is computed. This error is then modified in two ways; first, gain is applied, and second, it is integrated. These two adjusted error terms are summed together and used as the output factor to drive a control device. The minimum and maximum valve limits and control action are also factored into the control loop.

- **Exhaust Volume Loop Tuning**

The control loop requires tuning in order to operate properly. All parameters such as the integration and proportional error gain must be entered via the FVC2000plus Configuration Tool.

FV2600 CONTROLLER OPERATION

Controller Inputs and Outputs

The FVC2600 Controller has multiple I/O making it suitable for a wide variety of applications. Following is a brief description of each input and output.

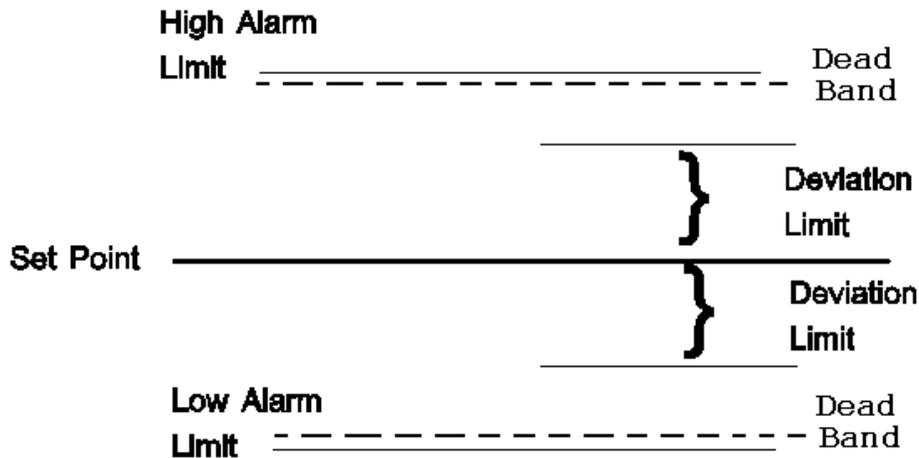
- **4 to 20 mA Input**
This current source input is not used by this product.
- **Digital Inputs**
The FVC2600 Controller provides two digital inputs for optional use. The inputs are designed to accept standard contact closures, such as relays. These inputs are programmable via the Configuration Tool.
- **I / P and 4 to 20 mA Output**
Two current source outputs are available for system use and are scaled to full-scale value as configured by the FVC2000plus Configuration Tool. The I/P output is assigned to the flow control logic output and is used to modulate the exhaust airflow damper. The 4-20mA output can be configured as Face Velocity, Flow Volume or Sash Position %.
- **VorTek Air Velocity Sensor Input**
A four-channel input is provided as a microphone interface for a standard Tek-Air EPC assembly. The hardware interface is an eight-pin (plus cable shield / connector shell) DIN connector.
- **Relay**
The relay is a single pole, double throw device. During normal operation, the relay is powered active. When an alarm condition occurs, the relay is non-powered.
- **Sash Position**
An "RJ" type connector containing dual 4 to 20 ma inputs representing the vertical and horizontal position of the fume hood sashes.

Alarms

- **Flow (CFM) Alarms**
An alarm condition occurs when the actual flow does not fall between the High and Low Alarm Limits, or is outside the Deviation Limit. The controller uses a 1-second time average of the raw flow signal to compare to the alarm limits.
- **Alarm Indicators**
When the airflow volume falls outside the Low or High Alarm Limit window, or outside the Deviation Limit, the audible alarm tone will activate and the display alarm red LED will flash. When the airflow volume falls outside the Low or High Alarm Limit window the relay will also become active (non-powered). The figure on the top of the next page illustrates this.

Note: the Deviation Limit can never rise above the High Alarm limit or fall below the Low Alarm limit. If so, the FVC2000plus configuration tool will display the invalid parameter message.

FV2600 CONTROLLER OPERATION



- **Alarm Delay**
A user settable alarm delay will enable the user to configure the amount of time an alarm condition must exist before the alarm condition causes the alarm routine to commence. This alarm delay will be selectable from a menu with the preset values of 5, 10, 20, and 30 seconds.
- **Alarm Acknowledge**
An acknowledge button is provided on the Controller display to disable the audible tone during the current alarm. Each alarm occurrence must be silenced (if desired) when it occurs. A latched or non-latched alarm can be selected. For example:
For a latched alarm selection: Alarm condition occurs and remains -- When the Mute button is pushed, tone stops, alarm LED becomes continuous. When alarm condition stops, alarm LED is turned off, and the relay returns to normal.
Alarm condition occurs and clears: When the Mute button is pushed, alarm LED and tone is turned off, and the relay returns to normal.
For a non-latched alarm selection: Alarm indicators (light and horn) stop when alarm condition ends. If button is pressed before alarm condition ends, the tone stops and the alarm LED becomes continuous.
- **Alarm Dead Band**
A dead band, approximately 5% of the flow full scale, is provided to prevent toggling of an alarm condition when the flow is near an alarm limit.
- **Alarms During Emergency (Purge)**
If an alarm condition occurs during purge, then the alarm LED will flash until the Mute button is pressed (it will then become continuous), while the relay will not indicate an alarm. The Display LCD will show the appropriate alarm message. The tone will only annunciate if "Re-beep" is the mute function selection.
- **Invalid Set Up Condition**
An invalid condition exists when the Low limit is set at or above the High limit. The two limits are not permitted to be any closer than a condition where the upper boundary of the Low limit is 1 ft/min less than the lower boundary of the High limit dead band. When an invalid condition exists, the Configuration Tool Display will show IL (invalid limits) when any parameters are configured, until the condition is corrected.

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CONFIGURATION TOOL OPERATION

The FVC-2000plus configuration tool is a hand-held device used to configure the operation of the FVC2000plus fume hood controller. The tool is menu driven, and incorporates a 4-line, 16-character per line, LCD window. Two different types of Configuration Tools are available, one is for ARCnet applications and the other is for Non-ARCnet applications. The two different types of tools are not interchangeable and must be ordered from the factory as either ARCnet or Non-ARCnet. The tool pictured below is configured for ARCnet



Key Pad Operation

1. The **MODE KEY** causes the tool to alternately select between displaying the Current Status and any other location in the System Menu Tree where the cursor is positioned, (unless the cursor is active in the option selection position).
2. The **ENTER KEY** is used to select menu categories and choose from listed options for configuring the Controller.
3. The **UP, DOWN, LEFT and RIGHT ARROWS** are used to move a cursor through the menus

Connecting the Tool

ARCnet Configuration

Using the white cable provided with the tool, simply attach one end into receptacle located on the lower left side of the Tool and the other end into the jack located on the bottom of the Fume Hood Display. The Fume Hood Display will automatically recognize that the Tool is connected and all information will now bypass the Display and be sent directly to the Tool.

Non-ARCnet Configuration

The Non-ARCnet Tool can be connected to either the cable that is plugged in at the back of the Display or directly to the Controller.

- To connect the Tool to the Display cable, you must first remove the Display from the Fume Hood, disconnect the permanent cable from the Display, and plug the permanent cable into the female end of the gray cable provided. Now connect the male end of the gray cable into the receptacle located on the lower left side of the Tool.
- To connect the Tool directly to the Controller, go to the location where the controller is mounted and open the enclosure door. Disconnect the permanent display cable from the Controller PC Board and connect the male end of the white cable into this location. Now connect the other end of this cable into the receptacle located on the lower left side of the Tool.

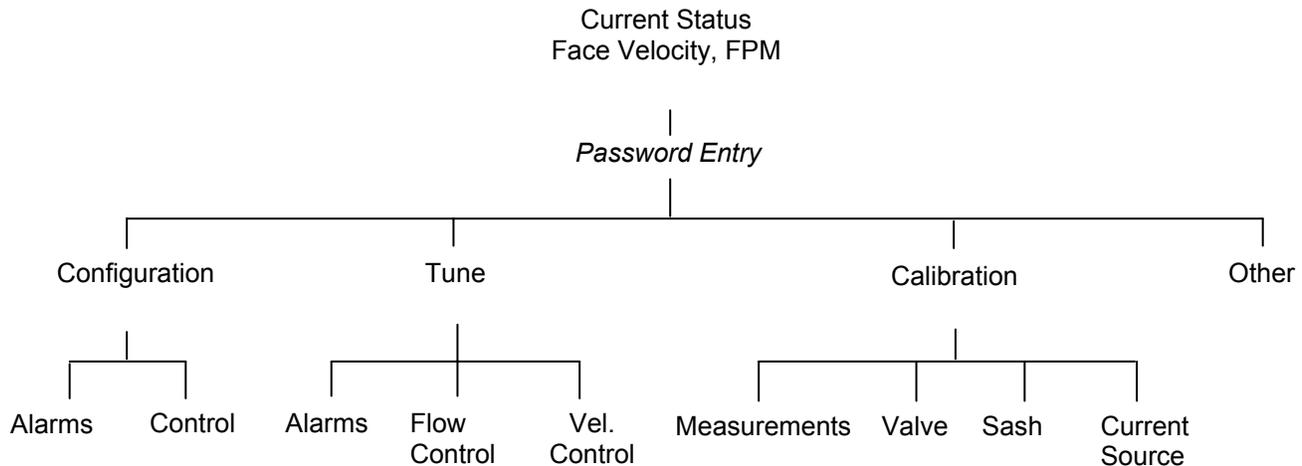
Upon connection the tool will display either, "**comm.=SPI**" for Non-ARCnet applications or "**comm.=SCI**" for ARCnet applications. One second later the display will change to indicate face velocity in FPM and the high and low alarm settings. This is the starting point for accessing all available menus.

CONFIGURATION TOOL OPERATION

Password Function

A Password function is provided to protect against unauthorized tampering with the controller. The factory preset default password is "1234". To access the Password Function, **PRESS** the down-arrow "v" key. The display should now read "Password Entry". Now use the arrow keys to enter "1234" and press "ENTER". You may now navigate through the Menu using the arrow keys; <, ^, >, and v.

Menu Hierarchy



Navigating Through Menus

The Menu's **Major Categories** includes; **Configuration, Tune, Calibration** and **Other**. Use the "<" and ">" keys to move to the desired Major Category.

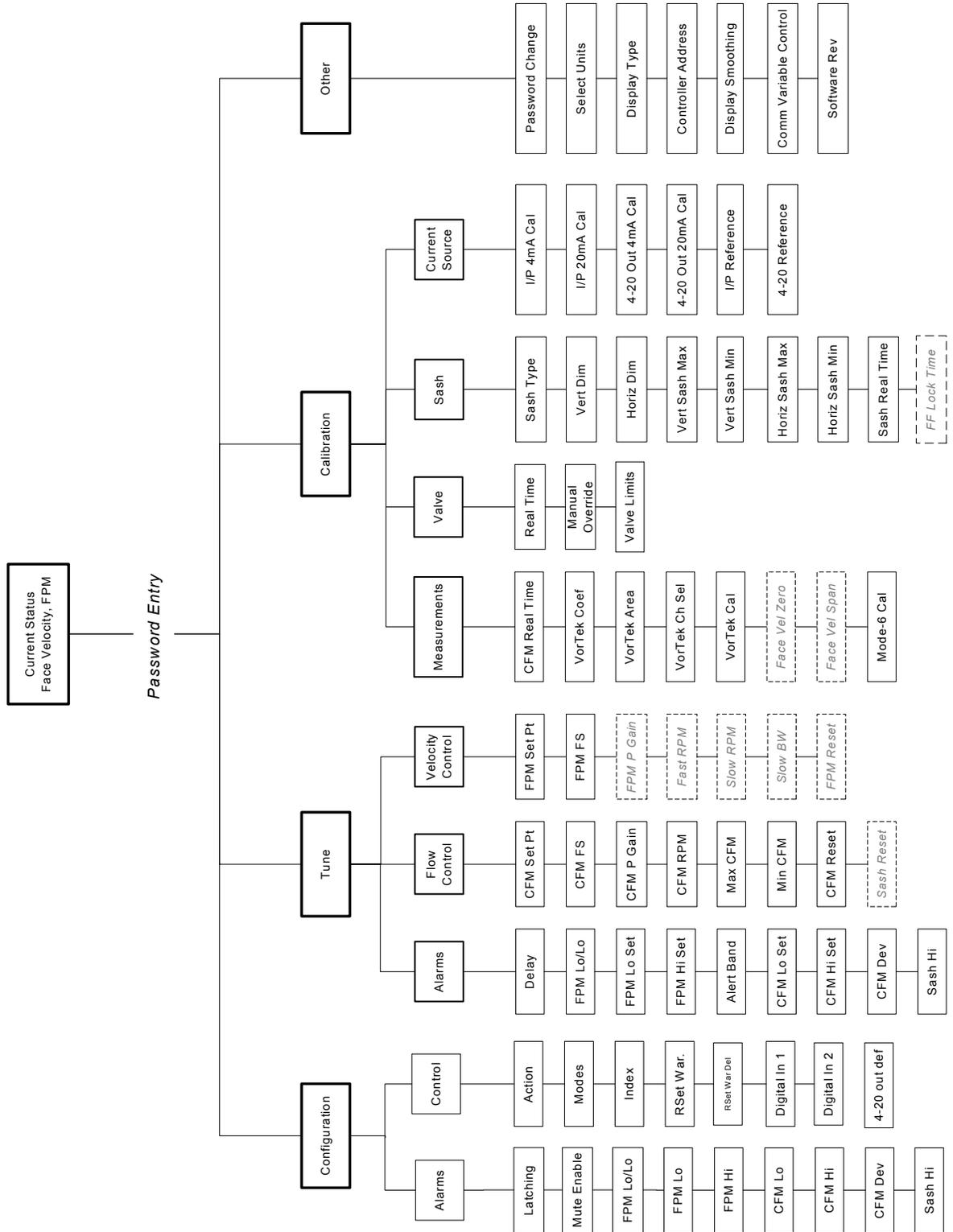
Once in the desired Major Category, use the "v" key to go to next level of menus, which contain the **Basic Functions**.

Once in the desired **Basic Function**, use the "^" and "v" keys to move the cursor to any desired **Parameter**. Use the ">" key to select a minor group or the "<" key to exit the group. Within the selected minor group, use the ^ and v keys to move the cursor to any desired sub-menu. When viewing a specific menu, a "*" cursor identifies the current selection. Use the ">" key to move to the options. The cursor will now become a ">" to indicate selection mode. Use the "^" and "v" keys to move the cursor among the options. In some of the specific tuning and calibration menus, you may need to use the "^" and "v" keys to adjust numerical data. Push Enter to select or the "<" key to return without selecting.

Chart Structure

The chart on the following page shows a more extensive menu structure of the FVC2000plus Configuration Tool. By viewing this chart, you can quickly determine where each menu item is located within the tree.

CONFIGURATION TOOL OPERATION



CONFIGURATION TOOL OPERATION

Configuration Tool Submenu Categories and Descriptions

Current Status	Displays the real time Face Velocity in FPM and Face Velocity Hi and Lo Alarm Status and values.	XXX FPM Hi = XXX Off Lo = XXX Off
----------------	--	---

Password Entry	The factory default password is 1234. Data can be observed but not changed without entering the password. The Password Entry display will only be displayed while the Password Protect is enabled. Once the password protect has been disabled by entering a valid password, the Password Entry menu item will no longer be displayed until the Password Protect has once again been enabled.	XXXX
----------------	---	------

Configuration

Alarms	Alarm Latching	Enables or disables the latching function of the alarm indication.	Off On
	Alarm Mute	Determines how the Display "Mute" Button will function. The "now" position acts like a momentary key. Immediately after selecting, the previously chosen option again becomes the current selection.	now Disable Enable Re Beep
	Face Velocity Lo/Lo Alarm	Enables or disables the face velocity low/low alarm.	Off On
	Face Velocity Lo Alarm	Enables or disables the low face velocity alarm.	Off On
	Face Velocity Hi Alarm	Enables or disables the high face velocity alarm.	Off On
	Volume Lo Alarm	Enables or disables the low airflow volume alarm.	Off On
	Volume Hi Alarm	Enables or disables the high airflow volume alarm.	Off On
	Volume Dev Alarm	Enables or disables the deviation airflow volume alarm function.	Off On
	Sash Open Alarm	Enables or disables the sash high alarm function.	Off On
	Control	Control Action	Selects the operation of the airflow control device.
Operational Mode 1 - 6		Selects the control mode of operation.	1 Vel Resets Valve 2 Vel Resets Valve 4 2 Pos Const Vol 6 Vol Resets Valve
Set Pt Reset Indexing		Determines if the control set point can be changed to the reset setpoint.	active not active
Reset Warning		Enables or disables the reset advanced warning signal.	Off On
Set Pt Reset Warning Delay		Enters the time delay value for the advanced reset warning.	30 min
Digital Input (1)		Selects the configuration of Digital Input 1.	set pt reset remote mute emergency
Digital Input (2)		Selects the configuration of Digital Input 2.	Set pt reset remote mute emergency
4-20ma Output Define		Selects parameter to be sent to the 4-20mA output (as % FS).	face vel flow vol sash %

CONFIGURATION TOOL OPERATION

Tune			
Alarms	Alarm Delay	Sets the Alarm Delay Value (sec.)	5 10 20 30
	Face Velocity Lo/Lo Alarm	When FV Lo/Lo is active, sets the Lo/Lo Face Velocity Alarm Set Point. Range {0 – 200 fpm}	0040
	Face Velocity Low Alarm	When FV Lo is active, sets the Low Face Velocity Alarm Set Point. Range {0 – 500 fpm}	0060
	Face Velocity Hi Alarm	When FV Hi is active, sets the High FV Alarm set point. Range {100 – 1000 fpm}	0400
	Face Velocity Display Alert Band	Sets the face velocity Alert Band value when in Alpha Mode. Range {0 – 50 fpm}	0015
	Volume Low Alarm	When CFM Lo is active, sets the low volume alarm set point. Range {0 – 500 cfm}	0000
	Volume Hi Alarm	When CFM Hi is active, sets the high volume alarm set point. Range {0 – 5000 cfm}	5000
	Volume Deviation	When CFM Dev is active, sets the CFM deviation alarm set point. Range {0 – 1200 cfm}	1200
	Sash Alarm Active Above	When Sash Hi Alarm is active, sets the sash % open alarm set point. Range {0 – 100%}	75%
	Flow Control	Volume Set Point	Sets the normal constant volume airflow set point desired. Range {0 – 5000 cfm}
Volume Full Scale		Sets the full scale airflow exhaust volume limit. Range {0 – 5000 cfm}	2000
Volume Prop. Gain		Sets the proportional gain value for the flow control loop. Range {0 – 50}	01.00
Volume Repeats / min		Sets the repeats / minute (error integration) for the flow control loop. Range {0 – 250}	005
Volume Max		Sets the maximum hood airflow exhaust volume permitted. Range {0 – 5000 cfm}	2000
Volume Min		Sets the minimum hood airflow exhaust volume permitted. Range {0 – 5000 cfm}	0000
Volume Reset Set Point		When Index is active, sets the reset constant airflow volume desired. Range {0 – 5000 cfm}	0500
Volume Sash Open Reset Position		When Index is active, sets the sash position for reset transition. Range {0 – 100% open}	50%
Velocity Control	Face Velocity Set Point	Sets the normal face velocity set point desired. Range {0 – 500 fpm}	0100
	Face Velocity Full Scale	Sets the full scale limit for hood face velocity. Range {0 – 1000 fpm}	0500
	Output to Valve	Displays real-time output to valve. Range {0 – 100%}	### %
	Face Velocity Reset Point	When Index is active, sets the reset FV set point desired. Range {0 – 500 fpm}	0075

CONFIGURATION TOOL OPERATION

Calibration			
Measurements	Flow Volume CFM Real Time	Real time hood exhaust volume	### CFM Hi = XXX Off Lo = XXX Off
	VorTek Coef. Hertz	Factory set calibration constants for converting VorTek Hz to CFM. Range {0 – 200}	165 10
	VorTek Area	Enter the actual duct area for fumehood exhaust airflow. Range {0.0 – 10 sq ft}	1.00
	VorTek Input Channel Sel.	Enter the active VorTek sensor channels. Factory set based on probe configuration. Range {8, 12, 14, or 15}	1 Sensor = "8" 2 Sensors = "12" 3 Sensors = "14" 4 Sensors = "15"
	VorTek Volume Cal.	Used to perform field calibration of VorTek coefficients. Submenus guide user through the steps.	Start
	Face Velocity Zero	Used to perform "zero face velocity" calibration.	
	Face Velocity Span	Used to perform face velocity calibration at the desired active face velocity.	
	Mode 6 Cal	Used to perform field calibration for Sash/Volume based control (Mode-6). Submenus guide user through steps.	Start
	Mode 6 Cal Sash Bypass%	For fume hoods with bypass, used to account for bypass area. % Open Sash Area.	
	Valve	Output to Valve Real Time	Displays the real time output to valve. Range {0%-100%}
Output to Valve Manual Override		Enables override control of I/P. Selecting will bring up new menu, which displays % valve output, and can be adjusted real time.	
Valve Control Max Output		Enables maximum limits to be placed on the I/P output. Range {0 – 100%}	100
Valve Control Min Output		Enables minimum limits to be placed on the I/P output. Range {0 – 100%}	0
Sash	Sash Type	Sets the type of fume hood sash.	Horizontal Vertical Both
	Vertical Sash Dimen. Width	Input the vertical sash width (ft).	Width ___ ft
	Vertical Sash Dimen. Height	Input the vertical sash height (ft).	Height ___ ft
	Horizontal Sash Dimen. Width	The horizontal width dimension entered into the tool is defined as the maximum possible open width remaining when all panels are overlapping as much as possible (ft). (This width is always less than the overall hood face width).	Width ___ ft
	Horizontal Sash Dimen. Height	The horizontal height dimension entered into the tool is defined as the actual height of the horizontal panels covering the face (ft).	Height ___ ft
	Set Vertical Sash Open	Open vertical sash 100% and enter real time.	* NOW
	Set Vertical Sash Closed	Close vertical sash 0% and enter real time.	* NOW
	Set Horizontal Sash Open	Open horizontal sash 100% and enter real time.	* NOW
	Set Horizontal Sash Closed	Close horizontal sash 0% and enter real time.	* NOW
	Sash Output Real Time	Displays both vertical and horizontal sash % open real time.	Horiz ___ % Vert ___ %

CONFIGURATION TOOL OPERATION

Calibration

Current Source	I/P Output Cal 4ma	Used to calibrate the 4ma "I/P Output". Factory set to 4ma.	*Modify
	I/P Output Cal 20ma	Used to calibrate the span "I/P Output". Factory set to 20ma.	*Modify
	4-20 Output Cal 4ma	Used to calibrate the 4ma "4-20ma Output". Factory set to 4ma.	*Modify
	4-20 Output Cal 20ma	Used to calibrate the span "4-20 Output". Factory set to 20ma.	*Modify
	I/P Reference Output	Used to select specific indicated current for the "I/P Output" or "auto" to enable normal operation.	4 ma 20 ma auto
	4-20 Reference Output	Used to select specific indicated current for the "4-20ma Output" or "auto" to enable normal operation.	4 ma 20 ma auto

Other

Password Change	Used to change the current password, only if the correct password was originally entered. Enter New Password {0000-9999}.	####
Units	Used to select either English or Metric Units. English = FPM (feet/min), CFM (cubic feet/min), Sq. Ft. (square feet). Metric = M/S (meters/sec), Cu M/S (cubic meters/sec), Sq M (square meters).	English Metric
Display Type	Used to select either alpha or numeric display.	Alpha Numeric
Address	Will display the Controller Comm. Address as set by the DIP switch on the Controller Circuit Board (read only).	
Display Smoothing	Used to select either fast or slow smoothing of the displayed value. Slow provides a 10 second average and fast provides a 3 second average.	Fast Slow
Comm Variable	Defines those parameters, which can be remotely changed via communications. Options are: 0 = No Transfers Allowed, 1 = Face Velocity Set Point, 2 = Face Velocity High Alarm Set Point, 4 = Face Velocity Low Alarm Set Point, 8 = Emergency, 16 = Face Velocity Low/Low Alarm Set Point and combinations created by adding the selection numbers. Should be kept a factory default of 31.	31
Revision	Displays the controller and configuration tool firmware revision.	Controller: U23 Tool: 4.9

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DISPLAY OPERATION

The Fume Hood Controller Display is comprised of a liquid crystal display, LED indicators, and three momentary push button switches. The display can be set to operate in either "Alpha" or "Numeric" mode. The display is designed to provide operational information only and access to adjustable parameters is restricted.



Button Functions

- Mute:** This button is used to acknowledge an alarm condition. Pressing this button causes the alarm tone to silence and the alarm LED to stay on continuously. If the "re-beep" mute option is active, the tone will beep twice within a 15 second period, until the alarm condition clears. If the alarms are not "latched", TONE & Alarm LED are automatically cleared when the alarm condition clears.

Pressing and holding the Mute Button for three seconds when there is no alarm will cause the display to perform a self-test. The self-test will illuminate all LED's, all display segments, and beep the alarm tone for one second. It will then display the current display software revision and then the controller address, each held on screen for two seconds.

- Emergency (PURGE):** Pressing this button will cause the hood exhaust valve to be opened to the maximum % open. If valve limits are used the valve will open up to the max open valve limit. Pressing again will return the valve to normal control.
- Parameters:** The parameters button provides the user with a method to look at important parameters concerning fume hood operation. When this button is pressed, the LCD Display will temporarily stop showing the primary default screen, and scroll through the list of parameters, one parameter at a time, each time the button is pressed. The display operation will return to the normal default screen five seconds after the button is released. The table below shows the available parameters and their sequence.

Sequence #	Parameter Description	Abbreviation	Data
0	Volume Set Point (CFM)	Sp	xxx
1	Valve Position (% Valve Open)	out	xxx
2	Calculated Face Velocity Measurement (FPM)	FACE	xxx
3	Volume Low Alarm Set Point (CFM)	Lo	xx
4	Volume CFM High Alarm Set Point (CFM)	Hi	xxx
5	Face Velocity Set Point (FPM)	Sp	xxx
6	Controller Software Revision	FHC	xxx
7	Volume Measurement (CFM)	Flo	xxx

LED Indicators

There are three LED indicators on the Display; Alarm (red), Normal (green), and Emergency (red).

Alarm: Will flash during an alarm condition until the Mute Button is pressed, then the LED will stay on continuous until the alarm condition is cleared.

Normal: Will be illuminated during normal hood operation.

Emergency: Will illuminate after the Emergency Purge Button has been pressed. It will turn off after the Emergency Purge Button is pressed again. Equivalent operation of the indicator can be accomplished via "Emergency" commands over the RS-485 communications link or by digital input.

DISPLAY OPERATION

Display Operation

The Display will communicate with the Controller once per second, to transfer data. If communication cannot be correctly completed over a period of 4 seconds, a C1 Error Message will be displayed on the LCD and the alarm tone will be activated. Pressing the Mute Button will silence the tone.

The response time of the numeric display measurement can be adjusted to provide a fast (3-second average) or slow (10 second average) visual response.

Alarm Indicators

All alarms can be turned ON or OFF using the Configuration tool. Reference the Configuration Tool Section for more information.

Face Velocity Alarm: When the face velocity falls outside the Low or High Alarm Limit window for a period of time exceeding the alarm delay, the audible alarm tone will activate. If there is no Low/Low alarm limit, the relay will also become active (un-powered). If there is a Low/Low alarm limit, the relay will activate when the face velocity falls below this limit.

Airflow Volume Alarm: When the air-flow volume falls outside the Low to High Alarm Limit window, or outside the deviation limit, for a period of time exceeding the alarm delay, the audible tone will activate. The relay will also become active (un-powered). Note that the Deviation Limit can never rise above the High Alarm Limit or fall below the Low Alarm Limit.

LCD Messages

The LCD Display has two distinct display types, “numeric” or “alpha”. The default value displayed will be the real time face velocity for “numeric” or a word indicating the condition of the face velocity for “alpha”.

Numeric Mode:

Numeric: The default screen will show the measured face velocity in the appropriate units.

100

Alpha: The default screen will show the current condition of the hood. If the hood is operating below the Hi Limit and above the Alert Msg Band, the screen will display “ALrt”.

ALrt

If the face velocity is below the lower edge of the Alert Band and above the Low Alarm Limit, the hood will display “nOri” for “normal”.

nOri

Both Numeric and Alpha: During Reset of the face velocity or airflow volume the Normal LED (green) will be off and the Display will alternate between “rEST” for “reset” and the measurement value.

rEST ↔ 100

In the event of an air flow volume alarm condition, the display will alternate between either “Lo Flo” or “Hi Flo” and the actual numeric measurement value.

Lo Flo or Hi Flo ↔ 150

If a Deviation alarm limit has been violated, the display will alternate between either “d Lo” or “d Hi” and the previous flow.

d Lo or d Hi ↔ 150

If a Sash Alarm Limit has been violated, the display will alternate between the current displayed value and “sash”.

SASH

During the preset warning sequence, the display alternates between “rEST” and the remaining time to reset in minutes.

rEST ↔ -10

For the controller operating in ARCnet communications, the Configuration Tool can be plugged directly into the display. While the Tool is connected, the Display LCD will show “tool”.

tool

START UP

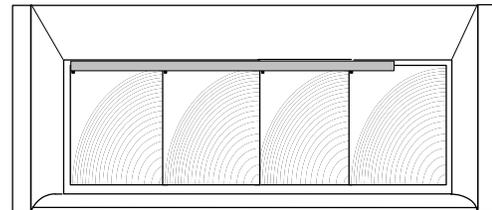
Before continuing with this section you should verify the FVC2600 has been installed and wired properly. You will also need to become familiar with the operation of the FVC2000plus Configuration Tool, which is explained in a previous section of this manual.

Horizontal Sash Sensor Calibration

If your FVC2600 does not include a horizontal sash sensor, then skip this section and proceed to the next.

The following procedure will calibrate the SPT2600 Transmitter with the Horizontal Sash Sensor. Once this procedure has been successfully completed, the SPT2600 will provide an output signal, which represents the open horizontal area. This procedure does not have to be performed again unless the sash configuration is changed.

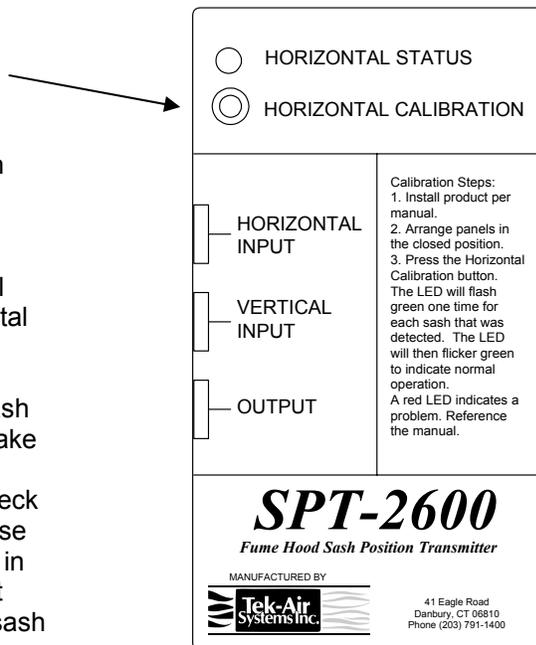
1. Arrange the horizontal sash panels in the closed position as shown to the right. If you are working on a combination type fume hood, then close the vertical sash completely.



2. On the SPT2600 there is a recessed button labeled "HORIZONTAL CALIBRATION". This button is recessed to prevent unintentional triggering. Using a small screwdriver, carefully press the HORIZONTAL CALIBRATION Button and observe the HORIZONTAL STATUS LED.
3. The HORIZONTAL STATUS LED should flash green one time for each sash detected then will quickly flicker green to indicate that the horizontal sash sensor is functioning normal.

If the HORIZONTAL STATUS LED does not flash green one time for each sash, then check to make sure all magnets are properly installed, and the poles are facing in the same direction. Also check to make sure the magnets are positioned in close proximity to the strip. If there is excessive play in the sashes, the magnet may be losing contact with the sensor strip. You may need to install sash guide shims on the sash to eliminate play in the sashes.

If the HORIZONTAL STATUS LED remains RED then there is a problem. Check magnets, and all connections.



START UP

FVC2600 Calibration

The following calibration procedure is intended to be performed by a Tek-Air Trained and Certified Technician with experience performing critical airflow measurements and calibration on fume hoods and ducts using ANSI methods and standards. Reference ANSI/ASHRAE 110-1995, *Method of Testing Performance of Laboratory Fume Hoods*, Section 6.2 Face Velocity Measurements.

Tools Required

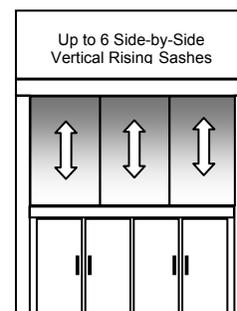
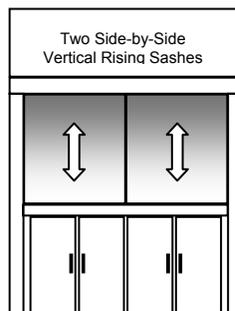
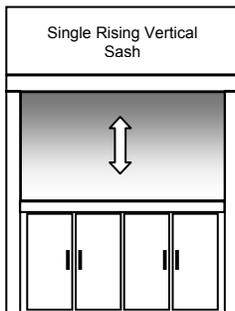
- Airflow Measurement Device
- Tape Measure
- Tek-Air FVC2000plus Configuration Tool, Software Version 4.8 or later

Information Required (Provided by End User)

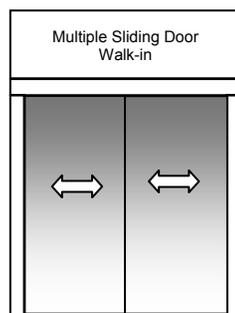
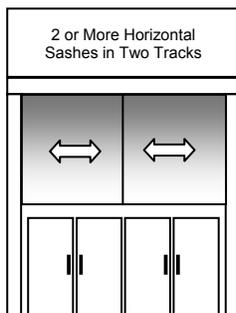
- Face Velocity Set-point
- Min. and Max CFM
- Alarm Set-points

Generally, there are three different types of fume hood sash configurations; Vertical, Horizontal and Combination. The FVC2600 Control System is designed to operate with most sash types, however there are custom fume hoods with sash configurations which the FVC2600 Control System can not be adapted to. The examples below show sash configurations for which the FVC2600 Control System is intended to operate with.

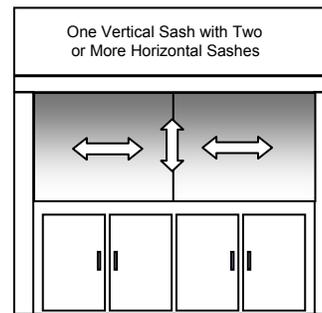
Vertical Sash Configurations



Horizontal Sash Configurations



Combination Sash Configurations



START UP

1. **CALIBRATE VT4000 AIRFLOW PROBE** *Note: Before proceeding, verify the exhaust system is operating properly and the static pressure is stable and being controlled to the desired set point.*
 - Go to the **Calibration / Measurements / VorTek Cal Menu** and select “Start”.
 - Enter the Maximum Design Airflow Volume (CFM). Usually this is the Maximum Airflow Volume Possible for the application plus 10% to 20%.
 - Wait for the airflow to stabilize within the duct, then perform a duct traverse.
 - Input the measured airflow volume and hit “Enter”.
 - Enter the Minimum Design Airflow Volume (CFM). This volume shall be greater than the minimum volume required to achieve 450 FPM duct velocity at the VorTek Airflow Sensor.
 - Wait for the airflow to stabilize within the duct, then perform a duct traverse.
 - Input the measured airflow volume and hit “Enter”.
 - Verify both calibration points with a traverse. If the desired accuracy is not obtained, repeat above steps. This completes the VorTek Calibration.

 2. **PERFORM FVC2000 MODE-6 CALIBRATION** *Note: Before proceeding, verify the lab temperature is within specified limits (typically 70 F +/- 3 F), the room pressurization is negatively biased and there are no supply diffusers in front of the hood face.*
 - Close all fume hood bypass dampers if possible. If the bypass dampers cannot be closed then the point at which the sash covers the Bypass shall be used for the Sash Minimum Opening during the calibration process.
 - Go to the **Configuration / Control / Modes Menu** and set to **Mode-6**. *Note: Once the Mode-6 Calibration Process is initiated, you must complete the entire process otherwise the controller operation will be unpredictable.*
 - Go to the **Calibration / Valve / Valve Limits Menu** and verify that the limits are set to “**Max Output = 100%**” and “**Min Output = 0%**”. If not, then change accordingly.
 - Go to the **Calibration / Sash Menu** and follow the set-up screens to calibrate the sashes for your application.
 - Go to the **Calibration / Measurements / Mode-6 Cal Menu** and start the Mode-6 Calibration process by pressing the “>” key then **Enter**. For Combination Type Sashes, perform the Mode-6 Calibration process with the horizontal panels closed as if it were a vertical sash type fume hood.
 - Set the desired face velocity set point.
 - Follow the tool on-screen directions and open the sash to the Maximum calibration height (*Usually 24” for Vertical Sashes*) then press **Enter**.
 - Calculate the required CFM needed to achieve your desired face velocity at the sash open area. (CFM_{max} = [desired Face Velocity (Fpm)] x Max Sash Area(Ft²)). Enter your calculated Maximum sash opening CFM value.
 - Once you have entered the value, wait for the controller to control to the entered value.
 - After the tool display shows that the controller is maintaining the set point, traverse the hood to obtain the actual face velocity. Press Enter once you have completed your traverse.
 1. Enter the Measured face velocity value into the tool.
 2. Move the sash to the Minimum Calibration Opening (*Usually 12” for Vertical Sashes*) then press **Enter**.
 3. Calculate the required CFM needed to achieve your desired face velocity at the sash open area. Enter your calculated Minimum sash opening CFM value.
 4. Once you have entered the value, wait for the controller to control to the entered value.
 5. After the tool display shows the controller is maintaining the set point, traverse the hood to obtain the actual face velocity. Press enter once you have completed your traverse.
 6. Enter the Measured value into the tool. The controller will continue with the calibration procedure.
 7. Enter the maximum desired volume set point. *Note: This volume must be high enough to achieve a safe operating face velocity with the sash 100% open.*
- **Mode-6 Calibration Continued on Next Page** --

START UP

-- Mode-6 Calibration Continued From Previous Page --

8. Enter the minimum desired volume set point. *Note: This volume shall be greater than the minimum volume required to achieve 450 FPM duct velocity at the VorTek Airflow Sensor.*
9. If applicable, adjust the bypass dampers as required by the specifications. The bypass dampers are sometimes used in VAV hoods to prevent dangerously high face velocities when at the min volume.
10. With vertical sash at or near the closed position, the displayed face velocity will read excessively high unless the Sash Bypass % factor is input. This factor is typically 1 or 2% depending on the specific hood. To determine an appropriate Sash Bypass %, open the vertical sash one or two inches and measure the average face velocity at this opening using a hotwire or similar device. Leave the vertical sash in this position and input a Sash Bypass % value between 1 and 5% and observe the displayed face velocity. The objective is to select a Sash Bypass % value that will cause the displayed face velocity to equal the traverse.
11. Confirm Mode-6 calibration performance.
12. For Combination Type Sashes, close the vertical sash and open the horizontal panel(s) and perform a traverse. Verify the displayed face velocity is equal to the traversed face velocity. If the face velocity needs to be adjusted, go to the **Calibration / Sash / Horiz Dimen Menu** and change the Horizontal Height dimension accordingly. Increasing the height will increase the airflow and decreasing the height will decrease the airflow.
13. Confirm calibration performance.

3. CONFIGURE ALARMS

Using the Configuration Tool, go to the **Configuration / Alarms Menu** and activate the alarms required per the job specification. Now go to the **Tune / Alarms Menu** and set the appropriate alarm set points.

4. FLOW CONTROL TUNING

The exhaust airflow volume control loop will need to be tuned to optimize performance for your application. This tuning is accomplished by adjusting the; **CFM Proportional Gain**, **CFM Repeats-per-Minute**, and **Valve Limits**.

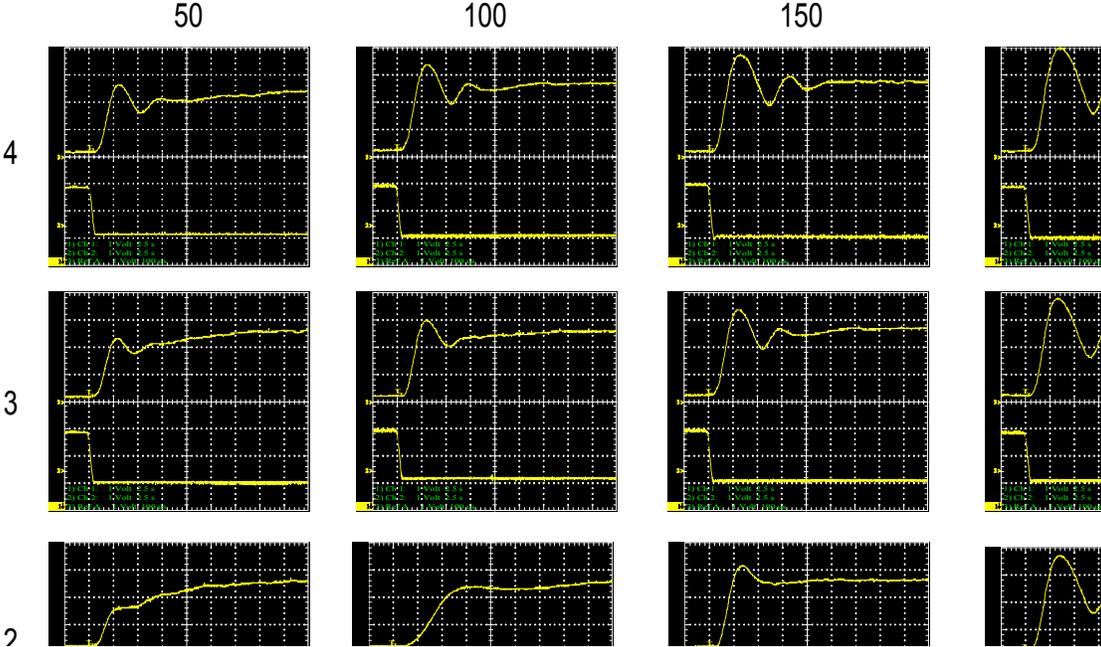
The Proportional Gain and Repeats-per-Minute are both applied against the error (*difference between the CFM Set Point and the Measured CFM*) and have a direct impact on the control loop response time. The Valve Limits are then applied to the output signal to the valve, thereby reducing overshoot and undershoot. Typical Valve Limits used should be approximately 20% outside of the normal operating range of the valve.

The chart on the following page illustrates the effect both Proportional Gain and Repeats-per-Minute have on the fume hood exhaust volume response. Each plot shows the sash movement (lower trace) and the exhaust airflow volume (upper trace) plotted against time. The plot on the upper right shows an extremely fast response with the Proportional Gain set to 4 and the Repeats-per-Minute set to 200, whereas the plot to the lower left shows a much slower response with the Proportional Gain set to 1 and the Repeats-per-Minute set to 50. The factory default setting for Prop Gain is 2 and Repeats-per-Minute is 150.

START UP

FLOW CONTROL TUNING

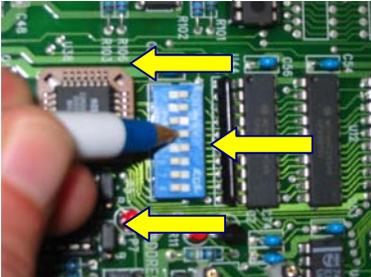
Each plot in the chart below shows the sash movement (lower trace) and the exhaust airflow volume (upper trace) plotted against time. The plot on the upper right shows an extremely fast response with the Proportional Gain set to 4 and the Repeats-per-Minute set to 200, whereas the plot to the lower left shows a much slower response with the Proportional Gain set to 1 and the Repeats-per-Minute set to 50. The factory default setting for Prop Gain is 2 and Repeats-per-Minute is 150.



TROUBLESHOOTING

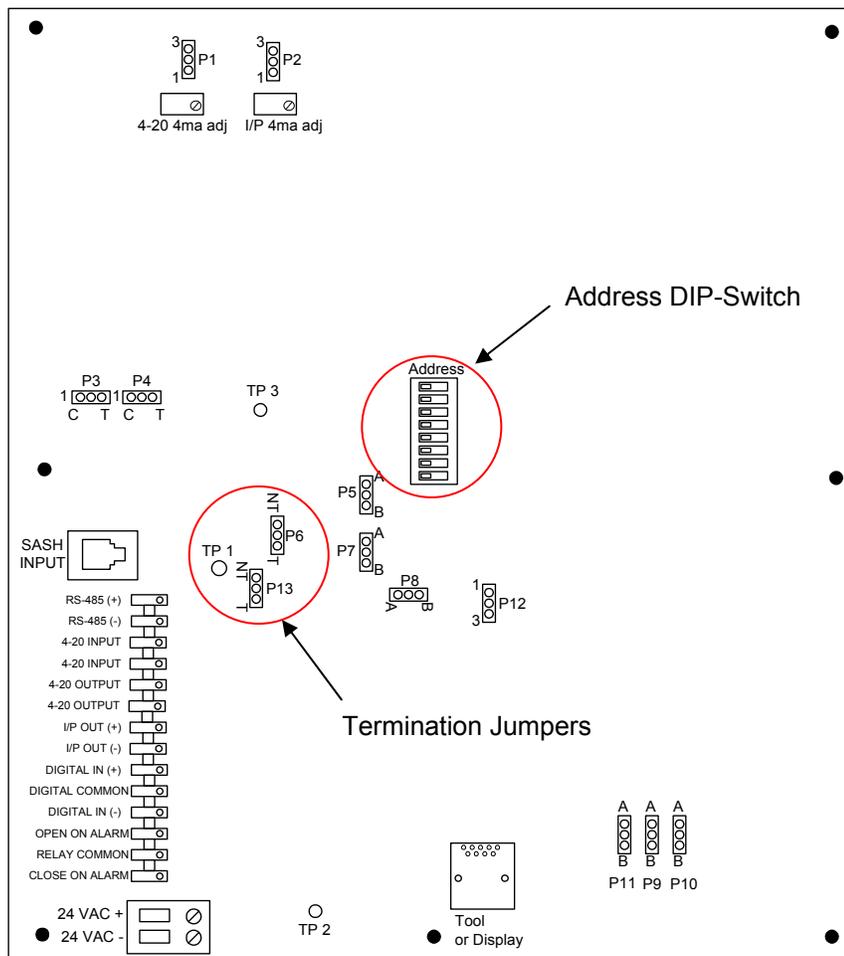
Symptom:	Corrective Action:
Display is blank.	<p>Check voltage at terminals 1 & 2 on controller. Should be 24 VAC, +/-10%.</p> <p>If 24VAC is OK at 1 & 2; and multiple units share same power, then check power polarity to verify the same between units. Correct any polarity problems found.</p> <p>If 24VAC is OK at 1 & 2 and Power Polarity is OK; then check Display Cable to confirm it is plugged in at both ends. If Display Cable is plugged in properly at both ends, and the Display is still blank, then display cable may be damaged. Replace Display Cable.</p> <p>If 24VAC is NOT present at 1 & 2; then check Transformer Secondary, Primary, Fuse or Circuit Breaker.</p>
No Airflow Reading.	<p>Check the VorTek Input Channel Select Configuration: Using the FVC Tool, go to the Calibration/Measurements menu and scroll to VorTek Input Channel Select. Confirm setting is in accordance with Qty of Sensors listed in the Configuration Tool Operation Section. For Example; a 1x2 Probe contains “2” Vortek sensors, therefore channel select should be set to “12”. A 1x1 contains “1” sensor, therefore setting should be “8”.</p> <p>Check the VorTek Cable: Check the cable connection between the VorTek 4000 Box and the FVC Controller. If the DIN Cable was pulled through conduit improperly, it may have been damaged.</p> <p>Check VorTek Installation: Confirm the VorTek Probe(s) have been installed in accordance with the airflow direction label.</p> <p>Check Exhaust Static Pressure: Perform a duct traverse in the same exhaust branch as the VorTek is installed to verify airflow. If insufficient airflow is present, then confirm valve is open. If valve is open and airflow is still insufficient, then have exhaust static system checked.</p>
Controller does not react to sash position change.	<p>Confirm Sash Sensors are Functioning Properly: Using the FVC tool, go to the Calibration/Sash menu and scroll to the Sash Output Real Time Function. Move the sash(s) and confirm the real-time % reported matches the actual position. If the real-time % reported does not react to changes in sash position, then the sash sensor(s) may be damaged or not connected properly. Check sash sensor wiring and installation. If the % reported changes with movement of sash(s), however the changes are not in accordance with actual movement, recalibrate sash(s) per manual.</p> <p>Confirm Controller is Operating in Mode-6: Using the FVC tool, go to the Configuration/Control menu and scroll to the Operational Mode. Confirm Operating Mode is set to Mode 6. If the control mode was found to be in “4”, most likely, the Mode-6 calibration was interrupted prior to completing. Return control mode to “6” and recalibrate.</p>

TROUBLESHOOTING

Symptom:	Corrective Action:
<p>Controller is “locked-up” and completely inoperable, however power is OK and all connections have been confirmed ok.</p>	<p>Reset Controller to Factory Defaults: For Controller Firmware Version U-23 or later, there is a “restore factory defaults” feature which may be used as a last attempt to restore controller from a “locked-up state” to avoid returning unit to factory. The following procedure will result in rewriting e^2 memory with the original factory default values.</p> <ol style="list-style-type: none"> 1. Remove Power from Controller. 2. Remove any field I/O installed at the Digital Inputs and Alarm Relay Outputs and Install Shunting Terminal Block on Digital Inputs 1&2 and Relay Alarm Outputs as shown in Picture Below: <p style="text-align: center;">SHUNTING TERMINAL BLOCK WIRING:</p> <p>DI-1: OPEN ON ALARM DI-2: RELAY COMMON DI-3: CLOSE ON ALARM</p>  <ol style="list-style-type: none"> 3. Set Address DIP to OFF Position for all 8-positions.  <ol style="list-style-type: none"> 4. Apply 24 VAC input power for 15-seconds minimum. You should now observe the “heartbeat” LED D5, blinks at fast rate. This indicates that the “restore factory default” procedure was successful. 5. Remove 24 VAC Power. 6. Remove the Shunting Terminal Blocks installed on Step 2 and reinstall field I/O. 7. Reset Address DIP to correct address. 8. Reapply input power. <p>Note: This procedure will not reset the calibration of the 4-20mA outputs. If calibration of the 4-20mA outputs is required, perform manually.</p>
<p>Heartbeat LED, D5, Flashes at a fast rate & controller is inoperable.</p>	<p>The address DIP is set to all zeros. Set address DIP accordingly.</p>

COMMUNICATIONS

An RS-485 interface is provided to permit digital communications between the FVC2000plus Fume Hood Controllers and other devices using either Open Protocol or ANSI Standard ARCnet Protocol. ARCnet Protocol is used mainly for Tek-Air SmartLab Systems where high-speed communication between devices within the lab is required. Open Protocol is typically used for applications where communications may be required directly to a BMS network, such as JCI N2, to facilitate system wide monitoring of critical parameters.



FVC2600 Controller PCB

Com. Wiring: For high-speed ARCnet communications, the network must be wired using low-capacitance, 2-wire, twisted-shielded-pair (Windy City Wire PN 042002 or equivalent). The polarity must be maintained throughout the network.

Termination: Any controller located at the end-of-line must be properly terminated using the Jumpers P6 and P13 located on the controller PCB as shown above. To set the termination jumpers, simply move the P6 and P13 jumper positions from the “NT” side of header to the “T” side of header.

Address: Each controller on the network must have a unique address, which is set by the Address Dip-Switch located on the controller PCB. For ARCnet networks, the available addresses are between 11 and 254. **Note: If the Address DIP is set to all zeros, the controller is inoperable and will not function.**

COMMUNICATIONS

Open Protocol Parameters for Transmission

Parameter #	Description	Read or Write	Definition
0	Face Velocity	Read	0 to 1000 fpm = 0 to 4095
1	Face Velocity Set Point	Read/Write	0 to 1000 fpm = 0 to 4095
2	Controller Output to the Valve	Read	0 to 100% = 0 to 4095
3-7	Not Used		
8	Local Emergency Override (status)	Read	0 = Normal, 1 = Emergency
9	Remote Emergency Override	Read/Write	0 = Normal, 1 = Emergency
10	Air Flow Volume	Read	0 to 5000 cfm = 0 to 4095
11	Not Used		
12	Sash Position (% open)	Read	0 to 100% = 0 to 4095
13	Not Used		
14	Air Flow Volume	Read	0 to 5000 cfm = 0 to 4095
15	Air Flow Volume Set Point	Read	0 to 5000 cfm = 0 to 4095
16	Air Flow Hi Alarm Set Point	Read/Write	0 to 5000 cfm = 0 to 4095
17	Air Flow Lo Alarm Set Point	Read/Write	0 to 5000 cfm = 0 to 4095
18	Air Flow Hi Alarm Status	Read	1 = Alarm, 0 = No Alarm
19	Air Flow Lo Alarm Status	Read	1 = Alarm, 0 = No Alarm
20	Day/Night Reset (Digital Input)	Read/Write	1 = Reset, 0 = Normal
21	Not Used		
22	Air Flow Volume Reset Set Point	Read/Write	0 to 5000 cfm = 0 to 4095

ARCnet Protocol Parameters for Transmission

Parameter #	Description	Read or Write	Definition
1	Face Velocity	Read	
2	Face Velocity Set Point	Read/Write	
3-9	Not Used		
10	Controller Output to the Valve	Read	
11	Remote Emergency Override	Read/Write	1 = Emergency Active
12	Local Emergency Override Status	Read	1 = Emergency Active
13	Day/Night Reset (Digital Input)	Read/Write	1 = Setback
14	Sash Position (% open)	Read	
15	Sash Reset Position (% open)	Read	
16	Sash Alarm Position (% open)	Read	
17	Sash Alarm Status	Read	1 = Alarm
18	Air Flow Volume	Read	
19	Air Flow Volume Set Point	Read/Write	
20	Air Flow Volume Reset Point	Read/Write	
21	Air Flow Hi Alarm Set Point	Read/Write	
22	Air Flow Lo Alarm Set Point	Read/Write	
23	Air Flow Hi Alarm Status	Read	1 = Alarm
24	Air Flow Lo Alarm Status	Read	1 = Alarm
25	Set Back Status	Read	1 = Set Back

COMMUNICATIONS

N2 Point Mapping to Support JCI Communications

NPT	NPA	UNITS	POINT DESCRIPTION	RANGE / VALUE	FVC MODEL (see note)					
					2100	2200	2300	2400	2500	2600
AI	1	FPM	Face Velocity	0 to 1000	✓	✓	✓	✓	✓	✓
AI	2	CFM	Exhaust Volume	0 to 5000	-	✓	-	✓	✓	✓
AI	3	%	Sash Position	0 to 100	-	-	-	✓	-	✓
AO	1	%	Valve Control Output	0 to 100	✓	✓	✓	✓	✓	✓
AO	2	FPM	Face Velocity Set point	0 to 500	✓	✓	✓	✓	✓	✓
AO	3	FPM	Face Velocity Reset point	0 to 500	✓	✓	✓	✓	✓	✓
AO	4	CFM	Exhaust Volume Set point	0 to 5000	-	-	-	-	✓	✓
AO	5	CFM	Exhaust Volume Reset point	0 to 5000	-	-	-	-	✓	✓
AO	6	%	Sash Position Reset %	0 to 100	-	-	-	-	-	✓
BI	1	Note 1	Local Emergency Status	0 or 1 (1= emergency)	✓	✓	✓	✓	✓	✓
BO	2	Note 2	Reset Status	0 or 1 (1 = reset)	✓	✓	✓	✓	✓	✓
BI	1	Note 3	Remote Emergency Override	0 or 1 (1= emergency)	✓	✓	✓	✓	✓	✓
BO	2	Note 4	Reset Request	0 or 1 (1= reset request)	✓	✓	✓	✓	✓	✓

Point Map Detail for FVC Point Attributes:

Point	Attribute	FVC2000 Description	N2 Designation
AI-1	8	Face Velocity Low Low Alarm	Low Alarm Limit
	9	Face Velocity Low Alarm	Low Warning Limit
	11	Face Velocity High Alarm	High Alarm Limit
AI-2	8	Volume Low Alarm	Low Alarm Limit
	11	Volume High Alarm	High Alarm Limit
AI-3	8	% Sash Position Alarm	Low Alarm Limit
	11	% Sash Position Alarm	High Alarm Limit

Notes: The Point Map for all Models is identical, however the following information applies:

- Indicates the point is NOT actually measured and the Bit “0” in the Object Status byte will be set to “1” indicating that the data is “Unreliable”.
 - ✓ Indicates the point is a measured parameter. However, in some cases, the local site-specific user may choose not to measure the point due to application requirements. Therefore, the local user must be cognizant that although Bit “0” in the object status byte is set to “0”, indicating that data is reliable, the point may not actually be a measured parameter.
1. Reports whether or not the fume hood controller is in Emergency mode, meaning that the air is being purged at the maximum exhaust volume limit.
 2. Reports whether or not the fume hood controller is currently operating using the Reset setpoint value (of either Face Velocity or Exhaust Volume).
 3. This BO allows the N2 Master device to put the fume hood controller into Emergency mode. If read, it will report what was written from this point.
 4. This BO allows the N2 Master device to direct the fume hood controller to operate at the Reset setpoint value of either the face velocity or exhaust volume (depending on the type of air control being performed). If read, it will report what was written from this point.

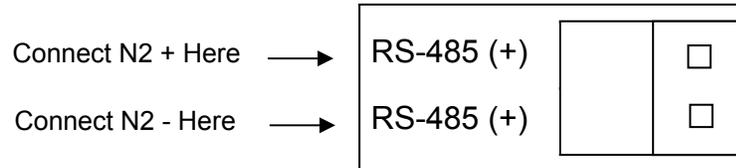
AI1 ~ AI3, AO1; BI1 ~ BI2: Will not accept a write command. An attempt to write to any of the points will not cause an error. The controller will continue to operate correctly.

AO1 is not command able. An attempt to command this point will not cause an error. The controller will continue to update this point.

AO2 ~ AO6: Values outside of range/value will be set to the min. or max. allowable value.

COMMUNICATIONS

Connect N2 to FVC2000 Controller as shown below:



Notes:

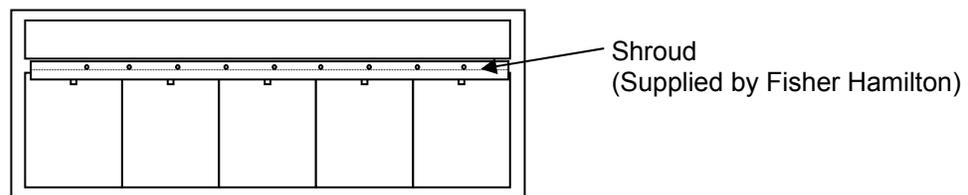
9. Terminal connection is NOT provided for N2 Reference. Keep shield continuous and **DO NOT** tie to controller ground.
10. Maintain polarity of communications wires.
11. Set termination jumpers P6 and P13 to "T" for "end of line" controllers. Otherwise P6 and P13 shall be in the "NT" position.

APPENDIX A

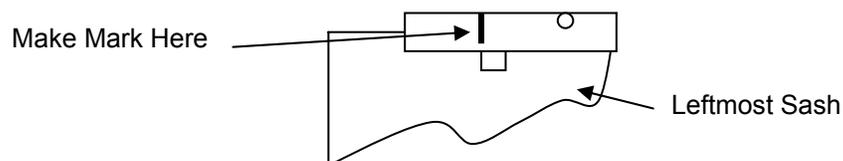
Fisher Hamilton SafeAir Combination Sash Type Fume Hood

In order to simplify installation of the Tek-Air Horizontal Sash Sensing System, Fisher Hamilton can make the following modifications to their fume hoods.

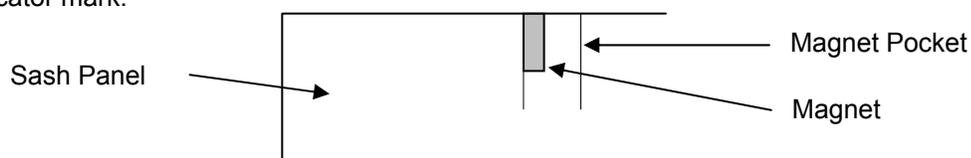
- Added a shroud to the sash frame, which will house the Horizontal Sash Sensor.
 - Added a pocket in the glass panel to accommodate the magnet.
 - Increased the clearance of the sheet metal louver panel.
1. Install the Vertical Sash Sensor cable to the Counter Weight Cable on the top of the fume hood using the hardware provided.
 2. The fume hood should have been shipped from the factory with a stainless steel shroud installed on the sash frame just below the vision panel as shown below.



3. Move one of the sash panels to the left most position and make a mark on the shroud where the magnet pocket lines up with the shroud as shown below. This step is necessary to properly align the Horizontal Sash Sensor for mounting into the shroud.



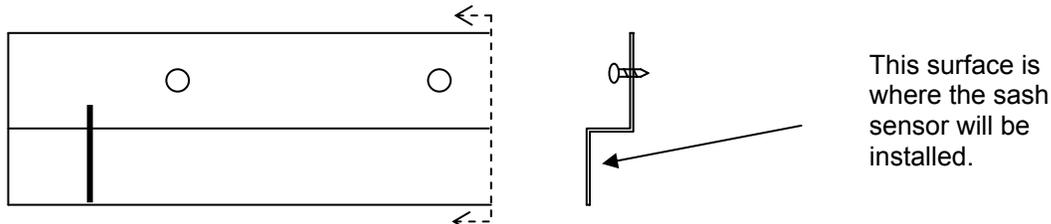
4. Remove the Shroud from the Sash Frame and put it aside for now.
5. Two different size magnets have been provided for this installation. The larger magnets are $\frac{1}{4}$ " wide and shall be used for the back sashes (closest to inside of hood). The smaller magnets are $\frac{1}{8}$ " wide and will be used for the front sashes (closest to outside of hood). Install the magnets to the sash panels as follows:
 - a. Remove sash panels from the track.
 - b. In the upper edge of each panel, there is a magnet pocket. Thoroughly clean the magnet pocket using the alcohol wipes provided. Any contaminants left on the glass will inhibit the adhesion of the magnets.
 - c. After the magnet pocket is clean and dry, remove the paper backing from the adhesive tape on the back of magnet and install into the pocket as shown below. The magnet must be flush with the top edge and to the left side of the magnet pocket. Also, the magnets must be positioned with the **poles oriented in the same direction for each sash**. The north-pole end of each magnet is identified with an indicator mark.



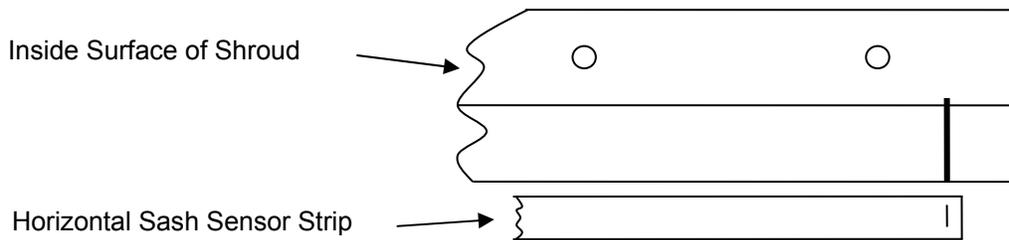
APPENDIX A

- d. Apply a steady pressure to the magnet for 5-10 seconds to ensure a good bond.
- e. Install a sash guide shim on the top edge of the back panels opposite the magnet, (clean sash where channel guide is to be installed). These guides will eliminate the excessive play in the panels, and ensure magnetic contact between the sash and reed sensor is maintained. Note: Be sure to place the sash guide so the panel is pushed towards the sash sensor strip.
- f. Replace the sash panels back into the fume hood.

- 6. Install the Horizontal Sash Sensor Assembly into the Shroud as follows:
 - a. Thoroughly clean the inside surface of the shroud with the alcohol wipes provided. Any contaminants left on the shroud surface will inhibit the adhesion of the strip.



- b. Because the mark you made in Step 3 is on the outside surface of the shroud and the Horizontal Sash Sensor is going to be mounted on the inside surface; you need to transfer this mark to the inside surface of the shroud. After you have made the mark on the inside surface, double check the accuracy because the System will not function properly if the Horizontal Sash Sensor strip is not aligned with the leftmost sash magnet.
- c. Remove the Horizontal Sash Sensor strip from the shipping tube. **Use extreme caution when handling the Horizontal Sash Sensor. Do not allow the sensor to flex or bend.**
- d. Align the mark that you just made with the indicator mark on the Horizontal Sash Sensor Strip.



- e. Carefully remove the paper backing from the adhesive tape sections on the Horizontal Sash Sensor. Align the Strip indicator line with the mark on the shroud and carefully place the strip onto the shroud. This aligns the first magnet in the sensor strip with the leftmost sash magnet.
 - f. Apply a steady even pressure to the areas over the adhesive tape for 5 to 10 seconds. Do not squeeze the sensor strip, as damage to the internal parts will result.
- 7. To complete the installation of the horizontal sash sensor, install the shroud back onto the sash frame using the hardware provided with the fume hood.

