Model 8680

SUREFLOW™
Adaptive Offset Controller

Operation and Service Manual

February 2002
P/N 1980286 Rev. C

TSI®

TSI Incorporated

Model 8680

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Adaptive Offset Controller

Operation and Service Manual

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Part number 1980286 Rev. C

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CONTENTS

How to Use This Manual

The SUREFLOW Operation and Service Manual is divided into two parts. Part one describes how the SUREFLOW unit functions and how to interface with the device. This section should be read by users, facilities staff, and anyone who requires a basic understanding of how the SUREFLOW operates.

Part two describes the technical aspects of the product which includes operation, calibration, configuration, and maintenance. Part two should be read by personnel programming or maintaining the unit. TSI recommends thoroughly reading this manual before changing any software items.

NOTE: This operation and service manual assumes proper SUREFLOW installation. Refer to the Installation Instructions to determine if the SUREFLOW has been properly installed.

PART ONE

User Basics

Part one provides a brief but thorough overview of the SUREFLOW product by maximizing information with minimal reading. These few pages explain the purpose (The Instrument), and the operation (Useful User Information, Digital Interface Module, Alarms) of the unit. Technical product information is available in Part Two of the manual. The manual focuses on laboratory spaces, however the information is accurate for any room pressure application.

The Instrument

The SUREFLOW Adaptive Offset Controller (AOC) maintains laboratory pressure and air balance. The AOC measures and controls all air flow into and out of the laboratory, and measures the pressure differential. Proper laboratory pressure differential provides safety by controlling airborne contaminants that can adversely affect workers in the laboratory, people in the laboratory vicinity, and experiments. For example, laboratories with fume hoods have negative room pressure (air flowing into the room), to minimize exposure to people outside the laboratory. The fume hood is the first level of containment, and the laboratory space is the second level of containment.

Room pressure, or pressure differential, is created when one space (hallway) is at a different pressure than an adjoining space (laboratory). The Adaptive Offset Controller (AOC) creates a pressure differential by modulating supply air into and exhaust air out of the laboratory (hallway space is a constant volume system). The theory is that if more air is exhausted out than is supplied, the laboratory will be negative compared to the hallway. A set offset may not maintain an adequate pressure differential under all conditions. The AOC compensates for the unknown pressure differential by mounting a pressure differential sensor between the hallway and laboratory that confirms correct pressure differential is being maintained. If pressure is not being maintained the AOC modulates the supply or exhaust air until pressure is maintained.

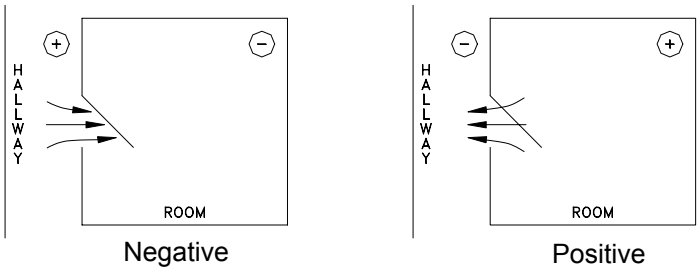

Figure 1: Room Pressure

Negative room pressure is present when air flows from a hallway into the laboratory. If air flows from the laboratory into the hallway the room is under positive pressure. Figure 1 gives a graphic example of positive and negative room pressure.

An example of negative pressure is a bathroom with an exhaust fan. When the fan is turned on, air is exhausted out of the bathroom creating a slight negative pressure when compared to the hallway. This pressure differential forces air to flow from the hallway into the bathroom.

The SUREFLOW device informs the laboratory users when the laboratory is under proper pressure, and provides alarms when the room pressure is inadequate. If the room pressure is in the safe range, a green light is on. If the pressure is inadequate, a red alarm light and audible alarm turn on.

The SUREFLOW consists of two pieces: a pressure sensor, and Digital Interface Module (DIM) / Adaptive Offset Controller (AOC). The AOC is internally part of the DIM module. The components are typically located as follows; pressure sensor above the laboratory entrance, DIM / AOC is mounted close to the entrance to the laboratory. The pressure sensor continuously measures the room pressure and provides room pressure information to the DIM / AOC. The DIM/ AOC continuously reports the room pressure and activates the alarms when necessary. The DIM / AOC controls the supply and exhaust dampers to maintain the pressure differential. The DIM / AOC is a closed loop controller that is continuously measuring, reporting, and controlling room pressure.

Useful User Information

The DIM has a green light and red light to indicate room pressure status. The green light is on when the room has proper room pressure. The red light comes on when an alarm condition exists.

Sliding the door panel to the right reveals a digital display and keypad (Figure 2). The display shows detailed information about room pressure, alarms, etc.. The keypad allows you to test the device, put the device into emergency mode, and program or change the device parameters.

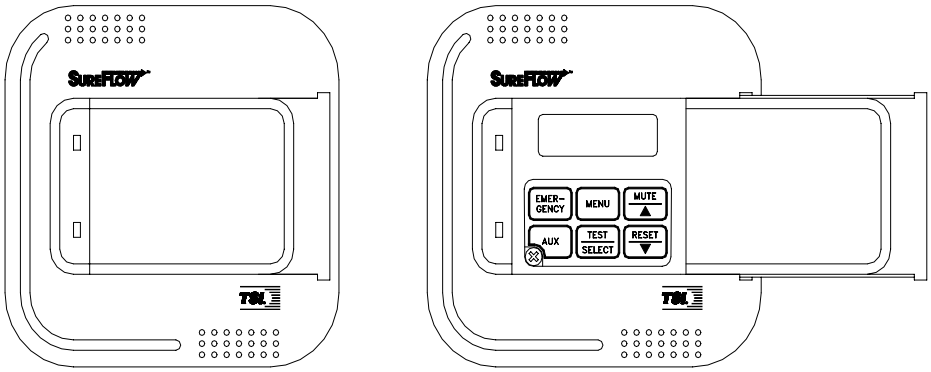

Figure 2: Digital Interface Module (DIM)

SUREFLOW has two levels of user information:

1. SUREFLOW has a red light and green light to provide continuous information on room pressure status.

2. SUREFLOW has a hidden operator panel providing detailed room status information, self-testing capabilities, and access to the software programming functions.

NOTE: The unit provides continuous room pressure status through the red and green light. The operator panel is normally closed unless further information on room pressure status is needed, or software programming is required.

Operator Panel

The DIM in Figure 3 shows the location of the digital display, keypad and lights. An explanation of the operator panel follows the figure.

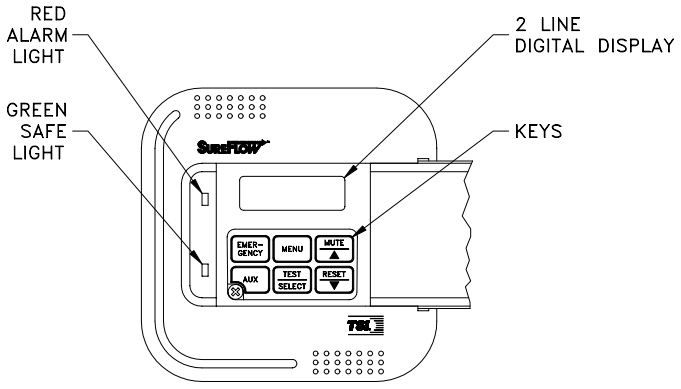

Figure 3: SUREFLOW Operator Panel - Open

Green / Red light

The green light is on when all the conditions for proper room pressure are adequate. This light indicates the laboratory is operating safely. If any of the room pressure conditions cannot be satisfied the green light turns off, and the red alarm light turns on.

Operator Panel

A cover hides the operator panel. Sliding the door panel to the right exposes the operator panel (Figure 2).

Digital Display

The alphanumeric digital display is a two line display that indicates actual room pressure (positive or negative), alarm status, menu options, and error messages. In normal operation (green light is on), the display indicates information about room pressure. If an alarm condition occurs the display will change from

STANDARD		STANDARD
NORMAL	*to read*	ALARM = *

* will state type of alarm; low pressure, high pressure, flow

When programming the unit, the display will change and now show menus, menu items, and current value of the item, depending on the specific programming function being performed.

NOTE: The AOC system will control room pressure without a pressure sensor installed. However, verification that room pressure is being maintained is not possible. The display will not indicate room pressure or room pressure status when no pressure sensor is installed. The alarms can be programmed to indicate when low supply or exhaust flow is present.

Keypad

The keypad has six keys. The gray keys with black letters are user information keys. In normal operation these keys are active. Additionally, the red emergency key is active. The gray keys with blue characters are used to program the unit. A thorough description of each key is given on the next two pages.

User Keys - Gray with Black Letters

The four keys with black letters provide you information without changing the operation or the function of the unit.

TEST Key

The **TEST** key initiates an instrument self-test. Pressing the **TEST** key activates a scrolling sequence on the display that shows the product model number, software version, and all set point and alarm values. The unit then performs a self test that tests the display, indicator lights, audible alarm, and internal electronics to ensure they are operating properly. If a problem with the unit exists, DATA ERROR will be displayed. You should have qualified personal determine the problem with the unit.

RESET Key

The **RESET** key performs three functions. 1) Resets the alarm light, alarm contacts, and audible alarm when in a latched or non automatic reset mode. The DIM must return to the safe or normal range before the **RESET** key will operate. 2) Resets the emergency function after the emergency key has been pressed (see **EMERGENCY** key). 3) Clears any displayed error messages.

MUTE Key

The **MUTE** key temporarily silences the audible alarm. The time the alarm is temporarily silenced is programmable by you (see MUTE TIMEOUT). When the mute period ends, the audible alarm turns back on if the alarm condition is still present.

NOTE: You can program the audible alarm to be permanently turned off (see AUDIBLE ALM).

AUX Key

The **AUX** key is active only in specialty applications and is not used on the standard SUREFLOW. If the **AUX** key is used, a separate manual supplement will explain the **AUX** key function.

Programming Keys - Gray with Blue Characters

The four keys with blue print are used to program or configure the unit to fit a particular application.

WARNING: Pressing these keys will change how the unit functions, so please thoroughly review the manual before changing menu items.

MENU Key

The **MENU** key performs three functions. 1) Provides access to the menus when in the normal operating mode. 2) When the unit is being programmed, the **MENU** key acts as an escape key to remove you from an item or menu, without saving data. 3) Returns the unit to the normal operating mode. The **MENU** key is further described in the **Software Programming** section of this manual.

SELECT Key

The **SELECT** key performs three functions. 1) Provides access to specific menus. 2) Provides access to menu items. 3) Saves data. Pressing the key when finished with a menu item will save the data, and exit you out of the menu item.

▲/▼ Keys

The ▲/▼ keys are used to scroll through the menus, menu items, and through the range of item values that can be selected. Depending on the item type the values may be numerical, specific properties (on / off), or a bar graph.

Emergency Key - Red with Black Letters

EMERGENCY Key

The red **EMERGENCY** key puts the controller into emergency mode. If the room is under negative room pressure control, the emergency mode will maximize the negative pressure. Conversely, if the room is under positive room pressure control the emergency mode will maximize the positive pressure.

Pressing the **EMERGENCY** key will cause the display to flash "EMERGENCY", the red alarm light to flash on and off, and the audible alarm to beep intermittently. To return to control mode press the **EMERGENCY** or **RESET** key.

Alarms

SUREFLOW has visual (red light) and audible alarms to inform you of changing conditions. The alarm levels (set points) are determined by administrative personnel, Industrial Hygienists, or the facilities group depending on the organization.

The alarms, audible and visual, will activate whenever the preset alarm level is reached. Depending on the SUREFLOW items installed, programmed alarms will activate when room pressure is low or inadequate, when room pressure is high or too great, or when the supply or general exhaust air flow is insufficient. When the laboratory is operating safely, no alarms will sound.

Example: The low alarm is programmed to activate when the room pressure reaches -0.001 inches H_2O. When the room pressure drops below -0.001 inches H_2O (gets closer to zero), the audible and visual alarms activate. The alarms turn off (when set to unlatched) when the unit returns to the safe range which is defined as negative pressure greater than -0.001 inches H_2O.

Visual Alarm Operation

The red light on the front of the unit indicates an alarm condition. The red light is on for all alarm conditions, low alarms, high alarms, and emergency. The light is on continuously in a low or high alarm condition, and flashes in an emergency condition.

Audible Alarm Operation- EMERGENCY key

When the **EMERGENCY** key is pressed, the audible alarm beeps intermittently until the **EMERGENCY** or **RESET** key is pressed terminating the emergency alarm. The emergency alarm cannot be silenced by pressing the **MUTE** key.

Audible Alarms - All Except Emergency

The audible alarm is continuously on in all low and high alarm conditions. The audible alarm can be temporarily silenced by pressing the **MUTE** key. The alarm will be silent for a period of time (see MUTE TIMEOUT to program time period). When the time out period ends, the audible alarm turns back on if the alarm condition is still present.

You can program the audible alarm to be permanently turned off (see AUDIBLE ALM). The red alarm light will still turn on in alarm conditions when audible alarm is turned off. The audible and visual alarms can be programmed to either automatically turn off when the unit returns to the safe range or to stay in alarm until the **RESET** key is pressed (See ALARM RESET).

Before Calling TSI

This manual should answer most questions and resolve most problems you may encounter. If you need assistance or further explanation, contact your local TSI representative or TSI. TSI is committed to providing high quality products backed by outstanding service.

Please have the following information available prior to contacting your authorized TSI Manufacturer's Representative or TSI:

- Model number of unit* 8680- ____
- Software revision level*
- Facility where unit is installed

* First two items that scroll when **TEST** key is pressed

Due to the different SUREFLOW models available, the above information is needed to accurately answer your questions.

For the name of your local TSI representative or to talk to TSI service personnel, please call TSI at:

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PART TWO

Technical Section

The AOC is ready to use after being properly installed. Please note that the AOC is part of the DIM module, and is not a separate component. Where AOC is written, the overall control sequence is being discussed, when DIM is written the manual is referring to programming the unit or viewing what is on the display. The pressure sensor is factory calibrated prior to shipping, and should not need adjustment. The flow stations need a zero point and/or a span programmed prior to using them. The Digital Interface Module (DIM) is programmed with a default configuration that can be easily modified to fit your application.

The Technical section is separated into five parts that cover all aspects of the unit. Each section is written as independently as possible to minimize flipping back and forth through the manual for an answer.

The **Software Programming** section explains the programming keys on the DIM. In addition, the programming sequence is described, which is the same regardless of the menu item being changed. At the end of this section is an example of how to program the DIM.

The **Menu and Menu Item** section lists all of the software items available to program and change. The items are grouped by menu which means all set points are in one menu, alarm items in another, etc.. The menu items and all related information is listed in table format and includes menu item name, description of menu item, range of programmable values, and how the unit shipped from the factory (default values).

The **Setup / Checkout** section; explains the AOC controller theory of operation, lists the menu items that need to be programmed for the system to operate, provides a programming example, and provides information to confirm system is operating correctly.

The **Calibration** section describes the required technique to compare the pressure sensor reading to a thermal anemometer, and how to adjust the zero and span to obtain an accurate calibration. This section also describes how to zero a TSI flow station transducer.

The **Maintenance and Repair Part** section covers all routine maintenance of equipment, along with a list of repair parts.

Software Programming

Programming the SUREFLOW is quick and easy if the programming keys are understood, and the proper key stroke procedure is followed. The programming keys are defined first, followed by the required keystroke procedure. At the end of this section is a programming example.

NOTE: The unit is always operating while programming unit (except when checking the control outputs). When a menu item value is changed, the new value takes effect immediately after saving the change.

NOTE: This section covers programming the instrument through the keypad and display. If programming through RS-485 communications, use the host computer's procedure. The changes take place immediately upon "saving data".

Programming Keys

The four keys with blue characters (refer to Figure 4) are used to program or configure the unit to fit your particular application. Programming the instrument will change how the unit functions, so thoroughly review the items to be changed.

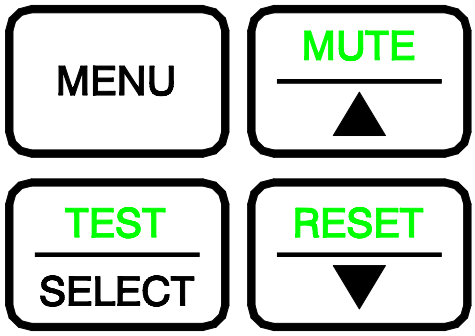


Figure 4. Programming Keys.

MENU Key

The **MENU** key has three functions.

1. The **MENU** key is used to gain access to the menus when the unit is in the normal operating mode. Pressing the key once will exit the normal operating mode and enter the programming mode. When the **MENU** key is first pressed, the first two menus are listed.

2. When the unit is being programmed, the **MENU** key acts like an escape key.
   - When scrolling through the main menu, pressing the **MENU** key will return the unit to standard operating mode.
   - When scrolling through the items on a menu, pressing the **MENU** key will return you to the list of menus.
   - When changing data in a menu item, pressing the **MENU** key will escape out of the item without saving changes.

3. When programming is complete, pressing the **MENU** key will return the unit to normal operating mode.

SELECT Key

The **SELECT** key has three functions.

1. The **SELECT** key is used to gain access to specific menus. To access a menu, scroll through the menus (using arrow keys) and place the flashing cursor on the desired menu. Press the **SELECT** key to select the menu. The first line on the display will now be the selected menu, and the second line will show the first menu item.

2. The **SELECT** key is used to gain access to specific menu items. To access a menu item scroll through the menu items until item appears. Press the **SELECT** key and the menu item will now appear on the first line of the display, and the second line will show the item value.

3. Pressing the **SELECT** key when finished changing an item will save the data, and exit back to the menu items. An audible tone (3 beeps) and visual display ("saving data") gives confirmation data is being saved.

▲/▼ Keys

The ▲/▼ keys are used to scroll through the menus, menu items, and through the range of item values that can be selected. Depending on the menu item selected the value may be numerical, specific property (on / off), or a bar graph.

NOTE: When programming a menu item, continuously pressing the arrow key will scroll through the values faster than if arrow key is pressed and released.

Keystroke Procedure

The keystroke operation is consistent for all menus. The sequence of keystrokes is the same regardless of the menu item being changed.

1. Press the **MENU** key to access the main menu.

2. Use the ▲/▼ keys to scroll through the menu choices. The blinking cursor needs to be on the first letter of the menu you want to access.

3. Press the **SELECT** key to access chosen menu.

4. The menu selected is now displayed on line one, and the first menu item is displayed on line 2. Use the ▲/▼ keys to scroll through the menu items. Scroll through the menu items until desired item is displayed.

   NOTE: If "Enter Code" is flashing the access code must be entered before you can enter the menu. Access code is found in Appendix C. Appendix C may have been removed from the manual for security reasons.

5. Press the **SELECT** key to access chosen item. The top line of display shows menu item selected, while the second line shows current item value.

6. Use the ▲/▼ keys to change item value.

7. Save the new value by pressing the **SELECT** key (pressing the **MENU** key will exit out of menu function without saving data).

8. Press the **MENU** key to exit current menu, and return to main menu.

9. Press the **MENU** key again to return to normal instrument operation.

If more than one item is to be changed, skip steps 8 and 9 until all changes are complete. If more items in the same menu are to be changed, scroll to them after saving the data (step 7). If other menus need to be accessed, press the **MENU** key once to access list of menus. The instrument is now at step 2 of the keystroke sequence.

Programming Example

The following example demonstrates the keystroke sequence explained above. In this example the high alarm set point will be changed from -0.002 inches H_2O to -0.003 inches H_2O.

❶ Unit is in normal operation scrolling room pressure, flows, etc.. Pressure is shown in this case.

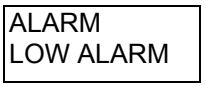
PRESSURE
-.00100 "H_2O

❷ Press the **MENU** key to gain access to the menus.

The first 2 menu choices are displayed.

❸ Press the ▼ key once. Blinking cursor should be on A of Alarm. Press the **SELECT** key to access the ALARM menu.
NOTE: Blinking cursor must be on A in Alarm.

Line 1 shows menu selected.
Line 2 shows first menu item.

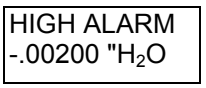


❹ Press the ▼ key once. HIGH ALARM will be shown on display.

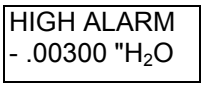
Menu selected
Item name

❺ Press the **SELECT** key to access the high alarm set point. The item name (HIGH ALARM) will now be displayed on line 1, and the item's current value will be displayed on line 2.

Item Name
Current Value



❻ Press the ▼ key to change the high alarm set point to - 0.003 inches H_2O.



❼ Press the **SELECT** key to save the new negative high alarm set point.

Three short beeps will sound indicating that the data is being saved.

Immediately after the data is saved, the SUREFLOW will return to the menu level displaying the menu title on the top line of the display and the menu item on the bottom line (goes to step 4).

WARNING: If the **MENU** key was pressed instead of the **SELECT** key, the new data would not have been saved, and the SUREFLOW would have escaped back to the menu level shown in step 3.

❽ Press the **MENU** key once to return to the menu level:

MENU

ALARM CONFIGURE

❾ Press the **MENU** key a second time to return to the normal operating level:

MENU

Unit is now back in normal operation

PRESSURE -.00100 "H_2O

Menu and Menu Items

The SUREFLOW is a very versatile device which can be configured to meet your specific application. This section describes all of the menu items available to program and change. Changing any item is accomplished by using the keypad, or if communications are installed through the RS-485 Communications port. If you are unfamiliar with the keystroke procedure please see **Programming Software** for a detailed explanation. This section provides the following information:

- Complete list of menu and all menu items.
- Gives the menu or programming name.
- Defines each menu item's function; what it does, how it does it, etc..
- Gives the range of values that can be programmed.
- Gives default item value (how it shipped from factory).

The menus covered in this section are divided into groups of related items to ease programming. As an example all set points are in one menu, alarm information in another, etc.. The manual follows the menus as programmed in the controller. The menu items are always grouped by menu and then listed in menu item order, not alphabetical order. Figure 5 shows a chart of all the Model 8680 controller menu items.

SETPOINTS	ALARM	CONFIGURE	CALIBRATION
SETPOINT	LOW ALARM	DISPLAY AVG	SENSOR ZERO
VENT MIN SET	HIGH ALARM	UNITS	SENSOR SPAN
TEMP MIN SET	MIN SUP ALM	ROOM VOLUME	ELEVATION
UNOCCUPY SET	MIN EXH ALM	EXH CONFIG	ACCESS CODE
MAX SUP SET	ALARM RESET	ACCESS CODE	
MIN EXH SET	AUDIBLE ALM		
TEMP LOW	ALARM DELAY		
TEMP HIGH	ALARM RELAY		
MIN OFFSET	MUTE TIMEOUT		
MAX OFFSET	ACCESS CODE		
ACCESS CODE			

CONTROL	SYSTEM FLOW	FLOW CHECK	DIAGNOSTICS
SPEED	TOT SUP FLOW	HD1 FLOW IN	CONTROL SUP
SENSITIVITY	TOT EXH FLOW	EX1 FLOW IN	CONTROL EXH
CONTROL SIG	OFFSET VALUE	SP1 FLOW IN	SENSOR INPUT
KC VALUE	SUP SETPOINT	ACCESS CODE	SENSOR STAT
TI VALUE	EXH SETPOINT		TEMP INPUT
KC OFFSET	ACPH		LOW ALM REL
ACCESS CODE	ACCESS CODE		HIGH ALM REL
			ACCESS CODE

INTERFACE	HOOD FLOW	EXHAUST FLOW	SUPPLY FLOW
NET PROTOCOL	HD1 DCT AREA	EX1 DCT AREA	SP1 DCT AREA
NET ADDRESS	HD1 FLO ZERO	EX1 FLO ZERO	SP1 FLO ZERO
ACCESS CODE	FLO STA TYPE	FLO STA TYPE	FLO STA TYPE
	TOP VELOCITY	TOP VELOCITY	TOP VELOCITY
	ACCESS CODE	ACCESS CODE	ACCESS CODE

Figure 5: Menu Items - Model 8680 Controller

SETPOINTS MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
SETPOINT PRESSURE SET POINT	The SETPOINT item sets the pressure control set point. The SUREFLOW controller will maintain this set point, negative or positive, under normal operating conditions. Pressure differential is not maintained by direct pressure control; i.e. modulating dampers in response to pressure changes. The pressure signal is an AOC input, that is used to calculate the required air flow offset value. The calculated offset value changes the supply (or exhaust) flow volume which changes the pressure differential. When the calculated offset value is between the MIN OFFSET and MAX OFFSET, room pressure control can be maintained. If the offset required to maintain pressure is less than the MIN OFFSET or greater the MAX OFFSET, pressure control will not be maintained.	0 to -0.19500 "H_2O or 0 to +0.19500 H_2O **-0.00100" H_2O**
VENT MIN SET VENTILATION MINIMUM SUPPLY FLOW SET POINT	The VENT MIN SET item sets the ventilation supply airflow set point. This item provides a minimum supply air flow to meet the ventilation requirement, by preventing the supply flow from going below the preset minimum flow. The controller will not allow the supply air damper to be closed further than the VENT MIN SET set point. If room pressure is not maintained at minimum supply flow, the general exhaust damper modulates open until pressure set point is reached (provided offset is between MIN OFFSET and MAX OFFSET).	Pressure based flow stations 0-2832 ft/min (0 - 14.4 m/s) x duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2). **0**
TEMP MIN SET TEMPERATURE MINIMUM SUPPLY FLOW SET POINT	The TEMP MIN SET item sets the temperature supply airflow set point. This item provides supply air flow adequate to meet the temperature requirements, by preventing the supply flow from going below the preset minimum flow. The controller will not allow the supply air damper to be closed further than the TEMP MIN SET set point. If room pressure is not maintained at minimum temperature flow, the general exhaust damper modulates open until pressure set point is reached (provided offset is between MIN OFFSET and MAX OFFSET). WIRING: This item requires a 0-5 or 0-10 VDC thermostat to be wired to the TEMPERATURE input (DIM pins 23 and 24). The thermostat toggles the AOC between VENT MIN SET and TEMP MIN SET.	Pressure based flow station 0 - 2832 ft/min (0 - 14.4 m/s) x duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2). **0**

SETPOINTS MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
UNOCCUPY SET UNOCCUPIED SUPPLY FLOW MINIMUM	The UNOCCUPY SET item sets a minimum supply flow set point when the laboratory is unoccupied (requires fewer air changes per hour). When UNOCCUPY SET is active, the VENT MIN SET and TEMP MIN SET set points are turned off, since only one minimum supply set point can be enabled. The controller will not allow the supply air damper to be closed further than the UNOCCUPY SET set point. If room pressure is not maintained at minimum supply flow, the general exhaust damper modulates open until pressure set point is reached (provided required offset is between MIN OFFSET and MAX OFFSET). WIRING: This item is enabled when the **AUX** key is pressed or the RS 485 communications sends a command. When **AUX** key is pressed UNOCCUPY SET is enabled and VENT MIN SET and TEMP MIN SET are disabled. Pressing the key a second time disables UNOCCUPY SET and enables VENT MIN SET and TEMP MIN SET.	Pressure based flow stations 0 - 2832 ft/min (0 - 14.4 m/s) x duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2). **0**
MAX SUP SET MAXIMUM SUPPLY FLOW SET POINT	The MAX SUP SET item sets the maximum supply air flow into the laboratory. The controller will not allow the supply air damper to open further than the MAX SUP SET flow set point. **NOTE**: The laboratory may not hold pressure set point when supply air is limited.	Pressure based flow stations 0 - 2832 ft/min (0 - 14.4 m/s) x duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2). **0**

SETPOINTS MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
MIN EXH SET MINIMUM EXHAUST FLOW SET POINT	The MIN EXH SET item sets the minimum general exhaust air flow out of the laboratory. The controller will not allow the general exhaust air damper to close further than the MIN EXH SET flow set point. **NOTE**: This item requires a TSI compatible flow station and control damper to be mounted in the general exhaust duct.	Pressure based flow stations 0 - 2832 ft/min (0 - 14.4 m/s) x duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2). **0**
TEMP LOW TEMPERATURE COOLING	The TEMP LOW item determines when the supply air changes from ventilation control mode (VENT MIN SET) to cooling temperature control mode (TEMP MIN SET). When the thermostat signal drops below the TEMP LOW voltage set point, the TEMP MIN SET is the supply air minimum (VENT MIN SET is overruled). Zero volts equates to maximum cooling. WIRING: The thermostat is connected to the temp input (pins 23 & 24, DIM). The 0-5 or 0-10 VDC thermostat signal is continuously monitored by the AOC.	Off, 0-10 VDC. **Off**
TEMP HIGH TEMPERATURE HEATING	The TEMP HIGH determines when the supply air changes from ventilation control mode (VENT MIN SET) to temperature heating mode (TEMP MIN SET). When the thermostat signal is greater than the TEMP HIGH voltage set point, the TEMP MIN SET is the supply air minimum (VENT MIN SET is overruled). If TEMP HIGH is programmed to be off, the supply air remains in ventilation mode when heating is required. 5 (0-5 VDC) or 10 volts equates to maximum heating. WIRING: The thermostat is connected to the temp input (pins 23 & 24, DIM). The 0-5 or 0-10 VDC thermostat signal is continuously monitored by the AOC.	Off, 0-10 VDC **Off**
MIN OFFSET MINIMUM FLOW OFFSET	The MIN OFFSET item sets the minimum air flow offset between total exhaust flow (fume hood, general exhaust, other exhaust) and total supply flow.	- 10,000 to 10,000 CFM **0**

SETPOINTS MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
MAX OFFSET MAXIMUM FLOW OFFSET	The MAX OFFSET item sets the maximum air flow offset between total exhaust flow (fume hood, general exhaust, other exhaust) and total supply flow.	- 10,000 to 10,000 CFM **0**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

ALARM MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
LOW ALARM LOW PRESSURE ALARM	The LOW ALARM item sets the low pressure alarm set point. A low alarm condition is defined as when the room pressure falls below or goes in the opposite direction of the LOW ALARM set point.	OFF 0 to -0.18500 "H_2O 0 to +0.18500 "H_2O **OFF**
HIGH ALARM HIGH PRESSURE ALARM	The HIGH ALARM item sets the high pressure alarm set point. A high alarm condition is defined as when the room pressure rises above the HIGH ALARM set point.	OFF 0 to -0.19500 "H_2O 0 to +0.19500 "H_2O **OFF**
MIN SUP ALM MINIMUM SUPPLY FLOW ALARM	The MIN SUP ALM item sets the supply flow alarm set point. A minimum flow alarm is defined as when the supply duct flow is less than the MIN SUP ALM set point. **NOTE**: Supply air duct size SP1 DCT AREA (Supply Flow menu) must be entered before MIN SUP ALM can be accessed. Actual total supply air flow is found in TOT SUP FLOW menu item (system flow menu). WIRING: This item is disabled when the UNOCCUPY SET is enabled [**AUX** key is pressed, or the RS 485 communications sends a command].	OFF, pressure based flow stations 0 to 2832 ft/min (0 - 14.4 m^2) times the supply duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the supply duct area in square feet (ft^2): square meters (m^2). **OFF**
MIN EXH ALM MINIMUM EXHAUST FLOW ALARM	The MIN EXH ALM item sets the general exhaust duct's flow alarm set point. A minimum flow alarm is defined as when the general exhaust duct flow is less than the MIN EXH ALM set point. **NOTE**: General exhaust air duct size EX1 DCT AREA (Exhaust Flow menu) must be entered before MIN EXH ALM can be accessed. Actual total exhaust air flow is found in TOT EXH FLOW menu item (system flow menu).	OFF, pressure based flow stations 0 to 2832 ft/min (0 - 14.4 m^2) times the exhaust duct area in square feet (ft^2): square meters (m^2). Linear based flow stations 0 to TOP VELOCITY times the supply duct area in square feet (ft^2): square meters (m^2). **OFF**

ALARM MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
ALARM RESET	The ALARM RESET item selects how the alarms terminate after the unit returns to control set point (pressure or flow). UNLATCHED (alarm follow) automatically resets the alarms when the unit reaches control set point. LATCHED requires the staff to press the **RESET** key after the unit returns to control set point. The ALARM RESET affects the audible alarm, visual alarm, and relay output, which means all are latched or unlatched.	LATCHED OR UNLATCHED **UNLATCHED**
AUDIBLE ALM AUDIBLE ALARM	The AUDIBLE ALM item selects whether the audible alarm is turned ON or OFF. Selecting ON requires the staff to press the **MUTE** key to silence the audible alarm. Selecting OFF permanently mutes all audible alarms, except when the **EMERGENCY** key is pressed.	ON or OFF **ON**
ALARM DELAY	The ALARM DELAY determines the length of time the alarm is delayed after an alarm condition has been detected. This delay affects the visual alarm, audible alarm, and relay outputs. An ALARM DELAY prevents nuisance alarms from people entering and leaving the laboratory.	20 - 600 SECONDS **20 SECONDS**
ALARM RELAY	The ALARM RELAY item selects which alarms activate the relay contacts (pins 13, 14 and 25, 26). Selecting PRESSURE triggers the relays when a pressure alarm is present. Selecting FLOW triggers the relays when a low flow conditon exists. This item only affects the relay contacts, all audible and visual alarms are still active regardless of the ALARM RELAY status. Pins 13, 14 - Low alarm relay: Low pressure *or* low supply flow. Pins 25, 26 - High alarm relay: High pressure *or* low exhaust flow.	PRESSURE or FLOW **PRESSURE**
MUTE TIMEOUT	The MUTE TIMEOUT determines the length of time the audible alarm is silenced after the **MUTE** key is pressed. This delay temporarily mutes the audible alarm. **NOTE**: If the DIM is in alarm when MUTE TIMEOUT expires, the audible alarm turns on. When the pressure returns to the safe range, the MUTE TIMEOUT is canceled. If the room goes back into an alarm condition, the **MUTE** key must be pressed again to mute the audible alarm.	5 to 30 MINUTES **5 MINUTES**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

ALARM CONSTRAINTS

There are a number of constraints built into the software that prevent users from programming conflicting alarm information. These are as follows:

1. The AOC does not allow the pressure alarms to be programmed within 20 ft/min (0.00028 " H_2O at 0.001 "H_2O) of the control set point.
   Example: The control SETPOINT is set at -0.001 "H_2O. The LOW ALARM set point cannot be set higher than -0.00072 "H_2O. Conversely the HIGH ALARM set point cannot be set lower than -0.00128 "H_2O.

2. The minimum flow alarms; MIN SUP ALM, MIN EXH ALM must be programmed to be at least 50 CFM less than the minimum flow set point.

3. The pressure alarms; LOW ALARM, HIGH ALARM can be programmed for positive or negative pressure. However, both the low and high alarm must be set either positive or negative. The AOC does not allow one positive alarm and one negative alarm.

4. Alarms do not terminate until the pressure or flow slightly exceeds alarm set point.

5. The ALARM RESET item selects how the alarms will terminate when controller returns to the safe range. The pressure and flow alarms all terminate the same; they are either latched or unlatched. If unlatched is selected the alarms automatically turn off when the value slightly exceeds set point. If latched is selected the alarms will not terminate until the controller returns to set point and the **RESET** key is pressed.

6. There is a programmable ALARM DELAY that determines how long to delay before activating the alarms. This delay effects all pressure and flow alarms.

7. The MUTE TIMEOUT item sets the length of time the audible alarm is off for all pressure and flow alarms.

8. The display can only show one alarm message. Therefore, the controller has an alarm priority system, with the highest priority alarm being displayed. If multiple alarms exist, the lower priority alarms will not display until after the highest priority alarm has been eliminated. The alarm priority is as follows:
   Pressure sensor - low alarm
   Pressure sensor - high alarm
   Low supply flow alarm
   Low exhaust flow alarm
   Data error

9. The low and high pressure alarms are absolute values. The chart below shows how the values must be programmed in order to operate correctly.

-0.2 inches H_2O (maximum negative)			0			+0.2 inches H_2O (maximum positive)
High Negative Alarm	Negative Set point	Low Negative Alarm	Zero	Low Positive Alarm	Positive Set point	High Positive Alarm

The value of each set point or alarm is unimportant (except for small dead band) in graph above. It is important to understand that the negative (positive) low alarm must be between zero (0) pressure and the negative (positive) set point, and that the high alarm is a greater negative (positive) value than set point.

CONFIGURE MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
DISPLAY AVG DISPLAY AVERAGE	The DISPLAY AVG item selects the display's averaging period. The display averaging period is the length of time the room pressure has been averaged before being displayed. The DISPLAY AVG item value may be set between 0.75 and 40 seconds. The higher the averaging value, the more stable the display.	0.75, 1, 2, 3, 5, 10, 20 or 40 seconds **20 seconds**
UNITS	The UNITS item selects the unit of measure that the DIM displays all values (except calibration span). These units display for all menu items set points, alarms, flows, etc..	FT/MIN, m/s, "H_2O Pa, mm H_2O **"H_2O**
ROOM VOLUME	The ROOM VOLUME item is used to input the volume of the laboratory. The laboratory volume is needed to calculate ACPH (air changes per hour). If the DIM displays English units, area must be entered in cubic feet. If metric units are displayed area must be entered in cubic meters.	0 - 100,000 cubic feet (0 - 3000 cubic meters) **0** The DIM does not compute volume. The volume must be first calculated and then entered into the DIM.
EXH CONFIG GENERAL EXHAUST DUCT CONFIGURATION	The EXH CONFIG menu item determines the exhaust configuration. If the general exhaust duct is separate from the total exhaust select SEPARATE (left side of Figure 6). If the general exhaust duct is part of the total exhaust select COMBINED (right side of Figure 6). The correct configuration is required for the control algorithm to function correctly.	SEPARATE or COMBINED **SEPARATE**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

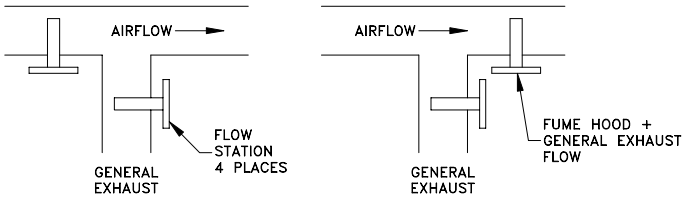


Figure 6: Exhaust Configuration

CALIBRATION MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
SENSOR ZERO	The SENSOR ZERO item is used to calibrate the TSI pressure sensor. A sensor zero should be established prior to adjusting the sensor span (see **Calibration** section following menu item section).	NONE **Unit is factory calibrated. No initial adjustment should be necessary.**
SENSOR SPAN	The SENSOR SPAN item is used to match or calibrate the TSI pressure sensor (velocity sensors) to the average room pressure velocity as measured by a portable air velocity meter. A sensor zero should be established prior to adjusting the sensor span, if the sensor was cleaned with a liquid cleaner (see **Calibration** section following menu item listing).	NONE **Unit is factory calibrated. No initial adjustment should be necessary**.
ELEVATION	The ELEVATION item is used to enter the elevation of the building above sea level. This item has a range of 0-10,000 feet in 1,000 foot increments. The pressure value needs to be corrected due to changes in air density at different elevations.	0 - 10,000 feet above sea level **0**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **ON**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

CONTROL MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
SPEED	The SPEED item is used to select the control output speed (supply and general exhaust). When this item is selected, a bar graph is shown on the display. There are 10 bars, each one representing 10% of speed. Starting from the right side (+ sign), 10 bars displayed indicates maximum speed. This is the fastest the controller will operate. 1 bar is the slowest the controller will operate. The more bars displayed, the faster the control output.	1 to 10 bars **5 bars**
SENSITIVITY	The SENSITIVITY item is used to select the integral dead band. The integral dead band determines when the controller uses integral control (slow control), and when the controller enters PID control (fast control). When this item is selected, a bar graph will be shown on the display. There are 10 bars total, with each one representing 50 CFM. Starting from the right side (+ sign), 10 bars displayed indicates no dead band so the controller is always in PID control mode. Each bar missing represents +/- 50 CFM of integral dead band. The less bars displayed, the larger the integral dead band. For example, with 8 bars displayed (2 bars missing) and an offset of 500 CFM, the integral dead band is between 400 and 600 CFM. When the measured offset is within this range, integral or slow control is used. However, when the flow offset falls below 400 CFM or rises above 600 CFM, PID control is enabled until the unit returns within the dead band. The SENSITIVITY item has a unique feature that when zero bars are displayed, the unit never goes into PID control. The control output is always a slow control signal. **WARNING:** When SENSITIVITY is set for 10 bars, the system is always in PID control, which will probably cause an unstable system. It is recommended that SENSITIVITY be set at 9 bars or less.	0 to 10 bars **5 bars**
CONTROL SIG CONTROL SIGNAL	The CONTROL SIG item determines the control signal's output direction. As an example; If the control system closes the exhaust damper instead of opening the damper, this option will reverse the control signal to now open the damper. **NOTE**: Changing the CONTROL SIG changes both the supply and exhaust damper directions. If only one damper needs to change direction, change that actuator jumper instead of changing the CONTROL SIG.	Direct or Reverse **Direct**

CONTROL MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
Kc VALUE Ti VALUE (primary flow control loop)	**WARNING:** The Kc VALUE and Ti VALUE allow you to manually change the primary PID control loop variables. **DO NOT CHANGE THESE VALUES UNLESS YOU HAVE A THOROUGH UNDERSTANDING OF PID CONTROL LOOPS. CONTACT TSI FOR ASSISTANCE PRIOR TO CHANGING ANY VALUES.** Contact TSI for assistance in determining your control problem and for instructions on how to change a value. Incorrectly changing a value will result in poor or non existent control. Suggestion: Before changing Kc or Ti, change the SPEED or adjust the SENSITIVITY to try to eliminate the problem. The Kc VALUE item changes the gain control coefficient of the primary control loop (flow tracking loop). When this item is entered, a value for Kc is indicated on the display. If the AOC is not controlling correctly, the Kc gain control coefficient may need adjusting. Decreasing Kc will slow the control system down, which will increase stability. Increasing Kc will increase the control system which may cause system instability. The Ti VALUE item changes the integral control coefficient of the primary control loop (flow tracking loop). When this item is entered, a value for Ti is indicated on the display. If the AOC is not controlling correctly, the unit may have an inappropriate integral control coefficient. Increasing Ti will slow the control system which will increase stability. Decreasing Ti will increase the control system speed which may cause system instability.	Kc = 0 - 1000 Ti = 0-1000 The range of values is very large. Poor control will occur if values are more than twice or less than 1/2 the default value **Kc = 80** **Ti = 200**

CONTROL MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
Kc OFFSET (pressure control loop)	**WARNING:** The Kc OFFSET sets the pressure control PID variable. **DO NOT CHANGE THIS VALUE UNLESS YOU HAVE A THOROUGH UNDERSTANDING OF PID CONTROL LOOPS. CONTACT TSI FOR ASSISTANCE PRIOR TO CHANGING ANY VALUES.** Contact TSI for assistance in determining your control problem and for instructions on how to change a value. Incorrectly changing a value will result in poor or non existent control. The Kc OFFSET item changes the gain control coefficient of the secondary control loop (pressure control loop). The pressure control loop is very slow when compared to the primary flow control loop. This menu item should not be changed unless problems with the pressure control loop can be established (confirm problem is not with primary flow control loop). When this item is entered, a value for Kc is indicated on the display. Decreasing Kc will slow the pressure control loop down, while increasing Kc will increase the pressure control loop speed.	Kc = 0 - 1000 The range of values is very large. Poor control will occur if values are more than twice or less than 1/2 the default value **Kc = 200**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

SYSTEM FLOW MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
TOT SUP FLOW TOTAL SUPPLY AIR FLOW	The TOT SUP FLOW menu item displays the current total measured supply flow into the laboratory. This is a system information only menu item: no programming is possible.	NONE: Read only value **NONE**
TOT EXH FLOW TOTAL EXHAUST AIR FLOW	The TOT EXH FLOW menu item displays the current total measured exhaust flow out of the laboratory. This item calculates total exhaust by summing EX1 FLOW IN and HD1 FLOW IN. This is a system information only menu item: no programming is possible.	NONE: Read only value **NONE**
OFFSET VALUE ACTUAL OFFSET VALUE	The OFFSET VALUE menu item displays the actual flow offset being used to control the laboratory. The OFFSET VALUE is calculated by the AOC control algorithm, which uses the MIN OFFSET, MAX OFFSET, and SETPOINT items to calculate required offset. This is a system information only menu item: no programming is possible.	NONE: Read only value **NONE**
SUP SETPOINT SUPPLY FLOW SET POINT (CALCULATED)	The SUP SETPOINT menu item displays the supply flow set point, which is calculated by the AOC control algorithm. The calculated SUP SETPOINT is a diagnostic item used to compare the actual TOT SUP FLOW to the calculated flow (they should match within 10%). This is a system information only menu item: no programming is possible.	NONE: Read only value **NONE**
EXH SETPOINT GENERAL EXHAUST FLOW SET POINT (CALCULATED)	The EXH SETPOINT menu item displays the general exhaust flow set point, which is calculated by the AOC control algorithm. The calculated EXH SETPOINT is a diagnostic item used to compare the actual TOT EXH FLOW to the calculated flow (they should match within 10%). This is a system information only menu item: no programming is possible.	NONE: Read only value **NONE**
ACPH CALCULATED AIR CHANGES PER HOUR	The ACPH (Air Changes Per Hour) menu item displays the current laboratory air changes. ACPH is calculated by the following formula: ACPH = (TOT EXH FLOW X 60 min/hour) / ROOM VOLUME. This is a system information only menu item: no programming is possible.	NONE: Read only value **NONE**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

FLOW CHECK MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
HD1 FLOW IN FUME HOOD EXHAUST FLOW	The HD1 FLOW IN menu item displays the current exhaust flow from a fume hood. This item is a diagnostics tool to compare the hood flow reading to a traverse of the duct work. If flow reading and traverse match within 10% no change is needed. If flow error is greater than 10% adjust the HD1 DCT AREA until error is within 10%. When a volt meter is hooked to the flow station output, a voltage should be displayed. The exact voltage displayed is relatively unimportant. It is more important that the voltage is changing which indicates the flow station is working correctly. 0 volts displayed equals zero flow. 5 volts displayed equals 2832 ft/min x duct area $(ft)^2$ - pressure based flow station. 5 volts displayed equals TOP VELOCITY x duct area (ft^2). - linear based flow station.	NONE: Read only value **NONE**
EX1 FLOW IN GENERAL EXHAUST FLOW	The EX1 FLOW IN menu item displays the current exhaust flow from a general exhaust. This item is a diagnostics tool used to compare the general exhaust flow to a traverse of the duct work. If flow error is greater than 10% adjust the EX1 DCT AREA until error is within 10%. When a volt meter is hooked to the flow station output, a voltage should be displayed. The exact voltage displayed is relatively unimportant. It is more important that the voltage is changing which indicates the flow station is working correctly. 0 volts displayed equals zero flow. 5 volts displayed equals 2832 ft/min x duct area $(ft)^2$ - pressure based flow station. 5 volts displayed equals TOP VELOCITY x duct area (ft^2). - linear based flow station.	NONE: Read only value **NONE**
SP1 FLOW IN SUPPLY AIR FLOW	The SP1 FLOW IN menu item displays the current supply air flow. This item is a diagnostics tool used to compare the supply flow to a traverse of the duct work. If flow error is greater than 10% adjust the SP1 DCT AREA until error is within 10. When a volt meter is hooked to the flow station output, a voltage should be displayed. The exact voltage displayed is relatively unimportant. It is more important that the voltage is changing which indicates the flow station is working correctly. 0 volts displayed equals zero flow. 5 volts displayed equals 2832 ft/min x duct area $(ft)^2$ - pressure based flow station. 5 volts displayed equals TOP VELOCITY x duct area (ft^2). - linear based flow station.	NONE: Read only value **NONE**

FLOW CHECK MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

DIAGNOSTICS MENU

SOFTWARE NAME	ITEM DESCRIPTION
CONTROL SUP SUPPLY AIR CONTROL OUTPUT	The CONTROL SUP item manually changes the control output signal to the supply air actuator/damper (or motor speed drive). When this item is entered, a number between 0 and 255 will be shown on the display indicating the control output value. Pressing the ▲/▼ keys change the count on the display. Pressing the ▲ key increases the displayed value, while pressing the ▲/▼ key decreases the displayed value. The supply air damper or VAV box should change (modulate) as the number changes. Depending on the actuator's jumper position 0 or 255 is full open on damper. Conversely 255 or 0 will be full closed. A count of 150 should position the damper approximately 1/2 open. On units controlling variable frequency drives, fan speed should increase or decrease as numbers change. **WARNING:** The CONTROL SUP function overrides the AOC control signal. Adequate room pressure will NOT be maintained while in this item.
CONTROL EXH EXHAUST AIR CONTROL OUTPUT	The CONTROL EXH item manually changes the control output signal to the exhaust air actuator/damper (or motor speed drive). When this item is entered, a number between 0 and 255 will be shown on the display indicating the control output value. Pressing the ▲/▼ keys changes the count on the display. Pressing the ▲ key increases the displayed value, while pressing the ▼ key decreases the displayed value. The exhaust air damper or VAV box should change (modulate) as the number changes. Depending on the actuator's jumper location 0 or 255 is full open on damper. Conversely 255 or 0 will be full closed. A count of 150 should position the damper approximately 1/2 open. On units controlling variable frequency drives, fan speed should increase or decrease as numbers change. **WARNING:** The CONTROL EXH function overrides the AOC control signal. Adequate room pressure will NOT be maintained while in this item.
SENSOR INPUT PRESSURE SENSOR SIGNAL CHECK	The SENSOR INPUT item verifies that the DIM is receiving a signal from the pressure sensor. When this item is entered, a voltage will be indicated on the display. The exact voltage displayed is relatively unimportant. It is more important that the voltage is changing which indicates the sensor is working correctly. 0 volts represents a negative pressure of -0.2 inches H_2O. 5 volts represents 0 pressure 10 volts represents a positive pressure of +0.2 inches H_2O.
SENSOR STAT SENSOR COMMUNICATION	The SENSOR STAT item verifies that the RS-485 communications between the pressure sensor and DIM is working correctly. Pressure sensor error messages do not display on DIM except when SENSOR STAT item is selected. This item displays NORMAL if communications are established correctly. If problems exist, one of four error messages will display: COMM ERROR - DIM cannot communicate with sensor. Check all wiring and pressure sensor address. Address must be 1. SENS ERROR - Problem with sensor bridge. Physical damage to pressure sensor or sensor circuitry. Unit is not field repairable. Send to TSI for repair. CAL ERROR - Calibration data lost. Sensor must be returned to TSI to be calibrated. DATA ERROR - Problem with EEPROM, field calibration, or analog output calibration lost. Check all data programmed and confirm unit is function correctly.

DIAGNOSTICS MENU (continued)

SOFTWARE NAME	ITEM DESCRIPTION
TEMP INPUT TEMPERATURE INPUT	The TEMP INPUT item reads the input from the thermostat. When this item is entered, a voltage will be indicated on the display. The exact voltage displayed is relatively unimportant. It is more important that the voltage changes indicating the thermostat is working correctly. The output range that can be read is 0-10 VDC. Zero volts correlates to maximum cooling, while 10 volts (5 volts on 0-5 V thermostats) correlates to maximum heating.
LOW ALM REL HIGH ALM REL RELAY OUTPUT	The relay menu items are used to change the state of a particular relay contact: LOW, HIGH. When an item is entered, the display will indicate either OPEN or CLOSED. The ▲/▼ keys are used to toggle the state of the relay. Pressing the ▲ key will OPEN the alarm contact. Pressing the ▼ key will CLOSE the alarm contact. When the contact is closed, the relay is in an alarm condition.
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON, a code is required before the menu can be entered. Conversely, if the ACCESS CODE is OFF, no code is required to enter the menu. Factory default for access code is OFF.
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.

INTERFACE MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
NET PROTOCOL NETWORK PROTOCOL	The NET PROTOCOL item selects the communications protocol used to interface with the building management system	MODBUS, CIMETRICS, **MODBUS**
NET ADDRESS NETWORK ADDRESS	The NET ADDRESS item is used to select the main network address of the individual room pressure device. Each unit on the network must have its own unique address. The values range from 1-247 If RS-485 communications are being used, then a unique NET ADDRESS must be entered into the unit. There is no priority between the RS-485 and keypad. The most recent signal by either RS-485 or keypad will initiate a change. RS-485 communications allows you access to all menu items except calibration and control items. The RS-485 network can initiate a change at any time.	1-247 **1**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

HOOD FLOW MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
HD1 DCT AREA FUME HOOD EXHAUST DUCT SIZE	The HD1 DCT AREA item inputs the fume hood exhaust duct size. The duct size is needed to compute the flow out of the fume hood. This item requires a flow station to be mounted in each fume hood exhaust duct. If the DIM displays English units, area must be entered in square feet. If metric units are displayed area must be entered in square meters.	0 - 10 square feet (0 - 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit. **0**
HD1 FLO ZERO FUME HOOD FLOW STATION ZERO	The HD1 FLO ZERO item establishes the flow station zero flow point. A zero or no flow point needs to be established in order to obtain a correct flow measurement output (see **Calibration** section). All pressure based flow stations need to have an HD1 FLO ZERO established on initial set up. Linear flow stations with a 1-5 VDC output also need to have an HD1 FLO ZERO established. Linear flow stations with a 0-5 VDC output do not need a HD1 FLO ZERO.	NONE
FLO STA TYPE FLOW STATION TYPE	The FLO STA TYPE item is used to select the flow station input signal. PRESSURE is selected when TSI flow stations with pressure transducers are installed. LINEAR is selected when a linear output flow station is installed (0-5 VDC): Typically a thermal anemometer based flow station.	PRESSURE or LINEAR **PRESSURE**
TOP VELOCITY MAXIMUM FLOW STATION VELOCITY	The TOP VELOCITY item is used to input the maximum velocity of a linear flow station output. A TOP VELOCITY must be input for the linear flow station to operate. NOTE: This item is disabled if a pressure based flow station is installed.	0 - 5,000 FT/MIN (0 - 25.4 m/s) **0**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

EXHAUST FLOW MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
EX1 DCT AREA GENERAL EXHAUST DUCT SIZE	The EX1 DCT AREA item inputs the general exhaust duct size. The duct size is needed to compute the total general exhaust flow out of the laboratory. This item requires a flow station to be mounted in each general exhaust duct. If the DIM displays English units, area must be entered in square feet. If metric units are displayed area must be entered in square meters.	0 - 10 square feet (0 - 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit. **0**
EX1 FLO ZERO EXHAUST FLOW STATION ZERO	The EX1 FLO ZERO item establishes the flow station zero flow point. A zero or no flow point needs to be established in order to obtain a correct flow measurement output (see **Calibration** section). All pressure based flow stations need to have an EX1 FLO ZERO established on initial set up. Linear flow stations with a 1-5 VDC output also need to have an EX1 FLO ZERO established. Linear flow stations with a 0-5 VDC output do not need a EX1 FLO ZERO.	NONE
FLO STA TYPE FLOW STATION TYPE	The FLO STA TYPE item is used to select the flow station input signal. PRESSURE is selected when TSI flow stations with pressure transducers are installed. LINEAR is selected when a linear output flow station is installed (0-5 VDC): Typically a thermal anemometer based flow station.	PRESSURE or LINEAR **PRESSURE**
TOP VELOCITY MAXIMUM FLOW STATION VELOCITY	The TOP VELOCITY item is used to input the maximum velocity of a linear flow station output. A TOP VELOCITY must be input for the linear flow station to operate. NOTE: This item is disabled if a pressure based flow station is installed.	0 - 5,000 FT/MIN (0 - 25.4 m/s) **0**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

SUPPLY FLOW MENU

SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE DEFAULT (bold)
SP1 DCT AREA SUPPLY AIR DUCT SIZE	The SP1 DCT AREA item inputs the supply air exhaust duct size. The duct size is needed to compute the supply air flow into the laboratory. This item requires a flow station to be mounted in each supply duct. If the DIM displays English units, area must be entered in square feet. If metric units are displayed area must be entered in square meters.	0 - 10 square feet (0 - 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit. **0**
SP1 FLO ZERO SUPPLY FLOW STATION ZERO	The SP1 FLO ZERO item establishes the flow station zero flow point. A zero or no flow point needs to be established in order to obtain a correct flow measurement output (see **Calibration** section). All pressure based flow stations need to have a SP1 FLO ZERO established on initial set up. Linear flow stations with a 1-5 VDC output also need to have a SP1 FLO ZERO established. Linear flow sup stations with a 0-5 VDC output do not need a SP1 FLO ZERO.	NONE
FLO STA TYPE FLOW STATION TYPE	The FLO STA TYPE item is used to select the flow station input signal. PRESSURE is selected when TSI flow stations with pressure transducers are installed. LINEAR is selected when a linear output flow station is installed (0-5 VDC): Typically a thermal anemometer based flow station.	PRESSURE or LINEAR **PRESSURE**
TOP VELOCITY MAXIMUM FLOW STATION VELOCITY	The TOP VELOCITY item is used to input the maximum velocity of a linear flow station output. A TOP VELOCITY must be input for the linear flow station to operate. NOTE: This item is disabled if a pressure based flow station is installed.	0 - 5,000 FT/MIN (0 - 25.4 m/s) **0**
ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON a code is required before the menu can be entered. Conversely if the ACCESS CODE is OFF no code is required to enter the menu.	ON or OFF **OFF**
END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.	

Setup / Checkout

The AOC is easy to program and setup. This section covers the theory of operation, required software programming, a programming example, and how to verify (checkout) that the components are functioning correctly. The AOC uses a unique control sequence that combines flow and pressure differential measurements to maintain air balance and laboratory pressure, while interfacing with a thermostat to maintain laboratory temperature. The overall AOC control sequence seems quite complicated initially, but the **Theory of Operation** section breaks the sequence down into sub-sequences which simplifies the total system.

Theory of Operation

The AOC control system requires the following measurement inputs to function correctly:

- General exhaust flow measured with a flow station (if general exhaust is installed).
- Fume hood exhaust flow measured with a flow station.
- Supply air flow measured with a flow station.
- Temperature measured with a thermostat (if temperature is incorporated into sequence).
- Pressure differential with a TSI pressure sensor (if pressure is incorporated into sequence).

Laboratory air balance

Laboratory air balance is maintained by measuring the fume hood exhaust (or other exhaust), subtracting an offset flow from the fume hood total, and then setting the supply air damper(s) to maintain the offset between supply air and fume hood exhaust. The general exhaust damper is normally closed, except when room pressure cannot be maintained. This may occur when the fume hood sashes are all down and the supply air is at a minimum position. The general exhaust damper opens to maintain the required offset and pressure differential.

Pressure control

The pressure differential signal is sent to the AOC (assumption: laboratory is under negative pressure). If pressure is at set point, the control algorithm does nothing. If pressure is not at set point the offset value is changed until pressure is maintained, or the minimum or maximum offset value is reached. If the offset value:

increases, the supply air is reduced until one of 3 events occur:

- Pressure set point is reached. The AOC maintains the new offset.
- The offset range is exceeded. The offset will be at maximum attempting to reach pressure set point. An alarm will trigger to inform you pressure differential is not being maintained.
- Supply air minimum is reached. The general exhaust begins to open (was closed) to maintain pressure differential.

decreases, the supply air increases until one of 3 events occur:

- Pressure set point is reached. The AOC maintains the new offset.
- The offset range is exceeded. The offset will be at minimum attempting to reach pressure set point. An alarm will trigger to inform you pressure differential is not being maintained.
- Supply air maximum is reached. The alarm will trigger to inform you pressure differential is not being maintained.

NOTE: The pressure differential is a slow secondary control loop. The system initially starts with a calculated offset value and then slowly adjusts the offset value to maintain pressure differential.

Temperature control

Temperature control is maintained by the thermostat which directly opens / closes the reheat coil when heating is required. In addition, the supply flow can toggle to temperature minimum if additional flow is required. When cooling is required the thermostat toggles the supply air from ventilation minimum to temperature minimum (usually a larger supply flow value). Once temperature is satisfied, the thermostat switches the supply air from temperature to ventilation minimum.

NOTE: The greatest flow requirement dominates the supply flow. If hood replacement air exceeds the ventilation or temperature flow minimums, the replacement air requirement is maintained (minimums are ignored).

In summary, understanding the AOC control algorithm is the key to getting the system functioning correctly. The AOC control algorithm functions as follows:

SUPPLY AIR =	GENERAL EXHAUST +	FUME HOOD EXHAUST	- OFFSET
Supply air is at minimum position; unless additional replacement air is required (fume hood or general exhaust).	General exhaust is closed or at minimum position; except when supply air is at minimum position and pressure control cannot be maintained.	Independent control loop by fume hood controller maintains face velocity. Hood exhaust flow is monitored by AOC. The AOC does not control the fume hood.	Programmed by user. User programs minimum and maximum offset.

Required Software Programming

The following menu items must be programmed for the AOC to function. See **Menu and menu items** section for information in individual menu items.

SUPPLY FLOW MENU	EXHAUST FLOW MENU	HOOD FLOW MENU	SETPOINT MENU
SP1 DCT AREA	EX1 DCT AREA	HD1 DCT AREA	MIN OFFSET
SP1 FLO ZERO	EX1 FLO ZERO	HD1 FLO ZERO	MAX OFFSET
FLO STA TYPE	FLO STA TYPE	FLO STA TYPE	EXH CONFIG
TOP VELOCITY	TOP VELOCITY	TOP VELOCITY	

NOTE: If temperature or pressure control is being maintained by the AOC, the following menu items must also be programmed:

- **Temperature** - The temperature cooling and heating values: VENT MIN SET, TEMP MIN SET, TEMP LOW, TEMP HIGH.

- **Pressure** - The pressure differential value: SETPOINT

There are additional programmable software menu items to tailor the controller to your specific application or increase flexibility. These menu items are not required to be programmed for the AOC to operate.

Programming Example

The laboratory shown is Figure 7 is being initially setup. The required HVAC information is below the figure.

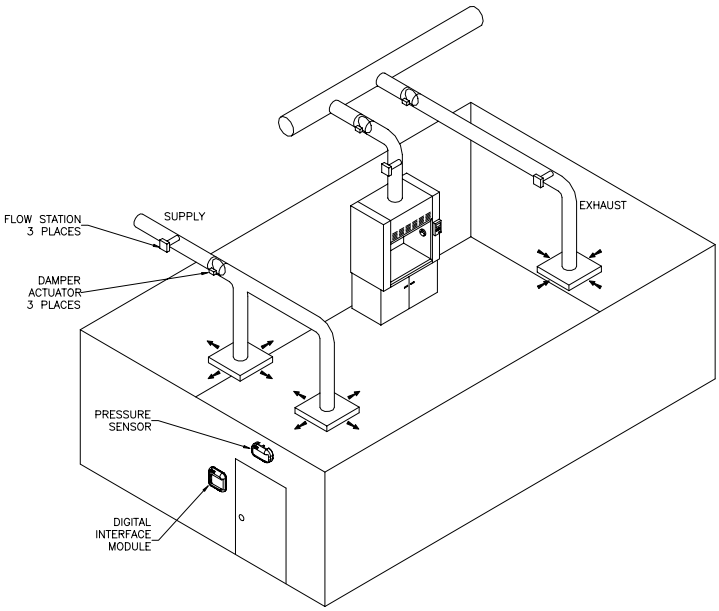


Figure 7: Laboratory Setup Example

Laboratory design:

Laboratory size	=	12' x 14' x 10' (1,680 ft^3).
5 foot fume hood	=	250 CFM min* 1,000 CFM max*
Flow offset	=	100 - 500 CFM*
Ventilation set point	=	280 CFM* (ACPH = 10)
Temperature set point	=	400 CFM*
Pressure differential	=	-0.001 " H_2O*

* Value supplied by laboratory designer.

Room Pressure Control System:

(1) Model 8680 Adaptive Offset Control System mounted in the laboratory.
(2) A through-the-wall pressure sensor mounted between the corridor (referenced space) and laboratory (controlled space).
(3) Damper or pressure dependent VAV box with actuator assembly mounted in supply air duct(s).
(4) Damper or pressure dependent VAV box with actuator assembly mounted in exhaust air duct.
(5) Flow station mounted in supply air duct.
(6) Flow station mounted in general exhaust air duct.
(7) Flow station mounted in fume hood exhaust duct.

Temperature Control System:

(1) Thermostat (deadband type) mounted in the laboratory.
(2) Reheat coil mounted in supply air duct(s).

Fume Hood Control System:

(1) Independent SUREFLOW VAV Face Velocity Control system.

Based on the preceding information, and knowing duct sizes, the following required menu items can be programmed:

MENU ITEM	ITEM VALUE	DESCRIPTION
HD1 DCT AREA	0.78 ft^2 (12 inch round)	Fume hood duct area
EX1 DCT AREA	0.55 ft^2 (10 inch round)	General exhaust duct area
SP1 DCT AREA	1.0 ft^2 (12" x 12")	Supply duct area
MIN OFFSET	100 CFM	Minimum offset.
MAX OFFSET	500 CFM	Maximum offset.
EXH CONFIG	Separate	

Additional menu items to program for temperature and pressure control

VENT MIN SET	280 CFM	10 air changes per hour
TEMP MIN SET	400 CFM	Required flow to cool laboratory.
TEMP LOW	1.2 volts	Thermostat switches from VENT MIN SET to TEMP MIN SET.
TEMP HIGH	OFF	Reheat only, no additional supply flow required.
SETPOINT	- 0.001 " H_2O	Pressure differential set point.

Sequence Of Operation

Beginning scenario: Laboratory is maintaining pressure control; -0.001 " H_2O.
Temperature requirement is satisfied.
Fume hood sashes are down, total hood exhaust is 250 CFM.
Supply air is 280 CFM (maintain ventilation).
General exhaust 130 CFM (calculated from below).

Fume hood	+	General exhaust	-	Offset	=	Supply air
250	+	?	-	100	=	280

The fume hood is opened so that the chemists can load experiments into the hood. The face velocity (100 ft/min) is maintained by modulating the fume hood dampers. The total fume hood flow is now 1,000 CFM.

Fume hood	+	General exhaust	-	Offset	=	Supply air
1,000	+	0	-	100	=	900

The supply air volume changes to 900 CFM (1,000 CFM hood exhaust - 100 CFM offset). The general exhaust is closed since no additional exhaust is needed for temperature or ventilation. However, the Digital Interface Module indicates the laboratory is now - 0.0002 "H_2O (not negative enough). The AOC algorithm slowly changes the offset until pressure control is maintained. In this case the offset changes to 200 CFM, which decreases the supply volume by 100 CFM. The additional offset maintains the pressure differential at - 0.001 "H_2O (set point).

Fume hood	+	General exhaust	-	Offset	=	Supply air
1,000	+	0	-	200	=	800

The hood is shut after the experiments are loaded so the initial conditions prevail.

Fume hood	+	General exhaust	-	Offset	=	Supply air
250	+	130	-	100	=	280

An oven is turned on and the laboratory is getting warm. The thermostat sends the AOC a signal to switch to temperature minimum (TEMP MIN SET). This increases the supply air to 400 CFM. The general exhaust air must also increase (damper opens) to maintain flow balance.

Fume hood	+	General exhaust	-	Offset	=	Supply air
250	+	250	-	100	=	400

The control loop continuously keeps the room balance, room pressure, and temperature control satisfied.

Checkout

The AOC controller should have the individual components checked prior to attempting control of the laboratory. The checkout procedure outlined below will confirm all hardware is performing correctly. The checkout procedure is not difficult and will catch any hardware problems. The steps are as follows:

Confirm wiring is correct.

The most common problem with installed hardware equipment is incorrect wiring. This problem usually exists on initial installation, or when modifications to the system take place. The wiring should be very closely checked to verify it exactly matches the wiring diagram. Polarity must be observed for system to operate correctly. The TSI provided cables are all color coded to ensure proper wiring. A wiring diagram is located in Appendix B of this manual. Wiring associated with non TSI components should be closely checked for correct installation.

Confirming physical installation is correct

All of the hardware components need to be installed properly. Review the installation instructions and verify components are installed properly at the correct location. This can be easily confirmed when checking the wiring.

Verifying individual components

Verifying all TSI components are operating correctly requires following a simple procedure. The fastest procedure involves first checking the DIM, and then confirming all component parts are functioning.

NOTE: These checks require power to the AOC and all components.

CHECK - DIM

Press **TEST** key to verify Digital Interface Module (DIM) electronics are functioning correctly. At the end of the self test, the display will show SELF TEST - PASSED if DIM electronics are good. If unit displays DATA ERROR at the end of the test, the electronics may be corrupted. Check all software items to determine cause of DATA ERROR.

If SELF TEST - PASSED was displayed proceed to check individual components. Enter **Diagnostics and Flow Check Menu** to check the following:

Control output - supply (if controlling supply air).
Control output - exhaust (if controlling exhaust air).
Sensor input (if pressure sensor is installed).
Sensor status (if pressure sensor installed).
Temperature input.
General exhaust flow station.
Supply flow station.
Fume hood flow station.

The menu items are explained in detail in the **Menu and Menu Items** section of the manual, so their function is not reviewed here. If the AOC system passes each of the checks, the mechanical piece parts are all functioning correctly.

CHECK - Control output - supply

Enter CONTROL SUP menu item in diagnostics menu. A number between 0 and 255 will be displayed. Press the ▲/▼ keys until either 0 or 255 shows on the display. Note the position of the supply air control damper. If display reads 0 press the ▲ key until 255 is shown on display. If display read 255 press ▼ key until 0 is shown on display. Note the position of the supply air damper. The damper should have rotated either 45 or 90 degrees depending on actuator installed.

CHECK - Control output - exhaust

Enter CONTROL EXH menu item in diagnostics menu. A number between 0 and 255 will be displayed. Press the ▲/▼ keys until either 0 or 255 shows on the display. Note the position of the general exhaust control damper. If display reads 0 press the ▲ key until 255 is shown on display. If display read 255 press ▼ key until 0 is shown on display. Note the position of the general exhaust damper. The damper should have rotated either 45 or 90 degrees depending on actuator installed.

CHECK - Sensor input

Enter SENSOR INPUT menu item in diagnostics menu. A voltage between 0 and 10 volts DC will be displayed. It is not important what the exact voltage is to pass this test. Tape over the pressure sensor (slide pressure sensor door open) and voltage should read approximately 5 volts (zero pressure). Remove tape and blow on sensor. Displayed value should change. If voltage changes, the sensor is functioning correctly. If voltage doesn't change, proceed to CHECK - Sensor status.

CHECK - Sensor status

Enter SENSOR STAT menu item in diagnostics menu. If NORMAL is displayed, the unit passes test. If an error message is displayed, go to diagnostics menu section of the manual, SENSOR STAT menu item for explanation of error message.

CHECK - Thermostat input

Enter TEMP INPUT menu item in diagnostics menu. A voltage between 0 and 10 volts DC will be displayed. The exact voltage displayed is not important as long as the voltage changes when thermostat changes. Zero volts equals maximum cooling while 10 volts (5 volts if 0-5 VDC thermostat) equals maximum heating.

CHECK - Flow station

The Flow Check menu lists all the flow stations that can be installed. Check each flow station menu item that has a flow station attached. Enter ___ FLOW IN menu item and the actual flow will be displayed. If the flow is correct no changes need to be made. If flow is incorrect adjust the corresponding ___ DCT AREA until actual flow matches flow station reading.

If unit passed all checks, the mechanical components are physically working.

Calibration

The calibration section explains how to calibrate and set the elevation for the AOC pressure sensor and how to zero a flow station.

NOTE: The pressure sensor is factory calibrated and normally does not need to be adjusted. However, inaccurate readings may be detected if pressure sensor is not installed correctly, or problems with the sensor exists. Before calibrating, check that the sensor is installed correctly (usually only a problem on initial set up). In addition, go into DIAGNOSTICS menu, SENSOR STAT item. If NORMAL is displayed, calibration can be adjusted. If an error code is displayed, eliminate error code and then verify pressure sensor needs adjustment.

Adjusting the SUREFLOW pressure sensor calibration may be required to eliminate errors due to convection currents, HVAC configuration, or equipment used to make the measurement. TSI recommends always taking the comparison measurement in the exact same location (i.e. under the door, middle of door, edge of door, etc.). A thermal air velocity meter is needed to make the comparison measurement. Normally the velocity is checked at the crack under the doorway, or the door is opened 1" to allow alignment of the air velocity probe making the measurement. If the crack under the door is not large enough, use the 1" open door technique.

All pressure transducer based flow stations and 1-5 VDC linear flow stations must be zeroed upon initial system set up. Linear 0-5 VDC flow stations do not require a zero flow to be established.

Calibrating Pressure Sensor

Enter calibration menu (see **Software Programming** if not familiar with key stroke procedure). Access code is turned on so enter access code. All menu items described below are found in CALIBRATION menu.

Elevation

The ELEVATION item eliminates pressure sensor error due to elevation of building. (See ELEVATION item in **Menu and Menu items** section for further information).
Enter the ELEVATION menu item. Scroll through the elevation list and select the one closest to the building's elevation.
Press the **SELECT** key to save the data and exit back to the calibration menu.

Sensor zero

Slide open pressure sensor door and tape over 1/2 inch diameter sensor orifice (see Figure 8).
Select SENSOR ZERO item.
Press **SELECT** key. Sensor zero procedure, which takes 120 seconds, is automatic.
Press **SELECT** key to save the data.
Remove tape from sensor orifice and close pressure sensor door.

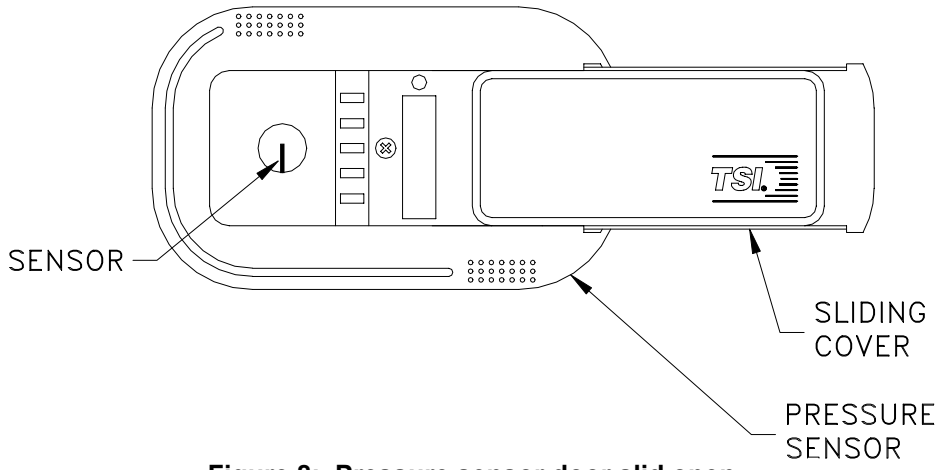


Figure 8: Pressure sensor door slid open

Sensor span

NOTE: Always take a sensor zero prior to adjusting the sensor span. A smoke test and a comparison measurement by an air velocity meter are required to calibrate the pressure sensor. The air velocity meter only gives a velocity reading, so a smoke test must be performed to determine pressure direction.

WARNING: The span can only be adjusted in the same pressure direction. Adjusting span cannot cross zero pressure. Example: If unit displays +0.0001 and actual pressure is -0.0001 do not make any adjustments. Manually change the air balance, close or open dampers, or open door slightly to get both unit and actual pressure to read in same direction (both read positive or negative). This problem can only occur at very low pressures so slightly changing the balance should eliminate the problem.

Perform a smoke test to determine pressure direction.
Select SENSOR SPAN item.
Position thermal air velocity meter in door opening to obtain velocity reading. Press ▲/▼ keys until pressure direction (+/-) and sensor span match thermal air velocity meter, and smoke test.
Press **SELECT** key to save sensor span.
Exit menu, calibration is complete.

Flow station pressure transducer zero

NOTE: Not required for linear flow stations with 0-5 VDC output.

Pressure based flow station

Disconnect tubing between pressure transducer and flow station.
Enter menu item that corresponds to flow station: Hood flow, Exhaust Flow, or Supply flow.
Select HD1 FLO ZERO to take a fume hood flow station zero.
or
Select EX1 FLO ZERO to take a general exhaust flow station zero.
or
Select SP1 FLO ZERO to take a supply flow station zero.

Press **SELECT** key. Flow zero procedure, which takes 10 seconds, is automatic.
Press **SELECT** key to save data.
Connect tubing between pressure transducer and flow station.

Linear flow station 1-5 VDC output

Remove flow station from duct, or cutoff flow in duct. Flow station must have no flow going past the sensor.
Enter menu item that corresponds to flow station location: Hood flow, Exhaust Flow, or Supply flow.
Select HD1 FLO ZERO to take a fume hood flow station zero.

or

Select EX1 FLO ZERO to take a general exhaust flow station zero.

or

Select SP1 FLO ZERO to take a supply flow station zero.

Press **SELECT** key. Flow zero procedure, which takes 10 seconds, is automatic.
Press **SELECT** key to save data.
Install flow station back in duct.

Maintenance and Repair Parts

The Model 8680 SUREFLOW Room Pressure Controller requires minimal maintenance. Periodic inspection of system components as well as an occasional pressure sensor cleaning are all that are needed to insure that the Model 8680 is operating properly.

System Component Inspection

It is recommended that the pressure sensor be periodically inspected for accumulation of contaminants. The frequency of these inspections is dependent upon the quality of the air being drawn across the sensor. Quite simply, if the air is dirty, the sensors will require more frequent inspection and cleaning.

Visually inspect the pressure sensor by sliding open the sensor housing door (Figure 9). The air flow orifice should be free of obstructions. The small ceramic coated sensors protruding from the orifice wall should be white and free of accumulated debris.

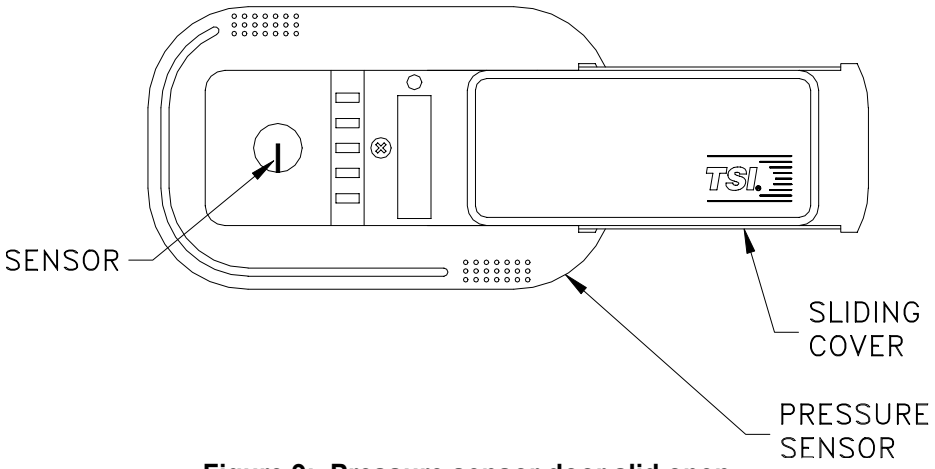


Figure 9: Pressure sensor door slid open

Periodically inspect the other system components for proper performance and physical signs of excessive wear.

Pressure Sensor Cleaning

Accumulations of dust or dirt can be removed with a dry soft-bristled brush (such as an artist's brush). If necessary, water, alcohol, acetone, or trichlorethane may be used as a solvent to remove other contaminants.

Use extreme care when cleaning the velocity sensors. The ceramic sensor may break if excessive pressure is applied, if sensor is scraped to remove contaminants, or if the cleaning apparatus abruptly impacts the sensor.

WARNING: If you are using a liquid to clean the sensor, turn off power to the Model 8680.

Do **not** use compressed air to clean the velocity sensors.

Do **not** attempt to scrape contaminants from the velocity sensors. The velocity sensors are quite durable; however, scraping may cause mechanical damage and possibly break the sensor. Mechanical damage due to scraping voids the pressure sensor warranty.

Flow Station Inspection / Cleaning

The flow station can be inspected by removing mounting screws and visually examining probe. Pressure based flow stations can be cleaned by blowing compressed air into the low and high pressure taps (flow station does not need to be removed from duct). Linear flow stations (thermal anemometer type) can be cleaned with a dry soft-bristled brush (such as an artist's brush). If necessary, water, alcohol, acetone, or trichlorethane may be used as a solvent to remove other contaminants.

Replacement Parts

All components of the room pressure controller are field replaceable. Contact TSI HVAC Control Products at (800) 777-8356 (U.S. and Canada) or (001 651) 490-2711 (other countries) or your nearest TSI Manufacturer's Representative for replacement part pricing and delivery.

Part Number	Description
800227	Digital Interface Module / Adaptive Offset Controller
800326	Pressure Sensor
800248	Sensor Cable
800414	Transformer Cable
800420	Transformer
800199	Controller Output Cable
800360	Electric Actuator
800119	Electric to Pneumatic Interface
800116	Pneumatic Actuator

Appendix A

Specifications

Dim and AOC Module

Display

Range	-0.20000 to +0.20000 inches H_2O
Resolution	5% of reading
Display Update	0.5 sec

Inputs/Outputs (See Wiring Information Appendix B for type.)

Switch in	SPST (N.O.) Switch. Closing switch initiates condition.

Outputs

Alarm Contacts	SPST (N.O.) Max current 5A, max voltage 150 VDC, 250 VAC. Maximum switch load 10 mA, 5 VDC. Contacts close in alarm condition.
Analog Input	0-5 or 0-10 VDC depending on input type.
RS-485	Yes

Operating Temperature	32 to 120°F
Input Power	24 VAC, 5 watts max
Dim Dimensions	4.9 in. x 4.9 in. x 1.35 in.
Dim Weight	0.7 lb.

Pressure Sensor

Temperature Compensation Range	55 to 95°F
Power Dissipation	0.16 watts at 0 inches H_2O, 0.20 watts at 0.00088 inches H_2O
Dimensions (DxH)	5.58 in. x 3.34 in. x 1.94 in.
Weight	0.2 lb.

Damper/Actuator

Types of Actuators	Electric or pneumatic
Input Power	Electric: 24 VAC, 7.5 watts max. Pneumatic: 24 VAC, 3 watts max.
Control Signal Input	0 volts damper closed 10 volts damper open
Time for 90° Rotation	Electric: 1.5 seconds Pneumatic: 5 seconds

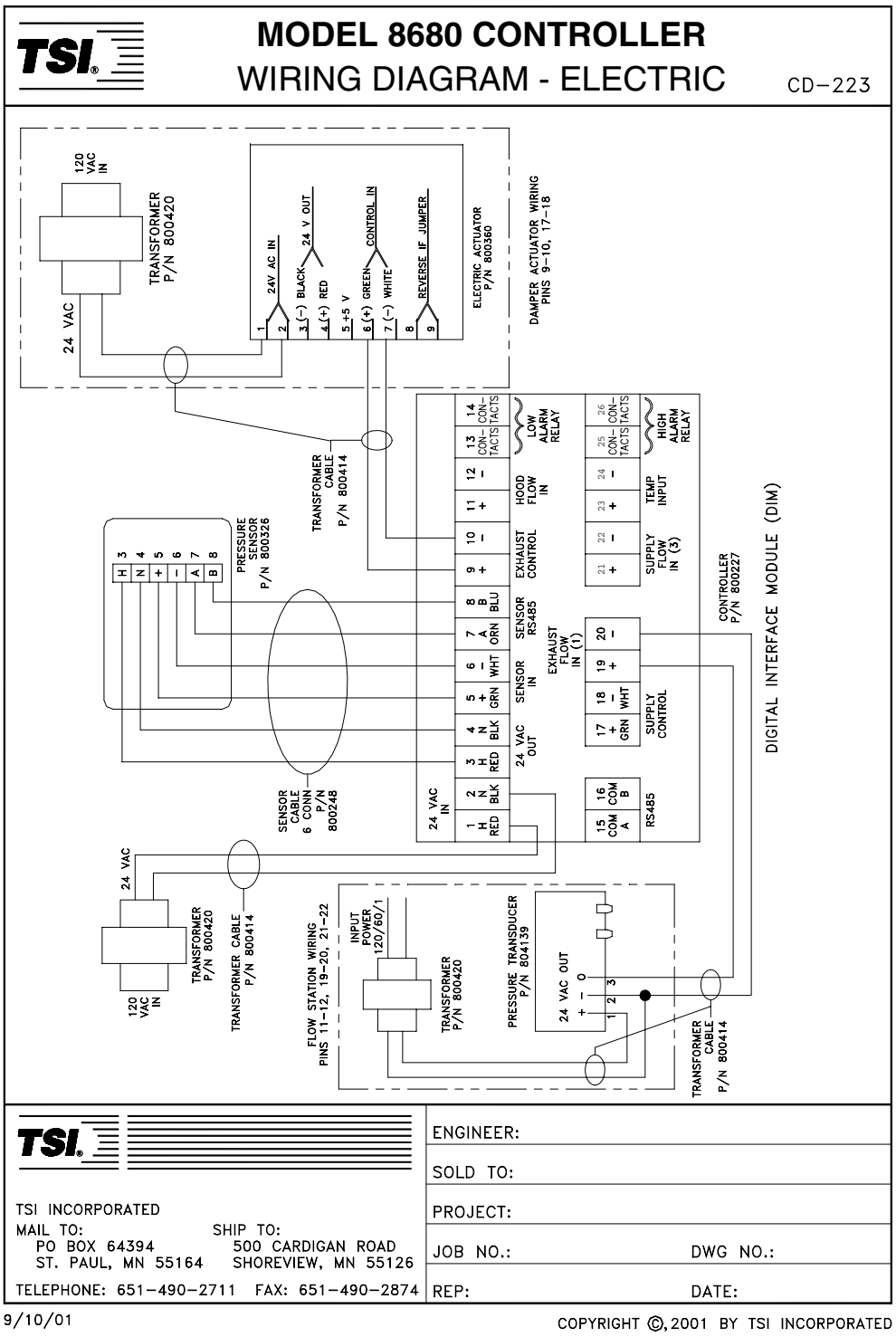
Appendix B

Wiring Information

Back Panel Wiring

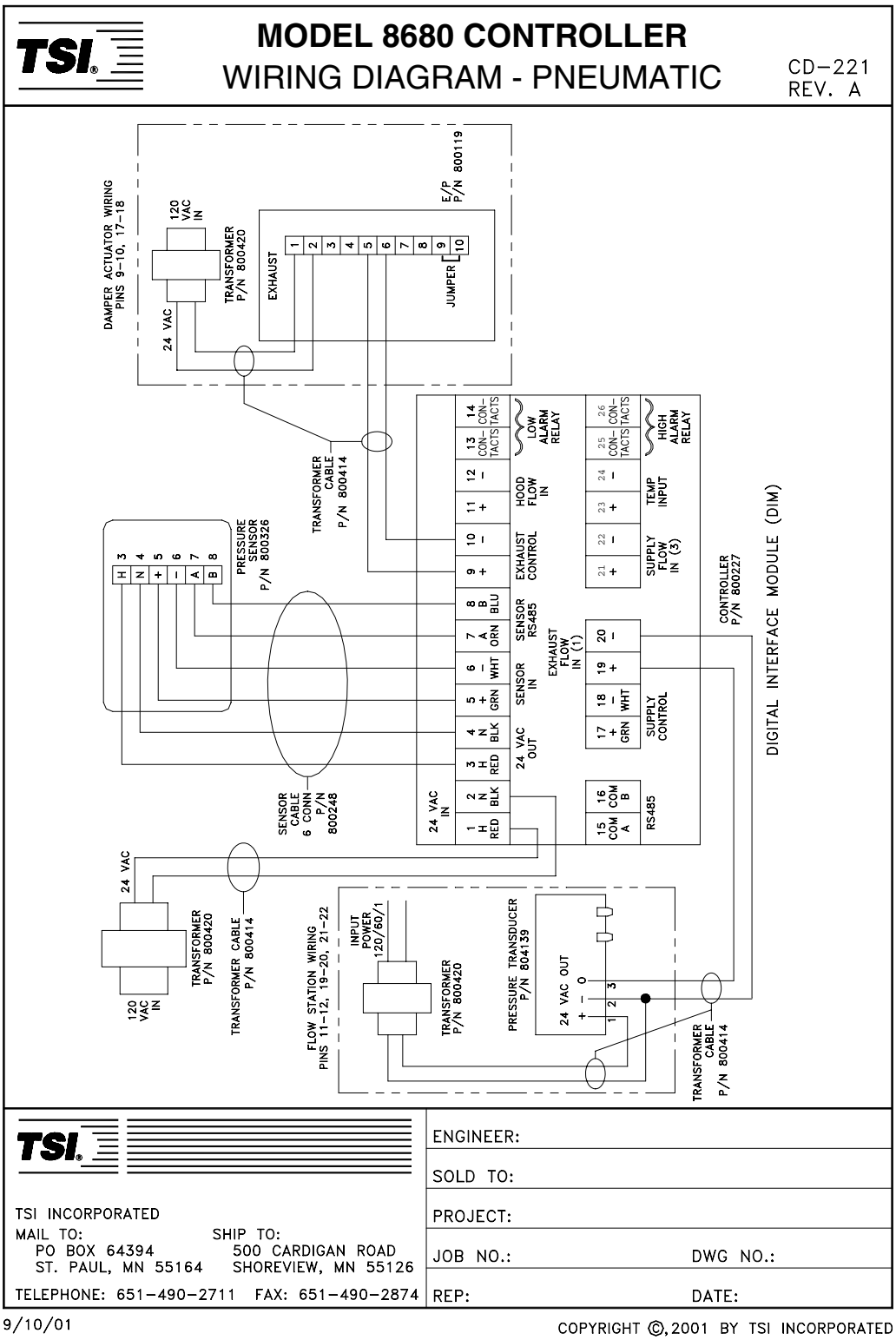
PIN #	Input / Output / Communication	Description
	DIM / AOC	
1, 2	Input	24 VAC to power Digital Interface Module (DIM). NOTE: 24 VAC becomes polarized when connected to DIM.
3, 4	Output	24 VAC power for Pressure Sensor
5, 6	Input	0 - 10 VDC pressure sensor signal
7, 8	Communications	RS - 485 communications between DIM and pressure sensor
9, 10	Output	0 - 10 VDC, general exhaust control signal. 10 VDC = open (n.o. damper)
11, 12	Input	0 - 5 VDC flow station signal - fume exhaust.
13, 14	Output	Low alarm relay - N.O., closes in low alarm condition. - See menu item LOW ALARM
15, 16	Communications	RS - 485 communications; AOC to building management system.
17, 18	Output	0 - 10 VDC, supply air control signal. 10 VDC = open (n.o. damper)
19, 20	Input	0 - 5 VDC flow station signal - General exhaust.
21, 22	Input	0 - 5 VDC flow station signal - Supply air.
23, 24	Input	0 - 5 VDC, 0 - 10 VDC thermostat signal
25, 26	Output	High alarm relay - N.O., closes in high alarm condition. - See menu item HIGH ALARM

WARNING: The wiring diagram shows polarity on many pairs of pins: + / -, H / N, A / B. Damage to DIM / AOC may occur if polarity is not observed.



WARNING: Controller must be wired exactly as wire diagram shows. Making modifications to the wiring may severely damage the unit.

Figure 10: Wiring Diagram - Damper System with Electric Actuator



WARNING: Controller must be wired exactly as wire diagram shows. Making modifications to the wiring may severely damage the unit.

Figure 12: Wiring Diagram - Damper System with Pneumatic Actuator

Appendix C

Access Codes

There is one access code for all menus. Each menu can have the access code ON or OFF. IF on the access code must be entered. Pressing the key sequence below will allow access to the menu. The access code must be entered within 40 seconds and each key must be pressed within 8 seconds. Incorrect sequence will not allow access to the menu.

Key #	ACCESS CODE
1	Emergency
2	Mute
3	Mute
4	Menu
5	Aux

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