CONTROLLED ENVIRONMENTS

Critical Environments

Models 8682
8682-BAC

SureFlow™
Adaptive Offset Controller

Operation and Service Manual

P/N 1980483, Revision E
February 2010

TRUST. SCIENCE. INNOVATION.

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8682-BAC

SUREFLOW™
Adaptive Offset Controller

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Part number 1980483

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Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for twenty-four (24) months, or the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions:

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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 controller 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™ controller installation. Refer to the Installation Instructions to determine if the SUREFLOW™ controller 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.

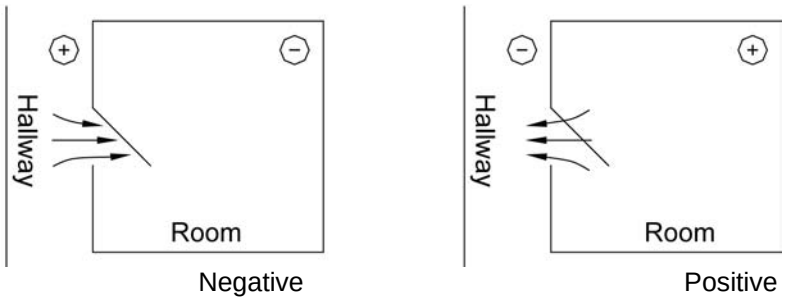

Figure 1: Room Pressure

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™ controller consists of three pieces: pressure sensor, Digital Interface Module (DIM), and Adaptive Offset Controller (AOC). The components are typically located as follows; pressure sensor above the laboratory entrance, DIM is mounted close to laboratory entrance, and the AOC in the ceiling space near the laboratory entrance. The pressure sensor continuously measures the room pressure and provides room pressure information to the DIM and AOC. The DIM continuously reports the room pressure and activates the alarms when necessary. The AOC controls the supply and exhaust dampers to maintain the pressure differential. The 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.

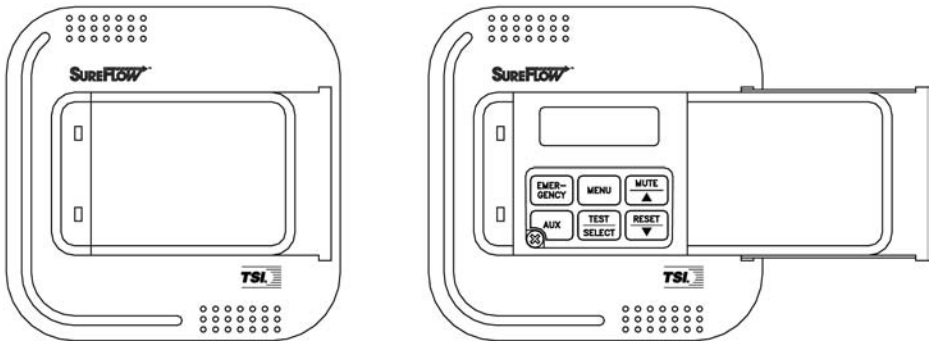

Figure 2: Digital Interface Module (DIM)

SUREFLOW™ controller has two levels of user information:

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

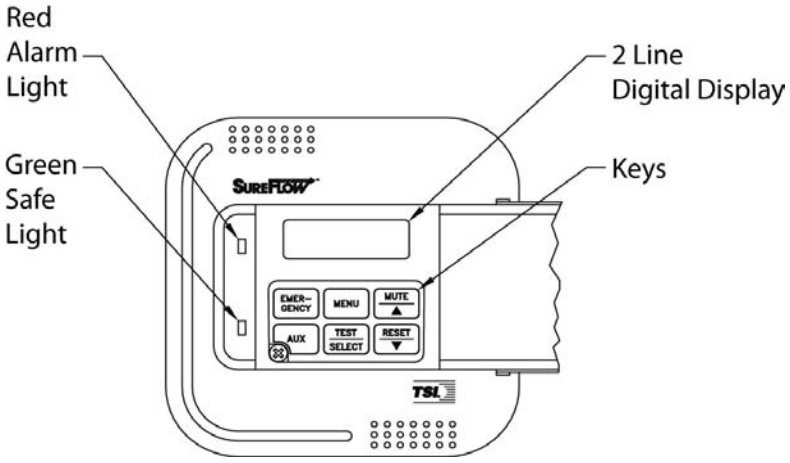

Figure 3: SUREFLOW™ Operator Panel–Open

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 personnel 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™ controller. 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™ controller 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™ controller 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* 8682- ____
- Software revision levels*
- Facility where unit is installed

* First three 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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Prior to shipping any components to TSI for service or repair, please utilize our convenient Return Material Authorization (RMA) Form, which is available online at http://rma.tsi.com.

PART TWO

Technical Section

The AOC is ready to use after being properly installed. The pressure sensor is factory calibrated prior to shipping and should not need adjustment. The flow stations must be calibrated 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™ controller is quick and easy if the programming keys are understood and the proper keystroke 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.

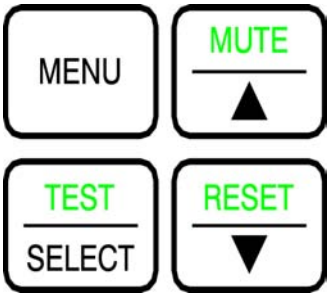


Figure 4: Programming Keys

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.

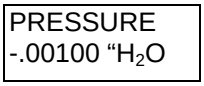
   NOTE: If "Enter Code" is flashing, the access code must be entered before you can enter the menu. Access code is found in Appendix D. Appendix D may have been removed from the manual for security reasons.
5. Press the **SELECT** key to access chosen item. The top line of display shows menu item selected, 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

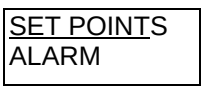
The following example demonstrates the keystroke sequence explained above. In this example the high alarm set point will be changed from -0.002 inches H_2O to -0.003 inches H_2O.

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



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

The first two menu choices are displayed.



❸ Press the ▼ key once. Blinking cursor should be on A in 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

```
ALARM
HIGH ALARM
```

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

```
HIGH ALARM
-.00200 "H2O
```

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


```
HIGH ALARM
- .00300 "H2O
```

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.

```
HIGH ALARM
Saving Data
```

Immediately after the data is saved, the SUREFLOW™ controller returns 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).

```
ALARM
HIGH ALARM
```

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

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


```
ALARM
CONFIGURE
```

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

Unit is now back in normal operation

```
PRESSURE
-.00100 "H2O
```

Menu and Menu Items

The SUREFLOW™ controller 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, 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 8682 controller menu items.

SET POINTS	**ALARM**	**CONFIGURE**	**CALIBRATION**
SET POINT	LOW ALARM	UNITS	SENSOR SPAN
REM SET POINT	HIGH ALARM	EXH CONFIG	ELEVATION
VENT MIN SET	REM LOW ALM	ACCESS CODES	TEMP CAL
COOLING FLOW	REM HIGH ALM		
UNOCCUPY SET	MIN SUP ALM		
MAX SUP SET	MAX EXH ALM		
MIN EXH SET	ALARM RESET		
MIN OFFSET	AUDIBLE ALM		
MAX OFFSET	ALARM DELAY		
TEMP SETP	MUTE TIMEOUT		
UNOCC TEMP			

CONTROL	**SYSTEM FLOW**	**FLOW CHECK**	**DIAGNOSTICS**
SPEED	TOT SUP FLOW	SP1 FLOW IN	CONTROL SUP
SENSITIVITY	TOT EXH FLOW	SP2 FLOW IN	CONTROL EXH
CONTROL SIG	OFFSET VALUE	SP3 FLOW IN	CONTROL TEMP
SUP CONT DIR	SUP SET POINT	SP4 FLOW IN	SENSOR INPUT
EXH CONT DIR	EXH SET POINT	EX1 FLOW IN	SENSOR STAT
TEMP DIR		EX2 FLOW IN	TEMP INPUT
REHEAT SIG		HD1 FLOW IN	OCCUPANT SWT
KC VALUE		HD2 FLOW IN	REMOTE SWT
TI VALUE		HD3 FLOW IN	LOW ALM REL
KC OFFSET		HD4 FLOW IN	HIGH ALM REL
TEMP DB		HD5 FLOW IN	LOW SUP REL
TEMP TR		HD6 FLOW IN	HIGH EXH REL
TEMP TI		HD7 FLOW IN	PRESS AOUT
			SUPPLY AOUT
			EXHAUST AOUT
			RESET TO DEF

INPUT CHECK

SUP 1
SUP 2
SUP 3
SUP 4
EXH 1
EXH 2
HOOD 1
HOOD 2
HOOD 3
HOOD 4
HOOD 5
HOOD 6
HOOD 7

INTERFACE

NET PROTOCOL*
NET ADDRESS*
LON*
MAC ADDRESS*
OUTPUT RANGE
OUTPUT SIG
MAX FLOW OUT

SUPPLY FLOW

SP1 DCT AREA
SP2 DCT AREA
SP3 DCT AREA
SP4 DCT AREA
SP1 FLO ZERO
SP2 FLO ZERO
SP3 FLO ZERO
SP4 FLO ZERO
FLO STA TYPE
TOP VELOCITY
SP LOW SETP
SP HIGH SETP
SP1 LOW CAL
SP1 HIGH CAL
SP2 LOW CAL
SP2 HIGH CAL
SP3 LOW CAL
SP3 HIGH CAL
SP4 LOW CAL
SP4 HIGH CAL
RESET CAL

EXHAUST FLOW

EX1 DCT AREA
EX2 DCT AREA
EX1 FLO ZERO
EX2 FLO ZERO
FLO STA TYPE
TOP VELOCITY
EX LOW SETP
EX HIGH SETP
EX1 LOW CAL
EX1 HIGH CAL
EX2 LOW CAL
EX2 HIGH CAL
RESET CAL

HOOD FLOW

HD1 DCT AREA
HD2 DCT AREA
HD3 DCT AREA
HD4 DCT AREA
HD5 DCT AREA
HD6 DCT AREA
HD7 DCT AREA
HD1 FLO ZERO
HD2 FLO ZERO
HD3 FLO ZERO
HD4 FLO ZERO
HD5 FLO ZERO
HD6 FLO ZERO
HD7 FLO ZERO
FLO STA TYPE
TOP VELOCITY

HOOD CAL

HD1 LOW CAL
HD1 HIGH CAL
HD2 LOW CAL
HD2 HIGH CAL
HD3 LOW CAL
HD3 HIGH CAL
HD4 LOW CAL
HD4 HIGH CAL
HD5 LOW CAL
HD5 HIGH CAL
HD6 LOW CAL
HD6 HIGH CAL
HD7 LOW CAL
HD7 HIGH CAL
MIN HD1 FLOW
MIN HD2 FLOW
MIN HD3 FLOW
MIN HD4 FLOW
MIN HD5 FLOW
MIN HD6 FLOW
MIN HD7 FLOW
RESET CAL

Figure 5: Menu Items - Model 8682 Controller

*LON Menu Item or MAC ADDRESS Menu Item will only appear as a menu option for the Model 8682 Adaptive Offset Controller that includes an optional Lon Works or BACnet board. The Menu Items NET PROTOCOL and NET ADDRESS will be deleted as menu options on Model 8682 Adaptive Offset Controllers that include either the optional Lon Works or BACnet board.

SET POINTS MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
PRESSURE SET POINT	SET POINT	The SET POINT 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 than MAX OFFSET, pressure control will not be maintained.	0 to -0.19000 in. H_2O or 0 to +0.19000 H_2O	**-0.00100" H_2O**
REMOTE OR ALTERNATE PRESSURE SET POINT	REM SET POINT	The REM SET POINT item sets an alternate control set point. The SUREFLOW™ controller will maintain the room pressure at the alternate set point when this item is enabled. This item is enabled when the REMOTE SWT contact closure, pins 3 and 4, is closed, or the RS 485 communications sends a command. **NOTE**: The REM SET POINT disables the ALARM DELAY.	0 to -0.19000 in. H_2O or 0 to +0.19000 in. H_2O	**0**
VENTILATION MINIMUM SUPPLY FLOW SET POINT	VENT MIN SET	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).	0 to 30,000 CFM (0 to 14,100 l/s) Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2).	**0**

SET POINTS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
SPACE COOLING SUPPLY FLOW SET POINT	COOLING FLOW	The COOLING FLOW item sets the space cooling supply airflow set point (CFM). This item defines a supply air flow intended to meet the space's cooling requirements by allowing the supply flow to increase, gradually, to the COOLING FLOW set point, from a minimum ventilation rate, when the space temperature is too warm.. If room pressure is not maintained, 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 1000 Ω platinum RTD temperature sensor to be wired to the TEMPERATURE input (AOC pins 29 and 30). The temperature sensor toggles the AOC between VENT MIN SET and COOLING FLOW.	0 to 30,000 CFM (0 to 14,100 l/s) Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2).	**0**

SET POINTS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
UNOCCUPIED SUPPLY FLOW MINIMUM	UNOCCUPY SET	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 COOLING FLOW 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 OCCUPANT SWT contact closure is *closed* (pins 11 and 12, DIM), or the RS 485 communications sends a command. When switch input is *open* VENT MIN SET and COOLING FLOW are enabled and UNOCCUPY SET is disabled.	0 to 30,000 CFM (0 to 14,100 l/s) Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2).	**0**
MAXIMUM SUPPLY FLOW SET POINT	MAX SUP SET	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.	0 to 30,000 CFM (0 to 14,100 l/s) Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2).	**OFF**

SET POINTS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MINIMUM EXHAUST FLOW SET POINT	MIN EXH SET	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**: The laboratory may not hold pressure set point when general exhaust air is constrained.	0 to 30,000 CFM (0 to 14,100 l/s) Linear based flow stations 0 to TOP VELOCITY times the duct area in square feet (ft^2): square meters (m^2).	**OFF**
MINIMUM FLOW OFFSET	MIN 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**
MAXIMUM FLOW OFFSET	MAX 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**
TEMPERATURE SET POINT	TEMP SETP	The TEMP SETP item sets the temperature control set point. The SUREFLOW™ controller will maintain the temperature set point under normal operating conditions.	50°F to 85°F	**68°F**
UNOCCUPIED TEMPERATURE SET POINT	UNOCC TEMP	The UNOCC TEMP item sets the temperature control set point while the room is in unoccupied mode. WIRING: This item is enabled when the OCCUPANT SWT contact closure is *closed* (pins 11 and 12, DIM), or the RS 485 communications sends a command. When switch input is *open* TEMP SETP is enabled and UNOCC TEMP is disabled	50°F to 85°F	**68°F**

SET POINTS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
LOW PRESSURE ALARM	LOW 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 in. H_2O 0 to +0.18500 in. H_2O	**OFF**
HIGH PRESSURE ALARM	HIGH 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 -0.18500 in. H_2O 0 to +0.18500 in. H_2O	**OFF**
REMOTE OR ALTERNATE LOW PRESSURE ALARM	REM LOW ALM	The REM LOW ALM item sets a remote or second low pressure alarm set point. A remote low alarm condition is defined as when the room pressure falls below or goes in the opposite direction of the REM LOW ALM set point. This item is enabled when the REMOTE SWT contact closure, pins 3 and 4, is closed, or the RS 485 communications sends a command.	OFF 0 to -0.18500 in. H_2O 0 to +0.18500 in. H_2O	**OFF**
REMOTE OR ALTERNATE HIGH PRESSURE ALARM	REM HIGH ALM	The REM HIGH ALM item sets a remote or second high-pressure alarm set point. A high alarm condition is defined as when the room pressure rises above the REM HIGH ALM set point. This item is enabled when the REMOTE SWT contact closure, pins 3 and 4, is closed, or the RS 485 communications sends a command.	OFF 0 to -0.18500 in. H_2O 0 to +0.18500 in. H_2O	**OFF**

ALARM MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MINIMUM SUPPLY FLOW ALARM	MIN SUP ALM	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(s) SP# 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 [SWITCH INPUT contact closure is *closed* (pins 11 and 12, DIM), or the RS 485 communications sends a command].	0 to 29,950 CFM (0 to 14,125 l/s) Linear based flow stations 0 to TOP VELOCITY times the supply duct area in square feet (ft^2): square meters (m^2).	**OFF**
MAXIMUM EXHAUST FLOW ALARM	MAX EXH ALM	The MAX EXH ALM item sets the general exhaust duct's flow alarm set point. A maximum flow alarm is defined as when the general exhaust duct flow is greater than the MAX EXH ALM set point. **NOTE**: General exhaust air duct size EX1 DCT AREA and / or EX2 DCT AREA (Exhaust Flow menu) must be entered before MAX EXH ALM can be accessed. Actual total exhaust air flow is found in TOT EXH FLOW menu item (SYSTEM FLOW menu).	0 to 30,000 CFM (0 to 14,100 l/s) Linear based flow stations 0 to TOP VELOCITY times the supply duct area in square feet (ft^2): square meters (m^2).	**OFF**
ALARM RESET	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**

ALARM MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
AUDIBLE ALARM	AUDIBLE ALM	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	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 to 600 SECONDS	**20 SECONDS**
MUTE TIMEOUT	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**
	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 in. H_2O at 0.001 in. H_2O) of the control set point.

   Example: The control SET POINT is set at -0.001 in. H_2O. The LOW ALARM set point cannot be set higher than -0.00072 in. H_2O. Conversely, the HIGH ALARM set point cannot be set lower than -0.00128 in. H_2O.

2. The minimum flow alarm: MIN SUP 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 affects all pressure, remote and flow alarms.

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

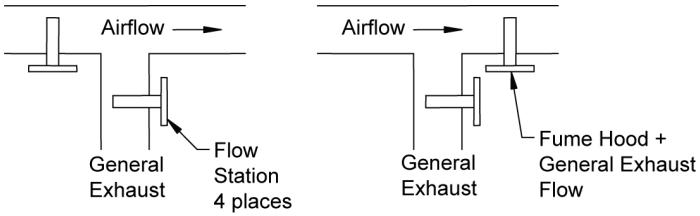
8. The display can only show one alarm message. Therefore, the controller has an alarm priority system, with the highest priority alarm being displayed. If multiple alarms exist, the lower priority alarms will not display until after the highest priority alarm has been eliminated. The alarm priority 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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
DISPLAY UNITS	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, in. H_2O Pa	**"H_2O**
GENERAL EXHAUST DUCT CONFIGURATION	EXH CONFIG	The EXH CONFIG menu item determines the exhaust configuration. If the general exhaust duct is separate from the total exhaust select UNGANGED (left side of Figure 6). If the general exhaust duct is part of the total exhaust select GANGED (right side of Figure 6). The correct configuration is required for the control algorithm to function correctly.  **Figure 6: Exhaust Configuration** **NOTE**: In either the GANGED or UNGANGED configuration a general exhaust flow measurement is required.	UNGANGED or GANGED	**UNGANGED**
	ACCESS CODES	The ACCESS CODES item selects whether an access code (pass code) is required to enter any menu. The ACCESS CODES item prevents unauthorized access to a menu. If ACCESS CODES is ON, a code is required before the menu can be entered. Conversely, if ACCESS CODES 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.		

CALIBRATION MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
SENSOR SPAN	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**.	
ALTITUDE	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 to 10,000 feet above sea level	**0**
TEMPERATURE CALIBRATION	TEMP CAL	The TEMP CAL item is used to match or calibrate the SUREFLOW™ controller temperature sensor to the actual space temperature as measured by a portable reference meter.	NONE	
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
SPEED	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	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 MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
CONTROL SIGNAL	CONTROL SIG	The CONTROL SIG item switches both the supply and exhaust control outputs from 0 to 10 VDC to 4 to 20 mA. TSI actuators require a 0 to 10 VDC control signal.	4 to 20 mA or 0 to 10 VDC	**0 to 10 VDC**
SUPPLY CONTROL DIRECTION	SUP CONT DIR	The SUP CONT SIG item determines the supply control signal's output direction. As an example; if the control system closes the supply damper instead of opening the damper, this option will reverse the control signal to now open the damper.	Direct or Reverse	**Direct**
EXHAUST CONTROL DIRECTION	EXH CONT DIR	The EXH CONT SIG item determines the exhaust 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.	Direct or Reverse	**Direct**
TEMPERATURE CONTROL DIRECTION	TEMP DIR	The TEMP CONT SIG item determines the temperature control signal's output direction. As an example; if the control system closes the reheat valve instead of opening the valve, this option will reverse the control signal to now open the valve.	Direct or Reverse	**Direct**
REHEAT CONTROL SIGNAL	REHEAT SIG	The REHEAT SIG item switches the temperature control output from 0 to 10 VDC to 4 to 20 mA.	4 to 20 mA or 0 to 10 VDC	**0 to 10 VDC**

CONTROL MENU *(continued)*

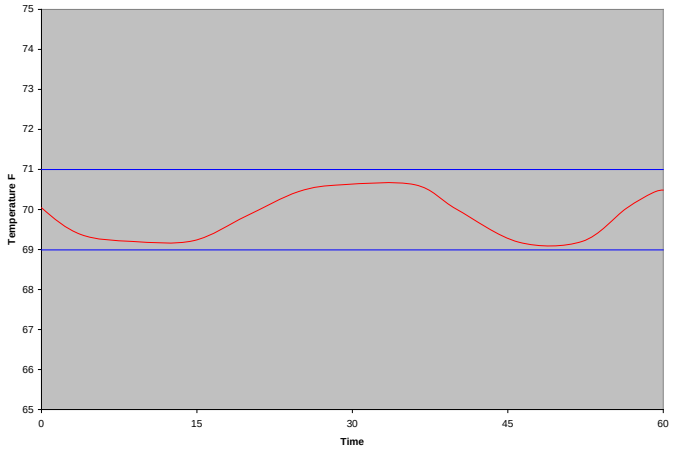
MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
Kc VALUE Ti VALUE	Kc VALUE Ti VALUE	**WARNING:** The Kc VALUE and Ti VALUE allow you to manually change the primary PID control loop variables. **DO NOT CHANGE THESE VALUES UNLESS YOU HAVE A THOROUGH UNDERSTANDING OF PID CONTROL LOOPS. 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 to 1000 Ti = 0 to 1000 The range of values is very large. Poor control will occur if values are more than twice or less than ½ the default value	**Kc = 80** **Ti = 200**

CONTROL MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
Kc OFFSET	Kc OFFSET	**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 ½ the default value	**Kc = 200**

CONTROL MENU *(continued)*

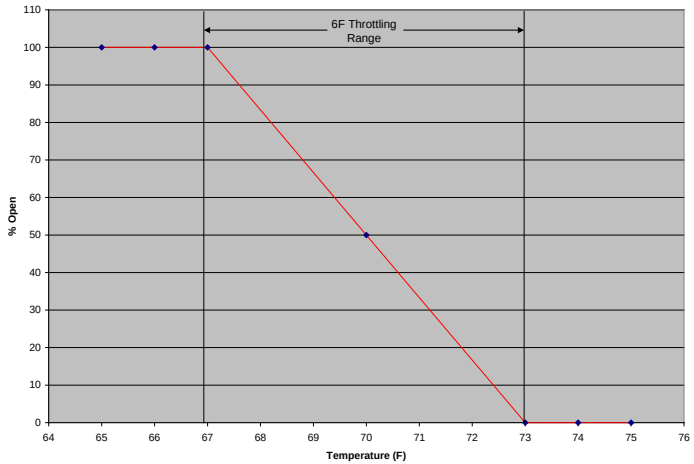
MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
TEMPERATURE SENSITIVITY	TEMP DB	The TEMP DB item determines the controller's temperature control deadband, which is defined as the temperature range above *and* below the temperature set point (TEMP SETP), where the controller will not take corrective action.	±0.0°F to ±1.0°F	**±0.3°F**



If TEMP DB is set to ±1.0°F, and the TEMP SETP is set to 70.0 °F, the controller will not take corrective action unless the space temperature is below 69.0°F or above 71.0°F.

CONTROL MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
TEMPERATURE THROTTLING RANGE	TEMP TR	The TEMP TR item determines the controller's temperature control throttling range, which is defined as the temperature range for the controller to fully open and fully close the reheat valve.	2.0°F to 20.0°F	**6.0°F**



If TEMP TR is set to 3.0°F, and the TEMP SETP is set to 70.0°F, the reheat valve will be fully open when the space temperature is 67°F. Similarly, the reheat valve will be fully closed when the space temperature is 73.0°F.

CONTROL MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
TEMPERATURE INTEGRAL TIME	TEMP TI	**WARNING:** The TEMP TI item provides you with the ability to manually change the temperature control loop algorithm. **DO NOT CHANGE THIS VALUE UNLESS YOU HAVE A THOROUGH UNDERSTANDING OF 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 nonexistent control. The TEMP TI item is used to read and change the temperature control integral time. When this item is entered, a value for the throttling range is indicated on the display in seconds. The integral time is set based on the lag time of the temperature control process. The purpose of integral control is to eliminate the offset associated with proportional control. A longer integral time will result in a more stable but slower control system. A shorter integral time will provide quicker reaction to changes in temperature but may result in an unstable system.	0 to 10,000 seconds	2400 seconds
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
TOTAL SUPPLY AIR FLOW	TOT SUP FLOW	The TOT SUP FLOW menu item displays the current total measured supply flow into the laboratory. This item calculates total supply by summing SP1 FLOW IN though SP4 FLOW IN. This is a system information only menu item; no programming is possible.	NONE: Read only value	**NONE**
TOTAL EXHAUST AIR FLOW	TOT EXH 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, EX2 FLOW IN, and HD1 FLOW IN through HD7 FLOW IN. This is a system information only menu item; no programming is possible.	NONE: Read only value	**NONE**
CONTROL OFFSET VALUE	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 SET POINT items to calculate required offset. This is a system information only menu item: no programming is possible.	NONE: Read only value	**NONE**
SUPPLY FLOW SET POINT (CALCULATED)	SUP SET POINT	The SUP SET POINT menu item displays the supply flow set point, which is calculated by the AOC control algorithm. The calculated SUP SET POINT 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**

SYSTEM FLOW MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
GENERAL EXHAUST FLOW SET POINT (CALCULATED)	EXH SET POINT	The EXH SET POINT menu item displays the general exhaust flow set point, which is calculated by the AOC control algorithm. The EXH SET POINT is a diagnostic item used to compare the actual EX1 FLOW IN and EX2 FLOW IN 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**
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
INDIVIDUAL SUPPLY AIR FLOW	SP1 FLOW IN SP2 FLOW IN SP3 FLOW IN SP4 FLOW IN	The SP# 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%, calibrate the flow station. In addition, summing SP1 FLOW IN through SP4 FLOW IN should equal TOT SUP FLOW. 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.	NONE: Read only value	**NONE**
INDIVIDUAL GENERAL EXHAUST FLOW	EX1 FLOW IN EX2 FLOW IN	The EX# 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%, calibrate the flow station. 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.	NONE: Read only value	**NONE**

FLOW CHECK MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
INDIVIDUAL FUME HOOD EXHAUST FLOW	HD1 FLOW IN *through* HD7 FLOW IN	The HD# 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%, calibrate the flow station. 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.	NONE: Read only value	**NONE**
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION
SUPPLY AIR CONTROL OUTPUT	CONTROL SUP	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 value between 0% OPEN and 100% OPEN 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% OPEN or 100% OPEN is full open on damper. Conversely 100% OPEN or 0% OPEN will be full closed. A value of 50% OPEN 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.
EXHAUST AIR CONTROL OUTPUT	CONTROL EXH	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% OPEN and 100% OPEN 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 exhaust air damper or VAV box should change (modulate) as the number changes. Depending on the actuator's jumper location 0% OPEN or 100% OPEN is full open on damper. Conversely 100% OPEN or 0% OPEN will be full closed. A value of 50% OPEN 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.
REHEAT VALVE CONTROL OUTPUT	CONTROL TEMP	The CONTROL TEMP item manually changes the control output signal to the reheat valve. When this item is entered, a number between 0% OPEN and 100% OPEN 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 reheat valve position should change (modulate) as the number changes. Depending on the actuator, 0% OPEN or 100% OPEN is full open on valve. Conversely 100% OPEN or 0% OPEN will be full closed. A value of 50% OPEN should position the damper approximately 1/2 open. **WARNING:** The CONTROL TEMP function overrides the AOC control signal. Adequate room temperature will **not** be maintained while in this item.

DIAGNOSTICS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION
SENSOR COMMUNICATION	SENSOR STAT	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.
TEMPERATURE INPUT	TEMP INPUT	The TEMP INPUT item reads the input from the temperature 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 changes, indicating the temperature sensor is working correctly. The output range that can be read is resistance.
UNOCCUPY SET INPUT	OCCUPANT SWT	The OCCUPANT SWT item reads the input of the OCCUPANT SWT contact pins 11 and 12 (DIM). When this item is entered, the display will indicate either open or closed. If the display indicates open, the AOC uses the VENT MIN SET or COOLING FLOW as the minimum supply flow set point. If the display indicates closed, the AOC uses UNOCCUPY SET as the minimum supply flow set point. The AOC will use the SET POINT pressure set point in either case.

DIAGNOSTICS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION
REM SET POINT INPUT	REMOTE SWT	The REMOTE SWT item reads the input of the REMOTE SWT contact pins 3 and 4. When this item is entered, the display will indicate either open or closed. If the display indicates open, the AOC uses the SET POINT pressure set point. If the display indicates closed, the AOC uses the REM SET POINT pressure set point.
RELAY OUTPUT	LOW ALM REL HIGH ALM REL LOW SUP REL HIGH SUP REL	The relay menu items are used to change the state of a particular relay contact: LOW, HIGH, LOW SUP, HIGH SUP. 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.
PRESSURE ANALOG OUTPUT	PRESS AOUT	The PRESS AOUT item is used to verify the analog outputs are working. When this item is entered, the number shown on the display indicates the last analog output value. The value displayed ranges from 0 to 255. The value 255 corresponds to 0 volts (4 mA) output and 0 corresponds to 10 volts (20 mA) output. Pressing the ▲/▼ keys change the count on the display. Pressing the ▲ key should increase the analog output. Pressing the ▼ key will decrease the analog output. The PRESS AOUT function used in conjunction with a volt meter will verify the individual analog output is operating correctly.
SUPPLY ANALOG OUTPUT	SUPPLY AOUT	The SUPPLY AOUT item is used to verify the analog outputs are working. When this item is entered, the number shown on the display indicates the last analog output value. The value displayed ranges from 0 to 255. The value 255 corresponds to 0 volts (4 mA) output and 0 corresponds to 10 volts (20 mA) output. Pressing the ▲/▼ keys change the count on the display. Pressing the ▲ key should increase the analog output. Pressing the ▼ key will decrease the analog output. The SUPPLY AOUT function used in conjunction with a volt meter will verify the individual analog output is operating correctly.

DIAGNOSTICS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION
EXHAUST ANALOG OUTPUT	EXHAUST AOUT	The EXHAUST AOUT item is used to verify the analog outputs are working. When this item is entered, the number shown on the display indicates the last analog output value. The value displayed ranges from 0 to 255. The value 255 corresponds to 0 volts (4 mA) output and 0 corresponds to 10 volts (20 mA) output. Pressing the ▲/▼ keys change the count on the display. Pressing the ▲ key should increase the analog output. Pressing the ▼ key will decrease the analog output. The EXHAUST AOUT function used in conjunction with a volt meter will verify the individual analog output is operating correctly.
RESET THE CONTROLLER TO FACTORY DEFAULT SETTINGS	RESET TO DEF	When this menu item is entered, the 8682 will prompt the user to verify that they want to do this by indicating NO. Use the ▲ keys change the display to YES, then press the **SELECT** key to reset the controller to its factory defaults. Pressing the **MENU** key before the **SELECT** key will exit out of the menu item. **WARNING:** If YES is selected, the Model 8682 will reset all menu items to their factory default settings: The controller will have to be reprogrammed and recalibrated after this operation is completed.
	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.

INPUT CHECK MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
INDIVIDUAL SUPPLY FLOW SIGNAL CHECK	SUP 1 *through* SUP 4	When one of these items is entered, a voltage, representing the corresponding flow input, will be displayed. If the voltage displayed is negative, double check the polarity of the flow input wiring.	NONE: Read only value	**NONE**
INDIVIDUAL EXHAUST FLOW SIGNAL CHECK	EXH 1 *and* EXH 2	When one of these items is entered, a voltage, representing the corresponding flow input, will be displayed. If the voltage displayed is negative, double check the polarity of the flow input wiring.	NONE: Read only value	**NONE**
INDIVIDUAL FUME HOOD EXAUST FLOW SIGNAL CHECK	HOOD 1 *through* HOOD 7	When one of these items is entered, a voltage, representing the corresponding flow input, will be displayed. If the voltage displayed is negative, double check the polarity of the flow input wiring.	NONE: Read only value	**NONE**
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
NETWORK PROTOCOL**	NET PROTOCOL	The NET PROTOCOL item selects the communications protocol used to interface with the building management system. If LONWORK's interface is being used, this menu item is deleted; no selection is required.	MODBUS, N2,	**MODBUS**
NETWORK ADDRESS**	NET 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 to 247	**1**
LON**	LON	When the SERVICE PIN option is selected, the Model 8682 sends a broadcast message containing its Neuron ID and program ID. This is required to install the Model 8682 on the LonWorks network, or to reinstall the Model 8682 after using the GO UNCONFIGURED command. Selecting the GO UNCONFIGURED option resets the Model 8682's authentication key. This is required in the event a foreign network tool inadvertently acquires a Model 8682 and installs it with network management authentication. The Model 8682's owner will then be unable to reclaim the Model 8682 over the network.	SERVICE PIN or GO UNCONFIGURED	

**The LON Menu Item will replace the Network Protocol and Network Address Menu Item on SUREFLOW™ controllers provided with the LonWorks board.

INTERFACE MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MAC ADDRESS**	MAC ADDRESS	The MAC ADDRESS assigns the device an address on the MS/TP BACnet network. This address must be unique for each device on the BACnet network.	1 to 127	**1**
ANALOG PRESSURE SIGNAL OUTPUT RANGE	OUTPUT RANGE	The OUTPUT RANGE item selects the resolution range of the linear analog pressure signal output menu item PRESS AOUT. There are 2 choices: LOW -0.01000 to +0.01000 in. H_20, or -500 to 500 FPM, or -2.5 to 2.5 m/s, or -25 to 25 Pa HIGH -0.10000 to +0.10000 in. H_20, or -1000 to 1000 FPM, or -5.0 to 5.0 m/s, or -50 to 50 Pa 0 volt / 4 mA represents maximum negative pressure differential. 5 volts / 12 mA represents a 0 room pressure differential. 10 volts / 20 mA represents maximum positive pressure differential. If the actual pressure exceeds the range, the output remains at maximum or minimum depending on direction of flow. The AOC updates the analog output every 0.1 second. **NOTE:** The units displayed for OUTPUT RANGE values are determined by the UNITS menu item in the **CONFIGURE MENU**.	LOW or HIGH	**HIGH**
OUTPUT SIGNAL	OUTPUT SIG	The OUTPUT SIG item selects the type of analog output signal, either 0-10 VDC or 4-20 mA. This item changes 3 analog outputs; pressure differential (DIM terminals 9, 10), total supply flow (TOT SUP FLOW), and total exhaust flow (TOT EXH FLOW) AOC terminals 50, 51, 52, and 53.	0 to 10 VDC or 4 to 20 mA	**0 to 10 VDC**

**The MAC ADDRESS Menu Item replaces the Network Address Menu Item on SUREFLOW™ controllers provided with the BACnet MSTP board.

INTERFACE MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
CONFIGURE MAXIMUM FLOW OUTPUT	MAX FLOW OUT	The MAX FLOW OUT item scales the flow analog outputs, pins 50, 51, 52, 53. The value selected equates to 10 volts or 20 mA. Zero volts or 4 mA equates to no flow. This item affects two analog outputs: TOT SUP FLOW and TOT EXH FLOW.	1,000, 5,000, 10,000, 20,000, 30,000 CFM 500, 2,500, 5,000, 10,000, 15,000 l/s	**10,000**
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
SUPPLY AIR DUCT SIZES	SP1 DCT AREA *through* SP4 DCT AREA	The SP# 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 to 10 square feet (0 to 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit.	**0**
SUPPLY FLOW STATION ZERO	SP1 FLO ZERO *through* SP4 FLO ZERO	The SP# 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 SP# FLO ZERO established on initial set up. Linear flow stations with a 1-5 VDC output also need to have a SP# FLO ZERO established. Linear flow sup stations with a 0-5 VDC output do not need a SP# FLO ZERO.	NONE	
FLOW STATION TYPE	FLO STA 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**

SUPPLY FLOW MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MAXIMUM FLOW STATION VELOCITY	TOP 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 to 5,000 FT/MIN (0 to 25.4 m/s)	**0**
SUPPLY FLOW LOW CALIBRATION SETTING	SP LOW SETP	The SP LOW SETP menu item sets the supply damper position for supply low flow calibration.	0% Open to 100% Open	**0% OPEN**
SUPPLY FLOW HIGH CALIBRATION SETTING	SP HIGH SETP	The SP HIGH SETP menu item sets the supply damper position for the supply high flow calibration.	0% Open to 100% Open	**100% OPEN**
SUPPLY FLOW LOW CALIBRATION	SP1 LOW CAL *through* SP4 LOW CAL	The SP# LOW CAL menu items display the currently measured supply flow rate and the calibrated value for that supply flow. The supply dampers will move to the SP LOW SETP damper position for the low calibration. The calibrated supply flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.		
SUPPLY FLOW HIGH CALIBRATION	SP1 HIGH CAL *through* SP4 HIGH CAL	The SP# HIGH CAL menu items display the currently measured supply flow rate and the calibrated value for that supply flow. The supply dampers will move to the SP HIGH SETP damper position for the low calibration. The calibrated supply flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.		

SUPPLY FLOW MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
RESET CALIBRATION	RESET CAL	The RESET CAL menu item restores the default calibration for the 4 supply flows. When this menu item is entered, the 8682 will prompt the user to verify that they want to do this by indicating NO. Use the ▲/▼ keys change the display to YES, then press the **SELECT** key to reset the calibrations. Pressing the **MENU** key before the **SELECT** key will exit out of the menu item.		
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
GENERAL EXHAUST DUCT SIZES	EX1 DCT AREA EX2 DCT AREA	The EX# 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 to 10 square feet (0 to 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit.	**0**
EXHAUST FLOW STATION ZERO	EX1 FLO ZERO EX2 FLO ZERO	The EX# 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 EX# FLO ZERO established on initial set up. Linear flow stations with a 1-5 VDC output also need to have an EX# FLO ZERO established. Linear flow stations with a 0-5 VDC output do not need a EX# FLO ZERO.	NONE	
FLOW STATION TYPE	FLO STA 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**

EXHAUST FLOW MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MAXIMUM FLOW STATION VELOCITY	TOP 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 to 5,000 FT/MIN (0 to 25.4 m/s)	**0**
EXHAUST FLOW LOW CALIBRATION SETTING	EX LOW SETP	The EX LOW SETP menu item sets the general exhaust damper position for general exhaust low flow calibration.	0% Open to 100% Open	**0% OPEN**
EXHAUST FLOW HIGH CALIBRATION SETTING	EX HIGH SETP	The EX HIGH SETP menu item sets the general exhaust damper position for the general exhaust high flow calibration.	0% Open to 100% Open	**100% OPEN**
EXHAUST FLOW LOW CALIBRATION	EX1 LOW CAL EX2 LOW CAL	The EX LOW CAL menu items display the currently measured general exhaust flow rate and the calibrated value for that general exhaust flow. The calibrated general exhaust can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.		
EXHAUST FLOW HIGH CALIBRATION	EX1 HIGH CAL EX2 HIGH CAL	The EX HIGH CAL menu items display the currently measured general exhaust flow rate and the calibrated value for that general exhaust flow. The calibrated general exhaust flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.		

EXHAUST FLOW MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
RESET CALIBRATION	RESET CAL	The RESET CAL menu item restores the default calibration for the 2 exhaust flows. When this menu item is entered, the 8682 will prompt the user to verify that they want to do this by indicating NO. Use the ▲/▼ keys change the display to YES then press the **SELECT** key to reset the calibrations. Pressing the **MENU** key before the **SELECT** key will exit out of the menu item.		
	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

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
FUME HOOD EXHAUST DUCT SIZE	HD1 DCT AREA *through* HD7 DCT AREA	The HD# 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 to 10 square feet (0 to 0.9500 square meters) The DIM does not compute duct area. The area must be first calculated and then entered into the unit.	**0**
FUME HOOD FLOW STATION ZERO	HD1 FLO ZERO *through* HD7 FLO ZERO	The HD# 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 HD# FLO ZERO established on initial set up. Linear flow stations with a 1-5 VDC output also need to have a HD# FLO ZERO established. Linear flow stations with a 0-5 VDC output do not need a HD# FLO ZERO.	NONE	
FLOW STATION TYPE	FLO STA 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**

HOOD FLOW MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MAXIMUM FLOW STATION VELOCITY	TOP 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 to 5,000 ft/min (0 to 25.4 m/s)	**0**
	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 CAL MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
HOOD # LOW CALIBRATION POINTS	HD1 LOW CAL *through* HD7 LOW CAL	The HD# LOW CAL menu items display the currently measured fume hood flow rate and the calibrated value for that fume hood flow. The calibrated hood flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.		
HOOD # HIGH CALIBRATION POINTS	HD1 HIGH CAL *through* HD7 HIGH CAL	The HD# HIGH CAL menu items display the currently measured fume hood flow rate and the calibrated value for that fume hood flow. The calibrated hood flow can be adjusted using the ▲/▼ keys to make it match a reference measurement. Pressing the **SELECT** key will save the new calibration data.		
MINIMUM HOOD # FLOWS	MIN HD1 FLOW *through* MIN HD7 FLOW	The MIN HD# FLOW menu items adjust the minimum flow value for each fume hood input. Use this menu item if the fume hood flow measurements are too low when the sash is closed.	0 to 10,000 CFM	**0**
RESET CALIBRATION	RESET CAL	The RESET CAL menu item restores the default calibration adjustments for the 7 hood flows. When this menu item is entered, the 8682 will prompt the user to verify that they want to do this by indicating NO. Use the ▲/▼ keys change the display to YES, then press the **SELECT** key to reset the calibrations. Pressing the **MENU** key before the **SELECT** key will exit out of the menu item.		
	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 temperature sensor to maintain laboratory temperature. The overall AOC control sequence seems quite complicated initially, but the Theory of Operation section breaks the sequence 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(s) measured with a flow station(s) (if general exhaust is installed).
- Fume hood exhaust flow measured with a flow station (total hood(s) flow is required).
- Supply air flow(s) measured with a flow station(s).
- 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 total 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 three 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 three 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

The Model 8682 receives a temperature input from a temperature sensor (1000 Ω Platinum RTD). The Model 8682 controller maintains temperature control by:

(1) Controlling supply and general exhaust for ventilation and cooling
(2) Controlling the reheat coil for heating

The Model 8682 has three supply flow minimum set points. The ventilation set point (VENT MIN SET) is the minimum flow volume required to meet ventilation needs of the laboratory (ACPH). The temperature supply set point (COOLING FLOW) is the theoretical minimum flow required to meet cooling flow needs of the laboratory. The unoccupied set point (UNOCC SETP) is the minimum flow required when the lab is not occupied. All of these set points are configurable. If the Model 8682 is in the Unoccupied Mode, the controller will control the supply air flow to the UNOCCUPY SET ventilation rate, the supply flow will not be modulated for space cooling; space temperature control will be maintained by modulating the reheat coil.

The Model 8682 continuously compares the temperature set point to the actual space temperature. If set point is being maintained, no changes are made. If set point is not being maintained, and the space temperature is rising, the controller will first modulate the reheat valve closed. Once the reheat valve is fully closed the controller will begin a 3-minute time period. If, after the 3-minute time period the reheat valve is still fully closed, the Model 8682 will then gradually begin increasing the supply volume by 1 CFM/second up to the COOLING FLOW set point.

The controller, when controlling supply flow for cooling, will not increase the supply flow above the COOLING FLOW ventilation rate. If the space temperature decreases below the set point, the controller will first reduce the supply volume. Once the supply volume reaches its minimum (VENT MIN SET), the controller will then start a 3-minute time period. If, after 3 minutes the supply flow is still at the VENT MIN SET flow rate, the controller will begin modulating the reheat coil open to meet the heating demand.

If the general exhaust is in the closed position and fume hood loads require additional replacement air, the Model 8682 will override ventilation or temperature set points to modulate supply for pressurization control. Temperature will then be controlled by the reheat valve in this sequence.

The control output items in the DIAGNOSTICS menu will show a percentage value. If control direction for a given output is set to DIRECT, the diagnostic value will be percent OPEN. If control direction for a given output is set to REVERSE, the diagnostic value will be percent CLOSED.

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 & HOOD CAL MENU	SET POINT MENU
SP1 DCT AREA *through* SP4 DCT AREA. SP1 FLO ZERO *through* SP4 FLO ZERO FLO STA TYPE TOP VELOCITY SP LOW SETP SP HIGH SETP SP1 LOW CAL SP1 HIGH CAL *through* SP4 LOW CAL SP4 HIGH CAL	EX1 DCT AREA EX2 DCT AREA. EX1 FLO ZERO EX2 FLO ZERO FLO STA TYPE TOP VELOCITY EX LOW SETP EX HIGH SETP EX1 LOW CAL EX1 HIGH CAL EX2 LOW CAL EX12HIGH CAL	HD1 DCT AREA *through* HD7 DCT AREA. HD1 FLO ZERO *through* HD7 FLO ZERO FLO STA TYPE TOP VELOCITY EX1 LOW CAL EX1 HIGH CAL *through* EX7 LOW CAL EX7 HIGH CAL	MIN OFFSET MAX OFFSET

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, COOLING FLOW, TEMP SETP.
- **Pressure** - The pressure differential value: SET POINT

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.

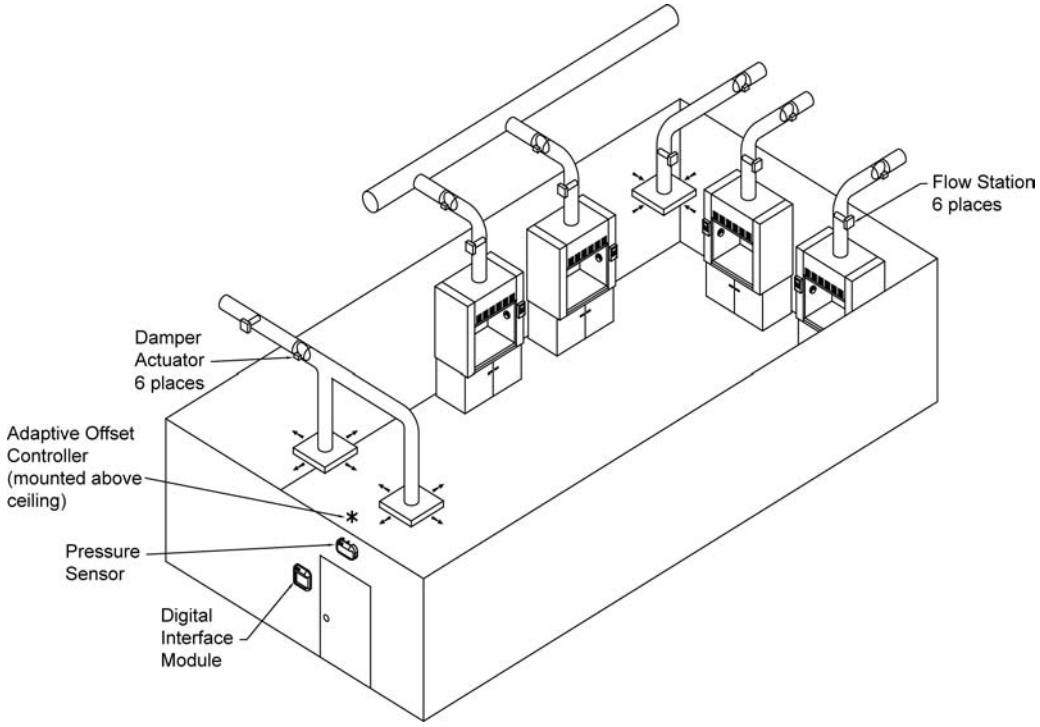


Figure 7: Laboratory Setup Example

Laboratory design:

Laboratory size	=	18’ x 30’ x 10’ (5,400 ft^3).
5 foot fume hood (4)	=	250 CFM min* 1,000 CFM max*
Flow offset	=	300–1000 CFM*
Ventilation set point	=	900 CFM* (ACPH = 10)
Supply Cooling Volume	=	1,200 CFM*
Pressure differential	=	-0.001 “ H_2O*
Temperature set point	=	72°F

* Value supplied by laboratory designer.

Room Pressure Control System:

(1) Model 8682 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, pressure dependent VAV box or valve with actuator assembly mounted in supply air duct(s).

(4) Damper, pressure dependent VAV box or valve with actuator assembly mounted in exhaust air duct.

(5) Flow station mounted in supply air duct. (Required for non-venturi valve applications only.)

(6) Flow station mounted in general exhaust air duct. (Required for non-venturi valve applications only.)

(7) Flow stations mounted in fume hood exhaust duct. (Required for non-venturi valve applications only.)

Temperature Control System:

(1) Temperature Sensor (1000 Ω Platinum RTD) 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 in. round)	Fume hood 1 duct area
HD2 DCT AREA	0.78 ft^2	(12 in. round)	Fume hood 2 duct area
HD3 DCT AREA	0.78 ft^2	(12 in. round)	Fume hood 3 duct area
HD4 DCT AREA	0.78 ft^2	(12 in. round)	Fume hood 4 duct area
EX1 DCT AREA	1.0 ft^2	(12" × 12")	General exhaust duct area
SP1 DCT AREA	3.33 ft^2	(24" × 20")	Supply duct area
MIN OFFSET	300 CFM		Minimum offset.
MAX OFFSET	1,000 CFM		Maximum offset.
EXH CONFIG	UNGANGED (Default value)		

Additional menu items to program for temperature and pressure control

VENT MIN SET	900 CFM	10 air changes per hour
COOLING FLOW	1,200 CFM	Required flow to cool laboratory.
TEMP SETP	72°F	Temperature sensor switches from VENT MIN SET to COOLING FLOW.
SET POINT	–0.001 in. 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 1,000 CFM.
Supply air is 900 CFM (maintain ventilation).
General exhaust 200 CFM (calculated from below).

Fume hoods + General exhaust - Offset = Supply air
1,000 + ? – 300 = 900

Two fume hoods are 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 2,500 CFM (1,000 + 1,000 + 250 + 250).

Fume hoods	+	General exhaust	-	Offset	=	Supply air
2,500	+	0		– 300	=	2,200

The supply air volume changes to 2,200 CFM (2,500 CFM hood exhaust –300 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 in. H_2O (not negative enough). The AOC algorithm slowly changes the offset until pressure control is maintained. In this case the offset changes to 400 CFM, which decreases the supply volume by 100 CFM. The additional offset maintains the pressure differential at –0.001 in. H_2O (set point).

Fume hoods	+	General exhaust	-	Offset	=	Supply air
2,500	+	0		– 400	=	2,100

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

Fume hoods	+	General exhaust	-	Offset	=	Supply air
1,000	+	200		– 300	=	900

An oven is turned on and the laboratory is getting warm. The temperature sensor sends the AOC a signal to switch to temperature minimum ventilation (COOLING FLOW). This increases the supply air to 1,200 CFM. The general exhaust air must also increase (damper opens) to maintain flow balance.

Fume hoods	+	General exhaust	-	Offset	=	Supply air
1,000	+	500		– 300	=	1,200

Three fume hoods are opened so the fume hood flow is now 3,250 CFM. In order to maintain air balance the general exhaust and supply air change to:

Fume hoods	+	General exhaust	-	Offset	=	Supply air
3,250	+	0		– 300	=	2,950

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 takes 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 C 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(s).
- Supply flow station(s).
- Fume hood flow station(s).

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 100% will be displayed. Press the ▲/▼ keys until either 0 or 100% shows on the display. Note the position of the supply air control damper. If display reads 0%, press the ▲ key until 100% is shown on display. If display reads 100%, 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 100% will be displayed. Press the ▲/▼ keys until either 0 or 100% shows on the display. Note the position of the general exhaust control damper. If display reads 0%, press the ▲ key until 100% is shown on display. If display reads 100%, 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 does not 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 – Temperature sensor input

Enter TEMP INPUT menu item in diagnostics menu. A temperature value will be displayed. The exact temperature displayed is not important as long as the temperature changes when space temperature changes.

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, recalibrate 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 calibrate 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 exist. 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 to 5 VDC linear flow stations must be zeroed upon initial system set up. Linear 0 to 10 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 keystroke 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.

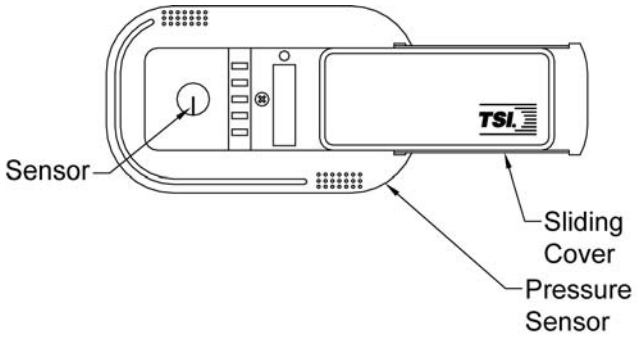


Figure 8: Pressure Sensor Door Slid Open

Sensor span

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 to 10 VDC output.

Pressure based flow station

Disconnect tubing between pressure transducer and flow station.

Enter menu that corresponds to flow station: Supply Flow, Exhaust Flow, or Hood Flow.

Select **SP# FLO ZERO** to take a supply flow station zero.
or
Select **EX# FLO ZERO** to take a general exhaust flow station zero.
or
Select **HD# FLO ZERO** to take a fume hood 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.

NOTE: #; insert number of flow station you are performing a zero on.

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 that corresponds to flow station location: Supply Flow, Exhaust Flow, or Hood Flow.

Select **SP# FLO ZERO** to take a supply flow station zero.
or
Select **EX# FLO ZERO** to take a general exhaust flow station zero.
or
Select **HD# FLO ZERO** to take a fume hood 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.

NOTE: #; insert number of flow station you are performing a zero on.

2-Point Flow Calibration

Supply and General Exhaust Flow Calibration:

Enter menu that corresponds to flow calibration: Supply Flow, Exhaust Flow.

Select **SP LOW SETP** to enter a supply flow low calibration set point.
or
Select **EX LOW SETP** to enter a general exhaust flow low calibration set point.

The DIM will display a value between 0% OPEN and 100% OPEN. Press the ▲ or ▼ keys to adjust the value displayed (and the damper position). Using a voltmeter, read the input voltage from the appropriate pressure transducer. When the voltmeter reading is approximately 20% of the full flow reading (100% OPEN) press the **SELECT** key to save the data.

then

Select **SP HIGH SETP** to enter a supply flow low calibration set point.
or
Select **EX HIGH SETP** to enter a general exhaust flow low calibration set point.

The DIM will display a value between 0% OPEN and 100% OPEN. Press the ▲ or ▼ keys to adjust the value displayed (and the damper position). Using a voltmeter, read the input voltage from the appropriate pressure transducer. When the voltmeter reading is approximately 80% of the full flow reading (100% OPEN) press the **SELECT** key to save the data.

then

Select **SP# LOW CAL** to enter a supply flow low calibration value.
or
Select **EX# LOW CAL** to enter a general exhaust flow low calibration value.

The DIM will display two airflow values. Press the ▲ or ▼ keys to adjust the value displayed on the right to match the actual measured airflow, which is obtained with a duct traverse measurement or with a capture hood measurement.

Press **SELECT** key to save data.

then

Select **SP# HIGH CAL** to enter a supply flow high calibration value.
or
Select **EX# HIGH CAL** to enter a general exhaust flow high calibration value.

The DIM will display two airflow values. Press the ▲ or ▼ keys to adjust the value displayed on the right to match the actual measured airflow, which is obtained with a duct traverse measurement or with a capture hood measurement.

Press **SELECT** key to save data.

Hood Flow Calibration

Enter HOOD CAL menu. Raise the fume hood sash, of a previously calibrated fume hood, from fully closed to an approximate height of 12”. Select the corresponding **HD# LOW CAL** menu item.

The DIM will display two airflow values. Press the ▲ or ▼ keys to adjust the value displayed on the right to match the actual airflow, which is obtained with a duct traverse measurement or by calculating the volumetric flow. Calculated volumetric flow can be determined by multiplying on the current sash open area by the displayed face velocity.

Press **SELECT** key to save data.

then

Raise the fume hood sash above the low flow calibration, or to its sash stop (approximately 18”). Select the corresponding **HD# HIGH CAL** menu item.

The DIM will display two airflow values. Press the ▲ or ▼ keys to adjust the value displayed on the right to match the actual airflow, which is obtained with a duct traverse measurement or by calculating the volumetric flow. Calculated volumetric flow can be determined by multiplying on the current sash open area by the displayed face velocity.

Press **SELECT** key to save data.

NOTE: Insert number of flow calibration you are performing.

A low flow calibration **must** be performed before its associated high flow calibration is performed. For example, in a laboratory that has two separate supply flows, SP1 LOW CAL must be completed before SP1 HIGH CAL. SP2 LOW CAL must be completed before SP2 HIGH CAL.

It is acceptable to complete all low flow calibrations before completing their associated high flow calibrations. To continue with the previous example: SP1 LOW CAL and SP2 LOW CAL could both be completed before completing SP1 HIGH CAL and SP2 HIGH CAL.

Fume hood face velocity calibration must be completed before beginning fume hood flow calibration.

Maintenance and Repair Parts

The Model 8682 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 8682 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.

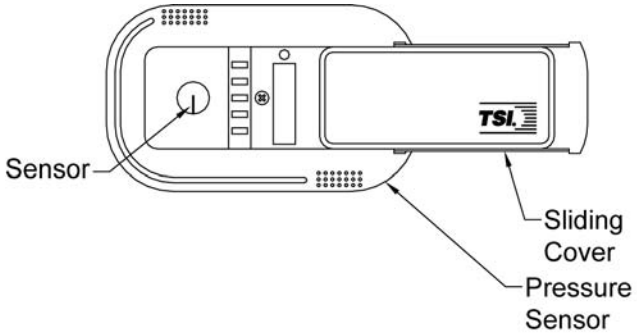


Figure 9: Pressure Sensor Door Slid Open

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 8682.

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) 874-2811 (U.S. and Canada) or (001 651) 490-2811 (other countries) or your nearest TSI Manufacturer's Representative for replacement part pricing and delivery.

Part Number	Description
800235	Adaptive Offset Controller
800259	Adaptive Offset Controller w/LON
868271	Adaptive Offset Controller w/BACnet
800228	Digital Interface Module
868270	Digital Interface Module (8682-BAC only)
800326	Pressure Sensor w/ Cable
800248	Sensor Cable
800416	DIM Comm Cable
800414	Transformer Cable
800420	Transformer
800199	Controller Output Cable
800360	Electric Actuator

Troubleshooting Section

The SUREFLOW™ Room Pressure Controller is designed to be trouble free. However, installation problems or interaction with other HVAC components may cause system problems. The SUREFLOW™ system is easy to troubleshoot if an organized approach to evaluate the system is taken. Troubleshooting is broken down into hardware and software problems. Hardware problems deal with the physical installation of the device. Hardware problems include wiring problems, incorrectly installed equipment, and add-ons or non-TSI equipment. Software problems include control problems, configuration problems, or interaction problems with the HVAC system.

The hardware test described in this section determines that all TSI mechanical components are functioning correctly. The hardware test requires the diagnostics menu items to be accessed. If you are unfamiliar with the SUREFLOW™ menus, see Software Programming for keystroke procedure. Troubleshooting the majority of problems is usually quick if the hardware test is followed.

Software and hardware problems are covered in the troubleshooting chart. Pick the problem that most closely resembles your problem and review the possible symptoms and corrective action. Software or system performance problems can and are affected by the supply air system, exhaust air system, or physical configuration of the room. Separating TSI system problems from the HVAC system can sometimes be difficult. TSI recommends confirming all hardware is operating correctly before troubleshooting software problems.

Hardware Test

Three tests need to be performed in order to determine all hardware is functioning correctly. The test are broken down into:

- Confirming wiring is correct.
- Confirming physical installation is correct.
- Verifying mechanical components.

Confirming 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. The TSI cables are all color coded to ensure proper wiring. A wiring diagram is located in Appendix C of this manual. Wiring associated with non TSI components should be closely checked for correct installation. If non TSI components are installed, consider disconnecting them for testing purposes.

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 is easily done when the wiring is checked.

Verifying mechanical components

Verifying all TSI components are operating correctly requires following a simple procedure. The fastest procedure to confirm all equipment is operating is to first test the DIM, and then go into the diagnostic menu to test each component.

NOTE: These tests require power to the units, so if unit has no power, refer to hardware troubleshooting chart to eliminate power problem.

TEST - 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 all 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 is displayed proceed to test individual components. Enter Diagnostics Menu and check the following:

- Control output - supply.
- Control output - exhaust.
- Control output - temperature.
- Sensor input.
- Sensor status.
- Temperature input.

NOTE: Skip any test that does not have option installed.

These diagnostic menu items are explained in detail in the next section (Diagnostics Menu) of the manual, so their function is not reviewed here. If the SUREFLOW™ system passes each of the tests, the mechanical piece parts are all functioning correctly.

TEST - Control output - supply

Enter CONTROL SUP menu item in diagnostics menu. A number between 0% OPEN and 100% OPEN will be displayed. Press the ▲/▼ keys until either 0% OPEN or 100% OPEN shows on the display. Note the position of the supply air control damper. If display reads 0% OPEN, press the ▲ key until 100% OPEN is shown on display. If display read 100% OPEN press ▼ key until 0% OPEN 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. If not, see the hardware section *Control system is not controlling*.

TEST - Control output - exhaust

Enter CONTROL EXH menu item in diagnostics menu. A number between 0% OPEN and 100% OPEN will be displayed. Press the ▲/▼ keys until either 0% OPEN or 100% OPEN shows on the display. Note the position of the general exhaust control damper. If display reads, 0% OPEN press the ▲ key until 100% OPEN is shown on display. If display read 100% OPEN press ▼ key until 0% OPEN 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. If not, see the hardware section *Control system is not controlling*.

TEST - Control output - temperature

Enter CONTROL TEMP menu item in diagnostics menu. A number between 0% OPEN and 100% OPEN will be displayed. Press the ▲/▼ keys until either 0% OPEN or 100% OPEN shows on the display. Note the position of the reheat valve. If display reads 0% OPEN, press the ▲ key until 100% OPEN is shown on display. If display read 100% OPEN press ▼ key until 0% OPEN is shown on display. Note the position of the reheat valve. The damper should have moved through its full stroke. If not, see hardware

section *Control system is not controlling*. Reheat valves typically move slowly, so you may have to wait to see the full motion.

TEST - 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 unit passes. If voltage doesn't change, proceed to TEST - Sensor status.

TEST - 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.

TEST - Temp input

Enter TEMP INPUT menu item in diagnostics menu. A temperature will be displayed. The exact temperature displayed is not important as long as the temperature changes when the RTD signal changes.

If unit passed all tests, the mechanical components are physically working. If problems still exist, go to troubleshooting chart for additional information, on both hardware and software symptoms.

Troubleshooting Chart

Symptom	Possible Cause	Corrective Action
Display is blank.	Fuse is blown.	Measure voltage at pins 33 and 34 on AOC. The voltage should nominally be 24–30 VAC. If correct voltage is measured, internal DIM fuse is probably blown. Unplug 14-pin connector from DIM for 2 minutes. The internal fuse will automatically reset. Plug unit back in and check display. If display is still blank, check all wiring, etc. If no problems are found, replace DIM. If zero volts are measured, see *No power to DIM*.
	No power to DIM.	Verify circuit breaker is on. Verify transformer primary measures 110 VAC. Verify transformer secondary measures 24–30 VAC. Verify electric AOC panel is receiving 24–30 volts between pins 33 and 34.
	DIM is defective.	If proper voltage is found between pins 1 and 2 of the DIM, all wiring has been checked, fuses have been reset, and screen is still blank, the DIM is probably defective. Replace DIM.
Control system is not controlling.	Incorrect wiring.	Verify correct wiring (see wiring diagram, Appendix C). DIM and AOC must be wired exactly as shown.
	Supply and exhaust control wiring reversed.	Verify supply control wiring (pins 44 and 45) goes to supply damper and exhaust control wiring (pins 46 and 47) goes to general exhaust damper.

Symptom	Possible Cause	Corrective Action
Control system is not controlling. *(continued)*	No control output signal.	Go into DIAGNOSTICS menu, CONTROL SUP or CONTROL EXH item. A number between 0% OPEN and 100% OPEN will be displayed. Pressing the ▲ key increases the number. Pressing the ▼ key decreases the number. To check the supply control output, measure the DC voltage between pins 44 and 45 on the AOC panel. To check the general exhaust control output, measure the DC voltage between pins 46 and 47 on the AOC panel. Change the CONTROL value about 40%. The voltage output should change approximately 4 volts. Change the CONTROL value to 59% OPEN. The voltage should read approximately 5 VDC. If no change occurs, disconnect control wires on pins 44 and 45 (or 46 and 47) and repeat test. If AOC panel still fails to change voltage output, AOC panel is probably defective.
	Bad actuator or E/P (damper doesn't move).	Go into DIAGNOSTICS menu, CONTROL SUP or CONTROL EXH item. A number between 0% OPEN and 100% OPEN will be displayed. Pressing the ▲ key increases the number. Pressing the ▼ key decreases the number. Change the CONTROL value to read 0% OPEN or 100% OPEN. Note damper position. Press an arrow key to change 0% OPEN to 100% OPEN or 100% OPEN to 0% OPEN. Note position of damper. Damper should have rotated 45 or 90 degrees depending on actuator system installed. If damper rotated 45 or 90 degrees, actuator is installed and operating correctly. If damper did not rotate, check that: • Jumper is installed correctly on actuator or E/P (Appendix C). • Damper is not physically stuck (screws, etc.). • Wiring is correct between actuators and controller. Check that voltage varies between 0 and 10 volts on pins 6 and 7 on electric actuator or E/P (see *No control output signal*). • Electric actuator is not over torqued. The electric actuator has current limiting protection. If damper is physically stuck or actuator is over current, the actuator will shut down. To restart either kill power to actuator or move damper in opposite direction it was trying to rotate (CONTROL SUP or CONTROL EXH menu item).
	Defective variable frequency drive (VFD).	Perform test described in *Control system is not controlling*. If CONTROL OUT is functioning, verify wiring to VFD by confirming CONTROL OUT voltage changes at VFD. If voltage changes, a problem with VFD exists. See VFD manual for further troubleshooting.
	Damper rotating opposite direction.	If damper is full open when it should be closed or full closed when it should be open, go into CONTROL menu CONTROL SIG menu item. Change direct to reverse or reverse to direct to change control output direction. The control sig changes the direction of both the supply and exhaust damper. If only 1 damper rotates incorrectly, change the jumper on the E/P or electric actuator.

Symptom	Possible Cause	Corrective Action
Control system is not controlling (continued)	Damper is full open or full closed, won't move.	Actuator jumper is missing or loose. Verify jumper is installed correctly. Control wires are loose. Check wires and verify control output is working (see *no control output signal*). If control output test passes, verify damper is rotating correct direction (see *damper rotating opposite direction*). If damper is rotating correctly and set point cannot be reached, DIM will fully rotate damper to get as close to set point as possible. Air balance needs to be adjusted.
Sensor does not calibrate.	Sensor communications not working.	Check SENSOR STAT item in diagnostics menu. If NORMAL is displayed, sensor is okay, if COMM ERROR is displayed, check wiring, pressure sensor address, and that DIP switch 1 & 2 are ON (Figure 10).
	Incorrect pressure sensor address.	Pressure sensor must have address of 1. Check pressure sensor DIP switches 5 & 6 and verify address 1 is correct (7-12 must be OFF).
Pressure sensor red LED is blinking (Figure 8).	Problem with sensor (slow uniform blink).	Check SENSOR STAT and confirm NORMAL is displayed. If ERROR is displayed, correct error.
	Communication (fast burst of non-uniform blinking).	Unit is communicating with DIM. This is normal.
	Red LED is constantly on.	This is normal when no problems exist or when no communication is occurring.

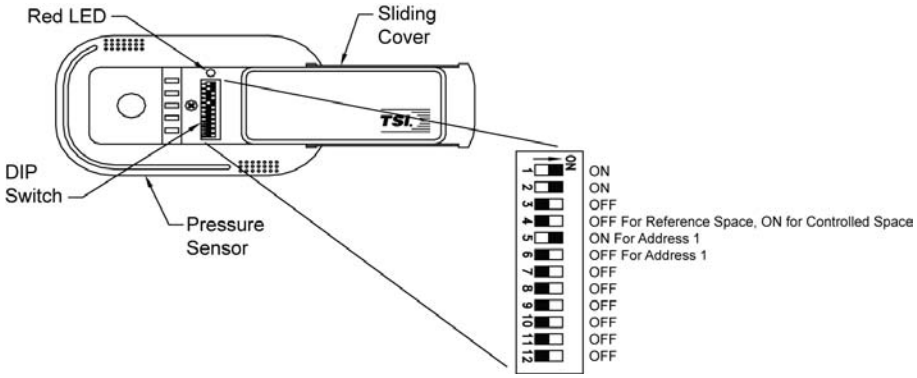


Figure 10: Pressure Sensor DIP Switch

Symptom	Possible Cause	Corrective Action
DIM always displays 0.200 inches H_2O.	Incorrect pressure sensor output.	Pressure sensor must be set for 0-10 volt output, not 4–20 mA. Check pressure sensor DIP switch 3 and make sure it is OFF (see Figure 10).
DIM does not respond to RS-485 communications.	Network protocol is incorrect. Incorrect network address. Incompatible software.	Go into INTERFACE menu, NET PROTOCOL item. The protocol must match host system. Select correct interface. The network address at the building automation system and at the DIM must match. The network address must be unique for each DIM. Data sent to DIM may be in form that the SUREFLOW™ controller cannot recognize.
DIM displays opposite pressure signal.	Sensor direction is incorrect.	Pressure sensor must have DIP switch correctly set for proper sign display. Verify DIP switch 4 is ON when sensor is mounted in the laboratory (controlled space), and OFF when sensor is mounted in corridor (reference space). See Figure 8.
Alarm relays don't work.	Alarms are turned off. Incorrect wiring. Relay may be defective.	Press **TEST** key. The individual alarm set points will display. If all alarm set points are zero, alarm relay is not active, so relay will not be required to change state. Check the wiring from SUREFLOW™ controller relay's output to the device that is connected to the relays. Disconnect the DIM wiring from relay contact pins 13 and 14 for low alarm relay and pins 25 and 26 for high alarm relay. Go into DIAGNOSTICS menu, LOW ALM REL or HIGH ALM REL. Connect an ohmmeter to relay terminals to verify contact open and closes. Press the ▲/▼ keys to manually trip the relay. If relay responds (contact opens and closes), the device connected is incompatible or defective. If relay doesn't respond, relay is defective (may be caused by incompatible device). Replace DIM.
"DATA ERROR" flashing on display.	DIM was hit by electrical disturbance.	All data may be lost or changed. Review all configuration parameters. DATA ERROR is removed by pressing the **RESET** key.
Actuator hunting. Display indicates steady pressure.	Control system is unstable.	Go into CONTROL menu, SPEED item. Turn speed down until hunting is eliminated. If speed is too slow review CONTROL menu items and adjust accordingly to eliminate hunting.

Symptom	Possible Cause	Corrective Action
Displayed pressure wildly fluctuating.	Control system is unstable.	Go into CONTROL menu, SPEED item, turn speed down until fluctuation is eliminated. If speed is too slow, review CONTROL menu items and adjust accordingly until performance is adequate.
	Exhaust system unstable.	Turn DIM to emergency. If pressure stabilizes, this is not the problem. Verify reference pressure is not fluctuating.
	Supply or exhaust air is affecting the sensor.	Check location of supply air diffusers and exhaust grilles. They should be as far from pressure sensor as is realistic, 6 feet preferred, 2-1/2 feet minimum. Supply diffuser terminal throw velocity must be less than 10 ft/min at the sensor. Relocate supply or exhaust as needed.
Temperature not controlling	Incorrect wiring.	Verify correct wiring (see wiring diagram, Appendix C). DIM and AOC panel must be wired exactly as shown.
	No control output signal.	Go into DIAGNOSTICS menu, CONTROL SUP or CONTROL EXH item. A number between 0% OPEN and 100% OPEN will be displayed. Pressing the ▲ key increases the number. Pressing the ▼ key decreases the number. Measure the DC voltage between pins 44 and 45 (46 and 47 for exhaust) on the AOC panel. Change the CONTROL value about 40%. The voltage output should change approximately 4 volts. Change the CONTROL value to 60% OPEN. The voltage should read approximately 5 VDC. If no change occurs, disconnect control wires on pins 25 and 26 and repeat test. If DIM still fails to change voltage output, DIM is probably defective.
	Bad actuator (valve doesn't move).	Go into DIAGNOSTICS menu, CONTROL TEMP. A number between 0% OPEN and 100% OPEN will be displayed. Pressing the ▲ key increases the number. Pressing the ▼ key decreases the number. Change the CONTROL value to read 0% OPEN or 100% OPEN. Note valve position. Press an arrow key to change 0% OPEN to 100% OPEN or 100% OPEN to 0% OPEN. Note position of valve. Valve should have moved full stroke.
	Valve rotating opposite direction.	If Valve is full open when it should be closed or full closed when it should be open, go into DIAGNOSTICS menu, CONTROL TEMP menu item. Change direct to reverse or reverse to direct to change control output direction.

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Appendix A

Specifications

Dim and AOC Module

Display

Range	-0.20000 to +0.20000 inches H_2O
Accuracy	±10% of reading, ±0.00001 inches H_2O
Resolution	5% of reading
Display Update	0.5 sec

Inputs/Outputs

See Wiring Information Appendix C for type.

Switch in	SPST (N.O.) Switch. Closing switch initiates condition.
Unoccupied Switch in	SPST (N.O.) Switch. Closing switch initiates condition.
Remote Switch in	SPST (N.O.) Switch. Closing switch initiates condition.
Flow in	0 to 10 VDC
Temperature In	1000Ω platinum RTD (TC: 385 Ω/100°C)

Outputs

Supply Control	0 to 10 VDC
Exhaust Control	0 to 10 VDC
Reheat Control	0 to 10 VDC or 4 to 20 mA
Low Alarm Range	-0.19500 to +0.19500 inches H_2O
High Alarm Range	-0.19500 to +0.19500 inches H_2O
Alarm Contacts	SPST (N.O.) Max current 2A Max voltage 220 VDC Maximum power 60 W Contacts close in alarm condition
Analog Outputs	0 to 10 VDC
RS-485	Modbus RTU or N2 standard
LON	Optional
BACnet MSTP	Model 8682-BAC only

General

Operating Temperature	32 to 120°F
Internal Scan Rate	50 msec
Input Power (including sensor)	24 VAC, 10 watts max @ 50 or 60 Hz
Dim Dimensions	4.9 in. × 4.9 in. × 1.35 in.
AOC Dimensions	12 in. × 16 in. × 4 in.
Dim Weight	0.7 lb.
AOC Weight	1.8 lbs

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. × 3.34 in. × 1.94 in.
Weight	0.2 lb.

Damper/Actuator

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

Appendix B

Network Communications

Network communications are available on the Model 8682. The Model 8682 can communicate with a building management system through Modbus, N2 or LonWorks protocols. The Model 8682-BAC can communicate with a building management system through BACnet MSTP protocol. Please refer to the appropriate section below for more detailed information.

Modbus Communications

Modbus communications are installed in the Model 8682 adaptive offset room pressure controllers. This document provides the technical information needed to communicate between the host DDC system and the Model 8682 units. This document assumes the programmer is familiar with Modbus protocol. Further technical assistance is available from TSI if your question is related to TSI interfacing to a DDC system. If you need further information regarding Modbus programming in general, please contact:

Modicon Incorporated (a division of Schneider-Electric)
One High Street
North Andover, MA 01845
Phone (800) 468-5342

The Modbus protocol utilizes the RTU format for data transfer and Error Checking. Check the Modicon Modbus Protocol Reference Guide (PI-Mbus-300) for more information on CRC generation and message structures.

The messages are sent at 9600 baud with 1 start bit, 8 data bits, and 2 stop bits. Do not use the parity bit. The system is set up as a master slave network. The TSI units act as slaves and respond to messages when their correct address is polled.

Blocks of data can be written or read from each device. Using a block format will speed up the time for the data transfer. The size of the blocks is limited to 20 bytes. This means the maximum message length that can be transferred is 20 bytes. The typical response time of the device is around 0.05 seconds with a maximum of 0.1 seconds.

Unique to TSI

The list of variable addresses shown below skips some numbers in the sequence due to internal Model 8682 functions. This information is not useful to the DDC system and is therefore deleted. Skipping numbers in the sequence will not cause any communication problems.

All variables are outputted in English units: ft/min, CFM, or inches H_20. The room pressure control set points and alarms are stored in ft/min. The DDC system must convert the value to inches of water if that is desired. The equation is given below.

$$\text{Pressure in Inches } H_2O = 6.2*10^{-8}*(\text{Velocity in ft/min} / .836)^2$$

Modbus Variables

These variables can be read using Modbus command **03 Read Holding Registers**. They can be written to using Modbus command **16 Preset Multiple Regs**. Many of these variables are the same “menu items” that are configured from the SUREFLOW™ keypad. The calibration and control items are not accessible from the DDC system. This is for safety reasons, since each room is individually setup for maximum performance.

8682 Modbus Variable List

Variable Name	Variable Address	Input Provided to Master System	Integer DDC system receives
Software Version	0	Current Software Version	1.00 = 100
Controller Type	1	Controller Model Number	8682
Emergency Mode	2	Emergency Mode Control	0 Leave emergency mode 1 Enter emergency mode
Control Mode	3	Control mode of device.	0 Normal 1 Unoccupied (Setback)
Status Index	4	Status of SUREFLOW™ device	0 Normal 1 Dim Data Error 2 Alarm = Low Pressure 3 Alarm = High Pressure 4 Alarm = Min Supply 5 Alarm = Max Exhaust 6 Data Error 7 Cal Error 8 Emergency Mode
Room Velocity	5	Velocity of room pressure	Displayed in ft/min.
Room Pressure	6	Room Pressure	Displayed in inches H2O. Host DDC system must divide by 100,000 to report pressure correctly
Total Supply Flow	7	Total supply into laboratory	Displayed in CFM.
Total Exhaust Flow	8	Total exhaust out of laboratory	Displayed in CFM.
Offset Set point	9	Current offset set point	Displayed in CFM.
Temperature	10	Current temperature value	Displayed in °F.
Fume Hood 1 Flow	11	Flow measured by flow station connected to hood input #1.	Displayed in CFM.
Fume Hood 2 Flow	12	Flow measured by flow station connected to hood input #2.	Displayed in CFM.
Fume Hood 3 Flow	13	Flow measured by flow station connected to hood input #3.	Displayed in CFM.
Fume Hood 4 Flow	14	Flow measured by flow station connected to hood input #4.	Displayed in CFM.
Fume Hood 5 Flow	15	Flow measured by flow station connected to hood input #5.	Displayed in CFM.
Fume Hood 6 Flow	16	Flow measured by flow station connected to hood input #6.	Displayed in CFM.
Fume Hood 7 Flow	17	Flow measured by flow station connected to hood input #7.	Displayed in CFM.
Exhaust 1 Flow	18	Flow measured by flow station connected to general exhaust input #1.	Displayed in CFM.
Exhaust 2 Flow	19	Flow measured by flow station connected to general exhaust input #2.	Displayed in CFM.
Supply 1 Flow	20	Flow measured by flow station connected to supply flow input #1	Displayed in CFM.
Supply 2 Flow	21	Flow measured by flow station connected to supply flow input #2	Displayed in CFM.
Supply 3 Flow	22	Flow measured by flow station connected to supply flow input #3	Displayed in CFM.
Supply 4 Flow	23	Flow measured by flow station connected to supply flow input #4	Displayed in CFM.

Variable Name	Variable Address	Input Provided to Master System	Integer DDC system receives
Pressure Set point	24	Pressure control set point	Displayed in ft/min.
Min Vent Set point	25	Minimum flow set point for ventilation.	Displayed in CFM.
Cooling Flow	26	Minimum flow set point for temperature control.	Displayed in CFM.
Unoccupied Min Set point	27	Unoccupied (Setback) minimum flow set point.	Displayed in CFM.
Low Alarm	28	Low pressure alarm set point	Displayed in ft/min.
High Alarm	29	High pressure alarm set point	Displayed in ft/min.
Min Supply Alarm	30	Minimum supply flow alarm	Displayed in CFM.
Max Exhaust Alarm	31	Maximum general exhaust alarm	Displayed in CFM.
Min Offset Set point	32	Minimum offset set point	Displayed in CFM.
Max Offset Set point	33	Maximum offset set point	Displayed in CFM.
Max Supply Set point	34	Maximum supply set point	Displayed in CFM.
Min Exhaust Set point	35	Minimum exhaust set point	Displayed in CFM.
Temp Set point	36	Temperature set point	Displayed in °F
Unoccupied Temp Set point	55	Unoccupied (Setback) temperature set point	Displayed in °F
Supply Damper Position	64	Current damper position for supply control	0 to 100%
Exhaust Damper Position	65	Current damper position for exhaust control	0 to 100%
Reheat Valve Position	66	Current valve position for temperature control	0 to 100%
Units	106	Current pressure units displayed	0 Feet per minute 1 meters per second 2 inches of H_2O 3 Pascal

*Note: Items in *italics* are **read only** variables.

EXAMPLE of **16 (10 Hex) Preset Multiple Regs** function format:
This example changes the minimum ventilation set point to 1000 CFM

QUERY	
Field Name	(Hex)
Slave Address	01
Function	10
Starting Address Hi	00
Starting Address Lo	19
No. Of Registers Hi	00
No. Of Registers Lo	01
Data Value (High)	03
Data Value (Low)	E8
Error Check (CRC)	--

RESPONSE	
Field Name	(Hex)
Slave Address	01
Function	10
Starting Address Hi	00
Starting Address Lo	19
No. of Registers Hi	00
No. of Registers Lo	01
Error Check (CRC)	--

Example of **03 Read Holding Registers** function format:
This example reads the total supply and total exhaust.

QUERY	
Field Name	(Hex)
Slave Address	01
Function	03
Starting Address Hi	00
Starting Address Lo	07
No. Of Registers Hi	00
No. Of Registers Lo	02
Error Check (CRC)	--

RESPONSE	
Field Name	(Hex)
Slave Address	01
Function	03
Byte Count	04
Data Hi	03
Data Lo	8E (1000 CFM)
Data Hi	04
Data Lo	B0 (1200 CFM)
Error Check (CRC)	

N2 Communications
Description of Variables

NPT - Network Point Type

Variables are defined as analog inputs, binary inputs, and analog outputs. Analog inputs are current control parameters and items that the controller is measuring. Binary inputs represent controller states. Analog outputs are the programmable set points for the isolation room pressure controller and monitor. These set points can be changed through the keypad or by overriding the current set point.

NPA - Network Point Address

Address of the desired point.

Change of Status (COS) - Room Pressure Analog Input

The 8682 has the ability to change control set points locally. The alarm set points need to be based on the controller's control set point (AO #1). For example the set point could go from -0.002 in. H_2O to +0.001 in. H_2O. If the COS alarm set points are not changed to accommodate, you could get low alarm or low warning messages when the unit is working correctly. If these alarm points are set outside of the negative and positive set point values, incorrect alarm messages can be prevented.

Override Analog Input Command

Analog Input values can be set using the override command. These values will be reset to the correct items when the Override is released. There is not a time-out on the override command.

Override Binary Input Command

Overriding a 1 to Emergency binary inputs enables that mode. To release the controller from emergency state, override a 0 to the Emergency input or press either the emergency or reset key. Releasing the override will return the controller to the Normal state.

The alarm and data error variables can be overridden, but this will not affect the controller. Overriding the low alarm variable will result in a change of status, but will not put the controller into low alarm mode. The local alarm modes can only be controlled locally. Only override these variables for diagnostic purposes and release them for normal operation.

Binary Input Data Error

Data Error binary inputs are used to indicate if something has gone wrong with the controller. Data Error indicates when some of the data stored on the device has been corrupted. The calibration and set point values should be checked on the controller.

Override Analog Output Command

The analog output variables can be overridden to change their values. The overridden value will be checked for validity. If invalid, the override command will be ignored and the value will not change. The override flag will not be set when the value is ignored. The override command will be cleared when the variable is reset in the menus. The variable will not reset with the release command.

Supported Commands

Command	Response
Request Device ID	Returns 0x10
Synchronize Time Command	Acknowledged. There Is No Internal Clock To Synchronize.
Poll Without/With Ack Message	Any Change Of Status Is Returned
Read Analog Input Command	Variable Value
Read Binary Input Command	Variable Value
Read Analog Output Command	Variable Value
Write Analog Input	Acknowledge
Write Binary Input	Acknowledge
Write Analog Output	Acknowledge
Override Analog Input Command	Acknowledge
Override Binary Input Command	Acknowledge
Override Analog Output Command	Acknowledge
Override Release Request	Acknowledge
Identify Device Type Command	Returns 0x10h

Note: Poll Without/With Ack Message will need to be sent twice in order to receive all of the possible change of status variables.

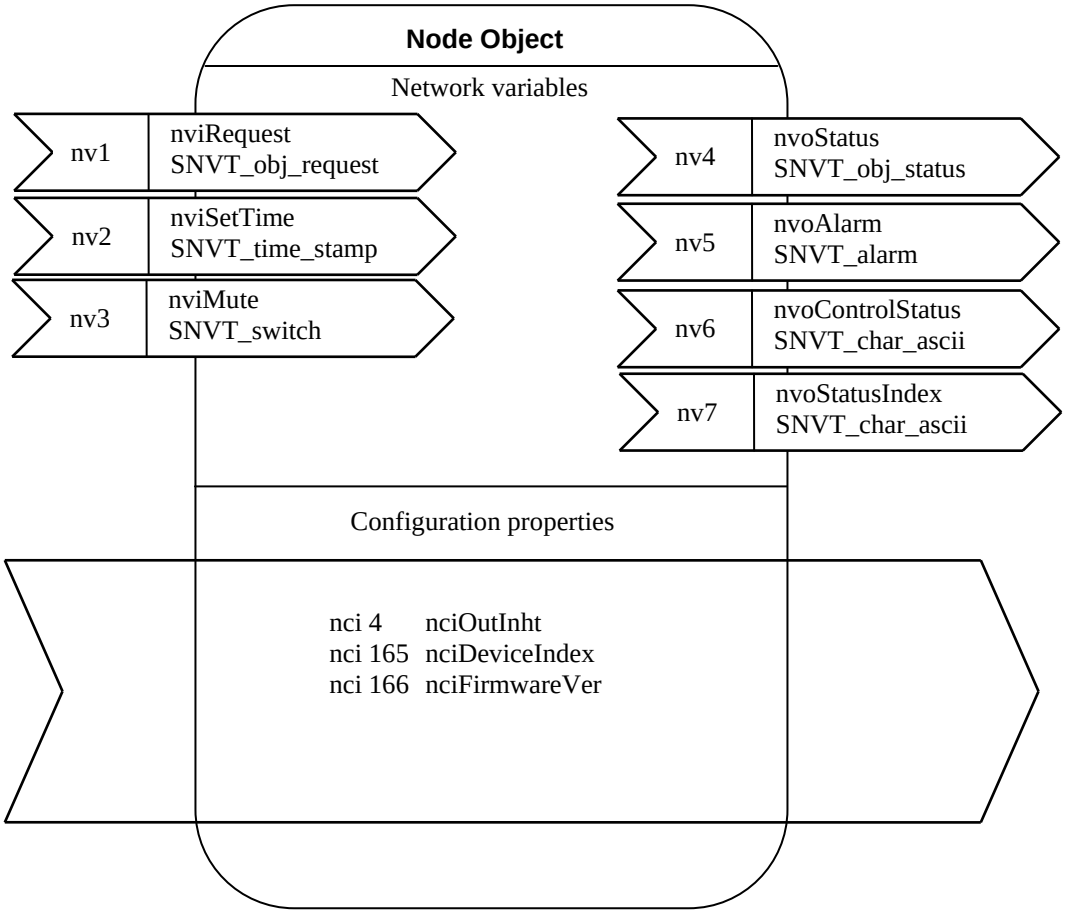
Variable Map

NPT	NPA	UNITS[i]	DESCRIPTION
AI	1	ft/min, m/s, in. H_2O, Pa	Room Pressure Value
AI	2	CFM, l/s	Current Offset
AI	3	°F, °C	Current Temperature
AI	4	CFM, l/s	Minimum Supply Set point
AI	5	CFM, l/s	Total Hood Exhaust
AI	6	CFM, l/s	Total Auxiliary Exhaust
AI	7	CFM, l/s	Total Supply
AI	8	CFM, l/s	Total Exhaust
AI	9	CFM, l/s	Hood 1 Flow
AI	10	CFM, l/s	Hood 2 Flow
AI	11	CFM, l/s	Hood 3 Flow
AI	12	CFM, l/s	Hood 4 Flow
AI	13	CFM, l/s	Hood 5 Flow
AI	14	CFM, l/s	Hood 6 Flow
AI	15	CFM, l/s	Hood 7 Flow
AI	16	CFM, l/s	Auxiliary Exhaust 1 Flow
AI	17	CFM, l/s	Auxiliary Exhaust 2 Flow
AI	18	CFM, l/s	Supply 1 Flow
AI	19	CFM, l/s	Supply 2 Flow
AI	20	CFM, l/s	Supply 3 Flow
AI	21	CFM, l/s	Supply 4 Flow
AI	22	%	Supply Control Output
AI	23	%	Exhaust Control Output
AI	24	%	Temp. Control Output
BI	1		Low Pressure Alarm 0=Normal 1=Low Alarm

NPT	NPA	UNITS[i]	DESCRIPTION	
BI	2		High Pressure Alarm	0=Normal 1=High Alarm
BI	3		Min. Supply Flow Alarm	0=Normal 1=Low Flow Alarm
BI	4		Max. Exhaust Flow Alarm	0=Normal 1=High Flow Alarm
BI[2]	5		Emergency Mode	0=Normal 1=Emergency
BI[2]	6		Unoccupied Mode	0=Normal Mode 1=Unoccupied Mode
BI	7		Data Error	0=Normal 1=Data Error
AO	1	ft/min, m/s, in. H_2O, Pa	Control Set point	
AO	2	ft/min, m/s, in. H_2O, Pa	Low Alarm Set point	
AO	3	ft/min, m/s, in. H_2O, Pa	High Alarm Set point	
AO	4	CFM, l/s	Minimum Supply Volume Ventilation Set point	
AO	5	CFM, l/s	Minimum Supply Volume Temperature Set point	
AO	6	CFM, l/s	Minimum Supply Volume in Unoccupied Mode	
AO	7	CFM, l/s	Minimum Supply Flow Alarm Set point	
AO	8	CFM, l/s	Max. Exhaust Flow Alarm Set point	
AO	9	CFM, l/s	Minimum Offset Set point	
AO	10	CFM, l/s	Maximum Offset Set point	
AO	11	CFM, l/s	Maximum Supply Flow Set point	
AO	12	CFM, l/s	Minimum Exhaust Flow Set point	
AO	13	°F, °C	Temperature Set point	
AO	14	°F, °C	Unoccupied Temperature Set point	
AO	15	#	Units	0=Feet per minute 1=Meters per second 2=Inches of H_2O 3=Pascals

[1]Units will correspond with choice in UNITS variable (AO #14). Flow rates will either be CFM or l/s, based on whether UNITS variable is set for an English or metric unit type. Temperatures will be either °F or °C, depending on the UNITS variable.

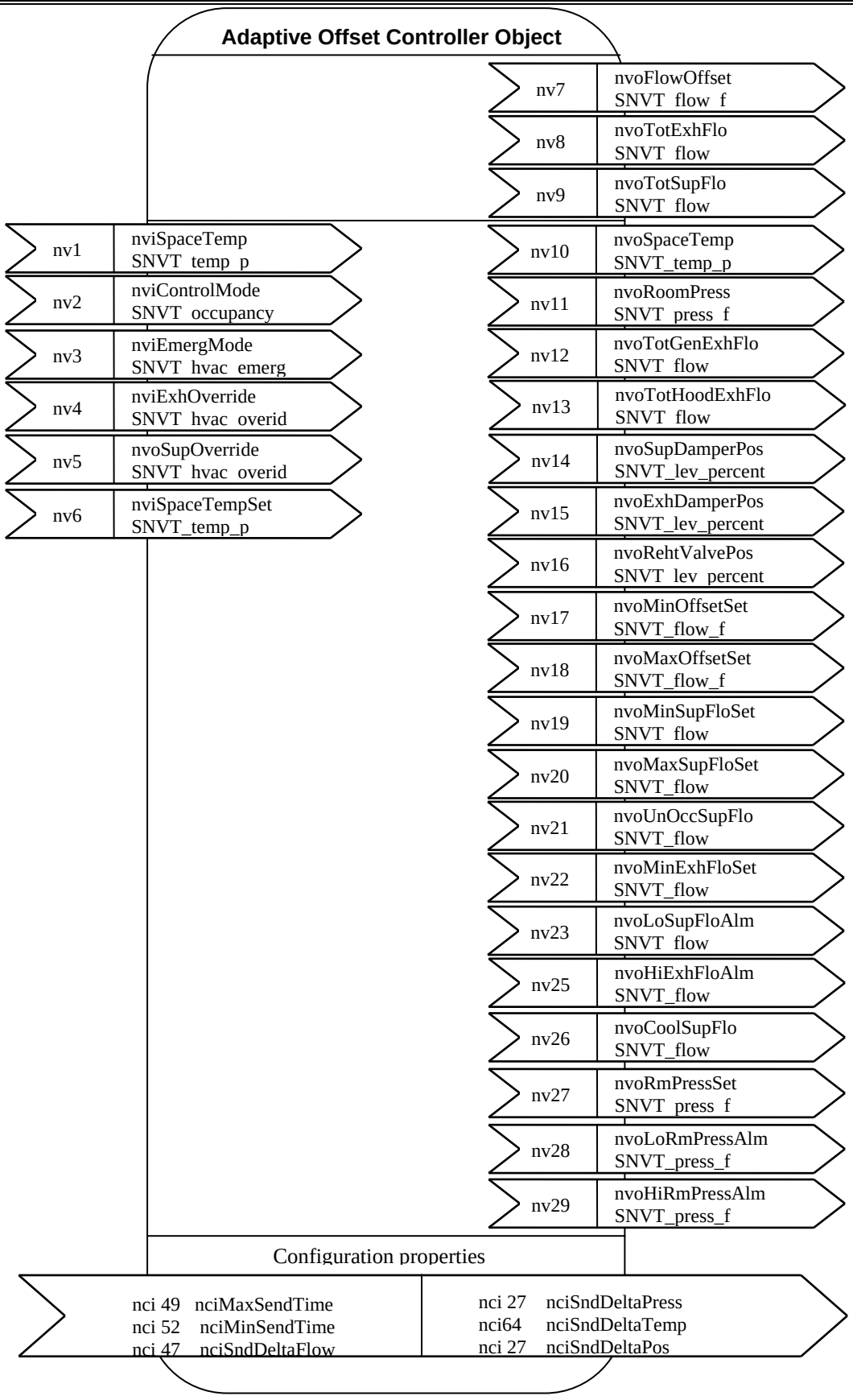
[2]These are the only binary units that can be remotely activated.



LON Works Room Controller Status Definitions

nvoControlStatus			nvoStatusIndex	
Bit	**Description**		**Bit**	**Description**
0	Standard		0	Normal
1	Unoccupied		2	Low Alarm
2	Communications Error		3	High Alarm
3	Remote Set point		4	Minimum Supply Alarm
4	LON Override		5	Maximum Exhaust Alarm
			6	Data Error
			7	Emergency

LonWorks Object



8682 BACnet MS/TP Protocol Implementation Conformance Statement

Date: July 11, 2007
Vendor Name: TSI Inc.
Product Name: SUREFLOW™ Adaptive Offset Controller
Product Model Number: 8682-BAC
Applications Software Version: 1.0
Firmware Revision: 1.0
BACnet Protocol Revision: 2

Product Description:

TSI SUREFLOW™ Room Pressure Controls are designed to maintain more exhaust from a laboratory than is supplied to it. This negative air balance helps ensure that chemical vapors cannot diffuse outside the laboratory. The SUREFLOW™ Model 8682 also controls the temperature of the laboratory space by modulating reheat and the supply air volume. Optionally, a room pressure sensor can be connected to the SUREFLOW™ Model 8682 controller to correct long-term changes in the building dynamics. This model controller is capable of acting as a stand-alone device or as part of a building automation system via BACnet MS/TP protocol.

BACnet Standardized Device Profile (Annex L):

☐ BACnet Operator Workstation (B-OWS)
☐ BACnet Building Controller (B-BC)
☐ BACnet Advanced Application Controller (B-AAC)
☑ BACnet Application Specific Controller (B-ASC)
☐ BACnet Smart Sensor (B-SS)
☐ BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Blocks Supported (Annex K):

DS-RP-B	DM-DDB-B
DS-WP-B	DM-DOB-B
DS-RPM-B	DM-DCC-B

Segmentation Capability:

Segmented requests not supported
Segmented responses not supported

Standard Object Types Supported:

	Dynamically Createable	Dynamically Deletable	Optional Properties Supported	Writable Properties (Data Type)
Analog Input	No	No		
Analog Value	No	No		Present_Value (Real)
Binary Input	No	No	Active_Text, Inactive_Text	
Binary Value	No	No	Active_Text, Inactive_Text	Present_Value (Enumerated)
Multi-state Input	No	No	State_Text	
Multi-state Value	No	No	State_Text	Present_Value (Unsigned Int)
Device Object	No	No		Object Name (Char String) Max Master (Unsigned Int)

Data Link Layer Options:
☐ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s)
☑ MS/TP master (Clause 9), baud rate(s): 76.8k 38.4k, 19.2k, 9600 bps
☐ MS/TP slave (Clause 9), baud rate(s):
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):
☐ Point-To-Point, modem, (Clause 10), baud rate(s):
☐ LonTalk, (Clause 11), medium:
☐ Other:

Device Address Binding:
Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐Yes ☑ No

Networking Options:
☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP
☐ BACnet/IP Broadcast Management Device (BBMD)

Character Sets Supported:
Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

☑ ANSI X3.4	☐ IBM™/Microsoft™ DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:
Not Applicable

Model 8682-BAC BACnet MS/TP Object Set

Object Type	Device Instance	*Units	Description	
Analog Input	1	ft/min, m/s, in. H_2O, Pa	Room Pressure	
Analog Input	2	cfm, l/s	Total Supply Flow	
Analog Input	3	cfm, l/s	Total General Exhaust Flow	
Analog Input	4	cfm, l/s	Total Hood Flow	
Analog Input	5	cfm, l/s	Total Exhaust Flow	
Analog Input	6	cfm, l/s	Supply 1 Flow Rate	
Analog Input	7	cfm, l/s	Supply 2 Flow Rate	
Analog Input	8	cfm, l/s	Supply 3 Flow Rate	
Analog Input	9	cfm, l/s	Supply 4 Flow Rate	
Analog Input	10	cfm, l/s	Exhaust 1 Flow Rate	
Analog Input	11	cfm, l/s	Exhaust 2 Flow Rate	
Analog Input	12	cfm, l/s	Hood 1 Flow Rate	
Analog Input	13	cfm, l/s	Hood 2 Flow Rate	
Analog Input	14	cfm, l/s	Hood 3 Flow Rate	
Analog Input	15	cfm, l/s	Hood 4 Flow Rate	
Analog Input	16	cfm, l/s	Hood 5 Flow Rate	
Analog Input	17	cfm, l/s	Hood 6 Flow Rate	
Analog Input	18	cfm, l/s	Hood 7 Flow Rate	
Analog Input	19	cfm, l/s	Supply Flow Set Point	
Analog Input	20	cfm, l/s	General Exhaust Flow Set Point	
Analog Input	21	cfm, l/s	Current Flow Offset	
Analog Input	22	°F, °C	Temperature	
Analog Input	23	% Open	Supply Damper Position	
Analog Input	24	% Open	Exhaust Damper Position	
Analog Input	25	% Open	Reheat Valve Position	
Analog Value	1		MAC Address	1 to 127
Analog Value	2	ft/min, m/s, in. H_2O, Pa	Room Pressure Set Point	-0.19500 to 0.19500 in. H_2O
Analog Value	3	ft/min, m/s, in. H_2O, Pa	Remote Pressure Set Point	-0.19500 to 0.19500 in. H_2O
Analog Value	4	ft/min, m/s, in. H_2O, Pa	Low Pressure Alarm	-0.19500 to 0.19500 in. H_2O
Analog Value	5	ft/min, m/s, in. H_2O, Pa	High Pressure Alarm	-0.19500 to 0.19500 in. H_2O
Analog Value	6	ft/min, m/s, in. H_2O, Pa	Remote Low Pressure Alarm	-0.19500 to 0.19500 in. H_2O
Analog Value	7	ft/min, m/s, in. H_2O, Pa	Remote High Pressure Alarm	-0.19500 to 0.19500 in. H_2O
Analog Value	8	cfm, l/s	Vent Min Set Point	0 to 30,000 cfm
Analog Value	9	cfm, l/s	Cooling Flow Set Point	0 to 30,000 cfm
Analog Value	10	cfm, l/s	Unocc Flow Set Point	0 to 30,000 cfm
Analog Value	11	cfm, l/s	Min Offset	0 to 30,000 cfm
Analog Value	12	cfm, l/s	Max Offset	0 to 30,000 cfm
Analog Value	13	cfm, l/s	Max Supply Set Point	0 to 30,000 cfm
Analog Value	14	cfm, l/s	Min Exhaust Set Point	0 to 30,000 cfm

Object Type	Device Instance	*Units	Description	
Analog Value	15	cfm, l/s	Min Supply Alarm	0 to 30,000 cfm
Analog Value	16	cfm, l/s	Max Exhaust Alarm	0 to 30,000 cfm
Analog Value	17	°F, °C	Temperature Set Point	50 to 85 °F
Analog Value	18	°F, °C	Unocc Temp Set Point	50 to 85 °F
Binary Value	1		Occ/Unocc Mode	0 Occupied 1 Unoccupied
Binary Value	2		Remote Mode	0 Normal Mode 1 Remote Mode
Multi-State Input	1		Status Index	1 Normal 2 Dim Data Error 3 Low Press Alarm 4 High Press Alarm 5 Min Supply Alarm 6 Max Exhaust Alarm 7 Data Error 8 Cal Error 9 Emergency
Multi-State Value	2		Emergency Mode	1 Exit Emergency Mode 2 Enter Emergency Mode
Multi-State Value	3		Units Value	1 ft/min 2 m/s 3 in. H_2O 4 Pa
Device	868001**		TSI8682	

* The units are based on the value of the Units Value object. When the Units Value is set to 1 or 3 the units are in English form. When the Units Value is set to 2 or 4 the units are metric. English is the default value.

** The device instance is 868000, summed with the MAC address of the device.

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Appendix C

Wiring Information

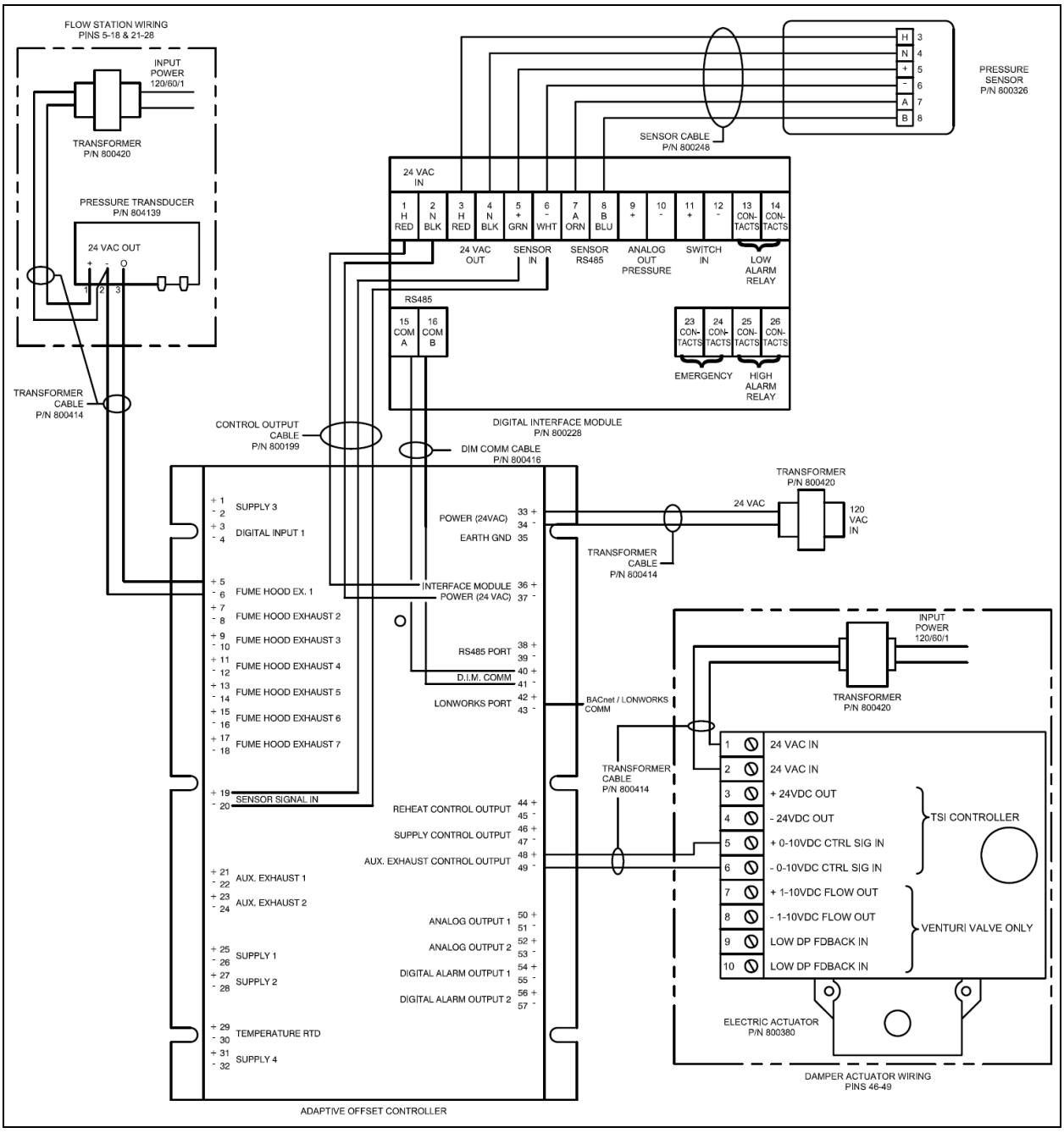
Back Panel Wiring

PIN #	Input / Output / Communication	Description
	DIM	
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 to 10 VDC pressure sensor signal
7, 8	Communications	RS-485 communications between DIM and pressure sensor
9, 10	Output	0 to 10 VDC pressure differential signal - See menu item OUTPUT SIG
11, 12	Input	Non powered switch input. - See menu item UNOCCUPY SET.
13, 14	Output	Low alarm relay - N.O., closes in low alarm condition. - See menu item LOW ALARM
15, 16	Communications	RS-485 communications; DIM to Adaptive Offset Controller (AOC)
17- 22	No Connection	No function.
23, 24	Input	Non powered switch input – N.O. contacts for Emergency input **NOTE**: Closing these contacts puts the unit into Emergency Mode. Set points will ***not*** be maintained in Emergency Mode.
25, 26	Output	High alarm relay - N.O., closes in high alarm condition. - See menu item HIGH ALARM
	AOC	
1, 2	Input	0 to 10 VDC flow station signal - Supply air.
3, 4	Input	Non powered switch input. - See menu item REM SET POINT
5– 18	Input	0–10 VDC flow station signal - fume exhaust.
21–24	Input	0–10 VDC flow station signal - General exhaust.
25–28	Input	0–10 VDC flow station signal - Supply air.
29, 30	Input	1000 Ω RTD temperature signal
31, 32	Input	0–10 VDC flow station signal - Supply air.
33,34	Input	24 VAC to power Adaptive Offset Controller (AOC). **NOTE**: 24 VAC becomes polarized when connected to AOC.
35	Ground	Earth ground
36, 37	Output	24 VAC Power for DIM.
38, 39	Communications	RS-485 communications; AOC to building management system (Modbus or N2)
40, 41	Communications	RS-485 communications; AOC to DIM
42, 43	Communications	LonWorks communications to building management system (optional) BACnet MSTP communications to building management system (8682-BAC)
44, 45	Output	0–10 VDC, reheat valve control signal. 10 VDC = open (n.o. damper) - See menu item REHEAT SIG
46, 47	Output	0–10 VDC, supply air control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG
48, 49	Output	0–10 VDC, general exhaust control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG

Wiring Information *(continued)*

PIN #	Input / Output / Communication	Description
	AOC *(continued)*	
50, 51	Output	0–10 VDC, total supply flow - See menu item OUTPUT SIG
52, 53	Output	0–10 VDC, total exhaust flow - See menu item OUTPUT SIG
54, 55	Output	Low supply flow alarm relay - N.O., closes in low flow condition. - See menu item MIN SUP ALM.
56, 57	Output	High exhaust flow alarm relay - N.O., closes in low flow condition. - See menu item MAX EXH ALM.

WARNING:	The wiring diagram shows polarity on many pairs of pins: ±, H / N, A / B. Damage to the DIM and 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 11: Wiring Diagram–Electric

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Appendix D

Access Codes

There is one access code for all menus. If the access code is required to enter a menu, 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. An 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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