HVAC Controls–Laboratory

Model 8650

SureFlow®
Face Velocity Controller

Operation and Service Manual

P/N 1980117, Revision L
March 2007

TSI®

Model 8650

SUREFLOW®
Face Velocity Controller

Operation and Service Manual

March 2007
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CONTENTS

How to Use This Manual

The SUREFLOW Operation and Service Manual describes how to operate, configure, calibrate, maintain and troubleshoot the Model 8650 SUREFLOW® Face Velocity Controller. The manual is divided into two parts. Part one describes the SUREFLOW unit 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 device operates.

Part two describes the technical aspects of the product which include operation, configuration, calibration, maintenance and troubleshooting. 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 that the SUREFLOW has been properly installed. Refer to the Installation Instructions if there is any question as to whether the SUREFLOW has been installed properly.

Part One

User Basics

This section is designed to provide a brief but thorough overview of the SUREFLOW product installed. These few pages explain the purpose (The Instrument) and the operation (Useful user information, Operator panel, Alarms) of the product. Technical product information is available in Part Two of the manual.

The Instrument

The SUREFLOW Face Velocity Controller measures, reports, and controls the "face velocity" in fume hoods. Adequate face velocity is a key component needed to protect fume hood users. An adequate face velocity will contain all the contaminants inside of the fume hood.

The fume hood exhaust system produces a negative pressure differential between the fume hood's interior and the laboratory, causing air to be drawn into the hood. The speed air entering the fume hood is called the face velocity. The Model 8650 SUREFLOW Face Velocity Controller continuously monitors fume hood face velocity by measuring the air velocity across a sensor mounted in the sidewall of the hood. The sensor and opening in the fume hood are driven by the same pressure differential so the velocity across each is related.

The SUREFLOW controller modulates the exhaust to maintain an adequate face velocity at all times through the fume hood. The controller displays the actual face velocity and has a green light on when the velocity is adequate. If problems occur with the exhaust system and the face velocity becomes inadequate, or too great, the displayed velocity will indicate actual velocity, and a red alarm light and audible alarm will turn on.

The SUREFLOW consists of three pieces; a velocity sensor, controller electronics, and a modulating device; pneumatic actuator/damper, electric actuator/damper, or variable frequency drive (VFD). The velocity sensor is mounted in the sidewall of the fume hood usually near the top of the sash. The controller electronics are typically mounted about eye level on the front of the fume hood cabinet. The damper/actuator is mounted in the exhaust duct, typically close to the fume hood (if VFD is used, mount where convenient). The velocity sensor continuously measures the face velocity and provides the face velocity information to the controller electronics. The controller compares the actual face velocity to the control setpoint and modulates the damper (VFD) if required.

Useful User Information

The controller has a green light (normal operation) and red alarm light (low and high alarms). The green light is on when the face velocity is adequate. The red alarm light comes on when the face velocity drops below a safe level, or exceeds a safe level. The display provides additional information by continuously indicating the actual face velocity.

Operator Panel

The SUREFLOW Face Velocity Controller is easy to use. All the information you need to know about face velocity is displayed on the Display Interface Module (DIM). In addition, all configuration, control, and calibration programming is accessible through the keypad. Specific details about the SUREFLOW front panel display and controls are described on the following pages. The front panel, shown in Figure 1 identifies the important features: display, keys and lights.

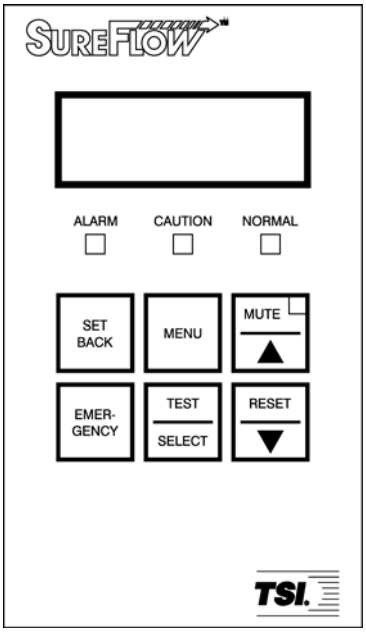

Figure 1: SUREFLOW Front Panel Display

Green/Red Light

The green light (NORMAL) is on when the face velocity is adequate. This light indicates the fume hood is operating safely. If the face velocity setpoint cannot be maintained, the green light turns off and the red alarm light turns on.

Digital Display

The alphanumeric digital display is a two-line display that indicates actual face velocity, alarm status, menu options, and error messages. In normal operation (green light is on), the display continuously indicates the actual face velocity. If an alarm occurs, the display will indicate both the actual face velocity and the type of alarm. As an example, if a low alarm condition occurs, the display will change from\to:

VELOCITY		ALARM=LOW
100 FT/min	will change to read	55 FT/min*

* will indicate actual face velocity (55 ft/min is example only)

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

Keypad

The keypad has six keys. The gray keys with black letters (4 keys) are user information keys. In normal operation these keys are active. Additionally, the red emergency key is active. The gray keys with blue characters (4 keys) are used to program the unit. A thorough description of each key is given below.

User Keys - Gray with Black Letters

The four keys with black letters provide 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 setpoint 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 face velocity must be in 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 an audible alarm. Pressing the **MUTE** key once temporarily silences the audible alarm. The alarm remains silent until the unit returns to control setpoint. Pressing the **MUTE** key twice, when controller is in alarm, will turn the yellow mute light on and permanently silence the audible alarm.

NOTE: You can program the unit so that the audible alarm cannot be permanently turned off (see menu item AUD DISABLE).

SETBACK key

The **SETBACK** key activates the setback or second setpoint face velocity. In setback mode, the controller controls at the setback setpoint, the display indicates SETBACK, and the yellow light (CAUTION) turns on. If the **SETBACK** key is pressed when the unit is in setback mode, the controller returns to normal control setpoint.

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 **SELECT** 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. The controller maximizes the face velocity by modulating the damper full open (VFD to maximum).

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** key or the **RESET** key.

Alarms

SUREFLOW controller has visual (red light) and audible alarms to inform you of changing fume hood conditions. The alarm levels (setpoints) are determined by facilities staff, which could be Engineering, Industrial Hygiene, or a facilities group depending on how the safety staff is organized.

The alarms, audible and visual, will activate whenever the preset alarm level is reached. The alarms will activate if the face velocity is low or inadequate, high or too great, or when the exhaust airflow is insufficient (need optional flow station installed). When the fume hood is operating safely, no alarms will sound.

Example: The low alarm is preset to activate when the face velocity falls below 60 ft/min. When the face velocity drops below 60 ft/min, 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 20 ft/min greater than alarm setpoint (80 ft/min).

Visual Alarm

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 - 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 once and permanently muted by pressing the **MUTE** key twice (yellow mute light turns on).

If the audible alarm has been temporarily muted (yellow mute light is off), the alarm is silent until the face velocity returns to the safe velocity range. The safe range is 20 ft/min above the low alarm setpoint and 20 ft/min below the high alarm setpoint. The controller automatically resets the alarm to sound again if another alarm occurs (see menu item ALARM RESET for options to turn alarms off). If the audible alarm is permanently muted (yellow mute light is on), the audible alarm will remain off until the **MUTE** key is

pressed (once). You can program the audible alarm so it cannot be permanently turned off (see menu item AUD DISABLE).

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 menu item 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* 8650-____
- Software revision level*
- Facility where unit is installed

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

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

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

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Part Two

Technical Section

The SUREFLOW Face Velocity Controller is ready to use after being properly installed and calibrated. The calibration procedure should take less than 15 minutes. Figure 2 shows the Digital Interface Module (DIM) which 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.

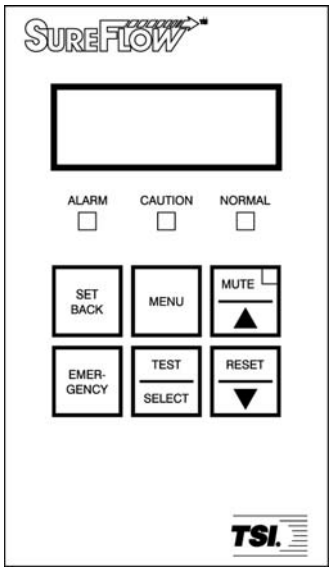

Figure 2: Digital Interface Module

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 setpoints are in one menu, control signal items in another, etc. The menu items and all related information is provided including; programming name, description of menu item, range of programmable values, and how the unit shipped from the factory (default value).

The **Calibration** section describes the required procedure to calibrate the controller. This section explains how to compare the controller's velocity reading to a portable thermal anemometer and then adjust the zero and span to establish an accurate calibration. This section also describes how to zero a TSI flow station transducer (if installed).

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

The **Troubleshooting** section is split into two areas: mechanical operation of the unit and system performance. Many external variables will affect how the unit functions so it is critical to first determine if the system is having mechanical problems—i.e., no display on unit, alarms don't function, damper doesn't modulate, etc. If no mechanical problems exist, look for performance problems (i.e., doesn't seem to read correctly, display fluctuates, etc.). The first step is to determine that the system is mechanically operating correctly, followed by modifying the configuration to eliminate the performance problems.

Software Programming

Programming the SUREFLOW 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: It is important to note that the unit is always operating (except when checking the CONTROL OUTPUT) when programming. When a menu item value is changed, the new value takes effect ***immediately*** after saving the change, not when the unit returns to normal operating mode.

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 in the instrument.

Programming Keys

The four keys with blue characters (refer to Figure 3) 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 menu items to be changed.

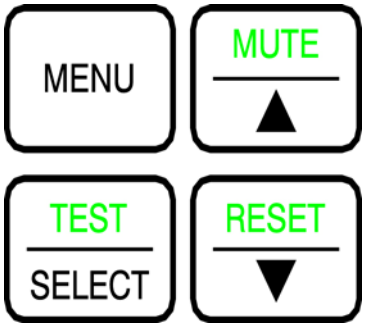

Figure 3: Programming Keys

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 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 menu items, 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 a menu 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 has been 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 item type the values may be numerical, specific properties (on/off), or a bar graph.

NOTE: When programming a numerical 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 keystroke sequence 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 1, 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.
5. Press the **SELECT** key to access chosen menu item. The top line of display shows menu item selected, while the second line shows current menu item value.
6. Use the ▲/▼ keys to change menu 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 low alarm setpoint will be changed from 80 ft/min to 60 ft/min.

❶ Unit is in normal operation and is displaying 100 FT/MIN.

```
VELOCITY
100 FT/MIN
```

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

MENU

The first 2 menu choices are displayed.

```
SETPOINTS
CONFIGURE
```

❸ Press the **SELECT** key to access the SETPOINT menu.

TEST / SELECT

NOTE: Blinking cursor must be on S in SETPOINTS.

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

```
SETPOINTS
SETPOINT
```

❹ Press the ▼ key until LOW ALARM is shown on display.

▼

Menu selected
Item name

```
SETPOINTS
LOW ALARM
```

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

TEST / SELECT

Item Name
Current Value

```
LOW ALARM
80 FT/MIN
```

❻ Press the ▼ key to change the low alarm setpoint to 60 FT/MIN.

▼

```
LOW ALARM
60 FT/MIN
```

❼ Press the **SELECT** key to save the new low alarm setpoint.

TEST
SELECT

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

LOW ALARM
SAVING DATA

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

SETPOINTS
LOW ALARM

WARNING: If the **MENU** key was pressed instead of the **SELECT** key, the new data would not have been saved, and the SUREFLOW would have escaped back to the menu level (step 4).

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

MENU

SETPOINTS
CONFIGURE

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

MENU

Unit is now back in normal operation

VELOCITY
100 FT/MIN

Menu and Menu Items

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

- Complete list of menus 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 setpoints 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 4 shows a chart of all the Model 8650 standard controller menu items.

SETPOINTS	CONFIGURE	CALIBRATION
SETPOINT	DISPLAY AVG	SENSOR ZERO
SETBACK	UNITS	SENSOR SPAN
LOW ALARM	ALARM RESET	ACCESS CODE
HIGH ALARM	OUTPUT SIG	
MIN DAMPER	AUD DISABLE	
MAX DAMPER	NET PROTOCOL**	
ACCESS CODE	NET ADDRESS**	
	LON**	
	MAC ADDRESS**	
	ACCESS CODE	

CONTROL	DIAGNOSTICS *
SENSITIVITY	CONTROL OUT
SPEED	ANALOG OUT
CONTROL SIG	LOW RELAY
KC VALUE	HIGH RELAY
TI VALUE	SETBACK IN
ACCESS CODE	EMERGENCY IN
	SENSOR INPUT
	ACCESS CODE

* Menu items located in ***Troubleshooting*** section.

** LON Menu Item will only appear as a menu option for the 8650 Fume Hood Controller that includes an optional LonWorks® board. MAC ADDRESS Menu Item will only appear as a menu option for the 8650 Fume Hood Controller that includes an optional BACnet board. The Menu Items NET PROTOCOL and NET ADDRESS will be deleted as menu options on 8650 Fume Hood Controllers that include the optional LonWorks board or BACnet board.

Figure 4: Menu Items - Model 8650 Controller

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SETPOINTS MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
CONTROL SETPOINT	SETPOINT	The SETPOINT item sets the face velocity control setpoint. The SUREFLOW controller will maintain this face velocity when normal operating conditions exist.	60 to 1000 ft/min	100 ft/min
CONTROL SETBACK SETPOINT	SETBACK	The SETBACK item sets an alternate face velocity control setpoint. The SUREFLOW controller will maintain this face velocity when normal operating conditions exist. A SETBACK condition is initiated when the **SETBACK** key has been pressed, the SETBACK contact input has been closed, or a command is received through the RS 485 network.	60 to 1000 ft/min	60 ft/min
LOW ALARM SETPOINT	LOW ALARM	The LOW ALARM item sets the face velocity low alarm setpoint. A low alarm condition is defined as when the face velocity is less than the low alarm setpoint.	OFF, 5 to 980 ft/min	60 ft/min
HIGH ALARM SETPOINT	HIGH ALARM	The HIGH ALARM item sets the face velocity high alarm setpoint. A high alarm condition is defined as when the face velocity exceeds the high alarm setpoint.	OFF, 80 to 1000 ft/min	140 ft/min
MINIMUM DAMPER POSITION SETPOINT	MIN DAMPER	The MIN DAMPER item is used to set the minimum damper position. The minimum damper position allows the setting of a minimum airflow through the fume hood. When the fume hood exhaust volume needed to maintain the set face velocity is less than the set minimum damper position (typically sash closed), the damper maintains the minimum damper position. Closing the sash further will result in an increase in the face velocity above the control setpoint. When this item is entered, the display will indicate the minimum damper position. The value displayed will be the % OPEN.	0 to 100%	0% OPEN

SETPOINTS MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MAXIMUM DAMPER POSITION SETPOINT	MAX DAMPER	The MAX DAMPER item is used to set the maximum damper position. The maximum damper position allows the setting of a maximum airflow through the fume hood. When the fume hood exhaust volume needed to maintain the set face velocity is greater than the set maximum damper position (typically sash open), the damper maintains the maximum damper position. Opening the sash further will result in a decrease in face velocity, which may cause a low alarm indicating an unsafe hood condition exists. When this item is entered, the display will indicate the maximum damper position. The value displayed will be the % OPEN.	0 to 100%	100% OPEN
ACCESS CODE	ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON, a code is required before the menu can be entered. Conversely, if the ACCESS CODE is OFF, no code is required to enter the menu.	ON or OFF	OFF

SETPOINTS/ALARM CONSTRAINTS

There are a number of constraints that prohibit you from incorrectly adjusting the setpoints. These are as follows:

1. The control SETPOINT and SETBACK setpoint have a lower limit of 60 ft/min. This is because generally accepted lab practices indicate that fume hood containment is lost below this face velocity.

2. The controller has been designed so that the LOW ALARM setpoint must be set at least 20 ft/min below the control SETPOINT. For example, if the control SETPOINT is 100 ft/min, the LOW ALARM setpoint cannot be greater than 80 ft/min. This prevents nuisance alarms from occurring during natural system fluctuations.

3. The controller has been designed so that the HIGH ALARM setpoint must be set at least 20 ft/min above the control SETPOINT. For example, if the control SETPOINT is 100 ft/min, the HIGH ALARM setpoint cannot be less than 120 ft/min. This prevents nuisance alarms from occurring during natural system fluctuations.

4. The SETBACK alarms; LOW and HIGH have the same alarm offsets (ft/min) as the standard alarms (user cannot program offset). For example the control setpoints and alarm setpoints are as follows:

LOW ALARM	SETPOINT	HIGH ALARM
80 FT/MIN	100 FT/MIN	130 FT/MIN

When the SETBACK mode is selected (setpoint = 60 ft/min), the alarm offset will follow:

SETBACK LOW ALARM	SETBACK SETPOINT	SETBACK HIGH ALARM
40 FT/MIN	60 FT/MIN	90 FT/MIN

Notice the 20 ft/min difference was maintained between the LOW ALARM and SETPOINT, and 30 ft/min difference was maintained between the SETPOINT and HIGH ALARM.

5. The ALARM RESET item selects how the alarms will terminate when controller returns to the safe range. The face velocity alarms all terminate the same; they are either LATCHED or UNLATCHED. If UNLATCHED is selected, the low alarm automatically turns off when the face velocity exceeds the alarm value by 20 ft/min. Conversely, the high alarm automatically turns off when the face velocity drops 20 ft/min below the high alarm setpoint. If LATCHED is selected, the alarms will not terminate until the face velocity is 20 ft/min greater than the low alarm setpoint (high alarm = 20 ft/min below high alarm) *and* the **RESET** key is pressed.

CONFIGURE MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
DISPLAY AVERAGE	DISPLAY AVG	The DISPLAY AVG item selects the display's averaging period. The display-averaging period is the length of time the face velocity has been averaged before being displayed. The DISPLAY AVG item value may be set between 0.3 and 40 seconds. The higher the averaging value, the more stable the display.	0.5, 1, 2, 3, 5, 10, 20 or 40 seconds	5 seconds
UNITS	UNITS	The UNITS item selects the unit of measure that the controller displays all velocity related menu items: setpoints, alarms, calibration, etc.	FT/MIN, m/s,	FT/MIN
ALARM RESET	ALARM RESET	The ALARM RESET item selects how the alarms terminate after the unit returns to control setpoint. UNLATCHED (alarm follow) automatically resets the alarm when the face velocity is 20 ft/min greater than the low alarm setpoint, or 20 ft/min below the high alarm setpoint. LATCHED requires the staff to press the **RESET** key after the face velocity exceeds the low alarm setpoint by 20 ft/min, or is 20 ft/min below the high alarm setpoint control setpoint. The ALARM RESET affects the audible alarm, visual alarm, and relay output, which means all are latched or unlatched.	LATCHED OR UNLATCHED	UNLATCHED
OUTPUT SIGNAL	OUTPUT SIG	The OUTPUT SIG item selects the type of analog *velocity* signal output (not control output signal). The analog output signal can either be 0-10 VDC or 4-20 mA.	0-10 VDC or 4-20 mA	0-10 VDC
AUDIBLE DISABLE	AUD DISABLE	The AUD DISABLE item selects if the audible alarm can be permanently muted by pressing the mute key once when not in alarm, and twice if in alarm (yellow light turns on). ON means the alarm can be permanently muted from the keypad. OFF means the alarm can only be temporarily muted from the keypad.	ON or OFF	ON
NETWORK PROTOCOL**	NET PROTOCOL	The NET PROTOCOL item selects the communications protocol used to interface with the building management system.	MODBUS *or* N2	MODBUS

CONFIGURE MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
NETWORK ADDRESS**	NET ADDRESS	The NET ADDRESS item selects the main network address of the face velocity controller. 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. **NOTE:** In setback mode there is no priority between the RS-485 and keypad. The most recent signal by either RS-485 or keypad will initiate a change. In emergency mode the keypad has a higher priority than the RS-485 command. A unit put into emergency by keypad must be removed by keypad (safety first). RS-485 communications allows you access to all menu items except calibration items. The RS-485 network can initiate a change at any time.	1-247	1
LON**	LON	When the SERVICE PIN option is selected, the Model 8650 sends a broadcast message containing its Neuron ID and program ID. This is required to install the Model 8650 on the LonWorks network, or to reinstall the Model 8650 after using the GO UNCONFIGURED command. Selecting the GO UNCONFIGURED option resets the Model 8650's authentication key. This is required in the event a foreign network tool inadvertently acquires a Model 8650 and installs it with network management authentication. The Model 8650's owner will then be unable to reclaim the Model 8650 over the network.	SERVICE PIN or GO UNCONFIGURED	

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

CONFIGURE MENU *(continued)*

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
MAC ADDRESS**	MAC ADDRESS	The MAC ADDRESS assigns the face velocity controller an address on the MS/TP BACnet network. This address must be unique for each device on the BACnet network.	1 - 127	1
ACCESS CODE	ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON, a code is required before the menu can be entered. Conversely, if the ACCESS CODE is OFF, no code is required to enter the menu.	ON or OFF	OFF
	END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes or press the **SELECT** or MENU key to exit out of the menu.		

**The MAC ADDRESS Menu Item will replace the Network Protocol and Network Address Menu Items on SUREFLOW controllers provided with the BACnet board.

CALIBRATION MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
SENSOR ZERO	SENSOR ZERO	The SENSOR ZERO item is used to calibrate the SUREFLOW velocity sensor at zero flow. A sensor zero should be established prior to adjusting the sensor span (see **Calibration** section following menu item listing).	NONE	Unit needs to be calibrated upon initial installation
SENSOR SPAN	SENSOR SPAN	The SENSOR SPAN item is used to calibrate the SUREFLOW velocity sensor to match the fume hood average face velocity. The average face velocity is measured by traversing the fume hood face with a portable air velocity meter (see **Calibration** section following menu item listing). A sensor zero should be established prior to adjusting the sensor span (see **Calibration** section following menu item listing).	NONE	Unit needs to be calibrated upon initial installation .
ACCESS CODE	ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON, a code is required before the menu can be entered. Conversely, if the ACCESS CODE is OFF, no code is required to enter the menu.	ON or OFF	OFF
	END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.		

CONTROL MENU

MENU ITEM	SOFTWARE NAME	ITEM DESCRIPTION	ITEM RANGE	DEFAULT VALUE
SENSITIVITY	SENSITIVITY	The SENSITIVITY item selects 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 each representing ±10 ft/min. Starting from the right side (+ sign), 10 bars displayed indicates no dead band so the controller will always be in PID control mode. The less bars displayed, the larger the integral dead band. For example, with 8 bars displayed and an operating setpoint of 100 ft/min, the integral dead band is between 80 and 120 ft/min. When the face velocity is within this range, integral or slow control is used. However, when the velocity falls below 80 ft/min or rises above 120 ft/min, PID control is enabled until the unit returns to setpoint. **WARNING:** When SENSITIVITY is set at 10 bars, the system is always in PID control, which will probably cause an unstable system. It is recommended that the SENSITIVITY be set at 9 bars or less.	0 to 10 bars	8 bars
SPEED	SPEED	The SPEED item selects the control output speed. When this item is selected, a bar graph is shown on the display. There are 10 bars, each one representing 10% of optimal 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 control output will move. The more bars shown, the faster the control output.	1 to 10 bars	10 bars
CONTROL SIGNAL	CONTROL SIG	The CONTROL SIG item determines the control signal's output direction. As an example; If the control system closes the exhaust damper instead of opening the damper, this option will reverse the control signal to now open the damper.	DIRECT OR REVERSE	DIRECT

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 items provide you with the ability to manually change the PI 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.** 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. When this item is entered, a value for Kc is indicated on the display. If the SUREFLOW is not controlling correctly; hunting, oscillating, or controlling slowly, the Kc VALUE control coefficient may need adjusting. Decreasing Kc will slow the control system down making it more stable. The Ti VALUE item changes the integral control coefficient. When this item is entered, a value for Ti is indicated on the display. If the SUREFLOW is not controlling correctly, the unit may have an inappropriate Ti VALUE control coefficient. Increasing Ti will slow the control system down making it more stable.	Kc = 0 - 1000 Ti = 0-1000 The range of values is very large. Poor control will occur if values are more than twice or less than 1/2 the default value	Kc = 100 Ti = 110
ACCESS CODE	ACCESS CODE	The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON, a code is required before the menu can be entered. Conversely, if the ACCESS CODE is OFF, no code is required to enter the menu.	ON or OFF	OFF
	END OF MENU	The END OF MENU item informs you that the end of a menu has been reached. You can either scroll back up the menu to make changes, or press the **SELECT** or **MENU** key to exit out of the menu.		

Calibration

The calibration section explains how to calibrate the SUREFLOW velocity controller and how to zero a TSI flow station pressure transducer (CFM option). The SUREFLOW Face Velocity Controller must be calibrated, after being installed on the fume hood, to provide accurate indication of fume hood face velocity. An orange WARNING label is attached to every SUREFLOW indicating this as follows:

WARNING Unit is not calibrated! Remove label only after field calibration is complete.

The label is to be removed when calibration is complete.

NOTE: This section assumes that the velocity sensor has been correctly installed. Inaccurate readings may be detected if velocity sensor is not installed correctly. Review the Installation Instructions and verify that the sensor is installed correctly (usually only a problem on initial set up).

The following items are needed to calibrate the SUREFLOW:

- Masking tape
- Portable Air Velocity Meter such as TSI VELOCICALC® Model 8384 or VELOCICHECK® Model 8330.

Calibrating Velocity Sensor

WARNING: The controller is disabled during sensor zero procedure and when adjusting the sensor span.

Enter CALIBRATION menu (see **Software Programming** if not familiar with key stroke procedure).

Sensor zero

1. Place a piece of tape over the velocity sensor opening to seal off air flowing past the sensor.
2. Select SENSOR ZERO item.
3. Press **SELECT** key. Sensor zero procedure, which takes 120 seconds, is automatic.
4. Press **SELECT** key to save the data.
5. Remove tape from velocity sensor.

Sensor span

NOTE: Always zero sensor prior to adjusting the sensor span. A comparison thermal anemometer is required to calibrate the velocity span. Confirm a good average face velocity is present in the fume face before adjusting the span.

1. Open the fume hood sash 60% and let the controller reach setpoint.
2. Select SENSOR SPAN item (30 second countdown).
3. Use a thermal anemometer to traverse the open sash area and obtain the average face velocity of the air passing into the hood.
4. Compare the thermal anemometer to the Model 8650 controller.
5. Press the ▲/▼ keys until the controller velocity matches the thermal anemometer velocity.
6. Press **SELECT** key to save sensor span.
7. Exit menu, calibration is complete.

WARNING:	Calibrating the span on the SUREFLOW may be an iterative process that takes 1–3 trials to get an accurate calibration. Checking the calibration must be done after each trial until an accurate calibration is verified.

Flow Station Pressure Transducer Zero

NOTE: Flow stations are optional and may not be installed in your system.

1. Disconnect tubing between pressure transducer and flow station.
2. Enter calibration menu.
3. Select EXH FLO ZERO menu item.
4. Press **SELECT** key. Flow zero procedure, which takes 10 seconds, is automatic.
5. Press **SELECT** key to save data.
6. Connect tubing between pressure transducer and flow station.

Optimizing Controller Performance

The SUREFLOW uses both integral and PID control methods. Integral control (slower control signal) is used when the controller is near setpoint. Integral control provides stability when natural system fluctuations occur such as operators working at hoods and lab doors opening. PID control (fast control) is used when responding to large disturbances to face velocity such as sash movements. PID control rapidly returns the face velocity to setpoint, thus assuring containment. Once the SUREFLOW is in PID control, it continues to control in this mode until the operating setpoint is met.

There are four menu items that change the characteristics of the control output signal;

1) SENSITIVITY
2) SPEED
3) Kc VALUE
4) Ti VALUE

TSI recommends only adjusting the SENSITIVITY and SPEED to fine tune the control signal. Only when the SPEED and SENSITIVITY items cannot provide a stable system should Kc VALUE and Ti VALUE be adjusted. The role of each menu item is covered in the **Menu and Menu Items** section of the manual. This section provides some guidance of when a menu item should be changed.

The controller is shipped with PID values that are appropriate for 95+ % of the fume hoods installed. In fume hoods where some adjustment is needed, minor changes to the SENSITIVITY and SPEED menu items will yield excellent control. The SENSITIVITY item selects when the unit goes into PID control. Each bar missing on the display indicates that the controller must be 10 ft/min away from control setpoint prior to activating PID control. If 4 bars are missing, the face velocity must be 40 ft/min off setpoint before PID control is activated. Conversely, if 2 bars are missing, the face velocity must only be 20 ft/min off setpoint before PID control is activated. The default of 2 bars missing is usually a good compromise between PID and integral control.

The SPEED menu item slows down the control output. The controller is shipped with a control signal capable of rotating the damper 90 degrees in 5 seconds. This may be too fast if the damper is in an unstable flow area (very near the exhaust fan), or there are competing air flows in the laboratory. SUREFLOW controllers modulating a VFD system will probably need to be slowed down, since the control signal is substantially faster than the VFD/fan can respond.

The remaining menu items, Kc VALUE and Ti VALUE should not be adjusted unless severe stability problems exist. Adjusting these variables may improve the response and stability, but the exact opposite may happen causing the controller to become unstable, hunt substantially, or have very slow response. If

controller performance cannot be improved by adjusting the SPEED and SENSITIVITY, the two menu items can be manually set to their default values.

Maintenance and Repair Parts

The Model 8650 SUREFLOW Face Velocity Controller requires minimal maintenance. Periodic inspection of system components as well as an occasional velocity sensor cleaning are all that are needed to ensure that the Model 8650 is operating properly. The Model 8650 should be calibrated annually. Refer to the **Calibration** section for further information.

System Component Inspection

It is recommended that the velocity 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 laboratory air is dirty, the sensors will require more frequent inspection and cleaning.

Visually inspect the velocity sensor. The air flow orifice should be free of obstructions. The small, cylindrical, ceramic sensor protruding from the orifice wall should be white and free of accumulated debris.

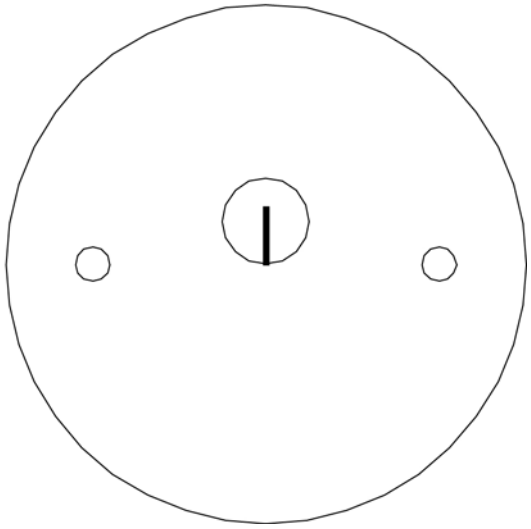


Figure 5: Velocity Sensor

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

Velocity 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 8650. Do **NOT** apply power before velocity sensor completely dries. 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 sensor warranty.

Replacement Parts

All components of the Face Velocity Control system are field replaceable. Contact TSI or your nearest TSI Manufacturer's Representative for replacement part pricing and delivery.

Part Number	Description
Found on back of unit	Model 8650 Face Velocity Controller
800320	Velocity sensor
800325	Velocity/Controller Sensor Cable
800414	Transformer Cable
800420	Transformer
800199	Controller Output Cable
800360	Electric Actuator
800119	Electric to Pneumatic Interface
800116	Pneumatic Actuator

Troubleshooting Section

The SUREFLOW Face Velocity 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 (mechanical) 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 laboratory 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 tests 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. A wiring diagram is located in Appendix B of this manual. The TSI cables are all color coded to ensure proper wiring. 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 Digital Interface Module (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 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 software may be corrupted. Check all menu 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
- Sensor input
- Analog output

NOTE: These diagnostic menu items are explained in the **Diagnostics Menu**, which is at the end of this section 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/damper rotation

Enter CONTROL OUT 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 control damper. If display reads 0% OPEN, press the ▲ key until 100% OPEN is shown on display. If display reads 100% OPEN, press ▼ key until 0% OPEN is shown on display. Note the position of the damper. The damper should have rotated 90 degrees. If

the damper rotated less than 85 degrees, see ***Troubleshooting chart; Control system is not controlling***.

Return controller to normal operation, and allow unit to modulate damper. Press the **EMERGENCY** key and verify damper opened completely. If damper opens completely, it passes test. If damper closes, go into CONTROL menu CONTROL SIG and change damper direction.

TEST - Sensor input

Enter SENSOR INPUT menu item in diagnostics menu. A number will be displayed. It is not important what the exact number is to pass this test. Tape over the velocity sensor. SENSOR INPUT should read a steady number. Remove tape and blow on sensor. Displayed value should change. If value changes, the unit passes. If display doesn't change, go to ***Troubleshooting chart; "SENSOR ERROR" flashing on display***.

TEST - Analog output

NOTE: This test is only performed if analog output feature is being used.

Enter ANALOG OUT menu item in diagnostics menu. A value between 0 and 255 will be displayed. Hook up a DC voltmeter to pins 9 and 10. Press the ▲/▼ keys to change output from 0 to 255. The value 255 corresponds to 0 volts (0 mA*) and 0 corresponds to 10 volts (20 mA). The value 150 corresponds to approximately 5 volts (12 mA).

*The Analog Out menu item spans 0 to 20 mA in this function only. At all other times the analog output is 4-20 mA.

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.

Diagnostics Menu

The items in the diagnostic menu aid in identifying problems the staff may encounter. The items in this menu temporarily change the function by pressing the ▲/▼ keys. No permanent change occurs with these menu items (except ACCESS CODE). Items are exited by pressing the **MENU** key. When an item is exited, the SUREFLOW returns to its normal state.

NOTE: An access code is used to prohibit unauthorized access to the DIAGNOSTICS menu. If you attempt to enter the DIAGNOSTICS menu when the access code is enabled, "Enter Code" flashes on and off on the display. To enter the menu, enter the DIAGNOSTICS menu access code found in Appendix C.

Control Output

Menu item - CONTROL OUT

The CONTROL OUT item changes the control output signal to the actuator/damper (or motor speed drive). When this item is entered, a number will be shown on the display indicating the last control output value. The range of values displayed is 0% OPEN – 100% OPEN. Pressing the ▲/▼ keys change the count on the display. Pressing the ▲ key should increase the displayed value, while pressing the ▼ key will decrease the displayed value. The control device should change as the number changes. On units controlling variable frequency drives, fan speed should increase or decrease as numbers change.

WARNING:	The CONTROL OUT function overrides the face velocity control signal. Adequate face velocity will **NOT** be maintained while in this menu item.

Analog Output

Menu Item - ANALOG OUT

The ANALOG OUT item varies the analog output from the SUREFLOW unit. When this item is entered, a number will be shown on the display indicating 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 ▲ key will increase the value displayed, and decrease the analog output. Pressing the ▼ key will decrease the value displayed and increase the analog output.

The ANALOG OUT function can be used in conjunction with a volt meter to verify the analog output is correct.

Low Alarm Relay

Menu Item - LOW ALM REL

The LOW ALM REL item changes the state of the low alarm relay. When this item is entered, the display will indicate either OPEN or CLOSED. The ▲/▼ keys are used to toggle the state of the relay. The ▲ key is used to OPEN the alarm contact. The ▼ key is used to CLOSE the alarm contact. When the contact is closed, the LOW ALM REL should be in an alarm condition.

High Alarm Relay

Menu Item - HIGH ALM REL

The HIGH ALM REL item changes the state of the high alarm relay. When this item is entered, the display will indicate either OPEN or CLOSED. The ▲/▼ keys are used to toggle the state of the relay. The ▲ key is used to OPEN the alarm contact. The ▼ key is used to CLOSE the alarm contact. When the contact is closed, the HIGH ALM REL should be in an alarm condition.

Setback Input

Menu Item - SETBACK IN

The SETBACK IN item reads the current state of the setback contact input. When this item is entered, the display will indicate either OPEN or CLOSED. If the display indicates CLOSED, the SUREFLOW has been put into setback mode through the contact input. If the display indicates OPEN, the SUREFLOW has not been put into setback mode through the contact input.

NOTE: The SUREFLOW may be in setback mode if it has been initiated through the keypad or the RS-485 network.

Emergency Input

Menu item - EMERGENCY IN

The EMERGENCY IN item reads the current state of the emergency contact input. When this item is entered, the display will indicate either OPEN or CLOSED. If the display indicates CLOSED, the SUREFLOW has been put into emergency mode through the contact input. If the display indicates OPEN, the SUREFLOW has not been put into emergency mode through the contact input. However, the SUREFLOW may be in emergency mode if it has been initiated through the keypad or the RS-485 network.

Sensor Input

Menu item - SENSOR INPUT

The SENSOR INPUT item verifies that the DIM or controller electronics is receiving a signal from the sensor. When this item is entered, a number will be indicated on the display. The exact number displayed is relatively unimportant. It is more important that the displayed number changes when the velocity changes (blow on sensor, move sash, etc.). If display does not change, see ***Troubleshooting chart; "SENSOR ERROR" flashing on display***.

Access Code

Menu Item - ACCESS CODE

The ACCESS CODE item selects whether an access code (pass code) is required to enter the menu. The ACCESS CODE item prevents unauthorized access to a menu. If the ACCESS CODE is ON, a code is required before the menu can be entered. Conversely, if the ACCESS CODE is OFF, no code is required to enter the menu.

Troubleshooting Chart

Symptom	Possible Cause	Corrective Action
Display is blank.	Fuse is blown.	Measure voltage at pins 1 and 2 on DIM 10-pin connector. The voltage should nominally be: 24–40 VDC when using TSI electric actuators. 24–30 VAC when using TSI pneumatic actuators. 24–30 VAC when using motor speed drives. If correct voltage is measured, internal DIM fuse is probably blown. Unplug 10-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 approximately 5 volts is measured, the fuse in the electric actuator or E/P is blown. Disconnect power to the electric actuator or E/P for two minutes to reset fuse. Disconnecting power requires either shutting off circuit breaker or disconnecting the wires on pins 1 and 2 on the electric actuator or E/P. If zero volts are measured, see ***No power to DIM***. Verify circuit breaker is on. Verify transformer primary measures 110 VAC. Verify transformer secondary measures 24–30 VAC. Verify electric actuator or E/P interface is receiving 24–30 VAC between pins 1 and 2. Verify 24–40 VDC is found between pins 3 and 4 of the electric actuator. Verify 24–30 VAC between pins 3 and 4 of the E/P interface. Verify DIM voltage on pins 1 and 2 is 24–30 VAC for pneumatic and VFD systems, or 32–40 VDC on electric actuators.
	No power to DIM.	Verify circuit breaker is on. Verify transformer primary measures 110 VAC. Verify transformer secondary measures 24–30 VAC. Verify electric actuator or E/P interface is receiving 24–30 VAC between pins 1 and 2. Verify 24–40 VDC is found between pins 3 and 4 of the electric actuator. Verify 24–30 VAC between pins 3 and 4 of the E/P interface. Verify DIM voltage on pins 1 and 2 is 24–30 VAC for pneumatic and VFD systems, or 32–40 VDC on electric actuators.
	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.

Symptom	Possible Cause	Corrective Action
Control system is not controlling.	Incorrect wiring.	Verify correct wiring (see ***Wiring diagram; Appendix C***). DIM must be wired exactly as shown.
	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.
	No control output signal.	Go into DIAGNOSTICS menu, CONTROL OUT 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 5 and 6 (10-pin connector) on the controller. Change the CONTROL OUT value about 40%. The voltage output should change approximately 4 volts. Change the CONTROL OUT value to approximately 59% OPEN. The voltage should read approximately 5 VDC. If no change occurs, disconnect control wires on pins 5 and 6 and repeat test. If DIM still fails to change voltage output, DIM is probably defective. If voltage changed DIM is working, either wiring or actuator (VFD) needs to be examined.
	Bad actuator or E/P (damper doesn't move).	Go into DIAGNOSTICS menu, CONTROL OUT 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 OUT 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 90 degrees. If damper rotated 90 degrees, actuator is installed and operating correctly. If damper did not rotate, check that: • Jumper is installed correctly on electric actuator or E/P. • 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 5 and 6 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 (CONTROL OUT menu item).

Symptom	Possible Cause	Corrective Action
Control system is not controlling *(continued).*	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 is full open or full closed, won't move.	Actuator jumper is missing, loose, or insulation is blocking contact. 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 setpoint cannot be reached, DIM will fully rotate damper to get as close to setpoint as possible. Fume hood exhaust; fan, static pressure, etc. needs to be adjusted.
.	Controller not calibrated.	Calibrate SUREFLOW controller. Controller is not calibrated leaving the factory, it must be field calibrated.
"SENSOR ERROR" flashing on display.	Poor sensor connections.	Verify the sensor cable is correctly plugged into the DIM and sensor. Connector is polarized but can be forced on backwards.
	Defective sensor.	Disconnect the velocity sensor cable from the back of DIM. Depress the latching piece on the connector to pull it out. Use an ohm meter to measure the resistance between the sensor connections indicated in figure below. The resistance between pins 3 and 4 should be between 10 and 12.5 ohms. The resistance between pins 2 and 4 should be between 120 and 140 ohms. If resistance does not measure correctly, verify that sensor cable is good.  **Figure 6: Velocity Sensor**
	Defective sensor cable.	Verify wire is terminated the same on both ends of cable. Confirm wire colors match pin 1 to 1, pin 2 to 2, etc. Test sensor cable with an Ohmmeter to ensure that cable terminations are good.
	Excessive face velocity.	Confirm the fume hood face velocity is over 1000 ft/min. If face velocity exceeds 1,000 ft/min, exhaust system needs balancing.
	Controller not calibrated.	Calibrate SUREFLOW Controller.
"DATA ERROR" flashing on display.	DIM was hit by electrical disturbance.	All data may be lost or changed. Review all configuration parameters. Check calibration of controller. DATA ERROR is removed by pressing the **RESET** key.

Symptom	Possible Cause	Corrective Action
Remote emergency doesn't work.	Incorrect wiring or defective switch. Defective controller.	Disconnect emergency remote wires from DIM. Verify wiring with an Ohmmeter by switching the emergency switch open and closed. If operational, reconnect to DIM. Verify wiring and switch are good. Enter DIAGNOSTICS menu EMERGENCY IN item. Display will indicate OPEN or CLOSED. Toggle the remote emergency switch, and the display should change between OPEN and CLOSED. If no change, replace DIM.
Remote setback doesn't work.	Incorrect wiring or defective switch. Defective DIM.	Disconnect remote wires from DIM. Verify wiring with an Ohmmeter by switching the setback switch open and closed. If operational, reconnect to DIM. Verify wiring and switch are good. Enter DIAGNOSTICS menu SETBACK IN item. Display will indicate OPEN or CLOSED. Toggle the remote setback switch, and display should change between OPEN and CLOSED. If no change, replace DIM.
DIM does not respond to network communications.	Network protocol is incorrect. Incorrect network address. Incompatible software. LonWorks or BACnet board not installed. Foreign network acquired controller. Bad LonWorks or BACnet board.	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 cannot recognize. Contact factory for further assistance. Go into CONFIGURE menu, LON item. Select GO UNCONFIG option, press the SELECT key. Return to the LON item, select the SERVICE PIN option and press the SELECT key. Selecting GO UNCONFIG will reset the 8650's authentication key, allowing the SERVICE PIN to install or reclaim the 8650 to the LonWork network. Contact factory for assistance.

Symptom	Possible Cause	Corrective Action
Alarm relays don't work.	Alarms are turned off. Incorrect wiring. Relay may be defective.	Press **TEST** key. The individual alarm setpoints will display. If all alarm setpoints are zero, alarm relay is not active, so relay will not be required to change state. Check the wiring from DIM relay's output to the device that is connected to the relays. Disconnect the wiring (10-pin connector) from relay contact pins 7 and 8 for low alarm relay and pins 9 and 10 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 ▲/▼ key 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.
Actuator hunting. Display indicates steady velocity.	Control system is unstable.	Go into CONTROL menu, SPEED item. Turn speed down until hunting is eliminated. If speed is too slow see ***Manual Section; Optimizing Controller Performance*** and adjust accordingly to eliminate problem.
Displayed velocity wildly fluctuating.	Exhaust system unstable. Laboratory supply air is affecting the sensor. Display averaging is very short. Controller needs calibration.	Turn DIM to emergency. If velocity stabilizes, this is not the problem. Check location of supply air diffusers. They should be located as far from the velocity sensor as is realistic, 10 feet preferred, 6 feet minimum. Supply diffuser terminal throw velocity must be less than 50% of the average controlled face velocity. Velocity in the fume hood chase (back side of sensor) should be less than 25% of the average controlled face velocity. The supply diffuser must be relocated if these parameters cannot be met. Lengthen the time constant by entering the CONFIGURATION menu, DISPLAY AVG item, and increase the average time. Calibrate SUREFLOW controller.
Analog output doesn't work properly.	Controller is connected to incompatible equipment.	Enter the DIAGNOSTICS menu, ANALOG OUT item. A number is displayed. Connect a voltmeter to pins 1 and 2 (8 pin connector). Pressing the ▲ key increases the displayed number and decreases the voltage (current) output. Pressing the ▼ key decreases the number and increases the voltage (current) output. If no change occurs, disconnect the analog out device and repeat above procedure. If voltage now changes, the controller is good, and the external device is defective. If no change occurs, DIM is defective.

Symptom	Possible Cause	Corrective Action
Displayed velocity doesn't match measured velocity.	Velocity sensor is dirty.	See ***Manual Section; Maintenance and Repair Parts***.
	Controller is not calibrated.	See ***Manual Section; Calibration***.
	Velocity sensor is not referenced to room air.	The velocity sensor must reference air from the same space as the fume hood space. If fume hood cabinet extends above to the ceiling, a Model 8691 Sensor Venting Kit must be installed.
Display does not read zero flow at zero flow.	SUREFLOW is not calibrated.	See ***Manual Section; Calibration***.
	Velocity sensor is not referenced to room air.	The velocity sensor must reference air from the same space as the fume hood space. If fume hood cabinet extends above to the ceiling, a Model 8691 Sensor Venting Kit must be installed.
Caution light momentarily goes on when sash is raised.	Control output needs adjustment.	See ***Manual Section; Optimizing Controller Performance***.
	Control response is slow.	Go into CONTROL menu, SPEED item and increase speed by one bar.
	Pneumatic actuator.	If TSI did not supply the pneumatic actuator, response may be slow if a large pneumatic actuator was installed.
Caution light on continuously. Display indicates steady velocity.	Controller is in setback mode.	Display should read SETBACK. Press **SETBACK** key, and control should return to normal.
	Controller is not controlling.	See Troubleshooting Chart; ***"Control System is Not Controlling."***
	Exhaust air is not adequate.	Turn controller to emergency. If displayed velocity doesn't increase, exhaust air is inadequate.

Symptom	Possible Cause	Corrective Action
Caution light on continuously. Displayed velocity wildly fluctuating.	Control is unstable.	Go into CONTROL menu, SPEED item. Turn speed down until velocity fluctuations are minimized.
	Exhaust system unstable.	Turn controller to emergency. If controller velocity stabilizes, this is not the problem.
	Laboratory supply air is affecting the sensor.	Check location of supply air diffusers. They should be as far from fume hood as is realistic (10 feet). The diffuser terminal throw velocity at the fume hood face should be less than 50% of the average fume hood controlled face velocity. Relocate supply air diffuser.
	Very high exhaust static pressure.	Turn controller to emergency. Open sash 50%. If velocity exceeds 500 ft/min, exhaust should be balanced.

Appendix A

Specifications

System Performance Specifications

Response Time	2 seconds nominal for 50 ft/min step change
Measurement Resolution	±1% of measurement
Temperature Compensated Range	55 to 95°F

Digital Interface Module

Display

Range	0 to 1,000 ft/min
Resolution	1 ft/min
Display Update	0.5 sec

Inputs

Setback In	SPST (N.O.) Switch. Closing switch initiates condition.
Emergency In	SPST (N.O.) Switch. Closing switch initiates condition.

Outputs

Analog Output

Type	0 to 10 VDC or 4 to 20 mA
Range	0 to 1,000 ft/min
Resolution	5 ft/min
Response Time	0.1 second

Low Alarm Range	5 to 980 ft/min
High Alarm Range	80 to 1,000 ft/min
Alarm Contacts	SPST (N.C.) Max current 5.0 amps, max voltage 150 VDC 250 VAC. Maximum switch load 10 mA, 5 VDC. Contacts close in alarm condition.
RS-485	Yes
Communications Protocols	Modbus RTU or N2 standard LonWorks (Optional) BACnet MS/TP (Optional)
Operating Temperature	32 to 120°F
Internal Scan Rate	50 msec
Input Power	24 VAC, 6 watts max
Dimensions	5.5 in. × 3.125 in. × 1.125 in.
Weight	0.75 lb

Velocity Sensor

Temperature Compensation Range	55 to 95° F
Power Dissipation	0.09 watts at 0 ft/min., 0.14 watts at 100 ft/min.
Dimensions (D x H)	2.75 in. × 1.25 in.
Weight	0.2 lb
Sensor Cable Specifications	4-conductor, 22 AWG, 4-pin polarized at both ends with a standard length of 6 ft, a maximum length of 10 ft.

Damper/Actuator

Types of Actuators	Electric or pneumatic
Input Power	Electric: 24 VAC, 7.5 watts max Pneumatic: 24 VAC, 3 watts max
Time for 90° Rotation	1.5 sec. electric, 5 sec. pneumatic

Appendix B

Network Communications

Network communications are available on the Model 8650. The Model 8650 can communicate with a building management system through Modbus, N2, LonWorks or BACnet MS/TP protocols. Please refer to the appropriate section below for more detailed information.

Modbus Communications

Modbus communications are installed in the Model 8650 adaptive offset room pressure controllers. This document provides the technical information needed to communicate between the host DDC system and the Model 8650 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 8650 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, and CFM. If the DDC system is to display different units, the DDC system needs to make the conversion.

XRAM 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 hood is individually setup for maximum performance. TSI offers a number of different models, so if a feature is not available on a unit, the variable is set to 0.

Modbus Communications *(continued)*

8650 Variable List

Variable Name	Variable Address	Input Provided to Master System	Integer DDC System Receives
Face Velocity	0	Current Face Velocity	Displayed in ft/min.
Status Index	1	Status of SUREFLOW device	0 Normal 1 Setback 2,3 Low Alarm 4,5 High Alarm 6,7 No Flow Alarm* 8,9 Sensor Error 10,11 Data Error 12,13 Emergency
Emergency Mode	2	Put unit in or out of emergency	Write only variable 0 Take unit out of emergency mode. 1 Put unit in emergency mode.
Setback Mode	3	Put unit in or out of setback	Write only variable 0 Take unit out of setback mode 1 Put unit in setback mode.
Main Setpoint	4	Main control setpoint	Displayed in ft/min
Setback Setpoint	5	Setback control setpoint	Displayed in ft/min
Low Alarm	6	Low alarm setpoint	Displayed in ft/min
High Alarm	7	High alarm setpoint	Displayed in ft/min
No Flow Alarm	8*	No flow alarm setpoint	Displayed in ft/min
Averaging Index	9	Display averaging period	0 .3 sec. 1 .5 sec. 2 .75 sec. 3 1 sec. 4 2 sec. 5 3 sec. 6 5 sec. 7 10 sec. 8 20 sec. 9 40 sec.
Units	10	Units of device	0 ft/min 1 m/s
Alarm Mode	11	Alarm reset mode	0 Unlatched 1 Latched
Output Signal	12	Output mode	0 4–20 Ma 1 0–10 Volt
Audible Disable	13	Permanent mute enable	0 Off 1 On
Network Protocol	14	Communications Protocol	0 Modbus 1 N2
Network Address	15	Communications Address	1-247
Control Action	23	Action of control signal	0 Reverse 1 Direct
Min Damper	39	Minimum damper position	0 to 255
Max Damper	40	Maximum damper position	0 to 255
Damper Position	46	Current damper position	0 to 100% * 100

*Not available on standard Model 8650s.

EXAMPLE of **16 (10 Hex) Preset Multiple Regs** function format:
This example changes the low alarm setpoint to 60 ft/min

QUERY		**RESPONSE**	
Field Name	(Hex)	Field Name	(Hex)
Slave Address	01	Slave Address	01
Function	10	Function	10
Starting Address Hi	00	Starting Address Hi	00
Starting Address Lo	06	Starting Address Lo	06
No. Of Registers Hi	00	No. of Registers Hi	00
No. Of Registers Lo	01	No. of Registers Lo	01
Data Value (High)	00	Error Check (CRC)	--
Data Value (Low)	3C		
Error Check (CRC)	--		

EXAMPLE of **03 Read Holding Registers** function format:
This example reads the face velocity and status index

QUERY		**RESPONSE**	
Field Name	(Hex)	Field Name	(Hex)
Slave Address	01	Slave Address	01
Function	03	Function	03
Starting Address Hi	00	Byte Count	04
Starting Address Lo	00	Data Hi	00
No. Of Registers Hi	00	Data Lo	64 (100 ft/min)
No. Of Registers Lo	02	Data Hi	00
Error Check (CRC)	--	Data Lo	00 (0 Normal)
		Error Check (CRC)	

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 setpoints for the face velocity controller. These setpoints can be changed through the keypad or by over-writing the current setpoint.

NPA - Network Point Address
Address of the desired point.

Change of Status (COS) - Face Velocity Analog Input
The 8650 has the ability to change control setpoints locally. The alarm setpoints need to be based on the controllers control setpoint (AI #2). The unit can be changed from Normal Mode to Setback Mode. For example the setpoint could go from 100 ft/min to 60 ft/min when the Setback key is pressed. If the COS alarm setpoints 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 setback and main velocity setpoint 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 the Setback or Emergency binary inputs enables the respective mode. To return the controller to normal mode from setback mode, press the Setback key on the controller, toggle the setback contact input, or release the override. To release controller from emergency state, override a 0 to the Emergency input, toggle the emergency contact input, or press either the emergency or reset key. Releasing the override will return the controller to the state it was in previous to the emergency, either Normal or Setback.

The alarm, data error, and sensor 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 Inputs, Sensor Error and Data Error
Sensor Error and Data Error binary inputs are used to indicate if something has gone wrong with the controller. The Sensor Error is set when the sensor on the controller has a malfunction. This indicates that service should be done on the controller. Data Error indicates when some of the data stored on the device has been corrupted. The calibration and setpoint 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.

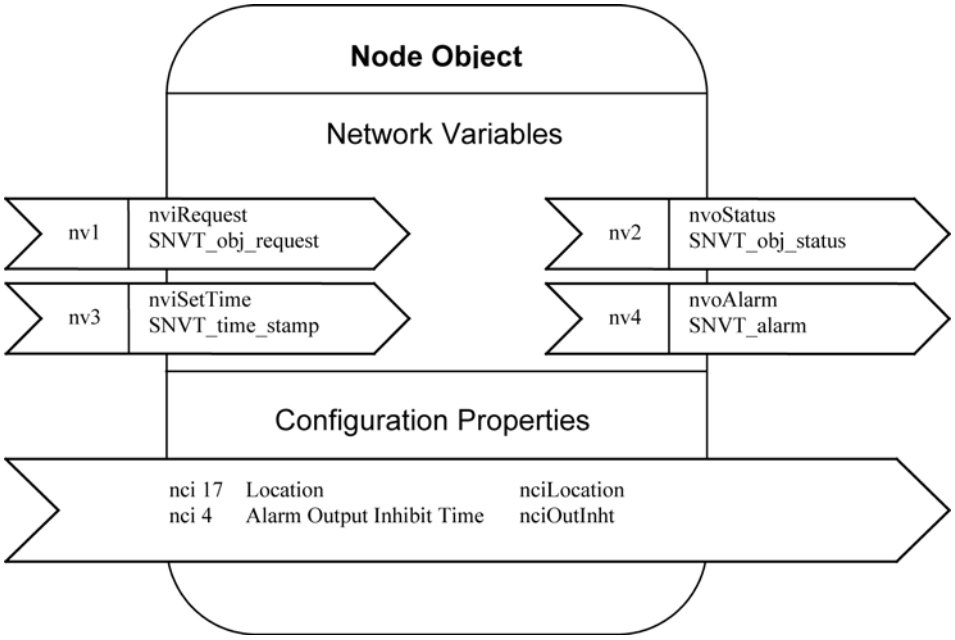
Variable Map

NPT	NPA	**Units	Description	
AI	1	ft/min,m/s	Face Velocity	
AI	2	ft/min,m/s	Current Face Velocity Setpoint	
AI	3	#	Control Output	
BI	1		Control Mode	0=Normal 1=Setback
BI	2		Low Face Velocity Alarm	0=Normal 1=Low Alarm
BI	3		High Face Velocity Alarm	0=Normal 1=High Alarm
BI	4*		No Flow Alarm	0=Normal 1=No Flow Alarm
BI	5		Sensor Error	0=Normal 1=Sensor Error
BI	6		Data Error	0=Normal 1=Data Error
BI	7		Emergency Mode	0=Normal 1=Emergency
AO	1	ft/min,m/s	Velocity Setpoint	
AO	2	ft/min,m/s	Setback Velocity Setpoint	
AO	3	ft/min,m/s	Low Alarm Setpoint	
AO	4	ft/min,m/s	High Alarm Setpoint	
AO	5*	ft/min,m/s	No Flow Alarm Setpoint	
AO	6	#	Units	0=English 1=Metric

* Not available on standard Model 8650s.

** The units of the variables are based on the units variable. When the units variable is set to 0 the values are in English form. When the units variable is set to 1 the units are metric. English is the default units.

LonWorks Node Object



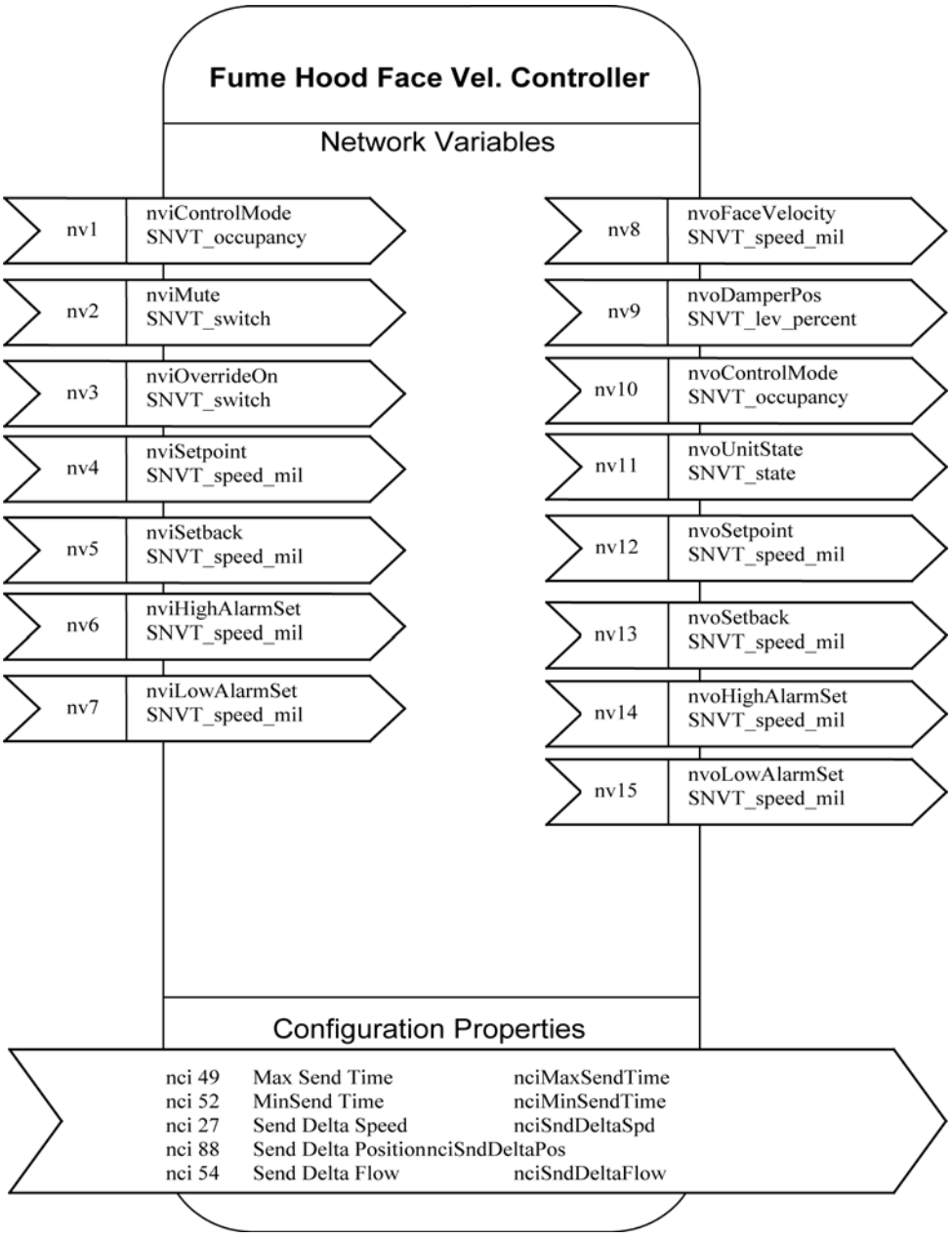
LonWorks Controller Status Definition

nvoUnitState

Bit	Description
0	0 = Occupied 1 = Unoccupied
1	Low Alarm
2	High Alarm
3	Sensor Error
4	Data Error
5	Emergency Mode
6	Override

Note Setting nviRequest.object_request to RQ_CLEAR_ALM clears the current alarm from the controller and the BAS.

LonWorks Object



8650 BACnet MS/TP Protocol Implementation Conformance Statement

Date: March 6, 2007
Vendor Name: TSI Inc.
Product Name: SUREFLOW Face Velocity Controller
Product Model Number: 8650-BAC
Applications Software Version: 1.0
Firmware Revision: 1.0
BACnet Protocol Revision: 2

Product Description:

TSI's SUREFLOW™ Fume Hood Face Velocity Controller provides a closed-loop VAV control system for proper lab hood containment. SUREFLOW assures safety by responding quickly during sash movement, or to disturbances within the sash plane, to maintain a constant face velocity and contain hazardous chemicals. SUREFLOW provides opportunities for energy savings, lower fan brake horsepower, smaller chillers and lower duct work cost by reducing the volume of air exhausted from a hood when the sash is not fully open. 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

BACnet MS/TP Object Set

Object Type	Device Instance	*Units	Description	
Analog Input	1	ft/min, m/s	Face Velocity	
Analog Input	2	%	Damper Position	
Analog Value	1		MAC Address	1 – 127
Analog Value	2	ft/min, m/s	Face Velocity Setpoint	
Analog Value	3	ft/min, m/s	Setback Setpoint	
Analog Value	4	ft/min, m/s	Low Alarm Setpoint	
Analog Value	5	ft/min, m/s	High Alarm Setpoint	
Analog Value	6	%	Min. Damper Position	0 – 100
Analog Value	7	%	Max. Damper Position	0 – 100
Binary Value	1		Units Value	0 ft/min 1 m/s
Multi-State Input	1		Status Index	1 Normal 2 Setback 3,4 Low Alarm 5,6 High Alarm 7,8 No Flow Alarm** 9,10 Sensor Error 11,12 Data Error 13,14 Emergency
Multi-State Value	1		Baud Rate	1 Auto 2 9600 3 19200 4 38400 5 76800
Multi-State Value	2		Emergency Mode	1 Take out of Emergency Mode 2 Put into Emergency Mode 3 Normal
Multi-State Value	3		Setback Mode	1 Take out of Setback Mode 2 Put into Setback Mode 3 Normal
Device	865001***		TSI8650	

* The units are based on the value of the Units Value object. When the Units Value is set to 0 the units are in English form. When the Units Value is set to 1 the units are metric. English is the default value.

** The No Flow Alarm is not available on standard Model 8650s.

*** The device instance is 865000, summed with the MAC address of the device.

Appendix C

Wiring Information

Back Panel Wiring

PIN #	Input / Output / Communication	Description
	J1 Terminal Strip	
1, 2	Input	24 VAC to power Digital Interface Module (DIM). **NOTE**: 24 VAC becomes polarized when connected to DIM.
3, 4	Communications	LonWorks or BACnet MS/TP communications to building management system (optional)
5, 6	Output	0–10 VDC, fume hood exhaust control signal. 10 VDC = open (n.o. damper) - See menu item CONTROL SIG
7, 8	Output	Low alarm relay - N.O., closes in low alarm condition. - See menu item LOW ALARM
9, 10	Output	High alarm relay - N.O., closes in low alarm condition. - See menu item HIGH ALARM
	J5 Terminal Strip	
7, 8	Communications	RS-485 communications; DIM to building management system (Modbus or N2)
5, 6	Input	Non powered switch input. - See menu item EMERGENCY IN.
3, 4	Input	Non powered switch input. - See menu item SETBACK.
1, 2	Output	0–10 VDC, face velocity signal output - See menu item OUTPUT SIG

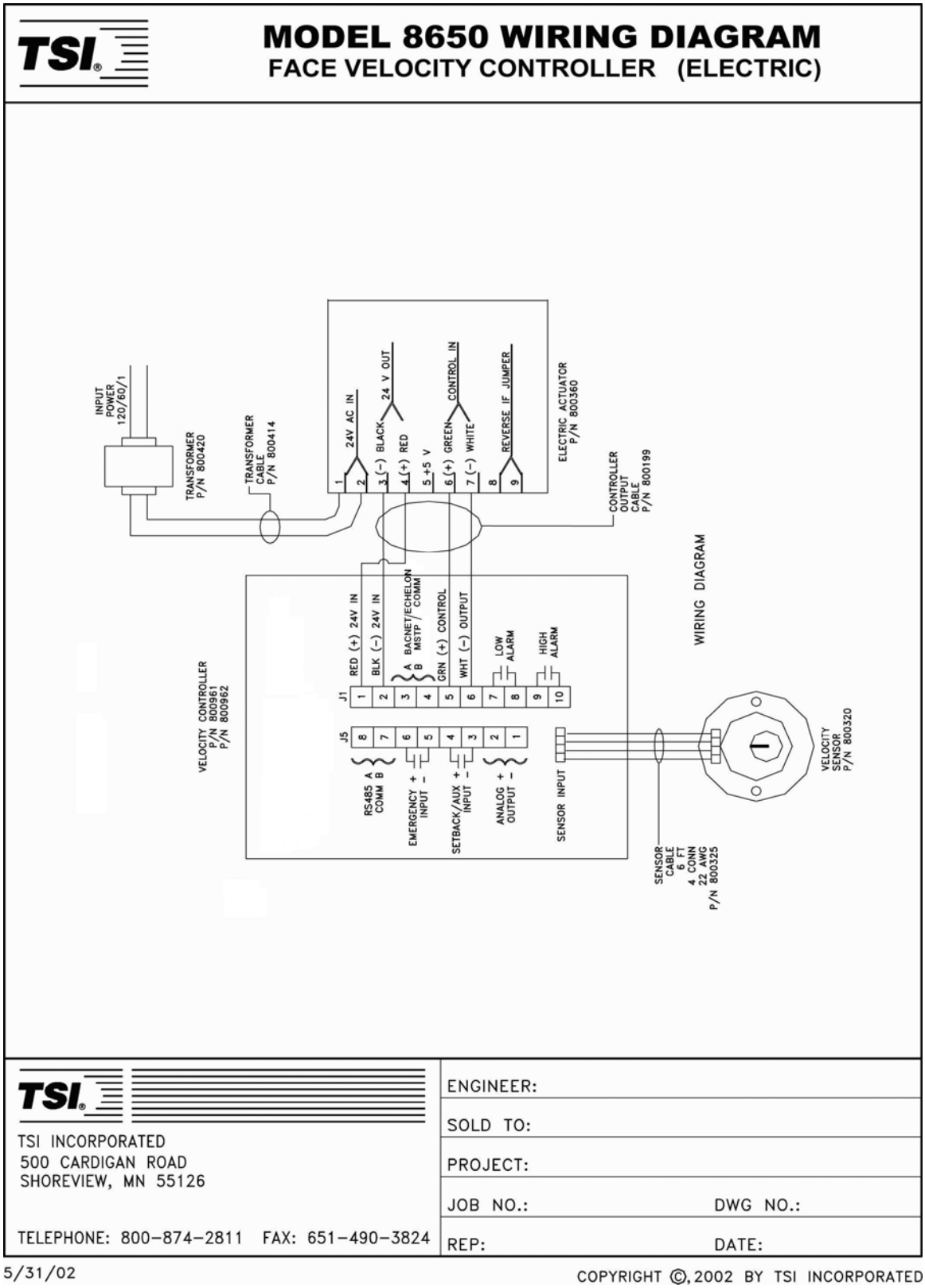


Figure 7: SUREFLOW Wiring Diagram - Electric Actuator

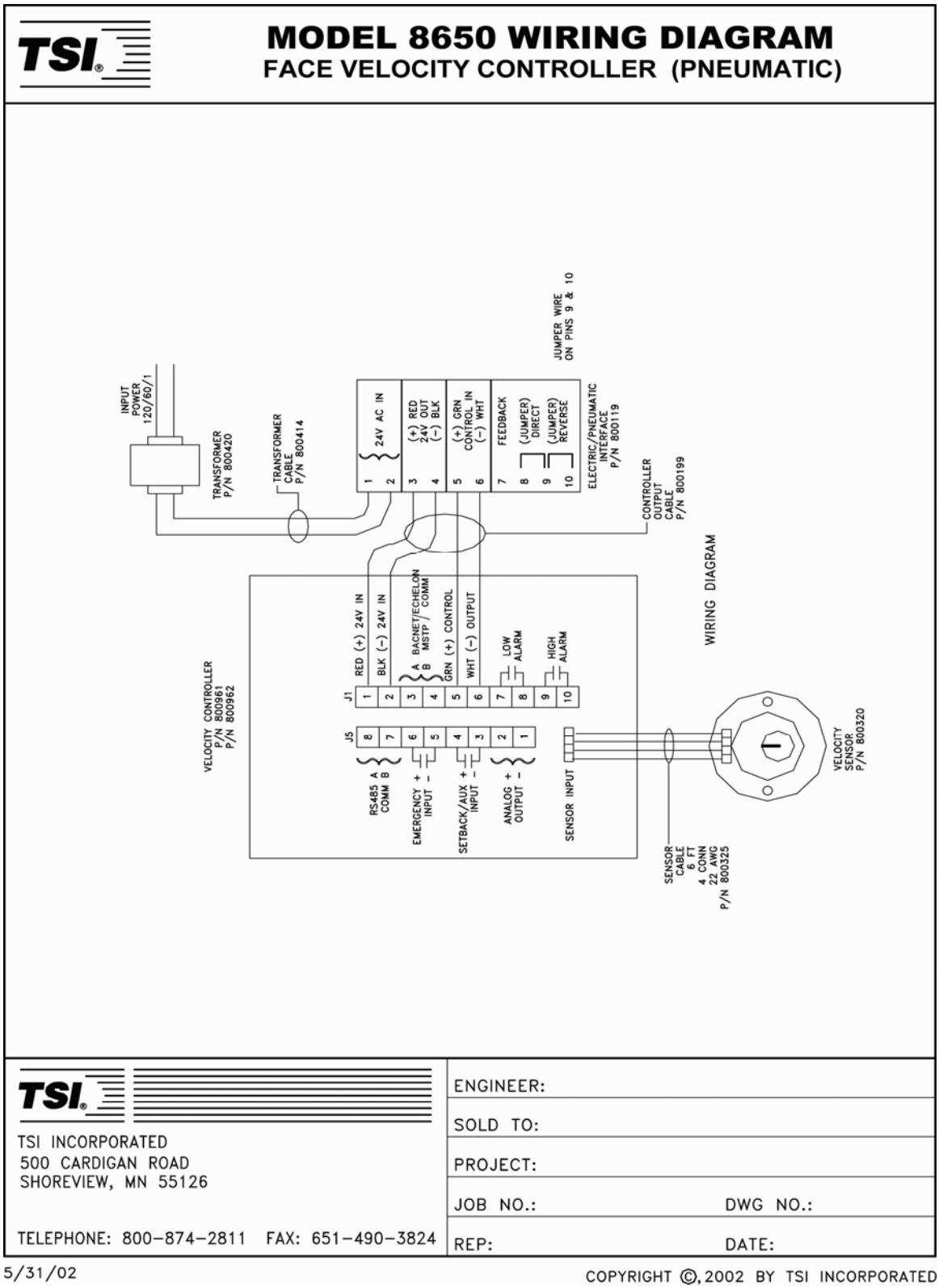


Figure 8: SUREFLOW Wiring Diagram - Pneumatic Actuator

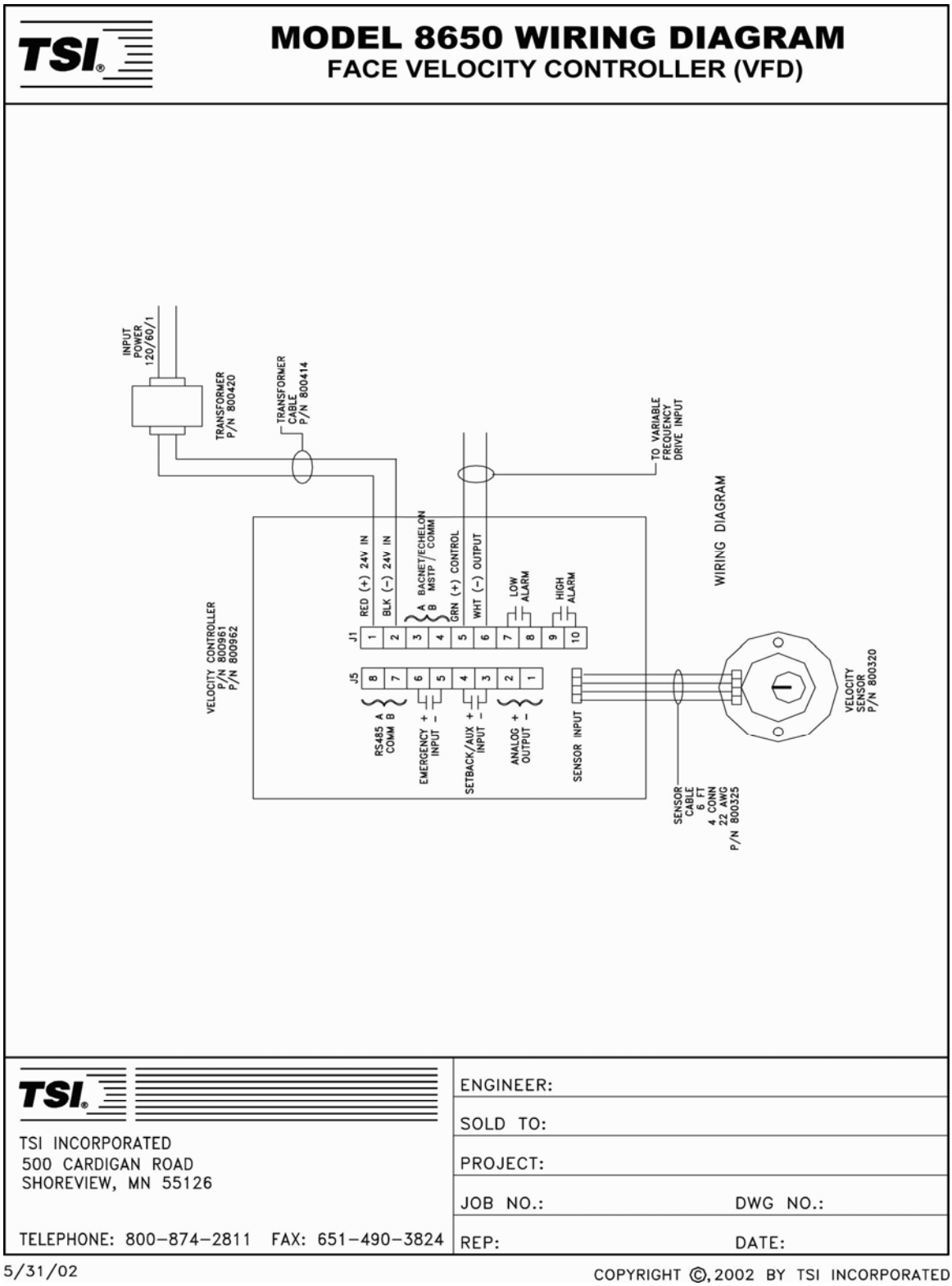


Figure 9: SUREFLOW Wiring Diagram - Variable Frequency Drive

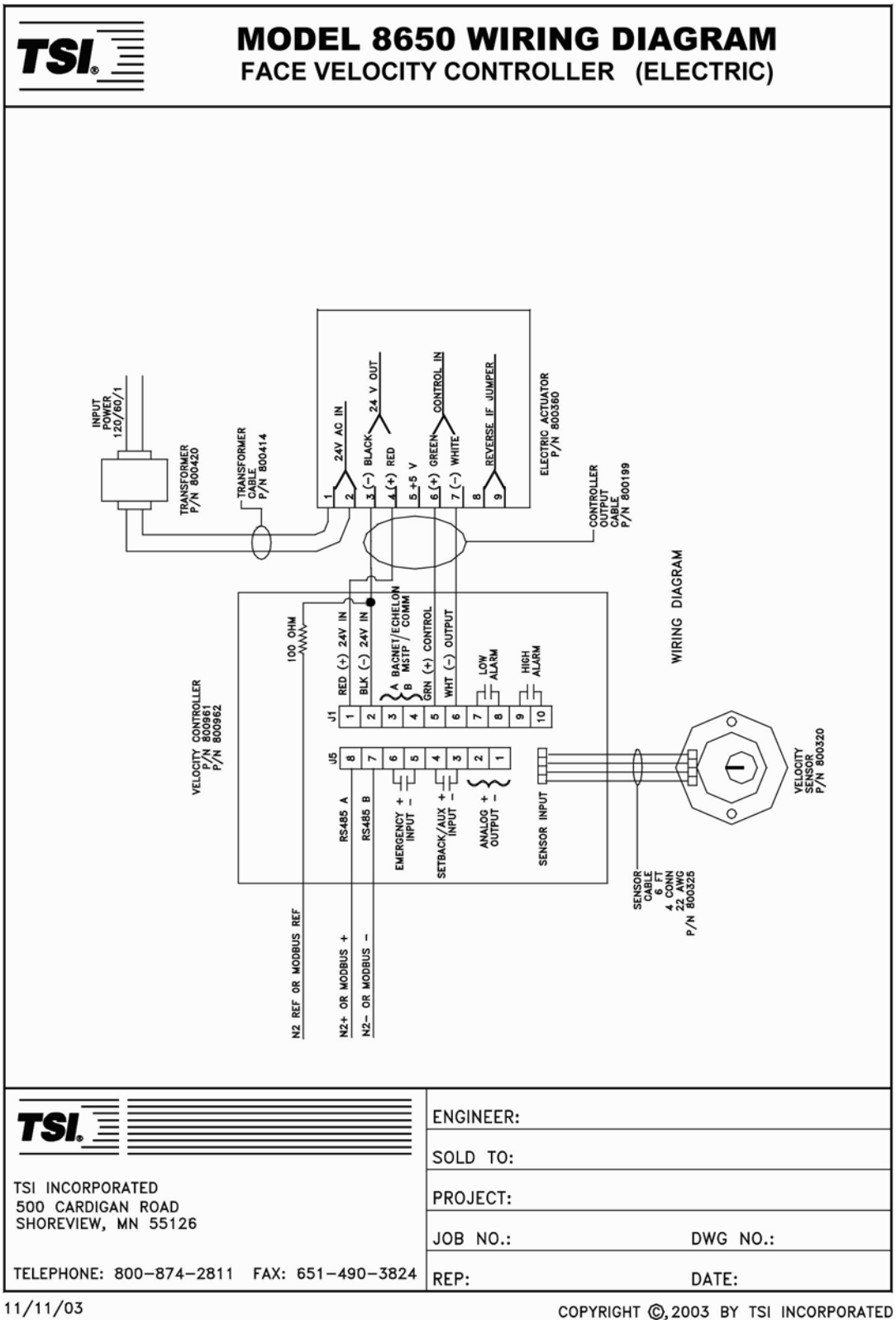


Figure 10: SUREFLOW RS485 Communication Wiring Diagram - Electric Actuator

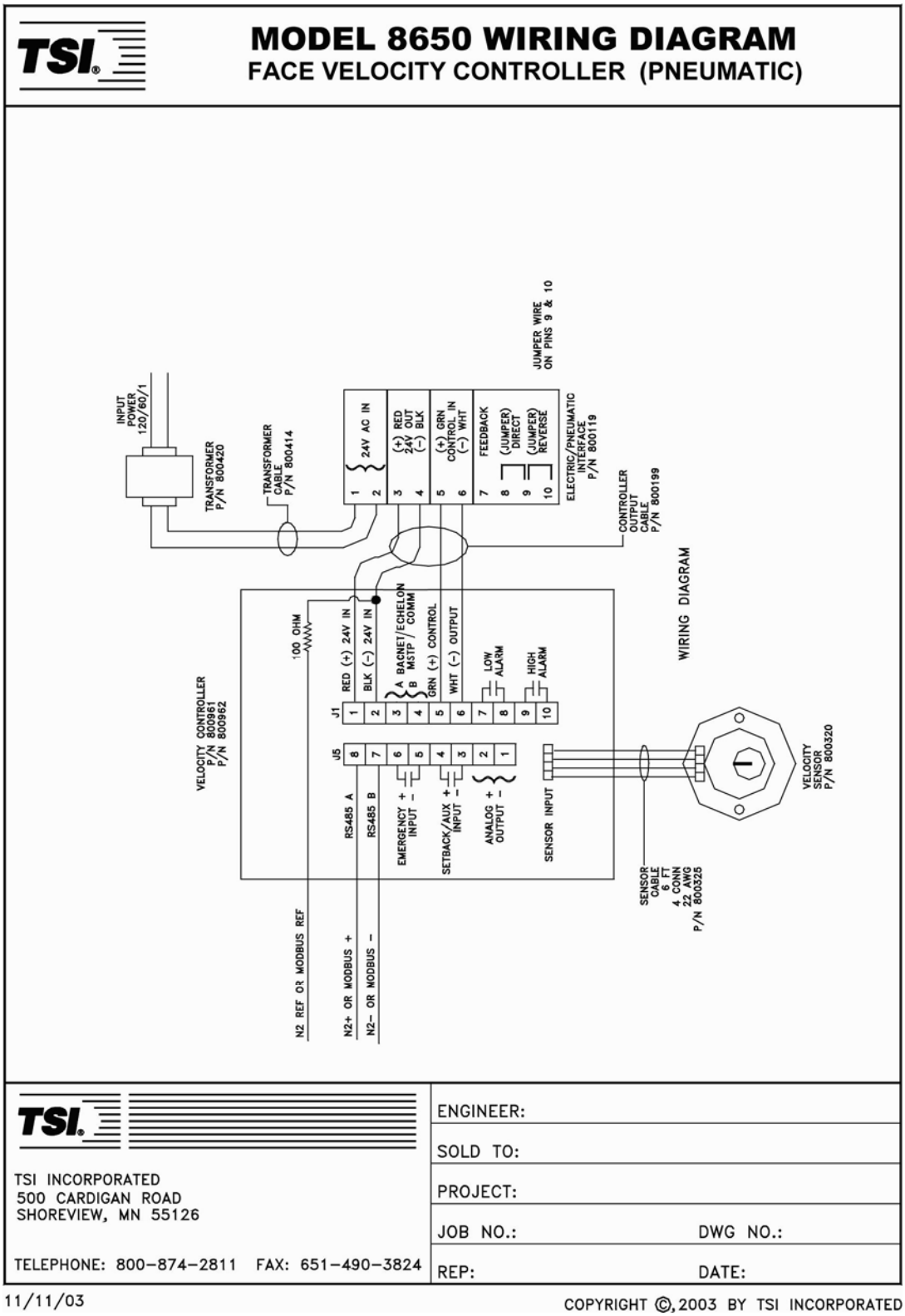


Figure 11: SureFlow RS485 Communication Wiring Diagram - Pneumatic Actuator

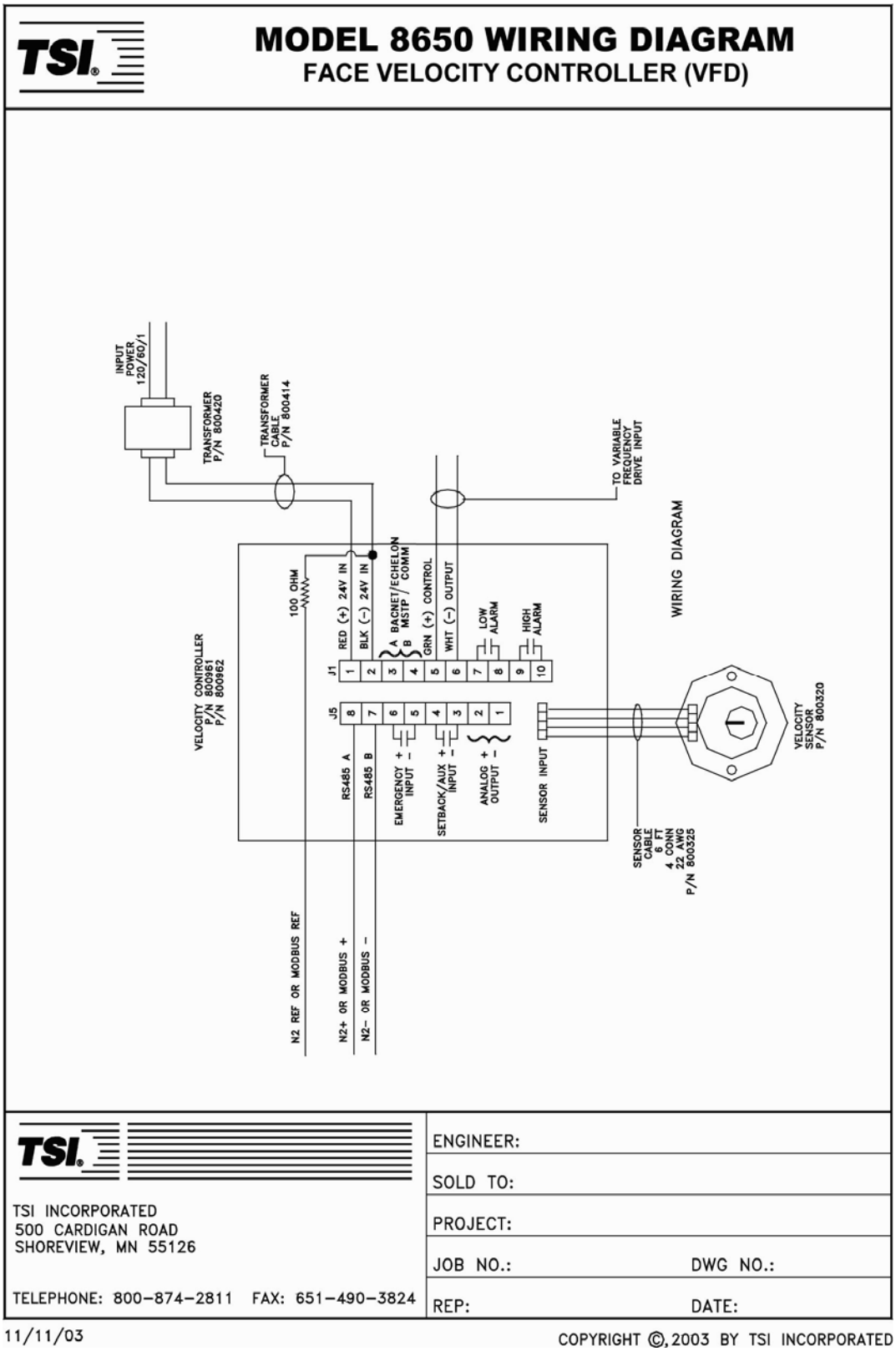


Figure 12: SUREFLOW RS485 Communication Wiring Diagram - Variable Frequency Drive

Appendix D

Access Codes

These are the access codes to the different menus of the SUREFLOW controllers. When an access code is required, pressing the following key sequence will provide access to the required menu.

Key #	Setpoints	Configure	Calibration	Control	Diagnostics
1	EMERGENCY	EMERGENCY	SETBACK	MENU	TEST
2	MUTE	MENU	MENU	MUTE	MUTE
3	MUTE	SETBACK	MUTE	RESET	SETBACK
4	MENU	MENU	MENU	EMERGENCY	SETBACK
5	SETBACK	MENU	SETBACK	SETBACK	MENU

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