APOGEE
Laboratory Room Controller
Owner's Manual

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WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case users at their own expense will be required to take whatever measures may be required to correct the interference.

SERVICE STATEMENT

Control devices are combined to make a system. Each control device is mechanical in nature and all mechanical components must be regularly serviced to optimize their operation. All Siemens Building Technologies branch offices and authorized distributors offer Technical Support Programs that will ensure your continuous, trouble-free system performance.

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TO THE READER

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How To Use This Manual

This manual is written for the owner and user of the Siemens Building Technologies, Inc. Fume Hood Controller. Direct communication with the Fume Hood Controller is accomplished by using the portable operator's terminal and CIS. For more information about these products, contact your local Siemens Building Technologies, Inc. representative. This section covers manual organization, manual conventions and symbols used in the manual, how to access help, related publications, and any other information that will help you use this manual.

Manual Organization

This manual contains the following chapters:

- *Chapter 1 - Introduction* describes the primary functionality of a Laboratory Room Controller and some typical configurations.
- *Chapter 2 - Hardware* describes the hardware components and the accessories that are used with the controller.
- *Chapter 3 - Controlling Laboratory Airflow* describes the control applications available for controlling ventilation and pressurization.
- *Chapter 4 - Controlling Laboratory Temperature* describes the control applications available for controlling temperature.
- *Chapter 5 - Monitoring Laboratory Operation* describes ways to monitor and verify safe operation of a LRC.
- *Chapter 6 - Point Database* defines the point database descriptors and includes addresses and applications.
- A *Glossary* describes the terms and acronyms used in this manual.
- An *Index* is provided to assist you in finding information.

Manual Conventions

The following table lists conventions to help you use this manual in a quick and efficient manner.

Convention	Example
Numbered Lists (1,2,3…) indicate a procedure with sequential steps.	1. Turn OFF power to the field panel. Turn ON power to the field panel. 2. Contact your local Siemens Building Technologies representative.
Actions that you should perform are specified in boldface font.	Type **F** for Field panels. Click **OK** to save changes and close the dialog box.
Error and system messages are displayed in Courier New font.	The message `Report Definition successfully renamed` appears in the status bar.
New terms appearing for the first time are italicized.	The Open Processor continuously executes a user-defined set of instructions called the *control program*.

Manual Symbols

The following table lists the symbols used in this Owner's Manual to draw your attention to important information.

Notation	Symbol	Meaning
WARNING:		Indicates that personal injury or loss of life may occur to the user if a procedure is not performed as specified.
CAUTION:		Indicates that equipment damage, or loss of data may occur if the user does not follow a procedure as specified.

Getting Help

For more information about the Laboratory Room Controller contact your Siemens Building Technologies, Inc. representative.

Where To Send Comments

Your feedback is important to us. If you have comments about this manual, please submit them to technical.editor@sbt.siemens.com.

1

Introduction

The Controller

The Siemens Building Technologies, Inc. Laboratory Room Controller (LRC) applies Direct Digital Control (DDC) technology to laboratory HVAC systems. Its primary functions are the following:

- pressurizing the laboratory (using volumetric tracking) so air moves into the laboratory from surrounding spaces
- delivering enough ventilation to the room to dilute air contaminants
- maintaining the desired air temperature in the room

The LRC is specifically designed to perform these functions in laboratories with VAV fume hoods. The components are selected and arranged to combine the speed, stability, and accuracy in airflow control that the VAV laboratory demands.

The LRC is equipped with ventilation and pressurization alarms that are designed to fit into a safety program. When the ventilation system fails to function properly, the LRC can detect and indicate the alarm condition throughout the facility. The LRC can activate alarm devices in or near the room and broadcast that information through the Building Automation System (BAS) to the people designated to respond to the problem.

As part of a networked BAS, the LRC makes it possible for the maintenance staff to monitor, troubleshoot and adjust laboratory HVAC operation remotely. The BAS can collect and process data from the LRC to generate longer-term records of laboratory operation. These records can be used as part of a building quality assurance program. Reports can also be tailored to serve as safety records, or for use in energy accounting.

To help you make the best use of your energy budget; the LRC has features that support reducing the ventilation rate during periods in which the laboratory is unoccupied.

LRC Configurations

The LRC is equipped to handle a variety of combinations of ventilation devices in one room. Each LRC in your system is initially set up to cover the equipment installed at that time. Laboratory ventilation systems are known to change from time to time, usually as exhaust devices are added, or removed. This section explains various ways your LRC may be adapted to accommodate changes in the ventilation equipment. Contact your local Siemens Building Technologies, Inc. representative for more specific information about your options.

Two versions of the LRC are available, one for pneumatic actuation (Applications 2601, 2602, and 2603) and the other for electronic actuation (Applications 2611, 2612, and 2613).

Configurations with General Exhaust

One Supply, One Hood, One General Exhaust - This is the most basic arrangement. The supply flow and general exhaust are controlled as described in *Chapter 3, Controlling Laboratory AirFlow*, to provide the required quantity of supply and exhaust air to meet both the needed ventilation and temperature for the laboratory space. The supply may be a single or dual duct terminal. If it is a single duct terminal, the controller runs Application 2601 or 2611 (refer to Figure 1-1); if it is dual duct terminal, the controller runs Application 2603 or 2613 (refer to Figure 1-2).

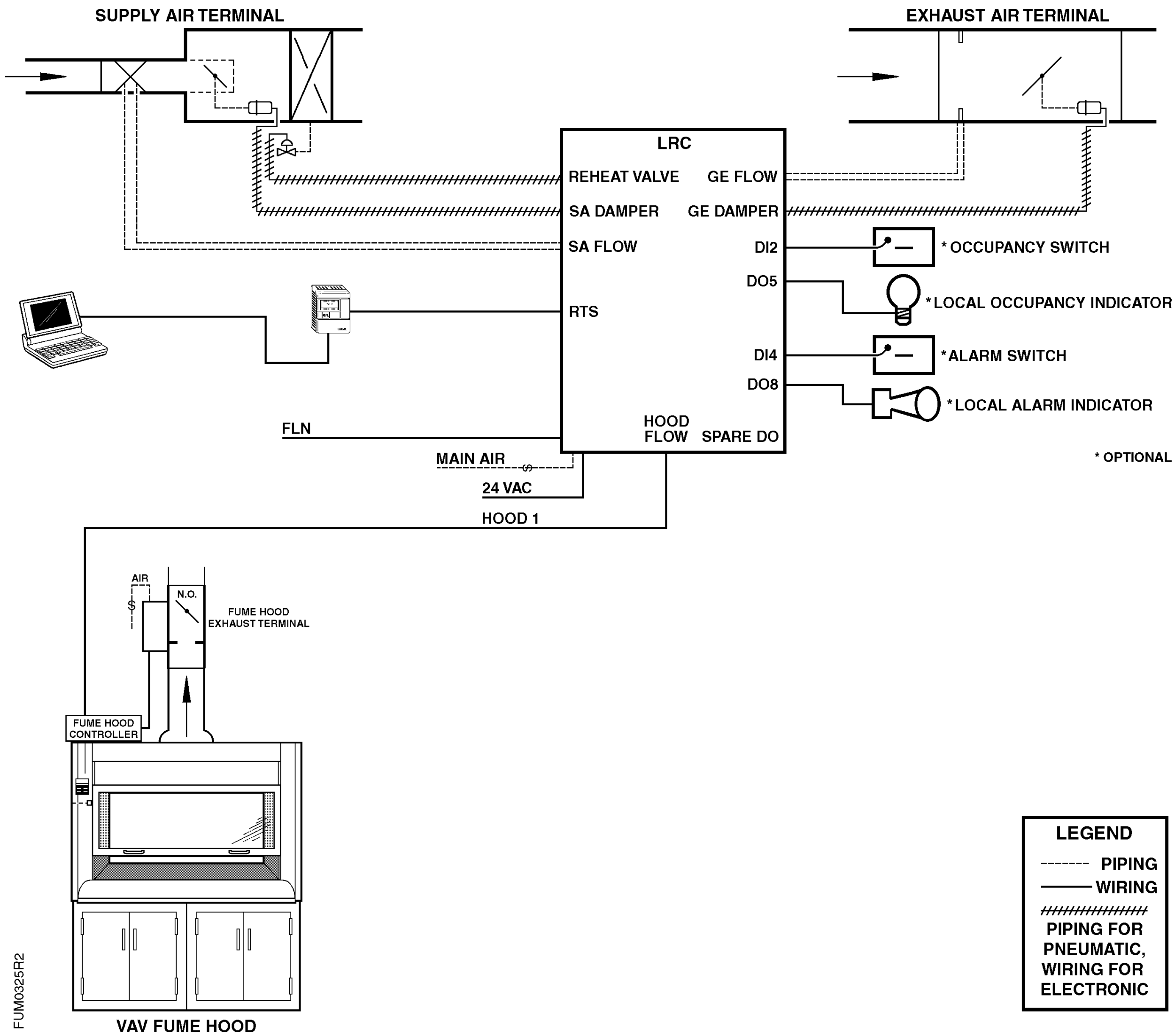

Figure 1-1. One Supply, One Hood, One General Exhaust.

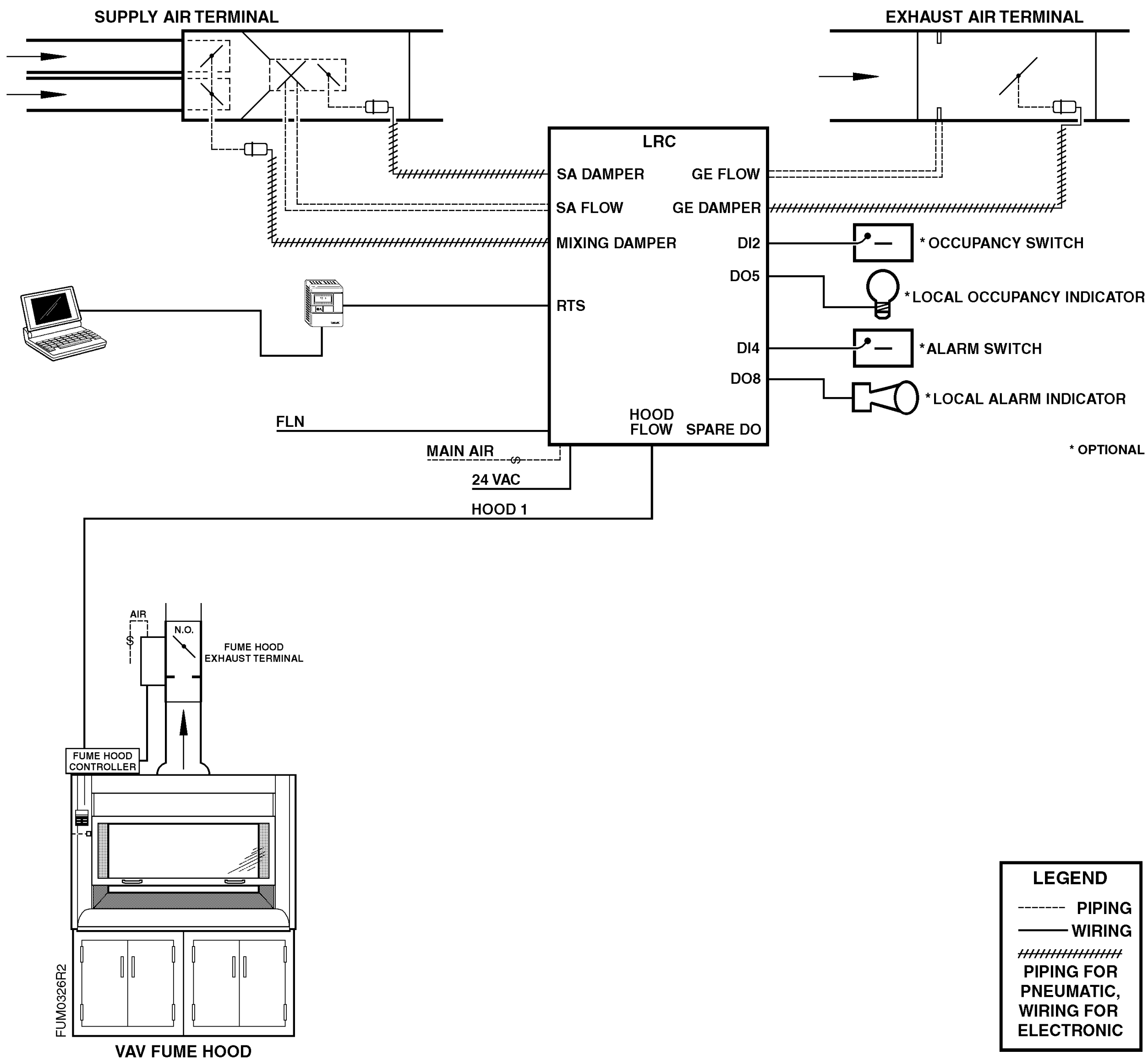

Figure 1-2. Dual Duct Supply, One Hood, One General Exhaust.

Occasionally, a change in the laboratory will lead to a change in the face velocity of the fume hood. Changes to the face velocity of the fume hood may not require changes at the LRC; however, the new range of fume hood airflows may lead to changes in the airflow limits of the supply and general exhaust terminals. The signal that connects the FHC to the LRC would have to be adjusted if the new maximum flow is more than the original signal range.

One Supply, Two or More Hoods, One General Exhaust - This configuration operates the same way as the One Supply, One Hood, One General Exhaust. The supply flow and general exhaust are controlled as described in *Chapter 3, Controlling Laboratory AirFlow*, to provide the required quantity of supply and exhaust air to meet both the needed ventilation and temperature for the laboratory space. The difference is that instead of just one fume hood, there can be a maximum of four. If more than one fume hood is present, a Fume Hood Flow Module (FFM) must be used. A FFM receives airflow signals from up to four FHCs, combines those signals, and delivers one combined airflow signal to the LRC. The FFM detects open circuit inputs so that it can correctly average only the signals connected to it, even when a FHC signal fails. Refer to Figure 1-3.

Adding more fume hoods to a system that only has one fume hood means adding a FFM to combine the signals. Adding fume hoods with Siemens Building Technologies, Inc. controls to a system that already has a FFM does not require any new room control components. In either case, it is necessary to re-evaluate the limits on the supply and exhaust airflows. These limits may need to be adjusted, or new supply or exhaust may need to be added. It may also be necessary to adjust the scaling factor that interprets the fume hood flow signal.

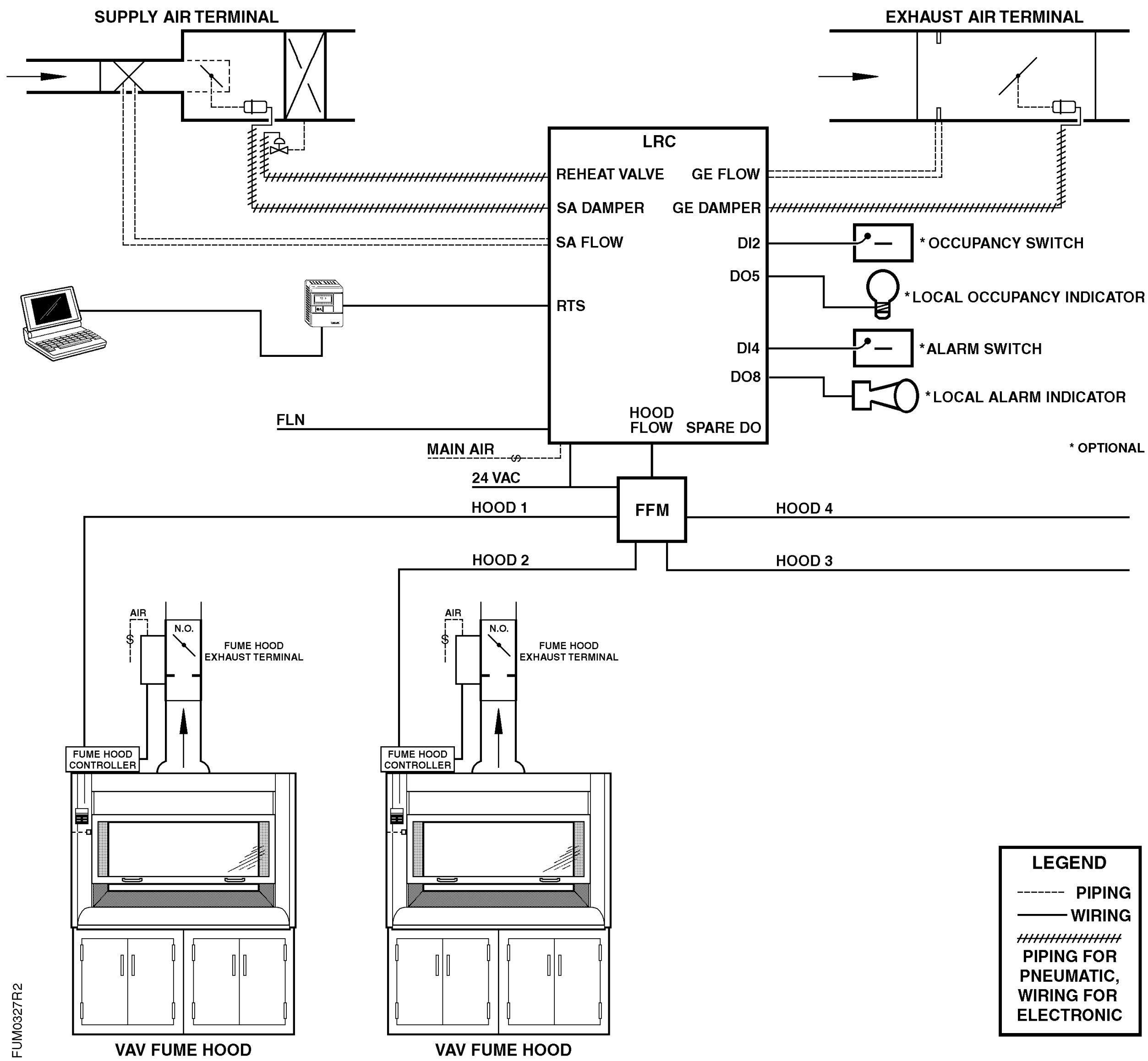

Figure 1-3. One Supply, Two or More Hoods, One General Exhaust.

Adding other exhaust devices - Other types of exhaust devices may be handled in a variety of ways (refer to Figure 1-4), including the following:

- Regulate the devices with a controller, such as the FHC, that delivers flow data as a 1 - 10 volt signal.
- Add a separate constant volume flow controller, not connected to the LRC, and tell the LRC how much air it draws by setting the point OTHER.EXH (Point 89).

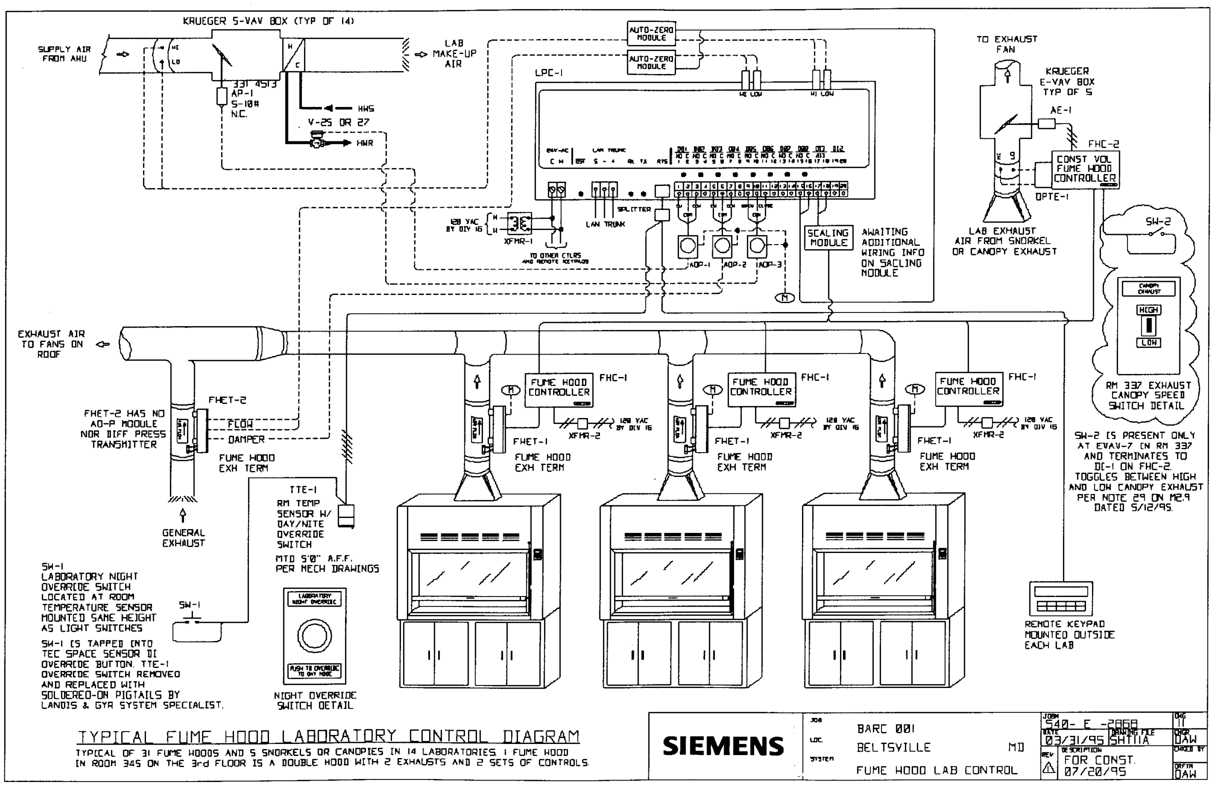

Figure 1-4. Additional Exhaust Devices.

Configurations without General Exhaust

One Supply, One Hood - This is the most basic arrangement. The supply flow must track the operation of the fume hood at all times. There is no opportunity to modulate it to cool the room or achieve minimum ventilation because there is no general exhaust. This HVAC arrangement only works if the minimum fume hood exhaust leads to enough supply flow to cover all the other requirements. In this configuration, the LRC runs Application 2602 or 2612 (refer to Figure 1-5).

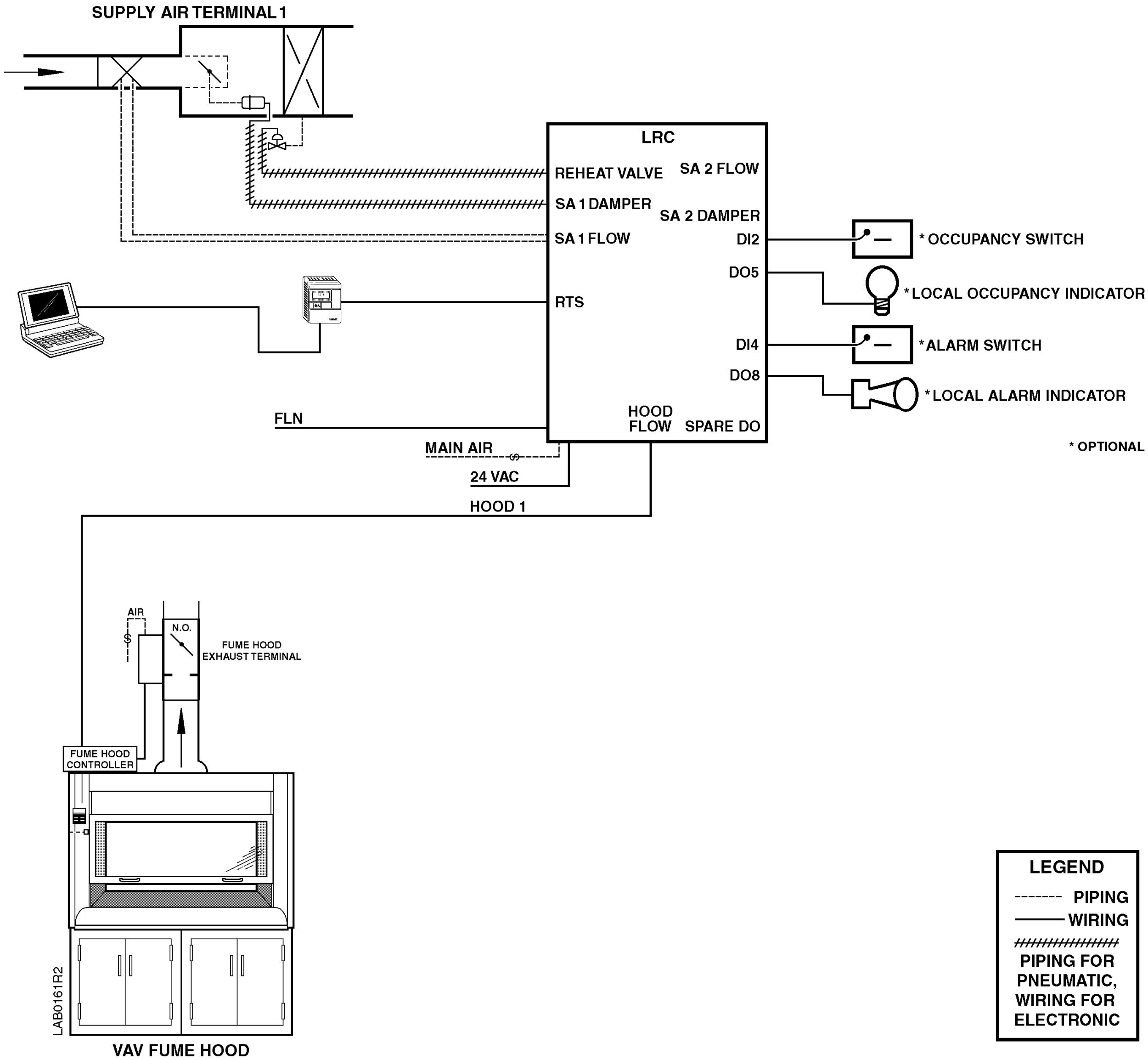

Figure 1-5. One Supply, One Hood.

One Supply, Two Hoods - This configuration works the same way as the basic arrangement. To add a hood, it is necessary to add a Fume Hood Flow Module (FFM). Also, it is necessary to adjust the scaling factor that relates to the fume hood flow signal. The supply air volume and terminal box size should also be reviewed to verify that the required amount of air can be provided to match the increased exhaust volume, and that the reheat coils are capable of providing the needed heating for proper temperature control.

Two Supplies, Two or More Hoods - The LRC can handle two supply terminals of the same or different sizes (refer to Figure 1-6). The controller will modulate their airflows up and down together, not in sequence. Here, too, the supply flow must be set to balance the fume hood airflow. When there is no general exhaust from the lab space, you cannot adjust the supply flow for any other purpose without upsetting room pressurization.

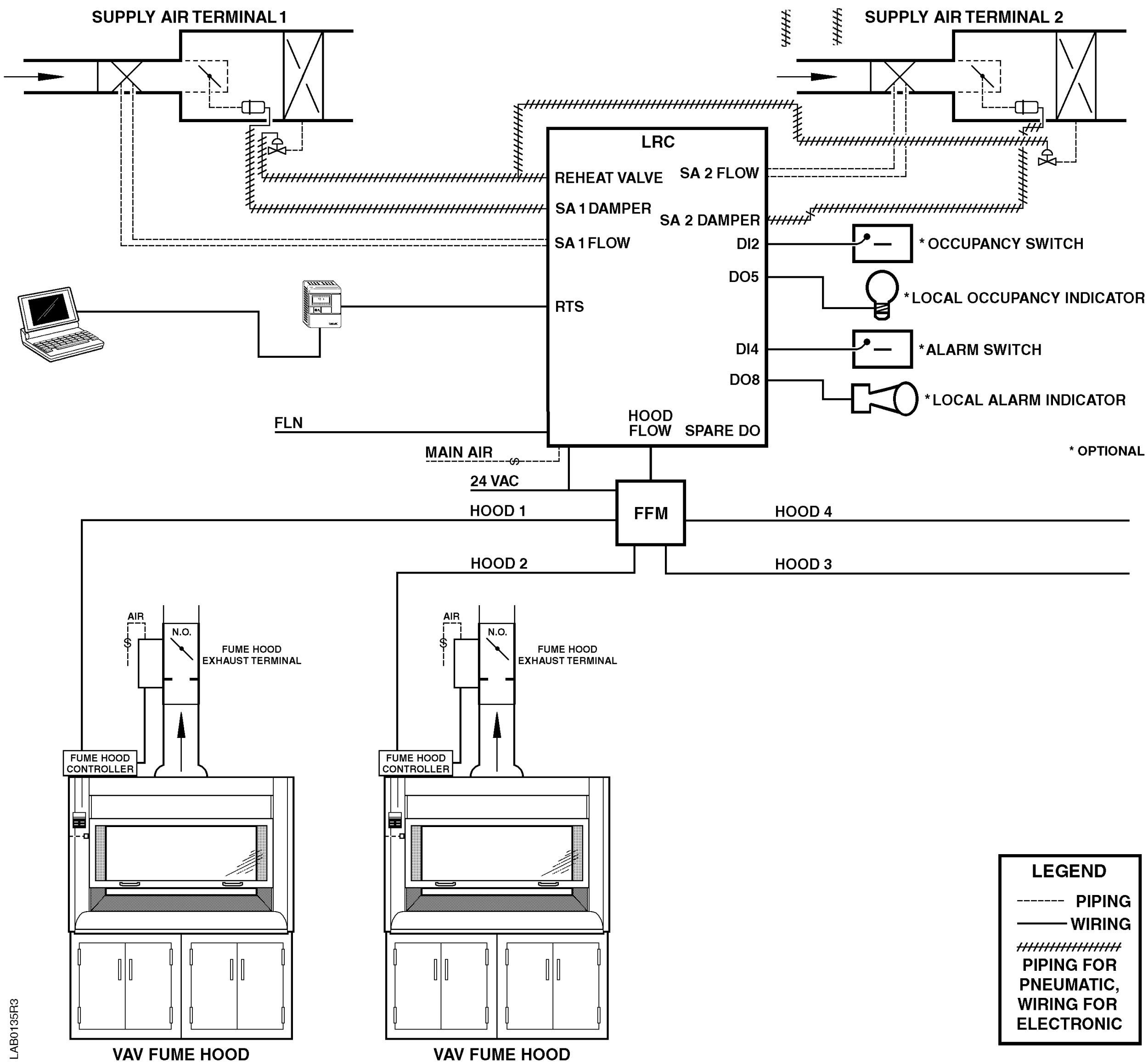

Figure 1-6. Two Supplies, Two or More Hoods.

2

Hardware

Laboratory Room Controller

The Laboratory Room Controller (LRC), Figure 2-1, controls airflow and temperature for laboratories with VAV or constant volume two position fume hoods.

The LRC has the following inputs and outputs:

IN	Pneumatic Actuation	Electronic Actuation
2 air velocity	0 - 2 in wc	0 - 2 in wc
1 room temperature sensor	Thermistor	Thermistor
1 hood flow signal	0 - 10 Vdc	0 - 10 Vdc
Occupancy	dry contact	dry contact
Alarm	dry contact	dry contact
OUT		
2 flow damper actuators	0 - 15 psi	Floating control high speed actuator
1 reheat (or mixing) actuator	0 - 15 psi	0 - 10 Vdc
1 local alarm	24 Vac	24 Vac
1 occupancy indicator	24 Vac	24 Vac

Environmental specifications

Enclosure Physical dimensions... Height 13-1/8 inches (333 mm)
Width 14-5/8 inches (371 mm)
Depth 4 inches (102 mm)
Pneumatic Actuation Weight 19.3 lbs.
(Weight includes: Enclosure, LCM, AO–P Modules, Autozero Modules, AO–P Transducer)
Electronic Actuation Weight 16.3 lbs.
(Weight includes: Enclosure, LCM, Autozero Modules)
Power requirements .... 24 Vac 50/60 Hz +15%, -20%
Ambient operating temperature.. 32°F to 104°F (0°C to 40°C)
Storage temperature .... -40°F to 167°F (-40°C to 75°C)
Relative humidity limits.. 10% to 95% RH, non-condensing
Power consumption... 24 VA peak

NOTE: The maximum power consumption can be 48 VA when external occupancy and alarm indicators are used.

NOTE: Each electronic actuator requires an additional 25 VA, 24 Vac source. DO NOT connect any other non-isolated devices to the transformer that powers the electronic actuators.

LRC Components

LRC components include:

- Enclosure
- Laboratory Controller Module (LCM)
- AO–P Transducer*
- AO–P Modules*
- Autozero Modules
- Terminal Block

* These parts are not included for Electronic Actutation.

Enclosure

Pneumatic Actuation

The LRC enclosure houses the LCM, two AO–P Modules, one AO–P Transducer, one terminal block, and two Autozero Modules. Figure 2-1 shows the enclosure with cover, and Figure 2-2 shows the LRC components in the enclosure. Pneumatic connections are made on the side of the enclosure via the eight ports (Figure 2-3) for flow pickups and pneumatic actuators. In addition to the wiring diagram provided on the inside of the enclosure cover, Figure 2-8 shows the connections and equivalent schematic diagram.

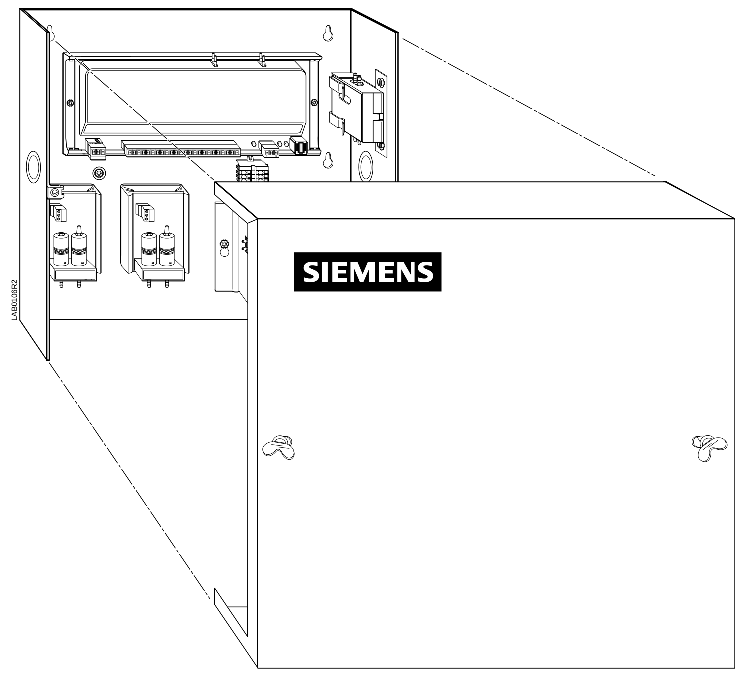

Figure 2-1. LRC and Enclosure.

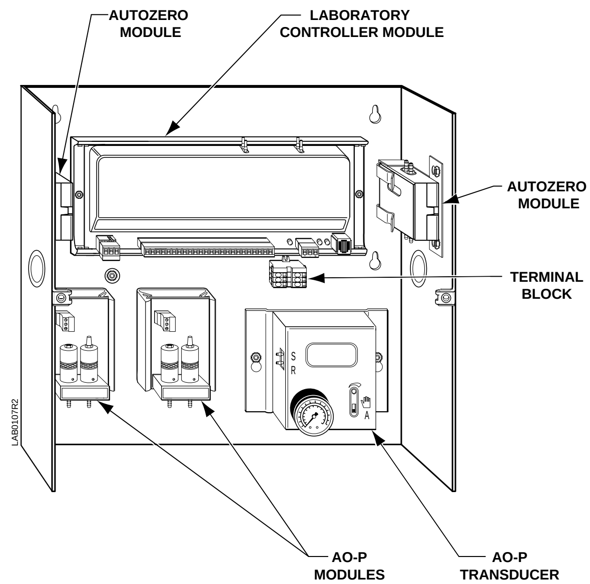

Figure 2-2. LRC Components and Enclosure for Pneumatic Actuation.

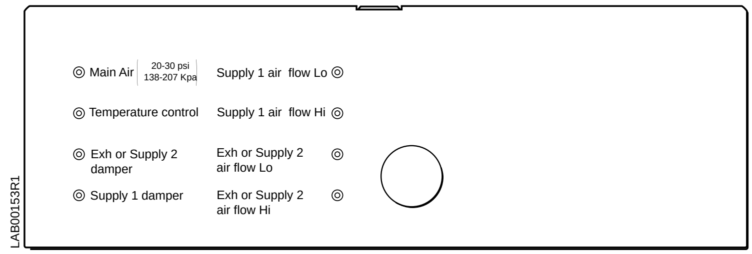

Figure 2-3. LRC Pneumatic Connections for Pneumatic Actuation.

A six-position terminal block located inside the enclosure is used to connect incoming 24 Vac power and earth ground for the entire LRC (refer to Figure 2-6).

Electronic Actuation

The LRC enclosure houses the LCM, one terminal block, and two Autozero Modules. Figure 2-4 shows the LRC components in the enclosure. Pneumatic connections (for flow pickups) are made on the side of the enclosure via four ports (Figure 2-5). In addition to the wiring diagram provided on the inside of the enclosure cover, Figure 2-9 shows the connections and equivalent schematic diagram including the connections to the AO-E modules.

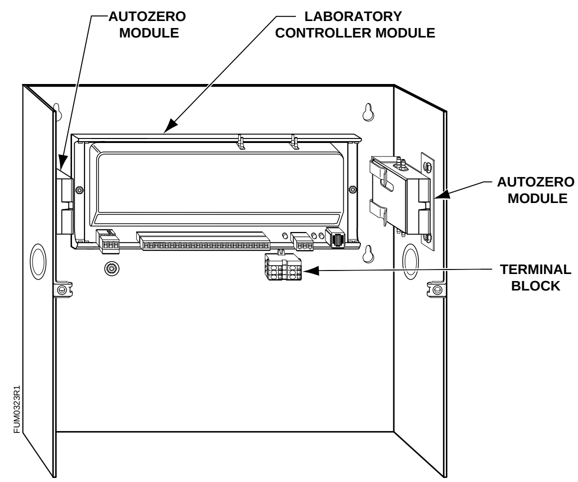

Figure 2-4. LRC Components and Enclosure for Electronic Actuation.

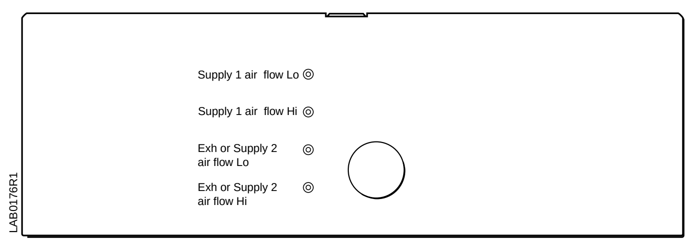

Figure 2-5. LRC Pneumatic Connections for Electronic Actuation.

NOTE: An earth ground is necessary with the LRC to provide resistance to electrical surges.

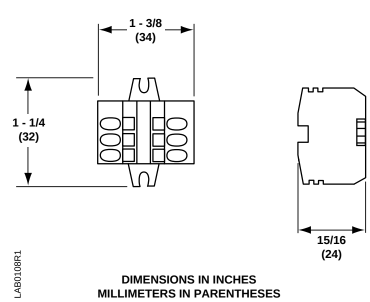

Figure 2-6. Terminal Block.

Laboratory Controller Module

The Laboratory Controller Module (LCM) is an electronic DDC device that controls independently, or as a part of a system with a field panel (refer to Figure 2-7).

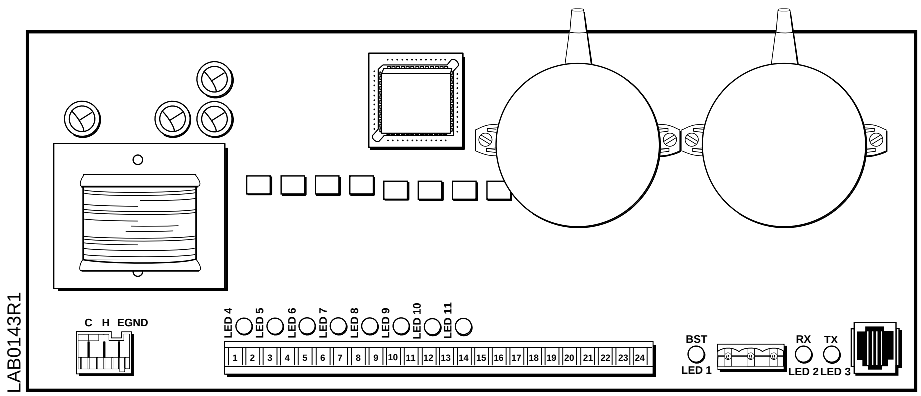

Figure 2-7. Laboratory Controller Module.

The controller output and input terminations are labeled on the inside of the controller enclosure cover.

LCM outputs

The LCM has eight digital outputs (DOs) and one 0–10 Vdc analog output (AO). Each is described in the following paragraphs.

Digital outputs - The LCM has eight DOs that are AC switching TRIACS. They are solid-state contact closures that switch 24 Vac only, with a maximum of 12 VA each. If a higher voltage or higher VA is required, interposing relays that are similar or equivalent to the Terminal Equipment Controller Relay Module (P/N 540-147) must be used.

The DOs are labeled “DO1” to “DO8” on the LCM's plastic cover. The DOs correspond to screw terminals 1 to 16. Each DO has two screw terminals. One screw terminal is a Normally Open terminal, labeled **NO**, and the other is 24 Vac Common, labeled **C**.

CAUTION:

The controller’s DOs control 24 Vac loads only. The maximum rating is 12 VA for each DO. For higher VA requirements, or for 110 or 220 Vac requirements, use an interposing 24 Vac relay similar or equivalent to the Terminal Equipment Controller Relay Module (P/N 540-147).

The TRIACs on the controller board switch the hot leg of the 24 Vac supply voltage to the "NO" terminal when energized. The common leg of the 24 Vac supply voltage is provided directly to the "C" terminal. Figure 2-8 and Figure 2-9 show actual connections and an equivalent schematic diagram.

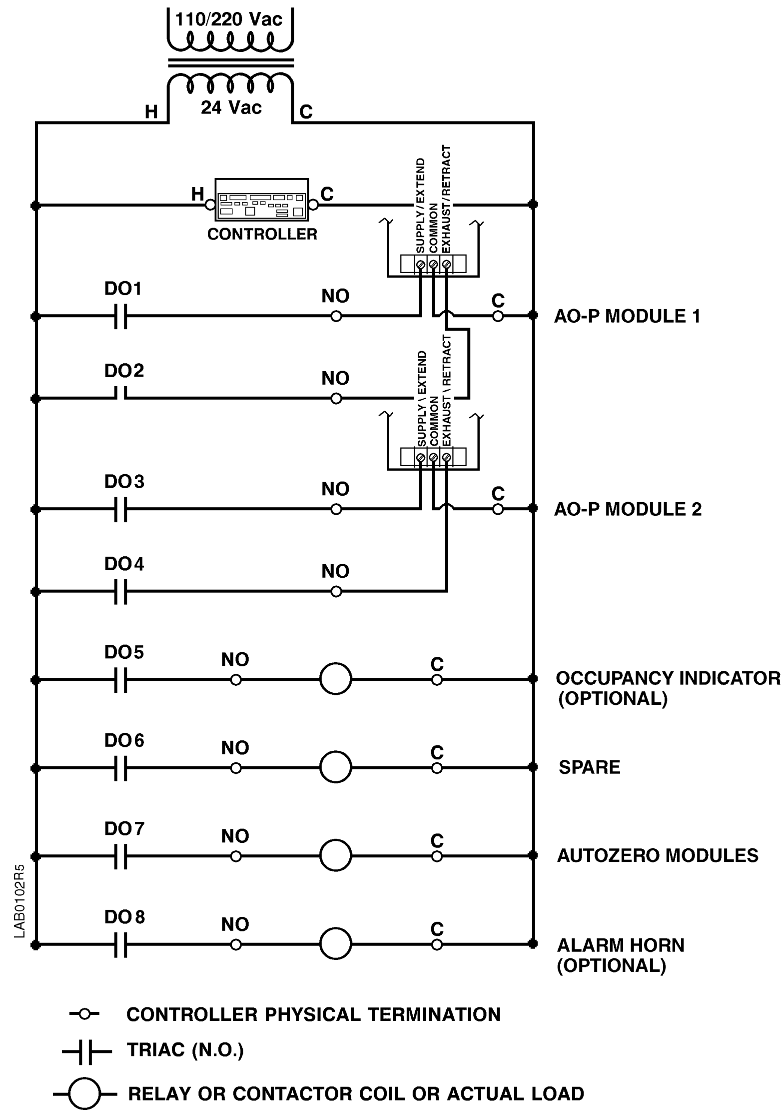

Figure 2-8. Connection and Equivalent Schematic Diagram for Pneumatic Actuation.

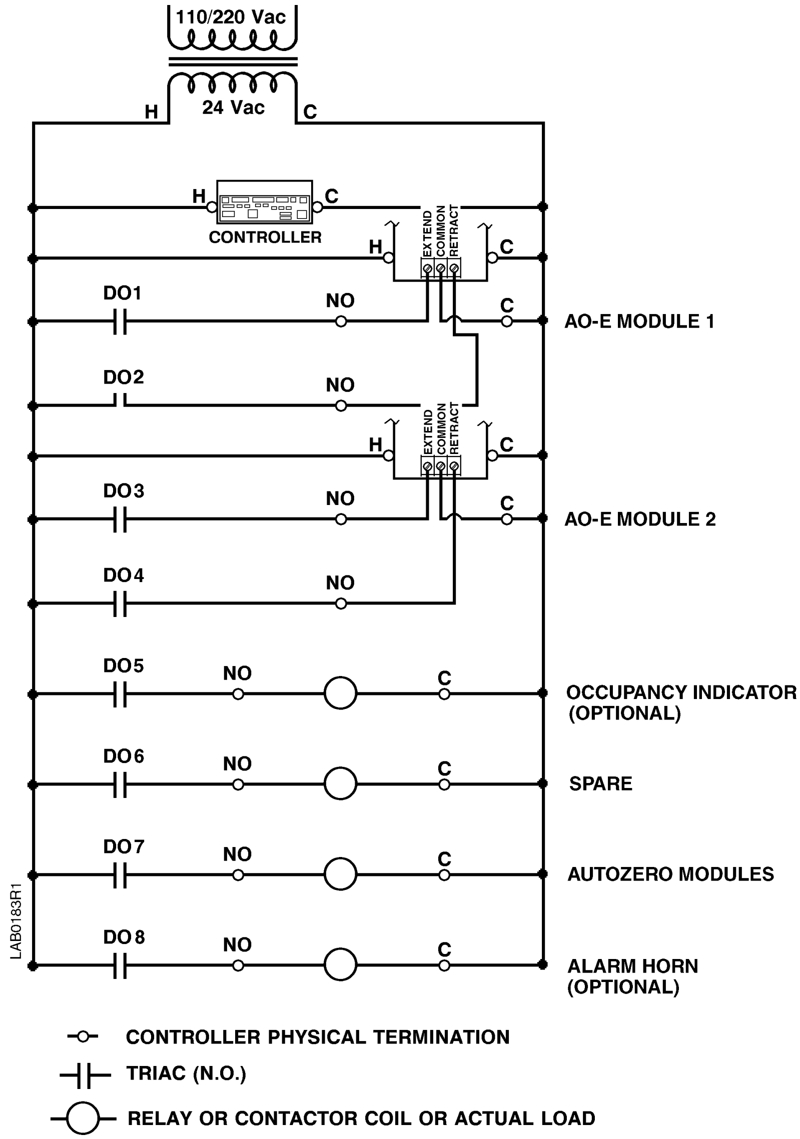

Figure 2-9. Connection and Equivalent Schematic Diagram for Electronic Actuation.

NOTE: If the LRC transformer is used to provide power for the AO-E module, it must be sized to account for the increased load requirements (25 VA per AO-E module).

0–10 Vdc analog output—The LRC has one 0–10 Vdc AO, and it is labeled “AO1” on the controller’s plastic cover. The AO corresponds to the screw terminals numbered 23 and 24.

The AO point consists of two screw terminals: signal and common. The signal and common terminals supply the output to the device connected to the controller. The maximum output of AO1 is factory set to 10 Vdc.

The maximum drive capability of AO1 is 10 mA DC. This is equal to a load of 500 Ω at 5 Vdc, and 1000 Ω at 10 Vdc.

LCM inputs

The LCM inputs include the following: one Room Temperature Sensor (RTS) port, one 0–10 Vdc analog input (AI), and two auxiliary (DI) ports. Each is described in the following paragraphs.

RTS port—The RTS port is located on the far right-hand side of the LCM. It is labeled “RTS” on the controller board and is used to connect the controller board to a room temperature sensor or to a laptop.

0–10 Vdc analog input—The 0–10 Vdc input is labeled “AI3” and is located at screw terminals signal (+) 17 and common (-) 18. This input is used for the flow from one Fume Hood Controller (FHC) or for averaging the flow from two to four FHCs connected to a 4:1 Fume Hood Flow Module (FFM).

Auxiliary DI ports—The auxiliary DI ports are labeled “DI2” and “DI4,” and correspond to screw terminals 19 and 20, and 21 and 22, respectively. These inputs only accept a dry contact input. Possible uses include attaching an occupancy switch, or an alarm switch.

CAUTION:

When connecting to the positive and negative input terminals, maintain polarity or the controller board may be damaged.

LCM indicators

The LCM has 11 Light Emitting Diode (LED) indicators. Their functions are described in Table 2-1, and their locations on the controller board are shown in Figure 2-7.

Table 2-1. Indicator Lights

LED Type (label)	Description
Digital output (LED 4 to LED 11)	ON/OFF status of DO1 to DO8. Lighted LED indicates its associated DO is energized.
Basic Sanity Test (BST) LED1	When flashing once per second, indicates program, Read Only Memory (ROM), and Random Access Memory (RAM) are all functioning properly.
Receive (RX) LED2	When flashing, LED indicates LRC is receiving information over the FLN trunk line.
Transmit (TX) LED3	When flashing, LED indicates LRC is transmitting information over the FLN trunk line.

Fume Hood Flow Module

The Fume Hood Flow Module (FFM, P/N 546-00351) collects information about flow rates from up to four fume hood flows (refer to Figure 2-10). The LRC responds to one fume hood flow signal. If the LRC is connected to one fume hood, a Fume Hood Controller provides airflow information. If there are two to four fume hoods, the FFM combines flow signals from the FHCs and supplies one flow signal to the LRC. The FFM does this by averaging the voltage signals that are connected to it. This results in a total hood flow signal ONLY if the incoming signals are scaled the same. The FFM detects open circuit inputs so that it can correctly average only the signals connected to it, even when a FHC signal fails.

The FFM mounts on a flat surface or to standard DIN rails.

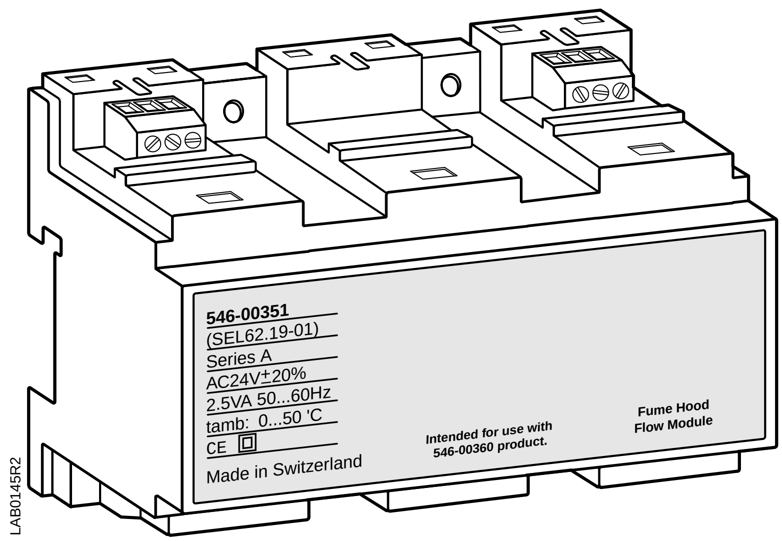

Figure 2-10. Fume Hood Flow Module.

Analog Output–Pneumatic Transducer

The Analog Output–Pneumatic (AO-P) Transducer is a non-bleed device which receives an electronic signal and converts it into an pneumatic signal. The transducer uses the pneumatic output to accurately position valves and damper actuators. Refer to Figure 2-11.

The transducer has a Hand-Auto Override switch and adjustable dial to allow manual control of pressure output.

Power consumption.. 1.0 VA
Air compressor consumption.. 8 SCIM

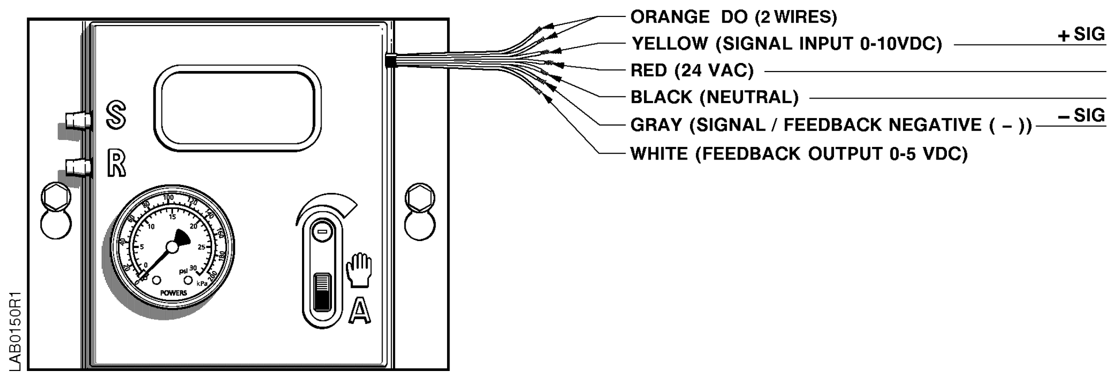

Figure 2-11. AO-P Transducer.

Laboratory Analog Output-Pneumatic Module

The Laboratory Analog Output-Pneumatic (AO-P) Module (P/N 546-00090) is the electro-pneumatic interface between the Laboratory Room Controller and the pneumatic damper actuator. The AO-P Module varies the pressure to the pneumatic actuator to move the damper to its proper position. Refer to Figure 2-12.

The AO-P Module has two solenoid valves. One valve connects the damper motor to main air; the other valve bleeds it to atmosphere. The bleed valve is normally open so the device bleeds the actuator if it loses power. Typically, the bleed solenoid is on (closing the valve) and the supply solenoid is off. In this state the pressure does not change and the damper does not move.

The AO-P Module also has an AC/DC switch. DC is the recommended position when the device is used with an LRC.

Power consumption... 5 VA total
....(2.5 VA per valve)
Supply pressure range .... 18–30 psi
....(124–207 kPa)
Supply requirements with the No. 3 actuator ....@ 20 psi (138 kPa)
....38 SCIM (10.4 sccs)

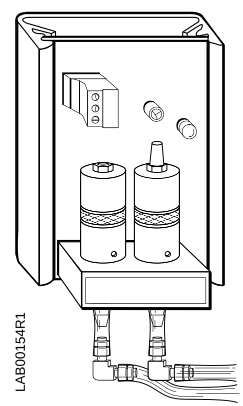

Figure 2-12. Laboratory AO-P Module.

Autozero Module

The Autozero Module allows the air velocity transducer to self-calibrate without closing the damper or changing the volume of air being delivered to the room. Refer to Figure 2-13.

Power consumption @24 Vac.. 1.5 VA
Storage temperature .... -40°F to 167°F (-40°C to 75°C)
Operating temperature ....32° to 122°F (0° to 50°C)

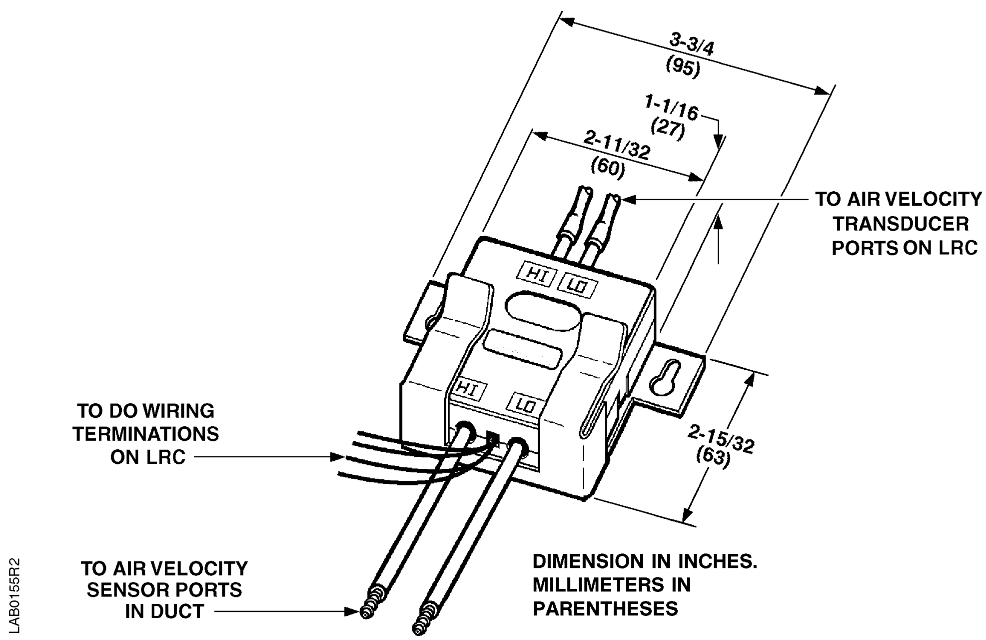

Figure 2-13. Autozero Module with Bracket.

Laboratory Analog Output-Electronic Module

The Analog Output-Electronic (AO-E) Module is an electronic interface between the LRC and the electronic actuator. The AO-E module varies the signal to the electronic actuator based on the two digital outputs from the LRC. The AO-E module will also accept the following control signals: FHC output, standard floating control, 0-10 Vdc, and 4-20 mA (Figure 2-14).

The AO-E module has the ability to failsafe (retracted or extended) or in the last position. It has a test mode to manually extend and retract the actuator to verify proper actuation. These modules are provided as part of the Electronic Actuator assembly that consists of the AO-E module and the electronic actuator, bracket and linkages in an equipment enclosure.

Power Consumption @ 24 Vac .... 25 VA Max

Ambient operating temperature.. 40° F to 104°F (5°C to 40° C)

Storage temperature .... 15 F to 140 F (-9 C to 60 C)

Relative Humidity limits .... 5% to 95% RH, non-condensing

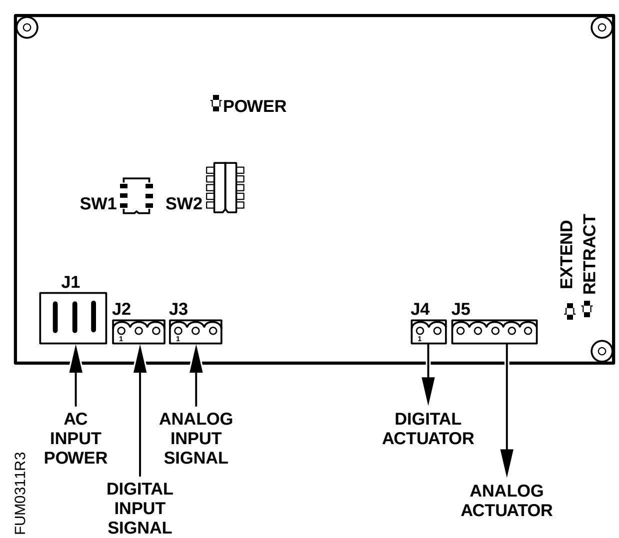

Figure 2-14. AO-E Module.

3

Controlling Laboratory Airflow

Laboratory Ventilation and Pressurization

Because a laboratory ventilation system is a safety device, it must be designed and operated to dilute and remove air contaminants in the laboratory and prevent those contaminants from moving through the building. In addition, the ventilation system plays a role in regulating the temperature of the laboratory room. The *Laboratory Control and Safety Solutions Application Guide*, available from your local Siemens Building Technologies, Inc. representative, introduces the issues and current design practices.

The following discussion of room pressurization applies to systems with a general exhaust (Applications 2601 and 2603 for pneumatic actuation and Applications 2611 and 2613 for electronic actuation). If Application 2602 for pneumatic actuation or Application 2612 for electronic actuation is used, the situation is much simpler. The supply tracks the fume hood exhaust, limited only by the supply maximum set point specified for each terminal.

The LRC dynamically selects two airflow set points, SUP VOL STPT and GEX VOL STPT. Through feedback control loops, the LRC adjusts the control dampers to drive the measured flow values, SUP AIR VOL and GEX AIR VOL, to the set points.

The set points are selected to operate the room at the lowest airflows that meet the following three goals. These goals are listed in order of priority.

1. Pressurize the room correctly.
2. Ventilate the room to dilute air contaminants.
3. Control the room temperature.

Under normal operating conditions, it is usually possible to achieve all three goals. However, when conflicts arise, the controller's highest priority is to correctly pressurize the room. Correctly pressurizing the room means maintaining the selected difference between the total supply flow and the total exhaust flow. That difference is calculated as follows:

VOL DIFFRNC = HOOD VOL + GEX AIR VOL + OTHER EXH - SUP AIR VOL - OTHER SUP

The LRC selects flow set points that drive this calculated flow difference to the selected value, VOL DIF STPT. Ventilating the room means keeping the value of SUP AIR VOL above the specified minimum value, SUP MIN. To control room temperature, the LRC drives SUP AIR VOL to a value calculated in the temperature control algorithm, TEMP CTL VOL. The supply flow only follows this value when it is consistent with the other goals.

Generally, the airflow control system follows two dynamic inputs: the flow through the fume hood(s), HOOD VOL, and the need for supply airflow to control the room temperature, TEMP CTL VOL. (It is also possible for the minimum and maximum flow limits to change with occupancy, but these values can generally be viewed as constant). When the controller receives these inputs, the flow control algorithm calculates how much supply flow is necessary to meet all the goals. The controller will then calculate the corresponding general exhaust flow set point and apply the maximum and minimum limits. The supply flow set point is then calculated to maintain the correct flow difference. If that value is above the supply maximum, then the set point goes to the maximum.

The Pressure Report, which is available through CIS, is the most convenient way to observe the operation of the ventilation and pressurization system. Table 3-1 describes its contents.

Table 3-1

Descriptor	Number	Function
VOL DIFFRNC	83	Difference between measured airflow into the room, and measured airflow out. VOL DIFFRNC = Point 53 - Point 69
VOL DIF STPT	88	Desired value for the flow difference. This value can be selected and adjusted to achieve room pressurization.
HOOD VOL	51	Airflow signal from the fume hood(s).
SUP AIR VOL	35	Measured value of the airflow delivered to the room by the supply terminal.
SUP FLO STPT	93	Desired value of the supply flow, chosen by the controller to achieve the correct flow difference for the room.
GEX AIR VOL	30	Measured value of the airflow from the room through the general exhaust terminal.
GEX FLO STPT	85	Desired value of the general exhaust. The controller selects the lowest value that will lead to adequate supply flow, and correct pressurization.
TOTL SUPPLY	69	Point 35 + Point 61. This is the measured value of the airflow delivered to the room by the supply terminal plus the value of any supply airflows not connected to the Laboratory Room Controller (LRC).
TOTL EXHAUST	53	Point 30 + Point 51 + Point 89. This value is the sum of the measured value of the airflow from the room through the general exhaust terminal, the airflow through the fume hoods, and any exhaust flows not connected to the LRC.
OTHER SUP	61	Value of any supply airflows not connected to the LRC. Must be entered to the controller to account for flows it cannot detect (i.e., office spaces connected to a laboratory).
OTHER EXH	89	Value of any exhaust airflows not connected to the LRC. Must be entered to the controller to account for flows it cannot detect (i.e., snorkel exhausts, canopy exhausts, etc.).
TEMP CTL VOL	9	Amount of supply airflow that the temperature control sequence determines is necessary to regulate the room temperature.

Setting the Flow Difference for Pressurization

The LRC adjusts the supply and general exhaust flows in a way that causes the measured difference (VOL DIFFRNC, Point 83) to match the set point (VOL DIF STPT, Point 88). These points can be accessed through the Overview report. This report is available through CIS, the field panel and Insight. When the controller successfully maintains the flow difference at the set point, the room should be effectively pressurized and an inward airflow should be observable at the door of the room.

NOTE: Pressurization can only be effective when the doors to the room are closed.

However, it is possible that even when the controller maintains the selected flow difference, that the room is not correctly pressurized and air is not flowing in at the door. In effect, the value of the set point may be too small to generate a reliable infiltration flow. A possible solution is to increase the set point for the flow difference, VOL DIF STPT (Point 88). Although it is likely that this adjustment took place at the time the system was commissioned, pressurization can be corrected this way.

While adjusting pressurization at a later time **may** be an appropriate response, be aware that doing this can mask another problem that should be corrected. Although many pressurization problems can be overcome by increasing the set point for the flow difference, it is better to identify and correct any problems that exist. The following sections describe some possible pressurization problems.

Improperly pressurized building environment

If an improperly pressurized building environment is causing problems in the laboratory, verify the following:

- Check the corridor and make sure that all doors are closed.
- Make sure there is adequate supply in the hallway.
- Check for other large exhaust sources.

Leakage from other spaces

Pressurization problems can be caused when excess air flows in from other spaces. This means that some space inside or outside the building is pushing enough air into the laboratory that it overcomes the controlled flow difference and causes a loss of pressurization at the doorway. Look for any possible source of infiltration in the room. Pay particular attention to windows and penetrations from above and below the laboratory. When it is practical, sealing those penetrations is a better solution than increasing the flow difference. A Siemens Building Technologies, Inc. representative can help you identify and correct the problem.

Inaccurate flow reading

It is possible that one of the flow values used by the LRC is not accurate. Examine the values displayed by the Pressurization report. This report is available through CIS, the field panel and Insight. If any of the values appear to be incorrect, take steps to calibrate or correct them. A Siemens Building Technologies, Inc. representative can help you with this process.

Setting Limits on Supply and General Exhaust Flow

At times, it may be necessary to adjust specified limits on airflow through the supply terminal or the general exhaust terminal. Possible reasons include:

- Changes in the minimum ventilation required, possibly due to new information about the work done in the room
- Attempts to extend the capacity of an overloaded fan system
- Changes in the amount of cooling required for a particular room

When adjusting the limits, the Facility Engineer must consider the mechanical capability of the particular equipment to operate at the new limits.

- Will the terminal deliver the maximum desired airflow?
- Will the damper regulate effectively at the desired minimum airflow?
- Will the airflow sensors stay within their effective ranges?

The Facility Engineer must also consider the effect on the room air balance. Is it possible to reach the new limits without upsetting the pressurization of the room? Moving the limits usually does not cause the LRC to violate pressurization, but if the changes are not balanced, they might not have the intended effect. For example, the supply flow maximum could be increased to get more cooling capacity, but the system may still be limited by the general exhaust. If the laboratory requires more cooling, the supply flow tracks the amount of exhaust air leaving the space, even though it may be well below the supply maximum. Although pressurization is not lost, the temperature control is not achieved unless the general exhaust volume is increased.

With that in mind, you can adjust the flow limits by setting values for the points in Table 3-2. These points are conveniently accessed using the Start-up report. This report is available through CIS, the field panel and Insight. Notice that there are two sets of limits, one for occupied periods and one for unoccupied periods. If the unoccupied ventilation rates are not used, set both the occupied and unoccupied rates to the same value. For more information on setting back ventilation rates for unoccupied periods, see *Setting the Unoccupied Flow Rates* in this chapter.

Table 3-2

Descriptor	Number	Function
OCC SUP MAX	31	Maximum supply in occupied mode.
OCC SUP MIN	32	Maximum supply in occupied mode.
OCC GEX MAX	33	Maximum general exhaust in occupied mode.
OCC GEX MIN	34	Minimum general exhaust in occupied mode.
OC V ALM LVL	90	Ventilation alarm level in occupied mode.
UOC SUP MAX	71	Maximum supply in unoccupied mode.
UOC SUP MIN	72	Minimum supply in unoccupied mode.
UOC GEX MAX	67	Maximum general exhaust in unoccupied mode.
UOC GEX MIN	68	Minimum general exhaust in unoccupied mode.
UC V ALM LVL	91	Ventilation alarm level in unoccupied mode.

Using an Unoccupied Mode

One of the tasks of a laboratory ventilation system is protecting the laboratory workers by diluting air contaminants with a supply of fresh air. Often this air supply is expensive to deliver. Energy-conscious managers can reduce this expense by reducing the ventilation rate when there are no people in the laboratory. Without a room occupant to protect, the same dilution and the same supply airflow **may not** be required. This is called *ventilation setback*. There are two issues involved: the potential to save energy and the safety of people who use the building.

The first issue is for the facility's Safety Officer to determine whether a reduced ventilation rate is acceptable when the room is unoccupied. This person should consider the sources of contaminants in the rooms, permissible concentrations, and the corresponding air change rates. The necessary information and philosophy should be found in the site's Chemical Hygiene Plan. The Safety Officer will then state if reducing the ventilation rate is safe and what ventilation rate is required during the unoccupied period.

The second issue is to decide how the LRC should determine when the laboratory is occupied and when it is not. Possibilities include either one or more of the following: schedules, switches and buttons in the room, as well as using the fume hoods. For more details, refer to the section *Determining Occupancy* in this chapter.

WARNING:

Regardless of how the LRC selects unoccupied mode; it is essential that the system clearly indicates that mode to occupants of the building. When a room is in unoccupied mode, there must be an indicator, such as a light, visible to anyone in the room or entering the room. Any workers who have occasion to enter the room must be trained to observe the indicator and know what it means to them. This is a critical part of laboratory safety training.

WARNING:

Do not reduce fume hood flow if ventilation is being set back.

Finally, before implementing ventilation setback, a building manager should estimate the energy savings available. Some key factors are described in the following sections.

Amount of setback possible

When determining the amount of setback possible, consider the following questions:

- How much of a reduction has the Safety Official endorsed?
- Is a corresponding reduction in exhaust possible?

The supply airflow doesn't only dilute contaminants; it also balances the exhaust flow. This means that correct pressurization is required, even when the need for ventilation is reduced. The general exhaust may be reduced as part of the ventilation setback strategy; however, that does not affect the fume hoods or any other exhaust devices. It is possible that the minimum exhaust will not allow supply flows as low as the minimum air change rate.

NOTE: If the laboratory does not have a general exhaust, it may be impossible to reduce the ventilation as the supply flow has to track the exhaust devices.

Hours of unoccupied operation

The hours of unoccupied operation for laboratories can vary greatly, but most laboratories are occupied less than half the time. These long unoccupied periods can make even a small reduction in flow cost-effective. An important consideration is how spaces are used.

Cost of conditioning supply air

The cost of conditioning supply air is usually the largest part of the cost savings. The energy savings depend on outside air conditions. The savings also depend on the particular HVAC system and the way it runs. What is the supply air temperature, and what do you spend to achieve it? If the energy source is free heat from a co-generation plant, you will get a different result than if the energy source is expensive chilled water.

Cost of moving supply and exhaust flows

The cost of moving supply and exhaust flows into and out of a room can be significant even in cases where the cost of conditioning the supply air is not. Reducing flow requirements at the fans can also lead to energy savings.

Setting the Unoccupied Flow Rates

The LRC supports ventilation setback by providing two sets of airflow minimums and maximums, one for occupied mode and another for unoccupied mode. Each mode contains the following:

- Supply Minimum
- General Exhaust Minimum
- Supply Maximum
- General Exhaust Maximum

For the occupied mode, the HVAC engineer usually selects the supply minimum to maintain the minimum ventilation rate, and sets the other three values according to equipment sizing. For example, the general exhaust maximum is usually determined by the maximum required cooling flow, less the minimum flows through the other exhaust devices. The supply maximum is usually set to balance the exhaust flows when they go to design flow.

When selecting flow limits for the unoccupied mode, it is important to know how those values were determined for the occupied mode. Assuming the supply minimum was selected to maintain the required air change rate, lowering the unoccupied value is the first step toward implementing a ventilation setback scheme. However, that may not actually lower the flows. It is possible that the general exhaust minimum must also be lowered. Again, it is important to know how the occupied value was selected.

Lowering supply and general exhaust minimums will usually result in lower airflows, but it is possible that the supply flow may still be high because fume hoods are being left open. The facility monitoring capabilities of the APOGEE can help pinpoint that problem (which hoods, which days, etc.) so corrective steps can be taken. Refer to *Chapter 5, Monitoring Laboratory Operation*.

It is also possible that airflows will stay high because the air is needed to cool the room. Some building operators choose to limit this cooling capability by lowering the general exhaust maximum. Some have even chosen to completely eliminate general exhaust during unoccupied periods by setting the general exhaust maximum to zero. These approaches are not usually recommended. In most cases, it is better to lower the minimums and let the controller reduce the airflow if that is consistent with the cooling requirements.

Remember that it is recommended that the APOGEE be set up to alarm when the ventilation is inadequate. Refer to *Using Airflow* for more information. It is possible that the ventilation rate selected for the unoccupied periods is lower than the alarm level chosen for the occupied mode. To prevent meaningless alarms, you should select a separate alarm level appropriate for the unoccupied mode.

Table 3-3 shows the points in the LRC that define a ventilation setback strategy. Select and set values for these points according to safety requirements and HVAC design criteria. The APOGEE provides access to these points through the Start-up report. This report is available through CIS, the field panel and Insight.

Table 3-3

Descriptor	Number	Function
OCC SUP MAX	31	Maximum supply in occupied mode.
OCC SUP MIN	32	Minimum supply in occupied mode.
OCC GEX MAX	33	Maximum general exhaust in occupied mode.
OCC GEX MIN	34	Minimum general exhaust in occupied mode.
UOC SUP MAX	71	Maximum supply in unoccupied mode.
UOC SUP MIN	72	Minimum supply in unoccupied mode.
UOC GEX MAX	67	Maximum general exhaust in unoccupied mode.
UOC GEX MIN	68	Minimum general exhaust in unoccupied mode.

The LRC selects one of these two sets of limits to apply at any moment. The selected values are displayed by the points in Table 3-4. Do not override these settings to implement a ventilation setback strategy. Instead, let the controller set them. Overriding the points will make it impossible for the controller to apply the proper limits according to occupancy.

Table 3-4

Descriptor	Number	Function
SUP MAX	76	The currently active maximum supply.
SUP MIN	77	The currently active minimum supply.
GEX MAX	74	The currently active maximum general exhaust.
GEX MIN	75	The currently active minimum general exhaust.

Determining Occupancy

Determining occupancy in a laboratory greatly depends on whether the laboratory works on a schedule or is available to personnel at undetermined times. If the laboratory has a set schedule, the LRC can be programmed to switch between occupied and unoccupied modes. However, if the laboratory is available to personnel at their discretion, it will be necessary to make the controller respond to the occupants themselves. Methods for this type of control include occupancy sensors, monitored light switches, a button used by the occupant, and monitoring the position of fume hood sashes. The LRC supports the following approaches and certain combinations of them:

- Schedule (implemented over the network)
- Light switch or other two-position switch in the room
- Push button on the thermostat
- Fume hood opening
- Occupancy sensor

The LRC also supports a custom-programmed occupancy scheme, implemented over the network.

LRC Priority

When combining data from several inputs to determine occupancy, the LRC always applies these rules:

- The controller works in the occupied mode whenever any one of the inputs indicates occupancy.
- The controller works in the unoccupied mode only when all of the inputs indicate vacancy.

Consider the following issues when using different methods of determining occupancy:

- **Schedule**: Schedules are often helpful, but rarely suitable as the only source of occupancy information. In a situation where workers mainly follow a schedule, it is a good start, but provisions must be made for exceptions to the schedule.
- **Light Switch**: Light switches can be very effective because there is no need to train workers to take an extra step. However, there are scientists who need to work with the lights off, so make sure all users are considered when deciding how occupancy should be determined.
- **Push Button**: Using a push button requires workers to adjust the thermostat when they want to work after hours. If those working in the laboratory are not used to turning the ventilation up and down, they must be trained to do so. Some people may feel that this method puts them in control; however others may find the extra step a bother.
- **Fume Hood Sash Opening:** Using an open fume hood sash as an indication of occupancy can be an important safety addition to an occupancy scheme. Fume hoods should be closed when no one is working in the laboratory. If laboratory workers are trained to close sashes as a matter of habit, then an open hood is a reliable indicator of the presence of a worker. Also, the fume hood is the primary device charged with protecting the lab worker; it does that best when the sash is closed. Reducing the ventilation rate (one of the secondary means of protection) when the fume hood is open is a questionable safety practice.

NOTE: Workers may be in the lab but not working in a fume hood; therefore, sash height may **not** always be a good indication of occupancy.

- **Occupancy Sensor**: An occupancy sensor can function exactly as the light switch does, but does not depend on the laboratory worker flipping a switch. However, it is important to carefully consider the type of sensor; for example, motion detectors may not notice a scientist at work.

Example 1: Occupancy Schedule Combined with a Manual Switch

The occupancy schedule, combined with a manual switch approach, makes sense in cases where the laboratory is primarily occupied according to a regular schedule, but must also be available to workers at unscheduled times. Here, the schedule is the main source of occupancy information. An operator sets up the schedule, using the Building Automation System (BAS), so that it covers the normal working hours. When a laboratory worker wants to use the laboratory outside the normal working schedule, that worker must flip a switch to "turn on" the laboratory ventilation. This can be the same switch that turns on the lights, or a separate switch. The worker will observe that the occupancy light in the room now indicates that the ventilation system is operating in the occupied mode, and that it is safe to work there. When the operator is finished working, the switch should be flipped again to "turn off" the laboratory ventilation. If the schedule still indicates an unoccupied period, the LRC switches to the unoccupied mode.

Example 2: Button on Thermostat Combined with Fume Hood Sash Positions

In this case, the lab worker uses the push-button on the room temperature sensor to tell the LRC to change the ventilation mode. Upon entering the laboratory, the employee must observe the occupancy indicator. If the lower ventilation rate is in effect, then the employee must press the button on the thermostat. Within a few seconds of this action, the room will shift to the higher ventilation rate. The employee may notice the change at the occupancy indicator light, or on the thermostat display screen. When the employee leaves, the button on the thermostat should be pressed again to switch the room back to unoccupied mode. As an additional safety, the LRC will operate at the higher ventilation rate whenever the fume hood is open.

If the laboratory operator presses the button upon leaving and the fume hood sash is open, the room will not switch to the lower ventilation rate. At this point, an informed worker may realize that the fume hood has been left open. Closing the hood will switch the room to the unoccupied mode.

Your local Siemens Building Technologies, Inc. office has the expertise to help design the occupancy detection scheme best suited to the operation of your facility, and to implement that system for you.

Working with Occupancy and Ventilation Setback

The value of the point OCC.UOC DO5 (Point 45) is always the current status of the room. This point may be used to drive a lamp, or other device that tells those using the laboratory that the room is running in the unoccupied mode. The occupancy status is also contained in OCC DISPLAY (Point 21). A digital room thermostat can read this point and display its value. It is not possible to override either of these points. If a BAS operator needs to manually set the occupancy status of the room, the operator must work through the command sources described below.

To view or record the occupancy status from the APOGEE, an operator must use OCC.UOC DO5 or OCC DISPLAY. Unlike many Siemens Building Technologies, Inc. room controllers, the state of the LCTLR point does not indicate the occupancy state of the room. (For more information, see TEC support in the Insight or field panel manuals).

All of the data in the controller that affects the occupancy state is contained in the Occupancy report. This report is accessible from CIS, the field panel and Insight. The Occupancy report includes the points in Table 3-5.

Table 3-5

Descriptor	Number	Function
OCC.UOC DO5	45	Occupancy state of LRC; may drive light in room.
OCC DISPLAY	21	Occupancy state of the LRC; drives display on thermostat.
NET OCC CMD	29	An occupancy input. This value comes to the LRC from the network. The value may also be set according to a schedule.
OCC SWIT DI2	24	State of a switch wired to LRC. Closed contact = ON = occupied.
OCC SWIT ENA	18	Connects Point 24 to Point 45. If this point is disabled, the switch does not affect occupancy.
OCC BUTTON	19	State of the push button switch on the thermostat. The momentary switch is only ON when the button is pushed. The value of this point provides no information on the occupancy state of the room.
BUTTON CMD	25	LRC's interpretation of Point 19. Records users request to change occupancy.
BUTTON ENA	12	Connects Point 25 to Point 45. If this point is disabled, the button does not affect occupancy.
HOOD VOL	51	Airflow signal from the fume hood(s).
HOOD UOC VOL	56	When HOOD VOL (Point 51) is below this value, hoods are considered closed for purposes of vacancy. (This value does not affect the operation of the hood or the room pressurization system).
HOOD OCC VOL	55	When HOOD VOL (Point 51) is above this value, hoods are considered open for purposes of occupancy. (This value does not affect the operation of the hood or the room pressurization system). Setting this value to zero means the hood flow does not affect Point 45.

Scheduling Occupancy

The LRC fits into the APOGEE as an LCTLR point. This is the same interface used for other room controllers and Fume Hood Controllers (FHCs). Scheduling features in the field panel and Insight allow you to set up regular "DAY" and "NIGHT" commands to any LCTLR device. Inside the LRC, those commands display as NET OCC CMD (Point 29). The LRC uses NET OCC CMD, along with any other active occupancy information to set the state of OCC.UOC DO5. If using ventilation setback without a schedule, manually command NET OCC CMD to the unoccupied state. This will allow other occupancy commands to operate.

Manually Commanding Occupancy

A building operator may have a reason to override the automatic control system, and manually force the occupancy state of the room. For safety reasons, it is not possible to manually command the OCC.UOC DO5 point that is used to select the ventilation rates.

Commanding an LRC to Occupied Mode

When commanding an LRC to occupied mode, use CIS to set the point NET OCC CMD to OCC. This command will last until it is released or changed through CIS or until a command comes in from the network. Another method is to use Insight or the field panel to command the state of the controller's LCTLR point to "DAY". This command is transferred to the NET OCC CMD point in the LRC. This manual command will block any automatic occupancy commands (like a schedule) until the point is released.

Commanding an LRC to Unoccupied Mode

When commanding an LRC to unoccupied mode, first determine why the room is in the occupied mode. Use the Occupancy report to check each command source. For each one that indicates occupancy, make sure there is a reason why this is not the right state. If you decide it is appropriate, override the state of the command source using the following methods:

- NET OCC CMD - Set Point 29 from CIS, or command the LCTLR to "NIGHT" from the field panel or from Insight.
- OCC SWIT DI2 - Temporarily disable the switch using Point 18, OCC SWIT ENA. Remember to enable it again when the problem is corrected.
- BUTTON CMD - In the room, press the occupancy button, or use Insight or the field panel to manually set the value of BUTTON CMD to UNOCC. When the value is set, release the point.
- HOOD VOL - If possible, close the fume hood, otherwise, temporarily set the value of HOOD OCC VOL to zero. This disables the fume hood effect on occupancy. Remember to return the point to its original value after the problem is corrected.

Using Airflow Alarms

The LRC's primary purpose is to maintain room pressurization and ventilation in laboratories. It is also designed to report abnormal conditions through your BAS to the people who need to respond. A Chemical Hygiene Plan and emergency response procedures need to address what to do when a LRC alarm is received.

The first thing to decide when using alarms is who needs the information. Possibilities include one or more of the following:

- laboratory workers
- Safety Officer
- HVAC maintenance crew

The second thing to decide is how to get the alarm to those people. The Siemens Building Technologies, Inc. BAS has powerful and flexible capabilities for automatically routing alarm information to the right places. Alarm notification options include local alarm devices (horns and lights) in or near the room, BAS terminals in control rooms and offices (these could be a personal computers or dedicated terminals), and automatic paging. Consult a Siemens Building Technologies, Inc. branch for more information.

The third thing to do is to develop the appropriate coordinated response procedures for everyone involved. For example, if a pressurization alarm is received at the central monitoring station, maintenance personnel should check the supply and exhaust flow rates by calling up a graphic or subpoint log for the controller in alarm and notify laboratory personnel that the room is not pressurized.

In another scenario, if a local alarm, such as a light or buzzer, indicates loss of pressurization, personnel in the laboratory should stop any fume-producing activities (such as pouring powders or heating liquids) and notify maintenance personnel immediately. In either case, all operations that might produce toxic fumes in the affected lab room should be ceased until the cause of the alarm is found and corrected.

Finally, all personnel should be trained on the meaning of the alarms and the planned responses to those alarms. Refresher training on alarm procedures is important and necessary.

Types of Alarms

Following is a discussion of the programmable alarms built into the LRC.

Volume Difference Alarm

The volume difference alarm (VOL DIF ALM) is designed to inform laboratory, safety, or maintenance personnel whenever the intended room pressurization is compromised. The desired amount of infiltration airflow (VOL DIF STPT) was selected with safety in mind. To use the alarm, select a lower infiltration value to set as the alarm limit (VOL DIF LVL). To serve this purpose, this value must be high enough that the safety officer is confident that the room is safely pressurized at this value of infiltration flow. For example, a volume difference set at 50% of the desired volumetric difference is a good starting point. The value must be set low enough that it is not tripped by common place events that do not compromise safety. If the value is set just a few cfm below the set point, normal variations in HVAC operation could cause frequent “false alarms”. Any value above this level must be considered safe.

WARNING:

A system that generates frequent false alarms is not safe.

To further enhance reliability of the LRC’s pressurization alarm, there is an adjustable alarm delay. A dynamic VAV ventilation system can produce flow readings far from set points for very brief times. Rather than have normal transient events trip a pressurization alarm; it is recommended that the DIF ALM DEL point be set so that normal fluctuations are separated from real problems. Ten seconds is often long enough to prevent nuisance alarms. A delay of more than a minute may mask problems. The Safety Officer should take part in selecting the length of the alarm delay.

Ventilation Alarm

The VENT ALM (Point 50) is designed to inform laboratory, safety, or maintenance personnel when the air change rate in the room is below the level selected to safely dilute air contaminants. The minimum supply flow was selected to ensure safe dilution. To use the ventilation alarm, set VENT ALM ENA (Point 17) to YES and select a lower airflow value to use as an alarm limit. This value must be high enough that the safety officer is confident that if the system runs consistently, just above the alarm level, it will be safe. For example, a value of 100 cfm below occupied/unoccupied minimum supply set point is a good starting point. The value must also be far enough below the flow minimum that it is not tripped by normal variations in the HVAC system.

Ventilation alarms also include an alarm delay (VENT ALM DEL) to prevent brief fluctuations from causing false alarms. The delay time can be selected with reference to the time it takes for concentrations of contaminants to build in the room. The Safety Officer should take part in selecting the length of the delay.

For laboratories that employ an unoccupied mode, the alarm limit can be set separately for occupied and unoccupied periods. Enter the selected alarm levels into the points OC V ALM LVL and UC V ALM LVL. If there is no difference between occupied and unoccupied periods, set the two points to the same value.

Troubleshooting Laboratory Air Flow

When problems arise with the laboratory ventilation and pressurization system, you can take a systematic approach to identify and correct the problem. This section outlines the recommended processes. Symptoms are listed; each followed by a series of questions designed to identify the problem.

Problem 1: Observed Positive Pressurization

If positive pressurization is observed physically, complete the following steps:

1. Is it a steady or dynamic condition? If it is dynamic, go to question two. If it is steady, go to question three.

2. Is it related to moving fume hood sashes, or does it continue when the sashes are still?

   If it is related to sash motion, the room pressurization system should be adjusted. This may involve tuning loops and adjusting the flow difference (VOL DIF STPT) for the room. Contact your Siemens Building Technologies, Inc. branch for assistance.

   If positive pressurization continues when the fume hood sashes are stationary, use the process described in *Problem 4: Unstable Airflow*.

3. Does the controller show the problem? Read the VOL DIFFRNC point. If it shows a negative value, or a value that is much less than the set point, then the measured supply flow is too high for the exhaust and the controller has recognized this situation. Look for overrides such as dampers (SUP DMPR CMD, etc.) and set points (SUP VOL STPT). Also, look for flow controls that cannot meet the set point (SUP AIR VOL, etc.).

   If the controller shows a positive value that is reasonably close to the set point (VOL DIF STPT), then there is a flow sensing problem. Look for failed or overridden flow readings (SUP VOL, HOOD VOL, etc.) and for readings that are obviously incorrect (OTHER SUP, OTHER EXH, etc.). Also, check HOOD VOL against the reading from the fume hoods controllers. Use the Pressure Report in CIS, the field panel, or Insight to investigate.

   If the procedures listed above do not fix the problem, the flow sensors may need to be recalibrated. Contact your Siemens Building Technologies, Inc. branch for assistance.

Problem 2: Ventilation Alarm

If there is a ventilation alarm, complete the following steps:

1. Verify that there is a problem by checking to see if the supply flow is low. If it is not, then the alarm is probably just a nuisance alarm. Adjust the limit (VENT ALM LVL) or delay the alarm (VENT ALM DEL). Be sure, however, to coordinate these actions with the safety officer.

   NOTE: The alarm setup points are in the Alarm report.

   On the other hand, if the supply flow is low, proceed with Step 2.

2. Using the Pressure report, check to see if the supply flow is at set point. By reading the supply flow values you can determine whether or not the flow is stable and near the setpoint. CIS and trend graph work the best for this.

   If the supply flow is at the set point, then the setpoint is low. Look for an override (SUP VOL STPT). Also, check the exhaust flow values (TOTAL EXH). If the exhaust flow is too low, it forces the LRC to keep the supply flow low.

   If the supply flow is not at the set point, go to Step 3.

3. Check to see if the supply flow is fluctuating back and forth past the set point or if it is staying low. If the supply flow is staying low, look for an override (SUP DMPR CMD). If there is no override, check the supply flow capacity by briefly opening the damper. You will need to troubleshoot the air supply system if you do not get enough flow with the damper open. Contact your Siemens Building Technologies, Inc. representative for assistance.

   If the supply flow is fluctuating back and forth past the set point, use the process described in *Problem 4: Unstable Airflow* to troubleshoot, or contact your Siemens Building Technologies, Inc. branch for assistance.

Problem 3: Pressurization Alarm

If there is a pressurization alarm, complete the following steps:

1. Verify that there is a problem by checking to see if the pressurization value (VOL DIFFRNC) is too low. If it is not, then the alarm is probably a nuisance alarm. Adjust the level (DIF ALM LVL) or delay the alarm (VOL DIF DEL). Be sure, however, to coordinate these actions with the safety officer. Use the Alarm Report to access these points.

   If the pressurization value is low, then refer to step three in *Problem 1: Observed Positive Pressurization*.

Problem 4: Unstable Airflow

If people in the room notice that one of the airflows in or out of the room continually cycles up and down, complete the following steps:

1. Verify that the airflow really is unstable by reading flow values (SUP AIR VOL, etc.) from the system. Look for significant fluctuation in the values. An Insight trend graph and CIS work best for this task.

2. Check to see if the set point is constant by reading the setpoint for that flow. If it fluctuates, trace that point back to the source of the variation. Some possibilities to check include the fume hood flow, the general exhaust flow, occupancy, and TEMP CTL VOL. The Overview Report contains most of the requested information.

   If the setpoint is stable, continue with Step 3.

3. Determine if the instability is in the central system or the local control loop. To do this, temporarily interrupt the flow control. Set the appropriate damper command point (SUP DMPR CMD, etc.) to zero. Read the flow values. If the values stabilize, then the flow control loop is out of tune. Contact your Siemens Building Technologies, Inc. branch for assistance.

If the flow continues to fluctuate with the damper locked in place; the instability is in the central system.

4

Controlling Laboratory Temperature

LRC Temperature Control System

The temperature control system in the LRC has two main components, the room temperature feedback calculations and the HVAC equipment sequencer. They interact as shown in Figure 4-1. The PID feedback calculations set the value of an intermediate point called TEMP LOOPOUT. This value reflects the thermal load currently acting on the room. A value of 100% corresponds to the maximum need for cooling. A value of 0% corresponds to the maximum need for heating. Based on that indication of load, the sequencer operates the heating and cooling equipment for the room.

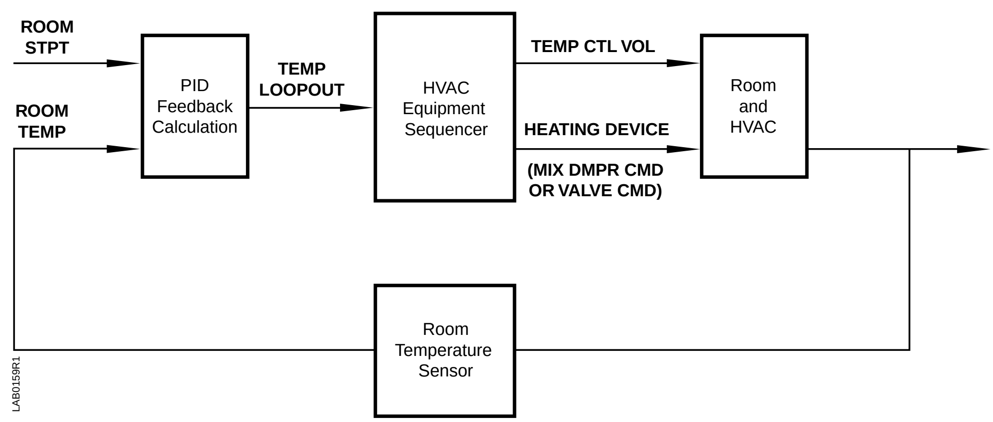

Figure 4-1. LRC Temperature Control System.

HVAC Sequencer

The HVAC equipment sequencer uses a set of sequencing points to tell the controller how to adjust heating and cooling flows according to TEMP LOOPOUT. The values of the sequencing points are selected when the LRC is applied to the room. These values are selected to prevent simultaneous heating and cooling, and so that the heat flow from the HVAC system varies as smoothly as possible across the range of TEMP LOOPOUT. The specific meaning and values of the sequencing points depends on the heating and cooling equipment used in the room.

Temperature control sequence of Applications 2601 and 2611

In the case of Applications 2601 and 2611, the sequencing points tell the controller how to modulate the cooling airflow and reheat valve. They function as shown in the Figure 4-2. When TEMP LOOPOUT is between REHEAT START and REHEAT END, the controller operates in terminal reheat mode, using the hot water valve in the supply terminal to balance the loads. It does this by setting the value of the point VALVE CMD. This value indicates the percentage of valve actuator strokes from closed (0%) to open (100%). The valve command is converted to the voltage that drives the valve actuator, REHEAT AO1.

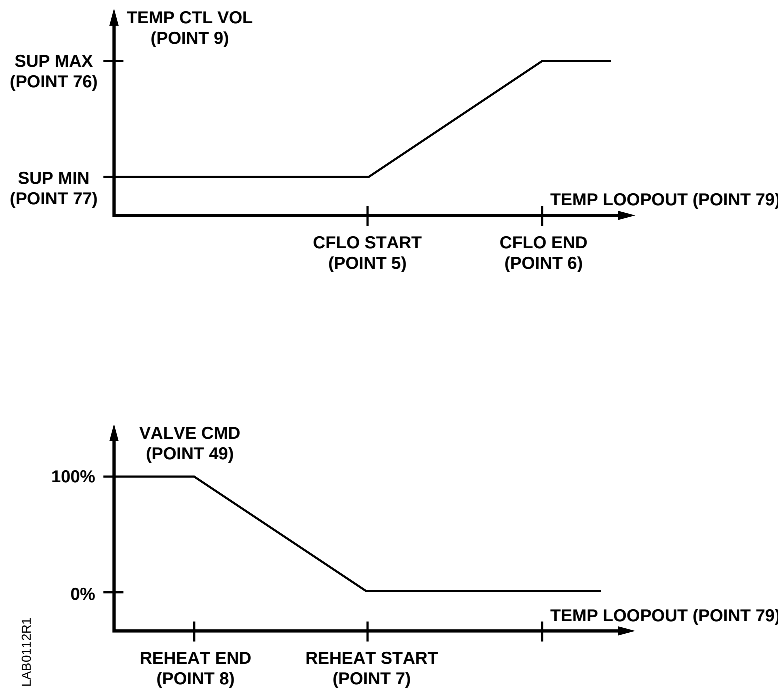

Figure 4-2. Temperature Control Sequence for Application 2601 and 2611.

When TEMP LOOPOUT is between CFLO START and CFLO END, the room operates in the cooling mode, adjusting the point TEMP CTL VOL to balance the thermal loads. TEMP CTL VOL indicates how much supply airflow is necessary to regulate the room temperature. The supply flow to the room goes to this value when it is consistent with pressurization and ventilation constraints. The actual supply flow (and the supply flow set point) may be more or less than TEMP CTL VOL.

Setting CFLO START at or above REHEAT START prevents simultaneous heating and cooling. In a typical Application 2601, the sequencing points are set as follows:

REHEAT END = 0%
REHEAT START = 50%
CFLO START = 50%
CFLO END = 100%

In some cases, temperature control performance can be improved by adjusting the values of the sequencing points to better match the thermal sizing of the HVAC components in the room. If there is any other heating or cooling equipment (such as perimeter radiation), the sequencing values may be set to make room for the additional device. The temperature control sequencing points are not included in any of the special purpose reports. They appear near the top of the report that includes all the LRC subpoints. For more information on sequencing points, consult your Siemens Building Technologies, Inc. representative.

The “Temp Control” subpoint report presents a picture of the current state of the temperature control system. There are a few typical scenarios that can be observed. In the first scenario, the controller is in the cooling mode, meaning that the point VALVE CMD is set to zero, and the value of the point TEMP CTL VOL is above the supply flow minimum. Typically, in this mode, the measured value of the point SUP AIR VOL is close to TEMP CTL VOL. This means that the thermal load is setting the supply flow. The measured supply flow may also be substantially less than TEMP CTL VOL. This usually means that the supply flow is limited by the need to keep the supply flow below the total exhaust. The general exhaust terminal may be at its capacity, which is the limit of mechanical cooling.

In the second scenario, the measured supply flow exceeds TEMP CTL VOL. This means that the fume hoods are so far open that the supply flow needed to balance the room pressure is more than the flow needed for cooling. Typically, this is not a stable condition and the LRC will move to the heating mode. In heating mode, TEMP CTL VOL goes to the supply minimum and the reheat valve opens to whatever value it takes to keep the room temperature at the setpoint. The actual supply flow may be at, or more, than TEMP CTL VOL.

The LRC data needed to work with temperature control issues is found in the TEMP CONTROL report. The points are described in Table 4-1.

Table 4-1.

Descriptor	Number	Function
ROOM TEMP	4	Value read from the room temperature sensor.
ROOM STPT	13	Desired value of the room temperature.
VALVE CMD	49	State of the reheat valve. Represents how far the valve is open.
REHEAT AO1	48	Voltage that drives the reheat valve, either directly or through a pneumatic transducer.
TEMP CTL VOL	9	Amount of supply flow that the controller calculates is necessary to regulate the room temperature.
SUP AIR VOL	35	Measured value of the airflow through the supply terminal.
TEMP LOOPOUT	79	Value calculated by the room temperature PID algorithm. It indicates the thermal load on the room.
ROOM P GAIN	63	Proportional feedback gain used to tune the room temperature control.
ROOM I GAIN	64	Integral feedback gain used to tune the room temperature control.
ROOM D GAIN	65	Derivative feedback gain used to tune the room temperature control.
ROOM BIAS	66	Starting point where the value of TEMP LOOPOUT goes when the controller turns on.
LOOP TIME	98	Time interval controls how often the LRC measures the room temperature and calculates a new output value.

Temperature control sequence of Application 2602 and 2612

In Applications 2602 and 2612, the supply airflow must track the fume hood flow; there is no opportunity to change the airflow to meet cooling demand. The sequencing function is typically set up as shown in the Figure 4-3. This means the sequencing points are set as follows:

REHEAT END = 0%
REHEAT START = 50%

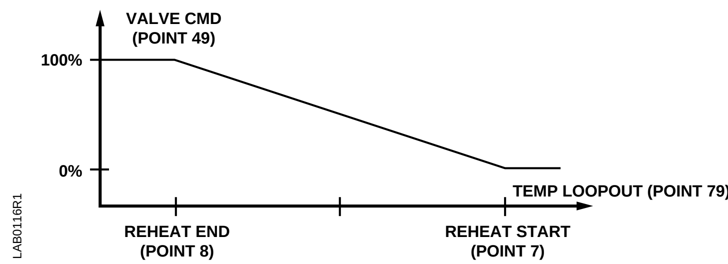

Figure 4-3. Temperature Control Sequence for Applications 2602 and 2612.

If there is any other heating or cooling device in the room, it may be accommodated by adjusting the values of the sequencing points. Consult your Siemens Building Technologies, Inc. representative for more information on using the sequencing points.

In normal operation, you will always observe VALVE CMD at some value between 0% and 100%. If the point reaches one of its limits, and stays there, then the thermal load on the room is outside the capacity of the HVAC system to control it. (The valve may normally reach its limits temporarily in response to a sudden change in thermal load. This does not indicate that the system is overloaded).

Temperature control sequence of Applications 2603 and 2613

Applications 2603 and 2613 covers rooms with dual-duct supply systems. The HVAC equipment sequencer can be set up to implement the three temperature control modes shown in Figure 4-4. In the cooling mode, the mixing damper is set to full cooling position and the sequencer adjusts the value of the TEMP CTL VOL point as the load changes. This is the mode where TEMP LOOPOUT is between CFLO START and CFLO END. The TEMP CTL VOL point indicates how much supply airflow is necessary to regulate the room temperature. The supply flow to the room goes to this value when it is consistent with pressurization and ventilation constraints.

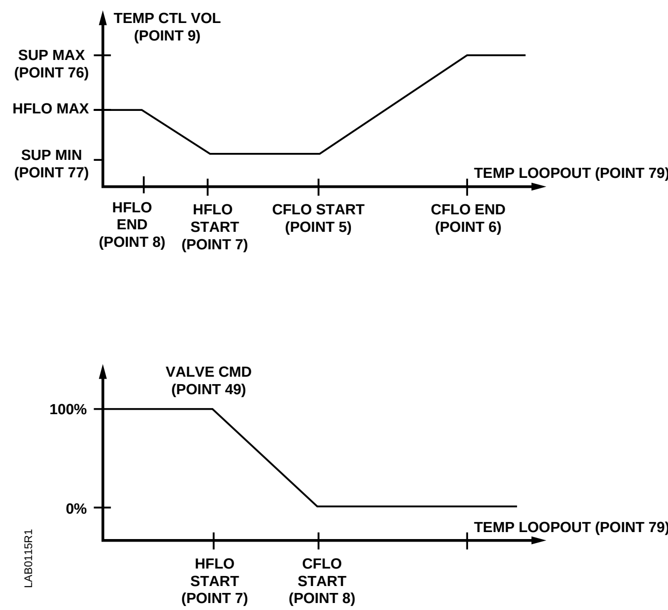

Figure 4-4. Temperature Control Sequence for Applications 2603 and 2613.

In the heating mode, the mixing damper is set to the full heating position. Here too, the sequencer adjusts the value of TEMP CTL VOL. The heating mode is active when TEMP LOOPOUT is between HFLO START and HFLO END.

The third mode is mixing. This mode is active when TEMP LOOPOUT falls between HFLO START and CFLO START. In this mode, the sequencer moves the mixing damper, adjusting the mix of the supply air from the hot and cold decks. If the thermal load can be met by adjusting the mix, there is no need to add airflow. The sequencer sets TEMP CTL VOL to the supply minimum.

To operate the room as described above, the sequencing points may be set as follows:

HFLO END = 0

HFLO START = 30

CFLO START = 60

CFLO END = 100

Some dual-duct HVAC designs do not include the heating mode described here. They mix warm air with cold to reduce the cooling effect of the supply flow, but they do not increase the supply flow to add heat to the room. The heating mode may be eliminated in the LRC by setting the sequencing points as follows:

HFLO END = 0

HFLO START = 0

CFLO START = 50

CFLO END = 100

The resulting temperature control sequence is illustrated in Figure 4-5.

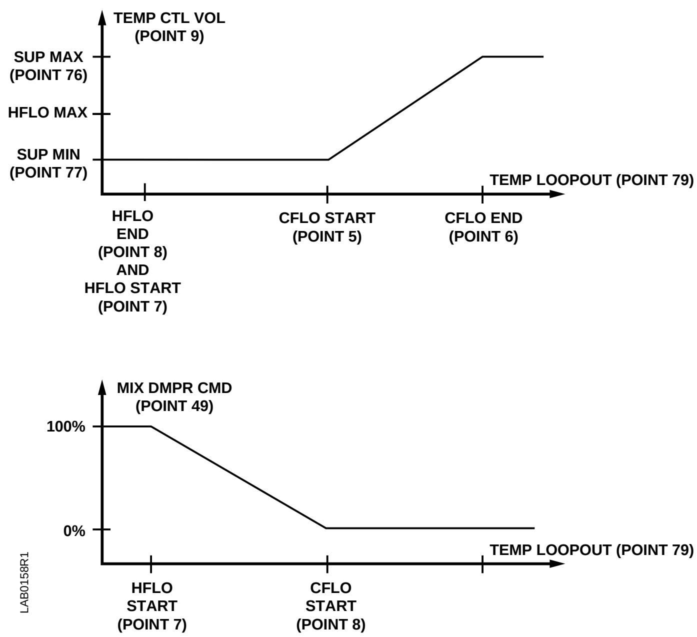

Figure 4-5. Adjusted Temperature Control Sequence for Applications 2603 and 2613.

In some cases, temperature control performance can be improved by adjusting the values of the sequencing points to better match them to the thermal sizing of the HVAC equipment. Consult your Siemens Building Technologies, Inc. representative for more information.

The “Temp Control” subpoint report presents the current state of the temperature control system. There are a few typical scenarios that can be observed. In the first scenario, the controller may be in cooling mode, meaning that MIX DMPR CMD is set to zero. When this happens, the room is using all cold air, and no hot air. The value of TEMP CTL VOL is above the supply flow minimum. Typically, in this mode, the measured value of SUP AIR VOL will be close to TEMP CTL VOL. This means that the thermal load is setting the supply flow. The measured flow may be substantially less than TEMP CTL VOL. In this case, the supply flow is probably limited by the need to keep the supply flow below the total exhaust. The general exhaust terminal may be at its capacity, which is the limit of mechanical cooling.

In the second scenario, the measured supply flow exceeds TEMP CTL VOL. This means that the fume hoods are so far open that the supply flow needed to balance the room pressure is more than the flow needed for cooling. Typically, this is not a stable condition and the controller moves to the mixing mode. In the mixing mode, TEMP CTL VOL goes to the supply minimum. The controller regulates the room temperature by modulating the mix of cold and hot supply air. As the need for heat increases, the mix moves toward heat, until MIX DMPR CMD reaches 100%. At that point, the controller shifts into a heating mode. Notice that TEMP CTL VOL rises above the minimum. If the need for heat is great enough, TEMP CTL VOL increases until it exceeds the quantity needed to balance the fume hoods. When this happens, then the supply volume tracks the TEMP CTL VOL and the room gets more hot air to regulate the temperature.

Table 4-2 describes the points discussed above.

Table 4-2.

Descriptor	Number	Function
ROOM TEMP	4	Value read from the room temperature sensor.
ROOM STPT	13	Desired value of the room temperature.
MIX DMPR CMD	49	Position of the mixing damper. 100% means hot, 0% means cold.
MIX AO1	48	Voltage that drives the mixing damper actuator through a pneumatic transducer.
TEMP CTL VOL	9	Amount of supply flow that the controller calculates is necessary to regulate the room temperature.
SUP AIR VOL	35	Measured value of the airflow through the supply terminal.
TEMP LOOPOUT	79	Value calculated by the room temperature PID algorithm. It indicates the thermal load on the room.
ROOM P GAIN	63	Proportional feedback gain used to tune the room temperature control.
ROOM I GAIN	64	Integral feedback gain used to tune the room temperature control.
ROOM D GAIN	65	Derivative feedback gain used to tune the room temperature control.
ROOM BIAS	66	Starting point where the value of TEMP LOOPOUT goes when the controller turns on.
LOOP TIME	98	Time interval controls how often the LRC measures the room temperature and calculates a new output value.

Setting the Room Temperature

The LRC operates the temperature control equipment available to it to keep the temperature measured by the Room Temperature Sensor at the set point. Some versions of the Room Temperature Sensor include an adjustment so the occupants of the room may select the desired temperature. Other versions do not have that adjustment.

If the thermostat does not include a set point adjustment, then ROOM SETPOINT (Point 13) must be set through the building automation system (BAS), either using CIS, the field panel or Insight. **Do not** set the value of ROOM TEMP (Point 4). This is the temperature reading from the room temperature sensor; overriding this value will disable room temperature control.

Siemens Building Technologies, Inc. has two types of Room Temperature Sensors with set point adjustments. Some of the Series 1000 thermostats have a sliding switch. If you command the set point from the BAS, it will override the point, and lock out commands from the thermostat. The series 2000 thermostats have buttons to adjust the temperature up and down. The LRC processes these commands as though they are BAS commands; therefore they are not blocked by a BAS command to Point 13.

5

Monitoring Laboratory Operation

Laboratory Room Graphics

An HVAC system operator can efficiently monitor the operation of an LRC room using Insight graphics. To be displayed on a graphic, subpoints must be unbundled by creating a logical point in the field panel with the appropriate address. Refer to your Insight manuals for information on how to do this. System performance will be improved if controller points, such as "Lab 1 Controller" are added to graphics in place of several subpoints, such as "Supply Flow" and "Total Exhaust". This gives the operator convenient access to any controller subpoint on a graphic by clicking on the controller information block and selecting "Report, Controller Information". This procedure is described in detail in the *Insight for PCs 5-Volume User Set* (125-1854).

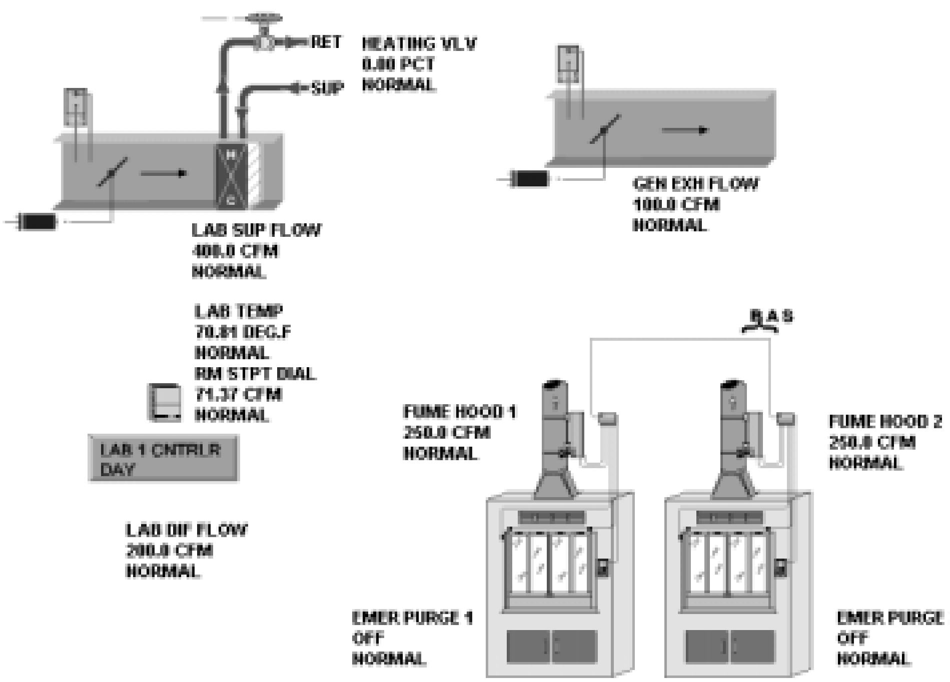

Figure 5-1. Lab Room Graphic.

Periodic Verification of Safe Laboratory Ventilation

When operating in a laboratory environment, it is important to purchase and commission a safe laboratory system. However, that system by itself is not enough. A Chemical Hygiene Plan should be in place that includes maintaining the system and verifying that it operates safely. Your Industrial Hygienist should suggest the interval based upon ANSI Z9.5, which recommends verifying pressurization regularly in intervals from one week to six months, depending on the hazard involved. All openings to surrounding spaces must be inspected and you must physically verify the direction of airflow. This applies even when continuous monitoring equipment is used. Periodic inspection complements continuous monitoring equipment. Monitoring equipment monitors the laboratory all day every day, providing much more thorough verification than is possible with inspections, however, inspection keeps the monitoring equipment reliable.

To be thorough, the inspection must include a full range of combinations of airflows, high and low hood exhaust, and high and low general exhaust. For most laboratories, a visual indication is the most cost effective. Test procedures should include recording the physical indicator you use, along with the value the LRC reports for the flow difference (VOL DIFFRNC). In this way, it is possible to record the controller’s assessment of pressurization and obtain an independent, physical confirmation. The test records should also indicate all the airflows in and out of the room as a way of documenting the test conditions.

Similarly, ANSI Z9.5 recommends inspection and verification of all ventilation system components. In addition to visual inspections, this may include verifying airflow readings against a recently calibrated device. Figure 5-2 is an example of the kind of document that helps maintain a safe working environment. Your local Siemens Building Technologies, Inc. office is qualified to carry out this service with documented procedures and documented results.

SIEMENS

Test Report No. ___________
Test Date ___________
Room Type ☐ Lab ☐ OR
Other ___________

Ventilation Assessment Data Sheet

Customer ______________________________ Room Tested ____________
Address ______________________________ Contact ____________
City & State ____________________ Zip________ Phone ____________

Room Diagram – Doors, BSCs, Fume Hoods, Exhaust and Supply Diffusers, and Workstations.

Supply Air Diffuser Airflow (Cu. Ft. per Min.)
1 ________
2 ________
3 ________
4 ________
5 ________
6 ________
7 ________
8 ________
9 ________
10 ________

TOTAL = ______ CFM

Exhaust Air Diffuser or Device Airflow (Cu. Ft. per Min.)
1 ________
2 ________
3 ________
4 ________
5 ________
6 ________
7 ________
8 ________
9 ________
10 ________

TOTAL = ______ CFM

Room Volume (LxWxH) = ____________________ Cubic Feet _____ %Fresh Air in Supply
% Fresh Air Provided by: Name ____________________ Title/Dept. ____________
Calculated Room Pressure: ☐ Positive (Supply>Exhaust) ☐ Negative (Supply<Exhaust)
Measured Room Pressure: ☐ Positive ☐ Negative
☐ Smoke Tube ______Inches Water on Magnehelic Gauge

Total Air Changes per Hour = Total Supply CFM ________x 60/Room Volume = _____ **ACH**
Outside Air Changes per Hour = Total ACH ____________x % Fresh Air = _____ **ACH**

Comments: ____
____

THIS REPORT IS ISSUED FOR ABOVE LISTED DATE ONLY, SEASONAL VARIATIONS AND HVAC SYSTEM MAINTENANCE AND OPERATIONS PROCEDURES CAN RESULT IN ROOM CONDITIONS THAT DIFFER FROM THOSE OBTAINED ON THE TESTING DATE.

Customer Signature ____________________ Serviced By ____________________
____________________ Local Address ____________________
Labor ____________________ ____________________
Parts ____________________ Telephone ____________________
Bill Customer ☐ YES ☐ NO Bill To (If other than customer)
Contract # ____________________ ____________________
____

Figure 5-2. Ventilation Assessment Sheet.

Maintaining Safety Records

ANSI Z9.5-1992 requires the designated cognizant person to maintain the permanent records of each laboratory ventilation system.

The quantity of air that moves through the room is a basic indicator of safety because it relates directly to the concentrations of air contaminants that develop. Sometimes this indicator is stated in terms of an air change rate. In the LRC, the point TOTL SUPPLY indicates the ventilation rate. (Some hygienists define the air change rate in terms of the exhaust flow. In that case, the point TOTL EXHAUST serves the purpose). Most users should have alarms on this value (refer to *Types of Alarms* in Chapter 3*, Controlling Laboratory Airflow*) for the purpose of quickly correcting emergencies. It is also worthwhile to keep track of this value over the long term. Collecting trend data on TOTL SUPPLY or hourly averages of the point makes it possible to track ventilation. Through APOGEE, this data can be automatically gathered, processed and archived to establish that the ventilation system has continued to function correctly, and to observe any unfavorable events or trends.

In a room controlled by an LRC, the points VOL DIFFRNC and VOL DIF ALM are also safety indicators. VOL DIFFRNC is the difference between the total exhaust airflow and the total supply airflow to the room. This flow difference draws air currents from surrounding spaces into the laboratory. The infiltrating airflow keeps contaminated laboratory air from spreading throughout the building. APOGEE can be used to keep track of this value day in and day out, making it possible for you to verify that the ventilation system works as designed to protect people outside the laboratory. This continuous monitoring complements the periodic inspections that verify that air moves in the right directions. The VOL DIFFRNCE data is calculated from several airflow measurements. As such, the value may fluctuate considerably. Sometimes the VOL DIF ALM point is a more appropriate indicator of safe pressurization because it gives a steadier picture of the situation. Often it is preferable to keep track of the alarm point instead of the flow difference.

Figure 5-3 is an example of a laboratory pressurization report generated by APOGEE. This report indicates the limits chosen to indicate safe pressurization and then shows if the room spent any time outside the limits during the report period. There are many ways to apply the APOGEE to generate this report, or one customized to your needs for records. Reporting can be done remotely on-line or locally using the BAS. Your local Siemens Building Technologies, Inc. office is qualified to describe your options and set up a safety reporting system that fits your organization.

Run Date: 6/6/97
Run Time: 10:47:26

Report Period:
Start Date: 3/2/97 Start Time: 00:00:00
End Date: 3/16/97 End Time: 00:00:00

Laboratory Room Performance Report
Sorted By Total Time Room Pressure in Alarm
(Values Above 0:15:00 Highlighted)

Lab Room #	Pressurization Low Limit Inches H20 or CFM	Pressurization High Limit Inches H20 or CFM	Total Time Room Pressure in Alarm	% of Time Room in Alarm	% of Time Room in Alarm During Occupied Period	% of Time Room in Alarm During Unoccupied Period	% of Time Room in Alarm During Weekend Period
327	100.000	300.000	02:33:47	1.00%	0.00%	2.00%	0.00%
331	100.000	300.000	00:02:21	0.00%	0.00%	0.00%	0.00%
334	100.000	300.000	00:00:34	0.00%	0.00%	0.00%	0.00%
330	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%
335	250.000	500.000	00:00:00	0.00%	0.00%	0.00%	0.00%
329	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%
338	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%
341	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%
342	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%
344	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%
347	100.000	300.000	00:00:00	0.00%	0.00%	0.00%	0.00%

Figure 5-3. Laboratory Room Performance Report.

System 600 maintenance records can also be used to educate laboratory occupants on proper laboratory work practices using actual information. If you do not have on-going safety training, consult your Siemens Building Technologies, Inc. representative for information on the safety training available through Siemens Building Technologies, Inc.

6

Point Database

Chapter 6 presents a description of the point database for Applications 2600 (Slave Mode) and pneumatic actuator Applications 2601, 2602, and 2603 as well as electronic actuator Applications 2611, 2612, and 2613, including point descriptors, point addresses, and a listing of applications in which each point is found.

Address	Descriptor	Application	Description
01	CTLR ADDRESS	2600, 2601, 2602, 2603, 2611, 2612, 2613	Identifies the controller on the LAN trunk.
02	APPLICATION	2600, 2601, 2602, 2603, 2611, 2612, 2613	Identification number of the program running in the controller.
{04}	ROOM TEMP	2600, 2601, 2602, 2603, 2611, 2612, 2613	Actual reading from the room temperature sensor.
05	CFLO START	2601, 2603, 2611, 2613	Point used to set up the temperature control sequence.
06	CFLO END	2601, 2603, 2611, 2613	Point used to set up the temperature control sequence.
07	REHEAT START	2601, 2602, 2611, 2612	Point used to set up the temperature control sequence.
07	HFLO START	2603, 2613	Point used to set up the temperature control sequence.
08	REHEAT END	2601, 2602, 2611, 2612	Point used to set up the temperature control sequence.
08	HFLO END	2603, 2613	Point used to set up the temperature control sequence.
{09}	TEMP CTL VOL	2601, 2603, 2611, 2613	Amount of supply airflow that the temperature control sequence determines is necessary to regulate the room temperature.
10	HFLO MAX	2603, 2613	Point used to set up the heating mode of a dual duct temperature control sequence.

continued on the next page. . .

Address	Descriptor	Application	Description
12	BUTTON ENA	2601, 2602, 2603, 2611, 2612, 2613	Connects Point 25 to Point 45. If this point is disabled, the button does not affect occupancy.
{13}	ROOM STPT	2600,2601, 2602, 2603, 2611, 2612,	Desired value of the room temperature.

Address	Descriptor	Application	Description
		2613	
{15}	HOOD SIG AI3	2601, 2602, 2603, 2611, 2612, 2613	Voltage that tells the LRC how much air the fume hood(s) is/are exhausting.
16	VENT ALM DEL	2601, 2602, 2603, 2611, 2612, 2613	Delay period that prevents “nuisance alarms” on the air change rate.
17	VENT ALM ENA	2601, 2602, 2603, 2611, 2612, 2613	When this is set to “yes”, the VENT ALM point can drive the ALARM DO8.
18	OCC SWIT ENA	2601, 2602, 2603, 2611, 2612, 2613	Connects Point 24 to Point 45. If this point is disabled, it does not affect occupancy.
{19}	OCC BUTTON	2600, 2601, 2602, 2603, 2611, 2612, 2613	State of the push button switch on the thermostat. The momentary switch is only ON when the button is pushed. The value of this point provides no information on the occupancy state of the room.
21	OCC DISPLAY	2600,2601, 2602, 2603, 2611, 2612, 2613	Occupancy state of the LRC; drives display on thermostat.
22	VOL DIF ALM	2601, 2602, 2603, 2611, 2612, 2613	Alarm point. ON means room pressurization may not be adequate.
{23}	NET ALM CMD	2600, 2601, 2602, 2603, 2611, 2612, 2613	Alarm data sent in to LRC from network.
{24}	DI 2	2600	State of a switch wired to the LRC. Closed contact = ON = occupied.
{24}	OCC SWIT DI2	2601, 2602, 2603, 2611, 2612, 2613	State of a switch wired to the LRC. Closed contact = ON = occupied.
{25}	BUTTON CMD	2600, 2601, 2602, 2603, 2611, 2612, 2613	LRC’s interpretation of Point 19. Records a user’s request to change occupancy.
26	GEX P GAIN	2601, 2603, 2611, 2613	Feedback gain. Used to tune general exhaust flow control loop.
26	SUP2 P GAIN	2602, 2612	Feedback gain. Used to tune flow control loop in Supply Terminal 2.
{27}	ALM SWIT DI4	2601, 2602, 2603, 2611, 2612, 2613	State of switch wired to the LRC. May be used to pick up alarm information from some other device in the room.
28	ALM SWIT ENA	2601, 2602, 2603, 2611, 2612, 2613	When this is set to “yes”, the ALM SWIT DI4 point can drive the ALARM DO8.
{29}	NET OCC CMD	2601, 2602, 2603, 2611, 2612, 2613	An occupancy input. This value comes to the LRC from the network or from a schedule.
{30}	GEX AIR VOL	2601, 2603, 2611, 2613	Measured value of the airflow from the room through the general exhaust terminal.
{30}	SUP2 AIR VOL	2602, 2612	Measured value of the airflow from the room through the general exhaust terminal.

continued on the next page. . .

Address	Descriptor	Application	Description
31	OCC SUP MAX	2601, 2603, 2611, 2613	Maximum supply in occupied mode.
31	SUP1 MAX	2602, 2612	Maximum supply flow allowed from terminal 1.

Address	Descriptor	Application	Description
32	OCC SUP MIN	2601, 2603, 2611, 2613	Minimum supply in occupied mode.
36	FLOW COEFF 1	2600	Calibration parameter for airflow sensor.
36	SUP FLO COEF	2601, 2603, 2611, 2613	Calibration parameter for airflow sensor.
36	SUP1 COEF	2602, 2612	Calibration parameter for airflow sensor.
37	DIF ALM ENA	2601, 2602, 2603, 2611, 2612, 2613	When this is set to “yes”, the VOL DIF ALM point can drive ALARM DO8.
38	DIF ALM LVL	2601, 2602, 2603, 2611, 2612, 2613	VOL DIF ALM is triggered when VOL DIFFRNC goes below this level.
39	DIF ALM DEL	2601, 2602, 2603, 2611, 2612, 2613	Alarm delay point to prevent “nuisance alarms” on the flow difference.
40	FAIL MODE	2601, 2602, 2603, 2611, 2612, 2613	Select “HOLD” or “CLOSE” to tell the supply damper(s) what to do when a flow measurement signal is lost.
{41}	DO1	2600	
{41}	SUP FILL DO1	2601, 2603	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{41}	SUP1 FILL DO1	2602	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{41}	SUP EXTN DO1	2611, 2613	Drives a LAB AO-E module to extend electronic actuator. Do not use or manually set this point.
{41}	SUP1 ETN DO1	2612	Drives a LAB AO-E module to extend electronic actuator. Do not use or manually set this point.
{42}	DO 2	2600	
{42}	SUP BLED DO2	2601, 2603	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{42}	SUP1 BLD DO2	2602	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{42}	SUP RETC DO2	2611, 2613	Drives a LAB AO-E module to retract electronic actuator. Do not use or manually set this point.
{42}	SUP1 RTC DO2	2612	Drives a LAB AO-E module to retract electronic actuator. Do not use or manually set this point.
{43}	DO3	2600	
{43}	GEX FILL DO3	2601, 2603	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{43}	SUP2 FIL DO3	2602	Drives a solenoid valve that moves a damper. Do not use or manually set this point.

continued on the next page. . .

{43}	GEX EXTN DO3	2611, 2613	Drives a LAB AO-E module to extend electronic actuator. Do not use or manually set this point.
{43}	SUP2 ETN DO3	2612	Drives a LAB AO-E module to extend electronic actuator. Do not use or manually set this point.

Address	Descriptor	Application	Description
{44}	DO4	2600	
{44}	GEX BLED DO4	2601, 2603	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{44}	SUP2 BLD DO4	2602	Drives a solenoid valve that moves a damper. Do not use or manually set this point.
{44}	GEX RETC DO4	2611, 2613	Drives a LAB AO-E module to retract electronic actuator. Do not use or manually set this point.
{44}	SUP2 RTC DO4	2612	Drives a LAB AO-E module to retract electronic actuator. Do not use or manually set this point.
{45}	DO5	2600	
{45}	OCC.UOC DO5	2601, 2602, 2603, 2611, 2612, 2613	Occupancy state of LRC; may drive light in room.
{46}	DO6	2600	
{46}	SPARE DO6	2601, 2602, 2603, 2611, 2612, 2613	Spare DO termination.
{47}	DO7	2600	
{47}	AUTOZERO DO7	2601, 2602, 2603, 2611, 2612, 2613	Drives the Autozero modules for calibrating the flow sensors. Do not use or manually set this point.
{48}	REHEAT AO1	2601, 2602	The voltage that drives the reheat valve, either directly or through a pneumatic transducer.
{48}	MIX AO1	2603	The voltage that drives the mixing damper actuator through a pneumatic transducer.
{48}	REHEAT AO1	2611, 2612	Voltage that directly drives the reheat valve.
{48}	MIX AO1	2613	Voltage that directly drives the mixing damper actuator.
{49}	VALVE CMD	2601, 2602, 2611, 2612	State of the reheat valve. Represents how far the valve is open.
{49}	MIX DMPR CMD	2603, 2613	Position of the mixing damper. 100% means hot, 0% means cold.
{50}	DO8	2600	
{50}	ALARM DO8	2601, 2602, 2603, 2611, 2612, 2613	Intended to drive local alarm device (horn, light, etc.). Function set up by setting alarm enable points.
{51}	HOOD VOL	2601, 2602, 2603, 2611, 2612, 2613	Airflow signal from the fume hood(s).
52	MAX HOOD VOL	2601, 2602, 2603, 2611, 2612, 2613	Hood exhaust airflow value that corresponds to 10 volts on HOOD SIG AI3. Must be setup to match the hood control equipment.

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Address	Descriptor	Application	Description
{53}	TOTL EXHAUST	2601, 2602, 2603, 2611, 2612, 2613	Point 30 + Point 51 + Point 89. This value is the sum of the measured value of the airflow from the room through the general exhaust terminal, the airflow through the fume hoods, and any exhaust flows not connected to the LRC.
54	FLOW COEFF 2	2600, 2602, 2612	Calibration parameter for airflow sensor.

Address	Descriptor	Application	Description
54	GEX FLO COEF	2601, 2603, 2611, 2613	Calibration parameter for airflow sensor.
54	SUP2 COEF	2602, 2612	Calibration parameter for airflow sensor.
55	HOOD OCC VOL	2601, 2602, 2603, 2611, 2612, 2613	When HOOD VOL (Point 51) is above this value, hoods are considered open for purposes of occupancy. (This value does not affect the operation of the hood or the room pressurization system). Setting this value to zero means the hood flow does not affect Point 45.
56	HOOD UOC VOL	2601, 2602, 2603, 2611, 2612, 2613	When HOOD VOL (Point 51) is below this value, hoods are considered closed for purposes of occupancy. (This value does not affect the operation of the hood or the room pressurization system).
57	VALVE CLOSED	2601, 2602, 2611, 2612	Setup point. Tells the LRC what voltage fully closes the reheat valve.
57	MIX FUL COLD	2603, 2613	Setup point. Tells the LRC what voltage fully strokes the mixing damper to cold.
58	VALVE OPEN	2601, 2602, 2611, 2612	Setup point. Tells the LRC what voltage fully opens the reheat valve.
58	MIX FUL HOT	2603, 2613	Setup point. Tells the LRC what voltage fully strokes the mixing damper hot.
59	GEX DMPR DIR	2601, 2603, 2611, 2613	Setup point. Indicates NOPEN or NCLOSE for general exhaust damper actuator.
59	SUP2 DIR	2602, 2612	Setup point. Indicates NOPEN or NCLOSE for damper actuator on supply terminal 2.
60	GEXDUCT AREA	2601, 2603, 2611, 2613	Internal cross-sectional area of the general exhaust duct where the flow sensor is installed.
60	SUP2 AREA	2602, 2612	Internal cross-sectional area of the supply terminal two duct where the flow sensor is installed.
{61}	OTHER SUP	2601, 2602, 2603, 2611, 2612, 2613	Value of any supply airflows not connected to the LRC. Must be entered to the controller to account for flows it can not detect.
62	SUP DMPR DIR	2601, 2603, 2611, 2613	Setup point. Indicates NOPEN or NCLOSE for damper actuator on supply terminal.
62	SUP1 DIR	2602, 2612	Setup point. Indicates NOPEN and NCLOSE for damper actuator on supply terminal one.
63	ROOM P GAIN	2601, 2602, 2603, 2611, 2612, 2613	Proportional feedback gain used to tune the room temperature control.
64	ROOM I GAIN	2601, 2602, 2603, 2611, 2612, 2613	Integral feedback gain used to tune the room temperature control.
65	ROOM D GAIN	2601, 2602, 2603, 2611, 2612, 2613	Derivative feedback gain used to tune the room temperature control.

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66	ROOM BIAS	2601, 2602, 2603, 2611, 2612, 2613	Starting point where the value of TEMP LOOPOUT goes when the controller turns on.
67	UOC GEX MAX	2601, 2603, 2611, 2613	Maximum general exhaust in unoccupied mode.

Address	Descriptor	Application	Description
68	UOC GEX MIN	2601, 2603, 2611, 2613	Minimum general exhaust in unoccupied mode.
{69}	TOTL SUPPLY	2601, 2602, 2603, 2611, 2612, 2613	Point 35 + Point 61. This is the measured value of the airflow delivered to the room by the supply terminal plus the value of any supply airflows not connected to the LRC.
70	SUP P GAIN	2601, 2603, 2611, 2613	Feedback gain. Used to tune supply flow control.
70	SUP1 P GAIN	2602, 2612	Feedback gain. Used to tune the flow control loop.
71	UOC SUP MAX	2601, 2603, 2611, 2613	Maximum supply in unoccupied mode.
72	UOC SUP MIN	2601, 2603, 2611, 2613	Minimum supply in unoccupied mode.
73	DO DIR.REV	2600, 2601, 2602, 2603, 2611, 2612, 2613	Makes it possible to reverse the action of the output TRIACs.
{74}	GEX MAX	2601, 2603, 2611, 2613	Currently active maximum general exhaust.
{75}	GEX MIN	2601, 2603, 2611, 2613	Currently active minimum general exhaust.
{76}	SUP MAX	2601, 2603, 2611, 2613	Currently active maximum supply.
{77}	SUP MIN	2601, 2603, 2611, 2613	Currently active minimum supply.
{79}	TEMP LOOPOUT	2601, 2602, 2603, 2611, 2612, 2613	Value calculated by the room temperature PID algorithm. It indicates the thermal load on the room.
{81}	SUP DMPR CMD	2601, 2603, 2611, 2613	Tells the supply damper how fast to move. Positive means opening. Negative means closing.
{83}	VOL DIFFRNC	2601, 2602, 2603, 2611, 2612, 2613	Difference between measured airflow into the room, and measured airflow out. Equal to Point 53 - Point 69
84	TRACK METHOD	2601, 2603, 2611, 2613	Details. When the value is STPT, the supply flow follows the GEN EXH STPT. When the value is FLOW, the supply flow follows GEN EXH VOL.
{85}	GEX FLO STPT	2601, 2603, 2611, 2613	Desired value of the general exhaust. The controller selects the lowest value that will lead to adequate supply flow, and correct pressurization.
{85}	SUP2 STPT	2602, 2612	Desired value of the supply 2 set point.
{88}	VOL DIF STPT	2601, 2602, 2603, 2611, 2612, 2613	Desired value for the flow difference. This value can be selected and adjusted to achieve room pressurization.

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Address	Descriptor	Application	Description
{89}	OTHER EXH	2601, 2602, 2603, 2611, 2612, 2613	Value of any exhaust airflows not connected to the LRC. Must be entered to the controller to account for flows it can not detect.
90	OC V ALM LVL	2601, 2602,	Ventilation alarm level in occupied mode.

Address	Descriptor	Application	Description
		2603, 2611, 2612, 2613	
90	OC V ALM LVL	2601, 2602, 2603, 2611, 2612, 2613	Ventilation alarm level in occupied mode.
91	UC V ALM LVL	2601, 2602, 2603, 2611, 2612, 2613	Ventilation alarm level in unoccupied mode.
{92}	VENT ALM	2601, 2602, 2603, 2611, 2612, 2613	Alarm point indicates inadequate air change rate.
{93}	SUP FLO STPT	2601, 2603, 2611, 2613	Desired value of the supply flow, chosen by the controller to achieve the correct flow difference for the room.
{94}	CAL AIR	2600, 2601, 2602, 2603, 2611, 2612, 2613	When the point is on, controller is calibrating the flow sensors. Turns off automatically when done.
95	CAL SETUP	2600, 2601, 2602, 2603, 2611, 2612, 2613	Configuration setup code for the calibration sequence options.
96	CAL TIMER	2600, 2601, 2602, 2603, 2611, 2612, 2613	Time interval, in hours, between the calibration sequence initiations if a timed calibration option is selected in the point CAL SETUP.
97	SUPDUCT AREA	2601, 2603, 2611, 2613	Cross-sectional area of the supply duct at the spot where the flow sensor is installed.
98	LOOP TIME	2601, 2602, 2603, 2611, 2612, 2613	Time interval controls how often the LRC measures the room temperature and calculates a new output value.
{99}	ERROR STATUS	2600, 2601, 2602, 2603, 2611, 2612, 2613	Used to diagnose controller board failures.

Glossary

Overview

The glossary contains terms and acronyms that are used in this manual. For definitions of point database descriptors, refer to *Chapter 4, Point Database,* in this manual. For definitions of commonly used terms as well as acronyms and abbreviations associated with the APOGEE, refer to the *Siemens Building Technologies Technical Glossary of Building Controls Terminology and Acronyms* (125-2185). This book is available from your local Siemens Building Technologies, Inc. representative.

AI

Analog Input. An AI point is a physical point that accepts a continuous variable signal.

AO

Analog Output. An AO point is a physical point that generates a continuous variable signal.

AO-E Module

Analog Output Electronic Module. The AO-E module is used to interface between the LRC output and the high speed electronic damper actuator.

AO-P Module

Analog Output-Pneumatic Module. The electro-pneumatic interface between the LRC and the pneumatic damper actuator.

AO-P Transducer

Analog Output-Pneumatic Transducer. A non-bleed device that receives an electronic signal and converts it into a pneumatic signal.

centralized control

The type of control offered by a controller that is connected, by means of a Floor Level Network (FLN), with a System 600 APOGEE field panel.

control loop

A PID algorithm that is used to control an output based on a set point and an input reading from a sensor.

Controller Interface

Operator interface software used with the Portable Operator's Software Terminal for the purpose of communicating with a Terminal Equipment Controller or a field panel.

CV

Constant Volume.

DDC

Direct Digital Control.

DI

Digital Input. A DI point is a physical output point that accepts a two-state signal (i.e., ON/OFF, OPEN/CLOSED, YES/NO, etc.)

DO

Digital Output. A DO point is a physical output point that generates a two-state signal (i.e.,, ON/OFF, OPEN/CLOSED, YES/NO, etc.)

English units

The foot-pound-second system of units for weights and measurements.

equipment controller

A FLN device that provides additional point capacity to a field panel or provides individual room or mechanical equipment control.

FFM

Fume Hood Flow Module. Collects information about flow rates or electrical signals that can be converted to flow rates for a maximum of four fume hood flows. '

FHC

Fume Hood Controller.

FLN

Floor Level Network.

field panel

Device containing a microprocessor for centralized control of system components and equipment controllers. A field panel samples and processes field data, initiates control actions, communicates with its operators, and generates reports, displays and warnings.

intercept

Factor which converts analog values (used by the controller) to a form which the user can understand (engineering units). Slope and intercept constants are determined by the type of field input/output represented by the physical or virtual point.

LCM

Laboratory Controller Module.

LRC

Laboratory Room Controller.

loopout

The output of the control loop expressed as a percentage.

LPS

Liters Per Second.

OCC mode

Occupied mode.

OFF text

Text indicating the de-energized state of a digital point (e.g., OFF, CLOSED, NO).

ON text

Text indicating the energized state of a digital point (e.g., ON, OPEN, YES).

override switch

Button on room temperature sensor that can be pressed by an occupant to change the status of a room from night mode to day mode for a predetermined time.

PID

Proportional, Integral, Derivative.

RTS

Room Temperature Sensor.

SI units

Systeme International d'Unites. The international metric system.

slave mode

Default application that comes up when power is first applied to the Laboratory Room Controller.

slope

Factor which converts analog values (used by the controller) to a form which the user can understand (engineering units). Slope and intercept constants are determined by the type of field input/output represented by the physical or virtual point.

stand-alone control

Type of control offered by a controller that is providing independent DDC control to a space.

Terminal Equipment

Siemens Building Technologies, Inc. product family of equipment controllers that house the Controller applications software used to control terminal units, such as heat pumps, VAV terminal boxes, fan coil units, unit ventilators, etc.

unbundle

Term that describes the entering of a point that resides in a controller's database into the field panel's database so that it can be monitored at and/or controlled from the field panel.

UNOCC mode

Unoccupied mode.

VAV

Variable Air Volume

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