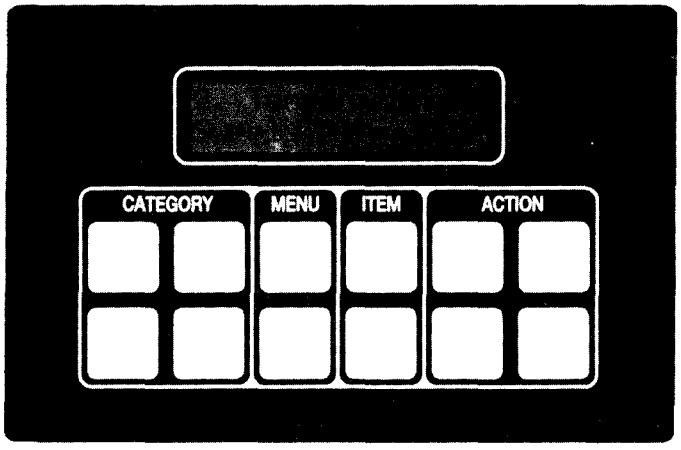
McQuay®
Air Conditioning

Operation Manual

Bulletin No. OM 123
September, 1994
Part No. 579083Y

MicroTech®
Self-contained Air Conditioning Unit Controller: VAV or CAV-DTC Control



Used With McQuay Models SWP, SWT and SCP Units

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Introduction

This manual provides information about the MicroTech® control system used in the McQuay® Self-contained Air Conditioning product line. It specifically describes the sequences of operation and programmable options for units with factory equipped variable air volume (VAV) equipment and units with factory equipped constant air volume, discharge air temperature control (CAV-STC). It also includes information on how to use the keypad/display to enter and display data.

For information on MicroTech components, input/output configurations, field wiring options and requirements, and service procedures, refer to Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. For installation and start-up instructions and general information on a particular Self-contained unit, refer to its model-specific installation manual (see Table 1).

Table 1. Model-Specific Self-contained unit Installation Literature

Self-contained Model	Installation & Maintenance Data Bulletin Number
SWP	IM 550

⚠WARNING

Electric shock hazard. Can cause personal injury or equipment damage.

This equipment must be properly grounded. Connections and service to the MicroTech control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

⚠WARNING

Excessive moisture in the control panel can cause hazardous working conditions and improper equipment operation.

When servicing this equipment during rainy weather, the electrical components in the main control panel must be protected from the rain.

⚠CAUTION

Extreme temperature hazard. Can cause damage to system components.

This MicroTech controller is designed to operate in ambient temperatures from –20°F to 125°F. It can be stored in ambient temperatures from –40°F to 140°F. It is designed to be stored and operated in relative humidity up to 95% (non-condensing).

⚠CAUTION

Grossly misadjusting Step-and-Wait parameters can cause erratic unit operation and equipment damage.

Step-and-Wait parameters should be adjusted only by trained personnel that have a thorough understanding of how they affect overall system operation.

NOTICE

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with this instruction 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 harmful interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. **McQuay International disclaims any liability resulting from any interference or for the correction thereof.**

Software ID

MicroTech Self-contained Air Conditioning Unit controller software is factory installed and tested in each unit prior to shipment. The program loaded into the controller is identified by its software part number (also referred to as the "Ident"). This number is printed on the software ID tag, a small label affixed to the control panel next to MCB1. For more information, refer to the "Software ID" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller.

The software part number is also encoded in the controller's memory and is available for display on menu 25 of the keypad/display or a PC equipped with MicroTech Monitor™ software. (For information on using the keypad/display, see the "Getting Started" portion of this manual.) Using menu 25 or Monitor software is the most reliable way of determining the controller's software part number. Software part number codification is as follows:

950600 02 0

Program number
Version (numeric)
Version revision (zero then alphabetical)

The standard software part number for the program used to control Self-contained Air Conditioning unit is 950600020. If the unit's program number does not match this number, it is likely that a special program has been loaded into the controller. In this case, some of the information in this manual may not be applicable.

Note: The information in this manual should be applicable with software version revisions following "0" (ie A,B,..etc.).

Getting Started

The MicroTech Self-contained Air Conditioning Unit Controller is a self-contained device that is capable of complete, stand-alone operation. It can also be included in a network with other unit and auxiliary controllers. Regardless of whether the controller is stand-alone or part of a network, you can display and modify information in the controller by using any of the following three methods:

- Using the keypad/display in the unit's main control panel
- Using the keypad/display in an optional Remote Monitoring and Control (RMC) Panel
- Using an optional PC equipped with Monitor software

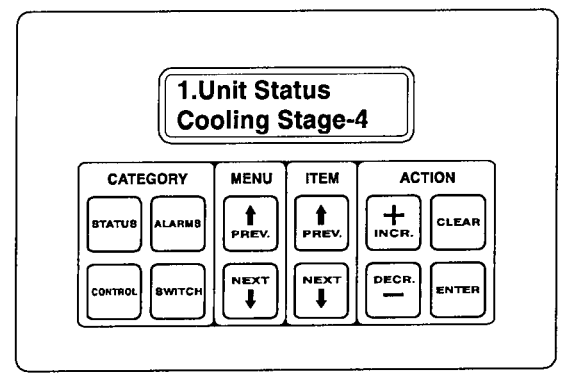
The following "Getting Started" sections describe how to use the keypad/display. For information on using the optional Monitor software package, see the user's manual supplied with the Monitor software.

Using the Keypad/Display

The Keypad/Display Board, shown in Figure 1, is provided with all MicroTech Self-contained Air Conditioning Unit Controllers. With the keypad/display you can monitor operating conditions, system alarms, control parameters, and schedules. After the password has been entered, you can edit setpoints, parameters, and schedules.

The optional RMC Panel has a keypad/display that can emulate the unit-mounted keypad/display. Once the RMC Panel's keypad/display is interfaced to the desired unit controller, it operates exactly the same as the unit-mounted keypad/display.

Figure 1. Keypad/Display



Menu Structure

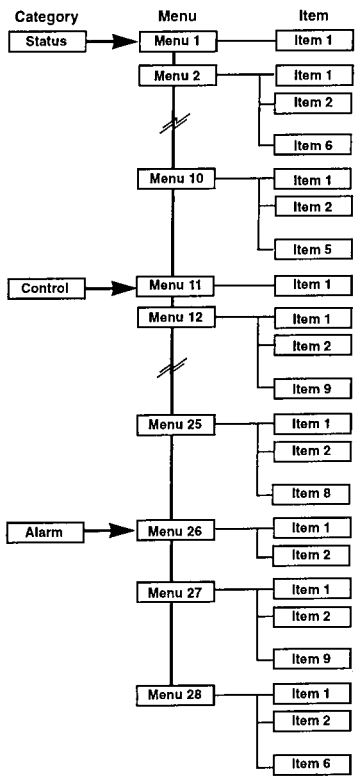
The keypad accessible information in the MicroTech controller is organized in a menu structure to provide quick access. As shown in Figure 2, this structure is divided into three levels: categories, menus, and items. The category, which is the highest level in the structure, can be "Status," "Control," or "Alarm." The name of each category describes the basic purpose of the menus it contains. Complete information on the contents of each menu is included in the following "VAV and CAV-DTC "Menu Tables" section.

Status Category
Menus in the Status category contain information about the current operating conditions in the unit. The fields in these menu items provide status information only and cannot be changed with the keypad. The Status category menus are summarized in Table 2.

Control Category
Menus in the Control category contain setpoints and parameters that define how the unit operates. After the password is entered, most fields in these menu items can be changed with the keypad. The Control category menus are summarized in Table 3.

Alarm Category
Menus in the Alarm category contain current and previous alarm information. The Alarm category menus are summarized in Table 4.

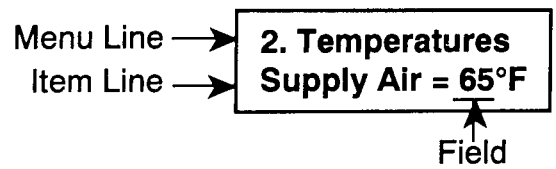
Figure 2. Keypad Accessible Menu Structure



Display Format

The information stored in the controller's menu structure can be viewed on the 2-line by 16-character LCD display. As shown in Figure 3, the current menu is displayed on the top line and the current item is displayed on the bottom line. The item line contains one or more fields that convey varying information.

Figure 3. LCD Display Format



Password Protection

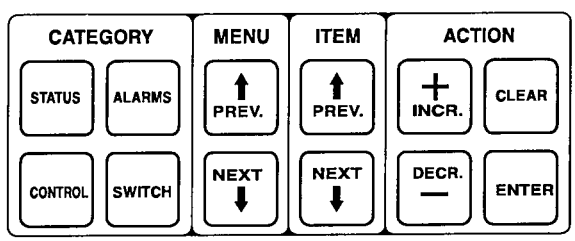
The MicroTech controller includes password protection to guard against the entry of inadvertent changes. When you attempt to change the value of an adjustable parameter with the keypad, the controller prompts you to enter the password. If the correct password is entered, the controller will allow you to make changes as desired. Fifteen minutes after the last keystroke is made, the controller will disallow further changes until the password is re-entered.

The keypad password for all controllers is the following key sequence: enter, enter, enter, enter. It is not adjustable. See "Keypad Functions" below for more information.

Keypad Functions

The MicroTech controller's keypad consists of 12 pressure sensitive membrane switches, which are divided into 4 groups: "Category," "Menu," "Item," and "Action." See Figure 4. Following are descriptions of these groups and the keys they contain.

Figure 4. Keypad



Category Group
Acting like bookmarks in the menu structure, the keys in the Category group provide quick access to the desired menus. By using these keys, you can minimize scrolling between menus with the keys in the Menu group (see below). Refer to Figure 2.

Status Key: Any time the status key is pressed, the first menu in the Status category is displayed. This is menu 1, "Unit Status."

Control Key: Any time the control key is pressed, the first menu in the Control category is displayed. This is menu 11, "Control Mode."

Alarms Key: Any time the alarms key is pressed, the first menu in the Alarm category is displayed. This is menu 26, "Curr Alarm."

Switch Key: The switch key toggles the display between associated Status and Control category menu items. It allows you to quickly check a controlled condition (temperature, pressure, position) against its setpoint. For example, by pressing switch when the duct static pressure is currently being displayed ("Duct=" item under menu 5), the duct static pressure setpoint will be displayed ("Duct Spt=" item under menu 17). If switch is pressed again, the actual pressure will be displayed again. Note that the switch key will not work with every menu item. Tables 3 and 4 list the switch key destinations for all applicable menu items.

Menu Group

The keys in the Menu group allow you to choose the menu you want to display. Refer to Figure 2.

Prev Key: When the Menu prev key is pressed, the display will scroll to the previous menu in the structure. This action will occur regardless of the current menu number. Note that you can "wrap around" from the first menu to the last menu by pressing the Menu prev key twice.

Next Key: When the Menu next key is pressed, the display will scroll to the next menu in the structure. This action will occur regardless of the current menu number. Note that you can "wrap around" from the last menu to the first menu by pressing the Menu next key twice.

Item Group

After you select a menu, you can choose the item you want to display by using the keys in the Item group. Refer to Figure 2.

Prev Key: When the Item prev key is pressed, the display will scroll to the previous item in the current menu. Note that you can "wrap around" from the first item to the last item by pressing the Item prev key twice.

Next Key: When the Item next key is pressed, the display will scroll to the next item in the current menu. Note that you can "wrap around" from the last item to the first item by pressing the Item next key twice.

Action Group

The Action group keys allow you to clear alarms or change setpoints and parameters in the selected item's field(s). Note that the password must be entered before any setpoint, parameter, or schedule changes can be made. See "Password Protection" above for more information.

Incr Key: When the incr key is pressed, the entry in the item's selected field will change to the next higher value or next available selection. The field being edited will flash until the enter or clear key is pressed.

Decr Key: When the decr key is pressed, the entry in the item's selected field will change to the next lower value or previous available selection. The field being edited will flash until the enter or clear key is pressed.

Enter Key: When the enter key is pressed, the entry in the item's selected field will be locked in. If the selected item has one field, pressing enter also completes the edit. If the selected item has more than one field, pressing enter also makes the next field available for editing with the incr and decr keys. If no change is desired, press enter until the desired field is flashing or the edit is complete. (It is possible to initiate an edit of a multi-field item by pressing the enter key. In this instance, the first field would be left unchanged and the second field would be available for editing.)

Clear Key: The clear key is used to clear alarms and edited (flashing) fields. When menu 26, "Curr Alarm," is in the display, pressing clear will clear the current alarm. When an item field is being edited, pressing clear will restore the field's previous entry and end the edit.

Keypad/Display Exercises

Following are three exercises that will guide you through some typical keypad operations. Note that often there is more than one way to perform an operation. For example, you can use the Menu group keys with or without the optional Category group keys to quickly find the menu you want to display.

Changing a Setpoint

In this exercise, assume that the Cooling Control Dead Band is 1°F. Using the following procedure, you will change this setpoint to 2°F and thus enable mechanical cooling.

1. Press control in the Category key group. The first menu of the Control category is displayed. This is menu 11, "Control Mode."
2. Press next in the Menu key group twice. Menu 13, "Clg Control," is displayed. The first item of this menu, "Setpoint=," is also displayed.
3. Press next in the Item key group once. The "Dead Band=" item is displayed. This is the Cooling Control Dead Band Setpoint. The default value of 1°F should also be displayed.
4. Press either incr or decr in the Action key group. The controller prompts you for the password.
5. Press enter in the Action key group four times. (This is the password.) The "Password Verified" message is displayed.
6. Press incr until the setpoint is 2°F. Notice that the adjustable field flashes during the change.
7. Press enter. The field stops flashing. This means that the new setpoint is locked in.

Clearing an Alarm

In this exercise, assume that a "fault" alarm exists. This type of alarm shuts down the unit and keeps it off until the alarm is manually cleared. If the conditions that caused the alarm are gone, you can clear a fault alarm by using the following procedure.

1. Press alarms in the Category key group. The first menu of the Alarm category is displayed. This is menu 26, "Curr Alarm." The first item of menu 26 is also displayed. It probably shows "No Active Alarms." Assume that a fault alarm exists.
2. Press clear in the Action key group. This clears the alarm and returns the unit to normal operation.

Modifying a Schedule

In this exercise, assume that a change in building occupancy requires the self-contained unit to run from 12:30 a.m. to 5:00 p.m. on Saturday. Currently, the unit is scheduled to be shut down on Saturday. Using the following procedure, you will change this schedule accordingly. (This procedure assumes that the password has previously been entered and the 15-minute authorization timer has not expired.)

1. Press alarms in the Category key group. The first menu of the Alarm category is displayed. This is menu 26, "Curr Alarm."

2. Press prev in the Menu key group four times. Menu 22, "Schedule," is displayed. The first item of this menu, "Override=," is also displayed. Note that you could have started at the beginning of the Control category of menus and stepped forward to menu 22 by using the next key, but it would have taken longer.
3. Press prev in the Item key group three times. (This makes use of the wrap-around capability.) Menu item "Sat," is displayed. The default start-stop schedule of 00:00–00:00 should also be displayed. Each of the four sets of zeros is an adjustable field: start hour, start minute, stop hour, and stop minute. Note that you could have stepped forward to "Sat" by using the next key, but it would have taken longer.
4. Press enter in the Action key group. The second field (start minute) flashes, indicating that it can be edited. *Since the desired schedule is* 00:30–17:00, the first field (start hour) does not need to be changed. By pressing enter instead of incr, you can bypass this field.
5. Press incr until the start minute field is 30. Notice that the adjustable field flashes during the change.
6. *Press enter. The second field stops flashing, and the third* field (stop hour) starts flashing. This means that the new start minute is locked in and the stop hour can be edited.
7. Press incr until the stop hour field is 17.
8. Press enter. The third field stops flashing, and the fourth field (stop minute) starts flashing.
9. Since the stop minute field does not require editing, press enter again. The fourth field stops flashing, thus completing the edit. Note that the same result could have been accomplished by pressing the clear key instead of the enter key.

VAV and CAV-DTC Menu Tables

The following tables show every menu, item, and field in the menu structure. *These menus and items can all be displayed* with the keypad/display. (Monitor software provides many additional monitoring features and adjustable parameters.)

Status Menus

Table 2 lists all possible menus and items in the Status category. The table's range column lists all possible values for each item. Following are brief descriptions of the Status category menus.

Unit Status
Menu 1, "Unit Status," tells you which operating or special state the unit is currently in. For more information, see the "Determining Unit Status" section in the "Operator's Guide" portion of this manual.

Temperatures
Menu 2, "Temperatures," provides the current temperatures at all connected sensor locations. Menu item "Cntl Temp=," displays the current Control Temperature, which is the temperature at the selected representative zone sensor.

Waterflow
Menu 3, "Waterflow," tells you if waterflow is present and whether the pump is on or off.

Fan/Airflow Status
Menu 4, "Fan/Airflow," tells you which fans are currently on and whether there is airflow through the unit. Airflow status is sensed by PC7, a differential pressure switch.

Airflow Modulation
Menu 5, "Airflow Mod," provides the VIV, inverter, or dual motor control parameters.

Economizer
Menu 6 "Economizer," tells you the current economizer position and whether it is enabled or disabled.

Cooling Status
Menu 7, "Cool Status," tells you which kinds of cooling, if any, are currently allowed. If cooling is disabled, it tells you why. For more information, see the "Determining Unit Status" section in the "Operator's Guide" portion of this manual.

Heating Status
Menu 8, "Heat Status," tells you whether heating is currently allowed. If heating is disabled, it tells you why. For more information, see the "Determining Unit Status" section in the "Operator's Guide" portion of this manual.

Operating Hours
Menu 9 "Operating Hrs," provides the operating hours for each compressor, cooling, economizer, heating and override.

Miscellaneous Status
Menu 10, "Misc Status," tells you heat output, outdoor damper position, head pressure, percent humidity and dewpoint temperature.

Table 2. Status Menus

Menu		Item			
No.	Name	Name	Range	Switch Key Destination	
				Menu	Item
1	Unit Status	_____	Off-Unoccupied	11. Control Mode	*current control mode*
			Off Fan Switch		
			Off-Network		
			Off-Manual		
			Off-Service		
			Off-Alarm		
			Calibrate		
			Start Requested		
			Startup Initial		
			Recirculate		
			Fan On		
			Heating		
			Morning Warm Up		
			Fan On-Htg -Stg		
			Post Heat		
			Economizer		
			Cooling		
			Heating-Stage		
			MWUP Htg-Stg		
			Fan On- Heating		
			Cooling-Stage		
			Unoccupied Heat		
			Unocc Htg-Stg		
			Unoccupied Cool		
			Unocc Clg-Stg		
			Unocc Economizer		
			Dehum-Fan On		
			Dehum-Heating		
			Dehum-Mwup Heat		
			Dehum-Fan On Ht		
			Dehum-Post Heat		
			Dehum-Economizer		
			Dehum-Cooling		
2	Temperatures	Cntl Temp= ____ °F	(Same as CT sensor)	12. Heat/Cool	Cntl Temp=
		Supply Air= ____ °F	0 – 255°F	13. Clg Control	Setpoint=
		Ent Water= ____ °F	0 – 255°F	13. Clg Control	Min EWT=
		Lvg Water= ____ °F	0 – 255°F	–	–
		Mixed Air= ____ °F	0 – 255°F	–	–
		Space= ____ °F	0 – 255°F	16. Unocc Htg/Clg	Cooling Spt=
		① Return Air= ____ °F	0 – 255°F	15. Alarm Limits	Hi Return=
		Outdr Air= ____ °F	—100 – 155°F	14. Htg Control	Max OAT=
3	Waterflow	② Waterflow= ____	Yes	–	–
			No	–	–
		Pump= ____	On	–	–
			Off	–	–
4	Fans/Airflow	Airflow= ____	Yes	–	–
			No	–	–
		③ Supply Fan= ____	On	–	–
			Off	–	–
		④ Supply Fan= ____	Off	–	–
			Low	–	–
			Hi	–	–
		Fan Op= ____	On	–	–
			Off	–	–
5	⑤ Airflow Mod	④ Velocity= ____FPM	0 - 1675 FPM	–	–
		④ Current= ____Amps	0 - 30 Amps	17. Motor Control	Amp Limit=
		⑥ Duct P= ____WC	0 - 4.00 WC	17. Duct Pressure	Duct Spt=
		⑦ Bldg P= ____WC	-0.25 - 0.25 WC	17. Bldg Pressure	Zone Spt=
		⑧ Vane Pos= ____%	0 - 100%	–	–
		⑨ Fan Speed= ____%	0 - 100%	–	–
6	⑩ Economizer	Position ____ %	0 – 100%	⑱ 18. Economizer	Min Airflow=
		Econo= ____	Disabled	⑱ 18. Economizer	Enthalpy=
			Enabled	–	–

Table 2. Status Menus (cont'd)

Menu		Item			
No.	Name	Name	Range	Switch Key Destination	
				Menu	Item
7	Cool Status	_____	Off-Unoccupied	–	–
			Off - No Flow	–	–
			Off - Temperature	–	–
			Network Disable	–	–
			Switch Disable	–	–
			Manual Disable	–	–
			Off-Alarm	–	–
			No Cooling Avail	–	–
			Compressors Only	–	–
			Economizer Only	–	–
			All Clg Allowed	–	–
8	Heat Status	_____	Off-OAT Lockout	–	–
			Off-Unoccupied	–	–
			Network Disable	–	–
			Switch Disable	–	–
			Manual Disable	–	–
			Off-Alarm	–	–
			Heating Allowed	–	–
9	Operating Hrs =	③ Fan= ____	0 - 50,000 Hrs	–	–
		④ Hi Spd Fan ____	0 - 50,000 Hrs	–	–
		④ Lo Spd Fan ____	0 - 50,000 Hrs	–	–
		⑪ Comp #1= ____	0 - 50,000 Hrs	–	–
		⑪ Comp #2= ____	0 - 50,000 Hrs	–	–
		⑪ Comp #3= ____	0 - 50,000 Hrs	–	–
		⑪ Comp #4= ____	0 - 50,000 Hrs	–	–
		⑪ Comp #5= ____	0 - 50,000 Hrs	–	–
		⑪ Comp #6= ____	0 - 50,000 Hrs	–	–
		⑬ Cooling= ____	0 - 50,000 Hrs	–	–
		⑯ Econo= ____	0 - 50,000 Hrs	–	–
		⑬ Heating= ____	0 - 50,000 Hrs	–	–
		Override= ____	0 - 50,000 Hrs	–	–
10	Misc Status	Heat Output= ____	Heat	–	–
			Cool	–	–
		Outdr Dmpr= ____	Close	–	–
			Open	–	–
		⑫ Head Pres= ____	0 - 255 PSI	19. Head Pressure	Setpoint=
		⑮ Humidity= ____%	0 –100 %	19. Humidity Ctrl	Humidity Spt=
		⑮ DewPt= ____°F	0 –100°F	19. Humidity Ctrl	DewPt Spt=

Notes:

1. Not available for units with 100% outdoor air.
2. Not available for units with no water flow switch.
3. Units with one motor only.
4. Units with two motors only.
5. Not available for one motor units without vanes or inverters.
6. Units with duct static pressure sensors only.
7. Units with building static pressure control only.
8. Units with variable inlet vanes only.
9. Units with inverters only.
10. Not available for units with no economizer.
11. Not available for units with chilled water.
12. Not available for units with compressors.
13. Not available for units with no heating.
14. Units with head pressure control only.
15. Units with dehumidification control only.
16. Units with airside economizer only.

Control Menus

Table 3 lists all possible menus, items, and adjustable fields in the Control category. The table's range column lists all possible values for each adjustable field. Following are brief descriptions of the Control category menus.

Control Mode
Menu 11, "Control Mode," allows you to set the unit for automatic or manual operation. For more information, see the "Auto/Manual Operation" section in the "Operator's Guide" portion of this manual.

Heat/Cool
Menu 12, "Heat/Cool," contains zone temperature parameters that are used to control the unit's heating and cooling equipment. For more information, see the "Description of Operation" portion of this manual.

Cooling Control
Menu 13, "Clg Control," contains parameters that are used to maintain cooling discharge air temperature control. For more information, see the "Description of Operation" portion of this manual.

Heating Control
Menu 14, "Htg Control," contains parameters that are used to maintain heating discharge air temperature control. For more information, see the "Description of Operation" portion of this manual.

Alarm Limits
Menu 15, "Alarm Limits," contains adjustable supply and return air temperature limits that are used to generate alarms. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Unoccupied Heating/Cooling
Menu 16, "Unocc Htg/Clg," contains the unoccupied heating (night setback) and unoccupied cooling (night setup) setpoints that are used to start and run the unit at night when heating or cooling is required. For more information, see the "Unoccupied Control" section in the "Description of Operation" portion of this manual.

Duct Pressure
Menu 17, "Duct Pressure," contains parameters that are used to maintain duct pressure control. These parameters only have meaning if the unit has been equipped for VAV applications.

Building Static Pressure Control
Menu 17, "Bldg Pressure," contains parameters that are used to maintain direct building static pressure control. These parameters only have meaning if the unit has been equipped with the direct building static pressure control option.

Motor Control
Menu 17, " Motor Control," contains parameters that are used to maintain dual motor control. These parameters only have meaning if the unit has been equipped with dual motors for air flow modulation.

Economizer
Menu 18, "Economizer," contains parameters that control the optional economizer. For more information, see the "Description of Operation" portion of this manual.

Head Pressure Control
Menu 19, "Head Pressure," contains parameters that control the optional head pressure control. For more information, see the "Description of Operation" portion of this manual.

Humidity Control
Menu 19,"Humidity Ctrl," contains parameter for humidity control. For more information, see the "Description of Operation" portion of this manual.

Timers
Menu 20 "Timers," contains adjustable timer settings that control the duration of initialization start-up, airflow check, tenant override, post start-up recirculation and morning warm-up operation. The tenant override timer setting is described in the "Auto/Manual Operation" section in the "Operator's Guide" portion of this manual. The recirculate, morning warm-up, and low supply temperature alarm delay timer settings are described in the "Description of Operation" portion of this manual.

Set Time/Date
Menu 21, "Set Date/Time," allows you to adjust the current day, date, and time. For more information, see the "Scheduling" section in the "Operator's Guide" portion of this manual.

Schedule
Menu 22, "Schedule," contains the internal scheduling parameters. It also includes an operator override timer that can be used to start and run the unit for a specified time period. For more information, see the "Scheduling" and "Auto/Manual Operation" sections in the "Operator's Guide" portion of this manual.

Optimal Start
Menu 23, "Optimal Start" contains the parameters for Optimal Start. For more information, see the "Description of Operation" portion of this manual.

Holiday Date
Menu 24, "Holiday Date," allows you to schedule 14 holiday dates. Each date can be assigned a duration from 1 to 5 days. On each day of the holiday period, the holiday schedule entered under menu 22 is used. For more information, see the "Scheduling" section in the "Operator's Guide" portion of this manual.

Service
Menu 25, "Service," contains eight service related items. The first item, "Mode=," allows you to place the unit into the Shutdown service mode. The second item, "Timers=," allows you to temporarily speed up most of the controller's process timers. For information on these, see the "Auto/Manual Operation" section in the "Operator's Guide" portion of this manual. The third through fifth item, are setup parameters that specify whether a sensor is connected to the controller. The seventh item specifies the baud rate. The eighth item, "IDENT=," displays the controller's software part number.

Table 3. Control Menus

Menu		Item					
No.	Name	Name (Default Shown)	Field No.	Range	Switch Key Destination		
					Menu	Item	
11	Control Mode	***Auto***	1	Off-Manual	1. Unit Status	current unit	
				Auto	–	status	
				Occupied	–	–	
				Occ-Cool Only	–	–	
				Occ-Heat Only	–	–	
				Occ-Fan Only	–	–	
				Calibrate	–	–	
12	Heat/Cool	Cntl Temp= ***Return***	1	⑲ Return	2. Temperatures	Cntl Temp=	
				Space	–	–	
				Netwrk	–	–	
				⑲ OAT	–	–	
				⑲ Mixed	–	–	
		Cooling Spt= ***72°F***	1	55 – 99°F	2. Temperatures	Cntl Temp=	
		Heating Spt= ***68°F***	1	40 – 99°F	2. Temperatures	Cntl Temp=	
		Clg Dead Band= ***1°F***	1	0 – 10°F	–	–	
		Htg Dead Band= ***1°F***	1	0 – 10°F	–	–	
		⑩ Htg PA= ***8 Min***	1	0 – 60 Min	–	–	
		⑪ Mod Limit= ***10°F***	1	1 – 60°F	–	–	
		⑪ Wait Time= ***1 Min***	1	1 – 60 Min	–	–	
		⑪ Max Step= ***10%***	1	1 – 100%	–	–	
13	Clg Control	⑫ Setpoint= ***55 °F***	1	40 – 100°F	2. Temperatures	Supply Air=	
		⑫ Dead Band= ***1°F***	1	0 – 10°F	–	–	
		⑤ Method= ***Nearest***	1	Nearest / Average	–	–	
		⑤,⑧ Min EWT= ***55 °F***	1	⑳ 20 – 100°F	2. Temperatures	Ent Water=–	
		Min Spt= ***55°F***	1	0 – 100°F	–	–	
		Max Spt= ***70°F***	1	0 – 100°F	–	–	
		Reset= ***No Reset***	1	Airflow	–	–	
				External	–	–	
				OAT	–	–	
				Return	–	–	
				Space	–	–	
				No Reset	–	–	
		Min Spt @= ***76°F***	1	0 – 100°F	–	–	
		Max Spt @= ***71°F***	1	0 – 100°F	–	–	
		Min Spt @= ***76°%***	1	0 – 100%	–	–	
		Max Spt @= ***71°%***	1	0 – 100%	–	–	
		Stg Timer= ***5 Min***	1	5 – 60 Min	–	–	
		⑥ Mod Limit= ***60°F***	1	1 – 60°F	–	–	
		⑥ Wait Time= ***30 Sec***	1	1 – 60 Sec	–	–	
		⑥ Max Step= ***30 Sec***	1	1 – 60 Sec	–	–	
		⑥ PA Time= ***60 Sec***	1	0 – 255 Sec	–	–	
14	⑦ Htg Control	⑬ Setpoint= ***100°F***	1	40 – 140°F	2. Temperatures	Supply Air=	
		⑬ Dead Band= ***1°F***	1	0 – 10°F	–	–	
		⑩ Fan-On Htg= ***No***	1	Yes / No	–	–	
		Max OAT= ***60°F***	1	0 – 100°F	2. Temperatures	Outdr Air=	
		Min Spt= ***60°F***	1	40 – 120°F	–	–	
		Max Spt= ***120°F***	1	40 – 120°F	–	–	
		⑭ Reset= ***No Reset***	1	Airflow	–	–	
				External	–	–	
				OAT	–	–	
				Return	–	–	
				Space	–	–	
				No Reset	–	–	
		⑭ Min Spt @= ***69°F***	1	0 – 100°F	–	–	
		⑭ Max Spt @= ***64°F***	1	0 – 100°F	–	–	
		Stg Timer= ***5 Min***	1	2 – 60 Min	–	–	
		⑮ Mod Limit= ***60°F***	1	1 – 60°F	–	–	
		⑮ Wait Time= ***30 Sec***	1	1 – 60 Sec	–	–	
		⑮ Max Step= ***30 Sec***	1	1 – 60 Sec	–		
		⑮ PA Time= ***60 Sec***	1	0 – 255 Sec	–	–	
15	Alarm Limits	Hi Supply= ***170°F***	1	90 – 250°F	2. Temperatures	Supply Air=	
		Lo Supply= ***40°F***	1	20 – 50°F	2. Temperatures	Supply Air=	
		① Hi Return= ***120°F***	1	90 – 150°F	2. Temperatures	Return Air=	

Table 3. Control Menus (Cont'd)

Menu		Item					
No.	Name	Name (Default Shown)	Field No.	Range	Switch Key Destination		
					Menu	Item	
16	Unocc Htg/Clg	Cooling Spt= ***85°F***	1	55 – 99°F	2. Temperatures	Space=	
		Heating Spt= ***55°F***	1	40 – 99°F	2. Temperatures	Space=	
		Clg Diff= ***3°F***	1	0 – 10°F			
		Htg Diff= ***3°F***	1	0 – 10°F			
17	⑱ Duct Pressure	Duct Spt= ***1.00"WC***	1	0 – 5.00"WC	3. Airflow Mod	Bldg P=	
		Deadbd= ***0.08"WC***	1	0.000 – 1.00"WC	–	–	
		Max Spt= ***2.00"WC***	1	.20 –4.00"WC	–	–	
		Reset= ***No Reset***	1	Position	–	–	
			1	No Reset	–	–	
		Mod Lim= ***0.040"WC***	1	0.020 – 0.250"WC	–	–	
		Wait Time= ***20 Ten***	1	10 Ten – 60 Sec	–	–	
		Max Step= ***20 Ten***	1	10 Ten – 60 Sec	–	–	
17	③ Bldg Pressure	Zone Spt= ***0.050"WC***	1	–0.250 – 0.250"WC	3. Airflow Mod	Bldg P=	
		Min Pos= ***60 %***	1	0 –100 %	–	–	
		Min Speed= ***60 %***	1	0 –100 %	–	–	
		Deadbd= ***0.008"WC***	1	0.000 – 0.100"WC	–	–	
		Mod Lim= ***0.040"WC***	1	0.020 – 0.250"WC	–	–	
		Wait Time= ***20 Ten***	1	10 Ten – 60 Sec	–	–	
		Max Step= ***20 Ten***	1	10 Ten – 60 Sec	–	–	
17	② Motor Control	Vel Diff= ***41 FPM***	1	0 - 410 FPM	–		
		Amp Limit= ***15 Amps***	1	0 - 99 Amps	5. AirFlow Mod	Current=	
18	④ Economizer	⑰ Min Airflow= ***10%***	1	0 – 100%	6. Economizer	Position=	
		⑰ Enthalpy = ***Yes***	1	No / Yes	6. Economizer	Econ=	
		⑰ Changeover= ***75°F***	1	0 – 100°F	6. Economizer	Econ=	
		⑱ EWT Diff= ***3°F***	1	0 – 10°F	–	–	
		Dead Band= ***1°F***	1	0 – 10°F	–	–	
		Mod Limit= ***60°F***	1	1 – 60°F	–	–	
		Wait Time= ***30 Sec***	1	1 – 60 Sec	–	–	
		Max Step= ***30 Sec***	1	1 – 60 Sec	–	–	
		PA Time= ***60 Sec***	1	0 – 255 Sec	–	–	
19	⑧ Head Pressure	Setpoint= ***160 psi***	1	140 – 210 psi	10. Misc Status	Head Pressure	
		Dead Band= ***10 psi***	1	0 – 10 psi	–	–	
		Mod Limit= ***30 psi***	1	1 – 60 psi	–	–	
		Wait Limit= ***10 Sec***	1	1 – 60 Sec	–	–	
		Max Step= ***10 Sec***	1	1 – 60 Sec	–	–	
19	⑨ Humidity Ctrl	Control= ***None***	1	None / Rel Hum / DewPt	–	–	
		Enabled= ***Occupied***	1	Always / Occupied	–	–	
		Sensor= ***Return***	1	Return / Space	–	–	
		Timer= ***10 Min***	1	1 – 60 Min	–	–	
		Humidity Spt= ***50 %***	1	0 – 99 %	10. Misc Status	Humidity	
		Humidity Db= ***2 %***	1	0 – 10 %	–	–	
		DewPt Spt= ***50°F***	1	0 – 99 °F	10. Misc Status	Dew Pt	
		DewPt DB= ***2°F***	1	0 – 10 °F	–	–	
		Min Stages= ***2***	1	1 – 8	–	–	
		Max Stages= ***4***	1	1 – 8	–	–	
20	Timers	Initial= ***180 Sec***	1	120 – 255 Sec	–	–	
		Recirc= ***3 Min***	1	1 – 60 Min	–	–	
		Airflow= ***2 Min***	1	0 Sec – 5 Min	–	–	
		Bypass= ***5 Min***	1	3 – 10 Min	–	–	
		Ovrde Inc= ***2 Hr***	1	0 – 5 Hr	–	–	
21	Time / Date	***hr:mn:sc***	1	0 –23	–	–	
			2	0 – 59	–	–	
			3	0 – 59	–	–	
		day mm:dd:yy	1	Sun – Sat	–	–	
			2	1 – 12	–	–	
			3	1 – 31	–	–	
			4	0 – 99	–	–	

Table 3. Control Menus (Cont'd)

Menu		Item				
No.	Name	Name (Default Shown)	Field No.	Range	Switch Key Destination	
					Menu	Item
22	Schedule	Override= ***0.00 Hr***	1	0.00 – 5.00 Hr	–	–
		NMP Sched No. ***N/A***	1	N/A, 1 – 32	–	–
		Sun ***00:00–00:00***	1	0 – 23	–	–
			2	0 – 59		
			3	0 – 23		
			4	0 – 59		
		Mon ***00:00–00:00***		(Same as Sunday)	–	–
		Tue ***00:00–00:00***		(Same as Sunday)	–	–
		Wed ***00:00–00:00***		(Same as Sunday)	–	–
		Thu ***00:00–00:00***		(Same as Sunday)	–	–
		Fri ***00:00–00:00***		(Same as Sunday)	–	–
		Sat ***00:00–00:00***		(Same as Sunday)	–	–
		Hol ***00:00–00:00***		(Same as Sunday)	–	–
23	Optimal Start	Opt Start= ***Off***	1	Off / On	–	–
		Auto Update= ***Yes***	1	Yes / No	–	–
		Ht Rate= ***0.400°F/M***	1	0 – 1.000 °F/M	–	–
		Heat OAT= ***35°F***	1	-100 – 155 °F	–	–
		Ht Factor= ***25 Min***	1	0 – 255 Min	–	–
		Cl Rate= ***0.400°F/M***	1	0 – 1.000 °F/M	–	–
		Cool OAT= ***85°F***	1	-100 – 155 °F	–	–
		Cl Factor= ***25 Min***	1	0 – 255 Min	–	–
24	Holiday Date	#1 Date= ***Dec 25***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#1 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#2 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#2 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#3 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#3 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#4 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#4 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#5 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#5 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#6 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#6 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#7 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#7 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#8 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#8 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#9 Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#9 Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#10Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#10Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#10Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#10Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#12Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#12Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#13Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#13Dur= ***1 Day(s)***	1	1 – 5 Days	–	–
		#14Date= ***N/A 0***	1	N/A, Jan – Dec	–	–
			2	0 – 31		
		#14Dur= ***1 Day(s)***	1	1 – 5 Days	–	–

Table 3. Control Menus (Cont'd)

Menu		Item					
No.	Name	Name (Default Shown)		Field No.	Range	Switch Key Destination	
						Menu	Item
25	Service	Mode=	***Normal***	1	Normal	–	–
					Shutdown		
		Timers=	***Normal***	1	Normal	–	–
					Fast		
		Space Sensor=	***No***	1	No	–	–
					Yes		
		Return Sensor=	***No***	1	No	–	–
					Yes		
		OAT Sensor=	***No***	1	No	–	–
					Yes		
		Alarm Out=	***Off***	1	*Off*	–	–
					Blink		
		Port A Baud=	***9600***	1	1200 / 2400 / 9600	–	–
		IDENT=	***950600020***	1	–	–	–

Notes:

1. Not available for 100 % Outside Air Control Units.
2. Units with Two Motors Only.
3. Units with building static pressure only.
4. Not available for units with no economizer.
5. Not available for units with chilled water.
6. Not available for units with compressors.
7. Not available for units with no heating.
8. Units with head pressure control only.
9. Units with dehumidification control only.
10. Units with zone heating control only.
11. Units with zone control of modulated heating or cooling.
12. Not available for zone control units with compressors and no economizer.
13. Not available for units with staged zone heating control.
14. Units with SAT heating control only.
15. Units with modulated heat only.
16. Units with duct static pressure control only.
17. Units with Airside Economizer Only.
18. Units with Waterside Economizer Only.
19. Not available on all configurations.
20. The minimum EWT varies with unit configuration: 20°F for units with Head Pressure Control and 55°F for units without Head Pressure Control.
21. These control temperature methods are not available in all unit configurations.

Alarm Menus

Table 4 lists all possible menus and items in the Alarm category. The table's range column lists all possible values for each item. Following are brief descriptions of the Alarm category menus.

Current Alarm

Menu 26, "Curr Alarm," tells you what the current alarm is and when it occurred. If there is no current alarm, the "No Active Alarms" message will be displayed. When the current alarm clears, it moves to the Previous Alarm menu. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Previous Alarm

Menu 27, "Prev Alarm," tells you what the previous alarm was and when it occurred. When the current alarm clears, it moves to this menu. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Compressor Alarm

Menu 28, "Comp Alarm," displays an alarm message for each compressor." For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Table 4. Alarm Menus

Menu		Item				
					Switch Key Destination	
No.	Name	Name (Default Shown)	Field No.	Range	Menu	Item
26	Curr Alarm	***Alarm Message***	–	None	–	–
				Filter Dirty		
				Air Flow Warning		
				Econo Stuck		
				No Water Flow		
				Heat Fail		
				Mixed T Prob		
				OAT Prob		
				Return T Prob		
				Zone T Prob		
				Supply T Prob		
				EWT Prob		
				Cooling 1 Fail		
				Cooling 2 Fail		
				Cooling 3 Fail		
				Cooling 4 Fail		
				Cooling 5 Fail		
				Cooling 6 Fail		
				AmpSensor Prob		
				VelSensor Prob		
				LoSpd Fan Prob		
				HiSpd Fan Prob		
				Freeze Problem		
				Vanes Stuck		
				Fan Fail		
				Low Supply T		
				High Supply T		
				High Return T		
				Supply T Fail		
				Return T Fail		
				Duct High Limit		
				Smoke Shutdown		
				Freeze Shutdown		
				High Temp Rise		
				OAT Fail		
				Zone T Fail		
				OA Damper Stuck		
				Mixed T Fail		
		@ hr:mn mm/dd/yy	–	–	–	–
27	Prev Alarm	1. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		1. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	2. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		2. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	3. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		3. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	4. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		4. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	5. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		5. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	6. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		6. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	7. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		7. ***@ hr:mn mm/dd/yy***	–	–	–	–
	Prev Alarm	8. ***Alarm Message***	–	(Same as "Curr Alarm")	–	–
		8. ***@ hr:mn mm/dd/yy***	–	–	–	–
		Clear Buffer= ***No***	1	No	–	–
				Yes		
28	① Comp Alarms	#1=***Alarm Message***	–	High Pressure	–	–
			–	Water Regulating Valve	–	–
			–	Frost	–	–
			–	Low Pressure	–	–
			–	Motor Protection	–	–
		#2=***Alarm Message***	–	(Same as #1)	–	–
		#3=***Alarm Message***	–	(Same as #1)	–	–
		#4=***Alarm Message***	–	(Same as #1)	–	–
		#5=***Alarm Message***	–	(Same as #1)	–	–
		#6=***Alarm Message***	–	(Same as #1)	–	–

Notes:
1. Not available for units with chilled water.

Operator's Guide

The following "Operator's Guide" sections provide information on the day-to-day operation of the Self-contained Air Conditioning Unit Controller. They tell you how to perform such common tasks as scheduling, displaying and clearing alarms, and setting the controller for manual operation.

For detailed information on the control processes and their programmable setpoints and parameters, see the "Description of Operation" and "MicroTech Control Features" portions of this manual.

Determining Unit Status

The MicroTech Self-contained Air Conditioning Unit Controller provides a variety of information that you can use to determine the overall status of the unit. At the keypad/display, most of this information can be found under menus 1 through 10. The following are available:

- Unit status
- Cooling status
- Heating status
- Temperatures
- Pressures
- Fan/Airflow status
- Airflow Mod (differential pressure switch)
- Economizer positions
- Operating Hrs position
- Misc Status

The first three items are very useful because they summarize the unit's status. Using them, you can quickly determine whether the unit is, for example, off, starting-up, heating, or cooling. If heating or cooling is disabled for any reason, you can find out why. Following are descriptions of the possible "unit status," "cooling status," and "heating status" states.

Unit Status

The unit status state (menu 1) tells you the overall state that the unit is currently in. At the keypad, it can be displayed simply by pressing the "Status" key. Except for the Calibrate, every unit status state displayed is an operating state.

Operating States
Operating states define the overall status of the unit under the various conditions that may occur during normal operation. The following operating states are possible:

- Off
- Start-up Initialization
- Recirculate
- Post Heat
- Fan On
- Fan On-Heating
- Economizer
- Cooling
- Morning Warm-up
- Heating
- Unoccupied Economizer
- Unoccupied Cooling
- Unoccupied Heating

For detailed information on these states, see the "Operating States and Sequences" section in the "Description of Operation" portion of this manual.

Calibrate
The Calibrate state is a special state that will only occur when the control mode (menu 11) is set to "Calibrate." During the Calibrate state, the controller automatically calibrates the position feedback pots on the economizer damper and supply fan inlet vane actuators. It also calibrates all the unit's static pressure transducers.

For more information on Calibrate, see the following "Auto/Manual Operation" section.

Cooling Status

The cooling status (menu 7) tells you whether cooling is enabled or disabled. If cooling is disabled, the reason is given. Following are descriptions of the various cooling status states.

Off-Unoccupied
When the unit is shut down by a scheduling function, all cooling will be disabled, and the cooling status will be Off-Unoccupied.

Off-No Flow
When no water is flowing to a unit and no airside economizer is enabled, all cooling will be disabled and the cooling status will be Off-No Flow.

Off Temperature
When Economizer is not present or Economizer is disabled and the EWT is too low for compressor operation, the cooling status is Off Temperature. Waterside economizer and compressor operation are disabled during Off-Temperature.

Network Disable
If the cooling status is Network Disable, it means that a network command has disabled all cooling.

Switch Disable
If the cooling status is Switch Disable, it means that the switches on a field supplied device have been set to disable cooling. All cooling will be disabled during the Switch Disable state.

Manual Disable
If the cooling status is Manual Disable, it usually means that the control mode (menu 11) has been set to one of the following: Off-Manual, Occ-Heat Only, Occ-Fan Only, or Calibrate. The Manual Disable cooling state can also occur if the controller is in the Shutdown service mode (menu 25). All cooling will be disabled during the Manual Disable state.

Off-Alarm
When the unit is shut down by an alarm, all cooling will be disabled, and the cooling status will be Off-Alarm.

Compressors Only
When the entering water temperature (outside air) is too warm for free cooling, but not cool enough to prevent mechanical cooling operation, the cooling status will be Compressors Only. In this state the unit will use mechanical cooling as required to maintain the cooling setpoints.

Economizer operation will be disabled, and the water valve (outside air damper) will be held at its minimum position. This status also appears when the unit does not an economizer.

Economizer Only
When the entering water temperature (outside air) is cool enough for free cooling and mechanical cooling is disabled, the cooling status will be Economizer Only. In this state the unit will use the economizer as required to maintain the cooling setpoints. Mechanical cooling will be disabled.

All Cooling Allowed
When the entering water temperature (outside air) is cool enough for free cooling, but not cool enough to prevent mechanical cooling (compressorized or chilled water), the cooling status will be All Cooling Allowed. In this state the unit will use the economizer or mechanical cooling as required to maintain the cooling setpoints.

Heating Status

The heating status (menu 8) tells you whether heating is enabled or disabled. If heating is disabled, the reason is given. Following are descriptions of the various heating status states.

Off-OAT Lockout
When the outside air is too warm for heating operation, the heating status will be Off-OAT Lockout. In this state the unit's heating equipment will be disabled.

Off-Unoccupied
When the unit is shut down by a scheduling function, all heating will be disabled, and the heating status will be Off-Unoccupied.

Network Disable
If the heating status is Network Disable, it means that a network command has disabled all heating.

Switch Disable
If the heating status is Switch Disable, it means that the Heat Enable input is open. All heating will be disabled during the Switch Disable state. This status also appears when heat is not installed.

Manual Disable
If the heating status is Manual Disable, it usually means that the control mode (menu 11) has been set to one of the following: Off-Manual, Occ-Cool Only, Occ-Fan Only, or Calibrate. The Manual Disable heating state can also occur if the controller is in the Shutdown service mode (menu 25). All heating will be disabled during the Manual Disable state.

Off-Alarm
When the unit or its heating equipment is shut down by an alarm, all heating will be disabled, and the heating status will be Off-Alarm.

Heating Allowed
When the outside air is not warm enough to prevent heating operation, the heating status will be Heating Allowed. In this state the unit will supply heat as required to maintain the heating setpoints.

Misc Status

Heat Output
The Heat Output is in the Cool(closed) position during normal operation. It is in the Heat(open) position when: 1) heat is supplied; 2) during the Recirculation period; 3)during the Post Heat period; 4)during the Start Initial state to keep the pump off; 5)during the unoccupied period when the Fan On output is on to keep the pump off during the unoccupied period. The Heat Output may not be used for signaling external heaters. The Heat Output is displayed on keypad menu #10.

Outdr Dmpr
The status indicates the position of the outdoor air damper (open or closed).

Head Pressure
A water regulating valve (WRV) modulates the flow to the condenser in response to a refrigerant pressure signal. The refrigerant pressure is displayed on keypad menu #10.

Humidity and Dewpoint
An analog sensor is mounted in either the space or return duct to sense relative humidity. The percent relative humidity and a calculated dewpoint are both displayed on keypad menu #10.

Auto/Manual Operation

⚠WARNING

Electric shock and moving machinery hazard. Can cause severe personal injury or death.

When the unit is in the Off operating state, power is not removed from the unit controller or components. Lock power off by means of the unit disconnect switch before servicing line voltage equipment or entering the unit.

Control Mode

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
11. Control Mode	Auto	Control Mode

You can set up the unit for automatic or manual operation by selecting the unit's control mode with the Control Mode parameter. Following are descriptions of the seven possible control modes.

Off-Manual
The Off-Manual control mode will place the unit into the Off-Manual operating state (see warning above). In the Off state the unit is shut down. For more information on operating states, see the "Operating States and Sequences" section of this manual.

Caution: The Off-Manual control mode can be overridden by an operator at a remote PC or RMC Panel (if any). To eliminate this risk, disconnect unit power or disconnect the communications cable from MCB1. This risk can also be eliminated by placing the unit into the Shutdown service mode (see below).

Auto
The Auto control mode allows the unit to operate automatically. This means that the unit will start and stop according to any external on/off switch, scheduling, tenant override, operator override, or unoccupied temperature control commands. Once running, the unit will act as required to maintain its temperature and pressure control setpoints.

Occupied
The Occupied control mode causes the unit to run continuously in the occupied mode. Any scheduling commands are prevented from shutting down the unit. Both heating and cooling are allowed to operate as necessary to maintain the temperature control setpoints.

Occ-Cool Only
The Occ-Cool Only control mode causes the unit to run continuously in the occupied mode. Any scheduling commands are prevented from shutting down the unit. Cooling is allowed to operate as necessary to maintain the temperature control setpoints. Heating is disabled.

Occ-Heat Only
The Occ-Heat Only control mode causes the unit to run continuously in the occupied mode. Any scheduling commands are prevented from shutting down the unit. Heating is allowed to operate as necessary to maintain the temperature control setpoints. Cooling is disabled.

Occ-Fan Only
The Occ-Fan Only control mode causes the unit to run continuously in the occupied mode. Any scheduling commands are prevented from shutting down the unit. Both heating and cooling are disabled.

Calibrate
The Calibrate control mode automatically calibrates the position feedback pot on the economizer valve (outdoor air damper) and VIV actuators. It also calibrates all the unit's static pressure transducers. Following is a description of the Calibrate procedure.

After Calibrate is selected, the controller shuts down the fans and drives open the economizer valve (outdoor air dampers or vanes) when three minutes have elapsed, the controller records the feedback value of the actuator as equivalent to its fully open position. The controller then drives the actuator closed. When three minutes have elapsed, the controller records the feedback value of the actuator as equivalent to its fully closed position. Since there is no airflow through the unit, the controller records the input voltages of all connected pressure transducers as equivalent to 0.000"W.C.

After the Calibrate procedure is complete, the controller shuts down the unit and places it into the Off-Manual control mode. The unit can be restarted by changing the control mode.

Note: Inverters are not calibrated.

Service Mode

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
25. Service	Mode= Normal	Service Mode

There are two service modes that can be selected only at the keypad with the Service Mode parameter: Shutdown and Normal. When the Shutdown service mode is selected, the unit is placed into the Off-Service operating state. In the Off state the unit is shut down. For more information on operating states, see the "Operating States and Sequences" section of this manual.

Unlike the Off-Manual control mode, the Shutdown service mode cannot be overridden by an operator at a remote PC or remote keypad. The only way to return the unit to normal operation is to select the Normal service mode at the keypad on the unit. This feature is meant to be used by a service technician who needs both power in the unit and assurance that the unit will not start unexpectedly.

Tenant Override

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
20. Timers	Ovrde Inc= 2.00 Hr	Override Increment

There are two types of tenant override functions: timed and nontimed. Both types place the unit into occupied operation regardless of any scheduling features. The control mode (menu 11) must be set to "Auto" to use the tenant override features.

Additional information is provided in the "Field Wiring" portion of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller.

Timed Tenant Override
The tenant override switch provided with several of the zone temperature sensor packages can be used to override unoccupied operation for a preprogrammed time period. You can set this time period with the Override Increment parameter, which can be set for any amount of time up to 5 hours in 15-minute increments (default is 2 hours at Menu 20).

When an occupant presses the push button switch on the zone sensor (SPT1), the Override Timer (menu 22) is set equal to the Override Increment. The unit will then start and run until the Override Timer expires. If the tenant override switch is pressed again while the unit is operational, the Override Timer will reset and the unit will continue to operate for another Override Increment. For example, assume that the Override Increment is two hours. One press of the override button will provide at least two hours of unit operation. If the button is pressed again one hour later, the Override Timer will be reset to two hours, and thus a total of three uninterrupted hours of operation will result provided the main switch (S2) is in the "Auto" mode and everything else is in the Auto mode also.

Nontimed Tenant Override
A simple SPST switch connected to the "External on/off" terminals on the output board can be used to override unoccupied operation. When this switch is closed, the unit will start and run in the occupied mode provided the main switch (S2) is in the "Auto" mode. When this switch is open, the unit will be controlled by any active scheduling function (internal, network, or external time clock). If there is no active scheduling function, the unit will remain in the unoccupied mode.

Operator Override

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
22. Schedule	Override= 0.00 Hr	Override Timer

From the keypad or PC, you can manually set the same Override Timer that is automatically set by the tenant override switch and Override Increment parameter (see "Tenant Override" above). When the Override Timer is set to a non-zero value, the unit will start and run in the occupied mode regardless of any scheduling features provided the main switch (S2) is in the "Auto" mode.

The unit will stop when the timer expires. Like the Override Increment parameter, the Override Timer can be set for any amount of time up to 5 hours in 15-minute increments. The control mode (menu 11) must be set to "Auto" to use the operator override feature.

Note: If the Override Timer's remaining time is larger than the Override Increment, pressing the tenant override button on the space sensor will have no effect. If the Override Timer's remaining time is less than the Override Increment, pressing the tenant override button will reset the Override Timer to the Override Increment.

Fast Timers

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
25. Service	Timers= Normal	Operation Timing Flag

If desired, you can temporarily speed up most of the controller's internal timers by using the Operation Timing Flag. When set to "Fast," the Operation Timing Flag will temporarily reset the settings for the following timers to 20 seconds:

- Start-up initialization timer
- Recirculate timer
- Low supply temperature alarm delay timer
- Cooling interstage timer
- Heating interstage timer

The timer settings will return to normal if (1) the Operation Timing Flag is set to "Normal" or (2) no keypad action occurs for 15 minutes. The purposes of these timers are described in the "Description of Operation" portion of this manual.

Caution: This fast timers feature is meant to be used only by a knowledgeable service technician to facilitate testing the unit. Prolonged operation in this mode could damage the unit.

Scheduling

The self-contained unit with the control mode set to auto can be scheduled for daily and holiday operation by using any one of the following four methods:

1. Unit controller internal scheduling
2. Network Master Panel (NMP) scheduling
3. Remote Monitoring and Control (RMC) Panel scheduling
4. External time clock

The following sections describe how to use the unit controller's internal scheduling features. Internal parameters that must be set to use any of the other three scheduling methods are also discussed.

For information on how to use the NMP and RMC Panel scheduling functions, refer to the literature provided with these panels.

Setting Time and Date

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
24. Set Time/Date	hr:mn:sc	Current Time
	day mm:dd:yy	Current Date

The MicroTech controller uses the date and time to execute its internal scheduling functions. Once set, the battery backed internal time clock will keep the current time regardless of whether power is being supplied to the unit.

You can set the time of day by entering the hour (0-23), minute (0-59), and second (0-59) into the Current Date parameter's three fields. You can set the date by entering the day (Sun-Sat), month (1-12), date (1-31), and year (0-99) into the Current Date parameter's four fields.

Daily Scheduling

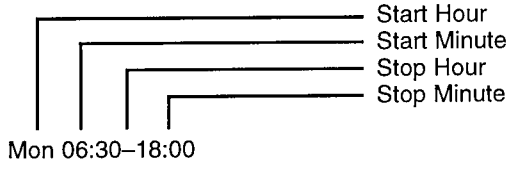
Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
22. Schedule	Sun 00:00–00:00	Sunday Schedule
	Mon 00:00–00:00	Monday Schedule
	Tue 00:00–00:00	Tuesday Schedule
	Wed 00:00–00:00	Wednesday Schedule
	Thu 00:00–00:00	Thursday Schedule
	Fri 00:00–00:00	Friday Schedule
	Sat 00:00–00:00	Saturday Schedule
	Hol 00:00–00:00	Holiday Schedule
	NMP Sched No. N/A	Network Master Panel Schedule

When the unit is in the Auto control mode (menu 11), the unit will start and stop according to the controller's internal schedule. You can set one start and one stop time for each day of the week and for designated holidays (see below). An example of how to use the keypad to enter or modify a schedule is given in the "Getting Started" portion of this manual.

As shown in Figure 5, each daily schedule has four adjustable fields: start hour, start minute, stop hour, and stop minute. The schedule shown in Figure 5 would cause the unit to start up at 6:30 a.m. and shut down at 6:00 p.m. every Monday.

Figure 5. Daily Schedule Fields



For continuous unit operation, set the schedule fields to "00:00–23:59." To keep the unit off for the entire day, set the schedule fields to "00:00–00:00" (this is the default setting).

Note: An internal daily schedule's start time must occur before its stop time; otherwise, the unit will not start that day. If you want to schedule the unit to shut down and then start up again on the same day, you must use an NMP schedule or an external time clock.

NMP Scheduling

If the unit controller is included in a MicroTech network with a Network Master Panel, an NMP schedule can be used instead of the internal schedule. To use an NMP schedule, the unit controller's Network Master Panel Schedule parameter must be set to the desired NMP schedule number. When the control mode (menu 11) is set to "Auto," the NMP schedule you selected will start and stop the unit.

Using an External Time Clock

If desired, an external time clock can be used to schedule unit operation. In this case, all internal daily schedules must be set to "00:00-00:00" (this is the default setting). When the control mode (menu 11) is set to "Auto," the external time clock will start and stop the unit.

Holiday Scheduling

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
22. Schedule	Hol 00:00–00:00	Holiday Schedule
	NMP Sched No. N/A	Network Master Panel Schedule
24. Holiday Date	#* Date= Dec 25	Holiday Date #*
	#* Dur= 1 Day(s)	Holiday Date #* Duration

You can schedule special operating hours for up to 14 holiday periods by using the controller's holiday scheduling feature. (The wildcard character in the above table could be any number between 1 and 14.) Whenever a holiday date occurs, the controller will use the Holiday Schedule's start and stop times for the number of successive days specified by the associated holiday date duration parameter. For example, assume that this year Christmas Eve occurs on a Thursday. Your building will be shut down on both Christmas Eve and Christmas Day, but will operate normally on the weekend. To schedule this holiday, set the Holiday Schedule to "00:00–00:00"; set the Holiday Date #1 parameter to "Dec 24"; and set the Holiday Date #1 Duration parameter to "2 Days."

If any of the 14 holiday dates are not required, enter "N/A" and "0" into the fields of those holiday dates (except for Holiday Date #1, this is the default setting).

To use the internal holiday scheduling feature, the Network Master Panel Schedule parameter must be set to "N/A" (this is the default setting).

Alarm Monitoring

About Alarms

The Self-contained Air Conditioning Unit controller is programmed to monitor the unit for specific alarm conditions that may occur. If the unit controller detects an alarm condition, it will indicate the alarm, identify the alarm, and execute appropriate control actions that will fail-safe the unit. For detailed information on these alarm-specific control actions, see the "Alarm Control" section in the "Description of Operation" portion of this manual.

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
25. Service	Alarm Out= Blink	Alarm indication
	Alarm Out= Off	Alarm indication

Alarm Indication

Under normal (non-alarm) conditions, the amber status LED on MCB1 will be continually lit and the alarm output will be energized. The alarm output's LED indicates the state of the output: On indicates energized and off indicates deenergized. Both N/O and N/C contacts are available. Typically, the alarm output would be connected to some type of field-supplied annunciator.

The method of alarm indication is set at Blink or Off at menu 25. Setting the Alarm Out=Blink cause the amber status LED on MCB1 to blink during alarm conditions. Setting the Alarm Out=Off causes the amber status LED to be off during alarm conditions. The Alarm Out=Off setting is used when communicating an alarm condition to a building management control system.

Note that the dirty filter alarms have a unique alarm indication. Instead of flashing on and off in equal one-half second intervals, the amber status LED and the alarm output LED will flash on for 9/10 second and off for 1/10 second when a dirty filter alarm occurs. The controller's dirty filter alarms are caused by a pressure drop (sensed by PS5) exceeding a field adjustable limit. The limit is set at 0.60 WC pressure drop at the factory. Adjustment at the sensor allow the limit to range from 0.17 to 5.00 WC pressure drop.

Priority

The various alarms that can occur are prioritized according to their severity. Three categories are possible: faults, problems, and warnings. Regardless of the alarm type, a message that identifies the alarm will be generated for display at the keypad/display or PC. Table 5 summarizes the alarms that can occur in CAV-ZTC units in the order of priority.

Faults: Faults are the highest priority alarms. If a fault occurs, the unit will be shut down until the alarm condition is gone and the fault is cleared. Most fault alarms must be manually cleared.

Problems: Problems have lower priority than faults. If a problem occurs, the unit will not be shut down, but its operation will be modified in some way to compensate for the alarm condition. Most problem alarms will automatically clear when the alarm conditions that cause them return to normal.

Warnings: Warnings are the lowest priority alarms. No control action is taken when a warning occurs; it is simply indicated to alert the operator that the alarm condition needs attention. Most warning alarms will automatically clear when the alarm conditions that cause them return to normal.

Alarm priority also exists within each category. The alarms in Table 5 are listed according to their priority. For example, in the fault category, the Freeze Shutdown alarm has higher priority than the Fan Failure alarm.

Table 5. CAV-ZTC Unit Alarms

Alarm Type	Alarm Message	Indication	Reset
Fault	Freeze Shutdown	Freeze condition occurred while fans were on	Manual
	Smoke Shutdown	Smoke detected at discharge air or return air detector	① Manual
	Duct High Limit	Duct High Limit in alarm position	Manual
	③ Zone Sensor Fail	Zone temperature sensor failed while it was the Control Temperature source	Manual
	MAT Sensor Fail	Mixed Air Temperature sensor is either shorted or open.	Manual
	OAT Sensor Fail	OAT temperature sensor is either shorted or open.	Manual
	Ret Sensor Fail	Return air temperature sensor failed while it was the Control Temperature source	Manual
	Sup Sensor Fail	Supply air temperature sensor failed	Manual
	High Return Temp	Return air temperature exceeded the High Return Temperature Limit setting (menu 15)	Manual
	High Supply Temp	Supply air temperature exceeded the High Supply Temperature Limit setting (menu 15)	Manual
	Low Supply Temp	Supply air temperature fell below the Low Supply Temperature Limit setting (menu 15)	Manual
	Fan Fail	Airflow not proven after the airflow check timer expired (default setting is 2 minutes)	Manual
	OA Damper Stuck	Outside air damper is stuck.	Manual
	Supply Vane Stuck	Variable Inlet Vanes are more than 25% open after units been off for three minutes.	Manual
Problem	Freeze Problem	Freeze condition occurred while fans were off	Auto
	Hi Spd Fan Prob	No air flow is sensed after two minutes of operation	Manual
	Lo Spd Fan Prob	No air flow is sensed after two minutes of operation	Manual
	Vel Sensor Prob	Air velocity is less than 215 FPM.	Manual
	Amp Sensor Prob	Amp sensor equals zero after airflow has been proven	Manual
	Cooling #6 Fail	High refrigerant pressure, low refrigerant pressure, frost switch in alarm position or a compressor motor protector trip condition occurred in refrigeration circuit #6	Auto
	Cooling #5 Fail	High refrigerant pressure, low refrigerant pressure, frost switch in alarm position or a compressor motor protector trip condition occurred in refrigeration circuit #5	Auto
	Cooling #4 Fail	High refrigerant pressure, low refrigerant pressure, frost switch in alarm position or a compressor motor protector trip condition occurred in refrigeration circuit #4	Auto
	Cooling #3 Fail	High refrigerant pressure, low refrigerant pressure, frost switch in alarm position or a compressor motor protector trip condition occurred in refrigeration circuit #3	Auto
	Cooling #2 Fail	High refrigerant pressure, low refrigerant pressure, frost switch in alarm position or a compressor motor protector trip condition occurred in refrigeration circuit #2	Auto
	Cooling #1 Fail	High refrigerant pressure, low refrigerant pressure, frost switch in alarm position or a compressor motor protector trip condition occurred in refrigeration circuit #1	Auto
	EWT Sensor Prob	Entering water temperature sensor failed	Auto
	② Zone Sensor Prob	Zone temperature sensor failed when it was not control temp or no return sensor present	Auto
	Ret Sensor Prob	Return air temperature sensor failed while it was not the Control Temperature source	Auto
	OAT Sensor Prob	Outside air temperature sensor failed	Auto
	Mix Sensor Prob	Mixed air temperature sensor failed	Auto
	High Temp Rise	Supply air temperature exceeds Mixed air temperature by 60°F	Manual
	Heat Fail	Safety lockout condition occurred in electric heat	Auto
	No Water Flow	Lack of water flow is indicated by an open water flow switch	Auto
Warning	Economizer Stuck	Economizer not fully closed during unit shutdown or not fully open during mechanical cooling operation with conditions acceptable for economizer operation	Manual
	Air Flow Warning	Airflow indicated while fans were off	Auto
	Filter Dirty	Pressure drop input across filter is in the alarm position	Auto

Notes:
1. A manual reset is required at smoke detector SDI before the Smoke Shutdown alarm can be cleared.
2. The Zone Sensor Problem alarm will occur if the Zone Temperature sensor fails while it is not the Control Temperature source or if there is a Return Temperature sensor.
3. The Zone Sensor Fail alarm will occur only if it is the selected Control Temperature source and there is no Return Air Temperature sensor.

Displaying Alarms

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
26. Curr Alarm	Alarm Message	
27. Prev Alarm	Clear Buffer= No	Clear Buffer Flag

Current Alarm

When the controller indicates that an alarm condition has occurred, you can find out what it is and when it happened by displaying the current alarm (menu 26) at the keypad or PC. (To do this at the keypad, simply press the alarms key.) The current alarm will remain current until either it clears (see below) or a higher priority alarm occurs.

Previous Alarm Buffer

When the current alarm is cleared or replaced by a higher priority alarm, it is stored in the previous alarm buffer (menu 27). The previous alarm also includes the time and date of occurrence. The previous alarm buffer holds the last 8 alarms in chronological order. The first item in the alarm buffer is more recent than the next item and so on. When a new alarm is added to the alarm buffer, the last item in the buffer is dropped.

If desired, you can clear the alarm buffer by changing the Clear Buffer Flag to "Yes." It will automatically change back to "No" after the buffer is cleared.

Clearing Alarms

Before any alarm can be cleared, the alarm conditions that caused it must have returned to normal. When the alarm conditions are gone, an alarm may be cleared either automatically or manually. See Table 5. ("Clearing" an alarm is the same as "resetting" an alarm.)

Alarms are arranged in increasing priority. A higher priority alarm replaces a lower priority alarm. An auto-reset alarm will immediately clear whenever the alarm conditions that caused it disappear. You can clear a manual-reset alarm at the keypad/display or PC. To clear an alarm from the keypad, simply press the clear key while the current alarm (menu 26) is in the display. Any alarm may also be cleared by placing the S2 switch on the front of the unit to Off and back to Auto or On. The eight previous alarms and the dates and times when they occurred are found in keypad Menu #27.

Compressors that are disabled due to alarm conditions are displayed on Menu #28. These alarms do not appear on menu #26 if a higher priority alarm occurred that cleared the compressor alarm and the compressor alarm conditions no longer exist. In this situation, the compressor alarms may only be cleared through Menu #28.

Note: Some of the safety devices that detect alarm conditions require a manual reset at the device before the controller alarm can clear. See Table 5.

Setting Alarm Limits

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	**Item**	
15. Alarm Limits	Hi Supply= 170°F	High Supply Temperature Limit
	Lo Supply= 40°F	Low Supply Temperature Limit
	Hi Return= 120°F	High Return Temperature Limit

Three alarms in Table 5 have adjustable limits that are used to trigger the alarm:

- High Supply Temperature
- Low Supply Temperature
- High Return Temperature

Although the default settings should be suitable for most applications, you can set these alarm limits as necessary with the keypad or a PC. The default settings are shown above.

Description of Operation

The following sections describe how the various VAV control processes work to maintain temperature and pressure control. The "Operating States and Sequences" section provides an overall description of unit operation. The subsequent sections provide detailed descriptions of the various control processes and how their setpoints and parameters affect them. Before changing any setpoints or control parameters, you should read and understand the sections that apply to your unit.

For detailed information on the Step-and-Wait function, which controls the unit's modulating valves and dampers, see the "MicroTech Control Features" portion of this manual.

Operating States and Sequences

Operating states define the current overall status of the Self-contained system. With a single keystroke, you can display the operating state and thus quickly assess the unit's condition. Each operating state summarizes the following information:

- Supply fan status
- Outdoor air damper status
- Supply fan inlet vane status
- Heating system status
- Airside and waterside economizer status
- Mechanical cooling system status
- Occupied output status
- VAV/Heat output status

Tables 6 and 7 show the operating states and the status information. Table 6 is for Mixed Air or 100% Return Air Unit and Table 7 is for 100% Outside Air Units.

Table 6. Operating States for Mixed Air or 100% Return Air

Operating State (Unit Status)	Supply Fans	Outdoor Damper Output	Supply Fan Airflow	Airside Economizer Airflow	Waterside Economizer Waterflow	Heat Enabled	Mechanical Cooling Enabled	VAV/ Heat Output (K6)	Occupied Output (K15)
Off	Off	Closed	0% Flow	Closed	Off	No	No	Open	① Open
Start-Up Initialization	Off	Closed	Minimum	Closed	Off	No	No	Open	Closed
Recirculate	On	Closed	Modulating	Closed	Off	No	No	Open	Closed
② Morning Warm-Up	On	Closed	Modulating	Closed	Off	Yes	No	Open	Closed
② Heating	On	Open	Modulating	Minimum	Off	Yes	No	Open	Closed
Fan On	On	Open	Modulating	Minimum	Off	No	No	Closed	Closed
② Fan On-Heating	On	Open	Modulating	Minimum	Off	Yes	No	Closed	Closed
Economizer	On	Open	Modulating	Modulating	Modulating	No	No	Closed	Closed
Cooling	On	Open	Modulating	③ Minimum or Open	⑤ Off or Open	No	Yes	Closed	Closed
Unoccupied Econ	On	Closed	Modulating	Modulating	Modulating	No	No	Closed	Closed
Unoccupied Cooling	On	Closed	Modulating	④ Closed or Open	⑤ Off or Open	No	Yes	Closed	Closed
② Unoccupied Heating	On	Closed	Modulating	Closed	Off	Yes	No	Open	Closed

Notes:
1. The Fan On output will open 3 minutes after the unit enters the Off state.
2. This state is not applicable to cooling only units.
3. When the outdoor air enthalpy is low, the economizer's outside air dampers will be fully open; when the outdoor air enthalpy is high, the economizer's outside air dampers will be at minimum position.
4. When the outdoor air enthalpy is low, the airside economizer's outside dampers will be fully open; when the outdoor air enthalpy is high, the airside economizer's outside dampers will be fully closed.
5. Waterside Economizer will be Off if the temperature delta between EWT and MAT is less than the differential.

Table 7. Operating States for 100% Outdoor Air

Operating State (Unit Status)	Supply Fan	Outside Air Damper	Supply Fan Airflow	Waterside Economizer Waterflow	Heat Enabled	Mechanical Cooling Enabled	VAV/ Heat Output (K6)	Occupied Output (K15)
Off	Off	① Closed	0% Flow	Off	No	No	Open	② Open
Start-Up Initialization	Off	Open	Minimum	Off	No	No	Open	Closed
Fan On	On	Open	Modulating	Off	No	No	Closed	Closed
⑤ Fan On-Heating	On	Open	Modulating	Off	Yes	No	Closed	Closed
④ Economizer	On	Open	Modulating	Modulating	No	No	Closed	Closed
Cooling	On	Open	Modulating	③ Off or Open	No	Yes	Closed	Closed
⑤ Heating	On	Open	Modulating	Off	Yes	No	Open	Closed
④ Unoccupied Econ	On	Open	Modulating	Modulating	No	No	Closed	Closed
Unoccupied Cooling	On	Open	Modulating	Off or Open	No	Yes	Closed	Closed
⑤ Unoccupied Heating	On	Open	Modulating	Off	Yes	No	Closed	Closed

Notes:
1. The outside air damper will close 3 minutes after the unit enters the Off state.
2. The Fan On output will open 3 minutes after the unit enters the Off state.
3. Waterside Economizer will be Off if the temperature delta between EWT and MAT is less than the setpoint at menu 18 (EWT Diff=).
4. This state is possible only on units that have a waterside economizer.
5. This state is not applicable to cooling only units.

Displaying the Operating State
The current unit status (menu 1) shown is the current operating state. At the keypad, you can display the current unit status simply by pressing the Status key. For more information, see the "Determining Unit Status" section in the "Operator's Guide" portion of this manual.

Operating State Descriptions

Off
Any of these conditions will prevent the unit from operating. All of them must be in the Auto position to allow operation. Off-service is a safety feature that can only be changed at the unit keypad. It can not be set though a remote keypad.

1. Off-Alarm
2. Off-Service
3. Off-Manual
4. Off-Network
5. Off-Unoccupied
6. Off-Fan Switch

These Off states are prioritized as shown above; the Off-Alarm state has the highest rank. Assigning priority to the Off states is essential. For example, if a unit is in the Off-Service state, an operator at a remote network PC would not be able to start that unit by removing the Off-Network command. (The Off-Service state occurs when a unit controller is placed into the Shutdown service mode.) If a unit is in the Off-Alarm state, nothing could start that unit until the alarm is cleared.

Start Requested
The Start Requested state is a transitional operating state. It will be momentarily displayed whenever the unit has been commanded to start.

Start-up Initialization
The Start-up Initialization operating state always occurs just after the Off and Start Requested states when the unit has been commanded to start. During Start-up Initialization, the unit is prepared for start-up.

For more information on Start-up Initialization, see the "Start-up Control" section.

Recirculate
The Recirculate operating state begins after Start-up Initialization when the fan is energized. It allows temperature conditions throughout the unit and space to equalize before temperature control begins. This feature is particularly important for applications in which the return air temperature sensor is being used for heat/cool changeover control.

For more information on Recirculate, see the "Start-up Control" section.

Post Heat
Post Heat eliminates duct overpressurization problems that could otherwise occur during the transition from heating to cooling operation when the VAV boxes regain zone temperature control.

Post Heat always occurs after the Recirculate, Heating, or Unoccupied Heating states. Typically, the VAV boxes are forced to a wide-open position during operation in these states to facilitate rapid heat transfer to the space. As a result, since they are still controlling duct static pressure, the supply fan inlet vanes open wide and deliver maximum airflow. During Post Heat, normal duct static pressure control is overridden and the supply fan inlet vanes are forced to a minimum position (17% open, fixed). The economizer maintains its previous position (closed or minimum), cooling and heating are disabled, and the VAV/Heat output remains open.

For more information on Post Heat, see the "Supply Fan Airflow" section.

Fan On
The Fan On operating state occurs during occupied operation when cooling and heating are either not required or disabled. During Fan On, the economizer dampers are at minimum position, and cooling and heating are disabled. The VAV/Heat output is closed (auto) and normal duct static pressure control is maintained.

Fan On-Heating
The Fan On-Heating operating state is similar to Fan On. The difference is that heating is enabled to prevent the discharge air temperature from falling below the current discharge air cooling setpoint during the Fan On-Heating state.

By supplying heat instead of closing the outside air dampers, the Fan On-Heating state assures that proper discharge air temperatures are maintained without sacrificing indoor air quality. This feature is particularly valuable for buildings in colder climates that have high minimum outdoor air volume requirements.

For more information, see the "Heating: Modulating" section.

Economizer
The Economizer operating state occurs when cooling is required to satisfy the occupied cooling setpoints and free cooling is available. During the Economizer state, mechanical cooling and heating are disabled. The economizer valve or dampers are modulated to maintain the discharge air cooling setpoint.

For more information, see the "Economizer" section.

Cooling
When mechanical cooling is required during occupied operation, the unit enters the Cooling state. Depending on the outside air enthalpy, the economizer valve or dampers will either be fully open or at minimum position during Cooling. Cooling will be supplied as required to maintain the discharge air cooling setpoint.

On units equipped with modulating chilled water, the unit status display will show "Cooling" during the Cooling state. On units equipped with compressors, the unit status display will show "Cooling-Stage *" during the Cooling state. The wildcard character indicates the number of active cooling stages.

For more information, see the "Cooling: Multistage" or "Cooling: Modulating" section, as applicable.

Morning Warm-up
The Morning Warm-up operating state occurs after the recirculation state when heating is required to satisfy the occupied heating setpoints. Morning Warm-up is similar to the Heating state; the difference is that the economizer and outside air dampers are held shut. If heat is not installed or is disabled, unit will still enter MWU if control temperature is low. The unit will remain in the Morning Warm-up state until either the heating load is satisfied or the morning warm-up timer (menu 20) expires, whichever happens first.

For more information, see the "Heating: One Stage" or "Heating: Modulating" section, as applicable.

Heating

The Heating operating state occurs when heating is required to satisfy the occupied heating setpoints. During the Heating state, the outside air dampers are held at their minimum position. The VAV/Heat output is open and normal duct static pressure control is maintained.

For more information, see the "Heating: One Stage" or "Heating: Modulating" section, as applicable.

Unoccupied Economizer

If the outside air is suitable for free cooling when night setup operation is required, the unit will start and operate in the Unoccupied Economizer state. During Unoccupied Economizer, the outside air dampers are modulated to maintain the discharge air cooling setpoint and the occupied output is closed. The VAV/Heat output is closed (auto) and normal duct static pressure control is maintained.

For more information, see the "Unoccupied Control" section.

Unoccupied Cooling

When mechanical cooling is required during unoccupied operation, the unit enters the Unoccupied Cooling state. Depending on the outside air enthalpy, the economizer valve or dampers will either be fully open or closed during Unoccupied Cooling. Cooling will be supplied as required to maintain the discharge air cooling setpoint.

On units equipped with modulating chilled water, the unit status display will show "Unoccupied Cooling" during the Unoccupied Cooling state. On units equipped with compressors, the unit status display will show "Unoccupied Cooling-Stage *" during the Unoccupied Cooling state. The wildcard character indicates the number of active cooling stages.

For more information, see the "Unoccupied Control" section.

Unoccupied Heating

The Unoccupied Heating operating state occurs when heating is required to satisfy the night setback setpoint during unoccupied periods. When it occurs, Unoccupied Heating always follows the Start-up Initialization and Recirculate operating states. During Unoccupied Heating, the outside air dampers are closed and the occupied output is closed. The VAV/Heat output is open and normal duct static pressure control is maintained.

For more information, see the "Unoccupied Control" section.

Sequence Charts

Operating states and the transitions between them help to describe the unit's sequences of operation. The following sequence charts show every possible operating state transition that can occur as a result of normal temperature and pressure control. Figure 6 is for units with return air and Figure 7 is for units with 100% outside air-cooling with modulating heat. Depending on the unit options, some operating states may not apply.

Figure 6. Sequence Chart for Return Air Units

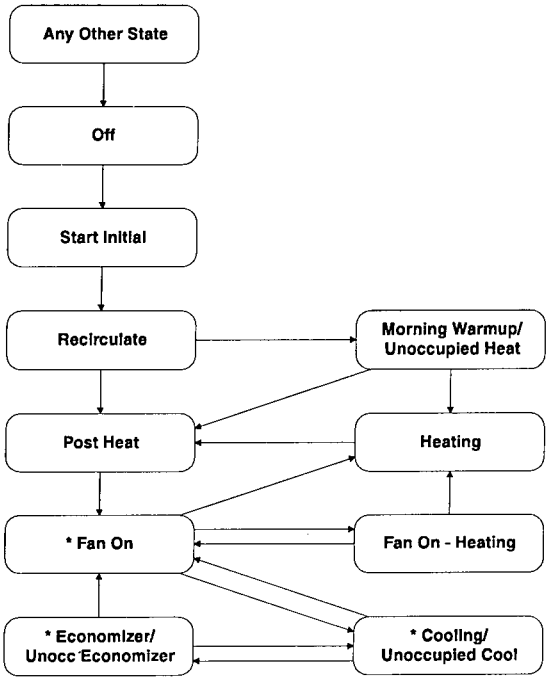
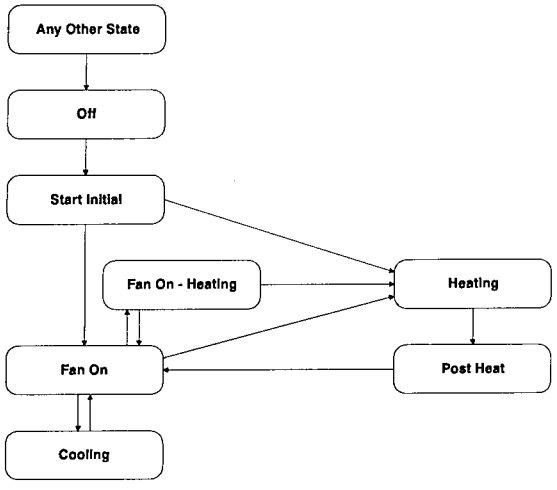


Figure 7. Sequence Chart for 100% Outside Air Units



Start-Up Control

A self-contained unit could start for a variety of reasons. For example, an internal or network schedule, an external time clock, a tenant override command, or night setback control could cause unit start-up. Regardless of the reason it starts, the unit will always go through a controlled start-up sequence before allowing temperature control to begin.

Before Start-Up

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
20. Timers	Initial= *180 Sec*	Start-Up Initialization

When the controller receives a start-up command, its operating state quickly changes from Off to Start Requested to Start-Up Initialization. During Start-Up Initialization, the Fan On output is closed to indicate that the fans are about to start, and the supply fan inlet vanes are modulated to a minimum position. The minimum vane position assures that the fans will start unloaded while allowing airflow status to be proven quickly. The duration of the Start-Up Initialization state is defined by the Start-Up Initialization Time parameter. Its default value is three minutes.

Caution: The Start-Up Initialization Time should be set so that the Start-Up Initialization state lasts long enough to allow any field-supplied equipment that is controlled by the Fan On output to prepare for fan operation.

Fan Start-Up: Mixed Air or 100% Return Air Units

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
20. Timers	Initial= *180 Sec*	Initialization Time
20. Timers	Airflow= *2 Min*	Airflow Check Time
20. Timers	Recirc= *3 Min*	Recirculate Time

After the start-up initialization timer expires, the unit enters the Recirculate operating state. During this state, the fans operate to allow temperature conditions throughout the unit and space to equalize before temperature control begins. Cooling and heating remain disabled, the water valve (outside air dampers) remain closed, and the VAV/Heat output is opened.

As soon as Recirculate begins, the supply fan starts and the following two timers reset and start counting down: (1) the airflow check timer, and (2) the recirculate timer.

The Fan Failure alarm, which indicates loss of airflow, is prevented from occurring just after fan start-up by the airflow check timer. Its default value is 2 minutes. The Fan Failure alarm cannot occur until this timer expires. Airflow status is sensed by a differential pressure switch (PC7).

After Recirculate, if the Control temperature is less than the Zone Heating setpoint minus the Zone Heating dead band the unit enters Morning Warm-up. The unit will remain in Morning Warm-up until one of the following is true: 1)Control temperature >= Zone Heating setpoint; 2)Unit has been in the occupied state for longer than the maximum Morning Warm Up Timer.

Fan Start-Up: 100% Outside Air Units

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
20. Timers	Initial= *180 Sec*	Initialization Time
20. Timers	Airflow= *2 Min*	Airflow Check Time

After the start-up initialization timer expires, the supply fan starts, normal temperature control begins and the airflow check timer resets and starts counting down. The Fan Failure alarm, which indicates loss of airflow, is prevented from occurring just after fan start-up by the airflow check timer. The Fan Failure alarm cannot occur until this timer expires. Airflow status is sensed by a differential pressure switch (PC7).

Heating is required when the space temperature is below the Zone Heating Setpoint by more than the Zone Heating Dead Band. (If a space sensor is not connected, this condition is not applicable.) If heating is not required, the unit goes to the Fan On State. From the Fan On State the unit can go to Fan On Htg if the SAT drops. For more information on these setpoints, see the "Heating: Multistage" or "Heating: Modulating" section, as applicable.

Heat/Cool Changeover

Temperature Control

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
12. Heat/Cool	Cntl Temp= *Return*	Control Temperature Source
	Cooling Spt= *75°F*	Control Cooling Setpoint
	Heating spt= *68°F*	Control Heating Setpoint
	Clg Dead Band= *1°F*	Control Cooling Dead Band
	Htg Dead Band= *1°F*	Control Heating Dead Band
13. Clg Control	Setpoint= __*°F*	Supply air cooling Setpoint

Control Temperature

The "Control Temperature" is the representative zone temperature. When compared with the zone cooling and heating setpoints, it determines whether the unit will supply cooling, heating, or neither. It also determines the amount of cooling or heating required to satisfy the load.

You can choose the source of the Control Temperature from among the following selections:

- Space temperature sensor
- Return temperature sensor
- Outdoor Air temperature sensor
- Mixed Air Temperature sensor (SAT for heat on 100% OA units)

Setpoints and Dead Bands

To determine whether to activate the unit's cooling or heating equipment, the controller compares the Control Temperature with separate cooling and heating enable setpoints. When the Control Temperature is above the cooling setpoint by more than the cooling dead band and SAT > SAT Clg Setpoint + SAT dead band, the cooling equipment is activated and the operating state changes to a cooling state (Economizer, Cooling, Unoccupied Economizer, or

Unoccupied Cooling). When the Control Temperature is below the heating setpoint by more than the heating dead band and SAT < SAT Htg Setpoint - dead band, the factory-installed heating equipment (if any) is activated and the operating state changes to a heating state (Morning Warm-up, Heating, or Unoccupied Heating).

Once the unit's cooling or heating equipment is activated, it will remain operational until the cooling and heating load is satisfied. For more information, see the following sections that apply to the cooling and heating equipment your unit is equipped with.

Note that cooling and heating can never occur simultaneously because the controller will prevent the setpoints and Dead Bands from being set so that there is overlap of the dead band ranges. In doing this, the controller will always give the zone cooling setpoint the highest priority. Regardless of whether you lower the cooling setpoint, raise the heating setpoint, or increase either dead band, the controller will automatically lower the heating setpoint enough to prevent the dead band ranges from overlapping.

Note: The above description assumes that cooling and heating control is enabled. If cooling or heating control is disabled, the cooling or heating equipment cannot be activated by the Control Temperature. Either could be disabled for a variety of reasons. For example, the outdoor air could be too cold for mechanical cooling or too warm for economizer cooling. You can find out by displaying the cooling status state (menu 7) or heating status state (menu 8).

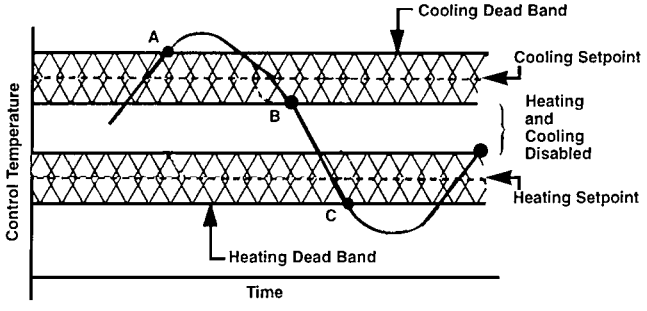
Note: During the Fan On-Heating operating state, the heating equipment can operate to maintain an acceptable discharge air temperature even though heating control is not required by the Control Temperature. For more information, see the "Heating: Multistage" or "Heating: Modulating" section, as applicable.

Typical Operating Sequence

Following is an illustration of heat/cool changeover control. Refer to Figure 8.

When the Control Temperature rises to the cooling enable setpoint plus the cooling dead band (Point A), all cooling (economizer and mechanical) is enabled. Then the Control Temperature begins to drop. When the Control Temperature falls below the cooling enable setpoint minus the cooling dead band (Point B), all cooling is disabled. Since heating is also disabled, the fans will simply circulate air. When the Control Temperature drops to the heating enable setpoint minus the heating dead band (Point C), heating is enabled (one-stage heating is also activated). Then the Control Temperature begins to rise. When the Control Temperature rises above the heating enable setpoint plus the heating dead band (Point D), heating is again disabled.

Figure 8. Typical Heat/Cool Changeover Operating Sequence



Multiple Unit Applications

Common temperature control for multiple unit applications is available with the optional Remote Monitoring and Control (RMC) Panel. To use this control strategy, you must select "Network" as the Control Temperature source at each unit controller in the group. In addition, you must set each unit controller's cooling and heating setpoints and dead bands so that they match the others in the group. For more information, see Bulletin No. OM 121, *MicroTech Remote Monitoring and Control Panel.*

Economizer (Waterside or Airside)

Temperature Control

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	**Item**	
12. Heat/Cool	Cooling Spt= *75°F*	Zone Cooling Setpoint
	Clg Dead Band= *1°F*	Zone Cooling Dead Band
	Clg PA= *12 Min*	Cooling PA Time
	Htg PA= *8 Min*	Heating PA Time
	Mod Limit= *10°F*	Setpoint Mod Limit
	Wait Time= *1 Min*	Setpoint Wait Time
	Max Step= *10%*	Setpoint Max Step
13. Clg Control	Setpoint= __ *°F*	Supply air cooling Setpoint
	Min Spt= *55°F*	Minimum Supply air cooling Setpoint
	Max Spt= *70°F*	Maximum Supply air cooling Setpoint
	Dead Band= *1°F*	Supply air cooling Dead Band
18. Economizer	Dead Band= *1°F*	Economizer Dead Band
	Mod Limit= *60°F*	Economizer Mod Limit
	Wait Time= *30 Sec*	Economizer Wait Time
	Max Step= *30 Sec*	Economizer Max Step
	PA Timer= *60 Sec*	Economizer PA Timer

If the entering water (outside air) is suitable for free cooling (see "Changeover Method" below), the unit controller will attempt to satisfy the cooling load by using economizer before using mechanical cooling. If the Control Temperature is greater than the zone cooling setpoint by more than the zone cooling dead band and the discharge air temperature is greater than the SAT cooling setpoint + SAT cooling dead band, then the control will enter the Economizer or Unoccupied Economizer state. Following is description of operation.

Note: You can determine whether economizer operation is enabled by displaying the cooling status state (menu 7). If it is either "All Cooling Allowed" or "Economizer Only," economizer cooling operation is enabled.

Step-and-Wait Process

When the economizer is operational (Economizer or Unoccupied Economizer state), the controller modulates the waterside economizer valve (airside economizer dampers) as required to maintain the current discharge air cooling setpoint. To do this it uses four Step-and-Wait parameters that are dedicated to economizer temperature control: (1) economizer dead band, (2) economizer mod limit, (3) economizer wait time, and (4) economizer max step. For most applications, the default values for these parameters will provide the best control. For more information, see the "Step-and-Wait Algorithm" section in the "MicroTech Control Features" portion of this manual.

If Step-and-Wait adjusts the economizer's outside air dampers to the minimum position during occupied periods, the controller will leave the Economizer state and enter Fan On. This can only happen if the Control Temperature is less than the SAT cooling setpoint by more than the SAT cooling dead band.

PA Time

Use of the Project Ahead Time or PA Time improves control by reducing overshoot when the measured variable must be changed to maintain the desired setpoint. The PA Time does this by modifying the action of the Step and Wait function so that control is based on what the value of the measured variable will be after the PA time has passed instead of what it is now. Use of such a Project Ahead Time for control stops the valve from opening or closing when it is rapidly approaching the setpoint. It also allows the position of the valve to start responding in the opposite direction before the measured variable passes through the dead band. This combination of normal Step and Wait parameters and a Project Ahead Time provides Proportional/Integral or PI control.

Mechanical Cooling

If the entering water temperature(outdoor air enthalpy) changes from low to high at any time while the economizer is operational (Economizer or Unoccupied Economizer state), the transition from economizer operation to mechanical cooling operation will occur. During occupied operation, the outside air dampers will go to the current minimum position setting (see "Minimum Ventilation Air Volume Control" below). During unoccupied operation, the outside air dampers will close.

The transition from economizer operation to mechanical cooling operation will also occur when conditions are such that the entering water temperature(outside air) is cool (low enthalpy), but unable to satisfy the cooling load. Normally, this will happen when (1) the waterside economizer valve (airside economizer damper) is more than 90% open and (2) the discharge air temperature is above the discharge air cooling setpoint by more than the discharge air cooling dead band value. The transition can also occur if (1) the economizer has been active for at least 10 minutes and (2) the discharge air temperature is above the discharge air cooling setpoint by an amount greater than or equal to the economizer dead band value plus 2°F. This backup feature will ensure that cooling is provided if the economizer gets stuck.

If the entering waterside economizer temperature (airside economizer enthalpy) is low when mechanical cooling is activated (Cooling or Unoccupied Cooling state), the waterside economizer valve (airside economizer dampers) will be driven to full open. They will remain there until either mechanical cooling is no longer necessary or the entering water (outdoor air) is no longer suitable for free cooling. If mechanical cooling is no longer necessary, the economizer will resume modulation. During occupied and unoccupied operation the water valve will close if entering water is not suitable for free cooling. During occupied operation, the outside air dampers will go to the current minimum position setting if the outdoor air is no longer suitable for free cooling. During unoccupied operation, the outside air dampers will close if the outdoor air is no longer suitable for free cooling.

For more information on mechanical cooling operation, see the "Cooling: Multistage" or "Cooling: Modulating" section, as applicable.

Changeover Method for Waterside Economizer

Keypad/Display ID		Parameter Name
Menu	Item	
18. Economizer	EWT Diff = 3°F	Economizer Changeover Setpoint

The suitability for free cooling is determined by the differential between the entering water temperature and the mixed air temperature. For free cooling to be enabled the differential between EWT and MAT must be equal to or greater than the EWT Diff setting at Menu 18 (default is 3 °F).

Changeover Method for Airside Economizer

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
18. Economizer	Enthalpy= Yes	Economizer Changeover Flag
	Changeover= 75°F	Economizer Changeover Setpoint

There are three methods of determining whether the outdoor air is suitable for free cooling. Two sense enthalpy (dry bulb temperature and humidity) and one senses outdoor air dry bulb temperature.

Enthalpy Changeover

The two optional enthalpy changeover methods use external controls. One compares the outdoor enthalpy with a setpoint; the other compares the outdoor enthalpy with the return air enthalpy. Both enthalpy controls generate a digital changeover signal that the controller receives at one of its inputs.

To use either of these enthalpy methods, the economizer changeover flag must be set for "enthalpy." (At the keypad, the "Enthalpy=" item's field must be set to "Yes.") The economizer changeover setpoint is ignored by the controller when either enthalpy method is used.

For more information on the external enthalpy controls, refer to the "Unit Options" portion of the model-specific installation manual (see Table 1).

Dry Bulb Temperature Changeover

All unit controllers include an internal dry bulb temperature changeover strategy that can be selected if desired. When this method is selected, the controller compares the outdoor air temperature to the economizer changeover setpoint. The external enthalpy control input is then ignored.

To use the dry bulb method, the economizer changeover flag must be set for "temperature." (At the keypad, the "Enthalpy=" item's field must be set to "No.") The economizer changeover setpoint will then be used by the controller to determine whether outdoor air may be used for cooling. If the outdoor air temperature is less than or equal to this setpoint, economizer cooling will be enabled. If the outdoor air temperature is above this setpoint by more than 1°F, economizer cooling will be disabled and the outside air dampers will either close (unoccupied) or go to minimum position (occupied).

Transition Economizer to Mechanical Cooling

The transition from economizer state to mechanical cooling state is identical for both waterside and airside economizers. A feedback potentiometer on the economizer actuator provides the position of the actuator to the MicroTech controller. When the economizer position exceeds 90% and the Discharge Air Temperature exceeds the Discharge Air tem perature by more than the dead band, the economizer is dri ven open continuously. If the discharge air temperature remains above the discharge air temperature setpoint by more than the dead band after the economizer has been driven open for the Cooling Stage Timer, the unit transitions to the Mechanical Cooling state.

Bypass Valve

The bypass valve to the condenser is closed in all states except the fan on, mechanical cooling, and economizer states. It is opened in the fan on state when cooling is required so that the program can determine:

- Whether water flow is established AND
- An accurate entering water temperature.

The bypass valve is open in the mechanical cooling state when mechanical cooling is required and water is not flowing through a waterside economizer. The bypass valve is opened in the economizer state if an airside economizer is installed and mechanical cooling is anticipated or the position of a waterside economizer does not exceed 90%. The bypass valve is not controlled on chilled water units.

The bypass valve may be linked electrically (slaved) to the economizer valve so that the bypass valve closes as the economizer opens. This provides nearly constant flow of water through the unit regardless of the requirements of the economizer. The bypass output relay is not wired to the valve in this situation.

100 % Outside Air Units

When the outside air damper output is on, the outside air dampers open during Start Initial and all operating states. The outside air damper remains open for 30 seconds after loss of airflow. The Recirculate, Morning Warm-up, and Post Heat states are skipped on startup. The unit goes from Start Initial to Heating if Heating is enabled and the Space Temperature is less than the Zone Heating Setpoint by more than its dead band. If not the unit goes to Fan On. The unit is then controlled in the normal manner.

Cooling: Multistage

Temperature Control

Programmable Parameters

Keypad/Display ID		Parameter
Menu	Item	Name
13 Clg Control	Setpoint= 55°F	Supply air Cooling Setpoint
	Method= Nearest/Average	Compressor Staging Method
	Stg Timer= 5 Min	Cooling Interstage Timer
	Dead Band= 1°F	Supply air Cooling Dead Band

If the unit is equipped with an economizer and conditions are suitable for free cooling, the unit controller will attempt to satisfy the cooling load by using economizer before using mechanical cooling. See the "Economizer" section above. If the unit is not equipped with an economizer, the controller will activate mechanical cooling whenever cooling is required.

If mechanical cooling is enabled (see note below) and economizer is either not available or not cool enough to maintain the current discharge air cooling setpoint, the controller will activate mechanical cooling. During occupied periods, the operating state will be Cooling. During unoccupied periods, the operating state will be Unoccupied Cooling.

When mechanical cooling is required, the controller will stage compressors up or down as required to maintain an average discharge air temperature control or the nearest discharge air temperature control. The type of control is selected at menu 13. Clg Control at item Method=Nearest/Average. Following is a description of Average and Nearest discharge air temperature control.

Note: You can determine whether mechanical cooling operation is enabled by displaying the cooling status state (menu 7). If it is either "All Cooling Allowed" or "Compressors Only," mechanical cooling is partially enabled. Cooling operation is further enabled by the Control Temperature. See the "Heat/Cool Changeover" section for more information.

Note: You can either enter a fixed discharge air cooling setpoint or allow the controller to reset it automatically. See "Setpoint Reset" below for more information.

Average Degree-Time Compressor Staging

This method is useful if the SAT must be provided at the desired setpoint to meet the cooling load of one or more spaces.

Except during unit shutdown, a stage change can only occur (1) after the cooling interstage timer has expired and (2) if the supply temperature is above or below the discharge air cooling setpoint by more than the discharge air cooling dead band. These constraints on compressor staging are essential for preventing short-cycling, which can reduce compressor life by causing improper oil return and excessive heat buildup in the motor windings. After these two conditions have been met, staging occurs as the controller attempts to equalize two running totals: degree-time above setpoint (DTA) and degree-time below setpoint (DTB).

Degree-Time Above Setpoint (DTA): Every 10 seconds the controller measures the number of degrees the discharge air temperature is above setpoint. Each new measurement is added to a running total called DTA.

Degree-Time Below Setpoint (DTB): Every 10 seconds the controller measures the number of degrees the dis-

charge air temperature is below setpoint. Each new measurement is added to a running total called DTB.

During normal operation, the number of stages will not change while the discharge air temperature is within the range above and below the discharge air cooling setpoint defined by the discharge air cooling dead band. Typically, during periods of constant cooling load, cooling is alternately staged up and down between the two stages that cause the discharge air temperature to fluctuate closely above and below setpoint. During periods of increasing or decreasing cooling load, two or more consecutive stage-ups or stage-downs can occur. Following are descriptions of the four possible consecutive staging changes.

Stage-Up to Stage-Down: After a stage-up occurs, the discharge air temperature usually begins to drop toward setpoint. DTA accumulates and continues to do so until the setpoint is reached. When the discharge air temperature drops below setpoint, DTA stops accumulating and DTB starts accumulating. When DTB equals or exceeds DTA, the stage-down will occur, but only if the interstage timer has expired and the discharge air temperature is below the setpoint by more than the dead band. (If either staging constraint has not been met, DTB will continue accumulating.) After the stage-down occurs, the DTA value is subtracted from both DTA and DTB. As a result, DTA is zeroed out and DTB is either zeroed out or largely reduced. The interstage timer is reset and degree-time accumulation resumes.

Stage-Down to Stage-Up: After a stage-down occurs, the discharge air temperature usually begins to rise toward setpoint. DTB accumulates and continues to do so until the setpoint is reached. When the discharge air temperature rises above setpoint, DTB stops accumulating and DTA starts accumulating. When DTA equals or exceeds DTB, the stage-up will occur, but only if the interstage timer has expired and the discharge air temperature is above the setpoint by more than the dead band. (If either staging constraint has not been met, DTA will continue accumulating.) After the stage-up occurs, the DTB value is subtracted from both DTB and DTA. As a result, DTB is zeroed out and DTA is either zeroed out or largely reduced. The interstage timer is reset and degree-time accumulation resumes.

Stage-Up to Stage-Up: If the cooling load increases after a stage-up occurs, the discharge air temperature may drop for a while and then rise again. Regardless of the DTA and DTB values, another stage-up will always occur if the discharge air temperature is above setpoint by more than the dead band after the interstage timer expires. After the stage-up occurs, DTA and DTB are zeroed out. The interstage timer is reset and degree-time accumulation resumes.

Stage-Down to Stage-Down: If the cooling load decreases after a stage-down occurs, the discharge air temperature may rise for a while and then drop again. Regardless of the DTA and DTB values, another stage-down will always occur if the discharge air temperature is below setpoint by more than the dead band after the interstage timer expires. After the stage-down occurs, DTA and DTB are zeroed out. The interstage timer is reset and degree-time accumulation resumes.

Typical Operating Sequence

Following is an illustration of degree-time compressor staging control. Note that this illustration is meant to show a variety of staging possibilities, not normal unit operation. Refer to Figure 9, which shows nine points on a graph of the discharge air temperature. The cooling interstage timer setting is 5 minutes.

Point 1: Assume that the controller has just staged up cooling and that DTA and DTB are zero. As a result, the discharge air temperature drops and the interstage timer is reset.

Point 2: DTA (Area A) equals DTB (Area B). However, since the 5-minute interstage timer has not expired, no staging action occurs.

Point 3: The interstage timer expires. DTB (Area B + Area C) is greater than DTA (Area A) and the discharge air temperature is below the setpoint by more than the dead band. Therefore, cooling is staged down. As a result, the discharge air temperature rises, the interstage timer is reset, and DTA is subtracted from both DTA and DTB. This zeros out DTA and leaves DTB equal to Area C.

Point 4: The interstage timer expires again. The discharge air temperature is above the dead band range, but since DTA (Area E) is not yet equal to DTB (Area C + Area D), no staging action occurs and thus the temperature continues to rise.

Point 5: DTA (Area E + Area F) is equal to DTB (Area C + Area D). Therefore, cooling is staged up. As a result, the discharge air temperature drops, the interstage timer is reset, and DTB is subtracted from both DTB and DTA. This zeros out both DTA and DTB since they are equal.

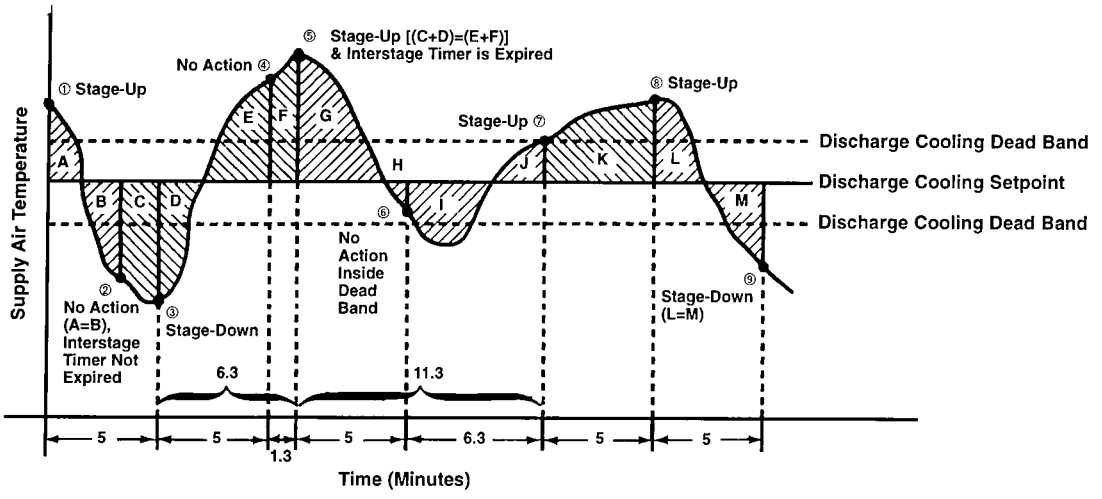
Point 6: The interstage timer expires. Because the cooling load is now increasing, the discharge air temperature only falls to within the dead band range. No staging action occurs for two reasons: (1) the discharge air temperature is within the dead band range and (2) DTB (Area H) is not yet equal to DTA (Area G). Even if the temperature falls below the dead band range (as shown just after Point 6), a stage-down does not occur because DTB remains less than DTA. The discharge air temperature starts rising again because the load is increasing.

Point 7: The discharge air temperature is again above setpoint by more than the dead band. Since the interstage timer expired at Point 6, cooling is staged up. As a result, both DTA and DTB are zeroed out and the interstage timer is reset. The discharge air temperature continues to rise, however, because the cooling load is still increasing.

Point 8: The interstage timer expires. Since the discharge air temperature is still above the dead band range, another stage-up occurs. As a result, DTA (Area K) is again zeroed out and the interstage timer is reset. The cooling load has leveled out, and thus the discharge air temperature drops.

Point 9: The interstage timer expires at nearly the same time that DTB (Area M) becomes equal to DTA (Area L). As a result, the interstage timer is reset, and DTA is subtracted from both DTA and DTB. This zeros out both DTA and DTB since they are equal.

Figure 9. Typical Compressorized Cooling Operating Sequence



Nearest SAT Compressor Staging

This method is useful if the load of all the spaces can be maintained with the SAT slightly above the SAT setpoint.

Except during unit shutdown, a stage change can only occur (1) after the cooling interstage timer has expired and (2) if the supply temperature is above or below the discharge air cooling setpoint by more than the discharge air cooling dead band. These constraints on compressor staging are essential for preventing short-cycling, which can reduce compressor life by causing improper oil return and excessive heat buildup in the motor windings. After these two conditions have been met, staging occurs as the controller increases or decreases the number of cooling stages whenever such a change results in the discharge air temperature being closer to the SAT cooling setpoint. This method will result in fewer stage changes and hence fewer changes in the discharge air temperature and airflow delivered to the zones. This method may be more desirable in an application with zones whose cooling loads can be met with discharge air temperatures close to the cooling setpoint.

Whenever the number of stages is changed, a SAT difference is calculated. This value is the change in the discharge air temperature between the time that the stage change is initiated and the Cooling Stage Timer expires. The assumption is that the supply will change by this amount if the previous stage change is reversed. If the SAT Error (the difference between the discharge air temperature and SAT cooling setpoint) equals half of the SAT difference, a stage change should result in a discharge air temperature on the other side of the cooling setpoint with the same SAT error. Therefore the discharge air temperature should be closer to the SAT cooling setpoint if the SAT difference is less than twice the SAT error. The changeover value to a lower number of stages is slightly biased to reduce the number of transitions and to bias the supply sir temperature towards the low side. The actual; equations are:

Stage up if: SAT - Cooling Setpoint > SAT difference / 2

Stage down if: Cooling Setpoint - SAT > (SAT difference / 2) + 1°F

Low EWT Cooling Lockout

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
13 Clg Control	Min OAT= *55°F*	Low Ambient Cooling Lockout Setpoint
- -	-	Low Ambient Cooling Lockout Differential

Mechanical cooling will be disabled whenever the EWT falls to the low ambient cooling lockout setpoint. When this occurs, the cooling status state will usually be "Economizer Only" if all cooling is not disabled for some other reason. (The cooling status could also be "Temperature/Enthalpy Disable," indicating that the outdoor air conditions are not suitable for either mechanical or economizer cooling. Normally, if the setpoints are set properly, this situation should never occur.) When the outdoor air temperature rises above the low ambient cooling lockout setpoint by more than the low ambient cooling lockout differential, mechanical cooling will be enabled again. The default value of this differential is 3°F (PC adjustable only).

Setpoint Reset

Programmable Parameters

Keypad/Display ID		Parameter Name
Menu	Item	
13 Clg Control	Setpoint= *55°F*	Supply air Cooling Setpoint
	Min Spt= *55°F*	Minimum Supply air Cooling Setpoint
	Max Spt= *65°F*	Maximum Supply air Cooling Setpoint
	Reset= *No Reset*	Cooling Reset Type
	Min Spt @ *90°F*	Reset Sensor Minimum Cooling Setpoint
	Max Spt @ *70°F*	Reset Sensor Maximum Cooling Setpoint

A variety of reset strategies are available (some require field wiring). Because they are programmable, you can change or eliminate reset strategies as desired.

When a reset strategy is operational, it will automatically change the discharge air cooling setpoint as required. You can display the current setpoint, but the controller will not let you change it. If you do not want reset, set the cooling reset type to "No Reset" (default). The controller will then allow you to enter a fixed discharge air cooling setpoint.

The following discharge air cooling reset methods are available:

- Space temperature
- Return air temperature
- Outdoor air temperature
- Supply fan airflow
- External 1-5 VDC or 4-20 mA signal

Regardless of the reset method, the minimum discharge air cooling setpoint and maximum discharge air cooling setpoint define the range of possible discharge air setpoints.

Reset from a Temperature Sensor

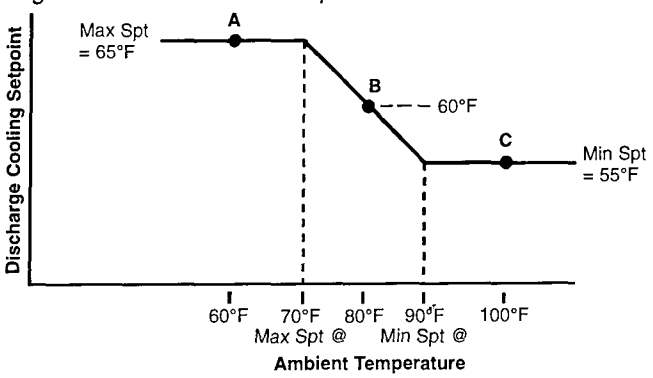
The discharge air cooling setpoint can be reset in response to three temperature sensors: space, return air, or outdoor air. When any of these methods is used, the current discharge air cooling setpoint is determined by the current temperature at the selected reset sensor. This reset action is illustrated in Figure 10. (The outdoor air reset method is shown.)

When the temperature at the selected reset sensor is greater than or equal to the reset sensor minimum cooling setpoint ("Min Spt @"), the current discharge air cooling setpoint will equal the minimum discharge air cooling setpoint ("Min Spt="). Point C in Figure 10 exemplifies this.

When the temperature at the selected reset sensor is less than or equal to the reset sensor maximum cooling setpoint ("Max Spt @"), the current discharge air cooling setpoint will equal the maximum discharge air cooling setpoint ("Max Spt ="). Point A in Figure 10 exemplifies this.

When the temperature at the selected reset sensor is between the reset sensor minimum and maximum cooling setpoints ("Min Spt @" and "Max Spt @"), the current discharge air cooling setpoint will vary linearly between the minimum and maximum discharge air cooling setpoints ("Min Spt=" and "Max Spt="). Point B in Figure 10 exemplifies this.

Figure 10. Reset from a Temperature Sensor



Note: To use the space temperature reset method, a zone temperature sensor must be field installed and connected to the unit controller. For more information, see the "Field Wiring" portion of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller.

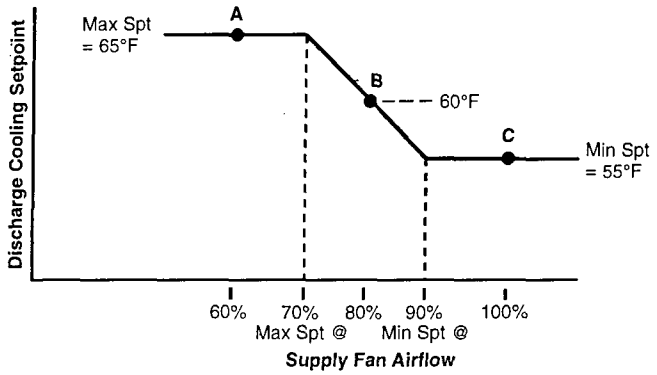
Reset from Supply Fan Airflow

The discharge air cooling setpoint can be reset in response to the supply fan airflow. When this method is used, the current discharge air cooling setpoint is determined by the current supply fan inlet vane position or inverter speed. The reset sensor minimum and maximum cooling setpoints are not used. This reset action is illustrated in Figure 11.

When supply fan airflow is selected as the type of reset, the cooling setpoint decreases from the maximum value to the minimum value as the fan speed or vane position increases. The Cooling Discharge Air Temperature Setpoint is controlled as indicated graphically below.

When the supply fan inlet vane position is between 30% and 90% open, the current discharge air cooling setpoint will vary linearly between the minimum and maximum discharge air cooling setpoints ("Min Spt=" and "Max Spt="). Point B in Figure 11 exemplifies this.

Figure 11. Reset from Supply Fan Airflow



Reset from an External Signal

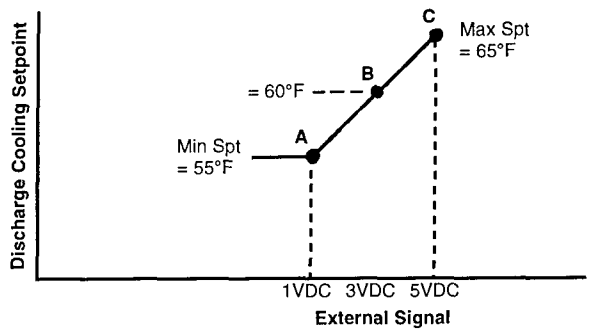
The discharge air cooling setpoint can be reset in response to an external signal to input #15. When this method is used, an external 1-5 VDC (or 4-20 mA) signal controls the current discharge air cooling setpoint. The reset sensor minimum and maximum cooling setpoints are not used. This reset action is illustrated in Figure 12.

When the external signal is 1 VDC (not adjustable), the current discharge air cooling setpoint will equal the minimum discharge air cooling setpoint ("Min Spt="). Point A in Figure 12 exemplifies this.

When the external signal is 5 VDC (not adjustable), the current discharge air cooling setpoint will equal the maximum discharge air cooling setpoint ("Max Spt="). Point C in Figure 12 exemplifies this.

When the external signal is between 1 and 5 VDC, the current discharge air cooling setpoint will vary linearly between the minimum discharge air cooling setpoint and maximum discharge air cooling setpoint ("Min Spt=" and "Max Spt="). Point B in Figure 12 exemplifies this.

Figure 12. Reset from an External Signal



Note: To use the external signal reset method, an external 1-5 VDC or 4-20 mA signal must be connected to the unit controller.

Airflow Modulation

The amount of airflow provided by units in VAV applications is varied by a Dual Motor system, Variable Inlet Vanes (VIV), or Inverters.

Dual Motor Systems

Keypad/Display ID			Parameter Name
Menu		Item	
17	Motor Control	Vel Diff= *41 FPM*	Velocity differential required for transfer from high to low speed motor
		Amp Limit = *15 Amp*	Low Speed motor current limit

Output 10

At low airflow requirements, the output is de-energized and the fan is driven at a low speed by a lower horsepower motor. When a large amount of airflow is required, the output is energized and the fan is driven at a high speed by a higher horsepower motor. The choice of motor speed is determined by two MicroTech inputs that monitor Low Speed Motor Amps and Air Velocity.

The unit starts at low speed. Switch over to high speed motor occurs when the Low Speed Motor Amps equals the factory set Current Limit. This Current Limit is normally the FLA of the low speed motor. The Air Velocity when the unit switches from low to high speed is saved by MicroTech. The unit switches back to low speed when the Air Velocity drops a fixed velocity below the Air Velocity at switch over from low to high speed. To prevent short cycling, the unit operates for at least ten minutes at high speed before it changes to low speed. Such a minimum operating time is not provided for low speed operation because the low speed motor could trip on overloads if it operates above its FLA.

VIV/Inverters

Outputs 9 and 10

Variable Inlet Vanes and Inverters are controlled in similar fashion. Inverters speed up or slow down the fan and vanes are opened and closed to provide duct static pressure or building static pressure control. Control sequences common to both duct and building static pressure control are discussed first. Then duct static pressure and building static pressure control are described.

If either duct or building static pressure control drives the vanes or inverters below a minimum position of 17% during operation, the vanes or inverters will be controlled to the maintain the minimum position until the static pressure drops below the setpoint by more than the dead band. This minimum position is required for VIV applications to avoid unstable operation due to fan stall conditions. This minimum position is required for Inverters to prevent inverter overheating.

During the Start Initial period, a Slower signal is be sent to Inverters so that inverter speed is zero when the fan is started. In order to avoid unstable operation due to fan stall conditions, Supply Vanes are driven to the fixed minimum position of 17% instead of the closed position during Start Initial period.

The Inverters and the Supply Vanes are both driven to the 17% minimum position during Post Heat operation after the recirculation period or after heat is provided while VAV boxes remain wide open. The purpose of this control is to keep duct pressures from getting too high due to rapidly closing VAV boxes.

In any Off state other than the Calibrate state, a Close signal is sent to Variable Inlet Vanes and a Slower signal is be sent to Inverters.

In the Calibrate state, the unit is off. The VIV actuator is first driven open for 3 to 4 minutes. The actuator position at the end of this period becomes the new fully open or 100% value. The actuator is then driven closed for 3 minutes. The actuator position at the end of this period becomes the new fully closed or 0% position. Inverters are not calibrated because fan operation may be required to speed up or slow down the inverters, and running the inverter at full speed for calibration may cause damage to the duct work.

Duct Static Pressure Control

Keypad/Display ID			Parameter Name
Menu		Item	
18	Duct Pressure	Duct Spt=*1.00"WC*	Duct Setpoint
		Deadbd=*0.08"WC*	Dead Band
		Max Spt=*2.00"WC*	Max Setpoint
		Reset=*No Reset*	Reset Method Position
		Mod Lim=*0.040"WC*	Mod Limit
		Wait Time=*20 Ten*	Wait Time
		Max Step=*20 Ten*	Max Step

In normal operation, vanes or inverters are controlled to maintain the Duct Static Pressure at the desired setpoint using the Step and Wait function. When the duct static pressure gets too low, the vanes (inverters) are opened (speeded up). When the duct static pressure gets too high, the vanes (inverters) are closed (slowed down). If two pressure sensors are provided, the Duct Static Pressure equals the minimum of the two sensors.

Instead of normal operation, the user may select control to a specific vane position or fan speed by selecting Reset=Position in menu # 17. In this situation, the required vane position or inverter speed is provided via network communication from another system or another MicroTech controller such as an RMC panel. The unit control does not allow this setpoint to be set below the minimum value of 17%. A separate set of Step and Wait parameters that are not changeable by the user is provided for this type of control.

Building Static Pressure Control

Keypad/Display ID			Parameter Name
Menu		Item	
18	Bldg Pressure	Zone Spt= *0.050"WC*	Duct Setpoint
		Min Pos= *60 %*	Dead Band
		Min Speed= *60 %*	Max Setpoint
		Deadbd= *0.008"WC*	Dead Band
		Mod Lim= *0.040"WC*	Mod Limit
		Wait Time= *20 Ten*	Wait Time
		Max Step= *20 Ten*	Max Step

The Variable Inlet Vanes or Inverters may be controlled based on Building Static pressure instead of Duct Pressure. This feature is provided primarily to maintain building static pressure for 100% outside air units with variable exhaust. The building static pressure sensor input replaces the first duct static pressure sensor input. Step and Wait is used to control the vanes or inverters. A minimum position of the Vanes or Inverters insures that sufficient ventilation is maintained even if that means that the building static pressure gets higher than desired. When the building static pressure gets too low, the vanes (inverters) are opened (speeded up). When the building static pressure gets too high, the vanes (inverters) are closed (slowed down).

Cooling: Modulating
(SCP units only)

Temperature Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
13	Clg Control	Setpoint= *55°F*	Supply air Cooling Setpoint
		Stg Timer= *5 Min*	Cooling Interstage Timer
		Dead Band= *1°F*	Supply air Cooling Dead Band
		Mod Limit= *60°F*	Supply air Cooling Mod Limit
		Wait Time= *30 Sec*	Supply air Cooling Wait Time
		Max Step= *30 Sec*	Supply air Cooling Max Step
		PA Time= *60 Sec*	Project Ahead Timer

On SCP units the chilled water coil replaces the waterside economizer coil. If the unit is equipped with an air economizer and the conditions are suitable for free cooling, the unit controller will attempt to satisfy the cooling load by using economizer before using mechanical cooling. See the "Economizer" section above. If the unit is not equipped with an economizer, the controller will activate mechanical cooling whenever cooling is required.

If mechanical cooling is enabled (see note below) and economizer is either not available or not cool enough to maintain the current discharge air cooling setpoint, the controller will activate mechanical cooling. During occupied periods, the operating state will be Cooling. During unoccupied periods, the operating state will be Unoccupied Cooling.

When mechanical cooling is required, the controller will modulate the cooling output as required to maintain the current discharge air cooling setpoint. To do this it uses four Step-and-Wait parameters that are dedicated to chilled water cooling temperature control: (1) discharge air cooling dead band, (2) discharge air cooling mod limit, (3) discharge air cooling wait time, and (4) discharge air cooling max step. The Step and Wait function is modified with a Project Ahead feature to reduce overshoot. For most applications, the default values for these parameters will provide the best control. For more information, see the "Step-and-Wait Algorithm" section in the "MicroTech Control Features" portion of this manual.

Note: You can determine whether mechanical cooling operation is enabled by displaying the cooling status state (menu 7). If it is "All Cooling Allowed" mechanical cooling is partially enabled. Cooling operation is further enabled by the Control Temperature. See the "Heat/Cool Changeover" section for more information.

Note: You can either enter a fixed discharge air cooling setpoint or allow the controller to reset it automatically. See "Setpoint Reset" below for more information.

Chilled Water: Valve Control

Modulating chilled water cooling is actually a two-stage process. During "stage 1" operation, the valve modulates as required to maintain the discharge air cooling setpoint. During "stage 0" operation, the valve is continuously driven closed, but the controller remains in the cooling state.

A stage change can only occur (1) after the cooling interstage timer has expired and (2) if the discharge air temperature is above or below the discharge air cooling setpoint by more than the discharge air cooling dead band. After any stage change occurs, the cooling interstage timer starts timing.

There is one additional constraint that applies to the stage-down transition from stage 1 to stage 0: The valve must be fully closed before the stage-down can occur. (To determine whether the valve is closed, the controller compares the stroking open time with the stroking closed time.)

Low Ambient Cooling Lockout

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
13	Clg Control	Min EWT= *55°F*	Low EWT Cooling Lockout Setpoint

Mechanical cooling will be disabled whenever the EWT falls to the minimum EWT lockout setpoint. The minimum EWT lockout setpoint is 20°F for units with head pressure control and 55°F for units without head pressure control. When the minimum EWT lockout occurs, the cooling status state will usually be "Economizer Only" if all cooling is not disabled for some other reason. When the EWT temperature rises above the minimum EWT cooling lockout setpoint by more than the EWT lockout differential, mechanical cooling will be enabled again. The default value of this differential is 3°F.

Setpoint Reset

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
13	Clg Control	Setpoint= *55°F*	Supply air Cooling Setpoint
		Min Spt= *55°F*	Minimum Supply air Cooling Setpoint
		Max Spt= *65°F*	Maximum Supply air Cooling Setpoint
		Reset= *No Reset*	Cooling Reset Type
		Min Spt @ *90°F*	Reset Sensor Minimum Cooling Setpoint
		Max Spt @ *70°F*	Reset Sensor Maximum Cooling Setpoint

A variety of reset strategies are available (some require field wiring). Because they are programmable, you can change or eliminate reset strategies as desired.

When a reset strategy is operational, it will automatically change the discharge air cooling setpoint as required. You can display the current setpoint, but the controller will not let you change it. If you do not want reset, set the cooling reset type to "No Reset" (default). The controller will then allow you to enter a fixed discharge air cooling setpoint.

The following discharge air cooling reset methods are available:

- Space temperature
- Return air temperature
- Outdoor air temperature
- Airflow
- External 1-5 VDC or 4-20 mA signal

Regardless of the reset method, the minimum discharge air cooling setpoint and maximum discharge air cooling setpoint define the range of possible discharge air setpoints.

The above reset methods are identical to the ones available for use with multistage mechanical cooling. For more information, see "Setpoint Reset" in the previous "Cooling: Multistage" section.

Heating: Multistage with Zone Control

Temperature Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
12	Heat/Cool	Heating spt= *68°F*	Zone Heating Setpoint
		Htg Dead Band= *1°F*	Zone Heating Dead Band
		Htg PA= *8 Min*	Heating PA Time
14	Htg Control	Min Spt= *60°F*	Minimum Supply air heating Setpoint
		Max Spt= *120°F*	Maximum Supply air heating Setpoint
		Stg Timer= *5 Min*	Heating Interstage Time

If heating is enabled (see note below) and there is a zone heating load, the controller will activate the first stage of electric heat as it enters the Morning Warm-up, Heating, or Unoccupied Heating state. This will occur when the Control Temperature is below the zone heating setpoint by more than the zone heating dead band value. Following is a description of operation.

Note: You can determine whether heating operation is enabled by displaying the heating status state (menu 8). If it is "Heating Allowed," heating is enabled.

Electric Heat Staging

After the heating interstage timer expires, staging occurs as the controller attempts to (1) keep the Control Temperature close to the zone heating setpoint and (2) keep the discharge air temperature within the range defined by the minimum and maximum Discharge Air Heating setpoints. After any stage-up or stage-down action, the heating interstage timer resets and starts counting down again.

Except during unit shutdown, a stage change can only occur after the heating interstage timer has expired. This constraint on electric heat staging is essential for preventing short-cycling, which can reduce contactor life. It also provides better temperature control.

Stage-Up Action: A stage-up can occur for two reasons: (1) the Control Temperature is below the zone heating setpoint by more than the zone heating dead band or (2) the discharge air temperature is below the Fan On - Heating Spt.

Stage-Down Action: A stage-down can occur for two reasons: (1) the Control Temperature is above the zone heating setpoint by more than the zone heating dead band or (2) the discharge air temperature is above the maximum Discharge Air Heating setpoint.

Note that a stage-down from stage 1 to stage 0 can occur. During stage 0 operation, all heating stages are off, but the controller remains in the heating operating state. After the interstage timer expires, another stage-down would cause the controller to leave the heating state.

There is one exception to the above interstage timing constraint: If the discharge air temperature drops below the minimum heating discharge air setpoint by more than the Discharge Air Heating dead band during stage 0 operation, the stage-up transition to stage 1 will occur regardless of the interstage timer or Control Temperature.

If contradictory stage change conditions exist when the heating interstage timer expires, the controller will stage heating up or down according to the minimum and maximum Discharge Air Heating setpoints. For example, if the discharge air temperature is below the minimum Discharge Air Heating setpoint (stage-up condition) when the Control Temperature is above the zone heating setpoint by more than the zone heating dead band (stage-down condition), a stage-up will occur.

Note: The controller will not allow you to set the minimum Discharge Air Heating setpoint above the zone heating setpoint. This restriction will ensure better zone temperature control during heating operation.

Project Ahead

The Project Ahead algorithm works to prevent the Control Temperature from overshooting the zone heating setpoint during periods in which the space temperature is changing while it is far from setpoint; for example, just after start-up. Using the heating PA time parameter, the controller anticipates what the Control Temperature will be if it continues to change at its current rate. The controller uses this anticipated Control Temperature as the input to its heating control processes. The result is that the heating output is increased or decreased early enough to avoid Control Temperature overshoot. For most applications, the default heating PA time value will provide the best control. See the "Project Ahead Algorithm" section in the "MicroTech Control Features" portion of this manual for more information.

High Ambient Heating Lockout

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
14	Htg Control	Max OAT= *55°F*	High Ambient Heating Lockout Setpoint
–		–	High Ambient Heating Lockout Differential

Heating will be disabled whenever the outdoor air temperature is greater than the high ambient heating lockout setpoint. When this occurs, the heating status state will be "Off-OAT Lockout" if heating is not disabled for some other reason. When the outdoor air temperature drops below the high ambient heating lockout setpoint by more than the high ambient heating lockout differential, heating operation will be enabled again. The default value of this differential is 3°F (PC adjustable only).

Morning Warm-Up Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
12	Heat/Cool	Heating spt= *68°F*	Zone Heating Setpoint
20	Timers	Max MWUP= *90 Min*	Maximum Morning Warm-Up Time

On mixed air units, morning warm-up operation occurs just after the recirculation state when the Control Temperature is less than the zone heating setpoint minus the zone heating dead band.

Morning Warm-up is similar to the Heating state; the only difference is that the outside air dampers are held shut during Morning Warm-up. The unit will remain in the Morning Warm-up state until either the Control Temperature equals the zone heating setpoint or the duration of morning warm-up operation exceeds the maximum morning warm-up time setting (default is 90 minutes), whichever happens first. In either case, since the Control Temperature will not have risen above the zone heating setpoint by more than the zone heating dead band when this occurs, the controller will enter the Heating state.

The maximum morning warm-up time parameter is provided to ensure that the required minimum ventilation air is being supplied after a known time regardless of the space temperature. For example, if actual occupancy is at 8:00 a.m. and unit start-up is scheduled for 6:30 a.m., a maximum morning warm-up time setting of 90 minutes would ensure that the outside air dampers open to minimum position when building occupancy occurs.

Discharge Air Low Limit Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
14	Htg Control	Fan On Htg= *60*	Fan On Heating Setpoint
		Fan-On Htg= *No*	Fan On Heating No/Yes
		Dead Band= *1°F*	Fan On Dead Band

If heating is enabled (menu 8) and there is no zone heating load (Fan On state)and Fan On Htg = Yes, the controller will activate the unit's electric heating equipment as required to prevent the discharge air temperature from becoming too cool. If it falls below the cooling SAT setpoint by more than the Discharge Air Heating dead band, the operating state will change from Fan On to Fan On-Heating. If the discharge air temperature rises above the cooling SAT setpoint by more than the Discharge Air Heating dead band when at stage 0, the controller will leave the Fan On-Heating state and enter Fan On. Stage timers also apply except for stage 0 to stage 1. Fan On-Heating temperature control is similar to that described above for the heating states. The difference is that the staging action is controlled by the discharge air temperature parameters instead of the zone temperature parameters.

Fan On-Heating is very useful for mixed air applications that require larger amounts of minimum outside air to accommodate, for example, indoor air quality requirements. If the outdoor air temperature is very cold, the mixed air temperature could become unacceptably cold in these units. Because the economizer dampers maintain their minimum position during Fan On-Heating, minimum ventilation requirements are never violated. Fan On-Heating is essential for 100% outdoor air applications in cold climates.

Heating: Modulating with Zone Control

Temperature Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
12	Heat/Cool	Heating spt= *68°F*	Zone Heating Setpoint
		Htg Dead Band= *1°F*	Zone Heating Dead Band
		Htg PA= *8 Min*	Heating PA Time
		Mod Limit= *10°F*	Setpoint Mod Limit
		Wait Time= *1 Min*	Setpoint Wait Time
		Max Step= *10%*	Setpoint Max Step
14	Htg Control	Setpoint=*100°F*	Supply air heating Setpoint
		Min Spt= *60°F*	Minimum Supply air heating Setpoint
		Max Spt= *120°F*	Maximum Supply air heating Setpoint
		Stg Timer= *5 Min*	Heating Interstage Time
		Dead Band= *1°F*	Supply air heating Dead Band
		Mod Limit= *60°F*	Supply air heating Mod Limit
		Wait Time= *30 Sec*	Supply air heating Wait Time
		Max Step= *30 Sec*	Supply air heating Max Step
		PA Timer = *60 Sec*	Project Ahead Timer

If heating is enabled (see note below) and there is a zone heating load, the controller will activate the unit's modulating heating equipment as it enters the Morning Warm-up, Heating, or Unoccupied Heating state. This will occur when the Control Temperature is below the zone heating setpoint by more than the zone heating dead band value. Following is a description of operation.

Modulating heating is controlled in a two-part process that constitutes a "cascade" control loop. In one part of the process, the Change function calculates a Discharge Air Heating setpoint based on the deviation of the Control Temperature from the zone heating setpoint. In the other part of the process, the Step-and-Wait function modulates the heating output as required to maintain the discharge air temperature at the current Discharge Air Heating setpoint. Note that the controller always sets the Discharge Air Heating setpoint. You can display it, but the controller will not let you change it.

Note: You can determine whether heating operation is enabled by displaying the heating status state (menu 8). If it is "Heating Allowed," heating is enabled.

Change Process

Before heating control is activated (Start-up Initialization, Fan On, or Recirculate state), the controller sets the Discharge Air Heating setpoint equal to the current discharge air temperature (menu 2) if the discharge air temperature is within the range defined by the minimum and maximum Discharge Air Heating setpoints. If the discharge air temperature is outside this range, the Discharge Air Heating setpoint is set equal to the minimum or maximum Discharge Air Heating setpoint.

When heating control is activated, the Change function starts periodically adjusting the Discharge Air Heating setpoint in response to the Control Temperature's deviation from the zone heating setpoint. If the Control Temperature is less than the zone heating setpoint by more than the zone heating dead band, the Discharge Air Heating setpoint is raised slightly. If the Control Temperature is greater than the zone heating setpoint by more than the zone heating dead band, the Discharge Air Heating setpoint is lowered slightly. If the Control Temperature is within the range above and below the zone heating setpoint defined by the zone heating dead band, the Discharge Air Heating setpoint is held constant. Regardless of the zone heating load, the Change function will not be allowed to adjust the Discharge Air Heating setpoint outside the range defined by the minimum and maximum Discharge Air Heating setpoints.

The Change function uses four parameters: (1) zone heating dead band, (2) setpoint mod limit, (3) setpoint wait time, and (4) setpoint max step. For most applications, the default values for these parameters will provide the best control. For more information, see the "Change Algorithm" section in the "MicroTech Control Features" portion of this manual.

Note: The controller will not allow you to set the minimum Discharge Air Heating setpoint above the zone heating setpoint. This restriction will ensure better zone temperature control during heating operation.

Project Ahead
The Project Ahead algorithm works to prevent the Control Temperature from overshooting the zone heating setpoint during periods in which the space temperature is changing. Using the heating PA time parameter, the controller anticipates what the Control Temperature will be if it continues to change at its current rate. The controller uses this anticipated Control Temperature as the input to its heating control processes. The result is that the heating output is increased or decreased early enough to avoid Control Temperature overshoot. For most applications, the default heating PA time value will provide the best control. See the "Project Ahead Algorithm" section in the "MicroTech Control Features" portion of this manual for more information.

Step-and-Wait Process: Valve Controlled Hot Water
When heating is operational (Morning Warm-up, Heating, or Unoccupied Heating state), the controller modulates the heating valve as required to maintain the current Discharge Air Heating setpoint. To do this it uses four Step-and-Wait parameters that are dedicated to heating temperature control: (1) Discharge Air Heating dead band, (2) Discharge Air Heating mod limit, (3) Discharge Air Heating wait time, and (4) Discharge Air Heating max step. For most applications, the default values for these parameters will provide the best control. For more information, see the "Step-and-Wait Algorithm" section in the "MicroTech Control Features" portion of this manual.

If the Step-and-Wait function fully closes the heating valve during occupied periods, the controller will leave the Heating state and enter Fan On. This can only happen if the Control Temperature is greater than the zone heating setpoint by more than the zone heating dead band. (To determine whether the valve is closed, the controller compares the stroking open time with the stroking closed time.)

Note: The heating interstage timer is ignored when modulating hot water heat is used.

PA Time
Use of the Project Ahead Time or PA Time improves control by reducing overshoot when the measured variable must be changed to maintain the desired setpoint. The PA Time does this by modifying the action of the Step and Wait function so that control is based on what the value of the measured variable will be after the PA time has passed instead of what it is now. Use of such a Project Ahead Time for control stops the valve from opening or closing when it is rapidly approaching the setpoint. It also allows the position of the valve to start responding in the opposite direction before the measured variable passes through the dead band. This combination of normal Step and Wait parameters and a Project Ahead Time provides Proportional/Integral or PI control.

High Ambient Heating Lockout

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
14	Htg Control	Max OAT= *55°F*	High Ambient Heating Lockout Setpoint
–		–	High Ambient Heating Lockout Differential

Heating will be disabled whenever the outdoor air temperature is greater than or equal to the high ambient heating lockout setpoint. When this occurs, the heating status state will be "Off-OAT Lockout" if heating is not disabled for some other reason. When the outdoor air temperature drops below the high ambient heating lockout setpoint by more than the high ambient heating lockout differential, heating operation will be enabled again. The default value of this differential is 3°F (PC adjustable only).

Morning Warm-Up Control

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
12	Heat/Cool	Heating spt= *68°F*	Zone Heating Setpoint
20	Timers	Max MWUP= *90 Min*	Maximum Morning Warm-Up Time

On mixed air units , morning warm-up operation occurs just after the recirculation state when the Control Temperature is less than the zone heating setpoint minus the zone heating dead band.

Morning Warm-up is similar to the Heating state; the only difference is that the outside air dampers are held shut during Morning Warm-up. The unit will remain in the Morning Warm-up state until either the Control Temperature equals the zone heating setpoint or the duration of morning warm-up operation exceeds the maximum morning warm-up time setting (default is 90 minutes), whichever happens first. In either case, since the Control Temperature will not have risen above the zone heating setpoint by more than the zone heating dead band when this occurs, the controller will enter the Heating state.

The maximum morning warm-up time parameter is provided to ensure that the required minimum ventilation air is being supplied after a known time regardless of the space temperature. For example, if actual occupancy is at 8:00 a.m. and unit start-up is scheduled for 6:30 a.m., a maximum morning warm-up time setting of 90 minutes would ensure that the outside air dampers open to minimum position when building occupancy occurs.

Discharge Air Low Limit Control

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
14	Htg Control	Fan-On Htg= *No*	Fan On Heating No/Yes
		Dead Band= *1°F*	Fan On Dead Band

If heating is enabled (menu 8) and there is no zone heating load (Fan On state) and Fan -On Heating = Yes, the controller will activate the unit's modulating heating equipment as required to prevent the discharge air temperature from becoming too cool. If it falls below the Fan On Heating setpoint by more than the Discharge Air Heating dead band, the operating state will change from Fan On to Fan On-Heating. If the heating valve is closed and the discharge air temperature rises above the cooling SAT setpoint, the controller will leave the Fan On-Heating state and enter Fan On. Except for the discharge air setpoint used, Fan On-Heating temperature control is similar to that described above for the heating states.

Fan On-Heating is very useful for mixed air applications that require larger amounts of minimum outside air to accommodate, for example, indoor air quality requirements. If the outdoor air temperature is very cold, the mixed air temperature could become unacceptably cold in these units. Because the economizer dampers maintain their minimum position during Fan On-Heating, minimum ventilation requirements are never violated. Fan On-Heating is essential for 100% outdoor air applications in cold climates.

Heating Control for Units with SAT Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
14	Htg Control	Setpoint= *100°F*	Discharge Air Heating Setpoint
		Min Spt= *60°F*	Minimum Discharge Air Heating Setpoint
		Max Spt= *120°F*	Maximum Discharge Air Heating Setpoint
		Reset= *No Reset*	Heating Reset Type
		Min Spt @ *60°F*	Reset Sensor Minimum Heating Setpoint
		Max Spt @ *20°F*	Reset Sensor Maximum Heating Setpoint

The unit enters the morning warm-up or heating states if the control temperature drops below the heating zone setpoint by more than the heating zone dead band and the Discharge Air Temp < SAT Htg Setpoint - SAT Heating Dead Band. The unit leaves heating state if the control temperature rises above the heating zone setpoint by more than the heating zone dead band.

In the morning warm-up or heating states, heating is controlled to maintain the discharge air temperature at the SAT heating setpoint. This setpoint may be fixed or reset based on the space temperature, the return air temperature, the outside air temperature, or an external signal at analog input # 15. The control temperature that indicates the condition of the zone is used to determine when heating is required. The desired space conditions are maintained by external devices such as VAV boxes. The unit may be a constant volume unit, but it is normally a variable air volume unit.

Heat also is controlled to raise the discharge air temperature to an acceptable level when the zone does not require heat if the user has selected fan on heating = yes. Heat is controlled to maintain the discharge air temperature at the current SAT cooling setpoint.

Staged Heating Control

One or two heating outputs, 11 and 12, control one or two electric heat stages. The number of stages normally does not change unless the time since the last stage change exceeds the heat stage timer, but there are three exceptions.

- The unit will transition from stage 0 to stage 1 before the stage timer expires in either heating or fan on heating if the discharge air temperature drops below an acceptable level and the user has selected fan on heating = yes.
- The heat stage timer is set to zero before heat is turned on so that the unit moves rapidly through heating stage 0 to heating stage 1.
- If heat is disabled or the control temperature rises above the heating zone setpoint by more than the dead band, the heating is staged off rapidly without regard to the stage timer. The unit remains in the morning warm-up state at stage 0. The unit reverts from heating to the fan on state.

In either the heating or morning warm-up state, the number of heating stages decreases when the stage timer has expired and the discharge air temperature exceeds the SAT heating setpoint by more than the SAT heating dead band. If the unit is in heating stage zero and the discharge air temperature exceeds the applicable setpoint by more than its dead band after the stage time, the unit leaves the heating or fan on heating state.

In either the heating or morning warm-up state, the number of heating stages increases when the stage timer has expired and the discharge air temperature is below the SAT heating setpoint by more than the SAT heating dead band.

In the fan on heating state, the stages of electric heat are controlled to maintain the current SAT cooling setpoint as described below.

The number of electric heat stages increases if both of the following are true:

- The time since the last stage change exceeds the stage timer or the number of heating stages equals zero.
- The discharge air temperature is below the SAT cooling set point by more than the SAT heating dead band.

The number of electric heat stages decreases when both of the following are true:

- The time since the last stage change exceeds the stage timer.
- The discharge air temperature exceeds the applicable minimum setpoint by more than the SAT heating dead band.

Modulating Hot Water Control

The two heating outputs, 11 and 12, close and open a modulating valve. In the morning warm-up or a heating state, the actuator for the modulating hot water valve is controlled to maintain the discharge air temperature at the SAT heating setpoint using the step and wait function. In the fan on heating state the SAT cooling setpoint is maintained instead. The step and wait function is modified with a project ahead feature to reduce overshoot of either the SAT heating setpoint or the fan on heating setpoint.

If the discharge air temperature exceeds the SAT heating setpoint by more than its dead band after the heating valve has been in the closed position for the heating stage time, the unit leaves the heating or fan on heating state.

The heating valve is considered to be closed when the heat valve open timer equals zero. The heat valve open timer is the net time that the valve is driven open. If an open signal is sent to the actuator, that time is added to the heat valve open timer. Similarly, when a close signal is sent to the actuator, that time is subtracted from the heat valve open timer.

Temperature Control

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
14	Htg Control	Setpoint= *100°F*	Discharge Air Heating Setpoint
		Stg Timer= *5 Min*	Heating Interstage Timer
		Dead Band= *1°F*	Discharge Air Heating Dead Band
		Mod Limit= *30°F*	Discharge Air Heating Mod Limit
		Wait Time= *30 Sec*	Discharge Air Heating Wait Time
		Max Step= *60 Sec*	Discharge Air Heating Max Step
		PA Time= *60 Sec*	Project Ahead Timer

If heating is enabled (see note below) and there is a heating load, the controller will activate the unit's modulating heating equipment. During occupied periods, the operating state will be either Morning Warm-up or Heating. During unoccupied periods, the operating state will be Unoccupied Heating. When this occurs, the VAV/Heat output will open. The open VAV/Heat output can be used to signal heat/cool VAV boxes that the unit is supplying heat.

When heating is required, the controller will modulate the heat output as required to maintain the current discharge air heating setpoint. To do this it uses four Step-and-Wait parameters that are dedicated to discharge air heating temperature control: (1) discharge air heating dead band, (2) discharge air heating mod limit, (3) discharge air heating wait time, and (4) discharge air heating max step. These step and wait function are modified with a project ahead feature to reduce overshoot of either the SAT heating setpoint or the fan on heating setpoint. For most applications, the default values for these parameters will provide the best control. For more information, see the "Step-and-Wait Algorithm" and "PA Time" sections in the "MicroTech Control Features" portion of this manual.

Note: You can determine whether heating operation is enabled by displaying the heating status state (menu 8). If it is "Heating Allowed," heating partially is enabled. Heating operation is further enabled by the Control Temperature. See the "Heat/Cool Changeover" section for more information.

Note: You can either enter a fixed discharge air heating setpoint or allow the controller to reset it automatically. See "Setpoint Reset" below for more information.

Hot Water or Steam: Valve Control

Modulating hot water or steam heating is actually a two-stage process. During "stage 1" operation, the valve modulates as required to maintain the discharge air heating setpoint. During "stage 0" operation, the valve is continuously driven closed, but the controller remains in the heating state.

A stage change can only occur (1) after the heating interstage timer has expired and (2) if the discharge air temperature is above or below the discharge air heating setpoint by more than the discharge air heating dead band. After any stage change occurs, the heating interstage timer starts timing.

There is one additional constraint that applies to the stage-down transition from stage 1 to stage 0: The valve must be fully closed before the stage-down can occur. (To determine whether the valve is closed, the controller compares the stroking open time with the stroking closed time.)

Note: A stage-down transition from stage 0 would cause the controller to leave the heating state. However, because the discharge air heating setpoint is typically set well above the mixed air temperature, this normally will not occur. Usually, the controller will leave the heating state because the overall heating load is satisfied. When this occurs during occupied periods, the controller will enter Fan On state. See "Discharge Air Low Limit Control" below for more information on Fan On-Heating.

High Ambient Heating Lockout

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
14	Htg Control	Max OAT= *55°F*	High Ambient Heating Lockout Setpoint
-	-	-	High Ambient Heating Lockout Differential

Heating will be disabled whenever the outdoor air temperature rises above to the high ambient heating lockout setpoint. When this occurs, the heating status state will be "Off-OAT Lockout" if heating is not disabled for some other reason. When the outdoor air temperature drops below the high ambient heating lockout setpoint by more than the high ambient heating lockout differential, heating operation will be enabled again. The default value of this differential is 3°F (PC adjustable only).

Setpoint Reset

Programmable Parameters

Keypad/Display ID			Parameter Name
Menu		Item	
14	Htg Control	Setpoint= *100°F*	Discharge Air Heating Setpoint
		Min Spt= *60°F*	Minimum Discharge Air Heating Setpoint
		Max Spt= *120°F*	Maximum Discharge Air Heating Setpoint
		Reset= *No Reset*	Heating Reset Type
		Min Spt @ *69°F*	Reset Sensor Minimum Heating Setpoint
		Max Spt @ *64°F*	Reset Sensor Maximum Heating Setpoint

By automatically varying the discharge air temperature to suit the building's heating load, discharge air temperature reset can make some VAV systems more energy efficient. A variety of reset strategies are available (some require field wiring). Because they are programmable, you can change or eliminate reset strategies as desired.

When a reset strategy is operational, it will automatically change the discharge air heating setpoint as required. You can display the current setpoint, but the controller will not let you change it. If you do not want reset, set the heating reset type to "No Reset" (default). The controller will then allow you to enter a fixed discharge air heating setpoint.

The following discharge air heating reset methods are available:

- Space temperature
- Return air temperature
- Outdoor air temperature
- External 1-5 VDC or 4-20 mA signal

Regardless of the reset method, the minimum discharge air heating setpoint and maximum discharge air heating setpoint define the range of possible discharge air setpoints.

Reset from a Temperature Sensor

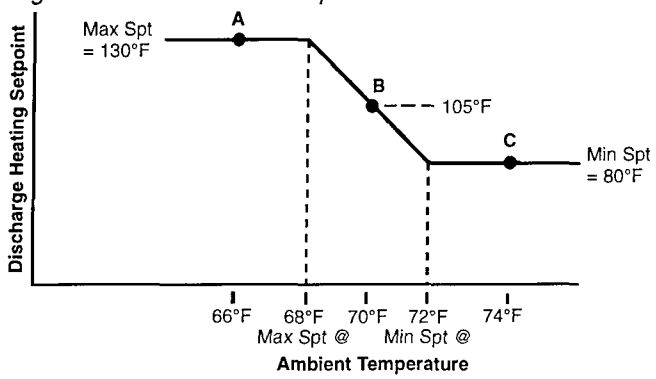
The discharge air heating setpoint can be reset in response to three temperature sensors: space, return air, or outdoor air. When any of these methods is used, the current discharge air heating setpoint is determined by the current temperature at the selected reset sensor. This reset action is illustrated in Figure 14. (The space temperature reset method is shown.)

When the temperature at the selected reset sensor is greater than or equal to the reset sensor minimum heating setpoint ("Min Spt @"), the current discharge air heating setpoint will equal the minimum discharge air heating setpoint ("Min Spt="). Point C in Figure 14 exemplifies this.

When the temperature at the selected reset sensor is less than or equal to the reset sensor maximum heating setpoint ("Max Spt @"), the current discharge air heating setpoint will equal the maximum discharge air heating setpoint ("Max Spt ="). Point A in Figure 14 exemplifies this.

When the temperature at the selected reset sensor is between the reset sensor minimum and maximum heating setpoints ("Min Spt @" and "Max Spt @"), the current discharge air heating setpoint will vary linearly between the minimum and maximum discharge air heating setpoints ("Min Spt=" and "Max Spt="). Point B in Figure 14 exemplifies this.

Figure 14. Reset from a Temperature Sensor



Note: To use the space temperature or outdoor air reset method, a zone temperature sensor or OAT sensor must be field installed and connected to the unit controller.

Reset from an External Signal

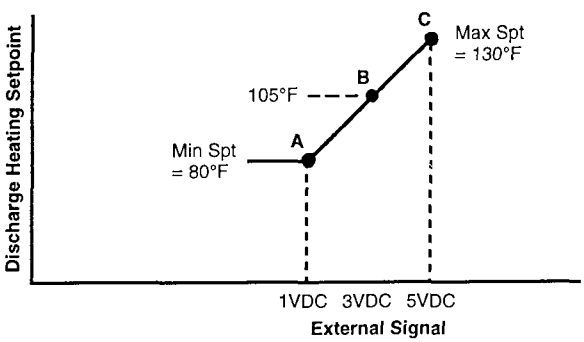
The discharge air heating setpoint can be reset in response to an external signal. When this method is used, an external 1-5 VDC (or 4-20mA) signal controls the current discharge air heating setpoint. The reset sensor minimum and maximum heating setpoints are not used. This reset action is illustrated in Figure 15.

When the external signal is 1 VDC (not adjustable), the current discharge air heating setpoint will equal the minimum discharge air heating setpoint ("Min Spt="). Point A in Figure 15 exemplifies this.

When the external signal is 5 VDC (not adjustable), the current discharge air heating setpoint will equal the maximum discharge air heating setpoint ("Max Spt="). Point C in Figure 15 exemplifies this.

When the external signal is between 1 and 5 VDC, the current discharge air heating setpoint will vary linearly between the minimum discharge air heating setpoint and maximum discharge air heating setpoint ("Min Spt=" and "Max Spt="). Point B in Figure 15 exemplifies this.

Figure 15. Reset from an External Signal



Note: To use the external signal reset method, an external 1-5 VDC or 4-20mA signal must be connected to the unit controller. For more information, see the "Field Wiring" portion of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller.

Note that in an Open Protocol network, the discharge air heating setpoint can be directly set by the building automation system. In this case, the heating reset type parameter must be set to "No Reset" (default).

Morning Warm-Up Control

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
12	Heat/Cool	Heating Spt= *68°F*	Heating Enable Setpoint
20	Timers	Max MWUP= *90 Min*	Maximum Morning Warm-up Time

Mixed Air morning warm-up operation occurs just after the recirculation state when the Control Temperature is less than the heating enable setpoint. If this is the case, the unit controller will enter the Morning Warm-up operating state after Recirculate.

Morning Warm-up is similar to the Heating state; the only difference is that the outside air dampers are held shut during Morning Warm-up. The unit will remain in the Morning Warm-Up state until either the Control Temperature equals the heating enable setpoint or the duration of morning warm-up operation exceeds the maximum morning warm-up time setting (default is 90 minutes), whichever happens first. In either case, since the Control Temperature will not have risen above the heating enable setpoint by more than the heating enable dead band when this occurs, the controller will enter the Heating state if Heat is enabled. Otherwise the unit will enter Fan On.

The maximum morning warm-up time parameter is provided to ensure that the required minimum ventilation air is being supplied after a known time regardless of the space temperature. For example, if actual occupancy is at 8:00 a.m. and unit start-up is scheduled for 6:30 a.m., a maximum morning warm-up time setting of 90 minutes would ensure that the outside air dampers open to minimum position when building occupancy occurs.

Discharge Air Low Limit Control

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
13	Clg Control	Setpoint= *55°F*	Supply air Cooling Setpoint
		Dead Band= *1°F*	Supply air Cooling Dead band

If heating is enabled (menu 8) and there is no heating load, the controller will activate the unit's modulating heating equipment as required to prevent the discharge air temperature from becoming too cool. If it falls below the current discharge air cooling setpoint by more than the discharge air cooling dead band, the operating state will change from Fan On to Fan On-Heating. Because there is no actual overall heating load, the VAV/Heat output (K6) will remain closed (auto) during Fan On-Heating. The closed VAV/Heat output can be used to signal heat/cool VAV boxes that the unit is supplying cool air. Except for the discharge air setpoint used, Fan On-Heating temperature control is identical to that described above for the heating states.

Fan On-Heating is very useful for applications that require larger amounts of minimum outside air to accommodate, for example, indoor air quality requirements. For a unit with SAT cooling control, heat is controlled to maintain the

discharge air temperature at the current SAT cooling setpoint if the user has selected fan on heating = yes. If the outdoor air temperature is very cold, the mixed air temperature could become unacceptably cold in these units. Because the economizer dampers maintain their minimum position during Fan On-Heating, minimum ventilation requirements are never violated.

Supply Fan Airflow

Static Pressure Control

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
17	Duct Pressure	Duct Spt= *1.00"WC*	Duct Static Pressure Setpoint
		Dead Band= *0.08"WC*	Duct Pressure Dead Band
		Mod Lim= *0.040"WC*	Duct Pressure Mod Limit
		Wait Time= *20 Ten*	Duct Pressure Wait Time
		Max Step= *20 Ten*	Duct Pressure Max Step

Except during the Post Heat state (see below), the controller will modulate the supply fan airflow as required to maintain the current duct static pressure setpoint whenever the fans are on. To do this it uses four Step-and-Wait parameters that are dedicated to duct static pressure control: duct pressure dead band, duct pressure mod limit, duct pressure wait time, and duct pressure max step. For most applications, the default values for these parameters will provide the best control. For more information, see the "Step-and-Wait Algorithm" section in the "MicroTech Control Features" portion of this manual.

Applications with Two Pressure Sensors
On units that use cooling only, a second duct static pressure sensor is optional. If a second sensor is connected, the controller will automatically select the lower of the two sensed pressures and use this value to control the supply fan airflow. On larger buildings, this strategy can be used to assure that adequate static pressure is available throughout the VAV system.

Setpoint Reset

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
18	Duct Pressure	Duct Spt= *1.00"WC*	Duct Static Pressure Setpoint
		Max Spt= *2.00"WC*	Maximum Duct Static Pressure Setpoint
		Reset= *No Reset*	Duct Pressure Reset Type

Note that in an Open Protocol network, the duct static pressure setpoint can be directly set by the building automation system. In this case, the duct pressure reset type parameter must be set to "No Reset" (default).

Multiple Unit Applications (Position Reset)
Common duct static pressure control for multiple unit applications is available with the optional Remote Monitoring and Control (RMC) Panel. To use this control strategy, you must select "Position" as the duct pressure reset type at each unit controller in the group. The RMC Panel's controller will then perform the control process using the conditioned duct static pressure values received from each unit controller in the group. After each process execution, the RMC controller will write the same supply fan inlet vane position to each unit controller. Each unit controller will then control its supply vanes to that position. Note that the unit controller's duct static pressure setpoint is not used in this strategy. However, if communications are ever interrupted, the affected unit controllers will use their own duct static pressure setpoints. Therefore, you should set each unit controller's setpoint so that it matches the others in the group. The maximum duct static pressure setpoint is not used. For more information, see Bulletin No. IM 444, MicroTech Self-contained Air Conditioning Remote Monitoring and Control Panel.

Post Heat (VIV only)

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
-	-	-	Post Heat Timer

On cooling only units or units with staged heating equipment the unit controller will enter the Post Heat operating state after leaving the Recirculate, Heating, or Unoccupied Heating state. During Post Heat, the VAV/Heat output remains open while the supply fan inlet vanes are forced to a minimum position (17% open, fixed). By forcing the supply vanes to their minimum position before the VAV/Heat output closes, Post Heat eliminates the possibility of duct overpressurization because the duct pressure drops before the VAV boxes can close off.

The Post Heat state lasts until either the supply fan inlet vanes reach their minimum position or the post heat timer expires, whichever happens first. The post heat timer's default setting is three minutes It starts timing when the controller enters Post Heat. When Post Heat is over, normal duct static pressure control will resume.

Unoccupied Control

Heating (Night Setback)

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
16	Unocc Htg/Clg	Heating Spt= *55°F*	Night Setback Setpoint
-	Unocc Htg/Clg	Htg Diff= *3°F* -	Night Setback Differential

If a zone temperature sensor is connected to the controller, night setback heating control is available regardless of whether the heating equipment is factory equipped or field installed in the ductwork. Following is a description of operation.

If the zone temperature falls to night setback setpoint when the unit is in the Off-Unoccupied state, the unit will start-up and run. The controller will enter the Unoccupied Heating state after Recirculate.

When the zone temperature rises above the night setback setpoint by more than the night setback differential, the controller will shut down the fans and return to the Off-Unoccupied state. The default value of this differential is 3°F.

After the unit is started, heating equipment control during night setback heating operation is similar to that during occupied operation. However, since the Control Temperature is likely well below the heating enable setpoint (menu 12), heating is enabled and disabled only by the zone temperature.

Emergency Occupied Mode (N/A for 100% Outdoor Air Units)

If the zone temperature sensor fails during the Off-Unoccupied state when the outdoor air temperature is below 40°F and the night setback setpoint is set above 40°F, the unit will start and operate in an emergency occupied mode. During this mode, the controller will operate just like it does during occupied; however, the return air sensor will be used as the Control Temperature sensor. If the outdoor air temperature rises above 40°F or if the Zone Sensor Prob alarm clears, the emergency occupied mode will end.

If desired, you can disable the emergency occupied mode by setting the night setback setpoint to 40°F.

Cooling (Night Setup)

Programmable Parameters

Keypad/Display ID			Parameter
Menu		Item	Name
16	Unocc Htg/Clg	*Cooling Spt= 85°F*	Night Setup Setpoint
-	-	-	Night Setup Differential

If a zone temperature sensor is connected to the controller, night setup cooling control is available. Following is a description of operation.

If the zone temperature rises to night setup setpoint when the unit is in the Off-Unoccupied state, the unit will start-up and run. If the unit has an economizer and free cooling is available, the controller will enter the Unoccupied Economizer state after Recirculate. Note that there is no minimum outside air damper position control during the Unoccupied Economizer state.

If economizer is either not available or not cool enough to maintain the current discharge air cooling setpoint, the controller will activate mechanical cooling as it enters the Unoccupied Cooling state. If free cooling is available, the economizer will be wide open during Unoccupied Cooling. If free cooling is not available, the economizer will be fully closed during Unoccupied Cooling.

When the zone temperature drops below the night setup setpoint by more than the night setup differential, the controller will shut down the fans and return to the Off-Unoccupied state. The default value of this differential is 3°F.

After the unit is started, cooling equipment control during night setup cooling operation is similar to that during occupied operation. However, since the Control Temperature is likely well above the cooling enable setpoint (menu 12), cooling is enabled and disabled only by the zone temperature. For more information, see the "Economizer" and "Cooling: Multistage" or "Cooling: Modulating" sections, as applicable.

Head Pressure Control

Programmable Parameter

Keypad/Display ID			
Menu		Item	
19	Head Pressure	Setpoint=	*160 psi*
		Dead Band=	*10 psi*
		Mod Limit=	*30 psi*
		Wait Limit=	*10 Sec*
		Max Step=	*10 Sec*

A water regulating valve (WRV) modulates the flow to the condenser in response to a refrigerant pressure signal from circuit #1 at Input # 15. Output 16 closes the WRV when the pressure gets too low and output 17 opens the WRV when the pressure gets too high. The WRV function operates only when circuit #1 is on. With circuit #1 down, compressor operation is allowed for remaining circuits without head pressure control if condenser water temperature is below 55°F Head pressure control is only provided on units that do not have a waterside economizer and do not have an External Reset.

Building Static Pressure Control

Programmable Parameter

Keypad/Display ID			
Menu		Item	
17	Bldg Pressure	Zone Spt=	*0.050"WC*
		Min Pos=	*60 %*
		Min Speed=	*60 %*
		Deadbd=	*0.008"WC*
		Mod Lim=	*0.040"WC*
		Wait Time=	*20 Ten*
		Max Step=	*20 Ten*

This feature is provided primarily to maintain building static pressure for 100% outside air units with variable exhaust. The variable inlet vanes (inverters) is controlled based on Building Static pressure instead of Duct Pressure. The building static pressure sensor input replaces the first duct static pressure sensor input. Step and Wait is used to control the variable inlet vanes (inverters). When the building static pressure gets too low, the variable inlet vanes (inverters) are open (speeded up). When the building static pressure gets too high, the vanes (inverters) are closed (slowed down). Regardless of the operating state, the controller will modulate the fan airflow as required to maintain the current zone static pressure setpoint whenever the fan is on. To do this it

uses four Step-and-Wait parameters that are dedicated to building static pressure control: (1) dead band, (2) mod limit, (3) wait time, and (4) max step. For most applications, the default values for these parameters will provide the best control. The result is that proper building pressure is maintained regardless of the building cooling load, varying outside air intake, or varying exhaust. For more information, see the "Step-and-Wait Algorithm" section in the "MicroTech Control Features" portion of this manual.

Optimal Start

Programmable Parameter

Keypad/Display ID			
Menu		Item	
23	Optimal Start	Opt Start=	*Off*
		Auto Update=	*Yes*
		Ht Rate=	*0.400 °F/M*
		Heat OAT=	*35 °F*
		Ht Factor=	*25 Min*
		Cl Rate=	*0.400 °F/M*
		Cool OAT=	*85 °F*
		Cl Factor=	*25 Min*

When Optimal Start is turned on, the number of minutes until startup is calculated before each scheduled start. The software uses the start history, outdoor air temperature, and space temperature to determine when the unit should start. It may start up to four hours before the scheduled start time. If the control temperature is below the heating setpoint by more than the dead band, Optimal Start will be based on the Heating parameters found in keypad menu #23. If the control temperature exceeds the cooling setpoint by more than the dead band, Optimal start will be based on the Cooling parameters. Startup occurs at the scheduled start time if the Control temperature is in between those limits.

When heating is required, a heating rate that varies with the outside air temperature is calculated based on the following formula:

Calculated Heating Rate = Ht Rate + (OAT - Heat OAT) / Heat Factor

The minutes to occupancy are calculated by dividing the difference between the heating setpoint and the space temperature by the Calculated Heating Rate.

Cooling operation is similar. The formula is:

Calculated Cooling Rate = Cl Rate - (OAT - Cool OAT) / Cool Factor

The minutes to occupancy are calculated by dividing the difference between the cooling setpoint and the space temperature by the Calculated Cooling Rate. If the user selects Auto Update, the parameters will be revised after each start in which they are used and the temperature change is significant.

Dehumidification

Programmable Parameter

Keypad/Display ID			
Menu		Item	
19	Humidity Ctrl	Control=	*None*
		Enabled=	*Occupied*
		Sensor=	*Return*
		Timer=	*10 Min*
		Humidity Spt=	*50 %*
		Humidity Db=	*2 %*
		DewPt Spt=	*50°F*
		DewPt DB=	*2°F*
		Min Stages=	*2*
		Max Stages=	*4*

The dehumidification function is available on all units to reduce the humidity in the space by cooling the discharge air low enough to wring moisture out of it and to reheat the discharge air to maintain the desired temperature.

An analog sensor is mounted in either the space or return duct to sense Relative Humidity. The sensor is connected to input #15 so dehumidification can not be used with either External Reset or Head Pressure Control. The Relative Humidity and a calculated Dewpoint are both displayed on keypad menu #10. Either may be used for control.

Dehumidification operation is initiated when Humidity Control is set to either Relative Humidity or Dewpoint and that value rises above the corresponding setpoint by more than its dead band. Humidity control is disabled if cooling is disabled or if heating is disabled for any reason except high OAT. A unit in the unoccupied state will be started when Dehumidification is initiated only if the Enabled= entry on the keypad is set to Always.

During Dehumidification, economizer operation is disabled. During Dehumidification, the heaters are controlled normally to maintain acceptable Discharge Air and Space Temperature conditions. The Fan On Hts feature is enabled automatically so that the heaters will be controlled to maintain the Fan On Heating setpoint if the Discharge Air gets too cold.

When Dehumidification is initiated during any state other then Mechanical Cooling, the number of compressors is controlled to minimum stages then increased to the maximum number of stages if the relative humidity or dewpoint stays above the setpoint by more than the dead band for more than the Cooling Timer. The number of compressors decreases to the minimum number of stages if the relative humidity or dewpoint drops below the setpoint by more than the dead band. Dehumidification terminates if the relative humidity or dewpoint drops below the setpoint by more than the dead band and the unit has been operating at the minimum number of stages for more than the Cooling Timer.

When Dehumidification is initiated during Mechanical Cooling, operation is similar to that described above except that the number of stages of cooling is set to the maximum number of stages if the number of cooling stages prior to dehumidification equal or exceeds the minimum number of dehumidification stages. When Dehumidification terminates, the number of cooling stages is set to whatever it was when the unit entered dehumidification.

Alarm Control

Following are descriptions of the various alarms that could occur in CAV-ZTC self-contained units. Note that some alarms are detected by optional equipment; for example, the freezestat or smoke detectors. If the unit is not equipped with the optional control, the associated alarm cannot occur.

Note: The cause of a manual reset alarm should be investigated and eliminated before the unit or any disabled equipment in it is placed back into service.

Faults

Freeze Shutdown
The Freeze Shutdown alarm will occur whenever the optional freezestat's (FS1) contacts open as a result of detecting an abnormally low water coil temperature when the fan has been running for more than 60 sec.

If the Freeze Shutdown alarm occurs, the MicroTech controller will shut down the fans, close the outdoor air dampers, open the waterside economizer, open the chilled water and heating valves. The unit will remain shut down until the Freeze Shutdown alarm is manually cleared.

Smoke Shutdown
The Smoke Shutdown alarm will occur whenever the contacts of the optional smoke detector (SD1) open. If this alarm occurs, the unit will be immediately shut down. The unit will remain shut down until the smoke detector is manually reset and the Smoke Shutdown alarm is manually cleared.

To determine the locations of the smoke detectors, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Duct High Limit
The Duct High Limit alarm will occur whenever the contacts of the duct high pressure limit control (DHL) open. If this alarm occurs, the unit will be immediately shut down. The unit will remain shut down until the Duct High Limit alarm is manually cleared.

Zone Sensor Failure
If the zone temperature sensor (SPT1) fails while it is the selected Control Temperature source on a 100% outdoor air unit, the Zone Sensor Fail alarm will occur. As a result, the unit will be shut down. It will remain shut down until the Zone Sensor Fail alarm is manually cleared. The Zone Sensor Fail alarm cannot occur on a mixed air or 100% return air unit.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller.

Mixed Air Sensor Failure
If the Mixed air temperature sensor (MAT) fails while it is the selected Control Temperature source, the Mat Sensor Fail alarm will occur. As a result, the unit will be shut down. It will remain shut down until the Mat Sensor Fail alarm is manually cleared. Note that the unit can be quickly restarted by selecting another Control Temperature source before clearing the alarm.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the Mat sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Outdoor Air Sensor Failure
If the outdoor air temperature sensor (OAT) fails while it is the selected Control Temperature source, the OAT Sensor Fail alarm will occur. As a result, the unit will be shut down. It will remain shut down until the OAT Sensor Fail alarm is manually cleared. Note that the unit can be quickly restarted by selecting another Control Temperature source before clearing the alarm.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the RAT sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Return Air Sensor Failure
If the return air temperature sensor (RAT) fails while it is the selected Control Temperature source, the Ret Sensor Fail alarm will occur. As a result, the unit will be shut down. It will remain shut down until the Ret Sensor Fail alarm is manually cleared. Note that the unit can be quickly restarted by selecting another Control Temperature source before clearing the alarm.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the RAT sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Supply Air Sensor Failure
If the supply air temperature sensor (SAT) fails, the Sup Sensor Fail alarm will occur. As a result, the unit will be shut down. It will remain shut down until the Sup Sensor Fail alarm is manually cleared.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the SAT sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

High Return Temperature
If the return air temperature exceeds or equals the high return temperature limit setting (menu 15) while the unit is operational, the High Return Temp alarm will occur. As a result, the unit will be shut down. It will remain shut down until the High Return Temp alarm is manually cleared.

High Supply Temperature
If the discharge air temperature exceeds or equals the high supply temperature limit setting (menu 15) while the unit is operational, the High Supply Temp alarm will occur. As a result, the unit will be shut down. It will remain shut down until the High Supply Temp alarm is manually cleared.

Low Supply Temperature
If the discharge air temperature equals or drops below the low supply temperature limit setting (menu 15) while the unit is operational, the Low Supply Temp alarm will occur. As a result, the unit will be shut down. It will remain shut down until the Low Supply Temp alarm is manually cleared.

On mixed air or 100% return air units, this alarm will be prevented from occurring until after the recirculate timer expires (menu 20).

On 100% outdoor air units, this alarm will be prevented from occurring until after the low supply temperature alarm delay timer expires (menu 20).

Fan Failure
The Fan Failure Alarm will occur on units if any of the follow are true:
* Building Static Pressure Control: Airflow switch is open and supply fan has been turned on for longer than two minutes.
* Duct Static Pressure Control: Airflow switch is open and the duct static pressure is less than half of the duct static pressure setpoint and supply fan has been turned on for longer than two minutes.
* Dual Fan Motor: (1) low speed motor problem and high speed motor problem have both occurred and not been manually cleared or (2) the high speed motor problem is active and high speed operation is required due to low speed fan motor amps.

If the Fan Fail alarm occurs, the unit will be immediately shut down. It will remain shut down until the Fan Fail alarm is manually cleared.

The setting on pressure switch PC7 can be adjusted. To determine the location of PC7, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

OA Damper Stuck
Economizer position feedback indicates that the outside air dampers are less than 50% open at the end of the Start Initial period for units with 100% outside air control.

Supply Vane Stuck
The Variable Inlet Vanes feedback indicates that the Vanes are more than 25% open and the unit has been off for more than three minutes. As a result, the unit will be shut down. It will remain shut down until the Supply Vane Stuck alarm is manually cleared.

Problems

Freeze Problem
The Freeze Problem alarm will occur whenever the optional freezestat's (FS1) contacts close as a result of detecting an abnormally low water coil temperature while the fans are off.

If the Freeze Problem alarm occurs, the MicroTech controller will keep the fans off, keep the outdoor air dampers closed, open the waterside economizer, open the chilled water and heating valves.

Whenever the freezestat opens, the Freeze Problem alarm automatically clears. This feature protects the coil(s) and allows the system to start normally after a cold night.

High Speed Fan Problem
The High Speed Fan Problem will occur if no air flow is sensed after two minutes of operation. The unit is turned off and restarted normally except that it operates at low speed fan only. This alarm is manually cleared.

Low Speed Fan Problem
The Low Speed Fan Problem will occur if no air flow is sensed after two minutes of operation. The unit is turned off and restarted normally except that it operates at high speed fan only. This alarm is manually cleared.

Current Sensor Problem
The alarm occurs on dual motor units when the following three conditions exist for 30 seconds: 1.) Unit is in low speed motor operation, 2.) airflow switch = flow and 3.) Motor amp sensor reads zero amps.

As a result of the alarm the unit will only operate in High Speed until the alarm is manually cleared.

Cooling 6,5,4,3,2, or 1 Failure
The Cooling # Fail is caused be High Pressure, Low Pressure, or Frost switch in alarm position or a Motor Protector alarm (indicated by the compressor contactor being off while MicroTech calls for compressor to be on) or a Water Regulating Valve alarm. The Water Regulating Valve alarm is determined by a Head Pressure setpoint. If the Head Pressure remains below the edited Head Pressure setpoint by more than the dead band for more than 180 seconds while compressor # 1 is on, compressors are disabled by the Water Regulating Valve alarm. The highest priority alarm condition that exists for each compressor is displayed on the Keypad and monitor screens even if a compressor alarm is not the current active alarm. The alarm priority is High Pressure (highest), Water Regulating Valve, Frost, Low Pressure, Motor Protector (lowest). The affected compressor is disabled by MicroTech. Another compressor is not brought on automatically to replace the compressor. The next compressor is brought on only if required by normal staging method. The disabled compressor is skipped as the number of stages increases and decreases so that a change in cooling capacity is not delayed due to a disabled compressor being called for.

High Pressure and Water Regulating alarms require manual clearing. Other alarms are cleared automatically when the alarm condition disappears and the stage timer expires. This will keep the compressor off for at least the stage timer. However, manual clearing is required if the same alarm occurs three times between 2:00 am of one day and 2:00 am of the next day.

Compressors that are currently disabled due to alarm conditions are shown in Menu #28 of the keypad. To release all disabled compressors, press the clear key at the first item of Menu #28. To release a single compressor for operation, press the clear key at the item that displays that compressor. The compressor will go back into alarm if the alarm condition still exists.

EWT Sensor Problem
The EWT Sensor Problem occurs when the entering water temperature sensor is shorted or open. The alarm disables the water cooled economizer. The alarm clears automatically when conditions disappear.

Zone Sensor Problem
If the zone temperature sensor (SPT1) fails, the Zone Sensor Problem alarm will occur. As a result, the unit will continue to operate, but the night setback, night setup and zone reset features will be disabled. In addition, if the Control Temperature source had been selected to be the zone sensor, the controller will automatically change it to the return air sensor. When the alarm condition is gone, the Zone Sensor Problem alarm will automatically clear.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. For more information on the emergency occupied mode, see the "Unoccupied Control" section.

Note: If SPT1 is not connected to the controller or if you want to disable the Zone Sensor Problem alarm, set the space sensor present flag to "No" (menu 25).

Return Air Sensor Problem
If the return air temperature sensor (RAT) fails while it is not the selected Control Temperature source, the Ret Sensor Problem alarm will occur. As a result, the unit will continue to operate, but the High Return Temp alarm and reset based on RAT will be disabled. When the alarm condition is gone, the Ret Sensor Problem alarm will automatically clear.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the RAT sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Outdoor Air Sensor Problem
If the outdoor air temperature sensor (OAT) fails, the OAT Sensor Problem alarm will occur. As a result, the unit will continue to operate, but the high ambient heating lockout and OAT reset will be disabled. When the alarm condition is gone, the OAT Sensor Problem alarm will automatically clear.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the OAT sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Mixed Air Sensor Problem
If the mixed air temperature sensor (MAT) fails, the Mixed Sensor Problem alarm will occur. As a result, the waterside economizer will be disabled. When the alarm condition is gone, the Mixed Sensor Problem alarm will automatically clear.

Information on troubleshooting analog input alarms is included in the "Test Procedures" section of Bulletin No. IM 608, MicroTech Self-contained Air Conditioning Unit Controller. To determine the location of the MAT sensor, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

High Temp Rise
The High Temperature Rise alarm occurs when unit has staged electric heat and discharge air temperature equals or exceeds mixed air temperature by 60°F. The electric heat is disabled by MicroTech. The High Temperature Rise alarm requires a manual reset.

Heating Failure
The Heat Fail alarm is applicable only to units equipped with electric heat. When the Heat Fail input is in the alarm position the unit will continue to operate, but one or two stages of electric heat will be disabled. The Heat Fail alarm will clear automatically when the condition disappears.

No Water Flow
Lack of water flow is indicated by an open water flow switch or a network signal. Cooling provided by compressors or waterside economizer is disabled. The only cooling that may be available is provided by an airside economizer. The No Water Flow alarm will clear automatically when the water flow input is in the flow position.

Warnings

Economizer Stuck
On units equipped with an economizer, the Economizer Stuck alarm will occur if either of two alarm conditions exists: (1) the economizer position > 10% and unit has been off for more than three minutes, or (2) Economizer position < 90% and unit has been in mechanical cooling with conditions acceptable for economizer operation for more than three minutes. Unit operation will not be affected by this alarm, but because stuck dampers could be a serious problem during cold weather, the Economizer Stuck alarm must be manually cleared. Note that the controller monitors the economizer actuator's position and that this value is available for display (menu 6).

If the economizer appears to open and close completely, but the monitored position does not indicate it, try having the controller perform the Calibrate procedure. For more information on Calibrate, see "Control Mode" in the "Auto/Manual Operation" section of this manual.

Airflow Warning
If differential pressure switch PC7 detects airflow after the fans are shut down and the airflow check timer expires, the Air Flow Warning alarm will occur. Unit operation will not be affected by this alarm. However, if the Air Flow Warning alarm occurs while the Fan On output is energized, the controller will prevent the Fan On output from de-energizing until the alarm clears. The airflow check timer is set at menu 20. The timer has a default of 2 minutes. It starts timing when the fans are shut down. The Air Flow Warning alarm will automatically clear when the PC7 contacts open.

The setting on pressure switch PC7 can be adjusted. To determine the location of PC7, refer to the "Control Locations" section of applicable model-specific installation manual (see Table 1).

Filter Dirty
If the pressure switch opens, the Filter Dirty alarm will occur. Unit operation will not be affected by this alarm. The Filter Dirty alarm will automatically clear when the pressure switch closes.

MicroTech Control Features

Step-and-Wait Algorithm

About Step-and-Wait

The MicroTech unit controller uses the Step-and-Wait algorithm to control modulating output devices in order to keep a controlled variable at or near the desired setpoint. For example, Step-and-Wait would be used to control a modulating hot water valve in order to maintain the discharge air temperature at or near the discharge air heating setpoint. As its name implies, Step-and-Wait "steps," or modulates, an actuator either open or closed for a certain amount of time and then "waits" for the effect on the controlled variable. Because Step-and-Wait uses integral control, "proportional droop" (load dependent offset) is eliminated. The tightest possible control is the result. Following is a general description of Step-and-Wait operation.

Description of Operation

⚠CAUTION

Grossly misadjusting Step-and-Wait parameters can cause erratic unit operation and equipment damage.

Step-and-Wait parameters should be adjusted only by trained personnel that have a thorough understanding of how they affect overall system operation.

Regardless of controlled output equipment or controlled variable, there are four Step-and-Wait parameters that regulate the control loop action: (1) wait time, (2) max step, (3) mod limit, and (4) dead band. Following are descriptions of each parameter and an example of how they work together. Refer to Figure 18.

Wait Time
The wait time sets the control loop sampling rate. During each wait time cycle, the controlled variable's sensor is read and the appropriate output response is generated. The wait time parameter's units are in time (seconds or tenths of seconds).

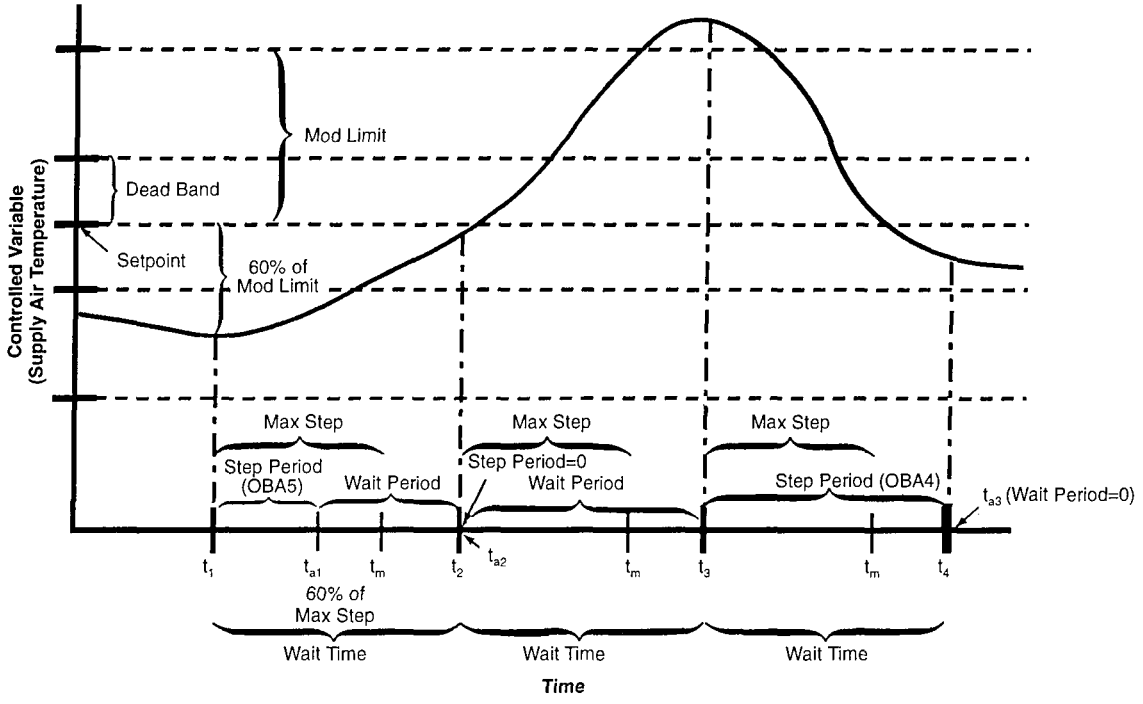
Max Step
The max step, which must be less than or equal to the wait time, sets the maximum time the actuator can be driven either open or closed during the wait time cycle. Depending on the deviation of the controlled variable from setpoint, the actual time the actuator is driven is some percentage of the max step. This actual driving time is called the "step period." The greater the deviation is, the greater the step period will be. After the step period, the actuator holds its position for the duration of the wait time. This holding time is called the "wait period." The max step parameter's units are in time (seconds or tenths of seconds).

There is one exception to the above description: The actuator will be driven for longer than the max step if the controlled variable is above or below the setpoint by more than the mod limit (see below).

Mod Limit
The mod limit sets the gain, the responsiveness of the control loop to a given variable's deviation from setpoint. For a given amount of deviation, it determines the actual amount of time the actuator is driven either open or closed during each wait time period. If the controlled variable is above or below the setpoint by more than the mod limit, the actuator will be driven either open or closed during the entire wait time cycle. If the controlled variable is far from setpoint, the actuator is effectively driven continuously. This feature assures that the controlled variable will approach its setpoint as quickly as possible during transient periods; for example, after unit start-up. The mod limit parameter's units are the same as the controlled variable's (temperature, pressure, or position).

Dead Band
The dead band sets a range in which no control action will be taken. If the controlled variable is within the dead band range, the actuator will hold its position. Note that the dead band parameter's value is added to and subtracted from the setpoint to determine the dead band range. For example, if the dead band is 3°F and the setpoint is 55°F, no control action will occur when the controlled variable is between 51°F and 59°F. The dead band parameter's units are the same as the controlled variable's (temperature, pressure, or position).

Figure 18. Typical Step-and-Wait Operating Sequence



Typical Operating Sequence

Following is an illustration of Step-and-Wait control. For this example, the controlled variable is discharge air temperature, and output device is a hot water valve actuator. Output relay K12 drives the valve open when energized, and K11 drives the valve closed when energized. Refer to Figure 18. Note that Figure 18 is intended to exemplify the different Step-and-Wait control actions; typical operation would be far more steady.

At the beginning of the first wait time cycle (time t1), the discharge air temperature is below the setpoint by more than the dead band. Since the deviation from setpoint is approximately 60% of the mod limit, the step period for this cycle (ts1) is set equal to 60% of the max step (tm). During the step period, output K12 is energized, and thus the hot water valve is driven open. As a result, the discharge air temperature rises.

At the beginning of the second wait time cycle (time t2), the discharge air temperature is within the dead band range, and therefore, the step period for this cycle (ts2) is set equal to zero. Since the step period is zero, neither K11 nor K12 is energized, and thus the hot water valve holds its position. The discharge air temperature might continue to rise, for example, because the heating load has decreased.

At the beginning of the third wait time cycle (time t3), the discharge air temperature is above the setpoint by more than the mod limit. Since the deviation from setpoint is greater than the mod limit, the step period for this cycle (ts3) is set equal to wait time. During the step period, output K11 is energized, and thus the hot water valve is driven closed for the full duration of the wait time cycle. As a result, the discharge air temperature drops rapidly.

Adjusting Step-and-Wait Parameters

Appropriate default Step-and-Wait parameter values are loaded into each controller at the factory (see Table 3). These default values will provide proper control for most applications; therefore, field tuning is usually not required. If the default values do not provide acceptable system operation, they can be adjusted.

If the controlled variable hunts above and below its setpoint or if it overshoots the setpoint too much during start-up or other abrupt changes in unit operation, Step-and-Wait control should be "slowed down" by decreasing the max step value, increasing the mod limit value, or both. Step-and-Wait control can also be slowed down by increasing the wait time. In some cases, increasing the dead band can also eliminate hunting problems.

If the controlled variable does not approach its setpoint fast enough during start-up or other abrupt changes in unit operation, Step-and-Wait control should be "speeded up" by increasing the max step value, decreasing the mod limit value, or both. Step-and-Wait control can also be speeded up by decreasing the wait time. Remember that the max step value must always be less than or equal to the wait time value.

The dead band affects the tightness of control. You can set it to a lower value to keep the controlled variable closer to its setpoint. However, if the dead band is set too low, it can cause hunting in some situations.

Note: Some Step-and-Wait control loops use position as the controlled variable. For example, this type of control is used to maintain the economizer dampers at the minimum position setpoint. The position Step-and-Wait parameters are available at a PC equipped with Monitor software, but not at the keypad. Typically, these position parameters should never require any adjustment.