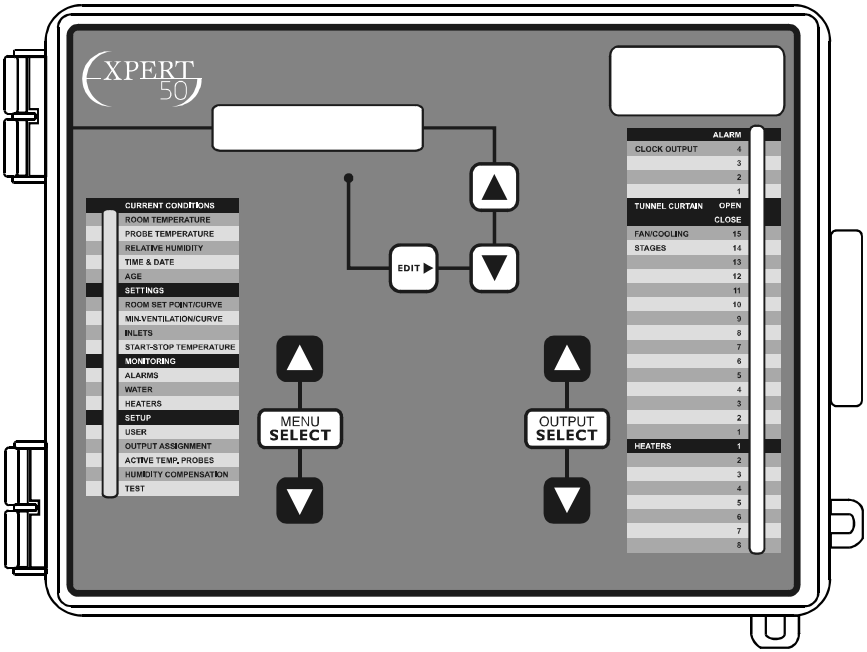
Temperature Controller

# Expert-50

## USER'S MANUAL




M 890-00075 rev. 10

PN895-00102 REV. 01

# TABLE OF CONTENTS

# PRECAUTIONS

We strongly recommend installing supplementary ventilation as well as a back-up thermostat on at least one fan stage (refer to the wiring diagram enclosed with this user's manual to connect the thermostat).

Although overload and overvoltage protection is provided for the controller circuits, we recommend installing additional protection devices in the electrical panel.

The room temperature where the controller is located MUST ALWAYS REMAIN BETWEEN 32°F AND 104°F (0°C TO 40°C).

To avoid exposing the controller to harmful gases or excessive humidity, it is preferable to install it in a corridor.

DO NOT SPRAY WATER ON THE CONTROLLER

**FOR CUSTOMER USE**
Enter the serial number located on the side of the controller below for future reference.

Model number: Expert-50
Serial number: _____

# FEATURES

The Expert-50 is an electronic device used for environmental control in livestock buildings. It allows the user to maintain a specified target temperature by controlling the operation of ventilation and heating equipment. Eight heater stages, 15 fan stages, tunnel curtains and 4 clock outputs can be connected to the controller. Fan stages can be configured to activate cooling systems in timer mode. In all, the Expert-50 provides up to 32 relay outputs and 2 variable-speed outputs. In addition, up to 12 air inlet modules can be connected to the Expert-50.

The main features of the Expert-50 are as follows:

**LCD DISPLAY**
An LCD display provides an efficient interface for displaying, monitoring and adjusting parameter values.

**PILOT LIGHTS**
Pilot lights indicating the state of outputs allow the user to monitor the operation of the system without having to enter the building.

**MINIMUM VENTILATION CYCLE**
When ventilation is not required for reducing room temperature, variable-speed outputs can be operated either continuously or intermittently to reduce the level of humidity and supply oxygen to the room.

**TEMPERATURE AND MINIMUM VENTILATION CURVES**
The controller can be set to automatically change the temperature set point and the minimum ventilation fan speed over a given period of time in accordance with the user's requirements by specifying a temperature curve and a minimum ventilation speed curve with ten different points each.

**PROBE READINGS RECORDED FOR PAST DAYS**
Minimum and maximum readings from temperature and humidity probes are recorded for the current day and the previous six days.

**WATER MONITORING**
A pulse input is provided for monitoring water consumption for the current days and the previous six days.

**ALARM MANAGEMENT**
Alarms are provided for high-low temperatures, defective probes and other system functions. Alarm states are kept in memory until acknowledged even if alarm situation has been rectified.

**HUMIDITY COMPENSATION**
The minimum ventilation speed can be adjusted automatically as a function of relative humidity. Cooling units can be shut off when humidity levels are too high. In addition, heater outputs can be activated when humidity levels are too high.

**SIX INDEPENDENT TEMPERATURE PROBE INPUTS**
Up to six temperature probes can be connected to the controller in order to obtain a more accurate reading of the average room temperature and a faster reaction time. Probes can be configured to use zoned heaters.

**PASSWORD PROTECTION**
A password feature can be enabled to restrict access to the controller setup functions.

**BACKUP BATTERY**
A backup battery allows the unit to keep time in case of a power failure.

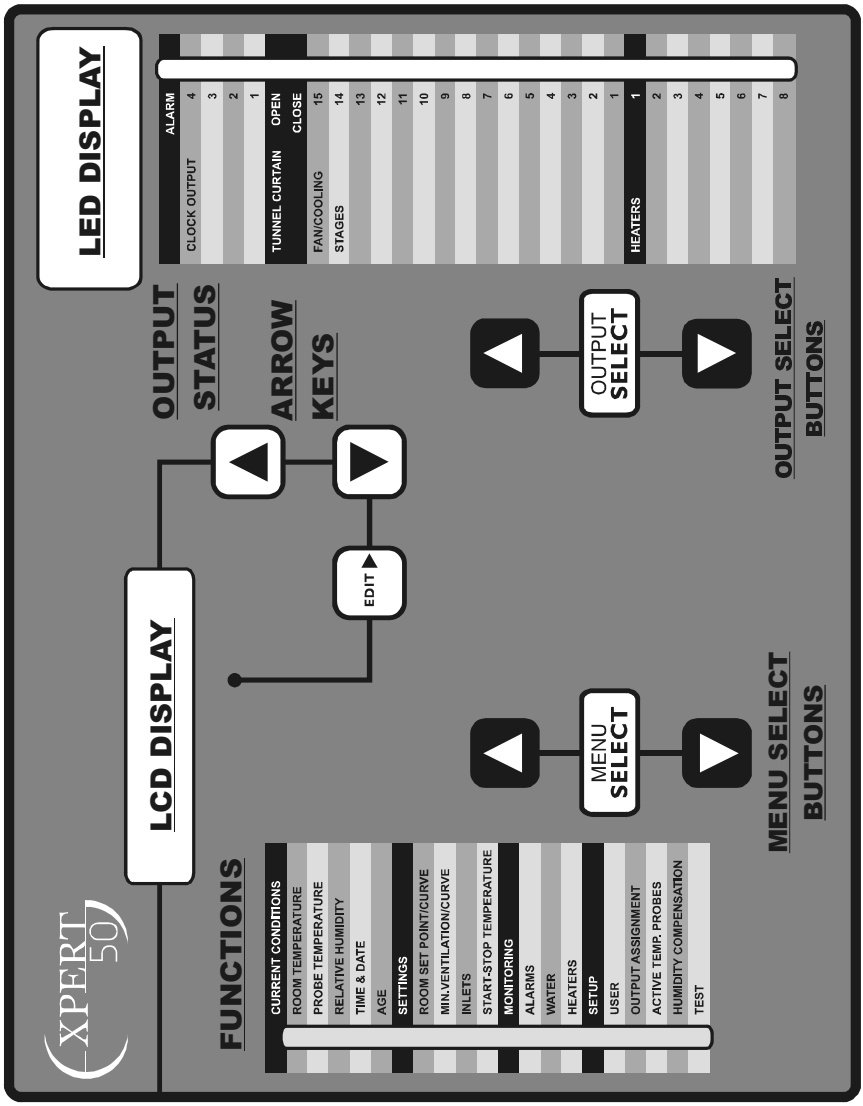
**OVERLOAD AND OVERVOLTAGE PROTECTION**
Resettable fuses are provided at low-voltage inputs and outputs of the controller to protect its circuitry in the case of an overload or overvoltage.

**COMPUTER CONTROL**
The controller can be connected to a computer, thus making it possible to centralize the management of information and diversify control strategies.

**TEST MODE**
A test mode allows you to simulate temperature changes and verify controller performance, as well as manually activate each output sequentially.

**CONTROL OF AIR INLET MOVEMENT**
If the Expert-50 is used in combination with one or more air inlet modules, the movement of air inlets can be coordinated with the operation of the fans using a potentiometer located on the panel drive. This allows the air inlets to be adjusted correctly, without the influence of uncontrollable factors such as wind or air from adjoining rooms.

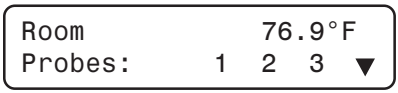
# LOCATION OF THE CONTROLS



**Room Temperature Display:** The display on the top right corner of the faceplate shows the current room temperature averaged over all selected room temperature probes.

**LCD Display:** The LCD display on the left gives the current readings and parameters to be adjusted when you select a function. The three keys to the right of the display are used to edit parameters and step through the display. When the parameters for a given function cannot all be presented at once on the display, arrows are displayed on the right hand side to indicate that additional parameters can be displayed using the arrow keys  .

After 5 minutes of inactivity, the display returns to the ROOM TEMPERATURE display.




**Adjusting a Parameter:** A parameter can be adjusted when it is flashing on the LCD display. Use the Edit key  to step through the parameters displayed. When the required parameter is flashing, use the arrow keys on the top right to adjust the parameter.

To step to another display screen, it may be necessary to press the Edit key several times to step through the remaining parameters displayed until the up- and down-arrows reappear to the right of the display.

# INSTALLATION

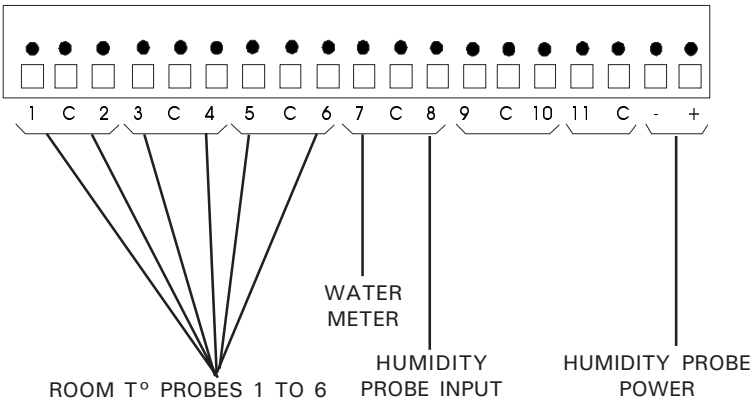
## MOUNTING INSTRUCTIONS

Open the latch and lift the cover. Remove the black caps located on each of the four mounting holes. Mount the enclosure on the wall using four screws. Be sure the electrical knockouts are at the bottom of the enclosure in order to prevent water from entering the controller. Insert the screws in the mounting holes and tighten. Fasten the four black caps provided with the controller onto the four mounting holes. The enclosure must be mounted in a location that will allow the cover to be completely opened right up against the wall.

## CONNECTIONS

To connect the controller, refer to the wiring diagram enclosed with this user's manual. Use the electrical knockouts provided at the bottom of the enclosure. Do not make additional holes in the enclosure, particularly on the side of the enclosure when using a computer communications module.

1. PROBE INPUTS




**WARNING**

**ALL WIRING MUST BE DONE BY AN AUTHORIZED ELECTRICIAN AND MUST COMPLY WITH APPLICABLE CODES, LAWS AND REGULATIONS. BE SURE POWER IS OFF BEFORE DOING ANY WIRING TO AVOID ELECTRICAL SHOCKS AND EQUIPMENT DAMAGE.**

Probes operate at low voltage and are isolated from the supply. Be sure that probe cables remain isolated from all high voltage sources. In particular, do not route the probe cables through the same electrical knockout as other cables. Do not connect the shield from the probe cable to a terminal or a ground.

**Extending a probe:** Each probe can be extended up to 500 feet (150 meters). To extend a probe:

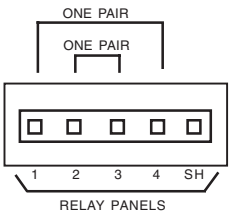
- Use a shielded cable of outside diameter between 0.245 and 0.260 in (6.22 and 6.60 mm) (the cable dimensions should not be under 18 AWG) to ensure the cable entry is liquid tight. **Do not ground the shielding.**
- It is preferable to solder the cable joint to ensure a proper contact between the two cables.

**CAUTION:** Do not run probe cables next to other power cables. When crossing over other cables, cross at 90°.

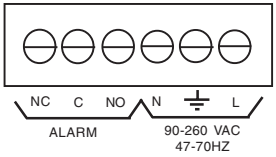
**Defective probes:** An alarm is generated when a defective probe is detected. To identify the defective probe, select the functions, PROBE TEMPERATURES and RELATIVE HUMIDITY. Dashes are displayed instead of a reading when the probe is defective. In the case of room temperature probes, the controller will operate according to the temperature of the remaining probes.

2. RELAY PANELS

Use a shielded cable with two twisted pairs. Connect the shielding to the SH terminal. Use one pair for terminals 1 and 4 and the other pair for terminals 2 and 3.



3. ALARM AND POWER SUPPLY




There are two types of alarms on the market. One type activates when current is cut off at its input, whereas the other activates when current is supplied at its input. For an alarm of the first type, use the NC terminal as shown on the wiring diagram. For an alarm of the second type, use the NO terminal.

4. AIR INLET MODULE COMMUNICATION HOOKUP

If air inlet modules are connected to the Expert-50, use id numbers within the range 4-15. Id numbers 1,2 and 3 are reserved for the Expert-50 and relay panel.

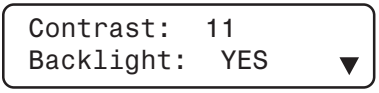
# CONTROLLER SETUP

The following section describes how to customize the controller for your particular application. Normally, this setup needs to be done only once. Setup parameters are grouped under two functions: USER and OUTPUTS. The USER setup is used for configuring display units, probe inputs, humidity compensation, the fan differential, etc. The OUTPUTS setup is used for configuring the outputs.

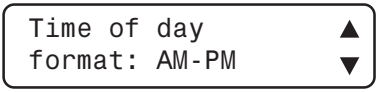
The parameters are presented below in the order they appear on the display. Press the down-arrow key to step to the next parameter. Press the Edit key and use the arrow keys to adjust a parameter value. When you are finished adjusting a parameter, press the Edit key to return to display mode or move to the next parameter. The user should step through all the parameters under these two functions at least once.

## USER SETUP

**1. Display Contrast and Backlight:** Press the Edit key to adjust the display contrast. Press the Edit key once again to turn the display backlight on or off. Note that the backlight is automatically turned off after 5 minutes of inactivity even if it is turned on. It is turned on again when a key is pressed.

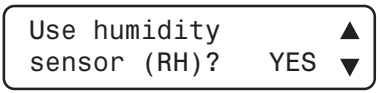



**2. Time of Day Format:** Press the Edit key to select either AM-PM or 24H time.

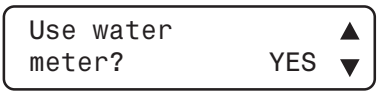



**3. Number of Temperature Probes in the Room:** Press the Edit key to set the number of room temperature probes wired in the controller (whether they are selected or not). Note that probes must be wired from left to right following the numerical order of the terminals on the board if 4 probes are not needed.

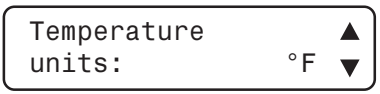
**4. Use Humidity Sensor:** Press the Edit key and set to YES if a relative humidity sensor is connected to the unit.



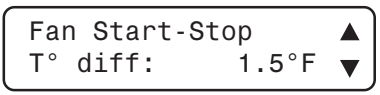

**5. Use Water Meter:** Press the Edit key and set to YES if a water meter is connected to the unit.



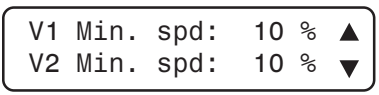

**6. Temperature Units:** Press the Edit key and choose between Fahrenheit and Celsius degrees for displaying temperature values.



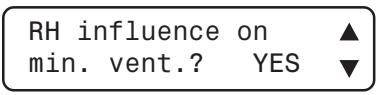

**7. Fan Start-Stop Temperature Difference:** Press the Edit key and adjust the maximum temperature difference between start and stop temperatures on fan stages.



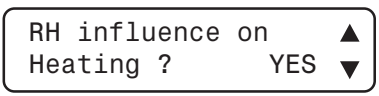

**8. Variable-Speed Fan Minimum Speeds:** Press the Edit key and adjust the minimum speed for the first variable output. Repeat for the second variable output.



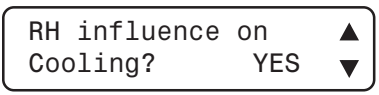

**9. Humidity Compensation on Minimum Ventilation:** Press the Edit key and set to YES to enable humidity compensation on the minimum ventilation cycle.



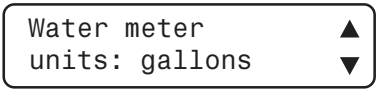

**10. Humidity Compensation on Heating:** Press the Edit key and set to YES to enable humidity compensation on heating.



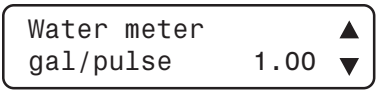

**11. Humidity Compensation on Cooling Stages:** Press the Edit key and set to YES to enable humidity compensation on cooling outputs.



**12. Water meter units:** Press the Edit key and choose between gallons and liters for displaying water consumption.

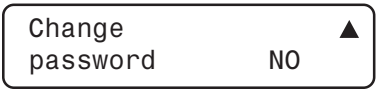



**13. Water Meter Calibration:** Press the Edit key and adjust the number of gallons or liters per water meter pulse.




**14 Change Password:** The user can define a password to restrict access to the functions contained in the SETUP section (USER, OUTPUTS and TEST). The password must be entered each time one of these functions is selected. When the correct password is entered, it does not need to be re-entered until the display times out (i.e. after 5 minutes of inactivity). The password is a sequence of three numbers from 0 to 99. To disable the password feature, set the password to 0 0 0.

- Press the Edit key. The change password state flashes. Use the arrow keys to set the change password state to YES.



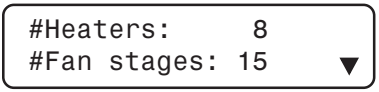

- The old password must be entered, one number at a time. Use the arrow keys to enter the first number. Press the Edit key to step to the next number. Use the arrow keys to enter the second number, etc.


- The new password must be entered, one number at a time. Use the arrow keys to enter the first number. Press the Edit key to step to the next number. Use the arrow keys to enter the second number, etc.

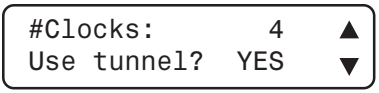

- The new password must be confirmed, one number at a time. Use the arrow keys to enter the first number. Press the Edit key to step to the next number. Use the arrow keys to enter the second number, etc.

## Output Setup

**1. Number of Heaters and Fan Stages:** Press the Edit key to adjust the number of heaters used. Press the Edit key once again to adjust the number of fan stages.

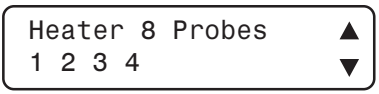



**2. Number of Clock Outputs/Tunnel Ventilation :** Press the Edit key to set the number of clock outputs used. Press the Edit key once again to enable or disable tunnel ventilation.



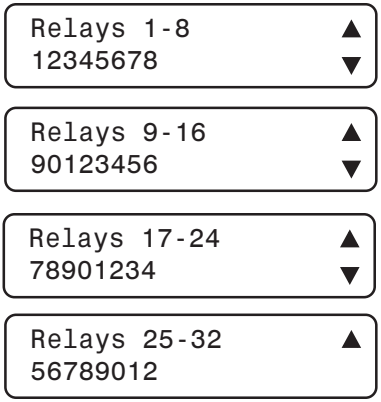

**3. Number of Inlets :** Press the Edit key to set the number of air inlet modules.


**4. Heater Probes on Heaters 1 - 8 :** Use the adjustment knob to select a heater stage. The probes assigned to the heater appear flashing on the display. Press the Edit key and use the arrow keys to enable or disable each probe individually for the heater. Press the down-arrow key to configure the relays for each heater (see below).

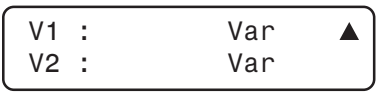



When the down-arrow key is pressed at this point, the LED of the last heater configured above flashes and the probe assignments for that heater are displayed. The user can now configure each output separately by selecting the output using the output select buttons and adjusting the parameters displayed. Configuration parameters vary according to the type of output. For example, probes are assigned when configuring a heater stage. Use the up- and down-arrow keys to step through all the display screens for a given output. The last display screen for all outputs is the relay assignment.

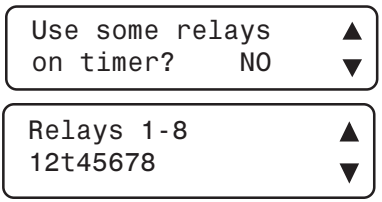
**Relay Assignments:** The Expert-50 can control up to 32 output relays. The mapping between the stages and the relays must be determined by the user. The relays are displayed in groups of 8 relays at a time. The relays assigned to an output correspond to the flashing numbers on the display. Press the Edit key to display each relay state and use the arrow keys to assign (ON) or deassign (OFF) the relay. Use the down-arrow key to step to the next bank of relays. Use the template at the end of this manual to map the relays before assigning them from the front panel. Use the TEST function to test all relay assignments.



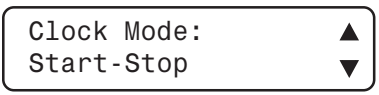

**Variable Output Assignments:** The Expert-50 controls two variable outputs for variable-speed fans. Each fan stage can use these outputs in variable or on-off mode. Press the Edit key and set the mode to 'Var' for variable, 'ON' for ON-OFF or 'OFF' to deactivate the output. Note that the variable outputs cannot be configured in variable mode on the last fan stage.




**5. Relays with Timer on Fan Stages 2-15:** For these fan stages, the user can configure certain relays to operate in timer mode for cooling while other relays operate in on-off mode. Press the Edit key and set the timer mode to YES to configure certain relays in timer mode for cooling. Press the down-arrow key to map the relays. If timer mode is set to YES, the user can choose between ON, OFF and timer when selecting a relay. When a relay is in timer mode, the digit of the relay alternates with the letter t.




**6. Clock Mode on Clock Outputs:** The user must choose between Start-Stop and Start-Running Time for the clock outputs. Press the Edit key and use the arrow keys to configure each output. Press the down-arrow key to map the relays to the output (see above).



# TEMPERATURE SETTINGS

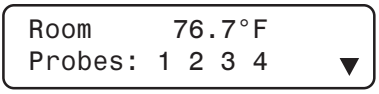
## VIEWING TEMPERATURES

The user can display the current average room temperature and individual probe temperatures. The controller also records the minimum and maximum temperature values for the current day and the past 6 days along with the clock time. The controller starts recording minimum and maximum values at midnight every day.

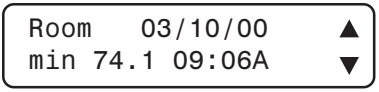
### 1 Viewing Room Temperature

The room temperature is the average value of all temperatures measured by selected probes in proper operating condition.

- Set the function to **ROOM TEMPERATURE** using the menu select buttons. The average room temperature is displayed as well as the probes selected for room average.




- Press the down-arrow key. The minimum temperature value for the current day is displayed, along with the time and date.




- Press the down-arrow key once again. The maximum temperature value for the current day is displayed, along with the time and date.

- Keep pressing the down-arrow key to display the minimum and maximum temperature values for the previous six days. Use the up-arrow key to return to the previous display screens.

## 2 Viewing Probe Temperatures

The controller can display probe temperatures individually whether the probe is selected or not for room average. Unconnected probes are displayed as OFF and their minimum and maximum values cannot be displayed. For example, if two probes are wired to the controller, then probes 5 and 6 will be displayed as OFF.

- Set the function to **PROBE TEMPERATURE** using the menu select buttons. Individual probe temperatures are displayed for the first four probes connected to the controller.

- Press the down-arrow key. The temperature of probes 5 and 6 are displayed.

- Press the down-arrow key. The minimum temperature value for Probe 1 for the current day is displayed, along with the time and date.

- Press the down-arrow key once again. The maximum temperature value for Probe 1 for the current day is displayed, along with the time and date.

- Keep pressing the down-arrow key to display the minimum and maximum temperature values for the remaining probes. Once all probes have been displayed, the display shows recorded minimum and maximum probe temperatures for the previous six days. Use the up-arrow key to return to the previous display screens.

## ❸ Average Temperature Probes

The controller uses the average reading of the activated probes to calculate the room temperature. Select the temperature probes that are used to monitor the ambient temperature. At least 1 temperature probe must be selected.

- Set the function to **ACTIVE TEMPERATURE PROBES** using the menu select buttons. The temperature probes are displayed.
- Press the Edit key in order to select the desired probe.

```
Probes: 123-5
```

- Use the arrow keys to set the probe status. A dash indicates that the probe is not used to calculate the average room temperature.

# TEMPERATURE SET POINT

The temperature set point is the target room temperature. It can be adjusted between -40.0°F and 100°F (-40.0°C and 37.8°C). Note that the temperature curve must be turned off to adjust this value.

## Adjusting Temperature Set Point

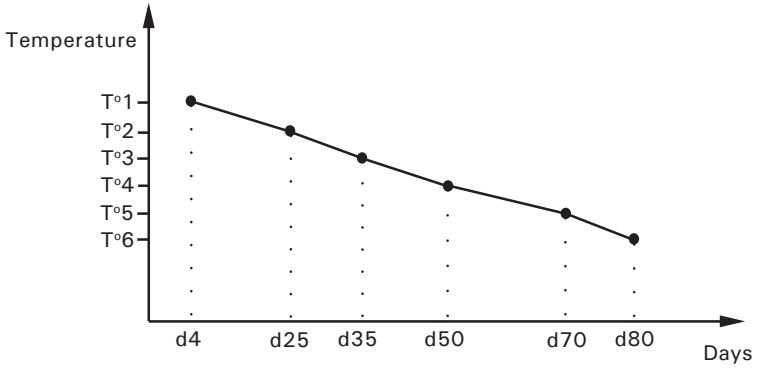
- Set the function to **ROOM SET POINT / CURVE** using the menu select buttons. The current set point is displayed, as well as the on/off state of the temperature curve.


- If the temperature curve is OFF, press the **Edit** key once. The set point flashes on the display. Use the arrow keys to adjust the set point to the desired value.

- If the temperature curve is ON, the temperature value displayed is the set point as determined by the temperature curve. Press the **Edit** key. The on/off state of the temperature curve starts flashing. Use the adjustment knob to turn the curve off. Press the Edit key twice. The temperature set point flashes on the display. Use the arrow keys to adjust the set point to the desired value.

## Temperature Curve

The user can define a temperature curve to adjust the set point automatically over a given time period.




A curve is defined using up to 10 points. Each point specifies a day number and a set point for that day. The herd age value defines the current day number used by the curve. Once the points of the curve are defined, the curve must be activated. The controller will change the temperature set point every hour in a linear fashion between consecutive points of the curve. When the last point of the curve is reached, the temperature set point for that day is maintained until the herd age is adjusted for starting a new herd or the set point is adjusted manually.

## NOTES:

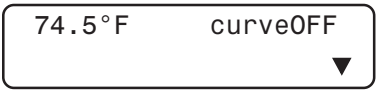
i) All ten points of the curve must be specified. If ten points are not needed, repeat the last temperature value for each unnecessary point.

ii) Certain restrictions apply to reduce the risk of errors:

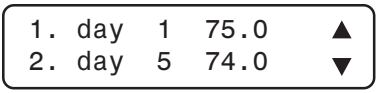
- The highest possible day number is 250.
- Decreasing day numbers are not allowed.
- Increasing temperatures are not allowed.

## 1 Specifying the Curve

- Set the function to **ROOM SET POINT** / **CURVE** using the menu select buttons. The current temperature set point is displayed, as well as the on/off state of the temperature curve.




- Press the down-arrow key. The first two points of the curve are displayed, i.e. the point number, followed by the day number and the set point value.




- Press the Edit key as required to adjust each parameter in turn. When a parameter flashes, it can be modified using the arrow keys.
- Press the down-arrow key to display and adjust the other points of the curve.

## 2 Activating / Deactivating Temperature Curve

- Set the function to **ROOM SET POINT** / **CURVE** using the menu select buttons. The current temperature set point is displayed, as well as the on/off state of the temperature curve.
- Press the Edit key once or twice until the on/off state of the curve flashes.
- Use the arrow keys to activate or deactivate the temperature curve.

## ❸ Viewing Current Set Point and Day Number

When the temperature curve is activated, the current temperature set point and day number can be viewed at any time. The current day number can also be adjusted in order to move forward or backward on the temperature curve.

**Note that the day number used by the curve is defined by the herd age value which is also used by the minimum ventilation curve.**

- Set the function to **ROOM SET POINT** / **CURVE** using the menu select buttons. The current temperature set point is displayed, as well as the on/off state of the temperature curve.
- Set the function to **AGE** using the menu select buttons. The current herd age is displayed.
- Press the Edit key. The age value flashes on the display.
- Use the arrow keys to set the age to the desired value.

# TIME AND DATE FUNCTIONS

## 1 Setting the Time and Date

- Set the function to **TIME & DATE** using the menu select buttons. The current time and date are displayed.

```
12:49.53 PM
03/15/2000
```

- Press the Edit key. The hours value flashes. Use the arrow keys to set the hours. Press the Edit key. The minutes value flashes. Use the arrow keys to set the minutes. When the minutes value is adjusted, the seconds are set to zero.

- Press the Edit key. The year flashes. Use the arrow keys to set the year. Press the Edit key. The month flashes. Use the arrow keys to set the month. Press the Edit key. The day flashes. Use the arrow keys to set the day to the appropriate value.

## 2 Setting the Herd Age

The herd age is used by the temperature and minimum ventilation curves, as well as for tunnel ventilation.

- Set the function to **AGE** using the menu select buttons. The current herd age is displayed.

```
Age:  24 days
```

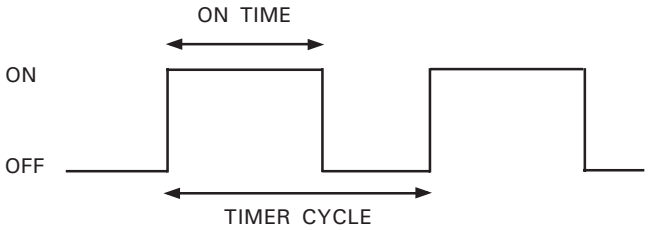
- Press the Edit key. The age value flashes on the display.

- Use the arrow keys to set the age to the desired value.

# MINIMUM VENTILATION

## PRINCIPLE OF OPERATION

When the room temperature is below the set point,the variable-speed fans can operate according to a minimum ventilation cycle. Running the fans even though ventilation is not required for reducing room temperature is useful to reduce humidity levels and supply oxygen to the room. It also prevents the fans from freezing in winter.




Either variable outputs or both can be used for minimum ventilation. Minimum ventilation fan speed can also be controlled over time using a curve (see below).

Note that the minimum ventilation curve must be turned off to adjust the minimum ventilation settings.

### 1 Adjusting Minimum Speeds

The minimum speed must be adjusted on both variable outputs used for minimum ventilation. To deactivate minimum ventilation on an output, set the minimum speed to OFF.

- Set the function to **MINIMUM VENTILATION/CURVE** using the menu select buttons. The current minimum speeds for the variable outputs are displayed, as well as the on-off state of the minimum ventilation curve.

```
V1   10%      curve OFF
V2   10%            ▼
```

- **If the curve is ON**, press the Edit key. The on-off state of the curve flashes on the display. Use the arrow keys to turn the curve OFF. Press the Edit key once again and follow the instructions below.

- **If the curve is OFF**, Press the Edit key. The minimum speed for variable output 1 flashes. Use the arrow keys to adjust the minimum speed to the desired value.

- Press the Edit key to adjust the minimum speed for variable output 2 as above.

## 2 Adjusting Timer Settings

The on time ranges from 0 to 99 minutes, 59 seconds and cannot be greater than the cycle time. The cycle time ranges from 1 minute, 30 seconds to 99 minutes, 59 seconds.

- Set the function to **MINIMUM VENTILATION / CURVE** using the menu select buttons. The current on time, cycle time, curve on/off state and fan selection are displayed.

- If the curve is ON, press the Edit key. The on/off state of the curve flashes on the display. Use the arrow keys to turn the curve off. Press the Edit key once again and follow the instructions below.

- If the curve is OFF, press the Edit key. The on time minutes value flashes on the display. Use the arrow keys to adjust the on time minutes to the desired value.

- Press the Edit key. The on time seconds value flashes on the display. Use the arrow keys to adjust the on time seconds to the desired value.

- Press the Edit key. The cycle time minutes value flashes on the display. Use the arrow keys to adjust the cycle time minutes to the desired value.

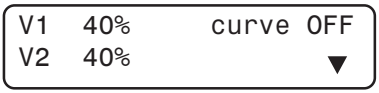
- Press the Edit key. The cycle time seconds value flashes on the display. Use the arrow keys to adjust the cycle time seconds to the desired value.

# MINIMUM VENTILATION SPEED CURVE

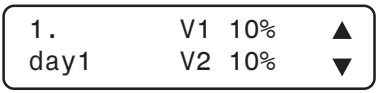
The user can define a minimum ventilation curve to adjust the minimum speed on both variable outputs automatically over a given time period. Each curve is defined by ten points. Each point specifies the day number and minimum speed for that day. The herd age value defines the current day number used by the curve. Once the points are defined, the minimum ventilation curve must be activated. When the minimum ventilation curve is activated, the controller adjusts the minimum speed every hour in a linear fashion between two consecutive points.*

## 1 Specifying Minimum Ventilation Curve

- Set the function to **MINIMUM VENTILATION** / **CURVE** using the menu select buttons. The current minimum speeds and curve on/off state are displayed.




- Press the down-arrow key twice. The day number and minimum speed for the first curve point are displayed.




- Press the Edit key as required to adjust each parameter in turn. When a parameter flashes, it can be adjusted using the arrow keys. Set the speed to OFF to deactivate an output.

- Press the down-arrow key to display and adjust the other points of the curve.

**NOTE:** All ten points of the curve must be specified. If you don't need ten different points, repeat your last minimum speed for each unnecessary point of the curve.

---

* This does not hold if the speed on an output is set to OFF at some points in the curve. In this case, the speed of the preceding point will be used right up to OFF point. Similarly, the output will remain deactivated following the OFF point right up to the next point.

## ❷ Activating / Deactivating Minimum Ventilation Curve

- Set the function to **MIN. VENTILATION / CURVE** using the function selector knob. The current minimum speeds and curve on/off state are displayed.

- If the curve is OFF, press the Edit key three times until the on/off state of the curve flashes. Use the arrow keys to activate the curve.

- If the curve is ON, press the Edit key once until the on/off state of the curve flashes. Use the arrow keys to deactivate the curve.

## ❸ Viewing Current Timer Settings and Day Number

When the minimum ventilation curve is activated, the current timer settings and day number can be viewed at any time. The current day number can also be adjusted in order to move forward or backward on the curve.

**Note that the day number used by the curve is defined by the herd age value which is also used by the temperature curve.**

- Set the function to **MIN. VENTILATION / CURVE** using the menu select buttons and press the page down key. The current on time and cycle time are displayed.

- Set the function to **AGE** using the menu select buttons. The current herd age is displayed.

- Press the Edit key. The age value flashes on the display.

- Use the arrow keys to set the age to the desired value.

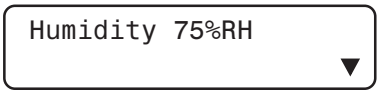
# HUMIDITY CONTROL

If a humidity probe is being used, the Expert-50 has three mechanisms for controlling humidity. When the relative humidity is too high, the minimum ventilation speed can be adjusted by a fixed amount. Secondly, the mist units are shut off whenever the relative humidity exceeds a user-defined maximum value (this applies to those relays configured in cooling timer mode for fan stages 2 to 15). Finally, the heater outputs can be activated in timer mode whenever the relative humidity exceeds a user-defined level. All these mechanisms must be enabled separately in the user setup.

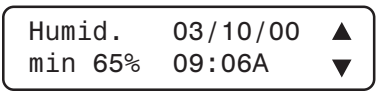
## 1 Viewing Relative Humidity

- Set the function to **RELATIVE HUMIDITY** using the menu select buttons. The relative humidity is displayed.

- Press the down-arrow key. The minimum humidity value for the current day is displayed, along with the time and date.




- Press the down-arrow key once again. The maximum humidity value for the current day is displayed, along with the time and date.



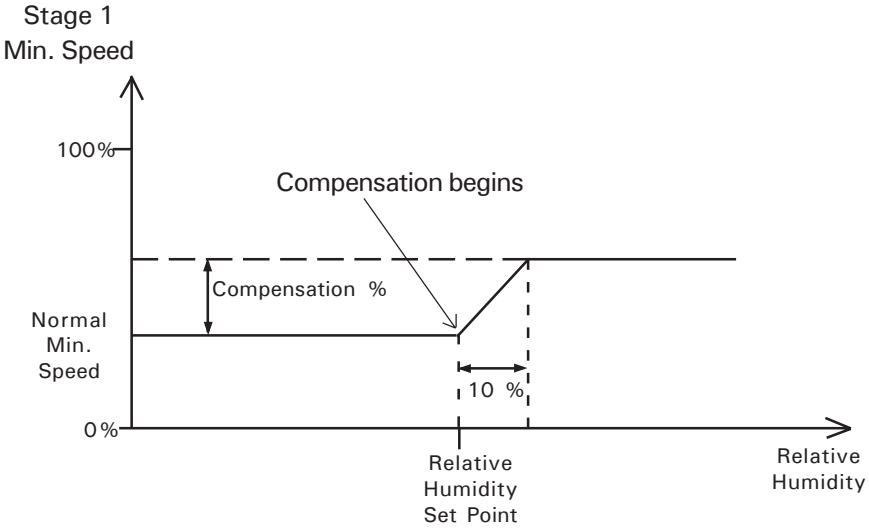

- Keep pressing the down-arrow key to display the minimum and maximum humidity values for the previous six days. Use the up-arrow key to return to the previous display screens.

## 2 Humidity Compensation

The stage 1 minimum speed can be adjusted automatically as a function of relative humidity. As humidity increases, the stage 1 minimum speed increases proportionally to compensate for the change. At humidity levels at or below the humidity set point, stage 1 minimum speed is equal to the normal uncompensated speed. The user specifies the percentage increase in minimum speed for a relative humidity equal to the humidity set point + 10%. For example, if the minimum speed is 40% and the

compensation adjustment is 30%, the minimum speed will be adjusted to 70% of full speed when the humidity rises 10% above the humidity set point. In addition to adjusting the minimum speed, the humidity compensation feature also changes the operation of the minimum ventilation cycle: if the controller is operating in minimum ventilation mode when the relative humidity exceeds the humidity set point, the minimum ventilation fans are operated continuously rather than cycled.

This feature also applies when the minimum ventilation speed is activated. Note that for the compensation to take place, the compensation feature must be activated by the user.




- Set the function to **HUMIDITY COMPENSATION** using the menu select buttons. The current speed increment is displayed, as well as the maximum humidity value

- Press the Edit key. The speed increment flashes. Use the arrow keys to adjust the speed increment to the desired value.

```
min. vent. comp.
+ 50% at 70% RH ▼
```

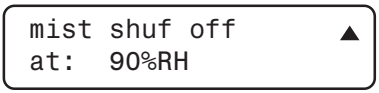
- Press the Edit key once again. The maximum humidity value flashes. Use the arrow keys to adjust the maximum humidity value to the desired value.

## 3 Adjusting Mist Shut-off

When a maximum humidity value is reached the mist units are shut off to avoid increasing the humidity level any further. The humidity level ranges from 0 to 100%.

Set the function to **HUMIDITY COMPENSATION** using the menu select buttons. The current maximum humidity value is displayed, as well as the on time increment.

- Press the down-arrow key. The mist shut-off value is displayed.

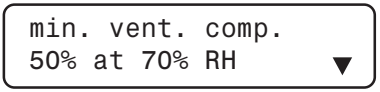



- Press the Edit key. The mist shut-off value flashes on the display.
- Use the arrow keys to adjust the mist shut-off to the desired value.

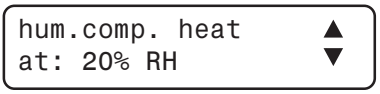
## 4 Adjusting Heater Compensation Level

When the relative humidity reaches this value, all heater outputs are activated according to the timer cycle defined below. The heaters are turned off when the room temperature exceeds the stage 2 start temperature minus one half the start-stop temperature differential.The humidity level can be adjusted from 0 to 100%.

- Set the function to **SETUP-HUMIDITY COMPENSATION** using the menu select buttons. The humidity compensation parameters are displayed, depending on which compensation mechanisms are enabled.




- Press the down-arrow key until the appropriate parameter is displayed
- Press the Edit key. The humidity level for activating the heaters flashes on the display.

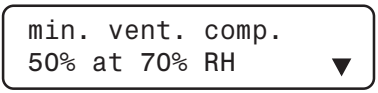



- Use the arrow keys to adjust the humidity level to the desired value.

## 5 Adjusting Heater Timer Cycle

This timer cycle is used to operate the heaters for humidity compensation. The on time and cycle time can be adjusted from 0 to 99 minutes, 59 sec.

- Set the function to **SETUP-HUMIDITY COMPENSATION** using the menu select buttons. The humidity compensation parameters are displayed, depending on which compensation mechanisms are enabled.



- Press the down-arrow key until the appropriate parameter is displayed

- Press the Edit key. The minutes value of the on time flashes on the display. Use the arrow keys to set the minutes to the desired value.

- Press the Edit key. The seconds value of the on time flashes on the display. Use the arrow keys to set the seconds to the desired value.

- Press the Edit key. The minutes value of the cycle time flashes on the display. Use the arrow keys to set the minutes to the desired value.

- Press the Edit key. The seconds value of the cycle time flashes on the display. Use the arrow keys to set the seconds to the desired value.

# AIR INLET CONTROL

If air inlet modules are used, the user can make individual probe assignments for each air inlet. In addition, a compensation can be applied to the air inlet opening calculated by the air inlet module, based on the temperature difference between the average Expert-50 room temperature and the average of the probes assigned to control the air inlet. Up to 12 air inlet modules can be connected to the Expert-50 (the number of inlets used is configured in SETUP OUTPUTS).

Inlets' reference numbers that used by the Expert-50 do not correspond to the ID numbers that are used by the air inlet modules. This is because ID numbers 1, 2 and 3 of air inlet modules are reserved. ID numbers should be assigned as follows:

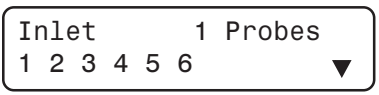
| Inlets' ID # on the Expert-50 | Inlets' ID # on the air inlet module |
|---|---|
| 1 | 4 |
| 2 | 5 |
| ... | ... |
| 12 | 15 |

## 1 Making Probes Assignments for Inlet Control

The air inlet module uses the average temperature of the probes assigned to the inlet.

- Set the function to SETTINGS-INLETS using the menu select buttons. The probe assignments for inlet 1 are displayed. The flashing probes are the ones assigned for controlling the inlet.

- Press the Edit key to change the assignment status of the first probe. Use the arrow keys to set the probe to ON or OFF.

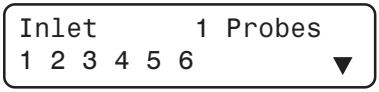



- Press the Edit key to change the assignment status of the other probes.

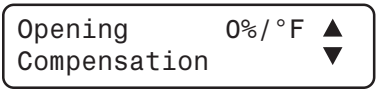
## ❷ Adjusting Air Inlet Compensation Value

The compensation is expressed as a percentage per degree difference between the average controller temperature and the average of the probes assigned to the inlet.

- Set the function to SETTINGS-INLETS using the menu select buttons. The probe assignments for inlet 1 are displayed. The flashing probes are the ones assigned for controlling the inlet.




- Press the down-arrow key. The compensation percentage for inlet 1 is displayed.

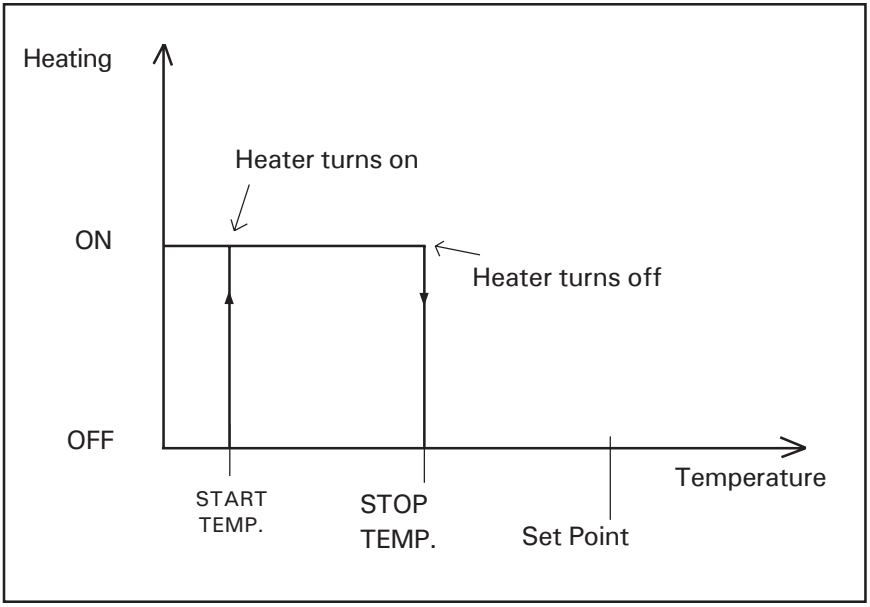



- Press the Edit key. The compensation percentage for inlet 1 flashes on the display. Use the arrow keys to adjust the compensation to the desired value.

- Press the down-arrow key to display and adjust the compensation percentages for the other inlets.

# HEATER SETTINGS

The Expert-50 has eight independent heater stages. A start and stop temperature is defined by the user for each stage. The stop temperature must be at least 0.5°F greater than the start temperature for a given heater. Start temperatures can be up to 14.5°F greater than the set point. A start temperature above the set point is used for controlling heat mats, for example. The number of heater stages needed and the probe assignments for each stage are determined during the controller setup. The following diagram shows the operation of the heaters.



## 1 Adjusting Heater Start and Stop Temperatures

Stop temperatures must be at least 0.5° greater than the start temperature.

- Set the function to **SETTINGS – OUTPUTS** using the menu select buttons. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.

```
Start: 76.5°F
Stop:  77.5°F
```

- Use the ouptut select buttons to select the heater stage to adjust. The corresponding LED on the right of the front panel flashes.
- Press Edit key. The start temperature flashes. Use the arrow keys to adjust the start temperature to the desired value.
- Press Edit key. The stop temperature flashes. Use the arrow keys to adjust the stop temperature to the desired value.

## 2 Viewing Heater On Time Statistics

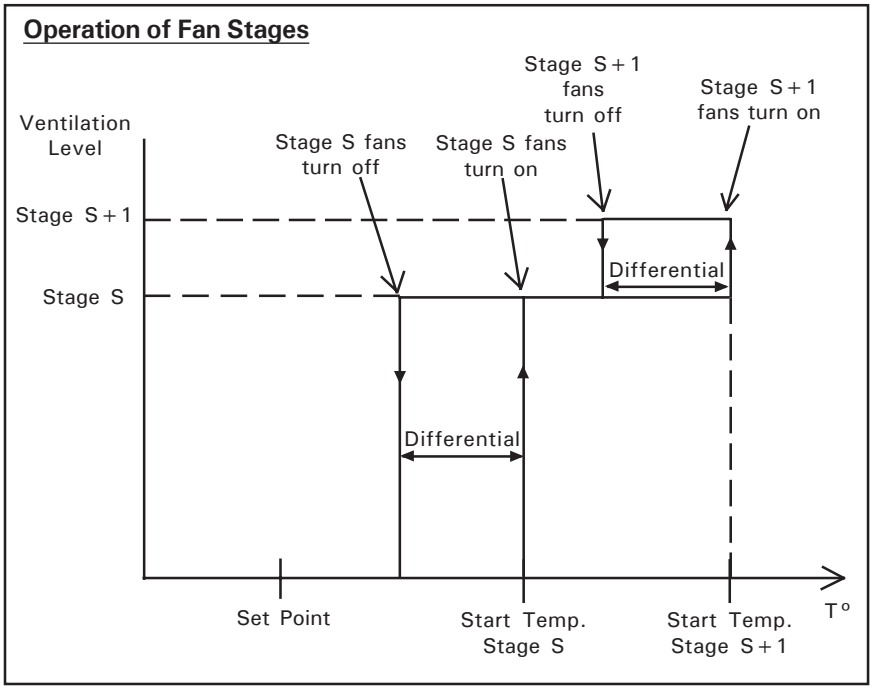
The Expert-50 records on times for the current day and for the past six days for each heater output.

- Set the function to MONITORING-HEATERS using the menu select buttons. The heater 1 on time for the current day is displayed in hours and minutes.
- Press the down-arrow key to display on times for the other heaters
- Keep pressing the down-arrow key to display on time values for the previous six days. Use the up-arrow key to return to the previous display screens.

```
Heater 1
06/21/00        9:06A ▼
```

# FAN SETTINGS

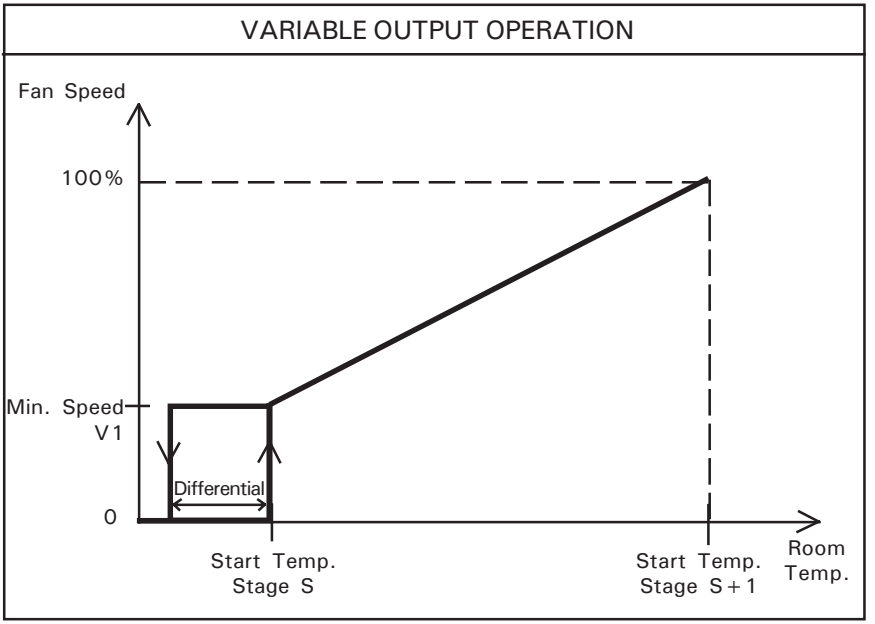
The Expert-50 controls up to 15 on-off fan stages. These stages operate in a sequence to increase the level of ventilation as the room temperature rises. Each stage can also activate two variable outputs and operate a combination of relays in timer mode for cooling (note that stage 1 can only operate variable outputs). The user defines a start temperature for each stage. When the room temperature reaches this value, the stage is activated. A differential common to all stages is used to determine when the stage is deactivated (see User Setup to adjust this differential). Fan stage outputs can also be configured to operate in timer mode.The following diagram shows how fan stages operate.




Start temperatures are defined with respect to the set point and with respect to each other. This means that when one of these values is adjusted, all the consecutive values are adjusted by the same amount. For example, if the set point is increased by 1°F, the start temperatures for all fan stages will be increased by the same amount. The minimum temperature difference between two start temperatures is 0.5°F. Note that stop temperatures cannot overlap the previous stage's start temperature even if this means the differential will be smaller than the prescribed value.

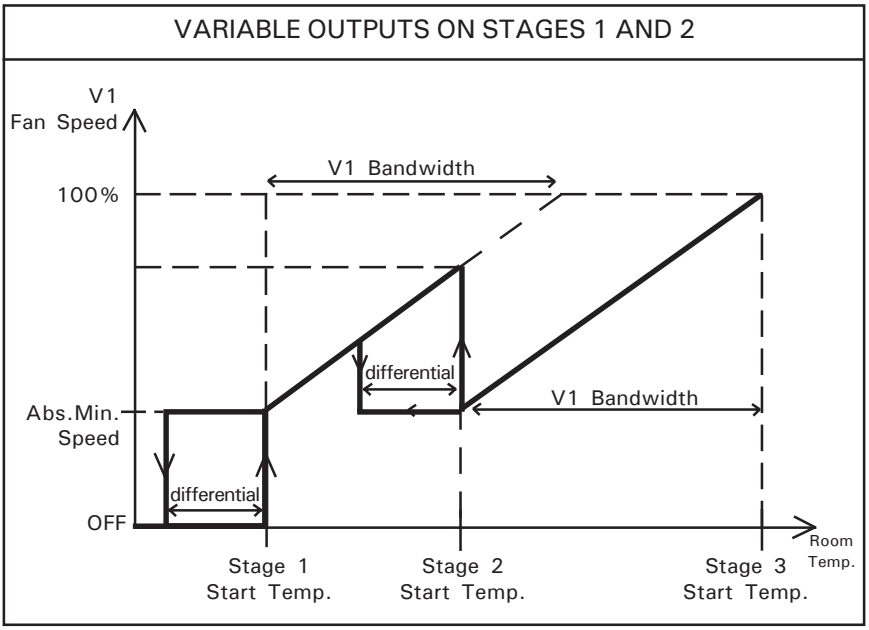
## Variable Outputs

A variable ouptut is activated when the start temperature of the stage that uses the output is reached. The output is activated at the absolute minimum speed defined for the output (see User Setup) and the speed increases up to full speed when room temperature reaches the start temperature of the next stage.




If the next stage does not use the output, it is deactivated. Otherwise, the speed is reduced to the minimum speed. If the last fan stage uses variable outputs, they must be configured in on-off mode (see Output Setup).

Stages 1 and 2 operate differently. Stage 1 can only operate variable outputs. On-off outputs are not permitted though the variable outputs can be operated in on-off mode. In addition, a bandwidth is defined for each variable output when activated on stages 1 and 2. The figure below illustrates this for variable output V1.

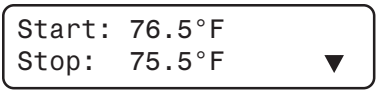



The bandwidth defines the interval over which the variable output goes from minimum to full speed. This is true even if full speed is never reached as in the example above. When the Stage 2 start temperature is reached, the variable output drops to its minimum speed value. The same bandwidth is then used to increase the speed as the temperature increases. Note that the Start-Stop temperature differential defined above for fan stages also applies to the variable outputs. When the temperature returns to the stage start temperature, the minimum speed is maintained over this interval.

## ❶ Adjusting Fan Start Temperatures

Note that the minimum temperature difference between two consecutive start temperatures is 0.5°F and the maximum is the value defined in the user setup. Note also that start temperatures for all consecutive stages are adjusted by the same amount. The stop temperature is automatically adjusted according to the common differential setting.

- Set the function to **SETTINGS – OUTPUTS** using the menu select buttons. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.

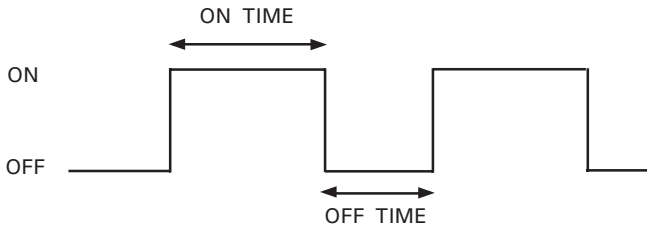



- Use the output select buttons to select the fan stage to adjust. The corresponding LED on the right of the front panel flashes.

- Press Edit key. The start temperature flashes. Use the arrow keys to adjust the start temperature to the desired value.

## 2 Adjusting Fan Timer Settings

If the fan stage includes certain relays configured to operate in cooling timer mode, a down-arrow appears on the right of the start/stop temperature display. When the temperature rises and a new stage is activated, the timer cycle starts with the on time portion. Conversely, when the temperature falls to the start temperature of the next lowest stage, the timer cycle starts with the off time potision. The user can adjust the timer settings as follows:




- Follow the procedure above to select the fan stage to adjust.

```
Start: 76.5°F
Stop:  75.5°F      ▼
```

- Press the down-arrow key to display the timer settings.

```
 ON time:  2m00    ▲
OFF time: 20m00
```

- Press the Edit key. The on time minutes value flashes on the display. Use the arrow keys to adjust the minutes to the desired value.

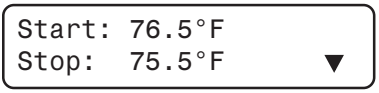
- Press the Edit key. The on time seconds value flashes on the display. Use the arrow keys to adjust the seconds to the desired value.

- Press the Edit key. The off time minutes value flashes on the display. Use the arrow keys to adjust the minutes to the desired value.

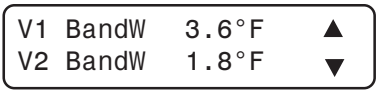
- Press the Edit key. The off time seconds value flashes on the display. Use the arrow keys to adjust the seconds to the desired value.

## 3 Adjusting Bandwidth on Variable Outputs

- Follow the procedure above to select the fan stage 1 or 2. The start and stop temperatures for the stage are displayed.




- Press the down-arrow key to display the bandwidths for the two variable outputs.

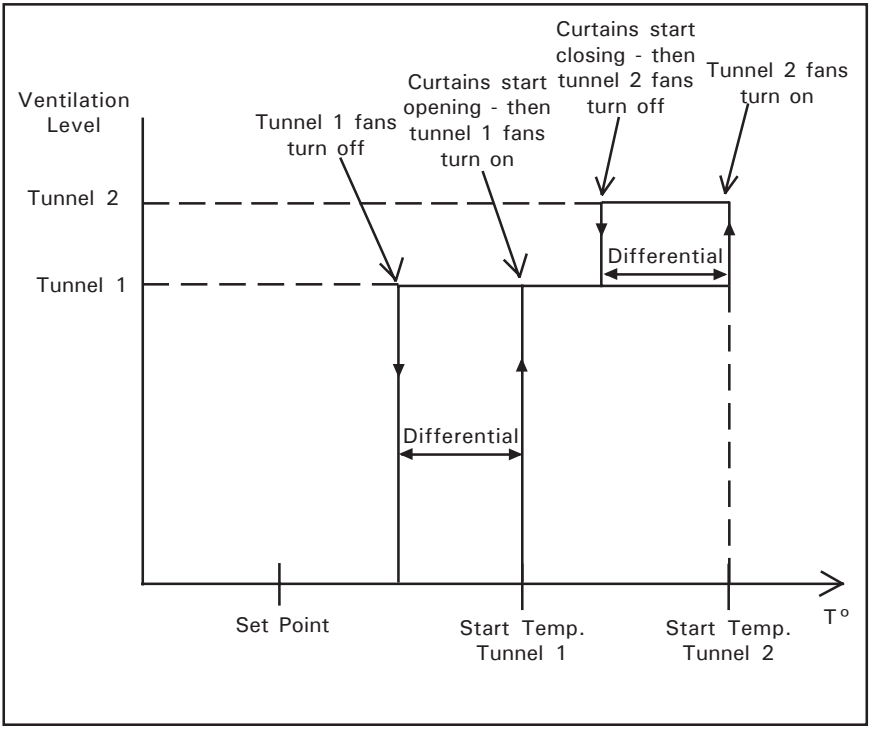



- Press the Edit key. The bandwidth for output V1 flashes on the display. Use the arrow keys to adjust the bandwidth to the desired value.

- Press the Edit key. The bandwidth for output V2 flashes on the display. Use the arrow keys to adjust the bandwidth to the desired value.

# TUNNEL VENTILATION

The Expert-50 allows you to control endwall curtains for tunnel ventilation. The user determines when to start tunnel ventilation by defining the starting fan stage and the stage at which the curtain is fully opened. When the first tunnel stage is reached, the curtains are opened according to the opening time defined for the first stage. When half of the opening time has elapsed, the fans for the stage are activated. When the next tunnel stage is reached, the curtains continue to open according to the opening time defined for that stage, etc. When the temperature drops, the same sequence is executed in reverse order. The following diagram sums up the operation of the first two tunnel stages.

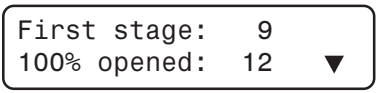



The user must also define a minimum animal age for using tunnel ventilation. Tunnel ventilation is never activated unless this age has been reached.

## 1 Adjusting First and Fully Opened Tunnel Stages

Fan stages 1 and 2 cannot be tunnel stages. The first and fully opened tunnel stages must be equal or in increasing order. Note all fan stages above the first tunnel stage are considered tunnel stages.

- Set the function to **SETTINGS** – **OUTPUTS** using the menu select buttons. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.

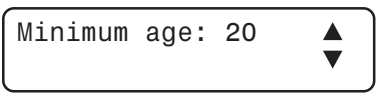



- Use the output select buttons to select **TUNNEL CURTAIN** – **OPEN**. The corresponding LED on the right of the front panel flashes.
- Press Edit key. The first tunnel stage flashes. Use the arrow keys to adjust the first tunnel stage to the desired value.
- Press Edit key. The fully opened tunnel stage flashes. Use the arrow keys to adjust the fully opened tunnel stage to the desired value.

## 2 Adjusting Minimum Age

The minimum age is used to prevent tunnel ventilation from being used when the animals are too young. The value ranges from 1 to 250 days. The tunnel stages do not operate until the herd age reaches this value.

- Set the function to **SETTINGS** – **OUTPUTS** using the menu select buttons. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.
- Use the output select buttons to select **TUNNEL CURTAIN** – **OPEN**. The corresponding LED on the right of the front panel flashes.
- Press the down-arrow key to display the minimum age.




- Press the Edit key. The minimum age value flashes on the display. Use the arrow keys to adjust the minimum age to the desired value.

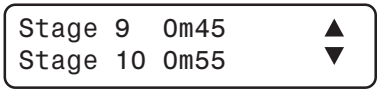
## ❸ Adjusting Curtain Operating Times

The curtain operating time is the time during which the curtain opens when a new tunnel stage is activated or closes when a tunnel stage is deactivated. This value is adjusted for each tunnel stage to control static pressure changes between tunnel stages*. When the temperature reaches the first tunnel stage starting temperature, the tunnel stage is delayed until half of the curtain operating time has elapsed (up to 30 seconds). When the last tunnel stage is reached, the curtains are opened continuously. Similarly, when the temperature drops to the start temperature of the first tunnel stage, the curtains are closed continuously. Operating times range from 0 minutes, 0 seconds to 15 minutes, 59 seconds.

- Set the function to **SETTINGS** – **OUTPUTS** using the function selector knob. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.

- Use the arrow keys to select **TUNNEL CURTAIN** – **OPEN**. The corresponding LED on the right of the front panel flashes.

- Press the down-arrow key twice to display the curtain opening times.




- Use the up-arrow and down-arrow keys to display the opening time to be adjusted. Press the Edit key as required until the minutes value of the opening time to be adjusted starts flashing. Use the arrow keys to adjust the minutes value to the desired value. Press the Edit key once again. The seconds value of the opening time starts flashing. Use the arrow keys to adjust the seconds value to the desired value.

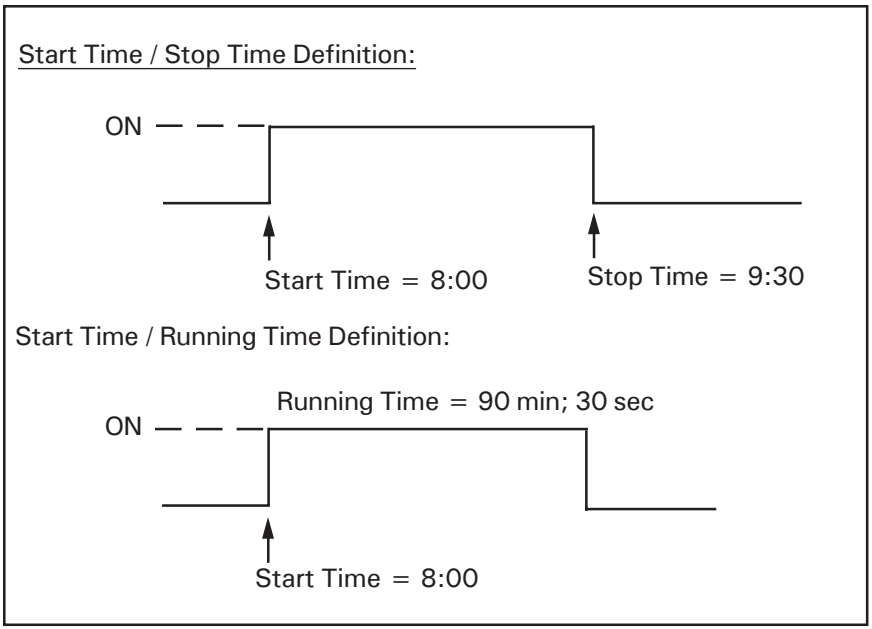
- Use the up-arrow and down-arrow and Edit keys to display and adjust the other opening times desired.

---

* If you do not want to control static pressure in this way, set the first and fully opened tunnel stages to the same value.

# CLOCK OUTPUTS

The Expert-50 has four timers for controlling various devices using the real-time clock. Each timer has 24 cycles defined using start and stop times or start and running times.




## Adjusting Clock Outputs

Each clock output has up to 24 clock cycles. Start and stop times can be adjusted to any clock time. Running times range from 0 hours, 0 minutes, 0 seconds to 15 hours, 59 minutes, 59 seconds.

- Set the function to **SETTINGS** – **OUTPUTS** using the menu select buttons. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.

```
1.Start:00:00A
  Stop: 00:00A    ▼
```

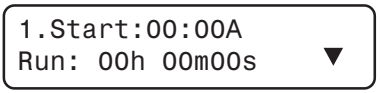
- Use the output select buttons to one of the four clock outputs. The corresponding LED on the right of the front panel flashes.

- Use the up-arrow and down-arrow keys to select the clock cycle to adjust. The clock cycle number appears on the top left hand side of the display.

- Press Edit key. The hours value of the start time flashes. Use the arrow keys to adjust the hours value to the desired value. Press the Edit key. The minutes value of the start time flashes. Use the arrow keys to adjust the minutes value to the desired value.

- If the timer is configured for start/stop times, press the Edit key. The hours value of the stop time flashes. Use the arrow keys to adjust the hours value to the desired value. Press the Edit key. The minutes value of the stop time flashes. Use the arrow keys to adjust the minutes value to the desired value.

- If the timer is configured for start/running times, press the Edit key. The hours value of the running time flashes. Use the arrow keys to adjust the hours value to the desired value. Press the Edit key. The minutes value of the running time flashes. Use the arrow keys to adjust the minutes value to the desired value. Press the Edit key. The seconds value of the running time flashes. Use the arrow keys to adjust the seconds value to the desired value. Note that if a power failure interrupts this output, it is reactivated for the remainder of the running time when power is restored.

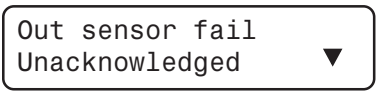


# ALARM SETTINGS

The alarm output is activated when certain alarm conditions are detected. For example, when the room temperature is too high or too low, an alarm is set off. Each new alarm type is recorded in memory until it is acknowledged by the user. If the alarm condition is still valid, the alarm is kept in memory. Otherwise, it is erased from alarm memory. The alarm conditions are as follows:

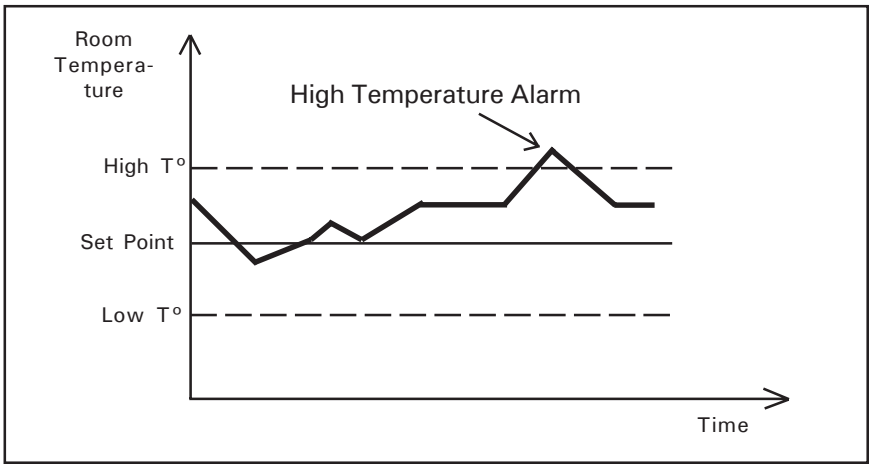
| Display | Meaning |
|---|---|
| Low T° | Low room temperature |
| High T° | High room temperature |
| Sensor fail | Room temperature probe is defective |
| RH sensor fail | Humidity probe defective |
| Low Battery | Backup battery is low |
| Power OFF | Power failure |
| Bad comm. ID#1 | Communication problem between main controller and the relay panel (relays #1 to 16). |
| Bad comm. ID#2 | Communication problem between main controller and the relay panel (relays #17 to 32). |
| Bad comm. ID#3 | Communication problem between main controller and the relay panel's variable module. |
| Bad comm. Inlet | Communication problem between main controller and the air inlet module. |
| Memory failure | Problem with memory chip |

When an alarm is ACTIVE, the alarm condition is still valid. The alarm remains in alarm memory even if the user acknowledges it. When an alarm is UNACKNOWLEDGED, it is kept in memory until it has been acknowledged by the user. Once this is done, it is erased from alarm memory. If an alarm is ACKNOWLEDGED, it has been acknowledged by the user but is still active.




Note that in the case of an active alarm, the alarm output remains activated even if the alarm is acknowledged.

The following diagram explains how temperature alarms are detected:




When the average room temperature exceeds the high temperature alarm setting, a high temperature alarm is generated. When the average room temperature drops below the low temperature alarm setting, a low temperature alarm is generated. Note that an alarm condition must remain active at least 30 seconds to be considered as an alarm.

## Adjusting Low and High Alarm Temperatures

The low alarm temperature can be adjusted from 40°F to 0.5°F below the set point. The high alarm temperature can be adjusted from 0.5°F to 60°F above the set point. A change in the set point will change these values by the same amount.

- Set the function to **SETTINGS – OUTPUTS** using the menu select buttons. The start and stop temperatures for Heater 8 are displayed and the Heater 8 LED on the right flashes.

- Use the output select buttons to select **ALARM**. The corresponding LED on the right of the front panel flashes.

- Press Edit key. The low alarm temperature value flashes. Use the arrow keys to adjust the low alarm temperature to the desired value.

```
Low:    74.5°F
High:   95.0°F
```

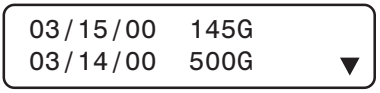
- Press Edit key. The high alarm temperature value flashes. Use the arrow keys to adjust the high alarm temperature to the desired value.

# WATER MONITORING

The Expert-50 provides a pulse input for monitoring water consumption. Water consumption is displayed for the current day and the past six days.

## Viewing Water Consumption

- Set the function to **WATER** using the menu select buttons. The water consumption for the current day and the previous day is displayed.




- Press the up-arrow and down-arrow keys to display water consumption figures for the five previous days.

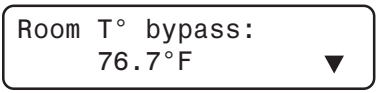
# TEST MODE

A test mode allows you to simulate temperature changes and verify controller performance. In test mode, the room temperature probe inputs are turned off, allowing the user to change the temperature used by the controller to operate the stages. The controller operates as before using the new temperature settings. The user can also activate each output separately.

## 1 Adjusting Room Temperature

When the room temperature is adjusted, the controller bypasses the temperature probe inputs and uses the new value as a reference.

- Set the function to **TEST** using the menu select buttons. The room temperature bypass value is displayed.

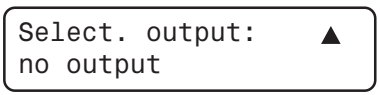



- Press the Edit key. The bypass value flashes. Use the arrow keys to set the bypass value to the desired value. The appropriate outputs are activated or deactivated immediately following the new temperature setting.

## 2 Activating Individual Outputs

- Set the function to **TEST** using the menu select buttons. The room temperature bypass value is displayed.

- Press the down-arrow key. The display shows "no output" meaning no output is activated. Press the Edit key. The Heater 8 output is activated and "heater 8" flashes on the display. Use the output select buttons to activate individual outputs in turn. To return to normal operations, press the Edit key or select another function.



# TECHNICAL SPECIFICATIONS

**Supply:** - 115/230 VAC (-18%, +8%),50/ 60 Hz, overload and over-voltage protection fuse F18-1A fast blow.

**Alarm Contact:** ON/OFF output, 24VDC or AC, 0.15A

**Temperature Probes:** Low voltage ( < 5V), isolated from the supply. Operating range: -40.0° to 120.0°F (-40.0° to 48.9°C). Accuracy: 1.8°F (1°C) between 41° and 95°F (5° and 35°C).

**Humidity Sensor Input:** 4 to 20mA current loop

**Water Meter Pulse Input:** Input pulse width > 12ms.

**Enclosure:** ABS, moisture and dust-tight.

**The room temperature where the controller is located MUST ALWAYS REMAIN BETWEEN 32° AND 104°F (0° AND 40°C).**

# FACTORY SETTINGS

| -PARAMETER | | FACTORY SETTING | RANGE OF VALUES |
|---|---|---|---|
| Temperature Set Point | | 75°F (23.9°C) | -40 to 100°F (-40 to 37.8°C) |
| Herd Age | | 1 day | 1 to 250 days |
| Minimum Ventilation | Minimum speed | | 0 to 100% |
| | On Time | 1m:30s | 0 to 99m:59s |
| | Cycle Time | 5m:00s | 0 to 99m:59s |
| | Minimum Speed Humidity Compensation | +0% | 0 to 100% |
| | Humidity Level for Compensation | 0% | 0 to 100% |
| Cooling | On Time | 0 | 0 to 99m:59s |
| | Off Time | 0 | |
| | Humidity Shutoff | 90% | 0 to 100% |
| Tunnel Ventilation | First Tunnel Stage | 9 | 3-12 |
| | Last Tunnel Stage | 12 | 3-12 |
| | Minimum Age | 20 days | 1 to 250 days |
| | Curtain Opening Time | 30s | 0 to 15m:59s |
| Clock Outputs | Running Time | 0 | 0 to 15h:59m:59s |
| Alarms | High Alarm Temperature | 95°F | 0.5 to 60°F (0.3 to 33.3°C) above the set point |
| | Low Alarm Temperature | 65°F | 0.5 to 40°F (0.3 to 22.2°C) below the set point |
| | Empty Zones Minimum Temperature | 40°F | -40 to 100°F (-40 to 37.8°C) |
| Heaters | Humidity Compensation Level | 0% | 0 to 100% |
| | Humidity Compensation On Time | | 0 to 99min 59s |
| | Humidity Compensation Cycle Time | | 0 to 99min 59s |

# RELAY ASSIGNMENT TEMPLATE

| OUTPUT/ RELAY # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | V1 | V2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heater 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Heater 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fan 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tunnel Open | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tunnel Close | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clock 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clock 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clock 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clock 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |