# CLIMATEBOSS
# Controller
# (RWL & GHK Mode)

## Operation Manual

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# Contents


Introduction ..... 3
Notes ..... 3
Home Screen Overview (RWL Version) ..... 5
"More" Screen Overview ..... 7
Controller Operations ..... 8
- Overview/Features ..... 8
- Controller Operations: Stages – DIF, DAY, NIGHT ..... 8
- Controller Operations: Options ..... 8
- Controller Operations: Target Temperature ..... 9
- Controller Operations: Proportional Outputs ..... 9
- Controller Operations: Heating Outputs ..... 10
- Controller Operations: Output Steps ..... 11
- Controller Operations: Output Temperature ..... 11
- Controller Operations: Output ON/OFF Transitions ..... 12

Menu Screen ..... 15
- Output Status ..... 15
- Settings options ..... 15
- Configuration options ..... 16

Programming ..... 19
- Stages – DIF, DAY, NIGHT ..... 19
- Programming Strategy (vents set to PID mode) ..... 19
- Proportional Outputs: 5-Step Vent Control or PID Control ..... 20
- Outputs (Heat 1, Cool 1…) ..... 21
- Date & Time ..... 22
- Dehumidification Vent Cycle ..... 22
- Timer/Mister Outputs ..... 24
- Shade/Energy Curtain Control ..... 27

*HAF and AUX Output Operation (Models C or H)* ..... 29
- AUX Outputs ..... 29
- Heat 3 Option (Models H & CH) ..... 29
- HAF Outputs ..... 30

Wind/Rain Alarm Integration ..... 30
Statistics ..... 31
Overrides ..... 32
- Target Temperature (Set Point) Override ..... 32
- Vent Cycle or Timer Manual Start ..... 32
- Outputs ..... 32

Error Codes ..... 32
Appendix A: Celsius Settings Conversions ..... 33
- Appendix B: Default Settings ..... 34
- Appendix C: Humidity Sensor Option ..... 35
- Appendix D: PAR/Light Sensor Option ..... 36

# Introduction

The Bartlett Instrument *ClimateBoss,* a greenhouse environmental controller, which features a versatile touch screen for easy programming and quick status indication. The manual starts with terminology, then a road map of the home screens (**Page 5**), followed by an overview of the operation, the menu items and then detailed programming instructions for each feature. These features include: 2 heating and either 4 vent outputs (RWL) or 4 cooling outputs (GHK), DIF, DAY, and NIGHT Stages, 2 cycle timers for irrigation, misting or lights, high and low temperature alarms, statistics, and much more. The *ClimateBoss* is equipped with Wi-Fi capabilities to receive firmware updates, as well as allow remote programming and monitoring of the controller through the Bartlett Headgrower app, available on Android, iOS, and desktop.

# Notes

- The controller uses a 24-hour clock format (military time). Ex: 5 PM = 17:00
- The DIF stage must start before the DAY stage and DAY must start before NIGHT
- Allowable target temperatures range from 32°F to 131°F.
- Allowable offsets for each heat ranges from 0°F to 31°F.
- When set for Louver/Fan (Forced Air) houses:
    - In single-zone mode, COOL 2, 3, 4 activate 30 seconds after COOL 1 to allow louvers to open.
    - In two-zone mode, COOL 2 and COOL 4 will not activate for 30 seconds after COOL 1 and COOL 3 (respectively).

## *Definitions*

First, we need to define and understand some terms.

| TERM | MANUAL DEFINITION AND DESCRIPTION |
|---|---|
| Output | OUTPUT is a relay that corresponds to a particular function – heat, open, close, timer, etc. |
| Target Temperature/Set Point | The base temperature set for each stage (DIF, DAY and NIGHT). Usually is the temperature for the first HEAT to come on. Commonly abbreviated as SP. |
| Step Size | The STEP SIZE is the amount of change required in temperature before the controller will transition to a new percentage. |
| Offset (Set Point +/-) | Used to calculate an output's activation temperature. The value represents the difference between the target temperature and when your output will turn on. Ex: with a target temperature of 50°F and an offset of -3, heat 1's activation temperature will be 47°F.<br><br>Commonly abbreviated as SP+/-. |
| Output Temperature | This is the TARGET TEMPERATURE with the OFFSET applied. |
| Trip Point | The temperature at which an output (relay) turns on or off. |
| Appliances | APPLIANCES are the heating and cooling connected to the controller. |

# Home Screen Overview (RWL Version)

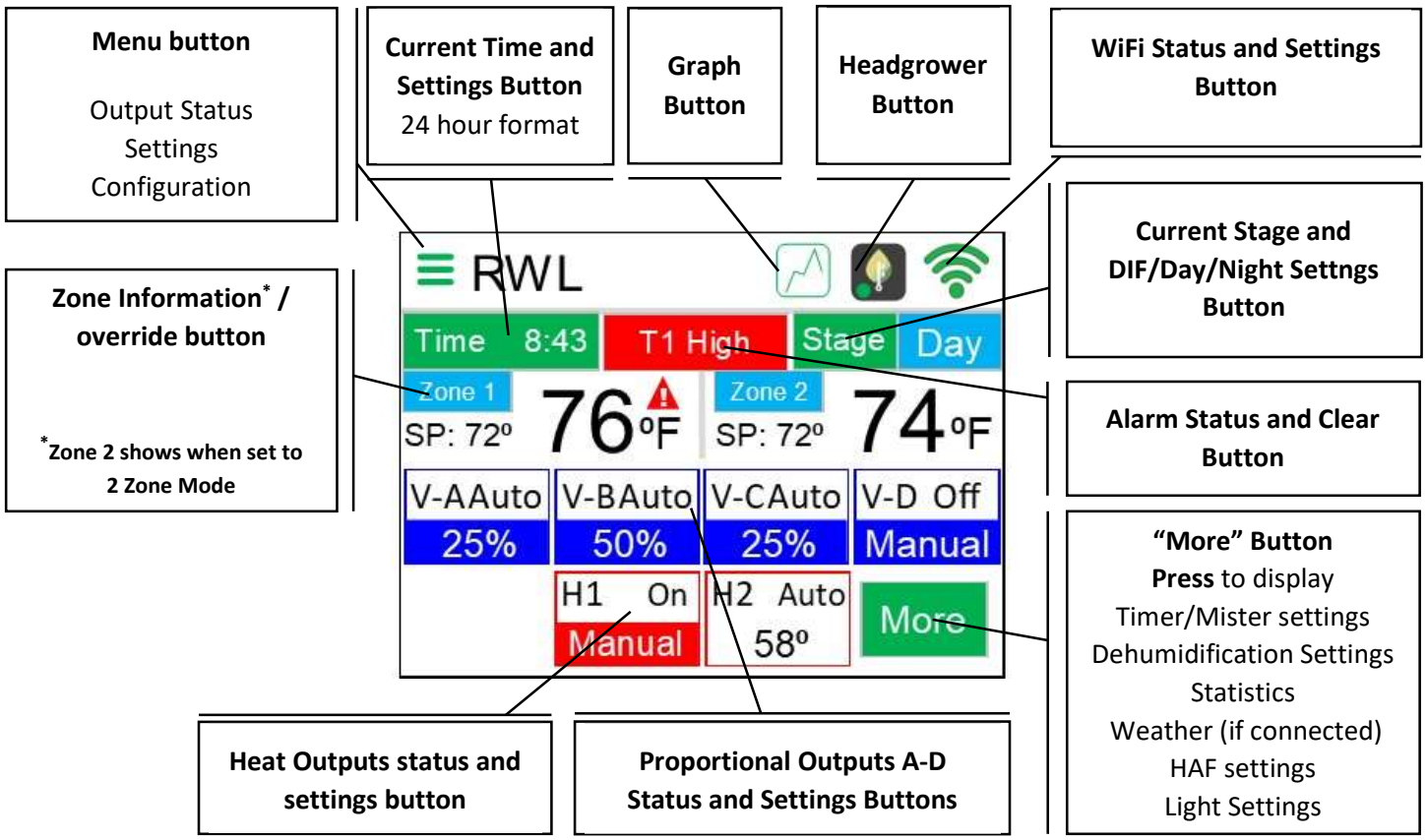



***Figure 2:*** *Home Screen Overview (RWL)*

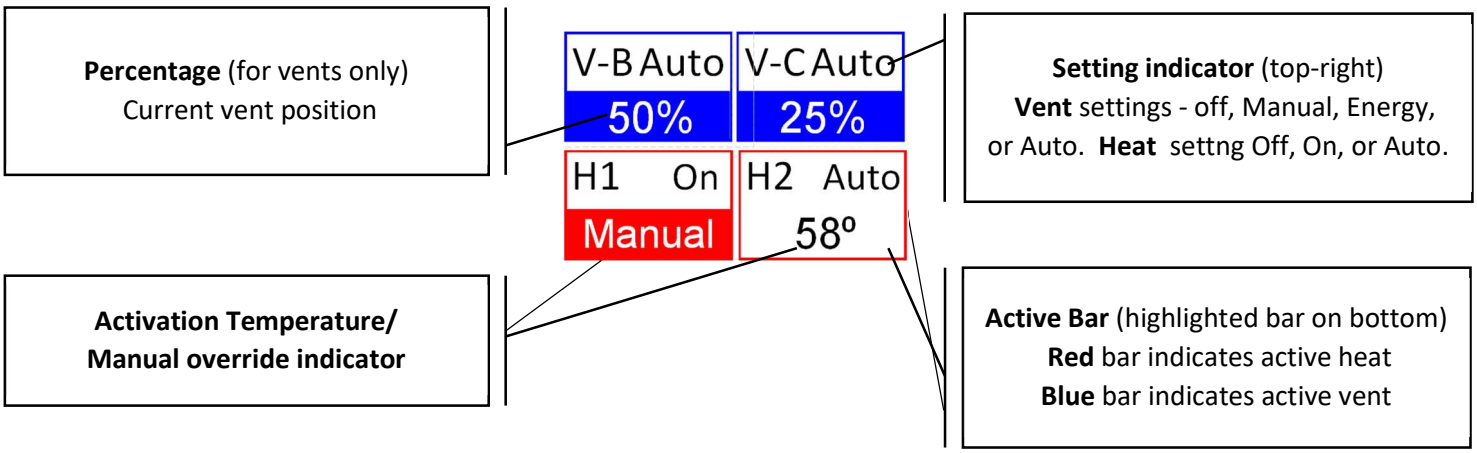



***Figure 1:*** *Output indicators (RWK)*

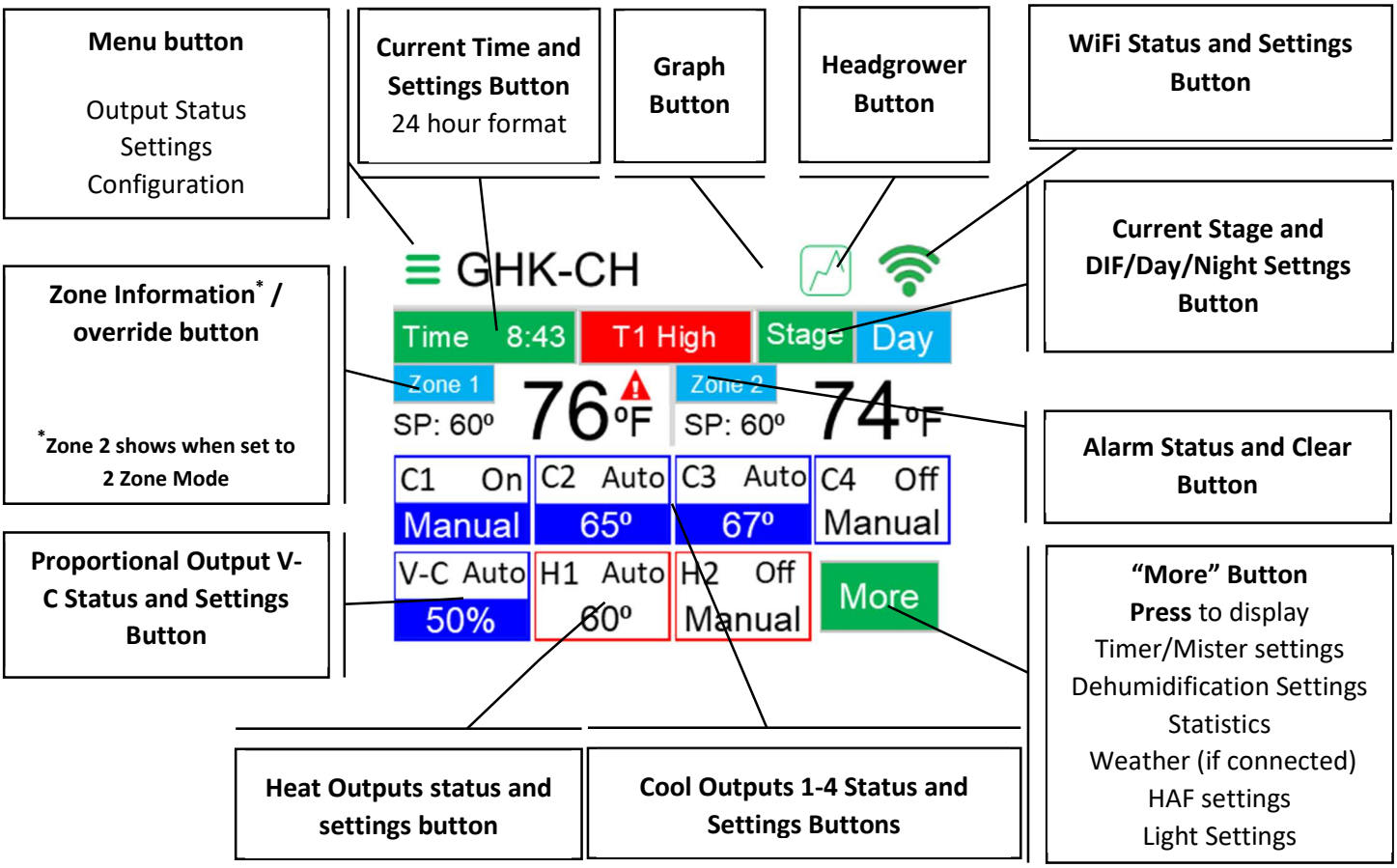



***Figure 3:*** *Home Screen Overview (GHK)*

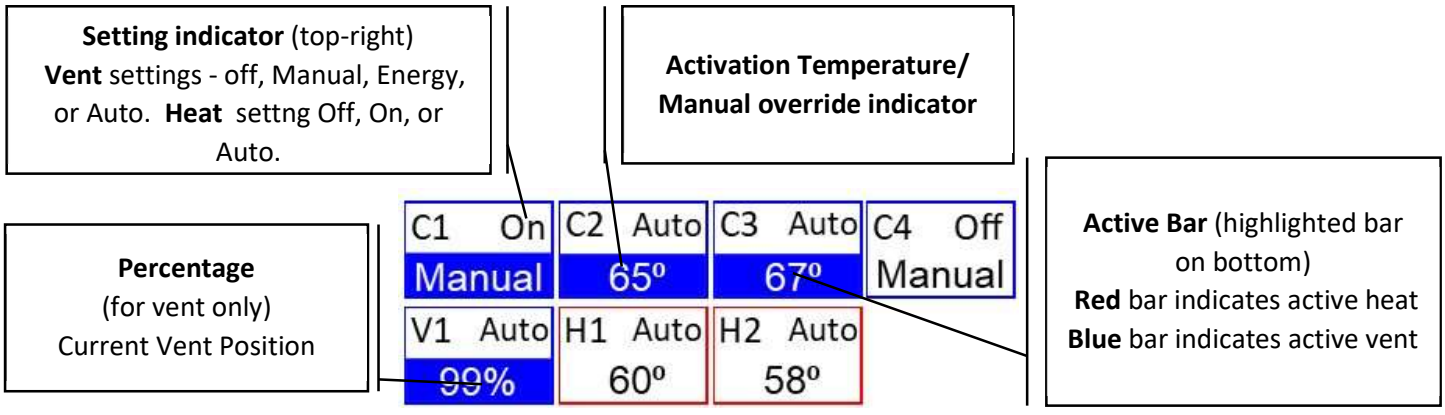



***Figure 4:*** *Output Indicators (GHK)*

# "More" Screen Overview

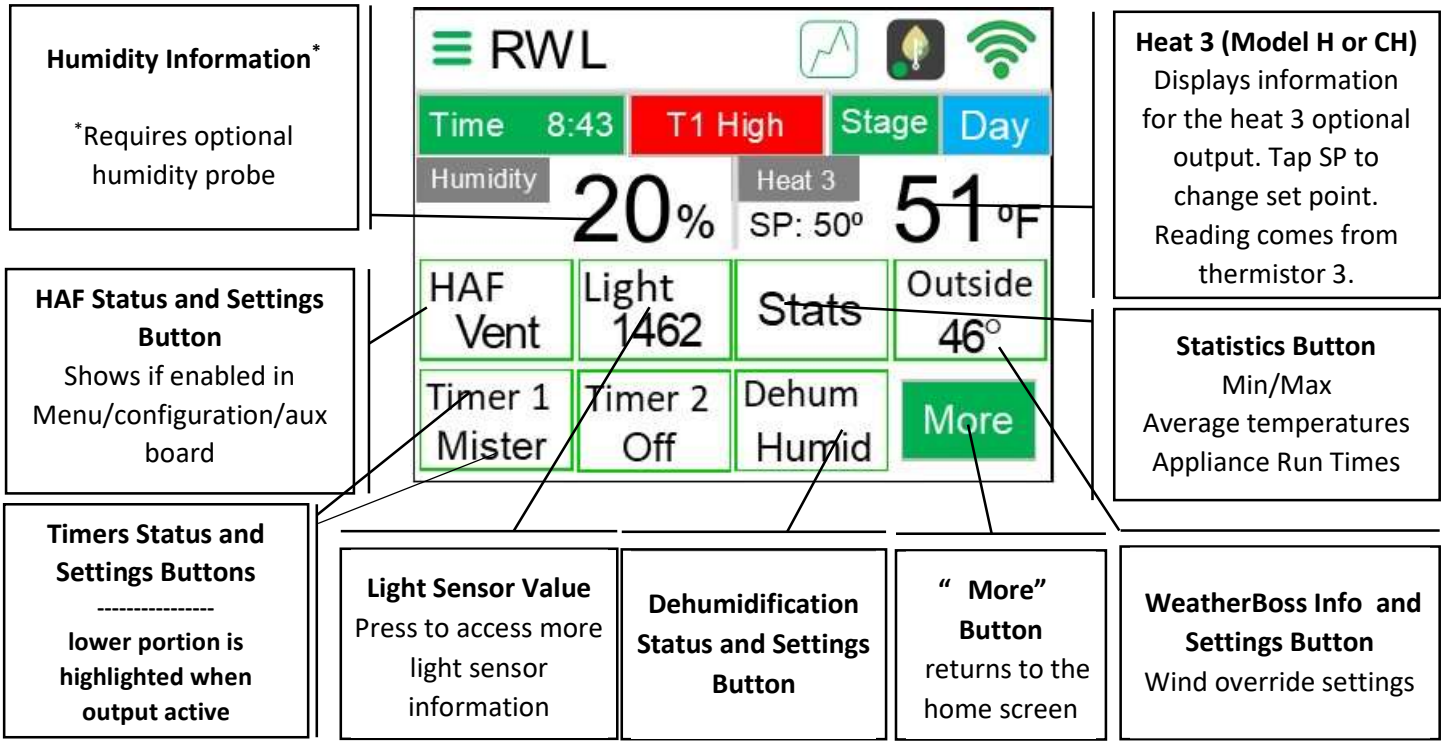



***Figure 5:*** *More Screen Overview (RWL)*

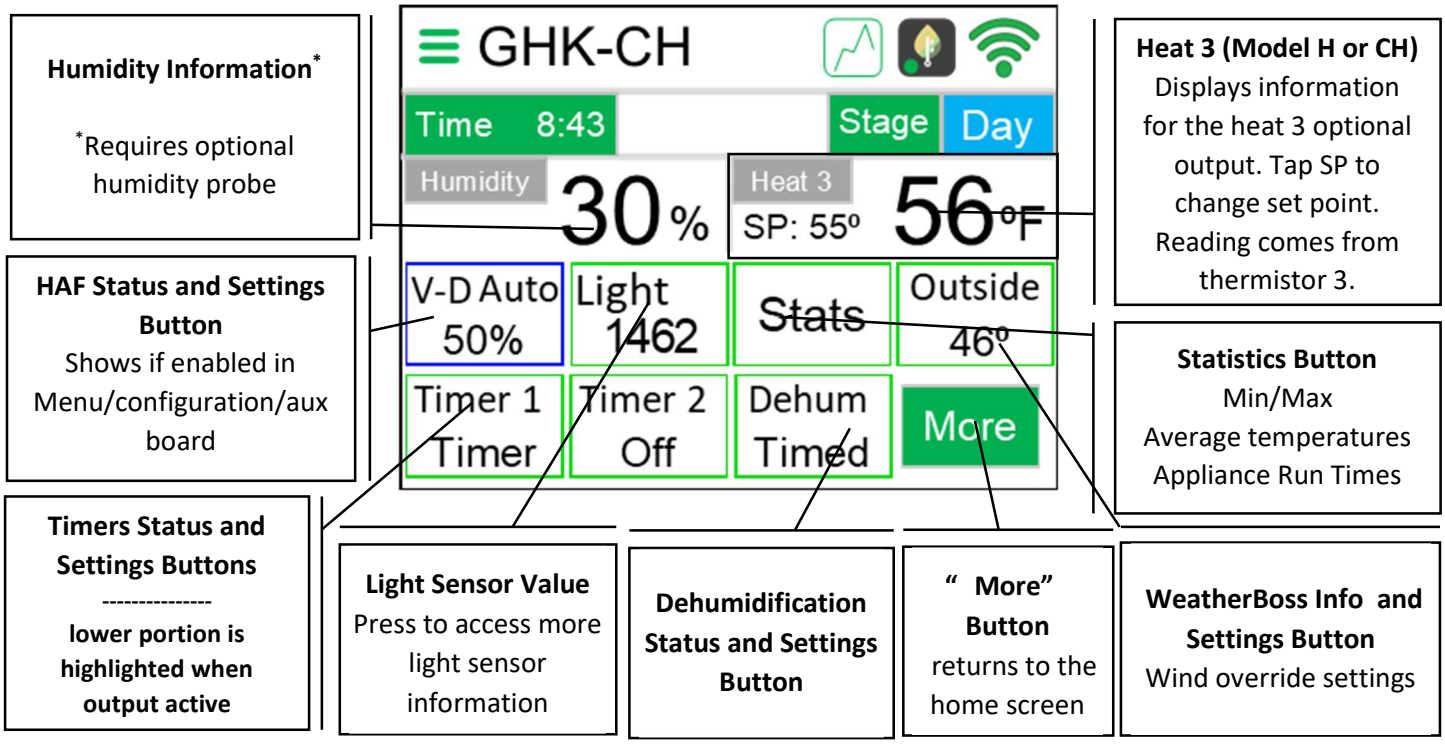



***Figure 6:*** *More Screen Overview (GHK)*

# Controller Operations

## Overview/Features

The *ClimateBoss* environmental controller for natural vent houses is a growing tool with multiple set points and data collection to save you time and money. Here are the *ClimateBoss* series main highlights.

- DIF, DAY, and NIGHT temperature setting for height control and energy savings.
- 2 temperature sensors allow 1 or 2 zone operation. (1 large area or 2 ground-to-ground houses)
- 2 heat steps and 4 proportional outputs for roof vents and sidewalls. (RWL mode)
- 2 heat and 4 cool outputs. (1 heat and 2 cools per zone in 2 zone) + 2 proportional (GHK mode)
- 4 proportional outputs with "vent saver" (PID) or 5-position operation
- High and Low temperature alarm settings. (in 2-zone mode, independent setting for each zone)
- Statistics/average temperature for each stage and 24hr period.
- Timer/Mister outputs for lights or irrigation/fogging.
- Optional humidity probe input to trigger a dehumidification vent cycle or a humidify misting cycle.
- Optional Light input for Shade control, supplemental lighting control or misting activation.

Controller Operations: Stages – DIF, DAY, NIGHT

## Controller Operations: Stages – DIF, DAY, NIGHT

The *ClimateBoss* has three operating stages (DIF, DAY, and NIGHT).

- The DIF stage allows you to adjust the temperature a few hours before sunrise to help control crop height.
- The DAY stage allows you to take advantage of solar energy to increase the daytime temperature so you can maintain the correct average daily temperature to control crop maturity.
- The NIGHT stage allows you to lower the temperature at night to save on heating.

Note – if you are not using a stage, simply set the temperature the same as the DAY setting.

## Controller Operations: Options

### *Option C – Adds Proportional Output for Curtain/Vent Control*

The model ACLIMATEBOSS-C has the standard features listed above plus time proportional outputs (open/close) to control a curtain, roof vent, or vent window. It has a programmable step size and 5 steps of control.

### *Option H – Adds 3rd Heat Output, Set Point Heat Output*

The model ACLIMATEBOSS-H also has the standard features and includes an extra heat output with an independent set point and a sensor for controlling boilers or bench heat. This is accessible from the *more* option on the home screen.

***Option CH – Curtain/Vent Control + Set Point Heat Output***

The model ACLIMATEBOSS-CH combines the standard feature, curtain/vent control, and set point heat.

On the home screen, you can check which model you are using by looking at the model at the top. It should say GHK, GHK-C, GHK-H, or GHK-CH.

You can also check your firmware version at any time through *Menu > Configuration > Controller Info.*

# Controller Operations: Target Temperature

The figure below explains the workings of the stages, DIF, DAY, and NIGHT.

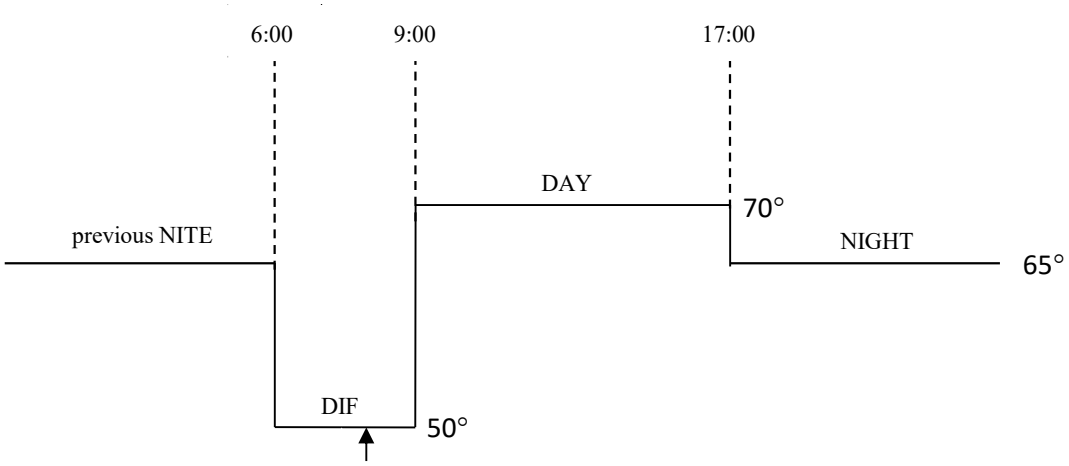



***Figure 7**: Target Temperature Changing With Time Of Day*

**Figure 7** shows the controller programmed the DIF stage to start at 06:00 (6:00 am), the DAY stage at 09:00 (9:00 am) and the NIGHT stage for 17:00 (5:00 pm). The target temperatures for the DIF stage: 50°F, the DAY stage: 70°F, and the NIGHT stage for 65°F. As indicated by the arrow, at 8:00 am you are in the DIF stage and the target temperature is 50°F.

# Controller Operations: Proportional Outputs

A proportional or incremental output for cooling consists of an open and close signal. They are used to operate vents, rollup walls, or curtains. For example, the *ClimateBoss* has up to 4 proportional outputs (GHK mode has 2, RWL mode has 4), each with independent settings so two could operate roof vents and the other two could operate side vents. The *ClimateBoss* calculates the required vent opening based on temperature. It then pulses the open or close signal to move the vent to the desired position.

The *ClimateBoss* proportional outputs have 2 operating modes to choose from. The first, labeled PID, is a vent-saver or drive-to-set-point algorithm. In PID mode, the vent will initially open to **PERCENT** 1 when the temperature rises 1 “step” above the target temperature. From there, the controller monitors the rate and direction of temperature change and adjusts the vents as needed. The

incremental change minimizes overshooting the correct opening and reduces movement. As a safety measure in cold weather, the maximum vent opening in PID mode is the value in **PERCENT** 5 + 6%.

The 5-step mode operates the vents using five positions defined by the user. These are given as percentages of the fully-opened position for the vent. Essentially, the *ClimateBoss* will wait for the greenhouse temperature to raise one **STEP** above the **TEMPERATURE SET POINT**. After the greenhouse temperature has been at this reading for the **THRESHOLD** time, the vent will open to the **STEP 1** percentage as defined by the user (see **Programming on Page 19** for more info). If the greenhouse temperature continues to climb to **TEMPERATURE SET POINT + (2 x STEP)**, the vent will open to the **STEP 2** percentage after the threshold time has expired. It may continue in this manner until the temperature has risen to **TEMPERATURE SET POINT+ (5 x STEP)** before opening to the final step/percentage.

See **Programming on Page 19**, for details on changing mode, step size, threshold time, full open time and weather override.

**Figure 8** (below) shows the activation temperatures with respect to the target temperature for each output

## Controller Operations: Heating Outputs

The target temperature is the baseline for determining when each heat comes on. Each heat has an offset to be subtracted from the target temperature to determine that output's activation temperature. Therefore, as the target temperature changes with the operating stage (DAY, DIF, NIGHT), the activation temperature for each output also changes. **Figure 8** shows the sample settings for the step temperatures and the activation temperatures with respect to the target temperature for each output.

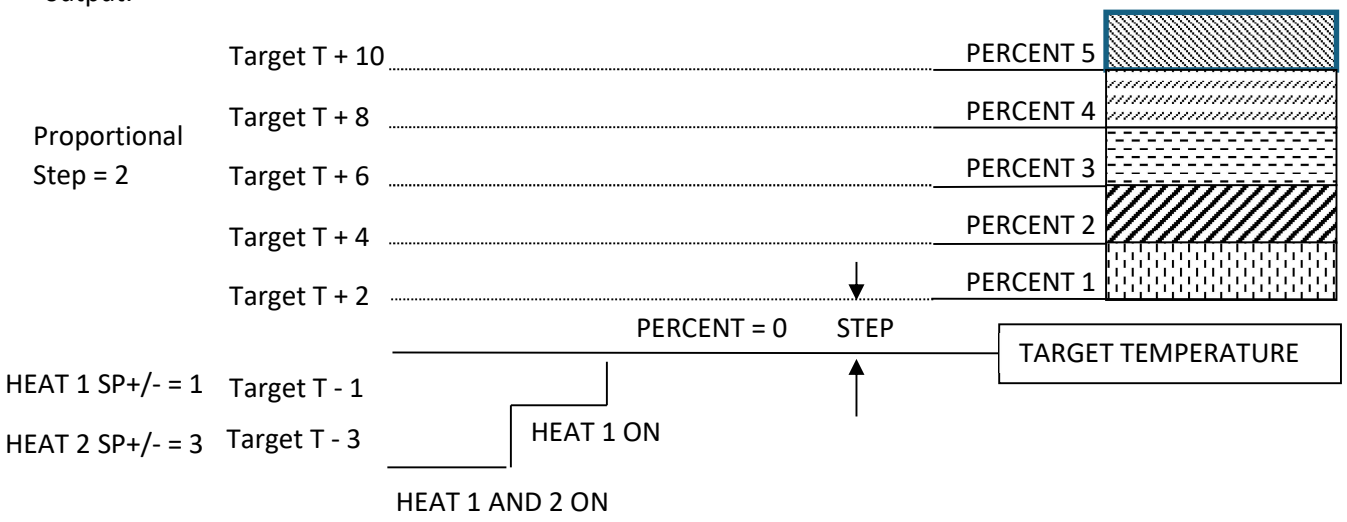



***Figure 8:*** *Set Points and Offsets*

## Controller Operations: Output Steps

The target temperature is the baseline for determining when each output comes on. Each output has a temperature offset to be added to (Cools) or subtracted from (Heats) the target temperature to determine that output's activation temperature. Therefore, as the target temperature changes with the operating stage, the activation temperature for each output changes. **Figure 9** shows the sample settings for the step temperatures and the activation temperatures with respect to the target temperature for each output.

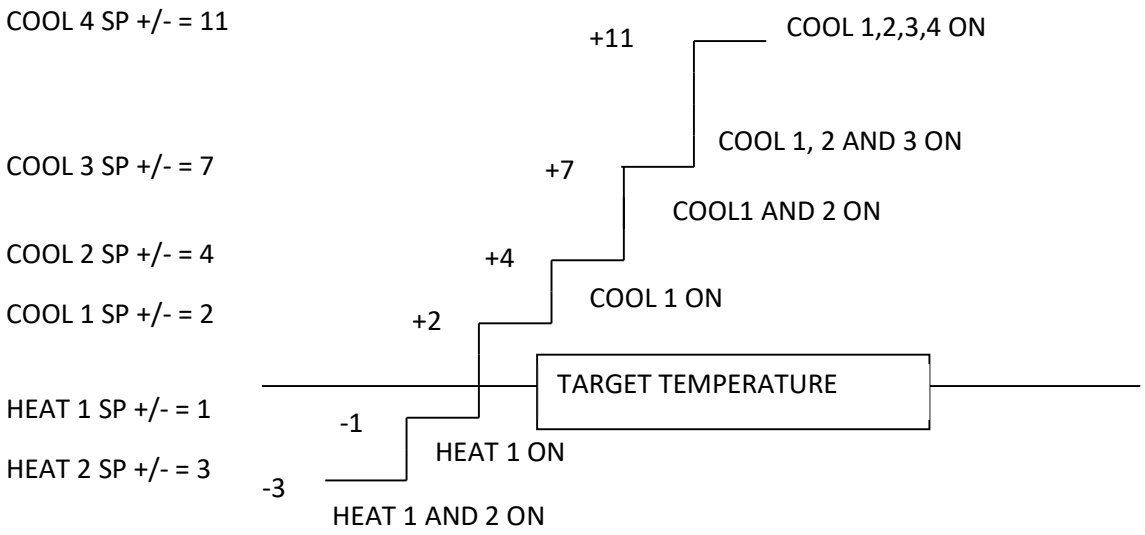



***Figure 9:*** *Output Steps*

## Controller Operations: Output Temperature

Using the information in **Figure 7 & Figure 8**, if the time is 8:00 AM the operating stage is DIF and the target temperature is 50°F. The output temperatures for each output are as follows:

| | Target Temperature | Step | Output Temperature |
|---|---|---|---|
| STEP 5 | 50° F | + 10 = | 60° |
| STEP 4 | 50° F | + 8 = | 58° |
| STEP 3 | 50° F | + 6 = | 56° |
| STEP 2 | 50° F | + 4 = | 54° |
| STEP 1 | 50° F | + 2 = | 52° |
| HEAT 1 | 50° F | - 1 = | 49° |
| HEAT 2 | 50° F | - 3 = | 47° |

***Table 1:*** *The Effect of Step on Target Temperature to Get Output Temperature*

Using the information in **Figure 7Error! No bookmark name given.** & **Figure 9**, if the time is 8:00 AM the operating stage is DIF and the target temperature is 50°F. The output temperatures for each output are as follows:

| | Target Temperature | Offset | Output Temperature |
|---|---|---|---|
| COOL 4 | 50° F | + 11 = | 61° |
| COOL 3 | 50° F | + 7 = | 57° |
| COOL 2 | 50° F | + 4 = | 54° |
| COOL 1 | 50° F | + 2 = | 52° |
| HEAT 1 | 50° F | - 1 = | 49° |
| HEAT 2 | 50° F | - 3 = | 47° |

***Table 2:*** *Step/Offset and Their Effect on Target Temperature to Get Output Temperature*

## Controller Operations: Output ON/OFF Transitions

The temperature where the output turns on or off is the trip point. The ON and OFF trip points for an output are separated slightly to prevent the rapid cycling of appliances, this is called hysteresis. When applied to your proportional outputs, it functions as a threshold time, or time spent above or below an output temperature before making the change.

## *Hysteresis*

For your heats or cools, the hysteresis setting, which is fixed at 1, is subtracted from your output temperature to get your ON value (for when your heat appliance will turn on) and is added to your output temperature to get the OFF value (for when your heat appliance will turn off).

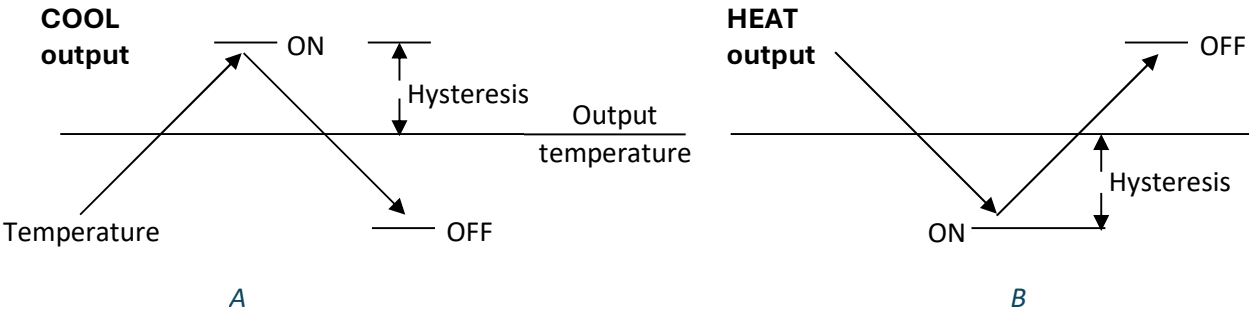



***Figure 10:*** *Hysteresis on both Cools and Heats*

Using the output temperatures from **Table 2** and a hysteresis setting of 1, the trip points for each output will be as follows (all temperatures are in $^{o}$F):

| | **Output Temperature** | **Hysteresis** | **ON** | **OFF** |
|---|---|---|---|---|
| COOL 4 | 61° | 1 | 62° | 60° |
| COOL 3 | 57° | 1 | 58° | 56° |
| COOL 2 | 54° | 1 | 55° | 53° |
| COOL 1 | 52° | 1 | 53° | 51° |
| HEAT 1 | 49° | 1 | 48° | 50° |
| HEAT 2 | 47° | 1 | 46° | 48° |

***Table 3:*** *Hysteresis and Trip Points*

## *Threshold (for Proportional Outputs)*

Hysteresis only applies to the heat outputs. For the proportional outputs (vents), it functions differently. They require the temperature to be above or below the next output temperature for a minimum amount of time before making the change. Once this time **threshold** has been exceeded, the output will move to the next step. The threshold is programmed through the menu options (see **Programming, page 19**)**.** See **Figure 11 & Figure 12** on the following page for a visualization.

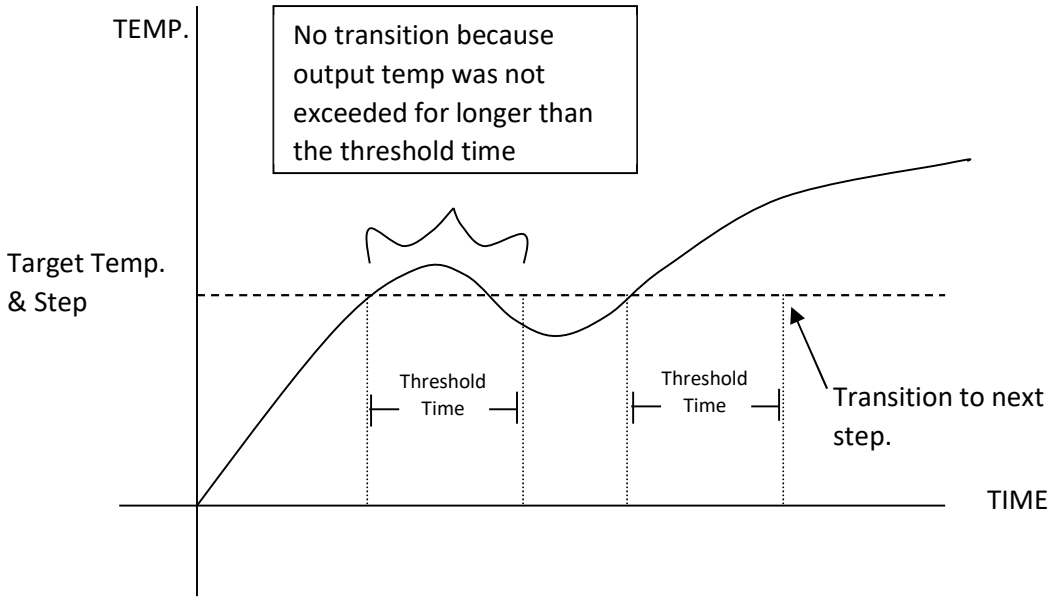



***Figure 11:*** *Threshold*

The figure below summarizes the information in the hysteresis and threshold tables graphically.

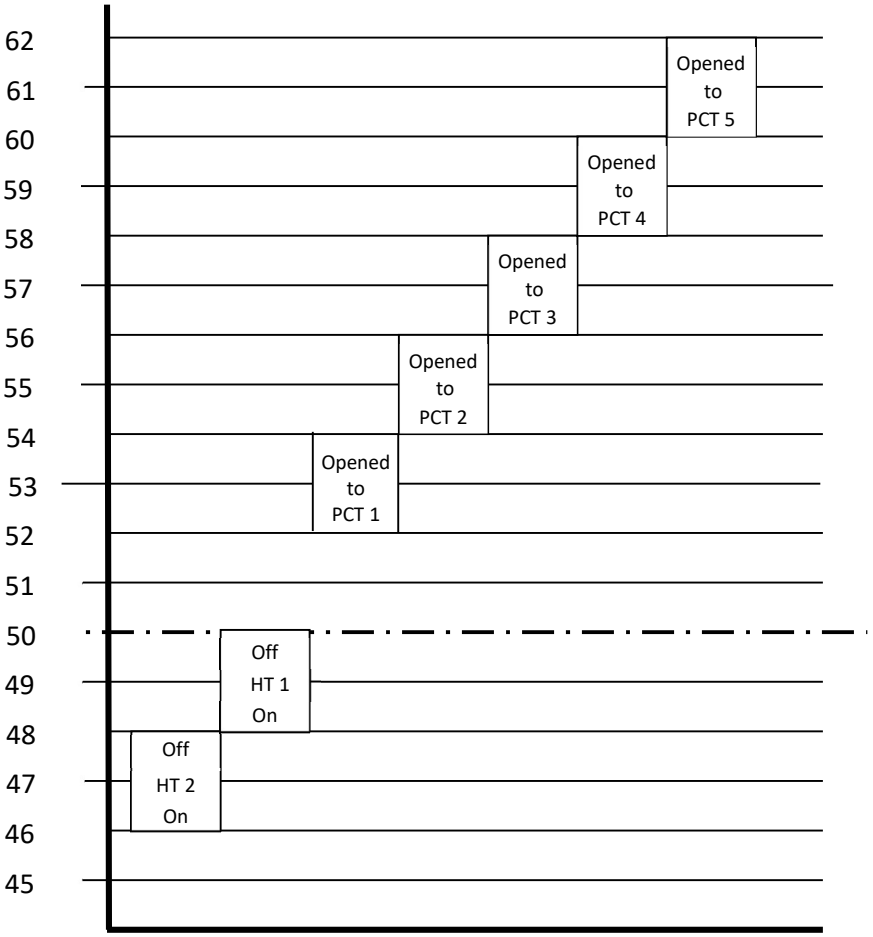



***Figure 12:*** *Hysteresis and Threshold*

# Menu Screen

By pressing the Menu button – indicated by 3 bars in the top left corner - on the Home Screen, you'll be taken to the Menu Screen. The Menu Screen has 3 options – **output status** for troubleshooting, **settings** and **configuration**.

## Output Status

This menu option shows all device outputs and their status (On / Off).

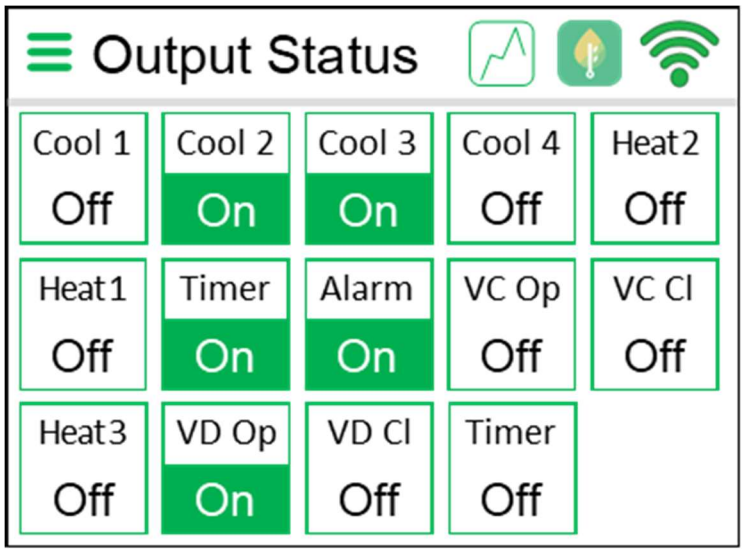



***Figure 13:*** *Output Status*

## Settings options

### Zone 1 Alarms

- **Zone 1 Low Alarm** - Used to set the temperature for Zone 1 low alarm. Default = 32°F. User can either set alarm temperature or disable alarm.
- **Zone 1 High Alarm** - Used to set the temperature for Zone 1 high alarm. Default = 131°F. User can either set alarm temperature or disable alarm.

### Zone 2 Alarms

- **Zone 2 Low Alarm** - Used to set the temperature for Zone 2 low alarm. Default = 32°F. User can either set alarm temperature or disable alarm. (Only appears when the controller is set for 2 Zones.)
- **Zone 2 High Alarm** - Used to set the temperature for Zone 2 high alarm. Default = 131°F. User can either set alarm temperature or disable alarm. (Only appears when the controller is set for 2 Zones.)

**On to Auto Time** – Sets duration time in minutes for when all outputs that have been turned on manually will return to auto. For more comfortable working conditions or if an emergency situation develops, any output may be turned on manually. On to Auto will return any output

that is set in the on position after a certain length of time has expired. To disable the On-to-Auto time, set to 0. Default = 10 minutes

**Heat/Cool Delay** – Sets the delay time (in minutes) when transitioning from cooling to heating. Default = 5 minutes. Minimum = 0 minutes. Maximum = 30 minutes.

**Thermistor Fail Mode** – Determine what the controller will default to if a thermistor fail error is detected. Setting to **Off** causes all outputs to turn off for the failed zone. Setting to **Heat** puts the controller in a 50% on/50% off heating duty cycle. The 50/50 cycle is designed for use during colder weather or in colder climates to prevent loss of crops. Default = Heat.

**Night Lockout Cools** – Used to disable all cooling outputs from running during the **Night** stage. This is used as an energy-saving feature. Enabling Night Lockout will prevent the dehumidification cycle from running in NIGHT mode.

**Set Clock** - Select to set the *ClimateBoss* clock. It is in military time. For Example: 3PM is entered as 15:00, 12AM is entered as 0:00, and 10AM is entered as 10:00. The clock can also be changed from the main screen by pressing Time.

**Set Date** – Select to set the Day, Month, and Year in the controller.

**Temperature/Speed Units** – Used to change the temperature & speed scale for the controller. Options are Fahrenheit/MPH or Celsius/KPH.

**Number of Zones** – Used to set the number of zones for the controller. When set to single-zone mode, the temperature readings from the 2 thermistors are averaged to determine the temperature. Both thermistors should be installed when using in single-zone. When set to 2 zone mode, thermistor 1 reads the temperature for zone 1 and thermistor 2 reads the temperature for zone 2. In 2 zone mode, the ClimateBoss has separate target temperatures for each zone. Default setting is 1 zone.

# Configuration options

**Controller Info** – Contains the **CIS ID** used to set a unique ID for each controller. **Firmware Version**, **Serial Number** and **Mac address** for the controller are also shown here. This information is used in conjunction with the Headgrower mobile app for remote monitoring and control of the Climate Boss. See the WiFi section for more information about firmware updates.

**WiFi –** Wi-Fi is used for Firmware download as well as for remote control and monitoring from the Headgrower mobile app (Requires subscription). These menu options can be accessed by pressing the WIFI icon on the home screen.

> **Enable Wi-Fi –** Enable or disable the Wi-Fi feature. **Disable** turns Wi-Fi capabilities off at all times. **Enabled** turns the Wi-Fi on any time it is within range of a setup Wi-Fi connection.
>
> **Wi-Fi Setup** – To set up Wi-Fi for the *ClimateBoss*, press "**Wi-Fi Setup**" and the controller will scan for nearby networks. Select your desired network and enter the password (if required) and press "**Save**".

*****For security reasons, we highly recommend that the user place all controllers into a separate logical network or VLAN, separate from other networks, routers, and hardware.**

**Update Firmware** – If your controller is connected to the internet through the WiFi module, by pressing Update Firmware, you will connect to www.bartlettinstrument.com to see if any updates are available. Once it has found the firmware, you have the option to update your controller. Updating firmware will **NOT** affect the timer programs.

**Reset WiFi** – Press Reset WiFi when having trouble with the WiFi connection. The controller will reset the WiFi connection and attempt to reconnect to your currently saved connection.

**Manual WiFi Setup –** Used to manually set up a WiFi network that is hidden or otherwise not found when running WiFi Setup. Enter the network name under SSID and press "**Save**". Under Password, enter the network password and press "**Save**".

**Advanced WiFi Setup** - helps customers diagnose WiFi configuration problems. Technicians may ask customers to utilize this menu if it is suspected that the firewall configuration is preventing correct connectivity. The Test DNS button will run a test to check if the domain name system records correctly associate the domain names needed for the controller.

**WiFi Status** - Displays the currently connected network, WiFi signal strength, and cloud connection status.

**Headgrower Options** – Separate documentation will be provided when you sign up for a a Headgrower subscription.

**Auxiliary Board** – Standard in the *ClimateBoss*. These outputs are configurable with the following options - (operation of HAF and AUX output are explained on page 29)

- 1 HAF, 2 Aux - allows operation of 1 additional auxiliary output for HAF fan control.
- 2 HAF, 1 Aux - allows operation of 2 additional auxiliary outputs for HAF fan control.
- Vent C + HAF – 3rd proportional output plus HAF fan control
- Vent C + Heat 3 – 3rd proportional output plus a 3rd Heat option

Auxiliary outputs are on when the percent open is greater than percent 1. The first auxiliary output is tied to Vent A and the second output is tied to Vent B.

**[Humidity] Calibration** – Used to enter the calibration code for the optional humidity sensor. Calibration codes can be found on the Humidity Calibration sheet sent with your humidity sensor. The humidity sensor does not come standard with the *ClimateBoss* but is an additional option. It can be used to run dehumidify cycles.

**Light Sensor Source**

- Off – Default value, used if no optional light sensor is connected

- BARSENZ-110 – Select if directly connecting the light sensor with the ClimateBoss. Often this selection means the light sensor installed inside the greenhouse.
- Weather Boss – Select this if the WeatherBoss has a light sensor connected and will provide the outdoor light reading across multiple greenhouses. If utilizing this option, remember to adjust light setpoint values to accommodate for the outdoor light level and not the light level within the greenhouse.

**Light Threshold Time** - Time, in seconds, to wait for any adjustments based on light sensor readings.

**Reset Factory Defaults** - Resets all settings to factory defaults. Upon selection, you will be asked to confirm before the controller will be reset.

**Calibrate Touch -** Used to re-calibrate the touch screen if buttons aren't working properly. Press the "**Calibrate Touch**" button and follow the onscreen instruction to re-calibrate.

**Software Reset** – Cycles power to the controller. This will NOT clear customer settings.

**Factory Protected** - Factory protected is used by Bartlett to set controller and display modes.

# Programming

## Stages – DIF, DAY, NIGHT

The *ClimateBoss* has 3 stages – DIF, DAY, and NIGHT. Each stage has a start time and a target temperature, as shown in **Figure 14**. (2-zone operation will have an additional target temperature for the second zone.

To change your stage settings, either use the *Program Settings* option in the menu or press the *current stage* button from the home screen (**Figure 2 and Figure 3**). The menu will look like **Figure 14,** seen below.

On this screen, you have both a start time and zone temperature for each stage. Keep in mind that you will only see the second zone if you are running your controller in two-zone mode.

To edit a start time, press the green text for the correct stage under the start column. Enter the time in the 24-hour clock on the next screen, then press save.

To edit a temperature, follow the same steps except under the zone1 or zone2 column, entering your desired temperature on the next screen.

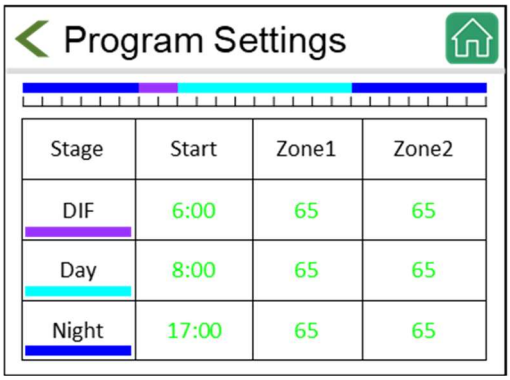



***Figure 14:*** *Program Settings*

You can see the timeline of your settings on the top of the screen, a full 24-hour timeline starting at 0:00.

## Programming Strategy (vents set to PID mode)

Basic programming consists of the following steps (1 zone):

1. Pick DAY start time – usually from 0 to 1 hour after sunrise.
2. Pick DAY temperature – usually where you want to start heating. (see note below if using 5-step)
3. Pick the NIGHT start time – usually an hour before sunset in the winter and up to an hour after in the summer.
4. Pick the NIGHT temperature – usually the same to a few degrees lower than day.
5. Pick the DIF start time – usually 1.5 to 1 hour before sunrise. (if not using DIF, set to same time as Day)
6. Pick the DIF temperature – for a reduced stretch, 5-10 ºF below NIGHT temperature, otherwise the same as night.
7. Determine Heat 1 offset – DAY temperature minus temperature to start heating.
8. Determine Heat 2 offset – same as Heat 1 offset for heats to run at the same time to a few degrees more.
9. Determine Vent 1 step size – Temperature to start cooling minus DAY temperature.
10. Determine Vent 2 step size – same as step 1 to a few degrees larger than step1.

Note – if vents are set to 5-step mode, the step size should be limited to 2-3 degrees. Therefore, the DAY temperature should be set to the first cooling point minus the step size.

## Proportional Outputs: 5-Step Vent Control or PID Control

There are 2 different options for running the proportional outputs – 5-Step Vent Control, or PID Control. When using 5-Step Vent Control, there are five steps in programming the proportional outputs: selecting a mode, choosing the step size, setting the percent open for each step, setting the threshold time for each output, and entering a full open time. The vent status box, on the home screen, is also the button to press to access the programming screen. The screen should look like **Figure 15**, seen below.

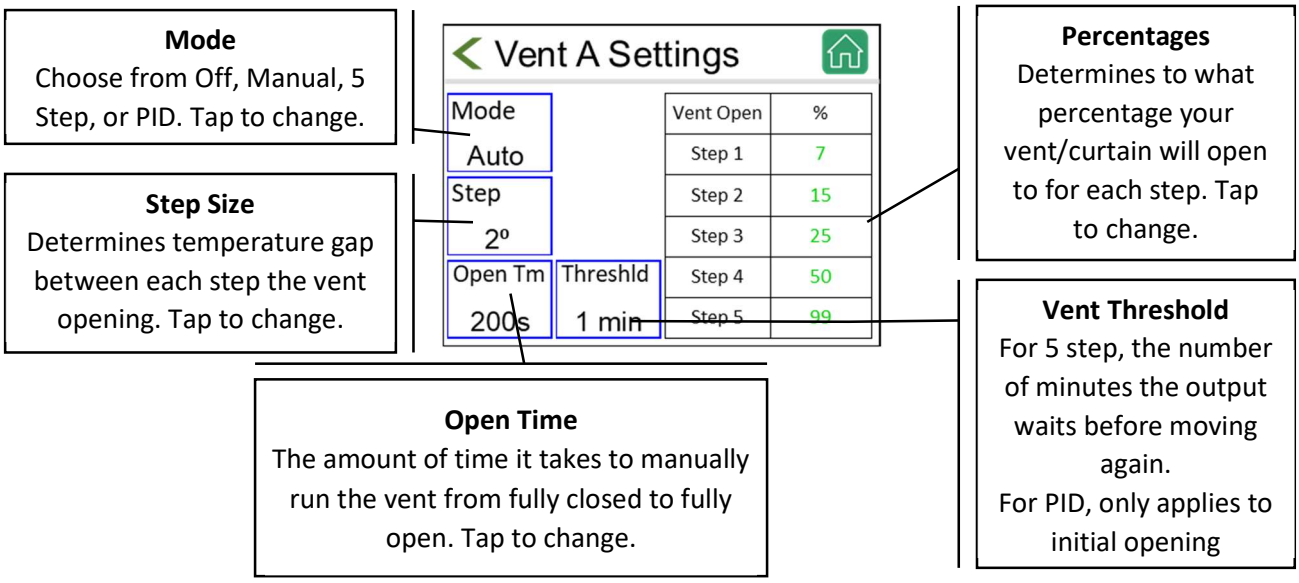



***Figure 15:*** *Vent Settings Page*

### *Options*

**Mode –** By tapping this box, you can select which mode you want your controller to run in. **Off** means the close output will stay active. **Manual** will make another box appear in which you can select a percentage for your curtain/vent. **5 Step** means the vent will open to different percentages based on your settings for Step and Percentages. **PID** (Proportional, Integral, and Derivative) is our vent save mode which tracks temperature change to mathematical determining how far to open a roof vent.

**Step Size** – Sets the tightness of control by determining how many degrees the temperature must rise above the target temperature before the vent opens to **Step 1,** then **Step 2,** then **Step 3, etc.** Tap this box to enter a value between 1 and 9.

**Vent Threshold –** In 5-step mode this is the number of minutes the temperature must be in the next step before the curtain/vent will open or close to the next setting. In PID-mode, this is the number of minutes the controller will rest at the first opening before making a second adjustment. Tap this box to enter a value between 1 and 9 minutes.

**Open Time –** You'll need to manually measure the amount of time (in seconds) to manually run the vent from fully closed to fully open. By tapping this box and entering a value between 0 and 9999 seconds, you can tell the controller the time that is required for the curtain or vent to transition from closed to full open.

**Percentages –** Determines to what percentage your vent/curtain will open to for each step. You can tap each green value in the chart to change it. Valid percentages are 0-99. 99% is full open. Percentages do **not** have to increase with increasing steps. For example, Step 1 & Step 2 could both be set to open the vent to 5%. When using PID Control, only percent 1 and percent 5 are used.

To synchronize the controller and appliance, set the curtain/vent to *off* and wait for the curtain/vent to close completely. Then, set the controller to *Auto* mode.

Your vent can also work with your Wind/Rain Alarm (not included) to automatically close your vents in the event of wind or rain. See page 30 for more information.

## Outputs (Heat 1, Cool 1…)

To access your output settings, either press *Heat/Cool Settings* in the menu or press any of your output indicators on the home screen (**Figure 2** and **Figure 4**)**.** You should see a screen like **Figure 14.** Be sure to read through the *Controller Operations* section of this manual so you are aware of how these values function. C1-C4 only apply when controller set for GHK mode.

**Mode**
On, Off, or Auto. Press to edit.

**Step (+/-)**
Difference between the temperature set point and the output's activation point. Press to edit.

Heat/Cool Settings

| | H1 | C1 | C2 | H2 | C3 | C4 |
|---|---|---|---|---|---|---|
| Dif | 65 | 68 | 70 | 65 | 72 | 73 |
| Day | 65 | 68 | 70 | 65 | 72 | 73 |
| Night | 65 | 68 | 70 | 65 | 72 | 73 |
| Mode | Auto | Auto | Auto | Auto | Auto | Auto |
| SP+/- | -2 | +3 | +5 | -4 | +7 | +8 |

***Figure 16:*** *Heat/Cool Settings*

**Output Temperature**
When the output will turn on. Not directly changeable. Rather, it is equal to Zone 1 Target Temperature for DIF (65, seen in **Figure 7)** + Cool 1 Step (+3)

### *Modes*

**Auto –** The auto mode automatically turns your outputs on and off depending on your **target temperature** (Set during Stage Programming, page 19) plus or minus your **step value**.

**On –** On setting activate the output regardless of temperature. The output will automatically be turned back to auto after a period of time determined by your On-to-Auto setting.

**Off –** Off setting deactivates the output regardless of temperature. The "on to auto" timer does NOT affect the "off" setting. To reactivate the output, manually select the auto or on setting.

### *Output Temperature*

The output temperature indicates when your appliance will activate. In the example of **Figure 11 (page 14)**, during the DAY, the Heat 1 appliance will turn on when the temperature falls below 69$^{o}$F. When the temperature goes back above 69$^{o}$F, the appliance will turn off.*

**note: because of the hysteresis setting (see Controller Operations), the appliance doesn't actually turn on until the temperature falls under 68$^{o}$F (69 – 1) or turn off until the temperature reaches 70$^{o}$F (69+1). This is to prevent the rapid cycling of your heats.*

This value is not directly changeable. Rather, it is calculated by taking your target temperature and adding/subtracting your offset value, see **Table 2 (page 12).**

Therefore, you edit this value by changing the offset value, seen below.

### *SP +/-*

To change your SP+/- (offset, or set point +/-) value, press the green number in the SP +/- row. Enter your value in degrees. It will automatically become a negative number.

## Date & Time

It is important to remember that the *ClimateBoss* uses a 24-hour clock (military time). For morning times, the clock setting will be from 00:00 until 11:59 and the afternoon settings are from 12:00 until 23:59.

To modify your current time, press the current time button on the home screen (**Figure 2 and Figure 3**). Enter the current time in military time and press save. You can also access this function from the Menu > Settings > Set Clock. To modify the current date, go to Menu > Settings > Set Date. Here, you set the day, month, and year individually.

## Dehumidification Vent Cycle

The vent cycle is a flexible dehumidification cycle. When active, the *Dehum* box on the more section of the main screen will be green and the orange box in the center will show the current cycle stage. The cycle can be started by a programmed start time, can be run manually, or can be run by high humidity if the optional sensor is installed. The dehumidify menu (**Figure 17**) consists of 8 different sections:

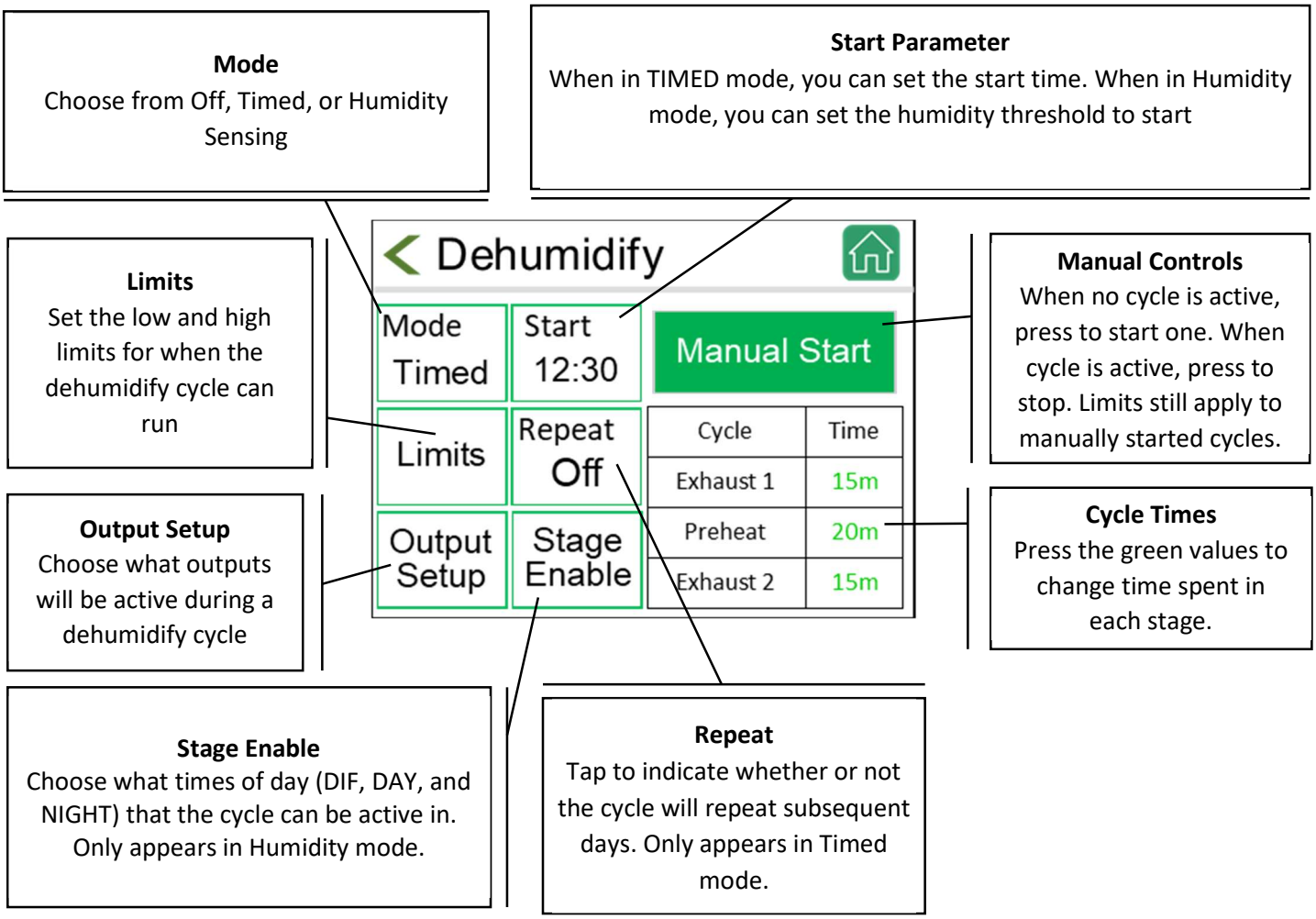



***Figure 17:*** *Dehumidification Vent Cycle*

## *Options*

**Mode –** By pressing the mode button, you are brought to a menu with three options: Off, Timed, and Humidity. Off means that the cycle will not run. Timed means that the cycle will start at a certain time during the day (with the option to repeat subsequent days). Humidity uses a humidity sensor (option is only available with an optional humidity sensor attached to the controller) to start the cycle when humidity breaches a set point.

**Limits –** The limits button allows you to set low and high limits to control when the cycle can run. If the temperature is below the low limit or above the high limit, the vent cycle will be aborted or will not start. By default, the limits are set to use your heat 1 output temperature as the low, and your cool 2 output temperature as your high. You can change it to use a custom value by pressing the checkbox next to *set temperature* and entering a value. The limits can only be set between the values of 32$^{o}$ and 131$^{o}$.

**Output Setup** – Pressing output setup will bring you to a menu showing all of your appliances. Here, you configure which appliances will be used during a vent cycle and whether the heats will

be used to maintain target temperature during the exhaust stages. If something is toggled off, it will not run during the vent cycle no matter its other settings.

On this menu, you will also see the option **Heat Enbl**. This option indicates whether your heat outputs will be active during the exhaust stage. When active, the heaters will work to maintain the programmed temperature in an exhaust stage. If inactive, the heats will remain off during an exhaust stage but if the temperature drops below 55$^{o}$F, the exhaust stage will be ended and the vent cycle will move on to the next stage.

**Start Parameter (Start or Humidity)** – If in *Timed* mode, this will show *Start* and will indicate a time of day that the cycle will start to run. If in *Humid* mode, this will show *Humidity* and will indicate a set point in which the cycle will start should humidity surpass it. To enter a value, press the start/humidity box, enter the value, and press save.

**Repeat –** This option only shows up if you are in *Timed* mode. Press it to toggle between on and off. If on, the vent cycle will continue to activate at its start time every day. If off, the vent cycle will activate at its start time a single time but then once the cycle completes, the mode will change to *Off.*

**Stage Enable** – This option will only appear if you are in *Humid* mode. It allows you to choose which times of day (DIF, DAY, NIGHT) the cycle can be active in. By disabling a time of day, the vent cycle will not activate during that day even if the humidity is above the set point.

**Manual Controls** – If no vent cycle is active, this green box will show *Manual Start*. By pressing it, you can start a cycle instantly. If there is a vent cycle active, the box will show *Manual Stop.* By pressing it, you can end the cycle. Manually started cycles will still be affected by any *limits* you have active.

**Cycle Time** – By pressing either exhaust 1, preheat, or exhaust 2, you will be able to enter the amount of time spent in each stage. Simply press the one you want to edit, enter a time in minutes (1-99), then press save.

### *Using the Vent Cycle in the 2-Zone Mode*

If you have the controller programmed for 2 zones but only want to use the vent cycle on one of the zones, go into the *output setup* and turn all the outputs for the zone not being vented to *off* (slider to the left) The zone with its settings at "Off" will function normally.

## Timer/Mister Outputs

The ClimateBoss has two, 2-stage timer outputs. The output refers to the physical relay output. The function of the output changes with the mode selected. The timers have three modes of operation – time of day timer, mister function or shade curtain function (Timer 1 only ). The 2-stage timer consists of two active stages (A and B) and IDLE time between the stages. Each stage is defined by a start time and run length. The active stages are shown on the midnight to midnight bar graph at the top of the timer display. The timer mode is for lights, irrigation or other appliance that needs to run at a specific time of day. The mister mode gives on-time/ cycle-time settings for running a mist solenoid. The shade mode will extend the curtain during the timer's active stage and retract during the idle stage. The shade mode also has a slow retract feature when used as an energy curtain.

All 3 modes can use a **light sensor** input. When running lights in the timer mode, the output will shut off when the light sensor reading exceeds a set point and come back on if the light level drops. The misting rate can be increased when the accumulated lights exceeds a set value and a shade curtain can be extended based on light level.

See the sections below for unique features of each mode.

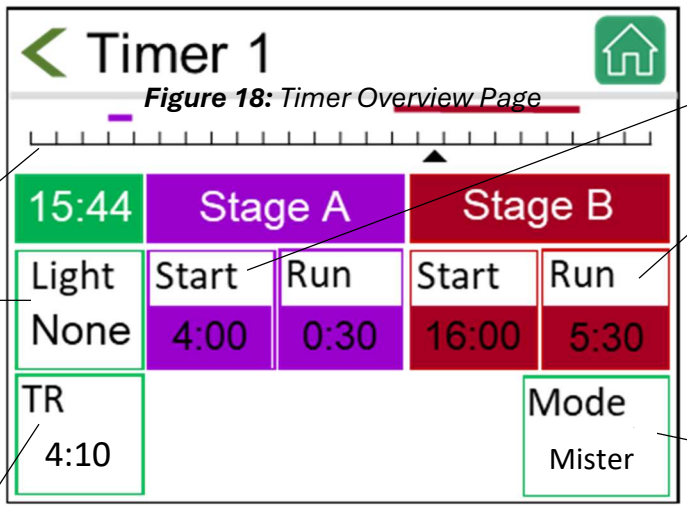



***Figure 18:*** *Timer Overview Page*

**Timeline:** Visual aid showing timer start, run time and current time

**Light Value:** Shows the current instantaneous light reading or None if no sensor configured.

**TR:** Time remaining (HH:mm). If timer is not running, will show X or 00:00.

**Start:** Only shown in Timer Mode – press for manual start.

**Abort/Stop**: Only shown in Timer Mode – press to stop timer for current stage.

**Start Time:** Shows the start time for a stage. Press to edit.

**Run Time:** Shows the run time for a stage. Press to edit.

**Mode Button:** Shows selected mode. Press to change and edit mode specific settings.

## *2-Stage Timer – programming quick start*

1. If using a light sensor, please ensure you have configured the controller for the correct sensor source and threshold time. To do so, press the menu button from the Home screen, then press Configuration. The two options necessary to configure are: Light Sensor Source and Light Threshold Time. Please see the description for each in the Configuration menu.
2. From the More Screen (or Home Screen 2), press either the Timer 1 or Timer 2 button
3. Press Mode button
    a. Select the mode – Timer/Mister/Shade
    b. Enable the timer – enable allows turning timer on/off without affecting settings
    c. Fill in additional setting such as light setpoint, on/cycle times, shade setting depending which mode is selected
    d. Press the back arrow to save the settings
4. Press Start button for stage A then enter and save start time – 24hr format
5. Press Run button for stage A then enter and save the duration of the stage – hr:min
6. Repeat for Stage B. If Stage B is not desired set duration to 0.
7. TR (time remaining) is informational to show how much longer an output will be active. It is color coded to the current stage.
8. Light Sensor Integration

a. The Light Value box reads the current light levels from the sensor.
b. The Light Set Point button allows you to configure the setpoint. Please refer to each Mode section for an explanation on how the timer will respond based on light level.

9. Timer mode has additional manual start and abort buttons.

## *Timer Mode*

The timer mode is for activating lights, irrigation valve or other appliances at a particular time of day for a programmed amount of time. **To program**, follow the steps in the quick start above. On the mode screen, set the mode to timer and enable the timer. If using the light sensor, the setpoint is adjusted on the mode screen, also. Use the back arrow to return to the timer main screen to set the start time and duration for Stage A. Repeat for Stage B.

**Manual timer mode**

The green "start" button on the timer's main screen will run a manual cycle. The cycle starts immediately and lasts for the programmed duration.

To program a manual timer cycle –

1. Press start – the duration time entry screen appears
2. Enter the length of time to run the timer. The format is hr:min
3. Press save. The controller goes back to the timer main screen and the start button is replaced with an "end" button. End will cancel the manual timer cycle. The manual cycle will show on the horizontal bar graph in green.

**Timer Abort button**

The "Abort" button will pause an automatic timer cycle. A "resume" button will replace the Abort button so the cycle can be reentered if desired. In a manual cycle, Abort acts like the "End" button.

**Light Set Point**

In the timer mode, the output will turn off if the light value reaches the light set point and remains above the set point for the configured light threshold. For example, consider a configuration where the light setpoint is 1500 and the light threshold is 120 seconds. If the light value reaches 1600, but then returns to 1100 after 10 seconds, the timer output will remain on the entire time. However, if the light value reaches 1550 and remains above 1500 for 120 seconds, the output will turn off and remain off until the light level returns to under 1500 for at least 120 seconds.

### *Mister Mode*

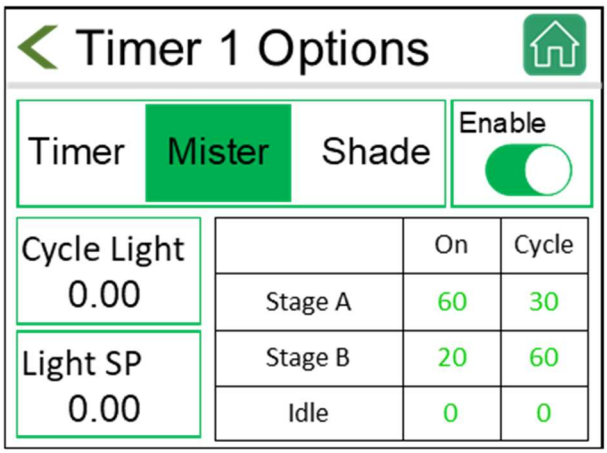



***Figure 19:*** Timer 1, Mister Mode

In the misting mode **(Figure 19)**, the timer output will activate for a number of seconds (the *On*-time) and will repeat after a number of minutes (the *Cycle* time). Stage A, Stage B and IDLE each have unique on and cycle times. For example, Stage A's start/run times can be set to cover the sunniest part of the day; Stage B's start/run times can be set to cover the dark of night and then the IDLE times will be during the shorter times with less intense sun. Stage A's cycle time will be the shortest; Stage B's the longest and IDLE's cycle time will be in between.

**To program**, from the timer screen, press MODE; press MISTER; then on time/cycle time grid appears. Press each square that you want to change and type in the new value and save. Remember ON time is in seconds (max 99) and cycle time is in minutes (max 99). Simply set the ON time to 0 for stages where no misting should occur. (if the light sensor is enabled, the MODE screen will have an accumulated light set point for decreasing the cycle time on sunny days.) Finally on the mode screen, ensure the timer function is enabled and press the back arrow. Next, on the timer main screen, program Stage A and B's Start time and Run times so the mist runs at the appropriate time of day.

**Light SP**

In mister mode, the daily light integral (see Appendix D) is used to adjust the cycle time. Set the Light SP to the DLI setpoint required before the controller automatically reduces the cycle time. Once the controller reaches the configured Light SP, the cycle time will be automatically reduced.

## Shade/Energy Curtain Control

The ClimateBoss's full featured shade control module uses time of day, light level (with optional light sensor) and/or temperature to activate. The shade control module also provides a slow retract mode for energy curtain use. Stage A and B define when the shade curtain will be active. The light and/or temperature set point determine when during the active stage that the curtain will extend.

**Time of day, shade control –** To have the shade curtain extend only by time of day, set Stage A/B's start and run times to be active when you want the shade to extend. To only use one of the timer stages, set the run time of the unused stage to 0. Then, set the light and temperature set points to 0 and 32 respectively.

**Time of day plus light level and/or temperature, shade control –** This is the same as above except the light and/or temperature set points need set to the appropriate levels. During the active time of stage A or B, and when the light level, or the temperature (zone 1 temperature if in 2-zone mode) exceeds their respective set point, the shade will extend. The light reading must meet the light threshold time requirement. The shade will retract when the timer stage ends or both temperature and light are below their set points. See Appendix D for details on light sensor settings.

**Slow Retract option –** The slow retract is generally used when an energy curtain is being used to retain heat at night. The slow retract will allow the cold air above the energy curtain to mix with the warm air to reduce any shock to the plants. The curtain retracts in 3 pulses separated by a pause time. The pulse length is set by step % on the mode screen when slow retract is enabled. The pause length between pulses is set by the pause button on the mode screen. The pause can be set from 0 to 30 minutes. The retract function will also be paused if the temperature drops more than 4 degrees. Once the temperature recovers, the retract will resume. After 3 pulses, the curtain will fully retract.

**To program shade –** from the Timer 1 screen, press MODE. On the MODE screen – press SHADE.

1. Enable the timer (slider shows green)
2. Enter the number of seconds required for the curtain to go from full extended to fully retracted
3. In "Temp sp" for shade operation, enter the maximum temperature at which the shade should extend. For energy operation, set this to 32
4. If the light sensor is enabled, set "light sp" to the instantaneous light level at which the shade should extend. Light level is in micromoles per meter squared per second. For energy curtain operation, set this to 0.
5. For energy curtain operation, you can enable slow retract by touching the slider.

- Set the step % to the amount the curtain should open each pulse. Typically, 10-15%. The first pulse will retract the provided step percentage (e.g. 25% if configured like Figure 16); then the second pulse would retract an additional percentage (total of 50% retracted based on Figure 16); 3rd pulse will retract an additional percentage (total of 75% retracted) and then - after the 3rd pause – the shade will be fully retracted (plants uncovered).

6. Set the pause time, in minutes, between pulses.
7. Press the back arrow when settings are complete.

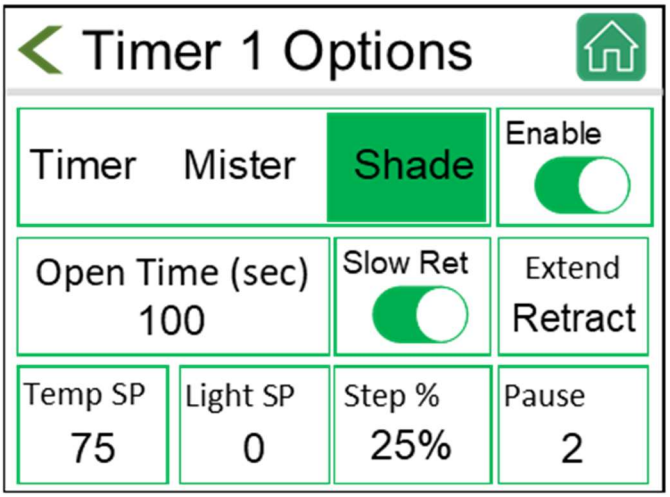



***Figure 20:*** Timer 1, Shade Mode as Energy

**** There are three additional, configuration items to note about the shade function:

- This uses the alarm relay so it can only be activated if the Alarm output relay is NOT being used.
- This does not use or affect your Zone 1 Low/High or Zone 2 Low/High Settings or the function of those alarms, it is only using the alarm relay connected to your shade or curtain to signal it to close.
- The Timer/Alarm feature coordinates the outputs to give a 10-second delay between extend and retract signals to allow the motor to come to a complete stop before changing directions.

**Pause Time (Min) –** How long, in minutes, the curtain will pause between pulses.

***Note: If there is a 4 degree drop at any point. The sequence will be interrupted and the curtain will pause until the temperature recovers.

# *HAF and AUX Output Operation (Models C or H)*

If you have a version of the ClimateBoss with an auxiliary board, you will either have 1 HAF and 2 AUX outputs, 2 HAF and 1 AUX output, Vent C + HAF output, or Vent C + Heat 3 output. The HAF outputs generally control circulation fans while the AUX output generally runs gable louvers and/or fans for cooling and dehumidification.

## AUX Outputs

AUX outputs function in response to the current vent step. Outputs connected to the aux input will activate when vents are above percent 1 setting.

## Heat 3 Option (Models H & CH)

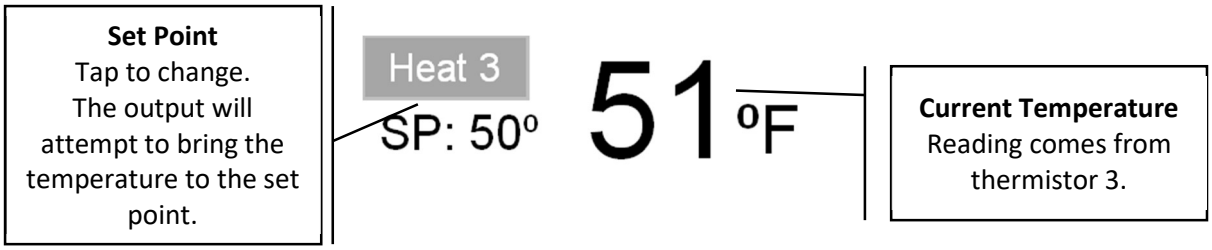



***Figure 21:*** *Heat 3*

The Heat 3 output is a set point heat with its own temperature sensor. It can be used for turning on a boiler based on outdoor temperature or controlling a bench heater. The settings for Heat 3 are not connected to the target temperature and do not change with the stage (DIF, DAY, NIGHT) as the target temperature does. You can access this setting at any time on the home screen of the controller (**Figure 2** and **Figure 3)** by pressing the green *More* button on the bottom right. The current temperature reading of Heat 3 and the current set point will be located on the mid-right of the screen. See **Figure 21.**

The Heat 3 output is currently active if the box surrounding Heat 3 is red. Grey indicates inactivity.

***Note in RWL mode – Using Heat 3 option will deactivates the HAF fan option.

## HAF Outputs

There are two options for controlling the HAF fans, **Vent** or **SP** (Set Point), as well as a manual on or off. These options are accessible from the home screen by pressing the 'more' button in the bottom right.

The first option is the mode. To change between off, on, or auto, press the "HAF mod" box. On the screen that shows up, you can select off, on, Auto by Vent, or Auto by Set Point. The different auto options are detailed below.

**Auto by Vent** – When "**Auto By Vent**" is selected, your HAF fans function in response to your main vent output's current step. If your vent is **below** step 2, your HAF fans will be turned on. If your vent is **at or above** step 2, your HAF output will turn off, as to not disturb the airflow. If you have model C, which has two outputs for HAF fans, the first output will work in response to zone 1's vent stage, while the second output will work from zone 2's vent stage.

**Auto by Set Point** – When "**Auto By SP**" is selected, your HAF fans function in response to the current temperature of your house. When the temperature is below the set point, your fans are on. When the temperature rises above the set point, they will turn off. You can set the set point by pressing the "**HAF S**" box and entering your desired temperature. If you have model C, which has two outputs for HAF fans, the first output will work in response to zone 1's current temperature, while the second output will work from zone 2's current temperature. You cannot, however, have a separate set point for each zone.

> *Note*: *this set point remains the same regardless of day transitions, where your other set points may differ. Keep this in mind when choosing an option. This does, however, open up the option of using the HAF output to controller a heater that isn't affected by the DIF, Day, and Night cycle.*

# Wind/Rain Alarm Integration

If your operation has Headgrower and a WeatherBoss, the *ClimateBoss* can look at the activity of the WeatherBoss through the computer software and react accordingly. By taking information from Headgrower, the *ClimateBoss* has access to information about outside temperature, humidity, wind speed, and rain. To access this screen, press the more button on the home screen, then press the box labeled outside (**Figure 5** and **Figure 6**). The screen will look like **Figure 22**, below.

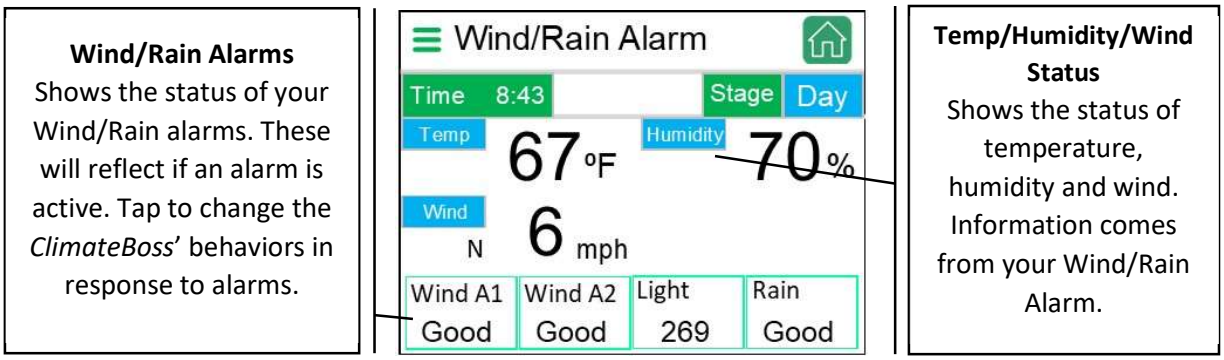



***Figure 22:*** *Weather Sensor Page*

The main functionality that the Wind/Rain alarm integration offers is the ability to close your vent in response to rain or wind. To do this, tap the wind/rain alarm status box**.** On the following screen showing a table of your alarms and vent, you can tap the green Yes/No boxes to toggle your preference.

# Statistics

The *ClimateBoss* collects and stores averages for 7 days. Each day it stores average temperature for each operating stage (DIF, DAY, NIGHT) as well as the average for the 24 hours from the start of DIF to the end of NIGHT.

To view the controller's statistics, press *Menu > Statistics.* You can also access the statistics from the more section of the controller's home screen.

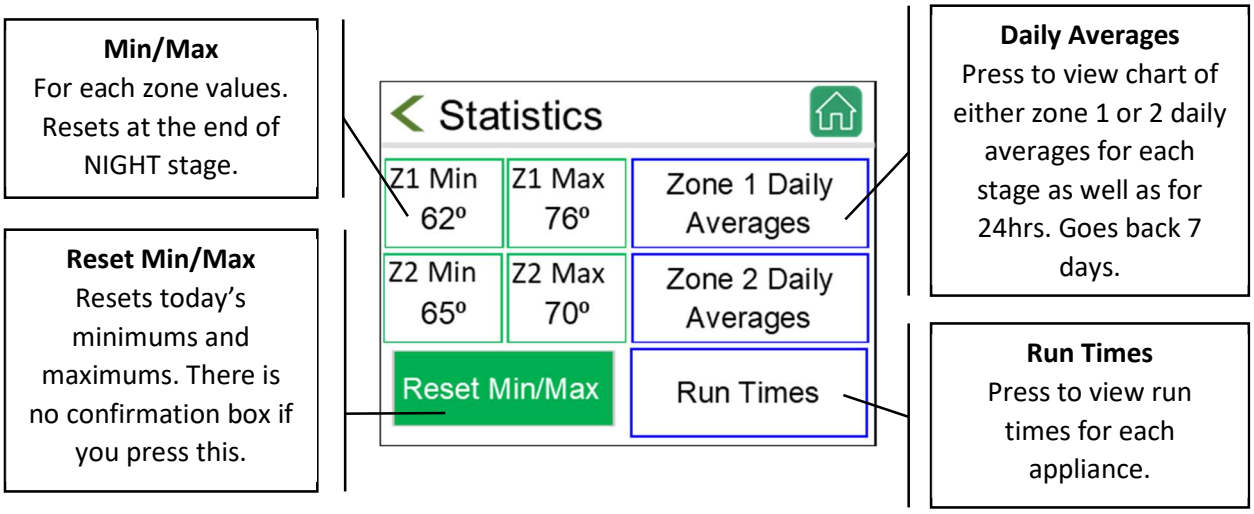



***Figure 23:*** *Statistics Screen*

The *ClimateBoss* also tracks the run time of each of the outputs: Heat 1, Heat 2. The *ClimateBoss* will store the information until it is reset and will also display the number of days since the last reset. To **view run times**, press the *Run Times* button in the bottom right of the statistics screen. To **reset run**

**times**, press the *Reset* button in the bottom left of the Run Times screen. A prompt will pop up confirming your decision. Press *yes* to proceed.

# Overrides

Not only is the *ClimateBoss* programmed for automatic operation but it can also give the grower temporary overrides of the target temperature, manual start of the timer or dehumidification options, and on/off control of each output.

## Target Temperature (Set Point) Override

The target temperature can be temporarily changed from the controller's home screen. This feature is primarily used for when you want to change the growing temperature because it is too uncomfortable to work in, but you want to revert back to the automatic program after you have completed your task.

To override, press the area of the home screen of zone you are working in and SP = XX underneath. See **Figure 24**. By tapping that box, you will be brought to a screen to enter a temperature. Entering a value will turn the Set Point yellow/orange on the home screen, signaling a manual override. The temperature will reset back to the normal programmed set point (see Stages, page 19) during the next stage transition (DIF, DAY, NIGHT).

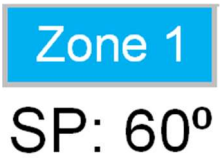



***Figure 24:*** *Set Point Override*

## Vent Cycle or Timer Manual Start

The dehumidification vent cycle or a timer cycle can be manually started. This allows you to program a cycle, set it to off and run it only on a manual cycle.

## Outputs

Each Heat or Cool output can be set to on or off, in addition to the automatic function. This will override the safety checks and you may have instances where the heats and cools run at the same time. For information on how to manually turn on or off an output, see **Page 21, Outputs (Heat 1, Cool1)**.

# Error Codes

**Clock** – indicates that the controller's clock is not functioning properly.

**TH1** – indicates that thermistor 1 has a short circuit or an open circuit

**TH2** – indicates that thermistor 2 has a short circuit or an open circuit

**T1 Low –** Indicates a low temperature alarm in Zone 1

**T2 Low –** Indicates a low temperature alarm in Zone 2

**T1 High –** Indicates a high temperature alarm in Zone 1

**T2 High –** Indicates a high temperature alarm in Zone 2

# Appendix A: Celsius Settings Conversions

When operating in Celsius mode the controller settings are different than in Fahrenheit mode. The following table will illustrate the differences between the temperature settings. Remember that the default setting for the controller is Fahrenheit.

| SETTING | CONTROLLER DEFAULT | COMMENTS |
|---|---|---|
| DIF target temperature | 18 | Maximum setting of 55.<br>Minimum setting of 1. |
| DAY target temperature | 18 | Maximum setting of 55.<br>Minimum setting of 1. |
| NIGHT target temperature | 18 | Maximum setting of 55.<br>Minimum setting of 1. |
| Hysteresis setting | 1 | Not changeable. |
| Alarm settings | Low value = 0<br>High value = 55 | Values of 1 through 55 accepted. |

Converting the Fahrenheit settings to Celsius temperatures generates the values in this table. Although the default setting for Alarm Low is 0, only values of 1 or higher are acceptable for entry. This is due to the internal conversion that the controller performs.

# Appendix B: Default Settings

See the following charts for the default settings of the *ClimateBoss* for Natural Vent Houses:

| STAGE SETTINGS | | | |
|---|---|---|---|
| **STAGE** | **START TIME** | **°F1** | **°F2** |
| DIF | 6:00 | 65 | 65 |
| DAY | 8:00 | 65 | 65 |
| NIGHT | 17:00 | 65 | 65 |

| OUTPUT SETTINGS (RWL Version) | | |
|---|---|---|
| **OUTPUT** | **MODE** | **OFFSET or STEP** |
| HEAT 1 and HEAT 2 | Auto | 0 |
| VENT 1 | Auto | 2 |
| VENT 2 | Auto | 2 |
| TIMER | Timer | N/A |

| OUTPUT SETTINGS | | |
|---|---|---|
| **OUTPUT** | **MODE** | **OFFSET or STEP** |
| HEAT 1 and HEAT 2 | Auto | 0 |
| COOL 1 and COOL 3 | Auto | 1 |
| VENT 2 | Auto | 4 |
| TIMER | Timer | N/A |

| DEHUMIDIFICATION VENT CYCLE DEFAULTS | |
|---|---|
| **OPTION** | **SETTING** |
| Start Time | 19.00 |
| Exhaust 1 | 00.00 |
| Preheat | 00.00 |
| Exhaust 2 | 00.00 |

| MENU SETTINGS | |
|---|---|
| **MENU FUNCTION** | **SETTING** |
| Temperature/Speed Units | Fahrenheit (°F), mph |
| CIS ID | 1 |
| On to Auto time | 10 |
| Heat/Cool Delay | 15 |
| Hysteresis | 1 (cannot be changed) |
| Alarms (both zones) | Low – 32 °F<br>High – 131 °F |
| Number of Zones | 1 |
| Thermistor Fail Mode | HEAT |
| Full Proportional Output Opening Time (RWL) | SEC1 –200<br>SEC2 – 200 |

| TIMER DEFAULTS | |
|---|---|
| **OPTION** | **SETTING** |
| Start Time | 12.00 |
| Run Time | 00.00 |
| Repeat | OFF |

| EXTRA MODES | DEFAULT SETTING |
|---|---|
| Timer or Mister | Timer Mode |
| Dehumidification Vent Cycle | Off |

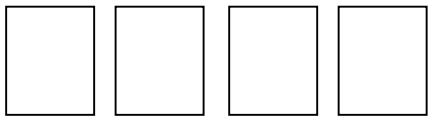
# Appendix C: Humidity Sensor Option

The *ClimateBoss* requires the AHUMSENZ humidity sensor to run the automatic dehumidification cycle. See page 6 of the ClimateBoss Installation Manual for installation guide.

**Notes**

- Proper calibration provides a ±2 percent accuracy on reading humidity levels.
- After 15 seconds without a keypress, the ClimateBoss will return to normal operation without saving the calibration data.
- Once entered, the calibration data remains until changed.
- Different humidity probes may have different calibration codes.
- Altering the calibration code value could invalidate readings. See below.

## CALIBRATION CODE



The numbers above are the calibration code. This is the value entered when the calibration code is requested below. The calibration code is also located on the label inside the humidity sensor casing.

To change/enter your calibration code, go to *Menu > Configuration > Humidity Cal.* On the screen with the number pad, enter your 4 digit code and press SAVE.
If necessary, you may need to fine-tune the calibration code. Changing the value by +5 will cause a 2% drop in humidity readings and a -5 change will cause a 2% rise in humidity readings.

For Example, if the calibration code is 6550 and a 4% drop in humidity readings is desired, then reentering the calibration data with a calibration code of 6560 will approximate this.

If modified, the humidity should be closely monitored to ensure proper humidity readings.

**Caution:** Changing the first two digits of the calibration code will cause erroneous readings by the probe and will invalidate all humidity readings.

# Appendix D: PAR/Light Sensor Option

The *ClimateBoss* requires the PARSENZ_110L10 light sensor to adjust timer output operations based on light levels. See page 11 of the ClimateBoss Installation Manual for installation guide.

**Instantaneous light level** – Both the shade and timer mode of the Timer outputs use the instantaneous light level to determine if the controller has exceeded the light set point. The instantaneous reading is known as the photosynthetic photon flux density (PPFD) in micromoles of photons per meter squared per second (µmol m-2 s-1).

**Daily Light Integral (DLI)** – The mister mode of the Timer outputs uses the daily light integral to determine if the cycle time should be reduced. This measurement is taken in moles of photons per meter squared per day (mol m-2 d-1).

**Light Threshold Time**

Please refer to the specification guide on the Bartlett Instrument website for detailed specification and installation guide for this sensor.

Moisture or debris on the diffuser is a common cause of low readings. The sensor has a domed diffuser and housing for improved self-cleaning from rainfall, but materials can accumulate on the diffuser (e.g., dust during periods of low rainfall, salt deposits from evaporation of sea spray or sprinkler irrigation water) and partially block the optical path. Dust or organic deposits are best removed using water or window cleaner and a soft cloth or cotton swab. Salt deposits should be dissolved with vinegar and removed with a soft cloth or cotton swab. Never use an abrasive material or cleaner on the diffuser.