



# Technical Specifications

## Firmware Control

### Description

AURA built an Internet based system to control our customer's Environmental Chambers. This Internet system allows clients to have bi-directional communication with their Chambers for the purpose of uploading current operational data and allowing changes to the current system. All of the information the application requests and sends is available through the communication interface designed into the Intellus Controller.

Our customer builds Environmental Chambers that have an Intellus Controller. The Intellus has all of the capability to change process setpoints and receive process values. The actual chamber processes include the control of light Intensity, temperature, humidity etc. Our application either pulls or pushes data to or from the Intellus controller based on a TCP/IP protocol utilizing a Microsoft Visual Basic application and XML.

The user of the equipment launches our application. The application follows Windows programming standards. There are two basic types of security. The first is the security of the web application; the second is the security of the controller itself. The web application requires a user to login with a password in order to access the controller(s). Once permission has been established, the application locates the controller(s) via their predetermined IP address. If a firewall is encountered, the application will not connect and a message returned.

Once connected, the application requests the Intellus configuration. This configuration information provides the basic controller information, including data such as whether certain controller channels and functions are being utilized. The application also requests the current data. Our design plan looks for all possible data inputs, including:

- ▶ Index of log point
- ▶ Date/time stamp of log point
- ▶ Temperature set point
- ▶ Temperature process value
- ▶ Humidity set point
- ▶ Humidity process value
- ▶ Lighting set points
- ▶ Lighting process value
- ▶ Auxiliary set point
- ▶ Auxiliary process value
- ▶ Alarm code

▶ Defrost status

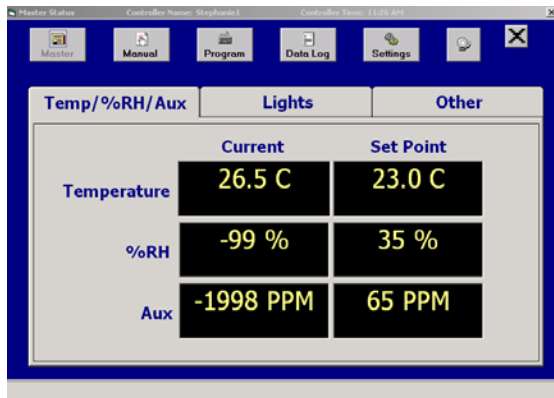
Four levels of security are available in each controller. An administrator has control over assigning a security level to each user for each controller. A user can have different access for different controllers. The application mirrors the security permissions of a particular controller.

User features included in the design:

- Read or change specific data control setpoints.
- Load new or modify an existing chamber control program.
- Log the data from the controller, as long as the user's PC was connected. Data will be lost if they are not logged in.
- Create graphs and reports from the data.
- Monitor the Controller(s) for alarms as long as the user is connected. It is possible that a remote user in this scenario could miss alarms. For example, if an alarm occurs while the user is logged off, the alarm condition corrects itself and the alarm is cleared on the Intellus either manually or automatically, then the user logs back in, they would have missed the occurrence.
- Capability to send alarm notification via e-mail and paging.
- User can control one to many chamber controllers from one to many locations independently.

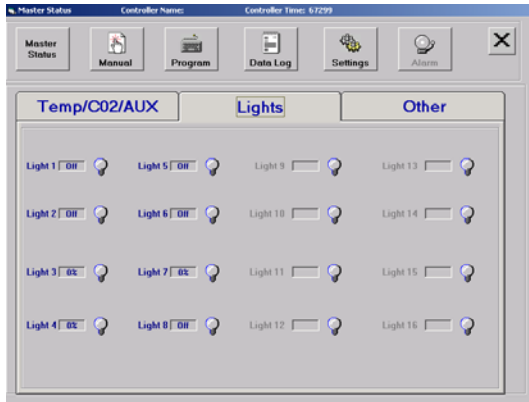
## Layout

### Touch Screen user Master Status Screen - Temp/C02/AUX tab

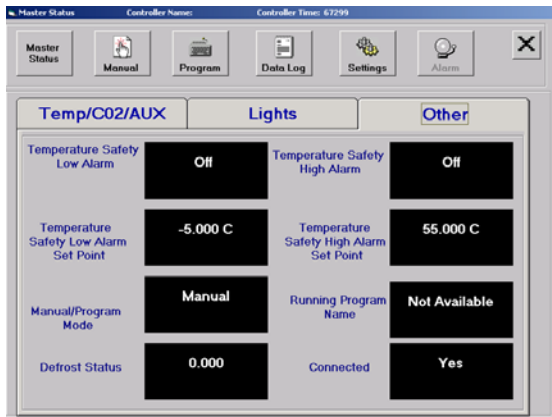


	Current	Set Point
Temperature	26.5 C	23.0 C
%RH	-99 %	35 %
Aux	-1998 PPM	65 PPM

## Touch Screen User Master Status Screen - Lights tab



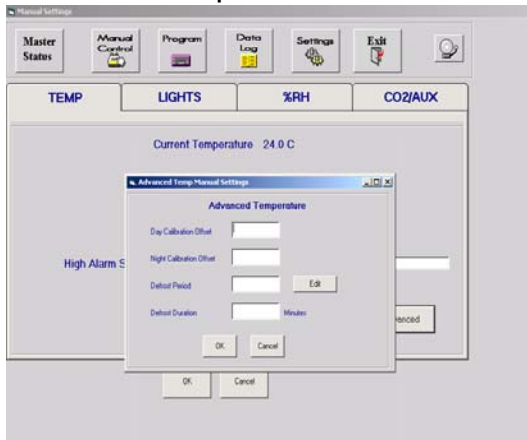
## Touch Screen User Master Status Screen - Other tab



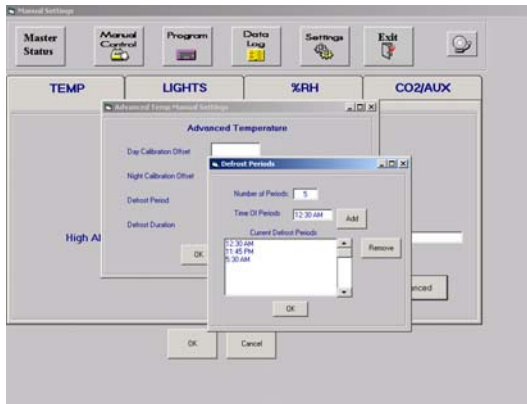
## Manual Settings - Temp tab



## Advanced Temperature Screen



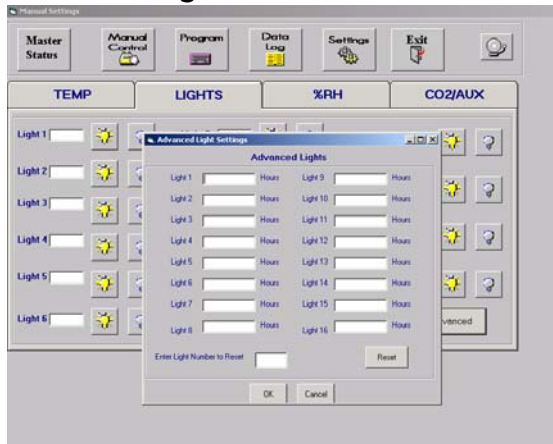
## Edit Defrost Periods Screen



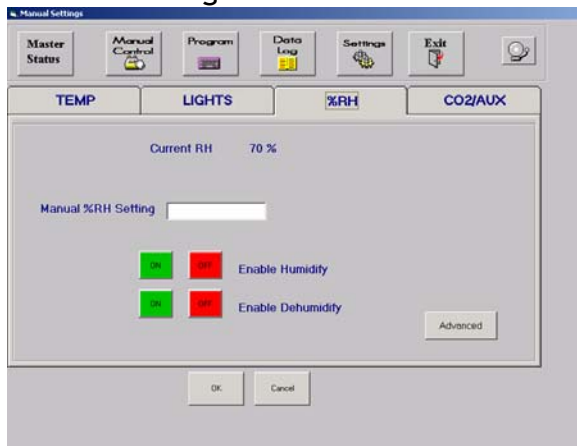
## Manual Settings - Lights tab



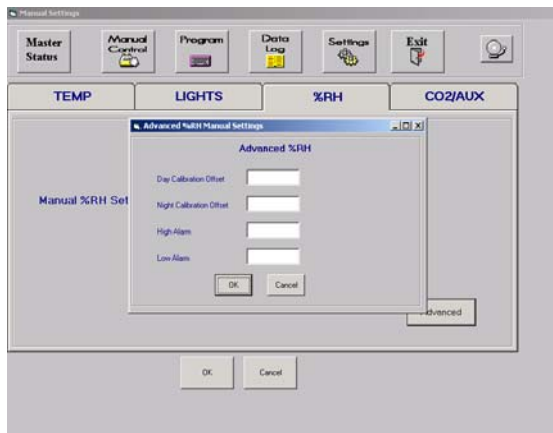
## Advanced Lights tab



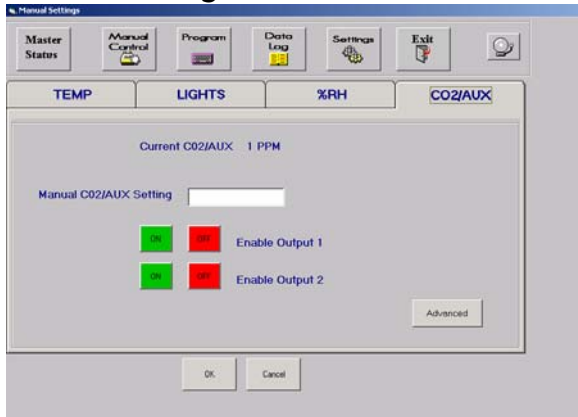
## Manual Settings - %RH tab



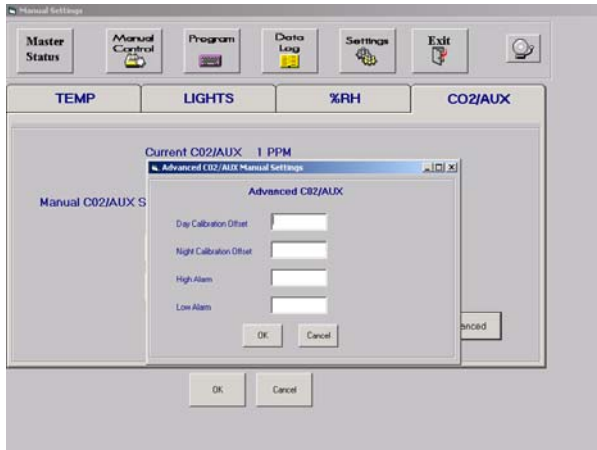
## Advanced %RH tab



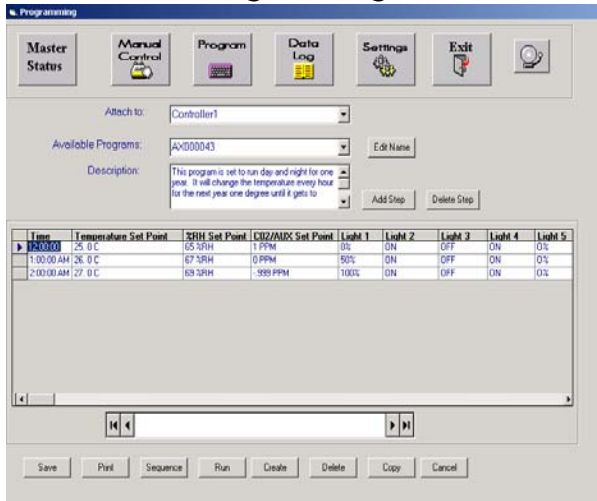
## Manual Settings - CO2/AUX tab



## Advanced CO2/AUX tab



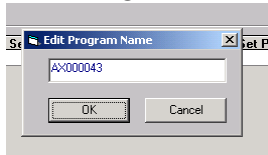
## Remote User Programming Screen



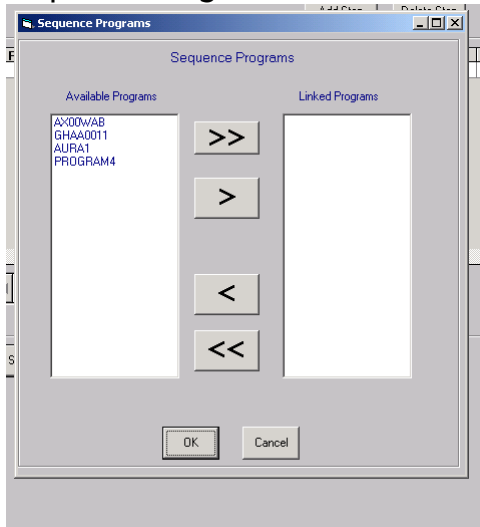
## Touch Screen User Programming Screen



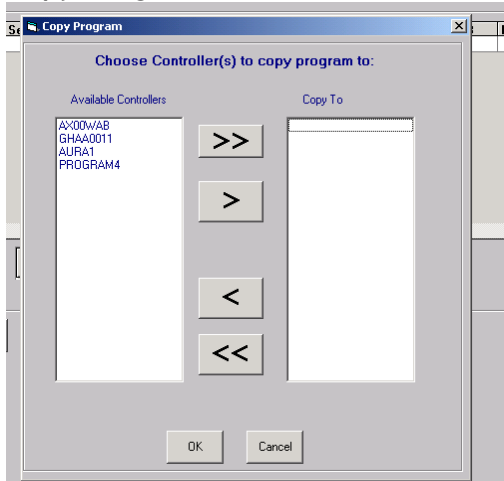
## Edit Program Name Screen



## Sequence Programs Screen



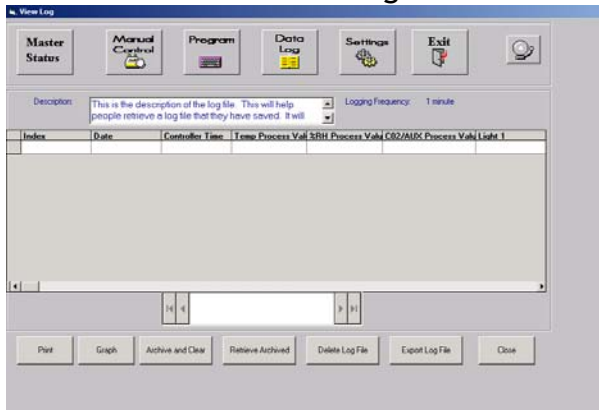
## Copy Programs Screen



## Remote user data log screen



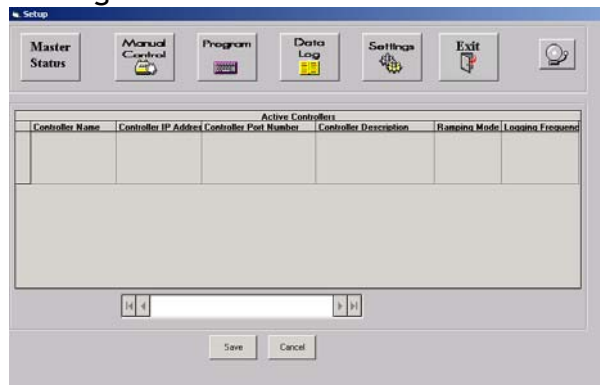
## Touch Screen User Data log screen



## Graphing Screen



## Setting Screen



## Project Scope

AURA's project scope documentation includes a description of the firmware control features and the user interface.

### 1.1. Reference Documents

- PRD PER00919 Revision 2.0
- Watlow Coding Standards and Practices  
<http://www.eng.win.watlow.com/firmware/codingpractices.htm>
- Design For Flash Download  
<http://www.eng.win.watlow.com/firmware/Documents/flash9.doc>
- Design For Embedded Functional Test  
[http://www.eng.win.watlow.com/firmware/Documents/test\\_spec9.doc](http://www.eng.win.watlow.com/firmware/Documents/test_spec9.doc)



2 = Run\_Flag (Functional Test/Application Code flag)

#### EEPROM System Data Assignments

- 3 - 4 = Version Number (unsigned int) assumed ##.##
- 5 - 6 = Build Number (unsigned int)
- 7 - 10 = Serial Number (unsigned int)
- 11 - 24 = Part Number (ASCII string)
- 25 - 26 = Date Code (unsigned int)
- 27 - 28 = High Cal mV (unsigned int) assumed #.###
- 29 - 30 = High Cal counts (unsigned int)
- 27 - 28 = Low Cal mV (unsigned int) assumed #.###
- 29 - 30 = Low Cal counts (unsigned int)
- 35 - 39 = Unused

#### EEPROM Application Data Assignments

40 - 127 = Application Space

#### 2.4.2. RAM

Device: AT90S2333 128 x 8

Register File (32)	0x0000
I/O Registers (64)	0x001F
Application Data	0x0029
Test Data	0x005F
	0x0060
	0x00??
	0x00??
	0x00DF

#### 2.4.3. FLASH

Device: 29F400 512kb x 8 (256kb x 16)

Test Code	0x0400
App Code	0xFFFF
	0x10000
	0x7FFFF

## 2.5. Code Reuse


### 2.5.1. Existing Libraries to Be Used

- 2.5.1.1. Watlow standard PID control algorithm.
- 2.5.1.2. Watlow standard ON/OFF control algorithm.
- 2.5.1.3. Watlow standard Alarm algorithm.

## 3. DESIGN SPECIFICATIONS

### 3.1. Process Analog Input Design

#### 3.1.1. Analog Input 1 (Temperature)

- 3.1.1.1. The sensor will be a 100 ohm platinum RTD using the DIN curve.
- 3.1.1.2. The operating range will be from  $-50.0^{\circ}\text{F}$  to  $300.0^{\circ}\text{F}$ .
-  3.1.1.3. The sampling rate will be 5 Hz.
- 3.1.1.4. Lead resistance compensation will be sampled and corrected for once every 10 seconds.
- 3.1.1.5. There will be a user adjustable offset value that is active when there are no lights energized.
- 3.1.1.6. There will be a user adjustable offset value that is active when any lights are energized. (logic output thresholds must be met)
- 3.1.1.7. An input error will cause the buzzer to be activated.
- 3.1.1.8. An input filter will be provided.

#### 3.1.2. Analog Input 2 (Relative Humidity)

- 3.1.2.1. The sensor will be user selectable between off, mA and Volts.
- 3.1.2.2. The mA range low will be adjustable from 0 to 20.
- 3.1.2.3. The mA range high will be adjustable from 0 to 20.
- 3.1.2.4. The Volts range low will be adjustable from 0 to 10.
- 3.1.2.5. The Volts range high will be adjustable from 0 to 10.
- 3.1.2.6. The operating range will be from 0% rh to 100% rh.
- 3.1.2.7. The sampling rate will be 5 Hz.
- 3.1.2.8. Temperature compensation will be provided in the sensor.
- 3.1.2.9. Vaisala and Rotronics rh sensors will be supported.

- 3.1.2.10. There will be a user adjustable offset value that is active when there are no lights energized.
- 3.1.2.11. There will be a user adjustable offset value that is active when any lights are energized. (logic output thresholds must be met)
- 3.1.2.12. An input error will cause the buzzer to be activated.
- 3.1.2.13. An input filter will be provided.

### **3.1.3. Analog Input 3 (Aux/co2)**

- 3.1.3.1. The sensor will be user selectable between off, a 100 ohm platinum RTD using the DIN curve, mV and Volts.
- 3.1.3.2. The mV range low will be adjustable from 0 to 200.
- 3.1.3.3. The mV range high will be adjustable from 0 to 200.
- 3.1.3.4. The Volts range low will be adjustable from 0 to 10.
- 3.1.3.5. The Volts range high will be adjustable from 0 to 10.
- 3.1.3.6. The operating range will be from -50.0°F to 300.0°F.
- 3.1.3.7. The sampling rate will be 5 Hz.
- 3.1.3.8. Lead resistance compensation will be sampled and corrected for once every 10 seconds when RTD is selected.
- 3.1.3.9. There will be a user adjustable offset value that is active when there are no lights energized.
- 3.1.3.10. There will be a user adjustable offset value that is active when any lights are energized. (logic output thresholds must be met)
- 3.1.3.11. An input error will cause the buzzer to be activated.
- 3.1.3.12. The units will be user selectable with 3 characters, for process type inputs.
- 3.1.3.13. An input filter will be provided.

## **3.2. Process Control Loop Design**

### **3.2.1. Control Loop 1**

- 3.2.1.1. This is the temperature control loop of the system.
- 3.2.1.2. This loop will use PID control or on/off control for both outputs.
- 3.2.1.3. Heat PID or on/off will be selected with a separate prompt.

- 3.2.1.4. Cool PID, on/off or complementary will be selected with a separate prompt.
- 3.2.1.5. This loop will be updated at 5 Hz.
- 3.2.1.6. The Proportional, Integral and Derivative terms for the indirect (heat) and direct (cool) sides will be user adjustable.
- 3.2.1.7. Positive deadband will be used.
- 3.2.1.8. This loop will allow auto-tuning of the PID parameters.
- 3.2.1.9. If the set point is not inside the set point range, the Control Loop outputs will be disabled.

### **3.2.2. Control Loop 2**

- 3.2.2.1. This is the relative humidity control loop of the system.
- 3.2.2.2. This loop will use PID control or on/off control for both outputs.
- 3.2.2.3. PID or on/off will be selected with a separate prompt.
- 3.2.2.4. This loop will be updated at 5 Hz.
- 3.2.2.5. The Proportional, Integral and Derivative terms for the indirect (humidify) and direct (dehumidify) sides will be user adjustable.
- 3.2.2.6. Positive deadband will be used.
- 3.2.2.7. This loop will allow auto-tuning of the PID parameters.
- 3.2.2.8. If the associated analog input is set to off then the channel will be disabled.
- 3.2.2.9. The humidify side of the control algorithm (PID or on/off) can be disabled independent of the control method selected.
- 3.2.2.10. The de-humidify side of the control algorithm (PID or on/off) can be disabled independent of the control method selected.
- 3.2.2.11. If the set point is not inside the set point range, the Control Loop outputs will be disabled.

### **3.2.3. Control Loop 3**

- 3.2.3.1. This is the co2/safety limit control loop of the system.
- 3.2.3.2. This loop will use PID control or on/off control for both outputs.
- 3.2.3.3. PID or on/off will be selected with a separate prompt.
- 3.2.3.4. This loop will be updated at 5 Hz.

- 3.2.3.5. The Proportional, Integral and Derivative terms for the indirect and direct sides will be user adjustable.
- 3.2.3.6. Positive deadband will be used.
- 3.2.3.7. This loop will allow auto-tuning of the PID parameters.
- 3.2.3.8. If the associated analog input is set to off then the channel will be disabled.
- 3.2.3.9. The indirect auxiliary side of the control algorithm (PID or on/off) can be disabled independent of the control method selected.
- 3.2.3.10. The direct auxiliary side of the control algorithm (PID or on/off) can be disabled independent of the control method selected.
- 3.2.3.11. If the set point is not inside the set point range, the Control Loop outputs will be disabled.
- 3.2.3.12. If the safety alarm source is the aux/co2 input, the channel will be disabled.

### **3.3. Process Discrete Input Design**

#### **3.3.1. Digital Input 1-3**

- 3.3.1.1. The digital input may be selected as active low or active high logic.
- 3.3.1.2. The functions supported are defined in the 'Logic Inputs' section.
- 3.3.1.3. The sampling rate will be 2 Hz.

### **3.4. Process Discrete Output Design**

#### **3.4.1. Digital Output 1**

- 3.4.1.1. The digital output is available in the low end controller and the high end controller.
- 3.4.1.2. The function is the indirect (heat) output A for the temperature control loop.
- 3.4.1.3. This output will be disabled, whenever the dehumidify output is energized.
- 3.4.1.4. The refresh rate will be 5 Hz.
- 3.4.1.5. The output will have an adjustable cycle time.

### **3.4.2. Digital Output 2**

- 3.4.2.1. The digital output is available in the low end controller and the high end controller.
- 3.4.2.2. The function is the indirect (heat) output B for the temperature control loop.
- 3.4.2.3. The refresh rate will be 5 Hz.
- 3.4.2.4. The output will have an adjustable cycle time.

### **3.4.3. Digital Output 3**

- 3.4.3.1. The digital output is available in the low end controller and the high end controller.
- 3.4.3.2. The function is the complimentary (cool) output for the temperature control loop. It takes the opposite state of indirect (heat) output B.
- 3.4.3.3. The refresh rate will be 5 Hz.
- 3.4.3.4. The output will have an adjustable cycle time.

### **3.4.4. Digital Output 4**

- 3.4.4.1. The digital output is available in the low end controller and the high end controller.
- 3.4.4.2. The function is the indirect (humidify) output for the relative humidity control loop.
- 3.4.4.3. The refresh rate will be 5 Hz.
- 3.4.4.4. The output will have an adjustable cycle time.

### **3.4.5. Digital Output 5**

- 3.4.5.1. The digital output is available in the low end controller and the high end controller.
- 3.4.5.2. The function is the direct (dehumidify) output for the relative humidity control loop.
- 3.4.5.3. The refresh rate will be 5 Hz.
- 3.4.5.4. The output will have an adjustable cycle time.

### **3.4.6. Digital Output 6**

- 3.4.6.1. The digital output is available in the low end controller and the high end controller.
- 3.4.6.2. The function is the indirect (co2) output for the co2/safety limit control loop.
- 3.4.6.3. The refresh rate will be 5 Hz.
- 3.4.6.4. The output will have an adjustable cycle time.

### **3.4.7. Digital Output 7**

- 3.4.7.1. The digital output is available in the low end controller and the high end controller.
- 3.4.7.2. The function is the direct (co2) output for the co2/safety limit control loop.
- 3.4.7.3. The refresh rate will be 5 Hz.
- 3.4.7.4. The output will have an adjustable cycle time.

### **3.4.8. Digital Output 8**

- 3.4.8.1. The digital output is available in the low end controller and the high end controller.
- 3.4.8.2. The function is the defrost output #1.
- 3.4.8.3. The refresh rate will be 5 Hz.

### **3.4.9. Digital Output 9**

- 3.4.9.1. The digital output is available in the low end controller and the high end controller.
- 3.4.9.2. The function is the defrost output #2.
- 3.4.9.3. The refresh rate will be 5 Hz.

### **3.4.10. Digital Output 10-16**

- 3.4.10.1. The digital outputs are available in the low end controller and the high end controller.
- 3.4.10.2. The functions supported are defined in the 'Logic Outputs' section.
- 3.4.10.3. The refresh rate will be 2 Hz.

### **3.4.11. Digital Output 17-24**

- 3.4.11.1. The digital outputs are available in the low end controller and high end controller.
- 3.4.11.2. The functions supported are off, light dimming, light on/off and event output.
- 3.4.11.3. Each digital output that is enabled will accumulate an on-time in hours and store it in non-volatile memory once every hour of control operation.
- 3.4.11.4. The user will be able to view and reset the light on-time value.
- 3.4.11.5. The refresh rate will be 10 Hz.

### **3.4.12. Digital Output 25-32**

- 3.4.12.1. The digital outputs are only available in the high end controller.
- 3.4.12.2. The functions supported are off, event on/off , and light on/off.
- 3.4.12.3. The refresh rate will be 10 Hz.

### **3.4.13. Safety Alarm Output (mechanical relay)**

- 3.4.13.1. The safety alarm output is available in the low end and high end controllers.
- 3.4.13.2. The refresh rate will be 2 Hz.

### **3.4.14. Buzzer**

- 3.4.14.1. The buzzer is available in the low end and high end controllers.
- 3.4.14.2. The refresh rate will be 1 Hz.

## **3.5. Display Design**

### **3.5.1. VFD Display**

- 3.5.1.1. The display will be 2 lines by 20 characters long.
- 3.5.1.2. The refresh rate will be 10 Hz.

### **3.5.2. LED Indicators**

- 3.5.2.1. LED 1 indicates when the temperature channel indirect (heat) output is active.
- 3.5.2.2. LED 2 indicates when the aux/co2 indirect output is active.

- 3.5.2.3. LED 3 indicates when the temperature channel direct (cool) output is active.
- 3.5.2.4. LED 4 indicates when the Program mode has been entered.
- 3.5.2.5. LED 5 indicates when the rh channel indirect (humidify) output is active.
- 3.5.2.6. LED 6 indicates when the 'defrost' operation has been activated.
- 3.5.2.7. LED 7 indicates when the rh channel dehumidify output is active.
- 3.5.2.8. LED 8 indicates when there is rs232 comms activity.
- 3.5.2.9. The refresh rate will be 10 Hz.

## **3.6. Keyboard Design**

### **3.6.1. Key 1**

- 3.6.1.1. The 'TIME' (TEMP in timer control) key is used to allow editing time based information on the display.

### **3.6.2. Key 2**

- 3.6.2.1. The 'LIGHTS' (TIMER in timer control) key is used to allow editing light based information on the display.

### **3.6.3. Key 3**

- 3.6.3.1. The 'TEMP/ALARM' (%RH) key is used to allow editing temperature based information on the display and clear the safety alarm.

### **3.6.4. Key 4**

- 3.6.4.1. The 'AUX/CO2' (STOP in timer control) key is used to allow editing auxiliary based information on the display.

### **3.6.5. Key 5**

- 3.6.5.1. The '% RH' (START in timer control) key is used to allow editing relative humidity based information on the display.

### **3.6.6. Key 6**

- 3.6.6.1. The 'PROG' (RESET in timer control) key is used to allow editing step based information on the display.

### **3.6.7. Key 7**

3.6.7.1. The 'UP' key is used to increment active data on the display.

### **3.6.8. Key 8**

3.6.8.1. The 'DOWN' key is used to decrement active data on the display.

### **3.6.9. Key 9**

3.6.9.1. The 'HELP' key is used to display user help information on the display.

### **3.6.10. Key 10**

3.6.10.1. The 'ENTER' (SET in timer control) key is used to enter changes on the display or acknowledge alarm conditions.

## **3.7. Control Functions**

### **3.7.1. Day/Night Control**

3.7.1.1. This control method will have a day period and a night period.

3.7.1.2. The transition between the day period and the night period will be determined by an external mechanical timer, logic input.

3.7.1.3. Each period contains the following data:

3.7.1.3.1. Set point for the temperature channel.

3.7.1.3.2. Set point for the relative humidity channel.

3.7.1.3.3. Set point for the aux/co2 channel.

3.7.1.4. In the day period, all light outputs and all event outputs will be on.

3.7.1.5. In the night period, all light outputs and all event outputs will be off.

3.7.1.6. The set points will do a step change between the day period and the night period.

3.7.1.7. The control continuously cycles between the day period and the night period.

3.7.1.8. This function is available in the low end controller and the high end controller.

### 3.7.2. Non-Ramping Control

- 3.7.2.1. This control method will allow the user to choose between diurnal and 96 step.
- 3.7.2.2. When diurnal is chosen the control will allow setting the following:
  - 3.7.2.2.1. The day set point for the temperature channel.
  - 3.7.2.2.2. The day set point for the relative humidity channel.
  - 3.7.2.2.3. The day set point for the aux/co2 channel.
  - 3.7.2.2.4. The day period start time.
  - 3.7.2.2.5. The day period end time.
  - 3.7.2.2.6. The night set point for the temperature channel.
  - 3.7.2.2.7. The night set point for the relative humidity channel.
  - 3.7.2.2.8. The night set point for the aux/co2 channel.
- 3.7.2.3. In the day period, all light outputs and all event outputs will be on.
- 3.7.2.4. In the night period, all light outputs and all event outputs will be off.
- 3.7.2.5. The control continuously cycles between the day period and the night period.
- 3.7.2.6. The 96 step method will be based on a 24 hour time period.
- 3.7.2.7. The time period starts at 12:00 AM (midnight) for display purposes.
- 3.7.2.8. There will be 96 programmable steps in 1 non-nameable file.
- 3.7.2.9. Each step contains the following data:
  - 3.7.2.9.1. The time of day (hour and minute) that this step starts.
  - 3.7.2.9.2. Set point for temperature channel.
  - 3.7.2.9.3. Set point for relative humidity channel.
  - 3.7.2.9.4. Set point for aux/co2 channel.
  - 3.7.2.9.5. Individual light settings.
  - 3.7.2.9.6. Event output settings.
- 3.7.2.10. The set point will do a step change from one step to the next.

- 3.7.2.11. When the file is run, it will loop continuously through its 24 hour period.
- 3.7.2.12. This function is available in the low end controller and the high end controller.
- 3.7.2.13. This function will be the default for the low end controller.

### **3.7.3. Ramping Control**

- 3.7.3.1. This control method will be based on a 24 hour time period.
- 3.7.3.2. The time period starts at 12:00 AM (midnight) for display purposes.
- 3.7.3.3. There will be 500 programmable steps.
- 3.7.3.4. Each step contains the following data:
  - 3.7.3.4.1. The time of day (hour and minute) that this step starts.
  - 3.7.3.4.2. Set point for temperature channel.
  - 3.7.3.4.3. Set point for relative humidity channel.
  - 3.7.3.4.4. Set point for aux/co2 channel.
  - 3.7.3.4.5. Individual light settings.
  - 3.7.3.4.6. Event output settings.
- 3.7.3.5. The set point will ramp from the previous steps set point (or the current manual set point, for the first step) to the current steps set point in the next steps time - current step time.
- 3.7.3.6. When a file is run, the control will loop continuously through its 24 hour period.
- 3.7.3.7. When the sequence is run, the control will cycle through each file for the number of iterations for that file. The entire sequence will loop continuously.
- 3.7.3.8. This function is available in the high end controller.
- 3.7.3.9. This function will be the default for the high end controller.

### **3.7.4. Timer Control**

- 3.7.4.1. The number of timers available, will be user adjustable up to 6.
- 3.7.4.2. Each timer value will be entered in hours and minutes up to 999 hours and 59 minutes.

- 3.7.4.3. When the timer is activated, the associated light output will be turned on, example: timer 1 turns on light output 1, timer 2 turns on light output 2 etc. and the timer will count down toward 0.
- 3.7.4.4. All other event outputs will remain off.
- 3.7.4.5. When the timer reaches 0 it will activate the buzzer and 0:00 will be displayed until the timer is run again.
- 3.7.4.6. This function is available in the low end controller and the high end controller.

### **3.8. Defrost Function**

#### **3.8.1. Defrost Sequence**

- 3.8.1.1. The defrost function can be disabled by the factory (setup menu defrost enabled option) and by the user.
- 3.8.1.2. If the factory defrost is enabled, defrost output #1 will be energized and defrost output #2 will be de-energized when defrost is not active, even if the number of defrosts is set to 0.
- 3.8.1.3. The number of defrost cycles in a 24 hour period can be set by the user up to 6. Setting the number of defrosts to 0 disables the defrost function.
- 3.8.1.4. The duration of all defrost cycles can be set by the user from 1 to 999 minutes.
- 3.8.1.5. The start time of each defrost cycle can be set by the user.
- 3.8.1.6. A defrost cycle consists of the following sequence.
  - 3.8.1.6.1. Defrost LED energizes.
  - 3.8.1.6.2. Defrost output #1 de-energizes. (unit cooler fans)
  - 3.8.1.6.3. Defrost output #2 energizes. (defrost heaters)
  - 3.8.1.6.4. Heat output A energizes. (hot gas valve solenoid valve)
  - 3.8.1.6.5. Heat output B de-energizes. (unit heater)
  - 3.8.1.6.6. Cool output de-energizes. (liquid line solenoid valve)
  - 3.8.1.6.7. Dehumidify output de-energizes. (dehumidifying solenoid valve)
  - 3.8.1.6.8. Humidify output de-energizes.
  - 3.8.1.6.9. Lighting outputs are de-energized.

3.8.1.7. When the defrost cycle completes or terminates, normal control will resume.

### **3.8.2. Defrost Termination**

3.8.2.1. If a digital input is set to Defrost Termination and it becomes active, the defrost cycle will be terminated and normal control will resume.

## **3.9. Real Time Clock Design**

3.9.1.1. The real time clock will be adjustable in hours and minutes.

3.9.1.2. The time will be displayed in AM/PM format (hours from 1 to 12).

## **3.10. Communications Design**

### **3.10.1.1. Serial communications**

3.10.1.1.1. The PPP protocol will be used.

3.10.1.1.2. All user adjustable parameters will be configurable through the HTML/XML protocol.

3.10.1.1.3. All status information such as process values and alarm status will be available through the protocol.

3.10.1.1.4. Refer to 'Percival Menus, Key Flow and Specifications.xls' file for the details of the parameter tags, parameter ranges and parameter default values.

3.10.1.1.5. Refer to 'Percival Menus, Key Flow and Specifications.xls' file - Each 'menu' will be returned as a HTML screen.

### **3.10.1.2. Ethernet communications**

3.10.1.2.1. All user adjustable parameters will be configurable through the HTML/XML protocol.

3.10.1.2.2. All status information such as process values and alarm status will be available through the protocol.

3.10.1.2.3. Refer to 'Percival Menus, Key Flow and Specifications.xls' file for the details of the parameter tags, parameter ranges and parameter default values.

3.10.1.2.4. Refer to 'Percival Menus, Key Flow and Specifications.xls' file - Each 'menu' will be returned as a HTML screen.

## **3.11. Alarms**

### **3.11.1.1. Temperature Soft Alarm**

- 3.11.1.1.1. The temperature alarm will be a dual sided process alarm.
- 3.11.1.1.2. The alarm output will drive the buzzer.
- 3.11.1.1.3. The buzzer can be silenced by pressing any key.
- 3.11.1.1.4. The alarm message will self clear.
- 3.11.1.1.5. The alarm source will be analog input 1 (temperature).
- 3.11.1.1.6. The refresh rate will be 1 Hz.

#### **3.11.1.2. Relative Humidity Soft Alarm**

- 3.11.1.2.1. The relative humidity alarm will be a dual sided process alarm.
- 3.11.1.2.2. The alarm output will drive the buzzer.
- 3.11.1.2.3. The buzzer can be silenced by pressing any key.
- 3.11.1.2.4. The alarm message will self clear.
- 3.11.1.2.5. The alarm source will be analog input 2 (relative humidity).
- 3.11.1.2.6. The refresh rate will be 1 Hz.

#### **3.11.1.3. Auxiliary/Co2 Soft Alarm**

- 3.11.1.3.1. The aux/co2 alarm will be a dual sided process alarm.
- 3.11.1.3.2. The alarm output will drive the buzzer.
- 3.11.1.3.3. The buzzer can be silenced by pressing any key.
- 3.11.1.3.4. The alarm message will self clear.
- 3.11.1.3.5. The alarm source will be analog input 3 (aux/co2).
- 3.11.1.3.6. The refresh rate will be 1 Hz.

#### **3.11.1.4. Safety Alarm**

- 3.11.1.4.1. The safety alarm will be a dual sided process alarm.
- 3.11.1.4.2. The alarm output will drive the safety alarm output and the buzzer.
- 3.11.1.4.3. The buzzer can be silenced by pressing any key.
- 3.11.1.4.4. The alarm message can be cleared by pressing the Temp/Alarm key.
- 3.11.1.4.5. The safety alarm relay will self clear.
- 3.11.1.4.6. The safety alarm source can be analog input 1 (temperature), analog input 3 (aux/co2) or a digital input set to 'External Safety Alarm'.

3.11.1.4.7. The refresh rate will be 1 Hz.

## 3.12. Logic Inputs

### 3.12.1.1. Functions

#### 3.12.1.1.1. Off

3.12.1.1.1.1. This is used to disable the function.

#### 3.12.1.1.2. Door open.

3.12.1.1.2.1. When the function becomes active a countdown timer with a user definable value, is activated.

3.12.1.1.2.2. When the function becomes active, a door open counter will be incremented. This counter will be volatile (lost when power is turned off). The user will be able to reset this counter.

3.12.1.1.2.3. When the function becomes active, a door open timer will time in tenths of a minute, the cumulative length of time the door is open. This timer will be volatile (lost when power is turned off). The user will be able to reset this timer.

3.12.1.1.2.4. The countdown timer and door open timer will run as long as any digital input set to this function is active.

3.12.1.1.2.5. If the countdown timer reaches 0 it will activate the buzzer.

3.12.1.1.2.6. One countdown timer, door open counter and door open timer will be used for all digital inputs set to 'Door open'.

3.12.1.1.2.7. If a second 'Door Open' digital input becomes active while the first is still active the countdown timer will not restart and the door open counter will not increment and the door open timer will not count double.

#### 3.12.1.1.3. External safety alarm.

3.12.1.1.3.1. This function triggers the safety alarm (see the 'safety alarm' section) when the logic input becomes active.

#### 3.12.1.1.4. External mechanical timer (day/night control).

3.12.1.1.4.1. When the function is active, it will be considered day and when the function is inactive, it will be considered night. (see the 'Day/Night Control' section)

3.12.1.1.4.2. If more than one digital input is set to this function, the first one, in the order digital input 1, digital input 2, digital input 3 will be used to control the action.

3.12.1.1.5. Defrost termination thermostat.

3.12.1.1.5.1. When the function becomes active, if a defrost cycle is in process it will be terminated.

### **3.13. Logic Outputs**

#### **3.13.1.1. Functions**

3.13.1.1.1. The logic outputs can be named with up to 8 characters.

3.13.1.1.2. The logic output name will always be used when referencing the logic outputs in other prompts.

3.13.1.1.3. When naming logic outputs, the 'PROG' key will move the cursor to the next character and wrap from the last character to the first. The 'UP' and 'DOWN' keys will change the character. The 'ENTER' key will move to the next prompt.

3.13.1.1.4. The logic outputs source can be analog input 1, analog input 2, analog input 3, analog input 3/lights, set point 1, set point 2, set point 3, set point 3/lights (analog), digital input 1, digital input 2, digital input 3 (digital in), event output 1, event output 2, event output 3, event output 4, event output 5, event output 6, event output 7 or event output 8 (event out).

3.13.1.1.5. The state of the logic output when the logic output is active is user selectable, active low or active high.

3.13.1.1.6. The logic output will take on the properties of a dual sided process type alarm with the 'alarm' regions being the logic output active state.

3.13.1.1.7. The 'lights' analog type selections are used in determining the analog offset to be used, day or night.

#### **3.13.1.2. Digital in Logic**

3.13.1.2.1. The logic output will become active when the digital input becomes active.

#### **3.13.1.3. Event out Logic**

3.13.1.3.1. If the event output is an on/off type, the logic output will become active when the event output becomes active.

3.13.1.3.2. If the event output is a light dimming type, the logic output will become active when the event output is greater than the user defined threshold.

### **3.14. User Configuration Functions**

#### **3.14.1. Menu System all control methods**

3.14.1.1. Refer to 'Percival Menus, Key Flow and Specifications.xls' file for the details of the menus and prompts.

##### **3.14.1.2. Display Loop**

3.14.1.2.1. On power-up or when returning to the 'Display Loop' from another menu, navigation will always begin at the top of the menu.

3.14.1.2.2. The 'Display Loop' will be the default menu on power-up. After 1 minute of no key activity, the display will return to the 'Display Loop'.

3.14.1.2.3. If there is an alarm condition and any key is pressed, the buzzer will be acknowledged and no further key action will be taken.

3.14.1.2.4. The status of the light outputs will be displayed in the 'Display Loop'. Light on/off types and event types will be '1' or '0' and the light dimming will be graphical blocks.

##### **3.14.1.3. User Level menu**

3.14.1.3.1. From the 'Display Loop' or a different 'User Level' menu the 'TEMP' key is pressed to access the 'User Level' temperature menu.

3.14.1.3.2. From the 'Display Loop' or a different 'User Level' menu the '% RH' key is pressed to access the 'User Level' relative humidity menu.

3.14.1.3.3. From the 'Display Loop' or a different 'User Level' menu the 'AUX' key is pressed to access the 'User Level' auxiliary menu.

3.14.1.3.4. From the 'Display Loop' or a different 'User Level' menu the 'LIGHTS' key is pressed to access the 'User Level' lights menu.

3.14.1.3.5. Navigating and changing values in a 'User Level' menu.

- 3.14.1.3.5.1. The 'UP' and 'DOWN' keys are used to navigate between the prompts.
  - 3.14.1.3.5.2. The 'UP' key moves back to the previous prompt.
  - 3.14.1.3.5.3. The 'DOWN' key moves forward to the next prompt.
  - 3.14.1.3.5.4. When reaching the end of a menu the navigation wraps back to the top.
  - 3.14.1.3.5.5. When reaching the top of a menu the navigation wraps back to the bottom.
  - 3.14.1.3.5.6. To edit a prompt the 'ENTER' key is pressed and the prompt value flashes.
  - 3.14.1.3.5.7. While the prompt text is flashing the value can be changed with the 'UP' and 'DOWN' keys.
  - 3.14.1.3.5.8. The 'ENTER' key is pressed to accept the value and stop the prompt value from flashing.
  - 3.14.1.3.5.9. When in the temperature menu, the 'TEMP' key is pressed to return to the 'Display Loop'.
  - 3.14.1.3.5.10. When in the relative humidity menu, the '% RH' key is pressed to return to the 'Display Loop'.
  - 3.14.1.3.5.11. When in the auxiliary menu, the 'AUX' key is pressed to return to the 'Display Loop'.
  - 3.14.1.3.5.12. When in the lights menu, the 'LIGHTS' key is pressed to return to the 'Display Loop'.
- 3.14.1.4. Setup Level menu
- 3.14.1.4.1. The 'PROG' key will not function when in the 'Setup Level' menus.
  - 3.14.1.4.2. To enter the 'Setup Level' menu selection prompt, the 'UP' and 'DOWN' keys are pressed and held for 3 seconds. This menu is password protected, see the 'menu system security' section.
  - 3.14.1.4.3. To exit the 'Setup Level' the 'UP' and 'DOWN' keys are pressed and held for 1 second.
  - 3.14.1.4.4. When at the menu selection prompt the 'UP' and 'DOWN' keys are used to choose the different menus to enter.
  - 3.14.1.4.5. Pressing the 'ENTER' key at the desired menu selection moves to that setup menu.
  - 3.14.1.4.6. Navigating and changing values in a 'Setup Level' menu.

- 3.14.1.4.6.1. The 'UP' and 'DOWN' keys are used to navigate between the prompts.
- 3.14.1.4.6.2. The 'UP' key moves back to the previous prompt.
- 3.14.1.4.6.3. The 'DOWN' key moves forward to the next prompt.
- 3.14.1.4.6.4. When reaching the end of a menu the navigation returns to the 'Setup Level' menu selection prompt.
- 3.14.1.4.6.5. When reaching the top of a menu the navigation returns to the 'Setup Level' menu selection prompt.
- 3.14.1.4.6.6. To edit a prompt the 'ENTER' key is pressed and the prompt value flashes.
- 3.14.1.4.6.7. While the prompt text is flashing the value can be changed with the 'UP' and 'DOWN' keys.
- 3.14.1.4.6.8. The 'ENTER' key is pressed to accept the value and stop the prompt value from flashing.

### **3.14.2. Menu System Day/Night control**

- 3.14.2.1. The 'LIGHTS' key does not function.
- 3.14.2.2. The 'PROG' key does not function.
- 3.14.2.3. The day and night set points for the 3 channels will be set in the channel 'User' menus.

### **3.14.3. Menu System Timer control**

- 3.14.3.1. The 'TIMER' key selects the available timers.
- 3.14.3.2. The 'SET' key is pressed to select a timer to be adjusted.
- 3.14.3.3. The 'UP' and 'DOWN' keys are used to adjust the time.
- 3.14.3.4. The 'SET' key accepts the value.
- 3.14.3.5. Pressing the 'TIMER' key while changing a value causes the change to be cancelled and returns to the 'Display Loop'.
- 3.14.3.6. Pressing the 'START' key starts the selected timer.
- 3.14.3.7. Pressing the 'START' key for 3 seconds, starts all timers.
- 3.14.3.8. Pressing the 'STOP' key stops the selected timer.
- 3.14.3.9. Pressing the 'STOP' key for 3 seconds, stops all timers.
- 3.14.3.10. Pressing the 'RESET' key stops and resets the selected timer.

- 3.14.3.11. Pressing the 'RESET' key for 3 seconds, stops and resets all timers.
- 3.14.3.12. The set point for temperature and relative humidity will be set in the channel 'User' menus.
- 3.14.3.13. The aux/co2 channel is not available.

#### **3.14.4. Menu System Non-Ramping control**

- 3.14.4.1. Files can only be run from the 'Display Loop' and cannot be run while auto tuning.
- 3.14.4.2. The status of the light dimming outputs will be displayed in the 'Display Loop'.
- 3.14.4.3. The 'User Level' lights menu is not accessible in the 'Diurnal' mode.
- 3.14.4.4. The 'User Level' menu is accessible when a file is running and any changes made to the lighting outputs (in the 96 step mode) will take affect until the next step is executed.
- 3.14.4.5. The 'PROG' key will function when in the 'User Level' menus.
- 3.14.4.6. The 'Setup Level' menu is not accessible when a file is running.
- 3.14.4.7. Manual mode
  - 3.14.4.7.1. The 'PROG' key is pressed, the 'Run Manual' option is selected with the 'UP' and 'DOWN' keys.
  - 3.14.4.7.2. Pressing the 'ENTER' key returns to the 'Display Loop' and the control uses the manual set points.
- 3.14.4.8. Program diurnal mode
  - 3.14.4.8.1. The 'PROG' key is pressed, the 'Enter/Edit Diurnal' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
  - 3.14.4.8.2. The 'UP' and 'DOWN' keys are used to change the 'Day temperature' and the 'ENTER' key is pressed to select the value.
  - 3.14.4.8.3. The 'UP' and 'DOWN' keys are used to change the 'Day humidity' and the 'ENTER' key is pressed to select the value.
  - 3.14.4.8.4. The 'UP' and 'DOWN' keys are used to change the 'Day auxiliary' and the 'ENTER' key is pressed to select the value.

- 3.14.4.8.5. The 'UP' and 'DOWN' keys are used to change the 'Day period start' and the 'ENTER' key is pressed to select the value.
- 3.14.4.8.6. The 'UP' and 'DOWN' keys are used to change the 'Day period end' and the 'ENTER' key is pressed to select the value.
- 3.14.4.8.7. The 'UP' and 'DOWN' keys are used to change the 'Night temperature' and the 'ENTER' key is pressed to select the value.
- 3.14.4.8.8. The 'UP' and 'DOWN' keys are used to change the 'Night humidity' and the 'ENTER' key is pressed to select the value.
- 3.14.4.8.9. The 'UP' and 'DOWN' keys are used to change the 'Night auxiliary' and the 'ENTER' key is pressed to select the value.
- 3.14.4.9. Program 96 step mode
  - 3.14.4.9.1. The 'PROG' key is pressed, the 'Enter/Edit 96 Step' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
  - 3.14.4.9.2. The 'UP' and 'DOWN' keys are used to select the step to be changed and will not function if a value is being adjusted. The steps can be scrolled through and any one can be edited with the following method until the 'PROG' key is pressed.
  - 3.14.4.9.3. Pressing the 'TEMP' key, '% RH' key, 'AUX' key or the 'TIME' key causes the corresponding set point to flash.
  - 3.14.4.9.4. While the set point is flashing, the value can be changed with the 'UP' and 'DOWN' keys.
  - 3.14.4.9.5. The 'LIGHTS' key is pressed to adjust each light output individually.
  - 3.14.4.9.6. The 'ENTER' key, 'TEMP' key, '% RH' key, 'AUX' key, 'TIME' key or the 'LIGHTS' key is pressed to accept the value, stop the current set point from flashing and cause the appropriate new set point to start flashing.
  - 3.14.4.9.7. The 'PROG' key is pressed to exit the step edit mode.
  - 3.14.4.9.8. The 'UP' and 'DOWN' keys are used to select 'Add Step', 'Delete Step' 'Delete All Steps' or 'Quit'.
  - 3.14.4.9.9. 'Add Step', inserts the new, modified step after the one selected and displays the new step.
  - 3.14.4.9.10. 'Delete Step', removes the selected step and displays the previous step.

- 3.14.4.9.11. 'Delete All Steps', removes all steps from the file and displays the program menu.
  - 3.14.4.9.12. 'Quit', exits the edit mode and returns to the 'Display Loop'.
  - 3.14.4.9.13. The default step data for the first step is, 12:00 AM (midnight), temperature set point at 24°C, relative humidity set point at 70%, auxiliary set point at 1 and all lights off.
  - 3.14.4.9.14. The default step data for all other steps, is the previous steps data with the time incremented by 1 minute.
  - 3.14.4.9.15. If a step is programmed with the same time as an existing step, a message will popup, informing the user of the error and the new step will be deleted.
- 3.14.4.10.        Run 96 step mode
- 3.14.4.10.1. The 'PROG' key is pressed, the 'Run 96 Step' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
  - 3.14.4.10.2. The file starts running at the appropriate step in the file, based on the current time.
  - 3.14.4.10.3. The file continues running until the manual mode is entered or the diurnal mode is run.
- 3.14.4.11.        Run diurnal mode
- 3.14.4.11.1. The 'PROG' key is pressed, the 'Run Diurnal' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
  - 3.14.4.11.2. The file starts running the appropriate period (day or night) in the file, based on the current time.
  - 3.14.4.11.3. The file continues running until the manual mode is entered or the 96 step mode is run.
- 3.14.5.        Menu System Ramping control method**
- 3.14.5.1. Files can only be started from the 'Display Loop' and cannot be run while auto tuning.
  - 3.14.5.2. The status of the light dimming outputs will be displayed in the 'Display Loop'.

- 3.14.5.3. The 'User Level' menu is accessible when a file is running and any changes made to the lighting outputs will take affect until the next step is executed.
- 3.14.5.4. The 'PROG' key will function when in the 'User Level' menus.
- 3.14.5.5. The 'Setup Level' menu is not accessible when a file is running.
- 3.14.5.6. When this control method is selected at the factory, the user will be able to select between the 'Non-Ramping' and 'Ramping' control methods.
- 3.14.5.7. Steps are grouped into 1 of 50 files total.
- 3.14.5.8. Any file can be run individually.
- 3.14.5.9. A sequence of up to 50 files can be created and run.
- 3.14.5.10. The user can determine the number of iterations, from 1 to 500 that each file in the sequence is run.
- 3.14.5.11. If a step is programmed with the same time as an existing step in the current file, a message will popup, informing the user of the error and the new step will be deleted.
- 3.14.5.12. Naming a file
  - 3.14.5.12.1. Each file can be named with up to 8 characters.
  - 3.14.5.12.2. The default name will be a 6 digit date code with a 2 digit index. (ex. A file created on July 31, 2000 would have a file name of '07310001' if no other file name begins with '073100').
  - 3.14.5.12.3. The 'PROG' key is pressed to move horizontally through the characters and to allow changing the character and causes it to flash. The last character wraps to the first.
  - 3.14.5.12.4. The 'UP' and 'DOWN' keys scroll through the characters. The characters can be slewed.
  - 3.14.5.12.5. The 'ENTER' key is pressed to exit the naming feature.
  - 3.14.5.12.6. If a file is named with the same name as an existing file, a message will popup, informing the user of the error and the file name will change back to the previous name.
- 3.14.5.13. Manual mode
  - 3.14.5.13.1. The 'PROG' key is pressed, the 'Run Manual' option is selected with the 'UP' and 'DOWN' keys.

3.14.5.13.2. Pressing the 'ENTER' key returns to the 'Display Loop' and the control uses the manual set points.

#### 3.14.5.14. Program create mode

3.14.5.14.1. The 'PROG' key is pressed, the 'Create Program' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.

3.14.5.14.2. The file name appears and can be changed (see Naming a file).

3.14.5.14.3. The 'UP' and 'DOWN' keys are used to select the step to be changed and will not function if a value is being adjusted. The steps can be scrolled through and any one can be edited with the following method until the 'PROG' key is pressed.

3.14.5.14.4. Pressing the 'TEMP' key, '% RH' key, 'AUX' key or the 'TIME' key causes the corresponding set point to flash.

3.14.5.14.5. While the set point is flashing, the value can be changed with the 'UP' and 'DOWN' keys.

3.14.5.14.6. The 'LIGHTS' key is pressed to adjust each light output individually.

3.14.5.14.7. The 'ENTER' key, 'TEMP' key, '% RH' key, 'AUX' key or the 'LIGHTS' key is pressed to accept the value, stop the current set point from flashing and cause the appropriate new set point to start flashing.

3.14.5.14.8. The 'PROG' key is pressed to exit the step edit mode.

3.14.5.14.9. The 'UP' and 'DOWN' keys are used to select 'Add', 'Delete' or 'Quit'.

3.14.5.14.10. 'Add', inserts the new, modified step after the one selected and displays the new step.

3.14.5.14.11. 'Delete', removes the selected step and displays the previous step.

3.14.5.14.12. 'Quit', exits the edit mode and returns to the 'Display Loop'.

3.14.5.14.13. The default step data for the first step of a new file is, 12:00 AM (midnight), temperature set point at 24°C, relative humidity set point at 70%, auxiliary set point at 1 and all lights off.

- 3.14.5.14.14. The default step data for all other steps, is the previous steps data with the time incremented by 1 minute.
- 3.14.5.15. Program edit mode
- 3.14.5.15.1. The 'PROG' key is pressed, the 'Edit Program' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
  - 3.14.5.15.2. The 'UP' and 'DOWN' keys are used to select the file to be changed.
  - 3.14.5.15.3. The file name appears and can be changed (see Naming a file).
  - 3.14.5.15.4. The 'UP' and 'DOWN' keys are used to select the step to be changed and will not function if a value is being adjusted. The steps can be scrolled through and any one can be edited with the following method until the 'PROG' key is pressed.
  - 3.14.5.15.5. Pressing the 'TEMP' key, '% RH' key, 'AUX' key or the 'TIME' key causes the corresponding set point to flash.
  - 3.14.5.15.6. While the set point is flashing, the value can be changed with the 'UP' and 'DOWN' keys.
  - 3.14.5.15.7. The 'LIGHTS' key is pressed to adjust each light output individually.
  - 3.14.5.15.8. The 'ENTER' key, 'TEMP' key, '% RH' key, 'AUX' key, 'TIME' key or the 'LIGHTS' key is pressed to accept the value, stop the current set point from flashing and cause the appropriate new set point to start flashing.
  - 3.14.5.15.9. The 'PROG' key is pressed to exit the step edit mode.
  - 3.14.5.15.10. The 'UP' and 'DOWN' keys are used to select 'Add', 'Delete' or 'Quit'.
  - 3.14.5.15.11. 'Add', inserts the new, modified step after the one selected and displays the new step.
  - 3.14.5.15.12. 'Delete', removes the selected step and displays the previous step.
  - 3.14.5.15.13. 'Quit', exits the edit mode and returns to the 'Display Loop'.

#### 3.14.5.16. Program delete mode

- 3.14.5.16.1. The 'PROG' key is pressed, the 'Program Delete' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
- 3.14.5.16.2. The 'UP' and 'DOWN' keys are used to select the file to be deleted.
- 3.14.5.16.3. The 'ENTER' key is pressed to select the file.
- 3.14.5.16.4. The user is prompted 'Delete this file?'.
- 3.14.5.16.5. The 'UP' and 'DOWN' keys are used to select 'Yes' or 'No' and the 'ENTER' key is pressed to make the selection.

#### 3.14.5.17. Program copy mode

- 3.14.5.17.1. The 'PROG' key is pressed, the 'Program Copy' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
- 3.14.5.17.2. The 'UP' and 'DOWN' keys are used to select the file to be copied.
- 3.14.5.17.3. The 'ENTER' key is pressed to copy the selected the file.
- 3.14.5.17.4. The program edit mode is entered at the naming prompt.

#### 3.14.5.18. Program sequence mode

- 3.14.5.18.1. The 'PROG' key is pressed, the 'Program Sequence' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
- 3.14.5.18.2. The 'Create' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.
- 3.14.5.18.3. The 'UP' and 'DOWN' keys are used to select from all available files and 'ENTER' is pressed to select it.
- 3.14.5.18.4. The 'UP' and 'DOWN' keys change the 'Number of iterations' and the 'ENTER' key accepts the value.
- 3.14.5.18.5. The 'PROG' key is pressed and the 'UP' and 'DOWN' keys are used to select 'Add', 'Delete' or 'Insert' and 'ENTER' is pressed to make the selection.
- 3.14.5.18.6. If 'Add' is selected, the 'UP' and 'DOWN' keys select from all available files. Pressing the 'ENTER' key inserts the selected file after the last file in the sequence. The 'UP' and 'DOWN' keys

are used to change the 'Number of iterations' and the 'ENTER' key accepts the value. The display returns to the current sequence file list.

3.14.5.18.7. If 'Delete' is selected, use the 'UP' and 'DOWN' keys to select a file in the sequence. Pressing the 'ENTER' key deletes the selected file from the sequence. The display returns to the current sequence file list.

3.14.5.18.8. If 'Insert' is selected, the 'UP' and 'DOWN' keys select from all available files. Pressing the 'ENTER' key selects the new file. The 'UP' and 'DOWN' keys are used to select the location in the sequence to insert the new file. Pressing the 'ENTER' key inserts the new file after the file location selected in the sequence. The 'UP' and 'DOWN' keys are used to change the 'Number of iterations' and the 'ENTER' key accepts the value. The display returns to the current sequence file list.

#### 3.14.5.19. Run file mode

3.14.5.19.1. The 'PROG' key is pressed, the 'Run File' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.

3.14.5.19.2. The desired file is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.

3.14.5.19.3. The file starts running at the appropriate step in the file, based on the current time.

3.14.5.19.4. The file continues running until the manual mode is entered or another file/sequence is run.

#### 3.14.5.20. Run sequence mode

3.14.5.20.1. The 'PROG' key is pressed, the 'Run Sequence' option is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.

3.14.5.20.2. The desired file in the sequence is selected with the 'UP' and 'DOWN' keys and the 'ENTER' key is pressed.

3.14.5.20.3. The sequence starts running the first iteration of the selected file, at the appropriate step in the file, based on the current time.

3.14.5.20.4. The sequence continues running until the manual mode is entered or another file/sequence is run.

### 3.14.6. Menu System Security

- 3.14.6.1. There will be 4 levels of user access for the different menus, Level 1 being the most access and Level 4 being the least access. Level 1, Level 2 and Level 3 will be password protected.
- 3.14.6.2. To enter the 'Security Level' menu, the 'UP' and 'ENTER' keys are pressed and held for 3 seconds, only from the 'Display Loop'.
- 3.14.6.3. A security level password must be entered. The 'SLVL' back door password is valid.
- 3.14.6.4. If the security level password entered is incorrect, the display will go back to the 'Display Loop'.
- 3.14.6.5. If the password entered is correct, the security level menu will provide the ability to change the Security Level, Level 1, Level 2 and Level 3 passwords. Level 4 is the default level and thus does not need a password.
- 3.14.6.6. Each password will be 4 characters in length.
- 3.14.6.7. Level 1 access will allow full access to the file programming, user menu, manual settings, display loop, starting/stopping/resetting timers and running files.
- 3.14.6.8. Level 2 access will allow full access to the user menu, manual settings, display loop and running files.
- 3.14.6.9. Level 3 access will allow full access to the temp high and low alarm settings, rh high and low alarm settings, aux high and low alarm settings and the display loop.
- 3.14.6.10. Level 4 access will allow full access to the display loop.
- 3.14.6.11. The default 'Security Level' password will be '1111'.
- 3.14.6.12. The default 'Level 1' password will be '0001'.
- 3.14.6.13. The default 'Level 2' password will be '0002'.
- 3.14.6.14. The default 'Level 3' password will be '0003'.
- 3.14.6.15. If no passwords are changed from the factory settings, Level 1, Level 2, Level 3 and Level 4 will all have Level 1 access and not require a password for entry.
- 3.14.6.16. This menu will also allow viewing the status of control outputs, logic outputs, event outputs 9-16 and digital inputs.
- 3.14.6.17. The 'Setup' menu is always password protected with the 'back door' password 'PICS'.

3.14.6.18. The 'Setup-PID' menu can also be accessed with the password 'APID'.

### **3.14.7. Login/Logout**

3.14.7.1. To login, the 'DOWN' and 'HELP' keys are pressed and held for 1 second, only from the 'Display Loop'.

3.14.7.2. The login password must be entered.

3.14.7.3. If the password entered is incorrect, the display will go back to the 'Display Loop' and the current login level will be Level 4.

3.14.7.4. When a level higher than Level 4 has been 'logged' into or a password is partially entered, it will revert to Level 4 if there has been no key activity for more than 5 minutes.

3.14.7.5. When the login password is being entered it will display as '\*\*\*\*'. The 'UP' and 'DOWN' keys are used to select the digit. Pressing the 'PROG' key moves to the next digit. When moving from one digit to the next, the digit just entered will be replaced with a '\*'.

3.14.7.6. There will be a 'back door' password 'SLVL' that will always allow full menu access (Level 1).

3.14.7.7. To log out, the 'DOWN' and 'HELP' keys are pressed and held for 1 second when logged in.

3.14.7.8. The current login level will be displayed in the upper left corner of the help text.

### **3.14.8. Operator Interface**

3.14.8.1. Prompt text on the top display will always be left justified.

3.14.8.2. Enumerated (non-numeric) type prompt selections will always be left justified.

3.14.8.3. Numeric type prompt values will always have the least significant digit in character position 6 (from the left), position 7 is always a space and 8-20 are used for the units.

### **3.14.9. Device Configuration**

3.14.9.1. There will be 4 sets of predefined parameter values that the user can choose from.

3.14.9.2. The sets will contain all user adjustable parameters except step settings.

### 3.14.10. Help System

- 3.14.10.1. Pressing the 'HELP' key will display the help text for the current prompt.
- 3.14.10.2. While help text is being displayed, the 'Up' and 'Down' keys will scroll the help text up and down if it won't fit on the display.
- 3.14.10.3. The help text will be defined by Percival.
- 3.14.10.4. Refer to 'Percival Menus, Key Flow and Specifications.xls' file for the details of the help text.

### 3.14.11. Language Requirements

- 3.14.11.1. The control will provide an English version only.

## 4. Validation Requirements

### 4.1. Unit Verification


- 4.1.1.1. Software unit modules will be tested with vector data and stub drivers.

### 4.2. Validation

- 4.2.1.1. The product will support automated validation processes from the Design for Automated Validation command set.

## Production Test and Calibration

- 4.2.1.2. These Standard Test Interface items are supported from the Embedded Functional Test command set:

Item	Command	Supported & Comments
RAM test		Yes
ROM test		Yes
Echo		Yes
Display Test		Yes, (VFD and LED)
Comms Select		Yes, (puts unit in Factory mode)
Set Real Time Clock		Yes
Get Real Time Clock		
Check Alarm		Yes

Set Serial Number		Yes
Get Serial Number		Yes
Set Part Number		Yes
Get Part Number		Yes
Set Configuration		Yes
Get Configuration		Yes
Set MAC Address		Yes
Get MAC Address		Yes
Read Analog In		Yes
Cal Analog In High		Yes
Cal Analog In Low		Yes
Set Actual Analog Out		No
Set Analog Out High Cal		No
Set Analog Out Low Cal		No
Cal Analog Out High		No
Cal Analog Out Low		No
Set Digital Out		Yes, (32 + 1 Mechanical)
Read Digital In		Yes, (3 + 10 keys)
Get Unit Hardware		Yes, (33 digital out, 13 digital in, 1 comm port)

4.2.1.3. Calibration outside of Watlow will not be allowed.