BTU Ventilation

XT Systems, let them SERVE you from anywhere.

XT-70 Ventilation Control Panel User's Manual

Manual XT-003.0

FORWARD

The new XT Series Control Panel from BTU Ventilation is built from the ground up for the 21st century farm manager. Simplicity of operation, combined with sophisticated on-board data analysis and internet communications make this a control panel of the future.

STANDARD FEATURES:

- Twelve temperature sensors
- Three humidity sensors
- One CO_2 sensor
- Fresh air door pulse or directional control
- Centrally distributed time, outside air temperature and outside air humidity to multiple panel complexes
- Ethernet panel-to-panel networking
- Pulse humidity control
- Infinite CO_2 control in refrigeration and cooling mode
- Refrigeration capacity control
- Fan frequency drive on-board controller
- Individual frequency setting for each mode
- Automatic pile temperature differential control
- All outputs are plug-in solid state modules for noise isolation
- All 4-20mA outputs are optically isolated
- All RS-485 communications are optically isolated
- Building cavity control on-board
- Manual - Off - Auto (MOA) switches for all outputs
- View multiple fan houses using a single graphical user interface
- Select from a number of different user interface options
- Flexible Heat mode, with pulsed output
- Setpoint ramping

INDUSTRY FIRSTS:

- On-board embedded web server
- No special PC programs required for remote monitoring and control
- Use any web browser on a PC, laptop, PDA or cell phone to monitor and control your storage
- Secure Socket Layer (SSL) for secure access
- Alarms and daily updates via e-mail or text messaging.
- File Allocation Table (FAT) file system. All data downloaded directly into a spreadsheet or database.
- Integrate all refrigeration information and controls into same database and user interface.
- Integrate smart door controls to identify individual door controls and for accurate door position.
- Designed for multiple fan house applications. Uses one user interface for additional fan houses.
- Single board design, multi-layer for noise rejection.

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1.1 XT Sensors: The XT panel can accept a number of different input sensors and has ten solid state 3 amp outputs. In addition, there are two analog outputs that are 0-20mA or 0-10VDC. The fresh air doors are controlled by two relay outputs.

XT Analog Inputs:

• Plenum 1	F	2250 ohm
• Plenum 2	F	2250 ohm
• Outside Air	F	2250 ohm
• Return	F	2250 ohm
• Pile 1	F	2250 ohm
• Pile 2	F	2250 ohm
• Pile 3	F	2250 ohm
• Pile 4	F	2250 ohm
• Pile 5	F	2250 ohm
• Pile 6	F	2250 ohm
• Pile 7	F	2250 ohm
• Pile 8	F	2250 ohm
• Outside Humid	%	4-20mA
• Plenum Humid	%	4-20mA
• Return Humid	%	4-20mA
• CO2	ppm	4-20mA

XT Analog Outputs:

• Freq Drive	0-20mA / 0-10VDC
• Refrigeration	0-20mA / 0-10VDC

XT Digital Inputs:

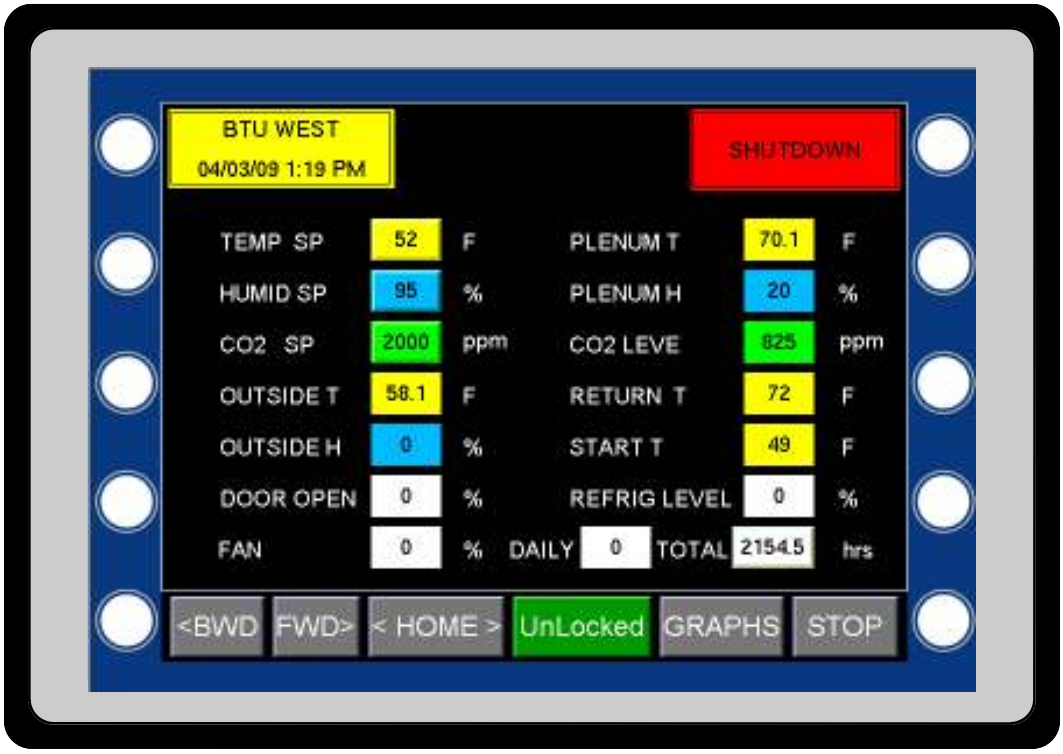
• Fan proving	Dry contact
• Cell pump proving	Dry contact
• Refrigeration Fail	Dry contact
• Remote Standby	Dry contact
• Spare	
• Spare	
• Spare	
• Spare	
• Low Temp	SPDT contact
• Air Restrict	Dry contact
• Start / Stop	Dry contact

XT Digital Outputs:

• Red light	3A 120VAC SS
• Yellow light	3A 120VAC SS
• Fan / Green light	3A 120VAC SS
• Evap cooling pump	3A 120VAC SS
• Humidifier pump 1	3A 120VAC SS
• Humidifier pump 2	3A 120VAC SS
• Heater	3A 120VAC SS
• Aux 1	3A 120VAC SS
• Aux 2	3A 120VAC SS
• Cavity heater	3A 120VAC SS
• Door open	12VDC/relay
• Door close	12VDC/relay

Note - The Aux 1, Aux 2, and cavity heater can be set to be interlocked with the Start / Stop switch, mechanical Low Temp and Air Restriction devices or to operate independently.

XT Panel Main Components



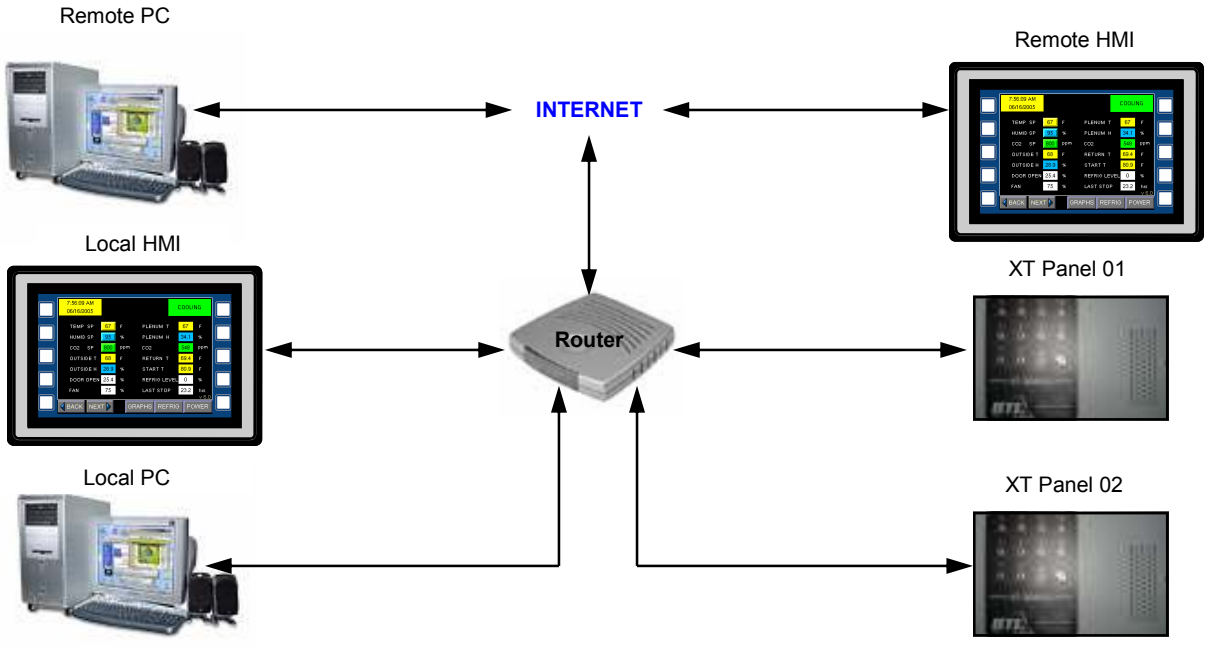
2.1 G70 HMI (Human Machine Mnterface) color touch screen: The XT panel has many options for user interfaces. The standard interface is a G70 and is a 320 x 240 color touch screen. An optional G75, 640 x 480 larger color touch screen, is also available. Active touch buttons are either labeled or shown as raised buttons. Pressing one of these buttons will produce a keypad for entering a new value.

The sole purpose of the HMI is to provide a friendly user interface to the XT control card. One HMI can communicate with multiple XT panels and more than one HMI can communicate with the same XT panel. The HMI is not necessary for the XT panel to run. A PC with the appropriate software can also act as an HMI. Ethernet is used for the communications connection between the HMI and XT panel. With the high speed of the internet, it is now possible to locate the HMI screen almost anywhere.

HMI Hot Keys: The HMI has a number of hot keys used to go directly to a screen verses using the FWD> and <BWD keys. For example, pressing the label TEMP SP on the home screen will directly bring up the Temperature Setpoint Ramp screen. Pressing the <HOME> key on any screen will go directly back to the first general screen (the home screen).

2.2 **XT Control Module:** The XT control module was designed for economics, ease of installation, manufacturing and flexibility. Each outputs on the XT module has a MOA (Manual-Off-Auto) switch and an LED indicator associated with it. By incorporating the MOA switches as part of the panel, it allows for a very compact module and also allows the microprocessor to read full switch status. The module also includes a refrigeration control potentiometer for use in manual mode. This allows adjustment of the output of the refrigeration for testing purposes. At all times, the low temperature and air restriction safeties, along with the Start/Stop switch, supervise the outputs. The Aux 1, Aux 2 and Cavity outputs can be set for supervision or act independently of the Start/Stop switch and system safeties.

3.1 Typical Ethernet Network Connections



4.1 XT Modes of Operation

SECONDARY MODES **MAIN OPERATIONAL MODES**

XT Modes: The XT Panel operates in two modes: the main operation mode and a secondary mode. Depending on the setup of the alarms, it is possible to continue running in an alarm mode.

For example, for a cell pump failure, the secondary mode would indicate a cell pump failure, send out the alarm, indicate an alarm (a blinking red light) but continue to run in Cooling or Refrigeration. Wetbulb calculation would be shut off.

Main Operation Modes:

● ○ ○	**Shutdown:**	Shutdown is activated by the Stop/Start switch set to the Stop position.
○ ● ○	**Standby:**	Standby can only be activated with the time clock set to standby or with no outside cooling available during Cooling mode.
○ ○ ●	**Cooling:**	Cooling mode can only be activated with outside cooling air available and time clock set to either Cooling or Refrigeration mode.
○ ○ ●	**Refrig:**	Refrigeration mode will be activated when cooling air is not available and the time clock is set for Run or Ref Only.
○ ○ ●	**Timed:**	Timed Run will be activated when the time clock is set to Run, there is no outside cooling air available and the refrigeration switch is set to Off.
● ○ ○	**Remote Stop:**	Remote stop is activated with the Stop button from either the HMI touchscreen or web interface.
● ● ●	**Test:**	The Test mode is a special mode that allows remote testing of all outputs. This is activated from either the HMI or the web interface.
● ● ○	**Low Temp:**	The low temp alarm is triggered by the backup low temp safety thermostat. It can only be reset with the Start/Stop switch.
● ○ ○	**Air Restriction:**	The Air Restriction alarm is triggered by the air pressure differential switch. It can only be reset with the Start/Stop switch.
● ○ ○	**Parameter Fail:**	The Parameter fail is triggered by an out-of-range setting on one of the critical parameters. If setpoint is < 32.0 or > 76.7, the alarm is triggered. If target is < 32.0 or > 76.7, the alarm is triggered. If pile diff selection > 8, the alarm is triggered. If Start differential > 50 or < -50, the alarm is triggered.

● ○ ○	**Comm Fail:**	Loss of communication between the Rabbit and P1 processor for more than three minutes. An internal comms bus failure is serious.
● ○ ○	**Power Fail:**	Loss of 110VAC control power.
● ● ○	**Remote Standby:**	Remote Standby is activated by a contact closure across input IN4. Typically used for off-peak power, ripple control or refrig defrost.
● ● ○	**Alarm Standby:**	Any alarm condition that was set to shut down the system.
○ ○ ●	**Cure:**	This mode is a Onion mode. This mode is used when the fresh air doors are being used to cure the onions.
○ ○ ●	**Burner:**	This mode is a Onion mode. This mode is used when the burner is being used to cure the onions.
● ○ ○	**Fan Fail:**	The fan input IN1 did not get a closed contact within the fan fail timer period. There is a programmable timer associated with this alarm.
● ○ ○	**Fan Off:**	The fan MOA switch is in the Off position.
○ ○ ●	**Warming:**	The Aux 2 switch has been configured for Warming and is in the Auto position. In Warming mode, the doors will open whenever the OSA is greater than the start temperature and will warm the plenum air up to the setpoint. The PID is running in a reverse mode, opening the doors whenever the plenum is too cold. When OSA is less than the start temperature the system will run in Cooling. The time clock must be set to Cooling for the Warming mode to operate.
○ ○ ●	**Cooling / Purge:**	The system is in Cooling and the return air heaters are being used to force the fresh air doors open. This cycle has been triggered by time and not the CO2 sensor.
○ ○ ●	**Refrig / Purge:**	The system is in Refrigeration and the fresh air doors are open to the max door setting. This cycle has been triggered by time and not the CO2 sensor.
○ ○ ●	**Timed / Purge:**	The system is in Timed and the time purge cycle is active. At the designated time, the fresh air door will open to the max door setting and purge for the programmed time. This cycle has been triggered by time and not the CO2 sensor.
○ ○ ●	**Refrig / ARL:**	The system is in Refrigeration and the ARL (ambient reverse loading) is active. The Fresh air doors are being used to bring in fresh air and keep the refrigeration running at a minimum setting.
○ ○ ●	**Cooling / CO2:**	The system is in Cooling and the CO_2 level is above The CO2 setpoint. The return air heaters are active to help open the doors and purge the CO_2.

○ ○ ●	**Refrig / CO2:**	The system is in Refrigeration and the CO_2 level is above CO2 setpoint. The fresh air doors are being used to purge the CO_2.
○ ○ ●	**Door Defrost:**	The system is in Cooling and the fresh air door defrost has been triggered. The doors are closed and the return air is being used to defrost them. This should only be used during extreme times of cold Outside air.
○ ○ ●	**Heat:**	This mode is used to turn on return air heaters when the system is running in Cooling, the doors are closed and the plenum temperature has drop below the Setpoint minus the heat differential.
○ ○ ●	**Cooling / Dehumid:**	The system is in a normal Cooling mode and has detected high humidity. In Onion mode, the burner is on low fire to bring in more fresh air. In Potato mode, the return air heater is used to dehumidify.
○ ○ ●	**Refrig / Dehumid:**	This is an Onion mode. The system is in a normal Refrigeration mode and the burner is being run on low fire.

4.2

Secondary Modes:

None: There are no secondary modes currently active.

Ramp: The setpoint and target are different values and the system is in the Ramp mode. The Ramp mode can ramp the setpoint up or down.

Fan Manual: The fan MOA switch is in the Manual position. The system will run as normal.

Cell Pump Fail: The Cell Pump Fail will trigger when the cell MOA switch is turned to Auto and the Cell pump input (IN2) is off. There is a programmable delay timer (CPF_timer) associated with this alarm..

Refrig Fail: The Refrig Fail Alarm will trigger when the refrigeration MOA switch is turned to Auto, the refrigeration input (IN3) is off and the system is in Refrigeration mode. The system will continue to run in Cooling mode if outside cooling is available.

Plen Sensor Fail: The Plenum Sensor Fail alarm is triggered by a programmable difference between Plen 1 and Plen 2. There is a programmable timer Associated with this alarm.

OSA Sensor Fail: The Outside Air Sensor Fail alarm is triggered by an out-of-range outside air sensor. There is a programmable timer associated with this alarm.

Fan Boost: The fan boost has programmable parameters that allow you to specify certain intervals for the fans to speed up stir the air and then go back to original speed. On the initial change the fans will speed up 5% per Minute. On termination the fans will change immediately to the original speed.

Low Dev: The Low Dev alarm will trigger when the plenum temperature drops below the low dev setting, the timer has expired and the fans are running. There is a programmable timer associated with this alarm.

High Dev: The High Dev alarm will trigger when the plenum temperature rises above the high dev setting, the timer has expired and the fans are running. There is a programmable timer associated with this alarm.

OSH Sensor Fail: The Outside Humidity Sensor Fail alarm is triggered by a out-of-range outside humidity sensor. There is a programmable timer associated with this alarm.

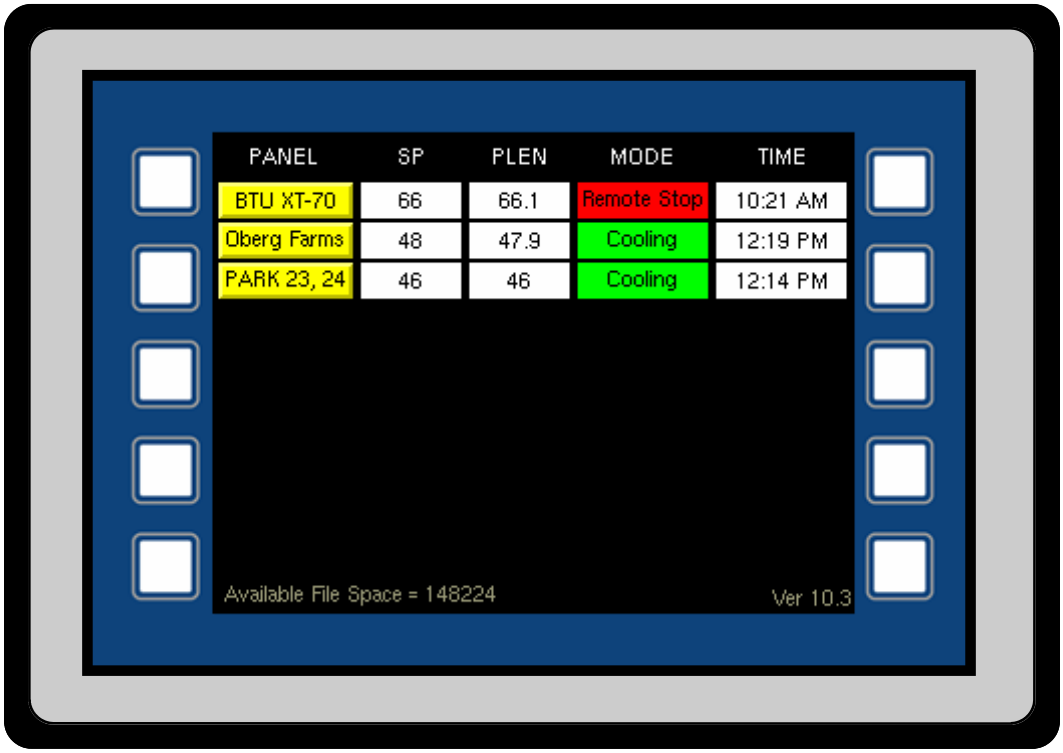
Low Humidity: The Low Humidity alarm is triggered when the plenum humidity level drops below the low humidity setting. The system must be in a valid operating mode. There is a programmable timer associated with this alarm.

High CO2: The High CO_2 alarm is triggered by a CO_2 level greater than the high CO_2 setting. The system must be in a valid operating mode. There is a programmable timer associated with this alarm.

Pile Humid Fail: This is an Onion alarm. The program has detected a failure with one of the two pile humidity sensors. There is a programmable timer associated with this alarm.

Pile Temp Fail: This is an Onion alarm. The program has detected a failure with one of the four pile sensors that are being used. See the sensor configuration to determine which sensors are being used. There is a programmable timer associated with this alarm.

HMI Operation:



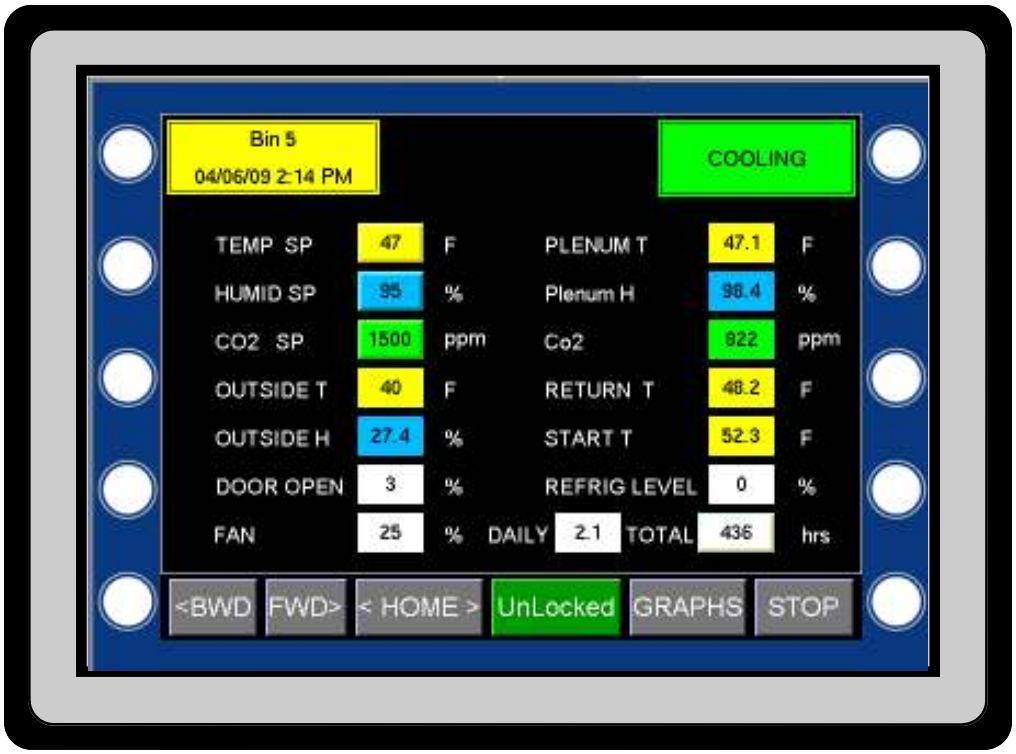
5.1 Main Home Screen:

The home screen will show the status of up to ten XT panels. Each of the panels are updated every second. The panel name is unique to each panel and can be set up with the web interface. To get to the main screen of any panel, press the PANEL name button. This will display the individual screens for a panel on the HMI. Pressing the <HOME> button from the home screen will take the HMI back to this screen.

Touchscreen:

The touchscreen can be activated by using your finger or any type of plastic stylus. Using a finger will leave prints and oil on the display screen. Care should be used when cleaning the screen not to scratch it. A clean soft cloth and a mild glass cleaner should be used to clean the screen, .

5.2 HMI Status Screen:



Note - to make any change to a system parameter, the Unlocked button must be green. See 5.3 on how to lock and unlock the system.

TEMP SP: Plenum temperature setpoint. To change the setpoint, press the yellow button A pop-up keyboard will be displayed. Type in the desired setpoint with or without a decimal place. Only one decimal place can be entered. Press Enter to send the new value or press Cancel to go back to the main screen. The range of the setpoint is 33.0 to 80.0 degrees F. A value outside this range will cause a Parameter Fail alarm.

HUMID SP: Plenum Humidity Setpoint. The humidity setpoint has a range from 0 to 100 %. To change the setpoint, press the blue button. A pop-up keyboard will be displayed. Type in the desired value. The value can be a number with zero or one decimal places.

CO_2 SP: CO_2 Setpoint. This is the upper limit for the CO_2 level in the storage. The best location for the CO_2 sensor is in the return air of the storage. The CO_2 Setpoint has a range of 0 to 10000 ppm. To change the CO_2 setpoint, press the green button. A pop-up keyboard will be displayed. The value is a whole number only.

OUTSIDE T: This is the outside air temperature in degrees F.

OUTSIDE H: This is the outside humidity.

DOOR OPEN: This displays the amount of fresh air that is being brought into the storage. It is a value from 0 to 100 percent. This is a important value and will be active in the Refrig/CO2 mode.

HMI Status Screen:

FAN: This is the current percentage of fan speed if variable frequency drives are used. This value will change depending on the current system mode.

PLENUM T: The plenum temperature is measured using two plenum sensors located close together. These two sensors are averaged and displayed as Plenum T. The reason for two sensors is to detect a sensor failure. If the difference between the two sensors is above a preset limit, the system will shutdown and display a plenum sensor alarm.

PLENUM H: Plenum Humidity. This value is used for the storage humidity control.

CO_2: This is the CO_2 level in ppm. This reading is taken in the return air and is a good indicator of the CO_2 level in the building. This reading is also used for the CO_2 control.

RETURN T: The return air temperature is located above the pile and is a good indicator of the amount of heat coming out of the pile or of the average pile temperature.

START T: Start Temperature. Start temperature is a calculated value used to determine when outside cooling is available. For outside cooling air to be available, the outside air temp must be below the start temperature.

REFRIG LEVEL: Refrigeration level is the current refrigeration operation level from 0 to 100 %.

DAILY: Actual run time since 12:00 Noon. The daily run time is cleared each day at noon.

TOTAL: Total run time of the system. At any time, press the TOTAL button to change the time to zero or to a preset value.

<BWD This button will return to the previous screen.

FWD> This button will advance to the next screen.

<HOME> This button will return to the main home screen.

Locked The Locked button will keep the keyboard locked and will not allow any changes to the setpoints. When the Locked key is pressed, a keyboard will appear. Type in the user-name and password separated by a period.

UnLocked Once the correct user name and password is entered, the key will change to UnLocked. To lock the system again, press the UnLocked key.

GRAPHS This button will advance to the real time graphs module and the activity log.

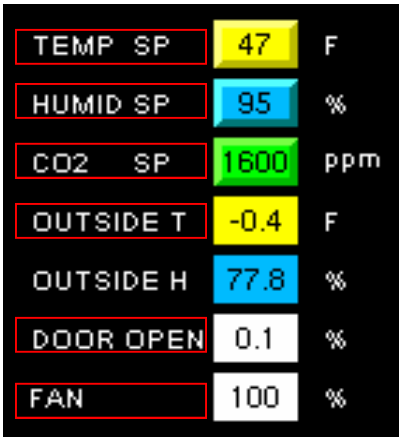
STOP This button will force the system into a Remote Stop mode. The Remote Stop will reset all alarms and act just like the local Start/Stop switch.

START Once the STOP button has been pressed and the system goes into Remote Stop mode, the STOP button will then display START. Press it once again and the system will resume normal operation.

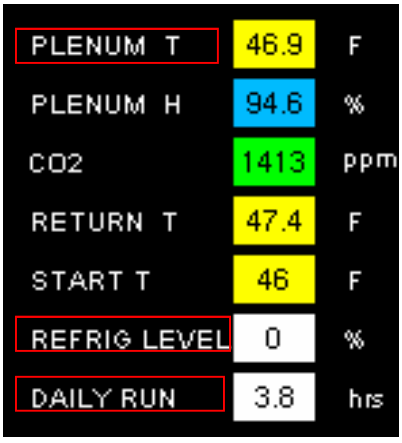
HMI HOT KEYS:

Hot keys allow the user to jump to any of the screens directly without using the FWD> and <BWD buttons. The labels for each of the parameters on the main screen are hot keys.

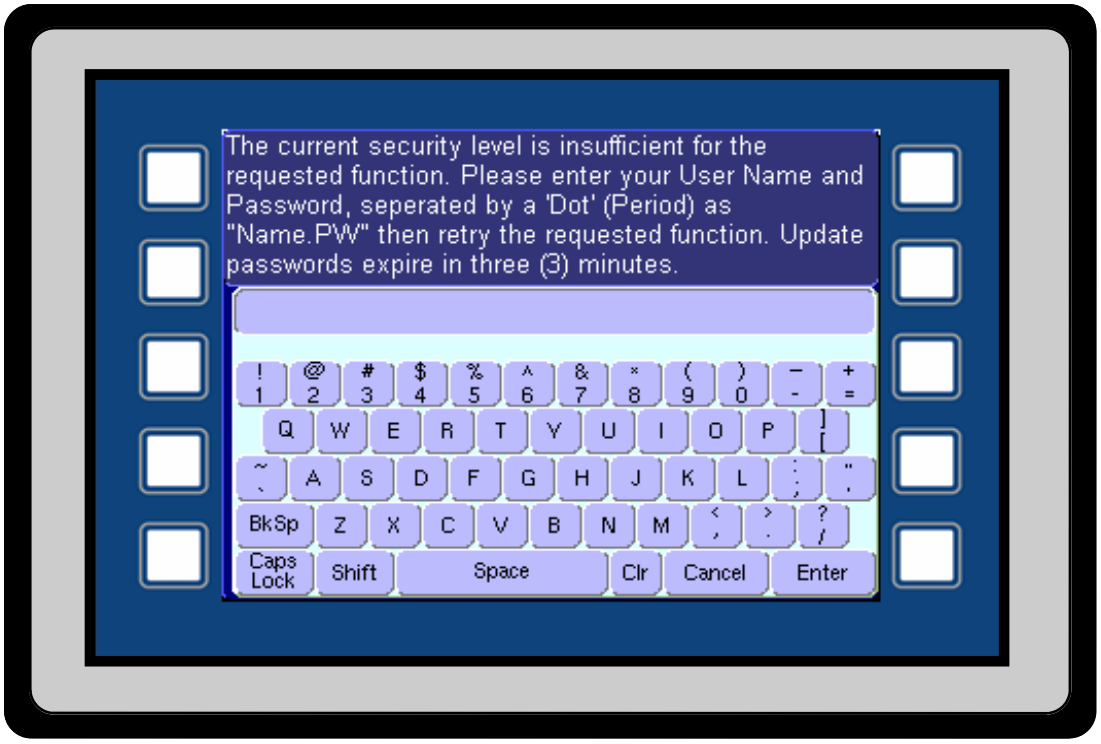
TEMPERATURE RAMP SETPOINT SCREEN →
HUMIDITY CONTROL SCREEN →
CO2 CONTROL AND MISC SCREEN →
OUTSIDE AIR CONTROL SCREEN →
FRESH AIR DOOR CONTROL SCREEN →
FAN SPEED CONTROL →



TEMPERATURE DEVIATION SCREEN →
REFRIGERATION CONTROL SCREEN →
RUN TIME CLOCK SCREEN →



HMI Password Screen:

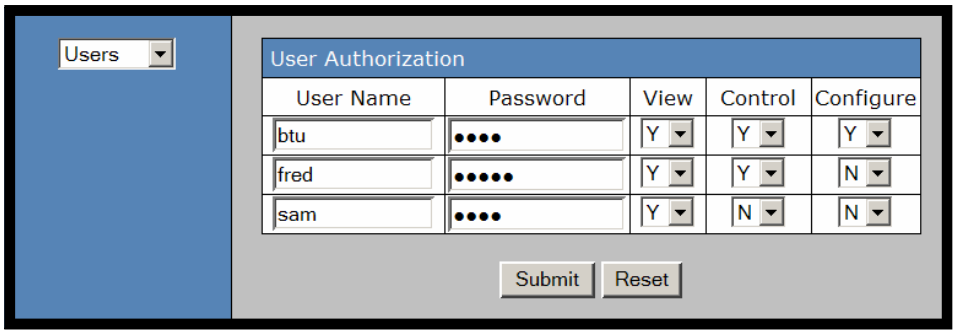


5.3 Password Screen:

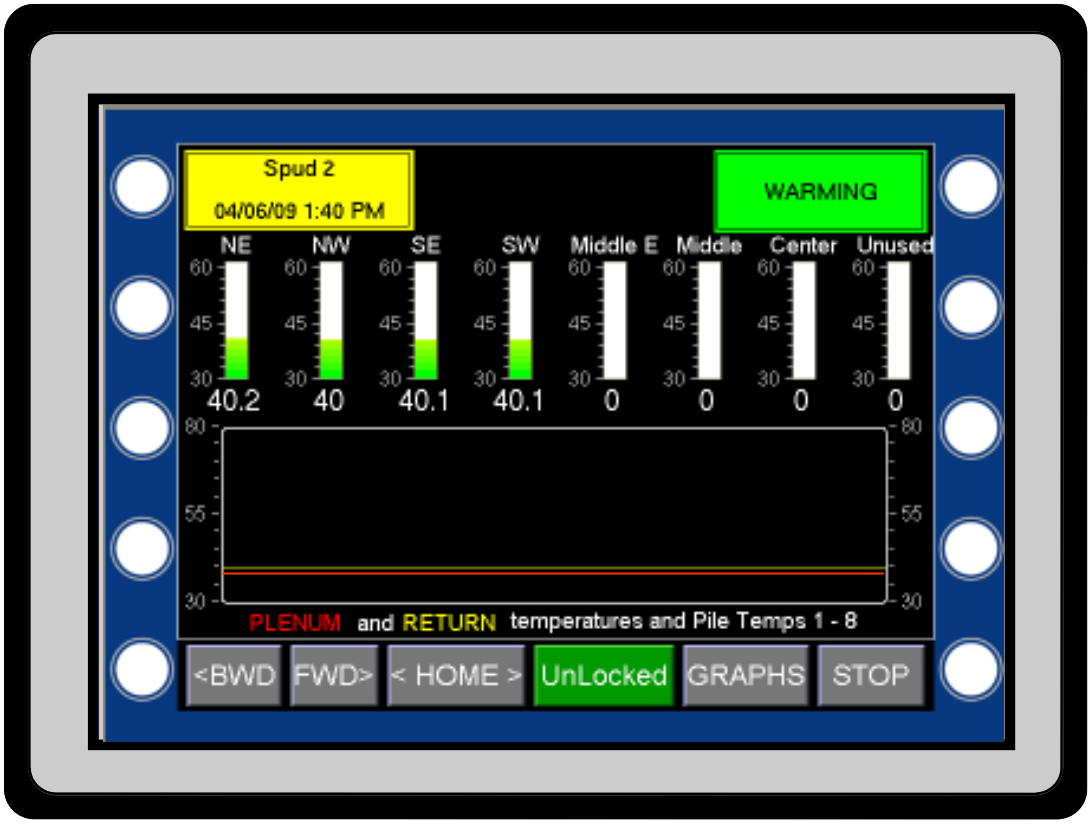
A valid username and password must be entered to unlock the system. There are three levels of password protection within the XT program. Three different passwords can be entered. All password information can only be entered using the XT web interface. The username and password can not be changed from the HMI, only from the web interface.

Level 1	**View only**	User is authorized to view only.
Level 2	**Control**	User is authorized to view and to make control parameter changes.
Level 3	**Configure**	User is authorized to view, to make control parameter changes and to make system configuration changes.

Web Interface User Authorization Screen



5.4 HMI PILE TEMPERATURES:

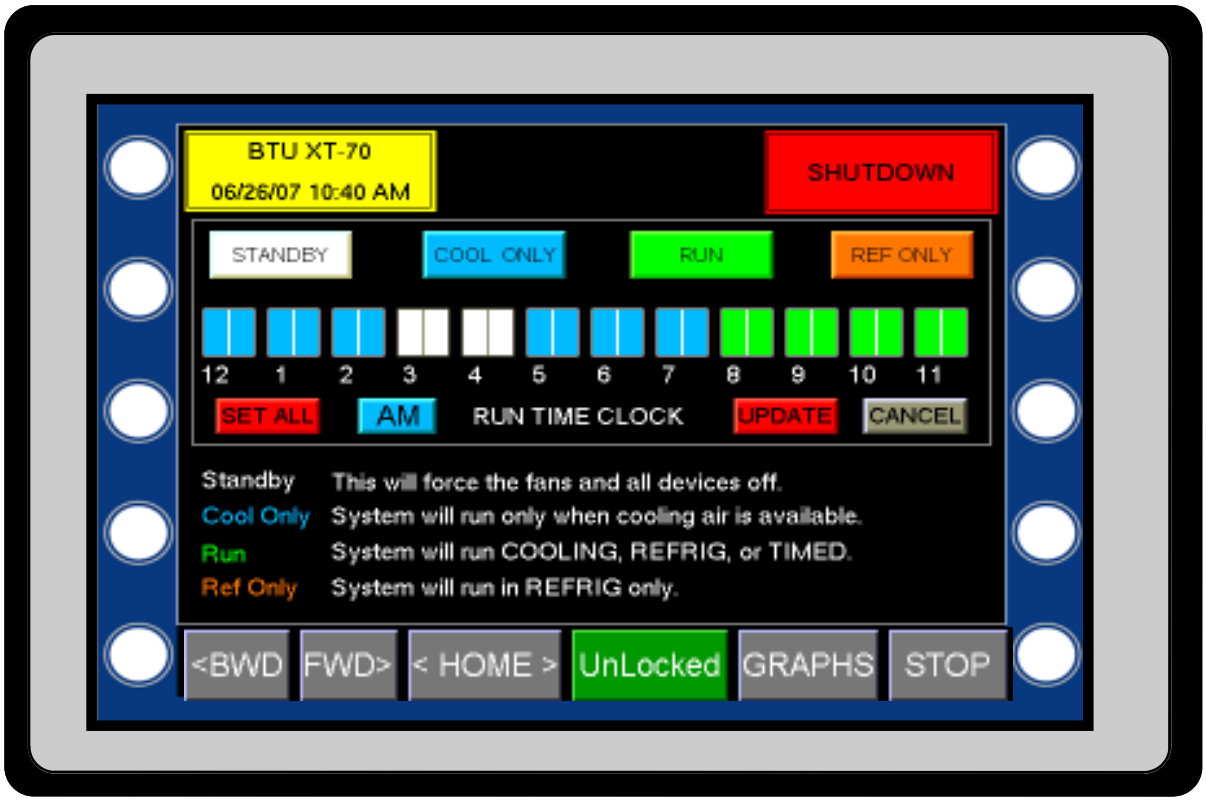


Each of the pile temperatures are displayed as a bar graph and in a window. The bar graph allows easy comparison between all of the pile temperatures. If the system is operating a cavity, some of the pile sensors may be designated as cavity sensors.

The line graph shows the plenum and return temperatures for the last 24 hours.

Each pile sensor can be individually named. This is done through the web interface and can be done remotely by the dealer. When the names of the pile sensors are changed, the names will appear on all of the records and also on the web pages.

5.5 HMI TIME CLOCK:



The XT panel runtime clock is used to designate how the panel is to run. It is the heart of the system and will determine the amount of runtime your storage will get each 24 hours. The time clock provides a visual aid on how the panel is set up. If the AM button is pressed, the display will show the PM settings for the time clock. Pressing the PM button will display the AM settings. Each colored block designates a half hour increment. The AM time clock starts at midnight and goes to noon. The PM time starts at noon and goes to midnight. To change a time, press one of the four mode buttons first and then press the desired 30 minute block. Modes can be changed by pressing the mode button at any time and then the 30 minute blocks. When done, press the program button. Pressing the cancel button discards any changes

Once the mode is chosen, press the SET ALL button to save the changes to all time clock slots.

STANDBY The STANDBY hours in the time clock will force the system to turn off. The fans and all other devices will be in the Off mode.

COOLING COOLING hours in the time clock will allow the system to run only when there is cooling air available. This mode will not run refrigeration or a timed run. If COOLING hours are programmed and there is no cooling air available, the system will go into Standby mode.

5.5 HMI TIME CLOCK:

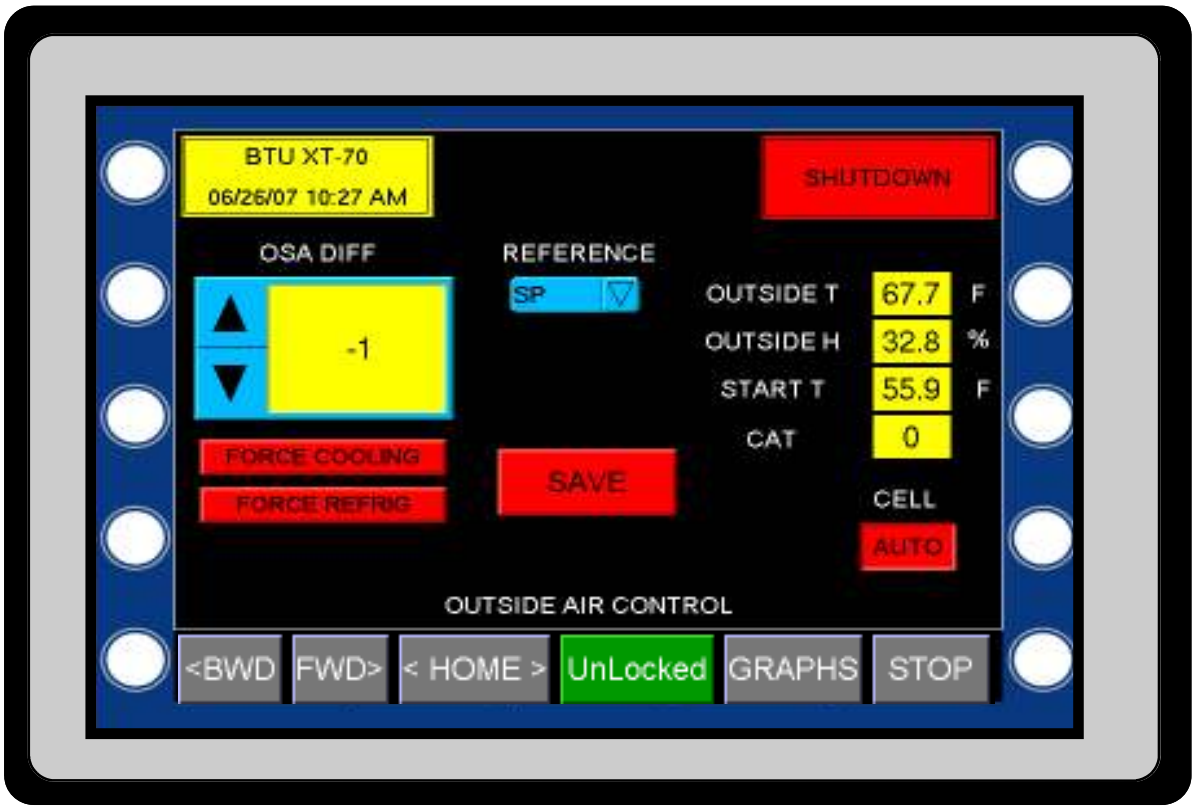
RUN

RUN hours in the time clock will cause the system to run even when cooling air or refrigeration is not available. If the refrigeration is in alarm or the switch is off, the system will run in a Timed run. The Cooling mode is available but the system will not go into Standby mode.

REF ONLY

REF ONLY hours in the time clock will cause the system to run only in Refrigeration or Timed mode. If cooling air becomes available, the system will continue to run in Refrigeration only. The Timed mode would activate only if the Refrigeration mode was not available or if the refrigeration switch is not in Auto.

5.6 HMI OUTSIDE AIR CONTROL:



5.6 HMI OUTSIDE AIR CONTROL:

The OUTSIDE AIR CONTROL screen parameter determines when cooling air will be available. The OSA Diff, or outside air differential, can be plus or minus and provides an offset from the selected reference. The possible references can be SP (setpoint), P1 (pile 1) through P8 (pile 8). With the most basic system with no evaporative cooling, the reference is equal to SP, the start temperature is equal to SP + OSA Diff. For example, if setpoint is 44.0° and the OSA Diff = -4°, the start temperature would equal 40.0° (44.0 – 4). Any time the outside air temperature falls below 40.0°, cooling air would be available. If P1 = 45.5° and the reference is set to P1, the start temperature would equal 41.5° (45.5 - 4). Great caution must be used when a reference other than SP is selected. If P1 through P8 are selected, make sure the sensors are buried and working correctly. About the only time P1 through P8 sensors would be used as a reference would be in the fall, when bringing in warm potatoes. For example, if the setpoint is set tor 58° and the potatoes are pulping at 65°, the pile would need to get to 58° as soon as possible. If your pile is at 65°, any air that can produce a plenum temperature of 65° or below would be desirable. By using P1 or P2 as a reference, cooling air would be available from 65° and below. The plenum temperature would drop to 58° if the outside air was cold enough.

If the storage has evaporative cooling or cell deck installed, this section will explain how the start temperature is calculated.

Theory: Evaporative cooling can drop the temperature going through the cell by saturating the air. If the incoming air is very dry (<30 %), drops of up to 20° can be achieved. If the incoming air is very humid (>70 %), there is very little room to saturate the air and 3 to 5 degrees of cooling may be all that is available.

Wet_D: Wetbulb depression is the theoretical temperature drop across the cell media. This is a calculation based on the air being 100 percent saturated when coming out of the cell.

Cell_eff: Cell Efficiency (0-100). The cell material, thickness, amount of water, and design can greatly affect how well the evaporative cooling will work. The cell efficiency variable will help to compensate and give an accurate start temperature. For example, most cells produce a temperature drop of about 80 percent of the actual calculated wetbulb. Thus, if the calculated wetbulb is 20° and the cell_eff was set to 80%, the adjusted wetbulb would be 16°.

Wet_A: Wetbulb adjusted. This is the theoretical wetbulb multiplied by the cell efficiency variable. This value should closely match the actual measured drops on the cell medium.

Start_T : Start temperature. Start_T = (Diff_ref + OSA_Diff + Wet_A)

Example: Diff_ref = SP, SP = 45.0°, OSA_Diff = -1, Wet_A = 12

Start_T = (45.0 - 1) + 12 = 56°.

If the outside air was 56° or less, cooling air would be available.

Short cycling of the system can happen when the outside air is very close to the start temperature. Clouds or other weather conditions can cause the outside air temperature to fluctuate very quickly around the start temperature. The XT panel uses a number of unique ways to prevent this condition from short cycling the system.

MCR Minimum Cooling Run. This variable is in minutes and by default is set to five minutes. Once the outside air drops below the start temperature, the system will go into Cooling mode. The MCR time will guarantee that the system will stay in cooling for the duration of the MCR timer. Thus, if the MCR is set to 5, the system would have to run in Cooling mode for a minimum of

HMI OUTSIDE AIR CONTROL:

five minutes.

CAT Cooling Air Timer. The CAT timer comes into play when the system terminates Cooling and goes into Standby mode. The default setting is three minutes. The CAT timer will start timing as soon as the system switches to Standby. This is a countdown timer, and once it reaches 0, the system will determine if the outside air temperature is below the start temperature. The system will go back into the Cooling mode if cooling is available. The CAT timer has an override condition - when the outside air is 3° less than the start temperature, the CAT will not be in affect.

RAS Plenum Rise Above Setpoint. The default setting for the RAS is .3°. This is used to determine when cooling air is no longer available. If the plenum temperature is higher than the RAS setting and the outside air temp is higher than the start temperature, the system will terminate cooling.

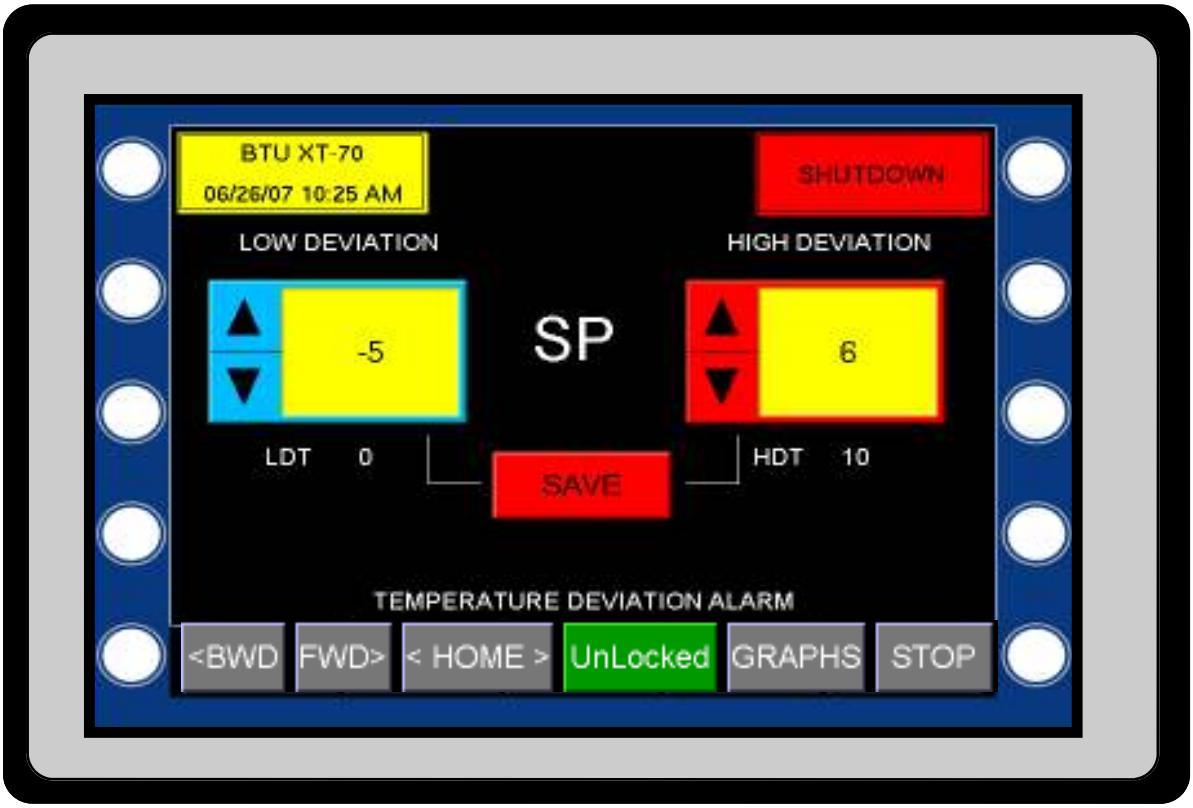
Summary of Cooling Air Logic:

Cooling air available	If OSA < Start_T and CAT satisfied or if (OSA - 3) < Start_T.
Cooling air not available	If OSA > Start_T
Terminate Cooling Run	If OSA > Start_T and Plenum temp > RAS and MCR satisfied.

The FORCE COOLING button can be used to force the system into a cooling mode. The time clock must be set to allow cooling. Once the system is in cooling, it will run for the minimum cooling time.

The FORCE REFRIG button can be used to force the system into a refrigeration mode. The time clock must be set to allow refrigeration. Once the system is in refrigeration, it will run for the minimum refrigeration time.

5.7 HMI TEMPERATURE DEVIATION ALARM:



The TEMPERATURE DEVIATION ALARM screen allows the user to set parameters for two alarms. The two alarms are the low deviation and high deviation alarms. These alarms are based off of setpoint, and use the plenum average temperature. If the plenum temperature drops below the low deviation setting for a programmed amount of time, the system will shut down on a low deviation alarm. The timer for the low deviation alarm is the LDT timer. The current value of the LDT is shown below the low deviation setting. This timer is in minutes and will count down when the alarm is active.

If the plenum temperature rises above the high deviation setting for a programmed amount of time, the system will shut down on a high deviation alarm. The timer for the high deviation alarm is the HDT. It is in minutes and will count down when the alarm is active.

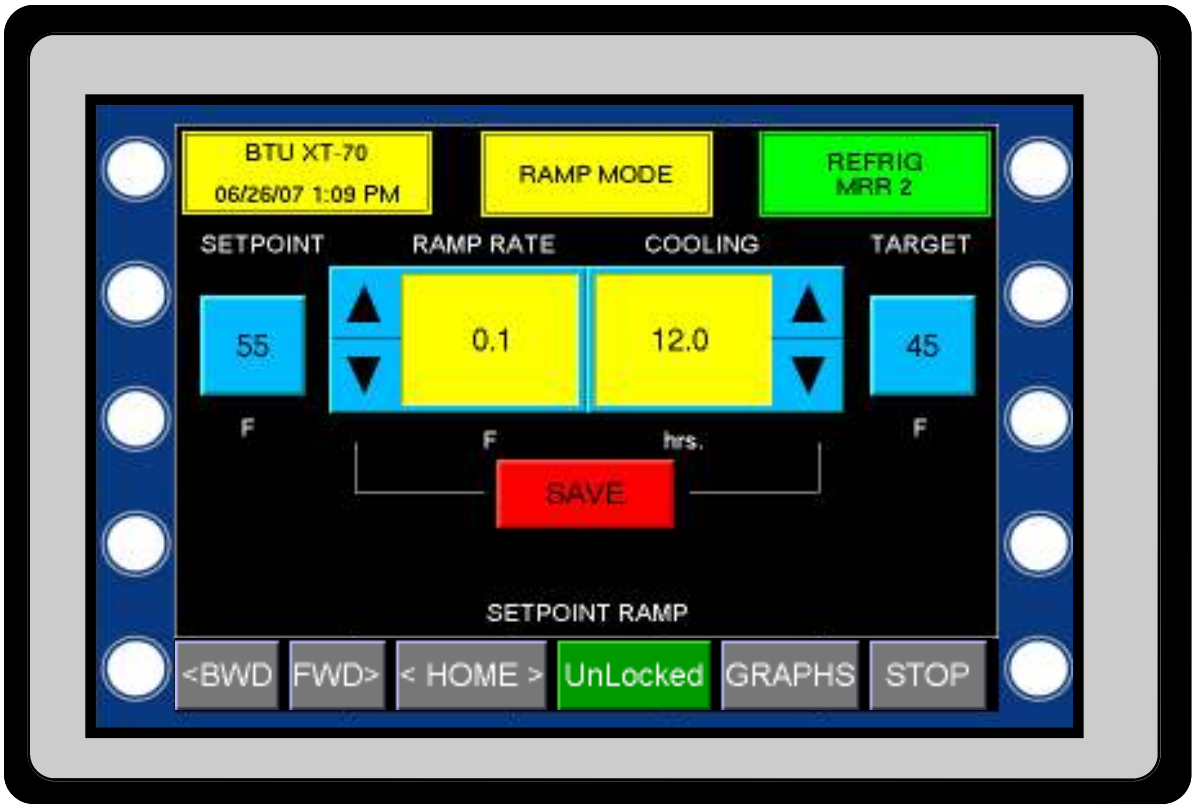
The high and low deviation alarms are active only when the system is in an active run mode.

The LDT and HDT can be set via the web interface or the HMI service screen with a valid password.

To change the values, press the spinner buttons. When done, press the SAVE button.

The two alarms can be set to soft, hard or off. If either alarm is set to off, the alarm is inactive. A soft alarm will alarm and show up as a secondary mode, but will not interrupt the normal operation. A hard alarm will show up as a secondary mode and will shut the panel down in Alarm Standby mode. ***Setting either timer to 0 will turn the alarm off. Setting the associated timer to a negative time will set it for a soft alarm and setting the associated timer to a positive time will set it for a hard alarm***. All timers are set in the E2 parameter screen, accessed by using the middle left outside button on the HMI.

5.8 HMI SETPOINT RAMP



The SETPOINT RAMP screen allows the user to set up the ramp function. The ramp function will allow the set-point to be automatically incremented to a target setpoint. An example of this could be seen in the fall. Once suberization has taken place, the ramp function could automatically drop the setpoint in small increments until the target temperature is reached.

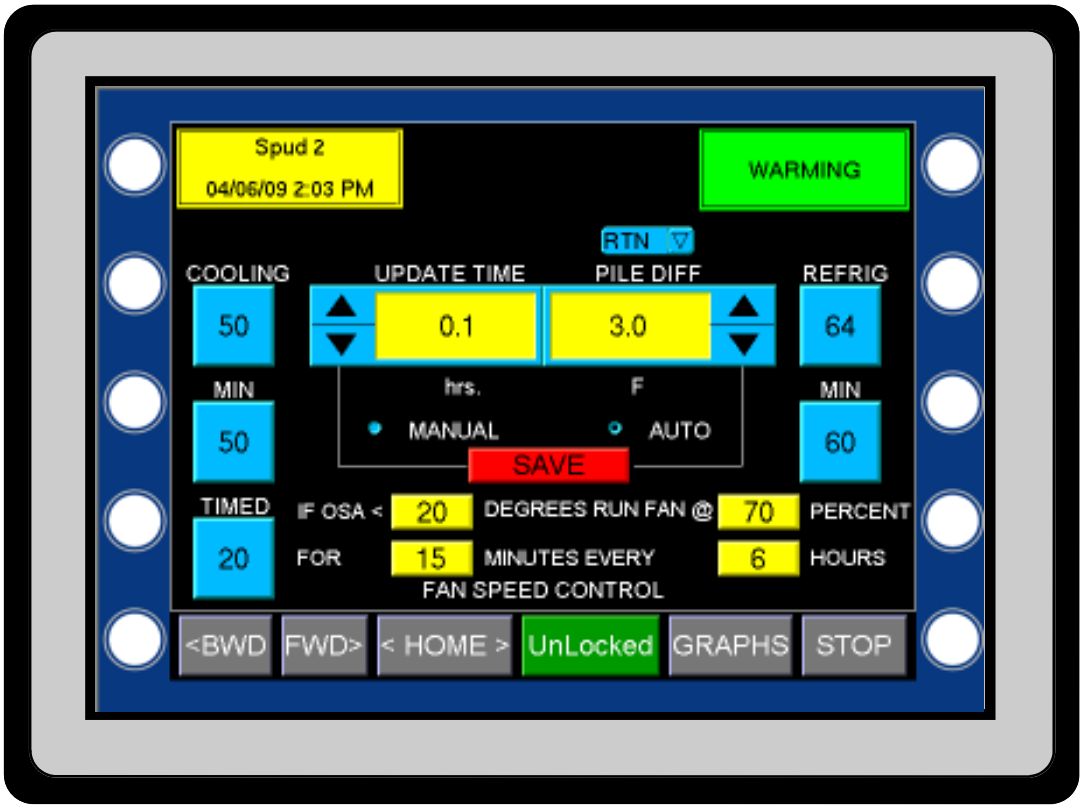
The setpoint can be changed from this screen also. To change the setpoint, press the SETPOINT button. A pop-up keypad will be displayed. Enter the desired value and press Enter. The target setpoint can be programmed the same way by pressing the TARGET button.

Whenever the setpoint and target are different values, the system is in the ramp mode. Any time the setpoint is changed from the HMI or web interface, the target setpoint is also changed to the same value. To activate the ramp, the target setpoint must be changed after the setpoint.

Other components of the ramp function are the ramp rate and cooling hours. The ramp rate is the amount the setpoint is incremented or decremented when the ramp is active. The cooling component is the number of hours of cooling that will take place before a ramp change is made. Typical values would be .1° for the rate and 6 hours for the cooling value. With these values, the setpoint would increment or decrement towards the target .1° every 6 hours of Cooling or Refrigeration runtime.

The ramp function can be used to either increment or decrement the setpoint.

5.9 HMI FAN SPEED CONTROL:



The FAN SPEED CONTROL screen allows the user to set up a number of parameters that will control the speed of the fans. Each of the five button can be programmed by pressing the button and then entering the value.

COOLING: This value is the percent output of the freq drive when the system is running in Cooling mode. This value will adjust when fan speed control is set to Auto.

MIN: The MIN button directly under the COOLING button is the lowest setting that the fans will ramp to when in Cooling mode and running in Auto.

TIMED: This value is the percent output of the freq drive when the system is running in Timed mode.

REFRIG: This value is the percent output of the freq drive when the system is running in Refrigeration mode.

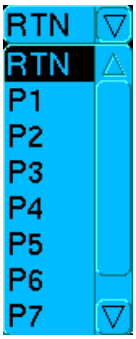
MIN: The MIN button directly under the REFRIG button is the lowest setting that the fans will ramp to when in Refrigeration mode and running in Auto. Note: if not running electronic expansion valves, the MIN should be set the same as the REFRIG.

AUTO / MANUAL: In the MANUAL mode, the fans will run at whatever speed the mode is set for. In Auto, the fan speed will automatically adjust from 100% to the MIN setting for either Cooling or Refrigeration mode. Once the system runs the amount of time equal to the UPDATE setting, it will either increment or decrement the fan speed by 5%. It looks at the top and bottom of the pile and compares it to the PILE DIFF setting. If the calcu-

lated value is above the pile differential, the fan speed will be incremented. If the calculated value is below the pile differential, the fan speed will be decremented.

PILE DIFFERENTIAL CONTROL:
For this application, the pile differential is defined as the difference between the plenum temperature and the return temperature when the fans are running. More air supplied to the pile in terms of runtime and cfm will cause the pile differential to be smaller. Less air will cause the differential to become larger. In the automatic mode, the speed of the fans will vary to maintain the pile differential setting. A typical setting would be 1.5°. Thus, if the difference between the plenum and return is greater than 1.5°, the speed would be increased. Any change in fan speed happens in increments of five percent. *Setting the Fan Speed control to Manual will disable the automatic pile differential.*

As the automatic pile differential changes the freq drive setpoint, the COOLING button value will change to represent the new value. The REFRIG and TIMED setpoint values will not change automatically.
Note - The pile differential generally takes a long time to change. The minimum suggested update time is 24 hours. Care should be taken if settings less than 24 hours are used.



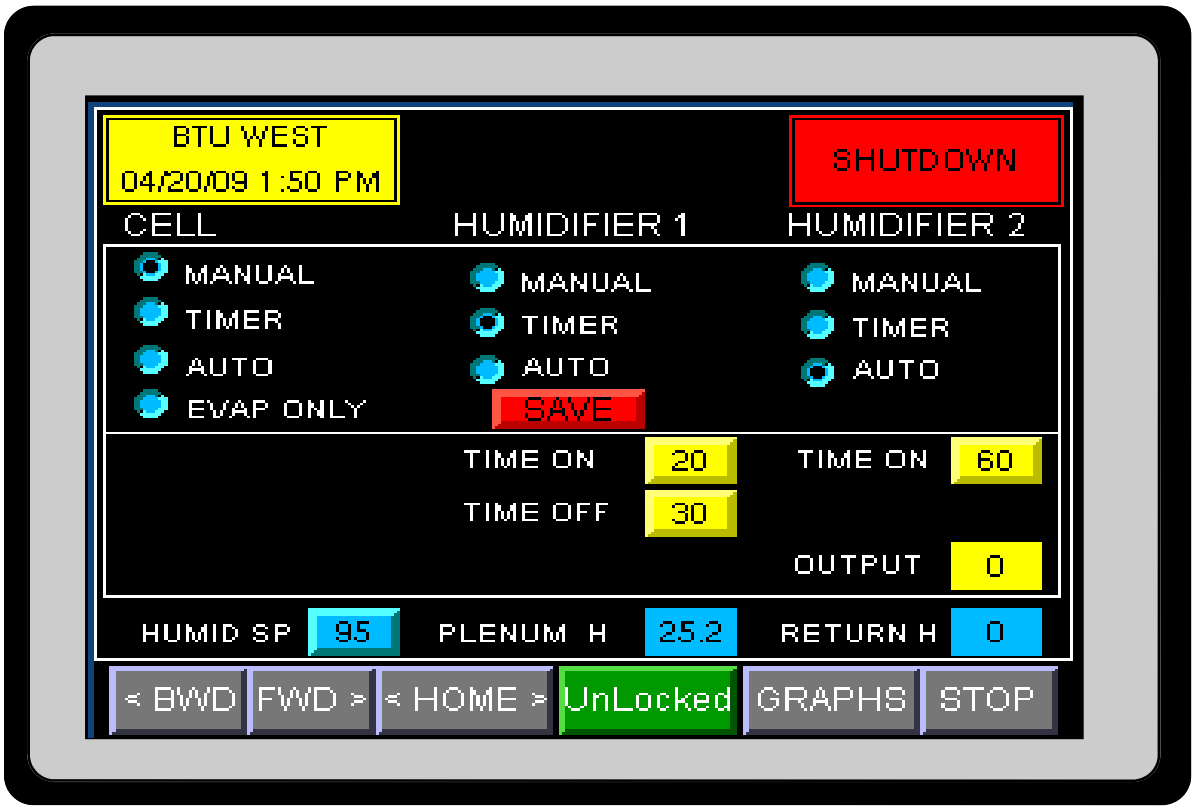
It is highly recommended that the RTN sensor is always used for the pile differential, but under certain conditions, it may be desirable to use one of the pile sensors. The drop down box is used to choose one of the pile sensors.

FAN BOOST: The Fan Boost mode is the latest in continuing development of the XT 70 panel.

The Fan Boost cycle is used for a couple of different scenarios. First is to stir the air up when the systems has been running at low fan speeds for extended periods of time. The second is to boost the fan speed during times of extremely cold weather. The following setup allows coverage of both of these conditions. If the use of the OSA condition is not desired, set it high. To deactivate the Fan Boost, set all parameters to zero.

Using the setting shown in the box above, here is an explanation of how the Fan Boost would work. If the outside air temperature is below 20°, the fans would speed up to 70% for 15 minutes every six hours. After the 15 minute run, the fans will go back to the original setting. If the original setting is above 70%, the fans would stay at the current speed and not change.

5.10 HMI HUMIDITY CONTROL:



The HUMIDITY CONTROL screen allows the user to make adjustments to the humidity control. **Caution: it is never recommended to control humidity using a evaporative cooling cell.** Humidity control should be achieved by controlling the water supply to centrifugal head humidifiers. The humidifiers should be wired so that the spinning head will come on when the fans are running. The pump should be controlled by the Humid 1 and Humid 2 outputs. Humidifiers can be tested with the fans running by using the MOA switches and switching the humidifier to Manual.

Depending upon the condition of the potatoes, many different setting could be used for the humidity control. Contact the local dealer for information on setting up humidity control.

The cell has up to four different operation modes. Each of the centrifugal humidifier has three types of control.

Caution: when operating in the high humidity ranges, 95-100 %, great care should be used and frequent checks on the humidity sensor should be done. The plenum should be visually checked daily to determine the amount of free water in the plenum.

The XT panel design was drawn from years of field experience, which led to creating humidity control that sets a new standard for the industry. A bad, saturated or out-of-calibration humidity sensor can cause many problems with old-style humidity controls.

The XT panel guards against these issues by having a failsafe Off mode of operation. An On time should always be programmed in. This On time acts as a minimum setting for the humidifiers. Thus, even if the humidity is

above the setpoint, the humidifiers will run for the minimum off time during each cycle. A humidity cycle is composed of 100 seconds. There can be any combination of On and Off cycles during this time. If running in the auto mode, there will be a output ranging from 0 to 100%. With an output of 60%, for example, there would be 60 seconds of humidity on and 40 seconds of humidity off.

Front Panel Switches: Each of the humidifiers has a MOA switch on the front panel. These switches must be set to Auto before the setting on the HMI can affect the operation.

Each of the humidifiers has different operations that can be selected.

MANUAL: If the humidifier is set to manual, it will run whenever the fans are on. Normally the cell should always be run in the Manual position. In the Manual position, the associated Time On, Time Off and Output are not shown.

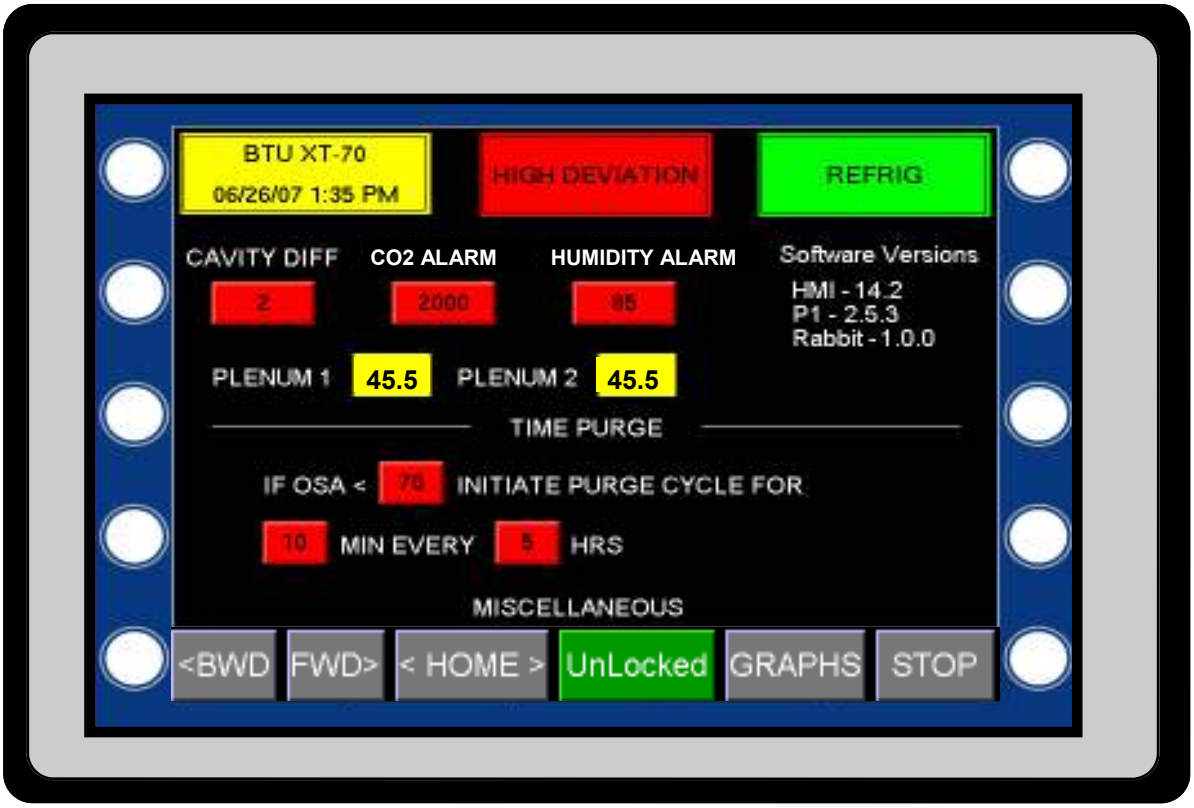
TIMER: In the Timer mode with the fans running, the humidifier will turn on for the programmed Time On and then turn off for the programmed Time Off. Each of these timers can be set up to 100 seconds. The time is in seconds. For example, if TIME ON = 20 and TIME OFF = 30, the humidifier would turn on for 20 seconds and then turn off for 30 seconds and then repeat the cycle.

AUTO: In the Auto mode with the fans running, the humidifier will turn on and off automatically. The humidity PID loop will look the humidity setpoint, the plenum humidity and generate a signal from 0 to 100%. This will be displayed as the OUTPUT. The TIME ON parameter becomes the minimum desired on time. If the TIME ON = 30%, the PID loop will generate an output from 30 to 100%. If the output is equal to 60%, the humidifier would be on for 60 seconds and off for 40 seconds.

EVAP ONLY: the Evap Only mode is used when minimum humidity is desired but evaporative cooling is still needed. The cell will turn on only when needed for cooling and then turn off when it gets cool enough outside to provide enough cooling without evaporative cooling.

After selecting the desired mode, press SAVE.

5.11 HMI MISCELLANEOUS:



CAVITY DIFF: the cavity differential is a + /- variable and is programmable by pressing the button. The cavity differential will help determine when the cavity heat will turn on and turn off. Typically, the pile 2 sensor is the controlling sensor and is located on top of the pile. Pile 8 would normally be the controlling cavity sensor. The XT panel allows setup for different controlling sensors. The example below explains how the cavity works.

Turn on: If P8 < P2 + cavity diff

Turn off: if P8 > P2 + cavity diff + 1.5

CO_2 ALARM: The XT panel will alarm when the CO_2 level rises above this value for longer than the associated timer. This value is programmable by pressing the button.

HUMIDITY ALARM: This value is programmable by pressing the button. The XT panel will alarm when the plenum humidity drops below this value for longer than the associated timer.

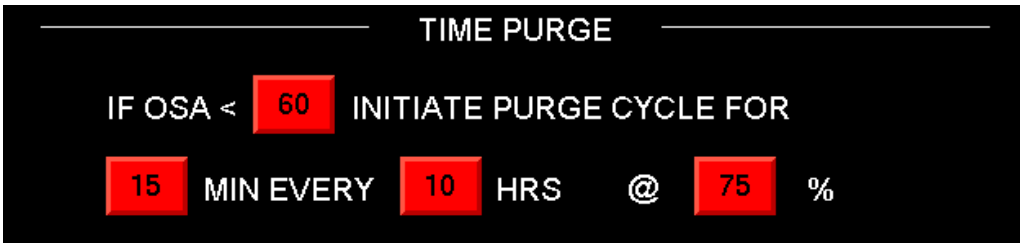
Both the CO_2 ALARM and the HUMIDITY ALARM have an associated timer. The two alarms can be set to soft, hard or off. If either alarm is set to off, the alarm is inactive. A soft alarm will alarm and show up as a secondary mode but will not interrupt the normal operation. A hard alarm will show up as a secondary mode and shut the panel down in Alarm Standby. Setting either timer to 0 will turn the alarm off. Setting the associated timer to a negative time will set it for a soft alarm and setting the associated timer to a positive time will set it for a hard alarm. All timers are set in the E2 parameter screen, accessed using the middle left outside button.

HMI MISCELLANEOUS:

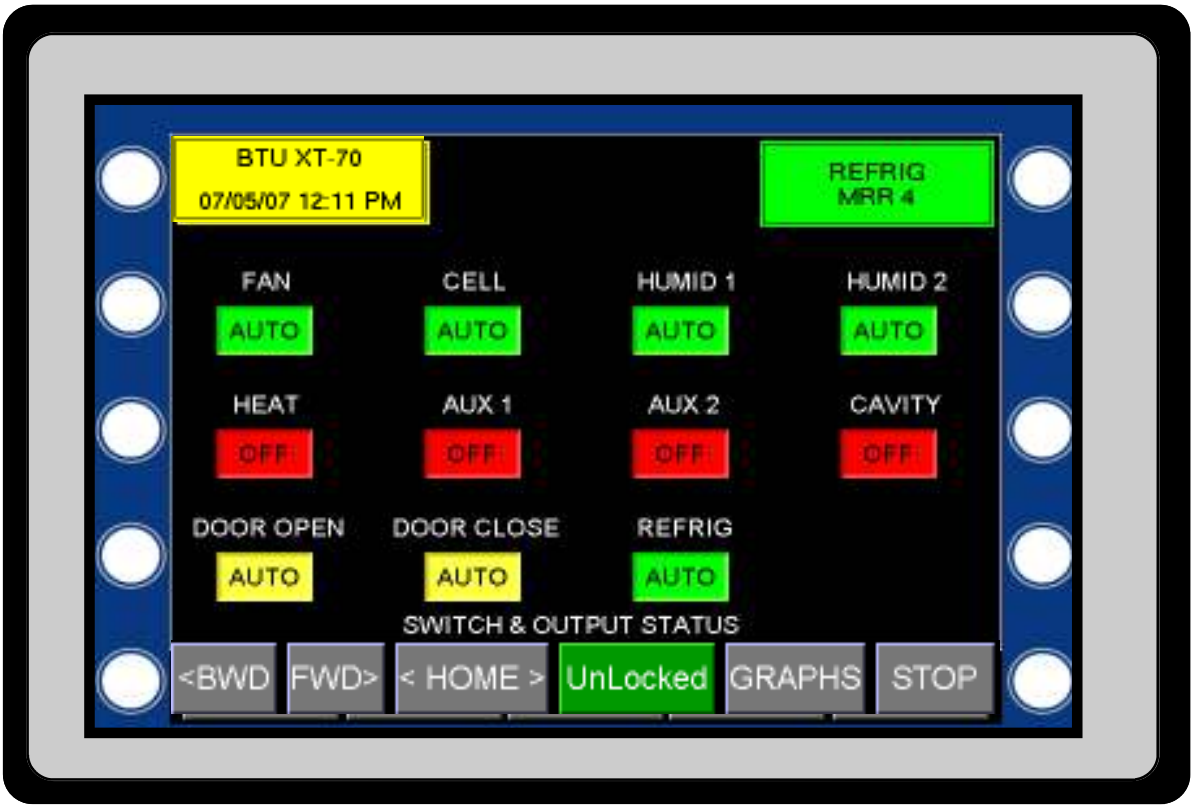
The plenum temperature is the average of the two sensors in the plenum. Using two sensors allows for greater accuracy, protection against drift and sensor failure. Both of the plenum sensors are displayed on this screen.

Time Purge is a mode that can be used if there is no CO_2 sensor. To use the Time Purge, the E2 parameter Purge_Cfg must firstbe set to 1. The E2 parameter Max_door must also be set to the desired setting. Do not go over 20%.

Use the buttons to set up the desired maximum outside air temperature, length of purge, the frequency of the purge and the fan speed during purge.



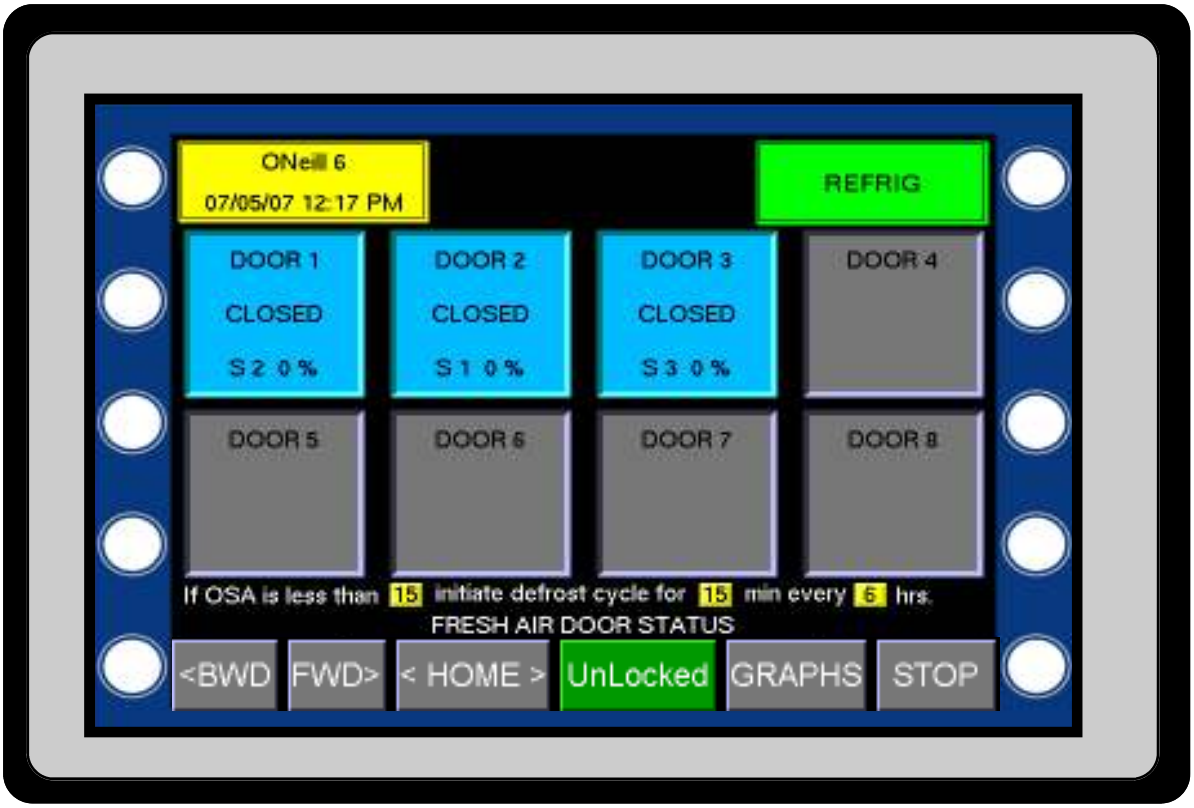
5.12 HMI SWITCH & OUTPUT STATUS:



The SWITCH & OUTPUT STATUS screen shows the status of both the MOA switch and the status of the XT solid state outputs. Each of the outputs has an associated box that will be either green or red. A green box indicates that the output is On and a red box indicates that the output is Off. The wording in the box will indicate the status of the associated MOA switch. The switch can have three positions, determined by the actual switch and a soft remote off position. The actual switch has three positions , Manual-Off-Auto. If the switch is in the Auto position and the button showing Auto was pressed, the status would change to R-OFF (remote off). Pressing the switch again will cause the switch status to change back to the Auto position.

The remote off position is used to turn devices off from a remote location, either from the HMI or the web interface.

5.13 HMI Fresh Air Door Status:



Fresh Air Door Status:
Using BTU SDX "Smart Door Controls", accurate door position, individual door statuses and any door failures can be displayed and incorporated into the XT historical data and alarming system.

A very flexible strategy allows for up to eight fresh air doors to be set up in almost any layout scheme. Each door can be individually set up as either stage 1,2,3 or 4 and there can be as many of each stage as needed. A simple set up procedure is done on the SDX cards. The XT panel communicates with SDX cards and automatically configures the FAD display screen. No setup is required within the HMI program.

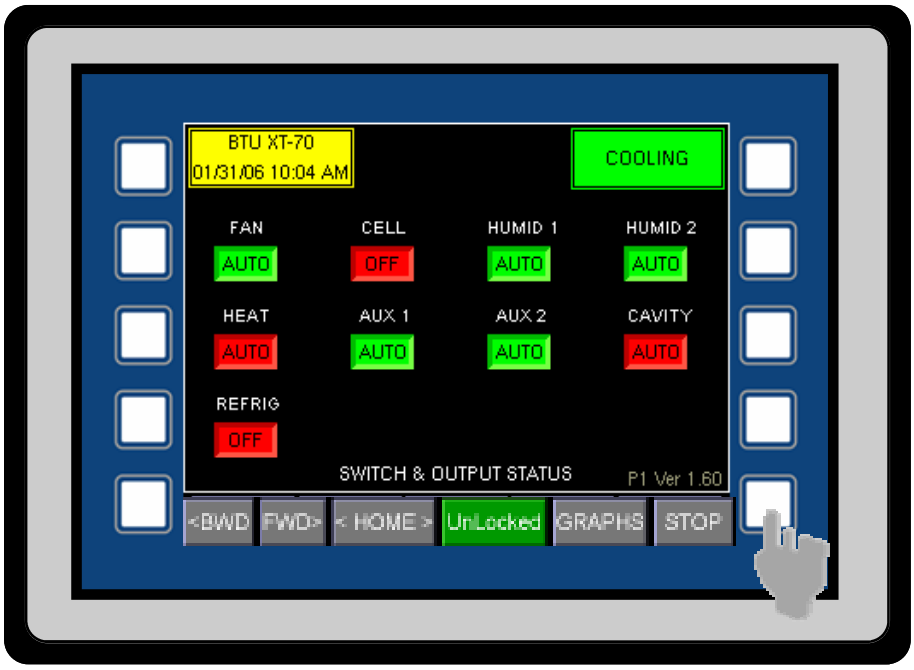
The above display show a three door system. Doors are numbered and arranged as if viewed from standing outside of the building. The door staging, S1, S2 and S3, is the sequence in which the doors will open.

S refers to the stage the door is programmed for. The percentage is the individual door open percentage. The door open percentage on the home screen is the overall average of the doors.

Green	Indicates the door is active, partially open or between retract and extend limit switches.
Yellow	Indicates that the door is fully open.
Blue	Indicates that the door is fully closed.
Grey	Indicates that there is no door affiliated with the door number.
Red	Indicates a door failure. A door failure will be indicated as a blown fuse, faulty limit switch, or the door has timed out (indication of a faulty drive motor). Note: If a door fails for any reason, the system will alarm or alert by sending a text message, will skip the failed door and will continue to run the system as long as the system setpoints can be achieved.

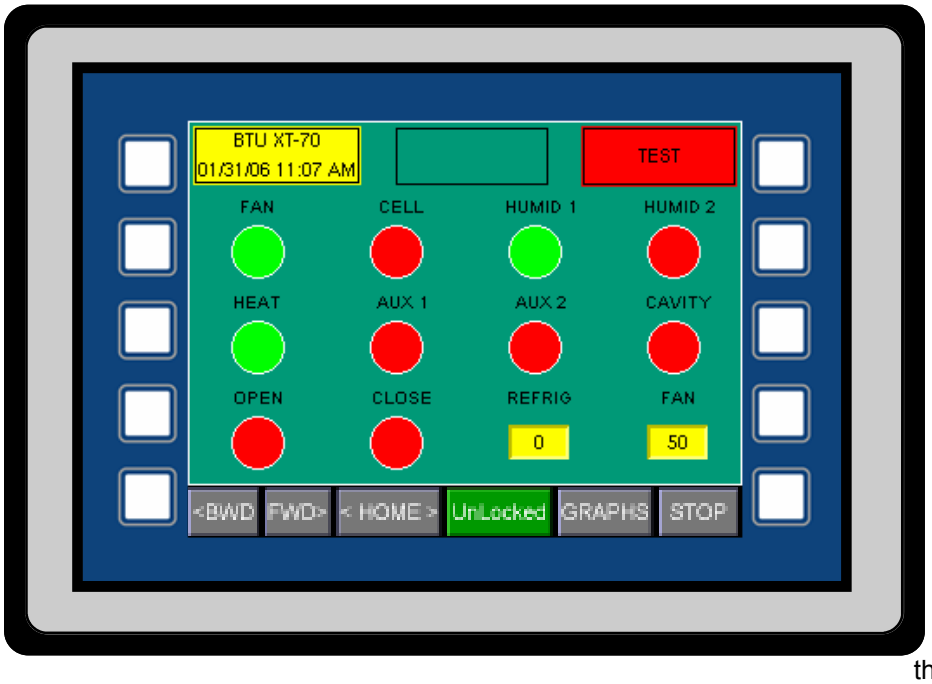
FRESH AIR DOOR DEFROST: Defrosts the doors using return air. To disable the door defrost, set each of the parameters to zero. For the above example, if the outside air is less than 15°, initiate a defrost cycle for 15 minutes every six hours. For a defrost cycle, the fresh air doors will go full closed and the return air will circulate and defrost the doors. After the defrost cycle, the doors will operate as normal.

5.14 HMI TEST MODE:



In order to place the XT panel into a test mode, first go to the SWITCH & OUTPUT STATUS screen. Once at this screen, press the bottom right outside button.

To leave the test screen, press the bottom right outside button again.



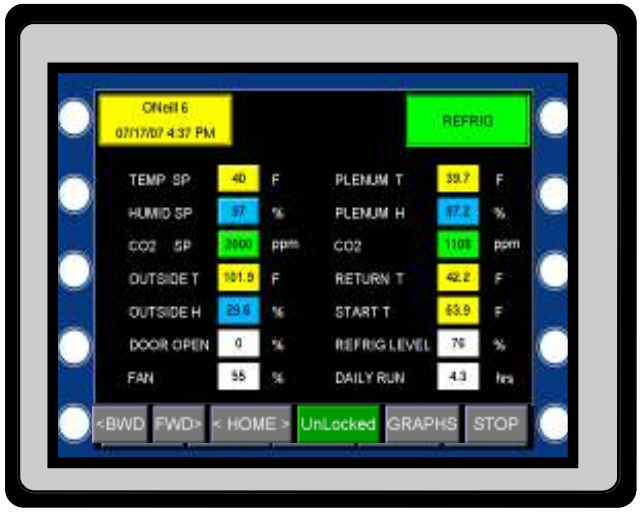
When the XT panels goes to the Test mode, all normal operation is suspended.

Caution: The test mode allows manual activation of all of the XT outputs. This should be done by a qualified service technician only.

Each of the cells give the status of each of the outputs. A red cell indicates that the output for that cell is Off. A green cell indicates that the output in On. Note: for the TEST mode to work, the MOA switch for each of the outputs must be in the Auto position.

To change an output, press the appropriate cell. The fan output must be set to On for the fan speed and refrigeration level to be active. To change the REFRIG and FAN output, press the button and type in the appropriate percentage.

5.15 HMI Graph Module:

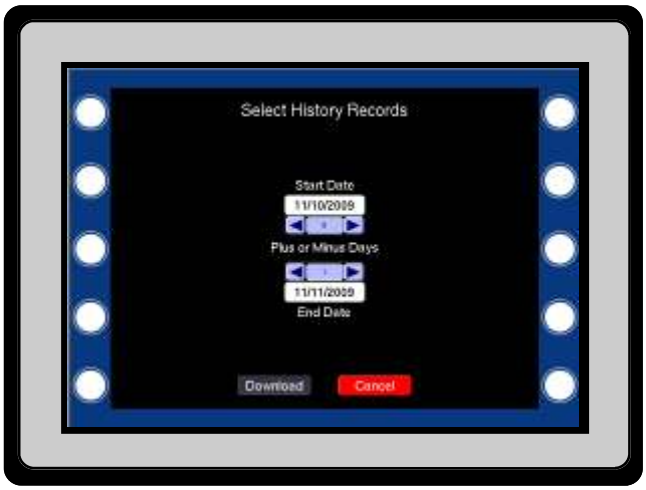


Pressing the GRAPH button from any screen will access the Graphing module

Use the arrow keys to select the date for the desired records.

The default will always be from midnight to the current time.

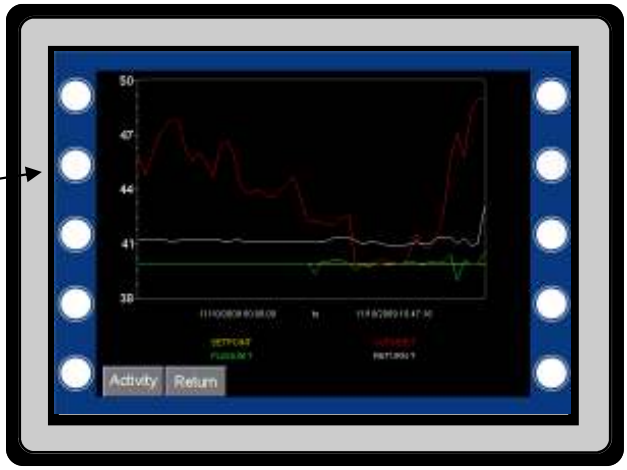
Click Download to access the records.



When downloading the number on the right will indicate the number of records being downloaded. If that remains at zero or hangs up click on Cancel to stop the download. When finished it will display the graph.

The graph displays the selected time frame. The vertical axes will auto scale. Up to four points can be selected to graph.

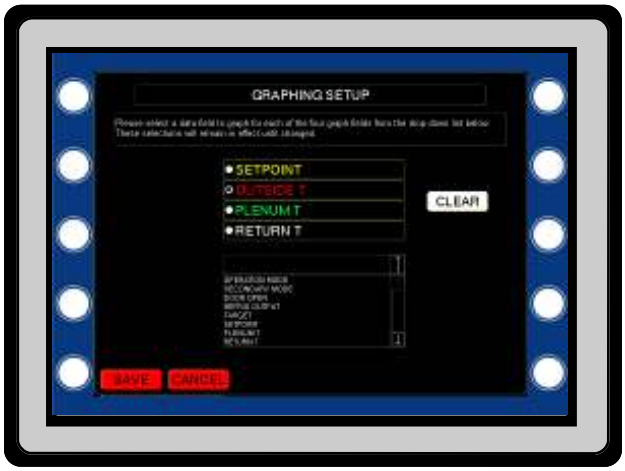
To change the graph points press the second button on the left.



To select the different graph values, click one of the four radio buttons and then on the drop down. Select the desired parameter.

To remove a channel, click on the radio button and then on CLEAR.

When done click on SAVE.



5.16 Activity Log

On the Graph page, click on the Activity button to see detailed operation.

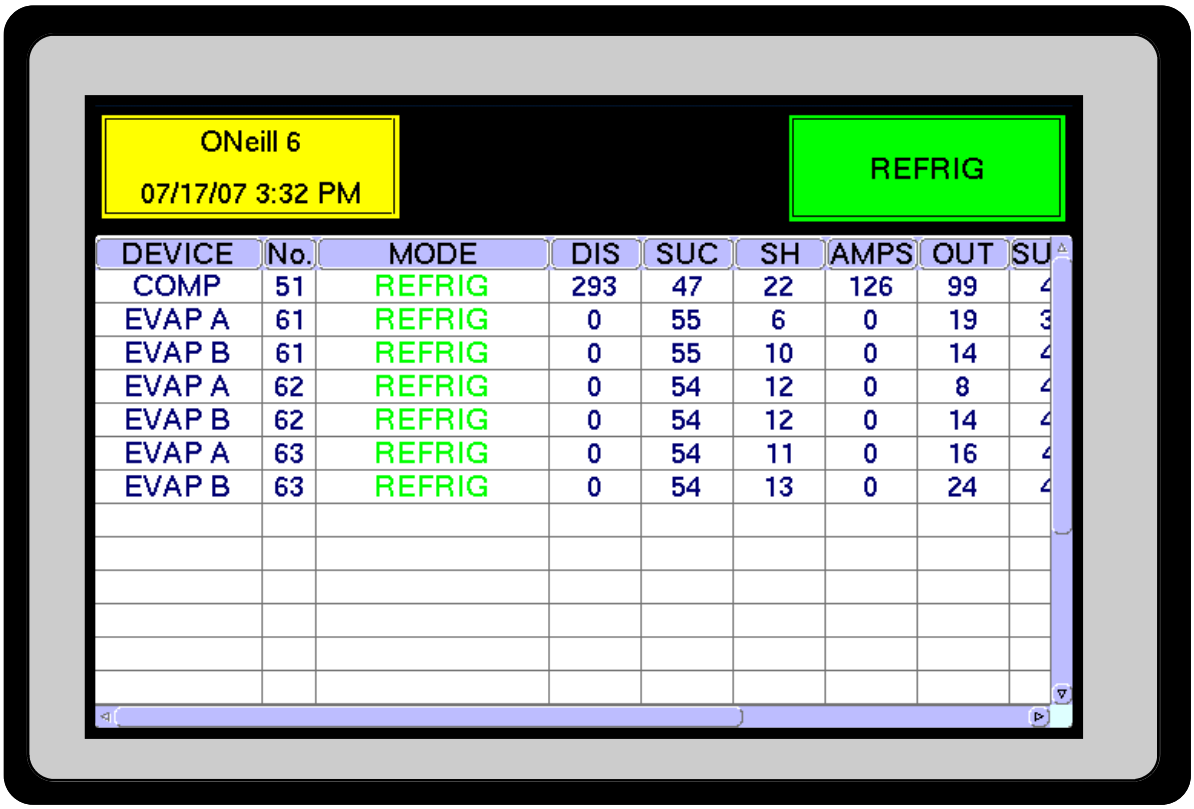
The activity log shows regular averaged records plus the activity. Any mode change will insert a instantaneous record into the log. All the information can be seen by scrolling up and down and left to right.

Click on Graphs to go back to the Graph page or on Return to go back to the main screens.

The record format can be changed by custom building a csv file. See appendix A for information on changing the records format.

5.17 HMI REFRIGERATION INTERFACE:

REFRIGERATION STATUS SCREEN



DEVICE	No.	MODE	DIS	SUC	SH	AMPS	OUT	SU
COMP	51	REFRIG	293	47	22	126	99	4
EVAP A	61	REFRIG	0	55	6	0	19	3
EVAP B	61	REFRIG	0	55	10	0	14	4
EVAP A	62	REFRIG	0	54	12	0	8	4
EVAP B	62	REFRIG	0	54	12	0	14	4
EVAP A	63	REFRIG	0	54	11	0	16	4
EVAP B	63	REFRIG	0	54	13	0	24	4

The Refrigeration Status screen is the last of the main screens and can be accessed using the <BWD and FWD> buttons, or by using the hot key, pressing Refrig Level on the main screen. Under the Device column, there will be either Comp (Compressor) or Evap (evaporator) showing. The main columns will show discharge pressure, suction pressure, superheat, amps, percent output, suction temperature, discharge temperature, superheat setpoint and lead compressor.

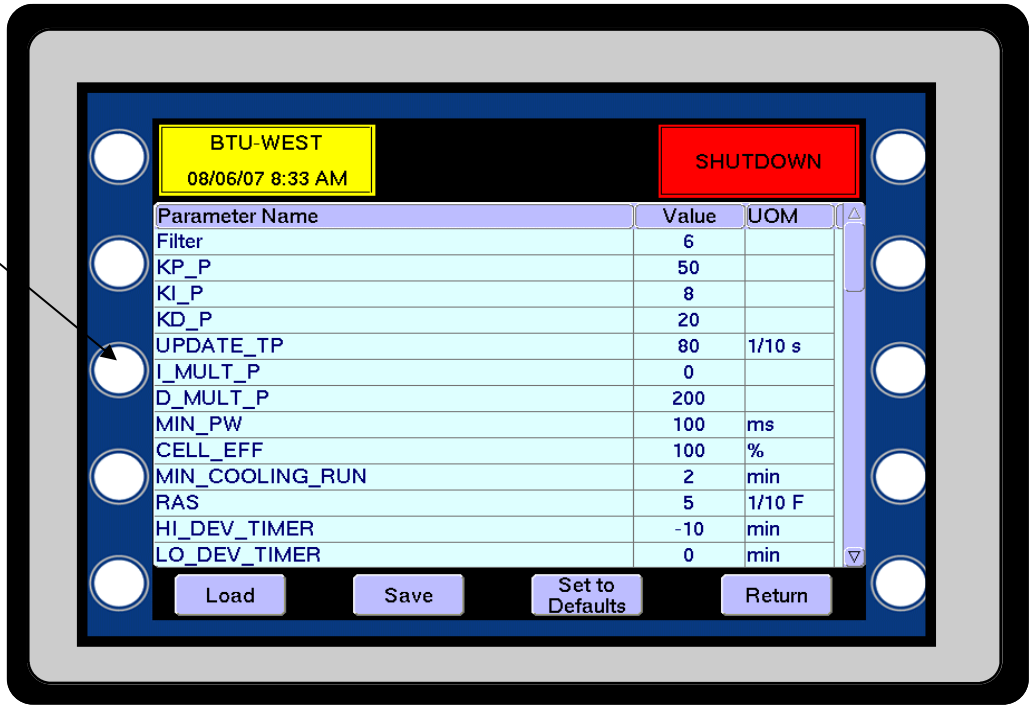
Pressing the RESET button for any of the devices will cause a reset of that card to occur. This can be used to reset an alarm.

5.18 E2 Memory Setup:

The XT-70 panel uses two types of memory to retain operating parameters. The main programmable parameters accessible on the HMI screens are flash parameters. The parameters are stored on a removable XD picture card. The other control parameters are saved on the E2 memory of the P1 processor. You must have the highest level of security to change these values.

To access the E2 parameters, press the middle left outside button.

If password protection is used, enter username and password.



To change a parameter, press the value and a pop-up keypad will appear. Enter the desired number. Make multiple changes, if desired, and ,when done, press Save and then Return. If Set to Defaults is pressed, the default values for all parameters will appear. They are not saved until Save is pressed. Pressing the Load button will load the screen with the current values.

6.1 E2 Parameters Definition:

FILTER — The filter is a value from 1 to 10. This number will weight the analog values for all the temperatures, humidity and CO_2 readings. **The default value is 6.** Increasing this value will cause the readings to be more highly filtered and slower to change.

KP_P — Cooling proportional gain. **The default value is 30.** Increasing this value will cause the overall system performance to become faster. P is most effective on sudden changes.

KI_P — Cooling integral gain. **The default value is 20.** The integral gain produces an error based on small errors over time. Increasing this value will cause the small error to be amplified over time, leading the system to be more sensitive to small errors.

KD_P — Cooling Derivative gain. The derivative is produced by a sudden change in the error. If the temperature is several degrees above setpoint, the PID will ramp quickly. The error may not change much until the door reaches a given position. At this point the tempera ture would drop quickly. The derivative acts like a brake and will offset the error when large changes are being made. If the temperature overshoots at start up, increase this value. **The default setting is 0.**

UPDATE_TP — This value is in 1/10's of a second, and determines when the PID loop is updated. **The default value is 50.** Increasing this value will slow down the entire loop. Decreasing will cause the loop and response to speed up. A value that is too low will cause the system to cycle around setpoint.

SCALE — This value is used initially for testing and is the overall scaling for the PID response. **The default setting is 0.** This is an engineering variable and should normally not be changed.

THRESHOLD — This is the switch over point for the KI divisor. **The default setting is 150**. This is an engineering variable and should normally not be changed.

MIN_PW: — This is the minimum pulse width time. A value of 0 will disable this function. **The default setting is 150** and the value is in milliseconds. Some door controllers will not respond to small pulses so, if this value is set to a number greater than zero, the panel will accumulate pulses until the MIN_PW is reached and the correction is made.

CELL_EFF: — Cell efficiency. The efficiency of different evaporative cooling cells can vary greatly depending on a number of variables. CELL_EFF allows the efficiency of a given evaporative cooling system to be set. This value can be determined by setting the cell to 100 percent and watching it on a good warm dry day. The setting is from 0 to 100 percent. **The default setting is 85%.**

MIN_COOLING_RUN: — This variable is in minutes and will guarantee that once in the Cooling mode, the system will stay in there for a minimum run time and will not short cycle. Typical settings would be from 15 to 30 minutes. **The default setting is 30 minutes.**

RAS: — Rise above Setpoint. The RAS variable is the amount the plenum can rise above setpoint before cooling air is terminated. For this variable to be active, the OSA needs to be above the start temperature. This setting is in 1/10ths of a degree. **The default setting is 3, or .3°.**

E2 Parameters Definition:

HI_DEV_TIMER:	High deviation timer. This timer will determine how long the plenum temperature can remain above the high deviation point before a high deviation alarm will occur. **The default setting is 10** and the unit of measure is minutes.
LO_DEV_TIMER:	Low deviation timer. This timer will determine how long the plenum temperature can remain below the low deviation point before a low deviation alarm will occur. **The default setting is 3**, and the units of measure are minutes.
COOL_AIR_TIMER:	Cooling Air Available Timer. When the mode changes from Cooling to Standby, this timer will be active. This setting will force the mode to stay in Standby until this amount of time elapses. This is to prevent short cycling when OSA cooling is marginal. The OSA needs to be within 3° for this to be active. **The default setting is 3 minutes.**
FAN_FAIL_TIMER:	Fan Failure Timer. When the fans are given a signal to start, this timer will start timing and will be reset once the fans are proven. If the fans fails to start, the system will go into Fan Fail Alarm mode after this amount of time elapses. **The default setting is 1 minute.** A setting of 0 will disable the Fan Fail Alarm.
CELL_FAIL_TIMER:	Cell Pump Failure Timer. When the cell pump is given a signal to start, this timer will start timing and will be reset once the cell is proven. If the pump fails to start, the system will go into a Cell Pump Fail Alarm after this amount of time elapses. **The default setting is 0**, which will disable the Cell Fail Alarm. A typical setting would be 1 minute.
PLEN_SEN_FAIL:	Plenum Sensor Fail Timer. If the plenum sensor were to short, open, or have the sensor difference exceed the PLEN_SEN_DIFF setting, this timer would have to time out before the Plenum Sensor Fail Alarm would be active. **The default setting is 3 minutes** and a 0 setting will disable the alarm.
OSA_TEMP_FAIL:	Outside Air Sensor Fail Timer. If the outside air sensor were to short or go open, this timer would have to time out before the Outside Sensor Fail Alarm would be active. **The default setting is 3 minutes** and a 0 setting will disable the alarm.
OSA_HUMID_FAIL:	Outside Air Humidity Sensor Fail Timer. If the outside humidity sensor were to fail, this timer would have to time out before an Outside Humidity Fail Alarm would be active. **The default setting is –10 minutes** and a 0 setting will disable the alarm.
LOW_HUMID_TIMER:	Plenum Low Humidity Timer. If the Plenum Humidity were to fall below the Low Plenum Humidity Setpoint, this timer would have to elapse before a Low Humidity Alarm would be active. **The default setting is -60 minutes** and a setting of 0 will disable the alarm. A negative setting will make the alarm soft only and not shut down the system.
HIGH_CO2_TIMER:	High CO2 Timer. If the CO2 level were to go above the CO2 Setpoint, this timer would have to elapse before the High CO2 Alarm would be active. **The default setting is -60 minutes** and a setting of 0 will disable the alarm.

E2 Parameters Definition:

	A negative setting will make the alarm soft only and not shutdown the system.
PLEN_SEN_DIFF:	Plenum Sensor Difference Alarm. The plenum has two sensors which are averaged for accurate temperature control. If the reading between these two sensors were to be greater than this setting, the plenum sensor fail timer would start timing out for a Plenum Sensor Fail Alarm. This setting is in 1/10ths of a degree. **The default setting is 10** or 1.0 degrees. A setting of 0 will disable this alarm.
CAVITY_CONFIG:	Cavity Sensor Configuration. The cavity uses two sensors for control, one for the cavity wall or cavity return air sensor and one for the pile sensor. The configuration setting sets which sensors are used. The first number is the wall sensor and the second number is the pile sensor. Example: If P1 is to be the Pile Sensor and P8 to be the wall sensor, then the setting would be 18. **The default setting is 18.**
MIN_REFRIG_RUN:	Minimum Refrigeration Run. This setting will allow the refrigeration to run for a minimum time, regardless of cooling air availability. **Default setting is 30 minutes.**
KP_1	Refrigeration proportional gain. **The default value is 20.** Increasing this value will cause the overall system performance to become faster.
KI_1	Refrigeration integral gain. **The default value is 4**. The integral gain produces an error based on small errors over time. Increasing this value will cause the small error to be amplified over time, leading the system to be more sensitive to small errors.
KD_1	Refrigeration Derivative gain. The derivative is produced by a sudden change in the error. If the temperature is several degrees above setpoint, the PID will ramp quickly. The error may not change much until the refrigeration reaches a given level. At this point the temperature would drop quickly. The derivative acts like a brake and will offset the error when large changes are being made. If the temperature over shoots at start up, you would want to increase this value. **The default setting is 10.**
UPDATE_T1	This value is in 1/10's of a second, and determines when the PID loop is updated. **The default value is 100.** Increasing this value will slow down the entire loop. Decreasing will cause the loop and response to speed up. A value which is too low will cause the system to cycle around the setpoint.
SCALE	This value is used initially for testing and is the over all scaling for the PID response. **The default setting is 3.** This is an engineering variable and should normally not be changed.
THRESH	This is the switchover point for the KI divisor. **The default setting is 50**. This is an engineering variable and should normally not be changed.
ROL_DIFF	Refrigeration operating level differential. This is a differential that is used for the

E2 Parameters Definition:

	minimum operating level. When the refrigeration output raise above the minimum setting plus the ROL_Diff, the ARL will shut off. **The default setting is 10 percent.**
DOOR_TIME:	Door open time. This time, in seconds, will determine the door position. This value is determined by timing the door open cycle and the door closed cycle. The two values should be averaged. **The default setting is 180 seconds.**
REF_LEVEL:	Refrigeration minimum operation level. The system will uses the fresh air doors to maintain a minimum operating level. This will keep the refrigeration from short cycling under light loads and also provides a constant CO_2 purge. **The default setting is 30 percent.**
LOW_CUTOUT	This is the point below setpoint where the ARL shuts off and allows the refrigeration PID loop to go to 0. This is a safeguard if the plenum temperature drops the setpoint this amount because the OSA is not warm enough. The setting is in .1 of a degree and **the default setting is 5 or .5**°
CO2_RAS / BURNER START:	CO2_Ras purge rise above setpoint. If the plenum rises above setpoint this amount during refrigeration, the doors will be blocked from opening any further. This value is in 1/10's of a degree. **The default setting is 5 or .5°.**
	Burner Start is a Onion parameter. This is the percentage that the gas valve will initially go to in burner mode and then it will start the PID control. The uom is percent. **The default setting is 20 percent.**
MAX_DOOR:	CO_2 purge max door opening. This setting will only allow the fresh air doors to open a maximum amount during a CO_2 purge for refrigeration. **The default set ting is 20%.**
CO2_DIFF / DEHUMID DIFF:	CO_2 differential. This setting will determine how far below the CO_2 Setpoint that the purge will go before shutting off. **The default setting is 200 ppm.**
	Dehumid Diff. This setting is used to determine that the OSA is cold enough to dry out the return humidity. This is used on the conventional Onion software. **The default setting is 10.**
BURNER_DEHUMID	This is an Onion parameter. This is the value the valve will initially go to when the burner is Dehumid. **The default setting is 10 percent.**
ROL_START_DLY:	Refrigeration operating level start delay. This timer provides an initial delay for the ARL loading control logic. **The default setting is 10 minutes.**
AUX 1_CONFIG:	This setting will configure the Aux 1 output for different control configurations. A setting of 0 will cause the Aux 1 output to follow the fan operation.
	A setting of 1 will configure Aux 1 for ERV control. Energy Recovery Ventilator Control turns on the Aux 1 output when CO_2 levels exceeds the CO_2 setpoint and shuts off when the CO_2 level drops below the CO2_DIFF. A setting of 2 will change the Aux 1 switch to a Dehumid switch. When this switch is in Auto, it will activate the Dehumidification logic. See the Dehumid flow chart for more

E2 Parameters Definition:

details. **The default setting is 0.** A setting of 05 will set the switch up for Ceiling heat. See E2 parameter C_H_TIME for more information.

AUX 2_CONFIG: This setting will configure the Aux 2 output for different control configuration. A setting of 0 will cause the Aux 2 output to follow the fan operation. **The default setting is 0.** A setting of 188 will activate the Warming mode. A setting of 05 will set the switch up for Ceiling heat. See E2 parameter C_H_TIME for more information.

DOOR_CONFIG This setting will configure the XT door open and close outputs for different control configurations. A setting of 0 will configure the outputs for pulse control. Pulse control will cause the open output to produce a open pulse and the close output to produce a close pulse. A setting of 1 will configure the outputs for directional control. Directional control will cause the open output to set a directional output and the close output to produce a pulse to either drive the doors open or close. External relays are needed for this mode. A setting of 2 is used for SCX cards and a setting of 3 is for single door with feedback pot on P8. **The default value for this setting is 0.**

FREQ_ET Variable Frequency Drive Elapsed Time. This variable is for display only and can not be changed. If running in the automatic pile differential mode, this will show how long the fan has run since the last update. When this variable is equal to the update time on the HMI, the system will increment or decrement the freq drive setting.

COOL_HRS Setpoint Ramp Cooling Hours. This variable is for display only and can't be changed. If in the ramp mode, this variable will show how long it has been since the last change. When it is equal to the cooling hours on the setpoint ramp, the ramp will occur and the COOL_HRS will be cleared to 0.

CO2_CONFIG This setting will cConfigure the XT CO_2 input (AN16) for a variety of CO_2 sensor ranges. **The default value for this setting is 0.**

A setting of
0 = 0 - 10000 ppm
1 = 0 - 2000 ppm
2 = 0 - 3000 ppm
3 = 0 - 5000 ppm
4 = 0 - 7000 ppm

HEAT_DIFF Heat Differential. This setting will determine when the Heat ON Timer will increase or decrease. If the plenum temperature is in the window of Setpoint - Heat_Diff then it will either increase or decrease the amount of heat. The heat mode will not start until the plenum is .5 degrees below Setpoint. Once the Heat mode is on then it will not shut off until the Plenum is equal or greater than the Setpoint. This setting is in 1/10ths of a degree. **The default setting is 2 or 0.2**°.

HEAT_UPDATE Heat Update Time is the time period that must elapse before the "heat On time" will increase or decrease. This setting is in seconds and has a range of 0 -100.

E2 Parameters Definition:

The default setting is 40 seconds.

HEAT_PW

Heat Pulse Width is the amount of time that the "heat On time" will increase or decrease. This setting is in seconds and has a range of 0 - 20. **The default setting is 5 seconds.**

Heat Example:

The goal of the heat mode is to maintain the plenum temperature between setpoint and the heat differential by cycling the Heater on and off. The amount of time On and time Off will change as needed to maintain a steady plenum temperature.

Settings: heat diff 0.2°F; heat update 40 seconds; heat pulse width 5 seconds

If the plenum temperature drops 0.5°F below setpoint, The Heat mode will be activated. There is no parameter that will allow anything other than .5. The heat output will be on for five seconds and off for 35 seconds. If plenum temperature remains below setpoint - heat diff, heat output will increase to ten seconds On and 30 sec Off. Heat On time will continue to increase, if needed, five seconds every 40 seconds until the heat stays on for 40 seconds of every 40 seconds.

When plenum temperature is between setpoint and the heat diff, the time On and time Off will freeze and neither increase nor decrease, if the plenum temperature hasn't changed since the previous update. If the plenum temperature has climbed since the previous update, the time On will decrease five seconds. If the plenum temperature has dropped since the previous update, the time On will increase five seconds.

If the plenum temperature climbs to setpoint, the heat On time will decrease to 0.

PANEL_CNFG

This has to do with the humidity sensors and the way they are read. The original XT board is slightly different than the Rev A and greater boards. If an original board, this needs to be set to 0. Rev A and greater should be set to 1. **The default setting is 1.** A setting of 2 will turn the Return Air Humidity sensor Input into a Ethylene sensor input.

PURGE_CNFG

Purge config. There are six possible configurations.
0 = No Time Purge or ARL/CO2
1 = Time Purge, no ARL/CO2
2 = ARL, no CO2 or Time Purge
3 = ARL/CO2, no Time Purge
4 = ERV (Energy Recovery Ventilation) No CO2
5 = ERV (Energy Recovery Ventilation) / CO2
6 = Time Purge / Cooling Purge with CO2 sensor
The default setting is 3.

E2 Parameters Definition:

SP_DIFF	This is a Onion parameter and applies to the MVG onion program only. Setpoint differential is used to determine when the temperature of the outside air is acceptable for both curing and cooling. **The default setting is 5.**
PILE H CFG	The Pile Humidity Config is a Onion parameter and applies to the MVG onion program only. This parameter is used to determine which of the pile humidity sensors is used for control. 1 = Pile 1H 2 = Pile 2H 3 = Highest of Pile 1H or Pile 2H Any other number will average Pile 1H and Pile 2H **The default setting is 1.**
DOOR CLOSE POS	This parameter is used on a single door to read the feedback potentiometer and calculate the door position. This is a DC voltage. This parameter applies primarily to Suberizer doors. See app note 21 for details.
DOOR OPEN POS	This parameter is used on a single door to read the feedback potentiometer and calculate the door position. This is a DC voltage. This parameter applies primarily to Suberizer Doors. See app note 21 for details.
PILE H TIMER	Pile Humidity Sensor Fail Timer. This is a Onion parameter and applies only to the MVG onion program. If a pile humidity sensor were to fail, this timer would have to time out before a Pile Humidity Fail Alarm would be active. **The default setting is 0 minutes** and a 0 setting will disable the alarm.
PILE T TIMER	Pile Temperature Sensor Fail Timer. This is a Onion parameter and applies only to the MVG onion program. If a pile temperature sensor were to fail, this timer would have to time out before a Pile Humidity Fail Alarm would be active. **The default setting is 0 minutes** and a 0 setting will disable the alarm.
OSA MAX	Outside Air Temperature Max. This is a Onion parameter and applies only to the MVG onion program. If the outside air temperature exceeds this value, then the system will be forced into STANDBY. **The default setting is 90.**
DH_DIFF	Dehumid Differential. This setting will make sure the OSA is cold enough to be dry air. A typical setting would be 5 to 10 degrees. This setting is in 1/10 of a degree. For 5°, set to 50. A zero setting will disable this feature. The Aux1_cfg would have to be set to 2 for this to be active. See the potato dehumid flow chart for more details.
PILE T CFG	The Pile Temperature Config is a Onion parameter and applies to the MVG onion program only. This parameter is used to determine which of the pile temperature sensors is used for control. 1 = Pile 1 Temperature 2 = Pile 2 Temperature 3 = Pile 3 Temperature 4 = Pile 4 Temperature

E2 Parameters Definition:

12 = Average of Pile 1 & 2
13 = Average of Pile 1 & 3
14 = Average of Pile 1 & 4
23 = Average of Pile 2 & 3
24 = Average of Pile 2 & 4
34 = Average of Pile 3 & 4
112 = Highest of Pile 1 or 2
113 = Highest of Pile 1 or 3
114 = Highest of Pile 1 or 4
123 = Highest of Pile 2 or 3
124 = Highest of Pile 2 or 4
134 = Highest of Pile 3 or 4

Any other number will average Pile 1, Pile 2 Pile 3 and Pile 4.
The default setting is 1.

KP_B

This is a Onion parameter. KP_B is the proportional value for the burner PID.
The default setting is 10.

C_H_TIME / KI_B

C_H_TIME is a potato parameter. This is active when either the Aux 1 or Aux 2 Config byte is set to 05. Which ever output is selected is connected to the Heat output, so either the heat or aux output will turn on the return air heater. The purpose of this is to help control the condensate on some of the older storages. The C_H_Temp setting is in hole numbers and is used to set the threshold when the outside air temperature drops below it will turn on. This parameter can be either plus or minus.

IF OSA IS LESS THAN C_H_TEMP FOR C_H_TIME MINUTES TURN ON HEAT.

KI_B is a Onion parameter. KI_B is the integral value for the burner PID.
The default setting is 5.

C_H_TEMP / KD_B

C_H_TEMP is a potato parameter. This is the time in minutes that the outside air must be less than C_H_TEMP before the heat is turned on.

This is a Onion parameter. KD_B is the derivative value for the burner PID.
The default setting is 0.

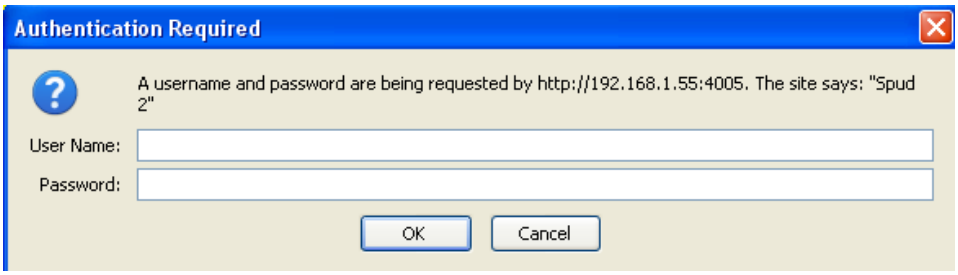
UPDATE_TB

This is a Onion parameter. UPDATE_TB is the update time for the burner PID. The time is in ms. **The default setting is 100.**

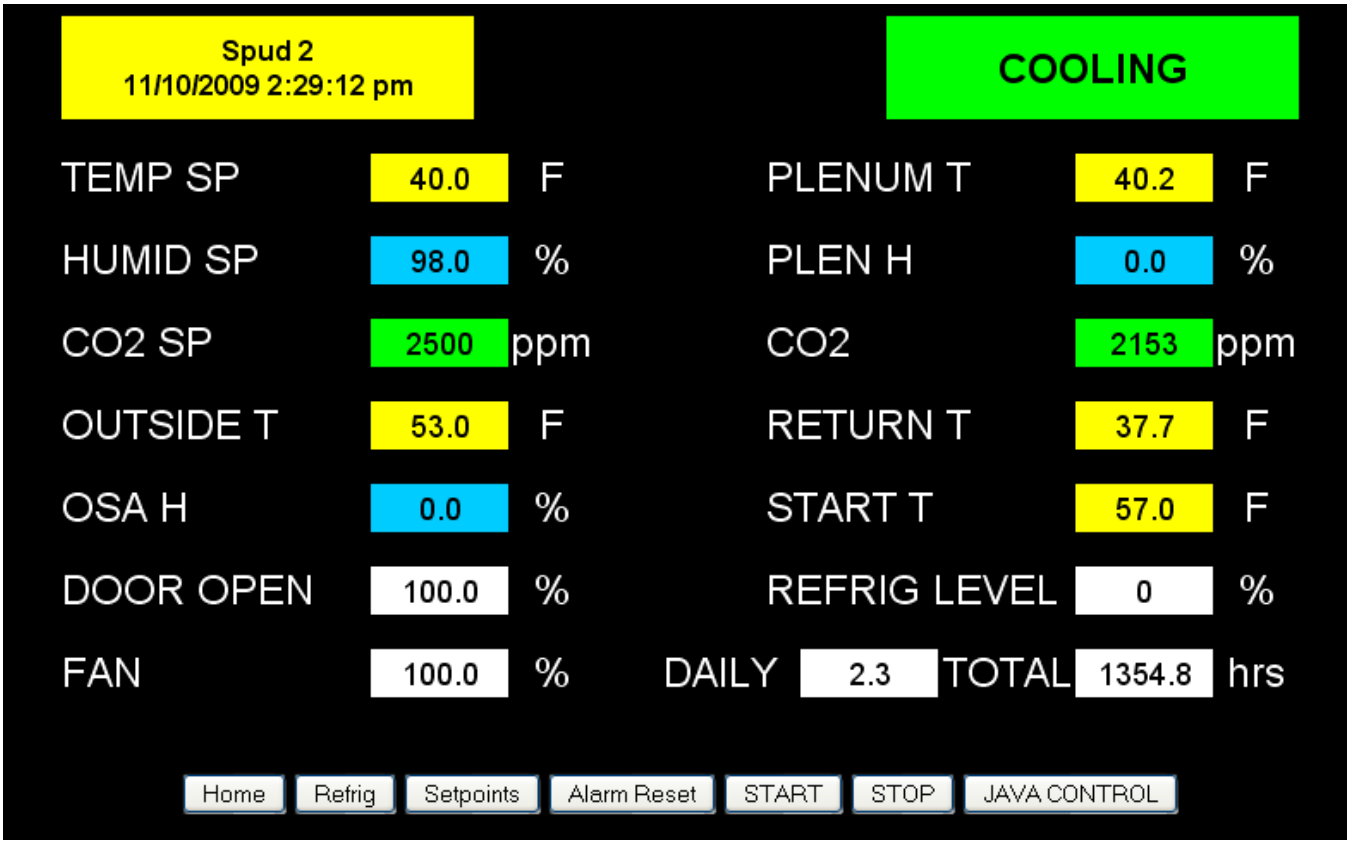
7.1 WEB INTERFACE:

The XT panel is accessible via an embedded web server. The embedded web server will serve directly to any web browser device. Each XT panel will have a unique static IP address. For example: 209.299.19.123:4001 To access this panel, type http://209.299.18.123:4001 in the browser's address bar.

The 4001 is the HTTP port that is assigned to the XT panel. The first screen that is shown is the username and password screen.



Enter a valid username and password and click on OK.

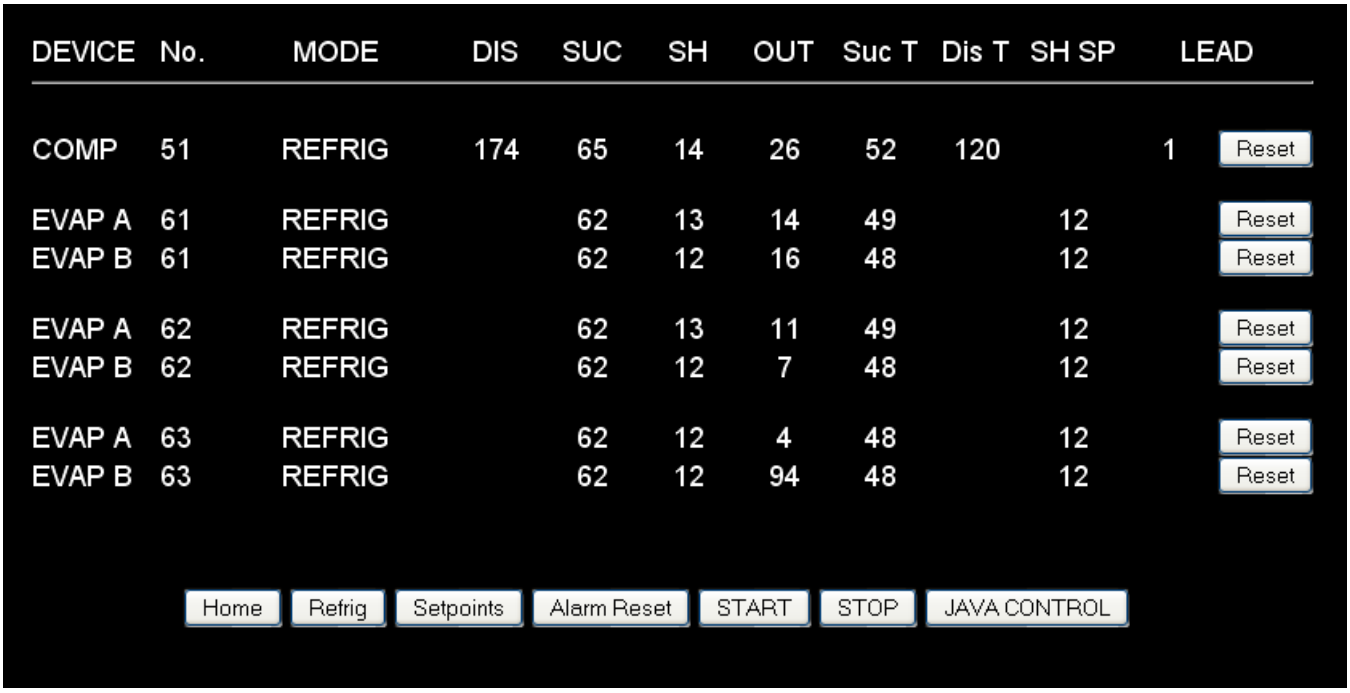


This screen is accessible using most cell phones and web browsers. The JAVA CONTROL button should only be used if you have a web browser that will run Java Applets. Most cell phones will not. If Java is not available then use the Refrig, Setpoints, Alarm Reset, START and STOP buttons.

The JAVA CONTROL is much easier to use for making monitoring and making changes to the XT panel.

7.2 WEB REFRIGERATION INTERFACE:

Click on the Refrig button to access the current refrigeration information and records. The individual refrigeration cards can also be reset from this page.



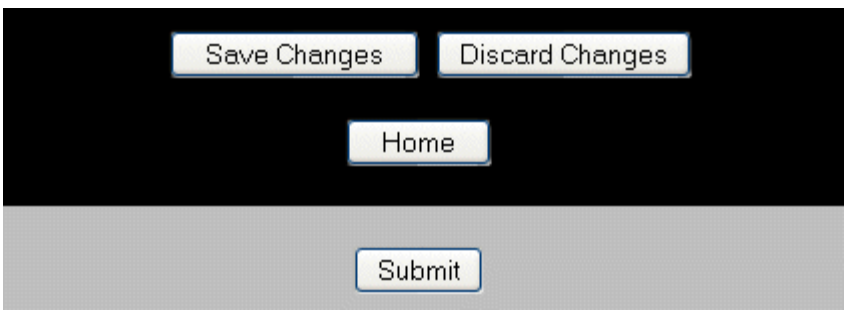
Alarm Reset:
This button will reset any of the XT alarms. The XT panel will cycle to Shutdown and then restart.

START:
This button will restart the XT panel if it is in a Remote Shutdown.

STOP: This button will put the XT panel into a Remote Shutdown.

7.3 Setpoints:

The Setpoints page contains all the main parameters for the operation of the panel. First make changes and then click on the Submit button. Next click on the Save Changes button.



Note - when making a change to the setpoint from this screen, the target must also be changed or the system will be in a ramp mode.

To make change click on desired parameter value, change the number and then click on submit. Then click on Save.

TEMPERATURE / RAMP		
SETPOINT	40.0	F
TARGET	40.0	F
COOLING HOURS	12.5	hrs
RAMP RATE	0.1	F

CO2 (ONION HMAX)		
CO2 SP / HMAX	2500	ppm
HIGH CO2 ALARM	0	ppm

FAN FREQ DRIVE		
COOLING SPEED	45.0	%
COOLING MIN SPEED	45.0	%
PURGE SPEED	75.0	%
REFRIG SPEED	45.0	%
REFRIG MIN SPEED	40.0	%
TIMED SPEED	20.0	%
UPDATE TIME	0.5	hrs
PILE DIFF SP	1.0	F
OSA TEMP	0.0	F
OSA SPEED	0.0	%
OSA RUN TIME	0	min
OSA FAN INTERVAL	0	hrs
FREQ PILE DIFF CONTROL	AUTO	
FREQ PILE DIFF REF	RTN	

HUMIDITY CONTROL		
HUMIDITY SP	98.0	%
LOW HUMIDITY ALARM	0.0	%
CELL TIMER ON	20	sec
CELL TIMER OFF	0	sec
H1 TIMER ON	50	sec
H1 TIMER OFF	50	sec
H2 TIMER ON	50	sec
H2 TIMER OFF	44	sec
CELL CONTROL	MAN	
H1 CONTROL	TIMER	
H2 CONTROL	AUTO	

TEMPERATURE DEVIATION ALARM		
HI DEV	2	F
LOW DEV	-2	F

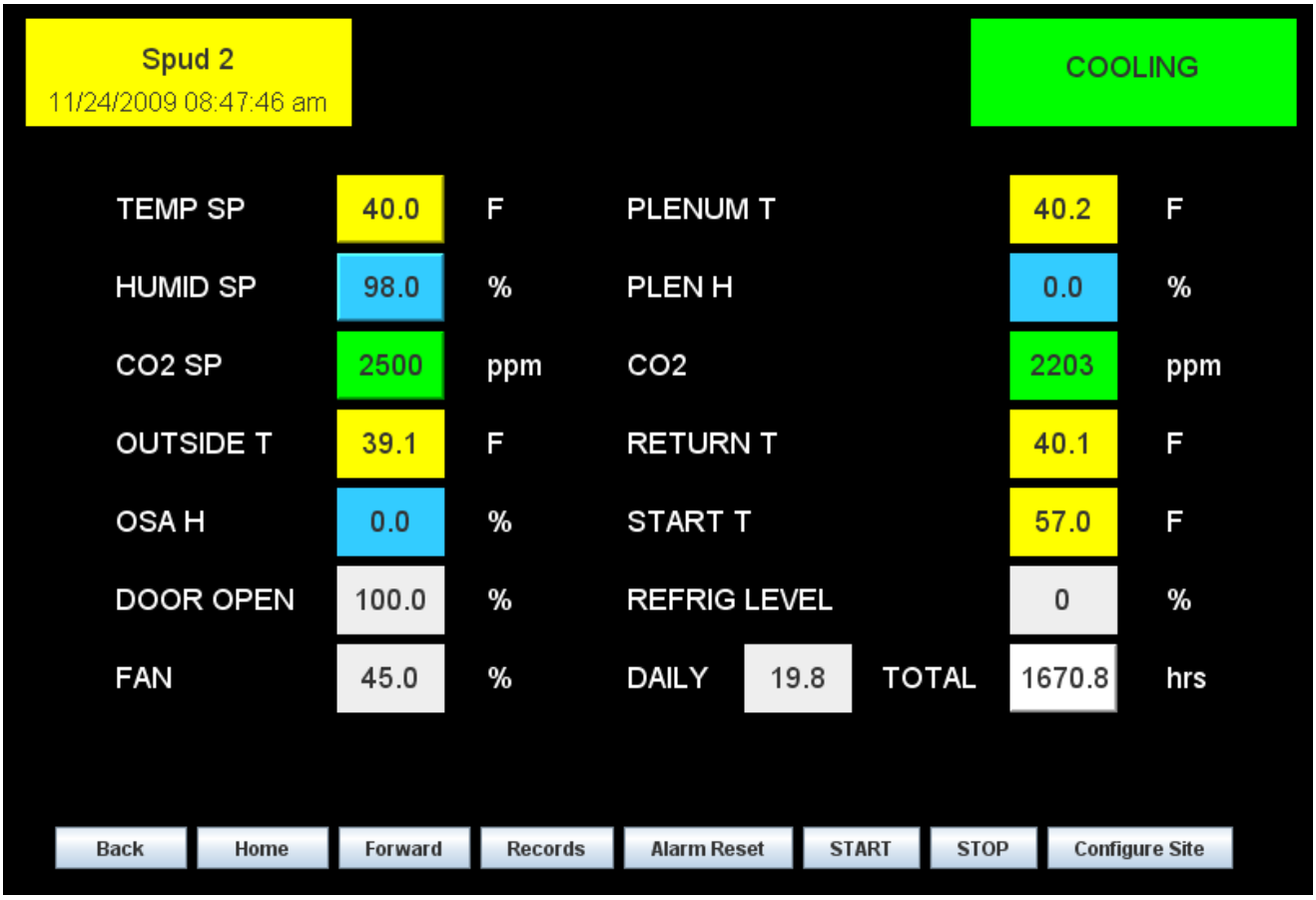
OUTSIDE AIR CONTROL		
OSA DIFFERENTIAL	17	F
DIFFERENTIAL REF	SP	

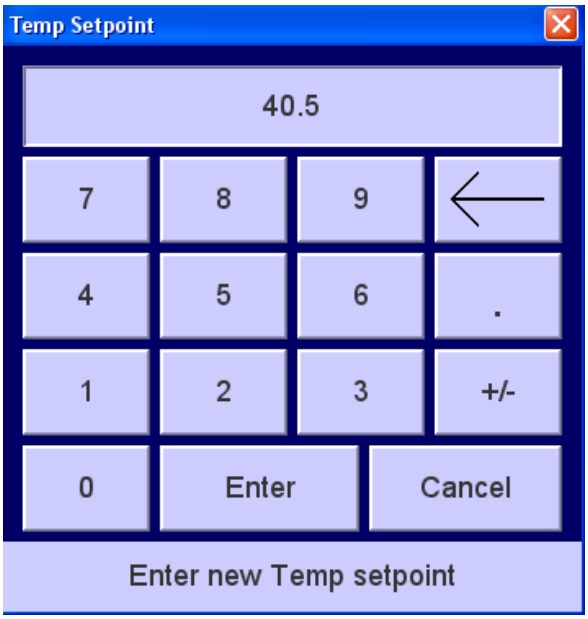
MISC CONTROL		
CAVITY DIFF	0.0	F
TOTAL RUN TIME	1652.7	hrs

DOOR DEFROST CONTROL		
DEF TEMP	0.0	F
DEF TIME	0	min
DEF INTERVAL	0	hrs

TIME PURGE CONTROL		
OUTSIDE AIR LESS THAN	60.0	F
PURGE TIME	15	min
PURGE INTERVAL	10	hrs
PURGE SPEED	75.0	%

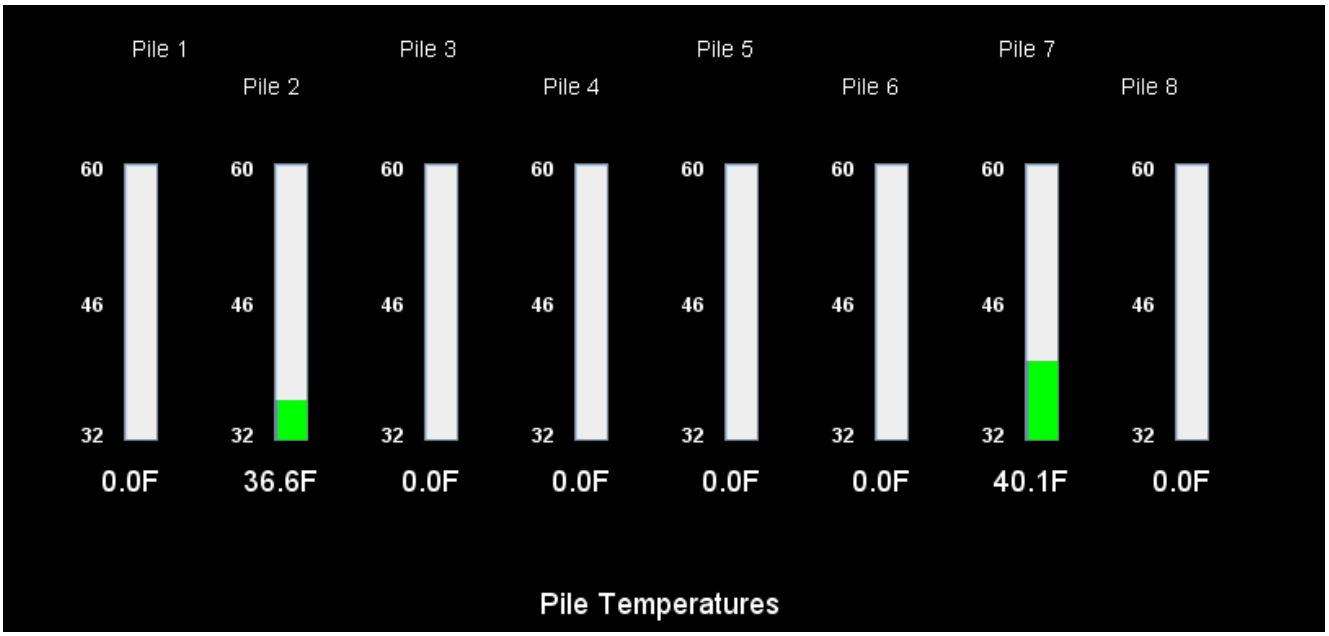
7.4 **Java Control:** Click on the Java Control button and the Java applet will load. This produces an exact replica of the HMI screens. To change the Temp SP, click on the yellow box and a key pad will be displayed.





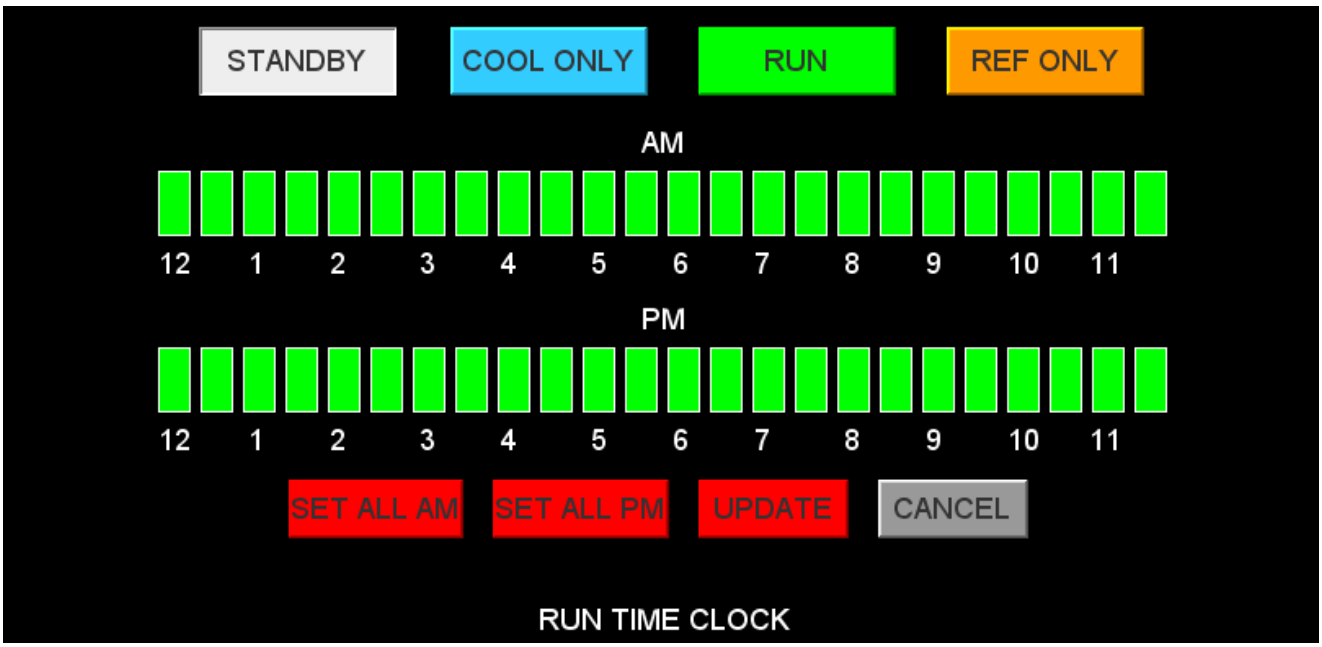
To make a change, enter the new value and then click on Enter.

7.5



This screen shows the pile temps. The names of each of the pile sensors can be changed to reflect the location.

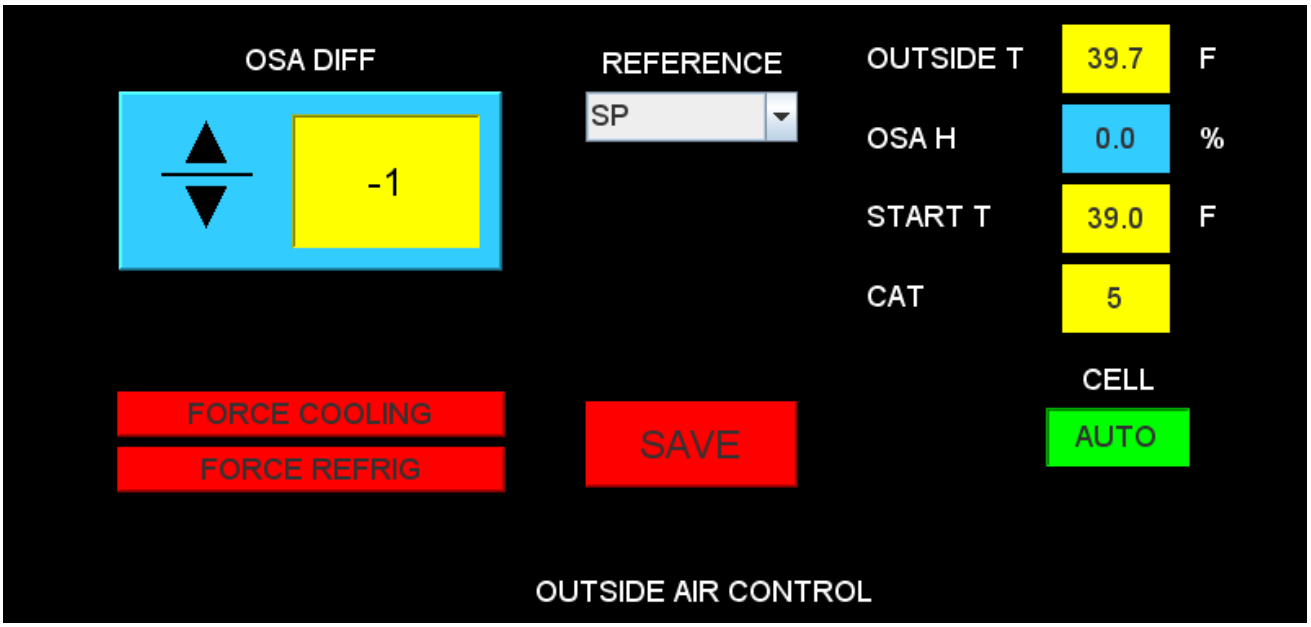
7.6



This screen shows the run time clock. To change click on the desired mode, STANDBY, COOL ONLY, RUN AND REF ONLY then click on the desired times. To save click on UPDATE. The SET ALL AM and SET ALL PM buttons can be used to set all the clock increments.

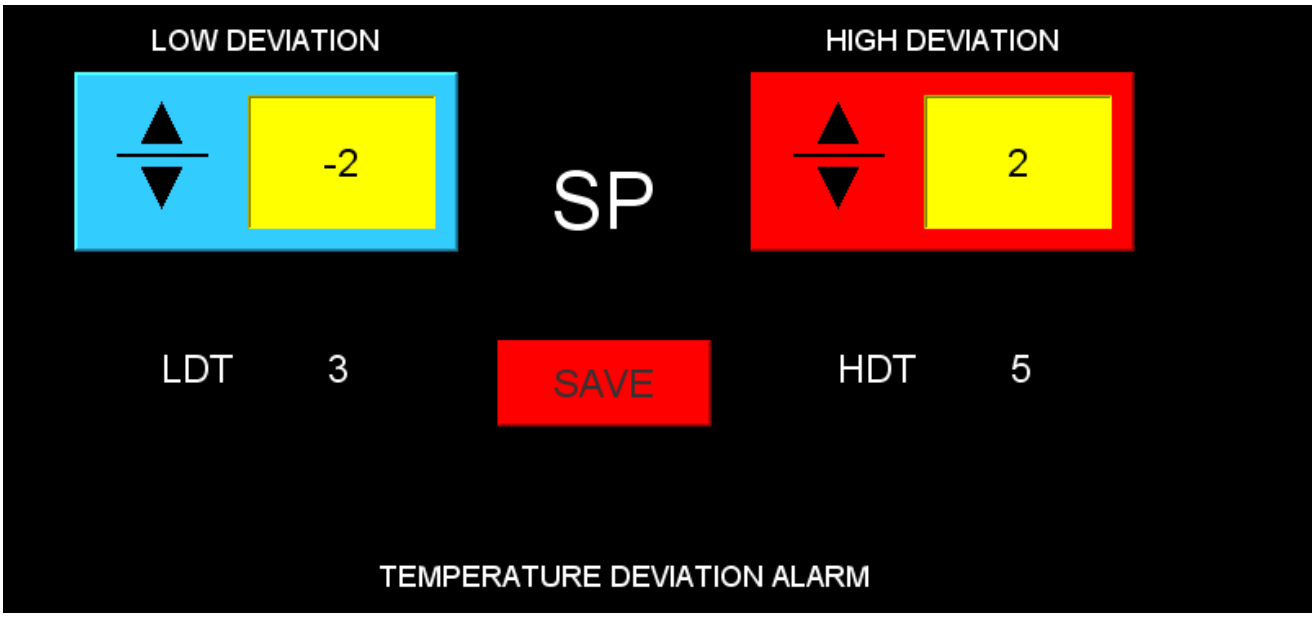
STANDBY	This will force the fans and all devices off.
COOL ONLY	System will run only when cooling air is available.
RUN	System will run COOLING, REFRIG, OR TIMED
REF ONLY	System will run in REFRIG only.

7.7



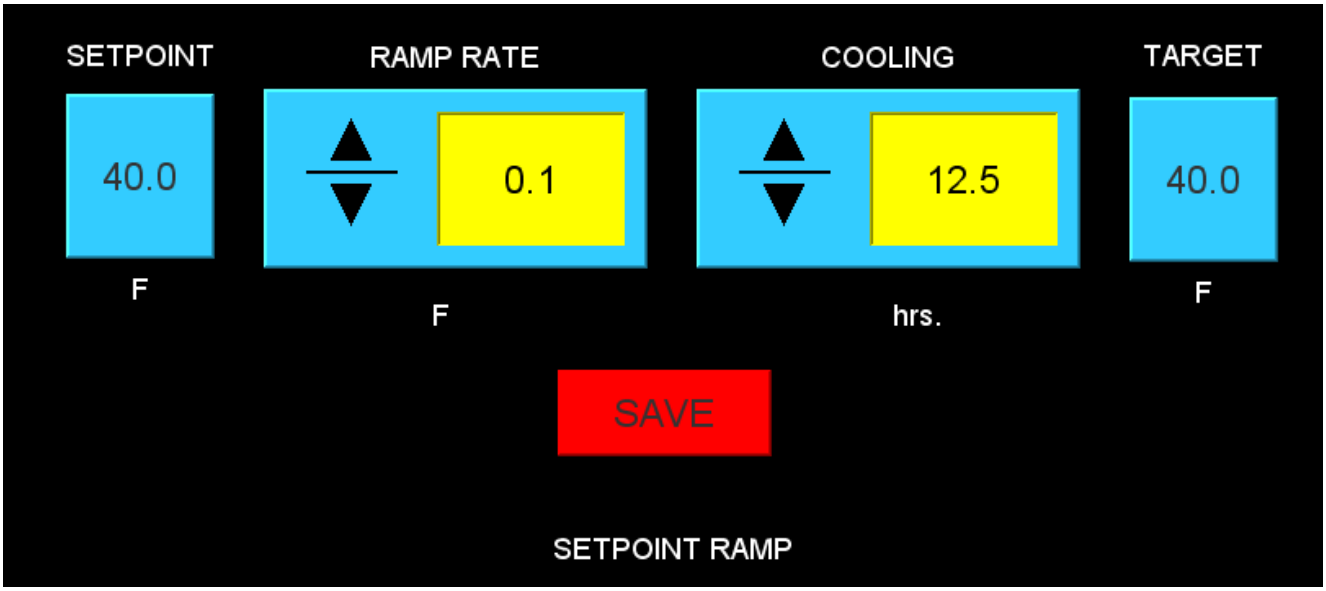
The OUTSIDE AIR CONTROL screen allows for the setting of the outside air differential and the reference. These values are used to calculate the START T. Any time the Outside air temp is less than the Start temp

7.8



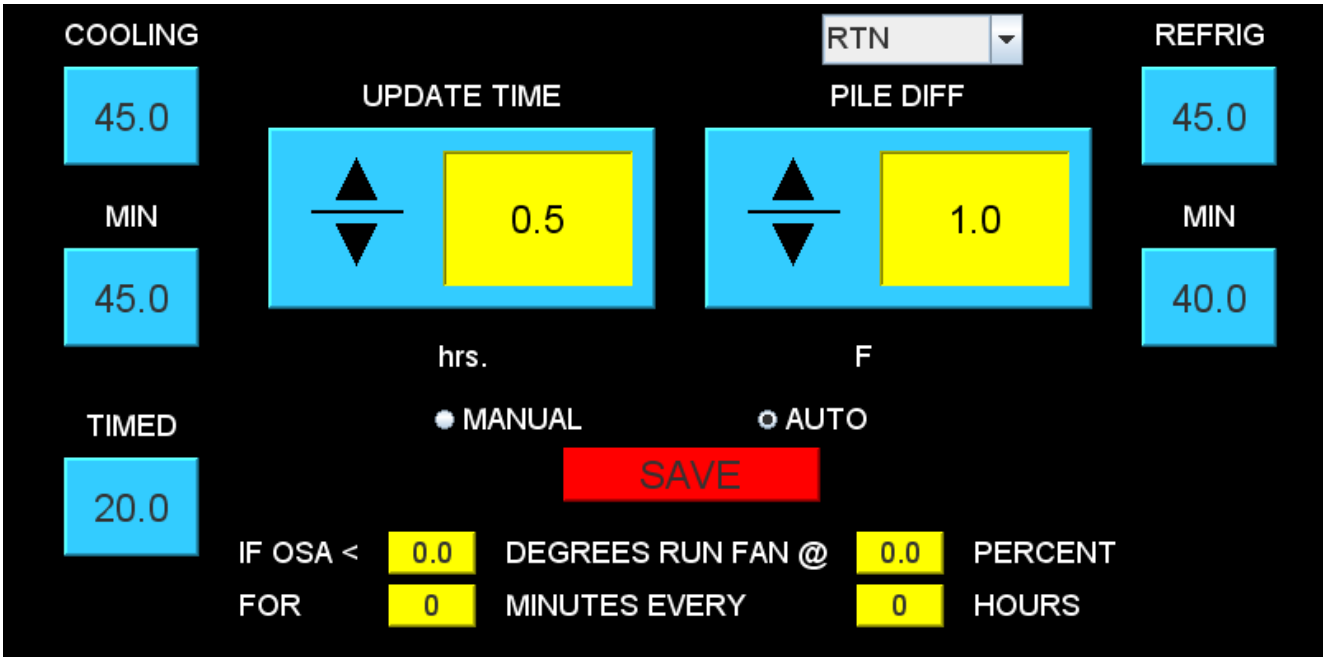
The Temperature Dev alarm screen allows the setting of the High and Low deviation. The LDT is the low deviation timer in minutes. It is a count down timer that is active when ever the plenum is below the setting. When the timer counts to zero it will trigger the alarm. The HDT is a similar timer for the High Deviation.

7.9



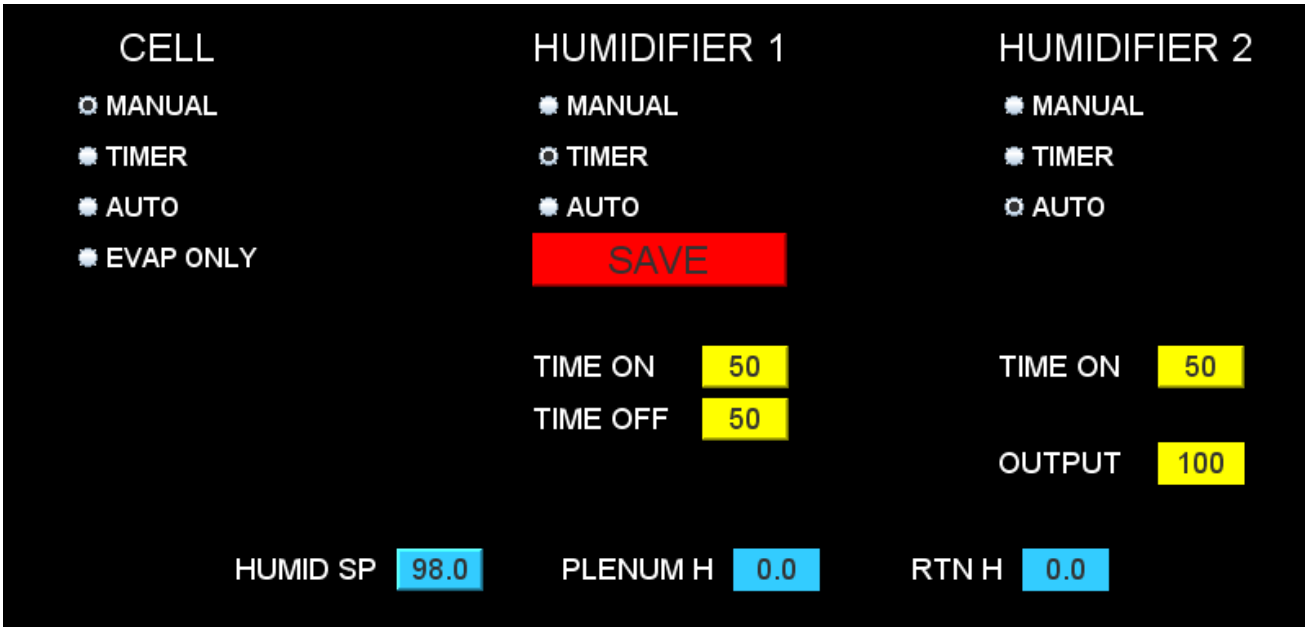
The Setpoint Ramp screen allows the ramp to be set up just like the HMI screen.

7.10



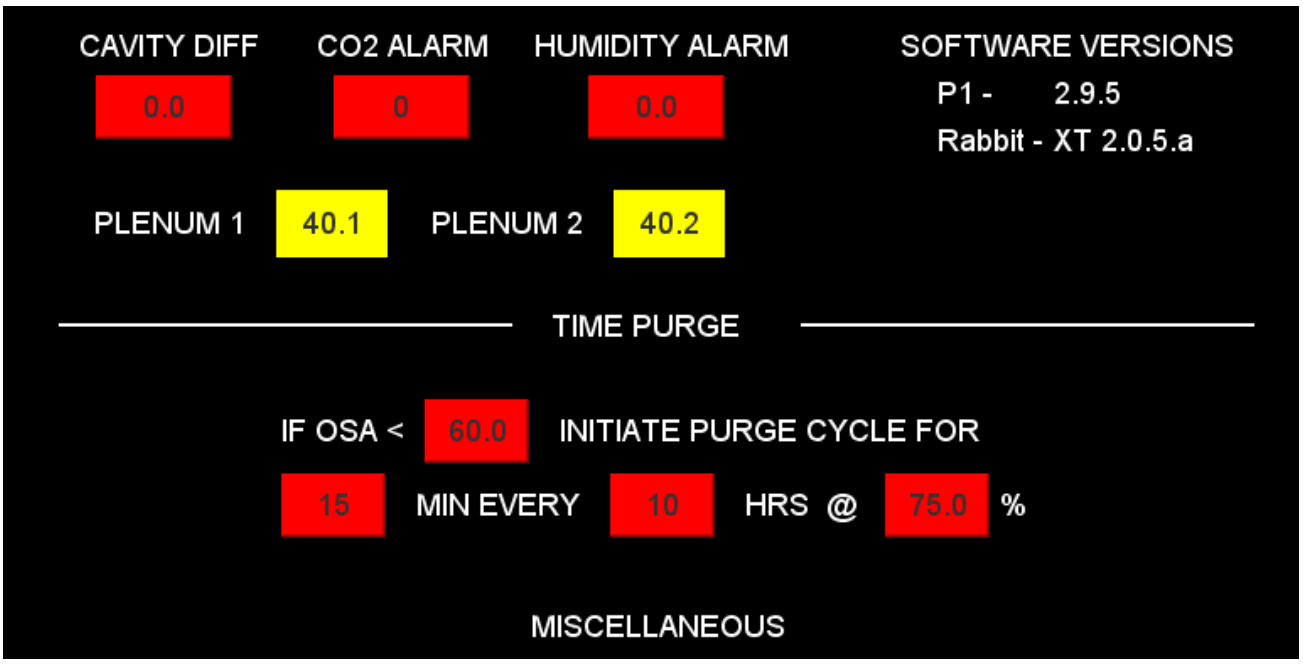
The Fan Speed Control page allows all setting for the speed of the Fan. See section 5.9 for more information.

7.11



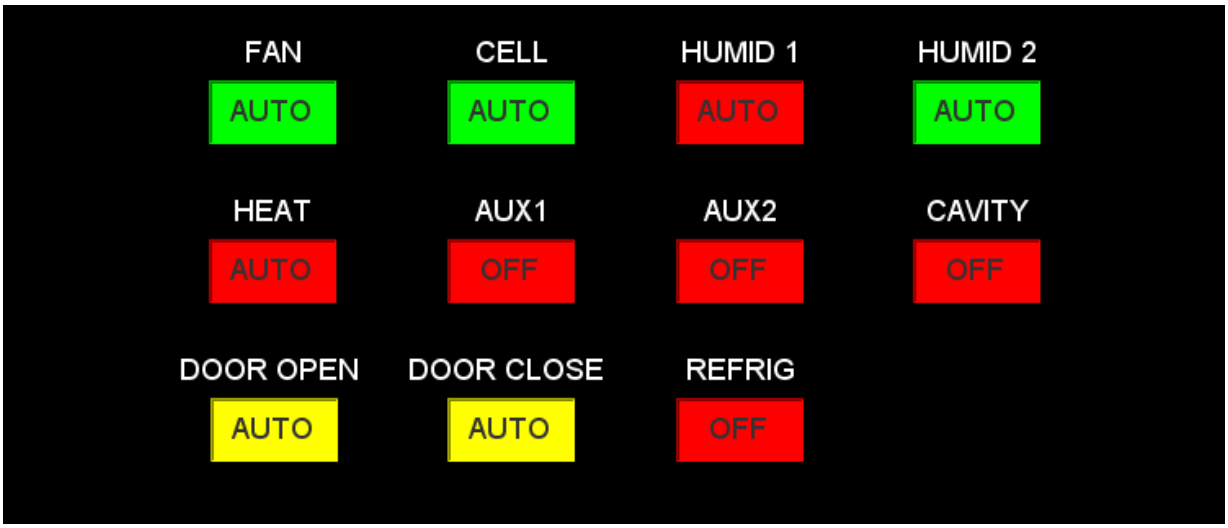
The Humidity screen allows all the humidity parameters to be set. See section 5.10 for more information.

7.12



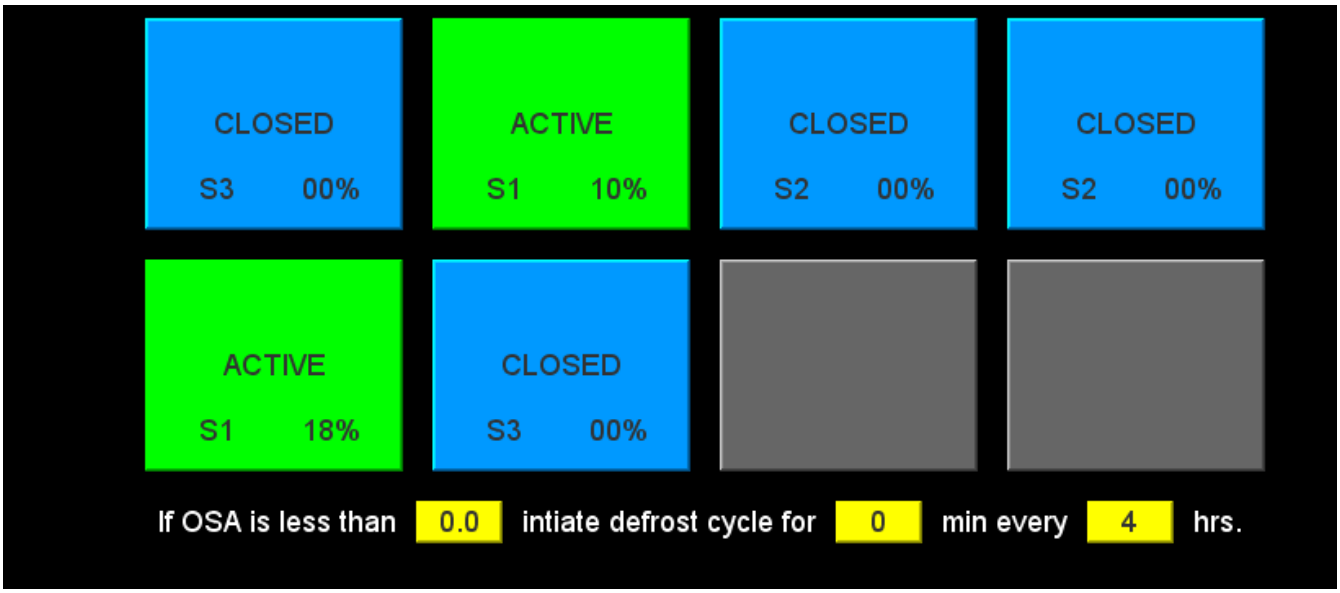
See section 5.11 for more information on the Miscellaneous screen.

7.13



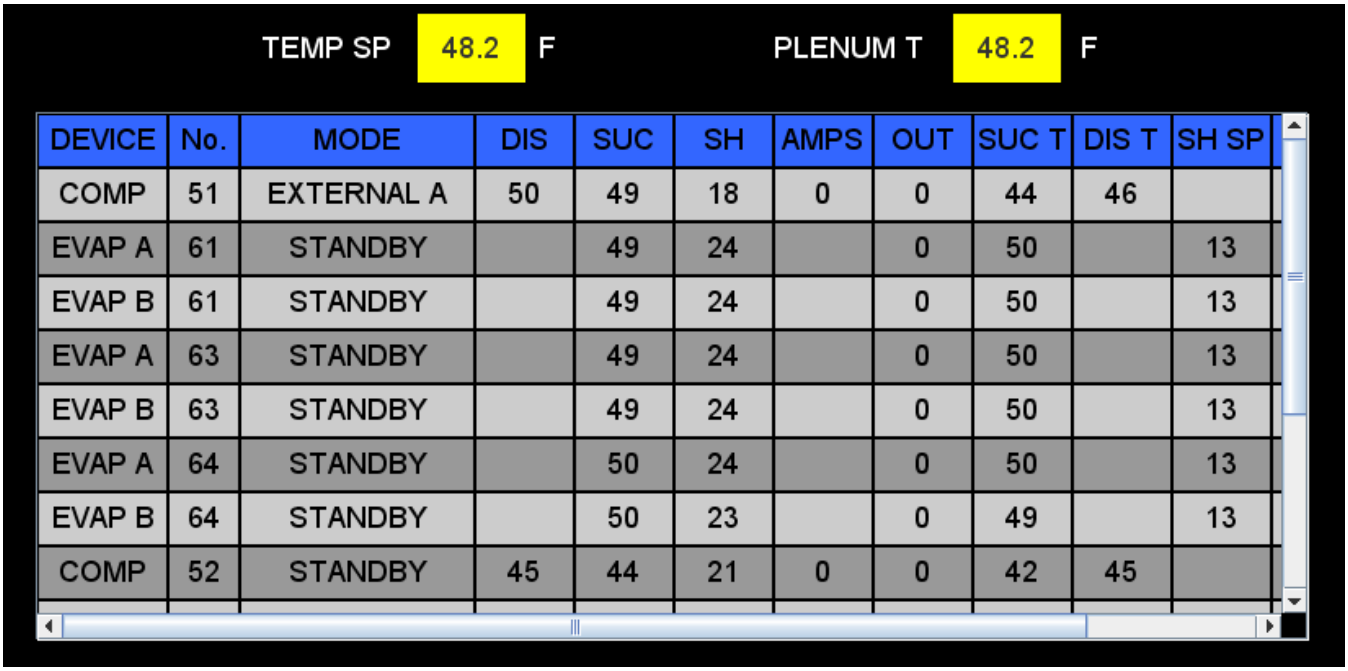
The Switch Status screen allow the user to view the status of all switches and remotely turn off or on. See section 5.12 for more information.

7.14



The Fresh Air Door Status screen allows the user to see the exact status of each door. See section 5.13 for more information.

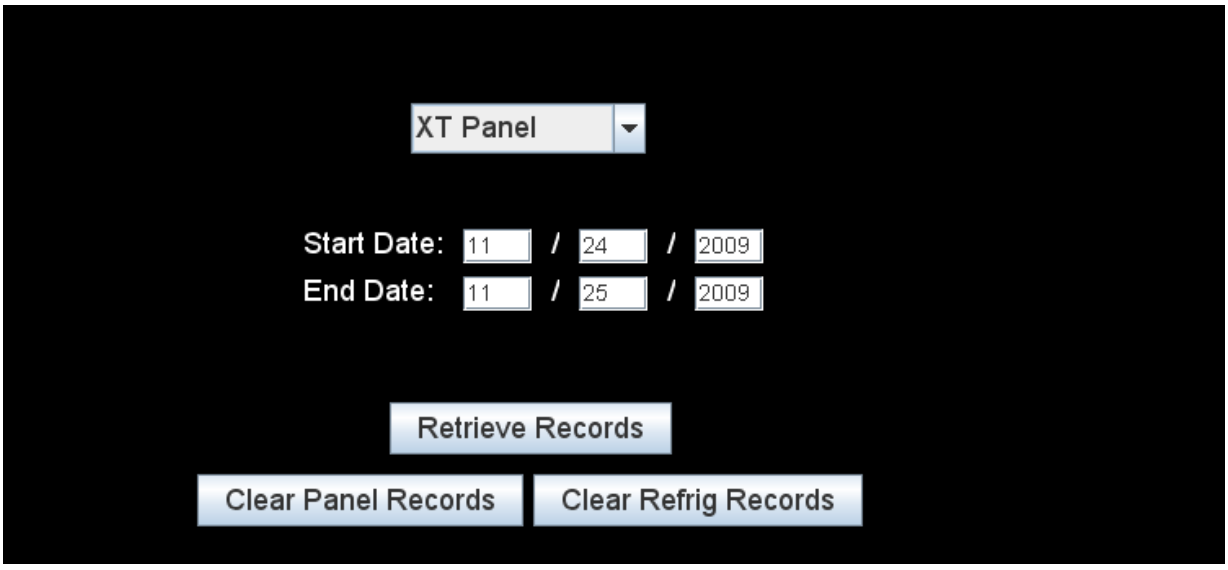
7.15



DEVICE	No.	MODE	DIS	SUC	SH	AMPS	OUT	SUC T	DIS T	SH SP
COMP	51	EXTERNAL A	50	49	18	0	0	44	46	
EVAP A	61	STANDBY		49	24		0	50		13
EVAP B	61	STANDBY		49	24		0	50		13
EVAP A	63	STANDBY		49	24		0	50		13
EVAP B	63	STANDBY		49	24		0	50		13
EVAP A	64	STANDBY		50	24		0	50		13
EVAP B	64	STANDBY		50	23		0	49		13
COMP	52	STANDBY	45	44	21	0	0	42	45	

The Refrigeration Status page allows the user to view all refrigeration parameters and operating conditions.

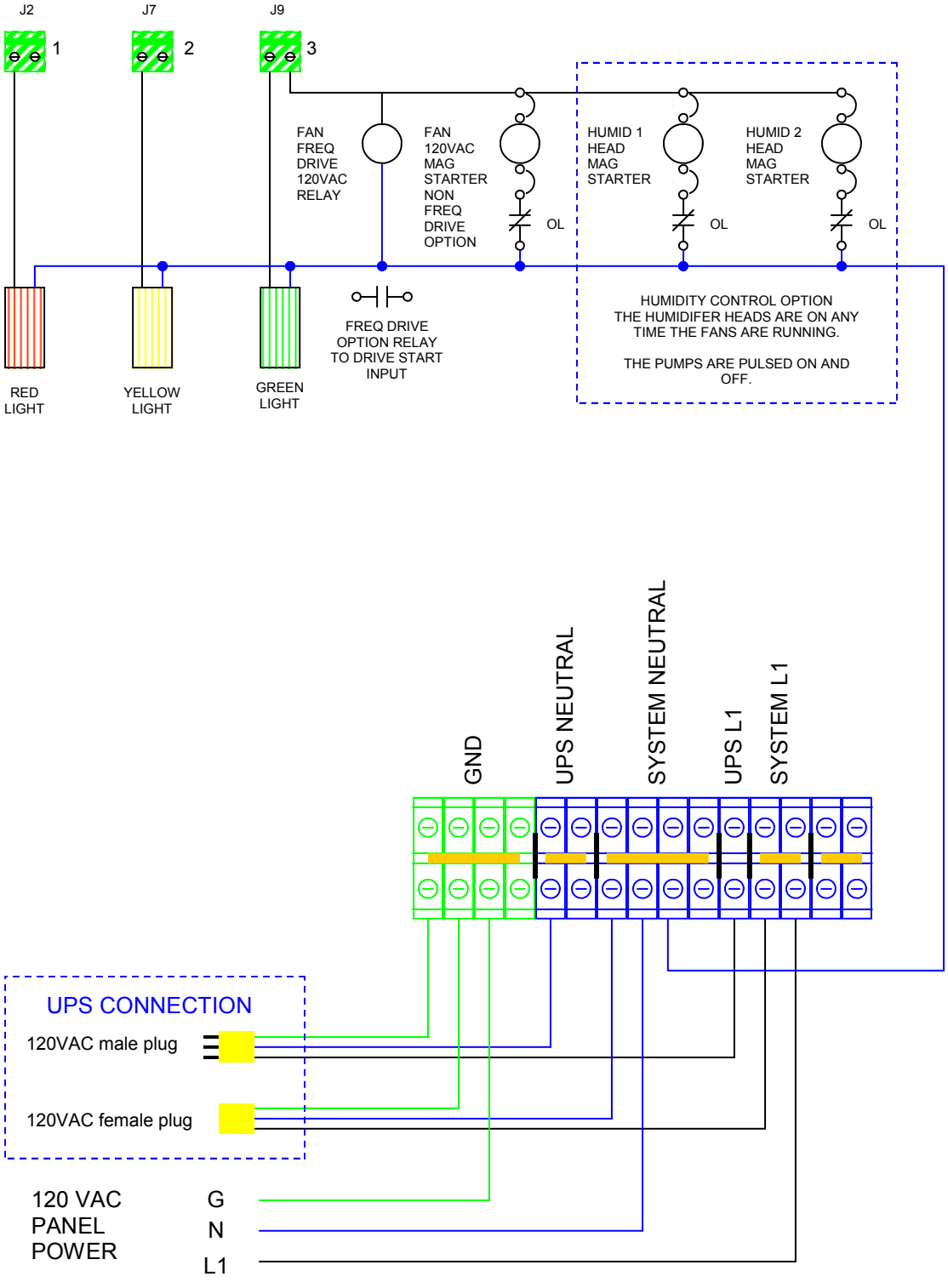
7.16



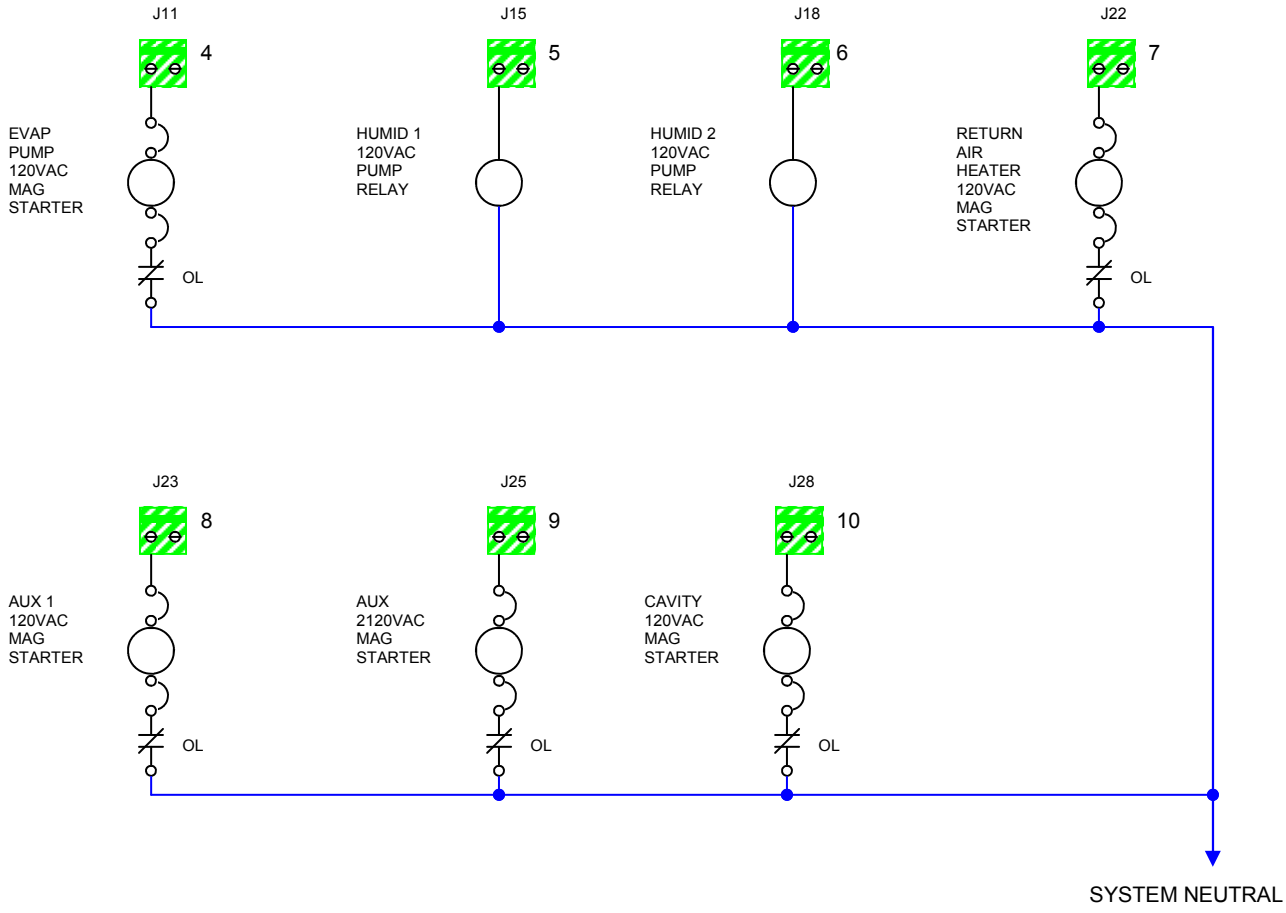
The Records button will allow the downloading of the records. The XT now stores two types of records, one for the XT panel and one set for the refrigeration system. Use the drop down to select the type of records first. Next enter the Start Date and End Date for the records. Click on the Retrieve Records button. A pop up screen should allow you to select Excel spread sheet for the download. See appendix for more information.

8.1

120VAC FIELD WIRING

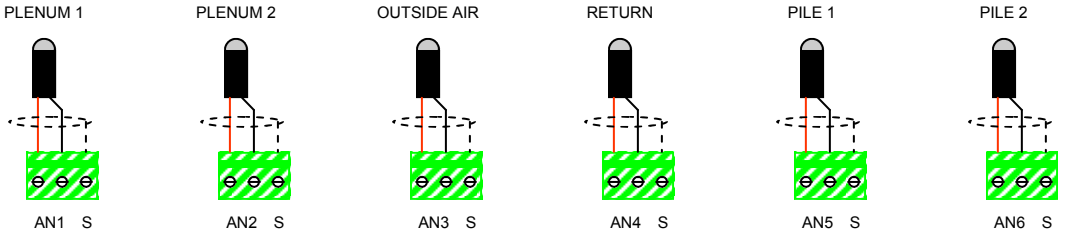


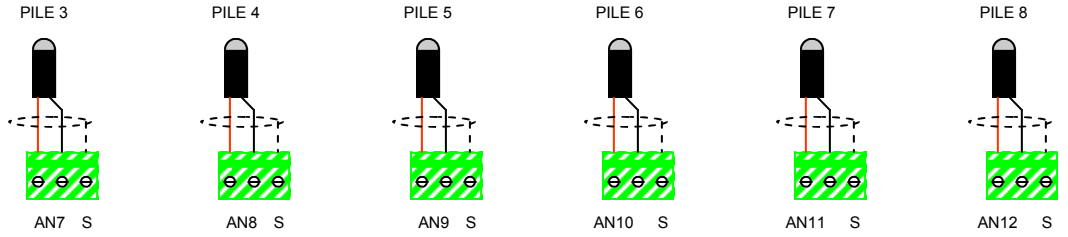
120 VAC FIELD WIRING

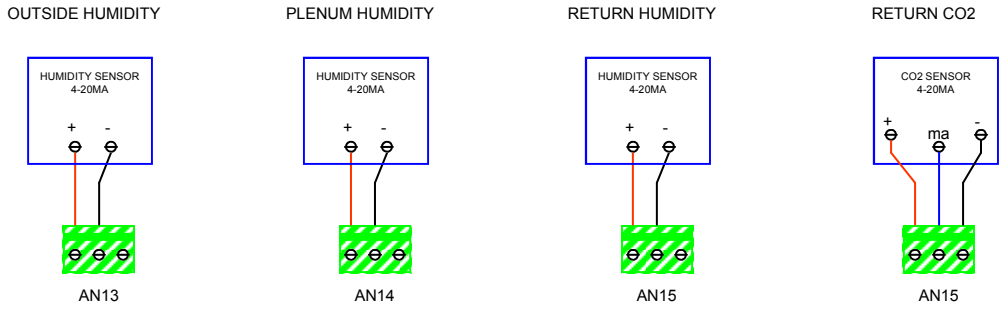


8.2

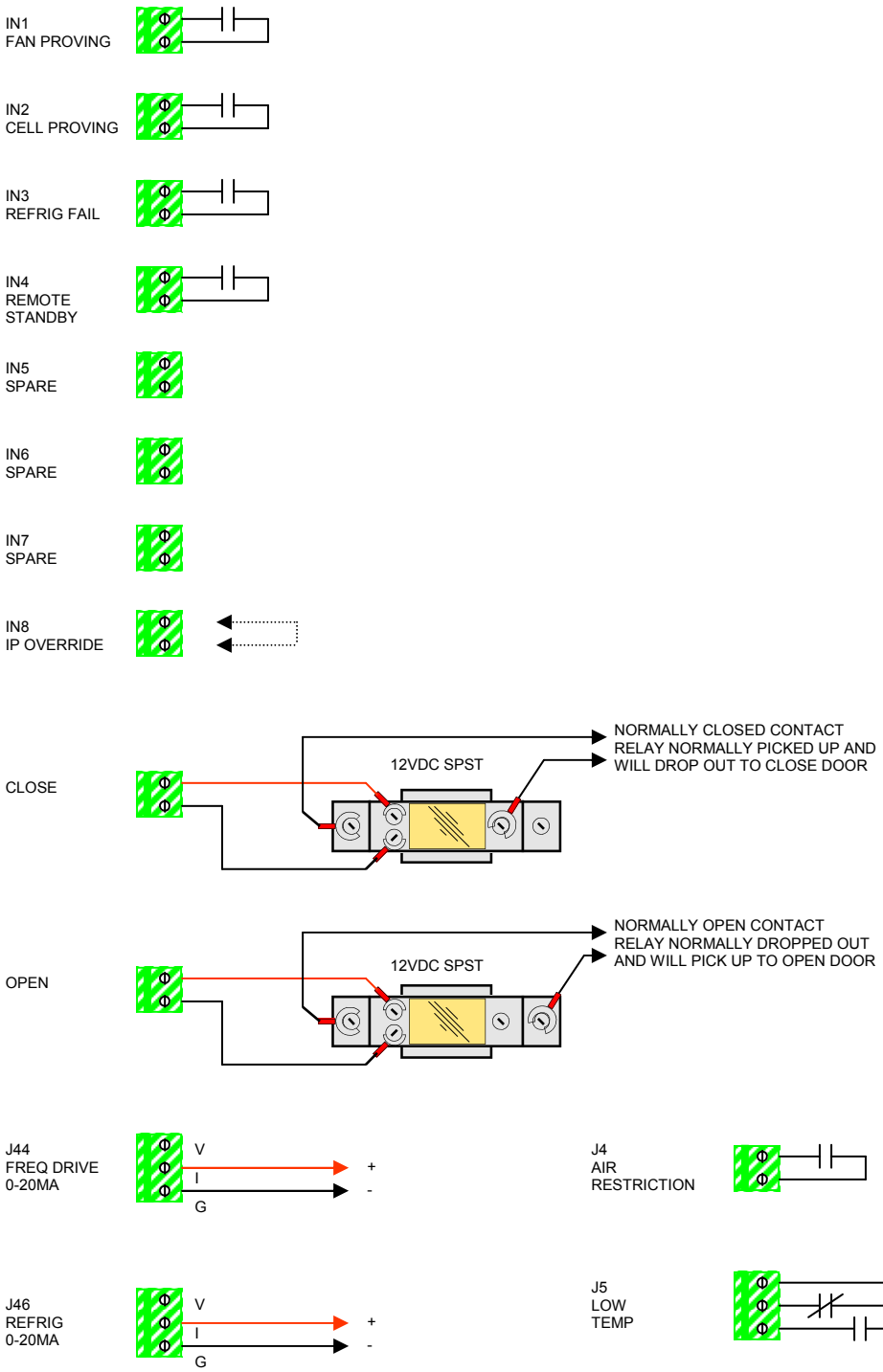
LOW VOLTAGE SENSOR FIELD WIRING







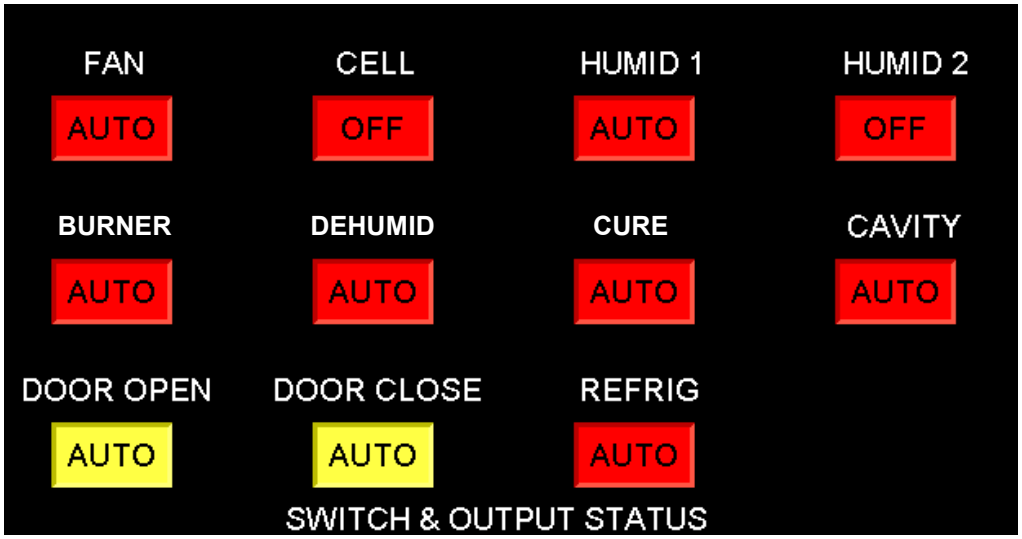
LOW VOLTAGE SENSOR FIELD WIRING



NOTE - LOW TEMP IS SHOWN IN NORMAL CONDITION. SHORT CIRCUIT MUST BE ON TOP TWO PINS FOR PANEL TO COME OUT OF SHUTDOWN.

9.0 ONION SUPPLIMENT:

The XT Panel can be either a Potato panel or an Onion panel by loading the correct software. This supplement will explain the differences in the Onion Logic and panel layout. The HMI (color touch screen) will automatically change depending on if it sees a potato or onion panel. For the Onion panel the some of the manual, off, Auto switches changes. The Heat switch needs to be relabeled Heat, Aux 1 relabeled to Dehumid and the Aux 2 relabeled to Cure.



This shows the HMI layout, the actual switches on the panel need to be relabeled.

The Onion panel operates in two distinct modes, Cure or Cooling. In the Cure mode the panel is looking for OSA temperatures greater than the Start Temp. In the Cooling mode the panel is looking for OSA temperatures less than the Start Temp. The Cure mode is the initial drying mode of the crop, that the system must be placed in following harvest. It usually runs at a higher temperature than is customary with a low humidity.

9.1 Cure Flow Chart Explanation:

Please refer to the CURE MODE flow chart for the following explanation. To enter the Cure mode the CURE switch must be in Auto. The run time clock must be set to RUN for the desired cure times. At this point the panel will look at the OSA temperature, if it is above the Start temperature it will try to cure the onions naturally using the warm dry outside air.

OSA > START TEMP The OSA Diff setting will affect the Start temperature and a suggested setting would be +3 to insure warm enough outside air. If the OSA temperature is less than the Start temperature then the panel will go to the Burner mode. The Burner mode will be covered later.

CPH < HMAX The outside air must also be dry enough. The CPH is calculated plenum humidity. The CPH is calculated by taking the outside air temperature and humidity and figuring out what the new value will be when mixed with the return air and warmed to the plenum temperature. Raising the temperature of the outside air will lower the relative humidity content. In this case we will be using 100% outside air and the CPH will roughly be the outside humidity. The HMAX is set to the operators preference, a typical setting would be 60%. Thus if the outside humidity was less than 60% the system would determine that the air is dry enough. If the outside humidity was greater than HMAX then the system would have to go to the BURNER mode.

OPEN FRESH AIR DOOR TO 100% Once the outside temperature and humidity have been confirmed to be warm and dry enough the system will go into the Cure mode and the fresh air doors will open to 100%.

BURNER SW AUTO If the outside temp is to cold or moist the system will check the burner switch. If it is not in auto then the system will reticulate the air with the fresh air door closed. With the burner switch in auto the burner will fire off and control temperature to the Setpoint.

CPH < HMAX This checks the outside humidity to determine if the outside air is dry enough to bring in during the burner operation. The fresh air doors will be modulated to control the humidity to the Humid Setpoint. If the CPH is not less than HMAX then the fresh air doors will remain closed.

MOD DOORS WITH HUMIDITY PID When in the burner mode and the outside air is dry enough the system will modulate the fresh air doors to control the humidity to the Humid Setpoint.

9.2

If the Cure switch is off then the system will switch to the COOLING MODE part of the flow chart.

REF ONLY TIME CLOCK If the time clock is set to REF Only then the system will switch to Refrigeration and not run in Cooling. The time clock should be set to Cooling or Run for normal operation.

OSA < START TEMP This decision will take the system to either Refrigeration or Cooling. If the outside temperature is not less than the start temperature, then the system will try and run in refrigeration. Cooling air will be available if the outside air is less than the start temperature.

REFRIGERATION BRANCH

RUN ONLY TIME CLOCK For the refrigeration to run the time clock must be in the Run mode. If not the system will go into STANDBY.

REFRIG SW AUTO If the refrigeration switch is in auto then the system will run in refrigeration, if not then it will go to the timed mode and reticulate the air.

COOLING BRANCH

STANDBY TIME CLOCK If the time clock is set to standby the system will stop and go to standby.

CPH < HMAX The system will now check the outside humidity to see if it is dry enough. The CPH is the calculated plenum humidity. When the outside humidity is warmed up to the plenum temperature it will be dryer. The HMAX is the desired highest plenum humidity. If the CPH is less than the HMAX then the cooling branch will be followed. If not then the system will go to Refrigeration.

BURNER SW AUTO If the burner switch is in auto then the system will consider if it needs to dehumidify. With the switch off the system will go straight to Cooling.

DEHUMID MODE This branch looks to see if the system is already in a dehumid mode, if so it will look to see if it can terminate the dehumidification.

RTN H > HSP If the return humidity is less than the humidity setpoint then the system will continue in the cooling mode. Once the return humidity is greater than the humidity setpoint then the outside air will be check to see if it is cold enough. In order to dehumidify the outside air must be cool enough that it can be warmed up to dehumidify.

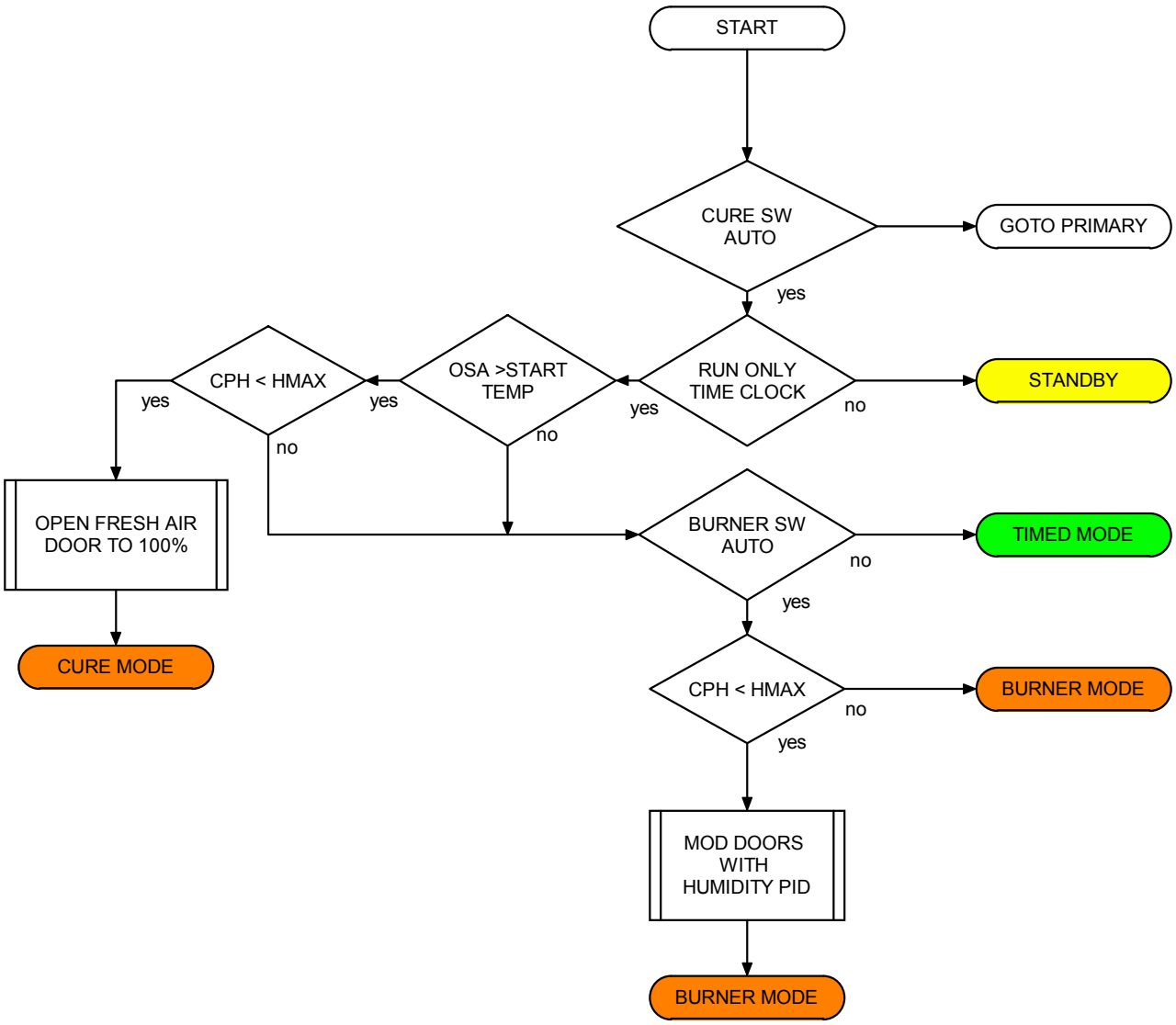
OSA < SP - De_diff The system will check and see if the outside air is less than the setpoint minus the dehumidify differential. A typical setting for the dehumidify differential would be 5 degrees. When the outside air is cool enough then the system will go into dehumid mode. In the dehumid mode the burner will fire on a low setting. The fresh air doors will continue where they were to control plenum temperature to setpoint. The low bruner firing rate will cause the doors to open and bring more fresh dry air in. If the outside air is to warm then the system will go back to the cooling mode.

RTH H => HSP The system will terminate the dehumid mode when the return humidity drops below the humidity setpoint.

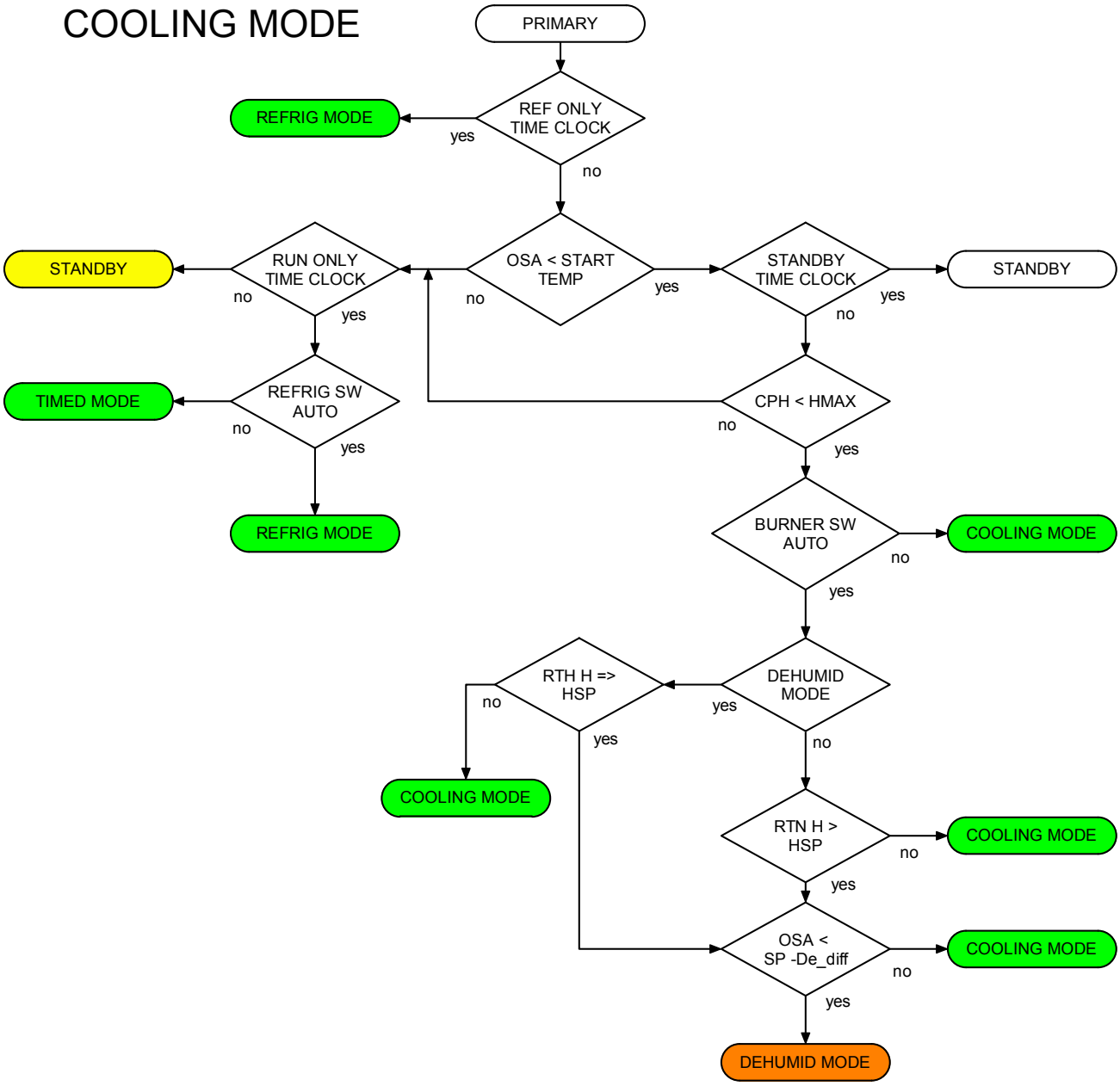
See Onion Flow Chart on the following pages:

9.3 XT ONION FLOW CHART
ver 1.6 8-13-07

CURE MODE



COOLING MODE



APPENDIX A: XT RECORDS FORMAT

General:

The XT-70 control panel up to 25 parameters to be chosen to use for records. Not only can the specific parameters to use be chosen, but so can the order of the records. The XT-70 will save 78,000 records and then will rollover when full by deleting the oldest record and replacing it with a new one. The records can be downloaded from a web browser or from the HMI. When downloaded with a web browser, they are loaded into a spreadsheet. It is also possible to access the data directly from a pre-setup template.

The XT-70 will also store refrigeration records for up to ten devices. The ten devices can be any combination of CR and ER cards. It will store up to 17000 records for each device. The records will also rollover when the slot is filled. They can be downloaded like the XT records.

The records are composed of both a historical averaged record and also an activity log. The time for the historical averaged record can be set. The activity log record will be generated any time there is a mode change. The activity record is not averaged and is an instantaneous record.

Records Setup:

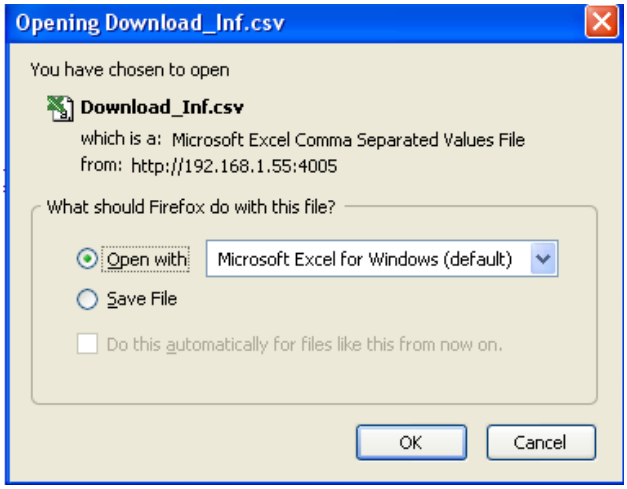
The format of the records is controlled by a CSV file that can be edited in Excel. This file will also allow the changing of the names of the pile sensors and the humidity and CO_2 sensors. There are numerous files already built that can be used and modified. These files are available on the BTU Tech website.

At any time, it is possible to download the existing file that the XT panel is using and make changes to it.

Access the panel via the webpage and click on 

On the Configuration page, click on Inf Manager

Now click on Download Current Card Configuration File



Click on OK and the file will open in Excel.

Click on File> Save As.. and use a name that will describe the panel. Changes can now be made. When done, save the file and upload it back into the panel.

The following shows the format of the CSV file. The sensors highlighted in yellow can be named. The record index refers to the order in which the values will appear in the records. All record index fields must have a value. If not being used, then insert a zero.

[XT_INF_01]		TERMINAL LABLE
[XT]		
<Plenum T - reference only>	<record index>	
<Start - reference only>	<record index>	
<Outside T - reference only>	<record index>	
<Return T - reference only>	<record index>	
<Pile 1 - **configurable**>	<record index>	AN5
<Pile 2 - **configurable**>	<record index>	AN6
<Pile 3 - **configurable**>	<record index>	AN7
<Pile 4 - **configurable**>	<record index>	AN8
<Pile 5 - **configurable**>	<record index>	AN9
<Pile 6 - **configurable**>	<record index>	AN10
<Pile 7 - **configurable**>	<record index>	AN11
<Pile 8 - **configurable**>	<record index>	AN12
<Outside H - **configurable**>	<record index>	H1
<Plenum H - **configurable**>	<record index>	H2
<CO2 level - **configurable**>	<record index>	H4
<Door Open - reference only>	<record index>	
<Operation Mode - reference only>	<record index>	
<Secondary Mode - reference only>	<record index>	
<Refrig Output - reference only>	<record index>	
<switch status 1 - reference only>	<record index>	
<switch status 2 - reference only>	<record index>	
<switch status 3 - reference only>	<record index>	
<output status - reference only>	<record index>	
<Return H - **configurable**>	<record index>	H3
<Freq Drive Current - reference only>	<record index>	
<Daily Run - reference only>	<record index>	
<CPH - reference only>	<record index>	
<Pile T - reference only>	<record index>	
<Pile H - reference only>	<record index>	
<setpoint - reference only>	<record index>	
<target - reference only>	<record index>	
<CO2 SP - reference only>	<record index>	
<humid sp - reference only>	<record index>	
<cooling sp - reference only>	<record index>	
<refrig sp - reference only>	<record index>	
<timed sp - reference only>	<record index>	

CSV Example:

Highlighted names can be changed to any name you want, with a ten character maximum.

[XT_INF_01]	
[XT]	
PLENUM T	4
START	5
OUTSIDE T	6
RETURN T	7
NE	8
NW	9
SE	10
SW	11
Middle E	12
Middle	13
Center	0
Unused	0
OSA H	14
PLEN H	15
CO2	17
DOOR OPEN	18
OPERATION MODE	1
SECONDARY MODE	2
REFRIG OUTPUT	19
SWITCH STATUS 1	20
SWITCH STATUS 2	0
SWITCH STATUS 3	0
OUTPUT STATUS	21
RTN H	16
FREQ DRIVE CURRENT	0
DAILY RUN	0
CPH	0
PILE T	0
PILE H	0
SETPOINT	3
TARGET	0
CO2 SP	0
HUMID SP	0
COOLING SP	0
REFRIG SP	0
TIMED SP	0

The numbers refer to the order of the records. In this example, the operation mode will be the first value, then the secondary mode, setpoint and so on.

Timestamp	OPERATION MODE	SECONDARY MODE	SETPOINT	PLENUM T	START	OUTSIDE T
4/2/2009 0:00	WARMING		39.7	40.2	60.1	91.9

Refrigeration records:

[CARD_1]	
	1
Discharge Pressure	1
Suction Pressure	2
Suction Super Heat	3
Amps	0
Output	4
Mode	5
Lead Compressor	6
Suction Temp	7
Discharge Temp	0
[CARD_2]	
	1
Discharge Pressure	1
Suction Pressure	2
Suction Super Heat	3
Amps	0
Output	4
Mode	5
Lead Compressor	6
Suction Temp	7
Discharge Temp	0
[CARD_3]	
	2
Suction Press A	5
Suction Temp A	6
Suction Press B	7
Suction Temp B	8
Super Heat SP	2
Super Heat A	3
Super Heat B	4
Valve pos A	9
Valve pos B	10
Mode	1

The refrigeration records are laid out in the same CSV file as the XT records. There can be up to ten devices and can be cut and paste to match up to the system. All cards must be in order, starting with Card 1. Below each card, identify the card type. 1 = CR-110 and 2 = ER-110 (required).

The numbers will set the order in which the values will appear.

Once the file is set as desired, then save it as a CSV file and use a name that references the given panel. Now upload the new file to the XT panel. Generally, when changes are made to this file, the records should be cleared.

Records Request:

There are a number of ways to retrieve the records from the XT. The first and easiest way it to use the web interface and select the desired date.

Any start date and ending date that has valid records can be entered. The start date begins at midnight. Thus, if today is the 4/2/09 and only today's records are wanted, use a start date of 4/2/09 and an end date of 4/3/09.

When Retrieve records is clicked on, a choice is given to save the records or to open them in a spreadsheet.

The next way to get records involves using a host of other applications to download the records. This could be a database, a spreadsheet or a custom program. Any records request involves the IP address of the panel.

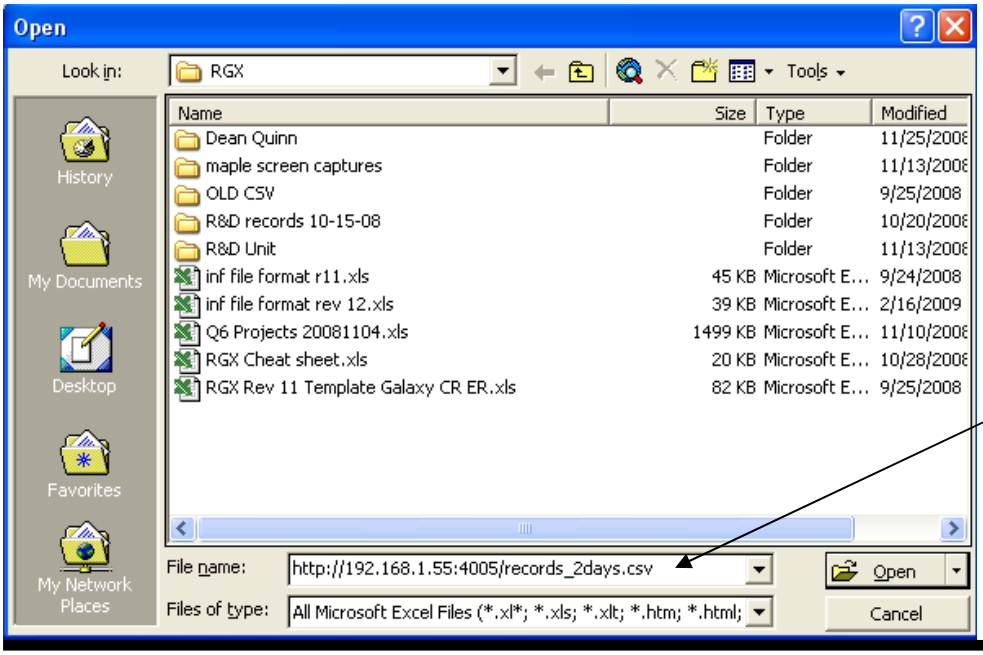
There is a variable format that would allow one to automatically pull records from any date and there is also a two day and a seven day fixed dump of records. The two day and seven day format are addressed here first.

The format for the last two days records is http://<ip address>/records_2days.csv

The format for the last seven days records is http://<ip address>/records_7days.csv

For example, to retrieve the last two days of records for an XT-70 panel at 192.168.1.55 at HTTP port 4005, the request would be: http://192.168.1.55:4005/records_2days.csv

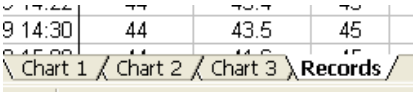
To load these records in an Excel spreadsheet, do a file open and use that address for the "File name:" field.



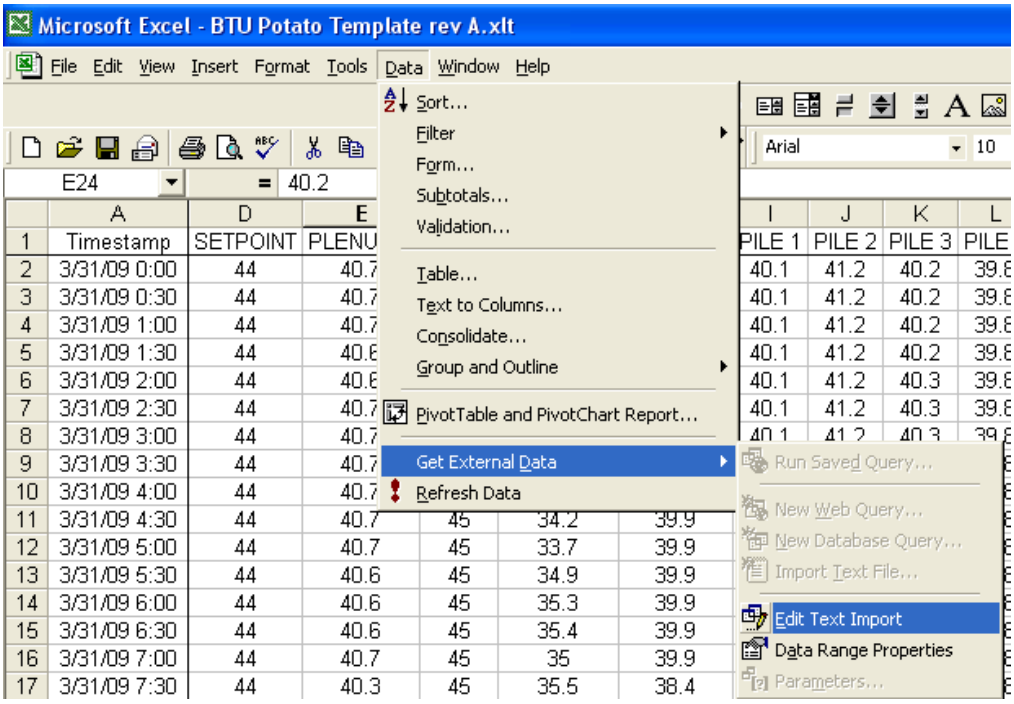
The XT panel acts much like a hard-drive. The difference is that the address or path is via the internet to gain access the XT.

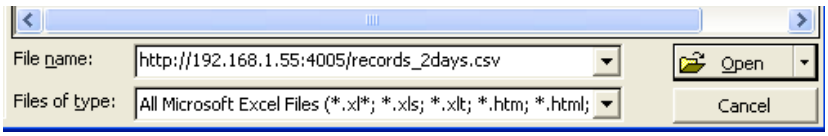
Two day and Seven day Templates:

The purpose of a template is to set up some predefined graphs and to be able to instantly download the data and apply it to the graphs. Excel allows one to build and save templates. Excel's normal file extension is xls. An Excel Template will have an extension of xlt. With a Template, one can set up graphs and different displays which will automatically load the data for the last two days or seven days when the spreadsheet is opened. The best way to start is with the BTU Potato Template.xlt file. Open this file (it may take a while to timeout if it is not pointed toward any data). The first thing to do is to point it toward the correct XT panel. To do this, click on the Record Tab at the bottom.



Click on any cell, then go Data> Get External Data> Edit Text Import.





Type in the IP address of the panel using the colon between the IP number and the HTTP port number. Records for either the last two days or seven days can be chosen here.

Click on Open and the file should load the new data for the last two or seven days.

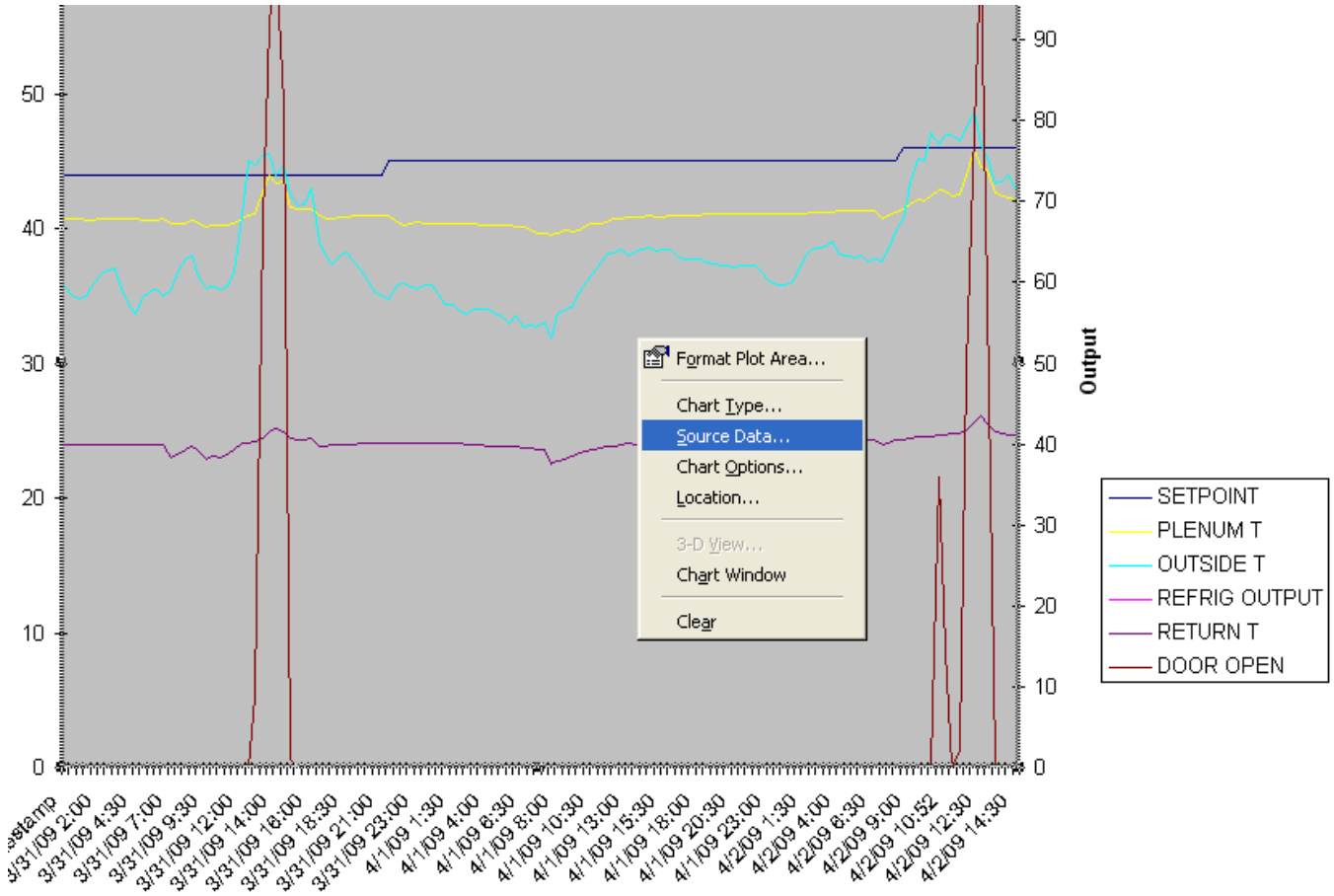
Do a Save As on this file and name it according to the panel name. Make sure that the file extension yis for a template (xlt) and not a worksheet (xls).

Now any time this file is opened, the last two days of data will automatically be loaded.

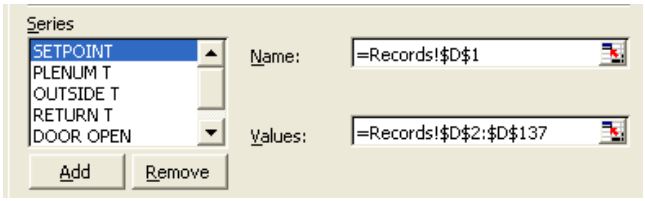
Excel Graphs & Templates:

The main part of the template is to get the data to load into the records page. The trick is that the exact number of records is unknown. Thus when the graphs are set up, they have to be inclusive of just the data. The BTU template can easily be modified it for a specific application.

Chart 1 is a dual axis graph and has temperatures on the left side and output percentage on the right side.



To make a change to the parameters being graphed, right click on the graph and select Source Data. Remove parameters by clicking on the parameter and then Remove. To change a parameter, select the parameter, determine which column the needed parameter is in and then change the alpha character in both the Name and Values boxes.



To add a button, click on Add. Then go to one of the other sensors and copy the Name string and paste it in to the new one and change the alpha character to match the desired value. Repeat for the Values field.

Getting Date Specific Data:

The second way to download data automatically is by using a date specific format. This will send a beginning date and ending date for the records. The request string would be as follows:

http://<ip address:port #>/records.csv?a=x&b=x&c=x&d=x&e=x&f=x&g=1&h=x

Where

a = record start month
b = record start day
c = record start year
d = record end month
e = record end day
f = record end year

x = value for corresponding variable

g = 1 this variable is only needed if the request is sent by an automated device, i.e. HMI, VPN, etc. It forces the formatting of the CSV to be strictly comma separated values with no other HTTP formatting.

h = 0 to 10 this variable indicates which device the request is for: 0 = XT, 1 to 10 = refrigeration cards

Example: to request records from a panel with an IP address of 192.168.1.55, HTTP port 4005, start date 4-3-09 and end date of 4-4-09, send the following request:

http://192.168.1.55:4005/records.csv?a=4&b=3&c=2009&d=4&e=4&f=2009&g=1&h=0

APPENDIX B:
XT DIAGNOSTICS PORT

General:

The XT Rabbit now contains a routine for doing a diagnostics on the unit. Use the programming cable and any terminal emulator to view the data.

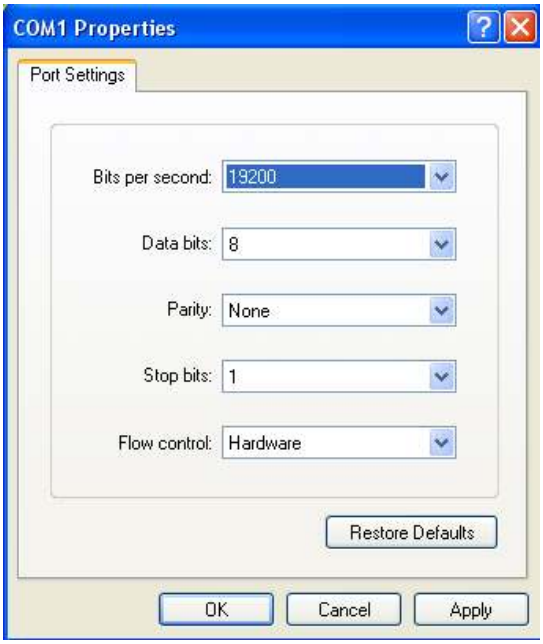
Use the same Rabbit programming cable normally used to program the Rabbit. Normally, the black plug marked PROG is used to plug into the Rabbit and program it. For this test, use the black plug marked DIAG. Power the panel down and plug it on to the Rabbit, with the red stripe down. If using an USB to serial converter, the converter's comport number is needed. Nearly all PC's and laptops today have a program called Hyper Terminal installed. It is located under Start> Programs> Accessories> Communications.

Create a new connection.

Type in a name such as Rabbit Test.

Click on OK

Select the proper Comport for the PC.



Set the Baudrate and other parameters as shown.

Click on OK.

With the cable plugged in and Hyper Terminal connected, power up the XT panel.

The initial string of data will be displayed.

Inside XT Panel Firmware - XT 1.3.1.a
I/O lines configured
OS Initialized
Queue Manager Initialized
Flash Initialized
socket Initialized
http Initialized
Starting OS
Attempting to read Misc Data
Misc Data read from page 1
flash_crc == EF41 calc_crc == EF41
ip address = 192.168.1.55
udp port = 4005
http port = 4005
panel # = 5
Alarm_Settings.crc == D3EE calc_crc == D3EE
flash_crc == D8DA calc_crc == D8DA
HTTP server Initialized
Authorizations Initialized
Record Task is not OK

Some of the valuable parameters displayed are the IP address, the port and the panel number information.

APPENDIX C: XT PURGE CYCLES

Theory

This application note will describe each of the seven purge cycles of the XT-70 panel.

0 = No Purge cycles
1 = Time Purge, no ARL or CO2
2 = ARL (Ambient Reverse Loading), no CO2 or Time Purge
3 = ARL & CO2, no Time Purge
4 = ERV (Energy Recovery Ventilation) no CO2
5 = ERV with CO2
6 = Time Purge / Cooling Purge with CO2 sensor

Application:

Purge_cnfg = 0

No Purge: Fresh air doors only open in the Cooling Mode to control temperature.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 0

Purge_cnfg = 1

Timed Purge: The Time Purge cycle is used when a CO2 sensor is not available for purge initiation.

Four parameters must be set to initiate the time purge. In the above example if the outside air is less than 40 degrees initiate a purge cycle for 15 minutes every 6 hours and set the fans

at 85%. Once the purge is over the fans will go to the previous setting.

If the XT panel is in Refrigeration or a Timed run the XT would pulse the fresh air doors open to the Max Door setting for the length of the purge.

If the XT panel is in Cooling and the Heat Switch is in Auto, the XT panel will turn the Return air heaters on for the duration of the purge.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 1

Purge_cnfg = 2

ARL: (Ambient Reverse Loading) This purge cycle uses the fresh air doors to false load the refrigeration when you have minimum loading and the refrigeration wants to cycle on and off. When the Refrigeration output drops below the minimum Refrig_Level setting, the XT panel will slowly pulse the Fresh Air doors in a Heat PID mode to bring in warm fresh air to keep the Refrigeration system running. The Refrigeration system will run at the minimum setting and the doors will modulate in a heat mode to control temperature. The doors can only open to the Max Door Setting. The ARL mode will not only keep the refrigeration running, but will purge the storage by bringing in fresh air after long runs of refrigeration. The ARL function is primarily used in the spring when the refrigeration load is light.

The Outside air temperature must be above the start temperature for the ARL to become active. Under some conditions it may be necessary to raise the start temperature to ensure the outside air is warm enough. This can be done using the OSA Diff setting. To protect against the OSA not being warm enough, the parameter LC (low cutout) is used. This is in 1/10ths of a degree and would have a default of 5.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 2

Ref_Level (ROL) *default setting = 30%*

ROL_Diff *default setting = 5%*

Low_Cutout *default setting = 5 tenths of a degree*

Max_Door *default setting = 20%*

ROL_Start_Dly default setting = 10 minutes

Set the following Main Flash parameters:

OSA DIFF this parameter is used to adjust the Start Temp. A suggested value for running ARL would be +5 degrees.

Purge_cnfg = 3

ARL / CO2: (Ambient Reverse Loading with a CO2 Sensor)

This configuration uses the same logic as the ARL purge_cnfg = 2. In addition to the ARL, this configuration uses a CO2 sensor to trigger a purge and monitor the CO2 levels during the ARL cycle. The ARL is active only during the Refrigeration cycle, but the CO2 purge can take place either in Cooling or Refrigeration. For the CO2 purge to become active, the CO2 must be greater than the CO2 SP. If the system is in Cooling and the Heat Switch is in Auto, then the Return air heater will turn on and force the fresh air doors open to purge the system. The heaters must be sized as to not raise the return air more than 3 degrees. The doors should open somewhere between 20 to 30%.
If the system is running in Refrigeration, the CO2 purge will become active when the CO2 level is greater than the CO2 SP. When this happens the doors will slowly open and the Refrigeration will continue to maintain temperature. Once the CO2 level has dropped below the Setpoint minus the CO2_Diff, the doors will slowly close.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 3

Ref_Level (ROL) default setting = 30 %

ROL_Diff default setting = 5 %

Low_Cutout default setting = 5 tenths of a degree

Max_Door default setting = 20 %

ROL_Start_Dly default setting = 10 minutes

CO2_Diff default setting = 200 ppm

CO2_RAS default setting = 5 tenths of a degree

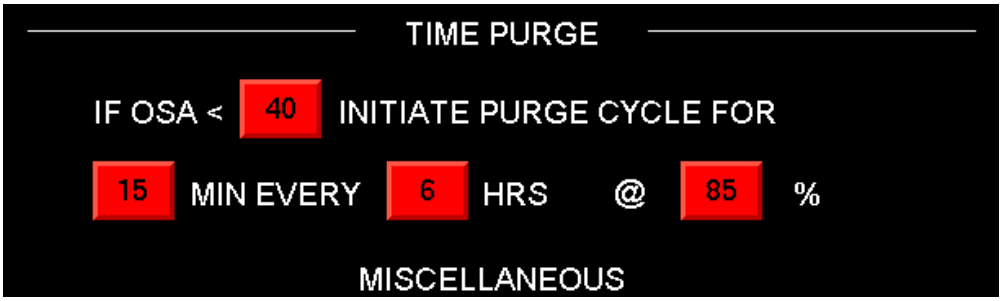
Set the following Main Flash parameters:

OSA DIFF *this parameter is used to adjust the Start Temp. A suggested value for running ARL would be +5 degrees.*

CO2 SP *this is the CO2 Setpoint. A suggested value would be 2000 ppm.*

Purge_cnfg = 4

ERV: (Energy Recovery Ventilator) The ERV purge uses a ventilator that will bring in fresh air. This configuration operates without a CO2 sensor, so it must trigger strictly on Time. The Aux 1 switch must be set to control the ventilator and must be in Auto. Four parameters must be set to initiate the ERV purge.



Example: ***(Buttons are main flash parameter that need to be set)***

If the outside air is less than 40 degrees, initiate a purge cycle for 15 minutes every 6 hours with fans at 85%. The fans will return to previous setting after purge.

If the XT panel is in Refrigeration or a Timed Run, the XT will turn the ventilator on. This purge does not activate if the panel is in Cooling.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 4

Aux 1_Config = 1

Purge_cnfg = 5

ERV / CO2: (Energy Recovery Ventilator with CO2 Sensor) The ERV purge uses a ventilator

that will bring in fresh air. This configuration operates with a CO2 sensor. This purge will work in either a Time or Refrigeration mode. The Aux 1 switch must be configured to control the ventilator and be set to Auto. If the CO2 level is greater than the CO2 SP, then the ventilator will be turned on. The ventilator will turn off when the CO2 level is below the CO2 SP - CO2 Diff.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 5

Aux 1_Config = 1

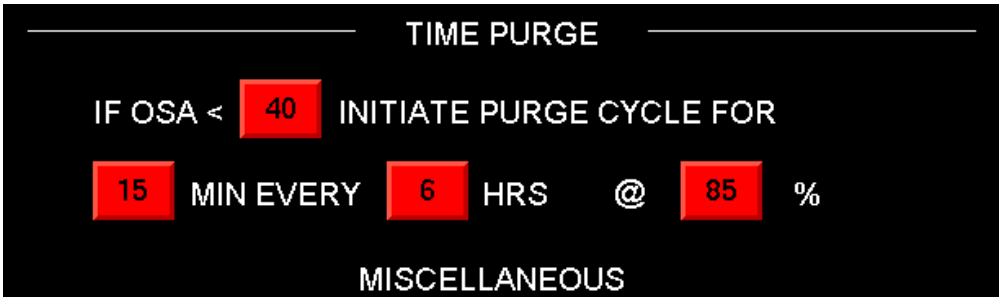
CO2_Diff *default setting = 200 ppm*

Set the following Main Flash parameters:

CO2 SP *this is the CO2 Setpoint. A suggested value would be 2000 ppm.*

Purge_cnfg = 6

Timed / CO2 Purge: This parameter is used when you do not have refrigeration but desire to recirculate the air when there is no cooling air available. A CO2 sensor is required and will be used to trigger the purge cycle. If you are in Cooling mode and the CO2 level is greater than the CO2 SP, the purge cycle will be activated. The Heat switch must be in Auto and the Return air heaters will then be turned on. The heaters must be sized as to not raise the return air more than 3 degrees. The doors should open somewhere between 20 to 30 %.
If the system is running in Timed Run mode, then the purge will be triggered by both time and CO2.



Example: ***(Buttons are main flash parameter that need to be set)***

If outside air is less than 40 degrees, initiate a purge cycle for 15 minutes every 6 hours and run the fans at 85%. If the XT panel is in cooling, the return air heaters will be turned on for

the duration of the purge cycle. In a Timed Run the fresh air doors would be open to the Max Door setting.

To use this configuration, set the following E2 parameters:

Purge_Cnfg = 6

Max_Door *default setting = 20 %*

Set the following Main flash parameters:

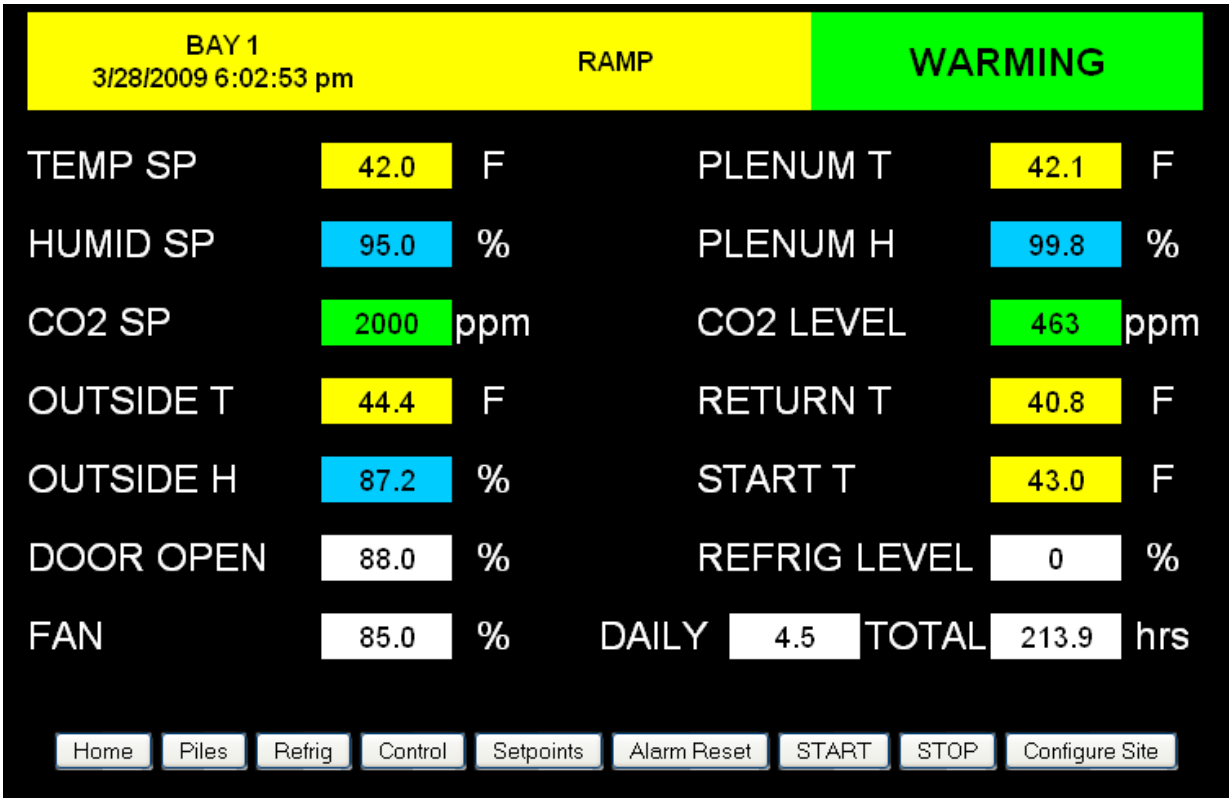
CO2 SP *this is the CO2 Setpoint. A suggested value would be 2000 ppm.*

APPENDIX D: XT WARMING MODE

The XT Warming mode is used to warm up product, particularly seed. The Warming mode uses the outside air when it is warm enough to warm the plenum to the desired setpoint. Caution should be used with the warming mode. In the warming mode, the PID is reversed and the fresh air doors are opened to bring in warm air if the plenum is below the setpoint. The Warming mode is only available if the outside air is above the start temperature. If the outside air is below the start temperature, the system will run in Cooling mode. The outside air differential may need to be adjusted positive to ensure the air is warm enough outside. In most cases, the cell would be shut off so that there was no evaporative cooling.

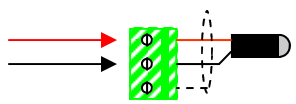
To activate the Warming mode, change Aux2_cfg in the E2 memory parameters to equal 188. The Aux 2 switch will then control the WARMING mode. If the Aux 2 switch is in the Off position, the panel will run normally. Switching the Aux 2 to Auto will activate the Warming mode.

For normal operation, set the Aux 2 config equal to zero.



APPENDIX E: SENSOR MEASUREMENTS

VDC

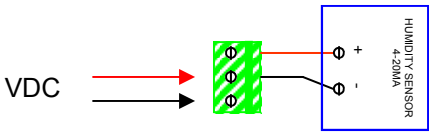


TEMP	RES	VDC	TEMP	RES	VDC	TEMP	RES	VDC
-76	283166	4.052	-33	59381	3.893	10	14228	3.365
-75	275825	4.051	-32	57036	3.885	11	13787	3.346
-74	268483	4.049	-31	54690	3.877	12	13345	3.326
-73	261142	4.048	-30	53042	3.871	13	12904	3.305
-72	253800	4.047	-29	51394	3.864	14	12463	3.282
-71	246459	4.045	-28	49747	3.856	15	12137	3.265
-70	239117	4.044	-27	48099	3.849	16	11812	3.247
-69	231776	4.042	-26	46451	3.841	17	11487	3.228
-68	224434	4.040	-25	44804	3.832	18	11161	3.208
-67	217093	4.039	-24	43156	3.822	19	10836	3.187
-66	209751	4.037	-23	41508	3.812	20	10511	3.165
-65	202410	4.034	-22	39860	3.801	21	10186	3.143
-64	195068	4.032	-21	38692	3.793	22	9860	3.119
-63	187727	4.030	-20	37524	3.784	23	9535	3.093
-62	180385	4.027	-19	36356	3.775	24	9293	3.074
-61	173044	4.024	-18	35187	3.765	25	9051	3.053
-60	165702	4.021	-17	34019	3.755	26	8808	3.032
-59	158361	4.018	-16	32851	3.744	27	8566	3.010
-58	151019	4.014	-15	31682	3.732	28	8324	2.987
-57	146020	4.011	-14	30514	3.719	29	8082	2.963
-56	141020	4.008	-13	29346	3.706	30	7839	2.938
-55	136021	4.005	-12	28515	3.696	31	7597	2.912
-54	131021	4.002	-11	27685	3.685	32	7355	2.884
-53	126022	3.998	-10	26854	3.673	33	7173	2.863
-52	121022	3.994	-9	26024	3.661	34	6992	2.841
-51	116023	3.990	-8	25193	3.649	35	6810	2.818
-50	111024	3.985	-7	24363	3.635	36	6628	2.794
-49	106024	3.980	-6	23532	3.621	37	6447	2.769
-48	102666	3.976	-5	22702	3.605	38	6265	2.743
-47	99308	3.972	-4	21871	3.589	39	6083	2.716
-46	95950	3.968	-3	21267	3.576	40	5902	2.688
-45	92592	3.964	-2	20663	3.563	41	5720	2.659
-44	89234	3.959	-1	20059	3.549	42	5582	2.637
-43	85876	3.954	0	19455	3.535	43	5445	2.613
-42	82518	3.948	1	18851	3.519	44	5307	2.589
-41	79160	3.942	2	18247	3.503	45	5170	2.564
-40	75802	3.936	3	17643	3.486	46	5032	2.538
-39	73456	3.931	4	17039	3.467	47	4894	2.511
-38	71111	3.925	5	16435	3.448	48	4757	2.483
-37	68765	3.920	6	15994	3.433	49	4619	2.454
-36	66419	3.914	7	15552	3.417	50	4481	2.424
-35	64073	3.908	8	15111	3.401	51	4377	2.401
-34	61727	3.901	9	14670	3.383	52	4272	2.377

TEMP	RES	VDC	TEMP	RES	VDC	TEMP	RES	VDC
53	4167	2.352	96	1441	1.303	139	573	0.641
54	4062	2.326	97	1411	1.284	140	560	0.629
55	3957	2.300	98	1380	1.265	141	550	0.619
56	3852	2.273	99	1350	1.246	142	540	0.609
57	3748	2.245	100	1320	1.226	143	530	0.600
58	3643	2.216	101	1290	1.206	144	520	0.590
59	3538	2.186	102	1260	1.186	145	510	0.580
60	3457	2.163	103	1230	1.166	146	499	0.570
61	3377	2.139	104	1199	1.145	147	489	0.560
62	3296	2.114	105	1175	1.129	148	479	0.550
63	3216	2.089	106	1151	1.112	149	469	0.540
64	3135	2.063	107	1128	1.095	150	461	0.531
65	3054	2.036	108	1104	1.078	151	452	0.523
66	2974	2.009	109	1080	1.061	152	444	0.515
67	2893	1.981	110	1056	1.043	153	436	0.506
68	2813	1.952	111	1032	1.025	154	427	0.498
69	2750	1.929	112	1008	1.007	155	419	0.489
70	2688	1.906	113	984	0.989	156	411	0.481
71	2626	1.882	114	965	0.974	157	403	0.472
72	2564	1.857	115	945	0.960	158	394	0.464
73	2501	1.832	116	926	0.945	159	388	0.456
74	2439	1.807	117	907	0.929	160	381	0.449
75	2377	1.781	118	888	0.914	161	374	0.442
76	2314	1.754	119	869	0.899	162	367	0.435
77	2252	1.727	120	850	0.883	163	360	0.428
78	2203	1.705	121	830	0.868	164	354	0.421
79	2155	1.683	122	811	0.852	165	347	0.413
80	2106	1.660	123	796	0.839	166	340	0.406
81	2058	1.637	124	780	0.826	167	333	0.399
82	2009	1.614	125	765	0.813	168	328	0.393
83	1960	1.590	126	750	0.800	169	322	0.387
84	1912	1.566	127	734	0.786	170	316	0.381
85	1863	1.541	128	719	0.773	171	311	0.374
86	1815	1.515	129	703	0.759	172	305	0.368
87	1776	1.495	130	688	0.746	173	300	0.362
88	1738	1.475	131	672	0.732	174	294	0.356
89	1700	1.454	132	660	0.721	175	288	0.350
90	1662	1.433	133	648	0.710	176	283	0.343
91	1624	1.411	134	635	0.698	177	278	0.338
92	1586	1.389	135	623	0.687	178	274	0.333
93	1547	1.367	136	610	0.675	179	269	0.328
94	1509	1.344	137	598	0.664	180	264	0.323
95	1471	1.321	138	585	0.652	181	260	0.318

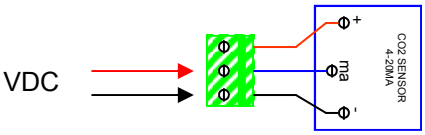
Convert VDC to Humidity

Humidity % = (VDC - .8)*31.25



Convert VDC to CO_2

CO_2 ppm = (VDC - .8)*3125



APPENDIX F: CO_2 MANAGEMENT

CO_2 buildup to levels higher than the control system setpoint is detrimental to the health of stored potatoes and can be caused by a number of things. Lack of fresh air is the primary factor, while temperature and product condition are contributing factors. Corrective action involves flushing or purging the storage with fresh air until CO_2 levels return to acceptable levels. For energy conservation reasons, it is important to initiate CO_2 control before levels get too high.

COOLING CO_2 CONTROL:
How CO_2 buildup is alleviated depends on the mode of operation of the XT control system. During Cooling mode, CO_2 buildup becomes a problem when outside air temperatures drop to lower extremes and fresh air intake is minimal. Typically, more fresh air is required to purge the excess CO_2 at times when less outside air is required to maintain system temperature at setpoint.

The XT control system addresses this problem in the following manner. In Cooling mode, when CO_2 levels rise above setpoint, a return air heater is activated to raise the return air temperature. Simultaneously, fresh air doors are pulsed open to introduce cooler outside air. This accomplishes two things: the cooler air counteracts the temperature rise caused by the heater while maintaining system temperature at setpoint and, at the same time, provides fresh air to purge the excess CO_2. The return air heater will remain on until the CO_2 level is 200 ppm below the system CO_2 setpoint. When that occurs, the heater will shut down and the fresh air doors will pulse closed to maintain system temperature at setpoint. This cycle could last for up to 20 minutes and could repeat every three to four hours for as long as outside temperatures are at lower extremes.

If the storage has been shutdown for an extended period of time, and CO_2 levels are very high, fan speed may need to be increased for a period of time to expedite flushing of the CO_2 to a more controllable level.

REFRIGERATION CO_2 CONTROL:
CO_2 levels will climb during periods of prolonged refrigeration which necessitates a different flushing strategy than that used in the cooling mode. The XT control system was designed with the ability to control fresh air door position concurrent with refrigeration control. This allows management of CO_2 by modulating fresh air doors to control CO_2 and modulating refrigeration to control temperature.

REFRIGERATION FALSE LOADING:
For a number of years, the conventional strategy was to use evaporator hot gas bypass to false load the coil and keep the refrigeration system running during periods of light loads. This is an effective way of loading the refrigeration system but it does nothing to alleviate CO_2 buildup. The XT control system has the ability to control false loading by introducing warmer fresh air through modulation of the fresh air doors while simultaneously purging the storage of CO_2.

Pertinent system parameters are:

Refrig. Min. Run Time When outside air and evaporative cooling is no longer effective due to outside air temperature and/or humidity, the control system will switch to refrigeration mode. This is the minimum time that the refrigeration system must run before the control system can revert back to Cooling mode.

Pulse Width Amount of time, in milliseconds, for each door open or close pulse.

Update Time Amount of time, in seconds, between each door open or close pulse.

Door Time Average, in seconds, of the time it takes the fresh air door to travel from full closed to full open and from full open to full closed. This average time is used to determine door position if the system is not equipped with BTU SDX (Smart Door Controls).

Max Door Open Maximum allowable door opening, in percent, during CO_2 control. It is critical that the fresh air door opening be limited during the refrigeration mode to avoid blocking return air to the coils.

Refrig Operating Level This is the lowest output level, in percent, that the refrigeration system should operate at. If the operating level is below this setting, the fresh air doors will gradually pulse open to false load the refrigeration system until the refrigeration level is above the ROL setting.

Plenum Rise Maximum allowable increase, in degrees F, of the plenum temperature above setpoint, when bringing in fresh air during Refrigeration mode. Typically set to 0.5° F.

CO_2 MANAGEMENT & REFRIGERATION CONTROL FLOW CHART:

Cooling Mode CO_2 Management

If the XT control system is in Cooling mode, the CO_2 level rises above the CO_2 setpoint and the heat switch is in Auto, the return air heater is turned on. The heater will remain on until the CO_2 level falls 200 ppm below the CO_2 setpoint.

Refrigeration CO_2 Management

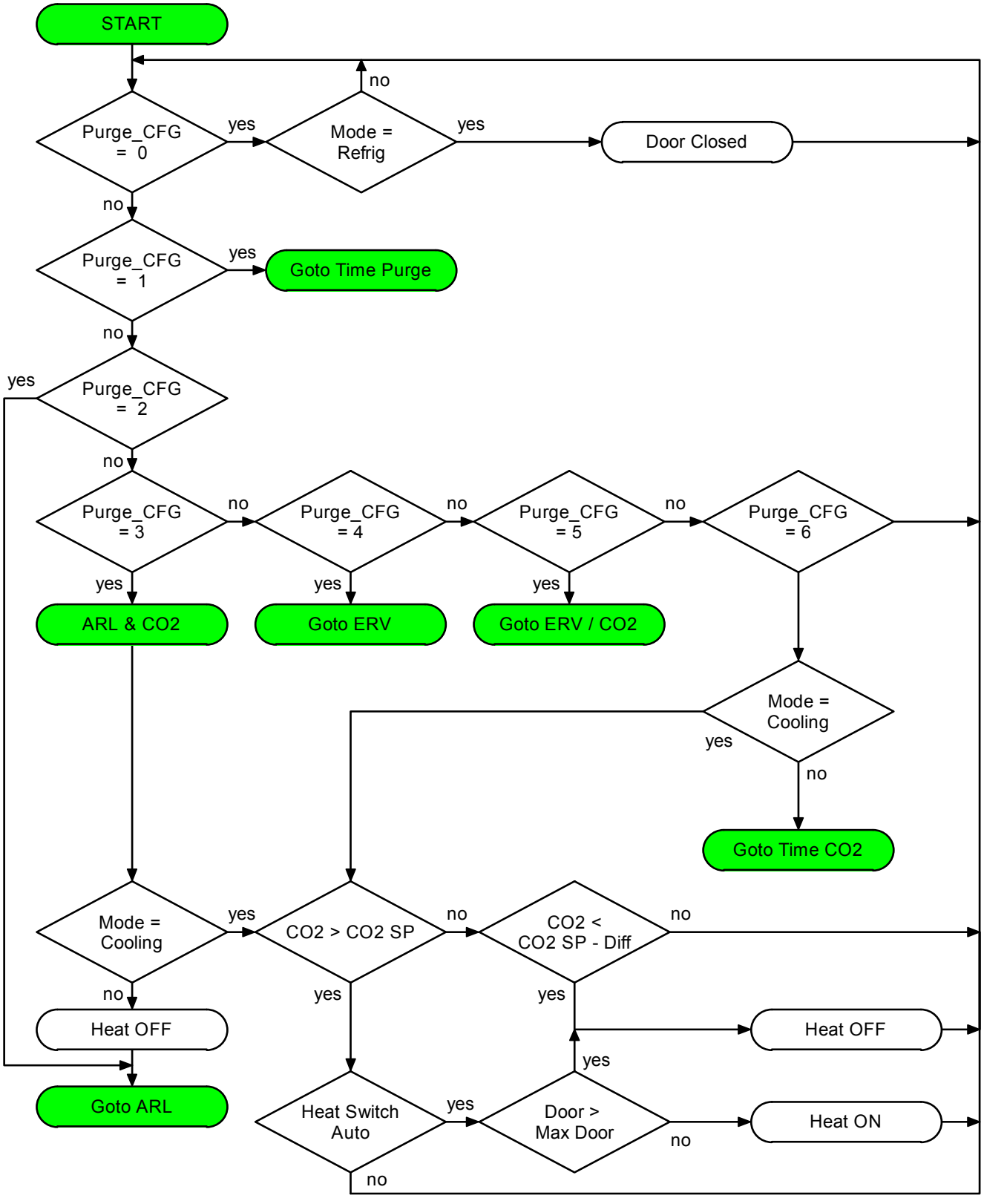
The refrigeration minimum run time must elapse before CO_2 control is initiated.

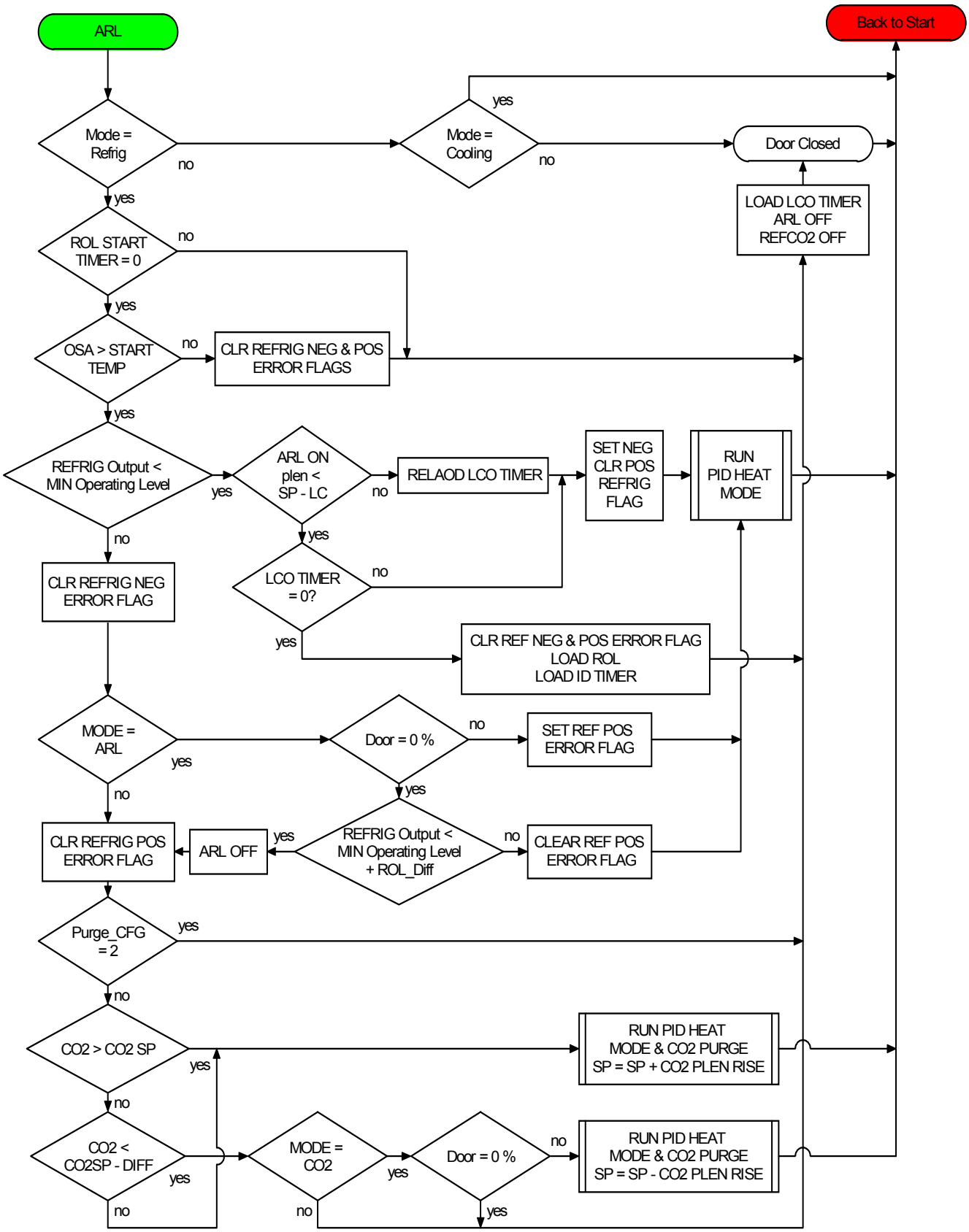
If the refrigeration system is operating below the refrigeration operating level (ROL) setting and the plenum temperature is below the allowable plenum rise, the fresh air doors will pulse open. This introduces warmer fresh air into the storage, ensuring the refrigeration system is operating above the ROL setting. The maximum door open setting establishes a maximum allowable door opening, in percent, to prevent low return air flow through the refrigeration evaporator coils. This operational strategy helps prevent the refrigeration equipment from cycling on and off and allows fresh air exchange during the refrigeration mode.

If the refrigeration system is operating above the ROL setting, the XT control system checks to see if the CO_2 level is above the CO_2 setpoint. If CO_2 levels are above setpoint, the plenum temperature is not above the plenum rise, and the door output is below the maximum door setting, the door will receive a open pulse.

If at any time the plenum rise is exceeded, the door will receive a close pulse.

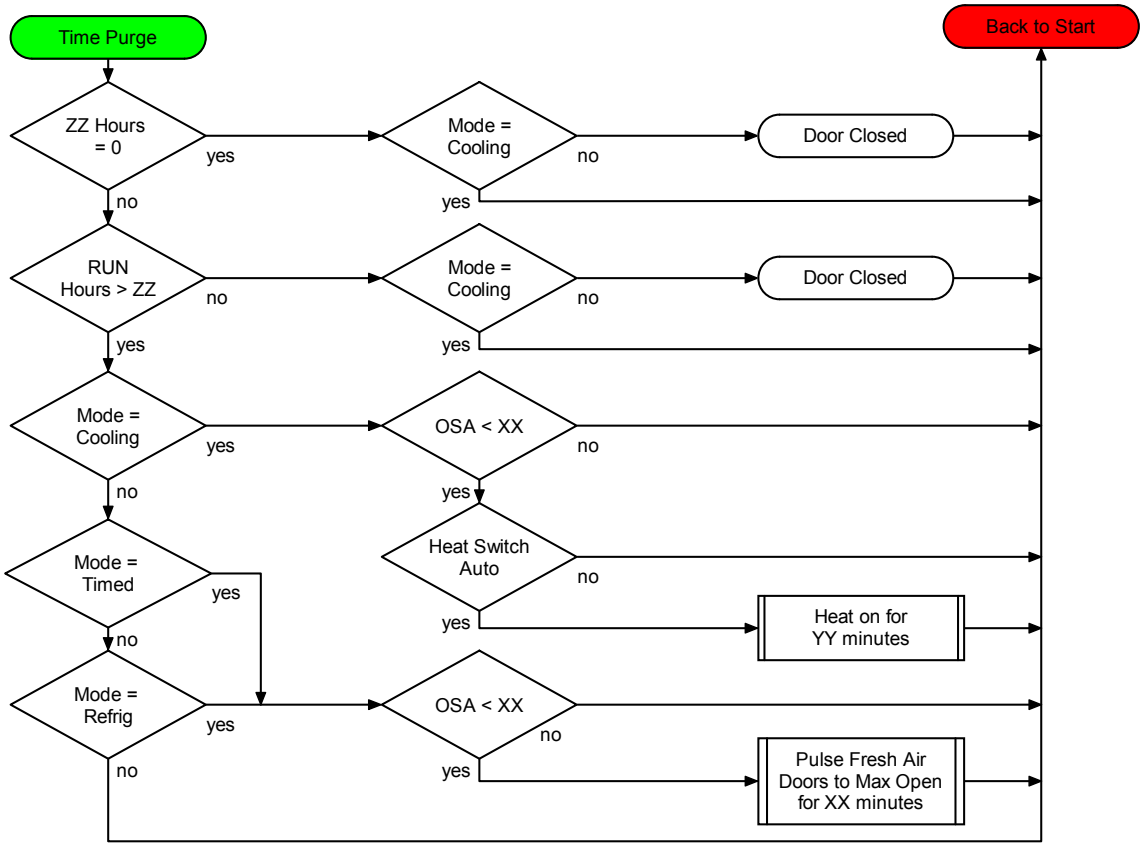
When the CO_2 level drops 200 ppm below the CO_2 setpoint, the door will receive a close pulse.

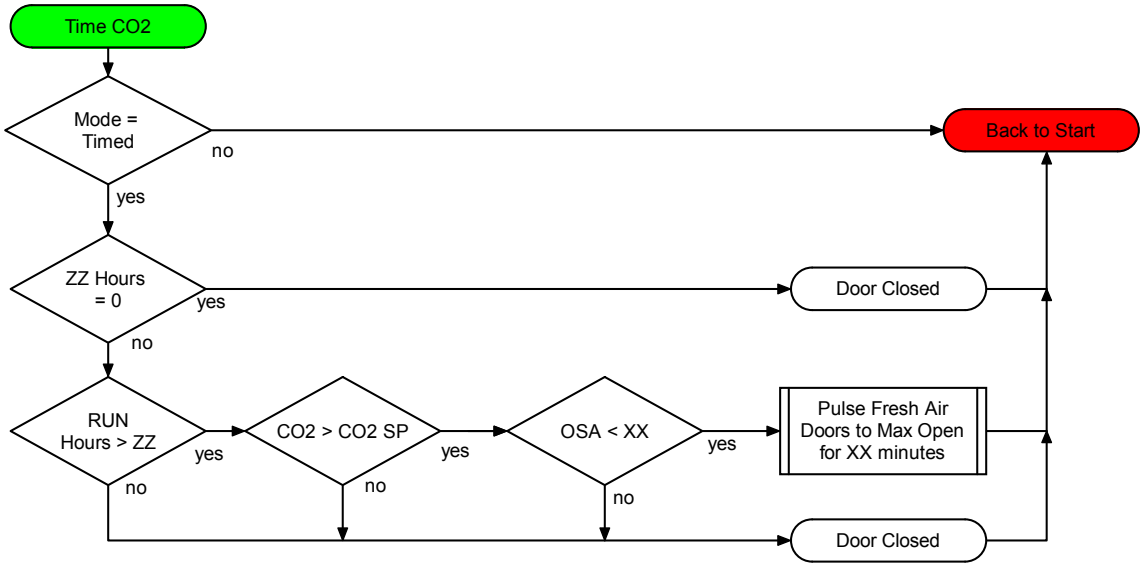

START
Purge_CFG = 0
yes
Mode = Refrig
yes
Door Closed
no
no
Purge_CFG = 1
yes
Goto Time Purge
no
yes
Purge_CFG = 2
no
Purge_CFG = 3
no
Purge_CFG = 4
no
Purge_CFG = 5
no
Purge_CFG = 6
yes
ARL & CO2
yes
Goto ERV
yes
Goto ERV / CO2
Mode = Cooling
yes
no
Goto Time CO2
Mode = Cooling
yes
CO2 > CO2 SP
no
CO2 < CO2 SP - Diff
no
no
Heat OFF
yes
yes
Heat OFF
yes
Goto ARL
Heat Switch Auto
yes
Door > Max Door
Heat ON
no
no


ARL
Back to Start
Mode = Refrig
no
yes
Mode = Cooling
yes
no
Door Closed
LOAD LCO TIMER
ARL OFF
REFCO2 OFF
ROL START TIMER = 0
no
yes
OSA > START TEMP
no
yes
CLR REFRIG NEG & POS ERROR FLAGS
REFRIG Output < MIN Operating Level
yes
no
ARL ON plen < SP - LC
no
yes
RELAOD LCO TIMER
SET NEG CLR POS REFRIG FLAG
RUN PID HEAT MODE
CLR REFRIG NEG ERROR FLAG
LCO TIMER = 0?
no
yes
CLR REF NEG & POS ERROR FLAG
LOAD ROL
LOAD ID TIMER
MODE = ARL
yes
no
Door = 0 %
no
yes
SET REF POS ERROR FLAG
CLR REFRIG POS ERROR FLAG
ARL OFF
yes
REFRIG Output < MIN Operating Level + ROL_Diff
no
CLEAR REF POS ERROR FLAG
Purge_CFG = 2
yes
no
CO2 > CO2 SP
yes
no
RUN PID HEAT MODE & CO2 PURGE SP = SP + CO2 PLEN RISE
CO2 < CO2SP - DIFF
yes
no
MODE = CO2
yes
no
Door = 0 %
no
yes
RUN PID HEAT MODE & CO2 PURGE SP = SP - CO2 PLEN RISE

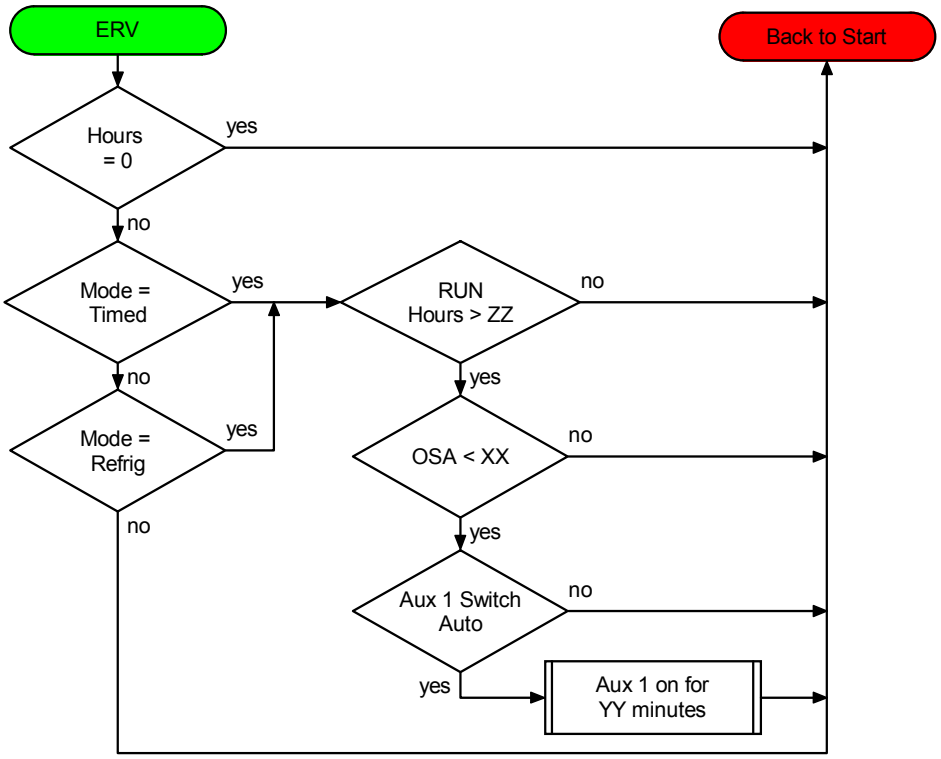
TIMED PURGE CONTROL

IF OSA < XX INITIATE PURGE CYCLE FOR YY MIN EVERY ZZ HOURS

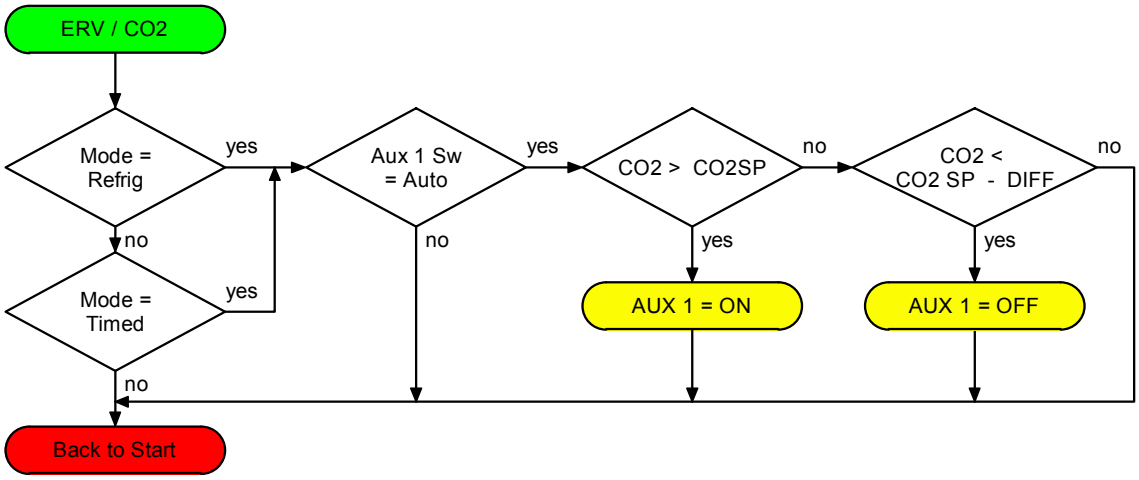




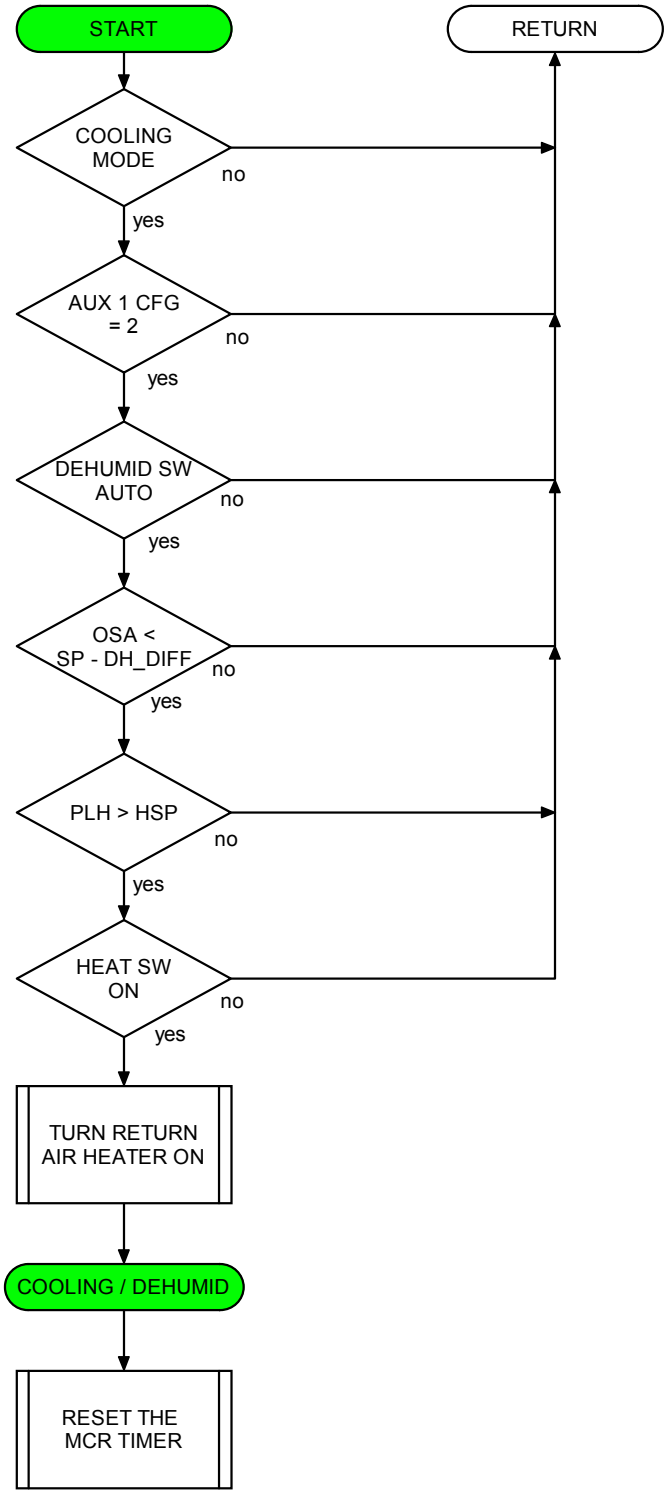
IF OSA < XX INITIATE PURGE CYCLE FOR YY MIN EVERY ZZ HOURS



ENERGY RECOVERY VENTILATION / CO2 CONTROL



APPENDIX G:
POTATO DEHUMID



AUX 1 CFG E2 MEMLOCATION MUST BE SET TO 2.

THE AUX 1 SWITCH BECOMES THE DEHUMID SW.

DH_DIFF IS THE DEHUMID DIFFERENTIAL. THIS SETTING WILL MAKE SURE THE OSA IS COLD ENOUGH TO BE DRY AIR. A TYPICAL SETTING WOULD BE 5 TO 10 DEGREES. THIS SETTING IS IN 1/10 OF A DEGREE. FOR 5 DEGREES, SET TO 50. ZERO SETTING WILL DISABLE FEATURE.

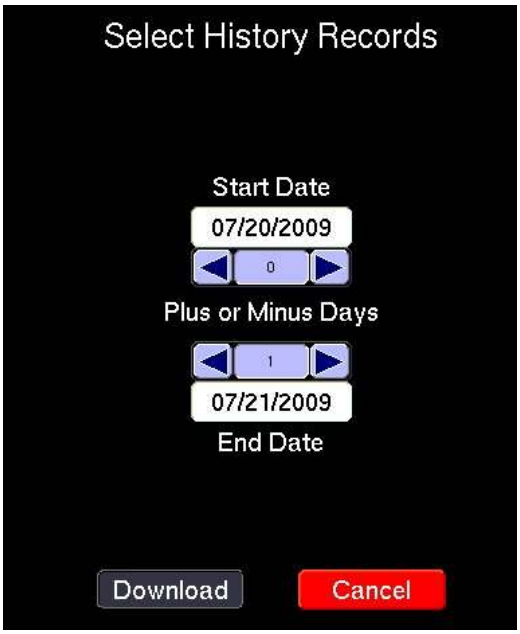
THE RETURN AIR HEATER MUST BE SIZED CORRECTLY, IF TO LARGE IT WILL CAUSE THE DOORS TO GO FULLY OPEN AND YOU WILL LOSE TEMPERATURE CONTROL.

WHEN THE COOLING / DEHUMID MODE IS FIRST INITIATED ACTIVATE THE MCR TIMER SO THAT ONCE YOU ARE IN THE MODE YOU WILL STAY THERE FOR THE LENGH OF THE MCR EVEN IF THE OSA WARMS UP.

APPENDIX H: HMI RECORDS

The HMI (Color Touch Screen) will now down load the records from the XT. This allows the labeling of the pile sensors and also all the activity records during mode changes to be displayed. The order of the selection and order of the records is determined by the inf csv file. See appendix A on how to set up the inf records format.

To access the records press the GRAPHS button on the bottom of the HMI.



To get the records from the XT panel, you need to select a start date and ending date. It will automatically come up with today's date as the Start Date and tomorrows date from the End Date. This will give you the records from midnight to present. If you want to change the interval use the spinner buttons.

Click on the Download button to get the records.

APPENDIX I:
Sweet Potato Operation

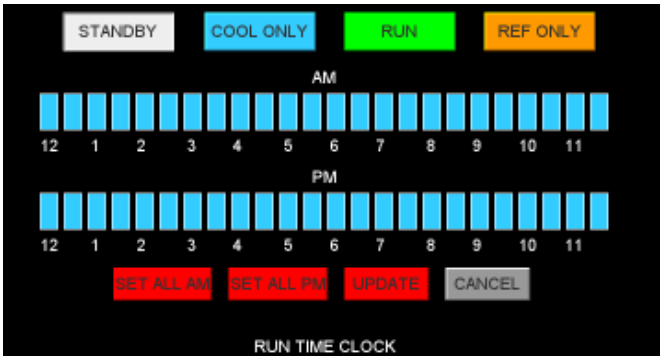
Application:

This application note will cover two types of storages. First are the conventional storages with fresh air doors, such as a conventional potato storage. The second will be storages that have no fresh air doors, but have roof vents, intake fans and exhaust fans.

In both cases, the Aux 2 switch will turn the Cure or Warming mode on. The Aux2_Config needs to be set to 188. **To activate the Cure or Warming mode, the time clock must be set to all Blue.**

Parameter Name	Value	Units
DOOR_TIME	180	s
REF_LEVEL (ROL)	20	%
LOW_CUTOUT	5	1/10 F
CO2_RAS / BURNER START	2	.1 F/%
MAX_DOOR	25	%
CO2_DIFF/DEHUMID_DIFF	200	ppm/%
BURNER_DEHUMID	10	%
ROL_START_DLY	10	min
AUX1_CONFIG	0	
AUX2_CONFIG	188	

Aux2_Config must be set to 188

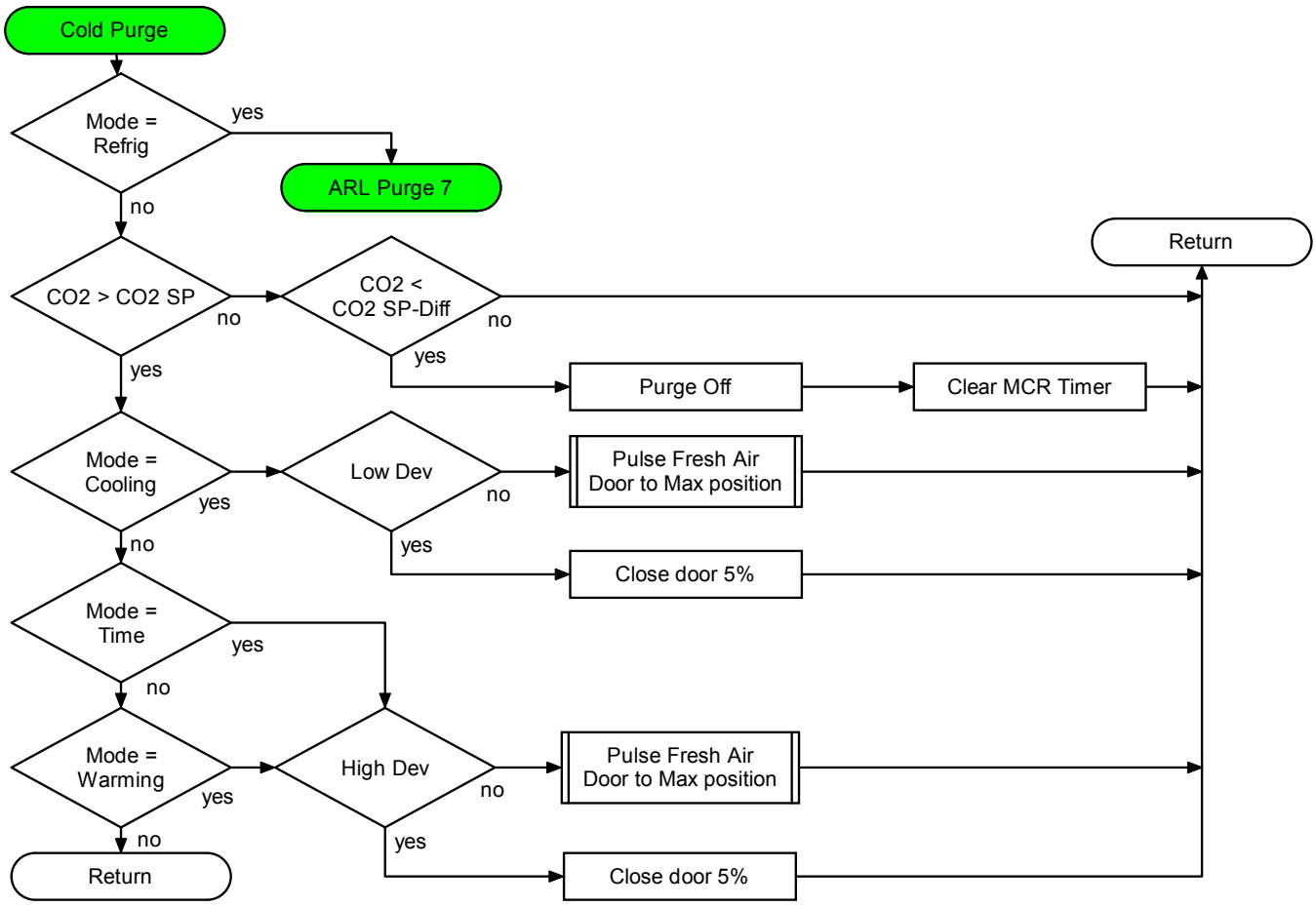


The warming mode is only used when trying to cure or warm up the product. During this time the time clock should be set to all blue and the Aux 2 switch should be set to Auto. **Once the cure cycle is complete, the Aux 2 switch should be turned off.**

With all of the time clock in Blue and the Aux 2 in Auto, the system will either run in Warming or Cooling. If the Outside air is less than the Start temperature then the system will run in Cooling. If the Outside air is greater than the Start temperature then the system will run in Warming. When the Aux 2 switch is off, then the system will run in Cooling only.

Purge Cycles During Cure with a CO2 Sensor:

Sweet potatos initially will give off a large amount of CO2. A typical setpoint would be 85 degrees during cure. If the product is brought in cooler than 85 degrees and the outside air is less than 85, heat will be needed. During this time of heating, the CO2 will need to be purged. If a CO2 sensor is being used, purge config 7 would be the ideal purge cycle.

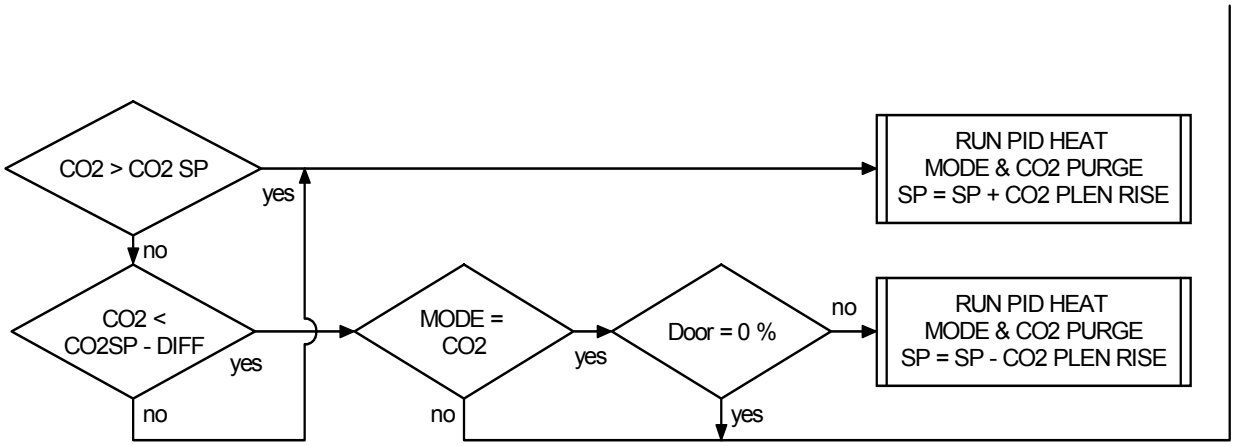


If the system is running in Cooling and the CO2 level exceeds the CO2 Setpoint, the fresh air doors will be pulsed open to the Max door setting. If during this opening of the fresh air doors, the plenum temperature drops below the Low Dev setting, the doors will be closed 5% until the plenum rises.

If the system is running in Warming and the CO2 level exceeds the CO2 Setpoint, the fresh air doors will be pulsed open to the Max door setting. During this operation, the plenum temperature will be monitored. If the Plenum temperature rises above the High Dev setting the doors will be closed 5% every update until the temperature goes below. **If the Heat switch is on the heat will come on if the plenum temperature drops below the SP minus the heat diff. This purge would typically be used without heat.**

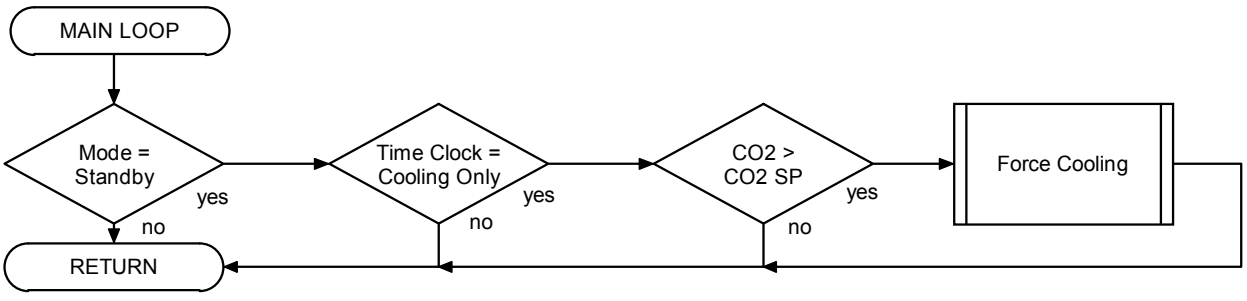
Purge Cycles During Refrigeration:

Purge 7 will also allow the system to purge CO2 during refrigeration. The ARL (ambient reverse loading) is also available in purge 7. The ARL will use the fresh air doors and ambient air to reverse load the refrigeration coils if the refrigeration level is very low and about to shut off. To disable the ARL, set the ROL E2 parameter to zero. If the CO2 level rises above the CO2 setpoint, the fresh air doors will gradually open to purge the CO2. Once the CO2 level drops below the CO2 Setpoint minus the CO2 differential, the doors will slowly close.



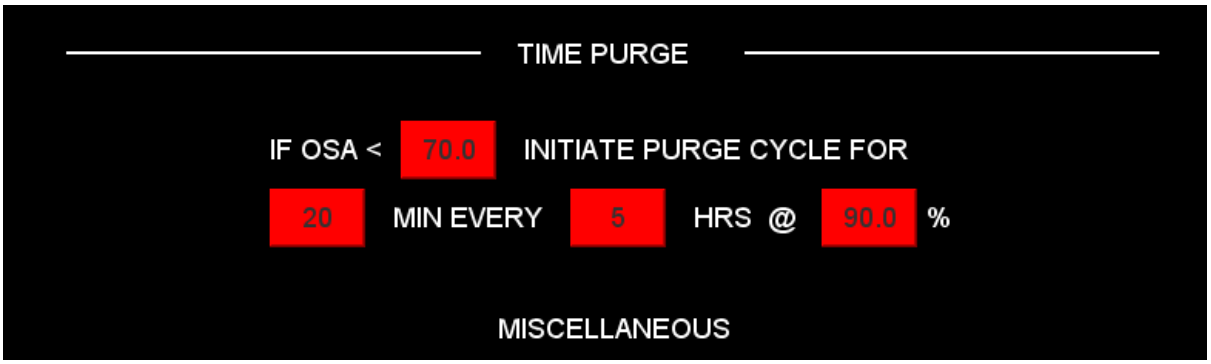
Purge Cycle During Standby:

If refrigeration is not available and the ambient air becomes too warm, the system will go into Standby. If the CO2 level is above the CO2 Setpoint, a forced Cooling cycle will begin. The fresh air doors will only open to the Max Open setting. Once the CO2 drops below the differential setting, the MCR (minimum cooling run) will clear and the system will go back to Standby.

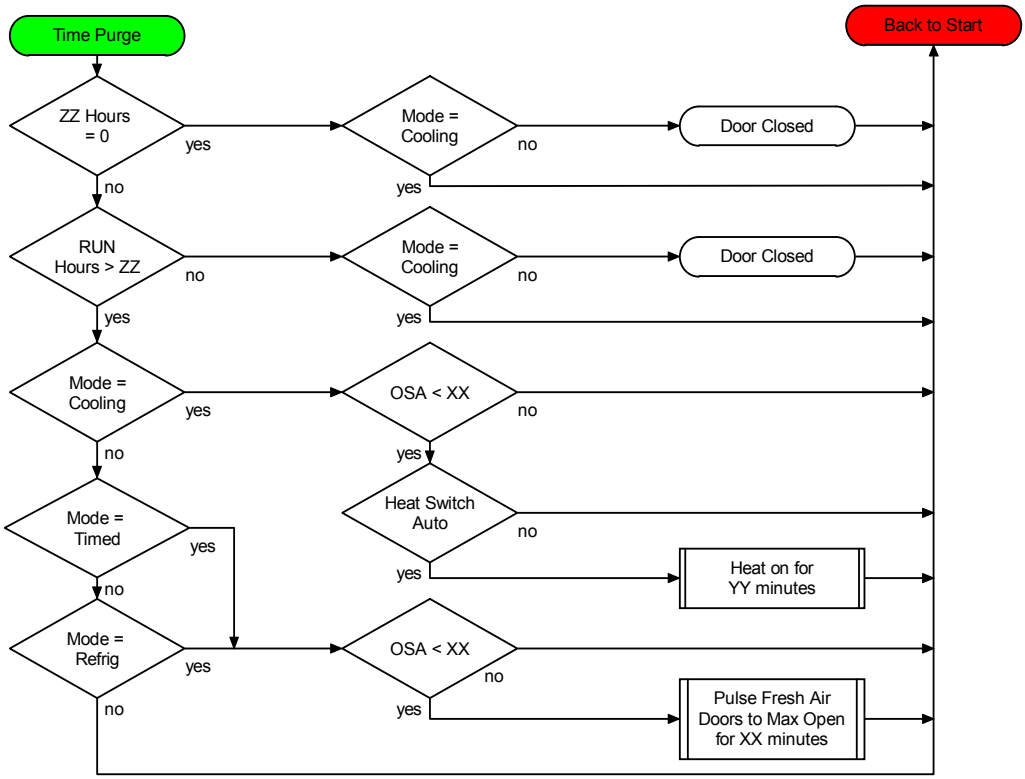


Purge Cycles During Cure without a CO2 sensor:

Without a CO2 sensor, a purge must be activated by time only. This purge currently requires heat. The purge config would need to be set to 1. This is Time only with no CO2 sensor.



When the purge config is set to 1, the above parameters will show on the Miscellaneous screen. These parameters will initiate a purge cycle according to the settings. To disable the time purge, set the parameters to 0. **To do a purge in the Cooling mode the heat switch must be in Auto. In Timed or Refrig, the system will pulse the fresh air doors to Max Open for the length of the cycle. In theory, this will only occur when there is no cooling air available, thus the air being brought in will be warmer than the pile.**

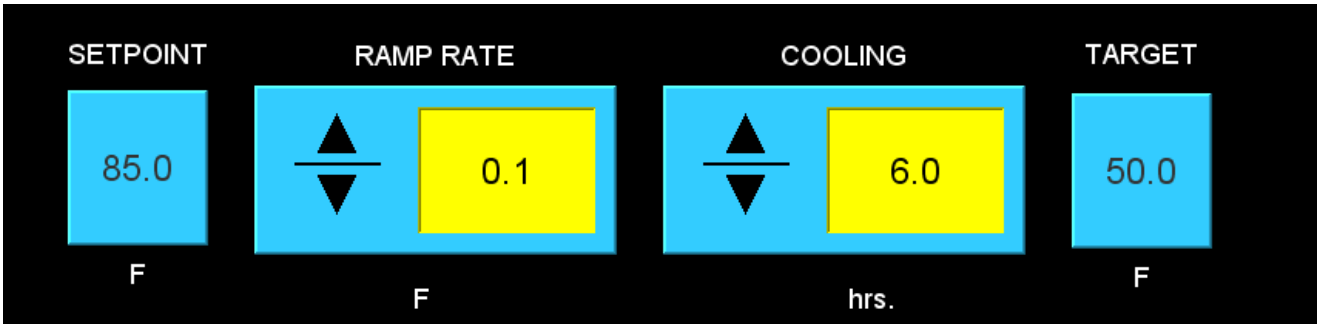


When the CO2 purge is triggered in the Cooling mode, it will be because the OSA is cold and the fresh air doors are only slightly cracked. The return air heaters will cause the air to warm by 3 to 4 degrees, causing the fresh air doors to open and the fans to speed up to purge the storage.

From Cure to Ramp Down & Purging:

Once the Cure cycle is done it is time to ramp down to the desired holding temperature. **The Aux 2 switch should be set to off once the cure cycle is complete.** The time clock needs to be set for the desired operation. If refrigeration is available, the time clock should be set to green. This will allow the system to run in either Cooling or Refrigeration. If refrigeration is not available, the system would run in either Cooling or Timed. In a Timed run, the fresh air doors would be closed and the fans would run at a minimum level to circulate the air.

The ramp mode is setup by setting the target to the desired long term storage temperature.



In this example, the Setpoint will be ramped down .1 degrees every 6 hours of Cooling. The ramp will shut off when the final Target temperature of 50 degrees is reached. **Note - anytime the Setpoint is changed from the main screen, the Target will be reset to the Setpoint and the ramp will turned off.**

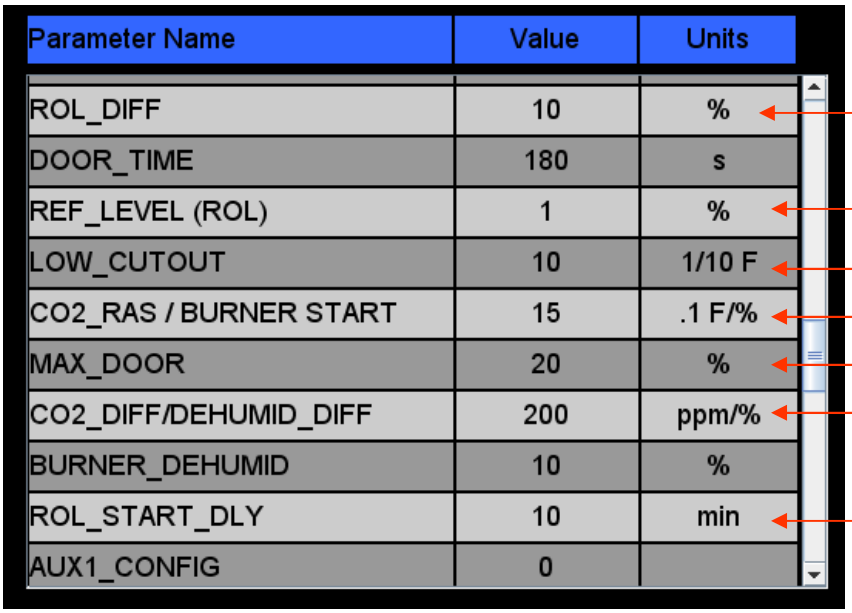
The outside air control can be referenced to Setpoint or any of the pile sensors. As an example, the temperature setpoint is 72 and the North West pile sensor, selected as the reference, is 85. With the OSA Diff set to zero, the system will start bringing in fresh air when the outside air temp is below 85 degrees. If the outside air gets below the 72 degrees, the doors will start to close and control temperature. This allows the system to bring in air cooler than the pile but warmer than the setpoint. This will greatly enhance the cooling run time available. **Once the pile is down to the long term storage setpoint, the reference should be changed to Setpoint.**

The purge config after the cure cycle will depend on if there is refrigeration, heat and a CO2 sensor.

Without a CO2 sensor, purge config 1 is the only choice. It is triggered by elapsed time and must have heat to purge when in the cooling mode. See previous page for explanation of purge config 1.

With a CO2 sensor and no refrigeration, purge config 7 would work best. This purge will work with or without heat. See previous page for explanation of purge config 7.

With a CO2 sensor and refrigeration, purge config 3 is the best purge cycle. Purge config 3 needs some additional setup. For sweet potatoe, we do not want to use ARL (ambient reverse loading).



Parameter Name	Value	Units
ROL_DIFF	10	%
DOOR_TIME	180	s
REF_LEVEL (ROL)	1	%
LOW_CUTOUT	10	1/10 F
CO2_RAS / BURNER START	15	.1 F/%
MAX_DOOR	20	%
CO2_DIFF/DEHUMID_DIFF	200	ppm/%
BURNER_DEHUMID	10	%
ROL_START_DLY	10	min
AUX1_CONFIG	0	

These are the parameters that should be set. The values shown are the suggested values.

For more information on each of these values, see the operators manual.

In this configuration, the system will only purge if the CO2 rises above the CO2 Setpoint. In Cooling mode, the return air heater will be turned on, raising the return temperature by 3 or 4 degrees. This will cause the fresh air doors to open and purge the CO2. This should only happen during cold temperatures when the doors are just barely open. In refrigeration, when the CO2 exceeds the setpoint the fresh air doors will gradually open up to the max doors setting. As soon as the CO2 drops below the CO2 Setpoint minus the CO2 Diff, the doors will gradually go closed.

Using Exhaust & Intake Fans:

This will describe how to set the panel up when dealing with retrofit buildings, that do not have fresh air doors. These buildings have roof vents where air is drawn in, goes down through the pile and is exhausted out through the side walls with fans. These fans have VFD to control the speed of the fans. The temperature control is achieved by speeding up and slowing down the exhaust fans. When the exhaust fans reach a certain speed, there is the option to turn on the intake fans to help supplement the roof vents.

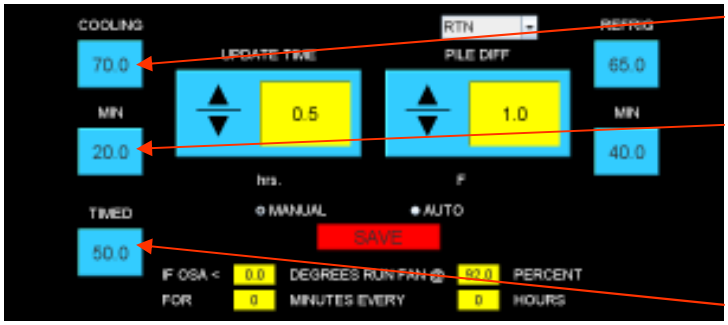
For this type of control, the door config must be set to 4.

Parameter Name	Value	Units
AUX2_CONFIG	188	
DOOR_CONFIG	4	

The door time is an adjustable parameter that will determine how fast the exhaust fans speed up and slow down. Since there are no actual fresh air doors, a virtual door position is created using the Door Time parameter. This parameter is in seconds and is used to calculate the door position as shown on the main screen. Normally, the door is positioned by pulsing the open and closed relays. The door position can be calculated by keeping track of the open and closed pulses. The Door Time parameter would be the amount of time it would take the door to fully open. For this application, we use the same calculations but without an actual door. Thus, the Door open position will represent the virtual position from 0 to 100%. This percentage will then be outputted to the exhaust fans in the exact percentage. Example - if the Door Open was reading 45%, the Exhaust fans would be running at 45%. A problem occurs when the plenum temperature is below the temperature setpoint and the PID continues to lower the fan speed to zero. During normal operation the exhaust fan should continue to run at a minimum speed.

Parameter Name	Value	Units
DOOR_TIME	30	s

DOOR OPEN 5.0 %



The Cooling button is the Max fan speed. The door position can go to 100%, but the fan will go no higher than this percentage. The MIN button on the left controls the minimum speed of the fan when the Door Open is zero. For example, if this is set at 20%, the exhaust fan can not slow down to less than 20%. The Timed button is the percentage at which the intake fans will start. The Aux 1 switch needs to be in Auto for the intake fans to run.

The PID loop will try to control temperature by varying the speed of the exhaust fans from the Min setting to the Cooling setting. The Door Open position will vary from 0 to 100 percent but the exhaust fans will vary only between Min and Cooling percentages.

Purge Cycle using Exhaust & Intake Fans:

Purge config 7 is best suited to this type of building. Purge 7 requires a CO2 sensor and will purge without any heat. See previous page for explanation of purge 7 or Cold Purge. In this case instead of the fresh air doors opening up to the max door setting, the exhaust fans will speed up to the max open setting. Once the CO2 has dropped to below CO2 Setpoint minus C02_diff, the exhaust fans will drop down in speed.

The intake fans will only be used when the exhaust fans reach a high enough speed that the roof vents can no longer provide enough air. The Aux 1 switch controls the intake fans. If the switch is in auto, the intake fans will start when the exhaust fans reach a given percentage.

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