

Sweet Potato Storage Operation  
APP- 038

Application:

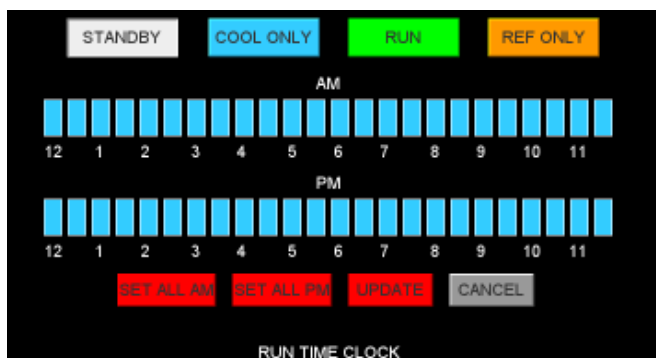
This application note will cover two types of storages. First are the conventional storages with fresh air doors, such as a conventional potato storage. The second will be storages that have no fresh air doors, but have roof vents, intake fans and exhaust fans.

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	

set to all Blue.

Aux2\_Config must be set to 188



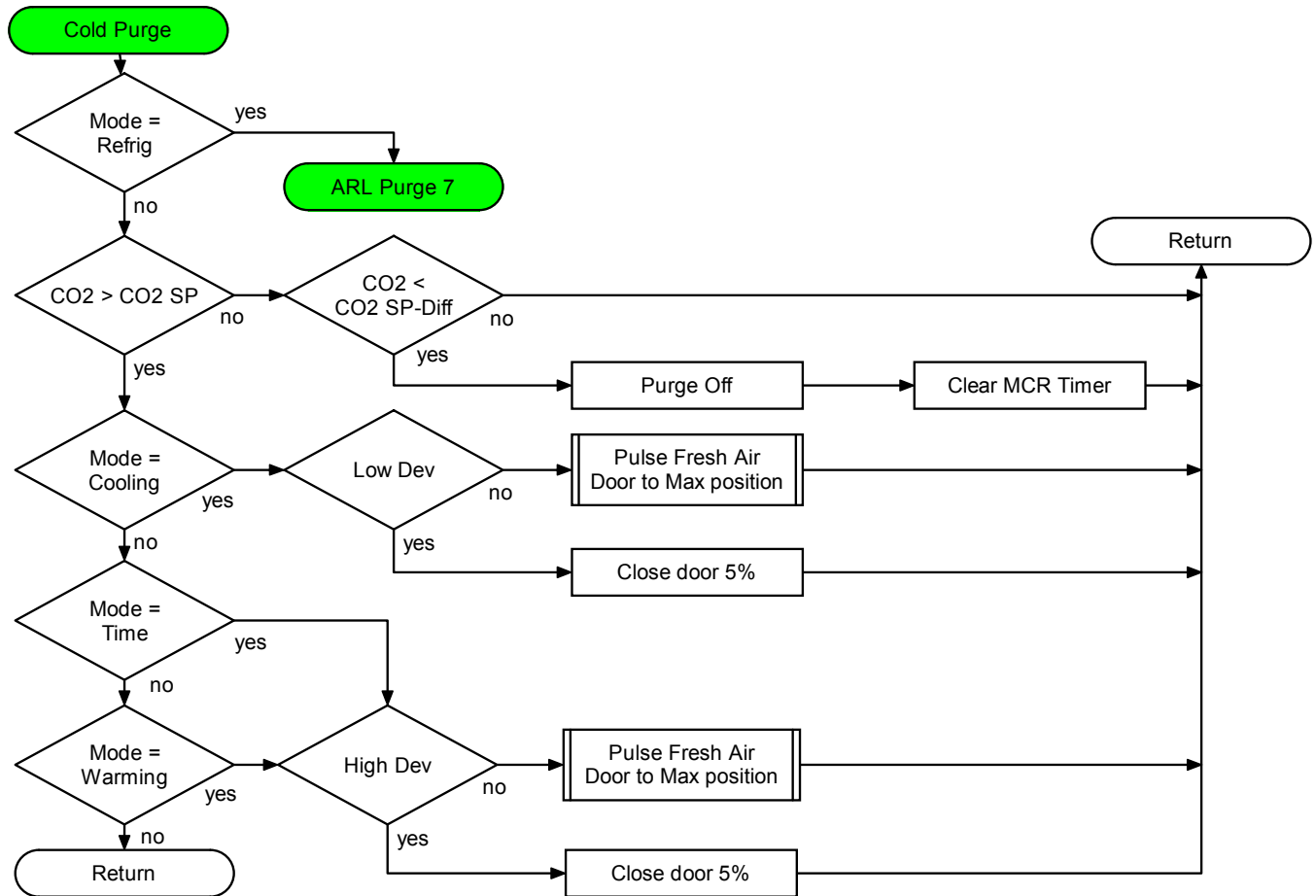
The warming mode is only used when trying to cure or warm up the product. During this time the time clock should be set to all blue and the Aux 2 switch should be set to Auto. **Once the cure cycle is complete, the Aux 2 switch should be turned off.**

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 potatoes 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.

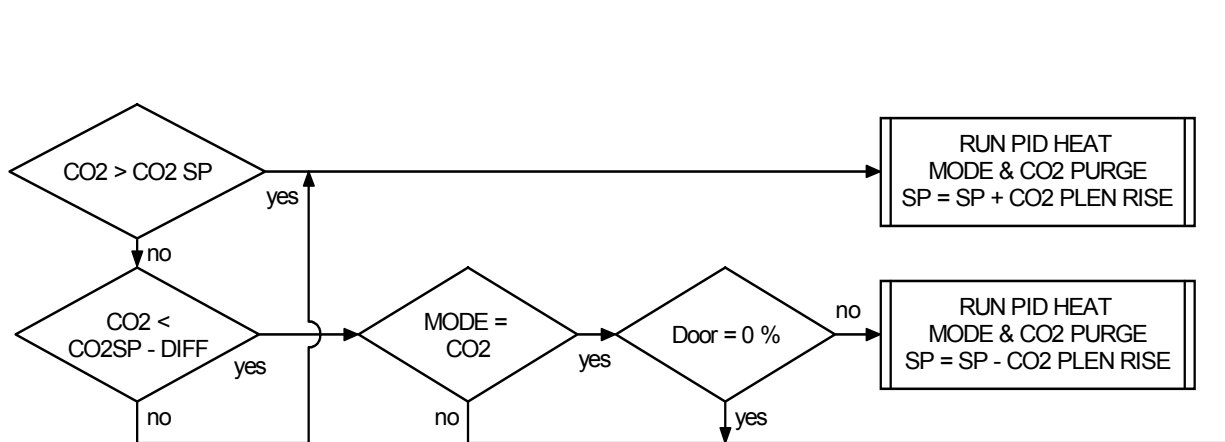


If the system is running in Cooling and the CO2 level exceeds the CO2 Setpoint, the fresh air doors will be pulsed open to the Max door setting. If during this opening of the fresh air doors, the plenum temperature drops below the Low Dev setting, the doors will be closed 5% until the plenum rises.

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.**

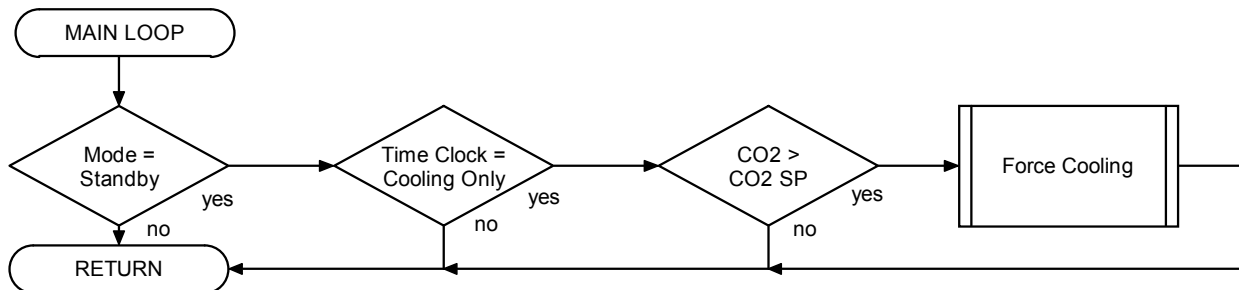
**Purge Cycles During Refrigeration:**

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.



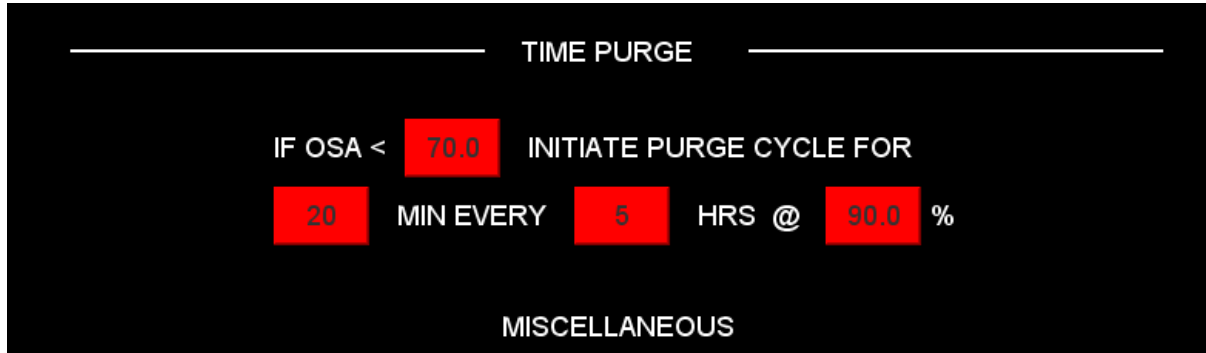
**Purge Cycle During Standby:**

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.

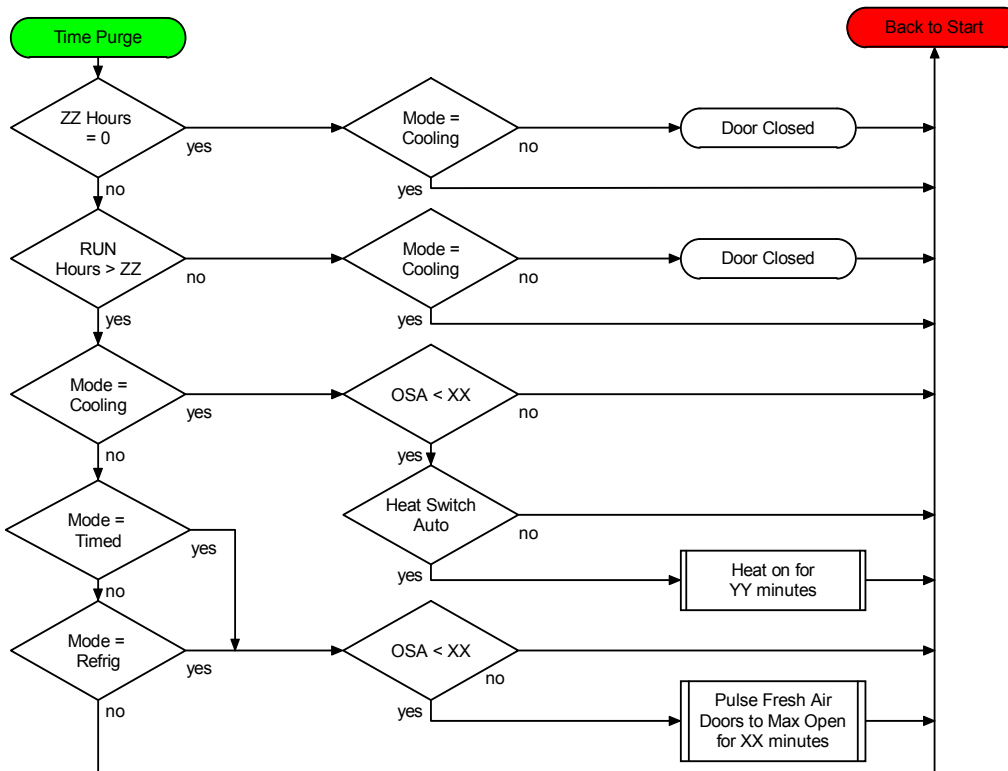


Purge Cycles During Cure without a CO2 sensor:

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.**

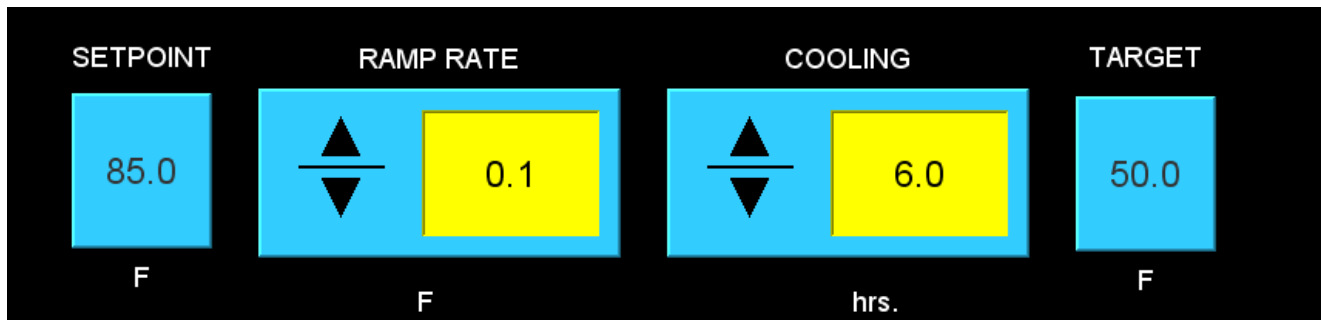


When the CO2 purge is triggered in the Cooling mode, it will be because the OSA is cold and the fresh air doors are only slightly cracked. The return air heaters will cause the air to warm by 3 to 4 degrees, causing the fresh air doors to open and the fans to speed up to purge the storage.

**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 be 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_CUTOOUT	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.

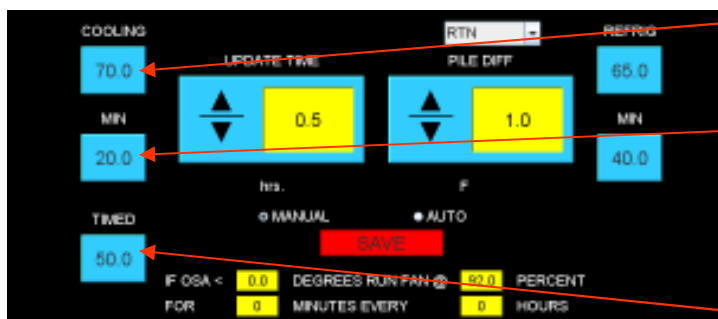
Parameter Name	Value	Units
AUX2_CONFIG	188	
DOOR_CONFIG	4	

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.

Parameter Name	Value	Units
DOOR_TIME	30	s



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.



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.