i-Controller 2.0 (6-70 Ton) MPU ASHP

Sequence of Operation Revision 300

Table of Contents

Unit Configurations

Tonnage	Compressors	Condenser Fans	Evaporator Coils	Outside Air Dampers (OAD)	Return Air Dampers (RAD)	Bypass Air Dampers (BAD)
6, 7, 8, 10	1	1	Single	1	1	1
9, 11, 13, 15	2	2	Single	1	1	1
14, 16, 18, 20	2	2	Single	1	1	1
25, 30	2	3	Single	1	1	1
26, 31, 40	4	4	Single	2 (Parallel)	2 (Parallel)	2 (Parallel)
50 - 70	4	6	Split	2 (Parallel)	2 (Parallel)	2 (Parallel)

Table 1. Unit Configuration Table

Sequence of Operation (No Comms – VCCX Only)

In the event a loss of BACnet communication occurs between the i-Controller and the VCCX controller, the following sequence will take place.

- The Outdoor Air Damper will close, Return Air Damper with open to 100%, and the Bypass Air Damper will close.
- Heating and Cooling modes will be activated based on return temperature. There will be no dehumidification. If the i-Controller has never been connected to the VCCX, the default heating and cooling set points will be used (77°F Cool/65°F Heat).
- During cooling mode, compressors will be controlled to maintain a coil temperature setpoint of 40°F.
- During heating mode, compressors will be controlled to maintain a coil temperature setpoint of 110°F.
- If equipped, auxiliary heating stages will be controlled to maintain a return temperature based on the heating set point once compressor heating is maximized. If outdoor temperature sensor fails during heating mode, compressor(s) will be turned off and auxiliary heating stages will be staged on.
- If the supply or return temperature sensor fails, a unit shutdown will occur.
- All other unit safeties apply. See “Unit Safeties” section.

Multi-Path Sequence of Operation

****Highlighted Values in this document are configurable parameters, adjustable and set as needed on a site-by-site basis. The configuration values of these properties are stored in the i-Controller Config file.**

The Multi-Path unit (MPU) sequence follows two modes of operation. The two modes of operation are based on Occupied (OCC) and Unoccupied (UNOCC) Time Schedules.

- Time Schedule: A list of times when planned events are to take place (e.g. opening and closing hours).
- Occupied (OCC): The hours when the store is open.
- Unoccupied (UNOCC): The hours when the store is closed.

The i-Controller is pre-configured with a default time schedule. The parameters file, unless specified by the customer, arrives with the default Time Schedule: Occupied at [9:00] am and Unoccupied at [9:00] pm. The time schedule is configurable allowing modifications as needed.

Network Communication

The i-Controller supports BACnet and Modbus protocols to communicate with the Building Management System (BMS). Modbus is the default communication protocol. If a BMS connection is not available, the Flō MPU is fully functional in stand-alone mode.

If a BMS connection is desired, the i-Controller will accept OCC/UNOCC, cooling/heating setpoints and Occupancy signal from the BMS master controller. Other optional values from the BMS include:

- Network outdoor air temperature
- Network outdoor humidity temperature
- Network enable/disable
- Load shed signal
- Exhaust fan interlock signal
- Max outdoor air damper position setting
- Outdoor air damper DCV adjustment setting

Smoke Detection and Unit Shutdown

A closed smoke detector input is required for MPU operation. When the input is closed, the unit will operate normally. When the input opens, the MPU will shut down. The opening of this input indicates an Emergency Shutdown condition has occurred. During an Emergency Shutdown an advisory entry will be generated and displayed in the alarm log.

In the event of a unit shutdown, all mechanical equipment (compressors, fans, heating module) will be disabled, and the outdoor air damper(s) will be closed.

The following events will cause a unit shutdown:

- Smoke Detection (Wet to controller & safety circuit)
- Phase Loss Detection (Dry to controller / Wet on safety circuit)
- Drain Pan Overflow Detection (Wet on safety circuit)
- Absence of a Digital Airflow Proof (Wet to controller. Supply fan will continue to operate for 10 minutes before shutting down.)
- Simultaneous Space and Return Temperature Sensor Failure
- Network Disable Signal Initiated by the Building Management System
- Breaching Low and High Supply Temperature Limits
- Supply Temperature Sensor Failure

Supply Fan Strategy

Variable Frequency Drive(s) (VFD)

The MPU is equipped with a Variable Frequency Drive (VFD) to control total air flow via the draw-through supply fan. The VFD runs continuously and will modulate between [50]-100% depending on the mode of operation. During Dehumidification or "Dehum + Cool" mode, the VFD will ramp down to allow for the return air damper position to reduce to its minimum position. This reduction provides more of a "Dual-Path" damper operation.

The VFD speed defaults are set as follows:

	VFD %	
Mode	**Occupied (OCC)**	**Unoccupied (UNOCC)**
Dehumidification[1]	[80%]	[50%]
Dehum + Cool[2]	[90%]	[50%]
Heat	[100%]	[100%]
Cooling/Fan Only	[100%]	[50%]

Table 2. VFD% Operation per Mode

[1]If the dew point in the space increases above the Unoccupied Dew Point Set Point + [2.0˚F], the supply fan will gradually ramp up to the Occupied Dehumidification or Dehum + Cool VFD percent until the dew point is below set point.

[2]" Dehum + Cool" mode refers to Dehumidification mode with space temperature greater than the Cooling set point.

Airflow Switches and Fan Proof

The MPU is equipped with a single airflow switch:

- **Digital Airflow Switch:** Provides a wet contact closure connected to the VCCX controller and indicates airflow within the unit's airstream. A fan 'proof' occurs when the input is closed. This switch is normally open (NO).

NOTE: If a Fan Fail advisory is generated via the digital '*proof*' input, a unit shut down will occur. The advisory must be manually cleared on the i-Controller display before the MPU will resume normal operation.

Airflow Dampers

The Multi-Path design has three airstreams controlled by independent dampers. Each damper or set of dampers (in larger units) has a designated position for each mode of operation.

Outdoor Air Damper(s) (OAD)

- During OCCUPIED mode, the OAD damper(s) will open to the specified operating position. The set position is the maximum allowable outdoor airflow (including DCV if applicable) and is determined during unit start-up and air balance.
- During UNOCCUPIED mode, the OAD damper(s) will close completely or to a minimum position if specified.
- The OAD will close completely in the event of a unit shutdown (see *Smoke Detection and Unit Shutdown*), a controller power reboot, or return temperature control.
- When transitioning from closed or minimum position to open, the OAD damper(s) will gradually open over a [10]-minute period. This is referred to as 'Slow Open'.
- If equipped, during Demand Control Ventilation (DCV) the OAD damper(s) will open an additional percentage.

Economizer Mode – Free Cooling

The Economizer Mode (Free Cooling Strategy) will use advantageous ambient conditions to provide cooling to the space when there is a demand. During Economizer Mode, all mechanical cooling (compressors, water-chilled coils, etc.) is locked out (no mechanical cooling will be used). This mode provides "free cooling" to the space to treat the sensible load while reducing energy consumption.

When the unit has a demand for Cooling Only, Economizer (ECON) Mode will compare the Ambient Temperature to the Cooling Setpoint. If the unit does not have an Outdoor Humidity Sensor, ECON mode will be initiated when the Outdoor Temperature is less than 55°F. If there the unit is equipped with an Outdoor Humidity sensor, when the Ambient Temperature is 10°F below the Cooling Setpoint and the Outdoor Dewpoint less than or equal to the Space Dewpoint Setpoint, ECON Mode will be enabled.

Once ECON mode has been initiated, the Outdoor Air Damper(s) will open to 100%. During ECON Mode, the space dewpoint and space temperature will be monitored in 30-minute intervals. If space dew point increases more than 1°F or space temperature does not decrease within 30-min, ECON mode will be disabled if ambient conditions allow, and mechanical cooling will resume. ECON mode will remain active if compressors are locked out due to ambient conditions.

Once disabled, ECON mode will not be initiated again until a new cooling demand and all other ECON conditions are met.

ECON Mode Initiation Parameters

Cooling Economizer mode is initiated when:

Unit has an Outdoor Humidity sensor:

- There is a Cooling only demand in the space
- Ambient Temperature(°F) < Space Cooling Temperature Setpoint(°F) - 10°F
- Ambient Dewpoint(°F) <= Space Dewpoint Setpoint(°F)

Unit does not have an Outdoor Humidity sensor:

- There is a Cooling only demand in the space
- Ambient Temperature(°F) < 55°F

ECON Mode Operational Parameters

During ECON Mode the unit will:

- Increase the OAD operational % to 100%
- ECON mode will be disabled if the demand is satisfied OR if within 30-minutes:
  - Space Temperature increases by 3°F or shows no change
  - Space Dewpoint increases by 2°F
  - ECON mode will not be allowed to run again after being disabled until the demand in the space has been cleared and there is a new Cooling Demand

Demand Control Ventilation (DCV) *(if equipped)*

If the CO2 level exceeds [800ppm], the OAD(s) will be opened past their current operating percentage/position. At a level of [1500ppm] or greater and a CO2 alarm will be generated. The additional OAD opening for high CO2 is set to a default value of [10%]. The additional percentage will be added incrementally to the current OAD position on a linear scale as the CO2 level increases from [800ppm] to [1000ppm] (e.g. at 900ppm, [5%] will be added to the OAD; at [1000ppm], [10%] will be added).

Return Air Damper(s) (RAD)

- The RAD(s) minimum opening is set to maintain the specified airflow for dehumidification. If space temperature increases above the cooling set point during dehumidification, the RAD(s) may open to the Dehum + Cool% [60%] for the fan to operate at the "Dehum + Cool" VFD setting.

- During slow open, the RAD positions for "Dehumidification" and "Dehum + Cool" will equal the RAD Min% + (OAD% Position Setting – Current OAD%) to maintain airflow across the cooling coil.

- During heating mode, the RAD will open to 100%.

Bypass Air Damper(s) (BAD)

- The BAD position will remain open to its maximum position throughout dehumidification to allow for cooling coil bypass.
  - The BAD will remain open to its minimum position for all other modes of operation and will close during heating mode.

Table 3 illustrates the expected damper positions for each mode of operation. Minimum and Maximum positions for each damper will be determined on a site-by-site basis.

	Damper Position Table					
	Occupied (OCC)			**Unoccupied (UNOCC)**		
Mode	**OAD %**	**RAD %**	**BAD %**	**OAD %**	**RAD %**	**BAD %**
Dehumidification	[20%]	[20%]	100%	[0%]	100%	[30%]
Dehum + Cool	[20%]	[40%]	100%	[0%]	100%	[30%]
Fan Only/Cool	[20%]	[60%]	[30%]	[0%]	100%	[30%]
Heat	[20%]	[100%]	[0%]	[0%]	100%	[0%]
DCV*	Current + [10%]	Current%	Current%	[10%]	Current%	Current%
Economizer*	100%	Current%	Current%	100%	Current%	Current%

*Table 3. Damper Positions per Mode (*if Equipped)*

Compressors

Compressor Staging

Compressors A1 and B1 are the *lead* compressors in the associated suction group, while compressors A2 and B2 are the *lag* compressors in the suction group. Compressor configuration and staging vary based on the unit size. Digital compressors will start at 100% for 30 seconds and then ramp down and begin to modulate. Two stage compressors will start at 67% and will stage up to 100% and then stage back to 67% before turning off. The table below illustrates compressors availability and staging based on unit size.

Lead Circuit Reheat, Reclaim, or No Reheat

Compressors A1 and B1 (*if equipped*) will both initiate first when there is a call for cooling or dehumidification. Compressors A2 and B2 (*if equipped*) will activate once the associated *lead* compressor has reached 100% capacity and the RUN time delay has expired.

Staging down, compressors A1 and B1 (*if equipped*) will modulate down to, 10% in cooling mode or 70% in dehumidification mode, and once the run time delay has expired compressor A2 and B2 (if equipped) will be turned off. Compressors A1 and B1 (if equipped) will continue to modulate until there is no call for cooling or dehumidification.

Lag Circuit Reheat

In dehumidification mode, compressors A2 and B2 (*if equipped*) will both initiate first when there is a call for dehumidification. Compressors A1 and B1 (*if equipped*) will activate once the associated *lag* compressor has reached 100% capacity and the RUN time delay has expired.

Staging down, compressors A1 and B1 (*if equipped*) will modulate down to 70%, and once the run time delay has expired compressor A1 and B1 (if equipped) will be turned off. Compressors A2 and B2 (if equipped) will continue to run until there is no call for dehumidification.

In cooling mode, compressors A1 and B1 (*if equipped*) will both initiate first when there is a call for cooling. Compressors A2 and B2 (*if equipped*) will activate once the associated *lead* compressor has reached 100% capacity and the RUN time delay has expired.

Staging down, compressors A1 and B1 (*if equipped*) will modulate down to, 10%, and once the run time delay has expired compressor A2 and B2 (if equipped) will be turned off. Compressors A1 and B1 (if equipped) will continue to modulate until there is no call for cooling.

Tonnage	**Compressor configuration**	**Digital Compressors** *(C) Cooling (D) Dehum*	**Two-Stage Compressors** *(If Equipped)*	**On/Off Compressors** *(If Equipped)*	**Reheat Circuit*** *(If Equipped)*
6, 7, 8, 10	A1	(C) 10-100% (D) 70-100%	NA	NA	Lead circuit
9, 11, 13, 15	A1, A2	(C) 10-100% (D) 70-100%	0%, 67%, 100%	NA	Lag circuit
14, 16, 18, 20	A1, A2	(C) 10-100% (D) 70-100%	0%, 67%, 100%	NA	Lag circuit
25, 30	A1, A2	(C) 10-100% (D) 70-100%	NA	0%, 100%	Lag circuit
26, 31, 40	A1, A2 ; B1, B2	(C) 10-100% (D) 70-100%	NA	0%, 100%	Lead circuit
50 - 70	A1, A2 ; B1, B2	(C) 10-100% (D) 70-100%	NA	0%, 100%	Lead circuit

Table 4. Compressor Staging Table

*Units manufactured before 2022 are all lead circuit reheat.

Dehumidification

Dehumidification takes PRIORITY OVER Comfort Cooling. Dehumidification is enabled based on the space dew point setpoint.

- (OCCUPIED) Space Dew Point > Occ Set Point [– 0.5˚F] = DEHUM ENABLE
- (OCCUPIED) Space Dew Point < Occ Set Point [– 1.25˚F] = DEHUM DISABLE
- (UNOCCUPIED) Space Dew Point > UnOcc Set Point = DEHUM ENABLE
- (UNOCCUPIED) Space Dew Point < UnOcc Set Point [– 0.75˚F] = DEHUM DISABLE

The suction pressure setpoint is reset based on the space dew point behavior and distance from space dew point setpoint. The suction pressure setpoint will be set to the maximum [118psig] of the scale upon initiation of dehumidification mode and will float towards the minimum of the scale [107psig] as the space dew point increases above set point. For units greater than 26 tons with multiple suction groups, both suction groups will be controlled to the same set point.

Comfort Cooling

Comfort cooling is enabled based on the space temperature setpoint.

NOTE: Dehumidification takes PRIORITY OVER comfort cooling.

- (OCCUPIED) Space Temp > Occ Cool Set Point [+ 0.25˚F] = COOL ENABLE
- (OCCUPIED) Space Temp < Occ Cool Set Point [– 0.75˚F] = COOL DISABLE
- (UNOCCUPIED) Space Temp > UnOcc Cool Set Point [+ 0.25˚F] = COOL ENABLE
- (UNOCCUPIED) Space Temp < UnOcc Cool Set Point [– 0.75˚F] = COOL DISABLE

During Occupied and Unoccupied Mode, the suction pressure setpoint is reset based on the space temperature behavior and distance from cooling setpoint. The suction pressure setpoint will be set to the maximum [150psig] of the scale upon initiation of cool mode and will float towards the minimum of the scale [120psig] as the space temperature increases above set point. For units greater than 26 tons with multiple suction groups, both suction groups will be controlled to the same set point.

Heating

Heating is enabled solely upon space temperature setpoint. The heating setpoint is configurable to accommodate the desired space temperature control. When heating is enabled, the discharge pressure setpoint is reset based on the space temperature behavior and distance from heating setpoint. The discharge pressure setpoint will be set to the minimum of the scale [300psig] upon initiation of heat mode and will float towards the maximum of the scale [450psig] as the space temperature decreases below set point. For units greater than 26 tons with multiple refrigeration circuits, both circuits will be controlled to the same set point.

- (OCCUPIED) Space Temp < Occ Heat Set Point [- 1.0˚F] = HEAT ENABLE
- (OCCUPIED) Space Temp > Occ Heat Set Point [+ 1.0˚F] = HEAT DISABLE
- (UNOCCUPIED Space Temp < UnOcc Heat Set Point [- 1.0˚F] = HEAT ENABLE
- (UNOCCUPIED) Space Temp > UnOcc Heat Set Point [+ 1.0˚F] = HEAT DISABLE

Compressor Safeties

Suction Pressure Transducer Failure: In the event of a suction pressure transducer failure, all associated compressors will be turned off. A sensor failure alarm will be generated. Alarms will automatically clear once the pressure transducer failure is repaired.

Discharge Pressure Transducer Failure: In the event of a discharge pressure transducer failure, the condenser fan(s) will be commanded to 100% and compressor(s) will remain enabled. A sensor failure alarm will be generated. Alarms will automatically clear once the pressure transducer failure is repaired.

Ambient Compressor Cooling Lockout: Compressors will be disabled for Dehumidification and Cooling if the outdoor air temperature is below 42˚F, and will remain locked out until the outdoor air temperature rises above 50˚F.
NOTE: This will not lock out compressors for heating mode.

Ambient Compressor Heating Lockout: Compressors will be disabled for heating if the outdoor air temperature is one degree below heat pump heating ambient lockout setpoint [10˚F] during occupied, [0˚F] during unoccupied and will remain locked out until the outdoor air temperature rises one degree above setpoint. During the lockout, emergency heat will be enabled. Note: lockout setpoint will be determined on a site-to-site basses.

Auxiliary Heat

Auxiliary heating is enabled when compressor heat cannot sustain the space conditions or during a compressor fault. Once auxiliary heating is enabled, heating stages are sequenced ON/OFF to maintain the space temperature to the heating set point. The following conditions will enable auxiliary heating:

- Outdoor temperature is below the ambient compressor heating lockout.
- All compressors have failed.
- A dehumidification + heat call.
- Single compressor fails and space temperature is below the AuxHeat enable setpoint.
- Compressors have been at full capacity (100%) for [120] minutes and space temperature is below the AuxHeat enable setpoint.

AuxHeat enable by space temperature:

- Space Temp < Active Heat Set Point [- 2.0˚F] = AUXHEAT ENABLE
- Space Temp > Active Heat Set Point [- 1.0˚F] = AUXHEAT DISABLE

Units equipped with staged electric auxiliary heat will be an auxiliary / emergency configuration. Stages defined as emergency will be locked out during compressor heating operation and only used when compressor heat is not available.

NOTE: Heat Stage 1 will remain active throughout mode.

Auxiliary Heating Safeties

High Supply Temperature: If supply temperature is > [130˚F], no additional stages of heating will be enabled.

Reheat Coil *(if equipped)*

The reheat coil(s) utilize compressor discharge heat to reheat the supply airstream throughout dehumidification. The coil(s) will only be enabled during dehumidification when the space temperature meets the following conditions:

Reheat Enable:

- Space Temp < [Reheat Set Point] = REHEAT ENABLE
- Space Temp > Reheat Set Point [+ 1.0˚F] = REHEAT DISABLE

Once enabled, the Reheat coil has a minimum run time of 8-minutes. As a default, the Reheat set point is set to the midpoint between the Occupied Heating and Cooling set point and can be adjusted if necessary.

Reheat Safeties

Upon compressor initiation, a startup flush is performed. The reheat valve will open for 30 seconds to flush the reheat coil. In cooling mode, a flush cycle is preformed every hour. In dehumidification mode, a flush cycle is preformed if the reheat valve position has been less than 70% for 20 minutes.

Heat Reclaim Coil *(if equipped)*

Heat reclaim is a process where heat from the refrigeration rack is transferred to a coil located in the MPU. Heat reclaim is used to raise the temperature of the supply air and will be enabled when the space temperature meets the following conditions:

- Space Temp < [Reclaim Set Point] = RECLAIM ENABLE
- Space Temp > Reclaim Set Point [+ 1.0˚F] = RECLAIM DISABLE

Once enabled, the Heat Reclaim Coil has a minimum run time of 15-minutes. As a default, the Heat Reclaim set point is set to the midpoint between the Occupied Heating and Cooling set point and can be adjusted if necessary. Reclaim output will be disabled during heating mode for units equipped with DX reclaim coils. If equipped with a CO2 reclaim coil, reclaim output will remain enabled during heating mode.

Air Cooled Condenser Control

Dehum Cooling Mode

Upon activation of a cooling or dehumidification mode the compressor(s) and condenser fan(s) will start and after a short delay reversing valve will energize for cooling. When the condenser fan(s) first enable, the fan(s) will maintain 100% speed for 10 seconds and then will modulate from the maximum speed of 100% to a minimum speed of 15% to maintain the head pressure setpoint.

Heating Mode

Upon activation of a heating mode the compressor(s) and condenser fan(s) will start, and the reversing valve will remain de-energized for heating. The condenser fan(s) will run at 100% during the heating mode of operation.

Defrost Mode

Defrost is initiated by a coil mounted temperature switch. When compressors are operation in heating mode, and the defrost temperature switch closes, the unit will enter defrost mode. During defrost mode compressors will ramp to full capacity, the reversing valve will energize, and the condenser fan(s) will turn off. Auxiliary heat will initialize to minimize temperature swing. Defrost will terminate after 10 minutes or the defrost temperature switch opens. Defrost will not be allowed for 30 minutes after the completion of a defrost cycle.

Air Cooled Condenser Safeties

- If the head pressure exceeds 550 PSIG, the condenser fan will immediately go to 100% speed and an alarm will be generated. Alarm will be reset once head pressure drops below 540 PSIG.
- If no head pressure sensor is detected, the condenser fan will go to 100% speed and an alarm will be generated. Alarm will automatically clear once the head pressure transducer failure is repaired.

MPU Safeties

Compressor Equipped Unit Safeties

- Low suction pressure mechanical cut-out at 60psig
- High discharge pressure mechanical cut-out at 600psig
- Compressor anti-short cycling timer of 3-minutes when suction group is enabled
- Compressor discharge temperature monitoring with condenser fast recovery. The fast recovery is both electromechanical and an application within the controller.

Safeties Included with All Units

- **Phase and brown-out protection:** Upon detection of a phase issue, the monitor opens the secondary 24VAC circuit, disables the control circuit and causes a unit shutdown. If the condition clears, the phase monitor will auto-reset.
- **Emergency Shutdown:** A 24VAC wet contact input is available to be used with a normally closed safety circuit. If this contact opens, it will immediately shut down the unit and generate an alarm. Alarm will automatically reset once the contacts are closed. Used for smoke detection and drain pan overflow.
- **Air Flow Switch:** A proof of flow switch provides a 24VAC wet contact closure when the supply fan in in operation. If this contact is open during a fan call, all cooling and heating are disabled, the outdoor air damper is closed, and an alarm will be generated. If the contact is closed within 10 minutes, the alarm will automatically reset, and the unit will restart. If the contact is open longer than 10 minutes, the unit will lockout on fan failure and require a manually reset of the alarm.
- **Supply Temperature Failure:** Upon detection of an open or shorted supply temperature sensor the unit will be completely shut down and an alarm will be generated. Alarm will automatically reset once the sensor failure is repaired.
- **Supply Temperature High Limit:** When the supply air temperature rises above the supply air high temperature cutoff, 150°F, the unit will immediately shut down and an alarm will be generated. Alarm will clear and unit will restart once the supply air temperature is 5 degrees below the supply air high temperature cutoff.
- **Supply Temperature Low Limit:** When the supply air temperature drops below the supply air low temperature cutoff, 40°F, for 10 minutes, the unit will completely shut down and an alarm will be generated. Alarm will clear and unit will restart once the supply air temperature is 5 degrees above the supply air low temperature cutoff.

MPU Alarms and Notices

The following alarms when detected, will be displayed in the i-Controller alarm log. All alarm timers are reset when alarms are manually cleared.

- **Clogged Filter Notice:** Alarm activated when the filters in the unit need to be replaced. Activated via a closure of the normal open clogged filter switch.
- **Fan Fail Alarm:** Alarm activated when the fan proof has not been made for more than 10-minutes. This alarm will cause a unit shutdown and must be manually reset in the display.
- **Emergency Shutdown Alarm:** Alarm activated when a smoke detection or drain pan overflow occurs. This alarm will cause the unit to shut down. Alarm is activated via an opening of the normal closed smoke detector input or the opening of the normally closed drain pan float switch and is automatically reset upon closure of both inputs.
- **Phase Loss Alarm:** Alarm activated when the digital phase monitor detects a fluctuation in the main unit power outside of the acceptable limits. This alarm will cause the unit to shut down after a 30-second delay. Alarm is activated via an opening of the normal closed phase loss input and is automatically reset upon closure of the input.
- **CO2 Notice*:** A high CO2 level notice is activated when the CO2 level in the space increases above the specified ppm limit (1500 ppm by default). The notice is automatically reset when CO2 level falls into the acceptable range.
- **Heat Alarm:** Alarm is activated if the supply temperature has not increased at least 5˚F with at least 50% compressor capacity activated for [30]-minutes. Alarm is automatically reset upon heat mode disable.
- **Heat Reclaim Notice*:** Alarm is activated if the supply temperature has not increased at least 5˚F after heat reclaim has been enabled for [30]-minutes. Alarm is automatically reset upon heat reclaim disable.
- **High and Low Supply Temperature Alarm:** When the supply air temperature rises above the supply air high temperature cutoff, 150°F, the unit will immediately shut down and an alarm will be generated. Alarm will clear and unit will restart once the supply air temperature is 5 degrees below the supply air high temperature cutoff. When the supply air temperature drops below the supply air low temperature cutoff, 40°F, for 10 minutes, the unit will completely shut down and an alarm will be generated. Alarm will clear and unit will restart once the supply air temperature is 5 degrees above the supply air low temperature cutoff.
- **Sensor Failure Alarm:** Alarm is activated when one or more of the temperatures, transducer, humidity, or CO2* sensors fail.
- **Refrigerant Leak Alarm*:** Alarm is activated if there is a leak in the store's refrigeration system. A digital signal is received from the refrigeration rack controller that signifies a leak has been detected. Once the signal is received, the OAD of the Flō unit will open to 100% to flush the store. The OAD will automatically return to normal operation once the refrigerant leak alarm has been resolved. Alarm is activated via a normal open network signal and is automatically reset upon an open signal. **If Equipped.*

Compressor Alarms for Digital and On/Off or Digital and 2-Stg Compressor Types

NO SUCTION PRESSURE SENSOR DETECTED: This alarm indicates the Suction Pressure Sensor is not detected by the system. There is no compressor failure from this alarm. The failure will be unsafe suction pressure.

NO HEAD PRESSURE SENSOR DETECTED: This alarm indicates the Head Pressure Sensor is not detected by the system. This will cause the condenser fan/valve to go to 100%.

HIGH HEAD PRESSURE DETECTED: This indicates a High Head Pressure Alarm condition which is activated when the Head Pressure rises above 550 PSIG. This will cause the condenser to go to 100%.

LOW SUCTION PRESSURE FAILURE: This alarm will occur if suction pressure stays below the low suction pressure setpoint for 1 minute or falls below 40 psi for 5 seconds. This alarm will shut down the system. Alarm will auto reset after the suction pressure has been above the low suction pressure setpoint for 5 minutes.

LOW SUCTION PRESSURE DETECTED: This alarm will occur if suction pressure falls below the low suction pressure setpoint for 20 seconds. The system will try to protect by lowering compressor modulation percentage.

COMPRESSOR FAULT: This alarm will occur if the compressor fails to run 45 seconds after the relay is activated or if the signal is lost after activation. This will cause an alarm and will shut down the compressor (relay). The system will retry after 5 minutes.

COMPRESSOR BAD TEMPERATURE: This alarm will occur if the discharge temp sensor measures less than -40 degrees F or more than 356 degrees F. This will cause an alarm and will shut down the compressor (relay). The system will retry after 5 minutes.

COMPRESSOR CUTOFF: This alarm will occur if the discharge temp sensor measures more than 265 degrees F. This will cause an alarm and will shut down the compressor (relay). The system will can be restarted after 30 minutes.

COMPRESSOR LOCKOUT: If active cutoff occurs 5 times within a 4-hour period, the compressor will be locked out. Must cycle power to RSMD to clear the alarm.

- If the Suction Pressure falls below the Unsafe Suction Setpoint for 5 seconds, that circuit's compressor will be locked out. Power will need to be cycled to restart the unit

Compressor Alarms for VFD Compressor Types

NO SUCTION PRESSURE SENSOR DETECTED: This alarm indicates the Suction Pressure Sensor is not detected by the system. The system will shut down due to Unsafe Suction safety and will retry after 5 minutes.
NO HEAD PRESSURE SENSOR DETECTED: This alarm indicates the Head Pressure Sensor is not detected by the system. This will cause the condenser fan/valve to go to 100%.

HIGH HEAD PRESSURE DETECTED: This indicates a High Head Pressure Alarm condition which is activated when the Head Pressure rises above 550 PSIG. This will cause the condenser to go to 100%.

LOW SUCTION PRESSURE FAILURE: This alarm will occur if suction pressure stays below the low suction pressure setpoint for 1 minute or falls below 40 psi for 5 seconds. This alarm will shut down the system. Alarm will auto reset after the suction pressure has been above the low suction pressure setpoint for 5 minutes.

LOW SUCTION PRESSURE DETECTED: This alarm will occur if suction pressure falls below the low suction pressure setpoint for 20 seconds. The system will try to protect by lowering compressor modulation percentage.

COMPRESSOR FAULT: This alarm will occur if the compressor fails to run 45 seconds after the relay is activated or if the signal is lost after activation. This will cause an alarm and will shut down the compressor (relay). The system will retry after 5 minutes.

COMPRESSOR BAD TEMPERATURE: This alarm will occur if the discharge temp sensor measures less than -32 degrees F or more than 310 degrees F. This will cause an alarm and will shut down the compressor (relay). The system will retry after 5 minutes.

LOW SUPERHEAT DETECTED: This alarm will be activated when the Superheat is less than 4 degrees F for 2 minutes during normal operation or for 4 minutes during the first 10 minutes. The system will shut down and will retry after 5 minutes.

HIGH SUPERHEAT WARNING: If superheat if above 25 degrees F for 2 minutes, this alarm will appear on the refrigeration module only.

HIGH SUPERHEAT FAILURE: If superheat is above 30 degrees F for 10 minutes, it will fail the compressor. It will retry after 5 minutes. If it fails twice in two hours, it will lock out the compressor.

HIGH SUPERHEAT LOCKOUT: If the module fails on high superheat twice in 2 hours, it will lock out the compressor. Power will need to be cycled to restart unit.

Additional Functionality

Additional features available in the i-Controller that are not included in the core sequence of operation.

Return Temp Control

In the event the space temperature probe is not yet installed or is malfunctioning outside of the probe operating range, the return air temperature reading will be used as the space temperature control value. If the unit is under return temperature control, the supply fan will continue to operate per the current mode, the OAD will close completely, and the RAD and BAD will revert to Unoccupied mode settings.

If a DCV demand exists during Return Temp Control operation, the OAD will open incrementally according to the current CO2 levels. If the **RETURN** and **SPACE** temperature sensors fail, the unit will enter a **SHUTDOWN** mode.

Set Point Limits and Adjustments

The OCC/UNOCC heating, cooling, and dehumidification set points are subject to the limits and requirements listed below.

- Heating set point limit: 50˚F - Cool SP - 4°F
- Cooling set point limit: Heat SP+ 4°F - 85˚F
- Dehumidification set point limit: 48˚F - 60˚F

A minimum difference of 4˚F between the heating and cooling set points is required to prevent the short cycling of operation modes. If the difference is less than 4˚F, the set points will automatically adjust per the following rules:

- Outdoor Air Temp > 60˚F: Heating Set Point = Cooling Set Point - 4˚F
- Outdoor Air Temp < 50˚F: Cooling Set Point = Heating Set Point + 4˚F

Reheat/Reclaim setpoints must be less than 2˚F below the OCC cooling set point, and 1˚F above the OCC heating set point. The Reheat/Reclaim disable point (cutout) must also occur no greater than 1˚F below the OCC cooling set point. If the inputted set point or cutout is not within these limits, the values will be automatically adjusted as follows:

- Reheat/Reclaim SP >= Occ Cool SP - 1˚F: Reheat/Reclaim SP = Occ Cool SP - 2˚F
- Reheat/Reclaim SP < Occ Heat SP + 1˚F: Reheat/Reclaim SP = Occ Heat SP + 1˚F
- Reheat/Reclaim SP + Cutout > Occ Cool SP - 1˚F: Cutout = Occ Cool SP - 1˚F - Reheat/Reclaim SP

Sensor Offsets and Limits

A minor offset may be used to calibrate a sensor and improve its accuracy. However, if a sensor requires an offset outside the allowable range, the sensor must be replaced.

The allowable offset range for each sensor type is:

- Temperature Sensors: +/- 3˚F
- Pressure Transducers: +/- 5psig
- Humidity Sensor: +/- 6%
- Dew Point Sensor: +/- 3˚F

Run-Time Delays *(Equipment Timers)*

Mechanical equipment within the unit may require safety time delays to protect against erratic behavior and preserve the life of the equipment. Time delays can be implemented as a minimum run time delay, meaning the minimum amount of time the equipment is required to run before it can be disabled. The delays can also be implemented as an ON delay, meaning the minimum amount of time required before the equipment is activated. Below is a list of equipment time delays.

- Compressor Stage Up Delay: 3-minutes
- Compressor Stage Down Delay: 1-minutes
- Compressor Minimum Run Time: 5-minutes
- Compressor Minimum Off Time: 3-minutes
- Heat/Cool changeover delay: 5-minutes
- Reclaim Minimum Run: 15-minutes
- Reheat Minimum Run: 8-minutes
- Heat Stage 2, 3, 4 On Delay: 5-minutes
- Heat Stage Minimum Run Time: 5-minutes

Load Shed

Electrical companies often offer rebates for reducing energy consumption during peak usage times. Load shed is an available option that reduces operation of the Flō unit when activated. A digital input or network signal can be sent to the controller to enable Load Shed mode. Once activated, the following will occur:

- Heating setpoint will be shifted by user defined offset. Default setting is -2°F and is adjustable from -5-0°F offset.
- Cooling setpoint will be shifted by user defined offset. Default setting is 2°F and is adjustable from 0-5°F offset
- Dewpoint setpoint will be shifted by user defined offset. Default setting is 1°F and is adjustable from 0-3°F offset.
- The supply fan is reduced to Min%, and the dampers will revert to Unoccupied mode settings

Energy Recovery Ventilation (ERV) *(if equipped)*

Energy Recovery Ventilation (ERV) is sometimes required for units with 100% outdoor air requirements. The ERV wheel exchanges energy between the incoming outdoor air and the exhausted return air. The exhausted air pre-conditions the outdoor air. The additional equipment required for this process includes: ERV Wheel, and Power Exhaust, the i-Controller ERV strategy also includes a Free Dehum Mode.

For the ERV strategy, the following sequence will take place.

The economizer will activate when there is a cooling or dehumidification demand in the space and OA Dew Point < 3.5˚F below the OCC Dew Point Set Point, this mode is activated.

- ERV is activated during Occupied hours and anytime the OAD is open.
- Power Exhaust is activated during Occupied hours.
- If Free Dehum Mode is active:
  - ERV Wheel and Power Exhaust is disabled.
  - MPU compressors are locked out.
  - OAD will open to 80% minimum.
- If the Outdoor Air temperature dips below defrost setpoint, the ERV defrost cycle will be initiated to ensure moisture does not freeze on the wheel surface. The defrost cycle proceeds as follows:
  - The ERV Wheel is activated for 5 seconds to move to a new position.
  - The ERV Wheel is held in this position for 30-seconds with the power exhaust ON to remove moisture from the wheel.
  - After 30 seconds, the ERV Wheel is activated again for 5 seconds to move to a new position.
  - The above activation / pause steps are repeated 12 consecutive timers to ensure moisture is removed from the entire wheel.
  - This defrost cycle will occur once every hour if the outdoor temperature remains below 10°F.

Return Air Power Exhaust *(if equipped)*

Return air power exhaust is an available option for MPU's. The power exhaust will operate according to the following sequence:

- The OAD is open and the end limit switch on the damper assembly is ON, the power exhaust is activated. If the exhaust fan is equipped with a VFD for variable power exhaust, the VFD will be set at minimum speed [20%].
- When the OAD closes and the end limit damper switch turns OFF, the power exhaust will be disabled.
- During a Smoke Alarm event, the variable power exhaust will be enabled, and the fan speed will be set to maximum speed [100%].

Exhaust Fan Interlocks *(if equipped)*

Exhaust fan interlocks are available in the i-Controller. The interlocks signify that an exhaust source is active and activate the OAD to open and additional [X%]. This default percentage is set to [10%] and can be adjusted using the display. A maximum of 1 interlock signal can be sent as digital inputs or 3 network signals to the i-Controller.