



# **ADDISON®**

## **SEQUENCE OF OPERATION FOR ALC CONTROL**

**AIR SOURCE HEATPUMP  
100% OUTSIDE AIR WITH ECW**

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# SEQUENCE OF OPERATION

The **ALC** controller is turned on by a switch located on its front upper left corner. Several **Occupancy Control** options are available for starting the unit. These can be selected from the **BACview** display pad on the **Controls** screen (requires user password). The Resident Program has an adjustable scheduler that uses the internal time clock to allow for separate Sequences for Occupied and Unoccupied periods. This can be accessed from the **BACview** display pad on the **Schedules** screen (requires user password). **NOTE:** All temperature-related events have an additional **10** second (fixed) "delay on make" to allow temperatures to settle.

## **OCCUPIED MODE:**

When the **BACview** Schedule calls for the start of the Occupied Mode, and the **ALC** controller has verified that there are no fault or shutdown conditions, after a **30** second (fixed) delay the unit goes into Occupied Mode:

### **1. Outdoor Air Damper (OD):**

- After the unit goes into Occupied Mode, the Outdoor Air (**OA**) damper will open. As the **OA** damper opens, the Outdoor Air Damper Actuator (**OADA**) auxiliary switches close.
- The **OA** damper stays open until the system reaches the end of the Occupied Mode period. It will remain open until the supply fan turns off. After the supply fan turns off, the **OA** damper will close.

### **2. Supply Fan (SF):**

- As the **OA** damper opens, the **OADA** auxiliary switch will close and the **SF** will turn on.
- The **SF** will run for 60 seconds (fixed) before cooling, dehumidification, or heating will be enabled.
  - The **SF** shall operate continuously while the unit is in the Occupied Mode. When the system reaches the end of the Occupied Mode period, the **SF** will continue to run for an additional **2** minutes before turning off.
- **SF-VSC:** Supply Fan with Variable Speed Control.
- The **SF-VSC** will modulate its speed based upon the **SF** Differential Pressure Transmitter (**SF-DPT**) signal and the supply duct static pressure set point.
- **Optional:** For constant air volume (**CAV**), select "**Manual Override**" in the **BACview** keypad and input the required speed (%) as determined in the field by Test and Balancing.

### **3. Exhaust Fan (EF):**

- At the same time the **SF** turns on, the **EF** will be enabled to run.
- The **EF** shall be enabled to run while the unit is in the Occupied Mode. When the system reaches the end of the Occupied Mode period, the **EF** will be enabled to run for an additional **2** minutes before turning off.
- **EF-VSC:** Exhaust Fan with Variable Speed Control.
  - If the Zone Differential Pressure Transmitter (**ZN-DPT**) signal is above the building static

pressure set point, the **EF-VSC** will modulate its speed based upon the **ZN-DPT** and the set point. If the **ZN-DPT** signal is below the building static pressure set point, the **EF** will modulate down to **0%** (adjustable) speed.

- **Optional:** For constant air volume (**CAV**), select "**Manual Override**" in the **BACview** keypad and input the required speed (%) as determined in the field by Test and Balancing.

### **4. Energy Conversation Wheel (ECW):**

- After the **SF** turns on, the **ECW** is enabled.
- **ECW with VFD Controlled Defrost (WM-VFD):**
- When the **OAT** is **3°F** (adjustable) or more above or below the **RAT**, the **ECW** will be on. It will be off if the **OAT** is less than **3°F** (adjustable) above or below the **RAT**. If the **WExAT** goes below **25°F** (adjustable), it will modulate speed down to **10 Hz** (minimum, adjustable) to allow for wheel defrosting. It will increase speed as the **WExAT** rises toward **25°F** (adjustable) or more.

### **5. Cooling Mode:**

- Reversing Valve is "**OFF**" in Cooling Mode.
- Cooling Mode is available when the Entering Coil Air Temperature (**ECAT**) is **1°F** (fixed) above the **ECAT** cooling lower limit (**55°F**, adjustable) and there is a demand for cooling.
- When the Entering Coil Air Temperature (**ECAT**) is **1°F** (adjustable) or more above the **ECAT** cooling set point (**70°F**, adjustable), compressor #1 turns on.
- When the **SAT** is **2°F** (adjustable) or more above the **SAT** cooling set point (**70°F**, adjustable), compressor #2 turns on -- not less than **30** minutes (adjustable) after compressor #1 turned on.
- When the **SAT** is **2°F** (adjustable) or more below the **SAT** cooling set point (**70°F**, adjustable), compressor #2 turns off.
- When the **ECAT** is **1°F** (adjustable) or more below the **ECAT** cooling set point (**70°F**, adjustable), compressor #1 turns off.
- Minimum **SF-VSC** modulation shall be **50%** (adjustable; 50% min.).
- **Optional:** When enabled, if there is a call for 1st stage cooling, 2nd stage cooling will be enabled after a 10-minute (adjustable) delay. Both compressors

modulate based upon the cooling set point. Default is "OFF".

- Compressor enabling logic includes a **5-minute** (fixed) minimum run-time and a **5-minute** (fixed) minimum timeoff delay to prevent compressor short cycling.
- **Digital Compressors:**
  - The **ALC** controls the capacity of the digital compressor by rapidly loading and unloading the compressor in **15** second intervals.
  - The digital compressor will modulate based upon the **SAT** sensor and set point (**70°F**, adjustable).
  - If the **DX LAT** drops to **38°F** or less for **3** minutes, the **ALC** controller will issue an alarm and the compressor stops. When the **DX LAT** warms back up to **55°F** or more, the compressor turns back on.
- If there is a current call for 1st stage cooling and compressor #1 is shut down due to an alarm (**HPS1**, **LPS1**, or **DX LAT1**), compressor #2 will be turned on to take its place until it returns.
- **Hot Gas Reheat (HGRH) – On/Off:**
  - When the **SAT** is **1°F** (adjustable) or more below the **SAT** cooling set point (**70°F**, adjustable), **HGRH** turns on and cycles based upon the **SAT** cooling set point.
  - When **SAT** is **2°F** (adjustable) or more above the **SAT** cooling set point, **HGRH** turns off.

## 6. Dehumidification Mode:

- Reversing Valve is "OFF" in Dehumidification Mode.
- Dehumidification Mode is available if the **ECAT** is **1°F** (fixed) above the dehumidification lower limit of **60°F** (adjustable) and there is no call for heating.
- When the Entering Coil Air Dew Point (**ECDP**) is **1°F** (adjustable) or more above the Supply Air Dew Point (**SADP**) set point (**53°F**, adjustable), Dehumidification Mode is enabled. After the minimum time-off delay, compressor #1 turns on.
- When the **SADP** is **2°F** (adjustable) or more above the **SADP** set point (**53°F**, adjustable), and after minimum time-off delay, compressor #2 turns on -- not less than 30 minutes (adjustable) after compressor #1 turned on. Both compressors respond in sequence and run at full cooling.
- **HGRH** is enabled to operate as necessary based upon the **SAT** dehumidification set point (**70°F**, adjustable).
- When **SADP** is **1°F** (adjustable) or more below **SADP** set point (**53°F**, adjustable), compressor #2 turns off.
- When the **ECDP** is **2°F** (adjustable) or more below the **SADP** set point (**53°F**, adjustable), compressor #1 turns off and Dehumidification Mode is disabled.
- **Digital Compressors:**
  - The **ALC** controls the capacity of the digital

compressor by rapidly loading and unloading the compressor in **15** second intervals.

- The digital compressor will modulate based upon the **SADP** sensor and **SADP** set point (**53°F**, adjustable).
- **Hot Gas Reheat (HGRH) – On/Off:**
  - When the **SAT** is **1°F** (adjustable) or more below the **SAT** dehumidification set point, **HGRH** turns on and cycles based upon the **SAT** dehumidification set point .
  - When the **SAT** is **2°F** (adjustable) or more above the **SAT** dehumidification set point, **HGRH** turns off.

## 7. Heating Mode:

- Heating Mode is available when the **ECAT** is **1°F** (fixed) below the **ECAT** heating upper limit (**60°F**, adjustable) and there is a demand for heating.
- Reversing Valve is "ON" in Heating Mode.
- When the **ECAT** is **1°F** (adjustable) or more below the **ECAT** heating set point (**55°F**, adjustable), compressor #1 turns on.
- When the **SAT** is **2°F** (adjustable) or more below the **SAT** heating set point (**70°F**, adjustable), compressor #2 turns on -- not less than **10** minutes (adjustable) after compressor #1 turned on.
- When the **SAT** is **2°F** (adjustable) or more above the **SAT** heating set point (**70°F**, adjustable), compressor #2 turns off.
- When the **ECAT** is **2°F** (adjustable) or more above the **ECAT** heating set point (**55°F**, adjustable), compressor #1 turns off.
- Heat pump operation shall be disabled if the **SF-VSC** modulation drops below **85%** (adjustable).
- **Optional:** When enabled, if there is a call for 1st stage heating, 2nd stage heating will be enabled after a **10-minute** (adjustable) delay. Both compressors modulate based upon the heating set point. Default is "OFF".
- Compressor enabling logic includes a **5-minute** (fixed) minimum run-time as well as the **5-minute** (fixed) minimum time-off delay to prevent compressor short cycling.
- **Digital Compressor:**
  - The **ALC** controls the capacity of the digital compressor by rapidly loading and unloading the compressor in **15** second intervals.
  - The digital compressor will modulate based on the **SAT** sensor and **SAT** heating set point (**70°F**, adjustable).
  - If there is a current call for 1st stage heating and compressor #1 is shut down due to an alarm (**HPS1**, **LPS1**, or **DX LAT1**), compressor #2 will be turned on to take its place until it returns.

- **Defrost Mode:** On defrost mode, the reversing valve will switch to cooling to defrost the built-up ice on the condenser coil.
- The unit is equipped with a **Defrost Timer**. The defrost timer provides a selectable time interval between defrost cycles. It will allow a **10** minute defrost every **30/60/90** minutes as long as the defrost thermostat is closed. The timer is factory set at **60** minutes. The time interval may be changed to **30** or **90** minutes if desired (disconnect power to the unit before moving the jumper). The hold input on the defrost timer allows the timer to accumulate time while the compressor is running in heating mode. A warm outdoor coil causes the defrost thermostat to open which will prevent time accumulation or end the Defrost period. The defrost timer allows up to a **10** minutes defrost cycle if the defrost thermostat is closed. When the defrost period ends, either by opening of the defrost thermostat or after the **10** minutes defrost period has elapsed, the timer is reset. By shorting the two test terminals together on the defrost timer, a **60** minute delay is reduced to **14** seconds and a **10** minute delay is reduced to **2.3** seconds for testing purposes.
- During defrost cycle, the auxiliary heat will energize based upon the **SAT** set point.
- **Auxiliary Heat:**
- After either heat pump has been enabled, when the **SAT** is **2°F** (adjustable) or more below the **SAT** heating set point (**70°F**, adjustable), and after a **10**-minute (adjustable) delay period, auxiliary heating will be enabled. When the **SAT** is equal to the **SAT** heating set point (**70°F**, adjustable), auxiliary heating will be disabled.
- **Modulated Auxiliary Heat:**
- **Modulating Gas Furnace:** On demand for auxiliary heating, the **ALC** controller modulates the gas furnace controller to control the gas flow based upon the **SAT** heating set point (**70°F**, adjustable).

## 8. Emergency Heating Mode:

- Compressors are “**OFF**” in Emergency Heating Mode.
- Emergency Heating mode is selectable using the **BACview** display pad or Building Automation System (**BAS**) (default is “**OFF**”). Emergency Heating mode will automatically be turned on if both heat pump compressors fail or are disabled due to either the **OAT** going below the Compressor Disable set point of **26°F** (adjustable) or the **SF-VSC** modulating below **85%** (adjustable).
- Emergency Heating Mode is available when the **OAT** is below the **OAT** heating upper limit (**60°F**, adjustable) and there is a demand for heating.
  - **Modulated Emergency Heat:**
  - **Modulating Gas Furnace:** On demand for emergency heating, the **ALC** controller modulates the gas furnace controller to control the gas flow based

upon the **SAT** heating set point (**70°F**, adjustable).

## UNOCCUPIED MODE:

- When the **Occupancy Control** indicates the end of the Occupied Mode, the compressor(s) and outdoor fan(s) will turn off (subject to minimum run-time). The **SF** and **EF** will continue to run for **2** minutes before turning off.
- After this, the **ECW** will turn off and the **OA** damper will close. The unit is now off.

## Safety Switches:

- **High Pressure Switch (HPS1):** If **HPS1** is open, compressor #1 will turn off and the **ALC** controller will issue an alarm. After manually resetting **HPS1**, the **HPS1** alarm will reset. Following a minimum time off delay, compressor #1 will turn on. If the **ALC** controller records **3** high pressure start/restart failure incidents within **1** hour, compressor #1 is locked out and the **ALC** controller will issue an alarm. The compressor lock-out can be reset in the **BACview** display pad or by cycling the power of the **ALC** controller.
- This sequence is the same for compressor #2, **Y2**, and **HPS2**.
- **Low Pressure Switch (LPS1):** If **LPS1** is open after the **LPS1** by-pass time, the **ALC** controller will issue an alarm and compressor #1 turns off. After **30** seconds (fixed), the **LPS1** alarm will reset. Following a minimum time off delay, compressor #1 will turn on. If the **ALC** controller records **3** low pressure start/restart failure incidents within **1** hour, compressor #1 is locked out and the **ALC** controller will issue an alarm. The compressor lock-out can be reset in the **BACview** display pad or by cycling the power of the **ALC** controller.
- This sequence is the same for compressor #2, **Y2**, and **LPS2**.

## Safety Shutdown:

- If a compressor fails to start **3** times in an hour due to high pressure switch lock out.
- If a compressor fails to start **3** times in an hour due to low pressure switch lock out.
- If a compressor fails to start **3** times in an hour due to DX leaving air temperature lock out.
- If the **ALC** controller detects an **SAT** sensor failure.

**Standard Alarms:** (alarms require reset in the **BACview** or cycling the power of the **ALC** controller unless noted)

1. **OADA Alarm:** When the **OADA** fails to open or closes due to **OADA-A** (adj.) being open; following **2** minute (adjustable) delay. Unit will automatically shut down.
2. **OADA Hand:** When the **OADA** is commanded closed

- but the **OADA-A** (adj.) still indicates to the **ALC** it is open; following **2** minute (adjustable) delay.
3. **ECW Alarm:** When the **ECW** fails to start or stops due to **WM-CS** open; following **1** minute (adjustable) delay.
  4. **ECW Hand:** When the **ECW** is commanded off but the **WM-CS** still indicates to the **ALC** it is on; following **1** minute (adjustable) delay.
  5. **Supply Fan Alarm:** When the **SF** fails to start and the **SF-APS** does not confirm air flow to **ALC**, following **1** minute (adjustable) delay. Unit will automatically shut down.
  6. **Supply Fan Hand:** When the **SF** is commanded off and the **SF-APS** still indicates air flow to **ALC**, following **1** minute (adjustable) delay. **OA Damper** (if existing) will be commanded to remain open.
  7. **Supply Fan Run Time:** When the **SF** run time has exceeded the maximum run time allotted (adjustable).
  8. **Exhaust Fan Alarm:** When the **EF** fails to start and the **EF-APS** does not confirm air flow to **ALC**, following **1** minute (adjustable) delay.
  9. **Exhaust Fan Hand:** When the **EF** is commanded off and the **EF-APS** still indicates air flow to **ALC**, following **1** minute (adjustable) delay.
  10. **Exhaust Fan Run Time:** When the **EF** run time has exceeded the maximum run time allotted (adjustable).
  11. **Compressor #1 Alarm:** Compressor stops due to **CC1-CS** open; following **60** second (fixed) delay. Compressor lock out occurs if alarm happens **3** times in **1** hour (**Compressor #1 STOP**).
  12. **Compressor #1 Hand:** Compressor is commanded off but the **CC1-CS** still indicates to the **ALC** it is on; following **60** second (fixed) delay.
  13. **Compressor #1 Run Time:** When the **C1** run time has exceeded the maximum run time allotted (adjustable).
  14. **High Pressure Switch #1 Alarm:** Compressor stops due to **HPS1** open; following **30** second (fixed) delay. Requires **HPS1** manual reset. Compressor lock out occurs if alarm happens **3** times in **1** hour (**High Pressure Switch #1 STOP**).
  15. **Low Pressure Switch #1 Alarm:** Compressor stops due to **LPS1** open; following **90** second (fixed) delay. Compressor lock out occurs if alarm happens **3** times in **1** hour (**Low Pressure Switch #1 STOP**).
  16. **Freeze Protection #1 Alarm:** Compressor stops due to **DX LAT1** freeze condition; following **3** minute (adjustable) delay. Compressor lock out occurs if alarm happens **3** times in **1** hour (**FP #1 STOP**).
  17. **Compressor #2 Alarm:** Compressor stops due to **CC2-CS** open; following **60** second (fixed) delay. Compressor lock out occurs if alarm happens **3** times in **1** hour (**Compressor #2 STOP**).
  18. **Compressor #2 Hand:** Compressor is commanded off but the **CC2-CS** still indicates to the **ALC** it is on; following **60** second (fixed) delay.
  19. **Compressor #2 Run Time:** When the **C2** run time has exceeded the maximum run time allotted (adjustable).
  20. **High Pressure Switch #2 Alarm:** Compressor stops due to **HPS2** open; following **30** second (fixed) delay. Requires **HPS2** manual reset. Compressor lock out occurs if alarm happens **3** times in **1** hour (**High Pressure Switch #2 STOP**).
  21. **Low Pressure Switch #2 Alarm:** Compressor stops due to **LPS2** open; following **90** second (fixed) delay. Compressor lock out occurs if alarm happens **3** times in **1** hour (**Low Pressure Switch #2 STOP**).
  22. **Freeze Protection #2 Alarm:** Compressor stops due to **DX LAT2** freeze condition, following **3** minute (adjustable) delay. Compressor lock out occurs if alarm happens **3** times in **1** hour (**FP #2 STOP**).
  23. **Sensor Failure:** Readings exceed sensor limits, following **2** minute (fixed) delay. Alarms reset automatically.
  24. **SAT Sensor Failure:** Open: **-60.2°F**, Short: **296°F**. Unit will automatically shut down.
  25. **High SAT Alarm:** **SAT** high limit, **130°F** (adjustable) with Gas Furnace Heat. Alarm resets automatically.
  26. **Low SAT Alarm:** **SAT** low limit, **40°F** (adjustable), following **10** minute (adjustable) delay. Unit will automatically shut down.
  27. **Heat Failure:** In heating mode and the **SAT** falls below **50°F** (adjustable), following **10** minute (adjustable) delay. Alarm resets automatically.