Integrated Sequence of Operation:

Coordinating Multiple AIRSYS Lead/Lag HVAC Controllers to Achieve Desired Control Scheme

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AIRSYS

Balance the Environment

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How to Coordinate Multiple AIRSYS Lead/Lag HVAC Controllers to Achieve Desired Control Scheme

While employing multiple lead/lag HVAC controllers for larger rooms has the benefit of added control and monitoring redundancies, care must be taken to coordinate their sequence of operation.

Due to non-uniform heat load distribution in most buildings, unbalanced loading on HVAC units can occur even if all lead/lag controllers have the same setpoints, which reduces system efficiency and increases maintenance cost.

This can be prevented by:

- Optimizing control setpoints across the lead/lag controllers
- Selecting appropriate location(s) for the indoor temp sensors
- Verifying the sequence of operation during regular PM schedule

Consider the two major benefits of correctly setting up the sequence of operation:

Balanced Wear and Tear

Distributing runtime across all HVAC units will reduce the maximum runtime on individual systems and thereby reduce the frequency and cost of maintenance. It also allows the units to age at approximately the same rate so eventual replacement can be done with a single team/project instead of having multiple dispatches.

Optimized System Efficiency

When no proper rotation is used and one or two units are constantly running, the filters can clog up much quicker than usual, which negatively affects system efficiency. The Variable EC fans installed in AIRSYS units also benefit from distributing heat load across all units since fan efficiency increases with lower load.

Control Logic Overview

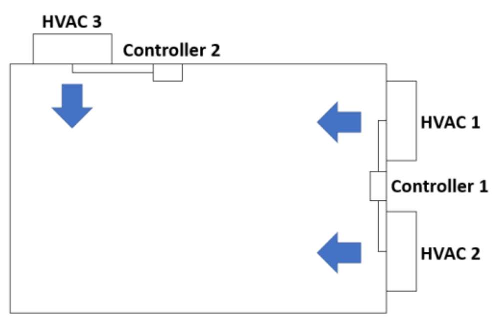
Each AIRSYS Lead/Lag Controller (Models ASLLC.2(A) and ASLLC.2(A).48) can control up to two units. There are two methods of cooling: Free Cooling (FC) and Direct Expansion (DX). FC uses direct outside air for extremely efficient cooling. DX uses the compressor to run a refrigeration cycle when FC is not available.

The controller(s) prioritize FC on all units before turning on DX. If FC cannot keep up with the heat load or if environmental conditions are unfavorable, DX will activate and rotate between the lead unit and the lag unit. The main setpoint determines the control temperature for FC. The lead unit's DX turns on at setpoint + lead offset. The lag unit's DX turns on at setpoint + lag offset.

While there is no single solution perfectly suited for all buildings, this document will go through the control optimization for several field examples and explain the rationale behind each selection.

Note: For exact steps on how to change each parameter, refer to the front sticker on the lead/lag controller or the WPU/IPU Installation & Operation Manual.

Case Study #1: Odd Unit



Objective: Control a single zone with 3 units (2 primary lead/lag and 1 backup). The temperature is to be maintained at 78-82°F with the backup unit only coming on above 90°F. All three units should share similar runtime through rotation.

Solution: Since each controller controls one or two HVAC units, these 3 units require 2 controllers. For reference, let HVAC 1 and HVAC 2 connect to controller 1 and HVAC 3 connect to Controller 2.

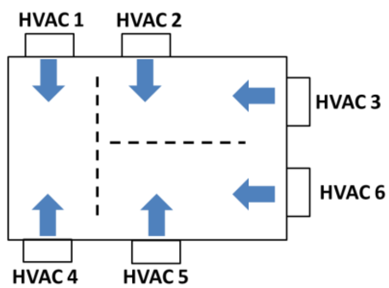
Both controllers should have a main setpoint of 78°F. This setpoint is the FC control point; since both controllers are controlling the same zone, it is recommended to have the same FC control point to maximize FC time.

For DX, the lead offset on controller 1 should be 2°F, the lead offset on controller 2 should be 4°F, and the lag offset on controller 1 should be 12°F. This will turn the lead unit on at 80°F, the lag unit on at 82°F, and the backup on at 90°F. The backup unit will be rotated on a schedule between HVAC 1 and HVAC 2 while HVAC 3 always comes on second to ensure distributed runtime.

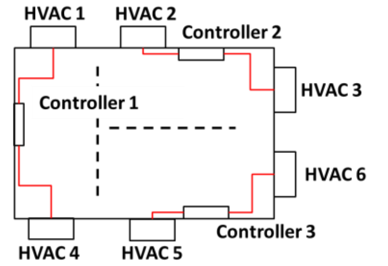
For this building, the indoor temperature sensor for both controllers should be placed at the same location and calibrated to within 0.5°F of each other. This is because the sequence is based on temperature control points that are very close to each other (78°F, 80°F, and 82°F) and thus susceptible to temperature gradient if they are scattered throughout the building.

Case Study #2: Separate Control Zones

Objective: Control 3 loosely contained zones with 6 units (3 lead and 3 lag). The two rooms on the right must be 75-80°F under normal conditions, and up to 85°F during emergencies. The room on the left has some non-sensitive equipment and can be maintained 75-90°F. All units shall share similar runtime through rotation.



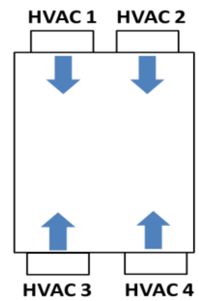
Solution: Since the zones must each maintained at a certain temperature, each zone should have one lead/lag controller installed. This means HVAC 1 and 4 connect to Controller 1, HVAC 2 and 3 connect to Controller 2, and HVAC 5 and 6 connect to Controller 3.



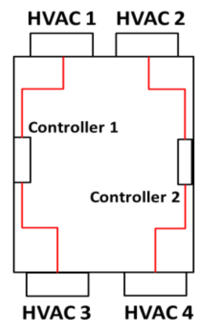
Since the containment is loose, all controllers' primary setpoint should be set to the same value to ensure optimal control over FC. In this building DX can be offset independently in each section as required since each zone is monitored and controlled independently. On Controller 1, the lead offset should be 10°F and the lag offset 15°F. On Controllers 2 and 3, the lead offset should be 5°F and the lag offset 10°F.

The indoor temperature sensor for each controller should be placed in its corresponding zone since each zone's temperature must be individually controlled.

Case Study #3: Staged Standby



Objective: Control a single zone with 4 units. 2 of the primary units will keep the indoor temp at 77-83°F. The first backup comes on 88°F and second backup at 93°F. The 2 backup units should rotate and become the primary units after some time. The customer requests that if there are 2 units running DX, that they be from different vertical columns. For example. if HVAC 1 is running and another unit is required, then either HVAC 2 or 4 should run.



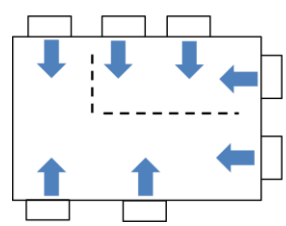
Solution: Have HVAC 1 and 3 connect to controller 1 and HVAC 2 and 4 connect to controller 2.

Note: the physical location of the controllers does not matter, as long as they are wired to the correct units.

Both controllers should have the main setpoint set to 77°F. Controller 1 should have lead offset set to 3°F and lag offset set to 16°F. Controller 2 should have lead offset set to 6°F and lag offset set to 11°F. This will allow HVAC 1 and 2 to be the primary units, switching to HVAC 3 and 4 after rotation.

The indoor temperature sensors do not need to be at the same location since the control points for the backup units are relatively far apart, thus making temperature gradients a non- issue. The sensors can be either placed at the center of the room or around hotspots. However, care should be taken to ensure that supply or exhaust air is not blowing directly or indirectly (reflected) at the sensors.

Beyond Case Studies: Adapting Solutions



The above case studies provide specific examples for specific objectives. Adapting solutions laid out in these case studies will require an understanding of the specific requirements of each site. Scaling and combining existing solutions may also help. For example, a combination of solutions laid out from Cases 1 and 2 can be used to tackle the layout given on the right.

If you would like further control recommendation, please contact us at ASNSupport@air-sys.com.