Smart Core Recovery System™

Innovating with the Geniox AHU

systemair

In 1974, Systemair developed the circular in-line centrifugal duct fan. The product was revolutionary in its time and we continue to look for ways to innovate. Since then, Systemair has expanded its product line to include air handling units (AHUs) for commercial use. Developed to provide tempered fresh air to commercial buildings, the Geniox AHU can handle airflows from 440 to 65,000 CFM. It is fully customizable, made of high-quality materials, and offers the ultimate flexibility to suit every project; however, that's not the reason this paper was written.

This discussion will revolve around Systemair's Smart Core Recovery System, in contrast to reverse-core and dual-core technology. These fascinating pieces of equipment are known for their high levels of efficiency. They significantly reduce equipment size downstream, and the best part: there is no need to pre-heat even at temperatures as low as -40°C. Although they offer many advantages, reverse-core and dual core are not without their drawbacks.

We'll explore these technologies, and how the Geniox AHU compares, specifically when it comes to **frost prevention**.

Overview of AHUs with Reverse-core or Dual-core Technology

Commonly known, AHUs introduce fresh air into the building through a single heat exchanger or energy recovery wheel. These units use two air streams:

- Nonconditioned, outdoor air is introduced through the core and then into the main areas of the building as supply air.
- Tempered, return air is brought through the core and then out of the building as exhaust air.

These air streams pass through the core in separate channels, actively energizing the core closer to room temperature.

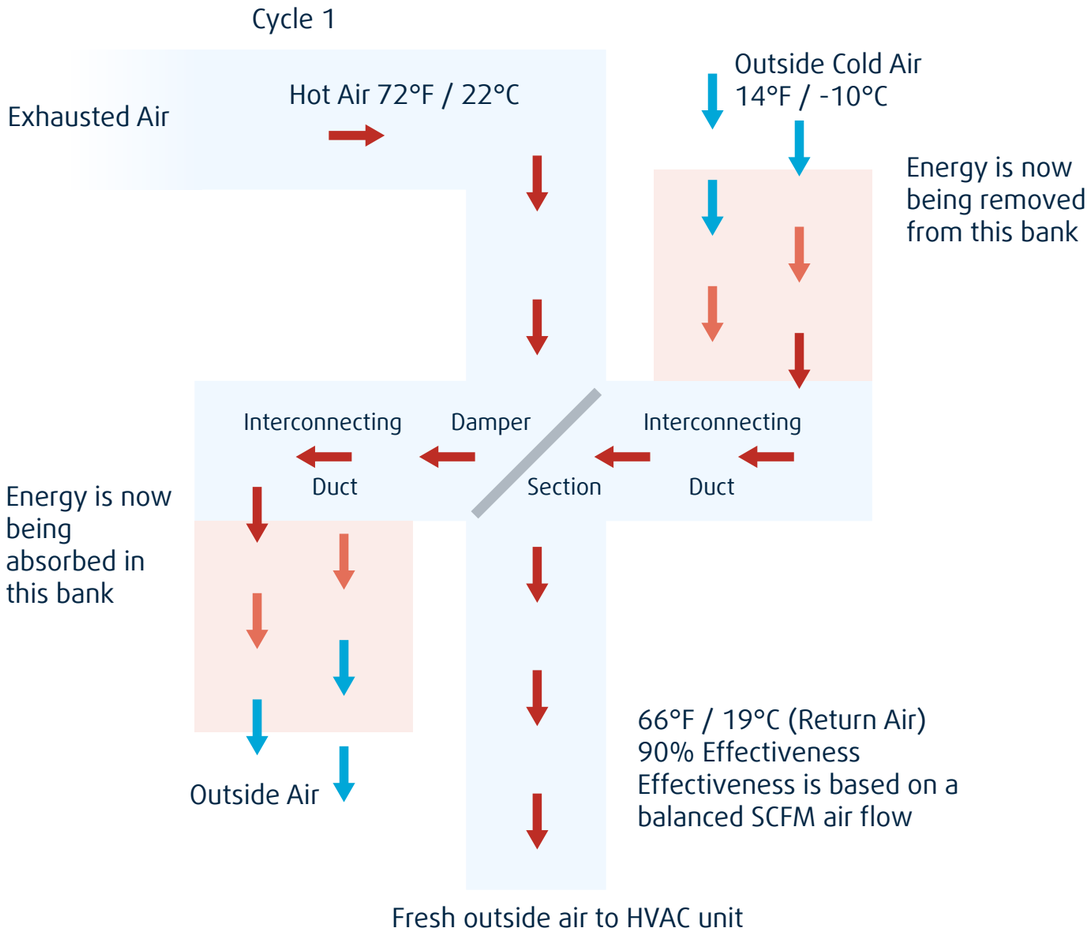
On the other hand, AHUs with reverse-core or dual-core technology have different mechanisms, since they use multiple cores.

Reverse-core Technology: How It Works

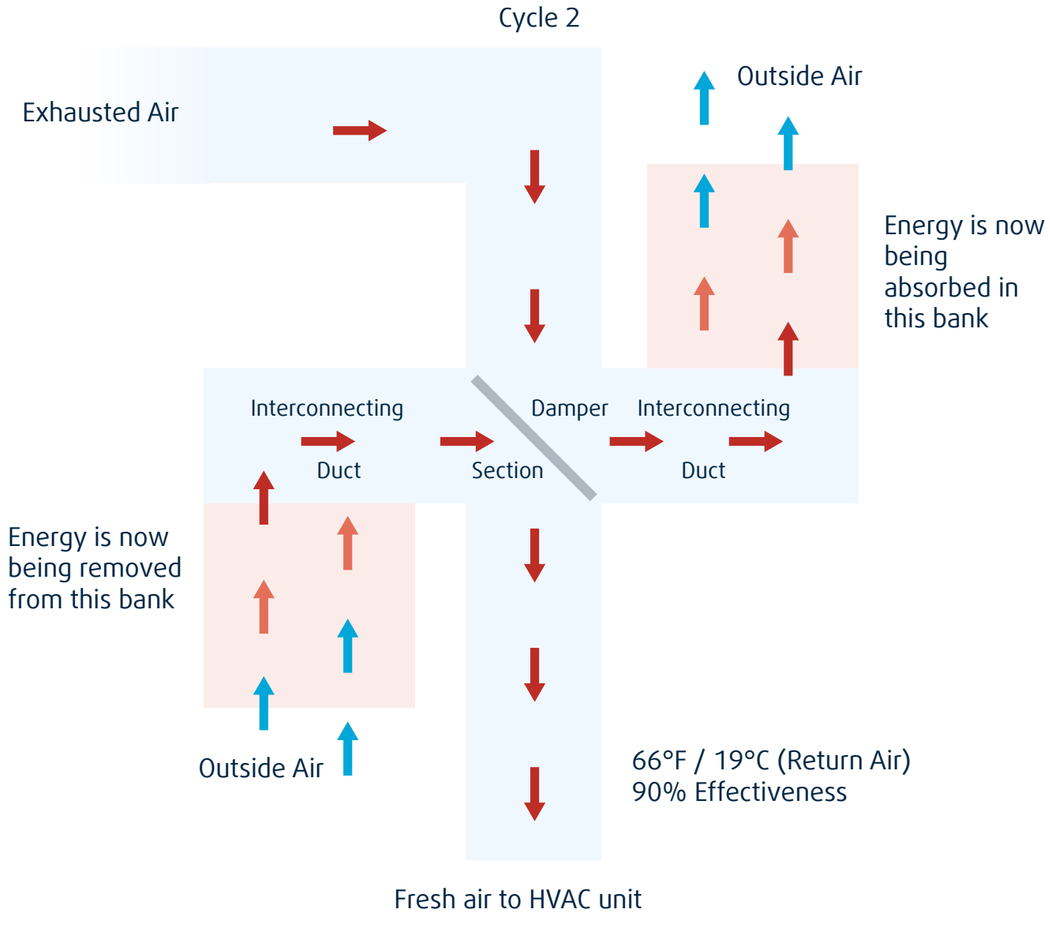
Think of this interconnected setup like the letter “T” with branches. The return air flows through the center of the interconnected ducts, bouncing off the damper separating fresh air from the exhaust air stream before being removed from the building through Core A (see Figure 1). This stream makes the inner side of the core warmer than the exterior.

On the other side, air is introduced through Core B. With the opposite side of the core warmer than the incoming air, the fresh air stream flows through the center of the interconnected ducts, bouncing off the damper that separates the exhaust air from the fresh air stream, before being supplied into the building.

After a short period, the inner damper changes position. The entire unit works in the opposite direction, and fresh air now is introduced and tempered through Core A while the exhausting air is removed through Core B (see Figure 2). This process happens throughout the entire operation sequence.



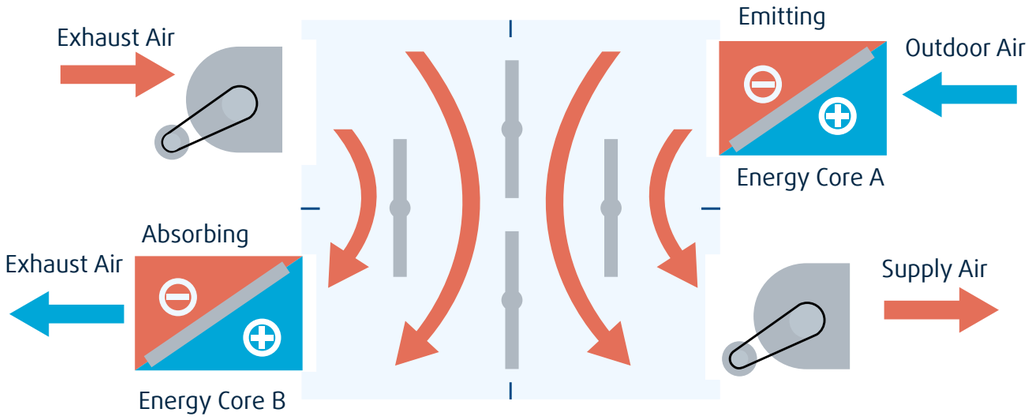
ABOVE: Figure 1 shows the airflows through Core A.



ABOVE: Figure 2 shows the airflows through Core B.

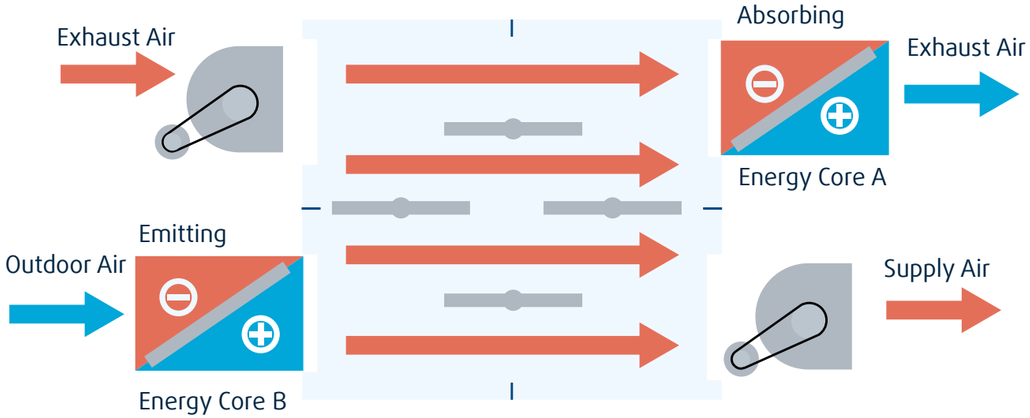
Dual-core Technology: How It Works

Like reverse-core technology, AHUs with dual-core technology use two phases. The first phase, lasting about a minute, moves the return air through the exhaust air stream energizing Core B (see Figure 3). On the opposite side, fresh air is introduced through Core A, and into the supply air stream. Internal dampers vertically separate the exhaust and supply air streams while Cores A and B become energized.

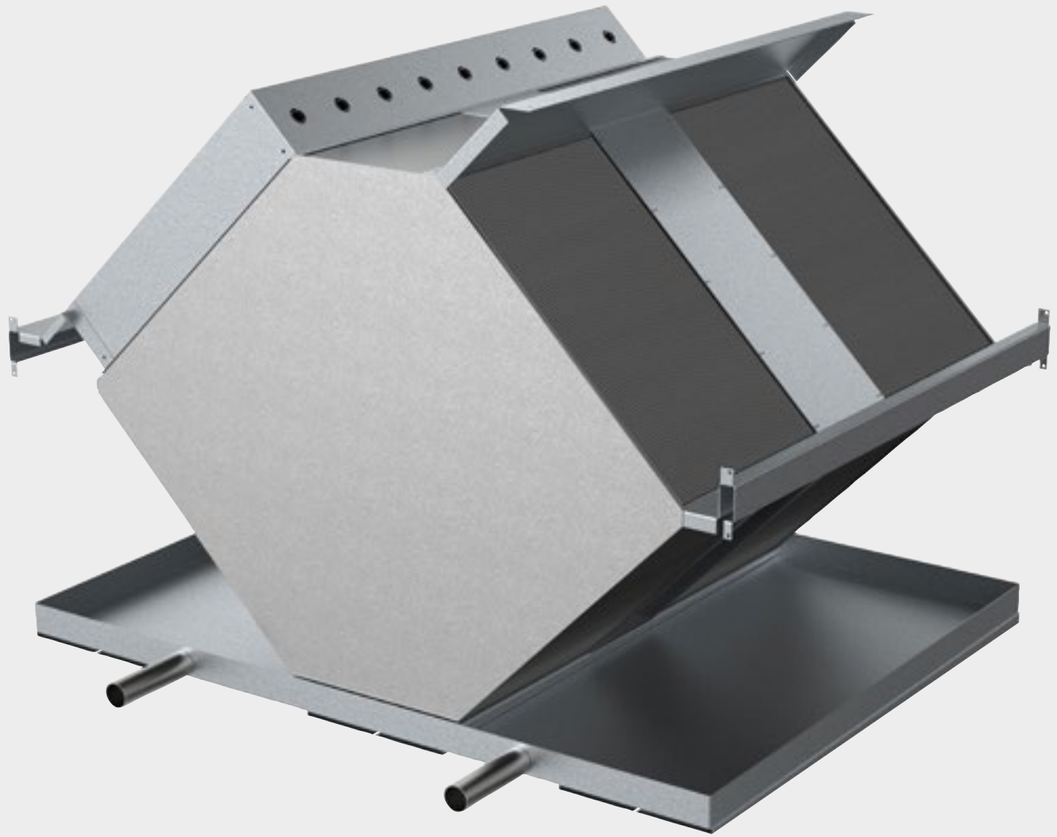


ABOVE: Figure 3 shows phase 1 of the dual-core technology.

These air streams are separated by setting the dampers in a vertical position. The second phase opens the dampers horizontally to utilize the energized cores and closes the return and supply air streams from one another (see Figure 4). Fresh air is now tempered through Core B before being introduced into the building, while the return air stream warms Core A for phase 1.



ABOVE: Figure 4 shows phase 2 of the dual-core technology.



Damper Positions and Frost Prevention

These AHUs use either a single damper (reverse-core) or multiple dampers (dual-core) to separate the supply and exhaust air streams. Reverse-core technology uses a diagonal-positioned damper that switches positions when the air streams switch. This process ensures both sides of each core experience warmer temperatures continuously to prevent frost.

Dual-core technology uses a similar premise in the process. As multiple dampers exist to block and direct air streams, and every minute the dampers switch positions from horizontal to vertical or vertical to horizontal. This keeps both sides of the core warm, preventing frost.

These technologies can prevent frost, but some questions remain, such as durability, air mixing concerns when the dampers flip, and heat recovery.

> **One of the things we find fascinating about their designs is how these AHUs prevent frost.**

Technological Insights

Knowing how these technologies work is important to understanding their intricacies and their value. Here are some of the advantages of using AHUs with these types of technologies:

Reverse Core

- High recovery rates
    - Up to 90% sensible recovery in the winter and 80% in the summer
        - Variable latent recovery
- A single, diagonal damper separates supply and exhaust air streams
- Frost prevention
    - Constantly changing damper positions and reverse airflow ensures frost cannot build up even at -40°F / -20°C

Dual Core

- High recovery rates
    - Up to 90% sensible recovery year round
        - 70% latent recovery during the winter
- Multiple dampers separate supply and exhaust air streams by alternating between a horizontal and vertical position.
- Frost prevention
    - Constantly changing damper positions and reverse airflow ensures frost cannot build up even at -40°F / -40°C

While these technologies certainly have their advantages, their disadvantages are what unfortunately will shine the most:

- High Cost
- Extremely large
- Constant damper switching wears down mechanical mechanisms
- Exhaust drain pans are needed
- Causes lower recovery efficiency than AHUs with static air paths.
- 3-5% air mixing; not suitable for healthcare and other high-risk facilities.
- Restricted to 35% RH indoors or the cores will freeze.

Innovation is something we hold in high regard at Systemair. Reverse-core and dual-core technologies are certainly innovative, but we believe their drawbacks are too steep to deem them a good fit for your building application.

Contrarily, **one of the things we find fascinating about their designs is how these AHUs prevent frost**. The continuous switching of air streams ensures frost never has the chance to build up; down to -40°F / -40°C. Now the question becomes, how does Systemair utilize frost prevention on their plate exchangers?

The Systemair Solution

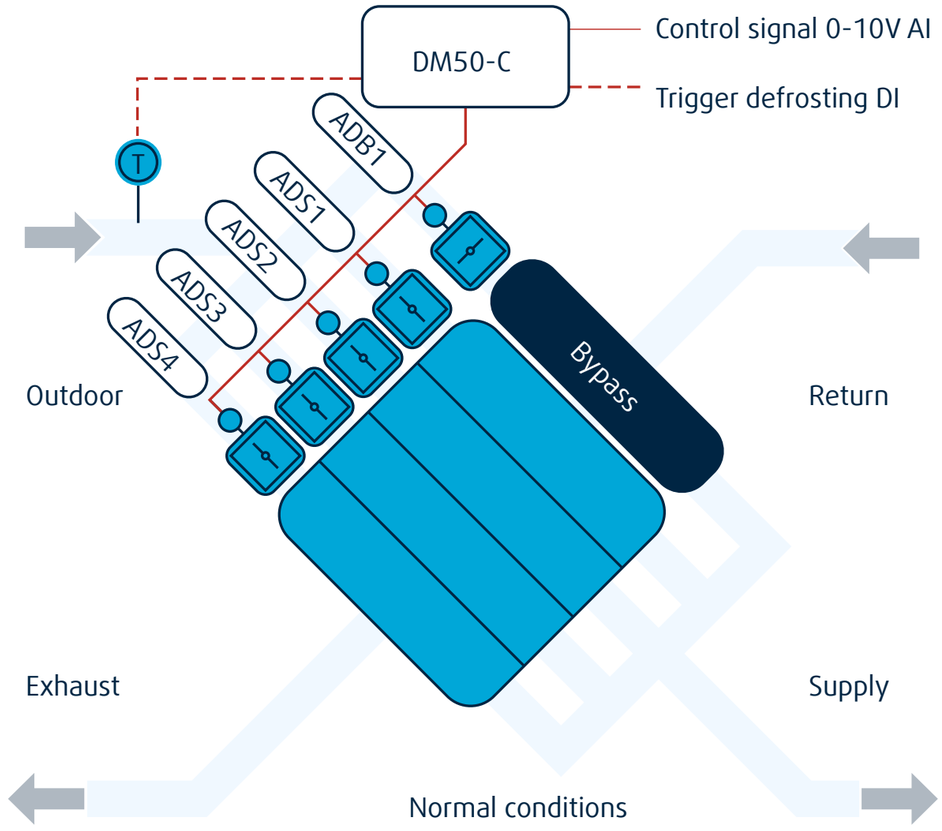
The Geniox AHU is a highly configurable AHU designed for buildings large and small. There are five different heat exchangers to choose from, three different coil types for heating and cooling, an integrated control system with a controller ready to match your requirements, and it can be installed indoors or out.

For frost prevention, the counterflow/ crossflow plate heat exchanger is equipped with dampers that can, in principle, completely close off the entire exchanger. The dampers only modulate when a call for defrost is required. We refer to this design as the “Smart Core Recovery System™”. Let’s dive into how this design works.

Smart Core Recovery System: How It Works

Plate exchangers within Geniox AHUs have the option to use the Smart Core Recovery System. This system is a set of four dampers that can block all four sections of a core and is on the outdoor supply side of the exchanger. A fifth damper, known as the bypass damper, is controlled by a separate control. During normal conditions, all dampers are controlled by the heat recovery control signal, 0–10V from the main controller.

The bypass damper and exchanger dampers modulate open together at an increased heat recovery signal. When the heat recovery signal is 100% and defrost is not active, the heat recovery dampers are fully open, and the bypass damper is closed (see Figure 5).



ABOVE: Figure 5 shows the bypass damper when the heat recovery signal is 100% and defrost is not active.

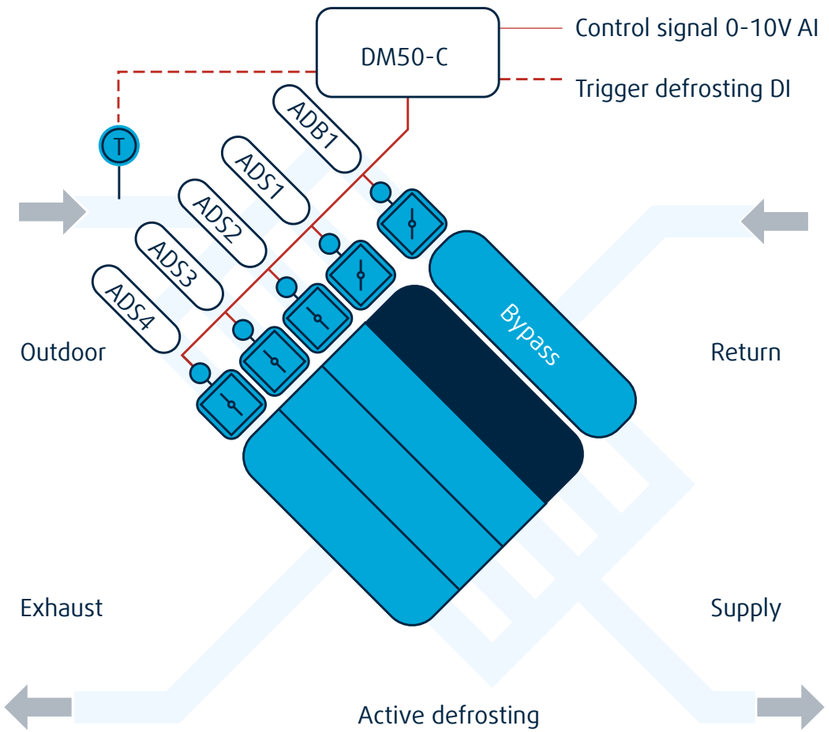
Defrosting Sequence

The defrosting sequence activates based on pressure sensors within the dampers. The sequence is on stand-by when temperatures are below freezing and will only initiate in the presence of frost. Once the pressure rises at or above 25% above the nominal core pressure, the defrosting sequence begins.

During a call for defrost, the bypass damper position modulates open (0–75%) to compensate for decreased temperature in the outdoor supply air. Simultaneously, the 1st section damper closes while the other dampers stay open (see Figure 6).

Then, 2–15 minutes later (depending on the set point), the second section damper closes while the first section damper opens. This sequence continues until all sections have been defrosted at least once. If the temperature is still below the set limit, the sequence starts again. If the pressure drops past a certain level, the defrosting sequence accelerates.

When the temperature drops below the set point or when a digital input calls for it, this sequence defrosts the exchanger constantly one section at a time.



ABOVE: Figure 6 shows the first bypass damper closed while the othe dampers stay open.

Types of Operating Setups

After closely examining the operations of the Smart Core Recovery System, the end user must know how to control this system. There are three different ways to operate the Smart Core Recovery System within the Geniox AHU:

1. Built-in Control
2. Customer Supplied Control with Pressure Monitoring
3. Customer Supplied Control without Pressure Monitoring

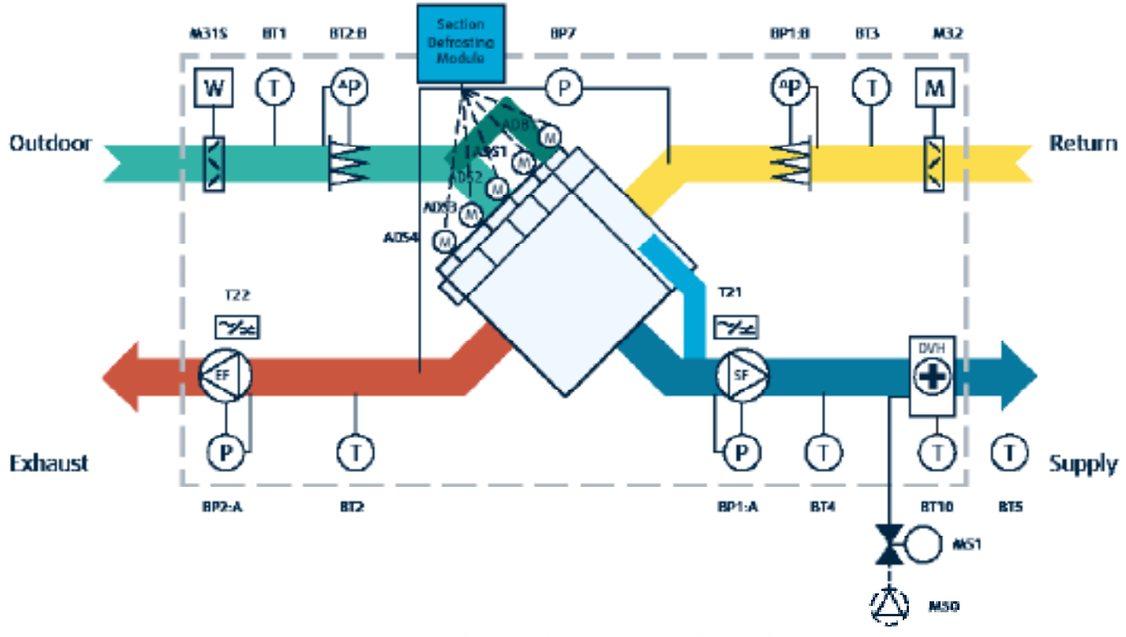
Built-in Control: How It Works

The heat exchanger signal is controlled by the 0–10V signal from the main controller.

The Smart Core Recovery System is activated to start the defrosting sequence and is monitored using a principal Corrigo controller. The controller constantly monitors the current pressure drop across the heat exchanger. During the summer, the controller automatically calibrates the differential pressure of the heat exchanger.

During operation, the maximum continuous differential pressure increases based on the current air streams moving through the heat exchanger. **Once the differential pressure is set, and when the extract air stream increases to the maximum differential pressure, the controller activates the Smart Core Recovery System to begin the defrosting sequence.** When the differential pressure decreases below the set value, defrosting ceases.

If the differential pressure does not decrease below the set value, a defrost alarm is activated, and the sequence restarts again for 2 minutes, to a maximum of 60 minutes (see Figure 7).



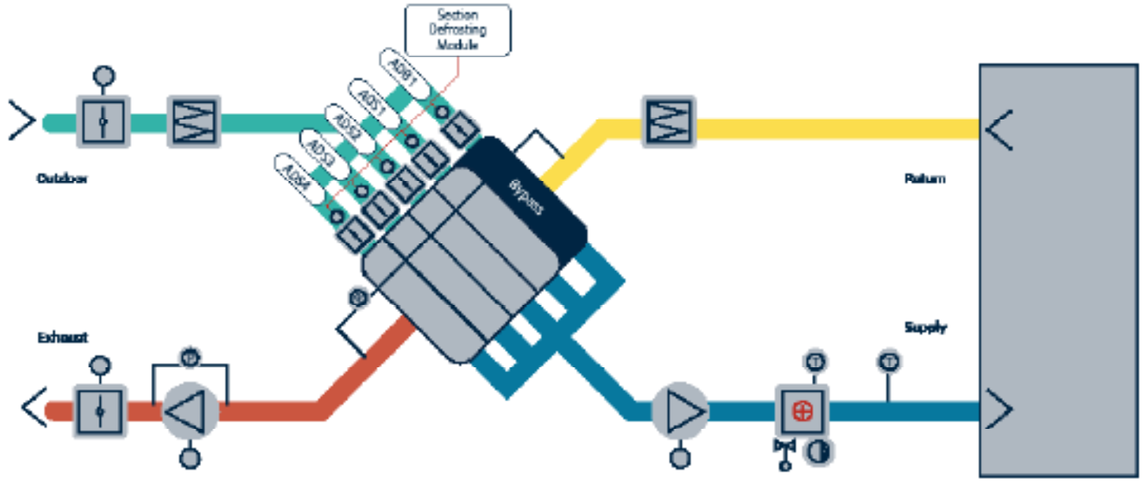
ABOVE: Figure 7 shows the operation when a defrost alarm activates due to differential pressure.

Customer Supplied Control with Pressure Monitoring: How It Works

The heat exchanger signal is controlled by the 0–10V signal from the main controller.

The Smart Core Recovery System is activated to start the defrosting sequence from the main controller and the system will always run a full sequence.

As a selectable feature, the defrosting sequence can operate either immediately after the sequence ends (0 minutes) or up to 20 minutes after the sequence has ended. This feature is known as Delayed Sequence Defrost (DSD) (see Figure 8).



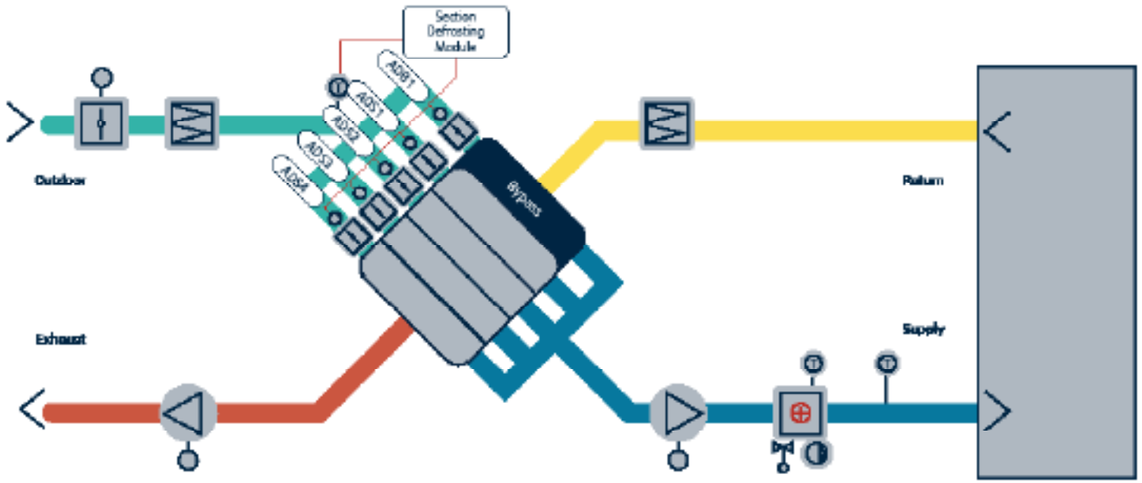
ABOVE: Figure 8 shows the Delayed Sequence Defrost.

Customer Supplied Control without Pressure Monitoring: How It Works

The heat exchanger signal is controlled by the 0–10V signal from the main controller.

When the outdoor air temperature reaches the temperature set point, the Smart Core Recovery System is activated to start the defrosting sequence through an outdoor air temperature sensor. The setpoint for starting defrost is selected by four digital inputs or an external HMI (options).

The DSD feature (0–20 minutes) is also a selectable feature with this setup (see Figure 9).



ABOVE: Figure 9 shows the Delayed Sequence Defrost with a 0-20 minute selectable feature installed.

How the Smart Core Recovery System Differs from Reverse-core and Dual-core Technology

Apart from the central differences between the Smart Core Recovery System and Reverse-core/dual-core, one of the strikingly largest contrasts is the latent/sensible recovery differences. Manufacturers who've created reverse-core and dual-core technologies tout 90% sensible recovery, with the ability to reach 95% sensible recovery. Additionally, their latent recovery is also high, with one manufacturer deeming latent recovery "variable".

As an engineer, you know the importance of third-party testing. Systemair has based the Geniox design on standards and testing from organizations and associations such as AHRI, AMCA, ASHRAE, CSA, EN ISO, NFPA, and UL. The other manufacturers cannot say the same. With the Geniox AHU, the recovery touted is the recovery the end user will receive.

With that being said, Geniox AHUs post high heat recovery efficiencies even in frigid temperatures (all the way down to (10.4°F / -12°C). Using the smart core recovery system and this thermal scenario, fresh air (after moving through the counterflow/crossflow core of a Geniox AHU) will be tempered to about 46.4°F / 8°C. Based off laboratory tests, the data tells us heat recovery efficiency of an 80%+ AHU would only drop about 2% when defrosting is active in this frigid scenario.

Additionally, on these other technologies, "frost prevention" is always active. Because the internal dampers are constantly switching throughout operation, these damper mechanisms will have to eventually be replaced/maintained. Whereas the Smart Core Recovery System is only active when defrost is needed. It is also not integral to the unit. Therefore, replacing it will not come at the cost of expensive repairs, increased downtime, or having to buy a new AHU in general.

Furthermore, the constant switching between air streams of dual- and reverse-core technologies decreases the recovery efficiency; causing the forced air system to work harder when fresh air is introduced. Since the Smart Core Recovery System only activates if frost is detected, Geniox AHUs can optimize your building's forced air system to reduce the amount of heat loss.

Parameter	Geniox AHU with Smart Core Recovery System	Dual-Core	Reverse-Core
Preheat needed	No	No	No
Efficiency level	85%+	85%+	85%+
Air stream modification	No	Yes	Moderate
Air switching during summer	No	Yes	Yes
Cross contamination levels	<0.5%	5%	5%
Active Frost Monitoring	Yes	No	No
Defrosting Mechanism	Yes	No	No
Third Party Verification	Yes	No	No

The Verdict

While other manufacturers may introduce innovative technologies, the absence of rigorous testing by third-party organizations and extensive field evaluations raises concerns about their reliability. Even if these technologies claim to withstand airflow down to -40°C (Dual Core), their recovery rates lack third-party verification, and the durability of minute damper control parts remains uncertain. In contrast, the Geniox AHU stands out as a tested, durable, and complete ventilation system right from the start. With a broad range of CFM options catering to various building applications and a reliable frost prevention method in the Smart Core Recovery System, it offers a level of assurance and performance that sets it apart. Trust in the proven track record of the Geniox AHU for a reliable, durable, and comprehensive ventilation solution.

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