AIRSYS

WHITE PAPER

The AIRSYS Inverter Driven Heat Pump

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Introduction

Traditional heating and cooling solutions tend to abruptly rev up at very high speeds when turning on and off. This short cycling, or abruptly turning on and off, produces a high fluctuation of hot and cold air flow that may not be necessary. Inverter driven systems are becoming more widely used to negate the less efficient means for traditional air conditioning of a space. By varying the capacity of airflow, inverter driven systems can provide a much more consistent delivery of hot and cold air by intelligently modulating the capacity of air flow to meet the set temperature in a room.

AIRSYS Refrigeration Engineering is now delivering a continuously variable heat pump unit for human comfort applications that provides both heating and cooling by using proven inverter driven technology controlled by a variable frequency drive (VFD).

Inverter driven technology utilizes brushless direct current (DC) motors that can switch quickly in a synchronous manner. Brushless DC motors eliminate electrical noise, reduce overall wear and tear on a motor, and provide maximum torque at lower speeds. Inverter drives achieve variable speed compression, which means a smoother, more streamlined approach to temperature delivery. By varying the temperature delivery gradually, there are huge energy savings which in turn result in reduced energy costs. The AIRSYS COM4T heat pump incorporates the highest part load efficiency in its class by varying the capacity of airflow much more intelligently than the competition by ramping up and down through many more stages than the competition. Most competitors use only one or two stages when turning on or off, which can cause more wear and tear, more noise and higher energy costs due to the abrupt "ON" or "OFF" states.

What Benefits Does Inverter Technology Bring?

2.1 Total Comfort Control

Traditional systems use a fixed-speed compressor, which cycles the unit on and off whenever the room goes above, or dips below the desired set point temperature. Fixed speed systems are extremely inefficient because they are either on full speed or completely shut off. This can lead to unpleasant temperature swings as the system strains to maintain a consistent temperature.

The AIRSYS inverter driven compressors, on the other hand have controls that are continuously adjusting the compressor speeds in real time, by ramping up or down power when needed. An AIRSYS inverter driven compressor provides a more accurate, on-demand approach to temperature control. For example, if the room temperature is already a comfortable 72 degrees, an inverter may slow the compressor's engine to a crawl. If the room temperature is uncomfortably warm at 80

degrees, the inverter compressor will switch into high gear, quickly returning to the set temperature comfort zone in a much more quiet manner than traditional fixed speed systems. The AIRSYS Inverter driven compressor manages the temperature fluctuation up to (≤1 °F).

The advantage of AIRSYS inverter driven heat pumps are also reflected in the rapid response time to regulate the ambient temperature, which allows the room temperature to reach the desired set point in the shortest amount of time. When the COM4T system turns on as room temperature fluctuates, the AIRSYS inverter driven compressor will promptly turn on and speed up to make the room warm up or cool down much more quickly.

This fast response time is also possible in defrost mode. In wintertime, when the air conditioner is working in heating mode, the external loop coil can become frosted. To ensure the heating performance is not compromised by freezing external temperatures, the AIRSYS COM4T unit will switch into defrost mode to protect the components inside the system.

Traditional systems use a fixed-speed compressor that normally takes 5~10 minutes to defrost. After defrosting, the system switches back to the regular heating mode. At this moment, it normally takes another 10~15 minutes before the system is able to provide stable heating capacity. A defrosting cycle can take no more than 20 minutes, which will greatly reduce human comfort.

AIRSYS inverter driven compressors run at the highest speed to provide more heat to defrost, which can reduce defrosting within three minutes. Once the system has completed defrosting, it will immediately switch to heating mode and produce stable heating capacity within 5~10 minutes.

2.2 Dialing in Efficiency and Savings

The size of your air conditioner impacts your energy bill more than you might think. Standard, fixed-speed air conditioners will run at peak power, regardless of the square feet of room. Bigger, is not necessarily better, in this case—especially if you have a smaller room. Inverter driven units, on the other hand, can dynamically adjust their compressor speeds based on a room's temperature. Because the unit only draws enough power to maintain a steady room temperature, its cooling or heating capacity adjusts to suit the needs of the room in a much more precise manner.

For fixed capacity systems each turn-on cycle requires a large in-rush current spike to get the compressor moving. Depending on how long the compressor was idle from the last cycle, it then takes time to reach peak performance. This period lasts from 1 – 5 minutes for each cycle where the machine is consuming 100% power but not delivering peak results. This is very much the same as your car engine performance. When you first turn the key, the engine consumes fuel, but you have gained no ground, which in turn is very inefficient. In fact, until the engine has been running for some time you are still consuming fuel below your expected miles-per-gallon rating.

According to AHRI, the average daily cycle for fixed capacity systems is two times per hour, or 48 times a day. This is close to 20,000 on and off cycles per year. The AIRSYS Inverter driven compressor will cut the on and off cycles by 90% to < 2,000. Less start-stop cycles = greater savings on energy consumption and eliminates wide temperature swings. With the Inverter driven compressor, there are NO in-rush currents, which will save you money on electricity and can save you money when sizing your utility power.

From an energy perspective, the inverter driven AIRSYS heat pumps have one additional significant benefit. While they meet the energy efficiency requirements for all 50 states at full speed (EER>11), the energy efficiency improves when the speed is decreased (EER up to 18 at partial load). This is one more important characteristic of the Inverter drive that reduces electricity consumption. The heating and cooling system should only be at full speed a VERY small percentage. of the time, thereby delivering energy efficiency well beyond federal, state and local requirements.

2.3 Quiet Operation

The AIRSYS inverter driven technology starts slowly by utilizing a stepless progression through varying stages. Most of the time you cannot even hear the unit come on. This is unlike traditional heat pumps where each start up can be quite startling. The AIRSYS inverter driven heat pumps were specifically designed to be quiet in all applications, but most importantly the classroom. The COM4T units have been tested and certified under 40 dBA on high speed, which is equivalent to the sound of light rain.

2.4 Reliability

By decreasing the amount of soft-starts and decreased amounts of on-off cycles, this will significantly reduce the wear and tear of components by slow and steady increases or decreases in speed vs. the heavy wear and tear from the dramatic on and off cycles from traditional non-inverter driven compressors.

What Other Options are Available for COM4T?

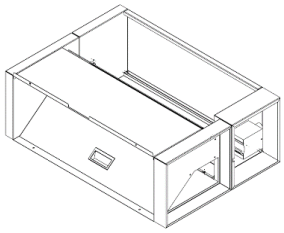
3.1 Positive Temperature Coefficient (PTC) Electrical Heater

The PTC electrical heater has both fast thermal response time and low inrush current. A protection device (detecting both current and temperature) will automatically cut current when unsafe levels are reached. When there is no air flow passing PTC heaters, the heaters will stop warming up. The outer edge of the PTC heating component is designed with double insulation. When in contact with metal, it will not cause short circuits.

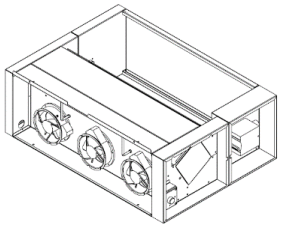
Compared with the traditional stainless steel electric heaters, the surface temperature of PTC electrical heat is much lower. The materials used in PTC heaters allow them to act as its own sensor, eliminating the need for subsidiary controls to regulate the heat. As a result, the heater eliminates the risk of overheating.

3.2 Various Ventilation Options

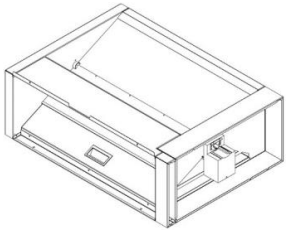
Commercial Room Ventilator (CRV): The power open, spring close, fresh air damper allows outside fresh air to enter the building. Adjustable actuator position allows varying amounts of outside air to enter the building.



Energy Recovery Ventilator (ERV): The energy recovery ventilator harvests energy contained in the exhaust air mixing it with fresh air across a stationary cubic heat exchanger. The filter medium is designed to be pulled out easily for cleaning and replacement.



Economizer: The economizer uses outdoor air to provide cooling when the outdoor temperature is both cool and dry. It will greatly save energy from stopping the compressor operation.



Conclusion

As the demand grows for more energy efficient HVAC systems to be deployed in schools, modular buildings and light commercial applications, Inverter driven technology will lead the way in helping site managers achieve much more impactful results. The many cutting-edge features used in the AIRSYS COM4T units are currently being deployed across the US. Our team of trained engineers, facility technicians and sales team members are available to assist you with your next project. Contact us today to join the progressive movement toward becoming a converter to inverter!

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An AIRSYS COM4T unit installation at an elementary school in Fontana, CA

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