

AIRSYS

WHITE PAPER

INVERTER DRIVEN TECHNOLOGY FOR TELECOM SHELTERS

Table of Contents

Introduction	2
What Benefits Does Inverter Technology Bring?	2
2.1 Real-time Cooling Capacity	2
2.2 Dialing in Efficiency and Savings	3
2.3 Multi-Operation Mode	3
2.4 Reliability	4
What Are Additional Benefits from the AIRSYS UNICOOL?	4
3.1 EC Supply and Condenser Fans	4
3.1 Electrical Expansion Valves	5
Conclusion	6
Contact	7

Introduction

With the continuous convergence and improvements of the existing 4G network and the intensive deployment of the 5g network infrastructure, telecom shelter equipment manufacturers have been responding to the new stringent energy code demands to ensure their new structures perform to the most precise expectations of specifying engineers. In the meantime, new telecom base stations are actively pursuing new technological advancements to consider how to balance future developments and protect their current investments for long term reliability. Inverter driven technology has taken its place front and center as the technology of the future for HVAC systems. But what really defines inverter driven technology and how can we integrate it into cooling systems for contemporary telecom shelter environments?

We have all experienced that loud on and off cycle produced from heating and cooling equipment. In many instances we tend to turn off the equipment due to the distracting sound. With Inverter driven systems the speed is controlled much more precisely than traditional fixed speed compressors. Instead of the abrupt "ON" or "OFF" modes, inverter driven compressors continuously and smoothly adjust the compressor speed in response to temperature demands of the room. Advanced HVAC systems that use inverter driven technology also use multi-unit and multi temperature room controls and advanced communication functions, which can perfectly satisfy the current load demands, but also offers the option of satisfying future increases in loads by adding more network equipment to the telecom site.

AIRSYS Refrigeration Engineering is now delivering a new generation of Wall Packaged Units (WPU) called UNICOOL, that use proven Variable Frequency Drive (VFD) technology. AIRSYS INVERTER driven technology isn't just a variable speed drive, it's a new technology utilizing brushless DC motors. Brushless motors eliminate electrical noise, brush wear/residue and risks of sparking, thus greatly improving system reliability. Variable speed compression means a smoother, more streamlined approach to temperature delivery that's also lighter on the pocketbook, saving you money in reduced energy costs. The AIRSYS UNICOOL system incorporates the highest part load efficiency in its application for even higher savings whenever less than maximum capacity is needed.



What Benefits Does Inverter Driven Technology Bring?

2.1 Real-time Cooling Capacity Management

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. This system relies on an all-or-nothing philosophy—with the compressor running at either zero or 100 percent. This can lead to unstable temperature swings as the system strains to maintain a constant temperature via many starts and stops.

The AIRSYS inverter driven compressors and controls are continuously adjusting the compressor speed in real time, by ramping up or down power when needed. An AIRSYS inverter compressor provides a more accurate, on-demand approach to temperature control. For example, if the room temperature is already a pre-set 80 degrees, an inverter may slow the compressor's engine to a crawl. If the room temperature is warm at 90 degrees, the inverter will push the compressor into high gear, quickly returning to the precise zone set by facility teams. It manages the temperature fluctuation as small as possible (≤ 1 °F). The suitable and stable room temperature is critical for IT device performance, which can help avoid IT device from crashing, shutting down, and potential damage due to extreme temperatures.

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 size of your room—whether it's 1,000, 2,000, or 10,000 square feet. 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 room temperature demands. Because the unit only draws enough power to maintain a steady room temperature, its cooling or heating capacity changes to suit the needs of the room.

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 technology 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 inverter driven compressor technology, there also are no in-rush currents, which will save you money on electricity and can save you money when sizing your utility power needs.

From an energy perspective, the inverter driven AIRSYS UNICOOL systems 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 Multi Operation Mode

Turbo Boost Mode

In some situations, such as extreme high outdoor temperature or increased equipment load, the heat load of the building may exceed the nominal cooling capacity of the HVAC system. When this happens, Turbo Boost Mode can be engaged automatically to deliver up to 125% of the nominal cooling capacity at the expense of slightly lower efficiency.

Comfort Mode

When site engineers visit sites to carry out service or maintenance, there is a Comfort Mode, which switches the set temperature to a comfortable room temperature and reduces noise while occupants inhabit the space. Comfort Mode reduces noise by 10-14 dBA by limiting the maximum frequency the compressor may run at. Maximum cooling capacity will be reduced by 15% and Turbo Boost will be disabled when quiet mode is enabled.

Synchronized Cooling Mode

With Variable Capacity systems, buildings with one or more redundant HVAC unit can use Synchronized Cooling Mode. This mode runs all available units at low speeds instead of having lead units take the entire load.

For example, a building with two units in lead/lag configuration, both units will decrease capacity simultaneously. So, instead of running 90% capacity on the lead unit, synchronized cooling mode would run both units at 45% capacity. At half the load, efficiency will be much higher and stress and noise from the compressor will be reduced to one-fourth. Redundancy is unaffected since if one unit has a mechanical cooling failure, the other unit will ramp back to full capacity to maintain site temperature. This mode allows any building with redundant units to perpetually achieve 14-16 EER except during emergency situations.

2.4 Reliability

With the AIRSYS inverter driven compressors, the benefit of having the soft-start feature and reduced on-off cycles, the units will significantly have less wear and tear on 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. AIRSYS inverter driven technology minimizes mechanical stress on compressor startups and eliminates spike voltage on start-ups, which will significantly increase the mechanical system reliability and extend the overall lifespan of the units.

What Are the Additional Benefits from the AIRSYS UNICOOL System?

3.1 Electronically Commutated (EC) Supply and Condenser Fans

As it's known, EC fans have the features of high energy savings, high efficiency, high reliability, long service life, small vibration and low noise. EC supply and condenser fans come standard on all UNICOOL models. They have a wide applicable voltage range of $(200-277v) \pm 10\%$, which allows UNICOOL systems to work in wide voltage ranges and reduce the fan failure rates caused by voltage fluctuation. The EC fans also have a smaller inrush current than traditional AC fans which has 3~5 times higher inrush current.

EC fans have excellent variable speed performance and high efficiency throughout 0% to 100% speeds. Both EC supply fans and condenser fans in AIRSYS UNICOOL systems will automatically adjust their speeds according to room temperature feedback. The refrigeration system pressure combined with the inverter compressor speed, will all help the system to achieve the maximum efficiency.

UNICOOL systems are designed with high static EC fans, which make systems deliver high air volumes even when the filter is blocked, or during high external resistance within the air ducts. This can ensure the system provides stable and efficient air volume and guarantee cooling system performance.

3.2 Electrical Expansion Valve (EEV)

Traditional thermal expansion valves tend to be responsible for insufficient cooling capacity, large system pressure fluctuations and unstable performance when the compressor starts, or when the ambient temperature increases. Due to its small opening and slow response speed, traditional thermal expansion valves may cause a risk of refrigerant liquid returning to the compressor, which will seriously impact the system 's reliability and potentially damage the compressor.

UNICOOL systems also have an adapting Electronic Expansion Valve (EEV), which responds quickly according to the changes of the environment and feedback from the cooling system. Associated with pressure transducer and temperature sensor, EEVs can accurately adjust the opening to control the superheat based on the real-time compressor suction temperature and pressure. This function will greatly reduce the risk of damage to the system and preserve the compressor's performance.

3.3 Optimized Structural Design

The UNICOOL system is AIRSYS' second generation of WPU's. The most prominent engineering feature in the UNICOOL system is the free cooling function, which directly brings in cold external air temperatures to essentially provide free cooling for the room. In certain climate zone conditions, Free Cooling can save up to 80% in energy costs. When free cooling mode is initiated, the cold external air is brought into the room by low side supply and then discharged out by a high side exhaust. There is a certain distance between air intake and exhaust, which can effectively avoid cross flow and achieve maximum free cooling efficiency. The air intake surface is large enough to ensure adequate free cooling air volume can flow, coupled with the pre-filter on the air intake side that prevents dust, insects and other dirty air from entering into the system.

The damper controlled by 0~10V stepless actuators make the system realize three different operation modes: mechanical cooling, free cooling and partial free cooling. When the system works in partial free cooling, the damper will automatically adjust the position to manage the fresh air volume and inlet temperature.

Both UNICOOL top supply and bottom supply units are designed with proper drainage for any water intrusion. There are drain pans below both the evaporator and condenser coils. The drain pans are positioned lower than the supply outlet, so water will not be blown into the room and potentially damage the IT equipment.

3.4 Intelligent Multi-Unit Controller

The AIRSYS UNICOOL system is designed to operate with AIRSYS Multi-Unit Controller (ASMUC) which can control up to six units at a time and up to 16 with an extension module. The controller can set up to four distinct control zones, each with their own temperature settings.

The ASMUC has an overview page that will give users immediate status of any connected HVAC. Detailed status of every temperature and pressure reading is available right at the controller for monitoring and troubleshooting. All parameters are available remotely through IP/SMNP for monitoring and setpoints and other critical control parameters can be changed remotely. A micro-USB port is also available for on-site software update and alarm log downloading to a personal computer.

The UNICOOL system is also equipped with its own individual controller, which allows it to operate in a Fully Functional Standalone Mode when communication is lost between the HVAC unit and the central controller. This includes free cooling, mechanical cooling, dehumidification, and heating. This eliminates the controller as a potential single point of failure for the HVAC system.

Conclusion

As the demand grows for more energy efficient HVAC systems to be deployed in telecom shelters, 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 UNICOOL systems are currently being deployed across the world. 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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Two Unit AIRSYS UNICOOL system installation at a telecom shelter located in Astoria, OR

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