DATA AIRE INC.

gForce ULTRA by Data Aire

User Manual

DX, Single and Dual Circuit

36, 45, 56, 70 and 106 kW

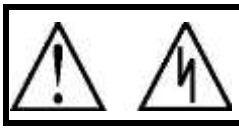
Air and Water/Glycol Cooled

CONGRATULATIONS ON THE SELECTION OF A DATA AIRE PRECISION ENVIRONMENTAL CONTROL SYSTEM. PROPER INSTALLATION, OPERATION AND MAINTENANCE OF THIS EQUIPMENT WILL ENSURE YEARS OF OPTIMAL PERFORMANCE.

There are separate User Manuals for other components of your Data Aire precision environmental cooling system including dap4™, condenser/condensing unit and fluid cooler.

NOTE: This manual is intended to assist trained service personnel by providing necessary guidelines for this particular equipment. Service to Data Aire units should be done by qualified individuals with an adequate background in areas such as HVAC, electrical, plumbing and electronics, as applicable.

WARNING: Service performed by unauthorized or unqualified technicians may void manufacturers' warranties and could result in property damage and/or personal injury.



NOTE: Special care should be given to those areas where these symbols appear.

Data Aire, Inc. reserves the right to make design changes for the purpose of product improvement or to withdraw any design without notice.

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1. INTRODUCTION

1.1 Product Information

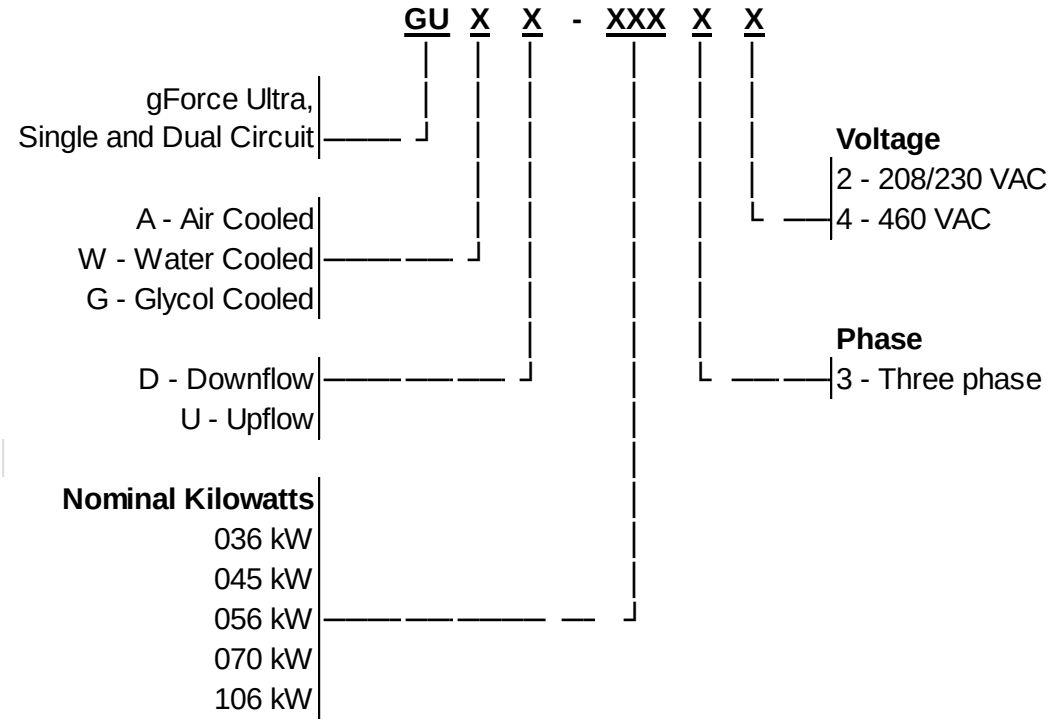
The Data Aire gForce Ultra environmental control, direct expansion, single and dual circuit Computer Room Air Conditioner (CRAC) equipment provides a high sensible cooling, is self-contained, factory assembled, piped, wired, and factory tested prior to shipment. These units include an enclosure/cabinet assembly, fan section, filter section, cooling coil, controls, and interconnecting piping internal to unit.

The Data Aire CRAC unit provides cooling, reheat, humidification, dehumidification and air filtration. The unit is provided with a Data Aire dap4™ microprocessor controller for precision control. The unit must be operated in a conditioned space within the operating envelope ASHRAE recommends for data centers. Maximum dew point is 59°F (15°C). Operating outside this envelope can alter the operating performance and decrease equipment reliability. Return air to the unit must be no cooler than the ASHRAE recommendation of 68°F (20°C) DB and 40% RH or minimum WB of 54°F (12.2°C) for proper unit operation. Operating below this can alter the operating performance and decrease equipment reliability. Refer to ASHRAE's publication, "Thermal Guidelines for Data Processing Environments."

The unique feature of the gForce Ultra is the application of variable capacity compressors. The quest for greater energy efficiency is continuous; efficiency benchmarks are always moving up. That's why Data Aire is moving toward variable capacity compressor technology for quieter, more energy-saving performance. Conventional compressors are designed to run at constant speed to handle a given capacity requirement. But in data center applications, the capacity requirement varies. In these situations, a constant speed compressor uses various capacity-regulation techniques and can be less efficient than a compressor utilizing variable capacity technology. A variable capacity compressor (VCC), on the other hand, saves energy and operates more quietly by varying speed to match the workload. Tests with VCC compressors have shown an immediate energy savings and sound level reductions.

1.2 Model Identification

gForce Ultra Model Number



1.3 Inspection

This Data Aire CRAC unit has been factory run-tested and has gone through a comprehensive inspection prior to its packaging and shipment to ensure that it arrives in excellent condition. However, shipping damage can occur and a visual inspection of the outer crating immediately upon delivery should be performed. Upon arrival of the unit and before unpacking it, verify that the labeled equipment matches the bill of lading.

Note: any external damage or transportation damage on the freight carrier's forms. Inspect the unit itself for internal damage. A claim should be filed with the shipping company if the equipment is damaged or incomplete.

Loose items such as remote control panels, disconnect switch handles, and spare air filters are packed inside the unit. Refer to the yellow shipping tag located on the unit door for details.

NOTE: Freight damage claims are the responsibility of the purchaser. Action to recover losses should be filed immediately. Please notify factory personnel of any claims.

1.4 Paperwork

Each Data Aire CRAC unit ships with a start-up sheet that should be completed during installation. Also included in the paperwork is a warranty/information packet that provides important wiring diagrams, specific component literature, warranty registration cards and other valuable paperwork, including a copy of this User Manual.

A yellow tag is attached to the outside decorative door to indicate articles that may have been packaged and shipped loose within the unit cabinet. Typically this would be jackstands, condensate pumps and other loose components that are not factory mounted.

WARNING: It is the responsibility of the installing contractor to return the start-up sheet and warranty registration card to Data Aire for proper activation of the unit warranty. Failure to do so may cause delays and some cases void the warranty.

2. INSTALLATION

NOTE: There is no intent on the part of Data Aire, Inc. to define local codes or statutes which may supersede common trade practices. The manufacturer assumes no responsibility for their interpretation. Consult local building codes and National Electrical Code (NEC) for special installation requirements.

2.1 Installation Checklist

As a precaution, review the following checklist to ensure proper operation:

Check for any damage

Check all wiring connections

Filters are properly positioned in air intake

WARNING: Before removing from the packaging inspect the unit for any damage. Report any damage to the carrier and file a damage claim.

2.2 Room Considerations

Precision air conditioning equipment is designed to control spaces within close tolerances of temperature and humidity. However, the room must be built with a proper vapor barrier. A film of polyethylene is often used on walls and ceilings. Walls and floors must also be painted with vapor-seal paint. Failure to provide a vapor barrier can compromise space conditions.

Introduction of outside air into the space should be minimized. Outside air in excess of 5% of the total circulated air volume can have a significant effect on the overall space conditions and result in poor space control.

Install the units as close as possible to the largest heat load.

2.3 Equipment Handling

WARNING: Only properly trained personnel wearing appropriate safety headgear, gloves, shoes and glasses should attempt to move the unit, lift it, remove packaging or prepare the unit for installation.

Move the unit in its upright position to the installation site using a forklift or pallet jack. It is recommended that the unit be protected from damage to the decorative doors during any storage or moving.

Keep tines of the forklift level and at a height suitable to fit below the skid and/or unit to prevent exterior and/or underside damage. Make sure the forks are spread to their widest allowable width for proper balance. Do not lift the unit any higher than 4 inches (100mm) off the ground. If necessary to lift higher than the suggested 4 inches (100mm), exercise great care to ensure proper handling of the unit.

Personnel not involved with the lifting of the unit should keep a safe distance from the unit.

The unit may be too tall to fit through a doorway while on the skid. Measure the unit and doorway heights and refer to the installation plans to verify clearances prior to moving the unit.

WARNING: Use care when moving. Improper handling could result in injury. Proper care should be taken when uncrating the unit. The packaging has wrapping bands with sharp edges that are under tension, crating has staples and splinters. Proper protective equipment should be worn by qualified personnel.

2.4 Rigging

Move the unit in its upright position to the installation site. It is recommended that the unit be protected from damage to the decorative doors during any storage or moving. Removal of the decorative doors is easily accomplished and may be done without moving the equipment.

The shipping skid should be left in place if the unit is being moved with a forklift. If the unit is being lifted, use spreader bars to prevent damage to the doors and panels.

The unit has 3/4” (19mm) holes in the shipping skid to which casters with 3/4” (19mm)

stems can be attached. This allows easy movement down halls, into elevators and through doorways. If clearance is a problem the casters may be inserted directly into the bottom of the 1" (25mm) tubular steel corner posts at the bottom of the unit.

WARNING: Improper lifting or moving of the equipment may result in damage to the decorative doors, panels or frame members.

2.5 Locating the Unit

Verify that the floor is level, solid and sufficient to support the unit. When installing the unit, sufficient space must be allowed for airflow clearance, wiring, plumbing and service access. It is recommended that each side and front have a clearance of at least 36" (914mm) to allow the doors to swing open and for servicing the unit.

The doors on some sides may not require as much service clearance. Refer to the particular unit component breakdown drawings for assistance. Rear clearance is not required, but 1" to 2" (25 to 50mm) of clearance is suggested.

For the best air distribution, the unit should be centered against the longest wall, distributing the cold air as close to heat load as possible, unless the unit is ducted. The unit should not be placed near any corner of the room or at the end of a long, narrow room. Install the units as close as possible to the largest heat load. Multiple units should be evenly spaced, as far apart as possible. It is recommended to install an under-floor water detection system.

Note: Condensation formation and frequent humidifier flushing are normal functions of this equipment. Proper drain connections must be made to ensure proper removal. Unit will require water connections for condensate removal and possibly for humidifier makeup water, chilled water and/or hot water. Installation of units above equipment that could sustain water damage should be avoided.

2.5.1 Downflow Units

Downflow units will typically sit on an elevated flooring system known as a raised floor. The unit discharges air downward which pressurizes the raised floor and channels upward through perforated floor tiles. Location and quantity of perforated tiles will dictate proper air distribution. If the raised floor is strong enough to support the unit

and local codes permit, the unit can be placed directly on top with cutouts made for the discharge openings.

Verify that the raised floor has been properly sized for the unit's airflow and the room is free of airflow restrictions. Perforated floor tiles in the raised floor should ensure minimal pressure loss. The raised floor must provide a minimum of 12" (305 mm) clearance. Ensure that there is adequate clearance above the unit for service, such as replacing filters. Optional plenums are available for downflow unit ducting.

There may be additional support required in the form of adjustable jackstands. These are adjustable, threaded leveling rods which support the unit in each of the corners and in the center on longer length units. Tighten the locknuts provided with each jackstand. The base plate can rest on the floor or on vibration pads.

Floorstands are also a way of supporting the unit. These are ordered to the height of the raised floor with leveling rods to allow adjustment. The floorstand has lips in each corner to align with the unit which is placed on top. It is recommended that the unit frame be bolted or screwed to the floorstand from below. Local building codes may dictate this procedure. After installation, the raised floor is typically built around the unit.

The raised floor serves as the distribution plenum for air on downflow units. Cables, piping, wiring raceways, inadequate floor height and any other restrictions can inhibit proper airflow. Care should be taken to avoid restrictions.

2.5.2 Upflow Units

Upflow units will typically be supported by vibration isolation pads and/or floorstands which may also include leveling screws. An air discharge plenum may be factory provided which ships loose and must be attached at the top of the unit frame. For in-room applications with supply and return grilles, several feet of clearance must be maintained at the intake and discharge of the unit.

Alternately, an air distribution plenum must be field fabricated with supply grilles to distribute the air. Units are shipped with Electronically Commutated (EC) motors often referred to as "plug fans". Fan speed is factory set based on order. Fan speed can be changed in 1% increments through the unit's microprocessor controller, Data Alarm Processor 4™ (dap4™) by several different methods. See the dap4™ User Manual for details and recommended settings.

WARNING: Do not operate upflow units without installing a plenum, ductwork or guard over the fan opening(s) on the top surface of the cabinet. Ductwork must be connected to the fan(s), or a plenum must be installed on the top of the cabinet for protection from rotating blower wheel(s) on upflow units. Risk of high-speed moving parts can cause injury or death. Disconnect all local and remote electric power supplies before working in the unit.

Note: Seal openings around piping and electrical connection to prevent air leakage. Failure to do so could reduce the unit's cooling performance.

2.6 Storage

Your Data Aire equipment comes ready for immediate installation. In some instances it may be necessary to store the equipment for a period of time. If you must store the equipment it should be done in a dry area, out of the weather, protected from damage by other equipment in storage or transportation equipment, never stacked, and avoid frequent relocation.

If equipment is stored for longer than 30 days special precautions must be taken to avoid coil damage. All coils should be charged and sealed with a low pressure (i.e., 1 to 3 PSIG, (7 to 21 kPa)) inert gas, such as nitrogen. This prevents contaminates from entering the coils: then when the seal is broken at installation, the rush of escaping gas verifies the coil is leak free. If coils are not charged and sealed condensation mixes with air pollutants forming a weak acid and over time can cause pin hole leaks to develop in the coil tubes.

When equipment is installed after storage, caution should be taken to inspect and replace, if required, rubber components. All moving parts, such as fans and motors, should be hand tested to ensure that they are free and clear prior to start-up. Finally, verify that all lubrication fresh and full.

2.7 Piping

Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and proper slope of the tubing coming from the evaporator. Tubing returns from the evaporator should

be designed so as not to trap oil and to prevent oil and refrigerant migration back to the compressor during off-cycles.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within the structure as well.

When piping, use copper tubing with appropriate supporting devices (supporting saddles, etc.). All field piping must be installed according to local codes. Avoid piping runs through noise-sensitive areas, such as office walls and conference rooms. Refer to Section 9.0 - Piping for piping guidelines and to the ASHRAE Refrigeration Handbook for general, good-practice refrigeration piping.

All piping below the raised floor must be located so that it does not restrict airflow. Plan the piping layout under the raised floor to prevent the airflow from being blocked. When installing piping on the subfloor, it is recommended that the pipes be mounted in a horizontal plane rather than stacked one above the other. Whenever possible, the pipes should be run parallel to the airflow.

Ensure that the tubing surfaces to be brazed are clean and that all burrs have been removed from the ends of the tubes. Ensure that all loose material has been cleaned from inside the tubing before brazing. Keep piping clean and dry, especially on units with R-410A refrigerant.

The units may be ordered with top or bottom connections.

2.7.1 Air Cooled Unit Piping

Air-cooled unit piping is crimped and brazed closed from the factory and contains a nitrogen holding charge. Each installation requires field-supplied refrigerant piping to a condenser.

Refer to section RECOMMENDED LINE SIZING charts on page 125 for a guideline on sizing refrigerant lines. The ultimate responsibility for line size selection is that of the installing contractor or project engineer. Data Aire does not assume this responsibility.

The chart covers distances up to 200 equivalent feet (61 m). For installations beyond this distance, consult ASHRAE or similar references.

Note: Standard piping practice must be used to ensure proper oil return and efficient operation. The interconnecting lines to the remote air cooled condenser or condensing unit must be installed by a qualified refrigeration mechanic.

2.7.2 Discharge Lines

Discharge lines, also called hot gas lines, should be trapped at the top (inverted) and bottom as well as every 15 to 20 feet (4.6 to 6.1 m) of vertical rise. Discharge check valves (field provided) are recommended on all installations, especially those where there are long pipe runs or cold climates. Check valves should be installed no less than six (6) to ten (10) feet (1.8 to 3.1 m) from the compressor. The evaporator section ships with a nitrogen holding charge. Do not vent the evaporator until all refrigerant piping is in place, ready for connection to the evaporator and condenser. The discharge, suction and liquid lines need to be refrigerant grade copper and in accordance with local code. All refrigeration piping should be installed with high temperature brazed joints. When brazing, a supply of nitrogen gas needs to be fed through the refrigerant lines. Be sure to open the other end of the refrigerant line to allow the nitrogen to bleed off and not pressurize the piping. Prevailing good refrigeration practices should be employed for piping support, leak testing, dehydration and charging the refrigerant circuits. During the installation, the lines should be capped off and filled with dry nitrogen at the end of each day's work or until the system is completed and sealed.

Data Aire recommends a silver/phosphorus/copper alloy with 5 to 15% silver be used to braze the refrigerant line sets to the indoor and outdoor units. Nitrogen needs to be flowing through the lines to eliminate carbon deposit build-up on the inside of the joints. Carbon could contaminate the refrigerant and restrict the metering device.

Piping must be supported within 18" (457 mm) of the inlet and outlet connections external to the unit. Internal to the unit, the inlet connection is located on the top header of all units. The discharge outlet is located at the bottom of the header.

Discharge line pressure should not exceed 9 PSI (62 kPa) for R-410A. Recommended gas velocity for proper oil return is 1,000 FPM (5.1 m/sec). Slope horizontal lines downward in the direction of the refrigerant flow. The recommended slope is 1/2" (12

mm) for every ten (10) feet (3 m) of line length. Discharge lines do not require insulation but due to the high temperatures of the refrigerant inside the line, the pipes may be insulated to protect against burns to individuals near or around the lines.

2.7.3 Liquid Lines

Liquid line size is determined by pressure drop and velocity. The liquid line pressure drop should not exceed 9 PSI (62 kPa) for R-410A. The recommended gas velocity should be between 200 and 300 FPM (1 to 1.5 m/sec). To avoid excessive liquid line pressure drop, the air cooled condenser should be located above or at the same level as the evaporator. Condenser installation more than ten (10) feet (3.1 m) below the evaporator is not recommended. Insulation of liquid lines is not required but can be useful in preventing condensation from forming and to avoid flashing on long pipe runs.

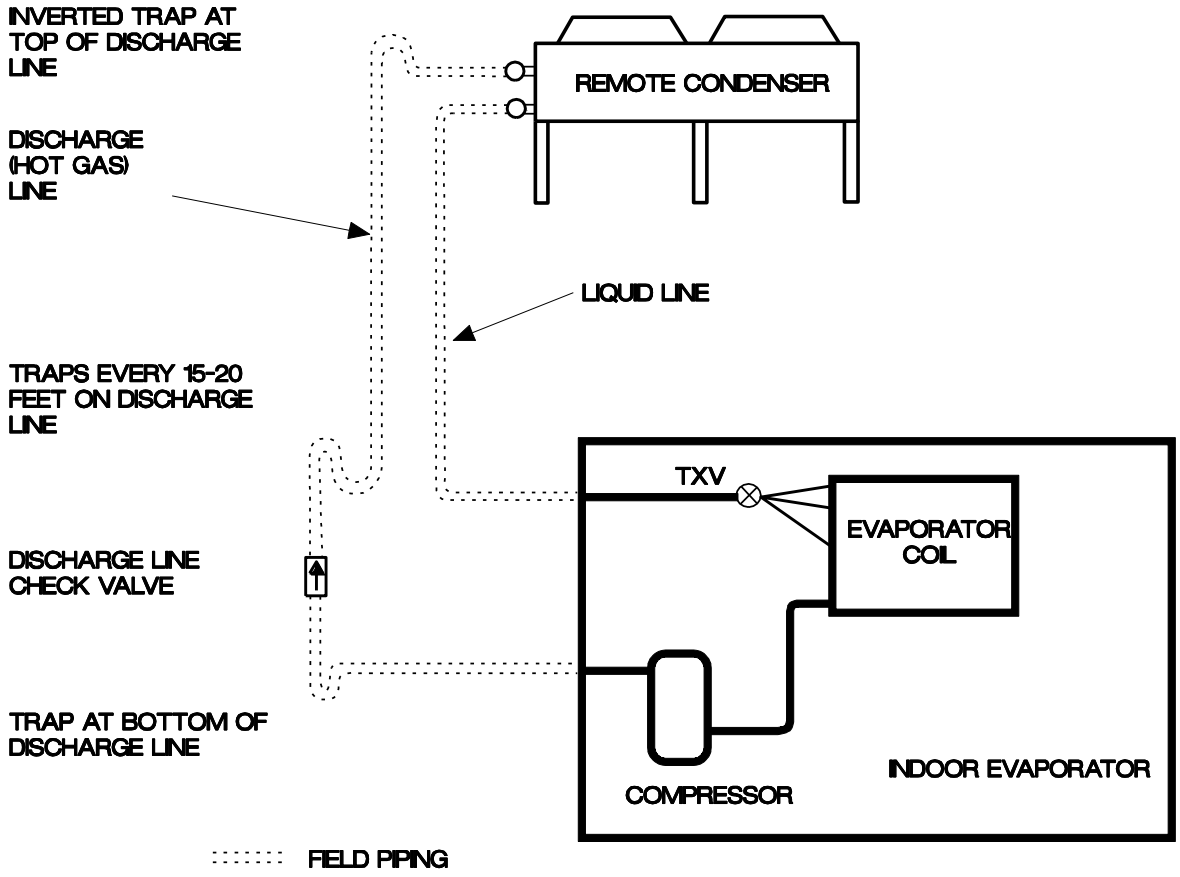
2.7.4 Connection Sizes, Air Cooled Units

Model Number	Liquid Line	Hot Gas Line
GUA* 036	7/8 (22 mm) O.D.	7/8 (22 mm) O.D.
GUA* 045	7/8 (22 mm) O.D.	7/8 (22 mm) O.D.
GUA* 056	7/8 (22 mm) O.D.	7/8 (22 mm) O.D.
GUA* 070	7/8 (22 mm) O.D.	7/8 (22 mm) O.D.
GUA* 106	1-3/8 (35 mm) O.D.	7/8 (22 mm) O.D.

* D=Downflow U=Upflow

Note: Field connections at the indoor evaporator and remote condenser or condensing unit will not necessarily be the same as the field pipe size required. In some cases these will vary significantly.

2.7.5 Field Piping, Remote Condenser



2.7.6 Water/Glycol Cooled Unit Piping

Water/Glycol-cooled units are factory-charged and tested. Field-supplied and field-installed piping is required from the unit to building water or tower water sources or the fluid cooler (i.e., dry cooler) and pump package. Pipe size will depend on length of run and the maximum water flow required.

The required field installed fluid cooler pipe sizes may or may not be the same as the connection sizes on the fluid cooler (refer to the Fluid Cooler User Manual for connection sizing). This will depend on the length of pipe and the calculated pressure drop of peripheral components.

Shutoff valves (field provided) should be installed within a few feet of the inlet and outlet connections of the evaporator to allow the unit to be isolated for service.

Drain/fill valves (field provided) should be located at the lowest point on the connected piping.

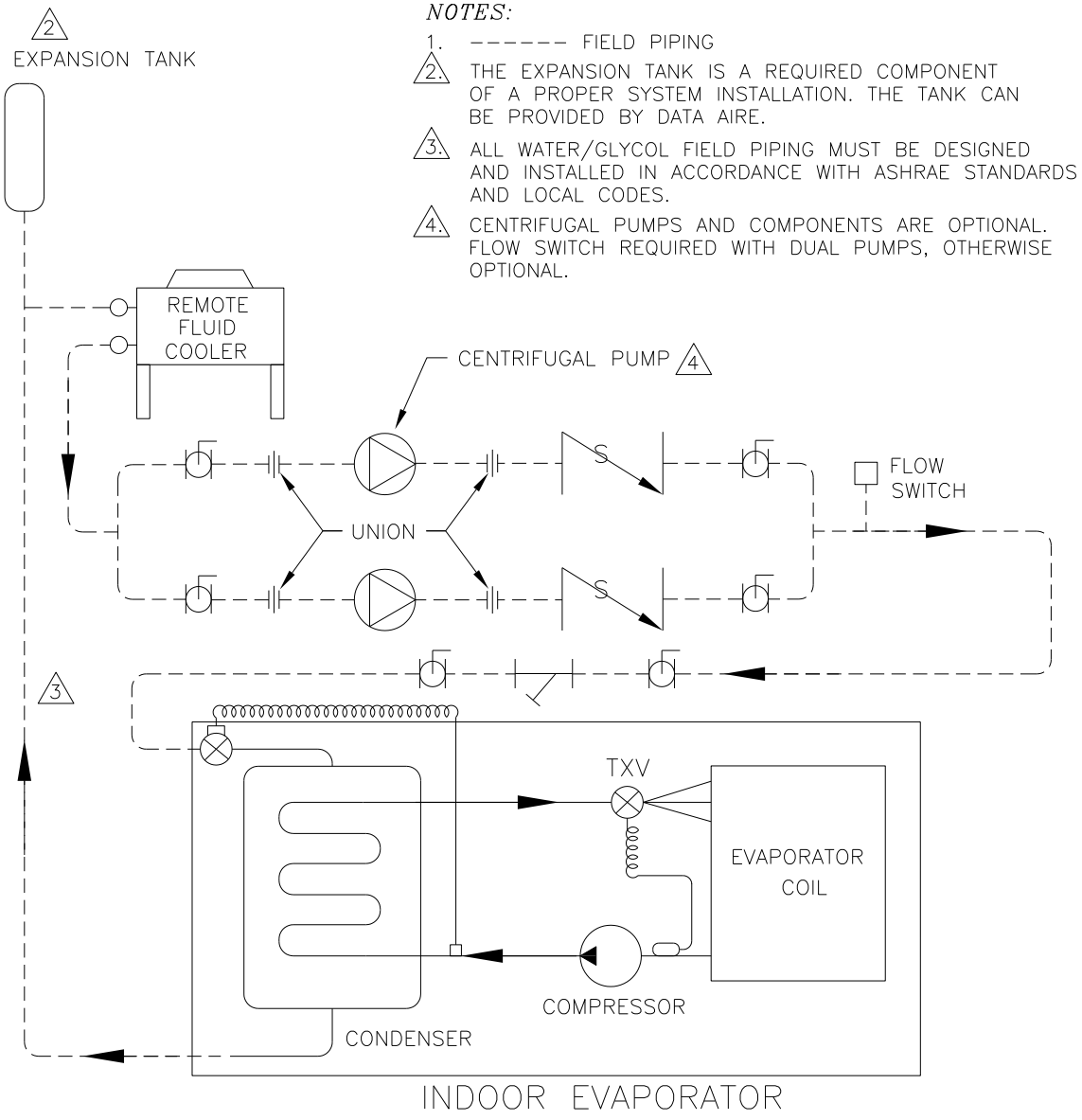
Water/glycol cooled units are shipped with plate/fin heat exchangers as standard equipment. A strainer (Data Aire provided) is shipped loose and is to be field installed in the supply line with shut-off valves (field provided) before and after the strainer. The strainers and water/glycol piping must be cleaned on a periodic basis. If the unit is shipped with optional shell and tube condensers, strainers are not required and not shipped with the unit.

All water pipes have a cap installed on the end of the pipe prior to shipment from the factory for pressure testing the system. These caps need to be removed before installing the piping to the units. Use a tube cutter for smaller pipes and a reciprocating saw with a metal cutting blade for larger pipe sizes or if there is a clearance problem. All connections need to be cleaned before connections are brazed together.

Note: One of the most common problems in a water/glycol system is the presence of air in the condenser water loop. Air vents must be installed in various locations the piping system to purge the air.

The water/glycol system may include a centrifugal pump (or pumps, for redundancy) available from Data Aire as an option, along with field provided union(s), shutoff valves, check valve(s) and a flow switch (Data Aire option). Pumps must be primed before operating per the pump manufacturer's guidelines.

2.7.7 Field Piping, Water/Glycol System



2.7.8 Connection Sizes, Water/Glycol Cooled Units

Model Number	Water In	Water Out
GUW or G* 036	2-1/8" (54 mm) O.D.	2-1/8" (54 mm) O.D.
GUW or G* 045	2-1/8" (54 mm) O.D.	2-1/8" (54 mm) O.D.
GUW or G* 056	2-5/8" (67 mm) O.D.	2-5/8" (67 mm) O.D.
GUW or G* 070	2-5/8" (67 mm) O.D.	2-5/8" (67 mm) O.D.
GUW or G* 106	2-5/8" (67 mm) O.D.	2-5/8" (67 mm) O.D.

* D=Downflow U=Upflow

2.7.9 Connection Sizes, Fluid Coolers

The information regarding fluid cooler (or often referred to as a "dry cooler") connection sizes can be found in the individual Fluid Cooler User Manuals which should be referred to for more complete details.

Models GHFC-200 and larger are double-wide units. Although the header connection for each section is 2-5/8" (67 mm), each unit comes with a factory provided header manifold kit with 3-1/8" (79 mm) field connections.

2.7.10 Auxiliary Chilled Water/Energy Saver Coil Piping

Units with Auxiliary Chilled Water cooling coil require a separate source of chilled water. These chilled water connection sizes will be equal to the condenser water connection sizes shown in the Fluid Cooler User Manual. Units with an Energy Saver cooling coil have shared piping with the condenser supply and return therefore do not require a separate water source.

All chilled water pipes have a cap installed on the end of the pipe for factory pressure testing of the system. These caps need to be removed before installing the water piping to the unit. Use a tube cutter for smaller pipes and reciprocating saw with a metal cutting blade for larger pipes or if there is a clearance problem. All connections need to be cleaned before connections are brazed together.

2.8 Condensate Drain Piping

Every indoor unit has a 3/4" (19 mm) copper stub provided for condensate removal. A union (field provided) is recommended at the field connection which will permit easy disconnection from the unit for cleaning.

A trap should be built into the drain line to prevent air from backing up into the unit. Drain lines should be pitched downward not less than 1/4" (6.35 mm) for each ten (10) feet (3.1 m) of horizontal run. Do not reduce the size of the drain line.

Some applications have no convenient means of allowing a gravity drain. When required, an optional condensate pump can be used. Condensate pumps are either factory mounted or shipped loose. Factory mounted condensate pumps do not require a separate power source.

Condensate pumps shipped loose (or field provided) typically require a dedicated 110 volt power source. Field pipe connections must be made to the pump discharge connection. A check valve must be installed to prevent short cycling. See condensate pump electrical requirements in Section 3.9.

Do not expose drain line to freezing temperatures. Drain line may contain boiling water therefore use copper or other suitable material. Drain line must comply with local building codes. It is recommended to install under-floor leak detection equipment whenever possible.

Note: Condensation formation and frequent humidifier flushing are normal functions of this equipment. Proper drain connections must be made to ensure proper removal. Unit will require water connections for condensate removal and possibly for humidifier makeup water, condenser water, chilled water and/or hot water. Installation of units above equipment that could sustain water damage should be avoided.

WARNING: The condensate drain MUST be connected to an external drain line (provided by others) before unit start up.

Note: Clogged or leaking drain lines can cause damage to the equipment and building.

Drain lines must be inspected regularly and maintenance must be performed to ensure that drain lines are clear and condensation runs freely through the drain system. The lines must be clear and free of obstructions and in good condition with no visible sign of damage or leaks.

This unit also requires an external water supply to the humidifier.

Improper installation, application and service may result in water leakage from the unit. Water leakage can result in severe property damage and loss of critical data center equipment.

Do not locate unit directly above any equipment that could sustain water damage. It is recommended to install leak detection equipment for unit and supply lines.

2.9 Humidifier Piping

2.9.1 Steam Generator Humidifier

The standard humidifier in the systems is a steam generator humidifier type with disposable cylinder. The humidifier makeup water should be brought to the humidifier through the field connection opening using 1/4" (6.4 mm) copper tubing. A compression fitting is provided at the humidifier.

A shutoff valve (field provided) should be installed outside the air conditioner to allow disconnection for service. An in-line water pressure regulator (field provided) and strainer (field provided) should be installed. Water pressure should be set between 20 and 80 PSI (128 and 552 kPa).

The humidifier has a drain at the bottom which is factory piped to the main condensate drain line. The dispersion tube also has a drain line. No additional field piping is required.

Note: Do not supply steam generating humidifier with softened water. Also, do not use hot water source.

2.10 Leak Testing

WARNING: No installation is complete until the entire system has been thoroughly checked for leaks. This includes checking the refrigerant tubing, flare fittings, pressure controls, Schrader fittings and compressor roto-lock service valves. Check both the field and factory connections.

In addition to the refrigeration system, check all condenser water lines, humidifier water makeup lines, condensate lines, condensate pumps, chilled water lines, centrifugal pumps and fluid cooler (where applicable).

When handling or recovering refrigerant it is not permissible to release refrigerant into the atmosphere. Many leak-test methods recommended in the past are no longer possible. Current standard practices must be used.

Pressurize the systems circuit(s) to 150 PSIG (1034 kPa) using dry nitrogen with a trace of refrigerant. Check the entire system for leaks with a suitable leak finder (per local code) including but not limited to all braze joints, caps, fittings, and flare nuts on both field and factory furnished components. After completion of leak testing, release test pressure and pull a vacuum on the system.

WARNING: Tightening of fittings and valves is the responsibility of the installing contractor.

WARNING: With any fluid connection there is risk of leakage. Water leakage could result in property damage to mission critical equipment. A water drain connection is required. Units with optional steam generator humidifiers will require an external potable water supply. Water leakage can result from improper installation and/or practices.

2.11 Evacuation

Moisture prevents the proper operation of both the compressor and the refrigeration system. Air and moisture reduces service life and increases condensation pressure, which causes abnormally high discharge temperatures that are capable of degrading the lubricating properties of the oil. The risk of acid formation is also increased by air and moisture, and it this condition can also lead to copper plating. All of these phenomena may cause both mechanical and electrical compressor failure. The typical method for avoiding such problems is to evacuate the system.

It is of the utmost importance that proper system evacuation and leak detection procedures be employed. Good evacuation processes include frequent vacuum pump oil changes and large diameter, short hose connections to both high and low sides of the system preferably using copper tubing or braided hose. If the compressor has

service valves, they should remain closed. A deep vacuum gauge capable of registering pressure in microns should be attached to the system for pressure readings. A shut-off valve between the gauge connection and vacuum pump should be provided to allow the system pressure to be checked after evacuation. Do not turn off vacuum pump when connected to an evacuated system before closing shut-off valve.

Evacuate the refrigerant lines, condenser coil and evaporator coil to 500 microns or lower (a micron gauge and 2-stage vacuum pump are required). Valve off and turn off the vacuum pump and wait at least 15 minutes to make sure the micron gauge reading does not go back above 750 microns. If it does, restart the vacuum pump and evacuate until the system reaches 500 microns. If the system still does not hold the pressure below 750 microns the system needs to be rechecked for leaks.

After the system has been satisfactorily evacuated the lines can be charged with refrigerant. Connect the pressure gauge manifold set to the high and low ports near the compressor. Connect the charging line to the refrigerant tank and set it for liquid feed. Open the refrigerant tank valve and purge the line at the manifold, then open the high side valve on the manifold only and allow the refrigerant to flow until the system pressure equalizes. At this point the system will have 75 to 80% of the total refrigerant charge. Start the blower and then the compressor checking the operating pressures and temperatures.

WARNING: Do not apply power to the compressor when in a vacuum.

3. ELECTRICAL CONNECTIONS

WARNING: The Data Aire cooling unit must be connected by a licensed and qualified electrician. Risk of electrical shock could result in injury or death. Disconnect all remote electrical power supplies prior to working on the unit. Follow all local codes.

NOTE: **Disconnect switches are optional.** The disconnect switch when turned OFF will de-energize the high voltage.

WARNING: Before proceeding with the electrical connections, make certain that the volts, hertz and phase correspond to that specified on the unit electrical nameplate. Use copper conductors only.

3.1 Electrical Service

Check to be sure the electrical service provided by the utility is sufficient to handle the additional load imposed by this equipment. Most units with secondary heat exchangers will require a separate power source and field provided interconnecting wires (see Section 3.5).

Remote condensers will typically require one power source. Glycol systems with fluid coolers and loose pump(s) typically require one power source for the fluid cooler and will require one additional source for single pump or two additional sources for dual pumps. Systems where the pump(s) are mounted and piped integral to the fluid cooler will usually require a single power source.

3.2 Nameplate Ratings

Refer to the unit electrical nameplate for equipment electrical requirements. Minimum circuit ampacity (MCA), also known as wire sizing amps, will dictate the minimum required wire gauge. Maximum Overcurrent Protection (MOP) device amps will dictate the maximum breaker or fuse size.

3.3 Grounding

The unit cabinet must have an uninterrupted true earth ground. An electrical ground wire of adequate size must be connected to the ground lug provided inside the main electrical box.

3.4 Voltage Tolerance

The supply voltage to the unit must be within 10% of the voltage indicated on the unit electrical nameplate. The maximum allowable voltage phase to phase imbalance must not exceed 3%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible damage. The local utility company should be contacted for correction of improper line voltage. Deviation from voltage ratings can cause premature failures and possibly void unit warranties.

WARNING: Check the wiring connections in the unit control panel to ensure they are tight. Screw terminals may become loose in transit. Tightening of wiring connections is the responsibility of the installing contractor.

3.5 Auxiliary Control Wiring

For secondary heat exchangers (condenser and fluid coolers) connect two 18 gauge wires (minimum size – good to 100 feet (30 m)) from the electrical box of the indoor evaporator to the electrical box of the remote heat exchanger. Refer to the wiring diagrams located in the electrical control panel of each unit. Follow the wiring diagrams for each piece of equipment. On most remote heat exchangers the terminals will be #39 and #40. All control wiring on Data Aire equipment is 24 VAC.

Condensing units (compressors mounted in the condenser) will typically require more wires (refer to unit wiring diagrams).

3.6 Remote Shutdown

Every gForce Ultra unit has remote shutdown contacts. These are intended for a field supplied dry contact or switch to be wired across two terminals. When the contactor or switch opens, the control circuit power is interrupted and the unit shuts down, including the control panel. The control circuit is 24 VAC and the field provided contact or switch should have a minimum rating of 10 amps. Use field-supplied Class 1 wiring.

The remote shutdown contacts are always terminals # 1 and # 2 on the terminal block designated TB1. The unit will ship with factory wired metal jumper clip that connects terminal # 1 to terminal # 2. Remove the clip prior to installing the field wires.

3.7 Remote Alarm Contacts

The dap4™ microprocessor control panel provides four (4) remote alarm output contacts that can be field accessed. The contacts include a Normally Open (NO) or Normally Closed (NC) on Alarm, dry contact, intended to be used in a control circuit not exceeding 5 amps at 24 VAC. Use field-supplied Class 1 wiring.

These programmable output contacts will close on a failure and remain closed until the alarm is no longer present. The terminal designations for these alarm output contact pairs are:

Remote Alarm Contacts Terminals	
TB1	**Function**
# 11	Remote Alarm 1 (Common)
# 12	Remote Alarm 1 (Normally Closed)
# 13	Remote Alarm 1 (Normally Open)
# 40	Remote Alarm 2 (Common)
# 41	Remote Alarm 2 (Normally Closed)
# 42	Remote Alarm 2 (Normally Open)
# 43	Remote Alarm 3 (Common)
# 44	Remote Alarm 3 (Normally Closed)
# 45	Remote Alarm 3 (Normally Open)
# 48	Remote Alarm 4 (Common)
# 49	Remote Alarm 4 (Normally Closed)
# 50	Remote Alarm 4 (Normally Open)

3.8 Condensate Pumps

A condensate pump is optional. Factory mounted pumps are pre-wired. While no outside power source is required, field piping is still a requirement.

WARNING: The condensate drain MUST be connected to an external drain line (provided by others) before unit start up. Without field piping condensate water will damage internal components.

Condensate pumps which ship loose, normally require a separate source of power. Always check the pump power requirements before connecting power. Condensate pumps are available in various voltages.

Factory installed condensate pumps are wired to display a "HIGH CONDENSATE WATER LEVEL" alarm. The wiring for this must be done in the field on pumps that ship loose.

3.9 Condensate Probe

One (1) condensate probe for sensing water under the floor is standard and is included with this unit. This comes in a plastic bag with about 15 feet (4.6 m) of coiled-up wire. The condensate probe is a rectangular box that is typically placed below the unit in a location where the water is likely to accumulate. Additional probes are available as an option.

Place the probe flat on the floor on top of a thin layer of non-conductive silicone. Secure the attached wires where necessary. A longer length of standard hookup wire may be used if required.

WARNING: Failure to remove the condensate probe from the plastic bag and uncoil the length of wire attached to the probe will leave the unit unprotected for sensing water under the unit and can result in a nuisance water detected alarm. Remove/disconnect the probe if it is not to be used.

3.10 Water Sensing Cable (Optional)

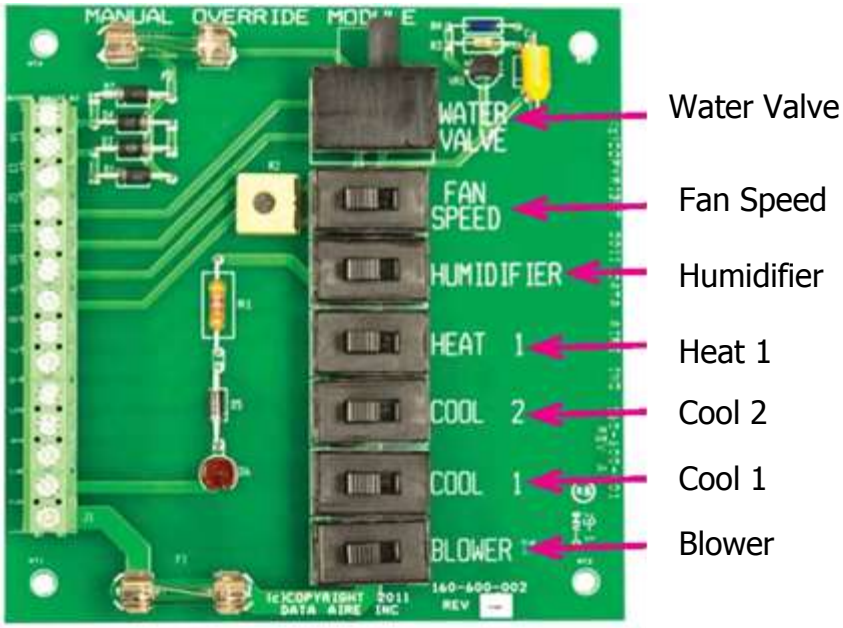
Some units may be equipped with an optional water detection cable in addition to or in lieu of the condensate probe. The cable can sense moisture anywhere along its length. It is typically placed below the unit in a rectangular pattern that matches the perimeter of the unit. The cable is connected to the terminal board and ready for installation. Cable lengths will vary depending on the original order and specifications. Care should be taken when installing the cable. Be sure the cable is not touching metal and/or any debris under the raised floor.

3.11 Remote Temperature and Humidity Sensors (Optional)

Remote temperature and humidity sensors are optional. Although existing unit mounted sensors can be removed for remote mounting, the remote sensor option provides a more convenient means of field installation. This is because the sensors are already connected to a predetermined length of cable and come mounted in a remote sensor enclosure. The temperature and humidity sensors require a total of five wires and should be twisted, shielded cable type.

3.12 Manual Override Switches

For testing and during start-up each gForce Ultra unit is provided with manual override slide switches. There are seven (7) slide switches. One for each of the following functions:



All automatic control is disabled but the safety switches remain functional. Simply slide the manual switches to energize the fan, compressor(s), humidification, reheat and other functions (as applicable).

The fan speed of the Electronically Commutated (EC) plug fan motor can be adjusted from 0 to 10 volts DC by adjusting the potentiometer at the left of the Fan Speed switch. The fan speed will increase 10% of the fan base speed for each one (1) volt adjustment (e.g., one (1) volt equals 10% speed). At ten (10) volts the motor is at full speed.

WARNING: Do not leave the unit in manual override. Slide the switches to the OFF position when completing testing and/or start-up. An alarm will be activated if units are left in the ON position.

3.13 Wiring Diagrams

Every Data Aire evaporator, condenser, condensing unit or fluid cooler comes with a wiring diagram. These diagrams are ladder type schematics intended for service personnel. The intent is to allow the technician to understand the wiring details associated with the electrical components and how they interface with the controls as well as peripheral equipment (including secondary heat exchangers).

The wiring diagram in the evaporator will indicate field interface terminals to the secondary heat exchanger. The internal wiring of the secondary heat exchanger is found on a separate diagram which can be found on the inside cover of the heat exchanger electrical box. Both diagram types are also placed inside the shipping/warranty packet secured in the evaporator section.

4. INSTALLATION OF REMOTE OUTDOOR HEAT EXCHANGER

Air cooled condenser and fluid coolers have individual User Manuals which should be referred to for more complete details.

5. CHARGING

NOTE: Improper charging procedure could cause compressor damage in several ways: excessive LP/HP pressure differences, liquid slugging or vacuum operation. The below system refrigerant charge procedure is strongly recommended to reduce these risks.

5.1 General Charging Guidelines

- Check the unit nameplate for refrigerant type to be used
- Refrigerant charging requires unit operation
- Calculate the amount of charge for the system
- Always use a scale to weigh in as much of the system charge as possible before starting the unit, record system charge when completed
- The refrigerant must be charged at the liquid side of the refrigeration circuit
- Care must be taken to prevent charging the system with too much refrigerant
- It is recommended to charge the unit with the return air setpoint between 75°F and 85°F (24 and 29°C)
- The return air temperature to the unit being charged must be stable and must be maintained greater than 65°F (18°C)
- If this is not possible due to lack of heat load, then load banks must be used to offset the cooling load during startup

5.2 Voltage Phase Check

5.2.1 Evaporator

Prior to charging, the correct voltage phasing should be checked on the indoor evaporator. EC plug fans are not dependent on the input power phasing and will always operate in the proper direction.

Since the scroll compressors are phase dependent, the easiest way to check proper phasing is to check the rotation of the constant speed scroll compressor (if available) on the evaporator section of dual circuit units by momentarily energizing the COOL 2 (constant speed compressor) switch on the Manual Override Module located next to the

microprocessor control module. Slide the Cool 2 switch to the ON position, observe the compressor operation for a short period of time then slide the switch back to the OFF position. An out of phase constant speed scroll compressor will draw relatively low amps and both suction and discharge pressures will remain nearly equal. If necessary, reverse any two of the three input line voltage wires at the line voltage field connection point to change the compressor rotation.

The gForce Ultra unit has a variable capacity compressor and an out of phase compressor will not turn ON and the VFD will show an error message. On the Manual Override Module located next to the microprocessor control module, slide the Cool 1 switch to the ON position, observe the VFD for an error message then slide the switch back to the OFF position. If an error message is observed, reverse any two of the three input line voltage wires at the line voltage field connection point to change the compressor rotation.

Although constant speed scroll compressors are phase dependent, units shipped from the factory are run tested, ensuring the compressor rotation is consistent with evaporator fan motor. However, a field change-out of a compressor may require checking proper phase.

5.2.2 Secondary Heat Exchanger

The secondary heat exchanger is ordered as three phase and the individual fan motors are three phase and will only run in one direction. Check operation by placing a momentary jumper across low voltage terminals # 39 and # 40 which will energize the control circuit.

NOTE: Disconnect pumps on glycol systems unless already filled with water/glycol solution.

Fans may not run because the head pressure is below the required cut-in pressure on air cooled condensers. On an R-410A system, the fan will not run until the head pressure is over 320 PSI (2206 kPa).

See separate User Manual for air cooled condensers or fluid coolers for the detail on the secondary heat exchanger.

5.2.3 Fan Speed Control System

The standard air cooled condenser provided with Data Aire gForce Ultra equipment has modulating Fan Speed Control (FSC) on the all motors. The modulation speed of the fans is directly proportional to the compressor head pressure.

5.3 Air Cooled Systems

5.3.1 Charging

5.3.1.1 Constant Speed Compressor

NOTE: Prior to refrigerant charging, a system vacuum and moisture removal procedure must have been carried out. Refer to Section 2.10 Leak Testing and Section 2.11 Evacuation prior to charging the system.

After field refrigerant piping is properly evacuated connect the refrigerant drum to the high side and charge with liquid. Make sure all hoses are properly purged. Systems with R-410A require approximately 3.0 lbs. per nominal ton. The compressor power must be off and prevented from starting inadvertently/automatically. From a vacuum, slowly open the service valve to feed liquid refrigerant into the high side of the system until the pressure equalizes. At this point there will be approximately 70-80% of the total charge in the system. It is likely that more refrigerant will be required to complete the charging procedure.

WARNING: Before starting a compressor, the crankcase heater should be energized for a minimum of 12 hours to reduce the possibility of liquid slugging on start-up. Failure to energize the crankcase heater could result in compressor damage. If the system is charged from a vacuum, the preheating of the compressor is not necessary.

Start the system and allow the system to stabilize to room temperature. Bubbles in the sight glass are not unusual at this point. It is likely that more refrigerant will be required to complete the charging procedure.

Adjust the refrigerant charge to the sub-cooling value shown in the table below and the sight glass has sparse bubbles. The unit should be allowed to stabilize for 15 to 20 minutes before meaningful measurements can be taken. After the system is allowed to stabilize, verification of a few key measurements should be noted. A properly charged system operating at typical parameters will have the following pressures:

Function	R-410A Conditions
Discharge Pressure	340 to 415 PSIG (2344 to 2861 kPa)
Suction Pressure	104 to 121 PSIG (717 to 834 kPa)
Superheat	6 to 12°F (3.33 to 6.67°C) Differential
Sub-Cooling	8 to 10°F (4.44 to 5.55°C) Differential Depending on ambient conditions

Measure the superheat at the compressor suction line at least 6 inches (152 mm) away from the compressor.

Note: Charging to a full liquid line sight glass should never be the sole means of determining the correct refrigerant charge. Other parameters such as superheat, suction pressure, head pressure, sub-cooling and ambient temperature are also important. A system charged to a clear sight glass is often overcharged.

5.3.1.2 Variable Capacity Compressor

NOTE: Prior to refrigerant charging, a system vacuum and moisture removal procedure must have been carried out. Refer to Section 2.10 Leak Testing and Section 2.11 Evacuation prior to charging the system.

After field refrigerant piping is properly evacuated connect the refrigerant drum to the high side and charge with liquid. Make sure all hoses are properly purged. Systems with R-410A require approximately 3.0 lbs. per nominal ton. The compressor power must be off and prevented from starting inadvertently/automatically. From a vacuum, slowly open the service valve to feed liquid refrigerant into the high side of the system until the pressure equalizes. At this point there will be approximately 70-80% of the total charge in the system. It is likely that more refrigerant will be required to complete the charging procedure.

WARNING: Before starting a compressor, the crankcase heater should be energized for a minimum of 12 hours to reduce the possibility of liquid slugging on start-up. Failure to energize the crankcase heater could result in compressor damage. If the system is charged from a vacuum, the preheating of the compressor is not necessary.

At this point, the unit and compressor will need to be started. Use the VFD "Hand on" key (7.5.1 Local Control for Charging) of the VFD controller to adjust the speed of the compressor to minimum frequency. Make sure to set the airflow of the unit to its full capacity.

NOTE: A quick and easy way to run the fans and compressor is by using the manual slide switches provided by the Manual Override Module (3.12 Manual Override Switches). Switch the fan and compressor manual switches to the ON position. All automatic control is disabled but safety switches will remain functional.

Start charging (slowly open the service valve to feed liquid refrigerant into the low side of the system) the unit with the compressor at its minimum frequency until the desired subcooling and superheat are met. Using the ▲ and ▼ buttons on the VFD, slowly ramp the compressor up to its maximum frequency while slowly feeding the system more refrigerant. When the compressor is at its maximum frequency, make sure to maintain the required subcooling and superheat shown in the table below. The unit should be allowed to stabilize for 15 to 20 minutes before meaningful measurements can be taken. After the system is allowed to stabilize, verification of a few key measurements should be noted. A properly charged system operating at typical parameters will have the following pressures:

Function	R-410A Conditions
Discharge Pressure	340 to 415 PSIG (2344 to 2861 kPa)
Suction Pressure	104 to 165 PSIG (717 to 1138 kPa)
Superheat	6 to 12°F (3.33 to 6.67°C) Differential
Sub-Cooling	8 to 10°F (4.44 to 5.55°C) Differential Depending on ambient conditions

Measure the superheat at the compressor suction line at least 6 inches (152 mm) away from the compressor.

When done charging, press the "Auto on" key on the VFD local display to return to normal operation controlled by the dap4™ controller. Also adjust the fan speed potentiometer back to the original position and set the slide switches OFF on the Manual Override Module.

Note: Charging to a full liquid line sight glass should never be the sole means of determining the correct refrigerant charge. Other parameters such as superheat, suction pressure, head pressure, sub-cooling and ambient temperature are also important. A system charged to a clear sight glass is often overcharged.

5.3.2 Flooded System Charging

Flooded systems are supplied with optional liquid receiver and head pressure control valve. When the ambient temperature falls during cold weather, the head pressure control valve will regulate the flow of refrigerant to ensure minimum receiver pressure. The condenser is partially flooded with liquid refrigerant in cold weather. In warm weather the extra refrigerant is stored in the receiver.

Flooded systems require more refrigerant than fan speed control systems. Connect the pressure gauge manifold set to the high and low ports near the compressor. Connect the charging line to the refrigerant tank and set for liquid feed. Open the refrigerant tank valve and purge the line. Open the high side valve on the manifold only and allow the refrigerant to flow until the system pressure equalizes. At this point the system will have 75 to 85% of the total refrigerant charge.

5.3.2.1 Constant Speed Compressor

Start the evaporator fan. From a vacuum, add liquid refrigerant to the high side of the system until the pressures equalize. Start the compressor.

NOTE: A quick and easy way to run the fans and compressor is by using the manual slide switches provided by the Manual Override Module (3.12 Manual Override Switches). Switch the fan and compressor manual switches to the ON position. All automatic control is disabled but safety switches will remain functional.

WARNING: Before starting a compressor, the crankcase heater should be energized for a minimum of 12 hours to reduce the possibility of liquid slugging on start-up. Failure to energize the crankcase heater could result in compressor damage. If the system is charged from a vacuum, the preheating of the compressor is not necessary.

Check the liquid line sight glass to get a feel for the approximate charge. Bubbles in the sight glass are not unusual at this point. It is likely more refrigerant will be required to complete the charging procedure.

If the receiver head pressure is below the required pressure (350 PSIG (2413 kPa) for R-410A), block part of the condenser coil surface until the pressure rises. During extremely cold weather all the condenser fan have to be de-energized to maintain head pressure.

Observe the sight glass on the receiver. Add refrigerant through the suction line until the level of liquid in the receiver is approximately 1/3 from the bottom (the leveling ball in the receiver will start to float) of the sight glass. At this point the receiver is 80% full. Observing the receiver sight glass becomes difficult when they are remote mounted near the condenser. The system should be allowed to stabilize for 15 to 20 minutes before meaningful measurements can be taken. After the system is allowed to stabilize, verification of a few key measurements should be noted. Add refrigerant to the system until the ball in the sight glass at the 1/3 level.

Function	R-410A Conditions
Discharge Pressure	322 PSIG (2220 kPa)
Suction Pressure	104 PSIG (717 kPa) or greater
Superheat	6 to 12°F (3.33 to 6.67°C) Differential

Measure the superheat at the compressor suction line at least 6 inches (152 mm) away from the compressor.

Remove any blocks that may have been used on the condenser coil. If the ambient temperature while charging is below 70ºF (21ºC), some of the refrigerant will be backed up in the condenser coil causing the liquid level in the receiver to drop (this is normal).

Note: Charging to a full liquid line sight glass should never be the sole means of determining the correct refrigerant charge. Other parameters such as superheat, suction pressure, head pressure, sub-cooling and ambient temperature are also important. A system charged to a clear sight glass is often overcharged.

5.3.2.2 Variable Capacity Compressor

At this point, the unit and compressor will need to be started. Use the VFD "Hand on" key (7.5.1 Local Control for Charging) of the VFD controller to adjust the speed of the compressor to minimum frequency. Make sure to set the airflow of the unit to its full capacity.

NOTE: A quick and easy way to run the fans and compressor is by using the manual slide switches provided by the Manual Override Module (3.12 Manual Override Switches). Switch the fan and compressor manual switches to the ON position. All automatic control is disabled but safety switches will remain functional.

WARNING: Before starting a compressor, the crankcase heater should be energized for a minimum of 12 hours to reduce the possibility of liquid slugging on start-up. Failure to energize the crankcase heater could result in compressor damage. If the system is charged from a vacuum, the preheating of the compressor is not necessary.

Check the liquid line sight glass to get a feel for the approximate charge. Bubbles in the sight glass are not unusual at this point. It is likely more refrigerant will be required to complete the charging procedure.

If the receiver head pressure is below the required pressure (350 PSIG (2413 kPa) for R-410A), block part of the condenser coil surface until the pressure rises. During extremely cold weather all the condenser fan have to be de-energized to maintain head pressure.

Observe the sight glass on the receiver. Add refrigerant through the suction line until the level of liquid in the receiver is approximately 1/3 from the bottom (the leveling ball in the receiver will start to float) of the sight glass. At this point the receiver is 80% full. Observing the receiver sight glass becomes difficult when they are remote mounted near the condenser. The system should be allowed to stabilize for 15 to 20 minutes before meaningful measurements can be taken. After the system is allowed to stabilize, verification of a few key measurements should be noted. Add refrigerant to the system until the ball in the sight glass at the 1/3 level.

Function	R-410A Conditions
Discharge Pressure	322 PSIG (2220 kPa)
Suction Pressure	104 PSIG (717 kPa) or greater
Superheat	6 to 12°F (3.33 to 6.67°C) Differential

Measure the superheat at the compressor suction line at least 6 inches (152 mm) away from the compressor.

Remove any blocks that may have been used on the condenser coil. If the ambient temperature while charging is below 70ºF (21ºC), some of the refrigerant will be backed up in the condenser coil causing the liquid level in the receiver to drop (this is normal).

Note: Charging to a full liquid line sight glass should never be the sole means of determining the correct refrigerant charge. Other parameters such as superheat, suction pressure, head pressure, sub-cooling and ambient temperature are also important. A system charged to a clear sight glass is often overcharged.

When done charging, press the "Auto on" key on the VFD local display to return to normal operation controlled by the dap4™ controller. Also adjust the fan speed potentiometer back to the original position and set the slide switches OFF on the Manual Override Module.

5.4 Water/Glycol System

5.4.1 Water/Glycol Cooled System Charging

All water/glycol cooled units are factory charged with refrigerant. The water regulating valve should be adjusted to maintain the required conditions. Field charging, if required, of water/glycol systems should be done by referring to the unit's electrical nameplate. The factory charge is indicated on the nameplate. Although this figure represents the initial factory charge, it is still necessary to measure and note proper unit operation including superheat, head and suction pressure. Some adjustment charge may be required.

Adjust the refrigerant charge until the sight glass clears or has sparse bubbles. The system should be allowed to stabilize for 15 to 20 minutes before meaningful measurements can be taken. After the system is allowed to stabilize, verification of a few key measurements should be noted.

Function	R-410A Conditions
Condensing Temperature	105 to 119^{0}F (41 to 48ºC)
Saturated Suction Temperature	33ºF (0.6ºC) or higher
Superheat	8 to 15ºF (4.44 to 8.33ºC) Differential

The superheat at the compressor suction line at least 6 inches (152 mm) away from the compressor.

All water/glycol cooled units have a water regulating valve. A head pressure transducer is connected to a Schrader fitting on the discharge line and water is regulated into the condenser coil (plate fin condensers are standard).

WARNING: Before starting a compressor, the crankcase heater should be energized for a minimum of 12 hours to reduce the possibility of liquid slugging on start-up. Failure to energize the crankcase heater could result in compressor damage. If the system is charged from a vacuum, the preheating of the compressor is not necessary.

Note: Charging to a full liquid line sight glass should never be the sole means of determining the correct refrigerant charge. Other parameters such as superheat, suction pressure, head pressure, sub-cooling and ambient temperature are also important. A system charged to a clear sight glass is often overcharged.

5.5 Check a Running Compressor

- Check current draw and voltage.
- Check suction superheat to reduce risk of slugging.
- Observe the oil level at start and during operation to confirm that the oil level remains visible.
- Excess foaming in oil sight glass indicates refrigerant on the sump.
- Monitor the oil sight glass for 1 hour after system equilibrium to ensure proper oil return to the compressor. This oil check has to be done over the speed range to guarantee:
    - A good oil return at low speed with minimum gas velocity.
    - A good oil management at high speed with maximum oil carry over.
- Check all tubes for abnormal vibration. Movements in excess of 1.5 mm require corrective measures such as tube brackets.
- When needed, add refrigerant.
- Do not overcharge the system.
- Record type and amount of refrigerant charge as well as operating conditions as a reference for future inspections.

5.6 Refrigerant Handling

The use of recovery/recycling units is required by U.S. Environmental Protection Agency (EPA) regulations. Technicians who service and dispose of air conditioning and refrigeration equipment must recover the refrigerant instead of venting it to the atmosphere.

Except for extremely small releases of refrigerant such as what occurs when disconnecting service hoses, a technician who knowingly releases or vents refrigerant to the atmosphere is in violation of this regulation. Refrigerant purchasers must be certified technicians and have a valid EPA certification card.

Warning: Pressure relief lines(s) must be vented to the atmosphere per the latest edition of ASHRAE Standard 15 and/or any local building, fire or mechanical codes. This applies to all units with either shell and tube condensers or high pressure relief valve options.

5.7 Commissioning

The system must be monitored after initial startup for a minimum of 60 minutes to ensure proper operating characteristics such as:

- Proper metering device operation and desired superheat readings
- Suction and discharge pressures are within acceptable levels
- Correct oil level in compressor sump indicating proper oil return
- Low foaming in sight glass and compressor sump temperature 10° F above saturation temperature to show there is no refrigerant migration taking place
- Acceptable cycling rates of compressors, including duration or run times

  Short cycling protection is provided in the VFD. It is factory preset "enabled" with default parameters. The minimum run time is set to ensure long enough running time at start up in order to create enough refrigerant flow velocity in the system to recover the oil to the compressor sump.

- Current draw of compressor within acceptable values
- No abnormal vibration or noise

5.8 Important Refrigeration Components

5.8.1 Variable Capacity Compressor with VFD

The unique feature of the gForce Ultra is the application of variable capacity compressor. The quest for greater energy efficiency is continuous; efficiency benchmarks are always moving up. That's why Data Aire is moving toward variable capacity compressor technology for quieter, more energy-saving performance. Conventional compressors are designed to run at constant speed to handle a given capacity requirement. But in data center applications, the capacity requirement varies. In these situations, a constant speed compressor uses various capacity-regulation techniques and can be less efficient than a compressor utilizing variable capacity technology. A variable capacity compressor (VCC), on the other hand, saves energy

and operates more quietly by varying speed to match the workload. Tests with VCC compressors have shown an immediate energy savings and sound level reductions.

5.8.2 Electronic Expansion Valve

The Electronic Expansion Valve (EEV) is standard for this unit. This high efficiency feature provides an EEV in place of the standard Thermal Expansion Valve (TXV). The EEV controls superheat through the dap4™ controls by actively measuring suction pressure via a transducer attached to the suction line and suction temperature via a thermal transducer strapped to the suction line. The EEV actively adjusts the orifice size and resulting mass flow of refrigerant to maintain the superheat setpoint. The EEV maintains more stable system balance and is more energy efficient. With variable capacity systems, an electronic expansion valve is the solution to handle refrigerant mass flow variations.

5.8.3 High Pressure Cutout Switch

Each refrigerant circuit is protected by a high pressure cutout switch with manual reset button. The switch is typically located in the evaporator near the compressor. The high pressure switch rating is:

R 410R Refrigerant	Setting
Cut-out (Open)	575 PSI
Cut-in (Close)	Manual Reset

5.8.4 Low Pressure Cutout Switch

Each refrigerant circuit has a low pressure cutout switch which features SPST open-low switch action and automatic reset. The switch is typically located in the evaporator near the compressor. The low pressure switch rating is:

R 410R Refrigerant	Setting
Cut-out (Open)	50 PSI
Cut-in (Close)	90 PSI

5.8.5 Liquid Line Solenoid Valve

Liquid line solenoid valve(s) (LLVS) are a standard feature on this unit. The LLSV are direct acting, NC (normally closed; i.e. closed when de-energized) solenoid operated valve(s). This has the advantage that the valve is closed when the system is not

running and when the solenoid valve is not energized. For this reason, an electrical power failure does not lead to any problems with the refrigeration system.

The primary purpose of a solenoid valve in a refrigerant liquid line is to helps prevent refrigerant migration (i.e., flow into the evaporator) during the OFF cycle.

6. GLYCOL SYSTEMS

6.1 Glycol Concentration

The system must be filled with water and the appropriate amount of glycol (either ethylene or propylene) inhibitors to protect against winter freeze-up and premature coil corrosion. To achieve the approximate glycol concentration, it is necessary to know the total system volume. This consists of the sum of the fluid cooler volume, the evaporator unit volume and the volume of the inter-connecting piping.

The following tables can be used for arriving at an approximate system volume. After installation, the glycol percentage should be checked. The glycol percentage should also be checked at regular intervals to ensure freeze protection.

6.2 Internal (Fluid) Volume – Downflow Units

Evaporator Model	Standard Unit Volume In Gallons (Liters)	Energy Saver Unit Volume In Gallons (Liters)
GUGD 036	7.9 (30.0)	10.1 (38.2)
GUGD 045	9.5 (35.9)	10.6 (40.1)
GUGD 056	9.9 (37.4)	16.3 (61.7)
GUGD 070	12.2 (46.1)	18.8 (71.2)
GUGD 106	16.2 (61.3)	22.9 (86.7)

6.3 Internal (Fluid) Volume – Upflow Units

Evaporator Model	Standard Unit Volume In Gallons (Liters)	Energy Saver Unit Volume In Gallons (Liters)
GUGU 036	7.9 (30.0)	9.2 (34.8)
GUGU 045	9.5 (35.9)	9.2 (34.8)
GUGU 056	9.9 (37.4)	15.9 (60.2)
GUGU 070	12.2 (46.1)	16.3 (61.7)
GUGU 106	16.2 (61.3)	23.1 (87.4)

Note: Risk of a leaking coil due to freezing and/or corrosion. Can cause equipment and serious building damage.

Note: Risk of corrosion can cause equipment damage. Contact a water consultant about water quality, corrosion and freeze protection requirements. Water chemistry varies greatly by location, as do the required additives, called inhibitors that reduce the corrosive effect of the fluids on the piping systems and components. The chemistry of the water used must be considered, because water from some sources may contain corrosive elements that reduce the effectiveness of the inhibited formulation. Preferably, surface waters that are classified as soft and are low in chloride and sulfate ion content should be employed. Proper inhibitor maintenance must be performed to prevent corrosion of system components. Consult glycol manufacturer for testing and maintenance of inhibitors.

Commercial ethylene glycol, when pure, is generally less corrosive to the common metals of construction than water itself. It will, however, assume the corrosively of the water from which it is prepared and may become increasingly corrosive with use if not properly inhibited.

6.4 Internal (Fluid) Volume – Fluid Coolers

6.4.1 Fluid Cooler Information

The information regarding fluid cooler (or often referred to as a "dry cooler") internal volume, the volume of the inter-connecting piping and the freezing point of aqueous solutions can be found in the individual Fluid Cooler User Manuals which should be referred to for more complete details.

7. Variable Speed Compressor

7.1 Features

As the leader in variable capacity compressor technology in the data center industry responding to environmental and energy challenges, Data Aire developed the gForce Ultra variable capacity compressor CRAC unit. The compressor technology uses a brushless Interior Permanent Magnet (IPM) design to provide higher efficiency. And it delivers efficiency across a wider range. A cooling solution optimized for energy consumption and for power grid requirements. Thanks to a 4:1 modulation ratio, the gForce Ultra can cycle from 25 to 100 RPS to provide greater savings.

Match exactly your cooling requirements to control temperature and humidity, critical for the best process as well as product quality.

7.2 Oil Management

Insufficient oil level can be the result of oil depositing itself in pipes and heat exchangers. The oil deposit can be returned to the crankcase by increasing velocity for short periods, at regular time intervals or when the velocity is too low to ensure adequate oil return.

With oil return management functions that are built into the control system, these two oil return mechanisms can be programmed in the variable frequency drive (VFD).

With the oil return management function enabled, the VFD performs oil return by boosting the compressor speed to an appropriate RPM for a selectable duration as programmed into the VFD parameters. This boost is performed at programmable fixed time intervals or if the compressor speed has been less than 3000 RPM (50 rps) for too long which is again a programmable parameter, whichever comes first. Therefore the maximum time between two consecutive oil return boosts is fully programmable.

Split system unit include an oil separator to allow proper oil return back to the compressor. This unit still performs the oil management function mentioned above to ensure oil in long line runs return the oil to the compressor. This is required to ensure any oil that bypasses the separator is return.

7.3 Crankcase Heaters

A crankcase heater will minimize refrigerant migration caused by the large temperature gradient between the compressor and the remainder of the systems. When the

compressor is idle, the oil temperature in the sump of the compressor must be maintained at no lower than the 10° F above the saturation temperature of the refrigerant on the low pressure side. This ensures that liquid refrigerant is not accumulating in the sump.

7.4 Oil Level

When the compressor is running under stable conditions the oil level must be visible in the sight glass. The presence of foam filling the sight glass indicates large concentration of refrigerant in the oil and/or presence of liquid returning to the compressor. The oil level can also be checked a few minutes after the compressor is shut down, the level must be between ¼ and ¾ of the sight glass. When the compressor is OFF, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

Always use original Danfoss POE oil 160SZ from new cans. Top-up the oil while the compressor is at idle. Use a Schrader connector or any other accessible connector on the compressor suction line and a suitable pump.

7.5 VFD Drive

There are tremendous energy saving and application advantages available by applying a VFD drive to compressor cooling. Variable speed control offers the ability to match the cooling capacity to the actual need. Costs are reduced through direct energy savings of operating at a lower speed. The drive can operate a variable capacity compressor over a wider range. Other advantages of the VFD are limiting the number starts and reduced start system shock thus reducing peak energy demand and system wear. Below is a figure showing the VFD control display and some general instructions required to charge the unit and monitor any alarms.

The local control panel (LCP) for the VFD drive is the combined display and keypad on the front of the unit. The LCP has several user functions:

- Start, stop, and control speed when in local control mode
- Display operational data, status, warnings and cautions
- Programming frequency converter functions
- Manually reset the frequency converter after a fault when auto-reset is inactive

7.5.1 Local Control for Charging

- Press the "Hand on" button. The display will show Hand Local Running.
- Use the ◀ and ▶ keys to move the cursor to the desired digit position, then use the ▲and ▼ keys to increase or decrease the desired RPM setting. As you change the value, the compressor will increase or decrease in speed.
- See example display below:

When done charging, press the "Auto on" key to return to normal operation controlled by the dap4™ controller.

7.5.2 View Drive Alarms

- Press the Alarm log key
- Use the ▲ and ▼ keys to move the cursor through the various alarms.
- See example display below:

When done, press the Auto on key to return to normal operation controlled by the dap4™ controller.

Note: If more information is required, see the full operating manual for the drive system.

8. CONTROLS

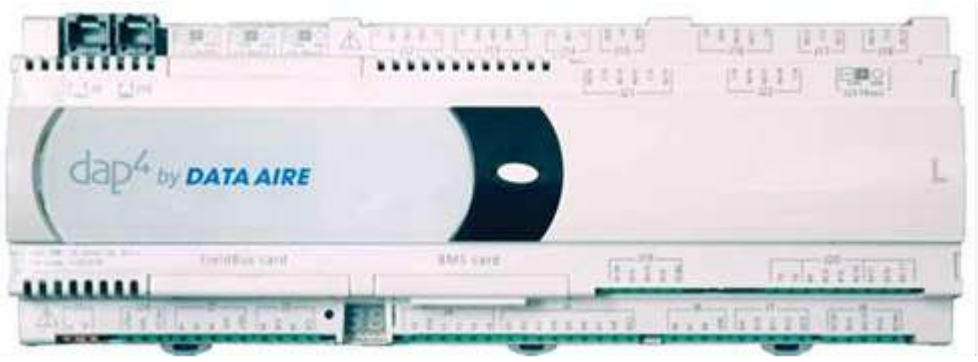
8.1 dap4™ Microprocessor Control Panel

The standard controller on all gForce Ultra units is the dap4™ microprocessor control panel. The unit is shipped with factory default settings. The settings can be changed to meet the controlled space criteria. The dap4™ consists of two main components: the control module and the display panel. The control module is located in the unit's electrical panel. The display panel is mounted on the front door. The two are connected by special telephone type cable harness[1]. All data displayed on the display screen originates from the control module. The display panel has a backlit LCD (liquid crystal display).

Note: The dap4™ microprocessor control panel has an entire manual dedicated to its use and operation. This manual must be referenced to complete a thorough unit installation. Start-up is not complete until the dap4™ control panel settings are established.

8.1.1 Control Module

8.1.2



[1] Regular telephone cable will not operate. Factory supplied cable is required.

8.1.2 Display Module

8.1.3 Buttons

There are six keys on the face of the display panel to retrieve or enter settings.

BUTTON	FUNCTION	DESCRIPTION
	Alarm	Allows viewing of active alarms Silences audible alarms Resets active alarms
	Menu	Allows entry to Main Menu
	Esc	Return to previous screen Hold 5 seconds to turn ON or OFF
	UP Arrow	Allows scrolling to previous screen Allows value changes (increase)
	ENTER	Allows entry to Menus Advances curser
	DOWN Arrow	Returns to next screen Allows value changes (decrease)

The Main Menu allows you to see the current unit status (temperature, relative humidity and operating mode – cooling, humidification, etc.).

8.1.4 Accessing Menus/Passwords

To access any Menu, a numerical password is required.

To enter the menu and Sub-Menu screens, press the MENU key on the display panel. A password will be requested. The password is a four digit entry (including 0). Units are

shipped from the factory with the password requirement bypassed to accommodate start-up and set-up. The display screen will have following message:

The Service Level Password setting from the factory is: **0000**

The cursor will be flashing by the Security Access message at the top of the screen. Press the ENTER key to move the cursor. The cursor will flash at the first input (represented by a 0). Press the UP or DOWN keys to increase or decrease the value. Once the value is entered, press the ENTER key to move to the next input. Increase or decrease the value by pressing the UP or DOWN keys. Once the value is entered, press the ENTER key to move to the next input.

Once all four values have been entered, press the ENTER key. If the password is incorrect, the following message will appear: **Password Wrong!** The cursor will return to the first input value. Follow the same procedure to re-enter the password.

Once the correct password is entered and accepted, the Menus will display on the screen. Only those Menus allowed through the Service Password will be available. Use the UP or DOWN keys to scroll through the available. Use the UP or DOWN keys to scroll through the available Menus.

NOTE: Factory Level menus are for configuring the unit. The dap4™ controller is used for a variety of equipment types. The controller is based on the unit type, unit components and options. Under normal circumstances these menus should not be changed. If they need to be changed, please

contact Data Aire engineering or service personnel.

8.1.5 Changing the Service Level Password

The Service Level password can be changed by doing the following:

Enter the Main Menu by pressing the MENU key. You will be prompted to insert the Service Level password. Enter the current password.

- Press the MENU key. The screen will display the following display:

- Press the ENTER key. The cursor will highlight the first input. Change the input by pressing the UP or DOWN key. Once the selected number is displayed, press the ENTER key to move to the next input. Repeat the same steps for each input.

After the last input has been entered, press the MENU key to return to Main Menu. The new password is stored.

8.2 Entering Menu Settings

NOTE: The dap4™ control panel is used on a variety of Data Aire equipment types including the gForce Ultra. Some Menus and Menu screens will appear that are not applicable to the gForce Ultra. In this document those Menu screens will be noted with the following message: **Disregard this Menu – it is not applicable to in row cooling units.**

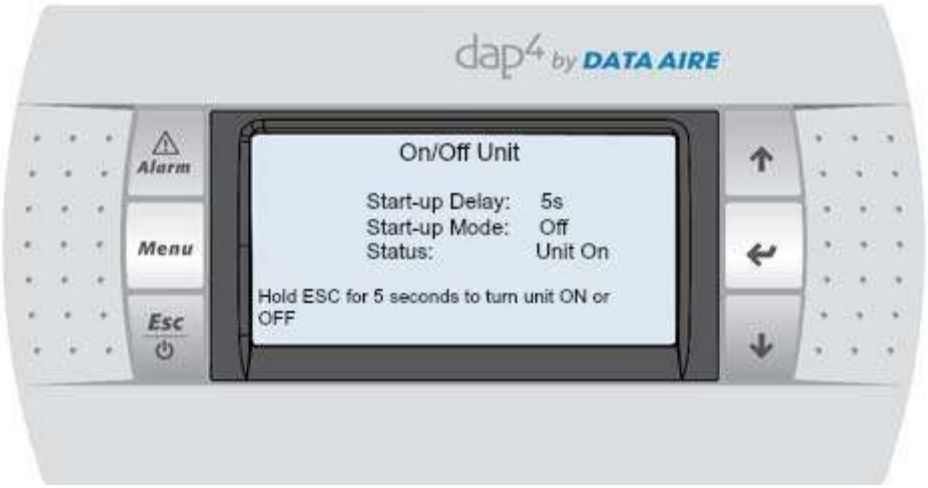
8.2.1 Menu A – ON/OFF

Menu A allows the unit power to be switched from ON to OFF and from OFF to ON (the Service level password is required).

Enter Menu A by pressing the MENU key. Use the UP or DOWN keys to scroll through the menus. Press the UP or DOWN key until "A. On/Off" is highlighted.

Press the ENTER key.

The following will appear on the display screen:



The cursor will be flashing at the upper left hand corner of the screen. Press the ENTER key. The cursor will move to the "Change to: "SWITCH OFF". Press either the UP of DOWN button to change the status. Press the ENTER key to save the setting.

- If selecting SWITCH OFF the STATUS will change to: OFFbyKey. The unit will be OFF
- If selecting SWITCH ON the STATUS will change to: UnitON. The unit will be ON

When switching from the SWITCH OFF selection to the SWITCH ON (and pressing the ENTER key), the following message will appear: **Time Before Start: XXs**

NOTE: The start time is a programmable time delay. It can be programmed from 5 to 600 seconds (see Menu J – Factory Settings).

Once the selection is made, to leave Menu A, press the MENU key. The Main Menu screen will continue to display other menus. To view any of these menus scroll to the desired menu. Press the ENTER key. If you choose to return to the main screen, press the Esc key.

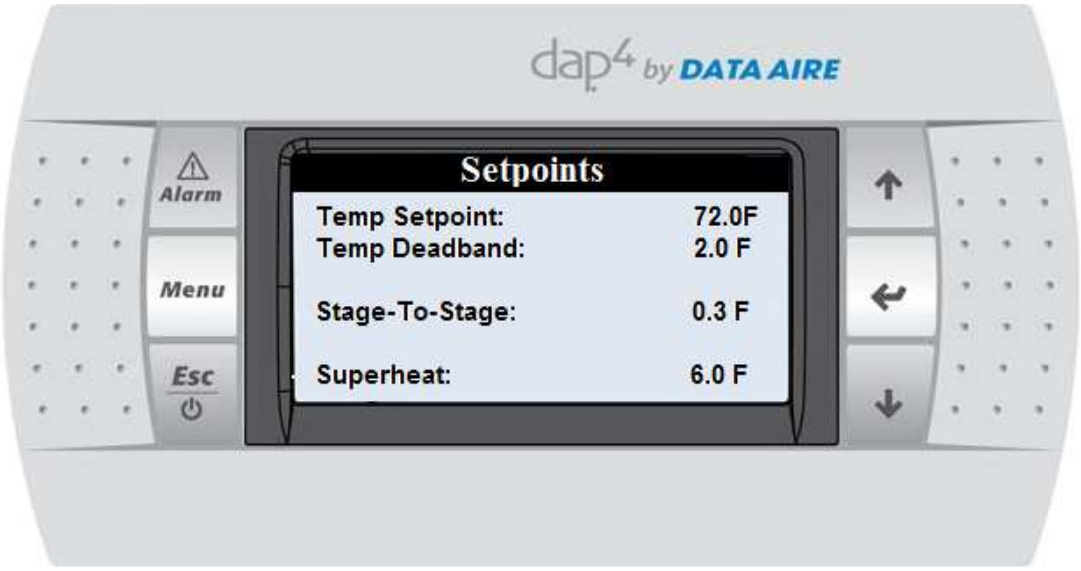
8.2.2 Menu B - Setpoints

MENU B allows viewing and changing of Setpoints (Service Level password is required for entry)

Press the UP or DOWN key until "B. Setpoint" appears and is highlighted. Press the ENTER key.

Use the UP or DOWN key to scroll through the screens. Menu B has two screens.

The following screen will appear:



This is for the cooling temperature setpoint settings (to control the chilled water valve or compressor capacity):

NOTE: The Temp Setpoint range is from 45.0°F to 105.0°F (factory setting is 72.0°F).

The Temp Deadband range is from 2.0°F to 5.0°F (factory setting is 2.0°F).

Superheat setpoint range is from 5.0°F to 15.0°F (factory setting is 6.0°F).

To change the values press the ENTER key to move the cursor to the desired input (Temp Setpoint). The cursor will flash next to the current entered value.

Press the UP or DOWN key to change the value. Once the value has been changed to the desired value, press the ENTER key. The cursor will move to the next input (Temp Deadband).

Change the value (if required) using the same procedure or press the ENTER key to return the cursor to the top of the screen (it will flash next to the title – Rack Temp Setpoints).

To see the next screen, press the DOWN key.

The following will appear if the fans are controlled based on Rack Temperature (values are for reference only):

This setpoint will control the fan motor modulation.

NOTE: The Temp Setpoint range is from 45.0°F to 105.0°F (factory setting is 72.0°F).

The Temp Deadband range is from 2.0°F to 5.0°F (factory setting is 2.0°F).

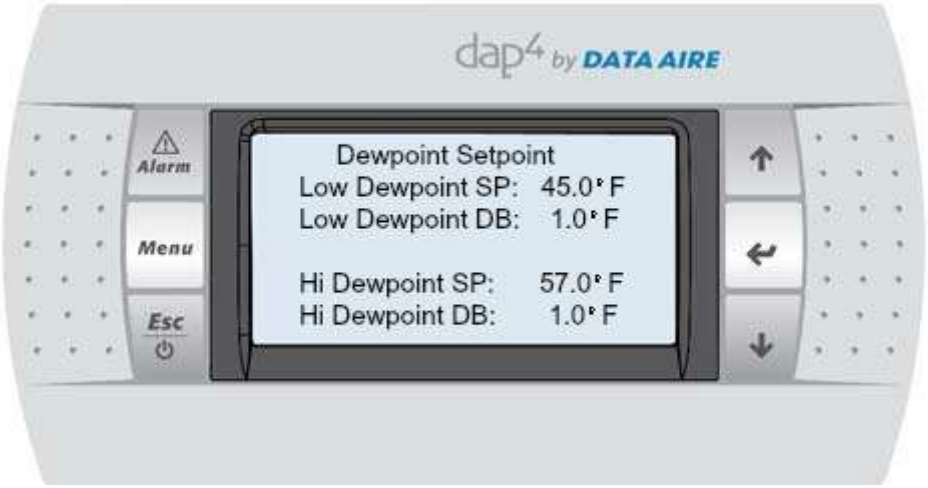
To change the values press the ENTER key to move the cursor to the desired input (Temp Setpoint). The cursor will flash next to the current entered value.

Press the UP or DOWN key to change the value. Once the value has been changed to the desired value, press the ENTER key. The cursor will move to the next input (Temp Deadband).

Change the value (if required) using the same procedure or press the ENTER key to return the cursor to the top of the screen (it will flash next to the title – Rack Temp Setpoints).

To see the next screen, press the DOWN key.

The following will appear on the first Menu B screen (values are for reference only):



To see the next screen, press the DOWN key.

The following will appear on the first Menu B screen (values are for reference only):

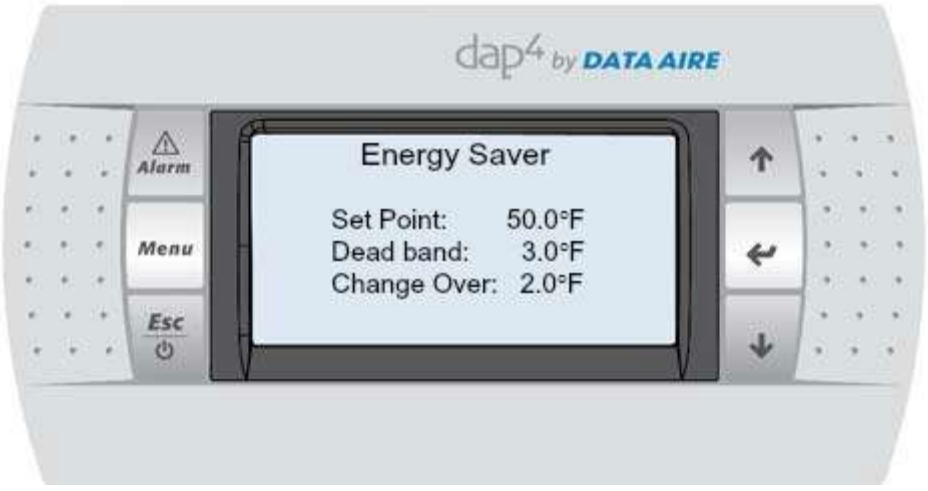
NOTE: The Hum Setpoint range is from 25% to 70% (factory setting is 50%).

The Hum Deadband range is from 1% to 15% (factory setting is 2%).

Follow the same steps as detailed for Temperature Setpoints to make any desired changes.

To see the next screen, press the DOWN key.

The following will appear on the first Menu B screen (values are for reference only):



Disregard this Menu – it is not applicable to in-row cooling units.

Press the MENU key to return to the Main Menu

8.2.3 Menu C – Clock/Scheduler

Disregard this Menu – it is not applicable to in-row cooling units.

8.2.4 Menu D – Input/Output

This is a view only menu. The values are factory set and only if instructed by Data Aire Engineering or Technical Service personnel should these be changed.

8.2.5 Menu E – Historical Data

Menu allows viewing of alarms, component runtime hours and re-setting of runtimes. Alarms will be displayed by the alarm name and the time/date of occurrence. In addition, it will display the temperature and humidity at the time of the alarm.

The following will appear on the first Menu E screen (values are for reference only):

Press ENTER once for the cursor to stay on the "→ Scroll Up/Down?" line.

Press the UP or DOWN key to view additional alarms.

Press the ENTER key to return to the title line.

Press the DOWN key to Run Hours and Reset

The following will appear on the first Menu E screen (values are for reference only):

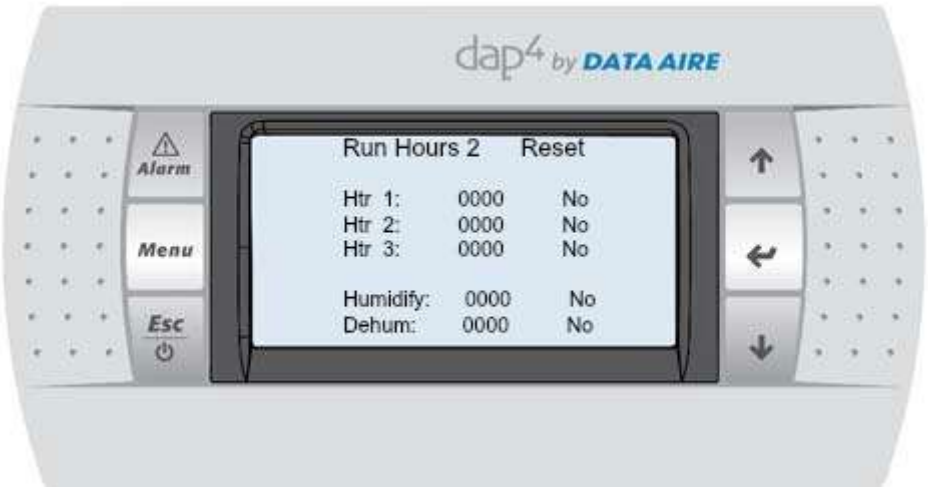
This screen (and the following two screens) gives you the option to reset the runtimes. Press the ENTER key to move the cursor over the No column. Press the UP or DOWN key to change the setting for No to Yes. When changing from No to Yes, the runtime will be erased to 0000.

Press the ENTER key to move the cursor. Follow the same procedure until all desired changes are made. Return the cursor to the title line (at the top of the screen) by pressing the ENTER key.

NOTE: This screen and the subsequent two screens will have information not applicable to gForce Ultra cooling units.

With the cursor flashing on the title, press the DOWN key to view the next screen

The following will appear on the second Menu E screen (values are for reference only):



Press the ENTER key to move the cursor. Follow the same procedure until all desired changes are made. Return the cursor to the title line (at the top of the screen) by pressing the ENTER key.

With the cursor flashing on the title, press the DOWN key to view the next screen

The following will appear on the third Menu E screen (values are for reference only):

Press the ENTER key to move the cursor. Follow the same procedure until all desired changes are made. Return the cursor to the title line (at the top of the screen) by pressing the ENTER key.

You also have the option to reset all runtimes (Screens 1 thru 3) by moving the cursor to "Reset All Runtimes".

To exit Menu E, with the cursor on the title line, press the MENU key.

Advance to Menu F (Information) by pressing the DOWN key.

8.2.6 Menu F – Information

This is a view only menu. Menu entry requires a service password to enter.

There are three screens – two with information detailing the processor version and data. The third screen details unit information including model number, serial number and Data Aire job number.

To view the screens, press the DOWN key. The cursor will not move as this is a view only screen. When calling for technical assistance please have the serial number from the Unit Identification screen.

Press the Menu key to exit Menu F

8.2.7 Menu G – Network Config

This menu allows programming of available protocols. Menu entry requires a service password. This is a factory set menu dependent on whether optional communication cards were ordered.

The following will appear on the screen (values are for reference only):

NOTE: If N/A has been selected (no communication card ordered), this will be the only screen viewed. If a protocol has been selected, additional screens will appear as detailed.

The following protocols are available:

- MODBUS
- MODBUS EXT (future use)
- LON
- BACnet TCP/IP
- BACnet MSTP

The following screen will appear when MODBUS protocol is selected:

The following screen will appear when LON protocol selected:

The following screen will appear when BACnet TCP/IP protocol is selected:

The following screen will appear when BACnet MSTP protocol is selected:

Press the MENU key to exit Menu I

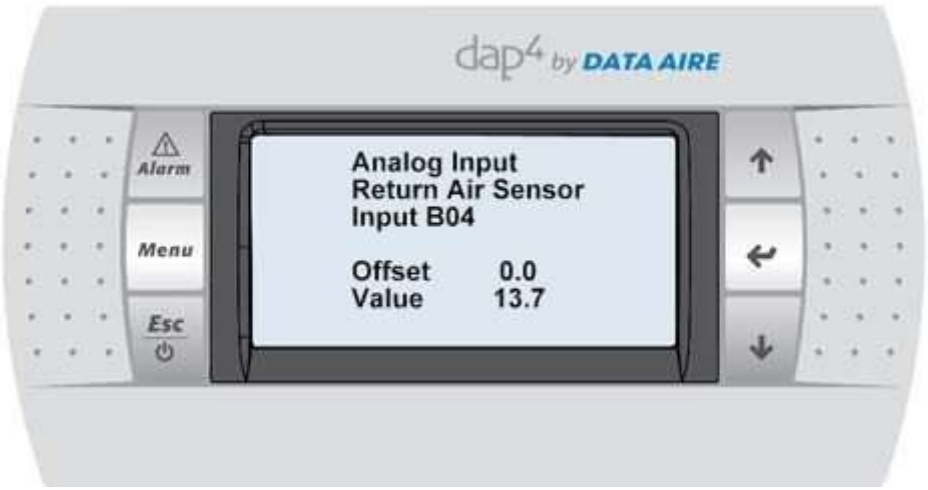
Press the ENTER key to advance to Menu H – Calibrate Sensors

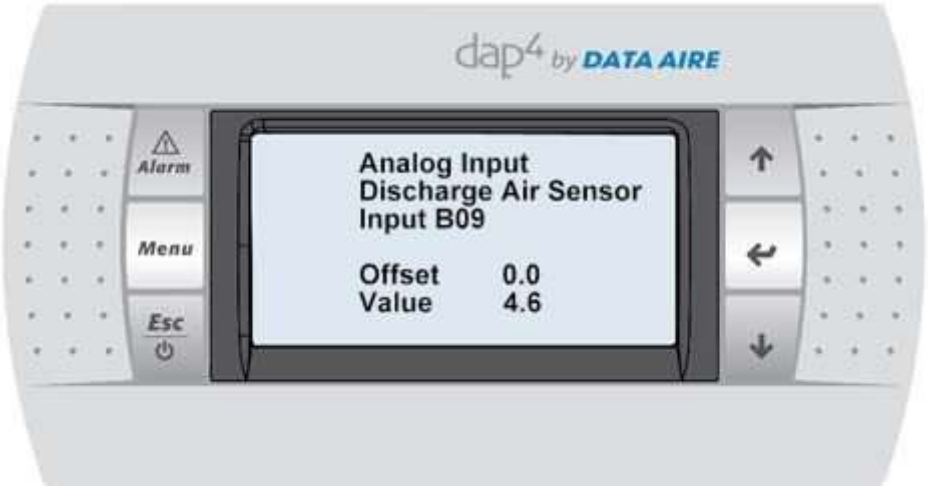
8.2.8 Menu H – Calibrate Sensors

Menu H allows calibration of the installed unit sensors (if required). The service level password is required for entry.

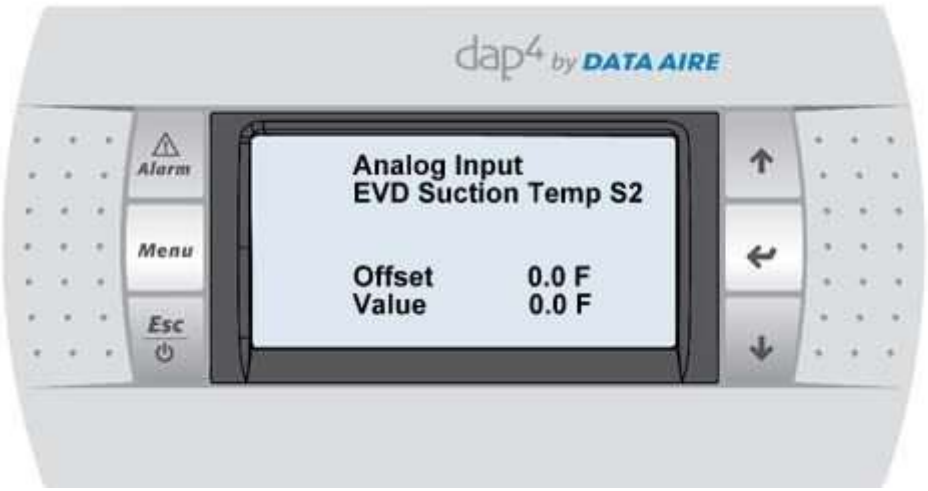
Press the ENTER key

The following screens will be displayed (values are for reference only):


dap4 by DATA AIRE
Alarm
Menu
Esc
Analog Input
Return Air Sensor
Input B04
Offset 0.0
Value 13.7


dap4 by DATA AIRE
Alarm
Menu
Esc
Analog Input
Discharge Air Sensor
Input B09
Offset 0.0
Value 4.6


dap4 by DATA AIRE
Alarm
Menu
Esc
Analog Input
Rack # 1 Temp
Input B05
Offset 0.0 F
Value 74.4 F



For all of the displays above, the cursor will flash by the Offset value. Press the UP or DOWN key to change the Offset value.

An independent calibrated meter should be used to verify the values before changing Offset.

Press the ENTER key. The cursor will advance to the title page. The Offset will be displayed and the Value will automatically change adding or subtracting the Offset.

With cursor on the title, Press the DOWN key to advance to the next screen.

Press the MENU key to exit Menu H – Calibrate Sensors

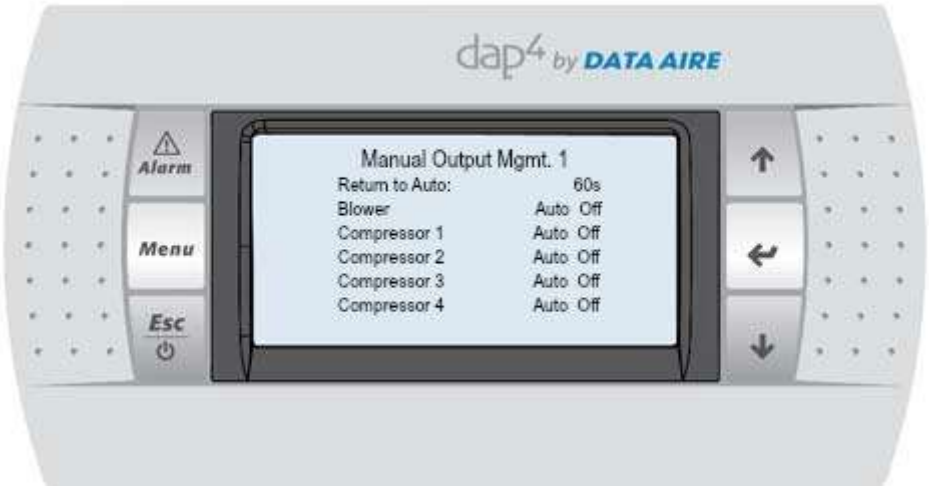
Press the ENTER to advance to Menu I – Manual Control

8.2.9 Menu I – Manual Control

Menu I allows manually running different unit components (the Service Level password is required). This menu should be used during service of the unit.

Press the ENTER key.

The following screen will be displayed (values are for reference only):

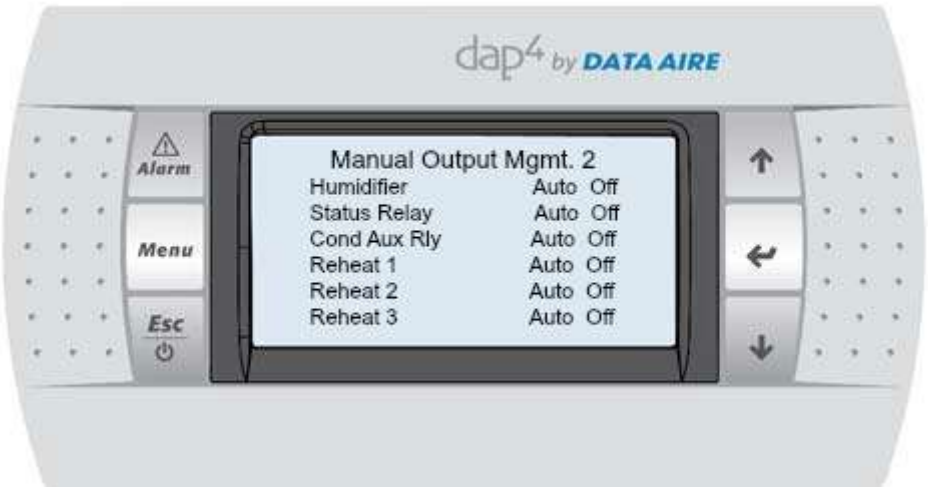


NOTE: The "Return to Auto" is programmable from 10 to 300 seconds. Once the set time has elapsed the functions will return to normal programmed operation (the default is 60 seconds).

Each component can be manually tested. Press the ENTER key to move the cursor to the selected component. To change from Auto (automatic) to Man (manual) press the DOWN key. To change from OFF to ON press the DOWN key.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):



Each component can be manually tested. Press the ENTER key to move the cursor to the selected component. To change from Auto (automatic) to Man (manual) press the DOWN key. To change from OFF to ON press the DOWN key.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

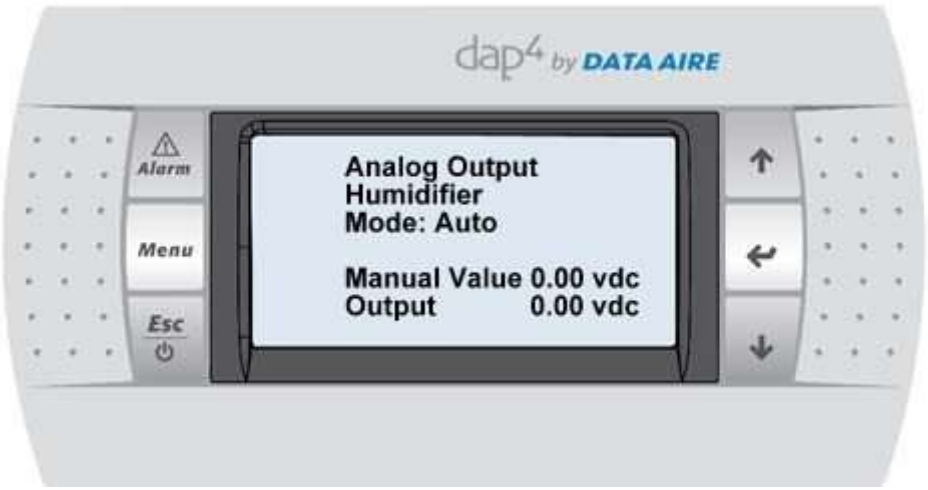
Each component can be manually tested. Press the ENTER key to move the cursor to the selected component. To change from Auto (automatic) to Man (manual) press the DOWN key. To change from OFF to ON press the DOWN key.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):



Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

Press the ENTER key to return to the main Menu.

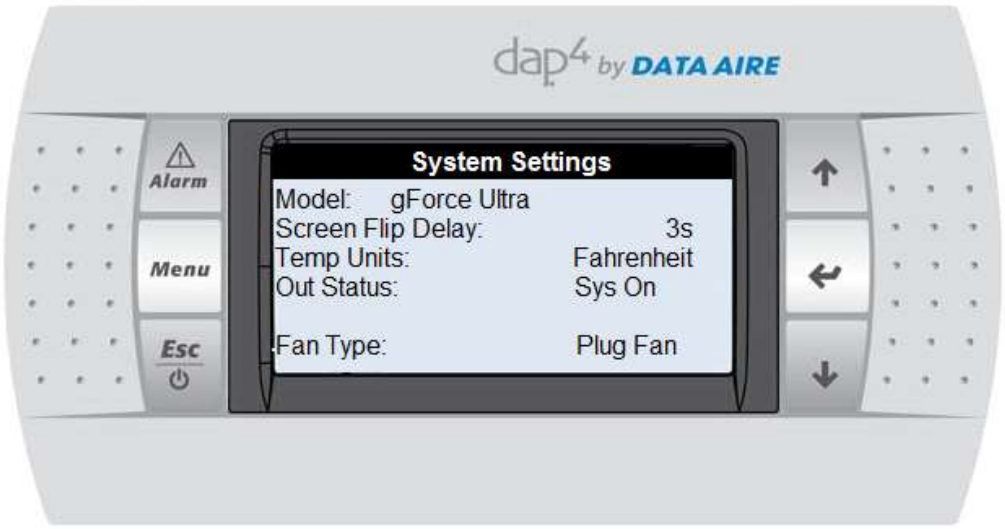
Press the DOWN key to advance to Menu J – Factory Settings

8.2.10 Menu J – Factory Settings

Menu J is for setting the control to the type equipment and options ordered. **This requires the Factory Level password and entry should be limited to Data Aire factory and service personnel.**

In the main menu screen press the UP or DOWN key until "J. Factory Settings" appears and is highlighted. Press the ENTER key.

The following will be displayed:



Model: gForce Ultra

Screen Flip Display: Selectable from 3 – 99 seconds

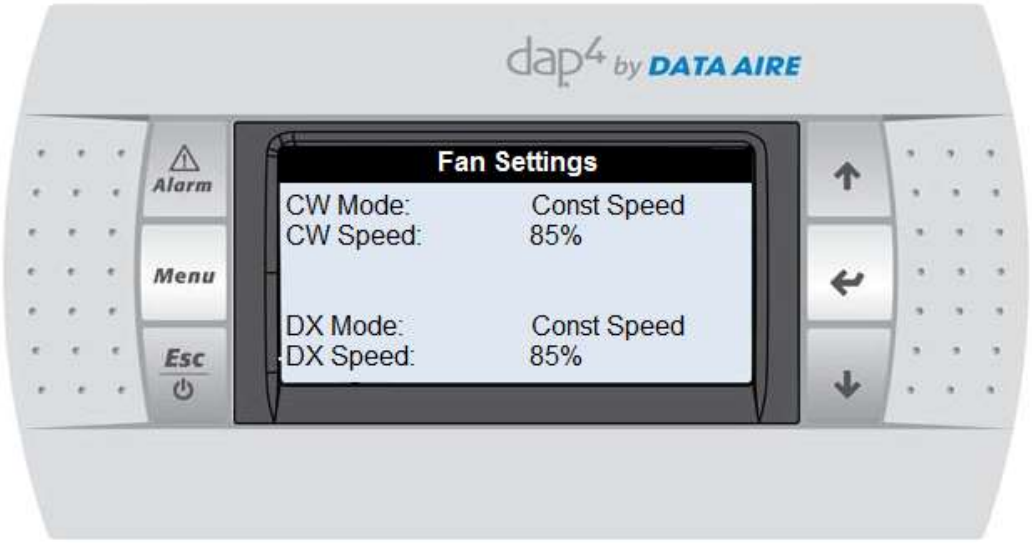
Temp Units: Fahrenheit or Celsius

Out Status: Allow the unit status to be selectable between: Sys On, Reheat On, Comps On, Hum On or Dehum On

Fan Type: The fan type is always plug fan for this unit model

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):



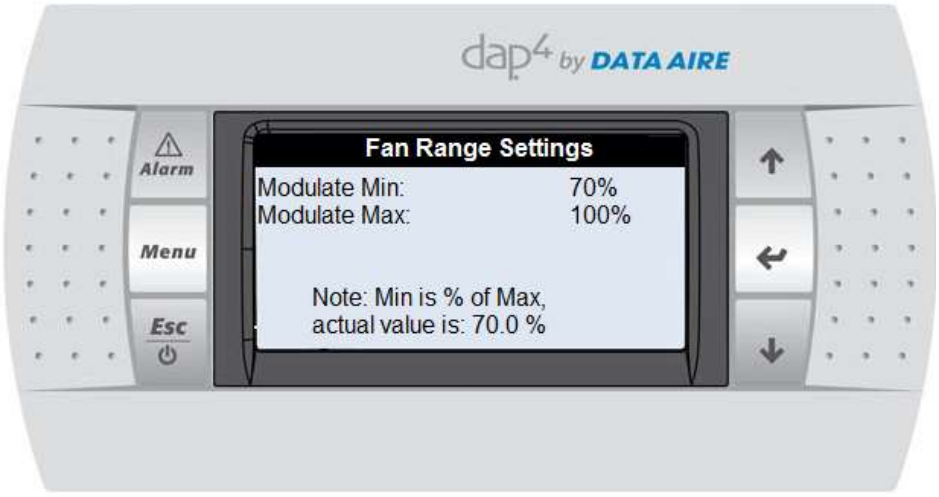
CW Mode: This is the fan control settings for the unit when a chilled water valve is used. There are 6 different modes.

DX Mode: This is the fan control settings for the unit when a compressor runs. There are 6 different modes:

- Const Speed: See section 9.1.6.
- BMS Speed: See section 9.1.5.
- Mod to Rack: See section 9.1.1.
- Mod to RetT: See section 9.1.3.
- Mod to Comp: See section 9.1.2.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The **Fan Range Settings** screen will be displayed only if the fan speed from the screen above was not in "Constant" mode (values are for reference only):

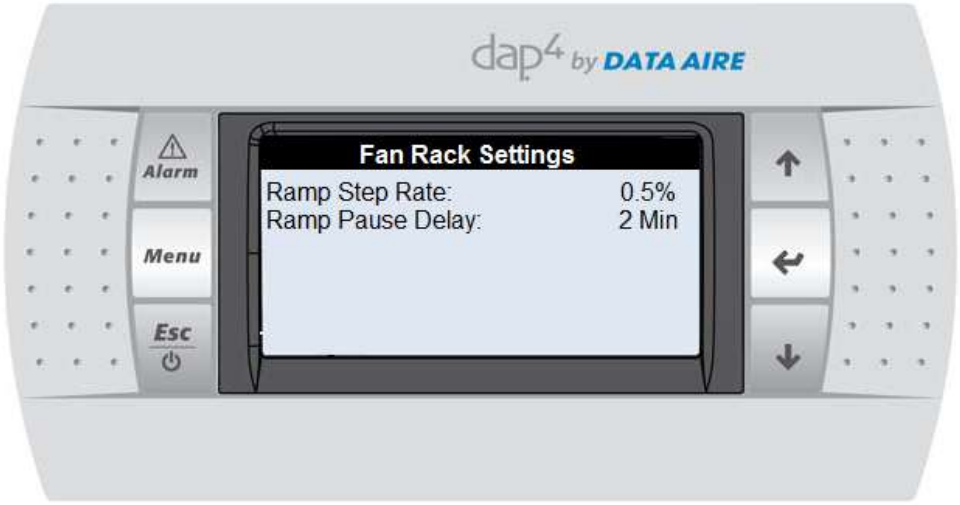


Modulate Min: This is the minimum speed the fan can run at. It is calculated as the percentage of the Modulate Max. For example, if the Modulate Max is 90% and Modulate min is 70%, the minimum fan speed is 90%x70% = 63%

Modulate Max: The maximum fan speed allowed

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The **Fan Rack Settings** screen will be displayed (values are for reference only):



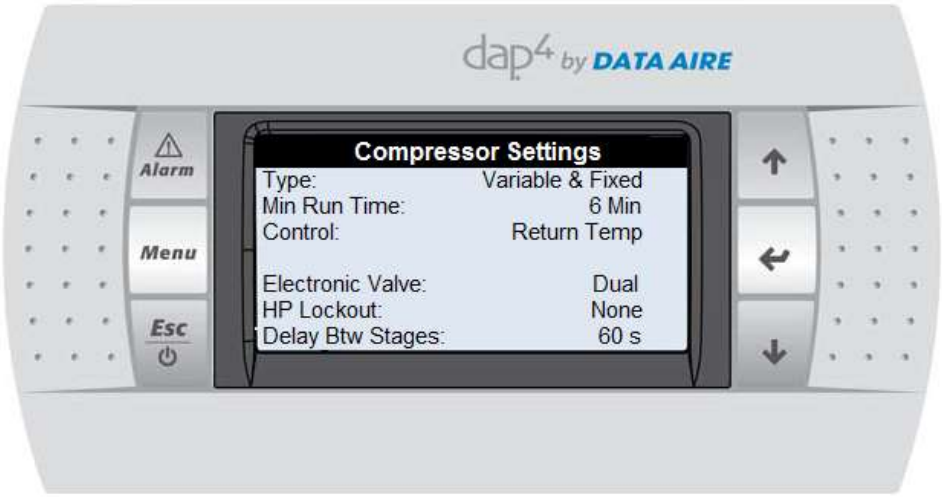
Ramp step rate: The rate at which the fan will change its speed in any modulation mode. The default rate is 0.5% per second and ranges from 0.1% per second to 5%

per second. It is recommended to keep the rate of change low to enhance system stability.

Ramp Pause Delay: When the rack temperature reaches rack temperature setpoint, the fan speed will stay at where it is for this amount of time. The default delay is 2 minutes and ranges from 1 to 5 minutes.

To go to the next screen, move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The **Compressor Settings** screen will be displayed (values are for reference only):



Type: Selectable compressor types are Variable & Fixed Speed for dual circuit units or Sngl Variable for single circuit unit. The other types (Sngl Primary, Singl Pri w/UnLdr, Dual Primary, Dual Pri w/UnLdr) are not applicable for gForce Ultra. See section **9.2** for control logic details.

Min Run Time: The minimum run time of the variable speed compressor for stabilizing purpose. The variable speed compressor needs to run for at least this duration before turning off, unless there are alarms. Selectable from 1 to 10 minutes, defaulted at 6 minutes.

Control: gForce Ultra allows the cooling function to be controlled by either Return Temperature or Supply Temperature. Default setting is Return Temp

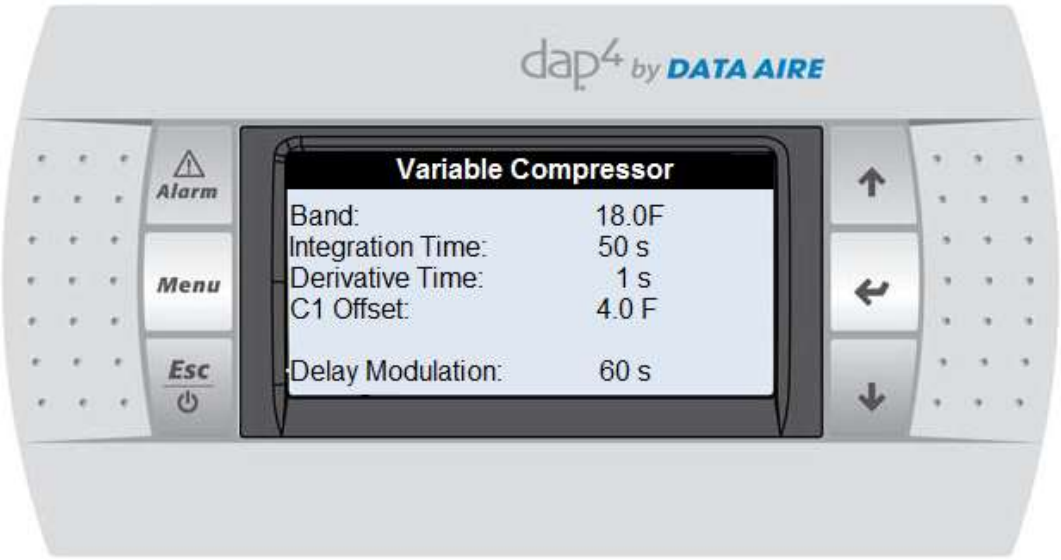
Cooling Mode: Only shown up if Supply Temp was selected for Control above, It is selectable between Normal and Precise. Precise mode allows the reheat to run at the same time with the compressors to allow more precise temperature control. Do not select this in gForce Ultra units. It is only applicable for fixed speed compressor units.

Electronic Valve: Single or Dual, depending on how many circuits are in the system. Electronic Expansion Valve (EEV) provides highest possible efficiency for the refrigerant circuit at a much wider range of unit operation compared to normal TXV. These valves are standard for gForce Ultra units to maximize efficiency at different compressor speed.

HP Lockout: Counts the number of compressor high head pressure alarms to lockout the compressor. Range is from 2 to 5 times per hour. Default setting is *None*.

Delay btw stages: The delay time between two cooling stages, defaults at 60 seconds, ranges from 30 to 300 seconds.

If the above **Control** setting was set for "**Supply Temp**", the next screen will be as followed



NOTE: Any changes in this screen might result in system imbalance, only change this when if you are familiar with tuning a PID.

Band: Band has the same unit as the setpoint and is tunable in the dap4™ controller. Increasing the band makes the system more stable and increases the steady state error. A good start for tuning the band is half of the setpoint. The default value is 18°F.

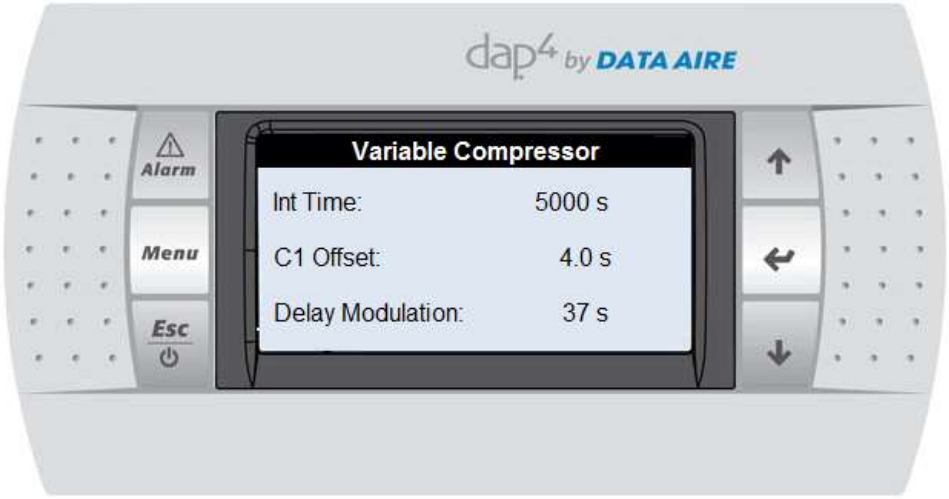
Integration Time: (Ti) Increasing Ti decreases the steady state error; but tends to make the system less stable and increase the overshoot. Therefore, the Band must increase in PI control and as a consequence the response speed will be slower. The default Ti is 50 seconds.

Derivative Time: (Td) Derivative is the speed at which the system reacts to a change in output. Increasing Td increases system stability, allowing the other two actions to be increased (with the respective benefits) while maintaining the same stability. Increasing the derivative time reduces the sensitivity to the output change. The default Td is 1 seconds.

C1 Offset: Compressor 1 will turn off at when temperature is below setpoint minus this amount and other conditions will applied.

Delay Modulation: This is the time delay before the PID modulation loop starts to work. Default at 60 seconds, selectable from 0 to 999 seconds.

If the above **Control** setting was set for "**Return Temp**", the next screen will be as followed



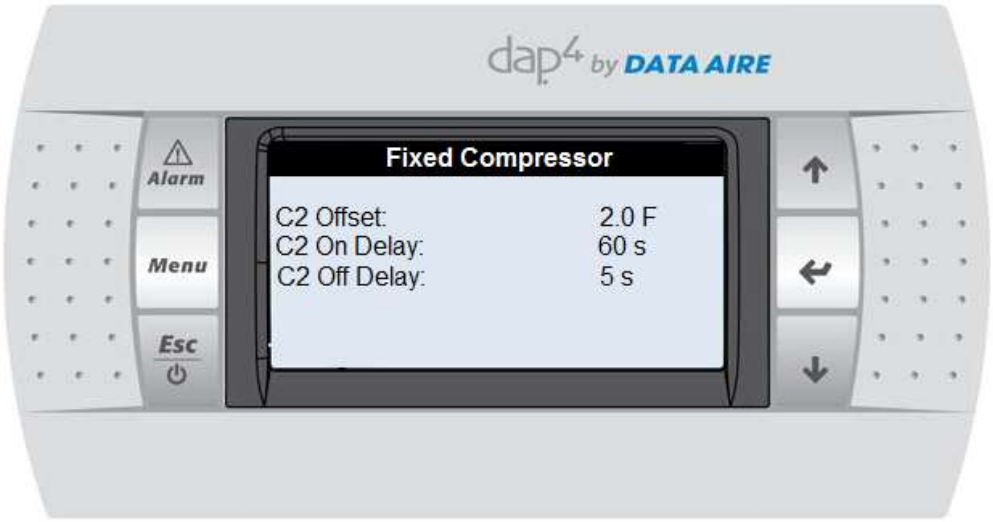
NOTE: Any changes in this screen might result in system imbalance, only change this when if you are familiar with tuning a PID.

Int Time: (Ti) Increasing Ti decreases the steady state error; but tends to make the system less stable and increase the overshoot. Therefore, the Band must increase in PI control and as a consequence the response speed will be slower. The default Ti is 5000 seconds.

C1 Offset: Compressor 1 will turn off at when temperature is below setpoint minus this amount and other conditions will applied.

Delay Modulation: This is the time delay before the PID modulation loop starts to work. Default at 60 seconds, selectable from 0 to 999 seconds.

If the compressor **Type** in the **Compressor Settings** page was selected as" Variable & Fixed", The **Fixed Compressor** screen will be displayed (values are for reference only):



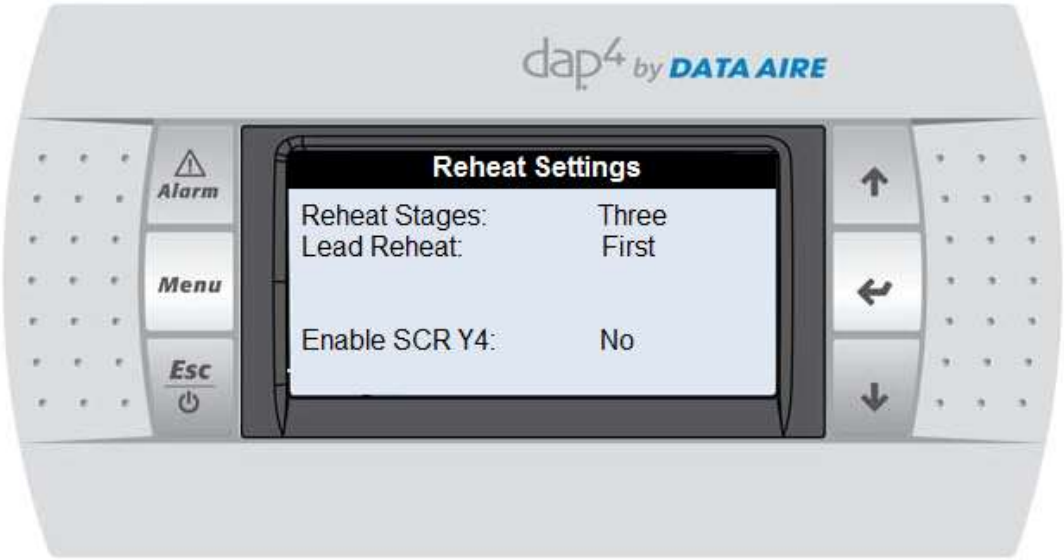
C2 Offset: Compressor 2 will turn off at when temperature is below setpoint minus this amount and other conditions will applied.

C2 On Delay: Compressor 2 will not run until compressor 1 has run for at least this amount of time and other conditions. Default value is 60 seconds, and selectable from 0 to 999 seconds.

C2 Off Delay: Compressor 2 will continue to run for this amount of time before turning off, with other conditions applied. Default value is 5 seconds, and selectable from 0 to 999 seconds.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The **Reheat Settings** screen will be displayed (values are for reference only):



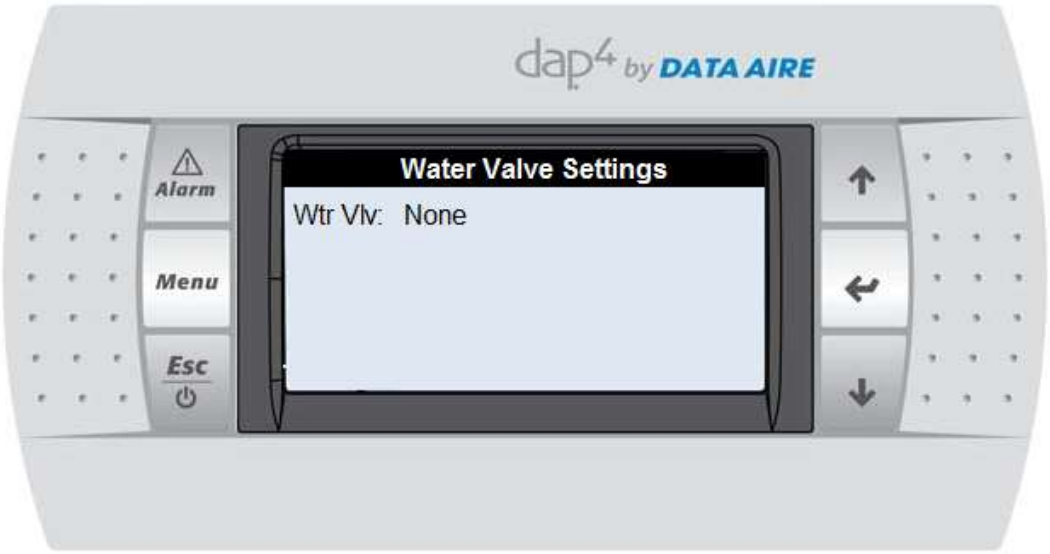
Reheat Stages: There is only one stage maximum for GIAX units. There are 3 choices

- 1-Elect: Reheat only comes ON in dehumidification mode (factory default)
- One: Reheat comes on in dehumidification mode and when temperature goes below cooling setpoint minus deadband
- None: Reheat is not available. In this case, dehumidification will not be available.

Enable SCR Y4: Allows Enable/Disable of the SCR control to modulate the reheat. Optional SCR hardware is required.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

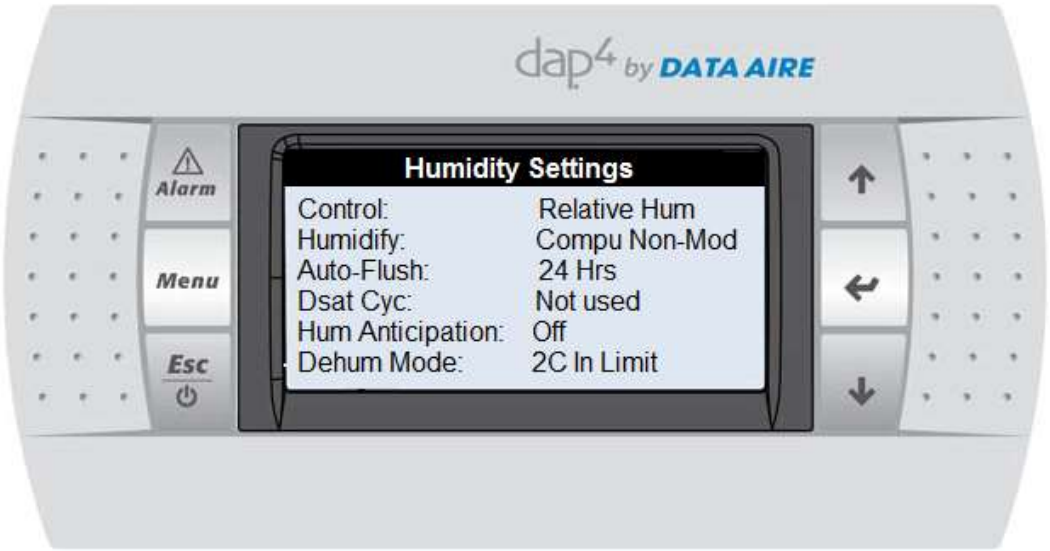
The **Water Valve Settings** screen will be displayed (values are for reference only):



Wtr Vlv: Type of water valve being used. Default setting is None, unless the unit has Economizer coil, then change this setting to Engy Svg Cool.

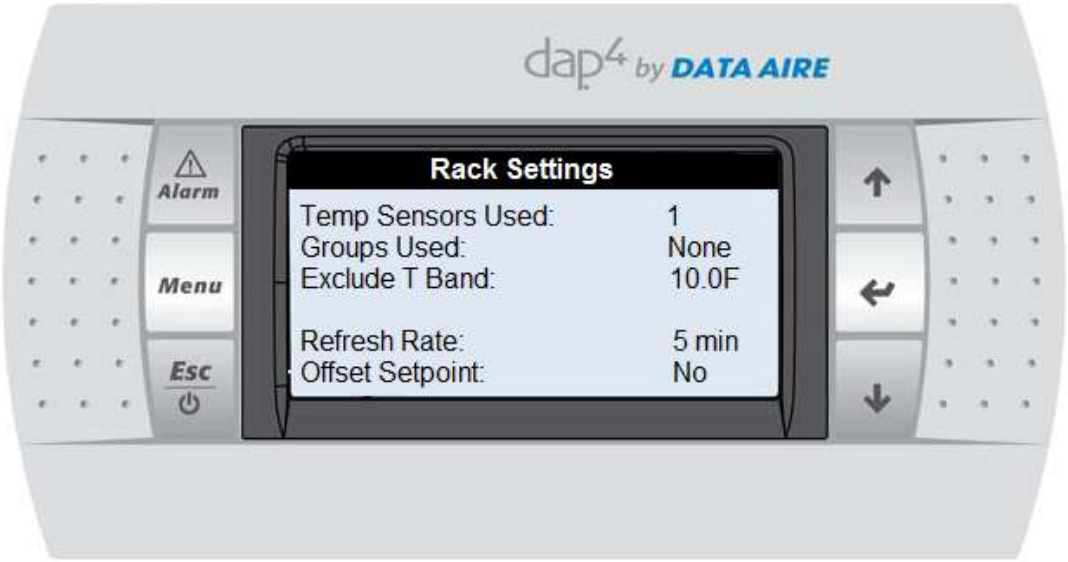
Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The screen **Humidity Settings** will be displayed (values are for reference only):



Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):



Temp Sensors Used: Up to 32 rack temperature sensors may be used. The default is None. The rack temperature can be used to control the fan speed when the fan control is set to "Mod to Rack". Otherwise, it is only for reference.

Group Used: This is the number of sensor groups. The default value is None. Rack sensors can be arranged in up to 16 individual groups. The temperature of each group is the average of its associated sensors

Exclude T Band: If any rack temperature sensor is higher or lower than the rack temperature this amount, it will be excluded from the rack temperature calculation.

Refresh Rate: This setting determines how often the highest of the rack temperature sensors or groups of sensors is calculated. The default value is every 5 mins.

Offset Setpoint: Default is No. This feature will automatically offset the temperature setpoint -0.1ºF every 60 seconds if the fan is running at its maximum speed yet the rack inlet temperature is not satisfied. The setpoint will not be offset below the discharge temperature limit which is default to 45ºF. Note: This feature requires an optional discharge air sensor.

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):

NOTE: This screen only appears when the "Electronic Valve" is selected as "One" or "Two" in "Compressor Settings" screen.

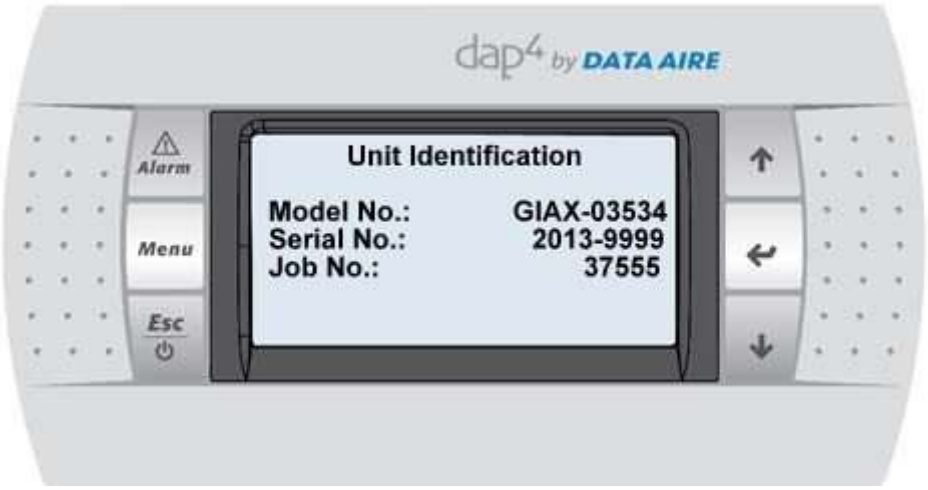
Super Heat: The current value of refrigerant super heat

Suction Temp: The current value of refrigerant suction temperature

Suction Pres: The current value of refrigerant suction pressure

Move the cursor to the title block by pressing the ENTER key stepping through all the inputs. To return to the main Menu press the ESC key or to view the following screen press the DOWN key.

The following screen will be displayed (values are for reference only):



The **Unit Identification** screen allows changing of the Model Number, Serial Number and the Job Number.

The **Settings Management** screen allows changing of the language and reset controller settings.

Press the ENTER key to return to the Main Menu.

Press the DOWN key to advance to Menu K – Alarms and Limits

8.2.11 Menu K – Alarms & Limits

Menu K is for the setting control alarms, limits, alarm enunciation mode, and to configure optional and custom alarms. Requires Service level password.

Press the DOWN key to advance to Menu K – Alarms and Limits

The following screen will be displayed (values are for reference only):

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

The following selections are available:

Audio Mode:	None (factory setting) Full On Long Beep Short Beep
Pwr-Up:	Auto, No Alarm (factory setting) Auto, With Alarm Man, Clr Alarm
Maint Due Msg:	None (factory setting) 1 – 1000 hours

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

The following selections are available:

Comp Short Cycle:	Yes or No (Yes - factory setting)
Floor Water Alarm:	Alarm Only (factory setting)
	Shutdown Unit
	Lockout Comps
Reset Alarm Log:	Yes or No (No – factory setting)
Alarm Screen Contact:	No Contact Message (factory setting)
	Service Company
	Maint Engineer
	Data Proc Mngr
	Custom Message (factory installed)

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

The following selections are available:

No Water Flow Action:	Turn Compressors Off
	Alarm Only (factory setting)
Wtr Flow Alm Dly:	5 to 190 seconds (5 - factory setting)
Air Flow Alm Dly:	5 to 180 seconds (5 – factory setting)

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

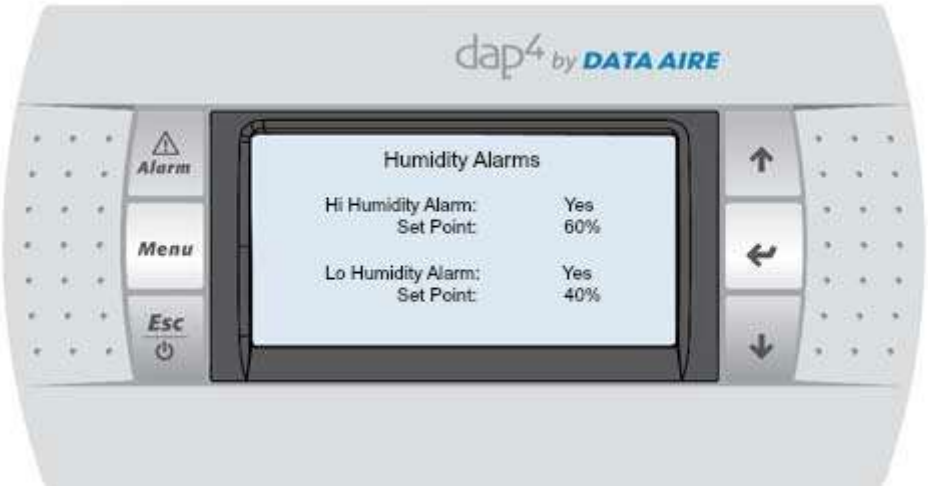
The following selections are available:

Firestat:	100 – 150°F (factory setting is 100°F)
Hi Temp Alarm:	Yes or No (factory setting is Yes)
Set Point:	70 - 120°F (factory setting is 80°F)
Lo Temp Alarm:	Yes or No (factory setting is Yes)
Set Point:	55 - 75°F (factory setting is 60°F)

NOTE: If No is selected for the Hi or Low Temp, the setpoint will not be displayed.

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):



Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

The following selections are available:

Hi Humidity Alarm:	Yes or No (factory setting is Yes)
Set Point:	35 – 90% RH (factory setting is 60%)
Lo Humidity Alarm:	Yes or No (factory setting is Yes)
Set Point:	10 – 65% RH (factory setting is 40%)

NOTE: If No is selected for the Hi or Low Humidity, the setpoint will not be displayed. Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

The following selections are available:

Alarm # 1	SEE TAG INSIDE DOOR	CHECK HUMIDIFIER CYL
	REHEAT INHIBITED	FAN MOTOR OVERLOAD
	HUMIDIFIER INHIBITED	CUSTOM MESSAGE
	REHEAT & HUM INHIBIT	POWER A OPERATING
	UNIT IN STBY	POWER B OPERATING
	UPS ON-CHK MAIN PWR	POWER A AVAILABLE
	STANDBY PUMP ON	POWER B AVAILABLE

Alarm # 2	SEE TAG INSIDE DOOR	CHECK HUMIDIFIER CYL
	REHEAT INHIBITED	FAN MOTOR OVERLOAD
	HUMIDIFIER INHIBITED	CUSTOM MESSAGE
	REHEAT & HUM INHIBIT	POWER A OPERATING
	UNIT IN STBY	POWER B OPERATING
	UPS ON-CHK MAIN PWR	POWER A AVAILABLE
	STANDBY PUMP ON	POWER B AVAILABLE

NOTE: Some alarm messages require optional devices.

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Press the ENTER key to move through the alarm/message inputs.

Press the UP or DOWN keys to change the alarm/message.

The following selections are available:

Alarm # 3	SEE TAG INSIDE DOOR	CHECK HUMIDIFIER CYL
	REHEAT INHIBITED	FAN MOTOR OVERLOAD
	HUMIDIFIER INHIBITED	CUSTOM MESSAGE
	REHEAT & HUM INHIBIT	POWER A OPERATING
	UNIT IN STBY	POWER B OPERATING
	UPS ON-CHK MAIN PWR	POWER A AVAILABLE
	STANDBY PUMP ON	POWER B AVAILABLE

Alarm # 4	SEE TAG INSIDE DOOR	CHECK HUMIDIFIER CYL
	REHEAT INHIBITED	FAN MOTOR OVERLOAD
	HUMIDIFIER INHIBITED	CUSTOM MESSAGE
	REHEAT & HUM INHIBIT	POWER A OPERATING
	UNIT IN STBY	POWER B OPERATING
	UPS ON-CHK MAIN PWR	POWER A AVAILABLE
	STANDBY PUMP ON	POWER B AVAILABLE

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 1				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
CW Sensor	Yes or No	Yes or No	Yes or No	Yes or No
DA Sensor	Yes or No	Yes or No	Yes or No	Yes or No
Fan Ovld	Yes or No	Yes or No	Yes or No	Yes or No
Smoke	Yes or No	Yes or No	Yes or No	Yes or No
Cond Wtr	Yes or No	Yes or No	Yes or No	Yes or No
Firestat	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 2				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
C1 Hi Pr	Yes or No	Yes or No	Yes or No	Yes or No
C1 Low Pr	Yes or No	Yes or No	Yes or No	Yes or No
C2 Hi Pr	Yes or No	Yes or No	Yes or No	Yes or No
C2 Low Pr	Yes or No	Yes or No	Yes or No	Yes or No
Short Cycl	Yes or No	Yes or No	Yes or No	Yes or No
Maint Tmr	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 3				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
Hi Humid	Yes or No	Yes or No	Yes or No	Yes or No
Low Humid	Yes or No	Yes or No	Yes or No	Yes or No
Humidifier	Yes or No	Yes or No	Yes or No	Yes or No
DA Low T	Yes or No	Yes or No	Yes or No	Yes or No
RA Low T	Yes or No	Yes or No	Yes or No	Yes or No
RA Hi Temp	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 4				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
Override	Yes or No	Yes or No	Yes or No	Yes or No
Air Flow	Yes or No	Yes or No	Yes or No	Yes or No
Wtr Flow	Yes or No	Yes or No	Yes or No	Yes or No
Power Up	Yes or No	Yes or No	Yes or No	Yes or No
Floor Wtr	Yes or No	Yes or No	Yes or No	Yes or No
Hum Inhbt	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 5				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
Heat Inhbt	Yes or No	Yes or No	Yes or No	Yes or No
Filter	Yes or No	Yes or No	Yes or No	Yes or No
Manl Ovrd	Yes or No	Yes or No	Yes or No	Yes or No
Hum Sensor	Yes or No	Yes or No	Yes or No	Yes or No
RA Sensor	Yes or No	Yes or No	Yes or No	Yes or No
"See Tag"	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 6				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
Unit Stdby	Yes or No	Yes or No	Yes or No	Yes or No
UPS is On	Yes or No	Yes or No	Yes or No	Yes or No
Stdby Pump	Yes or No	Yes or No	Yes or No	Yes or No
Hum Cyl	Yes or No	Yes or No	Yes or No	Yes or No
Cstm Msg 1	Yes or No	Yes or No	Yes or No	Yes or No
Cstm Msg 2	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Alarm Output Function 7				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
Cstm Msg 3	Yes or No	Yes or No	Yes or No	Yes or No
Cstm Msg 4	Yes or No	Yes or No	Yes or No	Yes or No
C1 Lockout	Yes or No	Yes or No	Yes or No	Yes or No
C2 Lockout	Yes or No	Yes or No	Yes or No	Yes or No
FreezeStat	Yes or No	Yes or No	Yes or No	Yes or No
Rack Hi T	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

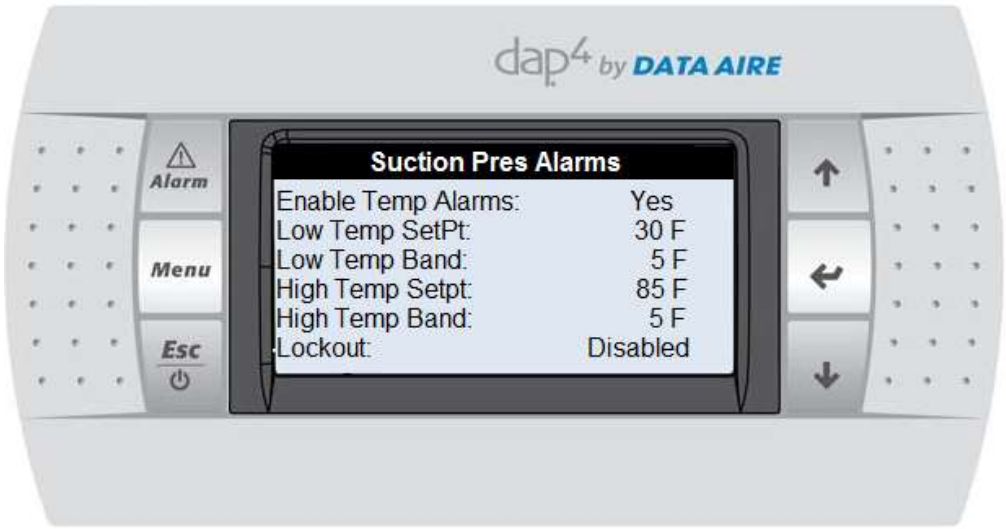
Alarm Output Function 8				
	Alarm 1	**Alarm 2**	**Alarm 3**	**Alarm 4**
Rack Low T	Yes or No	Yes or No	Yes or No	Yes or No
Rack Sns F	Yes or No	Yes or No	Yes or No	Yes or No
Lo Suct Prs	Yes or No	Yes or No	Yes or No	Yes or No
EVD Fault	Yes or No	Yes or No	Yes or No	Yes or No

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):



Once the selections have been made, with the cursor on the title line, Press the DOWN key to advance to the next screen.

The following screen will be displayed (values are for reference only):

8.2.12 Menu L – Configure I/O

Menu L is for setting the control to the type equipment and options ordered. This requires the Factory Level password and entry should be limited to Data Aire factory and service personnel.

See the dap4™ Operation Manual for details – available on the Data Aire website (dataaire.com).

8.2.13 Zone Master

The gForce Ultra units with optional Zone Master control will be shipped with a supplemental manual detailing programming and individual screens on the dap4™ controller.

8.3 Secondary Heat Exchangers

Most of the controls on remote condensers, condensing units and fluid coolers consist of basic electromechanical type components. Secondary heat exchangers have a separate User Manual which gives complete details on adjusting thermostat settings, etc.

9. Control Logic

The following describes the implementation of the gForce Ultra logic with dap4™ controller.

9.1 Fan Control Logic

There are six (6) different fan speed mode in DX logic:

- Fan Speed Modulation to Rack Temperature (Mod to Rack)
- Fan Speed Modulation Proportional to Cooling Demand (Mod to Comp)
- Fan Speed Modulation to Return Air (RA) Temperature (Mod to RetT)
- Fan Speed Modulation to Constant Static Pressure (Air Pressure)
- Fan Speed Modulation based on BMS (BMS Speed)
- Constant Fan Speed (Const Speed)

9.1.1 Fan Speed Modulation to Rack Temperature (Mod to Rack):

In this mode the DX fan speed modulates based on rack temperature. Modulation to Rack Temperature "Mod to Rack" mode is found under Menu J – Factory Settings, Fan Settings.

The fans are controlled based on the maximum rack temperature. A single sensor is standard. Two additional sensors are available as an option. If additional sensors are installed, the control logic will be based on the highest value.

The fan will operate on rack air SP (Setpoint) and DB (Deadband) as follows:

- When the Maximum Rack Temperature is increasing:

  If the Maximum Rack Temperature is greater than the Rack Temperature SP plus the (DB), the fans will start to ramp up from minimum allowable speed.

  If the Maximum Rack Temperature is greater than or equal to Rack Temperature SP plus DB plus 1°F, the fans will run at maximum speed.

- When the Maximum Rack Temperature is decreasing:

  If the Maximum Rack Temperature is less than the Rack Temperature SP plus 1°F, the fans will start to ramp down from allowable speed.

  If the Maximum Rack temperature is less than or equal to Rack Temperature SP, the fans will run at minimum speed.

9.1.2 Fan Speed Modulation Proportional to Cooling Demand (Mod to Comp):

Proportional fan speed control is based on the cooling demand. The fan speed ranges from 70% to 100% of fans total capacity. When the fans start, they operate at the minimum fan speed. As the compressor modulates from minimum to maximum speed, the fan speed will modulate proportionally to the compressor VFD between the minimum fan speed to the maximum fan speed. The fans will operate at the maximum fan speed when reheat or humidification is required.

9.1.3 Fan Speed Modulation to Return Air (RA) Temperature (Mod to RetT):

The dap4™ controller is set for fan speed control based on Return Air (RA) temperature. As the RA temperature rises, the fan will start at the minimum speed and increase by 10% for every 0.1ºF above RA Temp setpoint plus RA Temp deadband.

9.1.4 Fan Speed Modulation to Constant Static Pressure (Air Pressure):

In the Constant Static Pressure Control mode, the fan proportionally increases or decreases the speed to maintain a constant static pressure set-point in the controlled space.

NOTE: This feature requires an optional differential pressure transmitter to measure and control the static pressure of the controlled space.

9.1.5 Fan Speed Modulation based on BMS (BMS Speed):

In this mode, the controller allows the BMS to change the constant fan speed mode of the fans from 70% to 100%. The fans will run at a constant speed in this mode. When the fans start, they will operate at the front panel's programmed constant fan speed then it will modulate to the BMS programmed fan speed when a network communication with a BMS is established.

If the reheat or humidifier is required, the maximum fan speed setting is used. If reheat or humidifier is required while the fan speed is commanded by the BMS to a value that is lower than the maximum fan speed, the fan speed will automatically increase to the maximum speed. The fan speed will revert to the BMS programmed fan speed when reheat or humidification is no longer needed.

9.1.6 Constant Fan Speed (Const Speed):

In this mode, the fan speed can be set at the required speed and remains fixed at that speed. Field adjustment is available via the front display panel and can be manually adjusted via the "Constant Fan Speed" menu. This value is adjustable from 70% to 100%, which results in an analog output of 7 VDC to 10 VDC. In this mode, the fans will start and operate at this constant design fan speed all the time.

9.2 Compressor

9.2.1 Return Air Temperature Control Mode

9.2.1.1 Single DX circuit- one variable speed compressor system

- Compressor settings type in dap4™ Factory Settings menu is programmed to "Single Variable" and Control mode is set to "Return Temp".
- There is a five (5) minute delay between start-to-start of the compressor. The delay will be increased to six (6) minutes for one (1) hour following the detection of a short-cycle condition even if the short cycle alarm is disabled using a short cycle alarm menu.
- There is a two (2) minute delay between stop-to-start.
- Once variable speed compressor C1 comes on, it must remain on for a minimum runtime even setpoint satisfies.
- If variable speed compressor C1 runs at the minimum speed for a period of time, it will automatically ramp up to the maximum speed for one minute to maintain the minimum compressor oil level. The temperature may drop slightly during this override period.
- Compressor C1 cycles on and modulate as follows to maintain setpoint:

<u>Return air temperature is rising (On cycle):</u>

- When return air temperature = Temperature Setpoint + Temperature Deadband variable speed compressor starts and ramp up to maximum speed. For instance: SP = 72ºF, DB = 2ºF. Compressor will be on at 74ºF.
- Variable speed compressor will then use PI (Proportional and Integral) control algorithm to main the setpoint. Proportional band is the same as deadband. The Integral band is programmed in Factory settings menu. In most cases there is no need to change the P and I value as the result of temperature control fluctuation.

Return air temperature is dropping (Off cycle):

- As the return air temperature reaches setpoint, the compressor will ramp down to its minimum speed. (Note: If variable speed compressor runs at the minimum speed for a long period of time, it will automatically ramp up to the maximum speed for one minute to maintain the minimum compressor oil level. The temperature may drop slightly during this override period).
- Compressor continues to run at minimum speed then turns off when return air temperature drops to temperature setpoint – C1 offset. C1 offset is programmed in Compressor/Factory settings menu, default value is 2ºF. For instance: SP= 72ºF, C1 offset = 2ºF, compressor goes off at 70ºF.

9.2.1.2 Dual DX circuit: Combination of a variable speed compressor (C1) and a fixed speed compressor (C2)

- Compressor settings type in dap4™ Factory Settings menu is programmed to "Variable + Fixed" and Control mode is set to "Return Temp".
- There is a five (5) minute delay between start-to-start of the same primary stage. The delay will be increased to six (6) minutes for one (1) hour following the detection of a short-cycle condition even if the short cycle alarm is disabled using a short cycle alarm menu.
- There is a two (2) minute delay between stop-to-start of the same compressor.
- There is minimum two (2) minutes delay between the start of variable speed compressor and start of fixed speed compressor.
- Once variable speed compressor C1 comes on, it must remain on for a minimum runtime even setpoint satisfies.
- Compressor cycles on and modulate as follows:

Return air temperature is rising (On cycle):

- When return air temperature rises to temperature setpoint + temperature deadband, Variable speed compressor C1will start and ramp up to its maximum speed. For instance: SP = 72ºF, DB = 2ºF. Compressor will be on at 74ºF.
- Variable speed compressor will then use PI (Proportional and Integral) control algorithm to main the setpoint. Proportional band is the same as deadband. The Integral band is programmed in Factory settings menu. In most cases there is no need to change these P and I settings.
- Fixed speed compressor C2 cycles on when return air temperature rises to Temperature Setpoint + Temperature DB + Stage-to-Stage Band and

compressor C1 has operated at above 95% of its maximum speed for the "C2 on delay" period. C2 on period is programmed in Compressor/Factory settings menu (default=60s). For instance: SP = 72ºF, DB = 2ºF, STS = 0.3ºF. Compressor will be on at 74.3ºF.

Return air temperature is dropping (Off cycle):

- Fixed speed compressor C2 turns off when return air temperature drops below Temperature Setpoint – STS Band (default STS band=0.3ºF) for duration of C2 off delay (default =5s). For instance: SP = 72ºF, STS = 0.3ºF. Compressor goes off at 71.7ºF after 5 seconds delay.
- After Fixed speed compressor C2 turns off, variable speed compressor C1 ramps up to its maximum speed and operates at maximum speed for a "Delay Modulation" period (default=60s). The Delay modulation is set in the Compressor/Factory settings menu.
- Variable speed compressor C1 will then modulate to maintain setpoint and turns off when return air temperature drops to temperature setpoint – C1offset (default=2ºF); and C1 has operated for at least minimum runtime period. For instance: SP= 72ºF, C1 offset = 2ºF, compressor goes off at 70ºF if it has ran for 6 minutes (minimum runtime is fset to 6 minutes).

9.2.1.3 Energy saver/ auxiliary cooling without DX cooling assist.

The energy saver logic is similar to current energy saver logic without DX cooling assist.

- Energy Saver/Auxiliary Chilled Water Cooling will be available whenever the incoming water supply is below the setpoint of the Energy saver Water Thermostat in menu B-setpoint – Energy Saver
- The Energy Saver/Auxiliary Chilled Water mode will operate when space temperature is between the return air setpoint plus deadband and plus Energy saver to DX change-over band. If the temperature rises above this range, Energy Saver/Auxiliary Chilled Water Cooling will be inhibited for at least 15 minute to an hour (see Energy saver Lockout setting in Factory settings menu for details) and only DX cooling will be available. After a lockout time delay, system will try Energy Saver/Auxiliary Chilled Water Cooling again.
- The chilled water valve proportionally opens 10% for each 0.1ºF above the Temperature Setpoint + Temperature Deadband.
- If the temperature is consistently rising, then the valve will be opened wider. Likewise, if the temperature is consistently falling, then the valve will be close gradually. However, if temperature movement changes directions, then it must

change the amount of the deadband before the valve will be repositioned. The temperature can be slowly drifting back and forth within a deadband window at any point in the adjustment period and no valve position changes will be made.

- If the current temperature is higher than temperature setpoint, the following sequence is used to determine the new valve position.

  Current Temperature = Setpoint + Deadband + 0.0ºF = 0% Position
  Current Temperature = Setpoint + Deadband + 0.1ºF = 10% Position
  Current Temperature = Setpoint + Deadband + 0.2ºF = 20% Position
  Current Temperature = Setpoint + Deadband + 0.3ºF = 30% Position
  Current Temperature = Setpoint + Deadband + 0.4ºF = 40% Position
  Current Temperature = Setpoint + Deadband + 0.5F = 50% Position
  Current Temperature = Setpoint + Deadband + 0.6ºF = 60% Position
  Current Temperature = Setpoint + Deadband + 0.7ºF = 70% Position
  Current Temperature = Setpoint + Deadband + 0.8ºF = 80% Position
  Current Temperature = Setpoint + Deadband + 0.9ºF = 90% Position
  Current Temperature = Setpoint + Deadband + 1.0ºF = 100% Position

- The chilled water valve proportionally closes 10% for each 0.1ºF below the temperature setpoint + 1.0ºF.
- If the current temperature is lower than at the last adjustment period, the following sequence is used to determine the new valve position.

  Current Temperature = Setpoint + 1.0ºF = 100% Position
  Current Temperature = Setpoint + 0.9ºF = 90% Position
  Current Temperature = Setpoint + 0.8ºF = 80% Position
  Current Temperature = Setpoint + 0.7ºF = 70% Position
  Current Temperature = Setpoint + 0.6ºF = 60% Position
  Current Temperature = Setpoint + 0.5ºF = 50% Position
  Current Temperature = Setpoint + 0.4ºF = 40% Position
  Current Temperature = Setpoint + 0.3ºF = 30% Position
  Current Temperature = Setpoint + 0.2ºF = 20% Position
  Current Temperature = Setpoint + 0.1ºF = 10% Position
  Current Temperature = Setpoint = 0% Position

- When unit switches to DX mode because chilled water temperature is higher than Energy saver chilled water setpoint or because of the temperature is higher than setpoint plus deadband plus the energy saver change- over band, dap4™ will use the DX cooling logic above to maintain the return air temperature setpoint. All DX safeties are applied.

- If Chilled water temperature drops below Energy saver setpoint or return air temperature drops below setpoint plus deadband then system will switch back to Energy saver cooling after the energy saver lock out time delay.

9.2.1.4 Energy saver/ Auxiliary cooling with DX cooling assist.

- Energy Saver/Auxiliary Chilled Water Cooling can operate simultaneously with compressor cooling if Energy saver assist mode is set to 1 Comp or 2 Comp and the optional Discharge Air Sensor is required.
- If Energy saver chilled water is available (inlet water temperature is below energy saver water thermostat set in menu B-setpoint), the chilled water will be used as a primary cooling, and DX will be a supplemental cooling.
- The Energy Saver/Auxiliary Chilled Water Cooling logic will be the same and compressor rules for short-cycle time will not be violated.
- Low discharge temperature alarm limit must be set in menu K-Alarms & Limits. If Discharge temperature drops below this limit, compressors will be inhibited for at least 15 minutes and discharge temperature rises above this limit.
- If discharge temperature drops below the limit while the variable speed compressor finishing its minimum runtime the CW should close until discharge temperature rises above the limit.
- When DX cooling requires, the compressors will stage on as follows:

<u>Compressors on cycle</u>

- Variable speed compressor C1 comes on at Temperature Setpoint + Temperature Deadband + 1+ STS DB. For instance: SP=72ºF, DB=2ºF and STS=0.3ºF, the C1 compressor will on at 75.3ºF.
- Once variable speed compressor comes on it will ramp up its speed maximum speed for delay modulation then uses PI logic to maintain setpoint +1ºF.
- Fixed speed compressor C2 comes on at Temperature Setpoint + Temperature Deadband + 2ºF + STS DB and variable speed compressor has run at 95% speed for a C2on delay. This step only applies to dual compressor system. For instance: SP=72ºF, DB=2ºF and STS=0.3ºF, the C2 compressor will on at 76.3ºF.

<u>Compressors off cycle</u>

- Fixed speed compressor C2 cycles off at Temperature Setpoint + 2ºF, variable speed compressor C1 continues to run at 100%. For instance: SP=72ºF, the C2 compressor goes off at 74ºF.

- Variable speed compressor C1 starts to ramp down to minimum speed when return temperature reaches setpoint + 1ºF.
- Variable speed compressor cycles off at Temperature Setpoint.
- CW Valve will close 10% for every 0.1ºF below the setpoint plus 1ºF and completely close at setpoint.
- Compressor will not violate its minimum runtime.
  * This applies on dual compressor system.

9.2.2 Discharge Air Temperature Control Mode

9.2.2.1 Single DX circuit - One variable speed compressor system

- Compressor settings type in dap4™ Factory Settings menu is programmed to "Var. Sp" and Control mode is set to "Supply".
- There is a five (5) minute delay between start-to-start of the compressor. The delay will be increased to six (6) minutes for one (1) hour following the detection of a short-cycle condition even if the short cycle alarm is disabled using a short cycle alarm menu.
- There is a two (2) minute delay between stop-to-start of the compressor.
- Once compressor C1 comes on, it must remain on for a minimum runtime even setpoint satisfies.
- If variable speed compressor C1 runs at the minimum speed for a period of time, it will automatically ramp up to the maximum speed for one minute to maintain the minimum compressor oil level. The temperature may drop slightly during this override period.
- Compressor cycles on and modulate as follows:

<u>Discharge air temperature is rising (On cycle):</u>

- When discharge air temperature rises to Temperature Setpoint + Temperature DB (deadband), variable speed compressor C1 will start and operate at its minimum speed.
- dap4™ will then use PID (proportional-Integral- derivative) control logic to modulate the variable speed compressor C1 to maintain temperature setpoint. PID values are programmed in Factory settings menu.

Discharge air temperature is dropping (Off cycle):

- Compressor C1 turns off when discharge air temperature drops to Temperature Setpoint – C1 offset. C1 offset is programmed in Compressor /Factory settings menu.
- Compressor C1 can only turn off if minimum runtime has expired.

9.2.2.2 Dual DX circuit: Combination of a variable speed compressor (C1) and a fixed speed compressor (C2) system

- Compressor settings type in dap4™ Factory Settings menu is programmed to "Vari+Fixed " and Control mode is set to "Supply".
- There is a five (5) minute delay between start-to-start of the same primary stage. The delay will be increased to six (6) minutes for one (1) hour following the detection of a short-cycle condition even if the short cycle alarm is disabled using a short cycle alarm menu.
- There is a two (2) minute delay between stop-to-start of the same compressor.
- There is minimum two (2) minutes delay between the start of variable speed compressor and start of fixed speed compressor.
- Once variable speed compressor C1 comes on, it must remain on for a minimum runtime even setpoint satisfies.
- Compressor cycles on and modulate as follows:

Discharge air temperature is rising (On cycle):

- When discharge air temperature rises to temperature setpoint + 0.5 temperature deadband (SP+1/2 DB), variable speed compressor C1will start.
- dap4™ will then use PID (proportional – Integral - derivative) logic to control the compressor C1 speed to maintain temperature setpoint.
- Fixed speed compressor C2 will come on when discharge air temperature rises to Temperature Setpoint + Temperature Deadband (SP+DB) and compressor C1 has operated at above 95% of its maximum speed for at least C2 on delay. C2 on delay is programmed in Compressor/Factory settings menu.
- Once fixed compressor C2 started, the variable speed compressor C1 will operate at minimum speed for duration of Delay Modulation. Delay modulation is programmed in Compressor/factory settings menu.

Discharge air temperature is dropping (Off cycle):

- Fixed speed compressor C2 turns off when discharge air temperature drops to the temperature setpoint – C2 offset.
- Variable speed compressor C1 turns off when discharge air temperature drops to temperature setpoint – C1 offset.

9.2.2.3 Energy saver/ auxiliary cooling without DX cooling assist in discharge temperature control.

The energy saver logic is similar to current energy saver logic without DX cooling assist.

- Energy Saver/Auxiliary Chilled Water Cooling will be available whenever the incoming water supply is below the setpoint of the Energy saver Water Thermostat in menu B-setpoint – Energy Saver.
- If system switches to DX cooling and chilled water temperature drops below the energy saver setpoint, the system will switch back to chilled water cooling after an energy saver lock-out time delay.
- The Energy Saver/Auxiliary Chilled Water mode will operate when discharge temperature is between the discharge air setpoint plus Energy saver to DX change-over band. If the temperature rises above this range, Energy Saver/Auxiliary Chilled Water Cooling will be inhibited for at least 15 minutes to an hour it depends on Energy saver Lockout delay setting in Factory settings menu, and only DX cooling will be available during this period. After a lockout time delay, system will try Energy Saver/Auxiliary Chilled Water Cooling again. Reheat should not be used in this mode.
- When unit switches to DX mode it will use the DX cooling logic in item a and b above to maintain the discharge temperature setpoint. All DX safeties are applied.
- dap4™ uses a preset PID loop to control CW valve to maintain discharge air temperature setpoint if energy saver chilled water is available and discharge air temperature is below setpoint plus Energy saver to DX change-over band.

9.2.2.4 Energy saver/ auxiliary cooling with DX cooling assist in discharge temperature control.

- Energy Saver/Auxiliary Chilled Water Cooling can operate simultaneously with compressor cooling if Energy saver assist mode is set to 1 Comp or 2 Comp

- If Energy saver chilled water is available (inlet water temperature is below energy saver water thermostat set in menu B-setpoint), the chilled water will be used as a primary cooling, and DX will be a supplemental cooling.
- The Energy Saver/Auxiliary Chilled Water Cooling logic will be the same as the chilled water cooling logic of the discharge air temperature control, this means dap4™ uses a preset PID loop to control the CW valve to maintain a discharge air temperature setpoint,
- Low discharge temperature alarm limit must be set in menu K-Alarms & Limits. If Discharge temperature drops below this limit, compressors will be inhibited for at least 15 minutes and discharge temperature rises above this limit.
- If discharge temperature drops below the limit while the variable speed compressor finishing its minimum runtime the CW should close until discharge temperature rises above the limit.
- The following is the compressor staging sequence.

Compressors on cycle with energy saver

- Variable speed compressor C1 comes on at Temperature Setpoint + Temperature Deadband + STS Band. Once variable speed compressor comes on it will use PID logic to maintain temperature setpoint + 1ºF (to make sure CW is fully utilized).
- Fixed speed compressor C2 (*) comes on at Temperature Setpoint + Temperature Deadband + 1ºF + STS DB and variable speed compressor C1 has operated at 95% for at least the C2 on delay.

Compressors off cycle during energy saver mode

- Fixed speed compressor c2 (*) cycles off at Temperature Setpoint + STS DB for a C2 off delay duration and variable speed compressor C1 runs at 100% .
- Variable speed compressor C1 cycles off at Temperature Setpoint Compressor will not violate its minimum runtime and short cycle regulation.

* This applies on dual compressor system.

9.3 Safeties and Alarms

NOTE: All suction safeties are only applied to the variable speed compressor, not the fixed speed compressor.

Monitor the variable speed compressor's suction temperature using EVD drive communication. Add compressor high suction temperature alarm limits and default to 85°F (the range is 80 to 95°F). Also add a suction temperature deadband (1 to 5°F).

- When C1 has been running for 3 minutes and suction temperature is higher than the setpoint, generate a "C1 high suction temperature" alarm
- Shut down the C1 compressor during high suction temperature alarm. Alarm will automatically reset if suction temperature falls below the high suction temperature alarm limit minus the deadband and the variable speed compressor resumes operation if high suction temperature alarm has been cleared for 5 minutes.
- Add an alarm message to dap4™ display to notify the end-user that compressors lock-out are delayed by high suction temperature alarm time-out during this 5 minutes time-out.
- Add this alarm to alarm contacts list and BMS list.
- Add lock-out logic with adjustable allowable reset times. If the compressor reset times equal the programmable reset times then the compressor is locked out until it is manually reset. Add an additional menu in Alarm & Limit group to reset this lock-out.

Monitor the variable speed compressor's suction pressure using EVD drive communication.

- Add the variable speed compressors' low suction pressure cut-out setpoint at 90 psi (range is 85 to 110 psi) and suction pressure deadband at 5 psi (range from 1 to 10 psi).
- Shut the compressor down and generate a low suction pressure alarm message when suction pressure drops below the low suction pressure setpoint and C1 has been running for 3 minutes. The variable speed compressor will automatically cycle on when its suction pressure rises above cut-out pressure limit plus suction pressure deadband but it cannot violate the compressor short cycle time delay and allowable reset times mentioned below.
- Add a lock-out logic with allowable reset times that compressor is shut down by a low pressure condition. If the low pressure reset times in one hour equals the

programmed reset times, the compressor will be locked-out until the low suction pressure alarm is no longer exist and alarm message is manually reset on dap4™. This logic is similar to the existing high pressure alarm lock-out.

- If discharge temperature is installed, use low discharge temperature setpoint to turn off compressor when the discharge temperature goes below this setpoint.

- Monitor EEV's critical alarms and shut down the compressor until the alarm is clear. Add 60 seconds delay before registering the alarm. Display the EEV driver failure alarm messages on dap4™. Add these alarms to the alarm list and BMS point list. After these alarms are clear, reset the compressors.

  Low suction temperature (C1)
  EEPROM damaged (C1, C2)
  Sensor S1
  Sensor S2
  Sensor S3
  Sensor S4
  EEV motor error (C1 C2)
  LOP (low evaporation temperature) (C1)
  MOP (high evaporation temperature) (C1)
  LowSH (low superheat) (C1)

- If the superheat is over 54^0F for over 30 seconds, display alarm "Superheat is over 54^0F" and turn the compressor off. Add this alarm to the Alarm list and BMS. Reset the alarm if the superheat is below 40^0F and turn the compressor back on.

9.4 Dehumidification Mode

Dehumidification is controlled based on return air conditions and has five control modes: None, 1C In Limit (one compressor within reheat limit), 1C No Limit (one compressor without reheat limit), 2C In Limit (two compressors within reheat limit) and 2C No Limit (two compressors without reheat limits).

- There are three dehumidification control modes for single compressor unit: None, 1C in Limit and 1C No Limit.
- There are five dehumidification control modes for dual compressors unit.
- Reheat is required for dehumidification.
- Dehumidification cooling can be controlled by relative humidity and/or dew point.

- If dehumidification is programmed for "1C in Limit" or "2C in Limit" the dehumidification cooling will be inhibited by reheat if the return air temperature drops below Temperature Setpoint - Temperature DB - 2ºF. Dehumidification will be inhibited until the return air temperature rises above the Temperature Setpoint. Compressor short-cycle time will not be violated.
- If dehumidification is programmed for "1C No Limit" or "2C No Limit", dehumidification remains on until the humidity setpoint is reached. In this mode, dehumidification has priority and overcooling is disregarded. The reheat sequence will remain the same.
- There is a one (1) minute delay between stop-to-start of dehumidification cooling. Compressor short-cycle time delay will not be violated.
- There is a five (5) minute delay between dehumidification and humidification.
- Relative humidity control mode is not recommended for Discharge Temperature Control, Dewpoint Control method should be used in this case.
- The compressor staging sequence for dehumidification cooling is as follows:

9.4.1 Relative Humidity Control Mode

9.4.1.1 Single Variable Speed Compressor System

<u>Dehumidification cycles on</u>

- If the unit is not in cooling mode, the variable speed compressor turns on when humidity is at Humidity Setpoint (HSP) + Humidity Deadband (HDB).
  - The compressor will modulate speed from 0% to 100% in 1% RH above Humidity Setpoint + Humidity DB. For instance:
  - If Humidity = Humidity Setpoint + Hum Deadband, VFD will run at 0VDC
  - If Humidity = Humidity Setpoint + Hum Deadband + 0.1%, VFD will run at 10%
  - If Humidity = Humidity Setpoint + Hum Deadband + 0.2%, VFD will run at 20%, etc.
- If cooling required during dehumidification cycle and dehumidification mode is set to "1C in Limit" the temperature cooling control will override the dehumidification cooling control. If dehumidification mode is set to "1C No Limit", the unit will continue to finish the dehumidification cycle then switch to Temperature Control Cooling Mode.

<u>Dehumidification cycles off</u>

- Variable speed compressor C1 starts to ramp down in 0.1 % RH decrement when Humidity drops to Humidity Setpoint + 1%. Compressor decreases 10% speed for each 0.1% RH.
- When Humidity equals Humidity Setpoint, compressor runs at its minimum speed (0 VDC).
- When Humidity is at Humidity Setpoint – 0.5% and compressor minimum runtime expired, compressor turns off (NO2 start signal turns off).

9.4.1.2 Dual DX circuit with a variable speed compressor and a fixed speed compressor.

Dehumidification cycles on

- If the unit is not in cooling mode, C1 variable speed compressor turns on when humidity is at Humidity Setpoint + Humidity Deadband then runs at its minimum speed (0V).
- C1 compressor will modulate from 0% to 100% in 0.1% RH increment (10% speed for each 0.1% RH). It will operate at 100% speed when humidity rises to Humidity setpoint + Humidity deadband+ 1%. For instance:
- If Humidity = Humidity SP + Hum Deadband, C1 will run at 0%
- If Humidity = Humidity SP + Hum Deadband + 0.1%, C1 will run at 10%
- If Humidity = Humidity SP + Hum Deadband + 0.2%, C1 will run at 20%, etc.
- C2 fixed speed compressor cycles on at Humidity setpoint + Humidity deadband+1.1%.
- If space is overcool, reheat will come on based on temperature setpoint and C2 compressor will turn off. C1 variable speed compressor will continue to run until humidity setpoint satisfies but not to violate the dehumidification inhibit logic (In limit/ No limit) stated above.
- If unit is in cooling mode and dehumidification mode is set to "1C in Limit" or "2C in Limit", the temperature cooling control mode will override the dehumidification control (cooling control will follow the temperature setpoint). Otherwise, dap4™ will continue to finish the dehumidification cycle then reverse to Temperature Control Cooling Mode.

Dehumidification cycles off

- When humidity drops, fixed speed compressor C2 (NO3) will turn off when humidity = Humidity Setpoint +1%.

- Variable speed compressor C1 starts to ramp down in 0.1 % RH decrement when Humidity drops to Humidity Setpoint + 1% (decreasing 10% speed for every 0.1%RH).
- C1 compressor will run at its minimum speed when humidity = Humidity SP.
- Compressor C1 turns off (NO2 signal off) when humidity = Humidity SP - 1% and compressor minimum runtime has expired.

9.4.2 Dewpoint Control Mode

The humidifier control mode is set to Dew point. High Dewpoint Setpoint, Low Dewpoint Setpoint and Dewpoint Deadbands are programmed on dap4™ menu B - Setpoint

9.4.2.1 Single Variable Speed Compressor System

<u>Dehumidification cycles on- Dewpoint temperature is rising</u>

- If unit is not in cooling mode, the variable speed compressor turns on when dewpoint is at High Dewpoint SP - 1ºF and operates at minimum speed (0V) then it will modulate from 0% to 100% in 0.1% increment if dewpoint rises to high dewpoint setpoint. For instance:
- If Dewpoint = High Dewpoint SP – 1ºF, compressor will run at 0% (0VDC)
- If Dewpoint = High Dewpoint SP – 0.9ºF, compressor will run at 10% (1V)
- If Dewpoint = High Dewpoint SP – 0.8ºF, compressor will run at 20% (2V), etc.
- If unit is in cooling mode during dehumidification cycle and dehumidification mode is set to "1C in Limit", the cooling control (by temperature setpoint) will override the dewpoint control. If dehumidification mode is set to "1C No Limit", unit will continue to finish the dewpoint control cycle then reverse to the cooling control.

<u>Dehumidification cycles off - Dewpoint is dropping</u>

- Variable speed compressor C1 starts to ramp down in 0.1 % decrement when dewpoint drops to High Dewpoint Setpoint – High Dewpoint Deadband.
- Compressor will run at minimum speed (0V) when dewpoint is at High Dewpoint Setpoint – High Dewpoint Deadband - 1ºF
- Compressor turns off (NO2 start signal turns off) when dewpoint equals to high dewpoint setpoint – High Dewpoint Deadband - 1.5ºF and compressor minimum runtime has expired.

9.4.2.2 Dual DX circuit with a variable speed compressor and a fixed speed compressor

Dehumidification cycles on – dewpoint is rising

- If unit is not in cooling mode, If dewpoint continues to rise, the variable speed compressor will turns on when Dewpoint = High Dewpoint SP - 1ºF and operates at minimum speed (0V) then modulates from 0% to 100% in 0.1% increment if dewpoint rises to high dewpoint setpoint. For instance:
- If Dewpoint = High Dewpoint SP – 1ºF, compressor will run at 0% (0VDC)
- If Dewpoint = High Dewpoint SP – 0.9ºF, compressor will run at 10% (1V)
- If Dewpoint = High Dewpoint SP – 0.8ºF, compressor will run at 20% (2V), etc.
- C2 fixed speed compressor will cycle on when Dewpoint = High Dewpoint Setpoint.
- If space is overcool, reheat will come on based on temperature setpoint and C2 compressor will turn off. C1 variable speed compressor will continue to operate until dewpoint drops below High Dewpoint Setpoint – High Dewpoint Deadband - 1ºF but not to violate the dehumidification inhibit logic (In limit/ No limit) stated above.
- If cooling is on during dehumidification cycle and dehumidification mode is set to "2C in Limit" or "1C in Limit", the temperature cooling control will override the Dewpoint Control. If dehumidification mode is set to "1C No Limit" or "2C No Limit" the unit will continue to finish the dewpoint control cycle then reverse to the temperature control.

Dehumidification cycles off- dewpoint is dropping

- C2 fixed speed compressor (NO3) will turn off when Dewpoint = High Dewpoint Setpoint – High Dewpoint Deadband.
- Variable speed compressor C1 starts to ramp down in 0.1 % decrement when dewpoint drops below High Dewpoint Setpoint – High Dewpoint Deadband.
- C1 compressor will run at minimum speed when Dewpoint = High Dewpoint SP-Dewpoint Deadband - 1ºF.
- C1 compressor turn off (NO2) when Dewpoint = High Dewpoint SP – Dewpoint Deadband - 1.5ºF and variable speed compressor minimum runtime has expired.

9.4.2.3 High Relative humidity Limit in dewpoint control

- If high relative humidity condition occurs while humidity control mode is set to Dewpoint Control then Dewpoint Control has priority over the Relative Humidity Control.

- If high dewpoint setpoint satisfies but relative humidity rises to relative humidity setpoint, the dehumidification control will be as follows:

9.4.2.3.1 Single Variable speed compressor system

Dehumidification cycles on:

If unit is not in cooling mode, the variable speed compressor turns on when humidity is at Humidity Setpoint (HSP) - 1%. Compressor will modulate from 0% to 100%, 10% speed for every 0.1%RH. Compressor will run at 100% when humidity equals humidity setpoint.

Dehumidification cycles off:

Variable speed compressor C1 starts to ramp down in 10 % decrement when Humidity drops to Humidity Setpoint – Humidity Deadband. Compressor will run at minimum speed (0 VDC) when humidity equals Humidity Setpoint – Humidity Deadband - 1%. Compressor turns off when Humidity = Humidity Setpoint – Humidity Deadband - 1.5 % and minimum runtime expired.

9.4.2.3.2 Dual circuit with a variable speed compressor and a fixed speed compressor

Dehumidification cycles on:

If unit is not in cooling mode, C2 fixed speed compressor turns on when humidity reaches Humidity Setpoint (HSP). Compressor will not violate the compressor short cycle regulation.

Dehumidification cycles off:

Compressor C2 turns off when Humidity = Humidity Setpoint - Humidity Deadband.

10. REGULAR MAINTENANCE ITEMS

10.1 Air Filters

The air filter section is an integral part of the environmental control system, designed within the unit for easy front accessibility. An initial set of filters are factory installed in the unit. The filters are 4-inch (100mm) deep, disposable, pleated design, extended-surface, nonwoven, reinforced cotton fabric; supported and bonded to welded-wire grid; enclosed in cardboard frame design rated not less than MERV 8 per ASHRAE Std. 52.2. A filter differential switch for alarm activation is included.

Air filters should be checked on a regular basis and changed when they become dirty. This will ensure efficient operation of the unit. Spare air filters should be kept in stock as these tend to be a frequently replaced maintenance item. Air filters may require changing as often as monthly dependent on room or space conditions. New installations with construction dust will quickly clog filters requiring new filters.

The dap4™ control panel monitors the air filters status. A dirty filter alarm will be enunciated on the controls display screen. Although the unit may display a dirty filter alarm, this should not be relied on as the only determinant for replacing air filters. A misadjusted air filter differential pressure switch may not give a proper indication of a clogged filter.

To check the air filter pressure differential pressure switch for proper adjustment, temporarily cover approximately 75% of the return air opening using heavy cardboard or similar material. The alarm should energize when 75% of the air is blocked, simulating dirty filters. If the alarm energizes prematurely or does not energize at all, the pressure switch should be adjusted. All side panels must remain closed when determining if an adjustment is necessary.

WARNING: Air filters that require changing can restrict airflow and create problems such as coil icing or poor air distribution.

10.2 Fuses

Fuses may occasionally require changing especially with installations where the voltage is not consistent. Drops in voltage can create brief periods of high amp draw, causing fuses to blow. Always replace fuses with those of the equivalent rating with regard to:

1) amperage, 2) voltage, and 3) speed. For instance motors are inductive loads which require time delay fuses. Electric reheat and humidifiers are resistive loads requiring fast acting fuses.

10.3 Electric Reheat

The electric reheat is a finned enclosed, sheath type, fabricated of stainless steel core sheath with plated fins to withstand moist conditions. The reheat is installed on the air discharge side of the cooling coil and has three (3) stages. The reheat is capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section includes a safety switches to protect the system from overheating. The low-watt density elements eliminate ionization associated with open air electric resistance heating.

Heating elements do not normally require maintenance. However, they may accumulate a film of dust or dirt when unused for extended periods of time. When energized, the burning debris can create smoke or an unpleasant odor. To help avoid a problem, periodic cleaning is recommended.

10.4 Humidifier

The unit is provided with a self-contained, microprocessor-controlled steam generator type humidifier. The steam generating humidifier uses a disposable cylinder with electronic controls. The humidifier discharges pure steam with no material dust carry-over and has a self-regulating automatic flush cycle. Cylinders are disposable and do not requiring cleaning or maintenance. The humidifier fill level, water conductivity and flush rate automatically adapt, both in frequency and duration, to variations in the incoming water. The humidifier assembly is capacity field-adjustable and includes a high-water probe. Drain duration and drain interval are also field-adjustable.

10.4.1 Humidifier Canisters

The steam generator type humidifier does not require maintenance other than to replace the canister as required. The frequency of change will depend on usage and water type. A set of the humidifier manufacturer's instructions is included with the paperwork placed inside the unit when it ships.

10.5 Refrigerant Filter Drier

Factory installed refrigerant filter driers do not normally require maintenance. When replacing compressors or other repairs that open the refrigeration system to

atmosphere, it is advisable to replace the filter drier. The equivalent type and size should be used.

10.6 Current Sensing Relay

The current sensing relay is set at the factory and does not normally require adjustment in the field. But if the plug fan speed operating mode is change in the field and requires the no airflow alarm to be adjusted, follow these instructions:

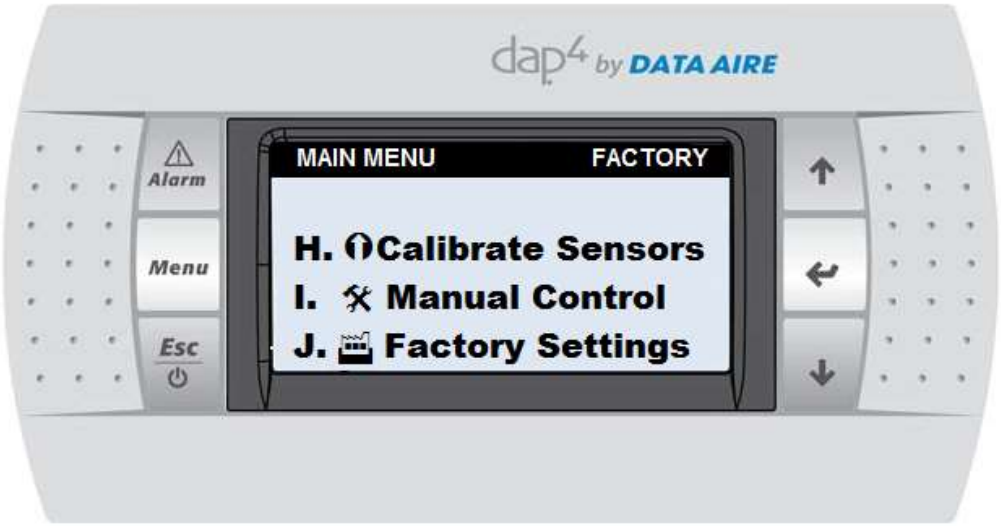
Figure 1 below shows a current sensing relay (CT) used to detect a "No Airflow Alarm". Before starting the adjustment, make sure you have a small flat blade screw driver that can fit in the potentiometer slot of the relay.

> ***NOTE:***
>
> When the green LED is on, the "No Airflow Alarm" message will appear.
>
> When the red LED is on, the "No Airflow Alarm" message will disappear.

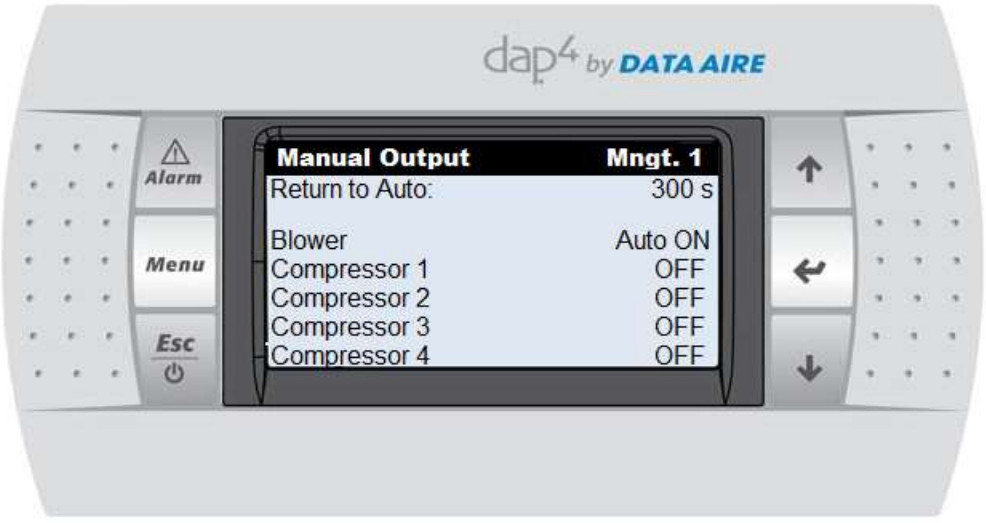
Figure 1: "No Airflow Alarm" Current Sensing Relay

The following steps indicate how to use the dap4™ controller to adjust the plug fan speed to temporarily reduce the plug fan current to set the current sensing relay.

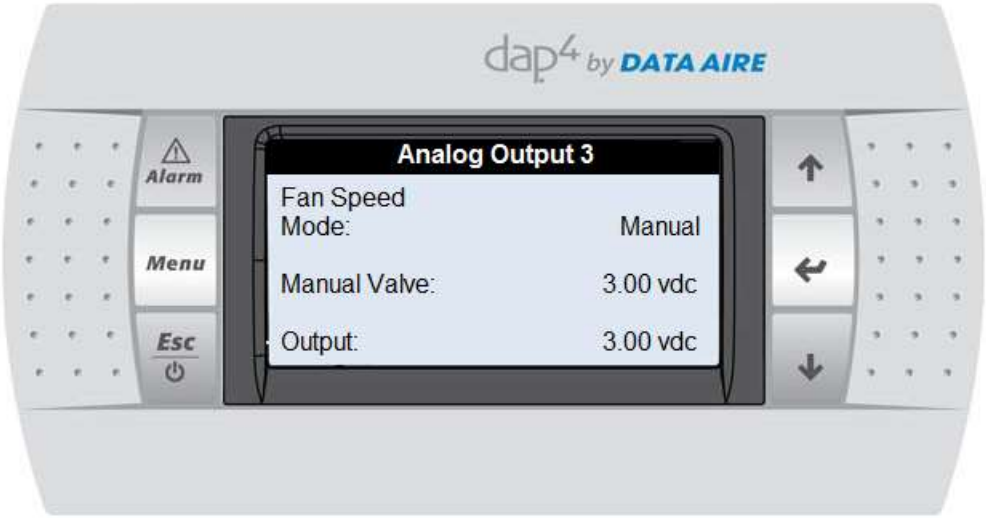
Press the MENU key and enter either Service or Factory Level password. Go to Menu I: Manual Control



Adjust the "Return to Auto" to 300 seconds. This will allow time to operate the plug fan(s) at a lower speed to make the current sensing relay adjustment before returning the unit back to the original speed.



Go to the Analog Output 3 menu and adjust the fan speed to the desired low limit operating point. In this example, the low limit is 30%. Change the "Mode" to "Manual" and "Manual Value" to 3.00VDC (i.e., 0 to 100% equals 0 to 10VDC).



At this point, you will probably get a "No Airflow Alarm" on the dap4™ display. Also, you will notice the green LED is ON at the current sensing relay because the fans are running at a slower speed than original speed (i.e., drawing lower current).

Use the small flat blade screw driver to turn the potentiometer clockwise until the red LED turns ON. Continue to turn the potentiometer another half turn to make sure that the setpoint is slightly lower than the required setpoint. In this example, 3.00VDC.

When the fan speed returns to original speed (after 300 seconds) the "No Airflow Alarm" should disappear.

The current sensing relay is now set and will trigger a "No Airflow Alarm" if for some abnormal reason, the fan current drops to an unusually low point

10.7 Plug Fans

Maintenance is not required on EC motor/plug fan modules. The motors are sealed, have maintenance free ball bearings and permanent lubrication. The only acceptable service is replacement.

10.7.1 Electronically Commutated Motors

Electronically Commutated (EC) motors with "plug fans" are standard on all gForce units.

NOTE: The plug fan modules are powered by high voltage input line power (i.e. 208-230V/3PH/50-60HZ or 380-460V/3PH/50-60HZ).

EC motors have built in protective features that include the following:

Over-Temperature protection of the (motor) electronics,

Over-Temperature protection of the motor,

Locked rotor protection,

Phase failure protection,

Under voltage detection,

Short circuit protection.

If any of the conditions exist, the motor stops electronically and an alarm (FAN FAILURE) will be indicated on the unit's controller screen.

The motor will not start-up automatically. To reset, the power supply must be switched to OFF for a minimum of twenty (20) seconds.

If for any reason the rotor is blocked, the motor will electronically switch off. Before looking for blockage make certain to remove power from the unit. Once the blockage is cleared the motor will automatically restart when powered on.

If there is an alarm condition indicated as "NO AIRFLOW", all active functions (cooling, heating and humidification will stop until the alarm is cleared.

EC motors have an under voltage protection. If the power supply voltage falls below 150 VAC/3Ø (for 208-230 volt motors) 290 VAC/3Ø (for 380-460 motors) for a minimum of five (5) seconds, the motor will automatically switch off and an alarm condition (NO AIRFLOW) will be energized and displayed. If the power supply voltage returns to the correct values, the motor will automatically restart.

NOTE: The unit's control panel (dap4™) has a time delay before the NO AIRFLOW alarm is energized. It is adjustable from 5 to 180 seconds (in 5 second increments). On site where a voltage problem is known to exist, the delay can be adjusted to eliminate "nuisance" alarms until the problem is corrected.

10.7.2 Testing

To test the plug fan modules in manual mode, use the manual override slide switch Fan Speed and adjust the potentiometer up and down to vary the fan speed to check proper response.

11. RECOMMENDED LINE SIZING

11.1 Hot Gas Lines – Single Circuit Units (Up To 200 Equivalent Feet (61 m))

kW (Tonnage)	50 Feet (15.2 m)	100 Feet (30.5 m)	150 Feet (45.7 m)	200 Feet (61.0 m)
36 (10.2)	1-1/8 (29)	1-1/8 (29)	1-3/8 (35)	1-3/8 (35)
45 (12.2)	1-1/8 (29)	1-1/8 (29)	1-3/8 (35)	1-3/8 (35)

11.2 Hot Gas Lines – Dual Circuit Units (Up To 200 Equivalent Feet (61 m))

kW (Tonnage)	50 Feet (15.2 m)	100 Feet (30.5 m)	150 Feet (45.7 m)	200 Feet (61.0 m)
56 (15.6)	1-1/8 (29)	1-1/8 (295)	1-3/8 (35)	1-3/8 (35)
070 (20)	1-1/8 (29)	1-1/8 (295)	1-3/8 (35)	1-3/8 (35)
106 (30)	1-3/8 (35)	1-3/8 (35)	1-3/8 (35)	1-5/8 (41)

11.3 Liquid Lines – Single Circuit Units (Up to 200 Equivalent Feet (61 m))

kW (Tonnage)	50 Feet (15.2 m)	100 Feet (30.5 m)	150 Feet (45.7 m)	200 Feet (61.0 m)
36 (10.2)	5/8 (16)	7/8 (22)	7/8 (22)	7/8 (22)
45 (12.2)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)

11.4 Liquid Lines – Dual Circuit Units (Up to 200 Equivalent Feet (61 m))

kW (Tonnage)	50 Feet (15.2 m)	100 Feet (30.5 m)	150 Feet (45.7 m)	200 Feet (61.0 m)
56 (15.6)	5/8 (16)	7/8 (22)	7/8 (22)	7/8 (22)
070 (20)	5/8 (16)	7/8 (22)	7/8 (22)	7/8 (22)
106 (30)	7/8 (22)	7/8 (22)	7/8 (22)	7/8 (22)

12. CONTACT DATA AIRE

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Fax: 714-921-6010 Main

714-921-6011 Engineering

714-921-6022 Parts Sales

Web Site: www.dataaire.com

Job/Unit Information:

Data Aire Job Number: _____

Evaporator Serial Number: _____

Evaporator Model Number: _____

Condenser/Fluid Cooler Serial Number: _____

Condenser/Fluid Cooler Model Number: _____

Date installed: _____ / _____ / 20_____

Installing Contractor: _____

13. MAINTENANCE/INSPECTION CHECKLIST

NOTE: Maintenance/inspection items are monthly unless otherwise specified.

<table>
<tr><th colspan="2">MAINTENANCE/INSPECTION CHECKLIST</th></tr>
<tr><td>Evaporator Model No.:</td><td>Evaporator Serial No.:</td></tr>
<tr><td>Technician:</td><td>Date:</td></tr>
<tr><td>Temperature/Humidity set at</td><td>_____ °F _____ % RH</td></tr>
<tr><td>Air Filters
___ Inspect and replace (if required)
___ Inspect grille area and ensure unrestricted</td><td>Air Distribution Section
___ Check restriction of grilles and discharge louvers</td></tr>
<tr><td>Electrical Section
___ Inspect fuses
___ Inspect/tighten all wire connections
___ Inspect contactor operation
___ Check operation sequence
___ Check calibration of change over thermostat (Energy Saver system only)</td><td>Controls
___ Check unit control operation
Check operation of the following:
___ High water alarm
___ Pressure differential switch
___ Fan current sensing switch</td></tr>
<tr><td colspan="2">EC Plug Fan Section:
___ Check plug fan wheel movement to be free and clear of any debris
Record motor voltage Record motor amp draw
Fan#1 L1 _____ V L2 _____ V L3 _____ V L1 _____ A L2 _____ A L3 _____ A
Fan#2 L1 _____ V L2 _____ V L3 _____ V L1 _____ A L2 _____ A L3 _____ A
Fan#3 L1 _____ V L2 _____ V L3 _____ V L1 _____ A L2 _____ A L3 _____ A
Record fan wheel speed (RPM)
Fan#1 _____ Fan#2 _____ Fan#3 _____</td></tr>
</table>

MAINTENANCE/INSPECTION CHECKLIST

Humidifier (Steam Generator) is equipped

___ Inspect drain valve/trap/drain line
___ Check for leaks (make-up water/hoses)
___ Check humidifier canister (replace if needed)
___ Check and clean fill strainer
___ Check operation
___ Record humidifier amp draw L1_____ L2 _____ L3 _____

Reheat
___ Inspect element (and clean if required)
___ Check wiring
___ Record amps _____ A

Refrigeration Piping
___ Check for lines (leaks/lines secure)
___ Check capillary lines

Condensers (Water-Cooled)

___ Check for leaks
___ Entering/leaving water temperatures ENT ____°F LVG ____°F

Compressor (Monthly)
___ Check for oil leaks
___ Check compressor mounting
___ Inspect wire connection

Compressor (Quarterly)	Compressor 1	Compressor 2
___ Record suction pressure	_____ PSIG	_____ PSIG
___ Record discharge pressure	_____ PSIG	_____ PSIG
___ Record superheat	_____ °F	_____ °F
___ Record sub-cooling	_____ °F	_____ °F
___ Check high pressure cut-out	_____ PSIG	_____ PSIG
___ Check low pressure cut-in	_____ PSIG	_____ PSIG
___ Check low pressure cut-out	_____ PSIG	
___ Record compressor amp draw	_____ L1	_____ L1
	_____ L2	_____ L2
	_____ L3	_____ L3

MAINTENANCE/INSPECTION CHECKLIST	
Condensate Pan and Pump (if equipped) ___ Check for leaks ___ Check for debris ___ Inspect/check float operation ___ Check pump operation	Air Cooled Condenser (if applicable) ___ Inspect coil/clean if required ___ Inspect motor/motor mounts ___ Inspect fan blade(s) ___ Check wiring ___ Inspect piping for leaks
Dry Cooler (if applicable) ___ Inspect coil/clean if required ___ Inspect motor/motor mounts ___ Inspect fan blade(s) ___ Check wiring ___ Inspect piping for leaks	Glycol Pump (if applicable) ___ Glycol leaks (pump area) ___ Pump operation ___ Auto air vent clean of mineral deposits
Equipment Runtimes Blower _____ hrs Compressor #1 _____ hrs Compressor #2 _____ hrs Condenser _____ hrs Reheat #1 (if equipped) _____ hrs Reheat #2 (if equipped) _____ hrs Reheat #3 (if equipped) _____ hrs Humidifier (if equipped) _____ hrs Dehumidification _____ hrs Energy Saver (if equipped) _____ hrs _____ Reset all to zero runtimes	

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