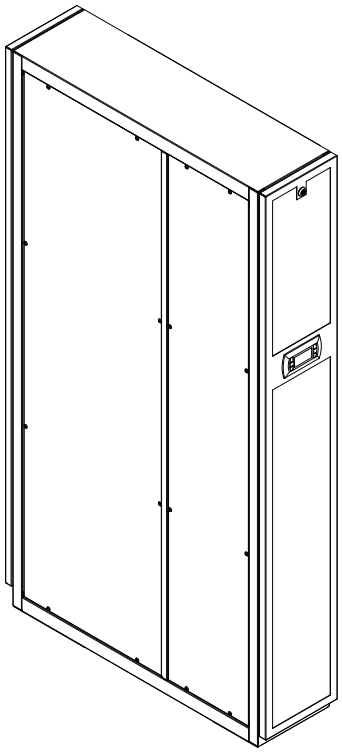
Installation, Operation, and Maintenance

CyberRow DX

Row-Based Precision Air Conditioners
12 kW - 33 kW / 60 Hz



⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

April 2023 **AH-SVX015A-EN**

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

⚠WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labeling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

Copyright

Trademarks

Table of Contents

Model Number Descriptions

Digit 1, 2, 3 — System

CSR = CyberRow System

Digit 4, 5, 6 — Nominal Capacity
MBh

042
084

Digit 7 — Cooling Method

C = Chilled Water
G = Glycol Cooled DX
W = Water Cooled DX
A = Air Cooled DX

Overview

General

The CyberRow precision data center air conditioning system covered by this manual is designed and manufactured by vendor Air Technology Systems, Inc. (vendor) and uses the latest, state-of-the-art control technology. Recognized as a world leader, vendor provides air conditioning systems using the finest materials available in the industry. The unit will provide years of trouble free service if installed and maintained in accordance with this manual. Damage to the unit from improper installation, operation or maintenance is not covered by the warranty.

STUDY the instructions contained in this manual. They must be followed to avoid difficulties. Spare parts are available from vendor to insure continuous operation. Using substitute parts or bypassing electrical or refrigeration components in order to continue operation is not recommended and will VOID THE WARRANTY. Due to technical advancements, components are subject to change without notice.

All CyberRow systems are designed to be installed indoors.

Product Description

CyberRow systems are available in Water cooled, Water/Glycol cooled or Air cooled Direct Expansion (DX) configurations. DX based CyberRow systems are designed to operate with R410A refrigerant.

DX based CyberRow cabinets are 12 -inches wide. The cooling capacity in BTU/Hr will depend on the compressor size. Refer to the unit nameplate to identify the capacity of your system.

Note: *CyberRow systems have been designed to capture and neutralize heat within close coupled rack-based environments. Any use beyond what is described in this manual is deemed to be not intended. Vendor is not liable for any damage resulting from improper use.*

The functional mode of operation is cooling which provides localized cooling to offset hot spots in data centers.

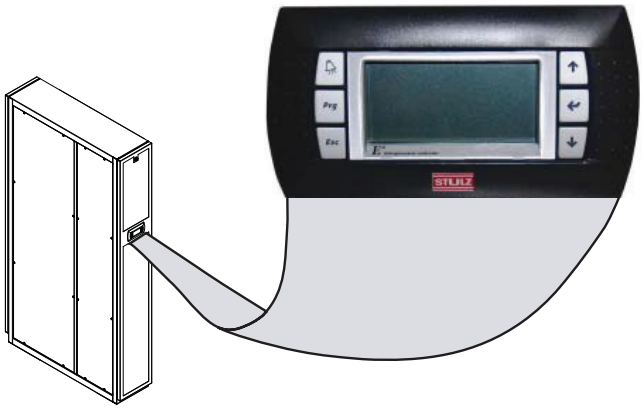
The CyberRow system captures high temperature (hot aisle) discharge air from adjacent rack-based IT equipment and reintroduces it as conditioned air through the front of the unit (cold aisle).

The system is equipped with highly reliable EC (Electronically Commutated) fans which offer considerable energy cost savings and long life. Using an electronically commutated permanent magnet DC motor, AC inverter whine is eliminated. Fan speed is continuously adjustable via a signal from the system controller without the use of VFDs. EC fans offer energy efficient, quiet, low vibration operation.

An advanced E² series microprocessor controller is mounted inside the CyberRow electric box. The controller provides the following features: input/output monitoring status, full integrated control of cooling, multi-unit control, and remote communication with a Building Management System (BMS).

The controller may interface directly to a BMS, allowing the ability to monitor the performance of the air conditioner and adjust operating parameters.

The E² user interface display panel is typically factory mounted on the front access panel of the unit.



Refer “E² Controller,” p. 27 for detailed instructions on operating the system controller.

Product Warranty

See the contract.

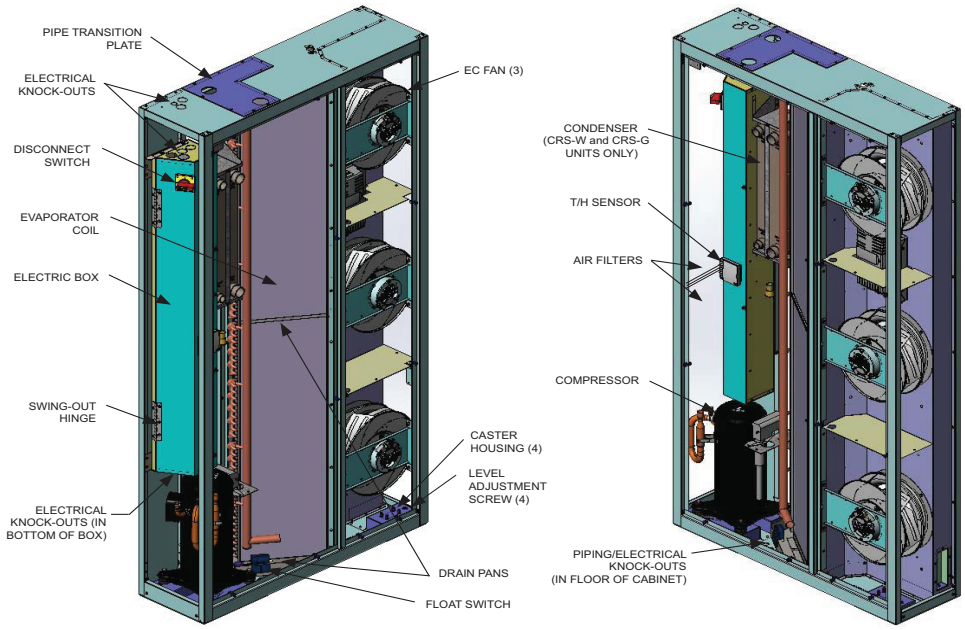
General Design

The CyberRow unit is housed in a steel frame type cabinet rated for indoor use. The exterior of the cabinet is coated with a powder coat finish to protect against corrosion. Removable access panels are located on the front and rear of the cabinet for easy access to all components. Operator controls are conveniently located on the front of the cabinet.

Note: *Customer specified non standard features or design variations may not be described in this manual. Refer to the installation and/or electrical drawings supplied with your unit for details of additional feature(s). In some cases, an addendum to this manual may also be included to further describe the feature(s).*

Figure 1, p. 8 depicts a typical internal layout and identifies the major components of a typical CyberRow unit utilizing Direct Expansion (DX) refrigerant. The location of some components may vary depending on the cooling configuration selected (Water, Water/Glycol or Air Cooled).

Figure 1. Typical internal layout- CRS-042/084



NOTE: CABINET ACCESS PANELS REMOVED TO SHOW INTERNAL PARTS.

Electrical Compartment

The electrical components are protected inside an electric box located behind the rear access panel. The electric box cover is safety interlocked with the service disconnect switch (See Figure 1) preventing the cover from being opened when the switch in the On position. The switch must be turned Off to gain access to the electrical compartment.

The service disconnect switch may be used to turn the unit off for emergency shutdown or when routine maintenance is performed. The handle of the switch may be locked in the Off position to prevent unintended operation.

Circuit Breakers/Motor Start Protectors

CyberRow units incorporate state of the art component protection with the use of motor start protectors and circuit breakers. If an overload occurs the switches must be manually re-set after the overload condition is cleared.

Compressor

A scroll compressor is utilized in DX based CyberRow systems. With fewer moving parts, scroll compressors have demonstrated superior

durability. The scroll compressor is designed around two identical spirals or scrolls that, when inserted together, form crescent shaped pockets. During a compression cycle, one scroll remains stationary while the other scroll orbits around the first. As this motion occurs, gas is drawn into the scrolls and moved in increasingly smaller pockets toward the center. At this point, the gas, now compressed to a high pressure, is discharged from a port in the center if the fixed scroll. During each orbit, several pockets of gas are compressed simultaneously, creating smooth, nearly continuous compression.

Electronic Thermal Expansion Valve

An auxiliary control module mounted to the door of the electric box, manages the operation of the electronic expansion valve (EEV). The control module manages the EEV based on input signals from the suction pressure and temperature sensors. It regulates the amount of refrigerant entering the evaporator to maintain the correct superheat temperature.

Electronic Hot Gas Bypass

Used for freeze protection and capacity control, an electronically controlled hot gas bypass valve is managed by the same auxiliary control module that manages the EEV valve. The hot gas bypass system allows the compressor to run continuously instead of cycling the compressor on and off for capacity control. The hot gas bypass system manages system capacity based on the suction temperature. The hot gas regulator valve meters hot gas into the evaporator coil during low load periods or when evaporator air flow is reduced.

Coil(s)

Cooling coils are aluminum finned/copper tube construction. The coils are leak tested and cleaned before installation by the factory. Condensate drain pans are provided to collect water condensed by the coils. The drain pans are emptied by a condensate pump that directs the water to a pipe stub located either at the top or the bottom of the A/C unit depending on the piping configuration (see Figure 9, p. 14 and Figure 11, p. 16).

A float switch is placed in the lower condensate pan to detect if the water level rises. If the condensate pan fails to drain, the

float switch signals the controller to annunciate an alarm and turn off the compressor and the fans.

Condensate Pump

A condensate pump is factory installed in the lower drain pan. The pump automatically eliminates condensate water from the drain pan. The pump has an internal float switch which turns the pump on and off based on the water level.

EC Fans

The unit is equipped with three high efficiency, Electronically Commutated (EC) fans. EC fans utilize a brushless motor equipped with permanent magnets and permanently lubricated ball bearings. The fan impellers are backward curved and attached to the rotor casing. The fan is balanced and aerodynamically optimized to minimize vibration.

The fans do not utilize drive belts. Fan speed is variable via a 0 to 10 VDC signal from the system controller. The fan motor is equipped with integral electronics and does not require the addition of secondary electronics such as thermal protection, inverters or filters. The fan will not produce AC inverter whine.

During start-up, the fans begin operating in stages with five second time delays. The middle fan starts first, then the upper fan, then the lower fan. The system controller monitors fan operation. If one or two of the fans fail to operate, the controller alerts the operator with an alarm message and increases the speed of the remaining fan(s) to compensate for the loss of air flow.

The system controller may be used to configure the fans with all three fans operating at the same variable speed (see “Air Flow/Fan Speed Control,” p. 35).

Temperature/Humidity Sensors

Control and alarm recognition takes place by means of the controller analyzing signal inputs from the sensors to manage the operation of the A/C unit consistent with the setpoints entered in the system controller. The system controller monitors a 4-20 mA temperature/humidity (T/H) sensor.

The return air is monitored by a temperature/humidity (T/H) sensor which is typically mounted inside the cabinet. As an option, the return air T/H sensor may be removed from the cabinet and mounted in the hot aisle. The actual sensor values may be viewed from the controller user interface display using the Information menu loop.

Optional Equipment

Remote Mounted Supply

Temperature/Humidity Sensor

As an option, a supply T/H sensor may be provided for field installation (see “Remote Temperature/Humidity Sensor,” p. 12). This is to be mounted in the supply (cold aisle) space for monitoring or control purposes. Refer to the electrical drawing supplied with your unit for wiring details specific to your system.

Water Detector

As an option, vendor offers spot type or strip/cable type water detectors (see “Remote Water Detectors,” p. 12). Upon sensing a leak, the water detector control circuit will signal the system controller of the alarm condition. The system controller is programmed to shut down the compressor and the fans when a leak is detected.

Smoke Detector

Optionally mounted in the return air side of the cabinet, a photo-electric smoke detector is used to sense the presence of smoke and signal the controller when a smoke alarm condition exists and shuts down the air conditioner.

Firestat

Optionally mounted in the return air side of the cabinet, a fire detector senses high return air temperature and signals the controller when a fire alarm condition exists and shuts down the air conditioner.

Installation

Receiving the equipment

CyberRow precision A/C system has been tested and inspected prior to shipment. Carefully remove the protective packaging and perform a visual inspection of the equipment immediately upon delivery to confirm that your equipment has been received in excellent condition. Remove the access panels and thoroughly inspect the interior of the unit for any signs of transit-incurred damage. If there is shipping damage, it must be noted on the freight carriers delivery forms BEFORE signing for the equipment. Any freight claims MUST be done through the freight carrier. vendor ships all equipment FOB. vendor can assist in the claim filing process with the freight carrier. Should any damage be present, notify vendor Product Support prior to attempting any repairs. Refer "Product Support," p. 69 of this manual for instructions.

A unit Data Package has been sent with your unit. It contains this manual, system drawings, applicable MSDSs, warranty registration, other component manuals and applicable instructions based on the configuration of your unit. The data package has been placed in your unit in a clear plastic bag. These documents need to be retained with the unit for future reference. The unit should always be stored indoors in a dry location prior to installation.

Note: *Items that have been shipped loose, such as the controller display panel, temperature/ humidity sensors, water detectors, etc., are shipped inside the air conditioner unless specified otherwise by the customer. Unpack and store these items in a safe place unless you are using them immediately.*

Moving the equipment

CyberRow systems are designed to be kept in a vertical position. The cabinet is equipped with shipping support brackets which are bolted to the skid to facilitate moving the unit prior to installation. Move the unit on the skid with a suitable device such as a forklift, pallet jack or roller bar and dollies which are capable of handling the weight of the equipment. For reference, a weight table is provided on the installation drawing. Unbolt the shipping support brackets from the skid, leaving them attached to the unit during the installation process.

⚠WARNING

Risk of Unit Tipping!

Failure to keep shipping support brackets in place while moving and positioning the cabinet will result in an unstable unit which could tip and result in death or serious injury.
Ensure that the shipping support brackets are attached to the front and rear of the cabinet after removing the unit from the skid.

Important: *If the shipping brackets must be removed before installing the server racks on each side, physically support each side of the cabinet to prevent it from tipping over.*

NOTICE

Unit Damage!

Failure to follow the instruction below could result in damage to the unit.
When moving the unit, lift it vertically and keep it in a level position.

Once the cabinet is removed from the shipping skid, it may be rolled into position on the casters which are mounted to the bottom of the unit. Do not remove the shipping support brackets unless server racks are installed on each side of the CyberRow cabinet.

The cabinet is equipped with an adjustable foot at each corner to raise the cabinet off the casters after the unit is positioned in its operating location. The adjustable feet are also used for leveling and overall height correction. To adjust the height, use a flat head screwdriver to turn the screws, located at the top of the four caster housings (accessed inside the front and rear corners of the cabinet per Figure 1, p. 8). Raise or lower each foot until the cabinet is level and even with the adjacent equipment racks (see Figure 2, p. 11).

Site preparation

Removable access panels are located on the front and rear of the CyberRow cabinet for easy service access. In order to have full service access to the internal components, no permanent obstructions should be placed in front or behind the cabinet.

Note: *Working clearance requirements need to be established prior to mounting the unit. Refer to local and national electrical codes.*

Important:

- *The unit must in installed in an air-conditioned space.*
- *Ensure the mounting surface is capable of supporting the weight of the equipment. Before installing the unit, refer to the weight table provided on the installation drawing.*

When determining the installation location, consider how you will route the piping and wiring into the cabinet and ensure access is available (see "Piping connections," p. 13 and "Refrigerant Piping," p. 15). The *CyberRow* system is ordered from the factory with pilot holes for piping and wiring in either the top or the bottom of the cabinet. See the installation drawing provided with your unit for the pilot hole locations.

Conditioned Space

Certain steps should be taken to minimize the effects of the environment surrounding the conditioned space. This is especially important for critical/ precision room preparation (computer data centers) requiring close tolerance control of

temperature and humidity. The conditioned space should be well insulated and include a vapor barrier. The installer should ensure that the proper insulation rating is used based on the design of the space, which was the basis for the system selected. The following table is a recommended minimum R-value (thermal resistance) to ensure optimum equipment operation.

Table 1. Thermal resistance

Structure	R-Value
Ceiling	R-38
Wall	R-21
Floor	R-19
Door	R-5

The vapor barrier is the single most important requirement for maintaining environmental control in the conditioned space. The vapor barrier in the ceiling and walls can be a polyethylene film. Concrete walls and floors should be painted with a rubber or plastic based paint. Doors and windows should be properly sealed and a door sweep used to minimize leakage. Outside or fresh air should be kept to a minimum (as it adds to the cooling load), while maintaining the requirement of the Indoor Air Quality (IAQ) standard. Lack of these steps can cause erratic operation, unstable room control and excessive maintenance costs.

Mounting/Placement

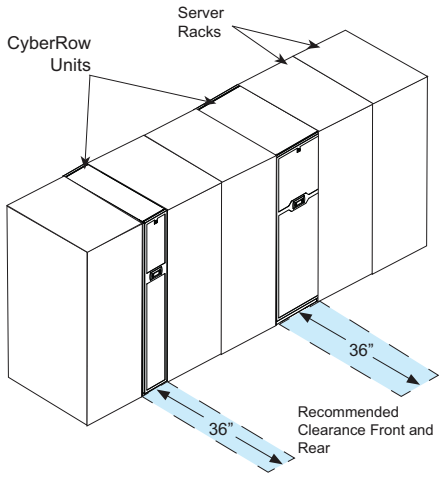
The *CyberRow* precision A/C system uses a frame and panel construction for unit rigidity and full service accessibility while the unit is mounted in place.

Note: *The equipment must be level to operate properly.*

CyberRow cabinets are designed to be installed in a row of servers between the server racks (see Figure 2 and Figure 3). They have a compact footprint, which allows the units to be placed adjacent to the heat producing equipment racks anywhere in the row. They provide cool, conditioned air through the front grille to the adjacent server modules on the cold aisle side of the row. It is recommended to position the unit to obtain optimum air circulation. Allow 36 inches clearance in the front and rear of the cabinet for servicing the unit.

The optimal placement location is next to highly loaded servers that throw off the most significant heat into the hot aisle side of the row. In this arrangement, the CyberRow minimizes hot spots. It is best not to place a CyberRow unit at the end of a row unless an air barrier is in place to prevent the conditioned air from being drawn around to the hot aisle side, bypassing the front of the servers. An air barrier must also be present to prevent conditioned air from being drawn over the top of the row into the hot aisle.

Figure 2. Recommended installation

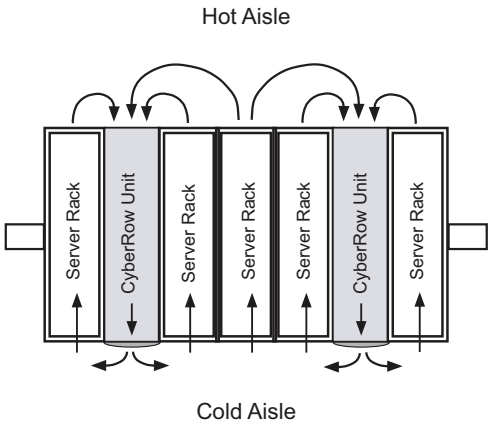


Note: *Placement of air barriers between the cold aisle/ hot aisle is important. If the supply discharge is too close to the hot aisle, the conditioned supply air will be recirculated back to the intake in the hot aisle side of the cabinet before it has circulated through the equipment to be cooled.*

Air Distribution

Air from the hot aisle is drawn into the rear of the CyberRow cabinet and passes through the fins of the cooling coil. The conditioned supply air discharges through the front of the cabinet (see Figure 3).

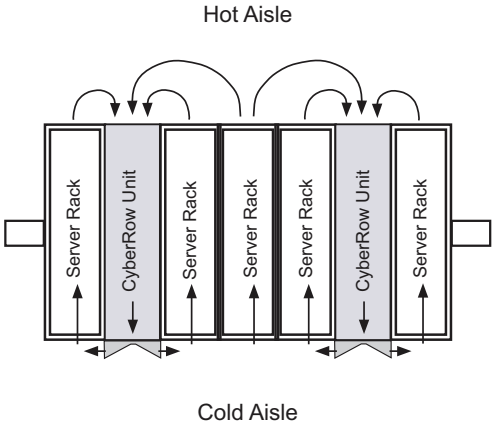
Figure 3. Typical air distribution



The front discharge panel directs the supply air out of the CyberRow unit where it will be drawn into the front of the server racks.

An optional front diverted air discharge panel is also available. This directs the supply air sideways out of the CyberRow unit and directly into the front of the server racks (see Figure 4, p. 12).

Figure 4. Front diverted air distribution



Optional Equipment (Field Installed)

Note: *Do not mount any optional equipment on the unit access panels.*

Remote Water Detectors

The remote water detector is normally placed on the sub-floor or in a field supplied auxiliary drain pan located beneath the unit. Vendor provides 2 types of water detectors:

Spot type water detector

Remove the protective cover and connect two control wires to the terminals on the base. Run the control wires into the electric box and connect them to the control terminal block as shown in the wiring diagram provided with your unit. Replace the cover and place the water detector(s) on the floor with the metal electrodes facing down. When water is present, current will flow between the electrodes. The base is provided with a mounting hole in the center which may be used to secure the water detector in place.

Figure 5. Spot type water detector

Note: *Do not place the spot type water detector on an electrically conductive surface.*

Cable type water detector

Lay the cable water detector fl at across the sub-floor where water could collect.

Secure the cable every 12-18 inches with J-clips or cable ties with adhesive mounting pads when installing it in the airstream. Secure it at each turn of the cable and when routing it around obstructions. Do not tie the water detector cable to a metal floor stand or to pipes.

When a water leak on the floor reaches the cable, current will flow between the cable wires. A two conductor wire harness is provided with a quick connect fitting on the end. The harness mates to the fitting on the water detector and connects it to the control terminal block inside the electric box as shown in the wiring diagram provided with your unit.

Figure 6. Cable type water detector

Remote Temperature/Humidity Sensor

Depending on the type of control selected, the temperature/humidity (T/H) sensor may be factory mounted or shipped loose for field installation. The remote sensor must be located so that it will prop- erly sense the temperature/humidity conditions to be controlled. The T/H sensor should not be mounted near a doorway or an area where it would be exposed to direct sunlight. When locating the sensor, consider the length of wire to be used. The sensor is typically provided with a 20 foot long cable. As an option, a 75 foot or 150 foot long cable may be provided. Follow the steps below to mount the sensor.

Figure 7. Remote temperature/Humidity sensor

1. Remove the cover from the base of the sensor by squeezing it at the top and bottom.

NOTICE

Sensor Damage!

The sensors can be damaged if handled improperly. Do not damage the exposed temperature/humidity sensors on the PC board when the cover is removed. Do not touch the sensor as this will affect its accuracy.

2. Place the base temporarily against the mounting surface.
3. Level the base. Mark and drill mounting holes through at least two of the available slotted holes.

4. Run the 3 conductor shielded cable through the opening in the base, then secure the base with screws ensuring the word TOP on the PC board is oriented upward.
5. Make the wiring connections. Refer to “Utility Connections,” p. 17, and refer to the wiring diagram supplied with your unit.
6. Seal the hole in the wall behind the sensor.
7. Replace the cover plate on the base.

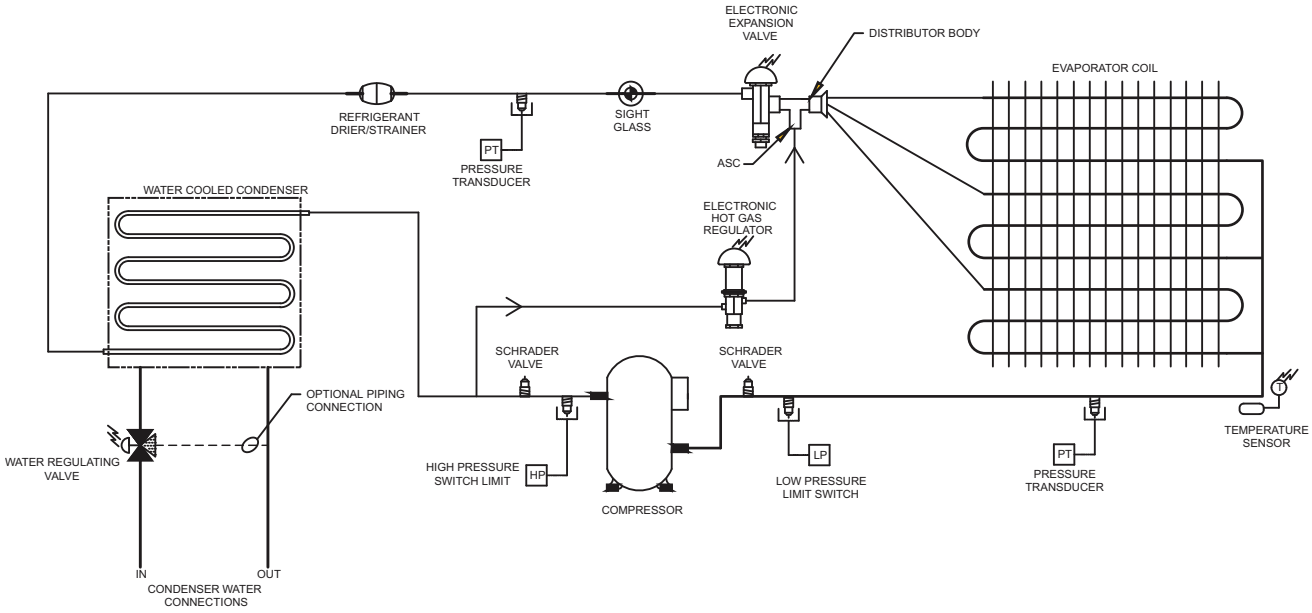
Outdoor Condensers

Referring to the IOM manual provided with the condenser, install the remote condenser in a secure location where it cannot be tampered with and the service disconnect switch cannot be inadvertently turned off. Locate the remote condenser where the fan is not likely to draw dirt and debris into the coil fins. The clearance around the condenser should be at least 1x the units width to ensure adequate airflow to the coil. Secure the condenser to prevent the system from moving during operation. It is recommended that the remote condenser be installed with vibration mounts to reduce vibration transmitted to the mounting surface.

Water- Water/Glycol Cooled DX (CRS-W and CRS-G Models)

The system utilizes an external source of fluid to provide coolant to the condenser inside the A/C unit. No refrigeration connections are required for self-contained water or glycol cooled systems (see Figure 8).

Figure 8. Typical W/G piping diagram



Piping connections

Important: *The cooling coil (and associated piping circuits) are pressurized (up to 100 psi) and sealed when they leave the factory. Before installing the interconnecting piping, release the pressure via an available stem valve or schrader valve prior to uncapping the pipes.*

Fluid supply and return lines are routed to either the top or bottom of the cabinet as specified when the CyberRow system is ordered (see Figure 9, p. 14). On units that are piped from the top, the supply and return connections are made outside the cabinet. On units that are piped from the bottom, the supply and return connections are made inside the cabinet.

Pipe connections are threaded NPT connections. The pipes are labeled; i.e. Supply, Return. When making the connections, a teflon tape thread sealant is recommended to minimize internal fouling of the piping.

Field piping is not necessarily the same size as the units pipe connections. Piping should be sized to match the system pressure drop and flow capacity, and may require reducing fittings to match the connection size on the air conditioner. An air vent and several schrader valves are installed in the precision A/C unit piping. It is recommended to provide manual shut-off valves for both the supply and return fluid for isolating the unit when performing routine maintenance or repairs. Refer to the piping diagram supplied with your unit

Note: *A 60-mesh strainer should be installed in the supply pipe. Ensure the strainer is readily accessible for servicing or replacement.*

For pipe connection sizes, refer to Table 2:

Table 2. Pipe connection sizes

Model #	Water Glycol Inlet/Outlet (in.)	Condensate Drain (in.)
CRS-042-W, -G	1 1/4	1/2
CRS-084-W, -G	1 1/4	1/2

Note: *Use standard refrigeration practices for piping, leak testing and filling the water glycol circuit.*

The piping should be isolated by the use of vibration isolating supports. Provide supports (clamps or hangers) as necessary every 5 to 10 feet along piping runs to minimize vibration and noise transmission.

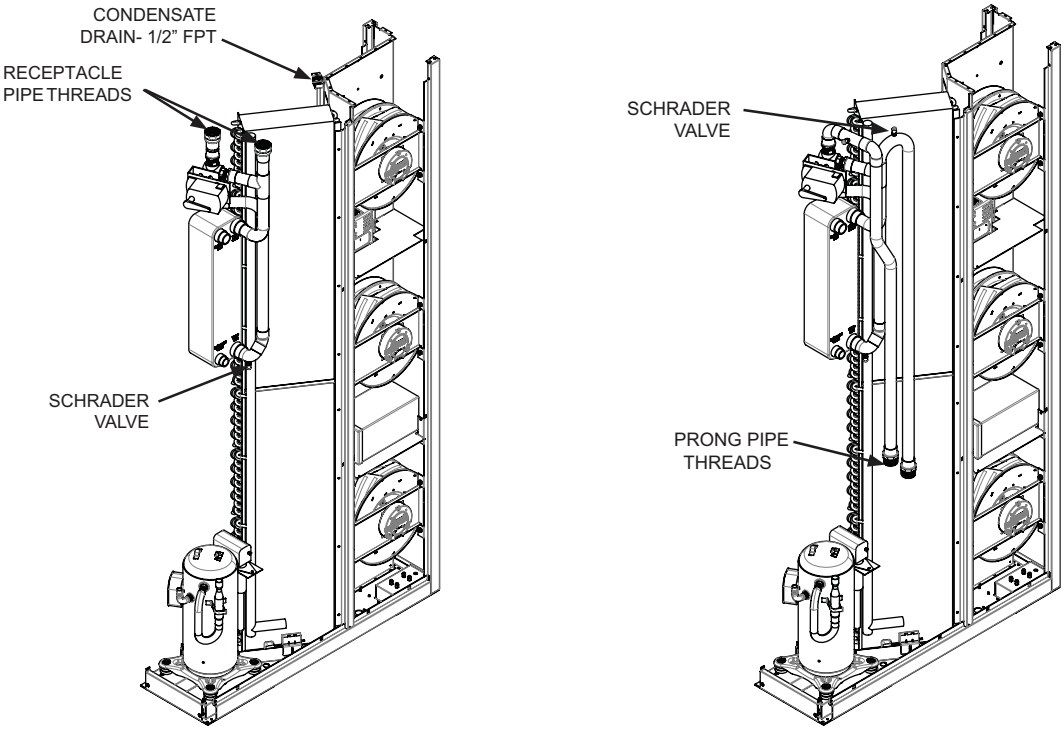
To reduce vibration transmission and prevent pipe damage, seal openings in walls using a soft flexible material to pack around the piping. After the piping is installed, seal the gaps between the pipes and the entrance holes so air will not leak around the pipes.

Note: *Water/Glycol lines should be insulated to prevent condensation from forming on the pipes if ambient dew point temperatures are higher than the fluid temperatures.*

Important: *After the interconnecting piping is installed, the entire piping circuit must be thoroughly flushed prior to operating the system.*

If newly installed supply and return piping is used, it is recommended that the piping system be cleaned prior to connecting it to the unit. If solvents/cleaning solutions are used, ensure they are completely flushed from the piping before connecting it to the unit. Failure to do so could result in equipment problems.

Figure 9. Water-Water/Glycol supply and return piping connections



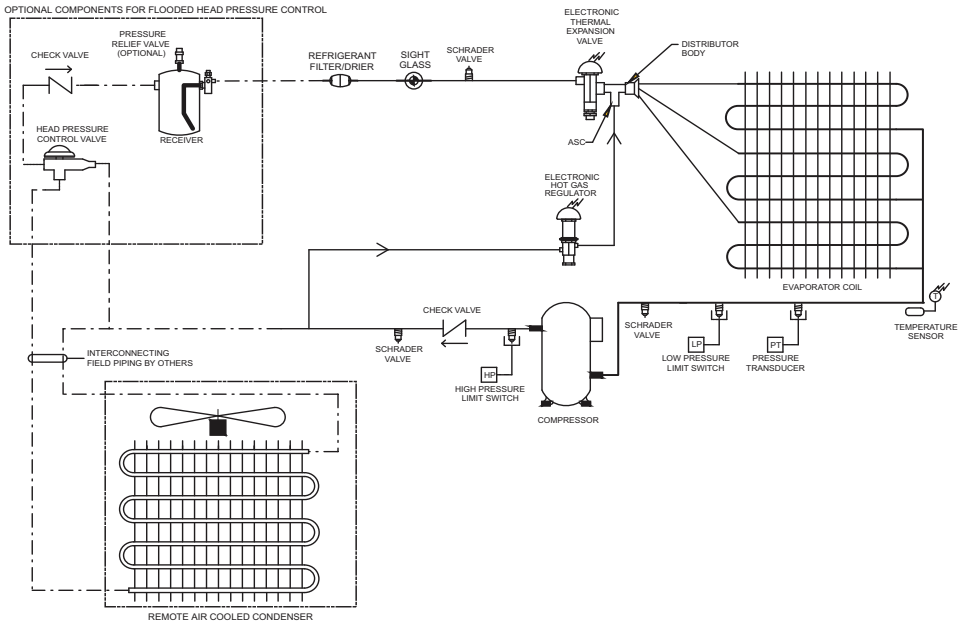
TOP ACCESS PIPING

BOTTOM ACCESS PIPING

Split Air Cooled Systems (CRS-A Models)

Split air-cooled systems with a remote condenser will require field installed refrigerant piping. All split systems are shipped with a dry nitrogen charge of 100 psig. Release the pressure via an available stem valve or schrader valve prior to uncapping the pipes. Do not release the pressure until the field installed refrigerant piping is ready to connect. Systems utilizing a remote condenser will require a copper liquid line and discharge line. See Figure 10, p. 15 and refer to the Installation, Operation, and Maintenance documentation provided with the condenser.

Figure 10. Typical remote air cooled DX piping diagram



Refrigerant Piping

Refrigerant lines for the A/C unit are routed to either the top or bottom of the cabinet as specified when the CyberRow system is ordered (see Figure 11, p. 16).

The connections are made inside the cabinet. The pipe stubs are labeled; i.e. Discharge, Liquid Line.

The refrigerant piping should be isolated by the use of vibration isolating supports. Provide supports (clamps or hangers) as necessary every 5 to 10 feet along piping runs to minimize vibration and noise transmission. To reduce vibration transmission and prevent pipe damage, when sealing openings in walls use a soft flexible material to pack around the piping. After the piping is installed, seal the gaps between the pipes and the entrance holes in the cabinet so air will not leak around the pipes.

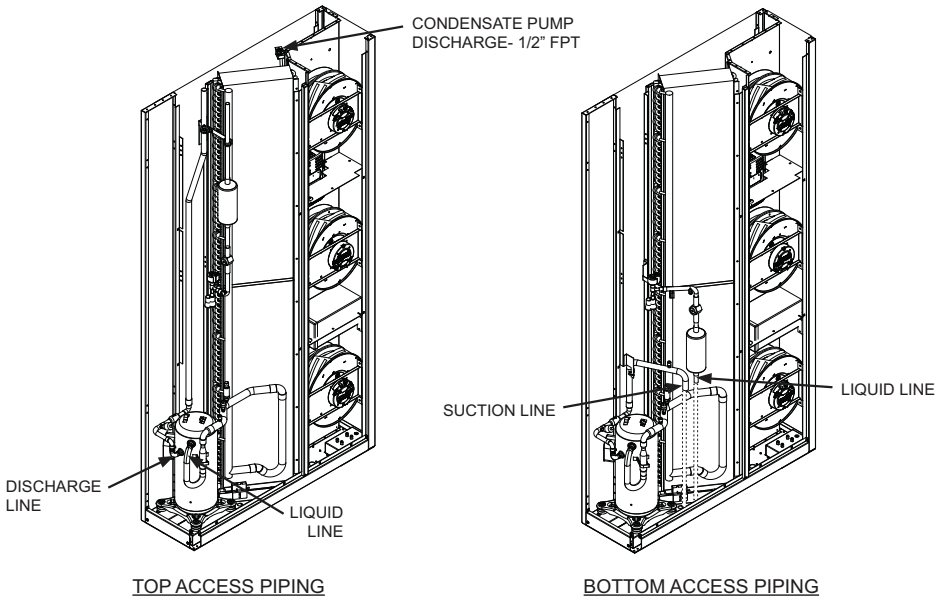
All refrigeration piping should be installed with high temperature brazed joints. Use standard refrigeration practices for piping, leak testing, dehydration and charging of the refrigeration circuits. For copper to copper brazing, phosphorous alloy containing a minimum of 15% silver is recommended. General purpose silver brazing alloy with 45% silver is recommended for brazing dissimilar metals.

Wrap wet rags around the pipes between the areas to be soldered and any nearby refrigeration components to keep excessive heat from traveling through the pipe and causing damage. Clear all pipe connections of debris and prep connections for soldering. Use only L or K grade refrigerant copper piping. Be careful not to allow solder/piping debris to get inside refrigerant lines. Dry nitrogen should be flowing through the tubing while soldering at a rate of not less than 1-2 CFM (0.028-0.57 M 3/ minute).

Table 3. Pipe connection sizes

Model #	Liquid Line (in.)	Discharge Line (in.)	Condensate Drain (in.)
CRS-042-W, -G	5/8	5/8	1/2
CRS-084-W, -G	5/8	5/8	1/2

Figure 11. DX Refrigerant piping connections



Refrigerant Pipe Sizing

Refrigerant lines for split systems must be sized according to the piping distance between the evaporator and the condenser. Each valve, fitting and bend in the refrigerant line must be considered in this calculation. Pipe sizes are given for equivalent feet, not linear feet. Do not confuse the terminologies.

For example, a 7/8 inch standard 90° elbow has an equivalent length of 1.5 feet; a 7/8 inch branch Tee has an equivalent length of 3.5 feet. These corrections must be accounted for when sizing your piping.

Note:

- *Refrigerant piping between the CyberRow unit and the remote condenser must not exceed 150 feet (total equivalent length). The maximum level drop from the CyberRow unit to the condenser must not exceed 20 feet.*
- *Consult ASHRAE standards and refer to the Copeland applications data guide for more detailed information regarding refrigerant line traps and line sizing.*

Refer to Table 4 for standard equivalent lengths, in feet, of straight pipe.

Table 4. Equivalent length (ft.) of straight pipe

OD (In.) Line Size	Globe Valve	Angle Valve	90° Elbow	45° Elbow	Tee Line	Tee Branch
1/2	9.0	5.0	0.9	0.4	0.6	2.0
5/8	12	6.0	1.0	0.5	0.8	2.5
7/8	15	8.0	1.5	0.7	1.0	3.5
1 1/8	22	12	1.8	0.9	1.5	4.5
1 3/8	28	15	2.4	1.2	1.8	6.0

Oil traps must be included every 20 feet in the vertical risers and the refrigerant lines must be sloped ¼ inch for every 10 feet in the horizontal lines to ensure proper oil return to the compressor. An inverted trap is required on the discharge line of the remote condenser to help prevent oil and liquid from flooding back to the compressor.

Remote Air Cooled Condensers

Refer to the Table 5, p. 17 and Table 6, p. 17 below. Systems utilizing air cooled condensers must not have a refrigerant line pressure drop over 14 psig across the condenser and the interconnecting piping to the condenser.

Note: *Ensure proper condenser selection to maintain reasonable sub-cooling temperatures.*

Table 5. Recommended discharge line sizes

CRS Model Number	Equivalent Length Ft.[a]		
	50'or less	100'or less	150'or less
042	5/8	5/8	5/8
084	7/8	7/8	7/8

(a) Equivalent Ft. accounts for the linear pipe length as well as equivalent length of Valves, Elbows and Tees as shown in the Table 4, p. 16.

Table 6. Recommended liquid line sizes

CRS Model Number	Condenser to A/C Unit / Receiver to Evap. (Equivalent Ft.[a])		
	50'or less	100'or less	150'or less
042	1/2	1/2	1/2
084	5/8	5/8	5/8

(a) Equivalent Ft. accounts for the linear pipe length as well as equivalent length of Valves, Elbows and Tees as shown in the Table 4, p. 16.

Vertical runs are based on a total rise of 30 equivalent feet. For longer rises, individual calculations should be made. Sizes assume the use of single risers; double rises may be necessary.

Note: *Do not exceed 150 ft maximum Liquid Line length.*

If the condenser is installed above the evaporator, the discharge line should include a p-trap at the lowest point in the piping. The highest point in the discharge line should be above the condenser coil and should include an inverted trap to help prevent oil and liquid from flooding back to the compressor during off cycles.

Condensate Drain Line

A condensate pump is factory installed. The drain line connection is typically a 1/2-inch FPT fitting. The installer must connect a drain line (customer supplied) to the drain fitting to remove water from the cabinet.

The condensate drain fitting is accessed through the top or bottom of the cabinet as configured with the water/glycol or refrigerant piping connections. The drain fitting is accessed from outside the cabinet on top piped units. The drain fitting is accessed inside the cabinet behind the front discharge panel on bottom piped units. An entrance hole for the drain line is provided in the floor of the fan compartment. See the installation drawing provided with your unit for the location of the condensate drain fitting.

Connect the drain line to the fitting and direct the water to an appropriate place, such as an open building drain with an air gap, per local and national plumbing codes. After the piping is installed, seal the gap between the drain line and the cabinet entrance hole so air will not leak.

NOTICE

Coil Fin Damage!

Failure to follow instruction below could cause corrosion on the coil fins and cause coil fin damage. Do not use chloride based water conditioning additives in condensate drain pans.

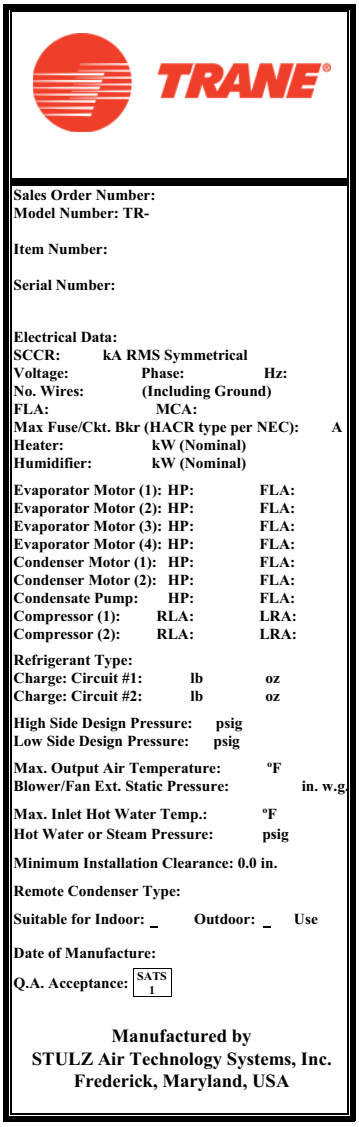
Utility Connections

Main Power

The CyberRow product offering is available in single or three phase variations and a wide range of voltages. It is imperative that the unit nameplate be examined to determine the operating voltage, frequency and phase of the system (see Figure 12, p. 18). The nameplate also provides the full load amps (FLA), the current the unit will draw under full design load, the minimum circuit ampacity (MCA) for wire sizing, and the maximum fuse or HACR (Heating, Air Conditioning, Refrigeration) breaker size (MAX FUSE/CKT BKR) for circuit protection. The units nameplate is located inside the cabinet within the electrical box.

Note: *If the nameplate states MAX FUSE/CKT BKR, it is required to use fuses or a HACR type circuit breaker to protect the system. Other protection devices are not allowed based upon the product listing.*

Figure 12. Sample nameplate



The unit is provided with terminals for all required field-wiring. Refer to the electrical drawing supplied with the unit for all power and control field-wiring. It is important to identify the options that were purchased with the unit in order to confirm which field connections are required.

Note: *All wiring must conform to local and national electrical code requirements. Use of copper conductors only is required. Wiring terminations may become loose during transit of the equipment; therefore, it is required to verify that all wiring terminations are secure.*

⚠WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.
Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

It is important to verify that the main power supply coincides with the voltage, phase and frequency information specified on the system nameplate.

The supply voltage measured at the unit must be within ±10% of the voltage specified on the system nameplate except for 208/230V single-phase units which have a different tolerance listed below.

A main distribution panel must be provided with a manual fused disconnect switch or HACR type circuit breaker per local and national electrical codes for service to the equipment. Do not mount a customer supplied manual fused disconnect switch or HACR type circuit breaker to the surface of the unit.

The unit is provided with main power and control pilot holes for connection of the field-wiring conduit. These pilot holes are located on the CyberRow unit based on the configuration. The pilot holes are located in the top of the cabinet or in the floor of the cabinet.

A label stating MAIN POWER INPUT is placed in close proximity. See the installation drawing provided with your unit for pilot hole locations. Terminate the main power wires at the line side of the service disconnect switch, located within the electric box. A separate equipment ground lug is provided within the electrical box for termination of the earth ground wire.

⚠CAUTION

Prior to unit operation, an adequate unit-to-earth ground must be connected to the unit.

Single-Phase Units 208/230V

The supply voltage for units that are designed for 208V operation must have a tolerance within -5% and +10%. If the measured supply voltage is 230V, the unit can operate with a tolerance of ±5% if the following change is made. The control transformers within the system must have the primary wire connected to its respective 240V tap instead of the 208V tap.

Three-Phase Units

Three-phase units are designed to have the L1, L2 and L3 supply wires connected to corresponding L1, L2 and L3 line terminals of the non-fused service switch. The unit will operate correctly if the supply wires are connected in this manner.

NOTICE

Compressor Damage!

Improper wire connections will result in the reverse rotation of the fans/blower motors and compressor and this may eventually result in damage to the compressor.
To correct this problem, exchange any two of the incoming main power wires at the main power service disconnect switch. Do NOT rewire the unit's individual components.

Optional Equipment

Additional control wires may be required depending on the options that were purchased with your unit. Optional sensors are to be connected directly to the control terminal board in the CyberRow electric box. You may route the wires through the top or bottom of the cabinet as preferred using the available knock-outs. Refer to the electrical drawing supplied with your unit to determine the total number of interconnecting conductors required for your system.

Note: *All wiring must be provided in accordance with local and national electrical code requirements for Class 2 circuits.*

It is important to note that the control transformer(s) supplied with the equipment have been sized and selected based upon the expected loads for each system.

NOTICE

Equipment Damage!

Connecting additional loads to the factory supplied control transformer(s) may result in overloading of the transformer(s).
Do not connect additional loads to the system control transformers.

Remote Water Detector

Refer to "Remote Water Detectors," p. 12. Each remote water detector used will require two conductors to be wired to the control terminal block within the unit electrical box. The wire insulation must be rated at 600V.

Remote Temperature/Humidity Sensor

Refer to "Remote Temperature/Humidity Sensor," p. 12. The remote temperature/ humidity sensor is equipped with a shielded cable. The shield is to be terminated at the unit electric box. The electric box includes a control terminal block with box type lugs for wire connections.

Remote On/Off

The unit is provided with a means to remotely turn off the air conditioning system. A normally closed switch is required for this purpose (customer furnished). Two conductors from the normally closed switch must be connected to the control terminal block located within the unit electric box. Refer to the supplied electrical schematic for the specific power rating of the switch and for wiring details.

See "Remote On/Off," p. 36 for additional information on the remote on/off feature.

Outdoor Equipment

The following sections detail field power wiring required for a typical system. Additional conductors may be required depending on the options purchased with the equipment. Refer to the electrical drawing supplied with your unit for the appropriate field wiring terminations required specifically for your system.

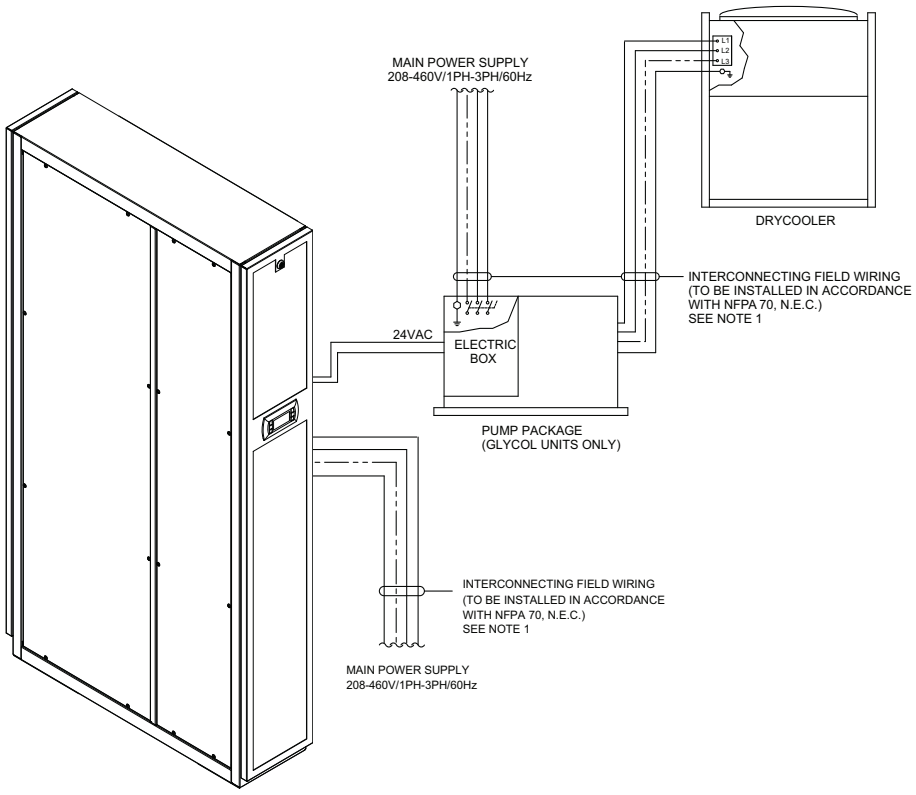
Water Cooled Systems (CRS-W Models)

Systems equipped with an internal water cooled condenser do not require field wiring to external components other than to optional sensors as selected (e.g. Flow Sensors, Remote Supply Air T/H sensor, Air Pressure, Customer Alarm Inputs).

Glycol Cooled Systems (CRS-G Models)

Glycol-cooled systems equipped with a pump package require field wiring between the A/C unit and the pump package (see Figure 13). The installer must wire two control conductors from the terminal board within the A/C unit, to the pump package electrical box. Refer to the electrical drawings supplied with your unit for the number of field wires required and for the appropriate wire terminations required for your system.

Figure 13. Interconnecting field wiring glycol systems



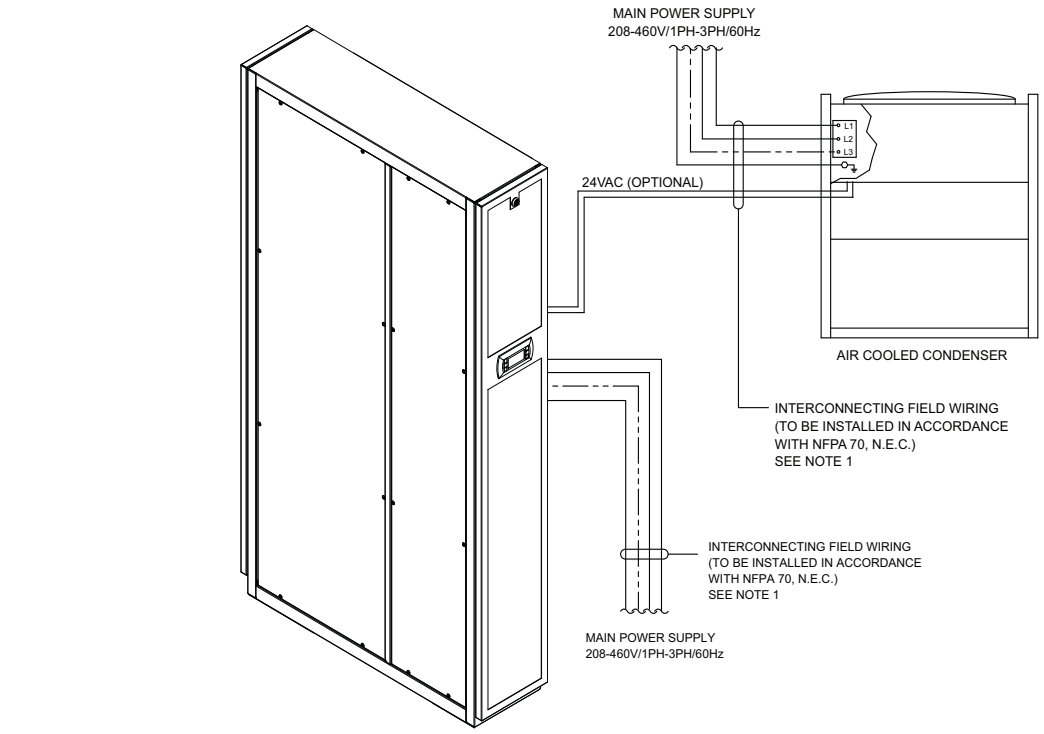
NOTE: PHANTOM WIRES (— - - -) NOT APPLICABLE FOR SINGLE PHASE POWER SUPPLIES.

Remote Condenser (CRS-A Models)

For systems equipped with a remote condenser, the installer must provide main power wiring to the main power distribution block located within the remote condenser electric box. A separate equipment ground lug is provided within the electrical box for termination of the earth ground wire. Refer to the electrical drawing supplied with your unit and the wiring diagram supplied with the condenser (typically located in the condenser electric box).

Control wires are not required between the remote condenser and the A/C system (see Figure 14, p. 21). As an option, control wiring may be installed between the A/C system and the condenser for the system controller to enable condenser operation only when the compressor is running. You must remove the jumper from the remote condenser terminal board (see the condenser wiring diagram). Wire 24 VAC control conductors from the terminal board within the A/C unit to the remote condenser terminal board. If control wires are not installed (and the jumper remains in place), the condenser is always enabled and will turn on and off based on the condensers pressure control settings. Refer to the electrical drawing for the correct number of field wires required and for the appropriate wire terminations required for your system.

Figure 14. Interconnecting field wiring remote condenser



NOTE: PHANTOM WIRES (—— – – –) NOT APPLICABLE FOR SINGLE PHASE POWER SUPPLIES.

System Charging Procedures

Water-Water/Glycol Cooled Systems

No field refrigerant charging is required for fluid cooled units. The following precautions must be observed when installing and filling the water-water/ glycol loop:

- The piping system must be cleaned prior to allowing water or water/glycol to flow through the system.
- Glycol must be mixed with water before it is added to the system. Use only water/glycol solution with inhibitors for corrosion protection.
- When filling the water-water/glycol loop all air must be bled from the piping system.

1. Open a vent valve at highest point of the system.
2. Fill the system until the solution is discharging from the vent with minimal signs of foaming due to air in the system.

Remote Air-Cooled Systems

Remote air-cooled systems are provided with a dry nitrogen holding charge which must be removed before piping and charging the unit. Before charging, check the unit nameplate to confirm the type of refrigerant to use.

Note: *Refrigerant charging must be performed by a qualified air conditioning technician.*

CyberRow systems utilize R410A refrigerant. R410A is a blended refrigerant recognized for being safer for the environment. Refrigerants that are multi-component blends have component parts with different volatilities that result in a change in composition and saturation temperature as evaporation and condensation occur. The composition of liquid R410A refrigerant however, remains relatively constant.

⚠CAUTION

System Contamination!

POE oil is used in systems with R410A refrigerant. POE oil quickly absorbs moisture when exposed to air. High POE oil moisture levels react with refrigerant to form acid, which could result in system contamination. Keep entire system sealed as much as possible and minimize exposure of POE oil to outside air.

R410A operates at high pressures which must be considered when checking the operating temperatures/pressures while charging or troubleshooting the system. Tables are provided in "Refrigerant Characteristics," p. 24 showing the temperature/ pressure characteristics for R410A.

Estimating Refrigerant Charge

When charging a system with R410A refrigerant it will be necessary to weigh in the refrigerant and confirm the charge is

correct by checking the superheat and subcooling temperatures (see “Refrigerant Charging Procedures,” p. 23).

You can estimate the amount of refrigerant required by adding the amount of refrigerant required for the A/C unit (Table 7) plus the condenser (Table 8) plus the interconnecting refrigerant piping between the A/C unit and the condenser (Table 9). The values in the tables are the estimated weights for the refrigerant circuit. Table 8 shows the estimated charge weights for vendor model SCS condensers. Depending upon site specific conditions, refrigerant may need to be added or removed when fine tuning the charge to obtain the correct superheat and sub- cooling temperatures.

Table 7. Estimated refrigerant charge weight for A/C unit

A/C Unit Model Number	Approximate R410A Charge
CRS-042- A	3.9 lbs
CRS-084- A	5.2 lbs

Table 8. Estimated refrigerant charge weight for vendor SCS condensers

SCS Model Number	R410A Charge (less receiver)	R410A Charge (with receiver)
SCS-060	2.8 lbs	12.2 lbs
SCS-096	3.6 lbs	15.7 lbs
SCS-120	5.4 lbs	23.6 lbs
SCS-192	8.2 lbs	35.9 lbs

Table 9. Weight of R410A refrigerant (lbs./100 Ft of type L tubing)

SCS Model Number	R410A Charge (less receiver)	R410A Charge (with receiver)
1/2	5.88	1.27
5/8	9.44	2.03
7/8	19.62	4.22
1 1/8	33.44	7.20
1 3/8	50.95	10.97
1 5/8	72.11	15.53
2 1/8	158.29	34.09

Example: Estimate the amount of refrigerant required for a refrigeration circuit in a system using R410A refrigerant consisting of a CRS-042-A unit connected with a 1/2 inch x 30 foot liquid line and 7/8 inch x 30 foot discharge line to a vendor Model SCS-060 condenser.

A/C Unit = **3.9 lbs**

+ 1/2 inch Liquid Line - 30 x 5.88/100 = **1.764 lbs**

+ 7/8 inch Discharge Line - 30 x 4.22/100 = **1.266 lbs**

+ Condenser= **2.8 lbs**

Estimated Refrigerant Charge = **9.73 lbs**
(Round off to nearest 0.1 lb = 9.7 lbs)

Preparing System For Charging

1. With all the system piping connections made, perform a dry nitrogen leak detection test on the system. Using dry nitrogen only, pressurize the system to 150 psig. Ensure all service and solenoid valves are energized open and that no part of the system is isolated from the pressurized nitrogen.
2. Since there is no refrigerant in the system to detect at this point, leaks may be detected by observing if there is been a change in the standing pressure after 12 hours. A significant drop in pressure (>10 psig) indicates a leak in the system that needs to be repaired. After the system is determined to be free of leaks, you may evacuate the system.

Evacuate the System

⚠CAUTION

A proper vacuum must be drawn on the refrigerant system to remove moisture prior to charging. If this is not done the refrigerant charge will combine with moisture in the pipes to form an acid that will eventually lead to compressor failure. A triple evacuation procedure with dry nitrogen is recommended especially for systems with newly installed refrigerant piping.

Note:

- *A vacuum pump should be used that is capable of evacuating the entire volume of the A/C system, including newly installed or existing piping. It is essential to use a well maintained pump that is in good operating condition. Always ensure it contains clean, fresh oil. Manufacturers recommend you change the oil in the pump regularly to maintain its ability to remove moisture.*
- *Use high quality hoses ensuring they are free of defects and do not leak. It is recommended to use copper tubing instead of hoses if possible due to the low vacuum that must be attained when evacuating the system. The use of short, large diameter hoses helps reduce evacuation time.*

3. After ensuring there are no leaks, relieve pressure and evacuate the entire system while maintaining all the solenoids open. Pull an initial vacuum of 1500 microns or lower using the suction and discharge service ports.

Note: *When pulling a vacuum, the schrader valves will unnecessarily restrict the openings, increasing the evacuation time. During the evacuation process it is recommended to remove the schrader valve cores with a schrader valve removal tool and draw the vacuum through the port on the removal tool.*

4. If you cannot evacuate the system below 1500 microns, close the vacuum pump isolation valve and perform a rate-of-rise test by observing the standing pressure over time. If the pressure rises slowly (up to 200 microns in 15

minutes) it indicates moisture is in the system that still needs to be boiled off. Proceed to Step 5. If the pressure rises rapidly up to atmospheric pressure (more than 50 microns per minute) it indicates a leak that was not detected during Step 2. In this case troubleshoot the entire system for leaks and repair them. Then begin the initial evacuation process again starting at Step 3.

5. If no leaks are detected after the initial vacuum, release the vacuum and pressurize the system with 2-3 lbs of dry nitrogen. Allow the system to stand for two hours with the dry nitrogen charge. This gives time for the nitrogen molecules to disperse in the system absorbing moisture.
6. After two hours, release the pressure. Then turn on the vacuum pump and evacuate the system a second time down to 1500 microns or less. Close the vacuum pump isolation valve and pressurize the system again with dry nitrogen and allow the system to stand for two hours as in Step 5.
7. After two hours release the pressure. Turn on the vacuum pump and complete the process of evacuating the system, this time with a goal of achieving a 250 micron vacuum or less. Close the vacuum pump isolation valve. When you can hold the vacuum at 500 microns or lower for at least 2 hours with no significant rise in pressure, the system is ready to charge.
8. Replace the schrader valve cores if you removed them during the evacuation steps. You may now introduce the refrigerant charge through the schrader valves.

Refrigerant Charging Procedures

R410A refrigerant must be weighed in when performing the charge. Referring to "Remote Water Detector," p. 19, calculate the estimated amount of refrigerant required for your system.

When charging a system using a blended refrigerant, it is essential that the composition of the refrigerant is maintained. To ensure correct composition, introduce the refrigerant (R410A) into the system in liquid

form rather than vapor form. Cylinders which are not provided with dip tubes should be inverted to allow only liquid refrigerant to charge the system. Keeping the temperature of the cylinder below 85°F will help maintain the correct refrigerant composition while the cylinder is emptied.

⚠WARNING

Confined Space Hazards!

Failure to follow instructions below could result in death or serious injury.
Do not work in confined spaces where refrigerant or other hazardous, toxic, or flammable gas may be leaking. Refrigerant or other gases could displace available oxygen to breathe, causing possible asphyxiation or other serious health risks. Some gases may be flammable and/or explosive. If a leak in such spaces is detected, evacuate the area immediately and contact the proper rescue or response authority.

Initial System Charge

Follow the step by step instructions below to charge systems using R410A refrigerant. The initial charge will be performed by introducing liquid refrigerant to the discharge side of the compressor or an available liquid line port with the A/C unit turned Off.

1. Bleed air from hoses and break the vacuum by supplying liquid refrigerant (R410A) to the discharge port near the compressor until the pressure is equalized. This holding charge allows the low pressure switch to hold enabling the compressor to operate throughout the process of charging the system.

Fine Tuning System Charge

Once the initial charge is completed, refrigerant will need to be added with the unit running.

Important: *An adequate heat load must be supplied to ensure a proper charge.*

2. Disconnect the refrigerant cylinder from the discharge side of the compressor and connect it to the suction side.
3. Referring to "Start-up/Commissioning," p. 26, start the A/C system and use the system controller to lower the room temperature setpoint 3-5°F below actual room temperature thus ensuring cooling remains on as the unit is charged.

When fine tuning the charge on cool days it may be necessary to restrict the airflow across the condenser coil to raise the pressure. The fan closest to the header must be running. When fine tuning the charge, ensure the pressures are correct for the type of refrigerant used. Refer to the tables in "Refrigerant Characteristics," p. 24 for the operating temperature and pressure ranges for R410A refrigerant.

4. Block off a portion of the intake air to the condenser until a constant discharge pressure can be obtained. This will lower the possibility of overcharging. Allow the discharge pressure to rise to 445-480 psig and hold it constant.
5. Slowly meter liquid refrigerant through the suction side while watching the pressure gauges and monitoring superheat and sub-cooling temperatures.

Note: *Add liquid refrigerant slowly to prevent the refrigerant oil from washing out of the compressor.*

6. Take a superheat temperature reading near the feeler bulb from the auxiliary control module with the temperature measuring device being well insulated. The ideal superheat temperature is 12-15°F. Maximum allowable superheat temperature is 20°F.

NOTICE

Compressor Failure!

Failure to follow instruction below could result in compressor failure.
Do not exceed 20ºF superheat.

7. While monitoring the pressure, take a sub-cooling temperature reading on the output side of the condenser. The sub-cooling temperature should be 10-20°F.
8. If necessary, (slowly) add liquid refrigerant to the suction side to achieve the correct sub-cooling temperature.

Important: *Remove the blockage from the air intake of the condenser.*

9. Fill out the applicable sections of the Warranty Registration and Start-up Checklist.

-30°F Ambient Applications

Note: *For units designed for -30°F operation, a receiver is used to store the refrigerant during the time the condenser is not utilizing the extra refrigerant charge.*

1. Follow steps 1-8 in "Refrigerant Charging Procedures," p. 23. Once superheat and sub-cooling temperatures are stabilized, additional refrigerant must be added to the receiver.

Note: *It is important not to exceed 80% of the total condenser and receiver volume to allow room for expansion.*

2. A refrigerant level sight glass is located on the side of the receiver to assist the service technician in charging the air conditioning system. The proper charge can be determined by viewing the level of refrigerant in the receiver while the unit is running at an elevated discharge pressure.
3. Keep the air intake to the condenser blocked and maintain the discharge pressure at 445 psig and hold it constant. The condenser fan nearest the condenser header should be operating continuously. All other fans, if additional fans exist, should be off during this time.
4. Add additional refrigerant charge to the receiver as needed until the refrigerant level rises to the center of the sight glass, indicating the receiver is 80% filled. When the refrigerant in the receiver reaches the sight glass, the unit is fully charged.

Important: *Remove the blockage to the air intake of the condenser.*

5. Fill out the applicable sections of the Warranty Registration and Start-up Checklist.

Refrigerant Characteristics

Pressure/Temperature Settings

The following table is provided to assist with the normal settings of the system for R410A refrigerant. Where applicable, minimum and maximum settings are given along with normal operating pressures.

Table 10. R410A refrigerant pressure/Temperature settings

	Normal	Min.	Max.
Sub-cooling °F	10	5	20
Superheat °F	15	10	20
Design Condensing Temp. @ 95°F Ambient	125	105	140

Table 10. R410A refrigerant pressure/Temperature settings

	Normal	Min.	Max.
Suction Pressure (psig)-	130	105	155
Fan Cycling Control- Fan On (psig)-	440	330	480
Fan Speed Control (psig)-	440	-	-

Saturated Refrigerant Pressure

The following refrigerant temperature/pressure table is provided for reference for R410A refrigerant.

Table 11. R410A Refrigerant pressures

Temp. (°F)	Pressure (psig)
20	78.4
22	81.9
24	85.5
26	89.2
28	93.1
30	97.0
32	101
34	105
36	109
38	114
40	118
42	123
44	128
46	133
48	137
50	143
55	155
60	170
65	185
70	201
75	218
80	236
85	255
90	274
95	295
100	318
105	341
110	365
115	391
120	418
125	446
130	477
135	508
140	541

Settings and Adjustments

Water-Water/Glycol Circuit

Condensing temperature is maintained by liquid flowing through a regulating valve and then into the condenser. The regulating valve opens to increase the liquid flow as the refrigerant pressure rises (or closes as the refrigerant pressure falls). The system controller monitors a signal from a pressure transducer to determine how far to open the valve. The controller automatically changes the control valve position to

maintain head pressure based on the difference between the setpoint value and the actual measured value. The controller transmits a proportional 0 to 10 VDC signal to the regulating valve with 10 VDC corresponding to the valve opening 100%.

The system controller is factory set for the correct condensing pressure however, it can be adjusted to increase or decrease the pressure. Adjustment is made by entering the Factory menu in the E² controller. Contact vendor Product Support for a password to enter the Factory menu and for technical assistance if adjustment is necessary.

Adjustments should be made in small increments. Adequate time must be allowed between adjustments for the valve to fully respond to the control signal and for the changes in system operation to be observed.

Low/High Pressure Limit Switch

Air conditioning systems utilizing DX refrigerant are equipped with hermetically sealed high-pressure and low-pressure switches. These switches are preset by the manufacturer and cannot be adjusted. The high- pressure switch opens at 630 psig and has a manual reset. The low-pressure switch opens at 65 psig (± 10) and closes at 105 psig (± 10) and has an automatic reset.

Electronic Expansion Valve

An electronically controlled expansion valve (EEV) maintains constant superheat of the refrigerant vapor at the outlet of the evaporator by metering the flow of refrigerant into the evaporator. Superheat is the difference between the refrigerant vapor temperature and its saturation temperature at a given suction pressure. By controlling superheat, the EEV keeps nearly the entire evaporator surface active while preventing liquid refrigerant from returning to the compressor. As a standard, superheat is factory set at 12-15°F and should not need adjustment. The superheat temperature is monitored and controlled by the auxiliary control module (EVD Driver) mounted on the door of the electric box. It is recommended that vendor Product Support be contacted if adjustment is required.

NOTICE

Compressor Failure!

Failure to follow instruction below could result in compressor failure.
Do not exceed 20ºF superheat.

Hot Gas Bypass

A electronic hot gas bypass system is provided for freeze protection and capacity control. The auxiliary control module (EVD Driver) mounted on the door of the electric box manages operation of the hot gas valve. The hot gas regulator valve allows refrigerant to flow from the discharge line directly to the evaporator through an auxiliary connection downstream of the thermal expansion valve. This is used to maintain the evaporator at a minimum constant pressure as the heating load varies.

The hot gas (discharge) regulating valve is set to prevent the surface temperature of the evaporator coil from dropping below 35°F. The bypass temperature is factory set and no adjustment should be necessary. It is recommended that vendor Product Support be contacted if adjustment is required.

EC Fans

The speed of the EC fans are controlled via a 0 to 10 VDC signal from the system controller. The controller is preset by the factory for the correct fan speed configuration and should not require adjustment. If it is determined that the air flow needs adjustment, this may be done using the controllers programming menu selections. Refer to “Air Flow/Fan Speed Control,” p. 35 for instructions on adjusting airflow using the system controller. It is recommended that vendor Product Support be contacted when initially making adjustments to the controller.

Start-up/Commissioning

Initial Operation

For new installations, ensure the unit is ready to operate by going through the Checklist for Completed Installation, located in Appendix A, prior to start-up.

Note: *A Warranty Registration and Start-up Checklist is provided in the unit data package. It should be completed during start-up and sent to vendor. This checklist should be used as a guideline for items that need to be confirmed during start-up.*

Start-up must be performed by a journeyman, refrigeration mechanic or an air conditioning technician.

Step by Step Start-up Instructions

1. Replace all equipment removed prior to performing the start-up checks.
2. Turn the system on with the service disconnect switch. Upon applying power to the controller it begins an initialization sequence, conducting internal diagnostics to confirm functionality (see "System Operation," p. 31).
3. After about 30 seconds the Main screen is displayed (see Figure 15). At the bottom of the screen a status message Unit On appears.

Figure 15. Main Display Screen

Note: *You may turn the A/C unit on and off at anytime by pressing and holding the Enter key for 3 seconds.*

4. After Unit On appears, the fans begin operating in 5 second, time delayed stages (adjustable). The middle fan is turned on 1st, then the upper fan, then the lower fan. The vendor logo in the display is replaced with a blower symbol.
5. A 45 second time delay is allowed after the first fan turns on before the controller polls the air proving switch. If adequate air flow is detected, the controller enables its outputs. If the actual room conditions are not within the range of the programmed setpoints, the system will begin operating in the required mode(s) (cooling, dehumidifying) to reach the setpoints. Symbols appear in the display to indicate the active operating modes (see "System Operation," p. 31).
6. Temperature and humidity alarms are masked out for 30 minutes to allow for conditions to stabilize without triggering nuisance alarms.
7. Ensure that all fans are rotating correctly and freely without any unusual noise.
8. Test cooling operation by decreasing the temperature setpoint (see "Setpoint Values," p. 37) to create a demand for cooling. The compressor will turn on and the supply air should feel cooler than the return air.

In all cases, 1 to 6 hours might be required to see the desired temperature and humidity level in the conditioned space. Once room conditions have been programmed or set, a repeat visit to the conditioned space may be required to ensure the system is meeting the rooms requirements.

Microprocessor Controller Programming

The E² microprocessor controller is factory programmed based on the features selected with the system. A user provided BMS may be used to directly interface to the E² controller. The operator may view all the available menu screens through a BMS, however, changes may be made only to basic parameters such as adjusting setpoints and setting and acknowledging alarms. More advanced parameter adjustments may be made through the user interface display (see Figure 16, p. 27). Operating instructions for the E² controller are provided in "E² Controller," p. 27.

E² Controller

General

The advanced microprocessor based, E² Series controller is a highly versatile and flexible A/C system controller. It is designed primarily for vendor Precision Air Conditioners. The controller is equipped with flexible software capable of meeting the specific needs of the application. The controller is completely programmed at the factory and therefore, most applications will require no field set up. However, the default setpoints and their ranges are easily viewed and adjusted from the user interface display. The program and operating parameters are permanently stored on FLASH-MEMORY in case of power failure.

The E² Series controller is designed to manage temperature and humidity levels to user defined setpoints via control output signals to the A/C system. Control parameters have variable outputs from 0 to 100% of the full rated capacity. The controller continually receives inputs for the measurable control conditions (temperature and relative humidity) via sensors installed in the cabinet. The internal logic determines if the conditions require cooling or dehumidification. Control setpoints are established to maintain the rooms designed conditions. The controller responds accordingly to changes and controls the output(s) to the air conditioning system so temperature/humidity conditions reach the user defined control setpoints.

Features

Field Configurable

The program for the E² Series controller is field configurable, allowing the operator the capability of selecting control parameters and setpoints specific to the application. Operator interface for the E² controller is provided via an attractive, door mounted user interface display panel. The display panel has a backlit LCD graphical display and function keys giving the user complete control and monitoring capability of the precision cooling system. The menu driven interface provides users the ability to scroll through and enter various menu loops. Monitoring of room conditions and A/C system operation is allowed without entering a password. Modifications to the control setpoints require the use of a password.

Password Protection

Access to the Info menu and Alarms log is allowed without the use of a password. The controller is programmed to recognize predetermined security levels before allowing access to display screens containing critical variables.

Three secured menu levels (Control, Service and Factory) support unique passwords that must be entered to access the menu screens so only authorized personnel may perform modifications to the settings.

Restorable Setpoint Parameters

Upon initial start-up the A/C system operates using the setpoints programmed by the factory. The customer may enter new operating parameters in the Control and Service menus and the system will then operate accordingly.

The new setpoints may be stored as Customer Default setpoints. The primary setpoints entered by the factory still remain stored in the controllers memory as Factory setpoints.

The setpoints for the system may be re-adjusted in the Control menu at any time. If it becomes necessary, the customer may restore the setpoints back to the Customer Default setpoint values or to the original Factory (primary) setpoint values in the Service menu (see “Save Configuration,” p. 48).

A/C Grouping pLAN Operation

Multiple A/C system controllers can be connected (grouped) to a pLAN local network, allowing the communication of data and information from each controller to a central control terminal or Lead controller. The Lead controller display screens can be used to monitor and adjust group control variables for the individual system controllers. Each E² controller connected to the pLAN network is to be identified with its own unique address.

Multiple A/C units consisting of up to eight (8) vendor precision air conditioners equipped with like controllers may be controlled and monitored via the E² series controller. With multiple A/C units each unit can selectively be configured as Active to operate as a primary A/C, Capacity Assist for staged operation or as Standby to come online in case of a failed air conditioning unit to ensure continuous availability.

The controller may also be configured to rotate units with timed duty cycling to promote equal run-time and assure that each A/C unit within the rotating group is operationally exercised on a periodic timed basis.

User Interface Display Panel

Your unit is equipped with an interface display panel typically mounted on the front panel of the A/C unit.

Figure 16. User interface display panel

The user interface display panel features an easy to read, backlit liquid-crystal alphanumeric display equipped with LED illuminated function keys. The screens that appear on the user

interface display panel present data that originates from the controller I/O module (Figure 16, p. 27). The controller is operated via a 6-key menu-driven loop structure and offers an alarm log plus four different interface menu levels to the operator; Information, Control, Service, and Factory. These menus permit the user to easily view, control and configure operating parameters for the A/C unit. (see Figure 19, p. 29.)

Function Keys

Table 12. Function keys

Key	Function
	Accesses the active alarm screen(s) Silences audible alarms Resets active alarms in the alarm menu
Prg	Accesses the main menu Illuminates yellow when unit is on
Esc	Returns to the previous menu level Cancels a changed entry
	Steps to the next screen in the display menu Increases the value of a modifiable numeric field
	Starts/Stops system operation Accepts current value of a modifiable field Advances the cursor to the next active alarm screen
	Steps back to the previous screen in display menu Decreases the value of a modifiable numeric field

Contrast Adjustment

Press and hold the Alarm and **(Prg)** keys; then use the Up and Down keys to adjust the contrast.

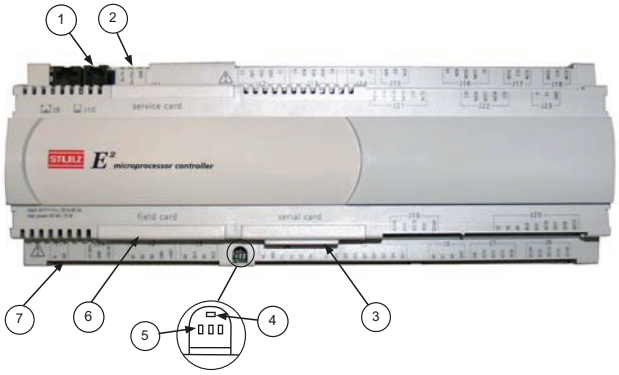
Alarms

Alarm conditions activate a red LED indicator that backlights the alarm function key. As an option, an alarm condition may also be enunciated by an audible alarm signal. An alarm is acknowledged by pressing the alarm key. This calls up alarm display screen(s) that provide a text message detailing the alarm condition(s). After an alarm condition is corrected, the alarm can be cleared by pressing the alarm key.

Controller I/O Module

The controller is a microprocessor based I/O module mounted inside the A/C system electric box (see Figure 17, p. 28). The controller I/O module contains the software that manages the operating parameters of the A/C system.

Figure 17. Controller I/O module



Controller I/O Module Layout

The controller I/O module contains the logic and input/ output terminals. See Figure 11 for details of the controller I/O module layout. The item numbers that follow coincide with the call-outs in Figure 17.

1. Connection (J10) for interface display panel
2. Connection for pLAN (J11)
3. Hatch for BMS or network card
4. Power on LED (Yellow)
5. Signal LEDs (Red, Yellow, Green)
6. Hatch for expansion I/O module(s)
7. Power connector (J1)

BMS Interface

The E² series controller may incorporate a BMS network card equipped with a communication port (Figure 18). This can be field connected through a serial interface to a Building Management System via Modbus, BACnet, SNMP or HTTP protocol as configured by the factory. A controller interfaced to a network must be configured for BMS communication.

Figure 18. BMS interface ports

BACnet MS/TP

Modbus RTU

BACnet IP, BACnet Ethernet, HTTP, SNMP, and Modbus IP

Navigating Controller Display Screens

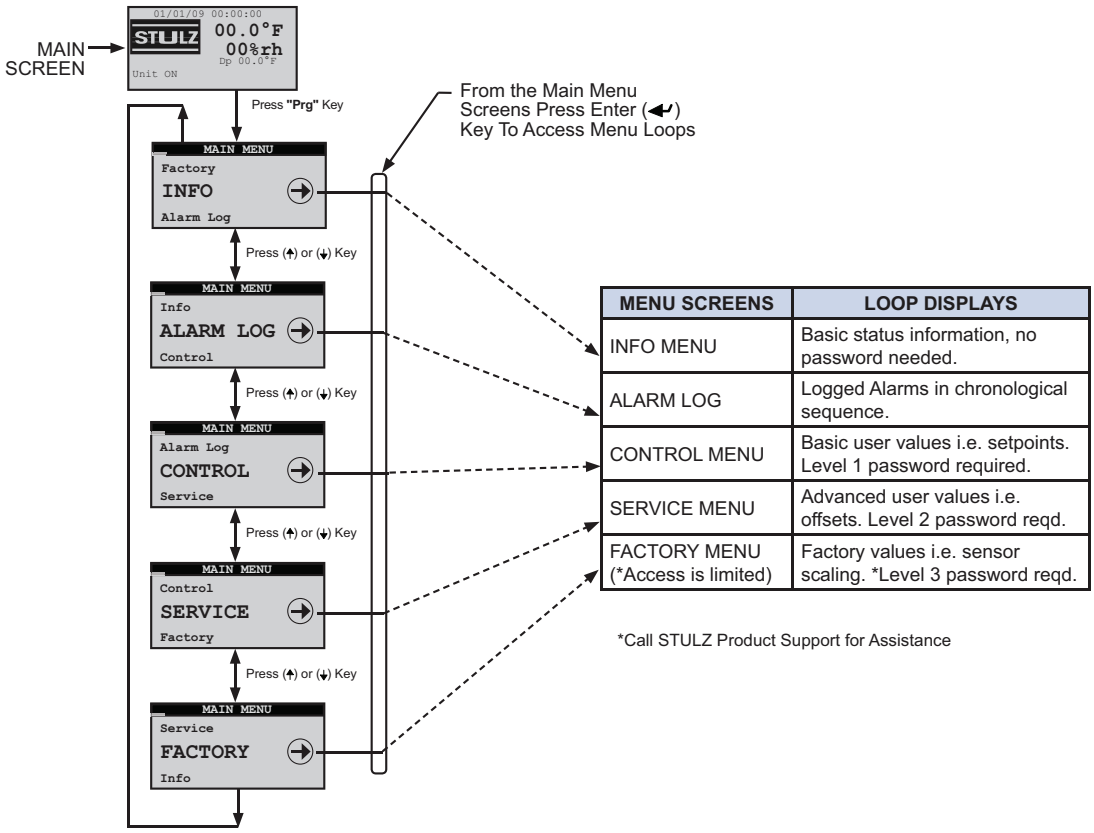
Menu selection

The E² Series controller provides five user selectable menus necessary to view operating data and enter setpoints for the system (see Figure 19). These menus may be accessed from a scrolling Main Menu screen by pressing the Program **(Prg)** key. You are then allowed to scroll between adjacent menu selections within the Main Menu by use of the Up and Down arrow keys. When the desired menu is centered in the screen with bold capital letters and an arrow ⊕ symbol pointing towards the Enter key, you may press the Enter key to access that menu loop. The user can access the menu loop screens located within the designated menu selection using the Up and Down arrow keys. Access to some menus may be protected by a built in security protocol and may require the use of a password to gain access.

Menus

From the Main screen you may press the Program **(Prg)** key to select from among the five menus shown in Figure 19.

Figure 19. Menu selections



MENU SCREENS	LOOP DISPLAYS
INFO MENU	Basic status information, no password needed.
ALARM LOG	Logged Alarms in chronological sequence.
CONTROL MENU	Basic user values i.e. setpoints. Level 1 password required.
SERVICE MENU	Advanced user values i.e. offsets. Level 2 password reqd.
FACTORY MENU (*Access is limited)	Factory values i.e. sensor scaling. *Level 3 password reqd.

*Call STULZ Product Support for Assistance

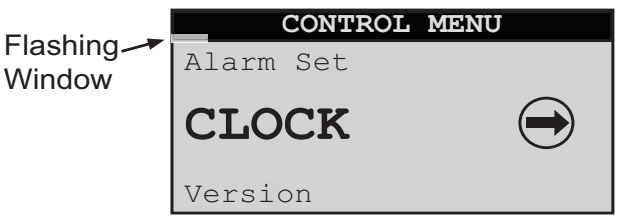
Display Variables

The user interface display panel provides screens with three (3) different forms of both the read only and the modifiable variables:

- Numbers are displayed as positive (+) or negative (-) integers.
- Dual-State can be toggled between two (2) values i.e. On/Off, Yes/No.
- Word Variables have a unique text message for each of the variables possible choices.

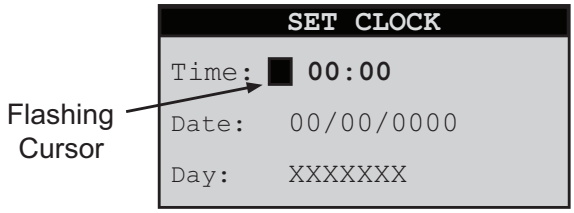
Cursor Position in Screens

The following display screen is shown as an example after accessing a new menu loop display screen using the function keys. The name of the menu loop is the line in the upper-most field of the screen. A flashing window also appears in the left of the uppermost field indicating you are in the top level of that menu loop.



From this position the Up and Down arrow keys may be used to access additional selections within the current display menu.

Each screen supports a specific functional requirement. Pressing the Enter key allows you access to the selected display screens to adjust any of the modifiable fields. If a screen with modifiable values is accessed, you may use the Enter key to insert a flashing cursor in the modifiable fields within that screen.

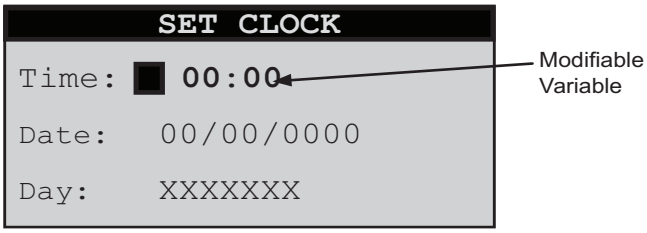


If the flashing cursor is located in a modifiable field, the value of the field will be changed with the use of the Up and Down arrow keys. When the Enter key is pressed the cursor moves to the next modifiable field. After entering the last modifiable field within a screen, pressing the Enter key removes the cursor and the flashing window reappears in the left-hand corner of the upper-most field of the current screen. From here advancement to the next adjacent menu loop screen will occur when the Up or Down key is pressed. Successive use of the Enter key will advance the cursor through the various modifiable fields of the display screen eventually returning to the first field.

Values that are already correct may simply be skipped over by using the Enter key without modification of the variable. The current value, if not changed, will be retained after pressing the Enter key. Values for fields being adjusted will automatically wrap when adjusted beyond the high or low limit established for that field.

Whenever the flashing cursor is located in a modifiable field, pressing the Escape (Esc) key one time returns the user to the next menu up. Each successive use of the Escape key returns you to the next menu level up until the Main screen is reached.

Modifiable Variables



For the purpose of this manual the examples of user modifiable variables within display screens will be denoted by bold text. (Please note the actual display may not use bold text.) Pressing the Enter key accepts the value displayed and advances the cursor to the next modifiable field. The Up or Down key may be used to modify the values of these fields.

If the modifiable field is a positive (+) number, the positive value is indicated by the absence of a (+) or (-) symbol.

The (-) negative symbol will be displayed to the left of the first digit for negative numbers.

Password Authorization Levels

Access to a menu loop may be requested from the main menu. Modifiable control screens have variables that affect system performance. Improper settings may result in erratic operation and possible system failure or damage. Anyone is allowed direct access to the Info and Alarm log display menus with no security password.

Only authorized personnel who possess a thorough understanding of the system operation should perform modifications to secured menu settings (Control, Service and Factory). These menus are configured with password protection, thus requiring a higher level of authority to access them. The screens must have accurate variables entered otherwise erratic operation may occur.

Password Protected Screens

Upon first attempting to select a secure menu in a given session, the Enter Password screen will be displayed. This screen displays the current security level authorized.

A session is defined as from the time access is gained to a secure menu until 60 seconds elapses with no key activity. Security access will be terminated at this point and the password will have to be re-entered to gain access. The menus that may be password protected by the user are the Control and Service menus. The Factory level menu screens are also password protected, however the password is set at the factory to limit access.

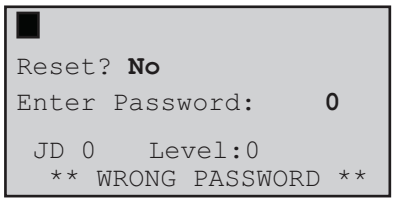
It is intended that access to the Factory menu screens only be granted while the user is working with the guidance of vendor Product Support (see “Product Support,” p. 69) because incorrect settings made at that level could unintentionally damage the equipment. The Access ID Code in the bottom left of the Enter Password screen is required when contacting Product Support to determine the correct Factory menu password for your specific controller.

The level of authority is established by entering the proper password for a given security level. The controller is shipped from the factory with preset passwords for all of the security levels.

Operators who are allowed access to the Service menu (level 2) for example, must know the password to enter that level. If the entered password equals or exceeds the level requested during a given session, the operator is allowed to access the requested loop. For example, if the entered password allows access to level 2 and the Control menu (level 1) is requested, access will be allowed. If the entered password authority level

is lower than the level requested, the words WRONG PASSWORD will appear for several seconds at the bottom of the screen.

Wrong Password



The WRONG PASSWORD message is displayed any time an incorrect password has been entered and the Enter key has been pressed. If the Wrong Password message appears, pressing the Enter key will return the operator to the **Enter Password** field.

A requested menu screen is displayed any time a valid password has been entered and the Enter key is pressed.

Note: *If you request the Control menu and enter the Service menu password, you are granted access to both.*

Setting the Passwords

The initial passwords are set by the factory to 0001 for the Control menu (Level 1) and to 0002 for the Service menu (Level 2). Upon entering the Service>Save Cfg menu, the operator is allowed to change the passwords for the menus. If changed, from that point on access may only be gained to that menu by personnel who know the password.

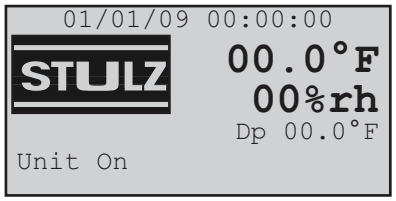
System Operation

Important: *Ensure all system hookups to the air conditioner(s) are completed and that power is available.*

1. Turn the main power disconnect switch for the A/C unit to On. Upon applying control power, the controller display function keys illuminate and the controller begins conducting internal diagnostics to confirm functionality. The controller monitors the alarm inputs and alarm logic to determine if it is safe to start the unit. After an initialization period of about 30 seconds the Main screen is displayed.

   The Main Screen is a status screen displaying the current date and time. It displays the current control temperature and relative humidity and the current temperature and dew point as calculated from the T/H sensor. It also displays the current system operating mode(s).

2. If the controller is configured for Automatic On operation (standard), a status message Unit On then appears in the display. If the controller is configured for Automatic On operation (standard), a status message Unit On then appears in the display.



3. If the status message OFF-Manual Restart Req appears instead of Unit On, the Automatic On feature may not be enabled. In this case turn the air conditioner on by pressing the Enter key.

Note: *You may turn the A/C unit on and off at anytime by pressing and holding the Enter key for 3 seconds.*

   Other status messages that may appear at the bottom of the screen are:

   OFF by remote shutdown - Indicates the Remote Start/Stop feature is enabled and requires a remote start switch to be turned On.

   OFF by Network - Indicates the unit is part of a group and is off due to a grouping priority command such as a compressor alarm or loss of airflow

   or,

   the BMS communication feature is enabled and the unit received a network signal to pause operation.

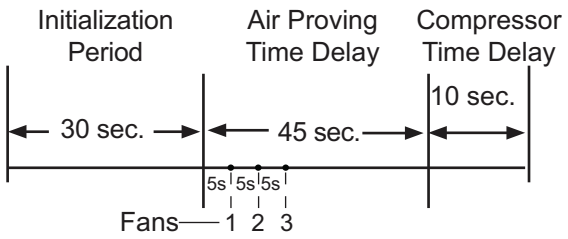
   OFF by Internal Alarm - Unit is off due to a group alarm condition. (Only active with grouped units.)

   Unit on CL Lockout - This indicates cooling has been locked out while there is a demand for dehumidification because the temperature is below the minimum temperature allowable for dehumidification (factory default setting is 4°F below setpoint).

4. After the initialization period expires, the controller enables the control output to the fluid control valve (CRS-W and CRS-G units) and the fans are allowed to begin operating.

5. The vendor logo in the display is replaced with a blower symbol. The fans begin operating in stages with five second time delays. The middle fan starts first, then the upper fan, then the lower fan.

6. Following a 45 second time delay (after the first fan turns on) the controller polls the air proving switch. If adequate airflow is detected, the controller enables the compressor to turn on if there is a demand for cooling or dehumidification as defined by the control setpoints.



7. The controller records the date and time power is re-initialized in the alarm history log.

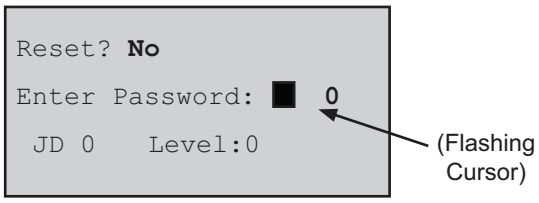
8. If the actual room conditions are not within the range of the programmed setpoints, the system will begin operating in the mode(s) required to reach the setpoints (cooling or dehumidifying). Symbols (shown below) appear in the display to indicate the active operating modes.

	Blower On
	Call For Cooling
	Dehumidifying

9. Temperature and humidity alarms are masked out for 30 minutes to allow for conditions to stabilize without triggering nuisance alarms.
10. Operator interface to the menu loops is available from the Main screen by pressing the Program **(Prg)** key. The controller starts a timer whenever a key sequence is initiated. Every time a button is pressed, the timer is reset. If there is no key activity for 60 seconds, the controller will return to the Main screen unless the Screen Lock feature is enabled in the Information menu loop (see page 4-16).

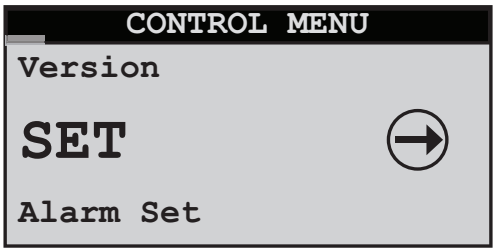
Setpoint Adjustment

1. From the Main screen, access the Main Menu screen by pressing the program **(Prg)** key.
2. Scroll through the Main Menu selections with the Up and Down arrow keys and select the Control menu by pressing the Enter key when CONTROL appears in bold letters in the center of the screen. A password entry screen will be displayed.
3. To access the Control menu, press the Enter key twice to insert a flashing cursor in the Enter Password field.

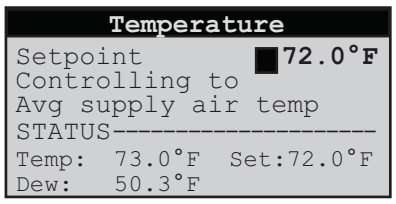


Change the 0 to 1 (or to the current Control menu password if it was changed in the Service menu) with the Up arrow key and then press the Enter key to accept the password. Press the Enter key again to access the Control menu screens.

4. From the Control menu, select Setpoints by scrolling through the menu selections with the Up and Down arrow keys and pressing the Enter key when SET appears in bold capital letters in the center of the screen.

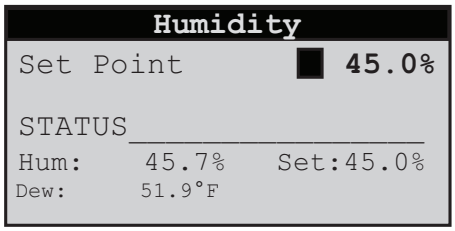


5. After entering the Setpoints screens, select the Temperature setpoint screen by scrolling the menu selections with the Up and Down arrow keys until the word Temperature appears in the field at the top of the screen.



Pressing the Enter key places the flashing cursor in the setpoint value field. Increase or decrease the Temperature Setpoint with the Up and Down arrow keys until the desired temperature value is shown. Press the Enter key again to accept the setpoint (this removes the cursor from the field).

6. From the Temperature setpoint screen, select the Humidity Setpoint screen by scrolling with the Up or Down arrow key. When the word Humidity appears in the field at the top of the screen, press the Enter key to move the cursor into the setpoint value field.



Increase or decrease the Humidity Setpoint with the Up and Down arrow keys until the desired humidity value is shown. Press the Enter key again to accept the setpoint and then press the Escape key to return to the Setpoints (SET) Control menu screen.

7. Press the Escape **(Esc)** key twice to exit the Control>Setpoints screens and return to the Main Menu screen.
8. Observe the indicator symbols in the Main screen to determine if the unit is operating in the required mode(s).
9. One to six hours may be required to see the desired temperature/humidity level in the conditioned space. Once room conditions have been programmed or set, a repeat visit to the conditioned site may be required to ensure the air conditioner is meeting the rooms requirements.

Saving and Restoring Setpoint Parameters

Upon initial start-up the A/C system operates using the setpoints programmed by the factory (primary setpoints) as the operating setpoints. As described in “Setpoint Adjustment,” p. 32, the customer may enter new operating parameters in the Control menu anytime and the system will then operate accordingly. The customer may store the new setpoints in the Service menu if it is intended to save them. Once stored, the Customer setpoints now become the operating setpoints. The primary setpoints entered by the factory still remain stored in the controllers memory as the Factory setpoints.

At any time, setpoints for the system may be re-adjusted to any value and the system will operate accordingly. If it becomes necessary however, the customer may enter the Service menu and restore the setpoints to the stored Customer operating setpoint values. The original Factory (primary) setpoint values may also be restored from the Service menu. Whichever setpoints are restored (Factory or Customer), become the current operating setpoints.

Alarms

As programmed into the system controller, an alarm condition activates the summary alarm logic which illuminates the alarm key and energizes an audible alarm. Some alarms are programmed by the factory to automatically shut down the A/C unit until the alarm condition is remedied and the alarm is cleared by pressing the alarm key. Some of the alarms that may be enabled by the factory are listed in “Alarm Log Menu,” p. 39.

Summary Alarm

A summary alarm will activate when the controller senses any programmed alarm condition. This illuminates the alarm key and if the option is selected, a N.O./N.C. summary alarm contact may be energized for remote monitoring of alarm conditions. If certain critical summary alarm conditions are detected, they will cause the A/C unit to shutdown.

Customer Alarms

A customer provided digital (on/off switching) alarm sensor may be connected to terminals provided in the electric box. This alarm input may be for any site specific alarm condition the user wishes to monitor that may or may not be provided in the standard controller alarms menu; i.e. Gas Detection, Intrusion Alarm, etc. Upon detection of a customer alarm, the controller will activate the summary alarm contact and display a screen mes- sage indicating a customer alarm message. The screen message Customer Alarm 1 (default) will appear in the controller display or the user may reconfigure the controller to display any alpha-numeric message desired, up to 20 characters long, in the Service>Options>Custom menu loop (see “Customer Alarm Input (Optional),” p. 46).

Custom Alarms

A custom (user configured) alarm is activated upon detection of one or more programmed alarm conditions as set by the operator in the Service>Options>Custom menu loop (see “Custom Alarm Setup (Optional),” p. 46). When a custom alarm condition is detected, a summary alarm is signaled and a designated set of N.O. and N.C. Custom Alarm relay contacts may be energized to provide remote indication of the specific alarm condition(s).

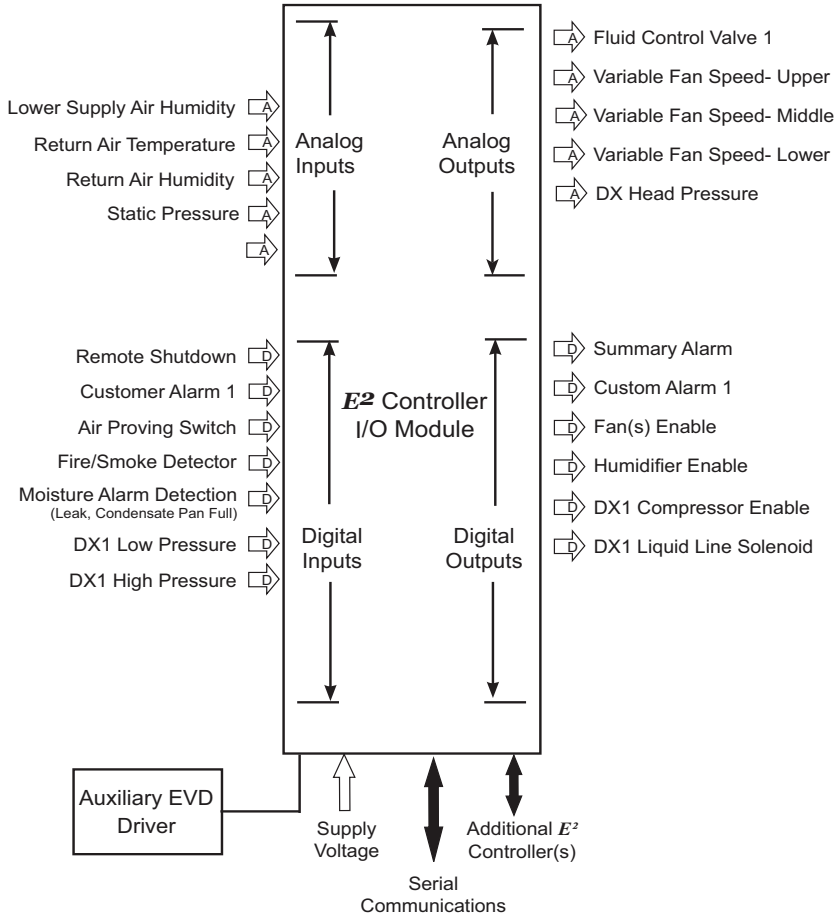
For example you may want to be notified when a change filter alarm is annunciated, giving notice that the air filters need to be cleaned or replaced. That way you are alerted before the filters are so badly clogged that airflow is reduced to a point where a Loss of airflow alarm is activated.

Controller operation

The E² Series controller is designed to control an air conditioning system in a space or process application to temperature and humidity levels as defined by the user. Conditioned air is supplied to the space as needed to maintain the temperature/humidity control setpoints.

The controller I/O module includes inputs and outputs as depicted in Figure 20, p. 34. Not all the inputs and outputs shown below are utilized, therefore, only the inputs/outputs required for the specific A/C system type and application are enabled.

Figure 20. Control inputs and outputs



The E² controller continually analyzes the demand for cooling, humidifying and dehumidifying against the control setpoints and determines the appropriate response (control output signals) to operate the A/C system. The controller is equipped with analog input positions for monitoring temperature and humidity sensor(s). The controller monitors the actual cold aisle supply air conditions for three fan zones (upper, middle and lower) as measured by temperature sensors mounted locally to each zone inside the CyberRow cabinet. The controller also monitors a temperature/ humidity (T/H) sensor which is mounted in the return (hot aisle) side of the cabinet.

A remote mounted supply air T/H sensor may also be provided as an option. The controller may be configured by the factory to manage system operation based on the remote T/H sensor inputs which is to be field installed in the supply (cold aisle) space.

Control Signals

Control output signals and alarm recognition takes place by means of the controller analyzing signal inputs from the sensor(s) and developing the appropriate digital or proportional response.

On/Off Digital Control

Based on control inputs, the controller provides an on/off output signal to activate certain modes of operation for the air conditioner (i.e. humidifier, fans, or annunciate an operating condition status i.e. alarm condition).

Proportional/Integral (P/I) Control

The controller calculates proportional control output signal(s) based on the analysis of input signals which then determines the air conditioners required mode(s) of operation. Signals representing temperature and humidity are each compared by the controller as a percentage value to the maximum control setpoint value resulting in control output values that are directly proportional to the input signal.

The integral value is used to gradually adjust the proportional output when the calculated output does not move the process variable closer to setpoint in a given period of time. Decreasing the integral value decreases the interval for the output corrections (speeding the rate of adjustment). Increasing the integral value increases the interval for corrections (slowing the rate of adjustment).

Control Methods

System operation depends on the controllers programmed operating configuration. Control takes place by means of the controller analyzing signal inputs from the supply air temperature sensors and the return air T/H sensor or optional remote mounted supply T/H sensor. The E² controller may be configured for temperature/relative humidity control (standard) or dewpoint control (optional) for cooling functions.

The control method, selected in the Factory menu, determines which sensors the controller uses to manage operation of the A/C system. You may view the method selected in the Control>Set menu, see "Setpoint Screens," p. 42.

Control Method	Control Sensor Selection
Temperature control	1. Supply air sensors
	2. Return T/H sensor
	3. Remote Supply T/H sensor

Temperature/RH Control

When enabled for temperature/RH control, the controller continuously monitors the selected combination of air temperature sensors and return T/H sensor or optional remote supply T/H sensor, as configured by the factory, to manage system operation.

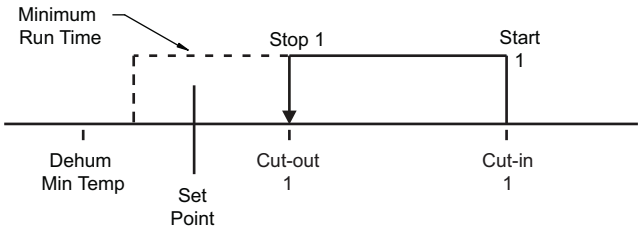
Operating Configurations

The operating configuration for the controller depends on what type of air conditioner is being controlled (i.e. AR, CW, W/G) and what features are selected. The operating configuration is preset by the factory according to the application. If certain features discussed in this manual are not factory enabled, no screens for that feature will appear in the controller user interface display.

Compressor Operation

The controller cycles the compressor on when it is determined that cooling is called for. The compressor is turned on based upon the controllers cooling response to temperature and humidity inputs from the air sensors. The compressor is enabled following a time delay, once the programmed Cooling Stage Enable setpoint value has been reached (see Figure 21, p. 35). The compressor runs at a constant speed and an electronic hot gas bypass system manages capacity in accordance with the demand for cooling. The compressor is turned off when the control cut-out setpoint is achieved, provided the minimum run time is expired. Operating setpoints for the compressor are programmed by the Factory and no adjustment should be necessary. It is recommended that vendor Technical Support be contacted if adjustment is required.

Figure 21. Compressor On/Off cycle



The cooling cut-in and cut-out setpoints are set with a minimum span of 2.0°F.

Note: *If the compressor cut-in/cut-out setpoints are set too closely together when adjusting setpoints, the compressor could run below the setpoint temperature during periods of light heat loads because of the minimum run time cycle.*

Water-W/G Operation

When the system is turned on the controller activates the fluid supply control valve with a proportional/integral (P/I), 0-10 VDC signal. The valve opens proportionally based on head pressure. The control parameters are adjustable in the Factory menu. Contact vendor Technical Support for guidance if adjustment is required.

The control valve changes position to adjust coolant flow to keep the head pressure to the control setpoint and maintain it. If the head pressure rises, the valve position continues to modulate open as needed, up to 100% (fully open), to maintain the control setpoint.

The control output signal is matched to the valve. If the valve typically opens at 2.5 VDC, the control I/O module will generate the appropriate voltage for opening the valve starting at the minimum voltage of 2.5 VDC. From there the signal increases as needed until the valve position reaches 100% open.

Air Flow/Fan Speed Control

The E² controller treats each EC fan as a variable speed fan. The controller manages the speed of each fan from a factory-set minimum up to a factory-set maximum speed. The minimum fan speed is used whenever the A/C unit has no cooling operations running. The maximum fan speed setting is used during times when the A/C unit is cooling. A dehumidification fan speed setting is used when the system is in the dehumidification mode. The speed settings are adjustable in the Service>Blower>Blower Set Up menu loop (see "Blower Set Up," p. 46).

EC fan speed is automatically varied based on temperature. There are mechanisms to trade-off the control valve opening versus fan speed. When the system enters the dehumidification mode, the fan speed automatically changes to the dehumidification speed setting.

The E² controllers software is equipped with an operational fail-safe mode. Upon sensing a temperature sensor failure, the controller signals an alarm. It continues to develop the fan control outputs by calculating the averaged value of the

remaining sensors to replace the input value of the failed sensor. If all the temperature sensors fail, the controller develops the control outputs based on the entered temperature setpoint value minus a 3°F temperature offset. This allows the CyberRow system to continue operating while the cause of the problem is corrected.

The controller continually monitors fan operation. CyberRow CRS-042 and CRS-084 units are equipped with a pneumatic air proving system connected to a flow switch that detects the loss of airflow when a fan fails to operate.

If one of the fans fails to operate, the controller alerts the operator with an alarm message and increases the speed of the remaining two fans to 99.9% to compensate for the loss of air flow. If the fault does not clear, the fans shut down for 5 seconds and then restart. If the fault continues, the fans reset a second time. If the fault does not clear after the second reset the fan(s) which generated the fault are shut down and the remaining fans continue operation at 99.9% speed.

In the event of a BMS monitoring/control signal failure, the E² controller will default to local operation at the current setpoints for the fans. The local sensors have priority over the BMS system.

Manual Speed Control

The controller continually controls the speed of each fan to values manually entered in the system controller Control>Set>Fan Control menu loop ("Setpoint Screens," p. 42) without regard to the temperature setpoint.

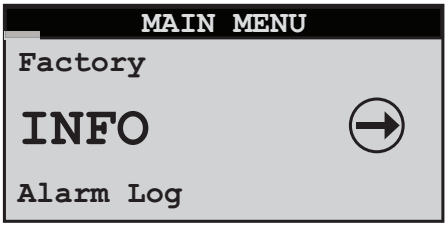
Remote On/Off

For Remote On/Off operation, terminal positions are provided to connect a remotely located, On/Off switching control device. If the A/C unit is turned on and the E² controller receives a remote input signal to turn off the A/C unit, the controller disables all control outputs and a message Off by Remote Shutdown appears in the main display screen. The A/C system will automatically be reenabled when the remote On/Off signal calls for the A/C unit to turn back on.

The control device may be an On/Off switch, thermostat or a humidistat. If customer provided, the remote On/Off control contacts must be sized appropriately. The Remote On/Off contacts must have a minimal rating of 24 VAC. Refer to the electrical drawing included with the A/C unit for the electrical specifications and for wiring details.

Menu Screens

Main Menu



The Main Menu is accessed from the Main screen by pressing the **Prg** key. The Main Menu screen provides a complete listing of the menu loops that are available. You may scroll through the menu categories using the Up and Down arrow keys. From the Main Menu screen you may select from among the following standard menus:

Info - Displays basic read-only status information. Allows you to monitor system operational parameters. No password is required at this level.

Alarm Log - Displays all alarms and power-ups in sequential order with a time and date stamp. No password is required at this level.

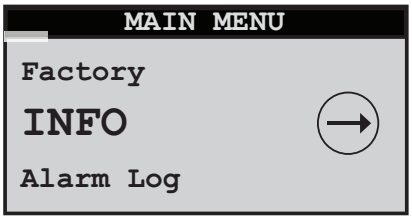
Control - Allows modification of basic control parameters such as setpoints and clock. Level 1 password is required to enter this menu.

Service - Allows modification of advanced control parameters such as offsets, blower speed, BMS set up and permits the user to save customer parameters and reset the controller to the customer or factory default values. Level 2 password is required to enter this menu.

Factory - Allows modification of more advanced control parameters such as sensor scaling, start-up delays and grouping parameters. Level 3 password is needed to enter this menu. Entry to the Factory menu is intended for qualified technicians working under the guidance of vendor Product Support during start-up and commissioning of the A/C system. The password to enter this menu may be obtained by contacting Product Support (see "Product Support," p. 69).

Information Menu Loop

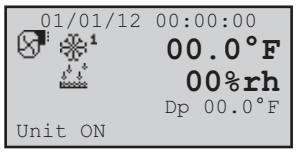
The Info menu screens may be accessed from the Main screen by simply scrolling with the Up and Down arrow keys. The same screens may also be viewed if you enter the Info menu by pressing the **Prg** key. The Info menu displays screens that provide current temperature and relative humidity conditions and shows the modes the A/C system is currently operating. There are no adjustable parameters in this loop. From the Info loop you may view the following display screens as they apply to the unit configuration:



Operating Conditions

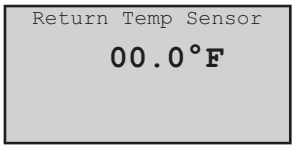
The first Info screen displays the current Date, Time and provides State of Operation icons.

The actual control temperature (°F) and relative Humidity (rh) is always displayed and dewpoint (Dp) will appear as derived from the control T/H sensor selection. The values displayed are used by the controller to develop control output signals for managing system operations.



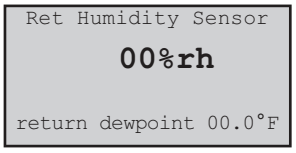
Return Temperature Sensor

Displays Relative Humidity as measured by the return temperature/humidity (T/H) sensor inputs. The return T/H sensor is typically factory mounted inside the cabinet. As an option, the return T/H sensor may be removed from the cabinet and remotely mounted in the hot aisle.



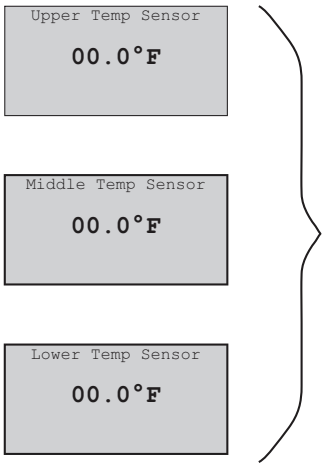
Return Humidity Sensor

Relative Humidity as measured by the return T/H sensor inputs. Return dewpoint is calculated by the controller based on the return T/H sensor inputs and then shown at the bottom of the display screen.



Temperature Sensors

The temperature screens display the supply air temperature as measured by sensors located in the cold aisle side of the CyberRow cabinet. The sensors are located within the cabinet in upper, middle and lower zones as called out in the display. Values measured by the sensors may be used to individually control the speeds of the fans.



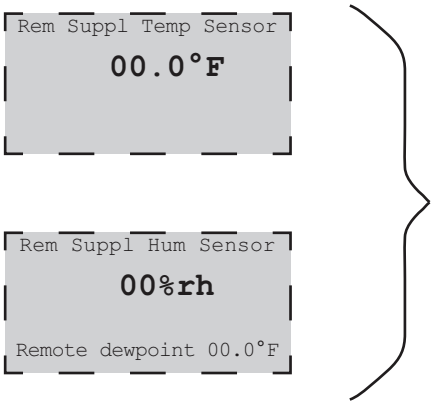
Screen Lock Feature

You may lock any of the status display screens, bypassing the display screen time-out function. This is sometimes useful to maintain visibility to a specific screen when testing, making adjustments or troubleshooting the system.

Simultaneously press the program **(Prg)** and Enter key for approximately 3 seconds to turn the screen lock feature On or Off. When a screen is locked it remains displayed unless you press the Up or Down arrow keys to select a different screen within the menu loop. A symbol appears in the upper right corner indicating the screen lock feature is On.

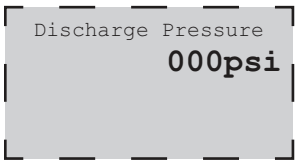
Remote Supply Temperature/Humidity Sensor

The remote temperature and humidity screens appear if your unit is configured for a remote supply T/H sensor. The screens display the supply air temperature and humidity as measured by the sensor which is to be customer installed in the cold aisle. Remote dewpoint is calculated by the controller based on the remote supply T/H sensor inputs and shown at the bottom of the display screen. Values measured by the sensor may be used to control the temperature and humidity.



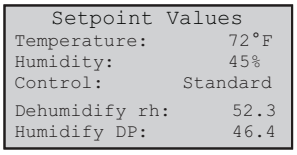
Discharge Pressure

The Discharge Pressure status screen only appears if your unit is a water or water/glycol cooled DX system. It displays the current operating head pressure. Discharge pressure is managed by the system controller based on the input of the head pressure transducer.



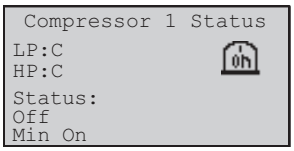
Setpoint Values

Displays the current operating Temperature and Humidity setpoints and control method. If configured for Dewpoint control, the controller displays the calculated dewpoint setpoints for dehumidification and humidification as derived from the operating temperature and humidity setpoints.



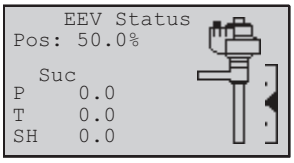
Compressor Status

Displays the status icon (On or Off) for the system compressor and shows the status of the High Pressure and Low Pressure switches (Open or Closed). It also shows the current status (On or Off) of the compressor and indicates Min On if the compressor minimum off time has elapsed. If the minimum off time has not elapsed, the display will show Min Off and the actual minimum off time will appear next to it.



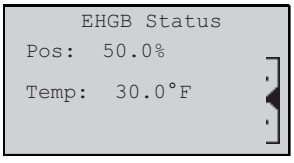
EEV Status

Displays the current operating position of the electronic expansion valve. The current suction pressure and temperature and the superheat temperature appear below. The bar gauge next to the valve icon provides a visual representation of the output signal controlling the valve position.



EHGB Status

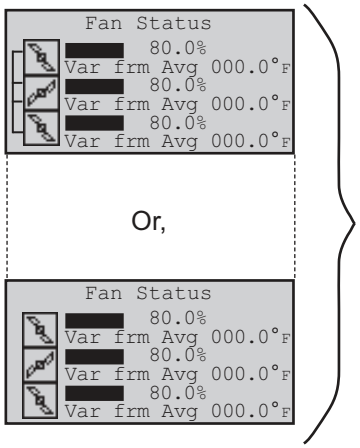
Displays the current operating position of the electronic hot gas bypass valve. The current suction temperature appears below. The bar gauge next to the valve icon provides a visual representation of the output signal controlling the valve position.



Fan Status

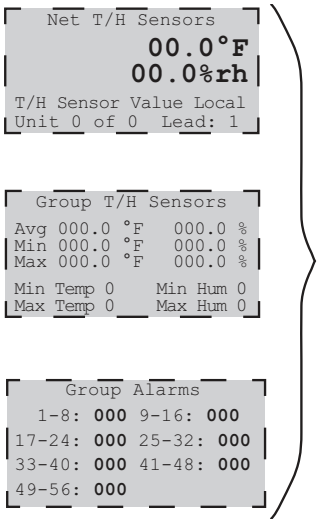
The Fan Status screen displays symbols indicating the operating status of the upper, middle and lower fans. The symbols are animated when the fans are running. If a fan is not running, the ⊠ symbol will appear instead. The value of the proportional output signal (0 to 100%) that controls each fan appears in the field to the right of each symbol. The animated icons are linked together indicating the three fans are being controlled to the same fan speed setting (default). The controller also displays the temperature value for the sensor from each fan zone. The fans may be linked or unlinked in any combination for individual zone temperature control (see "Setpoint Screens," p. 42).

The message "Var from Avg" or "Temp Prop" appears indicating the speed control configuration. The message in the field is replaced with Dehum when the system is in the dehumidification mode. In the dehumidification mode the animated icons are always inked together indicating the three fans are being controlled to the same (dehumidification) fan speed setting.



Group Information Menu Screens

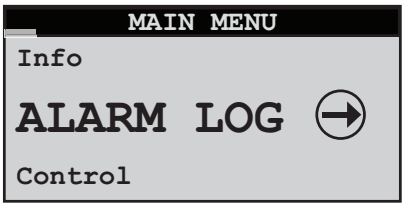
The Group Information menu screens only appear if the controller is set up to operate multiple A/C unit work group. See "Information Menu Group Menu Screens," p. 57 for a more detailed description of these screens.



Software Version/Date

Displays the type of A/C system the controller is configured for (W/G, AR), the vendor software version and its release date.

Alarm Log Menu



No password is required to view alarm display messages. If an alarm condition occurs, the first active alarm may be displayed by pressing the Alarm key. The alarm screen display text message will remain unchanged until the alarm condition is cleared.

If the alarms log is entered from the main menu, any other active alarm message(s) may be viewed by using the Up and Down arrow keys to scroll through alarm messages.

Alarms

The red LED backlight within the alarm key will illuminate any time an alarm condition is present or previous alarms existed without having been reset or cleared. An audible alarm will also activate when an alarm condition occurs. The audible alarm may be enabled or disabled in the Service>Options menu loop. The first active alarm screen may be displayed by pressing the Alarm key. The Alarm display provides you with a text message describing the abnormal operating condition. Use of the Up and Down arrow keys allows you to scroll for any additional alarm messages. Only active alarm screens will be displayed when the Alarm key is pressed. The alarm screen display will remain unchanged until the alarm condition is corrected and the alarm key is pressed again to clear the alarm.

When access is gained to the Alarm Log loop, use of the Up and Down arrow keys allows you to scroll through the log for a history of alarm messages. The alarms log may be cleared in the Service>Alarm log menu loop.

The application software supports two (2) types of alarms, Non-Critical and Critical. Any alarm may be programmed to activate the Custom (user configured) alarm relay contacts.

Non-Critical Alarms

A Non-Critical alarm will activate the alarm screen with which it is associated. These alarms are programmed to activate the Summary Fault alarm and close the Summary Fault relay contacts without stopping unit operation. Some examples of the factory programmed, Non- Critical alarms are:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- Moisture Detection
- Change Filter
- Sensor Failure
- Communication Failure

Critical Alarms

Critical Alarms will coincide with automatic shut down of the A/C unit(s) equipment as needed to prevent possible system damage. The A/C unit(s) equipment will remain shut down until the alarm condition(s) are no longer sensed and the controller has been reset. Some examples of Critical alarms are:

- No Air Flow (Air Proving Switch)
- High Head Pressure
- Low Suction Pressure
- Fire/Smoke Detection
- Off by Internal Alarm (Only for grouped systems)

Table 13. Alarm screen messages

Alarm Message	Description of Alarm Condition
High Temperature	Air temperature is above user defined alarm setpoint.
Low Temperature	Air temperature is below user defined alarm setpoint.
High Humidity	Humidity is above user defined alarm setpoint
Low Humidity	Humidity is below user defined alarm setpoint.
Sensor Failure	Sensor is disconnected or faulty. (The failed sensor is identified.)
Communication Failure	External and/or internal communication lost (BMS or pLAN).
Condensate Pan Full	Water level in condensate pan is reaching an unsafe level.
Moisture	Water sensed by any combination of a leak detector or condensate pan level switch.
Fan Failure	Upper, Middle and/or Lower fan failure.
Change Filter	Filter replacement time interval elapsed; filter needs to be replaced.
No Airflow	Insufficient airflow per air proving switch.
Smoke/Fire	An alarm condition detected by the smoke detector or firestat.

Table 13. Alarm screen messages (continued)

Alarm Message	Description of Alarm Condition
Optional Temp High Alarm	Temperature is above alarm threshold (user configurable).
Optional Temp Low Alarm	Temperature is below alarm threshold (user configurable).
High Head Pressure	Head Pressure is above user configured alarm threshold.
Low Suction Pressure	Suction Pressure is below user configured alarm threshold.
EVD Driver Offline	EEV and EHGB control driver error.

Control Menu

Control Menu Loop

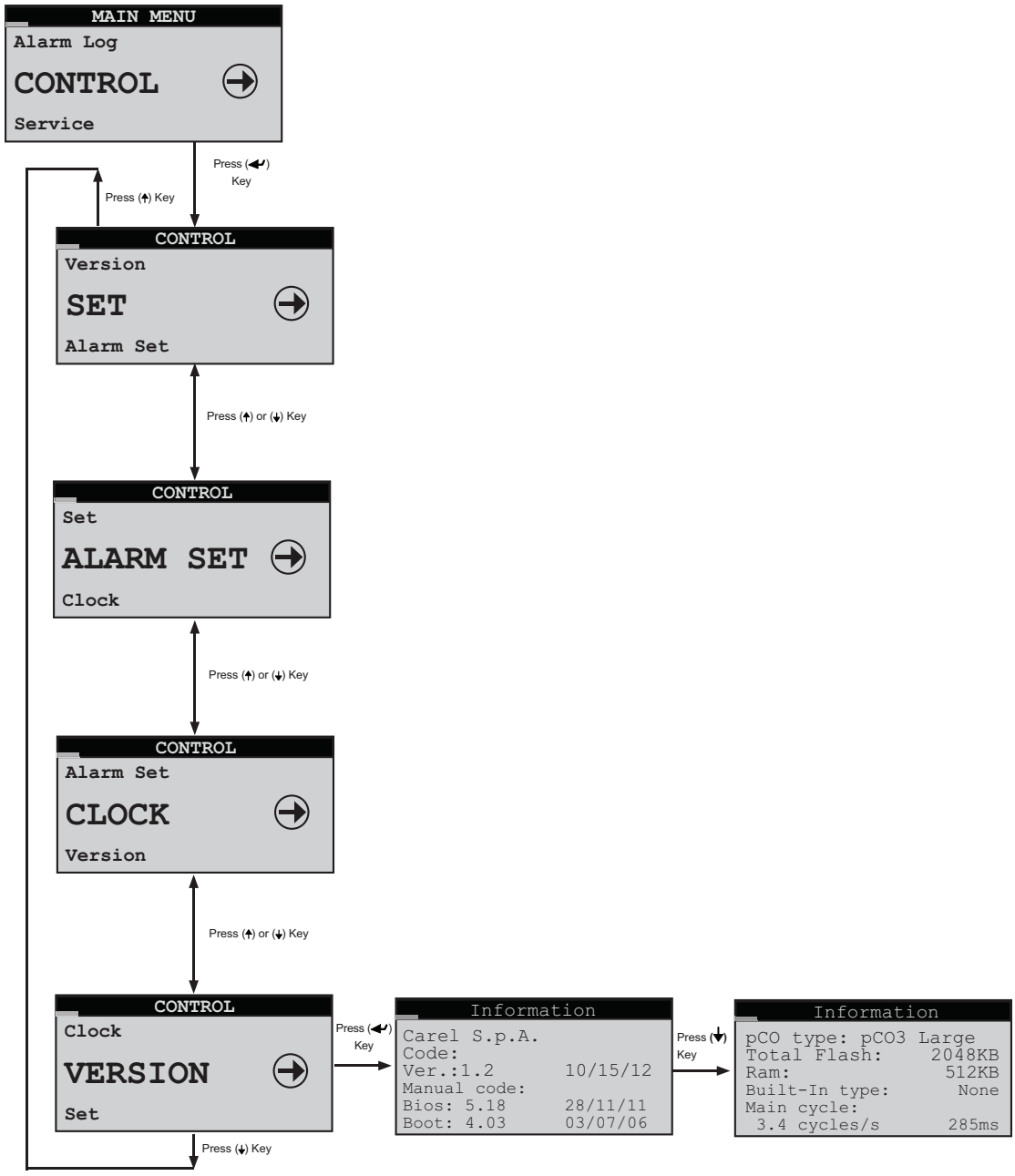
From the Control Menu you may select from 4 screen menus: Setpoints, Alarm Setpoints, Clock and Version. The controller may be programmed by the user to require level 1 password authorization to enter this menu loop (see “Password Authorization Levels,” p. 30). Once password access is granted, you may select and adjust the setpoints controlling the performance of the unit, enable alarms and determine their setpoints and set the clock.

The Setpoints (SET) screens allow you to view and adjust the temperature and humidity setpoint control parameters and compare them to system level operating data derived from the various Sensor/Transmitter inputs. See “Setpoint Screens,” p. 42.

The Alarm Setpoints (ALARM SET) screens allow you to enable and adjust the high and low temperature and humidity alarm setpoints and offsets and compare them to the control setpoints and to the system level operating data derived from the Sensor/ Transmitter inputs. See “Alarm Setpoint Screens,” p. 42.

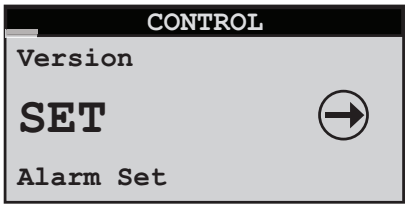
From the Clock screens you may view and adjust the current time, date and day and set up operating schedule(s) and setpoints for the A/C system. See “Clock Screen,” p. 43.

Figure 22. Control menu loop

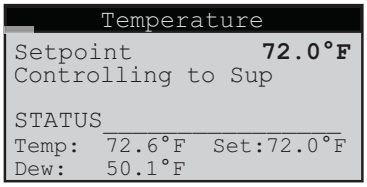


Two Version screens are provided for information only. They show controller hardware and software details that are useful to vendor Product Support if technical assistance is required.

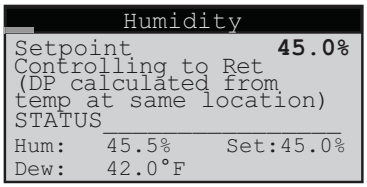
Setpoint Screens



The Setpoints (SET) screens below may be accessed from the Control menu.

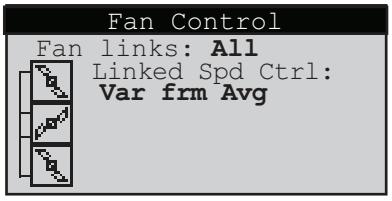


Press (↓) Key

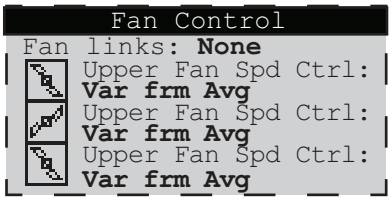


Press (↓) Key

The Temperature and Humidity setpoint screens allow you to view and adjust the control setpoints and compare them to system level operating data derived from the various Sensor/ Transmitter inputs.

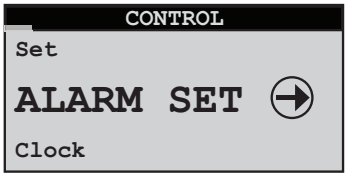


The Fan Control screen allows you to select a fan speed control method for each of the three fans. You may also link the fan temperature zones together in any combination so selected fans operate at the same speed. The linked zones use the average of the linked temperature sensors to control fan speed. Link bars appear to the left of the fan icons indicating which fan zones have been linked.

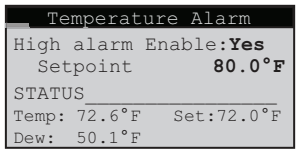


When fans are not linked, the controller adjusts the speed of each fan as necessary for that zone to meet the supply air temperature setpoint. When the system is in the dehumidification mode the fan speeds are automatically linked and controlled to the same speed.

Alarm Setpoint Screens

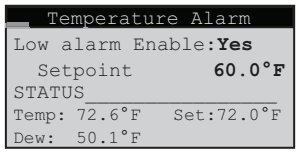


The Alarm Setpoints screens may be accessed from the Control menu. These screens allow you to enable the High and Low temperature and humidity alarms, adjust their setpoints and compare them to the control setpoints and to the current system level operating data derived from the sensor inputs.

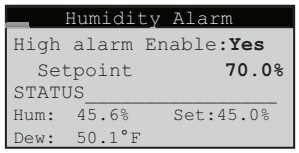


High Temperature Alarm

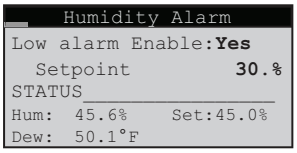
Press (↓) Key



Low Temperature Alarm



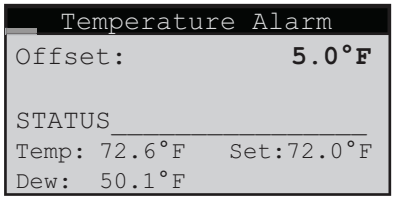
High Humidity Alarm



Low Humidity Alarm

Following the alarm enable screens are the alarm offset screens. From these screens you may adjust offsets for the high and low alarm setpoints at which the alarm will be cancelled. The entered offset applies to both the upper and lower values entered in the Alarm Setpoints Screens. The offset is subtracted when it is applied to the high alarm setpoint and it is added when it is applied to the low alarm setpoint.

Example 1: Temperature Alarm Offset



If the offset for the temperature alarm is set at 5.0°F (default), the high temperature alarm will cancel when the actual temperature drops to the High Temperature Alarm setpoint (80.0°F) - the Offset (5.0°F)

or,

80.0°F - 5.0°F = 75.0°F

The High Temperature Alarm will cancel at 75°F.

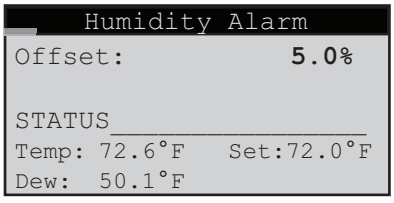
Conversely, the low temperature alarm will cancel when the actual temperature rises to the Low Temperature Alarm setpoint (60.0°F) + the Offset (5.0°F)

or,

60.0°F + 5.0°F = 65.0°F

The Low Temperature Alarm will clear at 65.0°F

Example 2: Humidity Alarm Offset



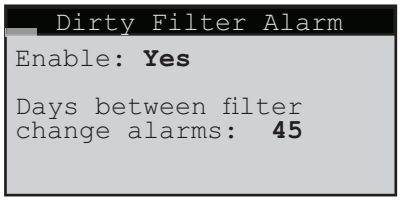
If the offset for the humidity alarm is set at 5% (default), the high humidity alarm will cancel when the actual humidity drops to the High Humidity Alarm setpoint (70.0%) - the Offset (5.0%)

or,

70.0% - 5.0% = 65.0%

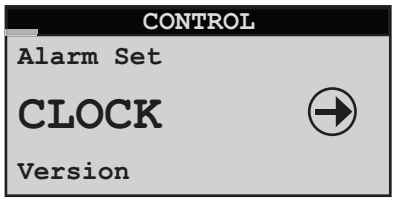
The High Humidity Alarm will cancel at 65%.

Dirty Filter Timer: :



This screen allows you to enable the dirty filter notification timer which provides an alarm indication when it is time to clean or change the air filter. The filter change period is adjustable and should be set according to the conditions at the site. Extremely dusty environments may require more frequent filter changes.

Clock Screen

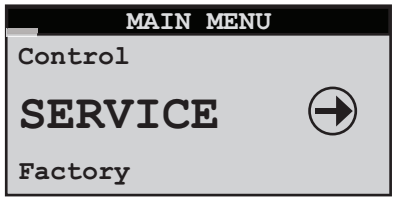


The Clock screens may be accessed from the Control menu. From this screen you may set the time, date and day.

The Set Clock screen allows you to set and/or adjust the current time, date and day.

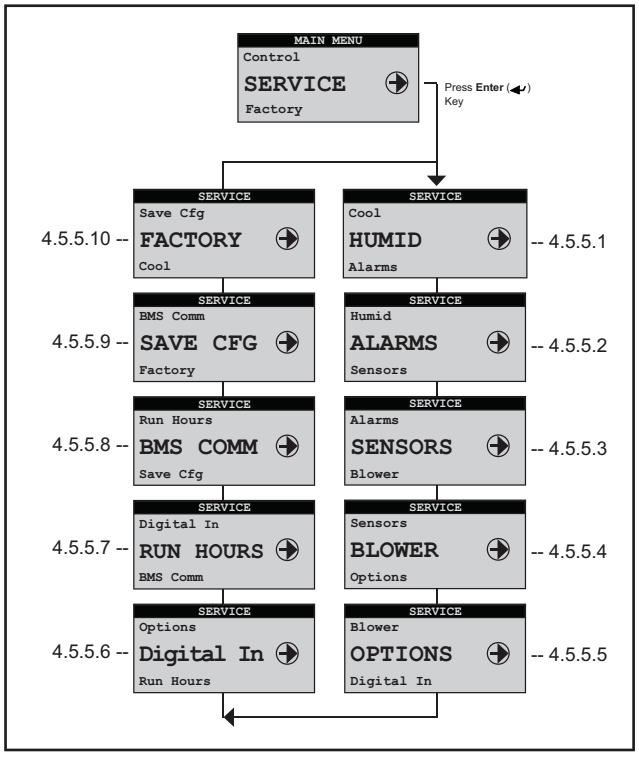
Service Menu

Service Menu Loop

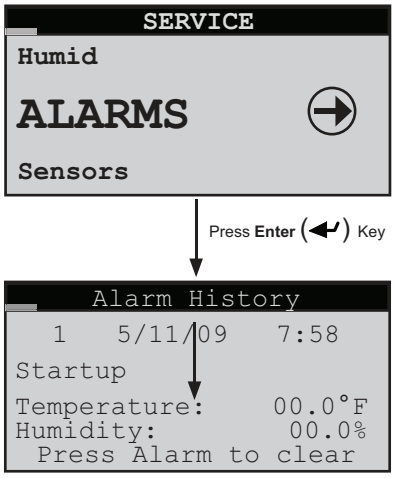


The Service screens allow the user to enter cut-in and cut-out values, calibrate the system control sensor(s), save and restore parameters and view the event log. The Service menu may be entered and programmed by the user via the password menu (requires level 2 password). Once password access is granted, the user may access the service screens.

Figure 23. Service menu loop selections



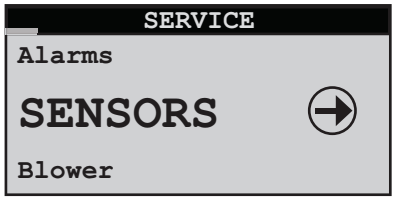
Alarms



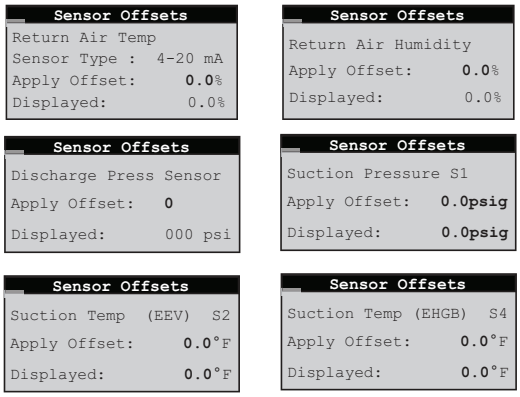
A log of events is stored for view from the Service>Alarms menu. This menu displays the last 50 events sequentially numbered in order of occurrence. The alarm log is cleared by pressing the Alarm key while in this menu.

Note: *If the Alarm key is pressed when in any of the Service>Alarms screens, all stored alarm messages will be permanently erased from the controllers memory.*

Sensors



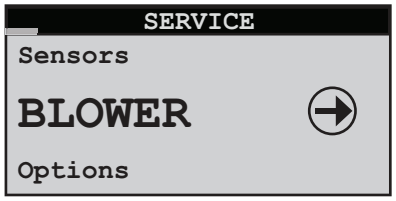
From the Service>Sensors menu you may access multiple display screens to enter offsets for calibrating the units various temperature, humidity and pressure sensors.



Additional sensor offset screens are available for optional sensors if enabled at the factory such as: Remote Supply Air Temp and Remote Supply Air Humidity.

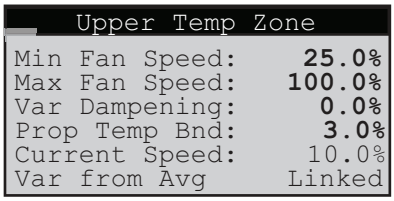
Note: *When calibrating sensors, an offset at one extreme may produce an error at the other extreme. Always verify that any offset is valid over the entire range of the sensor.*

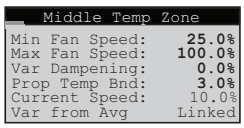
Blower

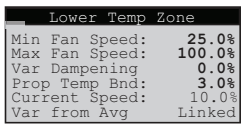


From the Service>Blower menu you may access screens to view and adjust the blower speed parameters.

Temp Zone Set Up:







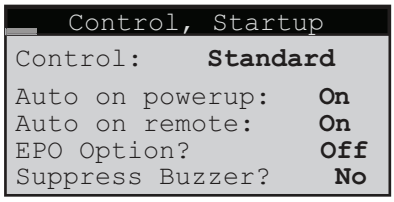
If your unit is configured for zone temperature control, Blower>Temp Zone display screens are available for the upper, middle and lower fan. These screens allow you to adjust minimum and maximum fan speed settings and modify the fan speed PI control response parameters.

The variable dampening value, used with Variance From Average fan speed control adjusts the effect of the variance on the final fan speed.

Options Menu Loop

From the Service>Options menu you may press the Enter key to access a menu loop with screens used to set up and adjust various options.

Control, Startup:



The Service>Options>Control, Startup screen allows you to select the control method.

Standard = Temperature/Humidity Control

Dewpoint = Dewpoint Control

<Reserved> = For future use. DO NOT select this control method.

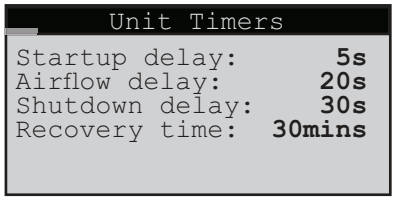
Auto on powerup - If set to On, the A/C unit turns on automatically when main power is applied.

Auto on remote - If set to On, the A/C unit may be turned on via a remote On/Off switch.

EPO Option (Emergency Power Off) - If set to On, the off delay timers are bypassed so compressors, blowers etc. stop operating immediately when the unit is turned off by a remote on/off signal or a critical alarm.

Suppress Buzzer - Allows you to enable or disable the alarm signal buzzer.

Unit Timers:



The Service>Options>Unit Timers screen allows you to adjust the unit timers controlling various start-up or shutdown delay periods.

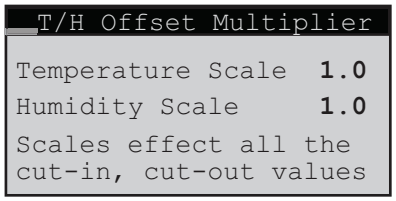
Startup delay - Time delay before blower(s) begin operating after pushing the Enter key or after turning the unit on with a remote on command.

Airflow delay- Time delay for allowing the blowers to reach adequate speed before the air proving sensor actively monitors an airflow alarm condition.

Shutdown delay - Time delay before unit stops operating after pressing the Enter key for 3 seconds or after turning it off with a remote off command.

Recovery time - Time period after startup that temperature and humidity alarms are masked from signalling nuisance high or low temperature and humidity alarms.

T/H Offset Scaling:



The Service>Options>T/H Offset Multiplier screen allows you to enter a multiplier to apply to scale both the temperature and humidity cut-in/cut-out offsets. The multipliers are factored to the system offset values set by the factory (shown below).

Default Cut-in/Cut-out Offsets

Temp.Cut-in Offset = 2.0°F; Cut-out Offset = 0.3°F
Humidity Cut-in Offset = -5.0%; Cut-out Offset = -2.0%

EXAMPLE 1: Temperature Offset Multiplier

With the default cut-in offset for temperature at 2.0°F, a multiplier of 1.0 x 2°F = 2°F. This means the unit will

begin operating in the cooling mode at 74.0°F (Setpoint 72.0°F + Offset 2°F).

Conversely, with the default cut-out offset at 0.3°F, the cooling mode will turn off at 72.3°F.

(Setpoint 72.0°F + (1.0 x Cut-out Offset 0.3°F)) 72.0°F + 0.3°F = 72.3°F

EXAMPLE 2: Temperature Offset Multiplier

If 2.0 is entered, the offset for temperature is multiplied by 2.0. (2.0 x 2°F= 4°F). This means the unit will begin

operating in the cooling mode at 76.0°F (Setpoint 72.0°F + Offset 4°F).

Conversely, the cooling mode will turn off at 72.6°F (Setpoint 72.0°F + (2.0 x Cut-out Offset 0.3°F)).

72.0°F + 0.6°F = 72.6°F

EXAMPLE 3: Humidity Offset Multiplier

If 1.3 is entered, the offset for humidity is multiplied by

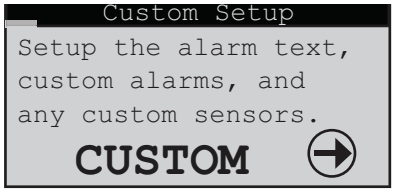
1.3. (1.3 x -5%= -6.5%). This means the unit will begin operating in the dehumidification mode at 38.5% (Setpoint 45.0% + Offset -6.5%).

Conversely, the dehumidification mode will turn off at 42.4%.

(Setpoint 45.0% + (1.3 x Cut-out Offset -2.0%))

45.0% + (-2.6%) = 42.4%

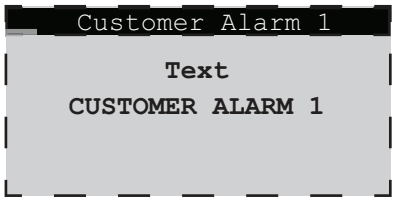
Custom Setup



From the Service>Options>Custom Setup screen you may press the Enter key to access a menu loop to set up custom alarm features. Any controller alarm or signal failure will activate the summary alarm output. Upon receiving an alarm indication, the user may press the alarm key and call up alarm screen messages.

Customer Alarm Input (Optional)

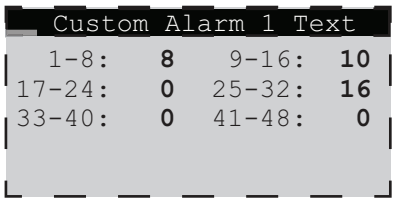
If enabled, a customer provided alarm input may be used to activate the Summary Alarm relay and show a specific Customer Alarm message in the alarm display screen. A Customer Alarm message may simply be displayed as CUSTOMER ALARM 1 as shown below, or you may press the Enter key and use the up and down arrow keys to construct a specific alpha/numeric message in the field stating the specific alarm condition in your own terms; i.e. GAS DETECTION, INTRUSION ALARM, etc. The Customer Alarm message may be set up on one line with up to 20 characters.



Note: *Display screens shown with a dashed border appear only if the applicable feature is enabled.*

Custom Alarm Setup (Optional)

The E² controller may be enabled to activate a Custom Alarm output and energize a designated N.O./N.C. relay. A custom alarm output is set up by adding the binary bitmask numbers assigned to the specific alarms and signal failures you wish to monitor via the relay and then entering them in the Custom Alarm Setup screen.



Note: *Custom alarm display screens may appear even if the feature is not enabled. In this case, changes made to these screens will have no effect.*

You can select any mix of the 48 alarm variables as shown in the tables that follow. As an example, for a custom alarm based only on the occurrence of moisture alarm, fire/smoke, condensate pan, failure of the return humidity sensor you would enter the following bitmask values for the applicable alarm numbers and enter 0 for the rest:

Custom Alarm number 1 - 8 Moisture alarm (No. 4) = **8**

Custom Alarm number 9 - 16 Fire/smoke (No. 10) + Condensate pan (No. 12) = 10 (2+8)

Custom Alarm number 25- 32 Return humidity sensor (No. 29) = 16

The custom alarms are set up by entering the bitmask totals developed from the tables on the following page.

Table 14. Alarms 1 to 8

No.	Description	Bit mask	Default
1	**Upper Fan alarm**	**1**	**1**
2	**Lower Fan alarm**	**2**	**2**
3	**Middle Fan alarm**	**4**	**4**
4	**Moisture alarm**	**8**	**8**
5	**Emergency shutdown**	**16**	**16**
6	**Remote shutdown**	**32**	**32**
7	Customer alarm 1	64	0
8	**Airflow alarm**	**128**	**128**

Factory Default Bitmask Total 191

Table 15. Alarms 9 to 16

No.	Description	Bit mask	Default
9	Filter alarm	1	0
10	**Fire/Smoke alarm**	**2**	**2**
11	**Water detection alarm**	**4**	**4**
12	**Condensate pan alarm**	**8**	**8**
13	**Circuit1 low pressure alarm**	**16**	**16**
14	**Circuit1 high pressure alarm**	**32**	**32**
15	Dual power input A alarm	64	0
16	Dual power input B alarm	128	0

Factory Default Bitmask Total 62

Note: *The default values (shown in **bold**) are factory set to generate a custom alarm output on any of the major alarms and any sensor failure. Only the enabled sensors can generate an alarm. To enable an additional custom alarm, add the alarm bitmask number to the factory default total and enter the new total for the applicable alarm numbers in the Custom Alarm Setup screen. If an alarm condition appearing in the following tables is detected, it needs to be reset at the units display terminal or via the BMS.*

Table 16. Alarms 17 to 24

No.	Description	Bit mask	Default
17	***Humidifier alarm***	***1***	***1***
18	High temperature alarm	2	0
19	Low temperature alarm	4	0
20	High humidity alarm	8	0
21	Low humidity alarm	16	0
22	High water temperature CW1	32	0
23	Low water temperature CW1	64	0
24	***Loss of power***	***128***	***128***

Factory Default Bitmask Total 129

Table 17. Alarms 25 to 32 (Sensor Failure Alarms)

No.	Description	Bit mask	Default
25	**Lower temperature sensor fail**	**1**	**1**
26	**Middle temperature sensor fail**	**2**	**2**
27	**Optional temperature sensor fail**	**4**	**4**
28	**Upper temperature sensor fail**	**8**	**8**
29	**Return humidity sensor fail**	**16**	**16**
30	**DX1 discharge pressure fail**	**32**	**32**
31	**Static air pressure sensor fail**	**64**	**64**
32	**DX1 suction press sensor fail**	**128**	**128**

Factory Default Bitmask Total 255

Table 18. Alarms 33 to 40

No.	Description	Bit mask	Default
33	**DX1 suction temp sensor fail**	**1**	**1**
34	**Custom sensor 1 fail**	**2**	**2**
35	Reserved	4	0
36	Reserved	8	0
37	Reserved	16	0
38	Reserved	32	0
39	Reserved	64	0
40	Reserved	128	0

Factory Default Bitmask Total 3

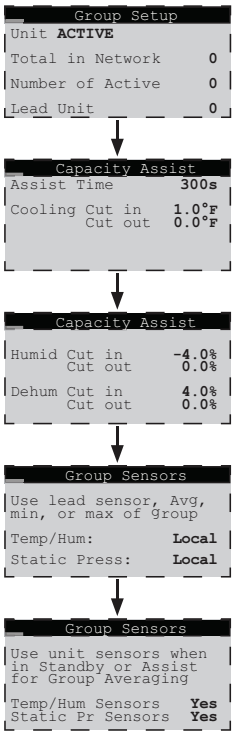
Table 19. 41 to 48

No.	Description	Bit mask	Default
41	System Off	1	0
42	BMS keep alive off	2	0
43	Customer alarm 2	4	0
44	Customer alarm 3	8	0
45	Flow switch	16	0
46	Reserved	32	0
47	Reserved	64	0
48	Reserved	128	0

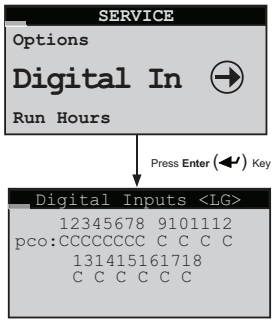
Factory Default Bitmask Total 0

Work Group Screens

The Service>Group display screens shown below only appear if two or more units are wired together as a group. They allow you to configure parameters that apply to how the A/C units interact in the work group. See “Communication with Controller,” p. 49 for a detailed description of how work groups are set up and for information on setting the operating parameters available in these screens.

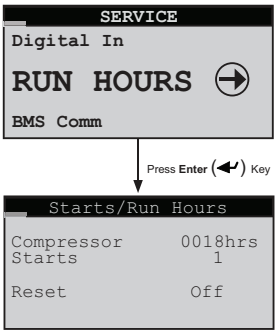


Digital In



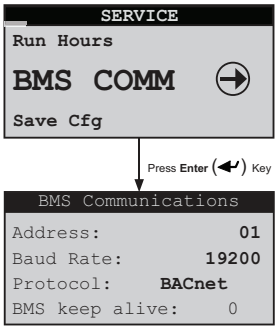
The Service>Digital In screen is provided for information only. It shows the state of each digital input as either Closed (+24 V) or Open (Gnd).

Run Hours



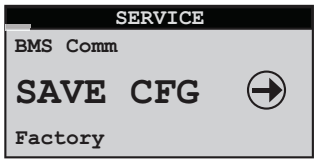
From the Service>Run Hours menu you may access a loop consisting of the component run hours display screens applicable to your unit using the Up and Down arrow keys. Each screen displays the number of run hours and number of starts logged for the component (i.e. compressor, fans, air filter changes, etc.). The run hours and starts values may be reset to 0 from the display screens. The values displayed in each screen are the values logged since the last time the screen was reset.

BMS Communication

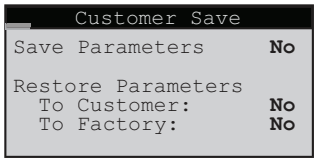


The Service>BMS Comm menu is used to set up parameters to allow a BMS (BAS) to interface with the controller. See "BMS Communication," p. 58 for a description of this screen and instructions for setting up BMS communication.

Save Configuration



The default setpoints may be restored and passwords may be changed from the Service>Save Cfg menu.



The first Service>Save Cfg menu screen allows you to save any adjustments made in Service level menu screens as the new Customer parameters or, restore the controller to the previously saved Customer parameters. The user may also restore the controller to original factory default parameter values shown in Table 20, p. 49.

Use the Enter key to move the flashing cursor to the field you wish to confirm and press the Up or Down arrow key. The word No will momentarily change to Yes indicating the command has been accepted. Then press the Enter key sequentially until the flashing cursor returns to the top left corner of the screen.

The table that follows are the Factory default parameters.

Table 20. Factory default setpoints

Parameter	Default value
Temperature Setpoint	72° F
Compressor Cut- in	74° F
Compressor Cut- out	72.3° F
Minimum Fan Speed	40%
Maximum Fan Speed	100%
Dehumidification Fan Speed	60%
Humidity Setpoint	45% RH
Dehumidify Cut-in	50% RH
Dehumidify Cut-out	47% RH

The second Service>Save Cfg menu screen allows you to set new passwords for entering the Control and Service menus.

Factory Menu

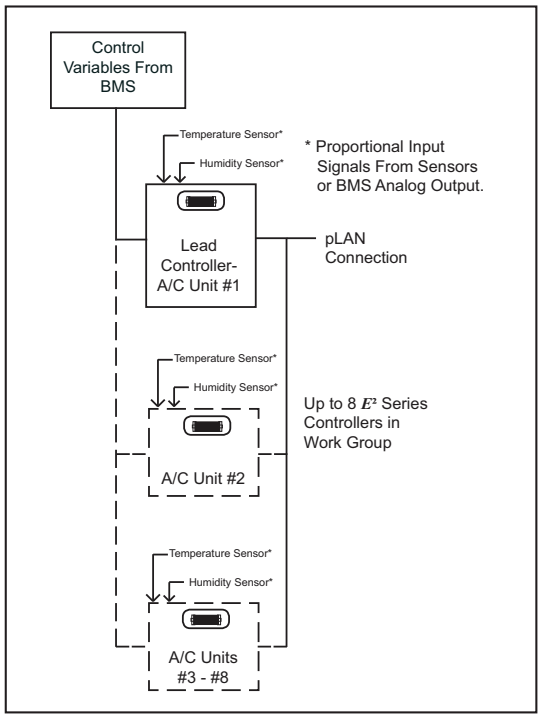
The Factory menu loop may be accessed from the Service>Factory screen. You must enter the factory level password to gain access to the loop. Contact vendor Product Support for the password and for guidance when adjustments must be made at this level.

Communication with Controller

It is possible for the E² controller to communicate in multiple ways. The controller may be set up to utilize a pLAN network to link with additional E² controllers to create a work group consisting of multiple A/C units (see “Work Group Set-up,” p. 49).

Using an expansion card, the unit may also be connected to a BMS for monitoring and control of data points using a variety of different serial communication protocols (see “BMS Communication,” p. 58).

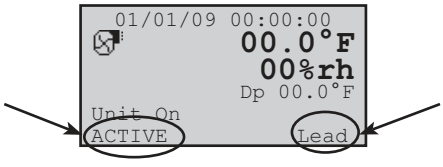
Figure 24. Configuring multiple A/C units



Work Group Set-up

The controller may be networked with a group of A/C unit controllers to manage their outputs as a system in an N+M (M = number of standby units) group. The controllers from up to seven additional A/C units may be tied to a Lead controller. The number of units to be assigned as Active, Capacity Assist or Standby duty is to configured by the factory however, they may configured in the field with assistance from vendor Product Support. A unit may also be designated as Out of Service.

The Main screen of each unit in the work group will indicate that units duty assignment in the bottom field. If the controller is the group Lead, it will be indicated in the bottom field also.



One controller may be designated as the work group lead and networked with the controllers from a series of up to 7 additional A/C units. If configured for multi-unit operation, the work group lead controller display panel allows access to the same data and group control sensor choices that are available from networked system controller display panels.

Standby

If the lead controller in the work group loses a signal acknowledgement from an active A/C unit in the group, that A/C unit is deemed as failed or taken out of service. The failed unit will be replaced with the first available standby unit from

the work group. The standby unit is cycled on and designated as the new active unit.

Capacity Assist

The Capacity Assist option can be used to maximize efficiency for conservation of energy and to more precisely control capacity at low demand. This feature enables Active A/C units to handle the demand up to a certain temperature/humidity setpoint and then enables additional units to begin operating as needed. If the Active A/C units are running and unable to satisfy the demand, Capacity Assist A/C unit(s) may be programmed to turn on to assist the Active units.

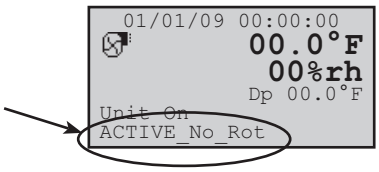
Each Capacity Assist unit may set to control operation based on its local temperature/humidity sensor values or control operation based on Network sensor values transmitted from the Lead controller. Multiple Capacity Assist units are typically set with each unit in the group assigned incrementally increasing/decreasing offsets for cooling, humidifying and dehumidifying so they will turn on one at a time only if the unit(s) currently operating are unable to satisfy the demand. They should incrementally turn off as each unit reaches its cut-out setpoint, while active A/C unit(s) continue to maintain room conditions at the desired level.

Unit Rotation

In this mode, the Lead controller will rotate duty between the grouped A/C units to promote equal run time and

will rotate the role of group lead. When set up for unit rotation, the A/C units will rotate duty in order of their group addresses. Active, Capacity Assist and Standby units are all in the rotation cycle so even a standby unit will be cycled into active duty on a scheduled basis.

A/C units in the group may have their duty assignments locked so they do not join the rotation cycle (and cannot take the lead). In this case the message No_Rot appears after the duty assignment displayed in the main screen.



An Active_No_Rot unit is always On therefore, it will not rotate out. An Active_No_Rot unit will still be able to take the role as lead controller during a rotation. Units designated as Out of Service do not rotate nor can they be used as lead units.

The rotation time period is typically 1 week, however it may be set by the user via the Factory menu. Call vendor Product Support for assistance when accessing the Factory menu.

Out of Service

A unit may be removed from the group entirely by placing it Out of Service. In this mode, the unit will not operate.

A unit may be placed in this mode as a safety measure to prevent it from unexpectedly starting when performing maintenance or repairs.

Configuring a Work Group

A workgroup can consist of up to 8 controllers (I/O boards) with pLAN addresses 1 to 8. Their corresponding display terminals will be assigned pLAN addresses from 32 down to 25. The E² controller program is defaulted with the controller address set to 1 and its terminal (display) address set to 32. As such, a normal stand-alone controller does not need any changes made to either the controller or the terminal address. The method to setting up work groups is to retain the first (group lead) controllers pLAN address as #1 and terminal address as #32 so that the sum of the addresses equals 33. The first controller added to the group is assigned pLAN address #2 and its terminal is assigned address #31, the sum of which again equals 33.

Note: *The sum of the controller and terminal address numbers must always equal 33.*

A work group should ALWAYS start with controller address 1 and go up from there. DO NOT skip over controller addresses. The list of suitable controller/display terminal address pairs is shown below:

Corresponding A/C Unit Controller to Terminal pLAN Addresses								
Controller (I/O board)	1	2	3	4	5	6	7	8
Display Terminal	32	31	30	29	28	27	26	25

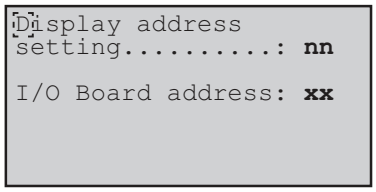
You must assign the terminal and controller I/O board addresses for each controller to be grouped. Review "Configure the Terminal Address," p. 50 to "Assign Terminal to Controller," p. 51 first, before turning power on and the assigning addresses. Do not interconnect the controllers together before assigning their terminal and I/O board pLAN addresses.

The first step is to change the terminal address of each controller to 0 referring to "Configure the Terminal Address," p. 50 below. You must set the terminal address to 0 before you can assign the controller (I/O board) address.

Note: *If the terminal remains inactive (no key is pressed) for more than 30 seconds, the group set up procedure is exited automatically, without saving any changes.*

Configure the Terminal Address

The address of the terminal (display) can only be configured if its telephone jack is connected to the I/O control module in the electric box and power is turned on. The factory default value for the display terminal address is 32. To reassign the terminal address, press and hold the Up, Down and Enter keys simultaneously for 5 seconds until the Address Configuration screen shown below appears with the flashing cursor in the top left corner:



1. To change the address of the terminal (Display address set- ting), press the Enter key once. The cursor will move to the address field (nn).
2. Use the Up, Down keys to select the desired value (0), and confirm by pressing Enter again.

The Display Address Changed screen will appear indicating the display address selected is not the same as the one saved previously and the new value will be saved to the permanent memory.

```
Display address
changed
```

3. Once the terminal address is set to zero, cycle the power to the unit Off and then back On.

Note: *If the Display address setting: field is set to 0, the terminal will communicate with the controller (I/O board) using point-to-point protocol (not pLAN). The display field I/O Board address: will disappear as it has no meaning until you set the controller (I/O board) pLAN address.*

Configure Controller (I/O Board) pLAN Address

Immediately after turning power back on, press and hold the Alarm and the Up Arrow keys simultaneously for 10 to 15 seconds. First you will see a display message self test please wait then the pLAN Address Configuration screen shown below will appear.

Important: *Do not press the Enter key, the cursor is already in the modifiable field.*

Press the Up Arrow key to set the pLAN address (#1 – 8) for the controller (I/O Board). The pLAN address #1 is already assigned by default to the first (Lead) controller in the group. Address #2 is to be assigned to the first controller added to the group (address #3 is to be assigned to the second controller added and so on). Then press the Enter key to confirm your selection. A message **NO LINK** will appear.

```
PLAN ADDRESS: 1
UP:     INCREASE
DOWN:   DECREASE
ENTER:  SAVE & EXIT
```

Controller Address Configuration

Next, press the Up, Down and Enter keys simultaneously. Reconfigure the terminal address following the steps in “Configuring a Work Group,” p. 50 again. This time set the terminal address to match the corresponding controller (I/O board) address.If the controller is assigned address 2, then the corresponding terminal address should be set to 31 as shown in the table on the preceding page. If the next controller is assigned address 3, the corresponding terminal should be set to 30.

After setting the correct terminal address, press the Enter key once to confirm your selection. A message NO LINK will appear. At this point, the terminal has been set with the correct address for the controller and the controller has been set for the terminal, but now they need to be assigned to each other.

Assign Terminal to Controller

1. Access the Terminal Address Configuration screen again using the Up, Down and Enter keys.
2. Press the Enter key until the cursor moves to the field I/O board address.
3. Using the arrow keys, enter the address (1 – 8) for the controller I/O board.
4. Press the Enter key twice to display the Terminal Configuration screen shown below.

```
P:02 Adr   Priv/Shared
Trm1 31       Pr
Trm2 None     --
Trm3 None     -- Ok?No
```

Terminal Configuration

5. Here too, the Enter key moves the cursor from one field to the next, and the arrow keys change the value of the current field. The field P:0_ depicts the pLAN address (1 – 8) assigned to the I/O board. In the example shown, the controller has been assigned address 2.
6. Press the Enter key to move to the field Trm1 xx. The field represents the address of the terminal associated with the controller. Using the arrow keys enter the address (25 – 32) of the terminal assigned to the controller (I/O board). In the example shown, address 31 has been entered for the first A/C unit added to the group.
7. The Priv/Shared column indicates the type of terminal. The workgroup is setup using private terminals. Do not change the value (Pr). Press the Enter key to move to the last field.
8. Enter the field Ok?No, choose Yes using the arrow keys and confirm by pressing Enter to save the data and exit the group set up procedure.
9. Referring to the wiring diagram provided with your A/C units, interconnect the units together with the pLAN cable(s) provided.

Fault messages

If the terminal detects the status of the I/O board it is associated with is off-line, the display shows the message: **I/O Board xx fault**. If this appears, check the Signal LEDs on the control I/O module (Figure 17, p. 28) for an error signal. See

"Troubleshooting the Control I/O Module Signal LEDs," p. 58 for guidelines on analyzing the signal LEDs.

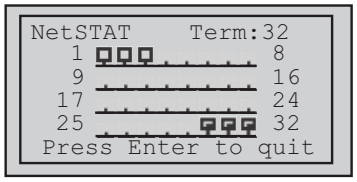
On the other hand, if the terminal receives no signal from the network, the display shows the following message:

NO LINK. If this appears, check the pLAN cables and ensure they are connected properly.

Displaying Network Status and Firmware Version

Once each A/C unit is configured with its new controller and terminal pLAN address, you can examine the entire network set up. Press the group set up keys (Up, Down, and Enter keys) together as done to access the Address Configuration screen but continue holding after the Address Configuration screen appears for at least 5 seconds until the Network Status screen appears.

The Network Status screen, shown below, provides overview of the pLAN group indicating which and how many devices are connected and the corresponding pLAN addresses.



Network Status

	Controllers (I/O Boards) active in network
	Terminals active in network
	No device connected

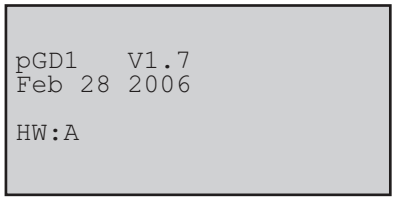
The example shown represents:

Controllers active in network, addresses: 1, 2, 3

Terminals active in network, addresses: 30, 31, 32.

The terminal for controller 1 is always addressed 32; the terminal for controller 2 is always addressed 31, and so on such that the sum of the controller address number and the terminal address number always equals 33. Therefore, when viewing controller number 1, its terminal address will be 32. When viewing controller number 2, its terminal address will be 31, and so on.

Press the up and down arrow key to display the next screen showing the version of the firmware residing in the terminal.



Firmware Version

To exit the Network Status loop, press Enter key.

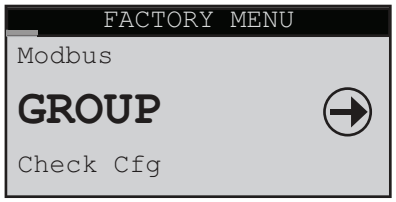
The next step is to access the Factory>Group screens used to configure the work group parameters ("Configure Work Groups," p. 52).

Configure Work Groups

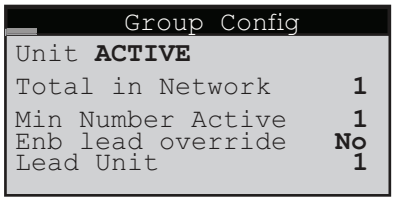
The Factory>Group menu screens only appear when multiple A/C units are grouped. These menu screens allow you to define grouping parameters (duty, rotation, offsets, etc) for the A/C units in the work group. These screens should be accessed after setting up the work groups "Configuring a Work Group," p. 50). The Factory>Group menu screens may be accessed from the main screen by pressing the **Prg** key and scrolling through the menu selections until the word Factory appears in the center of the screen.

Press the Enter key twice and you will be prompted to enter the password for the Factory level (contact vendor Product Support for the password).

Once the Factory level password is entered, press Enter to call up the menu screens. From here you may press the Up or Down arrow keys to scroll through the Factory menu selections.



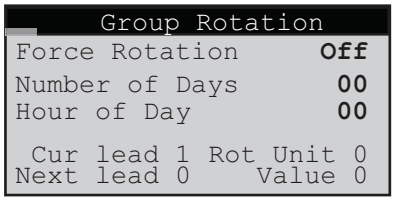
When the word GROUP appears in the center of the screen, press the Enter key to access the Factory>Group menu screens. From here you may use the Up or Down arrow keys to scroll through the Factory>Group menu selections.



Factory>Group> Group Config (Screen 1)

(See table below.)

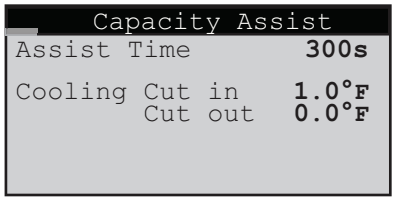
Display	Description	Variables	Default
Unit	Assign the duty of the A/C unit within the group. The duty must be assigned for each A/C unit at its local display terminal.	0= Out of Service 1 = Active 2= Standby 3= Assist 4= Active_No_Rot 5= Standby_No_Rot 6= Assist_No_Rot	1
Total in Network	Enter the total number of A/C units in the group.	0 to 9	1
Min Number Active	Enter the total number of active A/C units in the group.	0 to 9	1
Enb lead override	If set to yes, you may manually assign the lead unit in the following field.	0= No 1= Yes	No
Lead Unit	Identifies which A/C unit controller is currently the lead unit in the group. If Enb lead override is set to yes, you may select which unit is lead.	1 to 8	1



Factory>Group>Group Rotation (Screen 2)

From this screen you may set the schedule to rotate operation of the A/C units to promote equal run times.

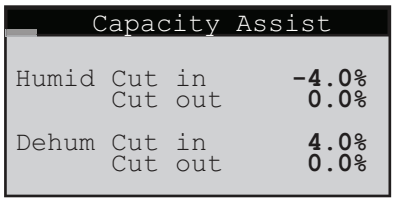
Display	Description	Variables	Default
Force Rotation	This field only appears on the Lead controller. If you select On and press Enter it initiates a manual rotation cycle to rotate duty between active and standby units. It also rotates the role of Lead controller. The field will disappear after the role of Lead is rotated to the next A/C unit.	0 = Off 1 = On	0
Number of Days	Enter the number of days between rotating active units.	0 to 999	0
Hour of Day	Enter the hour of day for unit rotation to occur.	0 to 23	0
Cur Lead	Identifies which A/C unit controller is currently the lead unit in the group.	1 to 8	0
Next lead	Identifies which A/C unit controller is designated to be the next lead unit.	1 to 8	0
Rot Unit	Identifies which A/C unit is designated to be the next unit to rotate duty.	1 to 8	0
Value	Identifies the duty of the A/C unit by displaying the variable number assigned in Factory>Group screen 1 (0=Out of Service, 1=Active, 2=Standby, etc.).	0 to 6	0



Factory>Group> Capacity Assist (Screen 3)

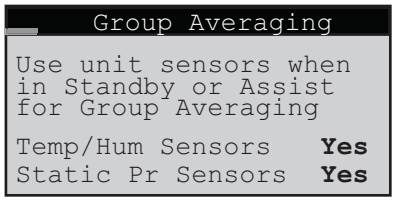
Each A/C unit in the group may be assigned local cut-in and cut-out setpoints for its capacity assist operation. The values entered are offsets which are applied to the control setpoints established at the lead controller. Each unit in the group should be assigned incrementally increasing/decreasing offsets for cooling humidifying and dehumidifying so they will turn on one at a time only if the unit(s) currently operating are unable to satisfy the demand.

Display	Description	Variables	Default
Assist Time	Enter the delay period for capacity assist unit(s) to begin operating.	0 to 999	300
Cooling Cut in	Enter a temperature setpoint offset for cooling capacity assist operation to begin.	-99.9 to 99.9	300
Cut out	Enter a temperature setpoint offset for cooling capacity assist operation to stop.	-99.9 to 99.9	0.0



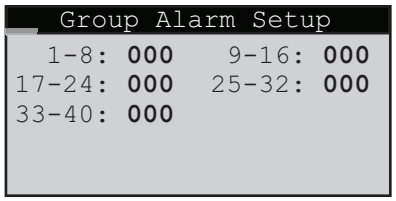
Factory>Group>Capacity Assist (Screen 4)

Display	Description	Variables	Default
Humid Cut in	Enter relative humidity setpoint offset for humidifying capacity assist operation to begin	-99.9 to 99.9	-4.0
Cut out	Enter relative humidity setpoint offset for humidifying capacity assist operation to stop	-99.9 to 99.9	0.0
Dehum Cut in	Enter relative humidity setpoint offset for dehumidifying capacity assist operation to begin	-99.9 to 99.9	-4.0
Cut out	Enter relative humidity setpoint offset for dehumidifying capacity assist operation to stop	-99.9 to 99.9	0.0



Factory>Group>Group Averaging (Screen 5)

Display	Description	Variables	Default
Temp/Hum Sensors	Enter Yes for the unit to respond to the local sensors to enable Standby or Capacity Assist operation. Enter No for unit to respond to the Group sensors.	0 = No 1 = Yes	Yes
Static Pr Sensors		0 = No 1 = Yes	Yes



Factory>Group>Group Alarm Setup (Screen 6)

This screen may be accessed on the controller for each unit to be grouped. You may enter bitmask numbers to establish which alarm conditions for that particular unit will initiate a group internal alarm. The group alarms may be set before the A/C units are wired together. When a group alarm condition is detected by a unit it causes that unit to temporarily switch over from Active to Off and if another unit is available in the group, it may rotate into its place. A status massage Off by internal alarm will appear in the Main screen of the unit that detected the group alarm and switched off.

See "Custom Alarm Setup (Optional)," p. 46 for an overview of how to select alarms using bitmask values. The Group Alarms bitmask values are shown in the following tables. The settings may be viewed at the Info level following the network sensors screen. If an alarm condition appearing in the following tables is detected, it needs to be reset at the units display terminal or via the BMS for the unit to return to Active and resume operation.

Table 21. Group Alarms 1 to 8

No.	Description	Bit mask	Default
1	Humidifier	1	0
2	Pump	2	0
3	Customer alarm 1	4	0
4	Circuit 1 high pressure	8	0
5	Circuit 1 low pressure	16	0
6	DX lockout	32	0
7	Humidifier lockout	64	0

Table 21. (continued)Group Alarms 1 to 8

No.	Description	Bit mask	Default
8	FC/AWS lockout	128	0

Table 22. Group Alarms 9 to 16

No.	Description	Bit mask	Default
9	Upper fan alarm	1	0
10	Middle fan alarm	2	0
11	Lower fan alarm	4	0
12	Water detection	8	0
13	Condensate pan	16	0
14	Moisture	32	0
15	Filter	64	0
16	Reserved	128	0

Table 23. Group Alarms 17 to 24

No.	Description	Bit mask	Default
17	High temperature	1	0
18	Low temperature	2	0
19	High humidity	4	0
20	Low humidity	8	0
21	High water temperature CW1	16	0
22	Low water temperature CW1	32	0
23	Reserved	64	0
24	Reserved	128	0

Table 24. Group Alarms 25 to 32

No.	Description	Bit mask	Default
25	Upper temp sensor	1	0
26	Middle temp sensor	2	0
27	Lower temp sensor	4	0
28	Return humidity sensor	8	0
29	Optional temperature sensor	16	0
30	Circuit 1 discharge pressure	32	0
31	Circuit 1 suction pressure	64	0
32	Circuit 1 suction temperature	128	0

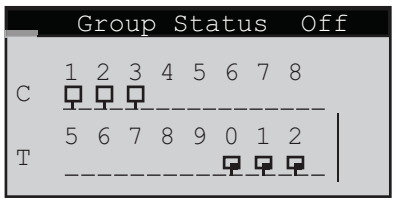
Table 25. Group Alarms 33 to 40

No.	Description	Bit mask	Default
33	Static air pressure	1	0
34	Differential air pressure	2	0
35	Dewpoint	4	0
36	Airspeed	8	0

Table 25. (continued)Group Alarms 33 to 40

No.	Description	Bit mask	Default
37	Reserved	16	0
38	Reserved	32	0
39	Reserved	64	0
40	Reserved	128	0

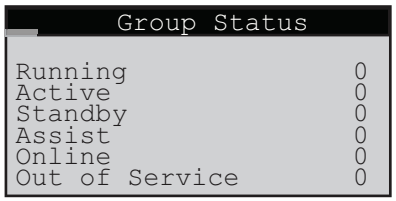
There are several automatic crossover signals that will cause a switch over from Unit Active to Unit Off. They are the occurrence of a remote shutdown command, unit shutdown from a group alarm or BMS command, fire/smoke detection, loss of all cooling (all compressors or all CW valves) or loss of airflow.



Factory>Group>Group Status (Screen 7)

The next screen, Factory>Group Screen 7, provides an overview of pLAN work group.

Display	Description	Variables	Default
Group Status	Indicates if multiple A/C unit grouping is enabled.	0 = On 1 = Off	0
C 1 2 3 4 5 6 7 8	Indicates the address (1-8) of each controller in the pLAN.		1
T 5 6 7 8 9 0 1 2	Indicates the address (25-32) of the terminal for each controller in the pLAN. The terminal address numbers range from 25 to 32 but only the last digit appears in the screen.		32



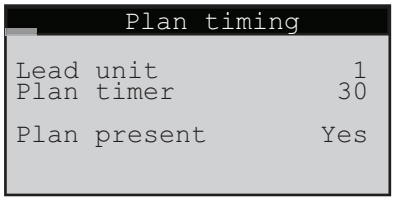
Factory>Group>Group Status (Screen 8)

This screen provides an overview of the current duty status for all the A/C units combined in the group.

Display	Description	Variables	Default
Running	Display indicates how many units in the group are currently operating.	0 to 8	0
Active	Display indicates how many units in the group are currently active.	0 to 8	0
Standby	Display indicates how many units in the group are currently in standby.	0 to 8	0

Display	Description	Variables	Default
Assist	Display indicates how many units in the group are currently operating in the capacity assist mode.	0 to 8	0
Online	Display indicates how many units in the group are currently available to operate.	0 to 8	0
Out of Service	Display indicates how many units in the group are not available to operate.	-	0

The final step to configure a work group is to access the Service>Options>Group Setup screens used to configure parameters that apply to how individual A/C units interact in the work group (see “Service>Options>Group Menu Screens,” p. 56).



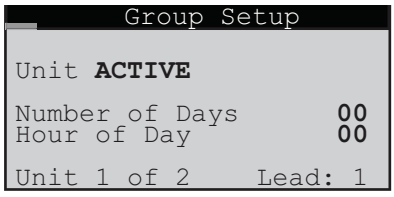
Factory>Group>Plan timing (Screen 9)

Display	Description	Variables	Default
Lead unit	Display indicates which unit is currently the lead.	0 to 8	0
Plan timer	Display indicates the time delay (in seconds) between the detection of a communication failure and the annunciation of a Comm alarm.	0 to 60	30
Plan present	Display indicates if a pLAN is detected by the controller.	0= No 1= Yes	No

Service>Options>Group Menu Screens

Accessed in the Service menu, the Service>Options>Group Setup screens only appear if two or more units are wired together as a work group.

Group Setup

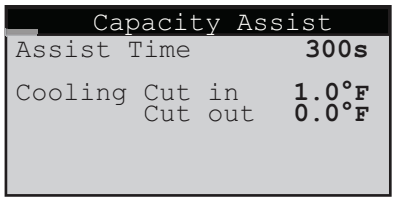


The Service>Options>Group Setup screen allows you to select the work group duty assignment for the A/C unit. The duty must be assigned for each grouped A/C unit at its local display terminal.

Enter the number of days between rotating active units. Enter the hour of day for unit rotation to occur.

The screen also displays a status message indicating which A/C unit you are accessing and which unit is currently the lead unit in the group.

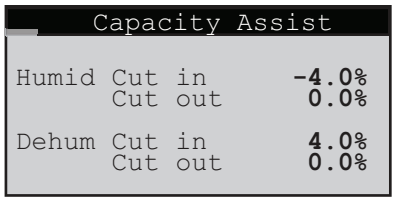
Capacity Assist



The first Service>Options>Capacity Assist screen allows you to enter the delay period for the unit to begin operating if it is in the capacity assist mode. Also, each A/C unit in the group may be assigned local cut-in and cut-out setpoints for its capacity assist operation. The values entered are offsets which are applied to the control setpoints.

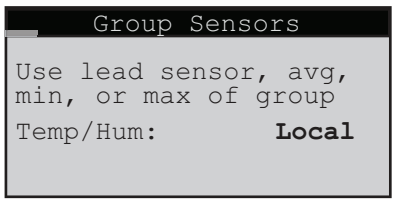
Each unit in the group should be assigned incrementally increasing/decreasing offsets for cooling, humidifying and dehumidifying so they will turn on one at a time only if the unit(s) currently operating are unable to satisfy the demand.

Capacity Assist #2



The second Service>Options>Capacity Assist screen allows you to adjust local capacity assist humidification and dehumidification setpoints.

Group sensors

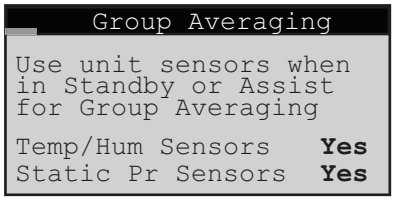


The lead controller polls the controllers from all the A/C units in the work group and calculates the averaged value of their temperature sensors and humidity sensors. It also determines the minimum (lowest) temperature sensor value and the lowest humidity sensor value in the A/C group and conversely, determines the maximum (highest) temperature sensor value and maximum humidity sensor value in the A/C group.

The Service>Options>Group Sensors screen allows you to select whether to control the A/C work group using the T/H sensors connected to individual A/C units (Local) or control the work group using network sensor values transmitted from the lead controller. You may select the network sensor values to be

the Lead, Average, Min or Max values. The selections made in this screen will affect all the controllers in the work group no matter which controller you access the screen from.

Group Averaging



Each unit in the group may be individually set to allow the lead controller to include its sensors for determining the group average value when it is configured for Standby or Capacity Assist operation. If set to no, the lead controller will not poll that units sensors when calculating the averaged values.

Information Menu Group Menu Screens

The following display screens are available in the Information menu loop ("Compressor Status," p. 38) if two or more units are wired together as a group. They display key operating parameters for grouped A/C units.

Group Sensor Values

This displays the current group temperature and humidity control values transmitted from the Lead controller. The field below displays the selected control T/H sensor arrangement (lead, avg, min, max, local) depending upon how the group is set up. See Service>Options screens, "Service>Options>Group Menu Screens," p. 56. The last field shows the unit group address assigned to the controller within the group and the address of the current lead controller.

Group Alarms

This screen only appears when the controller is wired with additional A/C unit controllers. It displays bitmask values indicating the alarm conditions that will initiate a group internal alarm causing the unit to switch over from Active to Unit Off. See Factory>Group (Group Alarm Set up) in "Configure Work Groups," p. 52.

Lead Controller Group Sensors

This screen appears only in the display of the controller that is designated as the Lead in a multi-unit work group. The lead controller polls the Temperature and Humidity sensors from all the A/C units in the work group and displays the averaged values. It also displays the value of the minimum (lowest) temperature sensor and the value of the minimum humidity sensor in the A/C group and conversely, displays the value of the maximum (highest) temperature sensor and maximum humidity sensor in the A/C group. The fields at the bottom are the addresses of the controllers in the group that have the min. (lowest) and max. (highest) temperature and humidity sensor readings.

Group Sensor Status

This screen appears only in the display of the controller that is designated as the Lead in a multi-unit work group. It shows what sensors exist on each A/C unit for the Lead controller to perform the group sensor averaging calculation. The numbers are the sums of index values assigned to the sensors as shown in the following key:

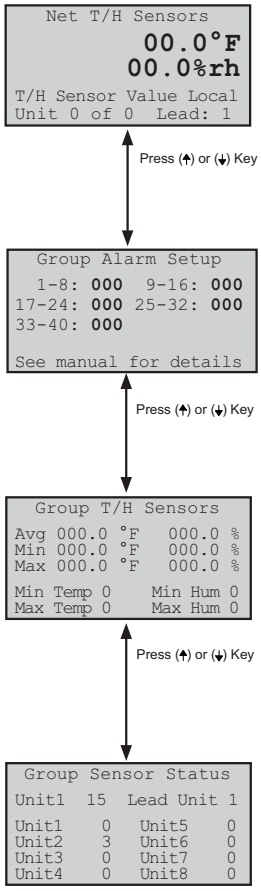
1 = Supply Temperature Sensor

2 = Return Humidity Sensor

4 = Remote Supply Temperature Sensor

8 = Remote Supply Humidity Sensor

16 = Static Pressure Sensor



To determine which sensors are enabled and operable for each unit, simply determine which index numbers, derived from the key above, will produce the number shown in the screen.

In the example shown, the number for the lead unit is 15. This results from adding 1 Supply Temperature + 2 Return Humidity + 4 Remote Supply Temperature + 8 Remote Supply Humidity together, confirming those sensors are operable.

The number shown for unit number 2 is three, the result of adding 1 + 2. This confirms unit number 2s Supply Temperature and Return Humidity sensors are detected by the Lead controller. If a one appeared instead for unit number 2, it

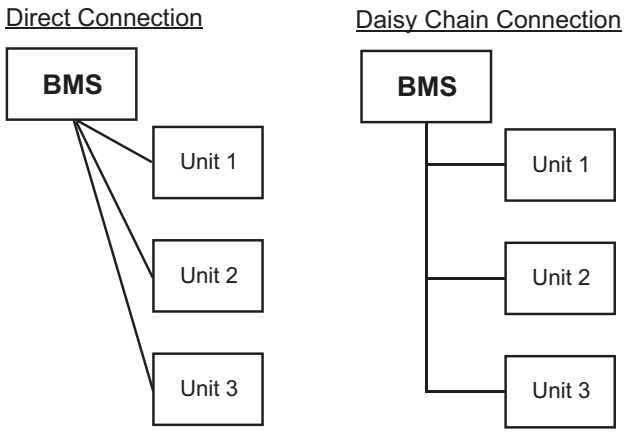
would indicate the signal for the Return Humidity sensor is not present. That sensor is either not enabled or it has failed.

BMS Communication

When BMS communication is utilized, the controller must be equipped with an optional expansion card designed for one of a variety of serial communication protocols available (see “BMS Interface,” p. 28). A communication port on the expansion card allows the controller to be field connected to a central Building Management System (BMS) for monitoring and control of data points.

A RS-485 serial port is available for Modbus or BACnet MS/TP protocols and a 10BaseT port is available for TCP/ IP based protocols such as BACnet over IP, BACnet over Ethernet, SNMP or HTTP.

Supported Protocols	Media	Connection
BACnet over IP	10BaseT	RJ45 direct
BACnet over Ethernet	10BaseT	RJ45 direct
HTTP	10BaseT	RJ45 direct
SNMP V1, V2c	10BaseT	RJ45 direct
Modbus over IP	10BaseT	RJ45 direct
BACnet MS/TP	twisted pair	daisy chain
Modbus RTU	twisted pair	daisy chain



If multiple A/C units are grouped together, each controller added to the group must be configured with a CPU address for BMS communication.

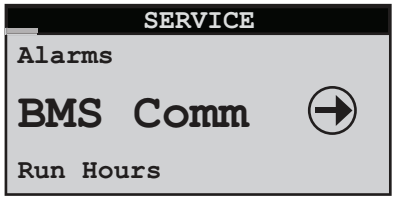
For complete details on utilizing BMS control, contact vendor Product Support (see “Product Support,” p. 69).

Direct BMS Control

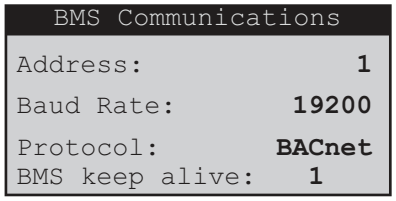
The controller may be configured to accept proportional analog signals that mimics a sensor. The controller will act on that signal whether it comes from a real sensor or a BMS analog output.

Refer to “BMS Parameters, Version 1.2,” p. 59 for the E² controllers BMS parameters.

BMS Communication



The Service>BMS Comm menu is used to set up the parameters to allow a BMS (BAS) interface for monitoring controller operation for the serial-based networks such as BACnet MS/TP. Units using the BACnet over IP, BACnet over Ethernet, or HTTP protocols do not need to change anything in this menu loop.



The BMS address and baud rate have meaning only on RS-485 networks and with the serial protocols of Modem, Modbus RTU, Commission, and Carel. The baud rate is fixed for BACnet. Systems utilizing a 10BaseT interface should use the defaults of address 1, baud rate 19200, and protocol BACnet.

Certain Integer and Digital variables that start with BMS (see page 4-35) require that the BMS keep alive parameter changes between 1 and 2 within a 10 minute span. The general procedure is to set up variables like the BMS low fan speed and then write a 1 to the BMS keep alive address.

Troubleshooting the Control I/O Module Signal LEDs

The E² control I/O module includes 3 signal LEDs (red, yellow and green) that provide information on the operation of the control module and status of the connection to the pLAN. These signal LEDs are positioned adjacent to the yellow, Power On LED (see Figure 17, p. 28). The signal LEDs may be used for diagnostic purposes if a problem arises with the controller.

Figure 25. Controller manual I/O modular signal LEDs

Key: ● LED off ○ LED on ⊖ LED flashing

RED LED	YELLOW LED	GREEN LED	
○	●	●	Application with error or no pLAN table.
○	○	○	Application with error or no pLAN table. Controller connected to ONLY one terminal.
●	○	○	Application with correct pLAN table.
●	○	○	Correct operation in pLAN.
●	⊖	●	Awaiting communication with WinLoad (factory configuration software). Check address.
●	⊖/●	●/⊖	(LED flashing alternately) Communication with WinLoad not valid. No power supply or wrong driver.
●	●	⊖	Communicating with WinLoad (in low level operation).
●	⊖	⊖	Communication with WinLoad on hold.
⊖	⊖	⊖	WinLoad not suitable or incorrect software protection password.
●	○	⊖	Communicating with WinLoad (in normal operation).
●	●	○	Controller supervisor protocol (subordinate) active on serial 0.

BMS Parameters, Version 1.2

Supported Protocols	Speed	Media	Connection	Notes
BACnet over IP	10 Mbps	10BaseT	RJ45 direct unit connection	Uses BMS addresses
BACnet over Ethernet	10 Mbps	10BaseT	RJ45 direct unit connection	Uses BMS addresses
HTTP	10 Mbps	10BaseT	RJ45 direct unit connection	Uses BMS addresses
SNMP V1, V2c	10 Mbps	10BaseT	RJ45 direct unit connection	Uses BMS addresses
Modbus over IP	10 Mbps	10BaseT	RJ45 direct unit connection	Uses Modbus addresses
BACnet MS/TP	19200 baud	Twisted pair	Daisy chain connection	Uses BMS addresses
Modbus RTU	19200 baud	Twisted pair	Daisy chain connection	Uses Modbus addresses

Table 26. Signed values for HTTP, SNMP / Modbus holding registers / Analog values for BACnet

BMS Address	Modbus Address	BACnet Address	Description	Default	Read/ Write
1	002	1	Temperature setpoint	72.0	R/W
2	003	2	Humidity setpoint	45.0	R/W
3	004	3	Average supply temperature display value	0.0	R
4	005	4	Return humidity sensor current value	0.0	R
5	006	5	Dewpoint of return temp and humidity	0.0	R
6	007	6	Dewpoint of remote temp and humidity	0.0	R
7	008	7	Middle fan speed	0.0	R
8	009	8	Upper fan speed	0.0	R
9	010	9	Lower fan speed	0.0	R
10	011	10	Middle fan manual speed	0.0	R/W
11	012	11	Upper fan manual speed	0.0	R/W
12	013	12	Lower fan manual speed	0.0	R/W
13	014	13	Static pressure sensor current value	0.0	R

Table 26. Signed values for HTTP, SNMP / Modbus holding registers / Analog values for BACnet (continued)

BMS Address	Modbus Address	BACnet Address	Description	Default	Read/ Write
14	015	14	C1 discharge pressure sensor current value	0.0	R
15	016	15	C1 suction pressure sensor current value	0.0	R
16	017	16	C1 suction temperature sensor current value	0.0	R
17	018	17	Return temperature display value	0.0	R
18	019	18	Remote temperature display value	0.0	R
19	020	19	Entering water temperature display value	0.0	R
20	021	20	Leaving water temperature display value	0.0	R
100	101	100	High air temperature alarm limit	80.0	R/W
101	102	101	Low temperature alarm limit	60.0	R/W
102	103	102	High humidity alarm limit	70.0	R/W
103	104	103	Low humidity alarm limit	30.0	R/W
104	105	104	High water temperature limit	60.0	R/W
105	106	105	Low water temperature alarm limit	40.0	R/W

Table 27. Unsigned values for HTTP, SNMP / Modbus holding registers / Analog values for BACnet

BMS Address	Modbus Address	BACnet Address	Description	Default	Direction
1	130	1001	Cooling analog output	0	R
2	131	1002	Middle Fan Speed analog output	0	R
3	132	1003	Upper fan analog control value	0	R
4	133	1004	Lower Fan analog control value	0	R
5	134	1005	Packed bit for BMS -alarms	0	R
6	135	1006	Packed bit for BMS -alarms	0	R
7	136	1007	Packed bit for BMS -alarms	0	R
8	137	1008	Packed bit for BMS -sensor fails	0	R
9	138	1009	Packed bit for BMS -sensor fails	7	R
10	139	1010	Packed bit for BMS -digital inputs	0	R
11	140	1011	Packed bit for BMS -digital inputs	0	R
12	141	1012	Packed bit for BMS -digital outputs	0	R
13	142	1013	Packed bit for BMS -digital outputs	0	R
15	144	1015	Prop humidifier control output	0	R
16	145	1016	Head pressure control output	0	R
100	229	1100	BMS keep alive parameter	0	R/W
101	230	1101	BMS low fan speed for CW units	0	R/W
102	231	1102	BMS run fan speed for CW units	0	R/W
103	232	1103	BMS dehum fan speed for CW units	0	R/W
104	233	1104	Fan link control (0 to 4) See 4.9.2.1	0	R/W
105	234	1105	Control mode of dewpoint, hybrid, standard	0	R/W
106	235	1106	Temperature control sensor selection	0	R/W
107	236	1107	Humidity control sensor selection	0	R/W
108	237	1108	Type of unit (valid numbers 0 to 6) See 4.9.2.1	0	R/W
110	239	1110	Lower fan speed control (0 to 2) See 4.9.2.1	0	R/W
111	240	1111	Middle fan speed control (0 to 2) See 4.9.2.1	0	R/W
112	241	1112	Upper fan speed control (0 to 2) See 4.9.2.1	0	R/W
123	252	1123	Current day	1	R/W
124	253	1124	Current month	1	R/W
125	254	1125	Current year	0	R/W

Table 27. Unsigned values for HTTP, SNMP / Modbus holding registers / Analog values for BACnet (continued)

BMS Address	Modbus Address	BACnet Address	Description	Default	Direction
126	255	1126	Current hour	0	R/W
127	256	1127	Current minute	0	R/W

Table 28. Variable/Value descriptions

Variable Description	Description for Value 0	Description for Value 1	Description for Value 2	Description for Value 3	Description for Value 4	Description for Value 5	Description for Value 6
Fan link control	None	Upper and Middle	Upper and Lower	Middle and Lower	All		
[X] fan speed control	Manual	Temperature Proportionate	Variance from Average				
Type of unit	Not Selected	CW-12 inches	CW-24 inches	AR-12 inches	AR-24 inches	W/G-12 inches	W/G-24 inches

Table 29. Boolean values for HTTP, SNMP / Modbus Coils / Binary values for BACnet

BMS Address	Modbus Address	BACnet Address	Description	Default	Direction
1	002	1	Global alarm output	0	R
2	003	2	System on status	0	R
3	004	3	Airflow has been proven	0	R
4	005	4	Call for cooling	0	R
5	006	5	Inverter status	0	R/W
6	007	6	Call for humidification	0	R
100	101	100	BMS value to pause the unit	0	R/W
101	102	101	BMS value to reset alarms	0	R/W
102	103	102	Force rotation of units in group manual or BMS	0	R/W
103	104	103	BMS value to switch CW sources	0	R/W
104	105	104	BMS value to switch dual power primary	0	R/W
105	106	105	BMS value to activate lockout function	0	R/W
106	107	106	Reset Dirty Filter Alarm	0	R/W

Table 30. Alarm packed bit variables

Bit	Alarms 1	Alarms 2	Alarms 3
0	Emergency shutdown	Middle fan alarm	Reserved
1	Remote shutdown	Upper fan alarm	Reserved
2	Customer Alarm 1	Lower fan alarm	Reserved
3	Airflow	High temperature	Reserved
4	Filter	Low temperature	Reserved
5	Fire/Smoke	High humidity	Reserved
6	Water detection	Low humidity	Reserved
7	Condensate pan	High water temp CW1	Reserved
8	Moisture	Low water temp CW1	Reserved
9	Circuit 1 low pressure	Customer Alarm 2	Reserved
10	Circuit 1 high pressure	Customer Alarm 3	Reserved
11	Pump	Flow alarm (temp sensors)	Reserved
12	Dual power input A	Flow alarm (flow switch)	Reserved

Table 30. Alarm packed bit variables (continued)

Bit	Alarms 1	Alarms 2	Alarms 3
13	Dual power input B	Reserved	Reserved
14	Humidifier	Reserved	Reserved
15	Loss of power	Reserved	Reserved

Table 31. Sensor failure packed bit variables

Bit	Sensor Failures 1	Sensor Failures 2
0	Middle temperature	Reserved
1	Upper temperature	Reserved
2	Lower temperature	Reserved
3	Return temperature	Reserved
4	Return humidity	Reserved
5	Static air pressure	Reserved
6	Suction pressure	Reserved
7	Suction temperature	Reserved
8	Discharge pressure	Reserved
9	Reserved	Reserved
10	Remote temperature	Reserved
11	Remote humidity	Reserved

Table 31. Sensor failure packed bit variables (continued)

Bit	Sensor Failures 1	Sensor Failures 2
12	Entering water temperature	Reserved
13	Leaving water temperature	Reserved
14	Reserved	Reserved
15	Reserved	Reserved

Table 32. Digital input packed bit variables

Bit	Digital Inputs 1	Digital Inputs 2
0	Remote shutdown	Customer alarm 2
1	Customer alarm 1	Customer alarm 3
2	Water	Reserved
3	Condensate pan	Reserved
4	Humidifier	Reserved
5	Moisture	Reserved
6	Middle fan alarm	Reserved
7	Upper fan alarm	Reserved
8	Fire/smoke	Reserved
9	Lower fan alarm	Reserved
10	Dual power input A	Reserved
11	Dual power input B	Reserved
12	Circuit 1 low pressure	Reserved
13	Circuit 1 high pressure	Reserved
14	Pump alarm	Reserved
15	Humidifier lockout	Reserved

Table 33. Digital output packed bit variables

Bit	Digital Outputs 1	Digital Outputs 2
0	Global alarm	Reserved
1	Custom alarm 1	Reserved
2	Manager fan enable	Reserved
3	DX1 enable	Reserved
4	DX1 liquid line solenoid	Reserved
5	Humidifier enable	Reserved
6	Dual power output A	Reserved
7	Dual power output B	Reserved
8	Pump enable	Reserved
9	Custom alarm 2	Reserved
10	Custom alarm 3	Reserved
11	Reserved	Reserved
12	Reserved	Reserved
13	Reserved	Reserved
14	Reserved	Reserved
15	Reserved	Reserved

The R/W BMS variables fall into two categories. Variables like the temperature setpoint are permanent. As permanent variables, they retain their value regardless of power loss or BMS communication failure. The controllers flash memory is limited to one million write cycles for permanent variables. The other category is the integer and digital variables that start with BMS. These are expected to be changed frequently and require that the BMS is active when changing them. All BMS variables require that the BMS keep alive parameter (Variable 100) changes between 1 and 2 within a 10 minute span. The general procedure is to set up variables like the BMS low fan speed and then write a 1 to the BMS keep alive address. If the controller does not see a 2 written to the BMS keep alive address within 10 minutes, all the BMS variables will revert to their previous values.

Table 34. Unsigned values for HTTP, SNMP / Modbus holding registers / Analog values for BACnet

BMS Address	Modbus Address	BACnet Address	Description	Default	Direction
100	229	1100	BMS keep alive parameter	0	R/W
101	230	1101	BMS low fan speed for CW units	0	R/W
102	231	1102	BMS run fan speed for CW units	0	R/W
103	232	1103	BMS dehum fan speed for CW units	0	R/W

Table 35. Boolean values for HTTP, SNMP / Modbus coils / Binary values for BACnet

BMS Address	Modbus Address	BACnet Address	Description	Default	Direction
100	101	1100	BMS value to pause the unit	0	R/W
101	102	1101	BMS value to reset alarms	0	R/W
102	103	1102	Force rotation of units in group manual or BMS	0	R/W
103	104	1103	BMS value to switch CW sources	0	R/W
104	105	1104	BMS value to switch dual power primary	0	R/W

Maintenance

Periodic General Maintenance

Systematic, periodic general maintenance of the CyberRow unit is required for optimum system performance. General maintenance should include, but is not limited to the following: replacing filters, tightening electrical connections, checking the condensate pans and drain line to ensure they are free of debris, cleaning the interior of the unit, inspecting the units components visually, checking level of refrigerant and ensuring no moisture is in the refrigerant IF APPLICABLE.

Use copies of the Periodic General Maintenance Checklist in this manual (see “Appendix A CRS-042-G Preventive Maintenance Inspection Checklist,” p. 70) to record periodic general maintenance inspections. For assistance, contact vendor Product Support. Ensure adherence to all safety statements while performing any type of maintenance.

⚠WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels could result in death or serious injury.
Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

Hazardous voltage will still be present inside the electric box at the motor start protectors and circuit breakers, even with the unit turned off at the micro- processor controller. To isolate the unit for maintenance, turn off power at the main power disconnect switch. Always disconnect main power prior to performing any service or repairs.

⚠WARNING

Rotating Components!

Failure to disconnect power before servicing could result in rotating components cutting and slashing technician which could result in death or serious injury. During installation, testing, servicing and troubleshooting of this product it may be necessary to work with live and exposed rotating components. Have a qualified or licensed service individual who has been properly trained in handling exposed rotating components, perform these tasks.

Filters

The filter is usually the most neglected item in an air conditioning system. To maintain efficient operation, the filter should be checked every 3 to 6 months and cleaned or replaced as required.

Note: *Conditions of spaces vary. Extremely dusty environments may require more frequent filter maintenance.*

The air filters are located behind the air intake grille at the rear of the cabinet. To access the filters, unlatch the rear access panel at the top and remove it from the cabinet.

Cleanable Filters

Cleanable filters are spring loaded in the holding trays in the access panel. Using a flat head screwdriver, gently push the filters to one side and remove the old filters from the trays (Figure 26, p. 63).

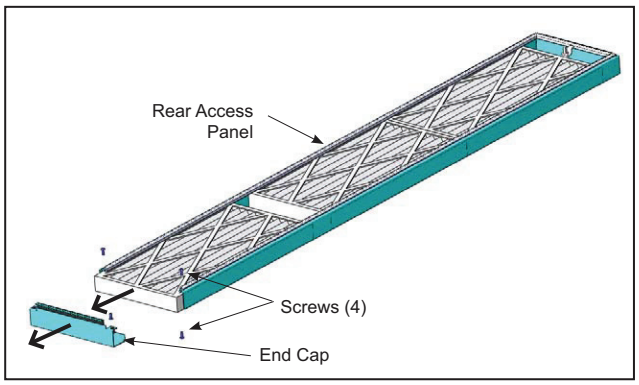
Figure 26. Cleanable filters

Clean the filter media using a vacuum cleaner, low pressure compressed air or rinse with water. A mild detergent such as dish washing liquid may be used. DO not use solvents or cleaning agents. Replace the filters every 2 to 3 years when they become too flimsy.

Cartridge Filters

Replaceable cartridge filters are held in place by an end cap in the bottom of the rear access panel. Lay the access panel down on a piece of cardboard and remove the four screws holding the end cap in place. Remove the end cap and slide the old filters out of the tray as shown in Figure 27, p. 64. Slide the new filters into the tray and replace the end cap. Ensure the four screws are fully tightened.

Figure 27. Cartridge Filters



EC Fans

Periodic checks of the EC fans should include checking the wiring, fan motor mounts, housing and impeller wheel. Ensure all electrical connections are tight. Check that all mounting fasteners are secure and the impeller wheel is tightly mounted. The impeller blades must be kept free of debris.

Coil

The coil should be inspected semi-annually and cleaned as required, following standard coil cleaning practices. Using a brush, clean the coil fins of all debris that will inhibit airflow. This can also be done with compressed air or with a commercial coil cleaner. Check for bent or damaged coil fins and repair as necessary. Check all refrigerant lines and capillaries for vibration isolation and support as necessary. Check all piping for signs of leaks.

Drain Pans

To ensure proper drainage, inspect the drain pans regularly. Make sure the drain pan outlets are always free of debris so they empty readily and ensure the drain pans do not leak.

NOTICE

Coil Fin Damage!

Failure to follow instruction below could cause corrosion on the coil fins and cause coil fin damage. Do not use chloride based water conditioning additives in condensate drain pans.

Condensate Pump

The condensate pump should be inspected semi-annually and cleaned. It will be necessary to remove the pump as described in “Condensate Pump Replacement,” p. 68. Inspect the water level switch and ensure that the float works freely. Wipe the float with a wet cloth and detergent to remove dirt. Check that the discharge line is open and water can pass through it freely.

A/C System

Check the refrigerant sight glass on a monthly basis while the unit is running and ensure it is free of bubbles. Bubbles in the sight glass indicate a low refrigerant charge or a clogged filter-drier. Check for humidity in the refrigerant by viewing the color of the indicator in the center of the sight glass and comparing it to the color scale on the outer ring. If humidity is present, the system must be evacuated and recharged.

Check the superheat and sub-cooling temperatures semi-annually and ensure they are within the range shown in the refrigerant pressure/temperature table in “Refrigerant Characteristics,” p. 24. If necessary, adjust the refrigerant charge to achieve the correct values. If the refrigerant level is low, check the system for leaks.

Troubleshooting

Turn off all power to the unit before conducting any troubleshooting procedures, unless the procedure specifically requires the system to operate. For troubleshooting purposes, the system may be operated with the doors open by using a pair of channel lock pliers to turn the shaft of the main power disconnect switch to the On position. When the switch is turned on, high voltage will be present inside the cabinet. Exercise caution to prevent injury. Keep hands, clothing and tools clear of the electrical terminals and rotating components. Ensure that your footing is stable at all times.

Table 36. Troubleshooting methods

Symptom	Probable Cause	Recommendation
Air Flow Too Low	Dirty air filters. (Reduced airflow)	Clean/replace filters.
EC Fan(s) Fail to Start	Power failure.	Check main voltage power source input cable.
	Motor starter protector tripped.	Reset motor starter protector and check amperage of motor.
	Control transformer circuit breaker tripped.	Check for short circuit or ground fault; if none reset circuit breaker.
	Condensate overflow switch open.	1. Ensure unit is level. 2. Check that condensate pan is draining.
	Defective contactor.	Repair or replace.
	No control signal to fan(s)	Check the Control I/O Board for a 0-10 VDC control signal to the fan(s). Refer to the electric drawing to determine the correct I/O board terminal numbers. This must done within 15 seconds of turning the disconnect switch "On" or the controller will go into "Air Proving Alarm" mode.
	EC fans internal overheat protection interrupted fan motor operation.	Determine the cause of the interruption and correct. Possible causes are: 1. Blocked rotor. 2. Low supply voltage > 5 seconds. 3. Loss of phase > 5 seconds. After causes 1, 2, and 3 are corrected, the motor will automatically reset. After the causes below are corrected, the fan(s) must be manually reset by turning off power for 20 seconds: 4. Over temperature of electronics. 5. Over temperature of motor.
Control is Erratic	Wiring improperly connected or broken.	Check wiring against electrical drawing.
Compressor Fails to Start	Temperature setpoint too high.	Adjust to desired temperature.
	Compressor internal overload protector is open.	Check compressor for short circuit or ground.
	Complete loss of refrigerant charge (low pressure safety switch tripped).	Locate and repair leak. Recharge system.
	Condenser pressure too high (high pressure safety switch tripped).	Check condenser for obstructions.
	Minimum off time has not expired.	Wait for time to expire
System Short of Capacity	Temperature setting too high.	Increase temperature setpoint.
	Discharge air short cycling back to return.	Check air barrier between hot/cold aisles.
	Low airflow.	1. Check filters. Replace as needed. 2. Check for and clear any obstructions across or in the (supply) discharge air stream. Clear coil fins of debris. 3. Check evaporator coil for bent fins. 4. Check correct rotation of fans.
	Low refrigerant (indicated by bubbles in sight glass).	Check for leaks Repair and recharge system.
	Expansion valve stuck or obstructed (short cycling or continuous running).	Remove valve and clear obstruction or replace valve.
	Clogged drier/strainer (feels cold).	Replace with new drier/ strainer.

Table 36. Troubleshooting methods (continued)

Symptom	Probable Cause	Recommendation
System Short of Capacity (CSR-W and CRS-G Units)	Low Water-Water/Glycol flow.	1. Check for leaks. Repair and recharge system. 2. Check for obstructions in supply/return lines. 3. Check for clogged strainer (if applicable).
	Supply water temperature too high.	Check chilled water supply.
Water-Water/Glycol Valve Fails to Open or Close	Temperature setpoint too high.	Adjust to correct temperature setting.
	No control power to the valve.	Valve actuator is wired incorrectly. Check wiring diagram and rewire if required.
	Actuator failed.	Replace actuator.
Condenser Pressure too High (CRS-A Units)	Non-condensable gas or air in the system.	Recover system, evacuate per "Preparing System For Charging," p. 22, recharge. Replace drier/strainer.
	Condenser air intake is blocked.	Remove debris and clean condenser.
	Overcharge of refrigerant.	Reclaim excess refrigerant from system.
	Condenser fan not operating.	Check pressure/temperature operating switches and motor. Replace as needed.
Condenser Pressure too High (CRS-W, -G units)	Flow of water/glycol too low (cont.)	1. Check glycol solution level and concentration. 2. Valves not open or partially open. Repair/replace as needed. 3. Air in system - bleed system. 4. Check all strainers and clean if needed.
	Water/glycol temperature too high.	Check flow and operation of drycooler.
	Control pressure set too high.	Adjust controller to obtain correct pressure.
	Water/glycol solution not mixed prior to adding to system.	Remove solution and premix. Refill system.
Condenser Pressure too Low	a. Loss of refrigerant (indicated by bubbles in sight glass).	Locate and repair leak. Recharge system.
	Condenser fan controls not set properly.	Adjust or repair controls.
	Control pressure set too low.	R410A- Readjust to 440 psig.
Noisy Compressor	a. Expansion valve stuck in open position (abnormally cold suction line).	Ensure feeder bulb is tight on suction line. Check operation and superheat.
	Broken compressor valve (compressor knocking, suction pressure rises faster than 2lbs/min after shutdown).	Replace compressor.
	Worn or scarred compressor bearings.	Replace compressor.
	Liquid slugging.	System overcharged. Reclaim excess refrigerant.
	Scroll compressor not properly phased.	Phase correctly at main power source. **DO NOT REWIRE COMPRESSOR**.

Field Service

Repairs must be performed by a journeyman, refrigeration mechanic, or air conditioning technician. Turn off power to unit at the main power disconnect switch before attempting to make repairs.

Note: *Do not attempt to make repairs without the proper tools.*

Water-Water/Glycol System

If the water or water/glycol system is not cooling or if cooling is reduced, check for fluid leaks in the system. Check for clogged water lines. If filters are installed in the fluid lines, check the condition of the filters. Clean or replace the filters if necessary.

In situations where scaling could be heavy, untreated water in the unit cooling coils may cause, over a period of time, a loss of heat exchange capacity due to a mineral deposit build-up inside the coil. Only a qualified service mechanic should clean dirty coils.

Leak Detection/Repair

A leak in a fluid cooling system will usually form a puddle of fluid beneath the unit that can be easily seen. Visually trace the leak up from the puddle to the area on the unit where fluid may be seen dripping.

When a leak is detected, turn off the fluid supply before attempting repairs. Adjacent piping must be thoroughly cleaned by removing all paint, dirt and oily film. Use wire brush,

sandcloth or sandpaper and wipe the area with clean, dry cloths. Protect nearby parts from heat damage by wrapping with water- soaked cloths.

For copper-to-copper (piping) repairs use a phosphorus copper brazing alloy with 15% silver. General purpose silver brazing alloy with 45% silver is to be used for copper-to-brass or copper-to steel repairs.

When repairs are completed, remove all traces of flux and flush the system. After any repair, pressurize the system to check for leaks prior to recharging the system.

DX System

It may be necessary to perform repairs on the refrigeration system. If field repairs are necessary, the following procedures apply:

Leak Detection

Several methods can be used to detect a leak in the refrigeration system. The most modern and easiest method is to use an electronic leak detector. Follow the manufacturers directions and any leak can be quickly located. A second method is to use soap bubbles. Apply a solution of soapy water with a brush or sponge to the joints and connections in the refrigeration lines. A leak in the lines will cause bubbles to form.

Leak Repair

When a leak is located, properly reclaim the remaining refrigerant charge before beginning repairs. Adjacent piping must be thoroughly cleaned by removing all paint, dirt and oily film. Use a wire brush, sandcloth or sandpaper and wipe the area with clean, dry cloths. Protect nearby parts from heat damage by wrapping with water-soaked cloths.

Refrigerant Piping

When replacing components within the cabinet of the unit, the following consumable materials are recommended: When brazing copper-to-copper connections (piping liquid line or suction line), use a phosphorus copper brazing alloy with 15% silver. General purpose silver brazing alloy with 45% silver is to be used for copper-to-brass or copper-to steel. For liquid line repairs at the drier, strainer, sight glass, or expansion valve, use a 95% tin to 5% antimony solder with flux.

When component replacement is complete, remove all traces of flux. After any repair, pressure check the system to ensure there are no leaks prior to recharging the system.

Refrigeration System Repairs

Compressor Failure

The compressor is the most important component of the air conditioner. Numerous safety devices are provided to protect the compressor from failing.

If a compressor failure has occurred, determine whether it is an electrical or a mechanical failure. An electrical failure will be indicated by the distinct pungent odor once the system has been opened. If a burnout has occurred, the oil will be black and acidic. A mechanical failure will have no burned odor and the motor will attempt to run, an abnormal or excessive noise may be present.

An analysis of the oil is the only way to determine the proper procedure for cleaning the refrigerant system. Acid test kits are available from several manufacturers for measuring the acid level in the oil. These are capable of making accurate acid measurements, but if they are not available, a check of the oil by sight and smell can give a quick indication if contamination remains in the system.

⚠CAUTION

Severe Burns!

Failure to follow instructions below could result in severe burns.
Avoid touching or contacting the gas and oil with exposed skin. Use long rubber gloves when handling contaminated parts.

All electrical connections should be checked to ensure they are tight and properly made. Check all circuit breakers, contactors and wiring. The contactors should be examined and replaced if contacts are worn or pitted.

If there is acid in the oil, there has been an electrical failure which has caused the compressor motor to burn out. The acid diffuses throughout the refrigeration system and must be removed by using a burnout filter kit before a new compressor is placed in service. Not only must the compressor be replaced, but also the entire refrigeration circuit must be cleaned of the harmful contaminants left by the burnout. See “Standard Cleanout Procedure,” p. 67 (Burn-Out/Acidic Cleanup) for the proper procedure.

If there is no acid in the oil, there has been a mechanical failure. See “Burn-Out/Acidic Cleanup Procedure,” p. 68 (Standard Cleanout) for the proper cleaning procedure.

⚠CAUTION

Damage to a replacement compressor caused by improper system cleaning constitutes abuse under the terms of the warranty. This will VOID THE COMPRESSOR WARRANTY. Always consult the factory prior to replacing the compressor.

Important: *PVE oil is used in systems with R410A refrigerant. If a replacement compressor is provided, ensure that it is filled with PVE oil before installing.*

Note: *Cleaning operations must be performed by a journeyman, refrigeration mechanic, or air conditioning technician.*

Standard Cleanout Procedure

1. Turn off power to unit at the main power disconnect switch.
2. Remove the old compressor and install the new compressor.

3. Remove the liquid line drier and install an oversized liquid line filter-drier (one size larger than the normal selection size).
4. Evacuate the system according to standard procedures. Normally, this will include the use of a high-vacuum pump and a low-vacuum micron gauge for measuring the vacuum obtained.
5. Recharge the system.
6. Turn on the power at the main power disconnect switch and start the system.

Burn-Out/Acidic Cleanup Procedure

1. These systems should be cleaned using the suction line filter-drier method.
2. Turn off power to the unit at the main power disconnect switch.
3. Remove the burned-out compressor and install the new compressor.
4. Install a suction line filter-drier designed for acid removal.
5. Remove the liquid line drier and install an oversized liquid line filter-drier (one size larger than the normal selection size).
6. Check the expansion valve, sight glass and other controls to see if cleaning or replacement is required.
7. Evacuate the system according to standard procedures. Normally this will include the use of a high-vacuum pump and a low-vacuum micron gauge for measuring the vacuum obtained.
8. Recharge the system through the access valve on the suction line filter-drier.
9. Turn on power at the main power disconnect switch and start the system.
10. A permanently installed suction line filter-drier permits small-system cleanup to be completed in one service call. The pressure drop across the suction line filter-drier should be measured during the first hour of operation. If the pressure drop becomes excessive, the suction line filter-drier should be replaced (See Sporlan Bulletin 40-10, for the maximum recommended pressure drop (PSI) for the suction line filter drier).
11. In 24 hours, take an oil sample. Observe the col- or and test for acidity. If the oil is dirty or acidic, replace the suction line filter-drier.
12. In 2 weeks, examine oil to determine if another suction line filter-drier change is necessary.

Component Replacement

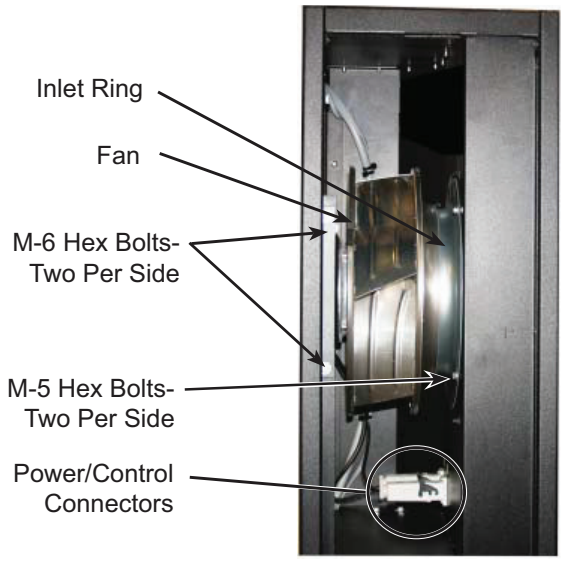
All electrical connections should be checked to ensure they are tight and properly made. Check all circuit breakers, contactors and wiring. The contactors should be examined and replaced if contacts are worn or pitted.

1. Turn off power to unit at the main power disconnect switch.
2. Remove the old component and install the new one.
3. Turn on power at the main power disconnect switch and start the system.

Fan Replacement

The EC Fans are located behind the front access panel. The panel must be removed to access the fans. The fans are equipped with quick connect fittings for the power and control cables to make swap-out easy. Lift the retaining latch on top of the power and control cable connector housings to unplug the cables. Cut the wire-ties holding the cable bundle in the cabinet.

Remove the four hex-bolts holding the inlet ring then remove the four hex-bolts holding the fan mounting bracket. Remove the fan assembly together with the inlet ring from the cabinet. Remove the mounting bracket from the old fan and install it on the new fan. Bolt the new fan assembly (together with the inlet ring) into the cabinet and plug the power and control cables into the connectors.



Condensate Pump Replacement

The condensate pump can be accessed directly through the front panel and is easily accessible for replacement by removing the front panel.

Reach inside the fan opening to grasp the pump. Tilt the pump up and cut the wire-ties holding the clear plastic discharge line. Remove the discharge line from the barbed stub fitting. Release the cable retaining clip on the side of the pump and cut the wire-ties holding the cable loop. Maneuver the pump into the fan opening with the cable still attached and remove the cover to expose the wire terminals. Remove the wires from the pump and remove the pump from the cabinet. Install the replacement pump in the same manner that the old pump was removed, reversing the procedure.

Product Support

Product Support provides aftermarket technical and field support, warranty authorization and part sales to contractors and end users. Factory authorized services are available by request and include:

- Factory Authorized Start-up/Warranty Inspection
- Commissioning Assistance
- Break Fix Repair
- Preventive Maintenance Contracts
- Performance Evaluations
- Technician and Owner Training

Factory Authorized Start-up/Warranty Inspection

Factory Authorized Start-up/Warranty Inspection ensures that your equipment is installed and operating per recommended guidelines. This essential service guarantees that equipment has the best warranty coverage available.

Precision cooling equipment is covered by an industry leading 24 Month Upgraded Parts Warranty and 90 Day Labor Warranty once Factory Authorized Warranty Inspection/Start-up is performed and start-up checklists are returned and validated by product support.

A Limited 12 Month Parts Only Warranty applies if Factory Authorized Start-up/Warranty is not purchased and start-up checklists are received from an unauthorized party and validated by product support.

Technical Support

When calling to obtain support, it is important to have the following information readily available, (information is found on the units nameplate):

- Unit Model Number
- Sales Order Number
- Item Number
- Unit Serial Number
- Description of Problem

Obtaining Warranty Parts

A support technician will provide troubleshooting assistance over the telephone.

If it can be determined that a part may be defective, a warranty authorization for a replacement part will be processed by Technical Support. The replacement part will then be shipped via UPS ground. If the customer requests that warranty part(s) be sent by any other method than UPS ground, the customer is responsible for the shipping charges.

The purchase order must contain the following items:

- Purchase Order Number
- Date of Order
- Stated Part Price
- Customer Billing Address
- Shipping Address
- Customers Telephone and Fax Numbers
- Contact Name
- Unit Model No., Serial No. and Item No.

The customer is responsible for the shipping cost incurred for returning the defective part(s). Return of defective part(s) must be within 30 days at which time an evaluation of the part(s) is conducted and if the part is found to have a manufacturing defect a credit will be issued.

When returning defective part(s), complete the Return Material Authorization Tag and the address label provided with the replacement part. For prompt processing, please affix the RMA in a prominent place on the external packaging of the returned part.

Obtaining Spare/Replacement Parts

Maintaining a recommended spare parts inventory is an industry best practice for critical facilities. Onsite spares kits reduce downtime and can eliminate the cost of expedited freight charges.

Appendix A CRS-042-G Preventive Maintenance Inspection Checklist

Complete a copy of this document for each CRS-042-G unit.

Site Name		**Site Contact**	
Site Address		**Site Phone**	
City, State		**Service Date**	
Zip		**Technical Name**	
Unit Model		**Unit Serial**	

Table 37. Current room conditions

Room Temperature:		Room Humidity:	

Table 38. Unit setpoints

Return Temperature:		Return Humidity:	
Remote/Supply Temperature:		Remote/Supply Humidity:	

Table 39. Electrical panel

Inspect unit disconnect for proper operation:	☐ Pass	☐ Fail	☐ N/A
Inspect internal wire for discoloration:	☐ Pass	☐ Fail	☐ N/A
Inspect fuses:	☐ Pass	☐ Fail	☐ N/A
Inspect for secure electrical connections:	☐ Pass	☐ Fail	☐ N/A
Inspect low voltage connections:	☐ Pass	☐ Fail	☐ N/A
Inspect relays and contactors for serviceability, i.e. pitted contacts, weak coils:	☐ Pass	☐ Fail	☐ N/A

Note: *The following should be performed by Trained Service Personnel only*

Table 40. Record supply voltage

L1-GND:		L2-GND:		L3-GND:	
L1-L2:		L2-L3:		L1-L3:	

Table 41. Unit operation

Verify Control Device Operation:	☐ Pass	☐ Fail	☐ N/A
Verify Customer Setpoints:	☐ Pass	☐ Fail	☐ N/A
Inspect Filter Clog/Air Safety Switches and Tubing:	☐ Pass	☐ Fail	☐ N/A
Chilled Water Valve Operation:	☐ Pass	☐ Fail	☐ N/A
Condensate pump operation:	☐ Pass	☐ Fail	☐ N/A

Table 42. Blow section

Inspect motor pulleys and sheaves for excessive grooves:	☐ Pass	☐ Fail	☐ N/A
Inspect bearings for excessive wear:	☐ Pass	☐ Fail	☐ N/A
Inspect Blower Section for any loose parts or debris:	☐ Pass	☐ Fail	☐ N/A
Filter condition:	☐ Replace	☐ Good	☐ N/A
Belt condition:	☐ Replace	☐ Good	☐ N/A

Table 43. Record fan motor amp draw

(Fan 1)L1:		L2:		L3:	
(Fan 2)L1:		L2:		L3:	
(Fan 3)L1:		L2:		L3:	

Table 44. Check compressor operation

Check electrical connections:	☐ Yes	☐ No	☐ N/A
Visual inspect for oil leaks:	☐ Yes	☐ No	☐ N/A
Check for excessive vibration:	☐ Yes	☐ No	☐ N/A
Check crankcase heater operation:	☐ Yes	☐ No	☐ N/A
Oil level during operation	Compressor 1:	☐ Empty ☐ ¼ ☐ ½ ☐ ¾ ☐ Full ☐ N/A	
	Compressor 2:	☐ Empty ☐ ¼ ☐ ½ ☐ ¾ ☐ Full ☐ N/A	
Sight glass	Circuit 1:	☐ Green ☐ Yellow ☐ N/A	
	Circuit2:	☐ Green ☐ Yellow ☐ N/A	

Table 45. Record compressor amp draw

(Compressor 1) L1:		L2:		L3:	
(Compressor 2) L1:		L2:		L3:	

Table 46. Record compressor amp draw

Circuit 1	Discharge Pressure:		Suction Pressure:	
	Discharge Line Temp:		Suction Line Temp:	
	Liquid Line Temp:			
	Subcooling:		Superheat:	
	EW		LWT:	
Circuit 1	Discharge Pressure:		Suction Pressure:	
	Discharge Line Temp:		Suction Line Temp:	
	Liquid Line Temp:			
	Subcooling:		Superheat:	
	EW		LWT:	

Table 47. Check heater operation

Check electrical connections:	☐ Yes	☐ No	☐ N/A
Check heater elements for any damage:	☐ Yes	☐ No	☐ N/A
Inspect heater overloads for damage:	☐ Yes	☐ No	☐ N/A

Table 48. Record heater(s) amp draw

(Heater 1)L1:		L2:		L3:	
(Heater 2)L1:		L2:		L3:	
(Heater 3)L1:		L2:		L3:	
(Heater 4)L1:		L2:		L3:	

Table 49. Site recommendations

1.
2.
3.
4.
5.

Table 50. Final verification

Technician Signature:		Date:
QA Verification:		Date:

Notes

Trane - by Trane Technologies (NYSE: TT), a global climate innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

AH-SVX015A-EN 08 Apr 2023
(NEW)