TRANE

Arctic

Installation, Operation, and Maintenance

Thermafit™ Air-to-Water Heat Pump

Model AXM

⚠ 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.

August 2022

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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-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

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 Labelling 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.**

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⚠ 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.**

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Table of Contents

Model Number Descriptions

Model Number and Coding

When contacting Trane for technical support, customer service, or parts information, be prepared to provide the model number and serial number of the heat pump modules in question. This information is located on the blue plastic heat pump nameplate that is affixed to each module.

Heat Pump Model and Serial Numbers

For future reference, record the model number and serial number for each module in the heat pump in the table below, Heat Pump Reference Data. Refer to the Trane nameplate on each module in the installed unit for the serial number and model number.

Table 1. Heat pump reference data

Module	Model Number	Serial Number
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Model Number

Critical information for contacting Trane technical support. Reference to the actual heat pump module serial number may also be beneficial. Each module has its own unique serial number.

Model Coding Key

Model numbers assigned to Trane systems provide a wealth of information about the features for a heat pump's "as-built" configuration.

Heat Pump Description

Heat Pump Scope

This manual provides relevant data to properly operate, maintain, and troubleshoot the Trane AXM air-to-water modular heat pump. Operator and maintenance personnel must be a qualified refrigeration technician and have a working knowledge of high voltage systems, low voltage control circuits, and components and functions.

Heat Pump Capacities

The AXM Heat Pump model is available in 30 nominal ton capacity modules. A minimum of 2 and up to 10 modules may connect together in a standard primary/secondary control system. The system consists of a primary heat pump module that contains the primary microprocessor controller, the power distribution panel, and one or more secondary modules. It is important to connect modules in the correct sequence as detailed in Handling of the Modules section of the Installation Mechanical chapter.

The AXM heat pump uses independent refrigeration circuits in each module with each vapor injected scroll compressors. Models are available with brazed- plate load heat exchangers. The brazed-plate heat exchanger is typically made of SAE Grade 316 stainless steel and 99.9% copper brazing materials. Standard interconnecting headers are composed of carbon steel.

Water quality must be monitored and maintained by a water treatment professional familiar with the materials of construction and operation of the equipment. The heat pump modules arrive fully charged with refrigerant. As required under Federal regulations, installation, initial start-up, and technical servicing should only be performed by fully qualified personnel.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Component Description

Every heat pump module is comprised of five basic components: compressor, load heat exchanger, expansion valves, reversing valves, and air coils. Each heat pump module contains one or more of these primary refrigeration components.

Vapor Injected Scroll Compressor

An enhanced vapor injection scroll compressor is provided on each refrigeration circuit for greater heating performance in low ambient temperatures.

Dual independent refrigeration circuits provided in each module each with Rotalock connections for compressor isolation, oil level sight glass, suction gas-cooled motor with solid-state sensors in the windings for overload protection, and circuit breaker protection. There shall be two independent compressors and refrigerant circuits per module. Compressors shall be mounted to the formed sheet metal frame with rubber-in-shear vibration isolators.

Load Heat Exchanger

Each module contains a brazed plate heat exchanger constructed with SAE Grade 316 stainless steel corrugated channel plates with copper filler material between each plate. The filler material forms a brazed joint at every contact point on the plates creating complex channels. This allows fluid to come into close proximity of the cold refrigerant, separated only by channel plates, thereby efficiently cooling the fluid to the required temperature. Interconnecting pipe headers between modules are schedule 10 carbon steel.

Pre-Installation

Preparation for Initial Startup

After the system is completely installed with all wires connected and all piping securely coupled, the heat pump can be prepared for initial startup.

Ensure there is a sufficient cooling or heating load available for proper testing of the heat pump system.

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Initial Startup

1. Close all drain valves and header purge valves.
2. Fill the heat pump with clean water/glycol mixture.
3. Inspect all connections for leaks during the filling process.
4. De-energize heat pump using industry-standard lockout/tagout procedures. Verify main power is turned off at the power distribution panel. Validate de-energization using voltage meter.
5. Inspect all electrical connections to ensure terminals are secure.
6. Inspect all fuses and overload settings to ensure they conform to specifications.
7. Inspect all refrigerant pressures for each module to ensure no refrigerant has been lost.
8. Check that pressure switches and thermostats have correct “cut-in” and “cut-out” settings.
9. Confirm the oil level is correct in each compressor.

NOTICE

Compressor Failure!

Failure to follow instructions below could result in catastrophic compressor failure.

Do not operate with insufficient oil.

10. Connect phase monitor wiring, if required.
11. Connect remote flow switch if the heat pump is so equipped.
12. Ensure refrigerant valves are open at the compressors.
13. Confirm that pressure and temperature switches are in the closed position.
14. Apply power to all modules in the heat pump.
15. Turn on the condenser and evaporator fluid pumps and ensure there is proper flow and the pressure drop across the system is as expected.
16. Monitor and record all temperatures and refrigerant pressures.

Table 2. Initial startup readiness checklist

☐	Startup Readiness Dimension
☐	Describe voltage service: ☐ Fused disconnect ☐ Non-fused disconnect ☐ 50 Hz ☐ 60 Hz
☐	Record rated power supply: __________volts_______ phase • Circuit breaker rating: _______
☐	Record supply voltage on Heat Pump nameplate: _________________
☐	Record power supply voltage to ground: L-1= _______, L-2 = _______, L-3 = _______
☐	Record voltage between each phase: L-1 to L-2 = ______, L-2 to L-3 = ______, L-1 to L-3 = ______ ☐ Agrees with nameplate values? ☐ Voltages must be within 2%.
☐	Check the box if all electrical connections inside the power distribution panel are tight.
☐	Check the box if all electrical connections inside each module electrical and control panel are tight. Ensure all components inside each module are securely mounted and have not shifted during shipment.
☐	Record the control voltage between TB-1-1 and TB-2-1: ________
☐	Check the box if heat pump system includes any remote panels (city water switchover, remote control panel, or customer supplied control devices). If so, voltage drops are likely to occur. Measure and record all control voltages: List devices: Voltage 1=_____________________ Voltage 2=_____________________ Voltage 3=___________________
☐	Check the box if there are any field-supplied wiring junction boxes located between the heat pump and any remote panels.
☐	Check the box if there are any splices made in the field-supplied wiring junction boxes.
☐	Check the box if there are any customer-supplied devices connected to the heat pump wiring. List devices: ____
☐	Check the box if there are any Trane remote devices connected to the heat pump wiring.
☐	Check the box if voltage drops are detected.
☐	Check the box if the appropriate water/glycol mixture has been added to the heat pump.
☐	Check the box if all Heat Pump modules are installed with minimum clearances available from all sides.
☐	Check the box if refrigeration gauges are indicating equal refrigerant pressures.
☐	Check the box if chilled water lines from Heat Pump to customer’s equipment are permanently connected.
☐	Check the box if chilled water lines have been flushed clean of mud, slag, and other construction debris.
☐	Check the box if all chilled water line filters and strainers are clean.
☐	Check the box if chilled water lines have been leak tested according to pre-startup instructions.
☐	Check the box if heat pump reservoir (if included) is at operating level with correct water/glycol mixture.

Table 2. Initial startup readiness checklist (continued)

☐	Startup Readiness Dimension
☐	Check the box if high voltage wiring is installed, tested, and functional.
☐	Check the box if all water, refrigeration, and electrical connections between heat pump modules are completed.
☐	Check the box if all control wiring between modular heat pumps is installed, tested, and functional.
☐	Check the box if control wiring is complete, including any additional remote interface panel or special-purpose wiring.
☐	Check the box if all responsible installing contractors and sub-contractors have been notified to have representatives available on site to provide technical support for the initial start-up procedure.
☐	Check the box if full load will be available for heat pump on the initial start-up date.
☐	Touchscreen Interface Panel: Record version and date of the software loaded into the touchscreen interface panel: Version: ________________________________ Date: ______________ ***Note:*** *To view the software version, from the home screen, press the software button on the System Control screen.*

Startup

As part of a continuous commitment to quality, initial startup of this Heat Pump must be done by Trane.

Installation Mechanical

Inspect and Report Damage

Upon receipt, inventory the shipment against the Trane bill of lading to ensure all modules and components have been delivered.

Inspect each package in the shipment for visible damage. Verify the correct model number and that all skids and cartons have been delivered. Any damage must be reported to the motor carrier and Trane within five days of receipt of the shipment.

Inspect all exterior components for concealed damage as soon as possible. Do not proceed with the installation of damaged equipment without prior approval of Trane.

Do not refuse delivery of damaged goods without prior authorization.

Inspection of Delivered Equipment

To report damage incurred in transit, complete the following:

1. Inspect each piece of equipment for visible damage before accepting delivery. Check for torn cartons, broken skids, bent metal and torn shrink wrap.
2. Ensure the delivery driver notes any damage on the bill of lading and completes a Carrier Inspection Report. Failure to comply may result in difficulties in resolving any claims for damage.
3. Inspect each piece of equipment for concealed damage before storage or as soon as possible after delivery.
4. In the event of suspected concealed damage, ask the driver to wait until you inspect the equipment. Concealed damage must be reported within five days of receipt of equipment.
5. If concealed damage is found, stop unpacking the shipment. Do not remove damaged material from the receiving location, take photos of the damage. The owner must provide reasonable evidence that the damage did not occur after delivery.
6. Notify the carrier of the damage as soon as possible. Request an immediate joint inspection by the carrier and consignee. A determination of responsibility will be made and the carrier will authorize repairs in the event of admission of fault.
7. Notify your local Trane CSO immediately. Trane will coordinate repairs with the carrier. Do not attempt to make repairs locally without permission.

Warranty Issues

Trane is not responsible for damages or for filing damage claims. It is the customer's responsibility to ensure that the necessary long term storage procedures have been completed and any deviations are reported to Trane immediately.

Long Term Storage Requirements

Appropriate preparation and storage of Trane heat pump components during extended periods of dormancy is essential to ensure the equipment does not sustain damage or degradation due to inactivity and operates properly after installation.

The customer must notify Trane during the sales process that the heat pump system may be transported by ocean freight or placed in long-term storage under any of these conditions:

- The heat pump will not be placed into operation for a period exceeding six months after leaving the Trane factory. That is, the initial start-up date will not occur within a six-month maximum dormancy window.
- The heat pump will be shipped using ocean transit for all or part of the delivery process.
- Cold temperature storage conditions fall below -20 °F (-29 °C).
- Ambient temperature storage conditions exceed 150 °F (66 °C).

Factory Preparation

Upon confirmation of an order requiring long-term storage or protection against extreme environments, Trane will inspect and protect vendor-supplied components before installation.

Prior to shipment, Trane will prepare each heat pump system for long-term storage in coastal or tropical environments by:

- Placing silica gel packs in all electrical panels and variable speed drive panels to prevent corrosion of electrical contacts and moisture from degrading sensitive controllers.
- Shrink-wrapping each heat pump using polyethylene film to limit environmental exposure and protect the Heat Pumps from damage during shipping.
- For multiple modular heat pump system assemblies shipped on a common skid, shrink wrap the entire skid rather than the individual modules.

Trane will document and photograph the status of the unit prior to shipment and carry out the instructions detailed in the factory order regarding in-shop preparation of units for long-term storage.

Customer Responsibilities

Upon receipt of a heat pump system, the customer must conduct thorough internal and external inspections, removing packaging material as needed for access to all components.

Visible damage must be noted on the signed and dated bill of lading. The customer may request a carrier inspection by telephone or in person, but any such request should be confirmed in writing. It is recommended that the customer request that the carrier inspect the damage within 72 hours of notification.

The customer must store the heat pump system in a dry, non-corrosive, dust- and vibration-free environment due to the exposure sensitivities of the microprocessor controllers and to prevent electrical terminations from deteriorating from non-use. Conditions in storage locations should not fall below -20 °F (-29 °C) or exceed 150 °F (66 °C).

Components sealed in plastic shrink-wrap are not exempt from these storage requirement. Moisture can potentially collect inside the plastic film, resulting in corrosion of the cabinet and electronic components. Any heat pump system packaging that is removed must be replaced with similar protective covering as soon as possible.

Failure to adhere to these long-term storage requirements may void the Trane warranty. Any component that is damaged or inoperable due to improper storage may have its warranty voided.

Handling of the Modules

The packaging from the factory permits lifting with a suitable crane. Ensure straps are in good working condition and that they are rated for the weight of the machines. Spreader bars may be required for effective rigging and to avoid damage to the heat pump modules.

The heat pump modules arrive fully charged with refrigerant. As required under Federal regulations, installation, start-up and service should be performed by fully-qualified, factory-certified, personnel.

⚠ 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

Electrical Shock, Explosion, or Arc Flash Hazard!

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

- **Install the product in an appropriate electrical/ fire enclosure per local regulations. Do not install the product in hazardous or classified locations.**
- **Do not use the product for life or safety applications.**
- **Do not exceed the product ratings or maximum limits. Products rated only for basic insulation must be installed on insulated conductors.**
- **Current transformer secondaries (current mode) must be shorted or connected to a burden at all times.**
- **Remove all wire scraps, tools, replace all doors, covers and protective devices before powering the equipment.**

Site Preparation and Clearances

Heat pump modules must be installed on a level surface that has been checked by a qualified structural engineer to support the weight of the fluid-filled modules and the connective piping to and from the heat pump. Installations must account for minimum service access clearances as may be practical or required by local building codes.

Heat Pump Clearances

One of the most critical factors affecting the performance of air-to-water heat pump is air flow above and around the heat pump modules. Walls, roofs, overhangs, and nearby mechanical heat sources can all degrade heat pump performance. The further heat pump is from such obstacles, the more efficiently it will operate.

Minimum Clearances

The unit must maintain clearance on all sides to provide for adequate ambient air circulation. See Figure 1, p. 14.

The air coils are designed for outdoor installation and must be mounted level on a roof or concrete slab that is strong enough to support the total equipment operating weight. Consult a professional structural engineer to determine safe mounting loads.

Unrestricted airflow must be provided to air coils. Avoid air recirculation from other nearby equipment. Locate the air coils away from building air vents and heat sources such as exhaust fans.

The unit should be located far enough away from any wall or other obstruction to provide adequate clearance for ambient air intake and discharge:

There should be no obstruction above the heat pump module to interfere with fan discharge of heated air. Even a partial overhang of an eave or awning can trap hot air and significantly degrade heat pump performance.

Each heat pump module must be as far away from any wall or barrier as space allows. Sufficient clearance must be maintained between the heat pump modules and any walls or other objects that can interfere with the free flow of air to the air coils.

Screening fences must have 50% open surface area, with one foot of bottom clearance, and must not extend higher than the top of the fan grill. Modules should be a minimum of three feet away from any fence. Failure to follow these minimum requirements may result in performance degradation.

Modules located in a sub-level or pit require special considerations to avoid air recirculation.

Do not attach ductwork to any fan or fan shroud. Contact product support for guidance on any potential ducting applications.

Refrigerant piping should be sufficiently flexible to prevent transmission of noise and vibration into the building.

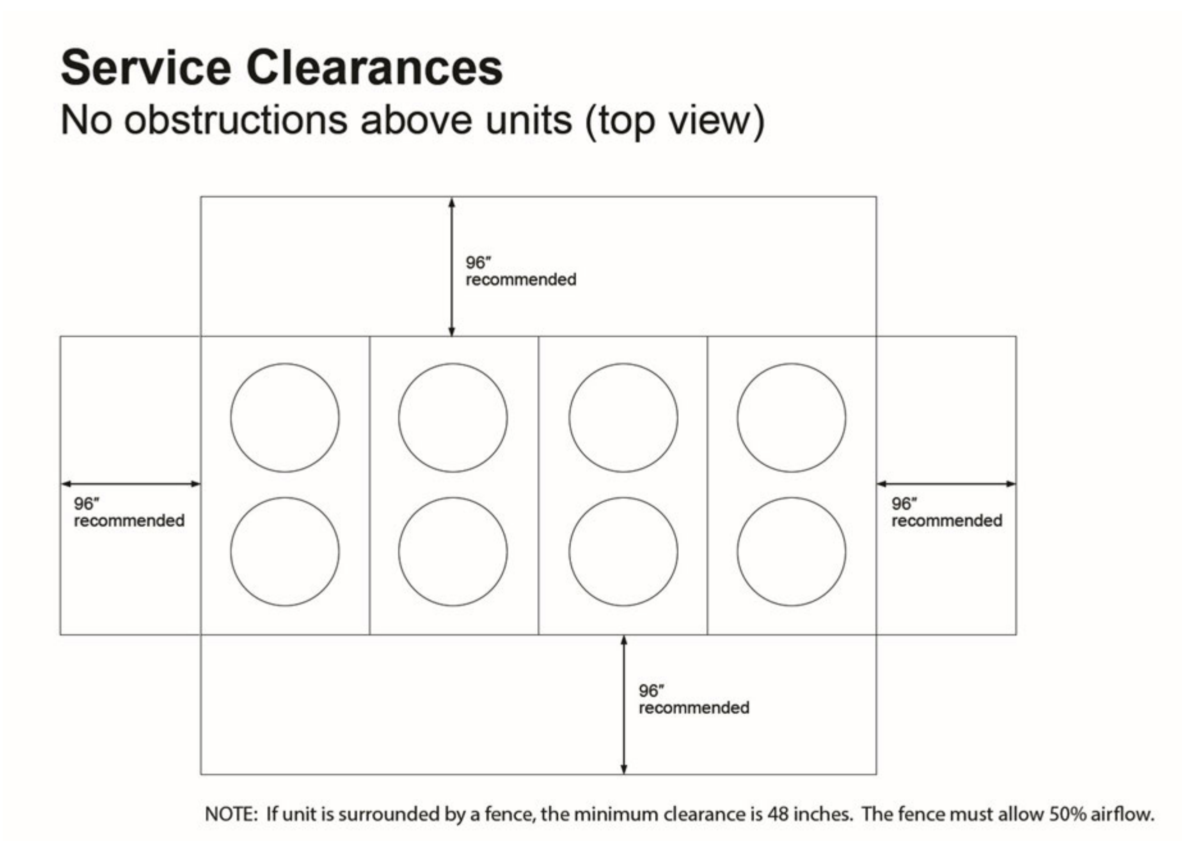
If the desired location for the heat pump is confined by walls, fences, overhanging roof eaves, or is located in a pit (sub-level site), contact Trane to discuss potential impact on equipment performance.

The National Electric Code or local, state, and regional building codes may require greater clearance for the modular heat pump than the figures listed in this publication. Always consult local regulatory agencies to ensure additional clearances are not required by building codes.

Service Access

Clearance must be maintained between the module and any nearby wall or impediment to provide sufficient room to access power distribution panel and electrical and control panels for routine maintenance and servicing. 36 to 48 inches of clearance is required to meet local and national electrical codes. Compressors, filter-strainers, and liquid line shutoff valves are accessible from any service access panel.

Figure 1. Recommended heat pump clearances



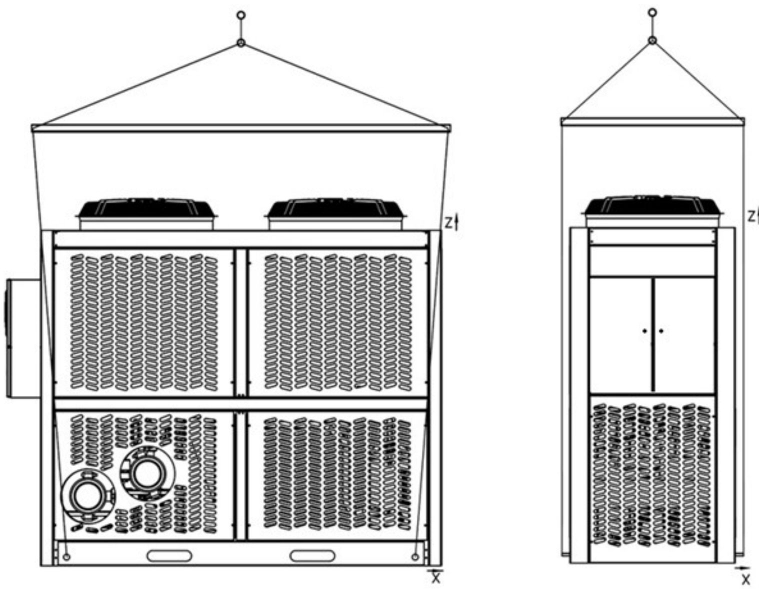
Note: *These clearances are general recommendations. Each installation has specific considerations. Contact Trane for definitive guidance and approval on a job-by-job basis.*

Rigging, Lifting, and Moving the Heat Pump

The air-to-water modular heat pump can be delivered to the customer's site as individual modules or as factory assembled single units, depending on customer requirements and preferences. Limitations on the methods and materials that can be used to rig, lift, or move a heat pump or an individual module include:

- Maintain the module in an upright position at all times.
- Certain configurations of modules can be top-heavy. Move modules slowly with consideration for each module's center-of-gravity.
- Rig, lift, and move by strapping and lifting using a properly configured floor jack or fork lift or by overhead means.
- Position lifting beams to prevent lifting straps from rubbing or contacting module side panels or electrical boxes.
- Do not use cables, chains, or any other type of metalized strapping to lift a module.
- Do not push a heat pump module while directly in contact with the floor using manual or mechanical means.

Figure 2. Recommended heat pump rigging



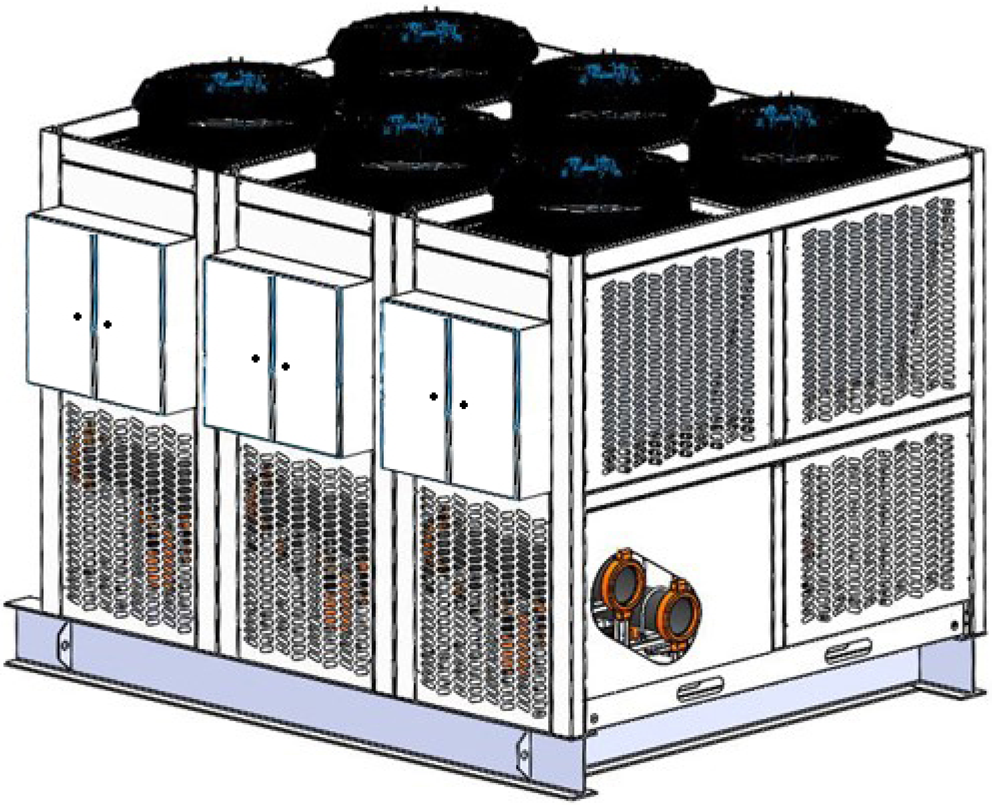
Mounting Rails

The heat pump must be positioned on a firm, level surface. When modules are installed onto structural steel rails, the rails must be level such that the modules are properly aligned. Mounting rails must be a minimum of 4 inches wide. Custom modules may have different requirements.

Consult submittal drawings to confirm dimensions. See Figure 3, p. 16.

All of the modules arrive with labels on the electrical and control panel. Review the installation drawings to determine which is the first, primary, module. Typically the primary module also has the power distribution panel attached to it.

Figure 3. Heat pump installation on mounting rails



While the compressors are installed with rubber-in-shear isolation pads, for additional vibration isolation, spring isolators may be installed under the structural steel mounting rails.

When installing modules directly onto a concrete pad, rubber-in-shear isolator pads may be installed under each module.

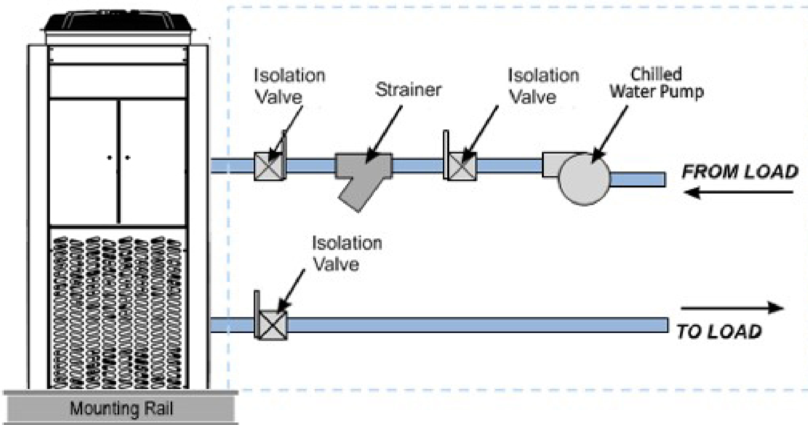
After setting each module, remove front or rear service panels to improve access to components when making connections.

Installation Piping

Install Piping and External Components

Proper support of piping and pipe hangers must consider the weight of the piping as well as the water weight inside the pipes. A 40-mesh screen strainer must be installed in each water/liquid system piping inlet for proper filtration an protection of the heat exchangers. The following figure provides a recommended installation of components.

Figure 4. Recommended heat pump piping



Initial Flushing of Piping

After installation of system piping and before connection to the heat pump system, it is important to clean and remove debris, weld slag, and other contamination deposited during fabrication of the piping system.

Important: *Do not flush through the heat pump modules.*

Typical flushing includes hot water with mild detergent followed by a dilute phosphoric acid solution until all visible residue is removed.

Only cleaning liquids, acids, and detergents compatible with SAE Grade 316 stainless steel, copper, and carbon steel should be used. Consult a professional water treatment specialist when in doubt.

Flushing should take place across a filter/strainer with a maximum 30 mesh screen and continue for a minimum of six hours with frequent removal of the screen to capture residue or until the strainer is clean.

After detergent and chemical cleaning, flush the water piping with fresh water for one hour to remove any remaining cleaning compounds.

Fill with Water/Glycol Solution

The installing contractor is responsible for charging glycol into the heat pump hydronic system.

1. Mix the concentrate of propylene glycol in a tank or drum for transfer into the heat pump. Use Table 7, p. 37 to determine the appropriate glycol concentration for the heat pump.
2. Mix the glycol and water externally before filling the heat pump to prevent clogging of the heat pump piping with a heavy concentrate.

Only after the above steps have been completed should the water piping be connected to the heat pump system.

Dowfrost

Important: *Dowfrost inhibited propylene glycol-based solution is listed as chemically acceptable by the US Department of Agriculture (USDA). The two ingredients in Dowfrost water/glycol mixture are generally recognized by the FDA as safe food additives under Parts 182 and 184 of the Food Additive Regulations.*

Connecting Module Couplings

Install each module according to its position number indicated on its electrical distribution cabinet. Install the primary module first. Each secondary module has the same installation procedure as the previous module.

Installation Electrical

Connecting Module Power and Control Wires

Connections are made at the primary module, which typically contains the power distribution panel .

⚠ WARNING

Proper Field Wiring and Grounding Required!

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Heat Pump Module Main Power

Modular systems feature single-point power connection from the utility service to the power distribution panel on the primary module as standard. Main power phases A, B, and C are connected to terminals A, B, and C respectively from left to right. Some systems have individual power supplied to each module in lieu of single point power.

Phase Monitor Installation

The heat pump is equipped with a phase monitor on the power distribution panel. It communicates with the primary microprocessor controller on the primary module electrical and control panel via the ID8 terminal. Ensure that the wiring from the primary microprocessor controller and terminal blocks to the phase monitor are connected and secure.

The phase monitor continuously monitors each of the three phases. The microprocessor receives input from the phase monitor indicating whether the voltage is within acceptable values. The phase monitor is designed to protect against under-voltage, voltage imbalance, phase loss, and phase reversal.

Set voltage adjustment knob at the desired operating line voltage for the equipment. This adjustment automatically sets the under-voltage trip point. Check the phase monitor after initial startup. If it fails to energize, (the LED glows red or blinks) check the wiring of all three phases, voltage, and phase sequence. If phase sequence is incorrect, the LED flashes green/red. To correct this, swap any two line voltage connections at the mounting socket. No further adjustment should be required.

Power Interlock Switch

Some air-to-water heat pump systems are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel. The disconnect switch must be turned to the off position before the panel can be opened for service.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Single Point Connections

For systems with single point power connections, detach the power cable on each module by cutting the wire tie installed for shipping.

1. Uncoil the power cable and snake it through each module to reach the power distribution panel.
2. Feed the taped end of the cable through the round opening on the extreme left of the power distribution panel.
3. Remove the tape and connect and tighten the cable ends to the breaker corresponding to the module number being connected. (For example, connect the cable for module #9 to the breaker labeled #9.)
4. Connect the green ground lead to the ground lug at the base of the enclosure.
5. Do not secure the ground wire until all of the ground wires are connected to the ground lug and then each can be tightened.
6. After connection, secure all power cables with standard wire ties.

Module Control Wiring

The primary controller communicates with the secondary controller in each heat pump module via a communication circuit. Each secondary controller is wired back to the Ethernet switch on the primary microprocessor controller.

Operating Principles

A typical HVAC system has a cooling requirement in the summer and shoulder seasons and a heating requirement in the winter and shoulder seasons. A modular air-source heat pump system provides an efficient means to address varying cooling and heating demands. The heat pump system can be sized for the greater of the cooling or heating demand. When the smaller of the demands is operating, not all modules operate thereby saving energy costs and improving efficiency. This also allows for the non-operating modules to be on standby should any of the operating modules require servicing. When the HVAC system demand switches between heating and cooling, the refrigeration cycle in each operating module is reversed to produce the required heating or cooling requirement. The air-source heat pump system does not simultaneously heat and cool; it produces either heating or cooling depending on the commanded mode of operation. The ambient air provides the heat source in heating mode where the air coil operates as an evaporator and a heat sink in cooling mode when the air coil operates as a condenser. When operating in heating mode in colder climates, frost will likely form on the air coils. The heat pump modules will periodically defrost the coils by reversing the refrigerant cycle. Modules are sequentially defrosted to minimize the impact to heating capacity. The defrost cycle must be considered when sizing the hydronic system volume to ensure heating supply capacity.

Minimum Fluid Volume and Avoidance of Short Loops

Adequate system fluid volume is an important system design parameter because it provides for stable fluid temperature control and helps limit unacceptable short cycling of compressors. The heat pump system temperature control sensors are located in the supply (outlet) and return (inlet) fluid connections to the building piping. This location allows the building piping system volume to act as a buffer to slow the rate of change of the system fluid temperature. If there is not a sufficient volume of fluid in the system to provide an adequate buffer, temperature control can suffer, resulting in erratic system operation and excessive compressor cycling. The situation can be more severe during the heating operation when individual modules switch to defrost mode. The modules on defrost mode not only stop providing heating capacity, but they also cool down the circulating hot fluid, increasing the heating demand and potentially causing a drop in hot fluid temperature. The defrost cycle can take 3 to 5 minutes to complete. A minimum of fifty times a module capacity or four-minute full load water circulation, whichever greater, is the recommended fluid system volume. So, as an example, for five 30 nominal ton ASHP bank, 30T x 50 = 1,500 Gallons. Assuming 2.4 gpm per ton for full load flow rate,150 x 2.4 x 4 = 1,440 Gallons. So, the greater value of 1,500 Gallons is recommended.

Operating Procedures

Operator Interface

The modular heat pump units, whether they are composed of a single module or up to 10 modules, are automated systems that use a main electrical panel to monitor, report, and modify critical system functions.

Heat Pump Power Panels

There are two different electrical panels used in the heat pump. The main power distribution panel receives power from the building source and distributes it to individual modules. The electrical and control panel on each secondary module receives power from the power distribution panel that powers the individual electrical components.

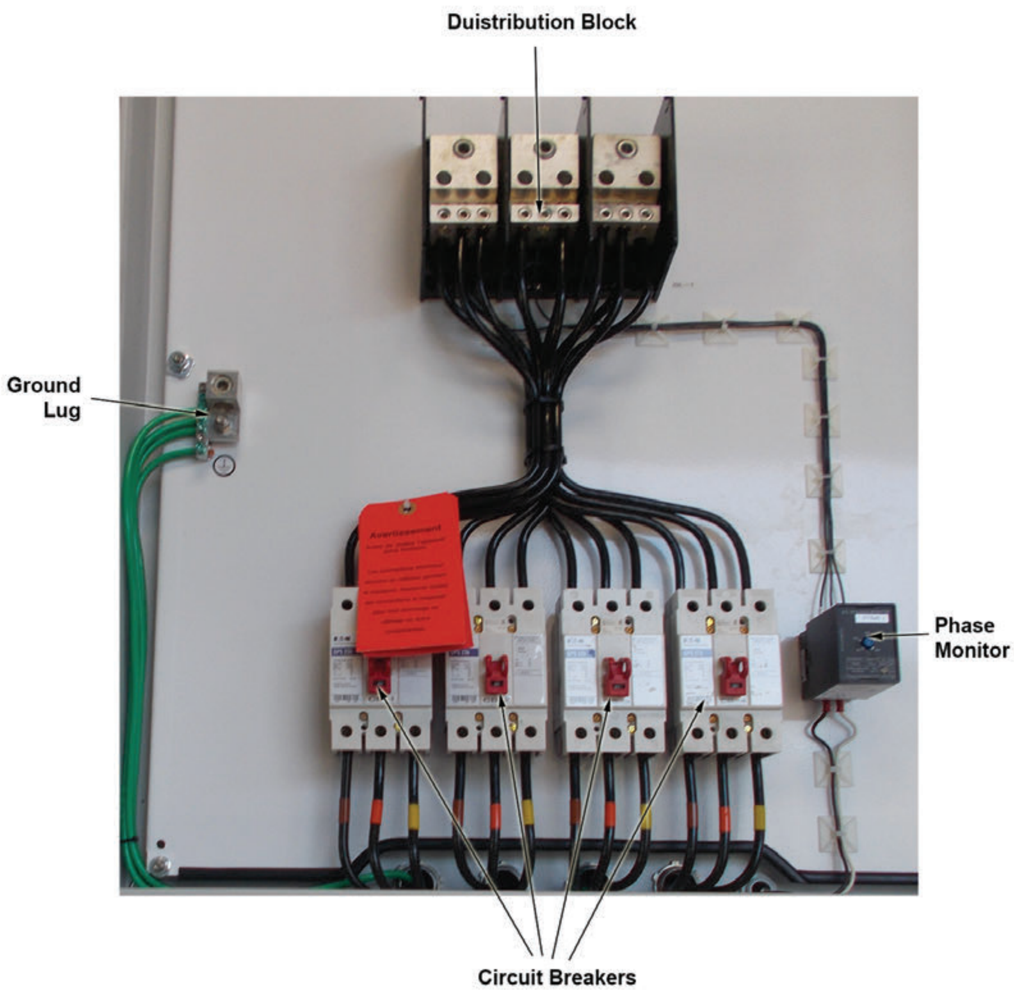
Panel-Mounted Disconnect Switch

Some heat pump systems are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel (or on each module’s electrical and control panel if the heat pump has power supplied to each individual module). The disconnect switch must be turned to the OFF position before the panel can be opened for service. When the panel door is open, the power is disengaged.

Power Distribution Panels

The power distribution panel distributes electricity from the external building power supply. It also houses a circuit breaker for each module, a phase monitor, and an optional main power disconnect switch. See following figure.

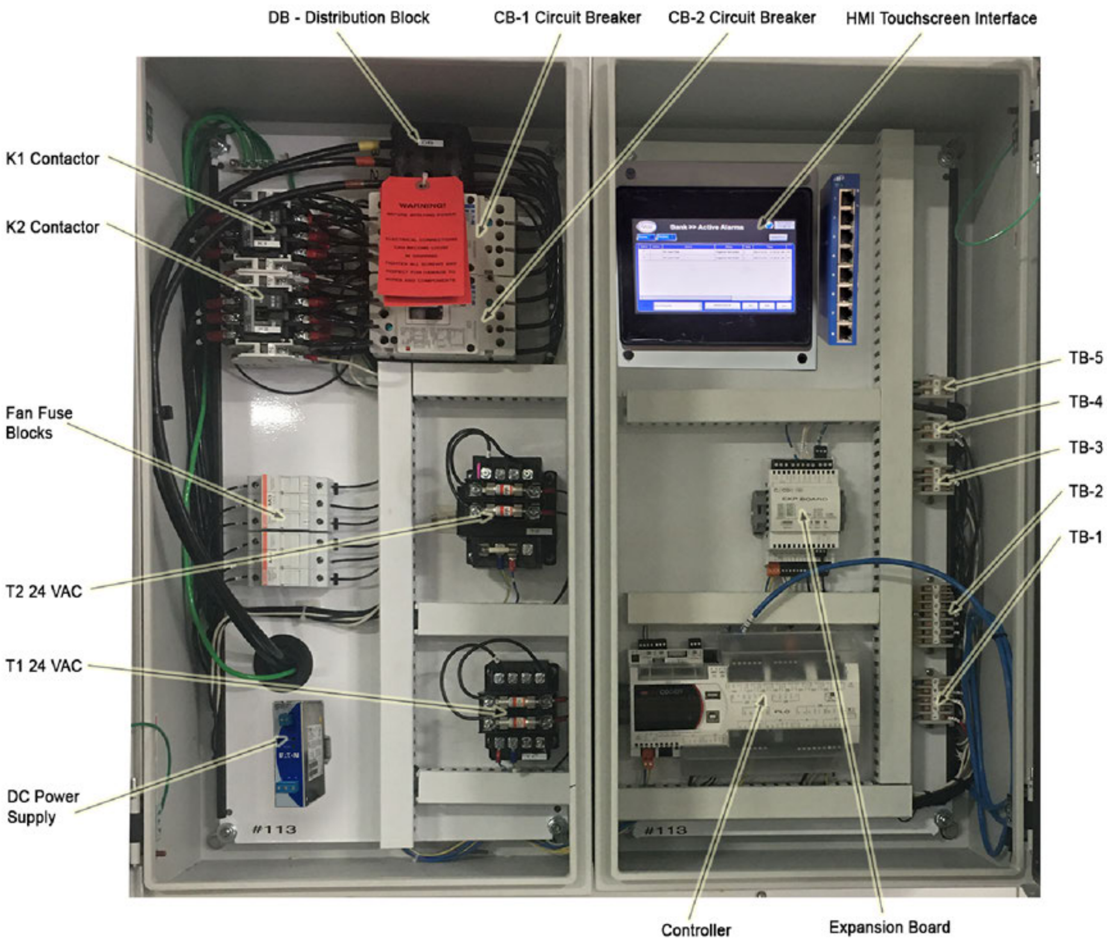
Figure 5. Power distribution panel



Module Electrical and Control Panel

Each module has its own electrical and control panel that distributes electricity to individual components. It also has fuses and breakers, compressor switches, and the microprocessor controller. See the following figure.

Figure 6. Module electrical and control panel



Electronic Control

The Modular heat pump models use Carel c.pCO series microprocessor controllers to monitor and report critical operating parameters. See Figure 8, p. 22. A primary controller is used to control and coordinate the functioning of all the secondary modules that make up the heat pump system. Each secondary module has its own controller.

There are five BMS communication options:

Note: *BMS is not included as standard, but available as an option.*

1. BACnet® MS/TP - Connection through built-in BMS2 port.
2. BACnet IP - BACnet router is used.
3. Modbus® RTU - Connection through built-in BMS2 port.
4. Modbus IP - Modbus router is used.
5. LonWorks® - LonWorks router is used.

Controllers

The distributed microprocessor control system enables all secondary modules to operate independently in the event that the primary microprocessor controller fails. All heat pump safeties including temperature set point, refrigerant pressures, and freeze protection are preserved. The distributed microprocessor control programming only lacks the ability to communicate with the BMS as well as rotate the lead compressors which typically occurs every 168 compressor operating hours.

In a normal configuration, a secondary controller controls the single module to which it is dedicated.

The secondary controller monitors key performance parameters for its module and sends real-time information to the primary controller. The primary controller monitors the performance of the heat pump, activating and deactivating modules as needed to maintain the leaving water temperature for the heat pump.

(See the following figure for a simplified example of a typical microprocessor controller network.)

Figure 7. Typical controller network

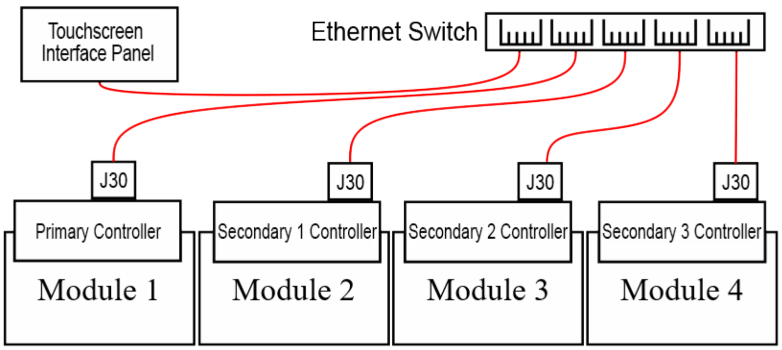


Figure 8. Carel medium c.pCO primary controller

Operating the Microprocessor

The touchscreen interface panel is ready to use when it is connected to the Ethernet switch and heat pump power is ON.

Upon initial startup, the status line will indicate that the heat pump is OFF. Press and hold the ON/OFF button on the touchscreen interface panel; for few seconds to turn the heat pumpON . The status line on the LCD screen of the primary module will indicate that it is powered.

Press and hold ON-OFF button to toggle the heat pump ON and OFF.

Microprocessor Functions

For practical purposes, all essential control information and operator actions are read and responded to using the touchscreen interface panel. The touchscreen interface panel is connected to the primary microprocessor controller and is the only way to access many primary controller functions.

NOTICE

Component Damage!

Failure to follow instructions could damage sensitive electronic components beyond repair.

To prevent arcing or surges of electrical current, do not use wires or cables to jump components or bypass the manufacturer's safety systems.

Password Protection

There are three levels of access to the functions displayed on the interface. The basic level, 'user,' does not require a password. The higher access levels are the technician ('tech') and administrator ('admin') levels that can only be accessed by Trane technical personnel. Contact Trane technical support regarding the possibility of any potential issues involving the higher-level functions.

Operator Control

A touchscreen interface panel is the primary means for the operator or maintainer to monitor and modify a host of functions involving temperatures, pressures, set points alarms, operating schedules, and elapsed operating hours. This touchscreen interface panel can be located within proximity of the primary microprocessor controller. It is typically located in the primary module.

The touchscreen interface is connected to and communicates with all module controllers via the Ethernet switch. It accesses overall heat pump functions and settings as well as individual module settings.

In this manual, all functions, procedures, checklists, system information, and changes in system parameters (set points, alarms, primary heat pump controls, and so forth) are written assuming the operator is using the touchscreen interface panel.

When connected to the Ethernet switch, the touchscreen interface panel displays current, real-time, information about the heat pump, as well as the status of critical parameters within each module of the Heat Pump.

Touchscreen Interface Panel

The touchscreen interface panel is used to adjust set points, clear alarms, and perform detailed setup of the microprocessor controllers.

Figure 9. Touchscreen interface panel

The interface panel displays information on its touchscreen whenever specific combinations and sequences of keys and buttons are pressed by the operator (See following figure).

Basic operator tasks are described in the following sequence of illustrations that comprise a controller tutorial.

Touchscreen Interface Tutorial

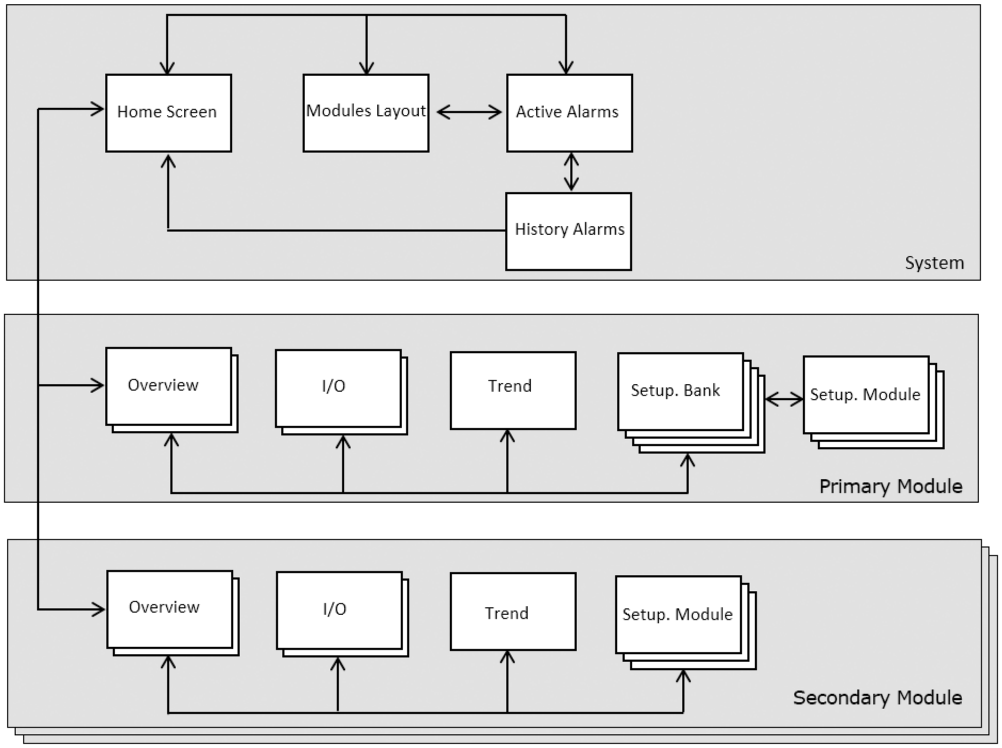
This section consists of a tutorial that first-time personnel can use to navigate through the various functions and features that are available in the interface.

Each of the main screens in the interface contains active hot spots to activate virtual buttons and switches by simply touching the screen.

Interface Menu Structure

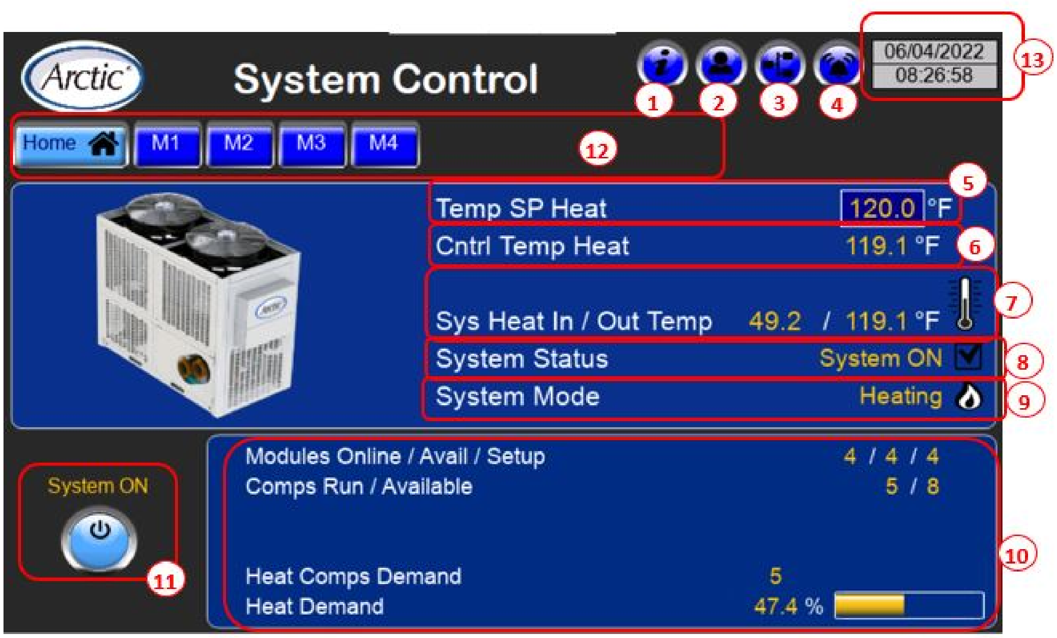
Key interface screens are organized according to system, primary module, and secondary modules functions. See Figure 10, p. 24.

Figure 10. Interface navigation scheme



Home Screen Features

Figure 11. HMI home screen

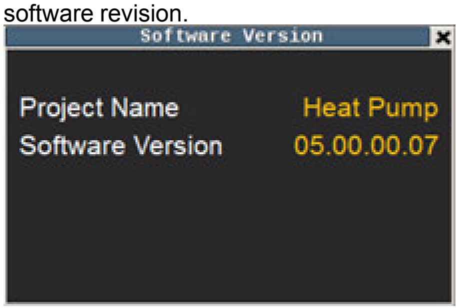


HMI Functions

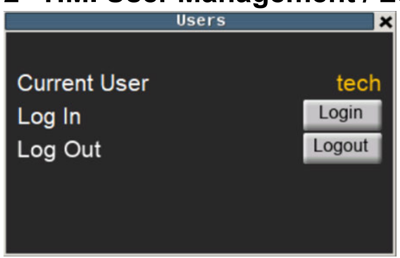
1 - HMI Software Version

Calls up the pop-up window

Project Name: HMI software project name; Software Version.: HMI software version. Consists of 4 two-digit numbers. First 2 numbers: major and minor software revision. Third number stands for special software revision. If any project has the special software, this number would be different from '00'. Fourth number stands for beta software revision.



2 - HMI User Management / Login



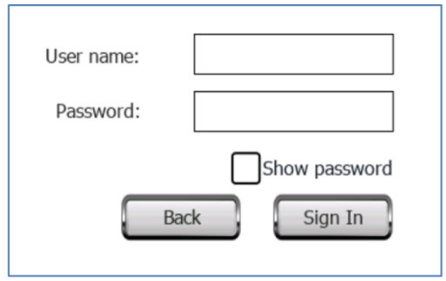
Current User: indicates which user is currently logged in. There are three users for the HMI: 'user', 'tech' and 'admin'.

- user - (default user) has access to viewing data mostly. The only allowed controls for this user are: turning Heat Pump bank on / off and turning compressors on / off (described below). There is no password for this user;
- tech - higher access than user but still limited. Beyond 'user' 'tech' can adjust cooling / heating setpoints, turn separate modules on / off and has access to some machine basic temperature control settings (described below). Password is 'tech2';
- admin - full access to all the settings.

Log in: Calls up user logging screen where user name and password have to be entered

Log Out: unhidden for 'admin' and 'tech' users only. It logs out from 'admin' or 'tech' user to a default user, which is 'user.'

Figure 12. User logging screen



3 - Module Layout Access

The module layout access button provides fast access to the module layout screen.

4 - Active Alarm Access

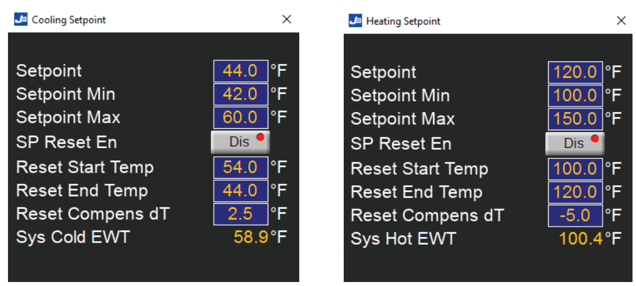
The active alarm access button provides fast access to a list of currently active system alarms.

5 - Setpoint

Calls up cooling / heating setpoint pop-up screens respectively depending on the Mode. Accessible for 'tech' only. These boxes themselves display the resulting cooling / heating setpoint used for machine temperature control.

Note: *The only box on these pop-ups accessible for 'tech' user. The other settings are view-only. See* *Figure 13, p. 25*

Figure 13. Cooling / heating setpoint



6 - Controlled Temperature Reading

7 - System Temperature Sensors Reading

Based on chilled water entering / leaving temperatures for Cooling Mode and hot water temperatures entering / leaving for Heating Mode

8 - System Status

Possible Options:

- System ON. System is not off by any of the conditions below.
- Phase Alarm. System is off by Phase Alarm if common Phase Monitor is used per Heat Pump.
- OFF by DI. System is off by opened state of primary PLC DI1 if corresponding option applies.

- OFF by Switch. System is off by software switch. It can be turned on / off either from Home Screen (button marked 11 on figure 1), which all users have access to. It can also be turned on / off from BAS (Building Automation System).

9 - System Mode

Indicates heat pump thermal mode: Cooling or Heating.

10 - Module/Compressor Status

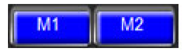
- Modules Online/Avail/Setup. Number of modules online and communicating / available for heat pump bank temperature control and number of modules set up for heat pump bank temperature control.
- Comp Run/Avail. Number of compressors currently running and number of compressors available for heat pump bank temperature control.
- Comp Demand. Cooling or Heating Demand value in number of requested compressors as well as continuous value in %. There is also a bar graph representation of Cooling or Heating Demand beside the % value.

11 - Power ON/OFF

Press and hold this button to toggle the software switch which powers the heat pump (and all its modules) on and off.

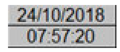
12 - Module Access

The module access buttons display the overview screen for each module. These buttons provide access to all heat pump modules screens individually. The number on the Mx button stands for the module number in the heat pump. Only modules that communicate directly with the touchscreen interface are viewable via the module access buttons.



13 - Date/Time

Current HMI date/time as set up in HMI system settings.

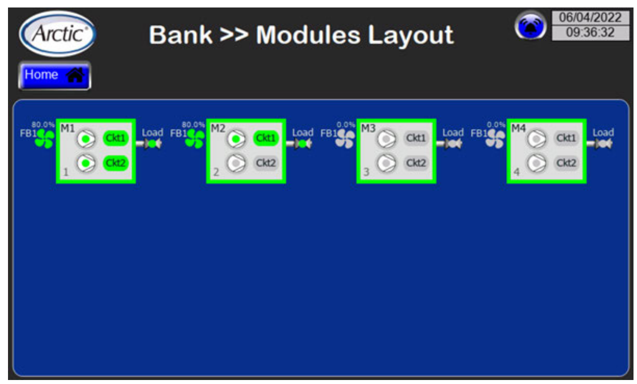


Modules Layout Screen

The heat pump can be composed of up to a maximum of ten modules. Pressing the LAYOUT button displays the screen showing the status of compressors and valves in each module. See figure below.

This screen is a graphical representation of modules available in the heat pump bank. See figure below.

Figure 14. Modules layout screen showing four compressors on four modules



Module Layout Screen Status Conditions

Each module picture is a set of images that show real-time color-coded state of compressor, refrigeration circuit, isolation valves, fans and module.

Table 3. Module status conditions

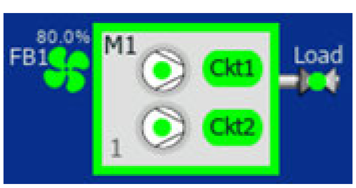
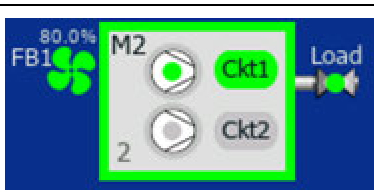
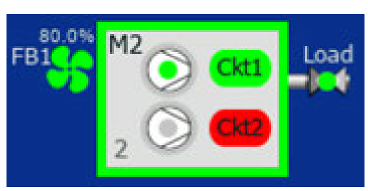
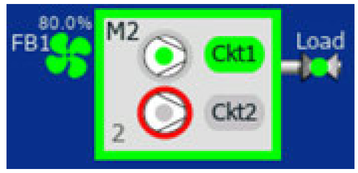
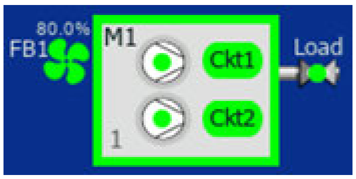
 Module is available and running	 Module is unavailable	 Module turned off by alarm and unavailable
 Refrigeration circuit 1 operational / circuit 2 non-operational	 Refrigeration circuit 2 in alarm	 Isolation Valves: Valve LED is green = valve is open Valve LED is gray = valve is closed

Table 3. Module status conditions (continued)

 Compressor 1 is running; Compressor 2 is not running	 Compressor 1 is running; Compressor 2 is in alarm	
 Fan bank running	 Fan bank not running	 Fan bank in alarm

Active Alarms Screen

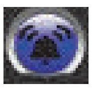


Figure 15. Active alarms for the heat pump

The active alarms screen lists all Active (Triggered) alarms as a table.

- Alarm is considered 'Active' (Triggered) if State Value' = 1, other words it's still active in the PLC
- If alarm is 'Not Active' (Not Triggered), its State Value' = 0 and it can be reset using Reset button.
- Both 'Active' and 'Not Active' alarms can be acknowledged. When 'Not Active' alarm is acknowledged, it can be reset, which will remove it from the list, so only 'Active' alarms will remain on the list.

Select

This column indicates if the alarm is selected or unselected for acknowledgment or resetting.

Action

This column gives alarm details if applicable.

Name

This column gives alarm name.

Alarm Status

This column displays the alarm state. There are five possible states for any alarm:

- TRIGGERED (ACTIVE) / NOT ACKNOWLEDGED
- TRIGGERED (ACTIVE) / ACKNOWLEDGED
- NOT TRIGGERED / NOT ACKNOWLEDGED
- NOT TRIGGERED / ACKNOWLEDGED
- NOT TRIGGERED - Alarm went away (inactive), acknowledged and reset (removed from Active Alarms list)

Both active and non-active alarms can be acknowledged. When a non-active alarm is acknowledged, it can be reset, which immediately removes it from the active alarms list.

When all non-active alarms have been acknowledged, only active alarms will remain on the list.

Description

This column describes the nature of each alarm.

Time

This column is the date-time stamp indicating exactly when the alarm occurred.

Check / Uncheck All

This button is used for selecting and deselecting all listed alarms.

Drop Down Menu

This is used to either list all the alarms, both active and non-active, or only active alarms (the default selection).

Reset PLC

This button is – used to reset 'Active' alarms in the PLC, so they could be further acknowledged / reset on the HMI.

Only alarms which alarm condition is false can be reset in the PLC otherwise Reset PLC will have no effect on it.

Alarm History

On the active alarms screen, pressing the alarm history button displays the alarm history screen.

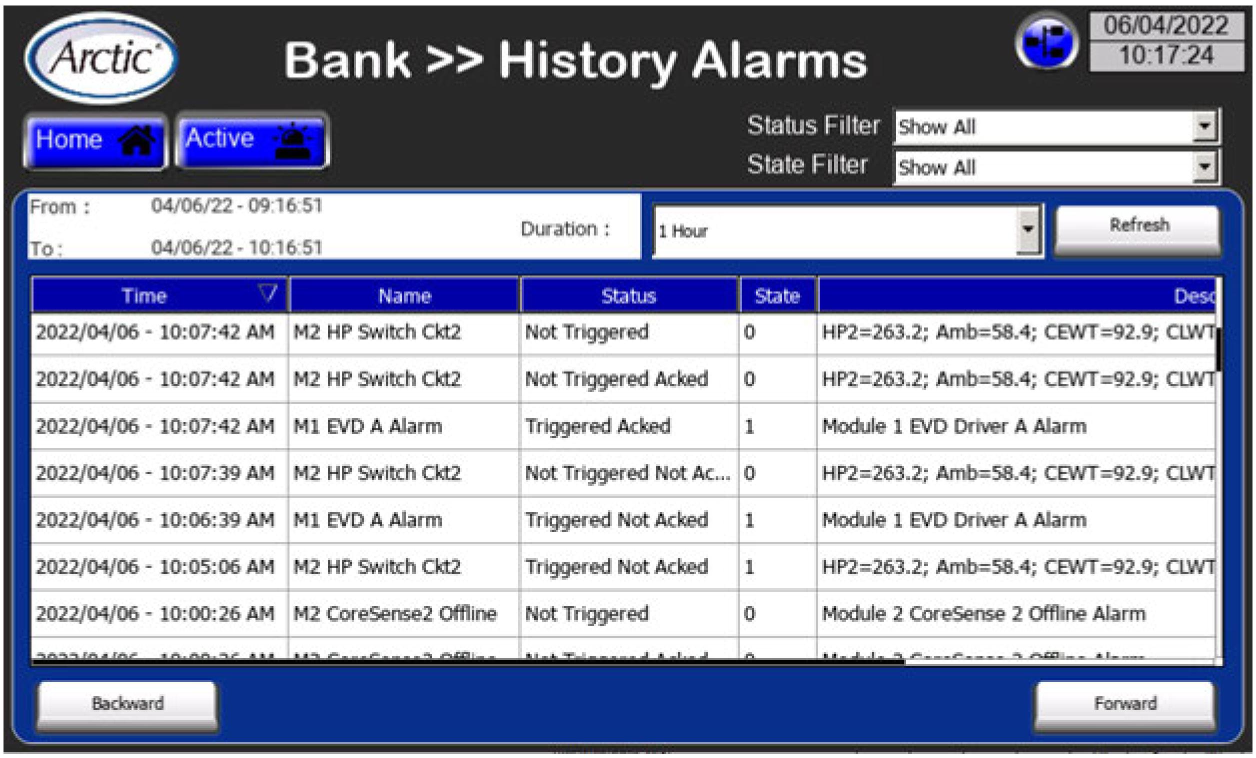


Figure 16. Alarm history

The alarm history screen displays the history of alarms recorded by the primary microprocessor (See Figure 16, p. 28).

History alarms list can be sorted by any column in ascending or descending order by tapping corresponding column header. Triangle that appears next to the header indicates which column is being sorted and direction of sorting.

By default sorting is applied to Alarm Time column in ascending order. Triangle is pointing upwards. Ascending order for Alarm Time column means that earlier records appear on the list first. For all other columns alphabetical sorting method applies.

Duration

Allows the selection of the time period for which the alarm history is displayed. Once the selection is made from the drop-down menu, pressing the REFRESH button updates the list and then 'From' and 'To' timestamps get updated accordingly.

Time

This is the time stamp that is displayed when the alarm status changes.

Status

This is the alarm event that logged alarm record. Only 'Active' alarms (Event Type = 'Triggered') are recorded. Status description – the same as 'Status' for Active alarms.

State

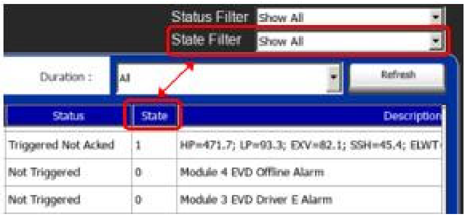
This is the same as ‘State’ for active alarms.

Description

This is the same as ‘Description’ for active alarms.

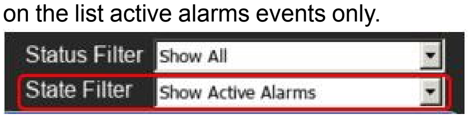
Alarms Filtering

‘State Filter’ applies to **‘Alarm State’**.

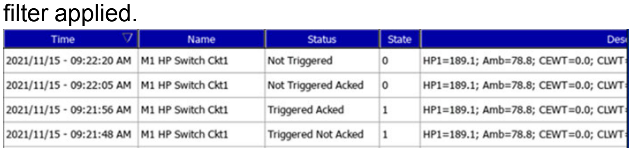


Alarm State: ‘0’ – Alarm inactive; ‘1’ – Alarm active (even if it has been acknowledged).

When State Filter selected to Show Active Alarms, it will hide from the list inactive alarm (State = ‘0’) and will leave on the list active alarms events only.



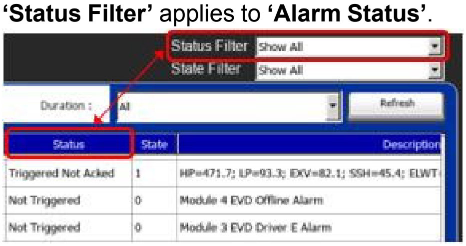
For example: High Pressure switch alarm records *before* filter applied.



High Pressure switch alarm records *after* filter applied.

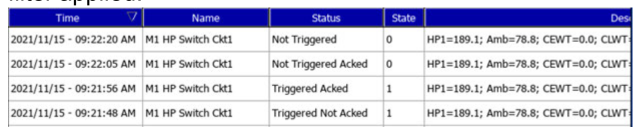
Any alarm events occurring after alarm went away, have been filtered off the list.

‘Status Filter’ applies to **‘Alarm Status’**.

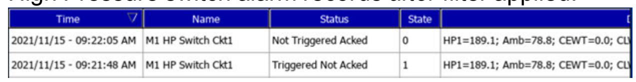


When Status Filter selected to Show Alarm Events, it will hide from the list non-alarm events, namely, alarm acknowledgement and alarm reset by user and will leave on the list alarm-related events only.

For example: High Pressure switch alarm records *before* filter applied.



High Pressure switch alarm records *after* filter applied.

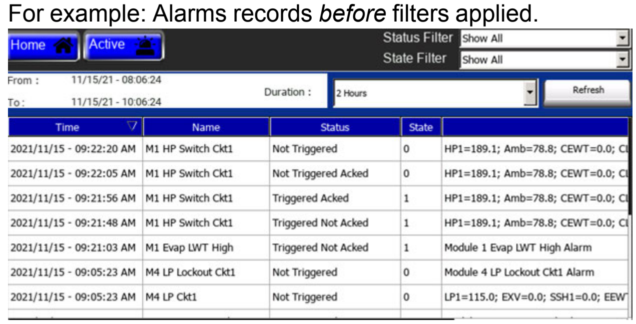


Any alarm events pertaining to user action (acknowledgement and reset) have been filtered off the list.

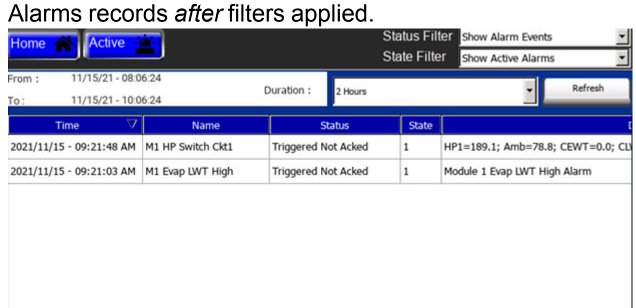
Combining both **‘State Filter’** and **‘Status Filter’** can enhance alarms viewing even more.

For instance, one needs to view only events when alarms occurred and hide all other ones (aka one alarm event for each alarm).

For example: Alarms records *before* filters applied.



Alarms records *after* filters applied.



Modules Overview Screens

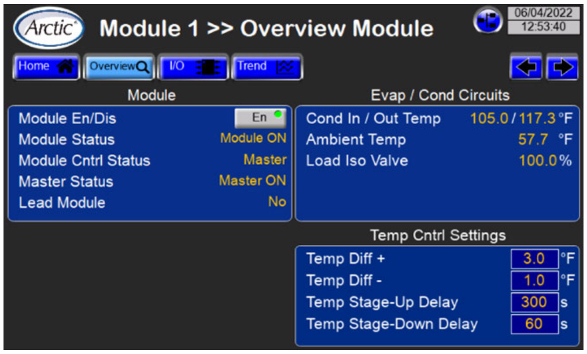
Each module controlled by the microprocessor controller has its own module screen within which the operator can monitor and maintain conditions affecting that module. Primary module access is made through the system control screen containing multiple controls and indicators:

On the home screen, pressing the **M1** button displays the Module #1 (primary module) overview 1 screen.

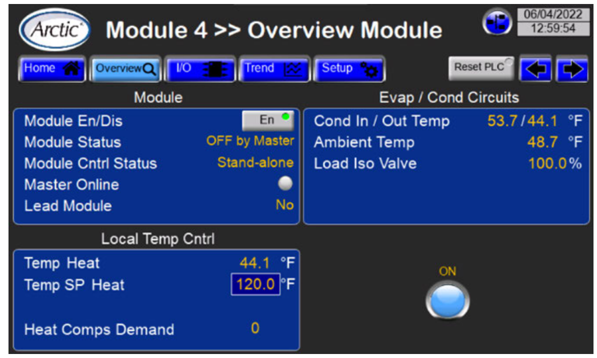
The overview menu is comprised of two screens:

Overview Module (primary and secondary) and Overview Circuits. Use the left and right scrolling buttons to scroll through the overview screens.

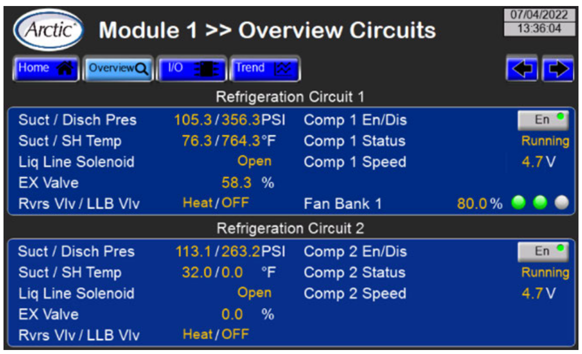
Table 4. The overview screens



Primary Overview Module Screen



Secondary Overview Module Screen



Primary and Secondary Overview Circuit Screen

Overview Module

Module En/Dis

Pressing this button enables or disables a module. If module is disabled, it's excluded from primary control compressors sequence. Not accessible for 'user.'

Module Status

Possible options:

1. Module ON. Module is ready to run.
2. OFF by Schedule. Module operates according to predefined schedule and is currently off as scheduled.
3. OFF by DI. Module is off by opened state of PLC DI1.
4. OFF by Keypad. Module is off by Module En/Dis button.
5. OFF by Alarm. Module is locked out by one of the major alarms.
6. OFF by Primary. Module is switching between control states Primary / Secondary / Stand-alone.
7. OFF by System. Module is off by one of the System Off conditions.
8. Man Mode. Module is in manual mode.

Module Cntrl Status

Possible options:

1. Primary. Module acts as a primary module. Primary module performs temperature control for either heating or cooling loads. It also acts as a Supervisor when communicating with secondary modules and defines how many modules need to run its compressors in order to satisfy heating or cooling controlled temperatures.
2. Secondary. Module acts as a secondary module. Conditions for the module to be a secondary module:
    a. Its PLC has been assigned IP address from secondaries addresses range
    b. It's communicating with primary module
    c. Primary module exists on the network, in other words Primary PLC meets primary module conditions (see Primary Status below).
    d. Stand-alone. Module doesn't meet either primary module or secondary module conditions.

Primary Status

Applies to primary PLC only. Possible options:

1. Primary ON. All primary modules conditions are satisfied by module.
2. Waiting … All primary modules conditions are satisfied and module is counting down a delay before acquiring primary ON status.
3. OFF by Sensor. System cooling or heating temperature sensor failed.
4. OFF by no secondaries. Primary PLC communicates with no secondaries.

a. Primary Status states 3 or 4 will cause all the modules to run in Stand-alone mode. These failing conditions are false at normal primary/secondary operation.

b. Primary Online (Applies to secondary PLC only). LED is green - secondary PLC is communicating with primary PLC; LED is gray - secondary PLC is not communicating with primary PLC.

Lead Module

Indicates which module is currently a Lead Module in the heat pump.

Local Temp Cntrl

Applies only if module is running in Stand-alone Mode. Displays Load inlet and outlet temperatures and an opening status of Load Isolation Valves as well as Ambient Temperature.

Temp Heat/Cool

Local module hot or chilled water temperature control sensor.

Temp SP Heat/Cool

Local module heating or cooling temperature control setpoint. Can be adjusted by 'tech' user only.

Cool/Heat Comps Demand

Cooling or Heating Demand value in number of requested compressors.

Temp Cntrl Settings

Viewable / adjustable for 'tech' user only.

- Temp Diff +. Temperature control differential above setpoint or positive dead band (DB).
- Temp Diff -. Temperature control differential below setpoint or negative DB.
- Both of them define the temperature control DB.
- Temp Stage-Up Delay. When next compressor has been staged up, this delay has to elapse before next compressor is allowed to stage up.
- Temp Stage-Down Delay. When next compressor has been staged down, this delay has to elapse before next compressor is allowed to stage down.

On/Off Button

Used to turn secondary PLC module on / off in Stand-alone Mode. For primary PLC module, On / Off Button on the Home Screen serves the same purpose.

Overview Circuits

Refrigerant temperatures / pressures are displayed: suction pressure; discharge pressure; suction temperature; suction super heat temperature.

Liq Line Solenoid

Status of the solenoid valve installed on the liquid line pipe.

EX Valve

Indicates the position of electronic expansion valve, if installed.

Rvrs Valve

Reversing Valve position. Cool – module / circuit running in cooling mode or defrost cycle or compressor is off (default Reversing Valve position); Heat – module / circuit running in heating mode.

LLB Valve

Liquid Line Bypass solenoid valve state: OFF / ON.

Comp (X) En/Dis

Compressor enable / disable button.

Comp (X) Status

1. Comp OFF. Compressor is off and can't be turned on.
2. Ready. Compressor is off but can be turned on.
3. N/A
4. OFF by Evap Flow. Compressor has been called to run but waiting for Load Flow proof.
5. OFF by Min Off. Compressor is cycling through safety Minimum Off Time.
6. OFF by Switch. Compressor is off by En/Dis Switch.
7. OFF by Alarm. Compressor is off by Alarm.
8. Running. Compressor is running.
9. ON by Min On. Compressor has been called off although it keeps running due to safety Minimum On Time.
10. ON by Pumpdown. Compressor has been called off but keeps running due to Pump-down sequence.
11. Start Delayed. Compressor startup is delayed by EVX opening or staging delay.
12. OFF by Restriction. Module capacity limited by low Load Leaving Water Temperature.
13. N/A
14. OFF by Src Appch. Compressor is off by high Source Approach.
15. N/A
16. OFF by Min DP. Compressor is off as it can not build up Minimum Differential Pressure to operate Reversing Valve in a timely fashion.

Fan Bank (X)

Two controls components can be displayed.

LEDs. Green - corresponding fan in the fan bank is commanded on; Grey - corresponding fan is commanded off.

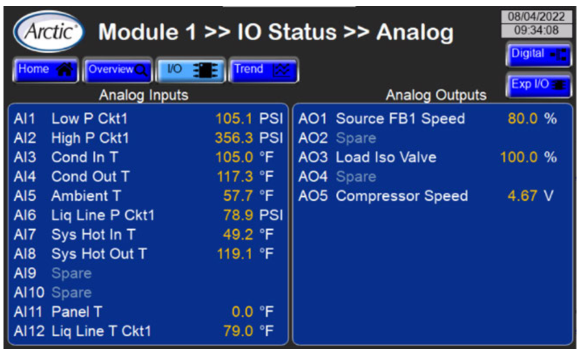
Module I/O Screens

Data is collected by sensors as either analog or digital signals and displayed on the IO Status screens.

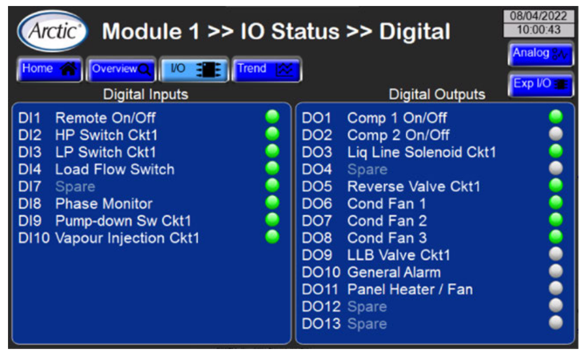
When the module screen is displayed, pressing the I/O button displays the I/O menu.

The I/O menu is comprised of three screens. When in the I/O menu switching between I/O screens is made by the means of respective buttons.

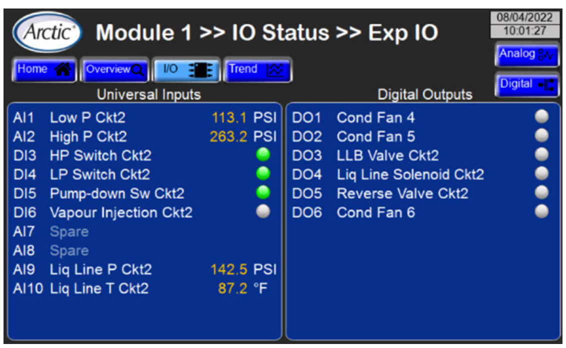
Table 5. The input/output screens



Primary/Seconday I/O Analog Screen



Primary/Seconday I/O Digital Screen



Primary/Seconday I/O Expansion Screen

When an I/O screen is displayed, switching to other I/O screens is accomplished by pressing their respective buttons:

- The ANALOG button displays the analog screen.
- The DIGITAL button displays the digital screen.

Analog Inputs

Analog input (AI) data includes these parameters:

AI1

This input indicates suction pressure Circuit 1.

AI2

This input indicates discharge pressure Circuit 1.

AI3, AI4

These inputs indicate Load Entering/Leaving Water Temperature.

AI5

These inputs indicates ambient temperature.

AI6

These inputs indicate Liquid Line Pressure Circuit 1.

AI7

These inputs indicate System Chilled / Hot Entering Water Temperature. Applies to Cooling / Heating Mode.

AI8

These inputs indicate System Chilled / Hot Leaving Water Temperature. Applies to Cooling / Heating Mode.

AI11

These inputs indicate the panel temperature (optional). This applies to Heating Mode. It is used when temperature control inside control panel is required either heating (for cold environment) or cooling (for hot environment).

AI12

These inputs indicate Liquid Line Temperature Circuit 1.

Analog Outputs

Analog output (AO) data includes these parameters:

AO1

These outputs indicate the variable speed of Fan Bank 1.

AO2

These outputs indicate the variable speed of Fan Bank 2 (if applicable).

AO3

These outputs indicate Load Isolation Valve position.

Digital Inputs

Digital input (DI) data includes these parameters:

Digital LEDs

There is an LED for each digital input that indicates its current state. For all inputs, the color of the LED signifies its current state:

Green LED — This digital input is energized, the connected device is closed.

Gray LED — This digital input is de-energized, the connected device is open.

DI1 Remote On/Off

This activates a module on or off via digital input. If the primary digital on-off input is enabled, toggling the **DI1** on the primary module will turn the entire heat pump on or off.

DI2, DI3

These show the Discharge / Suction Pressure switches of Circuit 1. DI closed - pressure is in the normal range; DI opened - pressure is exceeding normal range threshold (faulty state).

DI4

These show the state of Load flow switch. DI closed - flow present; DI opened - flow absent.

DI8 Phase Monitor

This is feedback for the three-phase power supply protection feature. If the digital input for this switch indicates closed, there are no power supply issues. If the digital input for this switch indicates open, a power supply failure has been detected.

If common power supply protection module is used for the heat pump, its failure will affect each module. In such a case this DI is optional for secondary module.

DI9

This is the feedback for Pump-down pressure switch of Circuit 1. DI closed - pressure is in the normal range; DI opened - pressure is exceeding normal range threshold (faulty state).

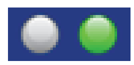
DI10

This is the feedback for Vapor Injection Circuit 1. Vapor Injection Status: DI closed – Vapor Injection running; DI opened – Vapor Injection not running.

Digital Outputs

There is an LED for each digital output which shows its current state.

Digital LEDs



There is an LED for each digital input that indicates its current state. For all inputs, the color of the LED signifies its current state:

Green LED — This digital output is energized, the connected device is powered up or running.

Gray LED — This digital output is de-energized, the connected device is not powered up or not running.

DO1, DO2 Comp On/Off

This digital output turns a compressor on and off.

DO3 Liq Line Solenoid Circuit 1

This digital output energizes and de-energizes the liquid line solenoid valve.

DO5

This digital output energizes and de-energizes the Reversing Valve Circuit 1. Energized – Heating Mode; deenergized – Cooling Mode or Defrost (default state).

DO6-DO8 Fans 1, 2, 3

This digital output is used to turn fans of Fan Bank 1 on and off.

DO9

This digital output is Liquid Line Bypass Solenoid Valve Circuit 1.

DO10 General Alarm

This digital output energizes when any of the following alarms occur:

- An alarm that shuts down and locks out compressor 1 or 2.

- An alarm that shuts down and locks out the entire module.

DO11 Panel Heater / Fan (optional)

This is the digital output is used when temperature control inside control panel is required (identical to AI11).

Expansion IO Screen

This screen is only applicable to the primary module. This screen controls analog inputs and digital requests.

AI1

These show the Suction Pressure of Circuit 2.

AI2

These show the Discharge Pressure of Circuit 2.

DI3, DI4

These show the Discharge / Suction Pressure switches of Circuit 2. DI closed - pressure is in the normal range; DI opened - pressure is exceeding normal range threshold (faulty state).

DI5

This is the feedback for Pump-down pressure switch of Circuit 2. DI closed - pressure is in the normal range; DI opened - pressure is exceeding normal range threshold (faulty state).

DO1, DO2, DO6

Fans 1, 2, 3. This digital output is used to turn fans of Fan Bank 2 on and off.

DO3

Liquid Line Bypass solenoid Valve Circuit 2.

DO4

Liq Line Solenoid Circuit 2. It energizes / deenergizes liquid line solenoid valve.

DO5

Reversing Valve Circuit 2. Energized – Heating Mode; deenergized – Cooling Mode or Defrost (default state).

Modules Trend Screen

When on the primary module screen, pressing the trend button displays the module trend screen.

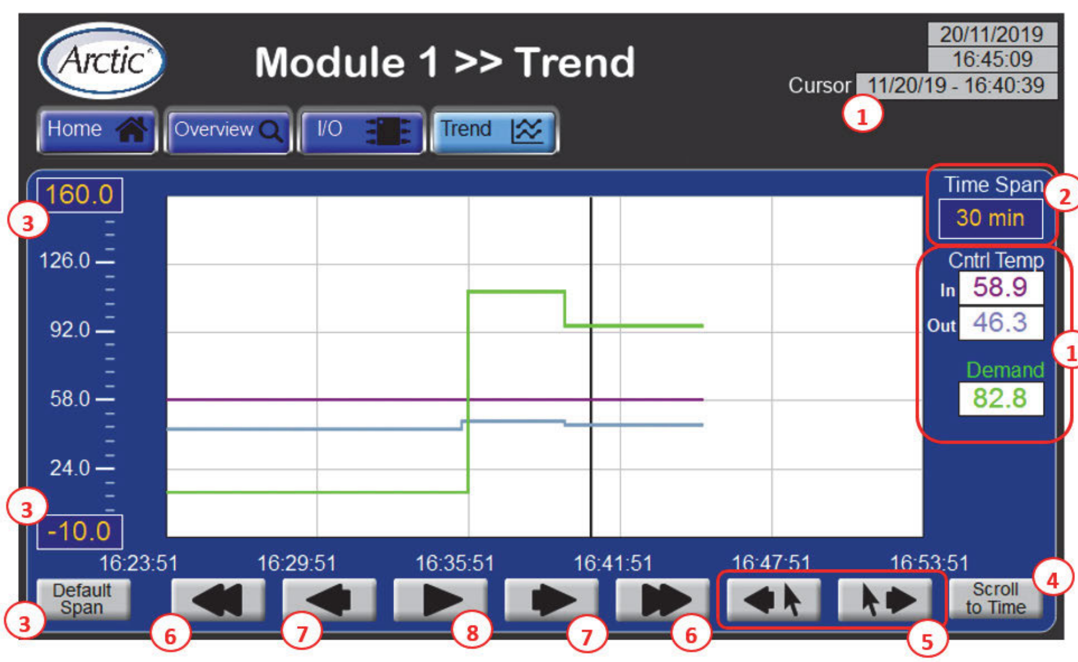
Module Trend Screen displays three trends: Controlled inlet / outlet water temperatures and Module Demand in %.

It displays Entering / Leaving Load Water Temperatures.

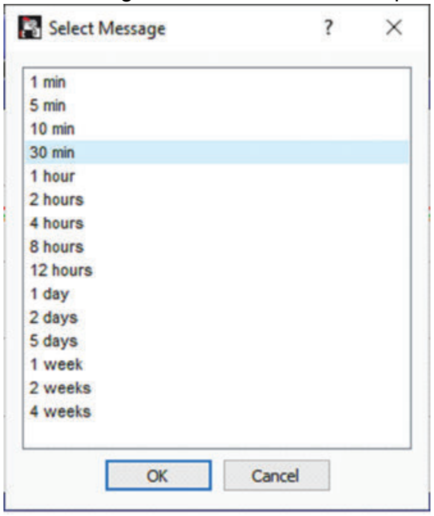
Trends can be viewed in real time as well as for the last seven days. Each variable is trended every three seconds. Trending data is stored on HMI internal memory.

Apart from displaying trends, Module Trend Screen has controls for viewing, scrolling, zooming, deleting trends etc.

Figure 17. Module trend screen



1. Trending variables instantaneous values according to cursor position. Current cursor timestamps are displayed as well.
2. Text box to select viewing time span. It's used for zooming in on trends time axis. Options for selection:



3. Maximum and Minimum thresholds for trends viewing. Used for zooming in on trends variables axis. Both Maximum and Minimum thresholds are adjustable via respective numeric boxes. Default Min / Max values: –10.0 / 160.0. 'Default Span' button is used to revert to defaults, so as to reset longitudinal zooming.
4. "Scroll to Time" button is used to return to real time viewing.
5. Cursor positioning buttons.
6. Buttons used to scroll back and forth in time. They implement time axis trends pages scrolling.
7. Buttons used to scroll back and forth in time. High resolution time axis scrolling.
8. Button is used to pause / resume real-time trending.

Operator Tasks

Before operating the unit, ensure that all compressor refrigeration service valves are fully back-seated counterclockwise.

NOTICE

Compressor Damage!

Failure to properly back-seat rotalock valves can cause compressor failure.
Verify the circuit breakers on the module electrical panel are turned to OFF position prior to applying power.

Normal Power Up

The following procedure is used for a startup resulting from scheduled seasonal or programmed cold shut down of the heat pump.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Important: *This start-up procedure is not to be used for the first-time initial startup for a newly installed heat pump. See Preparation for Initial Startup in the Installation section of this manual for instructions regarding that situation.*

1. De-energize the heat pump using standard lockout/ tagout procedures.
2. Using a known operational voltage meter, test and confirm the heat pump is de-energized before proceeding further.
3. Inspect power distribution fuses and overload settings to verify they are correct.
4. Verify that the oil level is correct in each compressor using the compressor sight glass.

Note: *See recommended inspection interval in the maintenance section of this manual.*

NOTICE

Compressor Failure!

Failure to follow instructions below could result in catastrophic compressor failure.
Do not operate with insufficient oil.

5. Verify that pressure and temperature switches are closed.
6. Restore power to all modules.
7. Inspect refrigerant pressures for each module using the touchscreen interface panel.
8. Verify that pressure switches and thermostats have the correct cut-in and cut-out settings using the touchscreen interface panel.
9. Verify heat pump water flow to condenser and evaporator.
10. Monitor and record temperature and refrigerant pressures registering on the touchscreen interface panel.

Emergency Power Shutdown

The heat pump does not include a disconnect switch as standard to turn off the high voltage to the modules. As per NFPA 70, The National Electrical Code, a disconnect must be installed within the line of sight of the electrical and control panel. Should an emergency condition arise, the disconnect switch must be opened to shut down all voltage to the heat pump.

There are several ways to interrupt power to all or part of the heat pump modular system:

- Disconnect the primary power source from the building that feeds electricity to the heat pump. This occurs in sudden emergencies (usually weather-related) or planned maintenance shut-downs.
- If equipped, press the panel disconnect switch on the exterior door of the heat pump's main power distribution panel.
- Move the circuit breaker switch to the OFF position (CB-1 and CB-2, etc.) on the power distribution panel. This cuts power to all of the heat pump modules.
- Move the circuit breaker switch to the OFF position (CB-1 and CB-2) on a module's electrical and control panel. This cuts power to the compressors in a single module. It does not cut power to electrical and control panel or other heat pump modules.
- Press the SYSTEM ON button on the touchscreen interface panel that is built into the power distribution panel door.

Note: *Pressing the ON-OFF button on the touchscreen interface panel does not de-energize the heat pump or the high voltage current into each module's electrical and control panel. This action sends a command to the controller in each module's compressors to discontinue electrical current to that component.*

Water Quality Guidelines

The heat pump is equipped with high efficiency compact brazed plate heat exchangers (BPHE). Water quality must be maintained periodically by the end user to avoid scaling and corrosion inside the heat exchangers.

Table 6. Water quality guidelines

Element /Compound/Property	Value/Unit
pH	7.5 - 9.0
Conductivity	< 500 µS/cm
Total Hardness	4.5 - 8.5 dH°
Free Chlorine	< 1.0 ppm
Ammonia (NH_3)	< 0.5 ppm
Sulphate (SO_4^{2-})	< 100 ppm
Hydrogen Carbonate (HCO_3^-	60 – 200 ppm
(HCO_3^-) / (SO_4^{2-})	> 1.5
(Ca + Mg) / (HCO_3^-)	> 0.5
Chloride (Cl-)	< 200 ppm

Notes:

1. Total Hardness/corrosion: Water with high hardness can cause corrosion problems due to its high ion content (Ca+2, Mg+2, Fe+2) which also means a high electrical conductivity and a high total dissolved solid (TDS). For this reason, too high hardness values should be avoided, not only due to higher risk of scaling, but also for corrosion risk. On the other hand, soft water, but not necessarily cation exchange softened water, may in contrast have a low buffering capacity and so be more corrosive. If the hardness values are outside the recommended range, other parameters such as oxygen content, conductivity, and pH values should be considered to evaluate the corrosion risk
2. Fe3+ and Mn4+ are strong oxidants and may increase the risk for localized corrosion on stainless steels in combination with brazing material copper.

Monitor Water Quality

Maintaining water/glycol mixture quality and cleanliness is critical to heat pump health and maintainability. Strainers should be checked and cleaned on a regular basis. Water/ glycol mixture samples should be taken and tested by a professional lab. The results will enable the accurate adjustment of quality thereby increasing the operational life of the Heat Pump.

Note: *Trane will not validate the heat pump warranty if the proper water/glycol mixture composition and quality is not maintained.*

Protect the heat pump from freezing, particularly if the heat pump has a set point that is lower than the freezing point of the water/glycol mixture in the heat pump. The heat pump is designed to operate with a maximum propylene glycol concentration of 40%. See Table 7, p. 37, for the effects on the heat pump when operating with other glycol concentrations.

Table 7, p. 37 shows the capacity reduction and the pressure drop that occurs when higher concentrations of glycol are used.

Maintain Glycol Level

When the heat pump has a water set point that is below the freezing point of the water/glycol in use, take precautions against freezing.

The glycol concentration should be based on the lowest fluid design temperature. See Table 8, p. 38, provides guidelines for adding propylene glycol.

Table 7. Glycol performance impact factors

Range Factor	Glycol Concentration Percentages and Performance Impact					
Propylene Glycol Concentration	30%		40%		50%	
Lowest Ambient Temperature	10 °F (-12 °C)		-4 °F (-10 °C)		-20 °F (-29 °C)	
Recommended Minimum Leaving Fluid Temperature	25 °F (-4 °C)		10 °F (-12 °C)		-10 °F (-23 °C)	
Leaving Temperature	Capacity Reduction Factor	Pressure Drop Factor	Capacity Reduction Factor	Pressure Drop Factor	Capacity Reduction Factor	Pressure Drop Factor
70 °F (21 °C)	0.96	1.27	0.93	1.43	0.91	1.63
60 °F (15.6 °C)	0.95	1.31	0.92	1.47	0.90	1.68
55 °F (13 °C)	0.95	1.31	0.92	1.50	0.89	1.73
50 °F (10 °C)	0.94	1.33	0.91	1.51	0.88	1.75

A 10% to 40% solution of glycol should be added to prevent pipe corrosion regardless of the fluid temperature. Propylene glycol has corrosion inhibitors that protect piping and components from corrosion and buildup of rust and other deposits. Trane recommends against using water/glycol solution in excess of 40% regardless of the ambient temperature conditions.

NOTICE

Equipment Damage!

Failure to follow instructions below could result in permanent damage to pump and internal cooling surfaces.

Do not use automotive antifreeze.

Note: *If glycol-free solutions are mandated at the heat pump site, special inhibitors are available for rust prevention, mineral deposit inhibition, and biological suppression. Adding these inhibitors to the water solution is strongly recommended.*

Heaters, heat tracing cable, and closed cell insulation can be installed on any exposed “wet” heat pump components for protection against freezing in low ambient temperature and low refrigerant pressure conditions. However, the best freeze prevention is using the appropriate concentration of glycol. Trane does not warranty any component that fails due to freezing.

Prevent Freezing

Many liquids expand in volume upon cooling. This expansion may cause pipes and other enclosed systems containing a liquid to rupture or burst when exposed to low temperature conditions. Burst protection is needed to protect piping and other enclosed systems when they are inactive as they could rupture due to expansion during cold weather or low refrigerant pressure.

Freeze points and burst points of glycol-water solutions are shown in Table 8, p. 38.

In order to maintain a high quality glycol solution, the water used in the glycol mixture must have very few impurities. Impurities in the water can increase metal corrosion, aggravate pitting of cast iron and steel, reduce the effectiveness of the corrosion inhibitors, and increase the depletion rate of the inhibitor package.

To assure inhibitor effectiveness, the levels of chlorides and sulfates in the water should not exceed 25 ppm each. The total hardness in terms of calcium carbonate should be less than 100 ppm. For best long-term results, de-ionized or distilled water is recommended. Trane can provide concentrated solutions of Dowfrost, propylene glycol, or premixed solutions for use with the heat pump.

NOTICE

Equipment Damage!

Failure to follow instructions below could result in permanent damage to pump and internal cooling surfaces.

Do not use automotive antifreeze.

Propylene Glycol

Glycol-based fluids provide such burst protection in water solutions due to their low freezing points. As a glycol-based fluid cools below the solution’s freezing point, ice crystals begin to form, and the remaining solution becomes more concentrated in glycol. This ice/water/glycol mixture results in a flowable slush, and remains fluid, even as the temperature continues to cool.

The fluid volume increases as this slush forms and the temperature cools, flowing into available expansion volume in the heat pump. If the concentration of glycol is sufficient, no damage to the heat pump from fluid expansion should occur within the temperature range indicated in Figure 18, p. 38. When liquids are cooled they eventually either crystallize like ice or become increasingly viscous until they fail to flow and set up like glass. The first type of behavior represents true freezing. The second is known as super-cooling. Glycols do not have sharp freezing points. Under normal conditions, propylene glycol sets to a glass-like solid, rather than freezing.

The addition of glycol to water yields a solution with a freezing point below that of water. This has led to the extensive use of glycol-water solutions as cooling media at temperatures appreciably below the freezing point of water. Instead of having sharp freezing points, glycol-water solutions become slushy during freezing. As the temperature falls, the slush becomes more and more viscous and finally fails to flow.

Table 8. Freeze and burst protection chart

Water/Glycol Temperature	Freeze Protection	Burst Protection
20 °F (-7 °C)	18% glycol mixture	12% glycol mixture
10 °F (-12 °C)	29% glycol mixture	20% glycol mixture
0 °F (-17.8 °C)	36% glycol mixture	24% glycol mixture
-10 °F (-23 °C)	42% glycol mixture	28% glycol mixture
-20 °F (-29 °C)	46% glycol mixture	30% glycol mixture

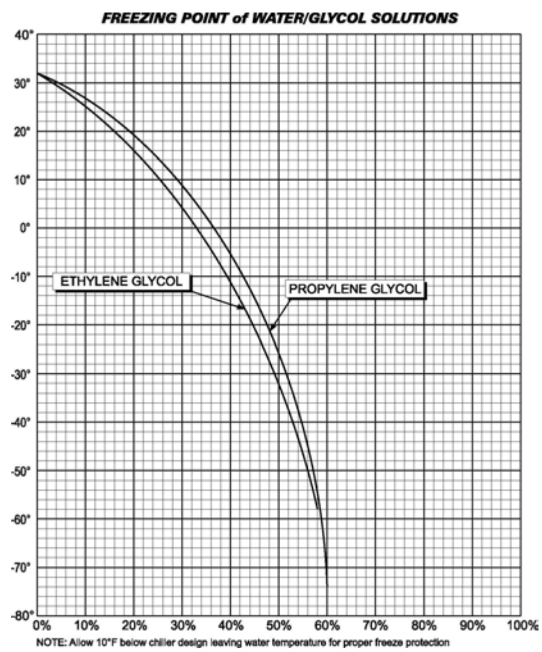
The precise concentration of glycol for a particular heat pump is affected by several key factors such as ambient temperature extremes, entering and leaving water temperatures, and heat pump size. A heat pump's optimum glycol concentration is modified by these considerations as reflected in Table 7, p. 37. These capacity correction factors are the "best informed estimates" for heat pump with copper load heat exchangers. The percentages may vary depending on the materials and alloys of the heat exchangers, total surface area, the amount of present or future fouling, and the brand of glycol used.

The calculations in this table are most accurate for Dowfrost (propylene glycol) and Dowtherm (ethylene glycol) branded products. Consult your local supplier or engineering contractor for more precise recommendations.

Storage Provisions

The heat pump controls are designed for storage in ambient temperatures from -20 °F (-29 °C) to 145 °F (63 ° C) with relative humidity from 0% to 100%. The glycol should be removed from the heat pump if the unit is to be stored for extended periods. Although fluids can be drained via the plug in the bottom of the brazed plate heat exchanger, the inhibitors are an approved glycol solution will best protect the surfaces of the load heat exchanger against oxidation if the glycol remains inside the heat pump during storage.

Figure 18. Water/Glycol concentration freezing points (in degrees fahrenheit)



Controls Interface

Microprocessor Control System

AXM air-to-water modular heat pump models employ a Carel c.pCO all-digital data control system to control and report key system settings and indicators.

Primary Microprocessor Controller

Figure 19. c.pCO primary controller

Secondary Microprocessor Controller

In a normal configuration, a secondary controller controls the single module to which it is dedicated. The distributed primary microprocessor controller system enables the heat pump to operate in the event the primary microprocessor controller fails. The system automatically fails-over to distributed primary control where each secondary controller operates its own module but lacks the ability to communicate with the BMS and rotate the lead compressors every 168 system operating hours.

Touchscreen Interface Panel

The touchscreen interface panel is the primary means for controlling and monitoring the system. See the following figure.

Figure 20. Touch interface panel

Operator Control and Monitoring

Each system is provided with a touchscreen interface panel that is used to turn the heat pump on and off, adjust set points, clear alarms, and perform detailed set-up of the microprocessor controllers.

Heat Pump Control

The operator uses three different types of controls and indicators to monitor and maintain the desired operating parameters in the heat pump - Power Distibution, Electrical Controls, and Refrigeration Controls. These controls and indicators are located in the power panels and the microprocessor controllers.

Power Distribution

There are two different types of electrical panels used in the heat pump . The main power distribution panel receives power from the building source and distributes it to the individual heat pump modules. The individual module electrical and control panel receives power from the power distribution panel and provides power to module's electrical components.

⚠ WARNING

Hazardous Voltage!

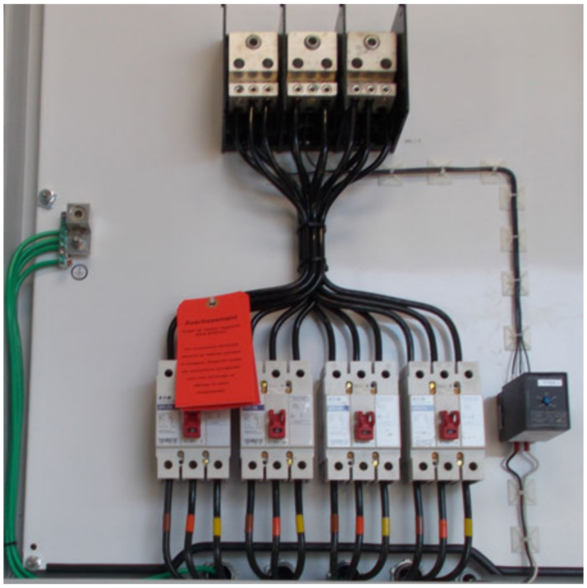
Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Main Power Distribution

The power distribution panel distributes electricity from the external building power supply. It also houses breakers, phase monitor, and may include a door-mounted system disconnect switch. See below figure.

Figure 21. Power distribution panel



Panel Disconnect

Some heat pump systems are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel (or on each module's electrical and control panel if the heat pump has power supplied directly to each individual module). The disconnect switch must be turned to the OFF position before the panel can be opened for service.

⚠ WARNING

PPE for Arc/Flash Required!

Failure to wear appropriate PPE could result in death or serious injury.
On this unit, if the handle shield is cracked the circuit breaker could arc/flash when reset. To avoid being injured, technicians MUST put on all necessary Personal Protective Equipment (PPE), in accordance with NFPA70E for arc/flash protection, PRIOR to entering the starter panel cabinet.

NOTICE

Component Damage!

Failure to follow instructions could damage sensitive electronic components beyond repair.
To prevent arcing or surges of electrical current, do not use wires or cables to jump components or bypass the manufacturer's safety systems.

Module Electrical and Control Panel

From the power distribution panel, power is fed to the individual heat pump modules and connects to each module's electrical and control panel. See the following figure.

Electrical Controls

The AXM heat pump is provided with controls and indicators to monitor the electrical activity and notify operators if problems arise.

Figure 22. Module electrical and control panel

Flow Switch

A flow switch is wired into the low voltage control circuitry used to detect the flow of liquid throughout the hydronic system. Flow switches are found on all brazed plate heat exchangers with isolation valves. Flow switches close when flow is detected allowing compressors to start. If there is no flow, compressors cannot operate.

After every heat pump power-on, all LEDs on the flow switch illuminate and go out again in sequence. The switch is ready for operation when an amber LED is visible on the switch display:

NOTICE

Proof of Flow Switch!

Failure to provide flow switches or jumping-out of switches could result in severe equipment damage.

Evaporator and condenser water circuits require proof of flow switches.

- **Failure to include the proof of flow devices and/or jumping out these devices could cause the unit to stop on a secondary level of protection.**
- **Frequent cycling on these higher level diagnostic devices could cause excessive thermal and pressure cycling of unit components (O-rings, gaskets, sensors, motors, controls, etc.) and/or freeze damage, resulting in premature failure of the chiller.**

Phase Monitor

A compressor can fail if operated in reverse for more than a minute. A phase monitor is used on three phase power systems to ensure that the electricity supplying the heat pump is configured appropriately. A phase monitor prevents a motor from operating in reverse—if any of the three legs of power are landed incorrectly—and will shut the system down upon detection of a reversed phase condition.

Refrigeration Controls

Controls on the refrigeration system are designed to provide safety for the major components and for proper operation of the system.

Pressure transducers convert pressure into an electronic signal that the microprocessor displays in pounds per square inch (psi). Transducers vary in pressure ranges that depend on the type of refrigerant used. Pressure transducers are calibrated using the interface panel.

Temperature sensors transmit temperature data electronically to the microprocessor for display in either Fahrenheit (°F) or Celsius (°C). Temperature sensors are calibrated using the interface panel.

Expansion Valve

An expansion valve is a metering device controlling the flow of refrigerant to the load heat exchanger based on the superheat.

Superheat is factory-set for around 12 °F (-11 °C). Close the valve to increase superheat. To accurately read superheat, install a temperature sensor at the load heat exchanger outlet. The sensor bulb should be located at the 4 o'clock or 8 o'clock positions on the pipe for the most accurate pressure measurement.

Ensure that the closed cell insulation covers the thermal expansion valve sensing bulb. If insulation is missing, the bulb will tend to feed more refrigerant to satisfy the superheat setting.

Solenoid Valve

The liquid-line solenoid valve is used in the refrigeration cycle to provide a refrigerant pump-down cycle at the end of a compressor's cycle. The liquid refrigerant is pumped out of the load heat exchanger to eliminate liquid refrigerant from migrating to the compressor in the off cycle.

Reversing Valves

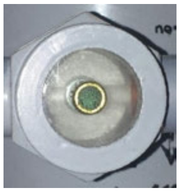
The heat pump reversing valve is an electro-mechanical 4-way valve that reverses the refrigerant flow direction. It moves heat from inside the building to the outdoors (cooling mode) or removes the heat from outside the building to the indoors (heating mode). Reversing valves are designed to lower the minimum operating pressure difference between high and low side. Pressure drop and valve leakage are minimized.

Electronic and Isolation Valves

Each brazed plate heat exchanger branch line shall include a manual inlet and an electronic discharge butterfly valves that allows system flow to each active module to match the cooling or heating requirements of the system. By isolating individual modules that are not operating, the hydronic system can have variable primary flow to the air source heat pump modules. The valves shall be the slow opening type to minimize the sudden change in flow to the previously active modules. The valves shall have a minimum opening cycle time of 30 seconds between the fully closed and open position and shall have roll grooved connections. The valves shall have a minimum close off pressure of not less than 75 psi and shall be rated for a maximum working pressure of 250 psi. The actuators shall be rated for 24 Vac.

Sight Glass

When the sight glass shows a green indicator, no moisture is present. When the sight glass shows a yellow indicator, there is moisture in the refrigerant line. Bubbles can be observed whenever heat pump cycling causes the pressure to change up or down.



NOTICE

Equipment Damage!

Failure to remove moisture from system could cause corrosion within the chiller/heater components, and degrade performance.
Perform vacuum evacuation of system to remove moisture.

Low Pressure Bypass

A control that uses a time delay that temporarily bypasses the low-pressure switch for cold weather start up. Once the delay opens (times out) the normal controls are put back on line within the control circuit.

Low Pressure Pump Down (LPPD) Controls

Allows the system to start in low ambient conditions and prevents flood-back to the compressor by pumping the liquid refrigerant out of the brazed plate heat exchanger. The LPPD control consists of a pressure switch that is set at “cut in” and “cut out” pressures that depend on the type of refrigerant in the system and is based on pressure at which the refrigerant reaches the freezing point of the load heat exchanger water/glycol mixture.

The set points are typically just below the freezing point. For R410A refrigerant and using water, the pressure is set at a 90 psi “cut out” (corresponding to 50 °F (10 °C)) and a 105 psi “cut in” (corresponding to 40 °F (4.4 °C)) cut in. For any other water/glycol mixture, contact Trane technical support for proper set points.

High and Low Ambient Controls

Some heat pump modules must be required to operate in low ambient temperatures to prevent refrigerant migration to the air coil. Without good head pressure control, insufficient refrigerant is fed to the brazed plate heat exchanger and will cause low suction pressure, heat exchanger freezing and will ultimately shut down the heat pump.

Thermal Capacity

The thermal capacity of the heat pump modules is dependent on the leaving temperature of the fluid maintaining a minimum fluid flow rate through the brazed plate heat exchanger and keeping debris out of the aircoil. In applications where it is desired to operate with a lower flow rate or higher temperature change, consult technical support for recommendations.

Sequence of Operations

This manual describes a typical air-to-water heat pump system with few, if any, optional components or devices attached.

Bank Controls Sequence

1. Air-to-Water Heat Pump machine can operate either in Cooling or Heating Mode. Operational Thermal Mode is defined by building needs for providing either chilled or hot water and can be commanded from BMS or local display user interface.
2. In Cooling Mode for both refrigeration circuits Reversing Valves connect suction side to Water Load Heat Exchanger, so it produces a cold water to satisfy cooling load. Discharge side is connected to Air-Source Coils, which are shared by both refrigeration circuits, so Fan Bank, installed on the Air-Source Coils, rejects generated heat when any refrigeration circuit is running.
3. In Heating Mode both circuits Reversing Valves connect discharge side to Water Load Heat Exchanger, so it produces a hot water to satisfy heating load. Suction side, in turn, is connected to Air-Source Coils, so running Fan Bank facilitates a heat transfer to/from environment.
4. Air-to-Water Heat Pump Bank can be turned on and off from BMS system via communication channel or via digital input signal DI 1 on the Primary Controller.
5. Besides, each Air-to-Water Heat Pump Module can be turned on and off individually by the same means.
6. When Air-to-Water Heat Pump Bank turns on, Primary Module tries to identify on the communication network the required number of Secondary Modules according to the Air-to-Water Heat Pump Bank number of Modules setting. Secondary Modules that respond to the Primary Controller, will become the part of the Air-to-Water Heat Pump Bank, otherwise, non-responding Modules, will run in Stand-alone mode if corresponding conditions are met.
7. In addition to Secondary Modules communication conditions, Primary Controller has to meet other conditions to be able to act as a Primary Module, such as, System Temperature Control Sensor has to be intact and Primary Controller itself has to communicate with other Secondary Controllers as well. When mentioned conditions are not met, all Air-to-Water Heat Pump Modules will switch automatically to Stand-alone mode.
8. Once Primary and Secondary Modules have been claimed, Primary Controller defines the Lead Module which will keep its Load/Source (if option selected) Isolation Valves opened at all times to allow for flow circulation.
9. Lead Module is rotated through Air-to-Water Heat Pump Bank based on time period or based on the chiller demand. Both options can be enabled/disabled individually. When Time Rotation is enabled, Rotation Period has to expire before Lead is rotated. Demand Rotation rotates Lead when the last compressor is staged off.
10. Primary Controller constantly monitors the Controlled Temperature and checks if it falls within Temperature Control Band. Temperature Control Band is the zone around Temperature Setpoint where Cooling / Heating Demand is modulating. When Load Water Controlled Temperature is below Control Band for Cooling Mode, Cooling Demand is 0%; when Load Water Controlled Temperature is above Control Band, Cooling Demand is 100%. When Load Water Controlled Temperature is changing within Temperature Control Band, Cooling Demand is modulating accordingly. The same goes for Heating Demand except for when Load Water Temperature is below Control Band, Heating Demand is 100% and when it is above Control Band, Heating Demand is 0% as heating temperature control is reversed versus cooling temperature control.
11. Compressors staging sequence always starts off from a Lead Module. When Bank Demand is 100%, compressors stage up; when Bank Demand is 0%, compressors stage down. Once next compressor comes on, Stage-up Delay has to expire before next compressor is allowed to turn on. The same goes for staging-down, Stage-Down Delay has to count down to ‘0’ before next compressor turns off.
12. When next Heat Pump Module comes into operation, it first opens its Load Isolation Valve. While Isolation Valve is opening, pumps ramp up to readdress increased flow demand. When Load Flow is confirmed by flow switch, compressors are allowed to start.
13. When Bank Demand reaches 0%, Air-to-Water Heat Pump Bank goes into staging-down sequence. Staging-down always starts from the compressor that was engaged last implementing LIFO sequence (Last In First Out).
14. When the last compressor on the Heat Pump Module stops, Isolation Valve starts closing. Pumps in corresponding circuits ramp down to adjust speed to a decreased flow demand.
15. For Air-to-Water Heat Pump Bank, Running in Heating Mode at low ambient temperature, Air-Source Coils of the module tend to frost up. The lower the ambient temperature, the faster frosting can develop.
16. To avoid Air-Source Coils frosting, module intermittently goes in Defrost Mode when respective conditions are met.
17. When running in Defrost Mode, module runs a reversed refrigeration cycle thus diminishing Air-to-Water Heat Pump Bank heating capacity.

18. To balance that out, only limited number of modules is allowed to run in Defrost Mode at the same time compared against number of modules running in heating mode. Besides, unbalanced heating capacity can be compensated by running additional modules in Heating Mode as driven by increased Heating Demand.

Heat Pump Performance Data

This manual uses a typical 60-ton air-cooled heat pump consisting of two modules with brazed plate load heat exchangers for example purposes. The model number and a heat pump's precise electrical and refrigerant data can be found on the heat pump model nameplate. See "Model Number and Coding," p. 6.

Table 9. Typical AXM air-to-water heat pump selection of two 30 ton modules

Heat Pump System (two 30-ton heat pump modules) Model # AXM030			
Unit			
Number of modules	2	Refrigerant	R410A
Compressors per Module			
Type	Scroll	Refrigerant Circuits	2
Number	2	Total refrigerant charge	42
Fans per module			
Type	EC axial fan	Number	2
Evaporator per module			
Type	Brazed Plate	Number	1
Weight per Module			
Net weight per module	3,000 lbs.		
Cooling conditions			
Fluid	water	Outlet fluid temperature	44 °F (7 °C)
Fouling factor	0.00010 h ft2- °F/Btu	Design ambient temperature	95 °F (37.3 °C)
Inlet fluid temperature	54 °F (12 °C)	Elevation	0 ft
Cooling performance per bank			
Cooling capacity	59.21 Tons	Flow rate	137.8 GPM
Minimum unloading	14.8 Tons	Pressure drop	10.2 ft H_2O
Compressors Input Power	67.97 kW	EER (A1)	9.62 Btu/Wh
Fans Input Power	6.000 kW	Efficiency - 100% Load	1.2493 kW/Ton
Total Input Power (A1)	73.97 kW	NPLV.IP	0.9125 kW/Ton
Heating conditions			
Inlet fluid temperature	109 °F	Design ambient temperature	19.99 °F
Outlet fluid temperature	120 °F	External Relative Humidity	0 %
Heating performance per bank			
Heating capacity	541.10 MBtu/h	Pressure Drop	18.3 ft H_2O
Compressors Input Power	68.00 kW	COP (A1)	2.14
Fans Input Power	5.990 kW	Total Air Flow	46,000 SCFM
Total Input Power (A1)	74.00 kW	Available Pressure	0 Psig
Flow Rate	98.01 GPM		
Electrical performance per Module			
Power Supply	460/3/60 V-ph-Hz	Chiller FLA	59.8 A

Table 9. Typical AXM air-to-water heat pump selection of two 30 ton modules (continued)

Input Power at Full Load	73.97 kW	Chiller MCA	68.0 A
Compressors	55.3 A	Chiller MOCP	100.0 A
Fans	4.5 A		
Electrical performance per power supply			
Number of power supplies	1	Chiller FLA	119.7 A
Modules per power supply	1	Chiller MCA	128.0 A
Power supply	460/3/60 V-ph-Hz	Chiller MOCP	150.0 A

Maintenance Procedures

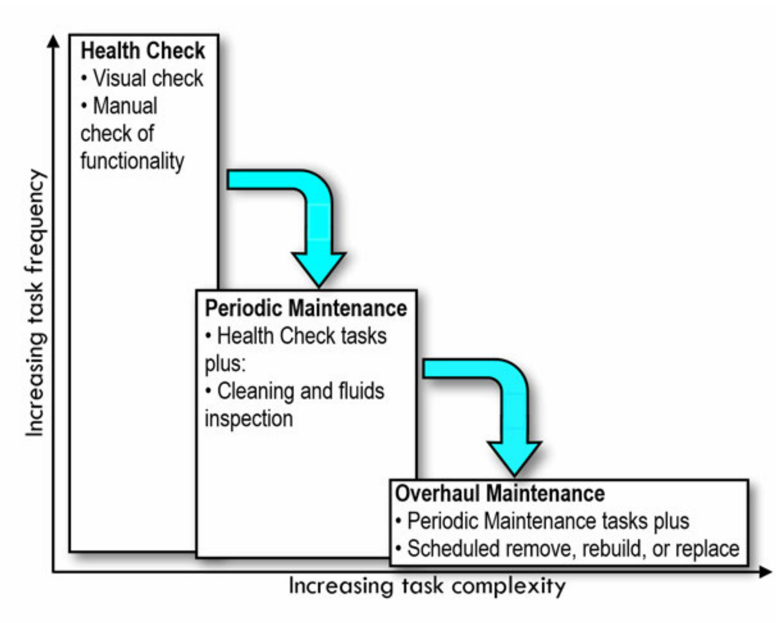
Maintenance Strategy

The primary goal of preventive maintenance is to avoid the consequences of equipment failure. Trane chillers are designed for ease of access with a premium placed on locating key components to facilitate visual inspection and hands-on verification. One approach to chiller maintenance envisions three levels of maintenance effort reflecting frequent, periodic, and scheduled maintenance tasks, with each level building on the previous level. See below figure.

- A daily or weekly "health check" involves habitual visual and manual inspections of the components of the chiller so that anomalies become evident when they occur.
- Weekly or monthly periodic maintenance involves cleaning specific components and inspecting glycol and lubrication fluids.
- Prudent maintenance strategy will anticipate and schedule replacement or rebuilding of critical components before they fail and require emergency response to keep chillers operational.

Maintenance for HVAC equipment and facilities can include a "preventive maintenance checklist" which includes small checks which can significantly extend service life. Other considerations such as weather and equipment age are taken into account; maintenance and equipment replacement is often performed before the hottest time of the year.

Figure 23. An approach to heat pump maintenance



Federal Clean Air Act

Responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be properly certified. The Federal Clean Air Act prescribes procedures for handling, reclaiming, recovering, and recycling of refrigerants and the equipment that must be used in maintenance procedures involving potential leakage of HVAC refrigerants. State and local governments may have additional requirements that must be followed to responsibly handle HVAC refrigerants.

Inspection and Maintenance Schedule

Proactive measures should be taken to prevent potential problems with the heat pumps. These include maintaining a operational log and conducting weekly, quarterly, and annual inspections of the heat pump. See following table.

Daily

A daily visual inspection can reveal obvious problems. Keep notes of the heat pump performance:

- Log pressures and temperatures.
- Visually inspect of the unit.

Table 10. Recommended heat pump service intervals

Task	Frequency
Visually inspect the heat pump	Daily
Log pressure and temperatures	Daily
Inspect touchscreen interface panel for alarm history	Weekly
Clean strainers on the inlet water pipe	Monthly
Check the compressor oil level sight glass	Monthly
Confirm the glycol concentration	Monthly
Confirm the refrigeration pressures	Monthly
Check the refrigeration liquid line sight glass	Monthly
Inspect refrigerant pressures and temperature set points	Quarterly
Inspect superheat (10 °F to 12 °F [5°C to 6°C]) and sub-cooling temperatures (10°F to 15°F [5°C to 8°C])	Quarterly
Inspect the load heat exchanger entering and leaving evaporator temperature	Quarterly
Collect water/glycol mixture sample for analysis	Quarterly
Inspect crankcase heaters	Quarterly
Inspect piping for signs of leaks	Quarterly
Inspect refrigerant piping for oil or refrigerant leaks	Quarterly
Observe refrigeration operating pressures	Quarterly
Confirm motor amperage draw and voltage	Quarterly
Confirm heat pump superheat and sub-cooling	Quarterly
Check for worn or burned contactors	Quarterly
Inspect all electrical connections and fuses	Annually
Inspect each compressor for refrigerant pressures, overheating, oil leaks	Annually
Inspect compressor terminals for pitting, corrosion, and loose connections	Annually
Inspect compressor oil level	Annually
Confirm and record compressor amperage draw and voltage	Annually
Compare water/glycol flow against design specifications	Annually

Weekly

Weekly inspection is a continuation and elaboration of daily best practice:

- Inspect touchscreen interface panel for alarm status and additions to the alarm history. (Do not clear alarms as this is a very important performance record if troubleshooting problems occur.)
- Listen for excessive vibrations or motor noise. This usually signals a loose brace or section of piping.
- Measure all refrigerant static pressure on any idle circuits. Record any significant changes or reductions in pressure.
- Clean strainers weekly during initial weeks after initial start up until water quality has been reliably established. Thereafter, inspect and clean strainers at least monthly .

Monthly

The monthly maintenance inspection examines many items that generally require frequent attention. This routine event identifies small problems early before they can become big problems requiring serious repair and refurbishment:

1. Remove the strainer on the inlet water pipe to the heat pump and verify that it is clean and free of debris.
2. Clean the strainer's mesh screen by back-washing with high water velocity. If fine particles cannot be removed with the water stream, use a mild detergent and a non-abrasive brush to remove them.
3. Check the compressor oil level sight glass. The oil should always be clear and free-flowing. Any milky or "slow rolling" effect indicates that liquid refrigerant is making its way back into the compressor and will cause premature compressor failure.

NOTICE

Equipment Damage!

Failure to remove moisture from system could cause corrosion within the chiller/heater components, and degrade performance.
Perform vacuum evacuation of system to remove moisture.

4. When the compressor is not operating, the oil level should be at least at the bottom of the sight glass, up to two-thirds full. When the compressor is operating, the oil level will normally be at the bottom of the sight glass, or even below, but it must be visible.

NOTICE

Compressor Failure!

Failure to follow instructions below could result in catastrophic compressor failure.
Do not operate with insufficient oil.

5. Low oil sight glass conditions could signify an undercharged heat pump that lacks proper refrigerant velocity to return oil to the compressor sump. Eventually, dry compressor starts could occur causing premature compressor failure. This may indicate that some oil has been lost from a previous refrigerant leak repair. The compressor data label indicates the correct oil type and quantity with which it should be filled.

Note: *A flashlight may be required to see the oil churning in the sump of the compressor. Adjusting the line of sight may be necessary to visually inspect the oil in the compressor sump during operation. At a minimum, the oil must be seen churning in the compressor sump. It should be clear.*

NOTICE

Compressor Failure!

Failure to follow instructions below could result in catastrophic compressor failure.
Do not operate with insufficient oil.

6. Check the glycol concentration using a refractometer.
7. Check the refrigeration pressures. For R410A refrigerant, low pressure refrigeration gauge should read 120 to 160 psi and high pressure refrigeration gauge should read 300 to 450 psi.

NOTICE

Compressor Damage!

Failure to follow instructions below could result in extensive compressor damage.
Verify that suction pressure is sufficient. Secure the circuit or module offline until status can be examined in detail.

Important: *Extended operation with suction pressures below 80 psi is a clear sign of insufficient refrigerant charge, refrigeration obstruction, or valve closed. This can cause extensive damage to a compressor.*

8. Check the refrigeration liquid line sight glass for persistent bubbles (“flashing”) .

Note: *Bubbles in the sight glass do not necessarily indicate loss or lack of refrigerant charge. Bubbles (commonly know as “flashing”) will occur whenever the condenser fans cycle until the expansion valve settles out the refrigerant flow. Occasional bubbles also form when the condenser head pressure control valve bypasses hot gas around the condenser coil in low ambient operation. If the refrigeration pressures are in the normal range, the unit is most likely adequately charged. “Flashing” could also indicate excessive superheat adjustment of the thermal expansion valve.*

Quarterly

The quarterly maintenance inspection is a comprehensive event that examines all aspects of the heat pump to identify early problems before they can damage a Heat Pump and require major repair or refurbishment:

1. Inspect alarm log, refrigerant operating/static pressures and temperature set points of each module independently.
2. Inspect heat pump superheat and sub-cooling. System superheat should be 10 °F to 12 °F (5 °C to 6 °C). System sub-cooling should be 10+ °F (5 °C) depending on the ambient conditions.
3. Inspect the approach delta T - entering heat exchanger water/glycol mixture temperature and leaving refrigerant temperature.
4. Inspect strainers. Ensure bypass valve is properly adjusted to a minimum of 25% open position.
5. Collect chilled water/glycol mixture sample for professional analysis. Check for cleanliness. Drain and refill with clean solution if excessive sludge or dirt is present. Flush the heat pump prior to refilling.
6. Inspect water/glycol mixture levels. Add glycol as required.
7. If equipped, inspect crankcase heaters for proper operation.
8. Inspect the water piping for signs of leaks at joints and fittings.
9. Inspect refrigerant piping circuit for signs of oil or refrigerant leakage. Conduct “sniffer test” to find refrigerant leaks. Inspect all pressure switch bellows.
10. Tighten all refrigeration piping connections (e.g. rotalocks , Schrader valves, caps, and ball valves).
11. Install a manifold and gauge set to observe heat pump’s refrigeration operating pressures.

a. Verify that the pressure controls (low pressure and high pressure switches) are "cutting in" and "cutting out" at the appropriate pressures.
b. Verify refrigerant charge by recording the superheat and sub-cooling temperatures.
c. Observe head pressure for signs of improper condensing from clogged strainers, or a modulating expansion valve issue.

12. Check compressor motor amperage draws and voltage supplies and maintain a record of those values. Verify that they are within the name plate rating. Also, check for voltage imbalance. The heat pump's phase monitor will open if the voltage imbalance exceeds 4%.
13. Check for chattering, excessive wear or burned contacts on motor starters. Replace contacts, if in doubt. It is recommended to replace contactors every 5-6 years.

Annually

The annual heat pump maintenance inspection is critical to the long-term performance of the Heat Pump. Whether a heat pump has a service life of 15 years or 30 years is almost entirely dependent upon how consistently and how diligently the annual maintenance inspection and tasks are performed. The annual event is a comprehensive inspection that examines all aspect of the heat pump to identify and repair small problems before they can become major issues that damage a heat pump and require significant repair or refurbishment.

1. Inspect all electrical connections for damage and ensure terminals are tight. Inspect all contactors for pitting and corrosion and replace as necessary. It is recommended to replace contactors every 5-6 years.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

2. Inspect fuses to ensure they are secure, of correct amperage ratng, undamaged and functioning.
3. Energize each compressor and check refrigerant pressures, signs of overheating, and oil leaks. Check for noises and for leaks with an electronic or bubble leak detector. Inspect flared fittings, refrigeration gauges, compressor connections, braze joints, pressure switches, and access ports on Schrader valves.

⚠ WARNING

Refrigerant under High Pressure!

Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.

System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

4. De-energize each compressor and inspect terminals for pitting, corrosion, and loose connections.
5. Inspect that the oil level is visible in each compressor and not discolored. Annual oil samples should be taken to be analyzed for destructive acids, corrosive materials, or metal deposits.
6. Inspect and record the compressor amperage draws and voltage.
7. Record water/glycol mixture flow to ensure it meets design specifications.
8. Tighten rotalock nuts at the compressors. The recommended torque is 80 lbf for 2 inch and larger and 60 lbf for rotalock nuts smaller than 2 inch.
9. Inspect all copper lines and control capillary tubing to ensure that the lines are separated and not vibrating against one another or the frame or housing.
10. Ensure all refrigeration lines are properly supported to prevent vibration from causing premature failure of copper piping.
11. Inspect all insulation on piping and control sensors. Repair and replace as necessary.
12. Inspect entire plumbing system for leaks.
13. Review logged alarms and look for repetitive trends. The heat pump can retain the previous 200 alarms with time and date of occurrence.
14. If equipped, inspect crankcase heaters to verify proper operation.
15. Sample refrigerant to analyze for moisture or acid.
16. Inspect operating pressures and temperatures and ensure the heat pump has a full refrigerant charge.

Maintenance Tasks

The maintenance tasks described herein present the basic, minimal, steps required to successfully complete a task. Local policies and protocols may require more elaborate procedures with additional checks and inspections.

Inspection Methods

Appropriate inspection for modern heat pumps can be described as "hands on." Where possible and appropriate, visual inspection should include touching the component or apparatus being inspection. The sense of touch provides additional feedback regarding temperature, texture, tightness, and dryness that “eyes only” inspection cannot match. Habitually touching each item to be inspected also ensures that items are not subconsciously skipped during the inspection process. For a summary of tasks, see , Recommended Heat Pump Service Intervals.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Critical Cleaning Tasks

Monitor temperature change and pressure drops across the load heat exchanger circuit to determine the frequency for strainer cleaning. Monitor water quality in the heat pump’s closed system to determine the optimum frequency for heat exchanger cleaning.

On multiple module heat pumps, Trane provides service isolation valves on each load heat exchanger to isolate each strainer for cleaning without disrupting the operation of any remaining modules in the heat pump.

Strainer Cleaning Procedure

Strainers at each load heat exchanger are critical for protecting the brazed plate heat exchanger’s small water passages as well as maintaining water/glycol mixture cleanliness. Service valves on the heat exchanger isolate each strainer for cleaning without interrupting the operation of other modules in the heat pump bank.

NOTICE

Equipment Damage!

Failure to follow instructions could result in equipment damage.

Do not operate without strainers in place.

1. De-energize power to the module containing the strainer by turning the power OFF at the breaker and/or disconnect.
2. Close the two service isolation valves between the header and the heat exchanger.

Note: *If this is a variable flow heat pump, the outlet may be equipped with an electronic valve that must be manually locked in the closed position.*

3. Remove the insulation to expose the roll grooved blind end cap or service cap on the end of the strainer housing. Utilize a short section of hose to connect to the valve on the end cap to relieve pressure and capture fluid. (Dispose of or re-utilize water/glycol mixture according to local protocols.)

⚠ CAUTION

Explosion Hazard!

Failure to relieve pressure gradually could result in minor to moderate injury and equipment damage.

Water/glycol mixture can be under considerable hydraulic pressure in the strainer housing. Close isolation valves fully. Relieve pressure using a boiler vale. Use extreme care to slowly remove the end cap and release pressure gradually.

4. Inspect the gasket and service cap for abrasions, tears, excessive dirt, or deterioration. Replace gasket if necessary.
5. Remove the strainer from the housing.
6. Clean the strainer inside and out using a soft natural bristle brush and tap water.
7. Clean the interior of the end cap (or service cap), and the gasket using a soft natural bristle brush and tap water. Apply a light coating of lubrication to the gasket.
8. Re-install the strainer in the housing (large end first). Replace the gasket and end cap and tighten coupling collar securely.
9. Ensure the water/glycol make-up system is operational to replenish the water/glycol mixture lost during the cleaning process.
10. Energize power to the module containing the strainer by turning power ON at the breaker and/or disconnect.

Air Coil Cleaning Procedure

Fouling of air coil will result in a gradual decline in performance of the heat pump and is particularly significant during high ambient operation:

1. Turn off and “lock out” the power to the heat pump module.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

2. Remove fan assembly to improve access to air coils.
3. Use a garden hose with spray nozzle or a long spray wand with a 90° turn spray head. (DO NOT use a pressure washer on air coils).

Note: *If heat pump is equipped with EC-type fan motors, remove the compressor-side V-baffle end cap, instead.*

NOTICE

Coil Damage!

High pressure water from a power washer can damage and distort the cooling fins on the coil. Using a pressure washer on condenser coils is not recommended. Damaged fins can adversely affect chiller efficiency.

4. Clean coils by spraying water in the opposite direction of the air flow, from top of the coil to the bottom. Spray in a consistent pattern to work the dirt and debris from the top to the lower part of the coil.
5. For extremely dirty coils, chemical soaking may be required to loosen debris build-up. Apply chemicals with a hand-held pump sprayer following a similar pattern used in the water cleaning.
6. Let the chemical mixture soak in the heat exchanger for a short period of time to loosen sediment and scale build-up. Trane recommends using straight tap water except in extreme cases. (Take extra precautions by covering electrical components with plastic bags, etc.)
7. After chemical cleaning, all surfaces must be flushed thoroughly with clean water to remove residual chemicals. Trace chemical residue may result in premature aluminum fin breakdown and deterioration requiring coil replacement.
8. Securely reinstall fan grill assembly (or V-baffle end cap).
9. Turn power back on individual unit after ensuring all electrical connections are wiped dry.
10. Ensure that each unit's panels are clean and clear of debris.

Heat Exchanger Cleaning Procedure

Fouling of the heat exchangers will result in a gradual decline in performance of the heat pump.

1. Isolate each heat exchanger using the isolation valves.
2. Back flush using the city water supply forced to a drain.
3. A brazed-plate heat exchanger is cleaned by back washing which is forcing a cleansing water/glycol mixture backwards through it at higher than normal pressures.
4. Flushing should take place across a maximum 30 Mesh screen filter/strainer with frequent screen cleaning to remove the debris from the heat pump. Flushing should continue until the screen is clean. After detergent and chemical cleaning, flush the piping for a minimum of one hour with fresh water to remove any remaining cleaning compounds.

Compressor Tasks

The AXM air-to-water heat pump has been designed for ease of maintenance access. When properly positioned within a machine room or space, Copeland compressors can be quickly removed for repair or replacement. (See "Site Preparation and Clearances," p. 13).

Remove Compressor

Verify that power is turned OFF via the heat pump module breaker that is found in the power distribution panel. Confirm module power is OFF by testing with known operational voltmeter. Once confirmed, install lockout/tagout equipment to ensure power is not turned on while service work is being performed.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

1. Close the suction and discharge rotalock valves. Firmly front-seat both rotalock valves clockwise.

Note: *Do not over-tighten as the valve can become difficult to loosen if over-tightened.*

2. Recover the remaining refrigerant charge from the compressor using a suitable recovery machine and a clean recovery cylinder that is pressure rated for the refrigerant being removed. Weigh refrigerant charge that was removed.
3. Remove all compressor electrical wiring, as well as safety and crankcase heater wiring. Make sure to notate all connection points for the new installation.

Note: *Be sure to document conductor/wire numbers and their corresponding termination points.*

4. Using a spud wrench, remove the rotalock nuts from the compressor.
5. Remove the four compressor mounting bolts from frame using two 1/2 inch sockets, or a socket and a wrench. (Install the nuts underneath the frame.)
6. Remove the compressor from the module.

Install Compressor

Verify that power is disconnected from the heat pump.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

1. Position the compressor into the heat pump and align the mounting holes. Apply anti-seize compound to the four mounting bolts, washers, and nuts before installation. Tighten nuts securely with 1/2–inch socket and wrench.
2. Remove Schrader valve fittings from old compressor and install them on new compressor with appropriate thread sealant.
3. Install the rotalock nuts on the compressor suction and discharge connections. Tighten with a spud wrench.
4. Charge compressor with 150 psi dry nitrogen and conduct a bubble and electronic leak check.
5. Evacuate new compressor using the suction and discharge Schrader valves. Monitor and ensure that at least a 500 micron or lower vacuum is achieved (250 to 500 micron range would be ideal.)
6. Weigh in amount of refrigerant charge that was removed.
7. Reconnect compressor electrical connections exactly as they were removed, crankcase heater, and high pressure switch.
8. Replace the electrical and control panel cover securely.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

9. Restore power to the module containing the compressor by removing the lockout / tagout in the power distribution panel.
10. Energize the new compressor allowing it to run as long as possible.
11. Observe and document the operating pressures of the newly installed compressor. It is advised that the expansion valve superheat adjustment be checked.

Controller Tasks

Replace PLC Logic Controller

Prior to servicing the controller, verify that the power to the heat pump is disconnected.

1. Remove all quick-connect black plugs and the one orange plug (power supply 24 Vac).

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.
Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/ tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

2. The PLC logic controller is DIN rail-mounted. Once plugs are removed, this will expose the gray secure tabs on the bottom rear of the PLC.
3. Using a flathead screwdriver, insert screwdriver into the slotted holes on the gray tabs and use downward force to release PLC.
4. Remove the PLC by lifting the bottom out and then up, off of the DIN rail.
5. Replace new controller in reverse fashion.

Note: *On a multiple modular system with multiple PLC's, it is imperative that the new PLC has the exact same programming as the remaining PLC's or it will not be compatible and would create havoc within the other PLCs.*

6. Energize power to the module by turning power ON at the breaker and/or disconnect.

Heat Pump Troubleshooting

General Approach to Fault Isolation

Trane manufactures heat pump with embedded fault detection and diagnostics in each module's controller that offers continuous dedicated monitoring to record and report faults as they occur in real time allowing repairs to be performed in a timely manner.

Various faults occurring in a building's HVAC system can lead to unnecessary energy consumption and poor thermal comfort for a building's occupants. Fault detection and isolation plays a significant role in monitoring, maintaining, and repairing heat pump to improve operator safety and minimize operating costs.

Fault detection is recognizing that a problem has occurred, even if the root cause is not yet known. Fault isolation is the process of reducing potential causes to determine the most likely source of heat pump failure.

Controller Diagnostic Codes

The following table assists in explaining the alarm codes that appear in the remote interface panel in the event of an alarm. The alarm history is accessed by pressing the alarm log key.

Table 11. Interface panel diagnostic code key

ALARM	RESET	ACTION
c.pCOe UI1 sensor failure	Auto	Shuts down Circuit 2 if Low Pressure sensor selected for Suction Pressure Alarm
c.pCOe UI2 sensor failure	Auto	Shuts down Circuit 2
c.pCOe UI9 sensor failure	Auto	Warning
c.pCOe UI10 sensor failure	Auto	Warning
c.pCOe Offline Alarm	Auto	Shuts down Circuit 2
c.pCOe wrong config Alarm	Auto	Warning
UI1 sensor failure	Auto	Shuts down circuit 1 if Low Pressure sensor selected for Suction Pressure Alarm
UI2 sensor failure	Auto	Shuts down Circuit 1
UI3 sensor failure	Auto	Shuts down local cooling control if Module is in Stand-alone Mode and respective Entering / Leaving Water sensor selected for Temperature Control
UI3 sensor failure	Auto	Shuts down local heating control if Module is in Stand-alone Mode and respective Entering / Leaving Water sensor selected for Temperature Control
UI4 sensor failure	Auto	Locks out module
UI4 sensor failure	Auto	Warning
UI5 sensor failure	Auto	Warning
UI6 sensor failure	Auto	Warning
UI7 sensor failure	Auto	Modules switch into Stand-alone Mode if both respective Cooling / Heating Mode selected and respective Entering / Leaving Water sensor selected for Temperature Control
UI8 sensor failure	Auto	Modules switch into Stand-alone Mode if both respective Cooling / Heating Mode selected and respective Entering / Leaving Water sensor selected for Temperature Control
UI11 sensor failure	Auto	Control panel heating / cooling control is disabled
UI12 sensor failure	Auto	Warning
Compressor 1 overload	User	Shutdown compressor 1
Compressor 2 overload	User	Shutdown compressor 2
EVD offline	Auto	Warning
EVD System Alarm	Auto	Warning
EVD Driver A Alarm	Auto	Warning

Table 11. Interface panel diagnostic code key (continued)

ALARM	RESET	ACTION
EVD Driver B Alarm	Auto	Warning
EVD 2 offline	Auto	Warning
EVD 2 System Alarm	Auto	Warning
EVD 2 Driver A Alarm	Auto	Warning
EVD 2 Driver B Alarm	Auto	Warning
Evaporator Freezing Alarm	User	Locks out module
Phase Monitor Alarm	Auto	Locks out module
Load Flow Alarm	User	Locks out module
HP Alarm	User	Shuts down Circuit 1 / 2
HP Switch Alarm	Auto	Shuts down Circuit 1 / 2
LP Alarm	Auto	Shuts down Circuit 1 / 2
LP Lockout Alarm	User	Shuts down Circuit 1 / 2
Ebm Papst Fan 1 Warning	Auto	Warning
Ebm Papst Fan 1 Failure	User	Shuts down Fan 1
Ebm Papst Fan 1 Offline	Auto	Shuts down Fan 1
Ebm Papst Fan 2 Warning	Auto	Warning
Ebm Papst Fan 2 Failure	User	Shuts down Fan 2
Ebm Papst Fan 2 Offline	Auto	Shuts down Fan 2
Ebm Papst Fan 3 Warning	Auto	Warning
Ebm Papst Fan 3 Failure	User	Shuts down Fan 3
Ebm Papst Fan 3 Offline	Auto	Shuts down Fan 3
Ebm Papst Fan 4 Warning	Auto	Warning
Ebm Papst Fan 4 Failure	User	Shuts down Fan 4
Ebm Papst Fan 4 Offline	Auto	Shuts down Fan 4
Rosenberg Fan 1 Warning	Auto	Warning
Rosenberg Fan 1 Failure	User	Shuts down Fan 1
Rosenberg Fan 1 Offline	Auto	Shuts down Fan 1
Rosenberg Fan 2 Warning	Auto	Warning
Rosenberg Fan 2 Failure	User	Shuts down Fan 2
Rosenberg Fan 2 Offline	Auto	Shuts down Fan 2
Rosenberg Fan 3 Warning	Auto	Warning
Rosenberg Fan 3 Failure	User	Shuts down Fan 3
Rosenberg Fan 3 Offline	Auto	Shuts down Fan 3
Rosenberg Fan 4 Warning	Auto	Warning
Rosenberg Fan 4 Failure	User	Shuts down Fan 4
Rosenberg Fan 4 Offline	Auto	Shuts down Fan 4
Secondary 1 communication lost	Auto	Warning

Table 11. Interface panel diagnostic code key (continued)

ALARM	RESET	ACTION
Secondary 2 communication lost	Auto	Warning
Secondary 3 communication lost	Auto	Warning
Secondary 4 communication lost	Auto	Warning
Secondary 5 communication lost	Auto	Warning
Secondary 6 communication lost	Auto	Warning
Secondary 7 communication lost	Auto	Warning
Secondary 8 communication lost	Auto	Warning
Secondary 9 communication lost	Auto	Warning
Primary communication lost	Auto	Secondary Modules switch into Stand-alone Mode
BMS offline	Auto	Warning
System Chilled LWT too high	Auto	Warning
System Hot LWT too low	Auto	Warning
Condenser LWT too low	Auto	Warning
Evaporator LWT too high	Auto	Warning
Error in the number of retain memory writings	User	Warning
Error in retain memory writings	User	Warning
Wrong Primary rotation control parameters	Auto	Warning
Wrong temperature control parameters	Auto	Warning
Wrong local rotation control parameters	Auto	Warning
Circuit 1 Differential Pressure low	Auto	Warning
Circuit 2 Differential Pressure low	Auto	Warning
Incomplete Defrost Cycle	Auto	Warning
Incomplete Defrost Cycle Lockout	User	Locks out module
Defrost Ambient Temperature high	Auto	Warning

Compressor Diagnostic Codes

Compressors used in Trane air-to water heat pumps use solid state protection and have PTC (Positive Temperature Coefficient) internal sensors with an avalanching resistance in the event of high temperatures. The sensors are calibrated for proper motor protection.

KRIWAN Flash Codes

The KRIWAN flash code allows for a quick and easy status display and troubleshooting.

The error code consists of a red and orange pulse frequency. They are continually displayed after each other. There is a 1.5 second pause before the red pulse sequence. There is a 0.8 second pause between the red and orange pulse sequences. The error code can be determined from the number of pulsing flashes.

Table 12. KRIWAN flash codes

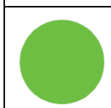
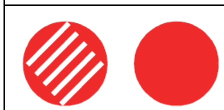
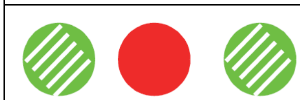
Error Category	1st Flashing Sequence (red LED)	2nd Flashing Sequence (orange LED)	Error Status
Motor temperature	1	1	Nominal response temperature of motor was exceeded
		2	Switch off due to blocked rotor
		3	Time delay active after motor temperature default
		4	Sensor fault motor PTC
		5	Time delay active after blocked rotor
General	3	1	Module undervoltage
		5	Time delay active, category general

Phase Monitor Protection

If the heat pump fails to power up, eliminate electrical phase issues by inspecting the phase monitor device located in the power distribution panel.

When all voltages are acceptable and the phase sequence is correct the output relay is energized and the LED glows green. Under-voltages and unbalanced voltages must be sensed for a continuous trip delay period before the relay de-energizes. Reset is automatic upon correction of the fault condition. The output relay will not energize if a fault condition is sensed as power is applied. The LED flashes red during the trip delay, then glows red when the output de-energizes. The LED flashes green/red if phase reversal is sensed.

Table 13. LED phase monitor diagnostic codes

LED Display	Indication
	Glowing green: All voltages are acceptable and phase sequence is correct.
	Flashing red: Trip delay prior to de-energizing. Glowing red: Output has been de-energized upon fault detection.
	Flashing red and green: Phase reversal is detected.
	No power to phase monitor.

If the phase monitor fails to energize (the LED glows red) check wiring of all three phases, voltage, and phase sequence. If phase sequence is incorrect, the LED flashes green/red. To correct this, swap any two line voltage connections at the mounting socket. No further adjustment should be required.

Symptoms and Solutions

This section lists the most common troubleshooting symptoms and the closest potential solution for each. The "References" column will list a reference within this manual, if applicable. This is not an exhaustive listing of all potential causes or resolutions, but represents the best direction in which to initiate a solution.

Note: *An anti-short cycle timer is included in the primary microprocessor controller to prevent the compressors from starting until the delay has elapsed. The microprocessor also provides minimum compressor run timers. Take these fixed timer parameters into consideration when conducting a fault isolation process.*

1. Symptom: Compressor will not start	
Possible Causes	**Potential Solutions**
Temperature control not in demand	Check setpoint
Flow switch open due to low water flow	Check flow switch functionality; Check flow rate
Low pressure, high pressure sensor open	Low/high pressure event has occurred; Obstructed BPHX or coil; Check fan settings and functionality; Check Sensor functionality

1. Symptom: Compressor will not start	
Possible Causes	**Potential Solutions**
High pressure switch open	High pressure event has occurred; Check fan settings and functionality; Check obstructed coils; Check pressure switch functionality
Compressor overload opened	Allow motor to cool and reset; High amp load/floodback; Compressor operating outside of operating envelope
No power to module	Check breakers and fuses; Energize from module electrical and control panel
Phase monitor open or tripped	Check phase sequence, unbalanced voltage, Overvoltage, Undervoltage; Loss of phase
Breaker tripped	Reset breaker; Check amp draw, high refrigeration pressure, low voltage, and lose connection
Overcurrent	Check overload (circuit breaker, compressor grounded,..)
Ambient temperature is lower than 0° F	Ambient temperature should be above 0° F

2. Symptom: Compressor will not run	
Possible Causes	**Potential Solutions**
Ambient temperature is lower than -5° F	Ambient temperature should be above -5° F
Main switch open or circuit breakers open	Check circuits and motor winding for shorts or grounds
Fuse is blown	Replace fuse or reset breakers
Investigate for possible overloading	Overloads are auto-reset. Monitor to assure the overload does not re-occur
Defective contactor or coil	Determine type and cause. Correct fault before resetting safety

3. Symptom: Compressor has excessive noise or vibration	
Possible Causes	**Potential Solutions**
Flooding of refrigerant back to compressor	Check setting of expansion valve; Check crankcase heater
Improper phase sequence	Check phase sequence
Improper or worn compressor supports (vibration-isolating mounting)	Replace supports
Faulty crankcase heater	Replace crankcase heater

4. Symptom: Compressor Loading/Unloading Cycles Too Short	
Possible Causes	**Potential Solutions**
Temperature differential set too low	Ramp/set temperature differential setpoint; Check stage up/down settings
Incorrect liquid temperature settings	Select proper control settings
Insufficient evaporator water flow	Check flow rate
Low system liquid/water volume	Water system volume needs to be increased

5. Symptom: Compressor loses oil	
Possible Causes	**Potential Solutions**
Low refrigerant charge	Check for leaks and repair. Add refrigerant to proper charge
Oil trapped in the system	Low refrigerant velocity caused by operation outside operating envelope; Check fan settings and functionality in heating mode
Defective crankcase heater	Replace crankcase heater

5. Symptom: Compressor loses oil	
Possible Causes	**Potential Solutions**
Compressor short cycling	Adjust proper control settings for Min. ON/OFF runtime
Liquid refrigerant	Check compressor superheat. Superheat at the compressor suction should be approximately 12° F

6. Symptom: Low refrigeration suction pressure	
Possible Causes	**Potential Solutions**
Lack of refrigerant	Check for leaks. repair and add charge
Evaporator dirty	Clean chemically
Suction line blockage	Check suction line for any obstacle
Condensing temperature too low	Check fan settings
Low water temperature	Raise set point; Check design specification
Low discharge pressure	Refrigerant charge; Replace compressor; Check fan settings
Improper expansion valve settings	Check EXV functionality and settings
Mis-adjusted or defective TXV	Adjust or replace valve
Compressor service valves closed	Dangerous! Turn counterclockwise completely
Clogged liquid line filter-drier	Replace filter drier or cartridges
Excessive glycol concentration	Charge to proper glycol concentration
Liquid line solenoid restricted or faulty	Replace solenoid valve, coil, or internals as necessary
Insufficient chilled water	Adjust flow rate through heat exchanger
Restricted water/glycol line	Clean strainers; Check manual and electronic valves
Water/glycol mixture contaminated	Intensive cleanup effort needed to identify source of contamination; External filter may be required
Evaporator clogged or fouled	Reverse flush with appropriate chemical solutions
LP alarm: Heating to defrost	Check solenoid valve; Check EXV start-up position settings on HMI (80%)
LP alarm: at the end of defrost	Check fan settings at defrost mode
LP alarm: start at low ambient in heating mode	Checking EXV start-up delay (needs to be set at 12s)
Incorrect fan speed	Check fan settings

7. Symptom: High refrigeration suction pressure	
Possible Causes	**Potential Solutions**
Incorrect fan speed in heating mode	Check fan settings
Leakage refrigeration through solenoid bypass (from receiver to evaporator entrance in cooling mode)	Check bypass solenoid valve to be close completely when system gets stable in cooling mode
High water temperature in heating mode	Check refrigerant charge; Check excessive load; Check design specification

8. Symptom: Low refrigerant discharge pressure	
Possible Causes	**Potential Solutions**
Insufficient refrigerant in heat pump ; Improper charge	Check for leaks. repair and add refrigerant as needed
Faulty compressor	Check compressor
Low ambient conditions in cooling mode	Check design condition

8. Symptom: Low refrigerant discharge pressure	
Possible Causes	**Potential Solutions**
Low suction pressure	See low refrigeration suction pressure
Incorrect fan control settings	Check fan settings

9. Symptom: High refrigerant discharge pressure	
Possible Causes	**Potential Solutions**
System overcharged with refrigerant (especially at low ambient temperature in heating mode)	Remove excess refrigerant
Dirty tube and fin surface	Clean with compressed air or water spray, use fin comb if fins are bent
Non-condensables in heating mode	Purge non-condensables
Incorrect fan control settings	Check fan functionality and settings
Condensing fans not operating in cooling mode	Check fan functionality and settings
Discharge shut off valve partially closed	Open valve
EXV does not function properly (especially at low ambient in heating mode)	Check EXV functions; Check SSH settings
Overshooting LWT temperature in heating mode	Water system volume needs to increase; Check stage band control settings

10. Symptom: Low chilled water temperature	
Possible Causes	**Potential Solutions**
Temperature controllers set too low	Reset temperature setpoint
Low water flow	Clean strainer; Check pump, VFD, and differential pressure settings; Check to ensure electric and manual water valves are fully open
Faulty system temperature sensor	Replace temperature sensor

11. Symptom: High chilled water temperature	
Possible Causes	**Potential Solutions**
Load higher than capacity of heat pump	Refer to heat pump design specifications
Loss of refrigeration charge	Check refrigerant charge
Fouled evaporator	Reverse flush evaporator; Check strainer for debris
High water flow rate	Check pump, VFD and differential pressure settings
Faulty system temperature sensor	Replace temperature sensor

12. Symptom: Compressor thermal protector switch open	
Possible Causes	**Potential Solutions**
Operating beyond design conditions	Check fan switch or fan pressure settings as appropriate
Discharge valve partially shut	Open valve
Faulty compressor overload	Replace overload if external type provided

13. Symptom: No low voltage (24 Vac)	
Possible Causes	**Potential Solutions**
Transformer primary side fuse open	Check fuse prong contact points; Replace fuse
Transformer defective	Replace transformer
No primary voltage on transformer	Check breakers, fuses; Check power supply specifications

14. Symptom: Thermal Expansion valve superheat too high	
Possible Causes	**Potential Solutions**
Water/glycol temperature too warm	Check setpoints; Check charge
Obstructed filter dryer	Replace dryer core
Low refrigerant charge	Recharge refrigerant as per data plate
Improper and not enough heat transfer at air coil	Check tube and fin surface; Check fan settings
Sensing bulb not properly located	Check if secured to pipe or insulated; Check sensor position on pipe
Defective or improper settings of EXV/TXV	Check EXV/TXV functions; Check EXV/TXV settings

15. Symptom: Thermal expansion valve superheat too low	
Possible Causes	**Potential Solutions**
Sensing bulb not properly located	Check if secured to pipe or insulated; Check sensor position on pipe
Defective thermostatic element (TXV is cooling mode)	Replace power head
EXV/TXV valve superheat setting is too low or not functioning properly	Check EXV/TXV settings and functionality

16. Symptom: Contactor/relay inoperative	
Possible Causes	**Potential Solutions**
Coil shorted or open	Replace coil
Mechanical parts broken or jammed	Replace assembly
Contacts pitted or burned	Replace contactors
No 24 Vac to coil	Replace secondary fuse to transformer; Check transformer

17. Symptom: Freeze protection safety activated	
Possible Causes	**Potential Solutions**
Chiller setpoint is too low	Use a proper setpoint
Low water flow	Clean strainer; Check pump, VFD and differential pressure settings
Low suction pressure	See “low suction pressure”

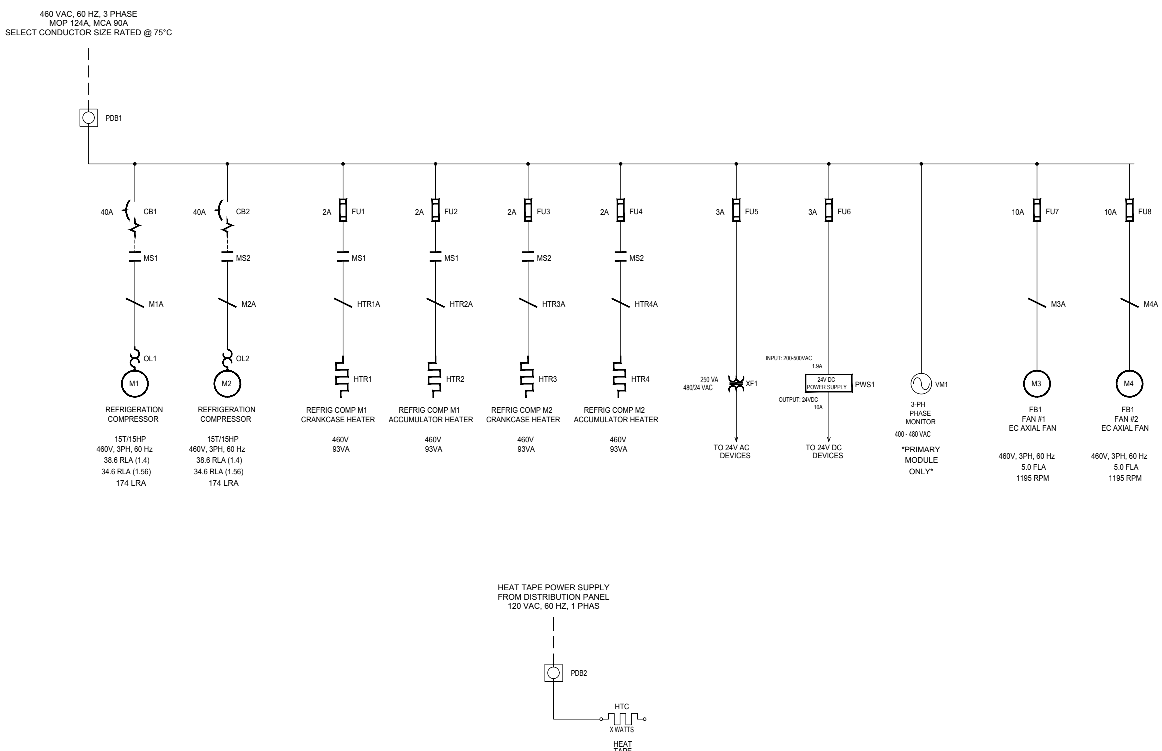
Logical Flow Diagrams

The following section presents the simplified logical flow block diagrams for the principal systems in the AXM air-to-water modular heat pump.

High Voltage Logical Flow

AXM heat pump models are available in a range of voltage/amperage/phase configurations to meet the demands of a worldwide market. The high voltage configuration for a heat pump module is listed on each module's name plate. The heat pump is designed to operate with high voltage power supplied to the unit at all times. See Figure 24, p. 62

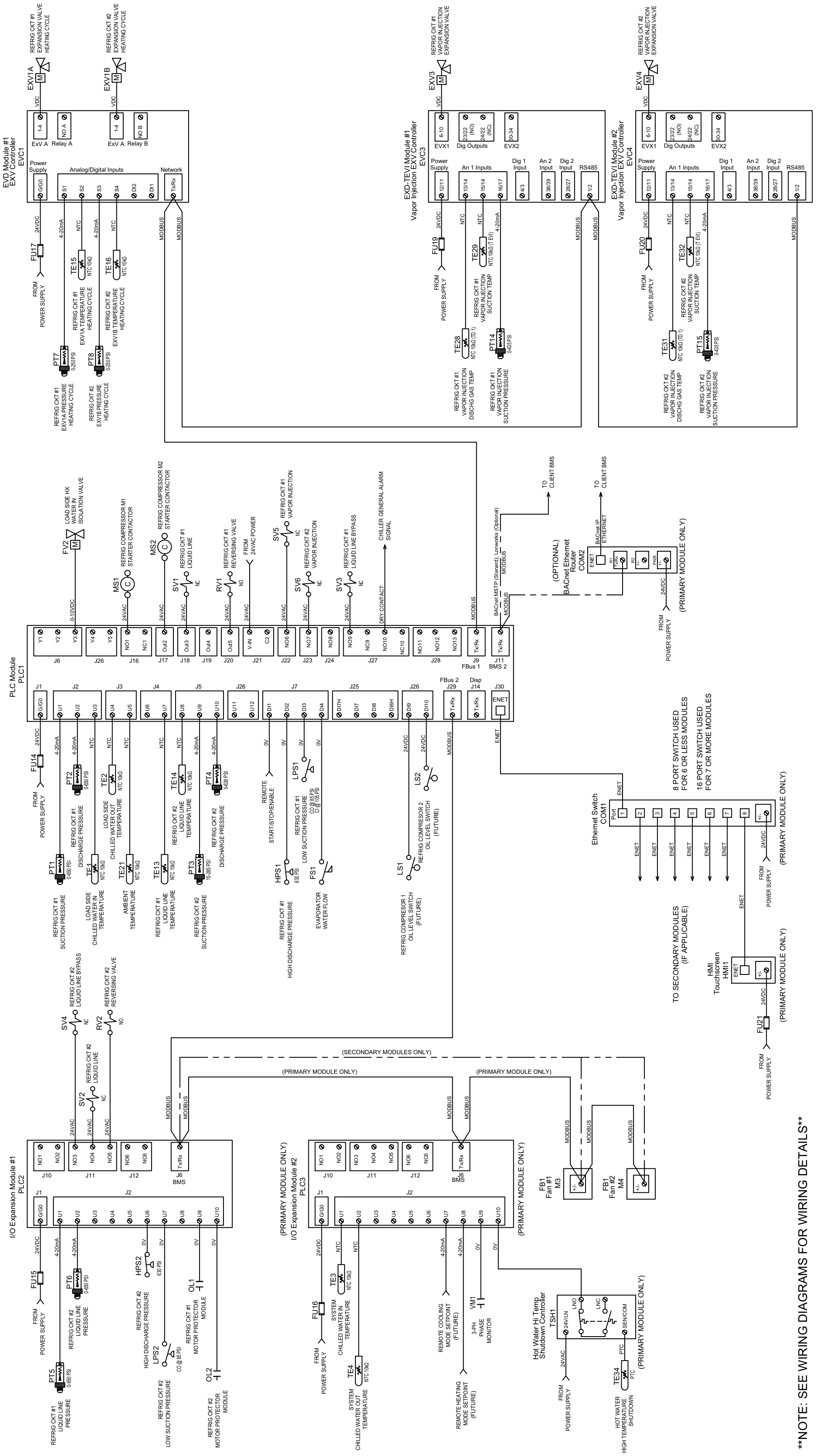
Figure 24. High voltage logical flow of single module



Control Logical Flow

The heat pump uses low voltage for controller and sensor circuits. See following figure.

Figure 25. Control logical flow



Refrigeration Logical Flow

AXM heat pump uses two independent refrigeration circuits per module using vapor injected scroll compressors. See below figure.

Figure 26. Product schematic - cooling mode

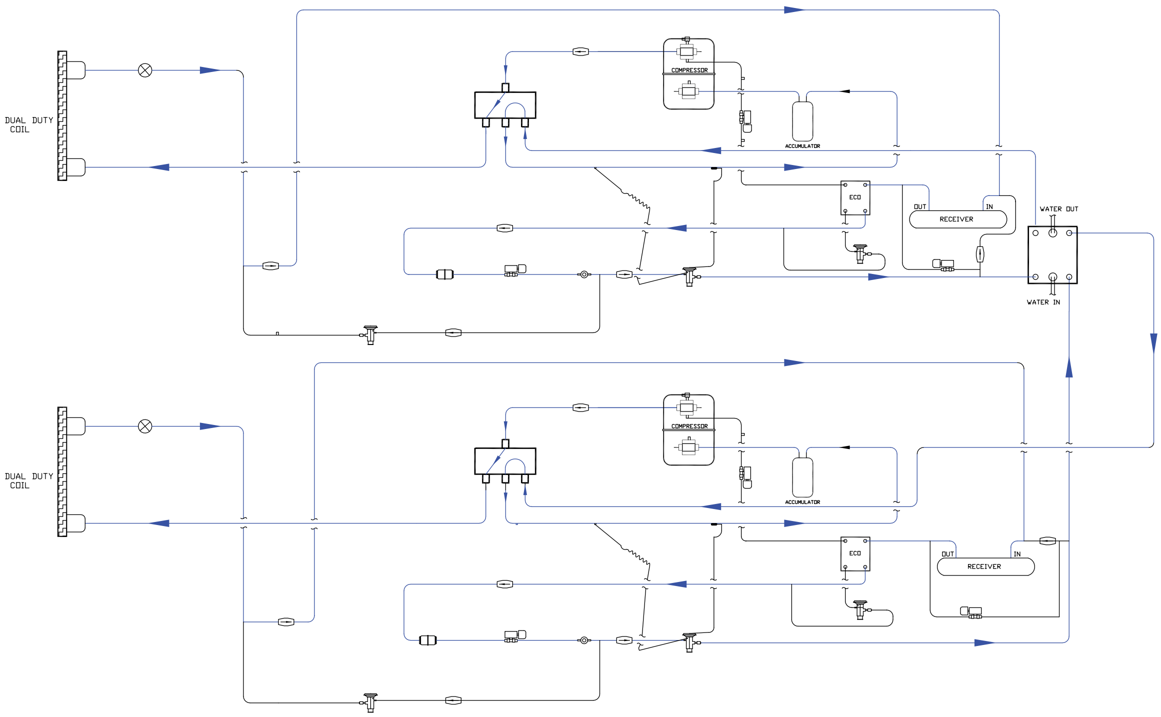
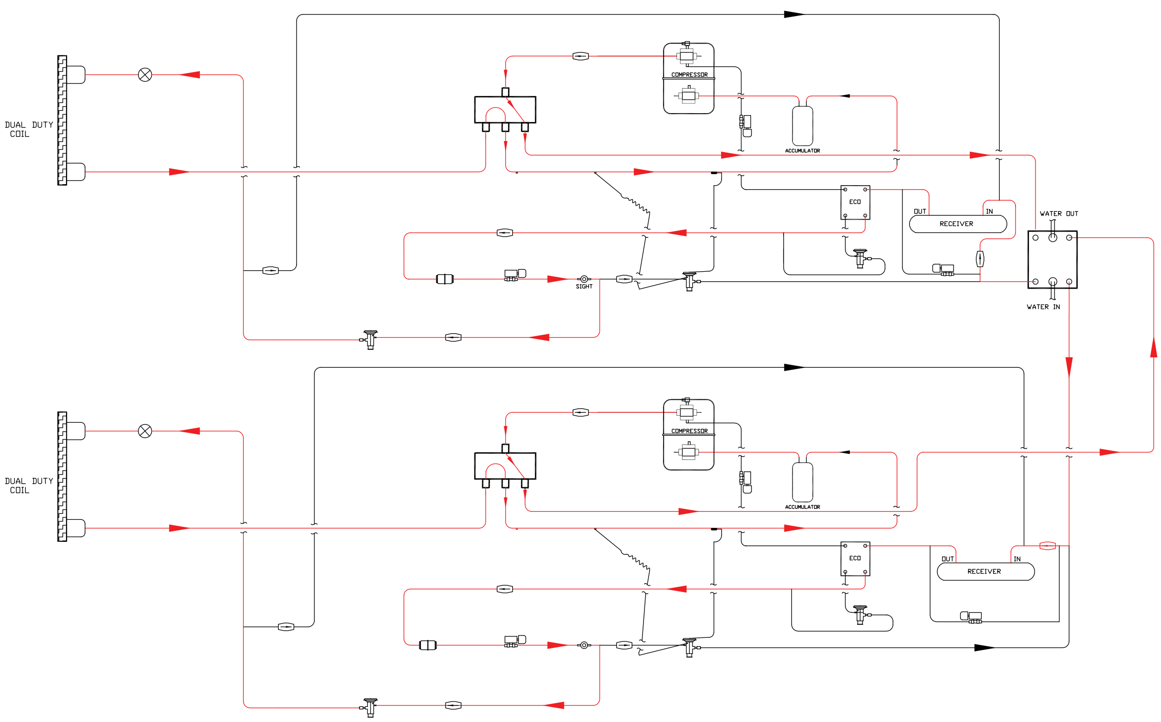


Figure 27. Product schematic - heating mode



Appendix A. Acronyms and Abbreviations

All acronyms and abbreviations used in this manual, on the heat pump controllers, and on module indicators and gauges are listed in the following tables.

Acronym List

All acronyms and abbreviations in this publication are listed in the following table, with their full spellings and expansions.

Table 14. Acronyms and abbreviations

Item	Expansion
410A	R410A
ACWS	Automatic City Water Switchover
AHRI	Air-Conditioning, Heating and Refrigeration Institute
AL	alarm
Alrms	alarms
Anlg	Analog
AO1	analog output one
Bd	board
btu	British thermal unit
C	Celsius
C1	Circuit 1
C2	Circuit 2
CB	Circuit Breaker
CE	Conformance European
ckt	circuit
CL	cool
Cntrl	Controller
Comps	Compressors
COND	condenser
CSA	Canadian Standards Association
DB	Dry Bulb
DB	Distribution Block
DifPr	Differential Pressure
Dly	Delay
DP	Differential Pressure
ECM	Electrically Commutated Motor
EER	Energy Efficiency Rating
EMC	Electromagnetic Compatibility

Table 14. Acronyms and abbreviations (continued)

Item	Expansion
EMI	Electromagnetic Interference
EPC	Extended Performance Compressor
EvapFl	Evaporator Flow
EVC	Electronic [expansion] Valve Controller
EXP1	Expansion Board 1
EXV	Electronic [expansion] Valve
F	Fahrenheit
FLA	Full Load Amperes
FLC	Full Load Current
FREECOOL	Free Cooling
FRI	Friday
gpm	gallons per minute
GUI	Graphical User Interface
HFC	Hydrofluorocarbon
HG	Hot Gas
Hotgas1	Hot Gas 1
HP	horsepower
HPS	High Pressure Switch
HT	heat
HVAC	Heating, Ventilation, and Air-Conditioning
Ident	Identification
IEEE	Institute of Electrical and Electronic Engineers
IGBT	Insulated Gate Bipolar Transistor
INFO	Information
Int	Integration
IP	Industry Pack
Iso	Isolation
LA	Low Ambient
lbf	foot pounds
LBV	Load Balance Valve
LED	Light-Emitting Diode
LIFO	Last In First Out
LLS	Liquid Line Solenoid
LP	Low Pressure
LPPD	Low Pressure Pump Down
LPS	Low Pressure Switch

Table 14. Acronyms and abbreviations (continued)

Item	Expansion
LRA	Locked Rotor Amperes
m	minute
Max	Maximum
Min	Minimum
MON	Monday
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NTC	Negative Temperature Coefficient
OA	Outside Ambient
OAT	Outside ambient Air Temperature
OD	Outside Diameter
ORD	Open on Rise Differential pressure
ORI	Open on Rise Inlet pressure
P	Process
PD	Pressure Differential
PE	Protective Earth
PLC	Programmable Logic Controller
PMD	Panel Mounted Disconnect
POE	Polyolester Oil
ppm	parts per million
Pres	pressure
psi	pounds per square inch
PumpDown	Pump Down
PumpMod	Pump Module
PWM	Pulse Width Modulation
Pwrup Stg Up	Power Up Stage Up
REFRIG	Refrigeration
RemOff	Remote Off
RMA	Returned Merchandise Authorization

Table 14. Acronyms and abbreviations (continued)

Item	Expansion
Rot	Rotation
rpm	revolutions per minute
RP	Redundant Pump
s	second
SAT	Saturday
SDT	Saturated Discharge Temperature
SP	Set Point
SSS	Solid State Starter
SST	Saturated Suction Temperature
StartPt	Stating Point
SUN	Sunday
Sys	System
Temp	Temperature
TEMPS	Temperatures
THU	Thursday
TT	Twin Turbine
TUE	Tuesday
TXV	Thermal Expansion Valve
U1, U2	binary 1, binary 2
UL	Underwriters Laboratories
UV	Ultraviolet
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VFD	Variable Frequency Drive
WED	Wednesday
Y1, Y2	analog output: y1 = condenser
Y4	analog output

Appendix B. Request for Initial Startup

AXM Air-to-Water Heat Pump

As part of a continuous commitment to quality, initial startup of this heat pump by a factory-certified technician may be purchased from Trane. No initial startup will be scheduled without a Request for Initial Startup form completed and on file with the Trane customer service department. Submitting this form indicates that all critical work described on the form has been completed. To prevent additional charges for aborted startups, the following items must be completely functional and operating and this form signed and returned to Trane at least 10 working days prior to the scheduled initial startup date.

Heat Pump Initial Startup Data

Model Number:	Primary Module Serial Number:
Primary Contact Name:	Primary Contact Phone:
Primary Contact FAX:	Primary Contact Mobile:
Name of Heat Pump Site:	
Physical Location of Heat Pump:	
Requested Date for Initial Start-up: **Requested Time for Initial Start-up:**	

Mandatory Initial Startup Requirements

Mandatory Tasks	Date Completed	Initialed Complete
All heat pump modules are installed with minimum clearances available from all sides.		
Refrigeration gauges are indicating equal pressures.		
Chilled water lines from heat pump to customer's equipment are permanently connected.		
Chilled water lines have been flushed clean of mud, slag, and other construction debris.		
All chilled water line filters and strainers are clean.		
Chilled water lines have been leak tested according to prestart instructions.		
Heat Pump reservoir (if included) is at operating level with correct water/glycol mixture.		
High voltage wiring is installed, tested, and functional.		
All water, refrigeration, electrical, and control connections between heat pump modules are completed.		
All control wiring between modular heat pumps is installed, tested, and functional.		
Control wiring is complete, including any remote interface panel or special-purpose module wiring.		
Automatic City Water Switchover (if included) is installed, flushed, and leak-tested.		
Condenser, if applicable, is installed, piped, wired, and leak-tested.		
All responsible installing contractors and sub-contractors are notified to have representatives available on site to provide technical support for the initial start-up procedure.		
Full load shall be available for heat pump on the initial start-up date.		

Initial Startup Agreement

By signing this form, you agree the heat pump is ready for initial startup. It is understood that, if the heat pump is not ready for initial startup due to site problems, the initial startup will be aborted at the discretion of the designated startup technician. Payment for an aborted startup will be forfeited. Rescheduled initial startups are subject to any additional costs that may have been incurred by the technician. An approved purchase order or payment in advance will be required to reschedule an aborted initial startup.

Name (Printed): ___________________________________ Date: _____________________________________

Signature: ____ Company: _________________________________

Trane creates comfortable, energy efficient indoor environments for commercial applications. For more information, please visit trane.com or americanstandardair.com

Arctic designs cost-efficient leading-edge chillers and applied solutions to meet individual customer needs—from large, medium to smaller-scale systems. For more information, please visit www.arcticchillergroup.com

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