BOSCH

Installation, Operation, and Maintenance Manual

MC Series Heat Pumps (R454B)

MC360 | MC480 | MC600 | MC720

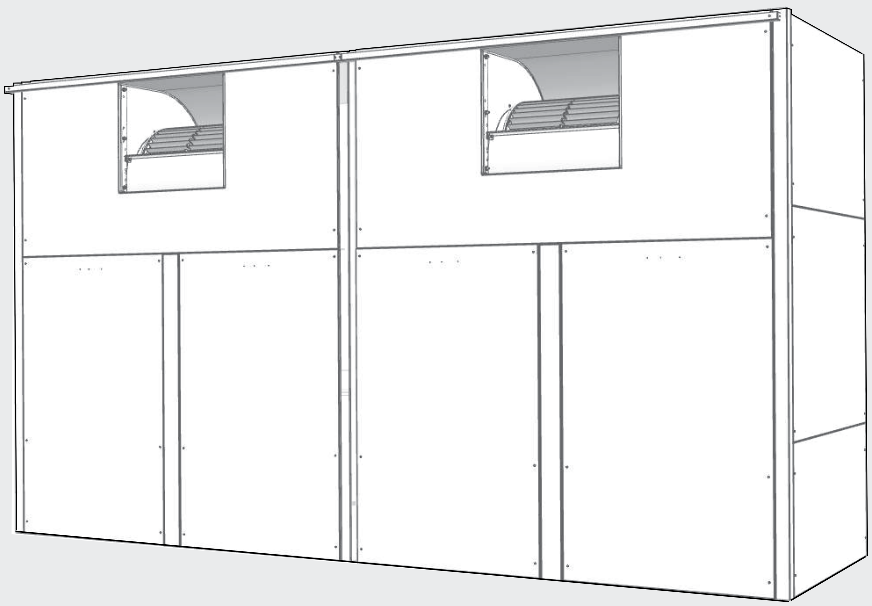

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Table of Contents

1 Document Conventions

1.1 Key to Symbols

1.1.1 Warnings

Warnings in this document are identified by a warning triangle followed by a signal word.

Signal words at the beginning of a warning indicate the type and seriousness of the ensuing risk if measures to prevent the risk are not taken.

The following signal words are defined and can be used in this document:

DANGER

DANGER indicates a situation that, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a situation that, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a situation that, if not avoided, could result in minor to moderate injury.

NOTICE

NOTICE is used to address practices not related to personal injury.

1.1.2 Important information

The info symbol indicates important information where there is no risk to property or people.

1.2 General Safety Instructions

DANGER

Personal injury hazard or property damage!

Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions that may cause death, serious personal injury and/or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory-authorized kits or accessories when modifying this product. Refer to the individual instructions packaged with the kits or accessories when installing.

DANGER

Electric shock!

Before performing service or maintenance operations on the system, turn OFF main power to the unit. Electrical shock will cause personal injury or death.

WARNING

Personal injury hazard!

Installation and servicing of this equipment can be hazardous due to system pressure and electrical components. Only trained and qualified personnel should install, repair, or service the equipment.

WARNING

Personal injury hazard!

When working on equipment, always observe precautions described in the literature, tags, and labels attached to the unit. Follow all safety codes. Wear safety glasses and work gloves. Use a quenching cloth for brazing, and place a fire extinguisher close to the work area.

WARNING

Fire hazard!

DO NOT use means to accelerate the defrosting process or to clean, unless recommended in these instructions.

WARNING

Fire hazard!

The appliance must be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance, or an operating electric heater).

WARNING

Fire hazard!

Auxiliary devices that may be a POTENTIAL IGNITION SOURCE must NOT be installed in the duct work. Examples of such POTENTIAL IGNITION SOURCES are hot surfaces with a temperature exceeding 700 °C and electric switching devices such as circuit breakers, contactors, motor starters, disconnect switches, etc.

CAUTION

Personal injury hazard!

Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing and gloves when handling parts.

NOTICE

Product damage!

To avoid equipment damage, DO NOT use these units as a source of heating or cooling during the construction process. Doing so may affect the unit's warranty. The mechanical components and filters will quickly become clogged with construction dirt and debris, which may cause system damage or failure.

WARNING

Personal injury hazard!

This appliance is not intended for use by people (including children) with reduced physical, sensory, or mental capabilities, or with lack of experience and knowledge, unless they are supervised or have been given instruction concerning use of the appliance by a person responsible for their safety.

Children should be supervised to ensure that they do not play with the appliance.

1.2.1 Refrigerant Safety Warnings

DANGER

Poisonous gas!

Poisonous gas can be created when refrigerant (R454B) is exposed to open flames.

WARNING

Risk of fire!

Flammable Refrigerant Used—To be repaired only by trained service personnel. DO NOT puncture refrigerant tubing.

WARNING

Risk of fire!

Flammable Refrigerant Used—Dispose of properly in accordance with federal or local regulations.

WARNING

Personal injury hazard!

DO NOT pierce or burn refrigerant lines.

WARNING

Asphyxiation hazard!

Be aware that refrigerants may not contain an odor.

To avoid the release of refrigerant into the atmosphere, the refrigerant circuit of this unit must be serviced only by technicians who meet local, state, and federal proficiency requirements.

All refrigerant discharged from this unit must be recovered WITHOUT exception. Technicians must follow industry accepted guidelines and all local, state, and federal statutes for the recovery and disposal of refrigerants. If a compressor is removed from this unit, refrigerant circuit oil will remain in the compressor. To avoid leakage of compressor oil, refrigerant lines of the compressor must be sealed after it is removed.

2 Model Nomenclature

MC 480 – 4VH C – S B S I U A – X X T A M X X X X 1 X X X X 1 X X X X S B A

1-2 3-5 6 7 8-9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

MODEL:
MC

NOMINAL CAPACITY:
360, 480, 600, 720

ELECTRICAL CONFIGURATION:
3 – 208–230/60/3
4 – 460/60/3
5 – 575/60/3

CABINET CONFIGURATION:
VH – Vertical, High Cabinet Configuration
VL – Vertical, Low Cabinet Configuration

COAX OPTIONS:
C – Copper
N – Cupro-nickel
X – No Condenser

WATER CONNECTION:
S – Side
X – N/A

RETURN AIR CONFURATION:
B – Back

DISCHARGE AIR LOCATION:
T – Top
F – Front
R – Rear

FAN/MOTOR OPTION:
I – Belt Drive, Inverter Duty

AIR COIL:
U – Uncoated

REVISION LEVEL:
C – Current revision

ELECTRIC HEAT:
X – None

CABINET CONSTRUCTION:
A – G90 Steel / 1/2" 1.5 LB Dual-Density Fiberglass
C – G90 Steel / 1/2" Closed-Cell Foam

APPLICATION:
G – Extended Range w/Schrader Valve (Geothermal)
T – TXV Option

GENERAL ELECTRICAL OPTIONS (Up to 5 Available per Unit):
B – Blower Monitor Relay
C – Compressor Monitor Relay
D – Phase Monitor
E – Pump/Valve Relay
G – Boilerless Control
H – Flow Proving Switch
K – Fire Alarm Relay/Dual Power
M – Wire to 208 Volts
X – As Default for Non-Used Electrical Codes

REFRIGERATION CIRCUIT OPTION:
B – Hot Gas Bypass
C – Hot Gas Bypass with Hot Gas Reheat
H – Hot Gas Reheat with On/Off
J – Hot Gas Reheat with Straight Cool
K – Hot Gas Bypass with Hot Gas Reheat, Modulating, and Straight Cool
M – Modulating Hot Gas Reheat
N – Modulating Hot Gas Reheat with Straight Cool
S – Straight Cool
T – Hot Gas Bypass with Straight Cool
X – None

TRANSFORMER:
1 – 100 VA

CONTROLS:
I – Inverter
J – DDC-5830-Multi-Protocol (BacNET, Modbus, N2) with VFD, with Expander
M – DDC-5830-Multi-Protocol (BacNET, Modbus, N2)
X – Standard

WATER-FLOW CONTROL OPTIONS:
X – None

ECONOMIZER:
E – Economizer with 3-Way Valve and Controls
H – Hot Water Coil
X – None

OPEN

AIR FILTRATION:
6 – 4" Pleated Filter Bank

MOTOR HP (BELT DRIVE ONLY)
F – 7.5
G – 10
H – 15
K – 20

DRIVE SPEED (MC ONLY):
A – 794 RPM
B – 813 RPM
C – 842 RPM
D – 871 RPM
E – 916 RPM
F – 949 RPM
G – 982 RPM
H – 1034 RPM
I – 1072 RPM
J – 1111 RPM
K – 1149 RPM
L – 1172 RPM
M – 1200 RPM
N – 1214 RPM
O – 1256 RPM
P – 1305 RPM

MOTOR/BLOWER ORIENTATION:
X – Blower and Motor Standard Orientation

AGENCY OPTIONS:
X – Standard, 5k SC CR
D – 5k SCCR, Dual-Point Power (Fire Alarm Relay)

STANDARD/SPECIAL:
S – Standard
A – Special #1
B – Special #2

CHANNEL:
B – Bosch

CODE STRING LEVEL:
A – Current

Figure 1 Model Nomenclature

3 General Description

MC series are available in two models:

VH CABINET

The VH design will facilitate on site handling and can be installed in locations difficult to access. All units may be broken down into separate modules that can pass through a 36” wide standard door or service elevator. All refrigerant circuits are factory charged and sealed. Water connections between sections have brass couplings providing for single water connections.

VL CABINET

The VL design allows for installation in those locations where there is a height restriction. The blower section is dropped into the main coils section reducing the overall height and increasing unit depth. Unit sizes MC480 through MC720 may be split into two sections for transportation and access into the plant room.

NOTICE

Product damage!

For well water applications, 50°F minimum entering water temperature (EWT) with sufficient flow is required to prevent freezing. Antifreeze solution is required for all closed-loop applications. Sufficient antifreeze solution is required to protect against extreme conditions and equipment failure. Frozen water coils are not covered under warranty.

3.1 Operating Limits

3.1.1 Environment

This equipment is designed for indoor installation only. Extreme variations in temperature, humidity, and corrosive water or air will adversely affect the unit performance, reliability and service life.

3.1.2 Power Supply

A voltage variation of ± 10% of nameplate utilization voltage is acceptable.

3.1.3 Unit Starting Conditions

Minimum ambient temperature for heating operation is 50°F. Minimum entering air for heating is 50°F. Minimum entering water temperature for heating with standard range units is 50°F and for extended range units is 20°F. Air and water flow rates must be within the cataloged range.

3.2 Normal Operating Conditions

Normal operating conditions must fall in the limits defined in the table below. (Refer to Table 1.)

<table>
<tr><th colspan="5">Operating Limits</th></tr>
<tr><th>Fluid Type</th><th colspan="2">Specification</th><th>Cooling</th><th>Heating</th></tr>
<tr><td rowspan="6">Air</td><td colspan="2">Minimum ambient air temperature</td><td>50°F</td><td>40°F</td></tr>
<tr><td colspan="2">Maximum ambient air temperature</td><td>100°F</td><td>85°F</td></tr>
<tr><td colspan="2">Rated ambient air temperature</td><td>80°F</td><td>68°F</td></tr>
<tr><td colspan="2">Minimum air coil entering air db/wb</td><td>65/57°F</td><td>45°F (db)</td></tr>
<tr><td colspan="2">Maximum air coil entering air db/wb</td><td>95/85°F</td><td>80°F (db)</td></tr>
<tr><td colspan="2">Rated air coil entering air db/wb</td><td>80/67°F</td><td>68/59°F</td></tr>
<tr><td rowspan="9">Liquid</td><td colspan="2">Antifreeze Protection Required (LWT/EWT)</td><td>–</td><td><40/<50°F</td></tr>
<tr><td colspan="2" rowspan="2">Minimum water coil entering fluid temperature</td><td rowspan="2">50°F</td><td>EXT 20°F</td></tr>
<tr><td>STD 50°F</td></tr>
<tr><td colspan="2">Maximum water coil entering fluid temperature</td><td>110°F</td><td>80°F</td></tr>
<tr><td rowspan="3">Rated water coil entering fluid temperature</td><td>Water Loop</td><td>86°F</td><td>68°F</td></tr>
<tr><td>Ground Loop</td><td>77°F</td><td>32°F</td></tr>
<tr><td>Ground Water</td><td>59°F</td><td>50°F</td></tr>
<tr><td>Maximum operating water pressure</td><td>Standard Unit</td><td colspan="2">450 psi/ 3,102 kPa</td></tr>
<tr><td colspan="2">Minimum operating water flow rate</td><td colspan="2">1.5 GPM per ton</td></tr>
</table>

Table 1

Note: Maximum and minimum operating limits may not be combined. Refer to Engineer Submittal Sheet on the product information page. (See the QR code on the back page of the IOM).

Acronyms:
EXT: Extended Range application option
STD: Standard application option
LWT: Leaving Water Temperature
EWT: Entering Water Temperature

4 Inspecting and Storing the Equipment

4.1 Moving and Storage

If the equipment is not needed for immediate installation upon its arrival at the job site, it should be left in its shipping factory condition and stored in a clean and dry area. Units must only be stored or moved in their normal, upright position at all times.

Units may be shipped in multiple sections depending on the model. Refer to table 2.

Units must be properly rigged with spreader bars as appropriate to avoid damage to the unit. Refer to Figure 2 for lifting details.

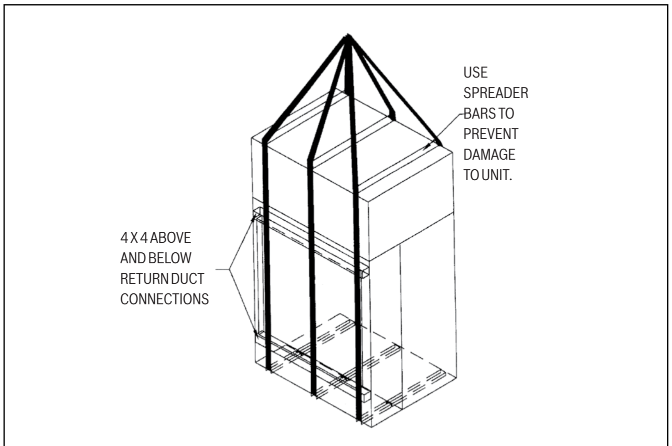

Figure 2

Sections	Number of Sections							
	MC360		MC480		MC600		MC720	
	VH	VL	VH	VL	VH	VL	VH	VL
Air Conditioning	1	1	2	2	2	2	2	2
Economizer/Filter	1	1	2	2	2	2	2	2
Fan	1	–	2	–	2	–	2	–

Table 2

NOTICE

Product damage!

Be careful to avoid damage to filter racks and duct flanges when storing or handling units.

NOTICE

Product damage!

Never lift or move units by filter racks, external piping, or attached options/ accessories.

NOTICE

Product damage!

Never stack units when transporting them.

NOTICE

Product damage!

DO NOT stack units when storing.

4.2 Initial Inspection

Verify that all items have been received and that there is no visible damage. Note any damage or shortage on all copies of the freight bill. Concealed damage not discovered until after removing the units from packaging must be reported to Bosch by the original purchaser by filing a claim at: www.claims.bosch-homecomfort.us

4.3 Inspection and Unpacking Prior to Installation

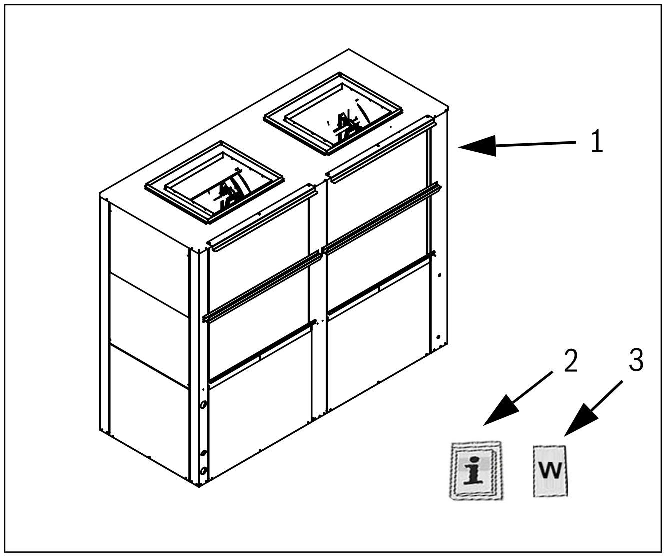

Figure 3 Standard Packaging

[1] MC Large Series Heat Pump
[2] Installation, Operation, and Maintenance Manual
[3] Warranty Documentation

Inspect the product carefully for any defects or other discrepancies. If any are identified, contact the Bosch Wholesaler/Distributor from which you purchased the unit.

The following should be checked:

- Compare the electrical data on the unit nameplate with ordering and shipping information to verify that the correct unit has been shipped.
- Verify that the unit is the correct model for the entering water temperature of the job.
- Only remove the packaging when the unit is ready for installation.
- Verify that the refrigerant tubing is free of kinks or dents, and that it does not touch other unit components.
- Inspect all electrical connections. Be sure connections are clean and tight at the terminals.
- Remove any shipping brackets from the unit attached to the pallet.

5 Unit Installation

This section contains information on the following:

- Location Selection—page 11
- Minimum Conditioned Room Area—page 12
- Protecting the Unit During Construction—page 13
- Condensate Drain—page 13
- Duct System—page 13
- Piping—page 13
- Electrical—Power Supply Wiring—page 15
- Electrical—Low-Voltage Wiring—page 16
- Specific Application Considerations—page 19
- Water Quality Considerations—page 21
- Post-Installation System Checkout—page 23
- Pre-Start-Up—page 23
- Start-Up—page 24
- Commissioning—page 24

⚠ **WARNING**

Personal injury hazard or property damage!

This product is to be installed, serviced, and uninstalled by professionals only.

NOTICE

Product damage!

DO NOT use MC series units for temporary heating, air conditioning or ventilation during construction, especially when plastering, sanding, or painting. Care should be taken to avoid introduction of dust, paint, or debris into the air coil. Warranty will be void if the units are used during construction.

5.1 Location Selection

Unit location selection is very important for proper installation, functioning, and ease of servicing.

When selecting a location for the unit, the following conditions must be met:

- Location must be indoors.
- The ambient temperatures must be maintained above freezing.
- Mount the unit using an adequate slope of the condensate lines to allow for proper drainage. If an appropriate slope cannot be achieved, a field-supplied condensate pump may be required.
- DO NOT allow the weight of the duct work to rest on the unit.
- Adequate clearance for filter replacement and drain pan cleaning must exist. DO NOT allow piping, conduit, etc. to block filter access.
- Sufficient access to allow maintenance and servicing of the fan and fan motor, compressor and coils must be allowed. Removal of the entire unit from the closet should not be necessary.
- An unobstructed path to the unit within the closet or mechanical room must be present. Space should be sufficient to allow return air to freely enter the unit.
- Ready access to water valves, fittings, and screwdriver access to unit side panels, discharge collar, and all electrical connections must be provided.
- DO NOT place the unit above supply piping.

NOTICE

Product damage!

MC series units are not approved for outdoor installation; therefore, they must be installed inside a structure in a conditioned space.

A “conditioned space” is a space within a building provided with heated or cooled air or both (or surfaces) and, where required, with humidification or dehumidification means to maintain conditions for an acceptable thermal environment.

5.2 Minimum Conditioned Room Area

The minimum height of the room is 7.2 feet (2.2 m).

Due to the flammable nature of the refrigerant, there are certain requirements that must be met to employ the use of MC units. If a unit is connected via a duct system, the total conditioned area must meet the minimum value shown in the table below. This value is only valid if the minimum airflow (Qmin) requirement is also met. Refer to the Blower Performance Table to verify airflow values. (See Table 15 on page 48.)

Unit Size	Number of Manifolded Refrigeration Circuits	Total Refrigeration Charge in oz (kg)	Refrigeration Charge per Circuit in oz (kg)	Ceiling Height in ft (m)					Qmin (m3/hr)	
				7.2 (2.2)	8 (2.4)	9 (2.7)	10 (3.0)	12 (3.7)	Per Refrigerant Circuit	Complete System
				Minimum Area of the Total Conditioned Space in ft^2 (m^2)						
MC360	2	528 (15.0)	264 (7.5)	973.2 (90.4)	878.1 (81.6)	780.5 (72.5)	702.5 (65.3)	585.4 (54.4)	878 (1492)	1756 (2984)
MC480	4	576 (16.3)	144 (4.1)	1061.7 (98.6)	957.9 (89.0)	851.5 (79.1)	766.3 (71.2)	638.6 (59.3)	479 (814)	1916 (3255)
MC600	4	1136 (32.2)	284 (8.1)	2093.9 (194.5)	1889.2 (175.5)	1679.3 (156.0)	1511.4 (140.4)	1259.5 (117.0)	945 (1605)	3778 (6420)
MC720	4	1056 (29.9)	264 (7.5)	1946.5 (180.8)	1756.2 (163.2)	1561.0 (145.0)	1404.9 (130.5)	1170.8 (108.8)	878 (1492)	3512 (5968)

Table 3

5.3 Protecting the Unit During Construction

Once the unit is properly positioned on the job site, cover it with either a shipping carton, vinyl film, or an equivalent protective covering. Cap opens ends of pipes stored on the job site. This precaution is especially important in areas where painting, plastering, or spraying of fireproof material, etc. is not yet complete. Foreign material that accumulates within the units can prevent proper start-up and require costly clean-up operations. Before installing any of the systems components, be sure to examine each pipe, fitting valves and remove any dirt or foreign material found in or on these components.

Be careful not to place the top section flat on a solid floor as the drain stubs can be damaged and the seal broken.

5.4 Condensate Drain

A drain line must be connected to the heat pump and pitched away from the unit a minimum of 1/4" per foot to allow the condensate to flow away from the unit.

This connection must be in conformance with local plumbing codes. A trap must be installed in the condensate line to ensure free condensate flow.

Units are not internally trapped.

A vertical air vent is sometimes required to avoid air pockets.

The depth of the trap depends on the amount of positive or negative pressure that is on the drain pan while the unit's fan is operating. A second trap must NOT be included. (See Fig.4)

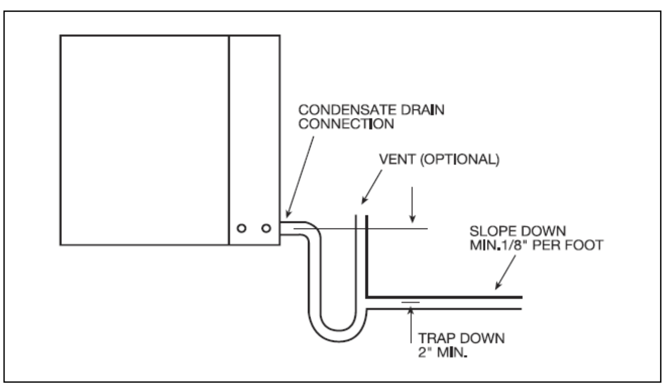

Figure 4

If the unit is equipped with a float-style condensate overflow switch, final adjustment must be made in the field.

5.5 Duct System

All MC Series models are provided with a supply air outlet collar and return air duct flange to facilitate duct connections.

A flexible duct connector is recommended for supply and return air duct connections on metal duct systems. In order to avoid heat loss or gain and prevent condensate forming during the cooling operation, insulate all metal ducting with a minimum of 1" duct insulation.

NOTICE

Product damage!

Application of the unit to uninsulated duct work is not recommended as the unit's performance will be adversely affected.

NOTICE

Product damage!

The factory-provided air filter must be removed when using a back-return air grill. The factory filter should be left in place on a free-return system.

For new or replacement market installations, please refer to current ASHRAE procedures for duct sizing to ensure proper unit's operation and air distribution. If the duct system is too small, larger duct work should be installed. Check for any leaks in the existing duct work and repair as needed.

DO NOT connect discharge ducts directly to the blower outlet.

5.6 Piping

Supply and return piping must be as large as the unit connections on the heat pump (larger on long runs).

NOTICE

Product damage!

No unit should be connected to the supply or return piping until the water system has been completely cleaned and flushed to remove any dirt, piping chips, or other foreign material.

Supply and return hoses should be connected together during this process to ensure the entire system is properly flushed. After the cleaning and flushing has taken place the unit may be connected to the water loop and should have all valves wide open.

In order to avoid possible vibration, use flexible hose between the unit and the rigid system.

Never use flexible hoses of a smaller inside diameter than that of the water connections on the unit.

Units are equipped with female pipe thread fittings for water connections.

NOTICE

Product damage!

Piping systems that contains steel pipes or fittings may be subject to galvanic corrosion. Dielectric fittings should be used to isolate the steel parts of the system to avoid galvanic corrosion.

To ensure against leaks and possible heat exchanger fouling, use an appropriate thread sealant when connecting water piping connections to the unit.

DO NOT overtighten the connections.

Install ball valves in the supply and return lines for unit isolation and unit water flow balancing.

MC units are supplied with a copper or an optional cupronickel condenser. Copper is adequate only for ground water that is not high in mineral content. (Refer to Table 9 on page 22.)

NOTICE

Product damage!

Proper testing is required to ensure the well water quality is suitable for use with water source equipment.

In conditions anticipating moderate scale formation or in brackish water, a cupronickel heat exchanger is recommended. (Refer to the Water Quality Table on page 22.) Water quality must meet the standards stated in the table.

Both the supply and discharge water lines will sweat if subjected to low water temperature. Insulate lines to prevent damage from condensation.

All manual flow valves used in the system must be ball valves. Globe and gate valves must not be used due to high-pressure drops and poor throttling characteristics.

Pressure/temperature ports are recommended in both the supply and return lines for system flow balancing and determining the system capacity versus rated conditions. The water flow can be accurately set by measuring the water-to-refrigerant heat exchangers water-side pressure drop. See the unit specification sheets for the water flow and pressure drop information.

NOTICE

Product damage!

DO NOT expose water piping to freezing ambient temperatures.

NOTICE

Product damage!

Never exceed the recommended water flow rates as serious damage or erosion of the water-to-refrigerant heat exchanger could occur.

Always check carefully for water leaks and repair appropriately.

5.6.1 Installation of Pressure Regulating Valves

Pressure regulating valves are used to increase or decrease water flow through the heat pump in response to refrigerant pressure. In some cases, more water may be required in heating than in cooling, or vice versa. With the MC heat pumps, these valves are not required. However, if installed, a pair of valves are required for proper operation, one valve for cooling (direct acting) and another valve for heating (indirect acting).

5.6.2 Discharge Water

The discharge water from the heat pump is not contaminated in any manner and can be disposed of in various ways depending on local building codes (for example: discharge well, dry well, storm sewer, drain field, stream or pond, etc.) Most local codes forbid the use of a sanitary sewer for disposal. Consult your local building and zoning department to insure compliance in your area.

5.6.3 Antifreeze

NOTICE

Product damage!

Antifreeze solution is required for all closed-loop applications. Sufficient antifreeze solution is required to protect against extreme conditions and equipment failure. Frozen water coils are not covered under warranty.

In areas where entering loop temperatures drop below 40°F or where piping will be routed through areas subject to freezing, antifreeze is needed. Alcohols and glycols are commonly used as antifreeze agents. Freeze protection must be maintained to 15°F below the lowest expected entering loop temperature. For example, if the lowest expected entering loop temperature is 30°F, the leaving loop temperature would be 22°F to 25°F. Therefore, the freeze protection must be at 15°F (30°F-15°F=15°F).

5.7 Electrical—Power Supply Wiring

5.7.1 Electrical Component Box Layout

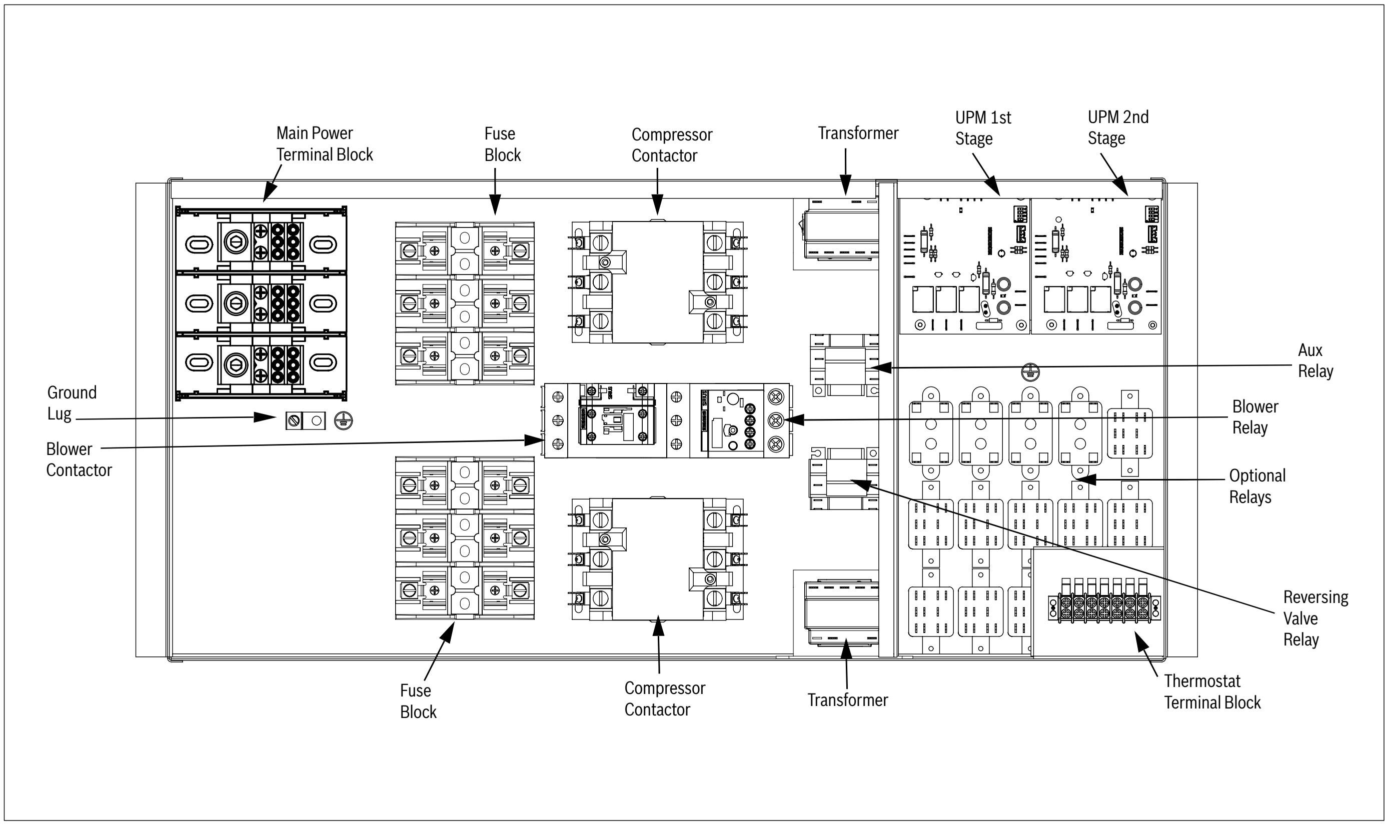

Figure 5

5.7.2 High-Voltage Wiring

WARNING

Personal injury hazard!

Field wiring must be installed by qualified and trained personnel.

All field-installed wiring must comply with the National Electric Code as well as all applicable local codes.

Refer to the unit electrical data on the unit's nameplate or its performance data sheet for the required voltage, phasing, branch-circuit protection sizing, and to determine the proper wire sizing. Operating the unit below the minimum voltage, above the maximum voltage, or with incorrect phasing can result in poor system performance or damage to the heat pump.

NOTICE

Product damage!

Power to the unit must be within the operating voltage range indicated on the unit’s nameplate or on the performance data sheet.

NOTICE

Product damage!

Operation of the unit on improper line voltage or with excessive phase imbalance will be hazardous to the unit, constitutes abuse, and may void the warranty.

WARNING

Personal injury hazard or property damage!

Properly-sized fuses or HACR circuit breakers must be installed for branch-circuit protection. See the unit nameplate for maximum fuse or breaker size.

For field electrical connection requirements, refer to the unit's wiring diagrams starting on page 54.

The unit is provided with wiring access openings for attaching common trade sizes of conduit. Route power supply wiring through this opening. Always connect the ground lead to the grounding lug provided in the control box and power leads to the line side of compressor contactor as indicated on the wiring diagrams starting on page 54.

WARNING

Personal injury hazard or property damage!

All high-voltage connections must be torqued as specified by the component's manufacturer.

To minimize the transmission of vibration from the unit cabinet to the building, enclose the power wiring to the heat pump in a flexible conduit.

5.7.3 Units with Dual Power Supplies

For models with dual power supplies, one power supply feeds the compressor, and a second power supply feeds the unit fan motor and control circuit. The compressor power supply must be connected to the line (L) side of the compressor contactor. The fan motor and control-circuit power supply must be connected to the terminal block located in a dedicated electrical box.

5.7.4 Transformer Settings for 208/230-V Units

As factory built, all 208/230-V units are set to operate at 240 volts unless the wire for the 208-V option is ordered. For job sites with a 208-V power supply, the primary leads on the unit transformer will need to be changed from 240-V to 208- V.

Refer to the unit wiring diagrams starting on page 54.

5.8 Electrical—Low-Voltage Wiring

5.8.1 Thermostat

Position the thermostat on an interior wall away from supply ducts and locations subject to direct sunlight and drafts. Place the thermostat base plate against the wall so that it is level and the thermostat wires protrude through the middle of the base plate. Mark the position of the base plate mounting holes and drill holes with a 3/16-inch bit. Install supplied anchors and secure base plate to the wall.

Thermostat wire must be 8-conductor wire. The minimum gauge needed is dependent on the length of the run. Refer to 5.8.3 Thermostat to HVAC Equipment Wiring. Strip the wires back 1/4-inch (longer strip lengths may cause shorts) and insert the thermostat wires into the appropriate connectors. Refer to Table 4. Tighten the screws to ensure secure connections. See instructions for the thermostat for detailed installation and operation information.

Thermostat wiring from the thermostat is connected to the 7-pin, screw-type terminal block, which is located in the electrical component box.

WARNING

Personal injury hazard!

Never route control wiring through the same conduit as power supply wiring.

Connection	Function
Y1	First-Stage Compressor Operation
Y2	Second-Stage Compressor Operation
G	Fan
O	Reversing Valve (energized in cooling)
NC	Transformer 24 VAC Common (extra connection)
C1	Transformer 24 VAC Common (primary connection)
R	Transformer 24 VAC Hot
H	Hot Gas Reheat

Table 4 Thermostat Connection Options

5.8.2 Thermostats with a Malfunction Light

If the unit is being connected to a thermostat with a malfunction light, this connection is made at the unit malfunction output or relay.

If the thermostat is provided with a malfunction light powered by the common (C) side of the transformer, a jumper must be used between the “R” and “COM” terminals of the “ALR”contacts.

If the thermostat is provided with a malfunction light powered by the hot (R) side of the transformer, then the thermostat malfunction light should be connected directly to the (ALR) contact on the unit’s UPM board

5.8.3 Thermostat to HVAC Equipment Wiring

The thermostat may not function properly if the total resistance of any of the thermostat to HVAC equipment wires exceeds 2.5 ohms. To ensure that wire length does not cause excess resistance, refer to Table 5 and ensure that the wires from the thermostat to the HVAC equipment are not too long.

Copper Wire Gauge	Maximum Wire Length
22 AWG (0,33mm2)	150 ft. (46m)
20 AWG (0,50mm2)	240 ft. (73m)
18 AWG (0,75mm2)	385 ft. (117m)

Table 5 Length by Wire Gauge for Thermostat to HVAC Equipment Wiring

5.8.4 Remote Sensor to Programmable Thermostat Wiring

Because remote temperature sensors measure resistance, very long cable runs can cause slight errors in the measurement. For the highest temperature reading accuracy, avoid exceeding the maximum recommended wire lengths show in Table 6.

Copper Wire Gauge	Maximum Remote Sensor Wire Length
22 AWG (0,33mm2)	1000 ft. (300m)
20 AWG (0,50mm2)	1500 ft. (450m)
18 AWG (0,75mm2)	2500 ft. (750m)

Table 6 Length by Wire Gauge for Remote Sensor to Programmable Thermostat Wiring

5.8.5 VA Capacity

Unit heat pumps are supplied with a 75 VA control transformer as a standard. Models with hot gas reheat, modulating hot gas reheat, economizer, and DDC are supplied with a 100 VA transformer. The 100 VA transformers are available as optional components for all unit sizes. The VA capacity of the transformer must be considered when connecting low-voltage accessories to the heat pump such as thermostats or solenoid valves. The total VA draw of the heat pump internal components plus attached accessories must be lower than the VA capacity of the unit control transformer.

WARNING

Personal injury hazard or product damage!

Exceeding the transformer capacity will result in low control voltage, erratic unit operation, or damage to the heat pump.

5.8.6 Low-Voltage VA Draw

Low Voltage VA Draw 360							
Standard Construction		Refrigerant Options		Electrical Options		Electrical Options	
Component	VA	Component	VA	Component	VA	Component	VA
Reversing Valve Solenoid 1	12	Total from 'Standard'	64	DDC	26	DDC Expander	13
Reversing Valve Solenoid 2	12	Hot Gas Reheat Solenoid 1	9	Reversing Valve Relay	10	A2L Mitigation Relay	4
Compressor Contactor 1	10	Hot Gas Reheat Solenoid 2	9	Aux Relay	10	Fire Alarm Relay	4
Compressor Contactor 2	10	Modulationg Reheat Valve 1	3	Hot Gas Reheat Relay 1	4		
Blower Contactor	10	Modulationg Reheat Valve 2	3	Hot Gas Reheat Relay 2	4		
UPM board 1st Stage	5	Economizer Valve	7	Economizer Relay	4		
UPM board 2nd Stage	5			Boilerless Control Relay	4		
				Cooling Relay	4		
				Heating Relay	4		
				Compressor Monitor Relay 1	4		
				Compressor Monitor Relay 2	4		
				Energy Management Relay	4		
				Blower Monitor Relay	4		
Total VA draw	**64**	**Total Draw Is Dependant on the Options Installed**		**Total Draw Is Dependant on the Options Installed**		**Total Draw Is Dependant on the Options Installed**	

Table 7 Low-Voltage VA Draw Table

Units supplied with 100VA Transformer(s) from factory (360 QTY 1; 480-720 QTY 2)

Low Voltage VA Draw 480-720							
Standard Construction		Refrigerant Options		Electrical Options			
Component	VA	Component	VA	Component	VA	Component (cont.)	VA
Reversing Valve Solenoid 1	12	Total from 'Standard'	136	DDC	26	DDC Expander	13
Reversing Valve Solenoid 2	12	Hot Gas Reheat Solenoid 1	9	Aux Relay	10	Hot Gas Reheat Relay 1	4
Reversing Valve Solenoid 3	12	Hot Gas Reheat Solenoid 2	9	Reversing Valve Relay 1	10	Hot Gas Reheat Relay 2	4
Reversing Valve Solenoid 4	12	Hot Gas Reheat Solenoid 3	9	Reversing Valve Relay 2	10	Hot Gas Reheat Relay 3	4
Compressor Contactor 1	10	Hot Gas Reheat Solenoid 4	9	Compressor Monitor Relay 1	4	Hot Gas Reheat Relay 4	4
Compressor Contactor 2	10	Modulationg Reheat Valve 1	3	Compressor Monitor Relay 2	4	Boilerless Control Relay 1	4
Compressor Contactor 3	10	Modulationg Reheat Valve 2	3	Compressor Monitor Relay 3	4	Boilerless Control Relay 2	4
Compressor Contactor 4	10	Modulationg Reheat Valve 3	3	Compressor Monitor Relay 4	4	Heating Relay 1	4
Blower Contactor 1	10	Modulationg Reheat Valve 4	3	Blower Monitor Relay 1	4	Heating Relay 2	4
Blower Contactor 2	10	Economizer Valve	7	Blower Monitor Relay 2	4	Cooling Relay 1	4
UPM board 1st Stage	5			Energy Management Relay 1	4	Cooling Relay 2	4
UPM board 2nd Stage	5			Energy Management Relay 2	4	Economizer Relay	4
UPM board 3rd Stage	5			A2L Mitigation Relay 1	4	Start/Stop Relay	4
UPM board 4th Stage	5			A2L Mitigation Relay 2	4		
Cross Functional Mitigation Relay 1	4			Fire Alarm Relay 1	4		
Cross Functional Mitigation Relay 2	4			Fire Alarm Relay 2	4		
Total VA draw	**136**	**Total Draw Is Dependant on the Options Installed**		**Total Draw Is Dependant on the Options Installed**			

Table 8 Low-Voltage VA Draw Table

Units supplied with 100VA Transformer(s) from factory (360 QTY 1; 480-720 QTY 2)

6 Specific Application Considerations

6.1 Well Water Systems

(Refer to Fig. 6)

A copper heat exchanger is adequate for ground water that is not high in mineral content. Should your well driller express concern regarding the quality of the well water available or should any known hazards exist in your area, we recommend proper testing to ensure the well-water quality is suitable for use with water source equipment. In conditions of brackish water or where moderate scale formation is anticipated, a cupronickel heat exchanger is required. Refer to the Water Quality Table on page 22 to ensure the water quality is suitably for use with water source equipment.

In well water applications, water pressure must always be maintained in the heat exchanger to avoid insufficient water flow. This can be accomplished with a control valve or a bladder-type expansion tank. When using a single water well to supply both domestic water and the heat pump care must be taken to ensure that the well can provide sufficient flow for both.

In well water applications, a slow-closing solenoid valve must be used to prevent water hammer.

Connect the solenoid valves across Y1 and C1 on the interface board for all. Make sure that the VA draw of the valve does not exceed the contact rating of the thermostat.

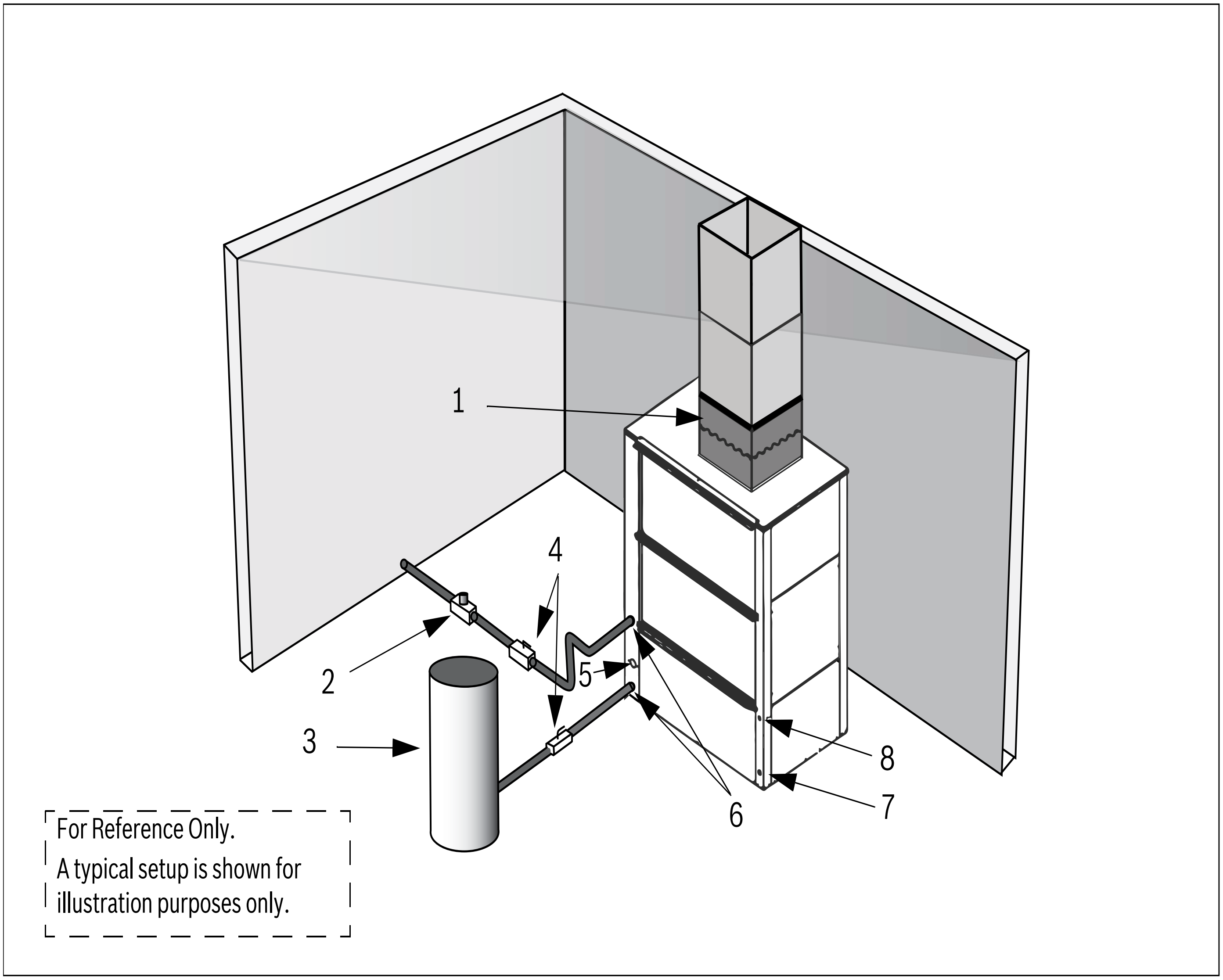

Figure 6 Typical Well Water Setup

[1] Flex Duct Connection
[2] Solenoid Valve, Slow Closing
[3] Pressure Tank (optional)
[4] Ball Valves
[5] Condensate Drain Connection
[6] P/T Ports (optional)
[7] Line Voltage Connection
[8] Low-Voltage Control Connection

6.2 Cooling Tower/Boiler Systems

(Refer to Fig. 7)

These systems typically use a common loop temperature maintained at 50°F to 100°F to ensure adequate cooling and heating performance.

In the cooling mode, heat is rejected from the unit into the water loop. A cooling tower provides cooling to the loop water thus maintaining a constant supply temperature to the unit. When utilizing open cooling towers, chemical water treatment is mandatory to ensure the water is free from corrosive elements. A secondary heat exchanger (plate frame) between the unit and the open cooling tower may also be used. It is imperative that all air be eliminated from the closed loop side of the heat exchanger to ensure against fouling. In the heating mode, heat is absorbed from the water loop. A boiler can be utilized to maintain the loop at the desired temperature.

NOTICE

Product damage!

Water piping exposed to extreme low ambient temperatures is subject to freezing.

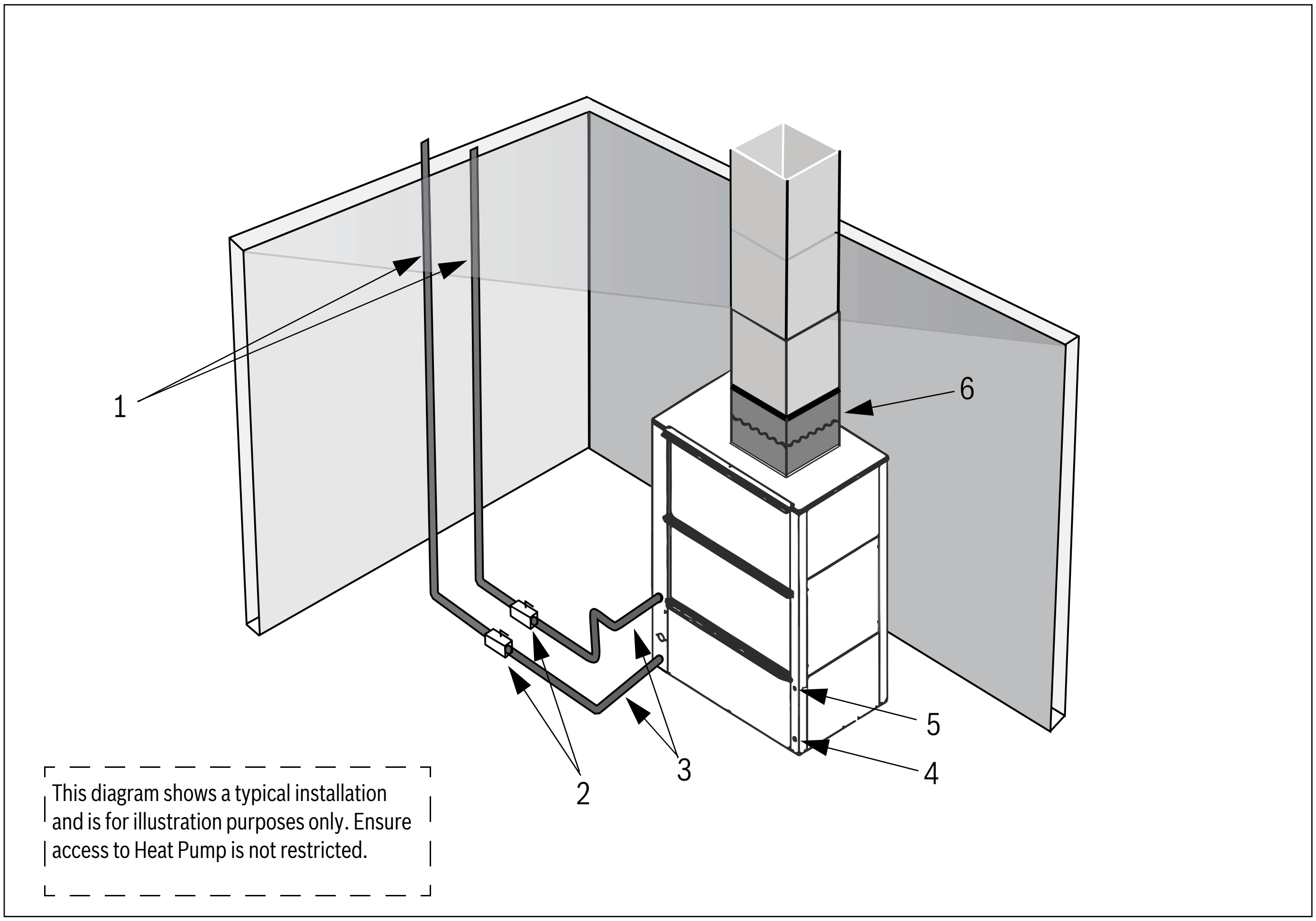

Figure 7 Typical Cooling Tower and Boiler System Setup

1] Supply and Return Line of Central System
[2] Ball Valves
[3] Hose Kits (optional)
[4] Line-Voltage Control Connection
[5] Low-Voltage Control Connection
[6] Flex Duct Connection

7 Water-Quality Considerations

NOTICE

Product damage!

Failure to ensure proper water quality and flow rates can shorten the life of the heat pump and potentially void the unit warranty.

Maintaining proper water quality is required to ensure proper operation of the heat pump. (See the Water Quality Table on page 22.)

For closed loop and boiler/tower systems, the water chemistry must be checked and maintained to ensure that corrosive elements, dissolved oxygen, and pH levels are kept in check. It is important to be sure that any additive, antifreeze, or corrosion inhibitor that is added to the water loop is compliant with all applicable laws and regulations and is compatible with copper, brass, and bronze alloys. Ensure that all recommended safety precautions are followed when handling or adding chemicals to the water loop.

For open loop systems, water quality is very important. The Water Quality Table on page 22 shows acceptable ranges for a variety of water-quality factors. The three main concerns in open loop installations are scaling, corrosion, and fouling.

In installations with hard water, scaling due to a buildup of carbonates on the heat exchanger wall can gradually degrade the heat pump performance over time. Heat pumps that are affected by scaling may exhibit low suction pressures in heating and high head pressures in cooling with a gradual loss of capacity and efficiency. Scaled heat exchangers can be cleaned by a qualified technician but care should be taken to avoid scaling in the first place. To limit scaling, water flow rates should be kept at 3 gallons/minute per nominal cooling ton (a 10°F temperature rise in cooling) and care should be taken to avoid air in the water lines from suction side leaks.

In installations with high hydrogen sulfide, chlorine or ammonia, corrosion is a potential problem. In these installations, a cupronickel heat exchanger is required along with maintaining proper flow and keeping air out of the system. If water quality is outside of the values in the water quality table, then a closed loop is required. Fouling due to iron bacteria can also pose problems in some open loop installations. Iron bacteria fouling can quickly degrade system performance and plug heat exchangers.

Air in the water system will greatly accelerate the fouling or corrosion process.

Water Quality			
Potential Problem	Water Characteristic	Acceptable Value	
		Copper	Cupronickel
	pH (Acidity/Alkalinity)	7–9	7–9
Scaling	Hardness ($CaCO_3$, $MgCO_3$)	< 350 ppm	< 350 ppm
	Ryznar Stability Index	6.0–7.5	6.0–7.5
	Langelier Saturation Index	-0.5 – +0.5	-0.5 – +0.5
Corrosion	Hydrogen Sulfide (H_2S)	< 0.5 ppm*	10–50 ppm
	Sulfates	< 125 ppm	< 125 ppm
	Chlorine	< 0.5 ppm	< 0.5 ppm
	Chlorides	< 20 ppm	< 150 ppm
	Carbon Dioxide	< 50 ppm	< 50 ppm
	Ammonia	< 2 ppm	< 2 ppm
	Ammonia Chloride	< 0.5 ppm	< 0.5 ppm
	Ammonia Nitrate	< 0.5 ppm	< 0.5 ppm
	Ammonia Hydroxide	< 0.5 ppm	< 0.5 ppm
	Ammonia Sulfate	< 0.5 ppm	< 0.5 ppm
	Dissolved Solids	< 1,000 ppm	< 1,500 ppm
Iron Fouling	Iron (Fe_2+ Iron Bacteria Potential)	< 0.2 ppm	< 0.2 ppm
	Iron Oxide	< 1 ppm	< 1 ppm
Erosion	Suspended Solids	< 10 ppm, < 600 µm size**	< 10 ppm, < 600 µm size**
	Maximum Water Velocity	6 ft/sec	6 ft/sec

Table 9 Water Quality

** No "rotten egg" smell present at < 0.5 ppm H2S.*
*** Equivalent to 30 mesh strainer*

8 Post-Installation System Checkout

After completing the installation and before energizing the unit, the following system checks MUST be made:

1. Verify that the supply voltage to the heat pump is in accordance with the nameplate ratings.
2. Make sure that all electrical connections are tight and secure.
3. Check the electrical fusing and wiring for the correct size.

DANGER

Electric shock!

Ensure the cabinet and electrical box are properly grounded.

4. Verify that the low-voltage wiring between the thermostat and the unit is correct.
5. Verify that the water piping is complete and correct.
6. Check that the water flow is correct and adjust if necessary.
7. Check the blower for free rotation and that it is secured to the shaft.
8. Verify that vibration isolation has been provided.
9. Confirm that all access panels are secured in place.
10. Verify that duct work has been properly fastened to supply and return duct collars.
11. Make sure return air filters are positioned correctly in the filter rack if removed during installation.

9 Pre-Start-Up

9.1 Checking Pulley Alignment and Belt Tensioning

Before starting the unit, check the belt tension and alignment. Even though factory-supplied drives are shipped aligned and tensioned, their condition may have changed during transport, storage, or installation.

Refer to the instructions found in the maintenance section of this manual for details. (See 16.7 Pulley Alignment and Belt Tensioning Procedure on page 36.)

9.2 Checking Scroll Compressor Rotation

Scroll compressors, like the ones used on the MC series, are phase sensitive. When out of phase, the compressors will run in reverse. After a few minutes of reverse operation, the compressor internal overload protection will open, activating the unit lockout. (This requires a manual reset. To reset, power cycle the unit.)

NOTICE

Product damage!

A compressor running in reverse has a noisier than normal operation and a lower current draw than its rated value.

This means that for proper operation, the correct direction of rotation must be ensured. The most accurate way to ascertain this is through the use of gauges. Follow the steps below when using gauges:

1. Connect service gauges to the suction and discharge pressure fittings.
2. Energize the compressor.

The suction pressure should drop and the discharge pressure should rise, as is normal on any start up. If the suction pressure does not drop and the discharge pressure does not rise to normal levels, follow the steps in 9.2.1 Correcting Direction of Rotation.

Alternatively, in locations with multiple units attached to the same branch circuit, where it is not feasible to place pressure gauges on all of them, and several units are determined to be phased incorrectly:

1. Install pressure gauges and a phase rotation meter on one system to serve as a baseline.
2. Check the remaining systems with the phase rotation meter.
3. Follow the steps in 9.2.1 to make corrections.

9.2.1 Correcting Direction of Rotation

If you determine that the entire job site has a concern with electrical phasing, contact the utility company to ensure phasing is corrected.

1. Turn OFF power to the unit. (Always follow your Lock-out/Tag-out procedure.)
2. Reverse any two of the unit power leads.
3. Reapply power to the unit and verify pressures are correct.

The suction and discharge pressure levels should now move to their normal start-up levels.

10 Start-up

Use the procedure below to initiate a proper start-up.

DANGER

Electric shock!

Disconnect switch is only to be closed when the electrical box cover is secured to electrical box and all exterior panels are secured on the unit.

1. Restore power to system.
2. Turn thermostat fan position to ON. Blower should start.
3. Balance airflow at registers.
4. Adjust all valves to the full-open position and turn ON the line power to the heat pump unit.
5. Operate unit in the cooling cycle first, then the heating cycle for unit operating limits. Allow 5 minutes between cooling and heating tests for pressure to equalize.

10.1 Unit Start Up Cooling Mode

1. Adjust the unit thermostat to the warmest position. Slowly reduce the thermostat position until the compressor activates.
2. Check for cool air delivery at unit grille a few minutes after the unit has begun to operate.
3. Verify that the compressors are ON and that the water flow rate is correct.
4. Check elevation and cleanliness of the condensate lines; any dripping could be a sign of a blocked line. Be sure the condensate trap includes a water seal.
5. Check the temperature of both supply and discharge water.
6. Check air temperature drop across the coil when compressors are operating.

10.2 Unit Start Up Heating Mode

Operate the unit in heating cycle after checking the cooling cycle. Allow 5 minutes between tests for the pressures to equalize.

1. Turn thermostat to lowest setting and set thermostat switch to HEAT position.
2. Slowly turn the thermostat to a higher temperature until the compressor activates.
3. Check for warm air delivery at the unit grille within a few minutes after the unit has begun to operate.
4. Check the temperature of both supply and discharge water. If temperature is within range, proceed. If temperature is outside the range, check the heating refrigerant pressures.
5. Once the unit has begun to run, check for warm air delivery at the unit grille.
6. Check air temperature rise across the coil when compressor is operating.
7. Check for vibration, noise, and water leaks.

11 Commissioning

Record all system vitals using the “check-out sheet” and keep with equipment. (See page 64.)

12 Safety Devices and the UPM Controller Overview

MC models are equipped with two or four Unit Protection Modules (UPMs) boards depending on unit size. The boards control the compressor operation and monitors the safety controls that protect the unit.

Always check incoming line voltage power supply and secondary control voltage for adequacy.

12.1 First-Stage UPM Board/s

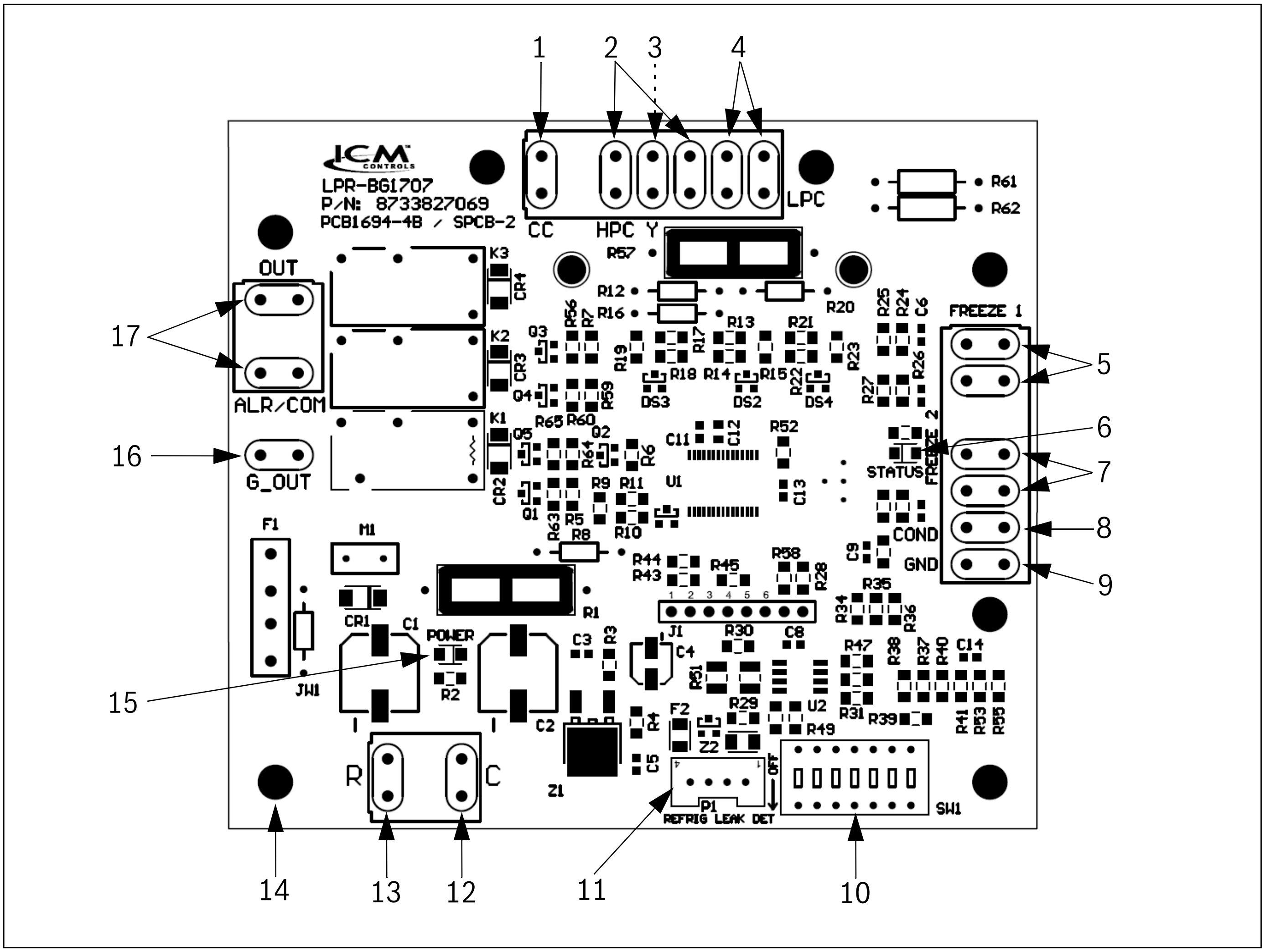

Figure 8 First-Stage UPM Controller Board

[1] Compressor Contact Output
[2] High-Pressure Switch Connection
[3] Call for Compressor (Y1)
[4] Low-Pressure Switch Connection
[5] Water Coil Freeze Connection (FREEZE 1)
[6] LED Status Indicator (Fault Status)
[7] Air Coil Freeze Connection (FREEZE 2)
[8] Condensate Overflow Sensor
[9] Ground Connection
[10] UPM Board Settings DIP Switch
[11] A2L Sensor
[12] 24VAC Power Common
[13] 24VAC Power Input
[14] UPM Standoff
[15] Power LED
[16] Fan (Fan in the event of an A2L leakage)
[17] Dry Contact (ALR/COM) DD

12.2 Second-Stage UPM Board/s

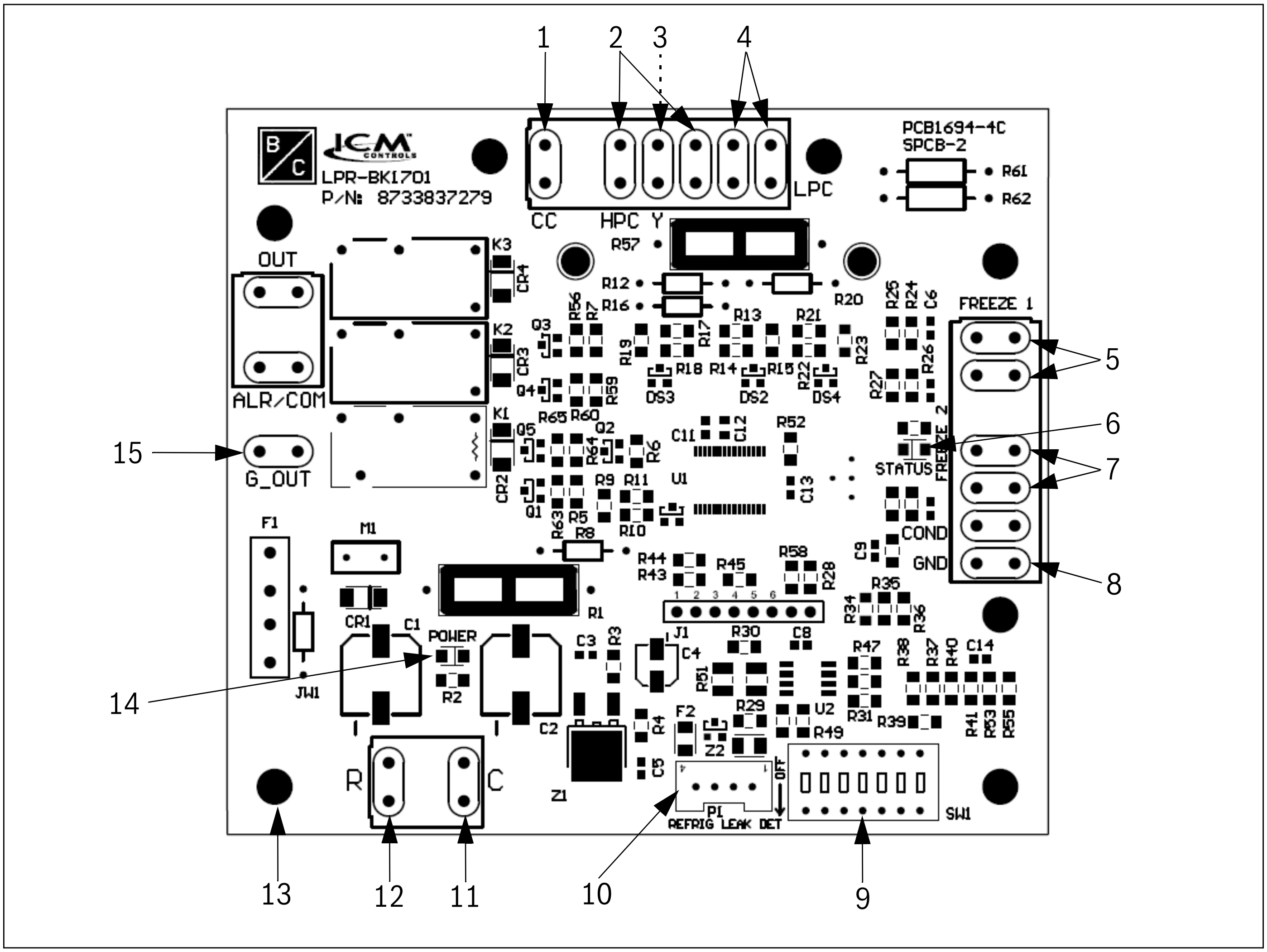

Figure 9 Second-Stage UPM Controller Board

[1] Compressor Contact Output
[2] High-Pressure Switch Connection
[3] Call for Compressor (Y1)
[4] Low-Pressure Switch Connection
[5] Water Coil Freeze Connection (FREEZE 3)
[6] LED Status Indicator (Fault Status)
[7] Air Coil Freeze Connection (FREEZE 4)
[8] Ground Connection
[9] UPM Board Settings DIP Switch
[10] A2L Sensor
[11] 24VAC Power Common
[12] 24VAC Power Input
[13] UPM Standoff
[14] Power LED
[15] Fan (Fan in the event of an A2L leakage)

When a malfunction light is used for diagnostic purposes, the connection is made at the unit's malfunction output–the Normally Open (NO) dry contact connection terminals of the UPM board. (Refer to Fig. 8, item [17].)

The safety controls that are monitored by the UPM include the following:

- High-pressure switch located in the refrigerant discharge line and wired across the HPC (High-Pressure Switch Connection) terminals on the UPM.
- Low-pressure switch located in the unit refrigerant suction line and wired across the LPC (Low-Pressure Switch Connection) terminals (LPC1 and LPC2) on the UPM.
- Waterside freeze protection sensor (FREEZE 1), mounted close to condensing water coil (Refer to Fig. 10), monitors refrigerant temperature between condensing water coil and thermal expansion valve. If temperature drops below or remains at freeze limit trip for 120 seconds, the controller will shut down the compressor and enter into a soft-lockout condition. The default freeze limit trip is 25°F; however, this can be changed by flipping DIP switch SW1. (Refer to Fig. 8, item [10], and Fig. 9, item [9].)

Only the compressor protection module is wired in series with the high-pressure switch (on both the first and second stage boards).

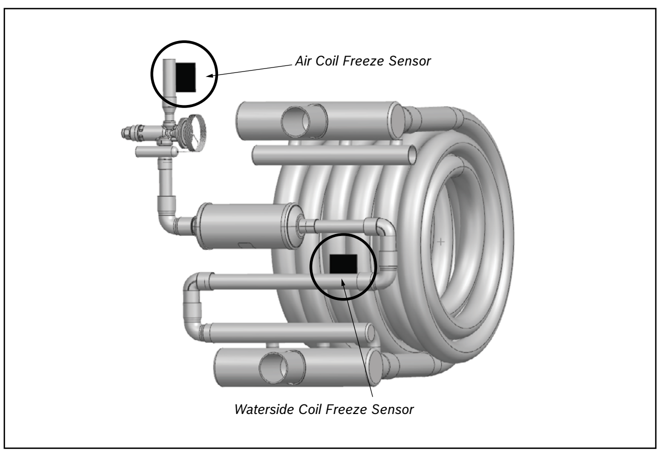

Figure 10   MC Freeze Sensor Locations

- Air coil freeze protection sensors are mounted close to evaporator coil between the thermal expansion valve and evaporator coil. (Refer to Fig. 10.)

Air Coil Freeze Sensors Locations

- The condensate overflow switch is standard in all MC units. It is located in the drain pan of the unit and connected to the "COND" terminal on the UPM board.(Refer Fig. 11.) (Refer to Fig. 8, item [8].)

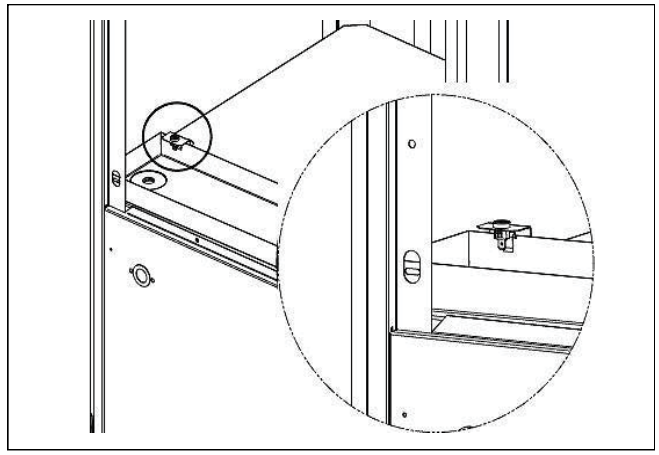

Figure 11   Condensate Overflow Protection Sensor

12.3 UPM Default Settings and DIP Switch Positions

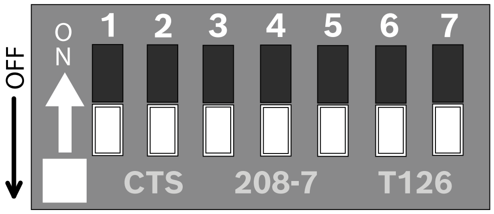

Figure 12 UPM Settings DIP Switch (SW1)

UPM DIP Switch Selectable Positions				
Position	Function	ON	OFF	Factory Default
1	Lockout	4	2	2
2	Reset	R	Y	Y
3	Alarm	Cont	Pulse	Pulse
4	Test	Yes	No	No
5	Freeze 1	15°F	25°F	25°F
6	Freeze 2	15°F	25°F	25°F
7	Pump	ON	OFF	OFF

Table 10 UPM DIP Switch Selectable Positions

When DIP switch position “7” for pump function is set to ON, it allows the loop pump to run for 30 seconds before starting the compressor when the UPM has not received a Y call in over 8 hours.

12.4 UPM Board Features

The UPM Board includes the following features:

- **ANTI-SHORT CYCLE TIMER:** Five-minute delay on break timer to prevent compressor short cycling.
- **COMPRESSOR MINIMUM RUN TIME:** The UPM has a minimum compressor run time of five minutes. If Y-call is removed the compressor will remain energized until the five minutes have expired.
- **RANDOM START:** Each controller has an unique random start delay ranging from 270 to 300 seconds on initial power up to reduce the chance of multiple unit simultaneously starting at the same time after power up or after a power interruption, in order to avoid creating a large electrical spike.
- **TEST DIP SWITCH:** The DIP switch position “4” controls the Test function. When it is set to “ON,” it will reduce all time delays settings to 10 seconds during troubleshooting or verification of unit operation. (Refer to Fig. 12.) (See Table 10.)

NOTICE

Product damage!

Operation of unit in test mode can lead to accelerated wear and premature failure of components. The Test switch must be set back to "OFF" after troubleshooting/ servicing.

- **LOW-PRESSURE BYPASS TIMER:** If the compressor is running and the low-pressure switch (either low-pressure switch 1 or 2, corresponding to the First-Stage or Second-Stage UPM boards) opens, the controller will keep the compressor ON for 120 seconds. After two minutes if the low-pressure switch remains open, the controllers will shut down the compressor and enter a soft lockout. The compressor will not be energized until the low-pressure switch closes and the anti-short cycle time delay expires. If the low-pressure switch opens two or four times in one hour, the unit will enter a hard lockout. In order to exit hard lockout power to the unit would need to be reset. The reset signal is either a Y or R signal depending on if DIP switch position “2” is set to ON or OFF. (See Table 10.) If the reset is set to R, the board must be manually powered OFF and powered back ON to exit the hard lock out.
- **HIGH-PRESSURE BYPASS TIMER:** If the compressor is running and the high-pressure switch (either high-pressure switch 1 or 2, corresponding to the First-Stage or Second-Stage UPM boards) opens, the controller will shut down the compressor and keep the compressor OFF until the switch closes and the anti-short cycle time delay expires. If the high-pressure switch opens 2 or 4 times (depending on DIP switch 1 position) within 1 hour then the unit will go to hard lockout and energize the alarm contact. (Refer to Fig. 8, item [17].) At any time during a Y1 and/or Y2 call when the high-pressure switch opens the control will flash the appropriate fault code.
- **BROWNOUT/SURGE/POWER INTERRUPTION PROTECTION:** The brownout protection in the UPM board will shut down the compressor if the incoming power falls below 18 VAC. The compressor will remain OFF until the voltage is above 18 VAC and ANTI-SHORT CYCLE TIMER (300 seconds) times out. The unit will not go into a hard lockout and does not need to be reset.
- **LED STATUS INDICATOR (Fault Status):** (Refer to Fig. 8, item [6].) The LED Status Indicator displays either a solid green indicating no faults or will blink a fault code in red. (Refer to Table 11 for a description of the blink codes.)

- **MALFUNCTION OUTPUT:** The alarm output is at the Normally Open (NO) dry contact. (Refer to Fig. 8, item [17].) If “PULSE” is selected, the alarm output will be pulsed. The fault output will depend on the DIP switch setting for Alarm. If DIP switch position “3” is set to “ON,” a constant signal will be produced to indicate a fault has occurred, and the unit requires inspection to determine the type of fault. If it is set to "OFF," a pulse signal is produced and a fault code is detected by a remote device indicating the fault. The remote device must have a malfunction-detection capability when the UPM board is set to "PULSE." (Refer to Table 11 for a description of the blink codes.)

If both UPM boards are flashing fault codes, the flashes will not be synchronized. Make sure to count the flashes on each UPM board to know what each are signaling.

Blinks	Fault	Fault Criteria
None (Solid)	None	None. Adequate 18–30 VAC power is present.
1	High Pressure Sensor #1	Refrigerant discharge pressure has exceeded 600 PSIG.
2	Low Pressure Sensor #1	Refrigerant suction pressure has fallen below 40 PSIG.
3	High Pressure Sensor #2	Refrigerant discharge pressure has exceeded 600 PSIG.
4	Low Pressure Sensor #2	Refrigerant suction pressure has fallen below 40 PSIG.
5	Freeze Sensor #1 Water Coil Freeze Condition	Refrigerant temperature to the water coil has fallen below 25°F for 30 seconds.
6	Condensate Overflow	Condensate levels in the unit drain pan are too high.
7	Brown Out	Control voltage has fallen below 18 VAC.
8	Freeze Sensor #2 Air Coil Freeze Condition	Refrigerant temperature to the air coil has fallen below 25°F for 30 seconds
9	Freeze Sensor #3 Water Coil Freeze Condition	Refrigerant temperature to the water coil has fallen below 25°F for 30 seconds.
10	Freeze Sensor #4 Air Coil Freeze Condition	Refrigerant temperature to the air coil has fallen below 25°F for 30 seconds
11	Refrigerant Leak	Refrigerant concentration has fallen outside of acceptable range (above 15% LFL, refer to leak detection system section)
12	Second-Stage UPM Board Fault	Lost communications with the Second-Stage UPM board

Table 11 UPM Fault Blink Codes

• **FREEZE SENSORS:**

Freeze Sensor	Location	Default Freeze-Limit Setting	Fault Code (Number of Flashes)
1	First-Stage Water Coil	25°F	5
2	First-Stage Air Coil		8
3	Second-Stage Water Coil		9
4	Second-Stage Air Coil		10

Table 12 Freeze Sensors

The UPM controllers constantly monitor temperature readings from all freeze sensors. If a temperature reading drops below or remains at the freeze-limit trip for 120 seconds, the controller will shut the compressor down and enter into a soft-lockout condition. The status LED on the UPM board corresponding to the tripped sensor will be active. (Refer to Fig. 8 and Fig. 9, item [6].) And the alarm contact will be active on the first-stage UPM. (Refer to Fig. 8, item [17].) The status LED will blink the fault code. The LED will flash the code associated with this alarm condition three times. If this alarm occurs two times (or four if DIP switch position “1” is set to “ON”) (Refer to Fig. 12)(See Table 10) within an hour, the UPM controller will enter into a hard-lockout condition.

The default setting for the freeze limit trip is 25°F for all freeze sensors. However, for Freeze Sensors 1 and 3 this can be changed to 15°F by flipping the DIP switch position “5” to “ON.” (Refer to Fig. 12.) The freeze limit trip should only be changed to 15°F when a closed loop system with appropriate antifreeze mixture is used. Freeze Sensor 1 is controlled by the DIP switch on the First-Stage UPM board (Refer to Fig. 8, item [10] for DIP switch location.). Freeze Sensor 3 is controlled by the DIP switch located on the Second-Stage UPM board (Refer to Fig. 9, item [10] for DIP switch location.).

NOTICE

Product damage!

If the unit is employing a fresh water system (no antifreeze protection), it is extremely important to have the Freeze 1 DIP switch position “5” set to OFF to shut down the unit at the appropriate leaving water temperature and protect your heat pump from freezing if a freeze sensor is included.

- **CONDENSATE OVERFLOW SWITCH:** All MC units are equipped with a condensate overflow switch that turns OFF the unit in the event that water in the drain pan surpasses the acceptable limit. Once water touches the pin on the sensor, the unit immediately enters a hard lockout condition that requires a manual lockout reset. This will occur even if there is no call for compressor operation.
- **INTELLIGENT RESET:** If a fault condition is initiated, the five-minute delay on break time period is initiated and the unit will restart after these delays expire. During this period the fault LED will indicate the cause of the fault. If the fault condition still exists or occurs two or four times (depending if the Lockout DIP switch position “1” is set to "OFF" or "ON")(See Table 10) before 60 minutes, the unit will go into a hard lockout and requires a manual lockout reset.
- **LOCKOUT RESET:** The method to exit a hard lockout depends of the Reset DIP switch setting:
    - To clear a hard lockout when the Reset DIP switch position “2” is set to “OFF” (Y), power can be cycled OFF then back ON either at the unit’s thermostat or at the circuit breaker.
    - To clear a hard lockout when the Reset DIP switch position “2” is set to “ON” (R), power must be cycled OFF then back ON at the circuit breaker (not at the thermostat).

(Refer to Fig. 12.)(See Table 10.)

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The blower motor will remain active during all lockout conditions.

12.5 Leak Detection System

The refrigerant leak detection system is comprised of two components: the A2L refrigerant sensor and the UPM board. The sensor continually samples the air and if the concentration of refrigerant detected is higher than the preset threshold (15% LFL), it sends a signal to the UPM, which then switches OFF the compressor and turns ON the blower. The compressor remains OFF until the saturation level is below (15%LFL) and the power is cycled in order to restore normal operations. If the A2L sensor is connected to the UPM, it must always remain connected. If communication is lost, the UPM enters a refrigerant leak hard lockout fault and energize the alarm contact. To test that the communication between the sensor and board is active, the sensor can be disconnected from the UPM, which should simulate a fault. The A2L sensor for the refrigerant leak detection system must only be replaced with the part specified on the spare parts list.

WARNING

Personal injury hazard!

The Leak Detection System requires that the unit remains powered except when servicing.

13 UPM Sequence of Operation

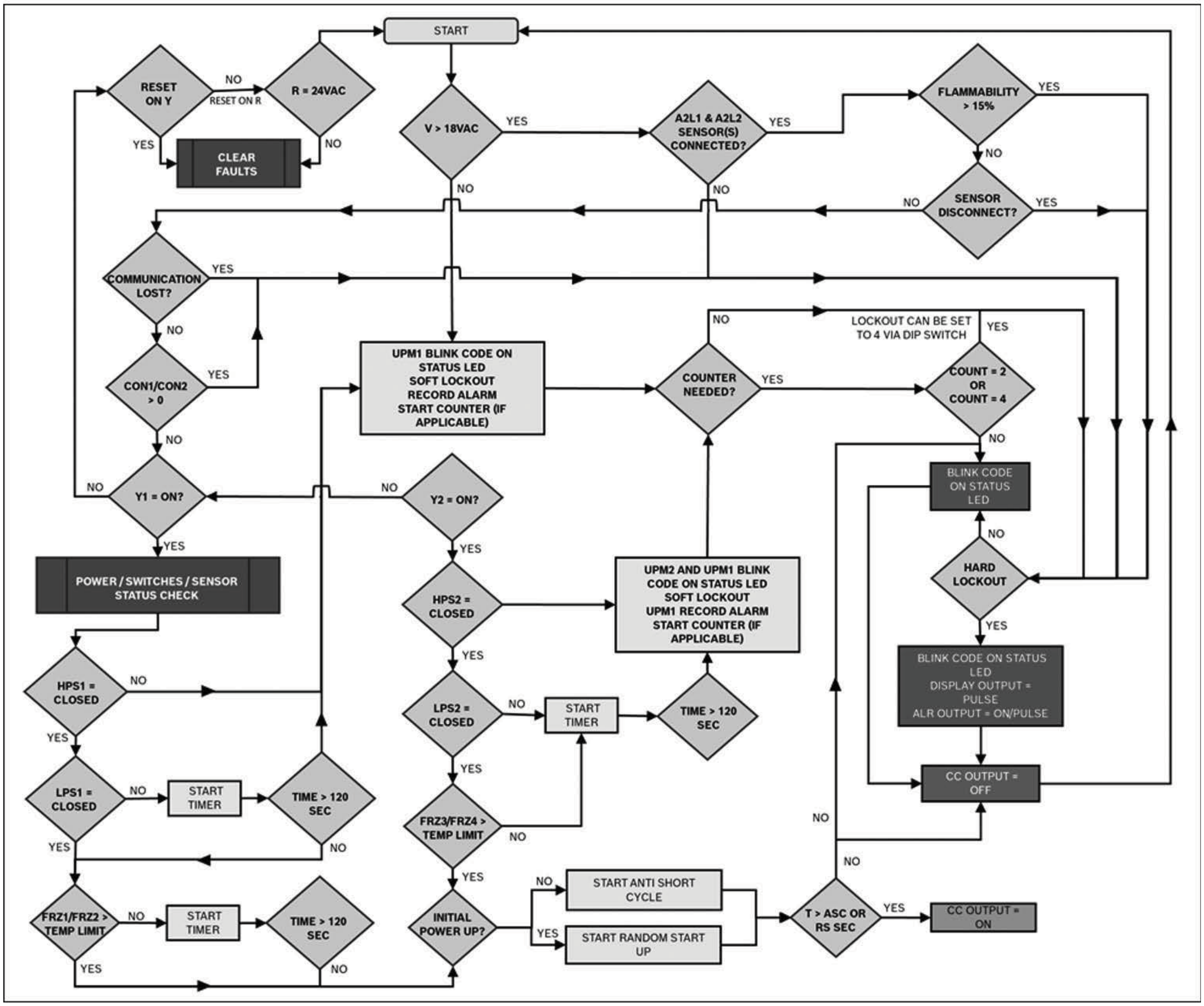

Figure 13 UPM Sequence of Operation

14 Unit Sequence of Operation by Mode

14.1 Cooling Mode

Energizing the “O” terminal energizes the unit reversing valve thus placing the unit into cooling mode. The fan motor starts when the “G” terminal is energized.

A fault condition initiating a lockout will de-energize the compressor irrespective of which stage is engaged.

On straight cool units, cooling mode is always active and there is no O signal (reversing valve).

14.2 Heating Mode

The first two stages of heating (Y1 & Y2) operate in the same manner as cooling but with the reversing valve de-energized. As the thermostat is satisfied, the compressors will remain on until the thermostat stages are satisfied.

Once the thermostat is satisfied, the compressor shuts down and the fan ramps down to either fan-only mode or OFF over a span of 30 seconds.

15 Factory-Installed Options

A number of options are available on MC Series of Heat Pumps. The following details the purpose, function, and components of each option.

15.1 Flow Proving Switch (DPS)

The function of the Flow Proving Switch is to prevent or stop compressor operation if the water supply fails. This prevents the unit from locking out on a safety requiring a manual reset to restart. The switch is installed in line between the water entering and leaving connections. If the pressure drop falls below the set value, the switch opens and de-energizes the DPS relay, thereby stopping the compressor. The blower operation is not be affected by this option.

15.2 Boilerless Control

The Boilerless Control option allows the water source heat pump to be operated in heating mode safely when installed in a system that has no means of heating the water loop. This option consists of an adjustable aquastat and relay. During the thermostat call for heating, if the aquastat detects a drop in water temperature below a preset limit, the relay disengages the compressor contactor and provides a dry-contact closure to divert unit operation from compressor heating to an alternate heat source (generally field-provided electric heat).

15.3 Variable Frequency Drive (VFD)

The VFD option for fan motors is available as a means to adjusting the airflow to any CFM value for ideal space conditioning.

15.4 Phase Monitor

This option offers protection against phase loss/reversal and imbalance. Upon application of power with the safety switches closed, the load energizes. If any of the safety switches open for longer than 600 ms, the fault light comes ON and the load will stay de-energized regardless of the state of the safety switches. Power must then be removed for 100 ms and safety switches must be closed in order to re-energize the load, upon which the fault light turns OFF.

15.5 Hot Gas Reheat (HGRH)

HGRH is an active dehumidification option available on the MC series that cools and dehumidifies return air, and then reheats it back to approximately entering dry bulb temperature using waste compressor heat. In this way, a unit with HGRH can efficiently remove humidity from the return air without altering the sensible temperature of the space.

There are several ways to control the heat pumps with hot gas reheat. You should choose the means that best suits your specific application. Most heat pump compatible thermostats in conjunction with a humidistat are acceptable for use.

Heat pumps with HGRH need to be connected to a humidistat along with a traditional thermostat or a combination thermostat/humidistat.

The thermostat connection “O” output for reversing valve energized in cooling mode is required.

15.5.1 Hot Gas Reheat Sequence of Operation—ON/OFF Control

The sequence of operation in the cooling and heating modes is the same as a regular heat pump. In reheat mode, the Reheat Relay Coil is energized through the “H” circuit when a call is sent from the humidistat. The Cooling Relay remains de-energized enabling the Reheat Solenoid. The Blower Relay, Reversing Valve, and Compressor Contactor are all energized through contacts on the Reheat Relay.

Reheat always operates in cooling mode.

Should the temperature in the space increase above the set point, the compressor terminal Y is energized, which de-energizes the Reheat Valve putting the unit into straight cooling mode. A call for cooling or heating will always take precedence over Hot Gas Reheat.

15.6 Modulating Hot Gas Reheat (MHGRH)

The purpose of MHGRH is to deliver air at or close to neutral conditions. A typical application for this would be in treating 100% outside air. This air would be ducted directly into the space relieving the unit handling the zone of any outside air load. This can result in a smaller zone unit, less air flow, and a savings in both the initial and operating costs. Control of the hot gas modulation is by the wall-mounted thermostat or the unit mounted DDC. A separate controller is used to control the unit itself.

15.6.1 MHGRH Sequence of Operation

MHGRH differs from ON/OFF functioning described for HGRH in that the reheat function is always active. Air is cooled and dehumidified by the cooling coil to around 55°F DB/54°F WB. The Reheat Coil raises the air stream temperature to a specified temperature (adjustable) and reduces relative humidity; delivering neutral air to the space. A sensor located in the supply air stream is set at the required leaving dry bulb temperature and will send a signal to the modulating hot gas reheat valve to direct the flow of hot gas to maintain that temperature.

15.7 Hot Gas Bypass

The function of hot gas bypass is to prevent icing of the air coil when the unit is operating at low-load conditions. This situation could arise if the space experiences widely different heating and cooling loads or a unit sized for heating that has a much lower cooling load, for example a conference center.

Without a hot gas bypass circuit the evaporating temperature will fall and ice could form on the coil restricting air flow and aggravating the situation. Eventually the coil could be totally blocked, resulting in possible refrigerant liquid entering the compressor and failure of the system.

The hot gas bypass valve, located in the compressor discharge line, diverts hot gas to the inlet of the air coil. The valve is factory set to open when the evaporating pressure falls to 95 PSI and will modulate to prevent the pressure falling any lower. This setting is field adjustable, and this set point may be adjusted as required.

15.7.1 Limit Switch

Units with the hot gas bypass feature include a limit switch on the suction line, which acts as a safety device. The limit switch shuts OFF the compressor if it senses the suction pressure is too high.

15.8 Economizer

MC series heat pumps can be provided an optional waterside economizer. The waterside economizer option allows a cooling demand to be satisfied by circulating cold water through a Water-to-Air Heat Exchanger (Economizer Coil) mounted to the return air opening of the heat pump instead of energizing the compressor. If water is below set point but additional cooling is required, then the aquastat sends a Y2 call that turns ON the first-stage compressor.

The major components of the Economizer option are the Economizer Coil, the Motorized Ball Valve (MBV), the aquastat, and the unit’s control circuit.

15.8.1 Economizer Sequence of Operation

The Economizer option operates in the following sequence upon receiving a call for cooling by the space sensor:

1. The “G” terminal energizes the Blower Relay, powering the Blower Motor.
2. The “O” terminal energizes the Reversing Valve Coil, setting the heat pump in the cooling mode and energizing the Economizer Relay (ER), if the loop water is below the set point of the aquastat and the switch “AQS” is closed.
3. The normally-closed contacts of ER open and the normally-open contacts of ER close.
4. The MBV will be de-energized in the bypass mode, routing water directly to the Water-to-Refrigerant Heat Exchanger.
5. On a rise in space temperature,Y1 closes, which energizes the MBV Relay if the temperature of the water is below the aquastat setpoint.
6. This energize the MBV in the economizer mode, diverting water first through the Economizer Coil then to the Water-to-Refrigerant Heat Exchanger in series.
7. Should the space temperature continue to rise, Y2 is energized allowing mechanical cooling. If at any time the water temperature rises above the aquastat set point the MBV will be energized in the bypass mode and fluid will bypass the economizer coil.

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Note that the Economizer Coil incorporates its own drain pan to collect condensate from the coil. This pan **MUST** be independently trapped and piped into the drain line for the heat pump.

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The MC series Economizer option is designed for **free-return** applications. If the heat pump is to be connected to return air duct work, the Economizer may need to be slightly modified.

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The MC series Economizer is designed for **cooling only**. If heating economizer operation is desired, consult the factory for applications and design information.

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Refer to the Condensate Drain section on page 13.

16 Maintenance

WARNING

Personal injury hazard!

Servicing of this equipment can be hazardous due to system pressure and electrical components. Only trained and qualified personnel should install, repair, or service the equipment.

DANGER

Electric shock!

Before performing service or maintenance operations on the system, turn OFF main power to the unit. Electrical shock will cause personal injury or death.

16.1 Filter Changes

Filter changes or cleaning are required at regular intervals. The time period between filter changes will depend upon type of environment where the equipment is used. In a single-family home that is not under construction, changing or cleaning the filter every 60 days is sufficient. In other applications such as motels where daily vacuuming produces a large amount of lint, filter changes may need to be as frequent as bi-weekly.

NOTICE

Product damage!

Equipment should never be used during construction due to likelihood of wall board dust accumulation in the air coil of the equipment that permanently affects the performance and may shorten the life of the equipment.

16.2 Annual Checkup

An annual "checkup" by a trained and qualified HVAC mechanic is required. Complete the check-out sheet on page 64 when performing the annual maintenance checkup. Record the performance measurements of volts, amps, and water temperature differences for both heating and cooling. This data should be compared to the information on the unit's data plate and the data taken at the original startup of the equipment.

16.3 Annual Condensate Drain Cleaning

Clean and flush the condensate drain annually to ensure proper drainage.

16.4 Blower Motor Lubrication (Optional)

Lubrication of the blower motor is not required; however, may be performed on some motors to extend motor life. Use SAE-20 non-detergent electric motor oil.

16.5 Handling Periodic Lockouts

Periodic lockouts almost always are caused by air or water flow problems. The lockout (shutdown) of the unit is a normal protective measure in the design of the equipment. If continual lockouts occur call a mechanic immediately and have them check for:

- water flow problems
- water temperature problems
- air flow problems, or
- air temperature problems

Use of the pressure and temperature charts for the unit may be required to properly determine the cause.

16.6 Installing Fan Motor Sheaves

When substituting field-supplied sheaves for factory-supplied sheaves, only the motor sheave should be changed.

To install sheaves on the fan or motor shaft:

1. Isolate power to the unit. (Always follow your Lock-out/Tag-out procedure.)
2. Remove side unit access panel(s).
3. Remove any rust-preventive coating on the fan shaft.
4. Make sure the shaft is clean and free of burrs.
5. Add grease or lubricant to bore of sheave before installing.
6. Mount sheave on the shaft. To prevent bearing damage, do not use excessive force.
7. After 1 to 3 minutes of operation, check the belt tension. Also check tension frequently during the first 24 hours of operation and adjust if necessary. Periodically check belt tension throughout the run-in period, which is normally the initial 72 hours of operation.

NOTICE

Product damage!

Every factory-assembled fan, shaft, and drive sheave assembly is precision aligned and balanced. If excessive unit vibration occurs after field replacement of sheaves, the unit should be rebalanced.

To change the drive ratio, follow the steps in section 16.7.2 Evaporator Fan Performance Adjustment on page 36.

16.7 Pulley Alignment and Belt Tensioning Procedure

16.7.1 Alignment

Make sure that fan shafts and motor shafts are parallel and level. The most common causes of misalignment are nonparallel shafts and improperly located sheaves. Where shafts are not parallel, belts on one side are drawn tighter and pull more than their share of the load resulting in those belts wearing out faster and requiring the entire set to be replaced before they reach their normal rated lifespan.
If the sheave is misaligned, belts enter and leave the grooves at an angle, resulting in excessive belt and sheave wear.

Checking Shaft Alignment

Check shaft alignment by measuring the distance between the shafts at three or more locations. If the distances are equal, then the shafts are parallel.

Checking Sheave Alignment

1. Isolate power to the unit. Always follow your Lock-out/Tag-out procedure.
2. To check the location of the fixed sheaves on the shafts, use a straightedge or a piece of string. If the sheaves are properly aligned, the string will touch them at the points indicated by the four arrows on the left side of Fig. 14.
3. Rotate each sheave a half revolution to determine whether the sheave is wobbly or the drive shaft is bent.
4. Correct any misalignment.
5. With sheaves aligned, tighten cap screws evenly and progressively.

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There should be a 1/8-in. to 1/4-in. gap between the mating part hub and the bushing flange. If the gap is closed, the bushing is probably the wrong size.

6. With taper-lock bushed hubs, ensure the bushing bolts are tightened evenly to prevent side-to-side pulley wobble. Check for a wobble by rotating sheaves and rechecking sheave alignment.

NOTICE

Product damage!

Anytime sheaves have moved, recheck the sheave alignment.

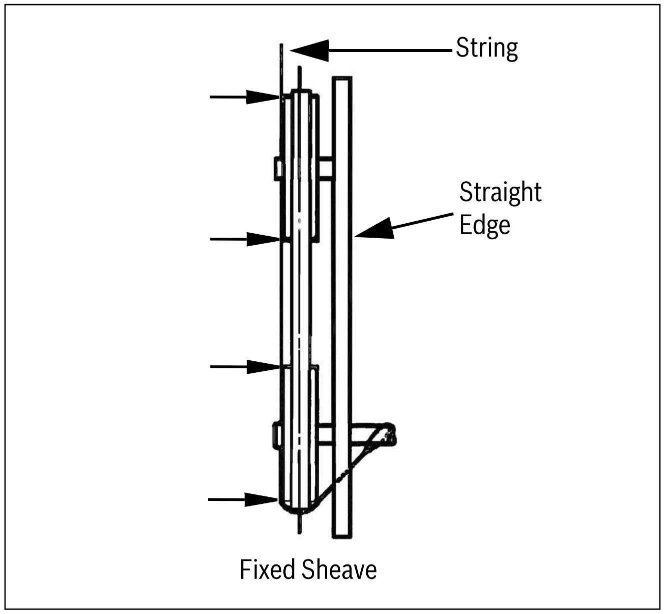


Figure 14 Sheave Alignment

16.7.2 Evaporator Fan Performance Adjustment

The motor pulleys used on MC units have a variable pitch. This means that the fan speed can be adjusted depending on the pitch diameter setting. To change fan speeds from factory settings:

1. Shut off unit power supply. Always follow your Lock-out/Tag-out procedure.
2. Loosen nuts on the four carriage bolts in the mounting base.
3. Using adjusting bolts and plate, slide the motor and remove the belt.
4. Loosen movable-pulley flange set screw.
5. Open the variable pitch pulley to decrease fan speed, and close it to increase fan speed.
6. Increasing the fan speed increases the load on the motor.
7. Replace and tighten the belts.
8. Restore power to the unit.

To align fan and motor pulleys:

1. Loosen fan pulley set screws.
2. Slide fan pulley along fan shaft.
3. Make angular alignment by loosening motor from mounting plate.
4. Restore power to unit.

16.7.3 Belt Tension Adjustment

Using a gauge, apply 4 lb of force to the center of the belt and adjust the tension until a deflection of 1/64-in. is achieved for every inch of shaft center distance. (Refer to Fig. 15.)

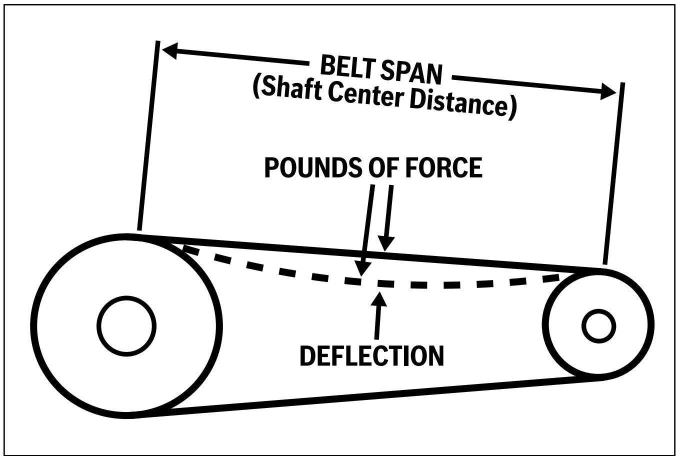


Figure 15 Fan Belt Tensioning

Ideal belt tension is the lowest value under which belt slip will not occur at peak load conditions.

Belt drives should not squeal under peak load conditions. If necessary, stop the drive, then start it again. If a squeal is heard, the belts should be tightened to the point where they do not squeal under peak load. Newly installed belts require about 24 hours to become fully seated in the groove.

Always check the drive alignment after adjusting belt tension.

17 Servicing and Repair Information

17.1 Confined Space Work

Work in confined spaces must be avoided.

17.2 Controlled Work Procedure

All work must be undertaken under a controlled procedure to minimize the risk of a flammable gas or vapor being present while the work is being performed.

17.3 Safety Checks

Prior to beginning work on systems containing flammable refrigerants, safety checks are necessary to ensure that the risk of ignition is minimized. The following precautions must be taken prior to conducting work on the refrigerating system.

17.3.1 Inform Everyone in the General Work Area

All maintenance staff and others working in the local area must be instructed on the nature of work being carried out.

17.3.2 Check for the Presence of Refrigerant

The area must be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with R-454B refrigerant; i.e., non-sparking, adequately sealed, or intrinsically safe.

17.3.3 Fire Extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire-extinguishing equipment must be available on hand. Have a dry powder or CO_2 fire extinguisher adjacent to the charging area.

17.3.4 Ignition Sources

Ensure the following prior to the work taking place:

1. The area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks.
2. "No Smoking" signs must be posted.
3. All possible ignition sources, including cigarette smoking, must be kept sufficiently far away from the site of installation, repair, removal, or disposal during which refrigerant may possibly be released and exposed to the surrounding area and the ignition sources.
4. Ensure that any person carrying out work in relation to a refrigerating system that involves exposing any pipe work knows that they must NOT use any sources of ignition in such a manner that it may lead to the risk of fire or explosion.

17.3.5 Ventilated Area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. The ventilation must safely disperse all released refrigerant, preferably expelling it externally into the atmosphere. The ventilation must be present during the period that the work is carried out.

17.3.6 Checks to the Refrigerating Equipment

Where electrical components are being changed, they must be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines must be followed. If in doubt, consult Bosch service and support for assistance.

The following checks must be applied to installations using flammable refrigerants:

1. Ensure the actual refrigerant charge is in accordance with the room size within which the refrigerant containing parts are installed.
2. Ensure that the ventilation machinery and outlets are operating adequately and are not obstructed.
3. Check the secondary circuit for the presence of refrigerant, if an indirect refrigerating circuit is being used.
4. Ensure the markings on the equipment continues to be visible and legible. Markings and signs that are illegible must be corrected.
5. Ensure the refrigerating pipes or components are installed in a position where they are unlikely to be exposed to any substance that may corrode refrigerant containing components, unless the components are constructed of materials that are inherently resistant to being corroded or are suitably protected against being so corroded.

17.4 Checks to Electrical Devices

Repair and maintenance to electrical components must include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then electrical supply must NOT be connected to the circuit until the safety fault is satisfactorily corrected. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution must be used. This must be reported to the owner of the equipment, so all parties are advised.

The following are required initial safety checks:

1. Ensure that capacitors are discharged—this must be done in a safe manner to avoid possibility of sparking.
2. Ensure that no live-electrical components and wiring are exposed while charging, recovering, or purging the system.
3. Ensure that there is continuity of earth bonding.

17.5 Repairs to Sealed Components

Sealed-electrical components must be replaced.

17.6 Repair to Intrinsically Safe Components

Intrinsically safe components must be replaced.

17.7 Check Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects. The check must also take into account the effects of aging or continual vibrations from sources such as compressors or fans.

17.8 Detection of Flammable Refrigerants

Under NO circumstances may potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) must NOT be used.

The following leak-detection methods are deemed acceptable for all refrigerant systems:

- Electronic leak detectors may be used to detect refrigerant leaks but in the case of flammable refrigerants, the sensitivity may not be adequate or may need re-calibration. (Detection equipment must be calibrated in a refrigerant-free area.). Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak-detection equipment must be set to a percentage for the Lower-Flammable Limit (LFL) (25% maximum) of the gas that is confirmed.
- Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine must be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work. Examples of leak detection fluids are:
  - bubble method
  - fluorescent method agents

If a leak is suspected, all naked flames must be removed/extinguished.

If a leakage of refrigerant is found that requires brazing, all of the refrigerant must be recovered from the system or isolated (by means of shut-off valves) in a part of the system remote from the leak.

17.9 Removal and Evacuation

When breaking into the refrigerant circuit to make repairs—or for any other purpose—conventional procedures must be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure must be adhered to:

1. Safely remove refrigerant following local and national regulations.
2. Evacuate.
3. Purge the circuit with inert gas (optional for A2L).
4. Evacuate (optional for A2L).
5. Continuously flush or purge with inert gas when using flame to open circuit.
6. Open the circuit.

The refrigerant charge must be recovered into the correct recovery cylinders if venting is not allowed by local or national codes. For appliances containing flammable refrigerants, the system must be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen must not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerants purging must be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process must be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system must be vented down to atmospheric pressure to enable work to take place.

WARNING

Fire hazard!

The outlet for the vacuum pump must not be close to any potential ignition sources, and ventilation must be available.

17.10 Charging Procedures

In addition to conventional charging procedures, the following requirements must be followed.

1. Ensure that contamination of different refrigerants does not occur when using charging equipment.
2. Ensure hoses or lines are as short as possible to minimize the amount of refrigerant contained in them.
3. Ensure cylinders are kept in an appropriate position according to the instructions.
4. Ensure that the refrigerating system is earthed prior to charging the system with refrigerant.
5. Be sure to label the system when charging is complete (if not already).
6. Use extreme care not to overfill the refrigerating system.
7. Ensure the system is pressure-tested with the appropriate purging gas prior to recharging the system.
8. Ensure the system is leak-tested on completion of charging but prior to commissioning. A follow-up leak test must be carried out prior to leaving the site.

17.11 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

Ensure the following:

1. Ensure that only appropriate refrigerant recovery cylinders are employed when transferring refrigerant into cylinders.
2. Ensure that the correct number of cylinders for holding the total system charge are available.
3. Ensure all cylinders to be used are designated for the recovered refrigerant and labeled for that refrigerant (i.e., special cylinders for the recovery of refrigerant).
4. Ensure all cylinders are complete with a pressure-relief valve and associated shut-off valves that are all in good working order.
5. Ensure empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.
6. Ensure the recovery equipment is in good working order.
7. Ensure set of instructions for the recovery equipment is at hand .
8. Ensure the recovery equipment is suitable for the recovery of the flammable refrigerant. If in doubt, the manufacturer should be consulted.
9. Ensure a set of calibrated weighing scales are available and in good working order.
10. Ensure the hoses are complete with leak-free disconnect couplings and are in good condition.
11. Ensure the recovered refrigerant is processed according to local legislations/regulations in the correct recovery cylinder, and the relevant waste transfer note arranged.
12. Ensure there is no mixing of refrigerants in the recovery units and especially not in cylinders.
13. If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body must NOT be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it must be carried out safely.

18 Decommissioning Information

Only trained and qualified technicians are allowed to decommission and dispose of equipment following the requirements and local codes.

WARNING

Personal injury hazard!

Decommissioning of this equipment can be hazardous due to system pressure and electrical components. Only trained and qualified personnel should install, repair, service, or disconnect the equipment.

18.1 Protecting the Environment

18.1.1 Components

By disposing of this product correctly you will help ensure that the waste undergoes the necessary treatment, recovery, and recycling, thus preventing potentially negative effects on the environment and human health, which could otherwise arise due to inappropriate waste handling.

Many parts in the Heat Pump can be fully recycled at the end of the product life. Contact your city authorities for information about the disposal of recyclable products.

18.1.2 Refrigerant

At the end of the service life of this appliance, and prior to its environmental disposal, a person qualified to work with refrigerant circuits must recover the refrigerant from within the sealed system as per applicable local codes.

18.1.3 Hazardous Waste

Some components in the Heat Pump may be considered as hazardous waste, such as batteries. For their disposal contact your local household hazardous waste collection site.

18.2 Decommissioning Procedure

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail.

It is recommended good practice that all refrigerants are recovered safely. Follow the procedure below.

1. Before attempting the procedure:

- Become familiar with the equipment and its operation.
- Ensure that electrical power is available for the recovery machine before the task is commenced.
- Ensure an oil and refrigerant sample is taken in case analysis is required prior to re-use of recovered refrigerant.
- Isolate the system electrically. Lock-Out/Tag-Out recommended.
- Ensure that mechanical handling equipment is available, if required, for handling refrigerant cylinders
- Ensure that all personal protective equipment is available and being used correctly.
- Ensure that the recovery process is supervised at all times by a competent person
- Ensure that the recovery equipment and cylinders conform to the appropriate standards.

2. Pump down refrigerant system, if possible.
3. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
4. Make sure that cylinder is situated on the scales before recovery takes place.
5. Start the recovery machine and operate in accordance with instructions.
6. DO NOT overfill cylinders (no more than 80% volume liquid charge).
7. DO NOT exceed the maximum working pressure of the cylinder, even temporarily.
8. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
9. Recovered refrigerant must NOT be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

18.3 Labeling

The following are required:

1. Equipment must be labeled stating that it has been decommissioned and emptied of refrigerant.
2. The label must be dated and signed.
3. Ensure that there are labels on the equipment stating the equipment contains flammable refrigerant.

19 Troubleshooting

19.1 Unit Troubleshooting

The troubleshooting information provided may reflect a fault that could have one or more causes and one or more solutions. Check each cause and adopt a “process of elimination” and/or verification of each before making any conclusion.

If troubleshooting a system that is low on refrigerant due to a system leak, DO NOT simply add refrigerant. The leak must be found and repaired per F-Gas regulation.

Faults may be indicated by the UPM LED Status Indicator or a remote device with a malfunction light. Refer to section 12 Safety Devices and the UPM Controller Overview starting on page 25.

19.1.1 Online Help Resources

For FAQs, videos, service bulletins, and more, visit our Service and Support web page at www.bosch-homecomfort.us/service or use your cell phone to scan the code below.

Unit Troubleshooting		
Problem	**Possible Cause**	**Action**
Entire unit does not run	Power Supply OFF	Apply power, close disconnect
	Blown Fuse	Replace fuse or reset circuit breaker. Check for correct fuses.
	Voltage Supply Low	If voltage is below minimum voltage specified on unit data plate, contact local power company.
	Thermostat/ Controller (DDC)	Set the fan to “ON”, the fan should run. Set thermostat to “COOL” and lowest temperature setting, the unit should run in the cooling mode (reversing valve energized). Set the unit to “HEAT” and to the highest temperature setting, the unit should run in the heating mode. If neither the blower or compressor run in all three cases, the thermostat could be miswired or faulty. To ensure it is a miswired or faulty thermostat, verify 24 volts is available on the condensing section low-voltage terminal strip between “R” and “C,” “Y” and “C,” and “O” and “C”. If the blower does not operate, verify 24 volts between terminals “G” and “C” in the air handler. Replace the thermostat if defective.
Blower operates but the compressor does not	Thermostat/ Controller (DDC)	Check settings, calibration, and wiring.
	Wiring	Check for loose or broken wires at compressor, capacitor, or contactor.
	Safety Controls	Check the UPM board red default LED for blink code.
	Compressor Internal Overload Open	If the compressor is cool and the overload will not reset, replace the compressor.
	Compressor External Overload Open	If the compressor is cool and the external compressor overload will not reset, then replace the external compressor overload.
	Compressor Motor Grounded	The internal compressor winding is grounded to the compressor shell. Replace the compressor. If the compressor is burnt out, install a suction filter dryer.
	Compressor Windings Open	After the compressor has cooled, check the continuity of the compressor windings. If the windings are open, replace the compressor.

Unit Troubleshooting		
Problem	**Possible Cause**	**Action**
Unit OFF on high-pressure control	Discharge Pressure Too High	"In “COOLING” mode: Lack of or inadequate water flow. Entering water temperature is too warm. Scaled or plugged condenser. In “HEATING” mode: Lack of or inadequate air flow. Blower inoperative, clogged filter or restrictions in duct work"
	Refrigerant Charge	The unit is low on refrigerant. Check for a refrigerant leak and repair, then evacuate and recharge with the factory-recommended charge.
	Low-Pressure Switch	Check for a defective or improperly calibrated low-pressure switch.
Unit OFF on low-pressure control	Suction Pressure Too Low	"In “COOLING” mode: Lack of/or inadequate air flow. Entering air temperature is too cold. Blower inoperative, clogged filter or restrictions in duct work. In “HEATING” mode: Lack of/or inadequate water flow. Entering water temperature is too cold. Scaled or plugged condenser."
	Refrigerant Charge	The unit is low on refrigerant. Check for a refrigerant leak and repair, then evacuate and recharge with the factory-recommended charge.
	Low-Pressure Switch	Check for a defective or improperly calibrated low-pressure switch.
Unit short cycles	Unit Oversized	Recalculate heating and or cooling loads.
	Thermostat/ Controller (DDC)	Thermostat was installed near a supply air grill; relocate thermostat. Readjust heat anticipator.
	Wiring and Controls	Check for a defective or improperly calibrated low-pressure switch.
Insufficient cooling or heating	Unit Undersized	Recalculate heating and or cooling loads. If excessive, possibly adding insulation and shading will rectify the problem.
	Loss of Conditioned Air by Leakage	Check for leaks in duct work or introduction of ambient air through doors or windows.
	Airflow	Lack of adequate air flow or improper distribution of air. Replace dirty filters.
	Refrigerant Charge	Refrigerant charge low causing inefficient operation.
	Compressor	Check for a defective compressor. If discharge is too low and suction pressure is too high, compressor is not pumping properly. Replace the compressor.
	Reversing Valve	A defective reversing valve is causing bypass of refrigerant from discharge of suction side of the compressor. Replace the reversing valve.
	Operating Pressures	Compare unit operation pressures to the pressure/temperature chart for the unit.
	TXV	Check the TXV for possible restriction or defect. Replace if necessary.
	Moisture, Non-Condensable	The refrigerant system may be contaminated with moisture or non-condensable. Reclaim the refrigerant, replace the filter dryer, evacuate the refrigerant system, and recharge with the factory-recommended charge.

Unit Troubleshooting		
Problem	**Possible Cause**	**Action**
No flow or low flow	No Power	Check the power supply.
	ON/OFF Switch is OFF	Set switch to the “ON” position.
	Compressor Contactor	Engage the heat pump contactor.
	Broken or Loose Wires	Repair the wires or tighten the connections.
	Air Lock	Purge air from the piping system.
	Stuck Pump Shaft or Impeller	Remove the pump cartridge and clean.
	Defective Pump	Replace the pump.
	Kinked or Undersized Water Piping	Repair the kink and check for proper line sizing.
High water temperature	Water Temperature-Limit Switch is Closed	"Check for a stuck limit switch. Check to see if sensor is not attached securely to line."
Low heat output	Scaled or Fouled Heat Exchanger	Clean the heat exchanger.

Table 13 Unit Troubleshooting

Compressor Troubleshooting					
Problem	**Mode**	**Check**	**Then**	**Possible Cause**	**Action**
No compressor operation	Cooling	Is the Fault LED blinking one (1) time on 1st stage UPM ONLY?	If Yes, Circuit 1 is affected.	High-pressure fault—No or low water flow.	• Check the water valves and/ or pumps for proper operation. • Check for water coil blockage.
				High-pressure fault—High water temperature.	Check water temperature—Is it in range?
		Is the Fault LED blinking three (3) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.	High-pressure fault—Fouled or scaled water coil.	Check for proper flow rate and water temperature, and a rise in water-side temperature in cooling mode.
	Heating	Is the Fault LED blinking one (1) time on the 1st stage UPM ONLY?	If Yes, Circuit 1 is affected.	High-pressure fault—No or low air flow.	Check the fan motor for proper operation.
					Check the air filter.
		Is the Fault LED blinking three (3) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.		Inspect the air coil for dirt/ debris.
					Check duct work—Are the dampers closed or blocked?
	Cooling	Is the Fault LED blinking two (2) times on the 1st stage UPM ONLY?	If Yes, Circuit 1 is affected.	Low-pressure fault—No or low air flow.	Check the fan motor for proper operation.
					Check the air filter.
					Inspect the air coil for dirt/ debris.
					Check ductwork—Are the dampers closed or blocked?
		Is the Fault LED blinking four (4) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.	Low-pressure fault—Low refrigerant.	Check the refrigerant pressure with a gauge set.

Compressor Troubleshooting					
Problem	**Mode**	**Check**	**Then**	**Possible Cause**	**Action**
No compressor operation	Heating	Is the Fault LED blinking two (2) times on the 1st stage UPM ONLY?	If Yes, Circuit 1 is affected.	Low-pressure fault—No or low air flow.	• Check the water valves and/ or pumps for proper operation. • Check for water coil blockage.
				Low-pressure fault—Fouled or scaled water coil.	Check for proper flow rate and water temperature, and a rise in water-side temperature in cooling mode.
		Is the Fault LED blinking four (4) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.	Low-pressure fault—Low refrigerant.	Check refrigerant pressure with a gauge set.
	Heating	Is the Fault LED blinking five (5) times on the 1st stage UPM ONLY?	If Yes, Circuit 1 is affected.	Freeze 1 fault, water coil—No or low water flow.	• Check water valves and/or pumps for proper operation. • Check for water coil blockage.
		Is the Fault LED blinking nine (9) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.	Freeze 1 fault, water coil—Low water temperature.	• Check water temperature—Is it below 40°F entering? • If heat pump is connected to a closed loop with antifreeze, check that position #5 (Freeze 1) of the DIP switch SW1 on the UPM board is in the ON position. (Refer to Fig. 12 and Table 10 on page 28.) (Refer the Freeze Sensors section page 30.)
				Freeze 1 fault, water coil—Low refrigerant.	Check refrigerant pressure with a gauge set.
	Cooling	Is the Fault LED blinking six (6) times on the 1st & 2nd stage UPMs?		Condensate fault—Poor drainage.	• Check the condensate pan for high water level. • Check the drain line for blockages, double trapping, or inadequate trapping.
				Condensate fault—Blocked return air.	• Check the air filter and return air duct work for blockage. • Check that there is adequate space between the return air opening and the walls or other obstructions on free return applications.

Compressor Troubleshooting					
Problem	**Mode**	**Check**	**Then**	**Possible Cause**	**Action**
No compressor operation	Cooling or Heating	Is the Fault LED blinking seven (7) times on the 1st & 2nd stage UPMs?		Brownout fault—Low voltage supply.	Check primary voltage—Ensure it is between the limits listed on the unit data plate.
				Brownout fault—Bad thermostat connection.	Check control voltage—If the voltage is below 18V, check the accessories connected to the unit and ensure they do not exceed the VA draw as described in 5.8.5 VA Capacity on page 17. (Also refer to Table 7-8 on page 18.)
					Check that thermostat wiring is proper gauge and length, that it is not damaged and that all connections at the thermostat and heat pump are secure.
	Cooling	Is the Fault LED blinking eight (8) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.	Freeze fault, air coil—No or low air flow.	Check fan motor for proper operation.
					Check the air filter.
					Inspect the air coil for dirt/ debris.
					Check duct work—Are dampers closed or blocked?
		Is the Fault LED blinking ten (10) times on the 1st & 2nd stage UPMs?	If Yes, Circuit 2 is affected.	Freeze fault, air coil—Blocked return air.	Check that there is adequate space between the return air opening and walls or other obstructions on free return applications.
				Freeze fault, air coil—Low refrigerant.	Check refrigerant pressure with a gauge set.
	Cooling or Heating	Is the Fault LED blinking eleven (11) times on the 1st & 2nd stage UPMs?		Refrigerant Leak Fault—refrigerant leaked.	• Check where the refrigerant has leaked. • Check brazing point.
					Check that the A2L sensor harnesses are connected to both UPM boards. (See UPM layouts depicted in Fig. 8 on page 25 and Fig. 9 on page 26.)
					Check that the harness is connected from the A2L sensor side.
					Check if there are any hissing or gurgling noises in the system.

Compressor Troubleshooting					
Problem	**Mode**	**Check**	**Then**	**Possible Cause**	**Action**
No compressor operation	Cooling or Heating	Is the Fault LED blinking twelve (12) times on the 1st & 2nd stage UPMs?		Communication is lost between the UPM 1st & UPM 2nd stages.	Check the A2L sensor is going to both the 1st and 2nd stage UPMs.

Table 14

20 Specification Tables

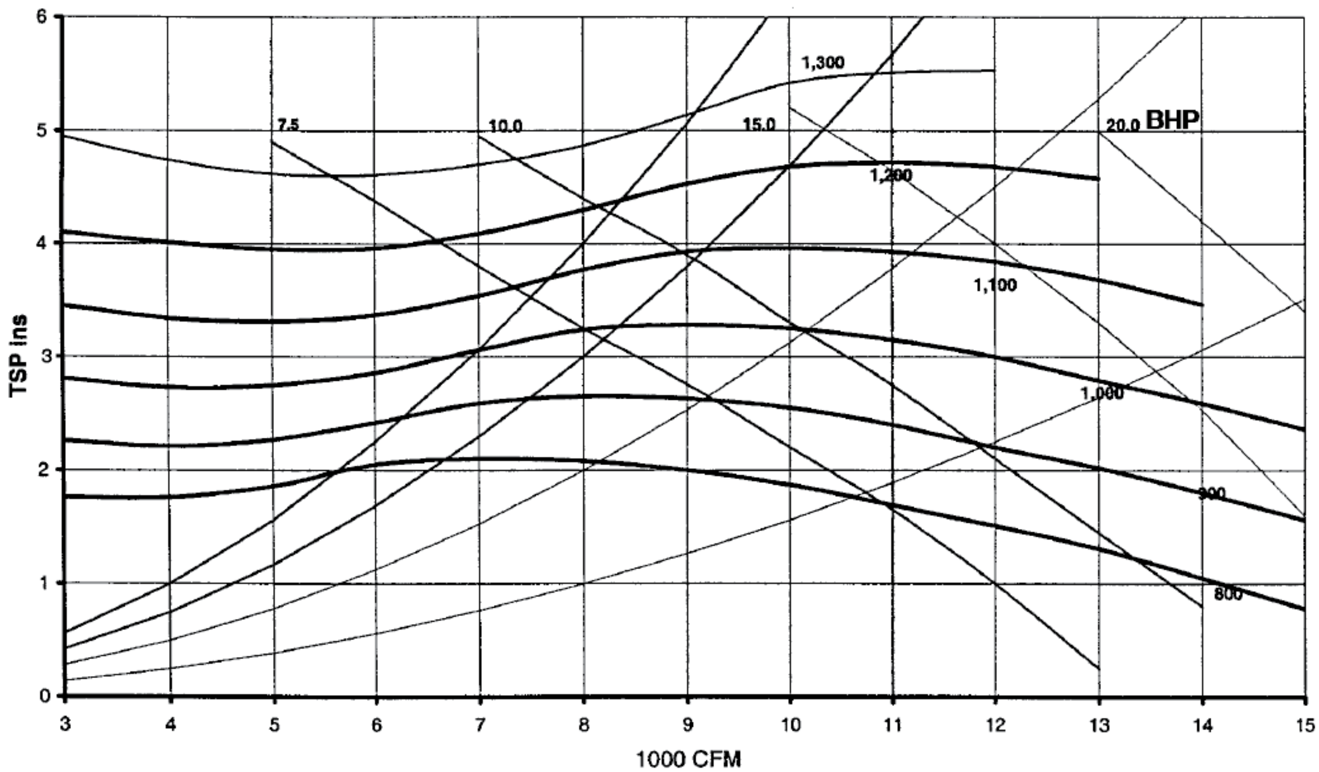
20.1 Blower Performance Table

Drive and Motor Selection														
Model	Nominal Airflow	Airflow	Total Static Pressure											
			2.00		2.50		3.00		3.50		4.00		4.50	
			RPM	HP	RPM	HP	RPM	HP	RPM	HP	RPM	HP	RPM	HP
360	12,200	9,500	813	7.5	871	7.5	949	10	1034	15	1111	15	1172	15
		10,000	813	7.5	916	10	949	10	1034	15	1111	15	1172	15
		10,500	842	10	916	10	982	15	1034	15	1111	15	1172	15
		11,000	842	10	916	10	982	15	1034	15	1111	15	1172	15
		11,500	871	15	916	15	982	15	1034	15	1111	15	1172	20
		12,000	871	15	949	15	982	15	1072	15	1111	20	1172	20
		12,500	871	15	949	15	1034	15	1072	20	1111	20	1172	20
		13,500	916	15	982	20	1034	20	1072	20	1149	20	-	-
480	16,000	13,000	794	7.5	916	7.5	982	7.5	1111	7.5	1200	10	1256	10
		14,000	794	7.5	871	7.5	982	7.5	1072	10	1172	10	1256	10
		15,000	794	7.5	871	7.5	982	7.5	1072	10	1172	10	1256	15
		16,000	794	7.5	871	7.5	982	7.5	1034	10	1149	10	1256	15
		17,000	794	7.5	871	7.5	982	7.5	1034	10	1111	15	1214	15
		18,000	813	7.5	871	7.5	949	10	1034	10	1111	15	1172	15
		19,000	813	7.5	871	15	949	10	1034	15	1111	15	1172	15
600	20,000	16,000	794	7.5	871	7.5	982	7.5	1034	10	1149	10	1256	15
		17,000	794	7.5	871	7.5	982	7.5	1034	10	1111	15	1214	15
		18,000	813	7.5	871	8	949	10	1034	10	1111	15	1172	15
		19,000	813	7.5	871	15	949	10	1034	15	1111	15	1172	15
		20,000	813	7.5	916	10	949	10	1034	15	1111	15	1172	15
		21,000	842	10	916	10	982	15	1034	15	1111	15	1172	15
		22,000	842	10	916	10	982	15	1034	15	1111	15	1172	15
		23,000	871	15	916	15	982	15	1034	15	1111	15	1172	20
		24,000	871	15	949	15	982	15	1072	15	1111	20	1172	20
720	24,000	19,000	813	7.5	871	7.5	949	10	1034	15	1111	15	1172	15
		20,000	813	7.5	916	10	949	10	1034	15	1111	15	1172	15
		21,000	842	10	916	10	982	15	1034	15	1111	15	1172	15
		22,000	842	10	916	10	982	15	1034	15	1111	15	1172	15
		23,000	871	15	916	15	982	15	1034	15	1111	15	1172	20
		24,000	871	15	949	15	982	15	1072	15	1111	20	1172	20
		25,000	871	15	949	15	1034	15	1072	20	1111	20	1172	20

Table 15

20.2 Blower Curves

MC360



MC480 - 720

Figure 16

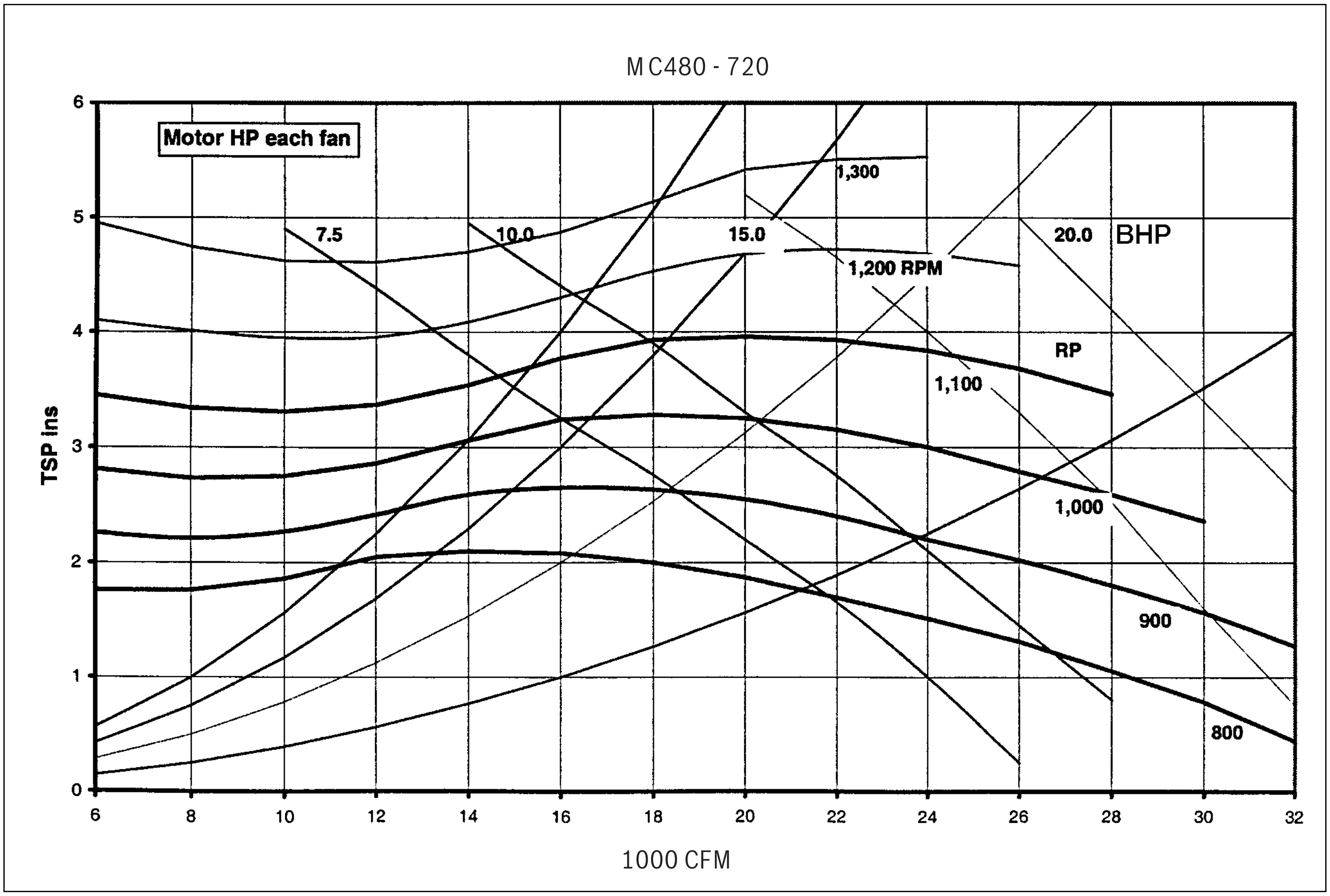

MC480 - 720
Motor HP each fan
7.5
10.0
15.0
20.0
BHP
1,300
1,200 RPM
1,100
RP
1,000
900
800
TSP ins
0
1
2
3
4
5
6
6
8
10
12
14
16
18
20
22
24
26
28
30
32
1000 CFM

Figure 17

20.3 Operating Temperatures and Pressures Table

Operating Data										
			Cooling				Heating			
Model	Enter Fluid Temp (°F)	Water Flow (GPM)	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Drop °F	Air Temp Rise °F
MC360	30	45	[redacted]				56-72	255-312	8-10	18-22
		90					64-80	265-323	4-5	20-25
	40	45	111-137	196-236	20-25	18-23	66-84	268-330	10-11	21-25
		90	106-131	168-206	9-14	18-23	75-94	279-342	5-6	23-28
	50	45	112-139	222-270	20-25	18-23	77-98	283-349	11-12	24-29
		90	111-137	194-239	10-13	18-23	88-110	293-361	6-7	26-32
	60	45	114-141	250-306	20-25	18-22	91-114	293-364	13-15	27-33
		90	112-139	221-273	9-14	19-23	103-128	308-381	7-8	30-36
	70	45	115-143	284-346	20-24	18-23	105-132	310-386	14-16	30-36
		90	114-141	253-312	9-14	18-23	120-148	329-407	8-9	33-40
	80	45	117-145	320-390	20-24	18-22	122-151	329-409	16-19	33-40
		90	115-143	288-354	10-13	18-23	140-171	351-434	9-11	37-44
	90	45	118-147	360-438	19-24	17-21	140-172	350-436	18-21	37-45
		90	117-145	329-401	9-12	18-22	162-196	377-464	10-12	41-49
	100	45	120-150	406-490	19-23	17-21	[redacted]			
		90	119-148	374-453	9-12	17-21				

Table 16

Operating Data										
			Cooling				Heating			
Model	Enter Fluid Temp (°F)	Water Flow (GPM)	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Drop °F	Air Temp Rise °F
MC480	30	60	[redacted]				56-72	261-318	8-10	18-22
		120					63-79	271-329	4-5	19-24
	40	60	112-138	208-248	22-26	20-25	65-83	273-335	9-10	21-25
		120	110-135	175-213	10-15	20-25	73-92	284-347	5-6	22-27
	50	60	113-140	233-281	21-26	20-25	76-97	287-353	11-12	23-28
		120	112-138	199-244	11-14	20-25	86-108	300-368	6-7	25-31
	60	60	115-142	262-318	21-25	20-24	89-112	303-374	12-14	26-32
		120	113-140	227-279	10-14	20-24	101-126	318-391	7-8	29-35
	70	60	116-144	296-358	20-25	19-24	102-129	320-396	14-16	29-35
		120	115-142	258-317	10-14	19-24	117-145	339-417	8-9	32-39
	80	60	118-146	332-402	20-25	19-23	118-147	340-420	15-18	32-39
		120	116-144	294-360	10-13	19-24	136-167	363-446	8-10	36-43
	90	60	119-148	373-451	20-24	18-22	135-167	361-447	17-20	36-44
		120	118-146	334-406	10-13	19-23	157-191	390-477	10-12	40-48
	100	60	121-151	420-504	19-24	18-22	[redacted]			
		120	120-149	379-458	10-13	18-22				

Table 17

Operating Data										
			Cooling				Heating			
Model	Enter Fluid Temp (°F)	Water Flow (GPM)	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Drop °F	Air Temp Rise °F
MC600	30	75					52-68	240-297	6-8	17-21
		150					59-75	228-286	4-5	18-23
	40	75	103-129	173-213	20-24	17-22	60-78	249-311	8-9	19-23
		150	101-126	155-193	9-14	17-22	66-85	256-319	5-6	21-26
	50	75	105-132	197-245	20-24	17-22	70-91	258-324	10-11	22-27
		150	104-130	179-224	10-13	17-22	77-99	264-332	5-6	23-29
	60	75	107-134	224-280	19-24	17-21	80-103	270-341	11-13	24-30
		150	106-133	206-258	9-14	17-21	89-114	279-352	6-7	26-32
	70	75	108-136	255-317	19-24	16-21	92-119	282-358	13-15	27-33
		150	106-133	207-266	9-14	17-22	103-131	304-382	7-8	29-36
	80	75	110-138	290-360	20-24	21-25	105-134	293-373	14-17	30-37
		150	109-137	273-339	9-12	16-21	119-150	307-390	8-10	33-40
	90	75	112-141	331-409	19-23	16-20	119-151	318-404	16-19	32-40
		150	110-138	297-369	9-12	16-20	137-171	326-413	9-11	36-44
	100	75	113-143	372-456	18-23	15-19				
		150	113-142	357-436	9-12	16-20				

Table 18

Operating Data										
			Cooling				Heating			
Model	Enter Fluid Temp (°F)	Water Flow (GPM)	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Rise °F	Air Temp Drop °F	Suction Pressure (PSIG)	Discharge Pressure (PSIG)	Water Temp Drop °F	Air Temp Rise °F
MC720	30	90					56-72	255-312	8-10	18-22
		180					64-80	265-323	4-5	20-25
	40	90	111-137	196-236	20-25	18-23	66-84	268-330	10-11	21-25
		180	106-131	168-206	9-14	18-23	75-94	279-342	5-6	23-28
	50	90	112-139	222-270	20-25	18-23	77-98	283-349	11-12	24-29
		180	111-137	194-239	10-13	18-23	88-110	293-361	6-7	26-32
	60	90	114-141	250-306	20-25	18-22	91-114	293-364	13-15	27-33
		180	112-139	221-273	9-14	19-23	103-128	308-381	7-8	30-36
	70	90	115-143	284-346	20-24	18-23	105-132	310-386	14-16	30-36
		180	114-141	253-312	9-14	18-23	120-148	329-407	8-9	33-40
	80	90	117-145	320-390	20-24	18-22	122-151	329-409	16-19	33-40
		180	115-143	288-354	10-13	18-23	140-171	351-434	9-11	37-44
	90	90	118-147	360-438	19-24	17-21	140-172	350-436	18-21	37-45
		180	117-145	329-401	9-12	18-22	162-196	377-464	10-12	41-49
	100	90	120-150	406-490	19-23	17-21				
		180	119-148	374-453	9-12	17-21				

Table 19

20.4 Water-Side Pressure Drop Table

Model	Water Flow Rate (GPM)	Water Side Pressure Drop with out Internal Valve (PSI)	Water Side Pressure Drop with Internal Valve (PSI)
MC360	45.0	1.7	2.1
	67.5	3.5	4.3
	90.0	5.8	7.3
	120.0	9.7	12.4
MC480	60.0	2.1	2.8
	90.0	4.4	5.9
	120.0	7.2	9.9
	160.0	12.0	16.7
MC600	75.0	1.6	2.6
	112.5	3.2	5.5
	150.0	5.4	9.5
	200.0	8.9	16.3
MC720	90.0	1.7	3.2
	135.0	3.5	6.9
	180.0	5.8	11.8
	240.0	9.7	20.3

Table 20

All values based upon pure water at 70° F.

21 Wiring Diagrams for Three-Phase Units

21.1 Two-Stage, Three-Phase Standard Unit with Belt-Drive Motor

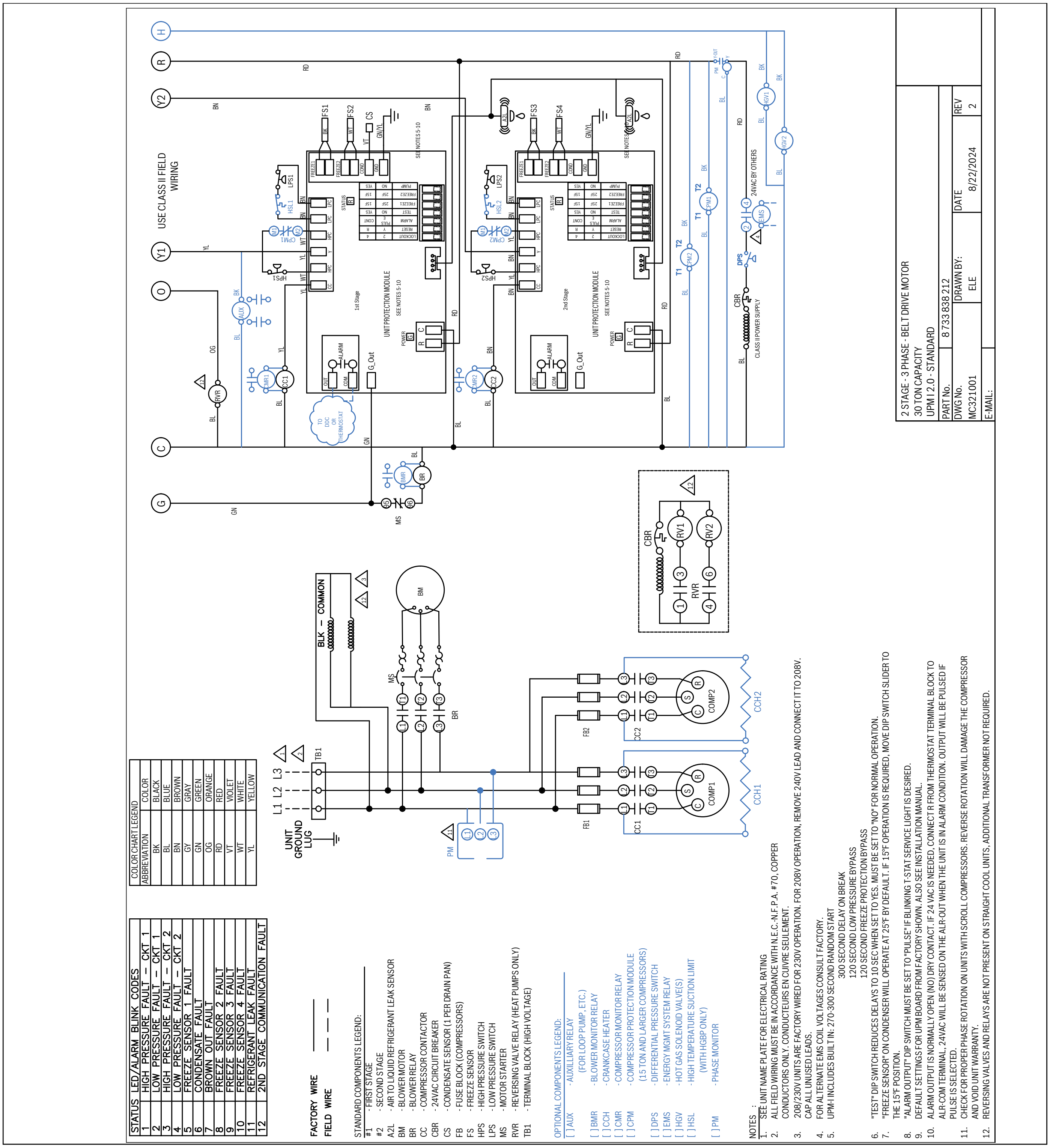


Figure 18

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

21.2 Two-Stage, Three-Phase Unit with Optional Components (MHGR) and Belt Drive Motor

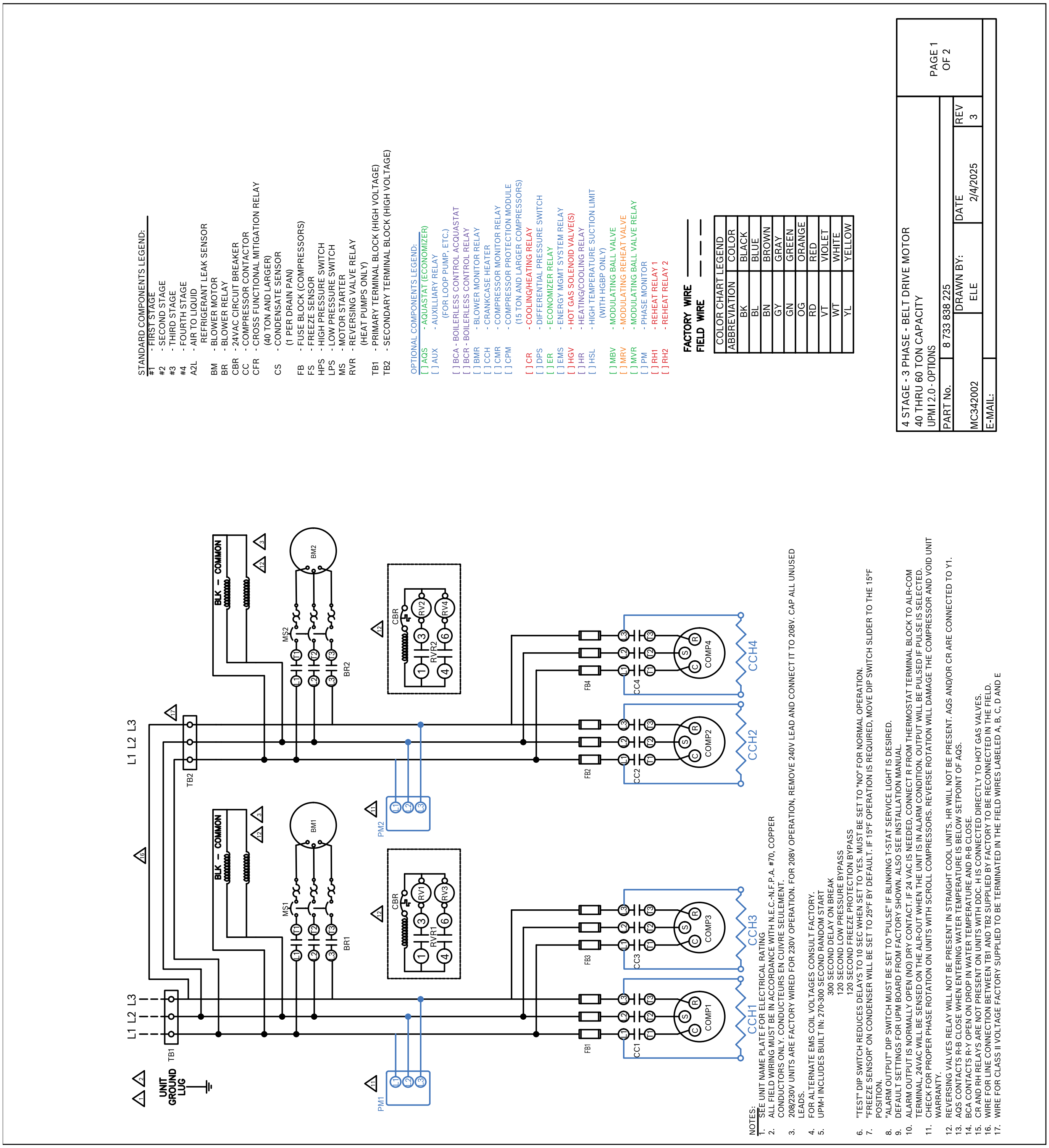


Figure 19

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

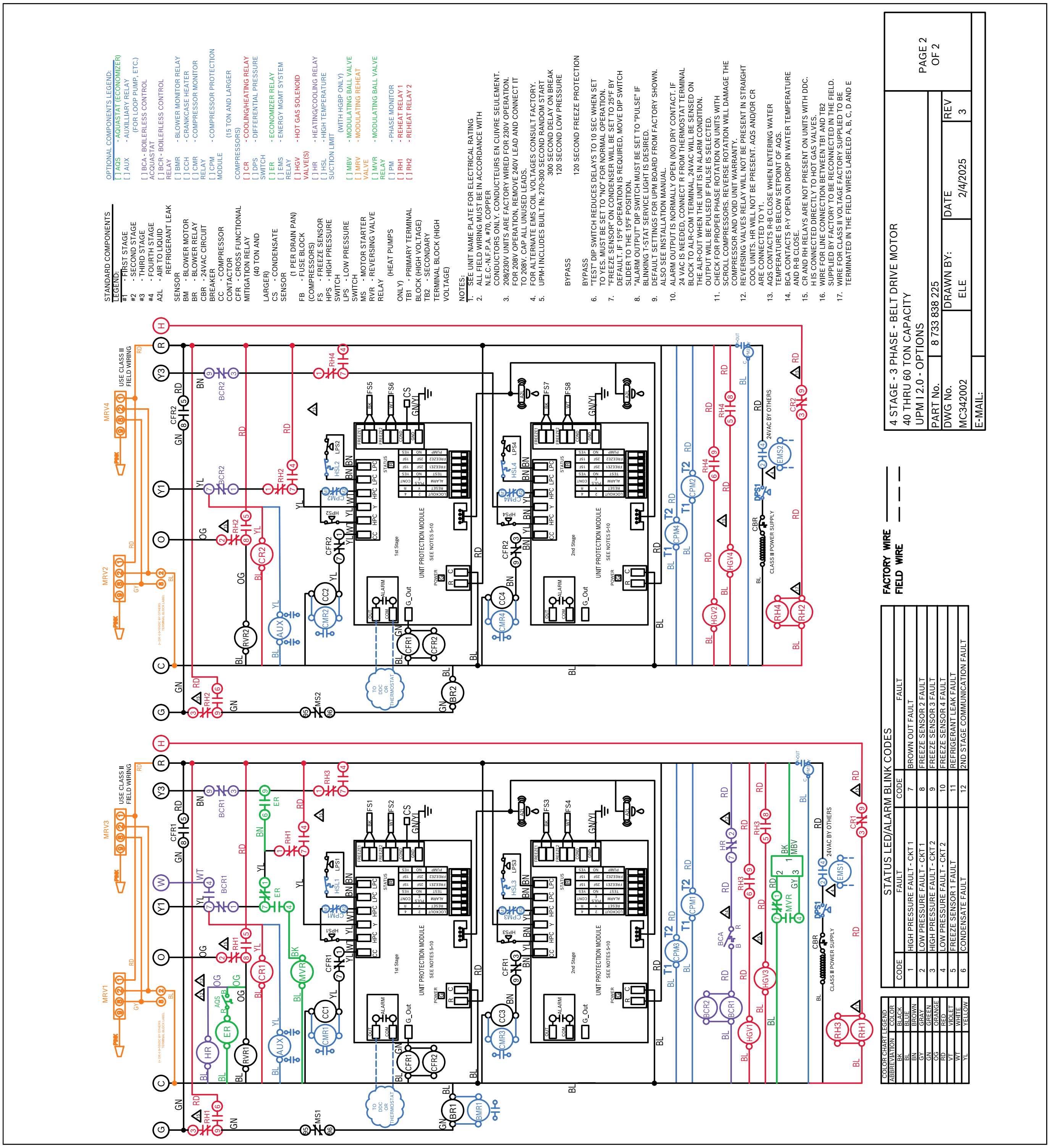


Figure 20

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

21.3 Two-Stage, Three-Phase Unit with DDC, Optional Components, and Belt-Drive Motor

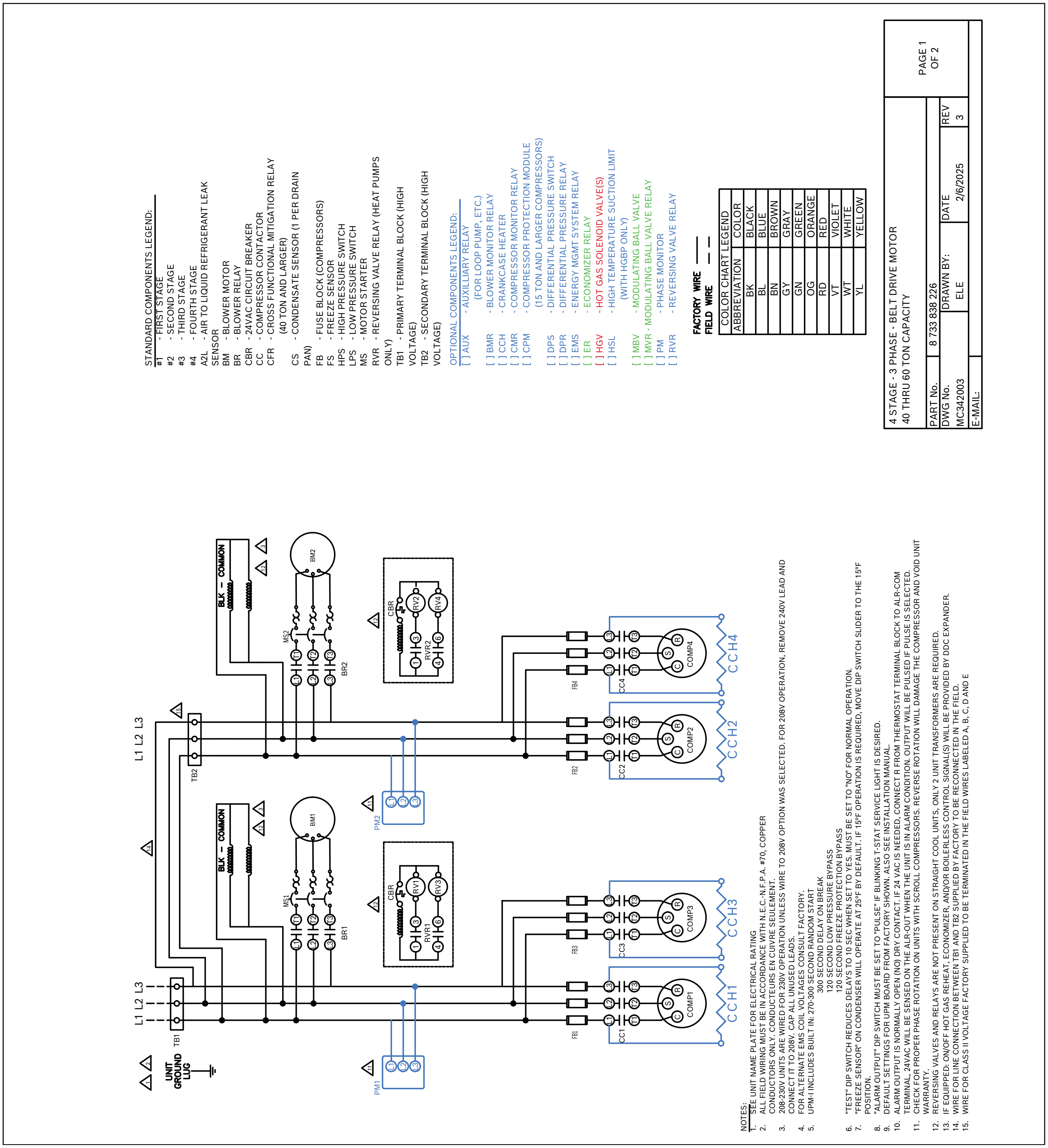


Figure 21

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

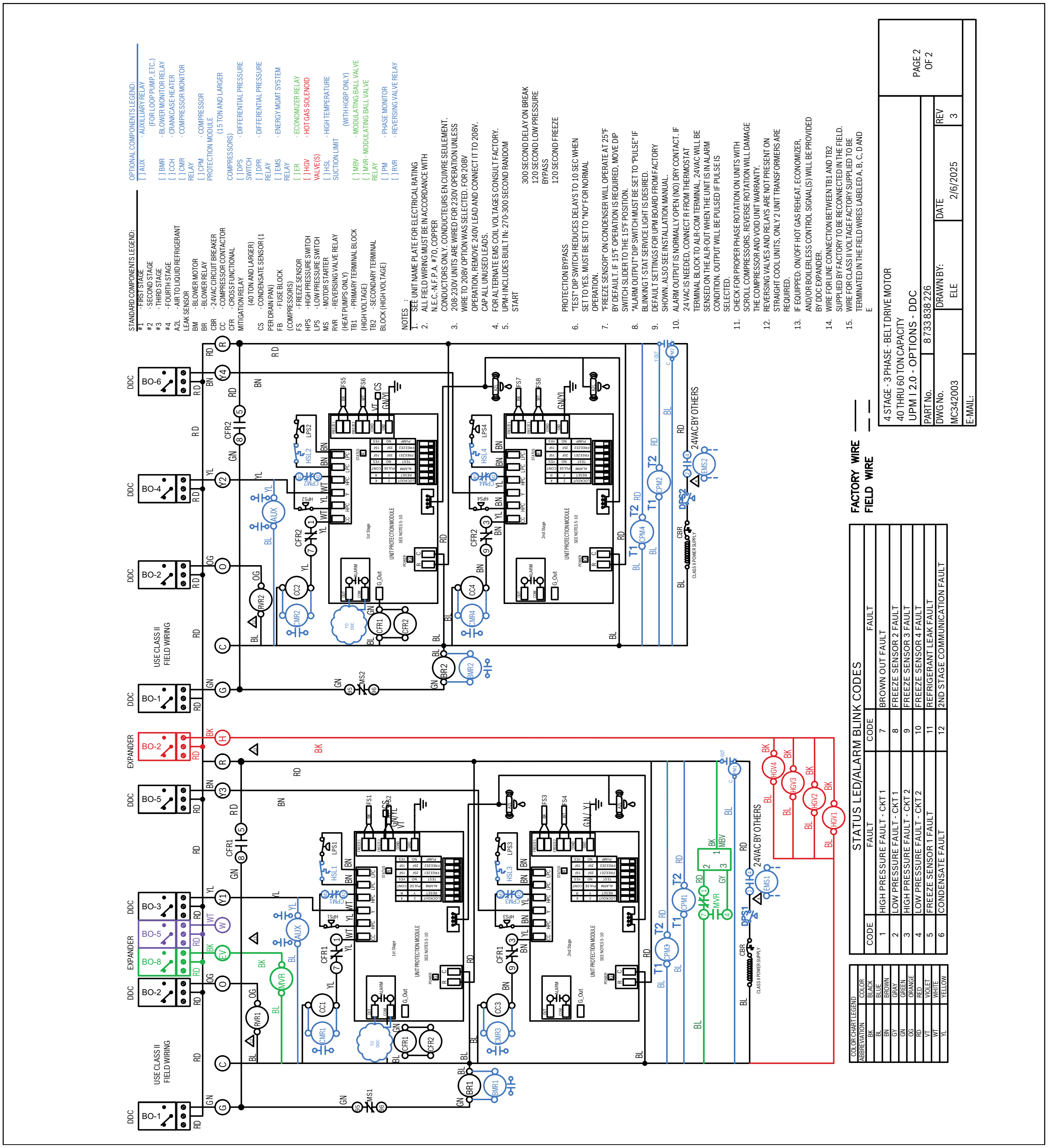


Figure 22

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

21.4 Two-Stage, Three-Phase Standard Unit with Dual-Point Power and Belt-Drive Motor

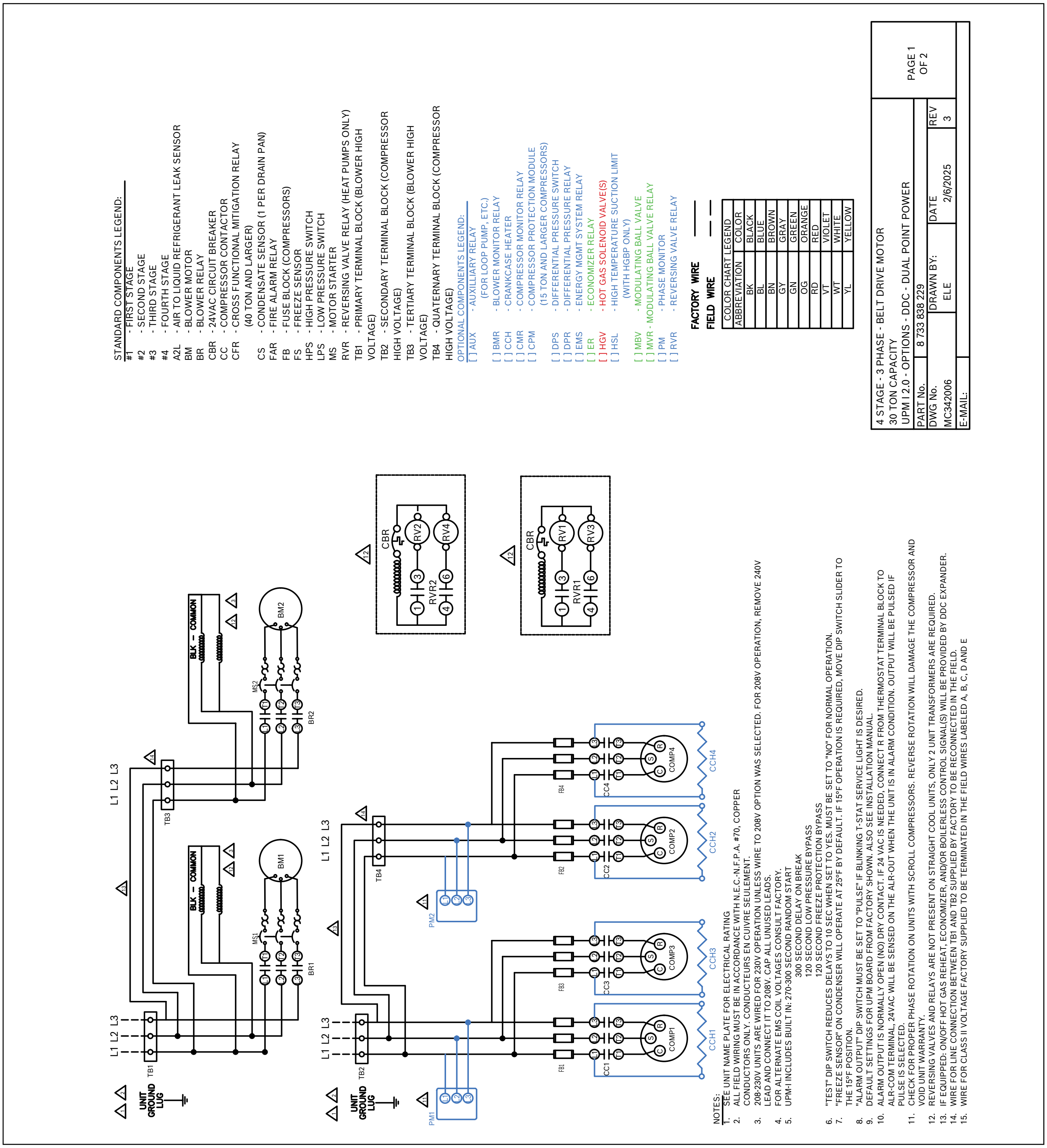


Figure 23

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

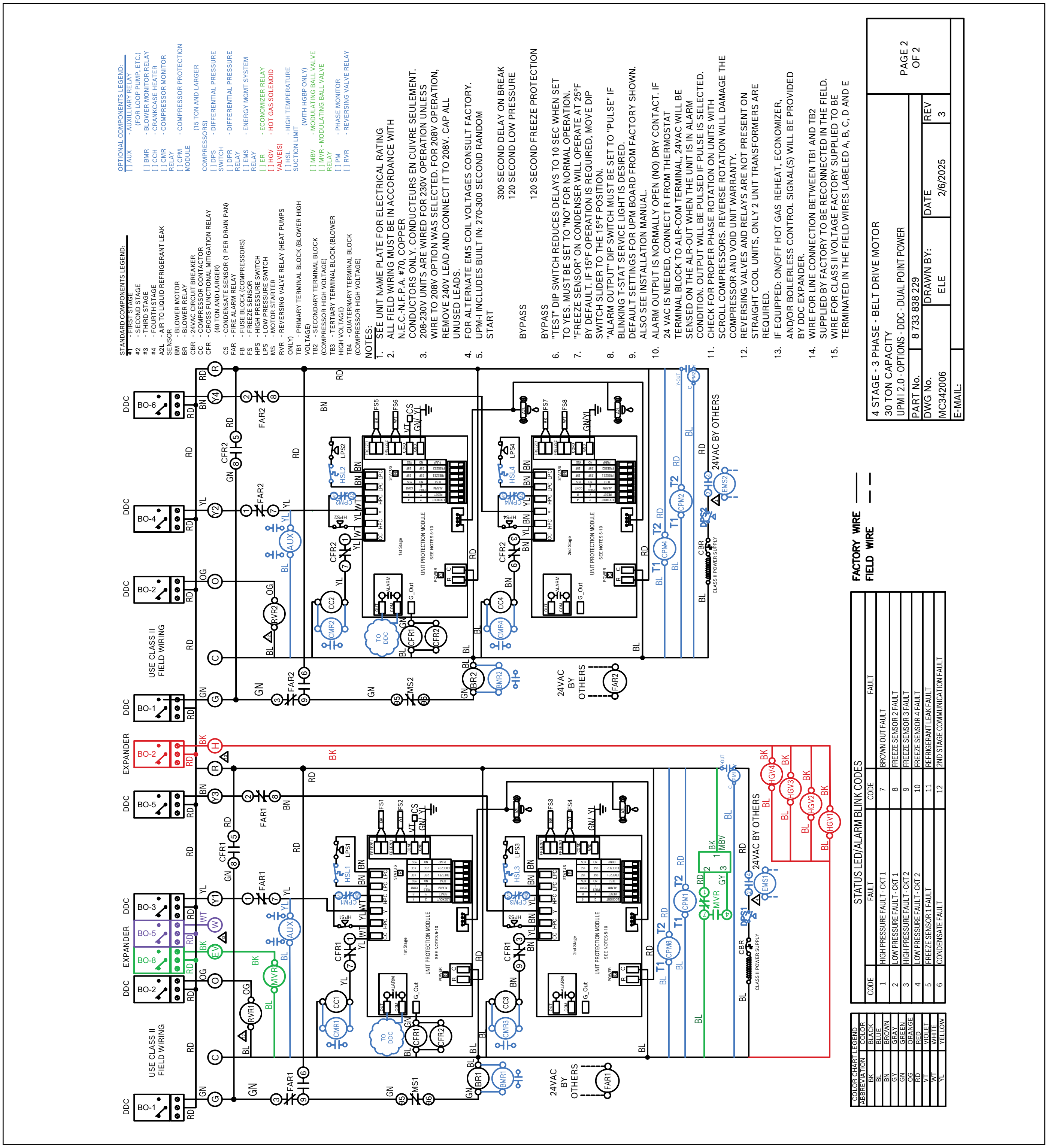


Figure 24

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

21.5 DDC Control 6126

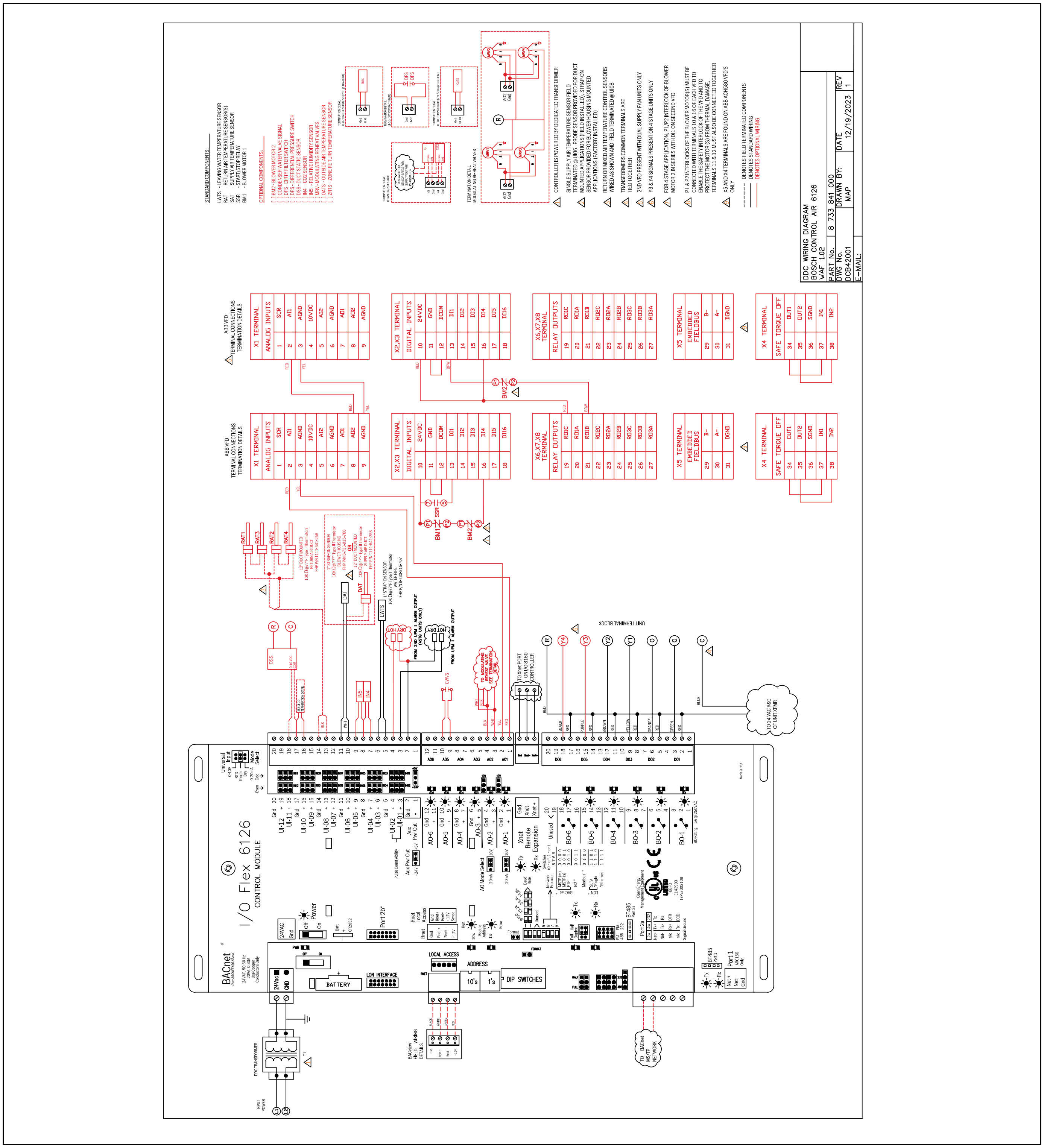


Figure 25 DDC Control 6126

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

21.6 DDC I/O Flex EX8160

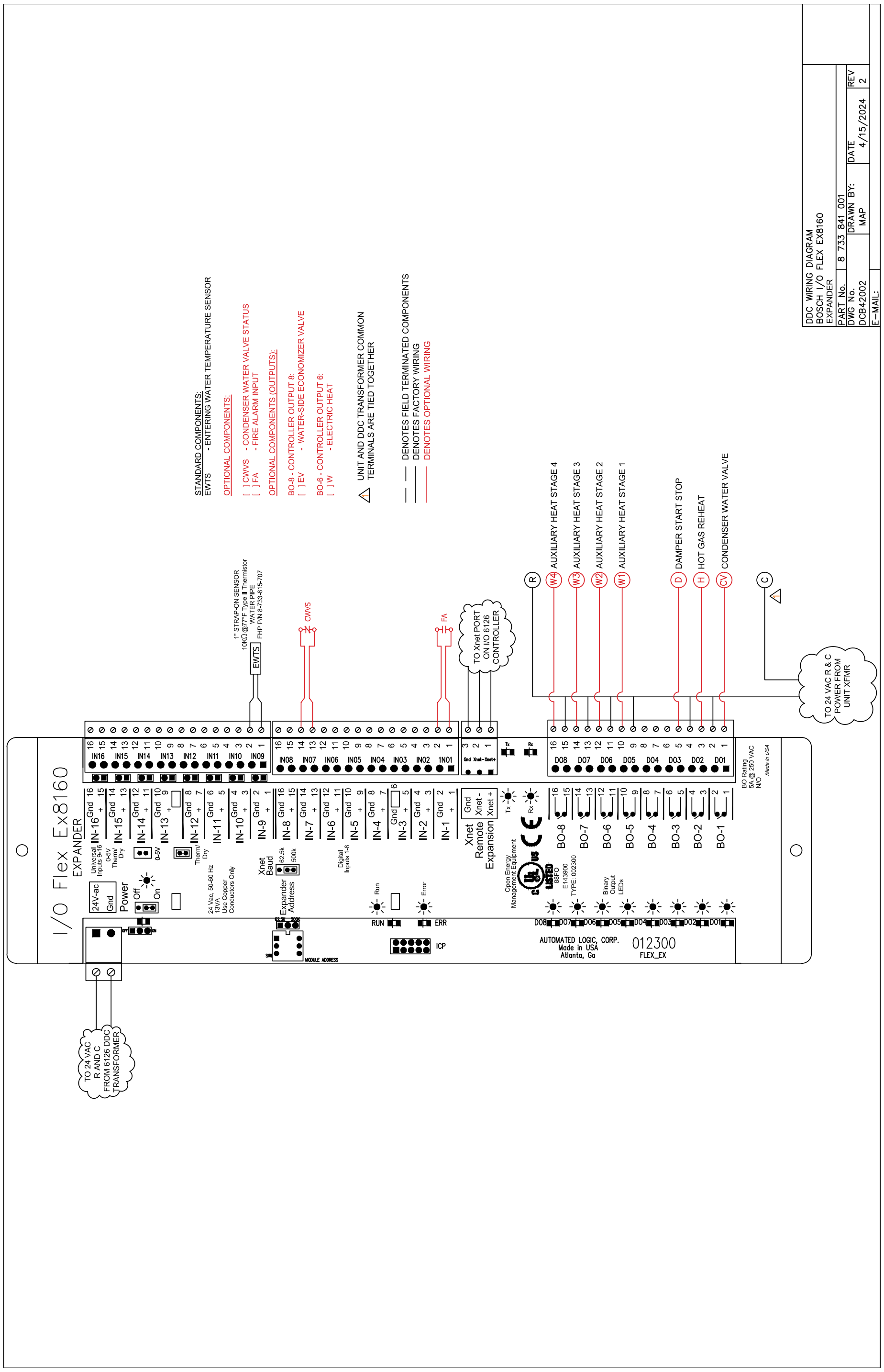


Figure 26 DDC I/O Flex EX8160

FOR REFERENCE ONLY. Actual unit wiring may vary from this example. Always refer to the wiring diagram attached to the unit.

22 Terminology

22.1 Acronyms

ASC—Anti-Short Cycle

AWG—American Wire Gauge

CFM—Cubic Feet per Minute

DDC—Digital Direct Controller

ECM—Electronically Commutated Motor

FLA—Full-Load Amps

GLHP—Ground Loop Heat Pump

HP—Horse Power

HPC—High-Pressure Switch Connection

HPS—High-Pressure Switch

IOM—Installation, Operation, and Maintenance Manual

LED—Light Emitting Diode

LPC—Low-Pressure Switch Connection

LPS—Low-Pressure Switch

LRA—Locked Rotor Amps

NO—Normally Open

NPA—Name Plate Amps

(R/A)—Return Air

RLA—Running Load Amps

22.2 Terms

Conditioned Space—Space within a building provided with heated or cooled air or both (or surfaces) and, where required, with humidification or dehumidification means to maintain conditions for an acceptable thermal environment.

Decommissioning—Means the final shut-down and removal from operation or usage of a product or piece of equipment containing fluorinated greenhouse gases.

Discharge Pressure—Referring to the pressure leaving compressor.

Reclamation—Means the reprocessing of a recovered fluorinated greenhouse gas in order to match the equivalent performance of a virgin substance, taking into account its intended use.

Recovery—Referring to the collection and storage of fluorinated-greenhouse gases from products (including containers and equipment) during maintenance or servicing or prior to the disposal of the products or equipment.

Recycling—Referring to the reuse of a recovered fluorinated-greenhouse gas following a basic cleaning process.

Repair—Referring to the restoration of damaged or leaking products or equipment that contain, or whose functioning relies upon, fluorinated-greenhouse gases, involving a part containing or designed to contain such gases.

Suction Pressure—Referring to the pressure entering compressor.

23 Check-Out Sheet

Customer Data

Customer Name:______________________ Date:______________________

Address 1:______________________

Address 2:______________________

Phone:______________________

Unit Number:______________________

Customer Data

Unit Make:______________________

Model Number:______________________ Serial Number:______________________

Refrigerant Charge (oz.):______________________

Compressor RLA:______________________ Compressor LRA:______________________

Blower Motor FLA (or NPA):______________________ Blower Motor HP:______________________

Maximum Fuse Size (Amps):______________________ Maximum Circuit Capacity:______________________

Operating Conditions	Cooling Mode	Heating Mode
Entering Air Temperature:		
Entering Air Measured at:		
Leaving Air Temperature:		
Leaving Air Measured at:		
Entering Fluid Temperature:		
Leaving Fluid Temperature:		
Fluid Flow (L/min):		
Compressor Volts:		
Compressor Amps:		
Blower Motor Volts:		
Blower Motor Amps:		
Source Fluid Type:		
Fluid Flow (gpm)*:		
Fluid-Side Pressure Drop*:		
Suction Pressure (psig)*:		
Discharge Pressure (psig)*:		
Suction Temperature*:		
Discharge Temperature*:		
Suction Superheat*:		
Entering TXV/Cap Tube Temperature*:		
Liquid Subcooling*:		

* Required for Troubleshooting ONLY

NOTES:

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NOTES:

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Watertown, MA 02472

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www.bosch-homecomfort.us

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