MC SERIES

APPLICATION manual

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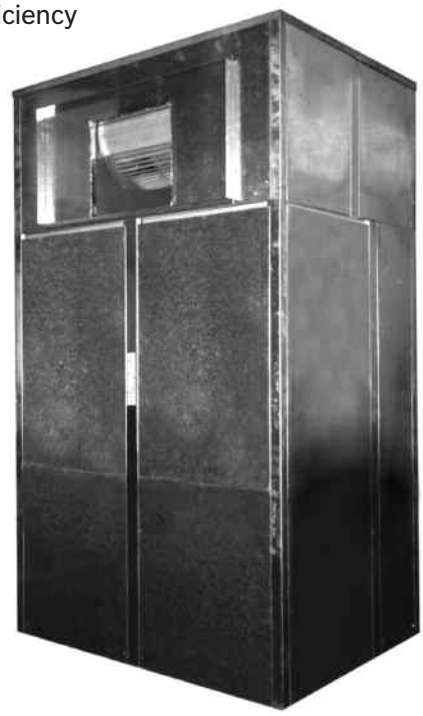
FHP brings to the market a first in large capacity modular reverse cycle units. Their many features and energy efficiency make them the ideal choice for either new construction or retrofit projects.



UNIT FEATURES

Modular Construction

- Separate modules (VH series) will pass through a 36" wide standard door
- No breaking of refrigerant lines required
- Water connections are heavy-duty bronze bodied unions
- Single power point connection

State of the art MCS Control System

- Optional Microprocessor based DDC controller allows multiple configurations for specific applications strategies
- LCD display of operating status and fault conditions in plain English

ENERGY WISE HVAC EQUIPMENT

FHP MANUFACTURING
601 N.W. 65th Court • Fort Lauderdale, FL 33309
866-642-3198 • 800-776-5529 Fax
www.fhp-mfg.com

ISO 9001:2000 Certified

970-385 Revised 0513

REVERSE CYCLE HEAT PUMP OPERATION

- Optional reverse cycle heating
- Takes full advantage of building diversity

ENERGY EFFICIENCY

- High efficiency in the cooling mode
- Economical operation in heating with reverse cycle operation
- Economizer operation reduces compressor operating hours increases system efficiency
- Individual units can be monitored for actual electrical usage by tenants

VARIABLE AIR VOLUME CAPABILITY

- Units can be fitted with VFD for additional energy savings
- Increased operational flexibility

QUIET OPERATION

- Scroll compressors for efficient quiet operation
- Heavy duty structural components
- Multi density coated glass fiber insulation

RELIABILITY

- Units are fully assembled and tested at the factory to ensure smooth assembly and start up in the field
- No reliance on central plant equipment for building climate control
- Multiple refrigerant circuits provide redundancy in the event of component failure

100% OUTSIDE AIR CAPABILITY

- Hot gas reheat for humidity control

HOT GAS BYPASS

- Allows operation under a wide variety of conditions
- Provides protection against coil freezing

DESIGN FEATURES:

UNIT CONSTRUCTION

The FHP MC series is available in two basic configurations:

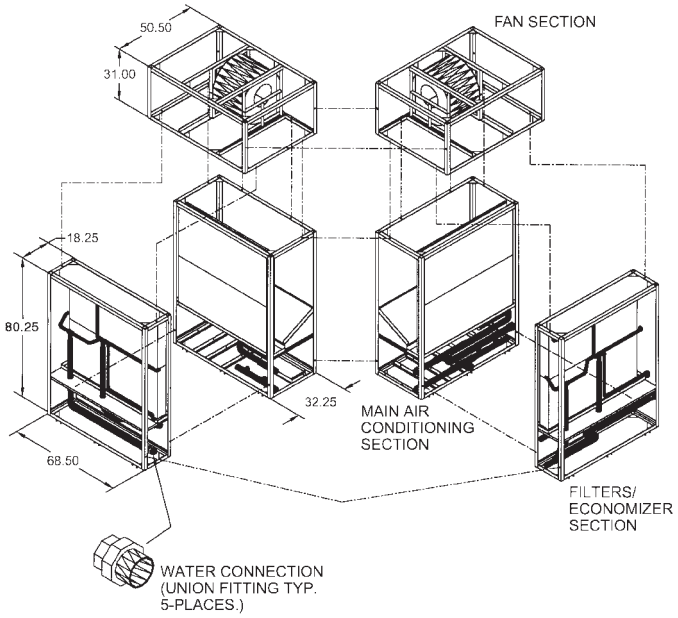
VH CONFIGURATION

The VH design concept is to provide a unit that will facilitate on site handling and can be installed in locations difficult to access. All units can be broken down into separate modules that can pass through a 36" wide standard door or service elevator. No refrigerant piping requires disconnection, maintaining circuit integrity. Water piping connections are made with the use of heavy-duty bronze-bodied unions so no welding or brazing is required in the field. Single supply and return connection to the unit are standard. This creative design allows the installer to transport and locate the modules in the equipment room without the use of heavy-duty cranes or lifts. Building penetrations or interior wall penetrations are not normally required on retrofit jobs where space is at a premium. The 30 ton module can be easily broken down into 3 separate modules - the fan module, main heating/cooling module and the economizer/filter bank. The 40 through 60 ton units can be broken into 6 separate modules, two each as previously mentioned. Very few competitive equipment manufacturers have this capability.

VL CONFIGURATION

The VL is designed for those applications where there is a restriction in the height of the unit. In this model the blower is dropped into the main coil section reducing the units overall height and increasing unit depth. Unit sizes MC480 through MC720 can be split into two sections for transportation and access into the plant room.

Please see unit drawings on pages 20 through 23 for unit dimensions.



VH Configuration

FLEXIBILITY

The FHP MC series is available in cooling only or with reverse cycle heating with either constant or variable air volume discharge to provide a highly efficient operating system. Water-side economizer packages are available to take advantage of free cooling. Optional field installed hot water coils provide preheating or heating. Hot gas bypass allows the unit to operate under a wide variation of conditions and the hot gas reheat option provides a means of controlling humidity, a major concern in the interior environment of a building.

UNIT PERFORMANCE

The units are available in four sizes from nominal 30 through 60 tons.

Performance is with nominal CFM and rated in accordance with ARI/ISO 13256-1 conditions. Performance numbers are gross.

Unit Size	CFM Range	Cooling Capacity Tons	EER	Heating Capacity MBH	COP
MC360	6,000 - 12,400	32.6	18.6	386.9	5.5
MC480	8,000 - 19,200	41.7	19.0	623.3	5.4
MC600	10,000 - 24,000	53.1	19.0	731.8	5.4
MC720	12,000 - 24,800	65.3	18.6	773.9	5.5

CABINET, CASING AND FRAME

For heavy-duty structural support an internal angle iron framework is utilized. The angle iron members are attached using 1/2 inch bolts and locking nuts for ease of disassembly and reassembly. The base-pan assembly is constructed of 14 gauge galvanized steel. Exterior panels are made of 18 gauge, G90 galvanized steel providing protection against corrosion. All panels are insulated with 1/2 inch thick dual density Neoprene backed fiberglass insulation for thermal and acoustic performance. Insulation meets the erosion requirements of UL 181. Base rails are provided to assist rigging the unit on site. All components are located for ease of inspection and service. Major components are out of the units air stream to allow maintenance while the unit is in operation. Service access is through the removal of access panels located on the unit.

COMPRESSORS

All units utilize high efficiency scroll compressors. The MC360 has two compressors while the MC480 through MC720 units contain four compressors for efficient part load control, quiet operation and system redundancy.

Each compressor has its own independent refrigerant circuit and is protected by individual branch fusing. Additional protection is provided by thermal overloads and high and low pressure safety switches. Suction and discharge schrader valves are provided for manifold gauge connections to facilitate servicing. Compressors are mounted on vibration isolators.

The entire condensing section is isolated from the air-handling compartment by the use of an insulated bulkhead partition designed to minimize sound transmission.

Externally equalized balanced port thermostatic expansion valves are utilized for wide range refrigerant metering control. Superheat shifts are minimal from cooling to heating operation ensuring stable operation in both the heating and cooling modes. All TXV's are factory set and are field adjustable for specific operating conditions. Reversing valves are large bodied to minimize refrigerant pressure drop. All refrigerant components are accessible from the front of the unit for service and maintenance.

CONDENSERS (water to refrigerant heat exchangers)

All condensers are coaxial tube-in-tube for maximum heat transfer efficiency and performance. Inner water tubes are either copper or optional cupro-nickel with large internal diameters for reduced water-side pressure drops. Outer tubes are steel, painted for corrosion protection. All condensers are rated at 450 PSIG operating refrigerant pressures and 400 PSIG water-side pressures. Condensers are individually leak tested. All condensers are chemically cleanable. Please consult the factory for cleaning procedures. Units are designed for single water supply/return connections with modules being connected by the use of heavy-duty bronze unions.

DX COOLING/HEATING COIL

Evaporators are enhanced fin, rifled tube type for maximum performance. Large face areas ensure low airside pressure drops and reduced face velocities to prevent condensate carry over and maximum moisture removal.

Coils are either three or four rows deep depending on unit model and mounted in small area, sealed drain pans to inhibit condensate buildup levels.

All drain pans are galvanized steel with Archem type coating for corrosion protection. Optional stainless steel drain pans are available. Bottom outlet fittings in drain pans ensure free draining. Optional condensate overflow switches are available.

Each refrigerant circuit is independently piped allowing part load operation in the event of a component failure. Compressor/evaporator staging is such that air stratification is kept to a minimum. The lower evaporators on each module are staged first to keep coils wet and enhance condensate removal. In the event of an evaporator failure only the individual coil need be changed compared to the full face evaporators utilized by some manufacturers.

ELECTRICAL

All units are completely wired and tested at the factory prior to shipment. Wiring complies with NEC requirements and units are UL 1995 safety certified and listed. Single point power supply is standard on all models. Each module has its own power block simplifying wiring in the field for knock down capabilities. Supply air fan motors are protected by use of a solid state adjustable current motor starter with reset.

Extra starter heaters are not required. All compressor power circuits are branch fuse protected. Control circuit power is provided by a factory mounted 100 VA low voltage transformer with an integral resettable circuit breaker. Solenoid valves are line voltage to reduce transformer loading.

SAFETY DEVICES AND THE UPM CONTROLLER

Each MC unit is factory provided with a Unit Protection Module (UPM) that controls compressor operation and monitors the safety controls that protect the unit. Unit sizes 480-720 will have a board in each section.

Safety controls include the following:

- High pressure switches located in the refrigerant discharge lines. One per refrigeration circuit.
- Low pressure switches for loss of charge protection located in the unit refrigerant suction lines. One per refrigeration circuit.
- Optional freeze protection sensor located on the leaving side of the water coil prevents unit operation below 35ºF. A freeze stat pin located on the board may be put in the YES or NO position depending whether the freeze stat is ordered

NOTE: The factory default is in the YES position. If the freeze stat option is not ordered the pin must be relocated to the NO position.

- Optional Condensate overflow protection sensor located in the drain pan(s) of the unit and wired to the UPM board.

The UPM includes the following features:

- **ANTI-SHORT CYCLE TIMER** – 5 minute delay on break timer to prevent compressor short cycling.
- **RANDOM START** – Each controller has a unique random start delay ranging between 270 through 330 seconds.
- **LOW PRESSURE BYPASS TIMER** - The low pressure switch is bypassed for 120 seconds after compressor start-up to prevent nuisance low pressure lockouts during cold start-up in the heating mode.
- **BROWNOUT/SURGE/POWER INTERRUPTION PROTECTION** – a 20 millisecond window is monitored for the above condition. Should any of these conditions be detected, the 5-minute delay on break timer and the random start timer delay are initiated.
- **MALFUNCTION OUTPUT** – The controller has a set of wet contacts for remote fault indication.
- **TEST SERVICE PIN** – A jumper pin is provided to reduce all time delay settings to 5 seconds during troubleshooting or verification of unit operation. Note that operation of the unit in test mode can lead to accelerated wear and premature failure of the unit.
- **L.E.D. FAULT INDICATION** – Two L.E.D. indicators are provided as follows:
- **GREEN:** Power L.E.D. indicates 18 – 30 VAC present at the board.
- **RED:** Fault indicator with blink codes as follows:

  One per Dual Circuits (UPM-II)

  - **ONE BLINK** 1st Stage high pressure lockout
  - **TWO BLINKS** 1st Stage low pressure lockout
  - **THREE BLINKS** 2nd Stage high pressure lockout
  - **FOUR BLINKS** 2nd Stage low pressure lockout
  - **FIVE BLINKS** Freeze Protection lockout
  - **SIX BLINKS** Condensate overflow lockout
- **INTELLIGENT RESET** - If a fault condition is initiated the 5 minute delay on break time period is initiated and the unit will restart after this delay expires. If the fault condition still exists or reoccurs within one hour, the unit will go into a hard lockout and require a manual lockout reset.
- **LOCKOUT RESET** - A hard lockout can be reset by turning the unit thermostat off and then back on or by shutting off unit power at the circuit breaker.

NOTE: The blower motor will remain active during a lockout condition.

MCS (MODULAR CONTROL SYSTEMS DDC CONTROLLER)

OPTIONAL MCS DDC CONTROLLER

An optional MCS DDC controller is available on the MC series. This controller can act as a stand-alone controller or interface with a building management system or be connected to a PC. Remote dial in capability through an optional modem is also available. The MCS has the capability to interface with BACNET communication protocol through an optional portal.

The controller is capable of monitoring and controlling temperatures, static pressure (VAV applications), humidity, fluid flow and airflow as required and when ordered with the appropriate sensors.

The standard unit controller is configured for constant volume, return air control. Optional control strategies are

available, for example, humidity/reheat control and variable air volume discharge air temperature control with return air reset. All safety inputs are monitored and alarm signals can be generated. The controller will automatically restart the machine following a non-critical alarm condition, not taking the unit off line unless the same alarm has occurred twice within an adjustable time period. Nuisance shut down of the unit is avoided while still providing protection against possible equipment failure. A record of faults and time of occurrence is kept in the controller to facilitate trouble shooting and servicing of the unit. A systems time clock is standard on all MCS controllers enabling programming for daily operations.

All necessary sensors are factory provided, field installed for application specific control strategy. The controller is conveniently located on the unit for easy reading and programming. A 2 line 16 character LCD displays all temperature, pressure and control functions in easy to read English. Battery back up is standard to prevent loss of operating parameters during power interruptions/losses. A four layered printed circuit board protects the microprocessor from power surges or fast transients across or over the lines. Please refer to the unit controller manual for further details

REVERSE CYCLE OPERATION

All MC series units are capable of operating in the reverse cycle heat pump mode for efficient, cost effective heating. The MC series is the only self-contained heat pump unit in its class. This feature allows the designer to take full advantage of building diversity, transferring excess heat from areas with a net cooling load to areas requiring heating providing a truly energy efficient system.

HOT WATER COIL

An optional one or two row hot water coil is available for hydronic heating. The coil is available either installed in the filter section (if the economizer option is not ordered) or for external mounting. In both cases piping, valves and controls are by others.

ECONOMIZER/FILTER BANK MODULE

Factory installed water-side economizer coils are available on all MC series units. The economizer package consists of full-face area multi-row copper tube, aluminum fin coils designed for low water-side pressure drops. A 3-way motorized ball valve is included in the package for water flow control. The valve includes a manual clutch option for field over-ride capability while an optional minimum positioner for the valve is also available. The economizer may be controlled through the optional controller which senses entering fluid temperature to the unit and opens the valve to allow flow through the economizer coil and condenser in series. In normal operation, flow is through the condenser only. The set point is adjustable between 45 degrees and 70 degrees in the cooling mode. A heating economizer cycle is also available utilizing high temperature loop fluid or high temperature fluid from a heat exchanger that is on a hot water hydronic loop. The package has a 400 PSIG design working pressure and is pressure tested for leaks at the factory.

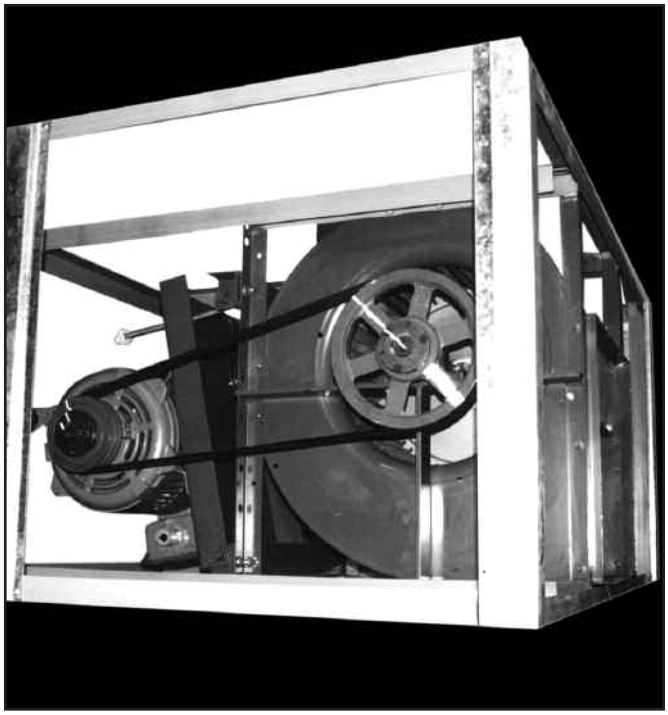
FILTERS

All MC series units come with standard 4 inch 30% efficiency pleated filters. Optional 65% 4 inch pleated filters are available. Filters are removable from the sides of the frames through filter access panels. Throw away construction filters should be field installed to protect the main filters during the construction period.

BLOWERS

The units contain either one or two forward curved high-pressure class II fan assemblies depending on the model size. The fans are double width, double inlet welded assemblies statically and dynamically balanced. In the VH Series, the fan module is isolated from the main module by the use of rubertex gaskets providing excellent vibration isolation and quiet operation. The modules are bolted together with 1/2 inch diameter bolts and locking nuts. Each fan is powered by it's own motor and drive assembly. Motors are mounted on individual motor platforms for stable operation and belt tension adjustment. All assemblies include 150,000-hour re-greaseable pillow block bearings with large diameter solid steel shafts for high torque/speed operation. Drive packages comprise multiple belt, fixed pitch blower pulleys and motor sheaves sized for specific application requirements of CFM, external static pressures, and motor horsepower. All components are easily accessible for general maintenance. Motors are open drip proof NEMA T-Frame E high efficiency EPACT rated with sealed ball bearings.

Optional factory installed variable frequency drives are available for variable air volume systems. The drives are located in the fan section and may be controlled by the optional DDC. A static pressure sensor is field installed in the supply duct plenum dictating motor speed based on an increase or decrease in the supply duct static pressure. VFD's are factory programmed per job specific design criteria.



All drives are NEMA 4/12 enclosed with an integral keypad for program adjustments. Removable access panels allow drive adjustments during motor operation. Constant power line reactors are also furnished with each drive for power supply filtration.

AVAILABLE OPTIONS

- Proof of fluid flow - factory installed differential pressure switch
- Entering/leaving fluid temperature sensors.
- Factory installed freeze protection sensor.
- Control algorithm options - space/return air control, discharge air with space/return air reset control, VAV control. Only available with optional DDC.
- Water-side economizer.
- Hot gas reheat on constant volume units with or without 100% outside air introduction - factory installed with controls for dehumidification applications when equipped with optional DDC.
- Hot water heating coils, one or two rows.
- Hot gas bypass for extended capacity operation and to prevent coil freezing at low load conditions.
- *MCS DDC Controller

TESTING

All completed units are leak checked, evacuated and factory charged with R-410A. Units are 100% run tested prior to shipment.

PERFORMANCE

For unit performance under specific conditions please contact you FHP Manufacturing representative.

CONSTANT VOLUME AIRFLOW

MC units are ideally suited to air condition large spaces in offices and shops providing a total climate control system. The units may be applied on a floor by floor basis or serve a specific area. Unit control is accomplished by sensing the space or return air temperature and staging the unit based on the control set point.

VARIABLE AIR VOLUME

MC units are available with a factory installed variable frequency drive package for modulating the airflow in response to changes in the system duct static pressure. VAV units have the ability to control temperatures in areas of different loading such as the interior and exterior zones of a building. Only the volume of air that is required to satisfy the space load is delivered providing significant savings in energy. Typically the system is designed to provide supply air at a constant temperature through the control of discharge air temperature. VAV terminals in the space modulate open or closed as the load varies increasing or reducing the airflow to satisfy the demand. Temperature reset based on return air temperature is also available.

DEHUMIDIFICATION

Indoor air quality is a major concern in the design and operation of today's buildings. Humidity levels, if not properly controlled, can play a major role in the development of fungal growth which is a major cause of the problem. Controlling the space temperature alone will not assure proper humidity control. To bring the humidity to an acceptable level requires cooling the air to a relatively low temperature, which can result in uncomfortable conditions within the space. The air, after dehumidification, needs to be reheated to avoid this problem. Typically electric heat has been applied to do this but is probably the most expensive option adding significantly to operating costs. An alternative would be to use hot water if it is available. Again this represents an additional operating cost. Addition hot water piping will be needed, increasing initial costs. MC units offer a factory installed hot gas reheat option that uses the hot refrigerant gas to reheat the air. All of the heat of rejection is not used to reheat the air so there is a net cooling effect but not enough to create uncomfortable conditions within the occupied space. Hot gas reheat operation is controlled through space humidity levels and only operates when needed.

SELECTION PROCEDURE

The following example is intended to illustrate the selection of an MC unit. For applications outside of the published data sheets please contact your FHP representative.

Requirements
FHP series MC unit is to provide cooling and reverse cycle heating. A water-side economizer coil is to be provided to operate when the loop water temperature falls below 60°F. Electrical service is 460/3/60

Design conditions:
Airflow ..... 16,000 CFM
External static pressure ..... 2.75"
Entering air temperature ..... 85/73°F
Flow rate ..... 120 GPM

Cooling
Cooling capacity total ..... 530,000 BTUH
Cooling capacity sensible ..... 390,000 BTUH
Entering temperature ..... 85°F

Heating
Capacity ..... 400,000 BTUH
Entering air temperature ..... 70°F
Entering water temperature ..... 65°F

Unit selection
Select the unit with the airflow and capacity closest to the specified requirements. From the unit specification sheet this would be a model MC480.

Cooling performance
From the MC480 specification data sheet:
AT 16,000 CFM and condenser water flow rate of 120 GPM
Total capacity ..... 534,660 BTUH
Sensible Capacity ..... 393,510 BTUH
Watts input ..... 32,760 Watts
EER 16.3
Heat rejection ..... 646,470 BTUH

Calculate:
Water temperature rise ..... $\frac{646,470}{500 \times 120}$ ..... 10.8°F

Leaving water temperature ..... 85 + 10.8 ..... 95.8°F
From the water-side component pressure drop table
Water pressure drop ..... 15.0 ft.

Heating performance
From the unit specification data sheet the entering water temperature falls between 60 and 70°F and the unit performance may be interpolated. Do not extrapolate unit performance.
Unit capacity ..... 615,395 BTUH
Watts input ..... 38,332 BTUH
Unit COP 4.7
Heat of absorption ..... 484,570 BTUH
Water temperature drop ..... $\frac{484,570}{500 \times 120}$ ..... 8.1°F

Leaving water temperature ..... 65 - 8.1 ..... 56.9°F

Economizer Performance
From the economizer performance sheet, based 80/67°F air and 120 gpm water entering at 45°F.
Total capacity ..... 552,000 BTUH
Sensible Capacity ..... 384,000 BTUH
The performance must be adjusted for specific operating conditions.

Fluid temperature correction factor:

Total capacity 0.470
Sensible capacity.....0.470

Air temperature Correction factor:

Total capacity correction at 73°F WB.....1.090
Sensible capacity correction at 85°F DB.....0.970

Economizer corrected capacity:

Total capacity.....552,000 x 0.470 x 1.090 .....282,790 BTUH
Sensible capacity .....384,000 x 0.470 x 0.970 .....175.065 BTUH

From a psychometric chart the leaving air conditions can be determined.
Leaving air DB/WB.....75.4/68.4°F
Water temperature rise..... $\frac{282,790}{500 \times 120}$ .....4.7°F

Leaving water temperature .....60 + 4.7 .....64.7°F

This is the entering water temperature to the unit condenser (64.7°F)

Water pressure drop through economizer.....13.1 Ft
Total water pressure drop with economizer operating is the sum of condenser and economizer
Total unit water pressure drop .....15.0 + 13.1 .....28.1 Ft

Fan Performance

Determine the internal air pressure drop through the unit
DX coil (wet) .....0.47"
Economizer coil .....0.26"
4" 30% filters (clean) .....0.09"
Total internal static pressure .....0.82"
Add external static pressure.....+ 2.75"

Total static pressure .....3.57"
From the MB480 fan curve
RPM.....1050
Motor - each.....10.0 HP.
From the drive selection table select drive.....041-017 two required

Unit Weight VH Configuration

From the table of unit weights
Main section .....2,350 lbs
Filter section.....620 lbs
Economizer .....400 lbs
Fan section.....1,300 lbs
Total weight.....4,670 lbs

Unit Electrical Data

From the table on unit electrical data
Compressor RLA 20.0
Number of compressors 4
Fan RLA.....12.6
Number of motors 2
Minimum circuit ampacity .....(Largest load x 1.25) + all other loads
Ampacity.....(20 x 1.25) + 3 x 20 + 2 x 12.6 .....110.8
Maximum fuse size.....(Largest load x 2.25) + all other loads
Fuse size.....(20 x 2.25) + 3 x 20 + 2 x 12.6 .....130.8
Use next smaller fuse size.....130

Note: Performance data calculated above is gross with no allowance made for fan HP.

MODULAR VERTICAL PACKAGE UNITS
SPECIFICATION DATA SHEET

FHP MANUFACTURING HIGH-EFFICIENCY WATER SOURCE HEAT PUMPS

MC360
MODULE-AIRE
R-410A

ELECTRICAL SPECIFICATIONS

ELECTRICAL CHARACTERISTICS	ELECTR. SYM.	COMPRESSOR EACH		BLOWER EACH		MIN. CIRCUIT AMPACITY	FUSE (T/D) HACR CIRCUIT BREAKER
		RLA	LRA	NPA	HP		
208-230/3/60	-3	59.1	425.0	See "Motor Nameplate Data" on Page 24			
460/3/60	-4	27.6	178.0				
–	–	–	–				
–	–	–	–				

BLOWER PERFORMANCE

See Blower Performance Curves

PERFORMANCE DATA

RATED IN ACCORDANCE WITH ARI 320				
COOLING		HEATING		
CAPACITY	EER	CAPACITY	COP	GPM
391200	18.6	386900	5.5	90.0

CAPACITY DATA

All performance at 12000 CFM and 90.0 GPM
NOTE: All capacities and efficiencies shown are gross values.

COOLING

Entering Water Temp.	Ent. Air Wet Bulb Temp.	Total Capacity BTUH	Watts Input	Heat Rejection BTUH	Sensible Capacity BTUH Ent. Air Dry Bulb ˚F			EER
					75˚	80˚	85˚	
50˚	61°	470,328	19,920	538,320	357,920	429,410	470,330	23.6
	64°	493,130	20,300	562,410	334,830	425,080	471,430	24.3
	67°	516,310	20,770	587,200	308,240	402,730	464,680	24.9
	70°	539,880	21,220	612,300	256,990	355,240	462,140	25.4
	73°	563,840	21,670	637,800	-	302,780	414,980	26.0
60˚	61°	437,560	20,910	508,930	332,980	399,490	437,560	20.9
	64°	458,770	21,330	531,570	311,500	395,460	438,580	21.5
	67°	480,340	21,750	554,570	286,760	374,660	432,310	22.1
	70°	502,270	22,260	578,240	239,080	330,490	429,940	22.6
	73°	524,550	22,770	602,260	-	281,680	386,070	23.0
70˚	61°	403,330	21,880	478,010	306,930	368,240	403,330	18.4
	64°	422,880	22,360	499,190	287,140	364,520	404,270	18.9
	67°	442,760	22,830	520,680	264,330	345,360	398,490	19.4
	70°	462,980	23,300	542,500	220,380	304,640	396,310	19.9
	73°	483,520	23,760	564,610	-	259,650	355,870	20.4
85˚	61°	349,800	23,660	430,550	266,200	319,370	349,800	14.8
	64°	366,760	24,180	449,290	249,030	316,140	350,620	15.2
	67°	384,000	24,690	468,270	229,250	299,520	345,600	15.6
	70°	401,530	25,200	487,540	191,130	264,210	343,710	15.9
	73°	419,340	25,690	507,020	-	225,190	308,640	16.3
100˚	61°	299,180	25,130	384,950	227,680	273,150	299,180	11.9
	64°	313,690	25,730	401,510	212,990	270,400	299,880	12.2
	67°	328,440	26,320	418,270	196,080	256,180	295,590	12.5
	70°	343,430	26,700	434,560	163,470	225,980	293,970	12.9
	73°	358,660	27,270	451,730	-	192,600	263,980	13.2

As a result of continuing research and development, specifications are subject to change without notice.

MECHANICAL SPECIFICATIONS

EVAPORATOR			
SQUARE FEET	ROWS DEEP	TUBE SIZE	FPI
23.2	4	1/2	12

BLOWER SIZE (EACH)	SHIP WEIGHT
18 x 18	2,866

CONDENSER WATER FLOW

WATER FLOW (GPM)	PRESS. DROP (FOH)
50.0	6.0
60.0	8.7
70.0	11.8
80.0	15.4
90.0	19.5
100.0	24.1

c UL us

HEATING

Entering Water Temp.	Dry Bulb	Heating Capacity BTUH	Heat of Absorption BTUH	Power Input Watts	COP
50°	60°	331,560	259,481	21,119	4.6
	70°	314,490	241,353	21,429	4.3
	80°	294,420	218,928	22,119	3.9
60°	60°	380,850	303,126	22,773	4.9
	70°	361,240	282,710	23,009	4.6
	80°	338,200	257,677	23,593	4.2
70°	60°	430,150	347,429	24,237	5.2
	70°	408,000	322,999	24,905	4.8
	80°	381,970	295,157	25,436	4.4
80°	60°	479,520	390,721	26,018	5.4
	70°	454,830	363,863	26,653	5.0
	80°	425,810	333,243	27,122	4.6

Units are complete packages containing all refrigeration components: compressor, reversing valve, thermal expansion valve metering device and water-to-refrigerant condenser. Also included are safety controls: Overload protection for motors, high and low refrigerant pressure switches and a lock-out control circuit.

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MODULAR VERTICAL PACKAGE UNITS
SPECIFICATION DATA SHEET

FHP MANUFACTURING HIGH-EFFICIENCY WATER SOURCE HEAT PUMPS

MC480
MODULE-AIRE
R-410A

ELECTRICAL SPECIFICATIONS

ELECTRICAL CHARACTERISTICS	ELECTR. SYM.	COMPRESSOR EACH		BLOWER EACH		MIN. CIRCUIT AMPACITY	FUSE (T/D) HACR CIRCUIT BREAKER
		RLA	LRA	NPA	HP		
208-230/3/60	-3	37.0	239.0	See "Motor Nameplate Data" on Page 24			
460/3/60	-4	20.0	125.0				
–	–	–	–				
–	–	–	–				

BLOWER PERFORMANCE

See Blower Performance Curves

PERFORMANCE DATA

RATED IN ACCORDANCE WITH ARI 320				
COOLING		HEATING		
CAPACITY	EER	CAPACITY	COP	GPM
500000	19.0	623000	5.4	120.0

CAPACITY DATA

All performance at 16000 CFM and 120.0 GPM
NOTE: All capacities and efficiencies shown are gross values.

COOLING

Entering Water Temp.	Ent. Air Wet Bulb Temp.	Total Capacity BTUH	Watts Input	Heat Rejection BTUH	Sensible Capacity BTUH Ent. Air Dry Bulb ˚F			EER
					75˚	80˚	85˚	
50˚	61°	599,670	25,390	686,330	456,350	547,500	599,670	23.6
	64°	628,740	25,890	717,100	426,910	541,970	601,080	24.3
	67°	658,300	26,480	748,680	393,010	513,480	592,470	24.9
	70°	688,350	27,060	780,710	327,660	452,940	589,230	25.4
	73°	718,890	27,630	813,190	-	386,050	529,100	26.0
60˚	61°	557,880	26,660	648,870	424,550	509,350	557,880	20.9
	64°	584,930	27,200	677,760	397,170	504,210	559,190	21.5
	67°	612,430	27,740	707,110	365,620	477,700	551,190	22.1
	70°	640,390	28,390	737,290	304,820	421,380	548,170	22.6
	73°	668,800	29,030	767,880	-	359,150	492,240	23.0
70˚	61°	514,240	27,900	609,460	391,340	469,500	514,240	18.4
	64°	539,170	28,510	636,470	366,100	464,770	515,450	18.9
	67°	564,520	29,110	663,870	337,020	440,330	508,070	19.4
	70°	590,290	29,700	691,660	280,980	388,410	505,290	19.9
	73°	616,480	30,290	719,860	-	331,050	453,730	20.4
85˚	61°	445,990	30,170	548,960	339,400	407,190	445,990	14.8
	64°	467,610	30,830	572,830	317,510	403,080	447,040	15.2
	67°	489,600	31,480	597,040	292,290	381,890	440,640	15.6
	70°	511,950	32,130	621,610	243,690	336,860	438,230	15.9
	73°	534,660	32,760	646,470	-	287,110	393,510	16.3
100˚	61°	381,460	32,040	490,810	290,290	348,270	381,460	11.9
	64°	399,950	32,800	511,900	271,570	344,760	382,350	12.2
	67°	418,750	33,550	533,260	250,000	326,630	376,880	12.5
	70°	437,870	34,040	554,050	208,430	288,120	374,820	12.9
	73°	457,300	34,770	575,970	-	245,570	336,570	13.2

As a result of continuing research and development, specifications are subject to change without notice.

MECHANICAL SPECIFICATIONS

EVAPORATOR			
SQUARE FEET	ROWS DEEP	TUBE SIZE	FPI
46.4	3	3/8	12
BLOWER SIZE (EACH)	SHIP WEIGHT		
18 x 18	4,846		

CONDENSER WATER FLOW

WATER FLOW (GPM)	PRESS. DROP (FOH)
80.0	6.7
90.0	8.4
100.0	10.3
110.0	12.6
120.0	15.0
130.0	17.6

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HEATING

Entering Water Temp.	Dry Bulb	Heating Capacity BTUH	Heat of Absorption BTUH	Power Input Watts	COP
50°	60°	530,500	415,175	33,790	4.6
	70°	503,180	386,162	34,286	4.3
	80°	471,080	350,291	35,391	3.9
60°	60°	609,360	485,001	36,437	4.9
	70°	577,990	452,340	36,815	4.6
	80°	541,110	412,273	37,749	4.2
70°	60°	688,240	555,887	38,779	5.2
	70°	652,800	516,799	39,848	4.8
	80°	611,150	472,251	40,697	4.4
80°	60°	767,230	625,150	41,629	5.4
	70°	727,730	582,183	42,645	5.0
	80°	681,300	533,193	43,395	4.6

Units are complete packages containing all refrigeration components: compressor, reversing valve, thermal expansion valve metering device and water-to-refrigerant condenser. Also included are safety controls: Overload protection for motors, high and low refrigerant pressure switches and a lock-out control circuit.

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MODULAR VERTICAL PACKAGE UNITS
SPECIFICATION DATA SHEET

FHP MANUFACTURING HIGH-EFFICIENCY WATER SOURCE HEAT PUMPS

MC600
MODULE-AIRE
R-410A

ELECTRICAL SPECIFICATIONS

ELECTRICAL CHARACTERISTICS	ELECTR. SYM.	COMPRESSOR EACH		BLOWER EACH		MIN. CIRCUIT AMPACITY	FUSE (T/D) HACR CIRCUIT BREAKER
		RLA	LRA	NPA	HP		
208-230/3/60	-3	53.6	245.0	See "Motor Nameplate Data" on Page 24			
460/3/60	-4	20.7	125.0				
–	–	–	–				
–	–	–	–				

BLOWER PERFORMANCE

See Blower Performance Curves

PERFORMANCE DATA

RATED IN ACCORDANCE WITH ARI 320				
COOLING		HEATING		
CAPACITY	EER	CAPACITY	COP	GPM
637200	19.0	731800	5.4	150.0

CAPACITY DATA

All performance at 20000 CFM and 150.0 GPM
NOTE: All capacities and efficiencies shown are gross values.

COOLING

Entering Water Temp.	Ent. Air Wet Bulb Temp.	Total Capacity BTUH	Watts Input	Heat Rejection BTUH	Sensible Capacity BTUH Ent. Air Dry Bulb ˚F			EER
					75˚	80˚	85˚	
50˚	61˚	764,280	32,360	874,720	581,620	697,790	764,280	23.6
	64˚	801,330	32,990	913,920	544,110	690,750	766,080	24.3
	67˚	839,010	33,740	954,160	500,890	654,430	755,110	24.9
	70˚	877,310	34,490	995,020	417,600	577,270	750,980	25.4
	73˚	916,240	35,220	1,036,450	-	492,020	674,350	26.0
60˚	61˚	711,070	33,820	826,500	541,130	649,210	711,070	21.0
	64˚	745,540	34,670	863,870	506,220	642,660	712,740	21.5
	67˚	780,600	35,350	901,250	466,020	608,870	702,540	22.1
	70˚	816,230	36,180	939,710	388,530	537,080	698,690	22.6
	73˚	852,440	37,000	978,720	-	457,760	627,400	23.0
70˚	61˚	655,410	35,560	776,780	498,770	598,390	655,410	18.4
	64˚	687,180	36,340	811,210	466,600	592,350	656,950	18.9
	67˚	719,490	37,100	846,110	429,540	561,200	647,540	19.4
	70˚	752,330	37,860	881,550	358,110	495,040	644,000	19.9
	73˚	785,710	38,610	917,490	-	421,930	578,290	20.4
85˚	61˚	568,420	38,450	699,650	432,570	518,970	568,420	14.8
	64˚	595,980	39,290	730,080	404,670	513,730	569,760	15.2
	67˚	624,000	40,120	760,930	372,530	486,720	561,600	15.6
	70˚	652,480	40,940	792,210	310,580	429,340	558,530	15.9
	73˚	681,430	41,750	823,920	-	365,930	501,540	16.3
100˚	61˚	486,170	40,840	625,560	369,980	443,870	486,170	11.9
	64˚	509,740	41,810	652,440	346,110	439,400	487,310	12.2
	67˚	533,710	42,770	679,680	318,620	416,290	480,340	12.5
	70˚	558,070	43,380	706,130	265,640	367,210	477,710	12.9
	73˚	582,830	44,310	734,060	-	312,980	428,960	13.2

As a result of continuing research and development, specifications are subject to change without notice.

MECHANICAL SPECIFICATIONS

EVAPORATOR			
SQUARE FEET	ROWS DEEP	TUBE SIZE	FPI
46.4	4	1/2	12
BLOWER SIZE (EACH)	SHIP WEIGHT		
18 x 18	5,700		

CONDENSER WATER FLOW

WATER FLOW (GPM)	PRESS. DROP (FOH)
110.0	7.3
120.0	8.7
130.0	10.1
140.0	11.7
150.0	13.5
160.0	15.4

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HEATING

Entering Water Temp.	Dry Bulb	Heating Capacity BTUH	Heat of Absorption BTUH	Power Input Watts	COP
50°	60°	624,110	488,433	39,753	4.6
	70°	591,980	454,310	40,337	4.3
	80°	554,210	412,106	41,636	3.9
60°	60°	716,900	570,595	42,867	4.9
	70°	679,990	528,879	44,275	4.5
	80°	636,600	485,029	44,410	4.2
70°	60°	809,690	650,927	46,517	5.1
	70°	768,000	607,999	46,880	4.8
	80°	719,000	555,592	47,878	4.4
80°	60°	902,630	735,475	48,976	5.4
	70°	856,150	684,920	50,170	5.0
	80°	801,530	623,412	52,188	4.5

Units are complete packages containing all refrigeration components: compressor, reversing valve, thermal expansion valve metering device and water-to-refrigerant condenser. Also included are safety controls: Overload protection for motors, high and low refrigerant pressure switches and a lock-out control circuit.

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FHP MANUFACTURING HIGH-EFFICIENCY WATER SOURCE HEAT PUMPS

MC720
MODULE-AIRE
R-410A

ELECTRICAL SPECIFICATIONS

ELECTRICAL CHARACTERISTICS	ELECTR. SYM.	COMPRESSOR EACH		BLOWER EACH		MIN. CIRCUIT AMPACITY	FUSE (T/D) HACR CIRCUIT BREAKER
		RLA	LRA	NPA	HP		
208-230/3/60	-3	59.1	425.0	See "Motor Nameplate Data" on Page 24			
460/3/60	-4	27.6	178.0				
–	–	–	–				
–	–	–	–				

BLOWER PERFORMANCE

See Blower Performance Curves

PERFORMANCE DATA

RATED IN ACCORDANCE WITH ARI 320				
COOLING		HEATING		
CAPACITY	EER	CAPACITY	COP	GPM
783600	18.6	77400	5.5	180.0

MECHANICAL SPECIFICATIONS

EVAPORATOR			
SQUARE FEET	ROWS DEEP	TUBE SIZE	FPI
46.4	4	1/2	12
BLOWER SIZE (EACH)	SHIP WEIGHT		
18 x 18	5,732		

CONDENSER WATER FLOW

WATER FLOW (GPM)	PRESS. DROP (FOH)
100.0	6.0
120.0	8.7
140.0	11.8
160.0	15.4
180.0	19.5
200.0	24.1

CAPACITY DATA

All performance at 24000 CFM and 180.0 GPM
NOTE: All capacities and efficiencies shown are gross values.

COOLING

Entering Water Temp.	Ent. Air Wet Bulb Temp.	Total Capacity BTUH	Watts Input	Heat Rejection BTUH	Sensible Capacity BTUH Ent. Air Dry Bulb ˚F			EER
					75˚	80˚	85˚	
50˚	61˚	940,660	39,840	1,076,640	715,840	858,820	940,660	23.6
	64˚	986,260	40,600	1,124,820	669,660	850,160	942,860	24.3
	67˚	1,032,620	41,540	1,174,400	616,480	805,460	929,360	24.9
	70˚	1,079,760	42,440	1,224,600	513,980	710,480	924,280	25.4
	73˚	1,127,680	43,340	1,275,600	-	605,560	829,960	26.0
60˚	61˚	875,120	41,820	1,017,860	665,960	798,980	875,120	20.9
	64˚	917,540	42,660	1,063,140	623,000	790,920	877,160	21.5
	67˚	960,680	43,500	1,109,140	573,520	749,320	864,620	22.1
	70˚	1,004,540	44,520	1,156,480	478,160	660,980	859,880	22.6
	73˚	1,049,100	45,540	1,204,520	-	563,360	772,140	23.0
70˚	61˚	806,660	43,760	956,020	613,860	736,480	806,660	18.4
	64˚	845,760	44,720	998,380	574,280	729,040	808,540	18.9
	67˚	885,520	45,660	1,041,360	528,660	690,720	796,980	19.4
	70˚	925,960	46,600	1,085,000	440,760	609,280	792,620	19.9
	73˚	967,040	47,520	1,129,220	-	519,300	711,740	20.4
85˚	61˚	699,600	47,320	861,100	532,400	638,740	699,600	14.8
	64˚	733,520	48,360	898,580	498,060	632,280	701,240	15.2
	67˚	768,000	49,380	936,540	458,500	599,040	691,200	15.6
	70˚	803,060	50,400	975,080	382,260	528,420	687,420	15.9
	73˚	838,680	51,380	1,014,040	-	450,380	617,280	16.3
100˚	61˚	598,360	50,260	769,900	455,360	546,300	598,360	11.9
	64˚	627,380	51,460	803,020	425,980	540,800	599,760	12.2
	67˚	656,880	52,640	836,540	392,160	512,360	591,180	12.5
	70˚	686,860	53,400	869,120	326,940	451,960	587,940	12.9
	73˚	717,320	54,540	903,460	-	385,200	527,960	13.2

HEATING

Entering Water Temp.	Dry Bulb	Heating Capacity BTUH	Heat of Absorption BTUH	Power Input Watts	COP
50°	60°	663,120	518,962	21,119	9.2
	70°	628,980	482,706	42,858	8.6
	80°	588,840	437,856	44,238	7.8
60°	60°	761,700	606,252	45,546	9.8
	70°	722,480	565,420	46,018	9.2
	80°	676,400	515,354	47,186	8.4
70°	60°	860,300	694,858	48,474	10.4
	70°	816,000	645,998	49,810	9.6
	80°	763,940	590,314	50,872	8.8
80°	60°	959,040	781,442	52,036	10.8
	70°	909,660	727,726	53,306	10.0
	80°	851,620	666,486	54,244	9.2

Units are complete packages containing all refrigeration components: compressor, reversing valve, thermal expansion valve metering device and water-to-refrigerant condenser. Also included are safety controls: Overload protection for motors, high and low refrigerant pressure switches and a lock-out control circuit.

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PHYSICAL DATA SPECIFICATIONS	MC - SERIES MODEL			
	360	480	600	720
PERFORMANCE				
COOLING CAPACITY - TONS	32.6	41.7	53.0	65.0
EER	18.6	19.0	19.0	18.6
WATER FLOW - GPM	90	120	150	180
HEATING CAPACITY - MBH	387	620	730	774
COP	5.5	5.4	5.4	5.5
COMPRESSORS				
QUANTITY	2	4	4	4
SIZE	15 HP	10 HP	12.5 HP	15 HP
EVAPORATOR COILS				
FACE AREA - SQ. FT.	22.6	45.2	45.2	45.2
ROWS	4	3	4	4
FPI	12	12	12	12
WATERSIDE ECONOMISER COILS				
FACE AREA - SQ. FT.	22.2	44.4	44.4	44.4
ROWS	3	3	3	3
FPI	10	10	10	10
HOT GAS REHEAT COILS				
FACE AREA - SQ. FT.	22.7	44.4	44.4	44.4
ROWS	1	1	1	1
FPI	8	8	8	8
HOT WATER HEATING COIL				
FACE AREA - SQ. FT.	22.2	22.2	22.2	22.2
ROWS (OPTIONAL)	1 (2)	1 (2)	1 (2)	1 (2)
FPI	10	10	10	10
EVAPORATOR FANS & MOTORS				
QUANTITY	1	2	2	2
SIZE - CLASS II	18 X 18	18 X 18	18 X 18	18 X 18
MIN. HP EACH	7.5	7.5	7.5	7.5
MAX. HP EACH	20	15	20	20
NOMINAL CFM	12,200	16,000	20,000	24,000
MINIMUM CFM CV	9,600	12,800	16,000	19,200
MINIMUM CFM W/HOT GAS BYPASS	6,000	8,000	10,000	12,000
MINIMUM CFM VAV	6,000	8,000	10,000	12,000
MAXIMUM DESIGN CFM	12,400	19,200	24,000	24,800
STANDARD MOTORS	15	10	15	15
FILTERS				
QUANTITY	8	16	16	16
NOMINAL SIZE (INCHES)	17 X 27 X 4	17 X 27 X 4	17 X 27 X 4	17 X 27 X 4
CONDENSERS				
QUANTITY MANIFOLDED CIRCUITS	2	4	4	4
TYPE	TUBE IN TUBE COAXIAL			
MAX. REF. WORKING PSIG	450	450	450	450
MAX. H20 WORKING PSIG	400	400	400	400
MIN. ENT. FLUID TEMP	45	45	45	45
MAX. ENT. FLUID TEMP	110	110	110	110

NOTE: PERFORMANCE IS AT ARI 320 RATING CONDITIONS. CAPACITY IS GROSS.

WATER-SIDE ECONOMIZER PERFORMANCE

	CFM	GPM	COOLING CAPACITY	
			TOTAL MBH	SENSIBLE MBH
MC360	12,000	60	336.0	258.0
		90	378.0	276.0
MC480	16,000	90	504.0	364.0
		120	552.0	384.0
MC600	20,000	120	620.0	452.0
		150	660.0	472.0
MC720	24,000	150	716.0	536.0
		180	756.0	552.0

• Capacities at 80˚F DB, 67˚F WB entering air and 45.0˚F entering water.

CORRECTION FACTORS

AIRFLOW

PERCENTAGE CFM	TOTAL COOLING CAPACITY	SENSIBLE COOLING CAPACITY
-20%	0.920	0.870
-10%	0.960	0.930
STANDARD	1.000	1.000
+10%	1.040	1.060
+20%	1.080	1.120

ENTERING AIR TEMPERATURE

ENTERING WB ˚F	TOTAL CAPACITY CORRECTION	SENSIBLE CAPACITY CORRECTION				
		ENTERING DB °F				
		70	75	80	85	95
57	0.851	0.961				
61	0.910	0.763	1.030			
64	0.955	0.615	0.881	1.148		
67	1.000		0.733	1.000	1.267	
73	1.090			.703	.970	
78	1.164				.723	1.257

ENTERING FLUID TEMPERATURE

ENTERING FLUID TEMPERATURE ˚F	TOTAL COOLING CAPACITY	SENSIBLE COOLING CAPACITY
45	1.000	1.000
50	0.790	0.890
55	0.610	0.780
60	0.470	0.470
65	0.350	0.350
70	0.240	0.240

To obtain economizer performance multiply the base performance by the CFM correction factor, entering air correction factor and entering fluid temperature factor as applicable

ONE ROW HOT WATER COIL CAPACITY

MODEL	WATER GPM	AIRFLOW CFM	CAPACITY MBH	LEAVING AIR ˚F	LEAVING WATER ˚F
MC360	60	6,000	349	113.4	168.4
		12,000	488	97.3	163.7
		14,000	523	94.3	162.6
MC480	120	8,000	558	124.0	170.7
		16,000	808	106.3	166.5
		18,000	856	103.6	165.7
MC600	120	16,000	808	106.3	166.5
		20,000	898	101.2	165.0
		24,000	976	97.3	163.7
MC720	120	20,000	898	101.2	165.0
		24,000	976	97.3	163.7
		28,000	1046	94.3	162.6

Coil performance is based on entering air temperature of 60˚F and 180˚F entering water.
Please contact your FHP representative for performance at other conditions and two row coil performance data.

AIR-SIDE PRESSURE DROPS - (INCHES OF H_2O)

MODEL	CFM	COILS				FILTERS		FACE VELOCITY
		COOLING	ECONOMISER	REHEAT	HOT WATER	4" - 30%	4" - 65%	
MC360	8,000	0.35	0.25	0.06	0.12	0.07	0.24	345
	10,000	0.53	0.32	0.07	0.17	0.12	0.30	431
	12,000	0.77	0.47	0.12	0.25	0.19	0.43	517
	13,000	0.90	0.56	0.15	0.29	0.22	0.51	560
MC480	12,000	0.26	0.15	0.02	0.06	0.05	0.10	259
	14,000	0.36	0.20	0.04	0.09	0.06	0.14	302
	16,000	0.47	0.26	0.05	0.11	0.09	0.19	345
	18,000	0.59	0.33	0.06	0.15	0.11	0.24	388
MC600	16,000	0.35	0.25	0.06	0.12	0.07	0.24	345
	18,000	0.43	0.28	0.07	0.16	0.10	0.26	388
	20,000	0.53	0.32	0.07	0.17	0.12	0.30	431
	22,000	0.64	0.40	0.12	0.24	0.15	0.40	474
MC720	20,000	0.53	0.32	0.07	0.17	0.12	0.30	431
	22,000	0.64	0.40	0.12	0.24	0.15	0.40	474
	24,000	0.77	0.47	0.12	0.25	0.19	0.43	517
	25,000	0.84	0.52	0.14	0.26	0.20	0.47	539

NOTE:
1) Cooling coil and economiser coil shown with wet surface.
2) Reheat coil and hot water coil shown dry.
3) Filters shown clean.
4) Two-row hot water coil shown.

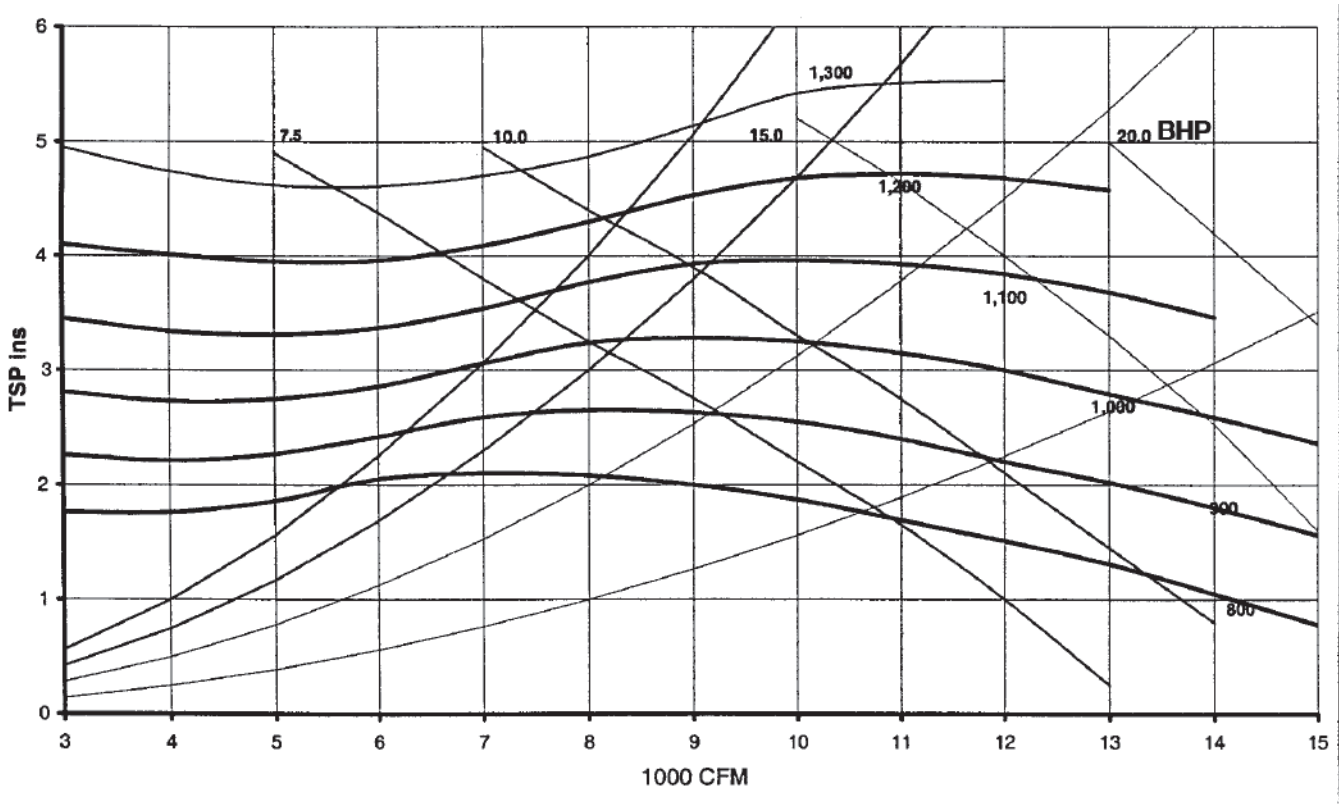
WATER-SIDE COMPONENT PRESSURE DROPS - (Ft. of H_20)

MODEL	GPM	CONDENSERS	ECONOMISER	HOT WATER COIL
MC360	60	8.7	13.1	4.2
	70	11.8	17.9	5.7
	80	15.4	23.5	7.5
	90	19.5	29.8	9.5
MC480	90	8.4	7.3	2.6
	100	10.3	9.1	2.9
	110	12.6	11.0	3.5
	120	15.0	13.1	4.2
MC600	120	8.7	13.1	4.2
	130	10.1	15.4	4.9
	140	11.7	17.9	5.7
	150	13.5	20.6	6.6
MC720	150	13.5	20.6	6.6
	160	15.4	23.5	7.5
	170	17.4	26.5	8.5
	180	19.5	29.8	9.5

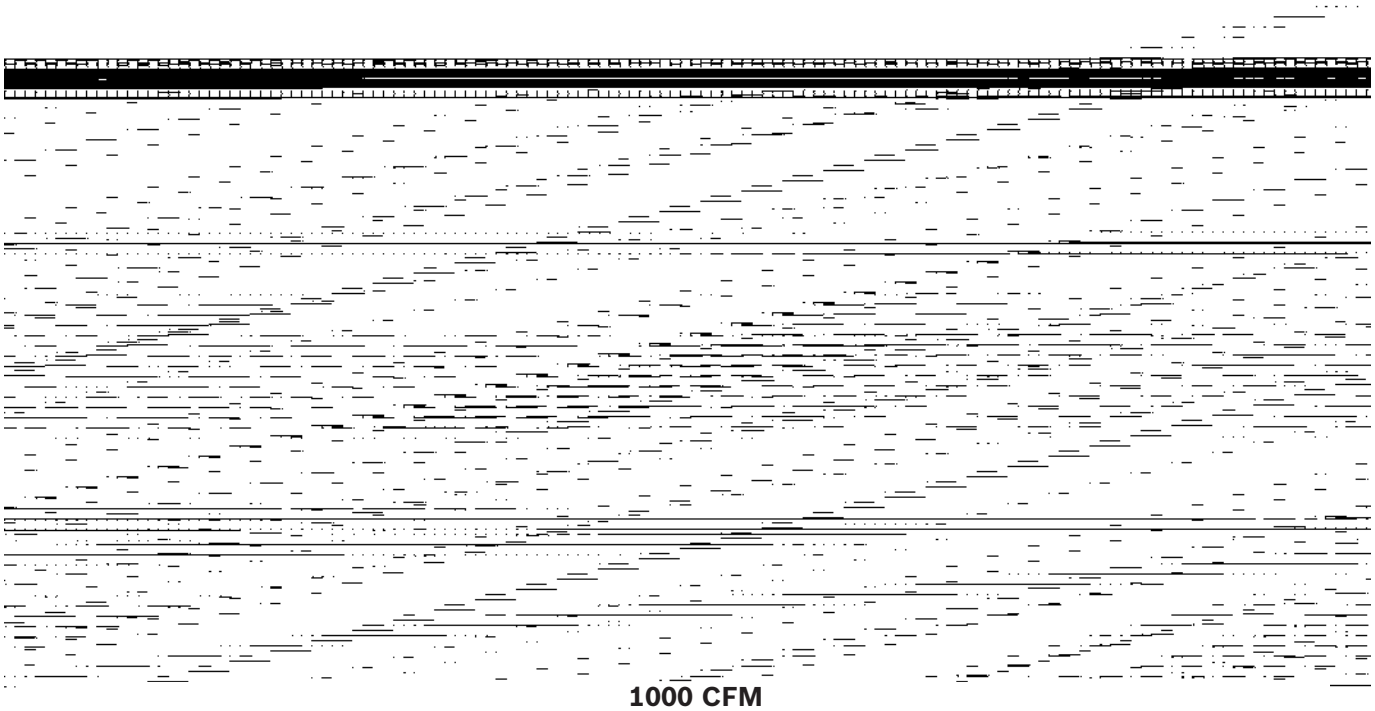
NOTE: ECONOMISER PRESSURE DROP INCLUDES MOTORIZED BALL VALVE AND ALL ASSOCIATED PIPING.
HOT WATER COIL IS 1 ROW

BLOWER PERFORMANCE

MC360



MC480 - 720



1000 CFM

DRIVE SELECTION TABLE

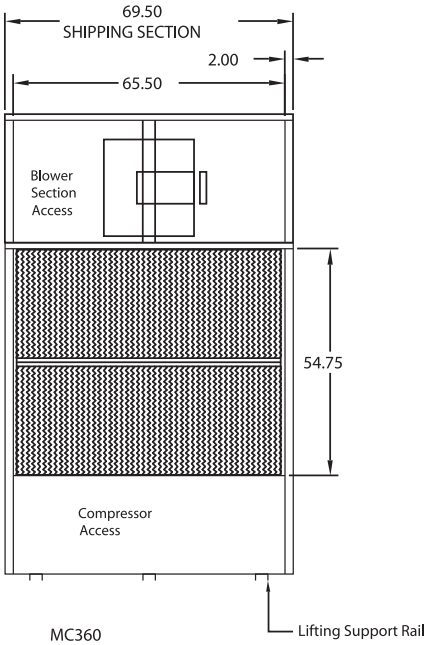
CFM	TOTAL STATIC PRESSURE - INS WATER											
	2.0		2.5		3.0		3.5		4.0		4.5	
	Drive Part #	HP	Drive Part #	HP	Drive Part #	HP	Drive Part #	HP	Drive Part #	HP	Drive Part #	HP
	041		041		041		041		041		041	
MC360												
9,500	-002	7.5	-006	15	-011	10	-018	15	-024	15	-030	15
10,000	-002	7.5	-008	10	-011	10	-017	15	-024	15	-030	15
10,500	-040	10	-008	10	-014	15	-018	15	-024	15	-030	15
11,000	-040	10	-008	10	-014	15	-017	15	-024	15	-030	15
11,500	-006	15	-009	15	-014	15	-018	15	-024	15	-031	20
12,000	-006	15	-012	15	-014	15	-021	15	-025	20	-030	20
12,500	-006	15	-012	15	-018	15	-022	20	-025	20	-031	20
13,500	-009	15	-015	20	-019	20	-022	20	-027	20	-	-
MC480 - REQUIRES TWO MOTORS												
13,000	000	7.5	-007	7.5	-013	7.5	-023	7.5	-041	10	-036	10
14,000	000	7.5	-005	7.5	-013	7.5	-020	10	-029	10	-036	10
15,000	000	7.5	-005	7.5	-013	7.5	-020	10	-029	10	-037	15
16,000	000	7.5	-005	7.5	-013	7.5	-017	10	-026	10	-037	15
17,000	000	7.5	-005	7.5	-013	7.5	-017	10	-024	15	-042	15
18,000	-002	7.5	-005	7.5	-011	10	-017	10	-024	15	-030	15
19,000	-002	7.5	-006	15	-011	10	-018	15	-024	15	-030	15
MC600 - REQUIRES TWO MOTORS												
16,000	000	7.5	-005	7.5	-013	7.5	-017	10	-026	10	-037	15
17,000	000	7.5	-005	7.5	-013	7.5	-017	10	-024	15	-042	15
18,000	-002	7.5	-005	7.5	-011	10	-017	10	-024	15	-030	15
19,000	-002	7.5	-006	15	-011	10	-018	15	-024	15	-030	15
20,000	-002	7.5	-008	10	-011	10	-017	15	-024	15	-030	15
21,000	-040	10	-008	10	-014	15	-018	15	-024	15	-030	15
22,000	-040	10	-008	10	-014	15	-017	15	-024	15	-030	15
23,000	-006	15	-009	15	-014	15	-018	15	-024	15	-031	20
24,000	-006	15	-012	15	-014	15	-021	15	-025	20	-030	20
MC720 - REQUIRES TWO MOTORS												
19,000	-002	7.5	-006	15	-011	10	-018	15	-024	15	-030	15
20,000	-002	7.5	-008	10	-011	10	-017	15	-024	15	-030	15
21,000	-040	10	-008	10	-014	15	-018	15	-024	15	-030	15
22,000	-040	10	-008	10	-014	15	-017	15	-024	15	-030	15
23,000	-006	15	-009	15	-014	15	-018	15	-024	15	-031	20
24,000	-006	15	-012	15	-014	15	-021	15	-025	20	-030	20
25,000	-006	15	-012	15	-018	15	-022	20	-025	20	-031	20

NOTE: 1) For the specific application CFM and TSP select the part number and motor HP.
2) MB480, 600 and 720 require a quantity of 2 drive packages.

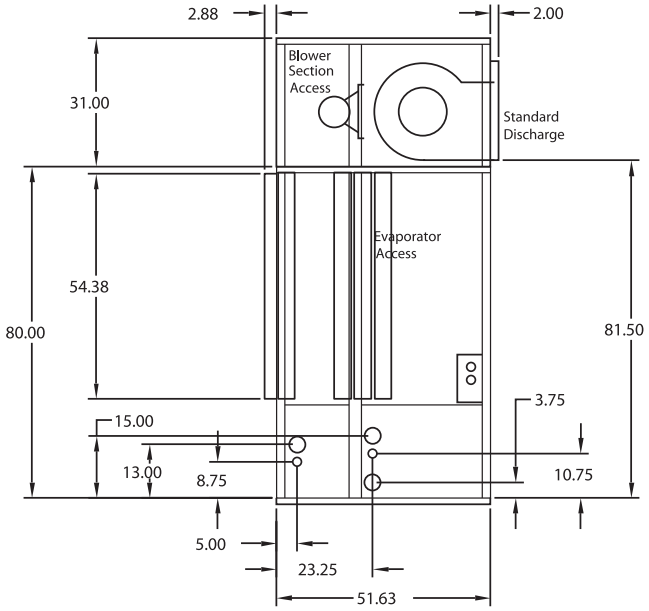
MC SERIES SHIPPING WEIGHTS (LBS)

MODEL	MC360	MC480	MC600	MC720		MC360	MC480	MC600	MC720
	VH CONFIGURATION					VL CONFIGURATION			
MAIN AIR CONDITIONING SECTION (EACH)									
NUMBER OF SECTIONS	1	2	2	2		1	2	2	2
MAIN SECTION EACH	1,450	1,175	1,550	1,575		2,100	1,825	2,200	2,225
REHEAT COIL OPTION EACH	40	40	40	40		40	40	40	40
FILTER/ECONOMISER SECTIONS (EACH)									
NUMBER OF SECTIONS	1	2	2	2		1	2	2	2
FILTER SECTION	310	310	310	310		310	310	310	310
ECONOMISER OPTION	200	200	200	200		200	200	200	200
BLOWER SECTION (EACH)									
NUMBER OF SECTIONS	1	2	2	2		INCLUDED IN MAIN AC SECTION			
FAN SECTION (MAX MOTOR SIZE)	650	650	650	650					
TOTAL UNIT									
NUMBER OF SECTIONS	3	6	6	6		2	4	4	4
TOTAL UNIT WITH OPTIONS	2,650	4,750	5,500	5,550		2,650	4750	5500	5550

NET WEIGHT IN LBS.

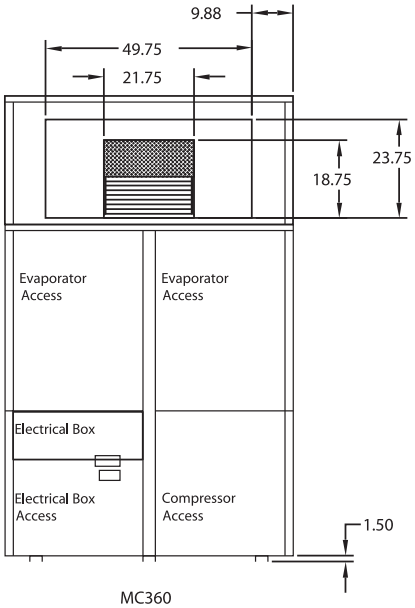


MC360
REAR VIEW
RETURN AIR VIEW

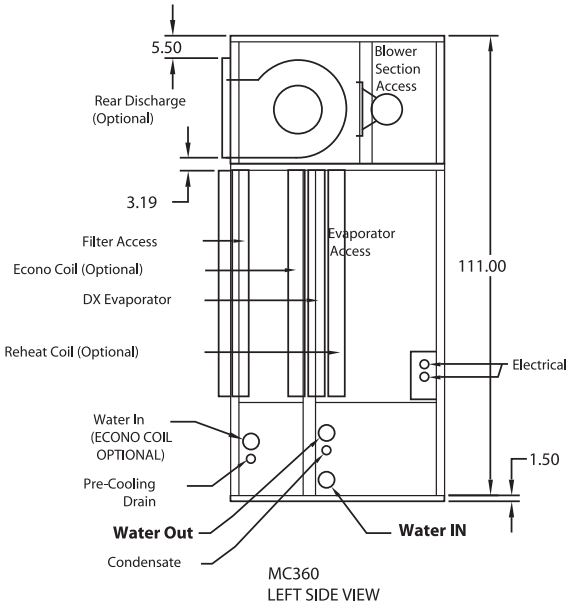


MC360
LEFT SIDE VIEW

– SBF –



MC360
FRONT VIEW



MC360
LEFT SIDE VIEW

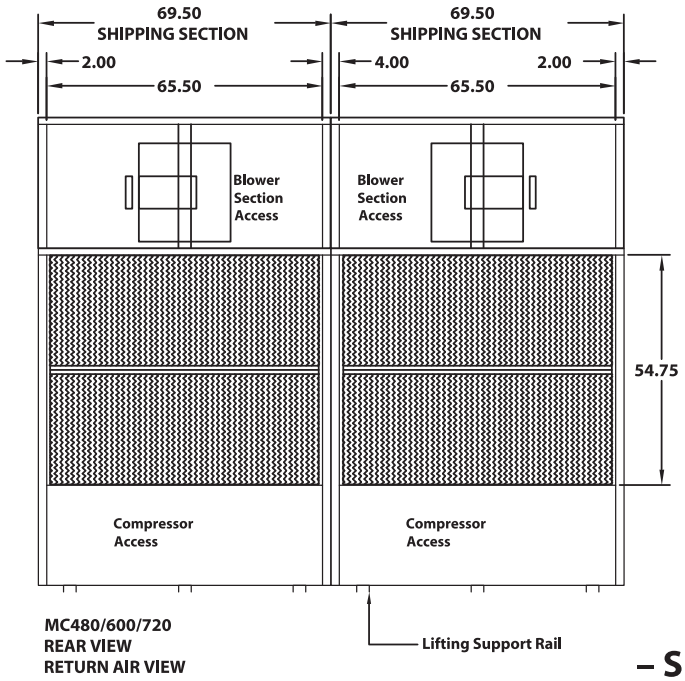
– SBF –

FILTERS				
Model	NOMINAL	ACTUAL	QUANTITY	**4 INCHES THICK
360	17 X 27	16.5 X 26.50	8	

WATER CONNECTIONS		
Model	360	*F.P.T. Type Connection
H20 IN*	2.5	
H20 OUT*	2.5	
Condensate*	1.25	
Pre-Cooling Drain*	1.25	

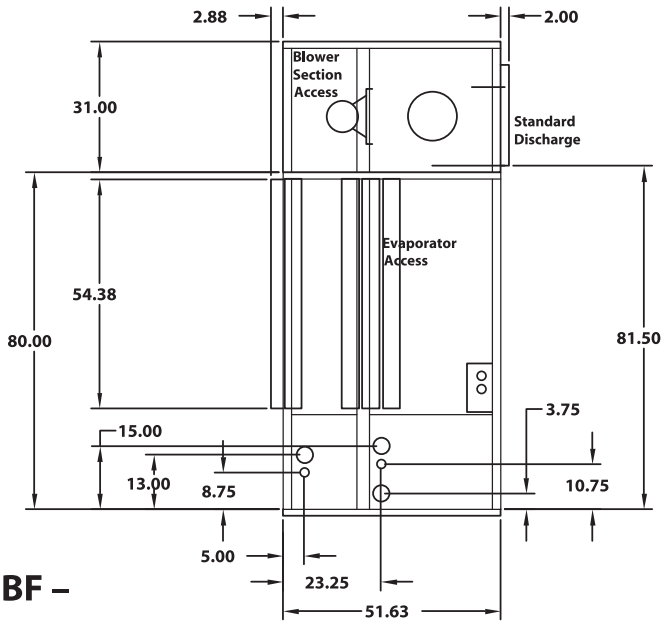
– SBR –

DRAWING NUMBER	MCVHC1
MC360 80 IN HIGH TOP OR FRONT DISCHARGE	

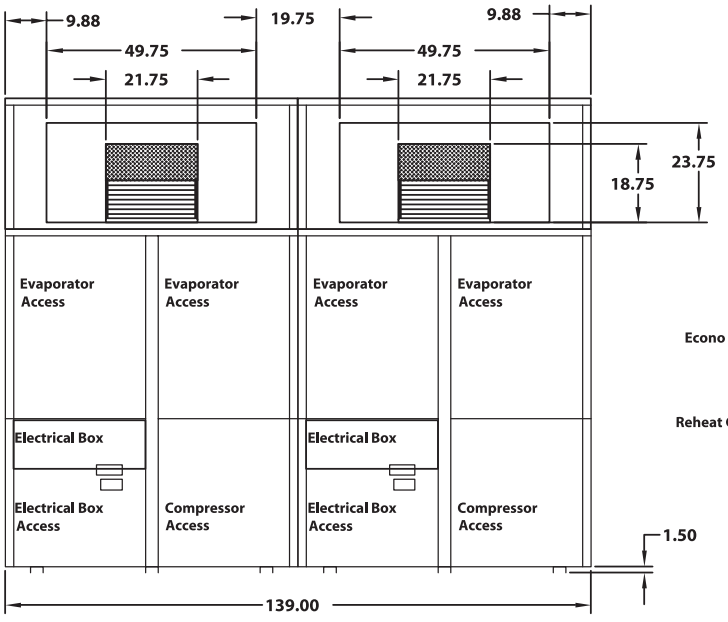


MC480/600/720
REAR VIEW
RETURN AIR VIEW

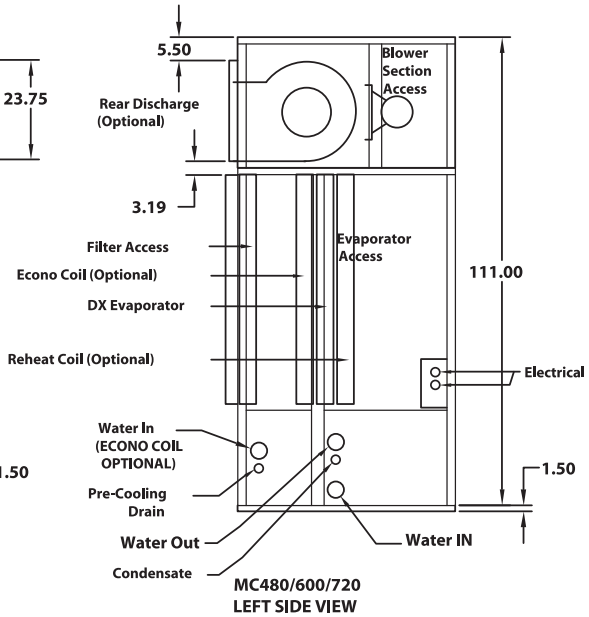
– SBF –



MC480/600/720
LEFT SIDE VIEW



MC480/600/720
FRONT VIEW



MC480/600/720
LEFT SIDE VIEW

– SBF –

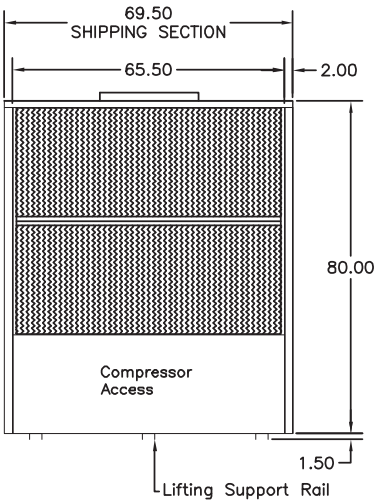
– SBR –

FILTERS				**4 INCHES THICK
Model	NOMINAL	ACTUAL	QUANTITY	
480, 600, 720**	17 X 27	16.5 X 26.50	16	

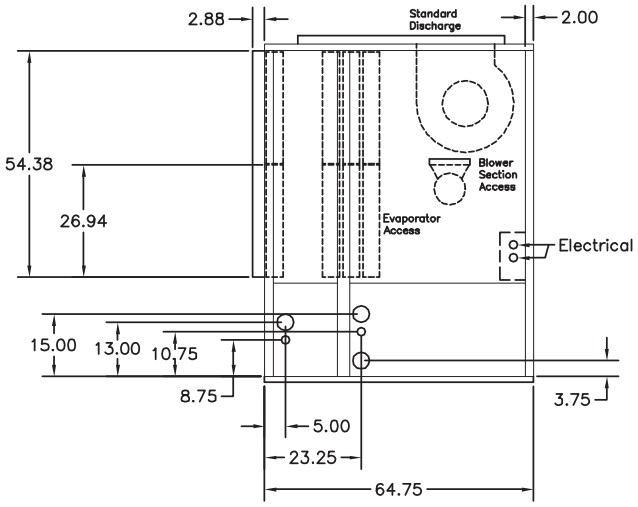
WATER CONNECTIONS				*F.P.T. Type Connection
Model	480	600	720	
H20 IN*	2.5	3.0	3.0	
H20 OUT*	2.5	3.0	3.0	
Condensate*	1.25	1.25	1.25	
Pre-Cooling Drain *	1.25	1.25	1.25	

DRAWING NUMBER MCVHC2

MC480/600/720
80 IN HIGH WITH TOP BLOWER
FRONT OR REAR DISCHARGE

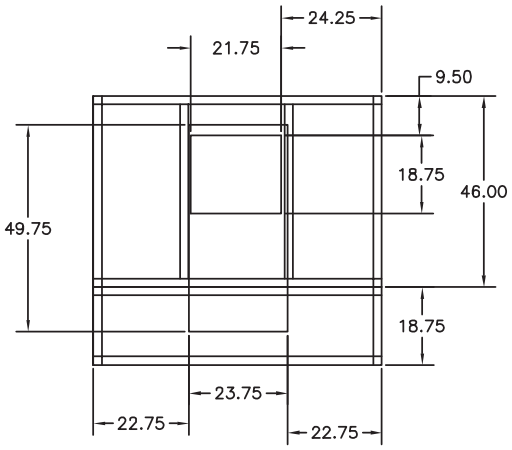


MC360
REAR VIEW
RETURN AIR VIEW

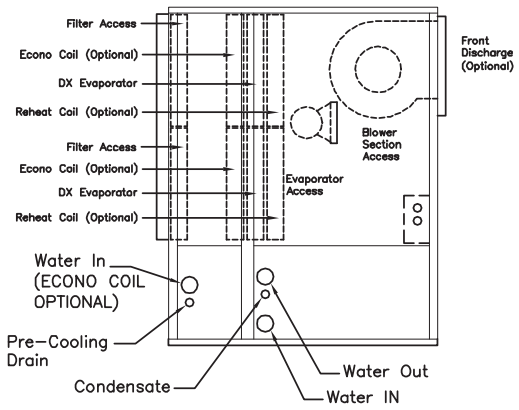


MC360
LEFT SIDE VIEW

– SBT –

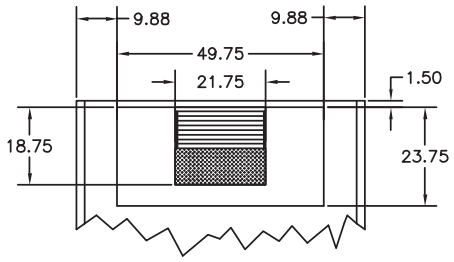


MC360 (TOP DISCHARGE)
TOP VIEW



MC360
LEFT SIDE VIEW

– SBF –



PARTIAL VIEW OF
FRONT DISCHARGE

FILTERS			
Model	NOMINAL	ACTUAL	QUANTITY
360**	17 X 27	16.5 X 26.50	8

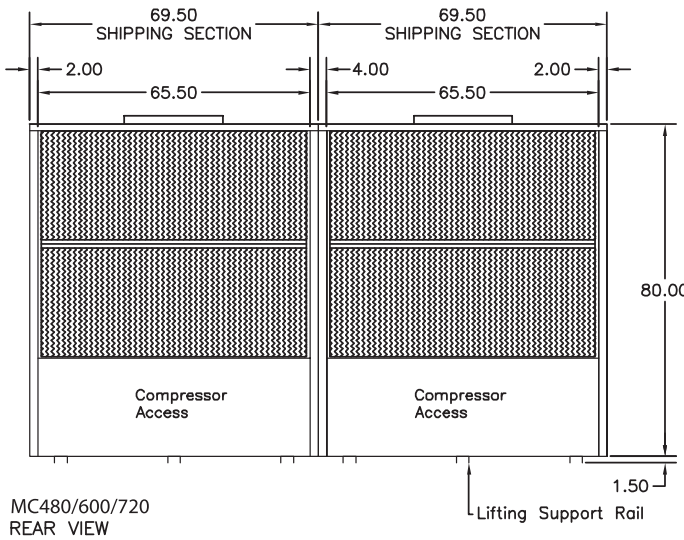
**4 INCHES THICK

WATER CONNECTIONS	
Model	360
H20 IN*	2.5
H20 OUT*	2.5
Condensate*	1.25
Pre-Cooling Drain*	1.25

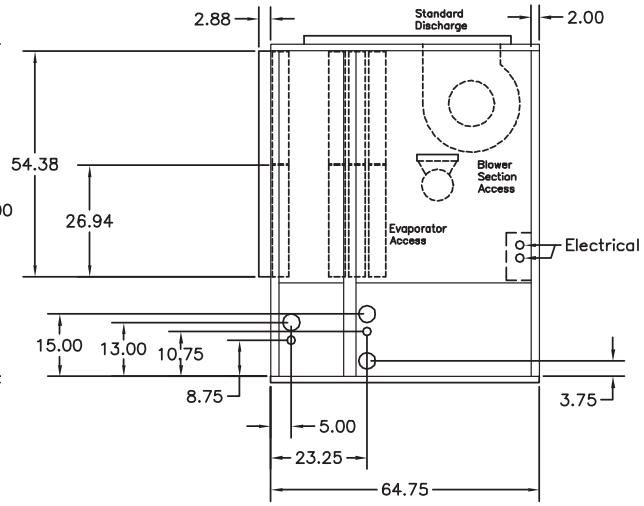
*F.P.T. Type Connection

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWING NUMBER	MCVLC1
MC360 80 IN HIGH TOP OR FRONT DISCHARGE	

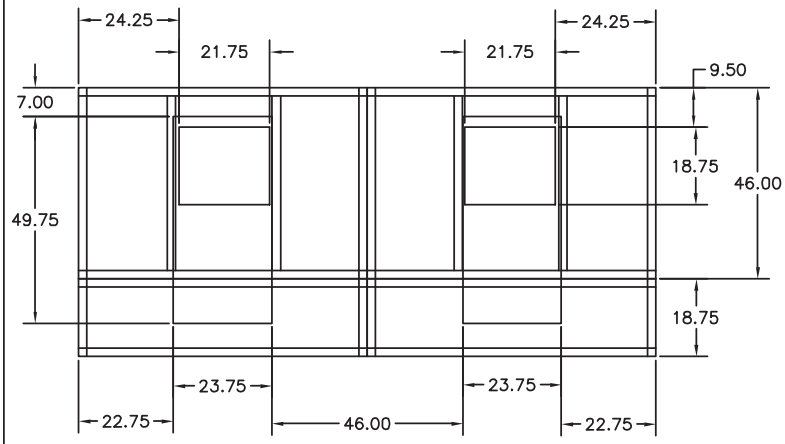


MC480/600/720
REAR VIEW
RETURN AIR VIEW

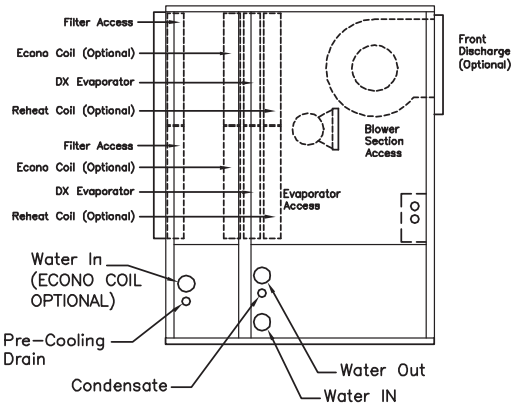


MC480/600/720
LEFT SIDE VIEW

– SBT –



MC480/600/720
(TOP DISCHARGE)
TOP VIEW

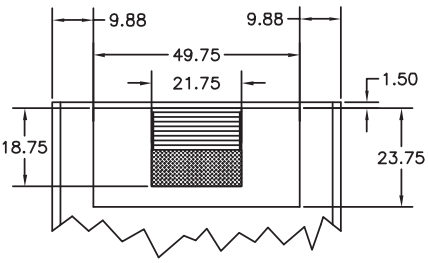


MC480/600/720
LEFT SIDE VIEW

– SBF –

FILTERS				
Model	NOMINAL	ACTUAL	QUANTITY	**4 INCHES THICK
480, 600, 720**	17 X 27	16.5 X 26.50	16	

WATER CONNECTIONS				
Model	480	600	720	*F.P.T. Type Connection
H20 IN*	2.5	3.0	3.0	
H20 OUT*	2.5	3.0	3.0	
Condensate*	1.25	1.25	1.25	
Pre–Cooling Drain*	1.25	1.25	1.25	



PARTIAL VIEW OF
FRONT DISCHARGE

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

DRAWING NUMBER	MCVLC2
MC480/600/720 80 IN HIGH TOP OR FRONT DISCHARGE	

UNIT ELECTRICAL SPECIFICATIONS

General

Wiring must comply with applicable codes.
A single power block is provided for power cables to the unit.
Each individual module has it's own terminal block and wiring between sections follows the concept of single point power supply.

Unit Disconnect

Unit disconnects are required under Article 440 of the National Electric Code. The disconnect switch should be located in accordance with NEC guidelines. Unit disconnects are not factory installed.

MOTOR NAMEPLATE DATA

HORSEPOWER	230-3-60	460-3-60	575-3-60
	FLA	FLA	FLA
7.5	19.4	9.7	7.8
10.0	25.2	12.6	10.3
15.0	38.6	19.3	15.4
20.0	49.6	24.8	19.8

NOTES:

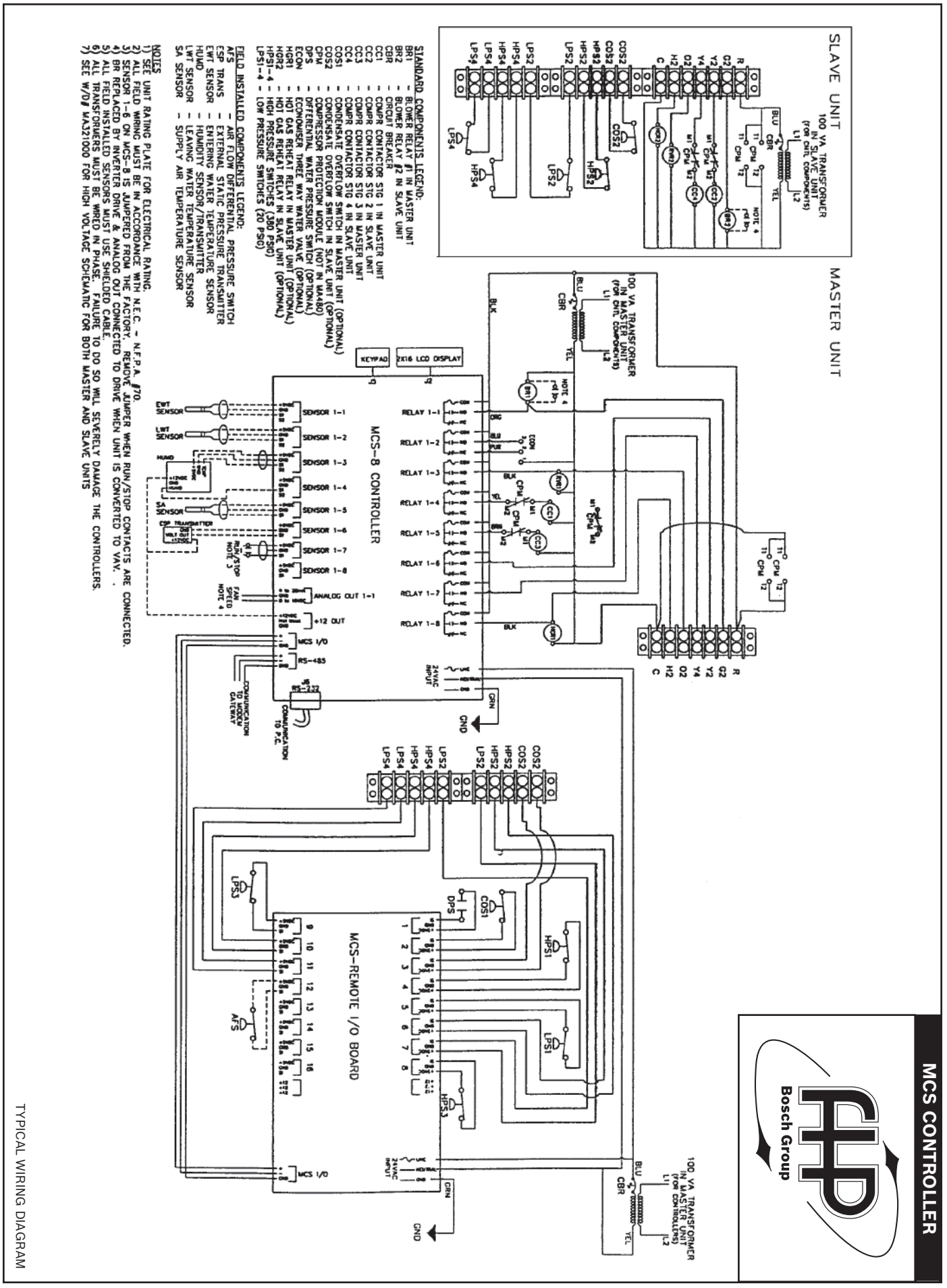
1. Model MC 360 uses one motor/blower assembly
2. Models MC 480,600 and 720 use 2 motor/blower assemblies
3. All motors are high efficiency open drip proof and meet all EPACT efficiency requirements.
4. Service factor is 1.15 on all motors.

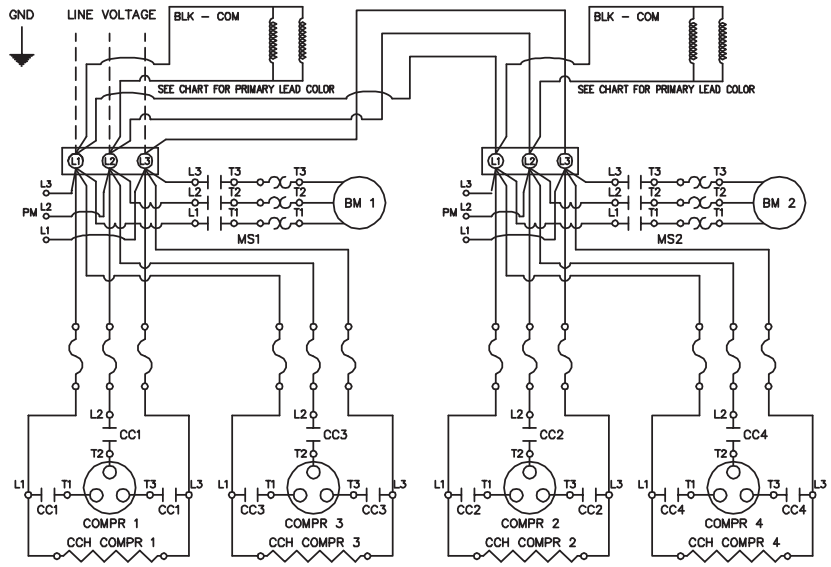
COMPRESSOR NAMEPLATE DATA

MODEL	QTY.	230-3-60		460-3-60	
		RLA (EA.)	LRA (EA.)	RLA (EA.)	LRA (EA.)
MC360	2	59.1	425	27.6	178
MC480	4	37.0	239	20.0	125
MC600	4	53.6	245	20.7	125
MC720	4	59.1	425	27.6	178

NOTE: All units are three phase power supply. Check compressor and blower rotations at start-up. See unit nameplate for allowable voltage tolerances.

Power lead wire sizing.
Minimum circuit ampacity: (largest load x 1.25) + all other loads
Max fuse size: (largest load x 2.25) + all other loads - use next smaller fuse size.
All wiring to be in accordance with N.E.C. table 310-16 or 310-19


SLAVE UNIT
MASTER UNIT
100 VA TRANSFORMER IN SLAVE UNIT (FOR CNTL COMPONENTS)
100 VA TRANSFORMER IN MASTER UNIT (FOR CNTL COMPONENTS)
100 VA TRANSFORMER IN MASTER UNIT (FOR CONTROLLERS)
MCS-8 CONTROLLER
MCS-REMOTE I/O BOARD
KEYPAD
2X16 LCD DISPLAY
STANDARD COMPONENTS LEGEND:
BR1 - BLOWER RELAY #1 IN MASTER UNIT
BR2 - BLOWER RELAY #2 IN SLAVE UNIT
CBR - CIRCUIT BREAKER
CC1 - COMPR CONTACTOR STG 1 IN MASTER UNIT
CC2 - COMPR CONTACTOR STG 2 IN SLAVE UNIT
CC3 - COMPR CONTACTOR STG 3 IN MASTER UNIT
CC4 - COMPR CONTACTOR STG 4 IN SLAVE UNIT
COS1 - CONDENSATE OVERFLOW SWITCH IN MASTER UNIT (OPTIONAL)
COS2 - CONDENSATE OVERFLOW SWITCH IN SLAVE UNIT (OPTIONAL)
CPM - COMPRESSOR PROTECTION MODULE (MOT IN MA480)
DPS - DIFFERENTIAL WATER PRESSURE SWITCH (OPTIONAL)
ECON - ECONOMISER THREE WAY WATER VALVE (OPTIONAL)
HGR1 - HOT GAS REHEAT RELAY IN MASTER UNIT (OPTIONAL)
HGR2 - HOT GAS REHEAT RELAY IN SLAVE UNIT (OPTIONAL)
HPS1-4 - HIGH PRESSURE SWITCHES (380 PSIG)
LPS1-4 - LOW PRESSURE SWITCHES (20 PSIG)
FIELD INSTALLED COMPONENTS LEGEND:
AFS - AIR FLOW DIFFERENTIAL PRESSURE SWITCH
ESP TRANS - EXTERNAL STATIC PRESSURE TRANSMITTER
EWT SENSOR - ENTERING WATER TEMPERATURE SENSOR
HUMD - HUMIDITY SENSOR/TRANSMITTER
LWT SENSOR - LEAVING WATER TEMPERATURE SENSOR
SA SENSOR - SUPPLY AIR TEMPERATURE SENSOR
NOTES
1) SEE UNIT RATING PLATE FOR ELECTRICAL RATING.
2) ALL FIELD WIRING MUST BE IN ACCORDANCE WITH N.E.C. - N.F.P.A. #70.
3) SENSOR 1-6 ON MCS-8 IS JUMPERED FROM THE FACTORY. REMOVE JUMPER WHEN RUN/STOP CONTACTS ARE CONNECTED.
4) BR REPLACED BY INVERTER DRIVE & ANALOG OUT CONNECTED TO DRIVE WHEN UNIT IS CONVERTED TO VAV.
5) ALL FIELD INSTALLED SENSORS MUST USE SHIELDED CABLE.
6) ALL TRANSFORMERS MUST BE WIRED IN PHASE. FAILURE TO DO SO WILL SEVERELY DAMAGE THE CONTROLLERS.
7) SEE W/D# MA321000 FOR HIGH VOLTAGE SCHEMATIC FOR BOTH MASTER AND SLAVE UNITS
MCS CONTROLLER
Bosch Group
TYPICAL WIRING DIAGRAM



FACTORY WIRE ———
FIELD WIRE – – – –

STANDARD COMPONENTS LEGEND:

BM – BLOWER MOTOR (1 PER SECTION)
BR – BLOWER RELAY
CC – COMPRESSOR CONTACTOR
CBR – 24VAC CIRCUIT BREAKER
CCH – CRANKCASE HEATER (WHEN SUPPLIED)
CPM – COMPR PROTECTION MODULE (13 TON AND LARGER COMPRS)
ER – ECONOMIZER RELAY
HPS – HIGH PRESSURE SWITCH
LPS – LOW PRESSURE SWITCH
MS – MOTOR STARTER
MBV – MOTORIZED BALL VALVE (IN ECONOMIZER SECTION)
MBVR – MOTORIZED BALL VALVE RELAY
RVR – REVERSING VALVE RELAY
RVS – REVERSING VALVE SOLENOID

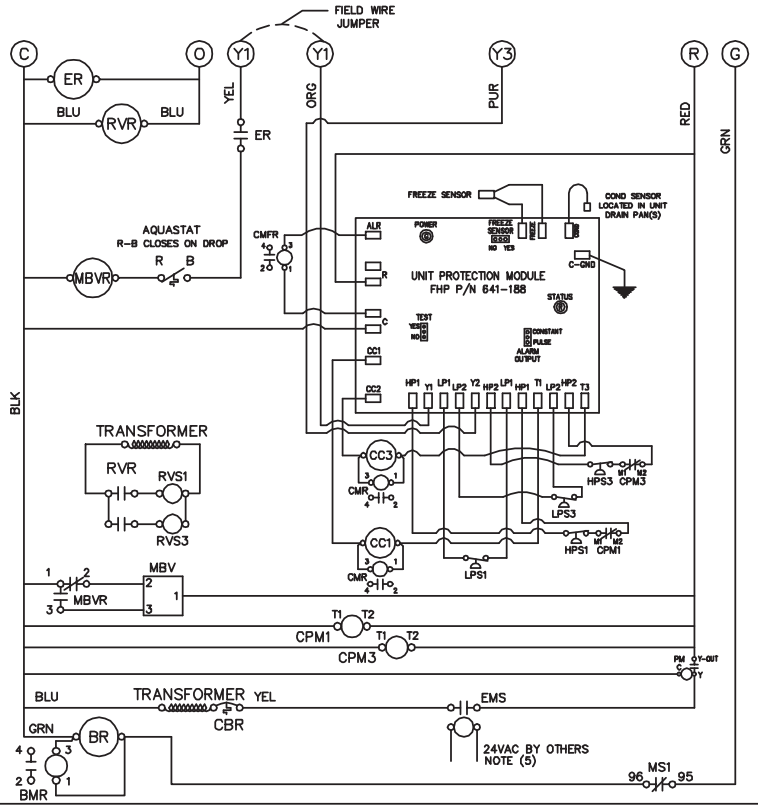
TRANFORMER PRIMARY LEAD CLR:	
208	– RED
240	– ORG
380	– PUR OR YEL
460	– BLK/RED
575	– GRY

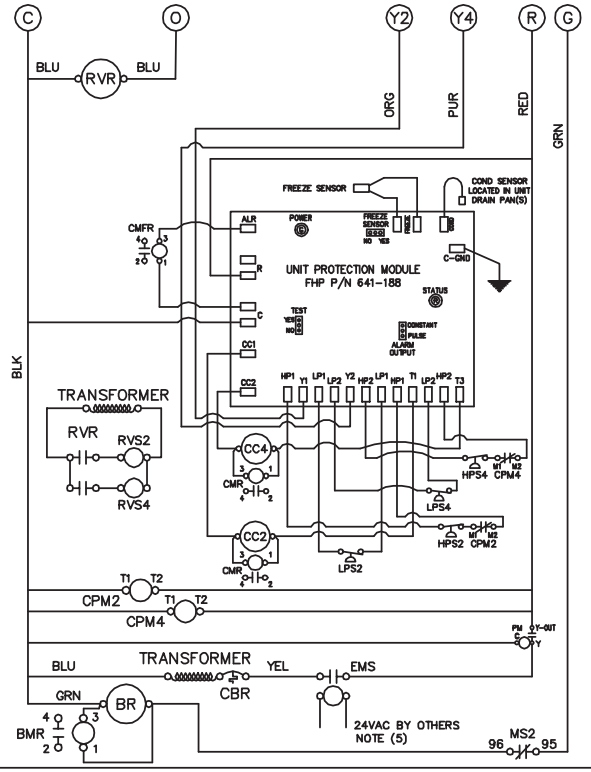
OPTIONAL COMPONENTS LEGEND:

[ ] BMR – BLOWER MONITOR RELAY
[ ] CMFR – COMPRESSOR MALFUNCTION RELAY
[ ] CMR – COMPRESSOR MONITOR RELAY
[ ] CS – CONDENSATE SENSOR (1 PER D–PAN)
[ ] EMS – ENERGY MANAGEMENT SYSTEM RELAY
[ ] FS – FREEZE SENSOR
[ ] HGL – HOT GAS LIMIT – (BYPASS ONLY)
[ ] PM – PHASE MONITOR

STATUS LED/ALARM BLINK CODES	
1	HIGH PRESSURE FAULT – CKT 1
2	LOW PRESSURE FAULT – CKT 1
3	HIGH PRESSURE FAULT – CKT 2
4	LOW PRESSURE FAULT – CKT 2
5	FREEZE SENSOR FAULT
6	CONDENSATE FAULT
7	BROWN OUT FAULT

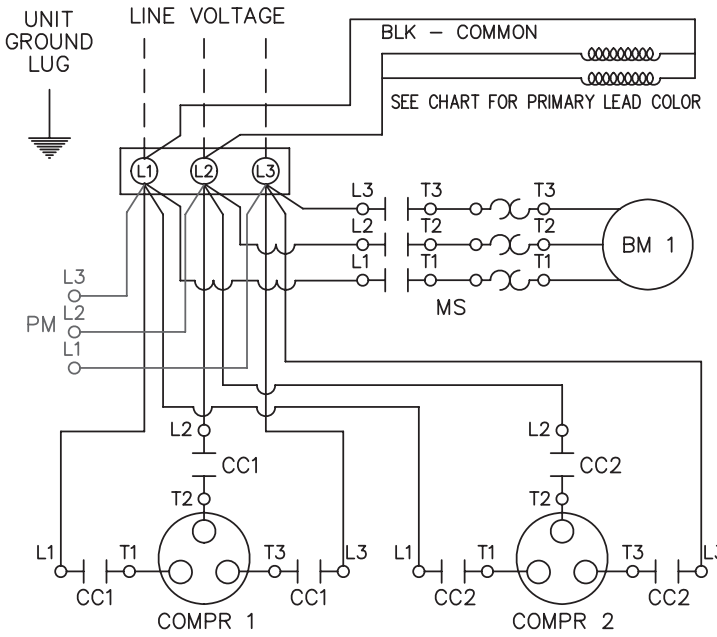
NOTES:
1. SEE UNIT NAME PLATE FOR ELECTRICAL RATING
2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH N.E.C.–N.F.P.A. #70
3. 208/230V UNITS ARE FACTORY WIRED FOR 208V OPERATION. FOR 230V OPERATION, REMOVE ORG LEAD AND REPLACE WITH RED LEAD. CAP ALL UNUSED LEADS
4. CHECK PHASE ROTATION ON ALL SCROLL COMPRESSOR UNITS. REVERSE ROTATION WILL DAMAGE THE COMPRESSOR AND VOID UNIT WARRANTY.
5. FOR ALTERNATE EMS COIL VOLTAGES CONSULT FACTORY.
6. UPM–II INCLUDES BUILT IN: 30–60 SECOND RANDOM START
   5 MINUTE DELAY ON BREAK
   90 SECOND LOW PRESSURE BYPASS
   5 SECOND 2ND STAGE DELAY
7. "TEST" JUMPER PIN REDUCES DELAYS TO 5 SEC WHEN SET TO YES.
8. "FREEZE SENSOR" JUMPER PIN MUST BE SET TO NO IF FREEZE SENSOR IS NOT INSTALLED.
9. "ALARM OUTPUT" JUMPER PIN MUST BE SET TO PULSE IF BLINKING T–STAT SERVICE LIGHT IS DESIRED.

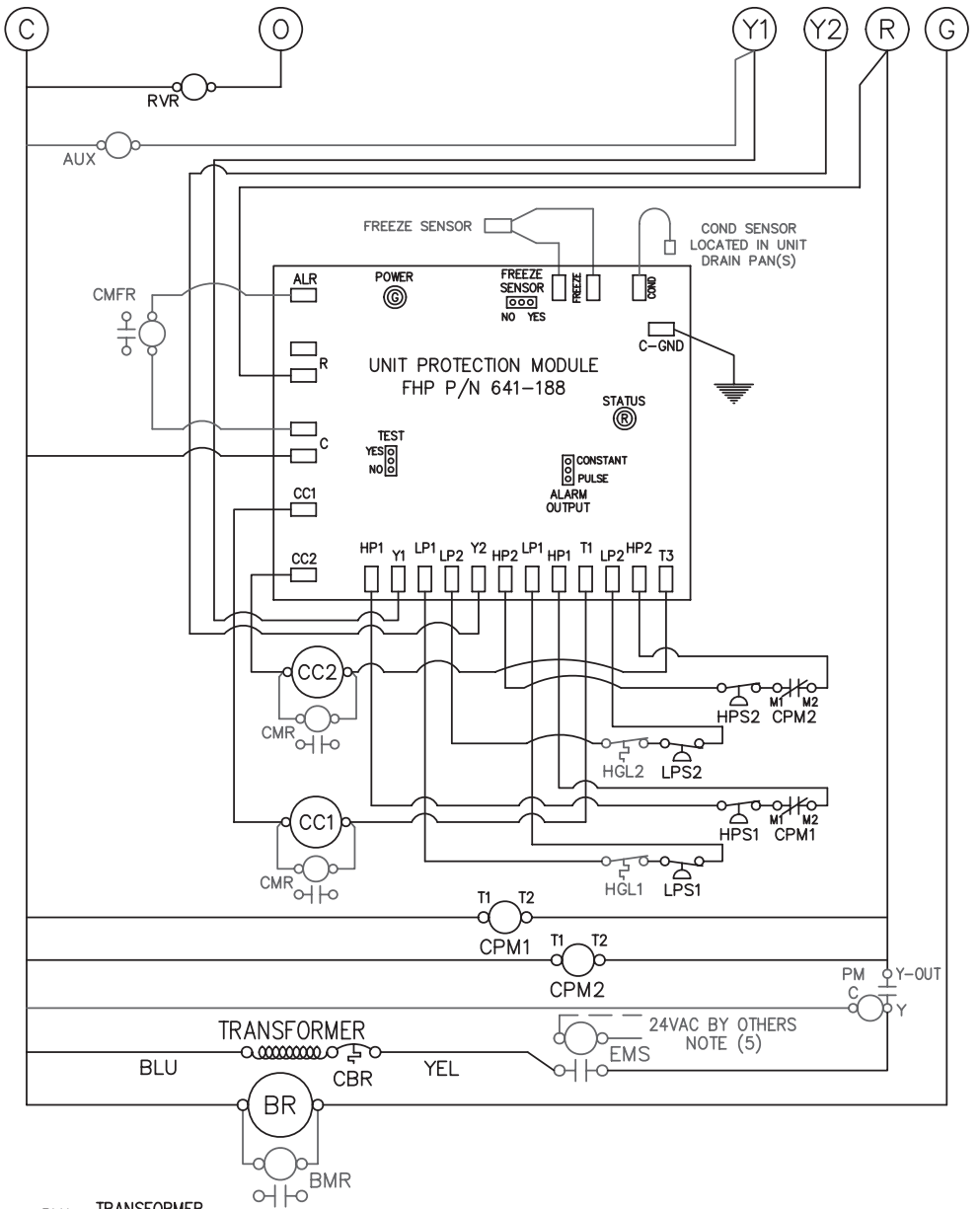


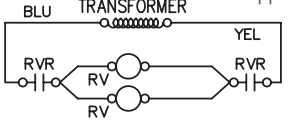


TYPICAL WIRING DIAGRAM

FOUR COMPRESSORS
DUAL BELT DRIVE BLOWERS







FACTORY WIRE ————
FIELD WIRE — — —

STANDARD COMPONENTS LEGEND:

#1	– FIRST STAGE
#2	– SECOND STAGE
BM	– BLOWER MOTOR
CC	– COMPRESSOR CONTACTOR
CBR	– 24VAC CIRCUIT BREAKER
CPM	– COMPR PROTECTION MODULE (15 TON AND LARGER COMPRS)
HPS	– HIGH PRESSURE SWITCH
LPS	– LOW PRESSURE SWITCH
MS	– MOTOR STARTER
RV	– REVERSING VALVE (HEAT PUMPS ONLY)
RVR	– REVERSING VALVE RELAY

TRANFORMER PRIMARY LEAD CLR:	
120	– WHT
208	– RED
240	– ORG
277	– BRN
380	– PUR OR YEL
460	– BLK/RED
575	– GRY

OPTIONAL COMPONENTS LEGEND:

[ ] AUX	– AUXILLIARY RELAY
[ ] BMR	– BLOWER MONITOR RELAY
[ ] CMFR	– COMPRESSOR MALFUNCTION RELAY
[ ] CMR	– COMPRESSOR MONITOR RELAY
[ ] CS	– CONDENSATE SENSOR (1 PER D–PAN)
[ ] EMS	– ENERGY MANAGEMENT SYSTEM RELAY
[ ] FS	– FREEZE SENSOR
[ ] HGL	– HOT GAS LIMIT – (BYPASS ONLY)
[ ] PM	– PHASE MONITOR

STATUS LED/ALARM BLINK CODES	
1	HIGH PRESSURE FAULT – CKT 1
2	LOW PRESSURE FAULT – CKT 1
3	HIGH PRESSURE FAULT – CKT 2
4	LOW PRESSURE FAULT – CKT 2
5	FREEZE SENSOR FAULT
6	CONDENSATE FAULT
7	BROWN OUT FAULT

NOTES:
1. SEE UNIT NAME PLATE FOR ELECTRICAL RATING
2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH N.E.C.–N.F.P.A. #70
3. 208/230V UNITS ARE FACTORY WIRED FOR 208V OPERATION. FOR 230V OPERATION, REMOVE ORG LEAD AND REPLACE WITH RED LEAD. CAP ALL UNUSED LEADS
4. CHECK PHASE ROTATION ON ALL SCROLL COMPRESSOR UNITS. REVERSE ROTATION WILL DAMAGE THE COMPRESSOR AND VOID UNIT WARRANTY.
5. FOR ALTERNATE EMS COIL VOLTAGES CONSULT FACTORY.
6. UPM–II INCLUDES BUILT IN: 30–60 SECOND RANDOM START
   5 MINUTE DELAY ON BREAK
   90 SECOND LOW PRESSURE BYPASS
   5 SECOND 2ND STAGE DELAY
7. "TEST" JUMPER PIN REDUCES DELAYS TO 5 SEC WHEN SET TO YES.
8. "FREEZE SENSOR" JUMPER PIN MUST BE SET TO NO IF FREEZE SENSOR IS NOT INSTALLED.
9. "ALARM OUTPUT" JUMPER PIN MUST BE SET TO PULSE IF BLINKING T–STAT SERVICE LIGHT IS DESIRED.

TYPICAL WIRING DIAGRAM

DUAL COMPRESSORS & SINGLE BELT DRIVE BLOWER

970-385 Revised 0513

FHP MANUFACTURING
ENERGY WISE HVAC EQUIPMENT

GUIDE SPECIFICATIONS

MC SERIES
VERTICAL PACKAGE UNITS

GENERAL

Furnish and install where shown on plans, FHP Manufacturing MC Series self-contained packaged air conditioning unit. Capacities, models and unit arrangement shall be as shown on the unit schedule and the contract drawings. Units shall be listed for UL and CUL. Units shall conform to ANSI/UL standard 1995. Unit shall be accepted for use in the City of New York by the Department of Buildings (MEA). Each unit shall be completely factory assembled, piped, wired and tested. Units shall be leak tested and charged with a full operating charge of Refrigerant 410A. Units shall then be disassembled into their individual modules for shipping and assembly on site. Installation and maintenance manuals and wiring diagrams shall be supplied with each unit. Factory test shall include, but not be limited to: complete run check of all electrical components and safeties, including proper control sequencing; pressure test of refrigerant coils and condensers; leak check of completed refrigerant circuits; leak check of completed water circuit; compressor run check.

CABINET

VH CONFIGURATION:

The unit shall be comprised of three distinct modules: 1) Main cooling/heating, 2) Filter/waterside economizer, and 3) Fan section. The unit shall be designed for easy assembly. The refrigeration circuit shall remain intact during disassembly/assembly. All modules shall be able to pass through a 36" steel framed door. The frame shall be fabricated of an angle iron framework. Unit exterior panels shall be 18 gauge G90 galvanized steel for corrosion protection. Each section shall incorporate removable access panels. The complete cabinet frame and access panels shall be insulated with 1/2 inch, dual density Neoprene backed fiberglass fiber insulation. The main cooling/heating section and the filter/waterside economizer section shall contain a galvanized steel drain pan coated with archem type paint for corrosion resistance.

VL CONSTRUCTION:

The unit shall be comprised of two distinct modules: 1) Main cooling/heating section with blower(s) and motor(s) 2) Filter/waterside economizer section. The unit shall be designed for easy assembly. The refrigeration circuit shall remain intact during disassembly/assembly. The frame shall be fabricated of an angle iron framework. Unit exterior panels shall be 18 gauge G90 galvanized steel for corrosion protection. Each section shall incorporate removable access panels. The complete cabinet frame and access panels shall be insulated with 1/2 inch, dual density Neoprene backed fiberglass fiber insulation. The main cooling/heating section and the filter/waterside economizer section shall contain a galvanized steel drain pan coated with archem type paint for corrosion resistance.

EVAPORATOR

The direct expansion coil shall be a minimum of 3 rows and fabricated from 3/8" or 1/2" O.D. seamless copper tubing mechanically bonded to rippled and corrugated aluminum fins. Each individual evaporator coil shall be removable for replacement without disturbing the remaining refrigerant circuits. Each evaporator coil circuit shall be fed by an adjustable thermostatic expansion valve, with external equalizer, sized to provide efficient operation at full and at part load operating points in the cooling and heating modes.

SUPPLY FAN

Supply fans shall be double width, double inlet forward curved type of Class II construction. All fans shall be statically and dynamically balanced. Fan shafts shall be mounted in heavy duty 150,000 hour greaseable pillow block bearings. The fan motor shall be open drip proof three phase, NEMA T frame E high efficiency EPACT rated, 1800 rpm, with grease lubricated ball bearings. The drive shall include fixed pitch sheaves with multiple V belts sized for 115% of the fan brake horsepower.

REVERSE CYCLE OPERATION

Units shall be equipped with reversing valves to allow operation in the reverse cycle heating mode. Electric heaters shall not be allowed as a substitute.

VARIABLE AIR VOLUME, (OPTIONAL)

Airflow modulation shall be achieved by the use of a factory controlled variable frequency drive. The unit shall be able to operate at 100% of rated airflow in the event of a failure of the VFD. Static pressure shall be controlled by the unit mounted MCS controller. Static pressure to be sensed by field installed duct sensors. The installer to provide and install wiring from the sensor to the unit mounted controller. The static pressure setpoint shall be keypad adjustable through the MCS controller.

REFRIGERATION CIRCUIT

Each unit shall contain multiple independent refrigeration circuits. Each circuit shall include a high efficiency heavy-duty scroll compressors. Each circuit shall have high and low pressure cutouts. Each circuit shall be dehydrated and factory charged with Refrigerant 410A. Suction and discharge schrader valves shall be provided for manifold gauge connections to facilitate servicing. Optional hot gas bypass shall be provided to allow unit operation under extended operating conditions avoiding coil freeze up.

COMPRESSORS

Each unit shall have multiple high efficiency scroll compressors with internal or external motor protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Each compressor shall be on an independent refrigerant circuit. The compressors shall be mounted on rubber isolators.

CONDENSERS

All condensers shall be coaxial tube-in-tube for maximum heat transfer efficiency and performance. Inner water tubes shall be either copper or optional cupro-nickel with large internal diameters for reduced waterside pressure drops. Outer tubes shall be steel, painted for corrosion protection. All condensers shall be rated at 450 PSIG operating refrigerant pressures and 400 PSIG waterside pressures. Units shall be rated down to 45°F without the use of water regulating valves.

WATERSIDE ECONOMIZER, (OPTIONAL)

A complete waterside economizer package shall be provided, including coil, control valves and factory piping. The complete economizer package shall be rated for 400 psig waterside working pressure. Economizer operation shall be controlled to maximize free cooling operation. Economizer shall be enabled by the optional MCS controller whenever the entering water temperature is less than an adjustable set point. Water flow shall pass through the economizer coil and condenser in series while in the economizer operating mode and shall bypass the economizer coil while not calling for economizer operation. Mechanical cooling or heating shall be enabled during economizer operation.

HOT WATER PREHEAT, (OPTIONAL)

Hot water coils shall be 1 or 2 rows, fabricated from 1/2"O.D. seamless copper tubing mechanically bonded to rippled and corrugated aluminum fins. Coil shall be field mounted.

HOT GAS REHEAT, (OPTIONAL)

Provide a one row hot gas reheat coil to allow the unit to operate in the dehumidification mode. Control of the hot gas reheat shall be provided by the unit controller.

FILTER SECTION

The unit shall be supplied with 4" deep pleated, 30% high efficiency filters. The filters shall have side access capability through an access panel.

ELECTRICAL

Each unit shall be wired and tested at the factory prior to shipment. Wiring shall comply with NEC requirements and shall conform with all applicable UL standards. The units shall have a single point power connection. The control power shall be supplied through a factory installed, low voltage control circuit transformer with an integral resettable circuit breaker. The fan motor starter shall have a magnetic three line, ambient compensated overload protector with a manual reset. A terminal block shall be provided for the main power connection.

Each unit shall be provided with a Unit Protection Module (UPM) that controls compressor operation and monitors the safety controls that protect the unit.

Safety controls include the following:

- High pressure switches located in the refrigerant discharge lines. One per refrigeration unit.
- Low pressure switches for loss of charge protection located in the unit refrigerant suction lines. One per refrigeration unit.
- Optional freeze protection sensor located on the leaving side of the water coil prevents unit operation below 35ºF. Freeze terminals must be jumped together if the freeze sensor is not installed.
- Condensate overflow protection sensor located in the drain pan(s) of the unit and wired to the UPM board.

The UPM includes the following features:

- **ANTI-SHORT CYCLE TIMER** – 5 minute delay on break timer to prevent compressor short cycling.
- **RANDOM START** – Each controller has a unique random start delay ranging from 270 to 300 seconds.
- **LOW PRESSURE BYPASS TIMER** – The low pressure switch will be bypassed for 120 seconds after compressor start-up to prevent nuisance low pressure lockouts during cold start-up in the heating mode.
- **BROWNOUT/SURGE/POWER INTERRUPTION PROTECTION** – a 20 millisecond window is to be monitored for the above condition. Should any of these conditions be detected, the 5-minute delay on break timer and the random start timer delay are initiated.
- **MALFUNCTION OUTPUT** – The controller shall have a set of wet contacts for remote fault indication.
- **TEST SERVICE PIN** – A jumper pin is to be provided to reduce all time delay settings to 5 seconds during troubleshooting or verification of unit operation.
- **L.E.D. FAULT INDICATION** – Two L.E.D. indicators are provided as follows:
- **GREEN:** Power L.E.D. indicates 18 – 30 VAC present at the board.
- **RED:** Fault indicator with blink codes as follows:

- ◦ **ONE BLINK** 1st Stage high pressure lockout
- ◦ **TWO BLINKS** 1st Stage low pressure lockout
- ◦ **THREE BLINKS** 2nd Stage high pressure lockout
- ◦ **FOUR BLINKS** 2nd Stage low pressure lockout
- ◦ **FIVE BLINKS** Freeze protection lockout
- ◦ **SIX BLINKS** Condensate overflow lockout
- ◦ **SEVEN BLINKS** Brown Out

- **INTELLIGENT RESET** - If a fault condition is initiated the 5 minute delay on break time period and the random start timer are initiated and the unit will restart after these delays expire. If the fault condition still exists or reoccurs within one hour, the unit will go into a hard lockout and requires a manual lockout reset.
- **LOCKOUT RESET** - A hard lockout can be reset by turning the unit thermostat off and then back on or by shutting off unit power at the circuit breaker.

NOTE: The blower motor will remain active during a lockout condition.

(OPTIONAL) AUXILIARY CONTROL OPTIONS

A pressure differential type water flow switch shall be provided, factory installed, to verify water flow status at the unit. Compressor operation shall be disabled and an alarm signal provided if condenser water flow is lost. Unit operation will be restored when water flow has been reestablished.

NOTES

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- Rooftop Units ..... 4 - 35 Tons
- Water to Water Chillers / Boilers ..... 3 - 35 Tons
- Split Systems ..... ½ - 25 Tons
- Variable Air Volume ..... 6 - 60 Tons

FACTORY INSTALLED OPTIONS

- Hot Gas Reheat (Dehumidification)
- Water-side Economizer
- Heat Recovery (Desuperheater)
- 100% Outside / Make up Air Units
- Cupronickel Water Coil
- Custom Options Available Upon Request

SOFTWARE

Our Engineering Application Data Software (EAD) is customized for the professional HVAC designer. Professional HVAC designers will find this software to be a valuable tool for equipment selection. EAD Software is available for HVAC designers through our network of representatives. To locate the FHP representative nearest you please refer to our web site at www.fhp-mfg.com.