freewatt®

HYDRONIC
freewatt SYSTEM
Model HDZ

POWERED by HONDA™

INSTALLATION, OPERATION & MAINTENANCE MANUAL

An ISO 9001-2008 Certified Company
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ecr innovative living™

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Check our website frequently for updates: www.**freewatt**.com www.ecrinternational.com

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As an Energy Star Partner, ECR International has determined the boiler included as part of **freewatt** System meets Energy Star guidelines for energy efficiency.

Honda MCHP is an Underwriter's Laboratory (UL) Listed, "Utility Interactive, Cogeneration, Stationary Engine-Generator Assembly, File Number FTSR.AU2004 (U.S.) and FTSR7.AU2004 (Canada)."

Boiler is design certified in US and Canada by Canadian Standards Association.

Safety Symbols

Manual contains important safety information. Read all **freewatt PLUS** System manuals for safety information and warnings.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, WILL result in death or serious injury

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Used to address practices not related to personal injury.

1 - SAFETY INFORMATION

⚠ WARNING

Fire, explosion, asphyxiation and electrical shock hazard. Improper installation could result in death or serious injury. Read this manual and understand all requirements before beginning installation.

⚠ WARNING

Do not install this system in mobile home! Boiler is not approved for installation in mobile home. Doing so could cause fire, property damage, personal injury or loss of life.

Instructions are intended as aid to qualified, service personnel for proper installation, adjustment and operation of this system. Read instructions before attempting installation or operation. Failure to follow instructions could cause malfunction of system and result in death, serious bodily injury, and/or property damage. Consult qualified installer, service agency or gas supplier for assistance or additional information.

WARNING

Do not store or use gasoline or other flammable vapors and liquids, or other combustible materials in vicinity of this or any other appliance.

Natural gas and propane are normally odorized by fuel supplier. Odorant may not be perceivable. Installation of UL and CUL recognized fuel gas detectors installed in accordance with manufacturer's instructions is recommended as additional safety.

Exhaust gases from furnace contain chemicals which may include carbon monoxide (CO). Carbon monoxide is odorless, tasteless, clear colorless gas, which is highly toxic. Even low concentrations are suspected of causing birth defects and other reproductive harm.

UL and ULC recognized CO detectors are required for all buildings equipped with ECR **freewatt PLUS** System. All CO detectors should be installed in accordance with manufacturer's instructions and applicable local building codes.

NOTICE

Installation Requirements Specific To The State Of Massachusetts, boiler installation must conform to Commonwealth of Massachusetts code 248 CMR which includes but is not limited to: Installation by licensed plumber or gas fitter.

1.1 Safety Information

1. Check all applicable state and local building codes and utility company requirements before installation. Installation shall conform to these requirements in their entirety. In the absence of these codes, use NFPA installation codes and authority having jurisdiction
2. Use only with gas approved for system components. Refer to boiler and MCHP unit rating plates.
3. Provide adequate combustion and ventilation air to system space as specified in Section 7, "Combustion Air and Vent Pipe."
4. Combustion products shall be discharged outdoors. Connect system components (boiler and MCHP unit) to approved vent system only, specified in Section 7, "Combustion Air and Vent Pipe'.
5. Allow system to cool before servicing.
6. Shut off electricity and gas supply connected to system before servicing.
7. Never test for gas leaks with open flame. Use commercially available soap solution specifically made for detection of leaks to check all connections see Section 8, 'Gas Supply Piping'.
8. Verify boiler gas input is correct. Over-firing may result in early failure of boiler components. Under-firing may result in too much air for combustion process resulting in poor or loss of combustion.
9. Follow regular service and maintenance schedule for efficient and safe operation.
10. Keep system area clean of debris and free from combustible and flammable materials.
11. System is not intended for temporary heating of buildings under construction.
12. System is not do-it-yourself project. Install and service by qualified professionals only.

2 - INTRODUCTION

2.1 Hydronic **freewatt** system is natural gas-fired micro-combined heat and power (micro-CHP) system suitable for residential and light commercial space and water heating applications up to 200,000 Btu/hr.

freewatt System consists of high efficiency (condensing) boiler, control module, hydronic hybrid integration (HI) module and HONDA MCHP unit.

- **freewatt** high efficiency boiler is certified as Category IV direct vent central heating boiler with all combustion air supplied directly from outdoors through special air intake system. Combustion products of **freewatt** Boiler are exhausted to outdoors through direct vent system.
- **freewatt** Hydronic hybrid integration (HI) module and control module integrate **freewatt** Boiler and HONDA MCHP unit into hydronic heating circuit of the building. Control module encloses the system controller, which is custom engineered micro-processor that monitors and controls operation of **freewatt** System. Coolant loop delivers heat from HONDA MCHP to brazed plate heat exchanger in Hydronic HI module, which transfers heat into hydronic heating circuit of building.
- Honda MCHP unit, Model MCHP1.2 U, is manufactured by Honda Corporation for use only with **freewatt** System. Unit produces electrical power while also generating heat in response to building's normal thermostatic heat demand. Unit produces 240VAC power delivered to main circuit panel through 240VAC dedicated circuit.
- Unit is certified under UL 2200 - Stationary Generators and UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.
- HONDA MCHP unit utilizes indoor air for combustion and vents combustion products to outdoors with PVC pipe. Honda MCHP unit is non-direct vent appliance.

2.2 Save These Instructions

Read this manual carefully and keep for future reference by service technician. Manual is considered permanent part of your Hydronic **freewatt** System and should remain with system.

Manufacturer is not responsible for any field installation changes made to system installation that are not described or acknowledged in this manual.

Product must be installed by licensed plumber or gas fitter when installed within Commonwealth of Massachusetts.

Appliance has been equipped for residential installations. If used for commercial applications, all code requirements must be adhered to for installation. May require additional controls or system components.

2.3 Read All Documents

Manual is to be used in conjunction with following manuals:

- Hydronic **freewatt** (Model HDZ) User's Information Manual.
- **freewatt** FW95M-200 Boiler Installation, Operation and Maintenance Manual, Parameter Guide, Control Manual & Troubleshooting Guide.
- HONDA MCHP, Model 1.2U, Installation Manual and Owner's Manual.
- HAI Thermostat Installation Instructions and Owner's Manual
- Applicable ECR Zone Control Manual
- **freewatt** Indirect Water Heater Set-up, Operating & Maintenance Instruction Manual
- MINT Utility Supplement

2.4 Important Application Notes

1. MAXIMUM RECOMMENDED DESIGN HYDRONIC WATER TEMPERATURE 160°F: Under-radiated distribution systems requiring high system water temperatures (above 180°F during design (coldest) day outdoor temperature conditions) are likely to significantly compromise electric generation performance of freewatt System. Strongly recommend hydronic heating system be designed for 160° F or lower water temperature to produce greatest annual electrical power generation and highest overall energy efficiency. May require installation of additional radiation or reconfiguration of existing radiation.
2. USE WITH ALL STANDARD FORMS OF HEAT RADIATION: Hydronic **freewatt** System may be applied to normal variety of heating loads served by conventional, multizone hydronic heating systems. These include base-board radiation, radiant floor heating, domestic hot water via indirect storage tank, powered convective heaters, hydro-air handlers, and others. NOTE: Application limited to specific air handler models.
3. USE SPECIAL PIPING CONFIGURATION: Hydronic **freewatt** Systems may use circulators or valves for individual zone temperature control. In all cases, overall configuration of hydronic distribution system must be in form shown in this manual with respect to overall arrangement of **freewatt** Boiler and MCHP unit with respect to zone loads. See specific piping schematics provided for systems zoned with circulators and valves and for systems using air handlers.

4. CORRECT ECR RELAY CONTROLS NEEDED: **freewatt** Control Module is common to all applications of hydronic **freewatt** System. There are different ECR zone pump/valve relay controls required for use with pump and valve-zoned systems and hydro-air systems. The appropriate pump/valve relay control from ECR family of zone controls must be used as supplied with **freewatt** System. See specific electrical wiring diagrams provide for circulator zoned systems, valve zone systems, and systems with air handlers.

5. NO ANTI-FREEZE: Do not use anti-freeze solution in **freewatt** System hydronic flow loop. Use only good quality water. If a particular zone requires anti-freeze protection, install heat exchanger to isolate anti-freeze solution from main hydronic system.

6. DOMESTIC HOT WATER PRIORITY MUST BE PROPERLY SETUP: Priority domestic hot water heating is available and must be properly selected in setup of Control Module and ECR zone controls. Mixing valve must be used on domestic water supply outlet of any indirect water heating tank applied with **freewatt**. Failure to install mixing valve will result in hot water scalding hazard. Indirect water heater aquastat should be set no higher than 120°F. Honda MCHP will heat tank above aquastat setting. See section 13 for additional details.

7. MUST USE ONE SPECIAL SMART ZONE THERMOSTAT: Hydronic system comes with special **freewatt** communicating thermostat utilized on single "Smart Zone". "Smart Zone" should be selected as zone with largest heating demand (but not domestic hot water zone). Normally, this would be largest space heating zone on first floor of a two story home. **freewatt** System will produce best electric power generation benefit if Smart Zone represents at least 25% of total home heating load. If there is no single large zone in existing distribution system, but many small zones, consider combining zones to achieve desired heat load for Smart Zone.

8. NO SETBACK RECOMMENDED FOR SMARTZONE THERMOSTAT: Contrary to standard HVAC industry practice for achieving maximum efficiency, setback should not be used with freewatt. Setback will limit the run time of the MCHP and maximize operation of the boiler, reducing electric power generation and overall energy and cost savings. Refer to section 13.3 for additional details.

9. EXPANDABLE TO ADDITIONAL ZONES: **freewatt** communicating thermostat is directly wired to **freewatt** Control Module circuit board. Additional three zones, with compatible conventional heating thermostats (new or existing) may also be connected directly to **freewatt** Control Module circuit board. If more than these compatible four zones (including priority domestic hot water and Smart Zone) are needed then **freewatt** System can be expanded to include additional heating zones. Additional ECR zone controls may be required.

10. MAY INSTALL AND OPERATE BOILER FIRST: To facilitate need to supply heat to building as quickly as possible, hydronic **freewatt** System may be installed by first installing **freewatt** boiler and Control Module in required piping configuration of Fig.17-1, 17-4 or 17-7 as applicable, leaving installation, commissioning, and operation of MCHP to later date (Cap off piping connections to MCHP). **freewatt** Boiler alone should provide sufficient heating capacity to meet normal loads if for any reason MCHP unit is not available for operation.

11. BOILER NEEDED FOR PROPER HEATING OPERATION: While MCHP unit will provide a significant portion of annual heating energy needed in home, MCHP unit alone cannot be expected to meet all desired comfort and/or freeze protection needs. Maintaining operation status of **freewatt** boiler as part of **freewatt** System is essential to meeting all comfort and/or freeze protection needs.

12. BYPASS MODE OF OPERATION; Provided "CHP MODE" switch in OFF position conveniently separates and maintains boiler heating function while disabling operation of MCHP unit and generation of electric power. This is Bypass Mode of operation. This allows boiler operation immediately upon installation to provide heating while allowing MCHP to remain OFF until interconnection approval is completed.

13. WILL FUNCTION WITHOUT INTERNET CONNECTION: Full heating operation of hydronic **freewatt** System is not dependent on maintaining a working connection to the Internet. However, not installing or ensuring that it is maintained will prevent remote communication with system by homeowner or service provider.

14. MUST INSTALL INDEPENDENT CARBON MONOXIDE (CO) DETECTOR(S): Installation of UL and ULC recognized CO detectors with audible alarms (not supplied with system) are required part of every **freewatt** installation. **freewatt** Exhaust Gas Detection System included as part of **freewatt** System does not provide audible alarm for protection of building inhabitants from potentially dangerous high levels of carbon monoxide. Install both the Exhaust Gas Detection System and separate and independent UL recognized CO Detectors.

15. TWO OUTDOOR TEMPERATURE SENSORS: Installation of two different outdoor temperature sensors is required for proper operation of hydronic **freewatt** System, both are supplied. One (Honeywell) connects directly to boiler and other (Tekmar) to **freewatt** Control Module.

16. WILL NOT OPERATE DURING ELECTRICAL OUTAGE: Hydronic **freewatt** System will not generate heat or electric power if not connected to local electric utility.

17. MUST USE "MINT" SOFTWARE: Installation, setup, commissioning and maintenance of the **freewatt** System requires use of the **freewatt** MINT software tool loaded on a laptop computer running Windows XP or Vista with working serial connection.

18. NATURAL GAS ONLY: Propane conversion is not available for this system.

19. HIGH ELEVATION: If **freewatt** System is to be installed at elevation above 3,300 feet, please call **freewatt** Technical Support Line for additional information.

2.5 Ratings and Capacities

Table 2-1 System Rating and Sizing

	Input (MBH)	Heating Capacity (MBH)	Overall Efficiency (%)	Net Power (kWe)	Weight (lbs)
Honda MCHP (0-3,300')	18.4	12.3	89%	1.2	180
Boiler (0-2,000')					
Max	200	190	95%		284
Min	80	76	95%		

- Ratings are for sea level applications. Consult boiler Installation, Operation, & Maintenance manual for high-altitude conversion or derating instructions. Consult ECR Technical Support for Honda MCHP high altitude conversion and derating instructions.
- Boiler manual also has I=B=R Net Rating (MBH) data for system design.
- Proper application of Hydronic **freewatt** System requires assessment of heat loss and needs of building to which it is applied.
- Relatively lower heat output of MCHP unit, priority heating device, and automatic modulation of firing rate of condensing boiler allows Hydronic **freewatt** System to be applied to wide range of loads without efficiency penalty.
- Overall system performance will depend significantly on sizing of heat distribution system relative to actual space heating demands.

Hydronic **freewatt** System effectively operates with two levels of heat:

- Honda MCHP's thermal output delivering low heat and boiler delivering high heat. **freewatt** uses proprietary heating algorithm to ensure long MCHP operating hours maximizing system's electrical power production. If additional heat is needed or anticipated, boiler will fire to provide this heat.
- In high heat mode, boiler will automatically modulate in range of 80,000 to 200,000 BTU/hour, and MCHP unit will continue to run, to provide needed level of heat supply. Hydronic **freewatt** System operates with automatic and programmable outdoor temperature reset of hydronic system operating water temperature in order to provide uniform heating.

Figure 2-1 freewatt System Components (Zoned with Circulators)

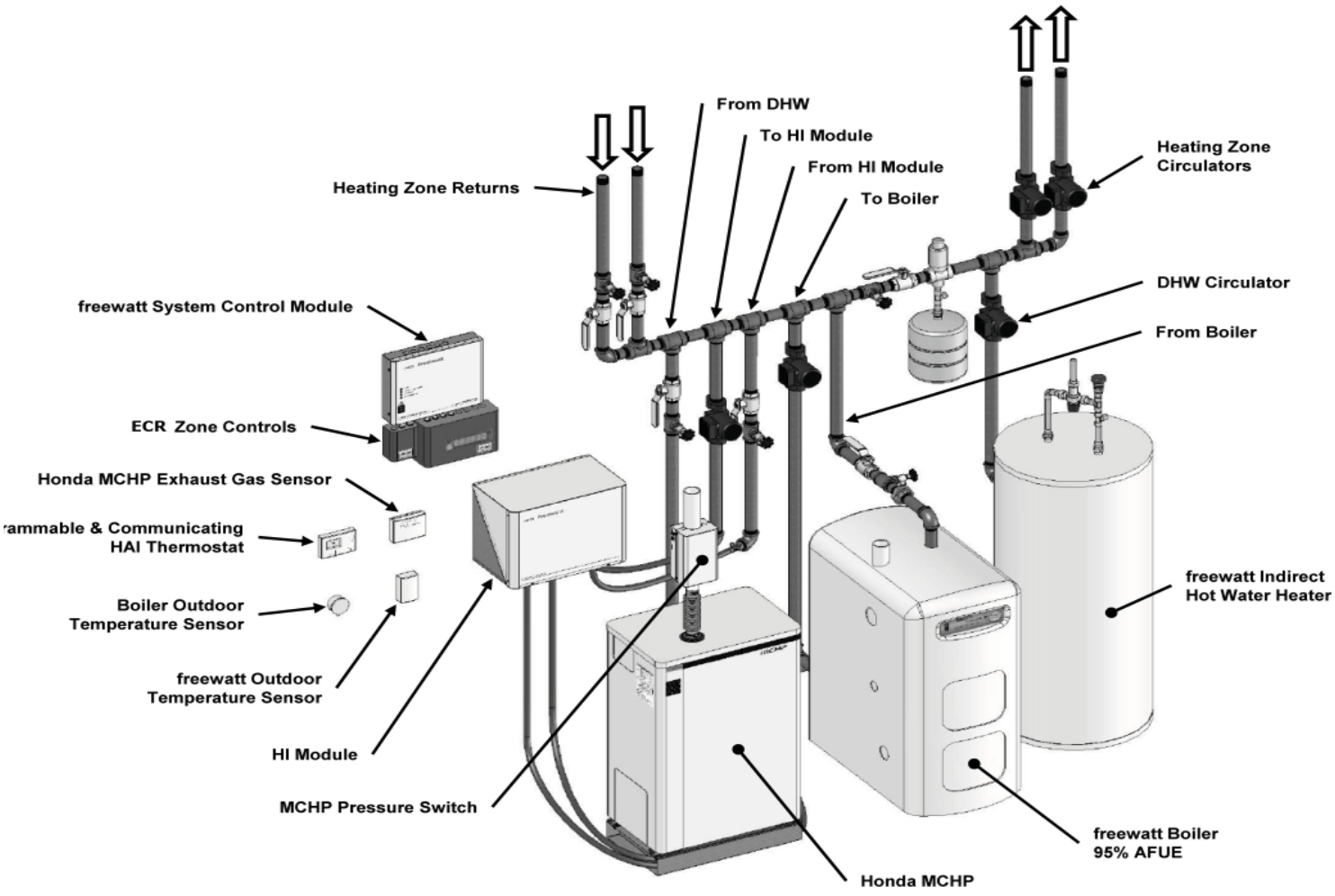
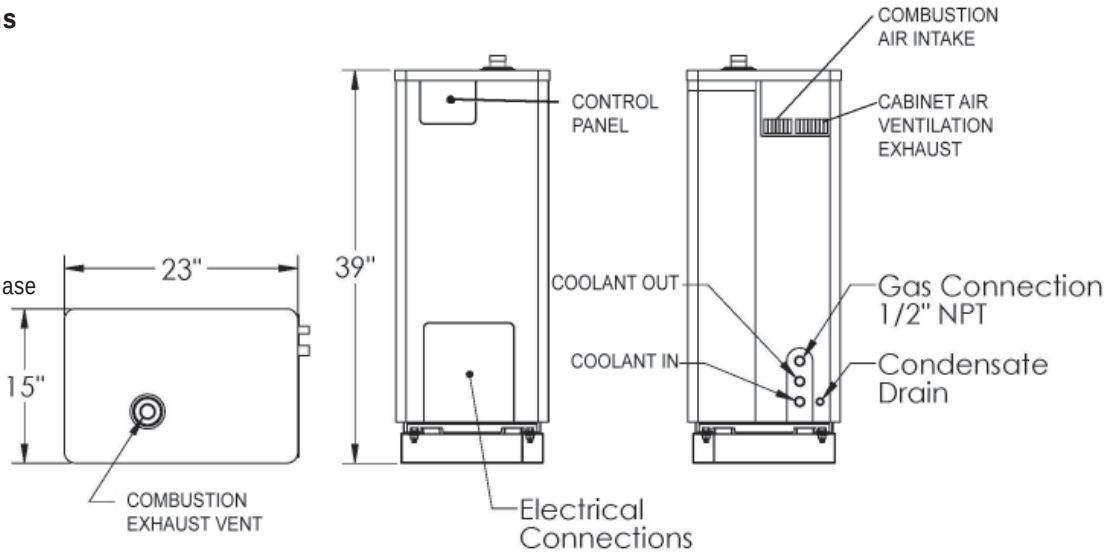


Figure 2-2 MCHP Dimensions

Clearances to Combustibles	
Top	14”
Front	0.4” (20” for Service)
Sides	0.4” (12” for Service)
Rear	0.4” (2” for Service)
Bottom	MCHP unit attached to provided sheet metal base anchored to Concrete floor.



Concrete Floor Requirements:

Thickness: 3” min.

Flatness: 1/2” per 10 FT class CX

Drop In Anchor: 3/8” OD x 1-3/4” long (5/16-18 thread) Qty 4

Figure 2-3 freewatt Boiler

Clearances to Combustibles	
Top	1” (8” for Service)
Front	0” (24” for Service)
Sides	1” (24” for Service
Rear	6”
Intake/Vent Piping	0”
Base	Combustible floor approved, not carpet.

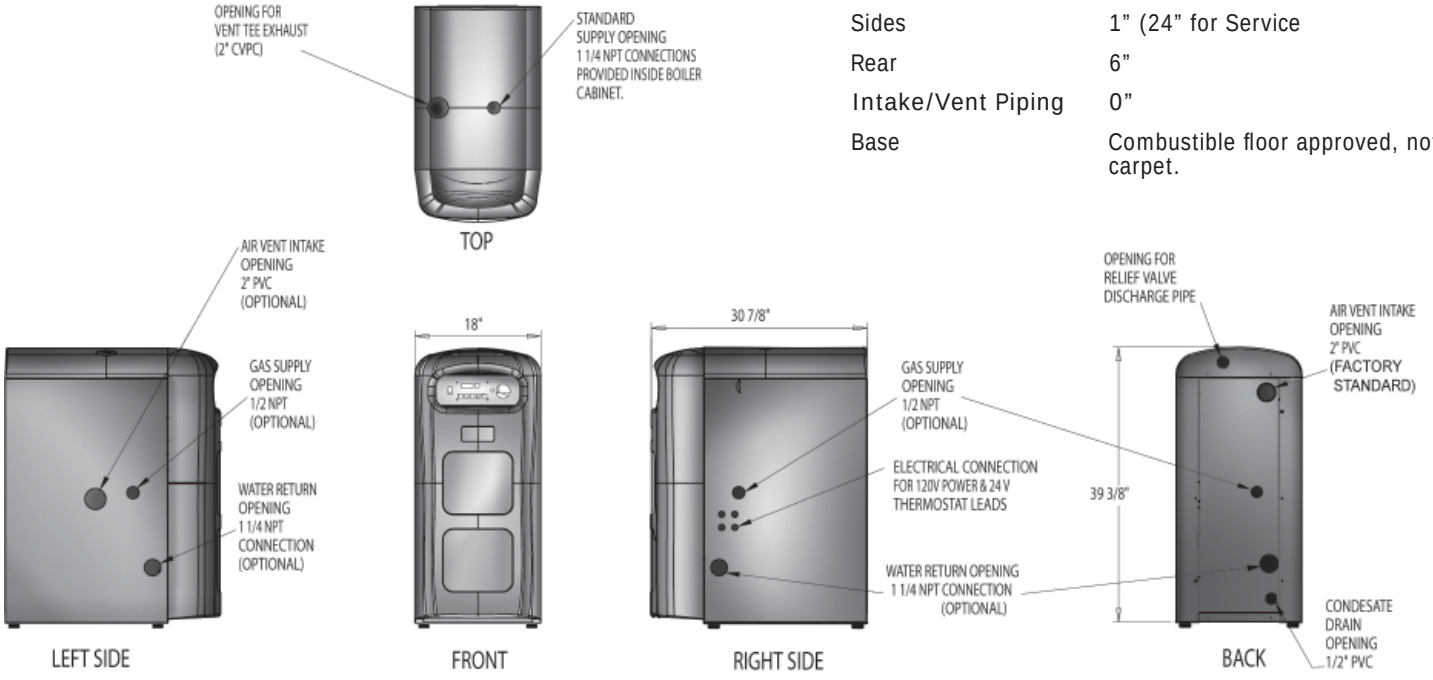


Figure 2-4 MCHP & Hydronic Hybrid Integration Module

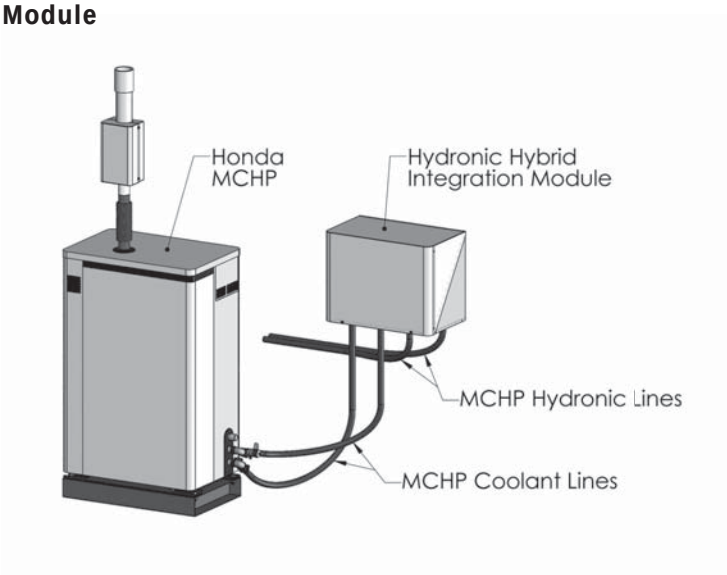


Figure 2-5 Hydronic Hybrid Integration Module

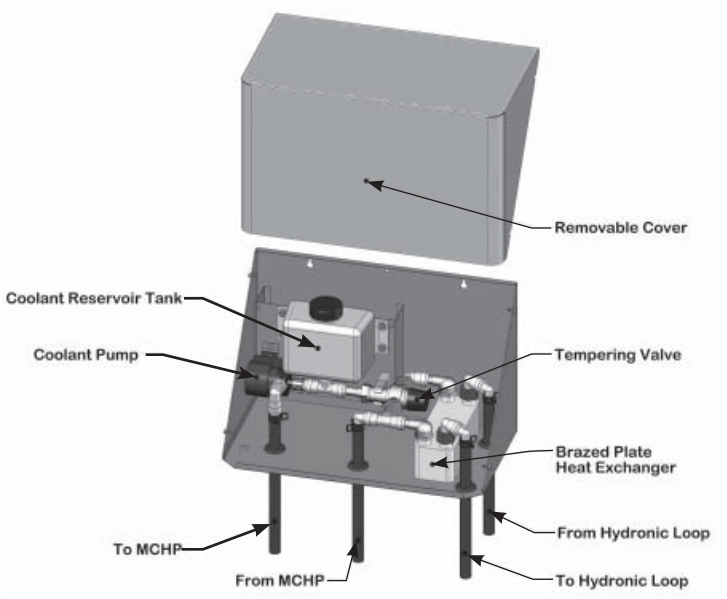
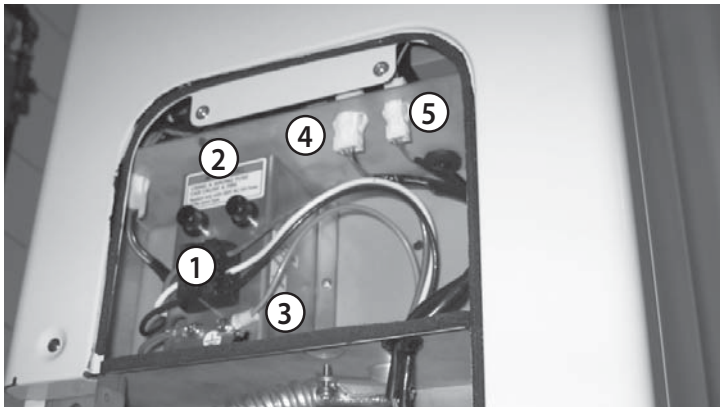


Figure 2-6 MCHP Electrical Connection Details



1. 240 VAC Power Terminal
2. 240 VAC Fuses
3. Ground Screw
4. Signal Cable (6 pin connector for RS-232 communications and on/off control)
5. Exhaust Gas Sensor (4 pin connector)

Figure 2-7 MCHP Front Interface Details

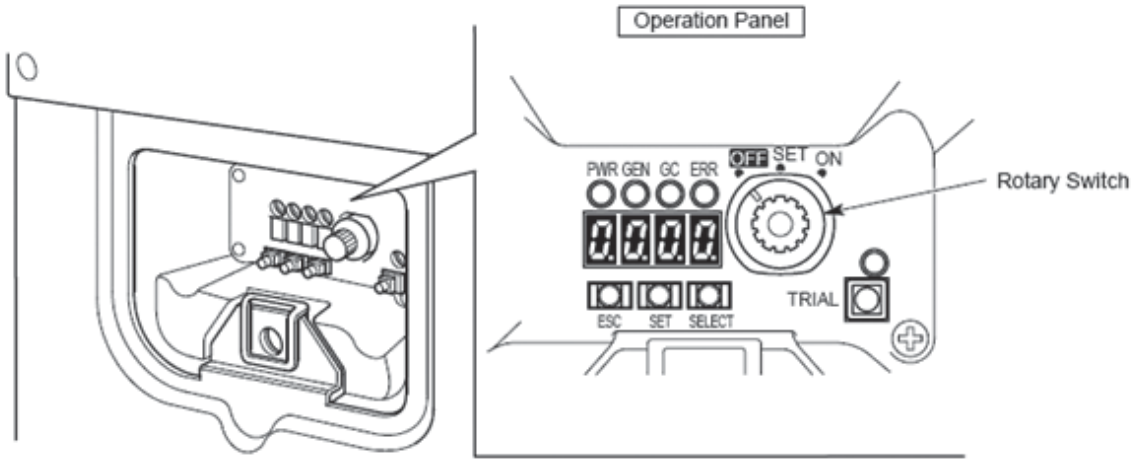


Figure 2-8 Typical freewatt Control Module Configuration

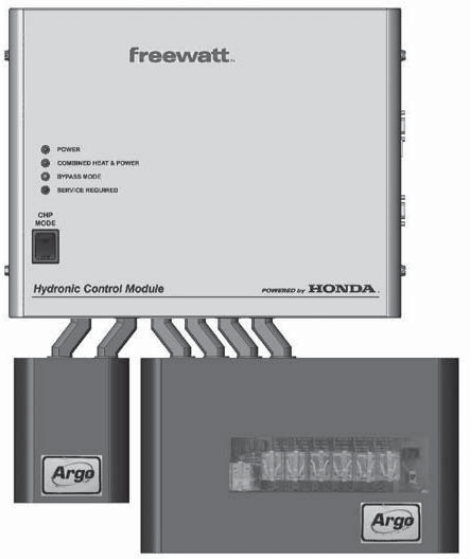
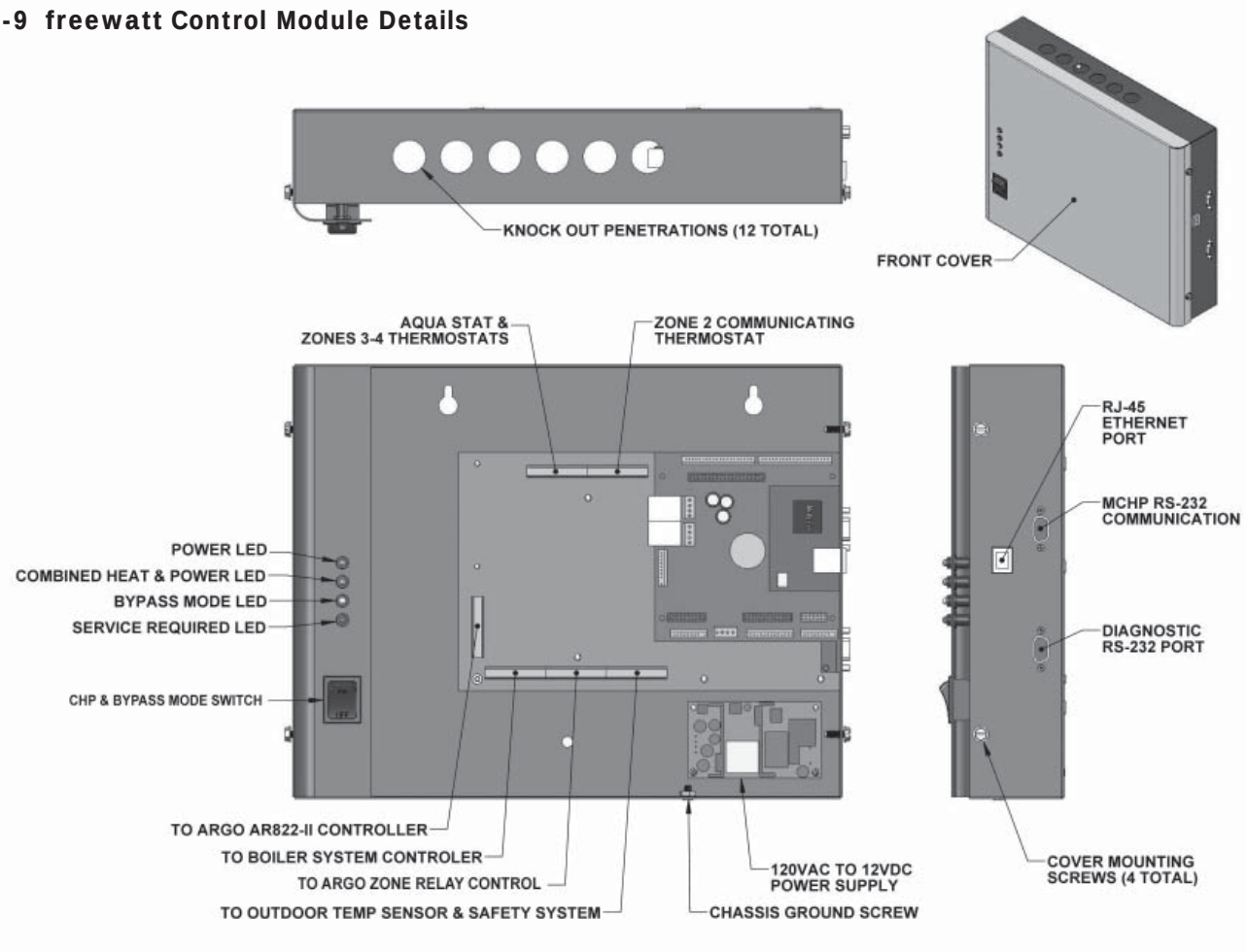


Figure 2-9 freewatt Control Module Details



3 - BEFORE INSTALLING THE SYSTEM

3.1 Codes

System incorporates gas-fired, appliances and shall be installed in accordance with all applicable federal, state and local building codes including, but not limited to following:

Fuel Gas

- United States: Installation shall conform to National Fuel Gas Code (NFPA-54/ANSI Z223.1-latest edition);
- Canada: Installation shall be in accordance with CSA-B149.1 and .2 installation codes.

Electrical:

- United States: Installation shall conform to National Electrical Code (ANSI/NFPA-70 latest edition);
- Canada: Installation shall be in accordance with the current edition of CAN/CSA-C22.1 Canadian Electrical Code (Part 1).

Condensate Disposal:

- Authority having jurisdiction

Installers:

- Authority having jurisdiction
- Follow maintenance recommendations outlined in this manual.

Grid Interconnection:

- Authority having jurisdiction with respect to interconnecting to grid.

3.2 System Sizing And Application

Select system with proper capacity before continuing installation. Heating Capacity should be greater than or equal to calculated peak heating load (heat loss) for building or area(s) served by system. See Section 2 page 6 for system ratings.

Base heat loss calculations on approved industry methods.

Hydronic **freewatt** System must be configured with Zone 2 operated by special Smart Zone HAI thermostat supplied with **freewatt** System.

- Zone 2, Smart Zone, must have sufficient thermal load to provide proper operation of MCHP unit. Too small of heat load in Smart Zone will result in frequent MCHP cycling and poor electrical power savings.
- Smart Zone should be selected as zone with largest heating demand (but not the domestic hot water zone). Normally, this would be largest space heating zone on first floor of a two story home.
- **freewatt** System will produce best electric power generation benefit if Smart Zone represents at least about 25% of total home heating load.
- If there is no single large zone in existing distribution system, but many small zones, consider combining zones to achieve desired heat load for Smart Zone.

freewatt System must be applied with hydronic heating systems having ample heat delivery capacity relative to maximum or design heat load. This is a requirement for **freewatt** and all other high-efficiency hydronic systems to achieve maximum energy efficiency.

- An “under-radiated” system that requires, high supply water temperature (above 180° F) to maintain comfort, during outdoor low-temperature design conditions will result in reduced contribution of MCHP to total heat delivery, thus, reduced electrical power production benefit.
- Preferred design operating temperature is 160° F. For proper application of **freewatt**, consider adding additional heat radiation to existing distribution systems that may be under-radiated.
- If any zone results in an essentially constant active call for heat during heating season (i.e., highly under-radiated zone) performance of power generation feature of **freewatt** System may also be adversely affected. Be sure that all zones have enough radiation, even during very cold weather, such that no zone thermostat will produce continuous call for heat (i.e., cannot be satisfied).
- **freewatt** requires different ECR zone relay controls depending on type of zoning utilized: either zoned by circulators, valves, or air handlers. Be sure you have correct ECR zone relay control before beginning installation.

3.3 Considerations for System Location

Before selecting location for system, following should be considered. Each system considered for installation must be:

- Select correct type of gas (natural gas);
- Connected to separate (two) combustion gas vent pipes discharging to outdoors: one for **freewatt** Boiler unit and one for MCHP unit and each vent must meet minimum and maximum vent lengths for each unit. See Section 7 of this manual.
- Connected to suitable combustion air intake piping system to supply correct amounts of fresh (outdoor) air for combustion (3” for **freewatt** Boiler) (not required for MCHP). See Section 7 of this manual.
- Connected to suitable forced hot water distribution system.
- Supplied with suitable 120VAC electrical supply for all system motors and controls and separate 240VAC supply for the MCHP unit.
- Connected to properly located thermostat or operating control (**freewatt** requires special communicating Smart Zone thermostat supplied with system and it must installed and connected to “Zone 2”.).
- Placed on level surface (must NOT be installed on carpeting).

- Condensate drain line must be pitched down to floor drain or external condensate pump with reservoir at ¼" per foot (wood frame or concrete blocks may be used to raise boiler). MCHP unit must be bolted to concrete floor as specified.

3.4 Locating the System

- Select level location, central to hot water distribution system served and close to vent and air intake terminals.
- Use accessibility clearances for system installation, if more stringent (i.e. larger clearances) than required fire protection clearances.
- Removable walls or partitions may be used to achieve accessibility clearances.
- Clearances shown in Figures 2-2 and 2-3 indicate required clearances.
- System shall be installed on solid, concrete floor with adequate make-up air available for 18,500 Btu/hr net input heating appliance.
- Equipment shall be installed in location facilitating operation of venting and combustion air intake piping systems as described in this manual (Section 7).
- Keep venting and combustion air intake passageways free of obstructions. Both venting and combustion air intake piping systems connected to outdoors must permit flow through piping systems without restrictions for system operation.
- Install control module components to protect from water (dripping, spraying, rain, etc.) during operation and service (pump replacement, MCHP maintenance, etc.).
- Locate system where ambient room temperatures (minimum possible temperatures where system is installed assuming system is not in operation and contributes no heat to space) are always at or above 32°F to prevent freezing of liquid condensate.

3.5 Combustion Air and Vent Pipe Requirements

- System requires dedicated direct vent system for boiler and separate vent for Honda MCHP discharging all combustion products to outside atmosphere.
- Boiler requires combustion air intake to complete direct vent system and provide air from outdoors. Honda MCHP requires make-up air from space where installed.

⚠ CAUTION

Keep system area clean of debris and free of flammable and combustible materials, vapors and liquids.

- Terminate combustion air and vent pipe connections together in same atmospheric pressure zone, through roof or sidewall (roof termination preferred). Consult Boiler and Honda MCHP Installation Manuals for required clearances and installation instructions.
- Concentric vent termination installation, refer to boiler Installation Manual for installation guidelines.

3.6 Condensate Drain Requirements

- Install condensate drain lines with pitch down to floor at minimum of ¼" per foot.
- External condensate pump (not furnished) may be used if floor drain is not available.
- Use condensate pump designed for flue gas condensate application.
- Consult boiler and Honda MCHP Installation Manuals for guidelines for condensate drain installation.

3.7 Foundation Requirements

- Place system on level concrete surface. DO NOT install on carpeting.
- System: Level System will allow the condensate drain lines to function properly. Shims should be used between boiler, floor, MCHP and base to make up for minor surface irregularities or tilt.
- HI Module: The HI Module will be mounted on the boiler or a nearby wall.
- Honda MCHP: Honda MCHP is supplied with a base to raise unit above floor and secure to concrete floor.

3.8 Removal of Existing Boiler from Common Vent System

Existing common venting system is likely to be too large for proper venting of appliances remaining connected to it. Refer to decommissioning procedure outlined in boiler Installation, Operation and Maintenance manual.

3.9 Special Requirements for Hydro-air Applications:

- Application of **freewatt** with Hydro-Air System Air Handler as Smart Zone requires Smart Zone Air Handler be of type powered with ECM blower motor.
- VHBXB Air Handlers manufactured by First Co. having ECM blower motor are known to work with **freewatt** System.
- Consult factory for before application of other air handlers with Smart Zone of **freewatt** System.

4 - PLACING THE SYSTEM

4.1 Ensure top of Hydronic Hybrid Integration (HI) module is mounted above Honda MCHP's top cover. HI Module bottom should not be above MCHP top. See Figure 2-4.

Place system to provide most direct connections to:

- combustion air/vent piping system,
- natural gas piping,
- distribution system,
- condensate removal system
- electrical system connections

4.2 Instructions outline preparation and placement of Hydronic **freewatt** System:

1. Determine location for boiler, MCHP and indirect hot water tank (if necessary), identify location for hydronic HI module, relay switches and circulators. Typical configuration for Hydronic **freewatt** System is shown in Figure 2-1.
2. Place crated boiler and Honda MCHP unit close to selected location, uncrate these two units.
3. Follow instructions in **freewatt** Boiler Installation, Operation and Maintenance manual for placing boiler. See Figure 2-3 for boiler details.
   - System configuration and final placement should allow for future servicing of equipment.
4. See Figure 4-2 for typical piping schematic to assist in determining best overall layout of **freewatt** System components.
5. Reference Honda MCHP Installation Manual for instructions regarding placement of unit.
6. Install MCHP unit base as specified in Honda MCHP, Installation Manual and Owner's Manual as summarized below and in Figure 4-1.
   A. Place base on concrete floor and check for level.
   B. Mark anchor bolt locations on concrete floor.
   C. Drill proper hole diameters in concrete for anchor bolts per manufacturer's installation instructions. If obstruction is hit, move base and re-drill.
   D. Attach base to anchor bolts with supplied hardware.

NOTICE

If unit needs to be shimmed level, washers should be located between MCHP and base.

Orientation of bolt & nut is important. Bolt must be installed from top with nut on bottom. Use nuts and bolts supplied in installation kit, not shipping bolts that attach MCHP to shipping pallet.

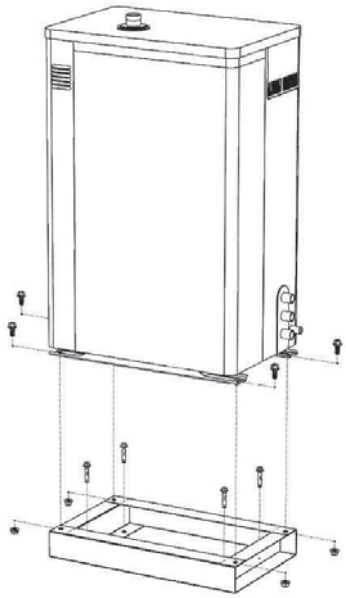
⚠ WARNING

Do not make any penetrations or drill any holes in MCHP cabinet. Do not attach any controls, wire, piping, conduit or other hardware to MCHP unit. Penetration or any modifications of MCHP cabinet will result in potential electrical or fire hazard.

7. After base is installed, place Honda MCHP on base and secure MCHP unit to base with supplied hardware. See Figure 4-1.
8. After determining location of Hydronic HI Module enclosure, mount enclosure on solid wall or partition. Recommend enclosure be located close to Honda MCHP. HI module may be mounted up to 10 feet away from Honda MCHP unit.
   - Locate enclosure with installation and service accessibility in mind. Refer to **System Components** Section.
   - Locate HI Module such that top of HI module is above top of installed MCHP unit.

   A. Install bottom of hydronic HI Module at height of 32" to 42" above floor elevation where base of Honda MCHP is installed.
   B. Position enclosure, level, and mark mounting holes.
   C. Start screws (#10; 4 (Qty); not supplied) for keyhole type mounting holes in upper corner(s). Tighten screws down to about 1/8" (3mm) from surface.
   D. Hang enclosure on screws, position enclosure and start bottom screws.
   E. Tighten all screws.

Figure 4-1 MCHP Base Installation

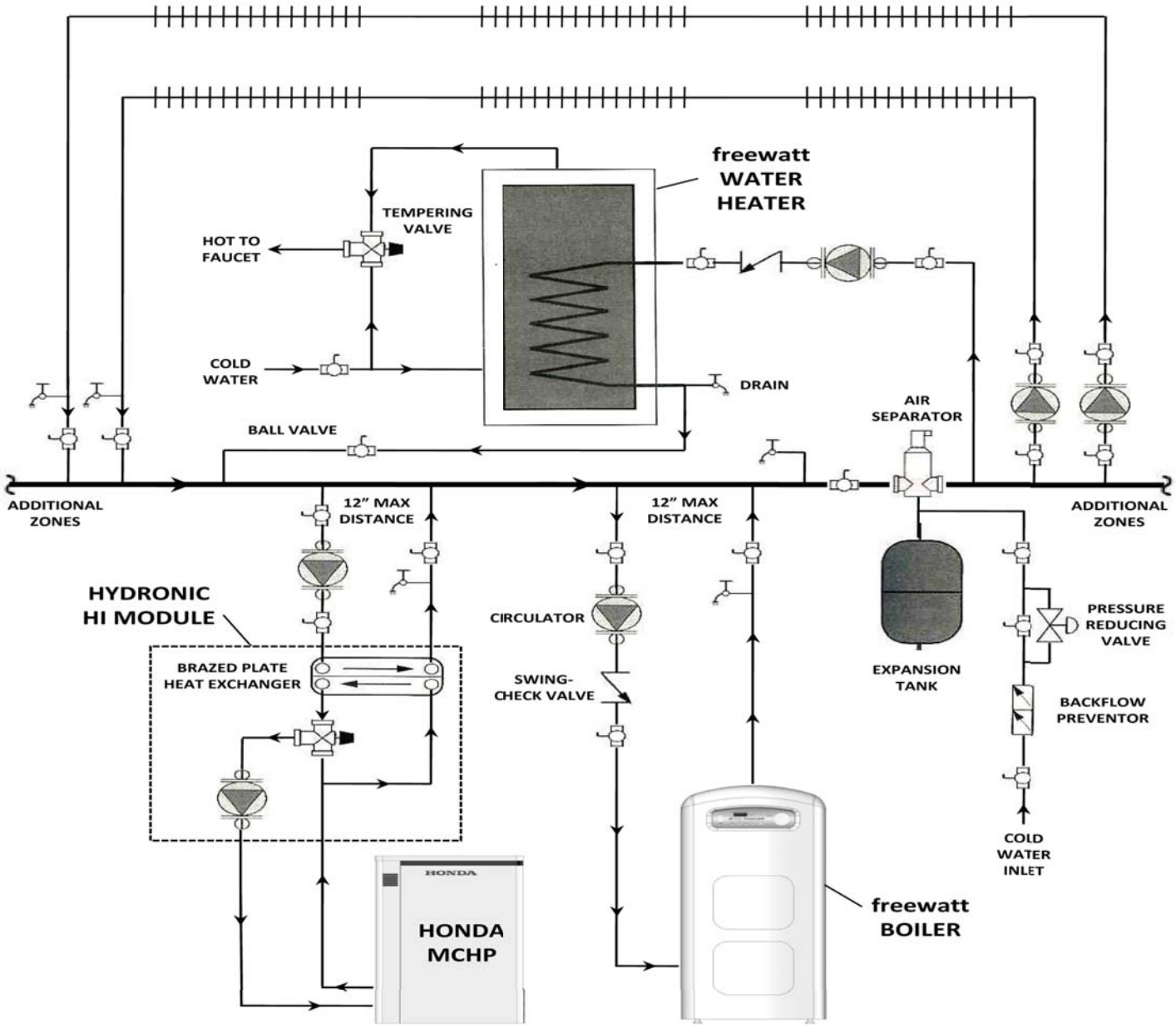


4.2 freewatt System Piping

Configure system piping to connect boiler and Honda MCHP to distribution piping.

- Hydronic **freewatt** piping configuration is modified primary-secondary allows heat from MHCP unit injected into return piping upstream from **freewatt** Boiler. Configuration ensures coldest return water delivered to MCHP unit's hydronic hybrid integration (HI) module.
- Figure 4-2 shows required **freewatt** distribution piping schematic for system zoned with circulators.
- Configuration of heating zones, boiler and MCHP heat sources as shown in Figure 4-2 is mandatory for proper operation of **freewatt** System.
- See Section 17 for specific piping schematics for
  a) circulator zoned systems,
  b) valve zoned systems
  c) systems with air handlers.

Figure 4-2 Hydronic freewatt System Distribution Piping Schematic with System Zoned with Circulators.



4.3 Important Design Tips

- Install bottom of Hydronic HI Module at height of 32" to 42" above floor elevation where Honda MCHP is installed.
- ½" Onix coolant tubing connecting Hydronic HI module and MCHP should be a maximum length of 10 ft.
- If indirect hot water tank is installed, install mixing valve. Mixing valve will provide anti-scalding protection and allow for summer operation of MCHP unit. Please review installation requirements with Installation Manual supplied with Indirect Water Tank

4.4 Near Boiler Piping

- Do not install copper piping directly into aluminum boiler casting due to galvanic corrosion between dissimilar metals. Two dielectric isolation unions shipped loose in boiler parts bag. Use of dielectric unions is required. **freewatt** Boiler is furnished with iron piping where necessary for supply and return connections.
- Configure near boiler piping in accordance with **freewatt** Boiler's Installation, Operation and Maintenance Manual. Overall configuration with MCHP unit and heated zones must be in conformance with Figure 17-1, 17-4 or 17-7 as applicable.
- **freewatt** Boiler is provided with 1 ¼" NPT return and supply piping connections as shown in Figure 2-3.
- **freewatt** Boiler Installation, Operation and Maintenance Manual includes directions on distribution system requirements, including expansion tank, make-up water, air separator, air vent and condensate drain piping (pump).
- Install 1 ¼" ball valves on supply and return legs of boiler connection to allow for future servicing of boiler or circulators.

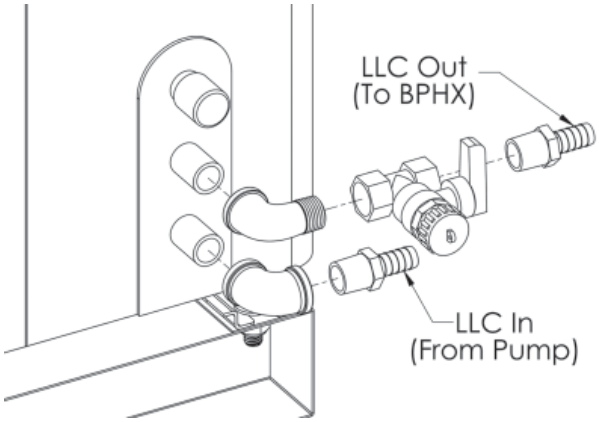
4.5 Honda MCHP & Hydronic HI Module

- Install near MCHP piping in accordance with Honda MCHP Installation manual and instructions found in this section.
- Typical piping configuration as shown in Figure 2-4; shows MCHP connecting to hydronic HI Module.
- Hydronic HI Module connects to hydronic water distribution system.
- Place hydronic HI module in location that allows for MCHP to connect with maximum 10 feet of ½" Onix tubing, also located vertically above MCHP unit (32" to 42" above MCHP's base level). Onix tubing is used to isolate any vibration from Honda MCHP unit and is provided with installation kit.

NOTICE

Following steps are required to install long life coolant (LLC) tubing between Hydronic HI module and Honda MCHP. If these steps are not followed, system will not operate properly, permanent damage to Hydronic HI Module or Honda MCHP may occur. Use only special long life coolant supplied with **freewatt** System. Use of any other coolant will void warranty.

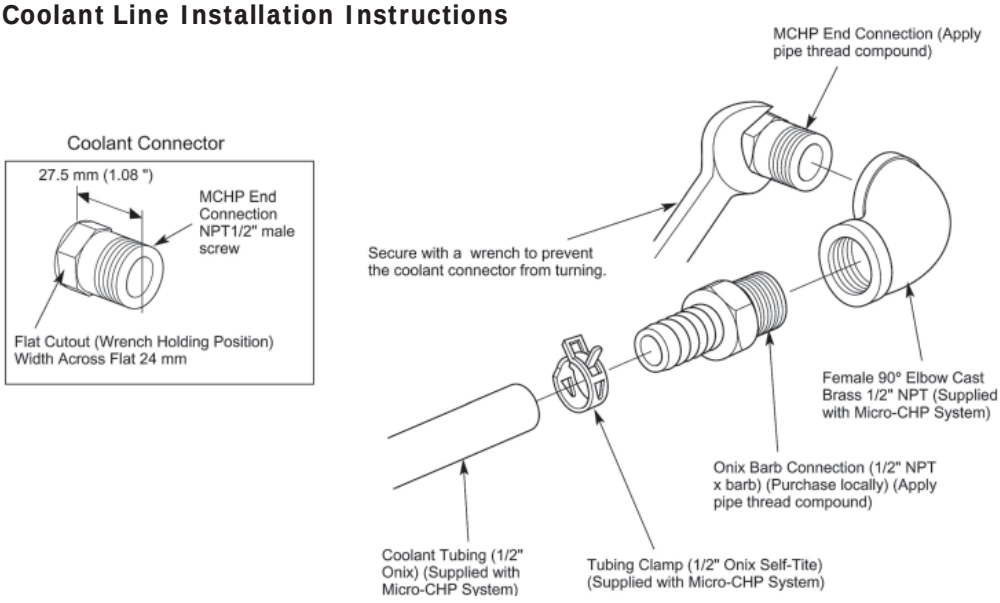
Figure 4-3 MCHP Coolant Loop Drain Tee (LLC = Special Long Life Coolant Supplied with System)



4-6 HI Module coolant tubing:

1. Prepare rear connections (LLC In and LLC Out) of MCHP with Teflon tape and pipe thread sealant. Install 1/2" NPT brass street elbow onto MCHP unit's 1/2" MNPT LLC Out fitting. Install other 1/2" NPT brass elbow onto MCHP unit's LLC In fitting. Install 1/2" NPT x 1/2" brass barb fittings into drain fitting and elbow. Point fittings in direction of front of hydronic HI Module. See Figures 4-3 & 4-4.
2. Long Life Coolant Out Tubing Installation [MCHP to BPHX; Figure 4-5]:
   A. BPHX = Brazed Plate Heat Exchanger in hydronic HI Module
   B. Route tubing through barged end of hole with grommet in Hydronic HI Module and install tubing onto end of 90° elbow fitting (barb x IPS) with SelfTite clamp (See Figure 4-5 and 4-7). Maximum Onix Tubing Length = 10 feet.
   C. Install IPS end of elbow (barb x IPS) into IPS tee fitting;
   D. Route other end of tubing to rear of MCHP and cut to length;
   E. On upper (LLC Out) MCHP Coolant connection, install tubing onto brass barb x elbow x drain tee fitting (factory supplied) with SelfTite clamp. See Figure 4-3 & 4-4.

Figure 4-4 MCHP Coolant Line Installation Instructions



3. Long Life Coolant In Tubing Installation [Pump to MCHP; Figure 4-6]:

A. Select section of Onix Tubing to extend from MCHP unit's lower (LLC In) Coolant connection to coolant pump in HI Module;

B. Route tubing through hole in bottom of Hydronic HI Module;

C. Install barbed end of elbow (barb x IPS) fitting into open tube end of tubing and secure with SelfTite clamp. See Figures 4-6 and 4-7;

D. Insert IPS end of same elbow (barb x IPS) fitting into female IPS swivel fitting on coolant pump & secure with collet clip supplied with female swivel fitting. Figure 4-7 and 4-8.

E. Route tubing to rear of MCHP (through open channel in front of MCHP base) and cut to length;

F. Install the tubing onto lower (LLC In) brass hose barb fitting and secure SelfTite clamp onto tubing. See Figure 4-4.

NOTICE

Use only Watts Radiant brass barb fittings with Onix tubing supplied with f**reewatt** System. Off-the-shelf brass fittings are made to different dimensions and tolerances, which may result in leaks.

Figure 4-5 Connection to HHI Module (BPHX)

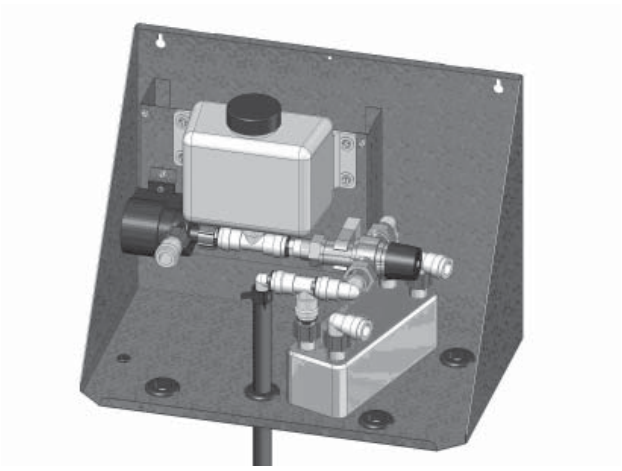


Figure 4-6 Connection to Pump

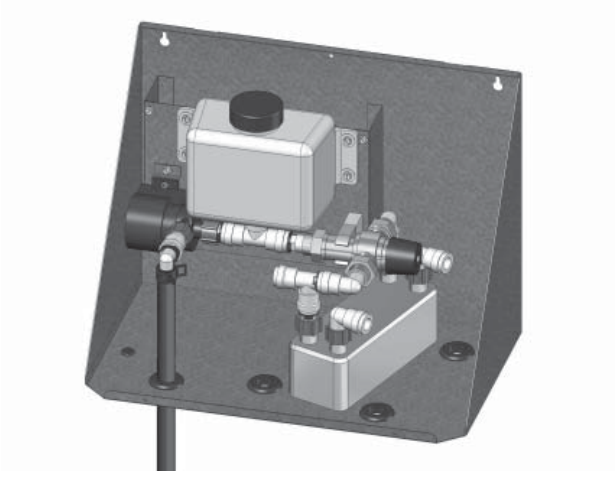


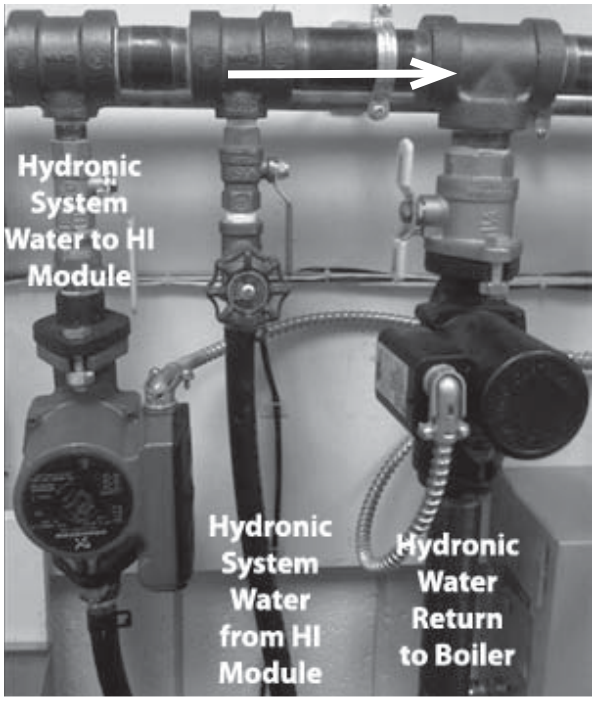
Figure 4-7 Hose Barb by IPS Elbow Fitting

Figure 4-8 Female Swivel Fitting (NPT by IPS)

4.7 HHI Module to Distribution Manifold

- Size tubing or piping that connects HI module with hydronic system distribution manifold at ½" NPT or larger to provide adequate flow for transfer of heat from MCHP's coolant into hydronic water.
- Pump shall provide flow of at least 4 gpm or more to brazed plate heat exchanger (~1 psi pressure drop) in Hydronic HI Module. Install pump below manifold to prevent air locking. Grundfos SuperBrute Pump (UPS1558FC) is suggested. Example of this piping design Figure 4-9.
- Route two lengths of Onix tubing through Hydronic Loop In and Hydronic Loop Out connections on bottom of HI Module Figure 2-5.
- Attach two supplied plastic barb x IPS elbows (Fig. 4-7) to tubing and secure with self tite clamps.
- Connect elbows to swivel fittings (Fig, 4-8) on BPHX and secure with collet clips.
- Route other ends of Onix tubing to distribution manifold connection points.
- Cut to length and install supplied 1/2" NPT x 1/2" brass barb fittings with self tite clamps for connection to distribution manifold piping.

Figure 4-9 - HI Module to Distribution Manifold Piping



4.8 Condensate Drain Piping

freewatt Boiler and MCHP unit will produce condensate at rates up to 2 ½ US quarts per an hour. Provisions must be prepared to drain condensate away from both appliances to ensure their proper operation.

- Boiler is supplied with factory-installed drain trap assembly with ½" dia. Sch. 40 PVC connection.
- Boiler and MCHP's drain trap assembly must be filled with water before operating system. Dry trap may cause the pressure switches to behave erratically, preventing the boiler from operating normally, or cause exhaust products to enter the building space.
- If floor drain is not available or inaccessible, install MCHP condensate line directly into condensate pump, located directly behind MCHP unit.
- Condensate line should have "Y connector", as shown in Figure 4-10, to ensure tubing is open to atmosphere, removing chance for air lock in line.
- Route boiler's condensate line behind MCHP unit and install directly into condensate pump.
- Boiler condensate vent drain tee is supplied and must be used.

Figure 20 - Condensate Lines

NOTICE

No additional electrical connections shall be made within **freewatt** System for 120 VAC power. If 120 VAC power is required for condensate pump, separate junction box and receptacle should be provided.

Review installation instructions for boiler and Honda MCHP to ensure proper system installation.

4.9 Onix Clamps

⚠ CAUTION

Do not solder near, or overheat, any Onix connections. Extreme temperatures associated with soldering may seriously damage the Onix and will void warranty.

All Onix and brass fitting surfaces must be clean and dry before making the connection.

Whenever possible, avoid making connections or splices in inaccessible locations.

Repairing Onix that has been in service in the **freewatt** System requires special attention. Any residual amounts of freewatt long life coolant inside the Onix tube must be removed. Use an alcohol swab or pad to remove the residue(s), then allow tube to dry prior to connection.

NOTICE

Do not use screw gun or wrench to tighten TorqueTite clamps. Safety glasses must be worn when installing SelfTite Clamps.

Minimum bending radius of ½" Onix tubing is 4".

Recommend use of Watts Radiant brass barb fittings with Onix tubing. Off-the-shelf brass fittings are made to different dimensions and tolerances, which may result in leaks.

Onix requires special Torque-Tite or Self-Tite mechanical clamps, designed for higher temperature and burst pressure ratings. Self-Tite clamps are supplied with **freewatt** System.

1. TorqueTite clamps are heavy-duty screw-type, wide-band, stainless steel clamps. An in./lb. torque wrench is required for installation. Each clamp should be tightened according to proper torque setting for size of clamp being used. Torque settings are listed on instruction sheet supplied with clamps.
   A. Do not over tighten TorqueTite clamp. Over-tightening may cause long-term damage to Onix tubing and/or to clamp itself.
2. SelfTite Clamps are chrome-vanadium, constant tension clamps. Watts Radiant recommends using SqueezeTite pliers to properly open and install these clamps.
   A. Do not to allow clamp to flatten while being held open. Flattened clamps will not fit properly over Onix and barb assembly.

4.10 Configuration of Heating Zones and Controls

Hydronic **freewatt** System may be applied to normal variety of heating loads served by conventional, multi-zone hydronic heating systems. These include;

base-board radiation,
radiant floor heating,
domestic hot water via indirect storage tank,
powered convective heaters,
hydro coils,
and others.

Use correct ECR heating zone control accessory kit, ordered separately, for type of zoning to be applied with hydronic **freewatt** system. Kit includes freewatt smart zone communicating thermostat, AR822-II pump relay for MCHP hydronic loop and appropriate zone control relay as follows:

Zone Pump Zone Control Accessory Kit includes ARM-6P for pump zoned systems,

Zone Valve Zone Control Accessory Kit includes AZ-6CP for valve zoned systems,

Hydro-air Zone Control Accessory Kit includes ARH-3 for distribution systems with air handlers.

Zone Pump and Zone Valve Systems

- Thermostats for up to four zones, pumps or zone valves must be wired through **freewatt** Control Module.
- In all applications, one zone of these four zones must designated "Zone 2 - Smart Zone".
- Zone 1 is used to accommodate indirect water heater having its own dedicated circulation pump. The required ECR heating zone relay controls for use with pumped zoned systems (ARM-6P) and valve zone systems (AZ-6CP) can accommodate total of 6 zones. If zones 5 and 6 are to be used with these zone controls, thermostats for these zones are connected directly to ARM-6P or AZ-6CP ECR relay controls (not to **freewatt** Control Module).
- If additional zones are needed, expand ECR control using the appropriate ECR expansion relay control.

Hydro Air Systems

- Use Zone 1 to accommodate indirect water heater having its own dedicated circulation pump.
- Two air handlers with circulators and two pumped zones with circulators can be accommodated through use of ECR ARH-3 control.
- One of the air handlers must be "Zone 2 - Smart Zone".
- If additional zones are needed, expand ECR control

using appropriate ECR expansion relay controls.

Select “Smart Zone” as zone with largest heating demand (but not the domestic hot water zone). Normally, this would be largest space heating zone on first floor two story home.

freewatt System will produce best electric power generation benefit if Smart Zone represents at least 25% of total home heating load. If there is no single large zone in existing distribution system, but many small zones, consider combining zones to achieve desired heat load for Smart Zone.

NOTICE

All installations of Hydronic **freewatt** System require use of AR822-II for operation of the circulator that provides hydronic water flow to the HI Module.

5 - EXHAUST GAS LEAK SENSOR

5.1 Install **freewatt** System Exhaust Gas Leak Sensor System in addition to separate, independently-installed and operating UL approved Carbon Monoxide Detector having audible alarm.

- Both Exhaust Gas Leak Sensor (supplied with **freewatt**) and audible UL approved Carbon Monoxide Detector (not supplied with **freewatt**) must be installed.
- **freewatt** System and **freewatt** Exhaust Gas Leak Sensor do not provide audible alarm for protection of building inhabitants from potential high CO hazards.
- Only function of **freewatt** Exhaust Gas Leak Sensor System is to automatically stop operation of MCHP unit in event it detects potentially hazardous level of carbon monoxide in vicinity of MCHP unit.

freewatt System Exhaust Gas Leak Sensor System uses Macurco CO Detector connected directly to Honda MCHP Unit. Follow installation directions below:

1. Read installation and operation manual for Macurco CO Detector that is part of Exhaust Gas Leak Sensor System;
2. Install Macurco CO Detector per manufacturer's instructions in close proximity of HONDA MCHP unit;
3. Install four-wire cable from Honda MCHP to Macurco CO Detector per wiring schematic found in Figure 5-1.
4. Ensure cable is properly secured (Max. Interval: every 3 ft.)

Exhaust Gas Leak Sensor (EGLS) monitors integrity of MCHP unit's combustion system and shuts down MCHP unit if certain potentially unsafe conditions are detected. It does this by monitoring carbon monoxide level in air space near MCHP unit. EGLS is independent of, and separate from, audible CO alarming system that must be installed with **freewatt** System in compliance with best practices for all fuel-fired central heating equipment.

NOTICE

freewatt Exhaust Leak Gas Sensor does not fulfill State of Massachusetts's CO detector and alarm requirement.

Exhaust Gas Leak Sensor does not provide audible alarm for potentially hazardous CO levels.

Exhaust Gas Leak Sensor is supplied with Hydronic **freewatt** System and is intended for installation in close proximity of Honda MCHP unit. Figure 5-1 shows connections between Honda MCHP and Exhaust Gas Leak Sensor. Exhaust Gas Sensor will automatically stop operation of MCHP unit upon detection of potentially dangerous levels of carbon monoxide gas regardless of source of carbon monoxide gas.

5.2 Preparation

Install following components before Exhaust Gas Leak Sensor installation:

- Boiler, Control Module & Hydronic HI Module
- Honda MCHP Unit
- Thermostat

NOTICE

Exhaust Gas Leak Sensor does not fulfill independent CO detector and audible alarm requirement of **freewatt** System. **freewatt** System requires separate CO alarm for protection of building inhabitants. This separate **freewatt** System installation requirement is fulfilled by complying with State of Massachusetts's CO detector and alarm requirements. Your state or local jurisdiction may have additional requirements regarding carbon monoxide detectors and alarms.

5.3 Installation

⚠ WARNING

Exhaust gases from this appliance contain chemicals which on some occasions may include carbon monoxide (CO). Carbon monoxide is odorless, tasteless, clear colorless gas, which is highly toxic. Even low concentrations are suspected of causing birth defects and other reproductive harm.

UL and ULC recognized Carbon Monoxide detectors are required for all buildings equipped with hydronic **freewatt** System. Install all Carbon Monoxide detectors in accordance with their manufacturer's instructions and applicable local building codes.

Exhaust Gas Leak Sensor is connected to Honda MCHP unit with field supplied 4 conductor stranded insulated cable (maximum allowable length 49 feet) and furnished 4 pin connector with noise filter and wiring pigtail (furnished with Honda MCHP).

1. ***Honda MCHP Connection***

   4-pin cable connector to Honda MCHP for Exhaust Gas Leak Sensor is factory-supplied and field installed. See figure 5-1 electrical schematic for wiring details.

   See Honda MCHP Installation manual for connections to Honda MCHP and for any servicing or troubleshooting.

2. ***Exhaust Gas Leak Sensor Connections***

Field install Cable connection to Exhaust Gas Leak Sensor after installation of sensor. Figure 5-1 shows field connections of cable to Exhaust Gas Leak Sensor. Install white jumper wire in field between second terminal (F) and fourth terminal (N.C.). Another Jumper may be installed between COM and B terminals instead of using crimp.

3. Install Exhaust Gas Sensor's cable connections properly or Hydronic **freewatt** System will not initialize and not operate (ERROR – 14 or 15 Flashes).

For more instructions on connecting Exhaust Gas Leak Sensor, see Honda MCHP installation manual.

5.4 Test Procedure

Before commissioning system, test Exhaust Gas Leak Sensor to ensure proper operation. Use Exhaust Gas Leak Sensor test button in accordance with procedure below.

Procedure should stop MCHP unit.

1. Disconnect **freewatt** System from Internet. Temporarily disconnect LAN (local area network) cable from side of **freewatt** Control module or disconnect LAN cable where it plugs into home's network.

2. Power is supplied to Exhaust Gas Leak Sensor by MCHP so MCHP must be operating during testing of Exhaust Gas Leak Sensor. If MCHP is not operating turn up thermostat until MCHP operates.

3. Wait few minutes for LED on Macurco CO Detector to begin glowing green. When LED on Macurco CO Detector is glowing green continuously, press button on Exhaust Gas Leak Sensor labeled "Push Here to Test or Reset" for at least 6 seconds. This action should cause **freewatt** System error condition.

4. LED indicator on Exhaust Gas Sensor must be solid green. If it is flashing red and green, sensor is initializing. Please wait approximately 3 minutes until LED is on solid green before proceeding.

5. Confirm that the Honda MCHP unit has stopped operating, and red "Service Required" LED on **freewatt** System's front panel is blinking error code "16", and yellow "Bypass" LED is on.

6. Clear error condition. To do this, turn OFF 120 VAC **freewatt** System Service Switch and 240 VAC Honda MCHP Service Switch.

7. Reconnect LAN cable to **freewatt** System.

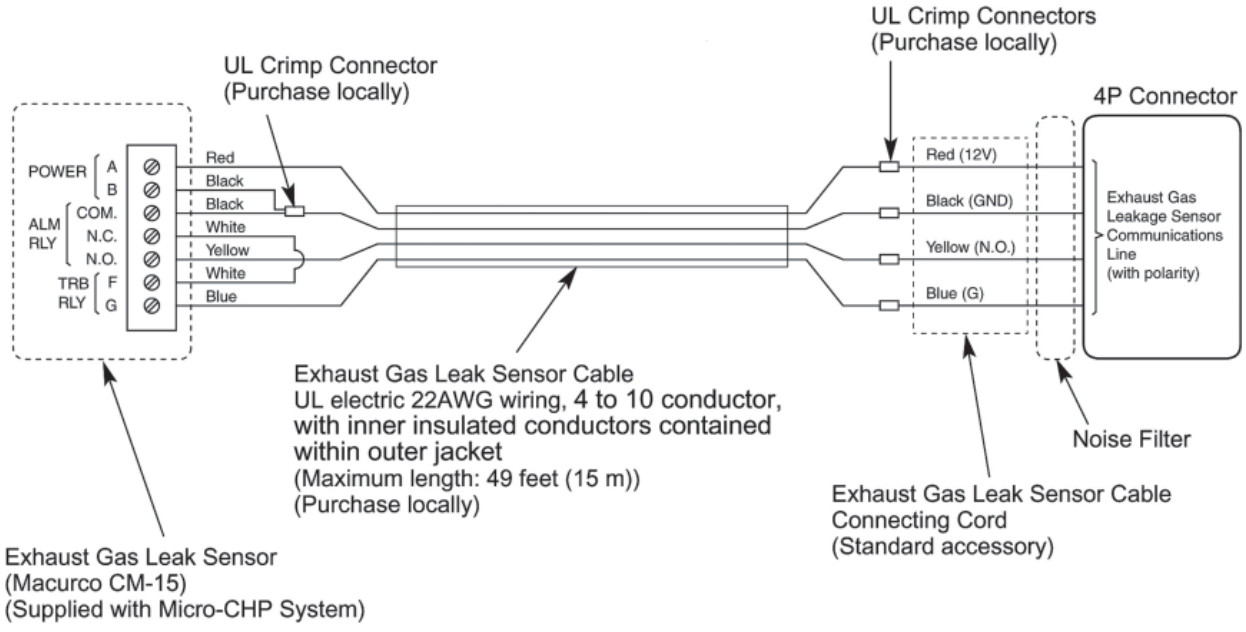
8. Turn power ON to Honda MCHP 240 VAC Service Switch first, and then turn ON **freewatt** System 120 VAC Service Switch, to return system to normal operation.

NOTICE

Replace Exhaust Gas Sensor every 5 years with identical unit and installed by qualified and properly trained service personnel.

If you push test button on **freewatt** Exhaust Gas Leak Sensor, **freewatt** generator will stop and red service required LED will indicate fault by flashing 16 times. If your system is connected to internet, fault message will be transmitted to **freewatt** service center. You must clear this fault condition to restore MCHP operation . To clear this fault, shut off electrical power to **freewatt** System and restore power to reset system using power switch on **freewatt** Control module.

Figure 5-1 Exhaust Gas Leak Sensor Connections



6 - MCHP PRESSURE SWITCH SYSTEM

MCHP Pressure Switch System is designed to detect gas flow blockage that may occur in the HONDA MCHP unit's exhaust vent. See Figure 6-1.

System is factory-assembled and supplied with Hydronic **freewatt** System for installation in MCHP's exhaust vent with cable that extends to control module. See Figures 6-2, 6-3 and 6-4.

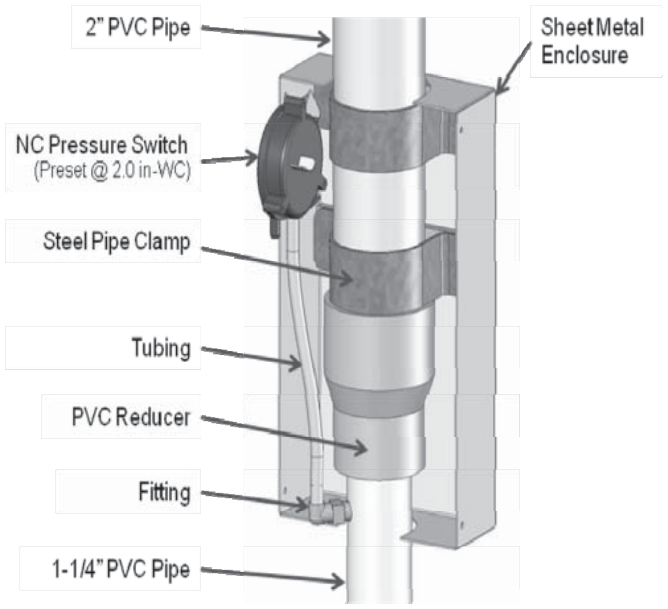
NOTICE

freewatt Boiler has its own pressure switch system detecting boiler vent blockage and operates independently of MCHP Pressure Switch System.

6.1 Installation of MCHP Pressure Switch

1. Attach Pressure Switch System PVC pipe section to rubber exhaust adapter to required depth (1") and install worm gear clamp;
2. Hold Pressure Switch System PVC pipe section vertical above HONDA MCHP with rubber exhaust adapter standing vertical and concentric with HONDA MCHP exhaust port. Distance between bottom PVC connection and MCHP connection should be 8" (+/- 1"). DO NOT pull pipe section too high and stretch adapter. DO NOT hold pipe section too low and allow exhaust adapter to slump;
3. Measure distance between PVC coupling and vent pipe fitting of exhaust vent piping system found directly above. Verify the pipe is vertical and concentric with Honda MCHP exhaust port;
4. Cut section of PVC pipe to fit measured distance;
5. Dry fit section of PVC pipe into vent pipe fitting and Pressure Switch System and check:
   - Level
   - Location (Upper Pipe and MCHP exhaust port are concentric)
   - Proper installation of rubber exhaust adapter with 8" (+/- 1") between bottom connection of system and MCHP connection. Rubber exhaust adapter should be:
     a. Plumb
     b. NOT Pulled or Compressed
     c. NOT Slumping or Installed at an Angle
6. Solvent cement section of PVC pipe into vent pipe fitting of exhaust piping system, verify pressure switch enclosure faces forward for future servicing;
7. Solvent cement section of PVC pipe into open socket reducer fitting of Pressure Switch System;
8. After placing worm gear clamps over rubber exhaust adapter ends, attach rubber exhaust adapter to MCHP and contoured PVC pipe end of Pressure Switch System;

Figure 6-1 Pressure Switch



9. Tighten worm gear clamps;
10. Inspect connections and clamps for proper welding and torque to ensure tight exhaust system;
11. Verify exhaust vent piping is supported in close proximity to vent pipe fitting to properly secure Pressure Switch System and rubber exhaust adapter.

6.2 MCHP Pressure Switch Cable

Pressure switch is connected to control module with two-wire cable. Cable is factory installed to pressure switch and is bundled outside pressure switch enclosure. Approximately 20 ft. of cable is supplied with Pressure Switch System to allow for quick connection to control module. Follow installation instructions below:

1. Unbundle cable and extend from Pressure Switch System to Control module;
2. Install two-wire cable end into **freewatt** Control module. Connect to controller circuit board terminal PRSW and GND, as shown in Figure 6-5;
3. Secure pressure switch cable to Honda MCHP with quick tie anchors

6.3 Pressure Switch Test

Check all connections before commissioning pressure switch system.

6 - MCHP PRESSURE SWITCH SYSTEM

Figure 6-2 Honda MCHP Venting Installation

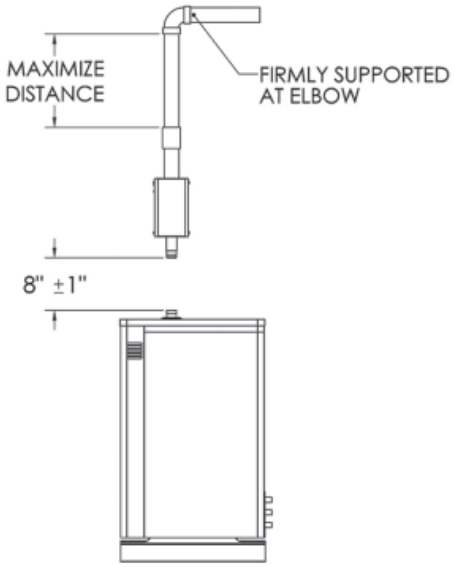


Figure 6-4 Correct Adapter Installation

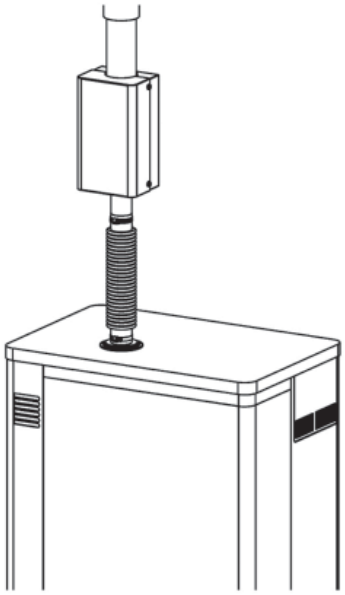


Figure 6-3 Incorrect Adapter Installation

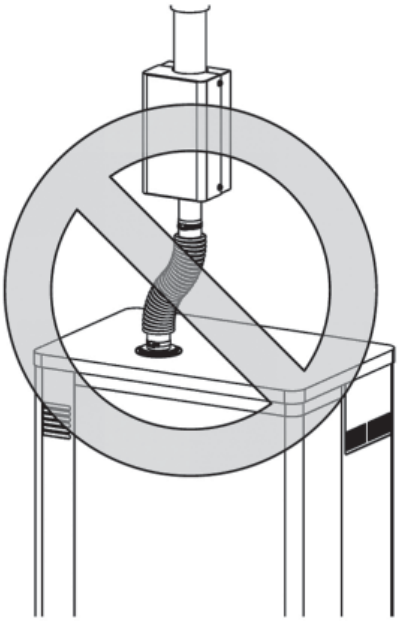


Figure 6-5 MCHP Pressure Switch Connection

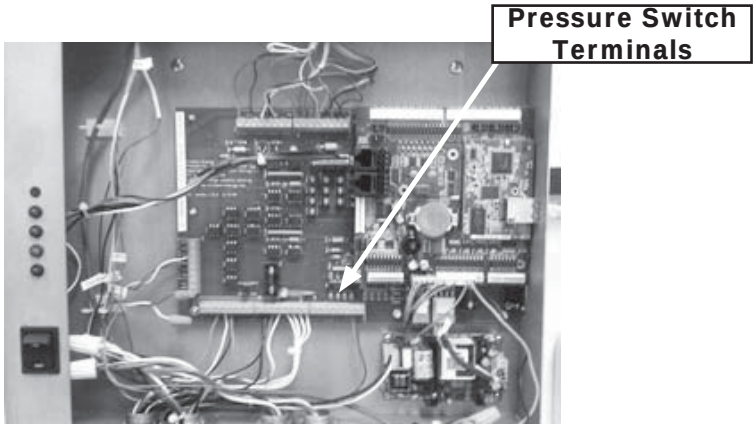
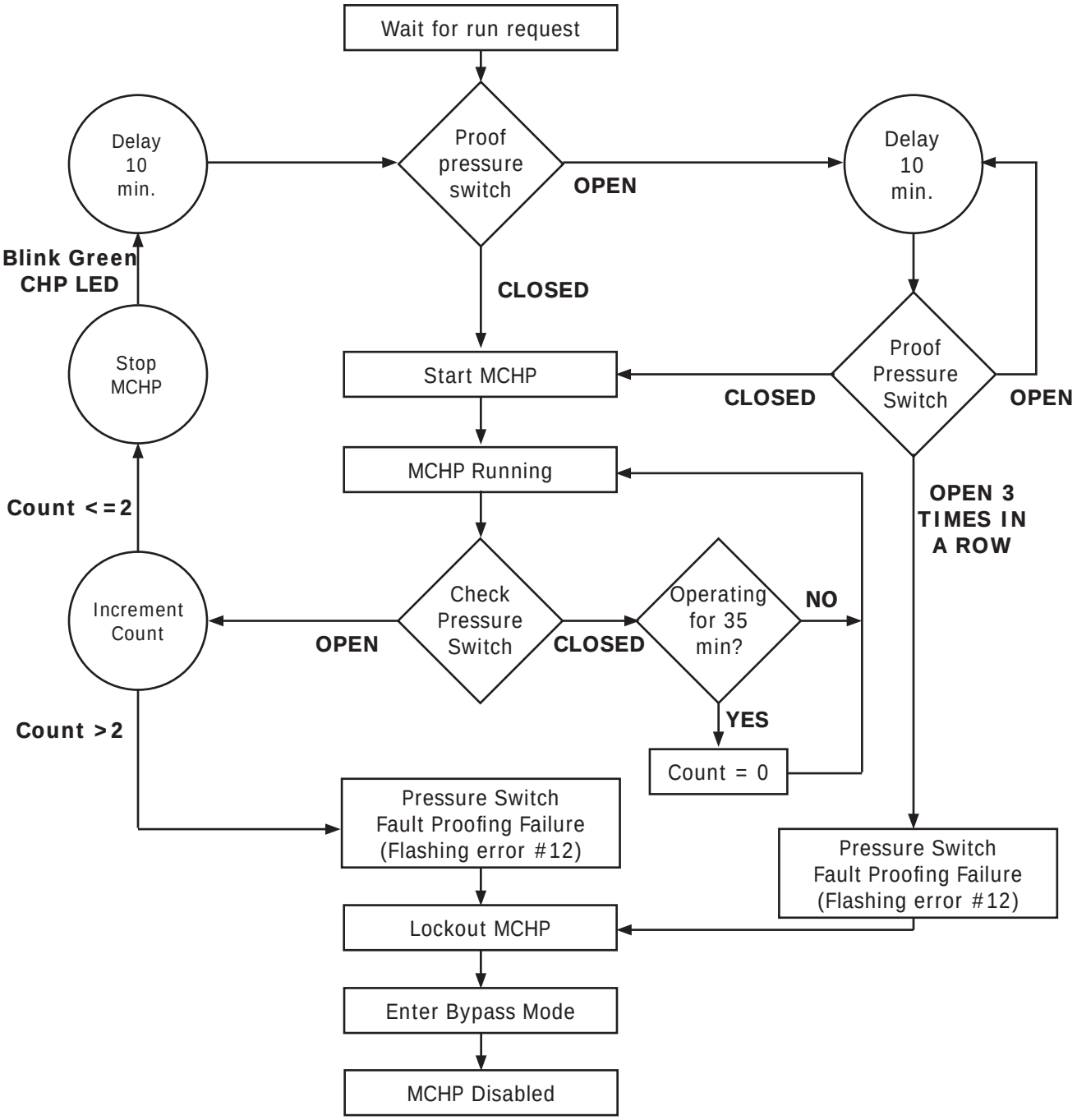


Figure 6-6 Sequence of Operation: MCHP Pressure Switch



7 - COMBUSTION AIR AND VENT PIPE

⚠ WARNING

Read, understand and follow all instructions in this section. Failure to properly vent or supply combustion air to this boiler can cause carbon monoxide poisoning, or an explosion or fire, resulting in property damage, personal injury or loss of life.

7.1 General Considerations

If this system is replacing Category I type boiler connected to chimney serving other appliances, perform tasks outlined in Section 5 of **freewatt** Boiler Installation, Operation and Maintenance Manual section "Removal of Existing Boiler from Common Vent System".

For home heating appliances connected to gas vents or chimneys, vent installations shall be in accordance with section "Venting of Equipment", of the National Fuel Code, ANSI Z223.1/NFPA 54, CSA-B149.1 and B149.2, and/or the authority having jurisdiction.

Provisions for combustion and ventilation air must be in accordance with Section, "Air for Combustion and Ventilation", of the National Fuel Gas Code, ANSI Z223.1/ NFPA54, CSA-B149.1 and B149.2, and/or the authority having jurisdiction.

Hydronic **freewatt** System has two separate components that require combustion air and discharge of combustion products.

- Boiler component requires dedicated direct vent system. All air for boiler's combustion is taken directly from outdoors through combustion air intake pipe. All combustion products are discharged to outdoors through vent pipe.
- Honda MCHP takes combustion air from interior open space and all combustion products are discharged to outdoors through vent pipe.

1. See installation instructions in boiler and Honda MCHP manuals for combustion air and vent pipe roof and sidewall termination (Roof termination is preferred). Combustion air and vent pipes for **freewatt** Boiler must terminate together in same atmospheric pressure zone as shown. Boiler and MCHP exhaust vents need not be in the same general location on exterior of building. Construction through which vent and air intake pipes may be installed is maximum 24 inches, minimum ¼" thickness.
2. Combustion air and vent pipe fittings must conform to American National Standards Institute (ANSI) standards and American Society for Testing and Materials (ASTM) standards D1784 (schedule 40 CPVC), D1785 (schedule 40 PVC), D2665 (PVC-DWV), D2241 (SDR-21 and SDR-26 PVC), D2661 (ABS-DWV), or F628 (schedule 40 ABS). Pipe cement and primer must conform to ASTM standards D2564 (PVC) or D2235 (ABS).
   - Canada construct all combustion air and vent pipes for this system of CSA or ULC certified schedule-40 CPVC, schedule-40 PVC, PVC-DWV or ABS-DWV pipe and pipe cement. SDR pipe is not approved in Canada.
3. Combustion air pipe and vent connections on boiler are 2" pipe size. Installed combustion air pipe and vents for boiler must be 3" size and, use 2" to 3" pipe coupling at boiler connections. MCHP vent connection size is 2". Either 2" or 1-1/2" vent size is permitted. Refer to **freewatt** Boiler IOM and MCHP IOM for specific venting instructions.
4. Exhaust transition from 2" pipe to 3" pipe must be made in vertical run. Transition pieces are not included. (See boiler installation manual for more details.)

7.2 Combustion and Vent Piping Length

Please refer to direct vent and non-direct combustion air and vent sections outlined in installation guides for boiler and Honda MCHP for specific installation procedures and specifications.

7.3 Installation

Please refer to direct vent and non-direct combustion air and vent sections outlined in installation guides for boiler and Honda MCHP for specific installation procedures and specifications. General guidelines for air intake and vent piping are found in FW95M-200 Boiler Installation, Operation and Maintenance Manual.

Use of periscopes on air intake and venting is allowed, but if they extend over 24" in length, the straight length should be insulated with proper weather-resistant pipe insulation.

7.4 Installation Requirements Specific To State Of Massachusetts:

- This product must be installed by licensed Plumber or gas fitter.
- When flexible connectors are used, maximum length shall not exceed 36 inches.
- When lever type gas shutoffs are used, they shall be T-handle type.

For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by Commonwealth and where side wall exhaust vent termination is less than seven (7) feet above finished grade in area of venting including but not limited to, decks and porches, following requirements shall be satisfied:

1. Installation of carbon monoxide detectors: At installation of side wall horizontal vented gas fueled equipment, installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with alarm and battery back-up is installed on floor level where gas equipment is to be installed. In addition, installing plumber or gas fitter shall observe that a battery operated or hard wired carbon monoxide detector with alarm is installed on each additional level of dwelling, building or structure served by side wall horizontal vented gas fueled equipment. It shall be the responsibility of property owner to secure services of qualified licensed professionals for installation of hard wired carbon monoxide detectors.
   A. In event the side wall horizontally vented gas fueled equipment is installed in crawl space or attic, hard wired carbon monoxide detector with alarm and battery back-up may be installed on next adjacent floor level.
   B. In event the requirements of this subdivision can not be met at time of completion of installation, owner shall have period of thirty (30) days to comply with above requirements; provided, however, that during said thirty (30) day period, battery operated carbon monoxide detector with alarm shall be installed.
2. Approved carbon monoxide detectors: Each carbon monoxide detector as required in accordance with above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.
3. Signage: Metal or plastic identification plate shall be permanently mounted to exterior of building at minimum height of eight (8) feet above grade directly in line with exhaust vent terminal for horizontally vented gas fueled heating appliance or equipment. Sign shall read, in print size no less than one-half (1/2) inch in size, “GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS”.
4. Inspection: State or local gas inspector of side wall horizontally vented gas fueled equipment shall not approve installation unless, upon inspection, inspector observes carbon monoxide detectors and signage installed in accordance with provisions of 248 CMR 5.08(2)(a)1 through 4.
5. Product-approved vent/air intake: Product-approved vent terminal must be used and, if applicable, product-approved air intake must be used. Installation shall be in strict compliance with manufacturer’s instructions.
6. Installation instructions: Copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with appliance or equipment at completion of installation.

7.5 freewatt System Combustion Air and Venting

Combustion air and venting installation procedures and specifications are based on installation specifications of boiler and MCHP. Installers are required to follow specific installation requirements found in boiler and MCHP installation manuals and following guidelines taken from these manuals.

7.6 United States *Direct Ven*t System Requirements

In addition to general guidelines, direct vent exhaust for boiler shall be installed in United States in accordance with following requirements. Allowable direct vent intake and exhaust piping lengths for boiler are found in FW95M-200 Boiler Installation, Operation and Maintenance Manual.

Note: boiler should be installed per ***Direct Venting*** requirements and MCHP installed per ***Non-Direct Venting*** Requirements. Distinction is noted to ensure proper location of vent terminations.

1. Clearance from bottom of termination to grade shall be 12” or increased to maintain 12” above anticipated accumulated snow level.

2. Vent shall not terminate over public walkways or over area where condensate or vapor could create a nuisance of hazard.
3. Vent termination shall be installed at least 1 foot from any opening through which flue gases could enter building.
4. Vent termination shall have minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators and relief equipment.
5. Locate vent terminal 3 feet horizontally from vent of any side wall vented fuel gas appliance or electric clothes dryer, except in case of hydronic **freewatt** System or where two or more of these systems are multi-vented.

7.7 United States *Non-Direct Vent* System Requirements

In addition to general guidelines, non-direct vent exhaust for MCHP shall be installed in United States accordance with following requirements. Allowable non-direct vent exhaust piping lengths for MCHP are found in Honda MCHP Installation Manual:

1. Clearance from bottom of termination to grade shall be 12” or increased to maintain 12” above anticipated accumulated snow level.
2. Vent shall not terminate over public walkways or over area where condensate or vapor could create nuisance of hazard.
3. Vent termination shall be installed at least 4 feet below, 4 feet horizontally from, or 1 foot above any door, window, soffit, under eave vent or gravity air inlet to building.
4. Vent termination shall have minimum horizontal clearance of 4 feet from electric meters, gas meters, regulators and relief equipment.
5. Locate vent terminal 3 feet horizontally from vent of any side wall vented fuel gas appliance or electric clothes dryer, except in case of our system or where two or more of these boilers are multi-vented.

8 - GAS SUPPLY PIPING

NOTICE

Boiler and HONDA MCHP units have been factory equipped to burn natural gas only. Honda MCHP can run on natural gas only. Do not attempt to run Honda MCHP on propane gas.

NOTICE

Connect boiler and Honda MCHP units only to gas supplied by commercial utility or supplier. Private gas wells do not generally provide gas with consistent, uniform and predictable heating values and densities. Many non-commercial wells contain impurities such as sulphur, which may damage boiler or Honda MCHP. These units cannot operate properly or safely using fuels outside normal commercial standards.

8.1 Check Gas Supply

Gas pipe to boiler must be correct size for length of run and for total BTU per hour input of all gas utilization equipment connected to piping. See Tables in boiler and Honda MCHP installation manuals for proper size. Be sure gas line complies with local codes and gas company requirements.

freewatt boiler and MCHP unit and their individual shutoff valves must be disconnected from gas supply piping system during any pressure testing of that system at test pressures in excess of ½ psig (3.5 kPa).

freewatt boiler and MCHP unit system must be isolated from gas supply piping system by closing respective individual manual shutoff valves during any pressure testing of gas supply piping system at test pressures less than or equal to ½ psig (3.5 kPa).

In order for proper operation of system, it is recommended line pressure be within minimum and maximum values in Table 8-1.

Table 8-1 – Natural Gas Supply Pressures

Component	Minimum (in. w.c.)	Nominal (in. w.c.)	Maximum (in. w.c.)
System	4”	7”	10”

Please consult the boiler and HONDA MCHP installation manuals for leak testing and purging gas lines.

8.2 Gas Piping

Consult boiler and Honda MCHP installation manuals for specific instructions regarding gas piping for these units.

9 - ELECTRICAL WIRING & CONNECTIONS

⚠ WARNING

Electric shock hazard. Turn off electrical power supply at service panel before making any electrical connections to avoid possible electric shock hazard. Failure to do so can cause severe personal injury or death.

9.1 Codes

Installations shall comply with National Electrical Code, any other National, State, Provincial or local codes or regulations, and in Canada, with CSA C22.1 Canadian Electrical Code (Part 1) and any local codes.

Wiring shall be N.E.C Class 1. If original boiler wiring must be replaced, use only type 105° C wire or equivalent. System shall be electrically grounded as required by National Electric Code ANSI/NFPA 70 – latest edition

9.2 Line Voltage Connections

System installation must include 120 VAC dedicated circuit (15 amp) to boiler, control module, circulator pumps and relay switches and single phase three wire plus ground 240 VAC dedicated circuit (2 pole; 15 amp) to Honda MCHP unit. 120 VAC dedicated circuit will extend to serviceman's switch for boiler and then feed boiler, control module, circulator pumps and relay switches. If power consumption of circulators requires another circuit, this will be used for circulators and relay switches.

9.3 Line Voltage Wiring Specifications

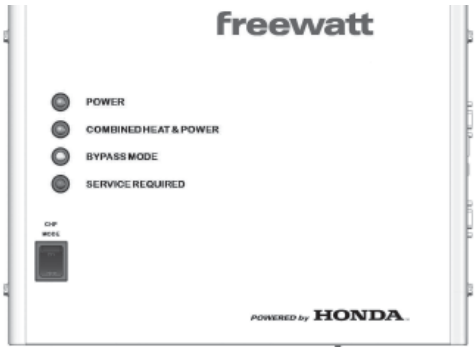
240 VAC Wiring: Wiring shall conform to National Electric Code and any other national, state or local code requirements. Wiring must be N.E.C. Class 1. In Canada, C.S.A. C22.1 Canadian Electrical Code Part 1 and any other national, provincial or local code requirements must be followed. Wiring must be C.S.A. C22.1 C.E.C. Part 1.

120 VAC Wiring: Wiring shall conform to National Electric Code and any other national, state or local code requirements. Wiring must be N.E.C. Class 1. In Canada, C.S.A. C22.1 Canadian Electrical Code Part 1 and any other national, provincial or local code requirements must be followed. Wiring must be C.S.A. C22.1 C.E.C. Part 1.

9.4 freewatt System Control Module Installation

Determine location of **freewatt** Control module, mount module's enclosure on solid wall or partition. Recommended enclosure be located close to **freewatt** boiler, Honda MCHP and HI Module, within reach of supplied, pre-terminated cable. Also, mounting 2 ft. wide x 4 ft. high sheet of plywood as mounting surface should allow control module, relay switches and HHI module to be installed. However, unit may be mounted up to 20 feet away. Locate enclosure with

Figure 9-1 Control Module



installation and service accessibility in mind.

- Position control module enclosure above ECR relay switches, place enclosure on relay switch modules with four ½" offset nipples, check for level, and mark mounting holes. See Figures 9-1, 2-8 and 2-9.
- Start screws (#10; 4 (Qty); not supplied) for keyhole type mounting holes in upper corner(s). Tighten screws down to about 1/8" (3mm) from surface.
- Hang enclosure on screws, level enclosure and tighten screws.
- Install four nuts on ½" offset nipples to secure enclosure to relay switch modules.

⚠ WARNING

Do not route unswitched line-powered cables or wires through the freewatt System as this may pose a potential electric shock hazard. Failure to do so can cause severe personal injury or death.

NOTICE

Recommend no additional electrical connections be made within **freewatt** Control module for line power. If line power is required for condensate pump, separate junction box and receptacle should be provided.

120 VAC dedicated circuit shall conform to NEC and use as minimum 3-conductor, 14 Ga. Cable.

9.5 ECR Zone Relay Controls

Install, connect, and set-up appropriate ECR Zone Relay Control for temperature control of different heating zones and for accommodation of indirect water heater (if used) as indicated below. Refer to Electric Schematics in section 17 for specific wiring details. For **freewatt** Systems zoned with circulators, use ECR ARM-6P control. ARM-6P control will accommodate up to six zones. If more zones are needed, expand ARM-6P with ECR AD-1 or AD-4 expansion controls or additional ARM-6P. For **freewatt** Systems zoned with valves use six-zone ECR AZ-6CP. AZ-6CP can be expanded up to ten zones with water heating priority with additional AZ control. For **freewatt** Systems with air handlers (hydro-air) use three zone ECR ARH-3 control, expanded as needed with additional ARH controls.

9.6 Wiring Instructions

1. Provide and install non-fused disconnect or 120VAC service switch (15 amp recommended) as required by authority having jurisdiction.
2. Route 120 VAC power wiring from service switch to boiler's line voltage terminal strip on boiler control panel as outlined in **freewatt** Boiler IOM. See Location 8 in Figure 9-2.
3. Route 120 VAC power wiring from service switch to ECR AR822-II and attach to 120 VAC power terminals.
4. Route power wiring from 120 VAC power wiring from junction / switch box to ECR ARM-6P (or AZ-6CP or ARH-3, as appropriate). Wiring can be routed through ½" offset nipple connector and into control module enclosure. Connect 120 VAC power wiring to 12 VDC power supply's pig tail in Control module using wire nuts and attach ground wire to control module enclosure's grounding screw located at inside bottom of enclosure. See Figure 9-3.
5. Wire control module to zone relay control and AR822-II following appropriate **freewatt** System low voltage and line voltage electrical schematics in section 17.
6. Wire circulators and MCHP's hydronic pump to zone relay control and AR822-II following instructions found in their installation manuals and **freewatt** System electrical schematics.
7. Connect MCHP Coolant Pump's 12VDC power cable to control module.
8. Connect Pressure Switch System, per applicable electrical schematic of section 17.
9. Connect four 24 VAC circuits between boiler control and **freewatt** Control Module per applicable electrical schematic of section 17.
10. Configure jumper on Control Module circuit board as show in Figure 9-5 for set-up of hydronic system water heating and space heating zones. If Zone 1 is connected to Aquastat in indirect water tank, jumper must be installed on DHW pins. If Zone 1 is connected to thermostat for space heating, jumper must be installed on HEAT pins. If indirect water heater is used with **freewatt** System, it MUST be connected to Zone 1 input on **freewatt** Controller.

Figure 9-2 Boiler 120 VAC Connections
(Refer to Electrical Schematic)

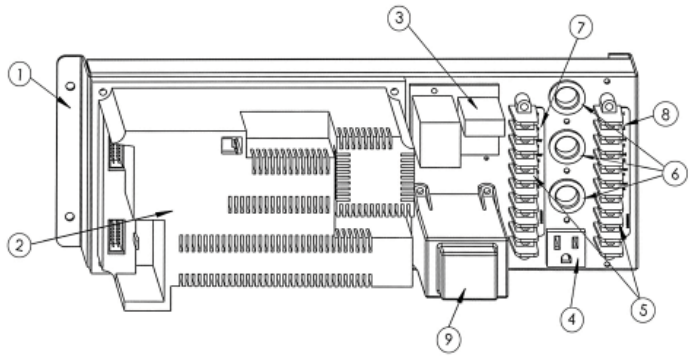


Figure 9-3 Control Module 120 VAC Connections

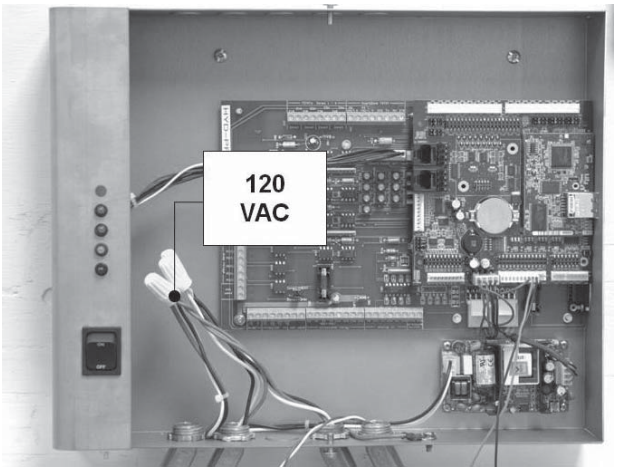
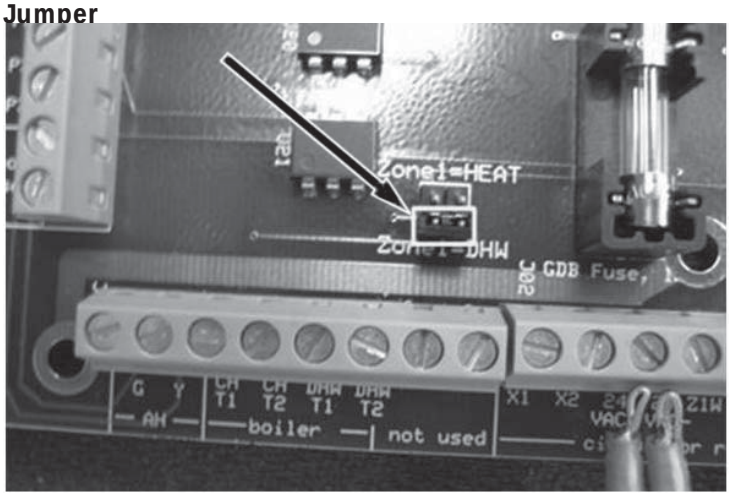


Figure 9-4 ARM-6P & AR822-II Wiring

ARM-6P		**freewatt** Control Module
TW1 (priority)	to	Z1W
TW - Zone 2	to	Z2W
TW - Zone 3	to	Z3W
TW - Zone 4	to	Z4W
TW and TR - Zone 5	to	Installer supplied thermostat of Zone 5
TW and TR - Zone 6	to	Installer supplied thermostat of Zone 6
AR822-II		Control Module
TR	to	P2T1
TW	to	T2T2

Figure 9-5 Control Module Configuration DHW or CH Jumper



9.7 Circulator Zoned System - ECR ARM-6P DIP Switch Settings

PRIORITY SWITCH: When **freewatt** System includes indirect hot water tank, configure ECR ARM-6P for Domestic Hot Water (DHW) Priority. This will require Priority Switch placed into ON position. When Priority Switch is ON, Zone 1 becomes heating priority and when Zone 1 calls for heat all other zones are temporarily deactivated (Priority LED is illuminated.) Timer automatically shuts off this feature if priority zone (Zone 1) calls for heat longer than 30 minutes, allowing all zones to operate. Cycle repeats in another 30 minutes until priority zone is satisfied. Priority Switch setting on ARM-6P must match Priority setting in **freewatt** Controller. Set using laptop and MINT Software tool.

9.8 Valve Zoned System - ECR AZ-6CP DIP Switch Settings

There are four "Option" switches that must be properly set on AZ-6CP controls as follows:

1. "Zone Valve/Pump Selection Switch" Set to "ON" when using Indirect Water Heater on Zone 1. [When Zone 1 is specifically configured for use with indirect water heater having its own "priority" circulator pump and all remaining zones are configured with single "primary" circulating pump and individual zone valves, switch allows for operation of separate water heating "priority" pump of Zone 1. To allow for operation of water heating " priority" pump in water heating applications of Zone 1, "Zone/Valve Pump" Switch must be in "ON" position. If "Zone/Valve Pump" Switch is in "Off" position, only Zone 1 zone valve terminals will be energized, as is appropriate if Zone 1 is central heating zone (and no indirect water heater is configured with **freewatt**). Place "Zone/Valve Pump" Switch in "OFF" position only if indirect water heater is not connected as Zone 1.

   IMPORTANT: "Priority Selection Switch" (item 2 below) must be in "ON" position when this "Zone/Valve Pump" Switch is in "ON" position. Also, when setting "Zone/ Valve Pump Selection Switch" in "ON" position, jumper wire must be installed between terminals 3 and 4 of "Zone 1" output of AZ-6CP control. Jumper is not required when using zone valve (no indirect water heater with separate "Priority" circulator) on Zone 1. Appropriate wiring is shown in Figure " Low Voltage Wiring: Primary/Secondary Piping with Zone Valve and Domestic Hot Water Priority Circulator".]
2. "Priority Selection Switch" Set to "ON" when using Indirect Water Heater on Zone 1. [This switch is used to set operational priority to domestic water heating when used with Zone 1. With this switch in "ON" position, call for heat by Zone 1 (indirect water heater) will activate "Priority" pump connecting to indirect water heater and all other zones will be temporarily deactivated. Thus, temporarily, no space heating will be supplied in response to any space heating thermostats. Priority LED on AZ-6CP will be illuminated when this priority function is active. After 30 minutes priority is terminated and all zones will operate normally. If after 30 minutes, water heating demand of Zone 1 is not satisfied, 30 minute temporary deactivation of all other zones will again resume and cycle will repeat. Thus, set "Priority Selection Switch" to "ON" for water heating priority and "OFF" for no water heating priority on Zone 1.]
3. "ZR-ZC Selection Switch": Set to "OFF"
4. "DPM-2 Selection Switch": Set to "OFF"

9.9 Hydro-Air Zoned System - ECR ARH-3 Settings

PRIORITY SWITCH: When **freewatt** System includes indirect hot water tank, configure ECR ARH-3 for Domestic Hot Water (DHW) Priority. This will required Priority Switch to be placed into ON position. Priority operation of Zone 1, water heating zone, will be similar to that described above for ARM-6P control.

9.10 HONDA MCHP Unit - Line Voltage Connections

NOTICE

Flexible metal conduit is required to provide vibration isolation for Honda MCHP. 240 VAC dedicated circuit shall conform to NEC and be minimum 4-conductor, 14 AWGwiring within flexible metal conduit.

Refer to Honda MCHP Installation Manual – Electrical Connections Section before performing installation instructions in this section.

Power supply must be single phase three wire plus ground 240 VAC 60 Hertz per Honda MCHP Installation Manual.

Recommended Breaker: 2-pole; 15 Amp breaker.

Remove cover plate, install blanking plate and connect 240 VAC power cable to terminal block on Honda MCHP unit. See Figure 2-6 for details.

Provide and install 240-VAC disconnect switch and junction box onto side of boiler or adjacent wall and extend 4-wire flexible metal conduit to MCHP unit's electrical terminal block. Do not attach any disconnect switch or junction box on to MCHP unit cabinet. Make no penetrations in MCHP cabinet.

9.11 HONDA MCHP Unit - Communication Connections

Connect Honda MCHP to freewatt Control Module with furnished RS232 communications cable.

1. Connect MCHP communication cable to RS232 communication port on side of freewatt control module enclosure. Figure 2-9.
2. Route cable to MCHP wiring compartment.
3. Connect cable to MCHP communications 6 pin connector, item 4 in figure 2-6.
4. Install strain relief for MCHP communications cable and exhaust gas sensor cable outside MCHP wiring compartment per figure 9-9.
5. Locate crimp connectors for exhaust gas sensor cable in wiring compartment per figure 9-6.

9.12 Smart Zone Thermostat Connections

Refer to instructions supplied with special "Zone 2 - Smart Zone" communicating thermostat for specific installation and operating instructions. Thermostat cable will extend from thermostat to Control Module and will be routed through low voltage knockout on control module enclosure as shown in Figure 9-7.

1. Install thermostat on inside wall away from influences of drafts, hot or cold water pipes, lighting fixtures, televisions, sun-rays, or fireplaces. Install "Zone 2 - Smart Zone" thermostat in accordance with guidance provide in Sections 2, 3 and 4. (Heating load for Zone 2 should not be less than about 25% of total for building).
2. Connect thermostat cable to thermostat per Figure 9-8. For HAI Smart Zone thermostat, use Honeywell Genesis Cable, Model Number 22 AWG 10/C STR CM-CL2 (or equal). This cable is 22 AWG, 10 Conductor, stranded cable meeting UL Standards 13 &144, NEC Article 725. Refer to **freewatt** HAI thermostat Installation manual for additional thermostat connection and option details.
3. Route cable to Control module. Cable will enter control module's enclosure through top knockout opening (See Figure 2-8 or 9-7) and connect to control module's TSAT connections.
4. Wire all other compatible zone thermostats (new or existing) and Indirect Water Heater aquastat as per requirements of each. ***Note:*** First four zones (including DHW if used) connect directly on circuit board of **freewatt** Control Module. All other zones connect directly to appropriate ECR zone relay control.

Figure 9-6 MCHP - Low Voltage Connection

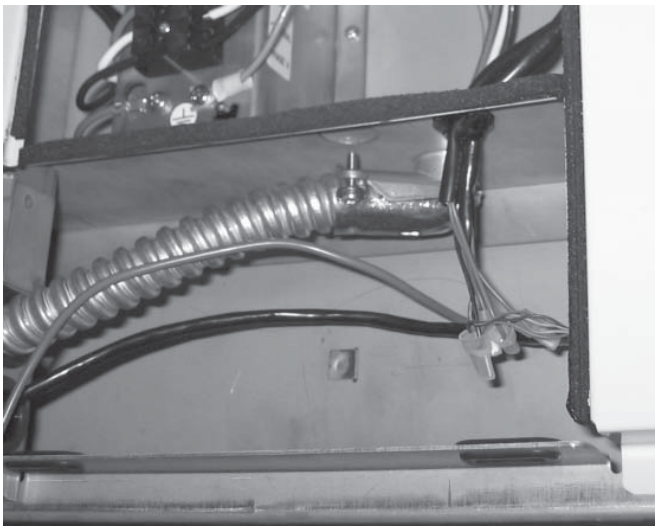


Figure 9-7 T-Stat Connection to Controller

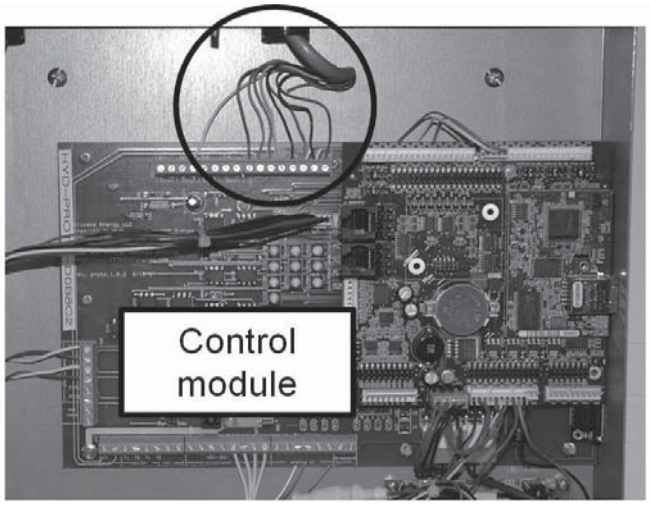


Figure 9-8 Thermostat Connections

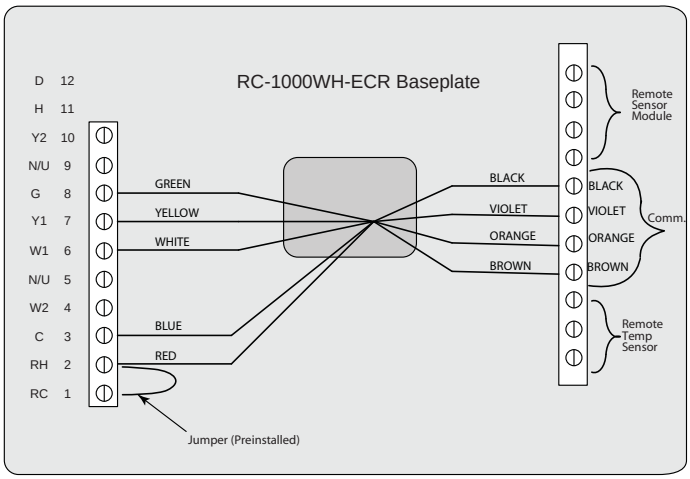
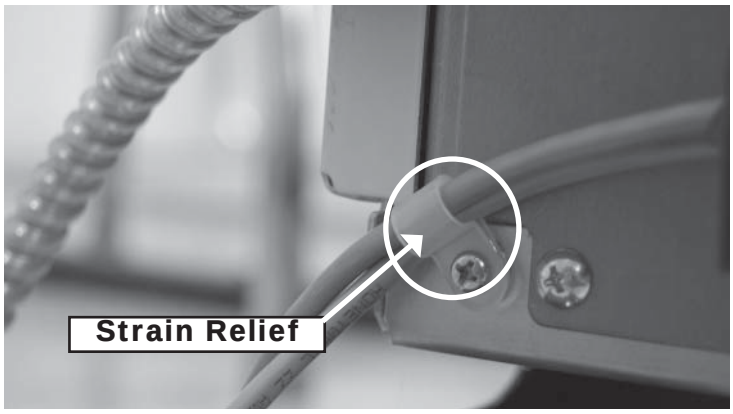


Figure 9-9 MCHP Low Voltage Wiring Strain Relief



5. **freewatt** Thermostat, when set in COOL MODE, may be used to control air conditioning system. For **freewatt** System configurations with ECR ARM-6P or AZ-6CP zone relay controls and separate cooling 24 VAC transformer (additional to **freewatt** System transformer) metal jumper between Terminal 1 (RC) and Terminal 2 (RH) on **freewatt** Thermostat on left terminal strip must be removed.
6. 24 VAC source for air conditioning system may be routed to **freewatt** Thermostat using spare grey wire in **freewatt** thermostat cable. Use Y wire of **freewatt** Thermostat cable to connect directly to Y input of air conditioning system (do not connect Y to **freewatt** control board). If thermostat supplied with **freewatt** System does not have terminal for RC, use external isolation relay for switching cool signal from thermostat. For **freewatt** System configurations using ARH-3 zone relay control with air handlers, wire thermostat for heating and cooling as indicated in electrical wiring diagram of section 17.

9.13 Outdoor Temperature Sensor

Mount supplied Tekmar 070 outdoor sensor on outside exterior wall per sensor manufacturer's instructions, shielded from direct sunlight or flow of heat or cooling from other sources. Northern exposure is preferred.

Route sensor's wires through exterior wall into house and through knockout on top of control module. Please reference Electrical Schematics for control module connections. Do not combine wires of Tekmar Outdoor sensor with those of **freewatt** Boiler Outdoor Sensor in single cable or conduit as electrical interference will result.

9.14 Internet Connection

Control module has RJ 45 network connection. Connection is found at right side of control module's enclosure. Connection point accepts CAT 5e cable. Commissioning instructions are found in section 11.4.

10 - COMPONENTS, CONTROLS AND ACCESSORIES

Section provides brief description of components, controls, and accessories of hydronic **freewatt** System. See Sections 13, 15 and 16 for sequence of operation, service hints and troubleshooting procedures. See separate "Repair Parts Manual" for locations of all components and accessories described.

10.1 ECR Zone Control Kits

ECR Zone Control kit must be purchased with system. Kit contains necessary relay controls and communicating thermostat.

550002147 - Zone Valve Accessory Kit

550002148 - Circulators Accessory Kit

550002149 - Hydro-Air Accessory Kit

10.2 Boiler

freewatt Boiler is Category IV, natural gas-fired, high efficiency (95% AFUE), condensing home heating appliance with infinitely modulating capacity from 80 to 200 MBH. Boiler can be used for wide variety of applications (with or without zones) including radiant floor heating, snow melting, baseboard heating, standing iron radiators and air coil units. All boilers are factory-assembled with controls and wiring, and tested to ensure dependable performance. Boiler has all applicable CSA and ASME certifications.

10.3 Control Module

Control module monitors and controls operation of Hydronic **freewatt** System. Sensing inside and outside temperature as well as other system temperatures and settings, proprietary heating algorithm controls operation of Honda MCHP to optimize its power production and low level heat delivery. Control module includes relay/interconnect board, DC power supply, and advanced single-board computer board incorporating powerful microprocessor, RS-232/RS-485 serial ports, and 10/100Base-T Ethernet port. See Section 11 for additional details.

10.4 Hydronic Hybrid Integration (HI) Module

Hydronic HI Module is location where heat in MCHP coolant is transferred into hydronic water. Hydronic HI module consists of brazed plate heat exchanger, mixing valve, coolant reservoir and coolant pump. Brazed plate heat exchanger provides effective heat transfer from compact, lightweight package. Hydronic water is pumped through secondary circuit, while MCHP coolant is pumped through primary circuit. Mixing valve is factory-set to deliver minimum 152° F coolant to pump, which then returns coolant to Honda MCHP unit. Coolant reservoir holds spare coolant and is also instrumental in proper commissioning of system.

Hydronic HI Module is designed to conveniently mount on adjacent wall or on side of boiler. Module's brazed plate heat exchanger has two ¾" NPT hydronic water connections and two ¾" NPT coolant loop connections connected to HI module. MCHP hydronic pump is mounted external to HI module as part of hydronic system piping. MCHP hydronic pump requires 120 VAC and is powered through the AR822-II relay control. Coolant pump operates on 12 VDC supplied directly by freewatt control module. **freewatt** control module operates both coolant pump and MCHP hydronic pump.

10.5 Honda MCHP Unit

Honda MCHP Unit is custom-engineered micro-combined heat and power module integrated into Hydronic **freewatt** System. MCHP unit is designed to start and stop by means of digital signal from control module when control module senses there is heat demand in dwelling. MCHP unit is UL certified for grid interconnection and, if your utility allows, unit can deliver electrical power back into electric grid. Unit also provides system operating data and diagnostic data to control module. More details on MCHP unit can be found in Honda MCHP Installation Manual and User's Guide.

10.6 Smart Zone Communicating Thermostat

System certified communicating HAI thermostat has ability to communicate directly with control module. Feature allows control module to download thermostat settings and maximize system's electrical power generation, while also providing higher level of comfort to dwelling. Zone to which this thermostat is applied is referred to as "Smart Zone" This supplied communicating thermostat must be used on one space heating zone of hydronic system. **freewatt** System will ***not*** work with any other thermostat installed in "Smart Zone". Compatible conventional thermostats, new or existing may be used in all other zones. See Section 20 for guidance on selecting **freewatt** compatible room thermostats.

10.7 Outdoor Temperature Sensor

Hydronic **freewatt** System uses two outdoor temperature sensors to anticipate heat demand within dwelling by tracking outdoor temperature. As outdoor temperature falls, control module will determine optimum temperature to activate Honda MCHP unit and provide thermal comfort, while also maximizing generation of electrical power. One temperature sensor (Honeywell) is connected directly to **freewatt** Boiler and other (Tekmar) is connected directly to **freewatt** Control Module. Both must be installed.

Wiring to each sensor should be routed separately to ensure signal quality.

10.8 Internet Connection

Control module can connect to high-speed internet service (Broadband cable, DSL, etc.) and will allow **freewatt** service provider to continuously monitor system's operating characteristics. If system has operating characteristics that are outside normal operating range and remote monitoring system is enabled and active, control module will notify service provider of this abnormality. Refer to Section 11 for setup details.

10.9 Website

Control module has web site address assigned to system at time of installation that allows homeowner and service provider to monitor or control system's operation. Refer to User's Information Manual for more information.

10.10 External Condensate Pump

For installation where there is no floor drain or other appropriate drainage receptacle available to receive condensate from system (boiler and MCHP unit), float activated condensate pump with integral sump is required. Condensate pump can be piped to remote tie-in point to sanitary sewer system (Please follow all state or local regulations regarding disposal of condensate). For this application, system must be installed so the proper pitch can be placed on piping to deliver condensate safely to external condensate sump.

10.11 Exhaust Gas Leak Sensor

Exhaust Gas Leak Sensor (EGLS) monitors integrity of Honda MCHP unit combustion system and shuts down MCHP unit if certain potentially unsafe conditions are detected. It does this by monitoring carbon monoxide level in air space near MCHP unit. Exhaust Gas Leak Sensor is independent of, and separate from, audible CO alarming system also installed with **freewatt** System in compliance with best practices for all fuel-fired central heating equipment. Proper installation of EGLS is required to commission Hydronic **freewatt** System.

10.12 Pressure Switch System

Pressure Switch System is intended to detect blockage of Honda MCHP unit's exhaust vent. This system is required to commission Honda MCHP unit.

10.13 Concentric Vent/Air Intake Termination (Optional)

Optional concentric vent/air intake termination for boiler utilizes single opening through wall or roof instead of separate openings for vent and air intake. MCHP unit will still require one opening for its exhaust vent.

11 - CONTROL MODULE FEATURES

11.1 System Control Design

Hydronic **freewatt** Control module is designed for central heating with boiler and micro-combined heat and power (MCHP) unit.

- Control module integrates Honda MCHP unit with boiler replacing an existing boiler installation. Controller uses inputs from communication thermostat and outdoor sensor to optimize operation of Honda MCHP unit. (Note: Boiler has second, independent outdoor temperature sensor.)
- Control module operates in combination with display/ user interface (ie. laptop computer or PDA) for both information and operation purposes. Control Module requires communicating thermostat and outdoor sensor to operate properly.
- Control module includes relay/interconnect board, DC power supply, and advanced single-board computer board that incorporates powerful microprocessor, RS-232/RS-485 serial ports, and 10/100Base-T Ethernet port.

11.2 Control Module Functions

Control module integrates boiler and Honda MCHP with communicating thermostat, outdoor temperature sensor and remote monitoring capability. Communicating thermostat and outdoor temperature provide control module with desired temperature settings and actual operating temperatures.

11.3 Display/User Interface

Using PC, homeowner can scroll through control settings and change operating settings to customize **freewatt** System operation. See separate document for "**freewatt** System Webpage" or User's Manual for more information on using embedded **freewatt** web page.

11.4 Internet Connection

Control Module connects to customer's home network in same way any computer or other network appliance does - by connecting via Ethernet connection available on most mass market routers. **freewatt** connection uses 10/100 Mbit/s wired Ethernet connection. Powerline network adapters may be used when direct wired connection isn't possible.

Control module is assigned static address outside of any DHCP range available from router. IP address, netmask, gateway and DNS addresses will need to be programmed into controller using **freewatt** MINT service tool.

Configure router to allow incoming traffic for diagnostics and embedded customer webpage. Routers refer to settings as 'port forwarding', 'applications', or 'virtual servers'. Refer to router manufacturer documentation or see www.portforward.com. Remote diagnostics requires port 4500 be directed to **freewatt** controller, customer webpage requires port 8082 be directed to **freewatt** controller.

Connect to Control Module using **freewatt** service tool to apply network settings to **freewatt** controller.

1. Select "Network Setup"
2. Default settings are DHCP – Check to see if an IP Address is acquired automatically in the "Router" text box. If so, proceed to the next step.
   A. If IP address does not appear in "Router" text box, check wiring, and verify internet connection
3. Select "Use Manual"
4. In "IP Address" text box, change last three digits of this field to .200 (xxx.xxx.x.200) (if this address is available on the network.
5. Select "Use Open DNS".
6. Select "Update".
7. Follow prompt to reset system
8. Disconnect and restart **freewatt** service tool. After reconnecting to system, check Network Status in "Network Setup".
9. If Network status is OK then open web browser and type http://xxx.xxx.x.200:8082 (Use actual IP address from "IP Address" text box) and **freewatt** status page should appear.
10. Change default user password for customer to something private.

DDNS service may be used to support dynamic IP addresses.

Turn on reporting from **freewatt** system to **freewatt** System telemetry server:

1. While connected to **freewatt** with **freewatt** service tool, select "Alerting Setup"
2. Verify database address is telemetry.**freewatt**.com
3. Verify sampling rate is 86400 (one report per day)
4. Click Enable Sampling Checkbox
5. Click update
6. Disconnect service tool from **freewatt** System.

Contact **freewatt** Technical Service for more details concerning connection.

12 - COMMISSIONING, START-UP, OPERATING AND CHECKOUT PROCEDURES

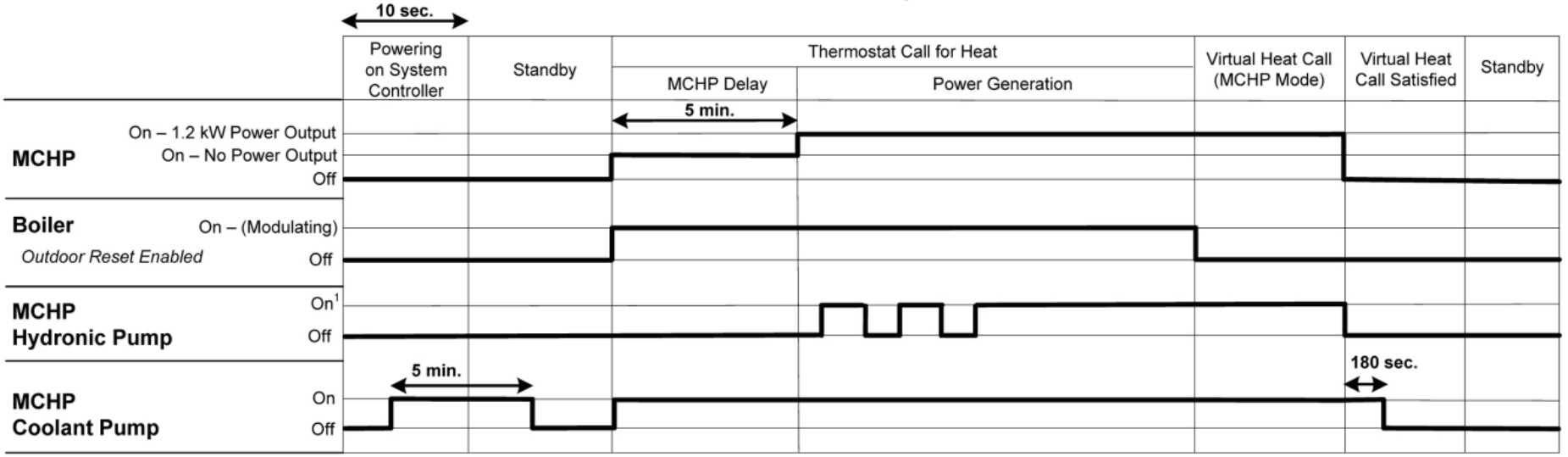
12.1 Commissioning Procedure

Refer to literature packet document “Hydronic freewatt System Model HDZ Commissioning, Start-Up, Operating and Checkout Procedure”.

HYDRONIC FREEWATT SYSTEM Model HDZ

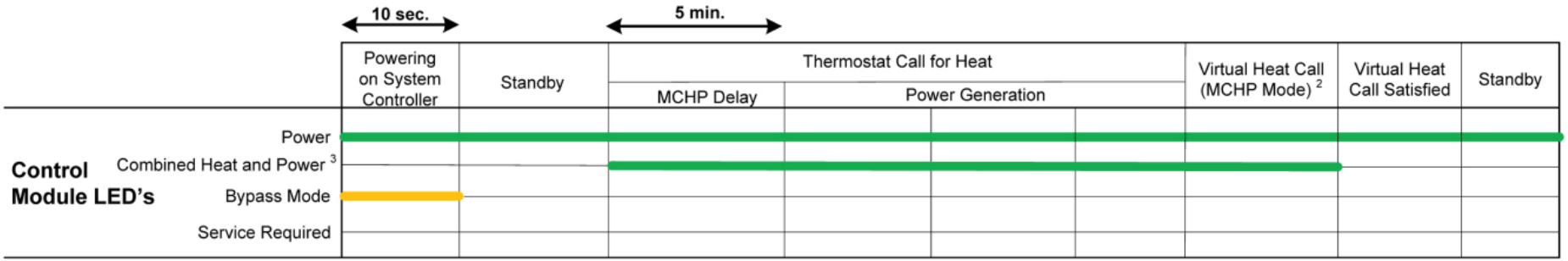
Sequence of Operation/Timeline: ***Normal MCHP Mode***

Mechanical Operations



[1]The System Controller will cycle the MCHP hydronic pump to maintain MCHP coolant temperatures

LED Display



[2]If every 2 minutes the Zone Controller turns OFF for 2 seconds and back ON, this is a normal function to inspect an expansion module for "Heat Call" activity during a Virtual Space Heating Call or Virtual Domestic Hot Water Call.

[3]If the CHP LED (Green) is flashing, this is a safety mode of operation that turns off the MCHP based on a spike of the coolant temperature above its recommended range of normal operation. In most cases, this mode will be temporary, but if it persists, please contact your dealer.

13 - SEQUENCE OF OPERATION

13.1 MCHP Operation: What to expect

freewatt System is designed to preferentially provide heat to home and indirect water heater by operating MCHP unit. Boiler is operated as supplemental heat supply as needed to maintain comfort. Preferential operation of MCHP is achieved in-part by allowing MCHP to operate at times when thermostat does not specifically call for heat, but, based on outdoor temperature, continuing need for heat can be established. Homeowner should expect MCHP to "run" longer and more often than boiler, even at times when thermostat may not indicate call for heat. In all cases, **freewatt** System is designed to maintain close control of building temperature and variations in room temperature should be less than those encountered with traditional thermostats with operating temperature dead band.

13.2 freewatt System Response to Heat Demands:

Like any central hydronic heating system, **freewatt** System heating function is generally activated by call for heat from thermostat or aquastat on indirect water heater. It does not function in any way to directly respond to electrical power demands in the home. Response of **freewatt** System to heat calls is as follows:

1. Upon demand for heat from any space heating zone, hydronic water flow to zone "radiators" is initiated, MCHP unit is started and boiler operation is enabled. Burner in boiler will fire as necessary to maintain currently required hydronic loop temperature as determined by programmed outdoor reset control of boiler. Initially boiler fires at lowest input rate and modulates to higher levels as determined by temperature response of hydronic loop temperature.
2. For Smart Zone, operation of MCHP unit, once initiated by call for heat, will continue beyond specific call for heat from Smart Zone Thermostat so long as outdoor temperature sensor indicates general need for heating of building (i.e. outdoor temperature about 55° F). Boiler operation is disabled immediately at end of call for heat from Smart Zone Thermostat. Operation of MCHP unit is terminated only when there is small temperature rise above current set temperature of Smart Zone Thermostat.
3. For any of other three heating zones with room thermostats wired directly to **freewatt** Controller, operation of MCHP will continue until initiating, or any new heat demand, zone is satisfied and **freewatt** Controller determines it is not possible either to 1) operate Smart Zone without exceeding small temperature rise above Smart Zone setpoint or 2) operate domestic water heating zone without causing unacceptably high temperature in MCHP coolant. Boiler burner operation is disabled immediately upon end of call for heat.
4. For any zones with room thermostats wired directly to ECR relay control (generally 5 and 6) or any ECR expansion relay control, operation of MCHP and boiler burner will terminate with end of heat call (either from initiating zone or any other zone.)
5. Upon call for heat as provided by Aquastat of Indirect Water Heating Tank of Zone 1, when Zone 1 is configured for heating of domestic water, water heating zone pump is started, MCHP operates, and boiler burner is enabled for operation to maintain to the temperature programmed as domestic water heating temperature (**freewatt** Boiler Parameter 1 + 33). When Aquastat is satisfied, boiler burner will be disabled and MCHP will continue to operate until **freewatt** Controller has determined it is not possible to

   1) operate Smart Zone without exceeding small temperature rise above Smart Zone spacing heating setpoint or

   2) operate domestic water heating zone without causing unacceptable high temperature in MCHP coolant. This will heat up the indirect water heater tank well beyond maximum recommended 120°F aquastat setting, allowing water heater tank to be used for thermal storage.
6. At all times of operation of MCHP unit, MCHP coolant temperature is monitored internally in MCHP unit and reported to **freewatt** Controller. If at any time MCHP coolant reaches level of the 185° F, MCHP operation will be terminated automatically by **freewatt** Controller and disabled for specific period of time ranging from 15 minutes to three hours. This can occur when, as result of low outdoor temperature, current target temperature of boiler control is high (about 160° F or above.) Can also occur if boiler temperature boost mode is not disabled as recommended. In either case, **freewatt** Controller logic takes into account frequency at which 185°F coolant temperature is reached and then determines for how long to disable operation of MCHP unit. This operational logic limits number of times MCHP is started and stopped in presence of high hydronic loop temperature.
7. Default setup of **freewatt** Controller is to provide 30 minute priority to DHW heating when DHW jumper in place. Priority action only pertains to achieving satisfaction of indirect water heater aquastat (not virtual heat call operation of MCHP unit.) Priority action can be deactivated by using Mint Service Tool.

13 - SEQUENCE OF OPERATION

13.3 Achieving Best **freewatt** System Performance

Homeowner dollar, carbon dioxide emissions, and energy savings with **freewatt** will be maximized by adjusting operating parameters of boiler and thermostat to achieve maximum preferential operation of MCHP unit (and minimum firing of boiler). Following steps will help in maximizing benefit of **freewatt** System.

1. Set top target temperature of boiler reset operating temperature control (parameter 4) at lowest possible temperature that will meet heating needs of home on coldest days of year. Recommended top target temperature is 160°F as per separate Commissioning Procedure document. Setting top target temperature greater than 160°F will significantly reduce operation of MCHP unit and resulting electric power production. Set target temperature lower if possible.
2. Set Aquastat on indirect water heater no greater than 120°F.
3. Minimize number of degrees of temperature setback with programmable thermostat. Unique to **freewatt**, deep setback will limit run time of MCHP unit and maximize operation of boiler, reducing electric power energy and cost savings. Generally, additional fuel cost of maintaining near constant room temperature during heating season will be far lower than saving due to electric power production by **freewatt** System.
4. Select Smart Zone and configure if necessary, so it represents at least about 25% of total heat demand of home.
5. Routinely setting individual zone thermostats such that Smart Zone set point is small amount (say 1 or 2 degrees) above other zones in home will tend to help maximize production of electricity by **freewatt** System.
6. Set **freewatt** Boiler parameter 11 to value of zero as suggested in separate Commissioning Procedure document. This turns off temperature boost feature of boiler control. If occupants are dissatisfied with response of heating system to thermostat set point adjustments, consider altering outdoor reset curve, using Parameters 4, 5, 6, and 7 before adjusting Parameter 11 to non-zero setting. Keeping parameter 11 at zero will be most beneficial when there are heating zones that do not have critical heating comfort requirements but will produce nearly constant call for heat. Near constant call for heat can result from heating zone being “under radiated” or as result of heat convectors being closed off. **freewatt** will perform best when all heating zones have appropriate amount of radiation.

13.4 Use of Bypass Mode

- Bypass Mode disables **freewatt** Control Module/ Hybrid Integration Module and HONDA MCHP.
- Mode also connects thermostat directly to boiler and allows system to deliver heat to dwelling.
- Switch CHP Mode Switch to OFF to force bypass mode of operation. This is useful to disable Honda MCHP operation while final approval for grid interconnection is pending.
- **freewatt** System will go automatically into bypass if fault develops in subsystem (Control module/ HI Module and Honda MCHP) or critical MCHP maintenance procedure is not performed on schedule.
- Bypass mode is also useful in temporarily stopping operation of MCHP unit if fault condition is indicated or any other operational concerns arise with MCHP unit operation.
- **freewatt** System may be left in Bypass Mode until service can be provided as boiler will continue to provide heat.

14 - MAINTENANCE AND CLEANING

⚠ WARNING

Disconnect electrical power supply to **freewatt** System before attempting any maintenance. Failure to do so can cause electrical shock resulting in personal injury or loss of life.

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Always verify proper operation after servicing.

Hydronic **freewatt** System, more specifically boiler & Honda MCHP unit, have specific maintenance and cleaning procedures outlined in their Installation, Operation and Maintenance manuals provided with this manual. Please review these manuals before proceeding to system procedures found below.

Regular service and maintenance by qualified service agency must be performed to assure safe, trouble-free operation and maximum efficiency. Service or inspect system at least once every 12 months.

14.1 Beginning of Each Heating Season

Schedule annual service call by **freewatt** dealer or other certified service agency, which includes:

1. Boiler: Examine boiler per its annual inspection/service procedures outlined in its Installation, Operation and Maintenance Manual. Inspections include, but are not limited to:
   - A. Heat Exchanger's Flue Passageways
   - B. Burner
   - C. Combustion Fan
   - D. Circulator
   - E. Electrical Connections
   - F. Condensate Drain
   - G. Intake Air and Exhaust Piping
   - H. Boiler Operation (Safeties, Temperature Rise & Burner Ignition)
2. Control Module/Hybrid Integration (HI) Module: Examine Control module/HI Module per its annual inspection/service procedures outlined below:
   - A. Control Module: Check control module's functions through laptop computer or PDA. Detailed procedures are found in MINT Tool Supplement.
   - B. Communication/Electrical Connections: Inspect connections to and within Control Module and HI Module to verify they are secure and connected properly.
   - C. Bypass Switch: Place CHP Mode Switch in OFF position and operate boiler to verify switch is working properly. Place CHP Mode Switch in ON position after verification is complete.
   - D. Coolant Level: Check coolant level in coolant tank and fill with coolant, if necessary.
   - E. Mixing Valve: While system is operating, check coolant temperature being delivered by valve. Check for leaks and fix, if necessary.
   - F. Pump: Inspect pump and connections. Check for leaks and fix, if necessary.
   - G. Coolant Tubing and Connections: Inspect coolant tubing and connections for leaks and fix, if necessary.
   - H. Brazed Plate Heat Exchanger: Inspect heat exchanger for leaks and fix, if necessary.

Honda MCHP unit: Honda MCHP unit requires periodic inspection by certified service professional to maintain acceptable performance and ensure safe operation. These inspection/service procedures are outlined in unit's Installation, Operation and Maintenance Manual. Typically, these services are required every 6,000 hours, so operating time of unit will directly impact service interval. These inspections include, but are not limited to:

- **a.** Starting Ease
- **b.** Oil Leakage
- **c.** Engine Coolant
- **d.** Breather Tube
- **e.** Condensate and Condensate Drain
- **f.** Air Cleaner Element
- **g.** Intake Air and Exhaust Piping
- **h.** Ventilation Air Inlet and Outlet
- **i.** Coolant Tubing and Connections
- **j.** Electrical System and Connections
- **k.** Communication System and Connection
- **l.** Replace:
  - Engine Oil and Drain Washer.
  - Engine Oil Filter Cartridge.
  - Spark Plugs.
  - Adjust Clearance Between Tappets.

MCHP Owner's Manual outlines specific maintenance intervals (6,000, 12,000, 18,000 & 24,000 hours) and requirements for each interval. This maintenance should be conducted by certified service professional to maintain acceptable performance and ensure safe operation of your Honda MCHP.

14.2 freewatt Shutdown Procedure:

A. Preferred Shutdown Method: Set CHP MODE switch on control module to OFF. After shut down cycle of approximately three minutes is completed, set 120 VAC Service Switch to OFF position.

B. Emergency Shutdown Method: Set 120 VAC Service Switch and CHP MODE switch to OFF. Due to coolant pump turning off, HONDA MCHP may overheat and flash error message.

⚠ WARNING

Should overheating occur or gas burners or internal combustion engine fail to shut off, close manual gas valves for boiler and MCHP before shutting off electrical power to boiler. Failure to do so can cause an explosion or fire resulting in property damage, personal injury or loss of life. Before restarting boiler or MCHP, check all plastic vents, gas connectors and wiring for damage.

14.3 Draining Procedure

⚠ WARNING

MCHP coolant is 50/50 ethylene glycol solution and is toxic. Glycol solution is specially formulated with bittering agent to discourage accidental ingestion. Please use caution while servicing and dispose of coolant in proper manner.

During maintenance operations, it may be necessary to drain system. Please follow procedure found below:

1. Use preferred shutdown procedure.
2. When coolant achieves safe working temperature, inspect coolant tubing located on side of honda MCHP. One (1) coolant tube has drain fitting installed.

NOTICE

If system has been operating, wait for coolant to cool down. Several hours may be necessary to cool coolant fluid to safe working temperature.

3. Place towel under drain fitting at back of MCHP unit.
4. Remove drain fitting's cap.
5. Attach short section of garden hose onto drain fitting..
6. Insert open end of drain into clean container.
7. Remove the cap on coolant reservoir.
8. Open drain valve.
9. When reservoir is drained, replace cap on coolant reservoir. Disconnect Sea-Tech fitting that connects Onix tubing to front, left port of Brazed Plate heat exchanger in HI Module.
10. Apply low pressure compressed air or nitrogen to purge both lines (Onix tubing and Heat Exchange Port) alternately. NOTE: Do not exceed 28 psi.

14.4 Turning Off Gas to the System

freewatt System consists of two gas-fired units; boiler and HONDA MCHP unit. Each unit is installed with separate gas valve.

1. Use preferred shutdown procedure.
2. If service is required, turn off all electrical power to system (boiler and MCHP unit) at 120VAC and 240VAC circuit breakers serving **freewatt** System. Also, turn off 240VAC Service Switch and 120VAC Service Switch.
3. Boiler - Turn gas ball valve off, handle should be perpendicular to gas pipe.
4. MCHP Unit
   - Follow flexible stainless steel gas connector extending from right side of MCHP unit to its connection to gas piping.
   - Turn gas ball valve off, handle should be perpendicular to gas pipe.

15 - SERVICE HINTS

⚠ WARNING

Do not attempt to modify the characteristics of this home heating appliance in any way!! Fire, explosion or risk of shock hazard may cause severe injury or death.

15.1 Troubleshooting Tools

Following tools should be available prior to troubleshooting system:

1. Voltmeter with settings to check: 240 VAC, 120 VAC, 24 VAC and 12 VDC;
2. Continuity Tester;
3. Contact Thermometer; (Non-Contact Infrared Thermometer.)
4. Manometer with range of 0 to 20" of water column with 0.01" scale in range 0 to 6".
5. Laptop Computer Loaded with MINT Software Tool and MINT Software Utility Supplement

15.2 Initial Service Checks

Prior to troubleshooting, the following tasks should be performed:

1. Verify appropriate 120 VAC and 240 VAC circuit breakers at main electrical panel are switched ON. Also, check outdoor disconnect switch, if present, is switched ON.
2. Verify 240 VAC and 120 VAC electric service switches are turned ON.
3. Verify 120 VAC (minimum 108 VAC to 132 VAC) to system;
4. Check for 240 VAC (minimum 216 VAC to 264 VAC) to HONDA MCHP;
5. Verify thermostat has been placed into Heat Mode;
6. Verify thermostat is calling for heat on system control. If not, inspect thermostat connections to ensure proper contact;
7. Verify all external safety controls are installed and working properly;
8. Verify natural gas supply valve is open at gas meter, at all appropriate manual shutoff valves and at gas control valve for system. Gas pressures should be maximum of 10" w.c. (natural gas) with no flow or with system operating and minimum of 4" w.c. with gas flowing at maximum firing rate of **freewatt** Boiler (verify during system startup with boiler and HONDA MCHP operating simultaneously);
9. Check wire connectors at control module, boiler control and HONDA MCHP are securely plugged in or connected;
10. Check coolant tubing extending from HONDA MCHP to Hydronic Hybrid Integration Module is securely connected and not plugged or damaged;

NOTICE

If any component does not function properly, verify it is correctly installed and wired before replacing it.

Static electricity discharge can damage control module and boiler control. Touch metal surface to discharge static electricity before touching either control.

Control module and boiler control cannot be repaired. If either or both controls malfunction, control unit must be replaced.

Only trained service technicians should service control systems. After troubleshooting, follow "Sequence of Operation" in Section 16 of this manual for normal light off sequence.

All controls are factory tested in the assembly process and defective control is generally least likely cause. If either control is suspected to be defective, please read through "troubleshooting" section (Section 16) of this manual before replacing control.

If two consecutive controls appear to be failing or defective, chances are control is not defective and another problem is causing control to appear defective or fail (for example, electrical short burning out transformer).

11. Check coolant operating temperature. Using MINT tool, confirm that coolant leaving MCHP unit is in range of 172° to 176° F.
12. Check coolant tank in Hydronic Hybrid Integration Module. See that it is filled to at least above MIN level line.

15.3 Accessing freewatt System Operational Data and Codes

There are multiple means of accessing hydronic **freewatt** System operational data and error codes for purpose of troubleshooting. These are:

1. Observing and counting number of flashes of red "Service Required" LED on front of **freewatt** Control Module. See following diagnostic table entitled "Alarm Codes for System Service LED on **freewatt** Control Module.
2. Observing flash rate of green LED on front of **freewatt** Control Module labeled "Combined Heat and Power" (See information provide in Table entitled "Alarms Codes for Combined Heat and Power LED on **freewatt** Control Module).
3. Observing status (lighted or not) of array of 10 LEDs directly on **freewatt** control board in **freewatt** Control Module. (Cover must be removed to observe.) See Table entitled " Interpretation of **freewatt** control board LEDs"

15 - SERVICE HINTS

4. Reading boiler operation error code on **freewatt** Boiler electronic front panel per **freewatt** Boiler Control Manual and Troubleshooting Guide.
5. Using MINT software on portable computer connected to **freewatt** Control Module to display **freewatt** operating data and error codes for **freewatt** System and Honda MCHP unit per MINT software Manual.
6. Removing metal cover of control panel of MCHP (located on upper left hand side of unit) and reading error codes per Honda MCHP Installation and Operation Manual.
7. For **freewatt** systems operating with RC-1000 HAI thermostat, noting color of thermostat display (red for fault/alarm condition) and reading **freewatt** Control Module Error Message displayed. Error messages and meaning are identical to those provide in table “Alarm Codes for System Service LED on **freewatt** Control Module”.
8. If unit is supported with active Internet connection calling your ECR **freewatt** Technical Support representative.

16 - TROUBLESHOOTING

⚠ WARNING

Electrical shock may cause serious injury or death. Following procedures may expose you to dangerous line voltage so use caution to avoid touching live electrical contacts. All service must be performed by a trained service technician.

If overheating occurs or gas supply fails to shut off, do not turn off or disconnect electrical supply to boiler or hydronic hybrid integration module. Instead shut off gas at location external to appliance.

Do not use system if any part of gas control system (boiler or MCHP unit) has been underwater. A qualified service technician should inspect system and replace any part of control system and any gas control which has been underwater.

Use only your hand to turn gas control knob. Never use tools. If knob will not turn by hand, don't try to repair it. Force or attempted repair may result in fire or explosion.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light or start any appliance.
- Do not touch any electric switch or use any phone in the building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you can not contact your gas supplier, call the fire department.

Hydronic **freewatt** System consists of four major components: Boiler, Control Module, Hydronic Hybrid Integration (HI) Module and the HONDA MCHP. Boiler and Honda MCHP unit both have their own installation and service manual that outlines specific troubleshooting information regarding these units. Control module and Hydronic Hybrid Integration Module troubleshooting information are outlined in this manual.

After making any corrective actions, be sure to turn off power and restart system to clear error conditions.

Use BYPASS MODE, (CHP MODE OFF) to sustain heating operation if needed while resolving **freewatt** Controller or MCHP unit errors or malfunctions.

16.1 General Troubleshooting

If	And	Check or repair
No Control module or HI Module operation		120 VAC electrical connections Blown fuse on **freewatt** Control Module circuit board
No boiler operation		Thermostat settings Check Boiler per **freewatt** Boiler Control Manual and Troubleshooting Guide
HONDA MCHP overheats		•Coolant Pump functioning Properly •Circulators Functioning Properly •Air in Coolant Line •Coolant Line Blocked •Coolant lines piped correctly into the HONDA MCHP •Mixing valve setting
No power to thermostat	Display is blank	Check Control Module Connection Fuse in the thermostat 24VAC fuse in **freewatt** Control Module or Faulty wire connection
No HONDA MCHP operation		See MCHP Manual

16 - TROUBLESHOOTING

Alarm Codes for "System Service" LED on freewatt Control Module.		
RED LED STATUS	INDICATES	CHECK OR REPAIR ACTION
1 Flash	No or incomplete Communication To Smart Zone communicating Thermostat, system in Bypass Mode	Check cable and connections between Smart Zone Thermostat and HI Module. Check 24 volt power supply to thermostat. If cables and voltage are okay, check data registers in Smart Zone thermostat per procedure provided in Section 24 for specific thermostat provided with your **freewatt** System. Then, if error persists, replace Smart Zone Thermostat.
2 Flashes	Outdoor Temperature Sensor Error: Outdoor Temp Sensor may be missing, broken, have loose connection, incorrectly wired, or might have some source of electrical interference impairing sensor's correct operation. System in Bypass Mode.	Check Outdoor Sensor and Connections
3 Flashes	No or incomplete communication With HONDA MCHP. MCHP unit not operating, System in Bypass Mode	Reset System Power to verify error. Check 240VAC and MCHP on/off switch power to MCHP. Cables and connections between HONDA MCHP and HI Module. Check outdoor disconnect switch if present.
4 Flashes	HONDA MCHP Device Error, System in Bypass Mode	Check HONDA MCHP diagnostics.
5 Flashes	Reserved for Future Use	
6 Flashes	Flash Data Integrity Error. Flash memory on **freewatt** Controller is not properly initialized, and has lost its factory settings. This could be result of tampering or damage to **freewatt** Controller. System in Bypass Mode.	Replace **freewatt** control board.
7 Flashes	Reserved For Future Use	
8 Flashes	Reserved For Future Use	
9 Flashes	Reserved For Future Use	
10 Flashes	Blocked MCHP Exhaust detected, system in By-pass Mode.	Inspect Exhaust Piping for Blockage, clear blockage if present, reset System Power to clear error.
11 Flashes	Low Dwelling Temperature (< 45°F)	Check Boiler Operation. Check MCHP Operation
12 Flashes	MCHP Pressure Switch Failed Proving, system in Bypass Mode	Inspect MCHP Pressure Switch & Connections
13 Flashes	Software Watchdog Time-out, system in Bypass Mode	Replace **freewatt** control board.
14 Flashes	Exhaust Gas Leak Sensor failure or error. MCHP has shut down. System in Bypass Mode.	Check Exhaust Gas Leak Sensor (Macurco CO Detector), Cables and connections between the controller & alarm
15 Flashes	Exhaust Gas Leak Sensor has no power, MCHP unit has shutdown, system in Bypass Mode.	Check Power and Cables and connections between controller and Exhaust Gas Leak Sensor
16 Flashes	Exhaust Gas and Carbon Monoxide Detected by Exhaust Gas Leak Sensor or Exhaust Gas Sensor "Test Button" pushed, MCHP has shut down, system in Bypass Mode , possible unsafe carbon monoxide level.	IF THERE IS AN AUDIBLE ALARM FROM ANY CARBON MONOXIDE DETECTOR: LEAVE BUILDING AND CONTACT YOUR LOCAL HEALTH, SAFETY, OR FIRE OFFICIALS TO ASSIST IN DETERMINING CAUSE FOR ALARM. Audible alarm indicates high and potentially dangerous level of CO may be present in building. If no audible alarm is sounding, check function of audible alarm of separately installed CO detector(s) in building by pushing test button on all such units. If not functioning, high CO level may still be present: LEAVE BUILDING AND CONTACT LOCAL OFFICIALS FOR ASSISTANCE. If results of pushing test button on separately installed CO monitor(s) indicates correct function, reset **freewatt** System by opening 120VAC and 240VAC service switches on **freewatt** System and then closing switches to re-power and reset **freewatt** System controller. If system restarts without 16 flash error code indication, likely cause was activation of **freewatt** Exhaust Gas Leak Sensor test button. If this 16 flash error code persists (but without audible alarm for separately-installed CO leak detector) contact your local health, safety or fire officials to assist in determining if high CO level is actually present and is the cause for this error code. If no high CO levels are found, replace Exhaust Gas Leak Sensor.
Continuous Flash	Watchdog Reset, system in Bypass Mode	Replace **freewatt** control board.

16 - TROUBLESHOOTING

Alarms Codes for Combined Heat and Power LED on freewatt Control Module	
Combined Heat Power LED Status	Condition
Rapid Flash (~5 per second)	MCHP operation suspended on detection of high coolant temperature
Slow Flash (~1 per second)	MCHP operation suspended by action of MCHP Pressure Switch: possible MCHP vent blockage
Steady ON	Normal MCHP Operation

16.2 Control Board LED Interpretation

By removing cover of **freewatt** Control Module, status (lighted or not) of array of 10 green LEDS can be observed. Controller Board LEDs are valid only in Combined Heat and Power Mode (CHP Mode switch "ON"). They are not used when system is in Bypass Mode (CHP Mode switch "OFF"). Do not use Controller Board LEDs as indicator of system status when in Bypass Mode.

Controller Board LEDs, as labelled on Controller Board, indicate following:

	LED ON	LED OFF
MyZ1	Zone 1 circulator is ON	Zone 1 circulator is OFF
MyZ2	Zone 1 circulator is ON	Zone 1 circulator is OFF
MyZ3	Zone 1 circulator is ON	Zone 1 circulator is OFF
MyZ4	Zone 1 circulator is ON	Zone 1 circulator is OFF
mchpENB	MCHP enabled	MCHP disabled
X1X2	ECR XX end switch relay is closed	ECR XX end switch relay is open
MyEND	**freewatt** Controller has closed either DHW or CH input to boiler, requesting boiler operation	**freewatt** Controller is not requesting boiler operation
PUMP1	12 VDC coolant pump in HI Module is energized	12 VDC coolant pump is not energized
PUMP2	120 VAC Hydronic circulator connected to HI Module is energized	120 VAC Hydronic circulator is not energized
PUMP3	not used	not used

* NOTE: One or more zone circulators may be activated without specific call for heat by room thermostats or DHW aquastat as consequence of control logic that anticipates heat demand and attempts to maximize MCHP run time.

⚠ WARNING

Label all wiring prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Always disconnect power to system before servicing. Failure to comply could result in severe personal injury, or death.

16.3 freewatt Control Module Fuses

1. Turn OFF power to System using circuit breaker in home main electrical panel.
2. Remove **freewatt** Control module jacket.
3. Use new 5mmx20mm, 250 Volt, 1 amp fuse to replace either or both fuses as needed.

⚠ WARNING

Do not jumper fuse or replace with any fuse except as specified. Failure to comply could result in severe personal injury, or death.

4. Install control module jacket.
5. Restore power to system and verify system operation after completing service.

NOTICE

Check control module fuses before replacing control module or any major components (pump, motor, etc.). If one of these fuses is blown, it can prevent system control module or other components from operating.

16 - TROUBLESHOOTING

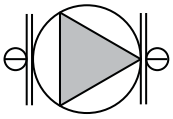
Fuse List						
Location	**QTY**	**Amp**	**Voltage**	**Spares**	**Shape**	**Size**
Hi-Module (Control board, F01, F02)	2	1	250	0	Cylinder	5mm X 20mm
Boiler (Control Board F1, Lower RH Corner)	1	5	250	2	Cylinder	5mm X 20mm
Boiler (Control Board F#, Middle Right Side)	1	4	250	2	Cylinder	5mm X 20mm
MCHP (Power Wire Harness, In-line, Left of inverter)	1	1	650	0	Cylinder	6.25mm x 32mm
MCHP (Bottom Half of Inverter)	2	15	250	0	Cylinder	6.25mm x 32mm
MCHP (Below Inverter, Sealed by Fuse Cap Holders)	2	5	Non-Serviceable		Rectangle	6mm x 10mm

Exhaust Gas Sensor System Troubleshooting		
IF	AND	CHECK or REPAIR
No Power To Exhaust Gas Sensor		Check Cable & Connections
Error Code #14		Is Exhaust Gas Sensor Present? Check Cable & Connections
Error Code #15		Is Exhaust Gas Sensor Present? Check Cable & Connections
Error Code #16		Is Exhaust Gas Sensor Present? Check Cable & Connections Loss of Power at Device? CO Detected

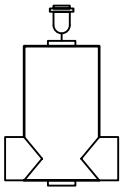
Pressure Switch System Troubleshooting		
IF	AND	CHECK or REPAIR
MCHP Will Not Start	System Service LED Flashing Error #10	Check for Blocked Vent Check for Broken or Loose Cable Connection Replace Pressure Switch
Pressure Switch Loop Not Closed	System Service LED Flashing Error #12	Check Cable & Connections Blown In-Line fuse Blockage in the Venting Replace Pressure Switch
No Exhaust Past Pressure Switch System		PVC Reducer Clogged?
Pressure Switch Not Switching State		Check Cable for a Short PVC Reducer Clogged? Check Switch's Hi and Lo Tubes for clog Replace Pressure Switch
Exhaust Products Leaking		Blockage in Vent PVC Reducer Clogged? Check PVC Connections for proper Solvent Weld Check Pressure Switch Tube Connections

17 - PIPING AND WIRING SCHEMATICS

Piping Schematic Symbols



CIRCULATOR
(With Isolation Flanges)



AIR SEPARATOR

BALL VALVE

3 WAY MIXING
VALVE

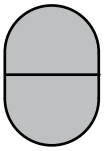
PRESSURE
REDUCER VALVE

HEAT EXCHANGER

BACKFLOW PREVENTER

ZONE VALVE

FLOW CHECK VALVE

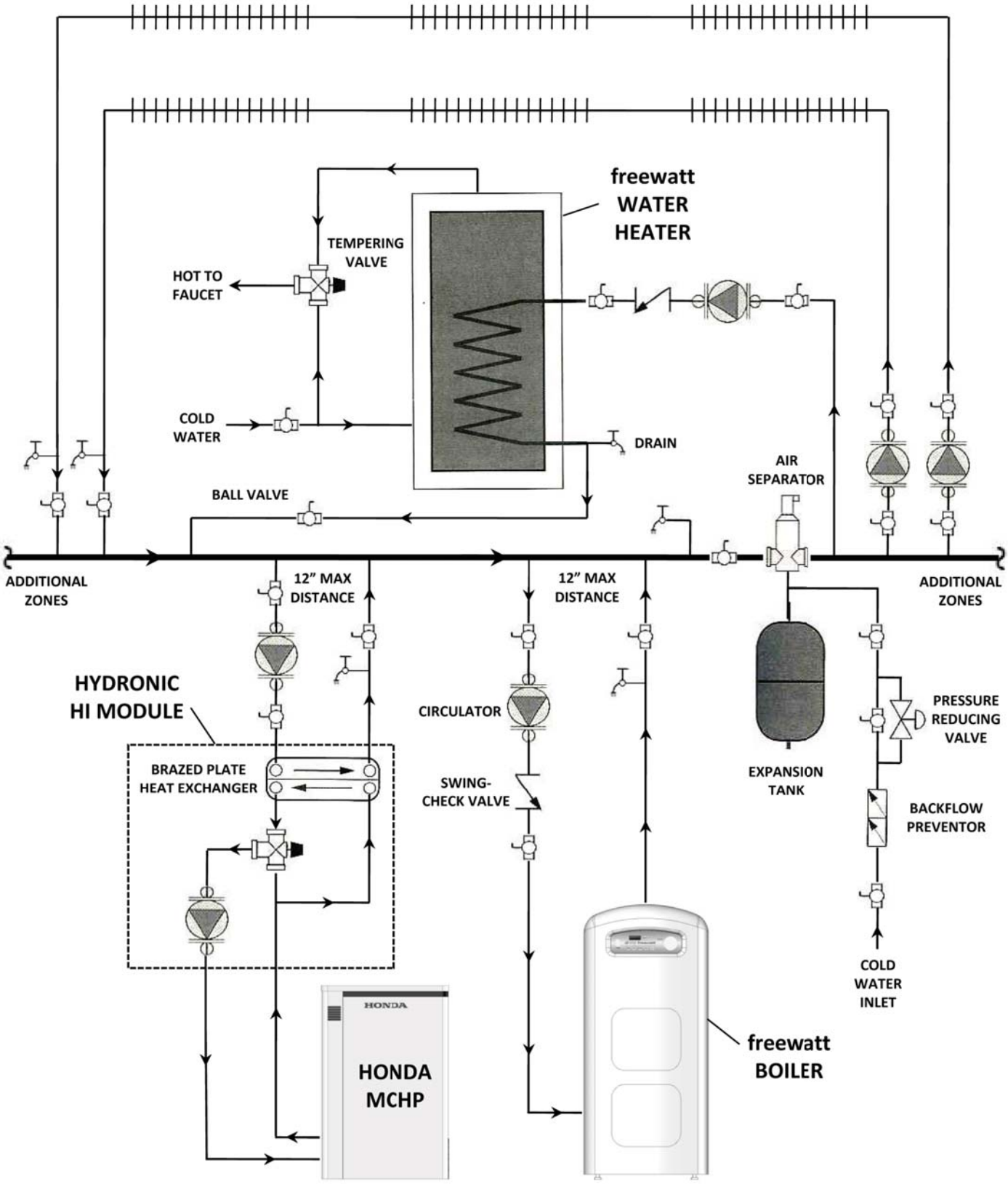


EXPANSION TANK

BOILER DRAIN VALVE

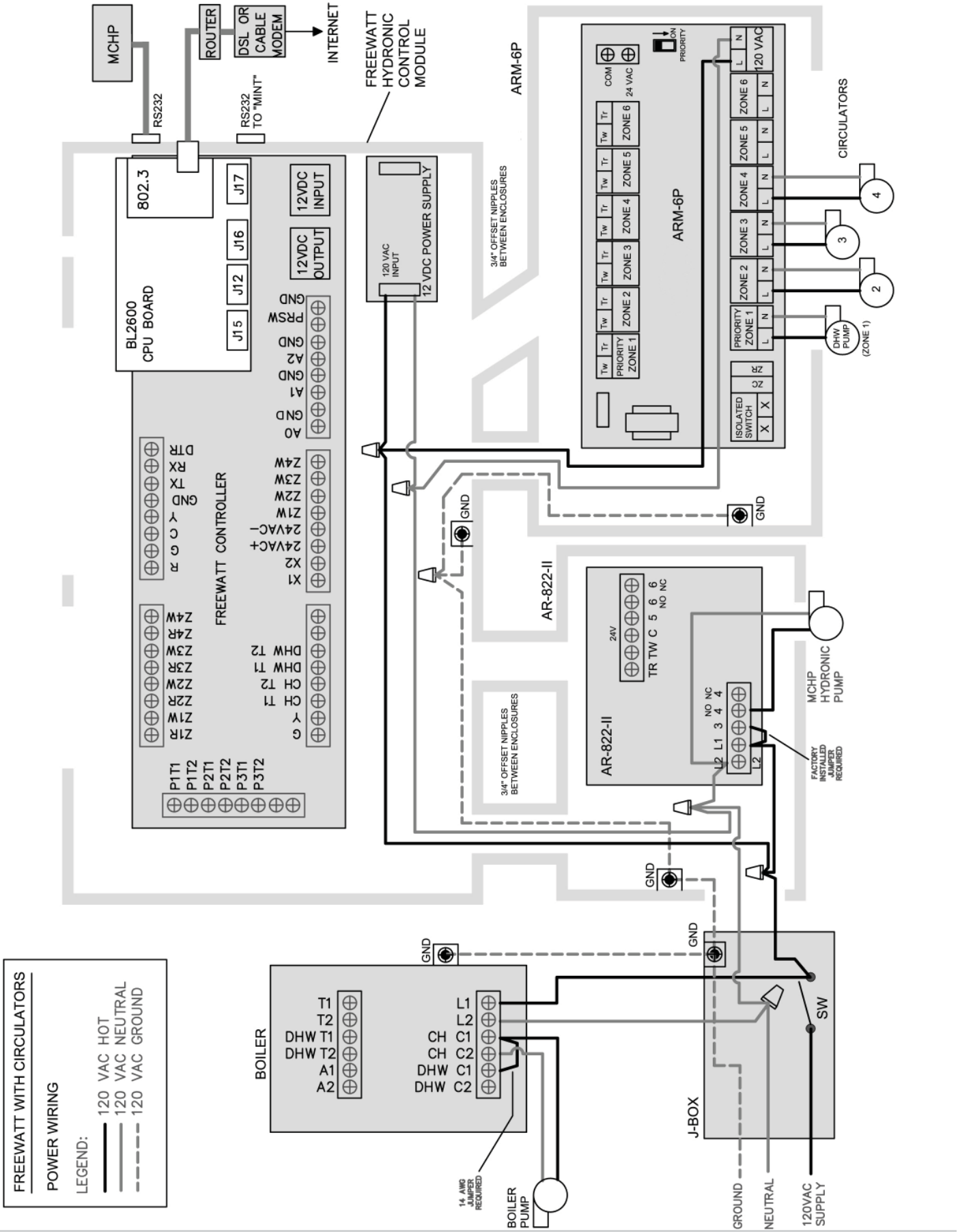
17 - PIPING AND WIRING SCHEMATICS

17-1 Primary/Secondary Piping With CIRCULATORS And Domestic Hot Water Priority Circulator



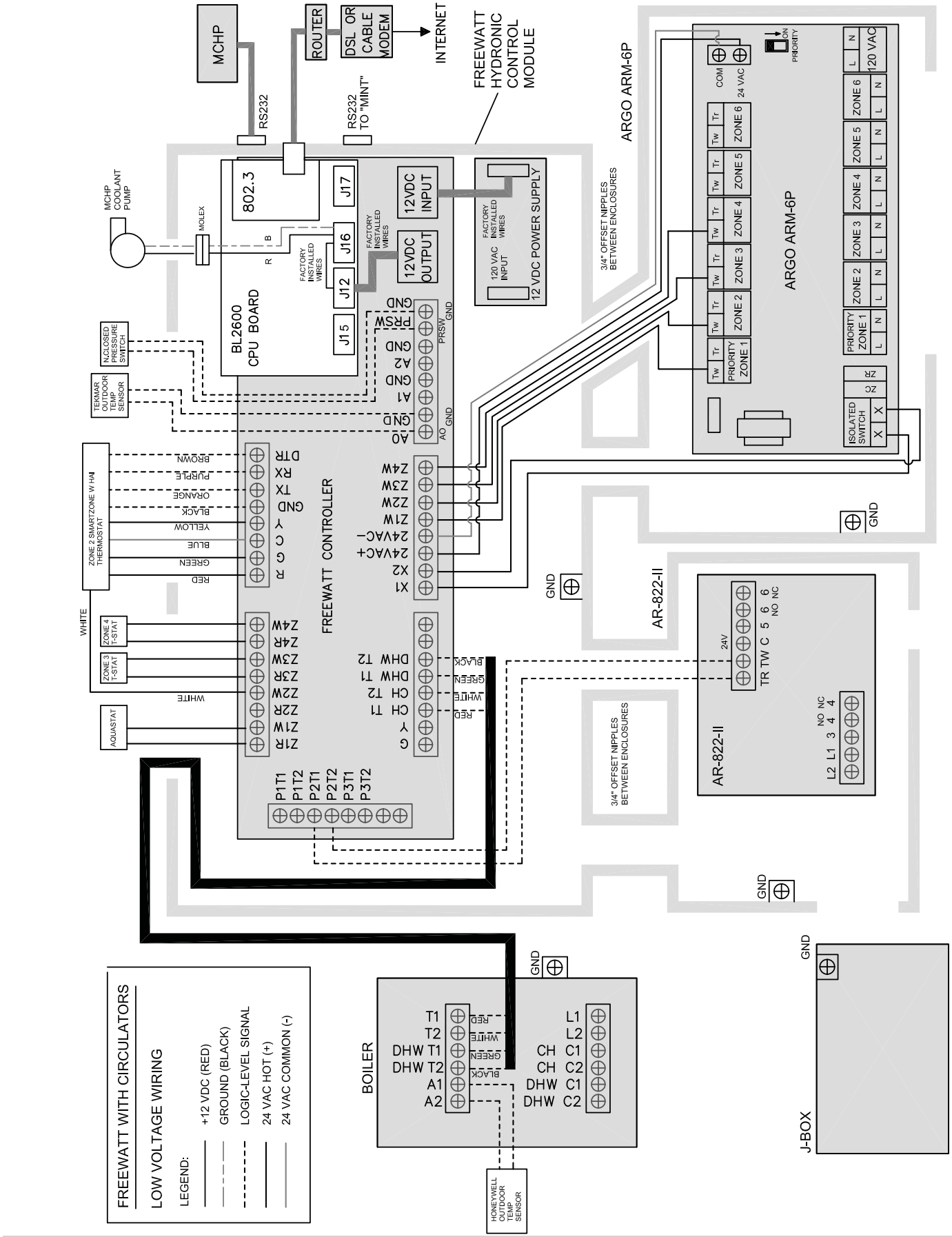
17 - PIPING AND WIRING SCHEMATICS

17-2 Line Voltage Wiring: Primary/Secondary Piping With CIRCULATORS And Domestic Hot Water Priority Circulator



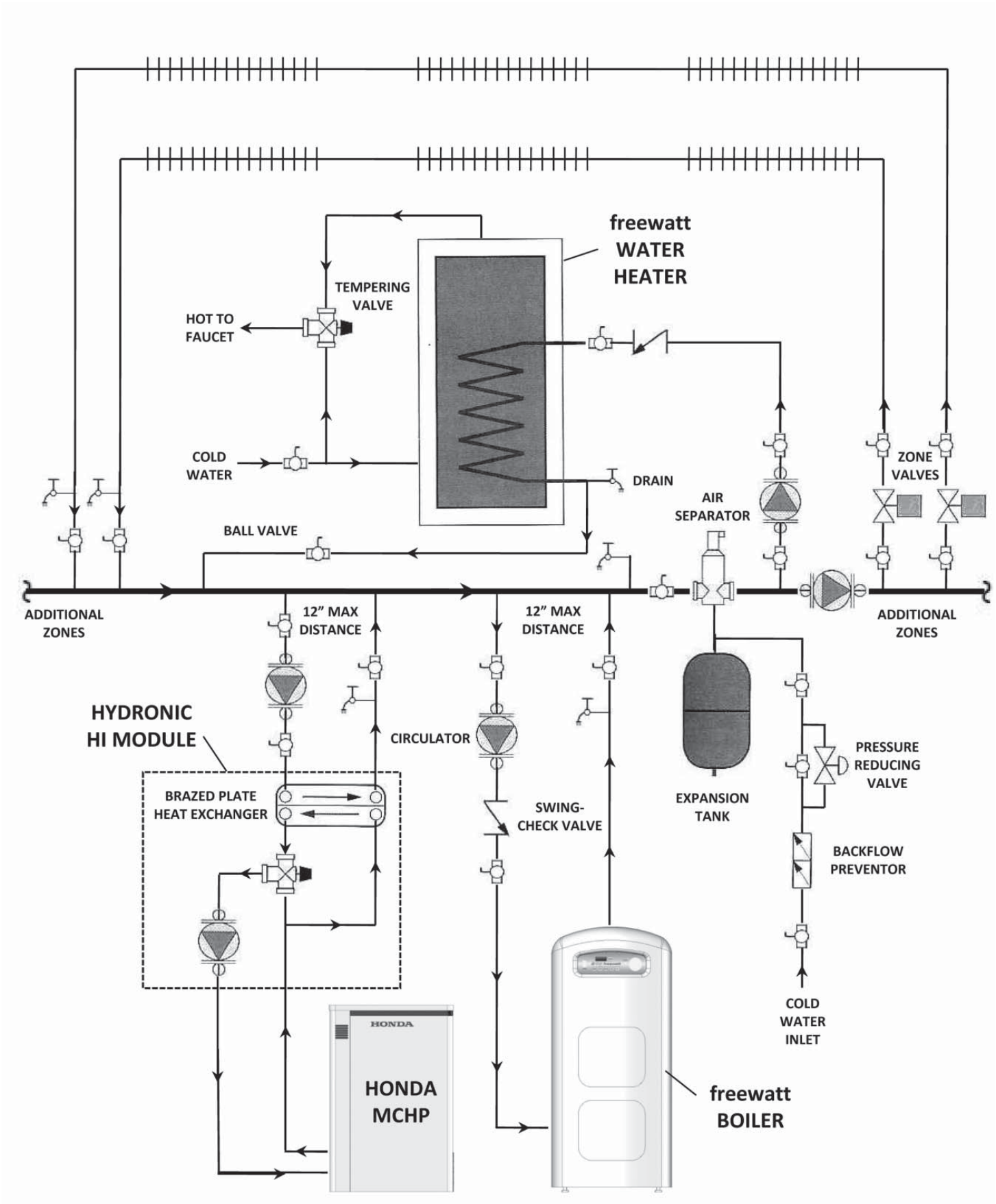
17 - PIPING AND WIRING SCHEMATICS

17-3 Low Voltage Wiring: Primary/Secondary Piping With CIRCULATORS And Domestic Hot Water Priority Circulator



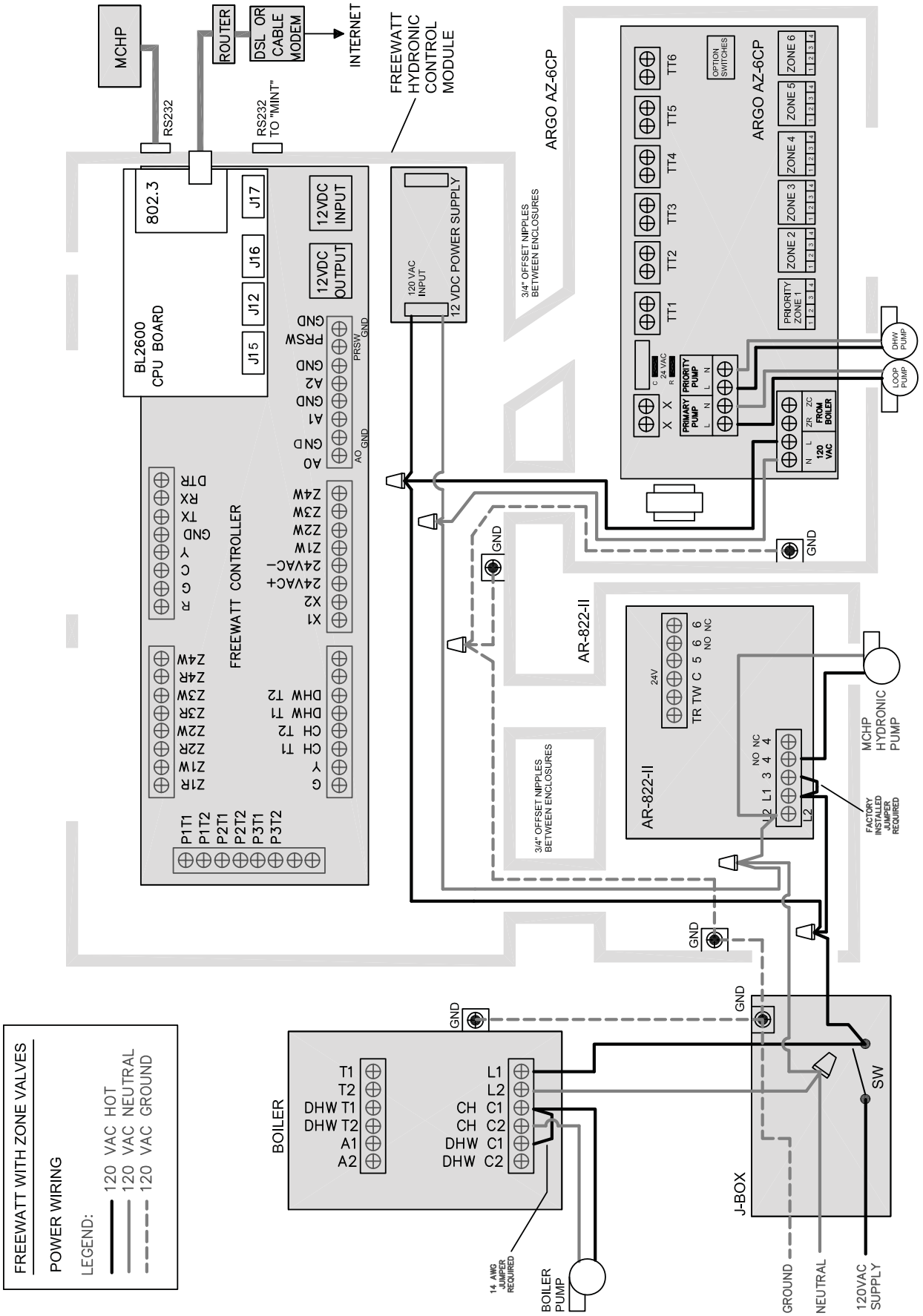
17 - PIPING AND WIRING SCHEMATICS

17-4 Primary/Secondary Piping With ZONE VALVES And Domestic Hot Water Priority Circulator



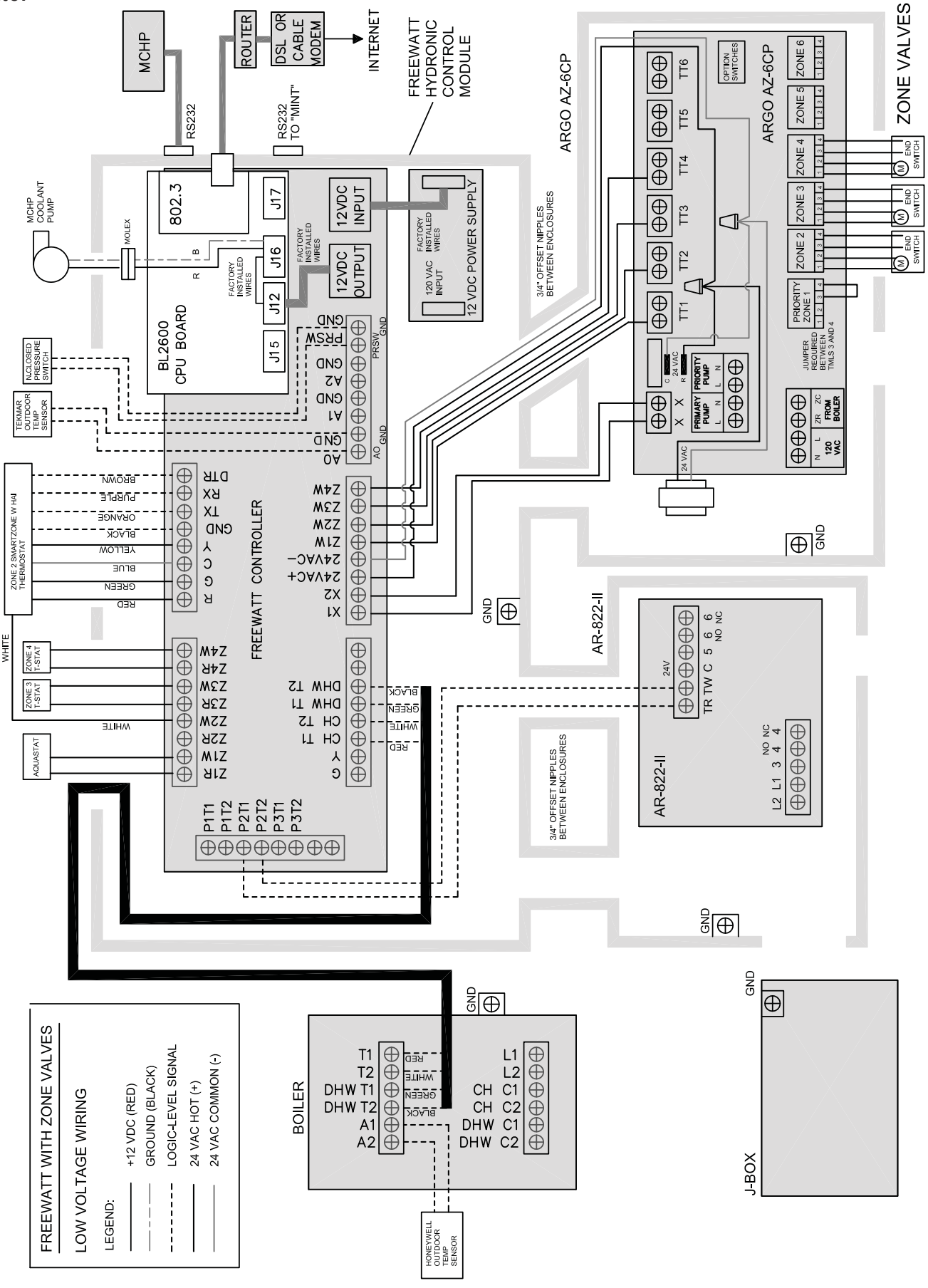
17 - PIPING AND WIRING SCHEMATICS

17-5 Line Voltage Wiring: Primary/Secondary Piping With ZONE VALVES And Domestic Hot Water Priority Circulator



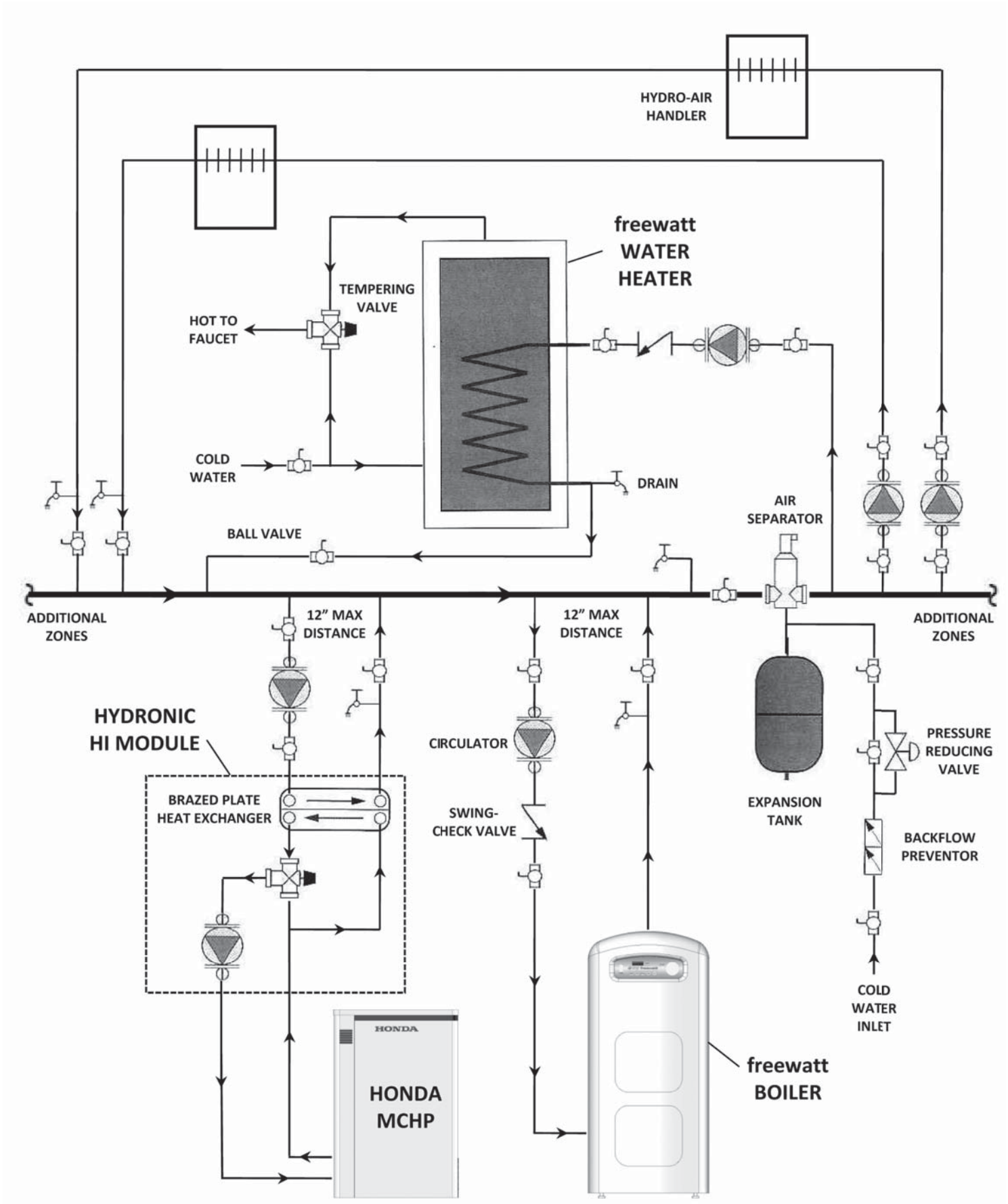
17 - PIPING AND WIRING SCHEMATICS

17-6 Low Voltage Wiring: Primary/Secondary Piping With ZONE VALVES And Domestic Hot Water Priority Circulator



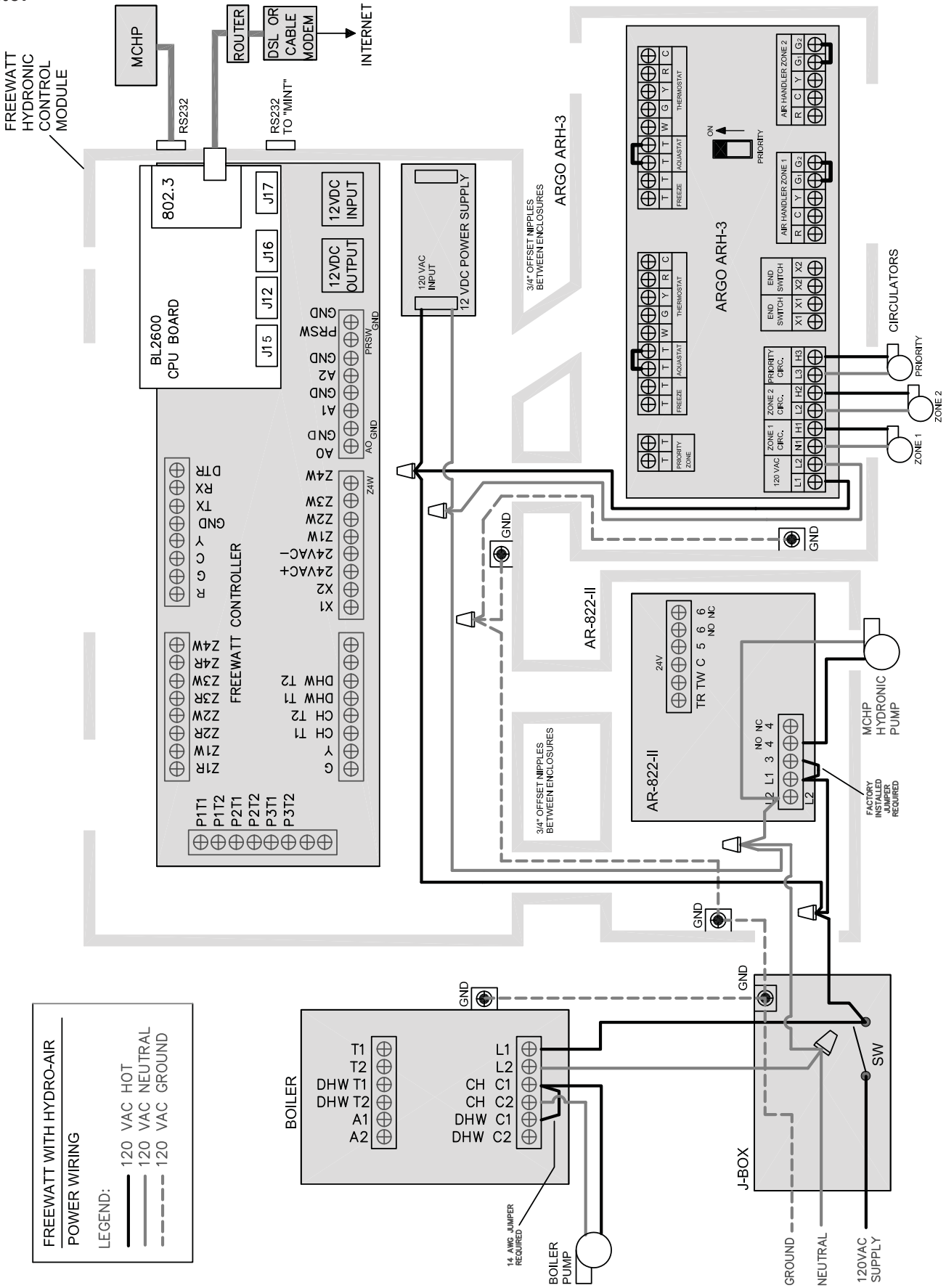
17 - PIPING AND WIRING SCHEMATICS

17-7 Primary/Secondary Piping With HYDRO-AIR And Domestic Hot Water Priority Circulator



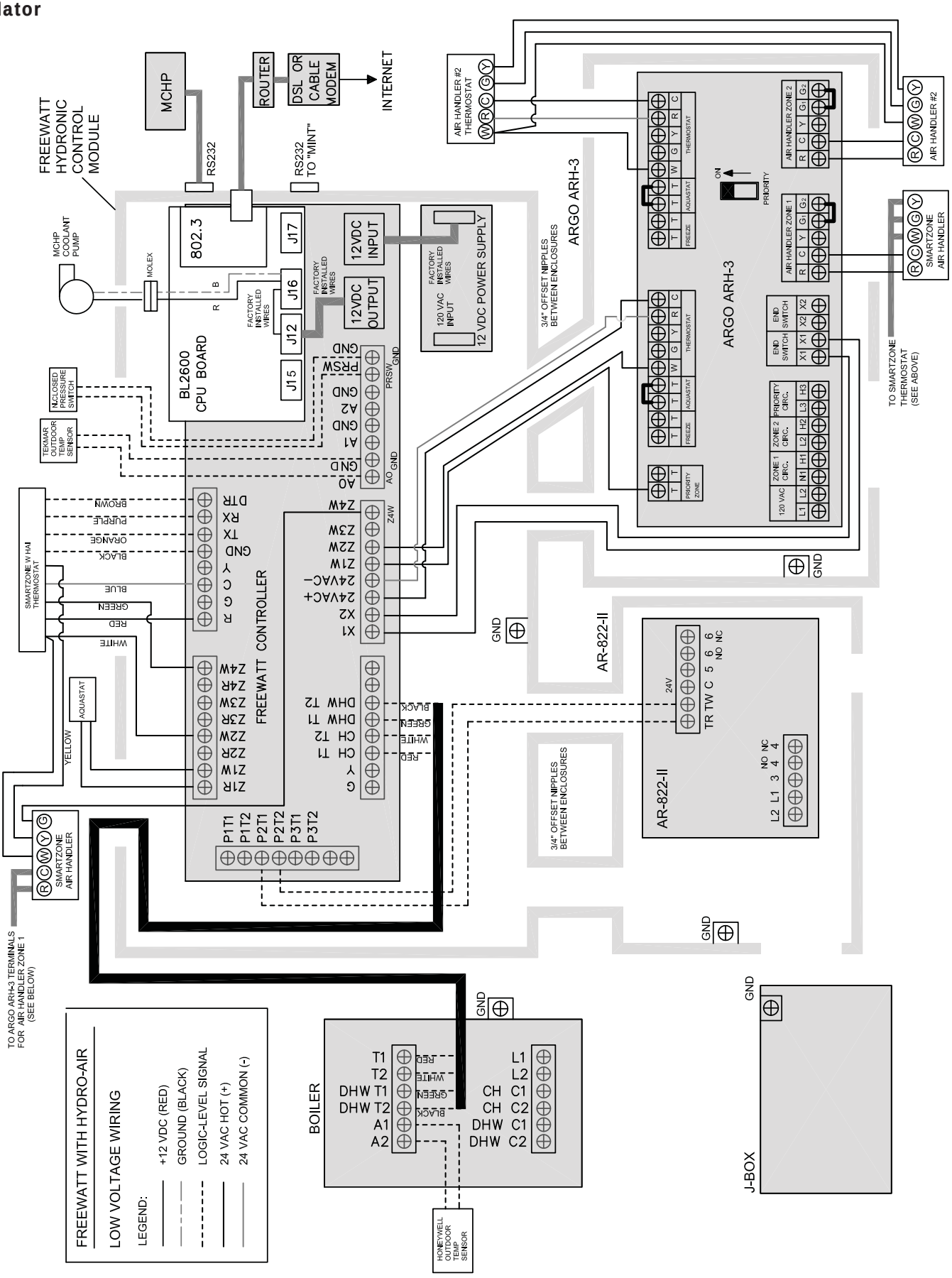
17 - PIPING AND WIRING SCHEMATICS

17-8 Line Voltage Wiring: Primary/Secondary Piping With HYDRO-AIR And Domestic Hot Water Priority Circulator



17 - PIPING AND WIRING SCHEMATICS

17-9 Low Voltage Wiring: Primary/Secondary Piping With HYDRO-AIR And Domestic Hot Water Priority Circulator



18 - COMPATIBLE ROOM THERMOSTATS FOR freewatt

18.1 freewatt Hydronic Zone Thermostat Requirements:

For all heating zones, except for Zone-2 (Zone 2 must use HAI Smart Zone Thermostat), select heat or heat/cool thermostat with following properties:

1. Thermostat must use isolated relay contacts to switch W call for heat signal. **freewatt** expects 24VAC "HOT" connected to thermostat's "R" terminal to pass directly thru thermostat's W relay to drive "W" signal back with minimal loss of signal voltage when calling for heat.
2. When not calling for heat, thermostat's W relay must present high-impedance (ie. no current flow) when open.
3. Thermostat must not add resistive elements to W signal path (resistors, voltage divider networks, MOSFET(s), transistors, etc.) when it is not calling for heat. Open circuit impedance of W signal path must be greater than 100,000 ohms, and preferably higher (ie 1 Megohms or more).

18.2 Known Problematic Thermostats:

1. Honeywell T87N, T87K

18.3 Known freewatt Compatible thermostats:

1. HAI Omnistat1, Onmistat2
2. LUX 1500
3. Braeburn Model 3000

18.4 Simple Tests That Can Be Used To Test Thermostat Compatibility:

1. Resistance test:
   A. Thermostat calling for heat, W relay closed: Thermostat relay impedance must be less than 40 ohms when measured across thermostat R and W terminals. Impedance greater that 40 ohms is unacceptable and will not work reliably with **freewatt** System.
   B. Thermostat not calling for heat, W relay open: Thermostat relay impedance should be greater than 1 Megohm (1 million ohms).
2. Voltage test:
   A. When attached to **freewatt** System and powered by 24 to 28 volts AC from **freewatt** Controller, AC voltage measured between 24V common terminal on circuit board J02 connector (labeled 24VAC - at bottom of board) and circuit board J02 W1, W3 or W4 terminals (at top of board) must be less than 1.5 Volts AC when there is no call for heat. If the voltage is greater than 1.5 Volts AC, thermostat is not suitable for use with **freewatt** System.
   B. When there is thermostat call for heat, voltage must be greater than 20 Volts AC. If voltage is less than 20 Volts AC, thermostat is not suitable for use with **freewatt** System.

18.5 Checking Communication Registers On Rc-80 Smart Zone Thermostat:

1. Verify display shows time & temperature (normal display).
2. Enter programming mode - following steps must be done in quick succession because programming mode will cancel itself automatically if no key is pressed in a few seconds. Press PROG-PROG-PROG-FAN to enter programming mode. Upper right corner displays register number ("00") and center of display is current value. It should say "1". If not, press up and down (set point adjust) arrows on right of thermostat to change this to "1".
3. Press PROG to advance the register counter in the upper right corner to "01". The center number should display "0". If not, press the up/down arrows until it does.
4. Press FAN to exit programming mode.

18.6 Checking Communication Registers On The Rc-1000 Smart Zone Thermostat:

1. Best way to restore communications on RC-1000-WH-ECR is to apply factory reset. This is only applicable on **ECR's** custom version of RC-1000 and not on units you may have acquired elsewhere. To start, press in ("click") on scroll wheel.
2. Select "Setup". Click.
3. Select "Installation Settings". Click.
4. Notice warning only for installers. You are, so press "Continue".
5. Select "Factory Reset" (last item in list). Click.
6. Press "Back" as required to return to normal operation. All settings, including setback programming have been cleared.

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