



Heat Pump Water Heaters

Application Manual

MWU Series – Underfloor Units



Heat Pump Water Heaters

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Note: Information in this document applies to UC8 controllers programmed with software version 4.08 or later.

Other relevant documents:

- MWU Technical Data
- MWU Installation & Maintenance
- MWU Specification Sheets

(Available at www.temperzone.biz)

While this Applications Manual has been prepared and provided in good faith, Temperzone Ltd reserves the right to make changes at any time as part of its continuous improvement programme.

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1. OVERVIEW

The Magnus MWU units from Temperzone are designed as In-Line Systems for underfloor heating applications. They are based on variable speed (inverter) compressor technology, combined with variable speed EC pumps. The MWU range eliminates the need for a buffer tank in most applications, improving both the efficiency and cost effectiveness of the installed system. In most installations, the system will interface either with a third party zone based controller on the manifold, or be controlled with a Temperzone wall controller where zone control is not required.

The MWU range is dedicated to Underfloor heating applications. It is not suitable for pool or spa heating (refer Temperzone for suitable model).

Consult this Application Manual during the design of the water heating system to ensure the system operates correctly. Where a proposed design is not covered in this manual, please contact Temperzone for assistance.

Any application must comply with local/national codes and regulations.

REFRIGERANT WARNING:

The Magnus MWU range is designed for use ONLY with refrigerant R410A. The use of other refrigerants is not authorised or approved by the manufacturer, and may cause problems such as poor performance, efficiency and durability. The use of alternative refrigerants will invalidate the unit warranty.

2. UNDERFLOOR HEATING

The Temperzone Magnus MWU Range of units is designed for use in Hydronic Underfloor heating systems, with or without zone controls. Careful consideration of unit selection, component and operating settings will provide a reliable and highly efficient water heating system. It is essential that the System Designer and Installer read and understand this manual to achieve the correct operating conditions for the unit.

The MWU range is available as a heating only system. For integrated heating and cooling systems, please select from the MWR range – refer to Temperzone.

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3. DESIGN PHILOSOPHY

The Magnus MWU Series of units are designed to be operated as an in-line heating system. When the heating controller or wall thermostat requires heating, the variable speed (inverter) compressor will start and increase in speed until the required supply water temperature is achieved. As individual zones open and close, the water flow rate back to the heat-pump water heater will change, and the compressor speed will automatically adjust to maintain the required supply water temperature and therefore match the heating demand. This results in a unit which responds rapidly to changes in the heating demand, enhancing system efficiency. During periods of low heating demand, the unit will occasionally cycle on and off to maintain the heating circuit temperature for as long as the heating controller requires.

In contrast, a system connected to a buffer tank is designed to maintain the temperature of the buffer tank. During periods of high heating demand, considerable mixing of the water from the underfloor manifold with the heated water from the heat pump water heater occurs. This mixing requires the water temperature from the heat pump to be hotter to ensure the water at the manifold is at the required temperature for distribution to the floor.

The Magnus MWU range is therefore not designed to be used with buffer tanks.

This greatly simplifies the installation of the unit, and decreases the capital cost of the heating system.

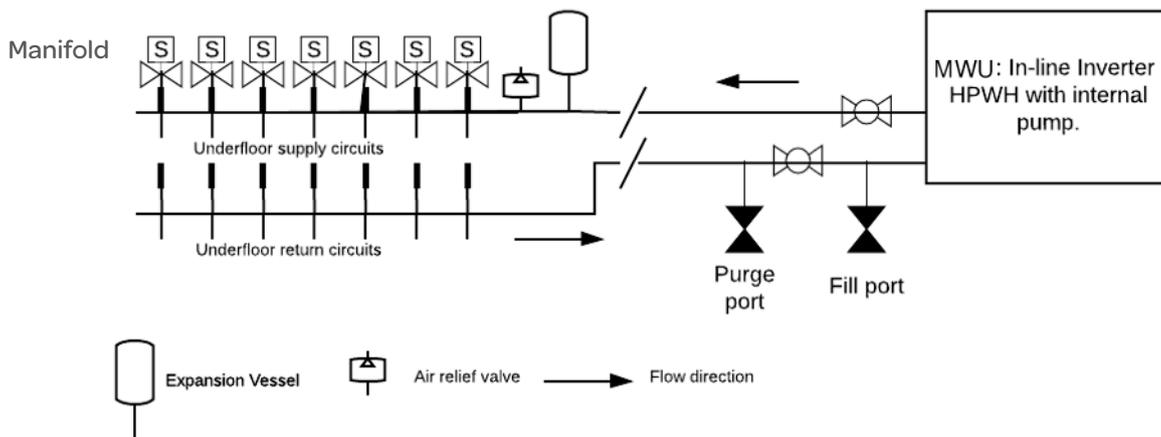


Figure 1

In most installations, the system will interface either with a third party zone based controller on the manifold, or be controlled with a Temperzone wall controller where zone control is not required.

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4. DETAILED DESCRIPTION OF OPERATION

The MWU range is designed to deliver a continuous supply of heated water at the required temperature during operation. The unit has an inlet and outlet water temperature sensor, and the inverter speed is controlled to maintain a constant target outlet water temperature. The temperature differential between the inlet and outlet sensors, combined with the flow rate determines the heating capacity required by the system. Ambient air temperature determines the heat generated by the system, at a particular compressor speed, when combined with the inlet and outlet temperatures.

Under low heating load conditions, the compressor will operate at minimum speed after the initial start-up period. Should the heating output at minimum speed exceed the heating demand, the compressor will stop operation until the heating loop cools by 5°C. This feature prevents short cycling of the system under low load conditions.

In order to maximize the efficiency of the system, the following factors are required to be considered:

- Minimise the leaving water temperature to the lowest value required to meet the heating demand.
- Minimise the return water temperature.
- Maximise the ambient air temperature.
- Minimise the use of maximum compressor speed (high heating demand), and short cycling of the unit (low heating demand), by not over or under specifying the size of the unit.

These factors will be explained in more detail in the following pages.

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5. DESIGN CONSIDERATIONS

Where possible, consider these factors when designing systems integrating the MWU.

Avoid the following:

- Installations where a micro-climate develops around the unit (ie too closed-in areas).
Ensure the cold air can be effectively dispersed from the surrounding area.
- Restricted Air Flows
Installations where plants or other objects restrict air-flow through the unit coils. The de-ice settings assume the unit coil has an unobstructed supply of air and the minimum clearance is adhered to. Ensure fences, etc., around the unit do not create a micro-climate around the unit, eg pooling of cold air. Cold air must be able to freely drain away from the site.
- Use of a mixing valve on zoning manifolds.
Ensure the unit is delivered water at the coldest temp. possible from the system; ie not mixed at the manifold.
- Excessive pump flow rates.
The use of high powered pumps significantly decreases the efficiency of the unit by increasing the return water temperature to the unit. The plastic in-floor tubing has a heat transfer limit, which is reached at approximately 2.5 l/min. per 100m of 15 mm tubing. Exceeding this flow rate has minimal effect on heat transfer to the floor, but deteriorates the efficiency of the MWU units.
- Under-sizing of piping to / from the manifold.
Locate the unit as close as practical to the manifold, and limit the number of 90 degree bends used.

Make Use of the following:

Higher ambients can be used to your advantage. Controllers often have time scheduling. If you want to use the floor as a heatsink, then heat during the (warmer) afternoon for the evening heating demand.

Water Treatment

The MWU contains copper and brass components, and is designed to be used without water treatment where non-ferrous components are used throughout the installed system. Where ferrous components are used, then a suitable water treatment is required. Adding a biocide to fresh water loops can help inhibit any micro-organism growth within the system that may occur where water treatment is otherwise not required.

Glycol should be used in particularly cold climates with unreliable electricity.

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6. UNIT SELECTION

The MWU range comprises of a 16 kW single phase model, and 20 kW and 37 kW 3 phase models. It is important to select the appropriate sized unit for the area being heated. Over-sizing of units is not recommended, as ideally the heating demand should match the operating range of the compressor. If the heating demand is too high for the capacity of the unit, then the compressor will operate too long at a high speed. If the heating demand is too low, the compressor will typically operate at a low speed, or cycle between on/off.

For a typically constructed house, the following unit sizing is recommended. For houses in cooler climates, use the lower end of the size range.

Model	Power Supply	Heated Area
MWU 180	Single Phase	250 – 350 m ²
MWU 250	Three Phase	350 – 500 m ²
MWU 450	Three Phase	500 – 750 m ²

For Operational Limits refer to the Product Review brochure and/or Specification Sheet for each model available at www.temperzone.biz.

Refer Section 4 for how to maximise efficiency and Section 5 on what to avoid in your design. A combination of the two will lower running costs and extend the life of your system.

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7. SITE REQUIREMENTS FOR TYPICAL INSTALLATION

7.1 Floor Tubing

For the most efficient system, install tubing in the floor at a density of approximately 100 mm between pipes. This typically allows a supply water temperature of 35°C (the default setting), which lowers the operating pressures in the refrigeration system in the unit. For a lower installed cost, the tubing density can be reduced to 200 mm between pipes, and a 45°C leaving water temperature selected, or a compromise in-between. The specified LWT should be reviewed during the heating season to ensure that the heating comfort needs to the occupants are being met, whilst selecting the lowest LWT as appropriate. In general, it is better to aim to increase the LWT set should this be required, rather than to set it too high initially.

The supply water temperature can be altered at time of commissioning to suit the density of tubing installed in the floor, and the heat-loss characteristics of the building (refer page 11).

7.2 Adequate Clearance

Mounting and positioning instructions are covered in the unit 'Installation & Maintenance' instructions.

The MWU unit should be externally installed (ie outdoors). Where installation is desired internally, sufficient ventilation must be provided to maintain the internal air temperature no lower than 5°C below the external ambient air temperature. It is possible to duct the exhaust air from the unit, however the external static at the fan must be less than 25 Pa. If ducting the exhaust air, it is recommended that an additional in-line fan be installed in the duct to maintain airflow through the unit.

In all installations, it is preferred that the coil be installed perpendicular to the wall. In installations where this is not possible, the coil must be installed a minimum of 500 mm from a wall. There must be no restriction to the airflow above the unit.

Note: The exhaust air from the unit is very cold when the unit operates at full capacity, and may be well below the freezing temperature. Take care when selecting the installation position that the exhaust air from the unit will not be under a window or plants which are cold sensitive. It is possible to get condensation on surfaces above the unit exhaust air which may deteriorate some surfaces.

MWU units are usually installed outdoors. Where an indoor installation is desired, sufficient ventilation must be provided to maintain the internal air temperature no lower than 5°C below the external ambient air temperature. It is possible to duct the exhaust air from the unit, however the static must remain at the fan must be less than 25 Pa. It is recommended that an additional in-line fan be installed to maintain airflow through the unit.

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7.3 Correct Pipe Sizing

The water supply to the zone manifolds must not be restricted. Maintain the same inner diameter throughout the piping system. Pipe-lengths should be as short as practical, and be **at least** the following sizes.

MWU 180, 250: 1" (25 mm) ID

MWU 450: 1³/₈" (35 mm) ID

The sizing system for plastic based piping systems are generally based on the external pipe diameter, so at least one size greater should be selected.

Note: Where thermoforming plastic piping is used, care must be taken not to overheat the joints, causing restricted flow. **Restricted flow rates may result in over-pressure (HP) faults occurring.**

All external piping should to be insulated to minimise any heat loss in cold ambient conditions.

7.4 Ancillary Items (External)

The following items must be installed as part of the system:

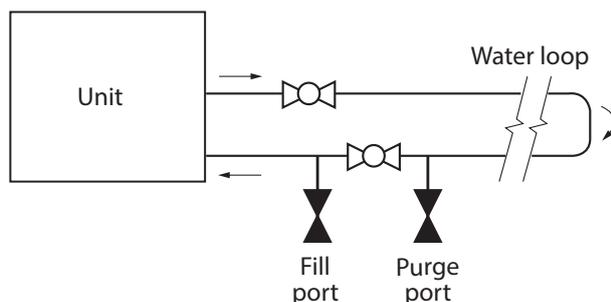
- (i) automatic air-bleeding valve,
- (ii) expansion tank, and
- (iii) water pressure gauge.

These are best installed at the manifold for underfloor heating systems. The automatic air-bleed valves function to remove small bubbles of air from the system when the pump is operating. Do not rely on these valves to remove the air from the pipes during commissioning. When commissioning, ensure the system is effectively purged through the purging port. Most systems will continue to expel air over a 24 - 48 hour period, when the floor is being actively heated.

7.5 Filling / Purging Port (External)

A filling port is required to be installed at the unit. It is essential the filling port is located on the return water (water inlet) to the unit. Either install two manual ball valves, with a filling port in-between, or install a dedicated filling port valve. The pump installed within the MWU units is not self-priming and air remaining in the system will result in the pump not operating.

Figure 2



A water pressure measuring point is required in the water loop (binder point or fixed gauge)

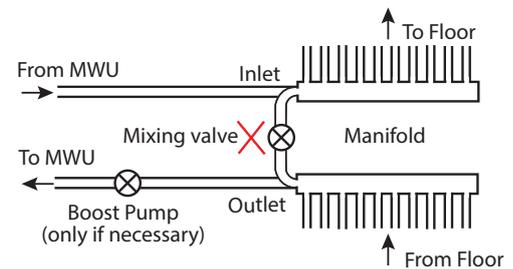
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7.6 DO NOT USE Manifold Bypass / Mixing Valves

The MWU Series is designed to heat the water to the required temperature for the application. It is essential that the temperature set-point of the unit is adjusted to meet the required temperature at the manifold. The greatest efficiency from the unit occurs when the MWU is heating the coldest possible water to the required temperature. DO NOT USE manifold bypass / mixing valves.

Mixing valves are designed for applications where the supply water temperature is hotter than that required at the manifold. They use some of the colder return water to decrease the supplied water temperature. Using these types of manifolds with the MWU units will significantly reduce system efficiency.



7.7 Underfloor Circuits : Correct Piping Type

Multi-layer piping (such as PEX-AL-PEX) should be used for underfloor heating installations. Each circuit should be a maximum of 100 m long, of 15 mm tubing. Take care to design the tubing layout to keep each circuit within the required lengths to avoid excessive pressure drops in any particular circuit. MWU underfloor heating systems are designed to operate without manual flow balancing in most installations.

The New Zealand Building Code (NZBC) B2 durability section requires verification from the tubing manufacturer that the tubing system has an expected lifespan of over 50 years as part of the Building Consent process.

7.8 Booster Pumps

The MWU unit is supplied with an internal pump (Wilo Stratos Para-Z 25/1-8) which is designed to provide sufficient flow for most applications. The pump operation is internally controlled by the unit controller through the 0-10V output V1.

Note: The pump operates a minimum flow when the input signal is 0V. To stop the pump, a control signal of 0.75V is used. The pump has an operation control range of 3-10V

Where additional flow is required, it is possible to add a **booster pump** to the manifold on the supply side. Where an additional pump is added, the operation of the pump should be connected to the heat required output of the zone controller, for example, via a relay.

Note: To accurately assess the suitability of the pump, it is necessary to wait until the floor is at operating temperature. When the floor is first heated from cold, all of the zones will likely be requiring heat. The flow from the unit will be spread across all zones, resulting in an apparent lack of flow. However, the compressor will be operating at maximum capacity, so no more heat can be produced into the floor even if there were to be more flow. As the floor warms, some zones will reach target temperature, and the remaining flow will be diverted to zones still requiring heating. There should be 2 – 2.5 l/min. at each zone (assuming 100 m pipe-lengths) once the floor is warm. This is the maximum flow through which the heat can be absorbed through the plastic

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tubing. Additional flow will result in warm water returning to the MWU, decreasing unit efficiency. In addition, the increased power consumption of an over-sized pump will decrease the operating efficiency of the overall system.

The MWU unit requires that at least one zone is uncontrolled to permit continuous water flow through the system when heating is required. If the floor temperature probe is being used, it should be installed in the uncontrolled zone. Heated towel rails or bathroom floors are suitable as uncontrolled zones.

Avoid manually balancing controlled zones at the manifold.

Manifolds mix the flow and return from the underfloor heating headers. They are very commonly used, but are designed for where the supply water temperature is hotter than what is actually required. The mixing valves temper to the correct temperature; exactly the opposite of what we want to do with our units. Allow the zoning system to direct the water to the zones requiring heating.

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8. CONTROLS

The MWU unit can be installed as a turnkey solution, ie no intervention required. The unit is pre-wired for dry contact remote on/off operation. Just connect water and power on. Alternatively for:

Single Zone Installation

- Connect the manifold directly to the MWU unit.
- Set the leaving water temperature (LWT) required value, if it is not the default 35°C, by adjusting the 'H' value using the UC8 controller's push-button (refer Installation & Maintenance document)
- Install a Temperzone TZT-100 room air temperature controller (wall thermostat) in an accessible location
- Option: Install a remote temperature sensor to control the slab temperature.

Multi-Zone Installation

- Install a zoned manifold system with controller (supplied by others).
- Use the remote on/off input to start /stop the unit.

The MWU can be controlled using a Temperzone TZT-100 wall thermostat. However, for Zone Control, a third party controller is required. The control needs to provide a zero voltage 'heat required' signal to the remote on/off input into the unit's UC8 controller. DO NOT control the MWU unit using the cool / heat inputs (CP/HT) on the UC8.

It is also possible to control the MWU through RS485 Modbus communications. Contact Temperzone for assistance. **Note:** Capacity control via BMS is not an option.

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9. SUPPLY WATER TEMPERATURE

The MWU has a default supply water temperature of 35°C. Overall system efficiency is reduced with increasing supply water temperature. The maximum recommended temperature is 45°C.

If the temperature of the water used for under floor heating is 40°C, maximum floor slab temperature will be 29°C. The room temperature is generally about 8°C cooler (ie a comfortable 21°C).

If it is deemed necessary to adjust the supply water temperature, proceed as follows:

- i) Remove the remote on/off plug (refer wiring diagram in Specification Sheet)
- ii) Press and hold the push-button in the centre of the MWU unit's UC8 controller
- iii) Scroll through the settings until the letter 'H' appears
- iv) Release the push-button, then press it again to increase the temperature to the required temperature.
- v) Once the required temperature is set, release the push-button and after 30 seconds the unit will return to start-up mode.

10. HP FAULT / AIR PURGING

If the unit stops, and the controller displays a 'HP' fault, the most likely reason is insufficient purging of air through the system.

Complete the following steps to purge air from the system:

- i) Run the hose for a short period prior to connecting to the filling port to flush any air out
- ii) Keep the hose connected on unit start-up, and open the purge port with the internal passage closed (filling port) or partially disconnect the return water pipe, and close the return side ball valve.
The unit should operate.
- iv) Once the unit is operating normally, then close the internal passage and purge port, and remove the hose.

Should this unit again result in a 'HP' fault, then repeat the above procedure.

Note: Cold water in the system is more likely to result in air-locks than warm water. Once the water heats the air will tend to be naturally removed through the automatic air-bleed. Cooler water absorbs air, and heating water will release it. Installing the air-bleed on the supply water side of the manifold allows the air to be removed prior to the water entering the plastic tubing. It is normal for the system pressure to reduce over several days as the remaining air is eliminated from the system. Return to site, and re-pressurise, ensuring that the water hose is free of air prior to connecting to the filling port.

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11. COMMISSIONING & MAINTENANCE

The Magnus MWU range has a controller (UC8) that controls the refrigeration system to provide optimal performance, efficiency and durability. When operating conditions are outside of the limits of the system, the system will report a fault condition. Multiple reported faults indicate that the unit requires service support and the unit will display a 'lockout code'.

The most likely fault is a high pressure (HP) fault, which will occur if there is insufficient water flow through the unit.

The unit is programmed to operate on its own based on the following conditions:

System Start:

- Remote on/off input is closed circuit (dry contact)
- Inlet water temperature is greater than 5°C lower than the target set temperature.
- Ambient temperature is above -15°C

System Stop:

- Remote on/off input is open circuit, or
- Outlet temperature is greater than 2°C above the target set temperature and the compressor has operated at less than 20% for longer than 2 minutes.

Refer to the 'Installation & Maintenance' document supplied with the unit for full commissioning and maintenance instructions.

Floors with zone control will experience considerable variation in flow rates between initial floor heat-up, and what is required to maintain the temperature of a heated floor. This is especially the case when only a single zone is requiring heating. The MWU is designed to accommodate a wide variation in flow. When commissioning, allow the system several days to reach operating temperature before making an assessment of the required in-operation flow rate.

12. SPECIFICATIONS

Refer to the Product Review or Specification Sheet for each model; available at www.temperzone.biz.

Specification Sheet includes such detail as:

- required water flow rate,
- min./max. inlet temperature,
- min. operating temperature,
- max. operating pressure.

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