WATERBASED UNDERFLOOR CONTROL

ENERGY EFFICIENT Heating&Cooling IN ONE

Intelligent Control
Maximum comfort with low energy consumption

Save up to 55% CO₂
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OJ Waterline™

Energy efficient system for underfloor heating

:: Save up to 55% energy compared to simple heating control systems
:: Comfort advantage with adaptive function
:: Heating and cooling control for true comfort
:: Humidity sensor to avoid condensation on floors
:: Area control for easy operation
:: Flexible installation for wired and wireless connection
:: Network communication for large applications
:: Easy installation with plug and lead connections
:: Optional weather compensation
The waterline system from OJ Electronics has been developed to provide a temperature control system for room heating and room cooling, integrated with switching of the primary heating and cooling sources, and the control of water temperature and mixing devices. This ensures the best possible comfort conditions and also reduces energy consumption.

Special demands
Underfloor heating makes special demands on the control system as users are in direct contact with the heated surfaces. A pleasant floor temperature, maintained within specific limits, is therefore required.

Heating functions
The OJ Waterline™ system provides true comfort through precise room temperature control, always ensuring optimal energy and savings through advanced control of boilers, pumps etc.

Cooling functions
In addition to controlling heating, all WLM masters have the ability to control the system for cooling.

- To enable the cooling function an interface module WLAC and humidity sensor WLH have to be connected.
- By using the humidity sensor the system limits the formation of condensation on floor surfaces due to high humidity.
- If cooling is being limited due to high humidity a dehumidifier can be enabled by the master.
- When cooling is enabled the cooling set point will be pre-determined by the master and will override any settings in any room controller to ensure optimum energy efficiency.
The system saves energy and prolongs service life

To improve reliability, the system tests any thermal actuators, pumps or mixing valves which have not been in use for the last three days. This does not, however, apply for the boiler output relay.

Precise control of room temperature

With traditional thermostat control, 100% heat output is provided for a given length of time. With PI control on the other hand, the water temperature for underfloor heating is controlled in relation to current heat demands. If much heating or cooling is required, the thermal actuator will be fully opened. Otherwise, opening is continually adjusted to suit current demand. PI control ensures rapid and stable control of room temperature, and allows optimum utilisation of supplementary heat sources, e.g. sunshine or people in the room.

Thermal actuators

The Master has 8 outputs for thermal actuators. If more outputs are required, an additional module can be connected, providing a total of 14 outputs. The Master and additional module are available with either 230 V or 24 V outputs for thermal actuators.

Interconnection of WLM products

For easy installation, interconnections between master modules, master and add on modules, and master and wireless receivers, are made by pre-wired plug in connectors (RJ45)

Timer control

Time control of the system is by using the WLCT programmable controller, but an external 7 day time switch can be connected to the master to control the entire system.

The thermal actuator is gradually closed as the required room temperature is approached, thus providing more accurate control and saving energy.
GREEN COMFORT
- Save up to 55%* energy

The WLM2 Heating & Cooling Waterline Master System has been designed to maximise user comfort with minimum energy consumption using features such as, individual temperature control, weather compensation and timed PI.

Save 30% energy with individual room temperature control
A common simple way of adjusting the energy needed to maintain the indoor temperature independently of the outdoor temperature, is to centrally adjust the general supply temperature according to the actual outdoor temperature.
This however cannot handle the different needs in individual rooms and in real life desired room temperatures will almost never be achieved.
In modern houses the need for better and more precise room temperature control is more and more often demanded as well as building regulations has changed or is changing towards this in many countries.
To meet these demands, individual room temperature controls are mandatory.
Without individual room control the temperature is often set higher than needed and cannot handle sun inlet or occupation, which means that the energy savings compared to uncontrolled rooms can be seen as high as 30%*.

PI control benefits
- save 20% energy
Simple bimetallic thermostats are well known to over and undershoot the desired temperature by 1 to 2°C which means wasting energy.
PI controlled thermostats adjusts the energy added into a room so over and undershooting is minimised.
Compared to a cheap ON/OFF thermostat, PI controlled room temperature can save up to 20%* energy.

Weather compensation
- save 10% energy
As water based underfloor heating systems consists of a pipe system that transports the hot water from the manifold to the floor where the heat is needed, there will also be an energy loss during that transportation. The higher the supply temperature is, the higher the energy loss.
To reduce this energy loss, a weather compensation function can be added, which ensures that the supply water temperature is reduced just to match the need according to the actual outdoor temperature.
Weather compensation can save up to 10%*.

Temperature setback
- save 10% energy
On underfloor heating systems with light floor constructions, it is energy efficient to lower the temperatures during night or when rooms are unoccupied.
Setting back the temperatures 6 hours during night time and 6 hour during day time is common.
Assuming roughly that the system reduces the energy consumption up to 20%* during the setback period, this would give and average energy saving of up to 10%*.

Save 50% energy with synchronized pump control
Simple systems without synchronized pump control often will keep the pump running more than needed.
The reason for this is that individual rooms almost never call for heat at the same time, and this means that in systems with more than a few rooms the pump will be running most of the time.
By using synchronized pump control, all heat demands from the rooms are collected and synchronizes the opening of actuator.
This is possible by using PI controlled heating, that only adds the needed heat amount into a room.
By doing this energizing the pump is reduced compared to an unsynchronized system.
If an unsynchronized system with more than 10 rooms is loaded 50%, the pump often is seen running nearly all the time.
On the WLM2 the synchronized action ensures that the pump only runs at 50% of the time, which in theory means up to 50% less running costs on the pump.

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Energy savings with the WLM2:
The WLM2 system can handle all of the previous mentioned energy saving functions. If the installation is meeting the most modern piping, insulation and floor construction types, this would in theory mean very high energy savings.

**Energy savings compared against central controlled heating systems, without individual room temperature control:**

-30% (individual room control)
-20% (PI control)
-10% (weather compensation)
-10% (setback temp)

= energy reduction up to **55%** *

**Energy savings compared against simple ON/OFF individual room controlled heating systems:**

-20% (PI control)
-10% (weather compensation)
-10% (setback temp)

= energy reduction up to **35%** *

*These are estimations made under the commonly used assumption that every unnecessary extra degree room temperature adds around 5-10% of energy waste. This applies to normal well insulated houses, and the energy waste increases further if the house is poor insulated.
Additional system features

Domestic hot water control
It is possible to control the domestic hot water temperature with a special controller to ensure optimum energy saving. A sensor from the controller measures the temperature in the storage cylinder. A zone valve is then controlled via the WLM master, which in turn activates the boiler on demand.

Radiator control
It is possible to control a radiator circuit room temperature with a special room controller to ensure optimum energy saving. The controller measures the temperature in the room, and a zone valve is then controlled via the WLM master, which in turn activates the boiler on demand.

2 step heating
If there is a need for enabling a secondary heat source in a room (e.g. a backup electrical radiator), it is possible to use a special room controller that will control two separate outputs. The second output will be activated only if the temperature cannot be achieved within a preset time period.

Weather compensation
The digital Master is capable of compensating for outdoor temperature. All that is required is an outdoor compensation module and a temperature sensor to be connected. Based on current outdoor temperature and heat demand, the Master varies the water temperature of the underfloor heating by means of a 2, 3 or 4-way mixing valve.

Mixing valve control
To obtain controlled supply water temperature the digital master provides a 24Vac, 0-10V output for the mixing valve. Control action is P + I and the parameters are adjustable in the master. The control signal can be reversed to 10-0V if required.

System check
Correct operation of the system can be checked using a special “Install Mode”. This enables the installer to individually test and prove each output.

Networking possibilities
In large buildings with multiple areas it is possible to use a master to create a network of multiple zones.
• A “network master” could be a digital version for centralized control of mixed supply water or a basic master where no mixing is required.
• “Slave Masters” can then be added to the network to create additional zones.
• “Slave Masters” controlling a common pump are connected as a string on the network system.
• Up to 15 strings, each of up to 9 masters, can be connected as a network.
• Switching between cooling and heating can be done via the “Network Master” using a single WLAC interface.

Commissioning mode
Digital masters include a special “commissioning mode”, which allows the temperature of the supply water to be controlled to assist the drying out of a newly laid concrete floor.
Note: This function relates to BS/EN-1264 part 4.

Adaptive function (optimum start)
The adaptive function allows the start time of the heating system to be automatically varied, thus providing energy savings, but ensuring that the room will reach the correct temperature at the desired time. A WLCT room controller is necessary on the system for the adaptive function to operate.

Weather compensation
The digital Master is capable of compensating for outdoor temperature. All that is required is an outdoor compensation module and a supply temperature sensor to be connected. Based on current outdoor temperature and heat demand, the Master varies the water temperature of the underfloor heating by means of a 2, 3 or 4-way mixing valve.

Temperature settings on the Master are factory-programmed (curve 1) but can easily be altered using the display (curve 2).
Wired and wireless communication

WIRED AND WIRELESS COMMUNICATION
The master is universal and can be used for wireless communication if a receiver is connected. Sensors with either wireless or cable communication can be combined in the same system.

**Wired communication**
Low-voltage sensors/controllers are connected to the Master in star or series using standard 2-core cables (0.25 mm²). The total length of cable may be up to 300 m with a maximum of 100 m between any two units.

If the system is subsequently extended, the new room sensor/controller is simply connected to the nearest cable or room sensor.

**Wireless communication**
The Master is universal and wireless communication is possible if a receiver is connected. A frequency band of 868 MHz is used in order to maximise communication stability. Activating the sensors/controllers is extremely easy: simply set the Master in learning mode and then press the activation button on the sensors/controllers. The sensors/controllers is powered by standard AAA batteries and an alarm signal indicates when these are running low. The alarm signal can be turned off for 24 hours until the batteries have been replaced.

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Room sensor/controller features

**Area control**
Using the room controller, the building can be divided into various areas, each containing rooms with a similar pattern of usage. Time and temperature settings can be made on the room controller for each change of usage, and these settings then apply for all the rooms within the area via a simple programming function in the room controller.

Users can still adjust the temperature of an individual room by +/- 4°C.

The room controller can be placed, and used, to control one of the rooms within the area, or it can be placed outside of the area, in a central position, for the convenience of the user. Therefore, a typical installation could have two or three room controllers placed in a central position and controlling all the rooms within the building.

**Simple sensor and controller activation**
The number of the output for the thermal actuator to be activated by the room sensor/controller must be set on the channel selector located behind the sensor/controller cover. If, for example, channel 4 is selected, the room sensor/controller will activate the thermal actuator connected to output 4 on the Master.

**Manual control**
A room sensor with function selector can be installed, allowing permanent override for that room to either setback or off condition.
Building Management Systems (BMS)

**BMS – simple operation of several applications in modern buildings**

Special BMS versions of the OJ Waterline Master offer an RS-485 BMS interface to support the increasing need for BMS systems in commercial installations and to meet the requirements of intelligent building management. BMS is short for Building Management System - a generic term for systems that can communicate with and control the various electronic equipment found in modern buildings such as:

- Alarms
- Ventilation
- Lighting
- Access
- Heating & cooling

BMS systems are operated from a centrally placed PC or terminal containing the customised BMS software.

The OJ Waterline BMS interface enables the following additional functions:

- Read and set all individual room and floor limit temperatures
- Status read-outs for all outputs, e.g. pumps, boiler and actuators
- Read and set weather compensation values
- Override functions to support testing
- Read-outs from all masters in an OJ Waterline network through the OJ Waterline BMS network master

BMS systems are used in large installations because:

- They ensure central access for the maintenance of building controls.
- They allow control system balancing so that, for example, ventilation and floor heating do not “fight” against each other.
- They enable remote control of various functions.

With BMS, OJ Waterline is able to read and set all individual room and floor limit temperatures.

This is very useful – in a hotel, for example, where the BMS terminal can be placed in reception. The BMS software could be designed in such a way that the receptionist can graphically select a room and activate the heating system when the room is booked.
THE MASTER PROVIDES SYSTEM BRAINPOWER

Based on the room temperatures, the master ensures optimum operation of boilers, pumps, and – on the digital master, water temperature control. It is especially important that operating temperatures are optimised as these are of crucial importance for energy consumption, and system service life.

- Using an external temperature sensor, the Digital Master can compensate for changes in outside temperatures. Water temperature is then adjusted automatically.
- Room temperature demands are communicated to the Master by wired, or by wireless signals.
- Outputs are incorporated in the master for the switching of thermal actuators, boilers, pumps, and mixing valves.
- Temperature settings can be set on the digital master by a simple 3 button system.
- Indicator lights show the status of the outputs, and also give error/fault messages for simple diagnostics.
- Each master can control a maximum of 8 rooms/zones.
- An ADD ON module can extend this to 14.
- A system with greater than 14 zones can be controlled by using more than one master in a network format (see page 6)
- The Master can be used for cooling control in addition to heating.

A cooling kit is required and the software enables dewpoint control to be achieved via a WLH room mounted humidity sensor.

- A Master, primarily used for underfloor heating, can also be used for domestic hot water control, and for control of a radiator circuit, by the addition of special versions of the room WLCT controller (see product program and paragraphs on page 11-12)

In addition, current room temperature for all room sensors/controllers in the home can be displayed, as can current floor temperature if floor sensors are installed. Whether the room sensors/controllers are functioning correctly can also be checked on the display in a table listing all room sensors/controllers.

Error codes (E0 to E9) are shown if faults occur, making it easy to locate and correct any faults.

Digital Master with graphic display

The display lights up when activated and the various temperature parameters are illustrated by simple symbols. Settings can be changed using the up-arrow, down-arrow and accept buttons.

A special service menu allows current readings for the following parameters to be accessed at any time:
- Outdoor temperature (if weather compensation is connected)
- Water temperature for the underfloor heating.
- Mixing valve control signal.

Master programme

- **Standard master**
  - 8 outputs for thermal actuators

- **Digital master**
  - 8 outputs for thermal actuators
  - and weather compensation

- **Additional module**
  - 6 outputs for thermal actuators
Sensors and controllers with wireless or cable communication

- can be combined on the same system.
- Wireless sensors use standard AAA batteries and give an alarm signal when the batteries are running low.
- Cable connected sensors use a 5v dc bus system and standard 2 core (0.25 mm²) cable can be used.
- All sensors can be changed from heating to cooling function by a remote signal sent to the master via a WLAC module.

A non adjustable version of the sensor can be provided for public buildings. All WLM temperature sensors are elegantly designed for mounting on wall surfaces, or on wall sockets.

- Temperature adjustment is restricted to +/- 4°C, preventing unintentional settings to very high or very low levels.
- Precise control is achieved by P+I action of the controlled output.
- Optional floor sensors can be used to ensure that floor temperatures are never too high or too low.
- A room controller provides for temperature levels to be changed to suit the occupancy of the room, thus ensuring that energy is used efficiently.
- One room controller can control a number of rooms with similar occupancy timings, but still maintaining the local +/- 4°C adjustment for individual requirements. (see paragraph on area control, page 8)
- Wireless and cable type sensors.

Room controller with timer

Energy consumption can be reduced if the temperature is lowered at night and during weekday daytime hours. Time controllers can thus save money.

The controller is programmed for comfort and setback periods for one or more rooms with similar pattern of use, e.g. three bedrooms. (see Save energy, page 4)

Room sensors/controllers in general

These are specially designed for waterbased underfloor heating systems. Models with wireless or cable communication are available and both types can be combined in the same system. As many as 24 room sensors/controllers can be combined in a single system, and each of them is capable of controlling one or more thermal actuators. Should a room sensor fail, the system maintains a minimum of 20% heat output, thus preventing unpleasantly low temperatures when occupants return home.

Room sensor with external floor sensor

These room sensors have two sensors. An internal temperature sensor for room temperature control and a floor sensor with higher priority that ensures floor temperature is maintained at a comfortable level all year round or prevents parquet floors from becoming excessively warm.

Floor sensors provide additional comfort on tiled floors and protection of wooden floors

Sensors/Controllers programme

WLTA  WLTM  WLTD  WLTP  WLCT2
<table>
<thead>
<tr>
<th>Control panel</th>
<th>Relay outputs</th>
<th>Control input</th>
<th>In/Outputs for weather compensation</th>
<th>Temperature settings:</th>
<th>Weather compensation:</th>
<th>Power supply</th>
<th>Dimensions (H/W/D)</th>
<th>Master types and accessories:</th>
<th>Cooling kit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 LED indicates power</td>
<td>- Thermal actuators or zone valves 8 outputs, max. 2 A direct Boiler, max. 4 A voltage free - Main pump, max. 4 A direct - Sec. pump, max. 4 A direct</td>
<td>- Setback temp. etc.</td>
<td>-</td>
<td>Permanent settings:</td>
<td>-</td>
<td>230V AC</td>
<td>130/315/53 mm</td>
<td>Outputs for 230 V thermoelements: WLM2-1BA</td>
<td>Cooling kit for standard masters: WLM2-BA-COOL</td>
</tr>
<tr>
<td>8 LEDs indicate thermal actuators</td>
<td>8 outputs, max. 2 A direct</td>
<td></td>
<td></td>
<td>Standard: Room temperature: 21°C</td>
<td></td>
<td></td>
<td></td>
<td>WLM2-1AO</td>
<td>Cooling kit for digital masters: WLM2-FS-COOL</td>
</tr>
<tr>
<td>3 LEDs indicate pumps and boiler</td>
<td></td>
<td></td>
<td></td>
<td>Standard: Setback temperature: 18°C</td>
<td></td>
<td></td>
<td></td>
<td>Outputs for 24 V thermoelements: WLM2-3BA</td>
<td></td>
</tr>
<tr>
<td>1 LED indicates setback temp. Reset for alarm and factory settings</td>
<td></td>
<td></td>
<td></td>
<td>Standard: Max. floor temperature: 27°C</td>
<td></td>
<td></td>
<td></td>
<td>- Receiver for wireless signal: WLRC-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Standard: Min. floor temperature: 17°C</td>
<td></td>
<td></td>
<td></td>
<td>Outdoor compensation module for weather compensation: WLM2-1AO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Standard: Max. supply water temperature: 55°C</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

8 outputs indicate power
8 LEDs indicate thermal actuators
3 LEDs indicate pumps and boiler
1 LED indicates setback temp.
Reset for alarm and factory settings
Backlit display

- Section pump, max. 4 A direct

**Room temperature can be adjusted ±4°C via the thermostat.**

**Wireless communication can be achieved by connecting a receiver (type WLRC-19) to the Master. Dimensions: (H/W/D) 80/80/24 mm.**
Room sensor/controller programme

**ROO**

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>Standard</th>
<th>Standard with function selector</th>
<th>Standard with function selector and floor sensor</th>
<th>Non-adjustable</th>
<th>4-event timer thermostat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature adjustment</td>
<td>±4°C</td>
<td>±4°C</td>
<td>±4°C</td>
<td>-</td>
<td>+5/+35°C</td>
</tr>
<tr>
<td>Functions</td>
<td>-</td>
<td>Auto, comfort, setback, frost</td>
<td>Auto, comfort, setback, frost</td>
<td>-</td>
<td>Auto, comfort, setback</td>
</tr>
<tr>
<td>Room sensor</td>
<td>Internal</td>
<td>Internal</td>
<td>Internal</td>
<td>Internal</td>
<td>Internal</td>
</tr>
<tr>
<td>Floor sensor</td>
<td>-</td>
<td>Incl. floor sensor</td>
<td>-</td>
<td>Can be connected</td>
<td></td>
</tr>
<tr>
<td>Dimensions (H/W/D)</td>
<td>80/80/24 mm</td>
<td>80/80/24 mm</td>
<td>80/80/24 mm</td>
<td>80/80/24 mm</td>
<td>80/80/24 mm</td>
</tr>
</tbody>
</table>

**C**

<table>
<thead>
<tr>
<th>Thermostat type:</th>
<th>WLTA-19</th>
<th>WLTM-19</th>
<th>WLTD-19</th>
<th>WLTP-19</th>
<th>WLCT-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wireless communication</td>
<td>WLTA-29</td>
<td>WLTM-29</td>
<td>WLTD-29</td>
<td>WLTP-29</td>
<td>WLCT-29</td>
</tr>
<tr>
<td>Floor sensor type</td>
<td>-</td>
<td>-</td>
<td>ETF-144/99A</td>
<td>-</td>
<td>ETF-144/99A</td>
</tr>
<tr>
<td>External room sensor type</td>
<td>-</td>
<td>ETF-944/99H</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Special types:**

- Radiator control
- Domestic hot water control
- 2-step control

- External sensor included, temperature range +5/+80°C.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Time</th>
<th>Temp.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program for weekdays, Mondays-Fridays:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☀️</td>
<td>06:00</td>
<td>21°C</td>
<td>MORNING: The day begins</td>
</tr>
<tr>
<td>🏡</td>
<td>08:00</td>
<td>19°C</td>
<td>OUT: At work, school, etc.</td>
</tr>
<tr>
<td>🏡</td>
<td>16:00</td>
<td>22°C</td>
<td>HOME: The family returns home</td>
</tr>
<tr>
<td>🌓</td>
<td>23:00</td>
<td>17°C</td>
<td>NIGHT: Bedtime</td>
</tr>
</tbody>
</table>

Program for Saturdays and Sundays:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Time</th>
<th>Temp.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>☀️</td>
<td>08:00</td>
<td>22°C</td>
<td>MORNING: It is the weekend so the day starts later</td>
</tr>
<tr>
<td>🌓</td>
<td>23:00</td>
<td>17°C</td>
<td>NIGHT: Bedtime</td>
</tr>
</tbody>
</table>

**4-event timer controller**

With a WLCT controller with integrated timer, energy consumption can be reduced by automatically lowering the temperature at night and during weekday daytime hours. Besides the current time and weekday, the controller display also shows the active comfort or setback period using logical symbols. The controller is pre-programmed with comfort and setback periods but these can easily be changed to suit personal requirements. The table shows the symbols used and the factory-programmed periods and temperatures.

For mounting direct on wall or in wall socket.

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Founded in 1964, OJ Electronics develops and manufactures specialised solutions for underfloor heating and HVAC controls and power. Combining in-house R&D with state-of-the-art production and quality-assurance technologies, OJ’s products are acclaimed for design, functionality, ease of installation and reliability.

It is important for OJ to develop the best solution for our customers, focusing on maximum comfort with minimum energy consumption.