Daikin Altherma™ (Air-to-Water Heat Pump Hydronic System)
Energy Efficient and Innovative Solution
A Residential System that Heats, Cools and supplies Domestic Hot Water.

Produced by the Residential Solution Sales Division.
Daikin AC Americas, Inc.

A ground breaking product that combines specialized components to provide the hydronic industry with an integrated solution for heating, cooling and domestic hot water with solar thermal options. This is accomplished by using a heat pump to heat water for space heating and domestic hot water, using the reverse cycle to chill water for cooling.

The data and suggestions in this document are believed current and accurate at the time of publication, but they are not a substitute for trained, experienced professional design, nor for the extensive technical documentation provided. Individual applications and site variations can significantly affect the results and effectiveness of any information. The reader must satisfy him/herself regarding the applicability of any article and seek professional evaluation of all materials. Daikin disclaims any responsibility for actions based on this document.
Introduction – What is Daikin Altherma?

Daikin Altherma is an eco-efficient air-to-water heat pump single hydronic system that produces heating loop water temperatures of 86°F to 131°F (30°C to 55°C). It extracts heat from a renewable and natural energy source, the outside air, and transfers it through refrigerant piping to a hydrobox. The hydrobox heats water through a brazed plate heat exchanger (refrigerant-to-water) that circulates through floor heating systems, fan coil units, low temperature radiators and also provides domestic hot water (DHW). The combination heating and cooling model can reverse the cycle to provide chilled water for cooling (41°F/5°C to 72°F/22°C).

Daikin Altherma with its variable speed inverter driven compressor provides a high level of comfort by allowing multiple zoning and by matching individual zone demands while achieving efficient full load operation (COP=2 to 5, EER=9 to 12+). This system is very quiet (49 dBA-sound pressure heating mode as compared to normal conversational speech-50dBA ) and does not intrude on the inside and outside aesthetics of the home.

Inverter control in combination with weather dependant (outdoor reset) control results in excellent efficiencies (COP’s).

**Inverter Operation = Improved Room Temperature Control**

- **Maximum efficiency** by controlling the compressor RPM, for adapting output and requirements.
- **Maximum comfort** under all conditions, including stable room temperatures
- **Soft start-up** (less than 5 Amps)
- **Increased operating life**, due to continuous partial-load operations

**T° LW = temperature to the floor heating loops**

- T° LW 78.8° F/26° C
- T° LW 86° F/30° C
- T° LW 93.2° F/34° C
- T° LW 100.4° F/38° C

**COP**

- 40%
- 60.8° F/16° C
- 60.8° F/16° C
- 60.8° F/16° C
- 60.8° F/16° C

**Outside Temperature**

- 14° F / -10° C

**Inverter Benefit**

- Slow start-up
- Temperature remains stable
- Heat pump with inverter
- Heat pump without inverter

**Heating load**

- 40%
- 100%
# System Options

## Daikin Altherma Split System

<table>
<thead>
<tr>
<th>Type</th>
<th>Detail</th>
<th>Model Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Split LT Altherma (Small Capacity)</strong></td>
<td>OD Unit (Split, 5kW, Nominal 18MBH)</td>
<td>ERLQ018BAVJU</td>
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<tr>
<td></td>
<td>OD Unit (Split, 7kW, Nominal 24MBH)</td>
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<tr>
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<td>Hydrobox (Heat Only, Back Up Heater 6kW)</td>
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</tr>
<tr>
<td></td>
<td>Hydrobox (Heat Pump, Back UP Heater 3 kW)</td>
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<tr>
<td></td>
<td>Hydrobox (Heat Pump, Back Up Heater 6kW)</td>
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<tr>
<td><strong>Split LT Altherma (Large Capacity)</strong></td>
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<td>OD Unit (Split, 14kW, Nominal 48MBH)</td>
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<td>OD Unit (Split, 16kW, Nominal 54MBH)</td>
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<td><strong>Hydrobox (Large Capacity)</strong></td>
<td>Hydrobox (Heat Only, Back Up Heater 3kW)</td>
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<td>Hydrobox (Heat Only, Back Up Heater 6kW)</td>
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<td>Hydrobox (Heat Pump, Back Up Heater 6kW)</td>
<td>EKHBX054BA6VJU</td>
</tr>
</tbody>
</table>
Daikin Altherma Monobloc System

Why a Heat Pump?

Heat pumps are considered the most energy efficient, electrically operated heating and cooling system on the market today. Daikin Altherma air-to-water heat pump delivers between 3 to 5 kWh of usable heat for every 1 kWh of electricity it uses. This equates to a Coefficient of Performance (COP) of 3 to 5 or 300% to 500% more efficient than resistance electric heat. Heat pumps use renewable energy sources such as the outside air and have no localized CO₂ emissions.

- Typically draws approximately 1/3 to 1/4 of the electricity of a standard resistance heater for the same amount of heating, reducing utility bills. This typical efficiency (300% to 400%) compares to 70-95% for a fossil fuel-powered boiler (fuel oil and gas).

<table>
<thead>
<tr>
<th>Type</th>
<th>Detail</th>
<th>Model Name</th>
</tr>
</thead>
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<td>OD Unit (Mono, Heat Only, 14kW, Nominal 48MBH)</td>
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<td>OD Unit (Mono, Heat Only, 16kW, Nominal 54MBH)</td>
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<td>OD Unit (Mono, Heat Pump, 11kW, Nominal 36MBH)</td>
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<tr>
<td>OD Unit (Mono, Heat Pump, 16kW, Nominal 54MBH)</td>
<td>EBLQ054BA6VJU</td>
<td></td>
</tr>
</tbody>
</table>
• As an electric system, no flammable or potentially asphyxiating fuel is used at the point of heating, reducing the potential danger to users, and removing the need to obtain gas or fuel supplies.
• The convenience of a single monthly utility invoice for your heating, cooling and hot water needs.
• May be used to heat water for space heating and domestic hot water (DHW) and can be used to chill water for space cooling.
• The same system may be used for air conditioning in summer, heating system in winter as well as heating DHW.
• Daikin Altherma with inverter technology to run a variable speed compressor reduces cycle losses, and turn down ratio of 7 to 10 adds comfort by load matching. It also saves electricity and extends the life of the compressor.
• When compared to geothermal, there is no expensive drilling or excavation work resulting in a small footprint outdoors. The cost of drilling or excavating can run anywhere from $10,000 to $30,000, or more depending on the terrain and other local factors (i.e. soil analysis).
• Improved installation with no need for combustion air ventilation, combustion gas evacuation (flue), no gas supply or storage tank for fuel oil.

Example
The electrical (power) input to serve a 10kW electric resistance heat can produce at best case 34,130Btu/hr of Heat (based on COP of 1).

For the equivalent electrical input, an Altherma ERLQ036 with EKHBX054 produces 35,300Btu/hr of Heat (based on 45°F Ambient, 113°F LWT) – thus COP of 3.26)

Why Hydronic Heating and Chilled Water Cooling?

Hydronic heating and chilled water cooling systems use water transported through piping to condition the air temperature inside a residence and heat DHW.

A Daikin Altherma heat pump can accomplish all three functions. With hundreds of possible system configurations, the proper design is capable of meeting the exact comfort needs of its owner. Some systems using Daikin Altherma may be as simple as a heating only application connected to a loop of flexible plastic tubing that warms the floor. Others may use Daikin Altherma connected to an assortment of heat emitters like low temperatures radiators, fan coil units, or radiant in floor. Those same applications can also provide a residence with domestic hot water and chilled water for cooling.
Typical Characteristics of Hydronic Systems

- Superior comfort: Hydronic heating has long been respected for its ability to provide excellent thermal comfort.

- **Room Temperature Profile Comparison:**

  ![Room Temperature Profile Comparison](image)
  
  *Data taken from Daikin House located in Ostend, Belgium*

- The best level of comfort can be achieved with an “in floor” radiant heating application and this added comfort allows the room set-point condition to be reduced by up to 3.6F versus alternative means of heating.

- Daikin Altherma can produce 41°F chilled water for cooling improving humidity control in humid climates.

- Unobtrusive installation: Hydronic heating and chilled water cooling has the ability to be installed without major modifications to the home structure. Water can absorb over 3400 times more heat (heat capacity of H₂O=62.4 Btu/ft³/°F; heat capacity of Air=0.018 Btu/ft³/°F; 62.4/0.018=3467) as the same volume of air for the same temperature change. This allows smaller pipes to be routed through the home instead of large ducts (see example below).
• Design Flexibility: Hydronic heating offers almost unlimited possibilities to accommodate the comfort needs, usage, aesthetic tastes, and budget constraints of just about any home. Daikin Altherma allows the combination of space heating, space cooling and supply DHW with a single system.

• Clean Operation (inside and outside the home): A major complaint from home owners of whole house heating and cooling systems is the amount of dust and other airborne pollutants their systems distribute through the house. Using radiant heat emitters, heat is distributed by natural convection. Even using individual room fan powered heat convectors reduces the amount of dust and pollutants circulated through the entire house.

• Quiet Operation: A properly installed hydronic system can operate with very low sound levels in the occupied areas of a home. Low temperature (86°F/30°C to 131°F/55°C) hydronic systems can all but eliminate the expansion noises of piping associated with some high temperature hydronic systems. Individual zone fan convectors, because of their size and low air flow, are quiet. Outdoor heat pump unit is quiet due to inverter driven compressor; the majority of the time the system is operating on lower capacity (can be less than 45 dBA-sound power) in a part load condition.

• Zone-ability: A heating and cooling system designed to maintain all areas of a home at the same temperature, at the same time, doesn’t give its owner much flexibility. The Daikin Altherma system provides the option of dividing the house into two or more independently-controlled comfort zones. This configuration can reduce energy consumption by allowing for different setpoint temperatures in unoccupied areas. It also allows the comfort level of rooms to be adjusted to suit individual tastes and activity levels.

• Overall Energy Efficiency: The small size of hydronic and chilled water tubing compared to forced-air ducting of equivalent heat carrying ability greatly reduces heat loss from the heat distribution system. It also cost more to insulate the ducting because of its greater surface area. The electrical energy required to circulate water through a properly designed hydronic system is usually a fraction of that used to move air in a similarly sized forced-air system. The cost of operating a typical 90 watt hydronic circulator for 4380 hours per heating season in an area where electricity costs 16 cents per kilowatt-hour is $63.07. Comparing this to a small furnace using a 400 watt blower motor would have an operating cost of $280.32 for that same period. Hydronic systems that heat the floors of rooms with high ceilings reduce energy consumption by reducing air temperature stratification.
What Daikin Altherma can do:

- Heating (59°F/15°C to 131°F/55°C LWT), cooling (41°F/5°C to 72°F/22°C LWT) and supply DHW (to 176°F/80°C) from a single system using low temperature heat emitters.
- Reduces energy use, thus reducing energy cost.
- Delivers between 3 and 5 kWh of usable heat for every kWh of electricity used.
- Localized CO₂ emissions = 0

What Daikin Altherma is not designed for:

- Replace a boiler used for high temperature heat emitters (water loop temperature in excess of 131°F/55°C).
- Deliver high leaving water temperature (greater than 122°F/50°C) with heat pump only at outdoor ambient temperatures below 25°F/-4°C.
- Quick recovery of DHW (i.e. 50 gallons of water in 15 minutes). Typical recovery for heat pump only is 1 gallon/minute at an 80°F/44°C temperature rise.

How can Daikin Altherma be Applied?

Customizable to your location

Daikin Altherma can be selected and optimized based on each projects individual needs, ambient design condition and budget. It is possible to size your heat pump to cover the entire load, utilize an ambient balance point temperature and compliment your Daikin Altherma system with Back-Up Heat or utilize an existing/alternative heat source such as a boiler as an auxiliary system utilized for those extreme cold days. These are summarized as follows:

**Mono-Energetic**

- 100% Heat pump coverage: selection of bigger capacity and higher investment cost heat pump

**Mono-Valent**

- Best balance between investment cost and running cost, results in lowest Lifecycle Cost

**Bi-Valent**

- Utilization of Heat Pump then switching over to alternative heat source like boiler for ultra cold climate heating days

The ultimate system in flexibility

New Construction • Concealed Units or Duct Free exposed • Cooling • Solar • Renovation / Replacement • MonoBloc or Split System • Space Heating • Zoning or Single Zone • Partial house or Whole House • Domestic Hot Water
The ultimate system for home comfort

Daikin Altherma – A great solution for LEED®, Low Energy and Net Zero Energy Homes

The Daikin Altherma product portfolio offers many attributes that make it appealing to the “green” movement and growing scope for high efficiency homes.

<table>
<thead>
<tr>
<th>Scope</th>
<th>Feature / Attribute</th>
</tr>
</thead>
</table>
| Environment | 1. All equipment contains materials that can be recycled.  
2. Altherma system inherent design and operational features mean effective tie in to Grid-Tied Solar PV (Low start up amps, operating amps, no locked rotor amps etc).  
3. DHW Production via Optional/3rd Party Solar Thermal solution and using the “Aero Thermal” Daikin Altherma serving as the Auxiliary Solution.  
4. A heating and DHW solution with NO Localized CO₂ emissions. |
| Efficiency | 1. Enhanced energy savings via Inverter Compressor operation where energy consumption matches the load.  
2. Further savings via the Outdoor Reset Function to control LWT depending on Ambient temperatures.  
3. Operational efficiencies (COP up to 4.5) similar to or better than Geothermal WSHP solutions, without the added cost of well drilling, excavation etc |
| Application | 1. Excellent flexibility for the architect / designer to apply the Altherma system to suit any home design, scale or performance scope.  
2. Unobtrusive and aesthetically pleasing complete Heating, Cooling and DHW  
3. Full utilization of hydronic circuit, thus small diameter piping, high heat transfer coefficient and comfort of Low Sound Level In-Floor Radiant, Low Velocity Fan Convectors or Radiators. |
Daikin Altherma – Using Solar Thermal for DHW applications

The use of solar energy is categorized into two applications
- Electrical use:
  - Photovoltaic - because of the low starting amps of the inverter driven compressor, Altherma is ideal for photovoltaic solar applications
- Thermal use:
  - Solar thermal makes up more than 90% or the solar energy capacity installed worldwide*
    - Domestic hot water heating
    - Space heating

The Daikin Altherma Air to Water Heat Pump systems can be combined with solar thermal systems and provide auxiliary creation of DHW via aero thermal energy from the heat pump and back up and booster heat energy via electrical resistance elements.

The optional solar kit (EKSOLHWBAVJU) can be connected to the Daikin domestic hot water tank. The solar kit enables domestic hot water to be heated by the sun when solar energy is available. The solar kit integrates the field-supplied solar thermal panels with a field supplied pump station and the Daikin domestic hot water tank. Solar domestic hot water priority can be defined through the Altherma interface control.

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*ESTIF: Solar Thermal Action Plan for Europe*
Daikin Altherma System Design and Operation Recommendations

Three (3) steps for a good design:

1) Accurate calculations of heat losses (transmission and ventilation losses).
2) Selection of Daikin Altherma based on heat loss calculation and preferably for low water temperature application (95°F/35°C to 104°F/40°C). Use the available Daikin Altherma selection and software tools.
3) Selection of heat emitters should be based on design $\Delta T$ of 9°F/5°C for optimum efficiency and capacity. The actual heat emitter $\Delta T$ can be designed between 5°F/3°C to 14°F/8°C. The circulator in the hydrobox section has a three speed motor and is factory set on high speed; remember to match the circulator speed with the required system flow (lower circulator speed can be selected at lower flow and head). If the system flow exceeds 12 gpm @ approximately 10 feet of head, a primary/secondary hydronic piping system is recommended.

Design hint: If the heat losses exceed the single total Altherma capacity at design ambient conditions, multiple Altherma systems may be used in unison to aid greater DHW consumption or larger heating loads in single zones. For multiple zones it is highly recommended to utilize multiple (separate) systems. Daikin Altherma can also be applied using an auxiliary boiler connected in parallel (Bi-Valent application)

Recommended Altherma leaving water temperature (LWT) selections conditions:

- 86°F/30°C to 95°F/35°C (at design conditions) for floor heating
- 86°F/30°C to 113°F/45°C (at design conditions) for fan coil units
- 104°F/40°C to 122°F/50°C (at design conditions) for low temperature radiators

Operating the System:

To get the most comfort with the lowest energy consumption with Daikin Altherma, it is very important to observe the following items:

- Define possible schedule timer actions for each day by filling out the form at the end of the operation manual can help minimize energy consumption.
- Make sure the heat pump system works at the lowest possible hot water temperature to heat the home. To optimize this, make sure the weather dependent set point (outdoor reset) is used and configured to match the installation environment (use the available selection and software tool).

Next recommendations apply to installations with an optional domestic hot water (DHW) tank:

- Make sure the DHW is only heated up to the hot water temperature required.
- Optimize the scheduling of DHW operation of the Altherma system so that DHW is heated via the system 1-2hrs prior to the DHW being required (refer to the schedule timer function and programming explained in the users operation manual).
Performance and Efficiency Simulation

Heating

Simulation in Baltimore, Maryland with 1800 ft² house with 32,000 BTU/h loss at 104°F leaving water temperature using radiant under floor heat (Daikin Altherma Simulation Software).

**Required and available capacities**

<table>
<thead>
<tr>
<th>Out temp. (°F)</th>
<th>0.0</th>
<th>8.1</th>
<th>13.1</th>
<th>20.2</th>
<th>29.7</th>
<th>36.3</th>
<th>50.3</th>
<th>60.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (BTU/h)</td>
<td>13800.0</td>
<td>27600.0</td>
<td>41400.0</td>
<td>55200.0</td>
<td>69000.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equilibrium point</td>
<td>13.1°F</td>
<td>28937 BTU/h</td>
<td>Seasonal COP</td>
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<tr>
<td>Total thermal energy</td>
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</table>

**HP capacity (Heat pump capacity):** The integrated heat generation capacity of the heat pump. This value takes into account the energy used for the defrost cycle. Heat pump capacity depends on the outside temperature and the leaving water temperature. The simulator calculates the heat pump capacity at the minimum night temperature in the winter as described in the meteorological data.

**BUH capacity (Backup heater capacity):** The nominal heat generation capacity of the electrical backup heater.

**System capacity:** Total heat generation capacity of the system, i.e. the sum of heat pump capacity and backup heater capacity.

**Spare capacity:** The surplus in heat generation capacity when compared to the required heating capacity, i.e. the difference between system capacity and required capacity.

**Equilibrium point or equilibrium temperature:** The outside ambient temperature at which the heat pump capacity matches the heating demand. It is therefore the lowest outside temperature at which no additional heat source is needed. The heat pump can cover the entire heating demand down to this outside temperature. For outside temperatures below this equilibrium temperature, additional heat from the backup heater is required to fulfill the heating demand. During transient conditions at system heat-up, the equilibrium point can shift to a higher temperature than the one it would be at during normal operations.
Energy consumption per month

Yearly energy consumption 4307 kWh
Primary energy use 10768 kWh

Design conditions
Required capacity
32000 BTU/h

Surface to be heated
1800 ft²

Zero capacity at outside temperature
60.8°F

The graph shows the energy consumption (input) per month for the heat pump and back up heater. There is made a separation between day and night operations to show the amount of energy consumption that falls under day and night tariff.
Independent Performance Verification

EPRI (Electrical Power Research Institute) tested a Daikin Altherma heat pump with domestic water heating at its Knoxville, Tennessee laboratory for operation and performance in a semi-controlled environment. The system tested has a nominal heating capacity of 38.2 kBtu/h (11.2kW). EPRI conducted a series of “draw test” for the water heating component of the Daikin Altherma system between August and October 2009. Using procedures loosely based on the U.S. Code of Federal Regulations water heating protocol1.

The draw test were conducted using Daikin Altherma’s heat pump only mode (i.e. no electric resistive heat elements were enabled) and a 120°F/40°C water tank temperature setting. Four (4) draw tests were executed, and a summary of each draw test is provided in Table 1.

As shown in Table 1, the water drawn out of the tank for each draw test is generally between 47 and 49 gallons. The average power draw during the reheat period was consistent among the four draw test (1.6kW to 1.8kW), however the maximum power draw varied quite largely (2.9kW to 4.4kW) with no apparent correlation to average outdoor temperature. The overall COP (Coefficient of Performance is quotient when “energy out” is divided by “energy in”) increases with increasing average outdoor temperature, as should be expected with an outdoor heat pump unit. A graph showing the trend of overall COP verses average outdoor temperature is shown in Figure 1.

Independent Testing of Daikin Altherma Domestic Hot Water Operation

Table 1
Summary of Draw Test Results for Altherma Water Heater

<table>
<thead>
<tr>
<th>Test Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>Test Duration (hours)</td>
<td>1.9</td>
<td>1.7</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Indoor Temp, Avg (°F)</td>
<td>71.9</td>
<td>71.2</td>
<td>73.9</td>
<td>73.0</td>
</tr>
<tr>
<td>Indoor Humidity, Avg (%RH)</td>
<td>45.7</td>
<td>45.6</td>
<td>44.2</td>
<td>47.4</td>
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<tr>
<td>Outdoor Temp During Reheat, Avg (°F)</td>
<td>68.5</td>
<td>73.2</td>
<td>78.2</td>
<td>80.9</td>
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<tr>
<td>Outdoor Humidity During Reheat, Avg (%RH)</td>
<td>88.1</td>
<td>76.1</td>
<td>60.7</td>
<td>56.9</td>
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<td>Water Draw Flow Rate, Avg (gpm)</td>
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<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
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<tr>
<td>Water Draw Inlet Temp, Weighted Avg (°F)</td>
<td>54.6</td>
<td>58.2</td>
<td>58.8</td>
<td>59.0</td>
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<td>Water Draw Outlet Temp, Weighted Avg (°F)</td>
<td>119.3</td>
<td>119.4</td>
<td>119.6</td>
<td>120.1</td>
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<td>Water Draw Volume (gal)</td>
<td>48.9</td>
<td>49.3</td>
<td>47.9</td>
<td>46.7</td>
</tr>
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<td>Water Draw Energy (ton-h)</td>
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<td>2.1</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Electric Power Reheat, Avg (kW)</td>
<td>1.7</td>
<td>1.7</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Electric Power Reheat, Max (kW)</td>
<td>4.4</td>
<td>2.9</td>
<td>4.3</td>
<td>3.0</td>
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<tr>
<td>Electric Energy Reheat (kWh)</td>
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<td>2.6</td>
<td>2.4</td>
<td>2.2</td>
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<tr>
<td>Overall COP (Btu/ltu)</td>
<td>2.6</td>
<td>2.8</td>
<td>3.0</td>
<td>3.2</td>
</tr>
</tbody>
</table>

DHW Draw (Tapping) test results ranged from 2.6 – 3.2 COP

Figure 1

[Graph showing Overall COP (Btu/ltu) against Average Outdoor Air Temp (°F)]
Independent Testing of Daikin Altherma Heating Operation

In the heating mode, hot water is generated by the Altherma hydrobox and is circulated through the heating water loop and heat is supplied to conditioned space through a fan coil air handler. The water loop temperature can be set through the Daikin Altherma controller in the range from 77°F (25°C) to 131°F (55°C).

Steady-state tests were run with water loop temperatures of 77, 95, 113, and 131°F (25, 35, 45, and 55°C). Figure 2 is a heating profile showing actual water loop temperature at the entrance to the fan coil and supply air temperature. The water loop temperature setting was adjusted throughout the test and the setting is indicated above or below the appropriate part of the graph and highlighted in yellow.

Figure 2
Daikin Altherma Case Study

The Challenge
Oregon locals embarking upon building the most sustainable energy efficient home possible, wanted a heating solution worthy of their green vision.

Daikin’s Solution
The first U.S. installation of Daikin Altherma™ - a domestic heating and hot water solution providing outstanding performance even during the coldest months.

Application:
Residential

Location:
Portland, Oregon
USA
The Bauman-Broussard home, which received a LEED Platinum rating, is the site of the first installation of Daikin Altherma in North America.

Daikin Altherma indoor Hydrobox with optional domestic hot water tank.
Case Study – Recorded Energy Consumption & Operating Cost

<table>
<thead>
<tr>
<th>MONTH</th>
<th>kWh Used</th>
<th>kWh Sold</th>
<th>NET kWh Used</th>
<th>Energy Use Charge Calc</th>
<th>Actual Cost</th>
<th>Avg kWh/Day</th>
<th>Avg Cost/Day</th>
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<tbody>
<tr>
<td>Feb-09</td>
<td>635</td>
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<td></td>
<td>250.000 kWh x 5.12400¢</td>
<td>$12.81</td>
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<td>March</td>
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**Note:** partial month: begin 2/13

**Note:** lower apt filled

**Total YTD:** 10422 kWh Used, 1064 kWh Sold, 9993 NET kWh Used

**AVE YTD:** $0.00, 25.05714286 kWh/D, $1.5536 Cost/Day
Summary

The residential heating, cooling and domestic hot water markets and requirements are changing;

- **Energy Prices** - the ever rising prices of fossil fuels due to increasing demand and reduced availability (also affects the price of electricity that is generated by fossil fuel)
- **Ecological Concern** - efforts to reduce emission of green house gases and energy consumption
- **Changing Legislations, Incentives** - to support the drive towards major changes in energy consumption habits for the purpose of achieving ecological targets in an effort to slow down, stop or even reverse climate change.

Market changes have driven home owners to seek alternatives to mainstream heating and cooling (i.e. central air conditioning systems with combustioned based ducted furnaces for heating, or combustioned based boiler systems) for their homes. Daikin Altherma can be applied with fossil fuel backup and thermal solar (hybrid system) for heating and DHW, forced air with chilled water for cooling, and has less install limitations than geothermal (no drilling or excavation); the versatility of Daikin Altherma makes it a viable alternative by combining an inverter driven compressor heat pump into a hydronic system that heats and cools the space along with the option of supplying domestic hot water with thermal solar option.

Conclusions

Daikin Altherma offers many advantages over traditional heating and DHW solutions. It provides significant viability to deliver efficient and eco-responsible comfort based on the following attributes that have been explained throughout this document: -

- Eco-efficient design
- **Utilization of renewable energy from the outside air**
- high full load and excellent part load efficiencies
- Attractive, “affordable” system price
- High operating and service reliability
- Low installation costs
- Flexible and simple installation
- Adaptable to radiant floor, fan coil & radiator applications
- No local consumption of fossil fuels
- 30-98% reduction in total CO₂ emissions
- Optional year-round comfort with active cooling function
- Simple match up for solar thermal and/or grid tied solar PV
- Excellent solution for Low Energy / Net Zero Homes