Variable Speed Solutions
Outstanding performance for residential applications
Heat pumps - an efficient technology using renewable energy

Environmental impact, reduction of carbon footprint and energy consumption are at the centre of every discussion. New legislation such as the Energy Performance of Buildings (EPBD) directive, the Renewable Energy Sources (RES) directive and Ecodesign have been implemented to improve the use of primary energy and promote energy efficiency in heating and cooling applications.

Although the RES directive acknowledges air, water and ground as renewable energy sources, most water heaters on the market today still use fossil fuels or direct electricity.

Heat pumps are recognized as the technology of choice to make renewable energy usable.

Solutions for heat pumps

Emerson provides solutions that not only reduce development time and cost, but also increase system reliability and performance, by combining know-how both in compressor technology and refrigerant flow control.

Its advanced key components for heat pump systems, such as the new Variable Speed compressor range, prove once more that Emerson drives technology and helps prevent global warming by reducing CO₂ emissions and primary energy consumption.
Your choice for an efficient heating solution

Emerson offers a wide selection of products from single components that can be implemented into heating and reversible systems, over a combination of compressors and controls, to the option of integrating its technologies into one highly efficient refrigerant module – tailored to application needs. The more integrated the solution, the more advantageous are time to market, investment and resources while reliability and efficiency will increase.

The integrated solution
Refrigerant module heating

Key benefits:
• Modular concept – reduced complexity
• Best reliability
• Short time to market

The combined solution
Copeland variable speed scroll and inverter drive with superheat envelope controller

Key benefits:
• Superheat envelope controller, electronic expansion valves and sensors
• Simplicity of adoption
• Integrated solution

The compressor solution
Copeland variable speed scroll and inverter drive

Key benefits:
• Superheat envelope controller, electronic expansion valves and sensors
• Simplicity of adoption
• Integrated solution
Variable speed scroll compressor and inverter drive
Outstanding performances and reliability based on a brushless permanent magnet motor matched with a highly efficient drive

Emerson introduces two variable speed compressor models:
• **ZHW** – Dedicated to heating applications, with Enhanced Vapor Injection
• **XHV** – Reversible cooling and heating applications, without Enhanced Vapor Injection

ZHW/XHV operating envelope

Key features:
• Designed for R410A
• Variable speed solution for best in class seasonal efficiency (SCOP and ESEER)
• Extended envelope of models without Enhanced Vapor Injection
• Variable Volume Ratio (VVR - ZHW only) and High Volumetric Efficiency valve (HVE) to boost both cooling and heating efficiency
• Wider modulation range with speed variation from 15 to 120Hz
• Compressor envelope, speed and safety information via driver serial communication (RS485 - Modbus)
• Drive with embedded compressor safety algorithms for superior reliability
• Enhanced Vapor Injection (ZHW only):
  + 15% COP
  + 25% Capacity
  VDE approved

ZHW & XHV variable speed scroll compressor line-up

<table>
<thead>
<tr>
<th>kW Heating Capacity</th>
<th>ZHW030</th>
<th>ZHW015</th>
<th>XHV038</th>
<th>XHV025</th>
<th>XHV018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditions: Heating kW evaporating -7°C, condensing 50°C, 4K subcooling, 5K superheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Superheat Envelope Controller (SEC)
All parameters under control

Integrated solution for superior reliability and efficiency

Key features:
- Compressor operating map management
- Compressor speed management
- Superheat control
- Enhanced Vapor Injection / Wet Vapor Injection control
- Compressor speed management during defrost
- Actuation of evaporator fan
- Smart crankcase heater control
- Oil recovery
- Energy meter
- Frequency management to avoid resonances
- Information available via serial communication (RS485 - Modbus)

Available for different system configurations

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Monobloc</th>
<th>Split</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-to-water</td>
<td>EVI* / non EVI</td>
<td>EVI / non EVI</td>
</tr>
<tr>
<td>Ground source</td>
<td>EVI / non EVI</td>
<td></td>
</tr>
</tbody>
</table>

*Enhanced Vapor Injection
XHV variable speed compressors
Optimized for average and warm climates

Key benefits:
• Wide operating envelope
• Increased efficiency at low ambient temperature conditions
• Variable speed and low superheat capability
• Enables highest A++/A+++ efficiency class possible*
• Speed variation between 15 to 120Hz

* Final efficiency class depending on final heat pump design

XHV operating envelope

• Designed for low water temperature
• Allows high water temperature for average climate
• Wet suction capability for improved system efficiency
• Axial and radial compliance for superior reliability

Simplicity of adoption

• Deep understanding of compressor interaction with the system embedded into the design process
• Supply fully qualified EMC compliant components
• Acoustic, vibration and numerical simulation capability
• Provide additional expertise on modal analysis, virtual prototyping, stress and sound evaluation
Refrigerant module heating
The core of next generation heat pumps

Key benefits
• Best SCOP
• Best reliability
• Reduced complexity
• Enables highest A++/A+++ efficiency class possible*
• Fully compliant with EMI/EMC normative and VDE certified

* Final efficiency class depending on final heat pump design

Refrigerant module heating operating envelope

Module components
• Copeland variable speed compressor and inverter drive
• Emerson electronic expansion valves
• Pressure temperature sensors
• 4-way reversing valve
• Plate heat exchanger(s)
• Liquid receiver
• Piping
• Emerson refrigerant circuit controller

Advanced functionalities
• Optimized evaporator fan speed control
• Defrost management
• Monitoring
• All SEC controller features
• Piping stress analysis
• Modal analysis to avoid resonance frequencies

Refrigerant Module Heating: finite element analysis
Primary energy ratio simulation

This simulation is based on air-to-water heat pumps, both at high (55°C) water temperature featuring different compressor technologies:

- **ZP** Fixed speed air conditioning optimized scroll
- **ZH** Fixed speed heating optimized scroll
- **ZHI** Fixed speed heating optimized scroll with Enhanced Vapor Injection
- **XHV** Variable speed scroll optimized for average and warm climates
- **ZHW** Variable speed heating optimized scroll with Enhanced Vapor Injection

### Minimum primary energy ratio (η%) requirements by equipment type:

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>2015 Tier 1</th>
<th>2017 Tier 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers</td>
<td>&gt;86%</td>
<td>&gt;86%</td>
</tr>
<tr>
<td>Low temperature (35°C) heat pump</td>
<td>&gt;115%</td>
<td>&gt;125%</td>
</tr>
<tr>
<td>High temperature (55°C) heat pump</td>
<td>&gt;100%</td>
<td>&gt;110%</td>
</tr>
</tbody>
</table>

* Label mandatory <70kW, limits apply to all water heater generators <400 kW

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For more details, see [www.emerson.com](http://www.emerson.com)

**Emerson Commercial & Residential Solutions**
Emerson Climate Technologies GmbH - Pascalstrasse 65 - 52076 Aachen, Germany
Tel. +49 (0) 2408 929 0 - Fax: +49 (0) 2408 929 570 - Internet: [www.emerson.com](http://www.emerson.com)

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