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 Climate Technologies 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.

The working principle of heat pump technology

Key factors for an improved efficiency, Emerson Climate provides solutions for two key elements: compressor and system design

* Seasonal Coefficient of Performance
Your Choice For An Efficient Heating Solution

Emerson Climate Technologies 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:
- Mutually optimized and qualified scroll and inverter drive
- Highest efficiency throughout the operating envelope and speed range
- With and without Enhanced Vapor Injection
- Copeland Scroll™ reliability standards
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 Climate Technologies Introduces Two Variable Speed Compressor Models:
- **ZHW** – Dedicated to heating applications, with Enhanced Vapor Injection
- **ZHV** – Reversible cooling and heating applications, without Enhanced Vapor Injection

**Key Features:**
- Designed for R410A
- Variable Speed Solution for best in class seasonal efficiency (SCOP and ESEER)
- **New** - Extended envelope of models without Enhanced Vapor Injection
- **New** - Variable Volume Ratio (VVR) and High Volumetric Efficiency valve (HVE) to boost both cooling and heating efficiency
- **New** - Wider modulation range with speed variation from 15 to 117Hz
- Compressor envelope, speed & safety information via driver serial communication (RS485 - Modbus)
- Driver with embedded compressor safety algorithms for superior reliability
- Enhanced Vapor Injection (ZHW only):
  - +15% COP
  - + 25% Capacity
  - VDE approved

**ZHW/ZHV Variable Speed Scroll Compressor Envelope**

**Variable Volume Ratio and High Efficiency Valve Effect**

**ZHW & ZHV Variable Speed Scroll Compressor Line-up**

*Conditions: Cooling kW* Evaporating 5°C, Condensing 50°C, Superheat 10K, Subcooling 0K
*Heating kW* Evaporating -7°C, Condensing 50°C, 4K Subcooling, 5K Superheat
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>Configurations</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>
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</tbody>
</table>

* Enhanced Vapor Injection
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

Module Components
• Copeland Variable Speed compressor and inverter drive
• Emerson Climate Technologies 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

* Final efficiency class depending on final heat pump design
Seasonal Coefficient Of Performance Simulation

Energy-related Products Directive (ErP) Labeling Scheme

<table>
<thead>
<tr>
<th>Eff. Class</th>
<th>High temperature</th>
<th>Low temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>η%</td>
<td>SCOP</td>
</tr>
<tr>
<td>A+++</td>
<td>150%</td>
<td>3.83</td>
</tr>
<tr>
<td>A++</td>
<td>125%</td>
<td>3.20</td>
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<tr>
<td>A+</td>
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<tr>
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<tr>
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<td>D</td>
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<tr>
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<tr>
<td>F</td>
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<td>0.83</td>
</tr>
<tr>
<td>G</td>
<td>&lt;30%</td>
<td>&lt;</td>
</tr>
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</table>

This table shows the ErP directive labelling scheme. The different efficiency classes, G to A+++ , refer to the European Average Climate -defined by the EN14825- and to two different water temperatures: high (55°C) and low (35°C). A heating system below 70kW will be classified within one of these categories based either on its SCOP value (calculated according to the EN14825) or on its primary energy efficiency level (η%).

Example: heat pump with SCOP = 3 (according to the EN14825) for a high temperature application. Considering that the primary energy conversion factor defined by the normative for the entire Europe is 2.5 we have: $2.5/3 = 120\% = \eta$

The heat pump in question is in class A+.

Simulation Of Primary Energy Efficiency Level

<table>
<thead>
<tr>
<th>Tech</th>
<th>High temperature (55°C) Single</th>
<th>2017 Required Primary Energy Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas C</td>
<td>72%</td>
<td>86%</td>
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<tr>
<td>Gas Cond. B</td>
<td>88%</td>
<td></td>
</tr>
<tr>
<td>Best Gas Cond. A</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>ZP B</td>
<td>83%</td>
<td>110%</td>
</tr>
<tr>
<td>ZH A+</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>ZHI A+</td>
<td>113%</td>
<td></td>
</tr>
<tr>
<td>ZHV A++</td>
<td>132%</td>
<td></td>
</tr>
<tr>
<td>ZHW A+++</td>
<td>134%</td>
<td></td>
</tr>
</tbody>
</table>

According to EN14825

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
- ZHV Variable speed scroll optimized for reversible applications
- ZHW Variable speed heating optimized scroll with Enhanced Vapor Injection

Minimum Primary Energy Ratio (η%) Requirements By Equipment Type*:

- **Boilers**
  - 2013: Tier 1 >86%
  - 2015: Tier 1 >86%
  - 2017: Tier 2 >125%

- **Low Temperature (35°C) Heat Pump**
  - 2013: Tier 1 >115%
  - 2015: Tier 1 >125%

- **High Temperature (55°C) Heat Pump**
  - 2013: Tier 1 >100%
  - 2015: Tier 1 >110%

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

Energy label example
Emerson Climate Technologies At A Glance

Emerson Climate Technologies is the world’s leading provider of heating, ventilation, air conditioning, and refrigeration solutions for residential, industrial, and commercial applications. We combine technically superior products and services from our industry-leading divisions and brands with our global engineering, design and distribution capabilities to create reliable, energy efficient climate systems that improve human comfort, safeguard food, and protect the environment.

For more details, see www.emersonclimate.eu