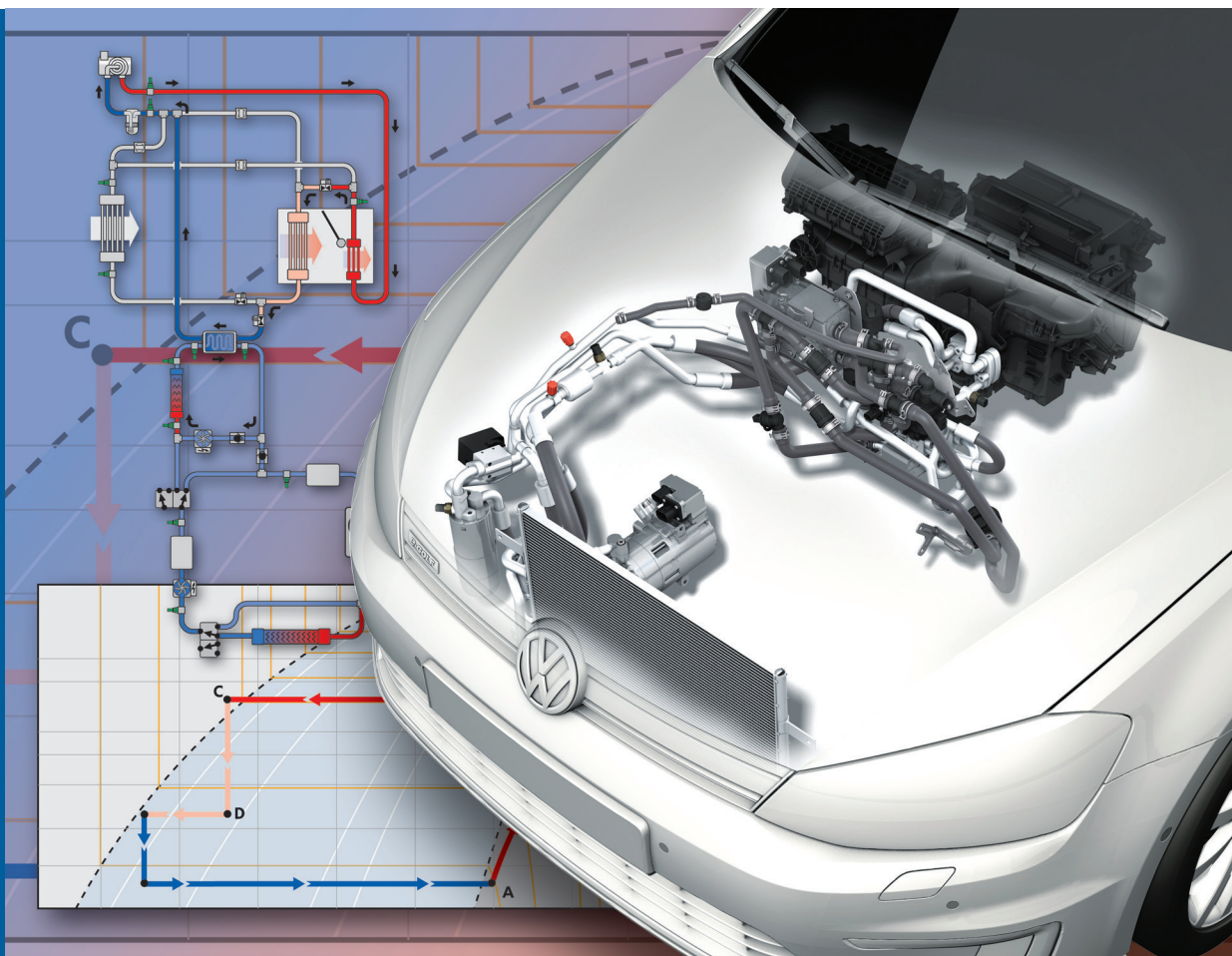




Self Study Program 880153

The Heat Pump from Volkswagen

Design and Function



Volkswagen Group of America, Inc.
Volkswagen Academy
Printed in U.S.A.
Printed 7/2015

Course Number SSP 880153

©2015 Volkswagen Group of America, LLC.

All rights reserved. All information contained in this manual is based on the latest information available at the time of printing and is subject to the copyright and other intellectual property rights of Volkswagen Group of America, LLC., its affiliated companies and its licensors. All rights are reserved to make changes at any time without notice. No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, nor may these materials be modified or reposted to other sites without the prior expressed written permission of the publisher.

All requests for permission to copy and redistribute information should be referred to Volkswagen Group of America, Inc.

Always check Technical Bulletins and the latest electronic repair information for information that may supersede any information included in this booklet.

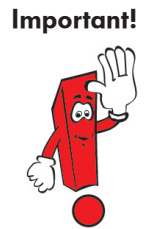
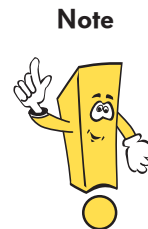
Trademarks: All brand names and product names used in this manual are trade names, service marks, trademarks, or registered trademarks; and are the property of their respective owners.

Contents

Introduction	1
Basic Principle of the Heat Pump	5
The Heat Pump in the e-Golf	7
Components	10
Function of the Heat Pump	20
System Overview	26
Service	27
Knowledge Assessment	28

This Self-Study Program provides information regarding the design and function of new models.

This Self-Study Program is not a Repair Manual. This information will not be updated. For maintenance and repair procedures, always refer to the latest electronic service information.



Page intentionally left blank for printing purposes

Introduction

Heat pump technology has been used in buildings for many years to reduce heating and cooling costs. At Volkswagen, this efficient technology is being used to produce heat in the e-Golf.

The heat pump system is a refrigerant circuit that is made up of numerous components. In this SSP, we will simply call it the heat pump.

In cars with an internal combustion engine, the heat produced by the engine can be used to heat the passenger compartment. Electrically driven vehicles, however, do not produce enough thermal energy to heat the vehicle interior.

Using a heat pump allows the heat from the outside air and the heat produced by the drive components to heat the vehicle interior. As a result, less battery power is required by the electrical high-voltage heater, reducing energy consumption. The range of the e-Golf with a heat pump is 30% greater with a heat pump than without one.



s532_006

Introduction

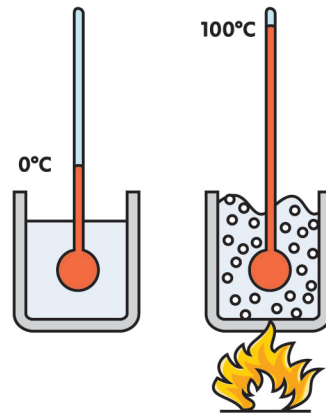
Physical Laws

What is heat?

Heat (mathematical symbol of Q , unit of joule) is a form of energy that is transferred between two systems due to temperature differences.

Heat always flows from a body of high temperature to a body of low temperature.

Heat can be transferred through thermal conduction, thermal radiation or convection.



s532_002

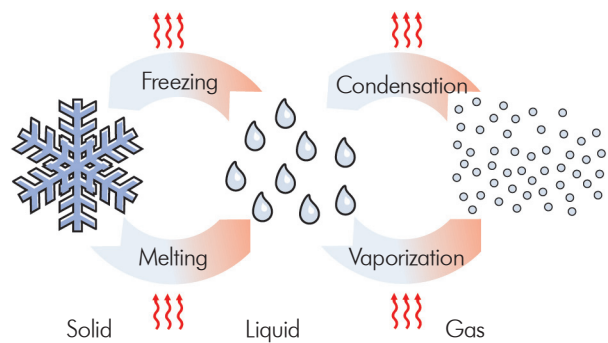
Phase Transition

There are three primary states of matter that substances can change between due to temperature or pressure; solid, liquid and gas.

To change its state of matter, a body must either absorb or release thermal energy:

- Melting: The transition from solid to liquid state. Heat is absorbed.
- Vaporization: The transition from a liquid to a gaseous state. Heat is absorbed.
- Condensation: The transition from a gaseous to a liquid state. Heat is released.
- Freezing: The transition from a liquid to a solid state. Heat is released.

The phases of water



Heat Pump

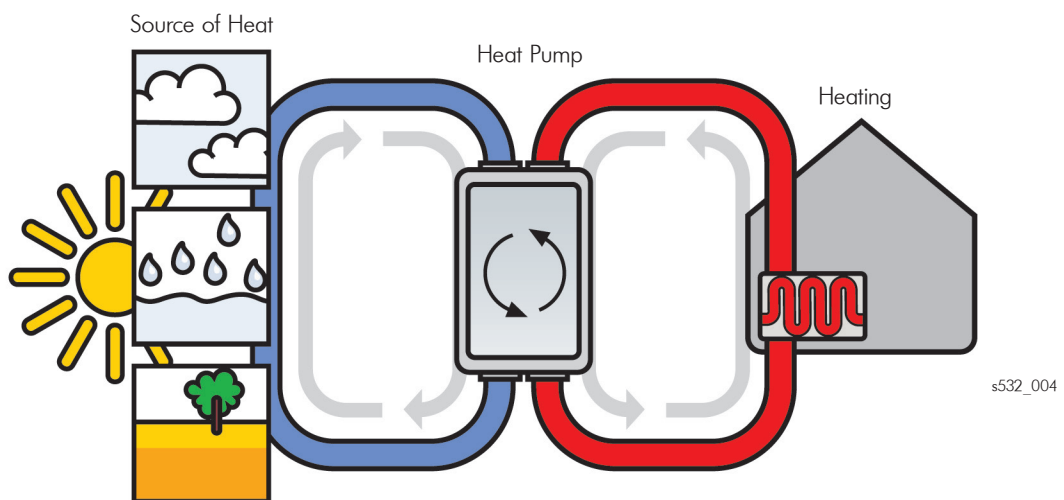
General Information

Heat pump technology makes use of these laws.

Water flows downhill by itself, but needs to be pumped uphill. The same can be said of heat: it automatically “flows” from a higher to a lower temperature level. Heat pumps use electrical energy to pump heat against the natural “temperature flow” from a lower to a higher temperature level.

Task

Heat pumps transport thermal energy from one location to another. They have been used in buildings for a long time for heating. Heat pumps have lower energy consumption, lower pollution levels and lower operating costs than traditional heating methods.



When reversed, this principle is used for cooling in refrigerators and air conditioning systems.

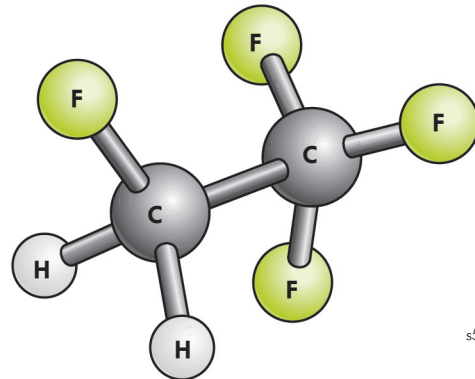
Introduction

Refrigerant

The heat pump uses R134a refrigerant. It is a chlorofluorocarbon (CFC) with a low boiling point. R134a is invisible in gas form and is colorless like water when in vapor and liquid states.

Characteristics

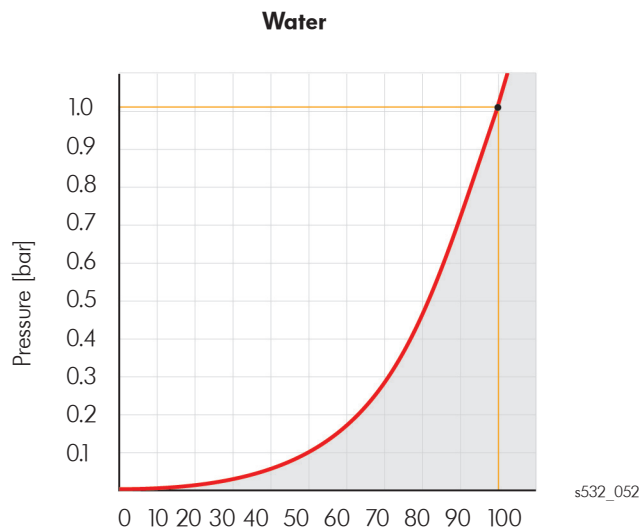
- Designation: tetrafluoroethane
- Chemical formula: $\text{CH}_2\text{F}-\text{CF}_3$
- Boiling point: -26.5°C (at approx. 1 bar)
- Solidification point: -101.6°C
- Critical temperature: 100.6°C
- Critical pressure: 4.056 MPa (40.56 bar)



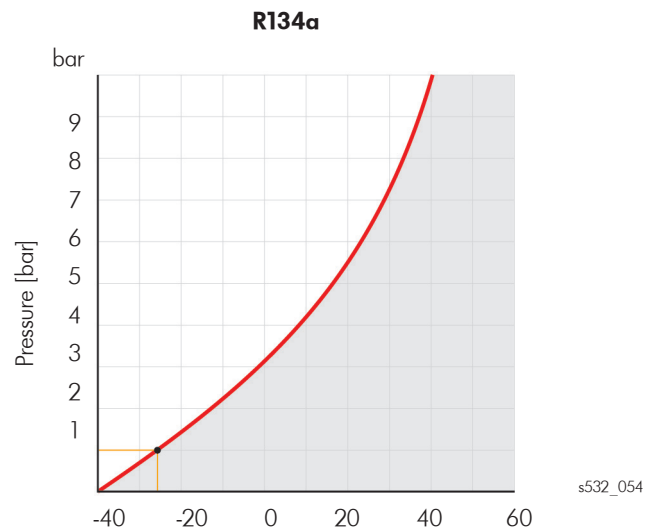
s532_042

Pressure and Boiling Point

The boiling point is the temperature at which a substance changes from liquid to gaseous state. The boiling point of a substance is always given at normal atmospheric pressure (1.01325 bar). The boiling temperature varies according to the pressure. It falls at low pressure and rises at high pressure. This behavior is illustrated as an evaporation curve in the pressure-temperature graphs.



s532_052



s532_054

These physical properties of R134a refrigerant are used in the heat pump. By specifically changing the pressure and the temperature, the refrigerant is able to:

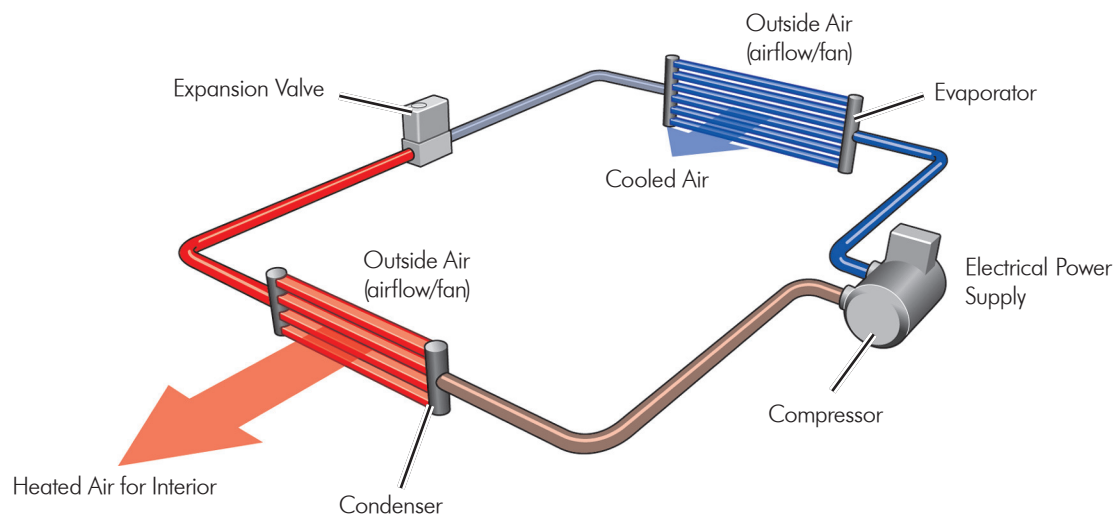
- evaporate and absorb heat at ambient temperature or
- condense and release heat at ambient temperature.

Basic Principle of the Heat Pump

Circuit Design

A heat pump basically consists of the following main components: a compressor, an evaporator, an expansion valve and a condenser.

In the closed heat pump circuit, the refrigerant circulates and changes between liquid and gaseous state, transferring and transporting heat. There is always a high pressure side and a low pressure side in this circuit.



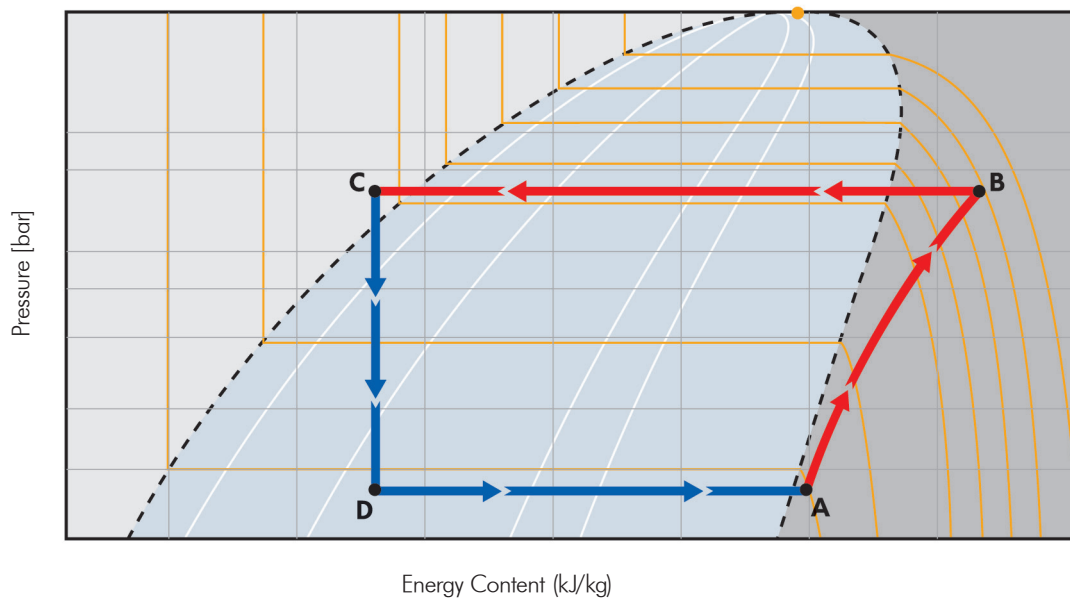
Function

- The compressor draws in cold, gaseous refrigerant at low pressure and compresses it under high pressure. The temperature rises. In this phase, the refrigerant is gaseous and under high pressure at a high temperature.
- Cold air (airflow/fan) flows through the condenser. The refrigerant transfers heat to the air and condenses. The heated air flows into the interior. In this phase, the refrigerant is liquid and under high pressure at medium temperature.
- The pressure of the liquid refrigerant is reduced significantly in the expansion valve. The reduced pressure leads to partial evaporation of the refrigerant. After expansion, the temperature of the refrigerant is significantly lower than the ambient temperature.
- In the evaporator, the pressure of the refrigerant being sprayed is further reduced and it evaporates. The heat of vaporization required for this process is drawn from the warmer outside air, which then cools. The now gaseous refrigerant leaves the evaporator.

Basic Principle of the Heat Pump

Phase Diagram of R134a Refrigerant

This diagram represents the phases of R134a in a heat pump circuit. You can see the energy content, the pressure, the temperature and the state of the refrigerant in each process. Other absolute values occur depending on the outside air temperature and the heating requirement inside the vehicle.



s532_012

- Gaseous Refrigerant
- Wet Steam Region of Refrigerant
- Liquid Refrigerant
- ■ ■ ■ Gas/liquid Region Borderline
- High-pressure Region
- Low-pressure Region
- Line of Constant Temperature (temperature curve)

Explanation

A - B: compression

The refrigerant is gaseous; the pressure and the temperature rise.

B - C: condensation

The refrigerant turns to liquid, the temperature falls and the pressure remains constant.

C - D: expansion

The pressure reduction leads to partial evaporation of the refrigerant and the temperature falls.

D - A: evaporation

The refrigerant becomes completely gaseous, the temperature rises slightly and the pressure remains constant.

K: critical point

The boiling line is to the left of the critical point and the saturated vapor line is to the right of it.

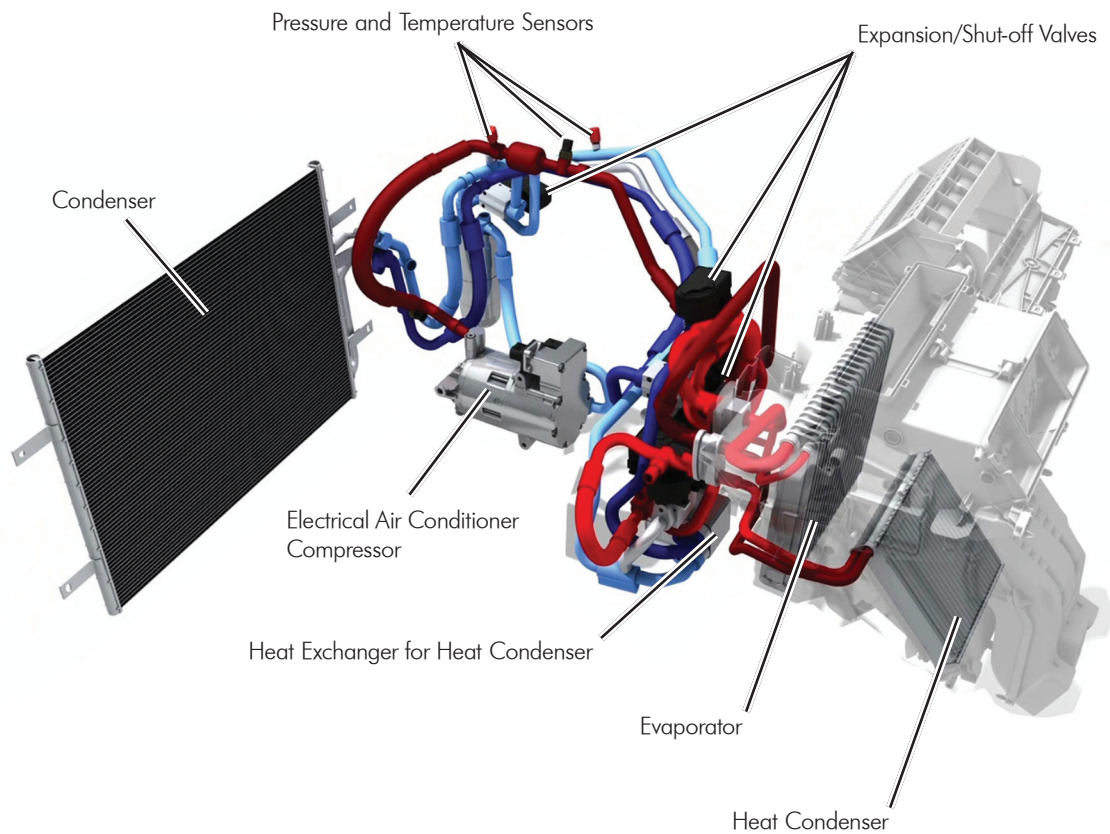
The Heat Pump in the e-Golf

System Configuration

Components like the electrical air conditioner compressor, the evaporator and the condenser run the air conditioning system in the e-Golf. The refrigerant circuit of the air conditioning system has been expanded for use with the heat pump to include refrigerant lines, electrical expansion valves, pressure senders, temperature senders and a heat condenser.

Since the heat pump system for the e-Golf also uses the heat produced by the motor and the power and control electronics for electric drive, a second expansion valve and a heat exchanger for the heat condenser are used in parallel to heat pump circuit.

Refrigerant Circuit

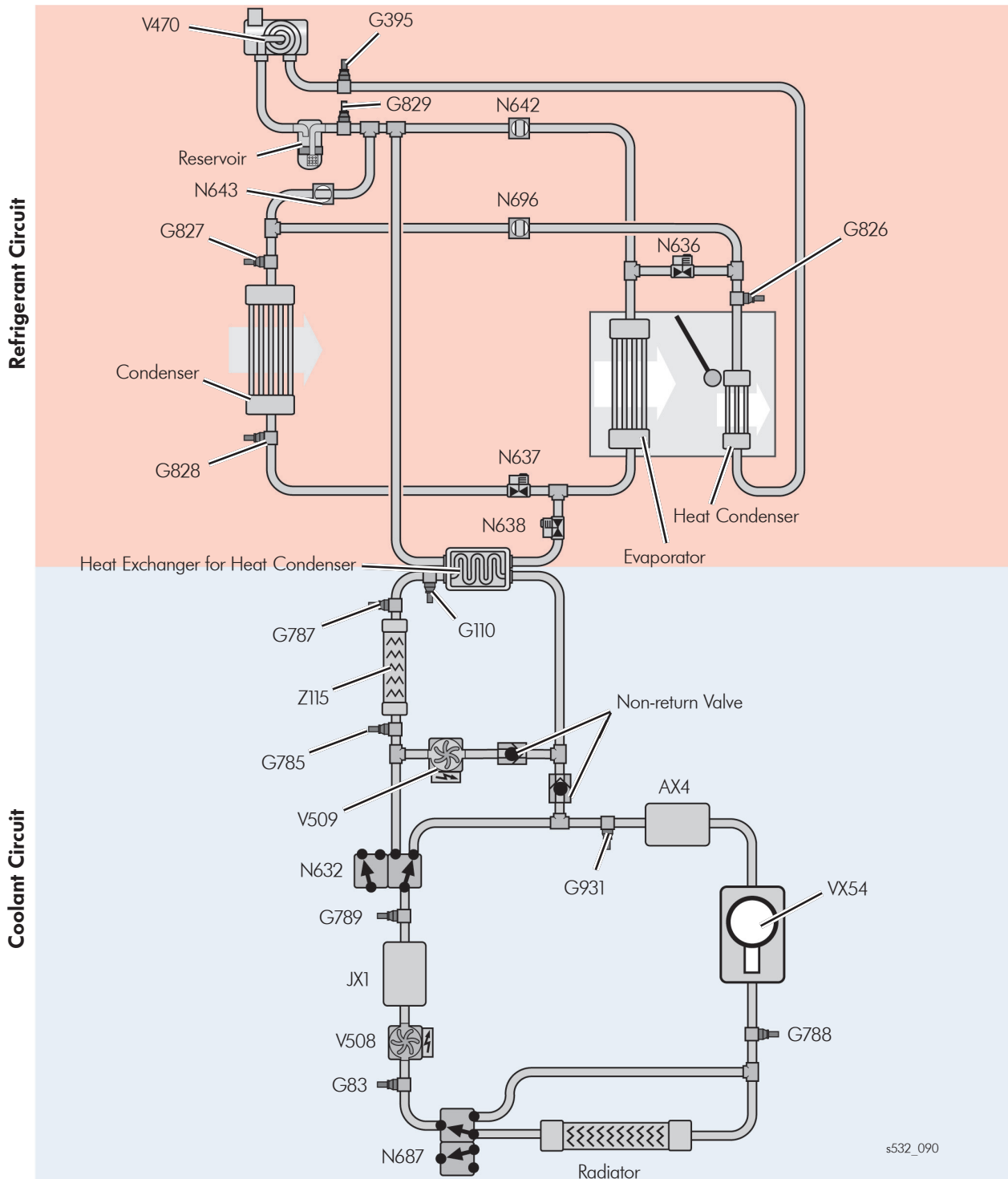


s532_007

The Heat Pump in the e-Golf

Schematic Diagram of the Coolant and Refrigerant Circuits



This schematic diagram provides a basic illustration for subsequent descriptions of components and the functions of the heat pump.



s532_090

The Heat Pump in the e-Golf

Key

AX4	High Voltage Battery Charger 1
G83	Engine Coolant Temperature Sensor on Radiator Outlet
G110	A/C Engine Coolant Temperature Sensor
G395	A/C Pressure/Temperature Sensor
G785	Temperature Sensor in Front of High Voltage Heater (PTC)
G787	Temperature Sensor after Heat Exchanger
G788	Temperature Sensor after Electro-Drive Drive Motor
G789	Temperature Sensor after Electric Drive Power and Control Electronics
G826	A/C Pressure/Temperature Sensor 2
G827	A/C Pressure/Temperature Sensor 3
G828	A/C Pressure/Temperature Sensor 4
G829	A/C Pressure/Temperature Sensor 5
G931	Temperature Sensor Before Charger
JX1	Electric Drive Power and Control Electronics
N632	Coolant Change-Over Valve 1
N636	Refrigerant Expansion Valve 1
N637	Refrigerant Expansion Valve 2
N638	Refrigerant Expansion Valve 3
N642	Refrigerant Cut-off Valve 4
N643	Refrigerant Cut-off Valve 5
N687	Radiator Bypass Switch-over Valve
N696	Refrigerant Cut-off Valve 1
V470	Electrical A/C Compressor
V508	Coolant Pump In Front of Electric Drive and Power Control Electronics
V509	Coolant Pump In Front of High Voltage Heater (PTC)
VX54	Three-phase Current Drive
Z115	High Voltage Heater (PTC)
	Refrigerant Circuit
	Coolant Circuit

The following terms are shortened in the remainder of this SSP:

- N636 Refrigerant Expansion Valve 1 to Expansion Valve 1 (EV1)
- N637 Refrigerant Expansion Valve 2 to Expansion Valve 2 (EV2)
- N638 Refrigerant Expansion Valve 3 to Expansion Valve 3 (EV3)
- N696 Refrigerant Cut-off Valve 1 to Cut-off Valve 1 (SV1)
- N642 Refrigerant Cut-off Valve 4 to Cut-off Valve 4 (SV4)
- N643 Refrigerant Cut-off Valve 5 to Cut-off Valve 5 (SV5)

Components

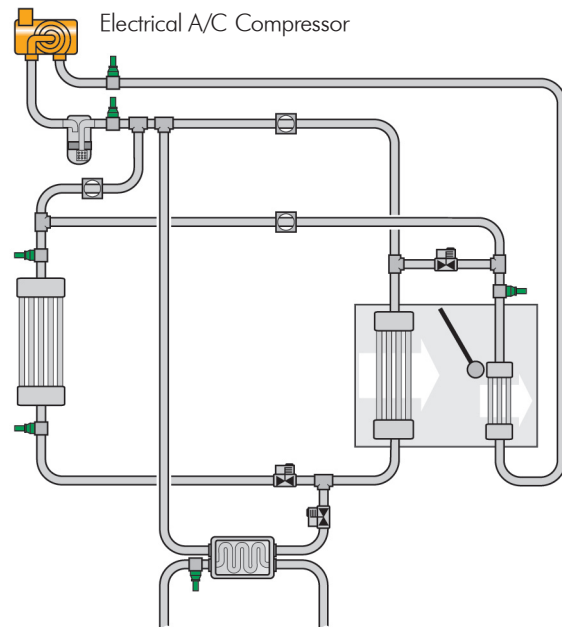
Electrical Air Conditioner Compressor

Location

The Electrical A/C Compressor V470 is bolted to the Three-phase Current Drive VX54.

Design

The e-Golf with heat pump uses an electrical air conditioner compressor with an internal scroll compressor design. It is identical to the air conditioner compressor used in the e-Golf without a heat pump.

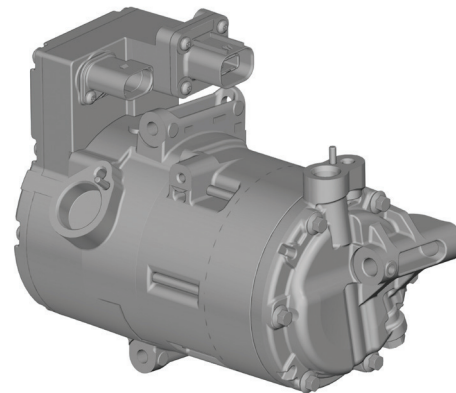


s532_024

Function

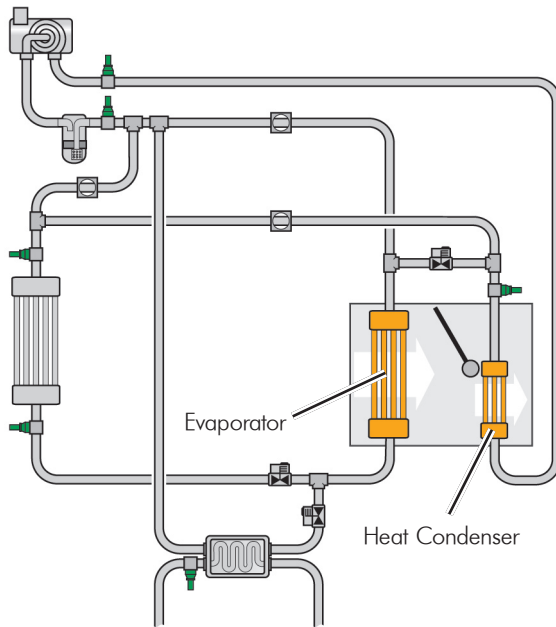
The electrical A/C compressor draws in the gaseous refrigerant at low pressure. It is compressed, the pressure increases and the temperature of the refrigerant rises.

The electrical A/C compressor pushes the refrigerant to the condenser as a hot gas. This compressor forms the separating point between the low and high-pressure sides of the refrigerant circuit.



s532_021

Heat Condenser and Evaporator



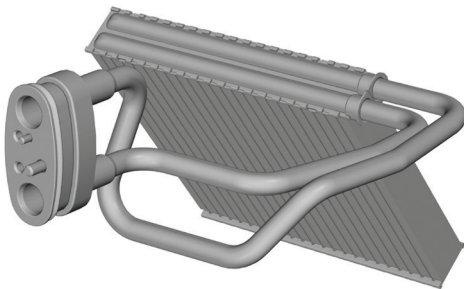
Location of Heat Condenser/ Evaporator

The heat pump in the e-Golf has a heat condenser and an evaporator. Both are located in the heater and air conditioning unit.

Design of Heat Condenser

The heat condenser is a serpentine-like pipe system with fins. This creates a large heat exchange area with good heat transfer. Airflow from the fan passes through the heat condenser.

Heat Condenser



Heat Condenser Function

Condensation is the transition of matter from a gaseous to a liquid state.

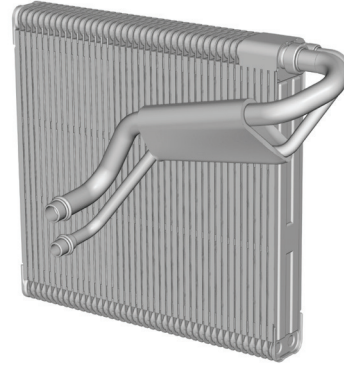
The hot, gaseous refrigerant reaches the condenser. The condenser pipes and fins absorb heat as cool outside air flows across the condenser. As it cools, it condenses and becomes a liquid. The cooled refrigerant is then guided into the vehicle interior.

Components

Evaporator Design

The evaporator has a similar design to the heat condenser and also has an internal flow of refrigerant. Air from the heater and air conditioning unit flows through the evaporator.

Evaporator



s532_025

Evaporator Function

The evaporator works as a condenser during heat pump operation ("heating" function). This means that the air flowing through the evaporator is heated.



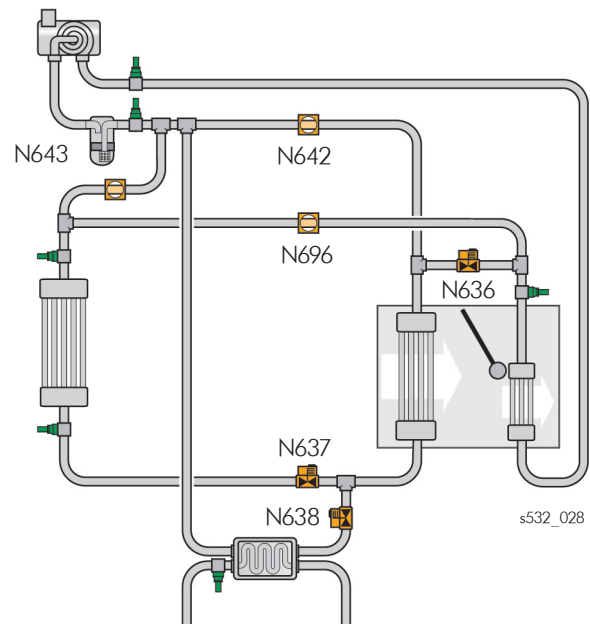
The evaporator works as an evaporator in "cooling" mode (function). This means that the air flowing through the evaporator is cooled.

Expansion Valves and Cut-off Valves

Locations of Expansion Valves/ Cut-off Valves

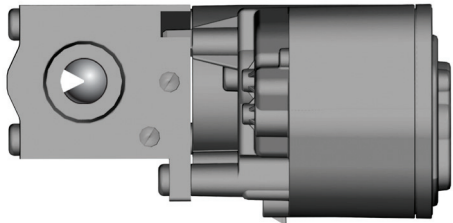
Three expansion valves and three cut-off valves are used in the heat pump circuit:

- N636 Refrigerant Expansion Valve 1 (EV1)
- N637 Refrigerant Expansion Valve 2 (EV2)
- N638 Refrigerant Expansion Valve 3 (EV3)
- N696 Refrigerant Cut-off Valve 1 (AV1)
- N642 Refrigerant Cut-off Valve 4 (AV4)
- N643 Refrigerant Cut-off Valve 5 (AV5)



s532_028

Expansion Valve



s532_011



Refrigerant flows through the Expansion Valve 2 N637 from the evaporator in the direction of the condenser in “heating” operating mode (function). In “cooling” operating mode (function), the refrigerant flows through the expansion valve in the opposite direction.

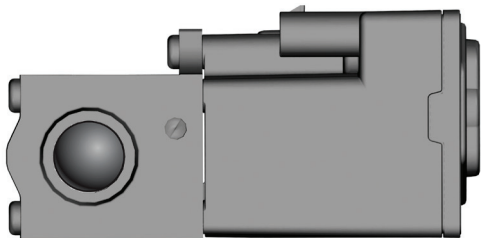
Design of Expansion Valves

The expansion valves have an identical design. A V-shaped control edge in the ball valve enables on-demand, stepless activation (0-100 percent).

Expansion Valve Function

The refrigerant can expand in the expansion valve, i.e. fill a considerably larger space (volume enlargement). The pressure then falls significantly. The liquid refrigerant partially evaporates, causing the temperature to fall.

Cut-off Valve



s532_017

Design of cut-off valves

The cut-off valves are ball valves that are either fully open or fully closed.

Cut-off Valve Function

The cut-off valves regulate the flow direction of refrigerant in the refrigerant circuit.



The expansion valves and cut-off valves are connected to the Thermal Management Control Module J1024 via the same LIN-Bus. Each compact valve connector has its own coded pin assignment.

Components

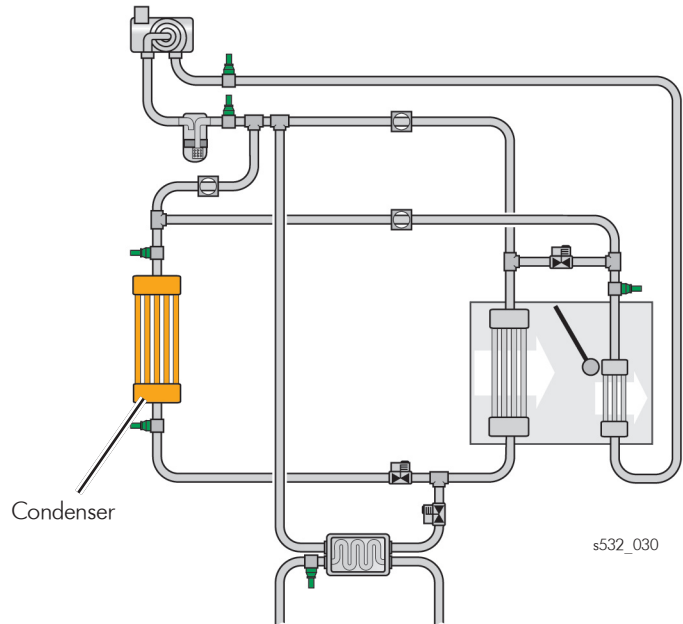
Condenser

Location

The condenser is located between the radiator fan and the radiator.

Design

The condenser is a conventional air conditioner condenser.

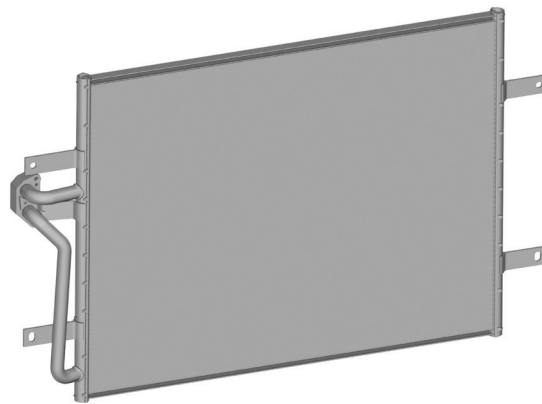


Function

The condenser operates either as an evaporator or a condenser according to the “cooling” or “heating” operating mode (function).

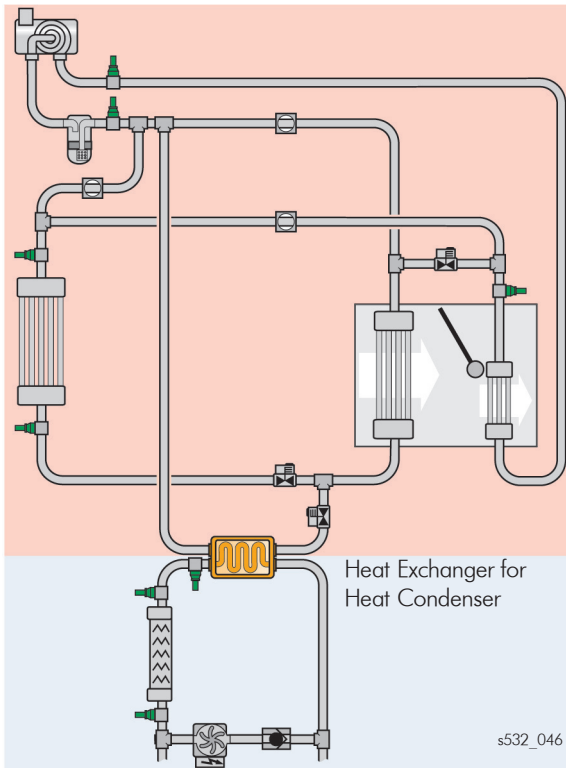
It works as an evaporator in heat pump mode, i.e. in the “heating” function. Evaporation refers to the transition from a liquid to a gaseous state.

In the evaporator, the refrigerant, which is no longer under pressure and is at ambient temperature, is completely evaporated. The heat required for this is drawn from the outside air that passes between the evaporator fins. The pressure of the refrigerant remains constant and the temperature rises slightly.



The evaporator functions as a condenser in “cooling” operating mode (function).

Heat Exchanger for Heat Condenser



Key

- Refrigerant circuit
- Coolant circuit

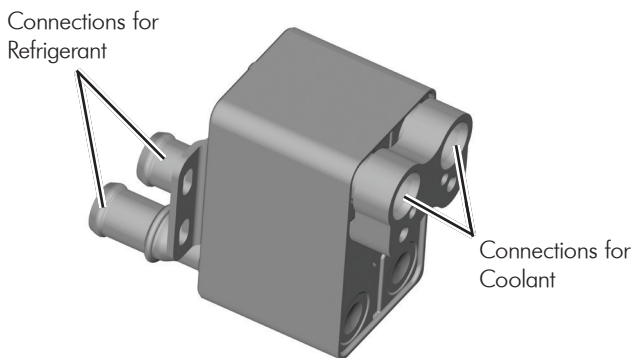
Location

The heat exchanger is located on a bracket mounted on the bulkhead in the engine compartment. Most of the heat pump components are mounted on it.

Design

The Heat Exchanger for Heat Condenser is just like conventional oil-to-coolant plate heat exchangers.

The coolant circuit is separate from the refrigerant circuit. Heat is exchanged without direct contact between or mixing of the fluids.



Function

In the Heat Exchanger for Heat Condenser, the heat of the coolant is transferred to the refrigerant and the refrigerant evaporates.

The heat from electronic components such as the three-phase current drive, the power and control electronics for electric drive and the charging unit is used.

Components

Reservoir

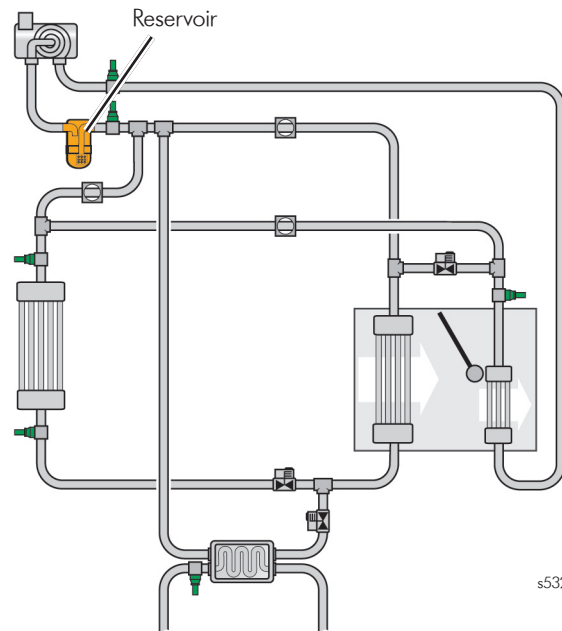
Location

The reservoir is upstream of the electrical air conditioner compressor in the refrigerant flow direction.

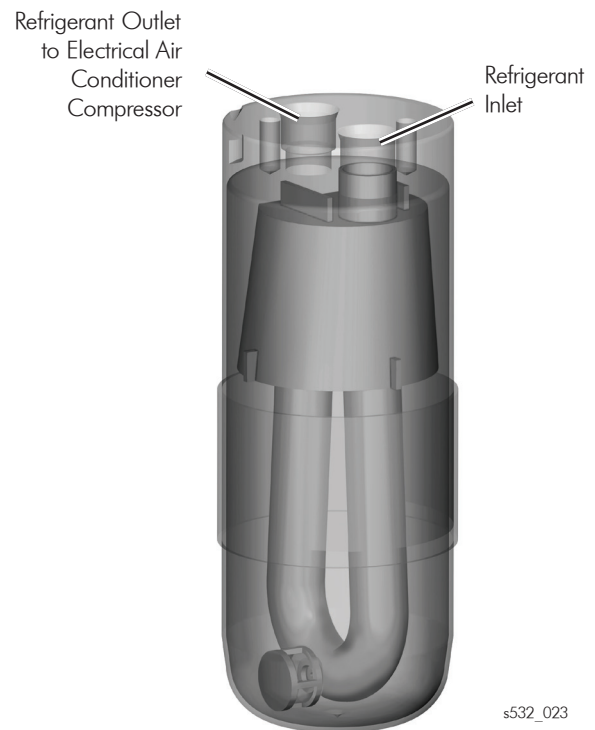
The reservoir is located at the front right in the wheel housing.

Design

It is identical to the reservoir in other vehicles with air conditioning.



s532_034

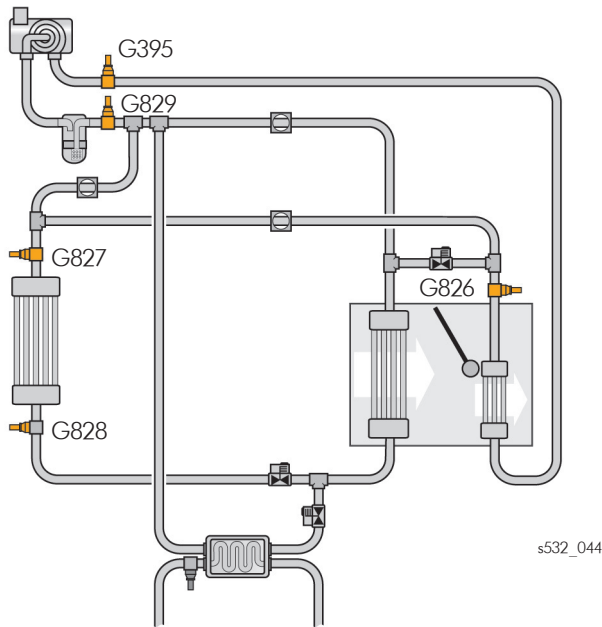


s532_023

Function

The reservoir is used in the refrigerant circuit as an expansion and supply tank for the refrigerant. Since the thermal loading of the evaporator and condenser and the speed of the electrical air conditioner compressor will vary during operation, different quantities of refrigerant will also be pumped through the circuit. The reservoir is incorporated into the circuit to compensate these fluctuations.

Refrigerant Pressure and Temperature Sensors



Location

A total of five refrigerant pressure and temperature sensors are installed in the heat pump circuit.

They are located on the assembly carrier:

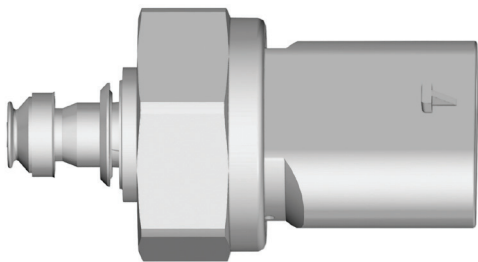
- G395 A/C Pressure/Temperature Sensor
- G826 A/C Pressure/Temperature Sensor 2
- G827 A/C Pressure/Temperature Sensor 3
- G828 A/C Pressure/Temperature Sensor 4
- G829 A/C Pressure/Temperature Sensor 5

Function

The refrigerant pressure and temperature sensors measure the pressure and the temperature of the refrigerant, convert the readings into an electrical signal and send it to the heat pump control module.

The following data is collected:

- Refrigerant pressure 0 to 36 bar
- Refrigerant temperature -40°C to $+150^{\circ}\text{C}$
- Internal temperature sender -40°C to $+140^{\circ}\text{C}$



The refrigerant pressure and temperature sensors can only be replaced after the refrigerant has been extracted.

Failure Effects

If one or more sensors fail, the refrigerant pressure and the refrigerant temperature are determined using a map. The heating up phase for the vehicle interior is increased and an entry is made in the event memory.

Components

Coolant Change-Over Valve 1 N632

Location

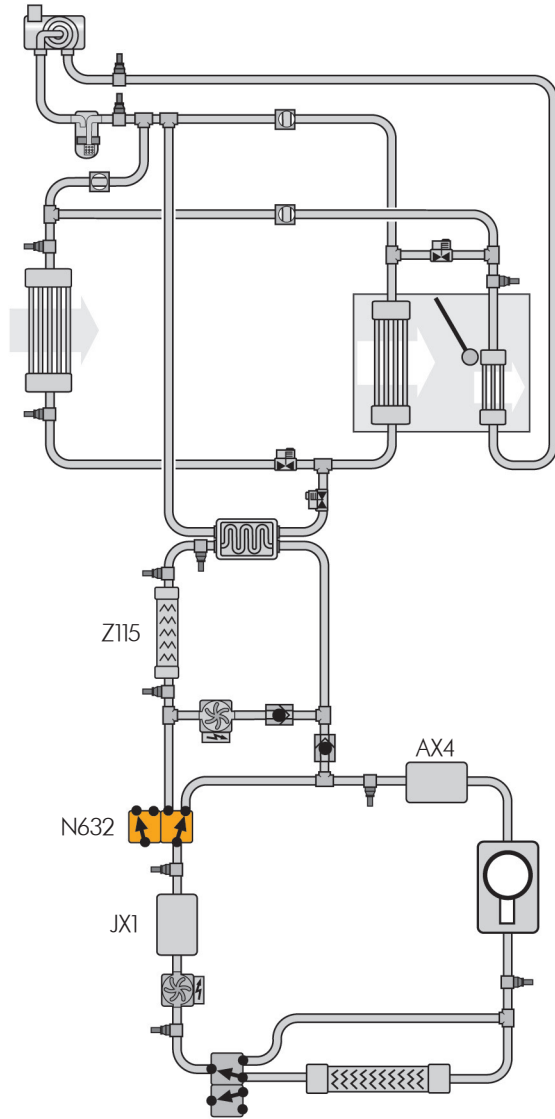
The Coolant Change-Over Valve 1 is located in the coolant circuit.

Design

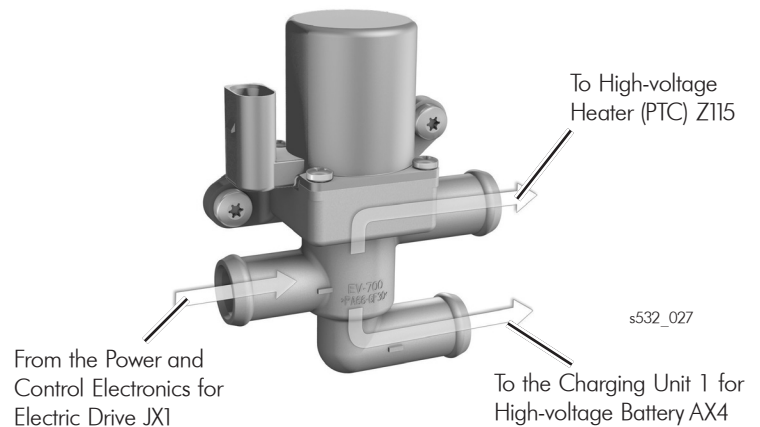
The Coolant Change-Over Valve 1 is a 3/2-way valve.

Function

This valve is used to switch between the large coolant circuit and the small coolant circuit with the high voltage heater (PTC). When not powered, it is constantly open and only the large coolant circuit is active. The heat-up phase of the vehicle interior takes longer.

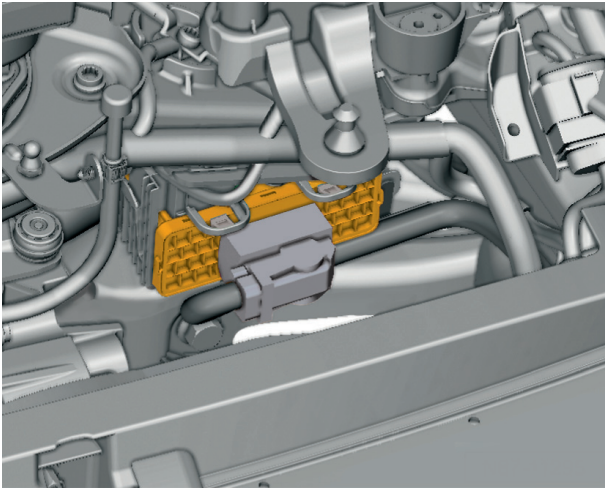


s532_092



s532_027

Thermal Management Control Module J1024



s532_051

Location

This control module is located in the engine compartment under the 12 V battery.

It is connected to the Data-Bus On-Board Diagnostic Interface J533 via the Extended CAN-Bus.

Function

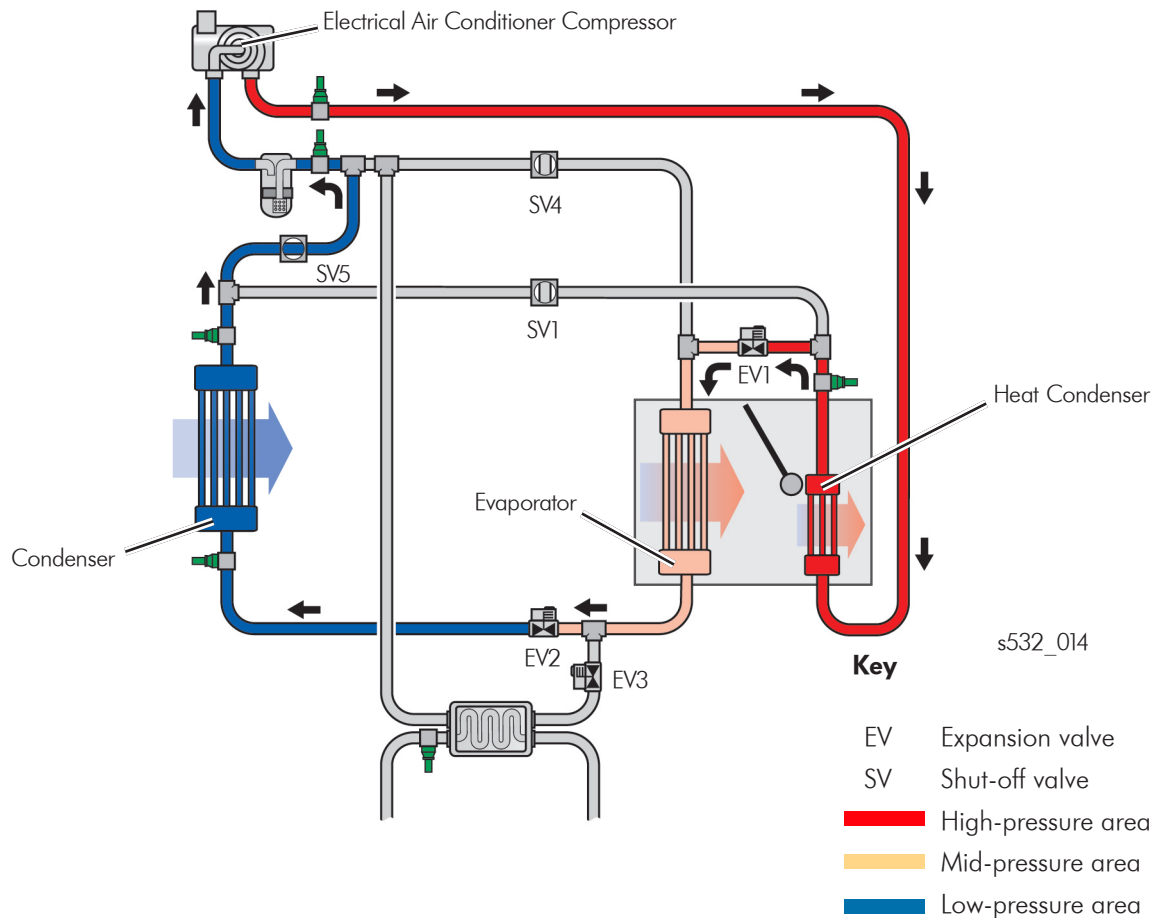
The Thermal Management Control Module J1024 takes care of all functions that are associated with controlling the refrigerant circuit.

Failure Effects

If the Thermal Management Control Module J1094 fails, the entire air conditioning system will not operate.

Functions of the Heat Pump

Heating Function in Air Mode



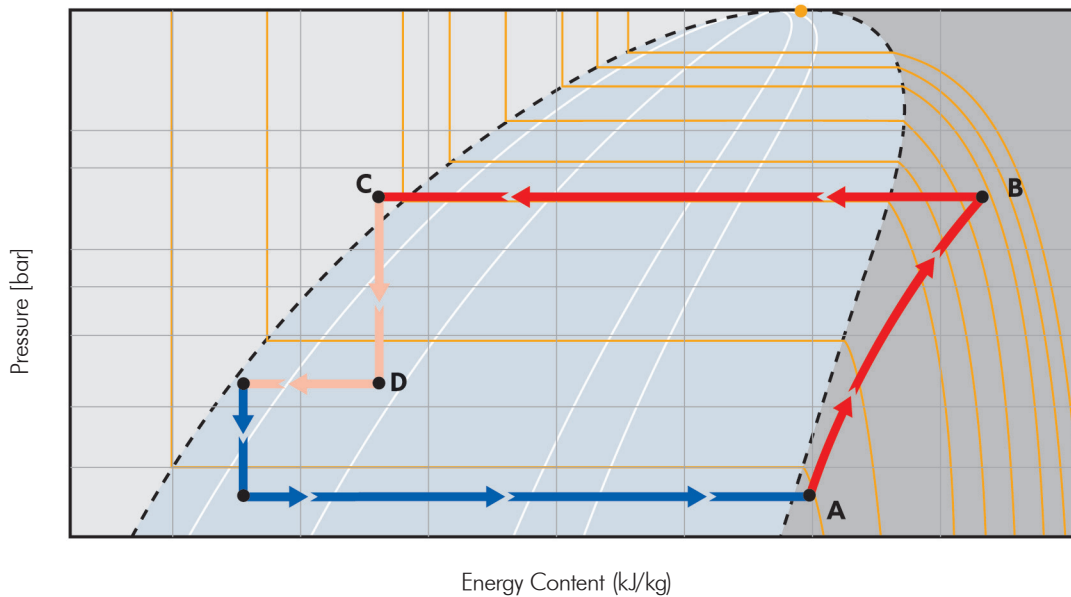
This function uses only the heat from the outside air to heat the vehicle interior.

1. The electrical air conditioner compressor compresses the refrigerant. The gaseous refrigerant is under high pressure at a high temperature.
2. In the heat condenser, the refrigerant transfers heat to the air and starts to condense. The heated air flows as heating air into the vehicle interior.
3. Cut-off valves 1 and 4 are closed. The pressure is reduced via Expansion Valve 1. The temperature of the liquid refrigerant decreases.
4. The evaporator now works as a condenser. The incoming refrigerant condenses and releases heat. The now pre-heated air flows to the heat condenser.
5. Expansion Valve 3 is closed. The refrigerant pressure is lowered further via Expansion Valve 2. The refrigerant temperature now falls below the ambient temperature.
6. The cold refrigerant, which is below ambient temperature, evaporates in the condenser. The heat of vaporization required for this process is drawn from the warmer outside air, which then cools down. The gaseous refrigerant leaves the condenser and flows through the open Cut-off Valve 5 in the direction of the air conditioner compressor.

Functions of the Heat Pump

Phase Diagram of the R134a Refrigerant

This diagram shows the state of the R134a refrigerant during the heating function (air mode).



Explanation

A - B: compression (electrical air conditioner compressor)
The refrigerant is gaseous; the pressure and the temperature rise.

B - C: condensation (heat condenser)
The refrigerant turns into liquid, the temperature falls and the pressure remains constant.

C - D: expansion (Expansion Valve 1)
The pressure is relieved via Expansion Valve 1. This leads to partial evaporation of the refrigerant and the temperature falls.

D - E: condensation (evaporator)
The refrigerant condenses, the temperature falls and the pressure remains constant.

E - F: expansion (Expansion Valve 2)
The pressure is relieved via Expansion Valve 2. The temperature falls below the ambient temperature.

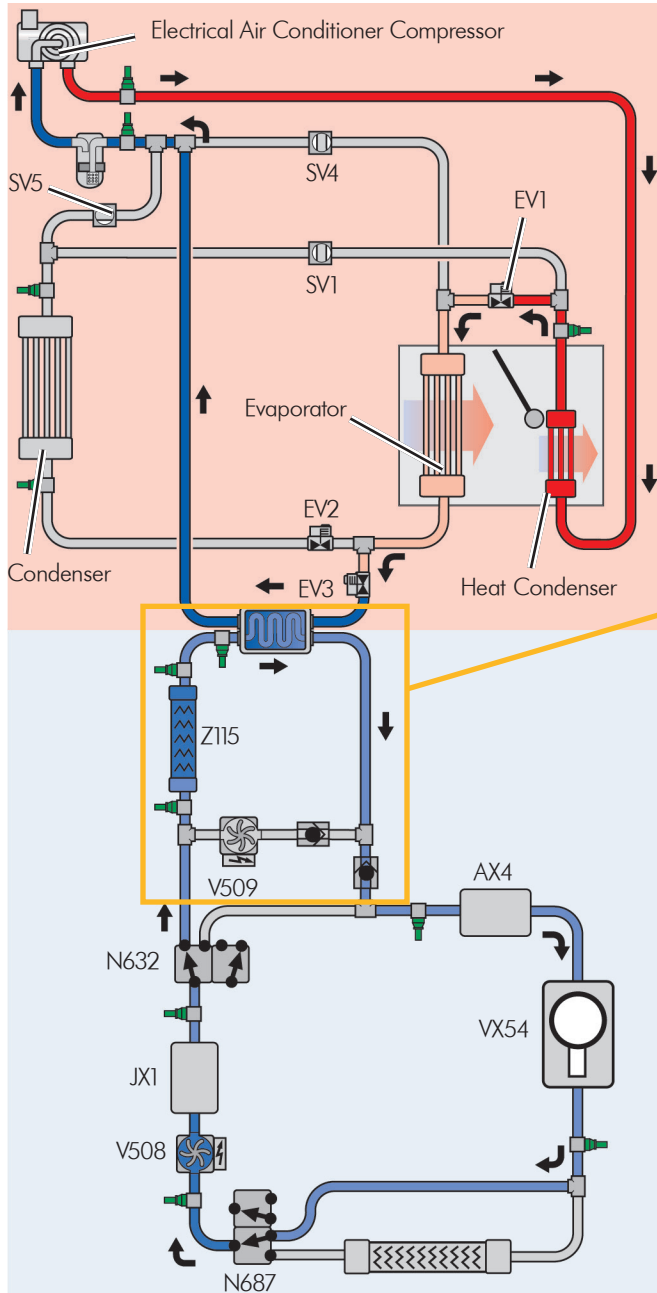
F - A: evaporation (condenser)
The refrigerant becomes completely gaseous, the temperature and the pressure remain constant.

K: critical point
The boiling line of the refrigerant is to the left of the critical point and the saturated vapor line is to the right of it.

Functions of the Heat Pump

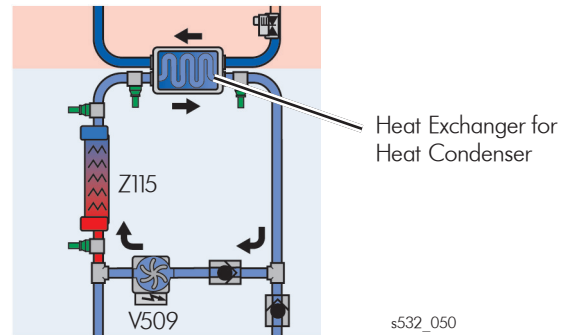
Heating Function in Coolant Mode

Refrigerant Circuit with Large Coolant Circuit



s532_048

Section of Small Coolant Circuit



s532_050

Key

- EV Expansion Valve
- SV Cut-off valve
- AX4 High Voltage Battery Charger 1
- JX1 Electric Drive Power and Control Electronics
- N632 Coolant Change-Over Valve 1
- N687 Radiator Bypass Switch-Over Valve
- V508 Coolant Pump in Front of Electric Drive and Power Control Electronics
- V509 Coolant Pump In Front of High Voltage Heater (PTC)
- VX54 Three-phase Current Drive
- Z115 High Voltage Heater (PTC)
- High-pressure Area
- Mid-pressure Area
- Low-pressure Area
- Coolant
- Refrigerant Circuit
- Coolant Circuit

Functions of the Heat Pump

Refrigerant Circuit

This function uses the thermal energy from the coolant circuit (three-phase current drive, power and control electronics and battery charging module).

1. - 4. The compressor compression and condensation in the evaporator is identical to the heating function in air mode.
5. Expansion Valve 2 is closed. The pressure is relieved by Expansion Valve 3 and the temperature of the liquid refrigerant decreases.
6. The refrigerant evaporates in the Heat Exchanger for Heat Condenser due to the addition of heat. The heat of vaporization required for this process is drawn from the warmer coolant, which then cools down. The gaseous refrigerant leaves the heat exchanger for heat condenser and flows in the direction of the air conditioner compressor.

Large Coolant Circuit

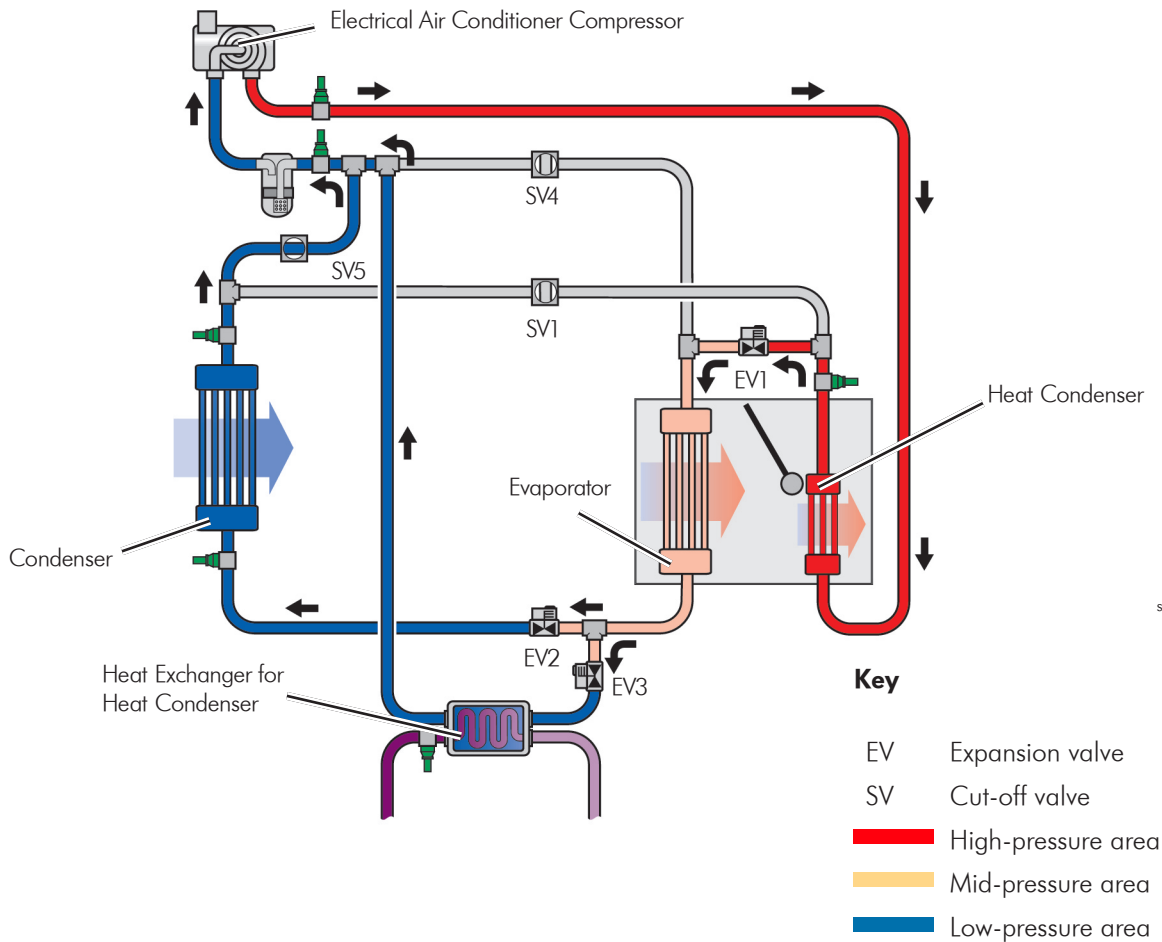
The coolant flows through the large coolant circuit to pull heat from the heat from the three-phase current drive, the power and control electronics and the battery charging unit. This circuit is run by the Coolant Pump in Front of Electric Drive Power and Control Electronics V508. The radiator is bypassed by actuating the Radiator Bypass Switchover Valve N687 to use heat efficiently.

Small Coolant Circuit

If the evaporation output of the large coolant circuit and the air is not sufficient, additional energy is supplied to the coolant circuit and the coolant is heated by activating the High Voltage Heater (PTC). To prevent the three-phase current drive, the power and control electronics for electric drive and the battery charging unit from heating up, the large coolant circuit is isolated from the small coolant circuit by actuating the Coolant Change-Over Valve 1 N632. The small coolant circuit is operated by activating the Coolant Pump in Front of the High Voltage Heater (PTC).

Functions of the Heat Pump

Heating Function in Combined Air and Coolant Mode

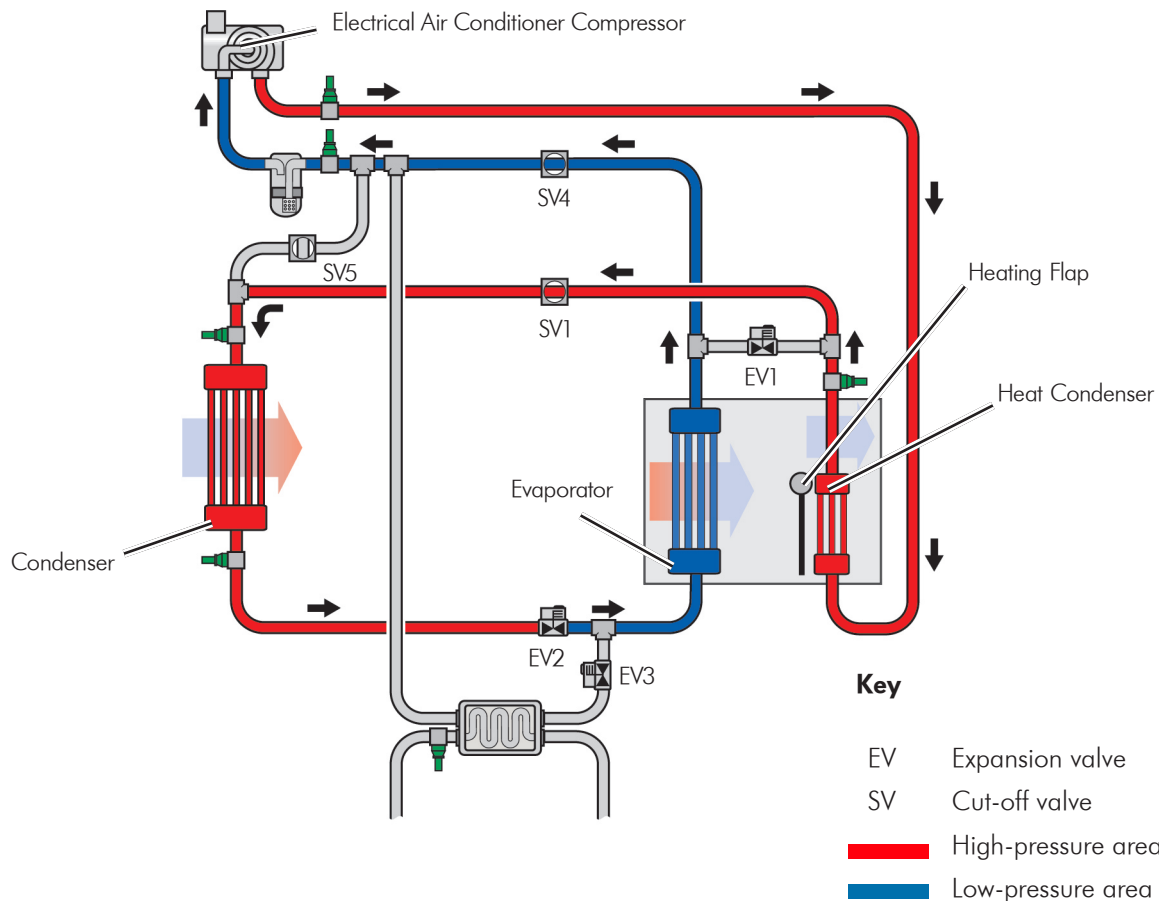


This function is a combination of the two functions described above. Heat from the outside air and the heat from the coolant are used simultaneously to heat the vehicle interior.

1. - 4. The process from compression in the electrical air conditioner compressor to complete condensation in the evaporator is identical to the heating function in air mode.
5. Expansion Valves 2 and 3 reduce the pressure. As a result, the temperature of the liquid refrigerant drops. After expansion, the refrigerant temperature is lower than the ambient temperature. The heat pump control module regulates how much refrigerant flows through each of the two expansion valves.
6. The cold refrigerant, which is below ambient temperature, evaporates in the condenser. The heat of vaporization required for this process is drawn from the warmer outside air, which then cools. The gaseous refrigerant leaves the evaporator and flows through the open Cut-off Valve 5 in the direction of the air conditioner compressor.
7. The refrigerant evaporates in the Heat Exchanger for Heat Condenser due to the addition of heat. The heat of vaporization required for this process is drawn from the warmer coolant. The gaseous refrigerant leaves the Heat Exchanger for Heat Condenser and flows in the direction of the air conditioner compressor.

Functions of the Heat Pump

Cooling Function



s532_022

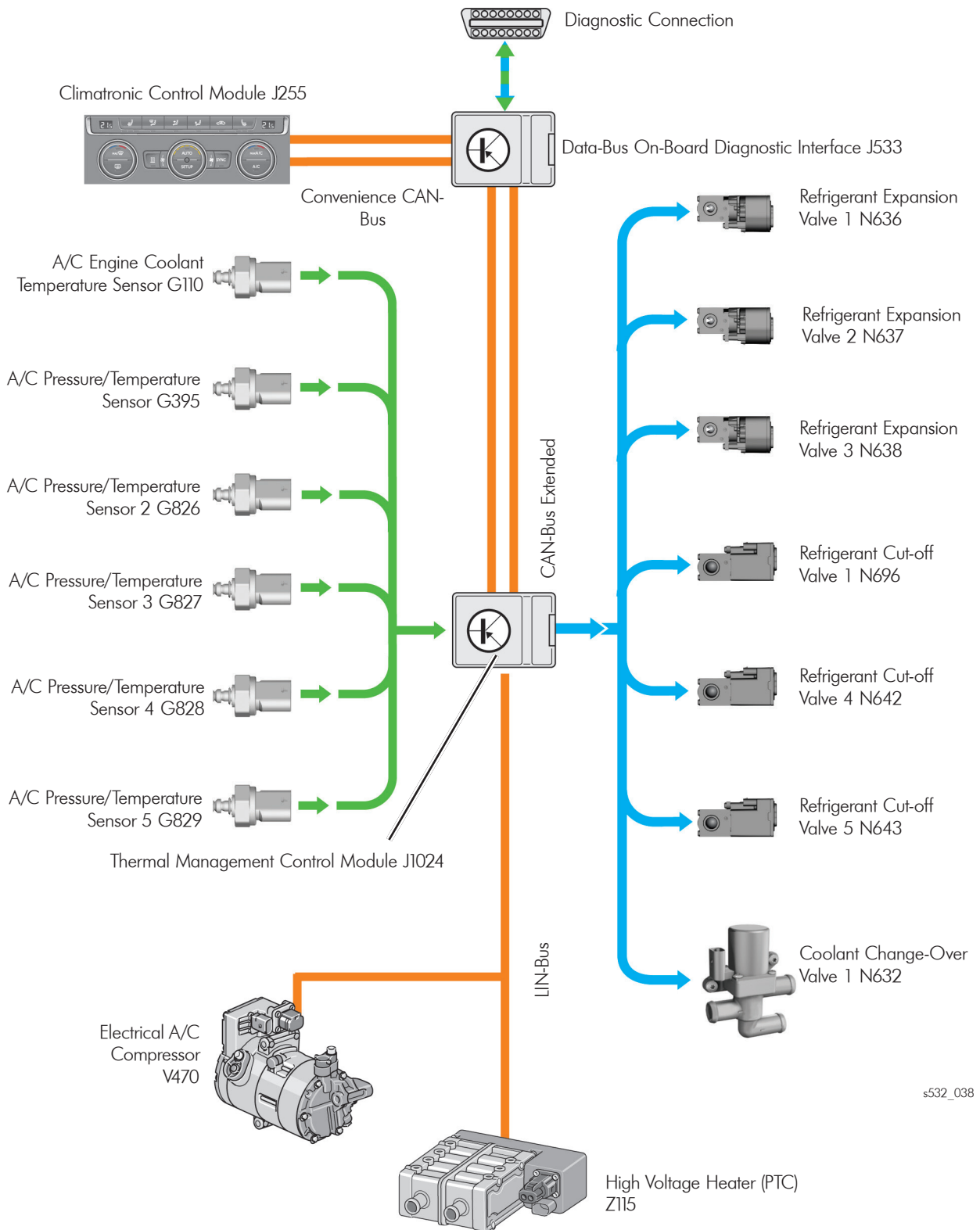
In this function, the heat pump circuit uses cold temperatures to cool the vehicle interior.

1. The electrical air conditioner compressor compresses the refrigerant. The gaseous refrigerant is under high pressure at a high temperature.
2. Cool air does not flow through the heat condenser since the heating flap is closed. The refrigerant does not condense here and also does not release any heat.
3. Expansion Valve 1 closes the access to the evaporator. The refrigerant flows through the open Cut-off Valve 1 to the condenser.
4. The airflow passes through the condenser. The refrigerant transfers heat to the air and condenses. The temperature of the refrigerant falls, the pressure remains constant.
5. The pressure and the temperature of the liquid refrigerant are reduced via Expansion Valve 2. After expansion, the refrigerant temperature is lower than the ambient temperature.
6. The refrigerant evaporates completely in the evaporator. The heat of vaporization required for this process is drawn from the outside air, which then cools down. The cooled air flows into the vehicle interior.
7. The gaseous refrigerant leaves the evaporator and flows through the open Cut-off Valve 4 in the direction of the air conditioner compressor.

System Overview

Sensors

Actuators



s532_038

The heat pump system is maintenance-free. The repair manual must be followed when emptying and filling the system. There are no special tools.

Only persons qualified to work on air conditioning systems may perform work on the heat pump system.

Before beginning servicing work on the heat pump system, please observe the repair manual information about any procedures that require de-energization by a High-Voltage Technician (HVT).

Important Links

The screenshot shows the top navigation bar with links for Home, VWwebsites, My Certification, Course Catalog Search, IIT Schedule, Library, and Logout. The main content area includes a 'Welcome' message, an 'Academy News' section with a 'Welcome to Certification 2013' announcement, and a 'Login' form with fields for 'Enter your last name:' and 'Enter the last 4 digits of your SS/SI/SAP number:', along with a 'Login' button and a car image.

https://www.datarunners.net/vw_crc/default.asp?pageid=home

The screenshot displays the vwwebsites.com homepage. It features a navigation menu with 'vwwebsites.com' and 'Academy Showroom generationVW+ Community Tools & Metrics'. A main banner for 'Tech Talk Special Edition: Beetle Window (801024)' is visible. Below the banner are several promotional tiles: '2012 5th Annual Qualification Championship National Finalists Winners Announced!', 'Get Program Info Here!', 'AFTER SALES 411 The Best Year Yet Get It!', 'What's your VWIQ?', and 'SPECIAL BROADCASTS'. A search bar is located at the bottom right.

www.vwwebsites.com

The screenshot shows the vwhub.com website. It features a 'Welcome to vwhub.com' message and a 'Français' link. The main content area includes a 'Sign In' form with fields for 'User ID' and 'Password', a 'Forgot Password' link, and a 'Submit' button. Below the sign-in form is a 'New Users Register' section with instructions and 'Register' buttons for 'New dealer user registration' and 'New corporate user registration'. At the bottom, there are links for 'VW customers and enthusiasts: www.vw.com www.vw.ca' and 'Learn more about vwhub.com vwhub.com Overview'.

www.vwhub.com

Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this Self-Study Program.

The Knowledge Assessment may or may not be required for Certification.

You can find this Knowledge Assessment at:

www.vwwebservice.com

For Assistance, please call:

Volkswagen Academy

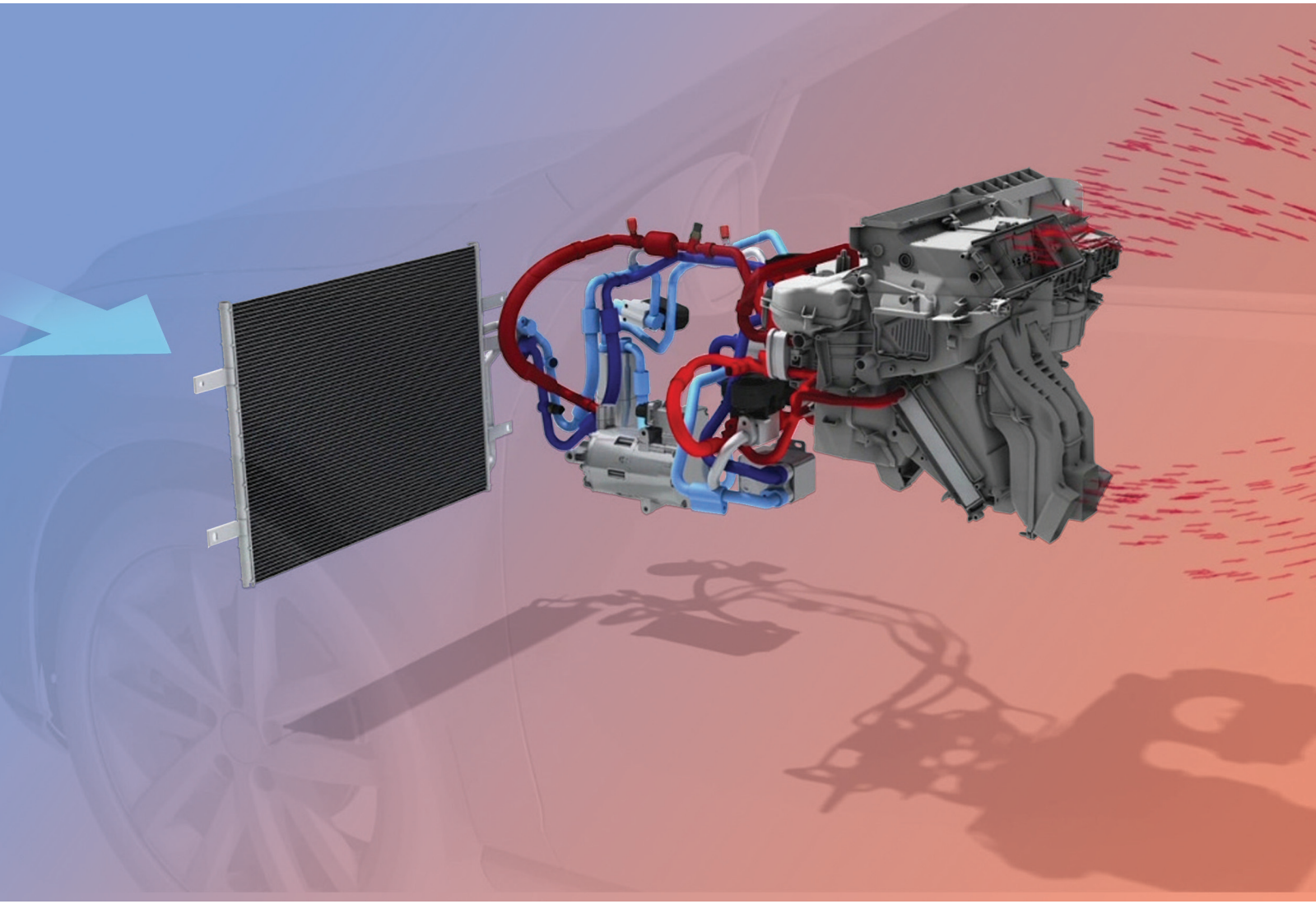
Certification Program Headquarters

1-877-791-4838

(8:00 a.m. to 8:00 p.m. EST)

Or, E-mail:

concierge@volkswagenacademy.com



Volkswagen Group of America
2200 Ferdinand Porsche Drive
Herndon, VA 20171
July 2015

