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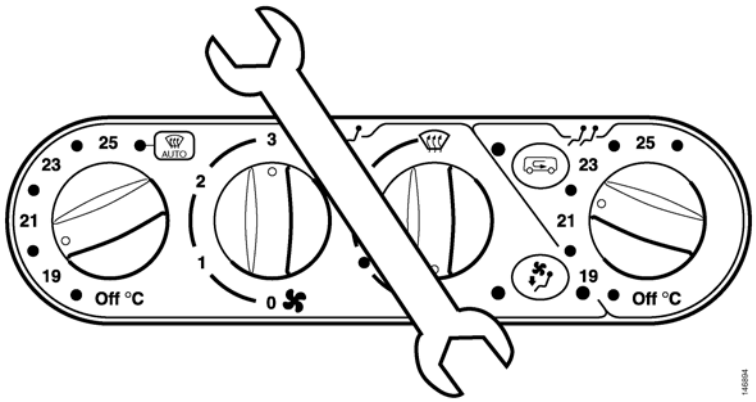
Issue 3 en

Heating, Ventilation and AC

OmniCity/OmniLink

Function description



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Contents

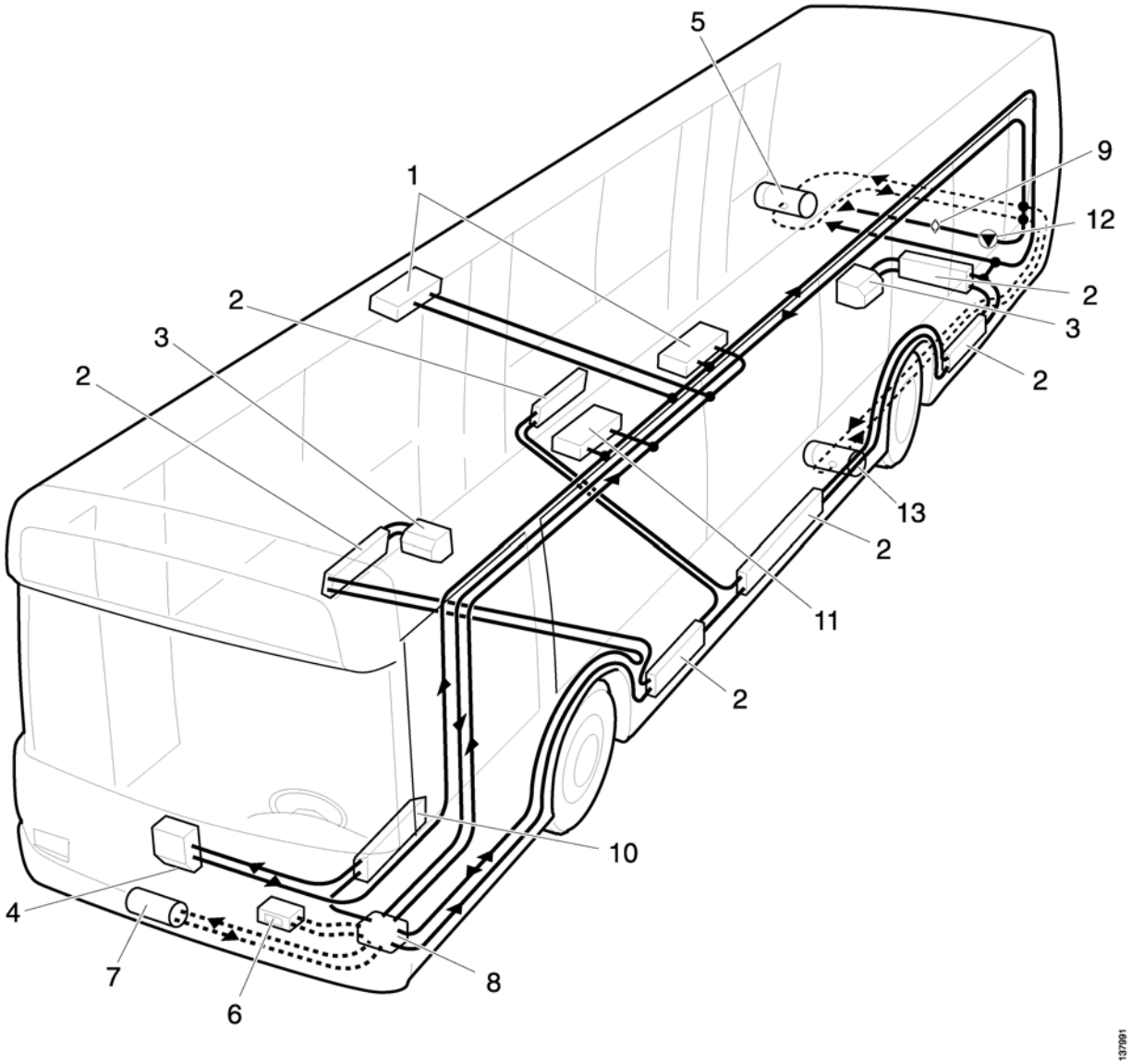
Function description

General

The climate control system in OmniCity and OmniLink is divided into two to four sub-systems which can be adapted to each customer's individual needs and wishes, depending on the options selected. The sub-systems are controlled by a climate control program in the bus BNS system (multiplex system).

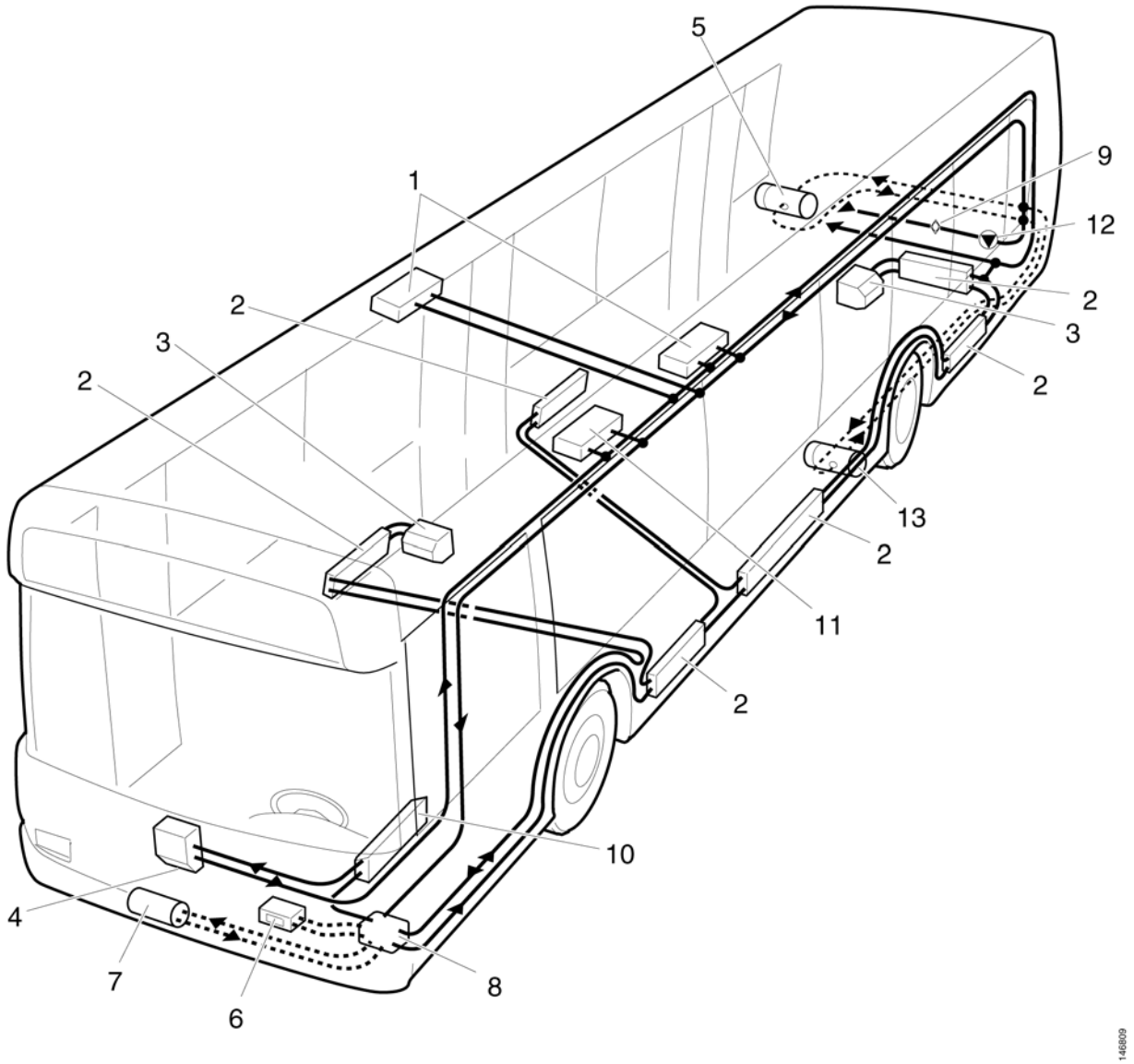
When the temperature for the passenger area and driver area is set, the climate system will attempt to attain this temperature by regulating the various sub-systems, i.e. heating, ventilation and AC (air conditioning).

Location of components, water to air heating system BNS I



1 *Roof unit, in the case of AC the units are replaced by an AC unit*
2 *Convectors, passenger area (option)*
3 *Heating fan*
4 *Heating fan, driver*
5 *Auxiliary heater, L bus (option)*
6 *Connection unit, ramp (option)*
7 *Electric auxiliary heater (option)*
8 *Central distribution unit*
9 *Water filter*
10 *Convector, driver area*
11 *Defroster unit, or combined AC/defroster unit*
12 *Feed pump*
13 *Diesel-powered auxiliary heater, N bus (option)*

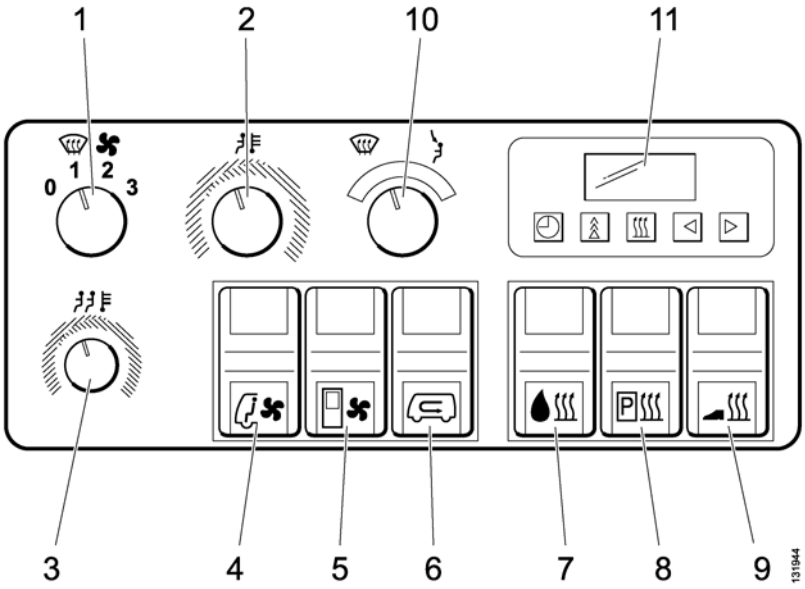
Location of components, water to air heating system BNS II



1 *Roof unit, in the case of AC the units are replaced by an AC unit*
2 *Convectors, passenger area (option)*
3 *Heating fan*
4 *Heating fan, driver*
5 *Auxiliary heater, L bus (option)*
6 *Connection unit, ramp (option)*
7 *Electric auxiliary heater (option)*
8 *Central distribution unit*
9 *Water filter*
10 *Convector, driver area*
11 *Defroster unit, or combined AC/defroster unit*
12 *Feed pump*
13 *Diesel-powered auxiliary heater, N bus (option)*

Controls

All the climate controls are located together on a panel in the driver area.



Climate control panel BNS I

1 *Fan speed, defroster*

2 *Temperature setting for the driver area and defroster (de-icing)*

3 *Temperature setting, passenger area*

4 *Heating fan, driver area*

5 *Door heating fans (Off or Auto)*

6 *Recirculation of ventilation air*

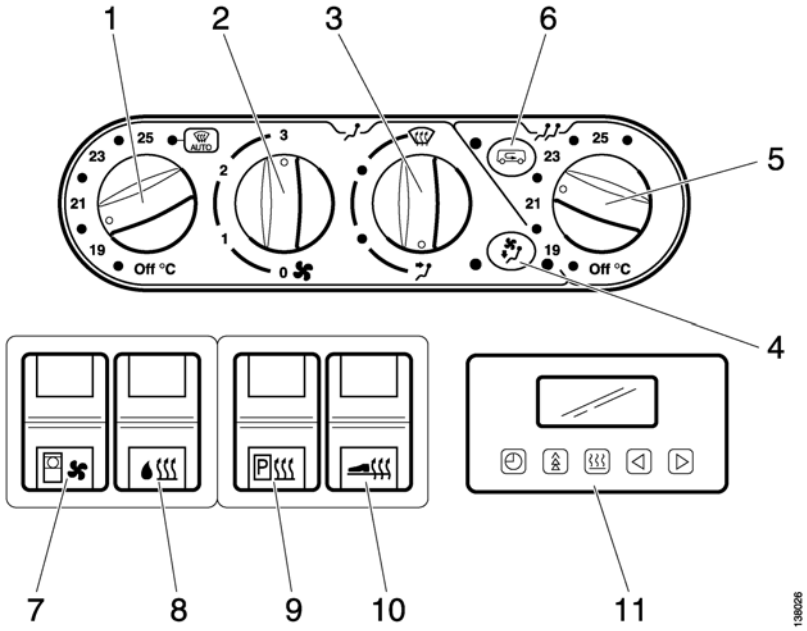
7 *Air dehumidification (reheat function).*

8 *Short break heating*

9 *Floor heating in the boarding area*

10 *Air distribution in the driver area, windscreen/driver*

11 *Timer for auxiliary heater (see the supplier's instructions)*



Climate control panel BNS II

1 *Temperature setting for the driver area and defroster*

2 *Fan speed, defroster*

3 *Air distribution in the driver area, windscreen/driver*

4 *Heating fan, driver area*

5 *Temperature setting, passenger area*

6 *Recirculation of ventilation air*

7 *Door heating fans*

8 *Air dehumidification (reheat function).*

9 *Short break heating*

10 *Floor heating in the boarding area*

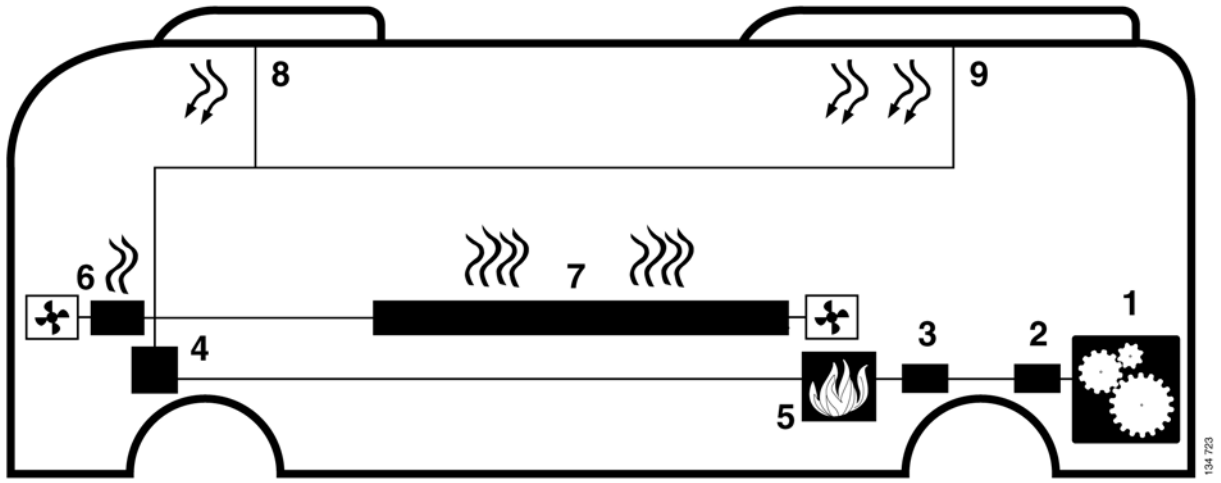
11 *(Auxiliary heater, see the supplier's instructions)*

Heating system

General

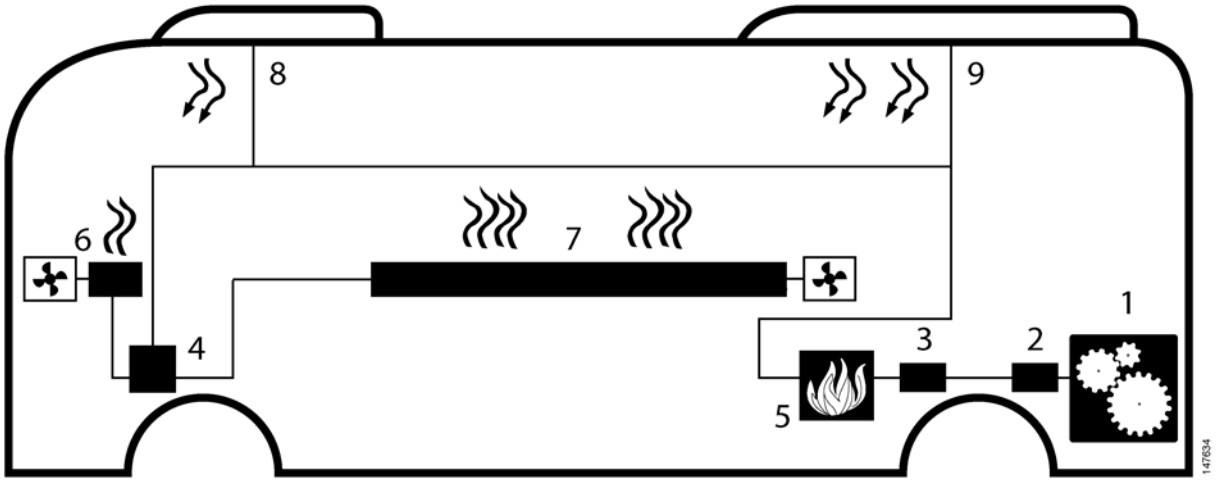
The engine coolant 1 is used as the primary heat source. The engine coolant is fed by a feed pump, 2, through a water filter, 3, to the heating system central distribution unit, 4, which is located at the front of the bus. In the central distribution unit, the heat is distributed to the different sub-systems; driver area heating, 6, passenger area heating, convector circuit, 7, defroster unit, 8, and passenger area heating, roof unit 9.

2-axle buses have five temperature sensors that register the temperatures outside, in the air duct, in the passenger area and in the driver area. 3-axle buses have seven temperature sensors. There is one separate inner temperature sensor for the passenger area and one for the driver area as well as outdoor temperature sensors which are common to both areas.



Schematic diagram of the heating system (BNS I)

1 *Engine*
2 *Water filter*
3 *Feed pump*
4 *Central distribution unit*
5 *Auxiliary heater*
6 *Driver heating*
7 *Passenger heating*
8 *Defroster unit*
9 *Roof unit*



Schematic diagram of the heating system (BNS II)

1 *Engine*
2 *Water filter*
3 *Feed pump*
4 *Central distribution unit*
5 *Auxiliary heater*
6 *Driver heating*
7 *Passenger heating*
8 *Defroster unit*
9 *Roof unit*

Feed pump

The feed pump is used to ensure sufficient flow and therefore an even distribution of heat to all circuits in the system.

The feed pump comes in three versions:

- U4814, used on 4x2 and 6x2*4 (13.7 metres)
- U4855, used on 6x2/2 and 6x2*4 (14.6 metres)
- U4851, used on older 6x2/2 and 6x2*4 (14.6 metres). Replaced by U4855.
- U4816, used on earlier bus models

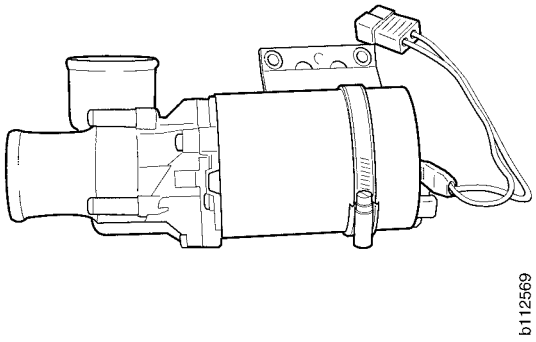
The U4814 and the 4816 have an electric motor with brushes whereas the electric motor on the U4851 is brushless.

When the engine is running, the feed pump starts if:

- The climate control program requests heating.
- The auxiliary heater is running.

The feed pump shuts down after a certain delay if the above criteria have not been met.

Note: If feed pump U4851 is started without any water in the system, it will race and will be automatically switched off. It can then only restart after 10 minutes.

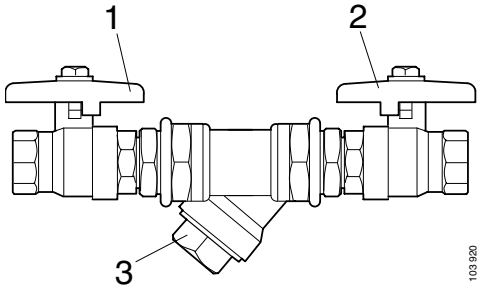


Feed pump

Water filter

The principal task of the water filter is to prevent coarse particles from reaching the various components of the heating system. There are two versions of the water filter.

On older bus models, the water filter 3 is located in the central distribution unit between two ball valves 1 and 2. This water filter can be accessed from underneath the bus.



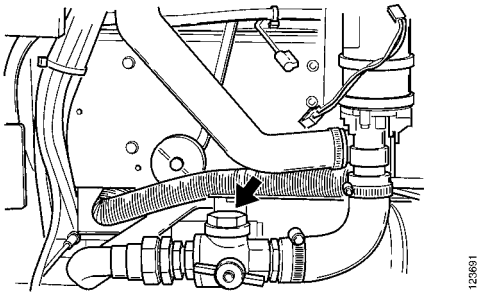
Water filter, old version

1 Ball valve

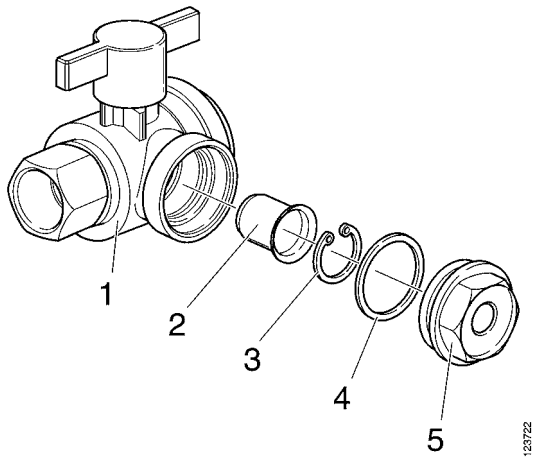
2 Ball valve

3 Water filter

On new bus models, the water filter and shut-off valve are integrated into the same component and located in the rear engine compartment.



Water filter, later version



1 *Valve housing*
2 *Filter strainer*
3 *Retaining ring*
4 *Gasket*
5 *Filter plug*

Central distribution unit

The structure of the central distribution unit varies depending on the options selected, but the choice of components and positioning are basically the same regardless of the configuration. A bypass line is connected between the outlet and inlet of the central distribution unit, when no auxiliary heater is installed.

Connection 1: supply from the feed pump.

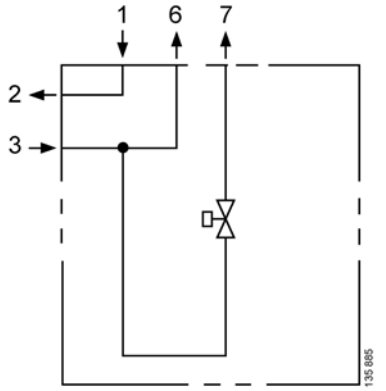
Connections 2 and 3: for front-mounted auxiliary heater (diesel or ethanol). 2 connected directly to 3, when no front-mounted auxiliary heater is fitted.

Connections 4 and 5: for front-mounted auxiliary heater (electric).

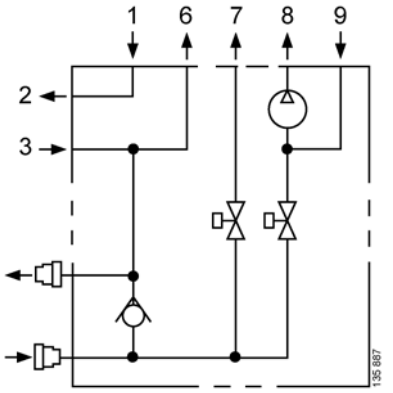
Connection 6: supply to roof unit.

Connection 7: supply to driver heating.

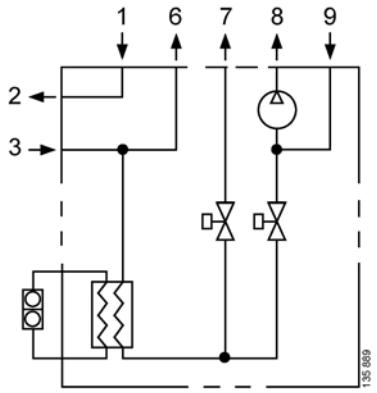
Connections 8 and 9: for passenger area convector circuit.



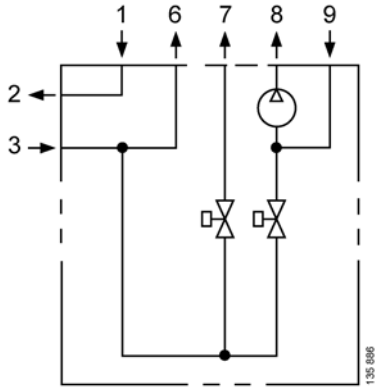
Central distribution unit for buses with roof unit (BNS I).



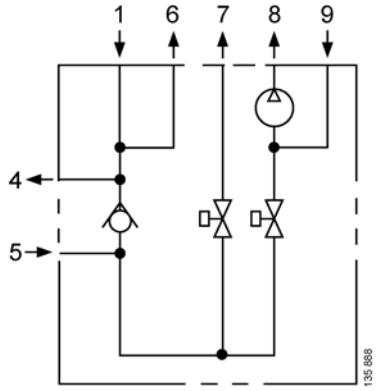
Central distribution unit for buses with roof unit, convectors and Hansen type ramp connections (BNS I).



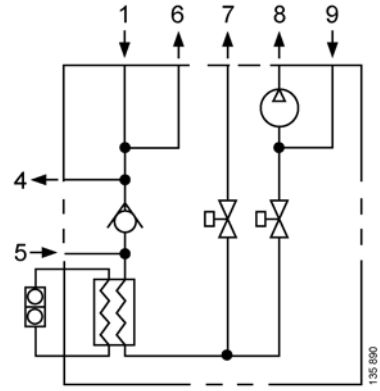
Central distribution unit for buses with roof unit, convectors and EK100/E type ramp connections (BNS I).



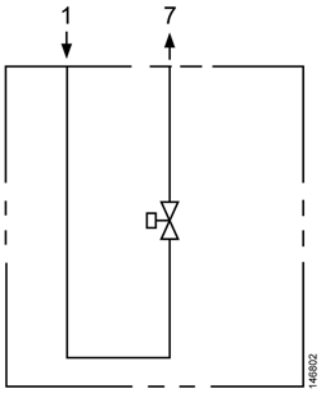
Central distribution unit for buses with auxiliary heater. Available on buses with roof unit and convectors (BNS I).



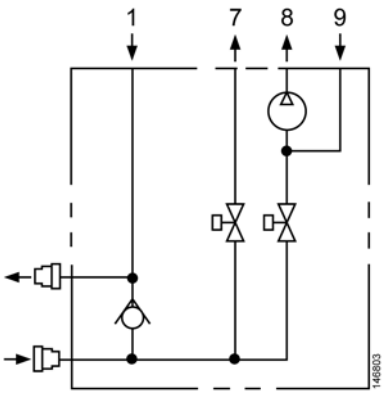
Central distribution unit for buses with roof unit, convectors and electric heating at the front (BNS I).



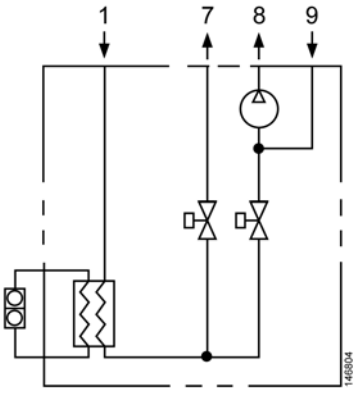
Central distribution unit for buses with auxiliary heater. Central distribution unit for buses with roof unit, convectors, EK100/E type ramp connections and electric heating at the front (BNS I).



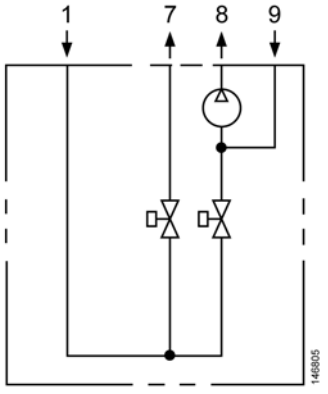
Central distribution unit for buses with roof unit (BNS II).



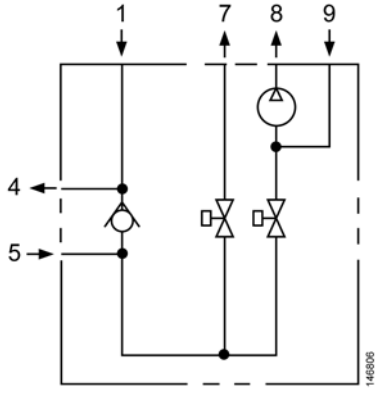
Central distribution unit for buses with roof unit, convectors and Hansen type ramp connections (BNS II).



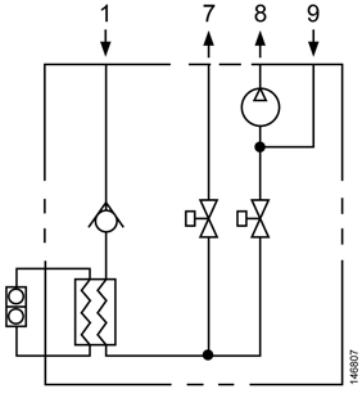
Central distribution unit for buses with roof unit, convectors and EK100/E type ramp connections (BNS II).



Central distribution unit for buses with auxiliary heater. Available on buses with roof unit and convectors (BNS II).



Central distribution unit for buses with roof unit, convectors and electric heating at the front (BNS II).



Central distribution unit for buses with auxiliary heater. Central distribution unit for buses with roof unit, convectors, EK100/E type ramp connections and electric heating at the front (BNS II).

Supply to auxiliary heater and roof circuits

Water (coolant) is carried from the engine via the feed pump and water filter (located in the engine compartment) on to the auxiliary heater (diesel or diesel/electric) and from there into the central distribution unit through inlet 12. The roof circuits are supplied with water from connection 13 (Applies to BNS I buses). On BNS II buses the roof circuits are supplied from the feed pump on to the central distribution unit.

The electric auxiliary heater at the front pumps heated water to the central distribution unit and on to the driver and convector circuits via an external electric (220 V) pump.

Note: All auxiliary heaters are optional.

Control of driver area circuit

A compressed air controlled ON/OFF valve 11 pulses heat to the driver area 10.

Control of passenger area circuit

A compressed air controlled ON/OFF valve 8 controls (pulses) the amount of heat supplied to the passenger area convector circuit. The circulation pump 2 circulates the flow to the convector circuit 7 and back to the central distribution unit via inlet 4 to obtain even heating in the bus.

Adaptation to ramp connection system, EK100E

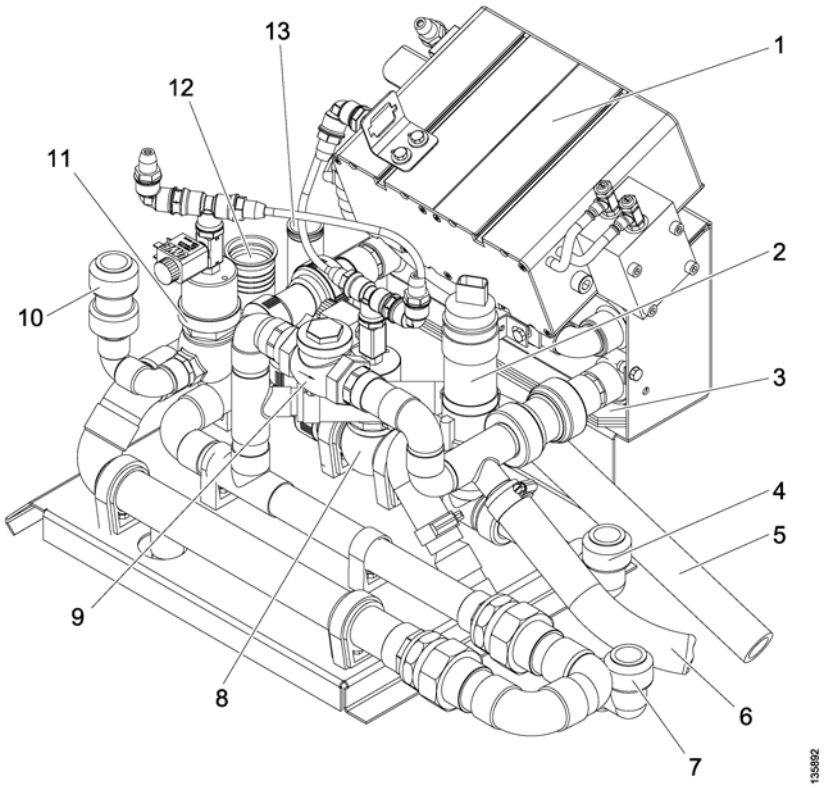
There are three different options for adapting the bus to a ramp connection system. In the option illustrated, the central distribution unit is equipped with junction box EK100E and heat exchanger P30.

Adaptation to ramp connection system, EK100

Same as EK100E but the junction box is replaced by a variant without integrated electric coupling.

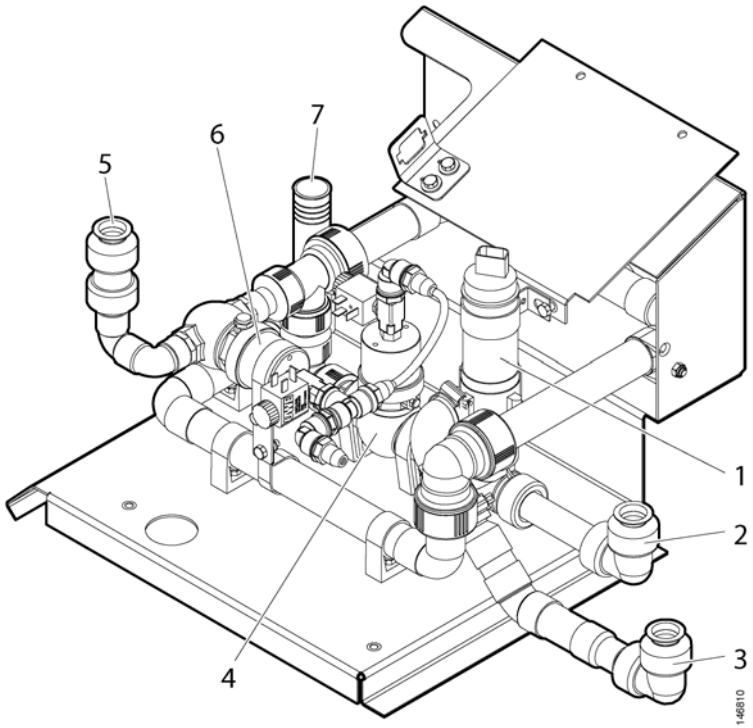
Adaptation to ramp connection system, heat exchanger on ramp

In this case the heat exchanger is located on the heating ramp. The central distribution unit only houses separate connections for compressed air and coolant along with a check valve.



Old central distribution unit (BNS I)

1 *Junction box EK100E*
2 *Circulation pump for convector circuit*
3 *Heat exchanger P30*
4 *Return from convector circuit*
5 *Return from electric auxiliary heater at the front*
6 *Supply to electric auxiliary heater at the front*
7 *To the convector circuit*
8 *ON/OFF valve for convector circuit*
9 *Check valve (only for auxiliary heater at the front)*
10 *Driver area heating*
11 *Solenoid valve, ON/OFF valve for driver area heating*
12 *Supply from engine*
13 *To the roof circuits*



New central distribution unit (BNS II)

1 *Circulation pump for convector circuit*

2 *Return from convector circuit*

3 *To the convector circuit*

4 *ON/OFF valve for convector circuit*

5 *Driver area heating*

6 *Solenoid valve, ON/OFF valve for driver area heating*

7 *Supply from engine*

Auxiliary heater

The auxiliary heater may be a diesel heater, an ethanol heater or a combination heater (electric/diesel or electric/ethanol). The purpose of an auxiliary heater is to provide supplementary heat to the heating system when the bus is parked. The function varies depending on the model.

Start/stop is regulated in the following way:

- The heater is turned on and off with the manual on/off switch on the timer or by a pre-programmed start time, see the manufacturer's instructions.
- During operation, the water temperature in the heater is controlled to a certain level by an internal control unit with temperature sensor.

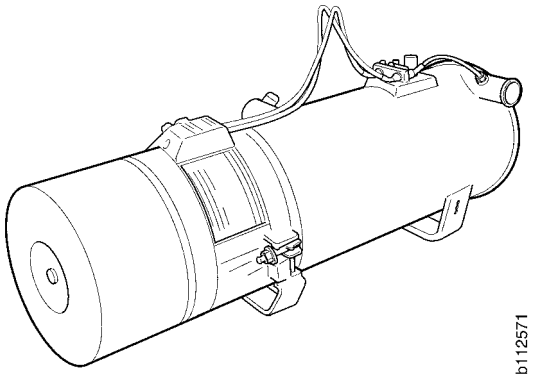
When the auxiliary heater is running, the climate control program is affected as follows:

- When the engine is running, the feed pump cannot be shut down.
- When parked, the climate control program starts the feed pump and makes sure that only the valves to the driver and passenger circuit convectors are open.

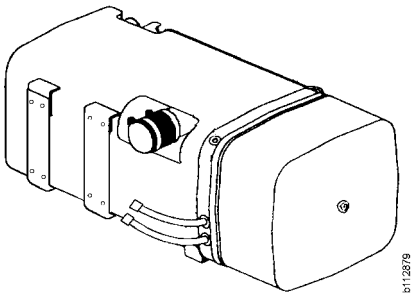
When the auxiliary heater is running, it seeks to maintain a specific water temperature. This is controlled by a built-in thermostat which starts or stops the auxiliary heater burner.

The auxiliary heater is turned off manually by the driver or by the timer after it has been on for a maximum of two hours, depending on the set time.

An electric auxiliary heater (400 V), which can be connected when the bus is parked, is also available as an option.



Webasto (diesel)



Stroco (ethanol or ethanol/electric)

Driver heating

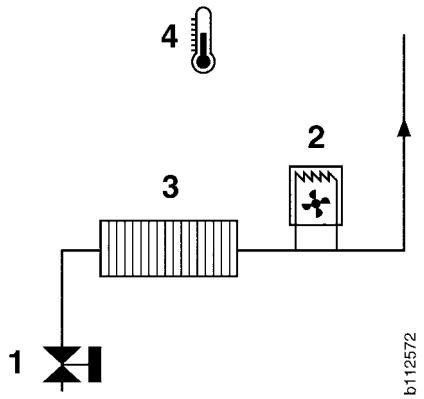
Driver heating is designed as a circuit. The amount of heat supplied to the circuit is controlled (pulsed) by a pneumatic water valve, 1, located on the central distribution unit. The valve is controlled by the climate control program. The circuit includes a specially adapted heating fan, 2, fitted at the front of the bus and an optional convector, 3, or heating fans. In addition to providing the driver with heat, the fan also improves the defroster function. The temperature in the driver area is detected by a temperature sensor 4.

The water valve for the driver fan and heating element, if applicable, is opened and adjusted when the driver temperature setting potentiometer is turned from its OFF position.

The fan is manually controlled by the driver.

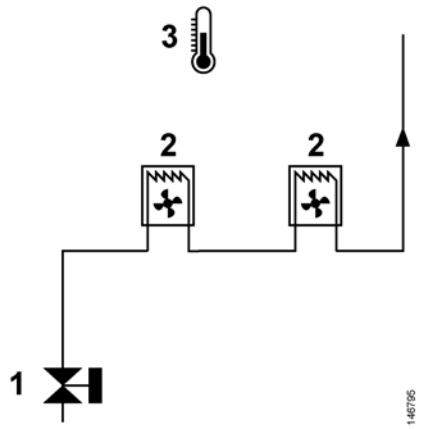
Note: To obtain a comfortable and pleasant climate in the driver area, keep the fan speed as low as possible.

(On older buses the fan is controlled automatically and starts when the automatic climate control module requires an additional amount of heat in order to maintain the set driver area temperature. The driver can then switch off the fan manually.)



Circuit diagram, driver heating with convector

1 *Water valve*
2 *Heating fan*
3 *Convector*
4 *Temperature sensor*



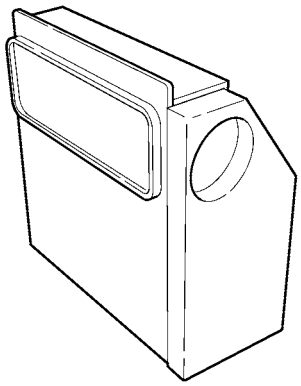
Circuit diagram, driver heating with heating fans

1 *Water valve*
2 *Heating fans*
3 *Temperature sensor*

When the engine is running the valve is controlled by the climate control program. On older buses the fan is also controlled by the climate control program. On newer buses the fan is controlled manually.

The driver can carry out the following manually:

- Change the fan speed (only on newer buses).
- Switch off the fan.
- Change the temperature setting.
- Regulate the air quantity and direction using the air vent in the driver area.



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Driver fan with integrated heating element

Passenger heating, heating element

Basic versions of buses are equipped with heating via the roof circuits. This is quite sufficient for buses in a mild climate. Convectors are available as an option and should be fitted in buses used in cold climates to provide adequate heating.

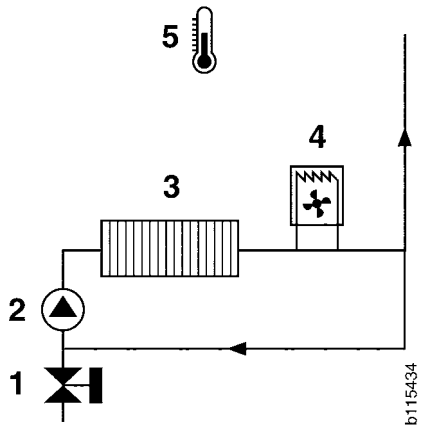
The primary source of heating for the bus passenger compartment is the heating element. The central distribution unit contains a pneumatic ON/OFF valve 1 and a circulation pump 2. The heat-emitting components in the circuit are convectors, 3, and heating fans, 4. The temperature is recorded by a temperature sensor 5.

On articulated buses, there are two separate temperature sensors, one for the front section of the bus and one for the rear. In addition, the heating fans in the front and rear sections are controlled separately.

The climate control program starts regulating the heat to the heating element circuit when the passenger temperature potentiometer is turned from its OFF position and the temperature detected is lower than the temperature setting. At the moment of starting, the circulation pump on the central distribution unit will be started. The heating fan also starts when it is calculated that the water has reached a certain temperature and heating is required.

When the engine is running, the circulation pump 2 runs continuously and the ON/OFF valve 1 on the central distribution unit opens/closes (pulses) according to the calculated heat requirement. When the ON/OFF valve opens, hot water is led from the engine and any auxiliary heaters into the heating element circuit and part of the water is returned to the engine at the other end of the circuit. When the ON/OFF valve is closed, the water will circulate in the circuit continuously since circulation pump 2 is running. The passenger area temperature is adjusted by means of a potentiometer located on the climate control panel in the driver area.

The climate control program stops regulating the heat to the heating element when the temperature exceeds the pre-set value and the climate control program has not opened the valve for 13 minutes or if the passenger temperature potentiometer is turned to its OFF position.

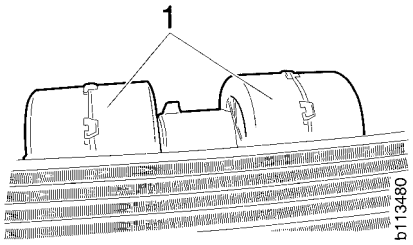


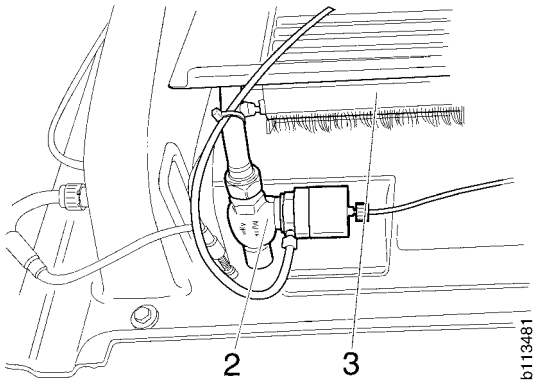
1 *ON/OFF valve*
2 *Circulation pump*
3 *Convectors*
4 *Heating fan*
5 *Temperature sensor*

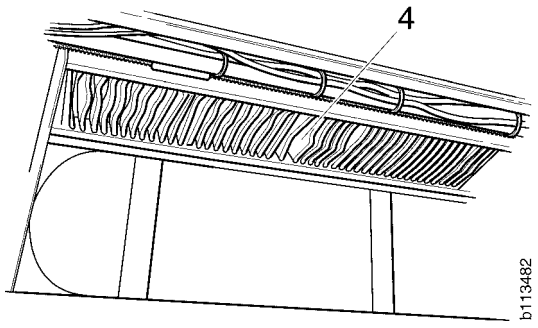
Passenger heating, roof

The roof heating function is integrated into two of the bus roof ventilation units or into the AC unit if this option has been selected. The roof unit comprises the following components:

- Double radial fan
- Pneumatically controlled water valve, type ON-OFF
- Heat exchanger
- Pneumatically controlled damper for selecting fresh air or recirculated air
- Air filter
- Pneumatic valve for damper and water valve







1 *Double radial fan*
2 *Water valve*
3 *Heat exchanger*
4 *Air filter*

Control starts when the engine starts and the temperature setting potentiometer in the passenger area is turned from its OFF position.

When the engine is running, the climate control program controls the valves to the roof unit so that the temperature in the passenger area is the same as the set temperature.

The damper is set to recirculation by the climate control program when:

- The AC unit is engaged and the external temperature is higher than the temperature in the passenger area, while that temperature is more than 4°C above the set value
- The amount of heat in the cooling system is not sufficient to achieve the desired temperature during extremely cold conditions or immediately after starting the bus for example.

Defroster

The defroster unit is the "overhead" defroster type. It blows air downwards from the top of the windscreen. This solution gives the air flow a much better "adhesion" against the window, i.e. it does not "whirl" away from the window towards the driver.

To make the defroster even more efficient, the driver area is designed so that the intake to the driver fan is located at the bottom of the windscreen.

The defroster fan is started manually by the driver and the defroster valve starts regulating the heat when the driver turns the temperature setting potentiometer from its OFF position. In this position, the climate control program starts to alternately open/close the defroster valve provided that the temperature level of the defroster air is below the default value.

When the engine is running, the defroster is controlled as follows:

- The temperature level of the defroster air is determined by the driver using a potentiometer on the control panel.
- The air to the defroster is controlled by the climate control program and can be drawn either from the outside (fresh air) or from inside the bus (recirculated air).
- Recirculated air is used when the AC unit is engaged and the external temperature is higher than the temperature in the passenger area, while that temperature is more than 4°C above the set value.
- The amount of heat supplied to the defroster is completely controlled by the climate control program which regulates the valve in the defroster unit.
- The driver controls the defroster fan and its speed in three different positions.
- The temperature is registered by the temperature sensor located in the defroster duct.

The driver can turn off the defroster manually by turning off the fan and turning the potentiometer to its OFF position.

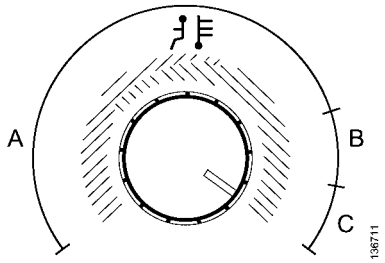
De-icing function

Old climate control panel

On buses with the old climate control panel (BNS I) the driver area temperature control has two de-icing positions:

- Full de-icing
- Partial de-icing

The heating and fan speed are both automatically controlled in these positions for optimum de-icing/ dehumidification of the windscreen.



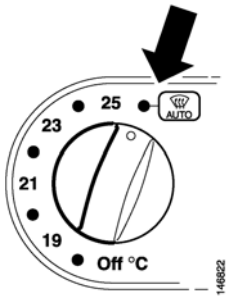
A. Controlling driver area temperature, approximately 17 - 25°C

B. Partial de-icing. Approximately 50°C for defroster air and approximately 25°C for air to driver area, fan speed 2.

C. Full de-icing. Approximately 75°C for defroster air and approximately 26°C for air to driver area, fan speed 3.

New climate control panel

On buses with the new climate control panel (BNS II) there is only *one de-icing position.* This position provides full de-icing.



AC system

Passenger AC

General

There are two basic designs of the AC system, one for two-axle buses and one for articulated buses.

Layout of two-axle buses

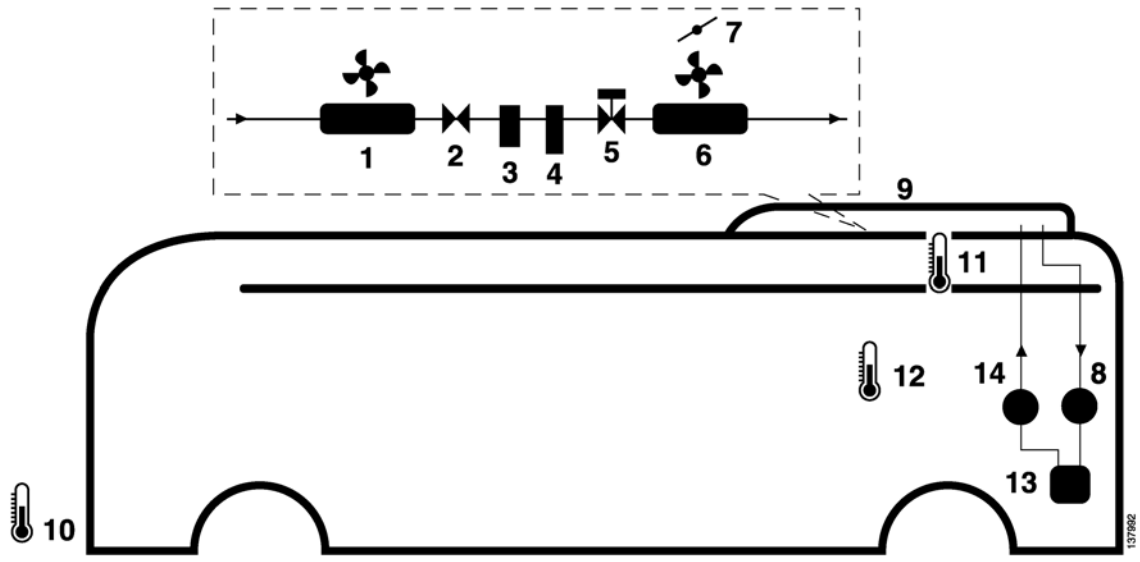
The AC system has three sensors that record the outside temperature, air duct temperature and the temperature in the passenger area. The sensors are common to the relevant climate zones and their use is integrated with other sub-systems. The system is controlled by the climate control program.

The AC system consists of one or two compressors with high and low pressure switches situated in the engine compartment and a roof unit fitted on the roof of the bus.

Where there are two compressors, their operation is synchronised and only one set of high and low pressure switches is fitted adjacent to the rear compressor.

The roof unit contains the following components:

- Condenser with fans.
- Safety valve.
- The storage tank, which "stores" the refrigerant during the liquid stage.
- The receiver dryer is used to extract dirt, moisture and acid from the refrigerant.
- Expansion valve.
- Condenser with fans.
- Damper for switching between fresh air and recirculated air.



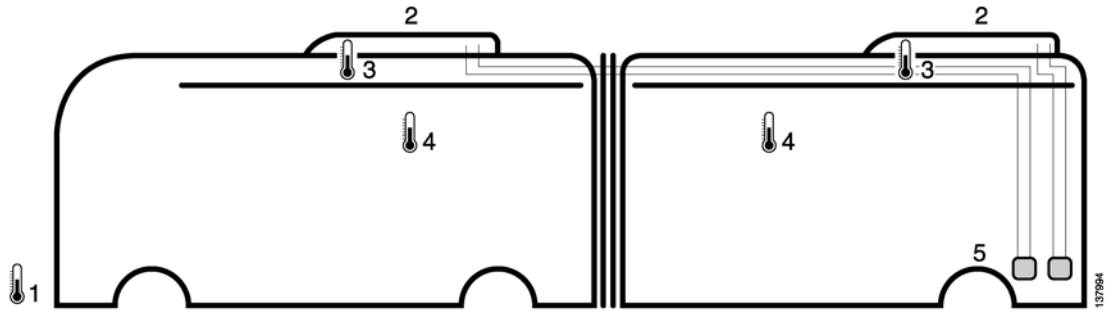
Schematic diagram of the AC system (two-axle buses)

1 *Condenser*
2 *Safety valve*
3 *Storage tank*
4 *Receiver dryer*
5 *Expansion valve*
6 *Evaporator*
7 *Damper for switching between fresh air and recirculated air*
8 *Low pressure switch*
9 *Roof unit*
10 *Sensor for outside temperature*
11 *Sensor for air duct temperature*
12 *Sensor for temperature in passenger area*
13 *Compressor*
14 *High pressure switch*

Layout of articulated bus

The AC system has two roof units 2 located on the roof of the bus. There are two compressors 5 in the engine compartment, each with two sets of high and low pressure switches.

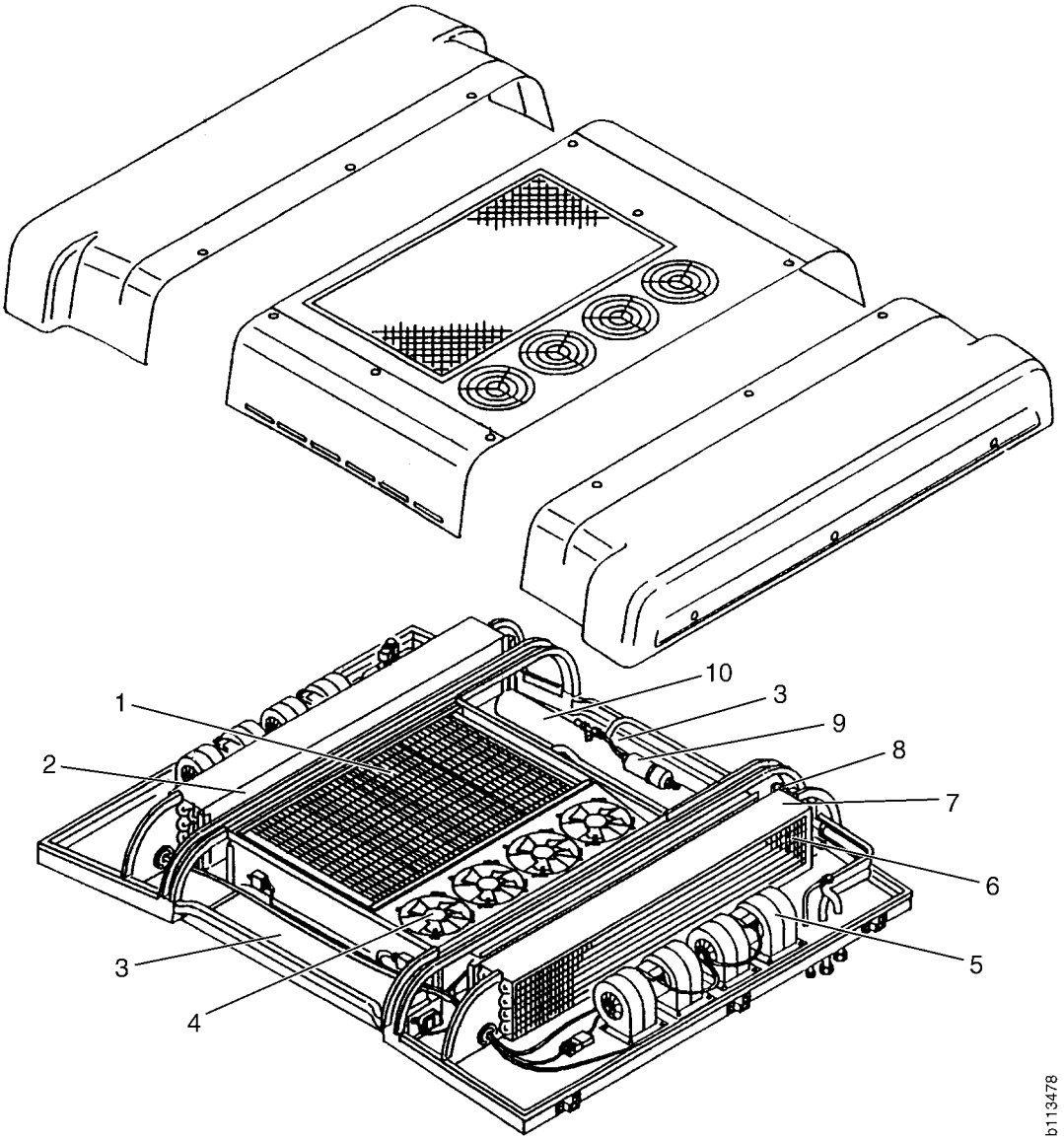
The AC system uses the sensor for outside temperature 1, two sensors for the air duct temperature 3 and two sensors for the temperature in the passenger area 4. The two AC units are controlled separately and consequently, there are two sets of temperature sensors. The sensors are, however, common to the entire climate system and their use is integrated with the heating and ventilation systems.



Schematic diagram of the AC system (articulated bus)

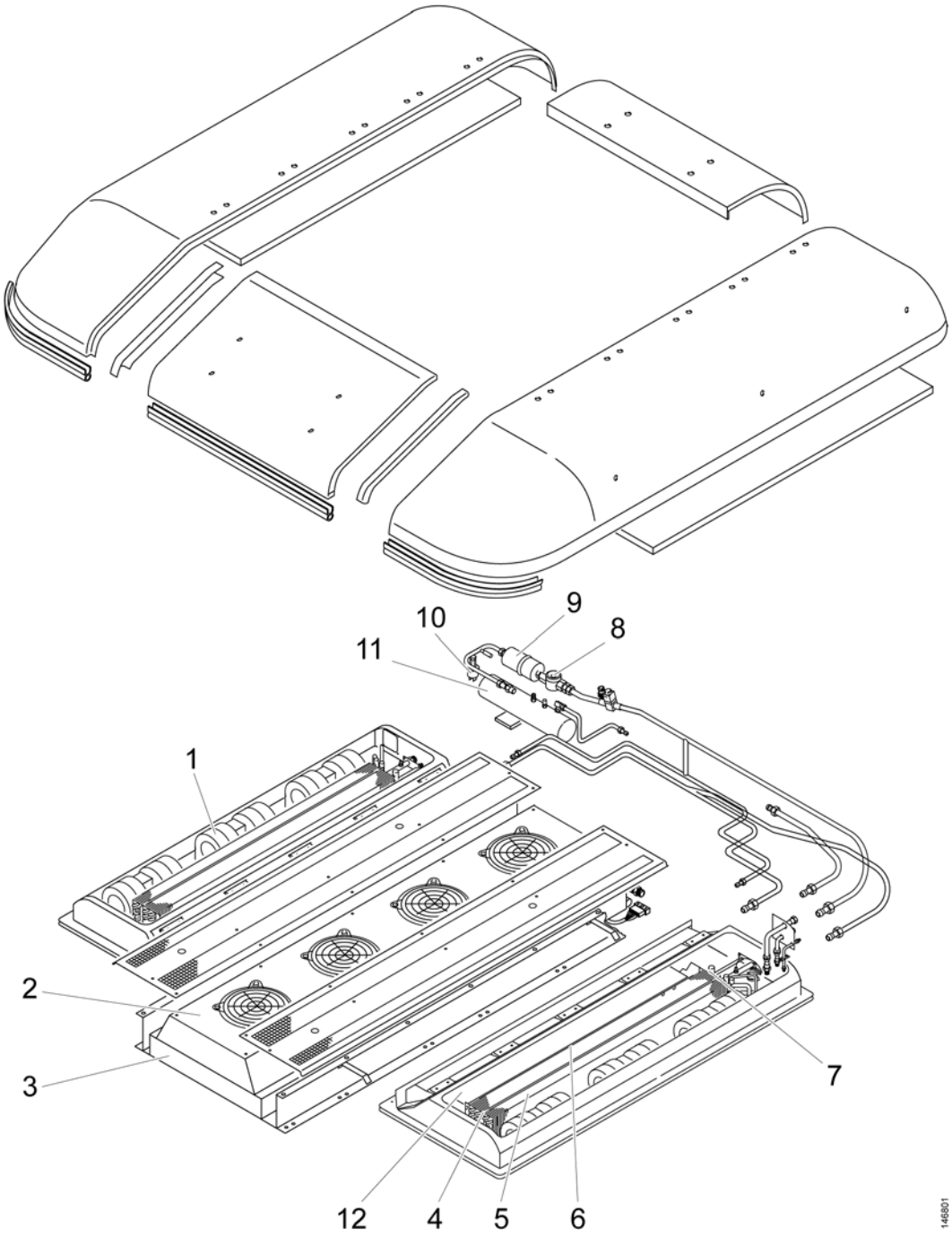
1 *Sensor for outside temperature*
2 *Roof unit*
3 *Sensor for air duct temperature*
4 *Sensor for temperature in passenger area*
5 *Compressors*

Location of roof unit components, CC220



1 *Condenser*
2 *Air filter, fresh air side*
3 *Damper for switching between fresh air and recirculated air*
4 *Axial fans*
5 *Double radial fan*
6 *Heat exchanger for heating ventilated air*
7 *Evaporator*
8 *Expansion valve*
9 *Receiver dryer*
10 *Storage tank*

Location of roof unit components, Aerosphere



1 *Radial fans*
2 *Condenser fans*
3 *Condenser*
4 *Evaporator*
5 *Heat exchanger*
6 *Air filter*
7 *Expansion valve*
8 *Level glass*
9 *Receiver dryer*
10 *Pressure switch*
11 *Storage tank*
12 *Damper for switching between fresh air and recirculated air*

Compressor

Two-axle buses have one or two compressors. Articulated buses always have two compressors. The compressors are located in the engine compartment and are belt driven from the engine. Engagement and disengagement is performed by an electromagnetic coupling controlled by the climate control program. If the refrigerant pressure is extremely high or low, the electromagnetic coupling disengages the compressor. The compressor draws refrigerant from the evaporator and thereby increases its pressure and temperature.

Condenser

The condenser comprises a large heat exchanger and a number of axial fans for cooling the hot refrigerant using fresh air. When heat is extracted, the refrigerant is converted from gas to liquid, which is called condensation.

Storage tank

The storage tank stores the refrigerant when it is in its liquid state.

Receiver dryer

The receiver dryer is used to extract dirt, moisture and acid from the refrigerant. The receiver dryer must be renewed at regular intervals to prevent damage to other components. See Inspection instructions.

Expansion valve

The expansion valves on the right and left side regulate the quantity of refrigerant supplied to the evaporator and are controlled by the output temperature from the evaporator and the system pressure. After the expansion valve, the pressure and temperature of the refrigerant drops.

Damper for fresh air/recirculated air

In order to be able to control the type of air being blown over the evaporator, there is a damper for fresh air and recirculated air in the AC unit. The damper is controlled electronically by the climate control program.

Evaporator

The evaporator comprises two heat exchangers, each with two (CC220) or three (Aerosphere) radial fans. The fans are controlled by the climate control programs at three different speeds. At the lowest speed, only one fan per heat exchanger is running. At medium speed, all fans are running.

Fresh air or recirculated air is blown into the evaporator through the heat exchanger and out into the bus air ducts. Heat is transferred from the blowing air to the refrigerant, which is converted from a liquid to a gaseous state. This is called evaporation.

The evaporator assembly also comprises a heat exchanger, which is connected to the heating system. This makes it possible to use the AC unit to heat the ventilated air, see Heating system.

An ice monitor has been fitted to prevent ice from forming in the evaporator assembly. This breaks the circuit when the temperature is too low and disengages the compressor.

Air filter

The earlier model of AC unit is fitted with two different air filters. One on the recirculated air side and one on the fresh air side.

The later version of the AC unit has only one air filter. It is located in the roof unit.

Refrigeration process

The way the AC unit works can be summarised as follows:

1 The compressors raise the pressure and temperature of the refrigerant.

2 In the condenser, heat from the refrigerant is released and the gas condenses, i.e. changes to its liquid state.

3 The storage tank stores refrigerant to meet the evaporator requirements.

4 The receiver dryer separates moisture and any dirt from the refrigerant.

5 The expansion valves separate the refrigerant high-pressure side from its low-pressure side.

6 Heat from the air passing through is added to the cold refrigerant in the evaporators. The refrigerant is converted into a gaseous state (evaporates).

7 The cycle is completed when the refrigerant reaches the compressor again.

Start

The AC unit is activated when the climate control program requests cooling, i.e. when the temperature in the passenger area exceeds the set temperature by approximately 2°C. This takes place provided:

- the external temperature exceeds 8°C.
- approximately 1 minute has elapsed since the engine was started.
- battery voltage exceeds 21 V.

When switching from heating mode to AC mode there is a delay of 10 minutes before the AC unit starts.

Operation

When the AC unit is in operation, it is entirely controlled by the climate control program, which alternately engages and disengages the compressor. When the AC unit cannot maintain the requested temperature and the passenger area temperature sensor registers a temperature level of approximately 3°C above the set temperature, the fans are started at maximum speed.

The position of the fresh/recirculated air damper is automatically determined by the climate control module, which sets it according to whether the external or passenger area temperature is lowest. The damper will be in the fresh air position if it is colder outside than inside. Otherwise, the damper will be set to recirculation position and air from the passenger area will be blown over the evaporator and out to the air ducts. The driver can set the damper to recirculation position manually.

Shutdown

The AC unit is turned off:

- when the temperature in the passenger area falls below the set level.
- in the event of abnormally high or low gas pressure. The AC unit starts again when the pressure levels in the system are normal.
- when the temperature in the evaporator is low and there is risk of ice forming. The AC unit starts again after approximately 30 seconds when there is no longer a risk of ice forming
- if the battery voltage drops below 21 V.

Air dehumidification

When the climate is in the transition zone between cold and warm, neither the AC system nor the heating system operates. In this position, the AC system uses air dehumidification to dehumidify the air, if the outside air humidity is high. In short, the climate control program requests cold as well as heat to obtain the pre-set passenger area temperature in the air duct and to remove moisture from the air via the AC unit.

Air dehumidification is activated using the switch in the driver area. Starting and blocking of the AC unit works in the way described under AC system, Start.

During air dehumidification, the AC unit will operate with the evaporator fans in speed position 2. The climate control program will adjust the temperature in the air duct towards the value that has been set. The damper will go to recirculation position automatically.

Air dehumidification automatically switches off 10 minutes after activation.

Driver area AC

General

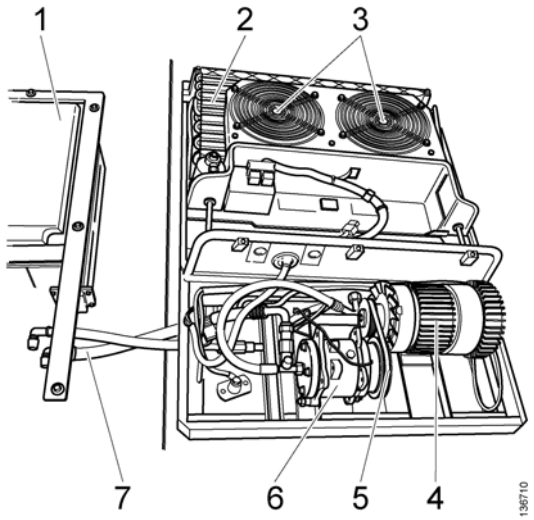
There are two different versions of driver area AC. One is combined with the passenger unit and the other operates completely separately.

All buses with driver AC have a damper housing above the windscreen to direct the air.

The separate driver area AC system is controlled by the climate control program and comprises the following components:

- Compressor
- Electric motor
- Drive belt
- High pressure switch
- Low pressure switch
- Safety valve
- Condenser
- Condenser fans
- Evaporator
- Receiver dryer

Where a driver AC and passenger AC are combined, the refrigerant flows from the roof unit on the passenger AC to the defroster evaporator and is controlled via a valve in the circuit.



Location of components, separate driver AC

1 *Evaporator (located in defroster unit)*
2 *Condenser*
3 *Condenser fans*
4 *Electric motor*
5 *Drive belt*
6 *Compressor*
7 *Evaporator hoses*

Ventilation system

General

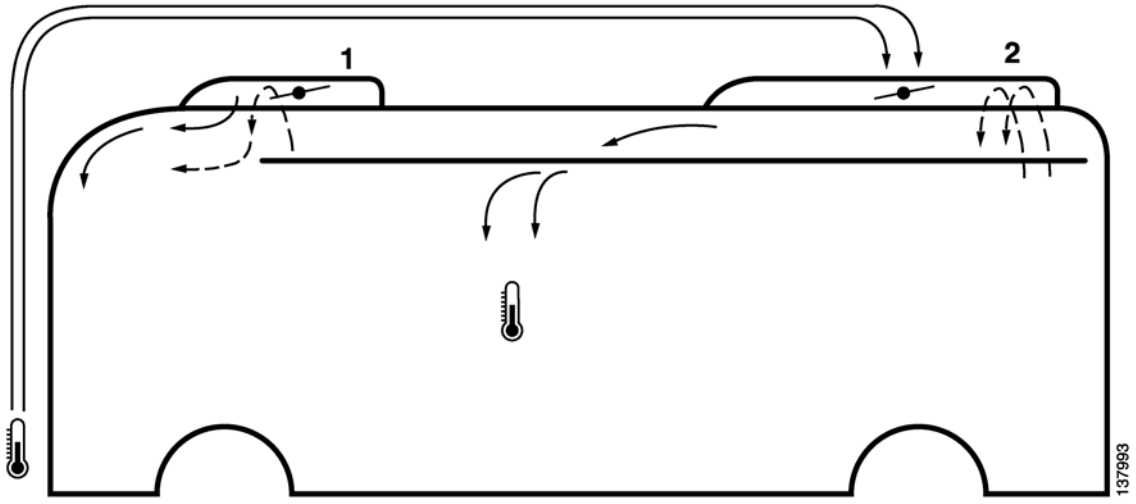
In principle, the ventilation system must ensure:

- a supply of fresh air to the bus through the defroster unit 1 and roof unit or AC unit 2.
- an increase in air quality by filtering incoming air and removing old air.

This must be done in a way that provides a continuous overpressure in the bus preventing cold draughts from the doors (or the articulation unit in an articulated bus) in the winter and preventing road dust from entering the passenger area in the summer.

The ventilation fans are located in the roof units. They blow fresh air and/or recirculated air through the bus ventilation ducts and out to the passenger area through slits running along and down the side windows and through the defroster duct above the windscreen.

On models with AC, the AC unit evaporator fans are used as ventilation fans. They can both deliver fresh air and recirculate the air in the passenger area depending on the position of the ventilation dampers. The air is heated or cooled in the AC unit and blown out through the bus ventilation ducts.



Schematic diagram of the ventilation system

1 Defroster unit

2 Roof unit

Starting/stopping

The ventilation system is integrated with other climate control components and, in principle, is started and switched off when the engine is started and switched off, or using the temperature control. When the temperature control is in the OFF position, the ventilation system is shut off.

Operation

Recirculated air and fresh air damper

- Selects fresh air or recirculated air depending on which has the lowest temperature.
- Moves from fresh air to recirculated air when the heating water valve is continuously open. This indicates that the outside temperature is too low for the heating to warm up the incoming air to the set temperature.
- Can be moved manually from fresh air to recirculated air via a switch on the control panel in the driver area.

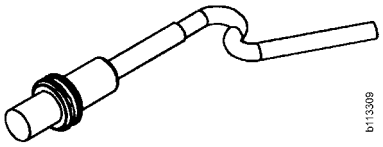
Fresh air fans

- Fan speed I is always active.
- On buses with convectors fan speed II is activated when the temperature in the passenger area is more than 1.5°C above the set temperature. On buses without convectors fan speed II is activated when the temperature in the bus falls below the set temperature.
- Fan speed III starts when the temperature in the passenger area is more than approximately 3°C above the set temperature.

Temperature sensor

Temperature sensor, external

The external temperature sensor is positioned on the left-hand side at the front of the bus and registers the external temperature This is necessary in order to prevent the climate control program from starting the AC unit in cold weather, i.e. when the temperature is lower than 8°C.

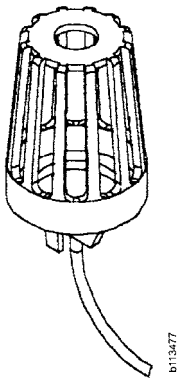


Air duct temperature sensor

Used to maintain the required temperature in the air duct.

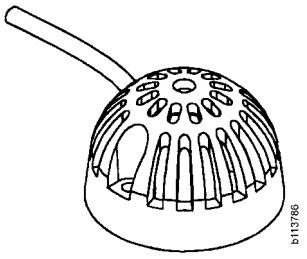
On buses without AC, with AC on older models or only driver AC, the air duct temperature sensor is situated in the roof duct under the roof unit air filter.

On buses with the newer type of AC unit, the temperature sensor is situated separately inside the roof duct.



Temperature sensor, passenger area and driver area

The passenger area temperature sensor is located opposite the left-hand roof unit and registers the current air temperature. There is also a temperature sensor in the driver area.



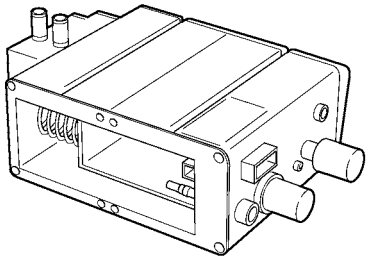
Ramp connection system

General

The ramp connection system provides the bus with heating and compressed air when it is parked. When required, the system must also be able to provide the bus with power to charge the battery and drive the feed pump.

The layout of the system will depend on the design of the heating ramp. There are two different systems:

- Ramp with heat exchanger in the bus and connection unit, EK 100, EK 100E.
- Ramp with heat exchanger, control and pump outside the bus and separate connections for coolant, air and electricity (Hansen).



Example of connection unit for ramp connection system

Connection unit with heat exchanger in the bus

System design EK100/EK100 E

- The connection unit EK100/EK100E operates as a connection point for air and water between the bus and the ramp. If the E-variant is selected, the battery voltage and any control signal can be fed via the EK block.
- The heat exchanger exchanges heat from the ramp to the bus internal heating system.
- The circulation pump supplies a flow through the heating circuits and the engine when the ramp connection is connected. The bus feed pump is used for this purpose, see Heating system.
- The temperature sensor is the same sensor used for the driver heating, see Heating system.
- The driver area heating fan is started at the ramp signal 2 to increase the heat supply when connected to the ramp.
- The control system is integrated into the multiplex system.
- A separate 7-pin connection is available as an option for battery voltage and signals to the climate control program for the high or low temperature function.

Function

The system starts when the driver connects to the EK100/ EK100E connection unit. The following takes place in the junction box:

1 The thumb grip on the junction block pushes in the microswitch on the junction box.

2 The compressed air valve on the junction box changes position.

3 The compressed air cylinder presses in the junction block.

4 Connections for coolant and compressed air open, and the electrical connection is established in the case of the EK100E.

5 The ramp system provides the bus with heating and compressed air.

6 When EK100E is used, the ramp system also provides the bus with a charging voltage of up to 15A and a high temperature signal.

When the ramp is connected, the following occurs:

- The ramp continuously supplies the heat exchanger with a flow of hot coolant.
- The ramp continuously supplies the bus with compressed air.
- The ramp provides the bus with a charging voltage of up to 15A (applies to EK100E only).

When the temperature in the passenger area has fallen below the preset value of 5 - 16°C (specified according to customer requirements), the feed pump 2 will start. Heat is absorbed from the heat exchanger 3 and distributed into the driver circuit 4 and into the passenger circuit, 5. No coolant flows out to the roof circuits since these valves are closed. In the passenger circuit, the water is distributed partly into the normal supply via the circulation pump and partly into the normal return line. The water circuits are combined at the rear of the bus and continue into the main return down to the engine 6.

The feed pump will be turned off when the temperature has risen above the set value. Heating continues until the bus is disconnected from the ramp or it enters the high-temperature mode.

In high-temperature mode, the reference temperature is changed from 5 - 16°C to 18°C after a delay of about 30 seconds. The feed pump is started at the same time and runs continuously while the climate control program starts and turns off the heating fan so that the correct temperature is obtained.

The driver switches the system off and disconnects the bus from the ramp by pushing in the thumb grip on the junction block. This has the following results:

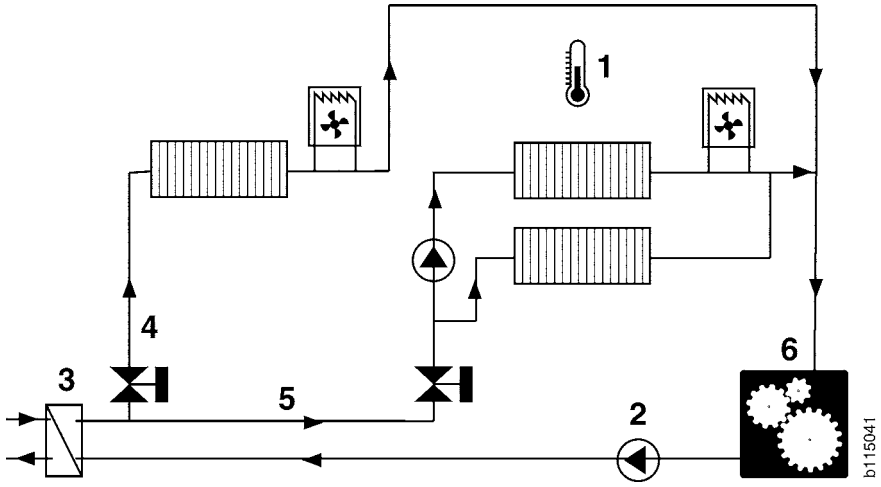
1 The microswitch on the junction box is deactivated.

2 The compressed air valve on the junction box changes position.

3 The compressed air cylinder presses out the junction block.

4 Connections for water and compressed air are closed.

5 The charging current is cut, applies to EK100E only.



Connection unit with heat exchanger in the bus

1 *Sensor for temperature in passenger area*

2 *Feed pump*

3 *Heat exchanger*

4 *Driver circuit*

5 *Passenger circuit*

6 *Main return to engine*

Separate connection with heat exchanger outside the bus

System design

In this variant all the components mentioned previously for the EK100/EK100 E connection units are installed in a box on the ramp.

Also present:

- Coolant connections in the form of leakproof connections, Hansen type, which are fitted on the central distribution unit.
- An air connection which is located outside the central distribution unit.
- A 3 pin electrical connection which is located outside the central distribution unit. The terminals are for battery voltage + and - and a signal for starting the driver area fan.
- An extra check valve fitted on the central distribution unit. This ensures the flow through the whole bus when establishing a connection with the ramp without affecting the operation when the engine is running.
- A control system for the ramp is located on the heating ramp.

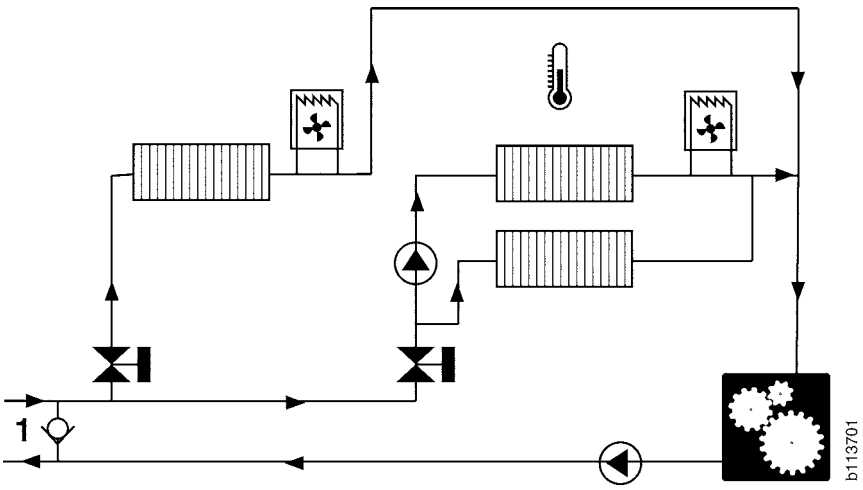
Function

The system is passive and all active parts are located on the ramp outside the bus.

A pump located on the ramp pumps heated coolant into the bus. The water is distributed into all the open circuits, driver heating, passenger heating and engine, as shown in the illustration. Check valve 1 prevents the flow from going directly back to the ramp.

The driver fan can be started via a 3 pin electrical connection.

Note: When connecting to the ramp with separate couplings, it is essential that the main power is turned off or the heating in the bus will otherwise be turned off due to the fact that all the water valves are closed.



Separate connection with heat exchanger outside the bus

1 Check valve

Fault control

AC system

If the pressure in the compressor is too high or too low, the relevant high or low pressure switch activates immediately and the compressor is disengaged as follows:

- The high pressure switch activates at 22.5 bar and is reset when the pressure has dropped to 15.5 bar.
- The low pressure switch activates at 0.2 bar and is reset when the pressure has dropped to 1.9 bar.

After a delay of about 1 minute, once the pressure has stabilised, the compressor will be re-engaged. If the pressure is still too high or too low, the compressor will be disengaged in the same way. If this is repeated after five attempts to start, the AC function will be completely blocked until the power has been cut and servicing will be required before it can be used. If there is a high pressure fault, no further attempts will be made to start.

When the temperature in the evaporator falls below -0.8°C, the ice monitor will activate and disengage the compressor. After a delay of approximately 30 seconds, when the temperature has risen above +2.5°C, the compressor is engaged again.