Contents

E85 Heating/air conditioning system

Introduction

This seminar working material describes the newly developed heating and air conditioning systems of the Z4. A differentiation is made between:

-Integrated heating control **IHS**

-Integrated heating and air conditioning control **IHKS**

-Integrated automatic heating and climate control **IHKA**

Compared to its predecessor, the Z3, the option integrated automatic heating and climate control IHKA including automatic recirculating air control AUC is a new feature in the Z4.

Essentially, a common part concept has been realized with IHS/ IHKS and IHKA.

Even the basic version (IHS) dispenses with the use of bowden cables.

In all three variants, the control panel consists of three control zones each with a rotary knob that are elevated from the instrument panel like "islands" to underscore the sporty characteristics of the roadster.

The rotary knobs feature improved haptics and more precision adjustment.

A special feature of the rotary knobs for the IHKA is their rotary function lighting.

Various function buttons that differ depending on the variant are integrated in the centre "island."

The island design renders a front panel unnecessary thus enhancing the high-grade appearance.

Advantages at a glance:

1. Sporty and high grade appearance of the control panel
2. The island design renders a uniform front panel unnecessary
3. Clearly arranged and therefore easy-to-use controls
4. Improved haptics and more precise adjustment for air distribution, blower stage and temperature setting
5. Common part concept implemented to a large extent, e.g. IHS and IHKS feature the same pc-board
6. No water shut-off valve and auxiliary water pump due to air-based control

System overview

- Bus network

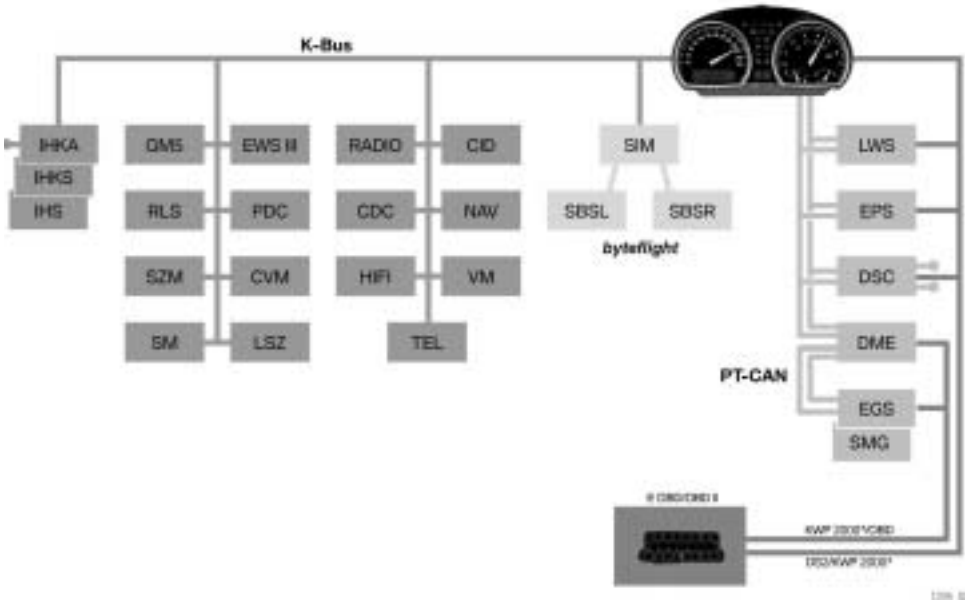

Fig. 1: Z4 Bus network

Index	Explanation	Index	Explanation
CDC	Compact disc changer	LWS	Steering angle sensor
CID	Central information display	NAV	Navigation computer
CVM	Soft-top module	PDC	Park distance control
DME	Digital motor electronics	RADIO	Radio
DSC	Dynamic stability control	RLS	Rain-low beam sensor
EGS	Electronic transmission control	SBSL	Satellite, left B-pillar
EPS	Electric power steering	SBSR	Satellite, right B-pillar
EWS III	Electronic vehicle immobilizer III	SIM	Safety and information module
GM5	General module 5	SM	Seat module
HIFI	Top-HiFi amplifier (DSP)	SMG	Sequential manual gearbox
IHKA	Integrated automatic heating and climate control	SZM	Centre console switching center
IHKS	Integrated heating and air conditioning control	TEL	Telephone control unit
IHS	Integrated heating control	VM	Video module
LSZ	Light switch centre		

IHKA system description

- Introduction

Compared to a manual control system, the integrated automatic heating and climate control (IHKA) offers the advantage of automatic adaptation of:

- Air volume control
- Temperature control
- Air distribution control

These control functions are calculated by the IHKA control unit from the input variables, controlled (characteristic curves) and monitored via various sensors.

The IHKA in the Z4 (E85) differs from the previous BMW systems (digital displays) in that it features an analogue control panel.

Special functions such as Defrost, Fresh air/AUC/recirculating air etc. are also controlled by the IHKA control unit.

In the IHKA (as in IHS/IHKS) the control panel and control unit form one component.

- System overview of IHKA input/output signals

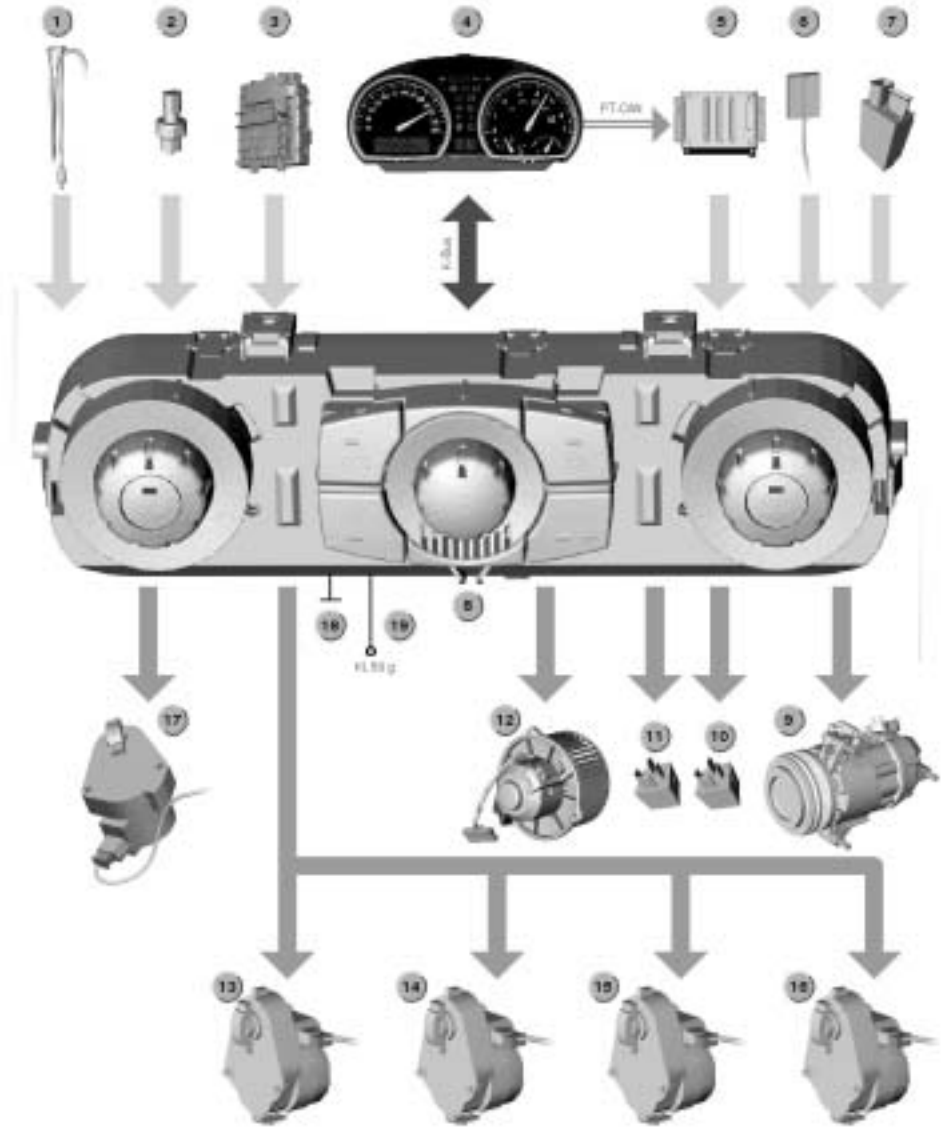

Fig. 2: IHKA system overview

Index	Explanation	Index	Explanation
1	Temperature sensor, evaporator	11	Relay 2, rear window defogger
2	Pressure sensor	12	Blower output stage and blower
3	Power distribution box with terminal 30, R and 15	13	Stepper motor, mixed air flap
4	Instrument cluster	14	Stepper motor, air distribution, top (defrost)
5	Digital motor electronics DME	15	Stepper motor, air distribution, centre (ventilation)
6	Temperature sensor, mixed air	16	Stepper motor, air distribution, bottom (footwell)
7	AUC sensor (automatic recirculating air control)	17	Actuator, fresh air/recirculating air flap
8	Control panel/control unit IHKA	18	Ground
9	Magnetic clutch, A/C compressor	19	Terminal 58g instrument lighting
10	Relay 1, rear window defogger		

IHKA components/functions

The IHKA consists of following components:

- Control panel/control unit IHKA
- Heater/air conditioner IHKA
- AUC sensor
- A/C compressor
- Pressure sensor
- Relay, rear window defogger

Note:

The IHKA on the E85 has no solar sensor (as on the E46 for instance). It is also not available as an option.

- IHKA system diagram

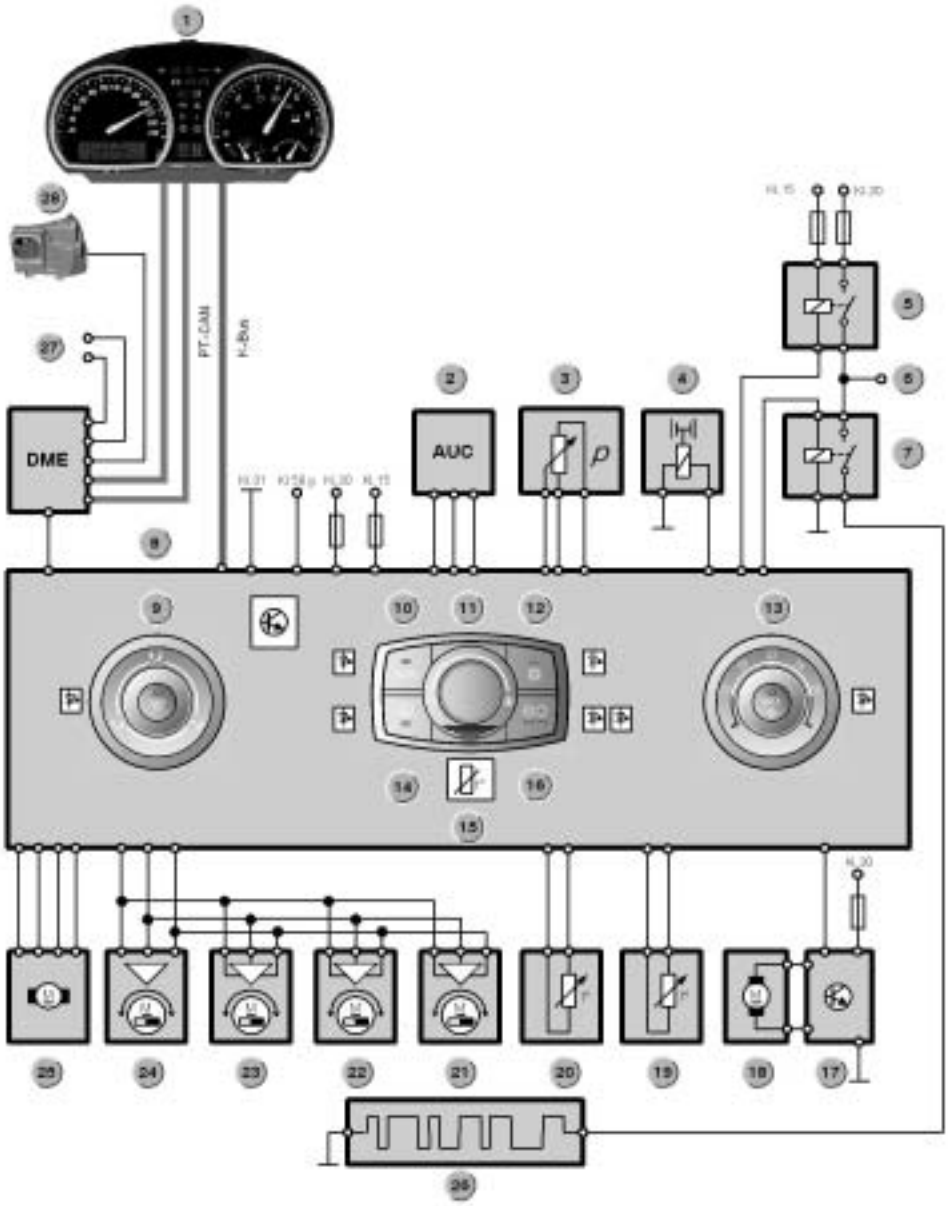

Fig. 3: IHKA system diagram

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Index	Explanation	Index	Explanation
1	Instrument cluster	15	Temperature sensor, vehicle interior (with blower)
2	AUC sensor (automatic recirculating air control)	16	AUC/recirculating air button (with two function lights)
3	Pressure sensor	17	Blower output stage
4	Magnetic clutch, A/C compressor	18	Blower motor
5	Relay 1, rear window defogger	19	Temperature sensor, mixed air
6	Hard top provisions	20	Temperature sensor, evaporator
7	Relay 2, rear window defogger	21	Stepper motor, mixed air flap
8	Control panel/control unit IHKA	22	Stepper motor, air distribution, top (defrost)
9	Rotary knob, air distribution and defrost button (with function light)	23	Stepper motor, air distribution, centre (ventilation)
10	AUTO button (with function light)	24	Stepper motor, air distribution, bottom (footwell)
11	Rotary knob, blower setting (with function light)	25	Actuator, fresh air/recirculating air flap
12	A/C button (with function light)	26	Rear window defogger
13	Rotary knob, temperature control and MAX AC button (with function light)	27	Temperature sensors (coolant temperature, outside temperature to digital motor electronics DME)
14	Button, rear window defogger (with function light)	28	Electric fan on radiator

IHKA control panel/control unit

The IHKA control panel/control unit is one component and is located in the centre of the instrument panel under the radio/ navigation control panel and above the centre console switch center.

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Fig. 4: Installation location of IHKA control panel/control unit

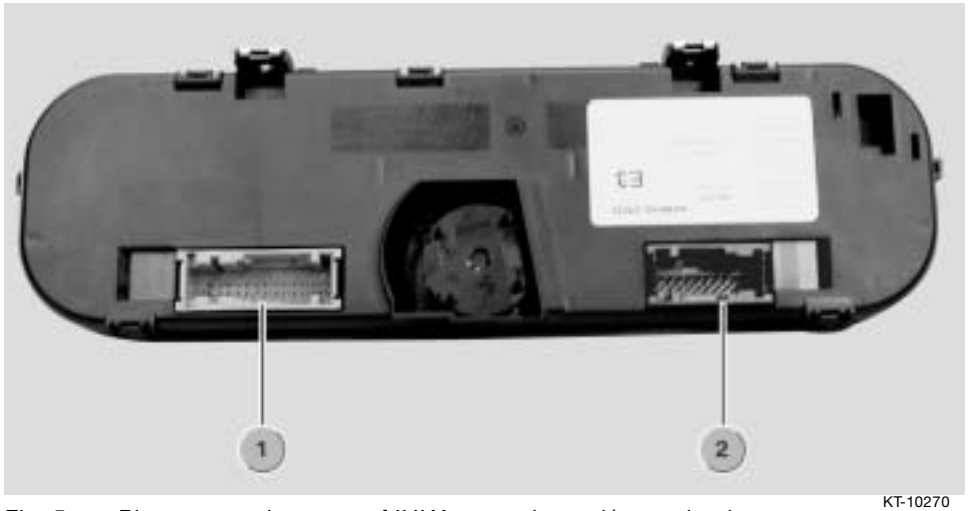

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Fig. 5: Plug connection, rear of IHKA control panel/control unit

Index	Explanation
1	24-pin plug connection to vehicle electrical system
2	18-pin plug connection to heater/air conditioner

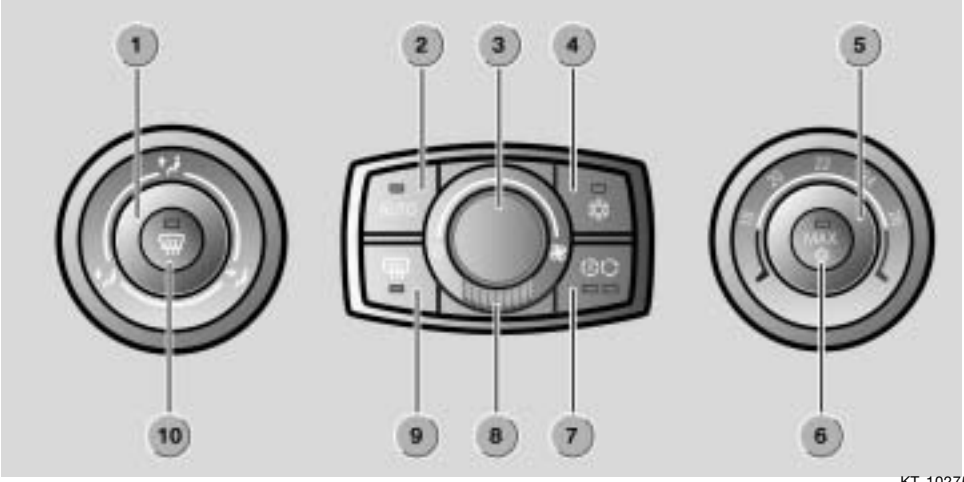

Fig. 6: Arrangement of IHKA controls

Index	Explanation	Index	Explanation
1	Rotary knob, air distribution (with function light)	6	MAX AC button (with function light)
2	AUTO button (with function light)	7	AUC/recirculating air button (with function light)
3	Rotary knob, blower setting (with function light)	8	Opening for force ventilated temperature sensor, vehicle interior
4	A/C button (with function light)	9	Button, rear window defogger (with function light)
5	Rotary knob, temperature setting (with function light)	10	DEFROST button (with function light)

The 3 control elements of the control panel/control unit are enclosed by finishers. These finishers are clipped into the instrument panel from the front and can be replaced.

The rotary button for air distribution (adjustment range 360°) features 3 main settings and 10 fine settings in between.

The rotary knob for blower setting (adjustment range approx.180°) features 1 main notch for the zero setting.
There are 14 precision graduations from the zero setting up to the maximum setting.

The rotary knob for temperature setting (adjustment range approx. 240°) has 2 main settings (maximum cold/maximum warm) with 23 precision graduations in between for individual temperature setting.

Temperature setting range:

- a) Maximum cold (corresponds to 16 °C or 60 °F)
- b) Individual temperature setting range
- c) Maximum warm (corresponds to 28 °C or 84 °F)

The intermediate positions can be selected in steps of 0.5 °C (or steps of 1 °F for USA).

The following buttons feature a green function light (LED): AUTO, A/C, MAX AC.

The button for AUC/recirculating air has 2 green function lights (LEDs).

The rear window defogger and defrost buttons feature an orange-coloured function light (LED).

When the light is switched on, the indicator light is activated via terminal 58g. The signal comes from the light switch center (LSZ).

The locator lights and function lights are dimmed corresponding to the position of the dimmer control wheel on the light switch center and/or depending on the ambient light conditions (photocell in light switch center).

Rotating function light

A special feature of the IHKA is the rotary function light in all three knobs.

Description based on example of the rotary knob for air distribution

The rotary knob for air distribution has an adjustment range of 360°. 8 LEDs are located on the pc-board under the rotary knob at its circumference to ensure it can be seen clearly enough from different viewing directions.

A light element is located in the rotary knob. The light element is connected mechanically to the rotary knob and turns together with it.

The light element functions as a light guide. It bundles the light of the LEDs and, due to its geometrical shape, guides it to the light outlet window of the rotary knob. This ensures the full light intensity is always emitted at the light outlet window.

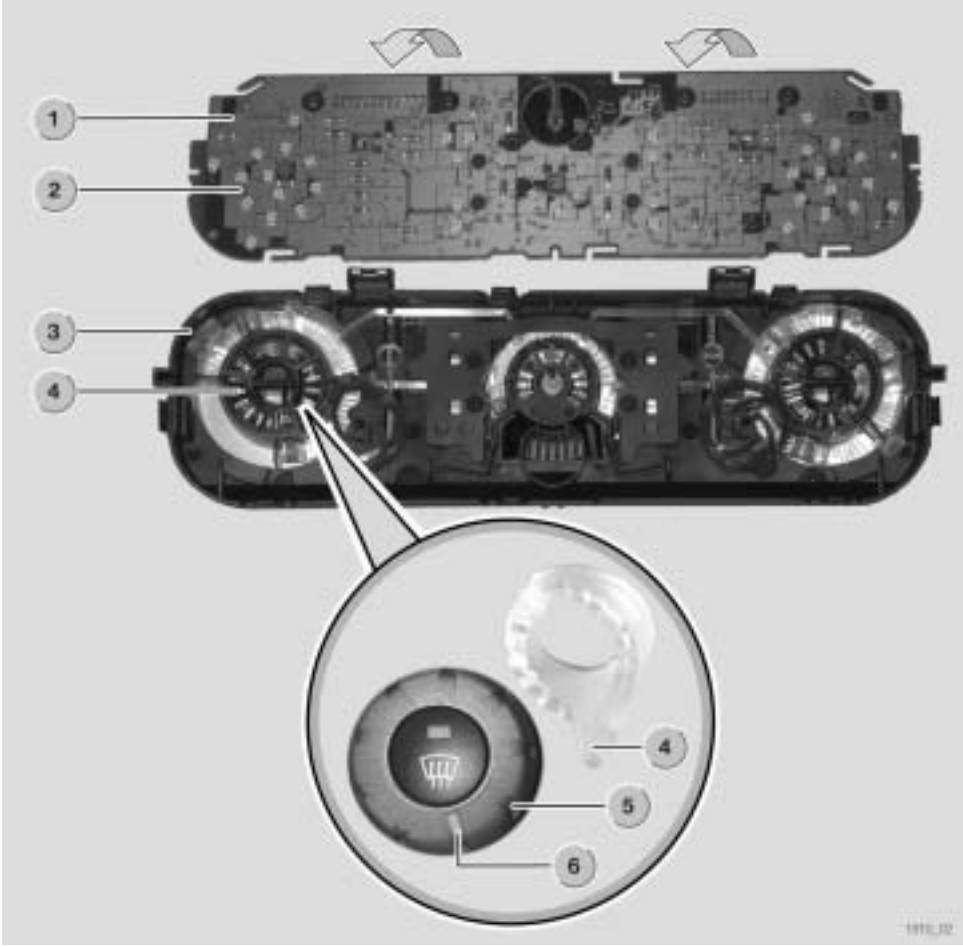

Fig. 7: Rotating function light KT-10551

Index	Explanation	Index	Explanation
1	PC-board	4	Light element
2	8 LEDs on circumference	5	Rotary knob, air distribution
3	Housing of IHKA control panel/control unit	6	Light outlet window

Vehicle interior temperature sensor

A force-ventilated vehicle interior temperature sensor is accommodated in the housing of the IHKA control panel/control unit.

The integrated sensor blower is activated at terminal 15 ON.

The sensor blower continues to run for 10 minutes at terminal 15 OFF.

The afterrunning period is necessary for controlling the temperature.
Otherwise, when the vehicle is parked for a short period of time (e.g. refuelling), due to internal heating, the temperature sensor would supply an incorrect signal for the vehicle interior.

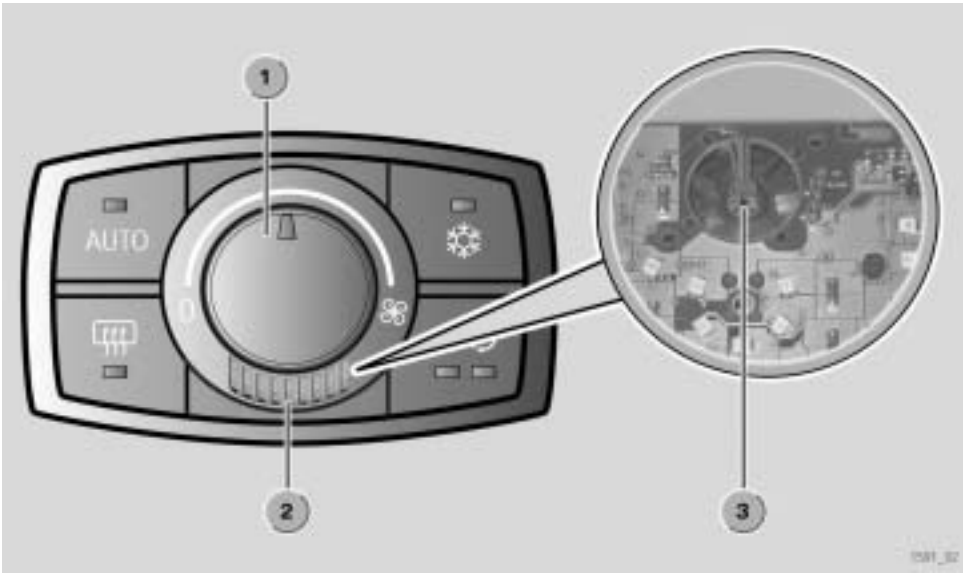

Fig. 8: Vehicle interior temperature sensor KT-10282

Index	Explanation
1	Rotary knob, blower setting
2	Openings for force-ventilated temperature sensor, vehicle interior
3	Vehicle interior temperature sensor (NTC on pc-board)

The vehicle interior temperature sensor has a value range from -45 °C (-49 °F) to 80 °C (176 °F).

The evaluation range of the vehicle interior temperature sensor is between 5 °C (41 °F) and 50 °C (122 °F).

Values below -45 °C (-49 °F) are stored as a short to positive or a break. Values above 80 °C (176 °F) are stored as a short to ground. The substitute value is 20 °C (68 °F).

The sensor blower is not included in the diagnostic procedure. In the event of a mechanical fault in the sensor blower, this fault will influence the temperature control.
An implausible temperature value may be supplied if the vehicle interior heats up, e.g. when stationary.

- IHKA heater/air conditioner

The following components are integrated in the IHKA heater/air conditioner:

- Actuator, fresh air/recirculating air flap
- Stepper motor, air distribution, bottom
- Stepper motor, air distribution, centre
- Stepper motor, air distribution, top
- Stepper motor, mixed air flap
- Temperature sensor, mixed air
- Blower output stage and blower motor
- Temperature sensor, evaporator

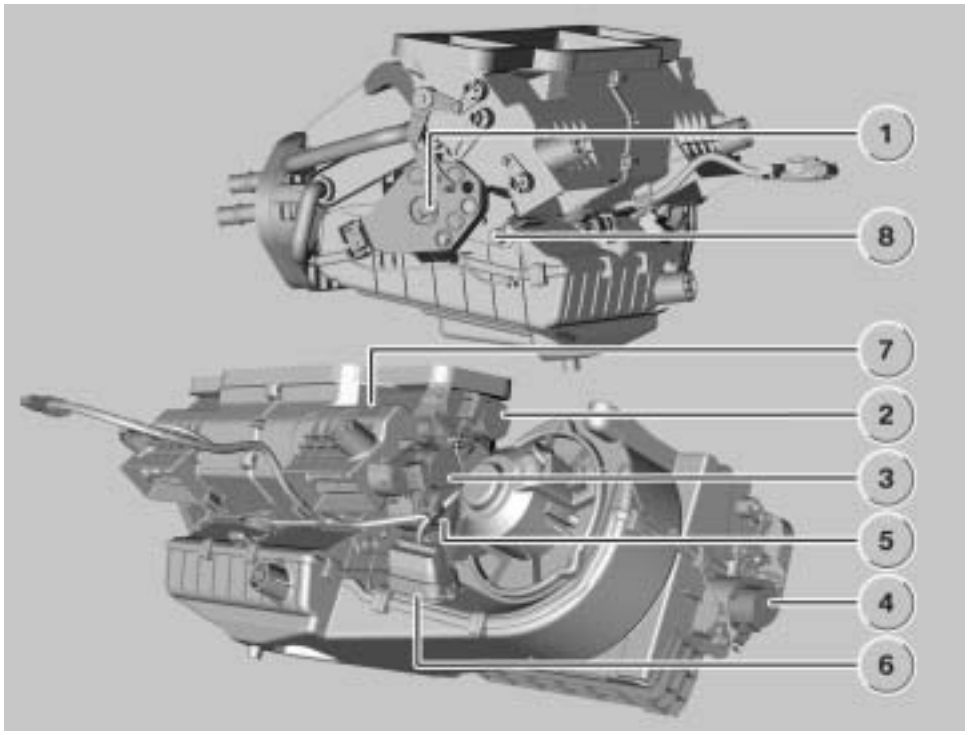

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Fig. 9: IHKA heater/air conditioner

Index	Explanation	Index	Explanation
1	Stepper motor, air distribution, top (defrost)	5	Stepper motor, mixed air flap
2	Stepper motor, air distribution, centre (ventilation)	6	Blower output stage
3	Stepper motor, air distribution, bottom (footwell)	7	Temperature sensor, mixed air
4	Actuator, fresh air/recirculating air flap	8	Temperature sensor, evaporator

Stepper motors

Note: The number of steps of the individual stepper motors depends on the adjustment range of the driven flap as follows:

- Air distribution, top (defrost), maximum number of steps 900, fail-safe direction flap open
- Air distribution, centre (ventilation), maximum number of steps 1390, fail-safe direction flap closed
- Air distribution, bottom (footwell), maximum number of steps 1600, fail-safe direction flap closed
- Mixed air flap, maximum number of steps 1770, fail-safe direction maximum warm

The flaps are moved to their limit stops after terminal 15 OFF.

The stepper motors are not able to detect their actual position. The stepper motors always move relative to a reference point. A flap end position (0% or 100%) serves as the reference point.

Temperature sensor, evaporator

Note: An evaporator temperature sensor is fitted on the heater/air conditioner for the purpose of acquiring the temperature of the air flowing out at the evaporator. The evaporator temperature sensor has a maximum value range from -45 °C (-49 °F) to 101 °C (214 °F). The evaluation range of the evaporator temperature sensor is between -5 °C (23 °F) and 25 °C (77 °F).

Values below -45 °C (-49 °F) are stored as a short to positive or a break. Values above 101 °C (214 °F) are stored as a short to ground. The substitute value is 0 °C (32 °F).

Mixed air temperature sensor

Note: A mixed air temperature sensor is fitted on the heater/air conditioner after the mixed air flap for the purpose of detecting the mixed air temperature.
The mixed air temperature sensor has a value range from -40 °C (-40 °F) to 105 °C (221 °F).

Values below -40 °C (-40 °F) are stored as a short to positive or a break. Values above 105 °C (221 °F) are stored as a short to ground.

The substitute value is 55 °C (131 °F).

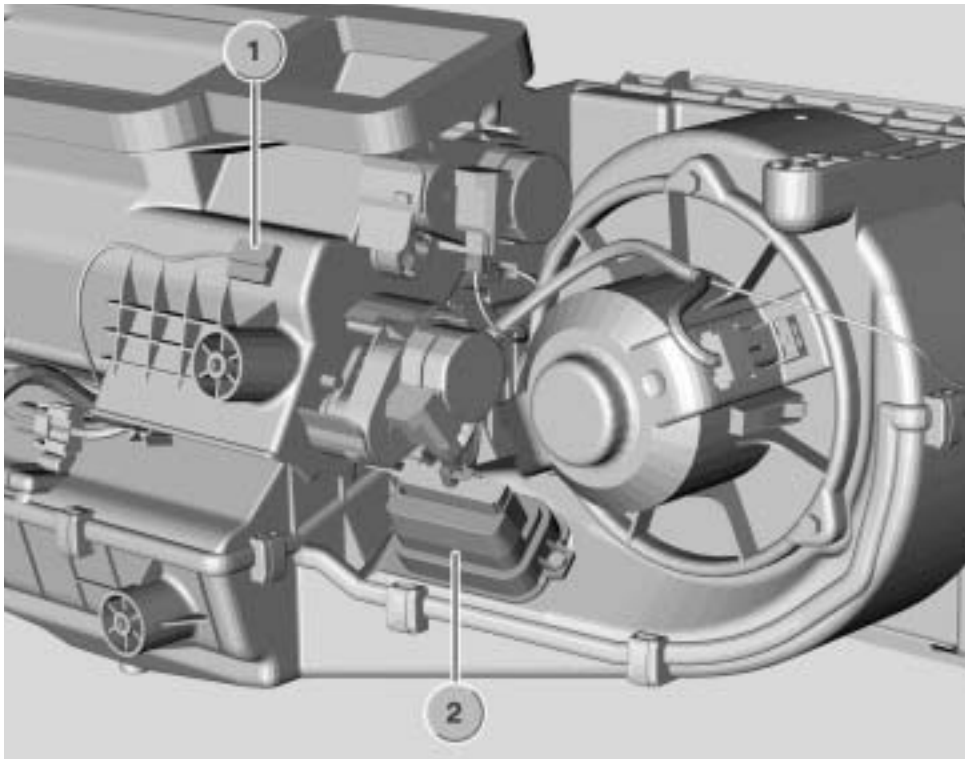

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Fig. 10: Heater/air conditioner, vehicle interior

Index	Explanation
1	Temperature sensor, mixed air
2	Blower output stage

Blower

In contrast to the E36/7, the radial blower in the Z4 is mounted transversely in the heater/air conditioner.

Blower activation:

From terminal 15 ON, the blower is activated corresponding to the function previously selected (DEFROST, MAX AC, automatic blower function, individual blower setting).

Blower activation takes place in linear form from 0 to 8 Volt.

The IHKA is switched off in the blower zero position. Blower activation is infinitely variable in AUTO mode.

The following 5 settings are possible for blower activation:

- Blower zero position
- Individual blower setting
- Automatic blower (AUTO mode)
- DEFROST/MAX AC function with automatic blower setting
- DEFROST/MAX AC function with individual blower setting

- AUC sensor

In AUC mode (automatic recirculating air control), a pollutant gas logic in the AUC sensor decides whether the system is to assume fresh air mode or recirculating air mode.

The AUC sensor requires a heating-up phase of 90 seconds.

The AUC sensor is located at the front left on the intake cowl of the electric radiator fan (600 W, hot country).

In the case of the 400 W electric radiator fan, the AUC sensor is mounted on the right on the intake cowl.

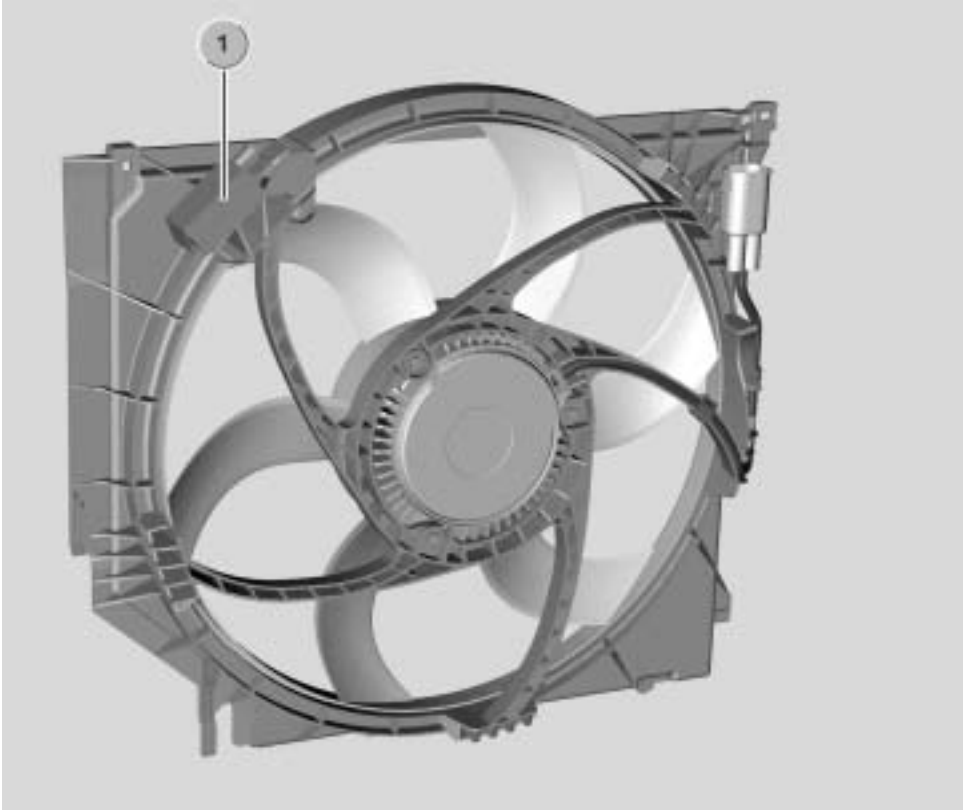


Fig. 11: AUC sensor installation location KT-10286

Index	Explanation
1	AUC sensor, electric fan 600 W

- A/C compressor

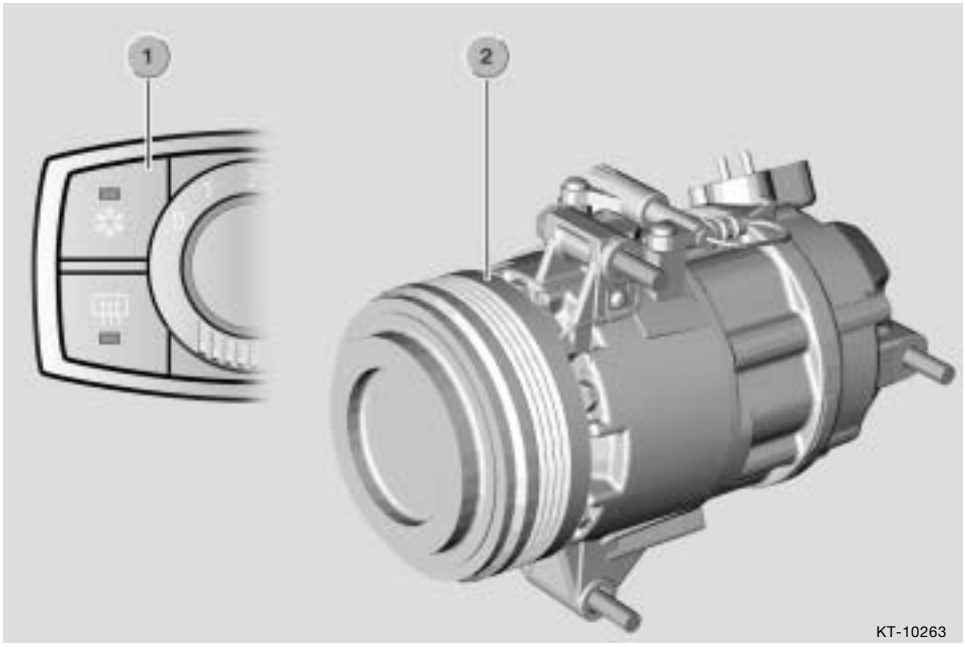


Fig. 12: A/C button and A/C compressor

Index	Explanation
1	A/C button
2	A/C compressor

The magnetic clutch for the A/C compressor is activated directly by the control panel/control unit and not by the digital motor electronics DME as known from the E46.

The Calsonic power-controlled A/C compressor is used in the E85.

Air conditioning mode is activated by pressing the A/C button. The DME is requested to increase the idle speed in order to compensate for the load.

On receiving the "A/C compressor ON" request from the control panel/control unit, the DME responds with an enable signal on a separate control line providing no full load cutout request is active.
Consequently, the control panel/control unit activates the magnetic clutch for the A/C compressor.

Switching conditions for the magnetic clutch of the A/C compressor

A/C compressor ON	A/C compressor OFF
A/C button pressed and	Evaporator temperature < -0.5 °C (depending on outside temperature) or
Evaporator temperature > 2 °C (depending on outside temperature) and	Blower zero position or
Outside temperature > -10 °C and	Outside temperature < -10 °C or
System voltage ≥ 9.7 V and	Terminal 15 OFF or
Within permissible pressure range	System voltage < 9 Volt or
	Outside permissible pressure range

Pressure monitoring

The pressure in the refrigerant circuit is monitored by a pressure sensor.

The load moment expected when switching on and during operation of the A/C compressor is derived from the pressure sensor signal.

The load torque in transferred via the K-bus and PT-CAN bus to the DME. The DME responds with corresponding engine control (adapted air and fuel volume).

An upper and lower switching threshold is defined for pressure monitoring:

Low pressure	High pressure
p_{min} OFF < 1.5 bar	p_{max} OFF > 32.0 bar
p_{min} ON > 2.0 bar	p_{max} ON < 24.0 bar

OFF and ON characteristics

The current "Air conditioning ON" function is stored in the EEPROM at terminal 15 OFF. The function light is switched off.

Derived from the key memory (personalizing), the function last selected is activated at terminal 15 ON.

The function light is switched on (if A/C mode ON).

A check is conducted at terminal 15 ON as to whether the blower is in zero position.

The heating/air conditioning system is switched off in blower zero position.

- Pressure sensor

The pressure sensor is fitted in the pressure line in the area of the drier.

Depending on the system pressure, it supplies the IHKA control unit with an analogue signal between 0.4 V and 4.6 V. The supply voltage is 5 V, the current intake is less than 20 mA.

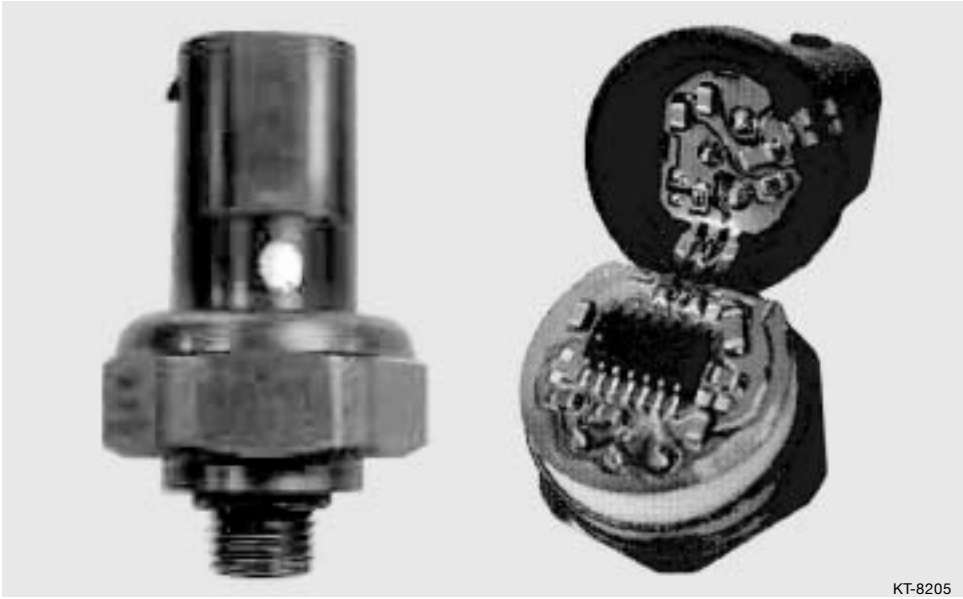


Fig. 13: Pressure sensor

- Relay, rear window defogger

The rear window defogger has 3 operating statuses.

Relay 1 for the rear window defogger is always activated as a hardtop may be fitted (no hardtop detection).

- **Defrost phase**
  This phase is started only after the first time the button for the rear window defogger is pressed after terminal 15 ON (see following table for duration).
  Relay 2 for the rear window defogger is activated at a rate of 100%. The system then assumes cyclic switching mode.
- **Cyclic switching**
  This mode takes place with one third of the total power output of the rear window defogger (pulse/pause ratio = 40 seconds ON/80 seconds OFF). Cyclic switching is deactivated from terminal 15 OFF.
- **Restart**
  If the rear window does not remain clear during or after cyclic switching, the full power output can be resumed by pressing the button for the rear window defogger again.
  The reheating phase is again followed by cyclic switching.

Operating status	Defrost phase	Cyclic switching	Restart
Duration	10 minutes (outside temperature ≥ -15 °C) 17 minutes (outside temperature < -15 °C)	30 minutes	5 minutes
Function light (LED)	ON	OFF	ON
Undervoltage monitoring	Inactive	Active	Active
Terminal 15 OFF and ON again during afterrunning period (sleep mode)	As before terminal 15 OFF	OFF	As before terminal 15 OFF

Undervoltage/overvoltage monitoring

The charge balance could move into the negative zone when the vehicle electrical system is subject to high load at low engine speeds (< 1500 rpm). For this reason, the relays for the rear window defogger are switched off if the voltage level drops or in the event of overvoltage (battery voltage > 16 Volt for 5 seconds).

If the system voltage measured at the IHKA drops below 11.4 Volt, the rear window defogger is switched off and only switched on again when the system voltage exceeds 12.2 Volt. The threshold values must be applied for longer than 10 seconds (hysteresis).

Switching off the relays when undervoltage/overvoltage is detected has no influence on the duration of the operating statuses (defrost phase, cyclic switching, restart).

The function light (LED) remains on while the relays are switched off in the event of undervoltage/overvoltage.

The rear window defogger is also switched off during engine start (K-bus telegram, terminal 50).

The heated outside mirrors are not activated simultaneously with the rear window defogger but rather separately (see technical documentation - Outside mirrors).

IHKA system functions

- AUTO mode

Notes on control concept

The following points must be observed when operating the air distribution and the blower:

In automatic mode (AUTO button), the mounting concept defined by the design influences the operational control logic.

Example:

- A high blower stage is set manually by means of the rotary knob for blower setting.
- AUTO mode is now selected. However, as the result of the previous manual intervention, the rotary knob for blower setting is still set to the high blower stage.
- Due to the defined conditions, AUTO mode drives the blower at medium speed.
- If the blower output is now to be increased slightly by turning the rotary knob to the right, a very large change is brought about in the blower output.

The manually adjustable air inlets must all be open to ensure optimum air distribution setting.

Automatic temperature control

The temperature is controlled by mixing:

- Outside air that flows through the evaporator = cold air
- Outside air that initially flows through the evaporator and then through the heat exchanger (reheat) = warm air

While doing so, the temperature control system determines a controlled variable.
Based on this controlled variable, the mixed air flap is activated such that the temperature required in the vehicle interior is set and maintained.

The electronics for temperature control essentially makes use of the following temperature sensors:

- Vehicle interior temperature sensor
- Temperature sensor, mixed air
- Temperature sensor, evaporator

The outside temperature and the coolant temperature are also used (transferred via K-bus from the instrument cluster).

Automatic air distribution control

There are 2 setting options for the air distribution:

Individual setting of the air distribution or automatic air distribution (AUTO button).

The function light in the rotary knob for air distribution goes out when the AUTO button is pressed.

The IHKA control unit sets the optimum air distribution corresponding to various input variables.

Automatic blower mode remains active if the air distribution rotary knob is turned manually during automatic air distribution. The function light in the AUTO button goes out.

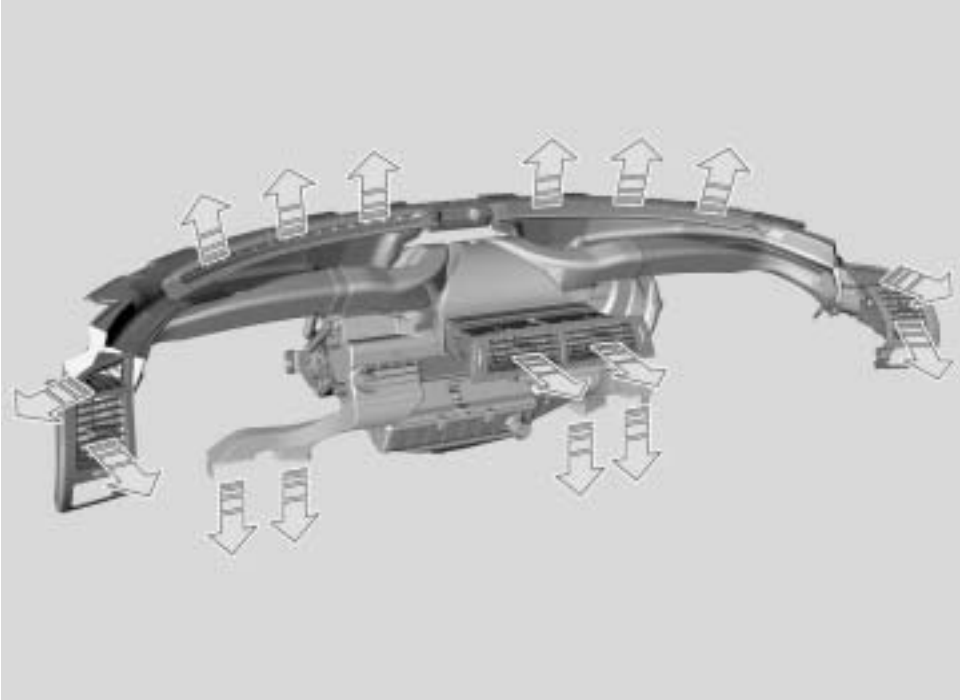


Fig. 14: Air distribution/air outlet KT-10249

Automatic air volume control

The air volume is controlled based on the position of the fresh air/recirculating air flap and the blower stages. The fresh air/ recirculating air flap (a total of 3 individual flaps) is powered by an actuator.

The system starts recirculating air mode by pressing the AUC/ recirculating air button. The fresh air inlet is closed and the recirculating air channel opened.

Air volume control features a dynamic pressure compensation function.

The automatic blower and flap function as well as the function LED "AUTO" corresponding to it is activated by pressing the AUTO button.

The IHKA control unit sets the optimum blower stage and position of the fresh air/recirculating air flap corresponding to various input variables.

- Special functions

MAX AC

The MAX AC function allows the user to request maximum cooling capacity with the simple push of a button.

The prerequisite is that the outside temperature is above 10 °C (50 °F).

The MAX AC function is deactivated by pressing another button or turning a rotary knob.

New feature:
In the MAX AC function, the blower output can be adjusted manually (except for blower zero position longer than 3 seconds) without exiting the MAX AC function.

KT-10283

Fig. 15: MAX AC button

On ending the MAX AC function, the settings that were active before MAX AC are adopted.

If the defrost function was active before MAX AC, the settings before defrost are adopted.

The A/C compressor remains switched on after ending the MAX AC function.
Exception: The A/C compressor is switched off when the MAX AC function is switched off via the A/C button.

DEFROST

The DEFROST function assumes a higher-ranking role in air distribution control.

Switching on the DEFROST function prevents misting of the front field of vision.

The defrost function is deactivated by pressing another button or turning a rotary knob.

New feature:
The blower output can be adjusted manually in DEFROST mode (except in blower zero position).

KT-10284

Fig. 16: DEFROST button

Window fogging is possible not only during engine start (see avoiding fogging at start). Under certain circumstances the windows can also fog up while driving (high humidity levels in the vehicle interior due to wet clothing). The DEFROST function can quickly remedy this situation.

On ending the DEFROST function, the settings that were active before DEFROST are adopted.

The DEFROST function can be activated as required when IHKA (blower zero position) is switched off. The blower runs at full power. The blower output cannot be varied.

If terminal 15 is switched off with the DEFROST function active, the DEFROST function is activated again at terminal 15 ON within the afterrunning period (10 minutes).

AUC/recirculating air

Automatic recirculating air control AUC is a standard feature on vehicles with IHKA.

Initially, the AUC function is activated when the AUC/recirculating air button is pressed in fresh air mode.
Pressing the button again activates the recirculating air mode.
Pressing the button once again returns to fresh air mode.

Recirculating air mode and AUC mode are indicated by green function lights (LED) on the control panel.

KT-10285

Fig. 17: AUC/recirculating air mode button

As was the case with previous heating/air conditioning systems, the AUC/recirculating air function also features "forced ventilation with fresh air," the activation and duration of which depends on whether the system is in A/C mode (compressor active).

The fresh air is already pre-dried if the A/C compressor is ON. The duration of recirculating air mode is therefore longer.

"Forced ventilation" cycles:

A/C button	Cycle
OFF	3 minutes recirculating air 1 minute fresh air
ON	12 minutes recirculating air 1 minute fresh air

- Other functions

Cold start interlock

The cold start interlock function intervenes in activation of the air distribution flaps and blower control.

The cold start interlock is active at low outside temperatures and low coolant temperatures (engine cold).

New feature:

The cold start interlock is not deactivated by a terminal change from terminal 15 ON to terminal 15 OFF.

When the switch-on conditions are fulfilled, the top air distribution flap (defrost) is fully opened and the bottom air distribution flaps (ventilation and footwell) are completely closed. As a result, no cold air is blown directly at the driver/passenger.

The automatic blower function must be selected for intervention in blower control.

Cooling mode (forced air recirculation at high outside temperatures)

Cooling mode serves the purpose of cooling a heated vehicle at high outside temperatures.

Cooling mode is active during engine start and applies both in AUTO mode and manual mode. The compressor must also be activated (= all switch-on conditions are fulfilled).

Cooling mode supersedes the AUC function (automatic recirculating air control). If the signal from the AUC sensor specifies fresh air mode, recirculating air mode is retained or set to a fresh air share of 20% when cooling mode is active.

A new feature is that cooling mode has been extended from 12 minutes to 15 minutes in tropics coding.

When the control variable y is below -90%, the fresh air/recirculating air flap is set to recirculating air for maximum 12 minutes. As a result, too warm air is not blown directly at the driver/passenger.
If, after this period of 12 minutes has elapsed, the control variable y is below -90%, the fresh air/recirculating air flap is set to 20% fresh air.

Avoiding fogging during start

The function for avoiding fogging during start is activated once at terminal 15 ON in automatic mode (AUTO button).

The prerequisite is that the outside temperature is above 0 °C (32 °F).

The top air distribution flap (defrost) is closed for 12 seconds. Consequently, fogging of the front field of vision caused by moist air from the evaporator is avoided.

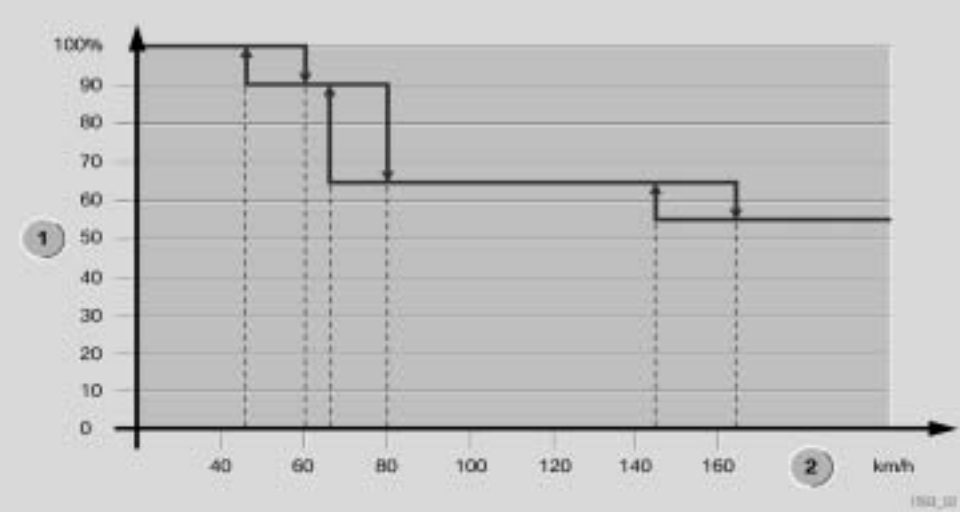
The function for avoiding fogging during start-up can be superseded by the cold start interlock. In this case, all air distribution flaps are closed.

Dynamic-pressure compensation

Without dynamic pressure compensation, as the driving speed increases, the air volume at the air inlet ducts also increases disproportionately. This effect is compensated in that the fresh air flap reduces the cross section of the air inlet duct dependent on the vehicle speed.

The calculation of the set position from the speedometer signal is subject to an afterrunning hysteresis to avoid permanent activation of the flap as the result of slight changes in the vehicle speed.
The vehicle speed information is made available via the K-bus from the instrument cluster.

The fresh air flap reduces the opening angle within a certain speed range according to an empirically defined characteristic curve.



KT-10253

Fig. 18: Dynamic-pressure compensation

Index	Explanation
1	Opening angle of fresh air flap
2	Vehicle speed

- Electric radiator fan

The electric radiator fan is activated by the DME that outputs the control voltage for the output stage of the fan.

Activation of the correct stage for the electric radiator fan (15 stages) is formed from the signal of the pressure sensor.

Tabular overview of the stages of the electric radiator fan:

Pressure in bar	Fan stage
8	0
9	2
10	3
12	5
14	6
15	7
16	8
17	9
18	10
19	11
20	12
21	13
22	14
23	15
29	15
35	15

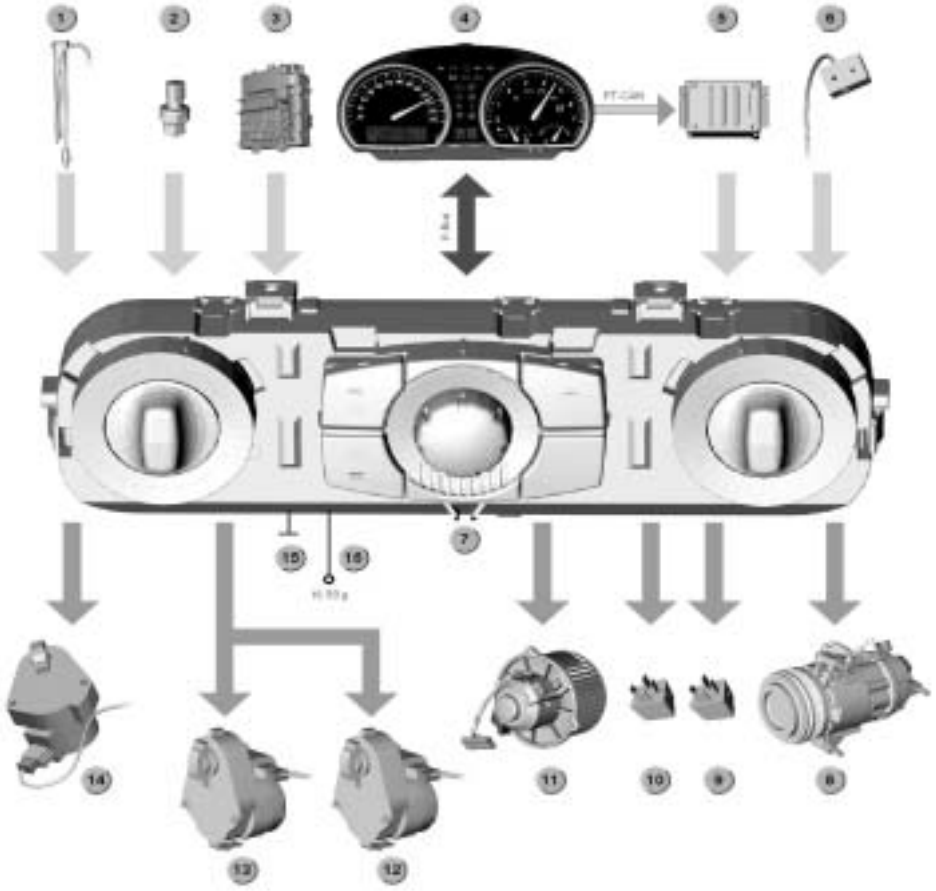
The electric radiator fan is available in 2 versions:

Power intake 400 Watt and 600 Watt (hot country).

IHKS/IHS system description

The variations of the IHKS/IHS systems compared to the IHKA are described in the following.

- System overview of IHKS/IHS input/output signals



Input signal
Output signal

Fig. 19: IHKS/IHS system

KT-10228

Index	Explanation	Index	Explanation
1	Temperature sensor, evaporator, **IHKS only**	9	Relay 1, rear window defogger
2	Pressure sensor, **IHKS only**	10	Relay 2, rear window defogger
3	Fuse holder with terminal 30, R and 15	11	Blower output stage and blower
4	Instrument cluster	12	Stepper motor, mixed air flap
5	Digital motor electronics DME, **input signal on IHKS only**	13	Stepper motor, air distribution
6	Microswitch, cam disc	14	Actuator, fresh air/recirculating air flap
7	Control panel/control unit IHKS/IHS	15	Ground (terminal 31)
8	Magnetic clutch for A/C compressor, **IHKS only**	16	Terminal 58g instrument lighting

IHKS/IHS components/functions

The IHKS/IHS system consists of following components:

- IHKS/IHS control panel/control unit
- IHKS/IHS heater/air conditioner
- Pressure sensor, **IHKS only**
- Temperature sensor on evaporator, **IHKS only**
- A/C compressor, **IHKS only**
- Relay, rear window defogger

- IHKS/IHS system diagram

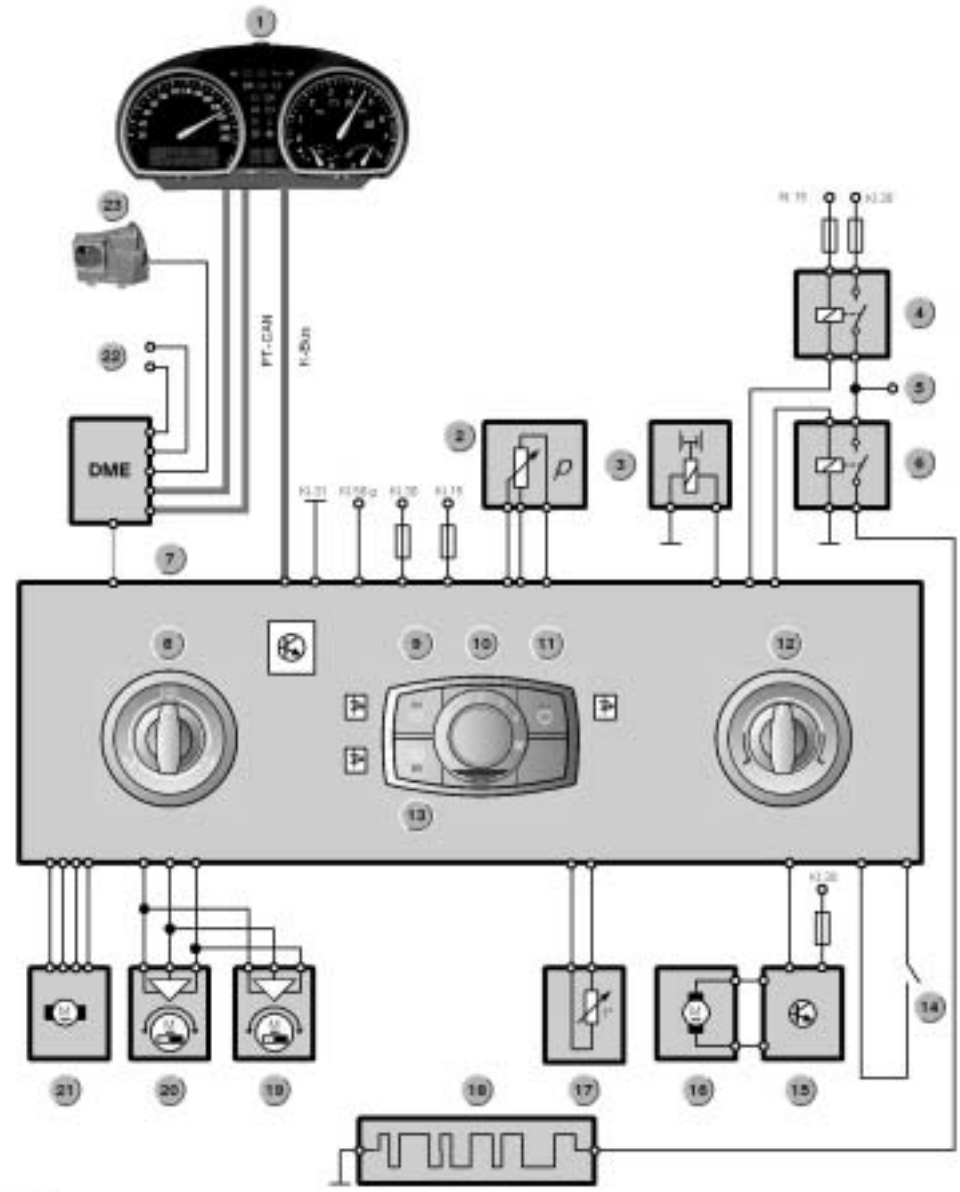
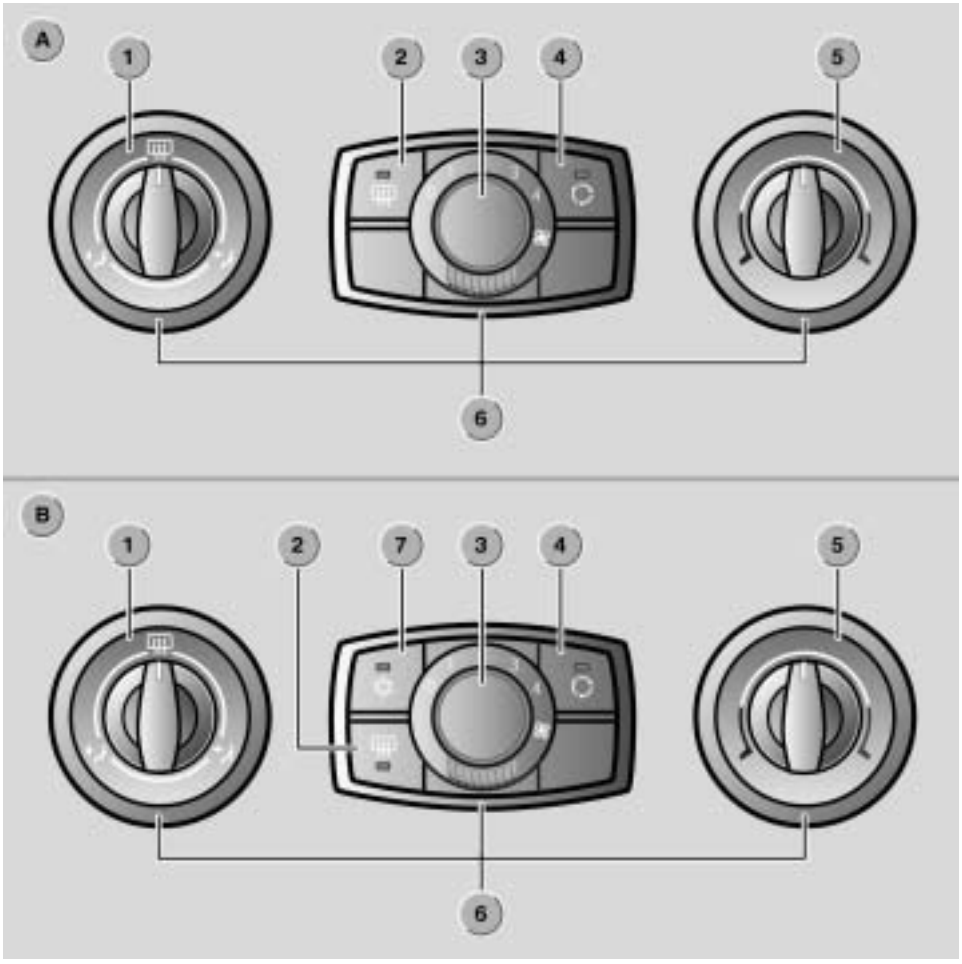


Fig. 20: IHKS/IHS system diagram

Index	Explanation	Index	Explanation
1	Instrument cluster	13	Button, rear window defogger (with function light)
2	Pressure sensor	14	Microswitch, cam disc
3	Magnetic clutch, A/C compressor	15	Blower output stage
4	Relay 1, rear window defogger	16	Blower motor
5	Hard-top provisions	17	Temperature sensor, evaporator
6	Relay 2, rear window defogger	18	Rear window defogger
7	Control panel/control unit IHKS/IHS	19	Stepper motor, mixed air flap
8	Rotary knob, air distribution	20	Stepper motor, air distribution
9	A/C button (with function light)	21	Actuator, fresh air/recirculating air flap
10	Rotary knob, blower setting	22	Temperature sensors (coolant temperature, outside temperature to digital motor electronics DME)
11	Recirculating air button (with function lighting)	23	Electric fan on radiator
12	Rotary knob, temperature control		

- IHKS/IHS control panel/control unit



KT-10242

Fig. 21: Design of control panel/control unit for IHS (top) and IHKS (bottom)

Index	Explanation	Index	Explanation
1	Rotary knob, air distribution	6	Finishers (fitted from front)
2	Button, rear window defogger	7	A/C button
3	Rotary knob, blower setting		
4	Recirculating air button	A	IHS control panel/control unit
5	Rotary knob, temperature setting	B	IHKS control panel/control unit

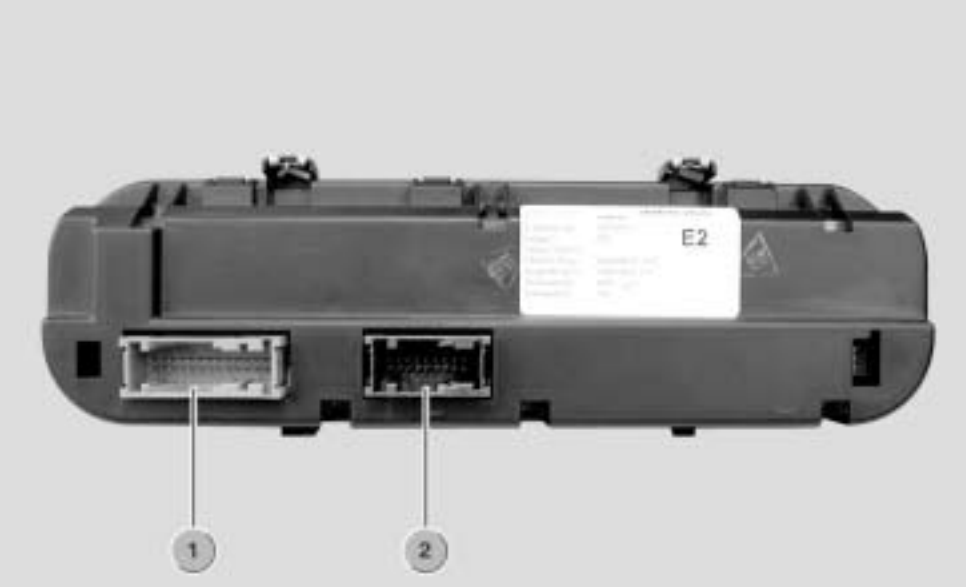


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Fig. 22: Plug connection, rear of IHKS/IHS control panel/control unit

Index	Explanation
1	24-pin plug connection, vehicle electrical system
2	18-pin plug connection, heater/air conditioner

The rotary knob for air distribution (control range 360°) features 3 rough settings and 9 fine settings.

The rotary knob for blower control (adjustment range approx.104°) provides the following setting options:

- 1 rough setting for zero position
- 8 fine settings for the 4 blower stages each with one intermediate stage

The rotary knob for temperature control (adjustment range approx. 244°) provides the following setting options:

- 23 fine settings over the complete adjustment range from cold to warm.

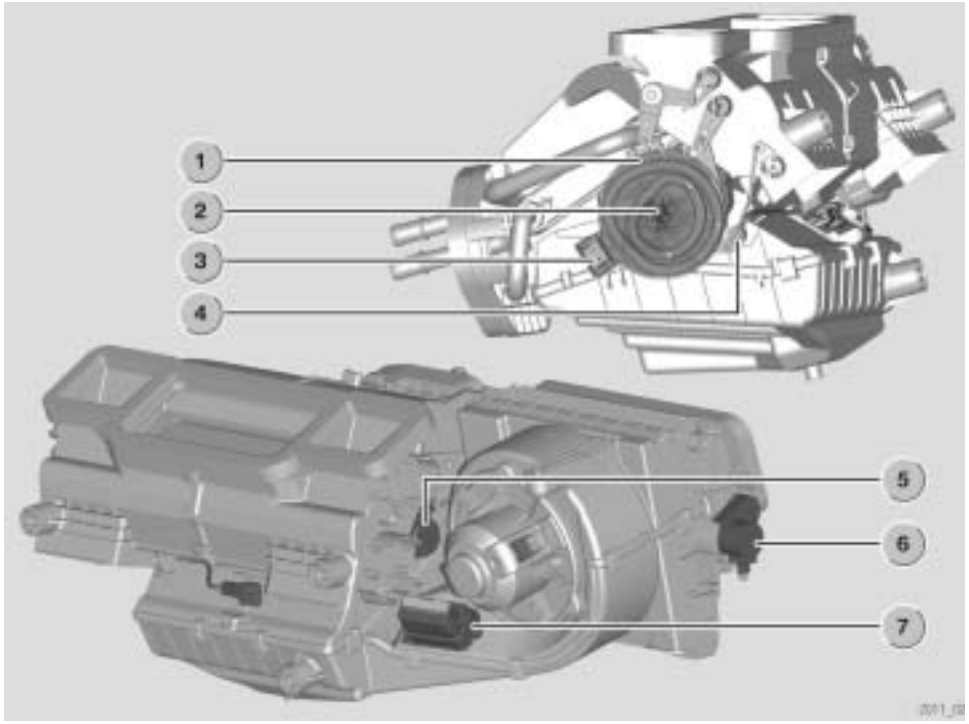
Note:

The rotary function light and the vehicle interior temperature sensor are features of the IHKA only.

- IHS/IHKS heater/air conditioner

The following components are integrated in the IHKS/IHS heater/air conditioner:

- Actuator, fresh air/recirculating air flap
- Stepper motor, mixed air flap
- Stepper motor, air distribution
- Cam disc with microswitch
- Blower output stage and blower motor
- Temperature sensor, evaporator, **IHKS only**



KT-10737

Fig. 23: Left view (top) and right view (bottom) of heater/air conditioner

Index	Explanation	Index	Explanation
1	Cam disc	5	Stepper motor, mixed air flap
2	Stepper motor, air distribution	6	Actuator, fresh air/recirculating air flap
3	Microswitch	7	Blower output stage
4	Temperature sensor, evaporator		

The stepper motor for the air distribution and for adjusting the in total 3 air distribution flaps is mounted directly behind the cam disc.

The control panel/control unit drives the stepper motor (corresponding to the required position) when the rotary control for air distribution is operated.

The cam disc moves the air distribution flaps by means of the central kinematics. A displacement of 180° takes about 18 seconds.

The actual position of the cam disc is detected by 2 cams of different width that switch a microswitch. This microswitch provides feedback relating to the position of the stepper motor and cam disc.

Central kinematics

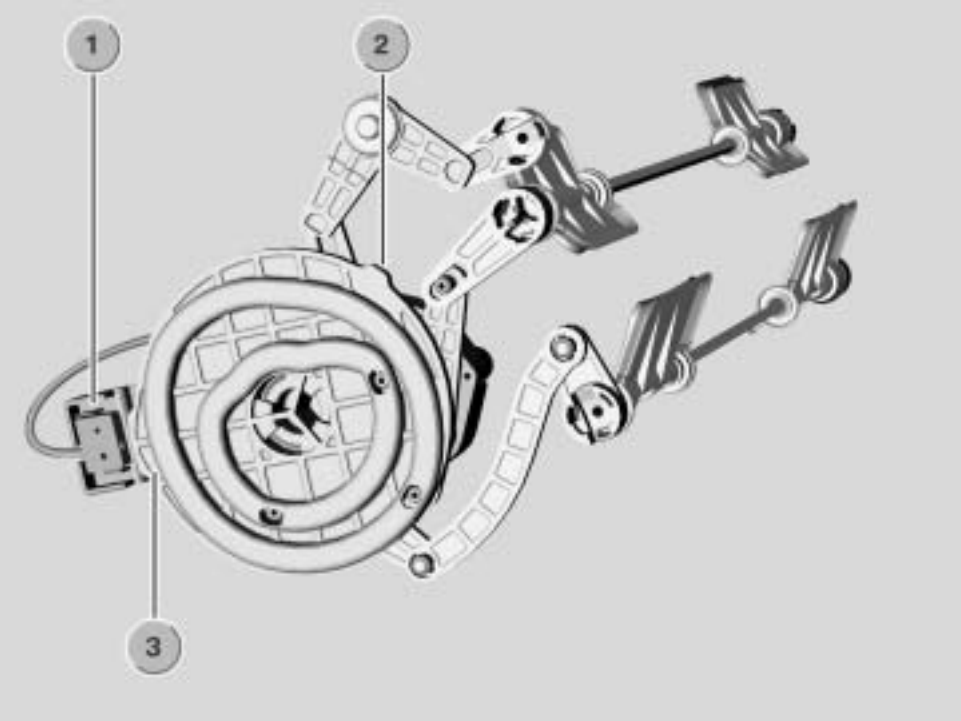


Fig. 24: Cam disc with microswitch and central kinematics KT-10250

Index	Explanation
1	Microswitch
2	Narrow cam
3	Wide cam

The central kinematics for air distribution is very similar to the IHKR in the E46. The larger cam disc serves as a differentiating feature.

On its circumference, the cam disc features 2 cams of different width that switch a microswitch.

The signals from the microswitch are received by the control unit which then correspondingly positions the air distribution flap.

The microswitch for the central kinematics is available as a service kit.

After terminal 15 OFF and an afterrunning time (sleep mode) of 10 minutes, the flaps are moved to their following end position:

- Defrost flap dependent on outside temperature
  > 10 ºC CLOSED (50 ºF),

  < 10 ºC OPEN (50 ºF)

- Ventilation flap CLOSED
- Footwell flap CLOSED

Calibration run

A calibration run is carried out in the event of a fault in the system (e.g. implausible position of cam disc) to redetermine the position of the cam disc.

The cam disc is moved until a cam trips the microswitch.

Based on this position, the set position specified at the control panel/control unit is then set.

Cam measurement (reference run)

A reference run takes place the first time the control panel/ control unit is operated after:

- Replacing the control panel/control unit
- Replacing the cam disc
- Interruption in power supply

During this reference run, the length and distances of both cams with respect to each other are measured and stored in the EEPROM.

A fault code is stored if cam referencing cannot be concluded successfully after 3 attempts. In this case, adjustment of the central kinematics for air distribution is possible only within restricted limits.

IHKS/IHS system functions

- Blower

As from terminal 15 ON, the blower is activated in linear progression from 0 to 8 Volt corresponding to the selected blower stage.

The IHKS/IHS is switched off in blower zero position and the following operating statuses apply:

- Blower switched off
- Fresh air/recirculating air flap closed
- Mixed air flap closed (to ensure the heat exchanger does not unnecessarily heat up the heater/air conditioner)
- Rear window defogger can still be activated
- Compressor switched off (IHKS)

- Temperature control

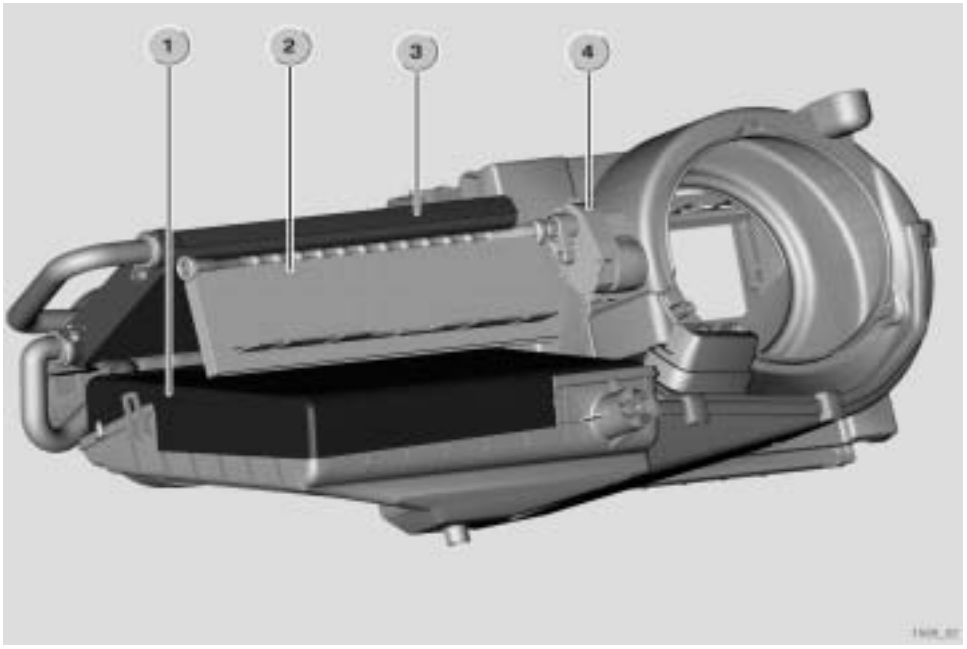


Fig. 25: Mixed air flap in heater/air conditioner KT-10248

Index	Explanation
1	Evaporator
2	Mixed air flap
3	Heat exchanger
4	Stepper motor, mixed air flap

Warm and cold air are mixed for the purpose of controlling the temperature. The required position of the mixed air flap is set at the rotary knob for temperature setting on the control panel/ control unit.

The outlet temperature is set by means of the mixed air flap. The mixed air flap is coupled by means of a stepper motor to the rotary knob.

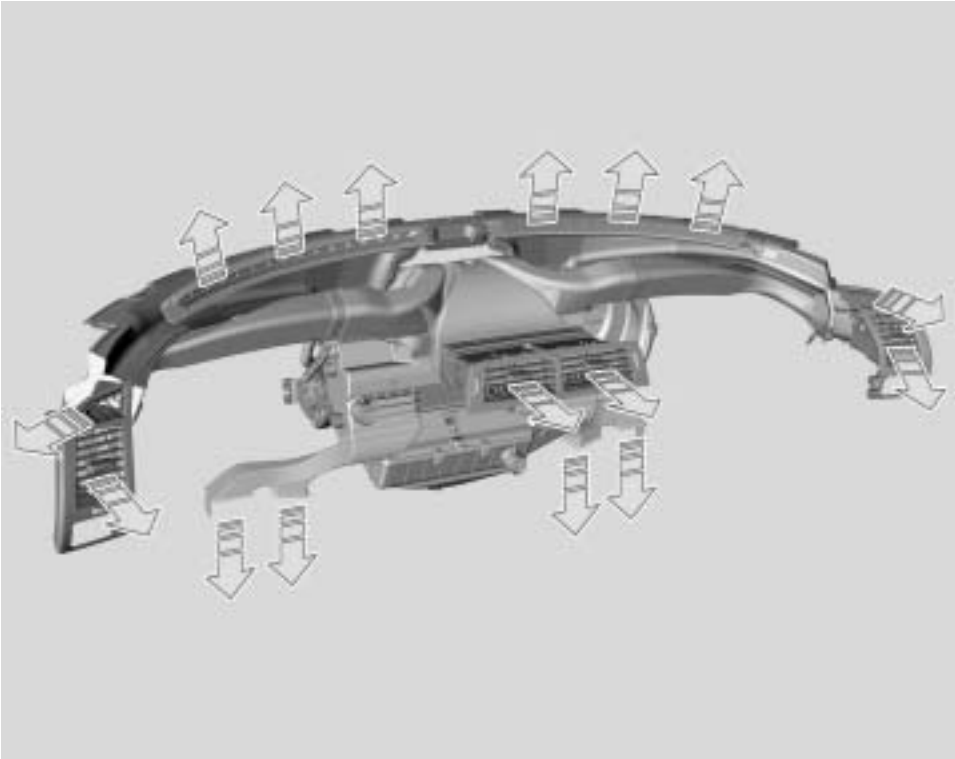
The temperature is controlled by mixing:

- Outside air that flows through the evaporator (IHKS only) = cold air
- Outside air that initially flows through the evaporator and then through the heat exchanger (reheat) = warm air

In the IHS, fresh air and warmed air that flows through the heat exchanger are mixed.

Changes in engine speed (e.g. idle speed or full throttle) do not trigger any subsequent temperature adjustments.

- Air distribution



KT-10249

Fig. 26: Air distribution/air outlet

The individual setting for the air distribution is realized with the 360° rotary knob on the control panel/control unit.

The main flap settings are:

- "Defrost"
- "Ventilation"
- "Footwell"

The stepper motor in the central kinematics adjusts the air distribution via a cam disc.

An important prerequisite for optimum air distribution setting is that the manually adjustable fresh air outlets are open.

- Air volume control

The air volume is controlled based on the position of the fresh air/recirculating air flap and the blower.

There is 1 flap at the fresh air inlet and 2 flaps for recirculating air control. The actuator for the fresh air/recirculating air flap adjusts these 3 individual flaps by means of a coupling linkage.

The system assumes recirculating air mode after pressing the recirculating air button. The fresh air inlet is closed and the recirculating air channel opened.

The actuator for the fresh air/recirculating air flap is not a stepper motor. Its position is determined based on the activation of 4 phases.

Notes for Service

- Control panel/control unit mounting concept

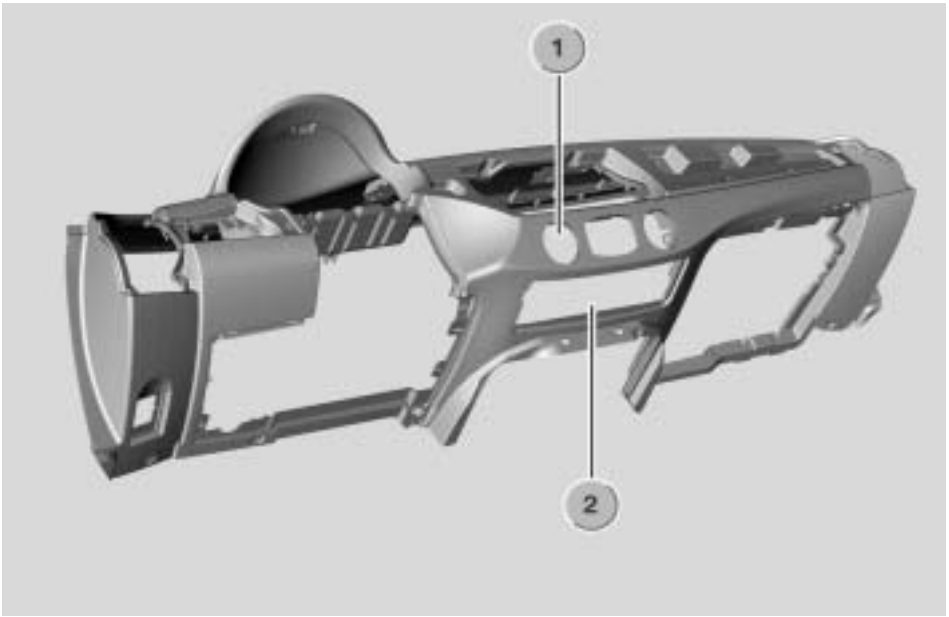
The new island design requires a new mounting concept. The control panel/control unit is mounted from the rear in the instrument panel.

3 finishers that can be replaced as individual parts are fitted from the front.

The control panel/control unit is secured by 2 side clips and 2 screws at the top.

The IHS/IHKS control panel/control unit can only be replaced as a complete component. Individual parts such as rotary knobs cannot be replaced.

To remove the control panel/control unit, it is first necessary to remove the centre fresh air grille outlet and the radio.
The control panel/control unit can then be removed by pulling down through the service opening in the instrument panel.
Particular care must be taken when removing the control panel/control unit to avoid scratches on the front of the control panel/control unit.



KT-10262

Fig. 27: Service and mounting openings in instrument panel

Index	Explanation
1	Mounting opening for the control panel/control unit
2	Service opening for the control panel/control unit

- Heater/air conditioner mounting concept

The heater/air conditioner is mounted by means of 4 mounting domes on the support tube between the A-pillars.

The heater/air conditioner is secured by means of 4 plastic screws. The plastic screws can be reused several times.

Repair kits for the mounting domes are additionally provided.

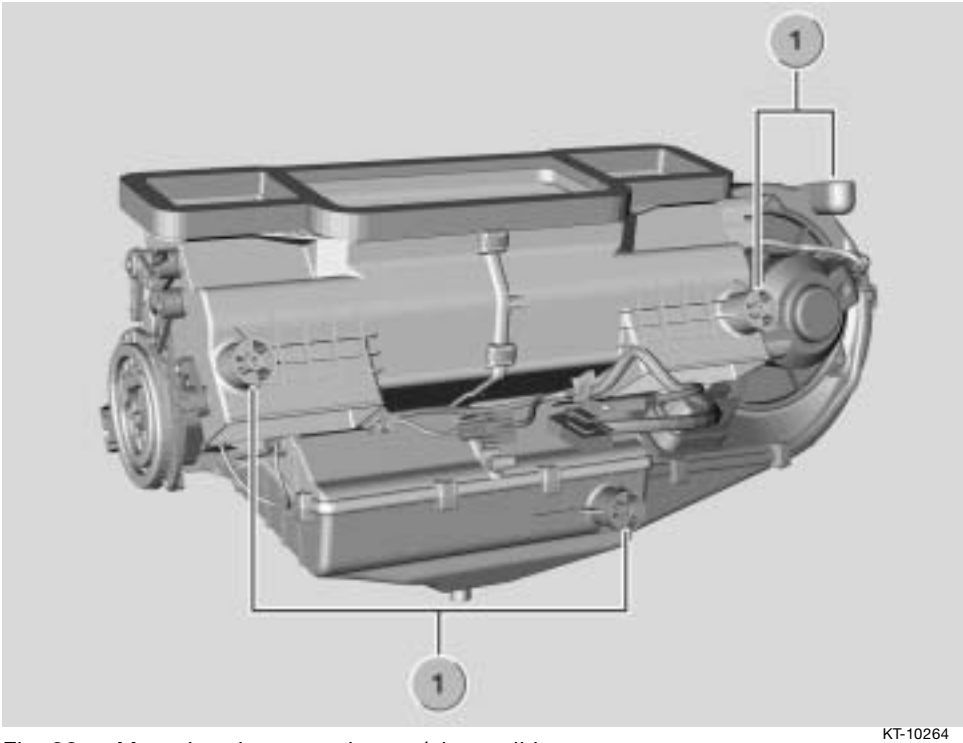


Fig. 28: Mounting domes on heater/air conditioner

Index	Explanation
1	Mounting dome

- Dryer mounting

The dryer is mounted at the top with a plastic bracket to the wheel arch behind the spring strut tower.

The pressure sensor is installed on the refrigerant line leading to the dryer.

Fig. 29: Plastic bracket for dryer

Index	Explanation
1	Pressure sensor
2	Plastic bracket for dryer

Removal of blower and stepper motors

It is necessary to disassemble the power distribution box including its bracket in order to remove the blower and stepper motors.

Evaporator

It is not possible to remove the evaporator.
The evaporator can be cleaned with a spray gun via the leadthrough of the temperature sensor to the evaporator.

Microfilter

The microfilter is located in the heater/air conditioner unit.

The filter can be changed via the footwell on the passenger's side.

Condensation water drain

The condensation water drain for the IHKA/IHKS on the centre tunnel is a 2-piece unit.

It consists of a ring grommet from above and a rubber grommet from below.

Diagnosis

- Transport mode

To save the vehicle battery during vehicle transport, a series of functions in the control units are deactivated in transport mode.

This also affects the IHKA.

Transport mode is set during vehicle production and must be disabled prior to vehicle handover to the customer.

Transport mode is deactivated via the diagnosis tester with the service function "Disable transport mode."

Transport mode is to be realized for all model series in 2002.

It is not possible to activate transport mode via the diagnosis tester.

- AUC test mode (automatic recirculating air control)

Differing from the E46, there is no button combination provided on the control panel/control unit that enables test mode for AUC.

- Compressor run-in protection

Compressor run-in protection is a function that is started automatically after installing a new control panel/control unit (important for initial assembly at the factory).
The switch-on conditions for the compressor, e.g. the outside temperature, are not taken into consideration.

The compressor run-in protection function has a duration of 90 seconds (with engine running at idle speed).
The function light in the A/C button flashes during this period.

- Car & key memory

The following table shows the car & key memory functions for the integrated automatic climate control IHKA.

Car memory	Setting	Explanation
Key memory	Active/not active	Key memory can be activated/deactivated. When active, various functions are stored key-specific.
Memory recirculating air	Active/not active	The recirculating air function is retained after a new start.
Cooling capacity	Normal/hot country	Cooling capacity EU or hot country (increased cooling capacity by correspondingly increasing the blower output)

Key memory	Setting	Explanation
Blower output	Increase/normal/ decrease	The blower output in automatic mode can be increased or decreased.
Correction set temperature	+3°/+2°/+1°/normal/ -1°/-2°/-3°	The temperature set at the control panel/ control unit can be corrected accordingly.
Air conditioning mode ON	Active/not active	The air conditioning is switched on by switching on the ignition or by pressing the button on the control panel/control unit.

The table below shows the function of the car & key memory for the IHKS/IHS.

Car memory	Setting	Explanation
Key memory	Active/not active	Key memory can be activated/deactivated. When active, various functions are stored key-specific.
Memory recirculating air	Active/not active	The recirculating air function is retained after a new start.

Key memory	Setting	Explanation
A/C mode ON (IHKS only)	Active/not active	The air conditioning is switched on by switching on the ignition or by pressing the button on the control panel.

- Coding

Tropics coding IHKA

The recirculating air function is retained after a new start. In addition, a previously selected recirculating air function is reactivated when the defrost function is switched off.

In both cases, the tropics coding prevents moist warm air from the outside flowing into the vehicle interior.

Hot country coding IHKA

In the hot country coding, the increased cooling capacity is achieved by correspondingly increasing the blower output.

Control panel/control unit coding

The function light on the button for the rear window defogger flashes if the control panel/control unit is not encoded.

For instance, right-hand drive or left-hand drive must be coded for activation of the stepper motors to ensure the correct bus addresses are used.