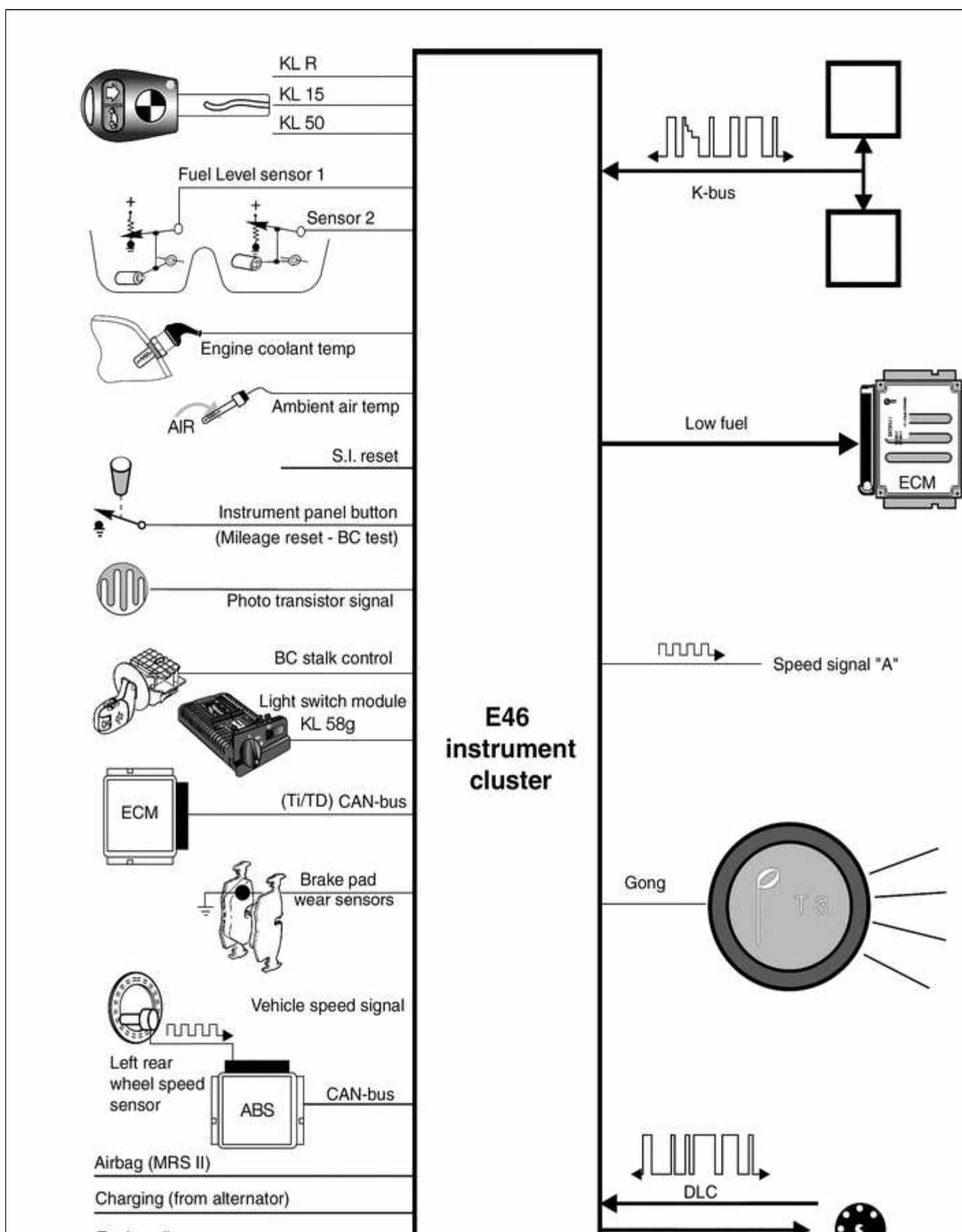
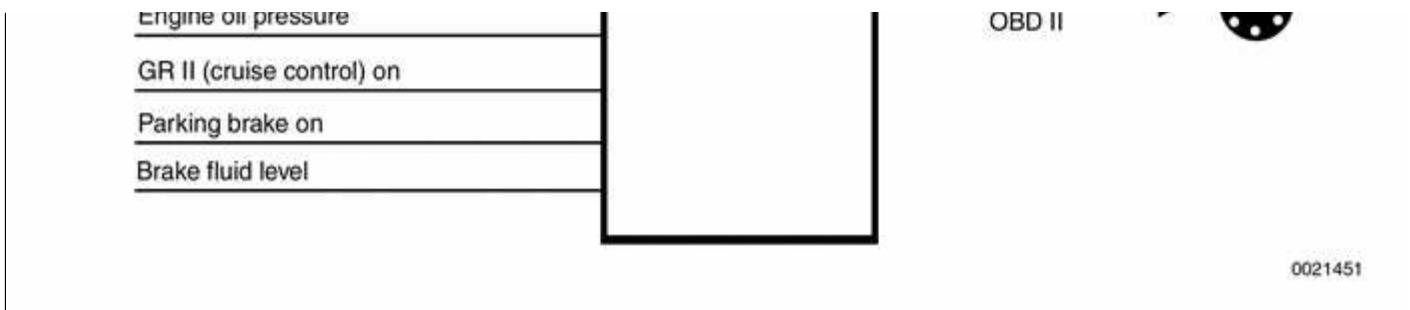


E46 instrument cluster



**E46
instrument
cluster**



Instrument cluster, self-testing



In addition to the storing diagnostic trouble codes (DTCs) and communicating through the diagnostic link, the instrument cluster is programmed with a series of test menus that can be accessed to check various functions and values. The odometer/On-Board Computer LCD block is used to display the test menus and results. There are a total of 21 test menus.

⇒ [Table a. Instrument cluster test functions](#) lists instrument cluster test menus and submenus.

To scroll through numbered test menus:

- ◆ Make sure ignition switch is OFF.
- ◆ Press and hold left cluster button.
- ◆ Turn ignition switch to "radio". Test 1 main menu will be displayed.
- ◆ Do nothing and display will automatically scroll through Test 1 submenus.
- ◆ Tap or press instrument cluster left button. This signals cluster to

display submenus or continue on to next main test menu.

Note:

- ◆ *Tests 1 and 2 are always unlocked.*
- ◆ *Tests 3 - 21 are only accessible after unlocking the test function.*
- ◆ *Test 19 is the unlock function for accessing the displays.*
- ◆ *If adjustment is necessary, enter into Test 20 using the cluster button. The correction factor number is changed by using the sub-menus for the 1s, 10s and 100s of the factor number. The digits will automatically scroll through 0 - 9 within each group (1s, 10s, 100s).*

Table a. Instrument cluster test functions

Menu	Submenu	Sample output	Meaning
Test 1: Vehicle specific data (see Note below)	1.0	12345	Vehicle identification number (VIN)
	1.1	4812	Body number
	6_1.2	834762	Part number of cluster
	1.3	010203	Coding/diagnosis/bus index
	1.4	3499	Manufacturing date (calendar week/year)
	1.5	04_600	Hardware/software version of cluster (hardware = 04, software = 6.00)
	3_1.6	415_06	Injection status, number of cylinders, engine factor
	1.7		

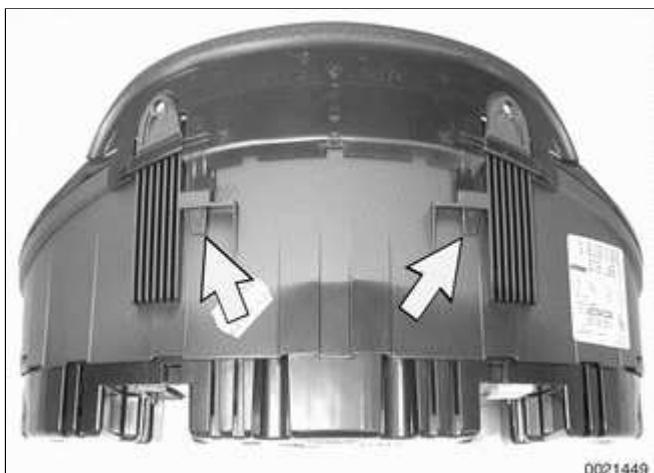
Menu	Submenu	Sample output	Meaning
Test 2: Cluster system test - activates gauge drivers, indicators and LEDs to confirm function (see Note)			
Test 3: SI data	3.0	1500	Liters
	3.1	0	Periodic inspection days (not applicable for US)
Test 4: Fuel consumption data (current)	4.0	0267	26.7 liters/1000km
	4.1	0073	7.3 liters/hour
Test 5: Fuel consumed/distance traveled	5.0	0195	9.5 liters/100 km
	5.1	226	Distance left to go (226 km)
Test 6: Fuel level sensor input in liters	6.0	237415	<p>Fuel level averaged</p> <ul style="list-style-type: none"> ◆ Left side fuel sensor input = 23.7 liters ◆ Right side fuel sensor input = 41.5 liters
	6.1	0652	Total tank level averaged = 65.2 liters
	1_6.2	0667	<p>Indicated value and tank phase</p> <ul style="list-style-type: none"> ◆ 1 = Both sensors OK ◆ 2 = One sensor faulty ◆ 3 = Implausible input
Test 7: Temperature and speed	7.0	032	Coolant temperature input = 32°C
	7.1	245	Outside temperature input = 24.5°C
	7.2	5283	Engine speed = 5,283 RPM
	7.3	058	Vehicle speed = 58 km/h
Test 8: Input values in HEX code	8.0 - 8.3	XXX	HEX code, instrument cluster inputs

Menu	Submenu	Sample output	Meaning
Test 9: Battery voltage	9.0	125	12.5 volts
Test 10: Country coding	10.0	02	US (= 02)
Test 11: Cluster code	11.0	000003	Cluster code
Test 12: Not used			
Test 13: Gong test	13.0	"Gong"	Activate gong by pressing button (gong response is delayed).
Test 14 Fault memory (not for diagnosis)			
Tests 15 - 18: Not used			
Test 19: Lock/unlock (see Note)		L-ON	Display changes from L-ON to L-OFF every second. To unlock test functions, press cluster button immediately when it changes to L-OFF. Tests are automatically locked when exiting test functions.
	19.0	L-OFF	
Test 20: Average fuel consumption correction factor (see Note)	20.0	XXX9	Press button when correct 1s position is attained.
	20.1	XX5X	Press button when correct 10s position is attained.
	20.2	12XX	Press button when correct 100s position is attained.
Test 21: Software reset	21.0	reset	Reset software

Instrument cluster, removing and installing



Remove instrument cluster retaining screws (**arrows**).



- Place a towel over steering column. Carefully tilt top of cluster out of dash panel. Unlock and disconnect harness connectors (**arrows**) from back of cluster.

Note:

Steering wheel does not need to be removed to remove instrument cluster.

- If it is necessary to replace cluster, detach trim by unlocking plastic clips (**arrows**) and pushing through slots.

- Installation is reverse of removal, noting the following:
 - ◆ Instrument cluster harness connector locking levers must be in up position before installing connector.
 - ◆ Recode new or replacement cluster using BMW scan tools DISplus, MoDiC or equivalent.

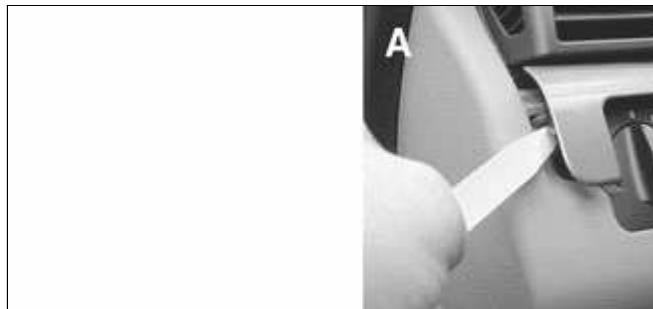
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General

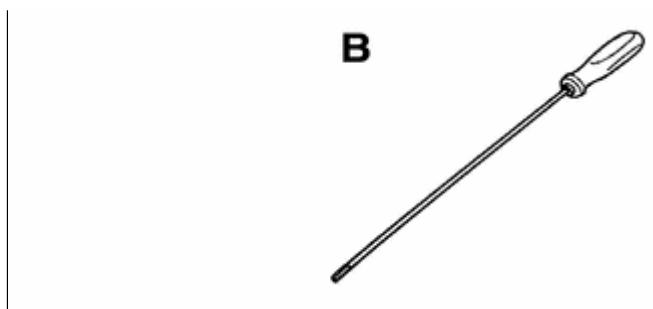
This repair group covers interior and exterior lighting, including repairs to the light switch assembly.

Special tools

Some special tools may be necessary to install or adjust lights and light fixtures.



- ◀ Plastic trim prying tool BMW 00 9 321



- ◀ Foglight/headlight adjusting tool 4 mm/6 mm Allen

Bulb applications

For convenience, the bulb applications for E46 cars are listed in ⇒ [Table a.](#)

Table a. E46 bulb applications

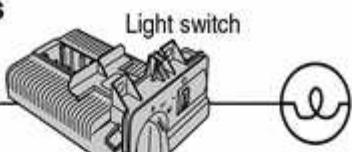
Location	Type & rating
Headlights	
High beam	H7 12V 55W
Low beam (Halogen)	H7 12 V 55 W

Table a. E46 bulb applications

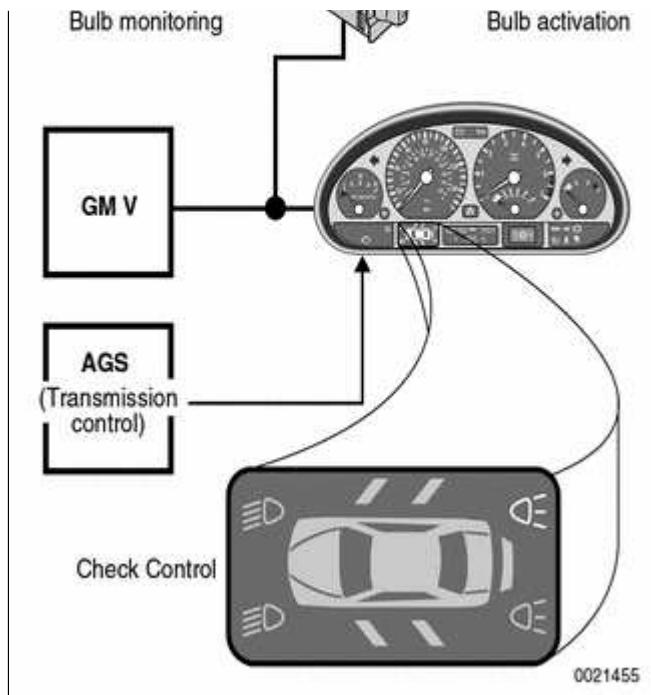
Location	Type & rating
Low beam (Xenon)	D2-S
Foglights	
Front	HB4
Rear (Euro only)	12V 21W
Turn signal and taillight	
Back-up	12V 21W
Brake	12V 21W
Brake/taillight	12V 21/4W
Licence plate	12V 5W
Side turn signal	W5W
Third brake light	LED
Turn signal (front or rear)	12V 21W
Interior lights	
Footwell	Softlite 5W
Glove compartment	Softlite 5 W
Passenger compartment, front or rear	Softlite 5W
Reading, front or rear	6W
Trunk or tailgate	Softlite 10W
Visor vanity	Softlite 10W

Light switch center (LSZ)

Light switch center functions



The light switch center (LSZ), mounted in the left side of the dashboard, consists of the following components:



- ◆ Headlight/tailight/running light control switch
- ◆ Foglight switch
- ◆ Instrument dimmer control
- ◆ Light control module

In addition to normal light control, the LSZ provides the following functions:

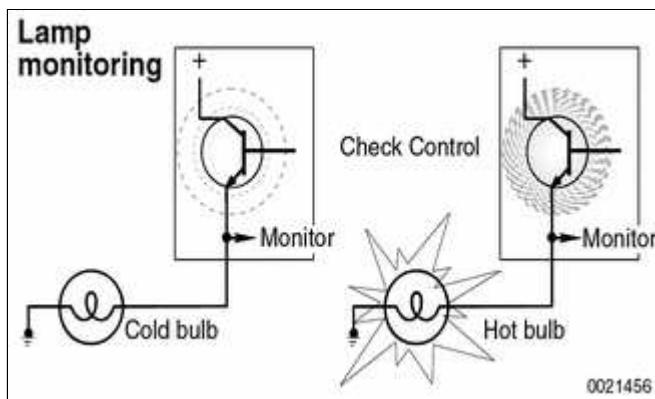
- ◆ Hot and cold monitoring of the exterior bulbs
- ◆ Emergency lighting function
- ◆ Short circuit protection
- ◆ Redundant storage of mileage and service interval data
- ◆ Automatic headlight adjustment (LWR) programmed control (if equipped)

Bulb monitoring

The light control module monitors the following bulbs in both hot and cold states:

- ◆ High/low beams
- ◆ Brake lights
- ◆ Turn signal lights
- ◆ Taillights

- ◆ Parking lights
- ◆ Side marker lights
- ◆ License plate lights

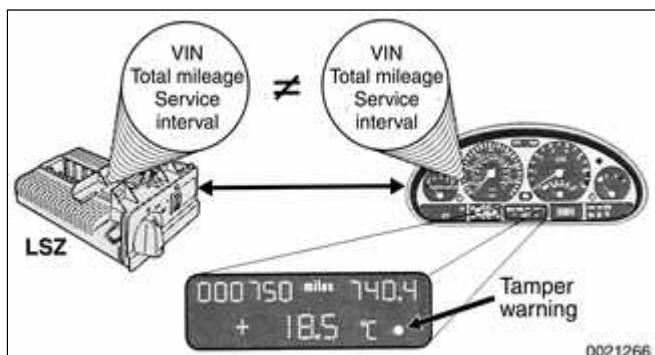


◀ Hot and cold monitoring of light bulbs allows the LSZ to detect defective bulbs. Hot monitoring checks the continuity of circuits while the lights are switched on. Cold monitoring consists of a brief pulse of current which is too short for the lights to illuminate. If the module detects a defective bulb, a signal is sent to the instrument cluster and Check Control is illuminated with the appropriate warning.

Home lighting

This convenience feature provides lighting for the driver and passengers to leave the vehicle and enter their house. The feature is switched on by activating the headlight flasher switch after the lights and ignition are switched OFF. The feature is switched off after the coded time delay or by switching the ignition ON.

Redundant data storage



◀ The light control module serves as the redundant storage module in parallel with the instrument cluster. This includes all data used for vehicle identification, encoded on the assembly line. In addition the total mileage and service interval data are also stored in the light control module. If either the instrument cluster or light control module has to be replaced, the data is taken from the remaining

module and transferred to the replacement unit.

Emergency (fail safe) lighting

The light control module provides emergency lighting in the event of an electronic module failure. Back up hardware allows the following lighting circuits to function:

- ◆ Low beam headlights
- ◆ Taillights
- ◆ Brake lights

The headlights and taillights come on as soon as the ignition is switched ON. The brake light operates when the brake pedal is pressed.

WARNING!

When working on electrical systems, remove the fuse protecting the circuit under repair. See ⇒ 610 Electrical Component Locations.

CAUTION!

- ◆ ***The headlight and foglight assemblies use halogen bulbs. To ensure the longevity of halogen bulbs, the bulb glass should not be handled. Dirt and skin oils may cause a bulb to fail prematurely. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.***
- ◆ ***Use only original equipment replacement bulbs. Non-original equipment bulbs may cause false failure readings on the***

Check Control display.

- ◆ ***To avoid marring car paint or trim, work with plastic prying tools or wrap the tips of tools with tape.***

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Light Switch

Light switch assembly, removing and installing



- ◀ Pry gently at left dashboard trim to remove.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.



- ◀ Remove light switch mounting screws (arrows).

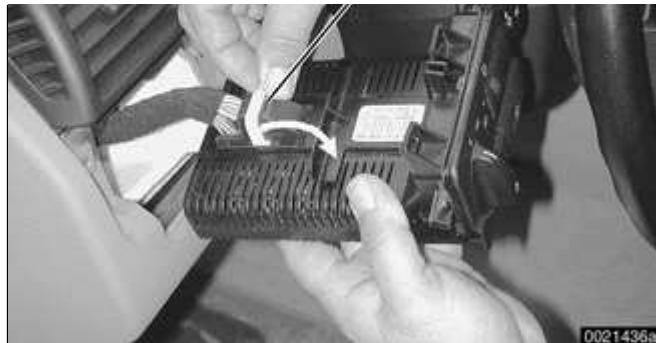
- Lift switch slightly and withdraw from dashboard.

Note:

- ◆ If the vehicle is equipped with a left side glove compartment, remove the compartment for improved access to the back of the headlight switch and its electrical harness.
- ◆ Remove the left side footwell trim (above the pedals) for better access to the headlight switch electrical harness. See ⇒ [513 Interior Trim](#).



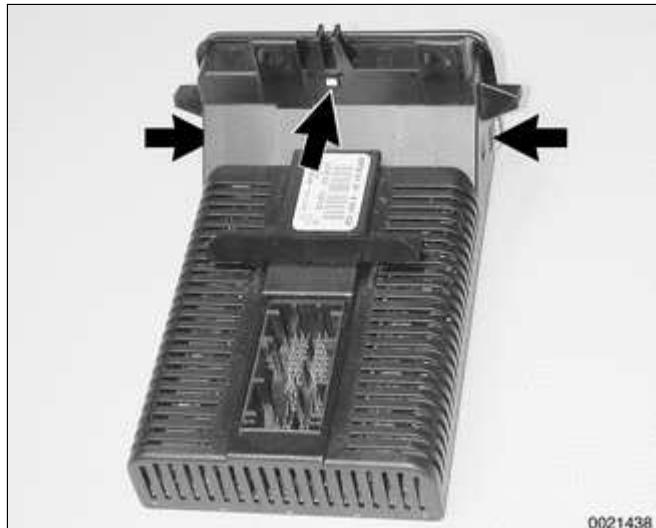
- ◀ To release harness connector latch:



- ◆ Swing latch backward (**arrow**).
- ◆ Pull electrical harness connector off switch assembly.
- Installation is reverse of removal.

Light control module, separating

- Remove light switch assembly as described earlier.



- ◀ Press in on tabs (**arrows**) in light switch assembly to separate light switch from light control module.

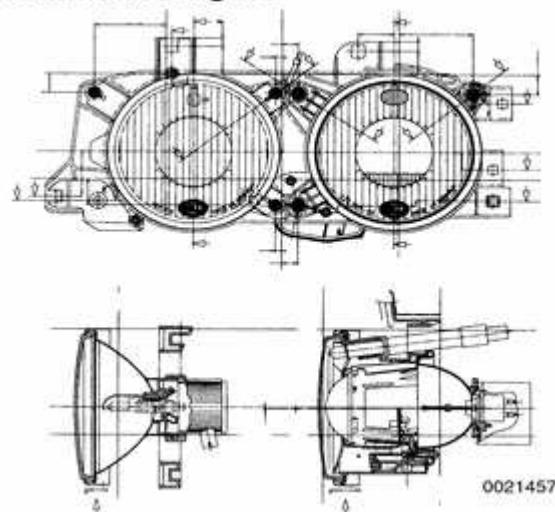


- ◀ Gently wiggle harness connector to remove from switch.

Headlights

E46 cars are equipped with Halogen headlights as standard equipment. Halogen bulb replacement is performed from the back (engine) side of the headlight assembly. The front face of each headlight assembly is a removable plastic cover.

Xenon headlights



◀ Optional Xenon low-beam headlights illuminate the road ahead and to the sides in greater detail than conventional headlights. Sometimes referred to as High Intensity Discharge (HID) lights, Xenon lights use less energy and last longer than other headlight bulbs.

Cars equipped with Xenon headlights also feature automatic headlight adjustment control (LWR) for varying passenger and cargo loads.

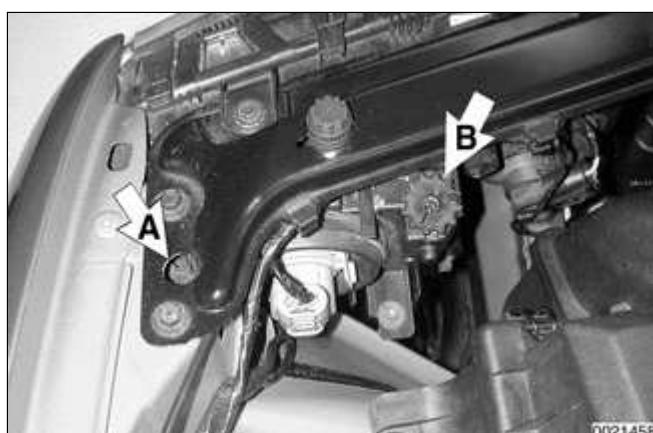
Components of the headlight system can be purchased from BMW. Use illustrations on the following pages to identify components.

Headlight aim, adjusting

Adjust headlight aim with correct tire pressures, fuel tank full, and weight of one person (approx. 75 Kg/200 lb) in driver seat.

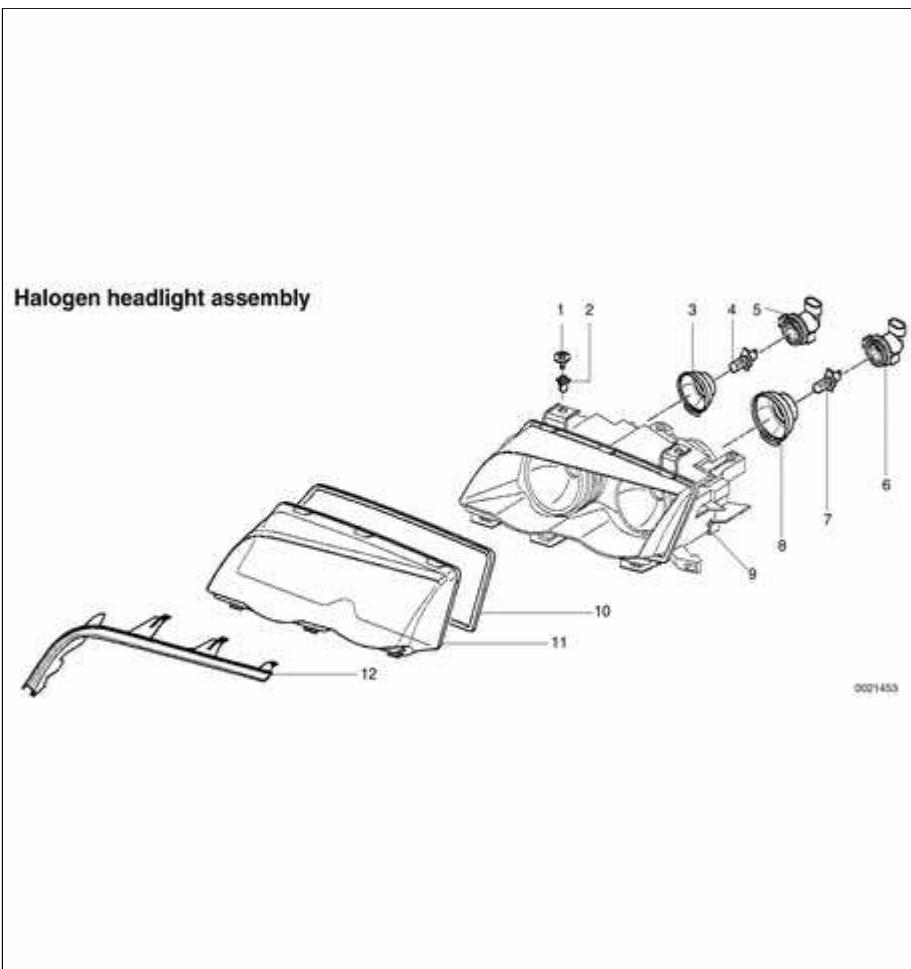
◀ Use 6 mm Allen wrench, phillips head screwdriver, or hand to adjust headlight by turning adjusting knobs.

- ◆ **A** is primarily for lateral adjustment.
- ◆ **B** is primarily for vertical adjustment.



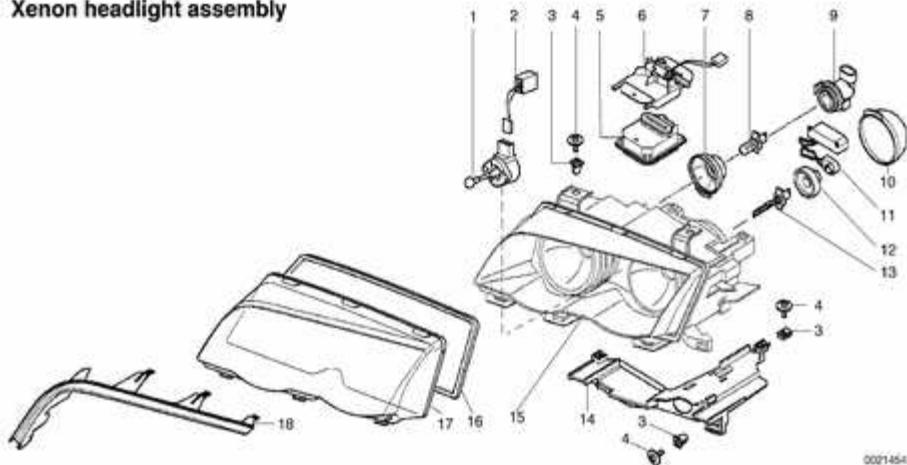
Note:

When adjusting headlights with automatic adjuster system (LWR), wait at least 30 seconds for the LWR to cycle and adjust to its calculated position.

**Halogen headlight assembly**

- 1 - Mounting screw
- 2 - Expanding nut
- 3 - High beam cover
- 4 - High beam bulb
- 5 - High beam bulb socket
- 6 - Low beam bulb socket
- 7 - Low beam bulb
- 8 - Low beam cover
- 9 - Headlight housing
- 10 - Sealing gasket
- 11 - Cover
- 12 - Cover lock strip

Xenon headlight assembly

Xenon headlight assembly

- 1 - Automatic headlight adjustment (LWR) stepper motor
- 2 - Electrical harness connector
- 3 - Expanding nut
- 4 - Mounting screw
- 5 - Xenon bulb control module
- 6 - Control module bracket
- 7 - High beam cover
- 8 - High beam bulb
- 9 - High beam bulb socket
- 10 - Low beam cover
- 11 - Xenon bulb ignition element
- 12 - Supporting ring
- 13 - Xenon low beam bulb
- 14 - Headlight assembly carrier plate
- 15 - Headlight housing
- 16 - Sealing gasket
- 17 - Cover

18 - Cover lock strip**Headlight bulb (Halogen),
replacing**

- ◀ Working in back of headlight assembly:
- ◆ Rotate headlight bulb retaining ring (**arrows**) counterclockwise.
 - ◆ Pull bulb socket and bulb out of headlight assembly.
 - ◆ Disconnect harness connector from socket.
 - ◆ Gently wiggle bulb and pull straight out of socket.
 - ◆ Replace bulb by pushing firmly into socket. Headlight bulb applications are listed below.
 - ◆ Installation is reverse of removal.

Note:

To remove left side high beam bulb, remove air filter housing cover. See ⇒ 020 Maintenance.

CAUTION!

Do not touch halogen bulbs with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

Headlight bulb (Xenon),

replacing

- Working in back of headlight assembly:
 - ◆ Remove low beam (Xenon) cover.
 - ◆ Twist Xenon ignition element counterclockwise and remove.
 - ◆ Rotate headlight bulb retaining ring counterclockwise. Pull bulb out of headlight assembly.
 - ◆ Installation is reverse of removal. Headlight bulb applications are listed below.

CAUTION!

Do not touch bulbs with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

Headlight bulb application	
Low beam (Halogen)	H7 12V 55W
Low beam (Xenon)	D2-S
High beam	H7 12V 55W

Headlight assembly, removing and installing

CAUTION!

Following headlight assembly work, headlight beam aim must be adjusted using special equipment.

- Disconnect harness connectors

from headlight assembly.

- If necessary, remove headlight washer spray nozzles. See ⇒ [611 Wipers and Washers](#).
- Remove front turn signal assembly as described later in this repair group.



◀ Use plastic prying tool to detach and remove trim piece below headlight assembly.



◀ Remove headlight mounting screws (**arrows**). Lift headlight assembly forward and out of car.



◀ During reassembly:

- ◆ Install top mounting screws hand tight.
- ◆ Pull headlight assembly toward front of car.



- ◆ Close engine hood and check to make sure that gap between hood and headlight assembly (**A**) is correct. See specification below.
- ◆ Open hood and tighten down mounting screws.
- ◆ Remainder of assembly is reverse of removal.

Headlight to hood gap

Dimension A	$5.0 \pm 1.0 \text{ mm}$ (0.20 ± 0.04 in.)
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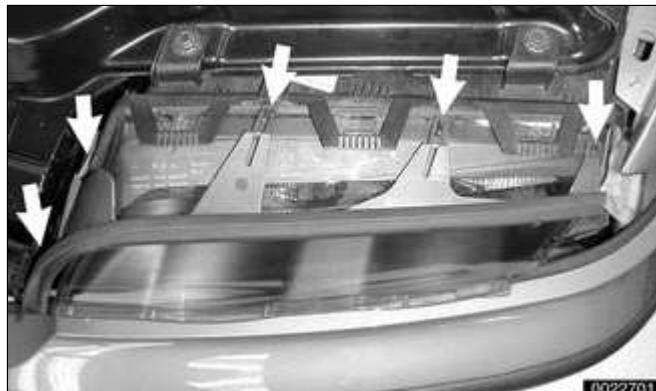
- Adjust headlight aim as described earlier.

Headlight lens, removing and installing

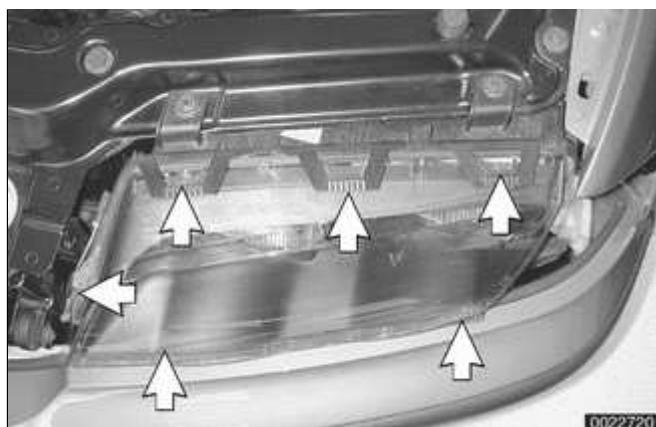
- If necessary, remove headlight washer spray nozzles. See ⇒ [611 Wipers and Washers](#).
- Remove front turn signal assembly as described later in this repair group.

◀ Use plastic prying tool to detach and remove trim piece below headlight assembly.





Unclip sealing gasket (**arrows**) and remove.



Release clips (**arrows**) retaining front lens.



Pull lens forward to remove.

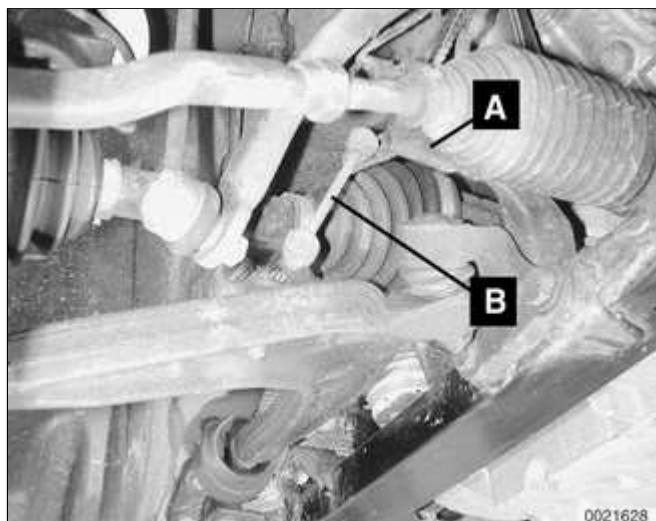
- Installation is reverse of removal.
Replace gasket between lens and body of light if necessary.

Automatic headlight adjustment (LWR)

Vehicles equipped with the optional Xenon low-beam headlight bulbs also feature automatic headlight adjustment (LWR). This system automatically adjusts the vertical positioning of the headlights to maintain optimum headlight beam angle for maximum driving visibility and to prevent undue glare for oncoming motorists. The system compensates for vehicle load

angle changes.

LWR monitors vehicle load via two hall effect sensors mounted to the front and rear suspension members. When an adjustment to the angle of the headlight beams is necessary, LWR simultaneously activates two stepper motors (one in each headlight assembly). The stepper motors drive a threaded rod that moves the lower edge of the headlight carrier plates. The pivoting movement adjusts the vertical position of the headlight beams.

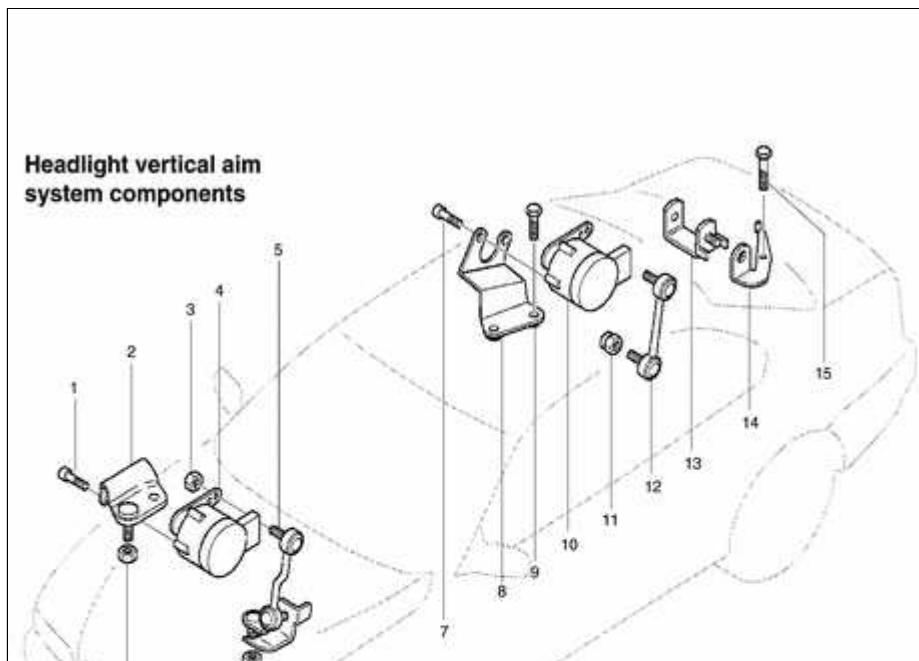


- At each axle of the vehicle, the LWR sensor (**A**) is mounted to a fixed point on the suspension subframe. A lever (**B**) is connected to the moving suspension member. The sensor output voltage changes as the suspension moves up and down.

All LWR diagnosis is accessed through the light control module.

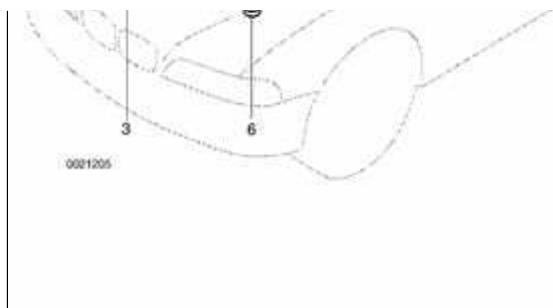
Note:

LWR is not available with standard halogen headlights.



Headlight vertical aim system components

- 1 - Bolt M5
- 2 - Right front ride height sensor mounting bracket
- 3 - Self-locking nut M6
- 4 - Front ride height sensor



- 5 - **Front ride height sensor link**
- 6 - **Self-locking nut M8**
- 7 - **Bolt M5**
- 8 - **Right rear ride height sensor mounting bracket**
- 9 - **Bolt M6**
- 10 - **Rear ride height sensor**
- 11 - **Self-locking nut M6**
- 12 - **Rear ride height sensor link**
- 13 - **Extension**
- 14 - **Bracket**
- 15 - **Bolt M6**

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Front Foglights

Foglight aim, adjusting



- ◀ Sedan or Sport Wagon: Use 4 mm Allen wrench to turn plastic adjuster (**arrow**) on outer edge of foglight.



- ◀ Coupe or Convertible: Use adjuster (**arrow**) on inside upper edge of foglight.



- ◀ 2001 models:
- ◆ Using plastic pry tool, pry off foglight cover at slot (**arrow**).
 - ◆ Adjust using 6 mm Allen on outside upper corner of foglight.



Foglight assembly, removing and installing

Sedan or Sport Wagon:

- ◆ Use plastic prying tool to lever out foglight assembly.

- ◆ Detach electrical harness connector.

Coupe or Convertible:

- ◆ Gently remove lower bumper trim.

- ◆ Working at foglight, detach grille and loosen mounting screws.

- ◆ Remove foglight assembly with grille attached.

- ◆ Detach electrical harness connector.

Unclip grille from foglight.

1 - Grille

2 - Foglight

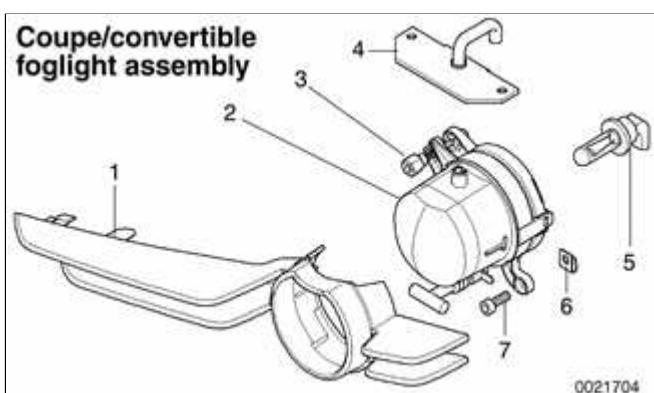
3 - Adjuster

4 - Support with grommet

5 - Foglight bulb

6 - Body nut

7 - Self-tapping screw



- Installation is reverse of removal, noting the following:
 - ◆ Sedan/Sport Wagon: Foglight must be snapped firmly into bumper retainers.
 - ◆ Coupe/Convertible: Keep ventilation grommets unkinked and firmly seated.
 - ◆ Adjust foglight aim as described earlier.

Foglight bulb, replacing

- Remove foglight assembly as described earlier.
- ◆ Twist and remove bulb from rear of foglight assembly.

CAUTION!

Do not touch halogen bulbs with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

- ◆ Installation is reverse of removal. Check electrical connector for corrosion. Spray with contact cleaner, if necessary.

Foglight application

Front foglight bulb	HB4
---------------------	-----

Turn Signals, Taillights

Front turn signal assembly, removing and installing

The procedure below also includes turn signal bulb replacement.



- ◀ With engine hood open, use a screwdriver to press turn signal assembly retaining clip down to disengage from retaining tab on headlight assembly frame.



- ◀ Screwdriver must reach into fender hole a minimum of 3 in. to reach the retaining tab.

- Push turn signal forward. Light slides straight out.
- Detach electrical harness connector.
- Twist and remove bulb from rear of turn signal assembly.

CAUTION!

Do not touch bulb with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

Note:

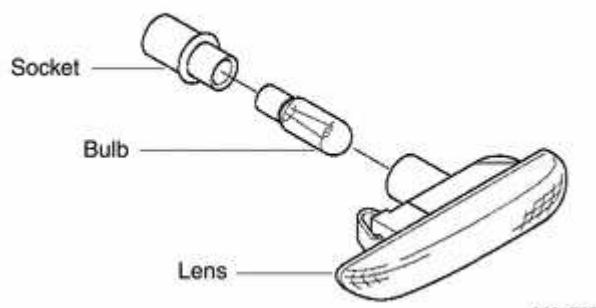
Before reinstalling, make sure rubber seal on wrap-around trim (underneath headlights) is firmly glued to trim. Reglue if necessary.

Front turn signal

Turn signal bulb	12V 21W
------------------	---------

Side turn signal assembly

Side turn signal assembly



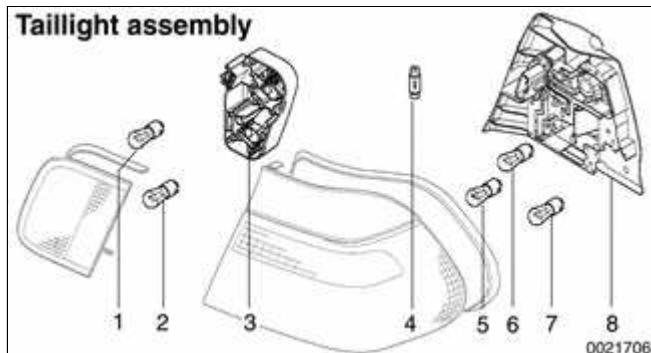
The yellow marker lights on the sides of the front fenders are turn signals. Use plastic prying tool to gently lever assembly out of fender.

Side turn signal

Side light bulb	12V 5W
-----------------	--------

Taillight assembly, removing and installing

Taillight assembly



Taillight assembly

- 1 - Backup light bulb 12V 21W
- 2 - Rear foglight bulb (Euro only) 12V 21W
- 3 - Trunk lid/tailgate bulb carrier
- 4 - Trunk light bulb 12V 10W
- 5 - Taillight/brake light bulb 12V 21/4W
- 6 - Turn signal bulb 12V 21W
- 7 - Brake light bulb 12V 21W
- 8 - Corner bulb carrier

In E46 cars, taillight functions are split. The corner bulb carrier on each side contains:

- ◆ Taillight bulb
- ◆ Turn signal bulb
- ◆ Brake light bulb
- ◆ Trunk light bulb

The bulb carrier on each side of the trunk or tailgate contains:

- ◆ Back-up light
- ◆ Rear foglight (European models only)
- To access taillight bulbs carriers, open trunk lid or tailgate.



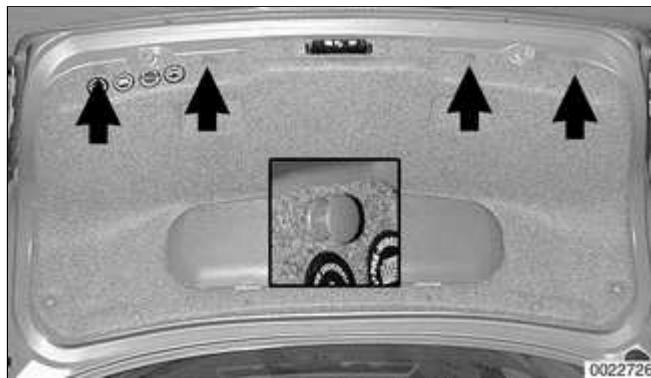
◀ To access corner bulbs:

- ◆ Sport Wagon: Remove cargo area side trim. See ⇒ [513 Interior Trim](#).
- ◆ Unlatch bulb carrier retainer (**arrow**), then pull carrier off taillight assembly.
- Detach electrical harness connector.
- Replace bulbs as necessary.

CAUTION!

Do not touch bulb with your bare hands. If necessary wipe bulb using

a clean cloth dampened with rubbing alcohol.



- ◀ To access trunk lid taillight bulbs:
Partially remove trunk lid trim panel by removing plastic expansion rivets (**arrows**). Expansion rivets are released by prying upper portion out (**inset**), then pulling off trunk lid.

- To access tailgate taillight bulbs:
Remove tailgate inside trim panel.
See ⇒ [412 Trunk Lid, Tailgate](#).



- ◀ Unlatch bulb carrier retainer (**arrow**), then pull carrier off.

- Detach electrical harness connector.
- Replace bulb(s) as necessary.

CAUTION!

Do not touch bulb with your bare hands. If necessary wipe bulb using a clean cloth dampened with rubbing alcohol.

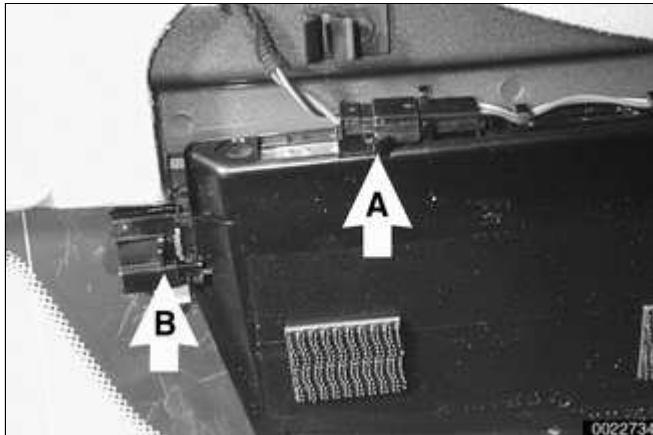
- Installation of either bulb carrier is reverse of removal.

Taillight applications	
Backup light bulb	12V 21W
Brake light bulb	12V 21W
Brake light/taillight bulb	12V 21/4W
Rear foglight (European only)	12V 21W
Turn signal bulb	12 V 21W

Backup light bulb	12V 21W
Brake light bulb	12V 21W
Brake light/taillight bulb	12V 21/4W
Rear foglight (European only)	12V 21W
Turn signal bulb	12 V 21W

Center brake light

The center brake light in all models is an LED unit. There are no replaceable bulbs.



◀ **Sedan or Coupe:** Working from rear seat in passenger compartment, gently pull off trim cover over third brake light (at top of rear glass).

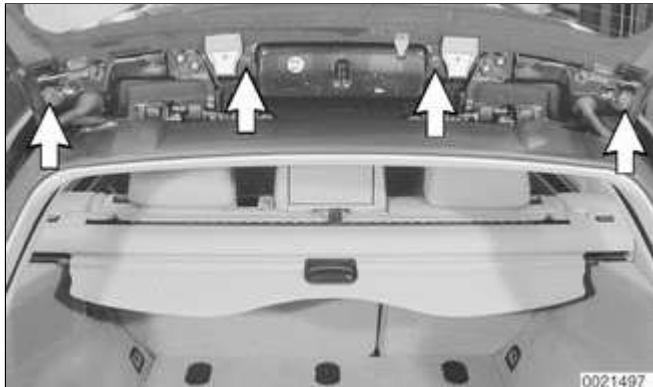
- ◆ Detach electrical harness connector (**A**).
- ◆ Remove retaining clips (**B**) on either side and remove assembly.

- **Convertible:** Remove inner trunk lid trim adjacent to license plate light assembly.

- ◆ Detach electrical harness connector
- ◆ Push center brake light out.

◀ **Sport Wagon:** Open rear window.

- ◆ Carefully detach rear window hinge cover.
- ◆ Remove rear spoiler mounting bolts (**arrows**).
- ◆ Detach electrical harness connector and rear washer hose from spoiler.
- ◆ Remove mounting screws and remove third brake light assembly from spoiler.
- ◆ When installing, be sure electrical harness and rear window washer



hose are not damaged or kinked.

Note:

Replace sealing plastic and grommets as necessary during reassembly.

Tightening torque	
Rear spoiler to rear glass	6 Nm (4 ft-lb)

License plate light, removing and installing



- Using a flat tipped screw driver, pry gently on right side of license plate light assembly (**arrow**). Lift off lens.

CAUTION!

To avoid marring trim, wrap the screwdriver tip with tape.

- Remove bulb.

Note:

Inspect bulb contact springs for damage and corrosion. Replace socket assembly if necessary.

License plate light application	
License plate bulb	12V 5W

- Installation is reverse of removal.

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Interior Lights

The ZKE V general module (GM V) controls the interior lighting automatically using input from several monitors. The lighting can also be manually controlled.

Each door lock actuator contains a hall effect sensor for the purpose of monitoring door open/closed status. The hall effect sensor is located directly behind the rotary latch plate encased in the lock actuator. The sensor is activated by the rotary latch plate position.

- ◆ Door closed: Rotary latch plate in latched position. Current flow through hall sensor <5 mA.
- ◆ Door open: Rotary latch plate in open position. Current flow through hall sensor >12 mA.

A change in current flow informs the GM V when a door is opened or closed.

The overhead front seat interior/map light unit contains a single main interior light. The light is controlled by the GM V automatically or by momentarily pressing the interior light switch located on the light assembly. The switch provides a momentary ground signal that the GM V recognizes as a request to either turn the light on (if off) or turn the light off (if on).

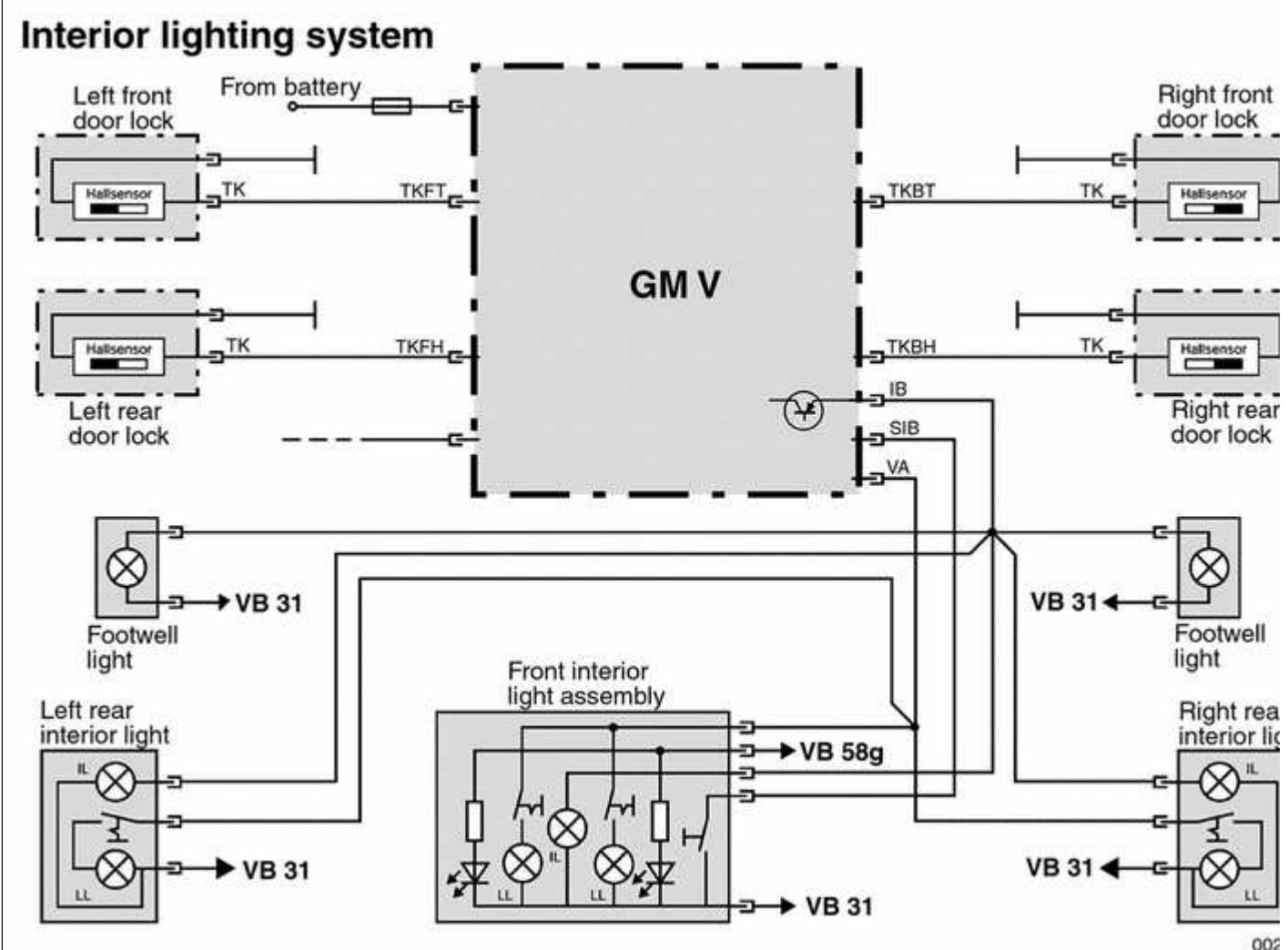
If the switch is held for more than 3 seconds, the GM V interprets the continuous ground signal as a request to turn the interior light circuit off (workshop mode). Workshop mode is stored in memory: Even if the GM V is removed from the power supply and reconnected, the lights do not come

back on unless the switch is pressed again.

There are two reading/map lights located in the front interior light assembly. Each is mechanically controlled by depressing the corresponding switch. The power supply for the map lights is supplied by the GM V.

There is a courtesy light in each front footwell. These lights are only operated when the GM V provides power to the interior lighting circuit.

Interior lighting system



Interior light automatic controls

The GM V provides 12 volts to the interior lighting circuit when the status of one of the following input signals changes:

- ◆ Door contact hall sensor active (door open)
- ◆ "Unlock" request received from driver door key lock hall sensor (ignition switch OFF)
- ◆ "Unlock" request from FZV keyless entry system received via K bus (ignition switch OFF)
- ◆ Vehicle exterior lights on for minimum of 2 minutes when ignition switch is OFF
- ◆ Active crash signal from MRS II control module
- ◆ Lock button of FZV key pressed with vehicle already locked (interior search function)
- ◆ Immediately after ignition switch is turned to "radio" position with driver door closed.
- ◆ When vehicle is locked (single or double) with door contacts closed.
- ◆ When vehicle door contacts are closed. Lights remain on for 20 seconds, then go to soft off.
- ◆ After interior search function is

activated, lights automatically turn off (soft off) after 8 seconds.

- ◆ After 16 minutes with door contact active (open door) and key off, lights are switched off (consumer cutoff function).

The component activation function of DIS also has the ability to switch the lights.

Interior light, footwell light, or cargo compartment light (Sport Wagon), replacing bulb



- ◀ Pry interior light fixture gently to remove.
 - ◆ Detach electrical harness connector.
 - ◆ Remove bulb and replace.

CAUTION!

When replacing bulbs, do not touch glass of bulb with fingers. Only touch bulb with clean cloth or bulb packaging.

- Installation is reverse of removal. Bulb types and specifications for various interior lamps are listed below.

Interior light applications

Footwell light bulb	Softlite 5W
Glove compartment light bulb	Softlite 5W
Passenger compartment bulb,	Softlite 5W

Interior light applications

front or rear

Reading bulb, front
or rear

6W

Tailgate courtesy
light bulb

Softlite 10W

Visor vanity light
bulb

Softlite 10W

Trunk light bulb, replacing

The trunk lights are integrated with the taillight assembly.



- ◀ Pry trunk light cover (**arrow**) gently to remove from taillight corner bulb carrier.
- ◆ Remove bulb and replace.
 - ◆ Installation is reverse of removal.

Trunk light application

Trunk light bulb

Softlite 10W

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General

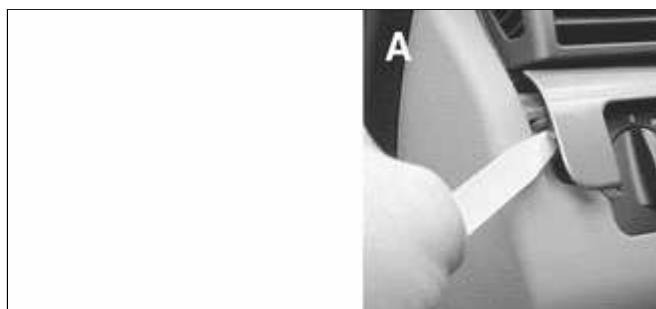
The repair information given under this heading applies to the heating and air conditioning system. Many of the procedures require that the A/C refrigerant charge be evacuated. See ⇒ [A/C system warnings and cautions](#) later in this repair group.

For information on the engine cooling system, see ⇒ [170 Radiator and Cooling System](#).

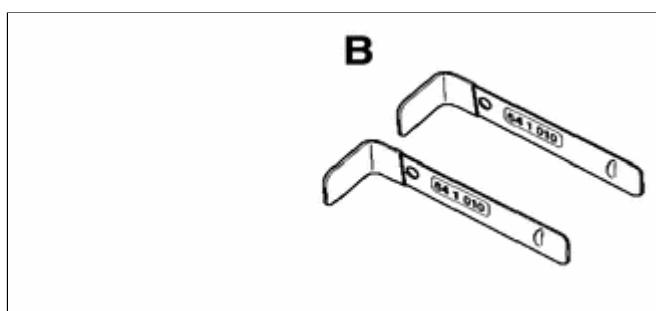
Special tools

Some special tools are necessary for heating and A/C repair procedures.

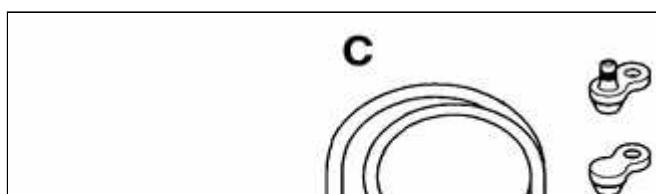
A variety of A/C system evacuation and recharge equipment is available. Follow the equipment manufacturer's recommendations and instructions.



- ◀ Plastic tool for prying off interior trim
BMW 00 9 321



- ◀ IHKA control panel removal tools BMW 64 1 010



- ◀ A/C line plug kit BMW 64 5 100

Note:

A/C system recharging procedures are



beyond the scope of this manual.

Integrated heating and cooling system (IHKA)

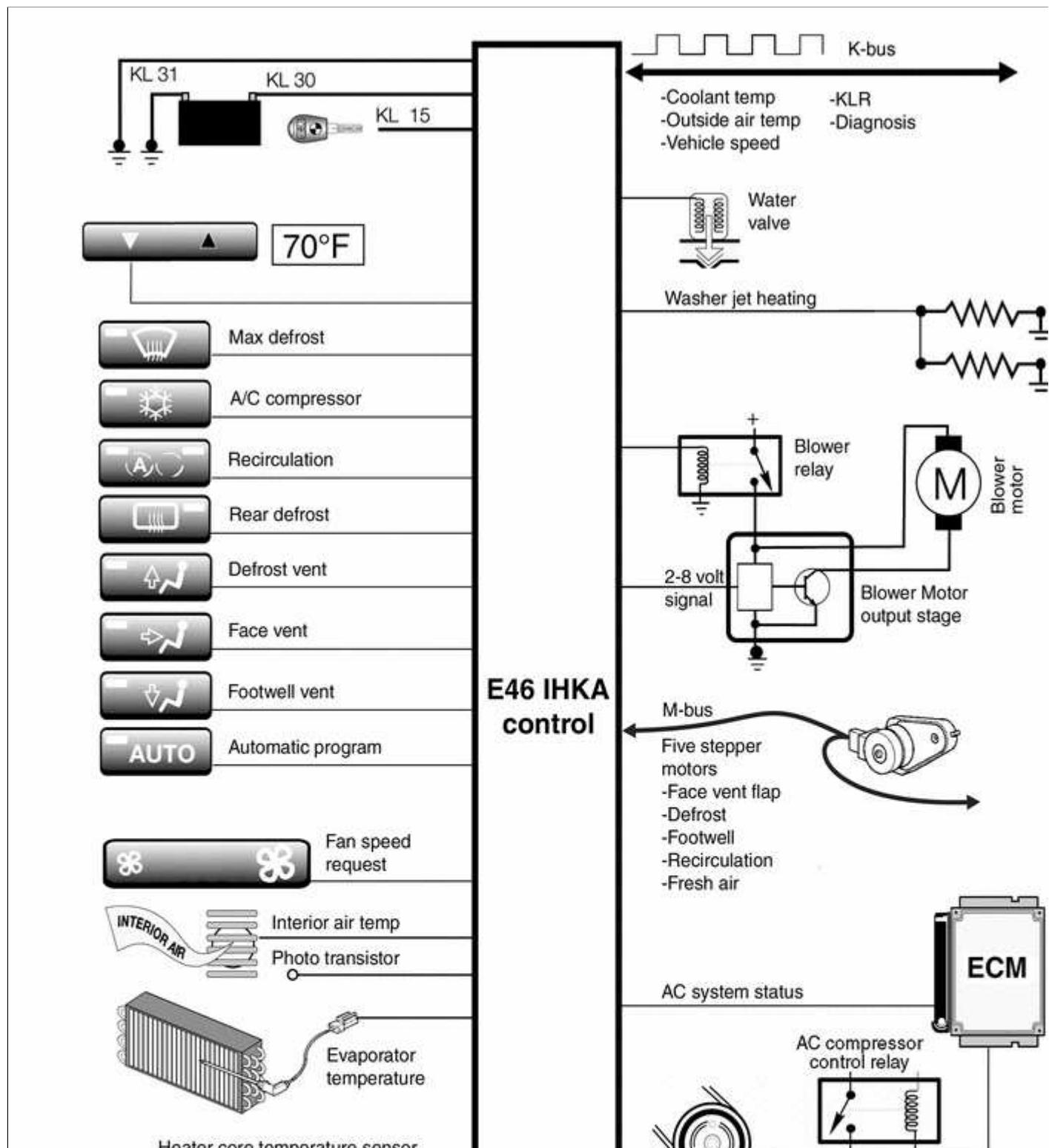
The E46 integrated automatic climate control system (IHKA) offers powerful cooling and heating, effective ventilation, and smooth operation in A/C mode.

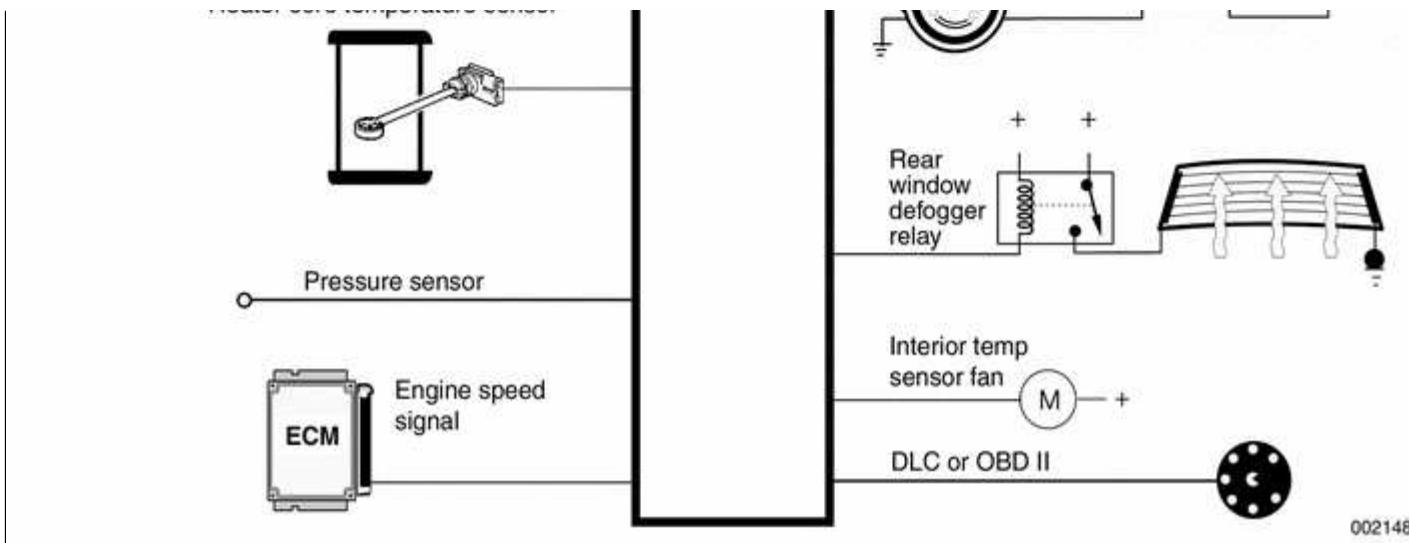
The E46 IHKA design includes the following:

- ◆ Use of R134a refrigerant only
- ◆ Single heater core for temperature regulation
- ◆ Maximum heating and cooling for defroster functions
- ◆ Rear window defogger operation integrated into the heating/cooling system
- ◆ Blower controlled through a final stage variable resistor
- ◆ Road speed dependent air distribution and fresh air volume
- ◆ Self-calibrating air distribution stepper motors controlled via M-bus
- ◆ Fresh air microfilter system
- ◆ Electronically regulated A/C compressor

- ◆ Heater control personalization via Car Memory/Key Memory

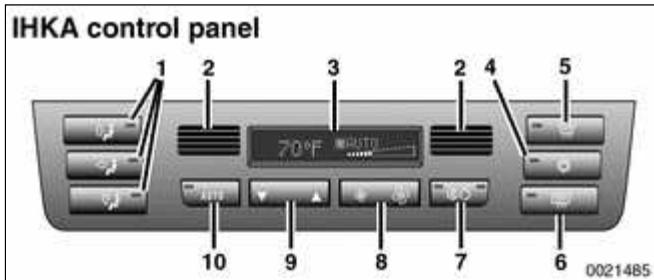
E46 IHKA control





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Control panel and module



◀ Heating and air conditioning functions are programmed via the center console mounted control panel. The control panel has large, easy to use soft-touch controls, an LED display and a single temperature setting.

- 1 - Manual air distribution control buttons
- 2 - Interior temperature sensor intake/outlet
- 3 - LCD matrix
- 4 - A/C control ("snowflake")
- 5 - Windshield defrost control
- 6 - Rear window defogger control
- 7 - Recirculation control
- 8 - Blower control
- 9 - Temperature control
- 10 - Automatic air distribution

The IHKA control module, integral with

the front panel, includes an EEPROM chip for storage of Diagnostic Trouble Codes (DTCs). Inputs to the module include:

- ◆ Heater core temperature sensor
- ◆ A/C evaporator temperature sensor
- ◆ Other programmed functions from Car Memory (such as rear window defrost timing).

The module can go into "sleep mode" to reduce power consumption when the ignition is switched OFF but still retain control panel settings and DTC information. If the control module is replaced it must be recoded using BMW scan tools DIS or MoDiC.

Heat regulation



◀ The E46 uses a single water valve and heater core to provide passenger compartment heat. The water valve is electrically pulsed to control the flow of coolant through the heater core.

Temperature regulation is based on the following inputs:

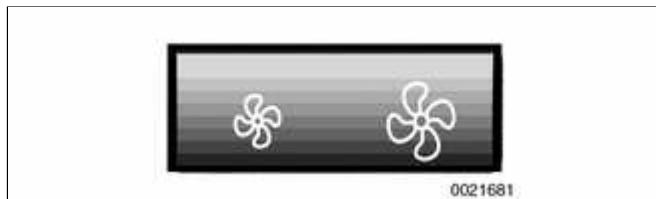
- ◆ Temperature control switch setting
- ◆ Interior temperature sensor signal
- ◆ Ambient temperature signal
- ◆ Heater core temperature sensor signal
- ◆ Evaporator temperature signal

- ◆ Solar sensor input (if applicable)

A rocker switch is used to select the desired cabin temperature, shown in the display matrix of the control panel. The range for temperature display is from 15° to 32°C (60° to 90°F).

A "service station" feature is integrated into the E46 IHKA. This prevents the heater core from being flooded with hot coolant when refueling the vehicle.

Blower control



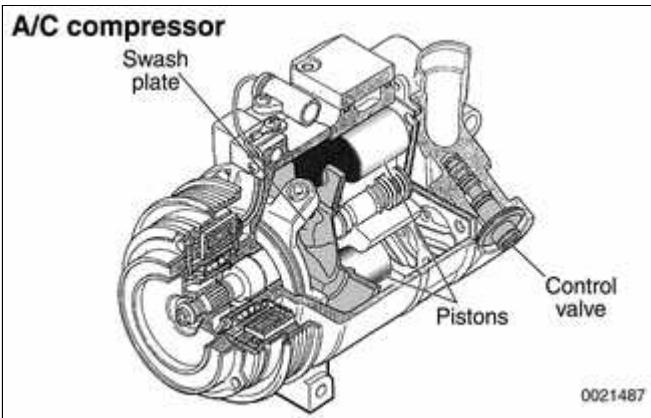
◀ The blower rocker switch on the IHKA control panel is the master switch for the entire system. Rocking the switch to select slower and slower fan speeds eventually results in the following:

- ◆ Blower motor turns off.
- ◆ All air distribution valves are closed.
- ◆ LED and LCD displays are switched off.
- ◆ Rear window defroster is switched off.
- ◆ A/C compressor is switched off.

Even in the lowest setting, the interior temperature sensor blower continues to operate and the IHKA control panel continues to signal the heater water valve for heat.

Regulated A/C compressor

The operation of the A/C compressor is modulated, eliminating noticeable on/off cycling. In order to reduce fuel consumption and improve vehicle performance, the system default is with the compressor OFF.



- ◀ The A/C system uses a variable displacement compressor. The swash plate of the compressor is hinged so that it can vary piston travel based on output requirements of the system.

A/C compressor function is controlled by the Engine Control Module (ECM) based on inputs from the IHKA control panel. Pressing the "snowflake" button is a request for A/C activation. As long as the evaporator temperature is above 2°C (36°F), the IHKA signals the ECM to activate the compressor.

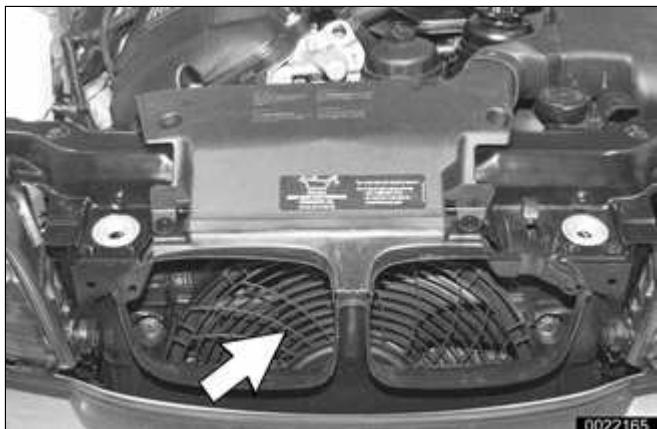
The IHKA control module sends the following signals to the ECM over the K-bus and CAN-bus via the instrument cluster:

- ◆ Request for A/C activation
- ◆ Load torque for switching the compressor
- ◆ Requested cooling fan speed

The IHKA determines the load torque for compressor activation and required engine cooling fan speed from the pressure sensor mounted on the receiver/dryer. The pressure sensor provides a linear voltage input signal (0 - 5 volts) to the IHKA control module. The module processes this signal and determines the load torque of the system (0 to 30 Nm with a variable displacement compressor). The higher the pressure in the system, the higher the voltage input signal to the IHKA module. The output

signal to the ECM enables the ECM to modify the idle speed, timing and fuel injection amount based on the load that is imposed when the compressor is activated.

Regulated engine cooling fan operation

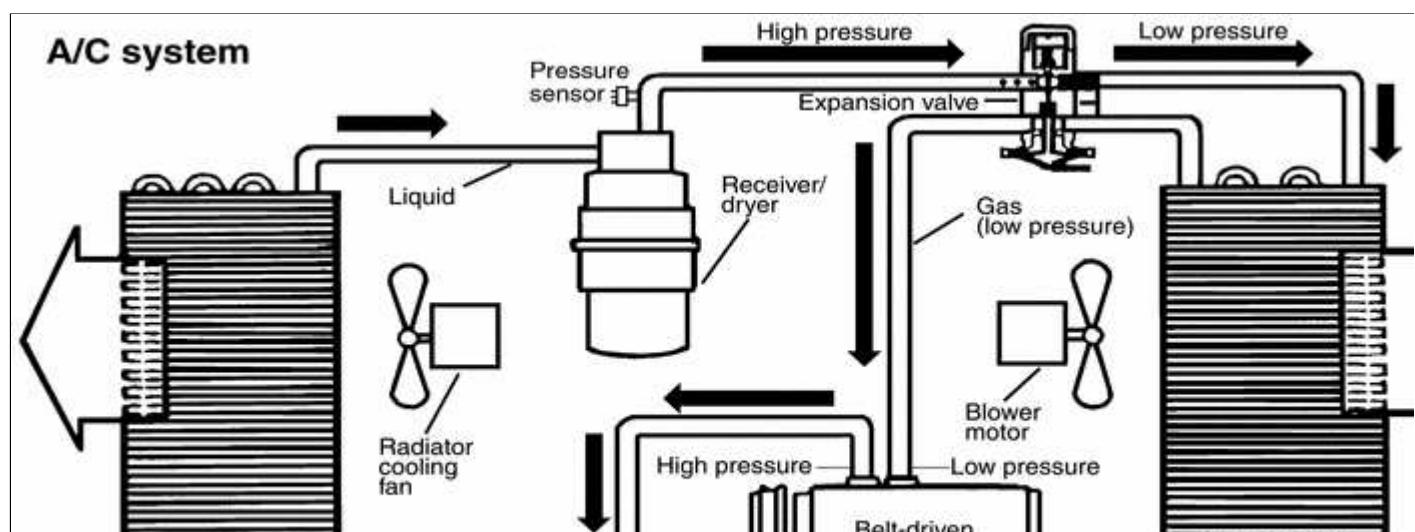


- ◀ The engine cooling fan (**arrow**) operates at variable speeds (15 stages) based on cooling system load. The ECM activates the fan through a pulse modulated final stage control. See ⇒ [170 Radiator and Cooling System](#) for further details.

Note:

- ◆ *Automatic transmission models: The engine cooling fan is located in front of the radiator. A belt-driven fan and fan clutch assembly is installed at the rear of the radiator.*
- ◆ *Standard transmission models: The electric engine cooling fan is installed at the rear of the radiator.*

A/C system





Maximum defrosting

- ◀ Pressing the defrost button turns on maximum defrost functions:
- ◆ Fresh air distribution valves are opened.
 - ◆ Recirculation valves are closed.
 - ◆ Windshield defrost vents are opened.
 - ◆ All other air distribution vents are closed.
 - ◆ Blower runs at maximum speed.
 - ◆ Rear window defroster is switched on.

Note:

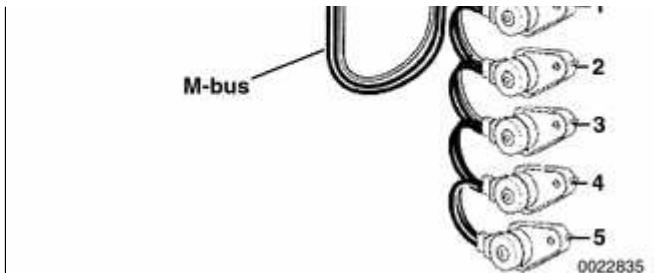
When windshield defrosting is turned on, the A/C compressor does not run automatically, although it can be turned on manually.

Air distribution control via M-bus

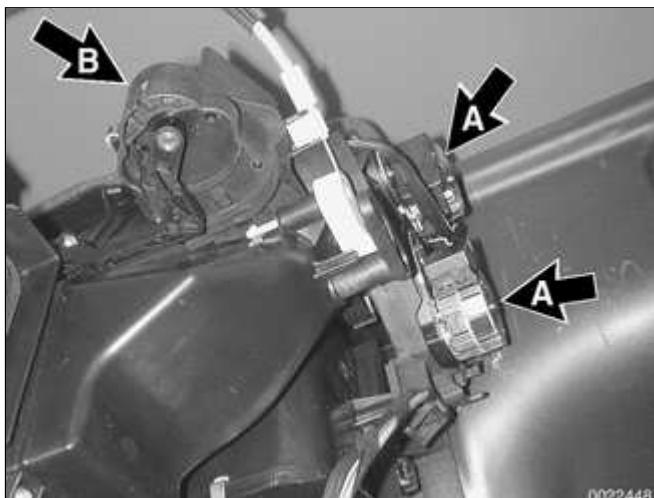


- ◀ Five stepper motors control fresh, heated and air conditioned air distribution.

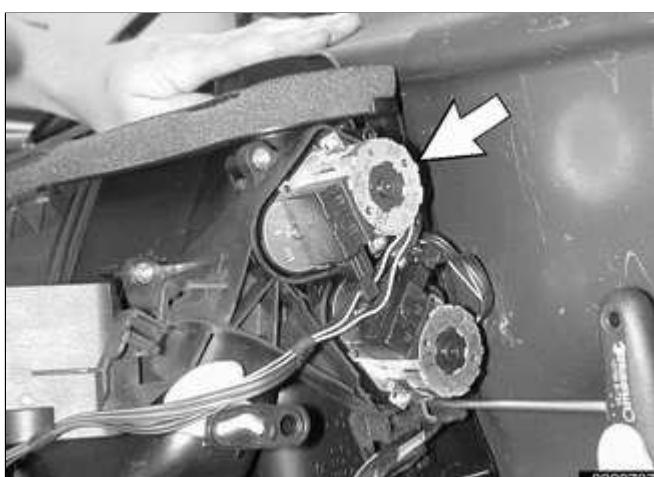
1 - Face vent



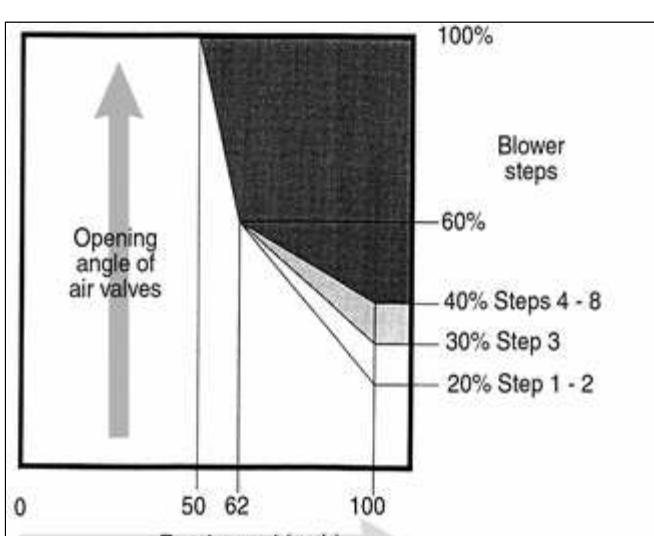
- 2 - Defrost
- 3 - Footwell
- 4 - Recirculation
- 5 - Fresh air



- Two different types of air distribution motors are used in the system. Fast acting motors (**A**) are used for the fresh air/recirculation flaps. (Right side shown.)
- Slower acting motors (**B**) are used for the other operations.



- The center dashboard air outlet distribution motor (**arrow**) allows ventilation air temperature to be controlled by the driver or passenger.



- When fresh air is selected, the fresh air inlet distribution flaps are positioned according to road speed and blower motor speed. The motors close the air inlet flaps incrementally according to road speed but the motion is damped to avoid closing and opening continually due to slight speed changes.



IHKA personalization

Car Memory/Key Memory allows various functions and features of IHKA control to be tailored to the driver's wishes. The functions of IHKA that can be programmed by the driver include:

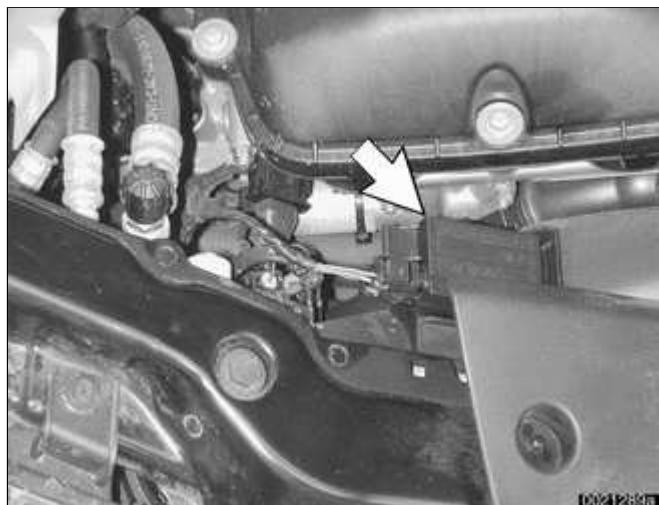
- ◆ Automatic activation of recirculation when the vehicle is started
- ◆ Blower speed adjustment (8-speed blower)
- ◆ Automatic opening of ventilation flaps with warm coolant
- ◆ Automatic closing of footwell flaps with A/C activation
- ◆ Automatic closing of defroster flaps with A/C activation
- ◆ Adjustments to set temperature
- ◆ Automatic activation of compressor control when the ignition is switched on
- ◆ Auto program for blower control when the ignition is switched on

These features are programmed using the coding/programming function of the DIS/MoDiC.

Note:

See ⇒ [515 Central Locking and Anti-theft](#) for an explanation of Car Memory/Key Memory.

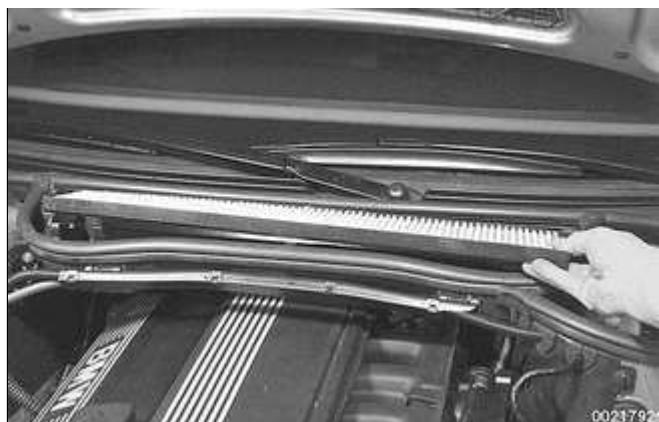
Automatic air recirculation



As of model year 2000, automatic recirculation control is available. This system uses an air quality sensor (AUC) (**arrow**), located at the top right corner of the radiator, to detect high levels of air pollution and automatically switch the IHKA to recirculation of interior air. The recirculation button on the IHKA control panel can be toggled to allow automatic, manual or no recirculation.

Once recirculation is turned on, it runs until it is turned off using the button. Once the ignition is turned off, the recirculation setting is saved for 15 minutes, after which the IHKA system reverts to fresh air mode. This feature can be over-ridden using the Car Memory feature, so that recirculating interior air is automatically selected on engine start-up.

Fresh air micro filter system



A fresh air micro filter system is used in all E46 models. The filter is housed below the fresh air inlet at the rear of the engine compartment. The filter can be serviced by releasing three-quick release screws and removing a plastic cover.

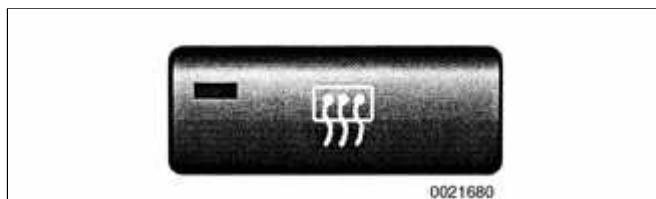
Service

The heating system is part of the engine cooling system and is sealed. The only required service is periodic coolant flushing. See => [170 Radiator and](#)

Cooling System.

Servicing the A/C system requires the use of specialized equipment. Follow the equipment manufacturer's instructions.

Rear window defogger



- ◀ The electric rear window defogger switch is integrated in the IHKA control panel. Pressing the rear window defogger button activates the rear window heating element for about 17 minutes, although this can be changed through Car Memory settings. Pressing the button again activates a cycle of 40 seconds on/80 seconds off for 5 minutes.

The defogger element in the rear glass is integrated with the radio antenna.



- ◀ The rear window defogger relay (**arrow**) is located in the right side of the luggage or cargo (Sport Wagon) compartment behind the trim.

Convertible heated rear window

In the E46 Convertible, both the soft top and the hard top are equipped with rear window defogger. Power is supplied by two relays located on the right side rear quarter panel behind the interior trim cover.

Rear defogger operation is controlled by the IHKA control module.

On hard top:

- ◆ Rear relay is energized.
- ◆ Power to hard top window is supplied through connector strip on hard top lock.

On convertible top:

- ◆ Rear relay is energized. It powers front relay.
- ◆ If convertible top control module (CVM) signals that convertible top is locked to windshield frame, front relay powers rear window heater grid.
- ◆ If convertible top is lowered, a signal from CVM to front relay prevents heated top operation.
- ◆ Front relay also signals sound system to switch stereo sound ON when top is up, stereo sound OFF when top is down.

Solar sensor

The purpose of the solar sensor is to detect and relay information about the amount and intensity of solar heating to the IHKA control module. The settings of the climate control system are changed to compensate for this additional influence.

Solar sensor



The solar sensor consists of a photoresistor installed in the right defroster outlet and a short harness.

The solar sensor receives power (5 volts) and ground from the IHKA control



module. The module then calculates voltage drop across the photoresistor and determines the degree of solar heating based on the change in voltage. Voltage drop across the photoresistor increases as solar radiation increases. The IHKA control module processes the photoresistor input every 10 seconds and also checks it for plausibility based on mapped values. Values outside the limit indicate a malfunction and the solar sensor signal is ignored by the module.

The IHKA module regulates interior climate settings using the following:

- ◆ Blower. The blower activation curve is changed.
- ◆ Ventilation. The opening angles of air distribution flaps are changed.

Troubleshooting of the solar sensor is carried out through the IHKA diagnostic program incorporated in DIS or MoDiC. The IHKA control module may set codes indicating a short or an open circuit.

To access the solar sensor, remove the trim in front of the main dashboard panel, ahead of the dashboard vents.

Troubleshooting

Trouble with the heating and A/C system can be broken down into one or more of the following categories.

Mechanical problems

- ◆ Control head malfunction
- ◆ Blower motor malfunction

- ◆ Noisy or seized compressor
- ◆ Noisy compressor clutch
- ◆ Malfunctioning belt

Diagnosis of noisy engine compartment components is covered in ⇒ [100 Engine-General](#). A/C belt replacement is covered in ⇒ [020 Maintenance](#).

Cooling system problems

- ◆ Coolant problems
- ◆ Cooling fan problems

Cooling system pressure testing and other diagnosis is covered in ⇒ [170 Radiator and Cooling System](#).

Refrigerant leak

Use diagnostic equipment to pinpoint refrigerant leaks. Replace leaky components or seals.

Note:

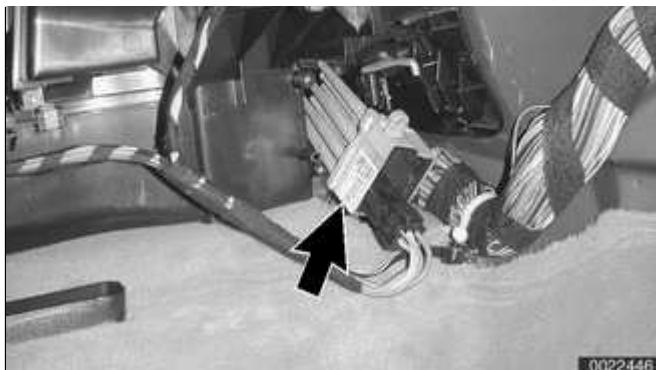
Diagnosis of A/C system components is beyond the scope of this manual. Follow the equipment manufacturer's instructions.

Odors

Mildew in the IHKA housing and in the evaporator fins can cause strong odors.



- ◀ Working under right side of dash, remove blower fan resistor pack (**arrow**) as described later in this repair group.



- Poke a spray wand through IHKA housing opening and spray commercially available cleaning agent on evaporator. Move wand back and forth to cover evaporator fins with liquid.
- Allow 5 minutes for liquid to drip through evaporator drain.
- Start car and run heater and A/C at maximum power for 5 minutes to dry out evaporator.

Functional problems

IHKA self diagnostics monitors the inputs and outputs of the system. If a fault is detected, a Diagnostic Trouble Code (DTC) is initially entered in RAM and then in the EEPROM when the ignition is switched off. A maximum of six DTCs can be stored in the EEPROM when the ignition is switched off. The E46 IHKA module is connected to the Diagnostic Link Connector (DLC) via the K-bus/instrument cluster. Use DIS, MoDiC or other suitable scan tool to access DTCs.

When troubleshooting problems with the E46 IHKA, it is important to note that because the Car Memory/Key Memory feature can change the functionality of the system, a review of memory settings should be performed prior to condemning a component as faulty.

Substitute value operation

If an input potentiometer, sensor or circuit fails or the signal from it is not plausible, the control module ignores the faulty signal and substitutes a

programmed substitute value. See ⇒ [Table a.](#)

Table a. Substitute programmed values for IHKA component inputs

Input	Working range	Substitute value
Heat exchanger sensor	5° to 124°C (41° to 255°F)	55°C (131°F)
Evaporator sensor	-10° to 30°C (14° to 86°F)	0°C (32°F)
Interior temperature sensor	10° to 40°C (50° to 104°F)	20°C (68°F)
Exterior temperature	K-bus	0°C (32°F)
Coolant temperature	K -bus	100°C (212°F)
Specified temperature	16° to 32°C (61° to 90°F)	22°C (72°F)

Note:

The substitute value for the evaporator temperature sensor is below the A/C compressor cycling temperature (2°C/34°F). If the evaporator temperature sensor signal is not plausible, the substitute value will switch the A/C OFF.

⇒ [Table b](#) lists resistance values and fault limits for IHKA temperature sensors.

Table b. Temperature sensor resistance values at 25°C (77°F)

Sensor	Resistance	Fault limit
Heater core	9 kΩ ± 2%	Temp >

Table b. Temperature sensor resistance values at 25°C (77°F)

Sensor	Resistance	Fault limit
		125°C (257°F)
Evaporator	9 kΩ ± 2%	Temp > 120°C (248°F)
Interior	10 kΩ ± 2%	Temp ≤ -46°C (-51°F)

⇒ [Table c](#) lists A/C evaporator temperature-dependent resistance values.

Table c. A/C evaporator temperature sensor resistance values

Temperature °C/°F	Resistance range kΩ
-5/23	11.7 - 11.9
0/32	8.8 - 9.2
5/41	6.8 - 7.2
10/50	5.3 - 5.6
15/59	4.2 - 4.5
20/68	3.3 - 3.6
25/77	2.6 - 2.9
30/86	2.1 - 2.3
35/95	1.7 - 1.9

⇒ [Table d](#) lists A/C expansion valve pressure values.

Table d. Expansion valve pressure values

Table d. Expansion valve pressure values

Inlet pressure	14 bar (203 psi)
Outlet pressure	1.8 bar (26 psi)
Leak test with detector pressure	1 - 2 bar (14.5 - 29 psi)

A/C system warnings and cautions

WARNING!

- ◆ *Always wear hand and eye protection (gloves and goggles) when working around the A/C system. If refrigerant does come in contact with your skin or eyes: do not rub skin or eyes; immediately flush skin or eyes with cool water for 15 minutes; rush to a doctor or hospital; do not attempt to treat yourself.*
- ◆ *Work in a well ventilated area. Switch on exhaust/ventilation systems when working on the refrigerant system.*
- ◆ *Do not expose any component of the A/C system to high temperatures (above 80C/176F) or open flames. Excessive heat causes a pressure increase which could burst the system.*
- ◆ *Keep refrigerant away from open flames. Poisonous gas is produced if it burns. Do not smoke near refrigerant gases for the same reason.*

- ◆ *The A/C system is filled with refrigerant gas which is under pressure. Pressurized refrigerant in the presence of oxygen may form a combustible mixture. Never introduce compressed air into any refrigerant container (full or empty).*
- ◆ *Electric welding near refrigerant hoses causes R-134a to decompose. Discharge system before welding.*

CAUTION!

- ◆ *As of January 1, 1992, any person who services a motor vehicle air conditioner must, by law, be properly trained and certified, and use approved refrigerant recycling equipment. Technicians must complete an EPA-approved recycling course to be certified.*
- ◆ *It is recommended that all A/C service be left to an authorized BMW dealer or other qualified A/C service facility.*
- ◆ *State and local governments may have additional requirements regarding air conditioning servicing. Always comply with state and local laws.*
- ◆ *Do not top off a partially charged refrigerant system. Discharge system, evacuate and then recharge system.*
- ◆ *Do not use R-12 refrigerant, refrigerant oils or system*

***components in R-134a system.
Component damage and system
contamination results.***

- ◆ ***The mixture of refrigerant oil (PAG oil) and refrigerant R-134a attacks some metals and alloys (for example, copper) and breaks down certain hose materials. Use only hoses and lines that are identified with a green mark (stripe) or the lettering "R-134a".***
- ◆ ***Immediately plug open connections on A/C components and lines to prevent dirt and moisture contamination.***
- ◆ ***Do not steam clean A/C condensers or evaporators. Use only cold water or compressed air.***

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