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E60 Climate Control

Initial Print Date: 08/03 Revision Date: 09/03

Model: E60

Production: Start of Production MY 2004

Climate Control

Objectives:

After completion of this module you will be able to:

- Identify and locate the components of the E60 Climate Control System
- Understand the differences between E39 and E60 IHKA
- Understand LIN bus operation
- Understand Condensation Sensor Operation
- Operate Features of the E60 IHKA System

E60 Automatic Heating and Air Conditioning System

Purpose of the System

The E60 IHKA system is designed using the same criteria as the E65. There are technological improvements as well as new or modified functions. As with E65, the design objectives were to meet the requirements of customers worldwide for heating and cooling capacity.

New System Components and Features

- Condensation Sensor (Mist Sensor) - The Condensation sensor evaluates the humidity level of the windshield area and implements control measures to reduce windshield fogging.
- New Bus System - The Local Interconnect Network (LIN Bus) connects all 9 step per motors and the blower controller.
- Modified Control Concept (As compared to E39) - Similar to E65, there is a reduction in the number of primary controls. The temperature and air volume are controlled by rotary knobs. Extended air conditioning functions such as air stratification are selected and activated by means of the controller in the CID.

Additional System Features

- Modified Display Concept - The Scope of display elements for the extended AC functions in the CID are similar to those in the E65. The required fan and temperature settings are not shown in the CID. The set values for temperature and air volume can be read from scale rings on the IHKA panel. Air distribution is set by means of the controller in the CID.

- Elimination of LCD Display - The LCD display from the E39 has been eliminated.

- No Bowden Cables - All flap positions are set by stepper motors which are controlled via the LIN bus.

- Separate Footwell Flaps for Left and Right

- Separate Ventilation Flaps for Left and Right

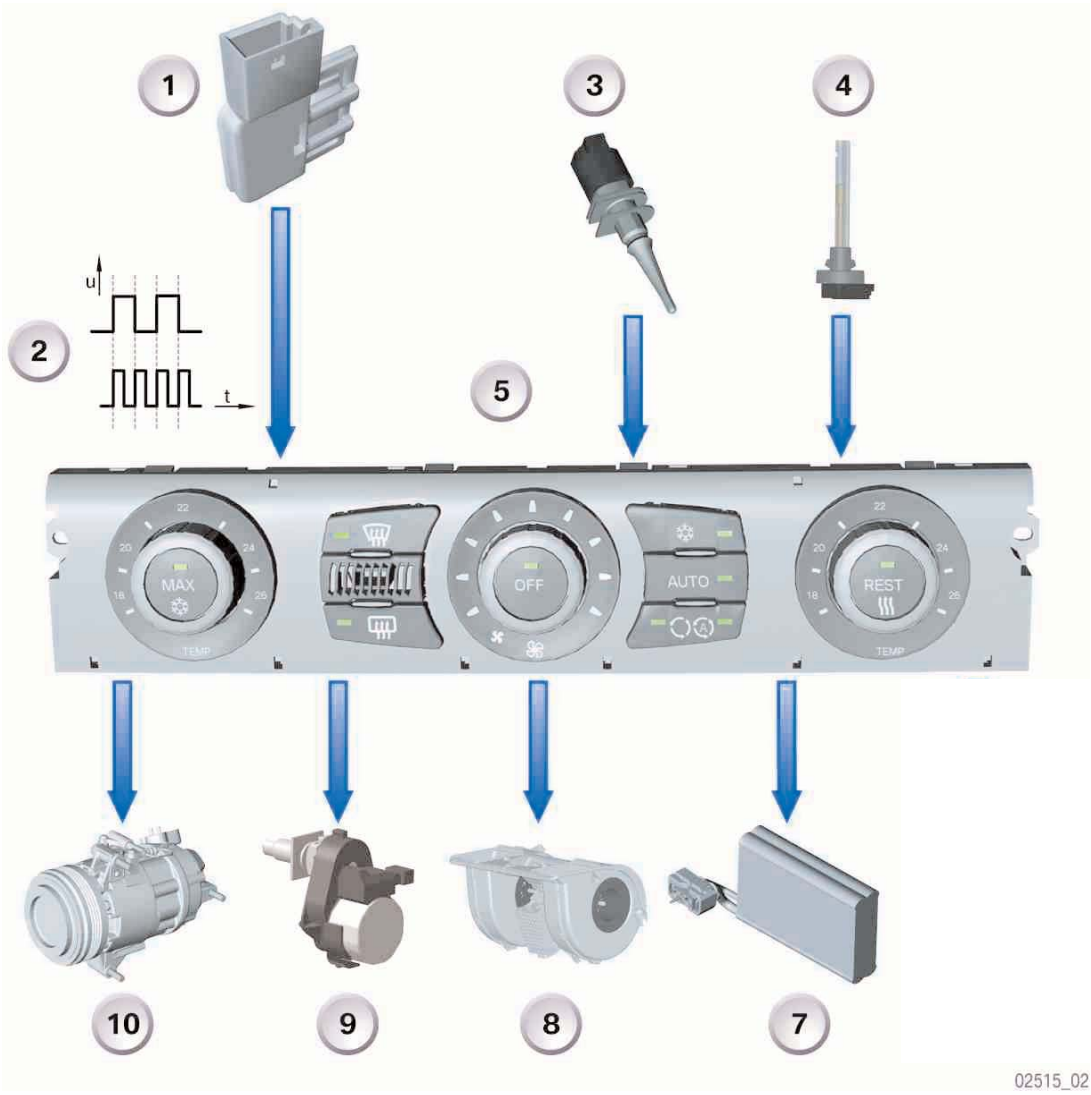
- New Suction Action Blower arrangement - The new blower arrangement allows for a more compact IHKA housing. The blower is arranged behind the evaporator. The heat exchanger for the heating system is positioned at right angles with respect to the evaporator and is arranged over the blower. The blower motor and blower motor housing can be removed without removal of the complete dashboard assembly.

- Clutchless A/C Compressor - The clutchless compressor is externally actuated and output regulated. The component and operation are carried over from the E65.

- AUC-2 Sensor - The AUC sensor is carried over from the E65.

- Solar Sensor - The solar sensor is located in the center of the dashboard and is also carried over from the E65/E66.

System Overview



1. Mist sensor
2. Mist sensor signal
3. Ambient temperature sensor
4. Face vent temperature sensor
5. IHKA control panel
6. Not shown
7. Evaporator and expansion valve
8. Blower and controller (on LIN bus)
9. Stepper motors (9 on LIN bus)
10. Clutchless AC compressor

System Components

The E60 Climate Control System consists of the following components:

Components Located in Passenger Compartment

- IHKA Control Panel/Module
- *Condensation (Mist) Sensor*
- Solar Sensor
- *CID and Controller*
- *Face Vent Temperature Sensor*

Components Located in (or on) IHKA Housing

- *9 Stepper Motors (all on LIN Bus)*
- *Blower Motor with Controller (on LIN Bus)*
- Evaporator Temperature Sensor
- 2 Heater Core Temperature Sensors (Left and Right)
- Heater Core (Heat Exchanger)
- Evaporator
- Expansion Valve

Components Located in Engine Compartment

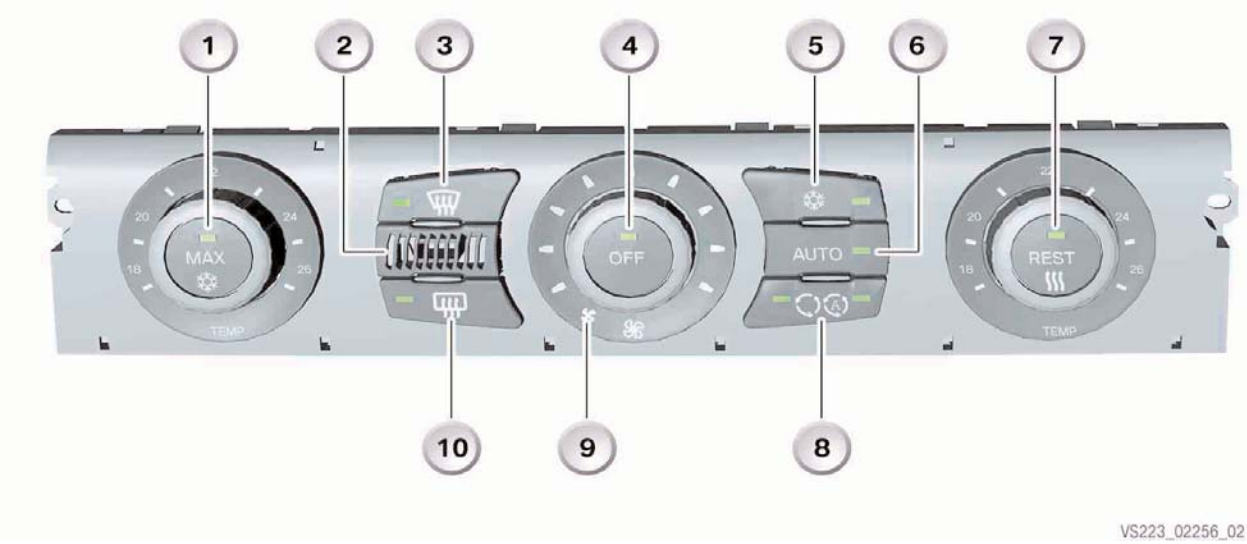
- A/C Compressor
- AUC Sensor
- Water Valves
- Auxiliary Water Pump
- A/C Condenser (with Integrated Receiver/Dryer)
- Auxiliary Cooling Fan
- A/C Pressure Sensor
- Refrigerant Lines
- Microfilter System

IHKA Control Panel/Module

The IHKA Control Panel/Module controls the following functions:

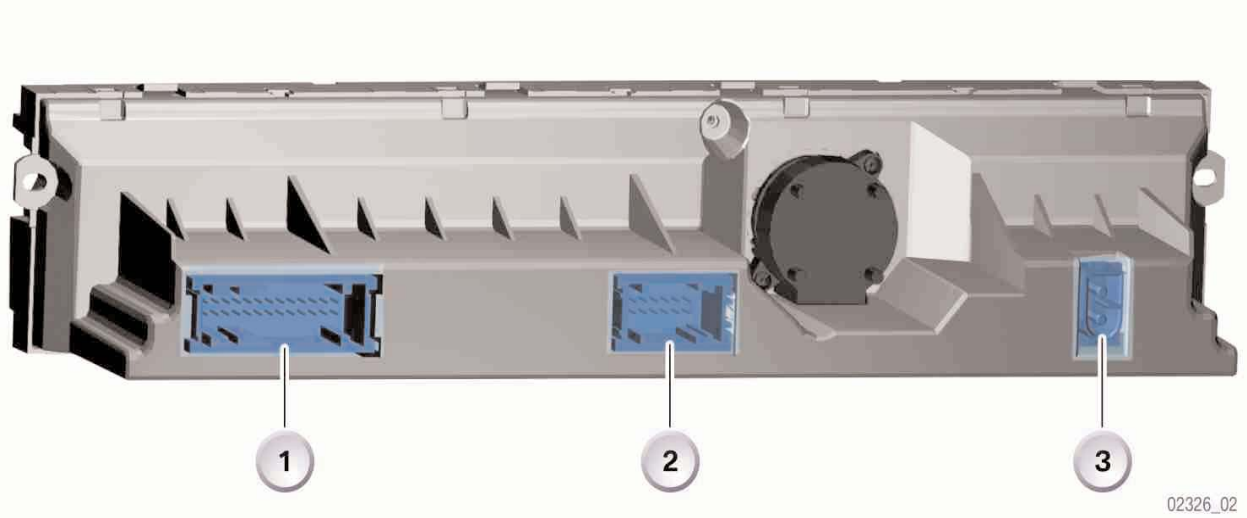
- Desired Temperature Setting, Left/Right
- Air Volume (Automatic and Manual Blower Settings)
- A/C On/Off Switch
- Recirculation Control (Including AUC)
- Rear Window Defogger
- MAX A/C
- Defrost Function

There are additional functions such as air distribution (defrost, face and footwell) and air stratification that are selected and controlled with the controller in the CID.



1. Rotary control for left side temperature setting with MAX AC button.
2. Opening for interior temperature sensor.
3. DEFROST Button
4. Rotary control for blower setting with OFF button.
5. A/C Button
6. AUTO Button (Automatic flap and blower function).
7. Rotary control for right side temperature setting with REST button.
8. AUC recirculating air button
9. Independent Heating Indicator (Not for US Market)
10. Rear window defogger button

Workshop Exercise - IHKA Control Panel



1. 26 Pin plug connection to vehicle electrical system
2. 12 Pin plug connection to heater/air conditioner
3. 2 Pin plug connection to front of power distribution box

Remove IHKA panel and connect breakout boxes

Record the steps and fasteners (if any) used to remove the IHKA control panel/module:

_____

_____

_____

_____

_____

List part numbers of breakout boxes and cables used:

_____

_____

List the connector numbers for the following connectors:

26 Pin _____ *12 Pin* _____ *3 Pin* _____

Workshop Exercise - IHKA Control Panel

List the connector and pin #'s of the power supply and ground connections to the IHKA panel:

KL 15 _____

KL 30 _____

KL 31 _____

List the Bus interface connections to the IHKA control panel:

How does the IHKA panel receive outside temperature information?

Can the interior temp sensor fan be replaced as a separate item?

Describe the AC compressor control circuit (list connectors, pins, etc.):

Condensation Sensor

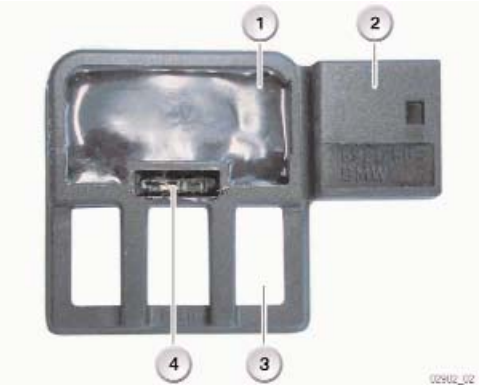
The condensation sensor is new to BMW climate control systems. The sensor is used to measure air humidity and temperature in the windshield area.

This information is sent to the IHKA control unit via a digital signal with a varying frequency. This information is evaluated by the IHKA control module, which then implements a series of countermeasures to prevent windscreen fogging. The countermeasures are implemented in the following sequence:

Measures	Action
1	Defroster flaps opened further
2	Recirculating air/AUC/automatic recirculating air switched to fresh air
3	Partial fresh air in connection with recirculating air/AUC/automatic recirculating air switched to fresh air
4	Minimum evaporator temperature (progressive evap temperature de-activated)
5	Blower air volume increased
6	Footwell share decreased
7	Temperature setpoint increased

These measures are implemented one after another until windscreen fogging is eliminated. Further steps are initiated if one measure proves to be ineffective. After successfully eliminating windscreen fogging, the measures are gradually cancelled in steps.

The sensor is located beneath the RLS on the windshield below the cover for the base of the rear view mirror. A special locating tool is used to install the new sensor, this tool is supplied with the replacement sensor. The sensor is affixed to the windscreen with an adhesive. If the sensor needs to be removed from the windshield it must be replaced.



1. Sensor Electronics
2. 3 Pin Connection
3. Moisture measuring cell
4. Well for laser adjusted resistors

Workshop Exercises - Condensation Sensor

Using the DISPlus or GT-1, record the following information:

What type of signal is sent from the condensation sensor to the IHKA module?

What is the pin and connector number for the condensation sensor signal at the IHKA control panel/module?

Measure and record the following signal information from the condensation sensor:

Frequency _____ *Duty Cycle* _____ *Voltage* _____

What is the observed condensation sensor values on status requests?

While observing status requests, place a cup of hot water near the condensation sensor and observe the new signal information.

What happens to the value on Status requests? _____

What other observation can be made when the mist sensor signal changes?

Is there a test plan available for the mist sensor?

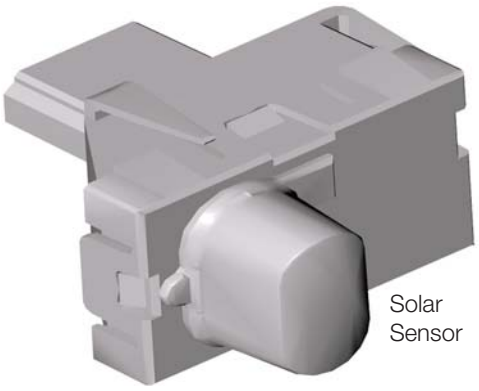
What is the special tool # used to install the condensation sensor?

Solar Sensor

The solar sensor is located in the center of the dashboard to the right of the center speaker grill.

The solar sensor operation is identical to the past models such as E65/E66.

As on previous models, the solar sensor signals will influence blower output, air stratification and ventilation flap operation.



Solar Sensor

AUC-2 Sensor

The AUC-2 sensor is located on the cooling fan housing at the top. The sensor operation is identical to the E65. The AUC-2 sensor will signal the IHKA to activate recirculation mode when the sensor detects oxidizable gases such as hydrocarbons, carbon monoxide and nitrogen oxides.

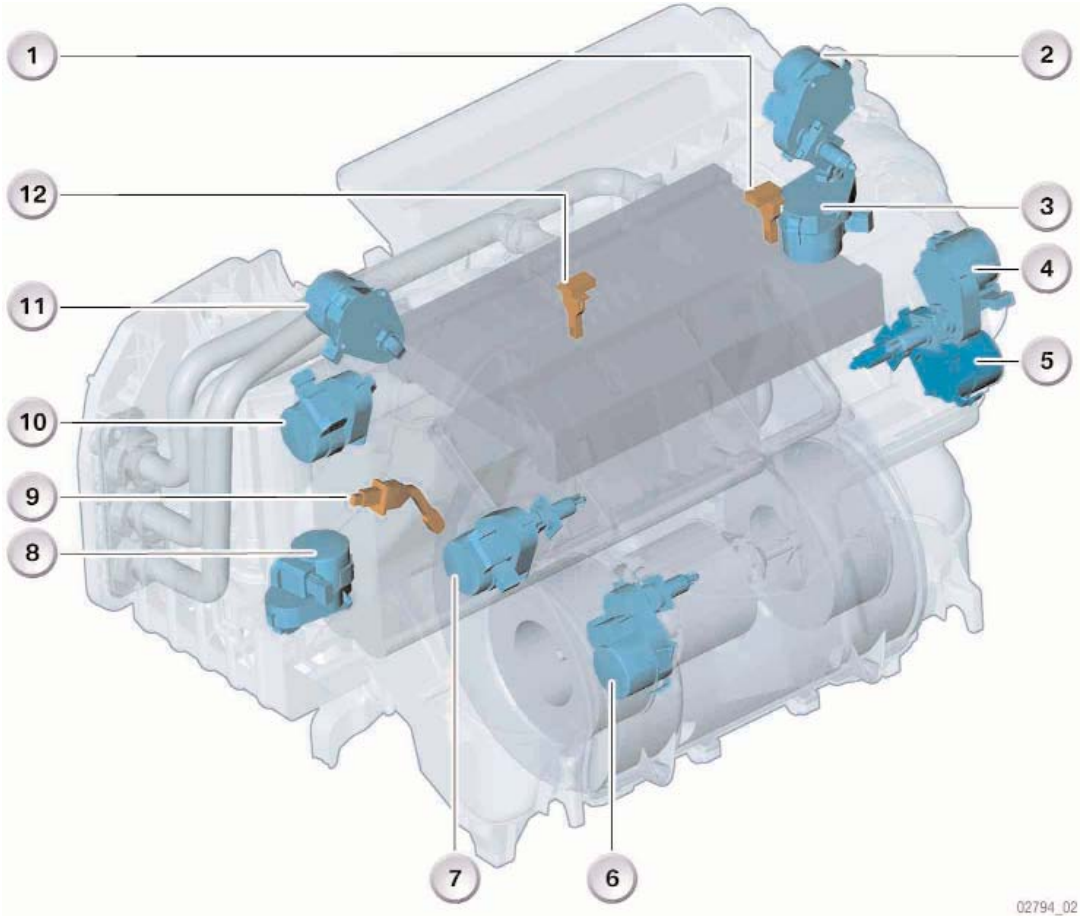
AUC-2 Sensor

CID and Controller

The CID and Controller are used for air distribution adjustments, air stratification and for the parked car ventilation features. The air volume for face vent, foot well and defrost can be adjusted independently for the driver and passenger.

1. Air volume, defrost
2. Air volume, face vent
3. Air volume, footwell

Components Located on IHKA Housing



1. Heater Core Temperature Sensor (RH)
2. Stepper Motor, right footwell
3. Stepper Motor, fresh air/recirc air (RH)
4. Stepper Motor, right side ventilation
5. Stepper Motor, air stratification
6. Stepper Motor, rear compartment (center)
7. Stepper Motor, left side ventilation
8. Stepper Motor, fresh air/recirc air (LH)
9. Evaporator Temperature Sensor
10. Stepper Motor, defrost
11. Stepper Motor, left footwell
12. Heater Core Temperature Sensor (LH)

Stepper Motors

These stepper motors are MUX5 motors (multiplex motor type 5).

There are 9 stepper motors used on the E60 IHKA system. All motors are connected to the LIN Bus. The LIN bus circuit consists of three wires, power (B+), ground and the LIN bus signal wire.

The stepper motors for the fresh air/recirculating air flaps are designed as high speed motors.

This system does not use any bowden cables for flap actuation.

Blower Motor with Blower Controller

The blower motor for generating the necessary air volume is fitted in the heater air conditioner. The blower features a symmetrical design and is equipped with two dual suction action radial fan wheels (four flute blower).

The blower controller is mounted directly on the housing of the blower motor. The controller features self diagnosis capabilities and is actuated by the control unit in the IHKA panel via the LIN bus. It is possible to replace the fan motor without the need to disassemble the instrument panel.

1. Blower controller on blower motor

Temperature Sensors

All temperature sensors used in the E60 IHKA system are NTC type. The E60 IHKA system uses the following temperature sensor inputs:

- Interior Temperature Sensor - Located in the IHKA control panel faceplate. The IHKA panel also incorporates a sensor fan which is removable and can be replaced as a separate part. The temperature sensor itself is not replaceable separately.
- Ambient (outside) Temperature - The ambient temperature sensor is an NTC sensor which is an input to the instrument cluster. The temperature signal is then sent to the IHKA control module via K-CAN.
- Two Heater Core Temperature Sensors - The Heater core temperature sensors can be accessed by removing the CID. The temperature sensors are used to monitor the temperature of the left and right side of the heat exchanger.
- Evaporator Temperature Sensor - As on previous models, the evaporator temp sensor is used to prevent evaporator freeze-up.
- Face Vent Temperature Sensor - There is one face vent temperature sensor located behind the center face vent. It can be accessed by removing the center face vent, IHKA panel and M-ASK.

Workshop Exercise - LIN Bus

List the LIN bus connections (Pin # and connector #) at the IHKA control panel:

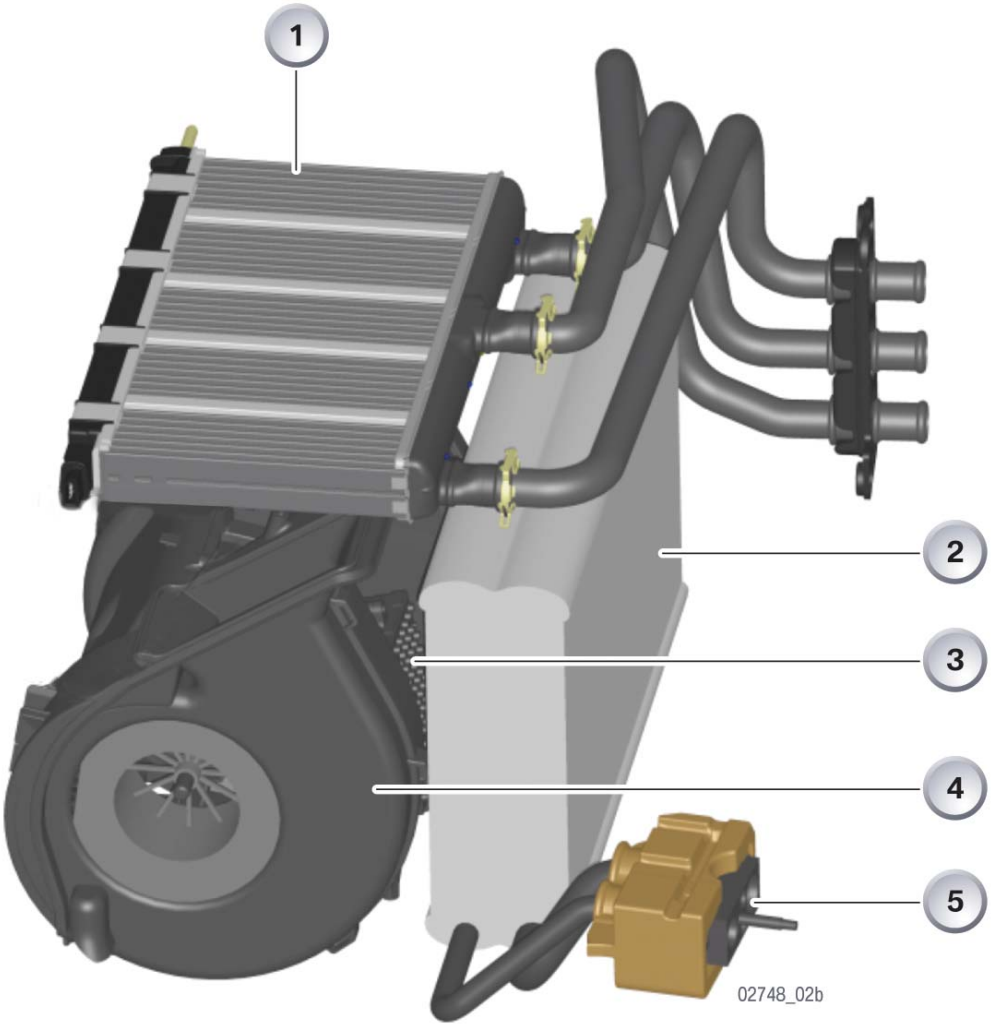
How many LIN bus connection are there at the IHKA panel?

Ground the LIN bus signal wire to the blower controller and record observations:

Ground the LIN bus signal wire to the stepper motors and record observations:

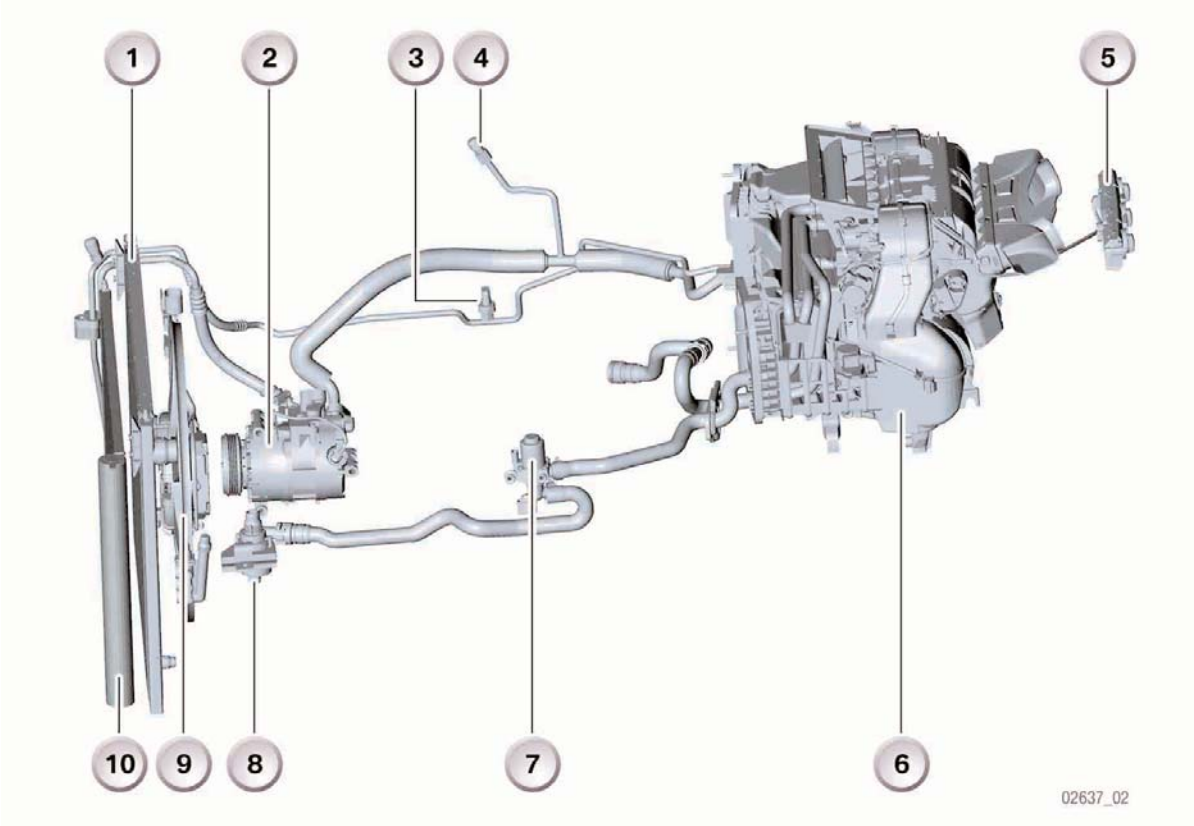
Notes:

Component Layout



1. Heater core
2. Evaporator core
3. Blower motor controller
4. Blower motor with housing
5. Expansion Valve

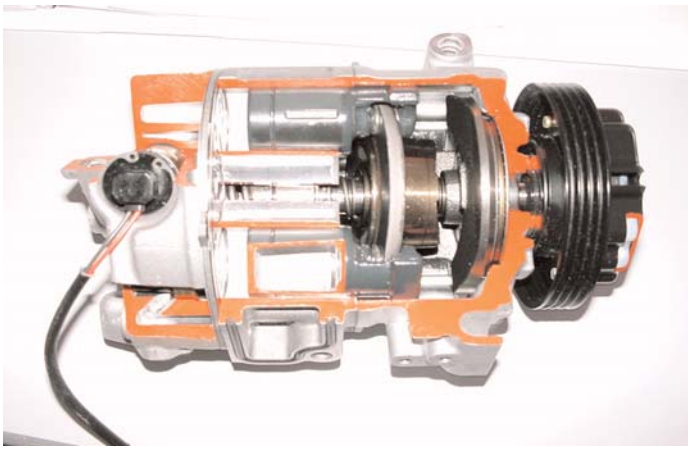
A/C System Component Layout



1. Radiator
2. A/C Compressor
3. Pressure Sensor
4. Service Connection,
5. IHKA Control Panel
6. Heater/AC Housing
7. Water Valve(s)
8. Auxiliary Water Pump
9. Electric Fan
10. Condenser with Dryer

A/C Compressor

The A/C compressor in the E60 is identical to the clutchless design introduced on the E65/E66



Pressure Sensor

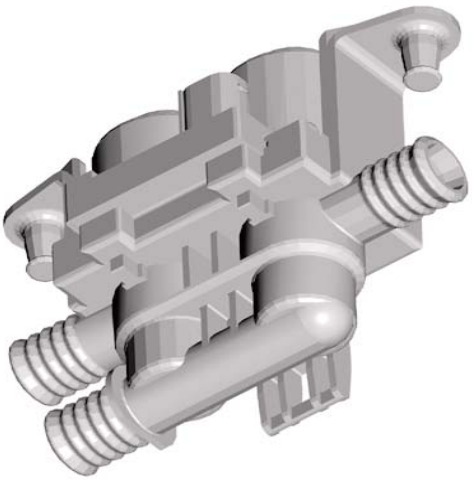
The pressure sensor is located in the high side pressure line between the condenser and the evaporator near the passenger side strut tower.

The sensor sends the IHKA control module an analog signal between 0.4V and 4.6V as a representation of system pressure.

The 5V supply is provided by the IHKA control module and the sensor current consumption is < 20mA.

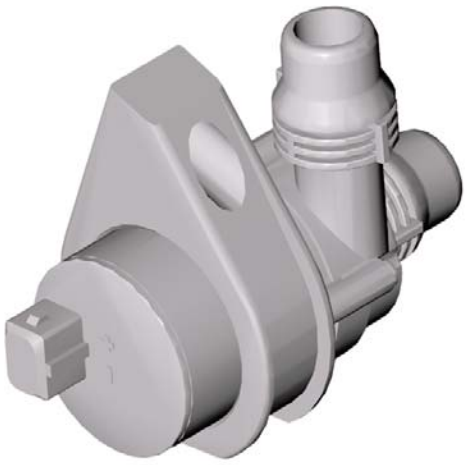
Water Valves

The water valves on the E60 are of the same design as used on previous models. The valves are normally sprung open and are pulse width modulated by the IHKA control unit. The IHKA control unit controls the valves via the B+ circuit, both valves are grounded at a common location. The valves are powered closed by the IHKA module when full cooling is needed. They are located on the driver's side strut tower.



Auxiliary Water Pump (ZWP)

The auxiliary water pump is mounted on the drivers side frame rail near the alternator. The ZWP enhances hot water flow through the heater core particularly when the engine is idling.

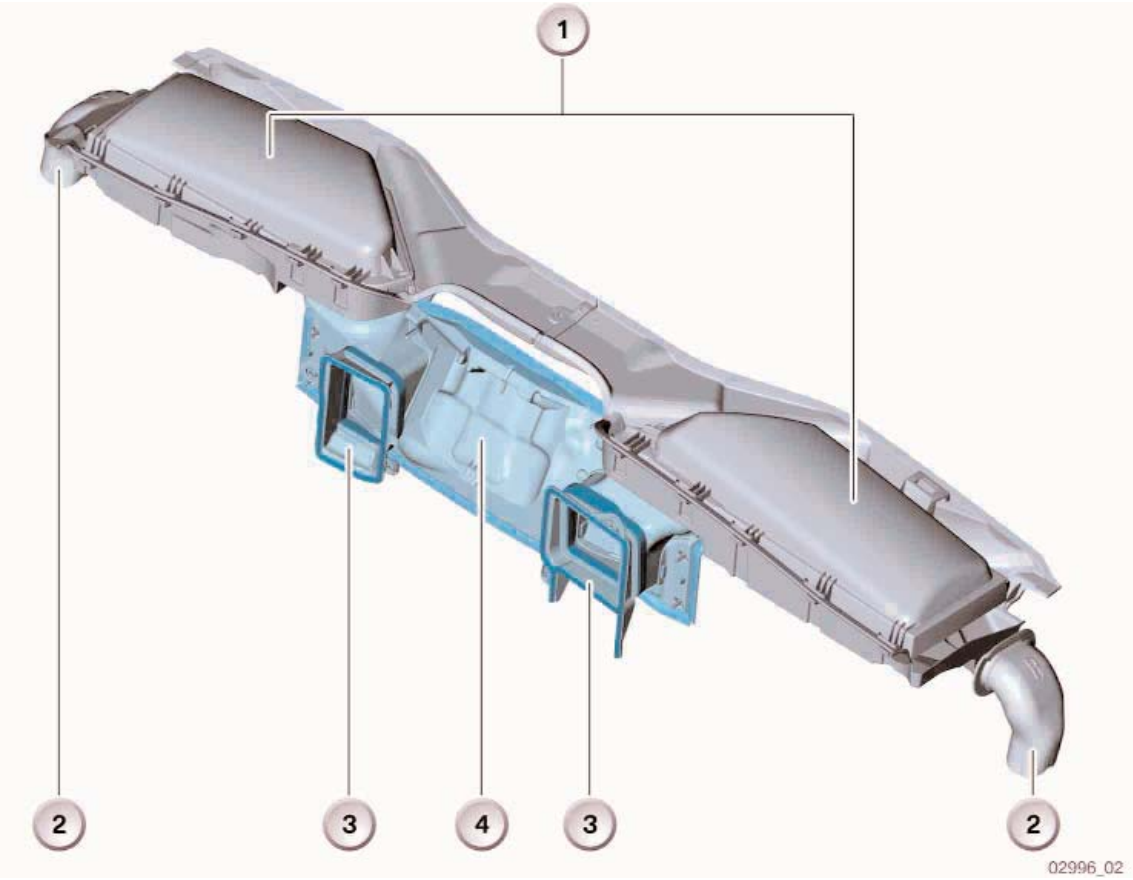


Microfilter System

An activated carbon microfilter is fitted on the E60 IHKA system. Microfilter replacement intervals are based on CBS data. Based on operating time and operating parameters, the "filter condition detection" system determines the load status of the filter without additional sensors. In this way, due dates for filter service are calculated together with other wear-registering components. After changing the filter, the CBS system must be reset via the instrument cluster or in the tester (DISplus/GT-1).

The following are recorded parameters for determining the filter load status:

- Blower Voltage
- Outside Temperature
- Sun Intensity
- Mileage
- Road Speed
- Rain Intensity
- Day Counter

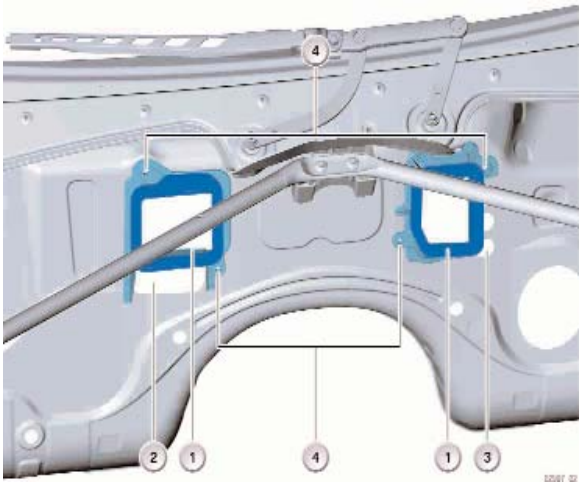


1. Microfilter Compartment
2. Water Drain
3. Bulkhead/filtered air duct seal
4. Filtered air duct

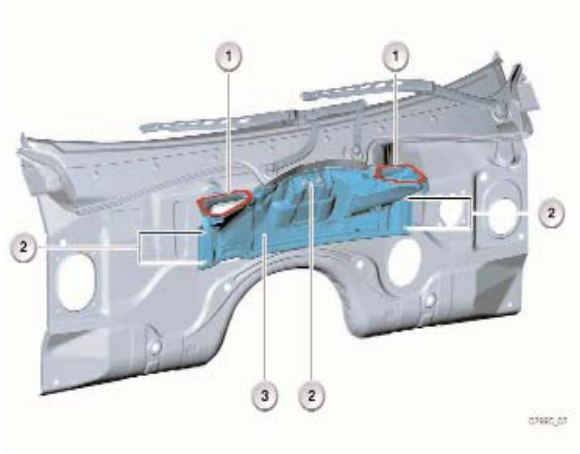
Workshop Hints

AC Housing Installation

Particular care must be taken when mounting the air conditioner on the inner side of the bulkhead to ensure the seals are fitted correctly. The butyl beading on the seal provides a tight seal with the bulkhead. When assembling, make sure the repair instructions are followed precisely. Failure to adhere to the procedure could result in interior water leakage.



1. Bulkhead/filtered air duct seal
2. Aperture for expansion valve
3. Aperture for water connections, heating circuit
4. Aperture for air conditioner and screw mounting points and seals



1. Intake/filter compartment seal
2. Threaded connection, filtered air duct
3. Filtered air duct

In the same way as for the seals, particular care must be taken when installing the filtered air duct and the filter compartment covers. Secondary (unfiltered) air may be drawn in from the engine compartment if the seal between the duct components is defective.

Initial Operation After Replacing the Refrigerant Compressor (Compressor Run-in)

In order to prevent compressor damage after installation, the compressor run-in procedure must be performed.

The “Run-in” procedure is identical to E65/E66 and can be found in the service functions menu.