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INTRODUCTION

The heating/air conditioning systems of the E36/5 and /7 (318ti and Z3) were specifically designed for use in these models. The system is a so-called “controlled” system. The temperature and air distribution are controlled, NOT regulated.

The systems are called “IHKS”. Translated from German, the acronym means, “Integrated Heating and Air Conditioning Control.”

Highlights of the IHKS system include:

• Compact heater case design with microfilter for air inlet (318ti only).
• Temperature control through air blending flap.
• Mechanical air distribution control.
• One fresh/recirc air flap stepper motor.
• Four-speed resistor controlled blower motor.
CONTROL PANELS

Control panels for the 318ti and Z3 systems are similar. Each consists of rotary knobs and push button switches. The control panel is integrated into the center console.

318ti

ROTARY KNOBS

- Right = Air distribution control
- Middle = Temperature control
- Left = Fan speed control switch

PUSH BUTTONS

- Top = Rear window defroster
- Middle = A/C compressor request switch
- Bottom = Recirculating air control button

The air distribution and temperature control knobs are mechanically linked to cables that operate the internal flap levers. The fan speed switch controls the blower speed through a resistor pack.
**Z3**

**ROTARY KNOBS**

- Right = Fan speed control switch
- Middle = Temperature control
- Left = Air distribution control

**PUSH BUTTONS**

- Bottom = Recirculating air control button
- Top = A/C compressor request switch
AIR DISTRIBUTION CONTROL

The air distribution is totally dependent on the position of the rotary knob. It is similar in operation to the E36 IHKR system. The defrost, face vent and footwell flaps are all controlled with a bowden cable and gear linkage mechanism. The knob rotates $360^\circ$ to give the following air distribution:

REAR WINDOW DEFROSTER

The rear window defroster is switched on through a relay when the control button button is pressed. It remains on until switched Off by the button or the ignition is switched Off. There is no timed operation for the rear window defroster.
COMPONENTS

HOUSING

The lightweight design of the IHKS housing provides a strong, compact, integral structure for the IHKS components. The Z3 and 318ti system housings are identical in function but have differences in the following areas.

- The Z3 has a dual squirrel cage blower wheel versus the single blower wheel of the 318ti.
- The Z3 housing has a slightly shorter profile.
- The Z3’s IHKS control module is mounted on the driver’s side of the housing versus the passenger’s side of the 318ti.
- The Z3 does not utilize an air inlet microfilter like the 318ti.
- The mounted angle of the heater core in the Z3 system is “flatter” in the housing compared with the 318ti.
TEMPERATURE REGULATION - HEATING

Discharge air temperature in the heating mode is controlled by the air blending flap. The rotary temperature knob controls the air blending flap, which determines how much air passes through the heater core.

Turning the knob clockwise will gradually increase the temperature of the air discharged into the cabin.
WATER VALVE

Water flow through the heater core is controlled by a water valve. The water valve is either open or closed. There is no pulsed regulation of the valve. The water valve is open except when the temperature knob is in the full cold position. This is controlled by a microswitch mounted on the heater control panel.

The microswitch provides either switched:
- Ground in the 318ti or
- Power in the Z3

HEATER CORE

The single heater core unit has one coolant supply tube and one return tube. The heater core can be removed without removing the housing from the vehicle.

Remove the retaining screws as shown in the illustration. Drain the coolant from the system and disconnect the hoses from the supply and return tubes. Slide the heater core from the housing.
TEMPERATURE REGULATION - AIR CONDITIONING

Discharge air temperature in the A/C mode is also controlled by the air blending flap. The rotary knob controls how much air passes through the heater core.

Compressor control is a function of the IHKS control module and the Engine Control Module (ECM). When the “snowflake” button is pressed, the ECM is signaled for idle stabilization; it then switches the compressor On by activating the control side of the compressor relay.

The ECM will switch the compressor Off when the IHKS control module senses that evaporator temperature has dropped to approximately 3°C (or under full load as with the previous ECM systems).
**EVAPORATOR TEMPERATURE SENSOR**

The evaporator temperature sensor is a long, thin probe which is inserted into the left side of the IHKS housing. The sensor is a Negative Temperature Coefficient (NTC) thermistor, whose resistance varies according to temperature.

The evaporator temperature sensor tip reaches several inches into the evaporator core, where an accurate measurement of the core’s temperature can be obtained.

**IHKS CONTROL MODULE**

The IHKS control module is mounted on the system housing:
- Z3 on driver’s side
- 318ti on the passenger’s side

The IHKS control module’s scope of function is to monitor the evaporator temperature sensor signal and notify the ECM to switch off the compressor if the evaporator is close to freezing temperature (3°C).

**EXPANSION VALVE**

The expansion valve of the IHKS system is accessible from inside the vehicle in the passenger’s footwell area.

To access the expansion valve, a housing cover must first be removed. The expansion valve is installed in the IHKS housing. Sound deadening putty is packed around the expansion valve to minimize noise. Remove the putty to access the mounting bolts.

When reinstalling the valve, make sure a sufficient quantity of putty is packed around the expansion valve to prevent a future noise complaint.
FAN SPEED CONTROL

318ti

Fan speed is controlled using a four-position switch and a resistor pack to vary blower motor voltage. The resistor pack is mounted on the heater case in the air stream for cooling purposes.

The resistor pack is accessible from the engine compartment with the microfilter removed. To access the microfilters, remove the air inlet grille at the center of the cowl. Unscrew the air inlet bulkhead panel and plastic cover. Pull the bulkhead panel from engine compartment and remove the exposed microfilters.

The fan switch is the master controller for the system. In the 0 position, the A/C compressor is switched off, the recirc flaps are opened, and the fresh air flaps are closed.

In fan speeds 1, 2 and 3, the blower motor’s speed is cut back with the resistor pack. In speed 4, the blower motor receives full battery voltage.

The recirc LED over the button will remain On when the fan switch is Off to indicate the recirc mode. There is no possibility of fresh air in the cabin with the fan switch Off.

The fresh air/recirc flaps are controlled with one motor. The fresh air flaps are open until the recirc button is pressed or the fan switch is switched Off.
The resistor pack in the Z3 IHKS is located on the blower motor. It's accessible from the engine compartment. Remove the blower motor cover. Unclip the resistor pack from the blower motor and pull outward.

On the Z3, the fan switch controls only the fan speed. It has no influence on the recirculating air function as it does on the 318ti. The fresh air flaps remain open when the switch is in the 0 position. If the recirculating air or “snowflake” button is pressed with the fan switch in the 0 position, the fan will automatically run at very slow speed.
IHKS DIAGNOSIS

The IHKS system is not connected to the diagnostic link. Conventional troubleshooting methods are used for diagnosis/troubleshooting problems with this system.

The best diagnostic tool you can have is a thorough understanding of the system’s individual components and the way they work. You should know which inputs affect which outputs, and how the ECM and IHKS module will respond if an input is outside allowable values.

Also, know how to use the resources available to you:

• Electrical Troubleshooting Manuals (ETMs).

• Service-Information Bulletins.

• Diagnosis and Information System (DIS). Refer to the DIS for repair manual procedures, technical data, etc.

• If insufficient cooling is the complaint, make sure the water valve is actually closing. Technician Tip: have an assistant turn the temperature knob from the Full Hot to the Full Cold position and back several times. Use a stethoscope to listen to the water valve, to make sure it is actually closing, and check temperature of heater hoses.

• Check high-side and low-side pressures when the compressor is operating.

• When leak checking, look for wet spots on the hoses or at fitting connections.
IHKS CONTROL
SYSTEM DIAGNOSIS

Start all diagnosis of the IHKS control system with the “IHKS Function Check.” The function check leads to a specific chart or test. Finish all diagnosis by repeating the “IHKS Function Check” to ensure correct diagnosis.

Some diagnostic procedures require the ignition switch to remain On for extended periods of time. Low battery voltage may result, causing incorrect voltage readings. If vehicle system voltage becomes low, connect a battery charger to the electrical system and apply a slow charge while testing.

Most intermittent failure, check suspect circuits for:

- Poor mating of connector halves or terminals backed out.
- Dirt or corrosion on the terminals.
- Improperly formed or damaged terminals.
- Poor terminals-to-wire connection
IHKS FUNCTION CHECK

The following procedures check the IHKS control system. All the steps can be performed without using tools. Detailed diagnostic procedures follow the system check and are referenced in each step.

Complete this check with the temperature outside the vehicle at 60° F or higher, and with the engine running.

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<th>NORMAL RESULT</th>
<th>FOR DIAGNOSIS REFER TO:</th>
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<td>1. “Snowflake” button: off. Fan speed control switch: 0.</td>
<td>● Blower is not running.</td>
<td>Symptom Table E</td>
</tr>
<tr>
<td>3. Increase fan speed control switch from 1 to 4.</td>
<td>● Increased air flow, at each step.</td>
<td>Symptom Table E</td>
</tr>
<tr>
<td>5. “Snowflake” button: off. Air temperature control knob: full cold. Fan speed control switch: 4. Toggle the recirculating air control button on and off.</td>
<td>● Air flows from the windshield outlets. ● Blower noise increases when the recirculating air control button is on and decreases when it is off.</td>
<td>Chart D Chart H</td>
</tr>
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</table>
IHKS SYSTEM DIAGNOSIS

- Ambient temperature must be at least 50°F (10°C).
- Start the engine and allow it to reach normal operating temperature.
- Push the "Snowflake" button.
- Turn the air temperature control knob to the coldest position.
- Turn the fan speed control switch to position 4.

What is the system status?

BOTH THE BLOWER AND THE A/C COMPRESSOR OPERATE.

What is the owner's complaint? Refer to:
- Insufficient cooling Chart B
- Insufficient heating Chart C

THE BLOWER DOES NOT OPERATE.

Refer to Symptom Table E, Blower Controls.

THE A/C COMPRESSOR DOES NOT OPERATE.

Refer to Chart A.

THE COMPRESSOR WORKS INTERVALLENTLY.

- Moisture in the system.
- Recover the refrigerant.
- Evacuate and recharge.
CHART A: A/C COMPRESSOR DOES NOT OPERATE

- Check for a loose or disconnected A/C compressor clutch coil connector. Is the connector loose or disconnected?

  NO

  YES
  - Repair the A/C compressor clutch connector. Does the A/C compressor operate?

  NO

  YES
  - With the engine off, attempt to rotate the A/C compressor clutch by hand. Is the compressor seized?

  NO

  YES
  - Recover the refrigerant and evacuate. Replace the A/C compressor. Replace the receiver/dryer. Recharge the system.

  NO

  YES
  - Check for A/C compressor clutch operation by connecting a fused jumper wire between the battery “+” terminal and the clutch coil pin 1, connector X163. Does the clutch engage?

  YES

  NO

  - Insufficient refrigerant charge. Leak test the system. Perform necessary repairs. Evacuate and charge the system.

  NO

  YES
  - Ignition switch on. Push the “Snowflake” button. Disconnect the pressure switch connector. Connect a fused jumper wire between the pressure switch connector pins 1 and 4. Does the clutch engage?

  NO

  YES

  NO

  YES
  - Remove the jumper wire. Check the system high-side pressure. Is it above 22 psi?

  NO

  YES
  - Connect a fused jumper wire from the A/C compressor housing to a good ground. Does the clutch engage?

  NO

  YES
  - Ignition switch on. Push the “Snowflake” button. Disconnect the pressure switch connector. Connect a fused jumper wire between the pressure switch connector pins 1 and 4. Does the clutch engage?

  NO

  YES
  - Replace the pressure switch. Refrigerant recovery is not required.

  NO

  YES
  - Electrical problem: refer to Chart D.

  NO

  YES
  - Repair the ground circuit problem.
CHART B: A/C INSUFFICIENT COOLING

- Check the outer surface of the condenser for dirt, leaves, or any other material that may restrict air flow. Remove material as necessary.
- Check the area between the condenser and the radiator for dirt, leaves, or other material that may restrict air flow. Remove material as necessary.
- Check the condenser and refrigerant lines/hoses for dents, kinks, or other restrictions. Replace any damaged components.
- Check the condenser, refrigerant lines/hoses, and all component connections for evidence of refrigerant leaks (oil residue, dirt accumulation, etc.). Repair or replace damaged components.
- With the A/C compressor operating, compare the clutch hub speed with the pulley speed. (Make chalk marks on the hub and pulley.) If clutch slippage is indicated, replace the clutch.
- With the “Snowflake” button pressed, the fan speed control switch in position 1, and the engine idling, check for auxiliary fan operation. The auxiliary fan should be operating.

Is any problem noted?

NO

- Ambient temperature must be 70°F (21°C) or above.
- The engine should be idling at normal operating temperature.
- The hood and all body doors should be open.
- Push the “Snowflake” button, turn the air temperature control knob to the coldest position and turn the fan speed control switch to position 4.

YES

- Repair as necessary.

Carefully touch the condenser outlet pipe. Does the condenser outlet pipe feel warm?

YES

- Have an assistant turn the air temperature control knob from full hot to full cold and back several times.
- Using a stethoscope, listen to the water valve.
- Does it open and close?

NO

- There may be a restriction in the high side of the system.
- Look for frost in the condenser or high pressure lines; frost indicates the location of the restriction.
- Recover the refrigerant.
- Repair the system as required.
- Evacuate and charge the system.

(Continued on next page)
CHART B: A/C INSUFFICIENT COOLING (Cont.)

(Continued from previous page)

YES

- Push the “Snowflake” button on. Turn the air temperature knob to the coldest position. Turn the fan speed control switch to 4.
- Close all windows and doors of the vehicle.
- Place a high-capacity fan in front of the vehicle to blow air through the condenser.
- Run the engine at 1500 RPM.
- Install a thermometer in the vehicle A/C outlet and check system performance according to the chart on the next page, after 5 minutes operation.
- Compare the high and low side pressures with the pressures on the Ambient Temperature/Relative Humidity Reference Chart.

Are pressures and outlet temperatures normal?

YES

- Continue diagnosis with “IHKS Controls Diagnosis.”

NO

- Troubleshoot the water valve circuit. Refer to Chart G.

Refer to “Insufficient Cooling, Abnormal Gauge Pressure Readings” on page 19.
CHART C: INSUFFICIENT HEATING

- Perform the IHKS Function Check to verify that the air temperature control, fan speed control switch, and air intake portions of the A/C system are operating properly.
- Check for air entry into the passenger compartment through missing or mispositioned grommets (e.g. steering shaft, hood release cable, wiring harness pass-throughs) and door seals. Repair as required.

- With the engine cool and turned off, check the coolant level in the reservoir. Is the coolant level low?

  - NO
  - Hook up the DIS.
  - Start the engine and read the engine coolant temperature from the Status List.
  - Does the coolant temperature increase steadily to normal operating temperature (about 195°F (90°C)) within 15 minutes?

    - YES
    - Turn the air temperature control knob to full hot.
    - Feel the inlet and outlet hoses of the heater core.
    - Do both the inlet and outlet hoses feel hot?

      - YES
      - Repair/adjust the cable/air blending flap mechanism.

      - NO
      - Repair/adjust the cable/air blending flap mechanism.

    - NO
    - Check for signs of leakage.
    - Repair as required.
    - Fill and bleed air from the coolant system.

  - NO
  - The thermostat is faulty.
  - Remove and test the thermostat.

- Turn the air temperature control knob from the full hot to the full cold position and back. Can you hear the air blending flap thump against its end stops?

  - NO
  - No problem found. Compare with a known good vehicle.

  - YES
  - Troubleshoot the water valve circuit. Refer to chart G.

- NO
- Check for a blockage in the heater core.

- YES
- Have an assistant turn the air temperature control knob from the full hot to the full cold position and back several times
- Using a stethoscope listen for the valve opening and closing.
  - Can you hear the valve operate?
CHART D: COMPRESSOR CLUTCH DOES NOT ENGAGE

- Do tests only when the outside temperature is above 16°C (60°F).
- Ignition switch: off.
- Pressure switch connector: Disconnected.
- "Snowflake" button: on.
- Fan speed control switch: 1.
- Start engine.
- Connect a fused jumper across pressure switch connector pins 1 and 4.

CLUTCH DOES NOT ENGAGE

- Replace the pressure switch.

CLUTCH ENGAGES

BATTERY VOLTAGE

- Remove the fused jumper from the pressure switch connector and reconnect the connector.
- Disconnect the evaporator temperature sensor connector.
- Check the continuity of the BRN wire from the evaporator temperature sensor connector to the IHKS control module.
- Measure the voltage at the evaporator temperature sensor connector pin 1.

LESS THAN BATTERY VOLTAGE

(Continued on page 22)

8 VOLTS

- Back probe the IHKS control module.
- Measure the voltage at pin 6. It should be 8V.
- If the voltage at terminal is less than 8V, replace the IHKS control module.
- If the voltage is 8V, check the .5 GRN wire for an open or short to ground.

LESS THAN 8 VOLTS

- Reconnect the evaporator temperature sensor.
- Disconnect the compressor control relay.
- Measure the voltage between the compressor control relay connector pin 6 and ground.

(Continued on page 22)
CHART D: COMPRESSOR CLUTCH DOES NOT ENGAGE (Cont.)

(Continued from page 21)

A

- Disconnect the pressure switch connector.
- Measure the voltage between pressure switch connector pin 4 and ground.

BATTERY VOLTAGE

LESS THAN BATTERY VOLTAGE

- Find the open in the .5 BLU/BLK wiring between the pressure switch and the IHKS control module.
- Check for an open or short to ground in the circuit between the pressure switch and the ECM.
- Check the ECM.

(Continued from page 21)

B

BATTERY VOLTAGE

LESS THAN BATTERY VOLTAGE

- Connect a fused jumper across the compressor control relay connector pins 6 and 2.
- Check the wire from fuse F39 (7.5A) for an open or short to ground.
- Check fuse F39 in the front power distribution box.

CLUTCH ENGAGES

CLUTCH DOES NOT ENGAGE

- Measure the voltage between the compressor control relay connector pin 4 and ground.
- Disconnect the compressor clutch connector X163.
- Check the associated wiring for an open or short to ground.
- Check the compressor temperature switch for an open.
  If OK, replace the compressor clutch.

BATTERY VOLTAGE

LESS THAN BATTERY VOLTAGE

- Measure the voltage between the compressor control relay connector pins 4 and 5.
- Check the wire from fuse F16 (5A) for an open.
- Check fuse F16 in the front power distribution box.

BATTERY VOLTAGE

LESS THAN BATTERY VOLTAGE

- Replace the compressor control relay.
- Check the .5 BLK/BLU wiring for an open.
- Check the ECM connector pin 48 for proper pin contact.
- Check inline connector X20 (pin 4) for proper contact.
- Check the ECM.
## SYMPTOM TABLE E: BLOWER CONTROLS

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<th>ACTION</th>
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<tr>
<td>Blower runs continuously with fan speed control switch in position 0 (ignition switch on).</td>
<td>Replace the blower switch.</td>
</tr>
<tr>
<td>Blower does not run in one of the fan speed control switch positions 1, 2, or 3.</td>
<td>Disconnect the blower resistor assembly; measure the voltage at the corresponding terminal of the connector. If battery voltage is present, replace the resistor assembly. If not, troubleshoot the fan speed control switch and wiring to the resistor assembly.</td>
</tr>
<tr>
<td>Blower does not run in position 4.</td>
<td>Troubleshoot the fan speed control switch and the wiring to splice X906.</td>
</tr>
<tr>
<td>Blower does not run in any speed.</td>
<td>Refer to Chart F.</td>
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## CHART F: BLOWER RELAY TEST

- Ignition switch On.
- Fan speed control switch in position 1.
- Disconnect the blower relay.
- Connect a fused jumper across blower relay connector pins 6 and 2.

**BLOWER DOES NOT RUN**

- Check fuse F20 in the front power distribution box.
- Check the continuity of the wiring from fuse F20 to the blower relay.
- Check the continuity of the 2.5 GRN/BRN wire from the blower relay to the blower switch.
- Check in-line connector X35 (pin 2) for proper contact.
- If OK, replace the fan speed control switch.

**BLOWER RUNS**

- Check for battery voltage at blower relay connector pin 8.
- Check for continuity to ground at blower relay connector pin 4.
- If OK, replace blower relay.
CHART G: INSUFFICIENT COOLING/HEATING
FLAP/VALVE TEST

- Ignition switch off.
- Listen to the air blending flap as the air temperature control knob is moved from the full cold to the full hot position.

Does the air blending flap thump against its full cold and full hot end stops?

YES

- Start the engine.
- Turn the air temperature control knob from the full hot to the full cold position.
- Using a stethoscope, listen to the water valve. It should close when the knob is turned to the coldest 20% of its travel.

Can you hear the water valve close?

NO

- Disconnect the water valve connector.
- With the air temperature control knob in the full cold position, measure the voltage at the water valve connector pin 1.

BATTERY VOLTAGE

- Water valve connector disconnected.
- Air temperature control knob in the full-cold position.
- Check the continuity to ground at the water valve connector pin 3.

NO CONTINUITY

- Remove the IHKS control panel.
- Disconnect the air temperature control switch.
- Measure the resistance between pin 2 of the air temperature control switch connector and ground.

LOW/0 RESISTANCE

- Check the air temperature control switch.

CONTINUITY OK

- Continue diagnosis with chart A.

HIGH/INFINITE RESISTANCE

- Check for an open in the ground circuit.

NO

- Remove the trim panel under the passenger side of the instrument panel.
- Check that the temperature control cable is attached to the blend flap lever.

LESS THAN BATTERY VOLTAGE

- Check fuse F23 (5A) in the front power distribution box.
- Check continuity of the .5 GRN/YEL and .5 YEL wiring from the fuse to the water valve.
- Check in-line connectors X35 (pin 4) and X85 (pin 1) for proper contact.

- Continue diagnosis following chart A.
**CHART H: AIR INTAKE**

- Ignition switch on.
- Fan speed control switch in position 4.
- Push the recirculating air control button on.

Does the fresh air/recirc flap move to the recirculating air position?

**NO**
- Disconnect the fresh air/recirc flap motor.
- Measure the voltage at pin 1 of the fresh air/recirc flap motor connector.

**BATTERY VOLTAGE**
- Measure the voltage at pin 3 of the fresh air/recirc flap motor connector.

**LESS THAN BATTERY VOLTAGE**
- Check fuse F23 (5A) in the front power distribution box.
- Check the .5 GRN/YEL wire for an open.
- Check terminal 1 for proper pin contact.

**YES**
- System operates correctly.

**BATTERY VOLTAGE**
- Check the ground for continuity at pin 2 of the fresh air/recirc flap motor connector.

**CONTINUITY**
- Replace the fresh air/recirc flap motor.

**LESS THAN BATTERY VOLTAGE**
- Check the .5 RED/YEL wire from the recirculating air control button to splice X10233 for an open.
- Check the .5 RED/YEL wire from splice X10233 to pin 3 of the fresh air/recirc flap motor connector for an open.
- Check pin 3 for proper pin contact.
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Revision Date: 12/00
IHKS - Heating and Air Conditioning

Purpose of the System

An integrated heating/air conditioning control system (IHKS) is used in the Z8 to provide the driver and passenger a comfortable atmosphere regardless of conditions outside the vehicle. The heater/air conditioner is designed as an air-based control. 6 actuators are used to distribute the air and control the temperature.

System Components

The IHKS consists of the following main components:

- Electronic Control panel/module with integrated fresh air grille
- Heater/air conditioner unit
- Five actuators (bus stepper motors) for controlling the recirculated air, temperature mixing, defroster, face vent and foot-well flaps
- One actuator (high speed stepper motor) for controlling the fresh air flap
- Electric shut-off water valve
- Electric auxiliary water pump
- Refrigerant pressure sensor
- Evaporator temperature sensor
- Rear window defogger relay
- Series resistors for blower motor