TABLE OF CONTENTS

Subject **Page**

WATER VALVES

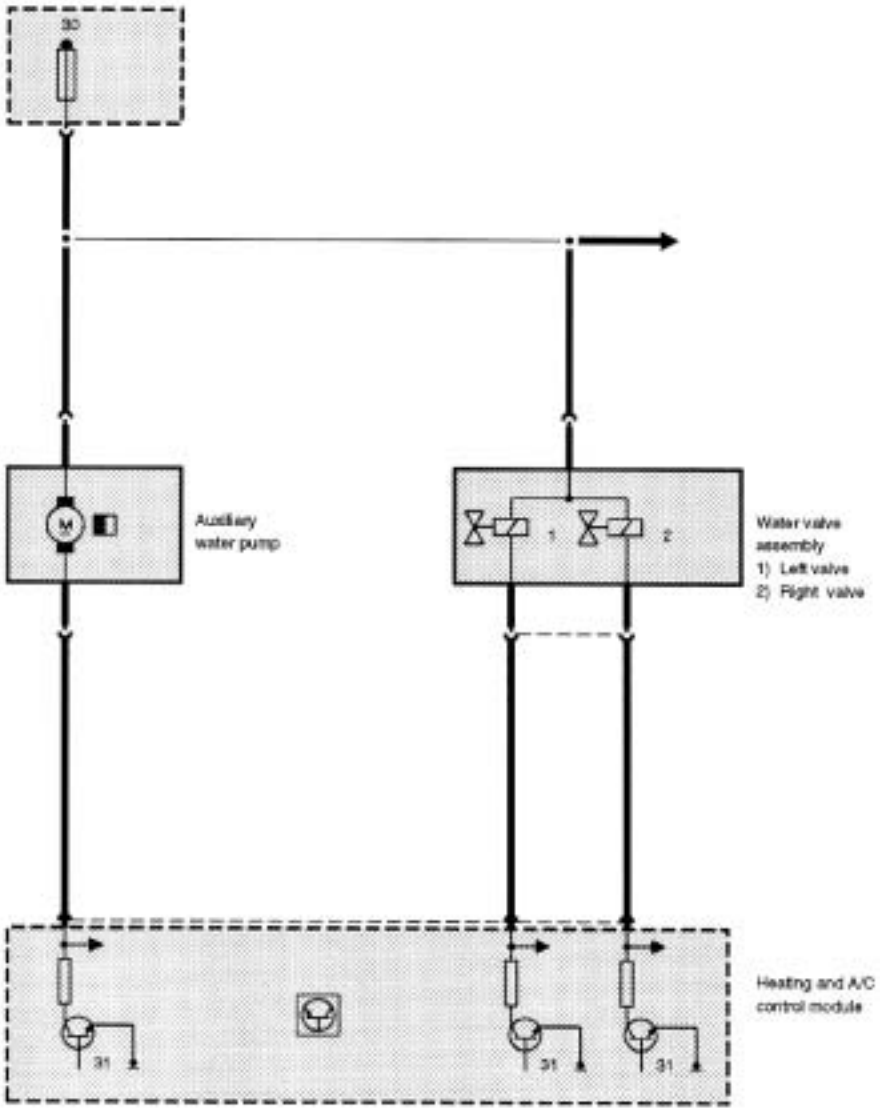
Temperature regulation on IHKA systems is accomplished by solenoid actuated water valve(s). The valve(s) are normally held open by spring pressure (failsafe), and are electrically closed by pulses from the IHKA control module to regulate the flow of hot coolant to the heater core(s).

The water valve(s) are pulsed according to the Y-factor, which is calculated from the following inputs:

- Desired temperature request (left and right if equipped)
- Interior temperature
- Heater core temperature(s)
- Ambient air temperature
- Blower speed request

When the desired temperature calls for maximum heat, the water valve(s) do not receive pulses and are mechanically sprung open.

Similarly, when maximum cooling is requested, the IHKA control module powers the water valve(s) completely closed.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

_____

AUXILIARY COOLANT PUMP

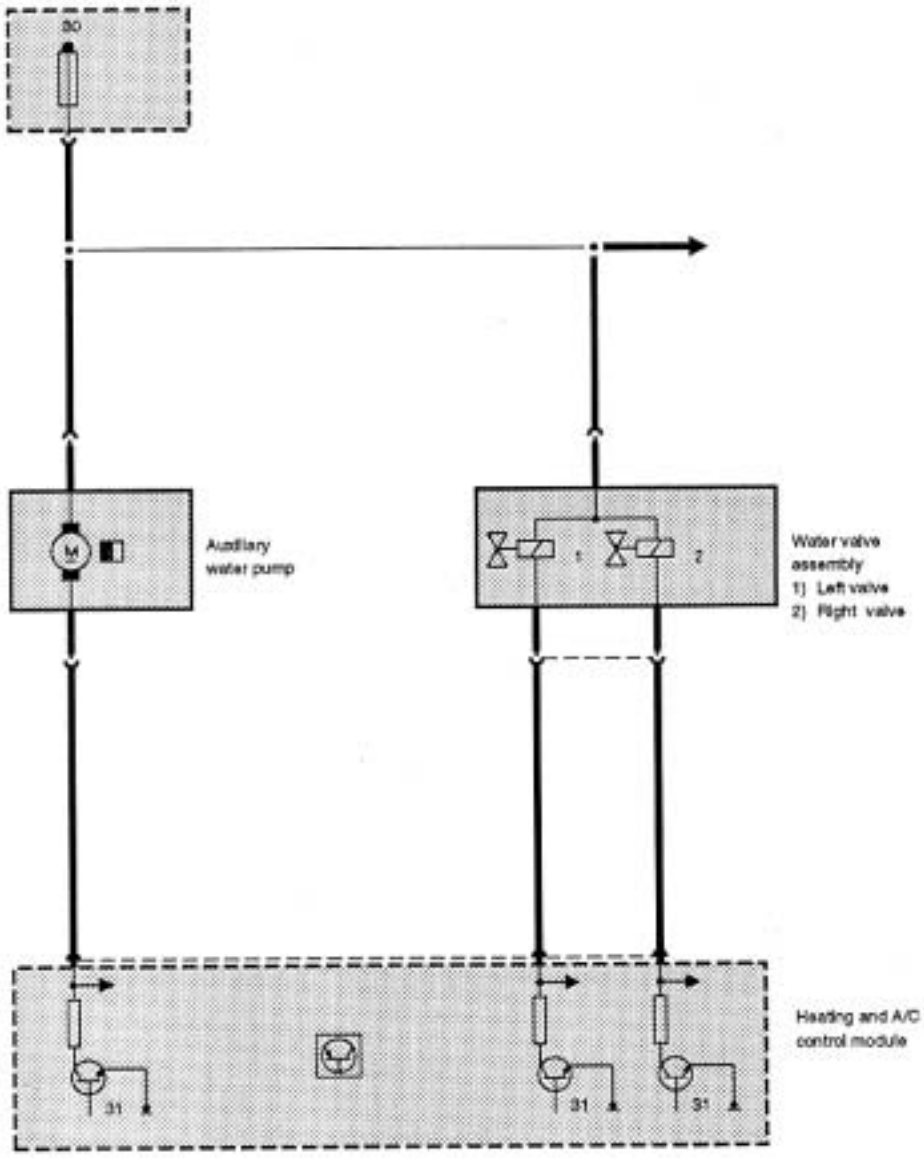
All models except E36/46 use an electrically powered auxiliary coolant pump to ensure that an adequate supply of hot coolant is always available to the heater core(s). The IHKA control module operates the pump directly (E31 uses a relay) by supplying the ground circuit.

Pump “ON” operating criteria (E38 shown as an example):

- Engine coolant temperature > 32ºF (supplied via K-Bus on E38/39/46)
- Y-factor > 5%
- Maximum defrost mode selected
- Maximum heating requested
- “REST” function requested

Pump “OFF” when:

- Engine coolant temperature < 32ºF and either Y-Factor < 0%, unless other inputs call for pump operation



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

_____

BLOWER SPEED SIGNAL

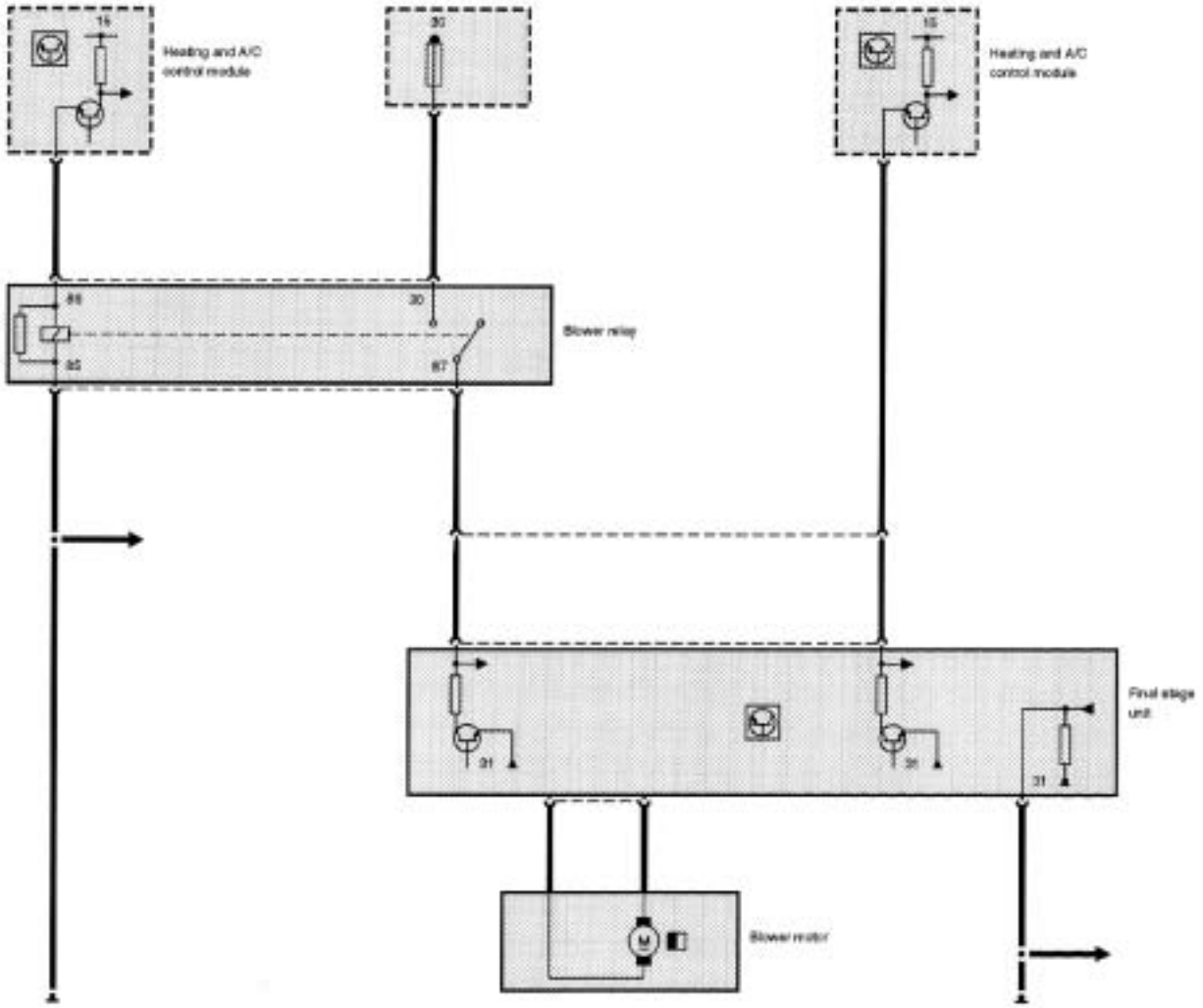
The blower speed is controlled by the IHKA control module regulating (varying) the ground circuit through the use of transistors (final stage unit).

The IHKA control module determines the appropriate blower speed using these primary inputs:

- Blower control thumbwheel/rocker switch inputs
- The “Y-factor”

In the case of the E38 (shown), each of the blower speed requests are monitored by the IHKA control module. The control module always runs the blower at the **higher** selected speed to ensure adequate air flow through the interior. The outlet flap opening will be reduced on the side requesting less blower speed.

NOTE: Some models do not use a blower relay.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

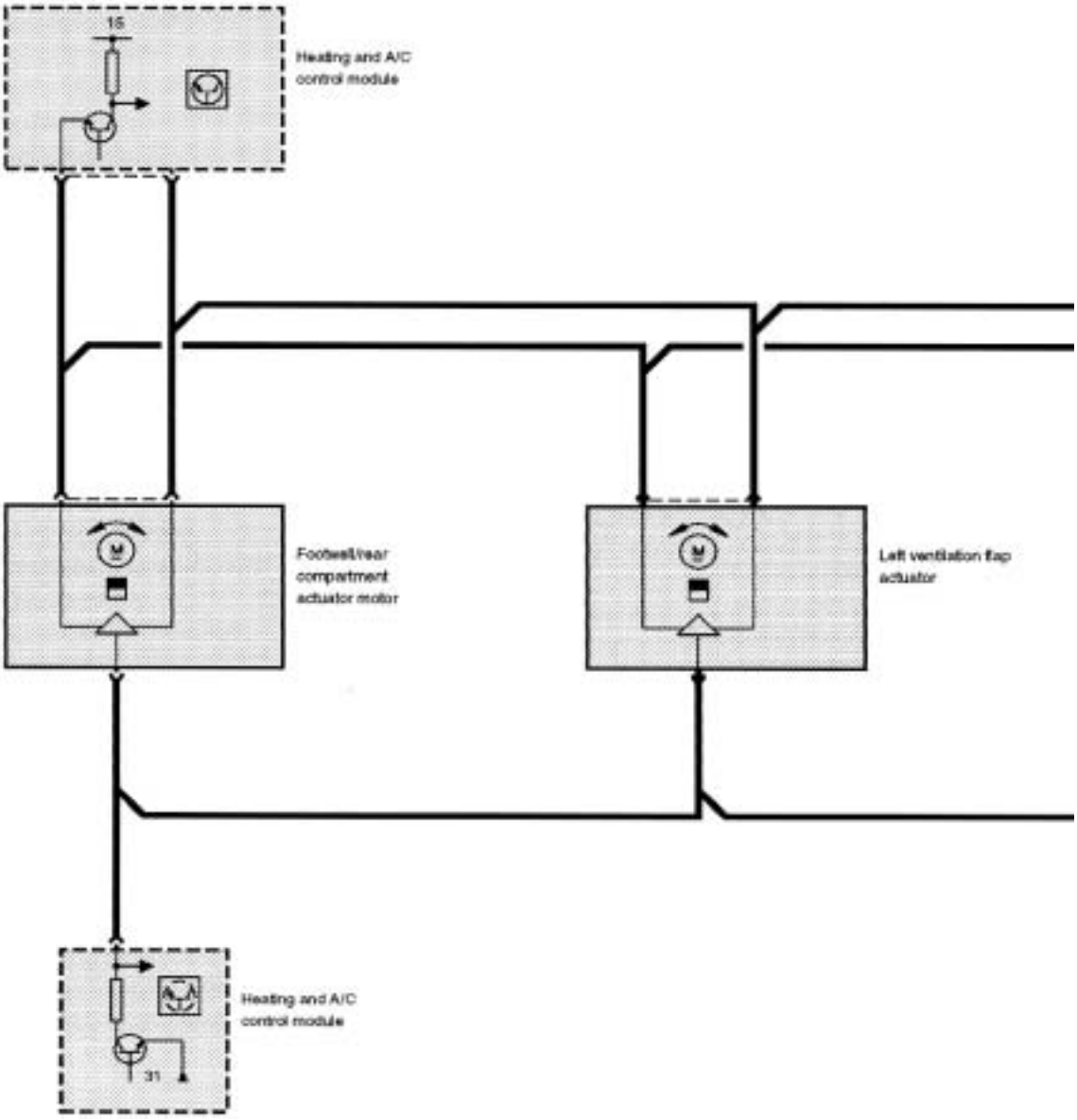
_____

STEPPER MOTOR CONTROL

Stepper motors are installed in the system to provide infinitely variable operation of the air outlet flaps for automatic climate control. M-Bus (3 wire flat harness) controlled motors are used to operate all flaps, with the exception on some models of a dedicated fresh air motor and circuit.

Each of these motors features its own electronic circuitry and is electrically coded, indicating that installation is unique to a specific flap.

These type of stepper motors receive power and ground on two of the terminals, and coded operating instructions on the third. The instructions are digital signals (500 Hz) that control opening or closing of the flaps. The microprocessor inside the stepper motor receives the instructions and converts them into pulses to operate the permanent magnet rotor.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

_____

COMPRESSOR CONTROL

Using the E38 (99 MY) for this test, activation of the compressor clutch is an output control function of the IHKA module. Activation is carried out directly through a final stage (no relay required).

If the evaporator temperature is above 37ºF (3ºC), and the refrigerant pressure sensor indicates acceptable pressure, the control panel/module then signals the ECM that it is about to activate the compressor. The IHKA module will then activate the compressor if a cancellation signal is not received from the ECM.

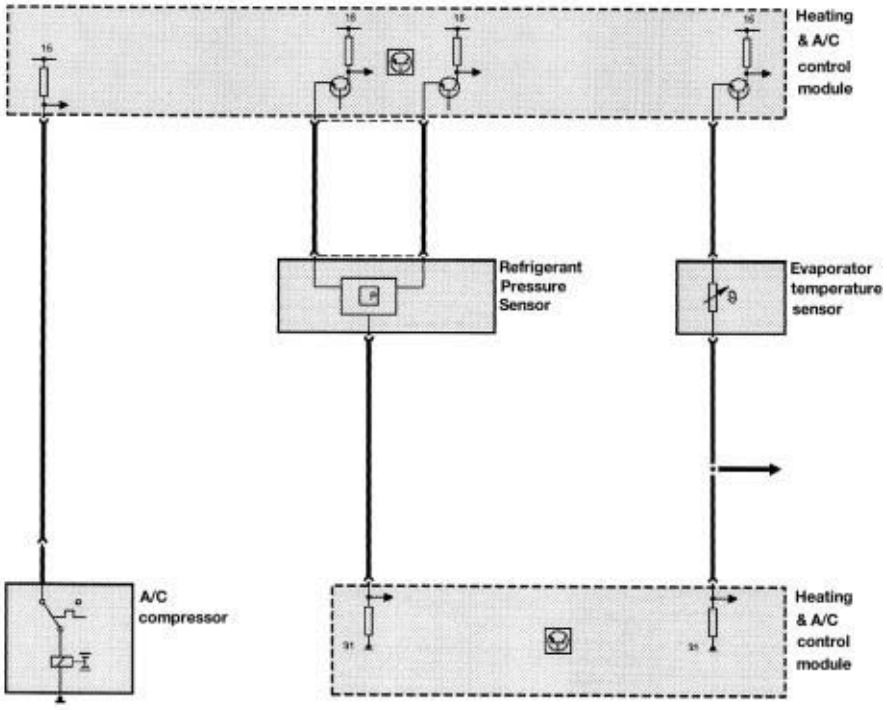
Additional criteria:

- If the “snowflake” button is on at engine start-up, the control module delays compressor clutch activation until the engine speed exceeds 600 RPM for at least 5 seconds.

- If the “snowflake” is switched off while the engine is running, the control module continues to cycle the compressor (with increasingly longer off times) for up to 15 minutes.

Compressor deactivation:

- ECM detects full load - signalling IHKA
- Evaporator temperature < 2ºC
- Coolant temperature > 120ºC
- Refrigerant pressure sensor indicates pressure is too low/high



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

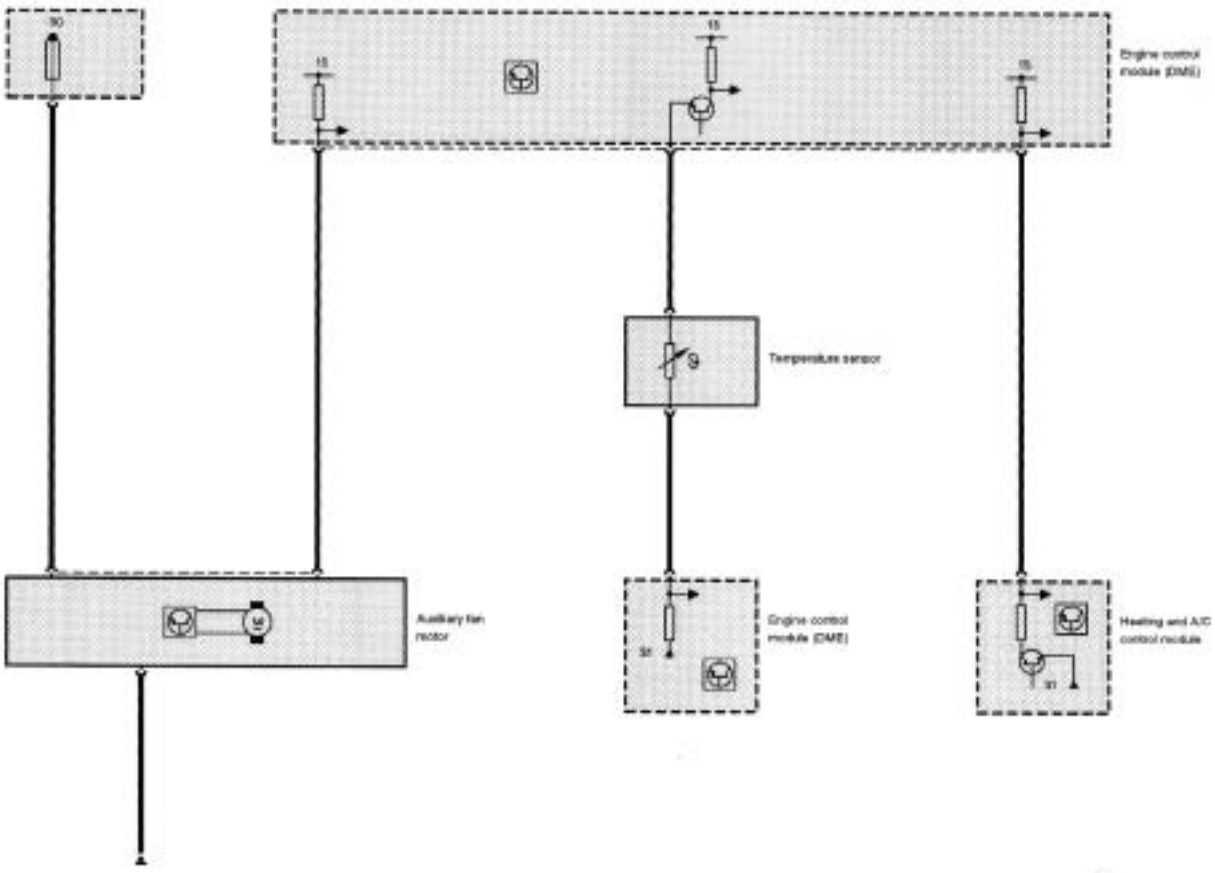
_____

AUXILIARY FAN CONTROL

Using a 99 MY vehicle (E38/39/46) for this test, the variable auxiliary fan is controlled by the ECM. The auxiliary fan request comes from the IHKA control module via the K-Bus. The fan speed request is based on the refrigerant pressure sensor input to the IHKA. Additional factors monitored by the ECM that influence fan operation are:

- Radiator outlet temperature sensor (exceeds the preset temperature)
- Vehicle speed
- Battery voltage level

The auxiliary fan motor incorporates an output final stage that activates the fan motor at variable speeds. The output stage receives an output signal (pulse width modulated 10-100 Hz) from the ECM which activates the motor.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

_____

REAR WINDOW DEFROSTER

Using the E38 as an example for this test, the rear window defroster operating strategy depends upon ambient temperature.

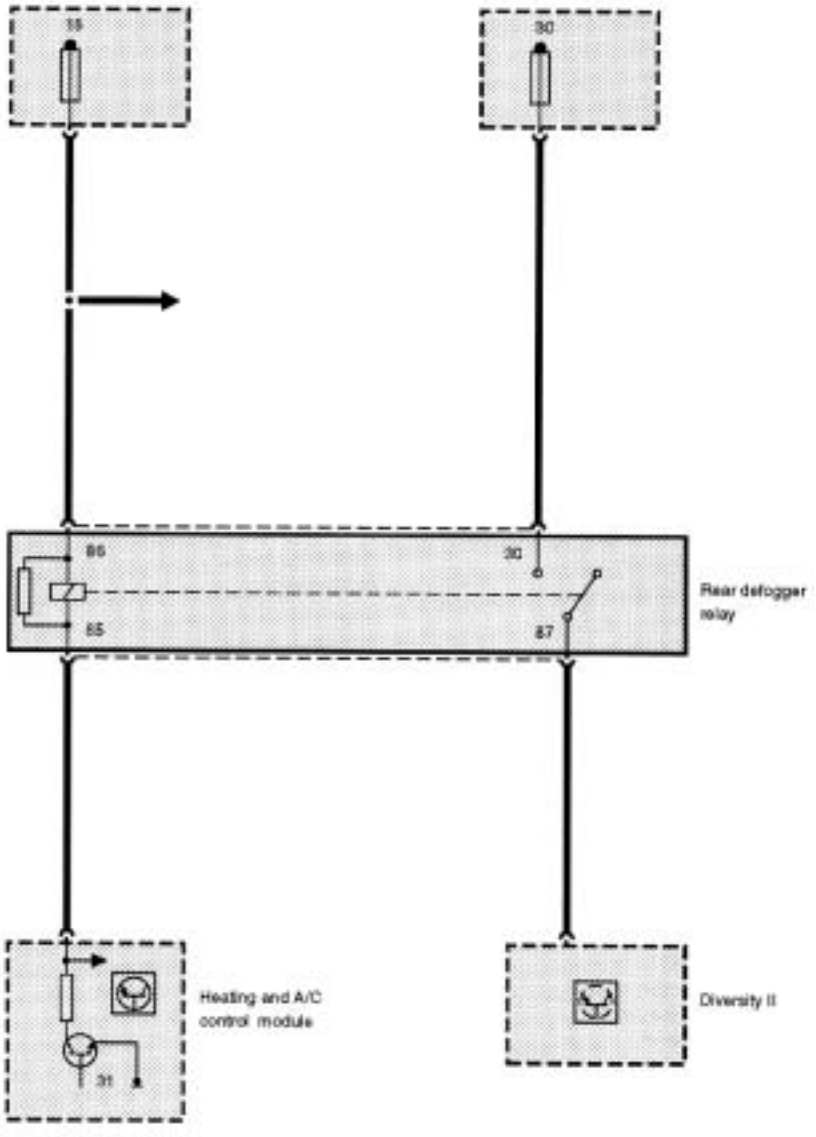
- If ambient temperature is < 5ºF (-15ºC), pressing the rear window defroster but ton (ignition switch in “Run”), requests the control module to activate the defroster for 17 minutes, and then switch it off.

- If the ambient temperature is > 5ºF (-15ºC), the control module acitvates the defroster for only 10 minutes before switching it off.

- Reactivating the defroster by pressing the button again will give an additional 5 minutes of defrosting, regardless of ambient temperature.

- If the ignition is switched “OFF” during defroster operation, the timer keeps operating and the defroster is deactivated. If the ignition is switched “ON” again with time remaining, the defroster is automatically reactivated until the timer runs out.

- If the battery voltage drops bellow 11.4 volts, the defroster automatically switched “OFF”, and will resume operation when the voltage rises above 12.2 volts.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

_____

WINDSHIELD BASE/ WASHER SPRAY JET HEATERS

Using the E38 as an example for this test, this circuit demonstrates that both heater systems are powered by the same relay.

- The lower portion of the windshield contains heating elements which when powered, prevent the wiper blades from freezing to the glass.

- The washer spray jet heaters are designed to prevent ice from forming on and obstructing the washer nozzles.

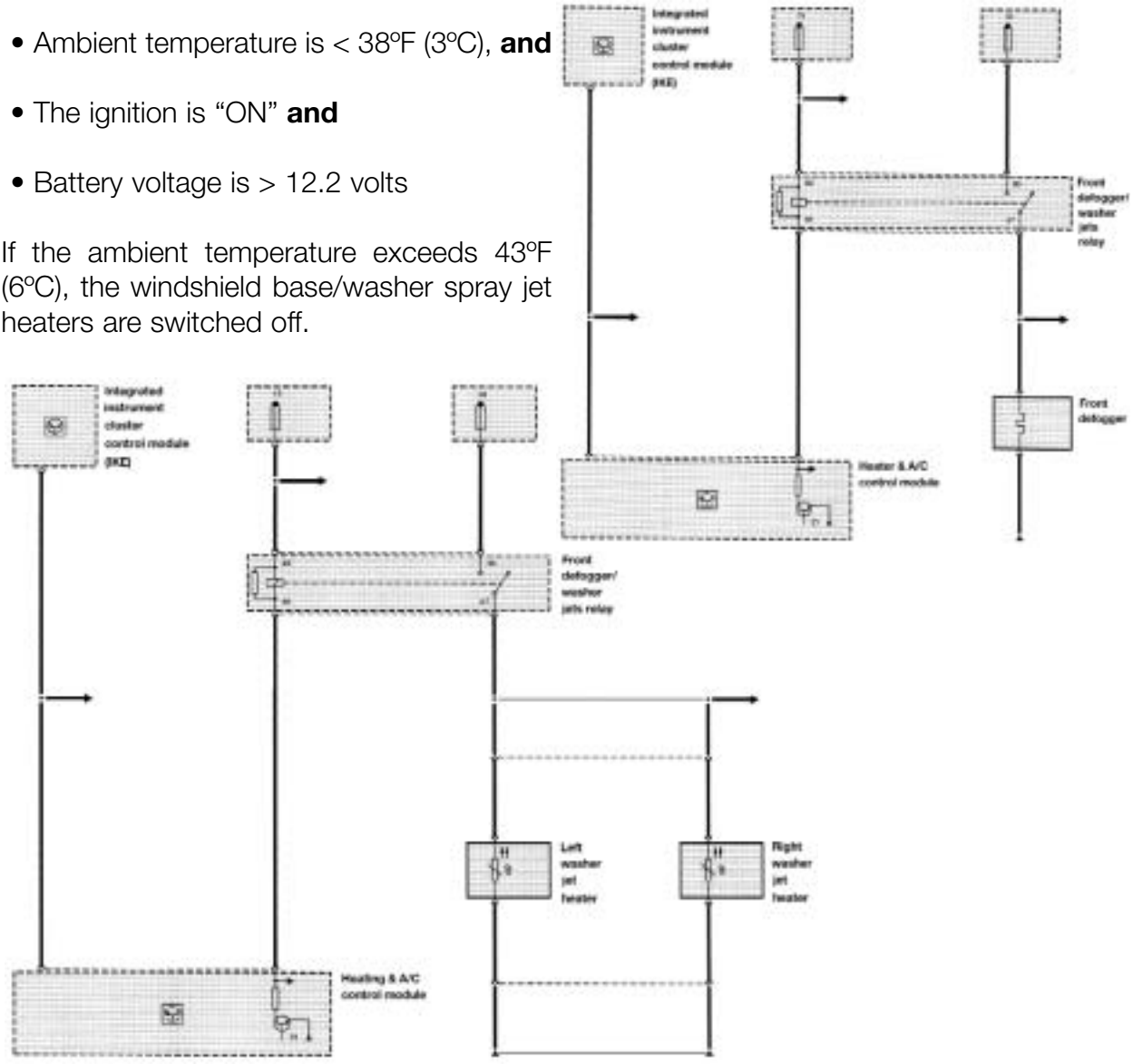
The control module monitors the signal from the ambient temperature sensor (K-Bus) and automatically activates the relay in this circuit when

- Ambient temperature is < 38ºF (3ºC), **and**

- The ignition is “ON” **and**

- Battery voltage is > 12.2 volts

If the ambient temperature exceeds 43ºF (6ºC), the windshield base/washer spray jet heaters are switched off.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

_____

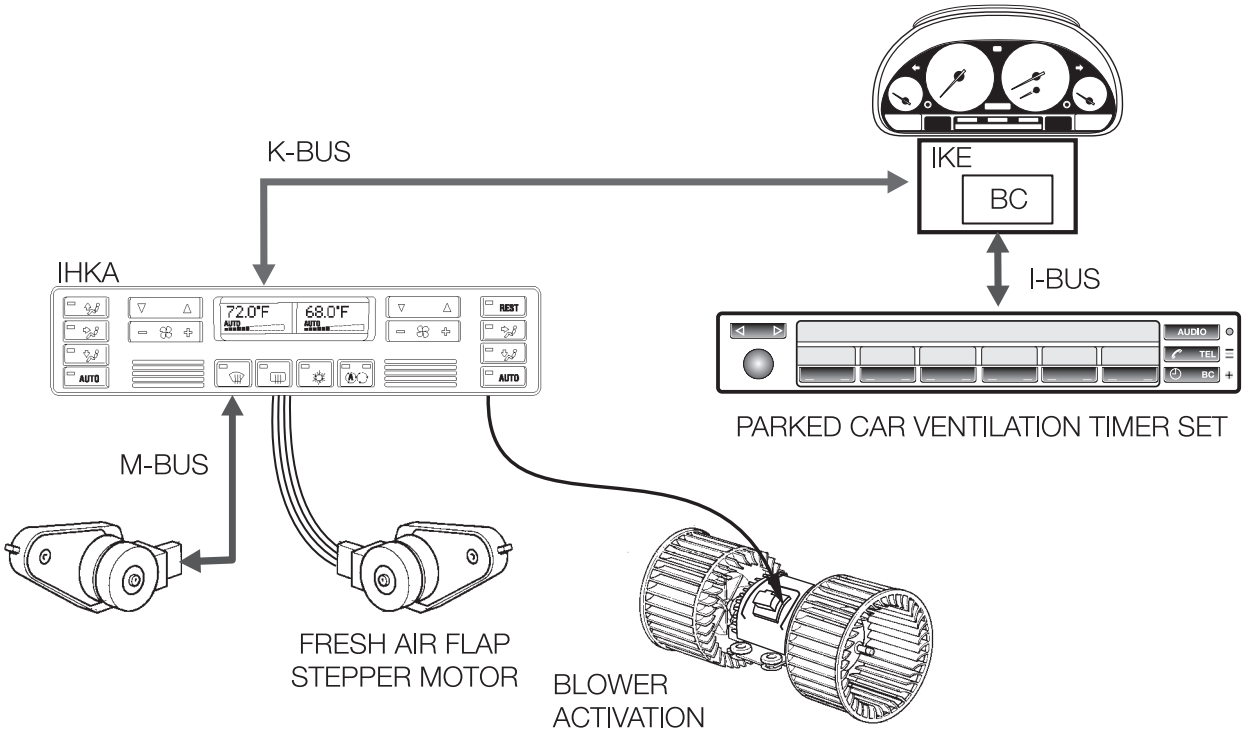
PARKED CAR VENTILATION

Parked car ventilation (if equipped), operates at pre-programmed times, the IHKA control module:

- Opens the fresh air flaps, face vent flaps, and
- Closes all other flaps, and
- Operates the blower motor at low speed for one-half hour

Using the E38 as an example:

- All switching is controlled directly by the IHKA control panel
- Desired ventilation “ON” times are programmed into the IKE On-Board Computer (BC) using the Multi-Information Display (MID)
- The BC in the IKE then communicates with the IHKA module over the I-Bus and the K-Bus



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

Notes: _____

_____

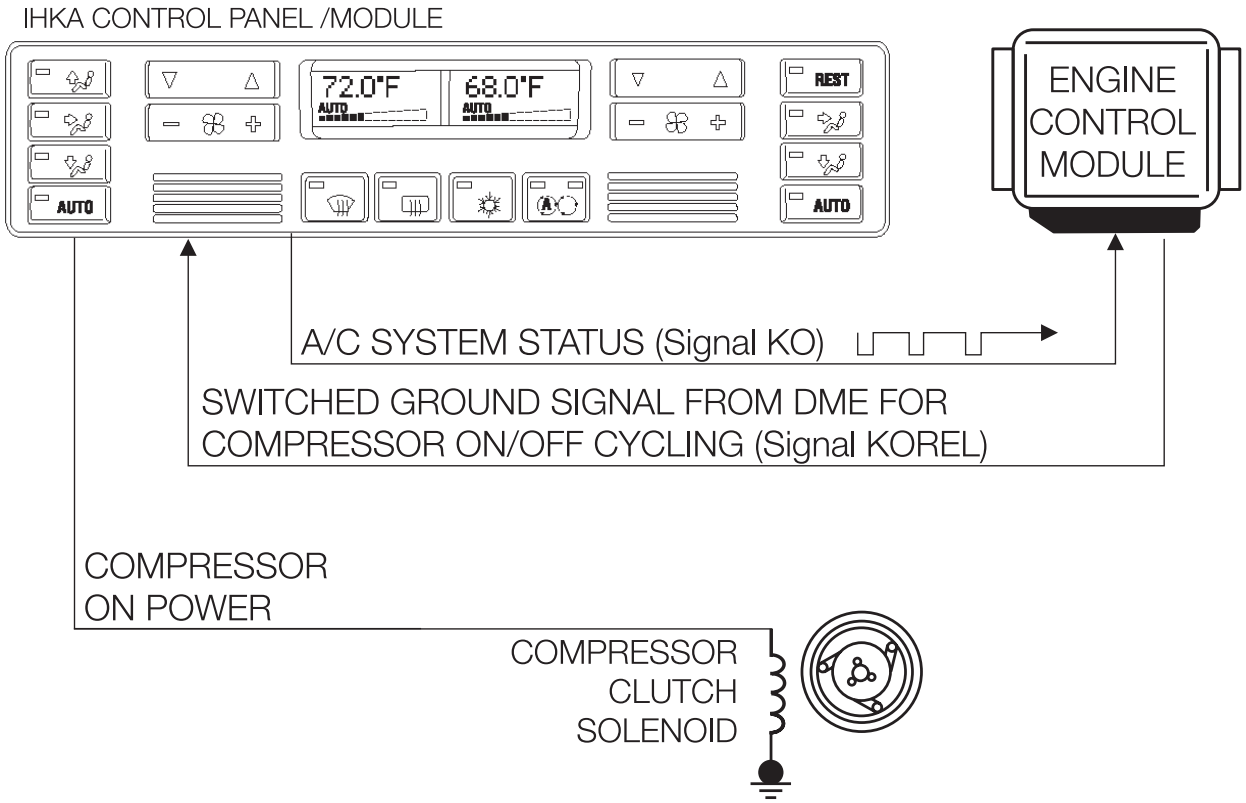
_____

IHKA/ECM INTERFACES

The IHKA signals the ECM when A/C is requested (KO signal), this alerts the ECM to stabilize idle speed (EML on 750iL) and compensate for the additional load. This signal is Pulse Width Modulated (5 Hz), which informs the ECM of the “get ready” request and the anticipated compressor load. On the 99 MY (E38/39/46), the A/C on signal is transmitted via the K-Bus/CAN-Bus.

On E38/39 models, the ECM sends a reply (KOREL) signal to the IHKA control module. If input conditions are correct, the IHKA will activate the A/C compressor. In addition this separate signal circuit is used to signal the IHKA to deactivate the compressor in the event that stand still full load conditions are present.

On E46/36 models, the A/C compressor relay is activated by the ECM.



NAME OF SIGNAL OR FUNCTION: _____

Vehicle: _____ **M.Y.:** _____ **System:** _____ **DIS CD Version:** _____

What type of output signal provides current to activate this circuit? ☐ Switched Power

☐ Switched Ground ☐ Pulse Width Modulated (PWM) ☐ Linear Voltage ☐ Linear Resistance ☐ Digital

Source: _____

How will the control system react if this signal becomes impaired or lost ?

_____

Substitute Value? ☐ Yes ☐ No **If yes what is it?** _____

Was a fault code(s) present with this defective signal/component? ☐ Yes ☐ No

If yes what is (are) the specific code(s)? _____

Does the DIS software provide a Status Display for this signal? ☐ Yes ☐ No

If "yes", what is it? _____

Is "component activation" possible with this signal/function? ☐ Yes ☐ No

If yes what does it do? _____

Does this help you with diagnosis? ☐ Yes ☐ No **Why?** _____

_____

Pin Numbers: What is the control module pin number for the signal? _____

Is there an associated ground wire? ☐ Yes ☐ No **If "yes", pin number?** _____

Are there any other signals/systems sharing the wire to consider? ☐ Yes ☐ No

If "yes" are there faults present in that system as well? ☐ Yes ☐ No

What is (are) the most suitable measurement(s) for this signal/component?

☐ Voltage ☐ Resistance ☐ Capacitance ☐ Inductance ☐ Temperature ☐ Current ☐ Pressure ☐ Scope

Signal Range?: _____ **Nominal Value?:** _____

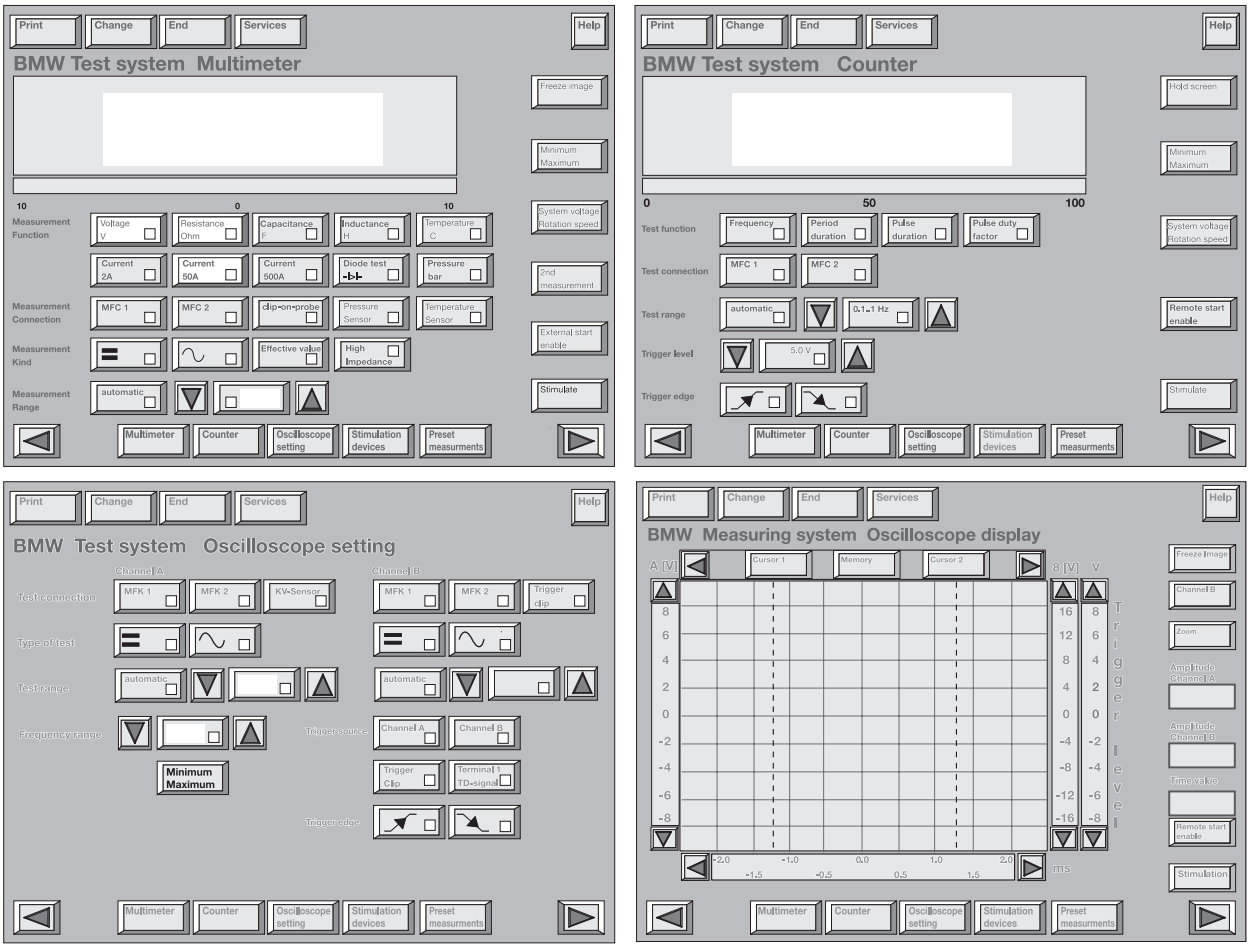
Notes: _____

_____

_____

MEASUREMENT SYSTEM WORKSHEET:

While connecting and setting up the DIS/MoDiC measurement system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.

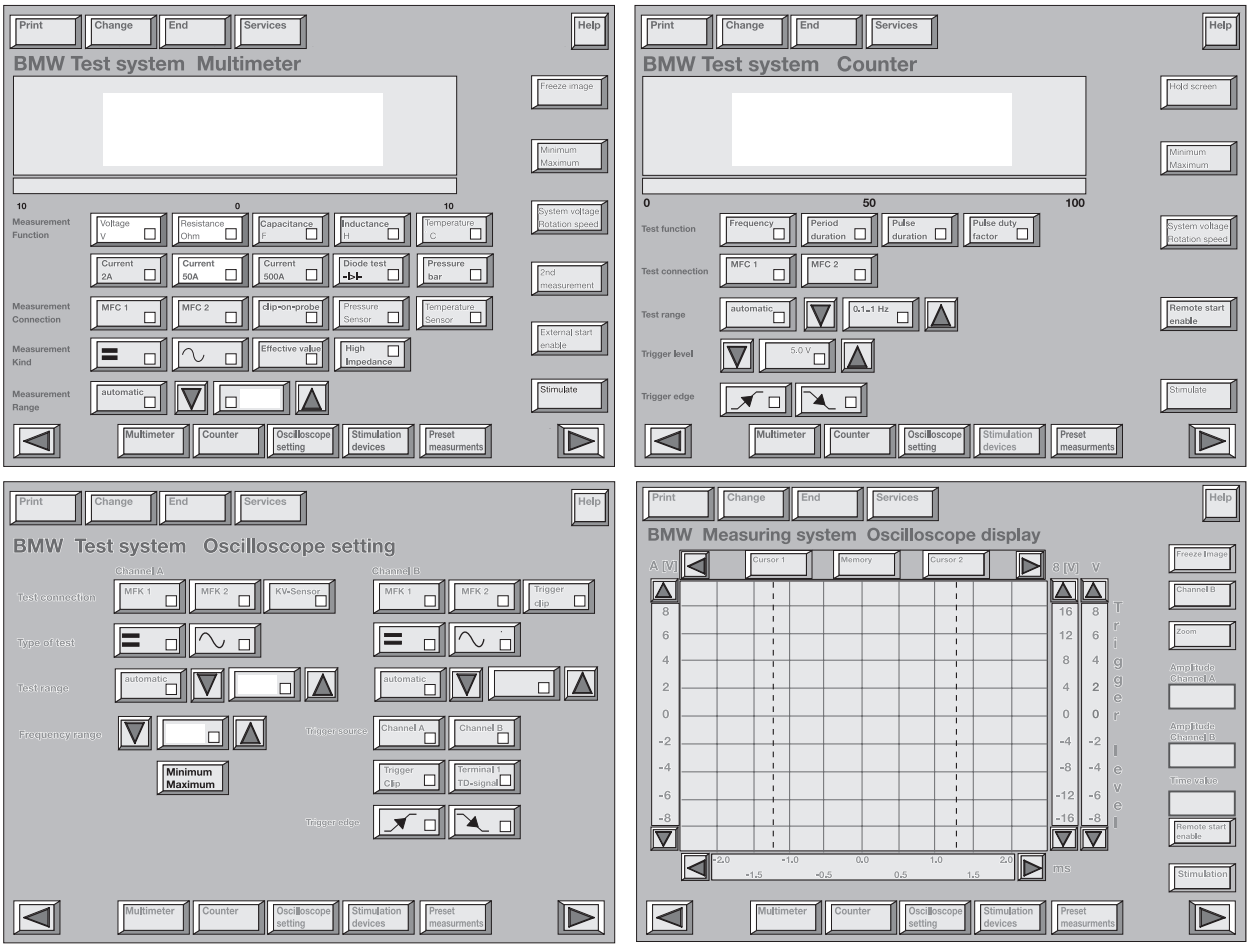


SUPPLEMENTAL ETM SCHEMATIC WORKSHEET:

Using your gained understanding of the signal and with the help of your instructor, supplement your ETM reference by sketching the circuit. Add the internal symbols (pin numbers, signal power supply, ground, final stage locations and signal monitor).

MEASUREMENT SYSTEM WORKSHEET:

While connecting and setting up the DIS/MoDiC measurement system for signal/circuit validation, note the settings in the appropriate locations for future reference. Document your findings by entering the displayed values in the Multimeter or Counter Display. If the signal requires the use of the oscilloscope, note your set up selections and sketch the waveform.



SUPPLEMENTAL ETM SCHEMATIC WORKSHEET:

Using your gained understanding of the signal and with the help of your instructor, supplement your ETM reference by sketching the circuit. Add the internal symbols (pin numbers, signal power supply, ground, final stage locations and signal monitor).

MEASUREMENT SYSTEM WORKSHEET:

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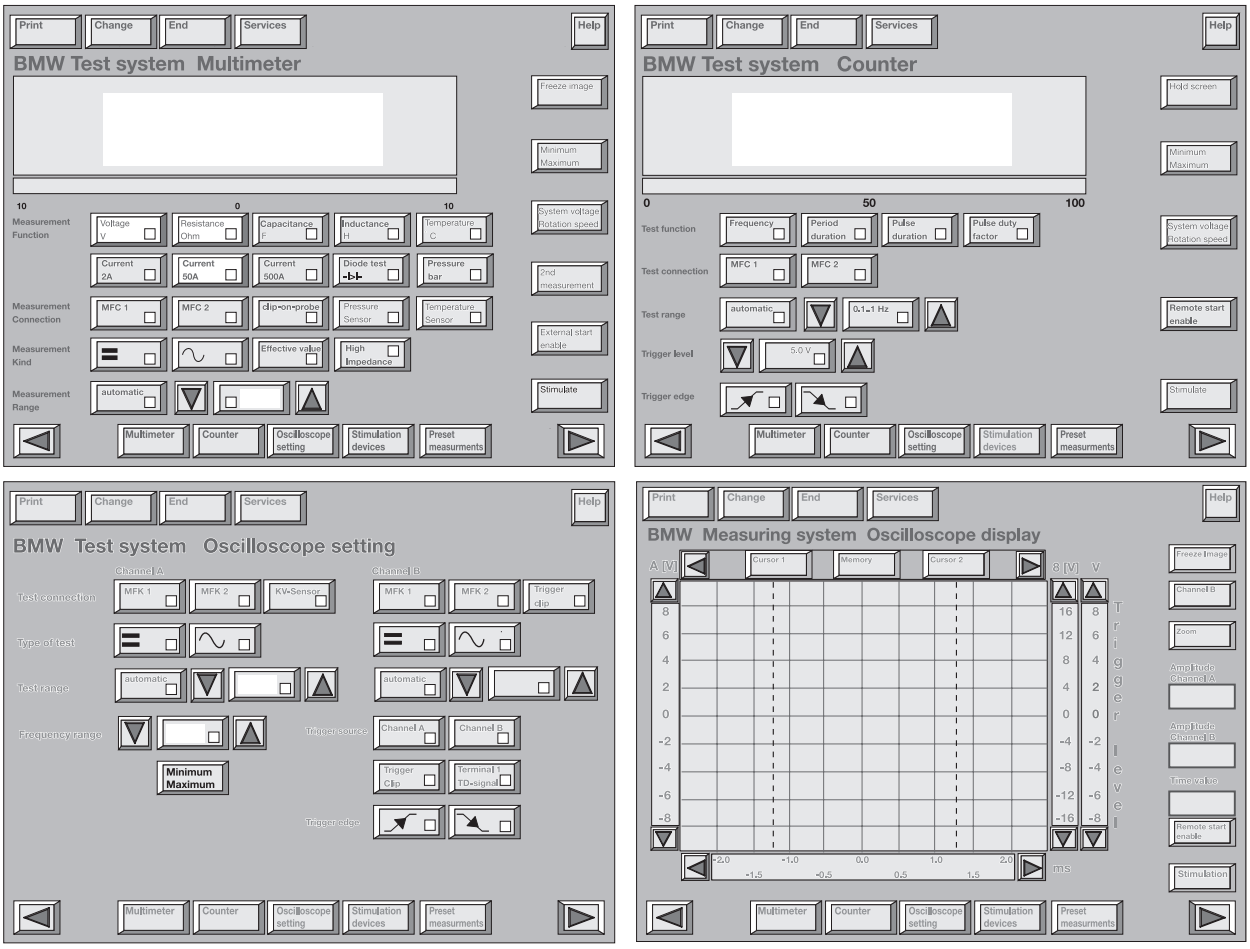

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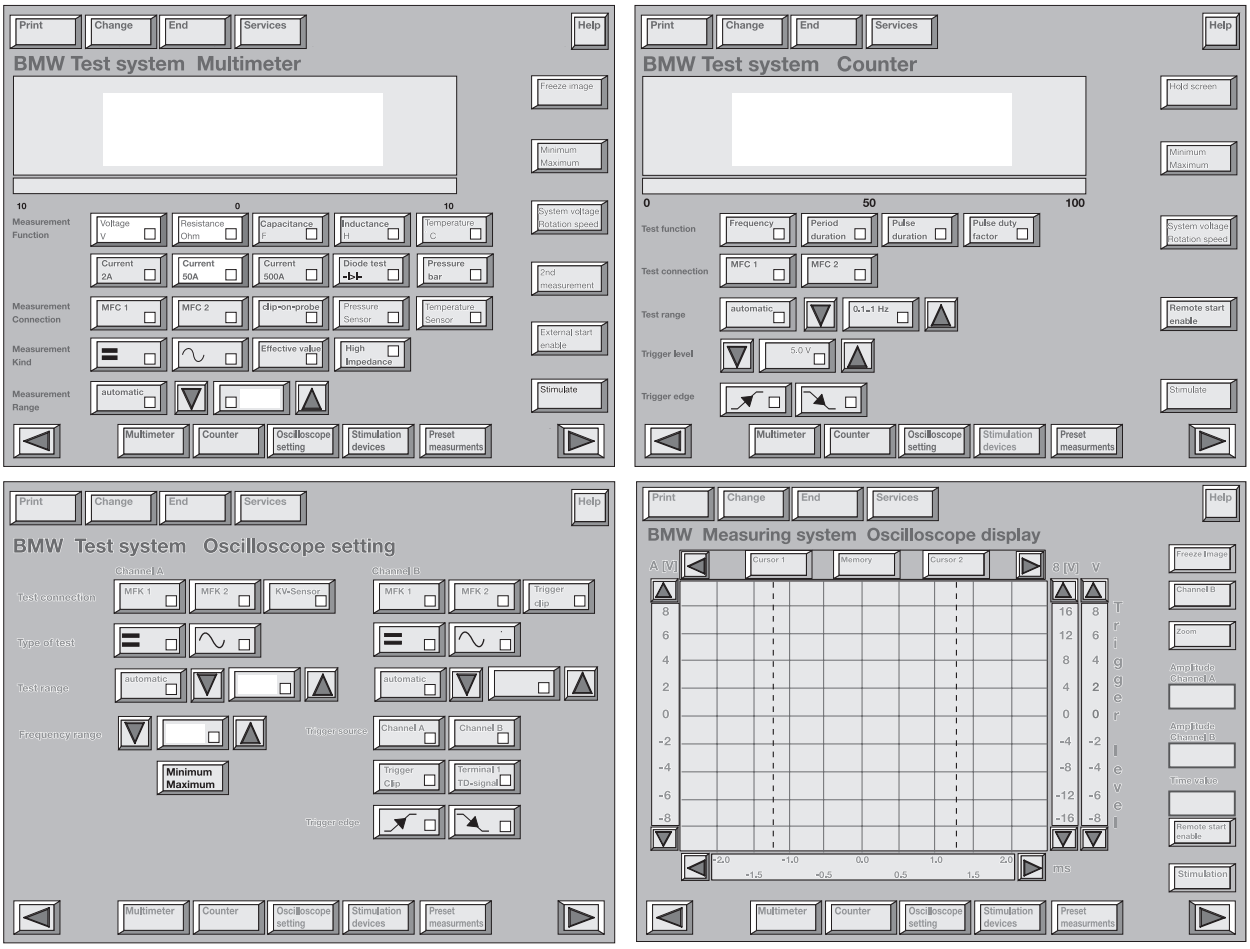

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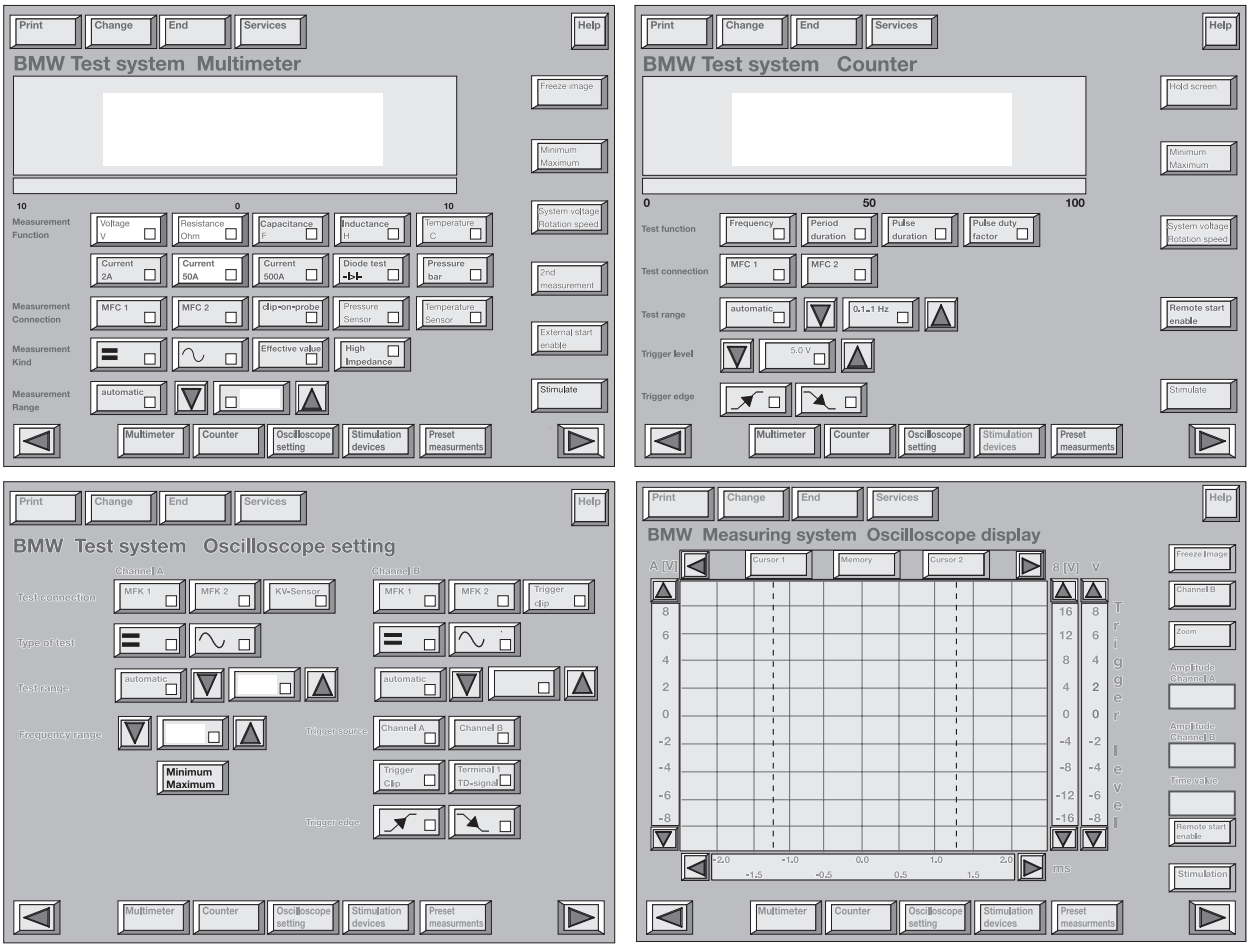

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