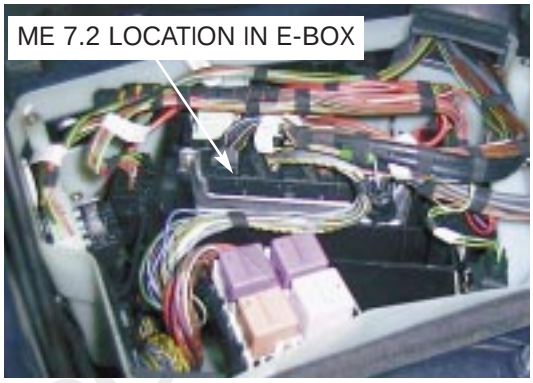
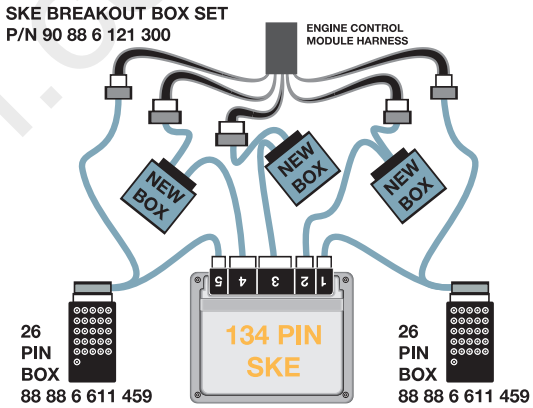
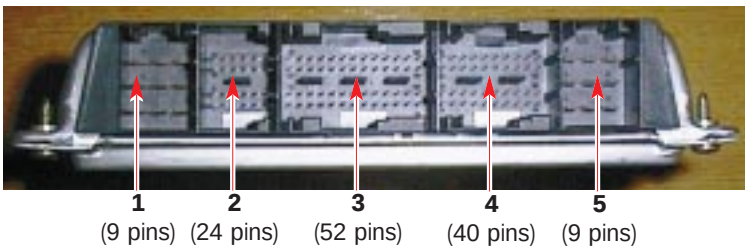
DME-ME 7.2 ENGINE MANAGEMENT SYSTEM

DME - ME 7.2 is the next generation of engine management systems for current and future powertrain control. ME 7.2 replaces M5.2.1 for all 8 cylinder engine applications. The “ME” designation identifies the system as “M = Motronic, E = EML.



- Manufactured by Bosch to BMW specifications
- 134 pin SKE (standard shell construction) control module located in E box
- New diagnostic communication protocol (KWP2000)
- Uses break-out box set (P/N 90 88 6 121 300)
- Integral EML throttle control system
  - monitors an interior installed PWG
  - actuates an electric throttle valve (EDK)
- Integral Cruise control functionality
  - monitors cruise control requests
  - monitors brake pedal and clutch switches
  - carries out throttle control directly via EDK
- Carries out DSC III torque reduction requests.
- VANOS control
- Integrated altitude sensor
- Integrated temp sensor for monitoring E box temperatures
- Control of E-box fan
- One touch engine start control
- Oxygen Sensor heating
- Engine overrev & Max speed limitation
- Active Hall sensor for camshaft position monitoring
- Single speed secondary air injection system
- Electrically heated coolant system thermostat (same function as previous M62 engine)
- Longlife spark plugs
- IHKA Auxiliary Fan control





This training manual only covers new or modified input signal components and output control functions. The balance of the ME 7.2 system functions are as per previous engine management systems. Refer to Engine Electronics (ST055) and OBD II (ST060) training course material for detailed functional descriptions.

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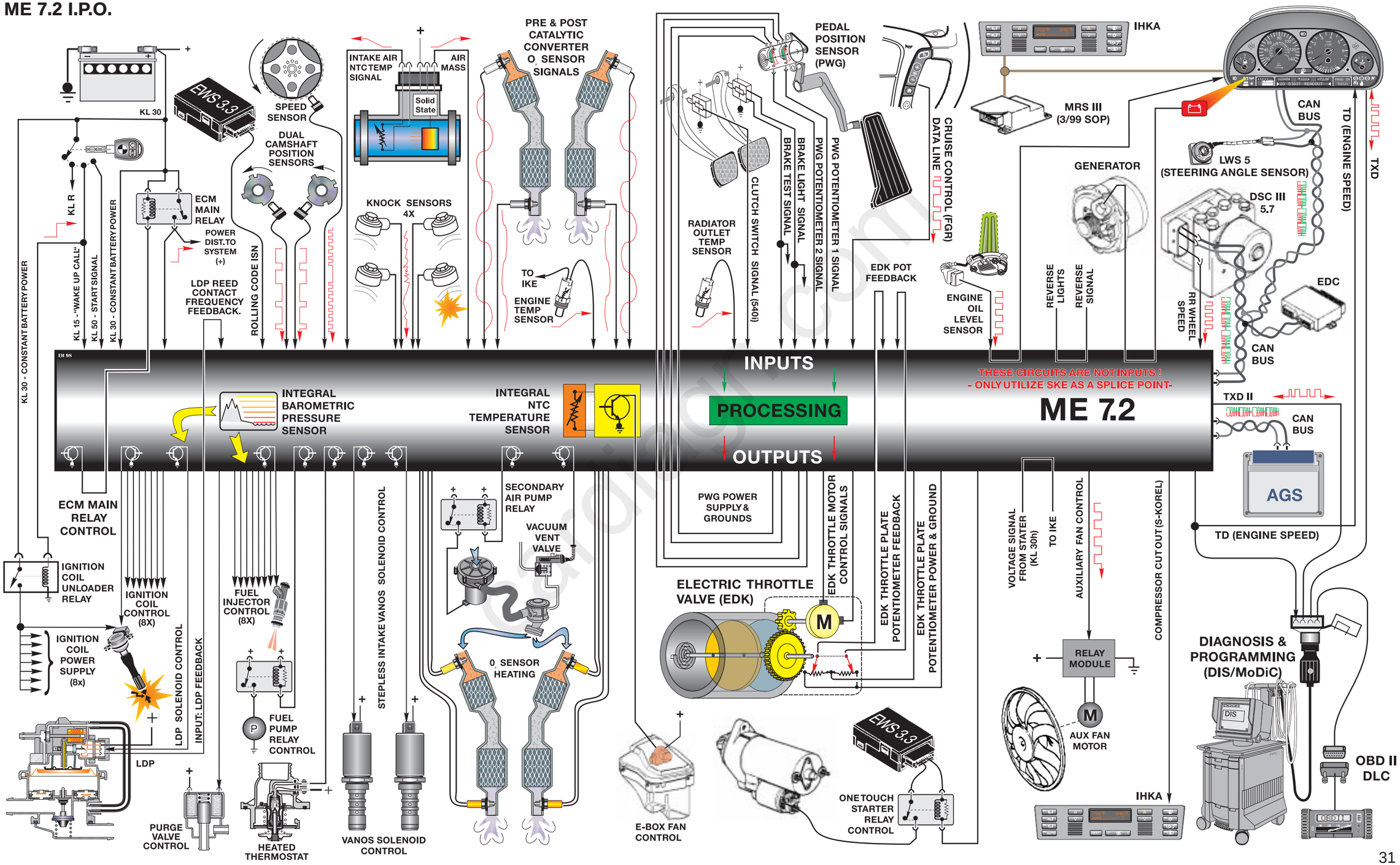
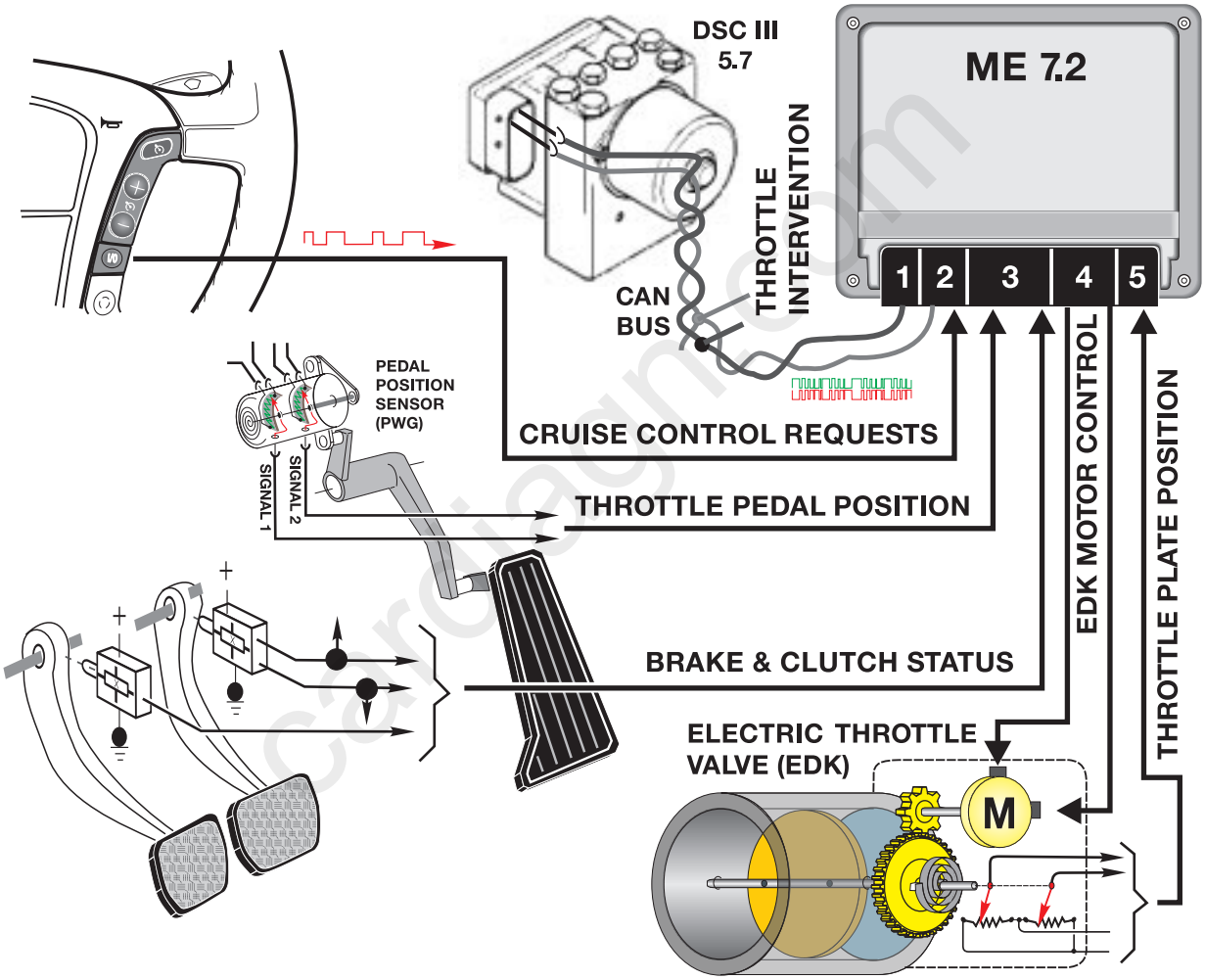
ME 7.2 I.P.O.


KL 30
EWS 3.3
SPEED SENSOR
DUAL CAMSHAFT POSITION SENSORS
INTAKE AIR NTC TEMP SIGNAL
AIR MASS
Solid State
PRE & POST CATALYTIC CONVERTER O SENSOR SIGNALS
KNOCK SENSORS 4X
KL R
ECM MAIN RELAY
POWER DIST.TO SYSTEM (+)
LDP REED CONTACT FREQUENCY FEEDBACK.
ROLLING CODE ISN
TO IKE
ENGINE TEMP SENSOR
KL 15 - "WAKE UP CALL"
KL 50 - START SIGNAL
KL 30 - CONSTANT BATTERY POWER
KL 30 - CONSTANT BATTERY POWER
INTEGRAL BAROMETRIC PRESSURE SENSOR
INTEGRAL NTC TEMPERATURE SENSOR
INPUTS
PROCESSING
OUTPUTS
THESE CIRCUITS ARE NOT INPUTS !
- ONLY UTILIZE SKE AS A SPLICE POINT-
ME 7.2
PEDAL POSITION SENSOR (PWG)
IHKA
MRS III (3/99 SOP)
CAN BUS
TD (ENGINE SPEED)
TXD
GENERATOR
LWS 5 (STEERING ANGLE SENSOR)
DSC III 5.7
RADIATOR OUTLET TEMP SENSOR
CLUTCH SWITCH SIGNAL (540i)
BRAKE TEST SIGNAL
BRAKE LIGHT SIGNAL
PWG POTENTIOMETER 2 SIGNAL
PWG POTENTIOMETER 1 SIGNAL
CRUISE CONTROL (FGR) DATA LINE
EDK POT FEEDBACK
ENGINE OIL LEVEL SENSOR
REVERSE LIGHTS
REVERSE SIGNAL
RR WHEEL SPEED
EDC
CAN BUS
TXD II
CAN BUS
AGS
TD (ENGINE SPEED)
ECM MAIN RELAY CONTROL
IGNITION COIL UNLOADER RELAY
IGNITION COIL CONTROL (8X)
IGNITION COIL POWER SUPPLY (8x)
LDP SOLENOID CONTROL
INPUT: LDP FEEDBACK
LDP
FUEL INJECTOR CONTROL (8X)
FUEL PUMP RELAY CONTROL
PURGE VALVE CONTROL
HEATED THERMOSTAT
STEPLESS INTAKE VANOS SOLENOID CONTROL
VANOS SOLENOID CONTROL
SECONDARY AIR PUMP RELAY
VACUUM VENT VALVE
O SENSOR HEATING
PWG POWER SUPPLY & GROUNDS
EDK THROTTLE MOTOR CONTROL SIGNALS
EDK THROTTLE PLATE POTENTIOMETER FEEDBACK
EDK THROTTLE PLATE POTENTIOMETER POWER & GROUND
ELECTRIC THROTTLE VALVE (EDK)
M
E-BOX FAN CONTROL
ONE TOUCH STARTER RELAY CONTROL
VOLTAGE SIGNAL FROM STATER (KL 30h)
TO IKE
AUXILIARY FAN CONTROL
COMPRESSOR CUTOUT (S-KOREL)
RELAY MODULE
AUX FAN MOTOR
IHKA
DIAGNOSIS & PROGRAMMING (DIS/MoDiC)
DIS
OBD II DLC

INTEGRAL ELECTRIC THROTTLE SYSTEM (EML)

FUNCTIONAL DESCRIPTION

When the accelerator pedal is moved, the PWG provides a change in the monitored signals. The ME 7.2 compares the input signal to a programmed map and appropriately activates the EDK motor via proportionally high/low switching circuits. The control module self-checks it's activation of the EDK motor via the EDK feedback potentiometers.



Requirements placed on the Electric Throttle System:

- Regulate the calculated intake air load based on PWG input signals and programmed mapping.
- Control idle air when LL detected with regard to roadspeed as per previous systems.
- Monitor the driver's input request for cruise control operation.
- Automatically position the EDK for accurate cruise control (FGR) operation.
- Perform all DSC III throttle control interventions.
- Monitor and carryout max engine and roadspeed cutout.

PWG SIGNAL MONITORING & PWG FAILSAFE OPERATION:

- As a redundant safety feature the PWG provides two separate signals from two integral potentiometers (Pot 1 and Pot 2) representing the driver's request for throttle activation.
- If the monitored PWG potentiometer signals are not plausible, ME 7.2 will only use the lower of the two signals as the driver's pedal request input providing failsafe operation. Throttle response will be slower and maximum throttle position will be reduced.
- When in PWG failsafe operation, ME 7.2 sets the EDK throttle plate and injection time to idle (LL) whenever the brake pedal is depressed.
- When the system is in PWG failsafe operation, the instrument cluster matrix display will post "Engine Emergency Program" and PWG specific fault(s) will be stored in memory.

Refer to page 38 for additional PWG component and signal information.

EDK FEEDBACK SIGNAL MONITORING & EDK FAILSAFE OPERATION:

- The EDK provides two separate signals from two integral potentiometers (Pot 1 and Pot 2) representing the exact position of the throttle plate.
- EDK Pot 1 provides the primary throttle plate position feedback. As a redundant safety feature, Pot 2 is continuously cross checked with Pot 1 for signal plausibility.
- If plausibility errors are detected between Pot 1 and Pot 2, ME 7.2 will calculate the inducted engine air mass (from HFM signal) and only utilize the potentiometer signal that closely matches the detected intake air mass.
  - The ME 7.2 uses the air mass signalling as a "virtual potentiometer" (pot 3) for a comparative source to provide failsafe operation.
  - If ME 7.2 cannot calculate a plausible conclusion from the monitored pots (1 or 2 and virtual 3) the EDK motor is switched off and fuel injection cut out is activated (no failsafe operation possible).
- The EDK is continuously monitored during all phases of engine operation. It is also briefly activated when KL 15 is initially switched on as a "pre-flight check" to verify it's mechanical integrity (no binding, appropriate return spring tension, etc). This is accomplished by monitoring both the motor control amperage and the reaction speed of the EDK feedback potentiometers. If faults are detected the EDK motor is switched off and fuel injection cut off is activated (no failsafe operation possible). The engine does however continue to run extremely rough at idle speed.
- When a replacement EDK is installed, the ME 7.2 adapts to the new component (required amperage draw for motor control, feedback pot tolerance differences, etc). This occurs immediately after the next cycle of KL 15 for approximately 30 seconds. During this period of adaptation, the maximum opening of the throttle plate is 25%.

Refer to page 39 for additional EDK feedback signal information.

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NEW OR MODIFIED INPUT SIGNALS/COMPONENTS

CAMSHAFT POSITION SENSORS

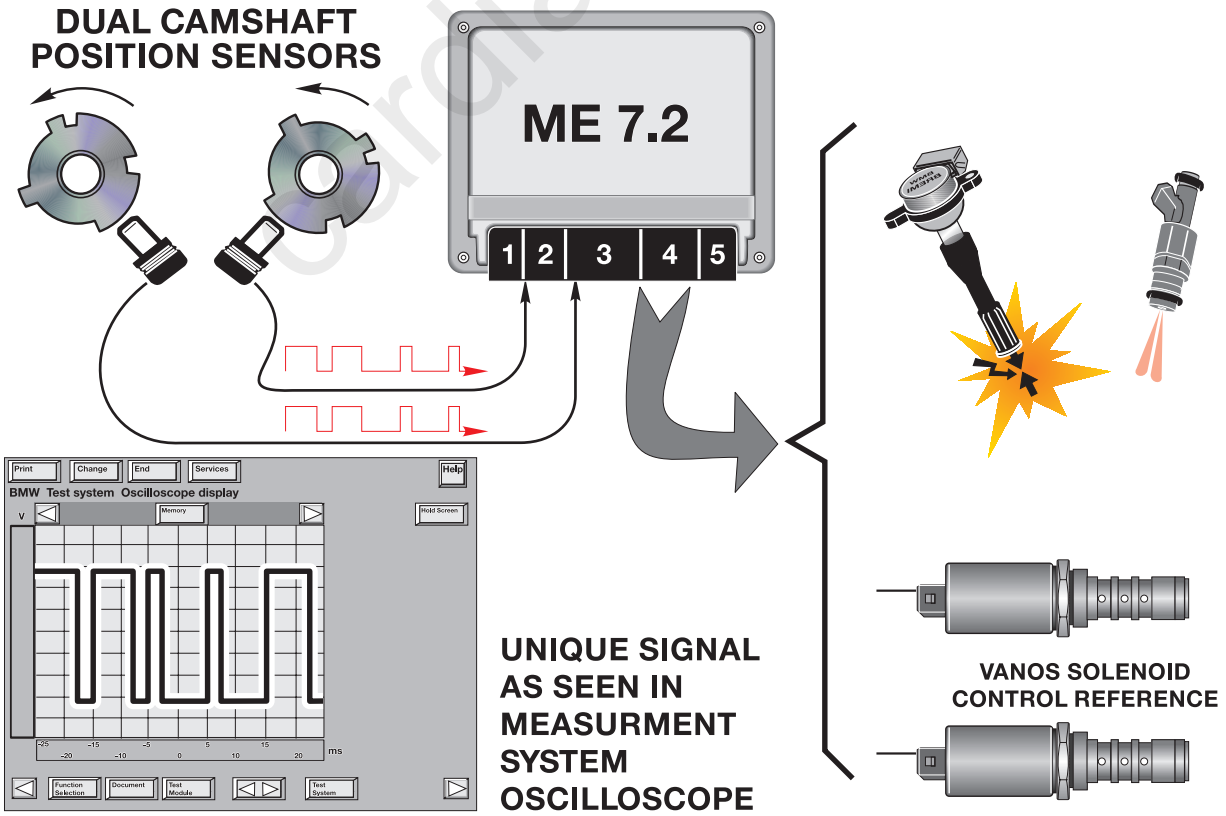
Located on the upper timing case covers, the camshaft position sensors monitor the position of the camshafts to establish start of ignition firing order, set up sequential fuel injection triggering and for accurate camshaft advance-retard (VANOS) timing feedback.

Each intake camshaft's advance-retard angles are adjusted simultaneously yet independently. For this reason ME 7.2 requires a camshaft position sensor on each cylinder bank for accurate feedback to monitor the VANOS controlled camshaft positioning.

The sensors are provided with operating power from the ECM main relay. The sensors produce a unique asymmetrical square-wave signal representative of the impulse wheel shape. The sensors are new in the fact that they are "active" hall effect sensors. Active hall sensors provide:

- low signal when a tooth of the camshaft impulse wheel is located in front of the sensor
- high signal when an air gap is present.

The active hall sensors supply a signal representative of camshaft position even before the engine is running. The ME 7.2 determines an approximate location of the camshafts positions prior to engine start up optimizing cold start injection (reduced emissions.)



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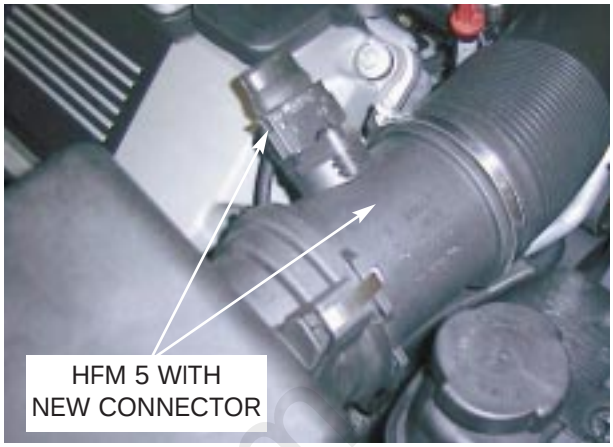
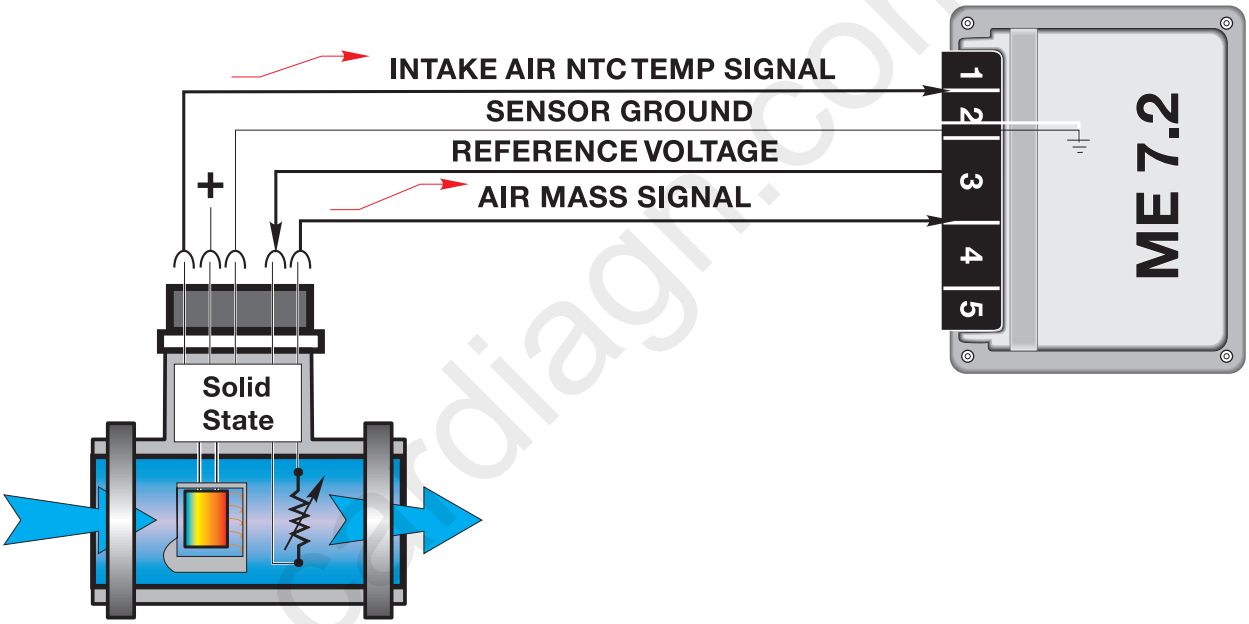
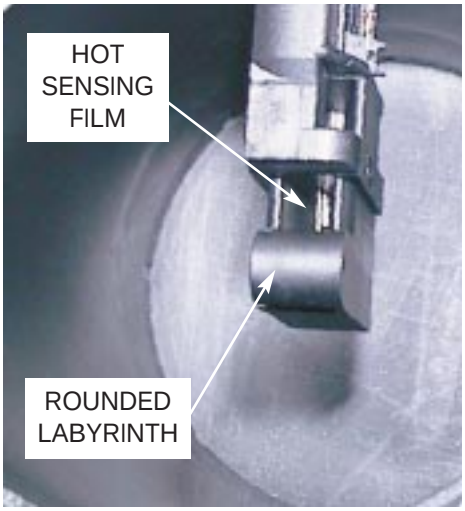
HOT FILM AIR MASS SENSOR (HFM 5)

The M62 TU is equipped with a new Hot Film Air Mass Sensor identified as HFM 5. It is a combined air mass/intake air temperature sensor. The separate intake air temperature sensor is no longer used on the M62 TU.

The HFM 5 is provided with operating power from the ECM main relay. Based on calculated intake air mass, the HFM 5 generates a varying voltage between 0.5 and 4.5 volts as an input signal to the ME 7.2







An additional improvement of the HFM 5 is that the hot film element is not openly suspended in the center bore of the sensor as with previous HFMs. It is shrouded by a round fronted plastic labyrinth which isolates it from intake air charge pulsations.

This feature allows the HFM to monitor and calculate the intake air volume with more accuracy. This feature adds further correction for calculating fuel injection “on” time (ti) which reduces emissions further.

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INTEGRATED AMBIENT BAROMETRIC PRESSURE SENSOR

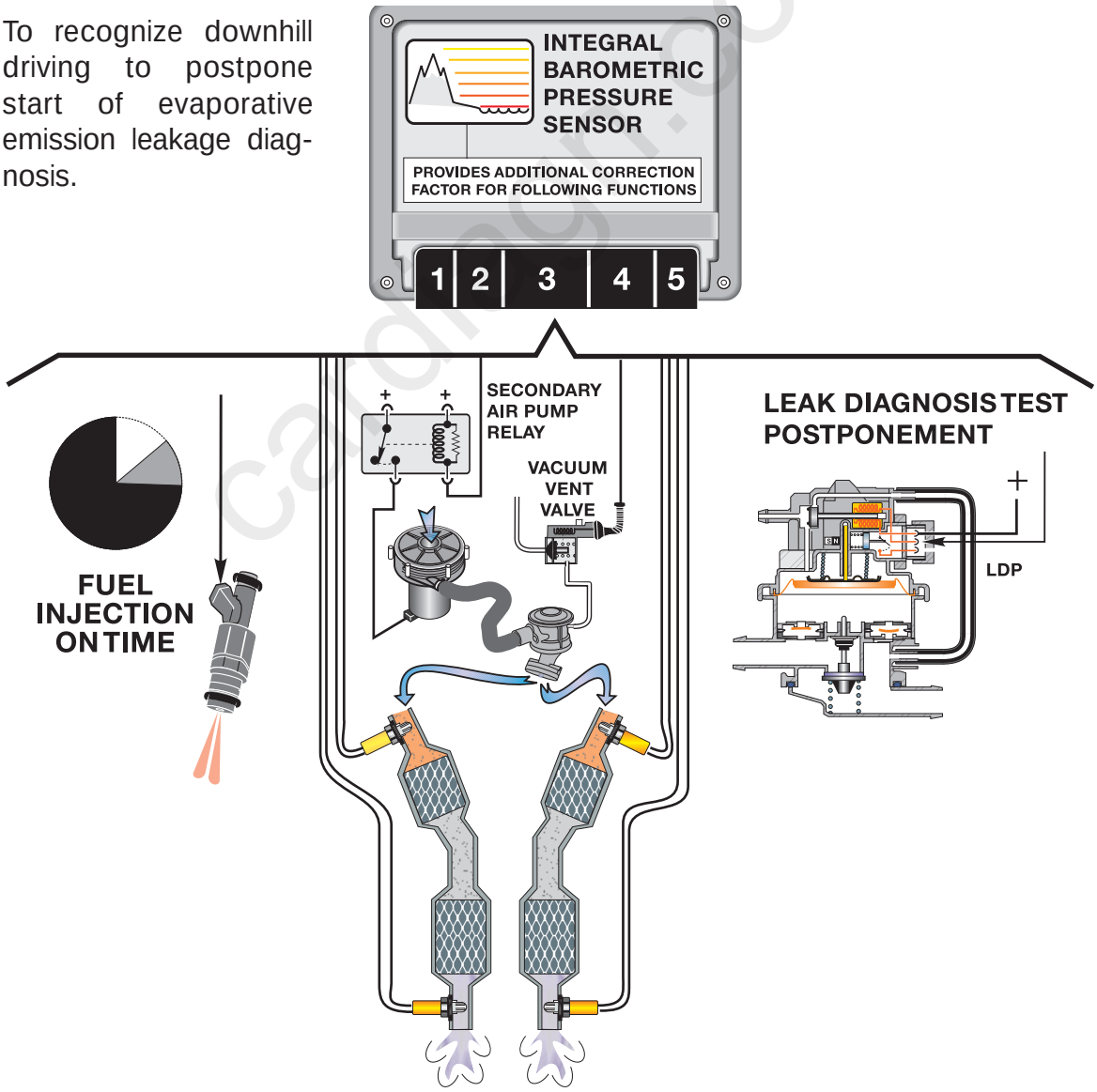
The ME 7.2 Control Module contains an integral ambient barometric pressure sensor. The sensor is part of the SKE and is not serviceable. The internal sensor is supplied with 5 volts. In return it provides a linear voltage of approx. 2.4 to 4.5 volts representative of barometric pressure (altitude).

The ME 7.2 monitors barometric pressure for the following reasons:

- The barometric pressure signal along with calculated air mass provides an additional correction factor to further refine injection “on” time.

- Provides a base value to calculate the air mass being injected into the exhaust system by the secondary air injection system. This correction factor alters the secondary air injection “on” time, optimizing the necessary air flow into the exhaust system.

- To recognize downhill driving to postpone start of evaporative emission leakage diagnosis.



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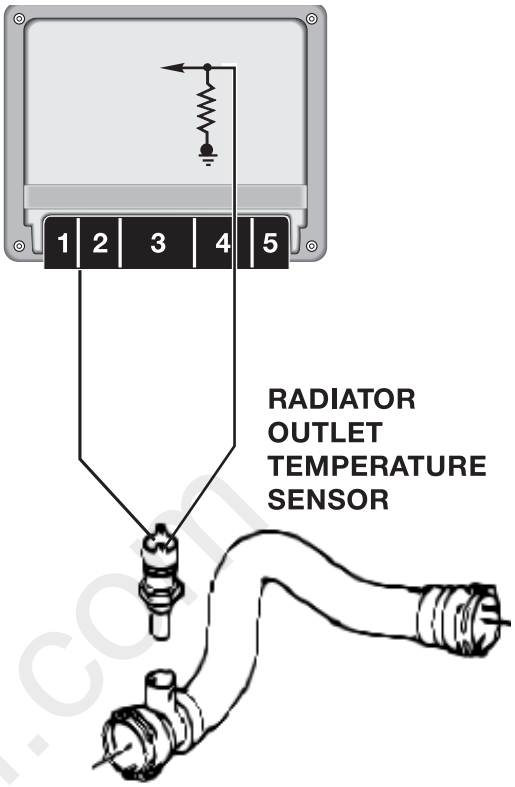
RADIATOR OUTLET TEMP SENSOR

First seen on the MS 42.0 control system, the ME 7.2 uses an additional water temperature sensor located on the radiator outlet.

ME 7.2 requires this signal to monitor the water temperature leaving the radiator for precise activation of the IHKA auxiliary fan.

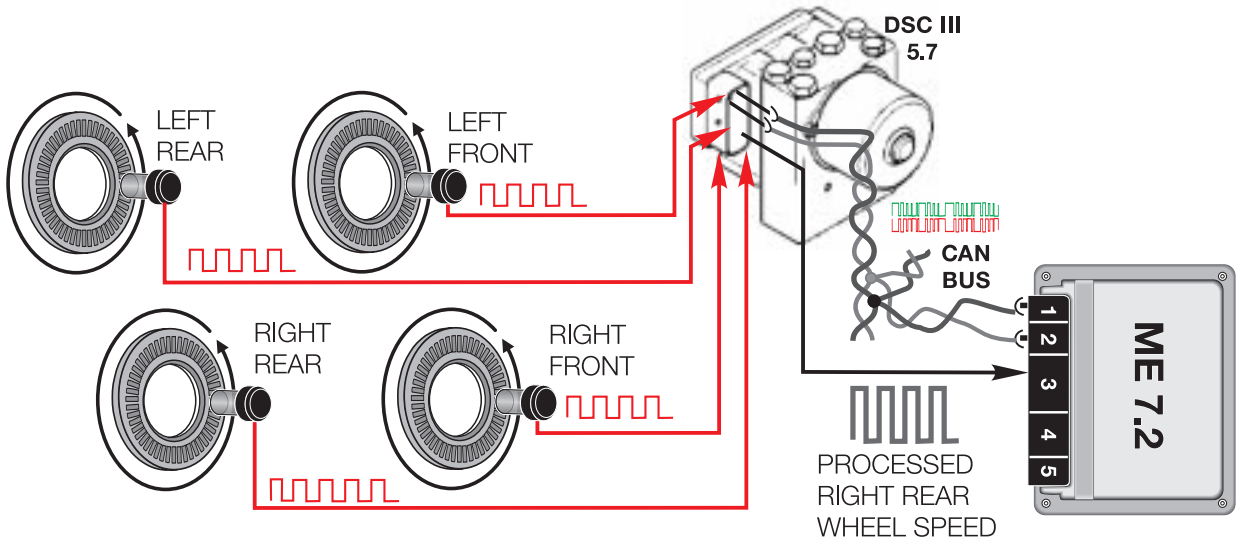


DSC III - ROAD SPEED SIGNAL

ME 7.2 receives the road speed signal directly from the DSC III control module for maximum vehicle speed management. The DSC control module provides a processed output of the right rear wheel speed sensor as a digital square wave signal. The frequency of the signal is proportional to the speed of the vehicle (48 pulses per one revolution of the wheel).

The cruise control function (FGR) of the ME 7.2 also monitors vehicle speed from the redundant vehicle speed CAN bus signal. The CAN bus speed signal is provided by the DSC III control module and based on the combined average of both front wheel speed signals.

Additionally, ME 7.2 monitors all four wheel speed signals via CAN bus signalling to detect abrupt fluctuations in vehicle speed signals for the purpose of detecting rough road surfaces. This is continuously monitored as part of the OBD II emission requirements providing a correction factor for misfire detection plausibility. Earlier systems only monitored the right rear speed signal input from DSC.



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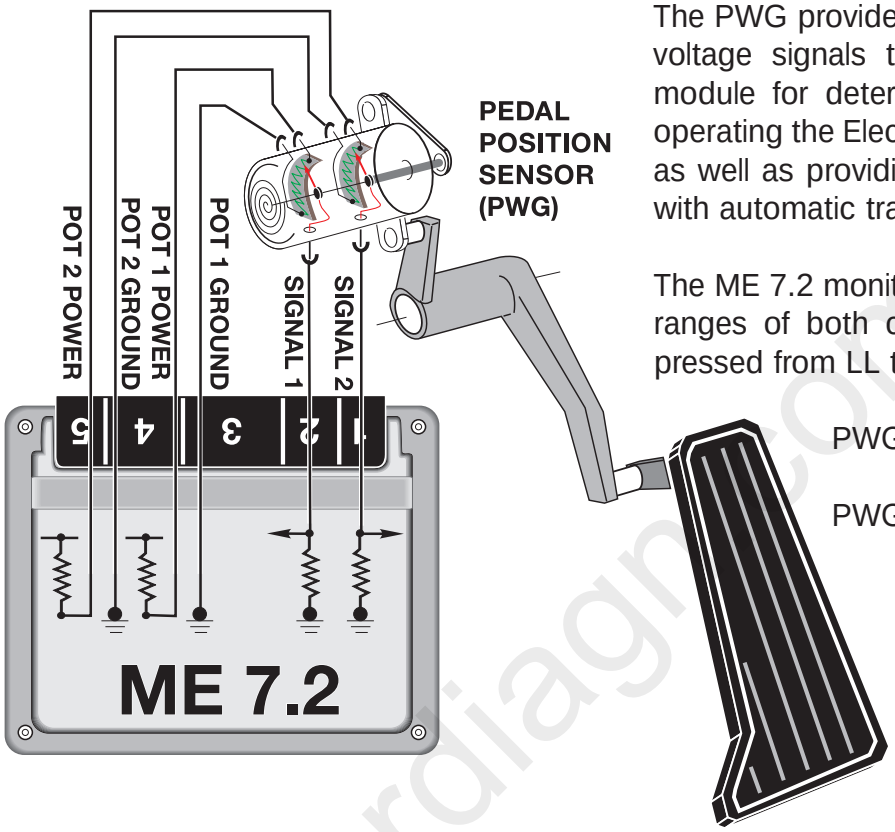
ACCELERATOR PEDAL SENSOR (PWG)

The driver's application of the accelerator pedal is monitored by a PWG sensor in the driver's footwell as with previous non-bowden cable EML systems.



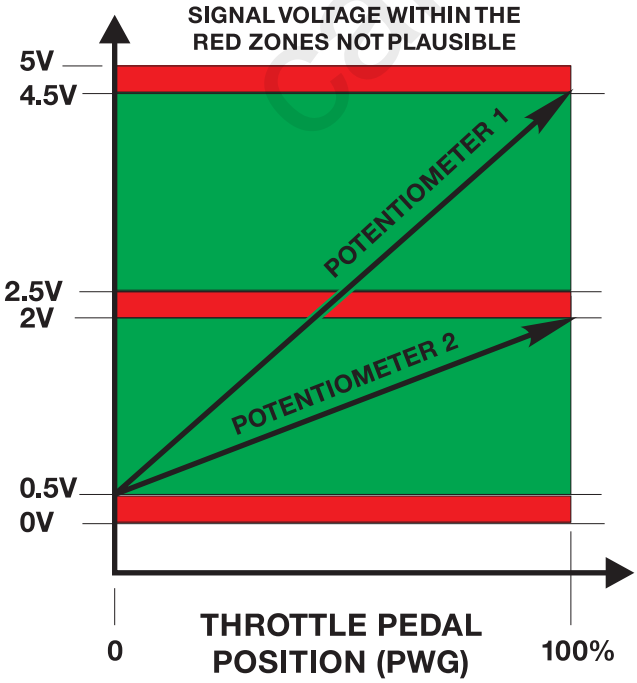
The PWG provides two separate variable voltage signals to the ME 7.2 control module for determining the request for operating the Electric Throttle Valve (EDK) as well as providing a kickdown request with automatic transmission vehicles.

The ME 7.2 monitors the changing signal ranges of both circuits as the pedal is pressed from LL to VL.

PWG Pot 1 = 0.5V to 4.5 V

PWG Pot 2 = 0.5V to 2.0 V

Standard transmission vehicles (E39 540i) have slightly lower voltage signals at max throttle position due to the throttle pedal stop (ie Pot 1 = 3.8volts).



However, ME 7.2 programming recognizes the lower values of a standard transmission vehicle as the max throttle position.

In vehicles equipped with an automatic transmission (A5S 440Z), the ME 7.2 recognizes the max pedal value (4.5V) as a kickdown request and signals the AGS via CAN bus.

The signals are continually monitored for plausibility. If the signal ranges are detected as incorrect, ME 7.2 will only utilize the signal of lesser voltage value as a failsafe measure. With this condition, the EDK will also be set to idle (LL) whenever the brake pedal is pressed. Refer to PWG monitoring and failsafe operation on page 33.

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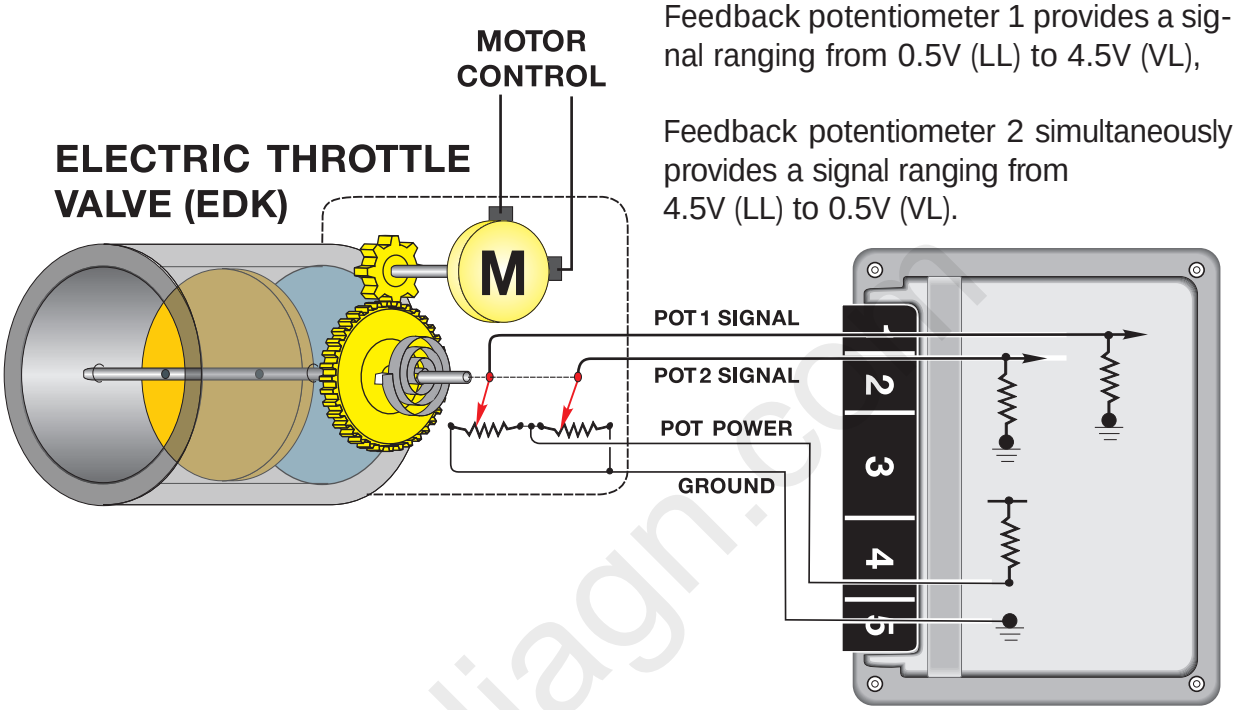
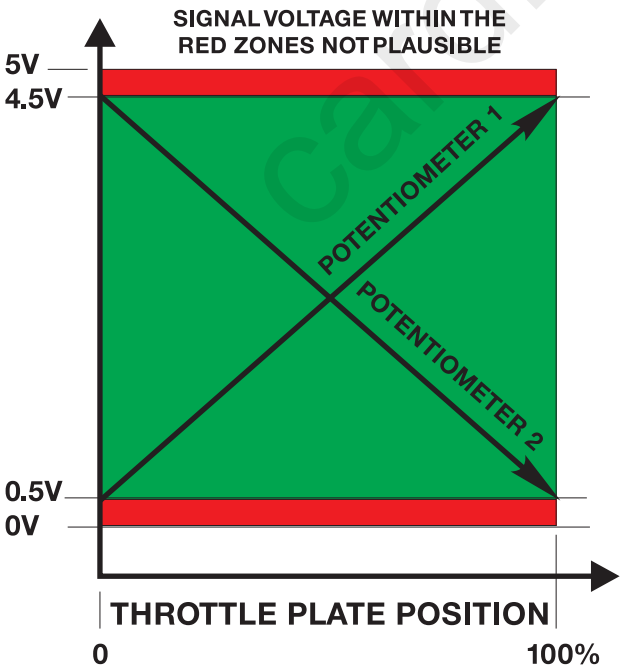
EDK THROTTLE POSITION FEEDBACK SIGNALS

The EDK throttle plate position is monitored by two integrated potentiometers. The potentiometers provide DC voltage feedback signals as input to the ME 7.2 for throttle and idle control functions.

Feedback potentiometer 1 provides a signal ranging from 0.5V (LL) to 4.5V (VL),

Feedback potentiometer 2 simultaneously provides a signal ranging from 4.5V (LL) to 0.5V (VL).





Pot signal 1 is the primary signal, signal 2 is used as a plausibility cross-check through the total range of throttle plate movement.

If there is an open or short in signal 1, signal 2 is used as a temporary substitute providing failsafe operation (faults stored).

If the signals are not plausible, ME 7.2 determines intake air mass from the HFM signal (virtual Pot 3) and compares it with Pot 1 and Pot 2. The signal that is closest to virtual Pot 3 is then used and the other disregarded.

If ME 7.2 cannot calculate a plausible conclusion from the monitored pots (1 or 2 and virtual 3) the EDK motor is switched off and fuel injection cut out is activated (no failsafe operation possible).

Refer to EDK monitoring and failsafe operation on page 33.

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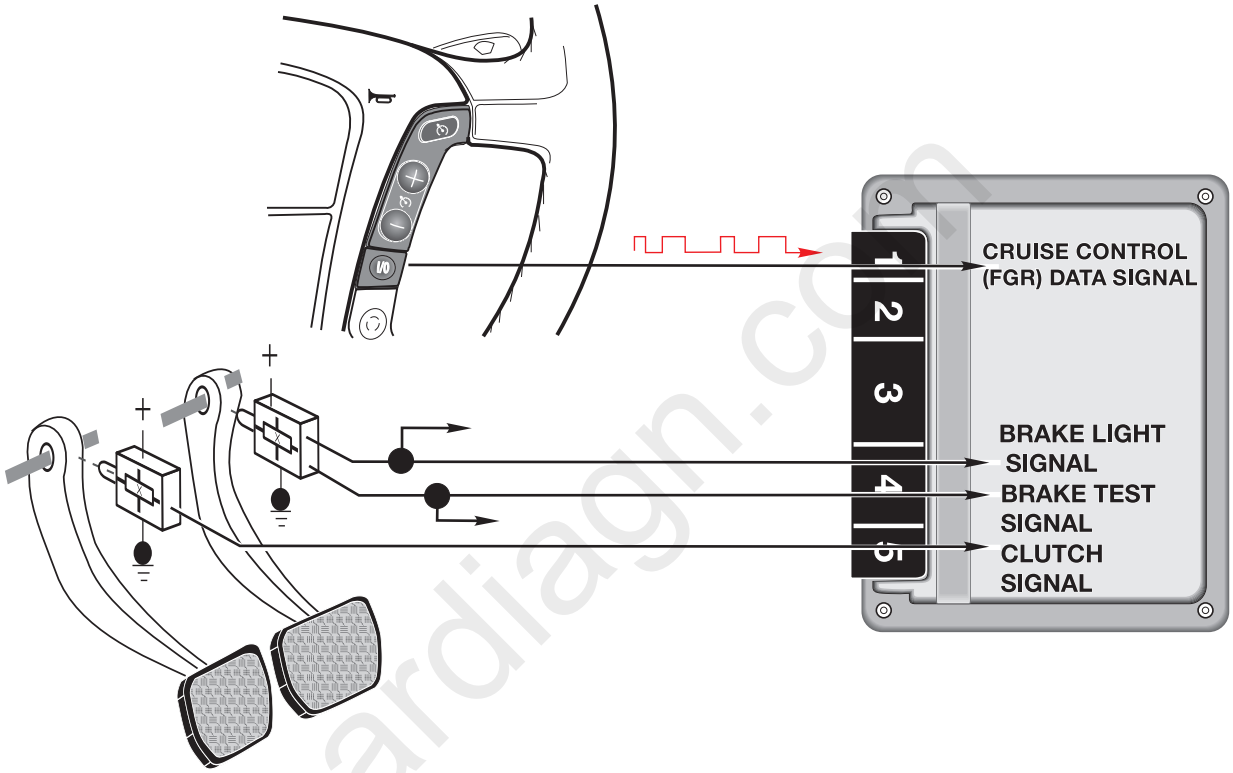
MFL CRUISE CONTROL DATA SIGNAL

The ME 7.2 control module provides the FGR cruise control function. Throttle activation is provided by ME 7.2 automatic control of the EDK and monitoring of the throttle plate position feedback potentiometer signals.

All of the familiar driver requested cruise control function requests are provided to the ME 7.2 control module via the MFL control module on a single FGR data signal wire.



BRAKE LIGHT SWITCH

The Electronic Brake Switch (Hall effect) provides brake pedal position status to the ME 7.2. The control module monitors both the brake light and a separate brake light test switch circuits for plausibility.

When the brake pedal is pressed the brake light segment of the switch provides a ground signal. Simultaneously, the brake light test switch (located in the same housing) provides a high signal.

CLUTCH SWITCH

The clutch switch is equipped on manual transmission vehicles for deactivating the FGR. It is housed in the footwell by the clutch pedal. The hall effect clutch switch interrupts the single wire circuit to the ME 7.2 control module when the clutch pedal is pressed.

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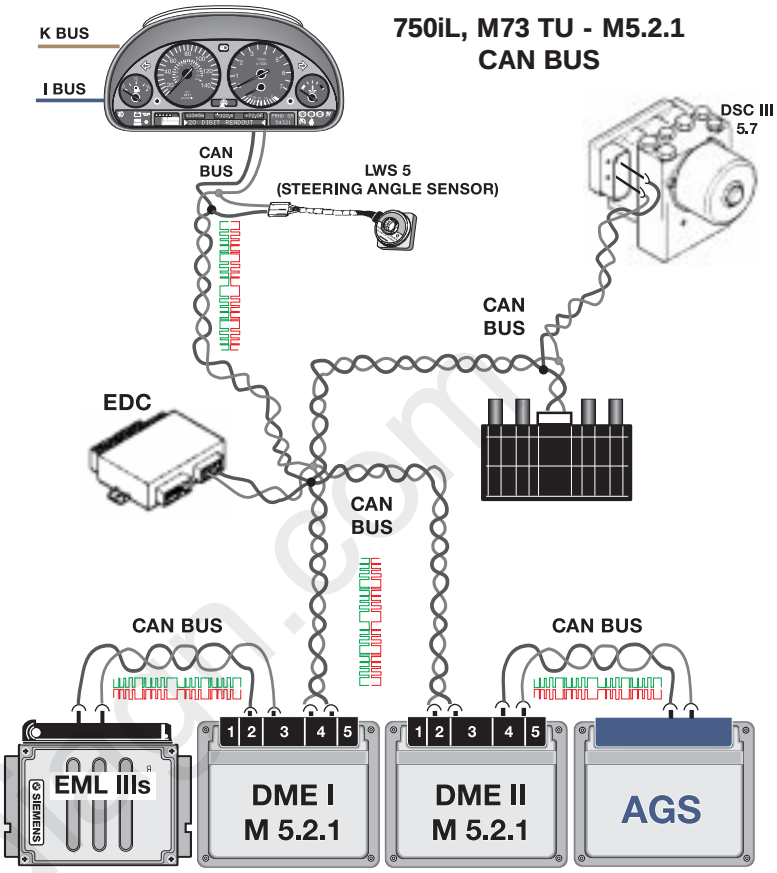
ME 7.2 & M5.2.1 CAN BUS TOPOLOGY

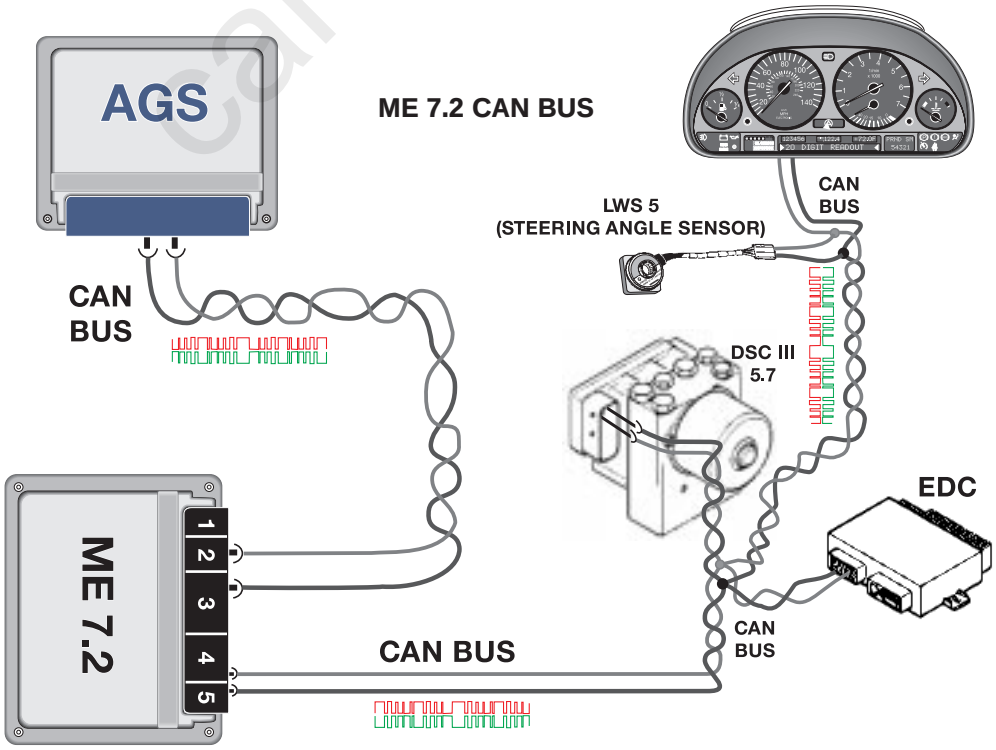
The CAN bus consists entirely of a twisted pair wire set. This configuration eliminates the need for a ground shield.

The Engine Control Modules (ME7.2 & M5.2.1) have two CAN bus communication ports, one dedicated to AGS (and DME I of the 750iL to EML) and the other for the balance of the vehicle's CAN bus control modules.

This configuration improves the reliability of CAN bus signalling. If an open occurs in one area, the other control systems can still communicate on either side of the open.

However, signals not reaching their intended recipients will cause CAN bus faults to be stored in the affected systems.



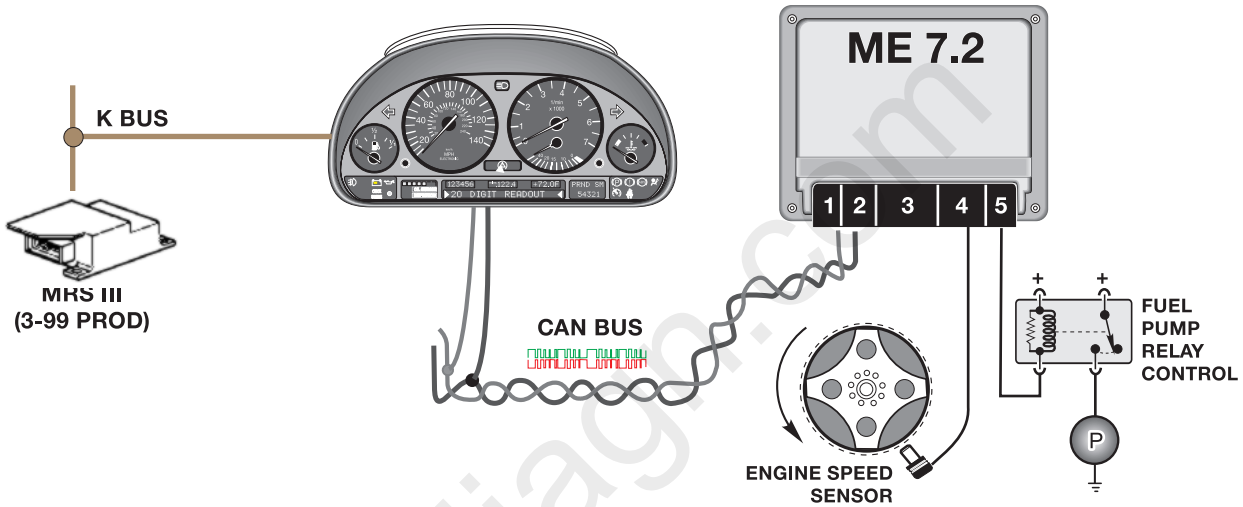


NEW OR MODIFIED OUTPUT CONTROL FUNCTIONS

FUEL PUMP RELAY CONTROL

ME 7.2 controls the fuel pump relay as with previous systems with regard to engine speed input for continual activation of the relay.

When MRS III is incorporated into production vehicles (SOP 3-99) the ME 7.2 will also switch off the fuel pump relay when an airbag is activated as an additional safety function.

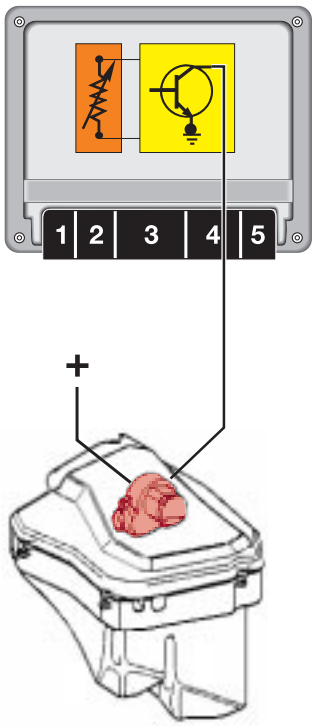


E BOX FAN CONTROL

The E Box fan is controlled by ME 7.2. The control module contains an integral NTC temperature sensor for the purpose of monitoring the E box temperature and activating the fan.

When the temperature in the E-Box exceeds predetermined values, ME 7.2 provides a switched ground for the E Box fan to cool the E box located control modules.

With every engine start-up, ME 7.2 briefly activates the fan ensuring continued fan motor operation for the service life of the vehicle. This feature is intended to prevent fan motor “lock up” from lack of use due to pitting or corrosion over time.



E-BOX FAN CONTROL

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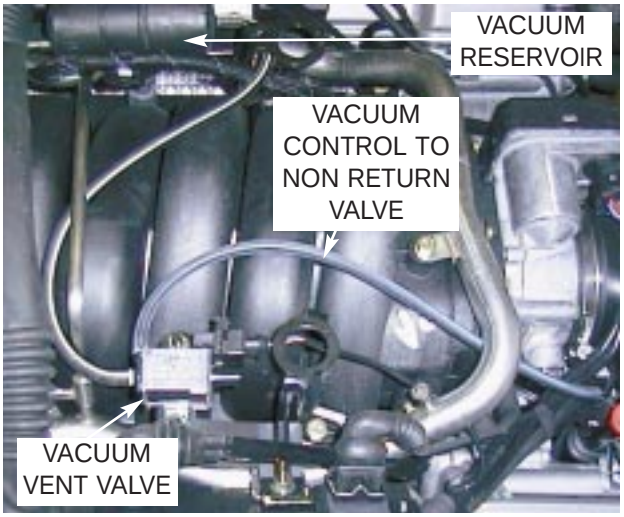
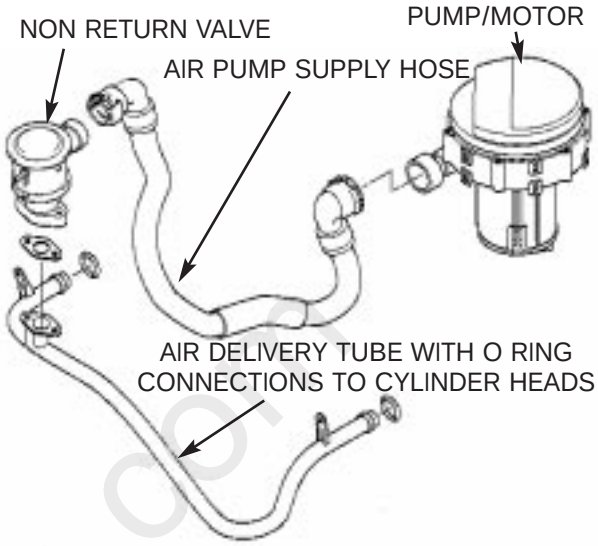
SECONDARY AIR INJECTION

The secondary air injection system is new to the 4.4 liter V8 engine. The system consists of the same components as previous systems with V8 specific locations.



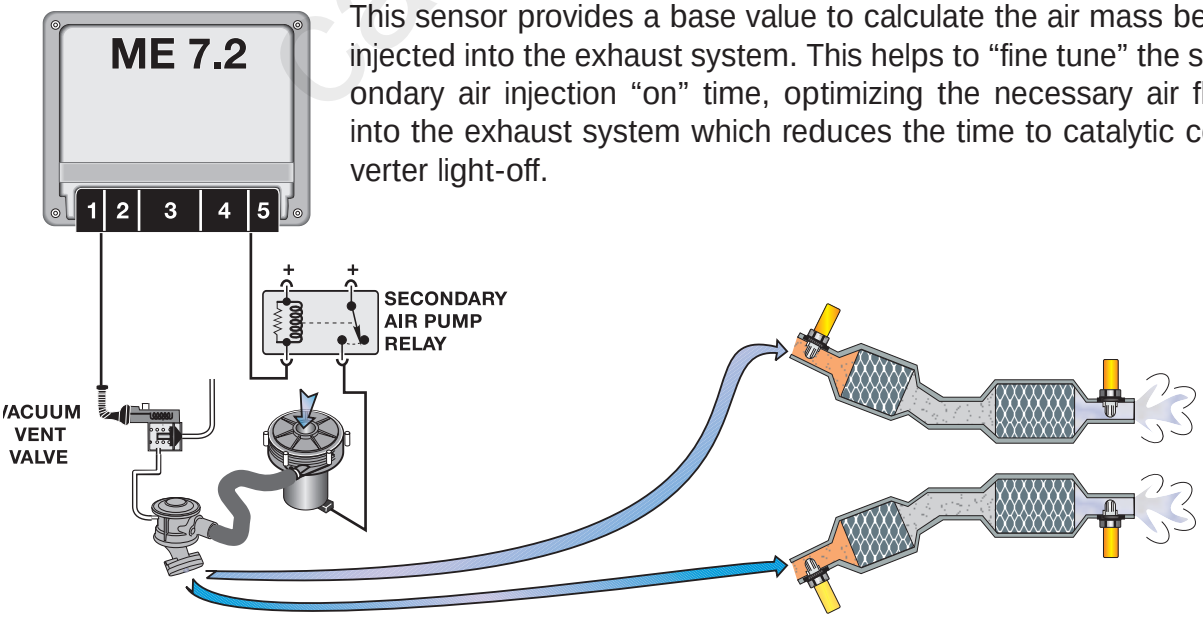


The DME ME7.2 control unit controls the vacuum vent valve and the secondary air injection pump relay separately but simultaneously.

The secondary air pump operates at a start temperature of between 10°C and 40°C. It continues to operate for a max. of 2 minutes at idle speed.

ME 7.2 contributes an additional correction factor for secondary air “on” time with the additional input from the integral ambient barometric pressure sensor.

This sensor provides a base value to calculate the air mass being injected into the exhaust system. This helps to “fine tune” the secondary air injection “on” time, optimizing the necessary air flow into the exhaust system which reduces the time to catalytic converter light-off.



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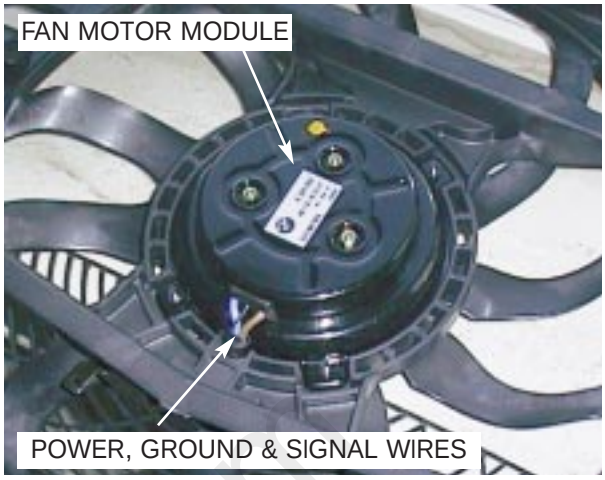
AUXILIARY FAN CONTROL

The Auxiliary Fan motor incorporates an output final stage that activates the fan motor at variable speeds.

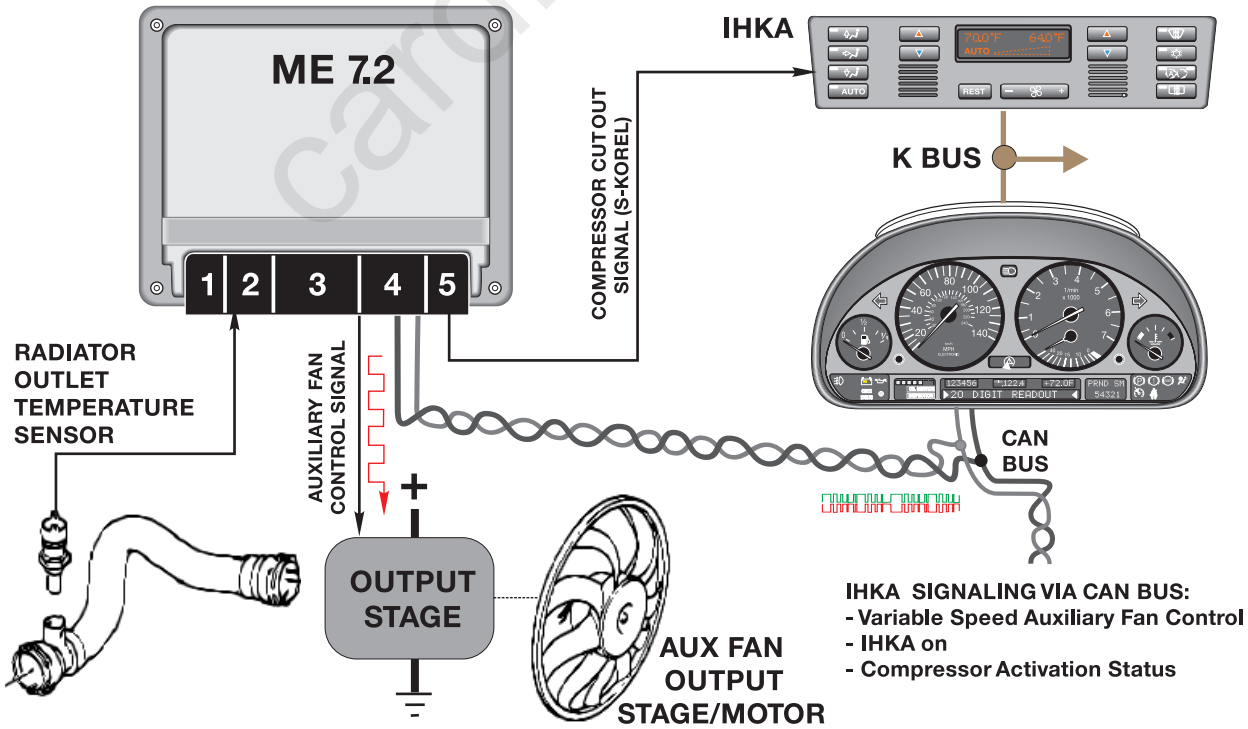


The auxiliary fan is controlled by ME 7.2. The motor output stage receives power and ground and activates the motor based on a PWM signal (10 - 100 Hz) received from the ME 7.2.

Similar to the aux fan in the E46 with MS 42.0 control, the fan is activated based on the following factors:

- Radiator outlet temperature sensor input exceeds a preset temperature.
- IHKA signalling via the K and CAN bus based on calculated refrigerant pressures.
- Vehicle speed
- Battery voltage level

When the over temperature light in the instrument cluster is on (120°C) the fan is run in the overrun function. This signal is provided to the DME via the CAN bus. When this occurs the fan is run at a frequency of 10 Hz.



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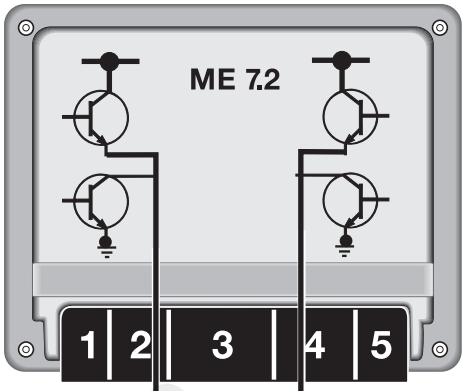
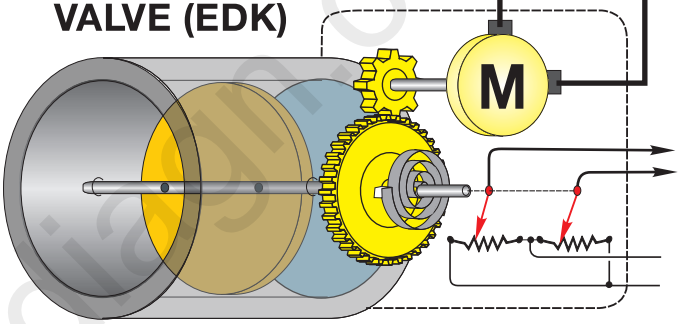
ELECTRIC THROTTLE VALVE (EDK) CONTROL

The throttle valve assembly of the M62 TU is an electric throttle valve (EDK) controlled by an integral EML function of the ME 7.2. The throttle plate is positioned by a gear reduction DC motor drive.

Similar to the original Bosch EML 1.2 and 1.7 systems, the motor is controlled by proportionately switched high/low PWM signals providing precise plate positioning. The PWM signal is at a basic frequency of 2000 Hz.





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