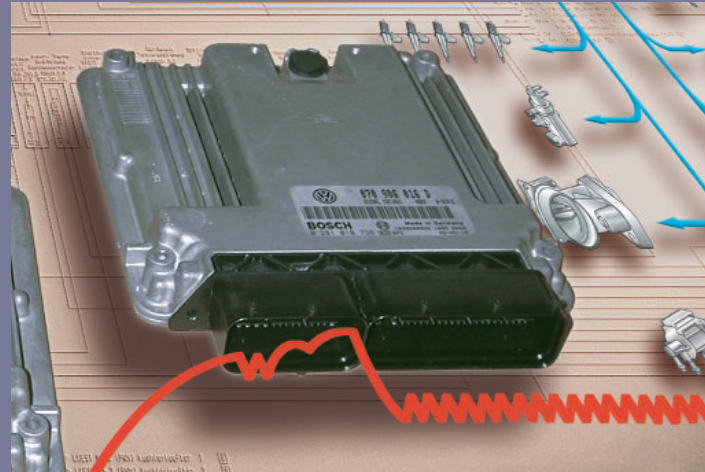


Touareg Electronic Diesel Control EDC 16 Design and Function



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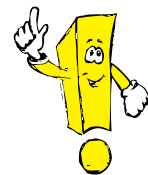
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New!



Important/Note!

The Self-Study Program provides you with information regarding designs and functions.

The Self-Study Program is not a Repair Manual.

For maintenance and repair work, always refer to the current technical literature.



Electronic Diesel Control

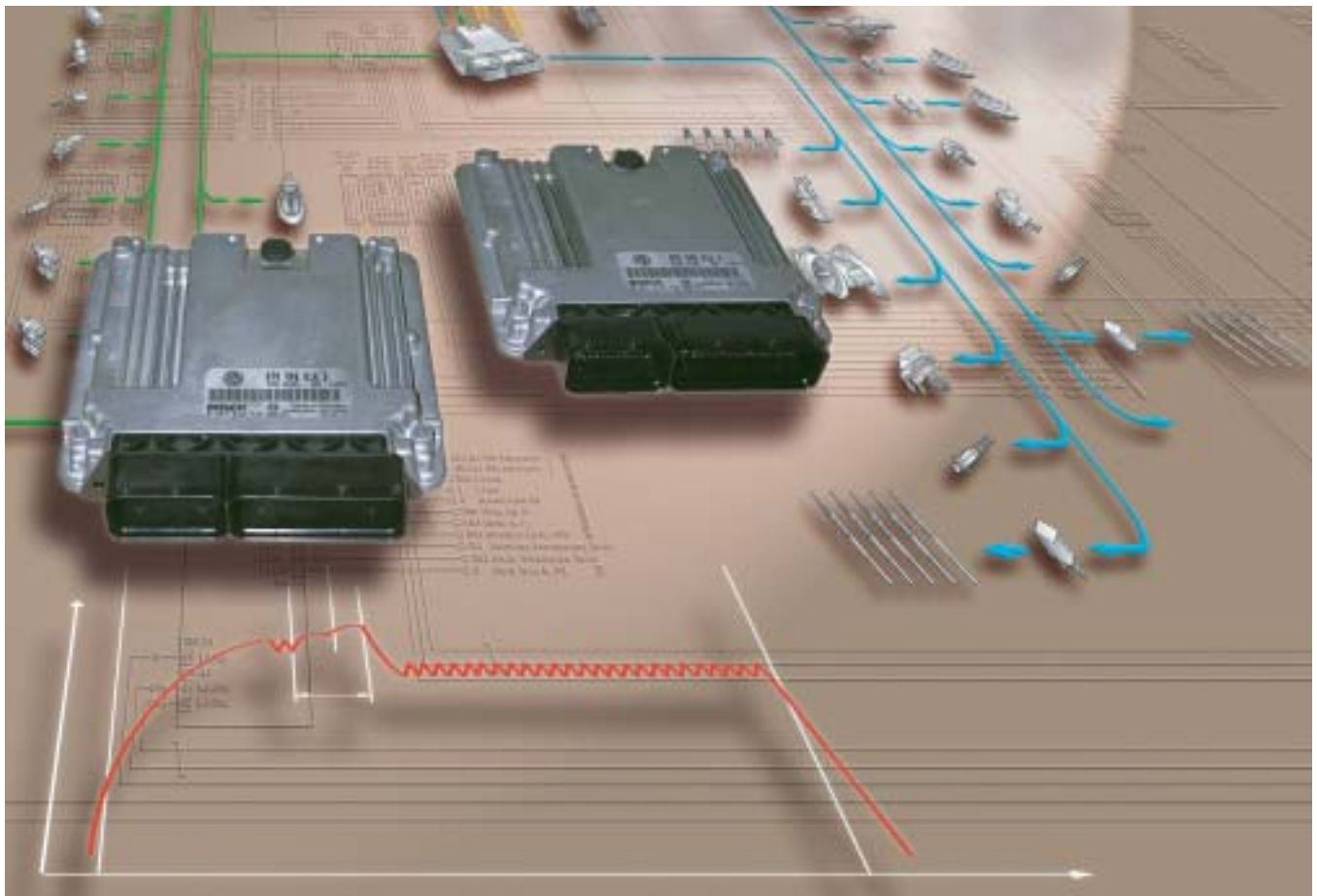
Greater complexity in the hardware and software for diesel engine management systems is necessary to meet the increasing demand for improvements in comfort and driveability characteristics, and to reduce fuel consumption and exhaust emissions.

With the advent of electronic diesel control EDC 16, an engine management system is available to meet this demand. This has

been achieved by improving engine control module processing performance and using a new signal processing system.



This Self-Study Program introduces the EDC 16 engine management system using the V10 TDI engine of the Touareg.



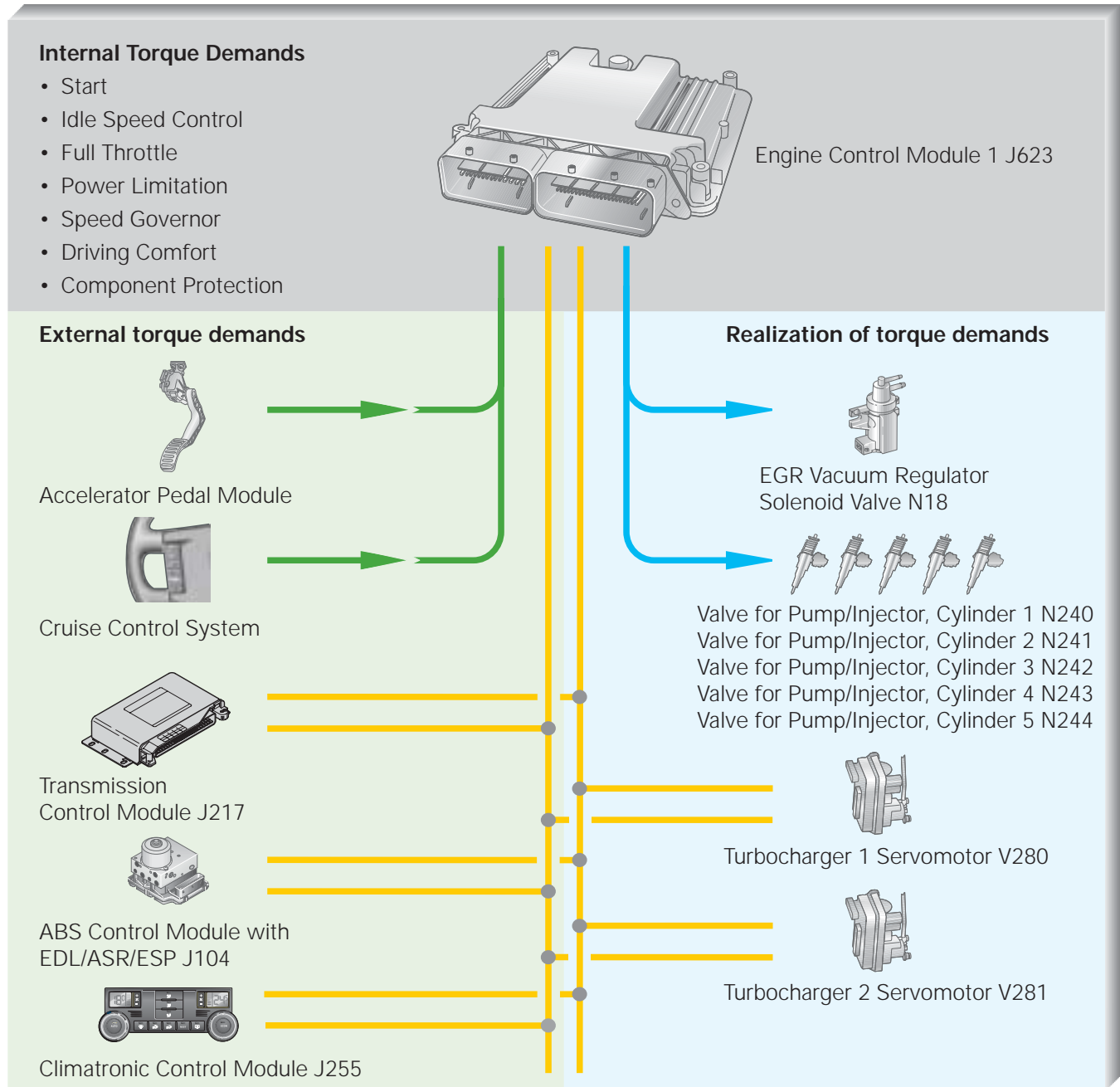
SSP304/301

Introduction

Bosch EDC 16

Bosch EDC 16 is a torque-orientated engine management system. As is the case with gasoline engines, in the EDC 16 system all torque demands are evaluated by the engine control modules.

This enhances adaptability between vehicle systems such as the engine management system, brake system, automatic transmission control system, and air conditioning system.



SSP304/062

Introduction

The Bosch EDC 16 engine management system is designed for use in both single and dual engine control module configurations. The configuration used depends on the number of cylinders in the engine.

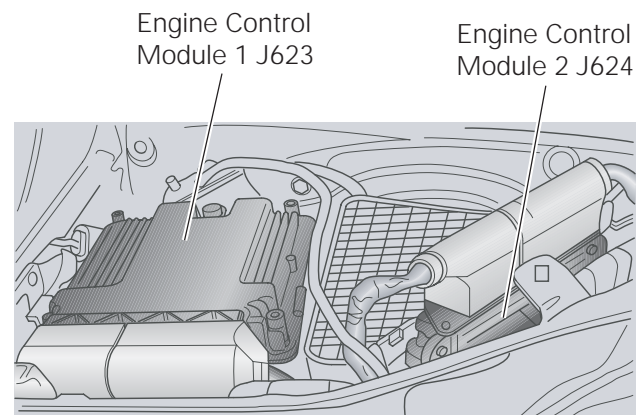
On the V10 TDI engine, Engine Control Module 1 J623 fulfills the basic functions for cylinder bank I and Engine Control Module 2 J624 for cylinder bank II. Basic functions are, for example, actuation of the solenoid valves for pump/injectors and exhaust gas recirculation.

Some of the functions that cover both cylinder banks, such as the coolant supply, are carried out by Engine Control Module 1 J623; others, like the smooth running control by Engine Control Module 2 J624.

Information received by Engine Control Module 1 J623 is sent to Engine Control Module 2 J624 via an internal CAN data bus.

Both engine control modules are identical.

The differentiation between Engine Control Module 1 J623 and Engine Control Module 2 J624 is made by a coding link in the connector for Engine Control Module 2 J624.

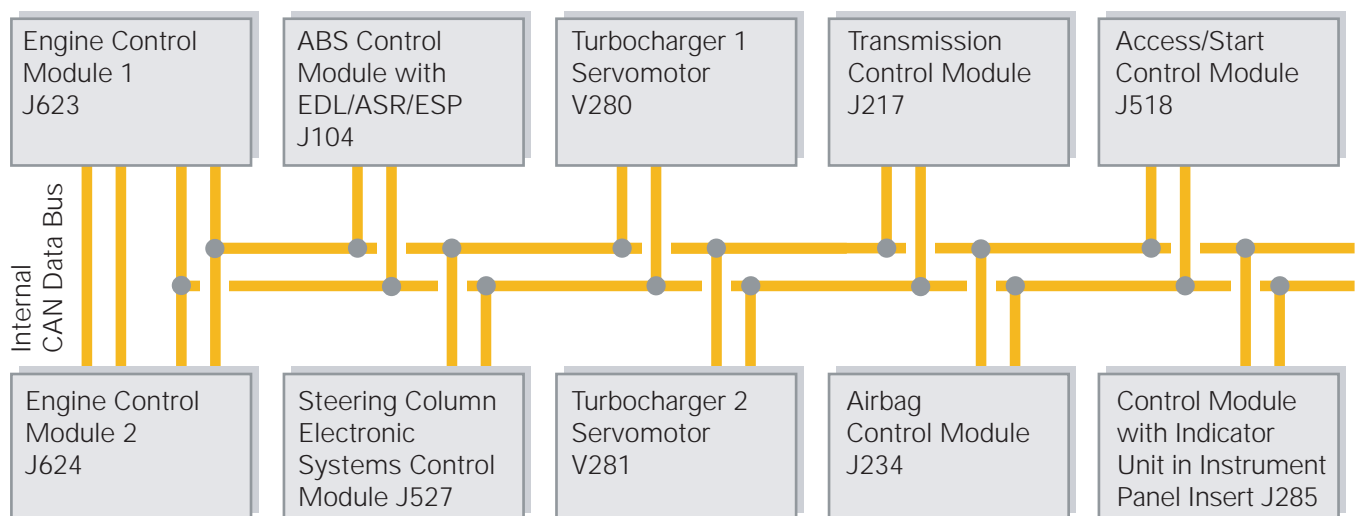


SSP304/071



After encoding, the engine control modules can no longer be interchanged.

Engine Control Modules in the Drivetrain CAN Data Bus



SSP304/026

System Overview

V10 TDI Engine EDC 16 System Overview

Sensors

Engine Speed Sensor G28

Throttle Position Sensor G79

Kick Down Switch F8

Closed Throttle Position Switch F60

Mass Air Flow Sensor G70

Heated Oxygen Sensor G39

Engine Coolant Temperature Sensor C62

Engine Coolant Temperature Sensor
(on Radiator) G83

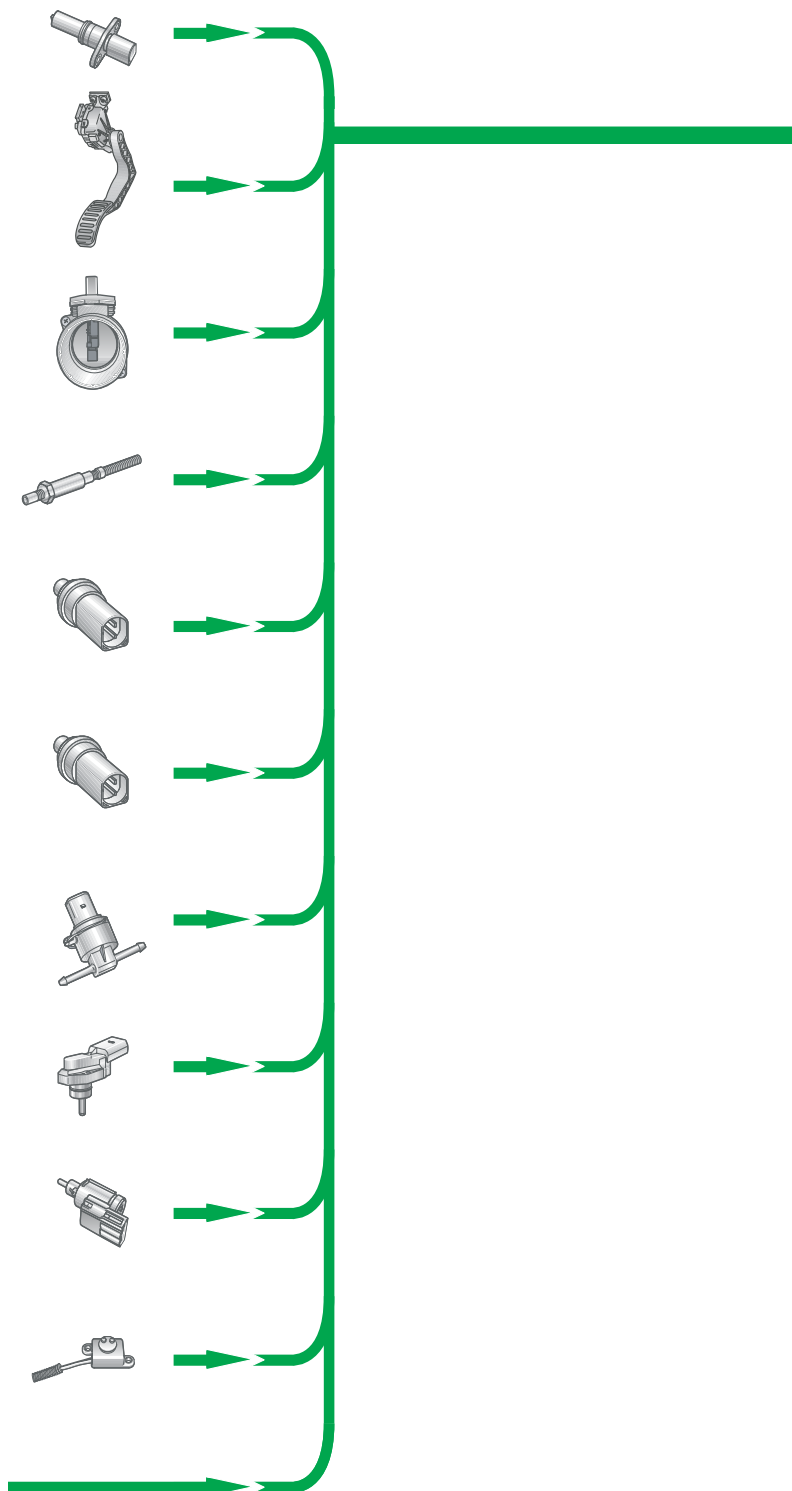
Fuel Temperature Sensor G81

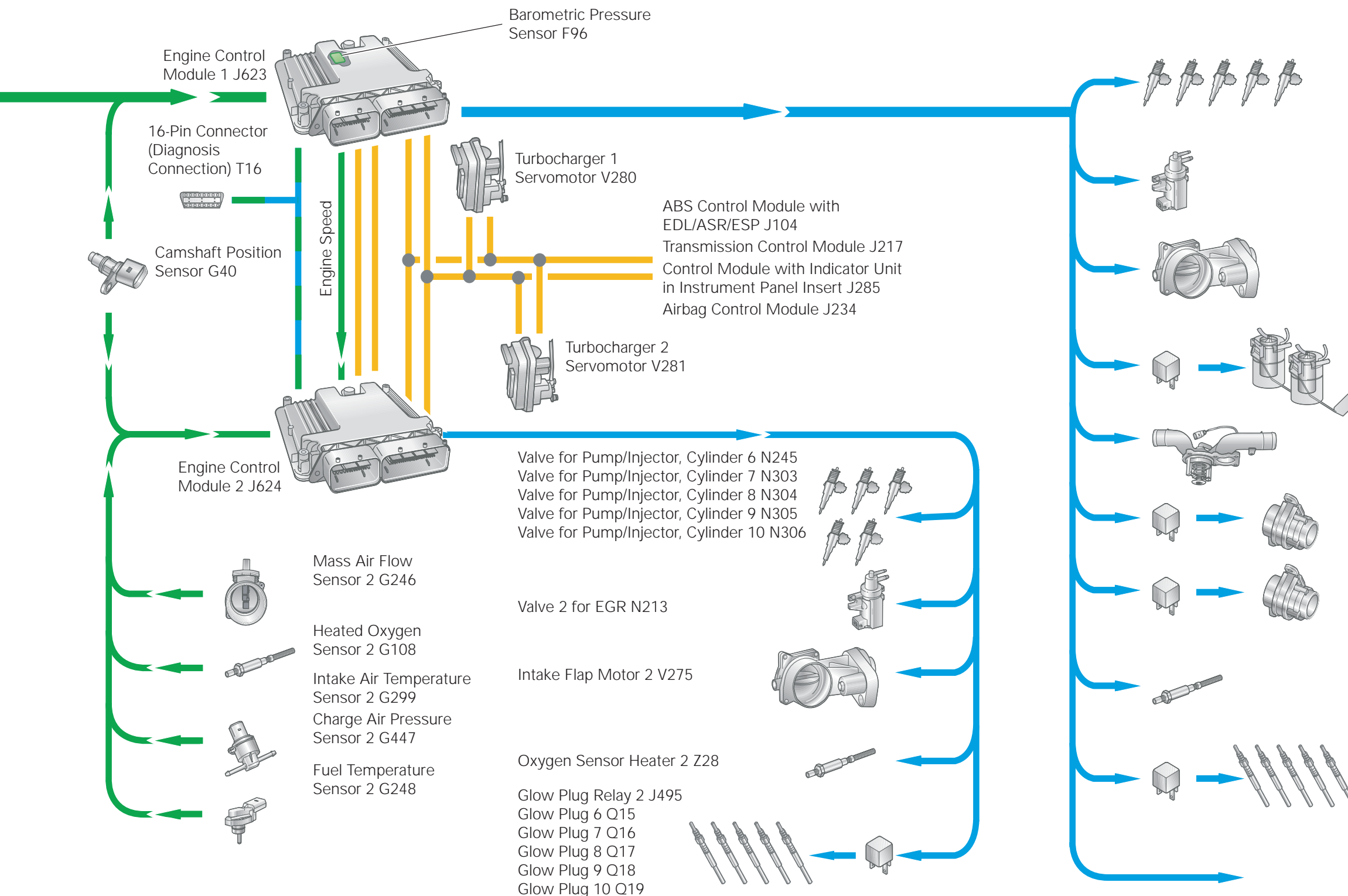
Charge Air Pressure Sensor G31
Intake Air Temperature Sensor G42

Brake Light Switch F
Brake Pedal Switch F47

Flexible Fuel Sensor G133

Additional Input Signals





SSP304/003

Subsystems



The illustrations in the subsystem examples show cylinder bank I of the V10 TDI engine.

Subsystem operation is similar for cylinder bank II as well.

Only components relevant to the subsystems are called out.

Fuel Metering Regulation

The quantity of fuel injected into the cylinders influences such engine properties as torque, power output, fuel consumption, exhaust gas emissions, and mechanical and thermal stress.

Fuel metering regulation enables optimal fuel combustion under all engine operating conditions.

Subsystem Operation

The specified torque is calculated from the internal and external torque demands.

To reach the required torque specification for this engine, a set quantity of fuel is required.

Example

The quantity of fuel is calculated by the engine control module based upon the following inputs:

- Driver requirements
- Engine speed
- Amount of air drawn
- Coolant temperature
- Fuel temperature
- Intake air temperature

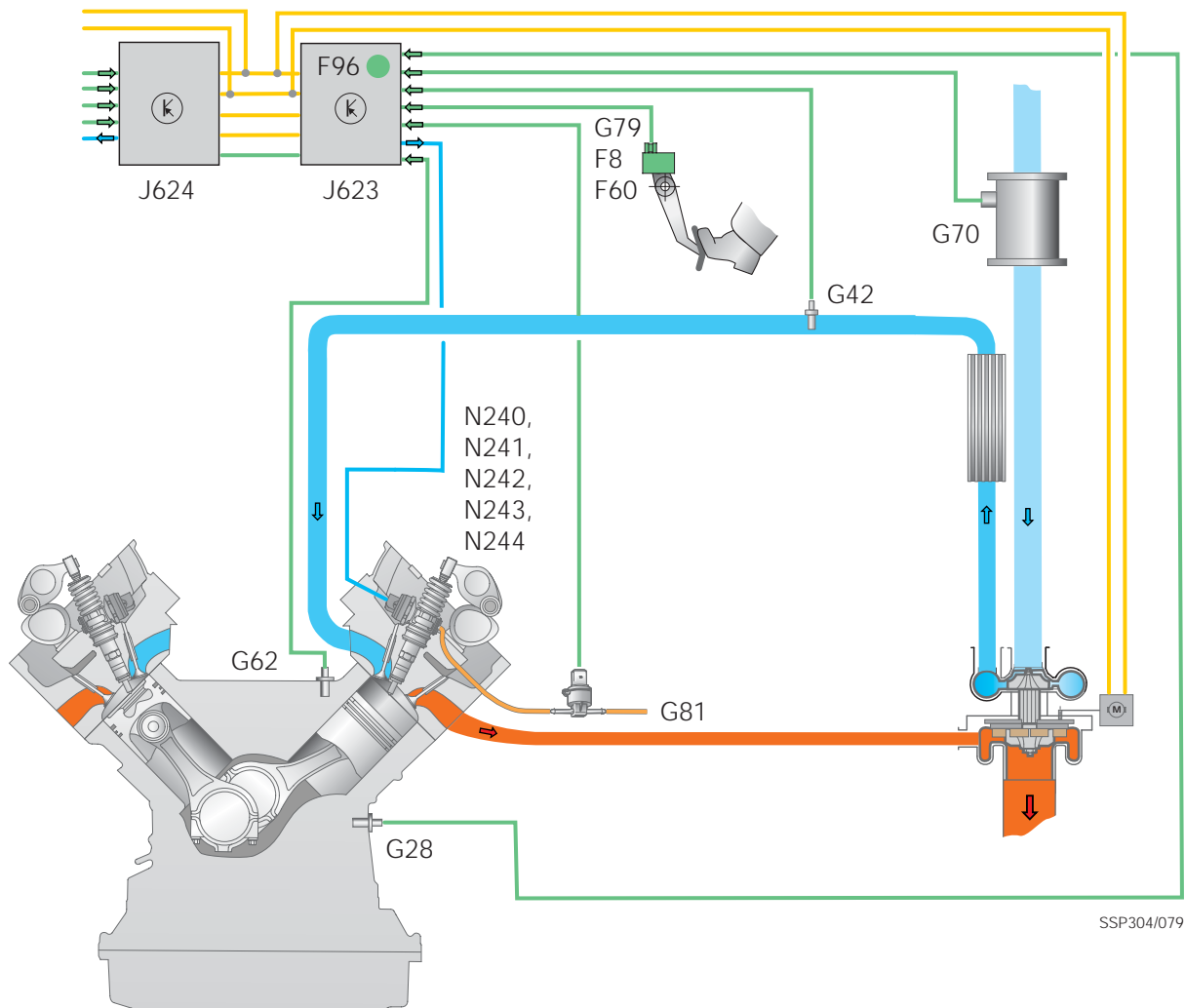
To protect the engine against mechanical damage and to prevent black smoke, there must be limitations on the quantity of fuel injected.

For this reason, the engine control module calculates a limit value for this quantity.

The fuel quantity limit value depends on the following inputs:

- Engine speed
- Air mass
- Air pressure

Subsystems



- F8 Kick Down Switch
- F60 Closed Throttle Position Switch
- F96 Barometric Pressure Sensor
- G28 Engine Speed Sensor
- G42 Intake Air Temperature Sensor
- G62 Engine Coolant Temperature Sensor
- G70 Mass Air Flow Sensor
- G79 Throttle Position Sensor
- G81 Fuel Temperature Sensor
- J623 Engine Control Module 1 (Cylinder Bank I)
- J624 Engine Control Module 2 (Cylinder Bank II)
- N240, N241, N242, N243, N244
Valves for Pump/Injectors, Cylinders 1
through 5 (Cylinder Bank I)

- Air Intake, Normal
- Air Intake, Compressed
- Exhaust Gas
- Input Signal
- Output Signal
- Drivetrain CAN Data Bus

Subsystems

Start of Injection Regulation

The start of injection regulation influences a number of engine properties, including engine performance, fuel consumption, noise levels, and exhaust emissions.

Start of injection regulation determines the correct timing for fuel delivery and injection at each cylinder.

Subsystem Operation

The engine control module calculates the start of injection from:

- Engine speed
- Calculated quantity of fuel to be injected from the fuel metering regulation.

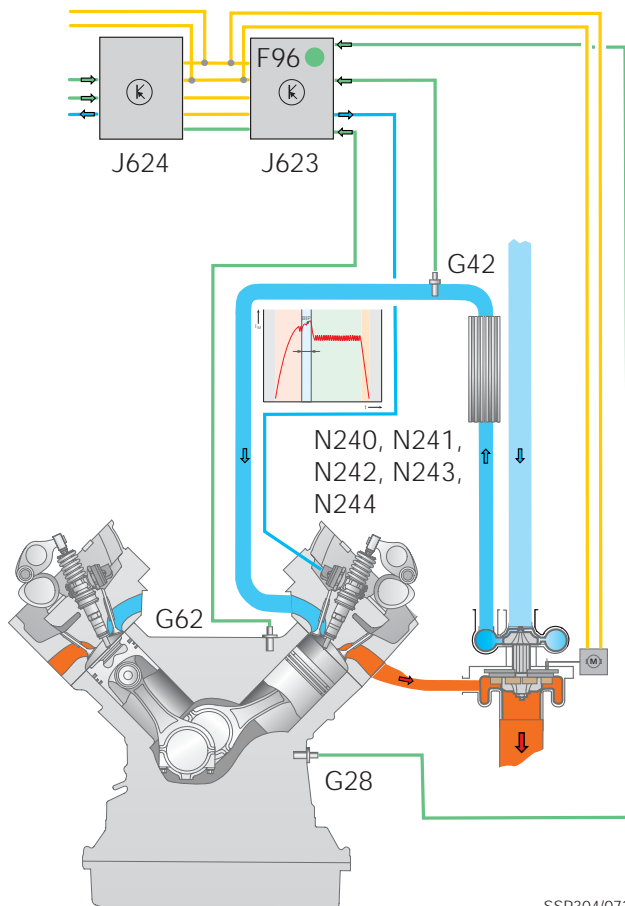
Additional influencing factors include:

- Coolant temperature
- Air pressure

The engine control module monitors the electrical current that actuates the solenoid valves at the pump/injectors.

This provides feedback to the engine control module of the actual point in time when injection begins.

The engine control module uses this feedback to regulate the beginning of injection periods (BIP) during subsequent combustion cycles and to detect malfunctions of the pump/injector solenoid valves.



- F96 Barometric Pressure Sensor
- G28 Engine Speed Sensor
- G42 Intake Air Temperature Sensor
- G62 Engine Coolant Temperature Sensor
- J623 Engine Control Module 1
- J624 Engine Control Module 2
- N240, N241, N242, N243, N244 Valves for Pump/Injectors, Cylinders 1 through 5 (Cylinder Bank I)

- Air Intake, Normal
- Air Intake, Compressed
- Exhaust Gas
- Input Signal
- Output Signal
- Drivetrain CAN Data Bus

SSP304/073

Start of injection is initiated when the pump/injector solenoid valve is actuated.

Actuating current applied to a pump/injector solenoid valve creates a magnetic field. As the applied current intensity increases, the valve closes; the magnetic coil presses the solenoid valve needle into its valve seat. This closes off the path from the fuel supply line to the pump/injector high-pressure chamber and the injection period begins.

As the solenoid valve needle contacts its valve seat, the distinctive signature of an alternately dropping and rising current flow is detected by the engine control module. This point is called the beginning of injection period (BIP). It indicates the complete closure of the pump/injector solenoid valve and the starting point of fuel delivery.



"Start of injection"

is the point in time when the actuating current to the pump/injector solenoid valve is initiated.

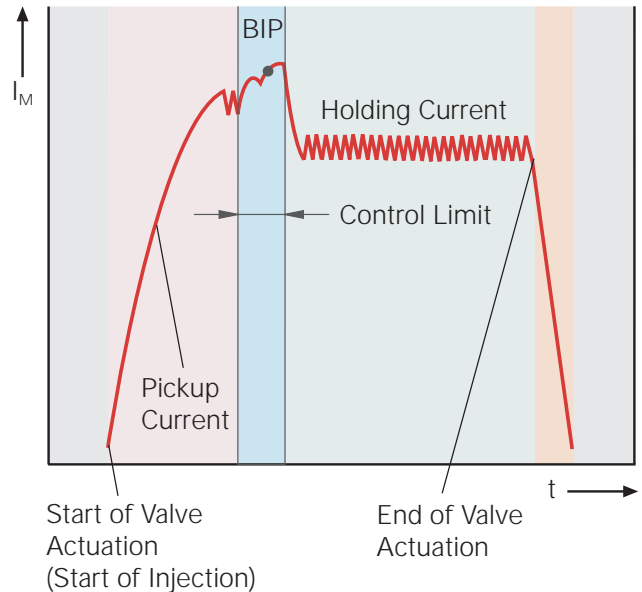
"Beginning of injection period (BIP)"

is the point in time when the solenoid valve needle contacts the valve seat.

With the solenoid valve closed, a holding current is maintained at a constant level by the engine control module to keep it closed. Once the required time period for fuel delivery has elapsed, the actuating current is switched off and the solenoid valve opens.

The actual moment at which the pump/injector solenoid valve closes (BIP) is used by the engine control module to calculate the point of actuation for the next injection period.

Current Pattern — Pump/Injector Solenoid Valve



I_M – Solenoid Valve Actuating Current

t – Time

BIP – Beginning of Injection Period (Valve Closes)

SSP304/072

If the actual BIP deviates from the mapped details stored in the engine control module, the engine control module will correct the point of valve actuation (start of injection) for the next combustion cycle.

To detect pump/injector solenoid valve faults, the engine control module evaluates the BIP position from the current flow pattern. If there are no faults, BIP will be within the control limit. If this is not the case, the valve is faulty.

Effects of failure

If a fault is detected at the solenoid valve, start of injection is determined based on fixed values from the control map. Regulation is no longer possible and performance is impaired.

Subsystems

Exhaust Gas Recirculation

When exhaust gas recirculation (EGR) occurs, some of the exhaust emissions from the combustion process are used again. Because the exhaust gases contain very little oxygen, the peak combustion temperature is lowered and nitrogen oxide emissions (NO_x) are reduced. Exhaust gas recirculation occurs up to an engine speed of approximately 3000 rpm.

Subsystem Operation

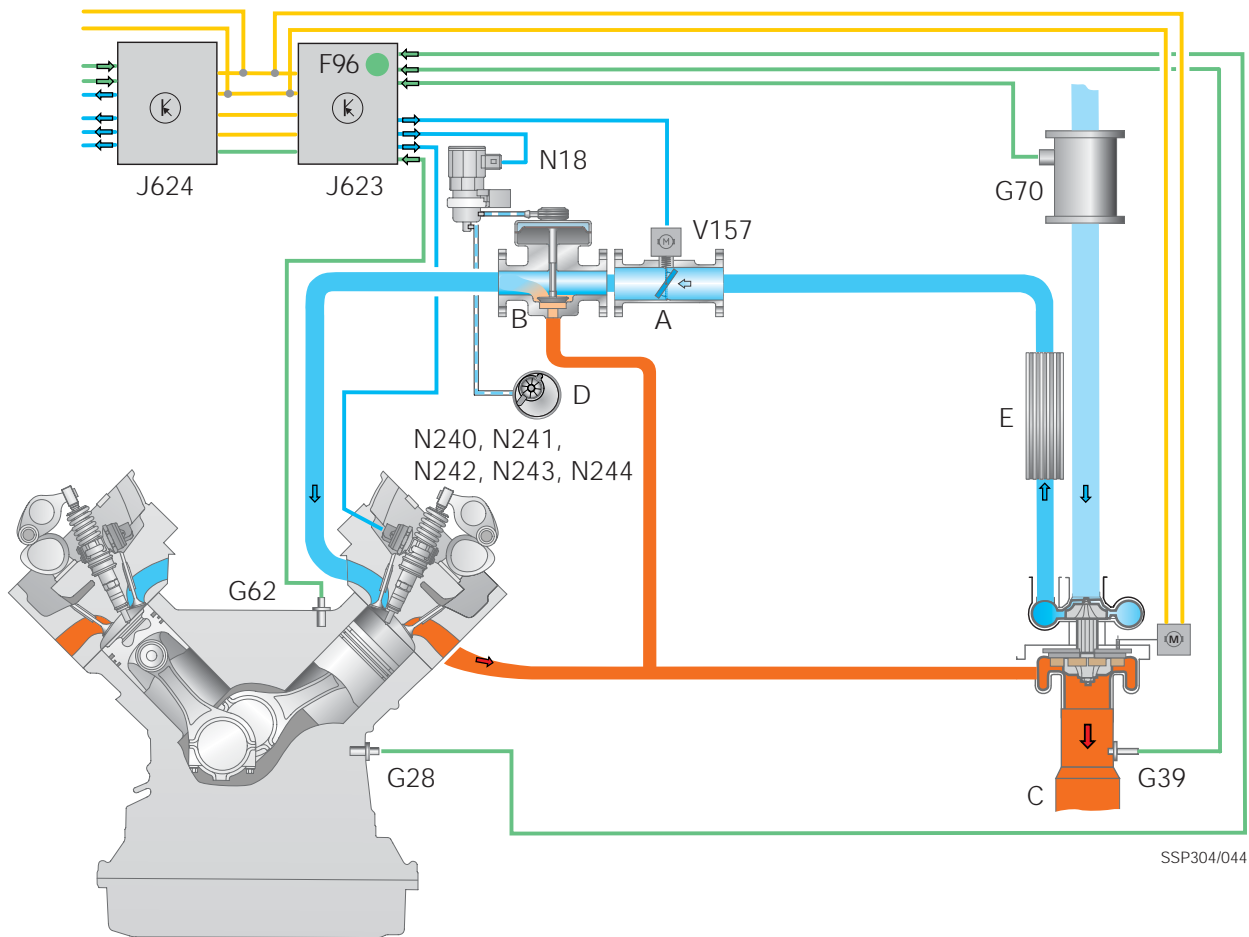
The amount of recirculated exhaust gas depends on the engine speed, the amount of fuel injected, the amount of air drawn in, the intake air temperature, and the air pressure.

Heated oxygen sensor control for exhaust gas recirculation

On the V10 TDI engine, the amount of recirculated exhaust gas is determined and corrected by oxygen sensor control. With this system, the oxygen content in the exhaust gas is constantly monitored and a sensor signal is sent to the engine control module.

If the actual oxygen content deviates from the specification requirements in the control map, the engine control module actuates the EGR Vacuum Regulator Solenoid Valve N18 and increases or decreases the amount of recirculated exhaust gas. With oxygen sensor control, the amount of recirculated exhaust gas can be determined precisely.

- If the oxygen content is too high, the amount of recirculated exhaust gas is increased.
- If the oxygen content is too low, the amount of recirculated exhaust gas is lowered.



- F96 Barometric Pressure Sensor
- G28 Engine Speed Sensor
- G39 Heated Oxygen Sensor
- G62 Engine Coolant Temperature Sensor
- G70 Mass Air Flow Sensor
- J623 Engine Control Module 1
- J624 Engine Control Module 2
- N18 EGR Vacuum Regulator Solenoid Valve
- N240, N241, N242, N243, N244 Valves for Pump/Injectors, Cylinders 1 through 5 (Cylinder Bank I)
- V157 Motor for Intake Flap

- A Intake Manifold Flap
- B EGR Valve
- C Catalytic Converter
- D Vacuum Pump
- E Charged Air Cooler

- Air Intake, Normal
- Air Intake, Compressed
- Exhaust Gas
- Coolant
- Vacuum
- Input Signal
- Output Signal
- Drivetrain CAN Data Bus

Subsystems

Charge Pressure Control

The charge pressure is controlled by a map that is stored in the engine control module.

Subsystem Operation

The engine control module sends a signal via the drivetrain CAN data bus to the turbocharger servomotors.

The signal generated by the engine control module determines a turbocharger vane setting value between 0% and 100%.

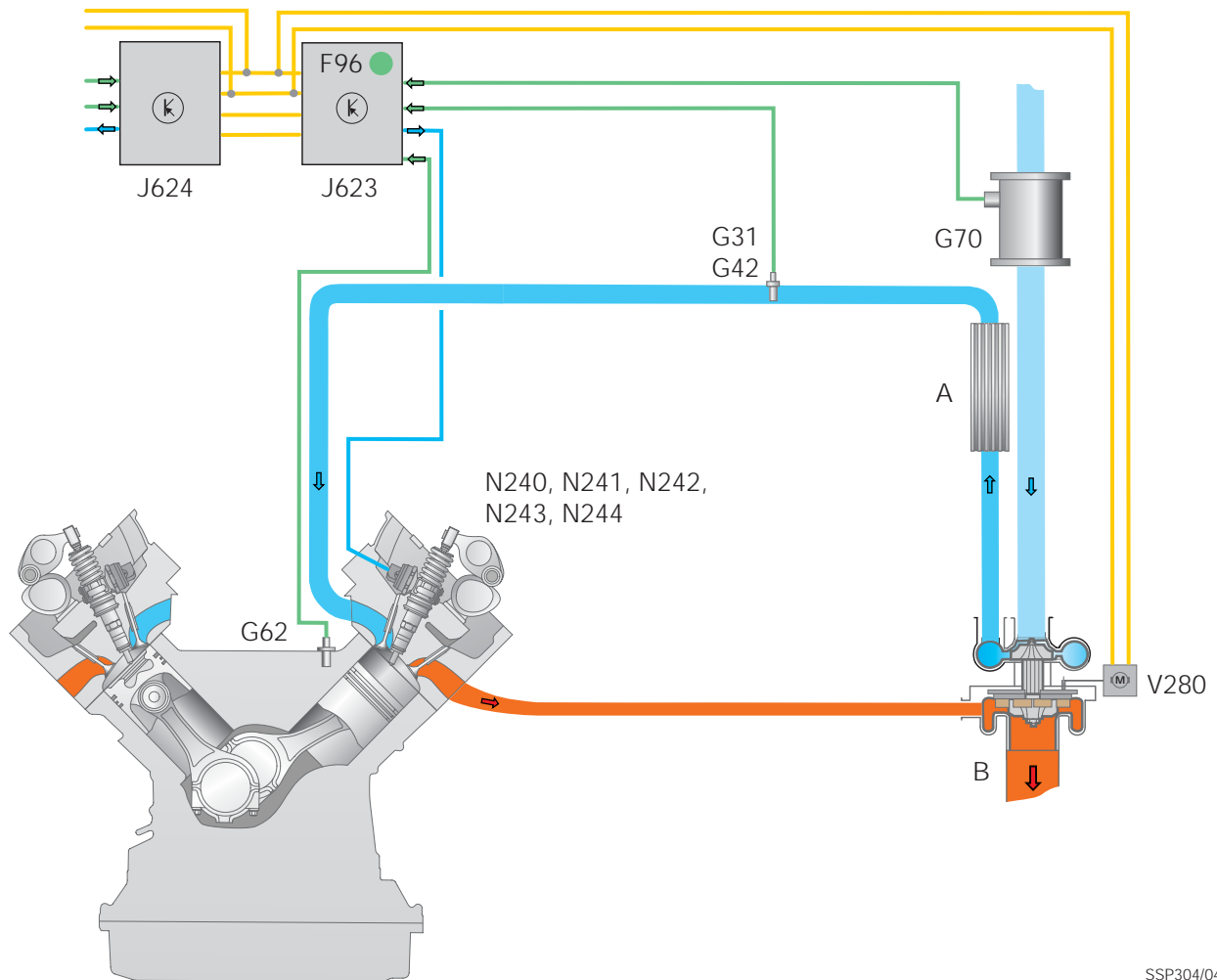
The turbocharger servomotors adjust the angles of the turbocharger vanes as instructed, which results in a corresponding adjustment in turbocharger impeller speed.

The charge pressure is increased or reduced accordingly.

Charge pressure control depends on the demand for torque.

To control the charge pressure, signals from the charge air pressure sensors are used. The signals from the intake air temperature sensors, Engine Coolant Temperature Sensor G62 and Barometric Pressure Sensor F96, are used as correction factors.

The charge pressure is reduced gradually when the vehicle is travelling at high altitudes to protect the turbocharger.



SSP304/045

- F96 Barometric Pressure Sensor
- G31 Charge Air Pressure Sensor
- G42 Intake Air Temperature Sensor
- G62 Engine Coolant Temperature Sensor
- G70 Mass Air Flow Sensor
- J623 Engine Control Module 1
- J624 Engine Control Module 2
- N240, N241, N242, N243, N244
Valves for Pump/Injectors, Cylinders 1 through 5 (Cylinder Bank I)
- V280 Turbocharger 1 Servomotor
- A Charged Air Cooler
- B Turbocharger

- Air Intake, Normal
- Air Intake, Compressed
- Exhaust Gas
- Input Signal
- Output Signal
- Drivetrain CAN Data Bus

Subsystems

Glow Plug System

The glow plug system makes it easier to start the engine at low outside temperatures. The system is controlled by the engine control module at coolant temperatures below 48°F (9°C).

The glow plug relays are actuated by the engine control module. Once actuated they distribute the current required for the glow plugs.

Glow Period

The glow plugs are activated when the ignition is switched on and outside temperature is below 48°F (9°C). The Glow Plug Indicator Light K29 will light up.

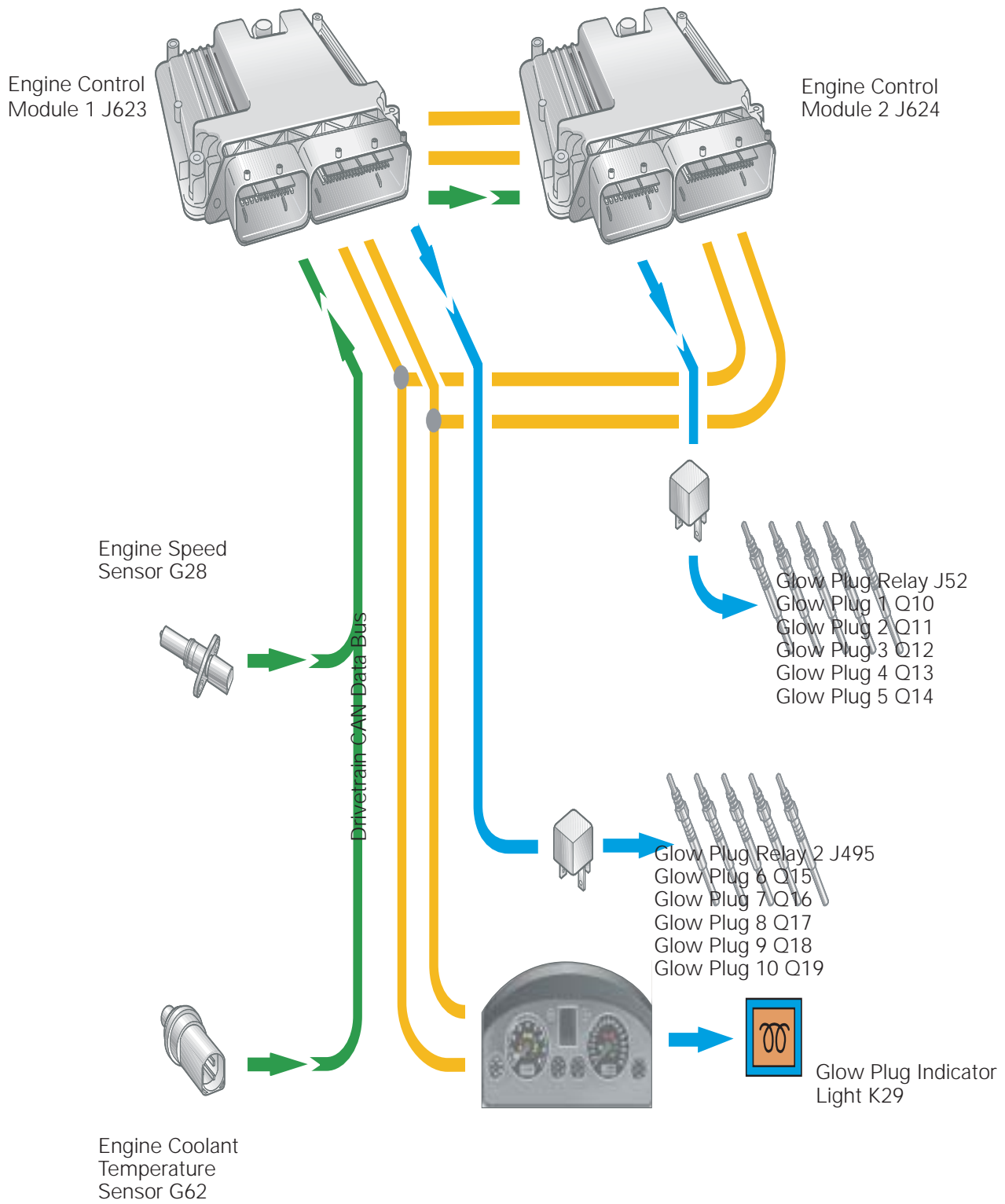
When the glow plug period has elapsed, the Glow Plug Indicator Light K29 will go out and the engine can be started.

Extended Glow Period

Once the engine starts, there is an extended glow period. This helps to lower the combustion noise. It also improves the idle speed quality and the carbon dioxide emissions are reduced.

The extended glow period lasts for a maximum of four minutes and is deactivated at engine speeds above 2500 rpm.

There is no extended glow period if the battery voltage is too low to support it.



Subsystems

Idle Speed Control

Idle speed control sets a predetermined engine idle speed depending upon the operating conditions. For example, a cold engine will have a higher idle speed than a warm engine.

Additional performance demands are also considered, such as:

- Electrical system requirements at low engine speeds.
- Power steering pump operation.
- The high pressures required for diesel injection.
- The energy required to overcome the internal friction of the engine.
- Torque converter operation at different loads.

Subsystem Operation

The specified engine idle speed is regulated by a map in the engine control module.

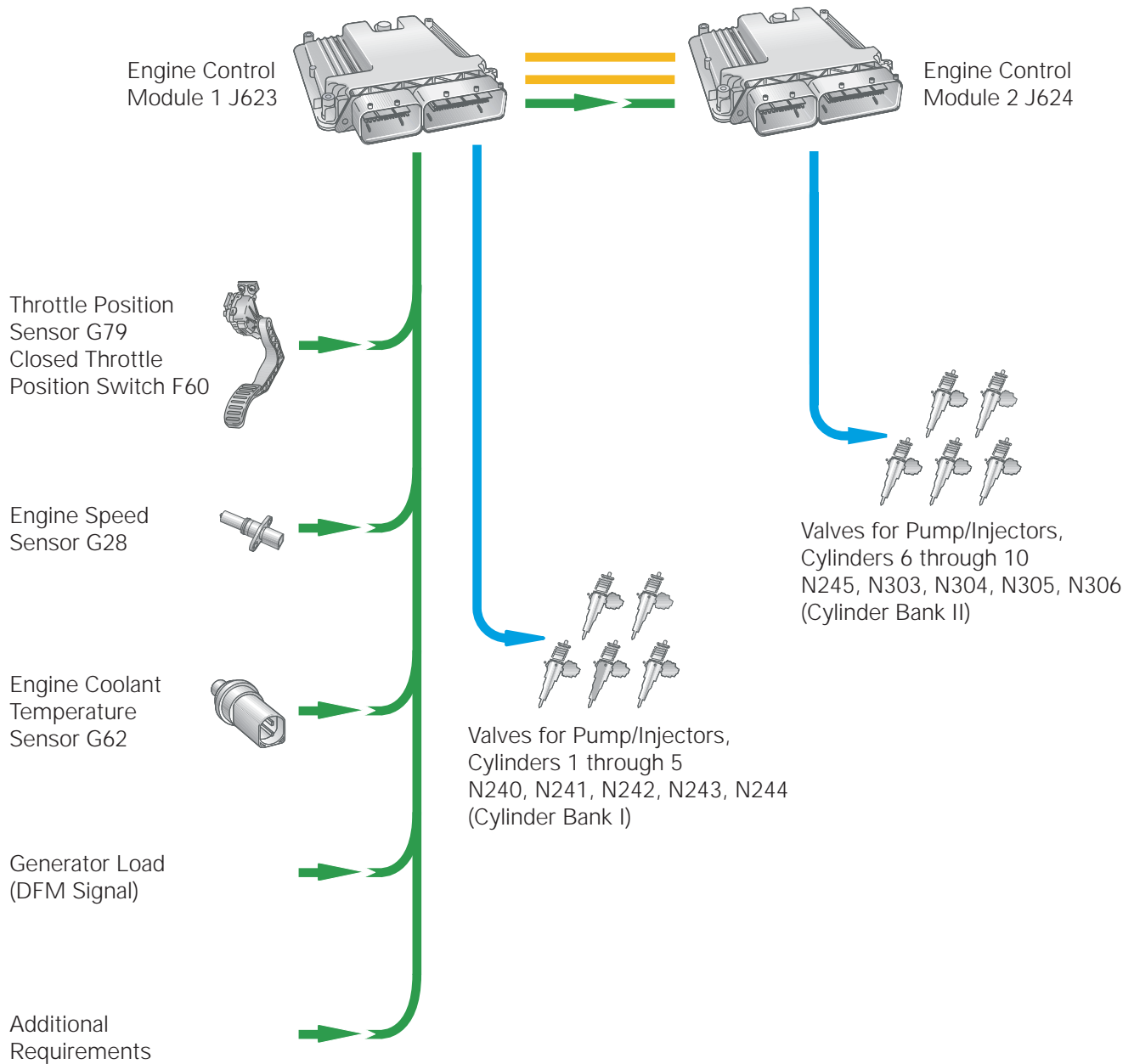
The map draws on information from:

- Engine Coolant Temperature Sensor G62.
- Load on the generator.
- Load on the vehicle electrical system.

The engine control module continually adapts the amount of fuel injected until the actual engine idle speed matches the specified value.

To avoid unnecessary emissions, the idle speed is kept to a minimum level, though during this process, demands on smooth running also play a role.

Subsystems



SSP304/074

Subsystems

Smooth Running Control

Smooth running control improves engine running at idle speed.

Different cylinders in an engine can often generate different levels of torque even though the same amount of fuel has been injected.

Possible causes of this include differences in any combination of the following:

- Tolerances of the parts.
- Cylinder compression.
- Friction in the cylinders.
- Hydraulic injector components.

The effects of these differences in torque include:

- Unbalanced engine running.
- Increased exhaust gas emissions.

The smooth running control is designed to detect the pulses in speed that are caused as a result. The pulses in speed are then

balanced by targeted control of the amount injected at the affected cylinders.

Subsystem Operation

Detection works at idle speed using a signal from the Engine Speed Sensor G28.

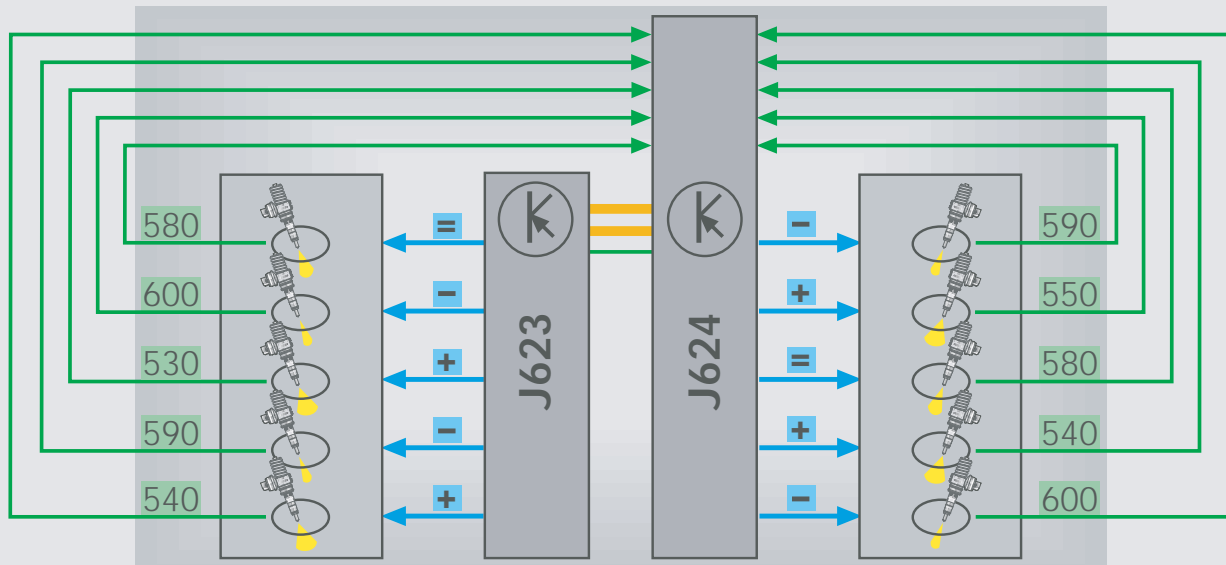
If the signals are received in a balanced rhythm, the cylinders are all working the same way.

If the performance of one cylinder is slower than the others, the crankshaft will need more time to reach the next point of ignition.

A cylinder that performs faster than the others will need less time than the others to reach the next point of ignition.

If the Engine Control Module 2 J624 detects a deviation, the affected cylinder will receive a smaller or greater amount of fuel until the engine runs smoothly again.

Example: Necessary changes in the amount of fuel injected at specified speeds of 580 rpm.



Actual Speed

Change in Quantity of Fuel Injected

SSP304/058

Active Pulse Damping

The active pulse damping system reduces the jerking movements that can be generated by engine load changes under acceleration.

Without Active Pulse Damping

Without active pulse damping, when the accelerator pedal is pressed, a large amount of fuel (blue curve) is injected for a brief period.

This sudden load change can lead to pulsations (red curve) in the vehicle drivetrain due to changes in engine torque.

These pulsations are perceived by the vehicle occupants as jerking movements.

With Active Pulse Damping

With active pulse damping, when the accelerator pedal is pressed, the amount of fuel injected (blue curve) is not the full amount demanded at the start by the accelerator pedal position.

Instead, injected fuel is reduced by about half and gradually increased over the first second or so of acceleration.

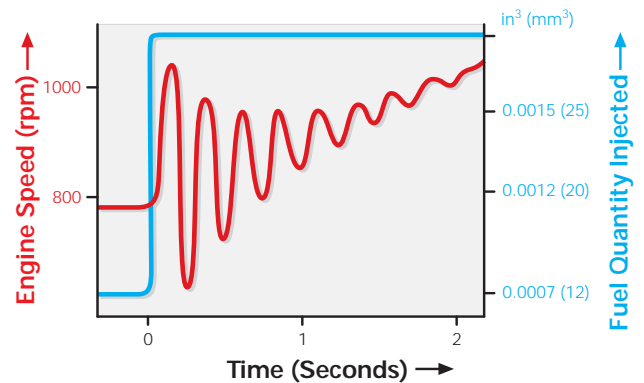
If there are pulsations in the vehicle drivetrain during that time, they are detected by evaluation of the engine speed signal.

When engine speed increases, the amount of fuel injected is reduced.

When engine speed decreases, fuel injected is increased.

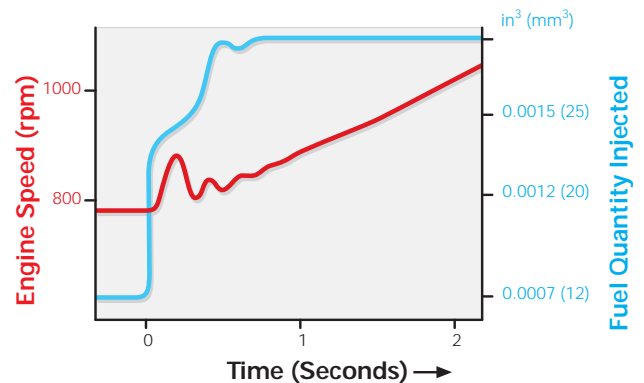
These damped pulsations (red curve) are less noticeable by the occupants of the vehicle.

Without Active Pulse Damping



SSP304/053

With Active Pulse Damping



SSP304/054

Subsystems

Governor

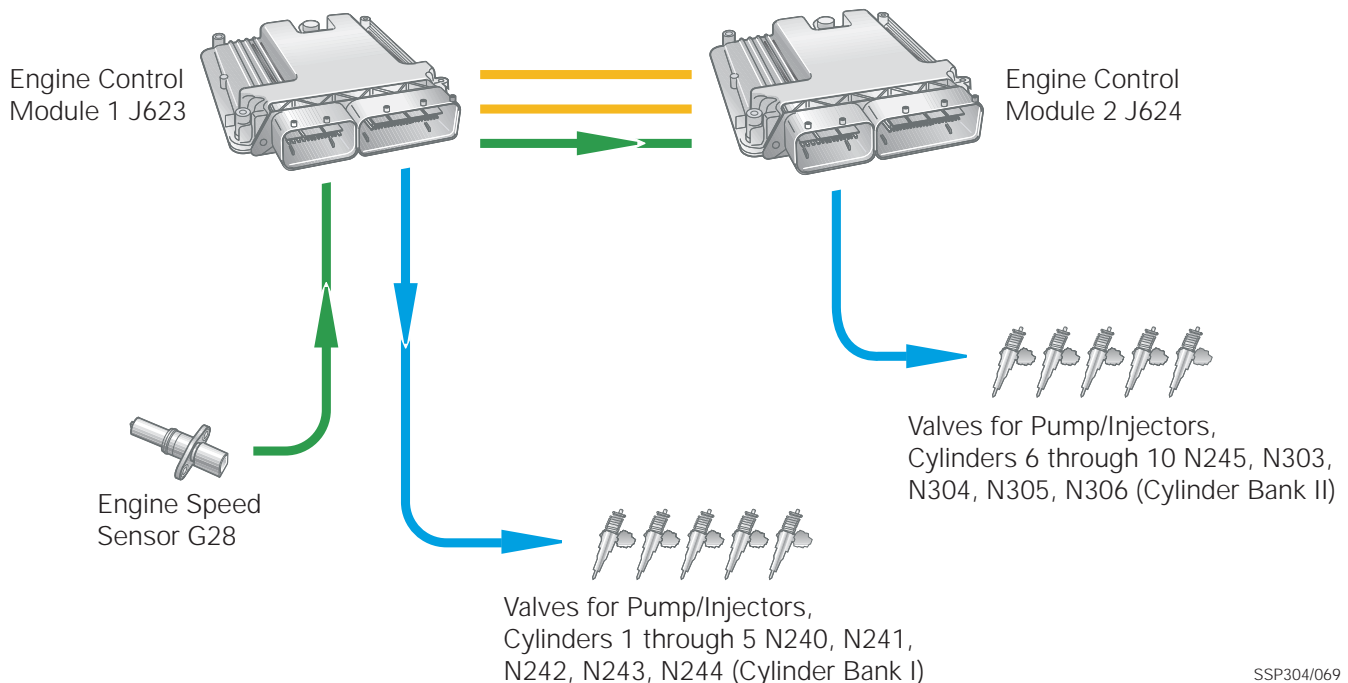
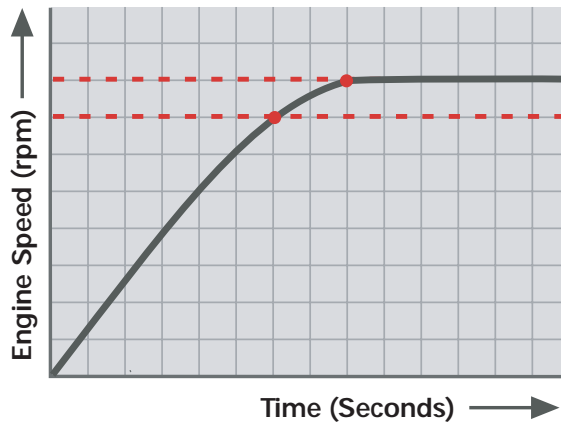
The governor protects the engine from over-speed damage. The engine is governed to a maximum permissible speed that cannot be exceeded for long periods of time.

Subsystem Operation

Engine speed regulation starts just before maximum permissible speed is reached. Once regulation starts, the amount of fuel injected is continually reduced.

When the maximum permissible engine speed is reached, the amount of fuel injected remains constant until the driving conditions change.

The adaptive function of the governor is kept as smooth as possible to prevent surges in the amount of fuel injected during acceleration.



SSP304/069

Cruise Control System

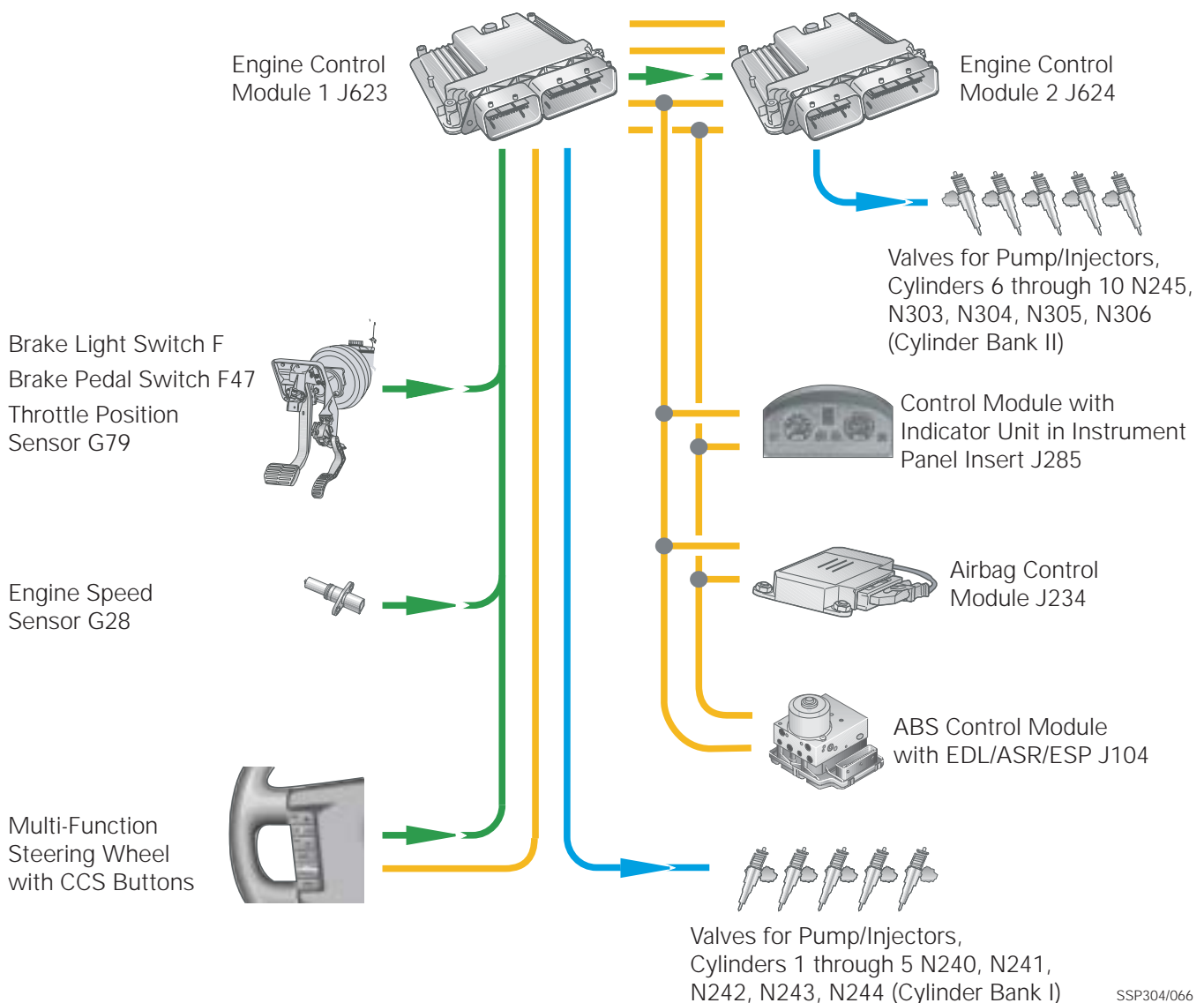
The cruise control system (CCS) allows the vehicle to be driven at a constant speed without the driver having to press the accelerator pedal.

Cruise control on the Touareg starts in the reduction gear at 3.7 mph (6 km/h) and in normal operation at 12.4 mph (20 km/h).

Subsystem Operation

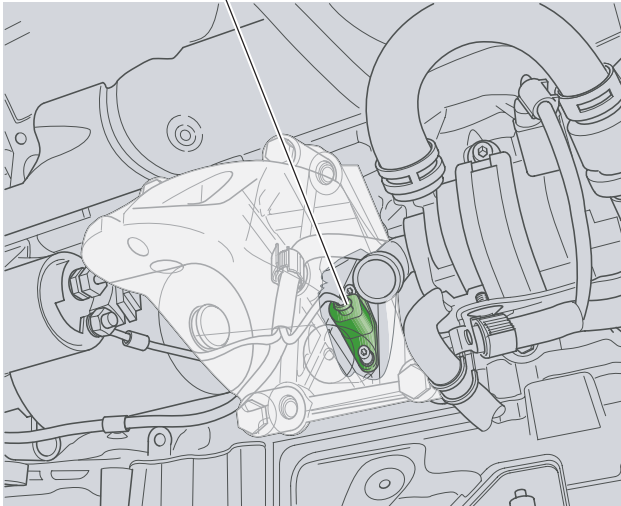
The specified speed is set using a button on the multi-function steering wheel. The signal is sent to Engine Control Module 1 J623 and passed on to Engine Control Module 2 J624 via an internal CAN data bus.

The engine control modules adapt the amount of fuel injected so that the actual speed is the same as the specified speed.



SSP304/066

Engine Speed Sensor G28



SSP304/008

Engine Speed Sensor G28

The Engine Speed Sensor G28 is bolted to the side of the cylinder block. It picks up the position of the crankshaft by reading a reference gap in the spacing of the teeth on an engine speed sensor wheel.

Signal Application

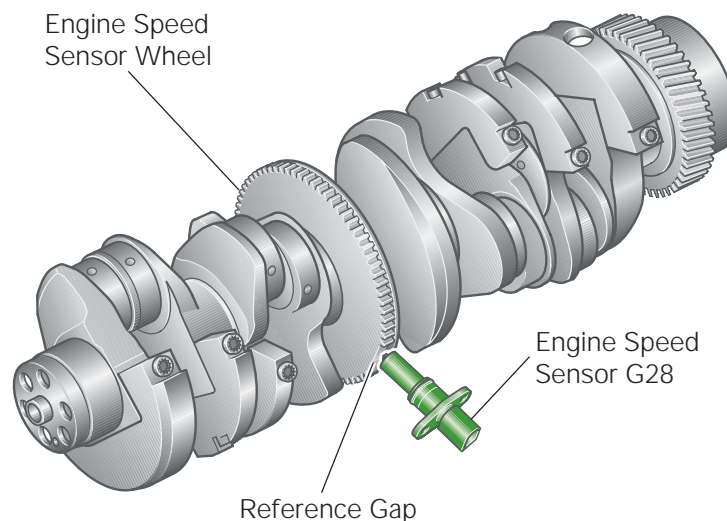
The signal from Engine Speed Sensor G28 is used to determine the speed of the engine and the precise position of the crankshaft. With this information, the amount of fuel injected and start of injection is calculated.

Effects of failure

In the case of signal loss, the engine will switch off and cannot be restarted.



The signal from the Engine Speed Sensor G28 is sent directly to Engine Control Module 1 J623. Engine Control Module 2 J624 receives the signal indirectly but simultaneously from Engine Control Module 1 J623 via a separate wire connection.



SSP304/059

Camshaft Position Sensor G40

The Camshaft Position Sensor G40 is a Hall-effect sensor. It is bolted to the cylinder head of cylinder bank I below the mechanical fuel pump.

Camshaft Position Sensor G40 scans the quick-start sender wheel to determine the position of the camshaft.

Signal Application

Using the Camshaft Position Sensor G40 signal, the relative position of the camshaft to the crankshaft is picked up quickly when the engine is started.

Together with the signal from the Engine Speed Sensor G28, the system can detect which cylinder is at top-dead-center (TDC).

Effects of failure

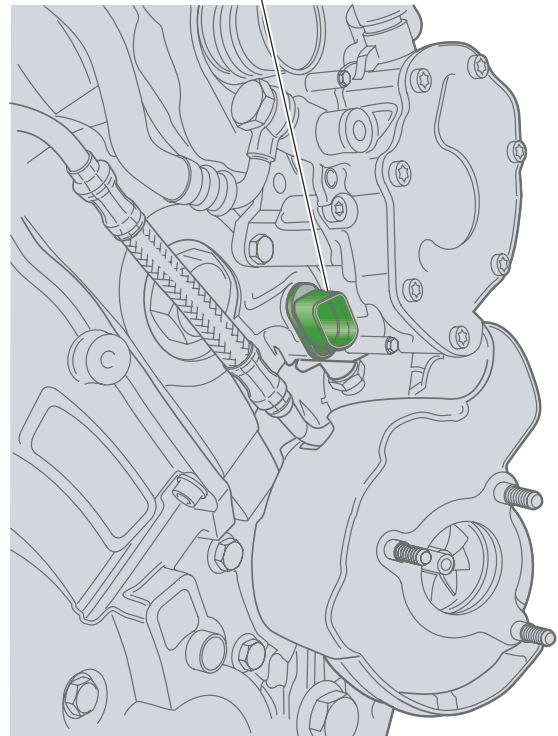
If the Camshaft Position Sensor G40 signal fails, the signal from the Engine Speed Sensor G28 is used in its place.

Because the position of the camshaft and the cylinders cannot be detected immediately, starting of the engine could take slightly longer than normal.



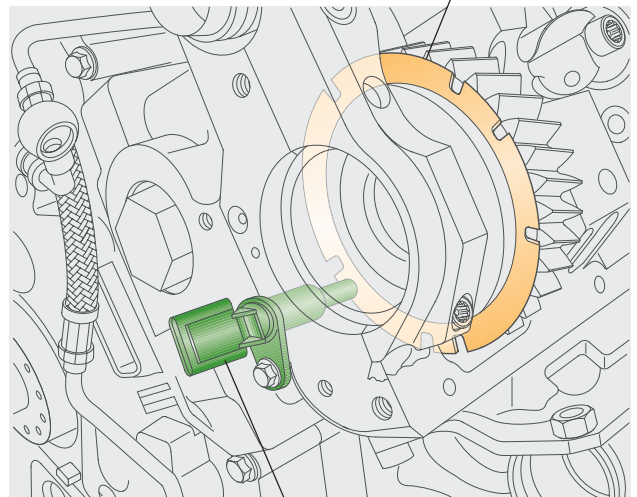
On the V10 TDI engine, just one Camshaft Position Sensor G40 is installed. The signal is sent to both engine control modules.

Camshaft Position Sensor G40



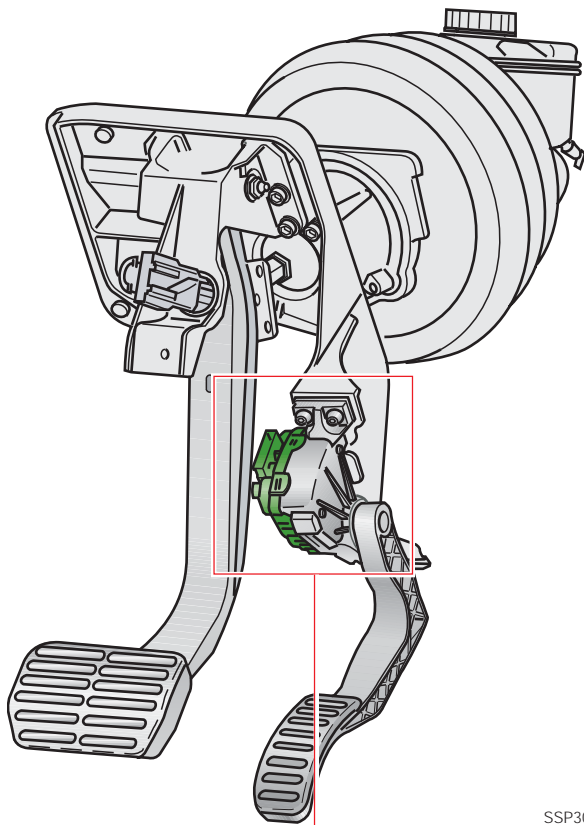
SSP304/007

Quick-Start Sender Wheel



SSP304/020

Camshaft Position Sensor G40



Accelerator Pedal Module

The Throttle Position Sensor G79, the Kick Down Switch F8, and the Closed Throttle Position Switch F60 are all incorporated into a single housing. This accelerator pedal module is mounted on the pedal cluster.

Accelerator Pedal Module Signal Application

Throttle Position Sensor G79

The Throttle Position Sensor G79 detects the position of the accelerator pedal across its entire range of movement.

It is a main input signal to calculate the amount of fuel to be injected.

Closed Throttle Position Switch F60

The Closed Throttle Position Switch F60 detects when there is no pressure on the accelerator pedal and sends a signal that initiates idle speed control.

Kick Down Switch F8

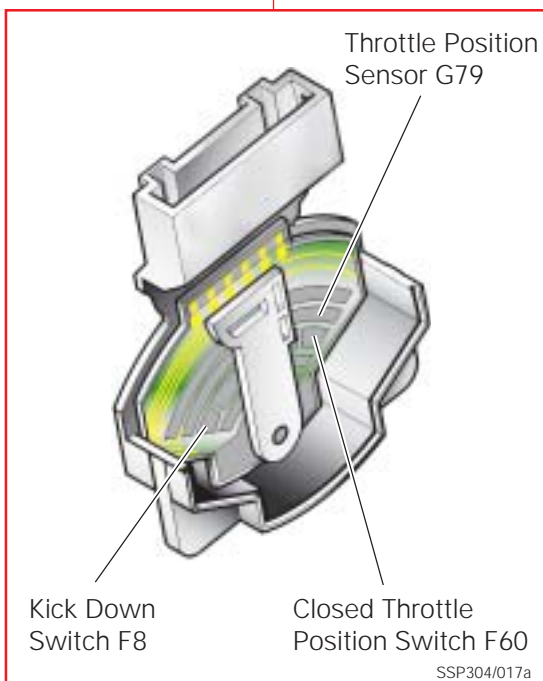
The Kick Down Switch F8 sends a message to Engine Control Module 1 J623 when the accelerator pedal is pressed all the way to the full extent of its travel.

This information is sent by the Engine Control Module 1 J623 via the drivetrain CAN data bus to the Transmission Control Module J217 and the kick-down function is activated.

Effects of failure

If the Throttle Position Sensor G79 signal fails, the position of the accelerator pedal will no longer be detected.

The engine will only run at increased idle speed and the Glow Plug Indicator Light K29 will flash.



Mass Air Flow Sensors

Each cylinder bank has its own hot film mass air flow sensor with backflow detection.

- Mass Air Flow Sensor G70 (bank I)
- Mass Air Flow Sensor 2 G246 (bank II)

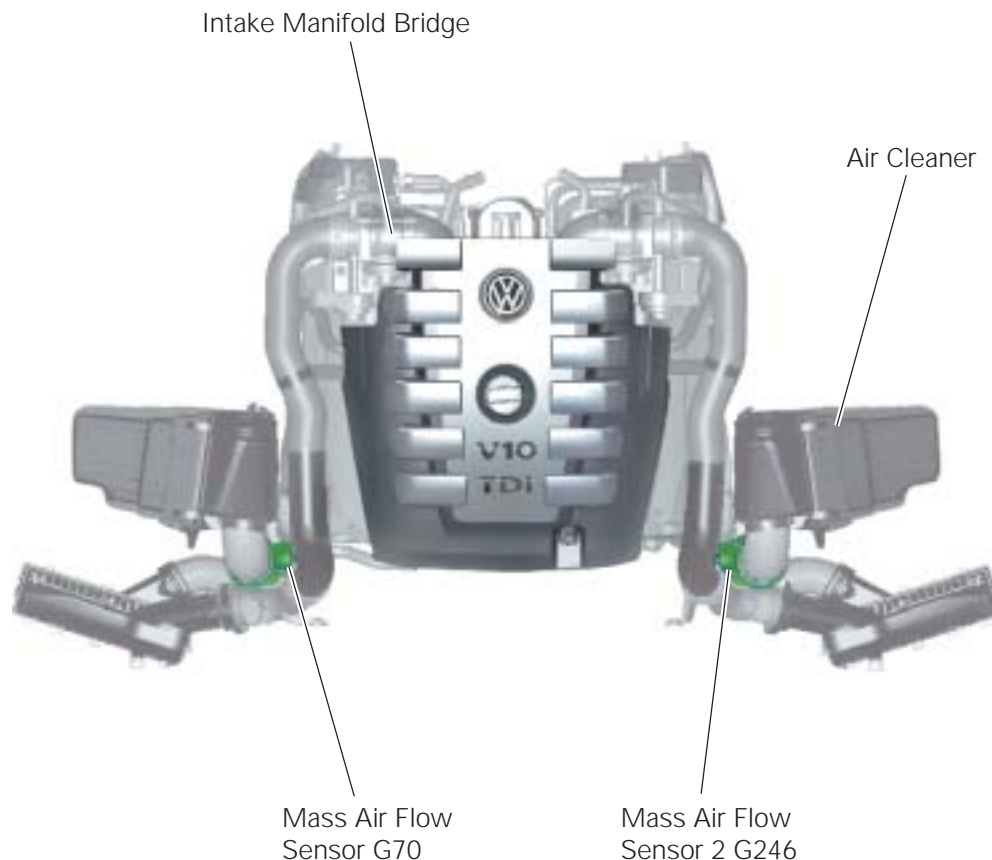
These sensors are installed in the intake passages in front of the intake manifold bridges. They determine the actual air mass drawn in for each cylinder bank.

Signal Application

The signals from the two mass air flow sensors are used by their respective engine control modules to calculate the amount of fuel to be injected and the amount of exhaust gas to be recirculated for each cylinder bank.

Effects of failure

If the signal from a mass air flow sensor fails, its respective engine control module operates using a predetermined replacement value and exhaust gas recirculation is switched off.



Sensors

Heated Oxygen Sensors

On the V10 TDI engine, broadband heated oxygen sensors are located in the exhaust system in front of the starter catalyst, one for each cylinder bank.

- Heated Oxygen Sensor G39 (bank I)
- Heated Oxygen Sensor 2 G108 (bank II)

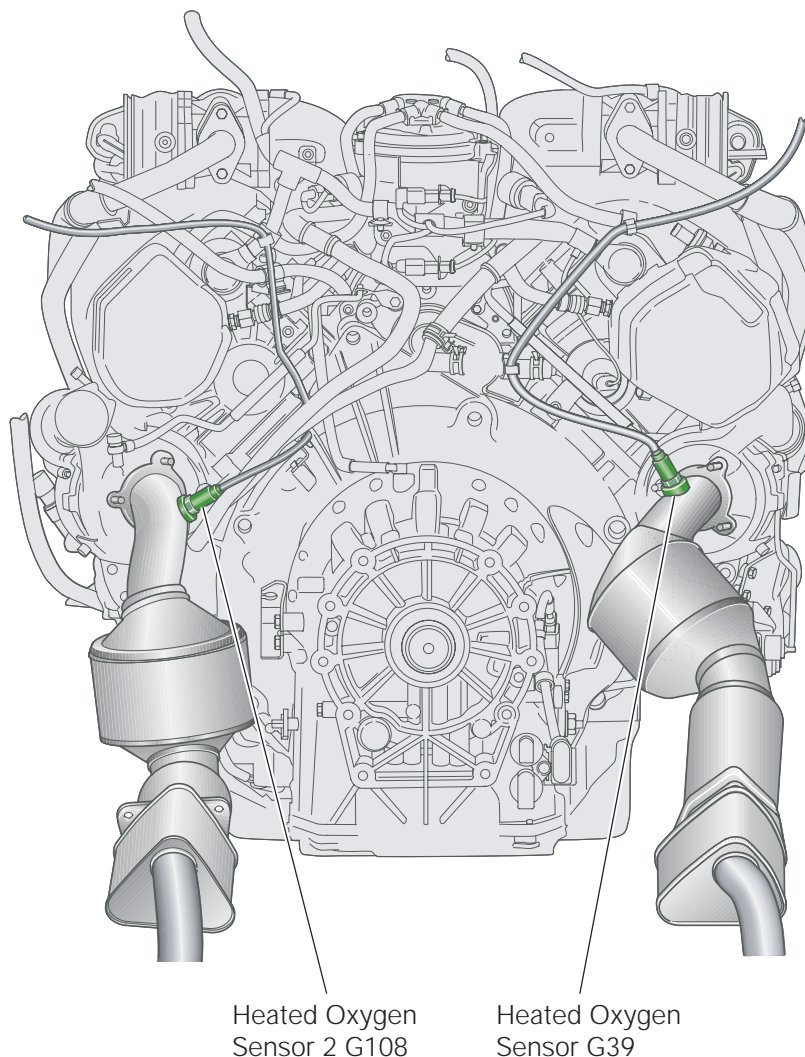
The remaining oxygen content in the exhaust gas is measured by these sensors.

Signal Application

Using the signals from both heated oxygen sensors, the amount of recirculated exhaust gas is corrected.

Effects of failure

If the heated oxygen sensor signals fail, the amount of recirculated exhaust gas will be determined by the mass air flow sensors. Because this method of regulation is not as precise, nitrogen oxide emissions levels may rise.



SSP304/033

Engine Coolant Temperature Sensor G62

The Engine Coolant Temperature Sensor G62 is mounted in the coolant connecting pipe between the cylinder heads. It sends the coolant temperature to Engine Control Module 1 J623.

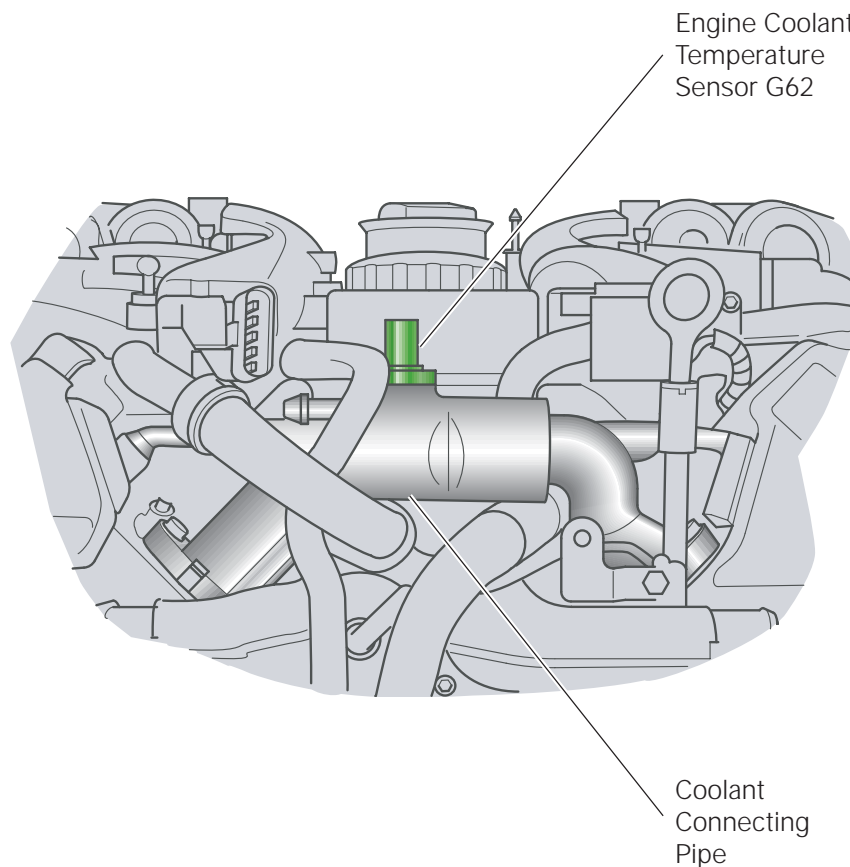
Signal Application

The coolant temperature is used by the engine control modules as a correction value to calculate such variables as the amount of fuel to be injected, the charge pressure, start of fuel delivery, and the amount of exhaust gas to be recirculated.

This information is also used to regulate the coolant temperature depending on the operating conditions.

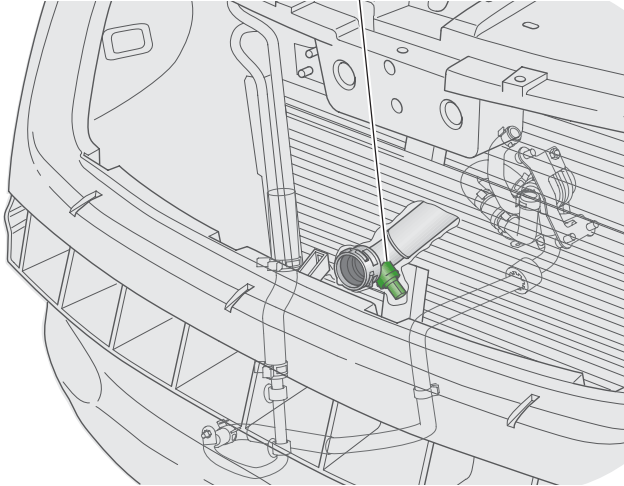
Effects of failure

If the Engine Coolant Temperature Sensor G62 signal fails, the Engine Control Module 1 J623 uses the signals from the Engine Coolant Temperature Sensor (on Radiator) G83 and the Fuel Temperature Sensor G81; Engine Control Module 2 J624 uses the signal from Fuel Temperature Sensor 2 G248.



Sensors

Engine Coolant Temperature
Sensor (on Radiator) G83



SSP304/035

Engine Coolant Temperature Sensor (on Radiator) G83

The Engine Coolant Temperature Sensor (on Radiator) G83 measures the coolant temperature at the radiator outlet.

Signal Application

By comparing signals from both Engine Coolant Temperature Sensor G62 and Engine Coolant Temperature Sensor (on Radiator) G83, the Engine Control Module 1 J623 can determine when to actuate the radiator-mounted coolant fans.

Effects of failure

If the signal from Engine Coolant Temperature Sensor (on Radiator) G83 fails, coolant fan output stage 1 remains constantly active.

Coolant temperature regulation is continued.

Fuel Temperature Sensors

The V10 TDI engine has a fuel temperature sensor for each cylinder bank.

- Fuel Temperature Sensor G81 (bank I)
- Fuel Temperature Sensor 2 G248 (bank II)

One of these sensors is installed in the return line to the fuel filter module on each side.

They are used to determine the fuel temperature.

Signal Application

The respective engine control modules calculate the fuel density from the fuel temperature.

This is used as a correction value to calculate the amount of fuel to be injected.

Effects of failure

If a fuel temperature sensor signal fails, its engine control module uses a replacement value from the signal sent by the Engine Coolant Temperature Sensor G62.

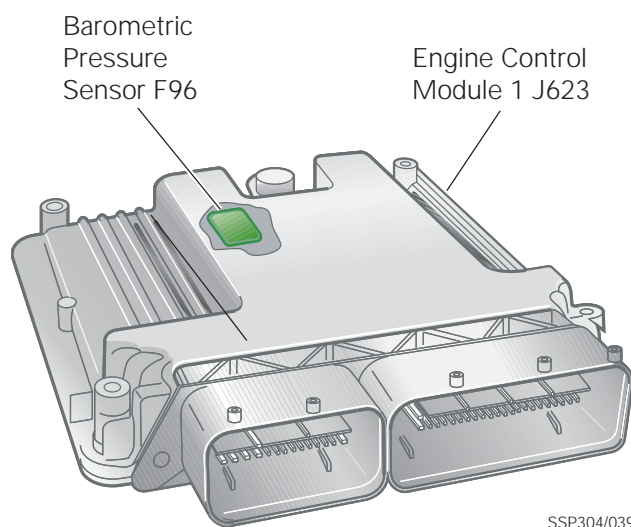
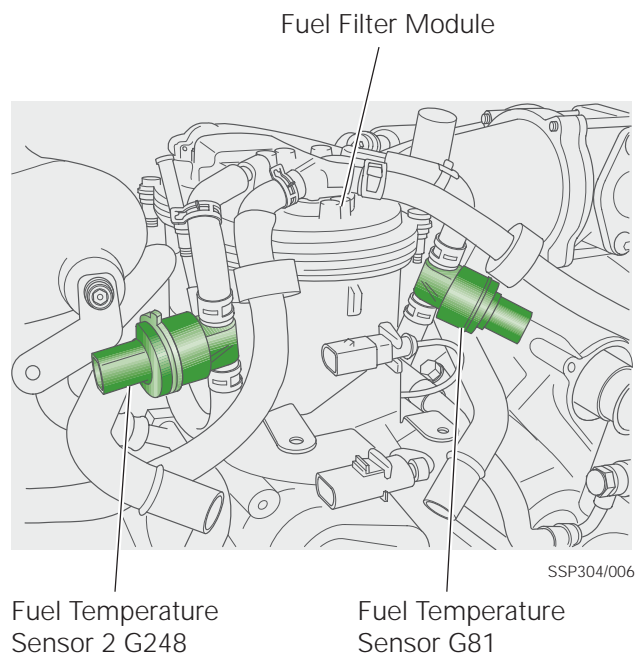
Barometric Pressure Sensor F96

The Barometric Pressure Sensor F96 is incorporated into the Engine Control Module 1 J623.

Signal Application

The Barometric Pressure Sensor F96 signal is used to determine a correction value for charge pressure control and exhaust gas recirculation.

If atmospheric pressure drops, exhaust gas recirculation will be switched off, and charge pressure increased. This assures optimal performance both at sea level and at higher altitudes.



Effects of failure

If the Barometric Pressure Sensor F96 signal fails, a replacement value is used.

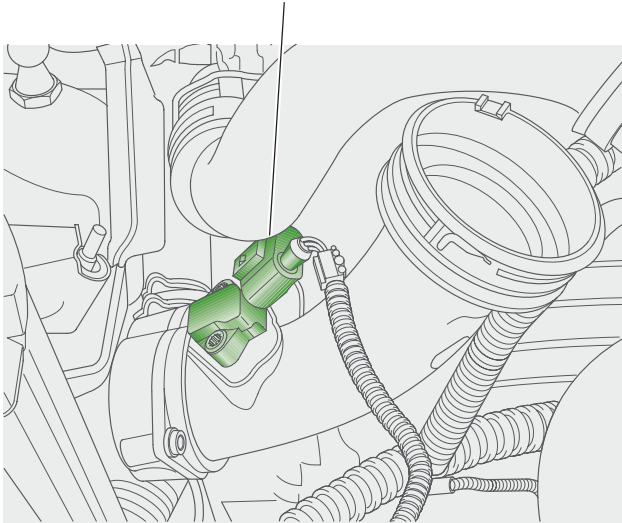
At high altitudes, black smoke could result from signal failure.

Sensors

Integrated Charge Air Pressure and Intake Air Temperature Sensors

Charge Air Pressure Sensor G31 and Intake Air Temperature Sensor G42 are integrated as one component, which is installed in the intake manifold for cylinder bank I.

Charge Air Pressure Sensor 2 G447 and Intake Air Temperature Sensor 2 G299



The Charge Air Pressure Sensor 2 G447 and Intake Air Temperature Sensor 2 G299 are also integrated into a single component, installed in the intake manifold for cylinder bank II.

Charge Air Pressure Sensors

- Charge Air Pressure Sensor G31 (bank I)
- Charge Air Pressure Sensor 2 G447 (bank II)

Signal Application

The signals from Charge Air Pressure Sensor G31 and Charge Air Pressure Sensor 2 G447 are required to regulate and monitor the charge air pressure.

The calculated values are compared by their respective engine control modules

with the specifications from the charge air pressure maps.

If the actual values deviate from the specification, the charge air pressure is altered accordingly by signals from the Engine Control Module 1 J623 via the drivetrain CAN data bus to Turbocharger 1 Servomotor V280 for cylinder bank I and Turbocharger 2 Servomotor V281 for cylinder bank II.

Effects of failure

If a charge air pressure sensor fails, the charge air pressure is controlled at an extremely low level to protect the engine from damage. Because of this, performance is impaired considerably.

Intake Air Temperature Sensors

- Intake Air Temperature Sensor G42 (bank I)
- Intake Air Temperature Sensor 2 G299 (bank II)

Signal Application

The signals from Intake Air Temperature Sensor G42 and Intake Air Temperature Sensor 2 G299 are required by their respective engine control modules to calculate a correction value for the charge air pressure.

When the signal from these senders is evaluated, the influence of the temperature on the density of the fuel is also considered.

Effects of failure

If an intake air temperature sensor signal fails, the engine control modules will use a fixed replacement value. The result could be impaired performance.

Combined Brake Light Switch F and Brake Pedal Switch F47

The Brake Light Switch F and Brake Pedal Switch F47 are combined in a single component mounted on the pedal cluster. Both switches send a signal to Engine Control Module 1 J623 when the brake is applied.

Signal Application

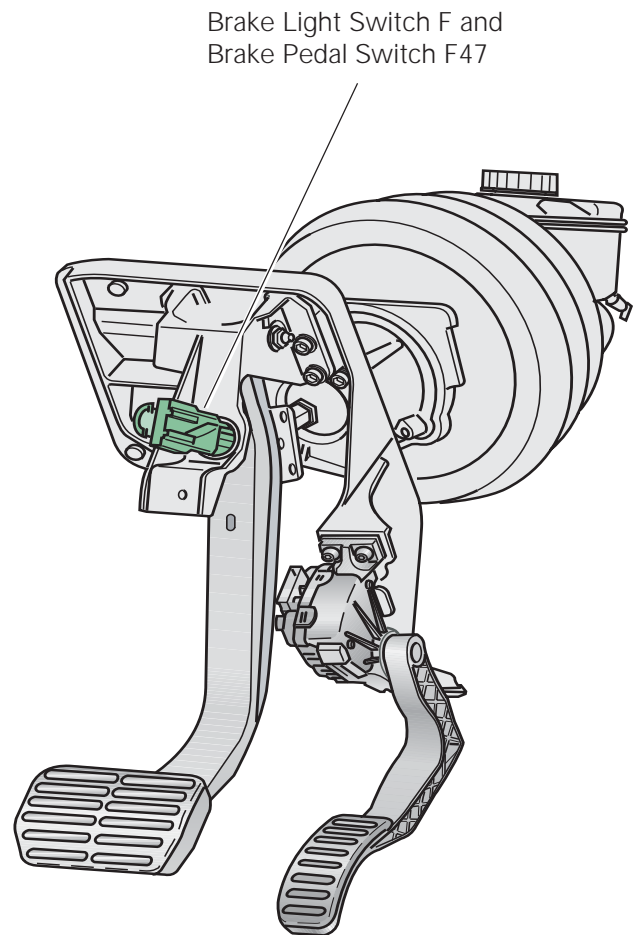
When the brake is applied, the cruise control system is switched off.

If actuation of the accelerator pedal and the brake pedal is detected, idle speed is increased.

Effects of failure

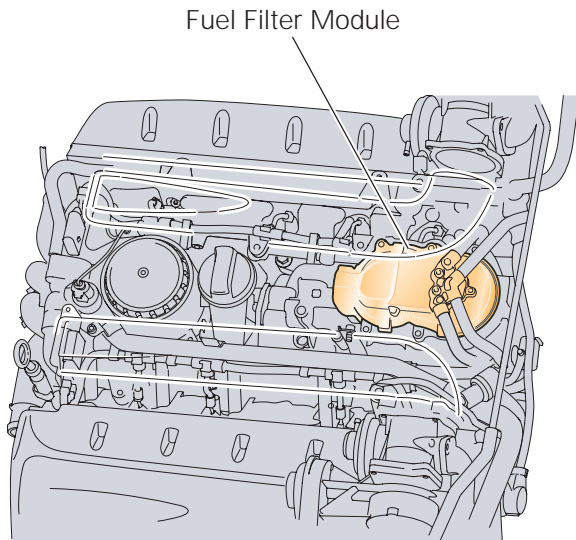
If the signal fails from one of these sensors, the amount of fuel injected will be reduced and the engine will have less output.

In addition, the cruise control system will be switched off.



SSP304/017b

Sensors



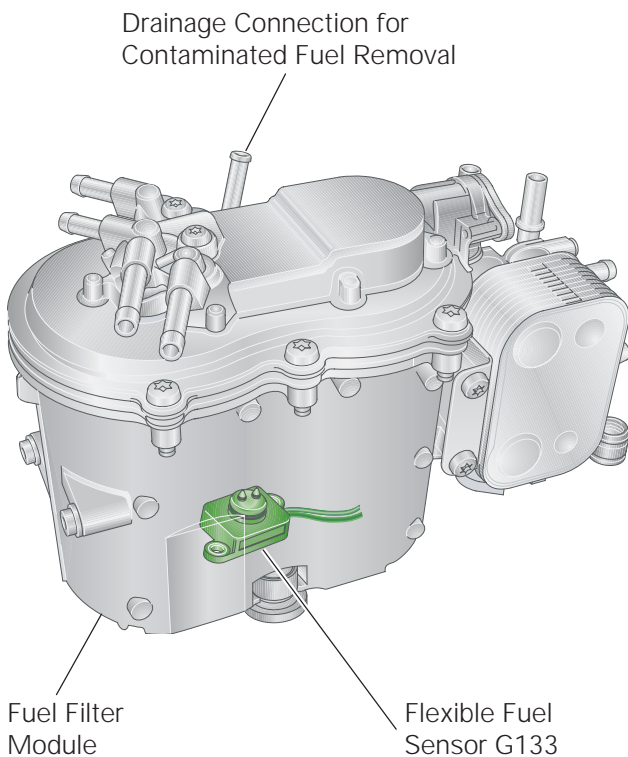
SSP304/082

Flexible Fuel Sensor G133

The Flexible Fuel Sensor G133 is bolted to the fuel filter module. Using two sensor contact pins immersed in the fuel at the bottom of the fuel filter module, it monitors the composition of the fuel to detect excessive water levels and sends a corresponding signal to Engine Control Module 1 J623.

Signal Application

If the signal from Flexible Fuel Sensor G133 indicates too much water is present in the fuel filter module, the Glow Plug Indicator Light K29 flashes on and off to alert the operator to shut down the engine as soon as possible to prevent water from entering the fuel injection system.



SSP304/047



Water in the system could result in corrosion damage.

Sensor Operation

A constant voltage is applied to Flexible Fuel Sensor G133 by Engine Control Module 1 J623.

With acceptable water level

When the water level in the fuel filter module is low, the Flexible Fuel Sensor G133 contact pins are surrounded by diesel fuel.

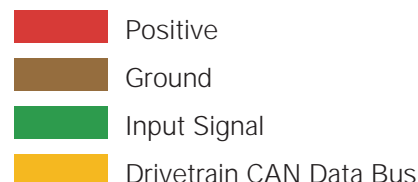
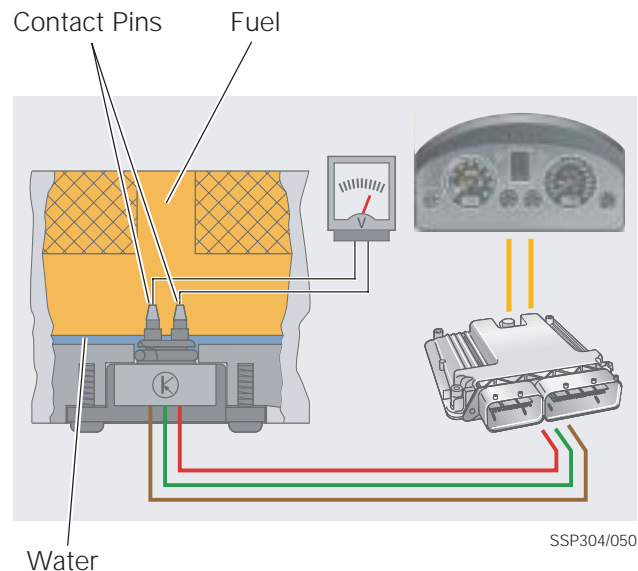
Because diesel fuel has a relatively low level of conductivity, there is a high signal response.

This signal indicates to the Engine Control Module 1 J623 that the water level is within acceptable limits.

The Engine Control Module 1 J623 sends this information to the instrument cluster.

The Glow Plug Indicator Light K29 does not light up.

With Acceptable Water Level



With water level too high

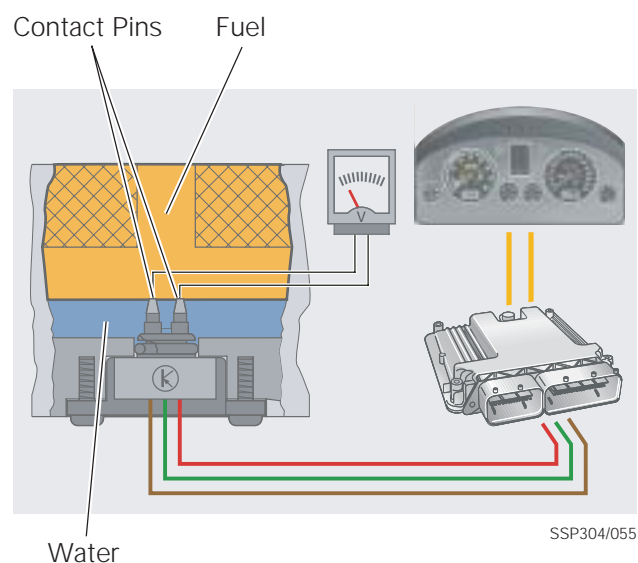
When the water level is too high, the contact pins are surrounded by water.

Because water has a high level of conductivity, there is a low signal response.

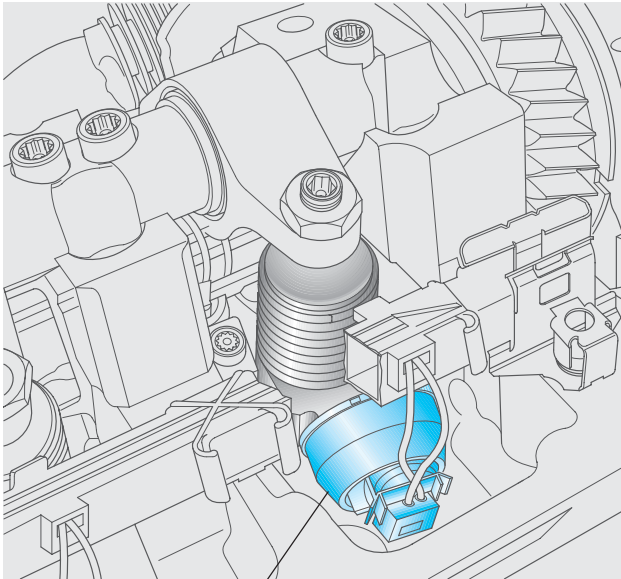
This signal indicates to the Engine Control Module 1 J623 that the water level is too high and sends the information to the instrument cluster.

The Glow Plug Indicator Light K29 will flash. This flashing light indicates a fault in the engine management system.

With Water Level Too High

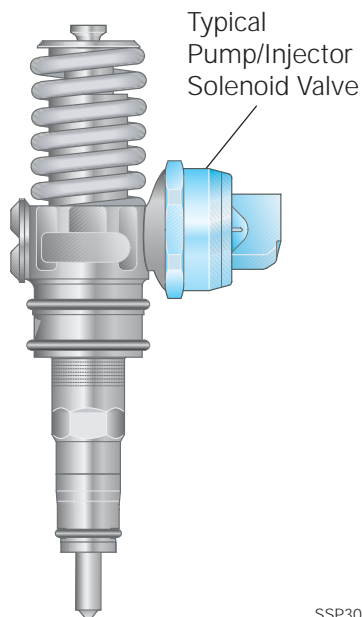


Actuators



SSP304/022

Typical Pump/Injector Solenoid Valve



SSP304/032

Pump/Injector Solenoid Valves

There is one pump/injector for each cylinder. The pump/injector solenoid valves are secured to the pump/injector bodies by union nuts.

- Valves for Pump/Injectors, Cylinders 1 through 5 N240, N241, N242, N243, N244 for cylinder bank I.
- Valves for Pump/Injectors, Cylinders 6 through 10 N245, N303, N304, N305, N306 for cylinder bank II.

These solenoid valves are actuated by their respective engine control modules, which control start of fuel delivery and the amount of fuel injected.

Function

As soon as a pump/injector solenoid valve is actuated by its engine control module, the valve needle is pushed onto its seat by the magnetic coil. This closes the path of fuel to the compression chamber of the pump/injector and injection starts.

The amount of fuel injected is determined by the length of time that the solenoid valve is actuated. As long as the pump/injector solenoid valve is closed, fuel is injected into the combustion chamber.

Effects of failure

If a pump/injector solenoid valve fails, the engine will not run smoothly. Performance will be impaired.

If the valve stays open, pressure cannot be built up in the pump/injector. If the valve stays closed, the pump/injector compression chamber cannot be filled. In either case, fuel cannot be injected into the cylinder.

Turbocharger Servomotors

The turbocharger servomotors are positioning motors for the turbocharger vanes. They are bolted to brackets beneath their respective turbochargers.

- Turbocharger 1 Servomotor V280
- Turbocharger 2 Servomotor V281

Each of these positioning motors has its own internal control module.

Function

The turbocharger servomotors are actuated by their respective engine control modules via the drivetrain CAN data bus.

Their engine control modules also receive feedback indicating vane position and any faults detected. This improves regulation and fault diagnosis.

The turbocharger vanes are actuated by a rod assembly.

Effects of failure

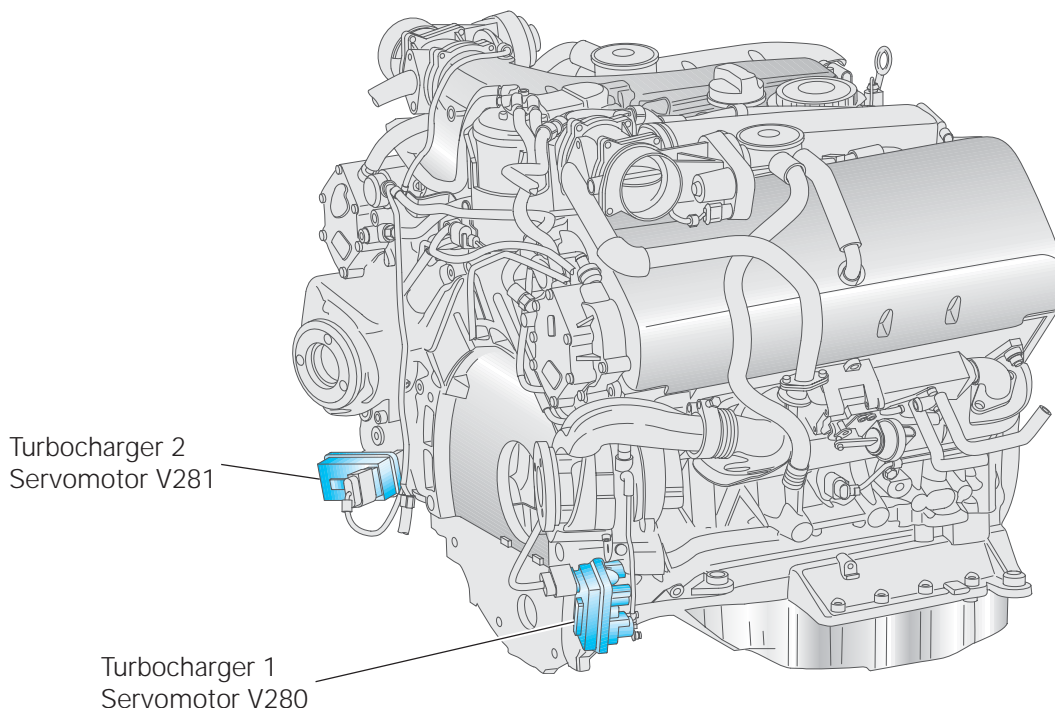
If the turbocharger servomotors fail in their function, charge pressure control is no longer possible.

Control of the amount of fuel injected is then determined only according to the engine speed.

Engine performance will be impaired.



Turbocharger servomotors are designed specifically for use with their respective turbochargers. Removal and installation as assemblies is required. Please refer to the Repair Manual for additional information.



SSP304/010

Actuators

EGR Vacuum Regulator Solenoid Valves

The electro-pneumatic EGR vacuum regulator solenoid valves for exhaust gas recirculation are located on the suspension strut towers.

- EGR Vacuum Regulator Solenoid Valve N18
- Valve 2 for EGR N213

Function

The two EGR vacuum regulator solenoid valves are actuated with duty cycles depending on internal control maps in their

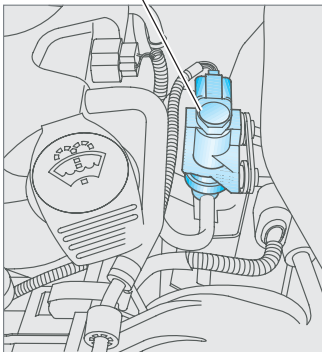
respective engine control modules. This sets the control pressure for the exhaust gas recirculation valve.

The cross section of the exhaust manifold is changed in the exhaust gas recirculation valve depending on the control pressure and the amount of recirculated exhaust gas set.

Effects of failure

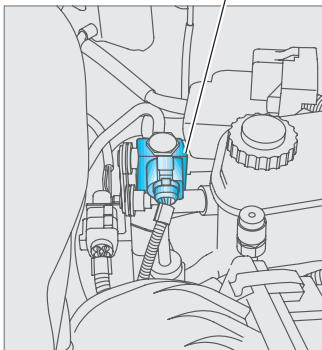
If the signal fails, exhaust gas recirculation may no longer be possible.

Valve 2 for
EGR N213

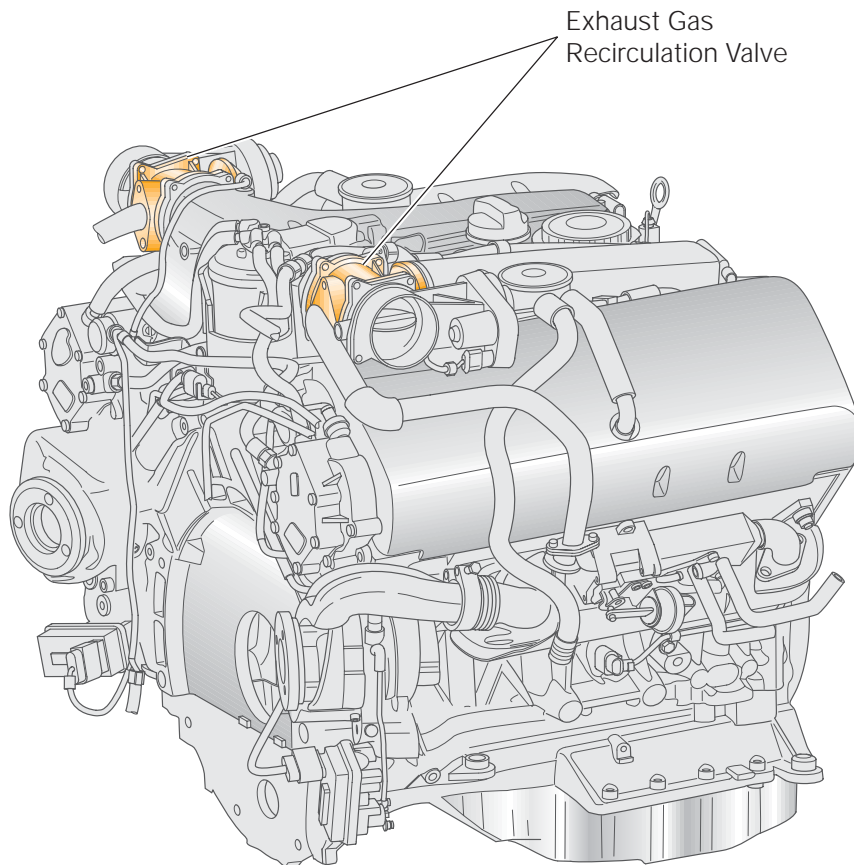


SSP304/012a

EGR Vacuum
Regulator
Solenoid
Valve N18



SSP304/012b



SSP304/012

Intake Manifold Flap Motors

The V10 TDI engine has two adjustable intake manifold flaps with electric motors to control the flap positions.

- Motor for Intake Flap V157
- Intake Flap Motor 2 V275

They are located just upstream of their respective exhaust gas recirculation valves.

Function

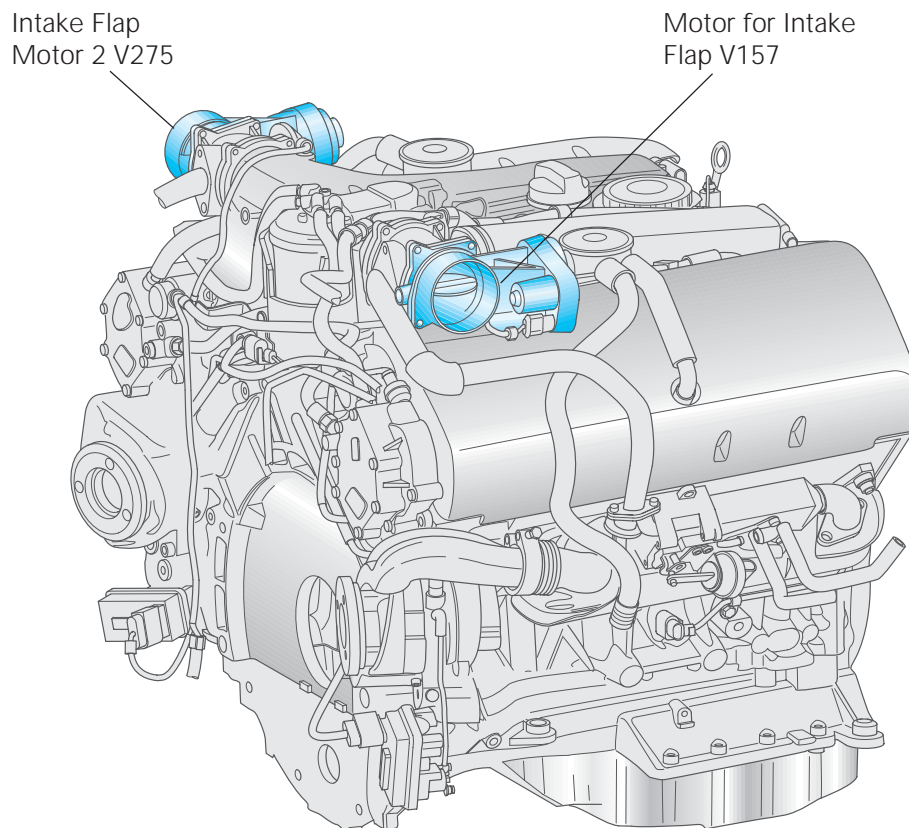
With the electrically adjustable intake manifold flaps, differences between air intake pressure and exhaust gas pressure are generated during certain operating

conditions. These differences in pressure create the conditions for effective exhaust gas recirculation.

When the engine is switched off, the flaps are closed and the flow of air is interrupted. As a result, less air is drawn into the cylinders and compressed, which helps smooth the run-down of the engine.

Effects of failure

If an intake manifold flap motor fails, effective exhaust gas recirculation is no longer possible.



SSP304/011

Actuators

Fuel Pumps

Both electric fuel pumps are installed in the fuel tank.

- Transfer Fuel Pump G23 with Sender for Fuel Gauge G and suction jet pump 1 are located in the main chamber of the fuel tank.
- Fuel Pump G6 with Fuel Supply Sensor 3 G237 and suction jet pump 2 are located in the secondary chamber of the fuel tank.

Function

Both electric fuel pumps are actuated via parallel circuits by the Fuel Pump Relay J17.

Suction jet pump 1 draws fuel from the main chamber into the presupply reservoir of Fuel Pump G6.

Suction jet pump 2 pumps out the secondary chamber into the presupply reservoir of Transfer Fuel Pump G23.

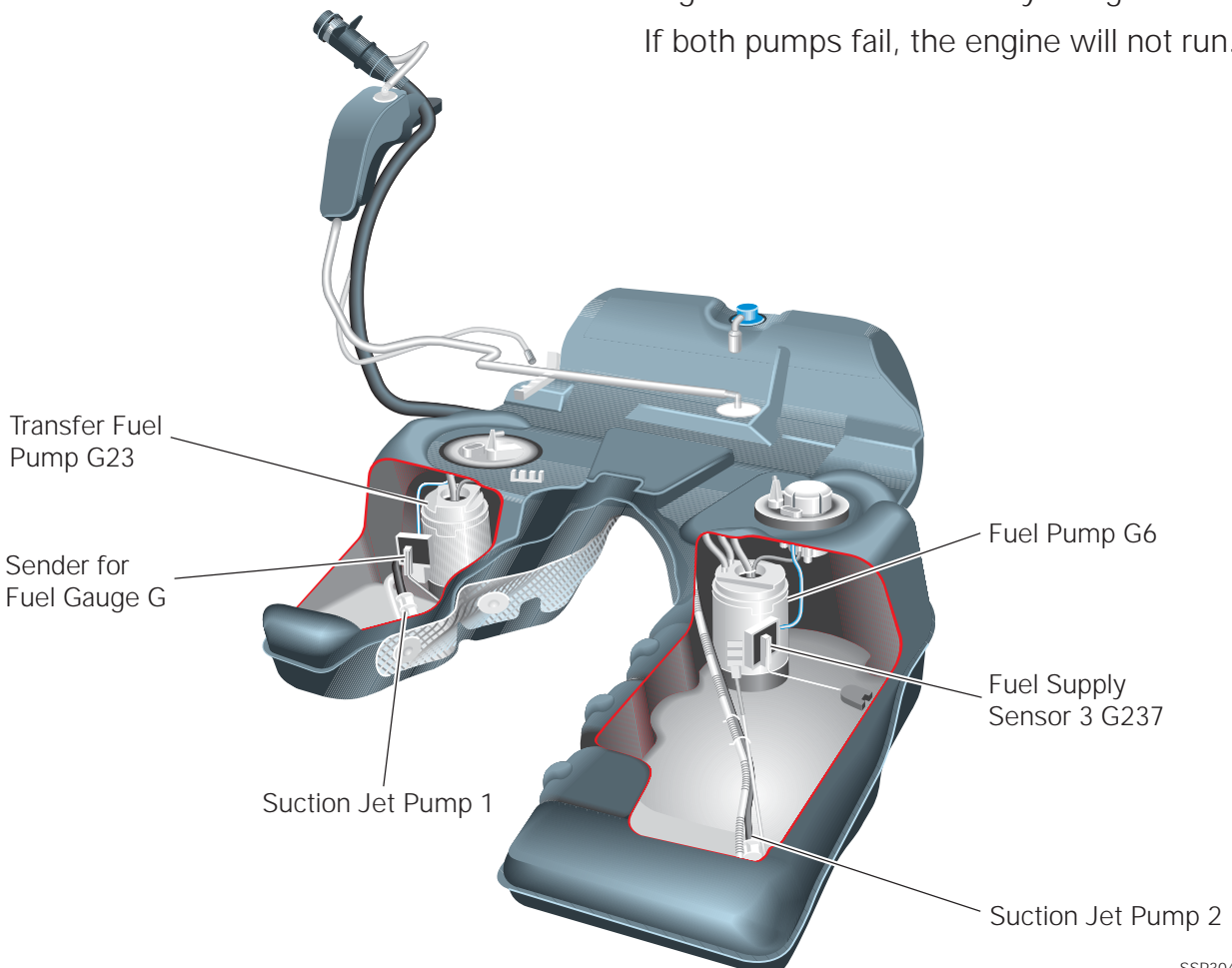
Both suction jet pumps are driven by their respective electric fuel pumps.

Effects of failure

If one pump fails, engine performance will be impaired due to a restriction in the amount of fuel supplied.

The maximum speed is unattainable and the engine will not run smoothly at high revs.

If both pumps fail, the engine will not run.



SSP304/049

Map Controlled Engine Cooling Thermostat F265

The Map Controlled Engine Cooling Thermostat F265 is installed in the coolant distribution housing. It controls switching between the large and small coolant circuits.

Function

Maps that contain temperature specifications depending on the engine load are stored in Engine Control Module 1 J623.

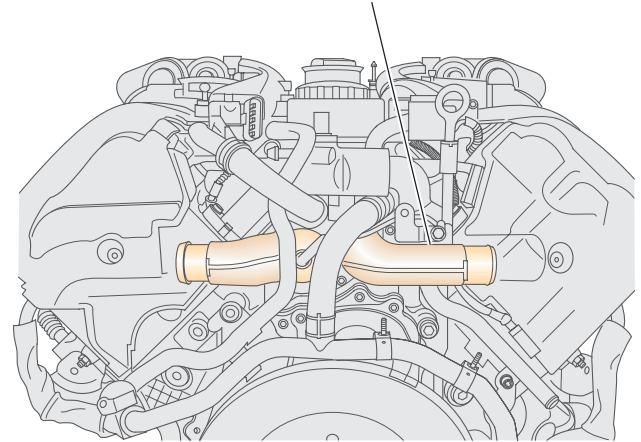
The Map Controlled Engine Cooling Thermostat F265 is actuated by Engine Control Module 1 J623 based on these control maps, according to the engine operating conditions.

Map-controlled engine cooling has the advantage that the coolant temperature can be adapted to the current operating conditions of the engine. This helps to reduce fuel consumption in the part-throttle range and exhaust gas emissions.

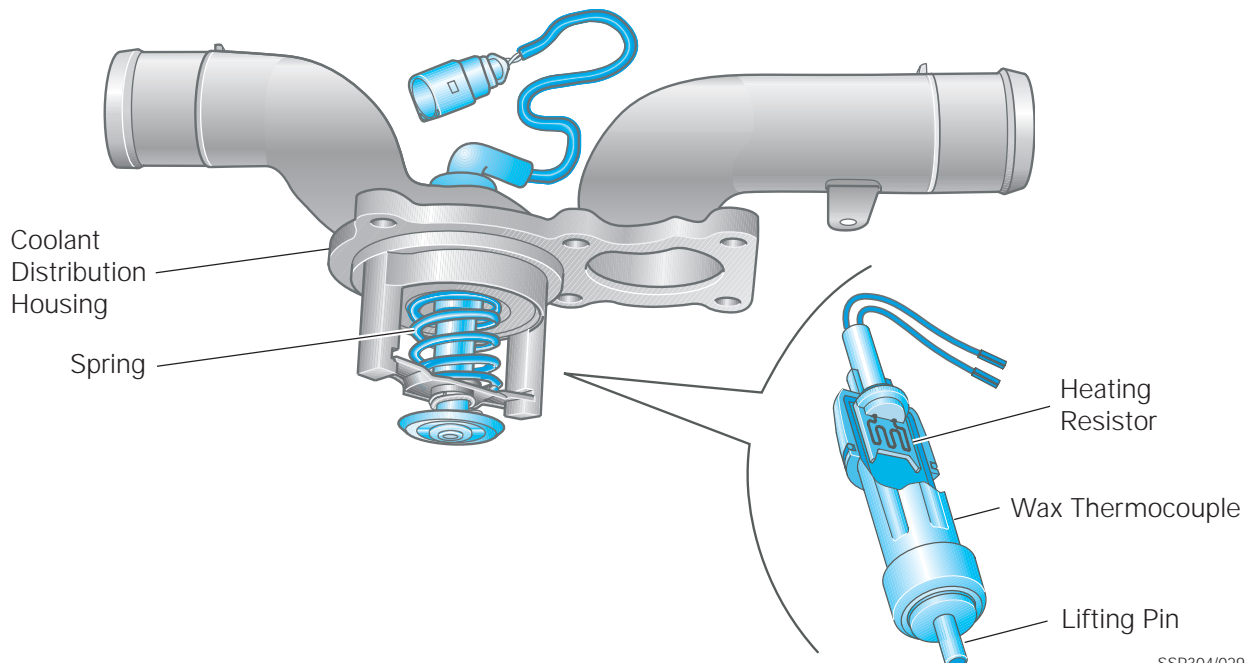
Effects of failure

If there is no operating voltage present, the large cooling circuit is opened by the wax thermocouple expansion element at a coolant temperature of 230°F (110°C) or above without the benefit of resistor heating, and the coolant fans are actuated.

Coolant Distribution Housing

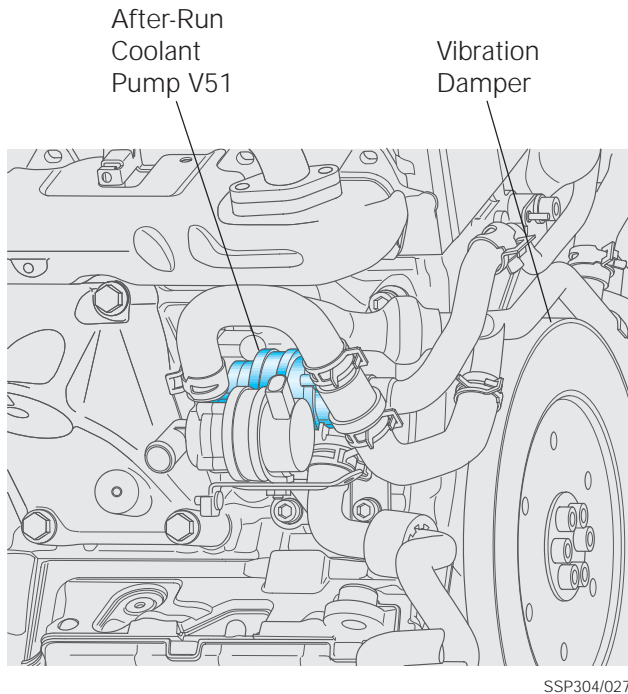


SSP304/016



SSP304/029

Actuators



Continued Coolant Circulation

The After-Run Coolant Pump V51 is located on cylinder bank I of the V10 TDI engine on the vibration damper side.

The After-Run Coolant Pump V51 is actuated by Auxiliary Engine Coolant Pump Relay J496.

The Auxiliary Engine Coolant Pump Relay J496 is installed in the electronics box in the plenum chamber.

Function

When the engine is switched off, the After-Run Coolant Pump V51 will remain activated for a maximum of 10 minutes. In this way, controlled cooling of the engine is achieved.

Effects of failure

If either the Auxiliary Engine Coolant Pump Relay J496 or the After-Run Coolant Pump V51 fails, continued coolant circulation will no longer be possible.

If the Auxiliary Engine Coolant Pump Relay J496 is defective, a fault will be stored.

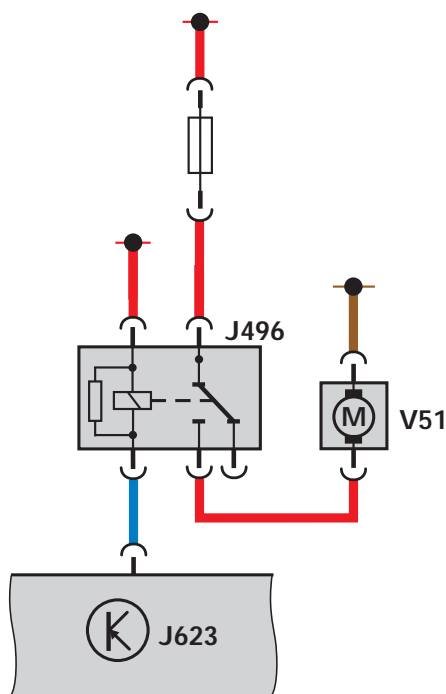
A defective After-Run Coolant Pump V51 cannot be detected.

Electrical circuit

J623 Engine Control Module 1

J496 Auxiliary Engine Coolant Pump Relay

V51 After-Run Coolant Pump



Fuel Cooling

The Pump for Fuel Cooler V166 is located on cylinder bank I on the vibration damper side of the engine.

The Pump for Fuel Cooler V166 is actuated by Relay for Pump, Fuel Cooling J445.

The Relay for Pump, Fuel Cooling J445 is installed in the electronics box in the plenum chamber.

Function

The Engine Control Module 1 J623 actuates the Relay for Pump, Fuel Cooling J445 at and above a fuel temperature of approximately 158°F (70°C).

The Engine Control Module 1 J623 sends a working current to the Pump for Fuel Cooler V166 and the fuel cooler is then surrounded by engine coolant.

Fuel temperature will drop.

Effects of failure

If the Relay for Pump, Fuel Cooling J445 or Pump for Fuel Cooler V166 fails, fuel will no longer be cooled.

The fuel tank and the Sender for Fuel Gauge G could become damaged.

A defective Relay for Pump, Fuel Cooling J445 is stored as a fault.

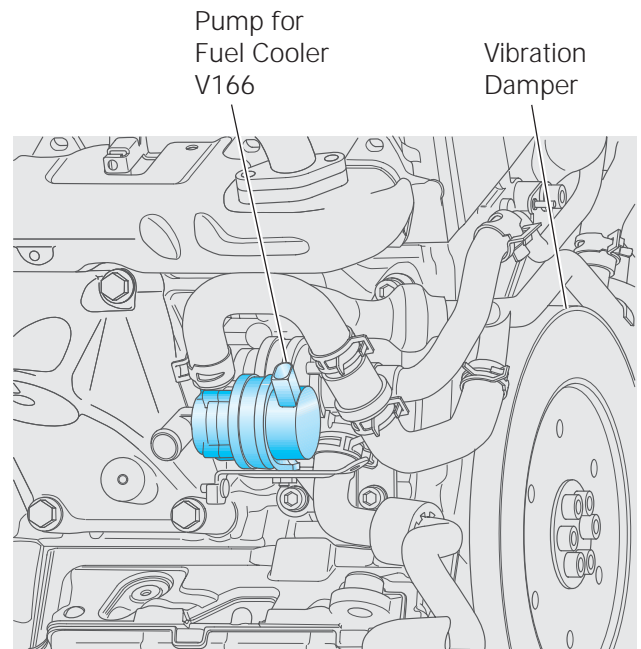
A defective Pump for Fuel Cooler V166 cannot be detected.

Electrical circuit

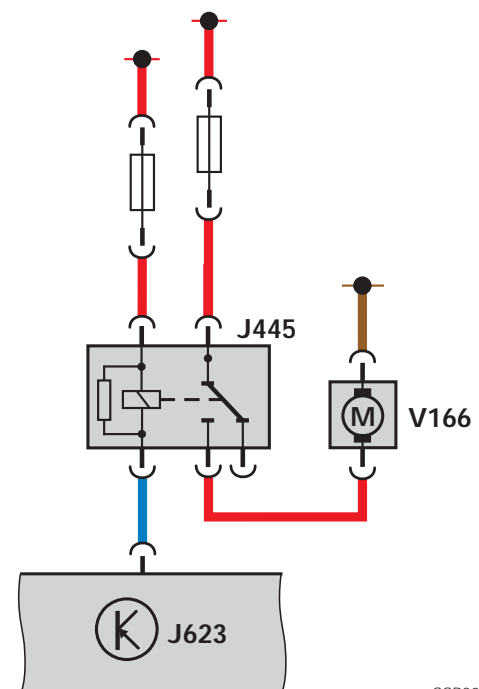
J623 Engine Control Module 1

J445 Relay for Pump, Fuel Cooling

V166 Pump for Fuel Cooler



SSP304/009



SSP304/068

Functional Diagram

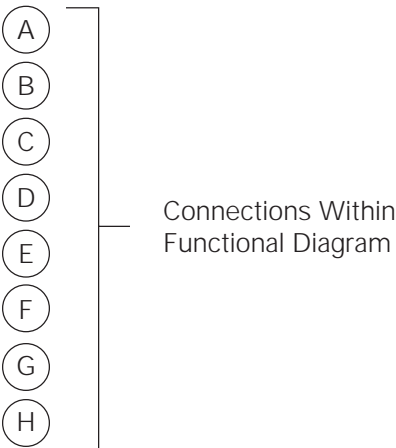
EDC 16 Functional Diagram for V10 TDI Engine

Components

F	Brake Light Switch
F8	Kick Down Switch
F47	Brake Pedal Switch
F60	Closed Throttle Position Switch
F265	Map Controlled Engine Cooling Thermostat
G6	Fuel Pump (Presupply Pump)
G23	Transfer Fuel Pump
G28	Engine Speed Sensor
G31	Charge Air Pressure Sensor
G39	Heated Oxygen Sensor
G40	Camshaft Position Sensor
G42	Intake Air Temperature Sensor
G62	Engine Coolant Temperature Sensor
G70	Mass Air Flow Sensor
G79	Throttle Position Sensor
G81	Fuel Temperature Sensor
G83	Engine Coolant Temperature Sensor (on Radiator)
G133	Flexible Fuel Sensor
J17	Fuel Pump Relay
J52	Glow Plug Relay
J317	Power Supply (Terminal 30, B+) Relay
J445	Relay for Pump, Fuel Cooling
J496	Auxiliary Engine Coolant Pump Relay
J623	Engine Control Module 1
N18	EGR Vacuum Regulator Solenoid Valve
N240	Valve for Pump/Injector, Cylinder 1
N241	Valve for Pump/Injector, Cylinder 2
N242	Valve for Pump/Injector, Cylinder 3
N243	Valve for Pump/Injector, Cylinder 4
N244	Valve for Pump/Injector, Cylinder 5
Q10	Glow Plug 1
Q11	Glow Plug 2
Q12	Glow Plug 3
Q13	Glow Plug 4
Q14	Glow Plug 5
V51	After-Run Coolant Pump
V157	Motor for Intake Flap
V166	Pump for Fuel Cooler
V280	Turbocharger 1 Servomotor
V281	Turbocharger 2 Servomotor
Z19	Oxygen Sensor Heater

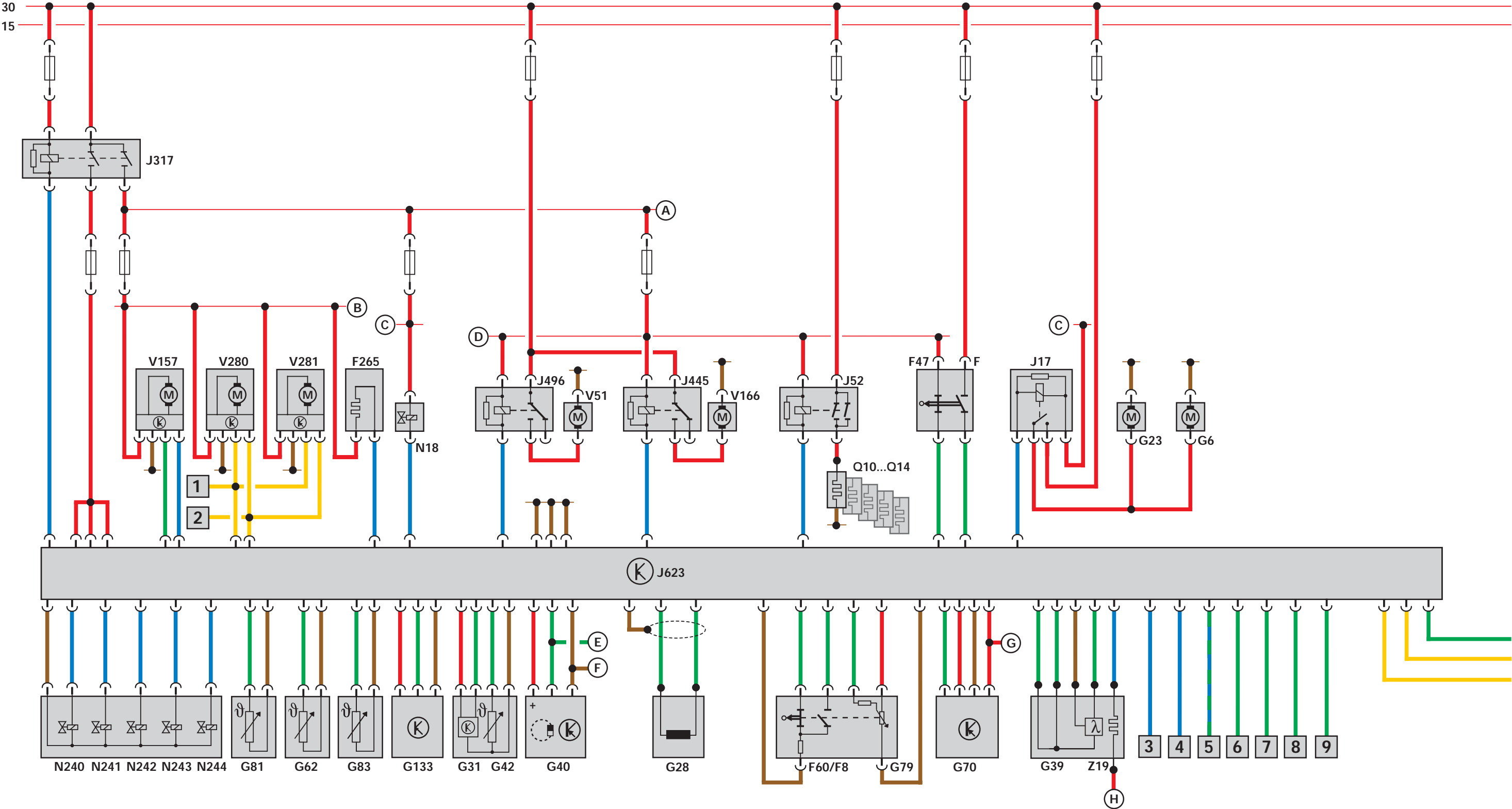
Additional Signals

1	Drivetrain CAN Data Bus (High)
2	Drivetrain CAN Data Bus (Low)
3	Radiator Fan Output Stage 1
4	Radiator Fan Output Stage 2
5	16-Pin Connector (Diagnosis Connection) T16
6	Cruise Control Switch E45 (On/Off)
7	Road Speed Signal
8	Generator Terminal DFM
9	Starter Relay J53



Color Coding

	Input Signal
	Output Signal
	Positive
	Ground
	CAN Data Bus
	Bidirectional



Functional Diagram

Components

- G108 Heated Oxygen Sensor 2
- G246 Mass Air Flow Sensor 2
- G248 Fuel Temperature Sensor 2
- G299 Intake Air Temperature Sensor 2
- G447 Charge Air Pressure Sensor 2

- J495 Glow Plug Relay 2
- J624 Engine Control Module 2
- J689 Power Supply Relay (Terminal 30, B+) Relay 2

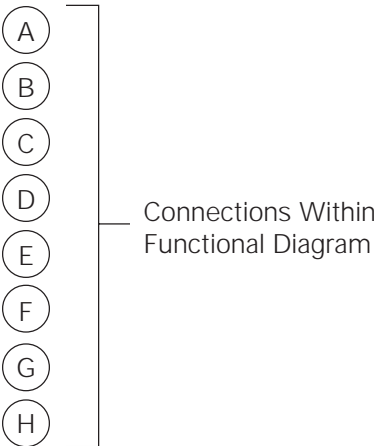
- N213 Valve 2 for EGR
- N245 Valve for Pump/Injector, Cylinder 6
- N303 Valve for Pump/Injector, Cylinder 7
- N304 Valve for Pump/Injector, Cylinder 8
- N305 Valve for Pump/Injector, Cylinder 9
- N306 Valve for Pump/Injector, Cylinder 10

- Q15 Glow Plug 6
- Q16 Glow Plug 7
- Q17 Glow Plug 8
- Q18 Glow Plug 9
- Q19 Glow Plug 10

- V275 Intake Flap Motor 2
- Z28 Oxygen Sensor Heater 2

Additional Signals

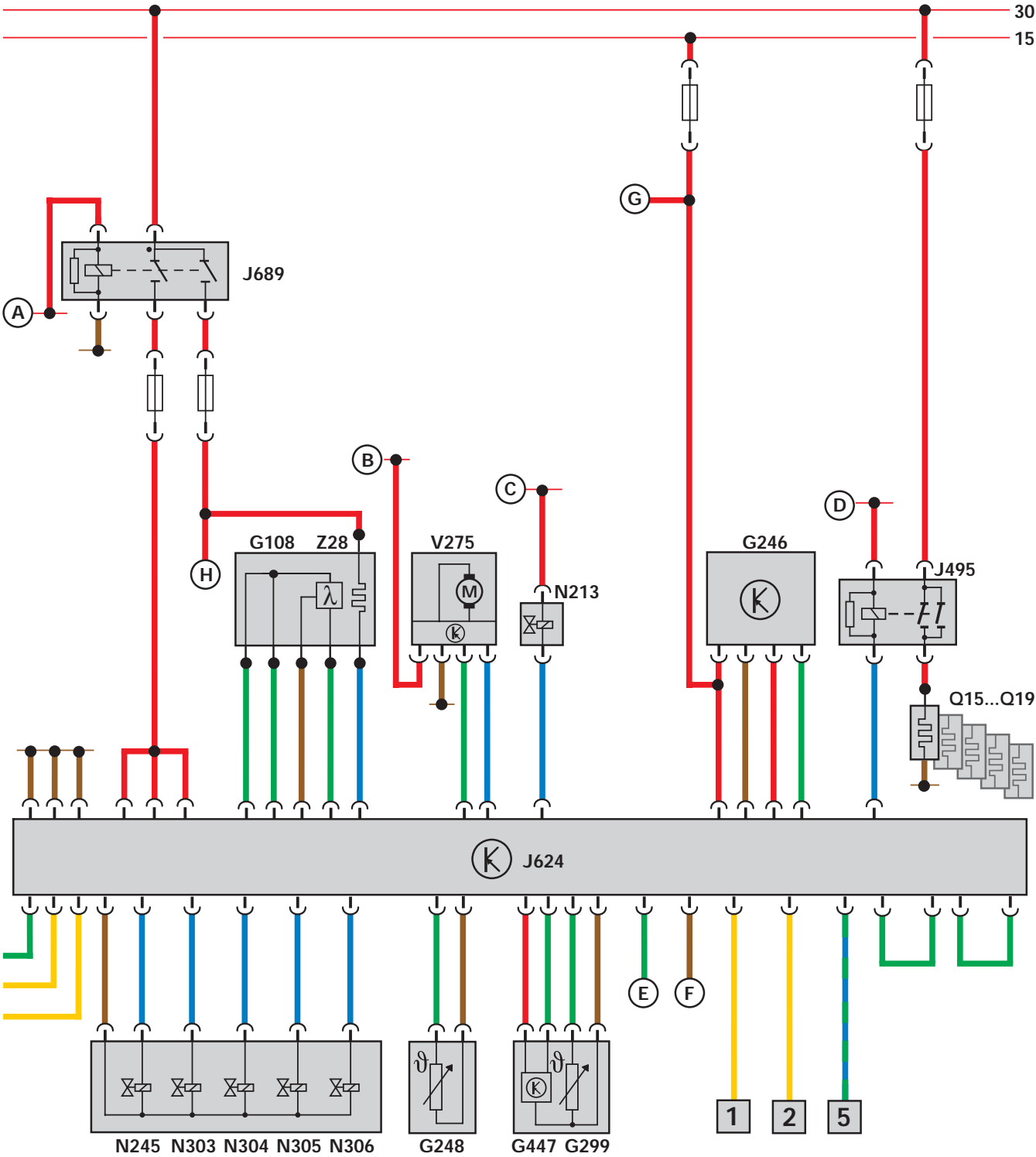
- 1 Drivetrain CAN Data Bus (High)
- 2 Drivetrain CAN Data Bus (Low)
- 5 16-Pin Connector (Diagnosis Connection) T16



Color Coding

- Input Signal
- Output Signal
- Positive
- Ground
- CAN Data Bus
- Bidirectional

Functional Diagram



Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this Self-Study Program.

The Knowledge Assessment may or may not be required for Certification.

You can find this Knowledge Assessment at:

www.vwwebservice.com

From the vwwebservice.com Homepage, do the following:

- Click on the Certification tab
- Type the course number in the Search box
- Click "Go!" and wait until the screen refreshes
- Click "Start" to begin the Assessment

For Assistance, please call:

Certification Program Headquarters

**1 – 877 – CU4 – CERT
(1 – 877 – 284 – 2378)**

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