

**Service.**



## **Self-Study Programme 304**

# **Electronic Diesel Control EDC 16**

Design and Function



The new EDC 16 engine management system from Bosch has its debut in the V10-TDI- and R5-TDI-engines.

Increasing demands on today's diesel engines in terms of comfort, fuel consumption, exhaust emissions and road handling, mean greater complexity in the hardware and software of engine management systems.

With EDC 16 electronic diesel control, an engine management system has been made available that meets these demands. This has been achieved above all by the greatly improved processing performance of the engine control unit and a new signal processing system.



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In this Self-Study Programme, you will be made familiar with the EDC 16 engine management system, using the V10-TDI-engine as an example. Your attention will be drawn to changes between the V10-TDI- and R5-TDI-engines.

**NEW**



**Important  
Note**



**This Self-Study Programme explains the design and function of new developments.  
The contents will not be updated.**

For the latest testing, adjusting and repair instructions, please refer to the relevant workshop literature.



<b>Introduction .....</b>	<b>4</b>
---------------------------	----------



<b>Engine management .....</b>	<b>6</b>
--------------------------------	----------



V10-TDI-engine system overview .....	6
Metering regulation .....	8
Start of injection regulation .....	10
Exhaust gas recirculation .....	12
Charge pressure control .....	15
Preglow system .....	16
Idling speed control .....	17
Smooth running control .....	18
Active pulse damping .....	19
Governor .....	20
Cruise control system .....	21
Sensors .....	22
Actuators .....	32
V10-TDI-engine functional diagram .....	44

<b>Service .....</b>	<b>46</b>
----------------------	-----------



Self-diagnosis .....	46
Workshop equipment .....	47

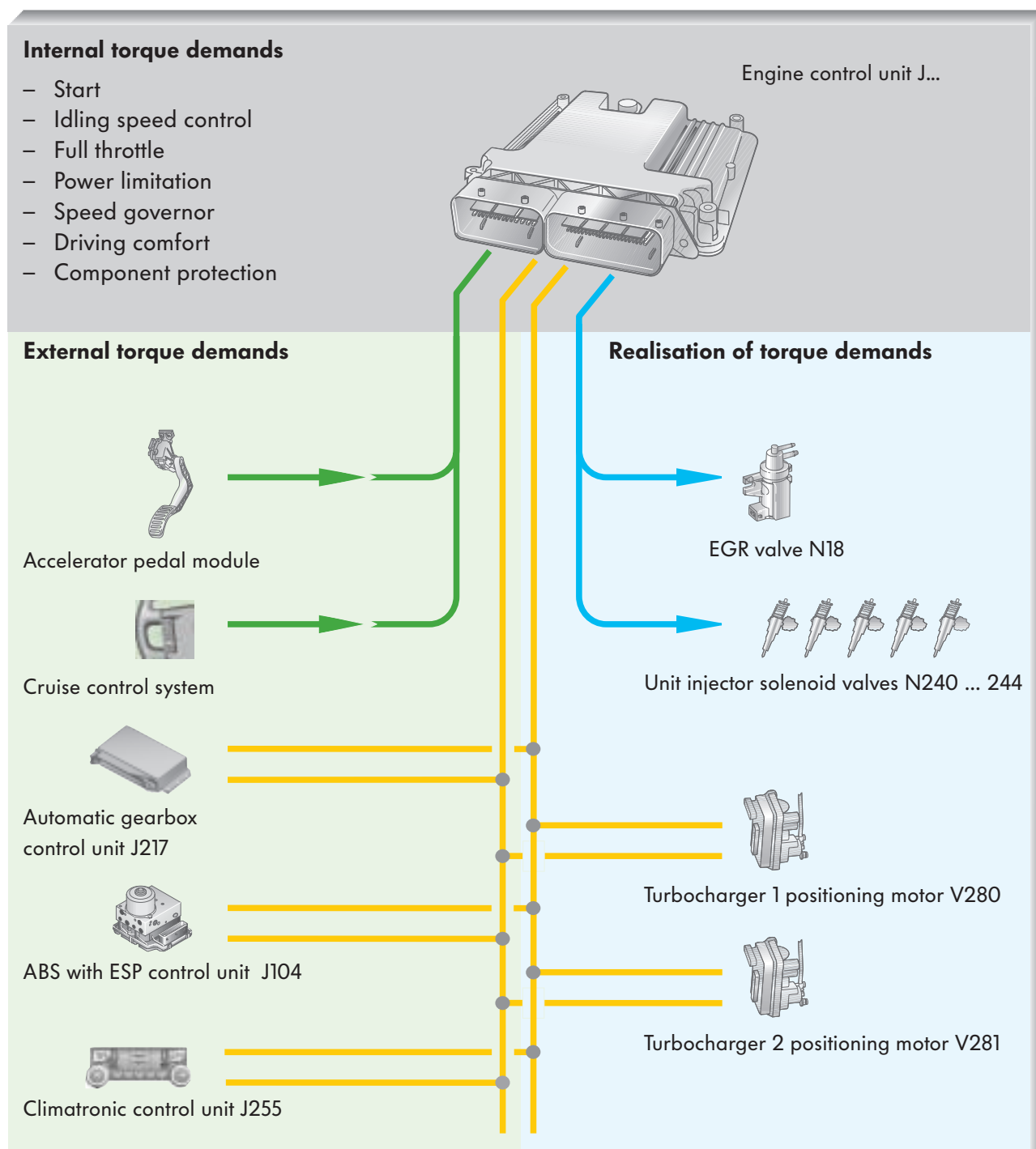
<b>Test your knowledge .....</b>	<b>48</b>
----------------------------------	-----------



# Introduction

## Bosch EDC 16

Bosch EDC 16 is a torque-orientated engine management system which is featured for the first time in a diesel engine. As is the case with petrol engines, in the EDC 16 system all torque demands are collected, evaluated and co-ordinated in the engine control unit. This has the advantage of better adaptability between the individual vehicle systems (engine management, brake system, automatic gearbox, air conditioning, ...).





The Bosch EDC 16 engine management system is designed to be compatible as both a single and double control unit concept. The actual concept used depends on the number of cylinders in the engine.

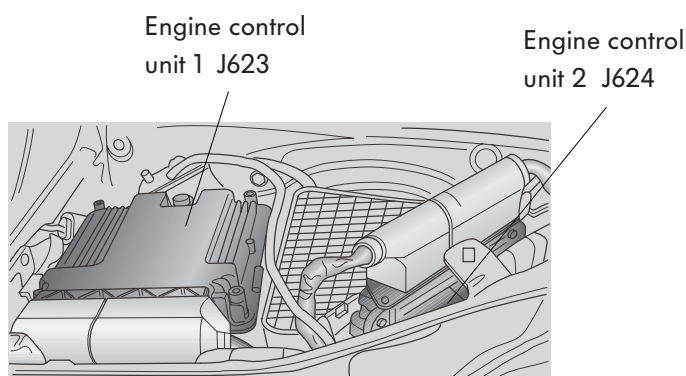
- On the R5-TDI-engine, engine control unit 1 J623 fulfils all functions.
- On the V10-TDI-engine, engine control unit 1 J623 fulfils the basic functions for cylinder bank 1 and engine control unit 2 J624 for cylinder bank 2. Basic functions are, for example, actuation of the unit solenoid injector valves and exhaust gas recirculation.

Functions that cover whole cylinder banks, such as the coolant supply, are carried out by engine control unit 1 J623, or the smooth running control by engine control unit 2 J624.

Information received by engine control unit 1 J623 is sent to engine control unit 2 J624 via an internal CAN databus.

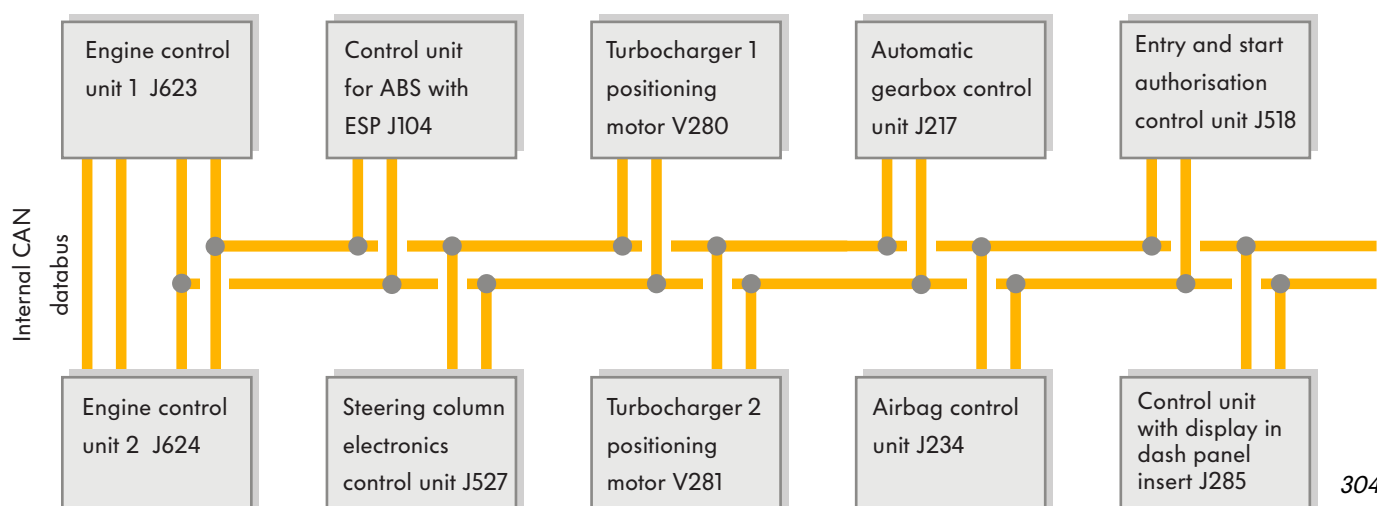


Both control units are identical and have the same part number. The allocation of engine control unit 1 and engine control unit 2 is done via a coding link in the connector for engine control unit 2. Following allocation, the control units can no longer be changed over.



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### Engine control units in the CAN drive train databus



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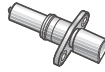
# Engine management

## System overview for V10-TDI-engine

### Sensors



Engine speed sender G28



Accelerator pedal position sender G79



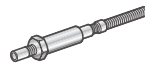
Kick-down switch F8

Idle switch F60

Air mass meter G70



Lambda probe G39



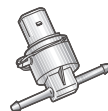
Coolant temperature sender G62



Coolant temperature sender radiator outlet G83



Fuel temperature sender G81



Charge pressure sender G31

Intake air temperature sender G42



Brake light switch F

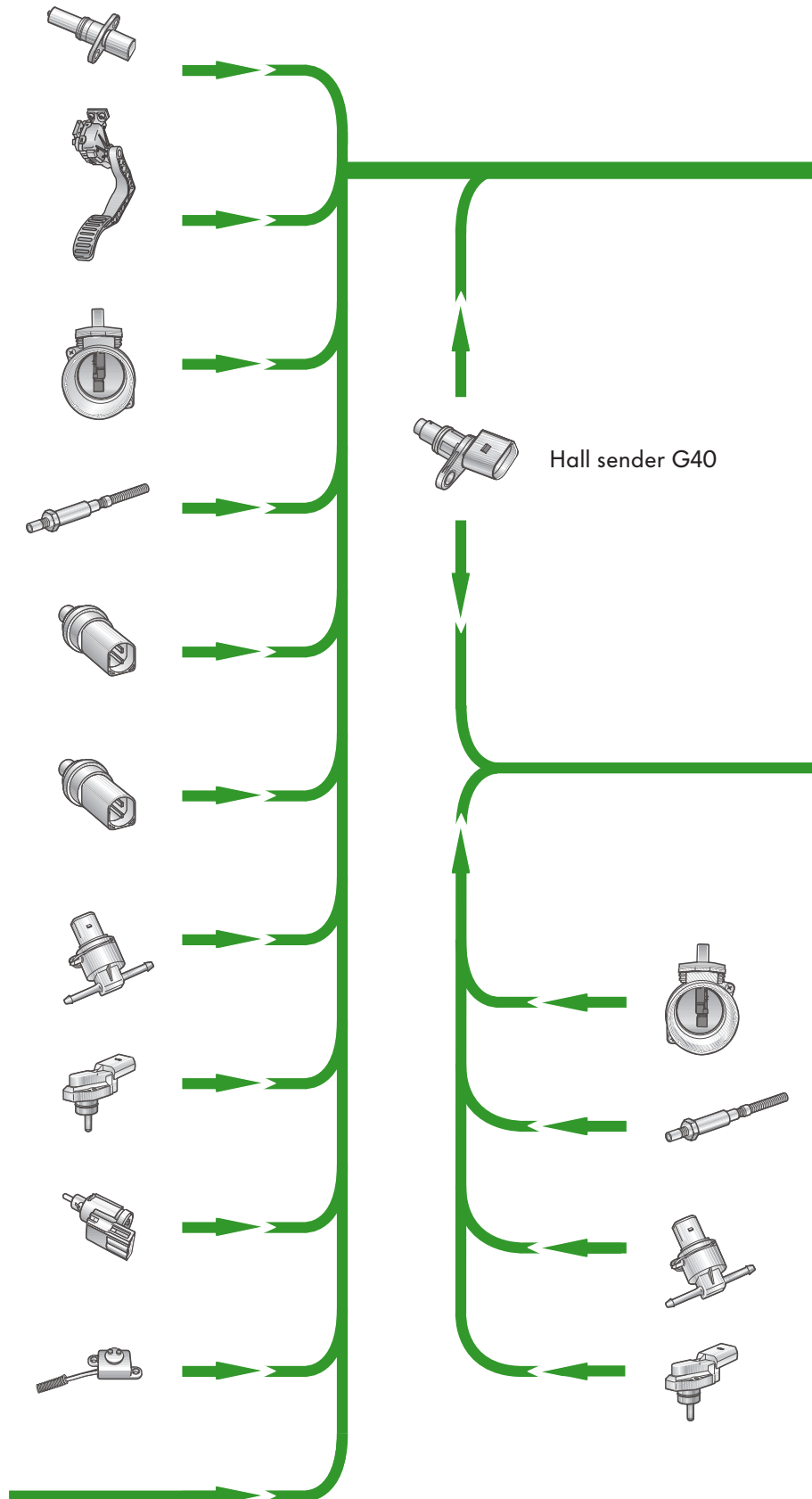
Brake pedal switch F47



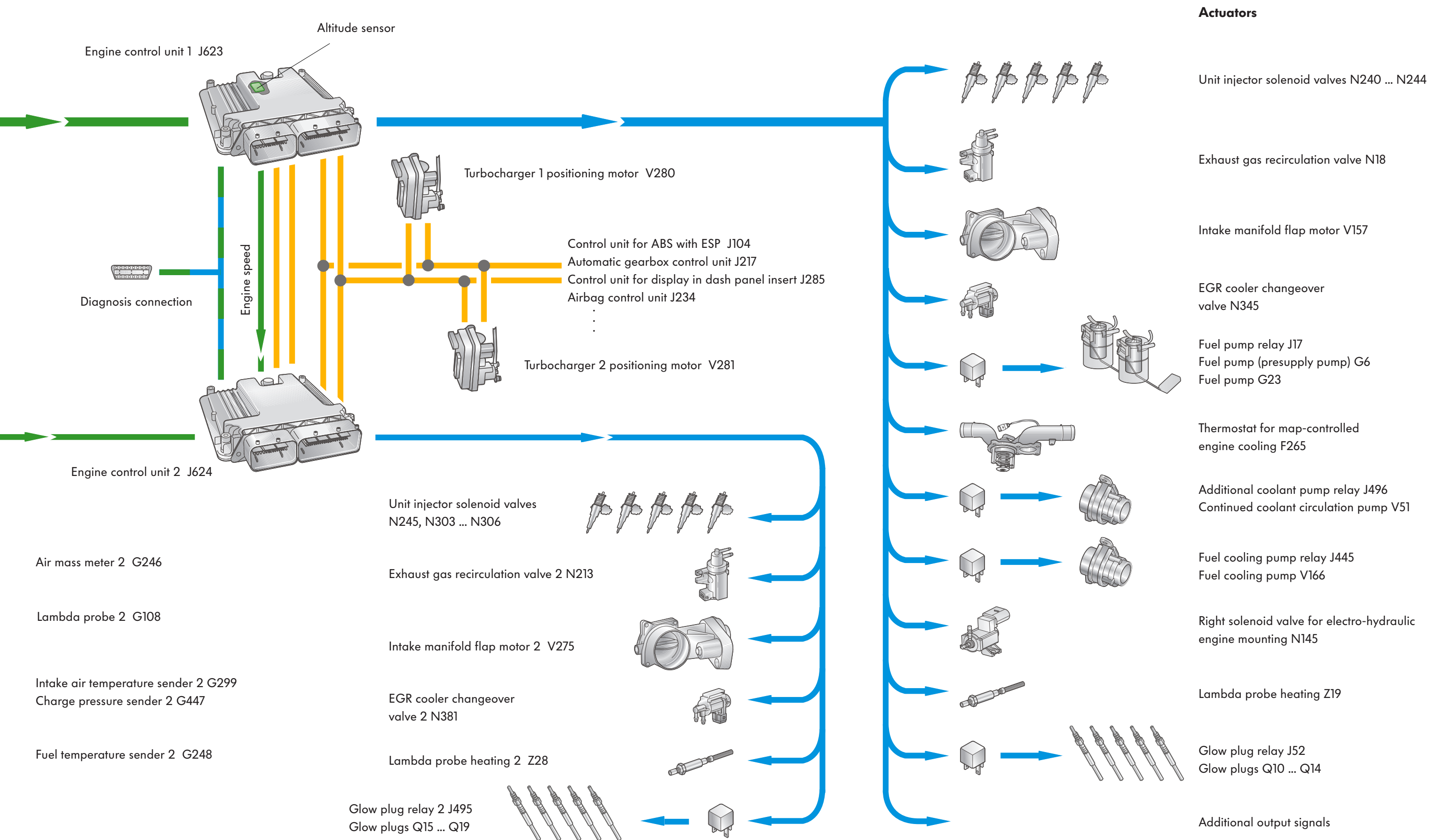
Fuel composition sender G133



Additional input signals



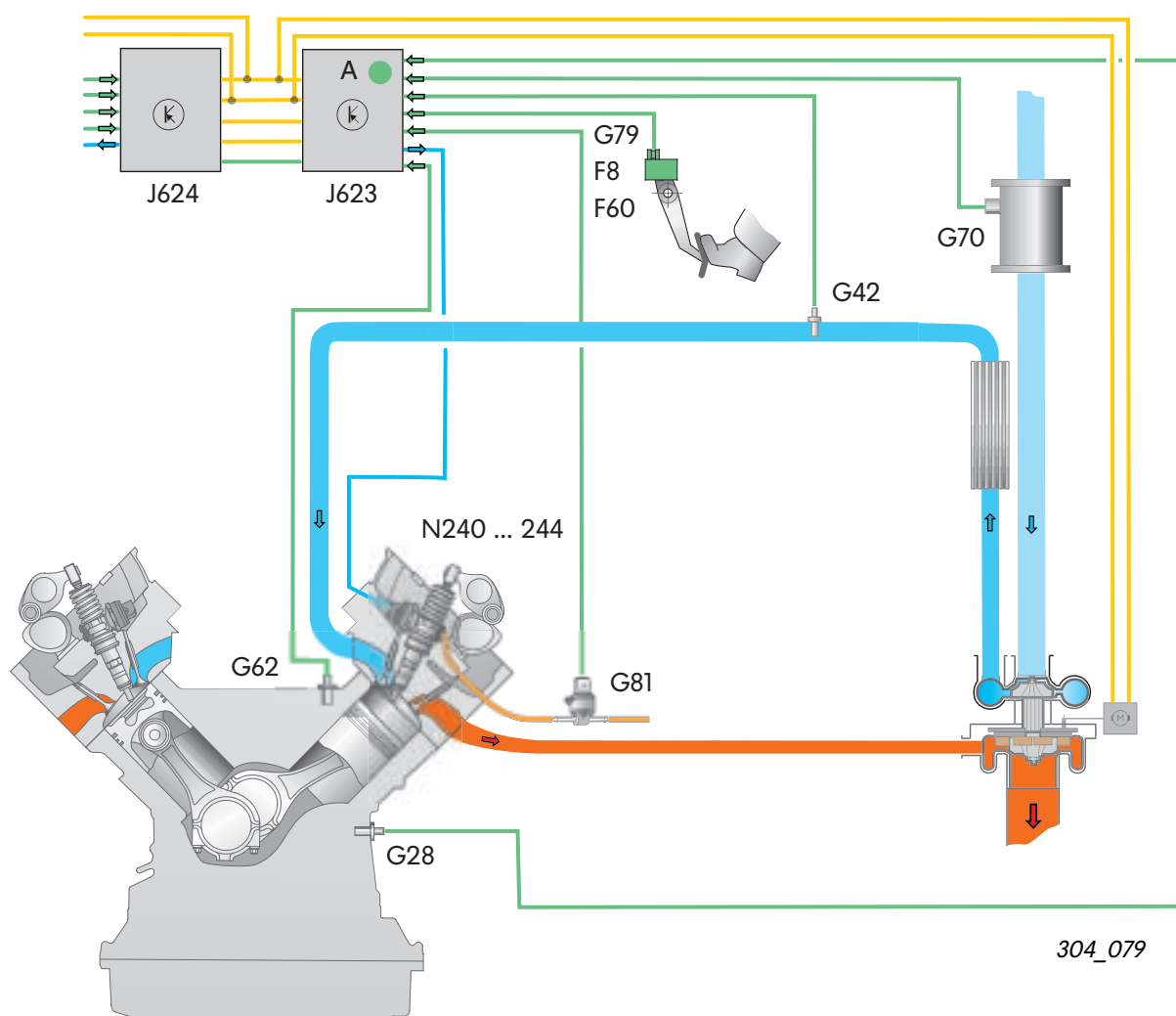





## Metering regulation

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

Thanks to the metering regulation, the engine can operate in all working conditions with optimal fuel combustion.



- |     |                                   |          |   |
|-----|-----------------------------------|----------|---|
| F8  | Kick-down switch                  | G81      | Fuel temperature sender                         |
| F60 | Idle switch                       | J623     | Engine control unit 1 (cylinder bank 1)         |
| G28 | Engine speed sender               | J624     | Engine control unit 2 (cylinder bank 2)         |
| G42 | Intake air temperature sender     | N240     | Unit injector solenoid valves, cylinders 1 - 5, |
| G62 | Coolant temperature sender        | ... N244 | cylinder bank 1                                 |
| G70 | Air-mass flow meter               |          |   |
| G79 | Accelerator pedal position sender | A        | Altitude sensor                                 |

- |   |                        |   |                          |
|---|------------------------|---|--------------------------|
|  | Air intake, normal     |  | Input signal             |
|  | Air intake, compressed |  | Output signal            |
|  | Exhaust gas            |  | CAN drive train database |



### **This is how it works:**

The specified torque is calculated from the internal and external torque demands. To reach this torque specification, a set quantity of fuel is required.

The quantity of fuel, for example, is calculated by the engine control unit with respect to

- the driver's requirements,
- the engine speed,
- the amount of air drawn,
- the coolant temperature,
- the fuel temperature and
- the intake air temperature.



However, to protect the engine against mechanical damage and to prevent black smoke, there should be limitations on the quantity of fuel injected. For this reason, the engine control unit calculates a limit value for this quantity.

The limit value depends on

- the engine speed,
- the air mass and
- the air pressure.



The parts systems illustrated as follows in this Self-Study Programme are based on the V10-TDI-engine as fitted in the Phaeton.

As can already be seen in the illustrated overview, reference is made only to cylinder bank 1 for description of the systems. Likewise, only the components belonging to the relevant parts system are included in the key.

# Engine management

## Start of injection regulation

The start of injection regulation influences a number of engine properties, such as the engine performance, the fuel consumption, the noise emissions and, equally as important, the exhaust emissions.

The start of injection regulation thus has the task of determining the correct point of fuel delivery and injection.

### This is how it works:

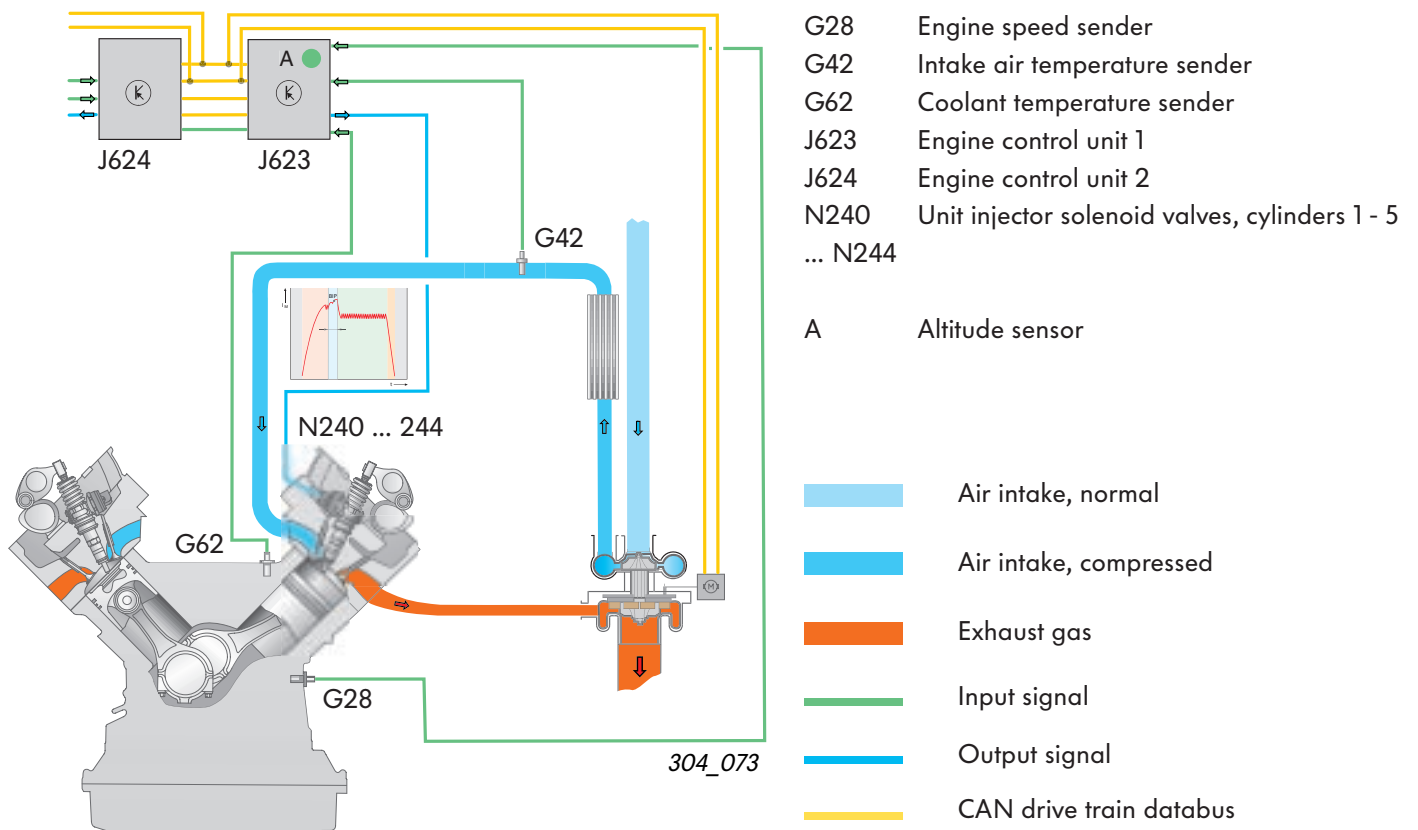
The engine control unit calculates the start of injection.

The specification depends on

- the engine speed and
- the calculated quantity of fuel to be injected from the metering regulation.

Further influencing factors are

- the coolant temperature and
- the air pressure.



In order that the start of delivery can be calculated optimally, the actual point at which delivery begins must also be registered.

To do this, the engine control unit monitors the flow at the unit injector solenoid valve. From the special flow pattern, the actual start of delivery, and thereby the start of injection, is determined.

### This is how it works:

Start of injection is initiated when the unit injector solenoid valve is actuated. For actuation, a magnetic field is created, current increases and the valve shuts.

When the valve shuts on the valve seat, a distinctive jolt is noticeable in the current flow. This is known as COI (Commencement Of Injection period).

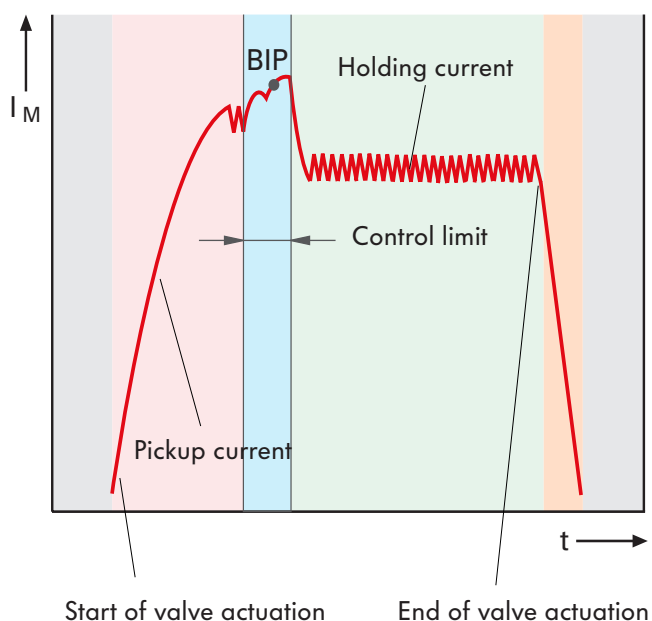
COI signals complete closure of the unit injector solenoid valve and thereby the point of delivery. The signal is received by the engine control unit.

If the valve is closed, current is maintained at a constant level. Once the required period of delivery has elapsed, actuation will cease and the valve will open.

The actual moment at which the unit injector solenoid valve closes, that is COI, is determined so that the point of actuation for the next injection period can be calculated.

If the actual COI deviates from the mapped details stored in the engine control unit, the engine control unit will correct the point of valve actuation.

Current pattern - Unit injector solenoid valve



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$I_M$  – Solenoid valve current  
 $t$  – Time  
 COI (BIP) – Point at which valve shuts

In order that faults can be detected at the solenoid valve, the engine control unit evaluates the COI position from the current flow pattern. If there are no faults, COI will be within the control limit. If this is not the case, the valve is faulty.

### Effects of signal loss

If faults are detected at the solenoid valve, start of delivery is determined based on fixed values from the map. Regulation is no longer possible and performance will be impaired.

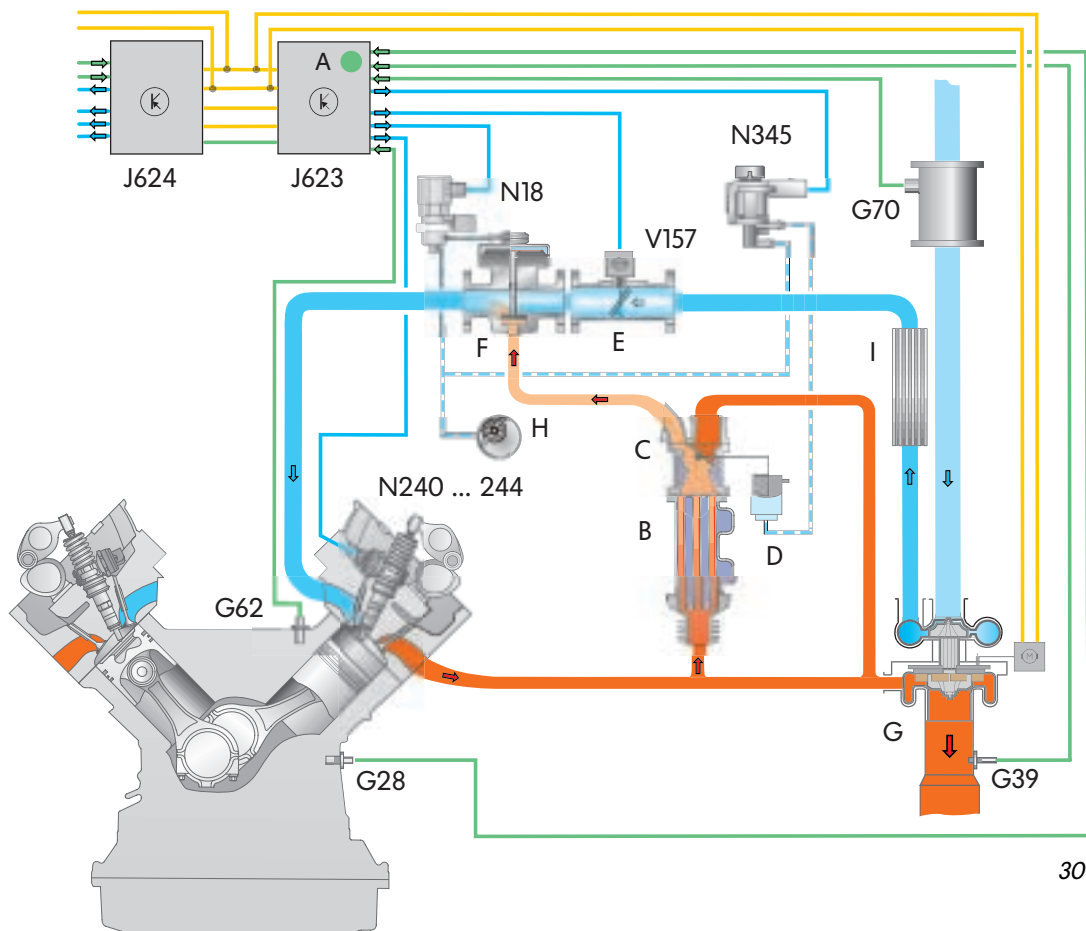


# Engine management

## Exhaust gas recirculation

Exhaust gas recirculation means that 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 ( $\text{NO}_x$ ) are reduced.

Exhaust gas recirculation occurs up to an engine speed of approximately 3000 rpm.



G28	Engine speed sender
G39	Lambda probe
G62	Coolant temperature sender
G70	Air mass meter
J623	Engine control unit 1
J624	Engine control unit 2
N18	Exhaust gas recirculation valve
N240 ... N244	Unit injector solenoid valve, cylinders 1 - 5
N345	EGR cooler changeover valve
V157	Intake manifold flap motor

A	Altitude sensor
B	EGR cooler (V10-TDI-engine, Phaeton)
C	EGR changeover flap
D	Vacuum unit
E	Intake manifold flap
F	EGR valve
G	Starter catalyst
H	Vacuum pump
I	Charged air cooler

## This is how it works:

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



### Lambda regulation for exhaust gas recirculation (V10-TDI-engine)




On the V10-TDI-engine, the amount of recirculated exhaust gas is corrected by Lambda regulation. With this system, the remaining oxygen content in the exhaust gas is calculated and the figure is sent to the engine control unit. If the actual oxygen content deviates from the specified figure, the engine control unit actuates the exhaust gas recirculation valve N18 and increases or decreases the amount of recirculated exhaust gas. With Lambda regulation, 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**.

### Exhaust gas recirculation control (R5-TDI-engine)

On the R5-TDI-engine, the amount of recirculated exhaust gas is stored in a map in the engine control unit. It contains a value for the necessary amount of fresh air for every operating situation.

If the air mass drawn in deviates from the specified figure, the amount of recirculated exhaust gas is adjusted respectively.

	Air intake, normal		Input signal
	Air intake, compressed		Output signal
	Exhaust gas, not cooled		CAN drive train databus
	Exhaust gas, cooled		
	Coolant		
	Vacuum		

# Engine management

## Exhaust gas recirculation cooling

The V10-TDI-engine in the Phaeton has an independent cooler for exhaust gas recirculation for each cylinder bank due to its emissions classification. The system cools the recirculated exhaust gas when the coolant temperature exceeds 50 °C.

This has two advantages:

- The combustion temperature is reduced and
- A greater amount of exhaust gases can be recirculated.

This means that there is less nitrogen oxide and the build up of carbon is reduced.

### This is how it works:

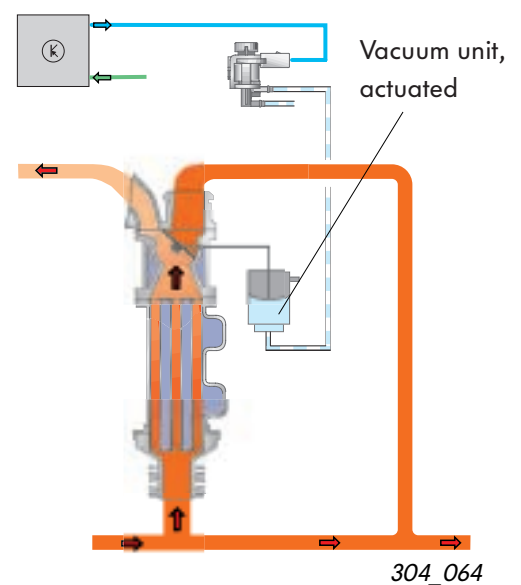
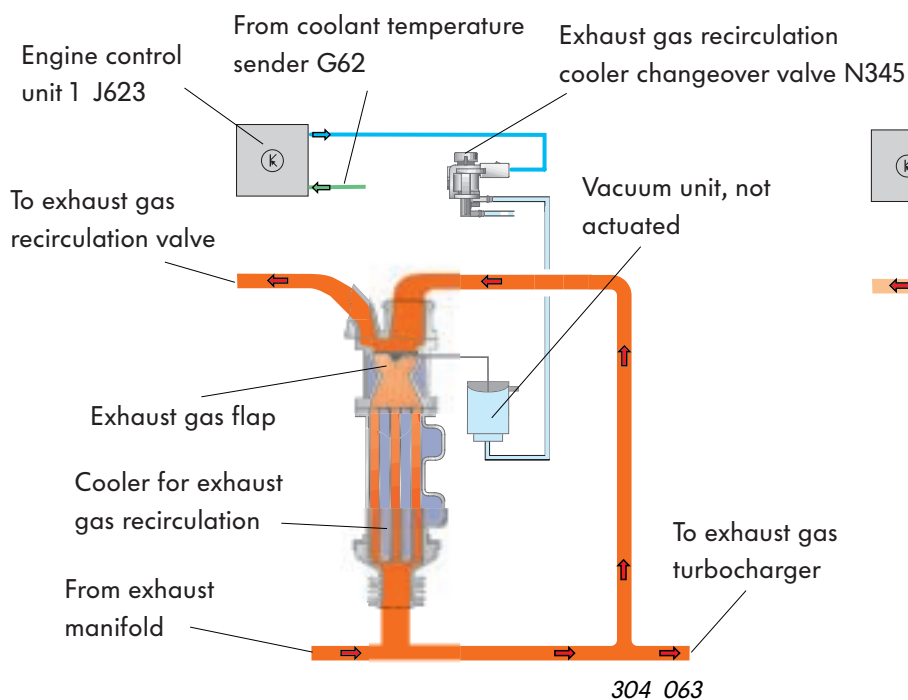
An independent exhaust gas recirculation cooler is used because continual cooling of the recirculated exhaust gas lengthens the period required for the engine to reach optimal operating temperature and leads to an increase in carbon dioxide and carbon monoxide emissions. For the independent cooling process, the exhaust gas is directed either past or through the cooler to the exhaust gas recirculation valve.

#### Without exhaust gas cooling

Up to a coolant temperature of 50 °C, the exhaust gas flap remains closed and the exhaust gas is directed past the cooler.

#### With exhaust gas cooling

From a coolant temperature of 50 °C, the exhaust gas flap is opened by the changeover valve. The recirculated exhaust gas will now flow past the cooler. The cooler output depends on the coolant temperature and the amount of recirculated exhaust gas.





## Charge pressure control

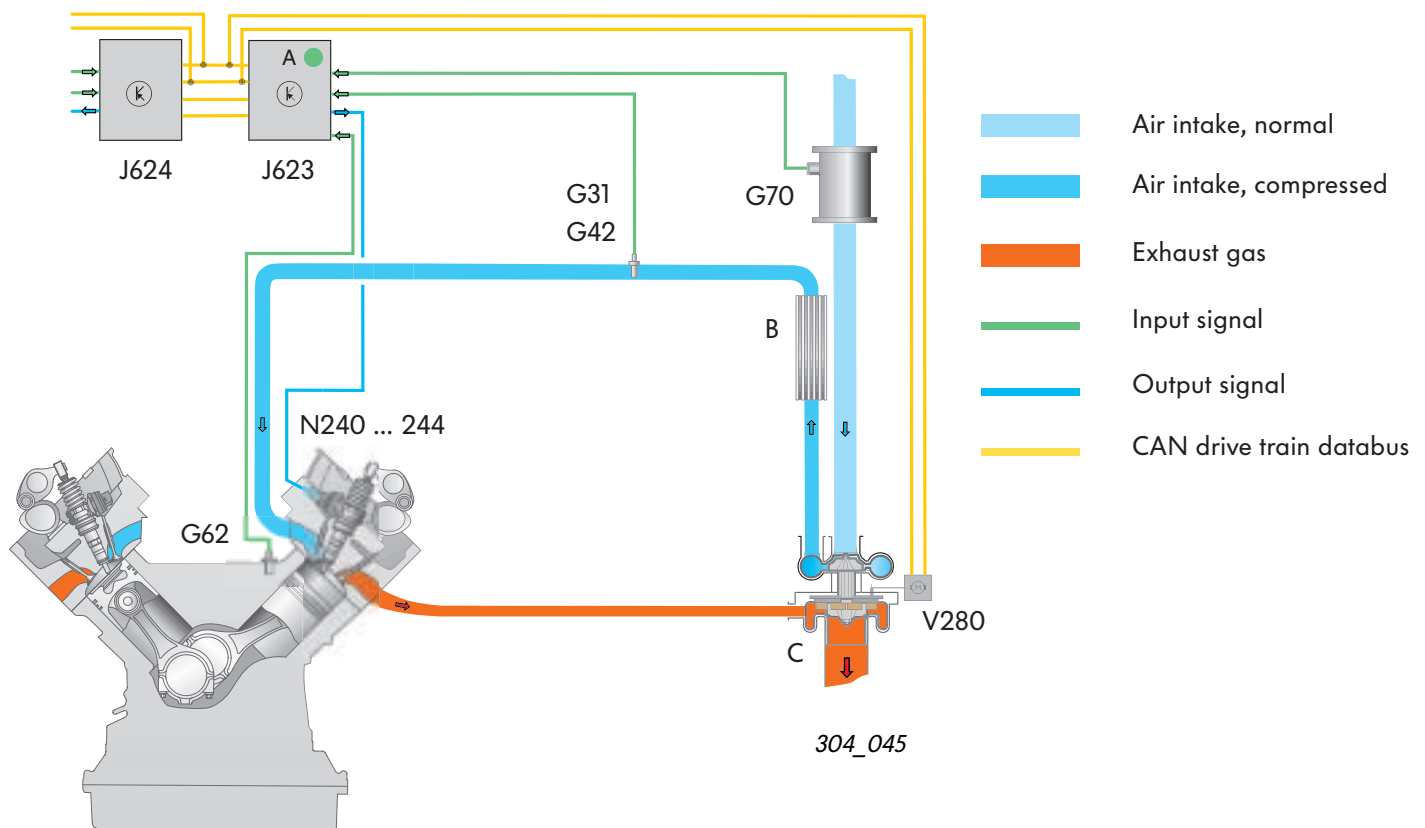
The charge pressure is controlled by a map that is stored in the engine control unit.

### This is how it works:

The engine control unit sends a signal via the CAN drive train databus to the turbocharger positioning motors. The signal will read between 0 and 100 % and is the value required for the guide vane setting. The positioning motor will adjust the position of the turbocharger guide vanes respectively and speed changes will result from the different angles. The charge pressure will be increased or reduced.

Charge pressure control works depending on the torque demand. To control the charge pressure, signals from the charge pressure sender are used.

The signals from the intake air temperature sender, coolant temperature sender and the altitude sensor are used as correction factors. The charge pressure is reduced gradually when the vehicle is travelling at high altitudes to protect the charger.



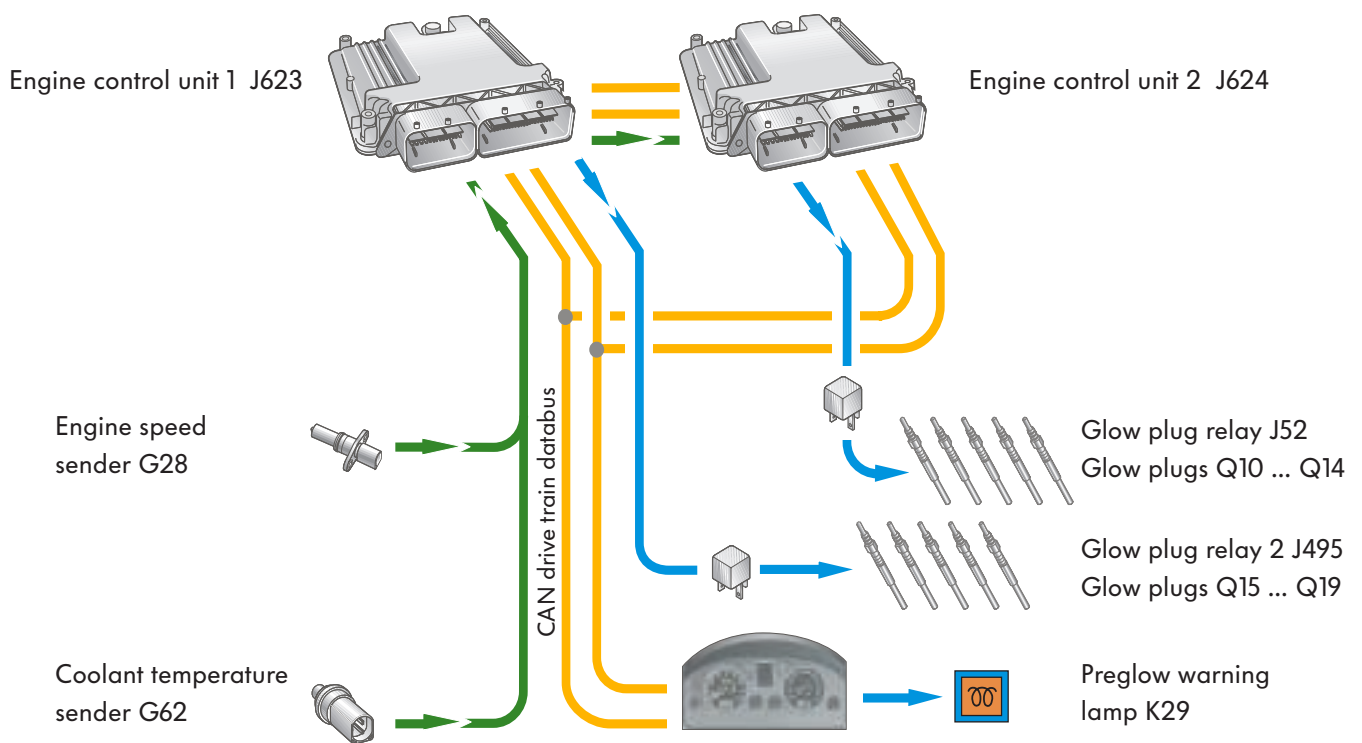
G31	Charge pressure sender
G42	Intake air temperature sender
G62	Coolant temperature sender
G70	Air mass meter
J623	Engine control unit 1
J624	Engine control unit 2

N240	Unit injector solenoid valves, cylinder 1 - 5
... N244	
V280	Turbocharger 1 positioning motor
A	Altitude sensor
B	Charged air cooler
C	Turbocharger

# Engine management

## Preglow system

The preglow system makes it easier to start the engine at low outside temperatures. It is activated by the engine control unit at coolant temperatures below +9 °C. The glow plug relay is actuated by the engine control unit. Once actuated it provides the current required for the glow plugs.



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### Preglow period

The glow plugs are activated when the ignition is switched on and outside temperature is below +9 °C. The preglow warning lamp will light up. Once the glow period has elapsed, the warning lamp 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 improves the idling 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 at above 2500 rpm. There is no extended glow period if, for example, the battery voltage is too low.