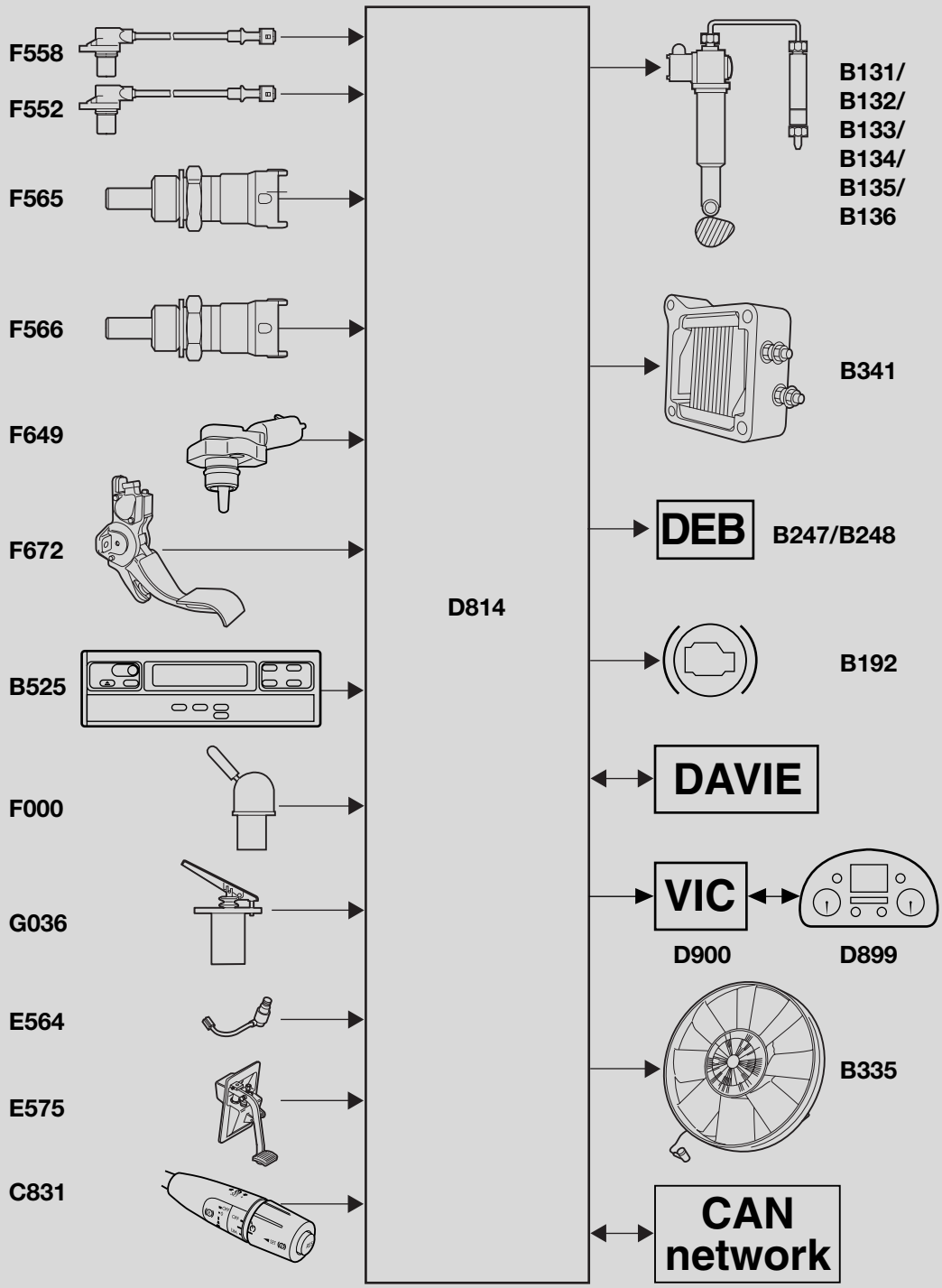
System manual
UPEC

*CF*75
*CF*85
*XF*95



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CONTENTS

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1. UPEC

1.1 GENERAL

If the vehicle has been modified and the configuration changed, the electronic unit may have to be re-programmed.

ELECTRONIC UNIT

Supply voltage	14 - 30 V
Terminating resistor in UPEC unit, between connection points B11 and B12	approx. 120 Ω
Engine speed output signal:	
type of signal	square-wave signal
number of pulses per crankshaft revolution	30
duty cycle	50%
average voltage	approx. 7 V

Atmospheric pressure sensor

Sensor type	piezo sensor
If the atmospheric pressure sensor fails, the default replacement value in the electronic unit is 800 mbar.	

PUMP UNIT

Voltage to solenoid valve	24 V
Draw-in current	approx. 10 A
Hold current	approx. 8.5 A
Solenoid valve resistance value	0.5 ± 0.1 Ω

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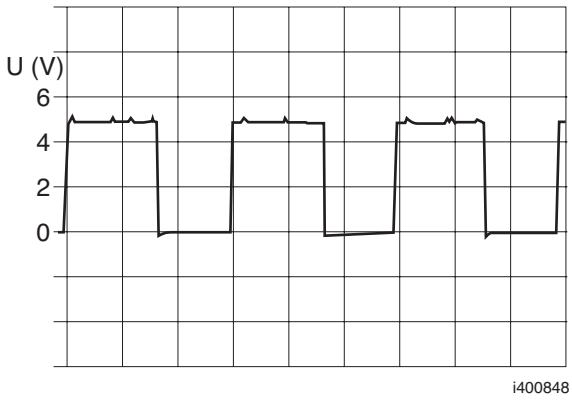
ELECTRONICALLY CONTROLLED FAN CLUTCH

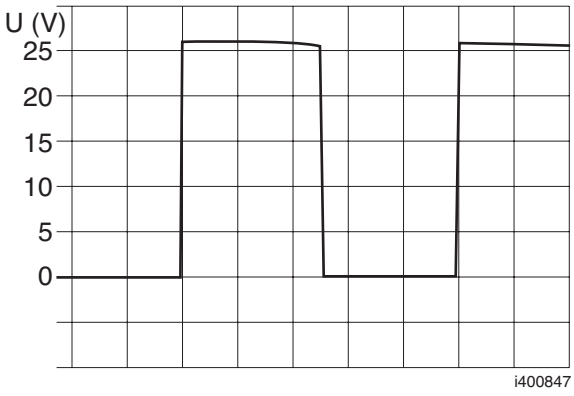
Type of speed sensor	Hall
Speed sensor output signal	Square-wave signal 5 V
Frequency at 1000 rpm fan speed	100 Hz
Pulses per fan revolution	6



i400848

Fan clutch control system	earth-controlled duty cycle
Duty cycle voltage level	24 V
Frequency of duty cycle signal	2 Hz
Duty cycle high (1)	Decreasing fan speed
Duty cycle low (1)	Increasing fan speed

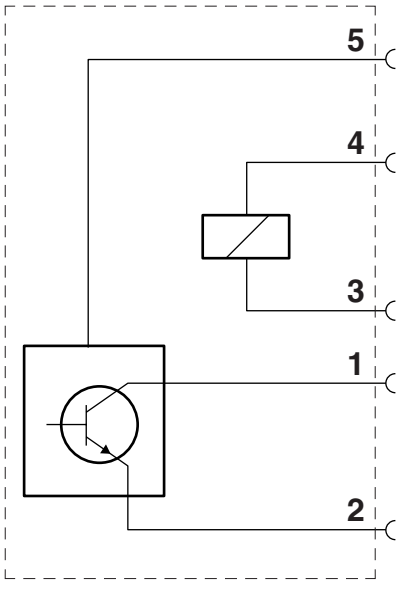
(1) Measured with plus probe on pin B3 and minus probe on pin A9



i400847

Electrical connections

1. Speed sensor output signal
2. Negative side of engine speed sensor
3. Fan speed control unit control signal
4. Power supply (24 V) to fan speed control coil
5. Supply voltage (5 V) to speed sensor



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ENGINE COOLANT TEMPERATURE SENSOR

Sensor type	NTC sensor
Output voltage to engine coolant temperature sensor	approx. 4.7 V (1)

(1) Measured at an open connection

Resistance in relation to measured temperature

Temperature (°C)	Resistance value (Ω)	
	Minimum	Maximum
-10	8244	10661
0	5227	6623
20	2262	2760
30	1553	1866
40	1080	1277
50	771	900
60	555	639
70	408	465
80	304	342
90	230	257
100	178	196
110	136	152

If the engine coolant temperature sensor fails, the default replacement value in the electronic unit is 66°C.

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FUEL TEMPERATURE SENSOR

Sensor type	NTC sensor
Output voltage to fuel temperature sensor	approx. 4.7 V (1)

(1) Measured at an open connection

Resistance in relation to measured temperature

Temperature (°C)	Resistance value (Ω)	
	Minimum	Maximum
-10	8244	10661
0	5227	6623
20	2262	2760
30	1553	1866
40	1080	1277
50	771	900
60	555	639
70	408	465
80	304	342
90	230	257
100	178	196
110	136	152

If the fuel temperature sensor fails, the default replacement value in the electronic unit is 38°C.

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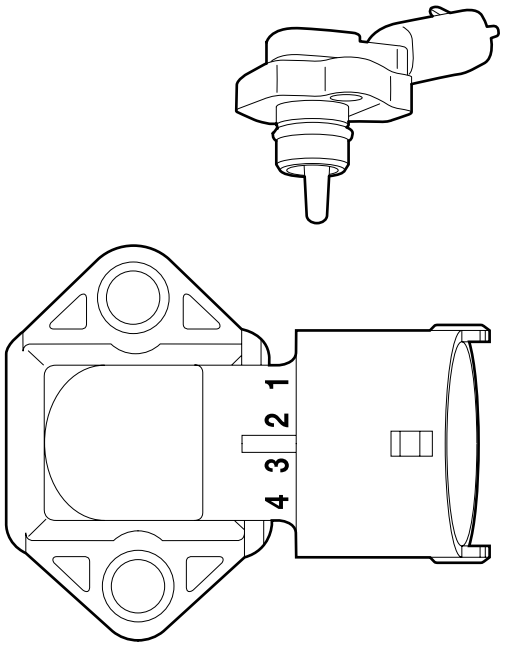
INLET AIR BOOST PRESSURE AND TEMPERATURE SENSOR

Electrical connections

1 Negative side of boost pressure sensor and inlet air temperature sensor
2 Positive side of inlet air temperature sensor
3 Boost pressure sensor supply voltage
4 Boost pressure sensor output signal



i 400441

Inlet air temperature sensor

Sensor type	NTC sensor
Output voltage to inlet air temperature sensor	approx. 4.7 V (1)

(1) Measured at an open connection

Resistance in relation to measured temperature

Temperature (°C)	Resistance value (Ω)	
	Minimum	Maximum
-10	8244	10661
0	5227	6623
20	2262	2760
30	1553	1866
40	1080	1277
50	771	900
60	555	639
70	408	465
80	304	342
90	230	257
100	178	196
110	136	152

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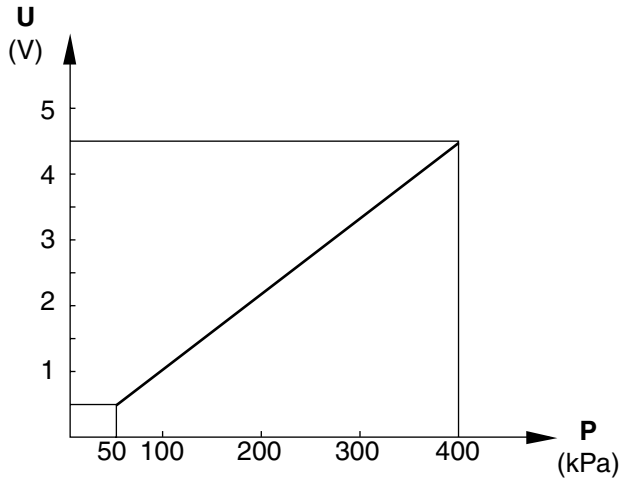
If the inlet air temperature sensor fails, the default replacement value in the electronic unit is 40°C.

Boost pressure sensor

Sensor type	piezo sensor
Boost pressure sensor supply voltage	approx. 5 V

Output voltage in relation to measured boost pressure (the absolute pressure is shown in the graph).

If the boost pressure sensor fails, the default replacement value in the electronic unit is 1.4 bar absolute pressure.



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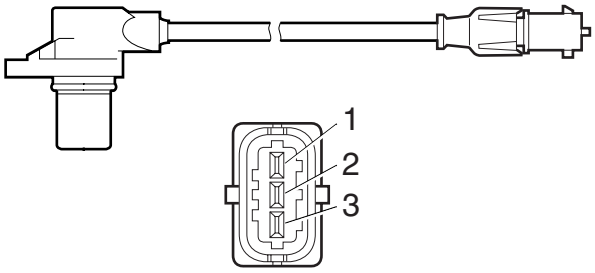
CRANKSHAFT SENSOR

Electrical connections

1 Crankshaft sensor earth
2 Crankshaft sensor signal
3 Shielding



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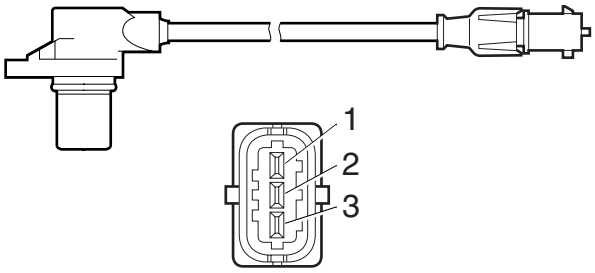
Resistance value	860 Ω ± 10% at 20°C
Type of signal	sine-wave signal
Number of pulses per crankshaft revolution	54
Effective voltage at engine starting speed	> 0.5 V (1)
Effective voltage at 1200 rpm.	> 10 V (1)

(1) The actual value may differ slightly from the minimum value specified due to tolerance differences in both the sensor and air gap.

CAMSHAFT SENSOR

Electrical connections

1. Camshaft sensor earth
2. Camshaft sensor signal
3. Shielding



i400442

Resistance value	860 Ω ± 10% at 20°C
Type of signal	sine-wave signal
Number of pulses per 2 crankshaft revolutions	7
Effective voltage at engine starting speed	> 0.5 V (1)
Effective voltage at 1200 rpm.	> 2.5 V (1)

(1) The actual value may differ slightly from the minimum value specified due to tolerance differences in both the sensor and air gap.

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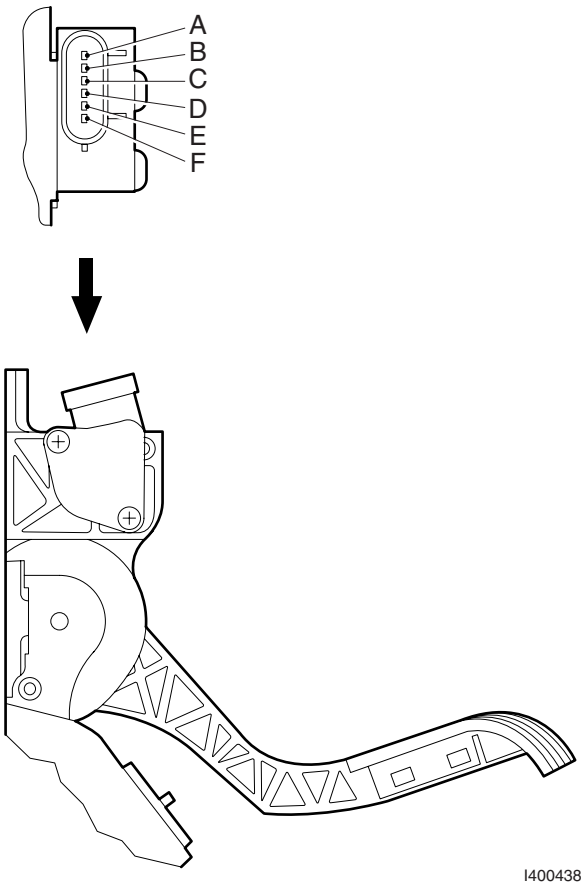
ACCELERATOR PEDAL SENSOR

Electrical connections

A. Potentiometer output signal
B. Earth
C. Potentiometer supply voltage
D. Idling switch supply voltage
E. Idling switch earth
F. Not in use



Potentiometer supply voltage	approx. 5 V
Idling switch supply voltage	approx. 4.7 V
Potentiometer resistance	1000 Ω ± 40%
Resistance in potentiometer output	1000 Ω ± 40%
Resistance over idling switch (if idling switch is closed)	1000 Ω ± 40%
Output voltage of potentiometer in no-load position	0.35 - 0.45 V
Output voltage of potentiometer in full-load position	minimum 2.9 V
Potentiometer output voltage in kickdown position	minimum 3.6 V

1.2 TIGHTENING TORQUES

The tightening torques stated in this section are different from the standard tightening torques stated in the overview of the standard tightening torques.
The other threaded connections not specified must therefore be tightened to the torque stated in the overview of standard tightening torques.

When attachment bolts and nuts are replaced, it is important that - unless stated otherwise - these bolts and nuts are of exactly the same length and property class as those removed.

Pump unit	
Pump unit electrical connection	1 ± 0.2 Nm
Sensors	
Engine coolant temperature sensor	max. 20 Nm
Fuel temperature sensor	max. 20 Nm
Attachment bolts, inlet air boost pressure and temperature sensor	4 Nm
Attachment bolt, crankshaft sensor	8 Nm
Attachment bolt, camshaft sensor	8 Nm

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1. UPEC FAULT-FINDING TABLE

1.1 INTRODUCTION

If there is a fault in the system, it is usually detected by the electronic unit in the form of a fault code. This fault code can be read out using DAVIE. The fault-finding table contains possible causes of symptoms not detected by the electronic unit.

1.2 FAULT-FINDING TABLE, ENGINE FUNCTIONS

SYMPTOM: ENGINE STALLS AND/OR ENGINE STARTS BUT DOES NOT FIRE	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with clean fuel
Air in fuel system	Check for drawing in of air
Fuel fine filter/coarse filter clogged	Replace fuel fine filter/fuel coarse filter and clean the system
No fuel supply/fuel lift pump defective; no delivery	Check: - the fuel level - the fuel pipes for blockage and leaks - the shut-off valve in the fuel supply pipe - the fuel lift pump - the gallery pressure
UPEC electronic unit defective	Replace the electronic unit
Pressure relief valve on pump housing does not shut off	Check the gallery pressure
Poor or broken earth connection on pin B1 and/or B2 of the ECU	Check the earth connection

SYMPTOM: LONGER START TIME BEFORE ENGINE FIRES	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with clean fuel
Air in fuel system	Check for drawing in of air
Fuel fine filter/coarse filter partially clogged	Replace fuel fine filter/fuel coarse filter and clean the system
Mechanical defect or clogging in pump units	Replace the pump units
Injectors defective	Inspect the injectors
Pressure relief valve on pump housing does not shut off	Check the gallery pressure
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace as necessary - the gallery pressure - the shut-off valve in the fuel supply pipe - the fuel pipes for blockage and leaks

SYMPTOM: DIESEL KNOCK DURING ACCELERATION	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with clean fuel
Injector defective	Inspect the injectors

SYMPTOM: IRREGULAR ENGINE RUNNING AND REDUCED ENGINE POWER	
Possible cause	**Remedy**
Air in fuel system	Check for drawing in of air
Connection points on pump units mixed up	Connect the correct connection points to the correct pump unit
Mechanical defect or clogging in pump units	Replace the pump units
Injector defective	Inspect the injectors
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace as necessary - the gallery pressure - the shut-off valve in the fuel supply pipe - the fuel pipes for blockage and leaks

SYMPTOM: REDUCED ENGINE POWER	
Possible cause	**Remedy**
Poor fuel quality	Drain fuel, flush fuel system, replace the fuel filters and fill fuel tank with fuel
Fuel fine filter/coarse filter partially clogged	Replace fuel fine filter and clean the system
Air filter clogged	Replace or clean the air filter
Turbocharger defective/wastegate control incorrect	Check the turbocharger/wastegate control and adjustment Check that the internal wastegate valve shuts fully
Air leak in inlet system	Pressure-test the inlet system
Pressure relief valve on pump housing does not shut off	Check the gallery pressure
Fuel lift pump delivery too low	Check: - the fuel lift pump and replace as necessary - the gallery pressure - the shut-off valve in the fuel supply pipe - the fuel pipes for blockage and leaks
Primer pump on fuel coarse filter not tightened	- Check the position of the primer pump
The coolant overheating safeguard is active because the coolant temperature measured is too high	

1

SYMPTOM: NO ENGINE SPEED SIGNAL ON THE ENGINE SPEED CONTROL APPLICATION CONNECTOR (A068)	
Possible cause	**Remedy**
Short circuit to earth or short circuit to supply or open circuit on pin B5 of the ECU	Check for: - short circuit to earth on pin B5 of the ECU - short circuit to supply on pin B5 of the ECU - open circuit on pin B5 of the ECU

SYMPTOM: ENGINE SPEED IS LIMITED TO A CERTAIN VALUE	
Possible cause	**Remedy**
Short circuit to earth on pin B28 of the ECU	- Check pin B28 of the ECU for short circuit to earth

1.3 FAULT-FINDING TABLE, VEHICLE FUNCTIONS

SYMPTOM: THE "CRUISE CONTROL" CONTROL FUNCTION CANNOT BE ACTIVATED	
Possible cause	**Remedy**
Steering column switch, mechanically defective/ interruption	Check: - the steering column switch in all positions
Condition(s) for disengaging cruise control present	Check for presence of disengaging condition(s)
Short circuit to supply on pin B31 of the ECU	Check connection point B31
The function has not been parametrised in the unit	Adjust the identity card

SYMPTOM: THE "VARIABLE VEHICLE SPEED LIMITATION" CONTROL FUNCTION CANNOT BE ACTIVATED	
Possible cause	**Remedy**
Open circuit on pin B31 of the ECU	Check connection point B31

SYMPTOM: THE "VEHICLE SPEED LIMITATION FOR SPECIAL APPLICATIONS" CONTROL FUNCTION CANNOT BE ACTIVATED	
Possible cause	**Remedy**
Open circuit on pin B21 of the ECU	Check connection point B21

SYMPTOM: THE "ENGINE SPEED CONTROL" CONTROL FUNCTION CANNOT BE ACTIVATED	
Possible cause	**Remedy**
Condition(s) for disengaging engine speed control present	Check for presence of disengaging condition(s)
Steering column switch, mechanically defective/ interruption	Check: - the steering column switch in all positions
The customer parameter settings have not been met	Check the customer parameter settings using DAVIE

SYMPTOM: GLOW FUNCTION CANNOT BE ACTIVATED	
Possible cause	**Remedy**
Defect/interruption in glow element	Check: - the glow element - the wiring
Glow plug relay, defect/interruption	Check: - the glow plug relay - the wiring
Condition(s) for disengaging pre-glowing and after-glowing function present	Check for presence of disengaging condition(s)

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SYMPTOM: REDUCED BRAKING POWER OF DEB	
Possible cause	**Remedy**
Condition(s) for disengaging engine brake present	Check for presence of disengaging condition(s)
Mechanical defect/interruption in engine brake operating switch	Check: - engine brake operating switch - the wiring
Mechanical defect in butterfly valve	Check: - the butterfly valve - the operation of the butterfly valve
DEB solenoid valve(s), mechanical defect	Check: - DEB solenoid valve(s)
Disengaging of engine brake by CAN connection	

SYMPTOM: EXHAUST BRAKE CANNOT BE ACTIVATED	
Possible cause	**Remedy**
Condition(s) for disengaging engine brake present	Check for presence of disengaging condition(s)
Mechanical defect/interruption in engine brake operating switch	Check: - engine brake operating switch - the wiring
Mechanical defect in exhaust brake solenoid valve	Check: - the exhaust brake solenoid valve
Mechanical defect in butterfly valve	Check: - the butterfly valve - the operation of the butterfly valve
Disengaging of engine brake by CAN connection	

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Contents UPEC

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1. GENERAL

1.1 INTRODUCTION

This system manual describes the layout, operation and inspection of the UPEC engine management system.
UPEC stands for "**U**nit **P**ump **E**lectronically **C**ontrolled".

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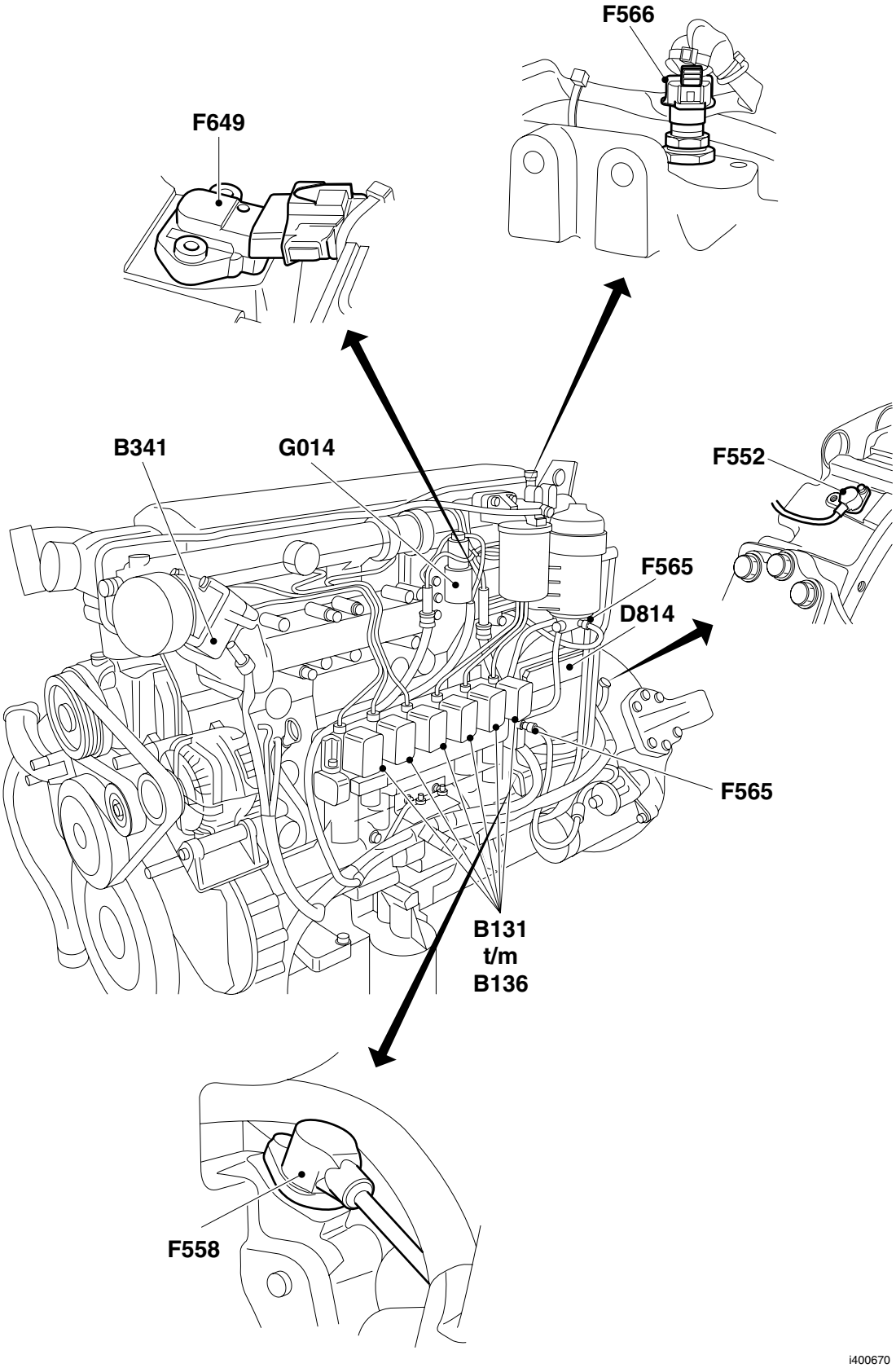
1.2 LOCATION OF COMPONENTS IN ENGINE



Basic code	Description	Location	Note
B131 to B136	Pump unit solenoid valve		
B341	Glow element		
D814	UPEC electronic unit		
F552	Crankshaft sensor		
F558	Camshaft sensor		
F565	Fuel temperature sensor	Location on pump housing or on fuel filter housing, depending on engine production date	
F566	Coolant temperature sensor		
F649	Inlet air boost pressure and temperature sensor		
G014	Glow plug relay		

2

2. SYSTEM DESCRIPTION

2.1 ELECTRICAL SYSTEM, UPEC SYSTEM

The electronic unit is the central controlling element of the UPEC injection system.
The functions of the UPEC system can be sub-divided into engine functions, vehicle functions and a diagnostic function.

Engine functions include:
- full-load limitation
- smoke limitation
- determining of timing and duration of injection
- injection quantity correction
- cold start
- control of boost pressure

Vehicle functions include:
- engine speed control using steering column switch
- engine speed control via application connector

  Note:
  The application connector is optional.

- vehicle speed limiter
- variable vehicle speed limiter
- cruise control

  Note:
  Cruise control is optional.

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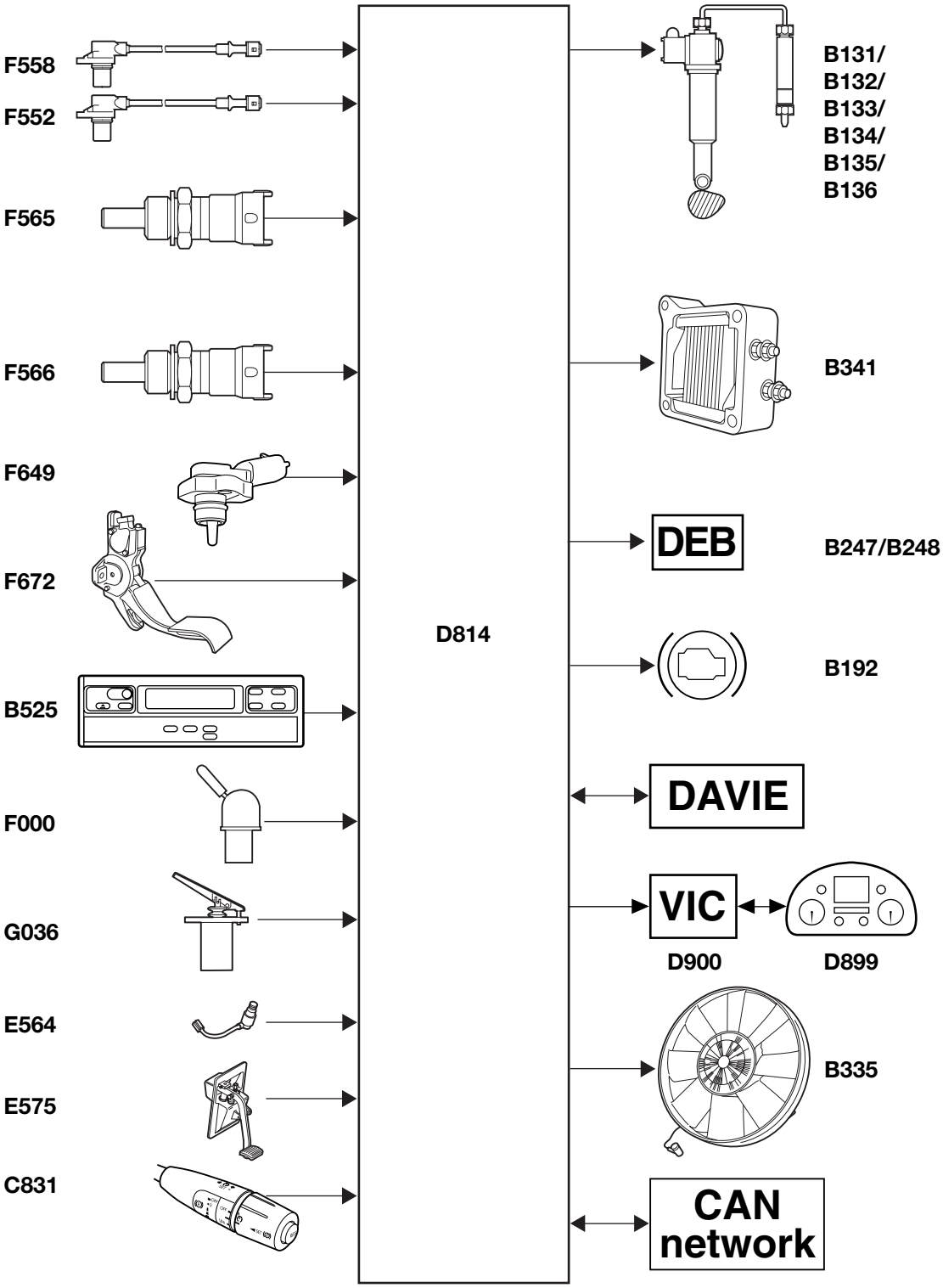
F558
F552
F565
F566
F649
F672
B525
F000
G036
E564
E575
C831
D814
B131/
B132/
B133/
B134/
B135/
B136
B341
DEB
B247/B248
B192
DAVIE
VIC
D900
D899
B335
CAN
network

i400431

For the control of engine and vehicle functions, the unit needs differing input signals and various components are activated by output signals.

Input signals
The most important input signals are:
- signal from camshaft sensor (F558)
- signal from crankshaft sensor (F552)
- signal from fuel temperature sensor (F565)
- signal from coolant temperature sensor (F566)
- signal from inlet air boost pressure and temperature sensor (F649)
- signal from accelerator pedal sensor (F672)
- vehicle speed signal (B525)
- signal from parking brake (F000)
- brake signal (G036 or G469)
- signal from engine brake switch (E564)
- signal from clutch pedal proximity switch (E575)
- signal from steering column switch (C831)

Output signals
After the input signals have been processed, the following parts are controlled via output signals:
- the pump units (B131/B132/B133/B134/ B135/B136)
- the glow element (B341)
- the DEB, if fitted (B247/B248)
- the exhaust brake (B192)
- the instrument panel via VIC (D900/D899)
- the electronically controlled fan clutch, if fitted (B335)

DAVIE
Communication with DAVIE for diagnostics.

CAN network
Via the CAN network, the UPEC electronic unit communicates with other electronic systems in the vehicle.

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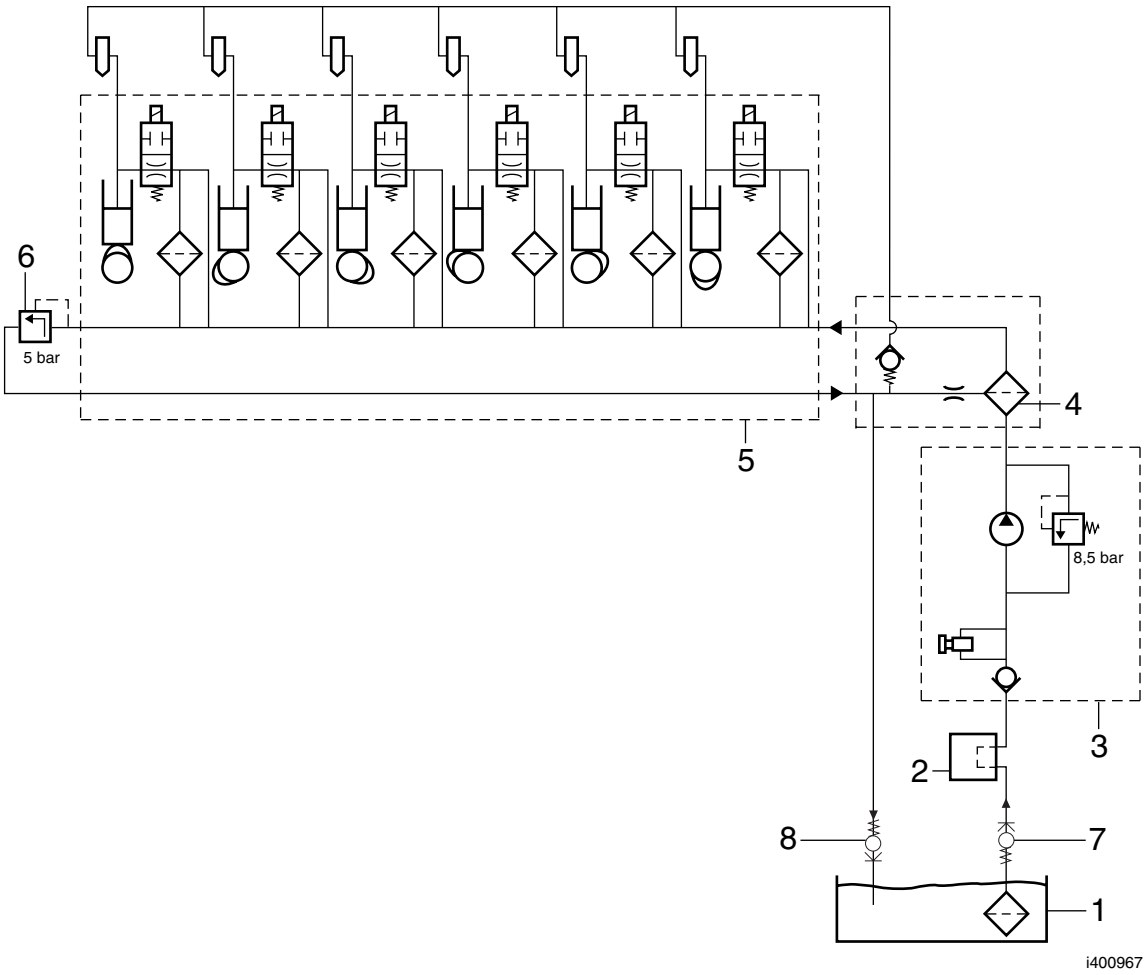
2.2 UPEC FUEL SYSTEM



The fuel lift pump (3) feeds the fuel from the fuel tank (1) through a shut-off valve (7) and the cooling plate (2).
The purpose of the cooling plate (2) is to ensure that the electronic unit does not become too hot.
The fuel lift pump (3) is fitted against the pump housing (5) and is driven by the camshaft in the pump housing.
From the fuel lift pump, fuel is forced towards the fuel fine filter (4).
For the purpose of constant bleeding, there is a calibrated bore in the fuel fine filter.
After the filter, the fuel enters the pump housing (5).
The pump units driven by the electronic unit are fitted in the pump housing (5).
The pump units force the fuel at high pressure (approx. 1600 bar) to the injectors.

At the end of the supply channel, there is a pressure relief valve (6) that connects the supply and discharge channels at a specific supply channel pressure. The pressure relief valve ensures a good degree of filling for the pump units. The discharge channel is connected to the return pipe leading to the fuel tank (1) via the fuel fine filter.

The injector leak-off pipe is connected to the return pipe via a non-return valve in the fuel fine filter. The return pipe contains a fuel shut-off valve (8). The return pipe is connected to the fuel tank (1).

The shut-off valves (7) and (8) are opened when the fuel pipes are connected. When the fuel pipes between engine and chassis are disconnected, the valves close off the pipes.

If the system has been 'open', the fuel system can be bled by means of the integrated primer pump in the fuel lift pump (3).

If the system has been 'open', the fuel system can be bled by means of the integrated primer pump in the fuel lift pump (3).

Note:
The shut-off valves (7) and (8) in the fuel supply and discharge pipes between the chassis and the engine are fitted from production date ≥2002-45 (chassis number ≥0E598000).

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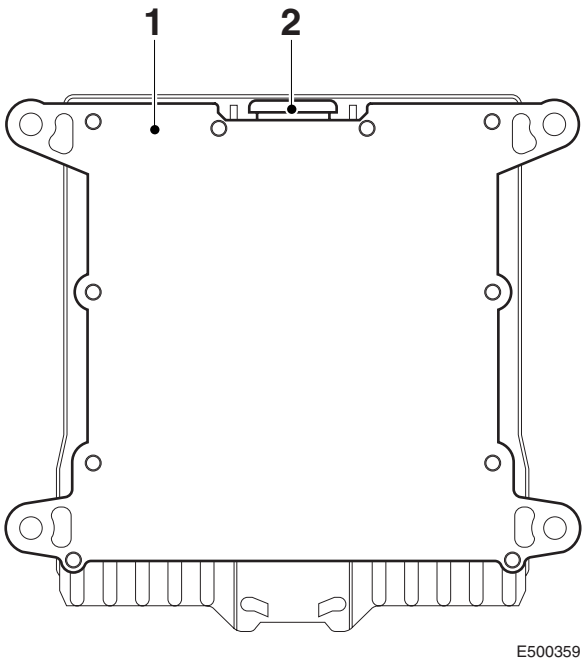
3. DESCRIPTION OF COMPONENTS

3.1 ELECTRONIC UNIT

The electronic unit (1) continually processes all input signals coming from the sensors, accelerator pedal position, etc.
All these data are compared with the values (maps and control quantities) stored in the electronic unit.
On the basis of these data, the electronic unit calculates the optimum injection timing and the required fuel injection quantity.
The pump units of the individual cylinders are energised accordingly.

The electronic unit incorporates a sensor that measures the atmospheric pressure.
The atmospheric pressure is measured via the vent opening (2) on the unit.



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Influence of atmospheric pressure on the system
The measured atmospheric pressure has an influence on:
1. the quantity of fuel injected in full-load control.

   At a low atmospheric pressure the quantity of fuel to be injected is reduced to prevent too high a turbocharger speed.

3.2 ACCELERATOR PEDAL SENSOR

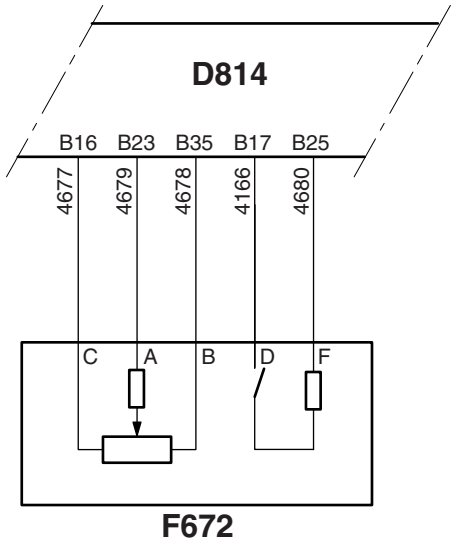
The accelerator pedal sensor (F672), which is connected to the electronic unit, is a potentiometer.
The output voltage of the potentiometer is a linear signal and is relative to the position of the accelerator pedal.

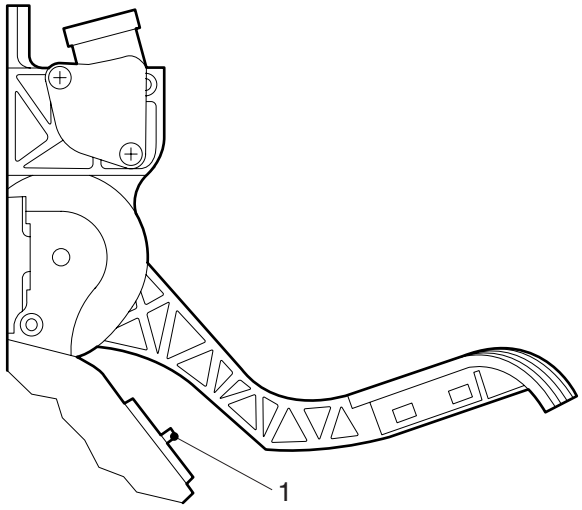
An idling switch that is connected to connection point B17 of the electronic unit runs parallel to the potentiometer.
The idling switch is open if the accelerator pedal is in the no-load position and will be closed on depressing the accelerator pedal.
The idling switch forms part of the emergency function. If the accelerator pedal sensor fails, this emergency function allows the vehicle to be driven to a safe place or a workshop.

If the kickdown switch (1) is operated, the electronic unit will recognise this position of the accelerator pedal by means of the output voltage from the potentiometer.

Influence of potentiometer output voltage on the system
The measured output voltage has an influence on:
1. the desired fuel injection quantity.

   The desired fuel injection quantity is corrected by the following functions: smoke limitation, maximum speed control, etc. and is therefore not necessarily the same as the actual fuel injection quantity.





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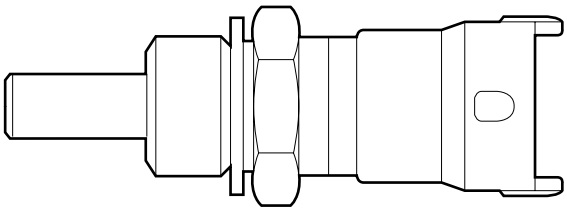
3.3 ENGINE COOLANT TEMPERATURE SENSOR

To measure the engine coolant temperature, a temperature sensor is used.
The temperature sensor is an NTC sensor (as the temperature rises the resistance becomes lower). In the event that the sensor fails, there is a pre-programmed replacement value for the sensor in the electronic unit.



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Influence of engine coolant temperature on the system
The measured engine coolant temperature has an influence on:

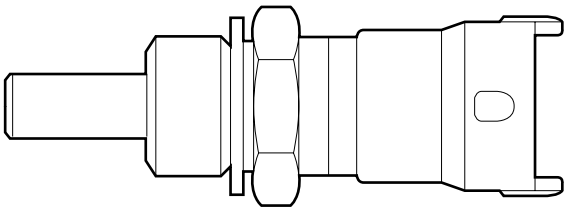
1. the injection timing when the engine is being started;
2. the injection timing for reducing the emission of white smoke;

   Note:
   This control takes place in combination with the inlet air temperature.

3. the pre-glowing and after-glowing times;
4. calculation of the fuel injection quantity when the engine is being started;
5. the reduction of engine power at too high a coolant temperature;
6. the control of the fan speed if the engine has an electronically controlled fan clutch.

3.4 FUEL TEMPERATURE SENSOR

To measure the fuel temperature, a temperature sensor is used.
The temperature sensor is an NTC sensor (as the temperature rises the resistance becomes lower).
In the event that the sensor fails, there is a pre-programmed replacement value for the sensor in the electronic unit.



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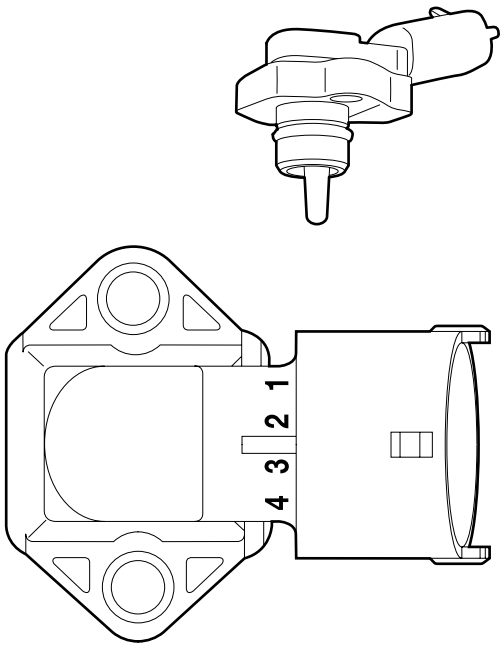
Influence of fuel temperature on the system
The measured fuel temperature has an influence on:

1. the correction of the quantity of fuel to be injected at a fuel temperature less than 0°C.
2. the pre-glowing and after-glowing times;
3. the correction of the control timing of the solenoid valve on the pump unit.

3.5 INLET AIR BOOST PRESSURE AND TEMPERATURE SENSOR

This sensor combines the function of measuring the boost pressure with that of measuring the inlet air temperature.

To measure the inlet air temperature, a temperature sensor is used.
The temperature sensor is an NTC sensor (as the temperature rises the resistance becomes lower).
In the event that the sensor fails, there is a pre-programmed replacement value for the sensor in the electronic unit.



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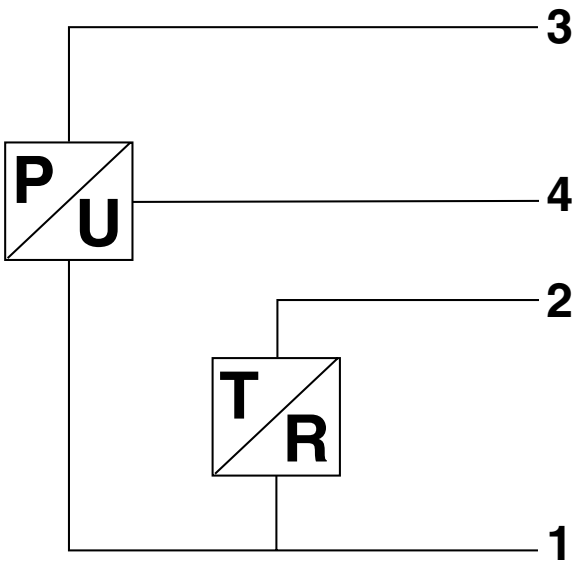
Influence of inlet air temperature on the system
The measured inlet air temperature has an influence on:
1. the injection timing for reducing the emission of white smoke;

   Note:
   This control takes place in combination with the coolant temperature.

2. the pre-glowing and after-glowing times;

3. the smoke limiting function (correction of measured boost pressure).



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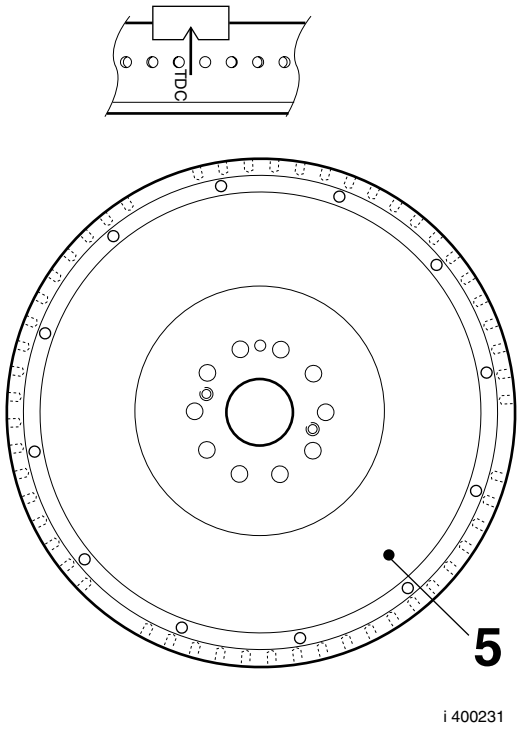
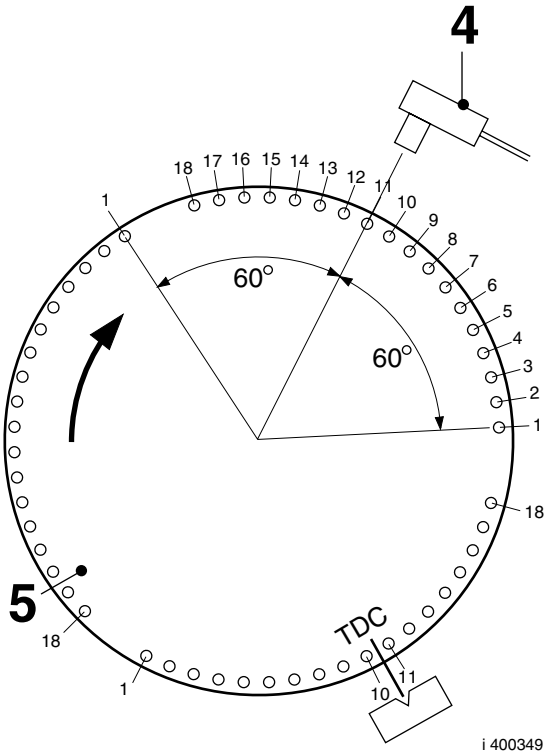
To measure the boost pressure, a boost pressure sensor is used.
The boost pressure sensor is a piezo pressure sensor type.
This sensor transmits the pressure to the electronic unit in the form of an electric signal (voltage).
In the event that the sensor fails, there is a pre-programmed replacement value for the sensor in the electronic unit.

Effect of boost pressure on the system:
The measured boost pressure has an influence on:
1. the fuel injection quantity (smoke limiting function).

3.6 CRANKSHAFT SENSOR





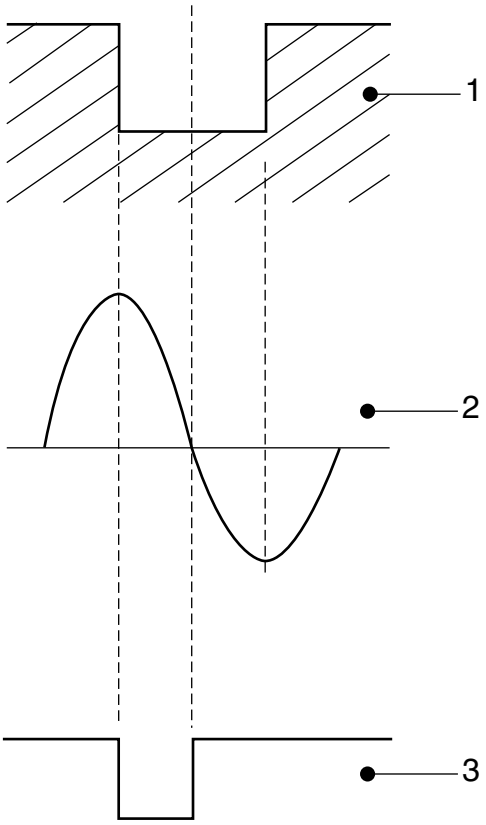
To register the engine speed and accurately determine the injection timing and therefore indirectly the timing of pump unit energising of the relevant cylinder, the crankshaft sensor (4) registers the speed and position of the crankshaft.
To that end there are three segments on the flywheel (5) (corresponding to cylinders 1-6, 5-2 and 3-4) at a crank angle of 120°, each of which has 18 holes at a distance of 6° crank angle. To recognise the following 'crankshaft segment', the segments are spaced at a distance equal to two missing holes.

The marking of top dead centre (TDC) on the flywheel is between holes 10 and 11 of the cylinder 3-4 segment.
The crankshaft sensor (4) is positioned in such a way on the flywheel housing that if cylinder 1 or 6 is in top dead centre position, the sensor (4) will be in front of hole 11 of the cylinder 1-6 segment.

The crankshaft sensor is an inductive sensor, which means that it emits a sine-wave signal (2) when it registers a hole (1).
The electronic unit converts the sine-wave signal into a digital signal (3) which can be used by the control system.

The crankshaft sensor is polarity-dependent.
The signal must be polarised in such a way that the positive half of the sine wave comes first to make possible the correct triggering of the 0-passage.
The digital signal has a rising side for the timing on the 0-passage of the sine-wave signal.

Influence of the crankshaft sensor signal on the system
The crankshaft sensor signal has an influence on:
1. the registration of injection timing determination.
2. the registration of the engine speed.
3. the registration of the engine speed for the following:
   - injection timing
   - injection duration
   - smoke limiting



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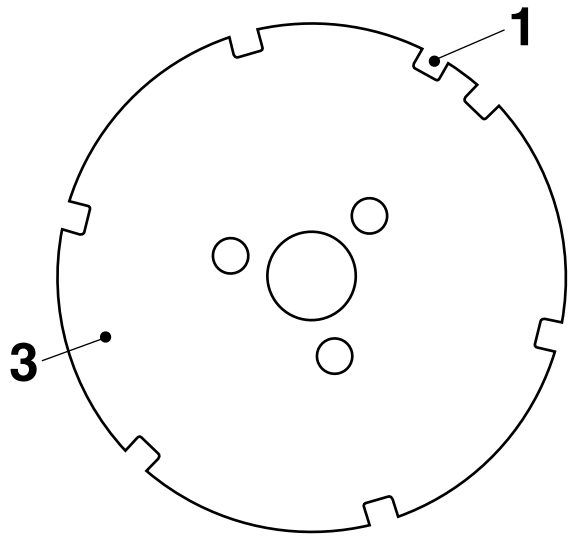
3.7 CAMSHAFT SENSOR



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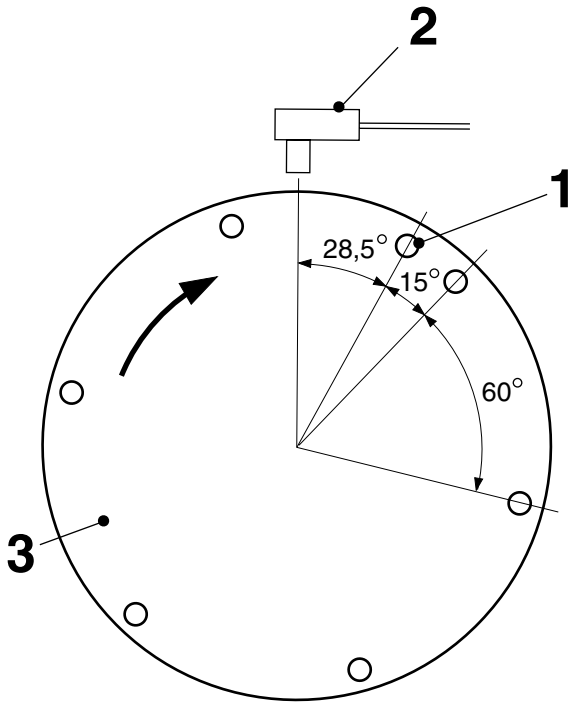

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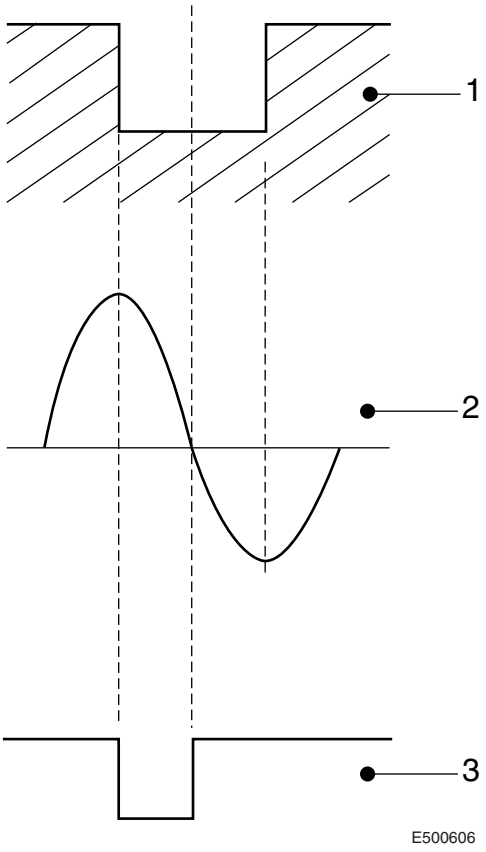
A camshaft sensor (2) is used to determine the synchronisation; this sensor synchronises the injection of cylinder 1 with the electronic system.
A pulse disk (3) is fitted to the camshaft in the pump housing for the synchronisation.
The pulse disk has a synchronisation hole (1) that corresponds to cylinder 1.
There are six other holes spread over the pulse disk at an angle of 60°.
The function of these holes is to determine the engine speed and injection timing if the crankshaft sensor fails.

At the point at which the camshaft sensor registers the synchronisation hole (1), the first cylinder is at 57 crank angle degrees before top dead centre (TDC) on the compression stroke.
The camshaft sensor is an inductive sensor, which means that it emits a sine-wave signal (2) when it registers a hole (1).
The electronic unit converts the sine-wave signal into a digital signal (3) which can be used by the control system.

The camshaft sensor is polarity-dependent.
The signal must be polarised in such a way that the positive half of the sine wave comes first to make possible the correct triggering of the 0-passage.
The digital signal has a rising side for the timing on the 0-passage of the sine-wave signal.

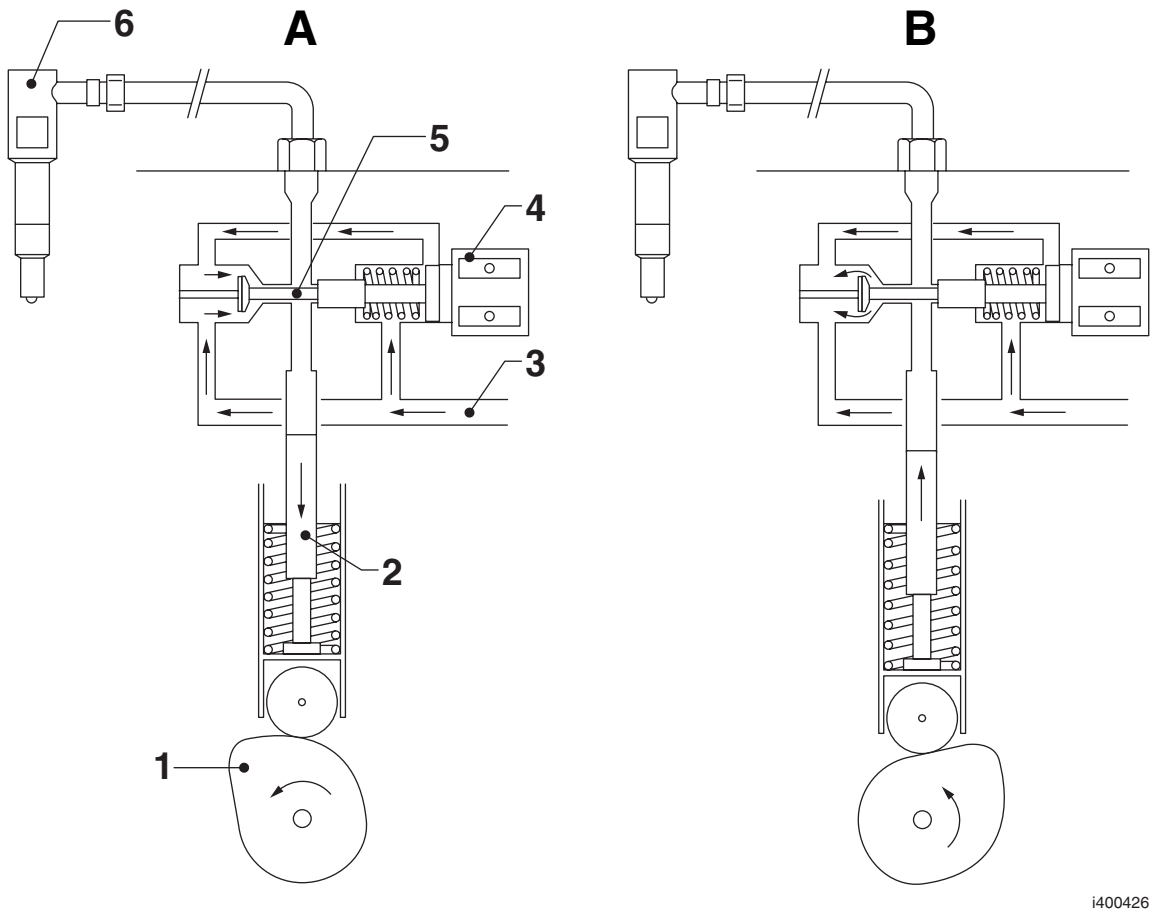
Influence of the camshaft sensor signal on the system

The camshaft sensor signal has an influence on:
1. registration of the synchronisation.
2. registration of engine speed and injection timing determination if the crankshaft sensor fails.



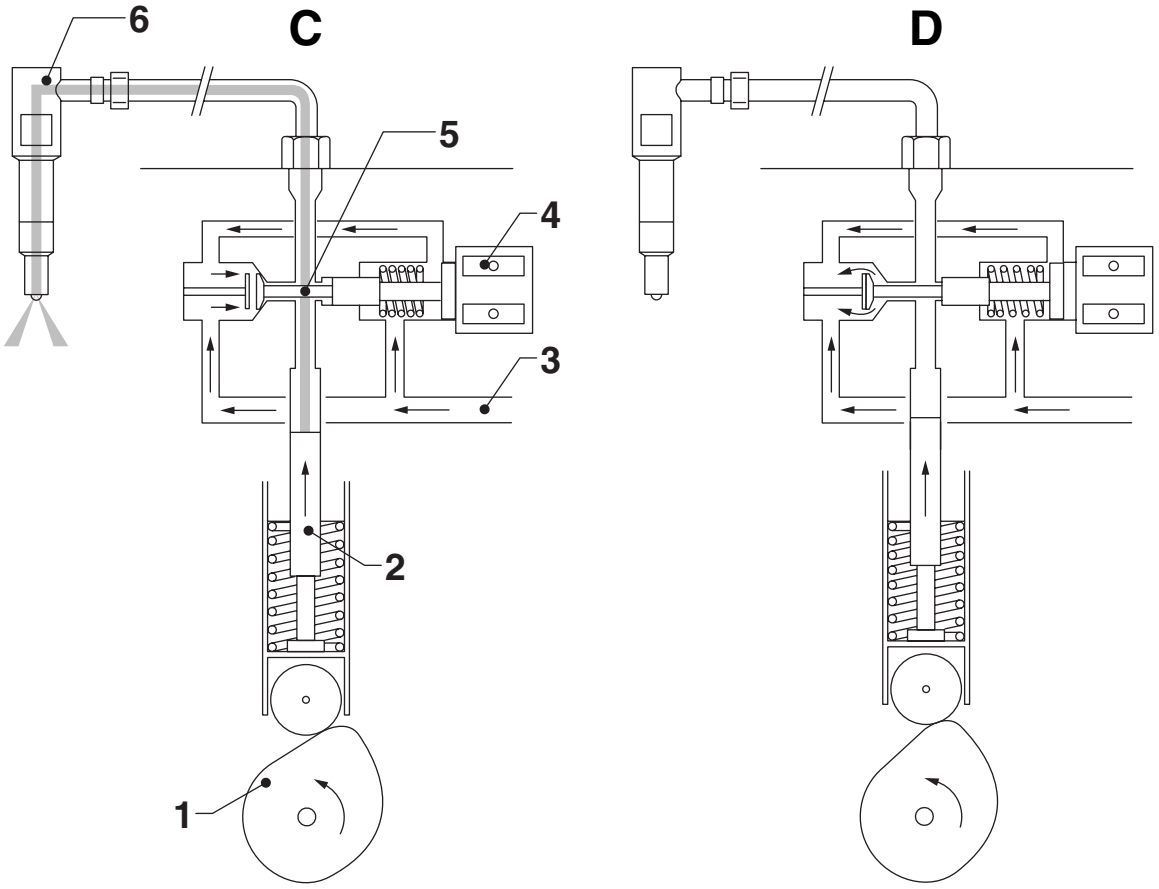
3.8 PUMP UNIT

Operating principle



Situation A
In this situation the pump plunger (2) makes the suction stroke.
Due to the constant overpressure in the supply area of the fuel system, the high-pressure area above the pump plunger (2) is filled via the fuel supply channels (3).

Situation B
In this situation the pump plunger (2) makes the compression stroke.
As the valve (5) has not yet closed the link to the fuel supply channels (3), there is no pressure build-up.



Situation C
In this situation, the injection timing is determined.
The electromagnet (4) is activated by the electronic unit.
In this way, the valve (5) closes the link between the space above the pump plunger (2) and the fuel supply channels (3).
There is now a pressure build-up above the pump plunger (2), causing fuel to be injected via the injector (6).

Situation D
In this situation the quantity of fuel to be injected is determined.
The electromagnet (4) is no longer activated by the electronic unit
The valve (5) opens the connection between the space above the pump plunger (2) and the fuel supply channels (3).
The fuel pressure above the pump plunger (2) will be quickly reduced.

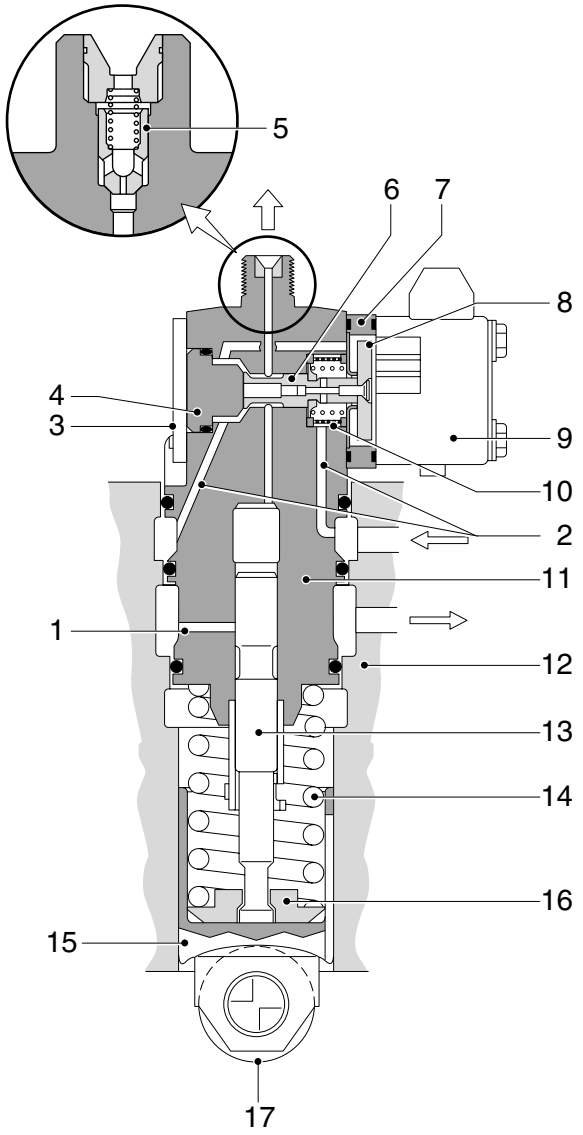
2

Pump unit function

The valve (6), back plate (8) and the pump plunger (13) are located in the top of the pump unit.
These parts are lubricated by the fuel.
A roller (17), tappet (15) and a spring (14) with spring retainer (16) are situated on the bottom of the pump unit.
These parts are lubricated by the engine lubrication system.
The lower sealing ring on the pump unit separates the fuel system from the engine lubrication system.

A pressure valve (5) is fitted on the top of the pump unit.
The function of the pressure valve is to prevent the supply section from being interrupted by pressure peaks from the injector pipe.

The injection timing and the quantity of fuel to be injected are controlled by a solenoid valve (9) that consists of an electromagnet and valve (6) with back plate (8), via the electronic unit control.



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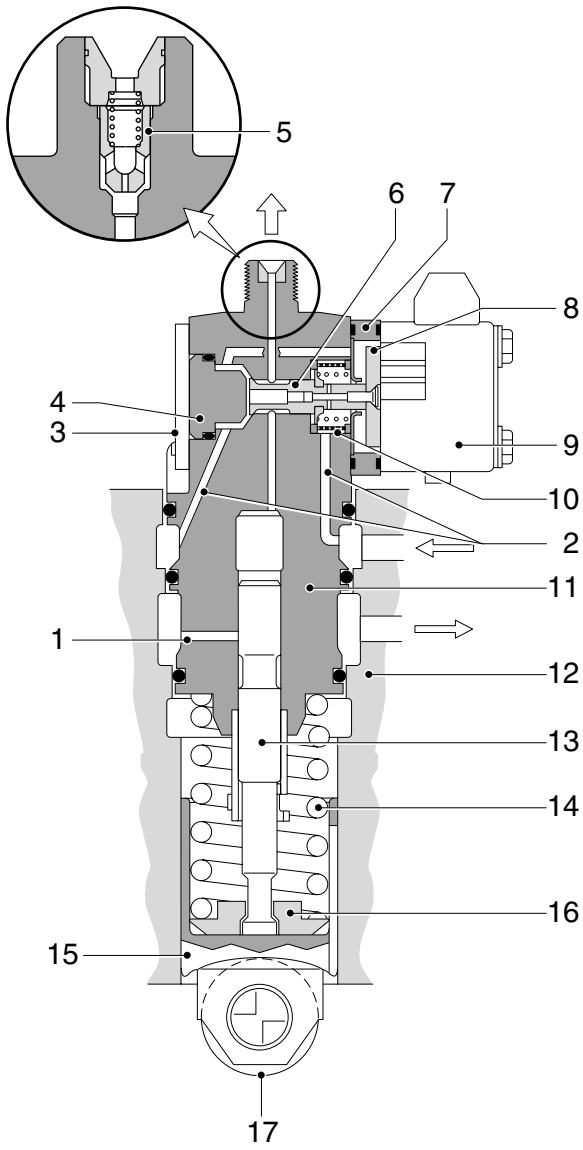
If the solenoid valve (9) is not energised, the valve (6) is forced against the valve stop (4) by the force of the valve spring.
This creates a very small opening between the space above the pump plunger (13) and the supply channels (2).

The fuel will now flow via the fuel supply channels (2) to the space above the pump plunger (13).
If the solenoid valve (9) is energised by the electronic unit, the back plate (8) with the valve (6) will be attracted by the electromagnet due to the influence of the magnetic field.
The valve (6) closes the connection between the space above the pump plunger (13) and the supply channels (2), causing pressure to build up in the space above the plunger (13).
This causes the injection.

The valve (6) is not re-opened against the force of the magnet due to the high pressure in the high-pressure area, as the forces in the slot of the valve (6) are balanced.
In other words, the left and right surfaces in the slot of valve (6) are equal.

The time at which valve (6) shuts depends on the injection timing calculated by the electronic unit.
The time that the valve (6) remains closed, and therefore the quantity of fuel to be injected, is also calculated by the electronic unit.



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3.9 ELECTRONICALLY CONTROLLED FAN CLUTCH

An electronically controlled fan clutch is used for accurate control of the fan speed.

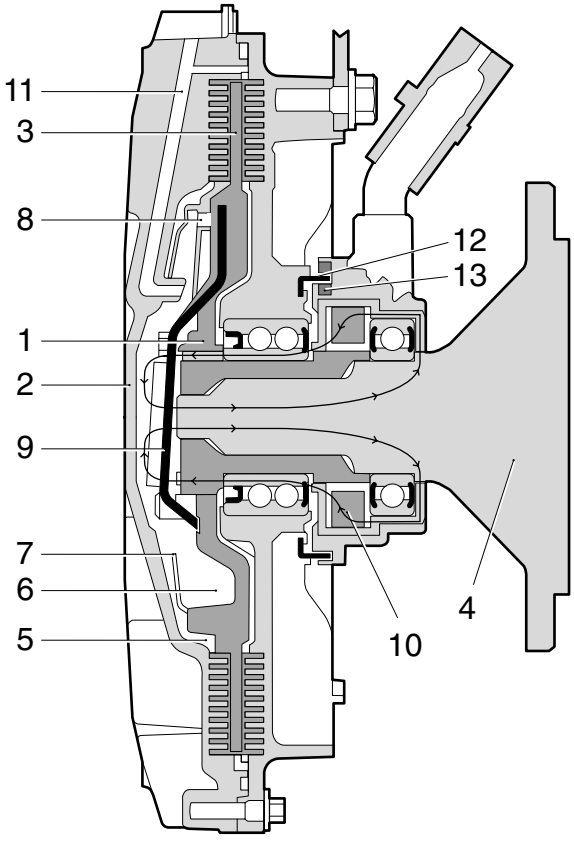
The electronically controlled fan clutch checks and controls the fan speed to ensure that the flow of cooling air through the cooling system is sufficient to keep the coolant temperature and/or inlet air temperature within certain limits.

The fan clutch is actuated by a duty cycle (PWM). Actuation depends on several variables:

- coolant temperature
- vehicle speed
- engine speed
- fan speed
- intarder activation
- internal slip of the fan clutch (slip heat protection)

Duty cycle high means decreasing fan speed.
Duty cycle low means increasing fan speed.
If it is not actuated, the valve (9) is fully open. So in the event of failure of the fan clutch control system, the fan will run at maximum speed.

The speed of the fan is sensed by a Hall sensor (13) and a pulse disc (12).
The sensor sends a signal to the electronic unit. The electronic unit uses this signal to check the internal slip of the fan and the response to controls.



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Design
The fan clutch is in two parts, a primary part (1) and a secondary part (2).

The primary part (1) consists of the rotor (3), which is fixed to the drive shaft (4). It also includes the supply chamber (6) for the silicone fluid.
The secondary part (2) includes the working area (5). The fan is fitted to the secondary part (2) and rotates freely around the drive shaft (4).
The supply chamber (6) consists of a raised ring (7) and part of the rotor (3). The supply chamber (6) has an opening (8) to the working area (5), which is closed by a valve (9).

The coil (10) fitted to the drive shaft (4) with bearings generates a magnetic field. The duty cycle to the coil (10) will be modified depending on the variables stated above. This will cause changes in the magnetic field and the valve (9) will be attracted either more or less. This opens and closes opening (8).

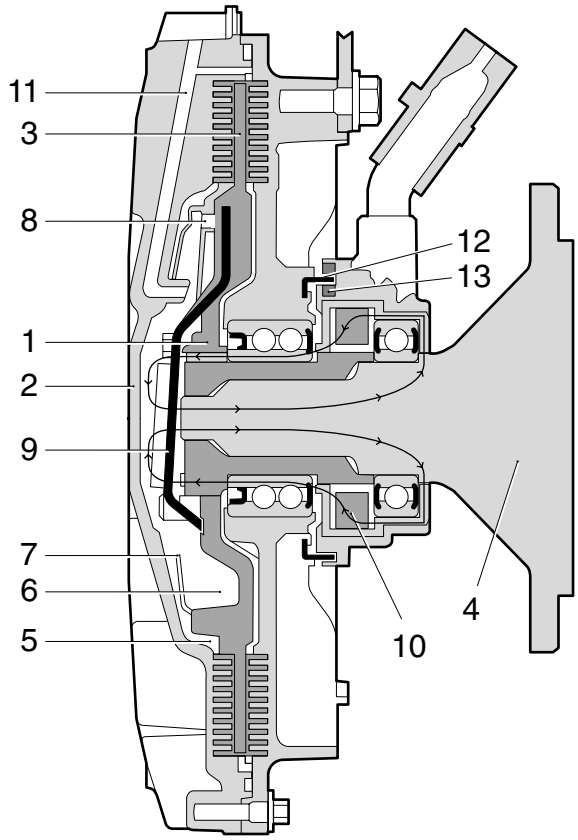
In the static state all silicone fluid will flow out of the supply chamber (6), while in the dynamic state the silicone fluid will remain in the supply chamber (6) as a result of the centrifugal force.

After the engine has started, the fan will always run for a short time, because the silicone fluid that has settled at the bottom will be forced outwards by the centrifugal force. Some of the silicone fluid will first flow through the working area (5). The silicone fluid causes friction between the rotor (3) and the working area (5). As a result, the difference in rotating speed (slip) between the working area (5) and the rotor (3) will decrease. The fan will start to run faster.

The silicone fluid will flow from the working area (5), back to the supply chamber (6) through the return holes (11).

When the valve (9) releases the opening (8) at a specific duty cycle, a specific quantity of silicone fluid will flow from the supply chamber (6) to the working area (5). The quantity of silicone fluid flowing through the working area determines the difference in rotating speed (slip) between the working area (5) and the rotor (3).

If the valve (9) releases the opening (8) further, the quantity of silicone fluid flowing through the working area (5) will increase. The friction between the working area (5) and the rotor (3) will increase and the difference in rotating speed (slip) between the working area (5) and the rotor (3) will decrease. The fan will start to run faster.



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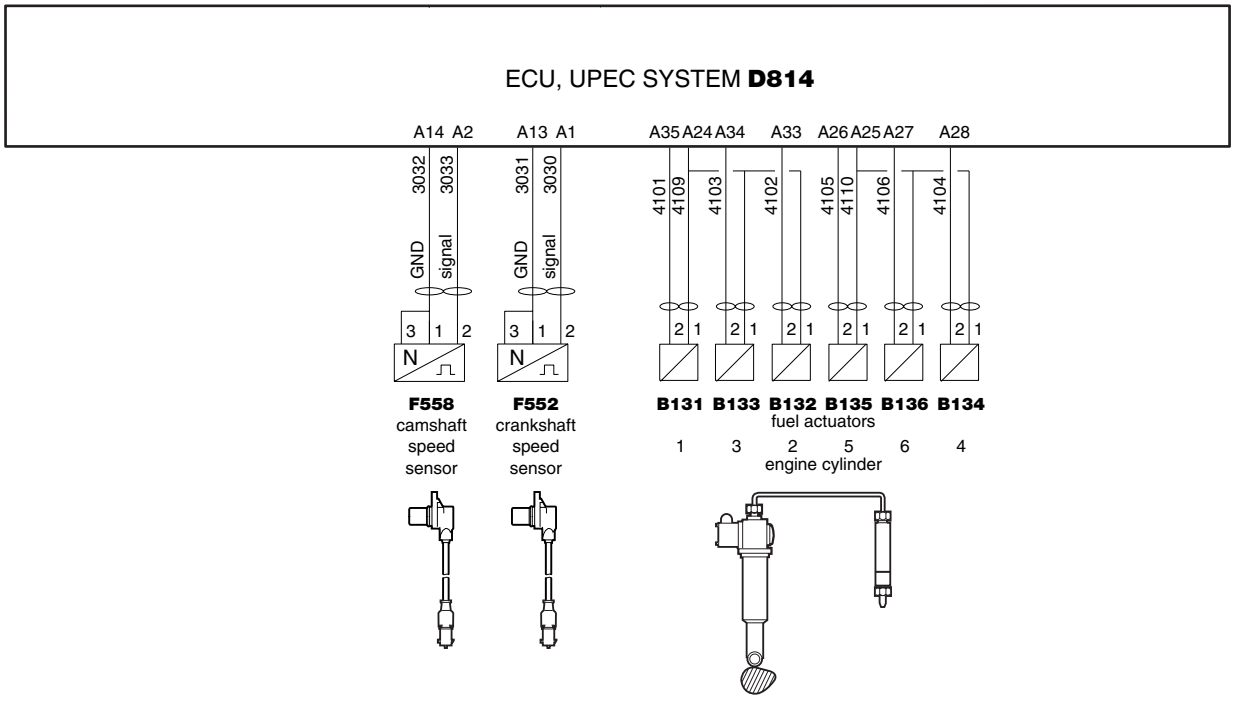
4. CONTROL FUNCTIONS

4.1 SYNCHRONISATION DURING STARTING



A crankshaft sensor (F552) and a camshaft sensor (F558) are connected to the electronic unit (D814).

For determining the injection timing, the electronic unit needs information relating to the position of cylinder 1 during starting.
Via this "position recognition", synchronisation can occur.
The position of cylinder 1 during starting is registered via the camshaft sensor (F558).

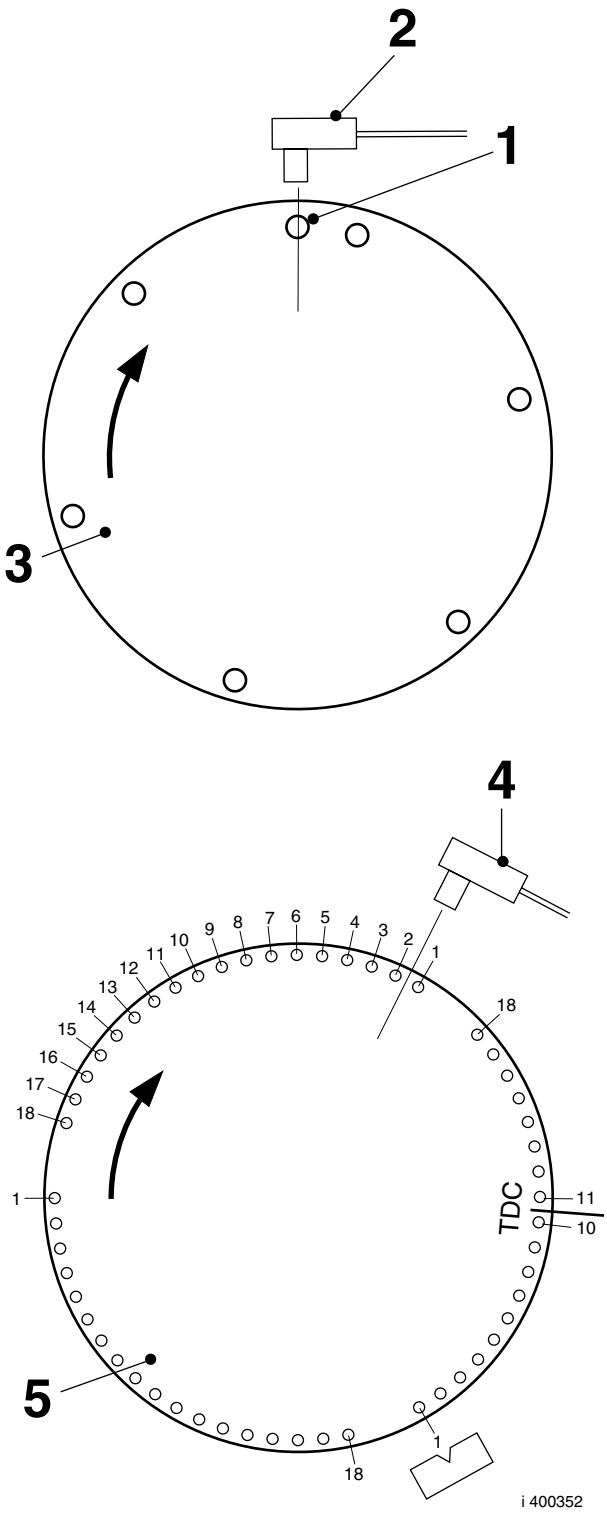
2

A pulse disk (3) is fitted to the camshaft in the pump housing.
The pulse disk has a synchronisation hole (1) that corresponds to cylinder 1.
There are three segments on the flywheel (5) (corresponding to cylinders 1-6, 5-2 and 3-4) at a crank angle of 120°, each of which has 18 holes at a distance of 6° crank angle. To recognise the following 'crankshaft segment', the segments are spaced at a distance equal to two missing holes.

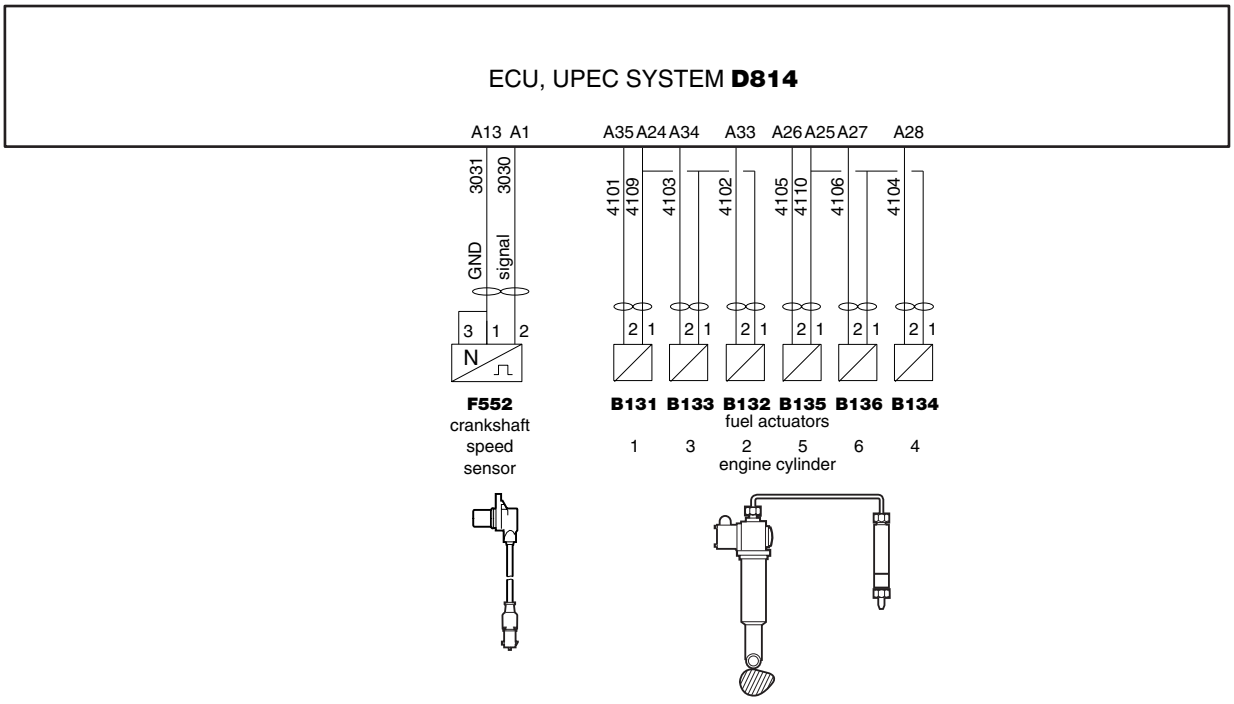
When the engine is started, the crankshaft sensor (4) registers the first hole of a "crankshaft segment" after the two missing holes on the flywheel (5).
After registration of the first hole, the electronic unit compares the position of the crankshaft with the position of the camshaft in the pump housing via the pulse disk (3).
If the camshaft sensor (2) registers the synchronisation hole (1) at that point, the "system" is synchronised on the first cylinder (first cylinder is now at 57 crank angle degrees before top dead centre) and the electronic unit can then activate the pump units (control of injection timing and injection quantity).

Synchronisation in the event of failure of the camshaft sensor
If the camshaft sensor (2) fails, synchronisation is no longer possible via the camshaft sensor.
During starting, the electronic unit will instead activate the pump unit of the fourth cylinder (B134) if it registers the area between the first and second holes of a "crankshaft segment".
This method of activation lasts as long as it takes for an increase in engine speed to occur.
When an increase in engine speed is registered, the electronic unit knows that the following "crankshaft segment" is before the first cylinder, after which the injection timing and injection quantity control can again take place.

Synchronisation in the event of failure of the crankshaft sensor
If the crankshaft sensor (4) fails, the pump unit of the first cylinder (B131) is energised if the synchronisation hole (1) has been registered by the camshaft sensor.
From this moment, injection timing and injection quantity control takes place over the remaining 6 holes of the pulse disk (3).



4.2 DETERMINATION OF INJECTION TIMING AND INJECTION QUANTITY



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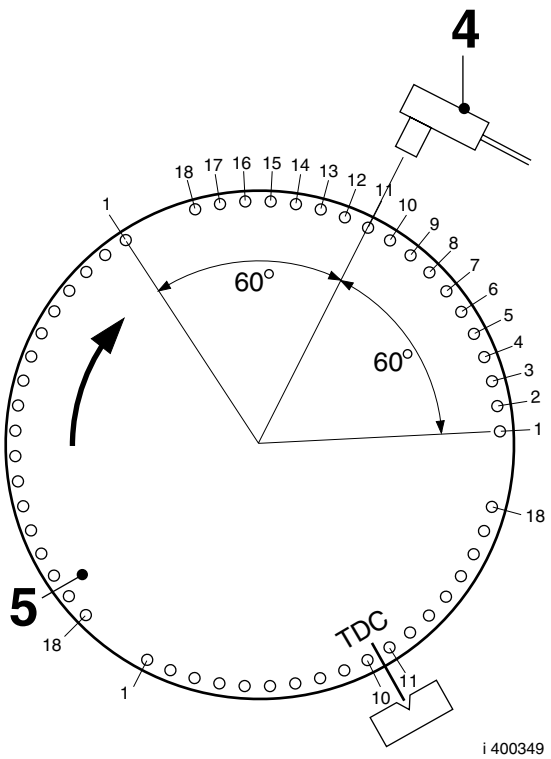
The quantity of fuel to be injected, which is calculated by the electronic unit (D814), must be converted into a point of time and a duration during which the pump unit solenoid valves must be energised.

The injection timing calculated by the electronic unit is also converted to a point of time at which the solenoid valves of the pump units are energised.
To determine the injection timing and injection quantity accurately and therefore indirectly the timing of the activation/deactivation of the pump units, there are three segments on the flywheel (5) (corresponding to cylinders 1-6, 5-2 and 3-4) at a crank angle of 120°, each of which has 18 holes at a distance of 6° crank angle.
To recognise the following 'crankshaft segment', the segments are spaced at a distance equal to two missing holes.
The registration of holes in the flywheel takes place via the crankshaft sensor (4).

The injection timing and the desired injection amount are determined by means of the holes due to the crank angle/time conversion.



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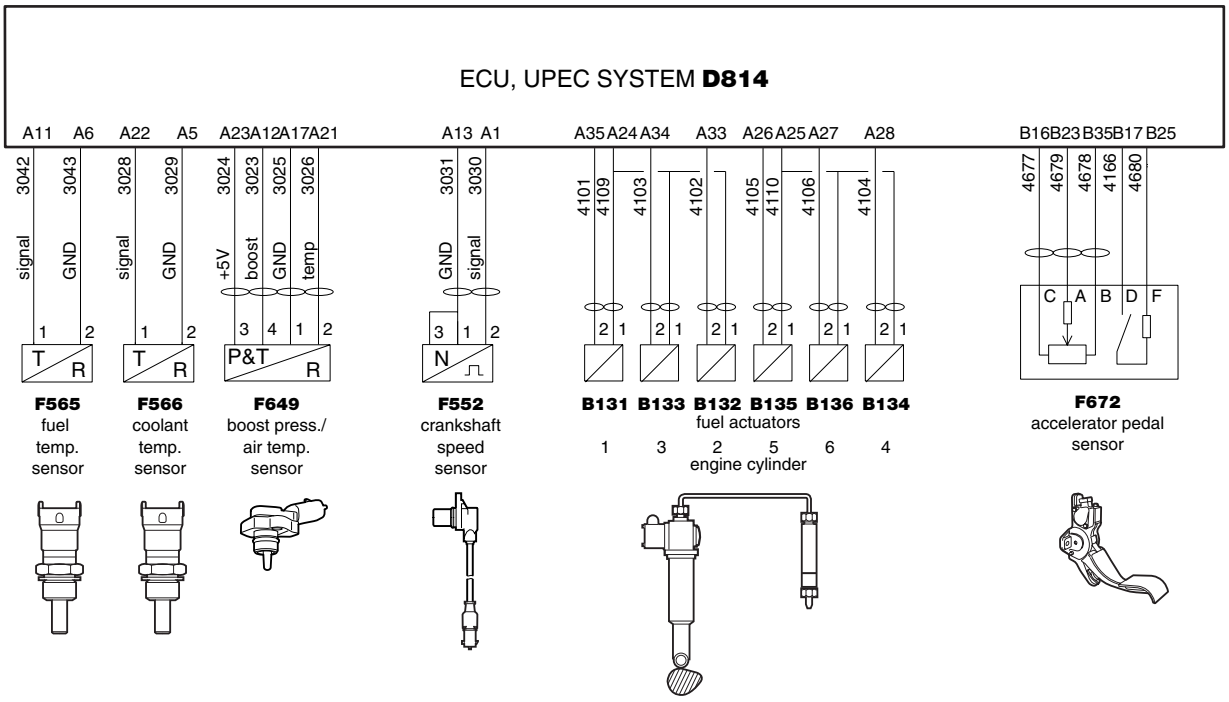
4.3 CONTROL OF THE INJECTION TIMING AND QUANTITY



Depending on the reading of various input signals, the electronic unit (D814) calculates the desired injection timing and the desired injection quantity. In this regard, the starting point is to reduce the emission of harmful gases (NOx and HC) as much as possible.
NOx will increase if the injection timing is brought forward too much.
HC will increase if the injection timing is delayed.

The following overview shows broadly which factors have an influence on the injection timing and quantity.

The injection timing is dependent on:

- engine speed in combination with the desired injection quantity

These two factors determine the injection timing by means of a map.

- coolant temperature.
  The injection timing during starting is determined by the current coolant temperature.
- inlet air temperature in combination with coolant temperature.
  These two factors determine the injection timing by means of a map to reduce white smoke development.

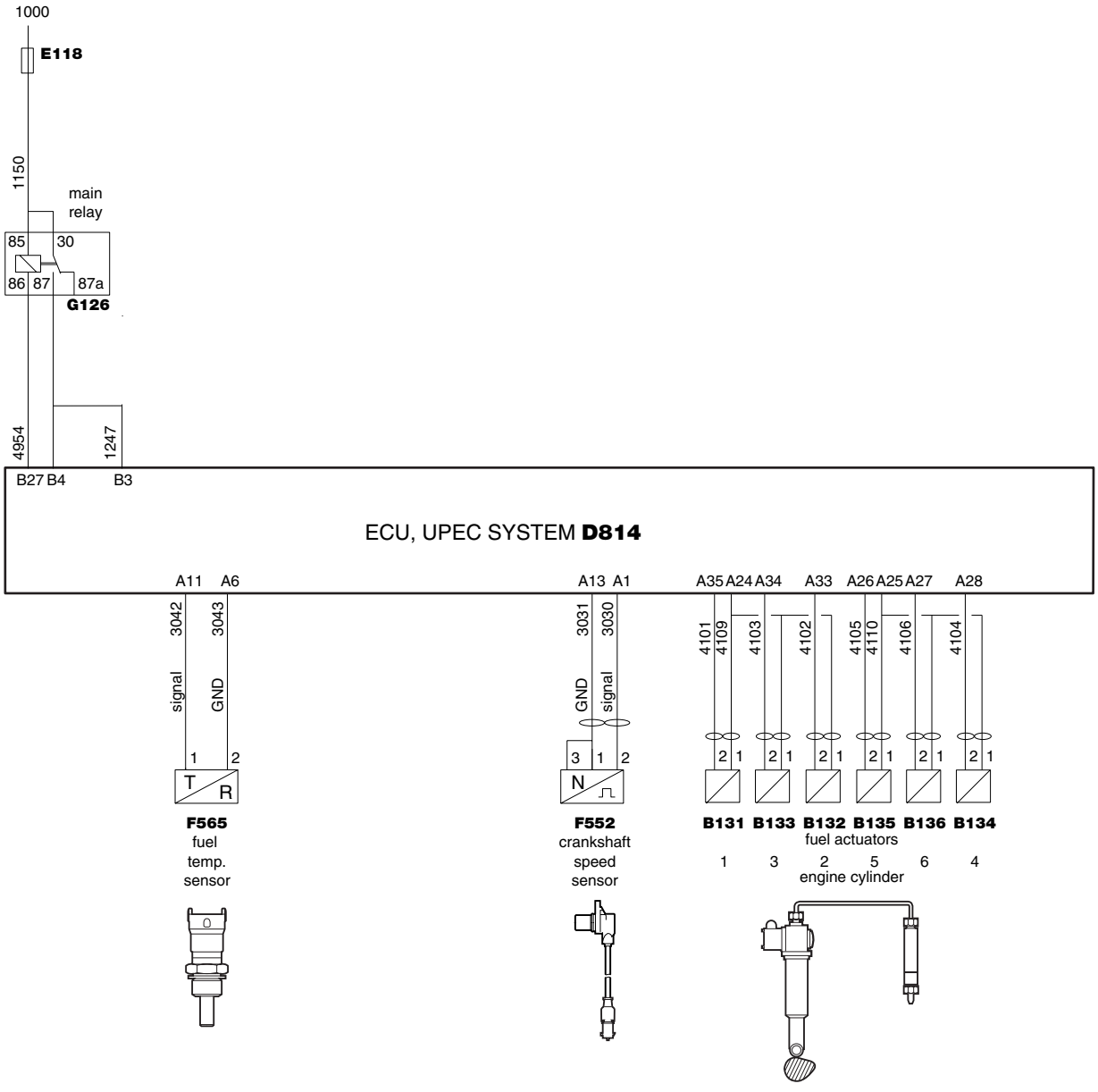
The injection quantity is dependent on:

- engine speed in combination with coolant temperature.
  These two factors determine the quantity of fuel to be injected during starting.
- position of the accelerator pedal.
  The position of the accelerator pedal sensor determines the required output and therefore the quantity of fuel to be injected.

  Note:
  Under the influence of various control functions, the quantity of fuel to be injected can be corrected by the unit.

- fuel temperature.
  If the fuel temperature is low, the density of the fuel will increase.
  To compensate for this, the quantity of fuel to be injected will be reduced at low temperatures.
- coolant temperature.
  At too high a temperature, the quantity of fuel to be injected is reduced to protect the engine.
- boost pressure in combination with inlet air temperature.
  These two factors determine the quantity of fuel to be injected in relation to the smoke limiting function.
- atmospheric pressure.
  At a low atmospheric pressure the quantity of fuel to be injected is reduced to prevent too high a turbocharger speed.

4.4 SOLENOID VALVE ENERGISING TIMING CORRECTION



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In the pump unit there is a valve that closes or opens the connection between the high pressure part and the fuel return connection.
A certain time is required to close the connection between the high pressure part and the fuel return connection.

This time is dependent on the production tolerances of the valve and the solenoid valve in the pump units, the engine speed (F552), the battery voltage and the fuel temperature (F565). For this reason, there is a solenoid valve energising timing correction in the electronic unit (D814).

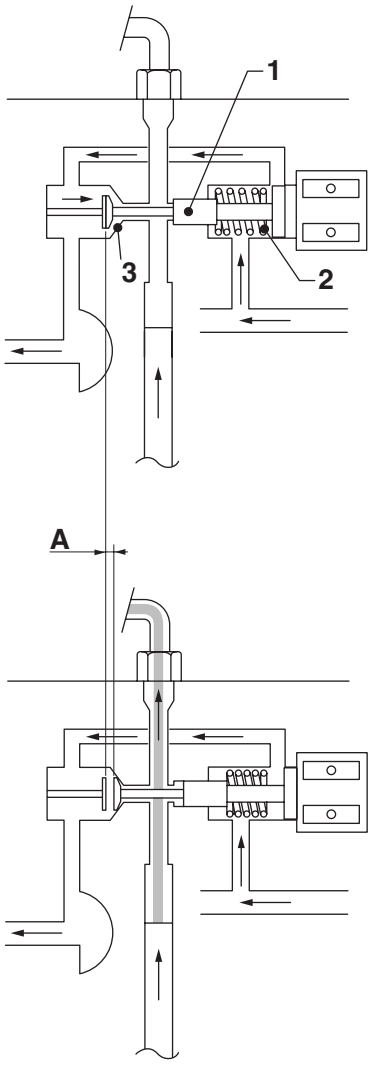
The electrical solenoid valve energising timing is corrected dynamically by this control, whereby the fixed value for the injection timing in the injection timing map can be obtained at all times.

If the solenoid valve is energised, the valve (1), under the influence of the magnetic field, will press against the ball-shaped locking surface (3), against the pressure of the spring (2).
The time required for bridging distance A is not only dependent on the production tolerances of the valve and solenoid valve, but also on battery voltage, fuel temperature and engine speed.

Battery voltage
A drop in battery voltage (for example when starting) alters the build-up of the magnetic field, increasing the time before distance A is bridged.

Fuel temperature
At a lower temperature the fuel has a higher viscosity, increasing the time before distance A is bridged.

Engine speed
At higher engine speeds, there will be a higher dynamic movement of fuel.
Due to the pressure pulses, it will be longer before distance A is bridged.



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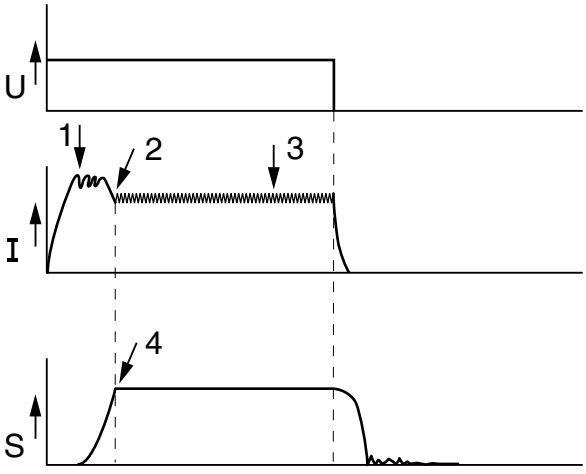
Explanation of graph

1. Solenoid valve pick-up current.
2. Valve stop recognition against tapered locking surface. This position is recognised by the electronic unit, as a self-induction change occurs as a result of the air gap becoming smaller between the back plate and magnet core.
3. Solenoid valve holding current.
4. Valve is closed.



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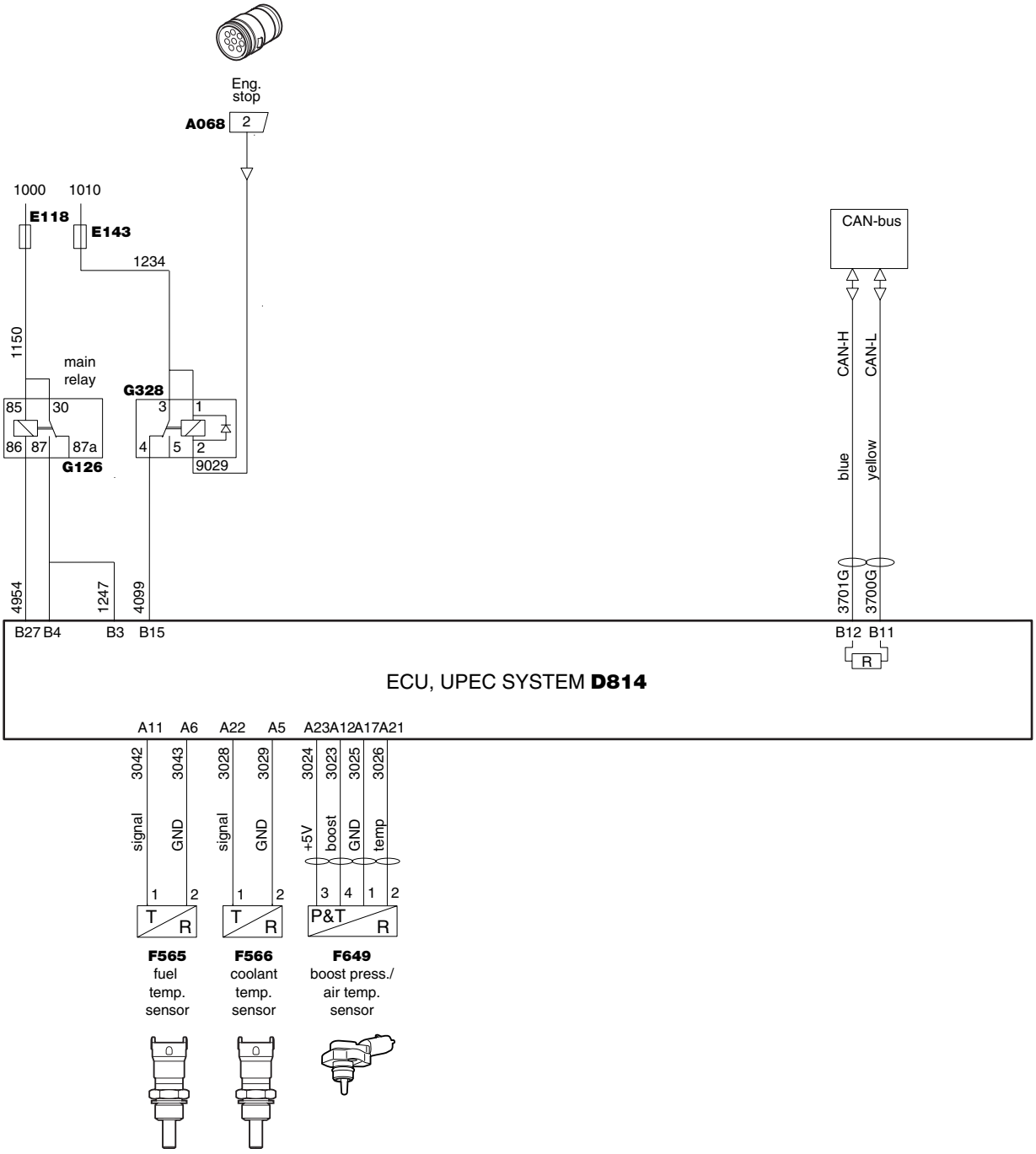
4.5 SWITCHING THE CONTACT ON/OFF



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Switching the contact on
If contact is switched on, there is input voltage on connection point B15.

Note:
The type of voltage supply to connection point B15 depends on the vehicle production date.

If there is an input voltage on connection point B15, a self-test is first carried out, after which the relay (G126) is activated.
Before activation of the relay (G126), connection point B27 is switched to earth via the electronic unit (D814).
If relay (G126) has been activated, there is a power supply to B3 and B4.
If there is a power supply to connection points B3 and B4, the various sensors are provided with power.
This self-test is a checking and processing of the various sensor readings, including those concerning the calculation of the start output, the duration of pre-glowing and after-glowing, injection timing, etc.
Furthermore, the unit will communicate, via the CAN connection, with the immobiliser to enable the supply of fuel.

Switching the contact off
If the contact is switched off, the voltage is removed from point B15.
There is now a transfer of stored faults from erasable memory to fixed memory.
After this, connection point B27 is no longer connected to earth, so that the relay (G126) is not activated.
Voltage is now removed from B3 and B4.

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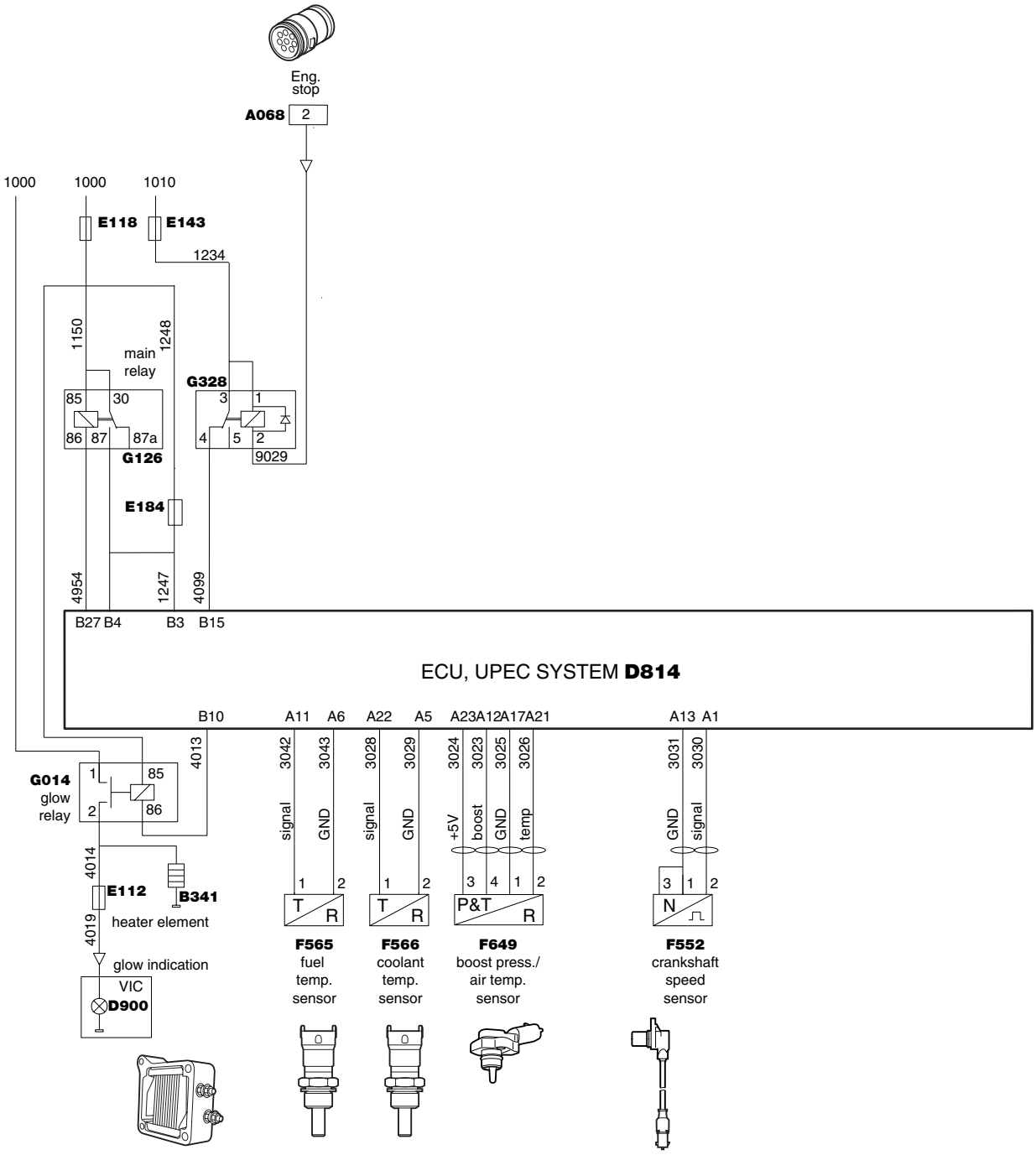
4.6 PRE-GLOWING AND AFTER-GLOWING



i400688

The electronic unit (D814) determines the necessary pre-glowing and after-glowing times automatically with reference to various input signals from the temperature sensors.
When the contact is switched on, the fuel temperature (F565), the inlet air temperature (F649) and the coolant temperature (F566) are measured.

The lowest measured temperature reading determines the pre-glowing and after-glowing times.

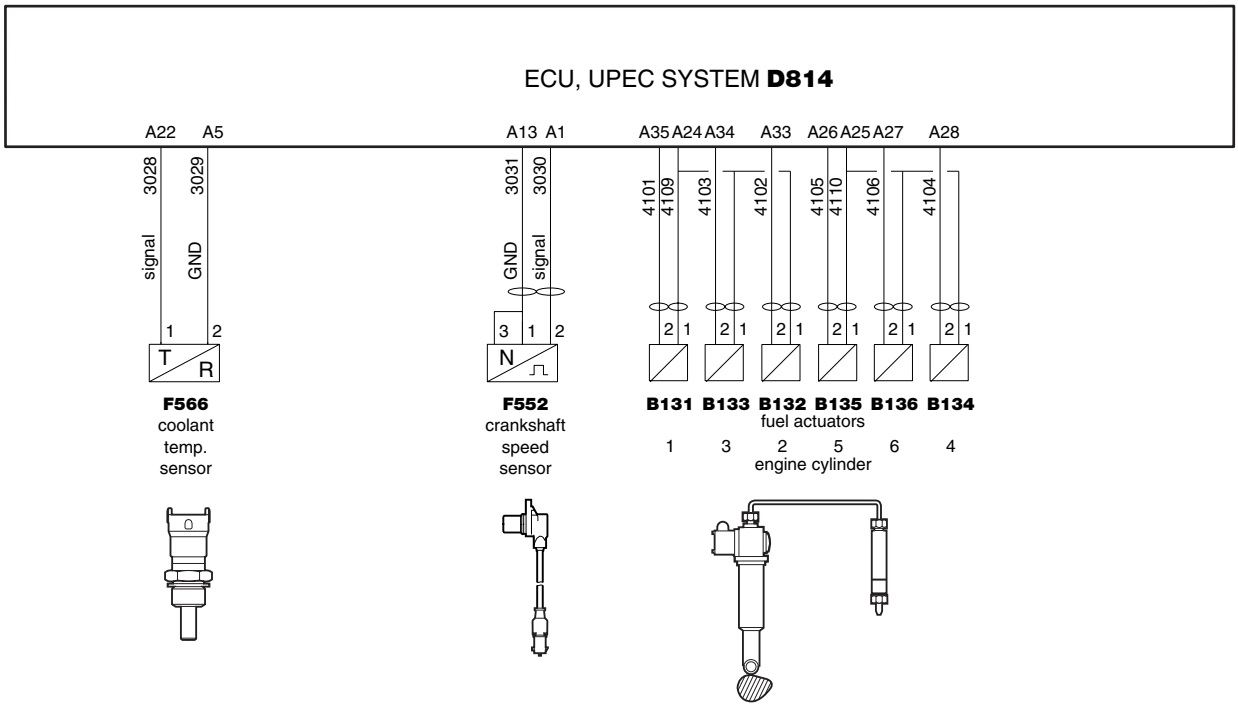
Conditions for the pre-glowing function
The pre-glowing function is only active if:
1. the battery voltage is higher than 15 V.
2. the measured temperature is lower than a pre-programmed value for activating the pre-glowing function in the electronic unit.
3. there is no engine speed signal (pre-glowing function is switched off when the electronic unit registers an engine speed signal).

   Note:
   During the period in which the engine is still turned by the starter motor, the pre-glowing function remains active.

Conditions for the after-glowing function
The after-glowing function is only active if:
1. the battery voltage is higher than 15 V.
2. the measured temperature is lower than a pre-programmed value for activating the after-glowing function in the electronic unit.
3. there is an engine speed signal.

If the glow function must be active, connection point B10 of the electronic unit is switched to earth.
As a result, relay (G014) is activated.

4.7 START OUTPUT



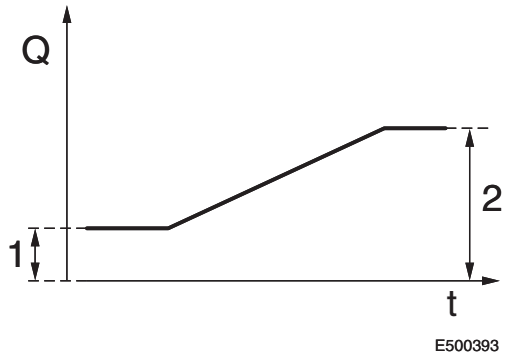
i400453

To allow the engine to be started quickly under all circumstances and with as little white smoke development as possible, the start output is calculated by the electronic unit (D814).

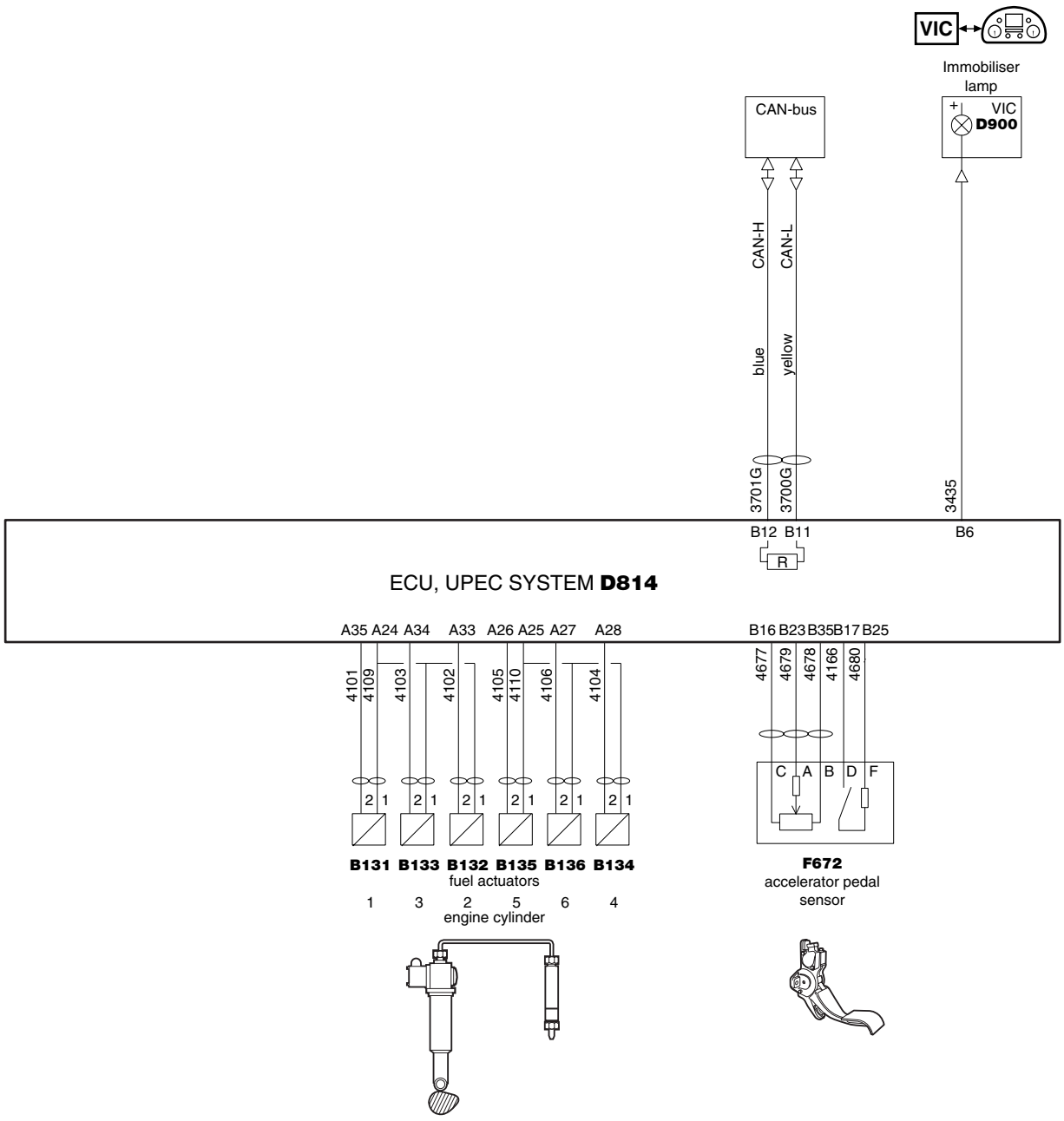
The quantity of fuel to be injected during starting is calculated on the basis of:
- coolant temperature (F566).
- engine speed (F552).
  The temperature determines the initial start output.
  When the engine speed increases, the fuel injection quantity decreases.
- start time
  After a certain time, the quantity of fuel injected increases.

In addition, the injection timing is brought forward to limit white smoke development.

Explanation of start output graph
The initial start output (1) depends on the coolant temperature.
If the engine does not start straight away, the quantity of fuel injected is gradually increased after a certain time until a maximum quantity (2) has been reached.
The maximum quantity of fuel injected during starting is limited by the coolant temperature.



4.8 CONTROL OF FUEL SUPPLY



As soon as the contact has been switched on, the identification procedure between immobiliser and contact key is started.
During this identification procedure between the immobiliser and the contact key, a second identification procedure is started between the UPEC electronic unit and the immobiliser via the CAN connection.

Once the code has been approved, the UPEC electronic unit will continually supply fuel.
If the identification codes do not match, or in the event of a failure in the CAN connection, the pump units are no longer activated by the electronic unit and an error message will be activated on the DIP display.
The UPEC electronic unit also activates the stop indicator on the instrument panel with a particular frequency.
The stop lamp is activated via connection point B6, which is connected to the VIC.

Note:
From UPEC version 6.4 the option to activate the stop indicator with a particular frequency is no longer used in the event of an immobiliser failure.

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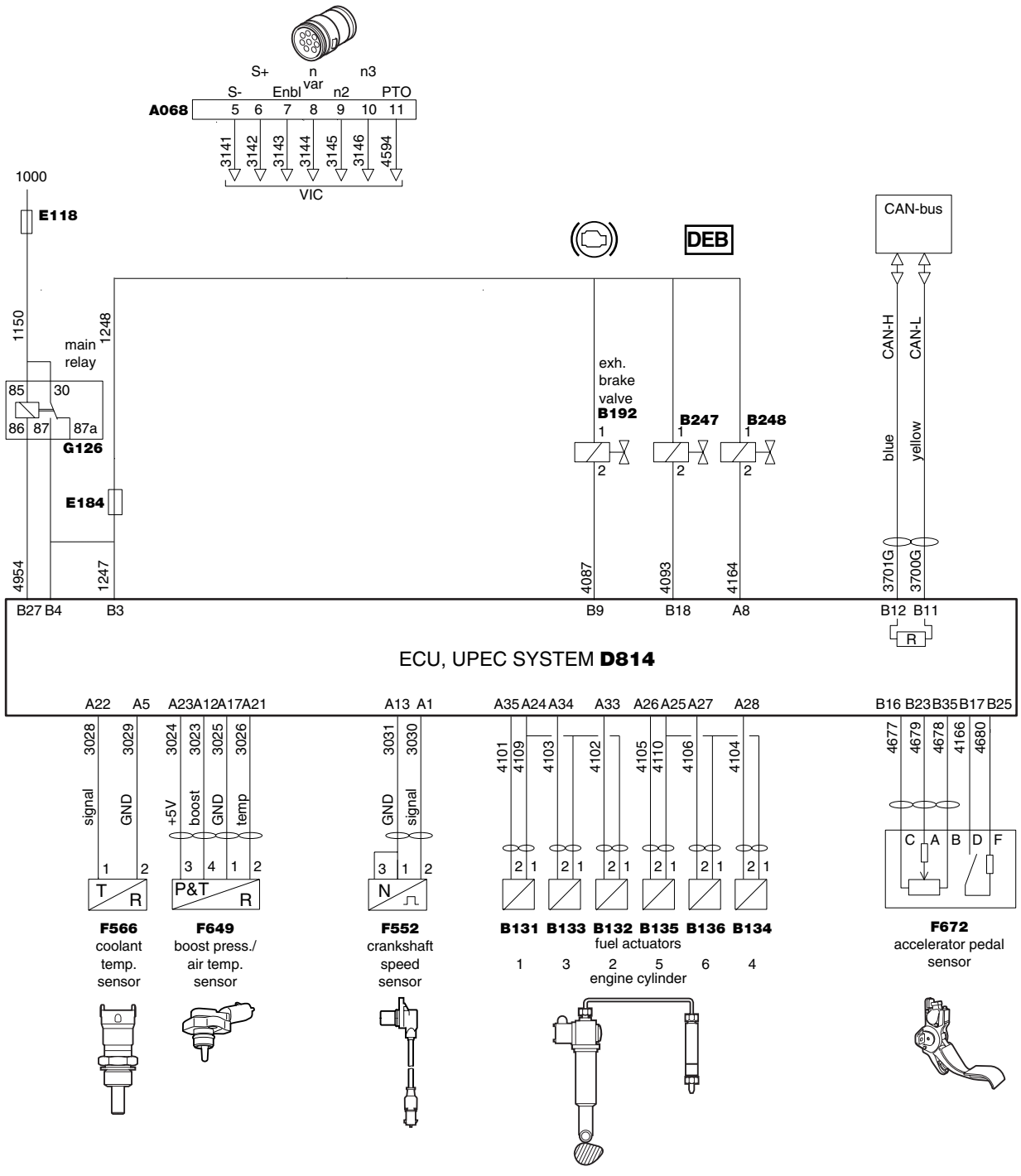
4.9 CONTROL VIA CAN NETWORK



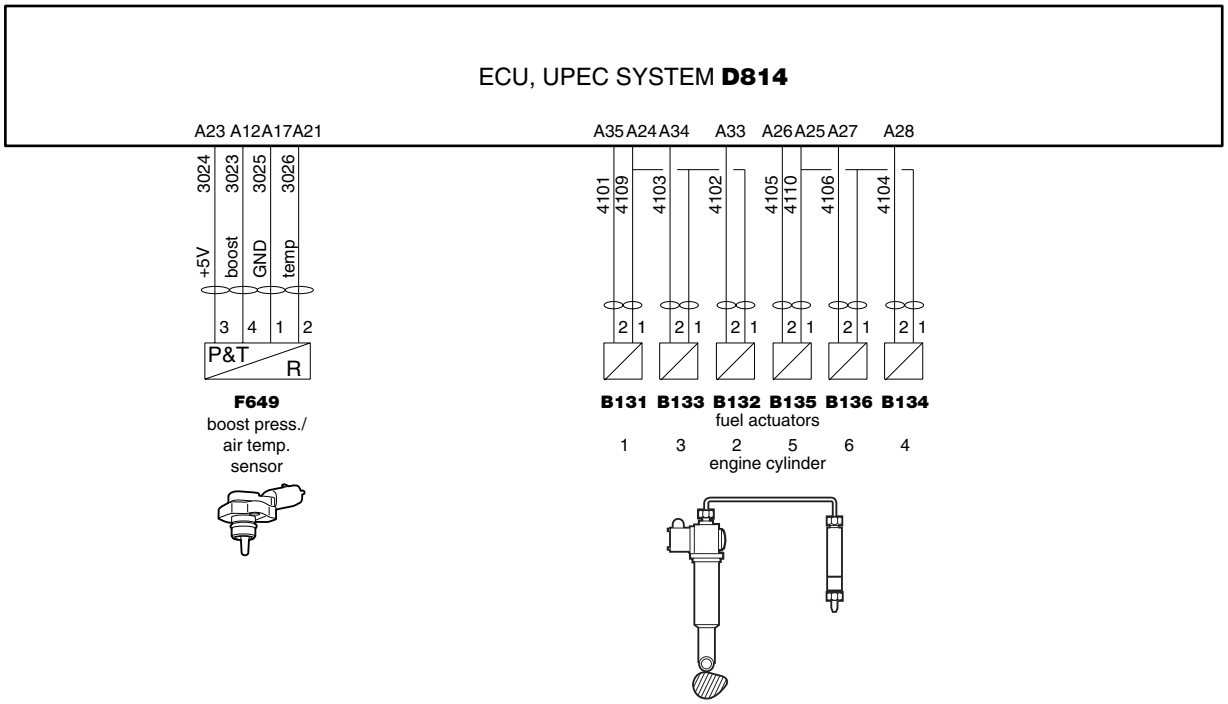
i400689-2

The UPEC electronic unit communicates with other electronic vehicle systems via the CAN connection on points B11 and B12.
An exchange of data can take place via this connection, so that other electronic systems can interface with UPEC control functions or make use of UPEC data for their own control functions.

Information that the UPEC unit receives concerns the following, among other things:
- request to switch off the engine brake function if the ABS or VSC control is active.
- request to reduce engine output if the ASR or VSC control is active.
- request to switch off cruise control when ASR is active
- request to activate the engine brake if the coolant temperature is too high or if the braking force is insufficient when the intarder is in V-constant function.
- request to activate engine brake during an EBS deceleration control.
- request to activate the PTO/engine speed control.
- request to switch off the engine brake function if the automatic gearbox lock-up is switched off.
- immobiliser identification code for permanent release of fuel.
- request to "accelerate" during an EBS drag torque control.
- request to switch off accelerator pedal function during an active clutch protection control.

Information sent by the UPEC unit includes:
- information regarding the coolant temperature.
- information about the engine speed.
- information about the engine torque delivered.
- information about the chassis number relating to inspection of the chassis number.
- information about the measured boost pressure.
- information about the fuel consumption.
- information regarding a fault in the UPEC system.
- information about the position of the accelerator pedal.
- information regarding whether or not the engine brake is active.
- information about the position of the parking brake.
- information about the position of the clutch pedal.
- information about the engine brake torque that can be delivered by the engine in relation to the engine speed.

4.10 SMOKE LIMITING

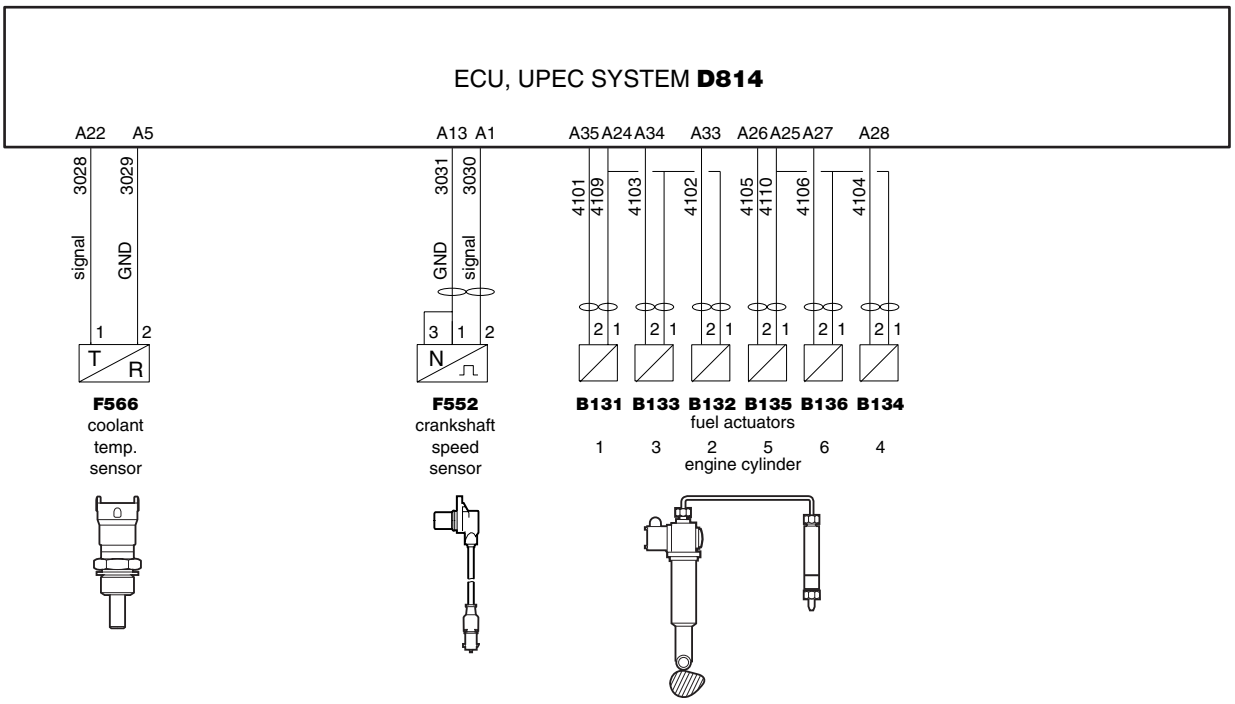


i400690

If more fuel is injected than necessary, the emission of soot will increase.
The point at which the soot emission starts increasing is the smoke limit.

As soon as the smoke limit is reached, the quantity of injected fuel is limited.
The range of limiting the quantity of injected fuel is determined by the boost pressure in combination with the measured inlet air temperature. Both are measured by the inlet air boost pressure and temperature sensor (F649).

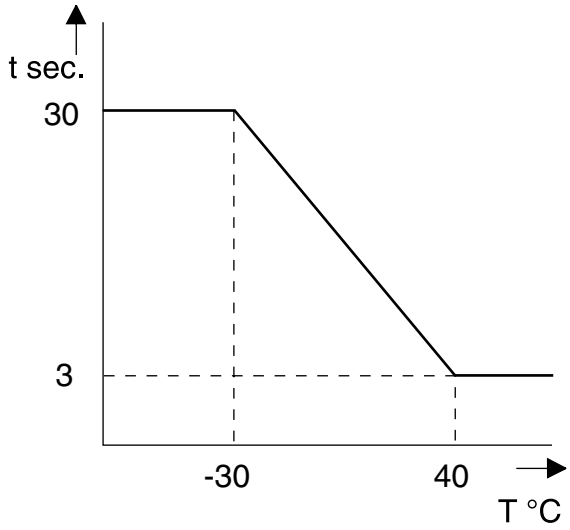
4.11 MAXIMUM ENGINE SPEED CONTROL



i400459

When the maximum engine speed is reached, the quantity of injected fuel is adjusted so that, under normal operating conditions, the maximum engine speed is not exceeded.

To prevent extra engine wear, the maximum engine speed after starting the engine is limited for a certain time to 1500 rpm.
This time depends on the coolant temperature (see graph).



E500386

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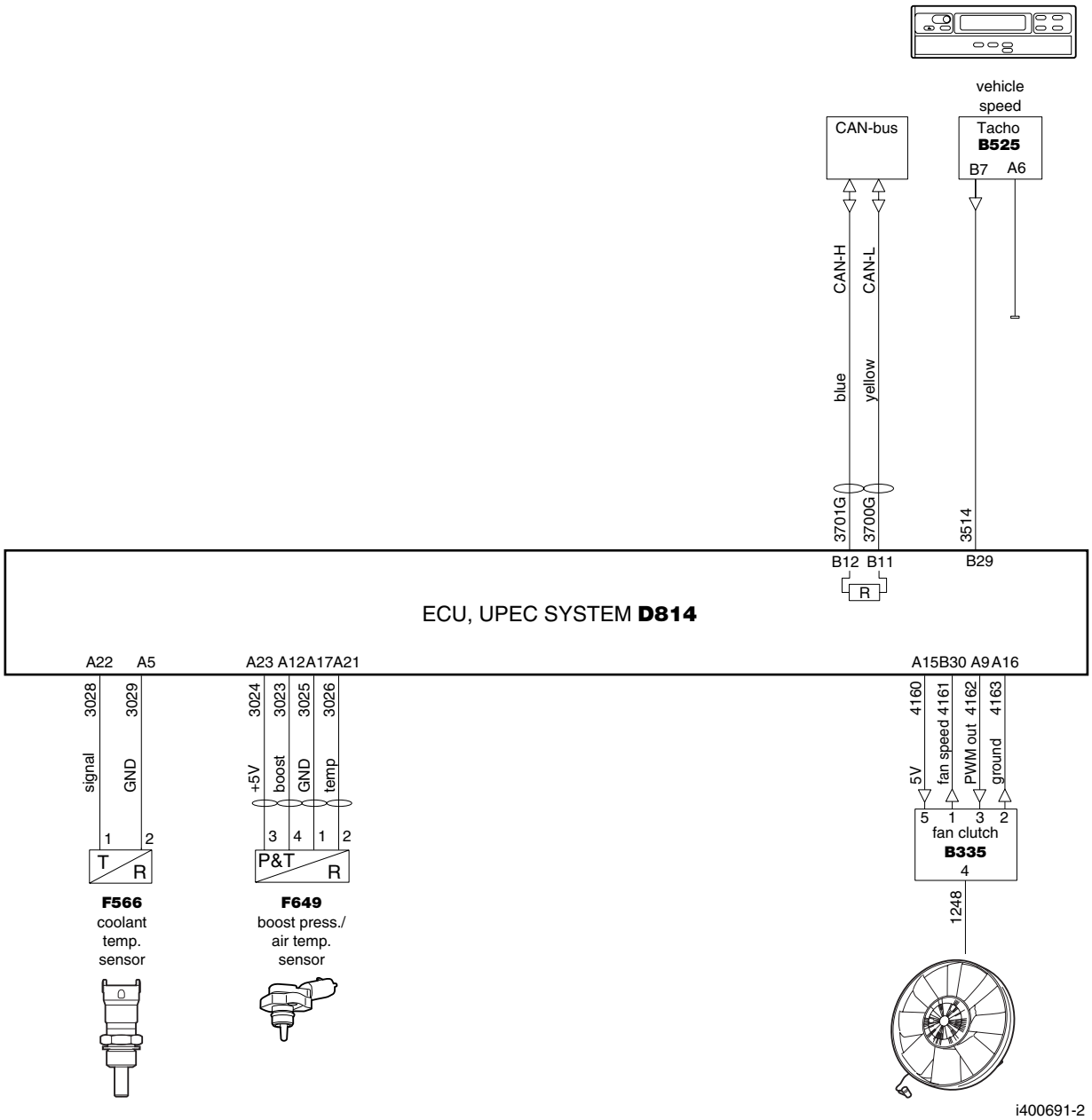
4.12 FAN SPEED CONTROL



An electronically controlled fan clutch (B335) is used with the cooling system.
Use of this fan clutch enables exact control of the fan speed.
The UPEC electronic unit (D814) checks and controls the fan speed with the aim of guaranteeing a sufficiently large cooling air flow throughout the cooling system and keeping the coolant temperature and/or inlet air temperature within certain limits.

The fan speed is controlled via a duty cycle (PWM signal) on connection point A9.
A low duty cycle reading results in the fan speed being adjusted to a high value.

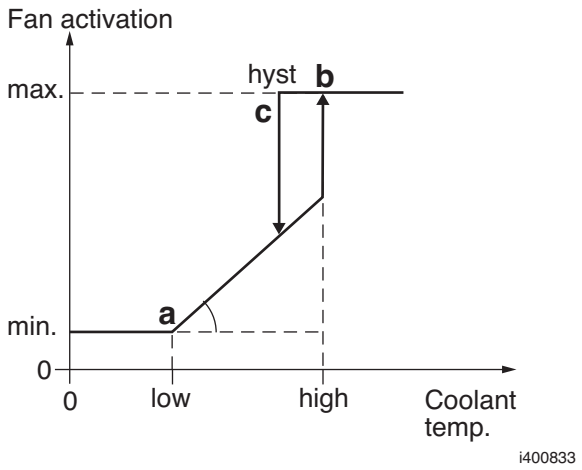
A high duty cycle reading results in the fan speed being adjusted to a low value.

The UPEC electronic unit gets feedback from the fan speed via a sensor that is connected to connection point B30.

Note:
The fan always runs at high speed for a specific period after the engine is started. This is because some of the silicone fluid has settled and is in the working chamber. If the silicone fluid is cold as well, the fan will run at high speed for some time.

The adjusted fan speed depends on a number of factors such as:
1. coolant temperature;
2. inlet air temperature;
3. activation of retarder;
4. ;vehicle speed
5. internal slip protection.

Coolant temperature
From a specific coolant temperature (a), the minimum actuation of the fan clutch increases evenly with the coolant temperature. When a specific higher coolant temperature (b) is reached, the fan clutch is immediately actuated to maximum. If the coolant temperature drops again following this, actuation stays maximum until a specific lower coolant temperature (c) is reached and then decreases again evenly as the coolant temperature decreases.



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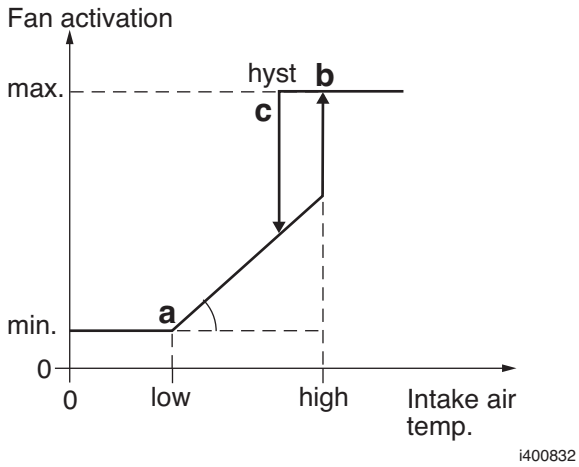
Inlet air temperature
From a specific inlet air temperature (a), the minimum actuation of the fan clutch increases evenly with the inlet air temperature. When a specific higher inlet air temperature (b) is reached, the fan clutch is immediately actuated to maximum. If the inlet air temperature drops again following this, actuation stays maximum until a specific lower inlet air temperature (c) is reached and then decreases again evenly as the inlet air temperature decreases.

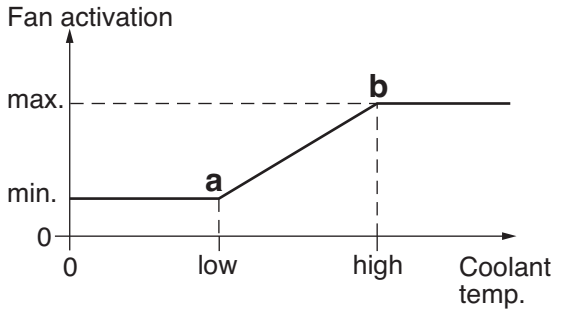


i400832

Activation of retarder
Two controls are used during activation of the retarder. A control that activates a time delay to control the fan clutch and a control that activates the fan clutch depending on the requested intarder braking power.

- **Intarder braking power**

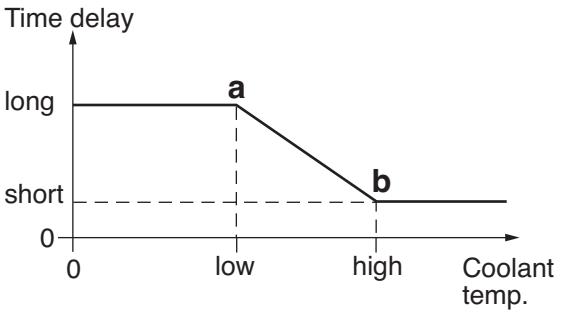
If the required braking power of the intarder is higher than a specific value, the intarder electronic unit will actuate the UPEC electronic unit to activate the fan clutch. This is to prevent excessive temperatures. The electronic unit will only increase actuation of the fan clutch above a specified low coolant temperature (a). Above a specified high temperature (b), the fan clutch is actuated to maximum.



i400834

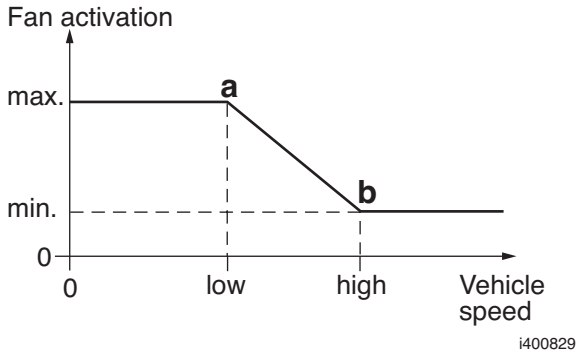
- **Time delay**

Depending on the current coolant temperature at the time the intarder is activated, the fan clutch is switched on either with or without a delay. If the coolant temperature is low, the fan clutch will only be activated after a few seconds (a). If the coolant temperature is high, the fan clutch will be activated with a short delay (b).

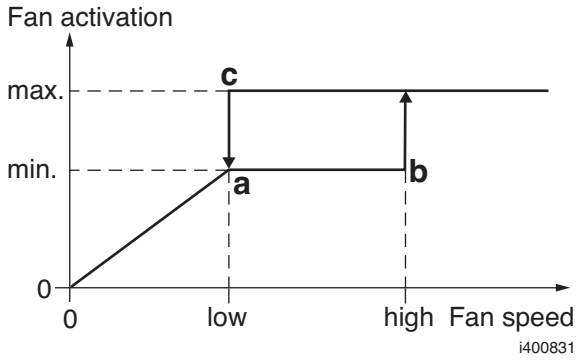


i400830

Vehicle speed
When the vehicle speed is low, there is little cooling from the air stream. Making activation of the fan clutch dependent on vehicle speed prevents the coolant temperature in the engine rising too rapidly. If the vehicle is stationary or is driving at low speed, the fan clutch will be activated with a high fan speed. Up to a specific vehicle speed (a), the fan speed will remain high and will then gradually decrease to a specific minimum fan speed at a specific higher vehicle speed (b).



Internal slip protection
If the engine speed is high (> 2000 rpm) and the fan clutch speed is low, the viscous fluid may burn as a result of internal slip. In order to protect the viscous fluid from excessive temperatures, a specific speed range of the fan clutch is not used. If a fan speed (a) is reached at which there is the risk of the viscous fluid overheating, the fan clutch will not be actuated further. Only when a specific required speed (b) is reached will actuation increase to a maximum value. This means that the calculated required speed between a and b is not used. When the fan clutch actuation is maximum, the slip is minimum and the fan speed is maximum. If the required fan speed drops again, the fan clutch actuation stays maximum until a specific required speed (c) is reached, at which point actuation drops to level (a).



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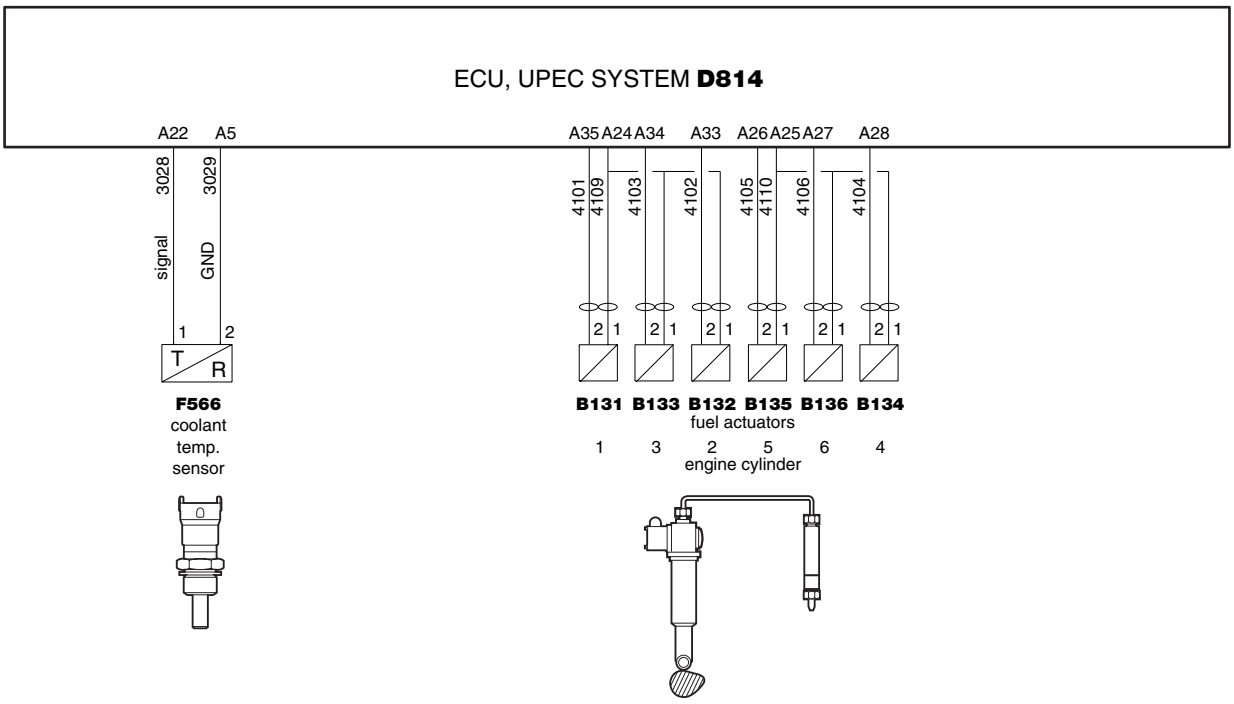
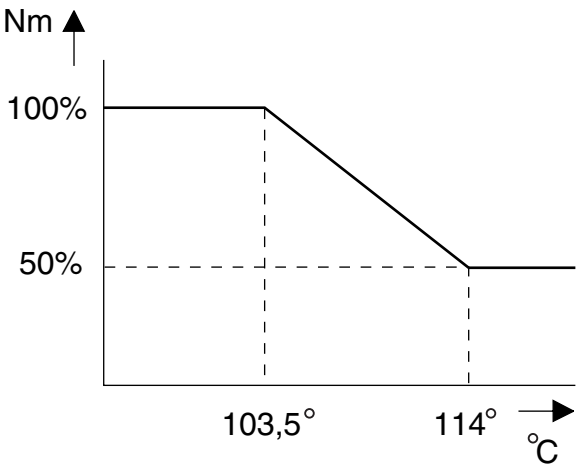
4.13 COOLANT OVERHEATING SAFEGUARD



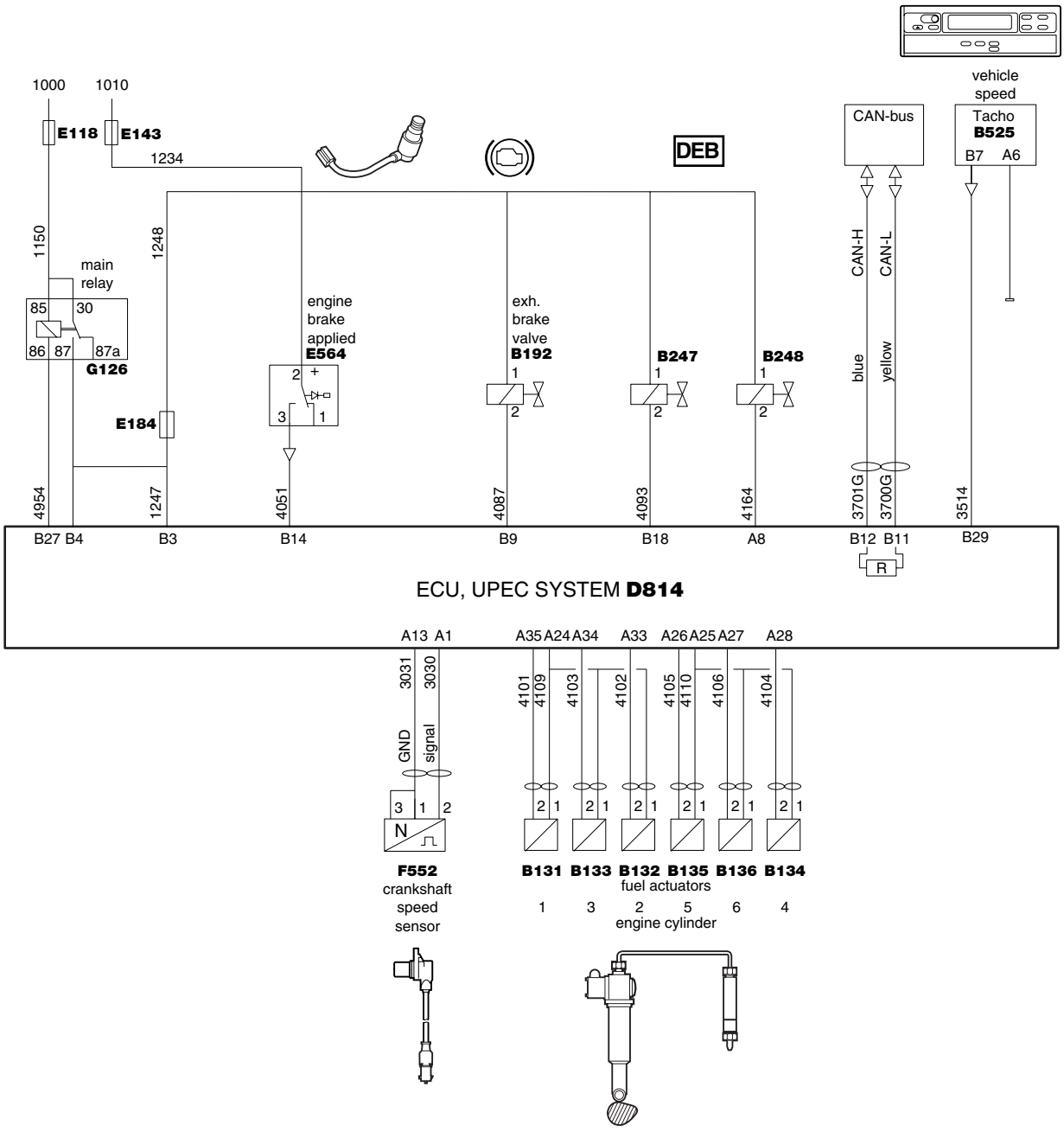
i400460

The coolant temperature is measured via the coolant temperature sensor (F566).
At too high a coolant temperature, there is an adjustment of the maximum torque (quantity of fuel injected).



i400461

4.14 ACTIVATION OF THE ENGINE BRAKE



i400462-2

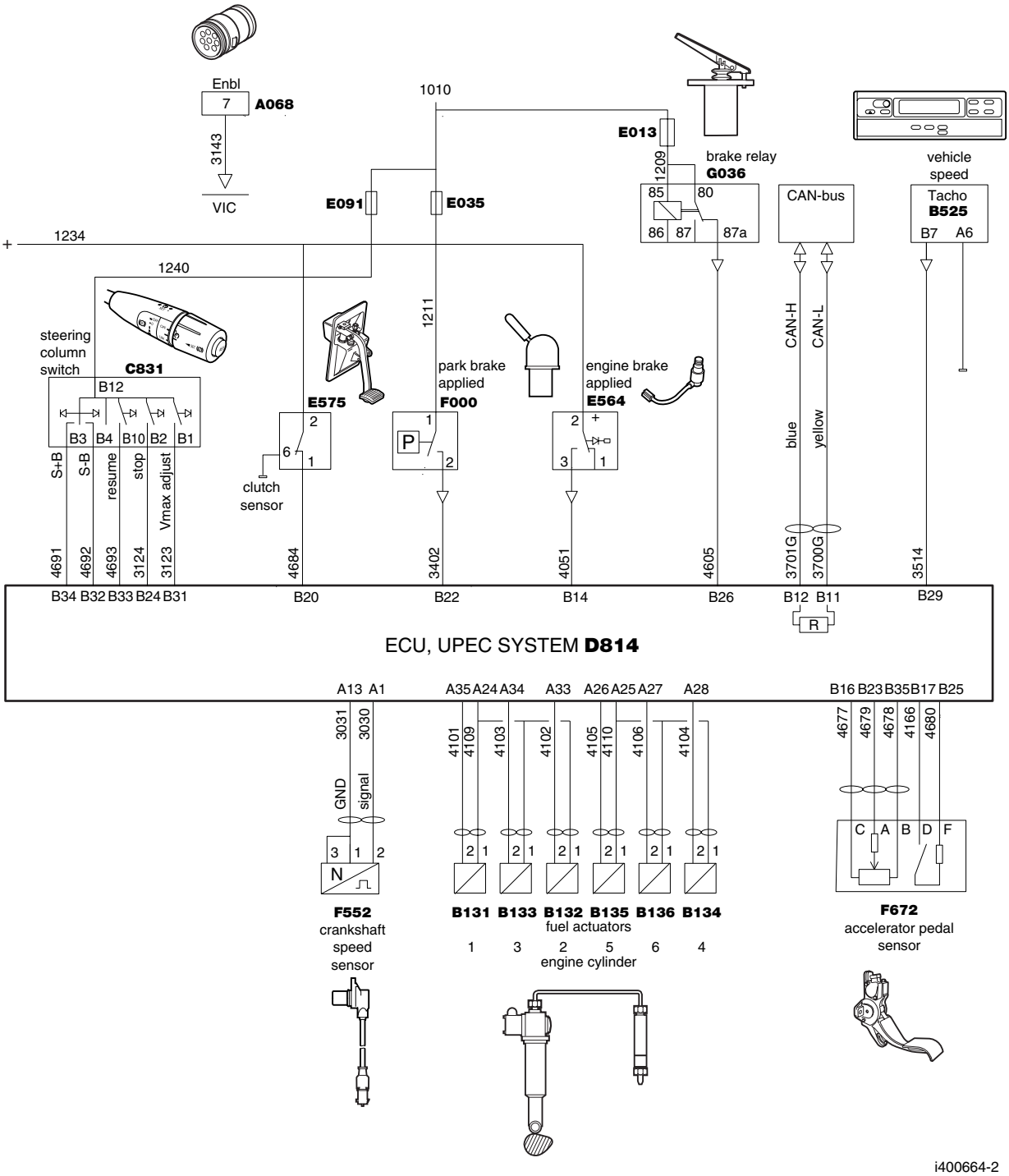
The engine brake consists of an exhaust brake and the DEB, if fitted.
If the engine brake switch (E564) is operated, there is an input signal on connection point B14 of the electronic unit (D814).
If the conditions are met, connection point B9 is switched to earth before activation of the exhaust brake valve (B192) and, if DEB is used, connection points B18 and A8 will be switched to earth to activate the DEB.

If the exhaust brake/DEB is activated, no more fuel is injected until idling speed is reached. At that moment, the electronic unit energises the pump units so that the quantity of fuel injected corresponds to the no-load position of the accelerator pedal.

Conditions for activating the engine brake
Connection points B9, B18 and A8 will be switched to earth if the engine speed is higher than or equal to 1000 rpm **and** the vehicle speed is higher than 3.5 km/h.
When connection points B9, B18 and A8 are switched to earth, this earth connection is broken again at an engine speed lower than 800 rpm **or** a vehicle speed lower than 3 km/h.

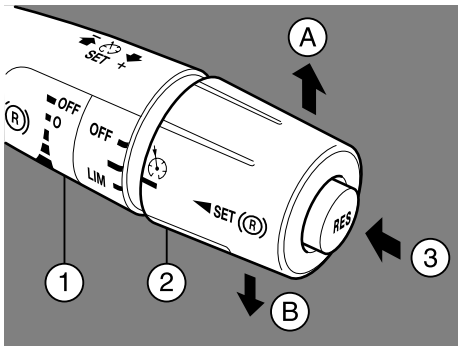
Note:
1. If the engine brake switch (E564) is pressed without the conditions having been met, connection points B9, B18 and A8 are not switched to earth.
   In this situation, the electronic unit activates the pump units so that the quantity of fuel injected corresponds to the no-load position of the accelerator pedal.
2. Connection points B9, B18 and A8 are no longer switched to earth if the UPEC electronic unit (D814) has received the message via the CAN connection that the engine brake must be switched off.
3. Via the CAN connection, the UPEC electronic unit (D814) of the intarder or the EBS system can receive the message that the engine brake must be activated.

4.15 ENGINE SPEED CONTROL USING STEERING COLUMN SWITCH



The engine speed control can be activated in two ways with the steering column switch (C831). These are:

1. by pressing the "RES" button (3).
2. by moving the steering column switch (1) briefly in the A (set+) direction once.



D000450

Activation with "RES" button on the steering column switch
By pressing the "RES" button (3), input voltage is applied to connection point B33 of the electronic unit (D814).
At that moment, the engine speed is increased to a value pre-programmed in the electronic unit (ex factory 1200 rpm).

Note:
The pre-programmed value in the electronic unit can be changed using DAVIE.

Activation with "set+" function on the steering column switch
By moving the steering column switch (1) in direction A (set+), the engine speed control can only be activated if the current engine speed is higher than or equal to the pre-programmed value in the electronic unit.

Note:
The pre-programmed value in the electronic unit is the minimum achievable engine speed when the engine speed control function is active.
This value can be changed using DAVIE.

If this condition has been met, a vertical movement of the steering column switch (input voltage on connection point B34) will activate the engine speed control. This will increase the engine speed.

Increasing or decreasing the engine speed
When the engine speed control function has been activated, the engine speed can be reduced by moving the steering column switch in direction B (set-).
In this direction, there is an input voltage on connection point B32.
By moving the steering column switch in direction A (set+), the engine speed will be increased.
In this direction, there is an input voltage on connection point B34.

The minimum and maximum achievable engine speed settings are determined by a value pre-programmed in the electronic unit.

Note:
The pre-programmed value in the electronic unit can be changed using DAVIE.

Conditions for activating the engine speed control function
Depending on the parameters programmed in the electronic unit with DAVIE, activation of the engine speed control function will be possible if one of several possible conditions is met.

Note:
If the vehicle has an AS Tronic gearbox, the parking bake must be engaged and the gearbox must be in neutral before the engine speed control function can be activated.

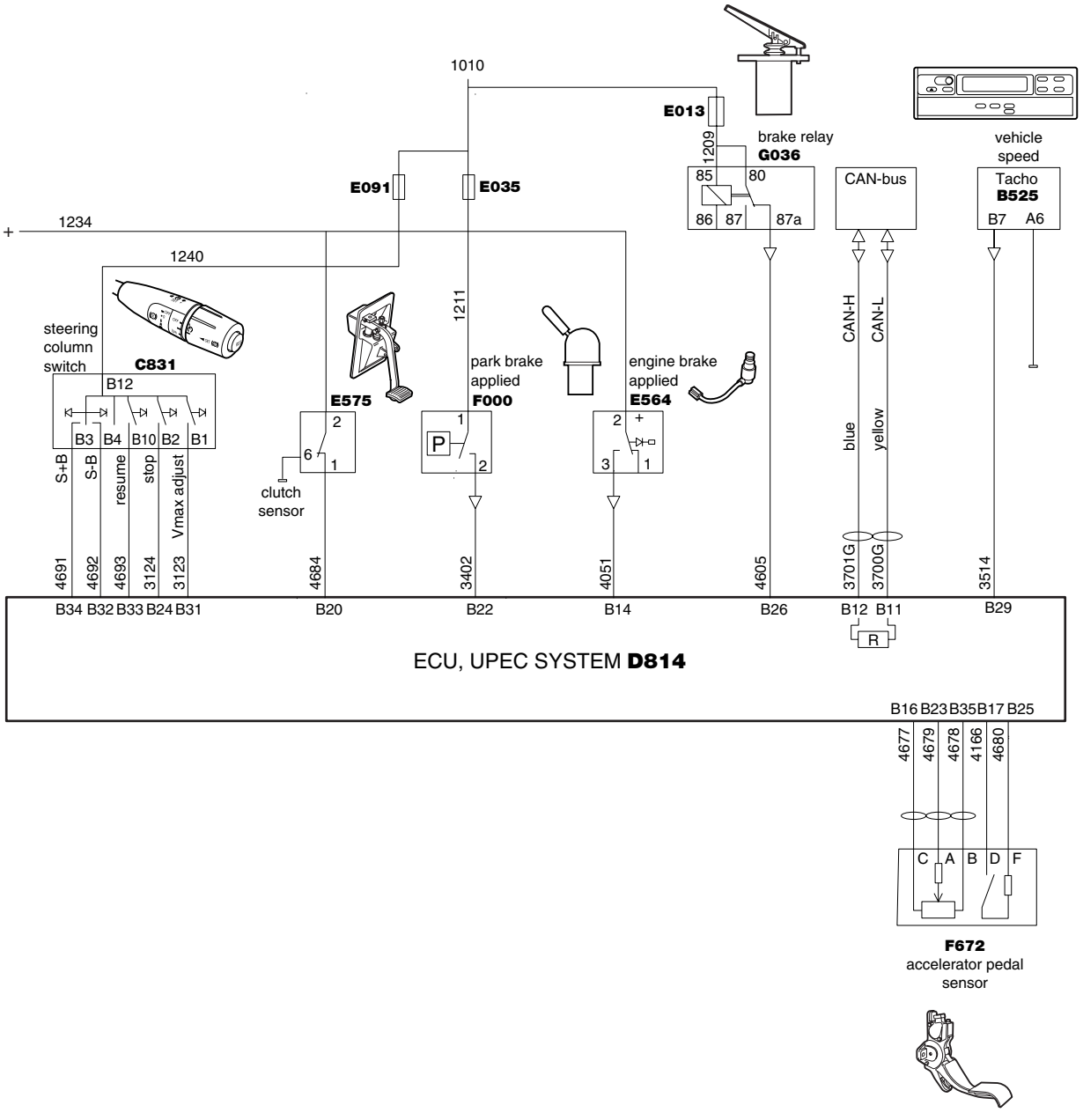
In addition, it is possible to drive the vehicle while the engine speed control function is active. This, of course, depends on the programmed conditions.
The maximum vehicle speed is now limited by a value pre-programmed in the electronic unit (ex factory 9 km/h).

Note:
The pre-programmed value in the electronic unit can be changed using DAVIE to a maximum of 30 km/h. This value may influence the vehicle speed at which the cruise control can be activated.

Deactivation of engine speed control

1. If the rotary switch (2) on the steering column switch is turned to the "OFF" position (input voltage on connection point B24).
2. By engaging the engine brake (input voltage on connection point B14).
3. If the retarder function is active (report via CAN network).
4. If the vehicle is being driven under engine speed control and the vehicle speed is greater than approx. 20 km/h (e.g. when going downhill).
5. If the conditions for activating the engine speed control function are no longer met.
6. If the steering column switch is switched off because the engine speed control function has been released via the application connector (A068).

4.16 CRUISE CONTROL



i400665-2

The cruise control function is activated using the steering column switch (C831).
Cruise control can be activated at speeds higher than a set value. This value may range between 30 and 45 km/h.

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Note:
The value at which the cruise control can be activated depends on the customer parameter programmed as the maximum vehicle speed at which it is possible to drive with the engine speed control function activated.

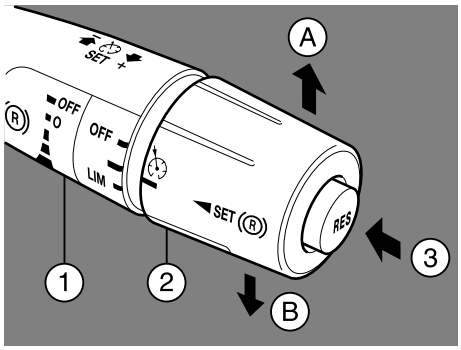
The cruise control is activated by briefly moving the steering column switch in the A (set+) or B (set-) direction once (input voltage on connection point B32 or B34).

When the steering column switch is operated, the current vehicle speed is stored as the desired vehicle speed in the electronic unit and is kept at a constant level by the control system.

Note:
When the cruise control function is engaged, the accelerator pedal function (F672) is still active.

By moving the steering column switch in the A (set+) or B (set-) direction, the desired vehicle speed can be increased or decreased respectively while the cruise control function is active.

By turning the rotary switch (2) on the steering column switch to the "OFF" position (input voltage on connection point B24), the cruise control is switched off.
By operating the "RES" button (3) on the steering column switch (input voltage on connection point B33), cruise control is re-activated at the last set desired vehicle speed.



D000450

Switching off cruise control

1. If the rotary switch (2) on the steering column switch is turned to the "OFF" position (input voltage on connection point B24).
2. By activating the brake light relay (input voltage removed from connection point B26).
3. By activating the engine brake switch (input voltage on connection point B14).
4. If the retarder function is active (report via CAN network).
5. If the vehicle speed (with the cruise control function activated) drops 5 km/h below the speed at which the cruise control can be activated.
6. By activating the parking brake switch (input voltage on connection point B22).
7. If the ASR system is active (message via CAN network).
8. If the clutch is engaged (no input voltage on connection point B20).

   Note:
   If the input signal on connection point B20 is not removed when the clutch is engaged (defective proximity switch), the cruise control will be switched off as the electronic unit will register a quick change in the engine speed in relation to the vehicle speed at that moment.

9. If the rotary switch on the steering column switch is turned to the "LIM" position for activating the variable vehicle speed limitation (input voltage on connection point B31).
10. If there is a vehicle speed deceleration of >2 m/sec^2 (measured on connection point B29).

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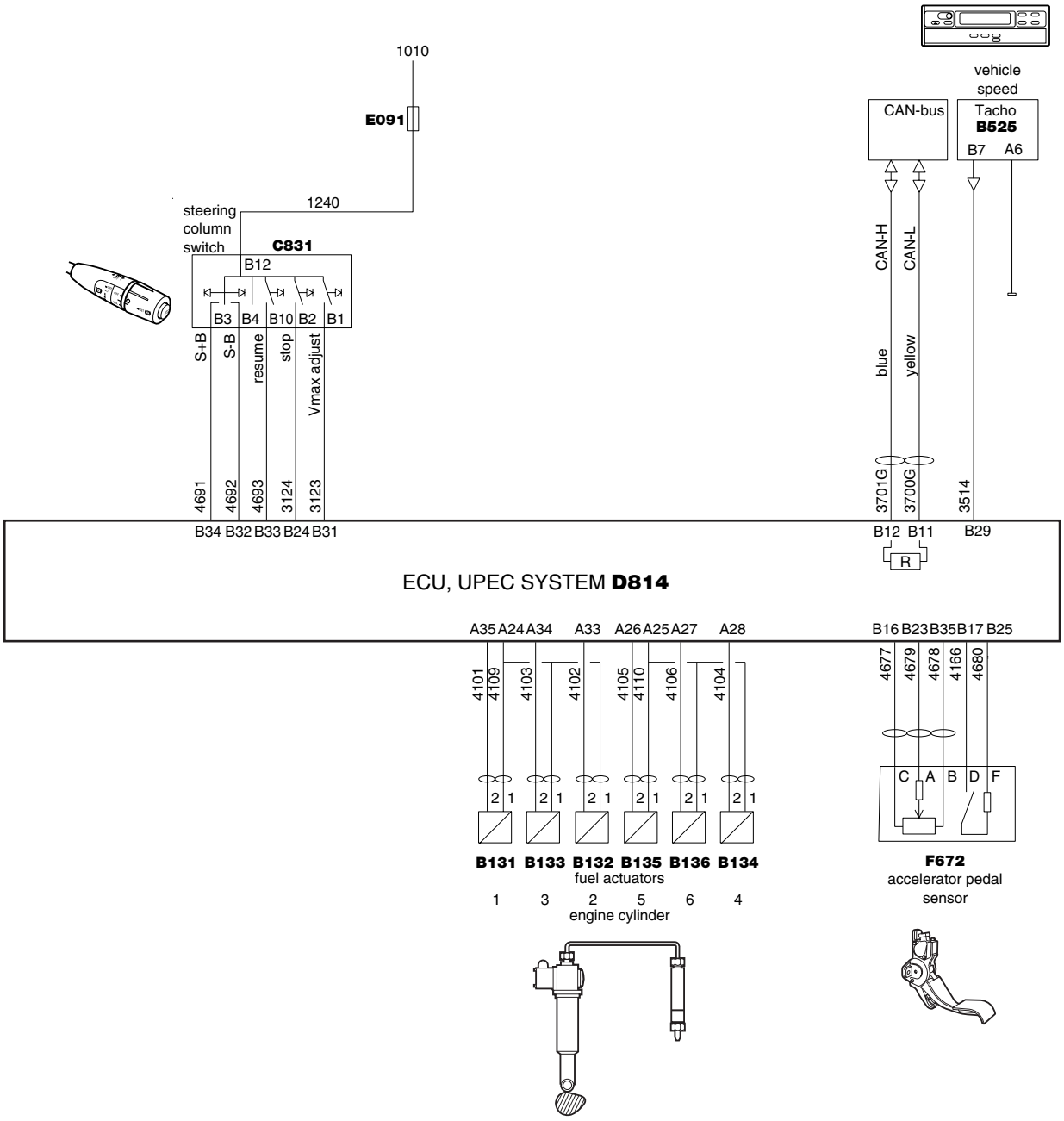
4.17 VEHICLE SPEED LIMITATION

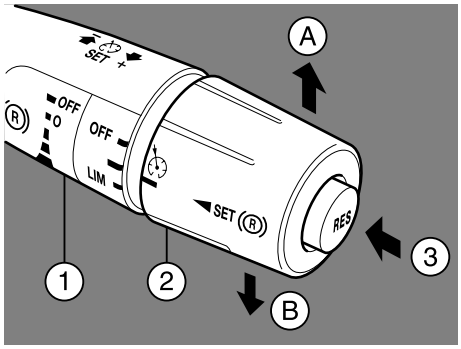


i400666-2

Vehicle speed limitation laid down by law
The maximum permitted vehicle speed is programmed in the electronic unit (D814).

The electronic unit registers the vehicle speed via connection point B29.

Variable vehicle speed limitation



D000450

The variable vehicle speed limitation allows the vehicle speed to be limited to a speed set by the driver.
The variable vehicle speed limiter can be activated once the vehicle speed is higher than 30 km/h.

The variable vehicle speed limitation is activated by turning the rotary switch (2) on the steering column switch to the "LIM" position (input voltage on connection point B31). If the variable vehicle speed limitation is activated, the set value will appear on the instrument panel display.

Note:
If there is input voltage on connection point B31, the cruise control is switched off.

If the variable vehicle speed limitation is activated, the vehicle speed being driven at that time is saved in the electronic unit as the desired vehicle speed limitation value.
Via the CAN network, the electronic unit receives information on the current vehicle speed limitation value that has been stored. This information then appears on the instrument panel display.

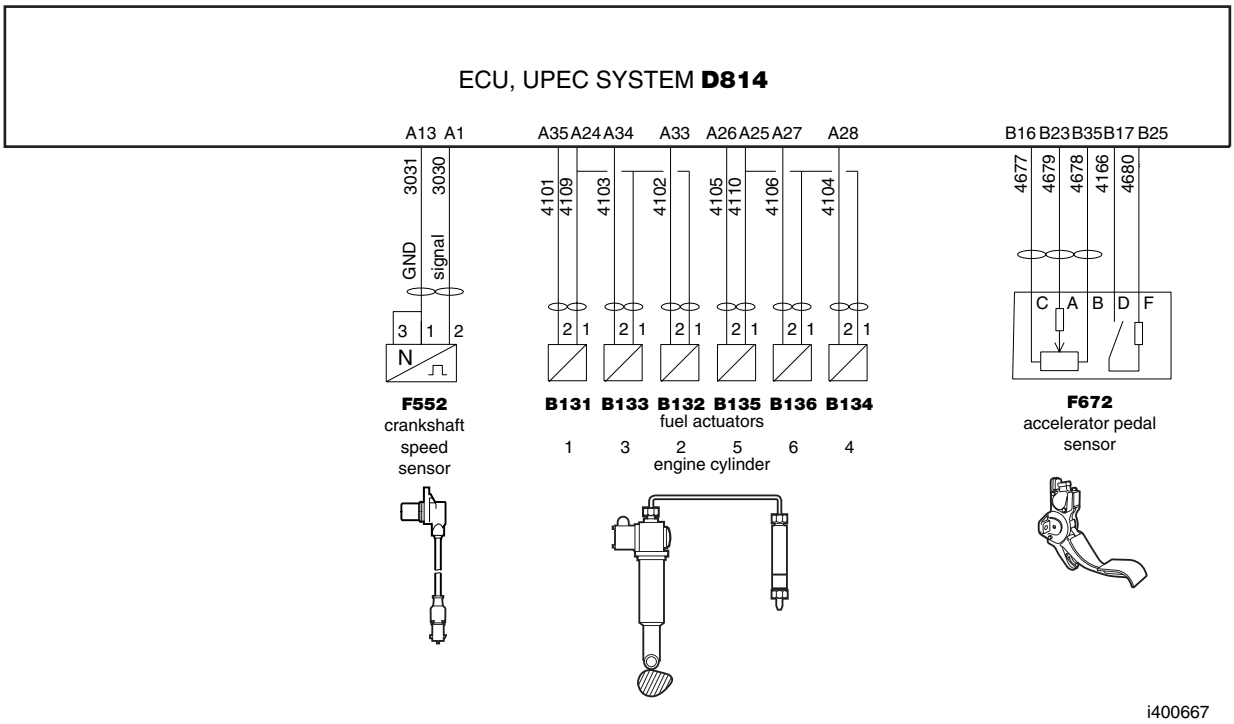
At the moment that the vehicle speed is limited by the electronic unit, the vehicle speed limitation value in the memory can be increased or decreased by moving the steering column switch in the A (set+) or B (set-) direction.

The variable vehicle speed limitation will be disengaged when:

1. the rotary switch (2) is returned to the centre position (input voltage removed from connection point B31).
2. the accelerator pedal (F672) is fully depressed, so that the kickdown switch is operated.
   The electronic unit recognises this position due to the potentiometer output voltage on connection point B23.

   Note:
   If the vehicle speed later falls to the previously saved vehicle speed limitation value, the variable vehicle speed limitation function is activated once again.

4.18 CONTROL SYSTEM IN THE EVENT OF FAILURE OF ACCELERATOR PEDAL SENSOR



Non-functioning potentiometer

If the potentiometer in the accelerator pedal sensor (F672) is not functioning, the (fully laden) vehicle can still reach a safe place by means of the idling switch in the accelerator pedal sensor.

An idling switch is fitted in the accelerator pedal sensor (F672) parallel to the potentiometer.
When the accelerator pedal is in the no-load position the idling switch is opened, so that there is no connection between points B17 and B25 of the electronic unit (D814).
In this situation, the electronic unit energises the pump units so that the engine speed gradually increases to approx. 1000 rpm.
On depressing the accelerator pedal, the idling switch is closed, so that there is a connection between points B17 and B25 of the electronic unit.
In this situation there is a gradual increase in the quantity of injected fuel. The maximum quantity of fuel to be injected is limited in this way to a certain percentage of the quantity of fuel injected at the normal full-load position of the accelerator pedal under full load.

Non-functioning idling switch
If there is an interruption in the idling switch, there is no connection between connection points B17 and B25 of the electronic unit (D814) when depressing the accelerator pedal.
In this situation, when the accelerator pedal is depressed the electronic unit energises the pump units so that the engine speed gradually increases to a maximum engine speed of approx. 1000 rpm.

If the idling switch has been short-circuited, there is a connection between points B17 and B25 of the electronic unit (D814) with the accelerator pedal in the no-load position.
In this situation, with the accelerator pedal in the no-load position the electronic unit energises the pump units so that the engine speed gradually increases to a maximum engine speed of approx. 1000 rpm.
The accelerator pedal function is otherwise disengaged.

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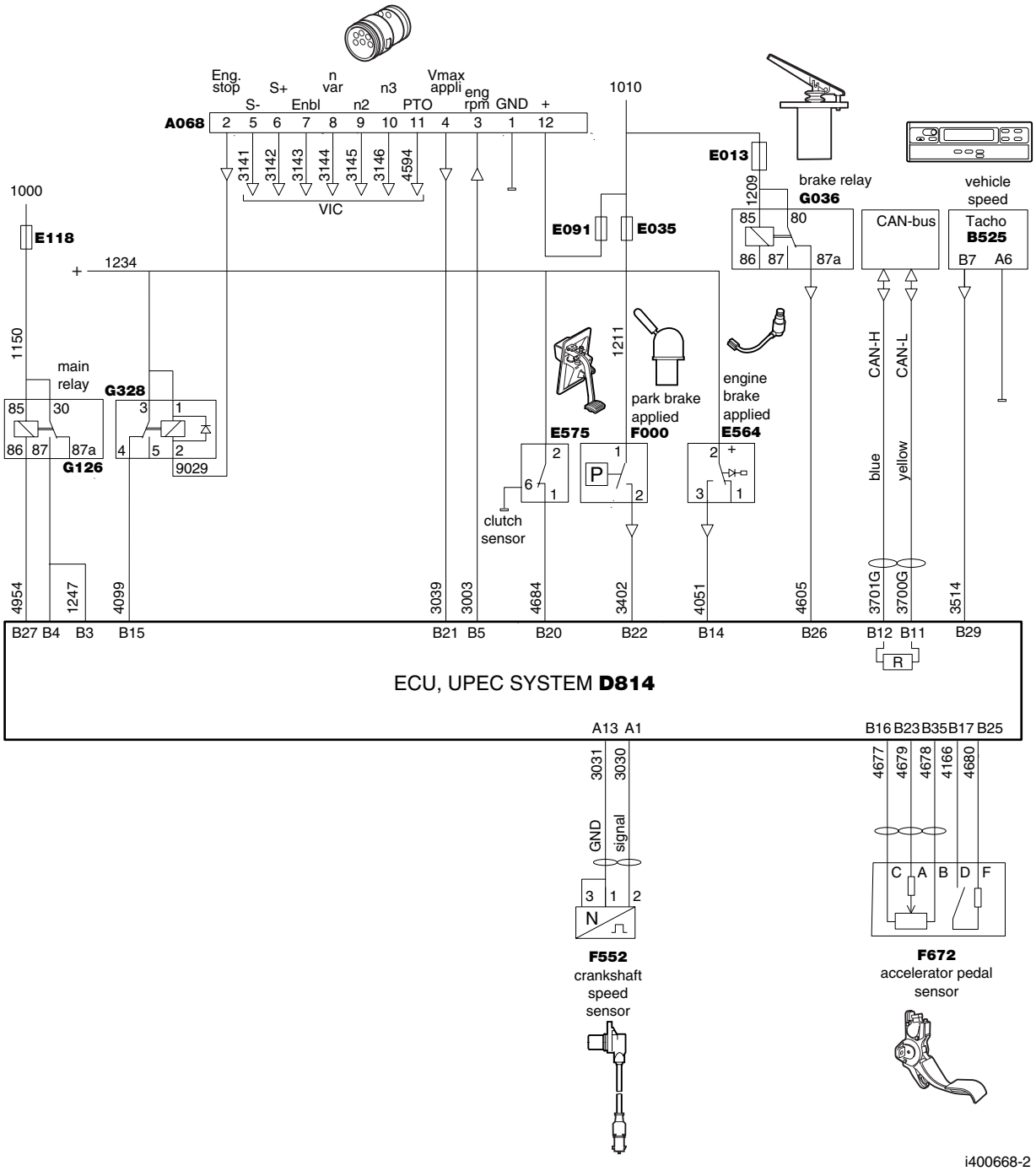
4.19 CONTROL FUNCTIONS VIA ENGINE SPEED CONTROL APPLICATION CONNECTOR



The following possibilities/control functions are available via the engine speed control application connector (A068):
- engine emergency cut-out
- vehicle speed limitation for special applications
- engine speed registration
- variable (PTO) engine speed control
- fixed (PTO) engine speed control n2 and n3

ENGINE EMERGENCY CUT-OUT
If connection point 2 of the application connector (A068) is switched to earth, the relay (G328) will be energised.
This causes the voltage to be removed from connection point B15 of the electronic unit (D814), so that connection point B27 is no longer switched to earth via the electronic unit.
The relay (G126) is no longer energised, so the voltage is removed from connection points B3 and B4.

Note:
On the instrument panel display, the error messages referring to other electronic systems can now be activated as the UPEC electronic unit can no longer communicate via the CAN network.

VEHICLE SPEED LIMITATION FOR SPECIAL APPLICATIONS
The maximum vehicle speed can be limited (for refuse collection vehicles for example). The default value is 20 km/h.
This is a pre-programmed value in the electronic unit. This value can be changed using DAVIE.

This function is active if there is input voltage on connection point B21 of the electronic unit (D814).
Connection point B21 is connected to connection point 4 of the application connector (A068).

ENGINE SPEED REGISTRATION
The engine speed is registered via the crankshaft sensor (F552).
The output signal of the crankshaft sensor is a sine-wave signal with a frequency that corresponds to the number of holes in the flywheel and the frequency of rotation of the flywheel.

2

For the output voltage on connection point B5 of the electronic unit (D814), the sine-wave signal in the electronic unit is "converted" into a square-wave signal with a frequency of 30 pulses per crankshaft revolution.
This signal is transmitted to connection point 3 of the application connector (A068).

CONDITIONS FOR ACTIVATING ENGINE SPEED CONTROL
All connections on the application connector (A068) that are applicable to the (PTO) engine speed control system are connected to the VIC electronic unit.
The UPEC electronic unit receives this information from the VIC unit via the CAN network.

The engine speed control function via the application connector (A068) is only released by the UPEC electronic unit once all the following conditions have been met.

Condition 1 The UPEC electronic unit must have received the "release engine speed control function" message from the VIC unit.

This message is sent by the VIC electronic unit if input voltage is applied to the VIC unit via connection point 7 (wire 3143) of the application connector.

Note:
Once the UPEC electronic unit has received the "release engine speed control function" message, all functions on the steering column switch - as far as engine speed control is concerned - are switched off.

Condition 2 The condition for activating the engine speed control function must have been met.

Depending on the parameters programmed in the electronic unit with DAVIE, activation of the engine speed control function will be possible if one of several possible conditions is met.
These are the same conditions as for activating the engine speed control using the steering column switch.

VARIABLE (PTO) ENGINE SPEED CONTROL
Once the conditions for activating the engine speed control have been met and there is a continuous signal present via connection point 8 (wire 3144) of the application connector on the VIC electronic unit, the variable engine speed control can be activated if the current engine speed is higher than or equal to a pre-programmed value in the electronic unit.

Note:
The pre-programmed value in the electronic unit can be changed using DAVIE.

The engine speed can be increased by applying input voltage to the VIC electronic unit, via connection point 6 ("set+", wire 3142) of the application connector.
The engine speed can be decreased by applying input voltage to the VIC electronic unit, via connection point 5 ("set-", wire 3141) of the application connector.

If the variable engine speed control is switched off during this control (no more voltage on connection point 8, wire 3144) and subsequently re-activated (voltage on connection point 8, wire 3144), the engine speed control will be activated at the last desired speed set using "set+" or "set-".

FIXED (PTO) ENGINE SPEED CONTROL N2 AND N3
If the conditions for activating the engine speed control have been met and a continuous signal is present via connection point 9 (wire 3145) or connection point 10 (wire 3146) of the application connector on the VIC electronic unit, the engine speed control will be activated to a pre-programmed value n2 (1300 rpm) or n3 (1400 rpm) respectively.

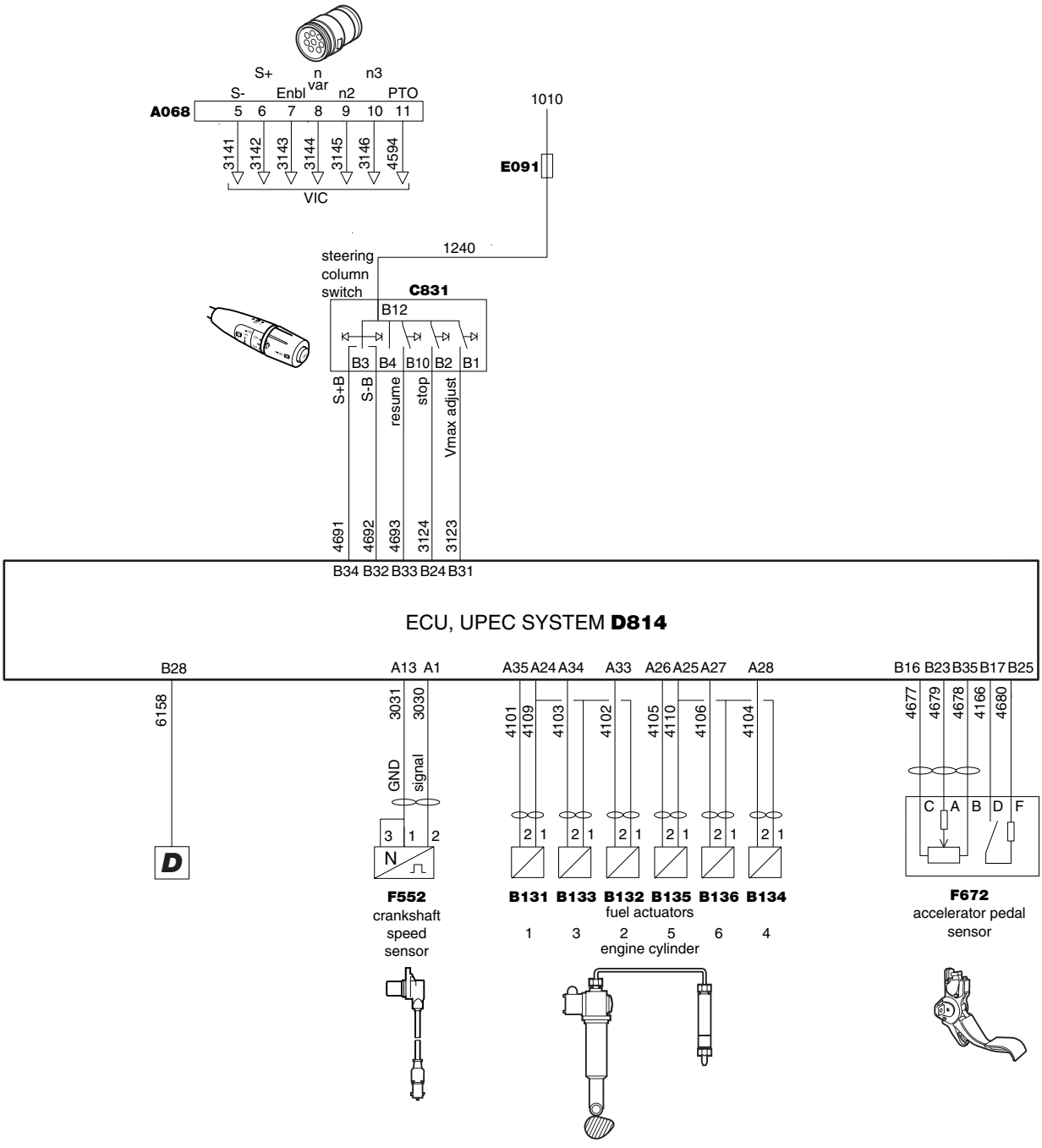
Note:
The pre-programmed value in the electronic unit can be changed using DAVIE.

Engine speed control priority determination
For the engine speed control via the application connector, n2 always has the highest priority; then n3; the variable engine speed control has the lowest priority.

Deactivation of (PTO) engine speed control

1. By engaging the engine brake (input voltage on connection point B14).
2. If the retarder function is active (message via CAN network).
3. If the vehicle is being driven under engine speed control and the vehicle speed is greater than approx. 20 km/h (e.g. when going downhill).
4. If the conditions for activating the engine speed control function are no longer met.
5. If there is no input voltage on the VIC unit via the application connector (A068), as far as the 'release of engine speed control' function is concerned.

4.20 ENGINE SPEED/TORQUE LIMITATION CONTROL



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If connection point B28 is switched to earth, the engine speed/torque limitation control is active. Depending on how the electronic unit is programmed, either the engine speed or the engine torque is limited to a certain programmed value.

The engine speed is limited to a pre-programmed value in the electronic unit (default value 1500 rpm)
With engines used in buses, the engine torque limitation function is active instead of the engine speed limitation function.

If this control is active, the engine speed or engine torque cannot increase beyond the programmed value in the electronic unit, using the accelerator pedal (F672), the steering column switch (C831) and the connection points on the application connector (A068).

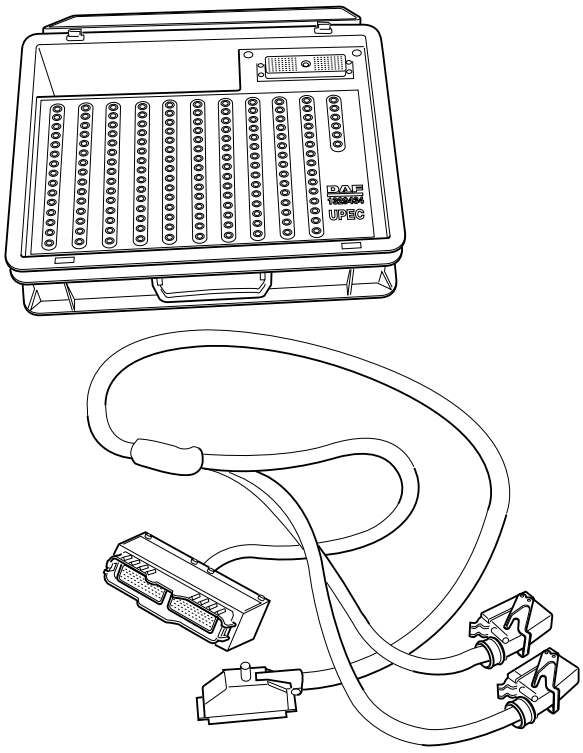
Note:
The pre-programmed value in the electronic unit can be changed using DAVIE.

5. INSPECTION AND ADJUSTMENT

5.1 ITEMS REQUIRING SPECIAL ATTENTION WHEN CHECKING THE SYSTEM

1. When a measured value is specified in the inspection table, a connection must be made with the multimeter.
   If no measured value is specified, a through-connection must be made.

2. When making through-connections and/or taking measurements on the system, use the BOB universal test box special tool (DAF no. 1329433) in combination with the UPEC BOB wiring harness (DAF no. 1329434).



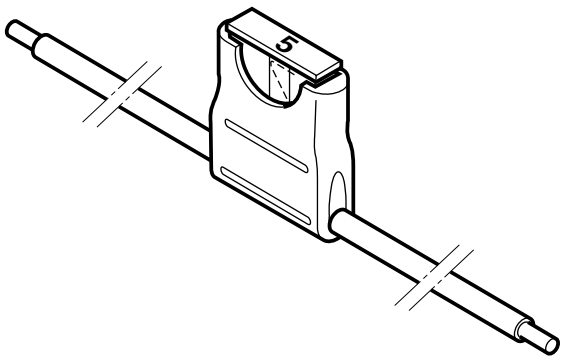
E500684

3. Switch the vehicle ignition off before removing or fitting a connector.

4. Use a fuse-protected wire when making a through-connection.

5. Always check the power and earth connections first in the event of a fault.
   Also check that good connections are made on the connector terminals (check for corrosion, etc.).

6. Variations in measurements may mean that measured values differ slightly from those specified.



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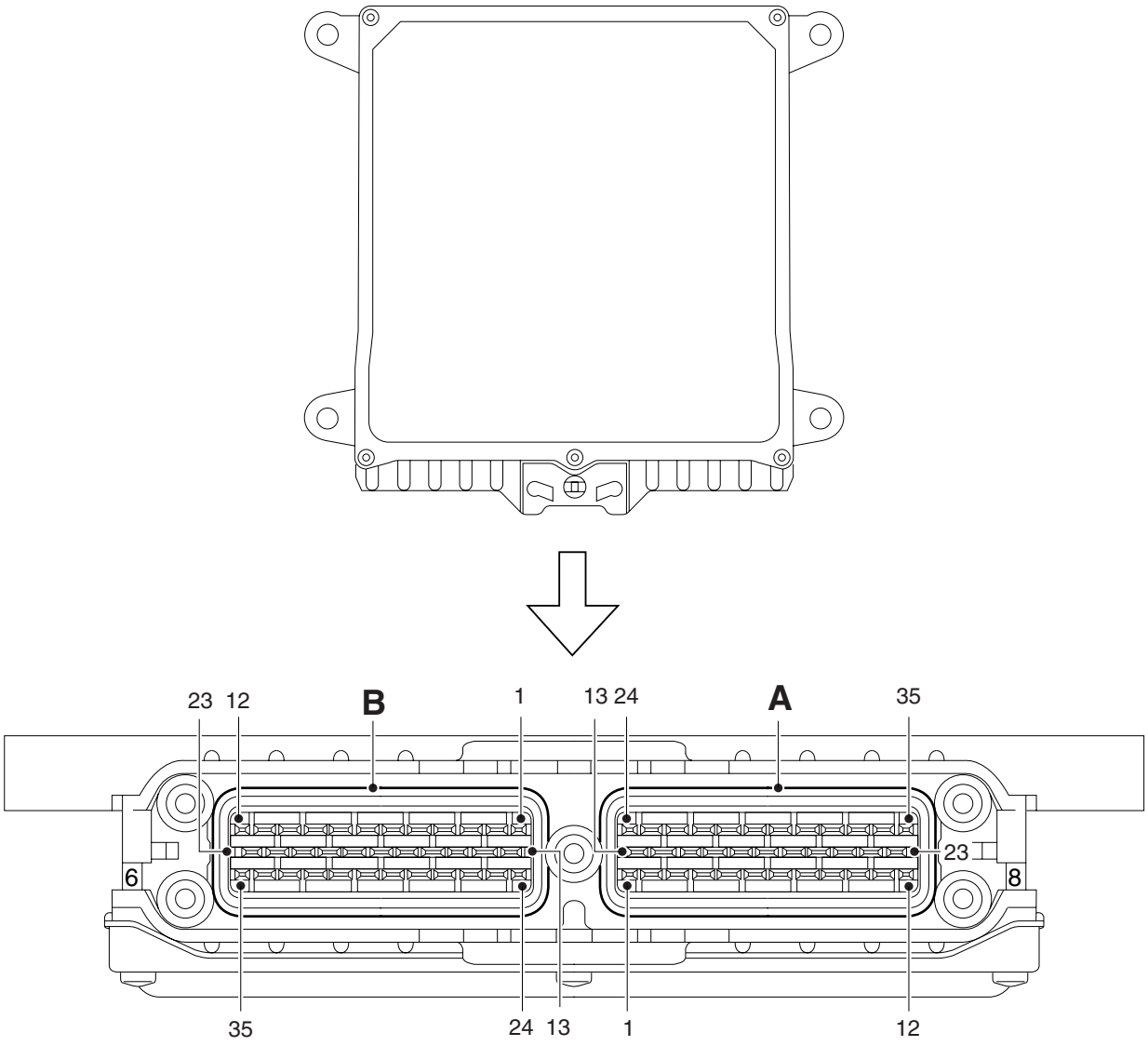
5.2 ELECTRONIC UNIT CONNECTION POINTS



E500355

Two connectors are fitted on the electronic unit:
connector A
connector B

Connector terminal A can be recognised by the code 8, shown on both the electronic unit and the connector.
Connector terminal B can be recognised by the code 6, shown on both the electronic unit and the connector.

Connection point	Wire number	Function
A1	3030	Crankshaft sensor signal
A2	3033	Camshaft sensor signal
A3		Not in use

Connection point	Wire number	Function
A4		Not in use
A5	3029	Negative side of engine coolant temperature sensor
A6	3043	Negative side of fuel temperature sensor
A7		Not in use
A8	4164	Activation of DEB solenoid valve
A9	4162	Signal (duty cycle) for fan clutch speed
A10		Not in use
A11	3042	Positive side of fuel temperature sensor
A12	3023	Signal (voltage) from boost pressure sensor
A13	3031	Crankshaft sensor earth
A14	3032	Camshaft sensor earth
A15	4160	Power supply (+5 V) to fan clutch speed sensor
A16	4163	Negative side of fan clutch speed sensor
A17	3025	Negative side of inlet air boost pressure and temperature sensor
A18		Not in use
A19		Not in use
A20		Not in use
A21	3026	Positive side of inlet air temperature sensor
A22	3028	Positive side of engine coolant temperature sensor
A23	3024	Power supply (+5 V) to boost pressure sensor
A24	4109	Signal high, pump units of cylinders 1 to 3
A25	4110	Signal high, pump units of cylinders 4 to 6
A26	4105	Signal low, pump unit of cylinder 5
A27	4106	Signal low, pump unit of cylinder 6
A28	4104	Signal low, pump unit of cylinder 4
A29		Not in use
A30		Not in use
A31		Not in use
A32		Not in use
A33	4102	Signal low, pump unit of cylinder 2
A34	4103	Signal low, pump unit of cylinder 3
A35	4101	Signal low, pump unit of cylinder 1
B1	9040	Earth
B2	9040	Earth

2

Connection point	Wire number	Function
B3	1247	Power supply via contact relay
B4	1247	Power supply via contact relay
B5	3003	Engine speed output signal
B6	3435	Output signal to instrument panel for immobiliser function PIN code
B7		Not in use
B8		Not in use
B9	4087	Activation of exhaust brake valve
B10	4013	Activation of glow element relay
B11	3700G	CAN-L connection
B12	3701G	CAN-H connection
B13	4697	Diagnostic connection, DAVIE
B14	4051	Input signal for engine brake operating switch
B15	4099	Supply voltage after contact
B16	4677	Power supply, accelerator pedal sensor potentiometer
B17	4166	Positive side of idling speed switch, accelerator pedal sensor
B18	4093	Activation of DEB solenoid valve
B19		Not in use
B20	4684	Input signal, clutch pedal proximity switch
B21	3039	Input signal, vehicle speed limitation (special applications)
B22	3402	Input signal for parking brake switch
B23	4679	Slider voltage, accelerator pedal sensor potentiometer
B24	3124	Input signal, stop function, vehicle/engine speed control
B25	4680	Negative side of idling speed switch, accelerator pedal sensor
B26	4605	Brake signal input
B27	4954	Activation of UPEC supply relay
B28	6158	Signal, engine torque/speed limitation
B29	3514	Input signal for vehicle speed
B30	4161	Input signal for electronically controlled fan clutch speed
B31	3123	Input signal for variable vehicle speed limitation
B32	4692	Set function, cruise control/engine speed control
B33	4693	Input signal for memory of cruise control/engine speed control
B34	4691	Set function, cruise control/engine speed control
B35	4678	Negative side of accelerator pedal sensor potentiometer

5.3 KEY TO BLOCK DIAGRAM

Basic code	Description
A021	Diagnostic connector (16-pin)
A068	Application connector, engine speed control
B131	Solenoid valve, cylinder 1 pump unit
B132	Solenoid valve, cylinder 2 pump unit
B133	Solenoid valve, cylinder 3 pump unit
B134	Solenoid valve, cylinder 4 pump unit
B135	Solenoid valve, cylinder 5 pump unit
B136	Solenoid valve, cylinder 6 pump unit
B192	Exhaust brake valve
B247	DEB solenoid valve
B248	DEB solenoid valve
B335	Electronically controlled fan clutch
B341	Glow element
B525	Modular tachograph (MTCO)
C831	Steering column switch, cruise control/engine speed control/retarder
D814	UPEC electronic unit
D900	VIC electronic unit
E013	Stop light fuse
E035	Fuse, instruments and warning lamps
E091	Fuse, steering column switch
E112	Fuse, glow indicator light
E118	Fuse, power supply
E143	UPEC fuse
E184	Fuse, additional functions
E564	Engine brake switch
E575	Proximity switch, clutch
F000	Parking brake switch
F552	Crankshaft sensor
F558	Camshaft sensor
F565	Fuel temperature sensor
F566	Coolant temperature sensor
F649	Inlet air boost pressure and temperature sensor
F672	Accelerator pedal sensor
G014	Glow plug relay
G036	Stop light relay
G126	Engine management supply relay
G328	Engine stop relay
G426	Contact relay
G469	Brake signal relay
I034	Stop light relay damping diode

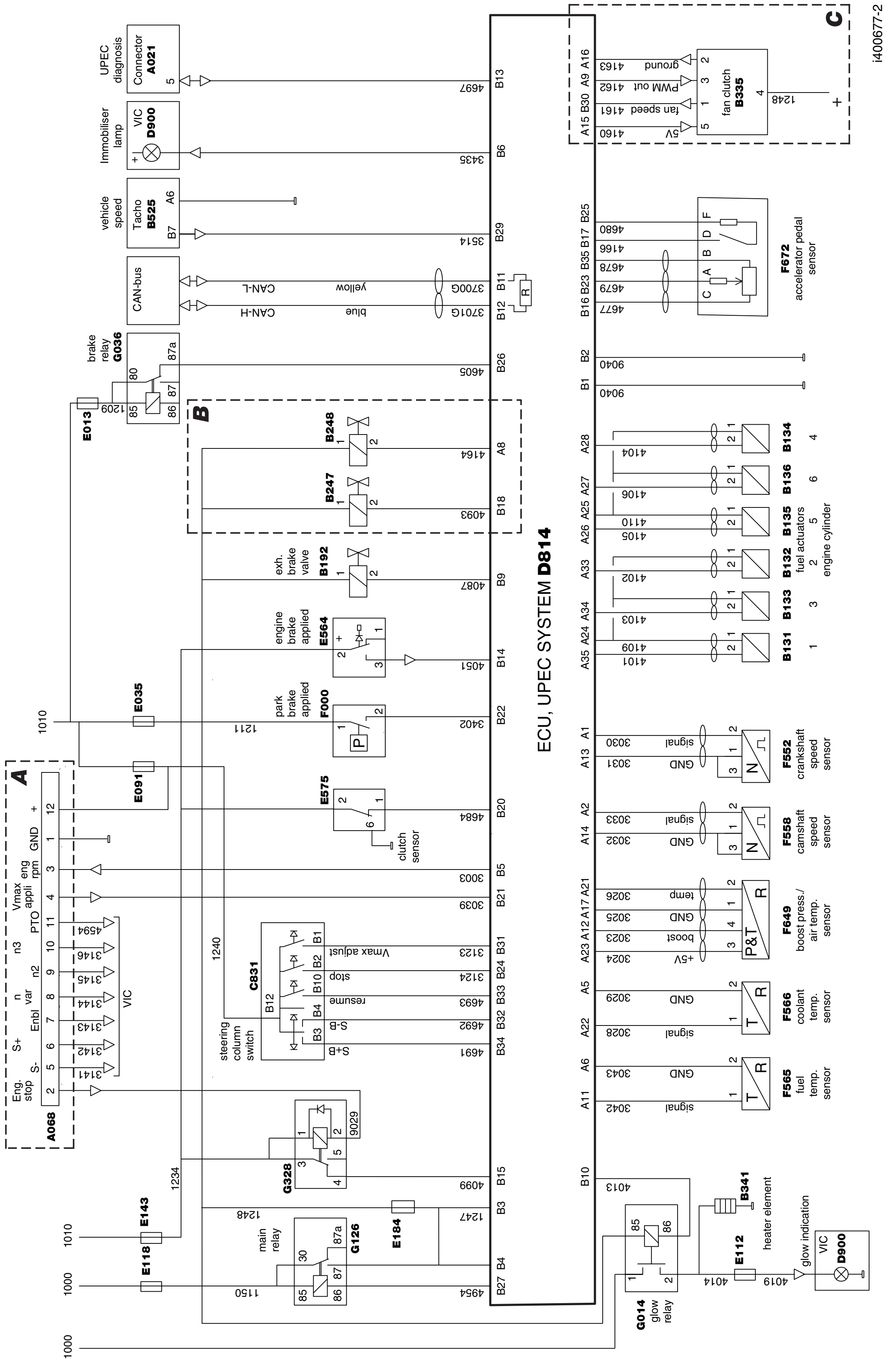
5.4 BLOCK DIAGRAM

Block diagram i400677 applies to:
- **CF75/85 models, production date <2002-41 (chassis number <0E595070)**

Explanation of block diagram

A: The application connector A068 is optional.
B: Only present if DEB is used.
C: Only present if the cooling system requires it.

2



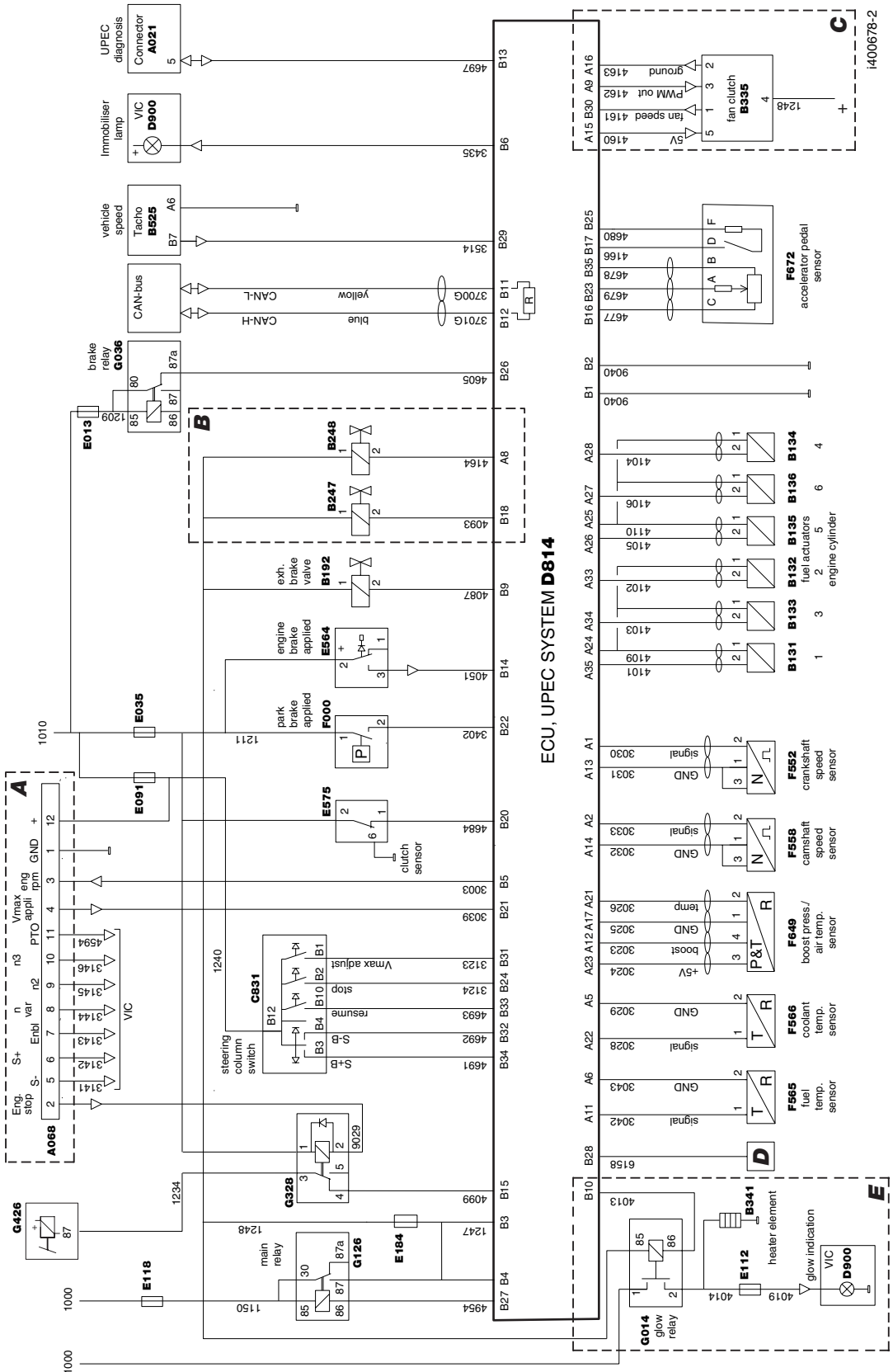
ECU, UPEC SYSTEM D814
UPEC diagnosis Connector A021
Immobiliser lamp VIC D900
vehicle speed Tacho B525
CAN-bus
CAN-H
CAN-L
yellow
blue
brake relay G036
E013
E035
E091
E118
E143
E184
E112
A068
Eng. stop
S-
S+
Enbl
n var
n2
n3
PTO
Vmax appli
eng rpm
GND
VIC
B
B248
B247
exh. brake valve B192
engine brake applied E564
park brake applied F000
E575
clutch sensor
steering column switch
C831
Vmax adjust
stop
resume
S-B
S+B
G328
main relay G126
glow relay G014
heater element B341
glow indication VIC D900
C
fan clutch B335
ground
PWM out
fan speed
5V
F672 accelerator pedal sensor
B134
B136
B135
B132
B133
B131
fuel actuators engine cylinder
F552 crankshaft speed sensor
F558 camshaft speed sensor
F649 boost press./ air temp. sensor
F566 coolant temp. sensor
F565 fuel temp. sensor
signal
GND
temp
boost
+5V
i400677-2

Block diagram i400678 applies to:
- **models CF75/85, production dates ≥2002-41 and <2003-13 (chassis numbers ≥0E595070 and <0E608863)**
- **XF95 model, production date <2003-13 (chassis number <0E608863)**

Modifications to CF75/85, production dates ≥2002-41 and <2003-13 (chassis numbers ≥0E595070 and <0E608863)
- UPEC software version 6.4.
- Switching of power supply after contact on connection point B15 modified.
- Wire 3435 to connection point B6 was fitted to activate the stop light in the case of an immobiliser failure; it no longer has any function.
- Added wire 6158 on connection point B28 for engine speed/torque limitation function.
- Different relay version for supply relay G126.
- Wire coding for supply voltage to components E575, E564 and G328 changed from wire number 1234 to wire number 1211.

Explanation of block diagram

A: The application connector A068 is optional.
B: Only present if DEB is used.
C: Only present if the cooling system requires it.
D: Wire 6158 is through-connected to the UPEC connector in the dashboard lead-through in the cab.
E: Only present if glow system is used.


ECU, UPEC SYSTEM D814
UPEC diagnosis Connector A021
Immobiliser lamp VIC D900
vehicle speed Tacho B525
CAN-bus
CAN-H blue 3701G
CAN-L yellow 3700G
brake relay G036
E013
E035
E091
E118
E184
E564 engine brake applied
F000 park brake applied
B192 exh. brake valve
B247
B248
E575 clutch sensor
steering column switch C831
Vmax adjust
stop
resume
S-B
S+B
main relay G126
G328
G426
G014 glow relay
B341 heater element
E112
glow indication VIC D900
A068
Eng. stop
S-
S+
n var Enbl
n2
n3
PTO
Vmax appli
eng rpm
GND
+
VIC
fan clutch B335
fan speed
PWM out
ground
5V
F672 accelerator pedal sensor
F552 crankshaft speed sensor
F558 camshaft speed sensor
F649 boost press./ air temp. sensor
F566 coolant temp. sensor
F565 fuel temp. sensor
B131 B133 B132 B135 B136 B134 fuel actuators engine cylinder
A
B
C
D
E
I400678-2

Block diagram i400673 applies to:
- **CF75/85 models, production dates ≥2003-13 and <2004-25 (chassis numbers ≥0E608863 and <0E646817)**
- **XF95 model, production dates ≥2003-13 and <2004-25 (chassis numbers ≥0E608863 and <0E646817)**

2

Modifications to CF75/85 and XF95, production dates ≥2003-13 and <2004-25 (chassis numbers ≥0E608863 and <0E646817)
- Wire 3435 on connection point B6 of the UPEC electronic unit is no longer fitted.
- Version of relay for brake signal on connection point B26 of the UPEC electronic unit is AS Tronic-dependent.

Explanation of block diagram

A: The application connector A068 is optional.

B: Only present if DEB is used.

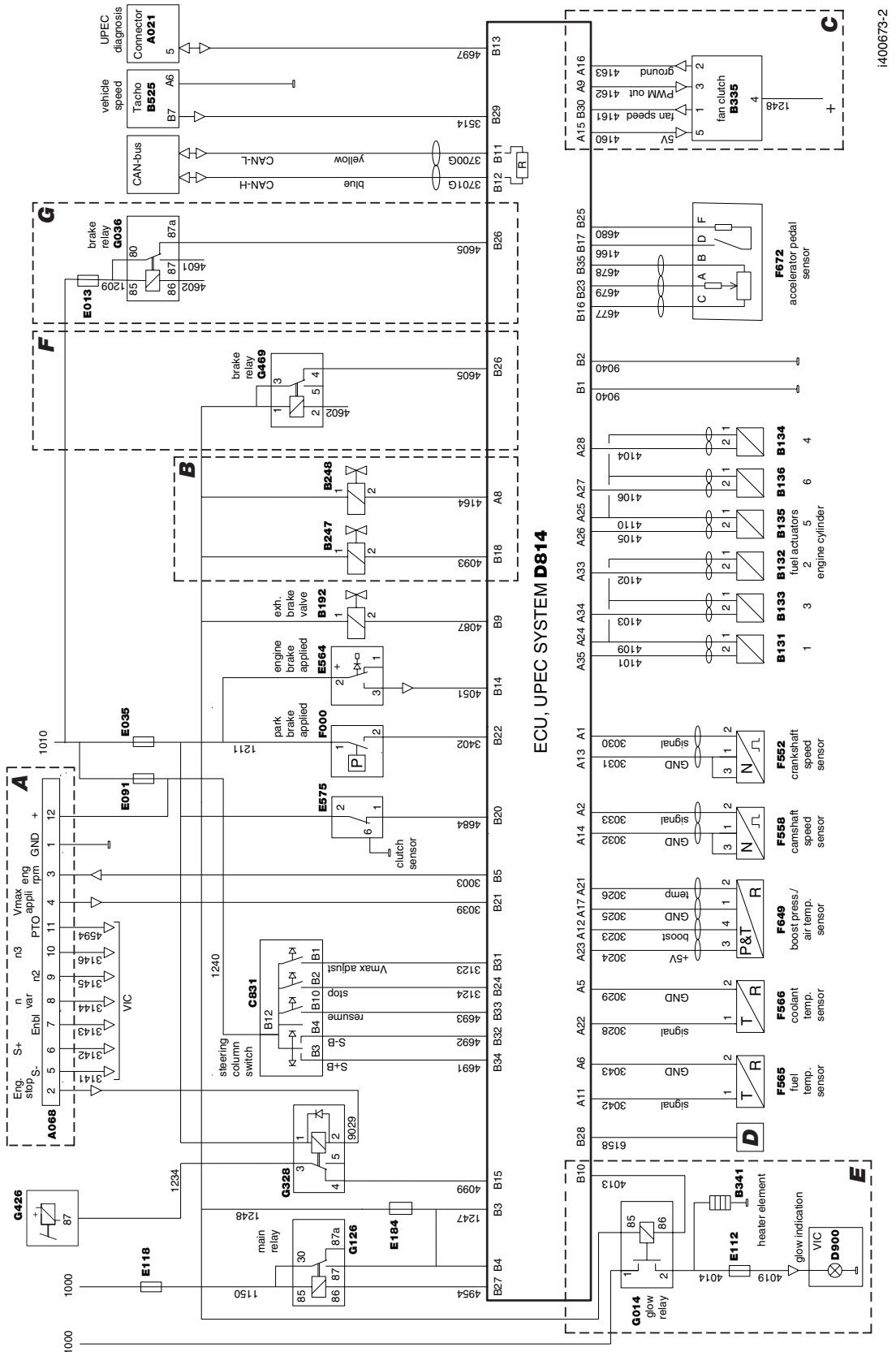
C: Only present if the cooling system requires it.

D: Wire 6158 is through-connected to the UPEC connector in the dashboard lead-through in the cab.

E: Only present if glow system is used.

F: On vehicles with AS Tronic relay G469 is used for connection point B26.
Note:
On an XF95 vehicle without AS Tronic, with production dates ≥2003-13 and <2003-38, relay G469 is also used.

G: On vehicles without AS Tronic relay G036 is used for connection point B26.

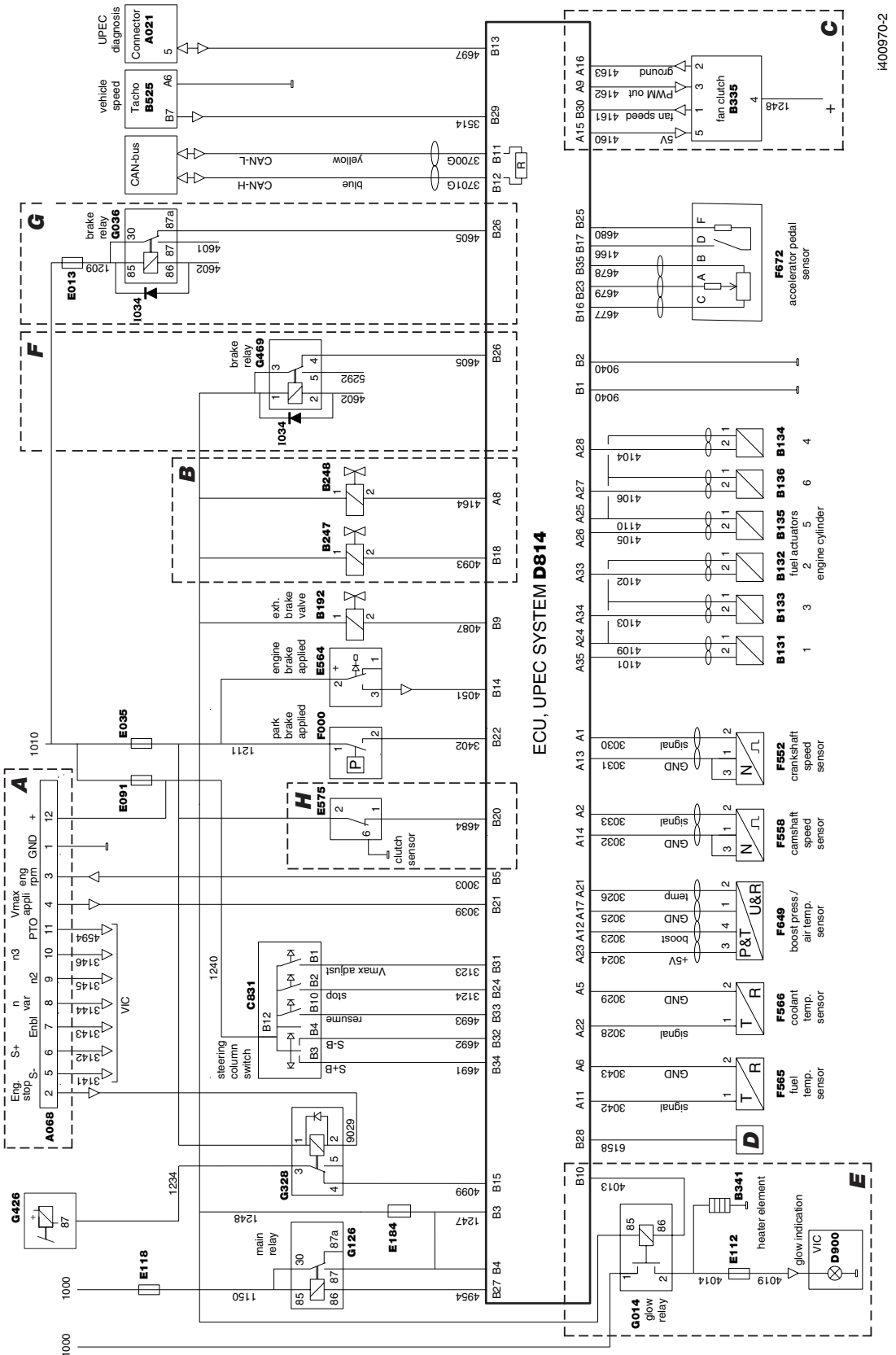

ECU, UPEC SYSTEM D814
i400673-2
A
B
C
D
E
F
G
A068
Eng. stop
S-
S+
n var Enbl
n2
n3
PTO
Vmax appli
eng rpm
GND
+
VIC
E035
E091
E118
E184
E013
G426
G036
brake relay
G469
brake relay
G126
main relay
G328
steering column switch
C831
Vmax adjust
stop
resume
S+B
S-B
B248
B247
exh. brake valve
B192
engine brake applied
E564
park brake applied
F000
E575
clutch sensor
UPEC diagnosis
Connector A021
vehicle speed
Tacho B525
CAN-bus
CAN-H
CAN-L
blue
yellow
3701G
3700G
R
fan clutch B335
5V
fan speed
PWM out
ground
F672
accelerator pedal sensor
F552
crankshaft speed sensor
F558
camshaft speed sensor
F649
boost press./ air temp. sensor
boost
temp
+5V
F566
coolant temp. sensor
F565
fuel temp. sensor
B131 B133 B132 B135 B136 B134
fuel actuators
engine cylinder
B341
heater element
E112
glow indication
VIC
D900
G014
glow relay

Block diagram i400970 applies to:
- **CF75/85 models, production date ≥2004-25 (chassis number ≥0E646817)**
- **XF95 model, production date ≥2004-25 (chassis number ≥0E646817)**

Modifications to CF75/85 and XF95, production date ≥2004-25 (chassis number ≥0E646817)
- Damping diode for relay I034 has been added to stop light relay G036 and brake signal relay G469.
- Relay circuit of G469 has been modified. Wire 5292 on connection point 5 of G469 has been added.

Explanation of block diagram

A: The application connector A068 is optional.
B: Only present if DEB is used.
C: Only present if the cooling system requires it.
D: Wire 6158 is through-connected to the UPEC connector in the dashboard lead-through in the cab.
E: Only present if glow system is used.
F: On vehicles with AS Tronic relay G469 is used for connection point B26.
G: On vehicles without AS Tronic relay G036 is used for connection point B26.
H: Only used on version with manual gearbox


ECU, UPEC SYSTEM D814
i400970-2
UPEC diagnosis
Connector A021
vehicle speed
Tacho B525
CAN-bus
CAN-H
CAN-L
blue
yellow
brake relay G036
brake relay G469
exh. brake valve B192
engine brake applied E564
park brake applied F000
clutch sensor E575
steering column switch C831
main relay G126
glow relay G014
heater element B341
glow indication VIC D900
fan clutch B335
fan speed
PWM out
ground
accelerator pedal sensor F672
crankshaft speed sensor F552
camshaft speed sensor F558
boost press./ air temp. sensor F649
coolant temp. sensor F566
fuel temp. sensor F565
fuel actuators
engine cylinder
VIC
Eng. stop
Vmax
eng rpm
PTO
Enbl
Vmax adjust
stop
resume
S+B
S-B
+5V
GND
signal
temp
boost

5.5 INSPECTION OF ELECTRICAL SYSTEM

There are two inspection tables:
- Inspection table for signal and voltage measurements.
- Inspection table for measuring resistance and activating components.

Explanation of inspection table
The inspection table is divided into a number of columns.
These columns may contain symbols and/or abbreviations.

"MEASUREMENT" COLUMN	
Symbol/abbreviation	**Explanation**
V AC	Measurement of AC voltage
V DC	Measurement of DC voltage
A	Current measurement
Ω	Resistance measurement
%	Measurement of duty cycle
Hz	Frequency measurement

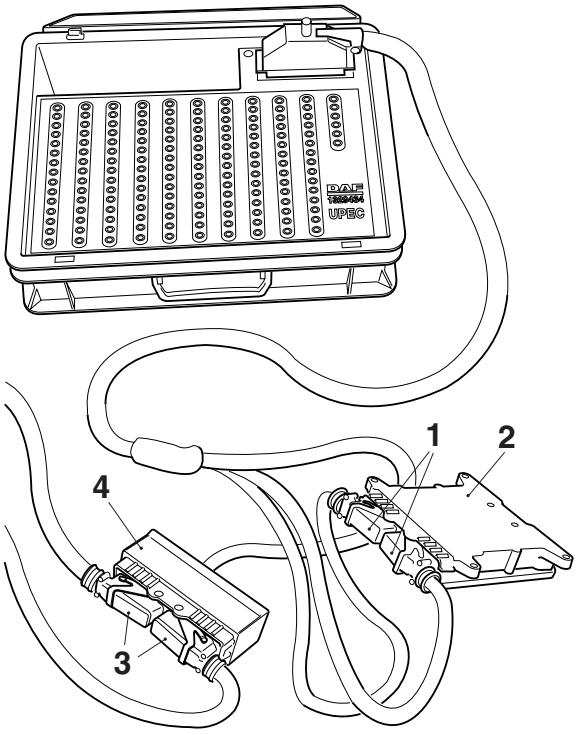
"READINGS" COLUMN	
Symbol/abbreviation	**Explanation**
*	For the readings, see 'Technical data'.
∞	Open connection

Note:
The readings obtained with the BOB universal test unit may differ slightly from the readings listed in the "readings" column due to the contact resistance in the BOB universal test unit and the BOB wiring harness.

INSPECTION TABLE FOR SIGNAL AND VOLTAGE MEASUREMENTS

1. Switch the vehicle ignition off.
2. Remove the electronic unit connectors.
3. Fit the UPEC BOB wiring harness (DAF no. 1329434) to the BOB universal test unit (DAF no. 1329433).

   Attach the connectors of the BOB cable harness to the UPEC electronic unit (2) and attach the connectors (3) of the UPEC electronic unit to the connection terminals (4) of the BOB cable harness.



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No.	INSPECTION	MEASURE-MENT	IGNITION	+ PIN	- PIN	READING	Note
1	UPEC electronic unit earth connection	V DC	ON	B1	Battery earth	<0.5 V	Switch on as many consumers as possible
2	UPEC electronic unit earth connection	V DC	ON	B2	Battery earth	<0.5 V	Switch on as many consumers as possible
3	UPEC electronic unit earth connection	V DC	ON	B25	Battery earth	<0.5 V	Switch on as many consumers as possible
4	Power supply after contact	V DC	ON	B15	B1	22 - 28 V	
5	Power supply via supply relay G126	V DC	ON	B3	B1	22 - 28 V	
6	Power supply via supply relay G126	V DC	ON	B4	B1	22 - 28 V	
7	Steering column switch C831 ("set+" function)	V DC	ON	B34	B1	0 V	Switch not operated
8	Steering column switch C831 ("set+" function)	V DC	ON	B34	B1	22 - 28 V	Move switch to "set+" position
9	Steering column switch C831 ("set-" function)	V DC	ON	B32	B1	0 V	Switch not operated
10	Steering column switch C831 ("set-" function)	V DC	ON	B32	B1	22 - 28 V	Move switch to "set-" position
11	Steering column switch C831 ("RES" function)	V DC	ON	B33	B1	0 V	"RES" button not operated

2

No.	INSPECTION	MEASURE-MENT	IGNITION	+ PIN	- PIN	READING	Note
12	Steering column switch C831 ("RES" function)	V DC	ON	B33	B1	22 - 28 V	"RES" button depressed
13	Steering column switch C831 ("OFF" function)	V DC	ON	B24	B1	0 V	Rotary switch in centre position
14	Steering column switch C831 ("OFF" function)	V DC	ON	B24	B1	22 - 28 V	Move rotary switch to "OFF" position
15	Steering column switch C831 ("LIM" function)	V DC	ON	B31	B1	0 V	Rotary switch in centre position
16	Steering column switch C831 ("LIM" function)	V DC	ON	B31	B1	22 - 28 V	Move rotary switch to "LIM" position
17	Engine brake switch E564	V DC	ON	B14	B1	0 V	Operating switch not operated
18	Engine brake switch E564	V DC	ON	B14	B1	22 - 28 V	Operate operating switch
19	Brake signal G469	V DC	ON	B26	B1	22 - 28 V	Brake pedal not operated
20	Brake signal G469	V DC	ON	B26	B1	0 V	Operate brake pedal
21	Parking brake switch F000	V DC	ON	B22	B1	0 V	Parking brake not engaged
22	Parking brake switch F000	V DC	ON	B22	B1	22 - 28 V	Engage parking brake
23	Vehicle speed signal B525	% V DC	ON	B29	B1	22%	Simulate 50 km/h
24	Supply voltage to potentiometer of accelerator pedal sensor F672	V DC	ON	B16	B1	approx. 5 V	
25	Supply voltage to idling switch of accelerator pedal sensor F672	V DC	ON	B17	B25	approx. 4.7 V	Accelerator pedal in no-load position
26	Output voltage, potentiometer of accelerator pedal sensor F672	V DC	ON	B23	B1	*	
27	Supply voltage to coolant temperature sensor F566	V DC	ON	A22	B1	approx. 4.7 V	Remove the connector on the coolant temperature sensor
28	Supply voltage to fuel temperature sensor F565	V DC	ON	A11	B1	approx. 4.7 V	Remove the connector on the fuel temperature sensor
29	Power supply for inlet air temperature sensor of inlet air boost pressure sensor/ temperature sensor F649	V DC	ON	A21	A17	approx. 4.7 V	Remove the connector on the inlet air temperature sensor
30	Power supply for boost pressure sensor of inlet air boost pressure and temperature sensor F649	V DC	ON	A23	A17	approx. 5 V	

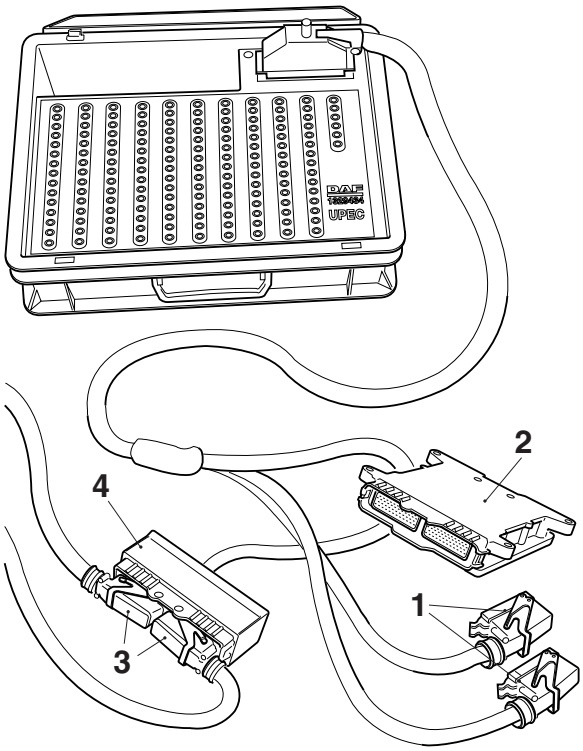
No.	INSPECTION	MEASURE-MENT	IGNITION	+ PIN	- PIN	READING	Note
31	Output voltage of boost pressure sensor of inlet air boost pressure and temperature sensor F649	V DC	ON	A12	A17	*	
32	Output signal, crankshaft sensor F552	V AC	ON	A1	A13	*	Measure output signal when the engine is running
33	Output signal, camshaft sensor F558	V AC	ON	A2	A14	*	Measure output signal when the engine is running
34	Engine speed output signal	% V DC	ON	B5	B1	*	Measure signal when the engine is running
35	Signal for controlling the fan speed of the electronically controlled fan clutch B335	% V DC	ON	B3	A9	*	Measure signal when the engine is running
36	Speed signal of electronically controlled fan clutch B335	Hz V DC	ON	B30	B1	*	Measure signal when the engine is running

2

INSPECTION TABLE FOR RESISTANCE MEASUREMENT AND ACTIVATION OF COMPONENTS

1. Switch the vehicle ignition off.
2. Remove the electronic unit connectors.
3. Fit the UPEC BOB wiring harness (DAF no. 1329434) to the BOB universal test unit (DAF no. 1329433).
   Attach the connectors (3) of the electronic unit (2) to the connection terminals (4) of the BOB wiring harness.
   The connectors (1) of the BOB wiring harness for the electronic unit may not be attached to the UPEC electronic unit.

Note:
If the electronic unit connectors have been removed and the vehicle ignition is then switched on, a fault message may be stored in the electronic units, which are interconnected via the CAN network.



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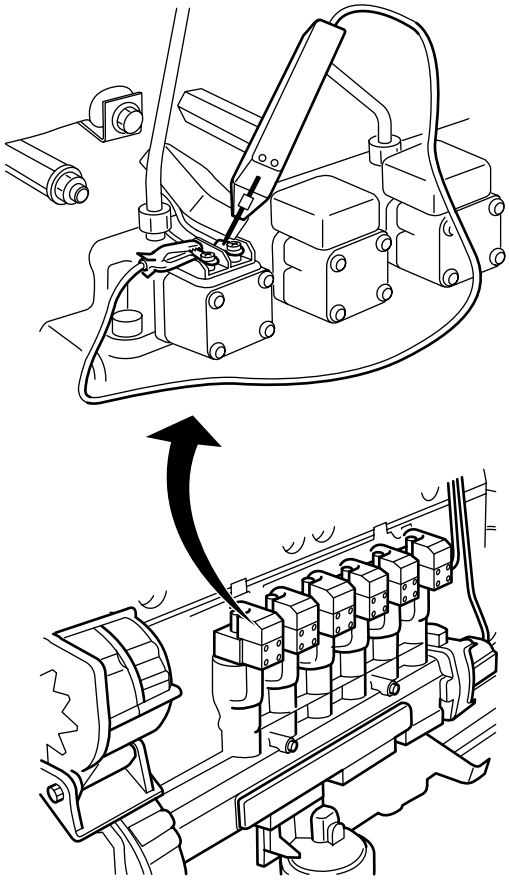
No.	INSPECTION	MEASURE-MENT	IGNITION	+ PIN	- PIN	READING	Note
Switch the contact OFF and make a through-connection between B27 and B1 (leave the connection for checks 1 to 4)							
1	DEB solenoid valve B247	Through-connection B18 to B1	ON				DEB solenoid valve is now active
2	DEB solenoid valve B248	Through-connection A8 to B1	ON				DEB solenoid valve is now active
3	Exhaust brake solenoid valve B192	Through-connection B9 to B1	ON				Exhaust brake solenoid valve is now active
4	Glow plug relay G014	Through-connection B10 to B1 <10 sec!	ON				Glow plug relay is now active
Switch the contact OFF and remove the through-connection between B27 and B1							
5	Accelerator pedal sensor F672 (idling switch)	Ω	OFF	B17	B25	∞	Accelerator pedal not operated
6	Accelerator pedal sensor F672 (idling switch)	Ω	OFF	B17	B25	*	Accelerator pedal in full-load position
7	Accelerator pedal sensor F672 (potentiometer)	Ω	OFF	B16	B35	*	

No.	INSPECTION	MEASURE-MENT	IGNITION	+ PIN	- PIN	READING	Note
8	Accelerator pedal sensor F672 (potentiometer output)	Ω	OFF	B23	B35	*	Depress accelerator pedal and check whether resistance gradually increases and decreases
9	Accelerator pedal sensor F672 (potentiometer, short circuit to earth)	Ω	OFF	B23	B25	∞	
10	Crankshaft sensor F552	Ω	OFF	A1	A13	*	
11	Crankshaft sensor F552 (short circuit to earth)	Ω	OFF	A1	B1	∞	
12	Camshaft sensor F558	Ω	OFF	A2	A14	*	
13	Camshaft sensor F558 (short circuit to earth)	Ω	OFF	A2	B1	∞	
14	Inlet air temperature sensor of inlet air boost pressure and temperature sensor F649	Ω	OFF	A21	A17	*	
15	Coolant temperature sensor F566	Ω	OFF	A22	A5	*	
16	Coolant temperature sensor F566 (short circuit to earth)	Ω	OFF	A22	B1	∞	
17	Fuel temperature sensor F565	Ω	OFF	A11	A6	*	
18	Fuel temperature sensor F565 (short circuit to earth)	Ω	OFF	A11	B1	∞	
19	Solenoid valve, pump unit B131, cylinder 1	Ω	OFF	A35	A24	*	
20	Solenoid valve, pump unit B132, cylinder 2	Ω	OFF	A33	A24	*	
21	Solenoid valve, pump unit B133, cylinder 3	Ω	OFF	A34	A24	*	
22	Solenoid valves of pump units B131 to B133, short circuit to earth	Ω	OFF	B1	A24	∞	
23	Solenoid valve, pump unit B134, cylinder 4	Ω	OFF	A28	A25	*	
24	Solenoid valve, pump unit B135, cylinder 5	Ω	OFF	A26	A25	*	
25	Solenoid valve, pump unit B136, cylinder 6	Ω	OFF	A27	A25	*	
26	Solenoid valves of pump units B134 to B136, short circuit to earth	Ω	OFF	B1	A25	∞	

5.6 INSPECTION, PUMP UNIT ENERGISING

With an LED voltage tester it is possible to check whether the electronic unit energises the pump units.
This makes it possible to establish whether the nature of the failure is mechanical (e.g. fuel supply) or electrical.

Connect the LED voltage tester to both electrical connections of the pump unit and start the engine.



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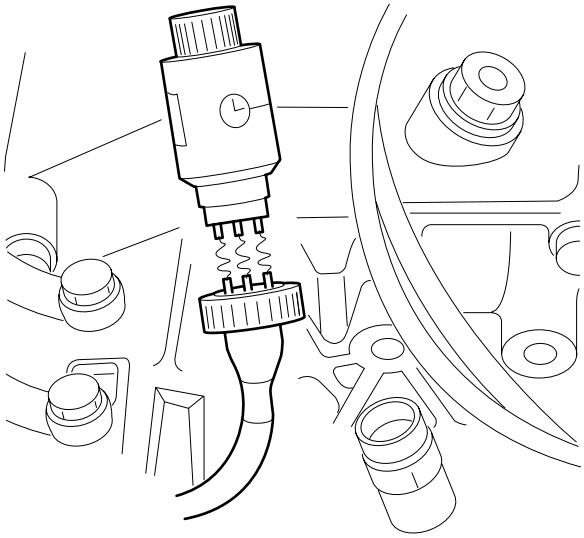
5.7 SIMULATION OF THE VEHICLE SPEED SIGNAL

The speed signal can be simulated with DELSI (DAF no. 0694941). DELSI must be connected to the speed sensor connector.



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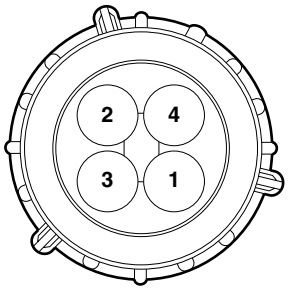
For connecting the DELSI to the speed sensor connector, it is necessary to make an adapter cable. The adapter cable must consist of the following wiring:

Pin 1: speed sensor, supply
Pin 2: speed sensor, earth
Pin 3: speed sensor, "real-time" speed/ distance signal
Pin 4: not in use

When the speed sensor connector is disconnected, an error is stored in the tachograph. This error can be deleted using DAVIE.



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5.8 CHECKING VEHICLE SPEED SIGNAL

The vehicle speed signal can be checked in two ways.

A. Using the duty-cycle function on the multimeter.
B. By measuring the average voltage.

2

A. Duty cycle
An accurate method is to measure the duty cycle. This measurement is carried out as follows:

1. Switch off the vehicle ignition and connect DELSI.
2. Connect the multimeter with one probe on the vehicle speed signal connection point, and the other probe on the earth terminal.
3. Select the duty-cycle function (%) on the multimeter and DC voltage operation.
4. Switch on the vehicle ignition and simulate a vehicle speed of 50 km/h using DELSI.
5. At this speed the reading should be 22%.
6. If the speed is increased the percent reading will rise and if the speed is decreased the reading will fall.

B. Average voltage
1. Switch off the vehicle ignition and connect DELSI.
2. Connect the multimeter with one probe on the vehicle speed signal connection point, and the other probe on the earth terminal.
3. Select DC voltage operation on the multimeter.
4. Switch on the vehicle ignition and simulate the vehicle speed to 50 km/h with DELSI.
5. The multimeter will then give a reading of approx. 2V.
6. When the speed is increased or decreased, the reading will increase or decrease.

6. REMOVAL AND INSTALLATION

6.1 FITTING INLET AIR BOOST PRESSURE AND TEMPERATURE SENSOR

1. Grease the sealing ring sparingly with mineral-oil-based grease.
2. Push the sensor into place (do not hit).
3. Fit the attachment bolt, tightening it to the specified torque. See "Technical data".

6.2 INSTALLATION OF CRANKSHAFT SENSOR

1. Grease the sealing ring sparingly with mineral-oil-based grease.
2. Push the sensor into place (do not hit).
3. Fit the attachment bolt, tightening it to the specified torque. See "Technical data".

6.3 INSTALLATION OF CAMSHAFT SENSOR

1. Grease the sealing ring sparingly with mineral-oil-based grease.
2. Push the sensor into place (do not hit).
3. Fit the attachment bolt, tightening it to the specified torque. See "Technical data".

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English
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