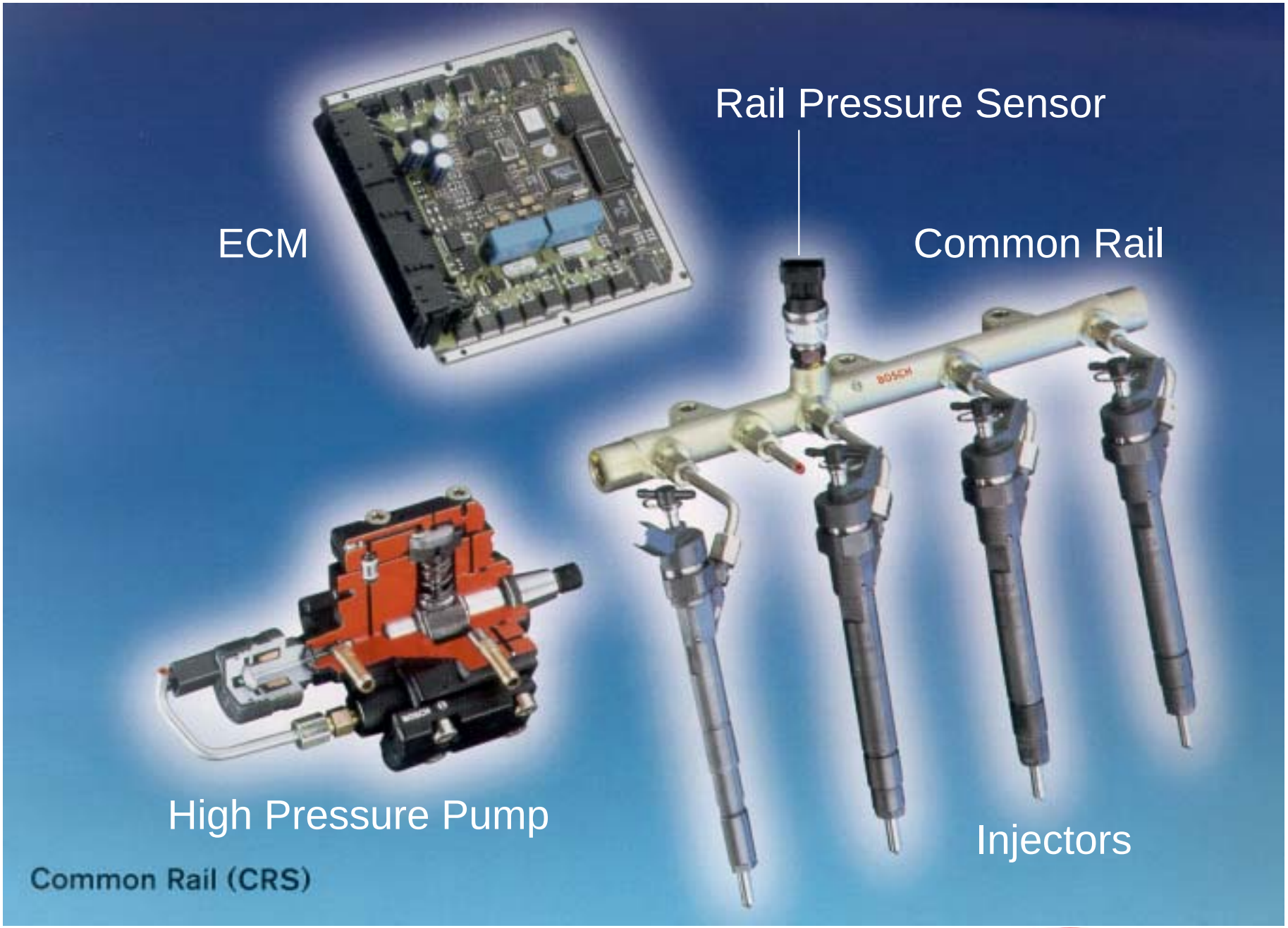
Common Rail (Bosch)

Chonan Technical Service Training Center

System Overview

System Overview

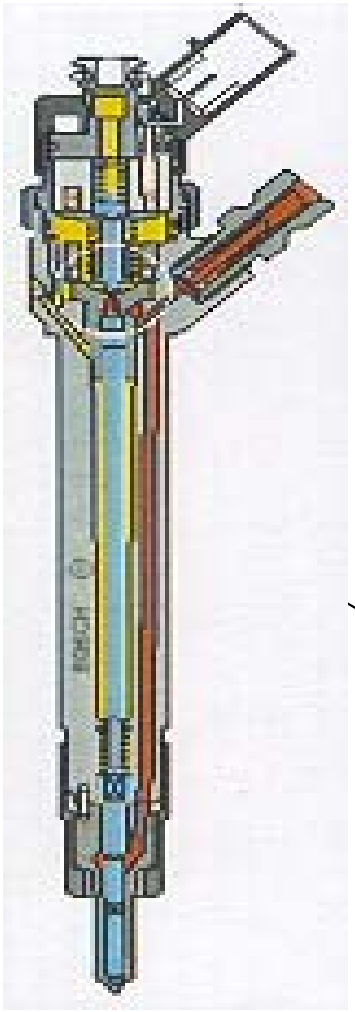


Comparison

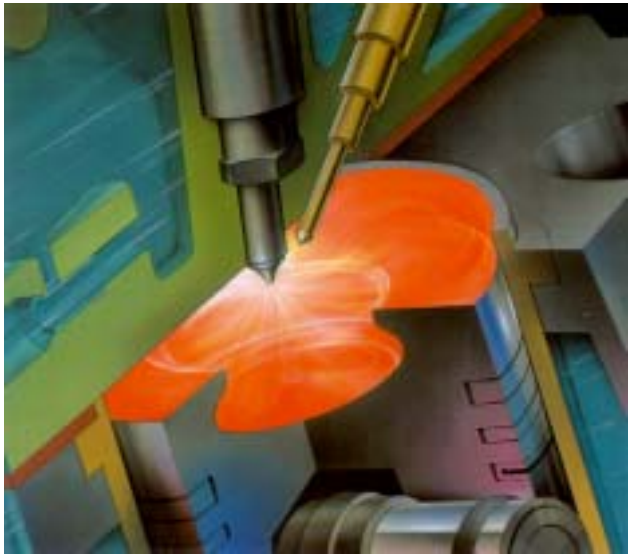

Comparison
Common Rail
Injection Pump
Engine Speed
Independance
Dependance
Pilot Injection
Possible
Impossible
Injection
Electrical
Mechanical

Common Rail System

ECM



Injector



Cylinder

Advantages

■ High Performance and Fuel Efficiency

- Electronically Controlled Common Rail Fuel Injection System to meet optimum combustion

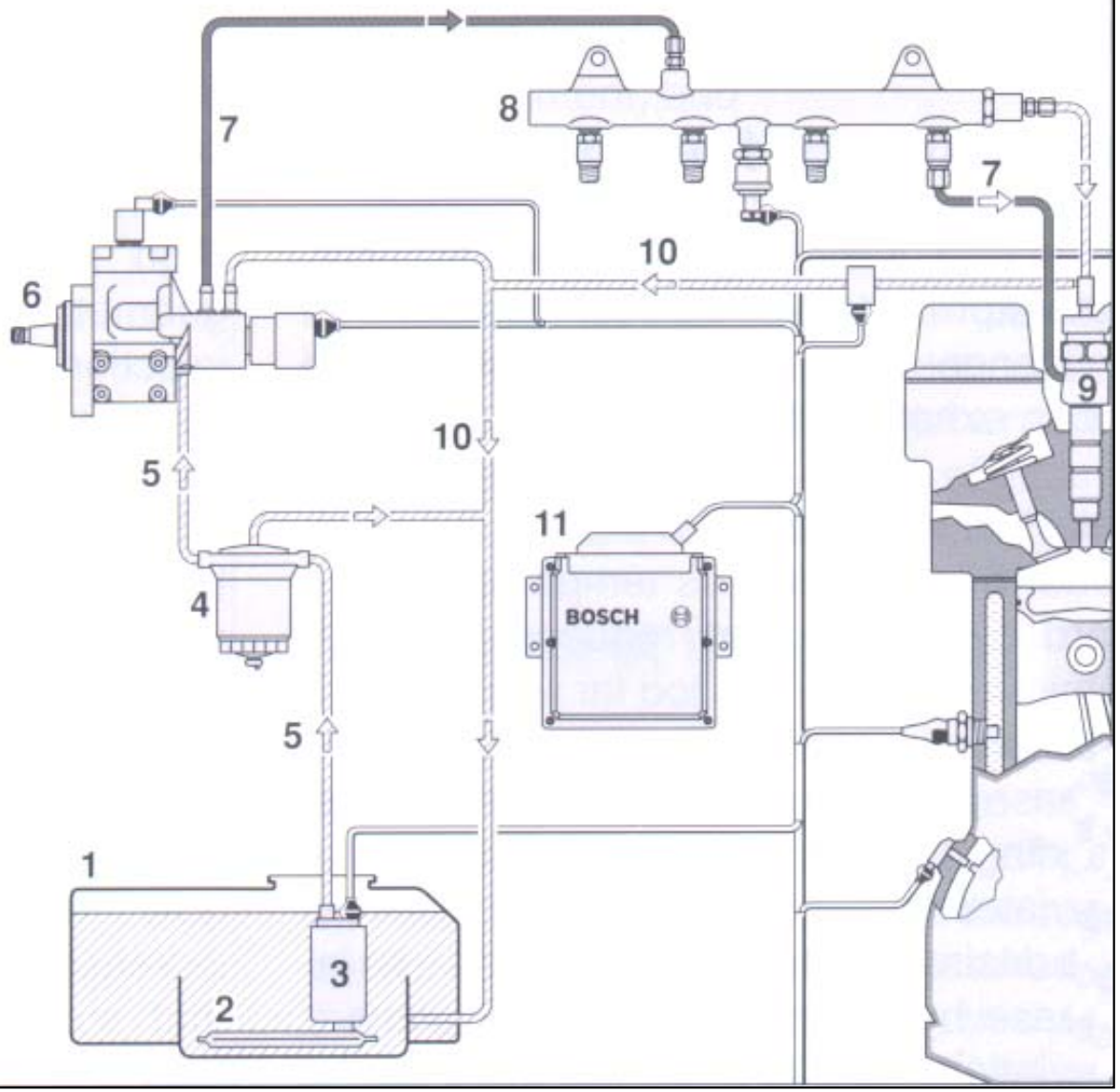
■ Low Emission & Low Noise

- Environment-friendly to Meet All The Emission Regulations of The World
- Central-vertically Located Injectors
- Pilot Injection of Common Rail Fuel Injection System

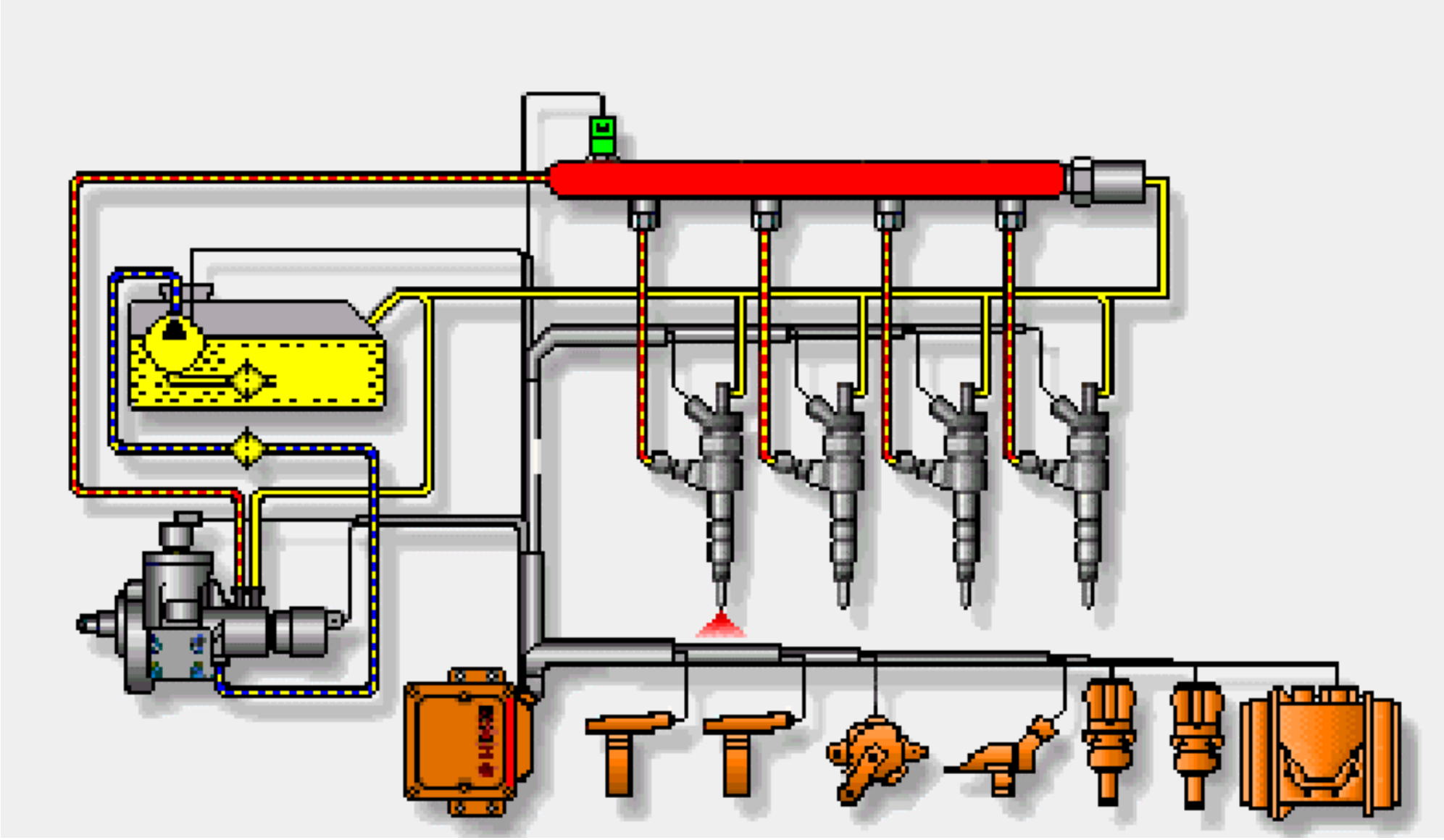
Low Pressure Circuit

Fuel system for a Common Rail fuel-injection system

1 Fuel tank,
2 Pre-filter,
3 Presupply pump,
4 Fuel filter,
5 Low-pressure fuel lines,
6 High-pressure pump,
7 High-pressure fuel lines,
8 Rail,
9 Injector,
10 Fuel-return line,
11 ECU.



High Pressure Circuit



High Pressure Circuit

- **Generate and store high pressure**
- **Closed-loop control of rail pressure**
- **Fuel Injection**

High Pressure Pump

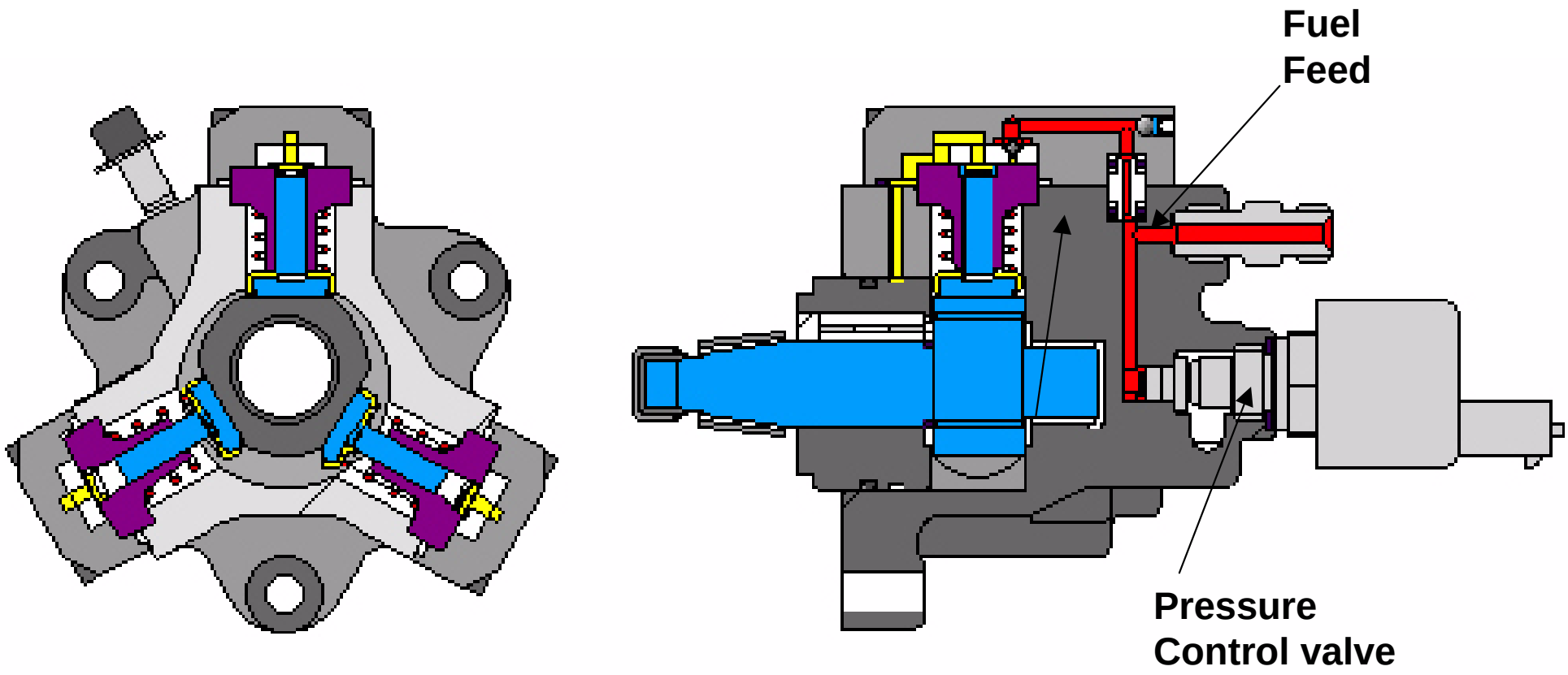
CP1

CP3

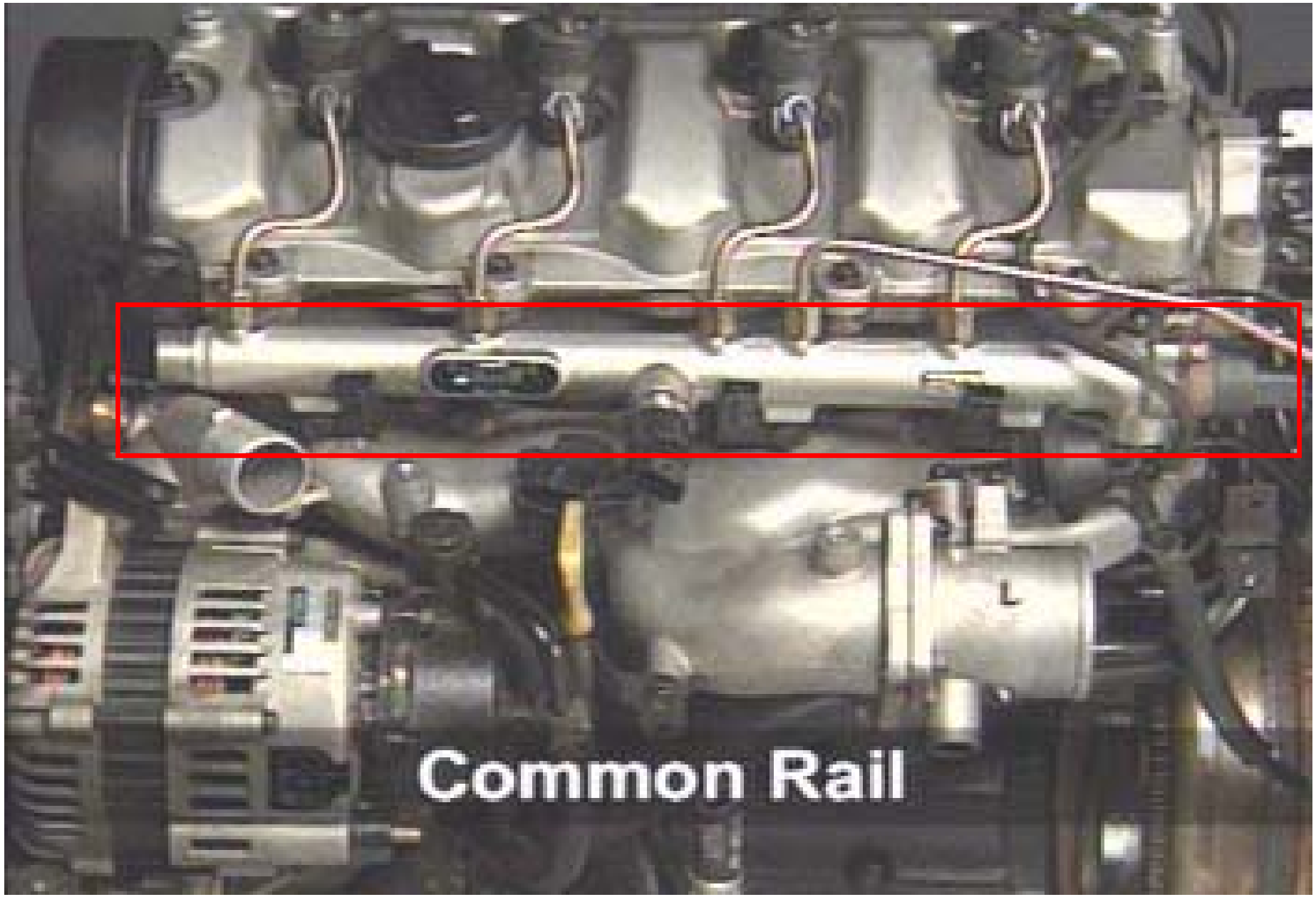
MPROP: (Magnetic Proportion Valve)

KUV: (Kraftstoff uber druck ventil.....Over pressure saftey valve)

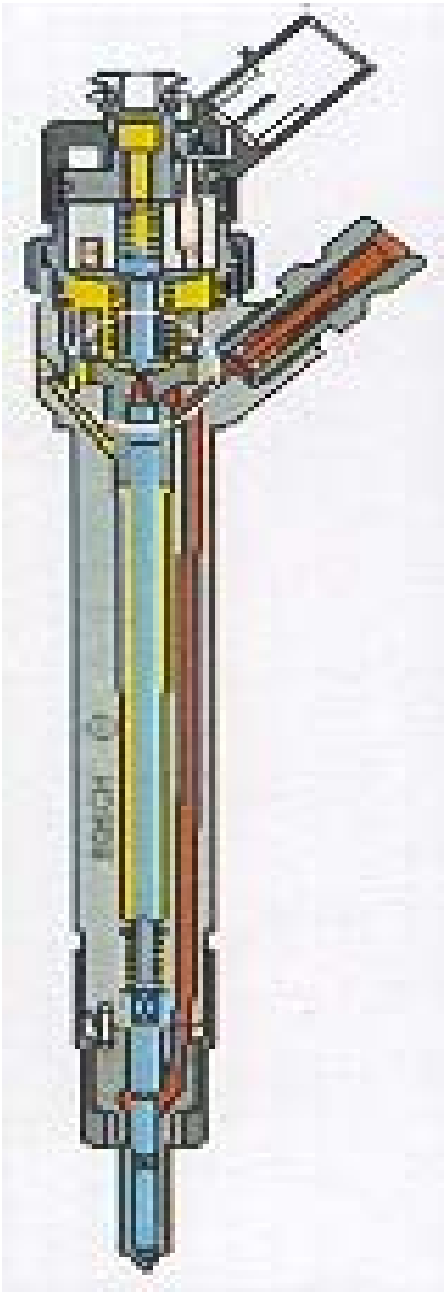
High Pressure Pump Operation

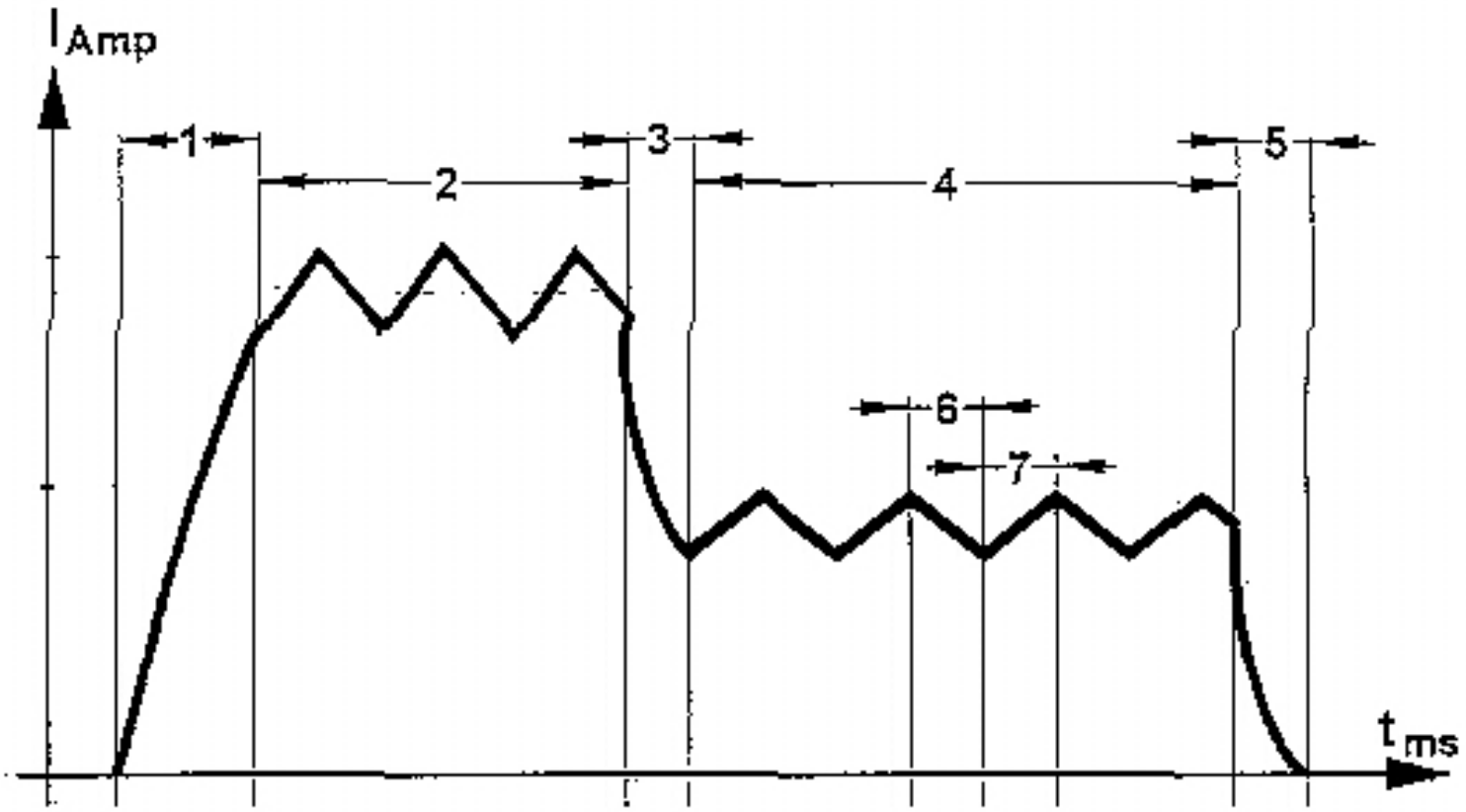


Common Rail



Injector Operation





1 = Capacitor disharge

2 = Injector pull in current

3 = Capacitor charge

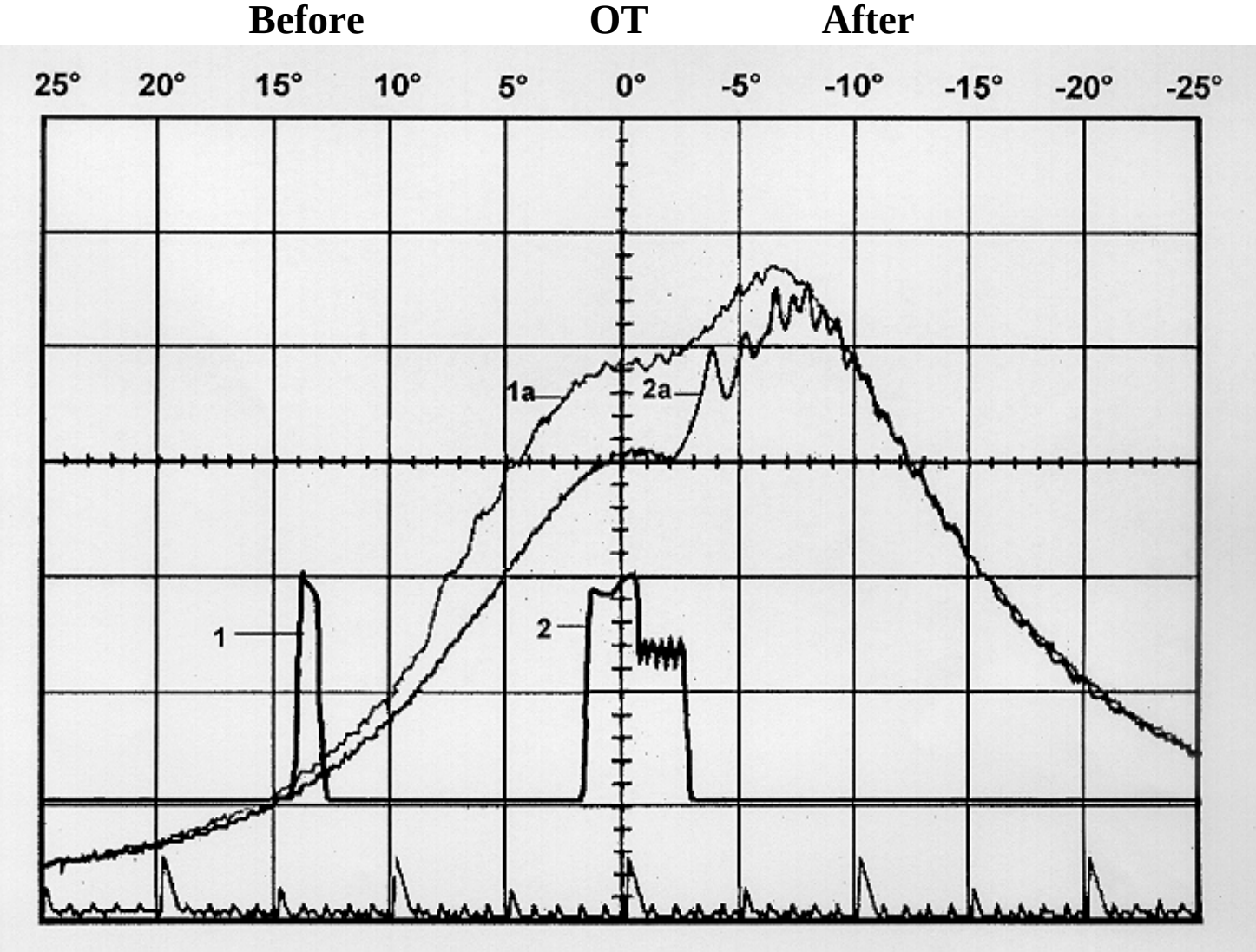
4 = Injector holding current

5 = Capacitor charge (PST off)

6 = Regulated holding current (free-wheeling)

7 = Regulated holding current (power stage on)

Pilot Injection

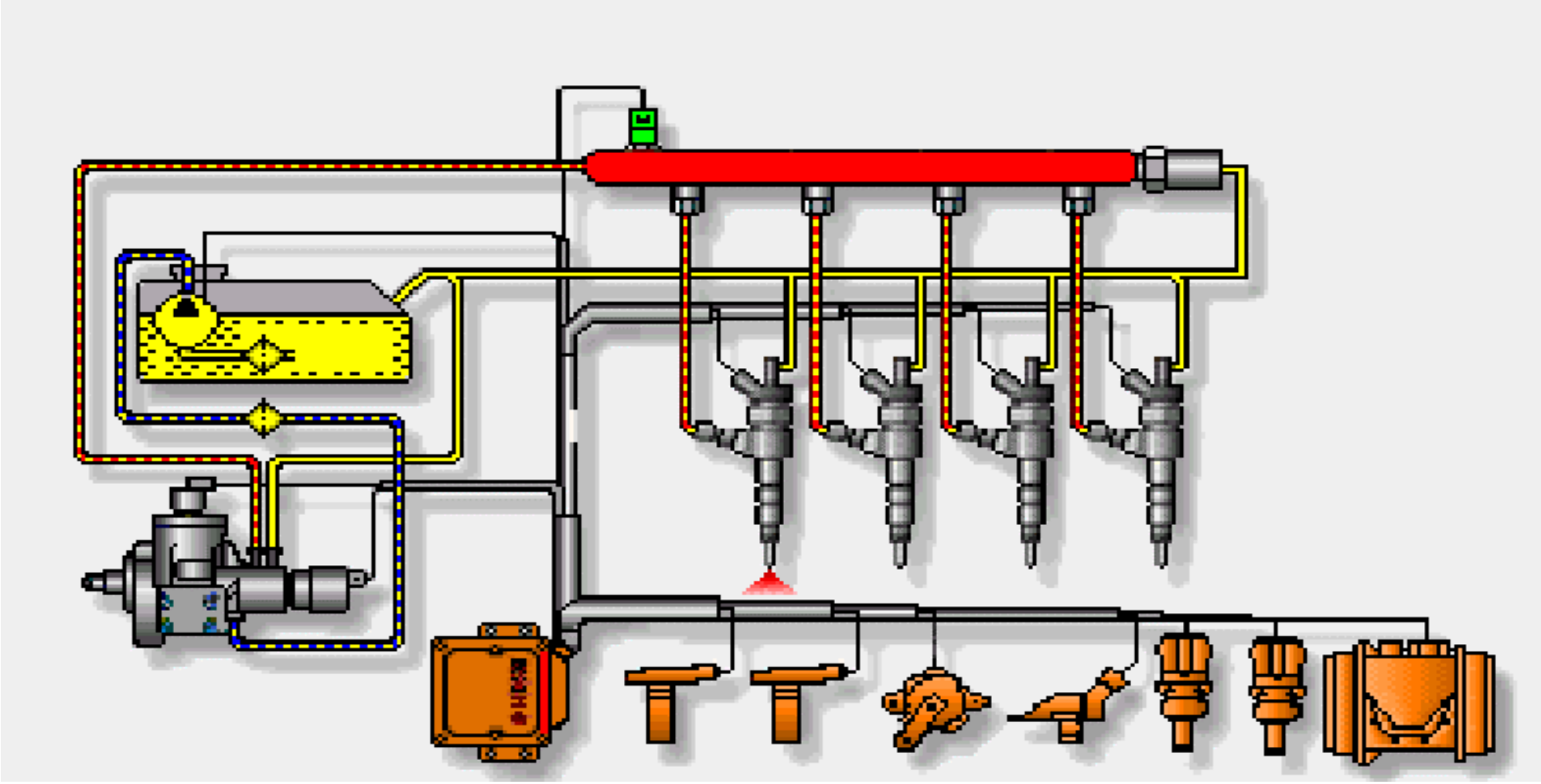


1 = Pre-injection 1a = Combustion pressure with pre-injection

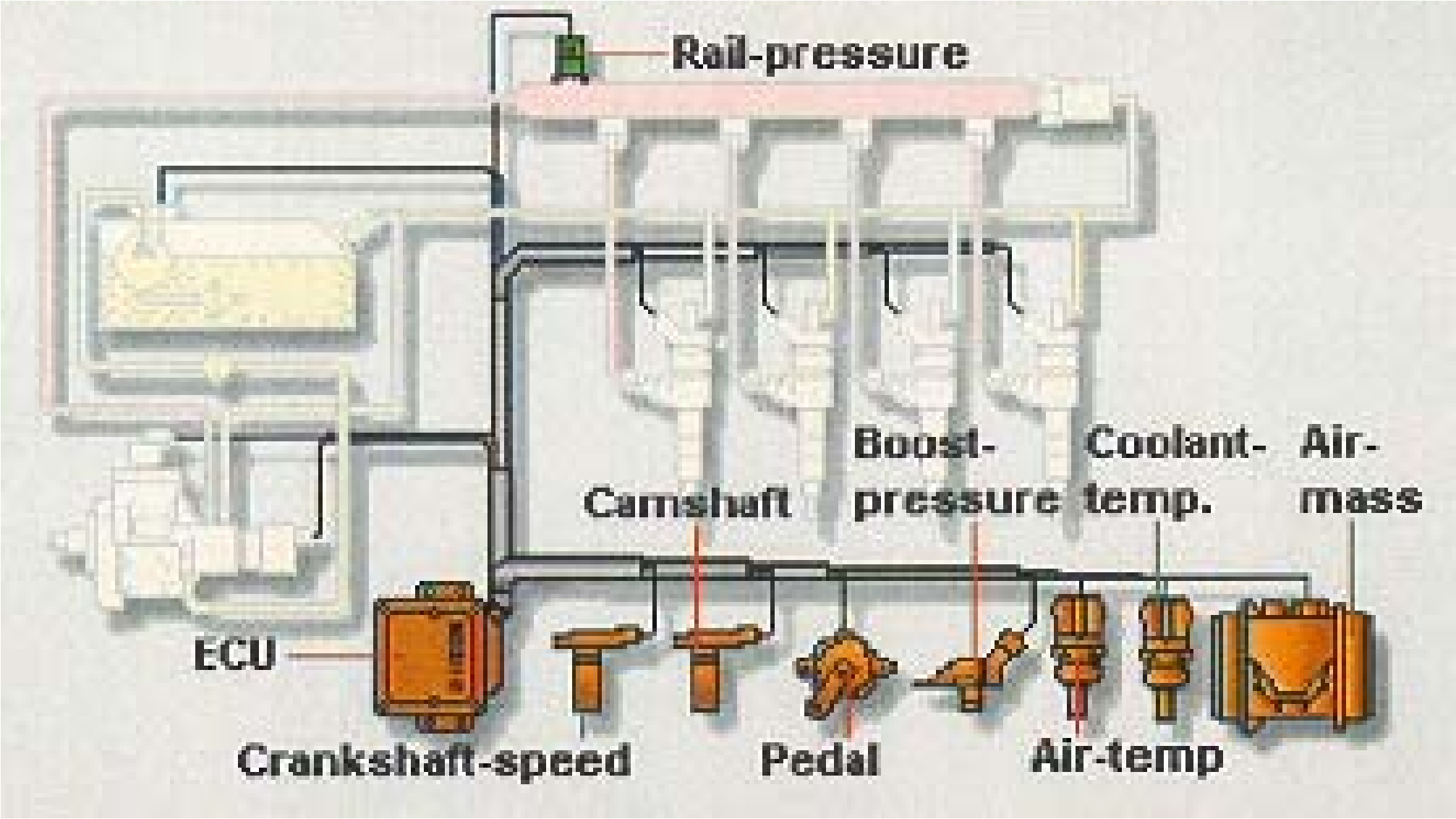
2 = Main injection 2a = Combustion pressure without pre-injection

SENSORS

Electronic Fuel Injection Control



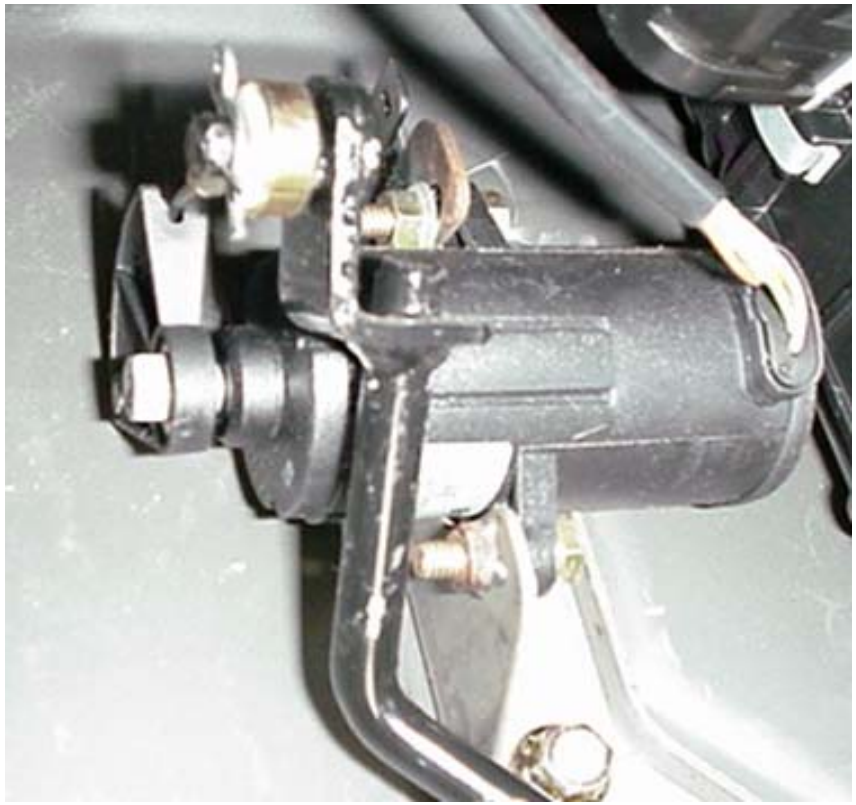
Sensors


Rail-pressure
Boost-
pressure
Coolant-
temp.
Air-
mass
Camshaft
ECU
Crankshaft-speed
Pedal
Air-temp

Accelerator-Pedal Sensor (Module)

Module Assembly

Sensor Assembly



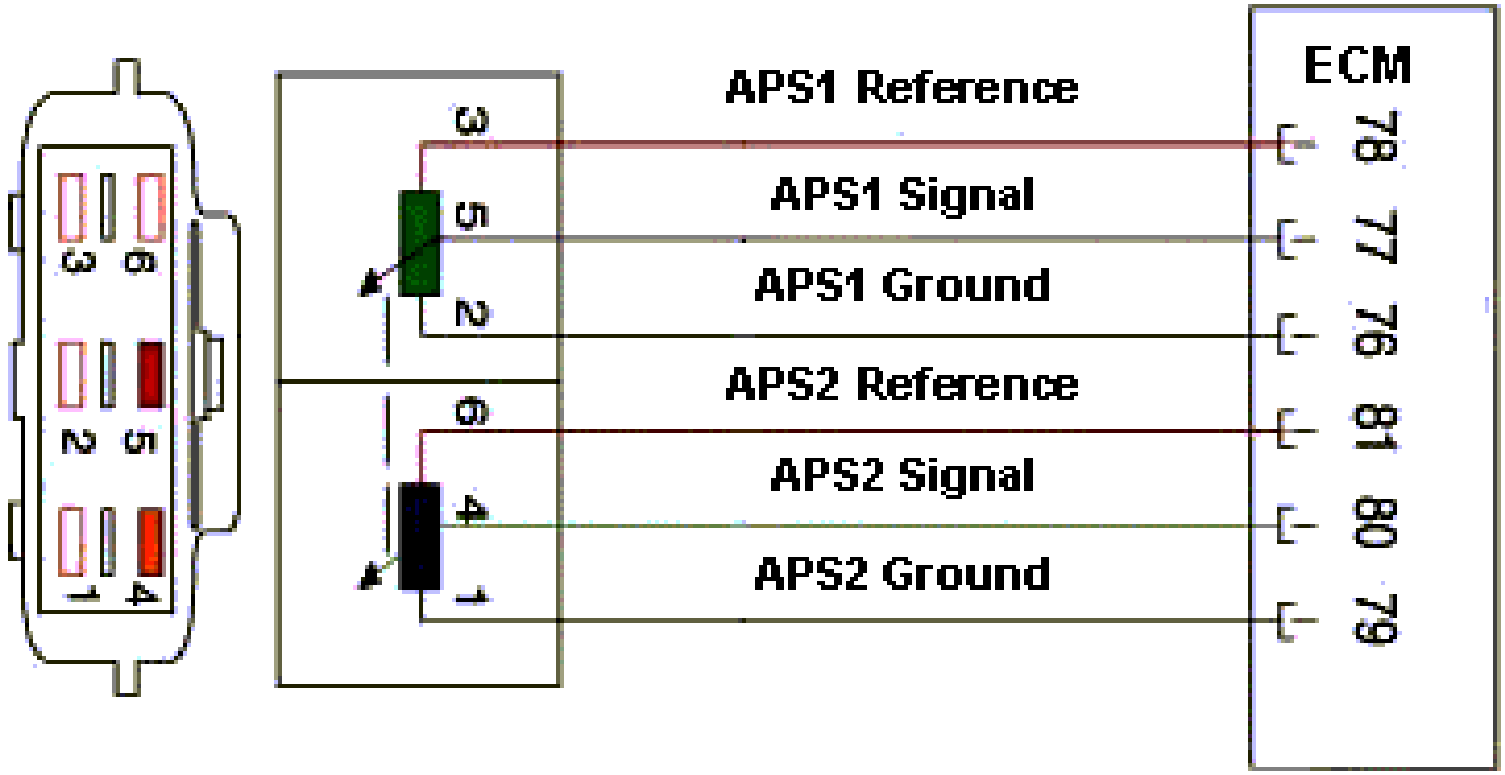
APM (Module, pedal/sensor, 1 unit)

LC, FC, SM(LHD)

APS (Pedal + sensor)

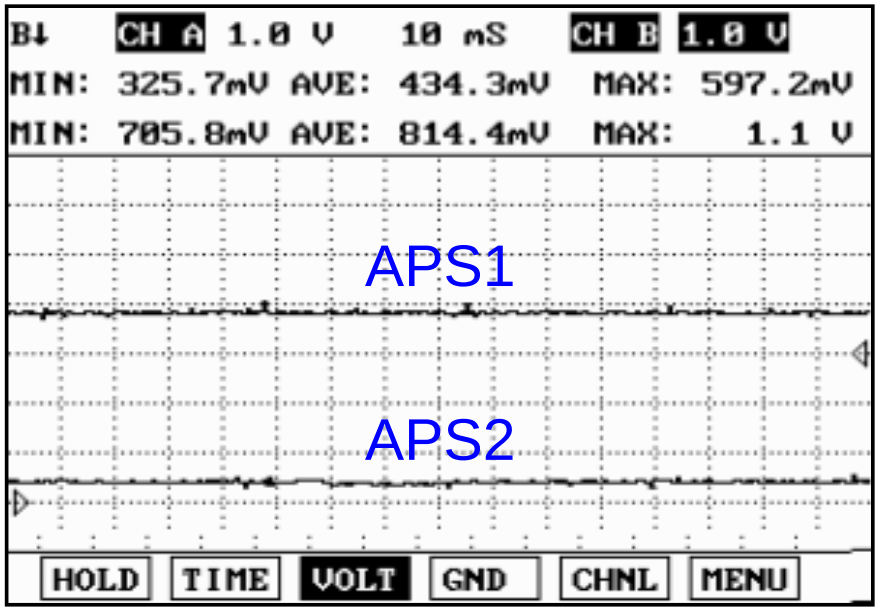
XD, FO, SM(RHD/LHD)

Accelerator-Pedal Sensor (Module)

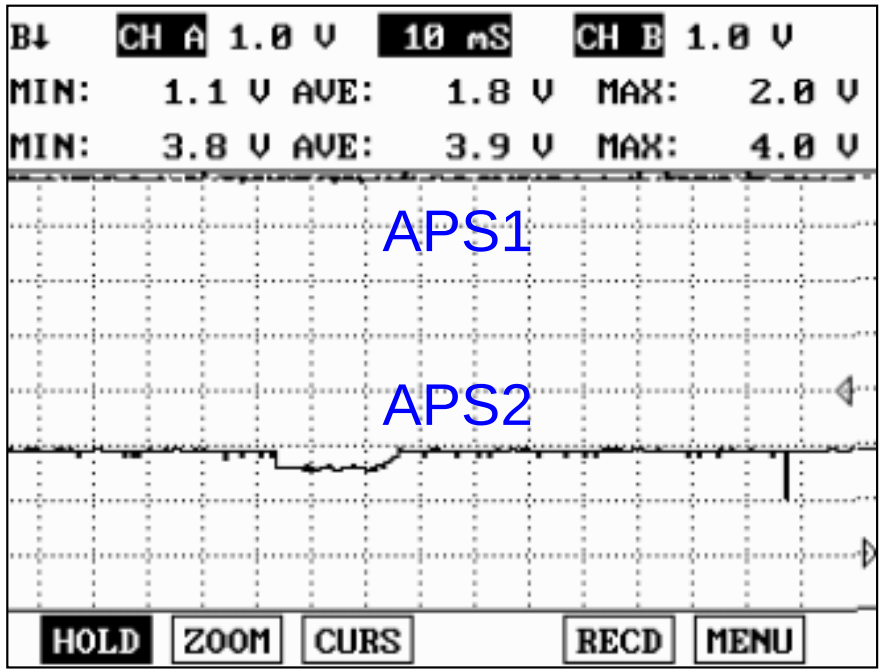


	Potentiometer 1	Potentiometer 2
IDLE	0.6 ~ 0.9V	0.25 ~ 0.6V
WOT	3.6 ~ 4.6V	1.6 ~ 2.5V

Accelerator-Pedal Sensor (Module)

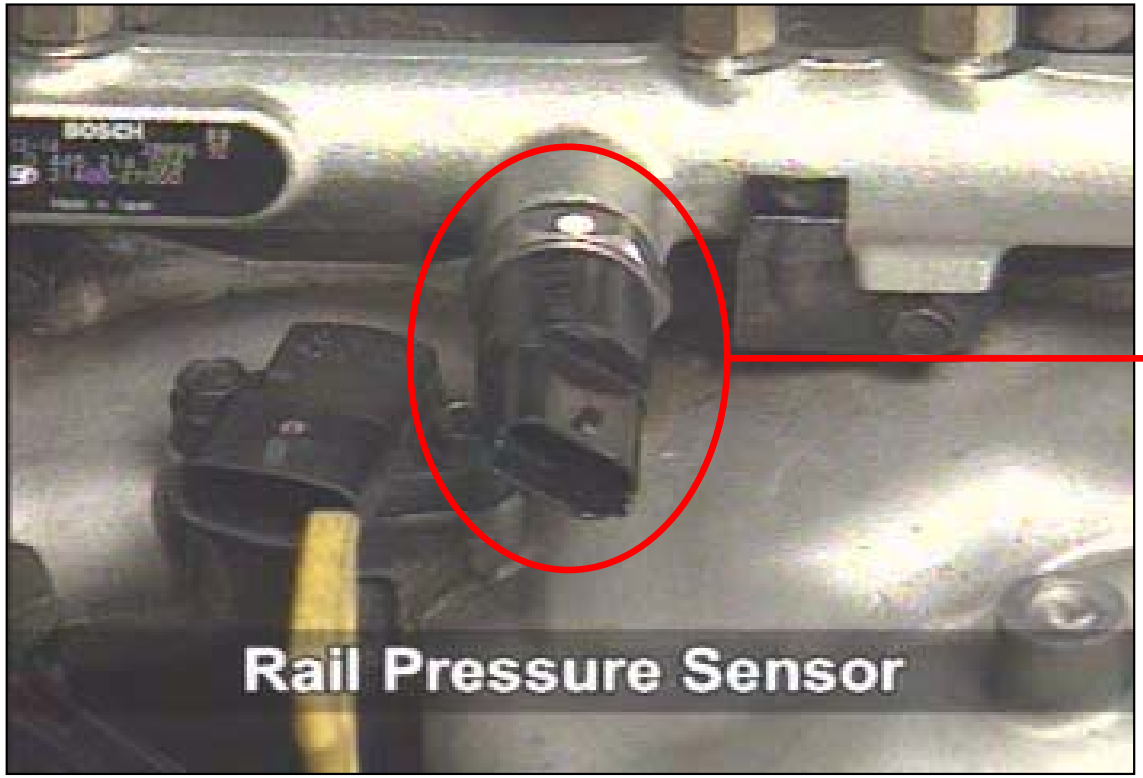


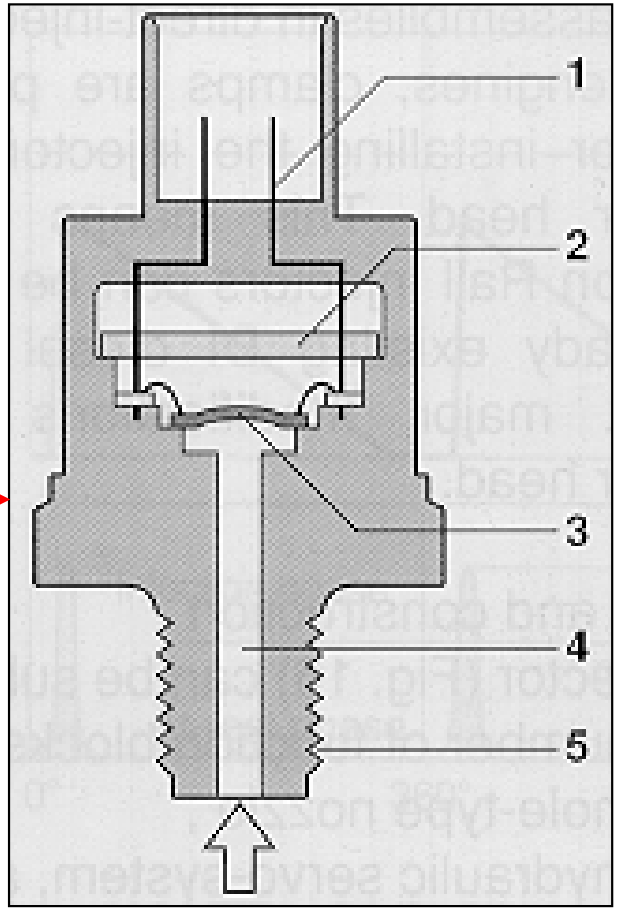
[Idle]
Average output signal in idle condition becomes 0.6~0.8V in APS 1.
(It depends on the vehicle)



[Load]
Average output signal in load condition becomes 3.9V in APS 1.
(It depends on the vehicle)

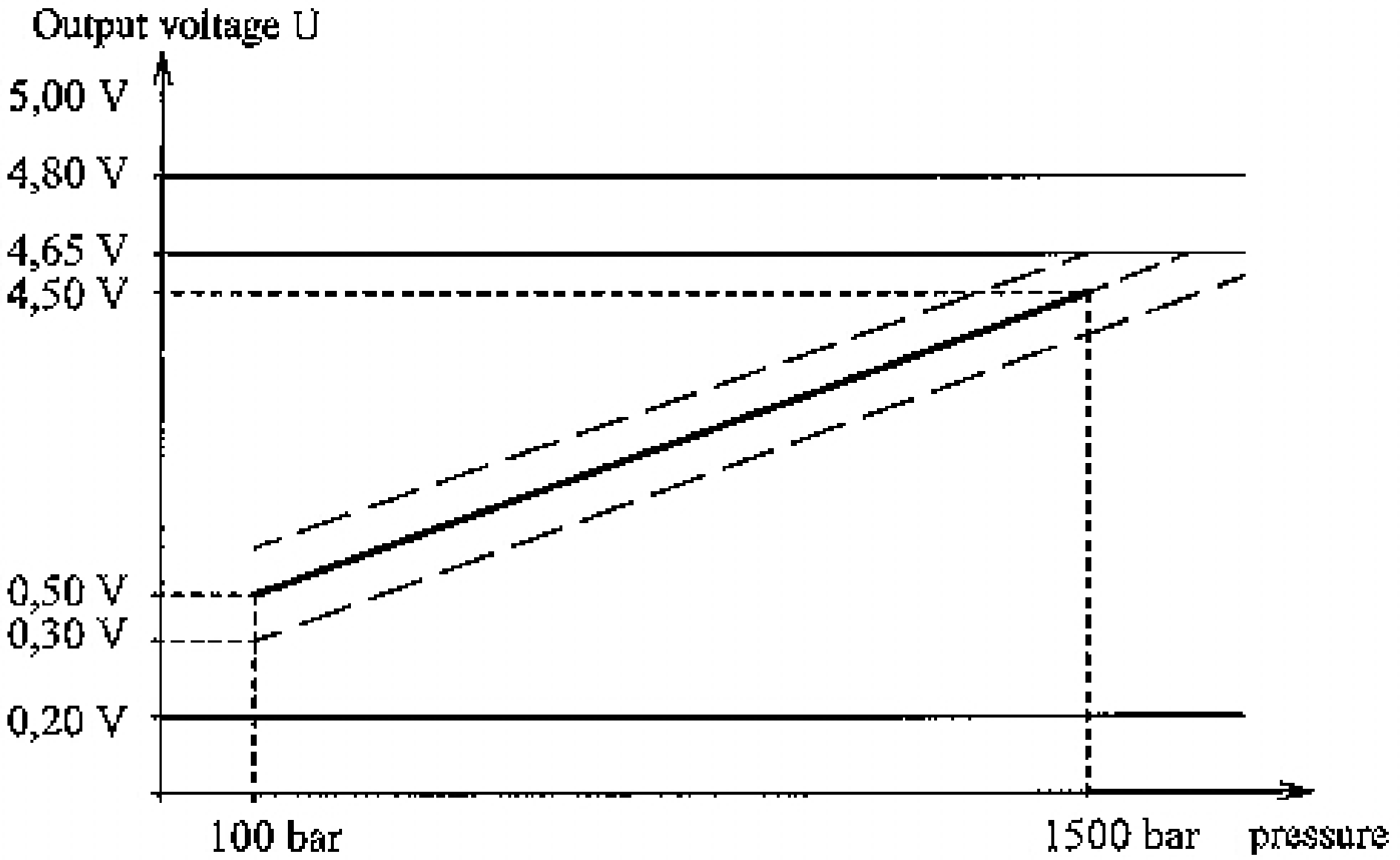
Rail Pressure Sensor



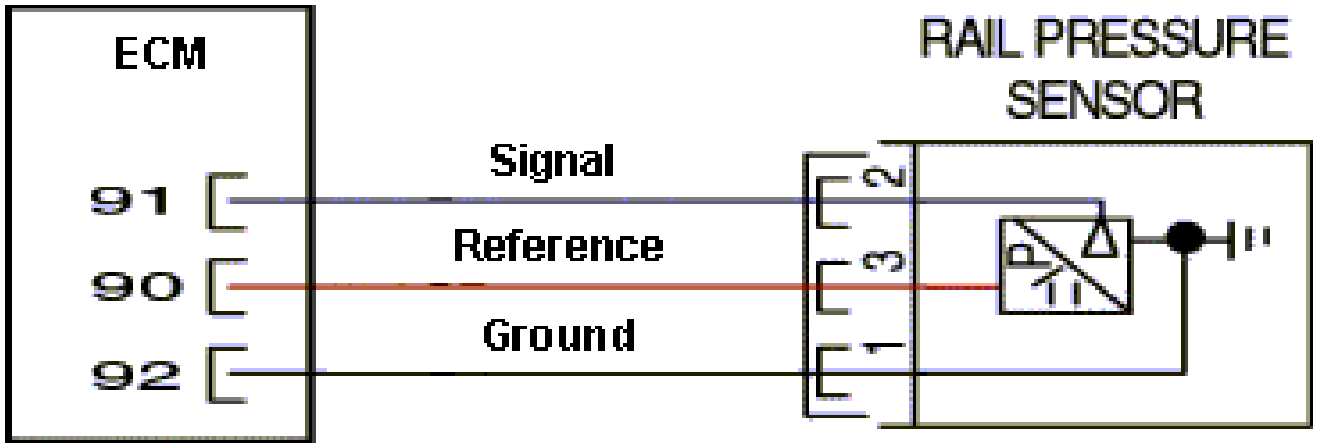


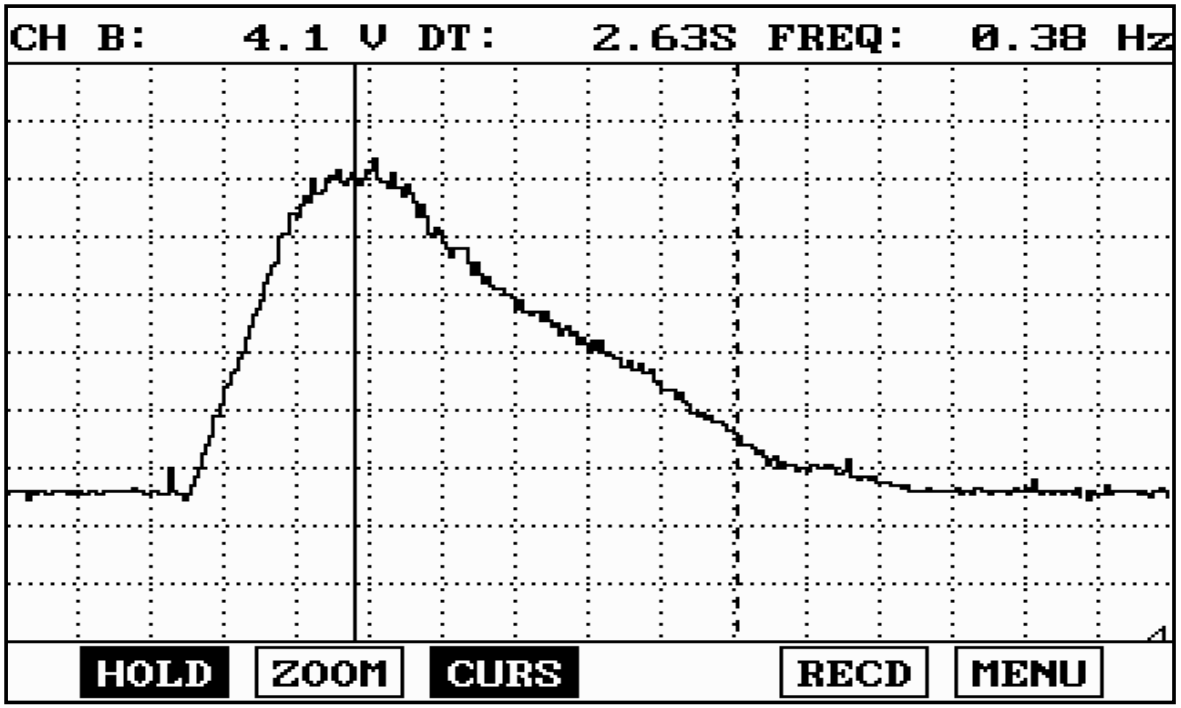
1 Electrical connections
2 Evaluation circuit
3 Diaphragm with sensor element
4 High-pressure connection
5 Mounting thread

Rail Pressure Sensor

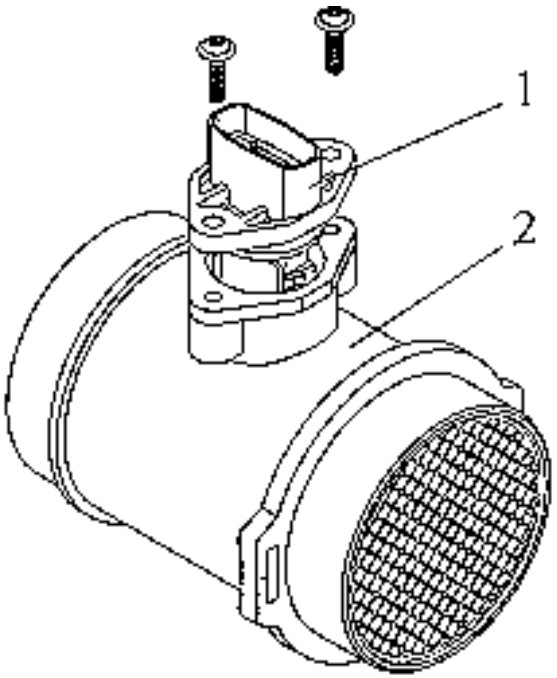


Rail Pressure Sensor

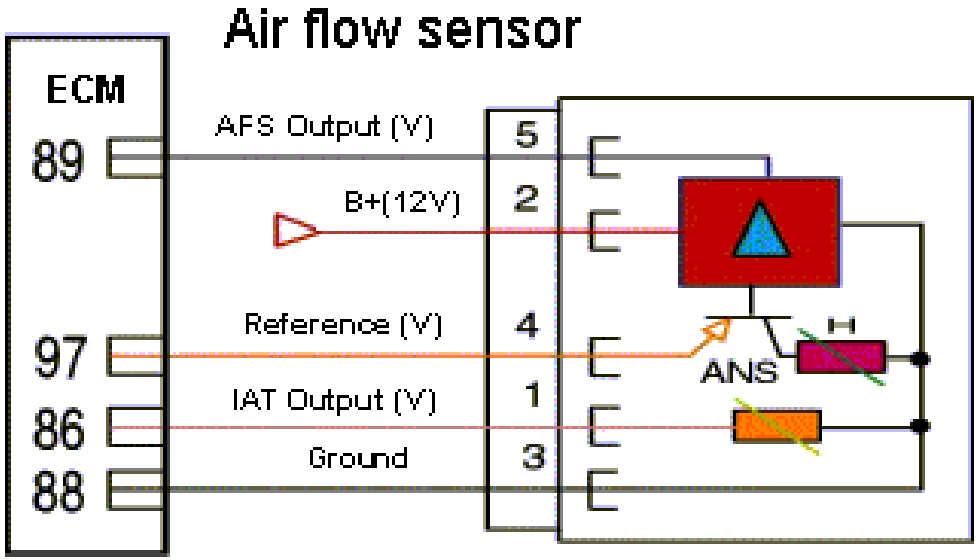




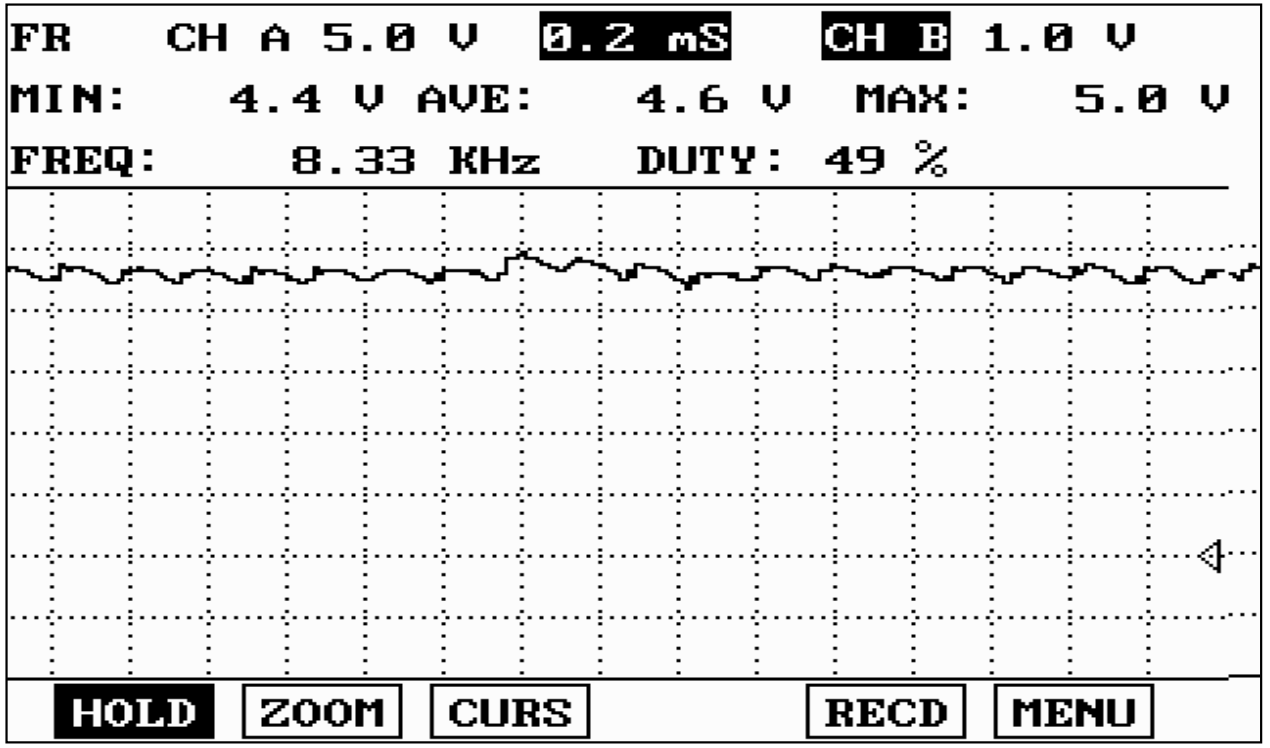
Air Flow Sensor (Hot Film Type)



1 Plug - in sensor
2 Cylinder housing
3 Cover of hybrid
4 Cover of measuring duct
5 Housing
6 Hybrid
7 Sensor
8 Mounting plate
9 O - ring
10 Temperature sensor

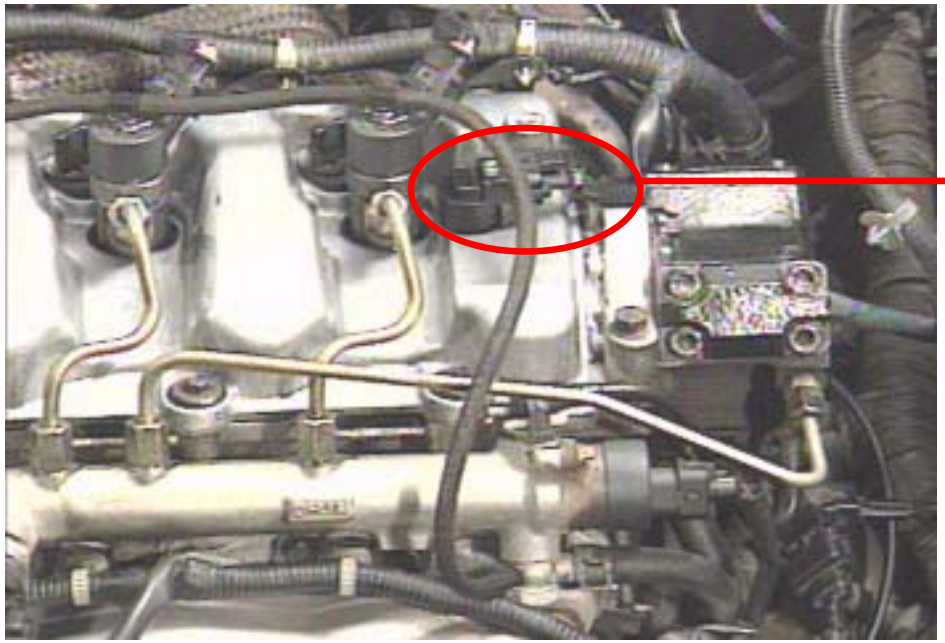


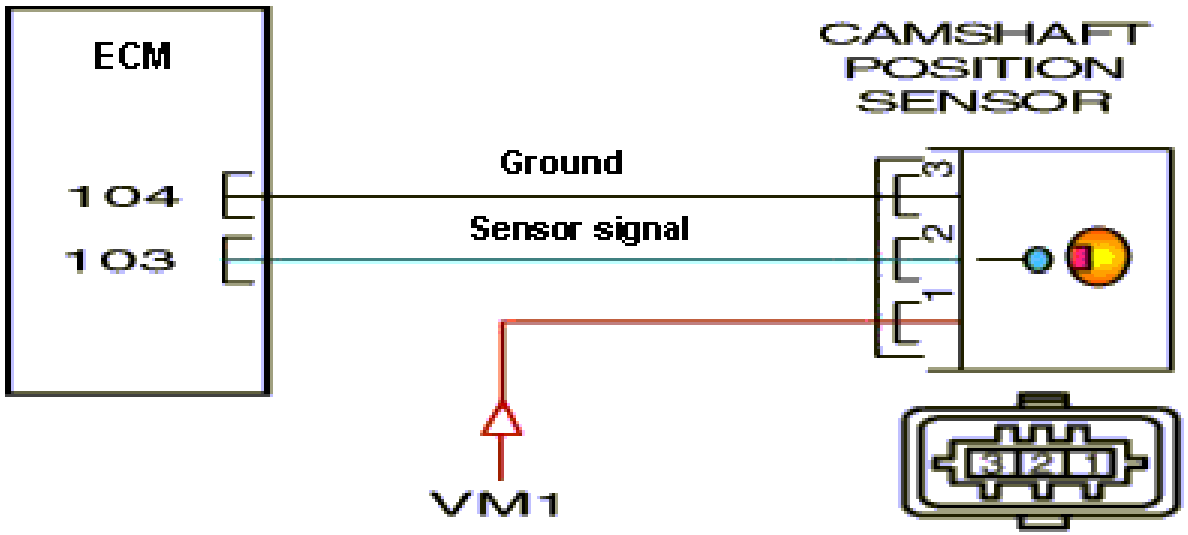
Air Flow Sensor (Hot Film Type)



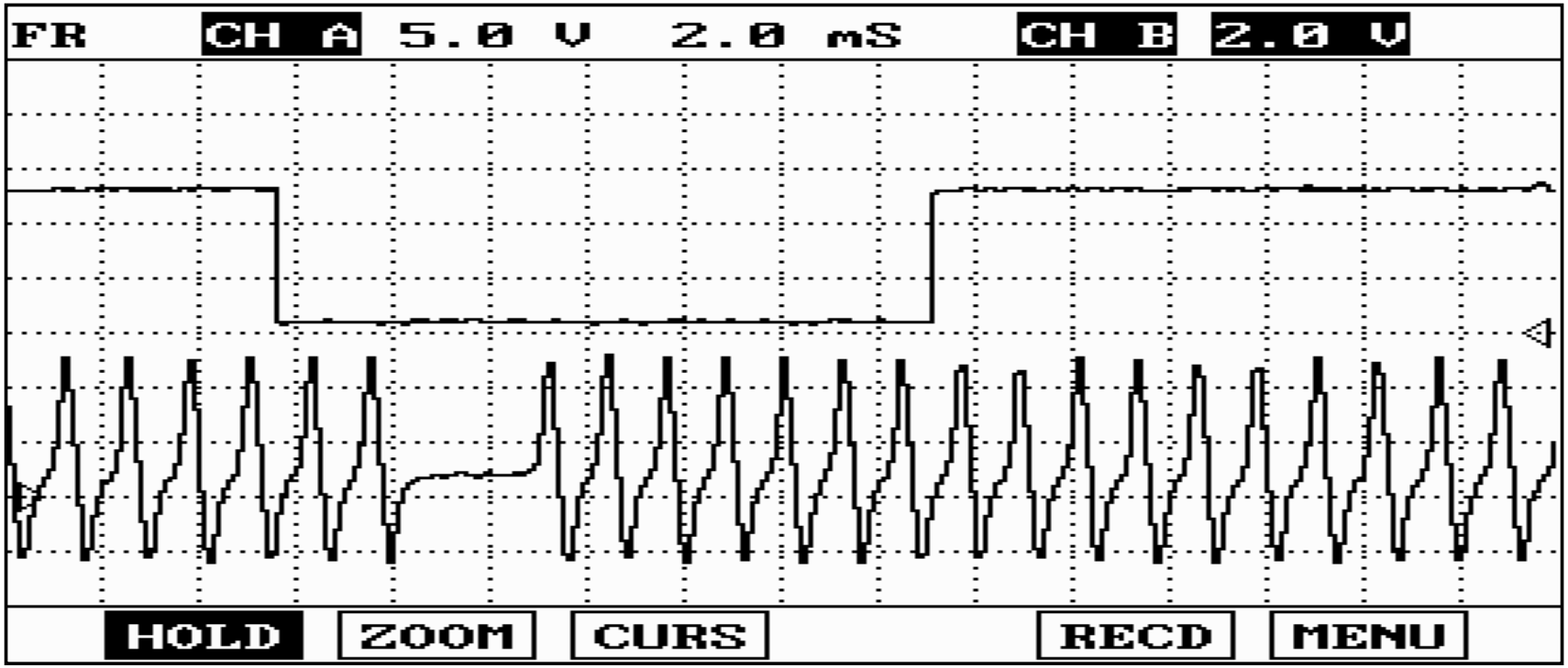
Code		Detail Description	Symptoms				Check Condition
DTC	CC		Fuel = 0	EGR off	Fuel Limit	MIL On	
P0100	C001	Signal below lower limit(Air mass <-20kg/h)		Y	Y		Eng. Run
	C002	Signal above upper limit(Air mass>800kg/h)					
	C003	General Error(Reference Volt> 4.7~5.1)					

Camshaft position sensor



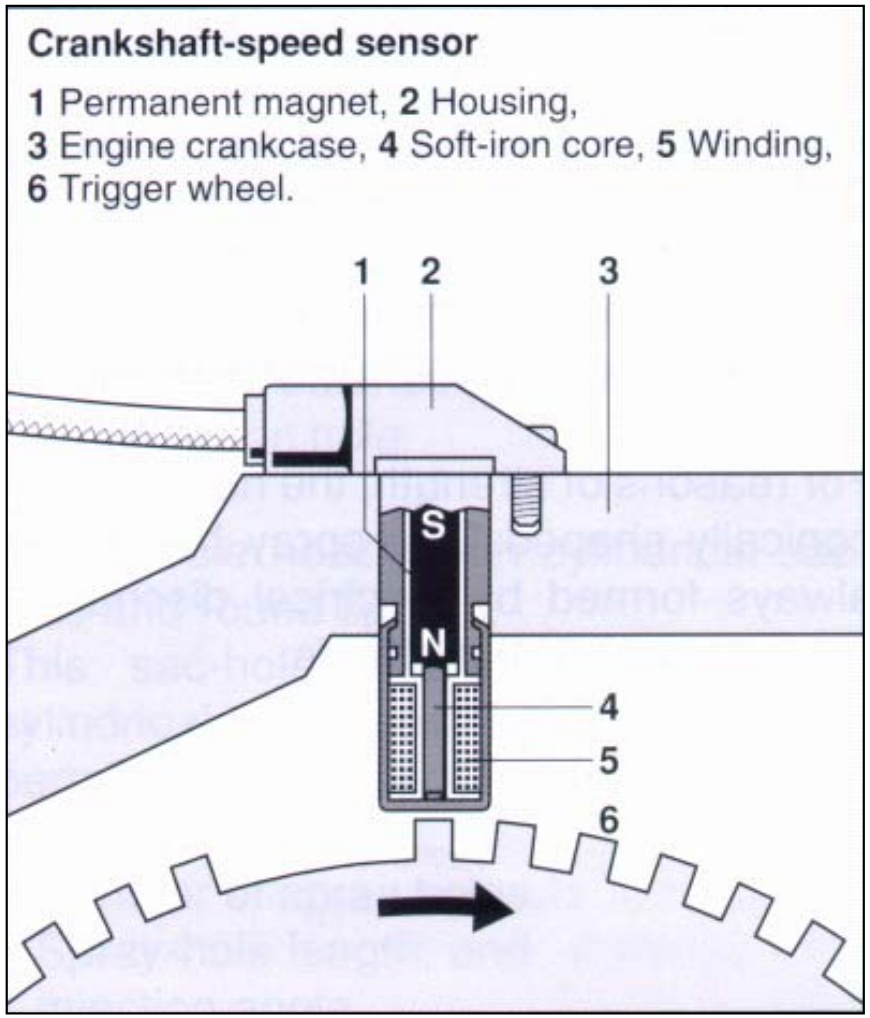


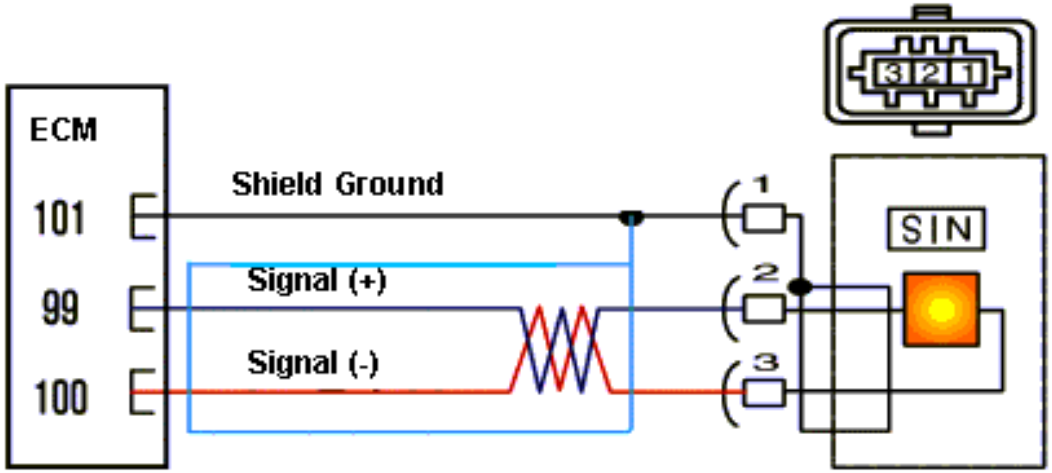
Camshaft position sensor



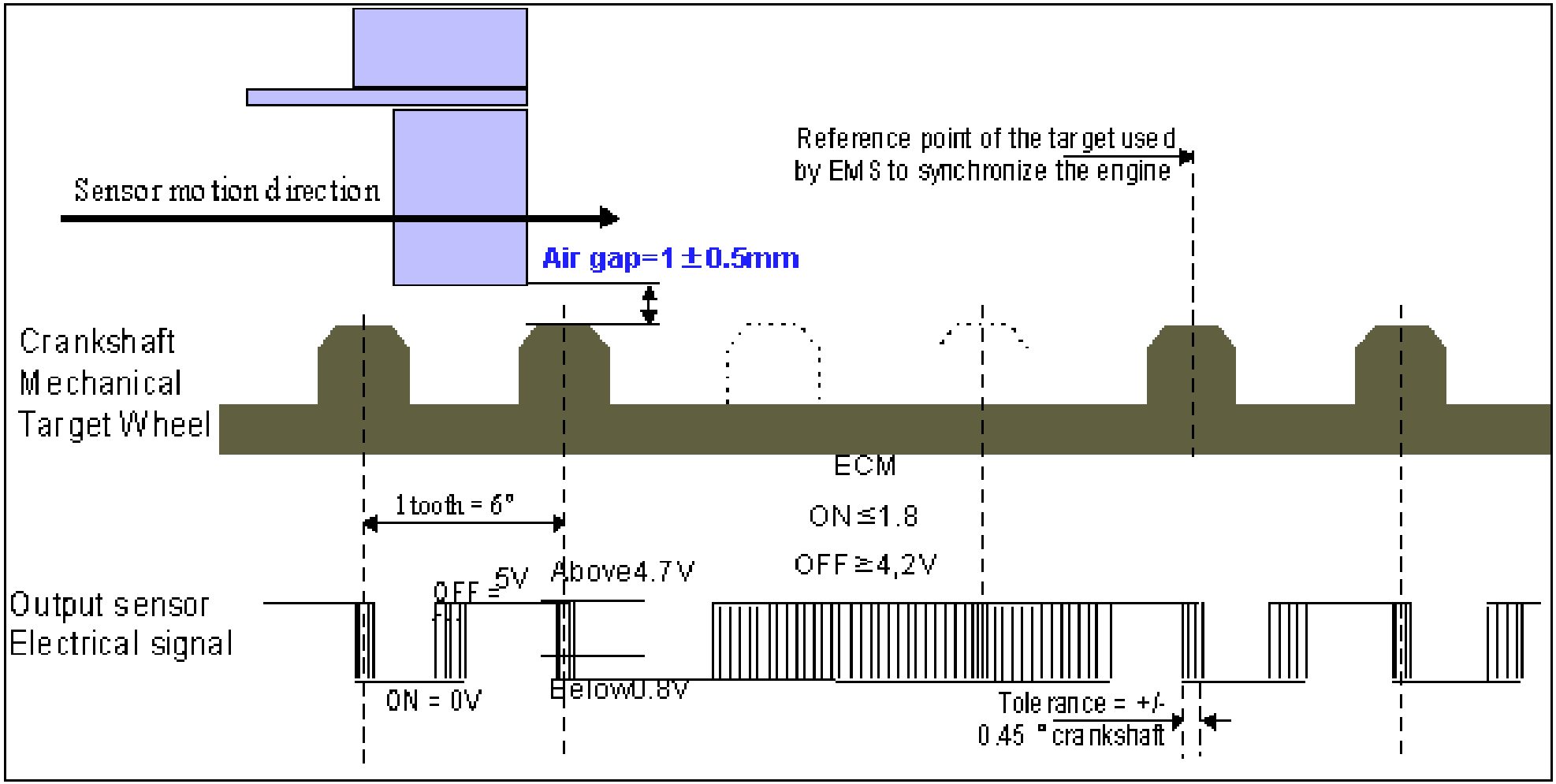
Code		Detail Description	Symptoms				Check Condition
DTC	CC		Fuel = 0	EGR off	Fuel Limit	MIL On	
0340	C001	CMP signal below lower limit(No signal)	No START			Y	Eng. Run
	C002	CMP Signal above upper limit					
	C003	CKP&CMP General error (Rationality check)	Y				
	C004	CKP Plausibility error					

Crankshaft Position Sensor

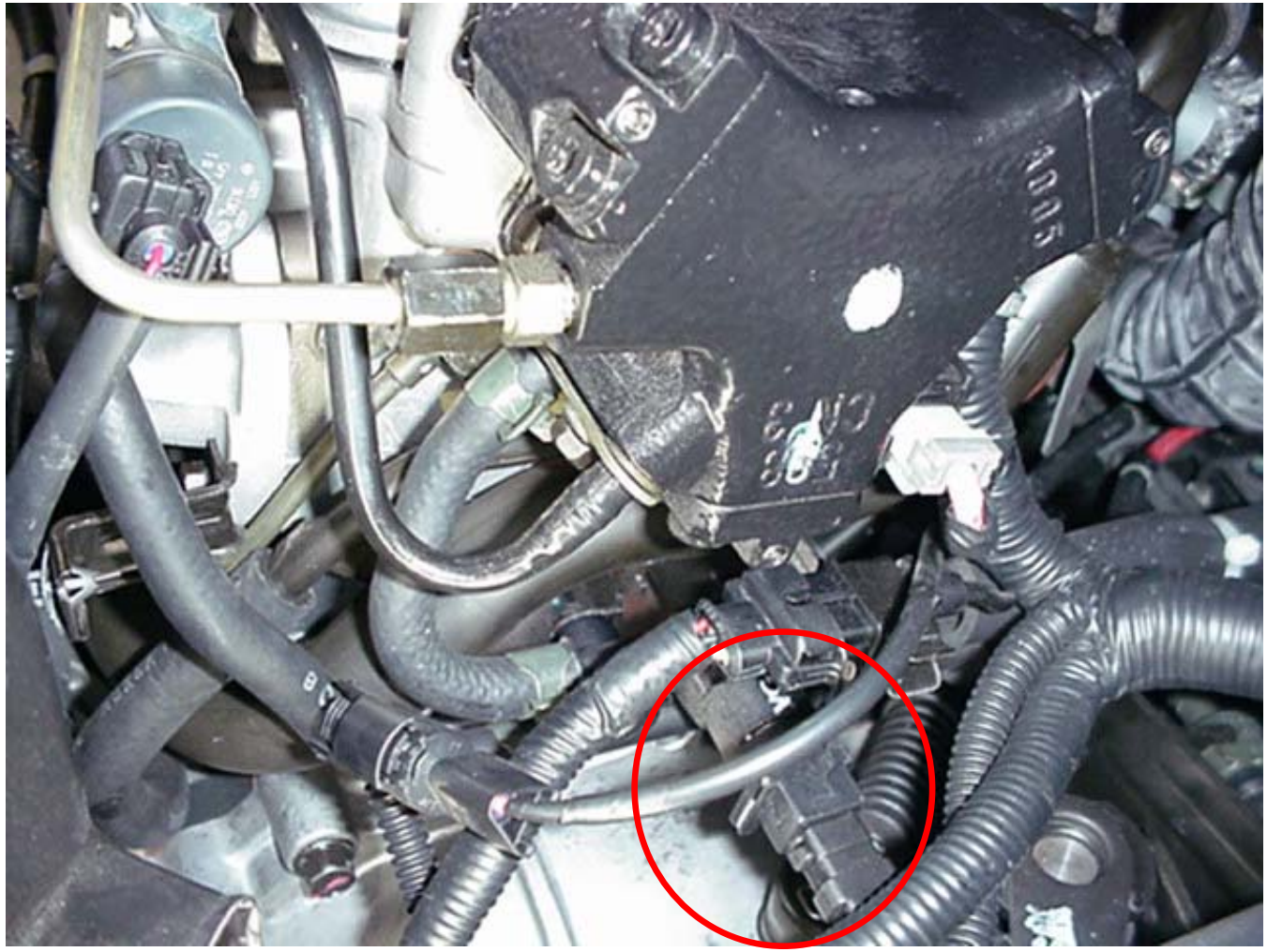




Crankshaft Position Sensor Operation



Fuel Temperature Sensor



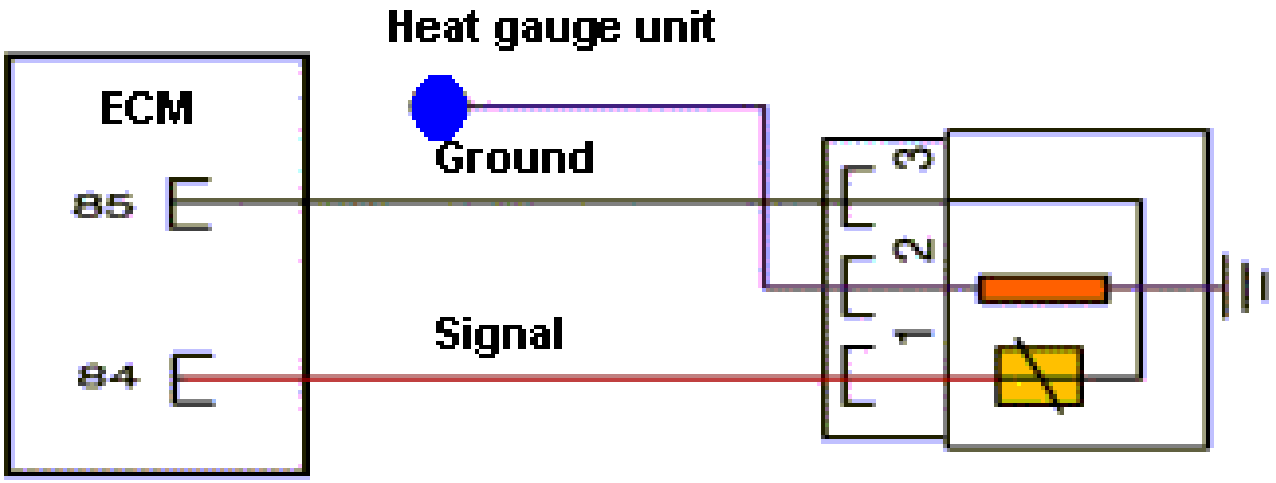
Fuel Temperature Sensor

Coolant Temperature Sensor

D-engine

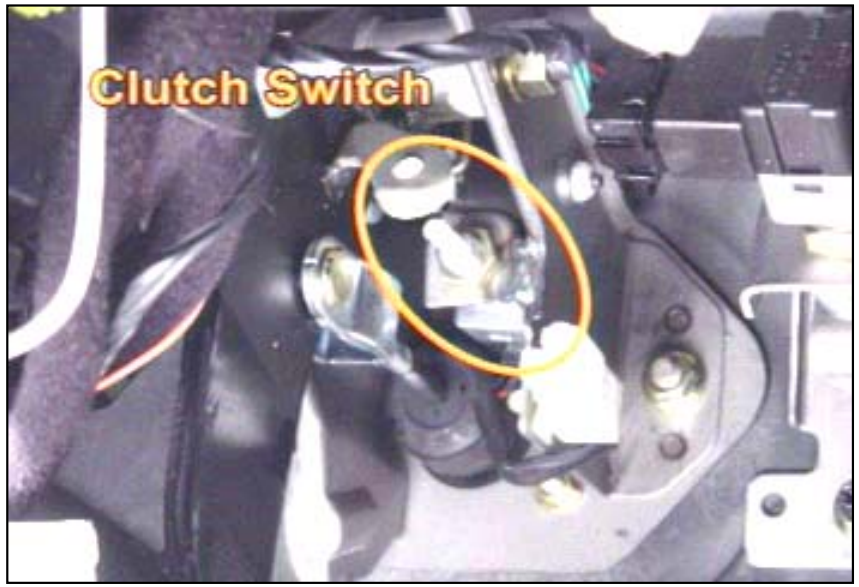
A-engine

Coolant Temperature Sensor



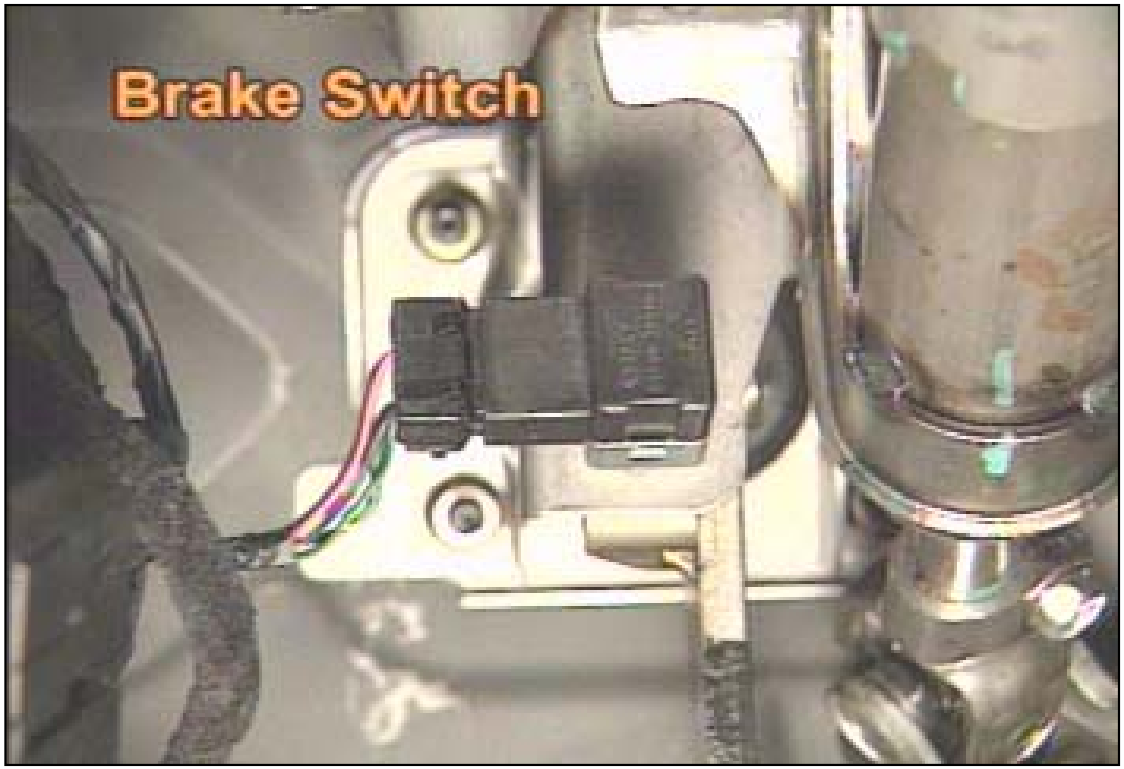
Code		Detail Description	Symptoms				Check Condition
DTC	CC		Fuel = 0	EGR off	Fuel Limit	MIL On	
C0115	C001	Signal below lower limit(Signal <225mV)					IG. On
	C002	Signal above upper limit(Signal>4.9V)					

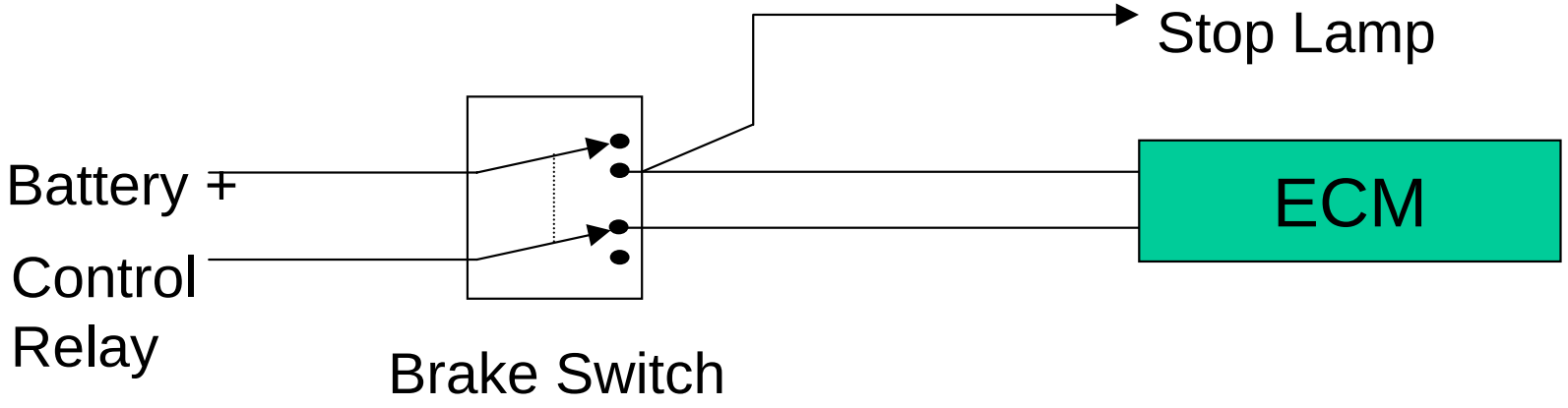
Clutch Switch



- Cancellation of cruise control
- Impending engine load signal (de-clutch, engage first gear, move off)
- To prevent engine RPM surging when de-clutching during gear changes, ECM adjusts injector operation.

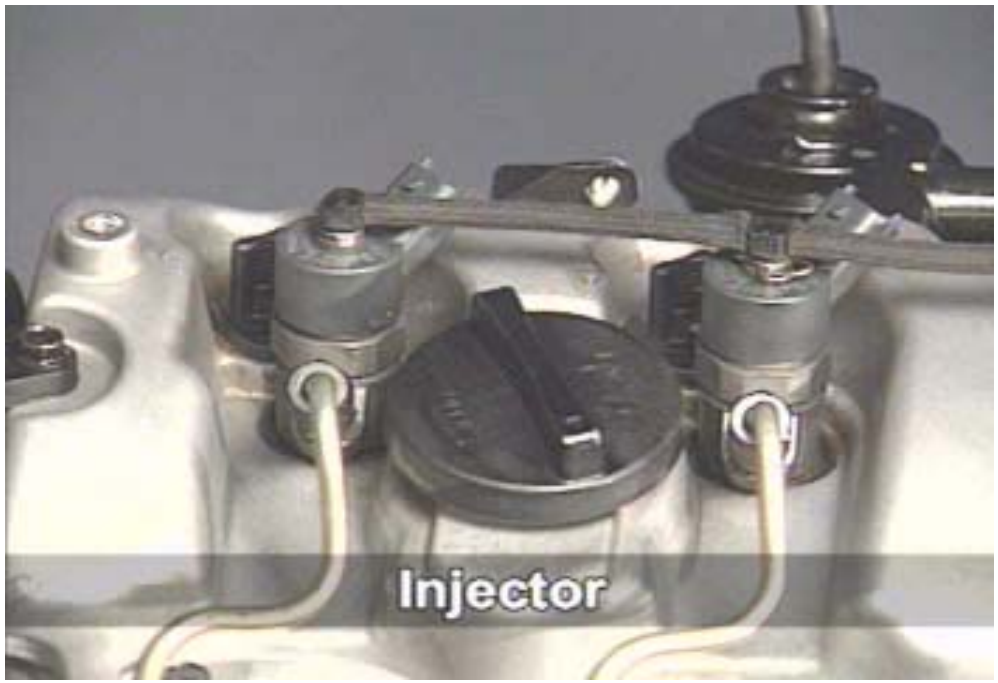
Brake Switch



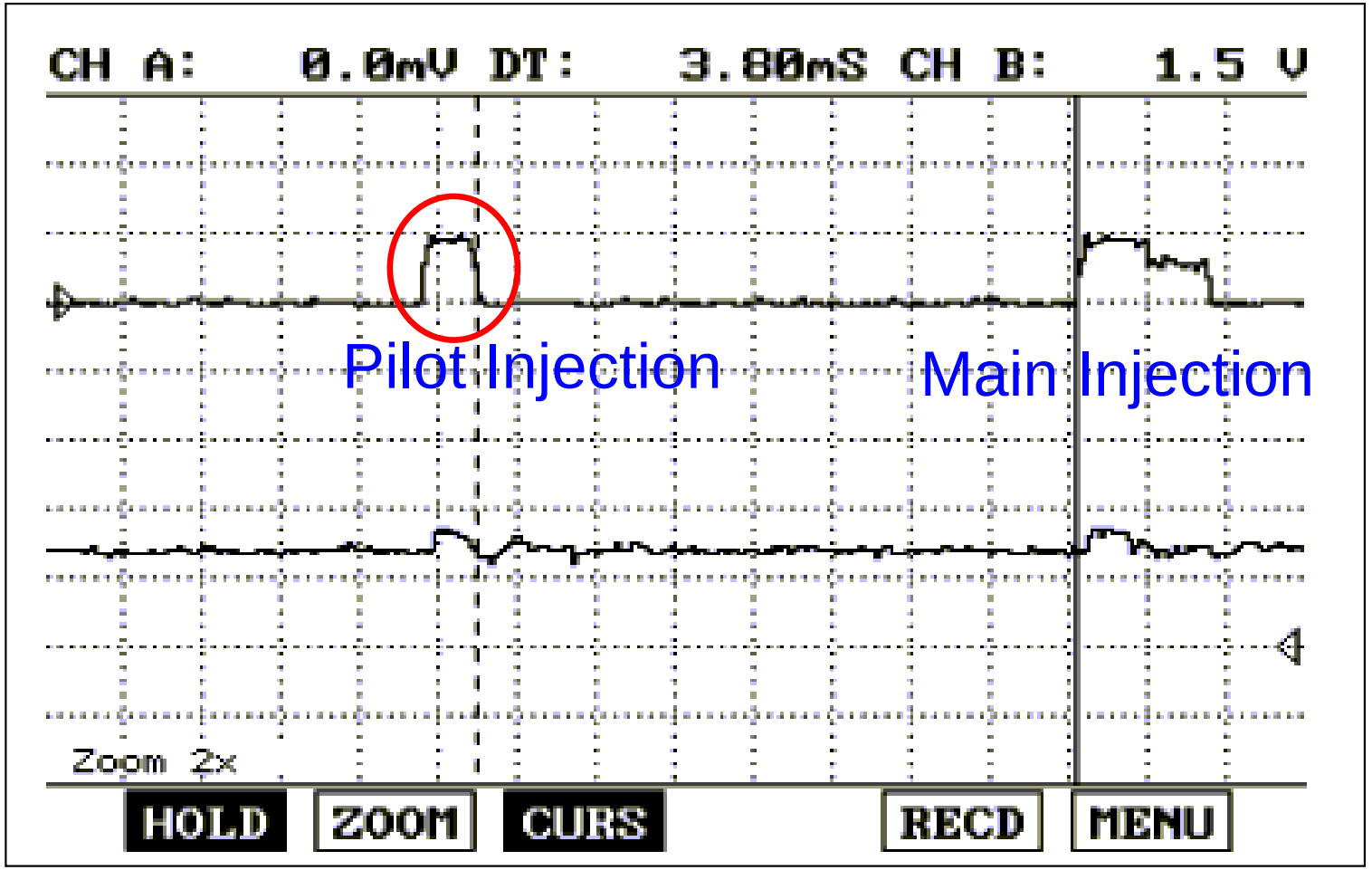


ACTUATORS

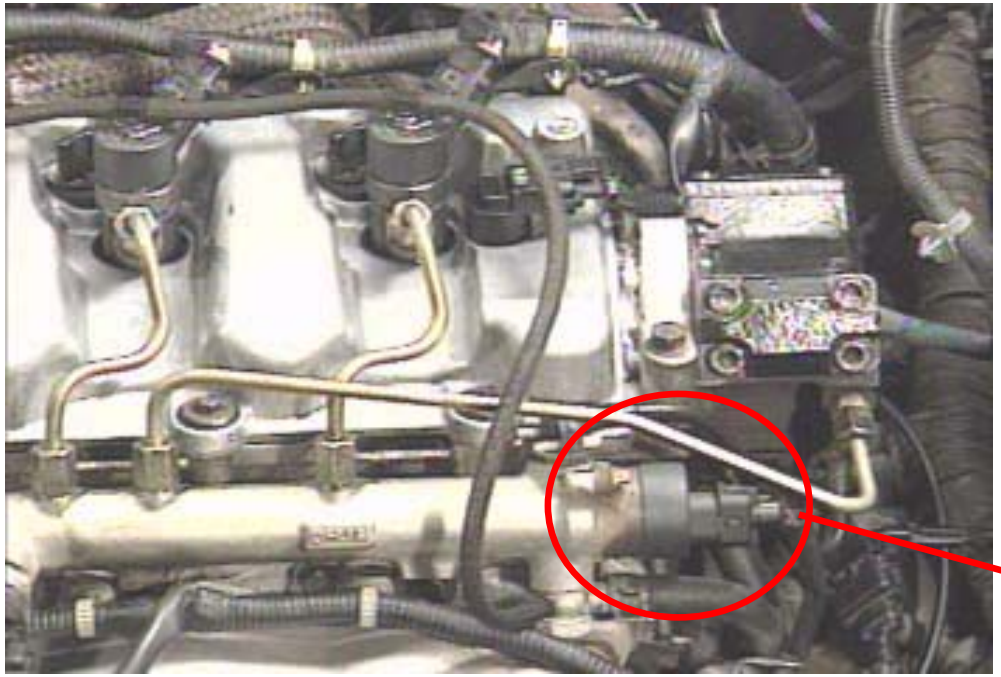
Injector



Injector

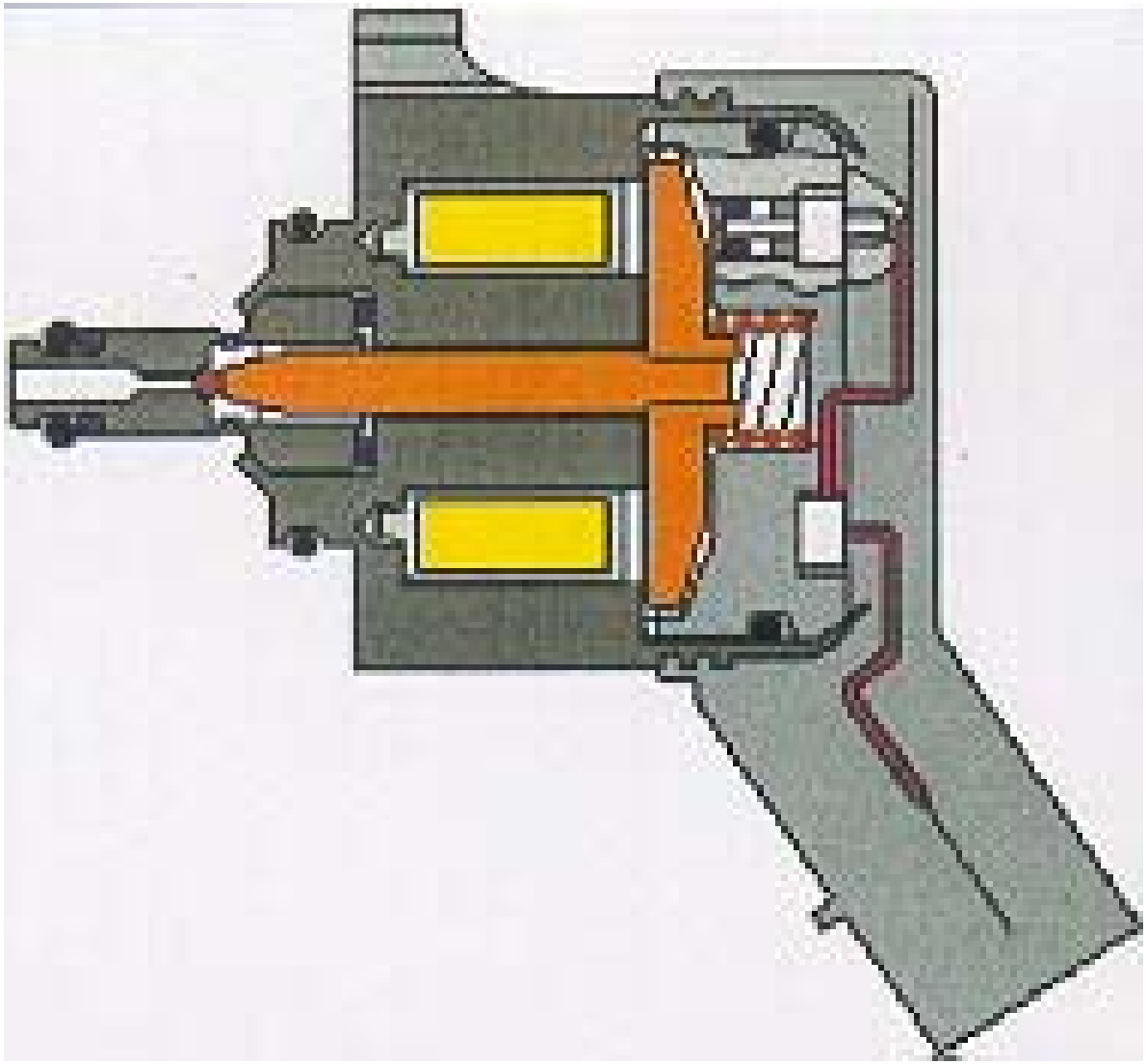

CH A: 0.0mV DT: 3.80mS CH B: 1.5 V
Pilot Injection
Main Injection
Zoom 2x
HOLD
ZOOM
CURS
RECD
MENU

Rail Pressure Control Valve

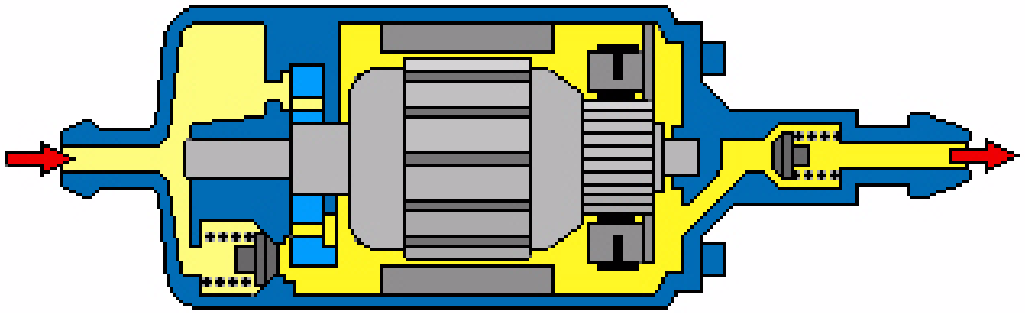


CP1

Rail Pressure Control Valve Operation



Pre-Supply Pump (low pressure pump)



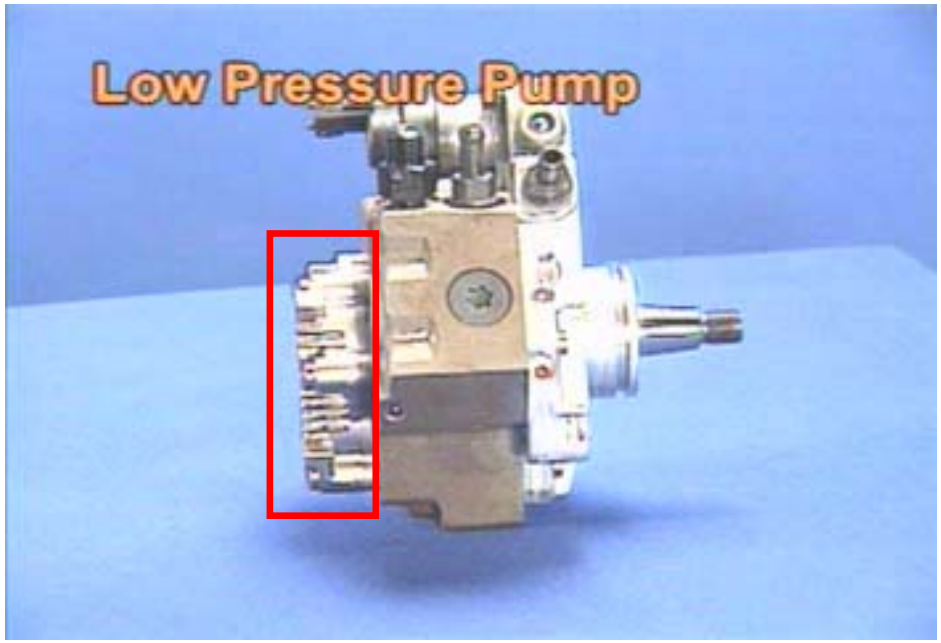
Pre-Supply Pump

Located next to the fuel tank

Electrical Pump

CP1

Pre-Supply Pump (low pressure pump)



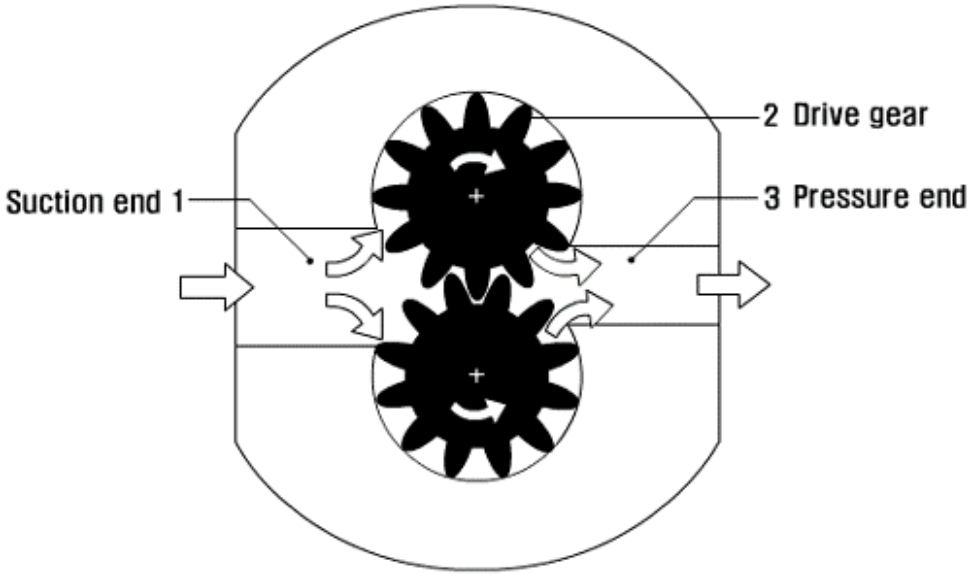
Low Pressure Pump

Located rear side of High Pressure Pump

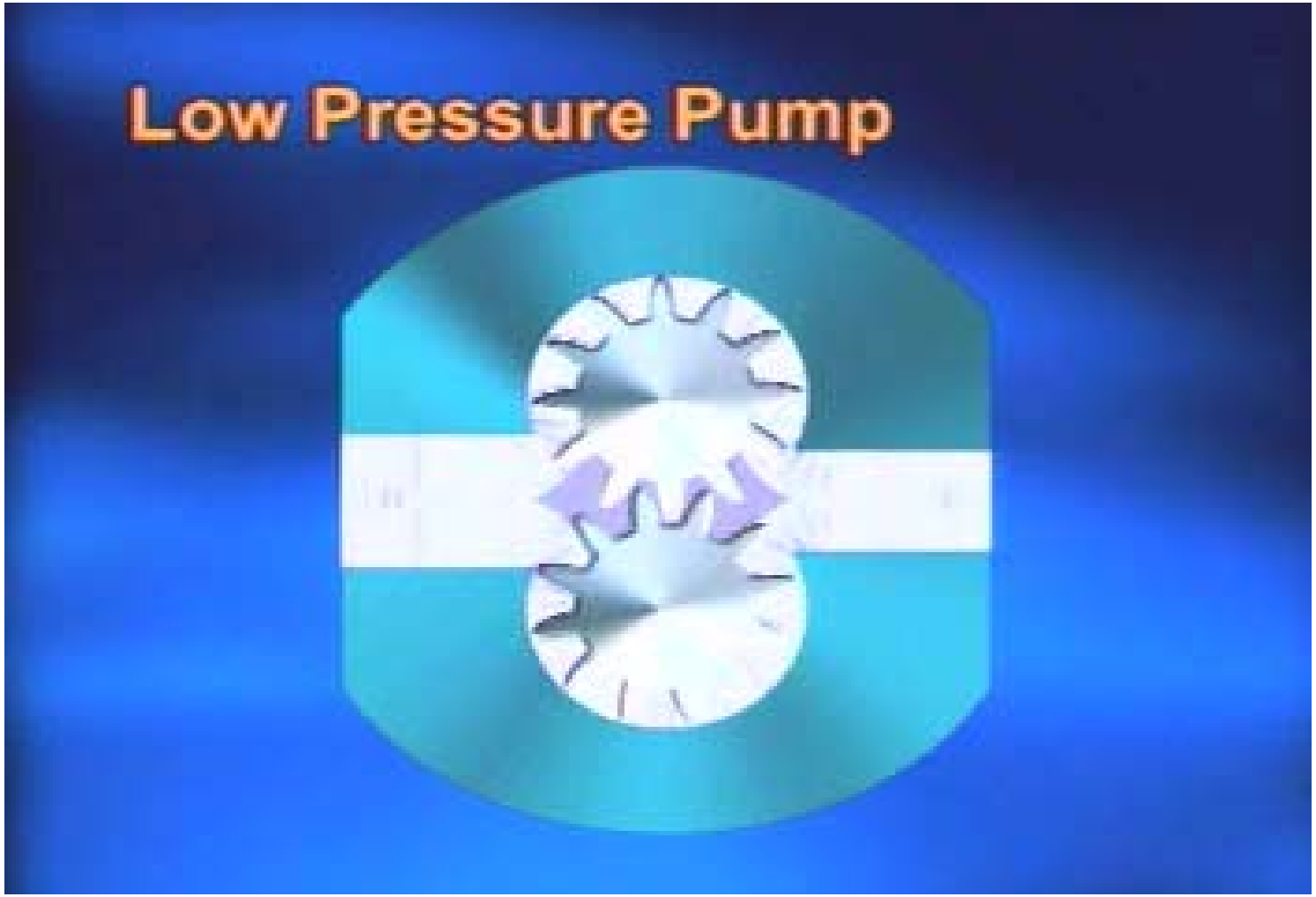
Mechanical Gear Pump

CP3

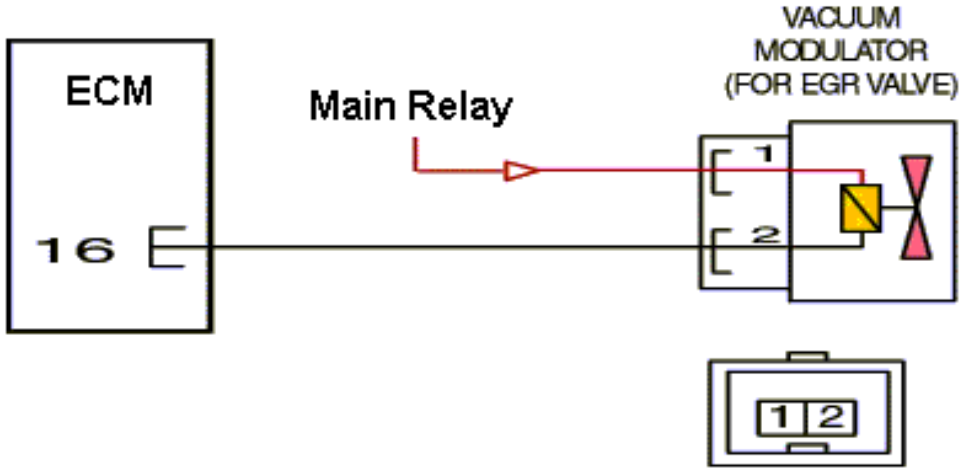
Gear-type fuel pump (schematic)



Pre-Supply Pump (low pressure pump) Operation



Exhaust Gas Re-circulation (EGR)

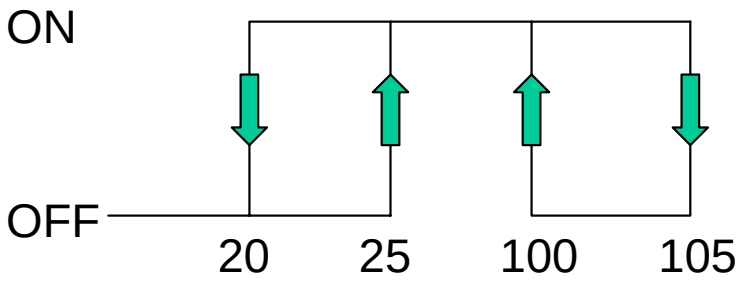


EGR Operation Condition

EGR OFF Condition

- Less than 650 RPM
- Pressure sensor malfunction
- Air flow sensor malfunction
- EGR malfunction
- Battery below 9V
- Injection Quantity over 42 mm^3
- Engine over 3050 RPM
- Idle condition (below 1000RPM for 52 sec´s

- Coolant Temperature



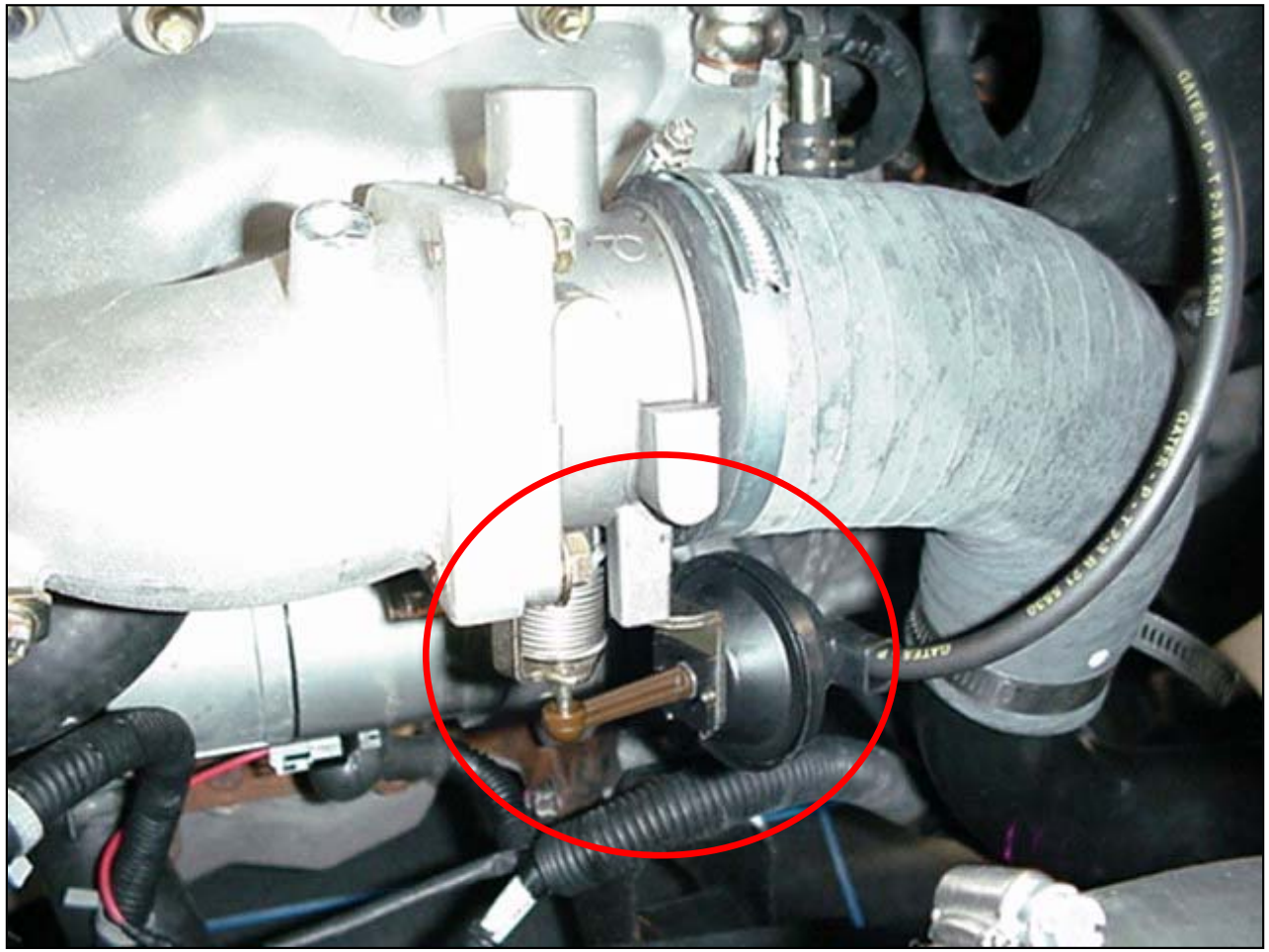
(Slight differences between models)

- Atmospheric pressure (high altitiude)

  Lower 920 mbar OFF

  Over 930 mbar ON

(EGR) Throttle valve control



Throttle Valve and Actuator

Glow Plug

Checking operation

Connect battery power to glow plug directly

Glow Plug

Pre glow

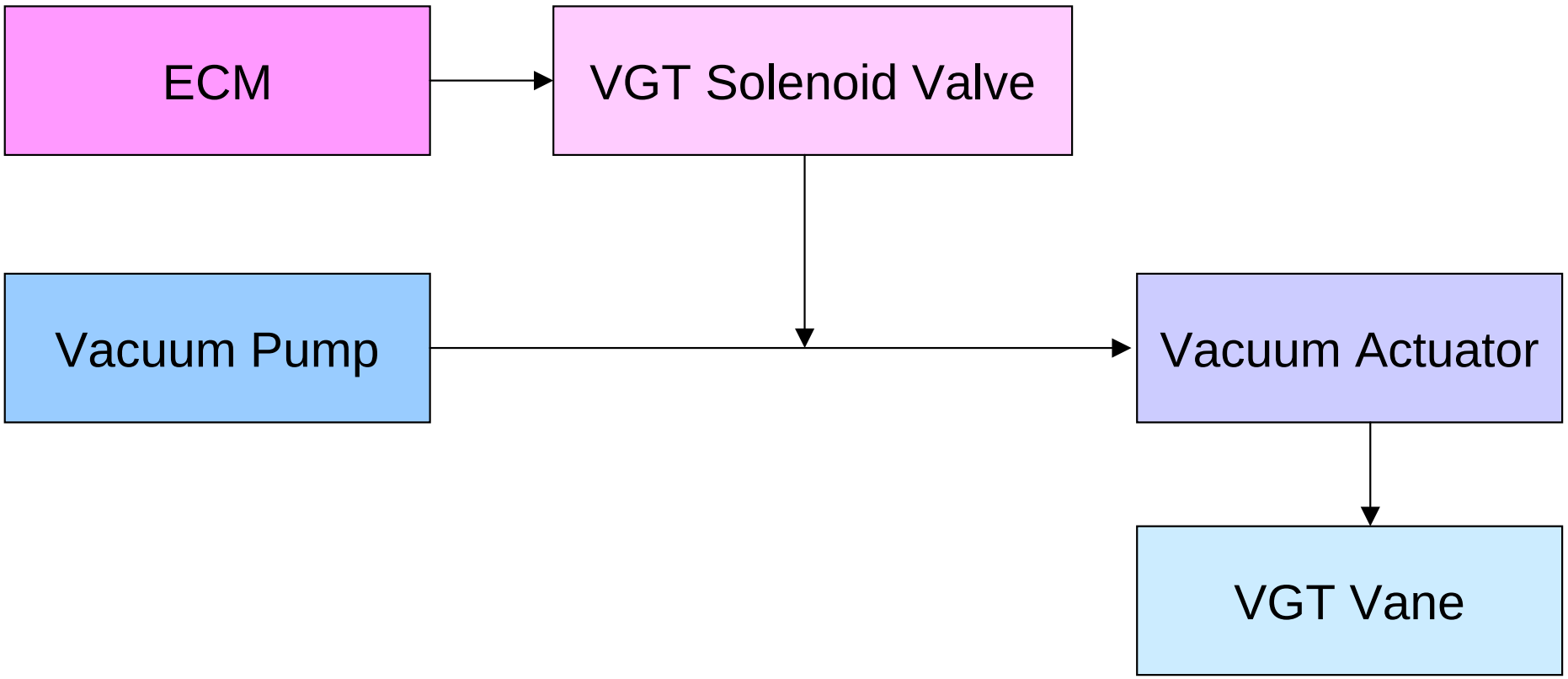
Coolant Temp.(℃)	-20℃	-10 ℃	20 ℃	50 ℃
Glow time (Sec.)	12	8	3	0.7

Post glow

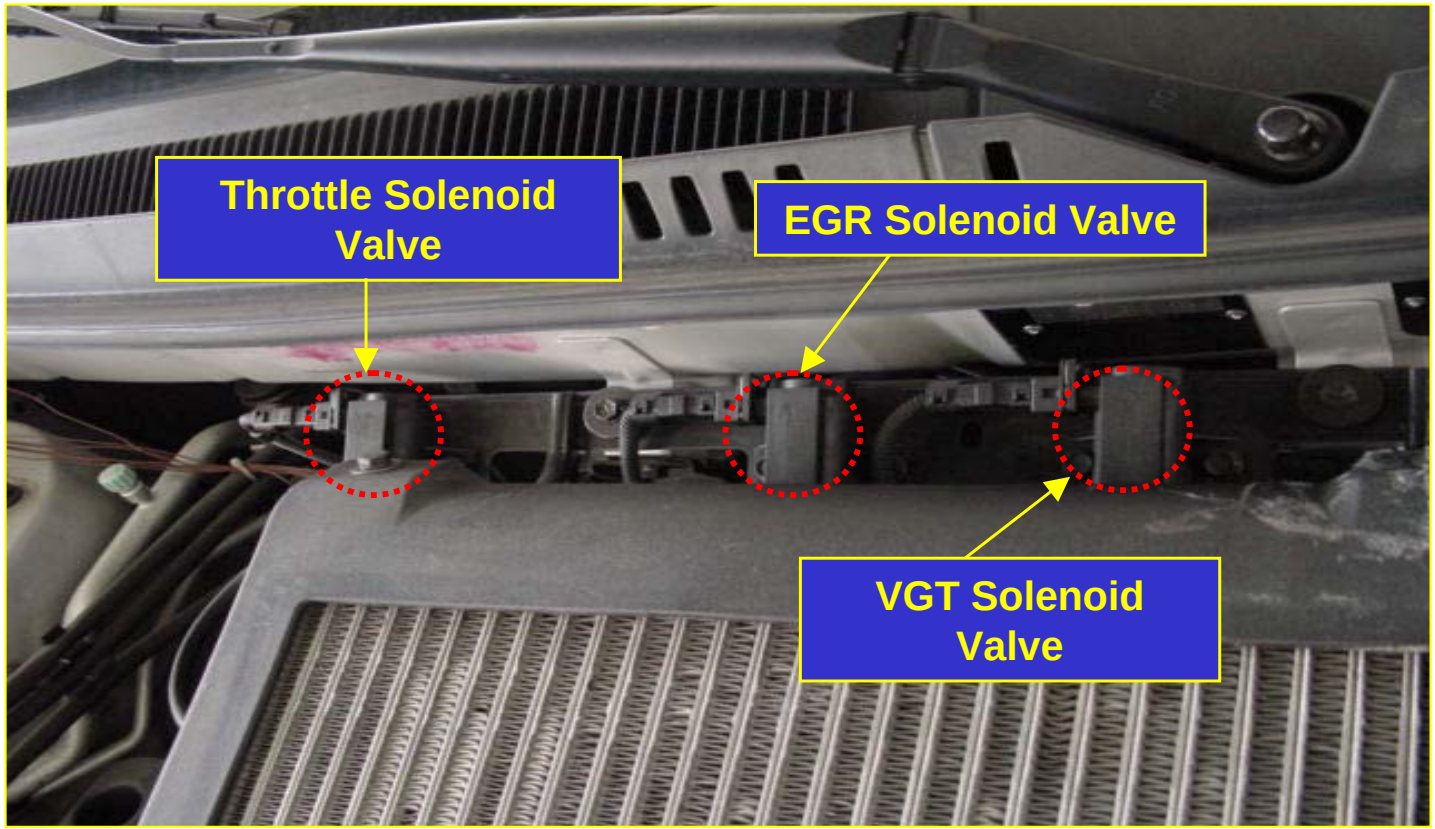
Coolant Temp.(℃)	-20℃	-10 ℃	20 ℃	40 ℃
Glow time (Sec.)	40	25	10	0

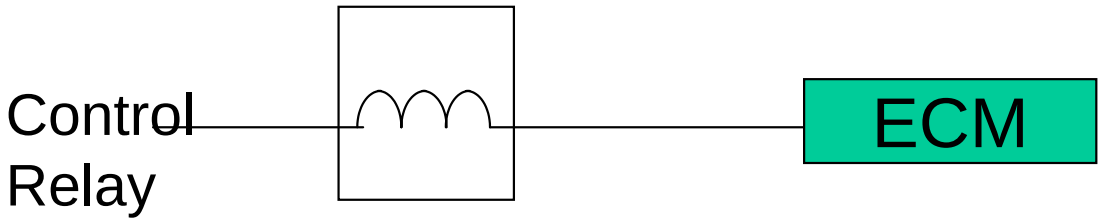
VGT (Variable Geometry Turbocharger)

The ECM is controlling a solenoid valve (duty ratio) to effect a vacuum on the actuator which in turn is connected to a linkage which pulls a rotating base plate. Inside the base plate are connected the vanes using a cam mechanism to determine the angle of vane pitch.



VGT (Variable Geometry Turbocharger)



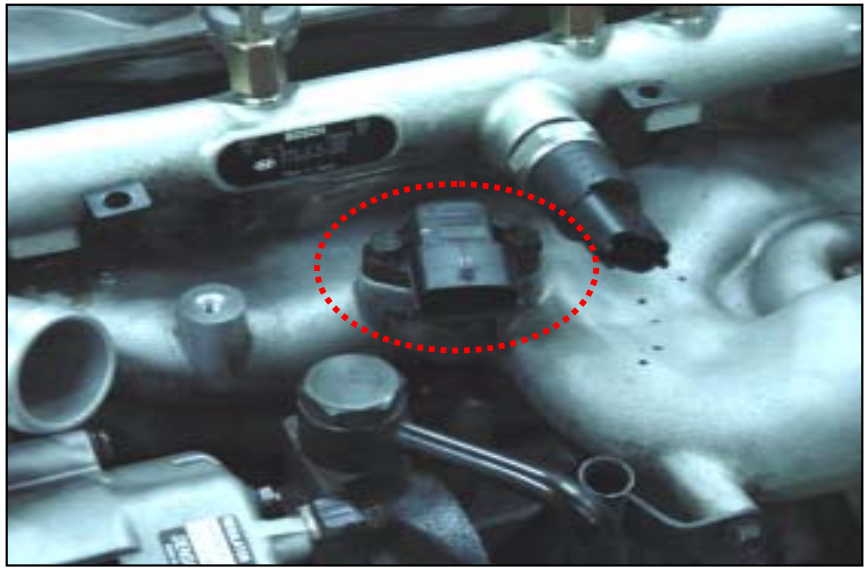


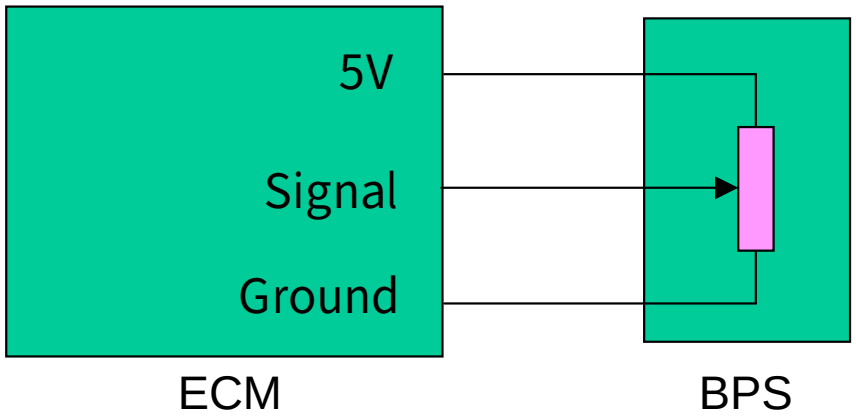
VGT Solenoid Valve

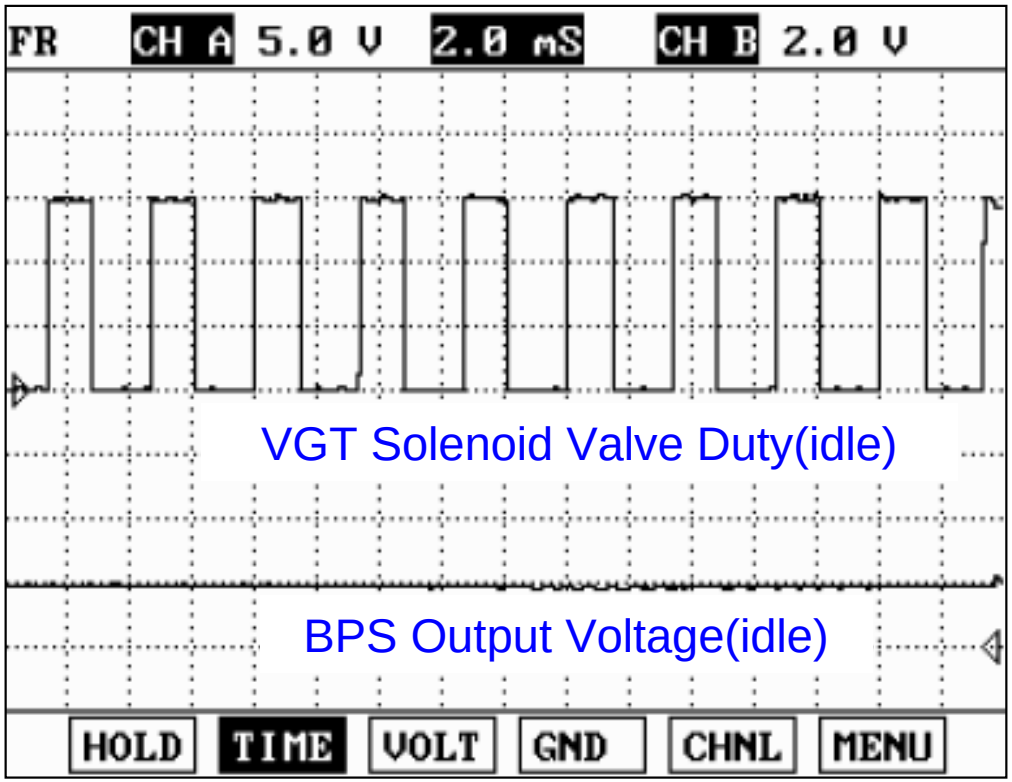
VGT (Variable Geometry Turbocharger)

BPS (Boost Pressure Sensor) for VGT

It monitors the boost pressure to control the vane of VGT.

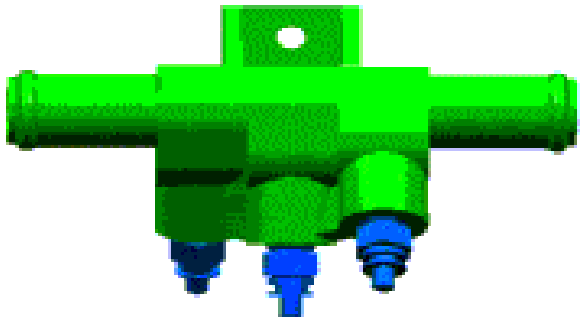




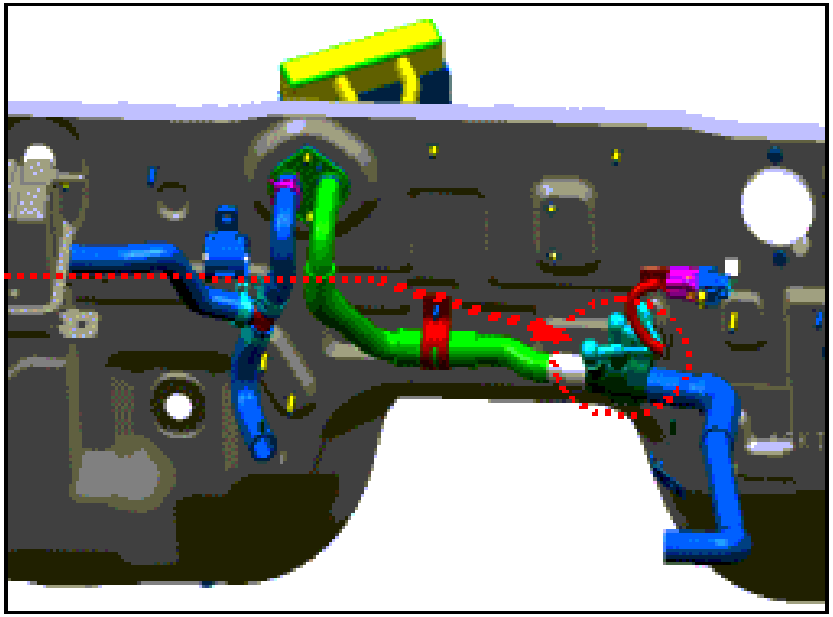


Auxiliary parts
&
Handling caution

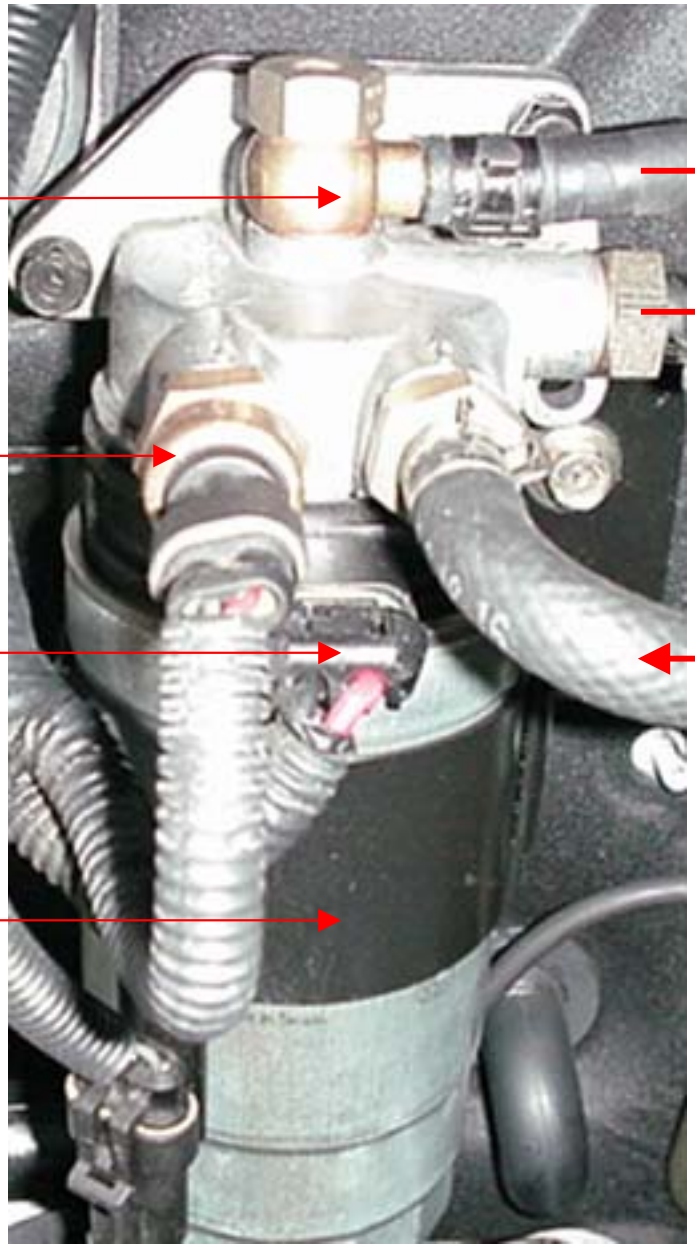
Pre-Heater



Three heating plugs

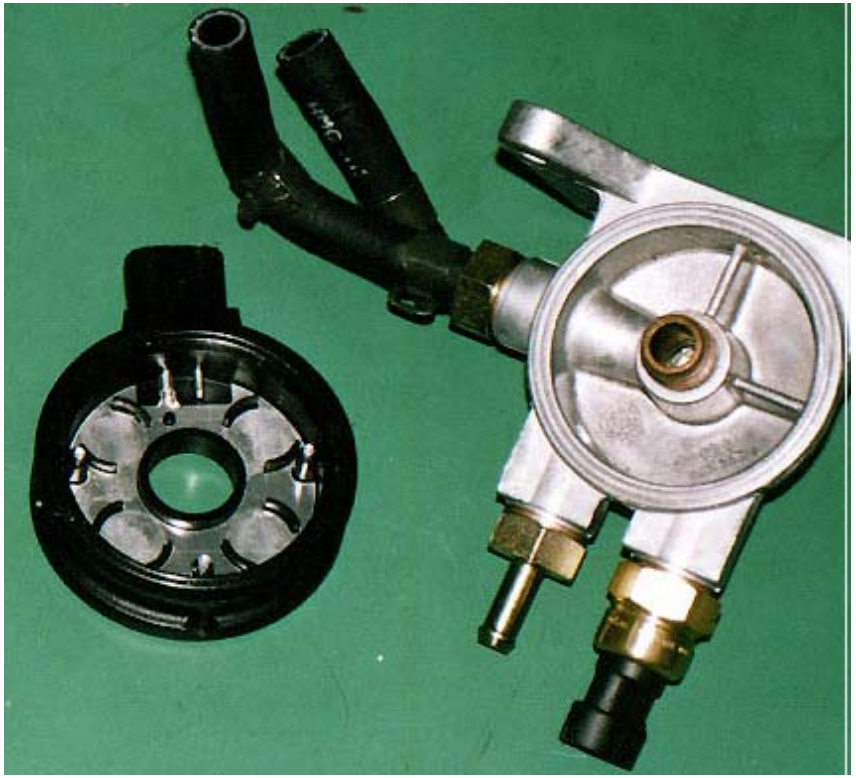


Fuel Filter Assembly



Fuel Filter Assembly

Fuel Filter Heater



Removing High Pressure Pipe

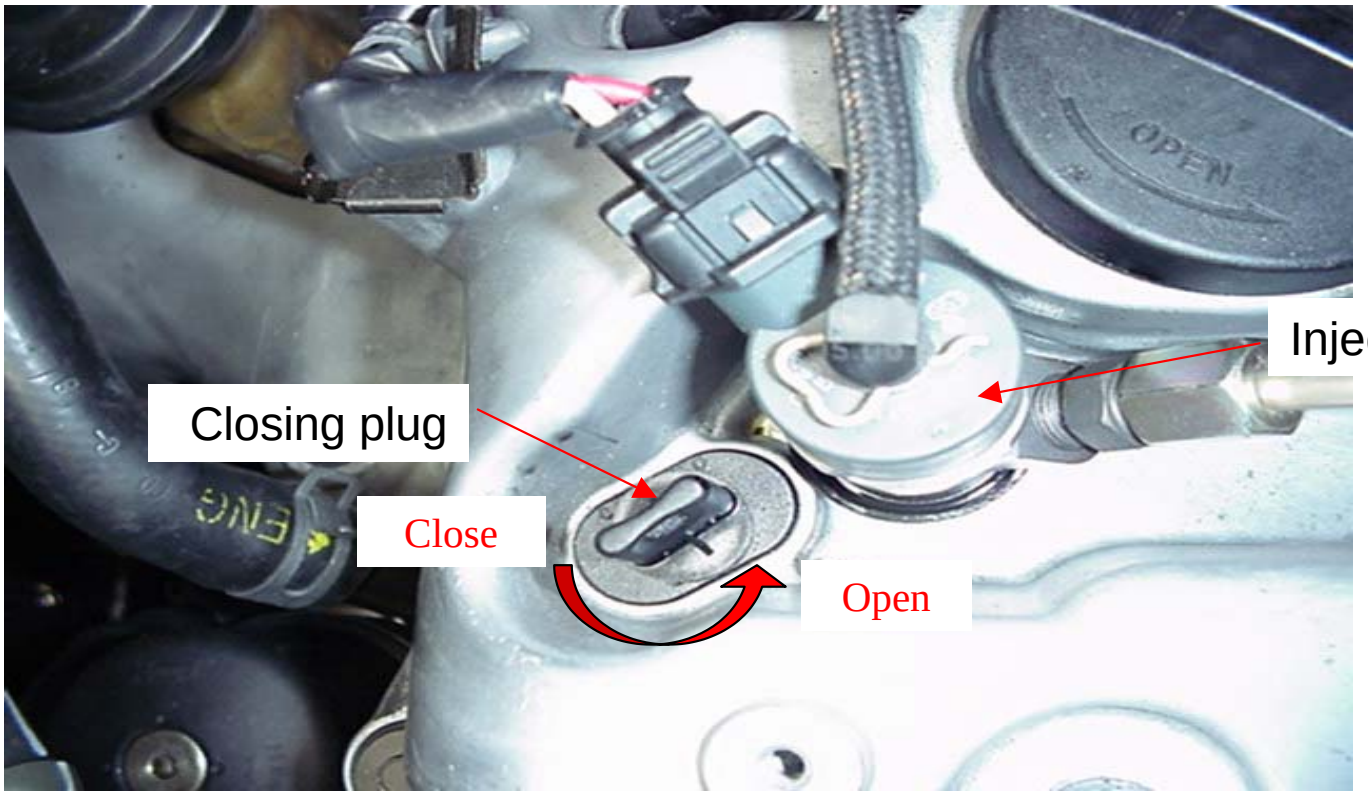
Never release high pressure pipes with running engine

Checking fuel pressure & checking injector operation

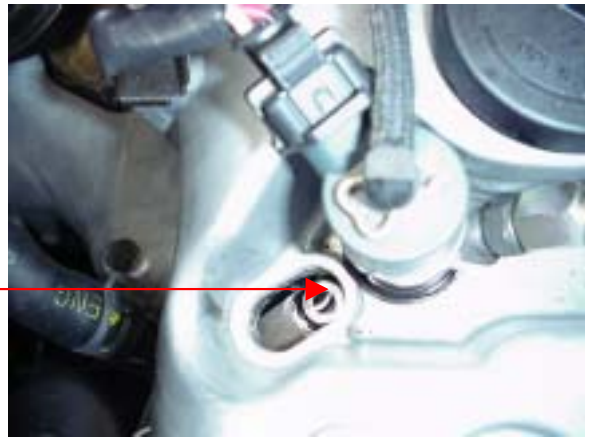
High pressure can be checked only via the Rail Pressure Sensor Voltage Reading.

High pressure can be checked only via the Rail Pressure Sensor Voltage Reading.

Removing and Installing Injectors



T40 Torx (torque: 2.7±0.2 kgm)



Removing and Installing Injectors

Removing and Installing Injectors

Before re-installing injector, clean cylinder head bore and sealing surface.

1) insert brush.
2) clean sealing surface and blow out.

Installing

1) Insert new copper seal ring (apply small quantity of grease to bond it to injector).
2) Insert injector (do not touch the nozzle tip) and sliding clamp with clamp bolt.
3) Fit Injector pipe (Nuts finger tight only)
4) Injector clamp bolt (**torque: 2.7±0.2 kgm**)
   * If injector too loose, cylinder may loose pressure,
   * If Injector too tight, may result in pinching of the needle, resulting in knocking or misfire.
5) Install high-pressure pipes
   (3.3±0.2 kgm - Newly revised on June 11, 2002)
   (Old specification : torque : 2.7±0.2 kgm)
   * **high-pressure pipes must be installed without tension**
6) Attach return leak rail. Never fit without clip.
7) Check installation by tugging it.
8) Attach elec. Connector.
9) Start engine and check leaks. Read out fault memory and cancel

Injector Handling

The injectors have 5 hole mini-sac spray nozzles, the bore is so small it is acheived using EDM (electrical discharge machining)

Checking of injector nozzles for spray pattern and fuel delivery quantity must be carried out by a Bosch workshop

Do Not Dismantel Injector nozzle and needle shaft

Risk of damage

Bosch agent only

DOC (Diesel Oxidation Catalyst)

Similar to the petrol version in design, ie. The Monolith is supported by a matting, to prevent cracking by shocks etc.

The Oxidisation catalyst has no oxygen sensor, and the precious metals are different.

In this type of catalyst approximately 4.5 – 5.0 Gramms of Platinum is used to change the state of Hydrocarbons (HC) and Carbonmonoxide (CO) to water and carbon dioxide. In addition a certain amount of Nitrogen Oxide (NO_X) is reduced.

As a result the level of soot particles are also reduced.