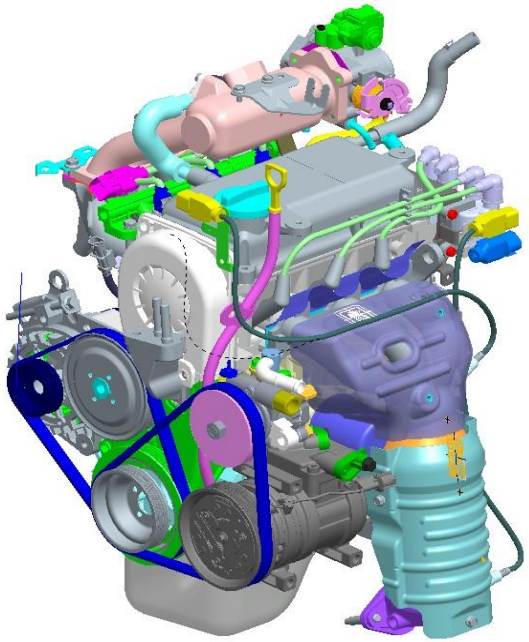
Engine

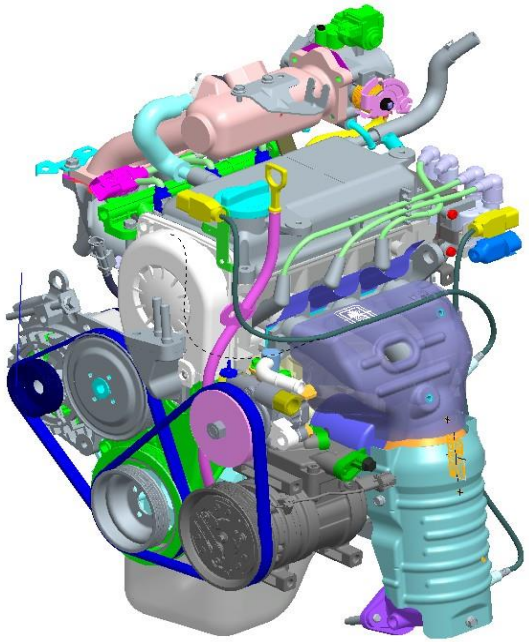


Application

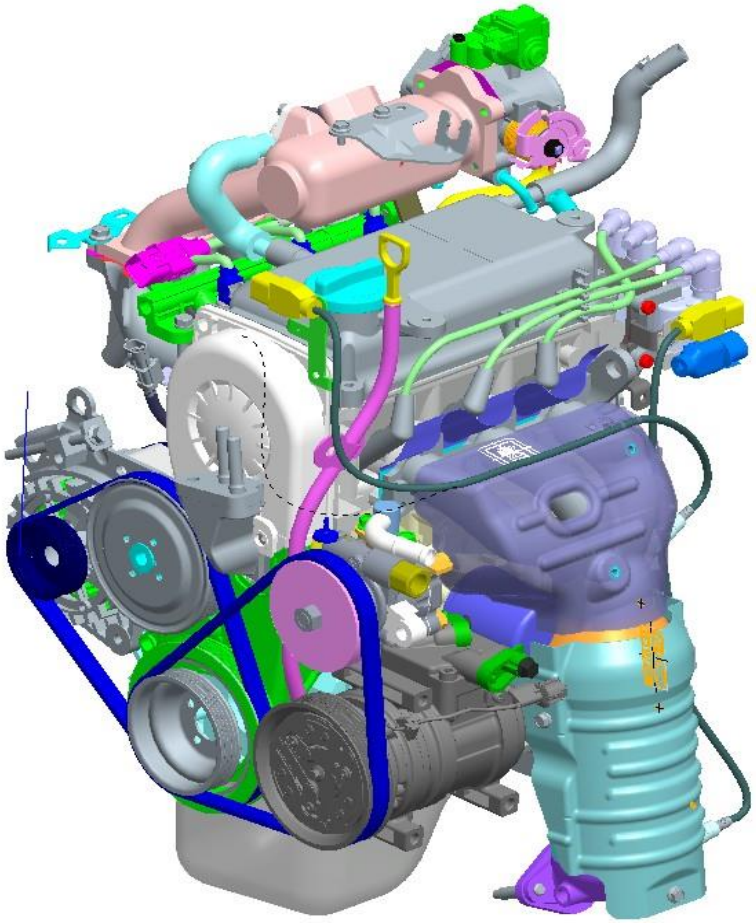
Engine			T/M		Area		
Model	Volume [cc]	Performance [PS/kgf.m]	M/T	A/T	India	Europe	General
ε-1.1	1,086	64/9.9	M5EF2	A4CF0	●	●	●
U-1.1	1,120	75/15.5	M5CF1	-	-	●	-

- Epsilon 1.1L engine is already used for Santro(Atoz)
- Kappa 1.2L engine, which is newly developed, will be applied in 2008.
- Common Rail U-1.1L engine is only for EU market with manual transaxle.
- Common Rail U-1.1L engine has 3 cylinders

Epsilon Engine



Epsilon engine



Engine	ε-1.1
Displacement (cc)	1086
Max. Power (PS / RPM)	64 / 5,500
Max. Torque (kgf·m / RPM)	9.8 / 2,800
Feature	• SOHC In-line 4 cylinders (12 valves) • One Timing Belt • DLI • BOSCH PCM • Return-less fuel system • ROSA type ISA

Tightening Torque

-When cold : 60 ~ 70 Nm

-When hot : 70 ~ 75 Nm

Traditional torque method is used. To keep proper installation, mentioned torque should be tightened with right procedure.

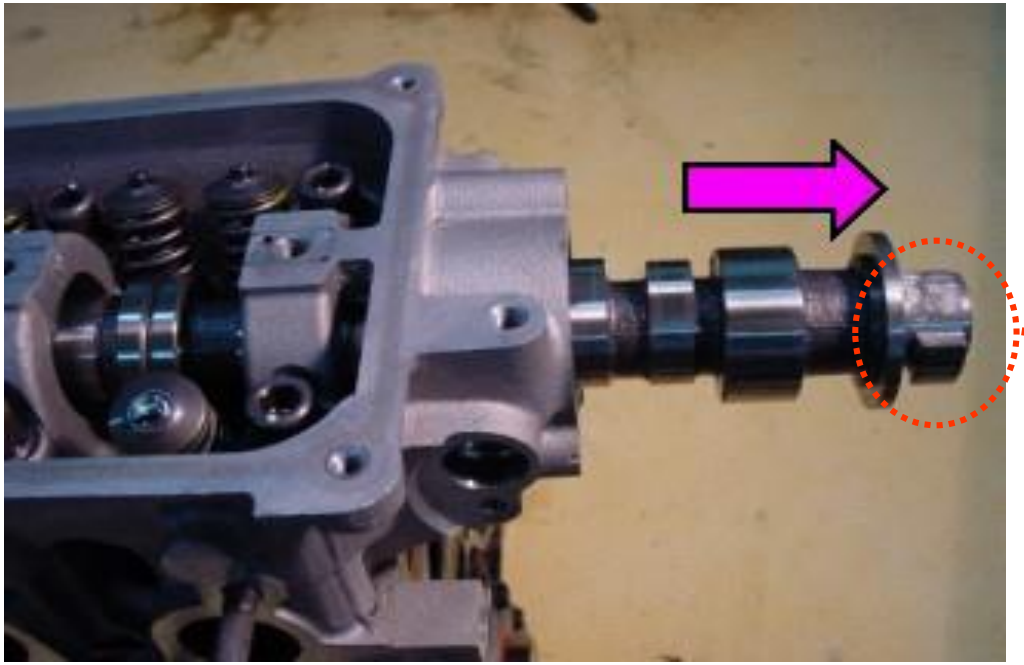
Rocker Arm

■ Adjustment Specification

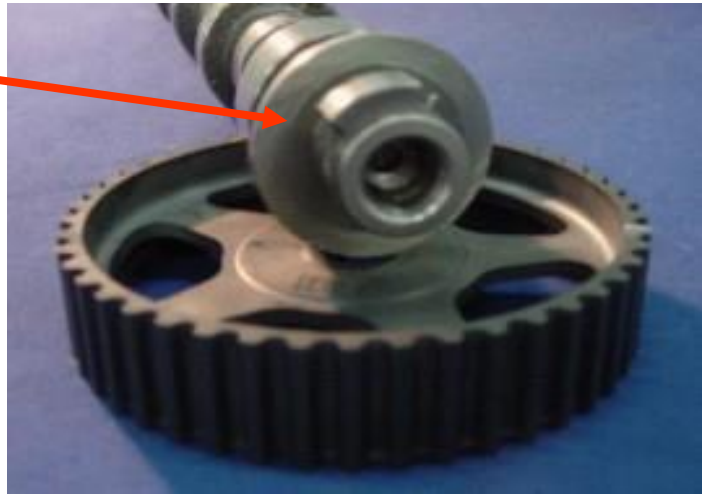
	Intake	Exhaust
Standard Clearance (Intake, mm)	0.2	0.25
Standard Clearance (Exhaust, mm)	0.1	0.17

No.1's TDC

Camshaft



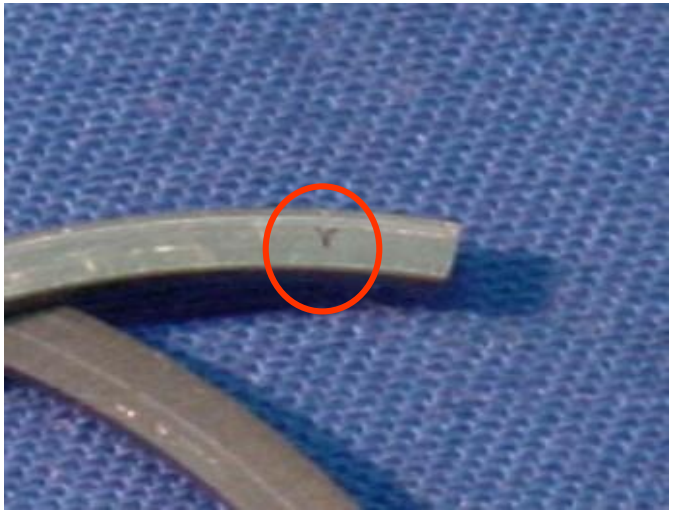
■ Target Wheel



Be sure to remove camshaft from front side to rear side(fly wheel side).

Piston

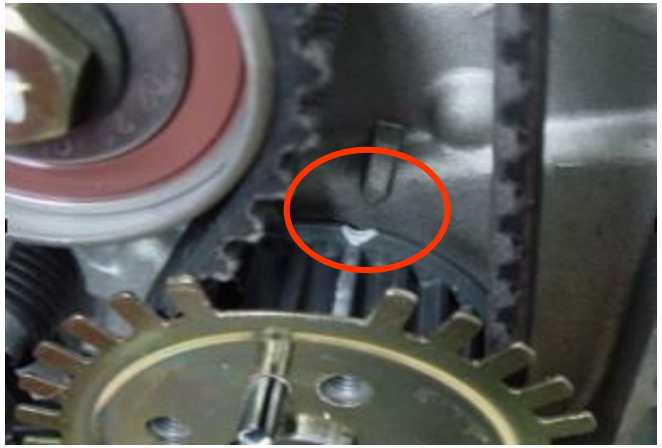
■ Upside Mark



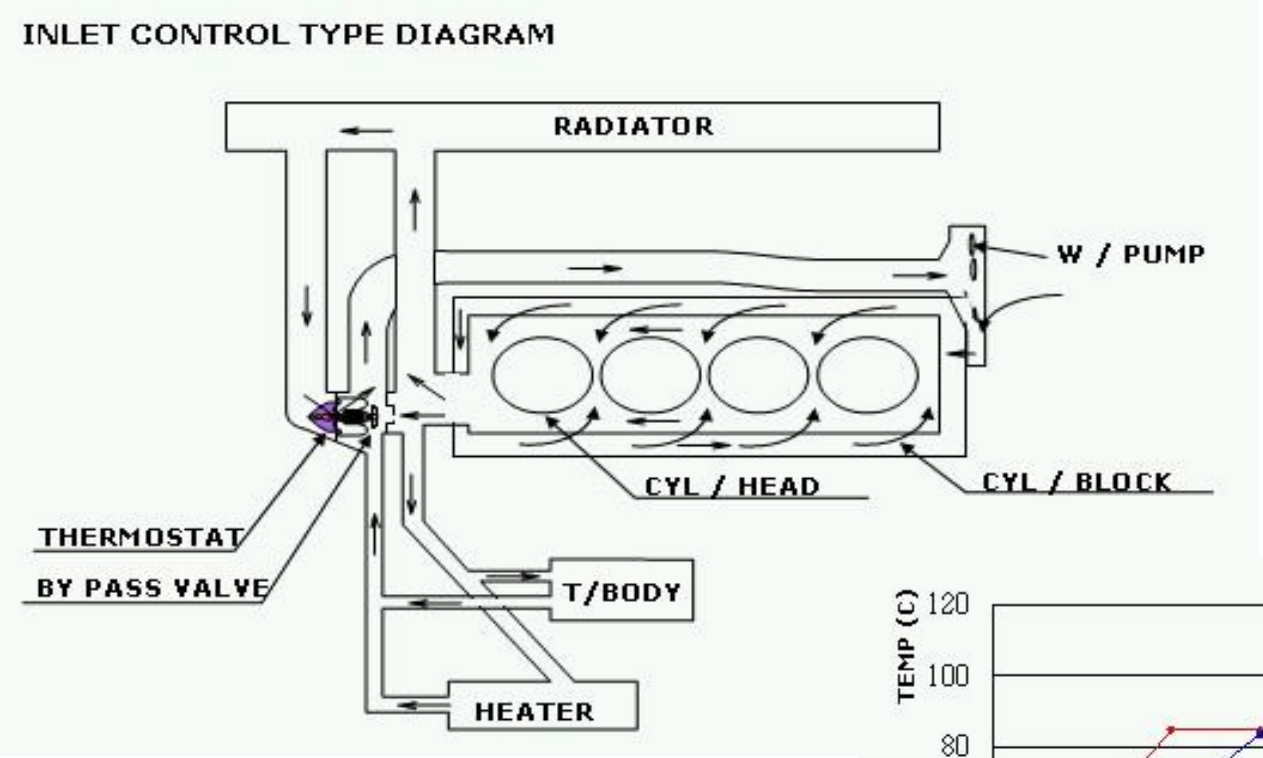
Top ring and second ring have unique up side mark. Be sure to keep this mark when you assemble piston ring to piston.

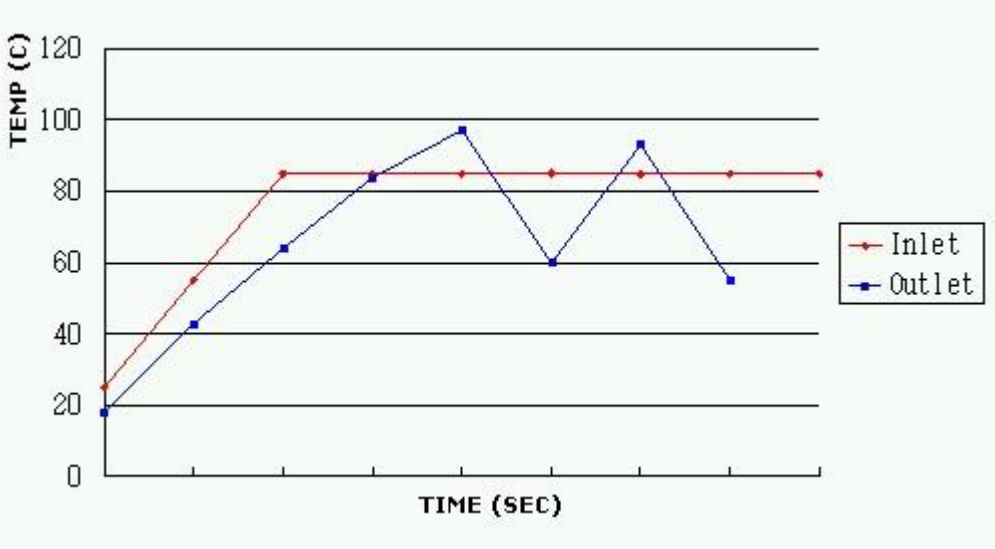
To assemble piston pin to piston SST(09324-33001) is needed.

Timing



Inlet Cooling System





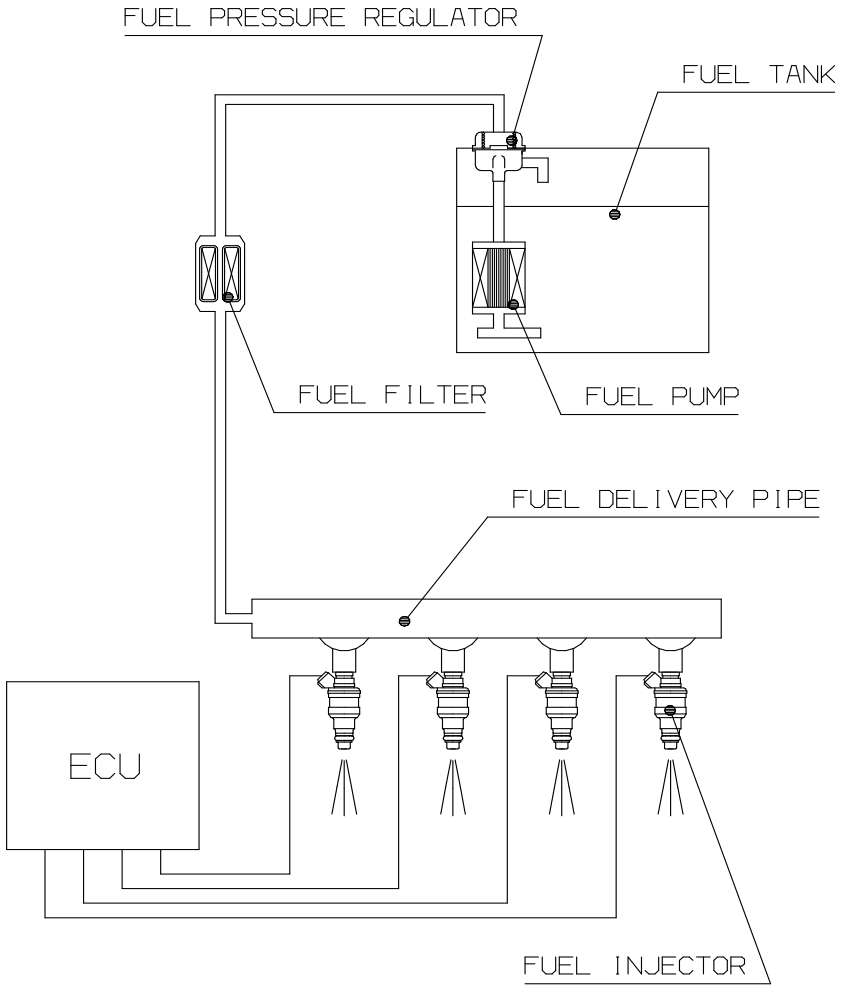
Thermostat opening temperature is 82℃.
When it fully opens, it becomes 95℃.

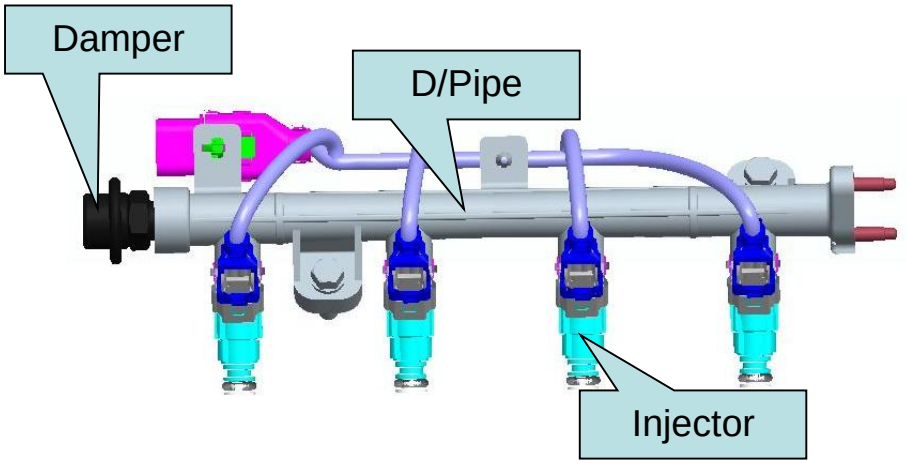
Oil Pump and Oil Pressure Switch

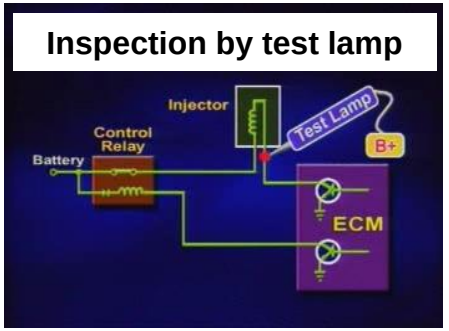
At engine idle condition after warm up, normally oil pressure reaches 147kpa(1.5kg/㎠)

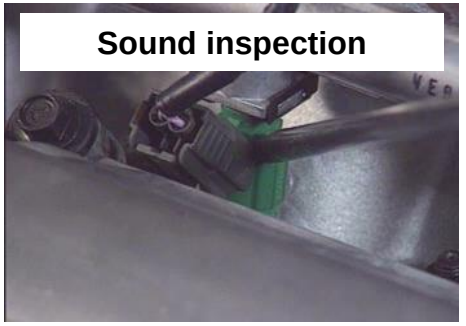
Oil pressure switch is screwed near engine oil filter. When the oil pressure goes down less than 0.5kg/㎠, oil pressure warning lamp turns on.

Return Less Fuel System (RLFS)

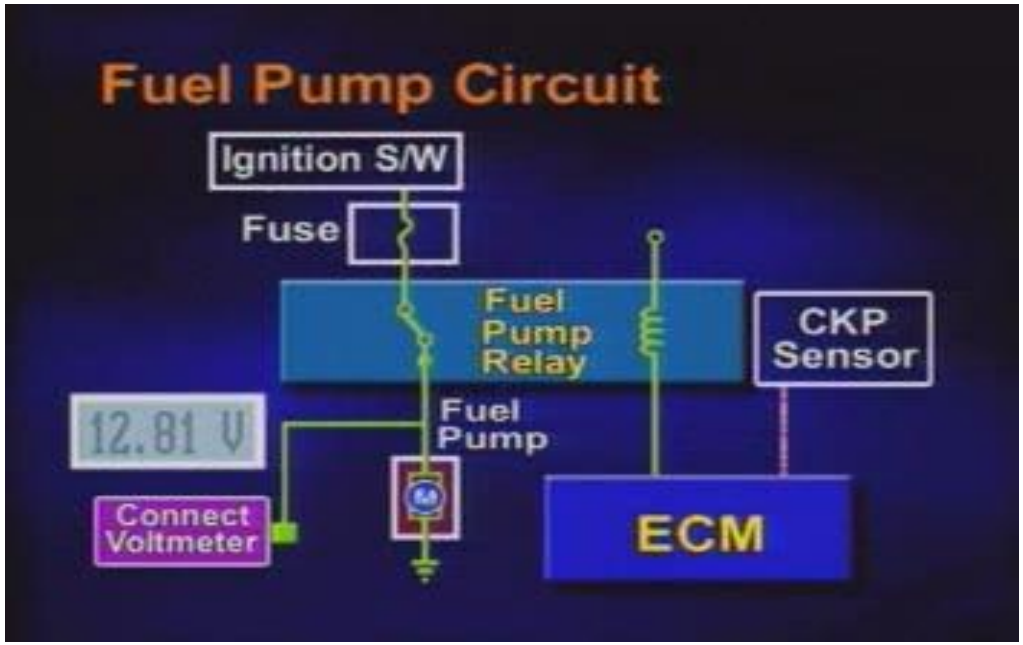


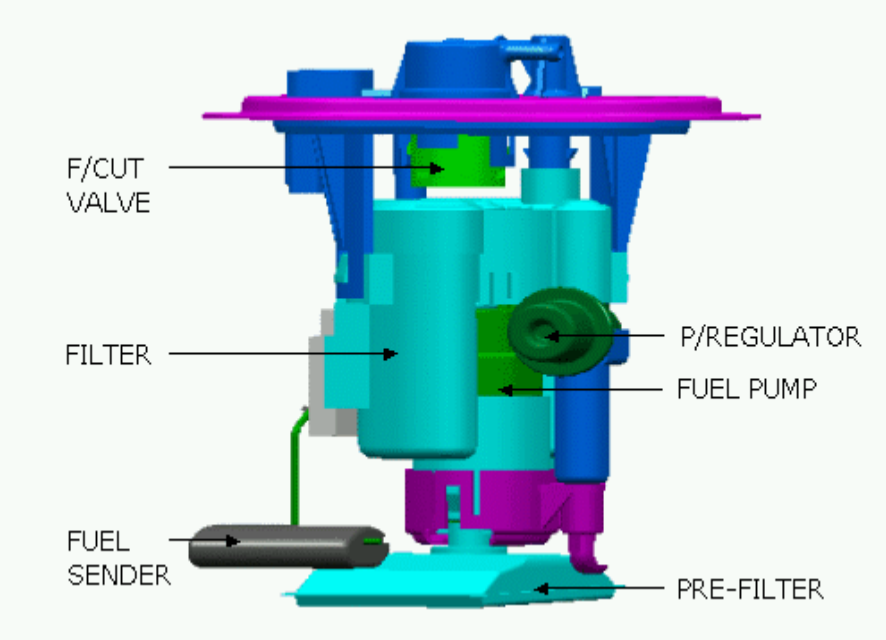




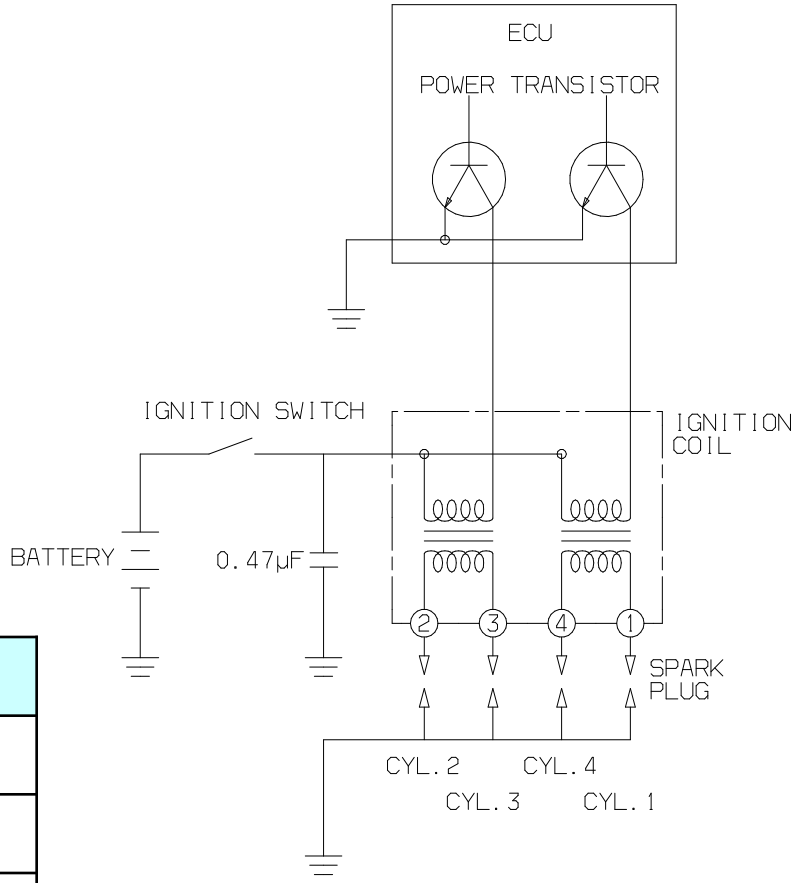


Fuel Pump





Ignition Coil and Spark Plug



Item		Specification	
Ignition Coil	Type	Mold Dual Coil	
	Resistance	Primary	0.82Ω±10%
		Secondary	15.5KΩ±10%

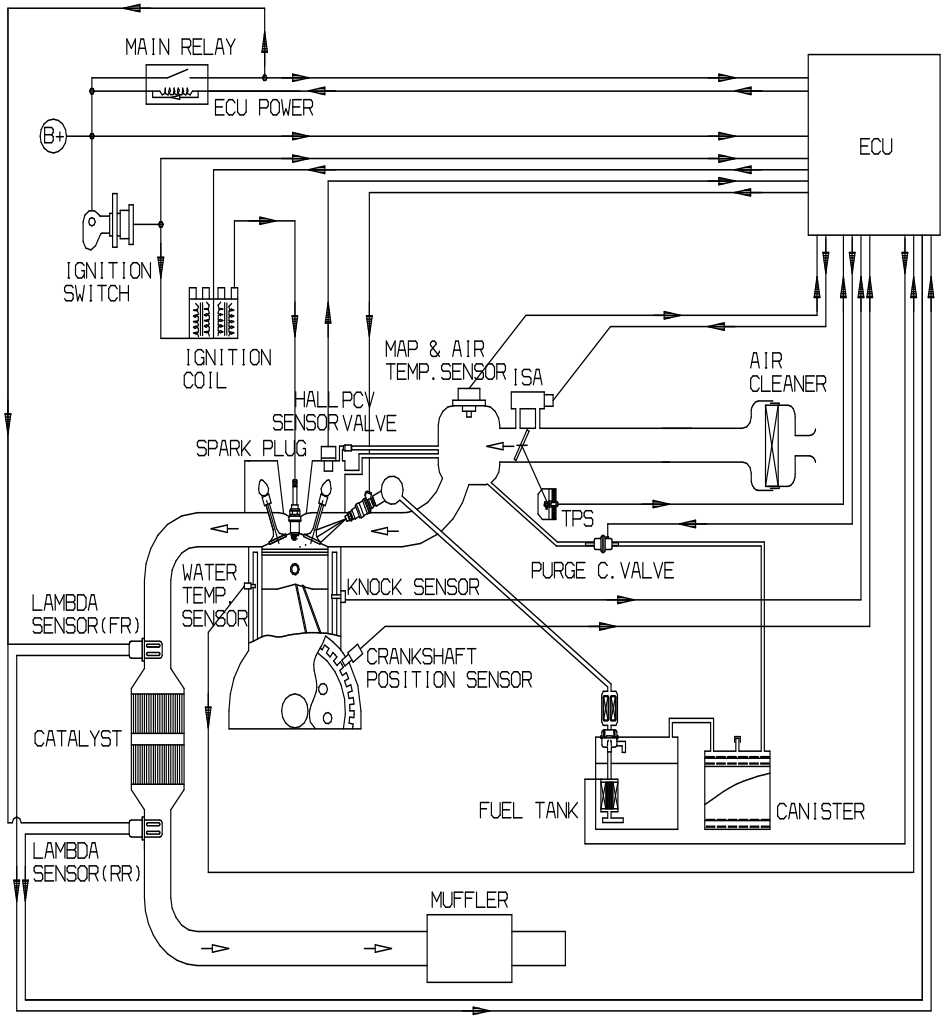
Input & Output

For European Market

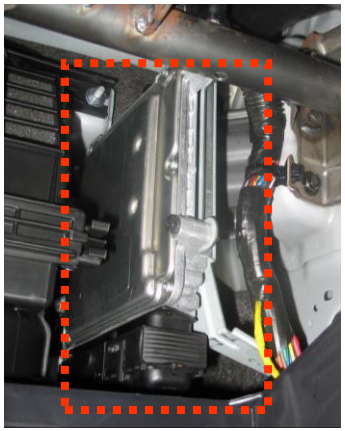
INPUT		OUTPUT
1. MAP & AIR TEMP. SENSOR 2. WATER TEMPERATURE SENSOR 3. THROTTLE POSITION SENSOR 4. CRANKSHAFT POSITION SENSOR 5. TDC SENSOR 6. KNOCK SENSOR 7. LAMBDA SENSOR(FR) 8. LAMDA SENSOR(RR) 9. ACCELERATION SENSOR 10. WHEEL SPEED SENSOR	⇨ E C U ⇨	1. FUEL INJECTOR 2. IGNITION COIL 3. MAIN RELAY 4. FUEL PUMP RELAY 5. PURGE CONTROL VALVE 6. IDLE SPEED ACTUATOR

For General Market

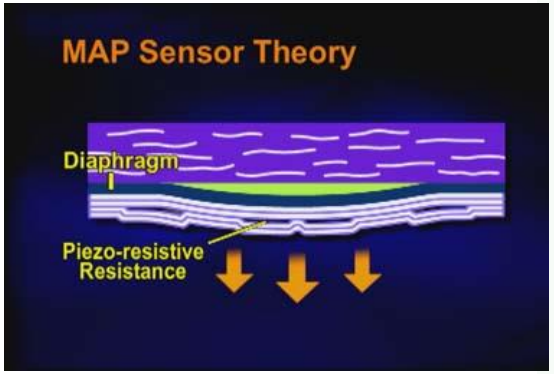
INPUT		OUTPUT
1. MAP & AIR TEMP. SENSOR 2. WATER TEMPERATURE SENSOR 3. THROTTLE POSITION SENSOR 4. CRANKSHAFT POSITION SENSOR 5. TDC SENSOR 6. KNOCK SENSOR (EXCEPT LOW OCTANE NATIONS) 7. LAMBDA SENSOR	⇨ E C U ⇨	1. FUEL INJECTOR 2. IGNITION COIL 3. MAIN RELAY 4. FUEL PUMP RELAY 5. PURGE CONTROL VALVE 6. IDLE SPEED ACTUATOR

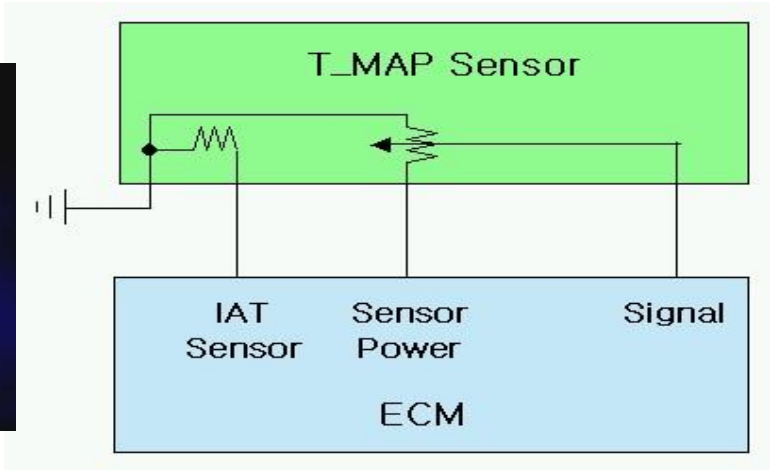


Bosch M7.9.8



T_MAP Sensor

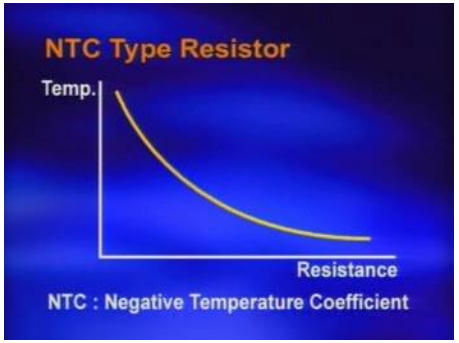


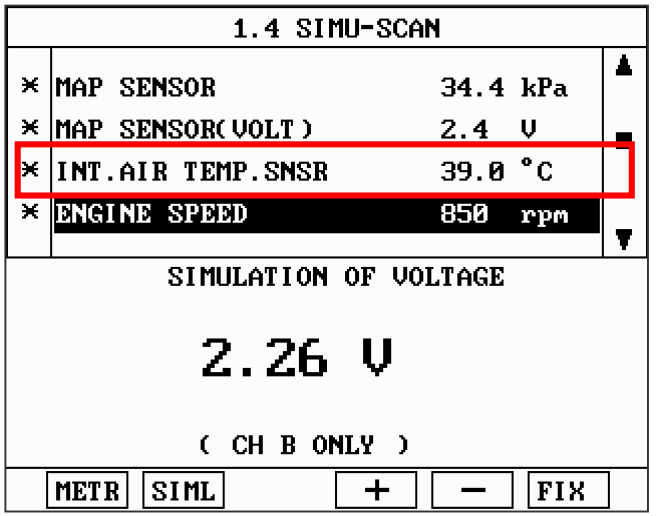


Intake air temperature sensor is integrated with T_MAP sensor. It produces 0.3 ~ 4.8 voltage range as signal.

At ignition on condition, it shows 3.8 ~ 4.2 V which is converted to atmospheric pressure.

IAT Sensor

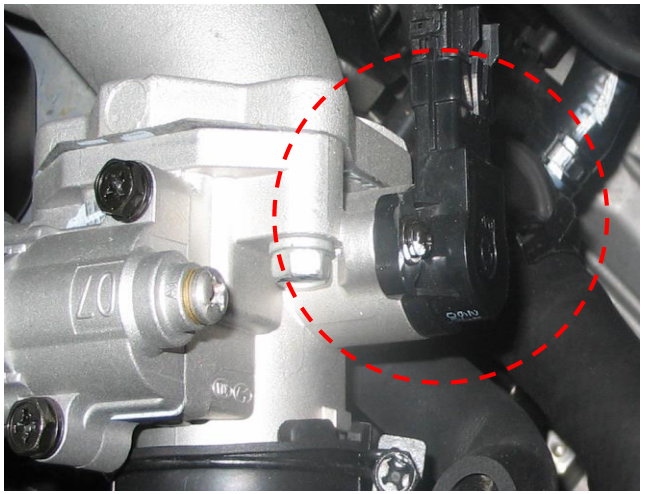


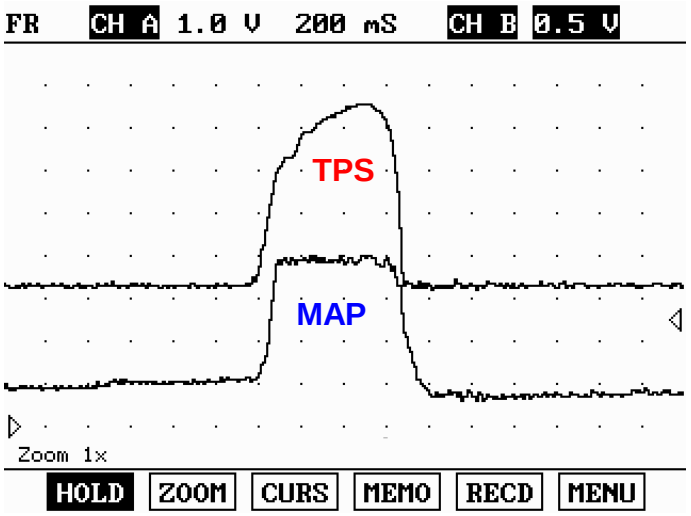


When IAT fault is detected, current data shows -40℃ an a default value.

Checking Condition	Temperature	Current Data	Remarks
IG On	0℃	4.0 ~ 4.4V	NTC type
	20℃	3.3 ~ 3.7V	
	40℃	2.5 ~ 2.9V	
	80℃	1.0 ~ 1.4V	

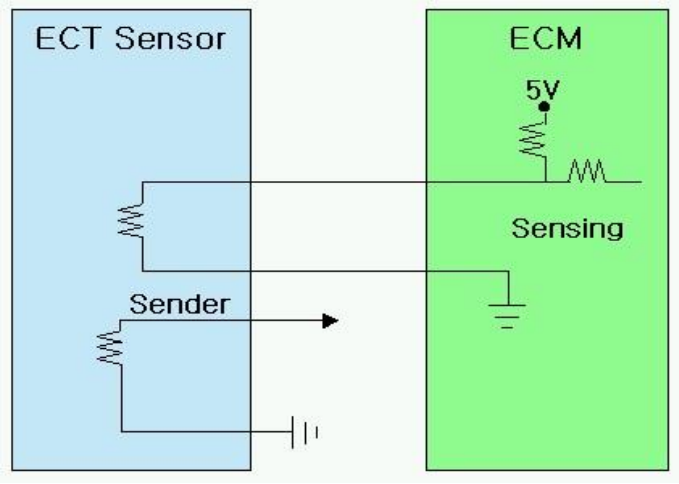
TP Sensor (Lever type)



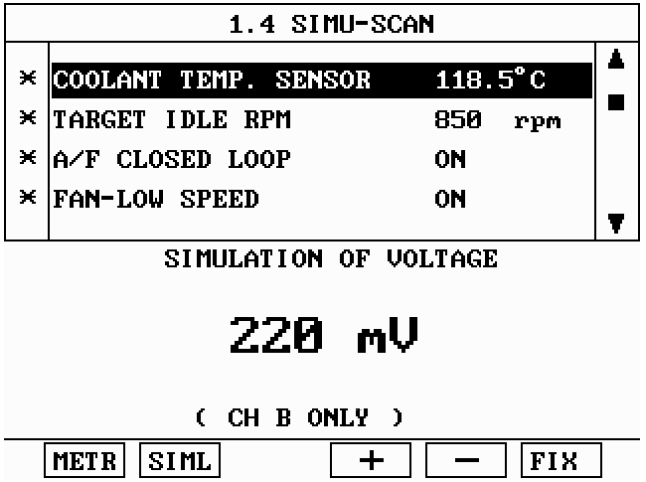


It’s better check TPS waveform with MAP signal’s together. Both signals are similar and signal trend has to be compared together.

ECT Sensor

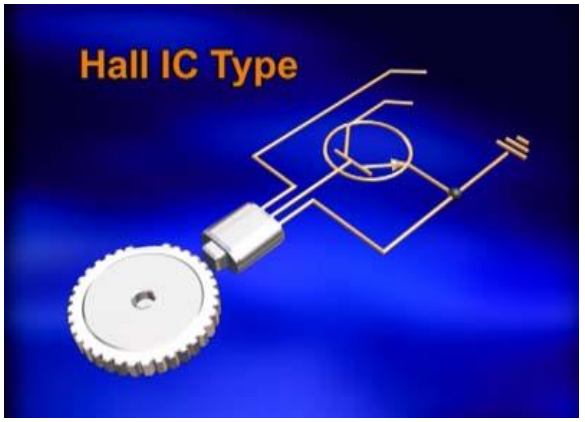


This sensor has 4 terminals. 2 are for ECT sensor. These two terminals are gold coated. Another 2 are for engine temperature indicator in cluster.



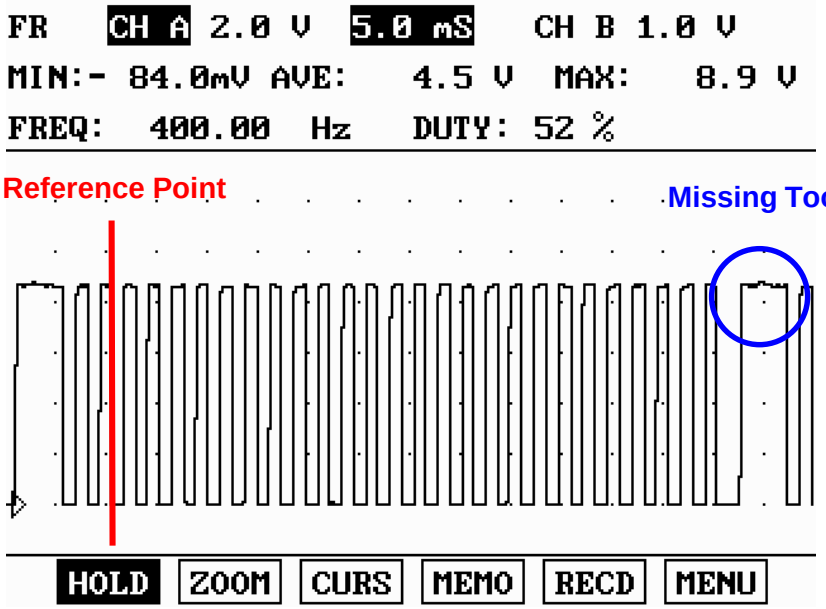
Checking Condition	Temperature	Current Data	Resistance (KΩ)
IG On	0℃	4.27±0.3V	5.18 ~ 6.60
	20℃	3.44 ±0.3V	2.27 ~ 2.73
	40℃	2.72±0.3V	1.059 ~ 1.281
	80℃	1.25±0.3V	0.298 ~ 0.322

CKP Sensor



Hall IC type CKP sensor is used. ECM No. 15 is used for sensor signal.

Unlike other general target wheel which is composed with 60 teeth including 2 missing teeth, it has 30 teeth with 2 missing. Except tis tooth unit, all logical processing in ECM is the same

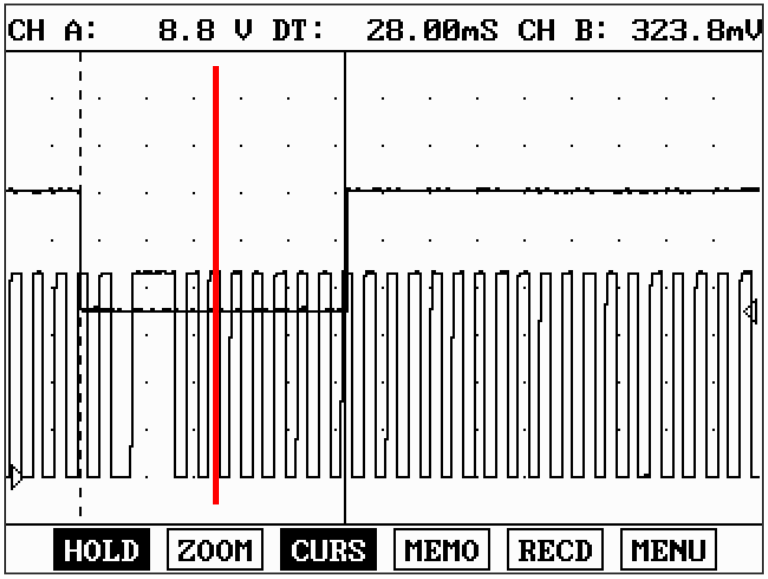


CMP Sensor

CMP sensor is also used from Hall IC.

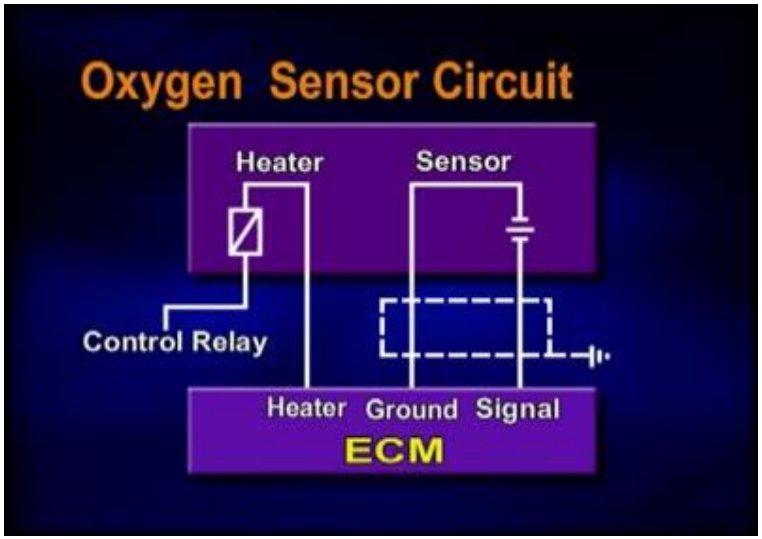
It distinguishes the cylinder No. by comparing with CKP sensor.

It is located near ignition coil. Camshaft target wheel shape is as shown on the picture.



[CMP with CKP Sensor Waveform]

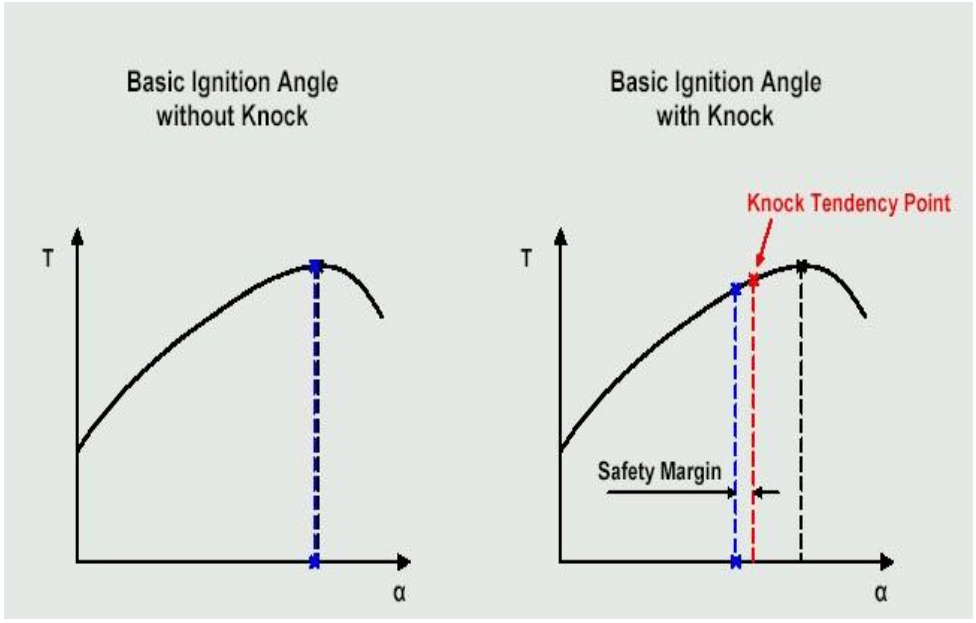
Oxygen Sensor

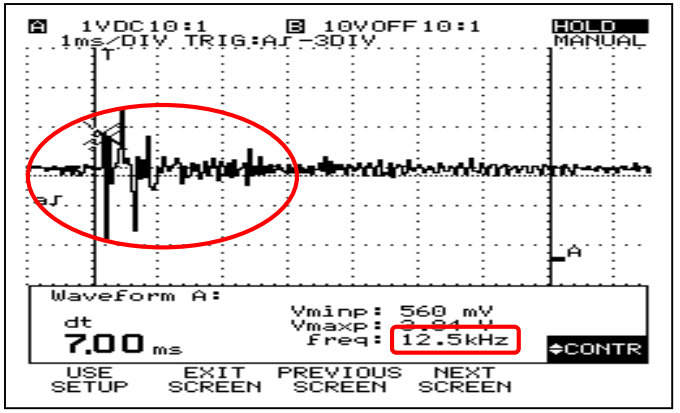


Zirconia type oxygen sensor is used.
The Zirconia oxygen sensor generates a small voltage depending on the exhaust gas condition.
The normal voltage range is 0.2 ~ 0.8 volts. 0.2 volts indicates a lean mixture and a voltage of 0.8v indicates a richer mixture.

Knock Sensor

Engine knock control is used to constrain the knocking. Knock sensor detects knocking generated in engine and retard ignition timing.
The knock sensor is installed at between No2. and No.3 cylinder. Like other piezo type sensors, this is made by piezo material. Tightening torque is 20±5Nm.





- Maximum Retard Limit : 12˚
- When knocking is detected : Initially retard 3˚ and increase step by step with 0.75˚

Wheel Speed Sensor

The main role of wheel speed sensor is detecting the rough load condition which allows misfire monitoring inhibition (EOBD:Euro3/Euro4). When the vehicle is running on rough load condition, the CKP angular speed is affected from this road condition. It can signal to ECM as a misfiring. In this case wheel speed sensor detects this kind of rough load condition and order ECM not to consider this situation as a misfiring.

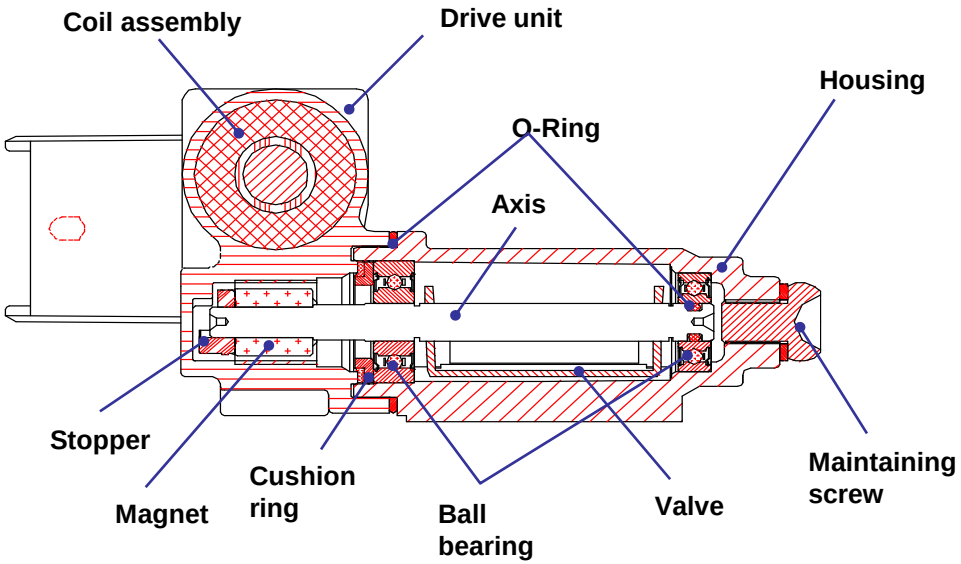
M/T		Input Variable	ECU PIN NO.
With EOBD	With ABS	ABS Signal	**K 64**
	Without ABS	Wheel Speed Sensor	**K 79, K 58 (K 64 open)**
Without EOBD	With ABS	Vehicle Speed Sensor	**K 64**
	Without ABS		**K 64**
AT		**Input Variable**	**PCM PIN NO.**
With EOBD	With ABS	ABS Signal	**K 20**
	Without ABS	Wheel Speed Sensor	**A 60, A 45**
Without EOBD	With ABS	From TCM	**K 20**
	Without ABS		**K 20**

Vehicle Speed Sensor

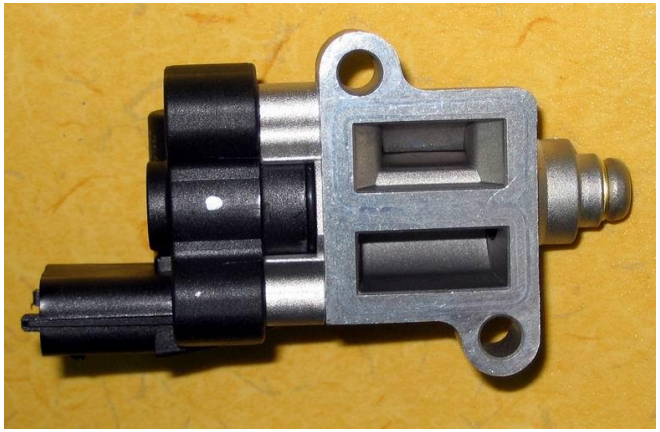
- Vehicle speed sensor is applied on MT only.
- In the case of AT, the vehicle speed sensor is eliminated. Instead, ECM receives a corresponding vehicle speed from others. (refer to the table below)

T/M	Type		Vehicle speed from	ECU PIN NO.
MT	With EOBD	With ABS	ABS unit	**K64**
		Without ABS	Wheel Speed Sensor	**K79, K58 (K 64 open)**
	Without EOBD	With ABS	Vehicle Speed Sensor	**K64**
		Without ABS		
AT	With EOBD	With ABS	ABS unit	**K20**
		Without ABS	Wheel Speed Sensor	**K60, K45**
	Without EOBD	With ABS	From TCM	**K20(from A49)**
		Without ABS		

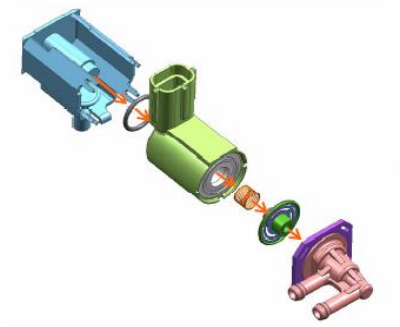
ISA (Idle Speed Actuator)

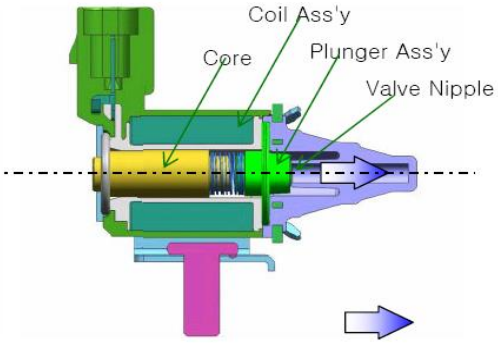


1. The ISA controls the proper intake air mass in every engine operating conditions.
2. The ECU controls the ISA (double coil of open/close) with frequency of 250Hz.
3. The ISA duty is determined by basic map and compensation of ATS, WTS, altitude and A/CON compressed load etc.



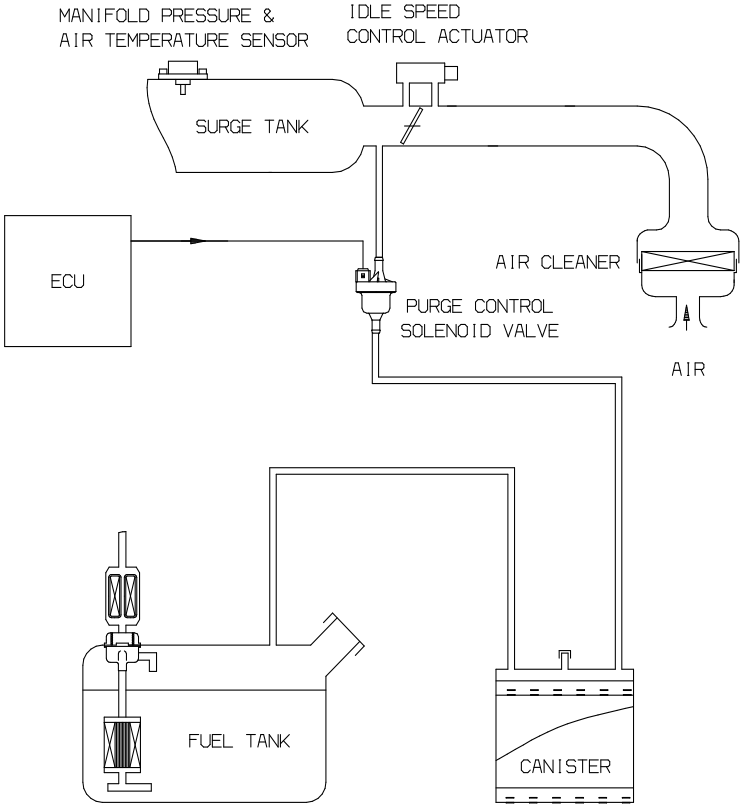
PCSV

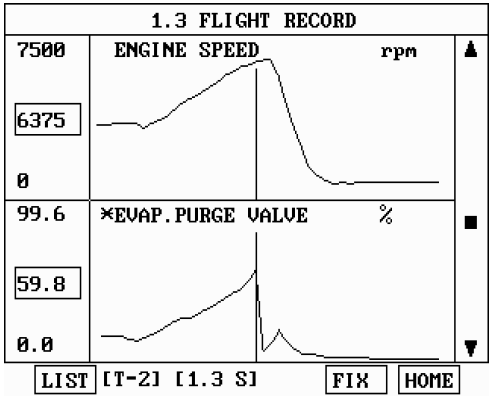




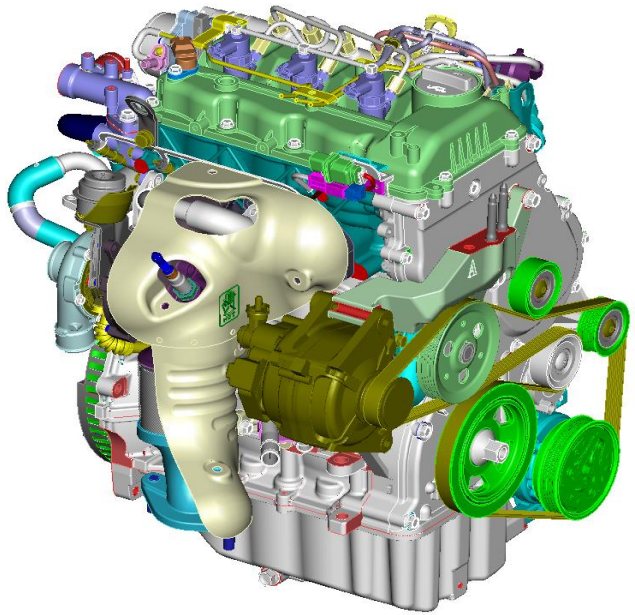
For Evaporative gas monitoring.

PCSV is installed between the canister and the intake manifold, it delivers or shuts the vapor gas to intake manifold, which is stored in the canister. The ECM controls the purge control solenoid valve.

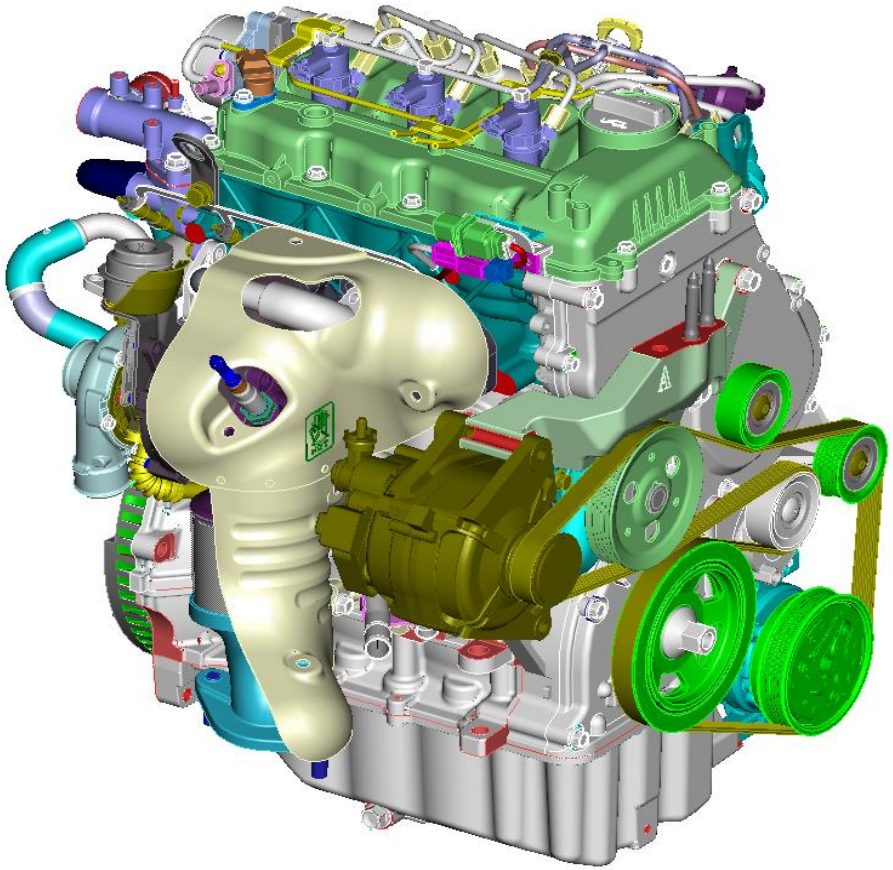




Common Rail U-Engine



U engine



Engine	U - 1.1 VGT
Displacement (cc)	1120
Max. Power (PS / RPM)	75 / 4000
Max. Torque (kgf·m / RPM)	15.5 / 2000
Feature	• VGT Turbo Charger • Timing Chain • Electrical EGR & EGR cooler • Lambda Sensor • Throttle flap • Serpentine belt • Bed Plate • In-line 3 cylinders

System Overview

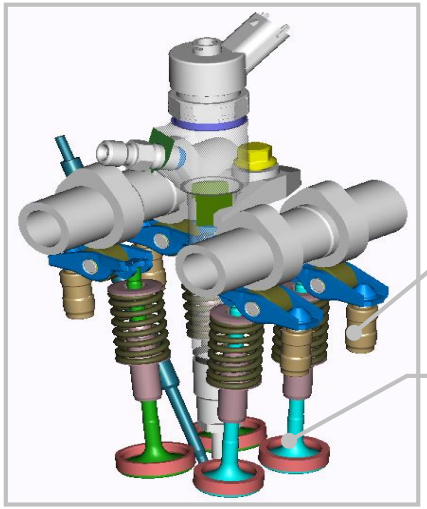
E.G.R cooler

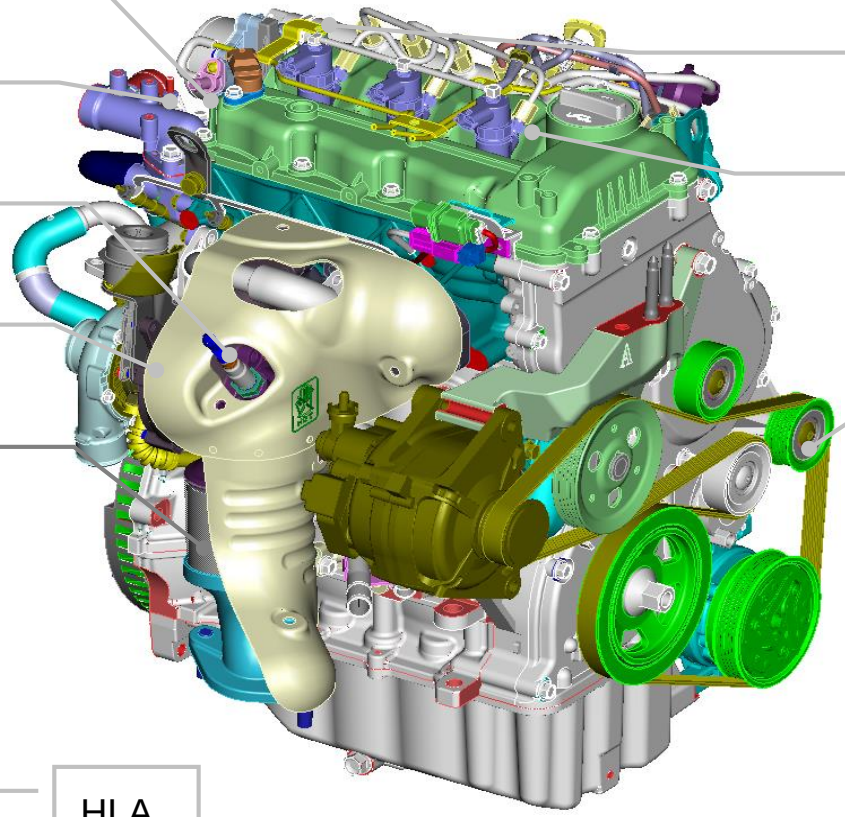
Electrical E.G.R

λ sensor

VGT

DOC (Diesel Oxidation Catalyst)





HLA

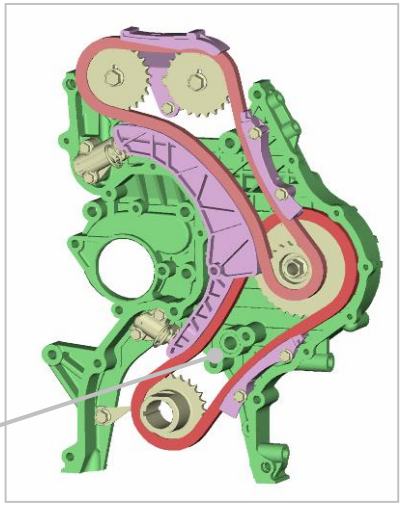
4 valve DOHC

Throttle flap

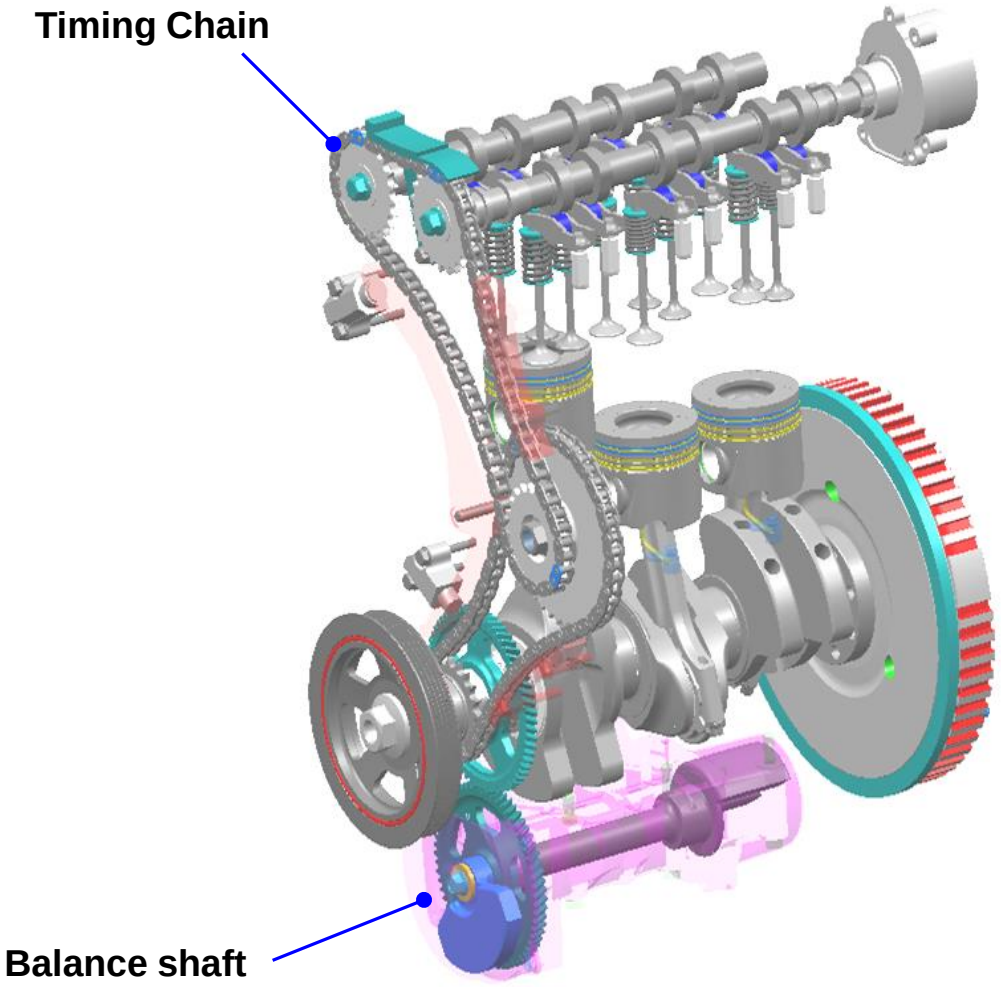
CRDi system
✓EURO-4: 1600bar

Serpentine belt

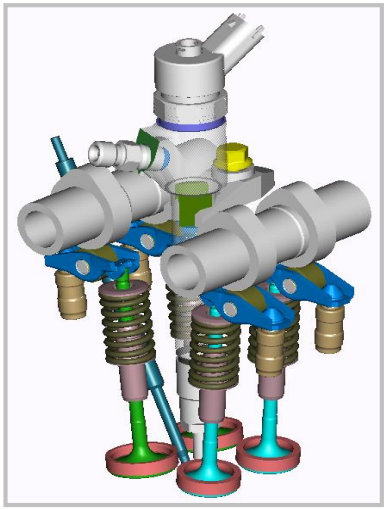
Timing chain



Timing System

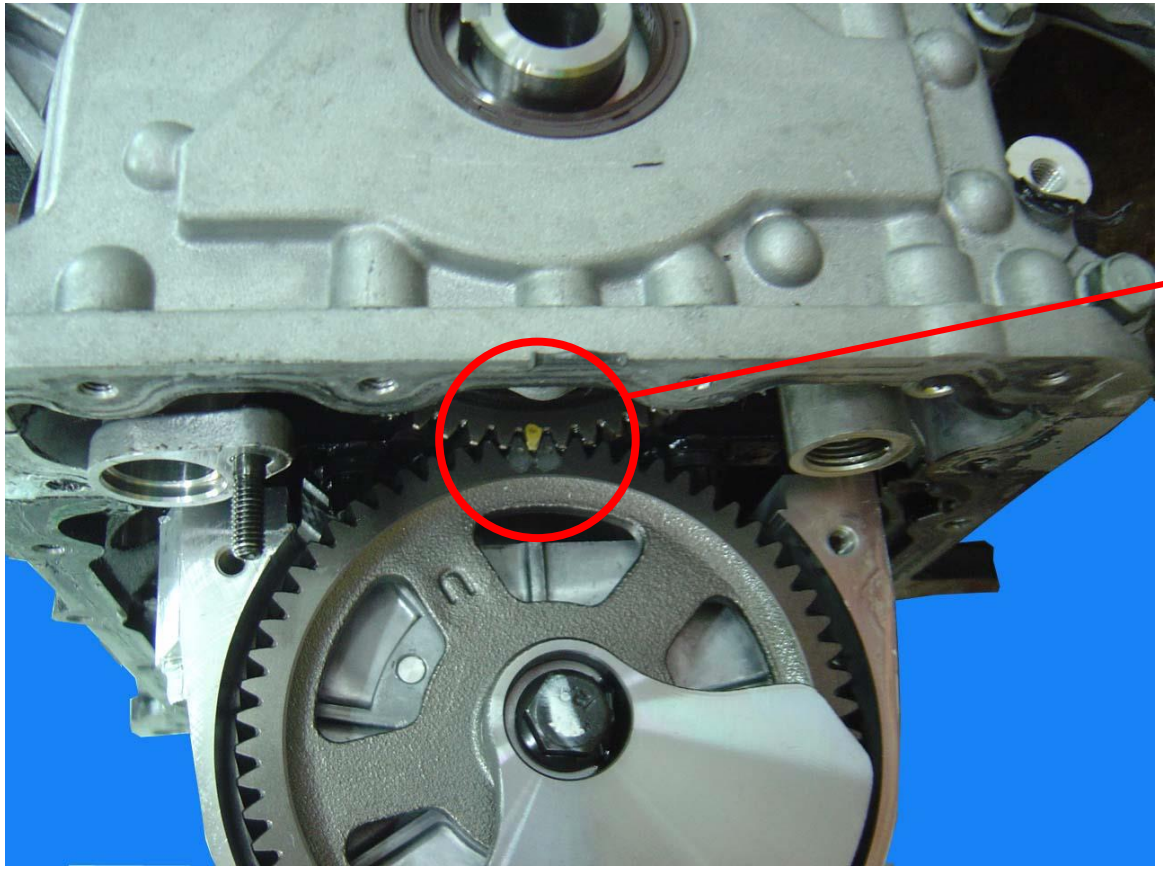


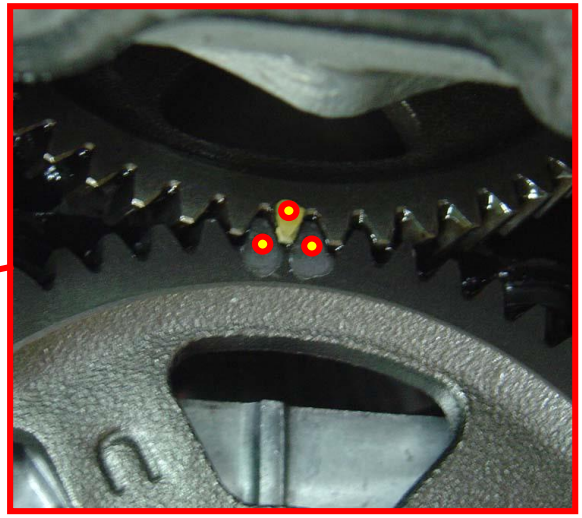
- **DOHC 4 Valve**
- **VALVE operating type**:
  - END PIVOT ROLLER SWING ARM



- **CAM operating type : 2 Chains**
- **Hollow camshaft**
- **Balance shaft is operated by gear**
  -> for reducing vibration

Balance Shaft



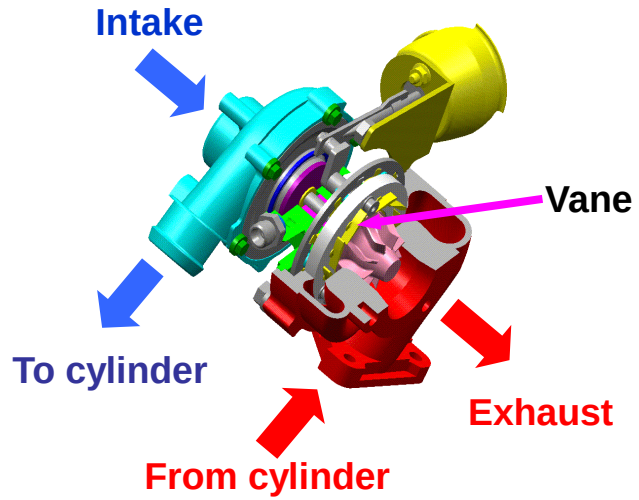


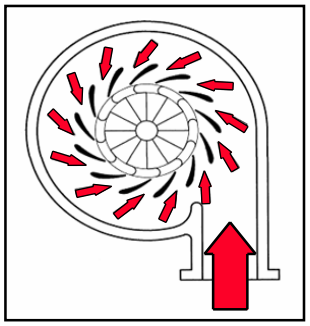
Timing Mark

Balance Shaft

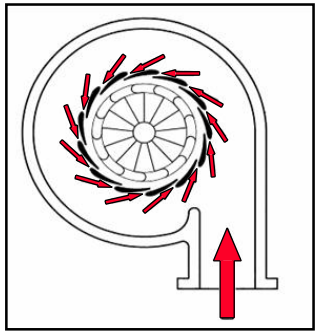
Intake / Exhaust manifold

◆ **VGT**





High Speed



Low Speed

◆ **Electrical EGR Valve**

- Valve type : linear solenoid type
- Control voltage : 13.5V (Duty control)
- Coil resistance : 7.3 ~ 8.3 Ω (at 20℃)

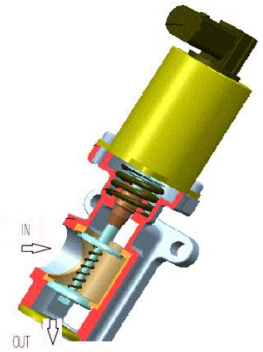
◆ **EGR COOLER**

- Coolant cooling type
- Reduced intake air temperature and increased intake air

  → Reduced NOx and PM

◆ **WCC (Warm-up Catalytic Converter)**

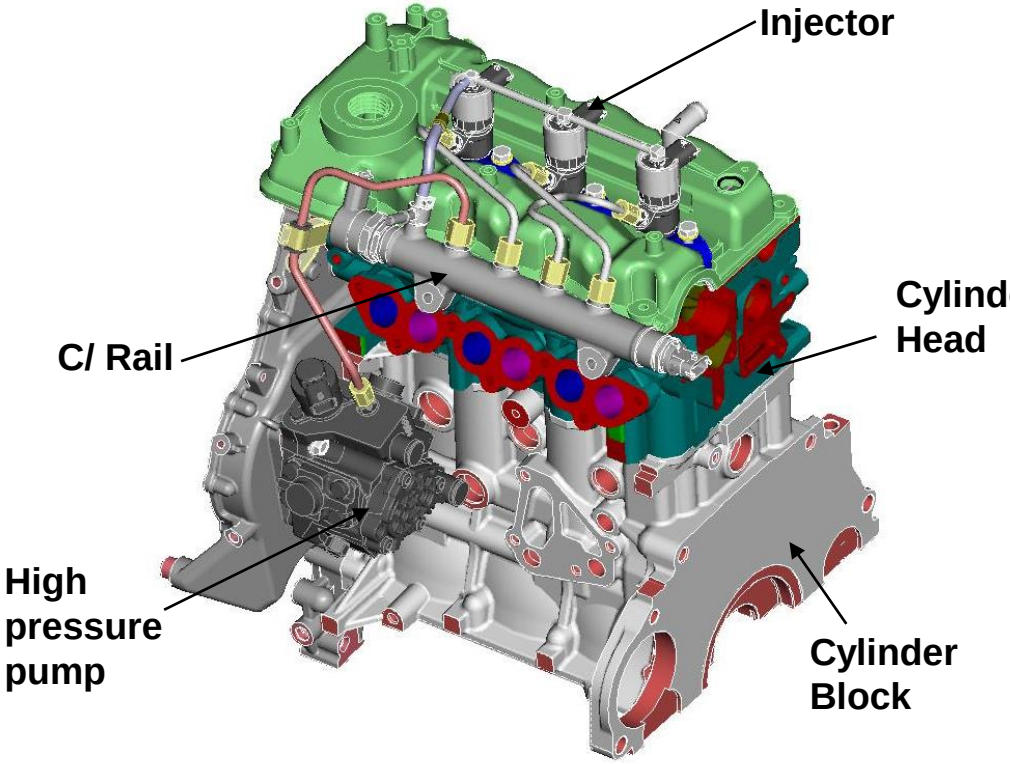
◆ **Lambda sensor**



E / EGR Valve

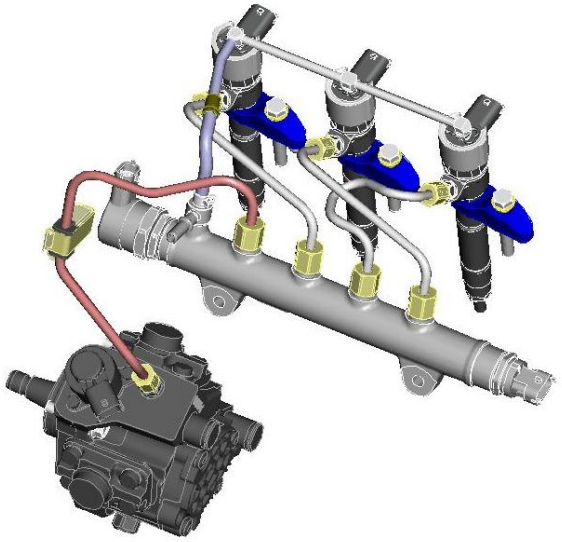
EGR cooler

Fuel system – location / component



◆ **Component**

- High Pressure Pump
- Common Rail
- Injector



◆ **Max. Pressure : 1600 bar**

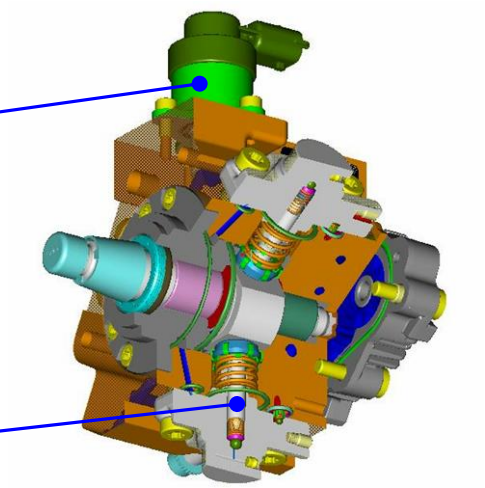
◆ **Duel pressure control (2 Governor control) : FPV + RPV**

※ FRV : Fuel Pressure regulator Valve , RPV : Rail Pressure regulator Valve

Fuel system – High Pressure Pump / Common Rail

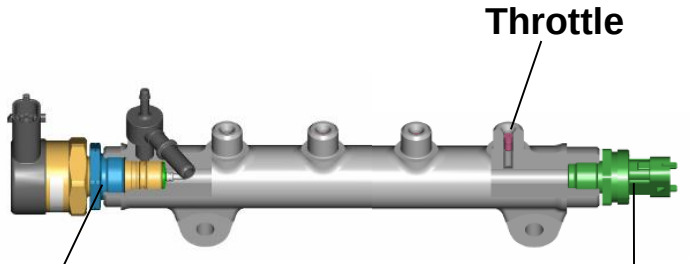
◆ **High Pressure Pump**

- Type : CP1H
- Max. Pressure : 1600 bar



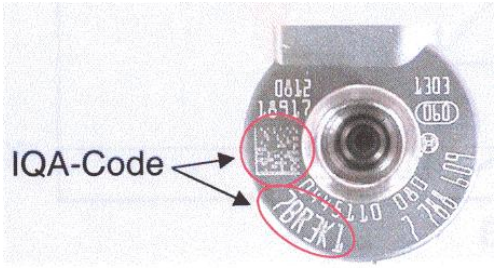
◆ **Common Rail**

- Allowed pressure : 1,600 bar
- Rail Pressure Sensor
  : Max. Measurement : 1,800 bar
- Applied RPV
- Throttle
  : Reduced fluctuation of fuel pressure to injector



Fuel system – Injector

- **Injector**
  - compensates fuel amount
    : Applied IQA (Injector Quantity Adjustment) code for compensating fuel amount of each injectors
  - Type : CRI2.2
  - Max. Pressure : 1600 bar

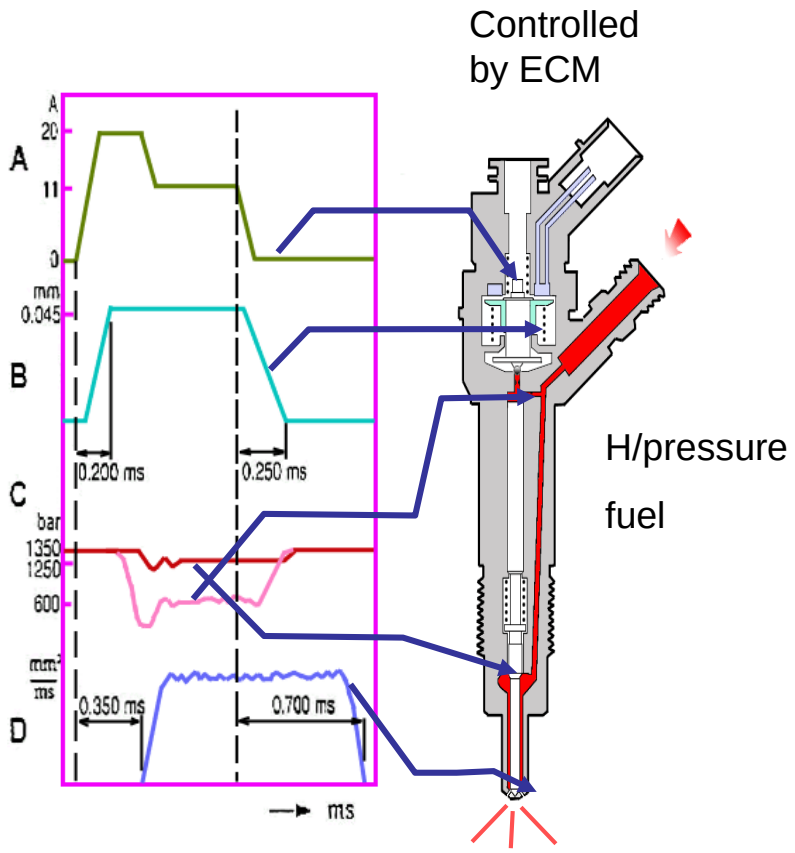


Ampere for solenoid control

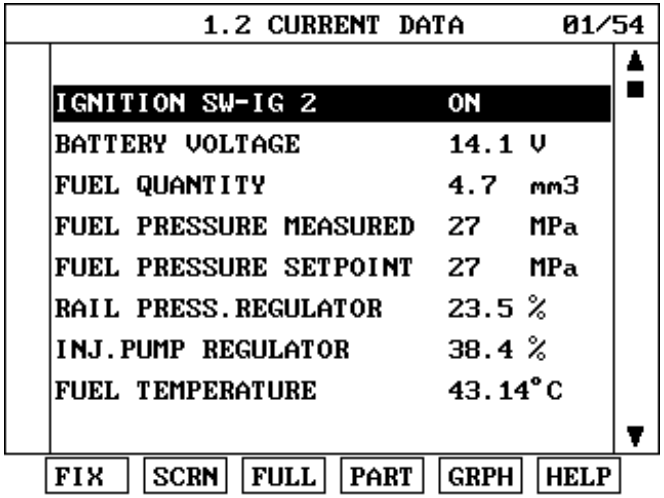
Lift of armature

Fuel pressure of injector inside

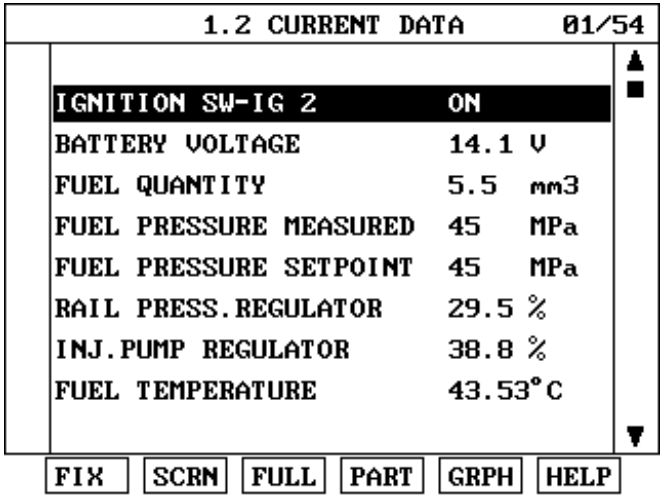
Injection pattern



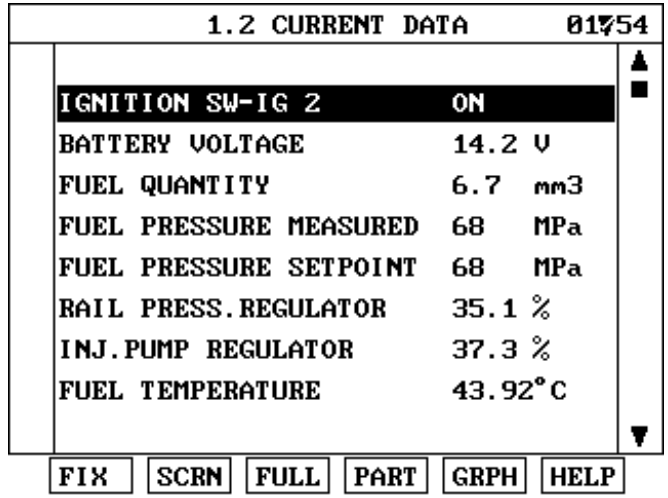
Current Data



Idle condition



1500 rpm



3000 rpm

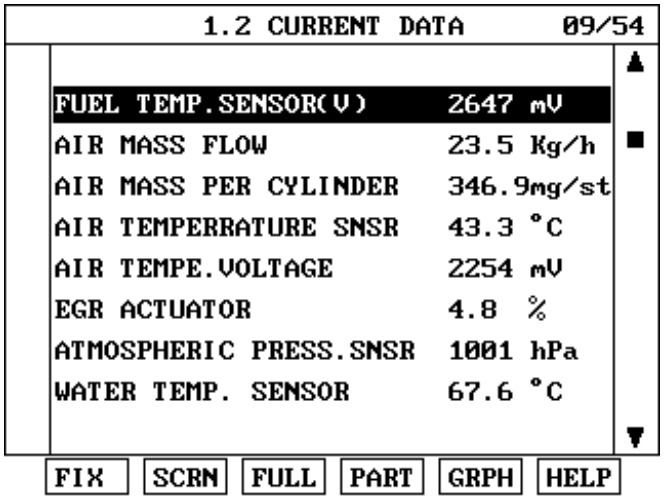
Conditions

-No Electrical Load

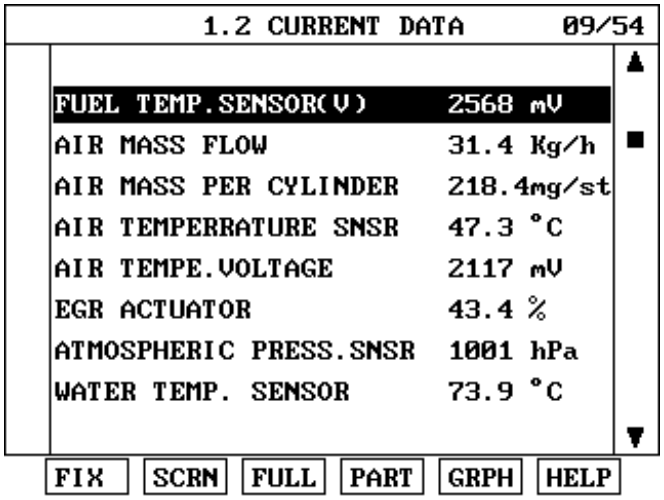
-Neutral (Manual Transaxle)

-No DTC

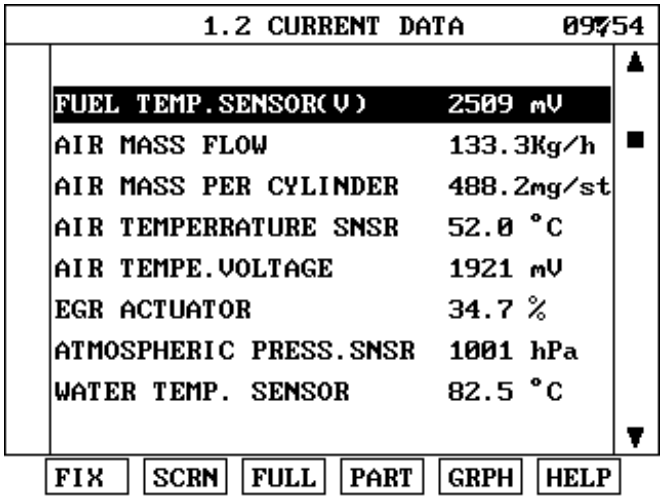
Current Data



Idle condition



1500 rpm



3000 rpm

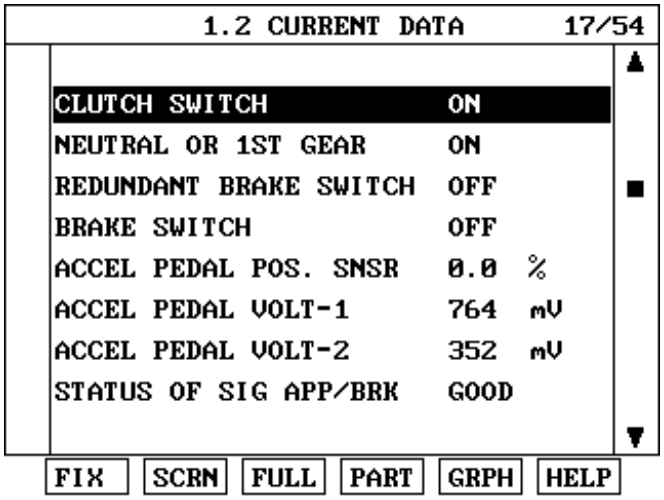
Conditions

-No Electrical Load

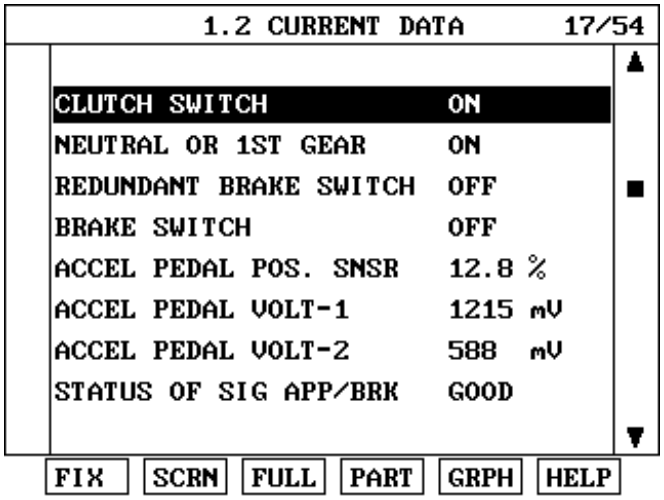
-Neutral (Manual Transaxle)

-No DTC

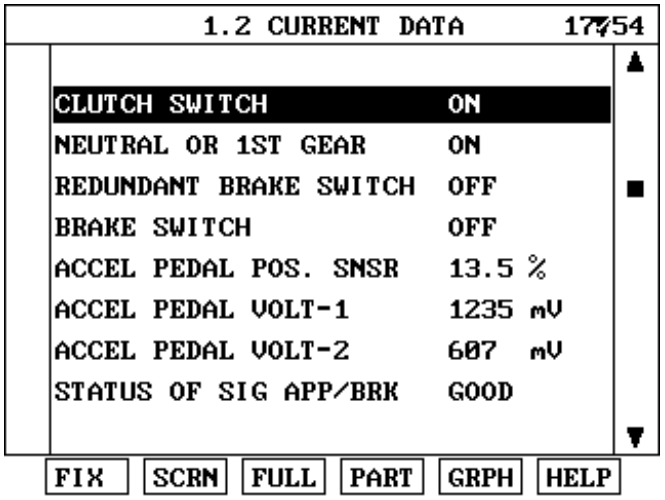
Current Data



Idle condition



1500 rpm



3000 rpm

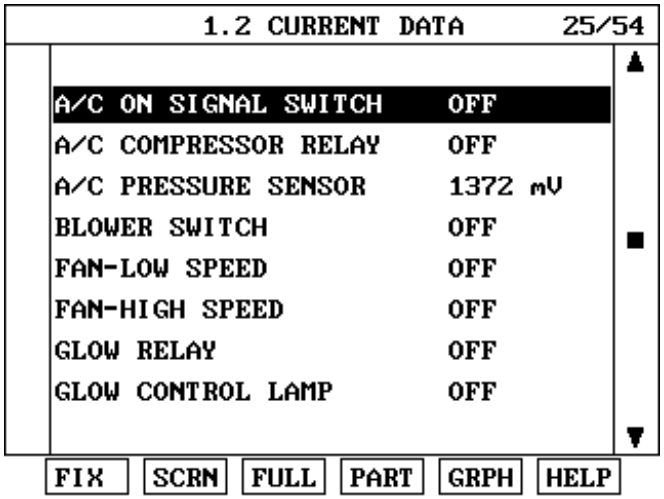
Conditions

-No Electrical Load

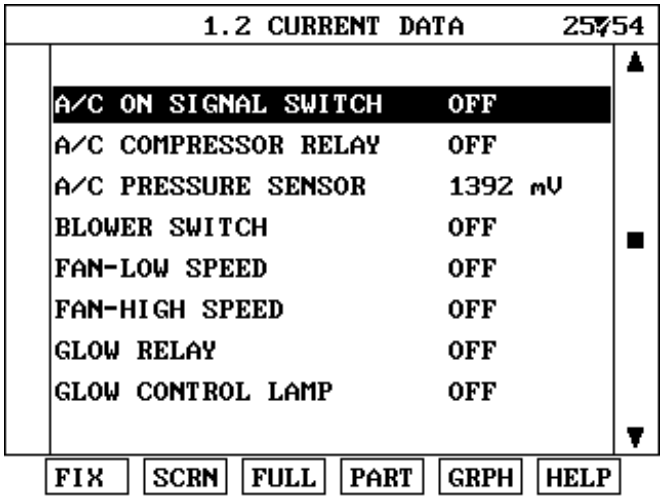
-Neutral (Manual Transaxle)

-No DTC

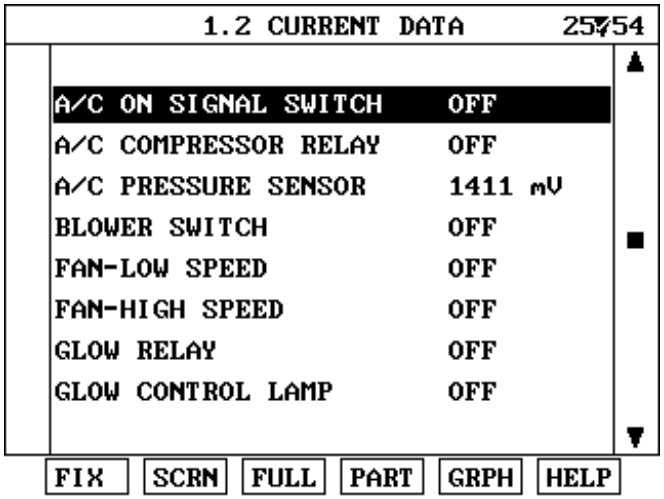
Current Data



Idle condition



1500 rpm



3000 rpm

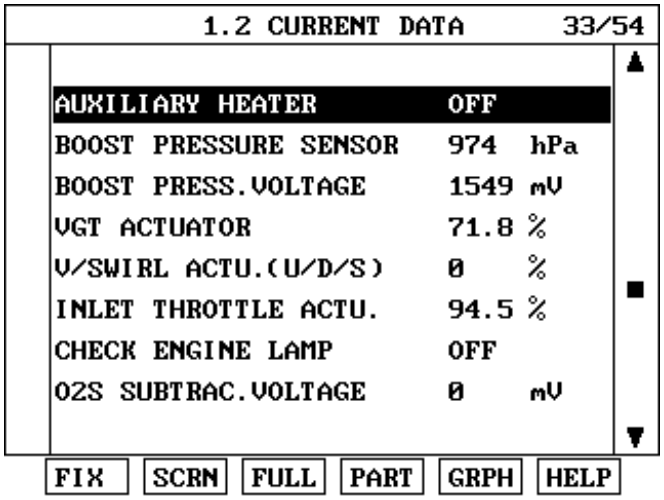
Conditions

-No Electrical Load

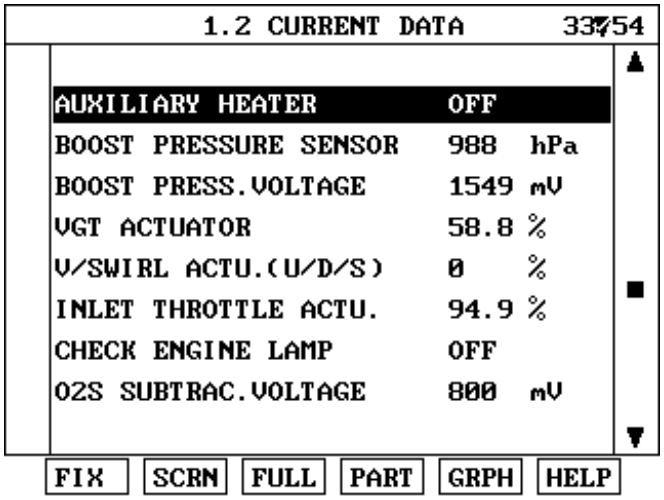
-Neutral (Manual Transaxle)

-No DTC

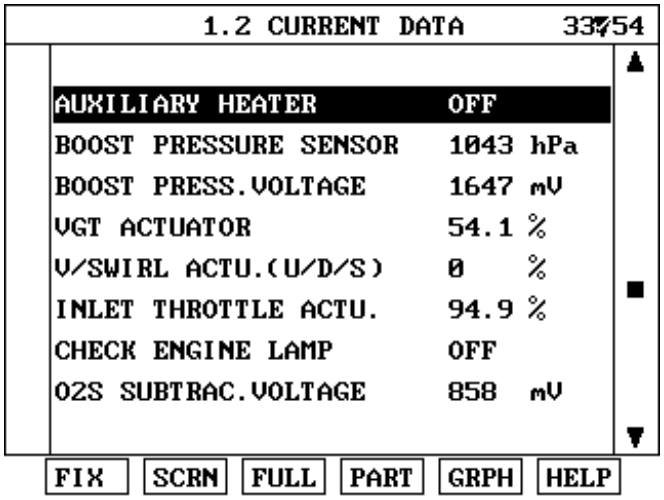
Current Data



Idle condition



1500 rpm



3000 rpm

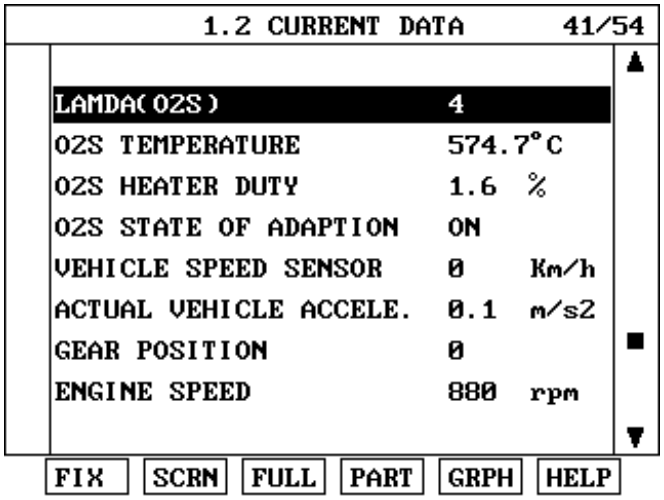
Conditions

-No Electrical Load

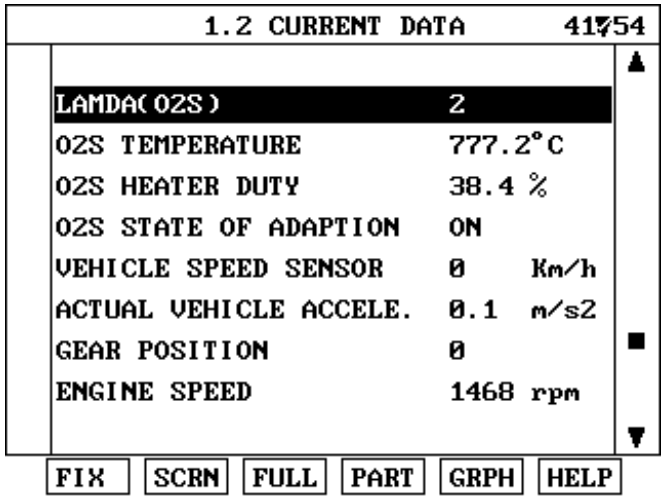
-Neutral (Manual Transaxle)

-No DTC

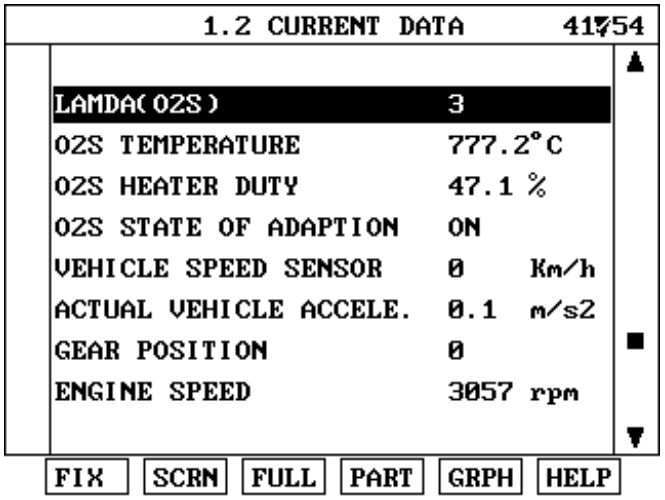
Current Data



Idle condition



1500 rpm



3000 rpm

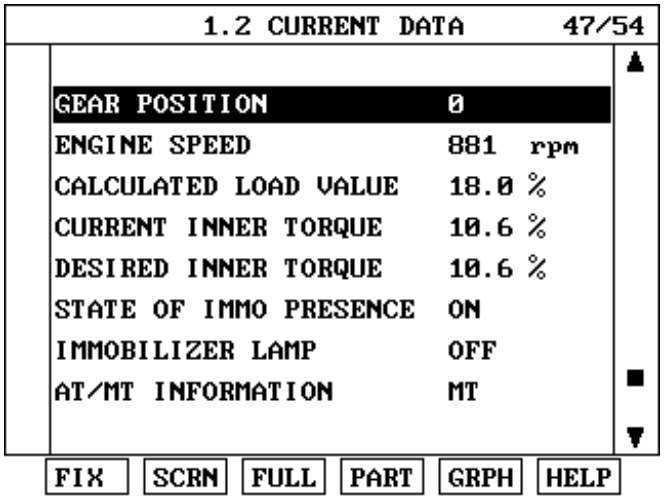
Conditions

-No Electrical Load

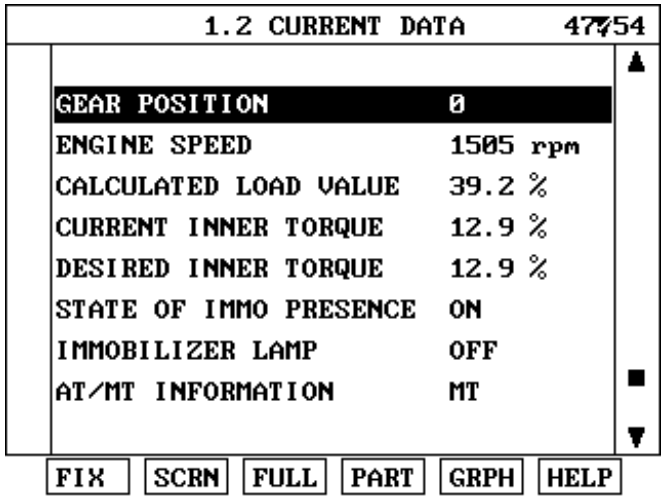
-Neutral (Manual Transaxle)

-No DTC

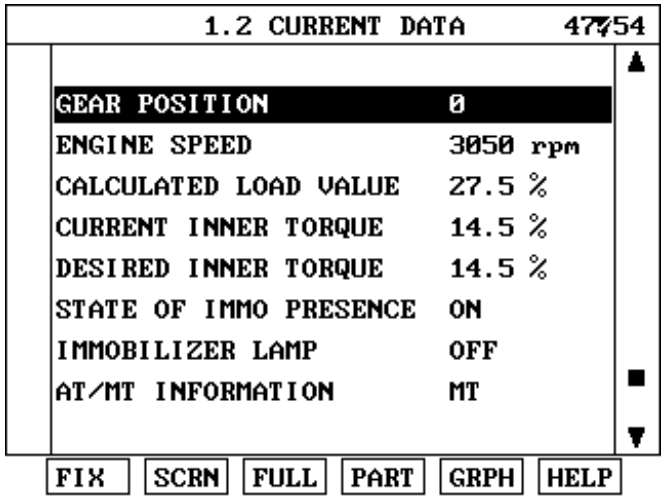
Current Data



Idle condition



1500 rpm



3000 rpm

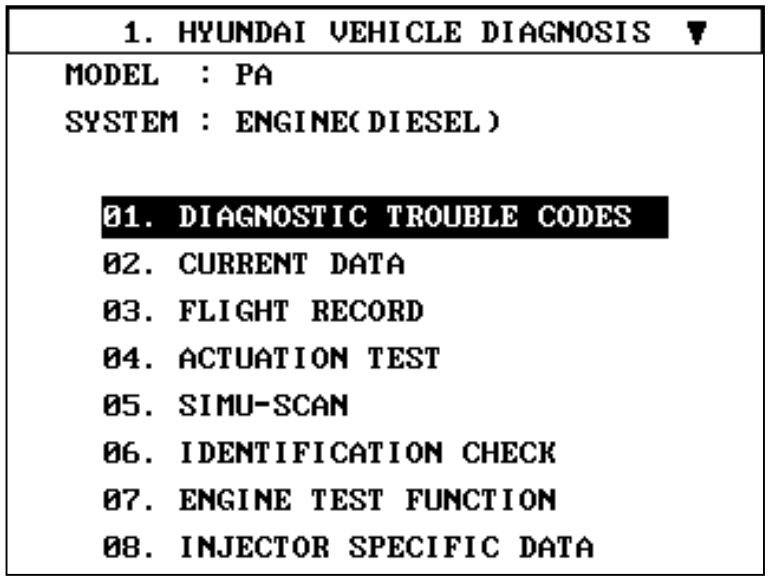
Conditions

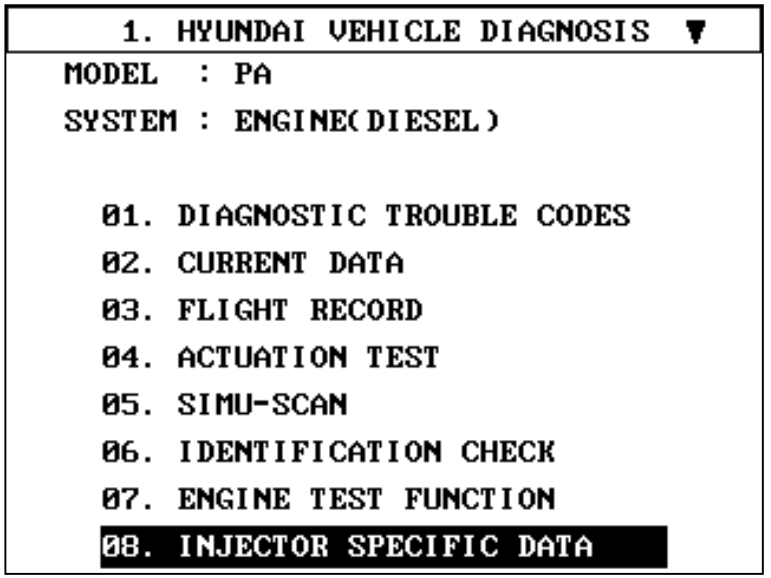
-No Electrical Load

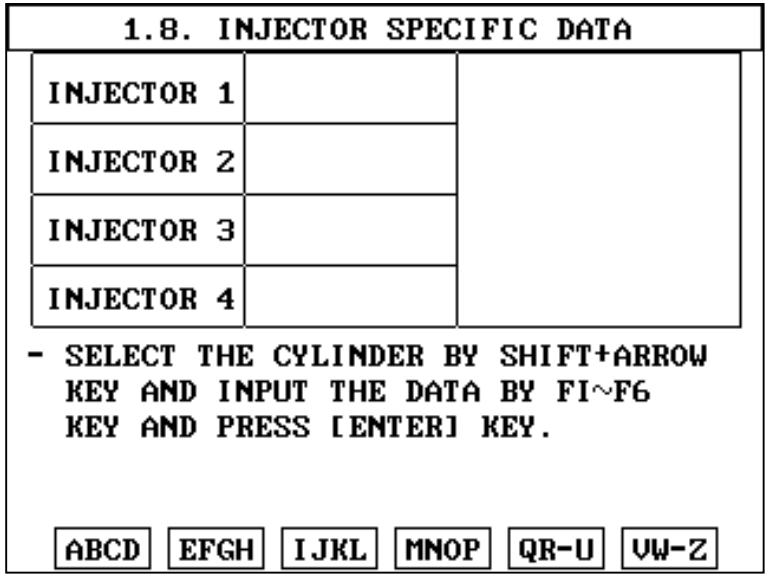
-Neutral (Manual Transaxle)

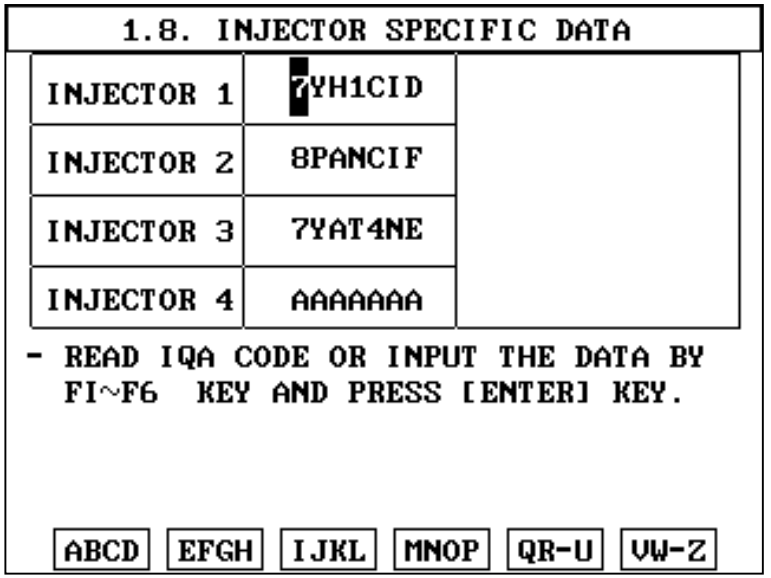
-No DTC

Injector specific data (IQA)

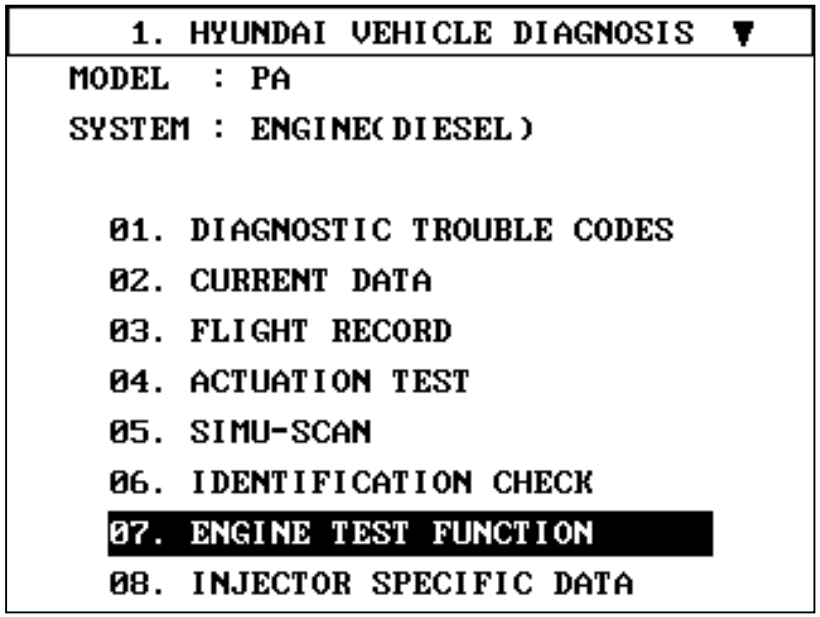


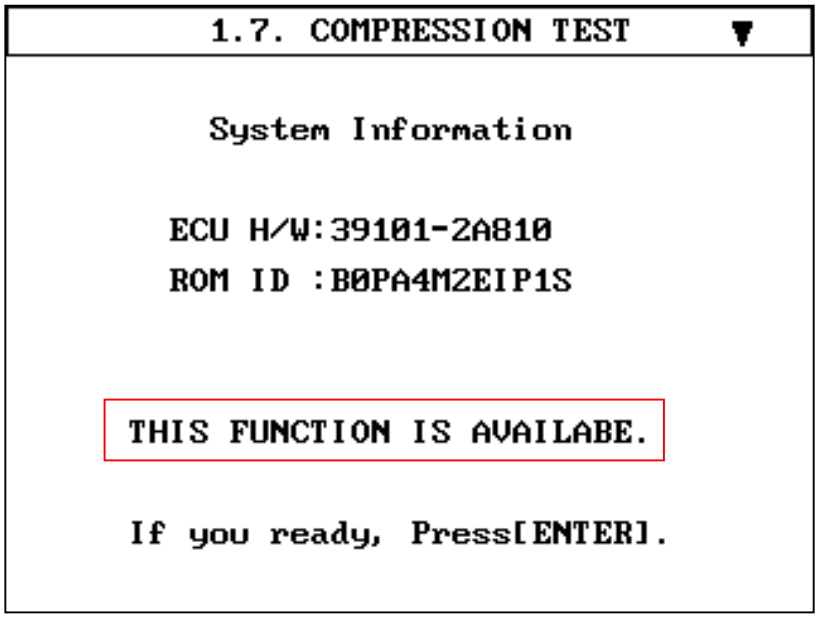






Engine Test Function



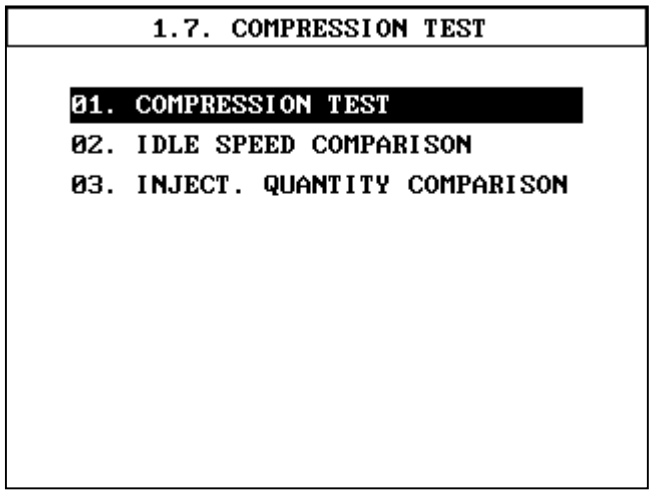


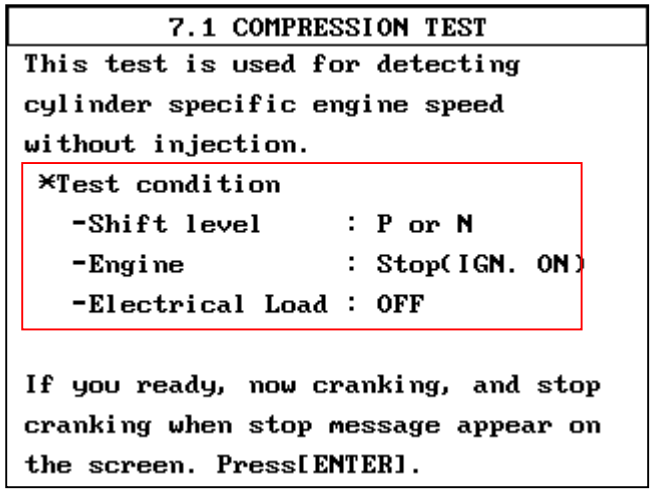
Engine Test Function is consist of 3 tests, which are tested by Hi-scan.

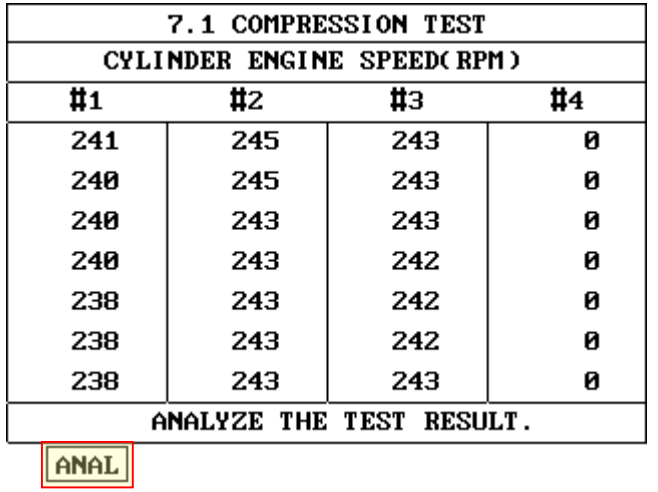
Those are test for mechanical condition of engine, mechanical condition of injectors and electrical compensated by ECM

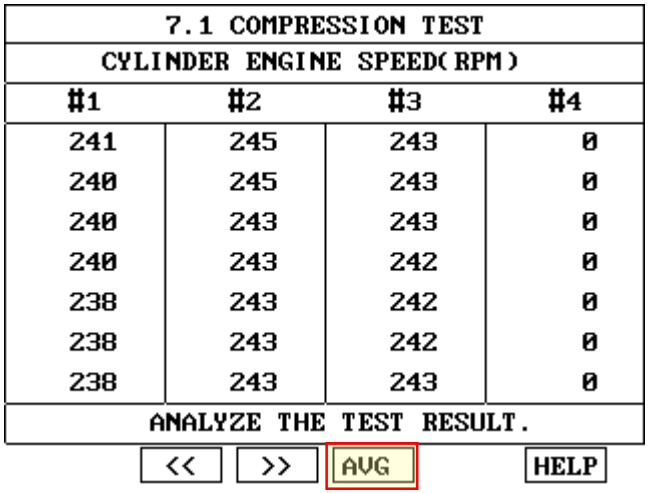
- Compression test
- Idle speed comparison
- Injection quantity comparison

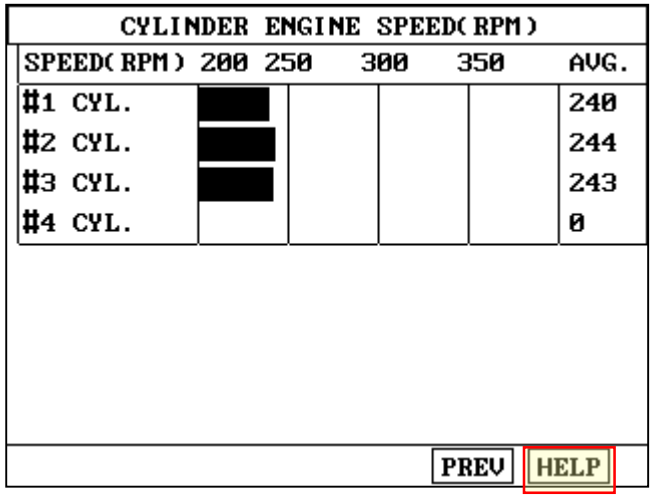
Engine Test Function – compression test

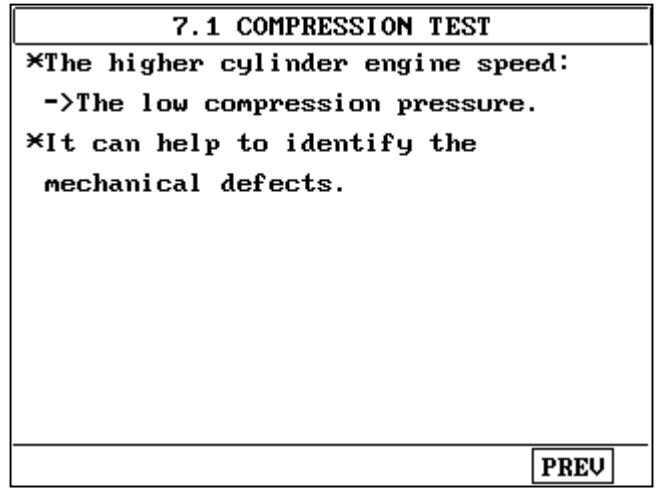




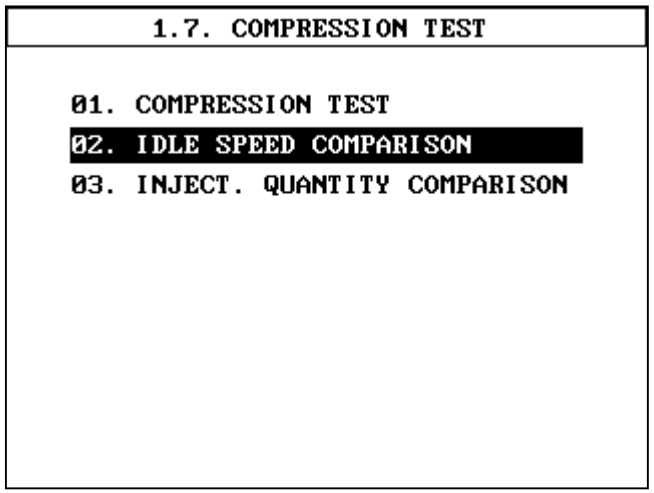


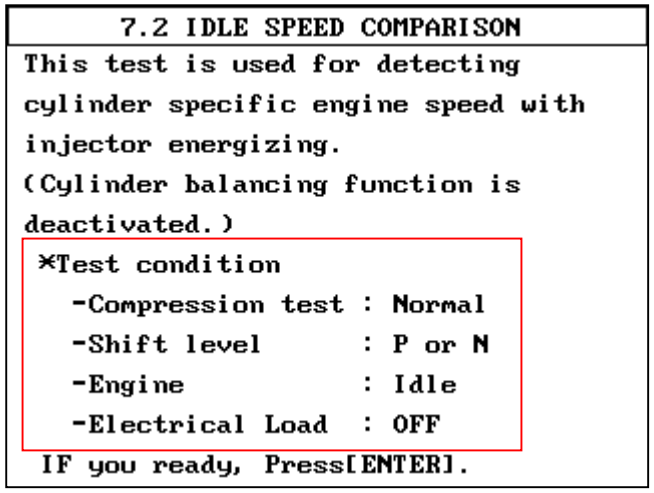


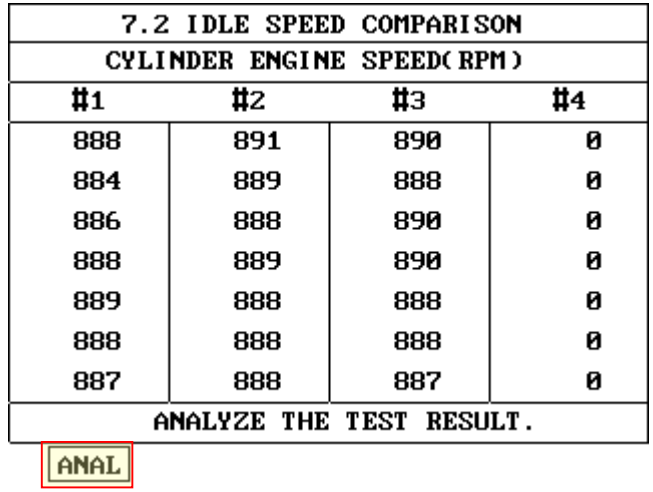


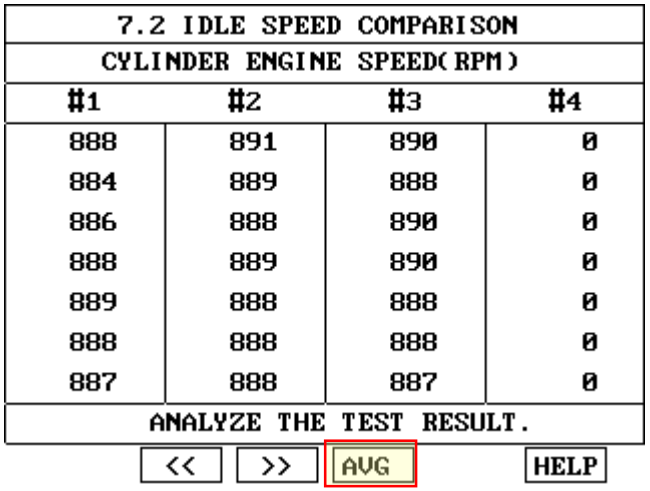


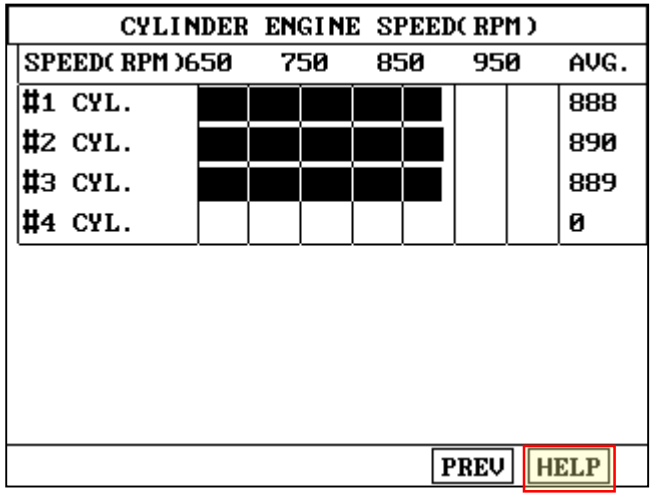
Engine Test Function – Idle speed comparison

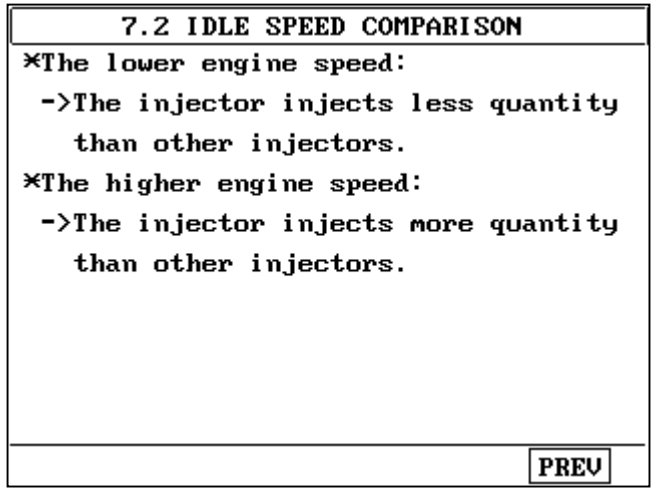












Engine Test Function – Injection quantity comparison

1.7. COMPRESSION TEST

01. COMPRESSION TEST
02. IDLE SPEED COMPARISON
03. INJECT. QUANTITY COMPARISON

7.3 INJECT. QUANTITY COMPARISON

This test is used for detecting cylinder specific quantity with individual energizing of injector. (Cylinder balancing function is activated.)

*Test condition
-Compression test : Normal
-Shift level : P or N
-Engine : Idle
-Electrical Load : OFF

IF you ready, Press[ENTER].

7.3 INJECT. QUANTITY COMPARISON

ENG. SPEED(RPM)				INJECTION QUANITY(MM3)			
#1	#2	#3	#4	#1	#2	#3	#4
879	880	880	0	0.1	-0.1	-0.0	-0.0
880	880	881	0	0.1	-0.1	-0.0	-0.0
880	879	881	0	0.1	-0.1	-0.0	-0.0
879	880	880	0	0.1	-0.1	-0.0	-0.0
879	880	879	0	0.1	-0.1	-0.0	-0.0
879	879	880	0	0.1	-0.1	-0.0	-0.0
880	880	881	0	0.1	-0.1	-0.0	-0.0

ANALYZE THE TEST RESULT.

ANAL

7.3 INJECT. QUANTITY COMPARISON

ENG. SPEED(RPM)				INJECTION QUANITY(MM3)			
#1	#2	#3	#4	#1	#2	#3	#4
879	880	880	0	0.1	-0.1	-0.0	-0.0
880	880	881	0	0.1	-0.1	-0.0	-0.0
880	879	881	0	0.1	-0.1	-0.0	-0.0
879	880	880	0	0.1	-0.1	-0.0	-0.0
879	880	879	0	0.1	-0.1	-0.0	-0.0
879	879	880	0	0.1	-0.1	-0.0	-0.0
880	880	881	0	0.1	-0.1	-0.0	-0.0

ANALYZE THE TEST RESULT.

<< >> AVG HELP

CYLINDER ENGINE SPEED(RPM)

SPEED(RPM)	650	750	850	950	AVG.
#1 CYL.	■	■	■	■	878
#2 CYL.	■	■	■	■	878
#3 CYL.	■	■	■	■	879
#4 CYL.					0

QUANT.(MM3)	-4	-2	0	2	AVG.
#1 CYL.					0.08
#2 CYL.					-0.05
#3 CYL.					-0.03
#4 CYL.					-0.00

PREV HELP

7.3 INJECT. QUANTITY COMPARISON

*The positive correction value:
->The fuel injection of the cylinder is less than that of other cylinder.
*The negative correction value:
->The fuel injection of the cylinder is more than that of other cylinder.
*Extreme correction value identifies a problematic injector.
After replacing a injector with newone ,retest & confirm the engine condition

PREV