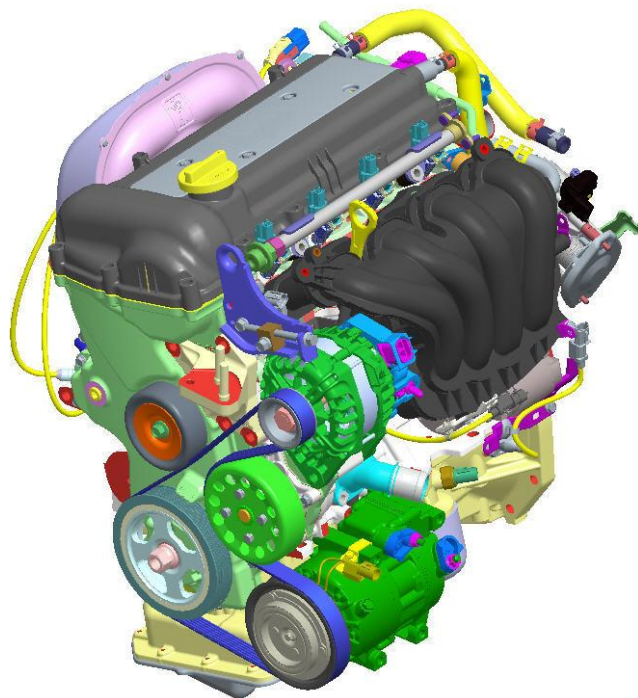


Engine

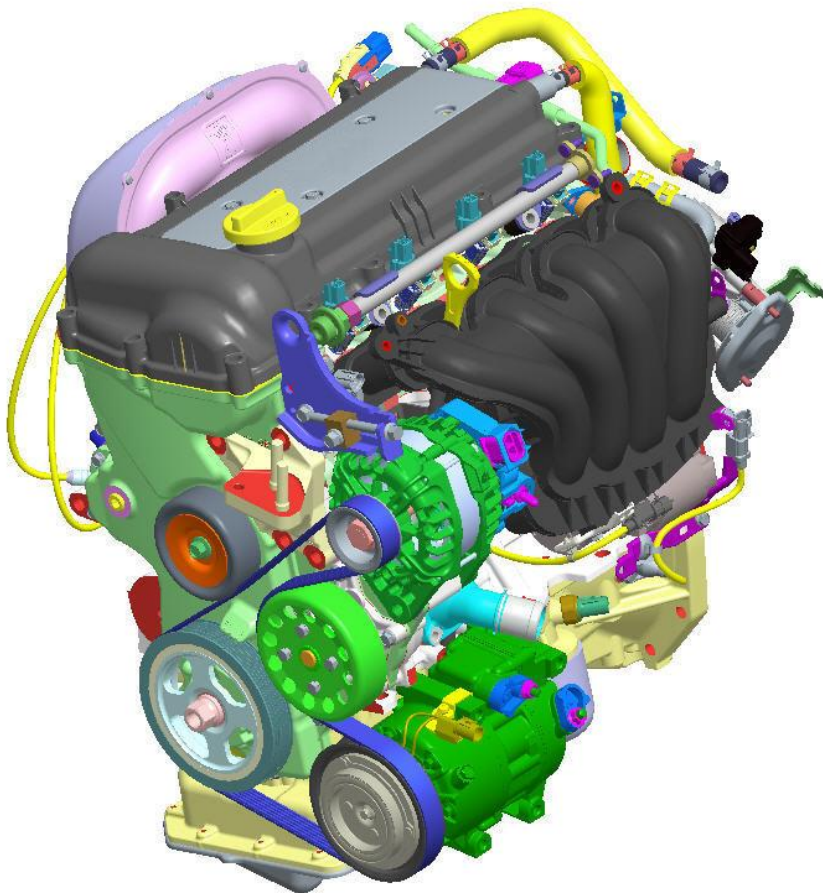


Application

Engine		EU	General	M / East	Australia	NA
Gasoline	$\gamma - 1.4$	●				
	$\gamma - 1.6$	●	●	●		
	$\beta - 2.0$	●	●	●	●	●
Diesel	U – 1.6	●	●	●		
	D – 2.0	●				

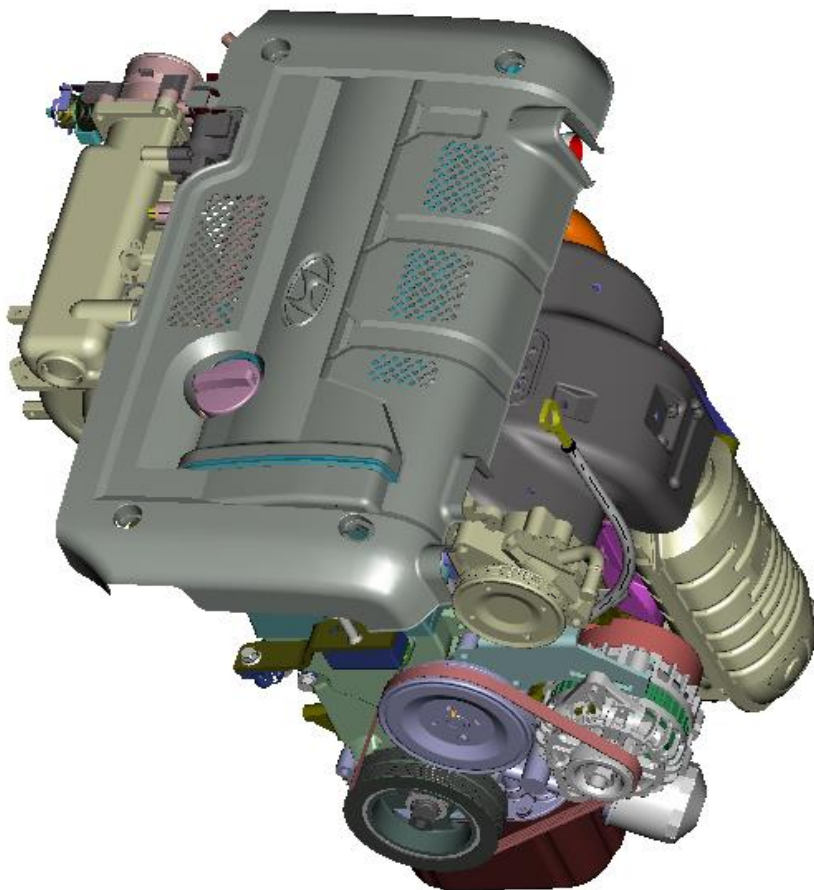
- Gamma 1.4L and 1.6L : Newly developed 4 cylinder gasoline engine
→ Applied to HD Elantra.
- Gamma 1.4L and Common Rail D 2.0L are only for EU market

Gamma engine



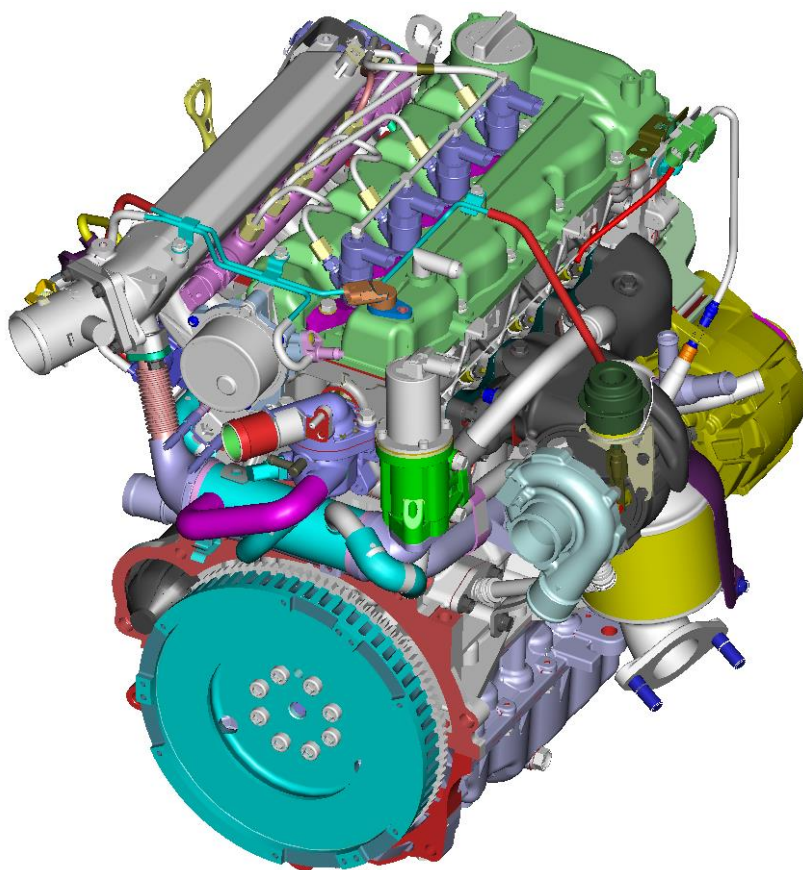
Engine	γ - 1.4 CVVT	γ - 1.6 CVVT
Displacement (cc)	1396	1591
Max. Power (PS / RPM)	109 / 6200	122 / 6200
Max. Torque (kgf·m / RPM)	14.0 / 5000	15.7 / 4200
Feature	<ul style="list-style-type: none"> • Timing Chain • Individual Ignition • Shim-less MLA (Solid tappet) • CVVT standard • Plastic Intake manifold (Reversed intake and exhaust manifold) • BOSCH PCM • Crankshaft offset : 10mm • Serpentine belt • Stainless steel exhaust manifold 	

Beta engine



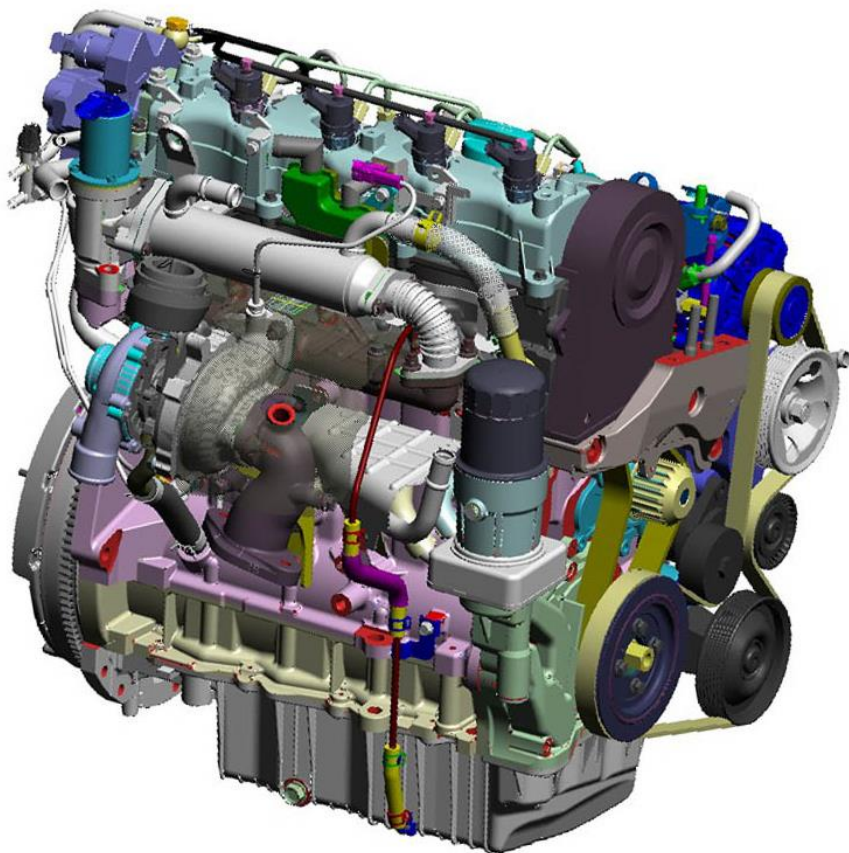
Engine	β - 2.0 CVVT
Displacement (cc)	1975
Max. Power (PS / RPM)	143 / 6000
Max. Torque (kgf·m / RPM)	19.0 / 4500
Feature	<ul style="list-style-type: none"> • SULEV Emission • Dual layer metal head gasket • Timing belt auto tensioner • CVVT • Siemens PCM • CAN Diagnosis • Aluminum oil pan

U engine



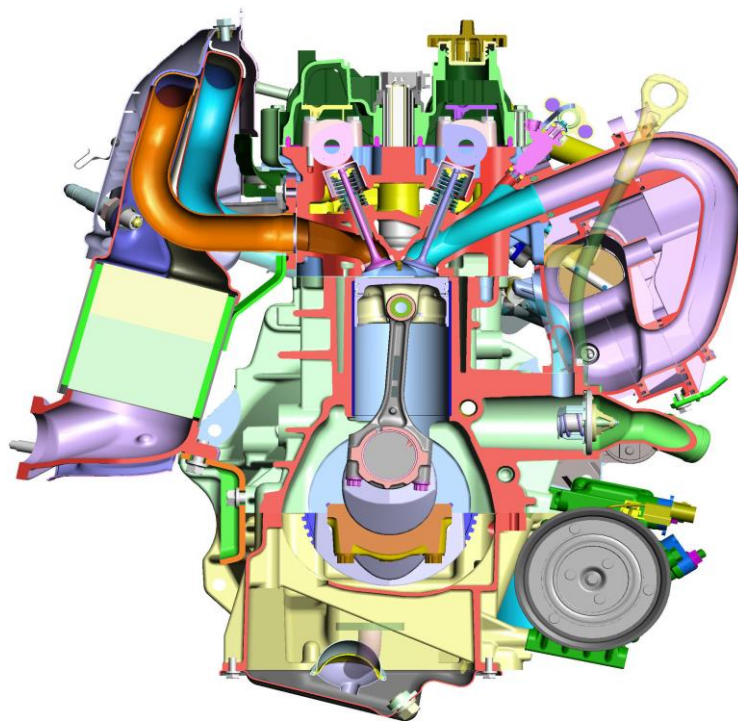
Engine	U - 1.6 VGT
Displacement (cc)	1582
Max. Power (PS / RPM)	115 / 4000
Max. Torque (kgf·m / RPM)	26.0 / 2000
Feature	<ul style="list-style-type: none"> • VGT Turbo Charger • Euro 4 Emission • Swirl Control Valve • Timing Chain • Electrical EGR & EGR cooler • Lambda Sensor • Throttle flap • Serpentine belt • Bed Plate

D engine



Engine	D – 2.0 VGT
Displacement (cc)	1991
Max. Power (PS / RPM)	140 / 4000
Max. Torque (kgf·m / RPM)	31.0 / 2000
Feature	<ul style="list-style-type: none"> • VGT Turbo Charger • Euro 4 Emission • Swirl Control Valve • Electrical EGR & EGR cooler • Lambda Sensor • Throttle flap • Serpentine belt • CPF

Gamma Engine

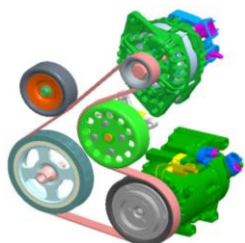


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FD - ENGINE

8

Item	Effect						Remark
	Performance	Emission	NVH	Weight	Cost	Endurance	
Al cylinder block	●			●			
Reverse In/Ex Mani	●	●	●	●			
CVVT	●	●					
Solid Tappet	●				●		
Timing Chain						●	
Serpentine belt			●	●		●	
Integrated ECU/TCU					●		
SUS Ex/Mani	●	●				●	
Ladder Frame			●				
Offset crank	●						



Serpentine belt



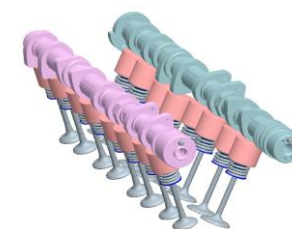
Timing chain



EX manifold

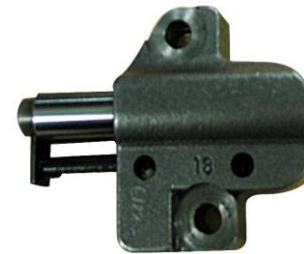
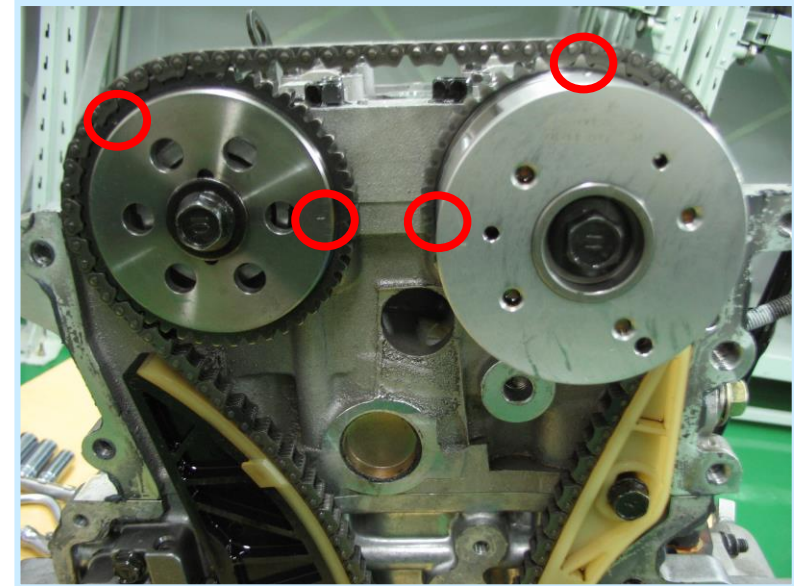
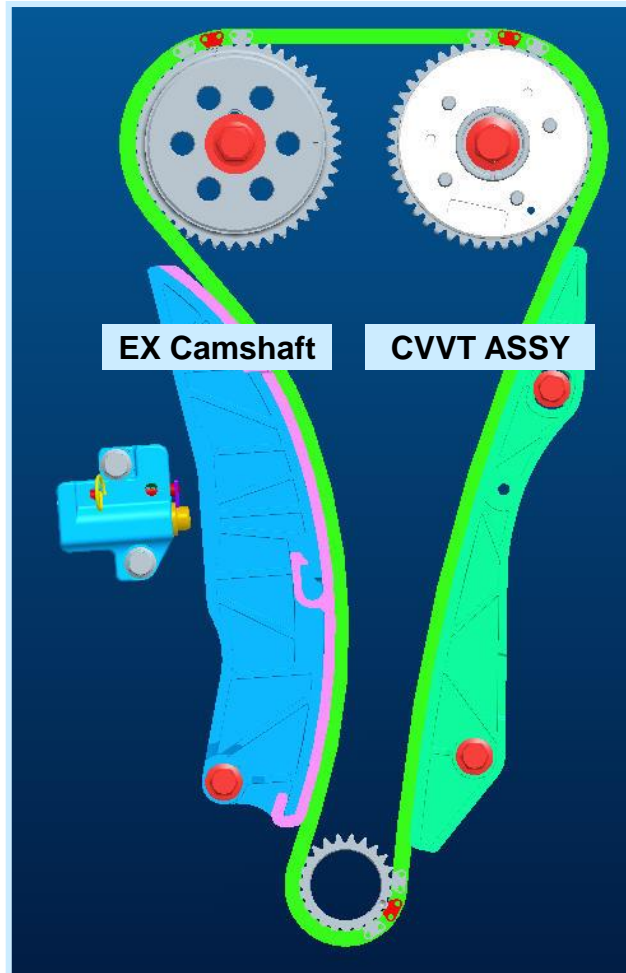


CVVT



MLA (Shimless type)

Timing Chain

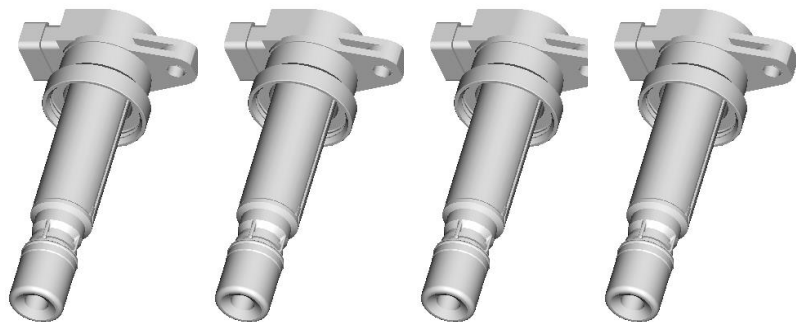


For Gamma



For Theta

Ignition and PCM



◆ Individual ignition control

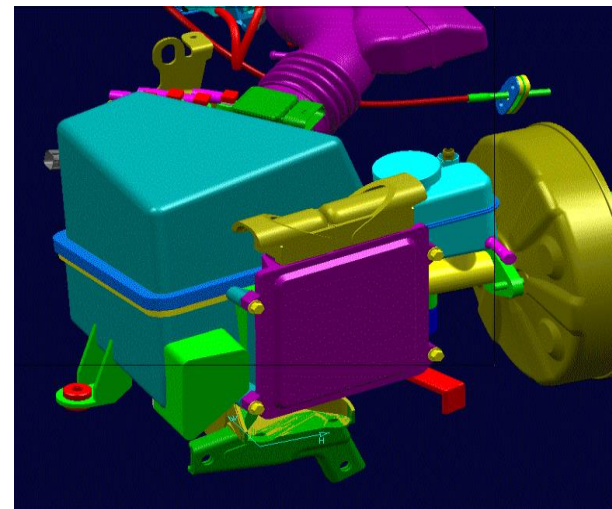
◆ PCM

- Integrated PCM (Power train Control Module)
→ ECM + TCM
- Waterproof computer Assembly, connector
- CAN (Controller Area Network) Diagnosis
- CAN & KW2000 Communication
- Pin : 154 pin (94 + 60 Pin)
- Operation voltage : 6.3 V ~ 16 V

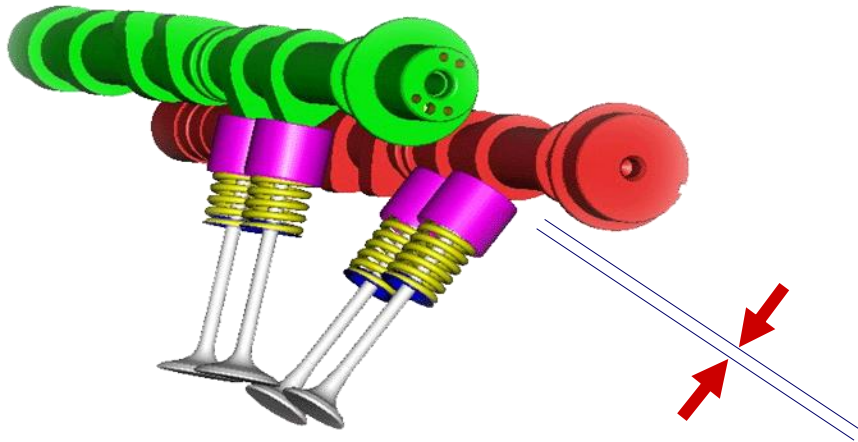
CAN Adaptor



CAN



MLA (Mechanical Lash Adjuster)



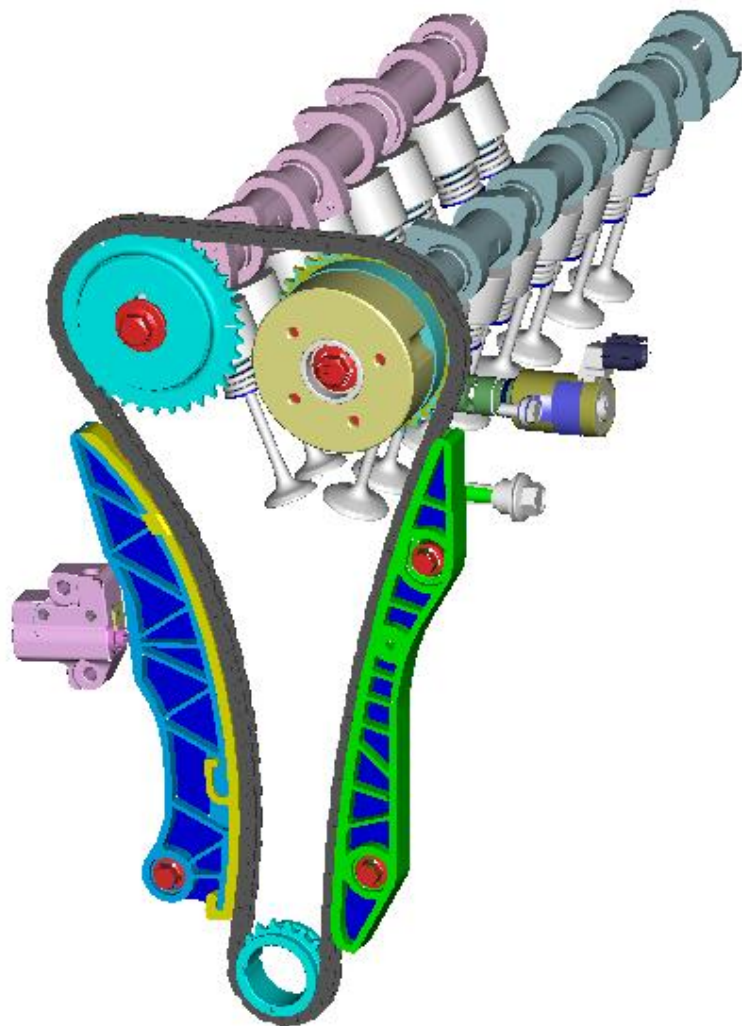
◆ Valve Clearance

- Intake : $0.2 \pm 0.03\text{mm}$ (0.17 ~ 0.23 mm)
- Exhaust : $0.25 \pm 0.03\text{ mm}$ (0.22 ~ 0.28 mm)

◆ Tappet

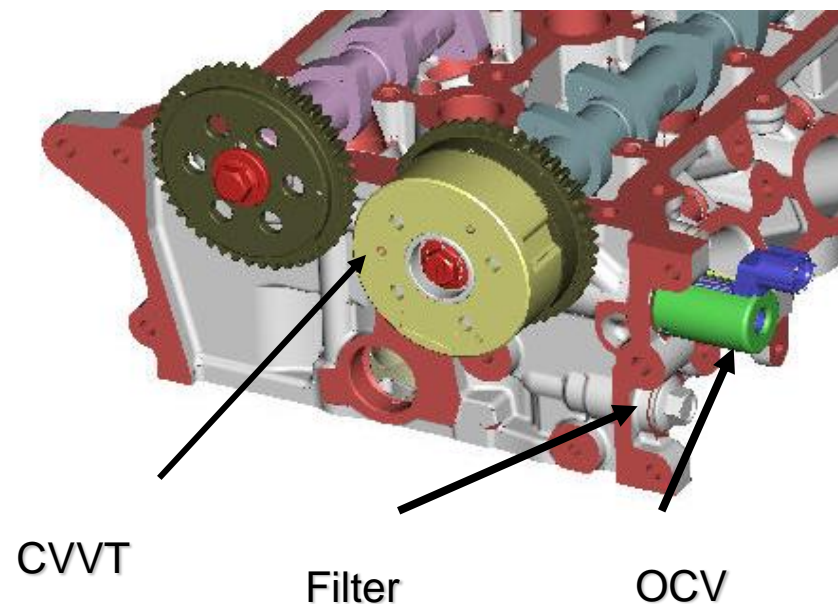
- 41 kinds tappet are supplied.
- Thickness : 3.000 ~ 3.600 mm
- Size and parts number of Tappets for gamma and mu engine are same

CVVT (Continuously Variable Valve Timing)

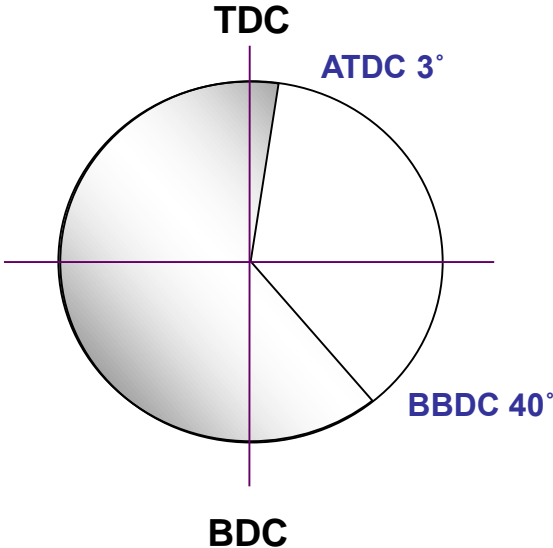
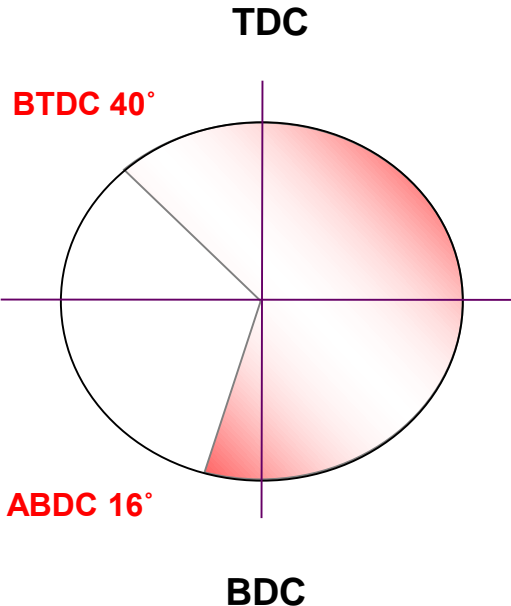
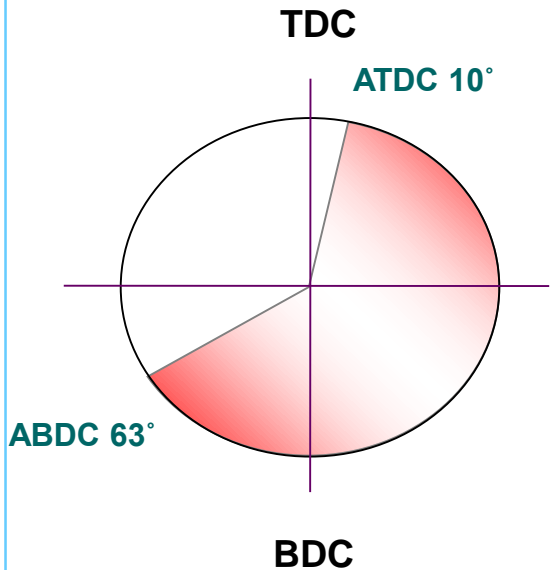


◆ CVVT

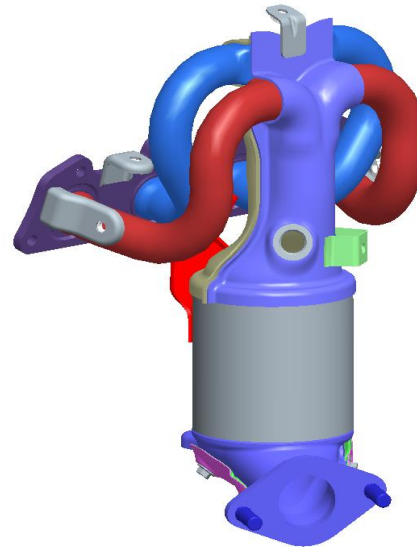
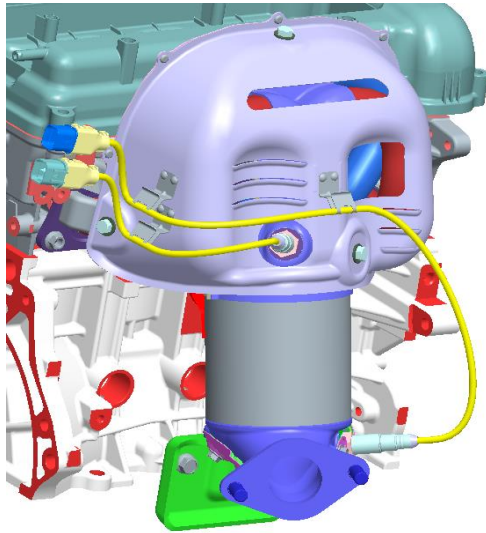
- Type : vane type
- Angle : 50° (Retard ~ Advanced)
- CVVT is a standard



CVVT (Continuously Variable Valve Timing)

Exhaust Valve	Intake Valve	
Duration : 223°	Duration : 236°	
	Full Advance	Full Retard
 <p>TDC</p> <p>ATDC 3°</p> <p>BBDC 40°</p> <p>BDC</p>	 <p>TDC</p> <p>BTDC 40°</p> <p>ABDC 16°</p> <p>BDC</p>	 <p>TDC</p> <p>ATDC 10°</p> <p>ABDC 63°</p> <p>BDC</p>

Exhaust and Intake Manifold

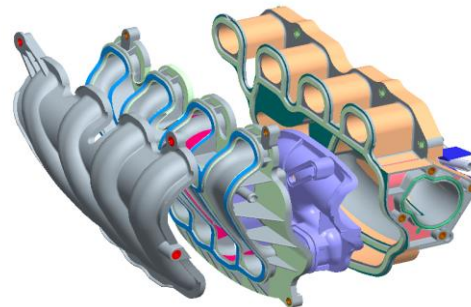
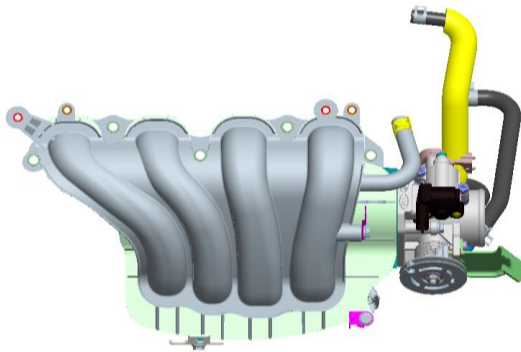


◆ Reversed intake manifold

- Decreasing intake air temp.
- Easy to repair injector
- Increasing Impact absorb area

◆ Intake Manifold

- Plastic Intake Manifold
(improve flow resistance)
- Intake resonator
(reduce pulsation resistance, noise)



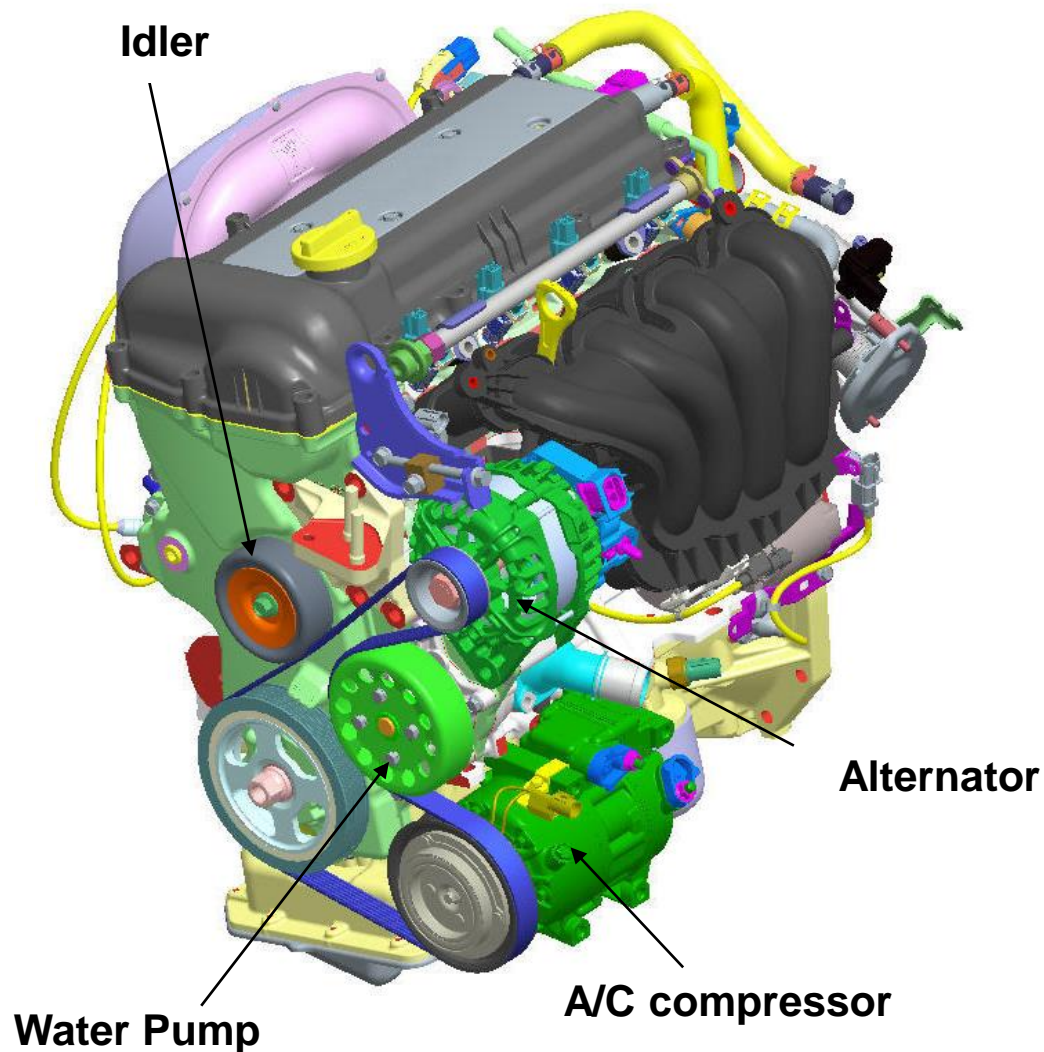
◆ Exhaust Manifold

- 4 - 1 Type
- With WCC
- Stainless Steel manifold

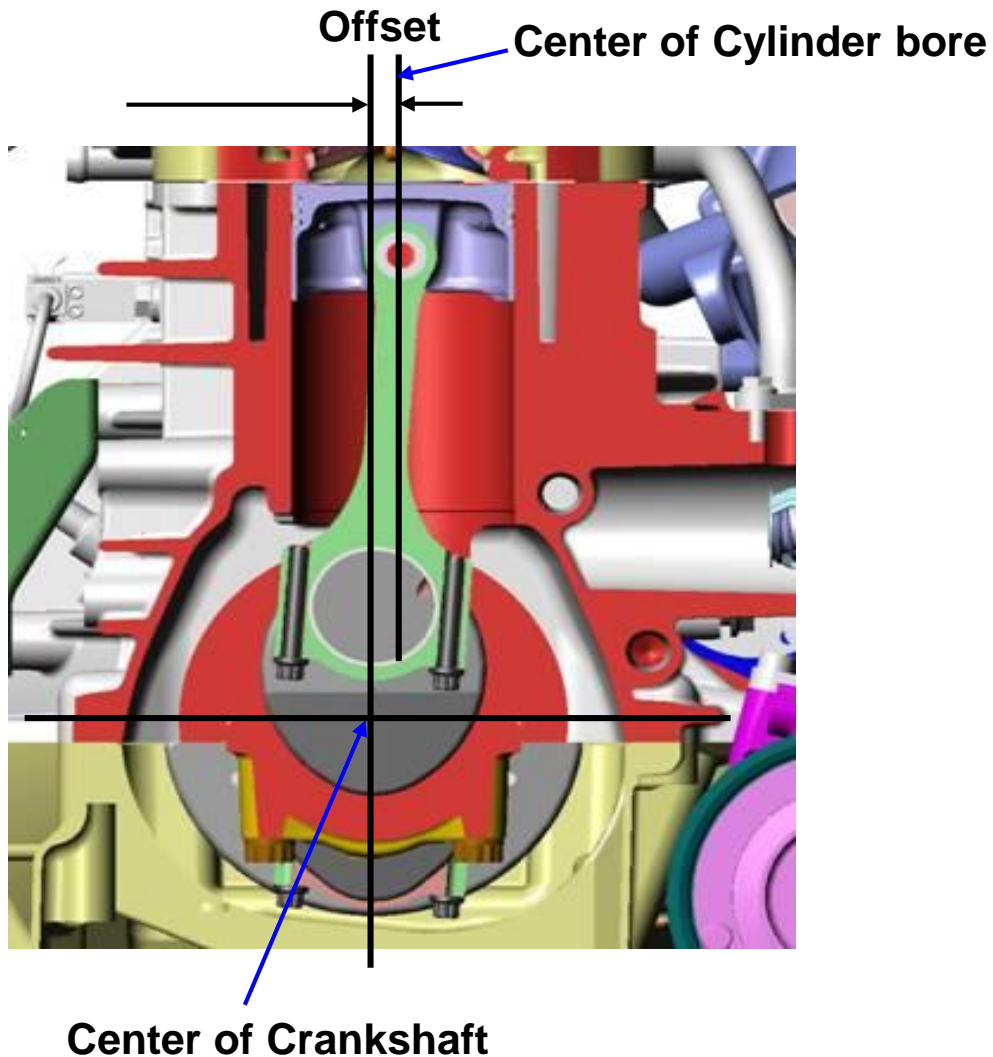
Driving Belt – Serpentine type

◆ Driving belt

- Serpentine type (One-Belt type)
- With MDPS
- Weight and size is reduced



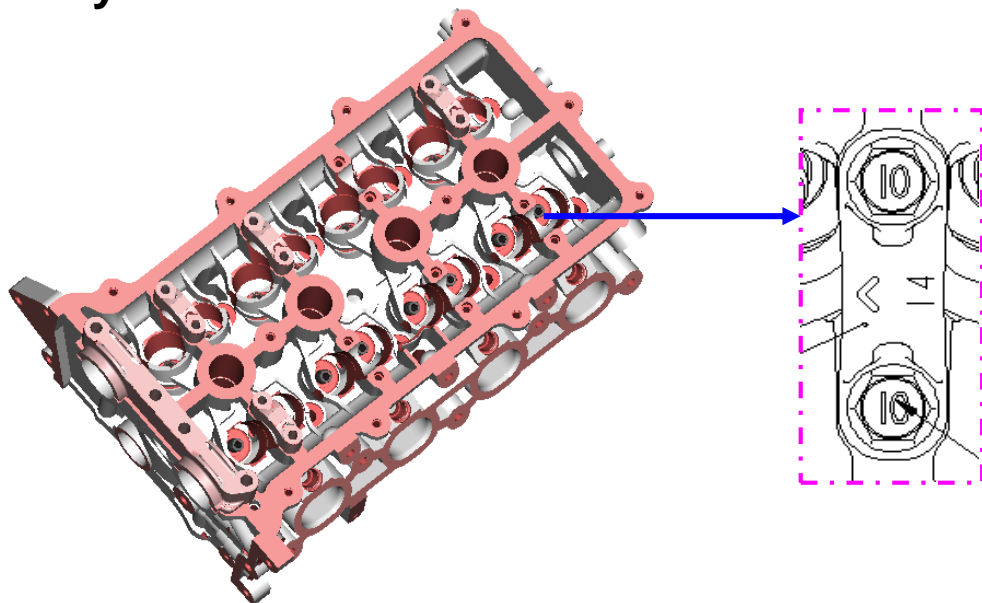
Crankshaft Offset



◆ Crankshaft offset

- For reducing fuel consumption
- To increase inertia moment
offset crank shaft is used

Cylinder Head



◆ Cylinder Head

- Aluminum block
- Tightening Torque
 - **2.0kgf-m + 90° + 100°**
 - **Use 10mm double hexagon wrench**
- Cap marking

NO	IN	EX
1	I1	E1
2	I2	E2
3	I3	E3
4	I4	E4

Cylinder Head Bolt

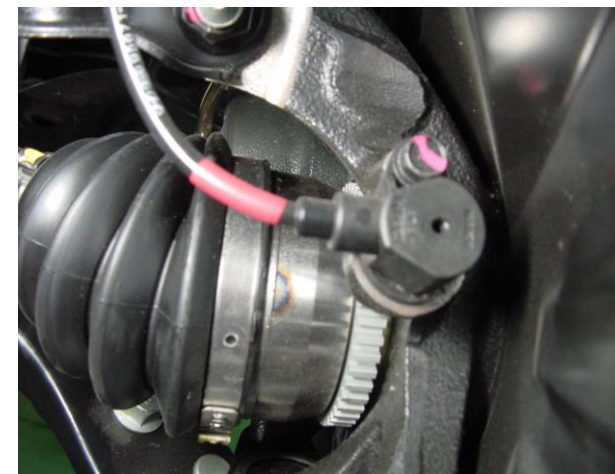


**Gamma 10mm
double hexagon**

**Theta 12mm
double hexagon**

VSS (Vehicle Speed Sensor)

Manual Transaxle		Input Variable	ECU PIN NO.
With OBD-II	ABS / ESP	ABS / ESP module	K 64
	CBS	FR WSS	K 79, K 58 (K 64 open)
Without OBD-II	ABS / ESP	VSS	K 64
	CBS		K 64
Auto Transaxle		Input Variable	PCM PIN NO.
With OBD-II	ABS / ESP	ABS / ESP module	K 20
	CBS	FR WSS	A 60, A 45
Without OBD-II	ABS / ESP	PG-B in A/T	K 20
	CBS		K 20



FR side WSS

FD - ENGINE

19

1.2 CURRENT DATA		01/68
TRANSAXLE RANGE SW	P, N	▲
A/C ON CONDITION	OFF	■
A/C SWITCH	OFF	
MALFUNCTION IND. LAMP	ON	
A/C COMPRESSOR	OFF	
FAN-LOW SPEED	OFF	
FAN-HIGH SPEED	OFF	
IGNITION SWITCH	ON	▼
FIX SCRN FULL PART GRPH HELP		

1.2 CURRENT DATA		09/68
IDLE STATUS	ON	▲
WIDE OPEN THROTTLE	OFF	■
FUEL-CUT OFF STATUS	OFF	
START SIGNAL	OFF	
FUEL PUMP RELAY	OFF	
MFI CONTROL RELAY	ON	
SYNCHRO. STATUS-CKP/CMP	ON	
A/F CLOSED LOOP	OFF	▼
FIX SCRN FULL PART GRPH HELP		

1.2 CURRENT DATA		17/68
KNOCKING DETECTED	OFF	▲
ENGINE RUNNING DETECT	OFF	■
CVT STATUS	OFF	
O2S OPERATION-B1/S1	OFF	
O2S OPERATION-B1/S2	OFF	
CANISTER PURG ACT	OFF	
CANISTER PURG ON	OFF	
IDLE CONTROL STATE	ON	▼
FIX SCRN FULL PART GRPH HELP		

1.2 CURRENT DATA		25/68
MAP SENSOR(VOLT)	4.0 V	▲
MAP SENSOR	1013. hPa	■
ENGINE LOAD	99.8 %	
THROTTLE P. SNSR(V)	0.3 V	
THROTTLE POSI. SENSOR	0.0 %	
ADAPTED THROTTLE ANGLE	5.5 %	
ENGINE SPEED	0.0 rpm	
BATTERY VOLTAGE	12.2 V	▼
FIX SCRN FULL PART GRPH HELP		

FD - ENGINE

20

1.2 CURRENT DATA		33/68
BATTERY CHARGING	0.0 %	▲
WATER TEMPERATURE	43.5 °C	
INTAKE AIR TEMPERATURE	21.0 °C	
PURGE CONTROL VALVE	0.0 %	■
NO.1 INJ.DURATION	0.0 mS	
NO.2 INJ.DURATION	0.0 mS	
NO.3 INJ.DURATION	0.0 mS	
NO.4 INJ.DURATION	0.0 mS	▼
FIX	SCRN	FULL PART GRPH HELP

1.2 CURRENT DATA		41/68
INDICATED ACTUAL TORQU	0.0 %	▲
TORQUE REQUEST FROM TC	99.9 %	
O2 SNSR VOLT.(B1/S1)	0.5 V	
O2 SNSR VOLT.(B1/S2)	0.5 V	
TARGET IDLE RPM	1030.rpm	■
ISC ACTUATOR DUTY	43.2 %	
ENGINE SPEED-FINE	0.0 rpm	
ENG. OIL TEMPERATURE	44.3 °C	▼
FIX	SCRN	FULL PART GRPH HELP

1.2 CURRENT DATA		49/68
CALCULATE OIL TEMPERAT	37.6 °C	▲
IGNITION TIMING - CYL1	0.0 °	
IGNITION TIMING - CYL2	0.0 °	
IGNITION TIMING - CYL3	0.0 °	
IGNITION TIMING - CYL4	0.0 °	
VEHICLE SPEED	0.0 Km/h	■
SHORT TERM FUEL	-0.0 %	
LONG TERM FUEL-IDLE	-1.6 %	▼
FIX	SCRN	FULL PART GRPH HELP

1.2 CURRENT DATA		57/68
LONG TERM FUEL-P/LOAD	2.0 %	▲
KNOCK ADAPTATION-CYL1	0.0 °	
KNOCK ADAPTATION-CYL2	0.0 °	
KNOCK ADAPTATION-CYL3	0.0 °	
KNOCK ADAPTATION-CYL4	0.0 °	
CAMSHAFT ADAPT.ANGLE#1	154.6°	■
CAMSHAFT ADAPT.ANGLE#2	523.2°	
CAMSHAFT ADAPT.ANGLE#3	660.0°	▼
FIX	SCRN	FULL PART GRPH HELP

FD - ENGINE

21

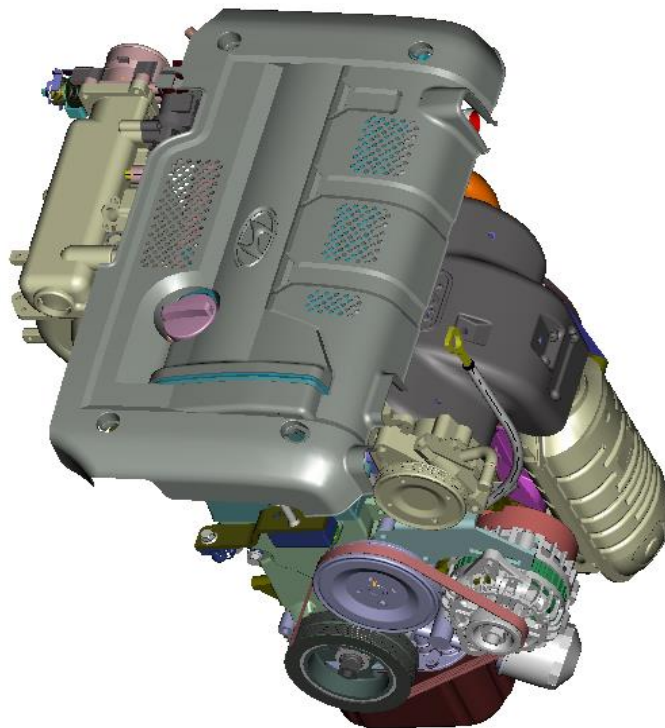
1.2 CURRENT DATA		61/68
KNOCK ADAPTATION-CYL4 0.0 °		▲
CAMSHAFT ADAPT.ANGLE#1	154.6°	
CAMSHAFT ADAPT.ANGLE#2	523.2°	
CAMSHAFT ADAPT.ANGLE#3	660.0°	
CAMSHAFT ADAPT.ANGLE#4	660.0°	
CAMSHAFT CONTROL	0.0 °	
CAMSHAFT POSITION	27.0 °	
CAMSHAFT POS.-TARGET	27.0 °	▼

1. HYUNDAI VEHICLE DIAGNOSIS
MODEL : FD
SYSTEM : ENGINE(GASOLINE)
UNLEAD 1.6L EOB
01. DIAGNOSTIC TROUBLE CODES
02. CURRENT DATA
03. FLIGHT RECORD
04. ACTUATION TEST
05. SIMU-SCAN
06. RESETTING ADAPTIVE VALUES
07. IDENTIFICATION CHECK
08. DATA SETUP(UNIT CONV.)

1.6. RESETTING ADAPTIVE VALUES	
RESET ALL ADAPTIVE VALUES	
CONDITION	IG KEY ON TRANSAXLE RANGE : P VEHICLE SPEED : 0 ENGINE OFF
PRESS [REST], IF YOU ARE READY !	
<input type="button" value="REST"/>	

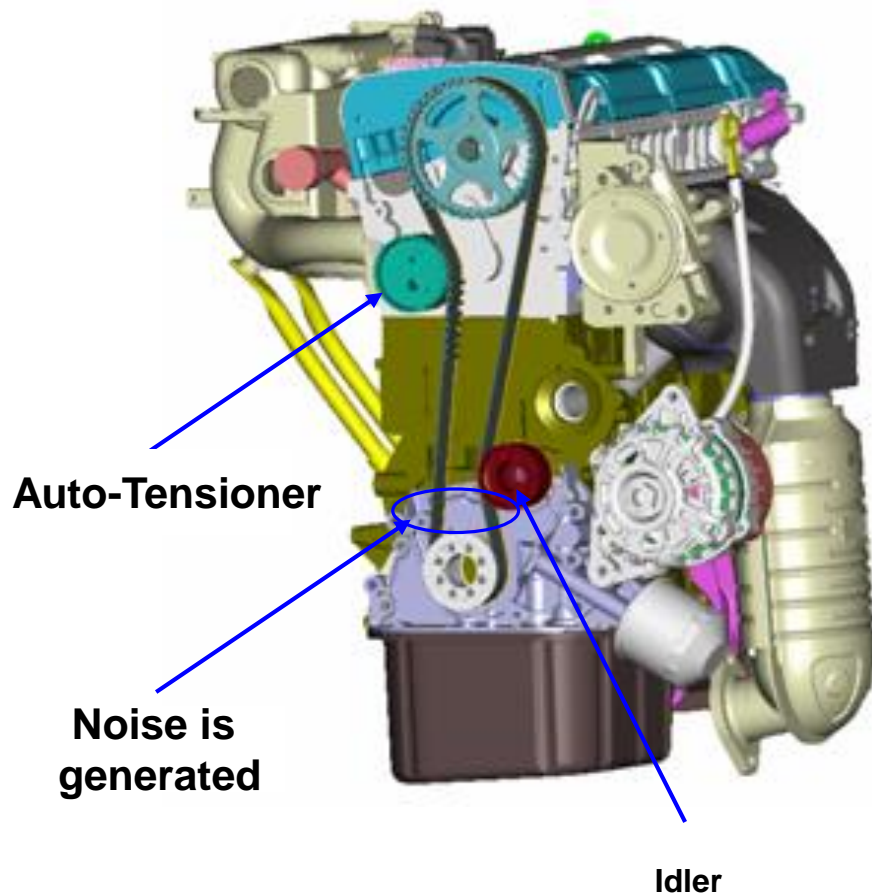
1.7 . IDENTIFICATION CHECK
MODEL : FD
SYSTEM : ENGINE(GASOLINE)
CAL NO: GFD-846CQQ
BOOT S/W NUM : 14901001
ECU S/W NUM : 9030936128
SYS SUP S/W NUM : M98C442A

Beta Engine



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Auto-tensioner for timing belt



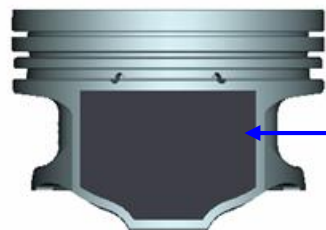
◆ Tensioner

- Mechanical tensioner → Auto-tensioner
- Increased endurance
- Reduced noise (from timing belt)

◆ CVVT

- CVVT is standard
- Angle : 45° (Retard ~ Advanced)

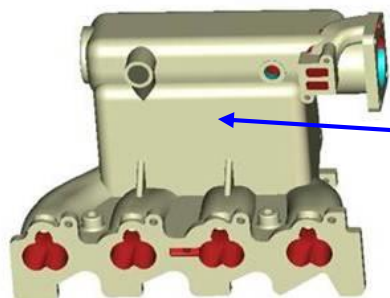
Changing Parts 1



Graphite coating

◆ Graphite coating

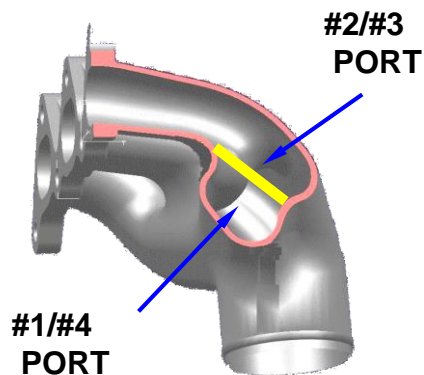
- Reduced noise / friction
- Low-tension piston ring
- Improved fuel efficiency



Resonator

◆ Resonator

- Improved engine performance at middle speed

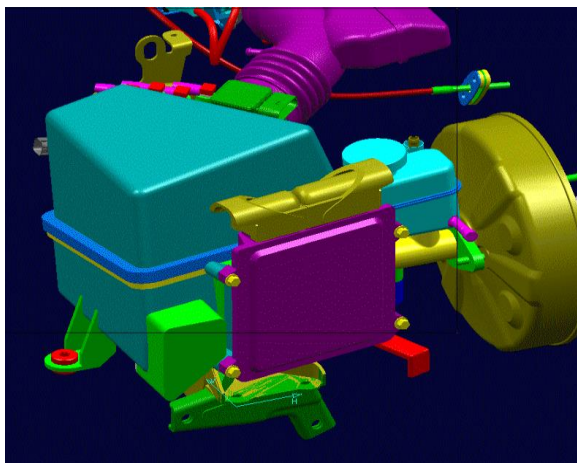


Section View

◆ Exhaust manifold

- Added wall : reduced interference
- Improved torque at low speed
- Improved power at high speed

Changing Parts 2



◆ PCM / ECM

- Engine room type (located on air cleaner side)
- Water proof

◆ Air flow sensor

- Changed direct type to indirect type (except N/A)
(MAF sensor → MAP sensor)

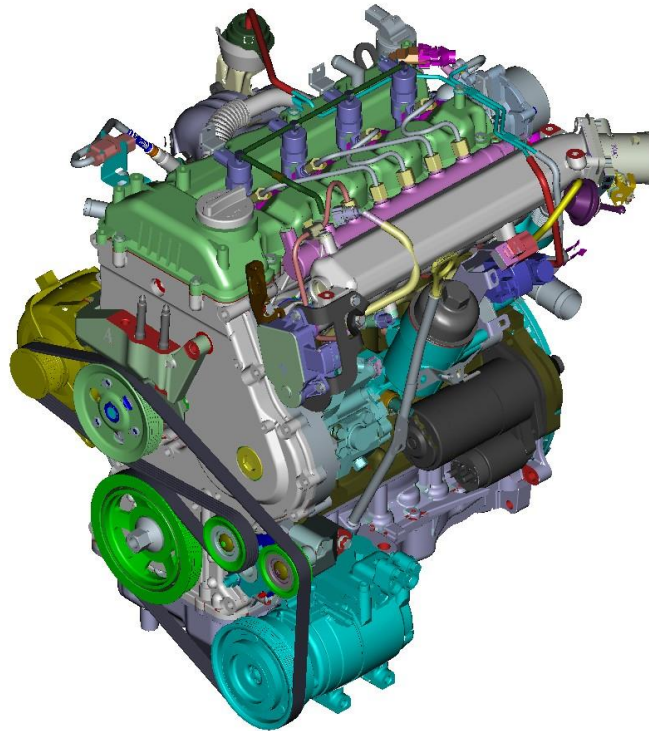


Direct type



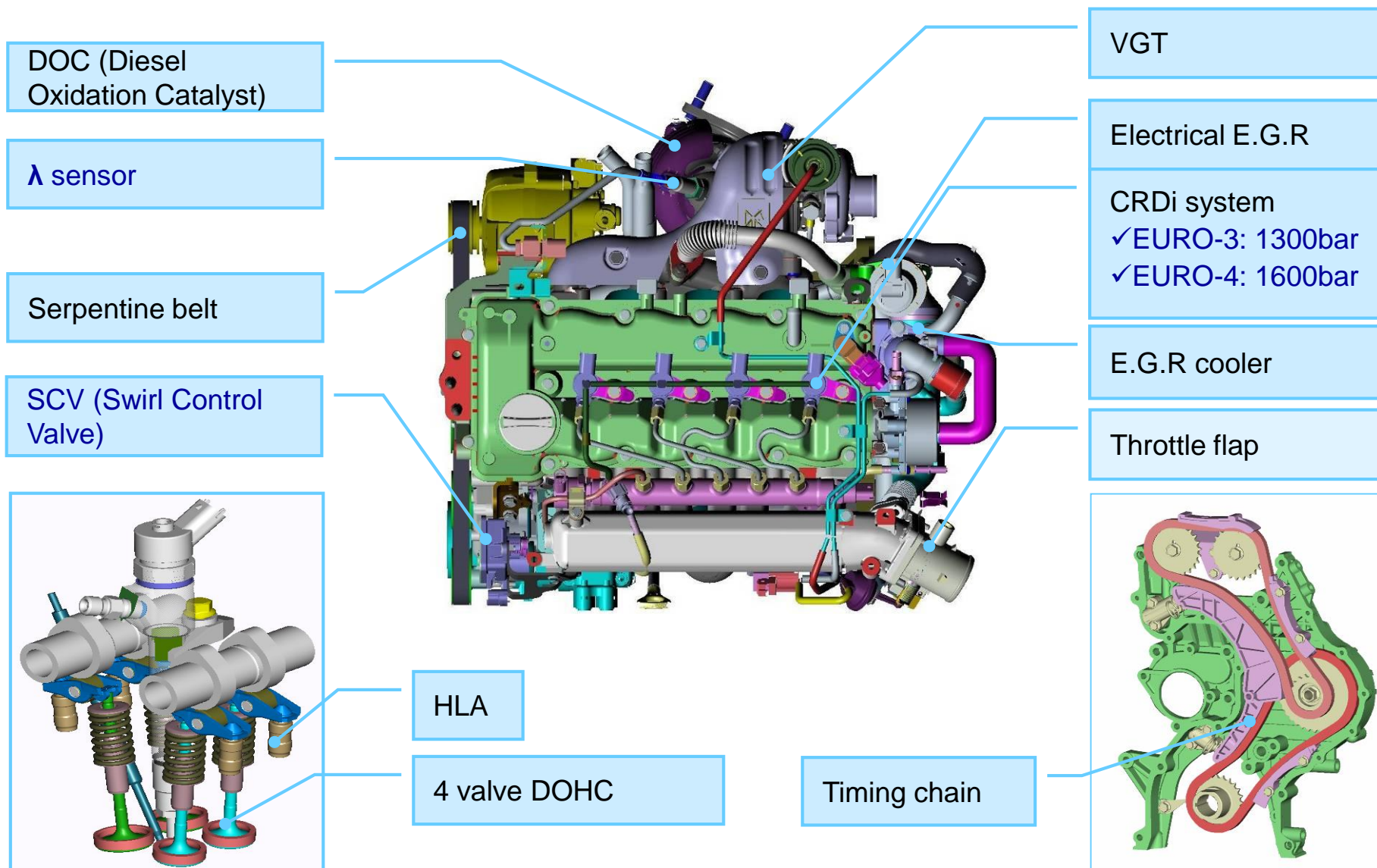
Indirect type

Common Rail U-Engine

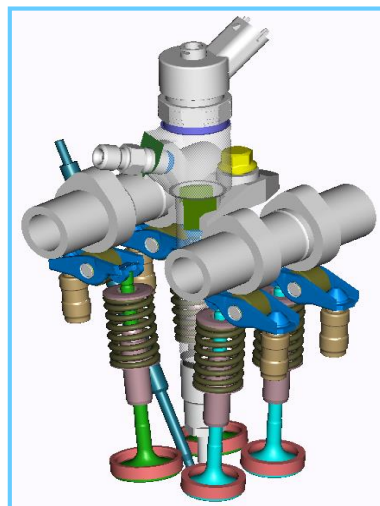
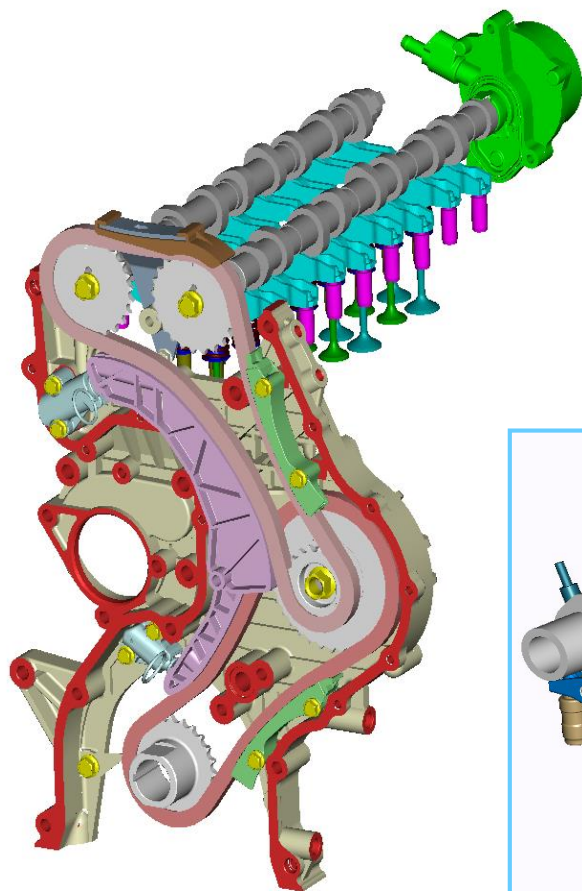


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FD - ENGINE

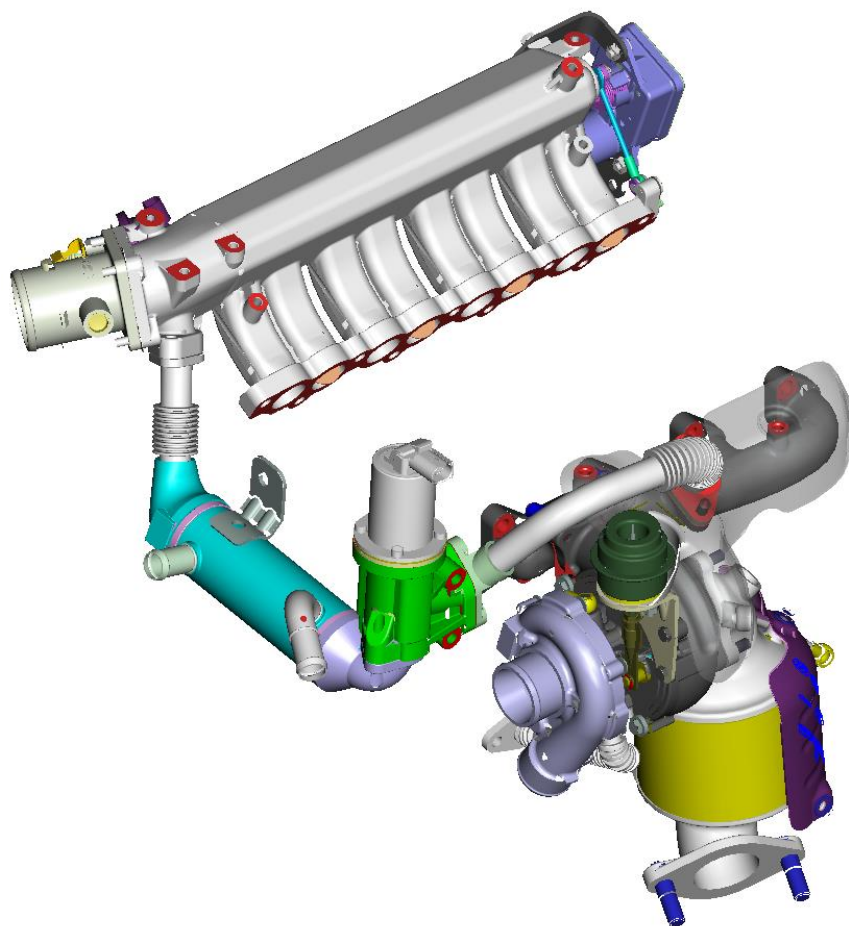


Timing System

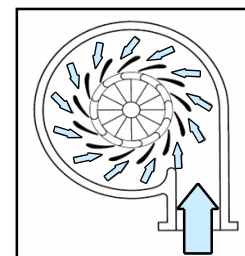


- ◆ DOHC 4 Valve
- ◆ VALVE operating type:
 - END PIVOT ROLLER SWING ARM
- ◆ CAM operating type : 2 Chains
- ◆ Hollow camshaft

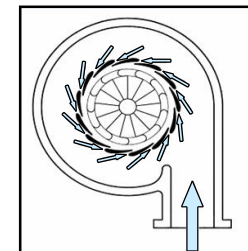
Intake / Exhaust manifold



◆ VGT

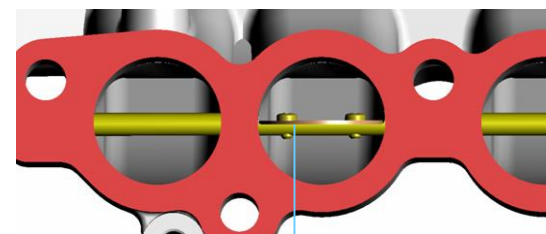


High Speed



Low Speed

◆ SCV (Swirl Control Valve)



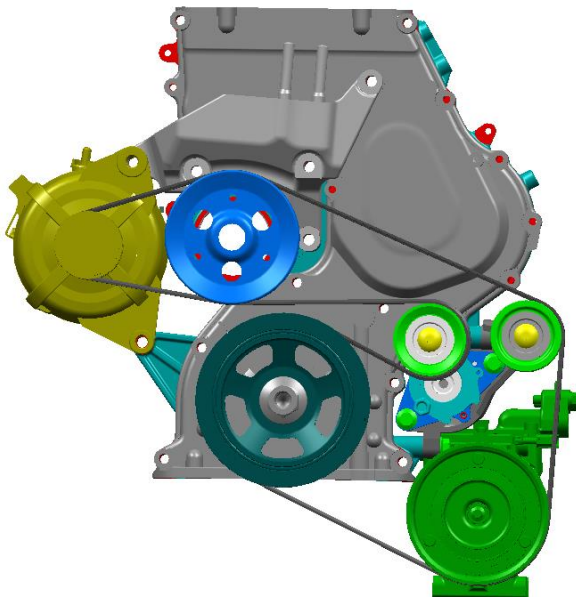
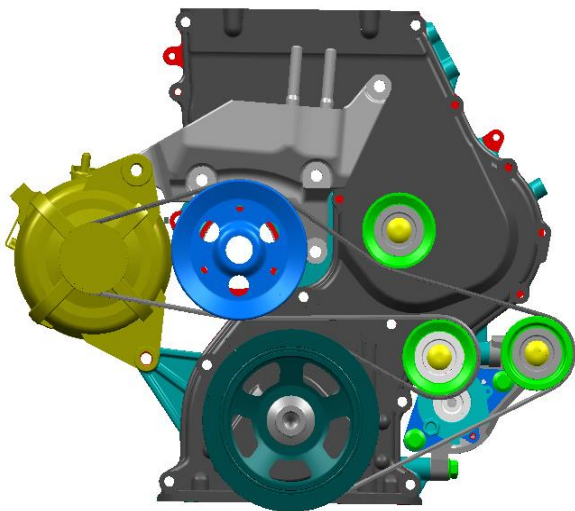
Swirl Control Valve

◆ Electrical EGR VALVE

◆ WCC (Warm-up Catalytic Converter)

◆ EGR COOLER

Serpentine Belt

	With A/C	Without A/C
Appearance		
Remark	P/S pump is not applied because of MDPS	

Changed items compared with XD U-1.5 (EURO-3)

	Item	Changed thing	Remark
Increased displacement	Cylinder block	Bore increased ($\Phi 75 \rightarrow \Phi 77.2$)	
	Cylinder head gasket	Changed shape	
	Piston	Diameter increased ($\Phi 75 \rightarrow \Phi 77.2$)	
EURO-4 (Performance, emission)	CRDi	Injection pressure increased (1350bar \rightarrow 1600bar)	U1.5 EURO-4 Common parts
	EGR cooler	Applied ($\Phi 54$)	
	SCV (Swirl Control Valve)	Applied	
	Lambda sensor	Applied	

Current Data

1.2 CURRENT DATA		01/54
IGNITION SW-IG 2	ON	▲
BATTERY VOLTAGE	11.77V	■
FUEL QUANTITY	0.00 mm3	
FUEL PRESSURE MEASURED	0 MPa	
FUEL PRESSURE SETPOINT	24 MPa	
RAIL PRESS.REGULATOR	12.35%	
INJ.PUMP REGULATOR	0.00 %	
FUEL TEMPERATURE	32.94°C	▼
FIX SCRN FULL PART GRPH HELP		

1.2 CURRENT DATA		17/54
CLUTCH SWITCH	ON	▲
NEUTRAL OR 1ST GEAR	OFF	
REDUNDANT BRAKE SWITCH	OFF	■
BRAKE SWITCH	OFF	
ACCEL PEDAL POS. SNSR	0.00 %	
ACCEL PEDAL VOLT-1	764 mV	
ACCEL PEDAL VOLT-2	372 mV	
STATUS OF SIG APP/BRK	GOOD	▼
FIX SCRN FULL PART GRPH HELP		

1.2 CURRENT DATA		09/54
FUEL TEMP.SENSOR(V)	3509 mV	▲
AIR MASS FLOW	0 Kg/h	■
AIR MASS PER CYLINDER	0 mg/st	
AIR TEMPERATURE SNSR	15.88°C	
AIR TEMPE.VOLTAGE	3509 mV	
EGR ACTUATOR	4.78 %	
ATMOSPHERIC PRESS.SNSR	1015 hPa	
WATER TEMP. SENSOR	15.88°C	▼
FIX SCRN FULL PART GRPH HELP		

1.2 CURRENT DATA		25/54
A/C ON SIGNAL SWITCH	OFF	▲
A/C COMPRESSOR RELAY	OFF	
A/C PRESSURE SENSOR	0 mV	
BLOWER SWITCH	OFF	■
FAN-LOW SPEED	OFF	
FAN-HIGH SPEED	OFF	
GLOW RELAY	OFF	
GLOW CONTROL LAMP	OFF	▼
FIX SCRN FULL PART GRPH HELP		

Current Data

1.2 CURRENT DATA		33/54
AUXILIARY HEATER	OFF	▲
BOOST PRESSURE SENSOR	1001 hPa	
BOOST PRESS.VOLTAGE	1588 mV	
UGT ACTUATOR	60.00%	
V/SWIRL ACTU.(U/D/S)	0 %	■
INLET THROTTLE ACTU.	4.71 %	
CHECK ENGINE LAMP	ON	
O2S SUBTRAC.VOLTAGE	0 mV	▼
<div> <div>FIX</div> <div>SCRN</div> <div>FULL</div> <div>PART</div> <div>GRPH</div> <div>HELP</div> </div>		

1.2 CURRENT DATA		47/54
GEAR POSITION	0	▲
ENGINE SPEED	0 rpm	
CALCULATED LOAD VALUE	0.00 %	
CURRENT INNER TORQUE	0.0 %	
DESIRED INNER TORQUE	0.0 %	
STATE OF IMMO PRESENCE	ON	
IMMOBILIZER LAMP	OFF	
AT/MT INFORMATION	AT	■
<div> <div>FIX</div> <div>SCRN</div> <div>FULL</div> <div>PART</div> <div>GRPH</div> <div>HELP</div> </div>		▼

1.2 CURRENT DATA		41/54
LAMDA(O2S)	1.13	▲
O2S TEMPERATURE	574 °C	
O2S HEATER DUTY	2.35 %	
O2S STATE OF ADAPTION	OFF	
VEHICLE SPEED SENSOR	0 Km/h	
ACTUAL VEHICLE ACCELE.	0.1 m/s ²	
GEAR POSITION	0	■
ENGINE SPEED	0 rpm	▼
<div> <div>FIX</div> <div>SCRN</div> <div>FULL</div> <div>PART</div> <div>GRPH</div> <div>HELP</div> </div>		

Injector correction & ID check

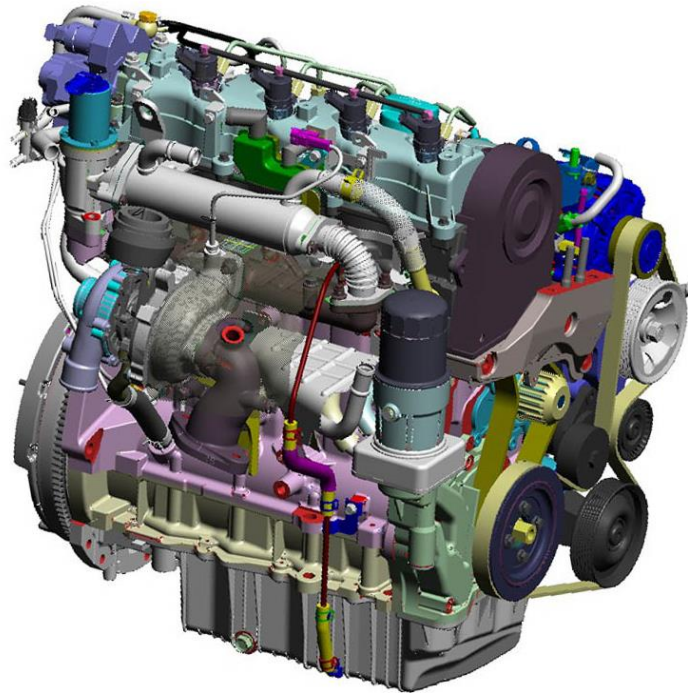
1. HYUNDAI VEHICLE DIAGNOSIS ▼	
MODEL :	FD
SYSTEM :	ENGINE(DIESEL)
01. DIAGNOSTIC TROUBLE CODES 02. CURRENT DATA 03. FLIGHT RECORD 04. ACTUATION TEST 05. SIMU-SCAN 06. IDENTIFICATION CHECK 07. ENGINE TEST FUNCTION 08. INJECTOR SPECIFIC DATA	

1.8. INJECTOR SPECIFIC DATA		
INJECTOR 1	8GZRYI4	
INJECTOR 2	ASHR55A	
INJECTOR 3	6RPMY51	
INJECTOR 4	BSIGBWC	
- SELECT THE CYLINDER BY SHIFT+ARROW KEY AND INPUT THE DATA BY FI~F6 KEY AND PRESS [ENTER] KEY.		
<div> <div>ABCD</div> <div>EFGH</div> <div>IJKL</div> <div>MNOP</div> <div>QR-U</div> <div>VW-Z</div> </div>		

1.8. INJECTOR SPECIFIC DATA		
INJECTOR 1		
INJECTOR 2		
INJECTOR 3		
INJECTOR 4		
- SELECT THE CYLINDER BY SHIFT+ARROW KEY AND INPUT THE DATA BY FI~F6 KEY AND PRESS [ENTER] KEY.		
<div> <div>ABCD</div> <div>EFGH</div> <div>IJKL</div> <div>MNOP</div> <div>QR-U</div> <div>VW-Z</div> </div>		

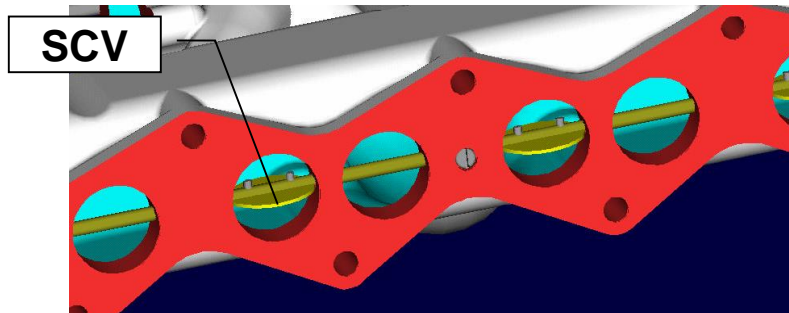
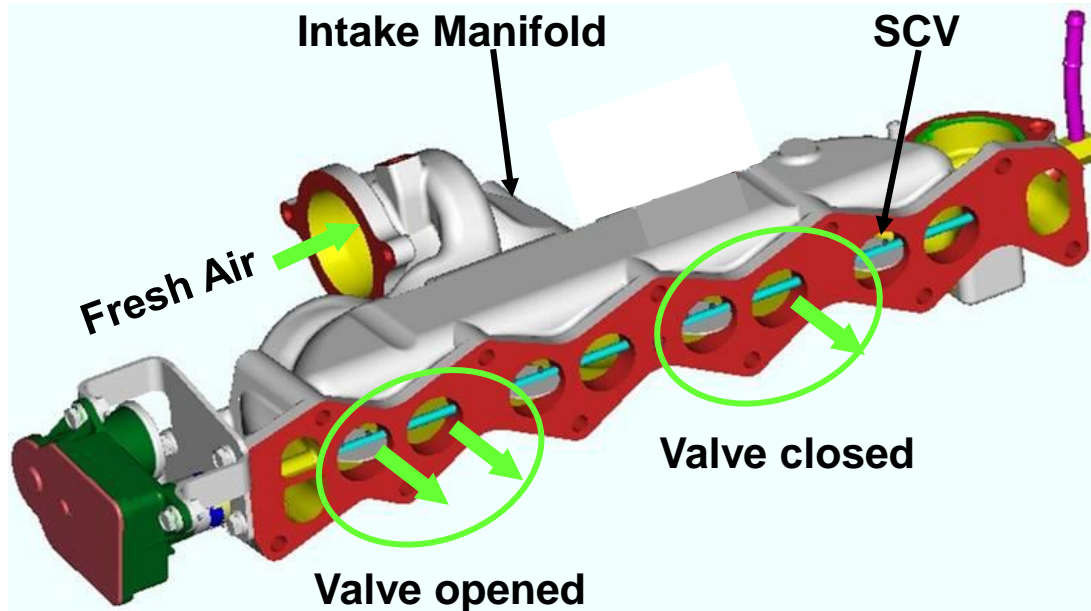
1.6 . IDENTIFICATION CHECK
MODEL : FD
SYSTEM : ENGINE(DIESEL)
CAL NUM:HDADI4UV01
ECU H/W:39100-2A700
ROM ID :70HD4A2DIP2S

Common Rail D-Engine



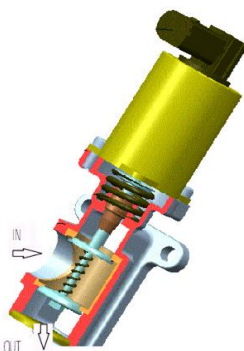
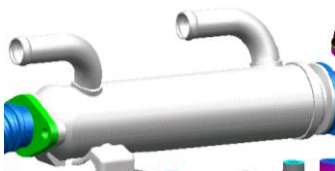
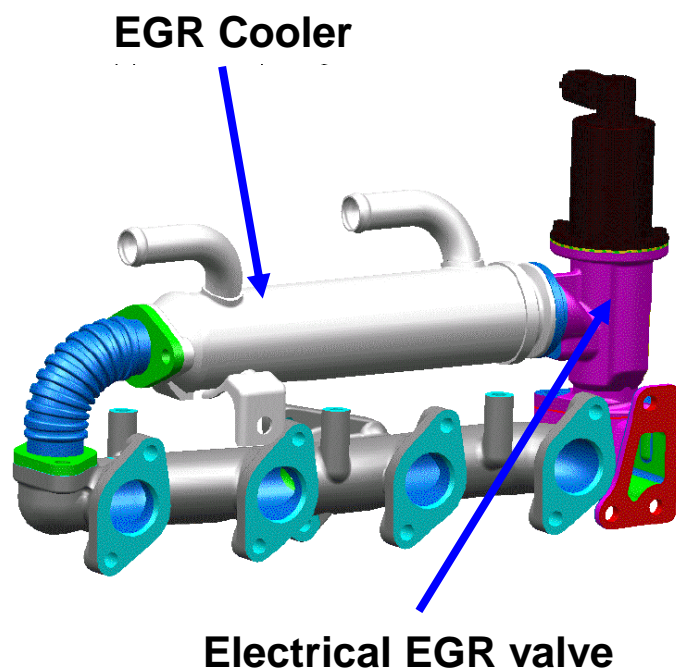
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SCV (Swirl Control Valve)



- ◆ **Middle/Low Speed, Low Load**
 - Valve Closed (Increased Swirl) :
Increased fuel/air mixture,
EGR ratio \uparrow
→ Reduced emission gas
- ◆ **High Speed, High Load**
 - Valve Opened (Decreased Swirl) :
Increased intake efficiency,
Reduced pumping loss
→ Improved performance

Electrical EGR & EGR cooler



◆ EGR Cooler

- Coolant cooling type
- Reduced intake air temperature and increased intake air
→ Reduced NOx and PM
- Diameter : 54mm

◆ Electrical EGR valve

- Valve type : linear solenoid type
- Deviation is reduced 50%
→ EGR is controlled precisely
- Max. flux : 88 ± 8 kg/hr (at 85%)
- Control voltage : 13.5V
- Control Signal : PWM (140Hz)