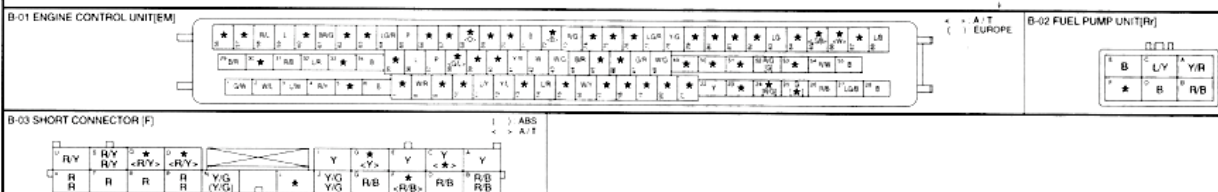




Fuel System

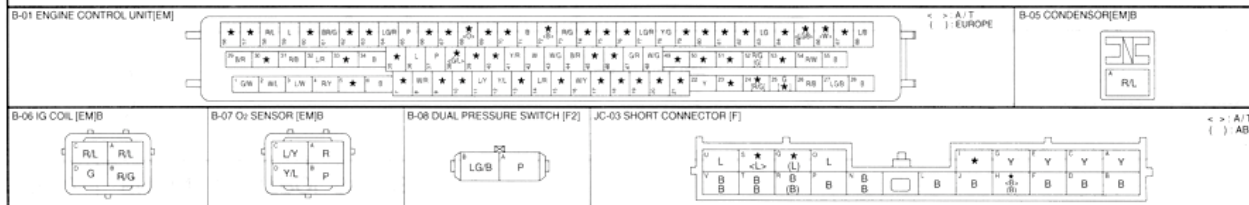
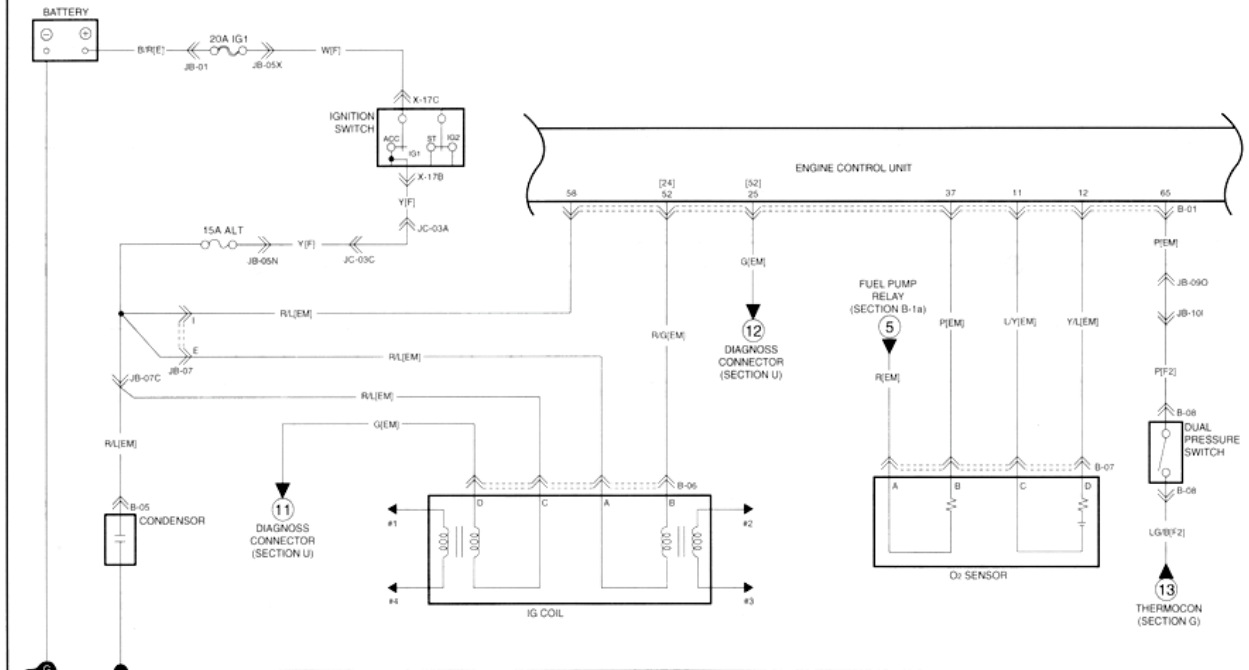
General Information

B-1a	ENGINE CONTROL SYSTEM
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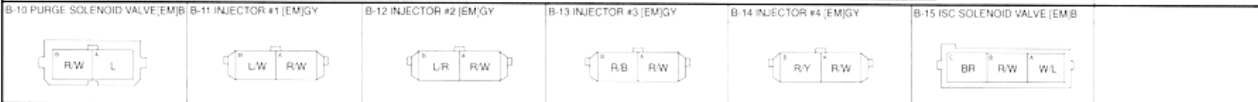
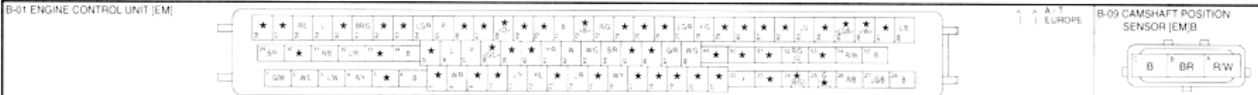
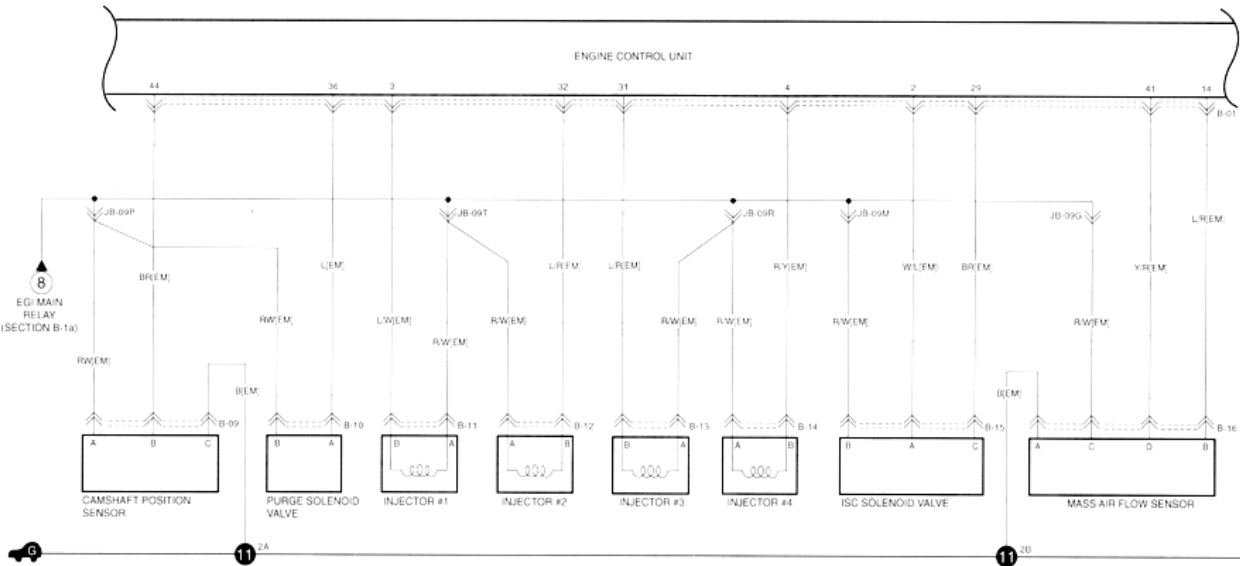
B-1b ENGINE CONTROL SYSTEM

| : EUROPE

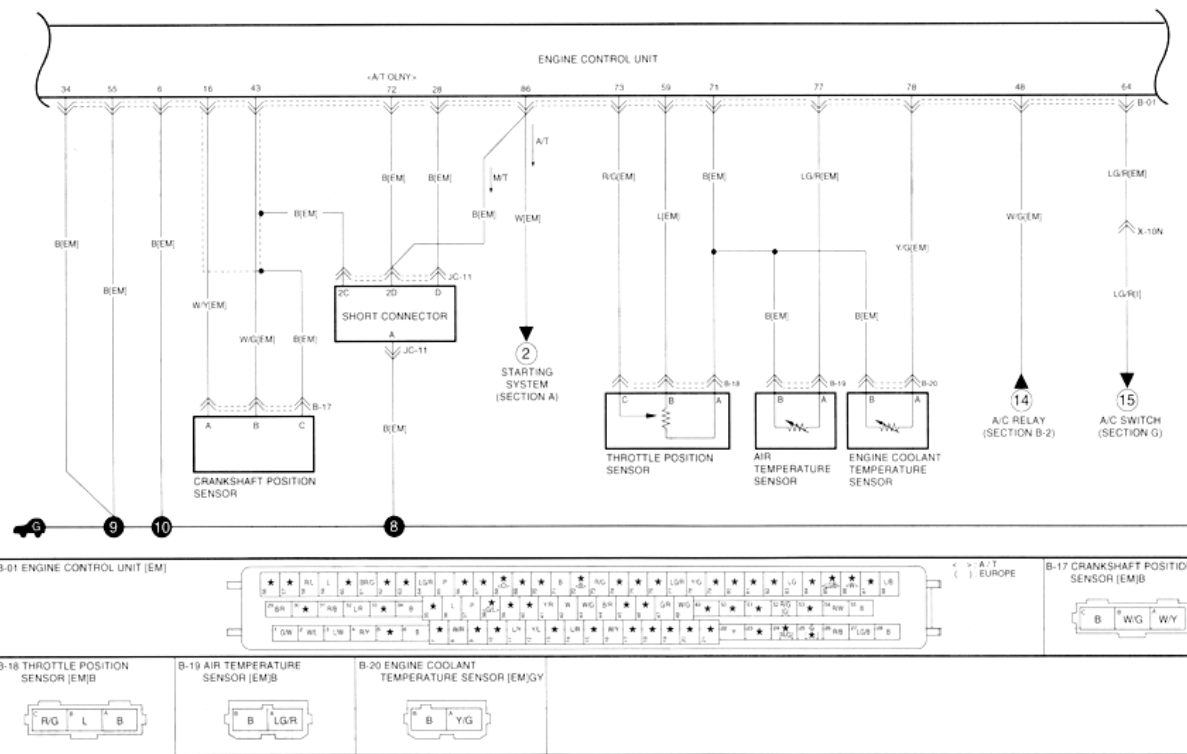


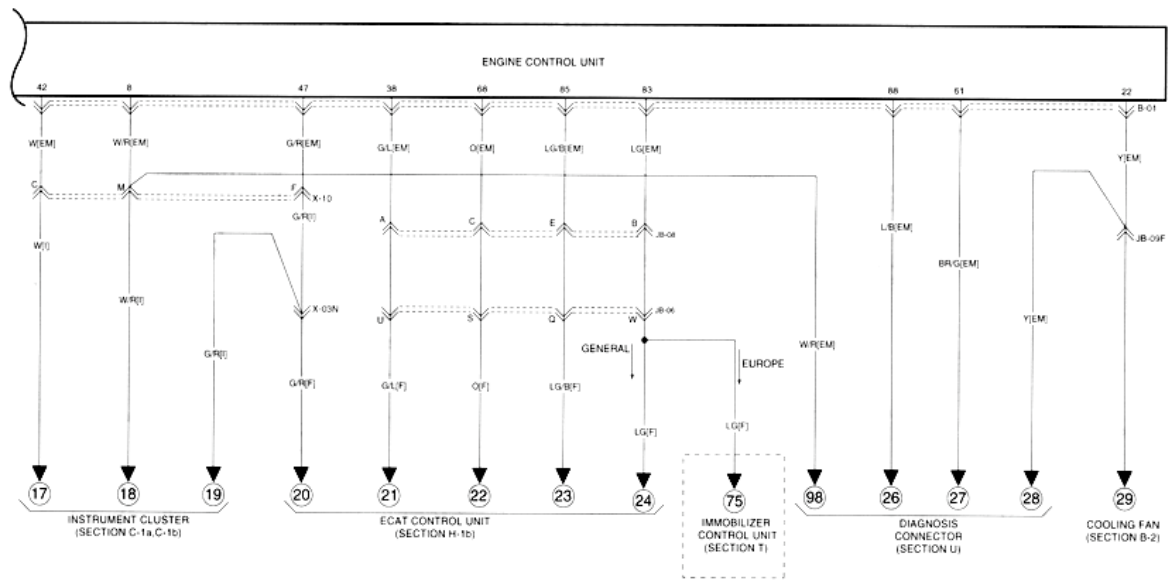
B-1c

ENGINE CONTROL SYSTEM



B-1d ENGINE CONTROL SYSTEM





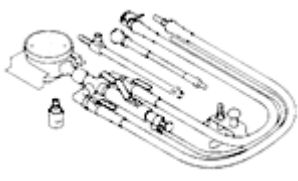
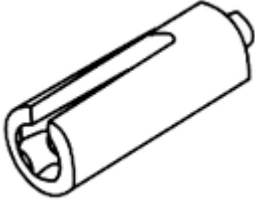
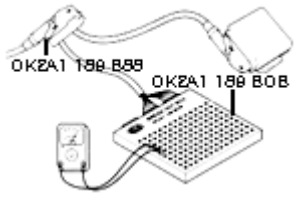
B-01 ENGINE CONTROL UNIT (EM)



Y: A 1.7
I: EUROPE



SPECIAL SERVICE TOOLS

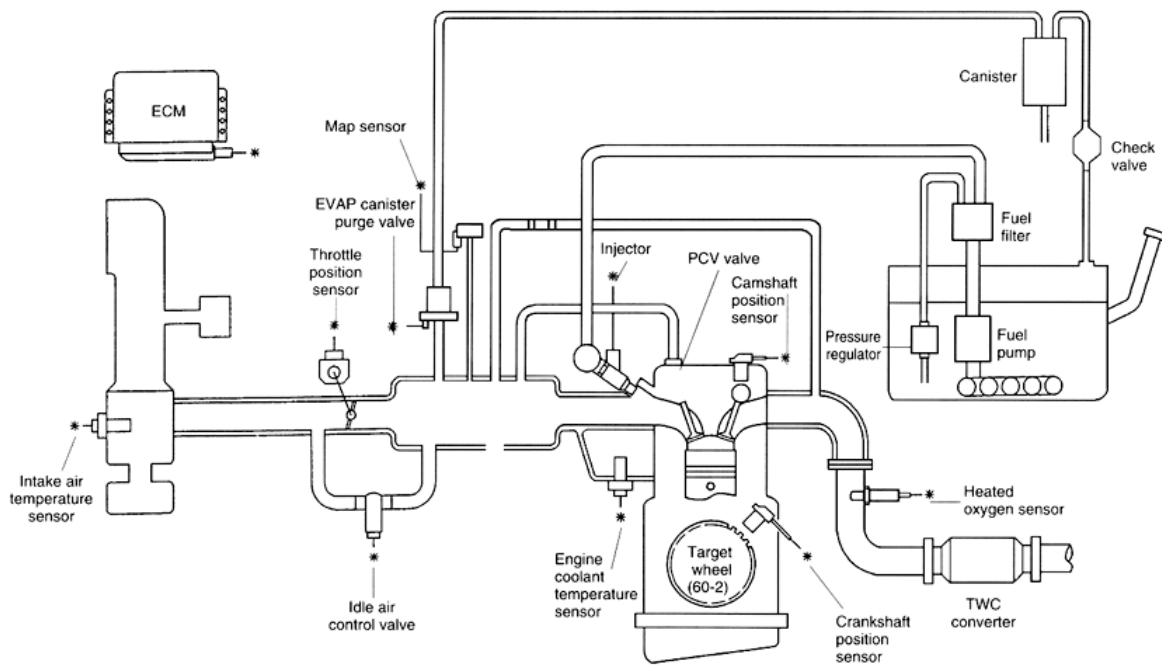
Tool (Number and Name)	Illustration	Use
0K2CA 089 HSP Hi-scan Pro		Used for diagnosis and DTC retrieval and erasing.
0K2A1 131 AA1 Fuel pressure gauge		Used for measuring fuel pressure.
0K9A4 400 001 Sensor remover and installer		Uses for removing and installing
0K2A1 189 B0B / 0K2A1 189 B88 Break out box		Used for measuring ECM terminal voltage and resistance

Fuel

Tool (Number and name)	Illustration	Use
0K21A1 131 AA1 Fuel pressure gauge		Used for measuring fuel pressure

Description

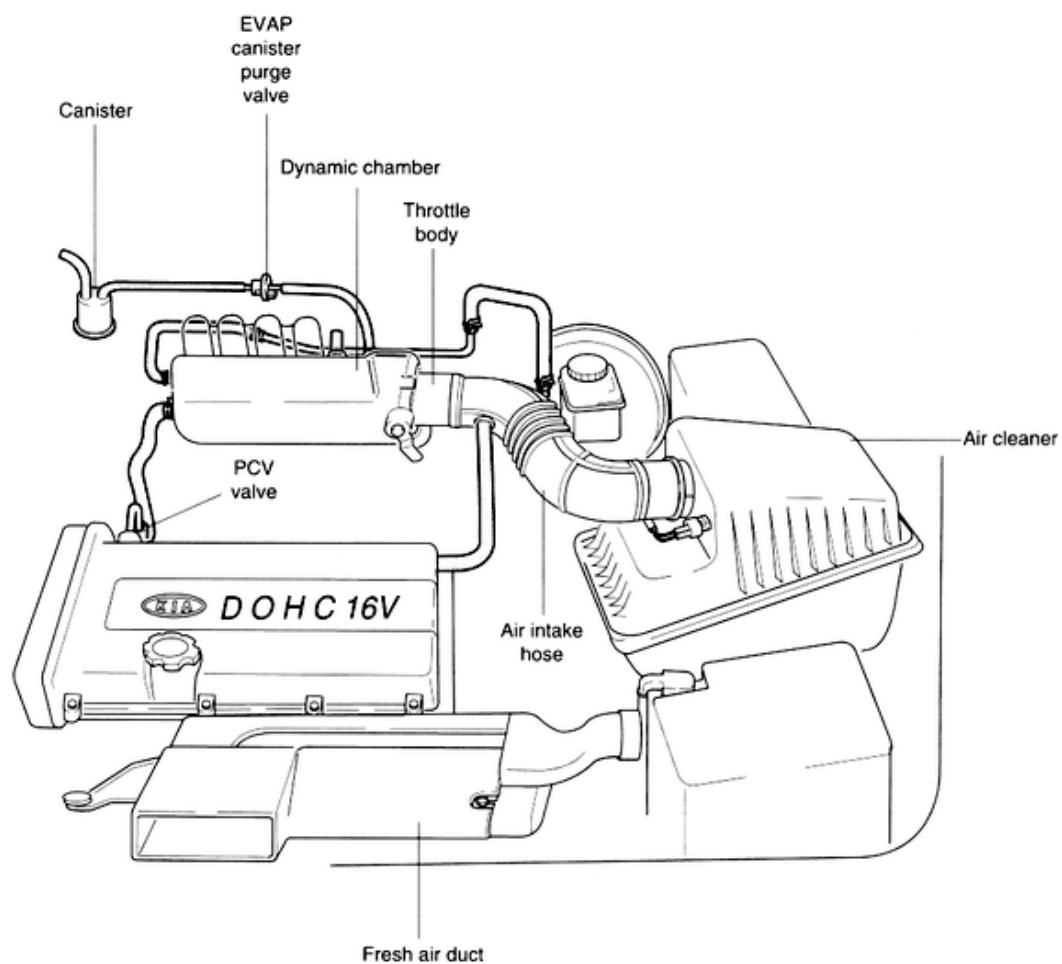
System diagram





Components

Vacuum hose routing





Diagnosis

General

Problem	Possible	Action
Engine cranks but will not start	Fuel pressure problem	Replace fuel pressure regulator Replace leaking injector Replace injector O-ring
Hard to start (cold engine)	Idle air control valve not working Defective throttle position sensor Fuel pressure too low Engine coolant temperature sensor open circuit or out of range	Replace Replace throttle body Replace regulator, check fuel line leakage Repair harness Replace sensor
Rough idle (cold engine)	Fuel injector flow Throttle plate stuck open Throttle position sensor malfunction Idle air control valve inoperative Air intake duct disconnected between MAF sensor and throttle body Leaking injector Leaking injector O-ring seals	Replace injector Clean and adjust throttle plate Adjust throttle cable Replace TP sensor Replace Reconnect air duct Replace Replace
Stalling or hesitation(hot or cold engine)	Throttle position sensor malfunction	Replace TP sensor
Hard start(hot engine)	Incorrect fuel pressure	Check pressure regulator or fuel pump
Stalls on quick stops or deceleration	Mass air flow sensor Open circuit or out of range	Replace MAF sensor Check electrical circuit (see Wiring Diagram)
Poor performance/loss of power	Clogged injectors Air filter clogged	Check injector flow rate Replace

Fuel gauge

Problem	Possible cause	Action
Fuel gauge shows empty at all fuel levels of fill	Loose or dirty wiring connections or short to ground wiring	Check wiring, connectors and sender assembly. Repair, clean or tighten as needed.
	Leaking sender float	Replace sender
	Missing sender float	Install float. Make sure float is secured on sender arm.
	Short circuit in sender assembly	Test for correct resistance values and replace as needed.
	Sender assembly arm movement obstructed	Inspect fuel tank and sender for cause. Correct or replace faulty component.
Fuel gauge will not read full when tank is full	Wrong sender installed	Check part number. If incorrect, install correct part
	Sender arm movement obstructed (float rod bent)	Inspect fuel tank and sender for cause. Correct or replace faulty component.

	Leaking float	Install new sender
	Sender or gauge calibration	Test correct resistance value and replace component as needed.
	Fuel tank not filling to rated capacity	Check fuel tank fill vent for kinks or obstructions. Correct as required and fill tank to verify proper capacity.
Fuel gauge shows full at all fuel levels	Loose or dirty wiring connections or open circuit in wiring	Check wiring, connections and sender terminals. Repair or clean if required.
	Open circuit in sending unit	Test for correct resistance values and replace if required.
	Sender arm movement obstructed	Inspect fuel tank and sender for cause. Gently bend float arm away from obstruction or replace component.
Fuel gauge reads incorrectly, but all fuel system components are running properly.	Fuel tank damage	Fuel sender mounting angle may have changed or the sender unit may be damaged.



Specifications

Item			Engine
			T8D
Idle speed (rpm)			800±50
Ignition timing (BTDC)			8°±5°
Throttle body	Type		Horizontal drift
	Throat diameter in (mm)		1.8 (42) x 2
Idle air control valve	Type		Rotary
	Resistance(at 68°F[20°C])(Ω)	Opening	16.5~18.5
		Closing	14.5~16.5
Air cleaner element			Dry, paper type
EVAP canister purge valve	Resistance(at 68°F[20°C])(Ω)		24~28
Engine coolant temperature sensor	Resistance (KΩ)	-4°F (-20°C)	16.2~1.6
		68°F (20°C)	2.45~0.25
		176°F (80°C)	0.32~0.03
Fuel injector	Type of drive		Electromechanical
	Number of spray ports		2
	Resistance(at 68°F[20°C])(Ω)		14~15
Heated oxygen sensor	Resistance(at 68°F[20°C])(Ω)		4~7
Main relay	Resistance(at 68°F[20°C])(Ω)		80~90
Fuel pump maximum pressure (kg/cm²)			4.5~6.5
Fuel filter	Low pressure side		Nylon element (in fuel pump)
	High pressure side		Paper element
Pressure regulator	Pressure (kg/cm²)		3.2~3.5
Fuel tank	Capacity (l)		50

ECM terminal voltage

56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28						

Terminal	Signal	Connected to	Test condition	Voltage
B01-1	Fuel pump relay control	Fuel pump relay	Key ON/Engine OFF	B+
			Idle	<2.0V
B01-2	Idle speed control-closing	Idle air control valve	Key ON/Engine OFF	3~4V (duty signal)
			Idle	5~6V (duty signal)
B01-3	Fuel injector control	Fuel injector #1	Key ON/Engine OFF	B+

			Idle	B+
B01-4	Fuel injector control	Fuel injector #4	Key ON/Engine OFF	B+
			Idle	B+
B01-5	-	-	-	-
B01-6	Injector ground	Ground	Constant	<1.0V
B01-7	-	-	-	-
B01-8	MIL control	Malfunction indicator light	Key ON/Engine OFF	<1.0V
			Idle	B+
B01-9	-	-	-	-
B01-10	-	-	-	-
B01-11	Front HO2S sensor ground	Front heated oxygen sensor	Constant	<0.5V
			-	-
B01-12	Front HO2S input	Front heated oxygen sensor	Key ON/Engine OFF	<0.5V
			Idle	<0~1V
B01-13	-	-	-	-
B01-14	Mass air flow sensor ground	Mass air flow sensor	Key ON/Engine OFF	0.01V
			Idle	0.02V
B01-15	-	-	-	-
B01-16	Crankshaft position sensor output A terminal	Crankshaft position sensor	Key ON/Engine OFF	<2V
			Idle	2~3V
B01-17	-	-	-	-
B01-18	-	-	-	-
B01-19	-	-	-	-
B01-20	-	-	-	-
B01-21	-	-	-	-
B01-22	Cooling fan relay control	Cooling fan relay	Operating cooling fan	<0.5V
			Not operating cooling fan	B+
B01-23	-	-	-	-
B01-24	Ignition coil control (with immobilizer)	Ignition coil (cyl 2 & 3)	Key ON/Engine OFF	B+
			Idle	B+
B01-25	Ignition coil control (without immobilizer)	Ignition coil (cyl 1 & 4)	Key ON/Engine OFF	B+
			Idle	B+
B01-26	Battery voltage	Battery	Key ON/Engine OFF	B+
			Idle	B+
B01-27	ECM main relay control	ECM main relay	Key ON/Engine OFF	<1V
			Idle	<1V
B01-28	ECM ground	Ground	Key ON/Engine OFF	<1V
			Idle	<1V
B01-29	Idle air control opening coil	Idle air control valve	Key ON/Engine OFF	8~11V
			Idle	8~10V
B01-30	-	-	-	-
B01-31	Fuel injector control	Fuel injector #3	Key ON/Engine OFF	<1V
			Idle	B+

B01-32	Fuel injector control	Fuel injector #2	Key ON/Engine OFF	B+
			Idle	B+
B01-33	-	-	-	-
B01-34	Output stage ground	Ground	Key On/Engine OFF	<1V
			Idle	<1V
B01-35	-	-	-	-
B01-36	EVAP canister purge solenoid control	EVAP canister purge valve	Key ON/Engine OFF	B+
			idle	B+
B01-37	Front HO2S heater ground	Front heated oxygen Sensor	Key ON/Engine OFF	0.0V
			Idle	0.32V
B01-38	Throttle position signal output	Transaxle control module	Key ON/Engine OFF	1.3V
			Idle Accelerator pedal fully	<2.0V
			Accelerator pedal released	1~3V
			Accelerator pedal fully depressed	7~9V
B01-40	-	-	-	-
B01-41	Mass air flow sensor input	Mass air flow sensor input	Idle (800 rpm)	0.9~1.1V
			Idle (at 3000 rpm)	1.8~2.0V
B01-42	Vehicle speed input	Instrument cluster	Key ON/Engine OFF	0.2 or 5V
			Vehicle rolling	0~4.5V (rectangular)
B01-43	Crankshaft Position Sensor input-B terminal	Crankshaft position sensor	Key ON/Engine OFF	1.6V
			Idle	2.4V
B01-44	Camshaft position sensor input	Camshaft position sensor	Key ON/Engine OFF	5V
			Idle	4.3~4.6V
B01-45	-	-	-	-
B01-46	-	-	-	-
B01-47	Engine RPM	Transaxle control module	Key ON/Engine OFF	<0.50V
			Idle	8~9V (rectangular)
B01-48	A/C cut relay control	A/C cut relay	Key ON/Engine OFF	B+
			Idle	B+
B01-49	-	-	-	-
B01-50	-	-	-	-
B01-51	-	-	-	-
B01-52	Ignition coil control (without immobilizer)	Ignition coil (Cyl 2&3)	Key ON/Engine OFF	B+
	Ignition coil control (with immobilizer)	Ignition coil (cyl 1&4)	Idle	B+
B01-53	-	-	-	-
B01-54	Power	EGI main relay	Key ON/Engine OFF	B+
			Idle	B+
B01-55	Ignition ground	Ground	Key ON/Engine OFF	<1V
			Idle	<1V
B01-56	-	-	-	-

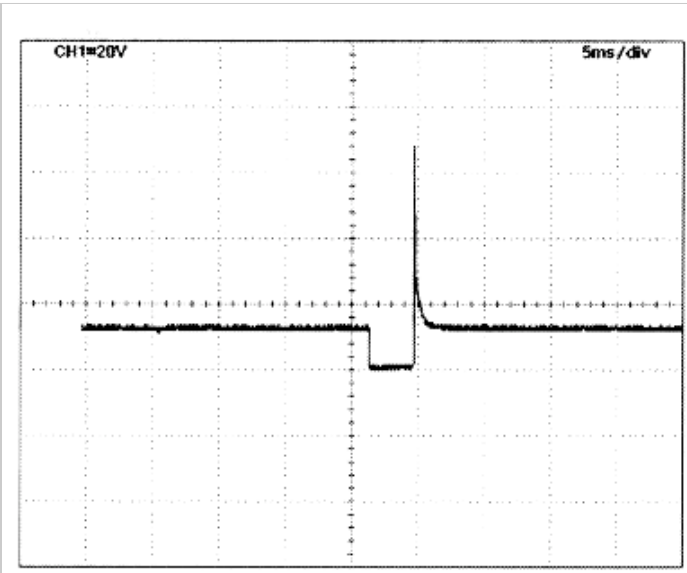
B01-57	-	-	-	-
B01-58	Ignition input	Ignition switch	Key ON/Engine OFF	B+
			Idle	B+
B01-59	Reference voltage	Throttle position sensor	Key ON/Engine OFF	Approx. 5V
			Idle	Approx. 5V
B01-60	-	-	-	-
B01-61	Engine test	-	-	-
B01-62	-	-	-	-
B01-63	-	-	-	-
B01-64	A/C request input	A/C switch	Key ON, A/C operating	<1V
			Key ON, A/C not operating	Approx. 5V
B01-65	A/C compressor Clutch operation	A/C dual Pressure switch	Key ON, A/C operating	<1V
			Key ON, A/C not operating	Approx. 5V
B01-66	-	-	-	-
B01-67	-	-	-	-
B01-68	Enginen torque signal	Transaxle control module	Key ON/Engine OFF	<1V
			Idle	1.5~1.7V
B01-69	-	-	-	-
B01-70	-	-	-	-
B01-71	Sensor ground	Engine coolant temperature sensor, Throttle position sensor, air temperature sensor	Key ON/Engine OFF	<1V
			Idle	<1V
B01-72	Groud n (A/T only) MT : Open	Ground	Key ON/Engine OFF	<1V
			Idle	<1V
B01-73	Throttle position sensor input	Throttle position sensor	Accelerator pedal released	0.6V
			Accelerator pedal fully depressed	Approx. 4V
B01-74	-	-	-	-
B01-75	-	-	-	-
B01-77	Intake air temperature sensor input	Intake air temperature sensor	Key ON/Engine OFF	2.5V
B01-78	Engine coolant temperature sensor input	Engine coolant temperature sensor	Key ON/Engine OFF	2.24V
			Idle (after warming-up)	1.1V
B01-79	-	-	-	-
B01-81	-	-	-	-
B01-82	-	-	-	-
B01-83	Diagnosis K-line	Data link connector or immobilizer (for Europe)	Because this terminal is for serial communication, good/no good judgement by terminal voltage is not possible	-
B01-84	-	-	-	-
B01-85	Torque reduction signal	Transaxle control module	Key ON/Engine OFF	5V
			Idle	4.8V
B01-86	Park/Neutral input (A/T only)	Transaxle control module	Key ON/Engine OFF	B+

			Idle	<1V
B01-87	-	-	-	-
B01-88	-	-	-	-

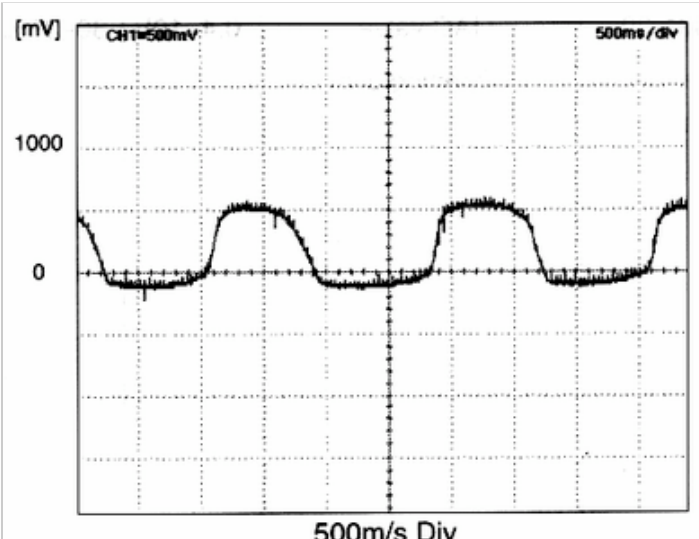
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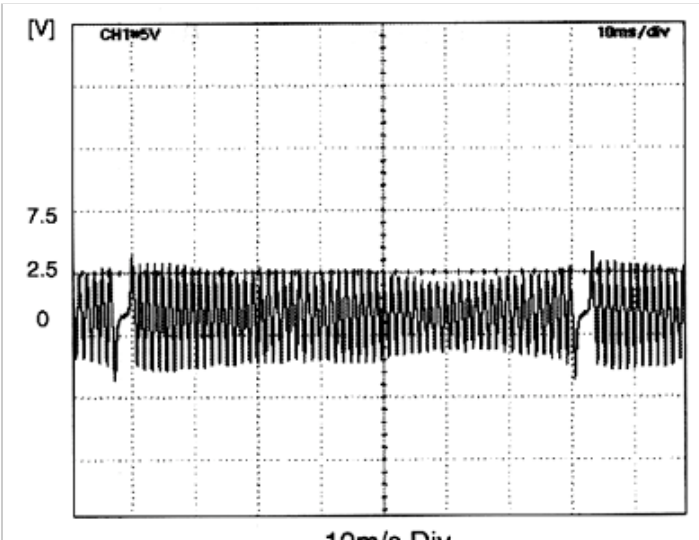
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-2	IAC valve (Closing coil)	4-6V	61~66%	100 HZ	

Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-3	Injector #1	B+	-	-	

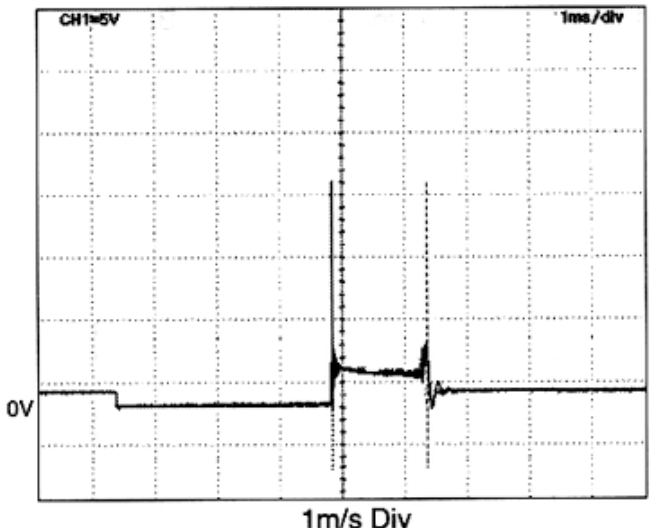
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-4	Injector #4	B+	-	-	

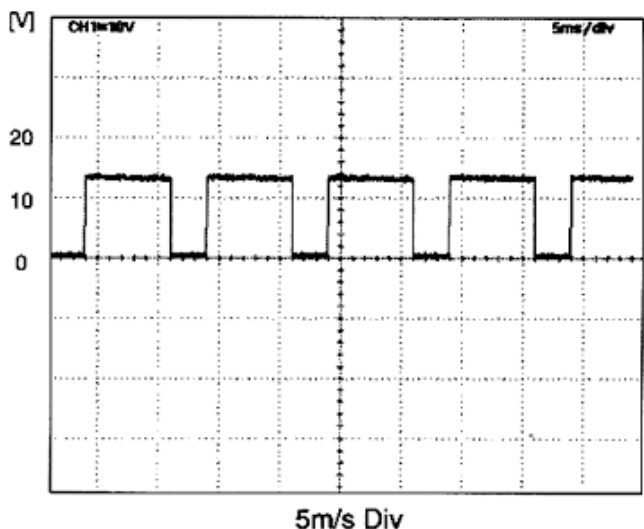
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	

B01-12	HO2S (front)	0-1V	-	-	
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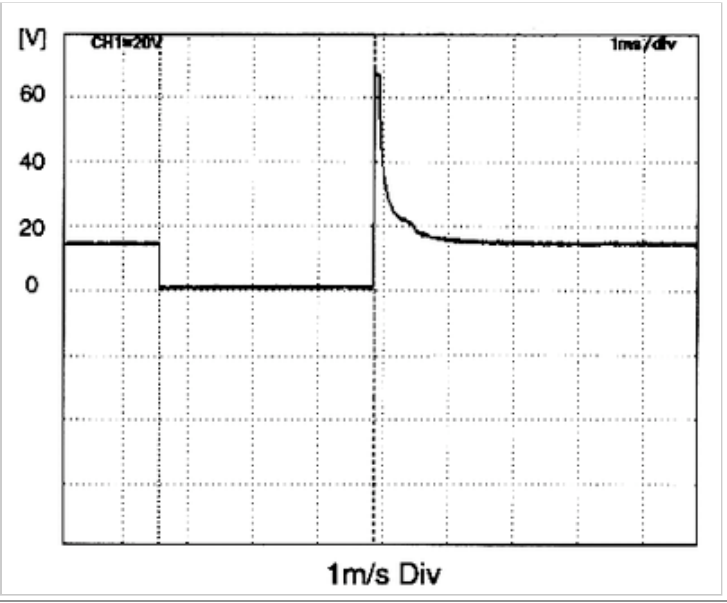
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-16	Crankshaft Position Sensor (+)	1.6~2.4V	-	-	

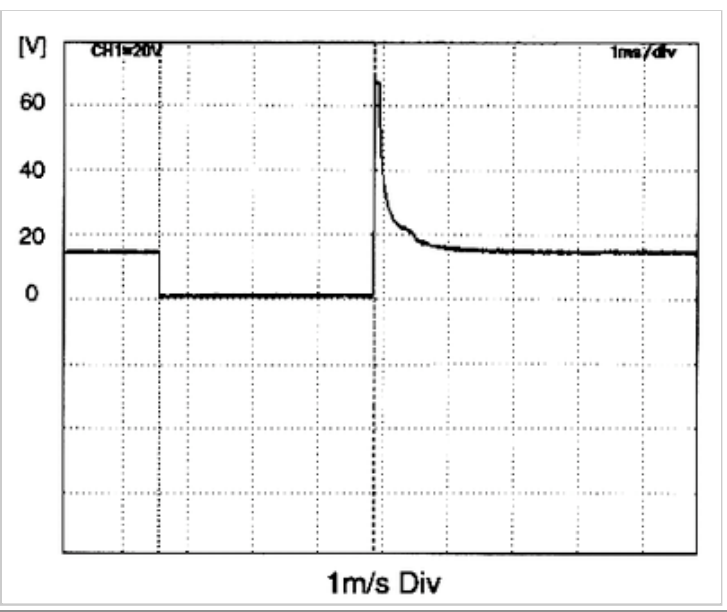
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	

B01-25 (Without immobilizer) B01-52 (with immobilizer)	Ignition coil (Cylinder 1&4)	B+	-	-	
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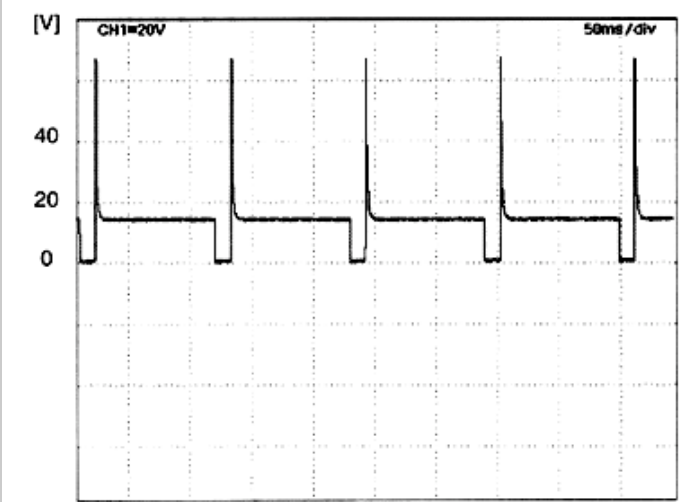
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-29	IAC valve (Opening coil)	0.4~10V	30~35%	100 HZ	

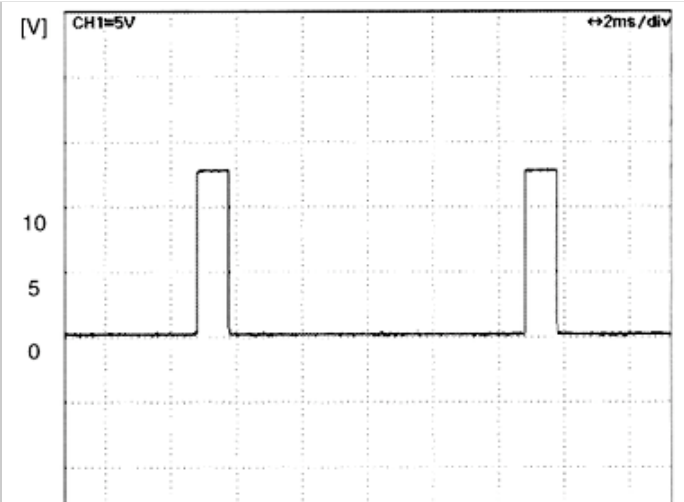
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	

B01-31	Injector #3	B+	-	-	
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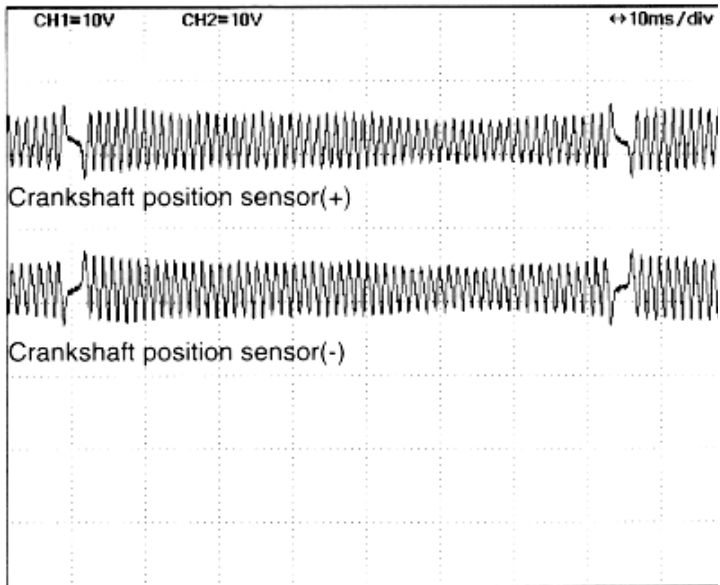
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-32	Injector #2	B+	-	-	

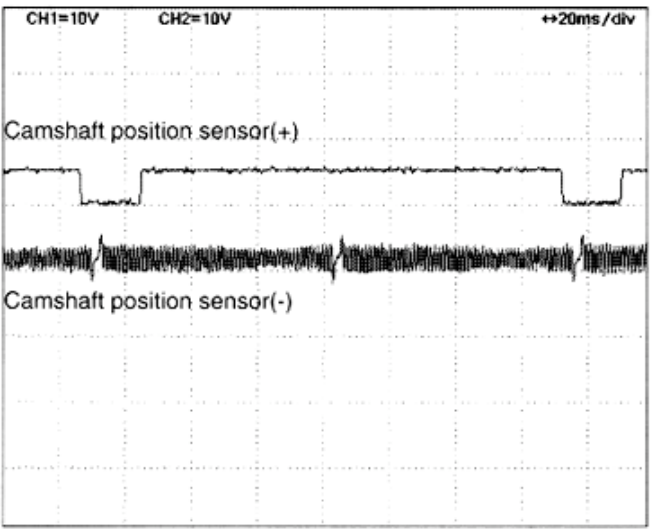
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	

B01-36	EVAP canister solenoid valve	B+	-	-	
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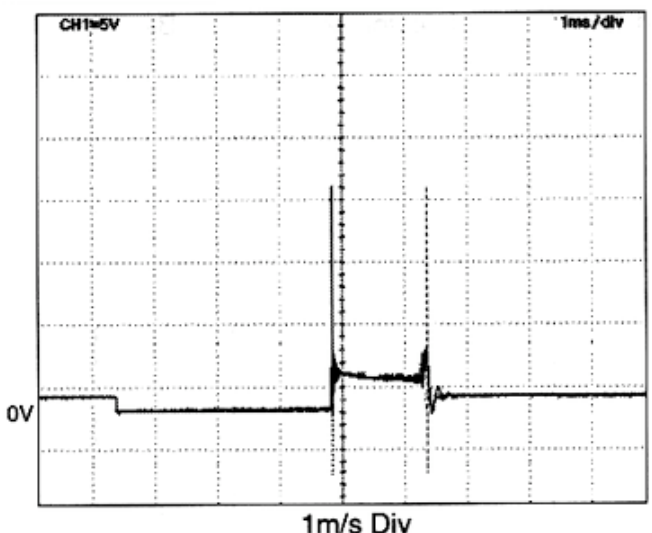
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-38	Throttle position sensor (Pulse width modulation)	1.4V	90%	100Hz	

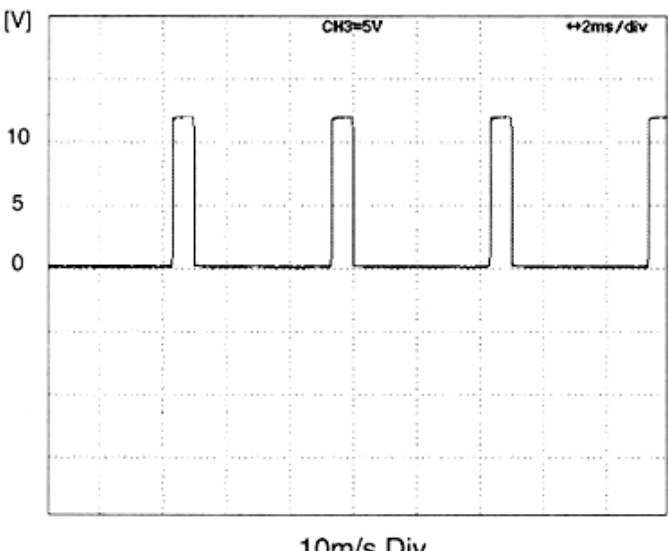
Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	

B01-43	Crankshaft Position sensor (-)	1.6~2.4V	-	-	
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Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-44	Camshaft Position sensor	4.3~4.6V	-	-	

Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	

B01-52 (Without immobilizer) B01-24 (With immobilizer)	Ignition coil control (Cylinder 2&3)	B+	-	-	
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Terminal	Signal	With engine Idling			Waveform (With engine idling)
		Voltage	Duty	Frequency	
B01-68	Torque reduction signal (TCM to ECM)	1.5~1.8V	86-89%	200Hz	

Specifications

Item			Specifications
Accelerator cable free play (mm (in))			3 (0.12)
Fuel injection volume (cu in/min (cc/min))			7.7 (126)
Fuel pressure ₁ (psi (kPa, kg/cm ²))			47~48 (320~330,3.2~3.3)
Fuel pressure ₂ (psi (kPa, kg/cm ²))			25 (180,1.5)
Fuel filter	Type	Low-Pressure side	Nylon element (in fuel pump)
		High-Pressure side	Paper element
Fuel pump pressure(min) (psi (kPa, kg/cm ²))			64(450,4.5)
Fuel specification			Unleaded
Fuel tank capacity (gal(liter))			13 gal. (50 liter)

Injector	Type	High ohmic electra mechanical
Resistance (Ω)		14.5
✓Fuel pressure with fuel pressure regulator		
✓Minimum fuel pressure fifteen minutes after ignition key is switched "OFF".		



Fuel System

Engine Control System



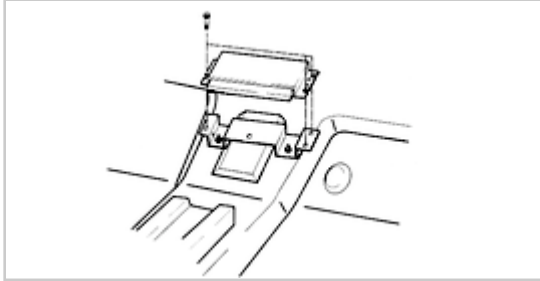
Fuel System

Engine Control System - Engine Control Module
(ECM)



Removal

1. Remove three bolts retaining ECM to floorboard.
2. Remove ECM from mounting brackets.
3. Disconnect ECM connector.



Installation

1. Attach connector to ECM.
2. Mount ECM onto mounting bracket in floorboard.
3. Install three bolts to retain ECM.
4. Connect ECM connector.



Fuel System

Engine Control System - Mass Air Flow Sensor
(MAFS)



Removal

NOTICE

Do not drop or subject the sensor to shock. Do not put objects inside the sensor.

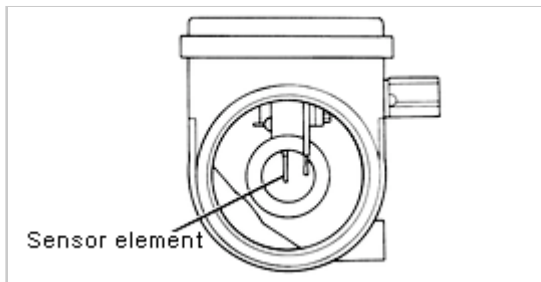
1. Disconnect mass air flow sensor connect.
2. Loosen air intake hose retaining clamps on both sides of mass air flow sensor.
3. Disconnect air intake hose from mass air flow sensor.
4. Remove two bolts attaching mass air flow sensor to mounting bracket.
5. Remove mass air flow sensor.

Installation

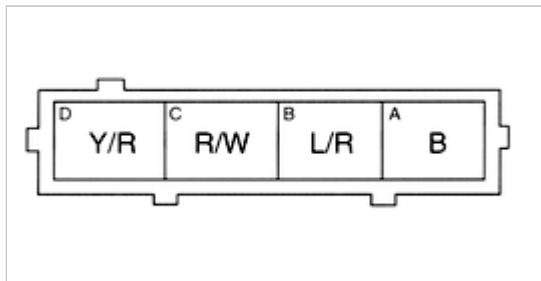
1. Attach mass air flow sensor to air intake hose and to mounting bracket.
2. Replace two bolts to retain mass air flow sensor to mounting bracket.

Tightening torque: 69~69.3 lb-in(7.8~10.8 N·m, 0.8~1 kg-m)

3. Reconnect air intake hose to the mass air flow sensor.
4. Tighten bolts of retaining clamps on both sides of mass air flow sensor.
5. Reconnect mass air flow sensor connector to sensor.



6. Warm up engine to normal operating temperature and let engine idle.
7. Connect voltmeter between terminal D (YEL/RED wire) and ground.
8. Verify that the voltage varies between 0.8V~1.2V.
9. Rev up engine and verify that voltage varies between 3.5V~4V.
10. If voltage is not within specification, replace mass air flow sensor.



Inspection

1. Check mass air flow sensor for damage, replace if necessary.



Fuel System

Engine Control System - Engine Coolant Temperature Sensor (ECTS)

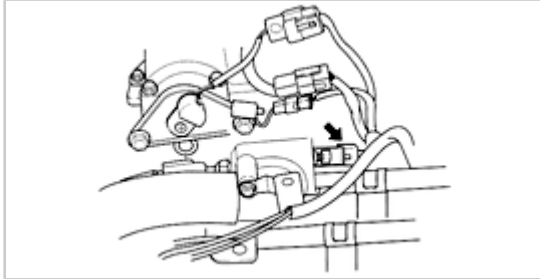


Removal

NOTICE

Engine coolant temperature sensor is located near thermostat.

1. Disconnect engine coolant temperature sensor connector.
2. Remove engine coolant temperature sensor.



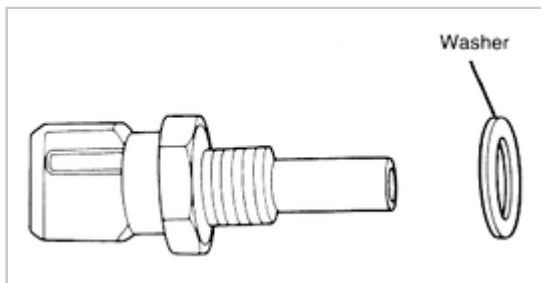
Installation

1. Install a new washer and engine coolant temperature sensor onto engine.

NOTICE

Tightening torque: 18-22 lb-ft (25-29 N·m, 2.5~2.9 kg-m)

2. Connect engine coolant temperature sensor connector.
3. Start engine and check for coolant leakage.



Inspection

1. Measure resistance of sensor using ohmmeter.

Water temperature°F(°C)	Resistance(kΩ)
68°F(20°C)	2.45± 0.24
176°F(80°C)	0.322± 0.032

2. If resistances are not within specification, replace engine coolant temperature sensor.



Fuel System

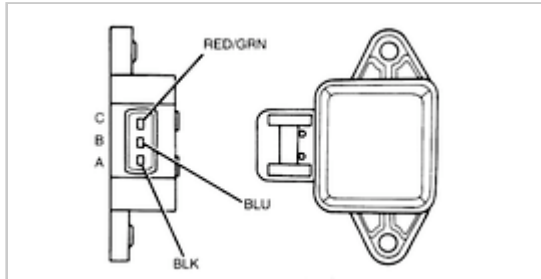
Engine Control System - Accelerator Position Sensor (APS)



Inspection

Throttle position sensor

1. Disconnect connector from throttle position sensor.
2. Connect ohmmeter between sensor terminals A and B.
3. Verify that resistance increases linearly according to throttle angle.



Specification: $2k\Omega \pm 0.4k\Omega$ (with throttle valve closed)

4. If resistance is not as specified, replace the throttle
5. Connect throttle position sensor connector.

Voltage

1. Verify that throttle is at the closed throttle position.
2. Turn ignition switch ON.
3. Connect voltmeter between terminal A (BLK wire) and C (RED/GRN wire) on throttle position sensor connector.
4. Verify that throttle valve is at closed throttle position.
5. Fully open throttle valve and verify that voltage at terminal C is within specification.
6. If not as specified, replace throttle position sensor.

Specification:

Measuring condition	Voltage(V)
Fully closed	0.4~0.6V
Fully open	4.1~4.3V

Removal

NOTICE

The throttle position sensor is not adjustable or replaceable. The throttle position sensor is part of the throttle body assembly.

For throttle body removal, refer to Fuel System, Section 22.

Installation

For throttle body installation, refer to Fuel System, Section 22.



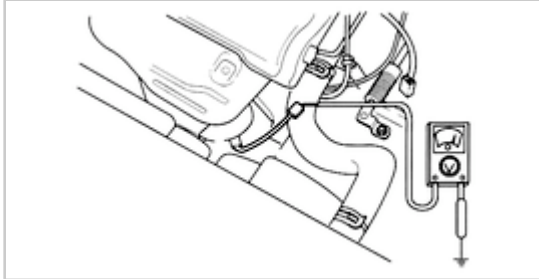
Fuel System

Engine Control System - Heated Oxygen Sensor
(HO2S)



Inspection

1. Warm up the engine to normal operation temperature.
2. Run engine at idle speed.
3. Connect a voltmeter terminal D (YEL/GRN wire) and ground.



4. Increase and decrease engine speed quickly several times.
5. Verify that meter reading varies between 0~1.0V.

NOTICE

Rear oxygen sensor voltage does not fluctuate as quickly as front oxygen sensor.

6. If not as specified, inspect:
 - A. On-board diagnostic system
 - B. System inspection
 - C. Intake manifold vacuum
 - D. Fuel line pressure
7. If all systems are normal, replace the heated oxygen sensor.

Front & rear heated oxygen sensor heaters

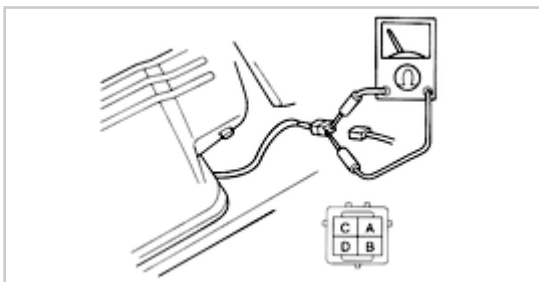
1. Ensure ignition switch is OFF.
2. Disconnect heated oxygen sensor connector.
3. Connect ohmmeter between terminal A and B and measure resistance.

Specification: 3.6~20.5Ω(68°F{20°C})

4. If not as specified, replace heated oxygen sensor.

Tightening torque: 22-36 lb-ft(30~49 N·m, 3~5 kg-m)

5. Reconnect heated oxygen sensor connector.



Removal

1. Disconnect heated oxygen sensor connector.
2. With standard oxygen sensor socket, remove heated oxygen sensor and washer.

Installation

1. Install heated oxygen sensor and washer.

Tightening lb-ft (30~49 N·m, 3~5 kg-m)

2. Reconnect heated oxygen sensor connector.



Fuel System

Engine Control System - Idle Speed Control Actuator
(InodeA)



Inspection

Ignition timing and idle speed

Ignition timing

1. Apply parking brake.
2. Warm up engine to normal operating temperature.
3. Turn OFF all electrical loads.
4. Connect timing light to number one spark plug wire.

NOTICE

A rubber inspection plug has been provided in the plastic coil cover (center of the cylinder head cover) directly over the number one(1) spark plug wire. Remove the inspection plug and connect the inductive pick-up of your tachometer or timing light to the number one(1) spark plug wire. If your tachometer/timing light inductive pick-up is too large, the coil cover will have to be removed.

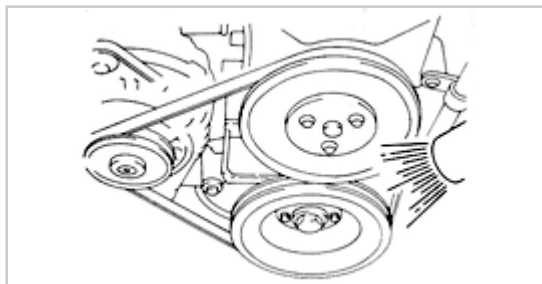
5. Verify that ignition timing marks on crankshaft pulley and timing mark on timing belt cover are aligned.

Ignition timing : BTDC $8^{\circ} \pm 5^{\circ}$ (at idle speed)

NOTICE

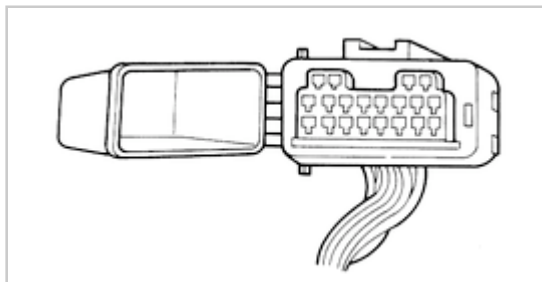
Ignition timing is not adjustable.

6. If timing is not within the specified range, replace the ECM.



Idle speed

1. Apply parking brake.
2. Warm up the engine to normal operating temperature.
3. Turn OFF all electrical loads.
4. Connect inductive tachometer to number one (1) spark plug wire or connect tachometer pic-up lead to terminal number three (0) in the data link connector(DLC).



NOTICE

The base idle speed is not adjustable. The idle speed is automatically controlled by the engine control module. Incorrect idle speed indicates a potential problem with the IAC system or an intake manifold leak.

5. Check that idle speed is within specified range.

Idle speed (transaxle in "NEUTRAL") : 800 ± 50 rpm

NOTICE

This is a "wasted spark" ignition system, some tachometers will indicate twice the actual engine speed.

6. Disconnect tachometer from DLC or spark plug wire.
7. Turn OFF engine.



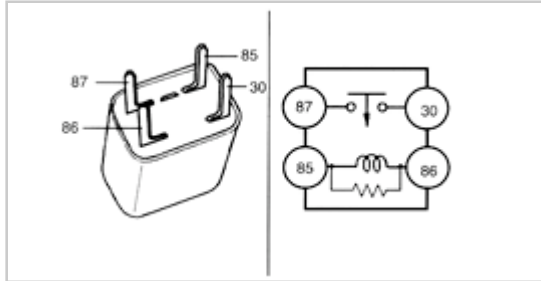
Fuel System

Engine Control System - Main Relay



Inspection

1. Remove cover from main fuse block.
2. Place a finger on main relay.
3. Verify that relay clicks when ignition switch is turned ON.



4. Verify that main relay clicks when ignition switch is turned ON and OFF.
5. Apply battery voltage(B+) to terminal 86 and ground terminal 85 of the relay.
6. Check continuity of relay as shown.

Terminals	B+ applied	B+ not applied
87~30	Continuity	No continuity

7. If not as specified, replace main relay.
8. Turn ignition switch OFF.
9. Replace the cover on main fuse block.



Fuel System

Engine Control System - Fuel Pump Relay



Check operation

WARNING

THE FUEL SYSTEM REMAINS UNDER PRESSURE WHEN THE ENGINE IS NOT RUNNING. RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING ANY FUEL LINE TO REDUCE THE CHANCE OF PERSONAL INJURY OR FIRE DAMAGE TO VEHICLE COMPONENTS.

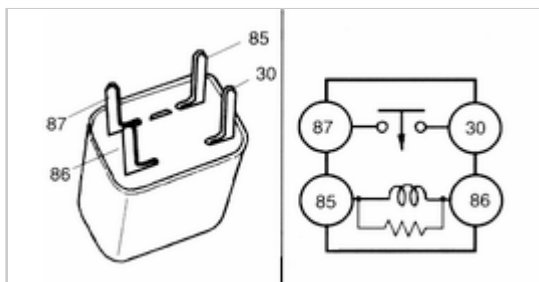
Listen for fuel pump relay clicking as ignition switch is turned "ON".

Continuity inspection

1. Check continuity between relay terminals.

B+ : Battery positive voltage

Terminal 85-86	Terminal 87-30
Apply B+ and ground	Continuity
B+ and ground not applied	No continuity Continuity





Fuel System

Engine Control System - Cooling Fan Relay

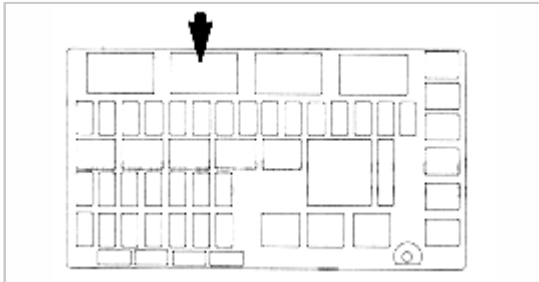


Removal

1. Disconnect negative battery cable.

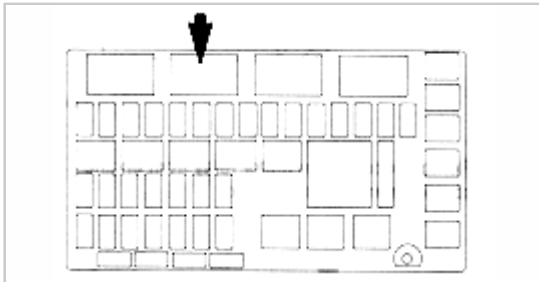


2. Remove cooling fan motor relay from engine compartment fuse/relay box.



Installation

1. Install cooling fan motor relay from engine compartment fuse/relay box.



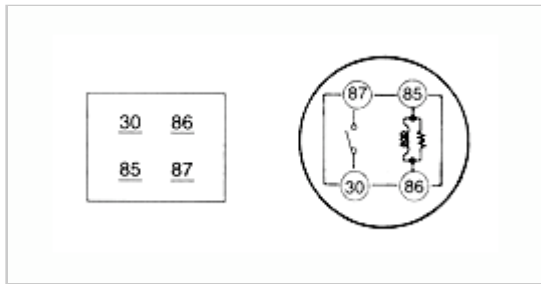
2. Connect negative battery cable.



Inspection

1. Check continuity with an ohmmeter.

Terminal	Continuity
30-87	No
85-86	Yes



2. Apply 12V to terminal 85 and ground to terminal 86.
Check for continuity between terminals 30 and 87.
3. If there is no continuity, replace cooling fan motor.



Description

Component description table

Component	Function	Remark
A/C relay	Controls A/C operation according to vehicle conditions and sends A/C operation condition signals to ECM.	Controls condenser fan operation
A/C switch	Controls battery power to A/C relay	Normally open type
Air cleaner	Filters air entering throttle body	Dry type
Camshaft position#(CMP) sensor	Detects No.1 cylinder TDC; sends signal to ECM	Installed at rear of cylinder head
Check valve	Maintains pressure in the Fuel tank and regulates vapor flow to the evaporative emissions canister	Located in the evaporative system lines next to the fuel tank
Crankshaft position#(CKP) sensor	Detects crank shaft angle from flywheel rotation and sends signal to ECM	SGT signal
Data link connector#(DLC)	Centralized service connector for on-board diagnosis	For on-board diagnosis and service/inspection
EGI main relay	Supplies battery power to electrical devices	1. Normal open type 2. Controlled by ECM
Engine control module#(ECM)	Detects the following:	
	1. A/C operation	1. Air conditioning switch
	2. Air/fuel ratio# (oxygen concentration)	2. Oxygen sensor
	3. Cranking signal	3. Ignition switch
	4. Engine coolant temperature	4. Engine coolant temperature sensor
	5. Engine speed	5. Crankshaft position#(CKP) sensor (SGT signal)
	6. Ignition ON signal	6. Ignition switch
	7. In-gear condition (A/T only)	7. Transaxle range switch (A/T)
	8. Intake air amount	8. Mass air flow sensor
	9. Intake air temperature	9. Intake air temperature sensor
	10. No. 1 piston TDC(compression stroke)	10. Camshaft position (CMP) sensor (SGC signal)
	11. Throttle valve opening angle	11. Throttle position sensor
	Controls operation of following:	
	1. A/C (cut-off)	1. A/C cut relay
	2. Self-diagnosis function	2. Hi-scan pro & MIL
	3. Fuel injection system	3. Injector
	4. Idle speed control	4. Idle air control valve
	5. Purge control system	5. Evaporative canister purge valve
	6 Fuel pump control	6. Fuel pump relay
	7 Cooling fan control	7. Cooling fan control relay

Engine coolant temperature (ECT) sensor	Detects engine coolant temperature and sends signal to ECM	Installed near thermostat
Intake air temperature(IAT)sensor	Detects intake temperature and sends signal to ECM	Installed in air cleaner thermostat
Fuel filter (high pressure side)	Filters fine dirt particles in fuel discharged from the fuel pump	-
Fuel filter# (low pressure side)	Filters fuel in fuel tank	Installed into fuel pump assembly
Fuel injector	Injects fuel into intake port	Controlled by signals from ECM
Fuel pressure regulator	Adjusts fuel pressure supply to injectors	Controlled by intake manifold vacuum
Fuel pump	Supplies fuel from fuel tank to fuel under pressure	Actuated by fuel pump relay installed
Fuel pump relay	Controls battery power to fuel pump	1. Normal open type 2. Actuated by ECM fuel pump control signal or by jumping data link connector terminal #1 to B+
Heated oxygen sensor	Detects oxygen density in exhaust gas and sends signal to ECM	1. Located in exhaust manifold 2. For air/fuel mixture adjustment
Idle air control(IAC) valve	Supplies intake air to engine, bypassing throttle valve	1. For idle speed control 2. Actuated by ECM idle speed control signal
Ignition coils	Supplies secondary voltage to spark plugs	Mounted directly above spark plugs
Ignition control module	Controls operation of ignition coils	Incorporated into ECM
Ignition switch	Starts engine and controls battery power to electrical devices	-
Intake manifold	Supplies intake air to all cylinders	-
Main relay	Supplies current to output devices and ECM	-
Mass air flow (MAF) sensor	Detects amount of intake air and sends signal to ECM	Hot film type
Positive crankcase ventilation (PCV) valve	Sends blow-by gas in crankcase into intake manifold (dynamic chamber)	1. Actuated by intake manifold vacuum 2. For blow-by gas recirculation
Resonance chamber	Reduces intake air suction noise and increases engine torque	-
Starter	Starts engine by rotating flywheel ring gear	-
Three way catalytic converter	Reduces HC, CO, and NO in exhaust through chemical reaction	For exhaust gas emissions reduction
Throttle body	Controls intake air amount	-
Throttle position sensor	Detects throttle valve opening angle and sends signal to ECM	Installed on throttle body
Transaxle control module(A/T)	Controls functions of transaxle for better performance and shift quality	Located below instrument panel behind left lower trim panel

Transaxle range switch(A/T)	Detects shift lever position and sends to ECM	1. For idle speed control 2. Load/no/load determination
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OBD-II overview

- Primary emission control system/components
- Heated oxygen sensors (includes heater)
- Catalyst
- Fuel system
- Evaporative emission system
- Misfire
- Comprehensive components (input and output)

Heated oxygen sensor monitoring

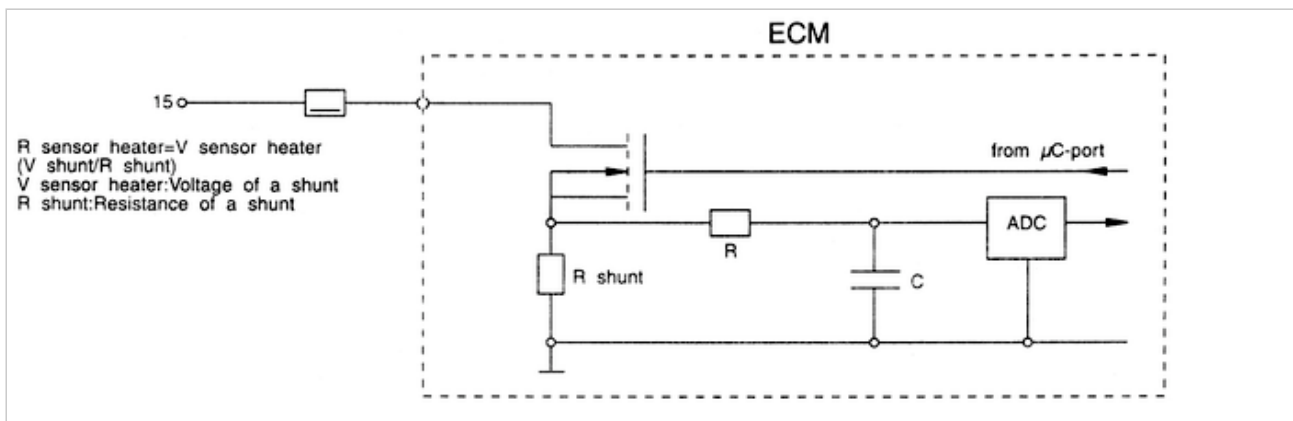
System description

Monitoring process

- Heater voltage and current.
- Period of front HO2S reaction
- Other parameter (Tv) to monitor sensor aging.

Heater voltage and current

The voltage readings taken from the HO2 Sensor are very temperature sensitive and are not particularly accurate below 300C. For this reason, heating of the HO2 sensor is necessary to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat the HO2 Sensor must be tested to ensure that it is heating the sensor properly.

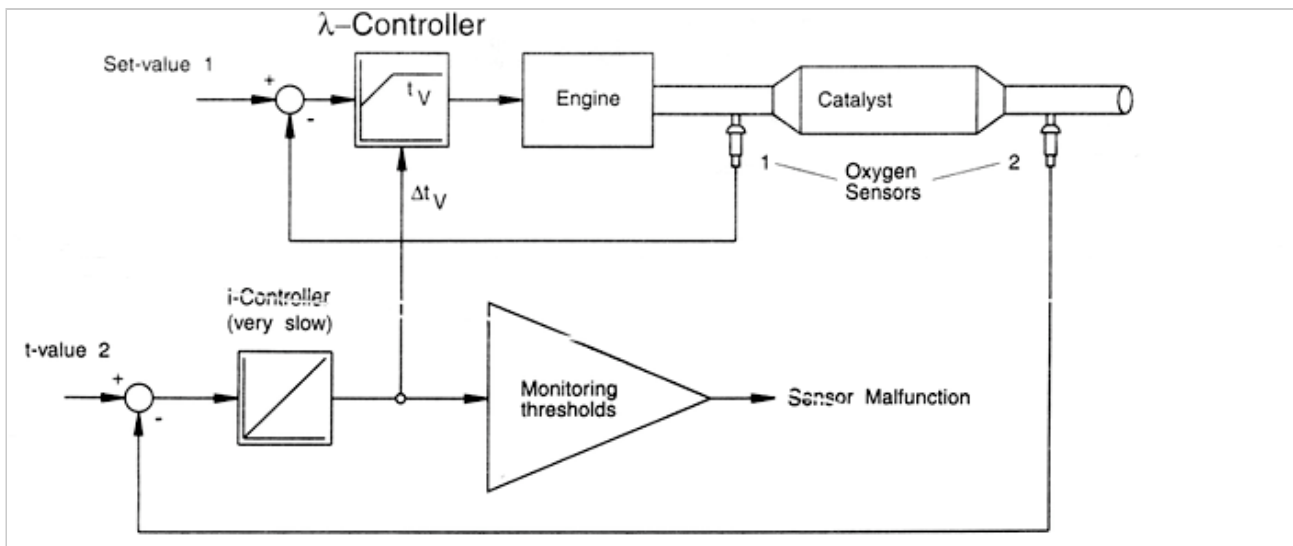


Period of front HO2 reaction

The ECM is supplied with information regarding the oxygen content of the exhaust gases by the front HO2S. The signal is used to compute the injection period. The front HO2S monitors the contaminated exhaust gases. This, in time, causes aging of the device and a change in the signal. To monitor the front HO2S responsiveness, the response period of the upstream oxygen sensor signal is compared with a lower and upper threshold. This comparison is done in an applicable range of engine speed and load with the engine at operating temperature. If the actual mean value of the period is outside of the lower and upper period thresholds the diagnostic trouble code is set.

Other parameter (Tv) to monitor sensor aging

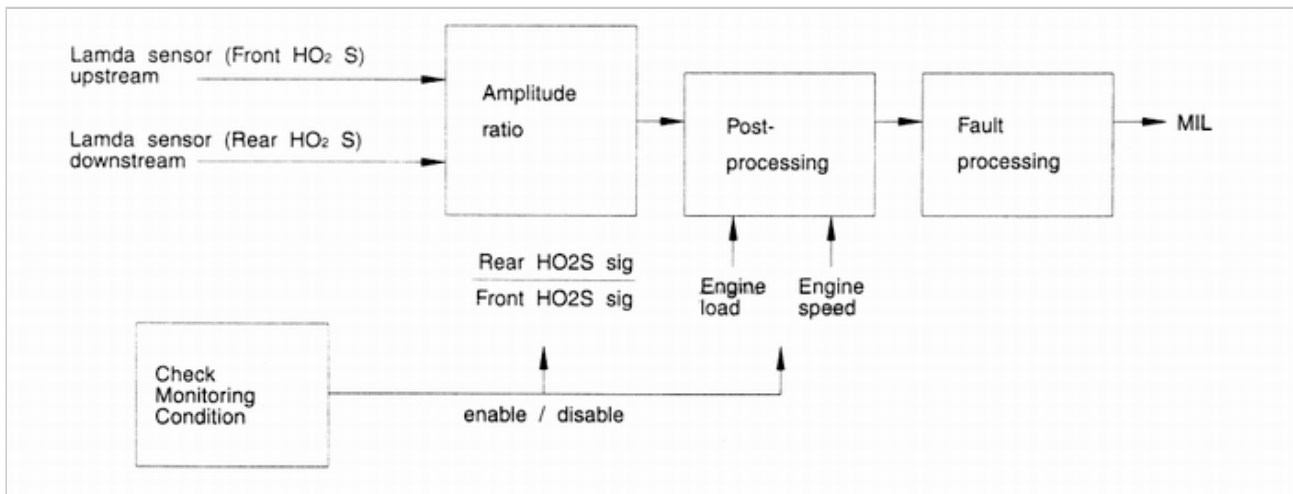
The sensor aging is monitored by comparing the front and rear HO2S and also using the correction value (Tv) which determines the mean value of the lean/rich shift necessary for optimal air/fuel ratio-control. With the help of this information, the ECM can make allowance for aging of the front HO2S in its injection period calculations. When the parameter-Tv is above or below the specific limits, the ECM will set the diagnostic trouble code HO2S Slow Response by aging.



MIL illumination

If any fault relating to HO₂S is detected, then the MIL is only turned ON if the same fault is again detected during a second drive cycle.

Three way catalytic converter (TWC) monitoring (System description)



Fuel system monitoring (System description)

- Engine load (MAF sensor)
 - Engine Speed (SGT)
 - Short fuel trim correction factor
 - Long fuel trim correction factor
- Fuel trim is monitored to meet the OBD-II requirements

1. Short fuel trim (FT)

Short FT is a temporary correction to fuel delivery which changes with every cycle of the front Heated Oxygen Sensor. Under normal conditions, it fluctuates rapidly around its ideal value of 0% correction and is set to 0% during open loop operation.

Short FT is a parameter of the OBD-II serial data stream and can be displayed by a scan tool. The normal range of shortFT is $\pm 25\%$, but under normal operating conditions it rarely goes beyond $\pm 10\%$. Short FT responds to changes in front HO₂S output. If basic injection duration results in a lean air/fuel ratio, Short FT responds with positive corrections (+1% to +25%) to add fuel and enrich the mixture. If basic injection is too rich, Short FT responds with negative corrections (-1% to -25%) to subtract fuel and lean the mixture.

2. Long Fuel Trim

Long FT is a data parameter on the OBD-II data streams. It is a more permanent correction to fuel delivery because it is part of the basic injection duration calculation. Long FT changes slowly, in response to Short FT. Its normal range is $\pm 25\%$, positive values indicating rich correction and negative values indicating lean correction.

Unlike Short FT which affects injection duration calculation in closed loop only, the Long FT correction factor affects the basic injection duration calculation in open and closed loop. Because Long FT is stored in a non-volatile RAM and is not erased when the ignition is switched OFF, the fuel system is able to correct for variances in engine and fuel conditions even during warm-up and wide open throttle conditions.

Monitoring process

MIL illumination

Evaporative emission controls (Evaporative Control System)

1. Fuel tank

The fuel tank is located under the rear of the vehicle. The fuel pump, fuel level sending unit and fuel tank pressure sensor are installed on the upper part of the fuel tank.

2. Fuel filler cap

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would prevent sealing fuel vapors. After the gasket on the fuel filler cap and the fill neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set

3. Evaporative emissions canister

A maintenance free, EVAP canister is used on the Rio located under the right side of the vehicle near the fuel tank. The EVAP canister is filled with granules of an activated carbon mixture. Fuel vapors enter into the EVAP canister and are absorbed by the charcoal granules. Fuel tank pressure vents into the EVAP canister and are temporarily held in the canister until they can be drawn into the intake manifold.

4. Purge solenoid valve

This valve is actuated by the purge control signal from the ECM and controls fuel vapor from the EVAP Canister to the intake manifold.

Misfire monitoring (System description)

Monitoring conditions

Monitoring process

MIL illumination

The MIL flashes while a catalyst damaging misfire is being detected.

COMPREHENSIVE COMPONENTS MONITORING

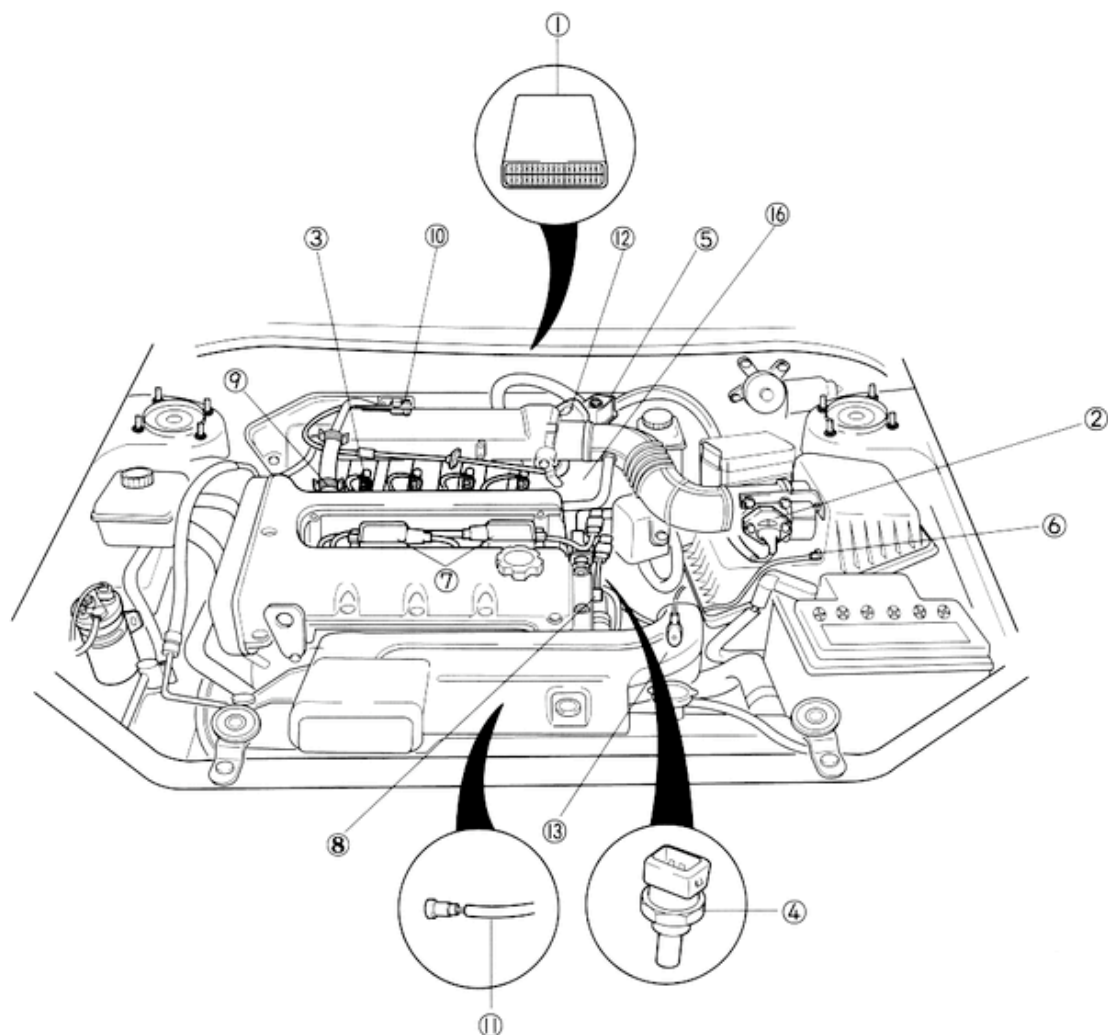
Any input or output components that can affect emissions or any input or output component used to monitor any other monitored component/system is monitored.

The lack of circuit continuity, any rationality, and out-of-range values to ensure proper operation of the input devices, are monitored for proper response to ECM commands.



Components

Underhood emission control components



- | | |
|---------------------------------------|---------------------------------|
| (1) Engine control module | (9) PCV valve |
| (2) Mass air flow sensor | (10) EVAP canister purge valve |
| (3) Injector | (11) Heated oxygen sensor |
| (4) Engine coolant temperature sensor | (12) Throttle position sensor |
| (5) Idle air control valve | (13) Crankshaft position sensor |
| (6) Intake air temperature sensor | |
| (7) Ignition coil assembly | |
| (8) Camshaft position sensor | |

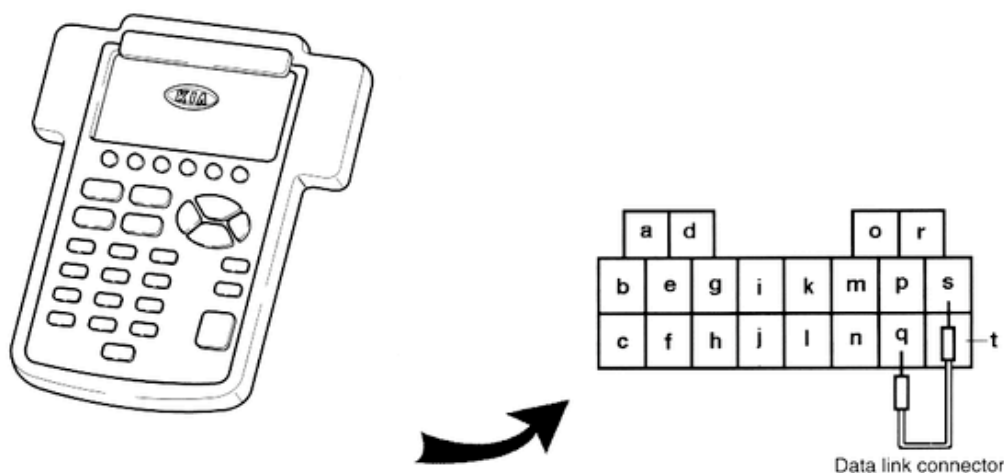


Diagnostic trouble codes retrieval procedure

1. Connect the Hi-scan pro to the Data Link Connector (DLC).
2. Turn the ignition switch ON.
3. Retrieve any DTC in ECM memory.

Clearing diagnostic trouble codes

1. Connect Hi-scan pro to the Data Link connector(DLC).
2. Turn the ignition switch ON.
3. Erase only DTC stored in ECM.



Data link connector 20 pin layout

PIN No.	Terminal function
A	Potwer supply for fuel pump test
B	Power supply for IG "ON"
D	Cooling fan test
F	Air bag unit
H	ABS unit
K	Communication diagnosis terminals for Hi-scan pro
M	Fail code output terminal for A/T vehicle
N	Test ground for A/T vehicle
O	Engine rpm check terminal
P	Engine fail code output terminal
Q	Engine test
R	Ground
S	Ground
T	Engine monitor terminal

OBD-II connector 16 pin layout

PIN No.	Terminal function
4	Ground
5	Ground
7	Communication diagnosis terminal for Hi-Scan Pro
16	Power supply

Diagnostic trouble code

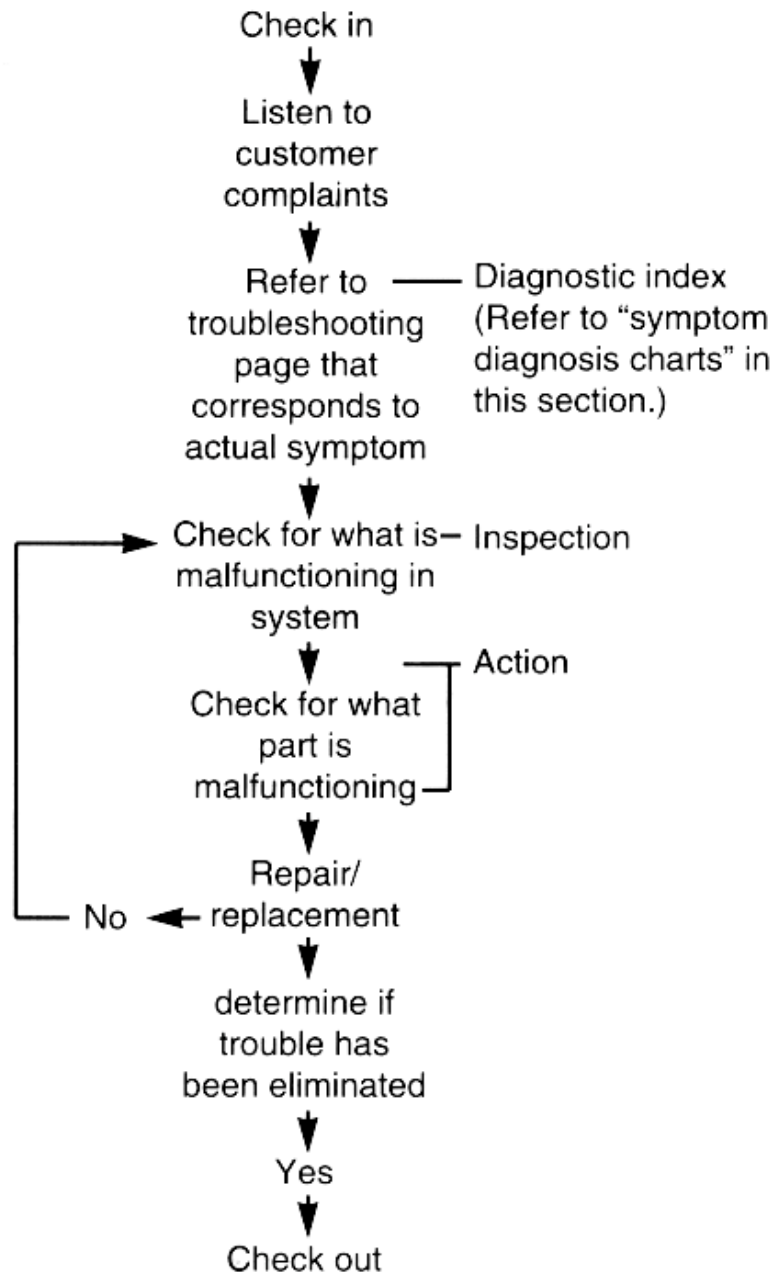
Diagnostic trouble code	Condition
P0100	Mass air flow (MAF) circuit malfunction
P0110	Intake air temperature (IAT) circuit malfunction
P0116	Engine coolant temperature (ECT) circuit range/performance problem
P0117	Engine coolant temperature (ECT) circuit low input
P0118	Engine coolant temperature (ECT) circuit high input
P0120	Throttle position sensor circuit malfunction
P0125	Insufficient coolant temperature for closed loop fuel control
P0130	Heated O ₂ sensor circuit malfunction (bank 1, sensor 1)
P0131	Heated O ₂ sensor circuit low voltage (bank 1, sensor 1)
P0132	Heated O ₂ sensor circuit high voltage (bank 1, sensor 1)
P0133	Heated O ₂ sensor slow response (bank 1, sensor 1)
P0134	Heated O ₂ sensor circuit no activity detected (bank 1, sensor 1)
P0135	Heated O ₂ sensor heater current malfunction (bank 1, sensor 1)
P0136	Heated O ₂ sensor circuit malfunction (bank 1, sensor 2)
P0137	Heated O ₂ sensor circuit low voltage (bank 1, sensor 1)
P0138	Heated O ₂ sensor circuit high voltage (bank 1, sensor 1)
P0140	Heated O ₂ sensor circuit no activity detected (bank 1, sensor 2)
P0141	Heated O ₂ sensor heater current malfunction (bank 1, sensor 2)
P0170	Fuel system malfunction (A/F adaptation diagnosis malfunction)
P0171	Fuel system too lean
P0172	Fuel system too rich
P0201	Cylinder 1 injector circuit malfunction
P0202	Cylinder 2 injector circuit malfunction
P0203	Cylinder 3 injector circuit malfunction
P0204	Cylinder 4 injector circuit malfunction
P0300	Random misfire detected
P0301	Cylinder 1 misfire detected
P0302	Cylinder 2 misfire detected
P0303	Cylinder 3 misfire detected
P0304	Cylinder 4 misfire detected
P0325	Knock sensor circuit malfunction
P0335	Crankshaft position (CKP) sensor circuit malfunction
P0336	Crankshaft position (CKP) sensor circuit range/performance

P0340	Camshaft position CMP sensor circuit malfunction
P0422	Main catalyst efficiency below threshold
P0443	Evaporative emission control system purge control valve circuit malfunction
P0501	Vehicle speed sensor circuit range/performance problem
P0506	Idle speed system rpm lower than expected
P0507	Idle speed system rpm higher than expected
P0560	System voltage malfunction
P0601	Internal control module memory check sum error
P1505	Idle control valve opening coil signal low
P1506	Idle control valve opening coil signal high
P1507	Idle control valve closing coil signal low
P1508	Idle control valve closing coil signal high
P1586	AT/MT condensation signal malfunction
P1693	TCU MIL circuit malfunction

Symptom related diagnostic procedure(Using this section Introduction)

Most of the fuel and emission control system is electrically controlled, often making it difficult to diagnose problems in the system, especially intermittent problems.

Before undertaking actual checks, take a few minutes to talk with a customer who approaches with a driveability complaint. The customer is often a good source of information on such problems, especially intermittent ones. Through talks with the customer, one can find out what the symptoms are and under what conditions they occur.



General description

The Engine Control Module (ECM) operates the fuel system. It regulates ignition timing, air fuel ratio, emission control devices, charging system, idle speed control, air conditioning clutch engagement, etc. The ECM has the ability to adapt to changing operating conditions.

The ECM receives input signals from various switches and sensors. Based on these inputs, the ECM regulates various engine and vehicle operations through different system components also known as ECM Outputs. On the other hand, the sensors and switches that provide inputs to the ECM are ECM Inputs. For example, the ECM adjusts ignition timing based upon inputs it receives from sensors that react to : engine RPM, engine coolant temperature, throttle position, transaxle gear, vehicle speed, etc. The ECM adjusts idle speed based on inputs it receives from sensors that react to : throttle position, vehicle speed, transaxle gear, etc.

- Mass air flow sensor

The Mass Air Flow (MAF) Sensor is the most direct method of measuring engine load because it measures the mass of air intake. This is also known as a "hotwire"

Sensor because it depends on the measurement of current flowing through heated wires to measure air flow. The hot

wire is heated to specific temperature differential above incoming air. Two wires inside the MAF Sensors are exposed to a portion of the airflow entering the engine :

The ambient temperature wire or "cold wire" isn't heated so this wire is the temperature of the surrounding air and serves as the reference temperature.

The hot wire is heated by the MAF to be a certain amount above the ambient air. As soon as air flows over the wire, both wires are cooled. The control circuits then apply more voltage to keep the hot wire at the original temperature differential. This creates a voltage signal monitored by the ECM. The greater the air flow and wire cooling, the greater the signal.

- Engine coolant temperature sensor

The Engine Coolant Temperature (ECT) Sensor provides an input voltage to the ECM relating to coolant temperature. The ECM uses this input signal along with inputs from other sensors to determine injector pulse width and ignition timing. As coolant temperature varies the ECT Sensor's resistance changes. The change in resistance results in a different input voltage to the ECM. When the engine is cold, the ECM will operate in Open Loop cycle. It will demand slightly richer air/fuel mixtures and higher idle speeds until normal temperatures are reached.

- Throttle position sensor

The Throttle Position (TP) Sensor is a variable resistor that provides the ECM with an input signal (voltage) that represents throttle blade position. The sensor is connected to the throttle blade position. The sensor is connected to the throttle blade shaft. As the position of the throttle blade changes, the resistance of the TP Sensor changes. The ECM supplies a 5V reference voltage to the TP Sensor. The TP Sensor output voltage (input signal to the ECM) represents the throttle blade position. This will usually vary from around 0.25V at minimum throttle opening, the around 4.7V at wide open throttle.

- Crankshaft position sensor

The Crankshaft Position (CKP) Sensor is used to signal the ECM when a spark and/or fuel injection event required. The output from this sensor, in conjunction with the Camshaft Position Sensor signal, is used to determine whether spark or fuel is required in a particular cylinder. The engine will not start without a CKP Sensor signal to the ECM. Refer to section EE-IG for more information.

- Camshaft position sensor

The Camshaft Position (CMP) Sensor works with the CKP Sensor to provide inputs to the ECM to establish and maintain correct injector firing order. Refer to section EE-IG for more information.

- Knock sensor

The Knock Sensor is a feedback signal used to control of ignition timing. When knocking occurs, the Knock Sensor sends the signal to the ECM. The ECM then retards the ignition timing to reduce or eliminate the knock.

- Intake air temperature sensor

This sensor measures the temperature of the intake air and converts its change into a resistance through a thermister similar to the ECT Sensor. By monitoring the IAT Sensor, the ECM detects the intake air temperature and use it as one of the signals to control fuel injectors and ignition timing.

- HO₂ (Oxygen) Sensor

Two heated O₂ Sensors are used in the vehicle. The sensors produce voltages from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air/fuel mixture), the sensors produce a low voltage. When there is a lesser amount (rich air/fuel mixture) the sensors produce a higher voltage. By monitoring the oxygen content and converting it to electrical voltage, the sensors act as a rich-lean switch.

Both HO₂ Sensors are equipped with a heating element that keeps the sensors at proper operating temperature during all modes of operation. Maintaining correct sensor temperature at all times allows the system to enter into closed loop operation faster and allows the system to remain in closed loop during periods of extended idle.

- Front HO₂ Sensor

The front (upstream) HO₂ Sensor is located in the exhaust downpipe after the TWC and provides an input voltage to the ECM. The input tells the ECM the oxygen content of the exhaust gas. The ECM uses this information to fine tune the air/fuel ratio by adjusting injector pulse width.

- Rear HO₂ sensor

The rear (downstream) HO₂ Sensor is located near the outlet end of the catalytic converter. The rear HO₂ Sensor input is used to detect catalytic converter deterioration. As the converter deteriorates, the input from the downstream sensor begins to match the upstream sensor input except for a slight time delay.

By comparing the rear HO₂ Sensor input to the input from the front sensor, the ECM catalytic converter efficiency.

Symptom Diagnosis charts

Description : Further describes the symptom. Confirm that the chart addresses the actual symptom before beginning troubleshooting.

Troubleshooting Hints : This describes the possible point of malfunction.

Step : This shows the order of troubleshooting. Proceed with troubleshooting as indicated.

Check : This describes an inspection to determine the malfunction of parts quickly.

Remedy : This recommends the appropriate action to take as a result (Yes/No) of the check.

DIAGNOSTIC SYMPTOM INDEX

NO.	TROUBLESHOOTING ITEM		DESCRIPTION
1	Will not crank or cranks slowly		Refer Engine Electrical System
2	Crank normally but will not start	No combustion	Engine cranks at normal speed but shows only partial combustion and will not continue to run
3		Partial combustion Engine cold	Engine cranks at normal speed but shows only partial combustion and will not continue to run
4		Partial combustion after warm-up	Engine start normally when cold, but will not start after running and hot soaked
5	Crank normally but hard to start	Always	Engine cranks at normal speed but requires excessive cranking time before starting
6		When engine is cold	Same condition as No.5 after running and cold; restarts normally after warm-up
7		After warm-up	Same condition as No.5 after running and hot soaked; starts normally when cold
8	Rough idle (Low idle speed/engine stalls at idle)	Always	Engine stalls or vibrates excessively at idle.
9		Before warm-up	Engine stalls or vibrates excessively at idle during warm-up
10		After warm-up	Engine runs normally at idle during warm-up but vibrates excessively or stalls after warm-up
11		When A/C ON	Engine stalls or vibrates excessively at idle when A/C ON
12	Rough idle/engine stalls just after starting		Engine stalls or vibrates excessively only just after starting (acceleration from idle)
13	High idle speed after warm-up		Idle speed excessive after warm-up
14	Idle moves up and down/idle hunting		Engine speeds up and down periodically at idle
15	Engine stalls on deceleration		Engine unexpectedly stops running while decelerating or after deceleration
16	Engine stalls suddenly (intermittent)		Engine intermittently stops running
17	Stumbles/hesitates on acceleration		Flat spot occurs just after accelerator depressed or mid jerking occurs during acceleration
18	Surges while cruising		Unexpected change in engine speed which is usually repetitive
19	Lack of power		Performance poor under load when throttle valve wide open Maximum speed reduced
20	Poor acceleration		Performance poor while accelerating
21	Runs rough on deceleration/backfire		Engine runs rough while decelerating and abnormal combustion occurs in exhaust system
22	Knocking		Abnormal combustion accompanied by audible "pinging" noise
23	Fuel odor		Gasoline odor in cabin
24	High oil consumption		Oil consumption excessive
25	MIL always ON		Kia Data Pro Scan Tool does not indicate Diagnostic Trouble Code but MIL always ON
26	MIL never ON		Kia Data Pro Scan Tool indicates malfunction
27	A/C does not work		Blower fan operates but magnetic clutch does not operate

Driveability definitions

Stumble : Mild jerking during acceleration.

Hesitation : Delay in increase in engine speed occurring just after the accelerator pedal is depressed.

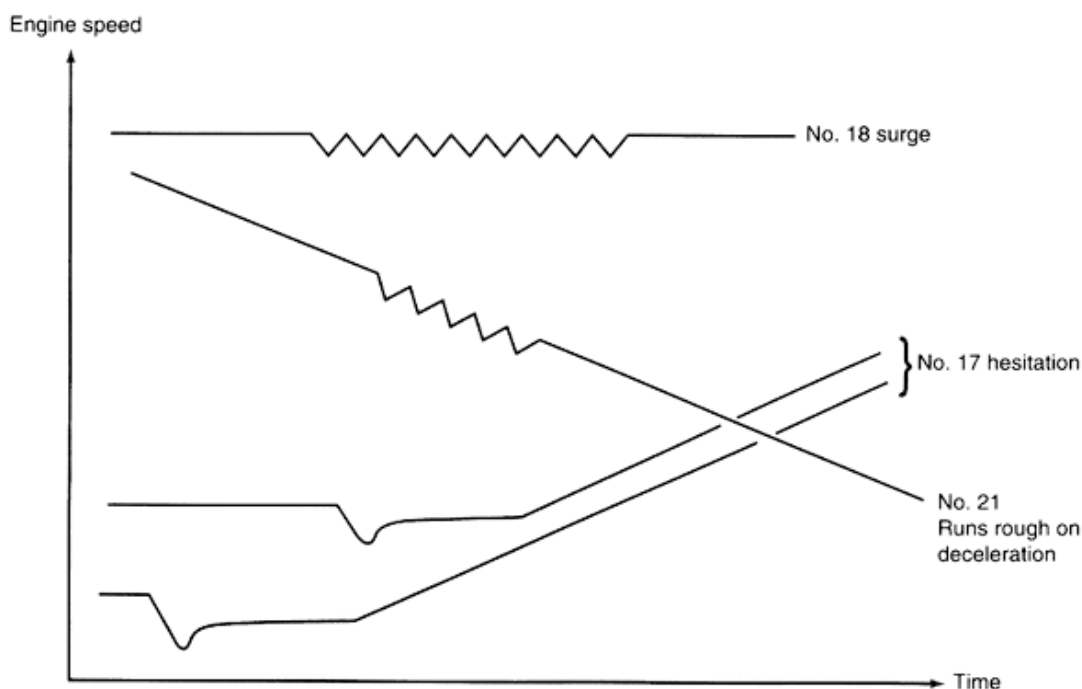
Surge : Continuous soft jerking during cruise.

Precautions for symptom diagnosis

Fuel system pressure release

WARNING

THE FUEL SYSTEM REMAINS UNDER PRESSURE WHEN THE ENGINE IS NOT RUNNING. RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING ANY FUEL LINE TO REDUCE THE CHANCE TO VEHICLE COMPONENTS. FUEL IS EXPLOSIVE. AN EMPTY FUEL TANK CAN STILL CONTAIN EXPLOSIVE GASES. SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY. REFER TO SECTION 22, FUEL SYSTEM FOR FUEL SYSTEM PRESSURE RELEASE PROCEDURE.



Symptom related diagnostic procedure

Symptom diagnosis chart

2	Cranks normally, but will not start (no combustion)
Description	· Cranks normally, but no combustion · Battery is OK · Throttle valve closed while cranking
(Troubleshooting hint) No fuel injection to engine because of fuel shortage or no ignition in all cylinders. 1. No spark · Ignition control malfunction · Malfunction of ignition system component 2. No fuel injection · Malfunction of fuel pump · Malfunction of injector	

3. Low fuel line pressure

4. Low engine compression pressure

Step	Check		Action
1	Check strong blue spark at each spark plug cord disconnected. Is blue spark present?	Yes	Go to step 5.
		No	Go to next step.
2	Check that malfunction indicator light is illuminated while ignition switch is ON. Does MIL stay on after engine start-up?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with diagnostic trouble codes, page 21-18.
		No	Go to next step
3	Check ignition system. Check resistance of DLI coils. Primary : Approx. 0.45~0.55Ω Secondary : 13 -15Ω Check wiring harness between ECM and DLI coil. Is resistance within specification?	Yes	Go to next step.
		No	Replace ignition coils or repair wiring harness.
4	Check high tension cords. Resistance : 16kΩ/m Check for damage to spark plug wires. Are spark plug wires OK?	Yes	Go to next step.
		No	Replace spark plug wires.
5	Connect data link connector terminals fuel pump and B+ with a jumper wire and check operational sound of fuel pump. Does fuel pump operate?	Yes	Check that engine starts on this condition. - Check fuel pump relay or wiring harness if engine starts. - Go to step 7 if engine does not start.
		No	Go to next step.
6	Check that battery voltage is applied on RED/BLK wire of fuel pump connector when ignition switch is ON.	Yes	Check continuity of fuel pump (between PNK/BLK and BLK).
		No	Repair the related wiring harness.
7	Crank engine and check operational sound of injector	Yes	Go to step 10.
		No	Go to next step.
8	Check that battery voltage is applied on injector connector when ignition switch is ON.	Yes	Go to next step.
		No	Check wire between main relay and injector.
9	Check that the resistance of injector is 14.5Ω.	Yes	Go to next step.
		No	Replace injector.
10	Connect the data link connector terminals FUEL PUMP and B+ with a jumper wire and check fuel line pressure while ignition switch is ON. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm ²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary. Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
11	Check engine compression pressure.	Yes	Go to next step.

	Engine compression pressure : 193 (1360 kPa, 13.6 kg/cm ²) at 300 rpm Is engine compression pressure within specification?	No	Check engine condition : - Wear of piston, piston rin and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head - Improper valve clearance - Valve stuck to guide
12	Check condition of all spark plugs. Spark plug gap : 0.027~0.031 in (0.7~0.8mm) Check for excessive carbon deposit and correct contact with spark plug wires. Are spark plugs OK?	Yes	Go to next stpe.
		No	Clean or replace.
13	Check crankshaft position sensor. Is crankshaft position sensor OK?	Yes	Go to next step.
		No	Check crankshaft position sensor and related wire harness.
14	Replace ECM and check for proper operation.		

3	Crank normally, but will not start (partial combustion)-When engine is cold		
Description	· Crank normally, but partial, not continuous, combustion occurs · Battery is OK · Fuel present in tank		
(Troubleshooting hint)			
1. Overrich air/fuel ratio · Clogged air cleaner element · Malfunction of mass air flow sensor			
2. Overlean air/fuel ratio · Incorrect fuel injection control (correction for engine coolant temperature) · Low fuel line pressure · Air leakage at intake system			
3. Low engine compression pressure			
Step	Check		Action
1	Check that malfunction indicator light is illuminated. While ignition switch is OK? Does the MIL remain on after engine start-up?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with OBD-II Diagnostic Trouble Codes, page21-18.
		No	Go to next step.
2	Disconnect spark plug. Crank engine and check for spark at plug wire terminal. Is spark OK?	Yes	Go to next step.
		No	Replace ignition coil or repair wiring harness
		No	Replace ignition coils or repair wiring harness.
3	Connect the data link connector terminals FUEL PUMP and B+ with a jumper wire and check fuel line pressure while ignition switch is ON. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.

4	Does injector operate while cranking engine?	Yes	Go to next step.
		No	Check that battery voltage is applied on injector connector and check wire between main relay and injector.
5	Check resistance of injector. Resistance : 14.5Ω Is resistance within specification?	Yes	Go to next step.
		No	Replace injector.
6	Check condition of IAC valve. Check for open circuit between IAC valve and ECM Check battery voltage is applied to Red/WHT wire of IAC valve Check ISC valve hose connection Is IAC valve OK?	Yes	Go to next step.
		No	Open circuit or incorrect voltage : - Repair wiring harness - Replace IAC valve
7	Check terminal voltage of mass air flow sensor, throttle position sensor, ignition coils, engine coolant temperature sensor. Are sensors functioning properly?	Yes	Go to next step.
		No	Repair as necessary.
8	Check MAF sensor and related. Is MAF sensor OK?	Yes	Go to next step.
		No	Replace MAF sensor.
9	Check that engine starts when engine coolant temperature sensor connector is disconnected. Does engine start?	Yes	Check engine coolant temperature sensor - If normal : check wiring harness between engine coolant temperature sensor and ECM - If not normal : replace engine coolant temperature sensor.
		No	Go to next step.
10	Check air leakage at intake system components.	Yes	Repair or replace.
		No	Go to next step.
11	Check engine compression pressure. Engine compression pressure : 193 psi (1360kPa, 13.6 kg/cm²) at 300 rpm Is engine compression pressure within specification?	Yes	Go to next step.
		No	Check engine condition. - Wear of piston, piston ring and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head- Improper valve clearance - Valve stuck to guide
12	Check condition of spark plug. · Spark plug gap : 0.027~0.031 in (0.7~0.8mm) · Excessive carbon deposit · Contact with high tension cord Are spark plugs OK?	Yes	Go to next step.
		No	Clean or replace.
13	Replace ECM and check for proper operation.		

4	Cranks, normally, but won't start (partial combustion) - After engine is warmed up
Description	· After engine is left hot after running, cranking speed is OK · Battery is OK · Engine starts normally when engine is cold
(Troubleshooting hint) 1. Overrich air/fuel ratio · Correction for coolant temperature · Fuel leakage at injector 2. Vapor lock occurs · Fuel pressure is not kept when engine stops	

Step	Check		Action
1	Warm up engine to normal operating temperature and stop engine. Connect the data link connector terminals FUEL PUMP and B+ with a jumper wire for 3 minutes while ignition switch is ON. Then check that engine starts. B+ with a jumper wire for 3 minutes while ignition switch is ON. Then check that engine starts. Does engine start?	Yes	Replace fuel with another brand.
		No	Go to step 2.
2	Connect the data link connector terminals FUEL PUMP and B+ with a jumper wire and check fuel line pressure while ignition switch is ON. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm ²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary. Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
3	Plug fuel pressure regulator outlet and check that fuel pressure is kept while ignition switch is OFF Fuel line pressure : 25 psi (180 kPa, 1.8 kg/cm ²) for 15 minutes Is fuel line pressure retention within specification?	Yes	Replace fuel pressure regulator.
		No	Check fuel pump pressure is kept. - If normal : check fuel leakage from injector - If not normal : replace fuel delivery module
4	Check that engine starts when engine coolant temperature sensor connector is disconnected. Does engine start?	Yes	Check engine coolant temperature sensor. - If normal : check wiring harness between engine coolant temperature sensor and ECM - If not normal : replace engine coolant temperature sensor
		No	Go to next step.
5	Check that malfunction indicator light is illuminated. Is MIL illuminated?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with diagnostic trouble codes, page 21-18.
		No	Go to next step.
6	Check terminal voltage of mass air flow sensor, throttle position sensor, ignition coils, engine coolant temperature sensor. Are sensor terminal voltages correct?	Yes	Go to next step.
		No	Check for causes.
7	Temporarily install a known good ECM and check for proper operation.		

5	Cranks normally, but hard to start - Always
Description	· Cranks normally, but cranking time up to starting is excessively long · Battery is OK · Engine is normal while engine is idling (Refer to "Rough Idling" if not in good idling condition)
(Troubleshooting hint) 1. Overrich air/fuel ratio · Incorrect fuel injection control (correction for engine coolant temperature_)	

- Low fuel line pressure
 - Air leakage at intake system
2. Overrich air/fuel ratio
- Clogged air cleaner element
 - Malfunction of manifold absolute pressure sensor
3. Spark plugs not in good condition

Step	Check		Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated for more than 3 seconds after ignition is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with diagnostic trouble codes, page 21-18.
		No	Go to next step.
2	Check vacuum in intake manifold while engine is idling. Vacuum : more than 18.9 in.Hg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check air leakage at intake system.
3	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Check air leakage at intake system.
4	Check if engine starts easily when throttle valve is held quarter open. Does engine start easily?	Yes	Check carbon deposit on throttle valve and go to step 6.
		No	Go to next step.
5	Check that fuel line pressure while engine is idling. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm ²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary
			Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
6	Check condition of IAC valve. Check for open circuit between IAC valve & ECM. Measure Battery voltage is applied to B/W wire. Check IAC valve hose connection. Is IAC valve OK?	Yes	Go to next step.
		No	Check for causes.
7	Connect data link connector terminals fuel pump and B+ with a jumper wire and check than engine starts. Does engine start?	Yes	Check fuel pump relay. - If normal, repair or replace wiring harness. - If not normal, replace relay.
		No	Go to next step.
8	Check for contamination of sensor inside mass air flow sensor. Is MAF sensor contaminated?	Yes	Clean or replace.
		No	Go to next step.
9	Check engine compression pressure. Engine compression pressure : 193 psi (1360 kPa, 13.6 kg/cm ²) at 300 rpm Is engine compression pressure within specification?	Yes	Go to next step.
		No	Check engine condition. - Wear of piston, piston ring and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head - Improper valve clearance - Valve stuck to guide

10	Check spark plug condition. Spark plug gap : 0.027~0.031 in (0.7~0.8mm) Check for excessive carbon deposit and correct contact with spark plug wires. Are spark plugs OK?	Yes	Go to next step.
		No	Clean or replace.
11	Replace ECM and check for proper operation.		

6	Crank normally, but hard to start - When engine is cold		
Description	· Cranks normally, but cranking time up to starting is excessively long · Battery is OK · Restart is normal after engine warmed up · Engine is normal while engine is idling (Refer to "Rough Idling" if not in good idling condition)		
(Troubleshooting hint)			
1. Overrich air/fuel ratio			
· Malfunction of manifold absolute pressure sensor			
· Contaminated air cleaner element			
2. Overlean air/fuel ratio			
· Malfunction of injection control (Correction for engine coolant temperature)			
Step	Check		Action
1	Check if malfunction indicator light is illuminated while ignition switc in ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes. page 21-18.
		No	Go to next step.
2	Check terminal voltage of mass air flow sensor, throttle position sensor, ignition coils, engine coolant temperature sensor. Are sensors OK?	Yes	Go to next step.
		No	Check for causes.
3	Check if engine starts easily when throttle valve is held one quarter open. Does engine start easily?	Yes	Check carbon deposit on throttle valve and go to step 6.
		No	Go to next step.
4	Check vacuum in intake manifold while engine is idling. Vacuum : more than 18.9 in.Hg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check air leakage at intake air system component.
5	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
6	Connect the data link connector terminals fuel pump and B+ with a jumper wire and check fuel line pressure while ignition switch is ON. Fuel line pressure : 40~51 psi (320~350 kPa, 3.2~3.5 kg/cm²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary Low pressure : Clamp return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
7	Replace ECM and check for proper operation. Is system operating correctly?	Yes	Road test and return vehicle to customer.
		No	Replace fuel with another brand.

7	Crank normally, but hard to start-After engine is warmed up		
Descirction	· After engine is left hot after running, cranks normally, but cranking time up to starting is excessively long · Battery is OK · Starts normally when engine is cold · Engine is normal while engine is idling (Refer to "Rough Idling" if not in good idling condition)		
(Troubleshooting hint)			
1. Overrichair/fuel ration			
· Malfunction of fuel ignition control			
· Fuel leakage from injector			
2. Vapor lock			
· Fuel leakage from injector			
Step	Check		Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page 21-18.
		No	Go to next step.
2	Check terminal voltage of manifold absolute pressure sensor, throttle position sensor, ignition coils and engine coolant temperature sensor. Are sensors OK?	Yes	Go to next step.
		No	Check for causes.
3	After engine idling and turn ignition switch OFF. Check that fuel line pressure is retained. Fuel line pressure : more than 25 psi (180 kPa, 1.8 kg/cm ²) for 5 minutes Is fuel line pressure retention within specification?	Yes	Go to next step.
		No	Plug outlet of fuel pressure regulator and turn ignition switch OFF. Then check that fuel line pressure is kept. - If normal : replace fuel pressure regulator - If not normal : check fuel pump pressure kept. If fuel pump is normal, check fuel leakage from injector.
4	Warm up engine to normal operating temperature and stop engine. Connect the data link connector terminals FUEL PUMP and B+ with a jumper wire for 3 minutes while ignition switch is ON. Then check that engine starts easily. Does engine start easily?	Yes	Replace fuel with another brand.
		No	Go to next step.
5	Replace ECM and check for proper operation operation. Is system operating correctly?	Yes	Road test and return vechcle to customer.
		No	Replace fuel with another brand.

8	Rough idling/Engine stops while idling - Always
Description	· Engine starts normally, but engine stops or vibrates while idling.
(Troubleshooting hint)	
1. Overrich air/fuel ratio	
· Air leakage	
· Malfunction of fuel injection control	
· Low fuel line pressure	
2. Clogging or malfunction of one or more injector	
3. Malfunction of manifold absolute pressure sensor	
4. Malfunction of IAC valve or related wiring	
5. Malfunction of spark plug	
6. Low engine compression pressure	

7. Malfunction of throttle position sensor or related wiring

Step	Check	Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Does the MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with diagnostic trouble codes, page 21-18.
		No Go to next step.
2	Check terminal voltage of mass air flow sensor, throttle position sensor, ignition coils, engine coolant temperature sensor. Are sensor OK?	Yes Go to next step.
		No Check for causes.
3	Check operating sound of injector while engine idling. Are injectors operating?	Yes Go to step 5.
		No Go to next step.
4	Check that approx. battery voltage is applied on injector connector while ignition switch is ON (approx. 12V). Is voltage within specification?	Yes Go to next step.
		No Check the wiring harness between ECM and injector.
5	Check the resistance of injector. Resistance : 14.5Ω Is resistance within specification?	Yes Go to next step.
		No Replace injector.
6	Ignition ON, throttle closed, measure voltage of throttle position sensor (0.3~0.7V). Is voltage within specification?	Yes Go to next step.
		No Replace throttle position sensor or repair wiring harness.
7	Check MAF sensor and related DTC. Is MAF sensor OK?	Yes Clean or replace.
		No Go to next step.
8	Check engine compression pressure. Engine compression pressure : 193 psi (1360 kPa, 13.6 kg/cm ²) - 300 rpm Is engine compression pressure within specification?	Yes Go to next step.
		No Check engine condition. - Wear of piston, piston ring and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head - Valve stuck to guide
9	Replace ECM and check for proper operation.	

9	Rough idling / Engine stops while engine is idling - Engine cold		
Description	· Engine speed is slow, engine stops or vibrates while warming up engine.		
(Troubleshooting hint)			
1. Insufficient intake air.			
· Malfunction of manifold absolute pressure sensor			
· Clogged air cleaner element			
· Malfunction of IAC valve			
2. Malfunction of fuel injection control.			
· Malfunction of fuel injection control devices			
(correction for engine coolant temperature)			
Step	Check		Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page 21-18.
		No	Go to next step.
2	Check air leakage at intake system and vacuum of dynamic chamber while engine is	Yes	Go to next step.

	idling. Vacuum : 18.9 in.Hg (480 mmHg) at idle Is intake manifold vacuum within specification?	No	Check air leakage at intake system.
3	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
4	Check terminal voltage of mass air flow sensor, throttle position sensor, ignition coils, engine coolant temperature sensor. Are sensors OK?	Yes	Go to next step.
		No	Check for causes.
5	Check resistance of engine coolant temperature sensor. · At -4°F(-20°C) : 14.6 to 17.8 kΩ · At 68°F(20°C) : 2.2 to 2.7 kΩ · At 176°F(80°C) : 0.29 to 0.35 kΩ Is resistance within specification?	Yes	Go to next step.
		No	Road test and return vehicle to customer.
6	Replace ECM and check for proper operation. Is system operating correctly?	Yes	Road test and return vehicle to customer.
		No	Replace fuel with another brand.

10	Rough idling/Engine stops while engine is idling - After engine is warmed up		
Description	· Engine operation is normal while warming up engine, but engine stops or vibrates after warming up.		
(Troubleshooting hint)			
1. Malfunction of IAC valve			
2. Overlean air/fuel ratio			
· Air leakage			
· Low fuel line pressure			
3. Malfunction of ignition system			
4. Overrich air/fuel ratio			
· Malfunction of fuel injection control			
(correction for coolant temperature)			
5. Low engine compression pressure			
Step	Check		Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page 21-18.
		No	Go to next step.
2	Check terminal voltage of mass air flow sensor, throttle position sensor, ignition coils, engine coolant temperature sensor. Are sensors OK?	Yes	Go to next step.
		No	Check for causes.
3	Check vacuum of intake manifold. Vacuum : more than 18.9 in.Hg (480 mmHg) at idle	Yes	Go to next step.
		No	Check for air leakage at intake system component.
4	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner.
5	Check fuel line pressure while engine is idling. Fuel line pressure : 46~51 pai (320~350 kPa, 3.2~3.5 kg/cm²) Is fuel line pressure within specificaliton?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary.

			Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
6	Disconnect engine coolant temperature sensor connector and check that engine condition improves. Does engine condition improve?	Yes	Replace the engine coolant temperature sensor.
		No	Go to next step.
7	Check operating sound of injector while engine is idling. Are injectors operating?	Yes	Go to step 10.
		No	Go to next step.
8	Check resistance of injector Resistance : 14.5Ω Is resistance within specification?	Yes	Go step 10.
		No	Replace injector.
9	Check engine compression pressure. Engine compression pressure : 193psi (1360 kPa, 13.6 kg/cm ²) at 300 rpm Is engine compression pressure within specification?	Yes	Go to next step.
		No	Check the engine
10	Replace ECM and check for proper operation.		

11	Rough idling / Engine stops while engine is idling - When A/C is in operation		
Description	· Engine stops or vibrates excessively when A/C is operating. · Idling condition is normal when A/C is turned OFF.		
(Troubleshooting hint)			
1. Malfunction of ISC control system			
2. Malfunction of A/C operational switch			
Step	Check		Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
2	Check air conditioner cut relay is ON/OFF when air conditioner switch is ON/OFF. Are A/C cut relay, blower switch and A/C switch OK?	Yes	Go to next step.
		No	Malfunction of air conditioner switch or air conditioner cut relay.
3	Check for continuity between B01-64, B01-65 and B01-48 of ECM. Does continuity exist?	Yes	Go to next step.
		No	Repair wiring harness.
4	Replace ECM and check for proper operation		

12	Abnormal idling / Engine stops immediately after starting	
Description	· Starting is normal, but engine vibrates excessively or stops immediately after starting (when accelerating from idling condition) · Idling condition is normal on other conditions.	
(Troubleshooting hint) 1. Malfunction of ISC system 2. Air leakage at intake system 3. Malfunction of manifold absolute pressure sensor		

Step	Check		Action
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
2	Is mass air flow sensor OK? (Page 21-89)	Yes	Go to next step.
		No	Repair mass air flow sensor or related wiring harness.
3	Check that voltage of throttle position sensor terminal B18-C is 0.3~0.7V and does not vary. Is voltage within specification?	Yes	Go to next step.
		No	Replace throttle position sensor or wiring harness.
4	Check for air leakage at intake system and vacuum of dynamic chamber while engine is idling. Vacuum : more than 18.9 in.Hg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check intake system and dynamic chamber.
5	Replace ECM and check for proper operation.		

13	High idle speed after engine warmed up		
Description	· Excessively high idle speed after engine warmed up		
(Troubleshooting hint) Excessive intake air flow 1. Throttle valve not closed completely 2. Malfunction of idle speed control · ISC valve stuck · ISC valve connector disconnected · Incorrect input signal from coolant temperature sensor			
Step	Check		Remedy
1	Check that throttle valve is closed completely when accelerator pedal is released. Is throttle valve closed?	Yes	Go to next step.
		No	Check correct installation and free operation of throttle linkage. If not normal, clean or adjust linkage.
2	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
3	Disconnect engine coolant temperature sensor connector and check if engine condition improves. Does engine condition improves?	Yes	Replace engine coolant temperature sensor.
		No	Go to next step.
4	Plug PCV hose connected with dynamic chamber and check engine speed decrease. Does engine speed decrease?	Yes	Check or replace the PCV valve.
		No	Go to next step.
5	Check that voltage of throttle position sensor terminal is (Y/B wire) is 0.3~0.7V and does not vary.	Yes	Replace throttle position sensor or wiring harness.
		No	Go to next step.
6	Check ECM terminal voltage. · ISC valve control	Yes	Go to next step.

	· A/C switch input · Park/neutral input Are voltages correct?	No	Replace as necessary.
7	Replace ECM and check for proper operation.		

14	Variation of idle speed / Idle hunting		
Description	· Periodic engine speed increase and decrease while engine is idling		
(Troubleshooting hint)			
1. Malfunction of throttle position sensor system			
2. Air leakage			
3. Malfunction of IAC control system			
4. Fuel injection is irregular			
5. Malfunction of ignition system			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
2	Check that voltage of throttle position sensor terminal B18-C is 0.3~0.7V and does not vary. Is voltage within specification?	Yes	Go to next step.
		No	Replace throttle position sensor or wiring hranness.
3	Check air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
4	Disconnect high tension cord and check equal engine speed decrease in all cylinders.	Yes	Go to next step.
		No	Go to step 7.
5	Check ECM terminal voltage. · ISC valve control · A/C switch input · Park/neutral input Are voltages correct?	Yes	Go to next step.
		No	Check for causes.
6	Check mass air flow sensor(Refer to page 21-89). Is MAF sensor OK?	Yes	Go to step 12.
		No	Replace the mass air flow sensor.
7	Check operating sound of injector while engine is idling. Are injectors OK?	Yes	Go to step 9.
		No	Go to next step.
8	Check that approx. battery voltage is applied to injector connector terminals. Is voltage within specification?	Yes	Go to next step.
		No	Check the wiring harness between ECM and injector.
9	Check resistance of injector Resistance : 14.5Ω Is resistance within specification?	Yes	Go to next step.
		No	Replace injector.
10	Check spark plugs for proper operation. Are spark plugs OK?	Yes	Go to next step.
		No	Clean or replace.
11	Check engine compression pressure. Engine compression pressure : 193 psi (1360 kPa, 13.6 kg/cm²) at 300 rpm Is engine compression pressure within specification?	Yes	Go to next step.
		No	Check for cause.
12	Check for fuel leakage from injectors.	Yes	Replace the injector

	Do injectors leak?	No	Go to next step.
13	Replace ECM and check for proper operation.		

15	Engine stalls on deceleration		
Description	· Engine stops unexpectedly during or after deceleration · Idling condition is normal		
(Troubleshooting hint) Engine speed decreases abruptly when accelerator pedal is released, which can cause connectors to come loose. 1. Malfunction of idle air control 2. Malfunction of throttle position sensor system 3. Malfunction of fuel cut control			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with Diagnostic Trouble Codes, page21-18.
		No	Go to next step.
2	Check throttle position sensor, IAC valve terminal voltage and related wiring harness. Are sensors OK?	Yes	Go to next step.
		No	Repair the wiring harness or replace defective component.
3	Check ECM terminal voltages for B01-2, B01-29, B01-59, B01-73 and B01-73. Are voltages within specification?	Yes	Go to next step.
		No	Check for cause and repair as necessary.
4	Check contact condition of the following connectors : - Throttle position sensor, mass air flow sensor, ignition coils, injector, crankshaft position sensor, fuel pump relay, ECM. Are terminal connections OK?	Yes	Go to next step.
		No	Repair or replace.
5	Replace ECM and check for proper operation.		

16	Engine stalls suddenly (Intermittent), sudden engine stop		
Description	· Engine stops suddenly and intermittently · Engine is normal until engine stops		
(Troubleshooting hint)			
1. Malfunction of IAC control system			
2. Malfunction of throttle position sensor system			
3. Intermittently loosened contact of electrical wiring harness			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition swithc is ON. Is MIL illuminated longer than 3 seconds after is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
2	Check contact condition of the following connectors : - Throttle position sensor, mass air flow sensor, ignition coils, injector, crankshaft position sensor, fuel pump relay ECM. Are connections OK?	Yes	Go to next step.
		No	Repair or replace as necessary.
3	Measure crankshaft position sensor and mass	Yes	Go to next step.

	air flow sensor signals. Are sensor signals OK?	No	Repair or replace.
4	Check ECM terminal voltages for B01-2, B01-29, B01-59, B01-71 and B01-73. Are voltages OK?	Yes	Go to next step.
		No	Check for causes and repair as necessary.
5	Replace ECM and check for proper operation.		

17	Stumble / Hesistation on acceleration		
Description	· Vehicle seems to stop for a time immediately after pressing accelerator or rattles a little during acceleration		
(Troubleshooting hint)			
1. Lean air/fuel ration on acceleration			
·Low fuel line pressure			
·Air leakage			
·Malfunction of fuel injection control			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
2	Check vacuum in intake manifold while engine idling. Vacuum : more than 18.9 in.Hg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check air leakage at air intake system and repair.
3	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
4	Check mass air flow sensor. -Internal resistane, voltage, contamination of sensor element etc. Is MAF sensor OK.	Yes	Go to next step.
		No	Replace the mass air flow sensor.
5	Check engine coolant temperature sensor. Is ECT sensor OK?	Yes	Go to next step.
		No	Replace the engine coolant temperature sensor.
6	Check throttle position sensor and related DTC. Voltage between terminals : Idling condition : 0.4~0.6V Throttle valve full open : 4.1~4.3V Is TP sensor OK?	Yes	Go to next step.
		No	Replace throttle position sensor.
7	Disconnect injector connector one by one while engine is idling, and check equal engine speed decrease for each cylinder. Does engine speed decrease equally for all cylinders?	Yes	Go to next step.
		No	Check injector.Refer to fuel System, Section 22.
8	Check correct installation and free operation of throttle linkage. Is throttle linkage OK?	Yes	Go to next step.
		No	Adjust or replace joint or damaged linkage and adjust deflection of throttle cable.
9	Check fuel line pressure while engine is idling. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm²)	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank.

			If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary. Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
10	Check air passage and vacuum hose installation. Are vacuum hoses OK?	Yes	Go to next step.
		No	Repair as necessary.
11	Check exhaust system clogging. Is exhaust system clogged?	Yes	Repair or replace necessary.
		No	Go to next step.
12	Replace ECM and check for proper operation.		

18	Surging while cruising		
Description	· Repeated engine speed variation occurs at all times		
(Troubleshooting hint)			
1. Malfunction of throttle position sensor system			
2. Misfire			
3. Loose contact of wiring harness			
4. Lean air/fuel ratio			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page 21-18
		No	Go to next step.
2	Check vacuum in intake manifold while engine idling. Vacuum : more than 18.9 inHg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check air leakage at air intake system and repair.
3	Check throttle position sensor. Voltage between terminals : Idling condition : 0.4~0.6V Throttle valve full open : 4.1~4.3V Is TP sensor OK?	Yes	Go to next step.
		No	Replace throttle position sensor.
4	Disconnect front heated oxygen sensor connector and check for proper operation. Is front HO2S OK?	Yes	Go to next step.
		No	Replace front heated oxygen sensor.
5	Check that vehicle speed sensor signal input to ECM B01-42. Is correct. Is signal correct?	Yes	Go to next step.
		No	Replace the wiring harness or vehicle speed sensor.
6	Check ECM terminal voltages for B01-42, B01-59, and B01-71 and B01-73.. Are voltages OK?	Yes	Go to next step.
		No	Check for causes and repair.
7	Check correct installation and free operation of throttle linkage. Is throttle linkage OK?	Yes	Go to next step.
		No	Adjust or replace joint or damaged linkage and adjust deflection of throttle cable.
8	Check cleanness of air cleaner element.	Yes	Go to next step.

	Is air cleaner element OK?	No	Replace air cleaner element.
		Yes	Go to next step.
9	Check fuel line pressure while engine is idling. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm ²) Is fuel line pressure within specification?	No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary. Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
10	Check exhaust system clogging. Is exhaust system clogged?	Yes	Repair as necessary.
		No	Go to next step.
11	replace ECM and check for proper operation.		

19	Lack of power		
Description	· Lack of power at full throttle · Lower maximum vehicle speed · Idling speed is normal		
(Troubleshooting hint) 1. Insufficient intake air · Throttle valve does not open fully · Clogged intake air system 2. Lean air/fuel ratio · Fuel line pressure decrease. · Malfunction of fuel injection. 3. Malfunction of ignition 4. Low engine compression pressure			
Step	Check		Remedy
1	Check the following items. - Clutch slippage - Brake dragging - Lack of tire air pressure - Improper tire size Are these systems OK?	Yes	Go to next step.
		No	Repair as necessary.
2	Is throttle valve fully open when fully depressing accelerator pedal fully?	Yes	Go to step 5.
		No	Go to next step.
3	Check correct installation of throttle cable. Is throttle cable OK?	Yes	Go to next step.
		No	Repair or replace throttle cable.
4	Check correct operation of throttle body. Is throttle body OK?	Yes	Go to next step.
		No	Repair or replace throttle body.
5	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to Troubleshooting with OBD-II Diagnostic Trouble Codes, page21-18.
		No	Go to next step.

6	Check the camshaft position sensor and DTC related. Is CMP sensor OK?	Yes	Go to next step.
		No	Replace camshaft position sensor or repair related wire harness.
7	Check throttle position sensor and related DTC Voltage between terminals : Idling condition : 0.4~0.6V Throttle valve full open : 4.1~4.3V Is TP sensor OK?	Yes	Go to next step.
		No	Repair intake system or dynamic chamber.
8	Check vacuum in intake manifold while engine is idling. Vacuum : more than 18.9 in.Hg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check injector. Refer to fuel system,section 22.
9	Disconnect injector connector one by one while engine is idling, and check equal engine speed decrease for each cylinder. Does engine speed decrease equally for each cylinder?	Yes	Go to next step.
		No	Replace air cleaner element.
10	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
11	Keep engine idling and turn ignition switch OFF. Check that fuel line pressure is retained. Fuel line pressure : more than 25 (180 kPa, 1.8 kg/cm ²) for 5 minutes. Is fuel pressure retention within specification?	Yes	Go to next step.
		No	Plug outlet of pressure regulator and turn ignition switch OFF. Then check fuel line pressure is kept. - If normal : replace pressure regulator. - If not normal : check fuel pump pressure kept. If fuel pump is normal, check fuel leakage from injector.
12	Does fuel line pressure increase when accelerating abruptly? Fuel line pressure : 48 psi (330 kPa, 3.3 kg/cm ²)	Yes	Go to next step.
		No	Check fuel line and fuel filter clogging and repair if as necessary.
13	Check mass air flow sensor -Internal resistance, contamination of sensor element,etc. -Measure output voltage 0.9~1.1V when idling 5V when open fully Is MAF sensor OK?	Yes	Go to next step.
		No	Replace ignition coils or repair wiring harness.
14	Check ignition system. - Check resistance of DLI coil Primary : 0.45~0.55Ω Secondary : 13~15 kΩ - Check wiring harness between DLI coil and ECM Is ignition system OK?	Yes	Go to next step.
		No	Replace spark plug wires.
15	Check spark plug wires. Are spark plug wires OK?	Yes	Go to next step.
		No	Replace spark plug wires.
16	Check spark plug. Are spark plugs OK?	Yes	Go to next step.
		No	Clean or replace.
17	Check engine compression pressure.	Yes	Go to next step.

	Engine compression pressure : 193 psi (1360 kPa, 13.6 kg/cm ²) at 300 rpm Is engine compression pressure within specification?	No	Check engine condition. - Wear of piston, piston ring and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head - Improper valve clearance - Valve guide stuck
18	Replace ECM and check for proper operation. Is system operation correctly?	Yes	Road test and return vehicle to customer.
		No	Replace fuel with another brand.

20	Poor acceleration/Lack of power		
Description	· Lack of power on acceleration · Lack of power at full throttle · Lower maximum vehicle speed · Idling speed is normal		
(Troubleshooting hint)			
1. Factors except engine malfunction			
· Clutch slippage · Brake dragging · Lack of tire air pressure · Improper tire size · Overload			
2. Insufficient intake air			
· Throttle valve does not open fully · Intake system clogging			
3. Overlean air/fuel ratio			
4. Malfunction of ignition			
5. Low engine compression pressure			
Step	Check		Remedy
1	Check the following factors OK? - Clutch slippage - Brake dragging - Lack of tire air pressure - Improper tire size - Overload Are the items OK?	Yes	Go to next step.
		No	Repair as necessary.
2	Is throttle valve open full when fully depressing accelerator pedal fully?	Yes	Go to step 5.
		No	Go to next step.
3	Check correct installation of throttle cable. Is throttle cable OK?	Yes	Go to next step.
		No	Repair or adjust throttle cable.
4	Check correct operation of throttle body. Is throttle body OK?	Yes	Go to next step.
		No	Repair or replace throttle body
5	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
6	Check camshaft position sensor and connector. Is CMP sensor OK?	Yes	Go to next step.
		No	Replace camshaft position sensor or repair related wire harness.
7	Check throttle position sensor. Voltage between terminals :	Yes	Go to next step.

	Idling condition : 0.4~0.6V Throttle valve fully open:4.1~4.3V Is TP sensor OK?	No	Replace throttle position sensor.
8	Check vacuum in intake manifold while engine is idling. Vacuum : more than 18.9 inHg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check air leakage into intake system and repair as necessary..
9	Disconnect injector connector one by one while engine is idling, and check equal engine speed decrease for each cylinder?	Yes	Go to next step.
		No	Check injectors. Refer to fuel system, page 22-20.
10	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
11	Replace air cleaner element. Fuel line pressure : 46~51 psi (320~350 kPa, 3.2~3.5 kg/cm ²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary. Low pressure : Block return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary.
12	Does fuel line pressure increase when accelerating abruptly. Fuel line pressure : 48 psi (330 kPa, 3.3 kg/cm ²)	Yes	Go to next step.
		No	Check fuel line and fuel filter clogging and repair as necessary.
13	Check mass air flow sensor -Internal resistance, voltage, contamination of sensor element, ect. -Measure output voltage IDLE(800rpm):0.9~1.1V NO LOAD(3000 rpm): 1.8~2.0V Is MAF sensor OK?	Yes	Go to next step.
		No	Replace mass air flow sensor.
14	Check ignition system. -Check resistance of DLI coil Primary : 0.45~0.55Ω Secondary : 13~15 kΩ Check wiring harness between DLI coils and ECM. Is ignition system OK?	Yes	Go to next step.
		No	Replace ignition coils or repair wiring harness.
15	Check spark plug wires. Are spark plug wires OK?	Yes	Go to next step.
		No	Replace spark plug wires.
16	Check spark plug - Spark plug gap : 0.027~0.031 in (0.7~0.8mm) - Excessive carbon deposit - Contact with high tension cord Are spark plugs OK?	Yes	Go to next step.
		No	Clean or replace as necessary.
17	Check engine compression pressure.	Yes	Go to next step.

	Engine compression pressure : 193 psi (1360 kPa, 13.6 kg/cm ²) at 300 rpm Is engine compression pressure within specification?	No	Check engine condition. - Wear of piston, piston ring and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head - Improper valve clearance - Valve guide stuck
18	Replace ECM and check for proper operation. Is system operating correctly?	Yes	Road test and return vehicle to customer.
		No	Replace fuel with another brand.

21	Rough engine runnin on deceleration / Backfire		
Description	· Rough engine running on deceleration and backfire · Transmission is normal		
(Troubleshooting hint)			
1. Overrich air/fuel ratio			
· Air cleaner element clogged			
· Malfunction of fuel injection system(fuel cut control)			
· Fuel leakage from injector			
· Malfunction of throttle position sensor			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated, Check for causes. Refer to Troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
2	Check vacuum in intake manifold while engine is idling. Vacuum : more than 18.9 mmHg (480 mmHg) Is intake manifold vacuum within specification?	Yes	Go to next step.
		No	Check air leakafe into air intake system.
3	Check cleanness of air cleaner element. Is air cleaner element OK?	Yes	Go to next step.
		No	Replace air cleaner element.
4	Check ECM terminal voltages for B01-14, B01-41, B01-59, B01-71 and B01-73. Are terminal voltages OK?	Yes	Go to next step.
		No	Check for cause and repair as necessary.
5	Check fuel injection system.(Section 22) Is fuel injection system OK?	Yes	Go to next step.
		No	Check injection system as necessary.
6	Check mass air flow sensor. -Internal resistance, voltage, contamination of sensor element, etc. -Measure output voltage · IDLE(800rpm):0.9~1.1V · NO LOAD(3000rpm): 1.8~2.0V Is MAF sensor OK?	Yes	Go to next step.
		No	Replace throttle position sensor.
7	Check throttle position sensor. - Voltage between terminals · When idling : 0.3~0.7V · When opening throttle valve fully : 4.1~4.3V - Check that idling voltage returns to specified value when releasing after pulling accelerator cable. Is TP sensor OK?	Yes	Go to next step.
		No	Replace throttle position sensor.
8	Check throttle body contamination. Is throttle body contaminated?	Yes	Clean or replace as necessary.
		No	Go to next step.

9	Check fuel leakage from injector. Do fuel injectors leak?	Yes	Clean or replace as necessary.
		No	Go to step 10.
10	Replace ECM and check for proper operation.		

22	Knocking		
Description	· Abnormal combustion occurs, accompanied by audible "pinging" noise		
(Troubleshooting hint)			
1. Improper ignition timing			
2. Carbon deposit in cylinder			
3. Engine Overheat			
4. Overlean air/fuel ratio			
· Incorrect fuel injection			
· Fuel line pressure decrease on acceleration			
Step	Check		Remedy
1	Check that malfunction indicator light is illuminated while ignition switch is ON. Is MIL illuminated longer than 3 seconds after ignition switch is turned ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble code,page 21-18.
		No	Go to next step.
2	Is throttle valve open fully when depressing accelerator pedal fully?	Yes	Go to step 5.
		No	Go to next step.
3	Check correct installation of throttle cable. Is throttle cable OK?	Yes	Go to next step.
		No	Repair or replace throttle cable.
4	Check correct installation of throttle body. Is throttle body OK?	Yes	Go to next step.
		No	Repair or replace throttle body.
5	Check engine compression pressure Engine compression pressure : 193 psi (1360 kPa, 13.6 kg/cm²) at 300rpm Is engine compression pressure within specification?	Yes	Go to next step.
		No	Check engine condition. - Wear of piston, piston ring and cylinder wall - Defect of cylinder head gasket - Deformation of cylinder head - Improper valve clearance - Valve stuck to guide
6	Check camshaft position sensor. Is CMP sensor OK?	Yes	Go to next step.
		No	Replace camshaft position sensor or repair related wire harness.
7	Check fuel line pressure while engine is idling. Fuel line pressure : 46~51 psi (320~350 kPa, 3.3~3.5 kg/cm²) Is fuel line pressure within specification?	Yes	Go to next step.
		No	High pressure : Disconnect return line from filter side. Blow through line towards tank. If line is clear, try with new pressure regulator. If line is blocked, check for blockage in return line and clean or replace as necessary. Low pressure : Clamp return line and check if pressure rises. If pressure rises, replace pressure regulator. If pressure does not rise, check fuel filter at fuel delivery module. If it is OK, measure fuel pump max. Pressure and replace as necessary
8	Check cooling system.	Yes	Go to next step.

	Is cooling system OK?	No	Repair or replace.
9	Replace ECM and check for proper operation. Is system operating correctly?	Yes	Road test and return vehicle to customer.
		No	Replace fuel with another brand.

23	Fuel odor		
Description	Fuel odor in passenger compartment		
(Troubleshooting hint)			
1. Loose connection of fuel system of evaporative gas control system			
2. Malfunction of evaporative gas control system			
Step	Check		Remedy
1	Check damage or leakage of fuel system or evaporative gas control system. Is systems leaking or damaged?	Yes	Repair or replace as necessary.
		No	Go to next step.
2	Check that malfunction indicator light is illuminated while ignition system is ON. Is MIL illuminated longer than 3 seconds after ignition switch ON?	Yes	Malfunction indicator light is illuminated. Check for causes. Refer to troubleshooting with diagnostic trouble codes, page21-18.
		No	Go to next step.
3	Warm up engine fully. After disconnecting vacuum hose from evaporative emissions canister to purge solenoid valve, check vacuum is applied to it. Is vacuum applied?	Yes	Go to step 6.
		No	Go to next step.
4	Check operational sound of EVAP canister purge solenoid valve is normal. Is EVAP canister purge valve OK?	Yes	Check vacuum hose clogging.
		No	Go to next step.
5	Check vacuum is applied to vacuum hose after applying battery voltage to EVAP canister purge solenoid valve. Is vacuum applied?	Yes	Check ECM terminal voltage.
		No	Replace EVAP canister purge valve.
6	Replace ECM and check for proper operation.		

24	High oil consumption		
Description	· High oil consumption		
(Troubleshooting hint)			
1. Malfunction of PCV valve			
2. Malfunction of engine (oil leakage)			
Step	Check		Remedy
1	Check damage, removal, clogging or sticking of PCV hose, nipples of ventilation hose fittings. Is PCV system OK?	Yes	Go to next step.
		No	Repair or replace as necessary.
2	Check that there is air pressure or oil in ventilation hose. Is ventilation hose OK?	Yes	Go to next step.
		No	Check engine condition - Oil leakage -Wear of valve seal -Wear of valve stem -Wear of valve guide
3	Check vacuum is applied on PCV valve while engine is idling.	Yes	Check engine condition. -Wear of piston ring groove

	Is vacuum applied?		-Malfunction of piston ring -Wear of piston or cylinder
		No	Replace the PCV valve.

25	MIL light ON continuously		
Description	· Hi-scan does not display diagnostic trouble code, but MIL on continuously		
(Troubleshooting hint)			
1. Short circuit of wiring harness			
2. Malfunction of ECM			
Step	Check		Remedy
1	Disconnct wire (WHT/RED) from ECM and check that MIL remains illuminated. Is MIL illuminated?	Yes	Replace ECM
		No	Check short circuit from meter set to ECM.

26	MIL does not light		
Description	· Kia power scan dispays malfunction code, but MIL does not illuminate		
(Troubleshooting hint)			
① Blub is blown			
② Open circuit			
Step	Check		Remedy
1	Check MIL bulb is OK. Is bulb OK?	Yes	Go to next step.
		No	Replace bulb.
2	Ground ECM wire (WHT/RED) with a jumper wire and check that MIL illuminates. Does MIL illuminate?	Yes	Go to next step.
		No	Repair wiring harness from ECM to meter set.
3	Check ECM connections. Are ECM connections OK?	Yes	Replace ECM
		No	Repair or replace ECM connector.

27	Air conditioner does not operate		
Description	· Blower motor operates, but magnetic clutch not engaged		
(Troubleshooting hint)			
1. Short or open circuit of wiring harness			
2. Malfunction of air conditioner relay, air conditioner switch, magnetic switch			
3. Malfunction of ECM			
Step	Check		Remedy
1	Check voltage of ECM terminal B01-64. Is voltage OK?	Yes	Go to next step.
		No	Check for causes.
2	Check voltage of ECM terminal B01-65. Is voltage OK?	Yes	Check air condition system.
		No	Replace ECM



Fuel System

Fuel Delivery System - Fuel Tank

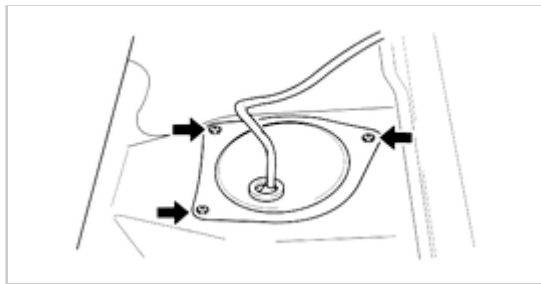


Removal

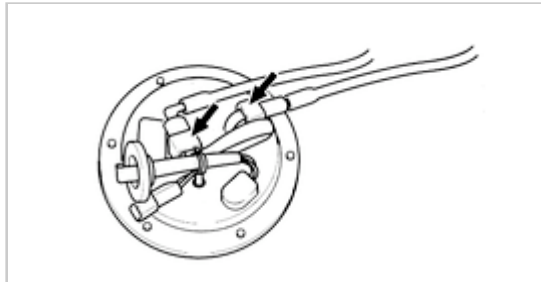
WARNING

FUEL IS EXPLOSIVE. AN EMPTY FUEL TANK CAN STILL CONTAIN EXPLOSIVE GASES. SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE AND KEEP SPARKS AND OPEN FLAMES AWAY. PURGE FUMES FROM THE TANK AS SOON AS POSSIBLE. DRAIN THE FUEL FROM THE FUEL TANK BEFORE REMOVING THE TANK.

1. Release fuel system pressure. Refer to "Releasing fuel system pressure" page 2-4.
2. Disconnect negative battery cable.
3. Remove rear seat cushion.
4. Disconnect fuel delivery module connectors.
5. Remove three screws attaching access cover.



6. Remove rubber grommet and wires from access cover.



7. Remove access cover.
8. Remove two fuel hose quick connectors from fuel delivery module.
9. Raise vehicle.
10. Position a lifting device below center of fuel tank.
11. Disconnect two fuel hose quick connector attached to fuel filter.
12. Disconnect fuel vapor hose attached to two way check valve.
13. Loosen one joint hose clamp attached to fuel tank.
14. Disconnect joint hose from fuel tank.
15. Disconnect bolts attaching insulator and insulator.
16. Remove two bolts attaching fuel tank straps and remove fuel tank straps.

CAUTION

Cover the open ports on the fuel tank with plastic caps or other available covers to avoid fuel vapor contaminating the work area.

17. Remove fuel tank from vehicle.

Installation

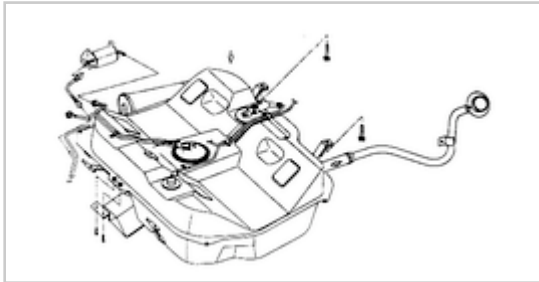
WARNING

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1. Raise vehicle
2. Remove protective caps from fuel tank ports.
3. Place fuel tank on lifting device and carefully raise fuel tank assembly into correct position.
4. Reconnect joint hose to fuel tank and tighten clamp.
5. Reconnect two fuel hoses to fuel tank.

NOTICE

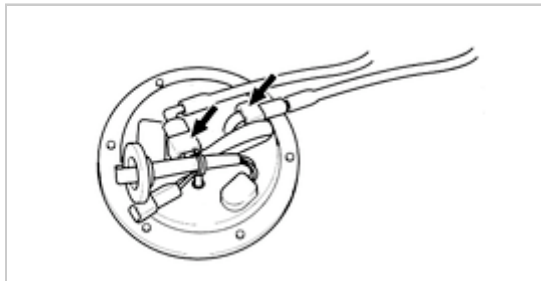
Push evaporative hose onto fuel tank fitting at least 1.0inch (25mm). Push fuel filler hoses onto fuel tank and filler pipes at least 1.4 in (35mm).



6. Install fuel tank straps.
7. Install and tighten two bolts for fuel tank straps.

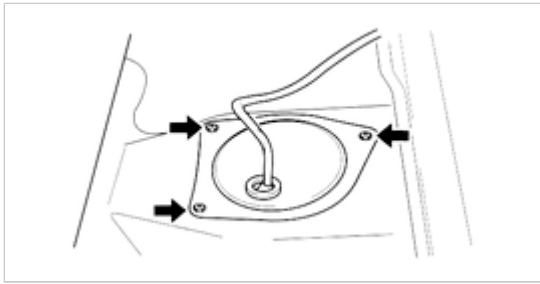
Tightening torque: 32~44 lb-ft (43~61 N·m, 4.4~6.2 kg-cm)

8. Install insulator and tighten bolts.
9. Lower vehicle.
10. Reconnect two fuel hoses to fuel delivery module.
11. Install rubber grommet and wires onto access cove.

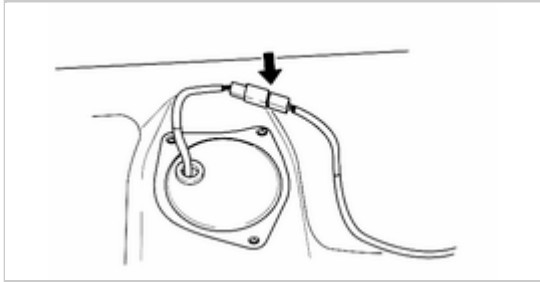


12. Install access cover and tighten three screws.

Tightening torque: 7.7~12.2 lb-ft (10.8~16.7 N·m, 1.1~1.9 kg-cm)



13. Reconnect connector to fuel delivery module.



14. Position wires correctly and secure to floor with tape

15. Reinstall rear seat cushion.

16. Reconnect negative battery cable.



Fuel System

Fuel Delivery System - Fuel Pump



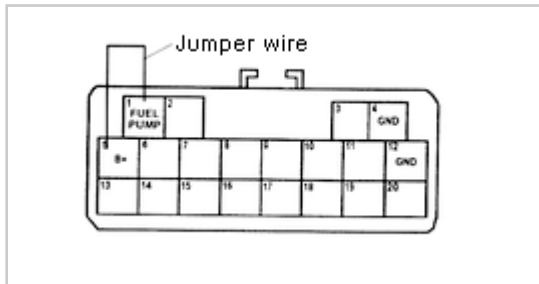
Fuel pump inspection

WARNING

THE FUEL SYSTEM REMAINS UNDER PRESSURE WHEN THE ENGINE IS NOT RUNNING. RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING ANY FUEL LINE TO REDUCE THE CHANCE OF PERSONAL INJURY OR FIRE DAMAGE TO VEHICLE COMPONENTS.

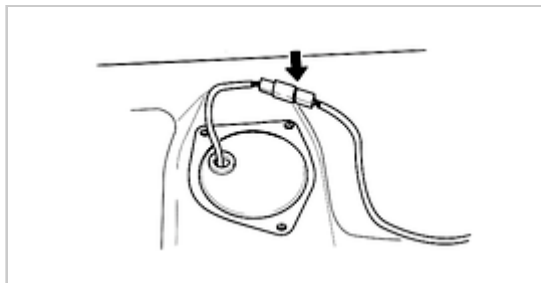
Fuel pump operation

1. Connect data link connector terminals FUEL PUMP and B+ with jumper wire.



2. Remove fuel filler cap.
3. Turn ignition switch "ON".
4. Determine if fuel pump is running by listening for sound of it at fuel filler inlet.
5. Install fuel filler cap.
6. If no sound was heard, measure voltage between fuel pump connector wire (PNK/BLK) to chassis ground.

Voltage : Approx. 12V

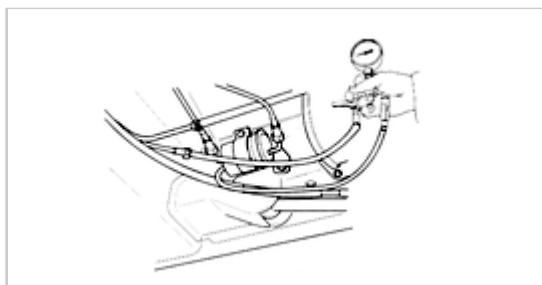


7. If voltage is not correct, check fuel pump relay and related wiring harness.
8. If you do not measure 12V, check for continuity between fuel pump connector terminal wires (PNK/BLK) and (BLK).
9. If there is continuity, replace fuel delivery module.
10. If there is no continuity, repair ground circuit.

Fuel pump maximum pressure

Perform pump operation inspection if regulated pressure is not as specified.

1. Disconnect negative battery terminal
2. Release fuel system pressure. Refer to "Releasing fuel system pressure".
3. Raise a vehicle.
4. Connect SST(0K2A1 131 AA1) to fuel filter and close the valve in line to fuel filter as shown.

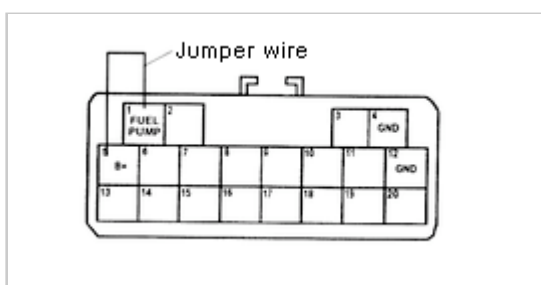


5. Connect negative battery terminal.

WARNING

THE FUEL SYSTEM REMAINS UNDER PRESSURE WHEN THE ENGINE IS NOT RUNNING. RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING ANY FUEL LINE TO REDUCE THE CHANCE OF PERSONAL INJURY OR FIRE DAMAGE TO VEHICLE COMPONENTS.

6. Connect data link connect terminals FUEL PUMP and B+ with jumper wire.



7. Turn ignition switch ON.
8. Measure fuel pump maximum pressure.

Fuel pump maximum pressure : 65~94 psi(450~650 kPa, 4.5~6.5 kg-m)

9. If not within specification, replace fuel delivery module.

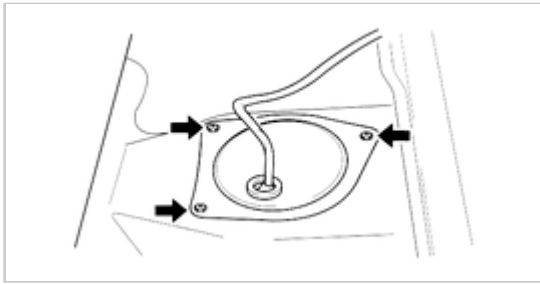
Removal

Fuel delivery module

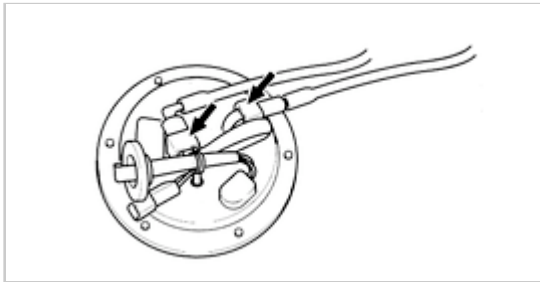
WARNING

FUEL IS EXPLOSIVE. AN EMPTY FUEL TANK CAN STILL CONTAIN EXPLOSIVE GASES. SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE AND KEEP SPARKS AND OPEN FLAMES AWAY. PURGE FUMES FROM THE HANG AS SOON AS POSSIBLE.

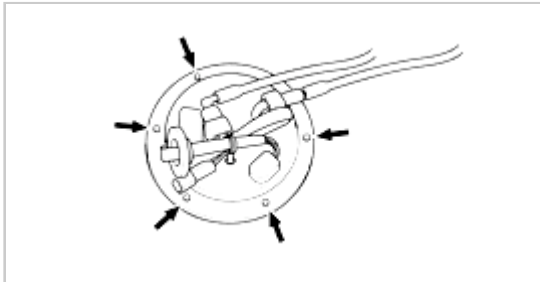
1. Release fuel system pressure. Refer to "Releasing fuel system pressure".
2. Disconnect negative battery cable.
3. Remove rear seat cushion.
4. Disconnect fuel delivery module connectors.
5. Remove three screws attaching access cover.



6. Remove rubber grommet and wires from access cover and remove access cover.
7. Disconnect to fuel hoses from to fuel delivery module.



8. Remove six screws attaching fuel delivery module and remove fuel delivery module from fuel tank.

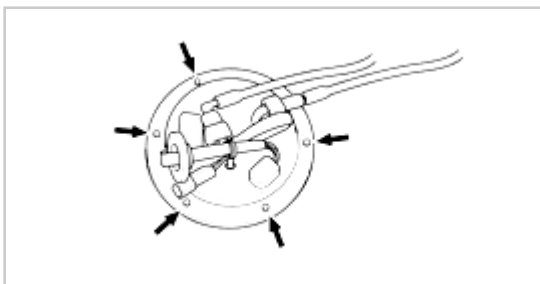


Installation

Fuel delivery module

1. Install fuel delivery module and tighten six screws.

Tightening torque : 7.7~12.2 lb-ft (10.8~16.7N·m, 1.1~1.7 kg-m)



2. Reconnect two fuel hoses to fuel delivery module.
3. Install rubber grommet and wire onto access cover.
4. Install access cover and tighten three screws for access cover.

Tightening torque : 7.7~12.2 lb-ft (10.8~16.7 N·m, 1.1~1.7 kg-m)

5. Reconnect one connectors to fuel delivery module.

6. Position wires and secure to floor with tape.
7. Install rear seat cushion.
8. Connect negative battery cable.



Fuel System

Fuel Delivery System - Fuel Filter

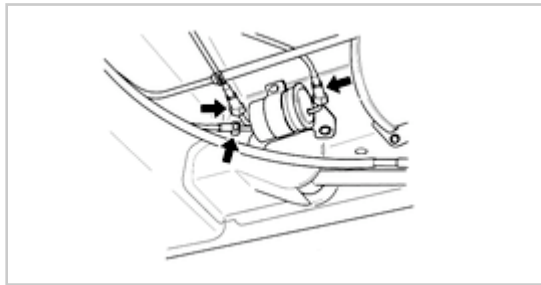


Removal

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

1. Depressurize fuel system. Refer to "Releasing fuel system pressure".
2. Disconnect fuel hoses from fuel filter.
3. Remove fuel filter and bracket.



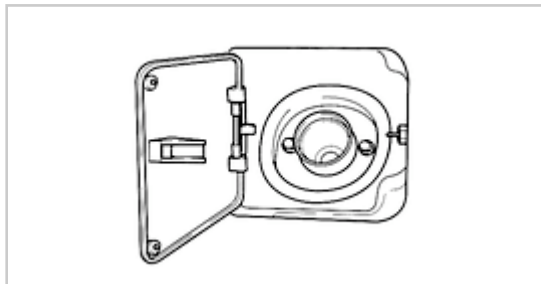
Removal

Fuel filler pipe assembly

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

1. Open fuel filler door.
2. Remove filler cap.
3. Remove two upper mounting screws from fuel filler pipe assembly.
4. Remove two bolts and two fasteners and remove splash shield from left rear wheel well.



5. Raise vehicle.
6. Remove two bolts from attaching fuel filler pipe assembly to vehicle sub-frame.
7. Loosen clamps and remove fuel filler pipe assembly from joint hose.

Installation

When installing fuel filter, push fuel hose fully onto fuel filter.

1. Install fuel filter and bracket.

Tightening torque : 9.5lb-ft(12.9N·m 1.3kg-cm)

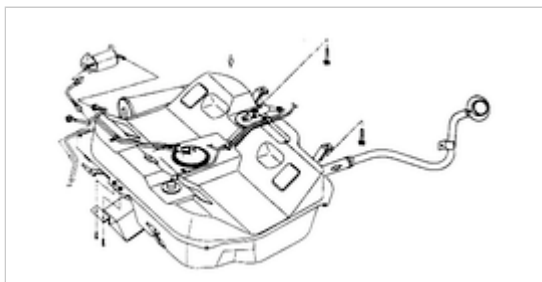
2. Connect fuel hoses.

Installation

Fuel filler pipe assembly

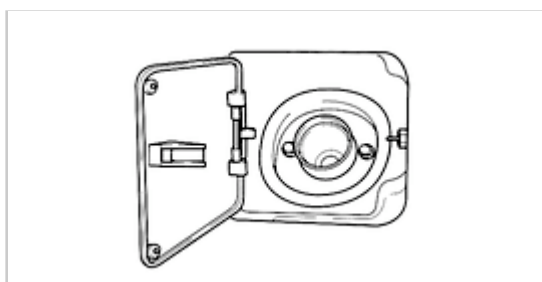
WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM PARTS, MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.



1. Raise vehicle.
2. Connect fuel filler pipe assembly to joint hose.
3. Install attaching bolts to bracket holding fuel filler pipe assembly to vehicle sub-frame.

Tightening torque.: 6.5~12.7 N·m,90~130 kg-cm)



4. Install splash shield and two bolt and two fasteners.

Tightening torque:7.7~12.2 lb-ft(10.8~16.7N·m, 1.1~1.7 kg-m)

5. Lower vehicle on hydraulic lift to ground level.
6. Install two upper mounting screws to fuel filler pipe assembly.

Tightening torque:1.8~2.5 lb-ft(2.5~3.5N·m, 25~36 kg-m)

7. Install filler cap.
8. Close the fuel filler door.



Fuel System

Fuel Delivery System - Injector



Check operation

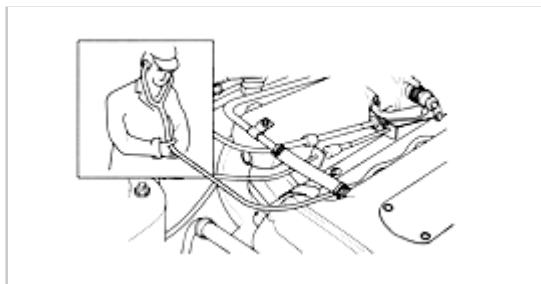
1. Warm up engine and let engine idle.
2. Listen for sound of each injector running by using sound scope or screwdriver.

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM, MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

CAUTION

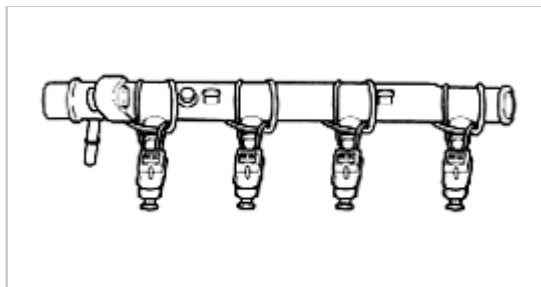
Make sure the fuel injectors are firmly seated on the fuel rail to prevent movement and possible damage.



3. If no sound is heard, measure injector resistance.
4. If injector is OK, check wiring to injector and voltages of ECM terminals 3, 32, 31, 4.
5. If removal of injector system is needed, refer to "On-Vehicle Service".

Fuel leakage test

1. Remove injectors together with fuel rail.
2. Secure injectors to fuel rail with wire.



3. Connect data link connector terminals FUEL PUMP and B+ with jumper wire.
4. Turn ignition switch ON.
5. Tilt injectors about 60 degrees and verify that no fuel leaks from the injector nozzles.
6. If fuel leaks, replace injector. Refer to "On-Vehicle Service".
7. Turn ignition switch "OFF" and remove jumper wire.

Volume test

1. Remove injectors together with fuel rail.
2. Secure injectors to distributor pipe with wire.

3. Reconnect injector connectors.
4. Connect jumper wire to injector ECM wires (BRN) and ground.
5. Turn ignition ON.
6. Turn injector volume with graduated container.

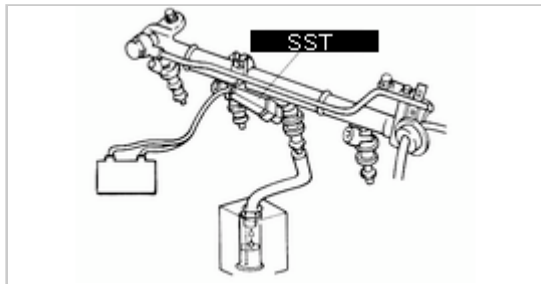
Injector volume: 130 cm³ (130 cc, 7.95 cu-in)/min

7. If not as specified, replace injectors. Refer to "On-Vehicle Service".

NOTICE

When reassembling fuel rail and injectors:

- Use new injector O-rings
- Apply a small amount of clean engine oil to each O-ring before installing

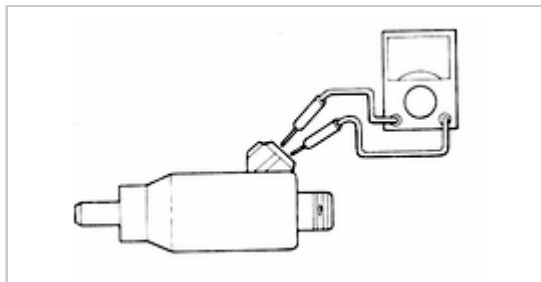


Injector resistance

1. Disconnect injector harness.
2. Measure resistance of each injector.

Resistance: 14.5 Ω at 68 °F (20°C)

3. If not within specification, replace injector. Refer to "On-Vehicle Service".



Removal

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM, MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

CAUTION

Make sure that fuel injectors are firmly seated into fuel rail to prevent movement and possible damage.

1. Depressurize fuel system. Refer to "Releasing Fuel System pressure" page 22-4.

2. Disconnect negative battery cable.
3. Disconnect four injector connectors.
4. Disconnect fuel line quick connector.
5. Remove accelerator cable bracket with bolts and one nut.
6. Disconnect accelerator cable.
7. Remove the two bolts attaching fuel rail to intake manifold.
8. Remove fuel rail assembly.
9. Remove four retaining clips attaching fuel injectors to fuel rail.
10. Remove fuel injectors.

Installation

1. Install injectors into fuel rail
2. Install four injector retaining clips.
3. Install and tighten fuel rail.
4. Reconnect accelerator cable.
5. Install and tighten accelerator cable bracket two bolts and one nut to dynamic chamber.
6. Reconnect fuel line quick connector.
7. Reconnect four injector connectors.
8. Reconnect negative battery cable.
9. Start vehicle and check for leaks.



Fuel System

Fuel Delivery System - Fuel Pressure Regulator

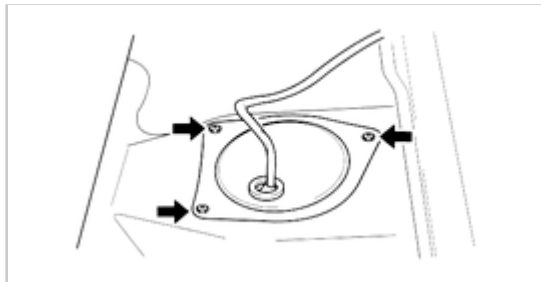


Removal

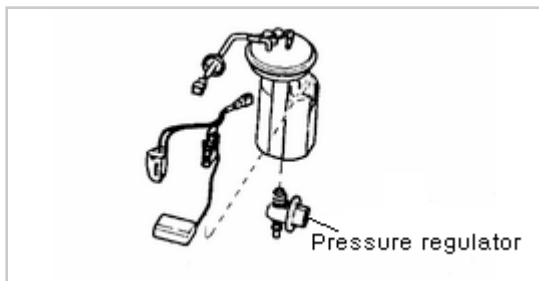
WARNING

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1. Disconnect negative battery cable.
2. Remove rear seat cushion.
3. Disconnect fuel delivery module connectors.
4. Remove three screws attaching access cover.



5. Remove rubber grommet and wires from access cover and remove access cover.
6. Disconnect two fuel hoses from fuel delivery module.
7. Remove six screws attaching fuel delivery module and remove fuel delivery module from fuel tank.
8. Remove fuel delivery module cover.
9. Remove pressure regulator from fuel pump.



Installation

1. Install pressure regulator to fuel pump.
2. Install fuel delivery module cover.
3. Install fuel delivery module and six screws.

Tightening torque : 7.7~12.2 lb-ft (10.8~16.7 N·m, 1.1~1.7 kg-m)

4. Reconnect two fuel hoses to fuel delivery module.
5. Install rubber grommet and wires onto access cover.
6. Install access cover and tighten three screws for access cover.

Tightening torque : 7.7~12.2 lb-ft (10.8~16.7 N·m, 1.1~1.7 kg-m)

7. Reconnect connector correctly to fuel delivery module.
8. Position wire and secure to floor with cushion tape.
9. Install rear seat cushion.
10. Reconnect negative battery cable.



Fuel System

Fuel Delivery System - Fuel Line



Removal

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

It may be necessary to remove other chassis brackets in order to gain access to fuel lines. If this is necessary, Refer to the appropriate sections for removal procedures.

1. Disconnect negative terminal from battery cable.
2. Loosen six retaining racket screws and remove two fuel lines from each bracket, one at a time, until two fuel line are free from brackets.
3. Loosen fittings at ends of fuel lines and carefully slide lines through undercarriage of vehicle chassis until they can be fully taken away from fixtures by taking off fastening clips.



Removal

Fuel rail

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM PARTS, MAKE WURE TO FUPPLY ADEQUATE VENTILATION TO THE WORK ATEA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

CAUTION

Make sure that fuel injectors are firmly seated into fuel rail to prevent movement and possible damage.

1. Depressurize fuel system. Refer to "Releasing fuel system pressure".
2. Disconnect negative battery cable.
3. Disconnect four injector connectors.
4. Disconnect fuel line quick connector from fuel rail.
5. Remove accelerator cable bracket two bolts and one nut
6. Disconnect accelerator cable.
7. Remove two bolts attaching fuel tail to intake manifold.
8. Remove two fuel rail assembly.
9. Remove four retaining clips attaching fuel injectors to fuel rail.
10. Remove two fuel injector insulators.
11. Remove fuel pulsation damper.

12. Clean mating surfaces.

Installation

WARNING

FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM, MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

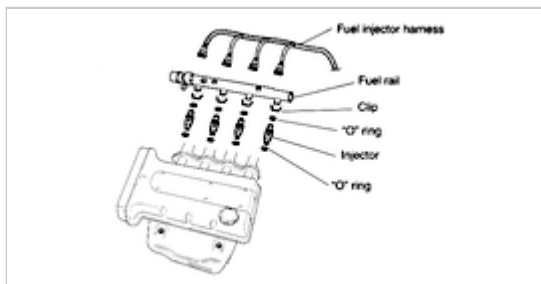
It may be necessary for transaxle assembly and other chassis brackets to be removed in order to reinstall fuel lines. If this is true, refer to appropriate sections for removal and reinstallation procedures.

1. Reinsert fuel lines carefully into each of six retaining brackets along undercarriage of vehicle chassis until all fuel lines have been properly positioned into place.
2. Tighten six bracket retaining screws.
3. Reconnect fuel lines/hoses.
4. Install clips to fasten fuel lines/hoses to fittings.
5. Connect negative terminal to battery cable.

Installation

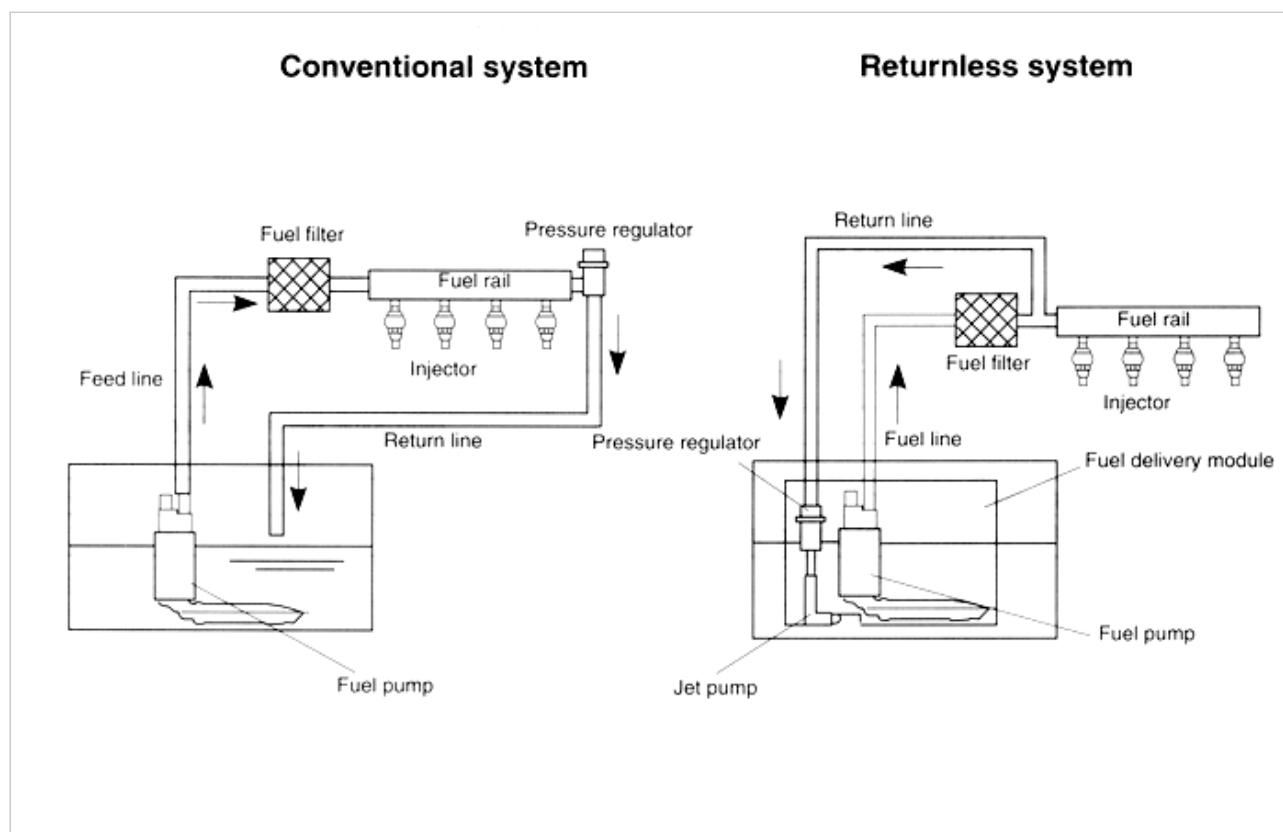
Fuel rail

1. Install and tighten pulsation damper.
2. Install two injector insulators.
3. Install injector into fuel rail and reinstall four retaining clips.
4. Install fuel tail and tighten two bolts.
5. Reconnect accelerator cable.
6. Install and tighten accelerator cable bracket two bolts and one nut do dynamic chamber.
7. Reconnect fuel line quick connector.
8. Reconnect four injector connectors.
9. Reconnect negative battery cable.
10. Start vehicle and check for leaks.





Description



Conventional

Today's most engines have more than 90% of the returning fuel to the tank in normal operational condition.

Temperature of the fuel being returned through the return line is raised by about 7~15°C as it absorbs cooling heat from underbody, fuel line, pipe friction, ect. in its course of travel.

The heated returning fuel continuously circulates and increases the temperature of the fuel in the fuel tank in the process. At the same time, the fuel subjected to a pressure of 2.5~3.0kg/cm² at the fuel line is placed under near atmospheric pressure as it passes through the pressure regulator.

In this occasion, a rapid evaporation of gasoline occurs being with its constituents having lower evaporation points, and the evaporated has is pushed toward the fuel tank.

The evaporated gas so generated is discharged to the atmosphere as it exceeds the storage limit of the vehicle.

Returnless system

In Returnless Fuel System, the returning line from distribution pipe to fuel tank has been removed, eliminating the possible evaporation of gasoline from return line heated by engine and dunk line heated by friction.

Moreover, by installing a pressure regulator in the fuel tank, the amount of gas evaporated as a result of pressure drop in return line of the pressure regulator is decreased by about 60-20% compared with conventional fuel system.

In addition, by installing a jet pump in Fuel Delivery Module, the fuel supplied to the module is smoothly provided to the fuel pump and helps maintain stable fuel delivery when fuel level is low.

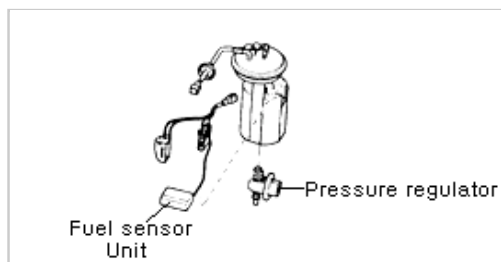
The system further prevents possible hunting when the vehicle runs at corner or along slopes, and reduces the amount of ineffective residual fuel.

Fuel delivery module

1. The fuel delivery module is installed in the fuel tank.

The fuel delivery module consist of following.

- A. Electric fuel pump
- B. Pressure regulator
- C. Fuel filter
- D. Fuel sender unit
- E. Fuel supply line connection



Electric fuel pump

The electric fuel pump is located in the fuel delivery module. It is mounted with and connected to the fuel sensor unit.

The fuel pump is an electric pump controlled by the engine control module (ECM) through the pump relay.

The motor rotates and impeller within the pump assembly. This causes fuel within the fuel tank to be drawn into the fuel inlet port. Fuel is pumped out to fuel injectors under pressure through the fuel feed pipes and hoses.

Fuel pressure is retained when the fuel pump is not running by means of a one-way check valve located within the pump.

Fuel pressure regulator and injector

The fuel pressure is regulated by a fuel pressure regulator.

The injectors are directly supplied with battery voltage through the main relay. Fuel is metered and injected into the intake ports according to the signals received from the ECM.

When these injection signals are applied to the solenoid coil of the injector, the needle valve is pulled off its seat.

Fuel is then injected into the intake port.

The amount of fuel supplied to the engine depends on the duration of time the injectors stay open.

Fuel sender assembly

The fuel sender system consists of a float, float arm, and a variable resistor. Fuel level is measured by the position of the float in the fuel tank, and is indicated by a gauge in the instrument panel cluster assembly. When the fuel level changes, the float position changes. The change in float position increases or decreases the resistance of the variable resistor. The change in resistance causes the position of the fuel gauge readout to change.

Fuel pipes and hoses

Fuel feed and return pipes (lines) and hoses carry fuel from the tank to the fuel rail. These pipes and hoses are attached to the underbody of the vehicle and must be inspected for kinks or dents which may restrict fuel flow.

Fuel vapor pipes and hoses carry fuel vapors from the fuel tank to the evaporative emissions canister located under the vehicle. The fuel vapors are stored in the canister when the engine is not running. When the engine is running at normal operating temperature, and the accelerator pedal is depressed, the engine control module (ECM) will command the evaporative emission solenoid purge valve to open and allow the stored fuel vapors to be purged into the intake manifold and be absorbed into the combustion process.

Fuel rail

The fuel rail supplies the necessary fuel to each individual fuel injector. It is mounted to the intake manifold.

The fuel pressure regulator is no longer mounted to the fuel rail. It is now located in the fuel tank on the fuel delivery module.

Service valve

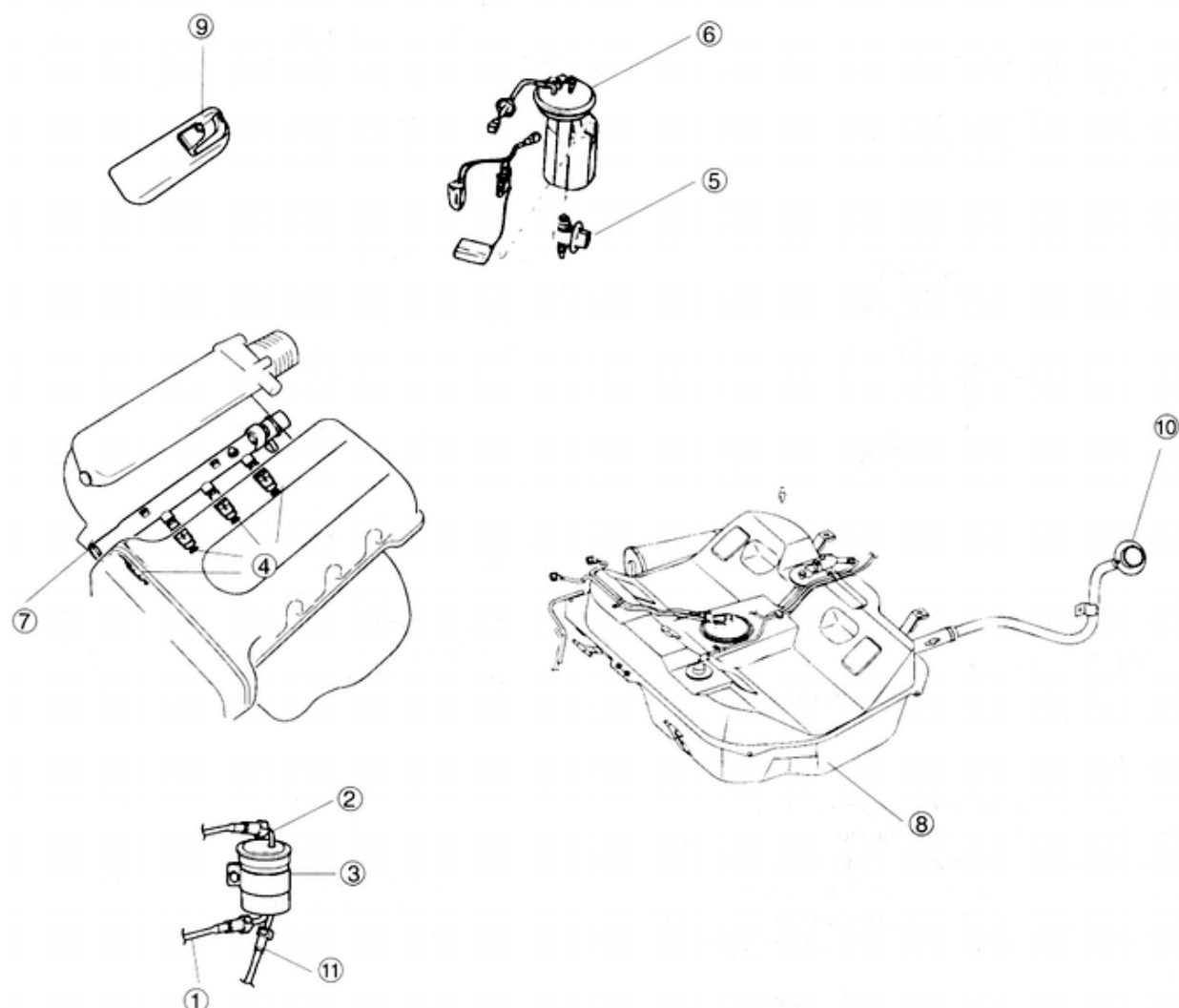
Service valve is located on the fuel rail and used for air bleeding after vehicle launch or maintenance.

Quick connector

Improved serviceability has been achieved to use a quick connector which enables easy and simple connection/disconnection of fuel rail. Refer to "Quick connector" for removal/installation.



Component



- (1) Return line
- (2) Feed line
- (3) Fuel filter (high pressure)
- (4) Fuel injector
- (5) Fuel pressure regulator
- (6) Fuel delivery module

- (7) Pulsation damper (only TED)
- (8) Fuel tank
- (9) Fuel filler lid opener
- (10) Filler pipe
- (11) Fuel line (to injector)

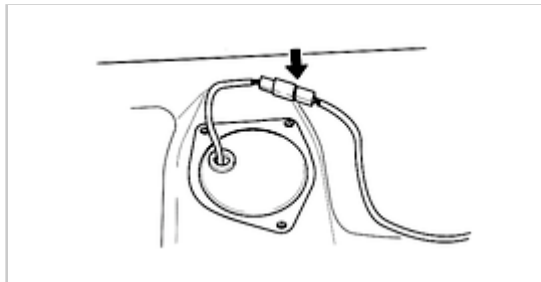


Releasing fuel system pressure

WARNING

THE FUEL SYSTEM REMAINS UNDER PRESSURE WHEN THE ENGINE IS NOT RUNNING. RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING ANY FUEL LINE TO REDUCE THE CHANCE OF PERSONAL INJURY OR FIRE DAMAGE TO VEHICLE COMPONENTS.

1. Start engine.
2. Disconnect fuel pump connector located below rear seat cushion.
3. Let engine stall, then turn OFF ignition switch.
4. Reconnect fuel pump connector.



Fuel line handling

WARNING

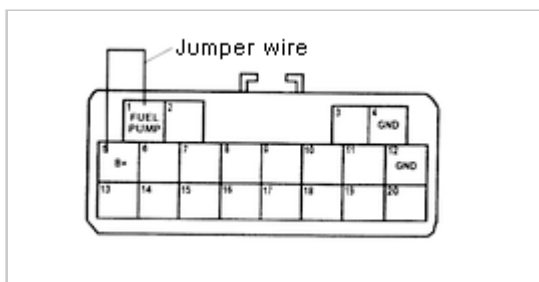
FUEL IS EXPLOSIVE. WHEN WORKING ON FUEL SYSTEM MAKE SURE TO SUPPLY ADEQUATE VENTILATION TO THE WORK AREA. DO NOT SMOKE, AND KEEP SPARKS AND OPEN FLAMES AWAY.

1. When disconnecting fuel hose quick connectors, use shop towels to absorb fuel, protecting equipment and personnel.

Priming the fuel system

After fuel pressure has been released, system must be primed to avoid excessive cranking to restart the engine. Follow steps below:

1. Connect data link connector terminals FUEL PUMP and B+ with a jumper wire.



2. Turn ignition ON for no longer than 10 seconds to pressurize system and check for fuel leaks. (Jumper wire gets hot if it is left in for longer than 10 seconds.)
3. Turn ignition switch OFF and remove jumper wire.

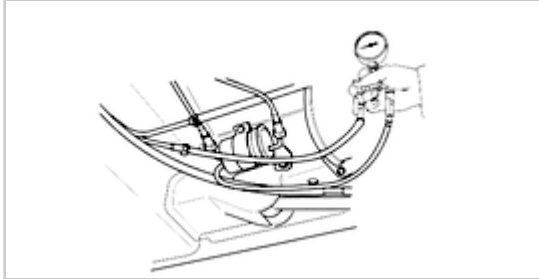
Fuel pressure hold inspection

1. Disconnect negative battery terminal.

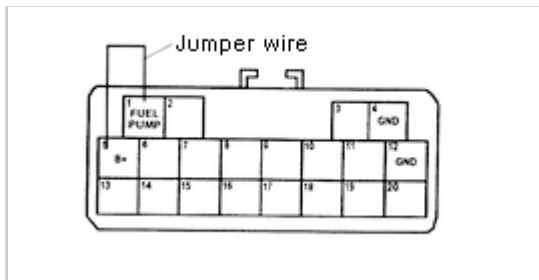
WARNING

THE FUEL SYSTEM REMAINS UNDER PRESSURE WHEN THE ENGINE IS NOT RUNNING, RELEASE FUEL SYSTEM PRESSURE BEFORE DISCONNECTING ANY FUEL LINE TO REDUCE THE CHANCE OF PERSONAL INJURY OR FIRE DAMAGE TO VEHICLE COMPONENTS.

2. Release fuel system pressure. Refer to "Releasing fuel system pressure".
3. Raise a vehicle.
4. Install SST(0K2A1 131 AA1) to fuel filter as described below.



5. Connect negative battery terminal.
6. Connect and link connector terminals FUEL PUMP and B+ with jumper wire.



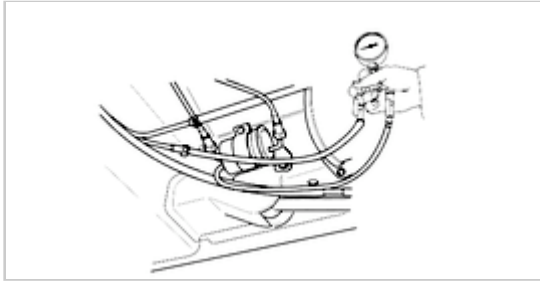
7. Turn ignition switch ON for 10 seconds to operate fuel pump.
8. Turn ignition switch OFF and remove jumper wire.
9. Inspect fuel pressure after 15 minutes.

Fuel pressure: More than 25 psi (180 kPa, 1.8 kg/cm²)

10. If not as specified, check the following components: do following inspections:
 - A. Fuel pump
 - B. Pressure regulator
 - C. Injectors

Fuel line pressure inspection

1. Disconnect negative battery cable.
2. Release fuel system pressure. Refer to "Releasing Fuel System Pressure".
3. Raise a vehicle.
4. Install SST(0K2A1 131 AA1) to fuel filter as shown.



5. Connect negative battery cable.
6. Connect data link connector terminals FUEL PUMP and B+ with jumper wire.
7. Turn ignition switch ON.
8. Inspect the fuel line pressure.

Fuel line pressure: 46~51psi (320~350 kPa, 3.2~3.5 kg/cm²)

Pressure too high:

- A. Check for restricted fuel return line
- B. If line is clean, replace pressure regulator

Pressure too low:

- A. Clamp return line and check if pressure rises
- B. If pressure does rise, replace pressure regulator.
- C. If pressure does not rise, measure fuel pump maximum pressure.

9. Turn ignition switch OFF and remove jumper wire.