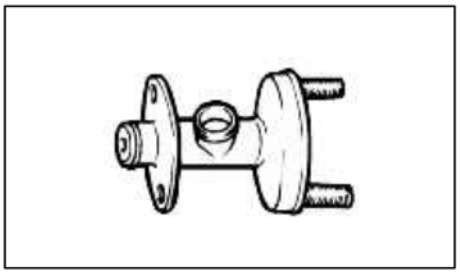
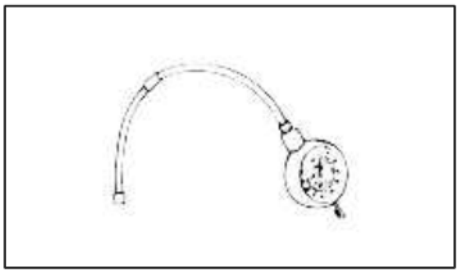
OPTIMA(MS) > 2005 > G 2.7 DOHC > Fuel System

Fuel System > General Information > Special Service Tools

SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Application
09353-38000 Fuel pressure gauge adapter		Connection of fuel pressure gauge to delivery pipe for measurement of fuel pressure.
09353-24100/0K2A1 131 001A Fuel pressure gauge & hose		

Fuel System > General Information > Troubleshooting

TROUBLESHOOTING

When checking engine trouble, it is important to start with an inspection of the basic systems. If one of the following conditions exists, (A) engine start failure, (B) unstable idling or (C) poor acceleration, begin by checking the following basic systems.

1. Power supply
   - A. Battery
   - B. Fusible link
   - C. Fuse
2. Body ground
3. Fuel supply
   - A. Fuel line
   - B. Fuel filter
   - C. Fuel pump
4. Ignition system
   - A. Spark plug
   - B. High-tension cable
   - C. Ignition coil
5. Emission control system
   - A. PCV system
   - B. Vacuum leak
6. Others
   - A. Ignition timing
   - B. Idle speed

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Trouble with the MFI system is often caused by poor contact of the harness connectors. It is important to check all harness connectors and verify that they are securely connected.

TROUBLESHOOTING GUIDE CHART

Main Symptoms / Sub-Symptoms / Check points	STARTING							Poor Idling					Poor Driving	
	Unable to start			Hard to start										
	Engine does not crank	Starter runs but engine does not crank	Incomplete combustion	Engine cranks slowly	Always	When the engine is cold	When the engine is hot	Incorrect fast idle	High idle speed	Low idle speed	Rough idling	Engine hesitates or accelerates poorly	Surging	Knocking
Starter relay	1													
Starter	2	2		1										
TR SW [A/T] or Clutch start SW [M/T]	3													
Flywheel [M/T] or Drive plate [A/T]		4												
MAF Sensor Circuit			3							3	10	8		
Idle Speed Control Actuator (ISA)			4		3	3	3	3	3	2	7			2
Fuel pressure regulator			5		5	5	5				4	13	1	
Water Temperature sensor circuit			6		4	1	1	2	2	1	2	9	6	
Compression			7		8						8	6		
Piston ring			8		9						9			
Ignition timing					10						11	16		
Timing belt (mark)			9								12			
Injectors			10		13	8	8		7	4	13	17	4	
ECU			11		14	9	9	4	8	5	15	18	5	
A/C circuit				2					6					
Connecting rod bearing				3										
Crankshaft bearing				4										
Fuel quality					1	2	2				1	4	3	
Spark plug					2						3	5	2	
Fuel pump					6	6	6				5	14		
Fuel lines					7	7	7				6	15		
Ignition circuit					11						14			3
Intake Air Temperature Sensor			2		12	4	4		4			10		1
Accelerator pedal link								1	1					
Throttle Position Sensor Circuit									5			7		
Cylinder head											16			
Clutch [M/T]												1		
Brakes not releasing properly												2		
HO2S circuit												11		
Crankshaft Position (TDC) sensor		3										3		
Battery voltage		1	1									12		

NOTE

The numbers in the columns indicate the proper troubleshooting sequence to be followed.

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Main Symptoms / Sub-Symptoms / Check points	Engine Stalls			Others				Refuelin
	Soon after starting	After accelerator pedal depressed	After accelerator pedal released	During A/C ON	Excessive fuel	Engine overheats	Engine over cools	Difficult to refuel overflowing spit-back
Fuel quality	1				2			
Fuel pressure regulator	2	4						
Fuel pump	3							
Fuel lines	4	5						
Idle Speed Control Actuator (ISA)	5		1	2				
Mass Air Flow Sensor Circuit	6	1	2		13			
Water Temperature sensor circuit	7				11			
Injectors	8	6			10			
ECU	9	7	3	3	17			
TP Sensor circuit		2			12			
Spark plug		3			6	8		
A/C circuit				1	14			
Fuel leakage					1			
Accelerator pedal link					3			
Clutch [M/T]					4			
Brakes drag when released					5			
Compression					7			
Piston ring					8			
Ignition timing					9			
HO2S circuit					15			
Intake Air Temperature sensor circuit					16			
Engine coolant leakage						1		
Cooling fan						2	1	
Thermo switch						3		
Radiator and radiator cap						4		
Thermostat						5	2	
Timing belt						6		
Engine coolant pump						7		
Oil pump						9		
Cylinder head						10		
Cyliner block						11		
ECT sender						12	3	
Crankshaft Position (TDC) Sensor	10	8	4	4				
Fill vent valve hose-clogging								1
Canister filter-Contamination								2
Fuel shut off valve-operation								3

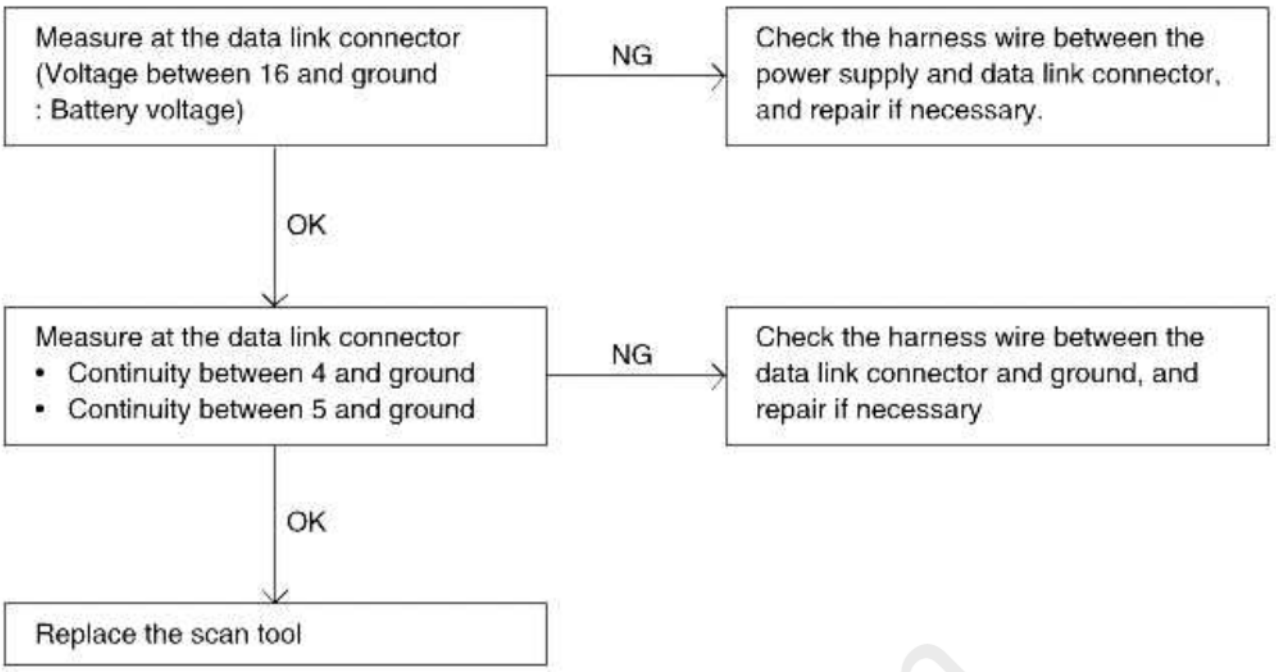
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NOTE

The numbers in the columns indicate the proper troubleshooting sequence to be followed.

PROBLEM (MFI TROUBLESHOOTING PROCEDURES)

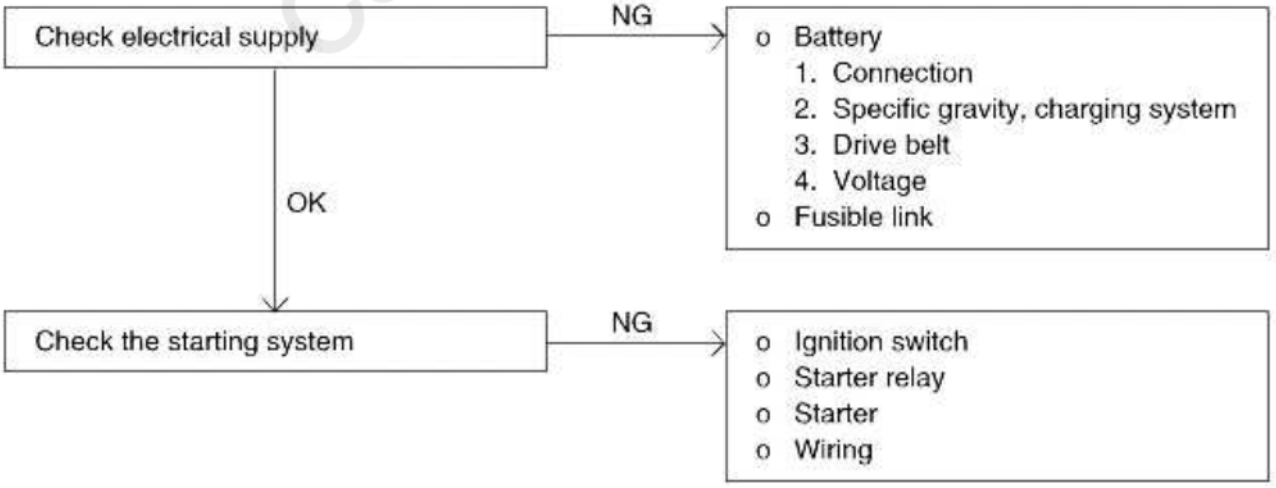
Communication with scan tool is not possible. (Communication with all system is not possible)



Scan tool communication with ECU is not possible

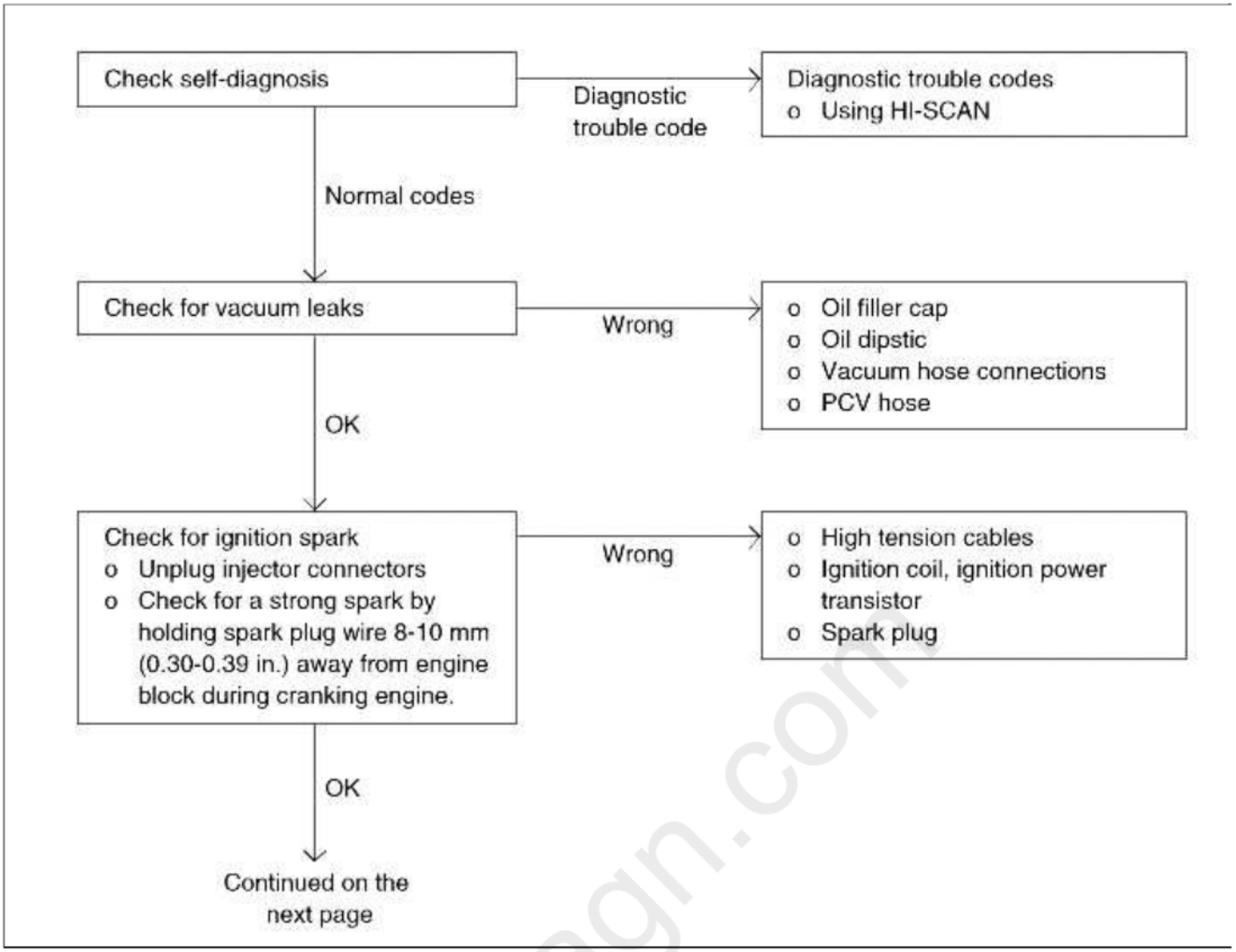
Comment	Probable cause
One of the following causes may be suspected. • No power supply to the ECU • Defective ground circuit of the ECU • Defective the ECU • Improper communication line between the ECU and scan tool	• Malfunction of the ECU power supply circuit • Malfunction of the ECU • Open circuit between the ECU and DLC

Engine will not start

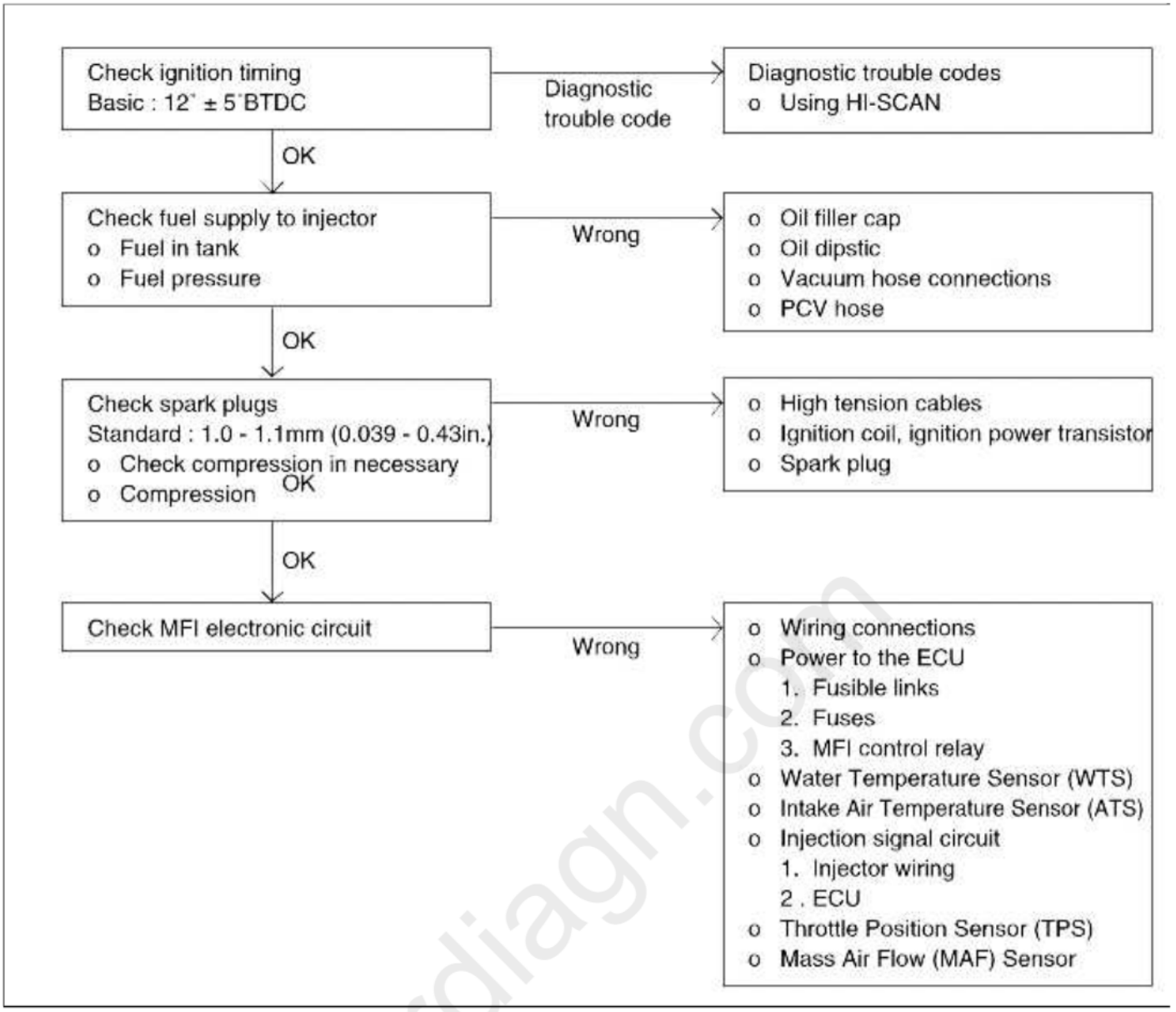


Difficult to start (Engine CRANKS)

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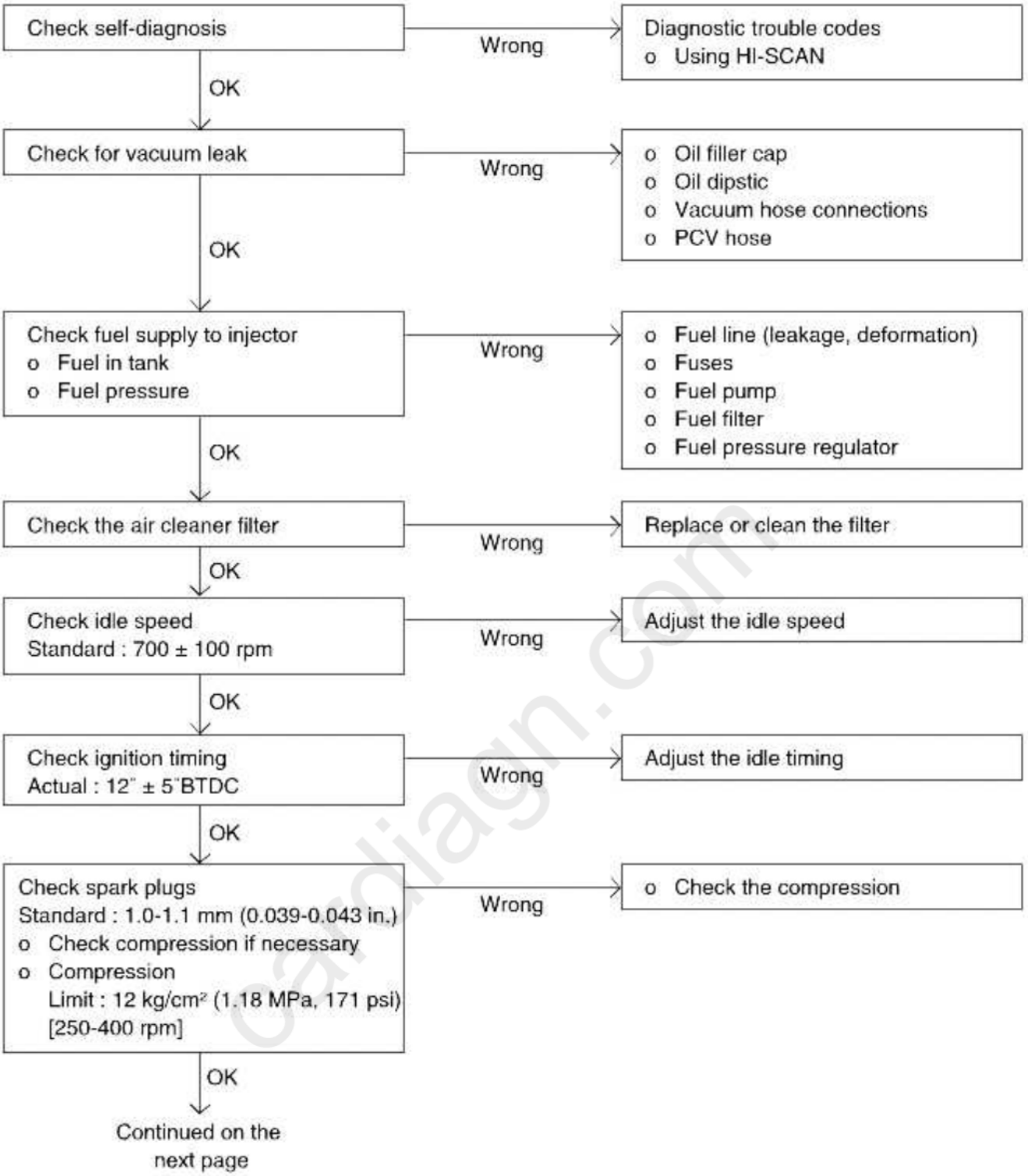


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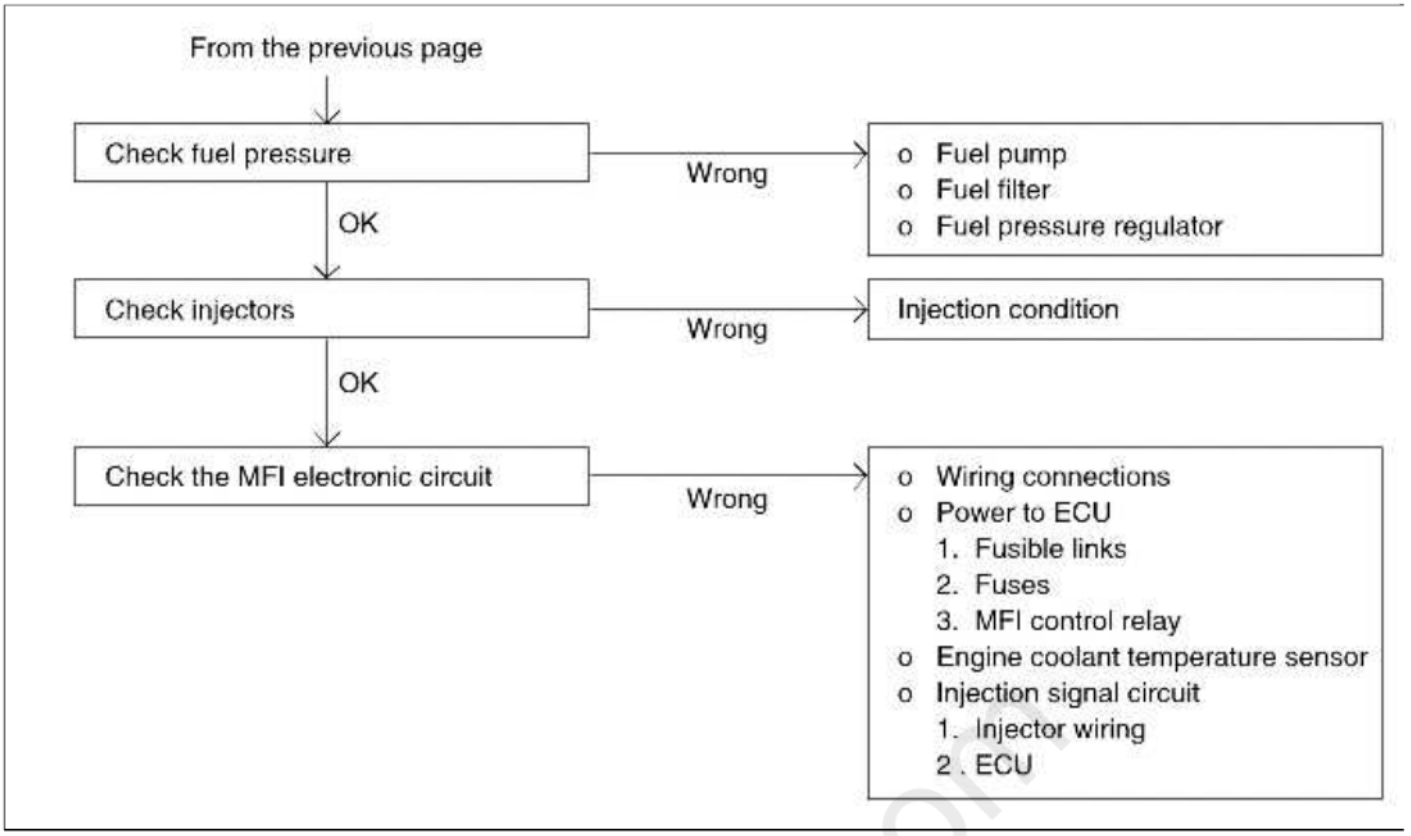


Rough idle or engine stalls

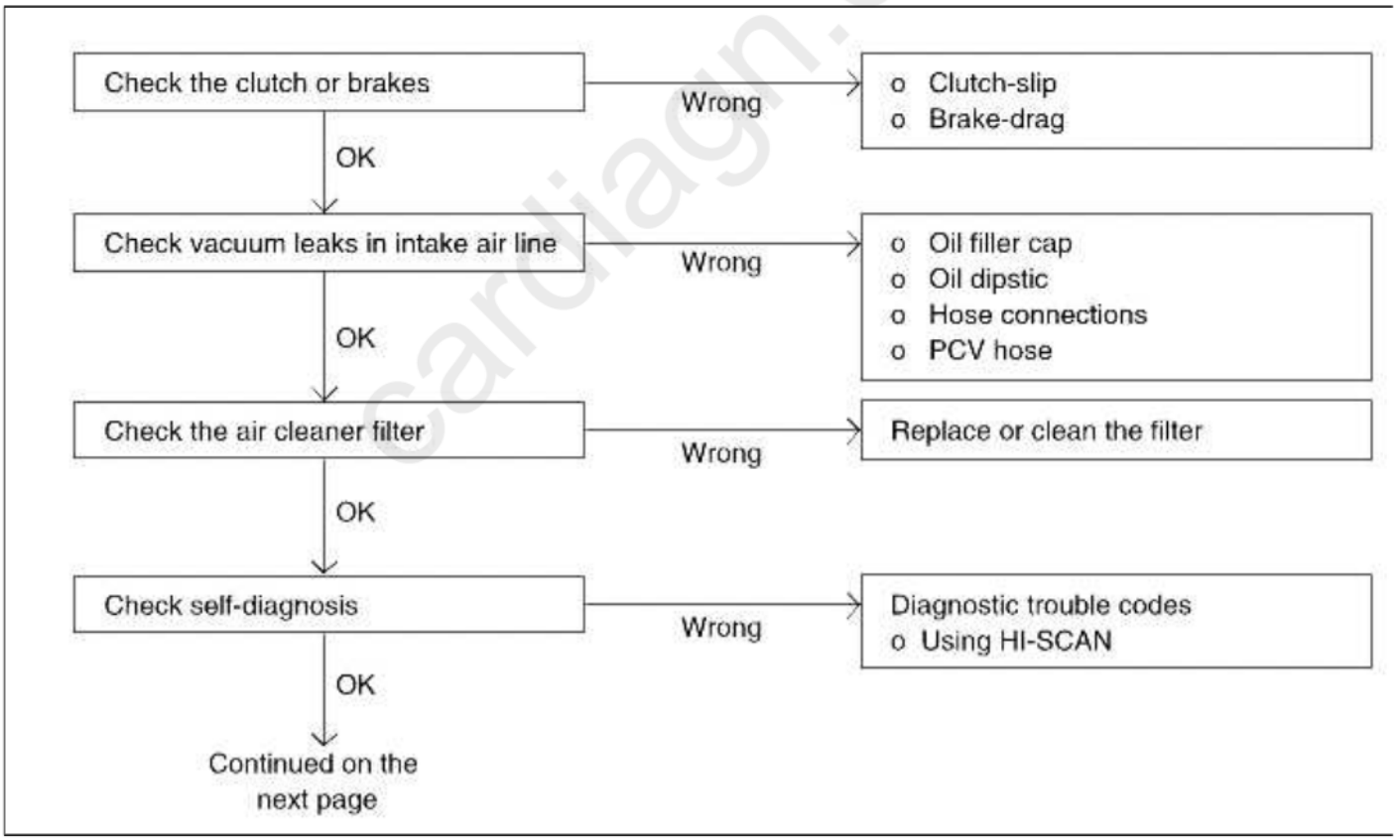
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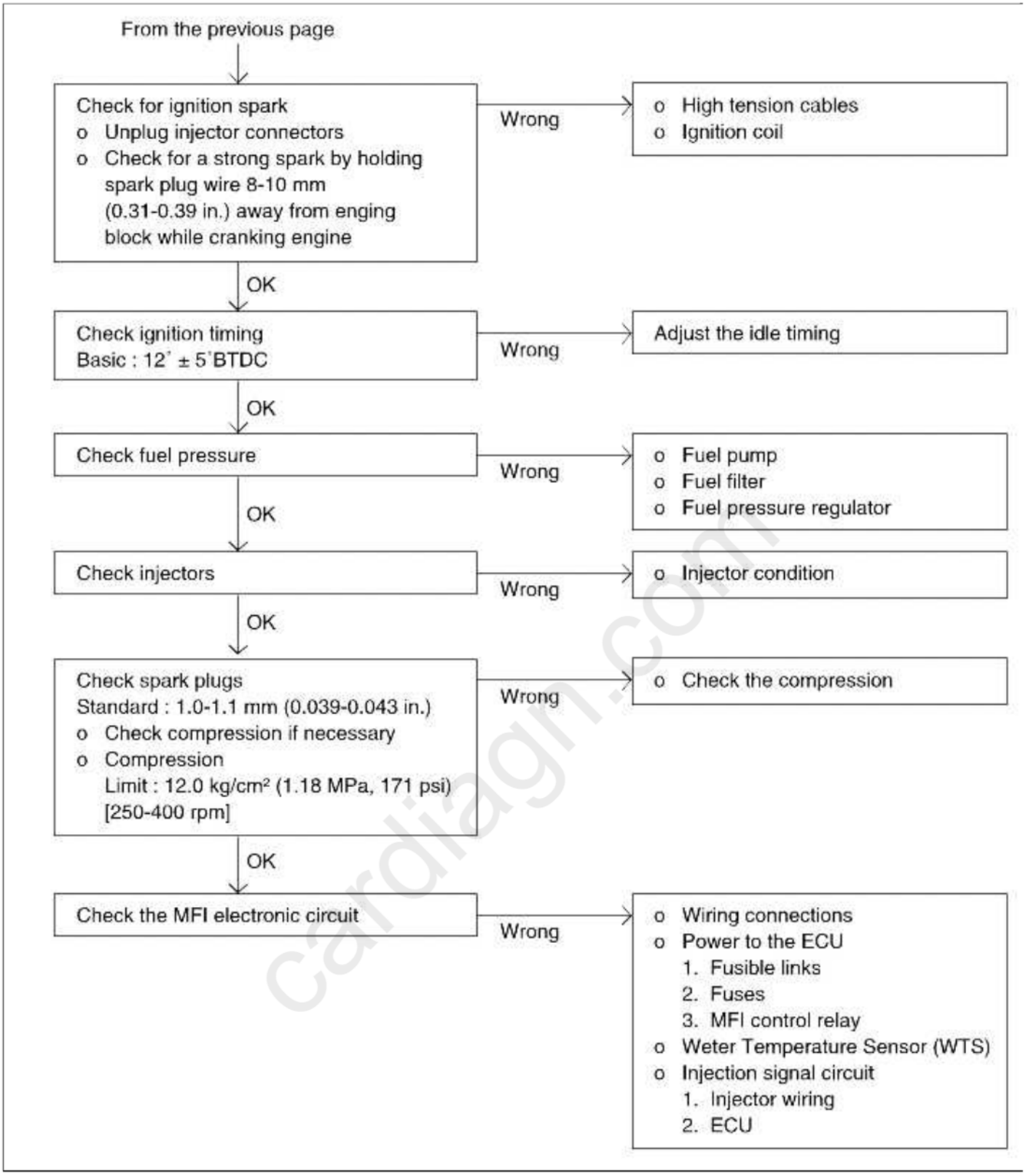
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Engine hesitates or accelerates poorly

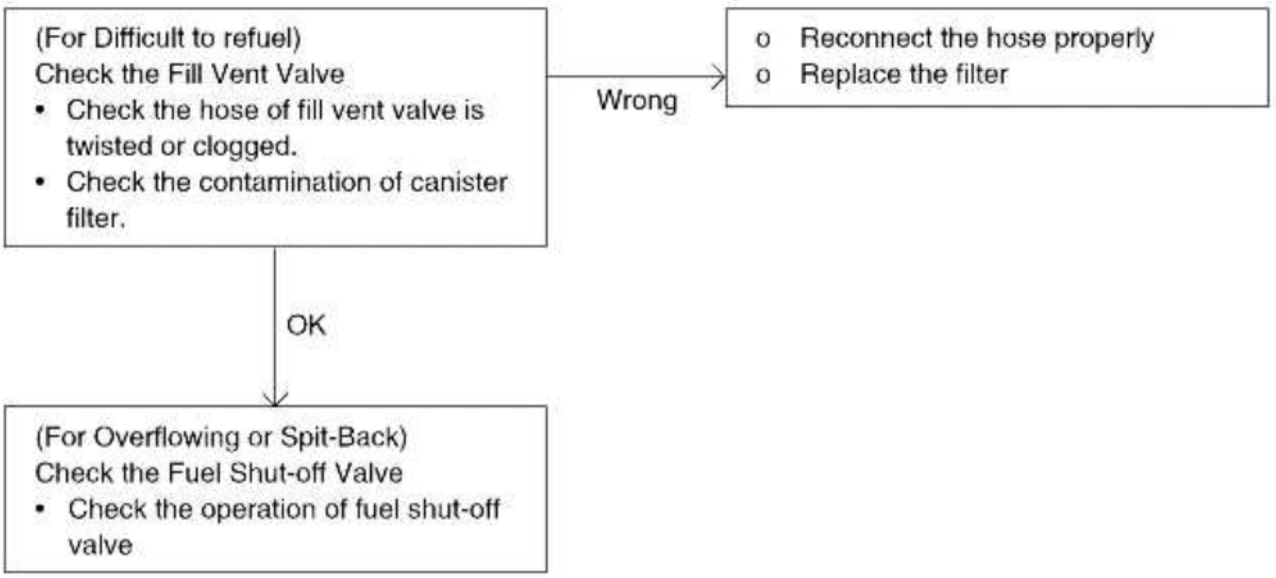


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Difficult to refuel/Overflowing or Spit-Back while refueling



NOTE

The proper operating condition of fuel shut-off valve is at the nominal volume of fuel (app. 65 liter)

TROUBLESHOOTING

Trouble condition	Probable cause	Remedy
Engine will not crank	Low battery charge	Charge or replace the battery
	Battery cables are loose, corroded or worn	Repair or replace cables
	Faulty transaxle range switch (Vehicle with automatic transaxle only)	Adjust or replace the switch
	Fusible link blown	Replace fusible link
	Faulty starter motor	Repair the starter motor
	Faulty ignition switch	Replace the ignition swtich
Engine cranks slowly	Low battery charge	Charge or replace battery
	Battery cables are loose, corroded or worn	Repair or replace cables
	Faulty starter motor	Repair the starter motor
Starter keeps running	Faulty starter motor	Repair the starter motor
	Faulty ignition switch	Replace the ignition switch
Starter spins but engine will not crank	Short in wiring	Repair the wiring
	Pinion gear teeth broken or faulty starter motor	Repair the starter motor
	Ring gear teeth broken	Replace the flywheel ring gear or torque converter

FUEL TANK AND FUEL LINE

Symptom	Probable cause	Remedy
Engine malfunctions due to insufficient fuel supply	Bent or kinked fuel pipe or hose	Repair or replace
	Clogged fuel pipe or hose	Clean or replace
	Clogged fuel filter of in-tank fuel filter	Replace
	Water in fuel filter	Replace the fuel filter or clean the fuel tank and fuel lines
	Dirty or rusted fuel tank interior	Clean or replace
	Malfunction of the fuel pump (Clogged filter in the pump)	Replace
Evaporative emission system malfunctions (when fuel filler cap is removed, pressure is released)	Incorrect routing of a vapor line	Correct
	Disconnected vapor line	Correct
	Vapor line is folded, bent, cracked or clogged	Replace
	Faulty fuel tank cap	Replace
	Malfunction of the overfill limiter (Two-way valve)	Replace

Fuel System > General Information > Repair procedures

THROTTLE BODY CLEANING

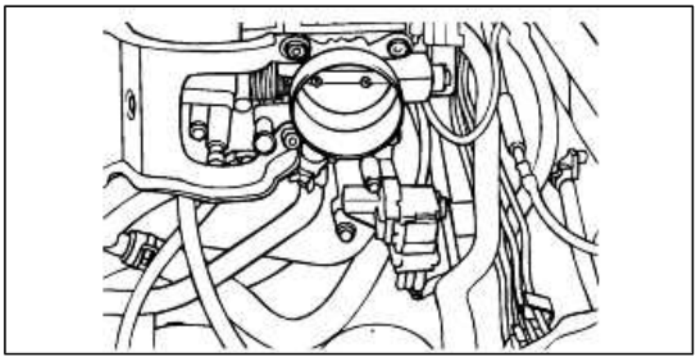
NOTE

Disconnect the intake air hose from the throttle body, and check the throttle valve surface for carbon deposits. Spray cleaning solvent on the valve to remove carbon deposits.

1. Warm up the engine, then stop it.
2. Remove the intake air hose from the throttle body.
3. Plug the bypass passage inlet of the throttle body.

NOTE

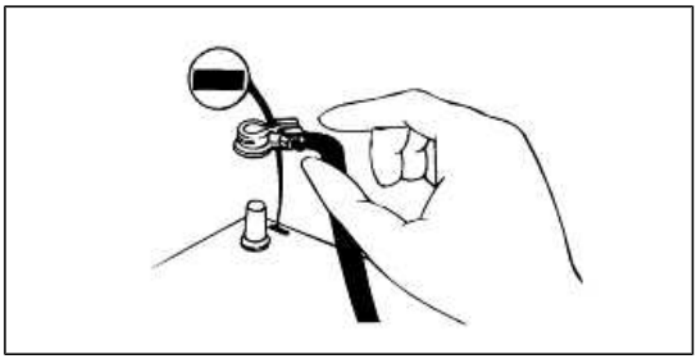
Make sure the solvent does not enter the by-pass passage.



4. Spray cleaning solvent onto the valve through the throttle body intake port and let it soak for about 5 minutes.
5. Start the engine, race it several times and allow the engine to idle for 1 minute.
6. Repeat Steps 4 and 5.
7. Unplug the bypass passage inlet.

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8. Attach the intake air hose.
9. Disconnect the battery ground cable for more than 10 seconds.



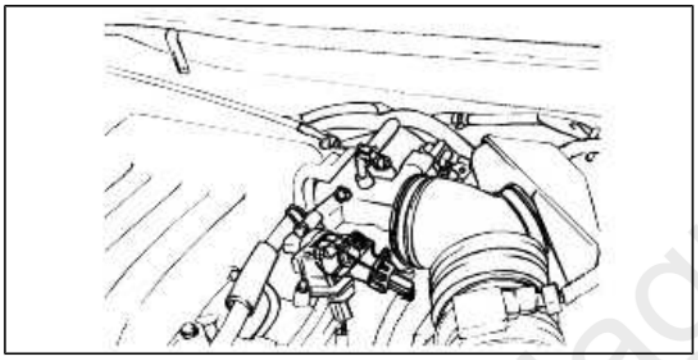
10. Adjust the SAS (Speed Adjusting Screw)

THROTTLE POSITION SENSOR (TPS) ADJUSTMENT

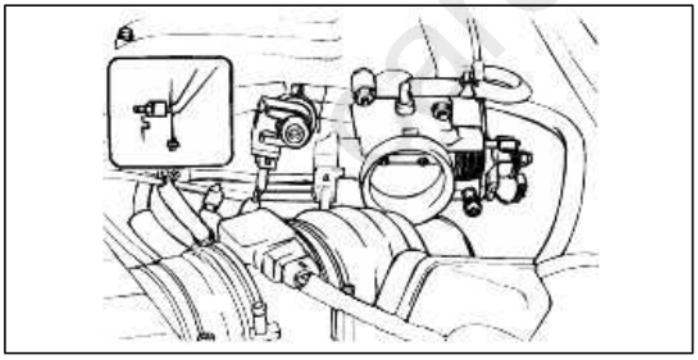
NOTE

Before adjusting the TPS, complete the basic idle speed adjustment.

1. Disconnect the throttle position sensor connector.

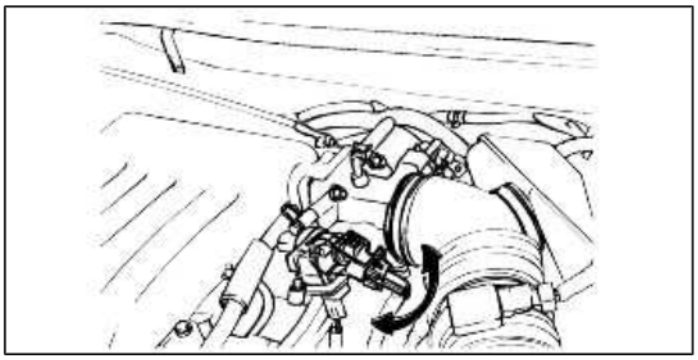


2. Using jumper wires, connect a voltmeter between terminal 1 and terminal 2 of the throttle position sensor connector.
3. Insert a 0.65 mm (0.0256 in.) thick feeler gauge between the fixed SAS and throttle lever.



4. Loosen the throttle position sensor mounting bolts and turn the TPS body fully counterclockwise.
5. In this condition, check that there is continuity between terminals 1 and 2.

6. Slowly turn the throttle position sensor clockwise until you find a point at which there is no continuity between termin al 1 and 2. Then, tighten the throttle position sensor mounting bolt securely.



7. Connect the throttle position sensor connector.
8. Connect the scan tool to the data link connector in the fuse box.
9. If the scan tool is not used, connect a voltmeter between throttle position sensor connector terminals 2 (sensor ground) and 3 (sensor output) using pin.

NOTE

- Do not disconnect the TPS connector.
- Use a digital type voltmeter to obtain an accurate value.

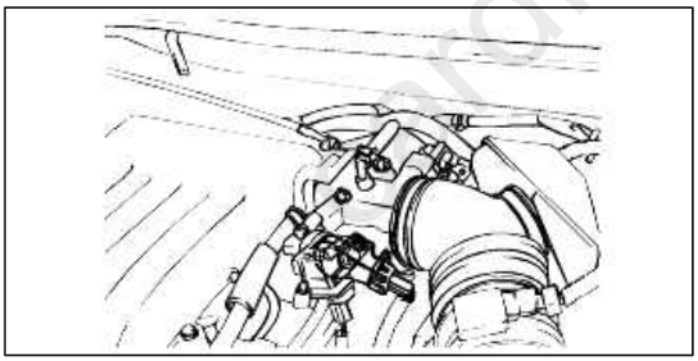
10. Turn the ignition switch "ON."

NOTE

Do not start the engine.

11. Check the throttle position sensor output voltage.

Throttle position sensor output voltage : 250-800 mV



12. If the voltage is out of specification, check the throttle position sensor and associated harnesses.
13. Remove the feeler gauge.
14. Turn the ignition switch OFF.

Fuel System > General Information > Specifications

SPECIFICATIONS

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Items				Specifications
Throttle body	Throttle Position Sensor (TPS)	Type		Variable resistor
		Resistance at curb idle		1.6 ~ 2.4 kΩ
		Output voltage at curb idle		250 ~ 800 mV
	Idle Speed Control Actuator (ISA)	Type		Double coil
		Resistance	Opening	14.5 ~ 16.5 Ω
			Closing	16.6 ~ 18.6 Ω
Sensors	Mass Air Flow (MAF) Sensor	Type		HOT Film sensor (MAF)
	Intake Air Temperature Sensor (ATS)	Type		Thermistor type (Built in MAF)
		Resistance		2.22~ 2.82 kΩ at 20°C(68°F)
	Water Temperature Sensor (WTS)	Type		Thermistor type
		Resistance		2.31~2.59 kΩ at 20°C (68°F)
				0.30~0.34 kΩ at 80°C (176°F)
	Heated Oxygen Sensor (HO2S)	Type		Zirconia type
	Vehicle Speed Sensor (VSS)	Type		Hall effect type
	Camshaft Position (TDC) Sensor	Type		Hall effect sensor
	Crankshaft Position (CKP) Sensor	Type		Hall effect sensor
Actuators	Injector	Type, number		Electromagnetic type, 6
		Resistance		13 ~ 16Ω at 20°C (68°F)
	Purge Control Solenoid Valve (PCSV)	Type		Duty cycle type
		Resistance		24.5 ~ 27.5Ω
Fuel pressure regulator	Injector opening pressure			300 ± 1.5 kPa (3.35 ± 0.06 kg/cm²)
Fuel tank	Capacity			65 lit (17.1 US gal, 14.3 Imp.gal)
	Return system			Equipped
Canister	Volume/Nominal working capacity			3.0 liter/150 g

SEALANT

Item	Specified sealant
Water Temperature Sensor (WTS)	LOCTITE 962T or equivalent

SERVICE STANDARDS

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Item		Standard valve
Actual ignition timing		BTDC 12° ± 5° at curb idle
Curb idle speed (rpm)		700 ± 100
Fuel pressure kPa (psi)	Vacuum hose disconnection	330 ~ 350 (47-50) at curb idle
	Vacuum hose connection	Approx. 270 (38) at curb idle

TIGHTENING TORQUE

Item	Nm	Kg·cm	lb·ft
Delivery pipe installation bolt	10-13	100-130	7-9.5
Water temperature sensor	20-40	200-400	14-29
Heated oxygen sensor	35-45	350-450	25.8-33.1
Heated oxygen sensor connector bracket bolt	8-12	80-120	5.8-8.7
High pressure hose and fuel main pipe	30-40	300-400	22-29
High pressure hose and fuel filter	25-35	250-350	18-25
High pressure hose to delivery pipe	3-4	30-40	2.2-3
Fuel pump assembly to fuel tank	2-3	20-30	1.4-2.2
High pressure hose at fuel tank	30-40	300-400	22-29
Throttle body to surge tank	15-22	150-220	11-12.7
Fuel tank drain plug	15-25	150-250	11-18
Fuel filter mounting bolts	9-14	90-140	6.5-10
Accelerator arm bracket bolts	8-12	80-120	5.8-8.7
Idle speed control actuator	6-8	60-80	4.4-5.8
Fuel sender to fuel tank	2-3	20-30	1.4-2.2

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Fuel System > Engine Control System > Description and Operation

DESCRIPTION

MULTIPORT FUEL INJECTION (MFI)

The Multiport Fuel Injection System consists of sensors which detect the engine conditions, the ENGINE CONTROL UNIT (ECU) which controls the system based on signals from these sensors, and actuators which operate under the control of the ECU. The ECU carries out activities such as fuel injection control, idle air control and ignition timing control. In addition, the ECU is equipped with several diagnostic test modes which simplify the

troubleshooting when a problem develops.

FUEL INJECTION CONTROL

The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions. A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel tank by the fuel pump, with the pressure being regulated by the fuel pressure regulator. The fuel thus regulated is distributed to each of the injectors. Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The firing order is 1-3-4-2. This is called multiport. The ECU provides a richer air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance. In addition, when the engine is warm or operating under normal conditions, the ECU controls the air/fuel mixture by using the heated oxygen sensor signal to carry out "closed-loop" control in order to obtain the theoretical air/fuel mixture ratio that provides the maximum cleaning performance from the three way catalyst.

IDLE SPEED CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that bypasses the throttle valve in accordance with changes in idling conditions and engine load during idling. The ECU drives the idle speed control (ISC) motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and air conditioning load. In addition, when the air conditioning switch is turned off and on while the engine is idling, the ISC motor operates to adjust the throttle valve bypass air amount in accordance with the engine load conditions in order to avoid fluctuations in the engine speed.

IGNITION TIMING CONTROL

The ignition power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing in order to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the ECU from the engine speed, intake air volume, engine coolant temperature and atmospheric pressure.

OTHER CONTROL FUNCTIONS

1. Fuel Pump Control : Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.
2. A/C Compressor Clutch Relay Control : Turns the compressor clutch of the A/C ON and OFF.
3. Fan Relay Control : The radiator fan and condenser fan speeds are controlled in response to the engine coolant temperature and vehicle speed.
4. Evaporative Emission Purge Control.

DIAGNOSTIC TEST MODE

- When an abnormality is detected in one of the sensors or actuators related to emission control, the CHECK ENGINE/MALFUNCTION INDICATOR LAMP illuminates as a warning to the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnostic trouble code corresponding to the abnormality is output.
- The RAM data inside the ECU that is related to the sensors and actuators can be read by means of the scan tool. In addition, the actuators can be controlled under certain circumstances.

HOW TO COPE WITH INTERMITTENT MALFUNCTIONS

Most intermittent malfunctions occur under certain conditions. If those conditions can be identified, the cause will be easier to find.

TO COPE WITH INTERMITTENT MALFUNCTION;

1. Ask the customer about the malfunction. Ask what it feels like, what it sounds like, etc. Then ask about driving conditions, weather, frequency of occurrence, and so on.
2. Determine the conditions from the customer's responses. Typically, almost all intermittent malfunctions occur from conditions like vibration, temperature and/or moisture change, poor connections. From the customer's replies, it should be reasoned which condition is influenced.

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3. Use simulation test In the cases of vibration or poor connections, use the simulation tests below to attempt to duplicate the customer's complaint. Determine the most likely circuit(s) and perform the simulation tests on the connectors and parts of that circuit(s). Be sure to use the inspection procedures provided for diagnostic trouble codes and trouble symptoms. For temperature and/or moisture conditions related intermittent malfunctions, using common sense, try to change the conditions of the suspected circuit components, then use the simulation tests below.
4. Verify the intermittent malfunction is eliminated. Repair the malfunctioning part and try to duplicate the condition(s) again to verify the intermittent malfunction has been eliminated.

SIMULATION TESTS

For these simulation tests, shake, then gently bend, pull and twist the wiring of each of these examples to duplicate the intermittent malfunction.

- Shake the connector up-and-down, and right-and-left.
- Shake the wiring harness up-and-down, and right-and-left.
- Vibrate the part or sensor.

A CAUTION FOR I/M TEST (VEHICLE WITH TRACTION CONTROL SYSTEM)

- To prevent the vehicle misfire, disconnect the connector of ABS.

SERVICE POINTS IN INSPECTING A BLOWN FUSE

Remove the fuse and measure the resistance between the load side of the fuse and ground. Set the switches of all circuits which are connected to this fuse to a condition of continuity. If the resistance is almost 0Ω at this time, there is a short somewhere between these switches and the load. If the resistance is not 0Ω, there is no short at the present time, but a momentary short has probably caused the fuse to blow.

The main causes of a short circuit are the following.

- Harness clamped by the vehicle body
- Damage to the outer casing of the harness due to wear or heat.
- Water getting into the connector or circuitry
- Human error (mistakenly shorting a circuit, etc.).

INSPECTING THE MFI SYSTEM

If the MFI system components (sensors, ECU, injector, etc.) fail, the interruption or failure to supply the proper amount of fuel for various engine operating conditions will result. The following situations may be encountered.

1. Engine is hard to start or does not start at all.
2. Unstable idle
3. Poor driveability

If any of the above conditions is noted, first perform an inspection by self-diagnosis and subsequent basic engine checks (ignition system malfunction, incorrect engine adjustment, etc.), and then inspect the MFI system components.

ON-BOARD DIAGNOSTICS

- The recording condition of diagnostic trouble code. After the ECU first detects a malfunction, a diagnostic trouble code is recorded when the engine is restarted and the same malfunction is re-detected. (Malfunction is detected in driving cycle). However, for fuel system rich/lean misfiring, a diagnostic trouble code is recorded on the first detection of the malfunction.
- The recording condition of diagnostic trouble code.The diagnostic trouble codes in ECU memory will be erased when removing the battery terminal from the battery or using scan tool. However, for fuel system rich/lean misfiring, a diagnostic trouble code is recorded on the first detection of the malfunction.
  - When driving conditions (engine speed, engine coolant temperature, etc.) are siMILar to those when the malfunction was first recorded.
  - When the ECU does not re-detect the malfunction for 80 driving cycles.

NOTE

A "driving cycle" consists of the engine start, vehicle operation beyond the beginning of closed loop operation.

Malfunction Indicator Light (MIL)

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An On Board Diagnostic lamp comes on to notify the driver that there is any problem on the vehicle.
However MIL will go off automatically after 3 subsequent sequential driving cycles not redetected same malfunction.
Immediately after the ignition switch turns on, the malfunction indicator light is lit for 5 seconds to indicate that the malfunction indicator light operates normally.
Following Items will be Indicated by the MIL

- Catalyst
- Fuel system
- Mass Air Flow (MAF) Sensor
- Intake Air Temperature Sensor (ATS)
- Water Temperature Sensor (WTS)
- Throttle Position Sensor (TPS)
- Upstream Oxygen Sensor
- Downstream Oxygen Sensor Heater
- Downstream Oxygen Sensor
- Upstream Oxygen Sensor Heater
- Injector
- Misfire
- Crankshaft Position (CKP) Sensor
- Camshaft Position (TDC) Sensor
- Evaporative Emission Control System
- Vehicle Speed Sensor (VSS)
- Idle Speed Control
- ECU
- Manifold Absolute Pressure (MAP) Sensor [For vehicle with EGR system]
- EGR System [For vehicle with EGR system]

INSPECTING THE MALFUNCTION INDICATOR LAMP (MIL)

1. After turning on the ignition key, check that the light illuminates for 5 seconds without engine running.
2. If the light does not illuminate, check for an open circuit in harness, blown fuse and blown bulb.

SELF-DIAGNOSIS

The ECU monitors the input/output signals (some signals at all times and the others under specified conditions). When the ECU detects an irregularity, it memorize the diagnostic trouble code, and outputs the signal to the self-diagnosis output terminal. The diagnosis results can be read out Hi-Scan Tool. Diagnostic trouble code (DTC) will remain in the ECU as long as battery power is maintained. The diagnostic trouble code will, however, be erased when the battery terminal or the engine control unit (ECU) connector is disconnected or erased by Generic Scan Tool.

CHECKING THE PROCEDURES (SELF-DIAGNOSIS)

NOTE

- When battery voltage is low, diagnostic trouble codes can not be read. Be sure to check the battery for voltage and charging system before starting the test.
- Diagnosis memory is erased if the battery or the ECU connector is disconnected. Do not disconnect the battery before the diagnostic trouble codes are completely read and recorded.

Inspection Procedure (Using Hi-Scan Tool)

1. Turn OFF the ignition switch.
2. Connect the scan tool to the data link connector on the lower crash pad.
3. Turn ON the ignition switch.
4. Use the Hi-Scan Tool to check the diagnostic trouble code.
5. Repair the faulty part from the diagnosis chart.
6. Erase the diagnostic trouble code.

7. Disconnect the Hi-Scan Tool.

OBD-II OVERVIEW

The goal of the On Board Diagnostics-II (OBD-II) regulation, which was mandated by the Environmental Protection Agency (EPA), is to ensure proper emission system operation for the life of the vehicle by providing the vehicle with an "on-board" diagnostic system which is capable of continuously monitoring the efficiency of the emission control system. To achieve this goal, OBD-II diagnostics monitors emissions-related components and systems for deterioration and identifies an emissions-related malfunction before the driver notices a problem with the vehicle. The Engine Control Unit (ECU) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the ECU senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code in the ECU memory. If the code applies to a non-emissions related component or system and the problem is repaired or ceases to the exist, the ECU cancels the code after a predetermined number of drive cycles. Certain criteria must be met before the ECU stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the ECU. Keep in mind though that the ECU might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. For example, lets SAY THE DTC criteria requires the ECU to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensors output circuit shorts to ground as a result of engine torque when the engine operates above 2400RPM (resulting in 0 volt input to the ECU). Since the condition happens at the engine speed above the maximum threshold, in this case 2000 RPM, the ECU will not store a DTC.

As a functional test, the MIL (check engine) illuminates at key ON before engine cranking. Whenever the ECU sets a DTC that affects vehicle emissions, it sends a signal to illuminate the MIL. There are some monitors that may take consecutive trips, with a detected fault, before the MIL is illuminated. This is also known as "PENDING" codes. Also, m the MIL flashes when the ECU detects an active engine misfire, then shuts off fuel to the affected cylinder. OBD-II diagnostics supports not only the standard test mode of OBD-II (Mode 01~Mode 07) but also an advanced test Mode (Mode 22: Supported PID-analog inputs and outputs, digital inputs and outputs). All of these diagnostic test modes are supported using Hi-Scan Pro through the DLC.

The ECU executes the following key monitoring for OBD-II:

- 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

Effective control of exhaust emission is achieved by an oxygen "feedback system" to the ECU. This "feedback" is accomplished with the HO2 Sensors. Once the HO2 Sensor reaches operating temperature, the sensor generates a voltage signal to the ECU that is inversely proportional to the amount of oxygen in the exhaust. This voltage signal is used by the ECU to calculate the fuel injector pulse width to maintain the ideal 14.7 to 1 Air Fuel (A/F) ratio. This is the ideal mixture because at this ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

MONITORING PROCESS

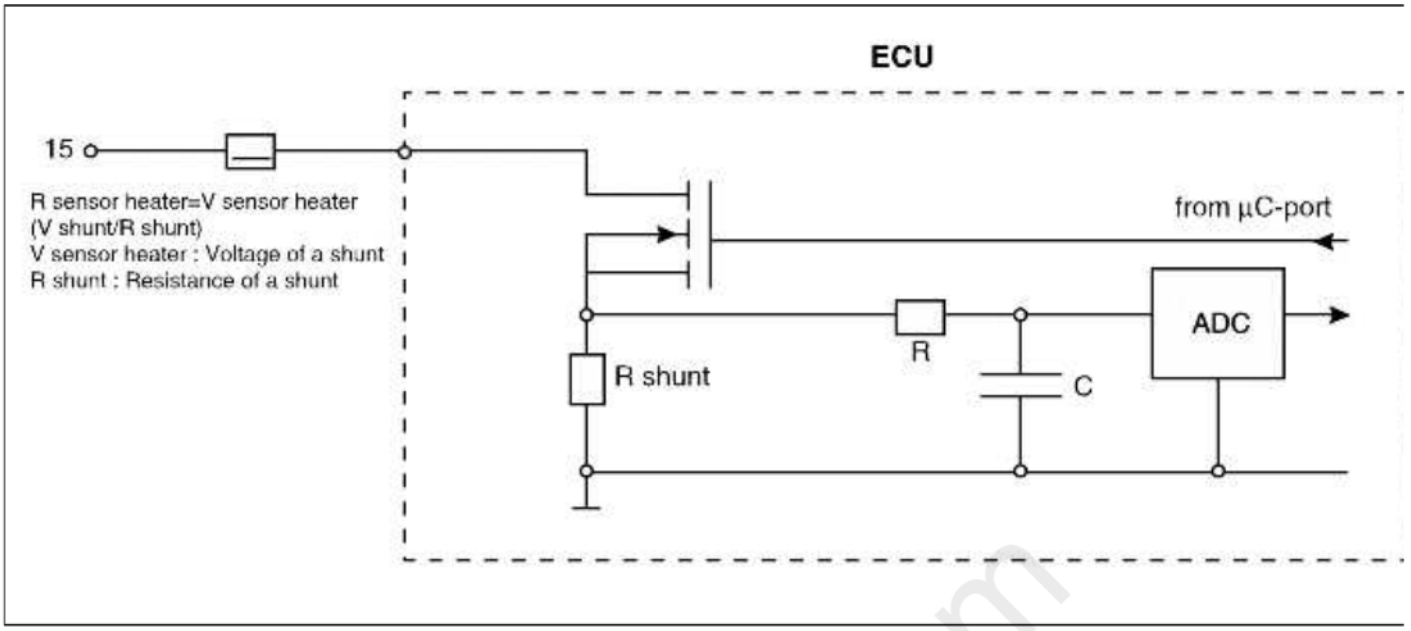
To achieve the requirements of the HO2S Monitoring diagnosis, diagnostic tests have been designed to monitor the following:

- 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 300°C. 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

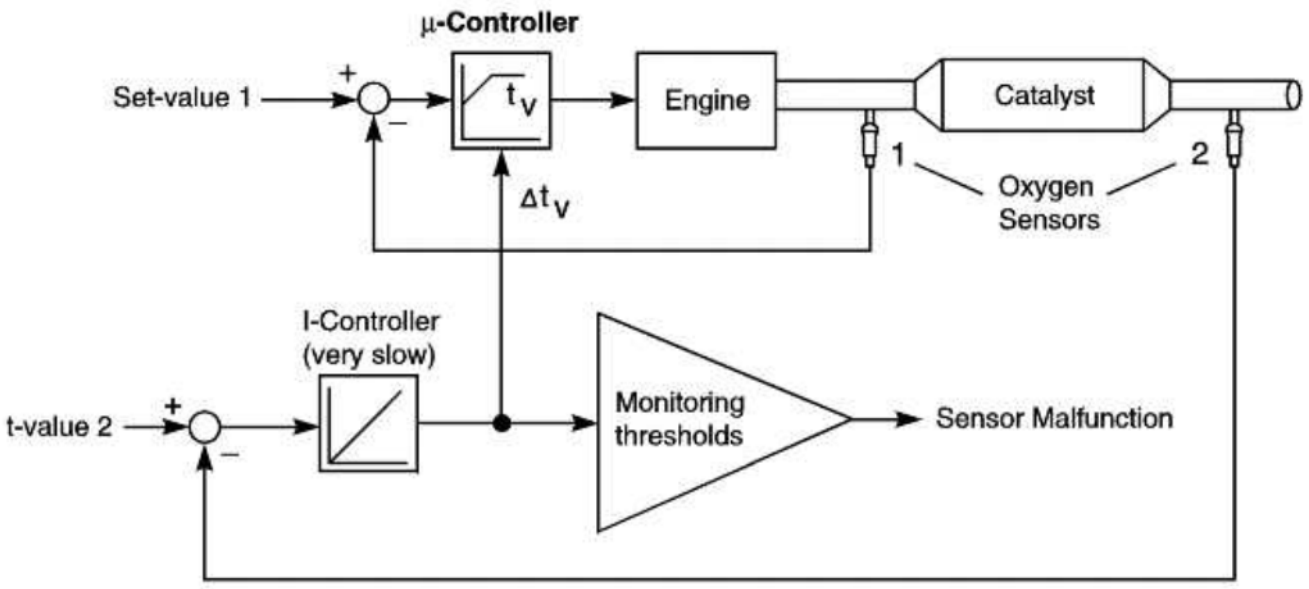
The ECU is supplied with information regarding the oxygen content of the exhaust gases by the front HO2S. The signal is used to compute the injection period. The front HO2S monitors the contaminated exhaust gases. This, in time, causes aging of the device and a change in the signal.

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 ECU 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 ECU will set the diagnosic trouble code HO2S Slow Response by aging.

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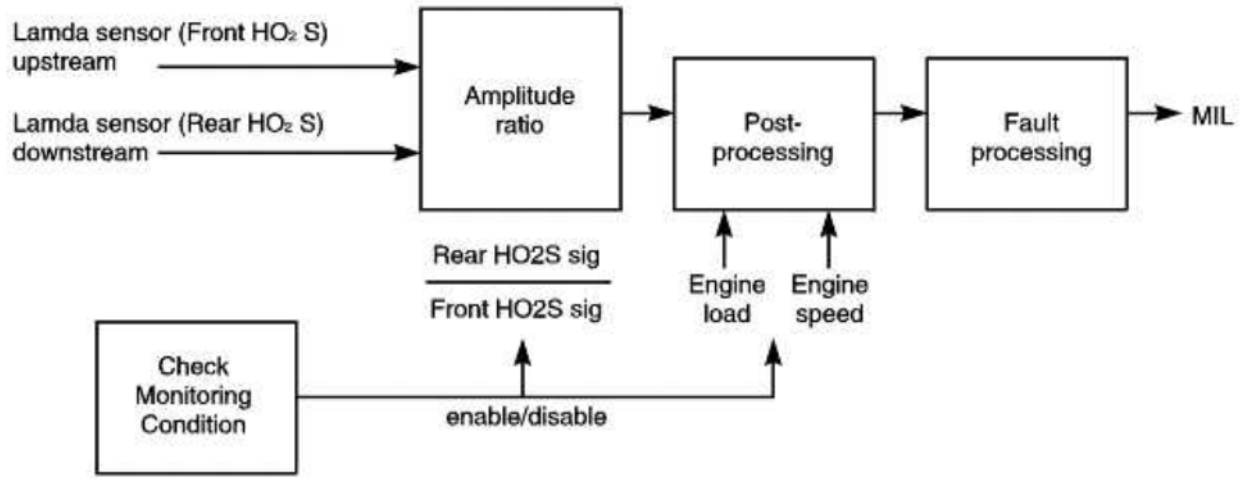
MIL illumination

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

CATALYST MONITORING

SYSTEM DESCRIPTION

To comply with clean air regulatings, vehicles are equipped with catalytic converters. These converters reduce the emissions of hydrocarbons, oxides of nitrogen and carbon monoxide. Normal vehicle operation or engine misfire can cause a catalyst to decay. A meltdown of the ceramic core can cause a reduction of the exhaust passage resulting in an increase in vehicle performance and deteriorate engine performance, driveablity and fuel economy. The catalyst uses dual oxygen sensor to monitor the efficiency of the converter because as a catalyst deteriorates, its oxygen storage capacity and its efficiency are both reduced. By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream (front) HO2 Sensor is used to detect the amount of oxygen in the exhaust gas before it enters the catalytic converter. A low voltage indicates a high oxgen content (lean air mixture) A high voltage indicates a low content of oxygen (rich mixture). When the front HO2 Sensor detects a lean condition, there is an abundance in the oxygen in the exhaust has. A functioning converter would store this oxygen so it can use it for the oxidation of HC and CO. As the converter absorbs the oxygen, there will be a lack of oxygen downstream of the converter. The output of the downstream (rear) HO2 Sensor will indicate limited activity in this condition. As the converter loses the ability to store oxygen, the condition can be detected from the operation of the rear HO2 Sensor. When the catalyst efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same downstream (rear) as upstream (front). The output voltage of the rear HO2 Sensor copies the voltage of the front HO2 Sensor. The only difference is a time lag (monitored by the ECU) between the switching of the HO2 Sensors. To monitor the system, the lean-to-rich switches of front to rear HO2 Sensors is counted. The ratio of rear switches to front switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer rear switches than it has front switches, that is, a ratio closer to zero. For a totally ineffective catalyst, this ratio will be one-to-one indicating that no oxidation occurs in the catalytic converter. The system must be monitored so that when catalyst efficiency deteriorates and exhaust emissions increase to over the legal limit, the MIL will illuminate.



FUEL SYSTEM MONITORING

SYSTEM DESCRIPTION

The determination of how much fuel to deliver to the engine is the calculation of injector pulse width. Basic injection duration (injector pulse width) is determined by :

- Engine load (MAF)
- 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 short FT is ±25%, but under normal operating conditions it rarely goes beyond ±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. It's normal range is ±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 swithed OFF, the fuel system is able to correct for variances in engine and fuel conditions even during warm-up and wide open throttel conditions.

MONITORING PROCESS

The ECU monitors the averages of long term and short term fuel trim. If these fuel trim values reach and stay at their maximum limits (±25%) for a defined period of time, a diagnostic trouble code is set.

MIL ILLUMINATION

When the fuel trim value exceeds the failure thresholds, when the MIL is only turned ON if the same fault is detected during a second drive cycle.

EVAPORATIVE EMISSION CONTROLS

EVAPORATIVE CONTROL SYSTEM

The evaporation control system prevents the emission of fuel tank vapor into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to a charcoal filled evaporative canister. The canister temporarily holds the vapors. The ECU allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

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.

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.

Evaporative emissions canister

The EVAP canister is filled with granules of an activated carbon mixture. Fuel vapors enter into the EVAP canister 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.

Canister close valve

The Canister Close Valve (CCV) closes off the air inlet to the Evaporative Emissions Canister for the Evaporative Emissions System leak detection inspection function. The CCV also prevents fuel vapors from escaping from the Evaporative Emissions Canister when the vehicle is not operating.

Purge solenoid valve

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

Fuel tank pressure sensor

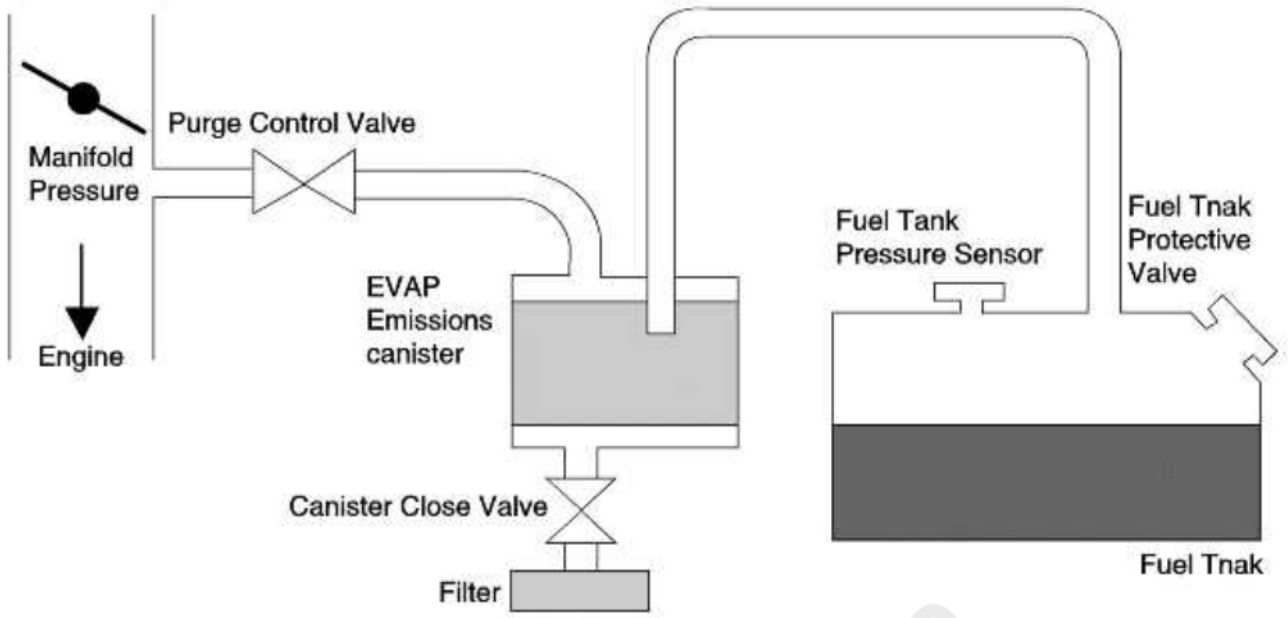
The Fuel Tank Pressure Sensor (FTPS) is an integral part of the monitoring system. The FTPS checks Purge Solenoid Valve operation and leak detection in the Evaporative Emissions System by monitoring pressure and vacuum levels in the fuel tank during and between Purge Solenoid Valve operating cycles.

EVAP SYSTEM MONITORING: LEAKAGE DETECTION

SYSTEM DESCRIPTION

The evaporative system is monitored by a pressure test. The canister close valve and fuel tank pressure sensor are used to close the system and observe tank pressure respectively.

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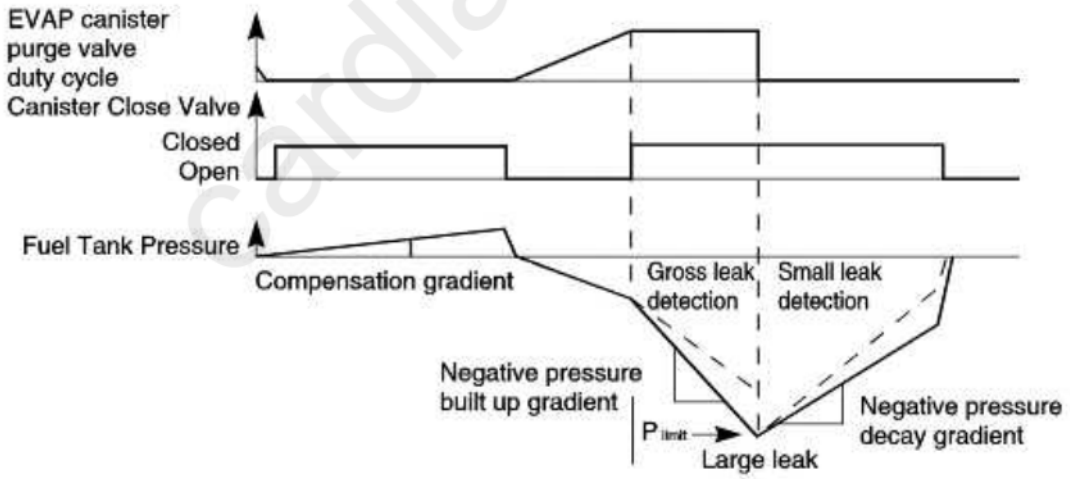


MONITORING CONDITIONS

The leak test is conducted when the vehicle is stopped during an idle condition.

MONITORING PROCESS

The canister close valve and the EVAP canister purge control valve are closed and an increase in fuel tank pressure caused by fuel evaporation occurs (compensation gradient). Afterwards, the canister close valve and the purge control valve are opened. The canister close valve will be shut if the purge control valve reached its final duty cycle.



1. Gross leak detection A gross leak is assumed if negative pressure is built-up below a certain threshold. In this case, the EVAP canister purge control valve is closed and the canister close valve is opened. then, the diagnosis is completed.
2. Small leak detection The EVAP canister purge control valve is closed as soon as the maximum vacuum level is achieved. The rate of vacuum loss will be corrected by the above compensation gradient. A small leak is assumed if this corrected rate of vacuum loss is above a certain threshold. Then, the canister close valve is opened and the diagnosis is completed.

MIL ILLUMINATION

If either a rough leak or a small leak is detected for two driving cycles, then a defective evaporative system is assumed and the MIL is illuminated.

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MISFIRE MONITORING

SYSTEM DESCRIPTION

Misfire is monitored by evaluating fluctuations of the angular velocity of the crankshaft position sensor. The crankshaft position sensor allows the ECU to monitor crankshaft speed variations during each cylinder power stroke. When all cylinders of an engine are firing evenly, the crankshaft speeds up evenly with each power stroke. During a misfire, crankshaft speed decreases in that cylinder. Kia OBD-II engines use a 60 minus 2 tooth crankshaft position sensor to measure crankshaft speed and position. The ECU uses this information to determine if a misfire occurs, which cylinder it is occurring in, and the degree of misfire. If a significant misfire is detected, a DTC is stored. The MIL in the instrument panel will illuminate, informing the driver of a malfunction.

MONITORING CONDITIONS

The misfire monitoring begins as soon as 2.9 to 50 ignitions pass after engine start. It is disabled while the ECU detects a sudden change of engine speed or load. The misfire monitoring covers the full range of engine operation.

MONITORING PROCESS

A new function for pre-filtering the sensor wheel segment duration has been introduced on the Optima in order to expand the misfire monitoring range. The sensor wheel segment duration is pre-filtered by this function and then the filtered value is used to calculate the engine roughness which is compared with the reference value to detect misfiring. With this function, it is possible to eliminate the influence of the crankshaft-synchronous oscillations on the detection of misfire. These oscillations can be caused by sensor wheel tolerance or crankshaft torsional vibration. The misfire monitoring of this vehicle covers nearly the full range of engine operation in case of random or continuous misfire, and for symmetrical misfire.

MIL ILLUMINATION

The MIL is illuminated when a misfire is detected which can cause the damage of catalyst or exhaust emission higher than 1.5 times certification standard (I/M failure). The MIL flashes while a catalyst damaging misfire is being detected.

COMPREHENSIVE COMPONENTS MONITORING

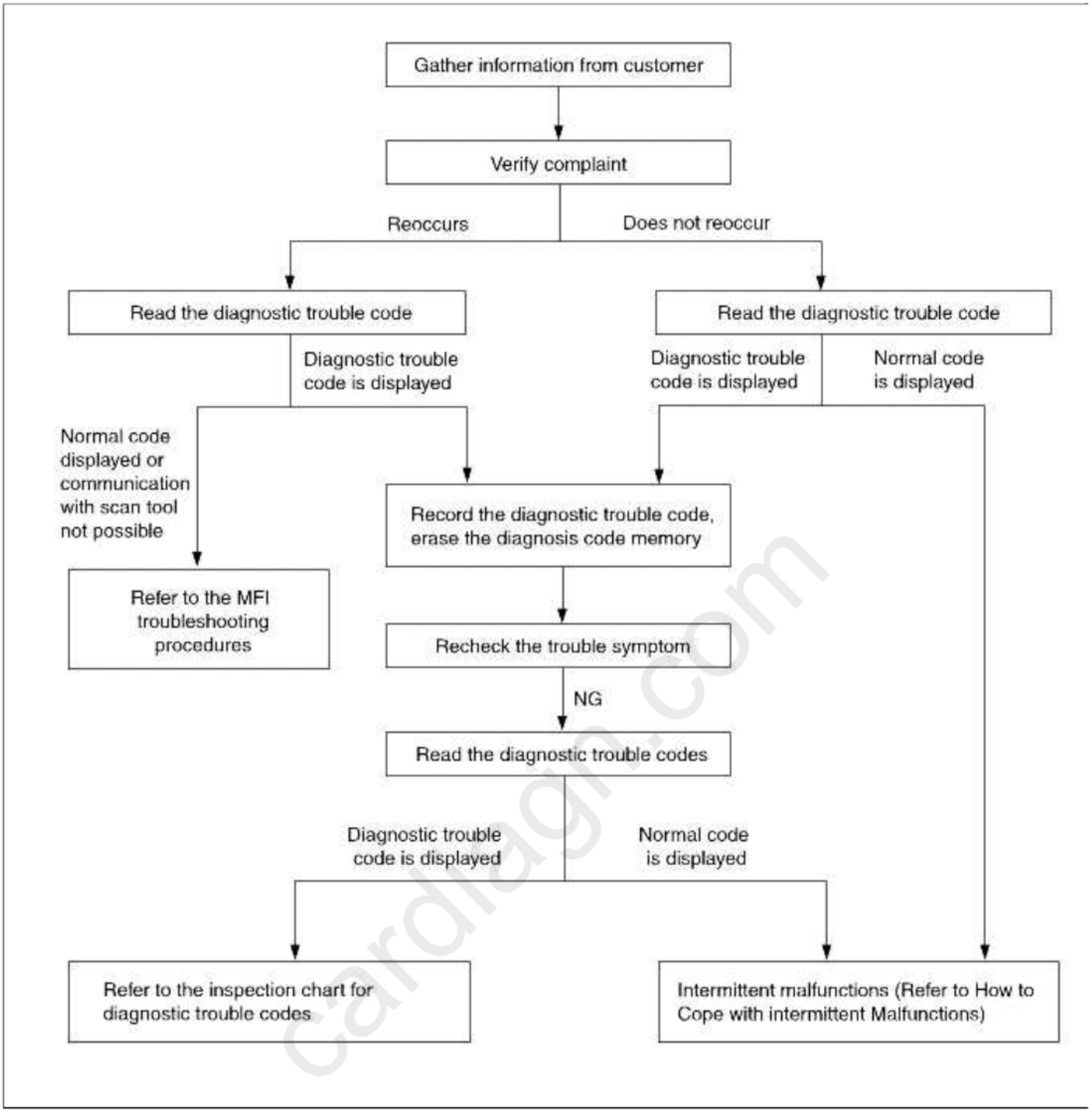
Any input or output components that can affect emissions or any input or output component used to monitor any other moniotred component/system is monitored. The lack of circuit continuity and rationality, and out-of-range values to ensure proper operation of the input devices, are monitored for proper response to ECU commands.

EGR SYSTEM MONITORING (FOR VEHICLE WITH EGR SYSTEM)

The EGR system is monitored by the measurement of manifold pressure variation by turning on EGR during coasting. The manifold pressure is measured before and after EGR valve has been activated and the corresponding pressure variation is compared with reference value to detect a EGR system malfunction.

DIAGNOSTIC TROUBLESHOOTING FLOW

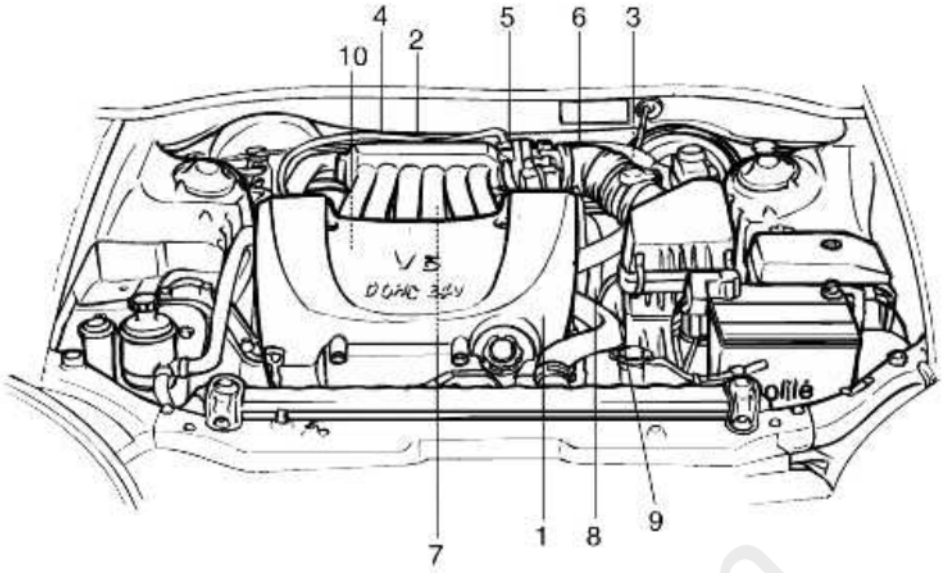
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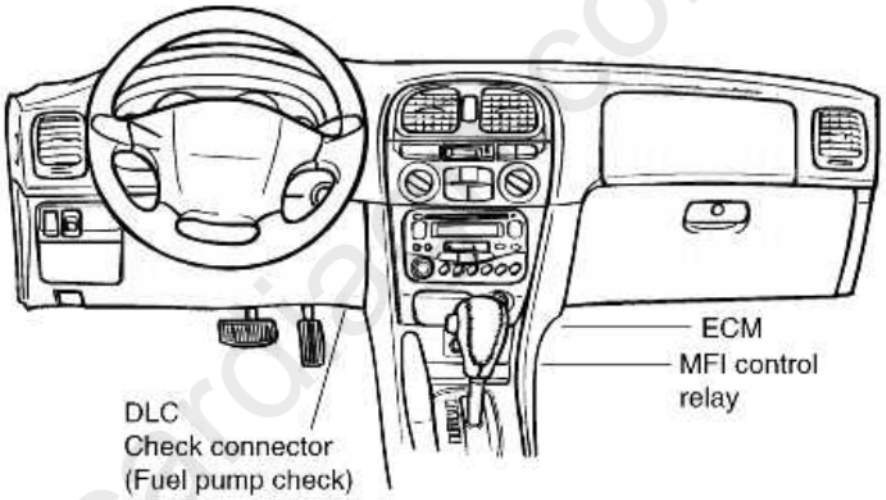


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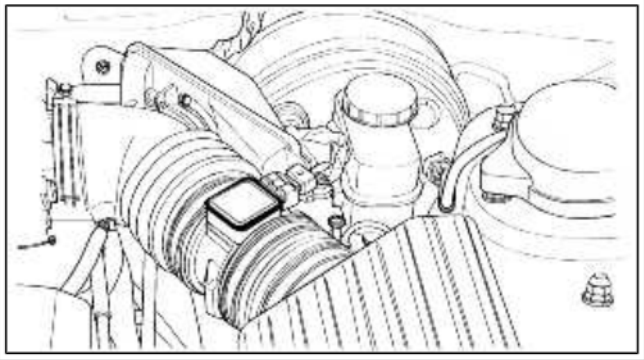
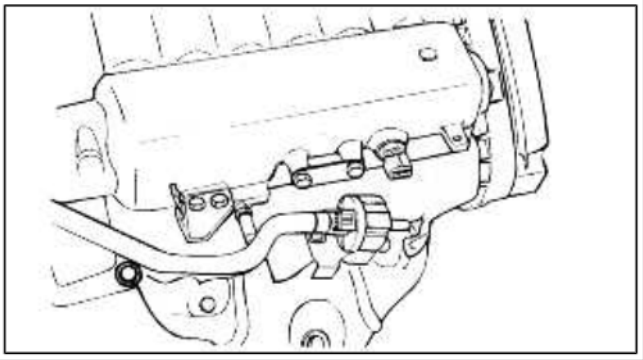
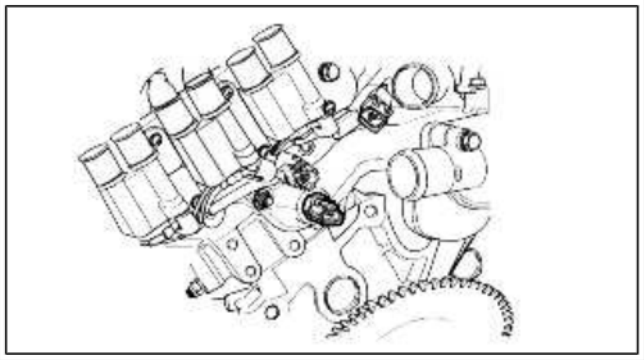
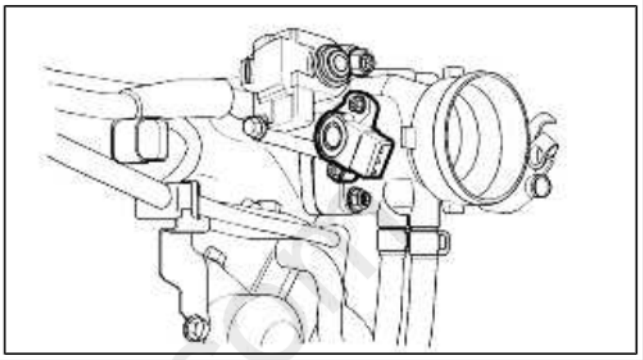
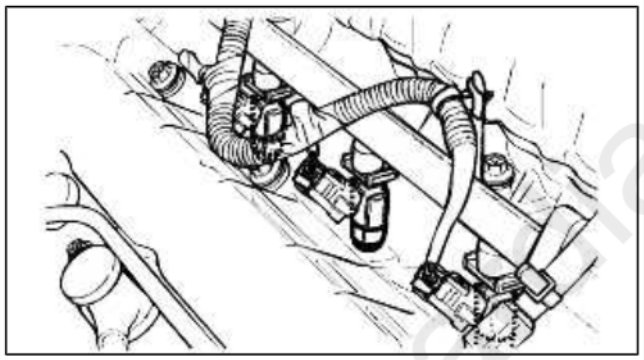
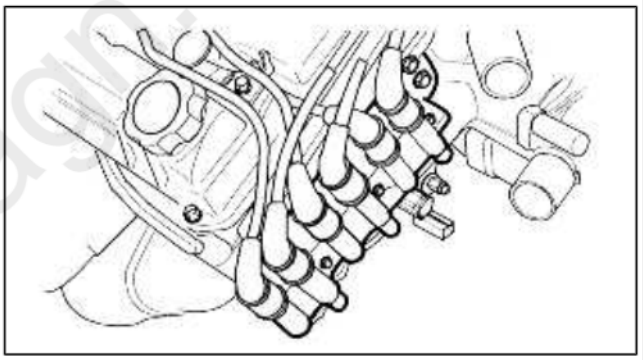
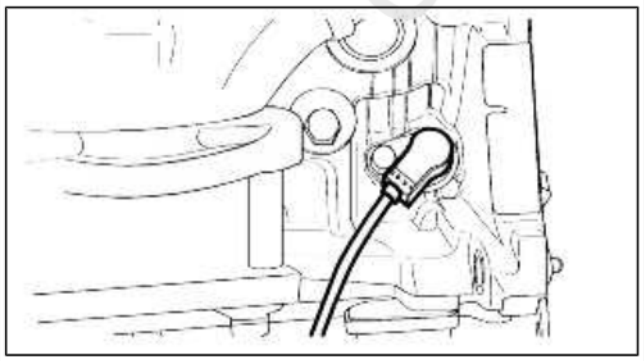
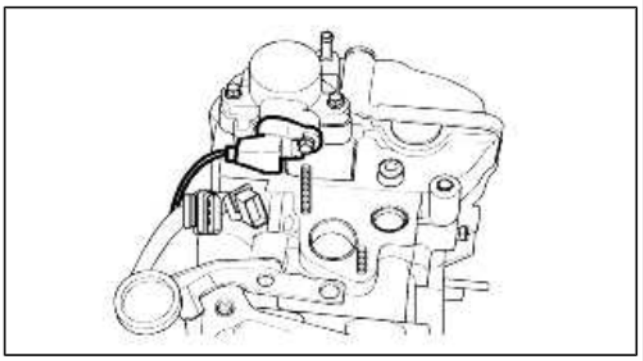
Fuel System > Engine Control System > Components and Components Location

LOCATION OF MFI COMPONENTS





1. Water Temperature Sensor (WTS)
2. Purge Control Solenoid Valve (PCSV)
3. Mass Air Flow (MAF) sensor
4. Intake Air Temperature Sensor (ATS)
5. Throttle Position Sensor (TPS)
6. Idle Speed Control Actuator (ISA)
7. Heated Oxygen Sensor (HO2S)
8. Camshaft Position (TDC) Sensor
9. Crankshaft Position (CKP) Sensor
10. Injector

Mass Air Flow (MAF) Sensor	Intake Air Temperature Sensor (ATS)
	
Water Temperature Sensor (WTS)	Throttle Position Sensor (TPS)
	
Injector	Ignition Coil
	
Camshaft Position (TDC) Sensor	Crankshaft Position (CKP) Sensor
	

Fuel System > Engine Control System > Troubleshooting

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODE

DTC	Diagnostic items	Trouble area	MIL

P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	• Dirty air cleaner • Air leak in intake system • Vacuum leak in intake system • Improper PCV valve • Contaminated, deteriorated or damaged MAF • Faulty mass air flow sensor or throttle position sensor • Poor connections at ECU, MAF, or TPS	O
P0102	Mass or Volume Air Flow Circuit Low Input	• Open or short to ground between MAF and ECU • Open or short to ground between MAF battery power and engine main relay • Faulty MAF	O
P0103	Mass or Volume Air Flow Circuit High Input	• Short to battery between MAF signal and ECU • Faulty MAF	O
P0112	Intake Air Temperature Sensor (ATS) Circuit Low Input	• Open or short to battery between ATS signal and ECU • Open between ATS ground and ECU • Faulty ATS	O
P0113	Intake Air Temperature Sensor (ATS) Circuit High Input	• Short to ground between ATS signal and ECU • Faulty ATS	O
P0116	Water Temperature Sensor (WTS) Circuit Range/Performance Problem	• After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) • Poor connections between WTS and ECU • Misplaced, loose or corroded terminals • Foreign materials fouled, contaminated, deteriorated WTS • Faulty WTS • Faulty thermostat	O
P0117	Water Temperature Sensor (WTS) Circuit Low Input	• Open or short to battery between WTS signal and ECU • Open between WTS ground and ECU • Faulty WTS	O
P0118	Water Temperature Sensor (WTS) Circuit High Input	• Short to ground between WTS signal and ECU • Faulty WTS	O
P0119	Water Temperature Sensor (WTS) Circuit Intermittent	• Short to battery between WTS and ECU • Poor connections between WTS and ECU • Misplaced, loose or corroded terminals • Foreign materials fouled WTS	O
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control	• After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) • Poor connections between WTS and ECU • Misplaced, loose or corroded terminals • Foreign materials fouled, contaminated, deteriorated WTS • Faulty WTS • Faulty thermostat	O

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P0128	Coolant thermostat stuck	• Thermostat stuck opened	O
P0121	Throttle Position Sensor (TPS) Circuit Range/Performance Problem	• Poor connection between TPS and ECU • Misplaced, loose or corrodes terminals • Contaminated, deteriorated TPS • Faulty TPS	O
P0122	Throttle Position Sensor (TPS) Circuit Low Input	• Open or short to ground between TPS reference power and ECU • Short to ground between TPS signal and ECU • Faulty TPS	O
P0123	Throttle Position Sensor (TPS) Circuit High Input	• Open or short to battery between TPS signal and ECU • Open between TPS ground and ECU • Faulty TPS	O
P0130	HO2S Circuit Malfunction-Open(Bank 1, Sensor 1)	• Open between front HO2S and ECU. • Faulty front HO2S • Poor connections bwtween front HO2S and ECU • Misplaced, bent, loose or corroded terminals.	O
P0131	HO2S Circuit Low Input (Bank 1, Sensor 1)	• Short to ground between front HO2S signal and ECU • Faulty front HO2S	O
P0132	HO2S Circuit High Input (Bank 1, Sensor 1)	• Open or short to battery between front HO2S signal and ECU • Faulty front HO2S	O
P0133	HO2S Circuit Slow Responsive (Bank 1, Sensor 1)	• Abnormal combustion • Improper fuel pressure • Front and rear HO2S connections reversed • Faulty fuel delivery system • Leak in intake system • Leak in exhaust system • Faulty front HO2S	O
P0134	HO2S Circuit No Activity Detected (Bank 1, Sensor 1)	• Open or short between HO2S signal terminal and ECU • Contaminated, deteriorated or aged HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty front HO2S	O
P0030	HO2S Heater Circuit Malfunction (Bank 1, Sensor 1)	• Open or short to battery between front HO2S heater and ECU • Short to ground between front HO2S heater and ECU • Open or short to ground between front HO2S heater and main relay • Incorrect front HO2S heater resistance • Faulty front HO2S heater	O
P0031	HO2S Heater Circuit Low Input (Bank 1, Sensor 1)	• Open or short to ground front HO2S heater signal and ECU • Open or short to ground front HO2S heater battery power and main relay • Faulty front HO2S heater	O

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P0032	HO2S Heater Circuit High Input (Bank 1, Sensor 1)	• Short to battery between front HO2S heater signal and ECU • Faulty front HO2S	O
P0136	HO2S Circuit Malfunction-Open (Bank 1, Sensor 2)	• Open between rear HO2S and ECU • Faulty front HO2S • Poor connctions between rear HO2S and ECU • Misplaced, bent, loose or corroded terminals	O
P0137	HO2S Circuit Low Input (Bank 1, Sensor 2)	• Short to ground between rear HO2S signal and ECU • Faulty rear HO2S	O
P0138	HO2S Circuit High Input (Bank 1, Sensor 2)	• Open or short to ground front HO2S heater signal and ECU • Faulty rear HO2S heater	O
P0139	HO2S Circuit Slow Response (Bank 1, Sensor 2)	• Abnormal combustion • Improper fuel pressure • Front and rear HO2S connections reversed. • Faulty fuel delivery system • Leak in intake system • leak in exhaust system • Faulty rear HO2S	O
P0140	HO2S Circuit No Activity Detected (Bank 1, Sensor 2)	• Open or short between rear HO2S signal terminal and ECU • Contaminated, deteriorated or aged rear HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty rear HO2S	O
P0036	HO2S Heater Circuit Malfunction (Bank 1, Sensor 2)	• Open or short to battery between rear HO2S heater and ECU • Short to ground between rear HO2S heater and ECU • Open or short to ground between rear HO2S heater and main relay • Incorrect rear HO2S heater resistance • Faulty rear HO2S heater	O
P0037	HO2S Heater Circuit Low Input (Bank 1, Sensor 2)	• Open or short to ground rear HO2S heater signal and ECU • Open or short to ground rear HO2S heater battery power and main relay • Faulty rear HO2S heater	O
P0038	HO2S Heater Circuit High Input (Bank 1, Sensor 2)	• Short to battery between rear HO2S heater signal and ECU • Faulty rear HO2S	O
P0150	HO2S Circuit Malfunction-Open (Bank 2, Sensor 1)	• Open between front HO2S and ECU • Faulty front HO2S • Poor connections between front HO2S and ECU • Misplaced, bent, loose or corroded terminals.	O
P0151	HO2S Circuit Low Input (Bank 2, Sensor 1)	• Short to ground between front HO2S signal and ECU • Faulty front HO2S	O
P0152	HO2S Circuit High Input (Bank 2, Sensor 1)	• Open or short to battery between front HO2S signal and ECU • Faulty front HO2S	O

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P0153	HO2S Circuit Slow Responsive (Bank 2, Sensor 1)	• Abnormal combustion • Improper fuel pressure • Front and rear HO2S connections reversed • Faulty fuel delivery system • Leak in intake system • Leak in exhaust system • Faulty front HO2S	O
P0154	HO2S Circuit No Activity Detected (Bank 2, Sensor 1)	• Open or short between HO2S signal terminal and ECU • Contaminated, deteriorated or aged HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty front HO2S	O
P0050	HO2S Heater Circuit Malfunction (Bank 2, Sensor 1)	• Open or short to battery between front HO2S heater and ECU • Short to ground between front HO2S heater and ECU • Open or short to ground between front HO2S heater and main relay • Incorrect front HO2S heater resistance • Faulty front HO2S heater	O
P0051	HO2S Heater Circuit Low Input (Bank 2, Sensor 1)	• Open or short to ground front HO2S heater signal and ECU • Open or short to ground front HO2S heater battery power and main relay • Faulty front HO2S heater	O
P0052	HO2S Heater Circuit High Input (Bank 2, Sensor 1)	• Short to battery between front HO2S heater signal and ECU • Faulty front HO2S	O
P0156	HO2S Circuit Malfunction-Open (Bank 2, Sensor 2)	• Open between rear HO2S and ECU • Faulty fornt HO2S • Poor connections between rear HO2S and ECU • Misplaced, bent, loose or corroded terminals	O
P0157	HO2S Circuit Low Input (Bank 2, Sensor 2)	• Short to ground between rear HO2S signal and ECU • Faulty rear HO2S	O
P0158	HO2S Circuit High Input (Bank 2, Sensor 2)	• Open or short to battery between rear HO2S signal and ECU • Faulty rear HO2S	O
P0159	HO2S Circuit Slow Response (Bank 2, Sensor 2)	• Abnormal combustion • Improper fuel pressure • Front and rear HO2S connections reversed • Faulty fuel delivery system • Leak in intake system • Leak in exhaust system • Faulty rear HO2S	O
P0160	HO2S Circuit No Activity Detected (Bank 2, Sensor 2)	• Open or short between rear HO2S signal terminal and ECU • Contaminated, deteriorated or aged rear HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty rear HO2S	O

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P0056	HO2S Heater Circuit Malfunction (Bank 2, Sensor 2)	• Open or short to battery between rear HO2S heater and ECU • Short to ground between rear HO2S heater and ECU • Open or short to ground between rear HO2S heater and main relay • Incorrect rear HO2S heater resistance • Faulty rear HO2S heater	O
P0057	HO2S Heater Circuit Low Input (Bank 2, Sensor 2)	• Open or short to ground rear HO2S heater signal and ECU • Open or short to ground rear HO2S heater battery power and main relay • Faulty rear HO2S heater	O
P0058	HO2S Heater Circuit High Input (Bank 2, Sensor 2)	• Short to battery between rear HO2S heater signal and ECU • Faulty rear HO2S	O
P0171	Fuel System Too Lean (Bank 1)	• Faulty fuel delivery system • Clogged fuel injectors • Faulty fuel injectors • Leak in intake system • Leak in exhaust system • Faulty MAF • Faulty TPS	O
P0174	Fuel System Too Lean (Bank 2)		O
P0172	Fuel System Too Rich (Bank 1)	• Faulty ignition system • EVAP canister purge valve malfunction • Leak in intake system • Leak in exhaust system • Faulty fuel delivery system - Clogged fuel injectors - Faulty fuel injectors - Fuel pressure too high - Fuel pressure regulator failure • Faulty MAF • Faulty front HO2S • Faulty TPS	O
P0175	Fuel System Too Rich (Bank 2)		O
P0261	Cylinder 1 Injector Circuit Low Input	• Open or short to ground between main relay and injector • Open or short to ground between ECU and injector • Faulty fuel injector	O
P0262	Cylinder 1 Injector Circuit High Input	• Short to battery between ECU and injector • Faulty fuel injector	O
P0264	Cylinder 2 Injector Circuit Low Input	• Open or short to ground between main relay and injector • Open or short to ground between ECU and injector • Faulty fuel injector	O
P0265	Cylinder 2 Injector Circuit High Input	• Short to battery between ECU and injector • Faulty fuel injector	O

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P0267	Cylinder 3 Injector Circuit Low Input	• Open or short to ground between main relay and injector • Open or short to ground between ECU and injector • Faulty fuel injector	O
P0268	Cylinder 3 Injector Circuit High Input	• Short to battery between ECU and injector • Faulty fuel injector	O
P0270	Cylinder 4 Injector Circuit Low Input	• Open or short to ground between main relay and injector • Open or short to ground between ECU and injector • Faulty fuel injector	O
P0271	Cylinder 4 Injector Circuit High Input	• Short to battery between ECU and injector • Faulty fuel injector	O
P0273	Cylinder 5 Injector Circuit Low Input	• Open or short to ground between main relay and injector • Open or short to ground between ECU and injector • Faulty fuel injector	O
P0274	Cylinder 5 Injector Circuit High Input	• Short to battery between ECU and injector • Faulty fuel injector	O
P0276	Cylinder 6 Injector Circuit Low Input	• Open or short to ground between main relay and injector • Open or short to ground between ECU and injector • Faulty fuel injector	O
P0277	Cylinder 6 Injector Circuit High Input	• Short to battery between ECU and injector • Faulty fuel injector	O
P0230	Fuel Pump Circuit Malfunction	• Open or short to ground between fuel pump relay and ECU • Open between fuel pump and ECU • Faulty fuel pump	▲
P0300	Random Misfire Detected	• Vacuum leak in air intake system • CKP circuit malfunction • Ignition circuit malfunction • Faulty ignition coil or plug wire • Spark plug malfunction • Low compression due to blown head gasket, leaking valve or piston ring • Low/high fuel pressure due to faulty pressure regulator, restricted fuel lines, plugged fuel filter or faulty fuel pump • Fuel injector circuit malfunction Faulty fuel injector	O
P0301	Cylinder 1 Misfire Detected		O
P0302	Cylinder 2 Misfire Detected		O
P0303	Cylinder 3 Misfire Detected		O
P0304	Cylinder 4 Misfire Detected		O
P0305	Cylinder 5 Misfire Detected		O
P0306	Cylinder 6 Misfire Detected		O
P0325	Knock Sensor Circuit Malfunction (Bank 1)	• Open or short to ground between knock sensor and ECU • Source of high resistance between knock sensor and ECU • Faulty knock sensor	▲
P0330	Knock Sensor Circuit Malfunction (Bank 2)		▲
P0335	Crankshaft Position (CKP) Sensor Circuit Malfunction	• Open or short to ground between CKP and ECU • Short to battery between CKP and ECU • Short between CKP wires • Out of allowable air gap	O

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		• Faulty Target wheel tolerance • Faulty CKP	
P0340	Camshaft Position (TDC) Sensor Circuit Malfunction	• Open or short to ground between TDC and ECU • Short to battery between TDC and ECU • Short between TDC wires • Poor connection between TDC connector & harness connector • Faulty TDC	O
P0350	Ignition Coil Primary/Secondary Circuit Malfunction	• Open or short between ignition coil and ECU • Open or short between ignition coil and spark plug • Short between ignition coil wires • Faulty ignition coil • Poor connection at ignition coil • Faulty ignition system	▲
P0351	Ignition Coil `A´ Primary/Secondary Circuit Malfunction		▲
P0352	Ignition Coil `B´ Primary/Secondary Circuit Malfunction		▲
P0353	Ignition Coil `C´ Primary/Secondary Circuit Malfunction		▲
P0354	Ignition Coil `D´ Primary/Secondary Circuit Malfunction		▲
P0355	Ignition Coil `E´ Primary/Secondary Circuit Malfunction		▲
P0356	Ignition Coil `F´ Primary/Secondary Circuit Malfunction		▲
P0420	Main Catalyst Efficiency Below Threshold (Bank1)	• Catalytic converter deteriorated	O
P0430	Main Catalyst Efficiency Below Threshold (Bank 2)	• Catalytic converter deteriorated	O
P0441	EVAP Emission Control System Purge Control Valve stuck opened	• PCSV stuck opened	O
P0442	EVAP Emission Control System - Small Leak (1mm)	• Fuel filler cap loose or missing • Fuel filler cap o-ring missing or damaged • Faulty or damaged fuel filler pipe • Leaking, disconnected or plugged fuel vapor lines • Fuel in lines due to faulty rollover valve, on-board refueling vapor recovery valve or stuck closed CCV • Canister close valve clogged, stuck open or closed	O
P0455	EVAP Emission Control System - Large Leak		O

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P0456	Evaporative Emission Control System-Small Leak Detected (0.5mm)	• Improperly installed purge solenoid valve • PSV stuck open or closed • Faulty fuel tank pressure sensor • Leaking canister or catch tank	O
P0444	EVAP Emission Control System Purge Control Valve Circuit Open	• Open or short between main relay and purge solenoid valve • Open or short between purge solenoid valve and ECU • Faulty purge solenoid valve	O
P0445	EVAP Emission Control System Purge Control Valve Circuit Short		O
P0447	EVAP Emission Control System Vent Circuit Open	• Open or short to ground between main relay and CCV • Open or short to ground between CCV and ECU • Short to battery between CCV and ECU • Faulty CCV	O
P0448	EVAP Emission Control System Vent Circuit Shorted		O
P0449	EVAP Emission Control System Vent Stuck Closed	• Stuck in valve closed position (CCV) • Faulty CCV	O
P0451	EVAP Emission Control System Pressure Sensor Range/Performance Problem	• Poor connections between FTPS and ECU • Misplaced, loose, bent or corroded terminals • Contaminated, deteriorated or damaged FTPS • Blocked vaper hose between canister and CCV • Stuck close CCV • Faulty FTPS	O
P0452	EVAP Emission Control System Pressure Sensor Low Input	• Open or short to ground between FTPS reference power and ECU • Short to ground between FTPS signal and ECU • Faulty FTPS	O
P0453	EVAP Emission Control System Pressure Sensor High Input	• Open or short to battery between FTPS signal and ECU • Open between FTPS ground signal and FTPS • Faulty FTPS	O
P0454	Evaporative Emission Control System-Pressure Sensor Intermittent	• Open or short to ground between FTPS and ECU • Short to battery between FTPS and ECU • Poor connections between FTPS and ECU • Misplaced, loose or corroded terminals • Foreign materials fouled FTPS • Faulty FTPS	O
P0461	Fuel Level Sensor Circuit Range/Performance Malfunction	• Open or short to battery between FLS and ECU • Short to ground between FLS and ECU • Poor connections between FLS and ECU • Misplaced, loose, bent or corroded terminals • Faulty FLS or FLS stuck	▲
P0462	Fuel Level Sensor Low-Stick		▲
P0463	Fuel Level Sensor High-Stick		▲
P0501	Vehicle Speed Sensor Circuit Malfunction	• Open between VSS and ECU. • Short to ground between VSS and ECU	O

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	(Refer to GR. "BRA" for the vehicles with ABS)	• Short between VSS wires • Faulty VSS	
P0506	Idle Control System RPM Lower Than Expected	• Open or short between main relay and ISA • Open or short between ECU and ISA • Intake system is plugged • Carbon fouled throttle plate • Faulty ISA	O
P0507	Idle Control System RPM Higher than Expected	• Short to ground between ISA and ECU • Air leak in intake system • Improperly adjusted accelerator cable • Faulty ISA • Faulty TPS • Faulty PCV/PCSV	O
P0560	System Voltage Malfunction	• Open or short to ground between ECU and battery • Reverse battery cable connection (+/- reverse) • ECU internal faulty • Faulty Alternator	▲
P0562	System Voltage Low Input		O
P0563	System Voltage High Input		O
P0605	ECU Malfunction	• Internal ECU malfunction	O
P1134	HO2S Circuit-Transition Switch Time Malfunction/Slip (Bank 1, Sensor1)	• HO2S Deteriorated • Foreign Material Deposit	O
P1154	HO2S Circuit-Transition Switch Time Malfunction/Slip (Bank 2, Sensor1)		O
P1166	Lambda bank control limit (Bank 1)	• P1166 is case for HO2S (Bank1, Sensor 1) Signal line open • P1167 is case for HO2S (Bank2, Sensor 1) Signal line open • Fuel System (Fuel Tank/Pressure Regulator/Fuel Pump/PCV) Failure • Poor Connection to Fuel Line Hose/ Sealing/Cut • Sealing Between Purge Valve and Fuel Tank • Air Leakage in Exhaust System • Ignition System (Ignition Coil, Spark Plug, Cable) Failure • Surge Tank and Intake Port Failure	O
P1167	Lambda bank control limit (Bank 2)		O
P1372	Segment Time Acquisition Incorrect	• Improperly installed target wheel • Faulty wires between ECU and CKP • Bad signal of CKP • Poor connection • Faulty CKP	▲
P1505	Idle Air Control Valve Opening Coil Signal Low Input	• Open or short to ground between ISA and ECU • Faulty ISA	O
P1506	Idle Air Control Valve Opening Coil Signal High Input	• Short to battery between ISA and ECU • Faulty ISA	O

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P1507	Idle Air Control Valve Closing Coil Signal Low Input	• Open or short to ground between ISA and ECU • Faulty ISA	O
P1508	Idle Air Control Valve Closing Coil Signal High Input	• Short to battery between ISA and ECU • Faulty ISA	O
P0551	Power Steering Switch Malfunction	• Open between power steering switch and ECU • Short to ground between power steering switch and ECU • Faulty power steering switch	▲
P1529	TCU Request for MIL ON/Freeze Frame to ECU via CAN	• This is only a request from TCU to turn the MIL ON. The fault code is stored in the TCU. The freeze frame data is stored in the ECU under the P1529 request code. Be sure to retrieve freeze frame data before clearing code P1529 from ECU.	O
P1602	Serial Communication Problem with TCU (Timeout)	• Open or short to ground between TCU signal and ECU • Short to battery between TCU and ECU • CAN message timeout from TCU • Faulty TCU	O
P0650	MIL Control Circuit Malfunction	• Open or short to ground between MIL and ECU • Faulty MIL	▲

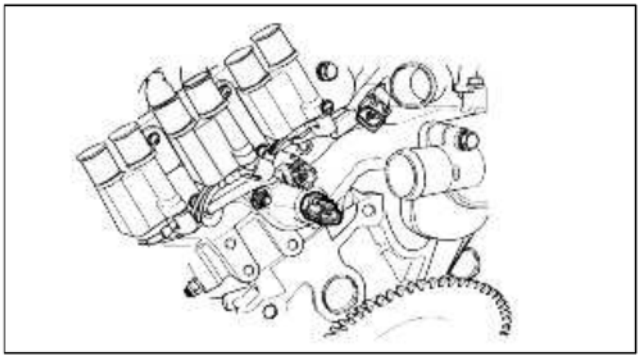
NOTE

O : Means fault code memory and MIL ON
▲ : Means fault code memory and MIL OFF

Fuel System > Engine Control System > Repair procedures

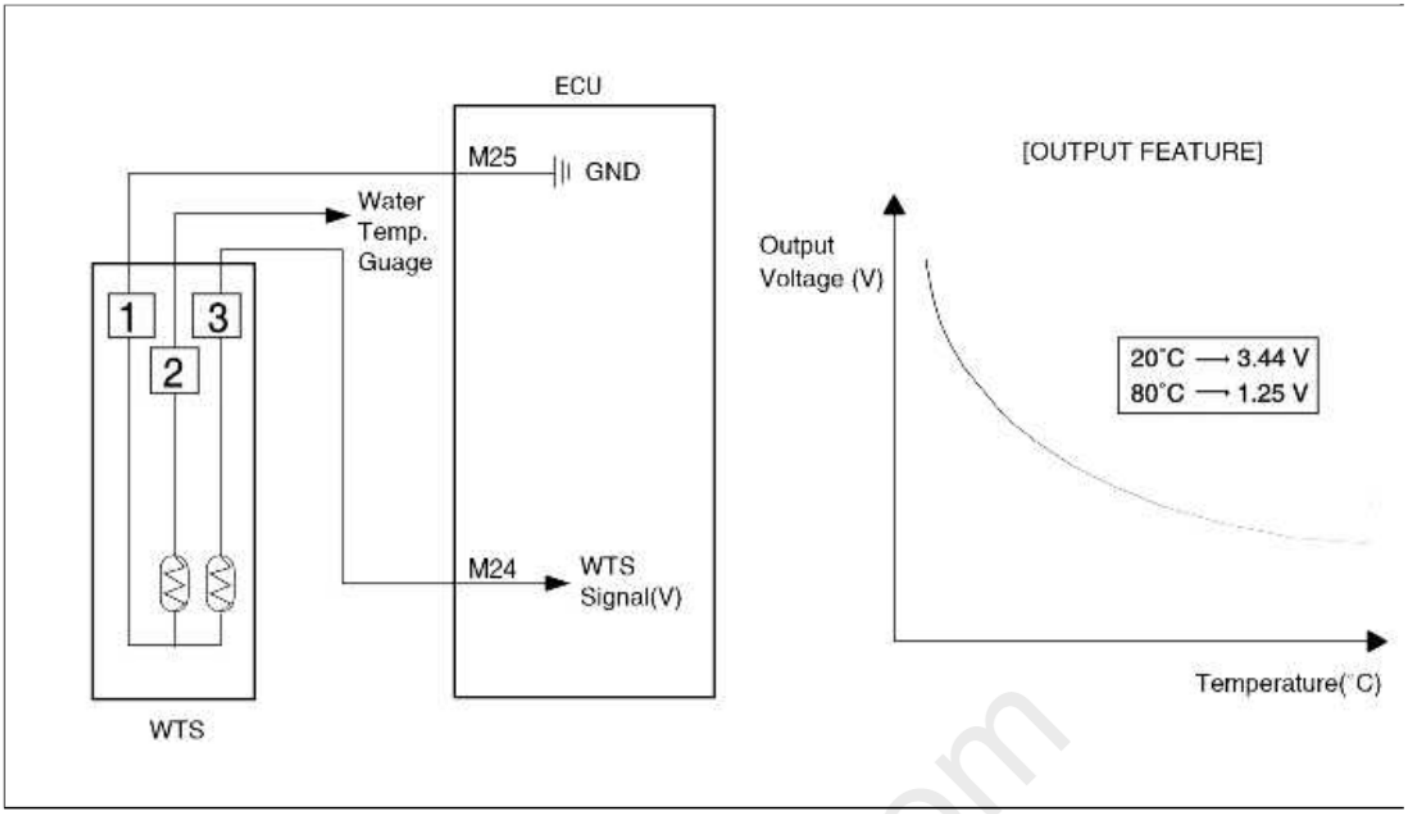
WATER TEMPERATURE SENSOR (WTS)

Water Temperature Sensor (WTS) installed in the engine coolant passage of the cylinder head detects the engine coolant temperature and emits signals to the ECU. This part employs a thermistor which is sensitive to changes in temperature. The electric resistance of the thermistor decreases in response to a temperature rise (NTC). The ECU determines engine coolant temperature by the sensor output voltage and provides optimum fuel enrichment when the engine is cold.

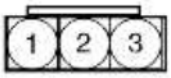


[CIRCUIT DIAGRAM AND OUTPUT FEATURE (WTS)]

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[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal M25	GND
2	Cluster	Guage Unit
3	ECU Terminal M24	WTS Signal Output

SENSOR INSPECTION (WTS)

1. USING HI-SCAN (PRO)

Check Item	Data Display	Check Condition	Water Temperature [°C (°F)]	Resistance (kΩ)
Water Temperature Sensor (WTS)	Water Temperature Sensor (WTS)	IG ON or Engine Running	-40 (-40)	48.14
			20 (68)	2.31 ~ 2.59
			80 (178)	0.32
			110 (230)	0.15

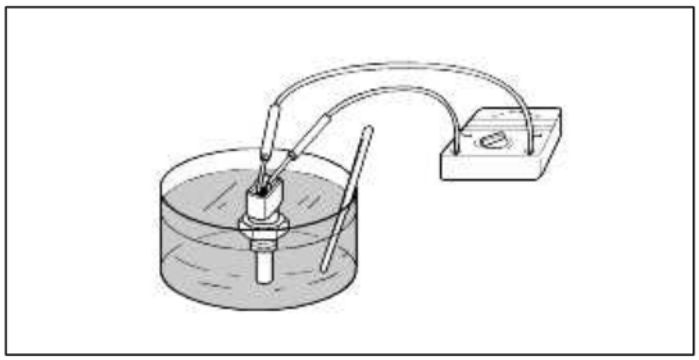
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2. USING MULTI-METER

(1) Remove the Water Temperature Sensor (WTS) from the intake manifold.

(2) With the temperature sensing portion of Water Temperature Sensor (WTS) immersed in hot engine coolant, check the resistance.

Temperature [°C (°F)]	Resistance (kΩ)
0 (32)	5.79
20 (68)	2.31 ~ 2.59
40 (104)	1.15
80 (176)	0.32



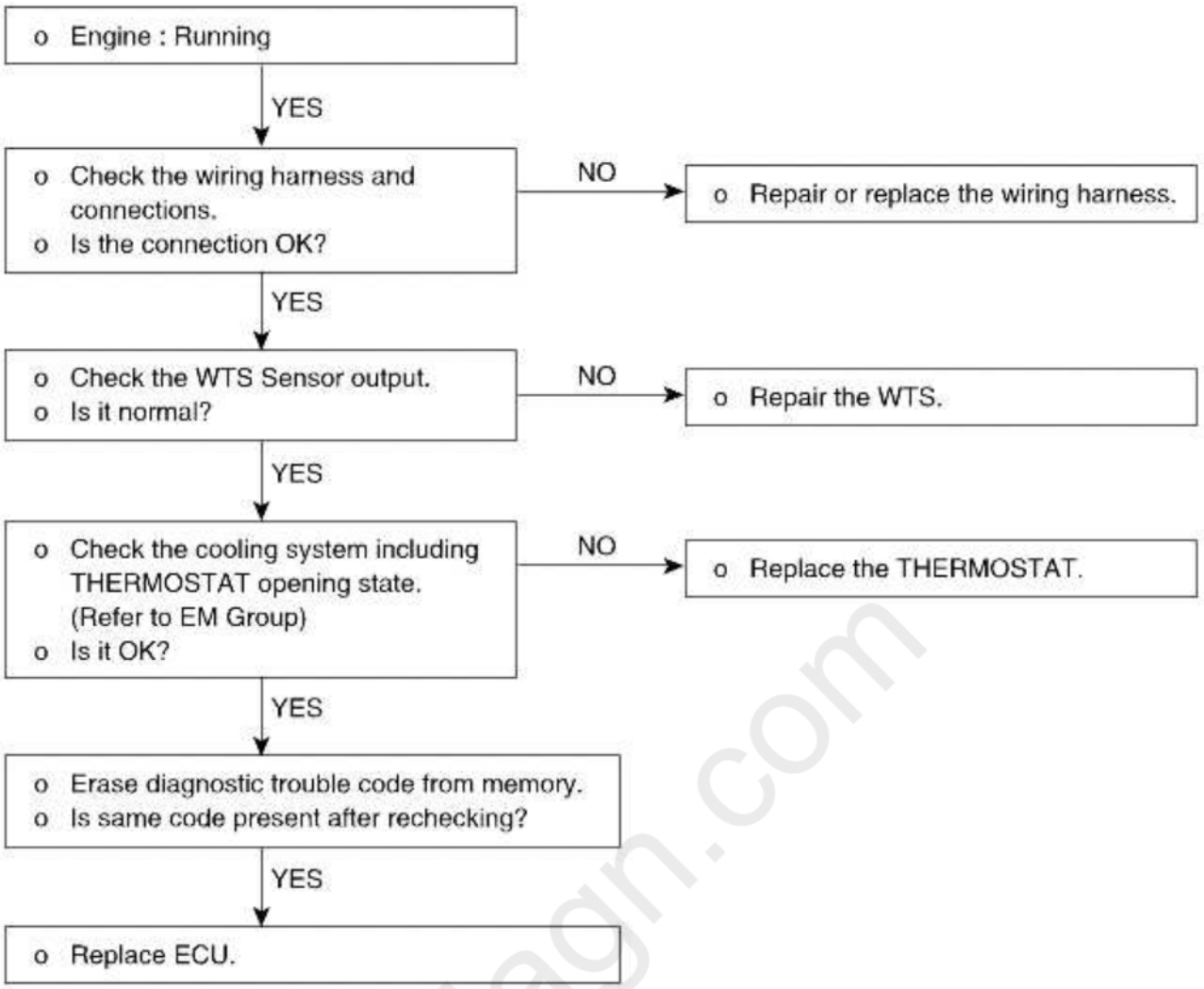
(3) If the resistance deviates from the standard value greatly, replace the sensor.

3. USING VOLT-METER

Check Item	Water Temperature [°C (°F)]	Voltage (V)
Water Temperature Sensor (WTS) Signal Output	20 (68)	3.6 - 3.8
	40 (104)	2.7 - 3.0
	80 (176)	1.2 - 1.5

TROUBLESHOOTING PROCEDURES

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TROUBLEHSOOTING HINTS

If the fast idle speed is not adequate or the engine gives off dark smoke during warm-up, the Water Temperature Sensor (WTS) might be the cause.

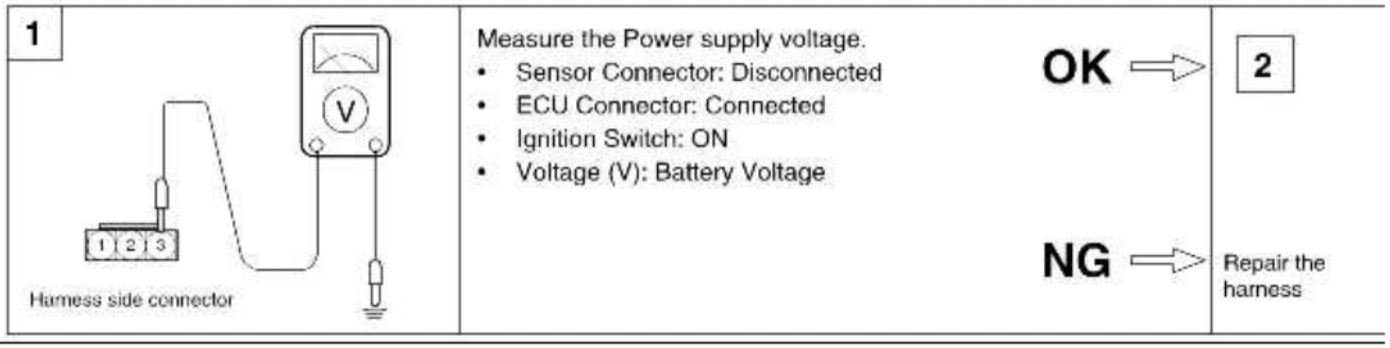
INSTALLATION

1. Apply sealant LOCTITE 962T or the equivalent to the threaded portion.
2. Install the Water Temperature Sensor (WTS) and tighten it to the specified torque.

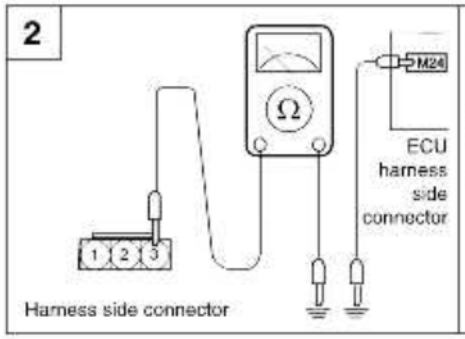
Tightening Torque : 20 ~ 40 N·m (2 ~ 4 kg·m, 14~29 lb·ft)

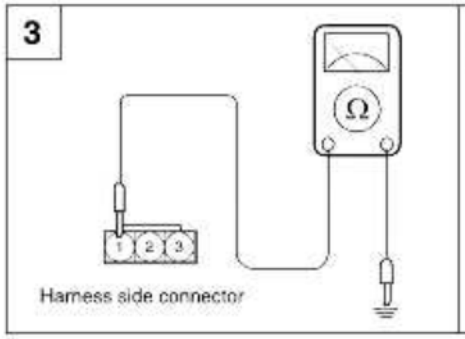
3. Securely connect the harness connector.

HARNESS INSPECTION PROCEDURES (WTS)



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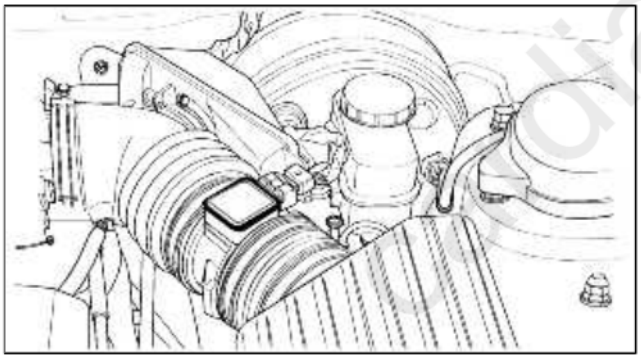
2		Check for an open circuit or a short circuit between ECU and Water Temperature Sensor (WTS). • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness

3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END! NG ⇨ Repair the harness

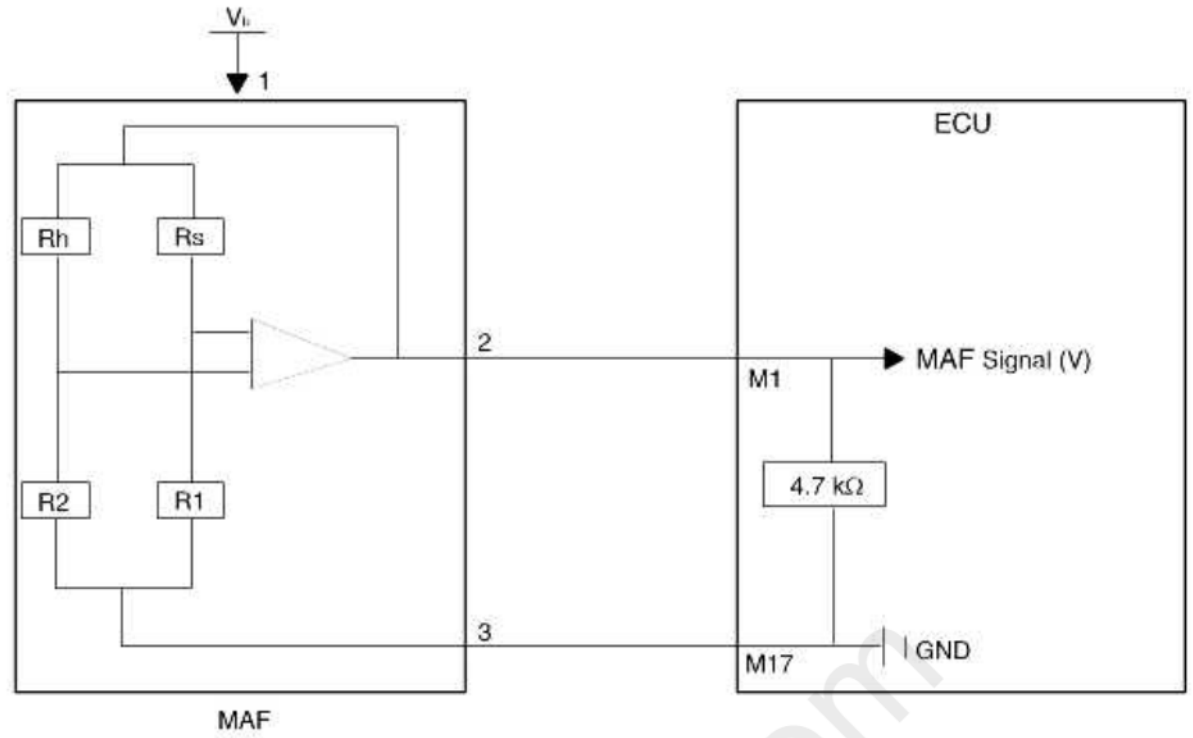
MASS AIR FLOW (MAF) SENSOR

This hot film type Mass Air Flow (MAF) Sensor is composed of a hot film sensor, housing and metering duct (hybrid sensor element). Mass air flow rate is measured by detection of heat transfer from a hot film probe because the change of the mass air flow rate causes a change in the amount of heat being transferred from the hot film probe surface to the air flow. The mass air flow sensor generates a pulse so it repeatedly opens and closes between the 5V voltage supplied from the ECU.

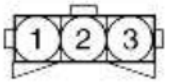
This results in the change of the temperature of the hot film probe and in the change of resistance.



[CIRCUIT DIAGRAM (MAF)]



[HARNESS CONNECTOR]



Pin	Connected to	Function
1	Main Relay	Battery Voltage
2	ECU Terminal M1	MAF Signal Output
3	ECU Terminal M17	GND

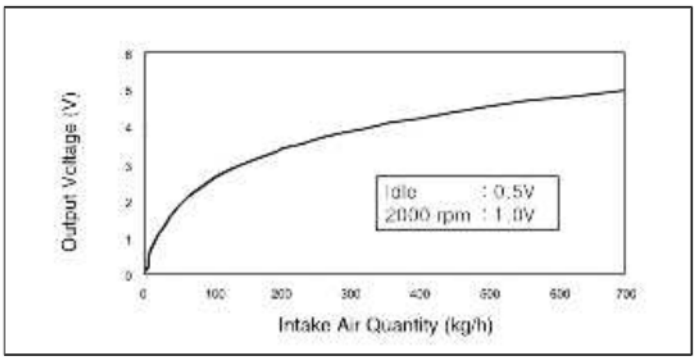
[CHARACTERISTIC OF MAF]

Item	Specification	Remark
Supply Voltage	7.5 ~ 16 V	
Operating Temperature Range	-40°C ~ 125°C	
Range of Air Flow	7 ~ 640 kg/h	
Output Voltage	0 ~ 5 V	
	Idle : 0.5 V	
	2000 rpm : 1.0 V	

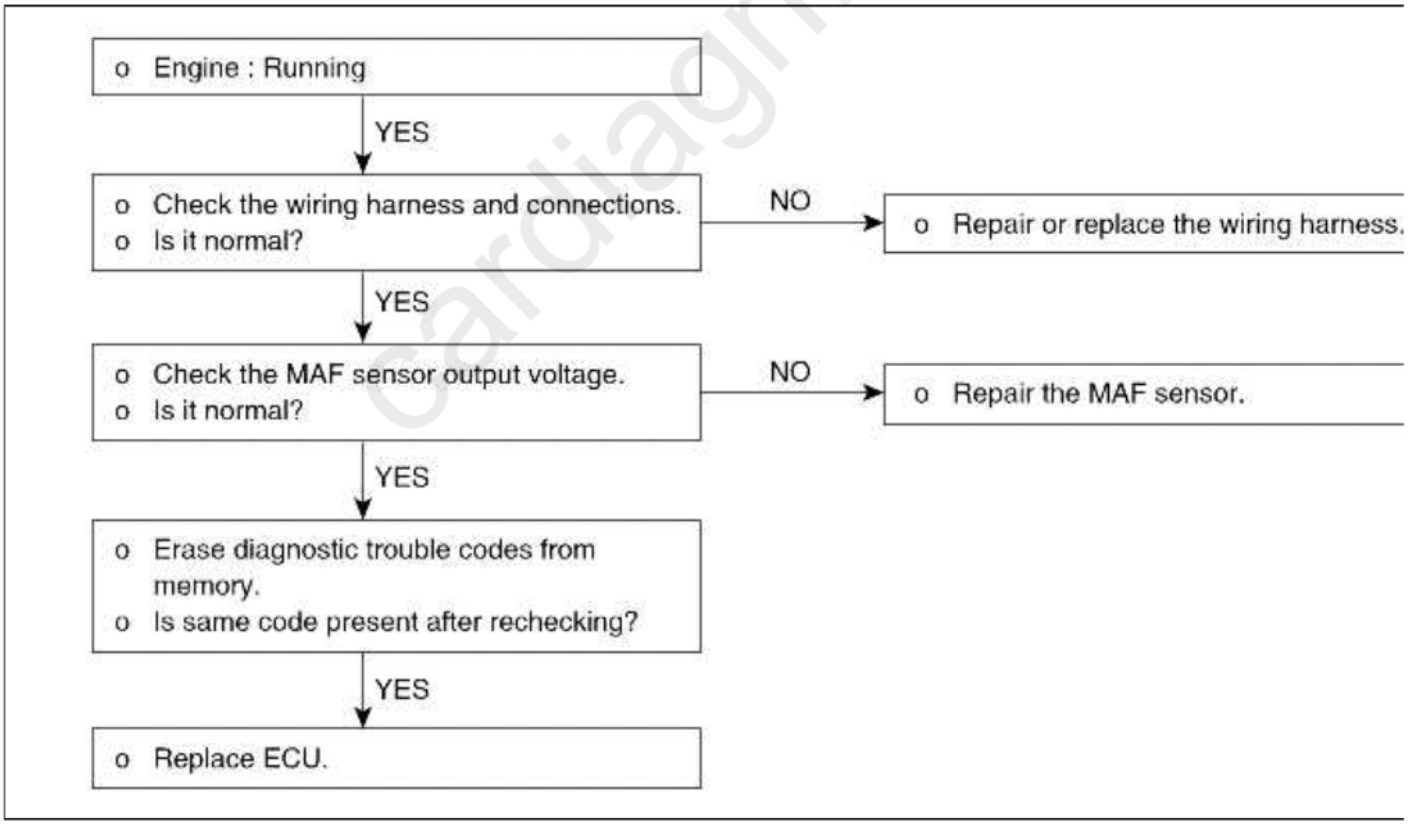
[OUTPUT VOLTAGE OF MAF]

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Output Voltage (V)	Intake Air Quantity (kg/h)	Output Voltage (V)	Intake Air Quantity (kg/h)
0.3	7.34	3.0	149.07
0.5	10.06	3.5	226.66
1.0	19.85	4.0	335.66
1.50	35.58	4.5	500.16
2.0	58.79	4.76	614.61
2.5	94.70	5.00	730.01



TROUBLESHOOTING PROCEDURES (MAF)



TROUBLESHOOTING HINTS

1. If the engine stalls occasionally, start the engine and shake the MAF sensor harness. If the engine stalls, check for poor contact at the MAF sensor connector.
2. If the MAF sensor output voltage is other than 0 when the ignition switch is turned on (do not start the engine), check for a faulty MAF sensor or ECU.

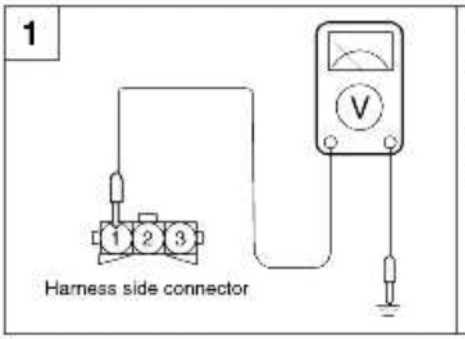
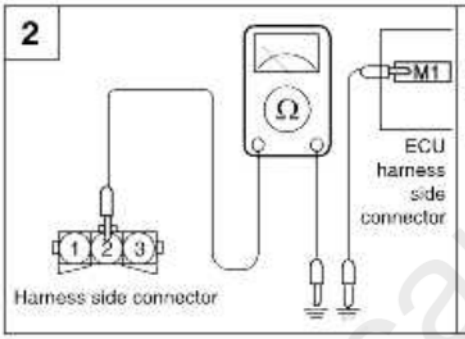
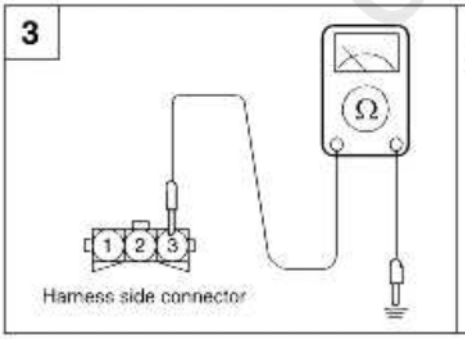
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3. If the engine can idle even if the MAF sensor output voltage is out of specification, check for the following conditions;
   A. Disturbed air flow in the MAF sensor, disconnected air duct, and clogged air cleaner filter.
   B. Poor combustion in the cylinder, faulty ignition plug, ignition coil, injector, and incorrect comparison.
4. Even if no MAF malfunction occurs, check the mounting direction of the MAF.

CAUTION

- When the vehicle is new [within initial operation of about 500 km (300 miles)], the Mass Air Flow (MAF) Sensor air quantity will be about 10% higher.
- Use an accurate digital voltmeter.
- Before checking, warm up the engine until the engine coolant temperature reaches 80 to 90 °C (176 to 198 °F).

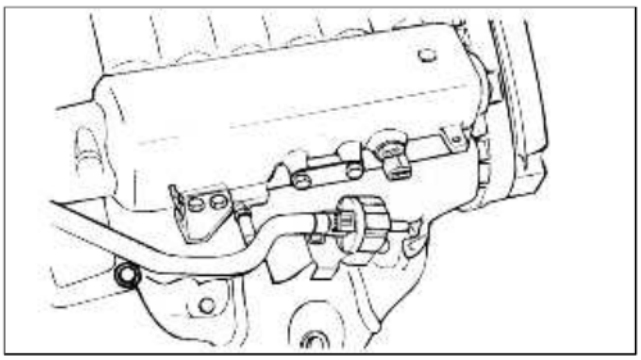
HARNESS INSPECTION PROCEDURES (MAF)

1		Measure the power supply voltage. • Sensor Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Mass Air Flow (MAF) Sensor. • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END! NG ⇨ Repair the harness

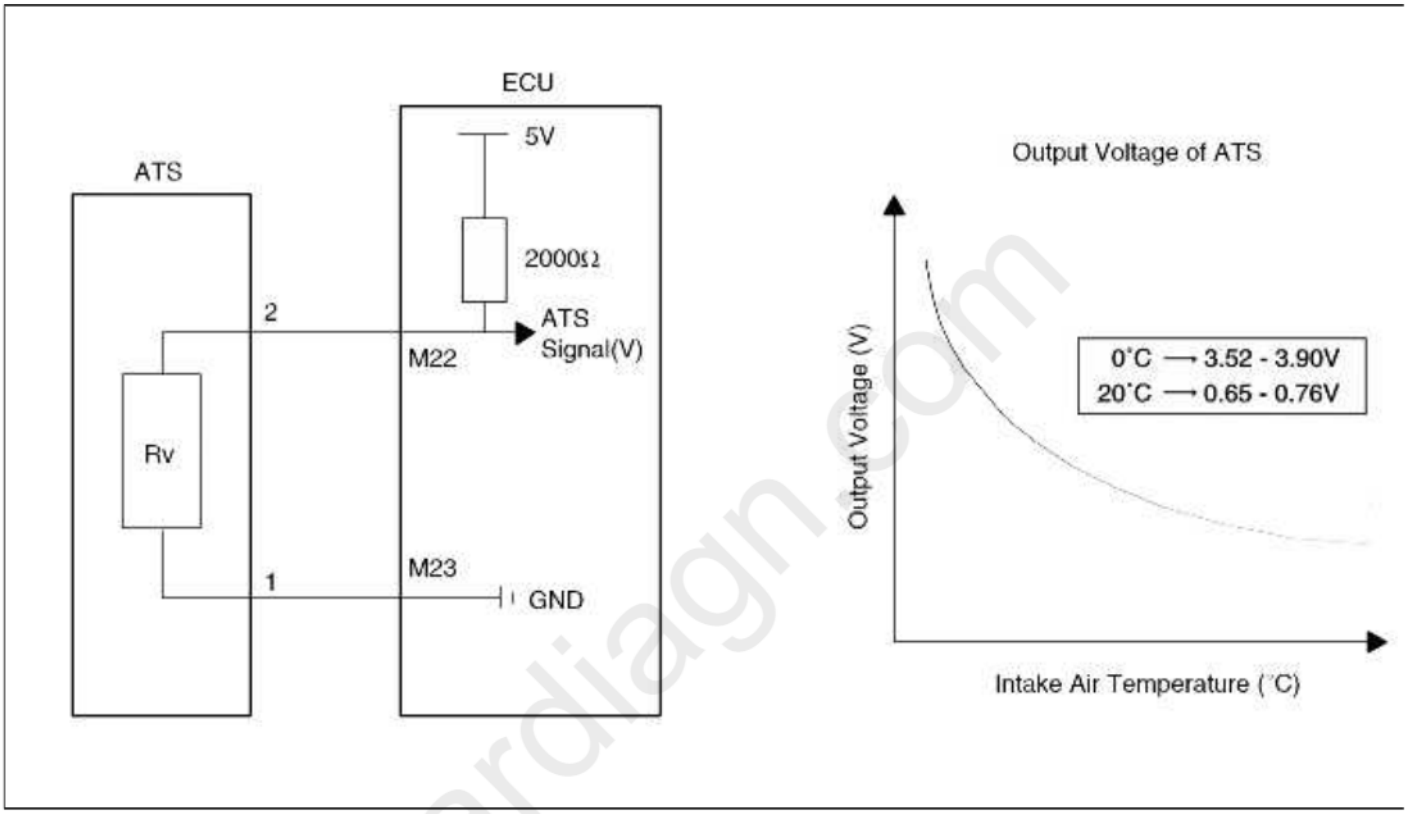
INTAKE AIR TEMPERATURE SENSOR (ATS)

The Intake Air Temperature Sensor (ATS) located on the intake manifold is a resistor-based snesor for detecting the intake air temperature. According to the intake air temperature information from the sensor, the ECU provides necessary fuel injection amount control.

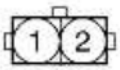
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[CIRCUIT DIAGRAM (ATS)]



[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal M23	GND
2	ECU Terminal M22	ATS Signal Output

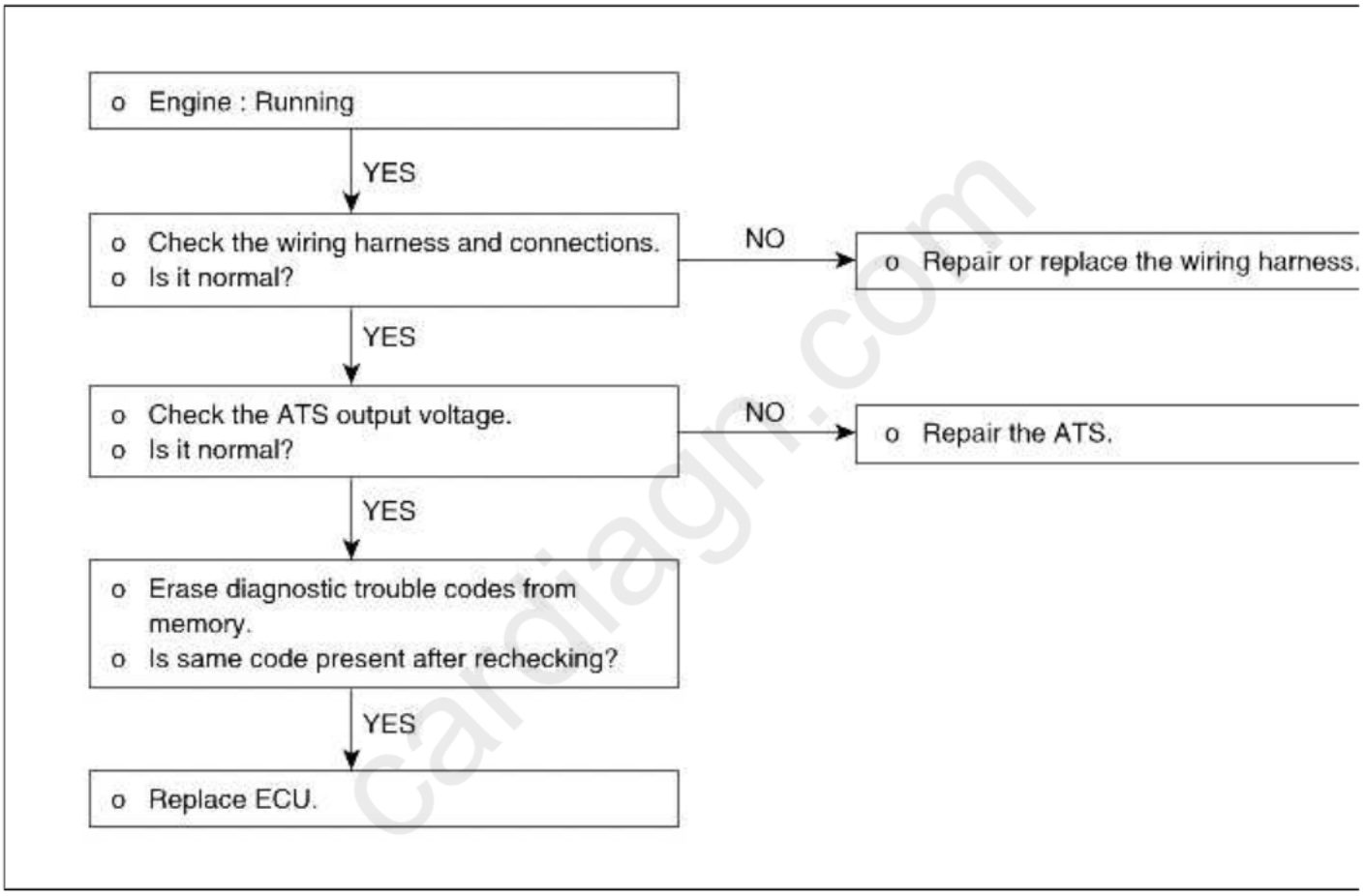
SENSOR INSPECTION

USING OHMMETER

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Check Item	Data Display	Check Condition	Intake Air Temp. [°C (°F)]	Resistance (kΩ)	Output Voltage (V)
Intake Air Temperature Sensor (ATS)	Intake Air Temperature	IG ON or Engine Running	-40 (-40)	38.85 - 61.20	4.72 - 4.84
			-20 (-4)	11.72 - 19.54	4.27 - 4.54
			0 (32)	4.75 - 7.11	3.52 - 3.90
			20 (68)	2.22 - 2.82	2.63 - 2.92
			80 (176)	0.30 - 0.36	0.65 - 0.76

TROUBLESHOOTING PROCEDURE (ATS)

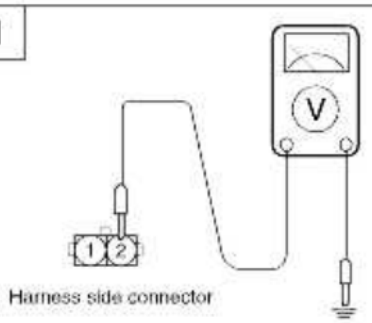
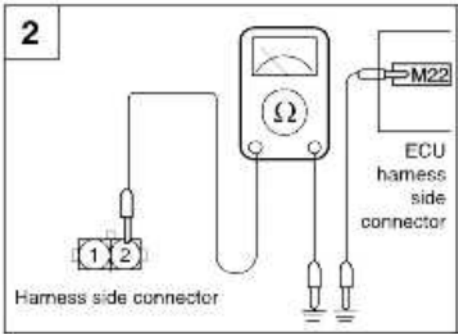
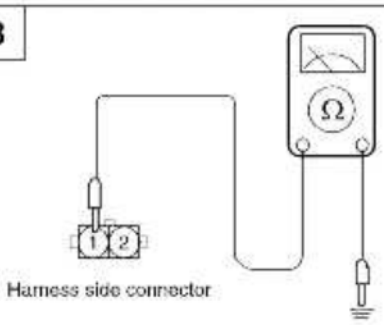


TROBLESHOOTING HINTS

The MIL is turned ON and DTC (Diagnostic Trouble Code) displayed on Hi-scan under the conditions as below.

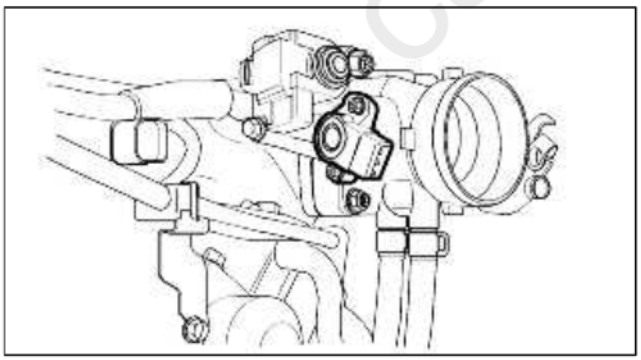
1. The manifold pressure indicates 118mb or less for 0.1 second when the ignition key is turned on.
2. The manifold pressure indicates 118mb or less when the rate is 1980 rpm or less.
3. The rate is 2400rpm or above when the manifold pressure indicates 986mb or above, or the accelerator pedal is released (on decceleration)

HARNESS INSPECTION PROCEDURES (ATS)

1		Measure the sensor supply voltage. • Sensor Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): 4.8 - 5.2 V	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Intake Air Temperature Sensor (ATS). • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END! NG ⇨ Repair the harness

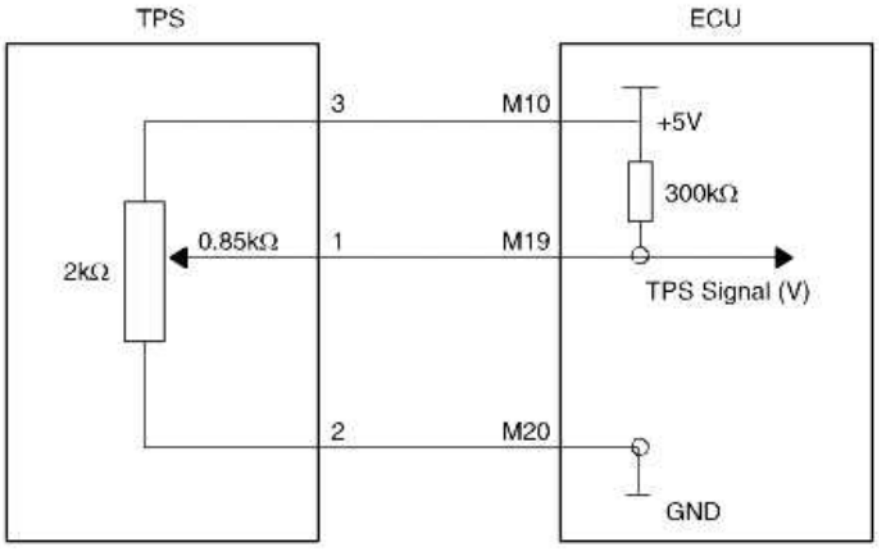
THROTTLE POSITION SENSOR (TPS)

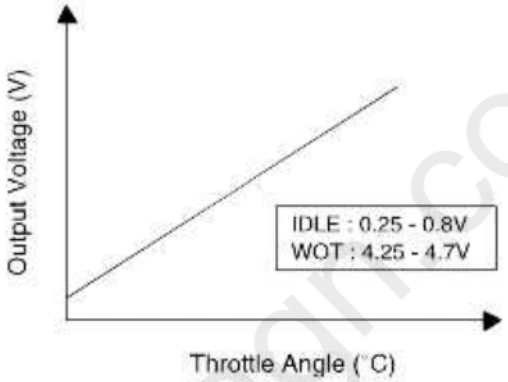
The TPS is a variable resistor type that rotates with the throttle body throttle shaft to sense the throttle valve angle. As the throttle shaft rotates, the output voltage of the TPS changes. The ECU detects the throttle valve opening based on voltage change.



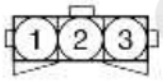
[Circuit Diagram (TPS)]

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[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal M19	TPS Signal Output
2	ECU Terminal M20	GND
3	ECU Terminal M10	Sensor Supply (5V)

SENSOR INSPECTION

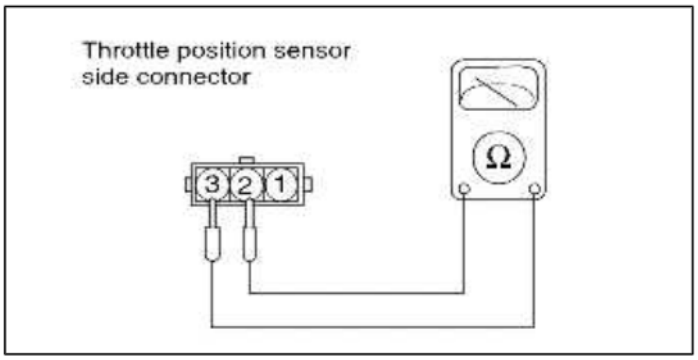
Check Item	Data display	Check conditions	Throttle valve	Test specification
Throttle position sensor	Sensor voltage	Ignition switch : ON	At idle position	250-800 mV
			Open slowly	Increases with valve opening
			Open widely	4.25 ~ 4.7V

USING VOLTMETER

1. Disconnect the throttle position sensor connector.

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2. Measure resistance between terminal 2 (sensor ground) and terminal 3 (sensor power).

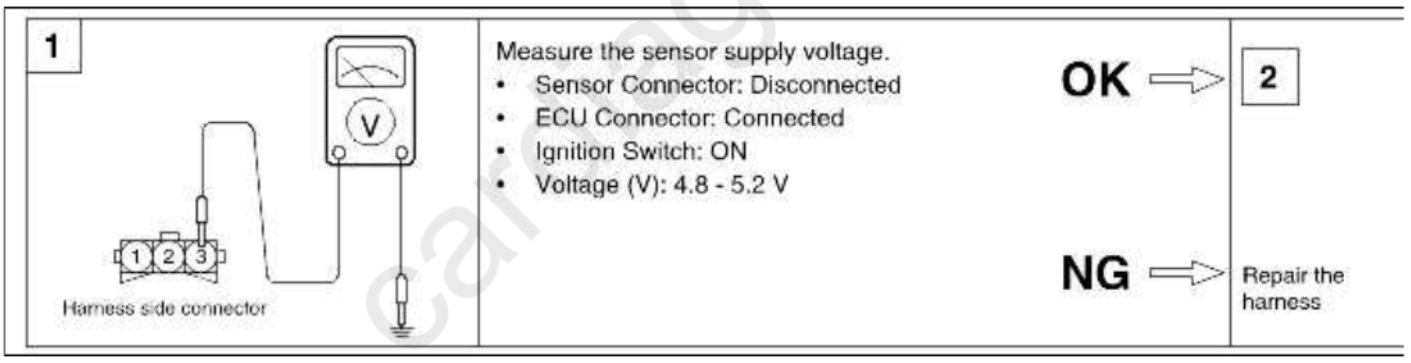


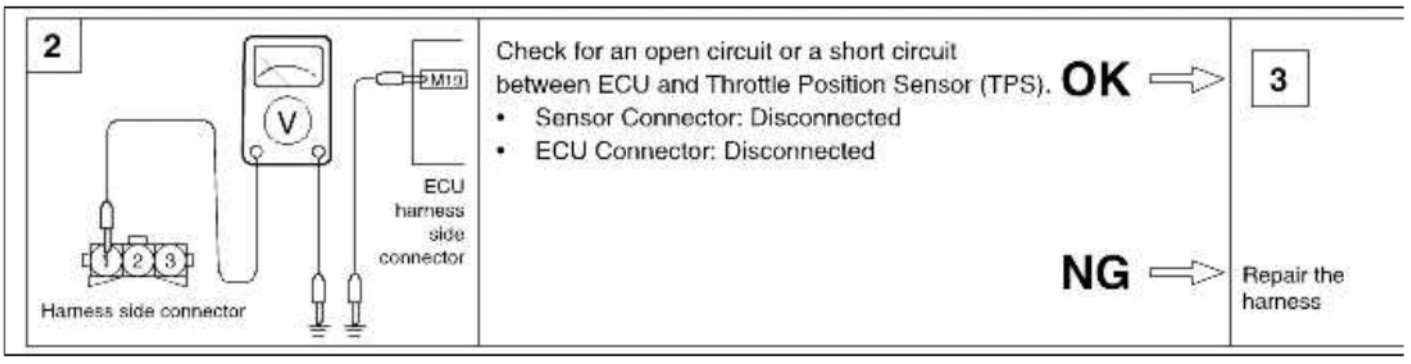
Standard value : 1.6 - 2.4 kΩ

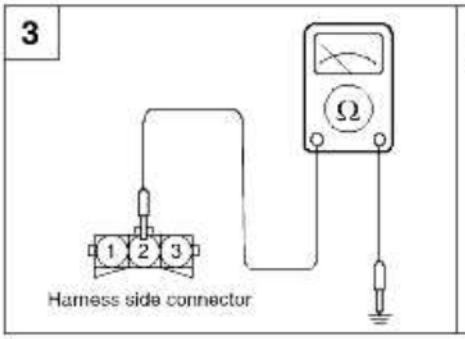
3. Connect a pointer type ohmmeter between terminal 2 (sensor ground) and terminal 1 (sensor output).
4. Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.
5. If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

Tightening torque
TPS : 1.5-2.5 Nm (15-25 kg·cm, 1.1-1.8 lb·ft)

TROUBLESHOOTING HINTS
The TPS signal is important in the control of the automatic transaxle. Shift shock and other trouble will occur if the sensor is faulty.
HARNESS INSPECTION TROCEDURES (TPS)



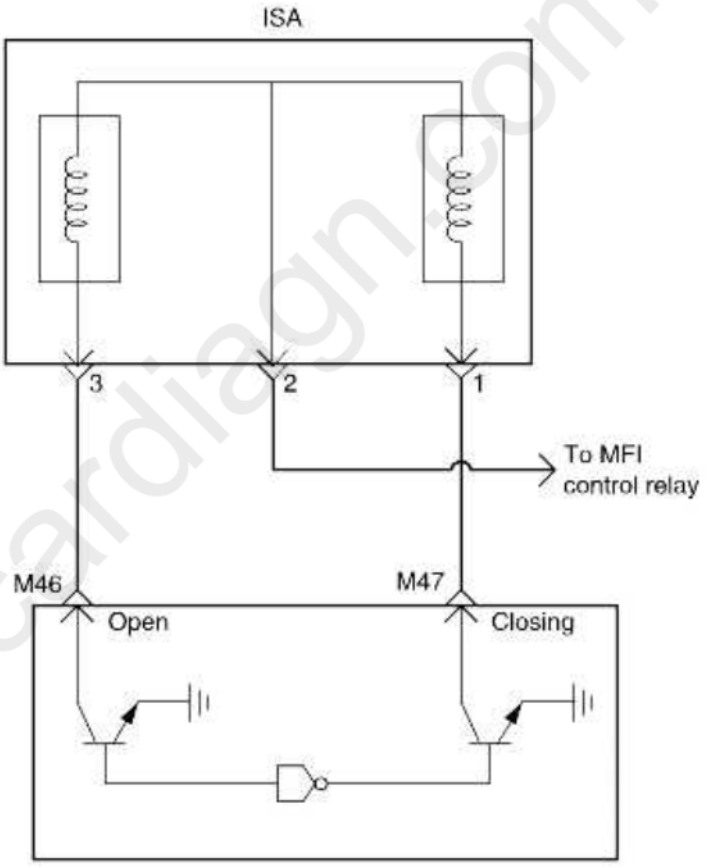


3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END NG ⇨ Repair the harness

IDLE SPEED CONTROL ACTUATOR (ISA)

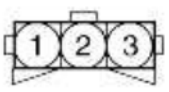
The idle speed control actuator is the double coil type and has two coils. The two coils are driven by separate driver stages in the ECU. Depending on the pulse duty factor, the equilibrium of the magnetic forces of the two coils will result in different angles of the motor. In parallel to the throttle valve, a bypass hose line is arrange, where the idle speed, actuator is inserted in.

[Circuit Diagram (ISA)]



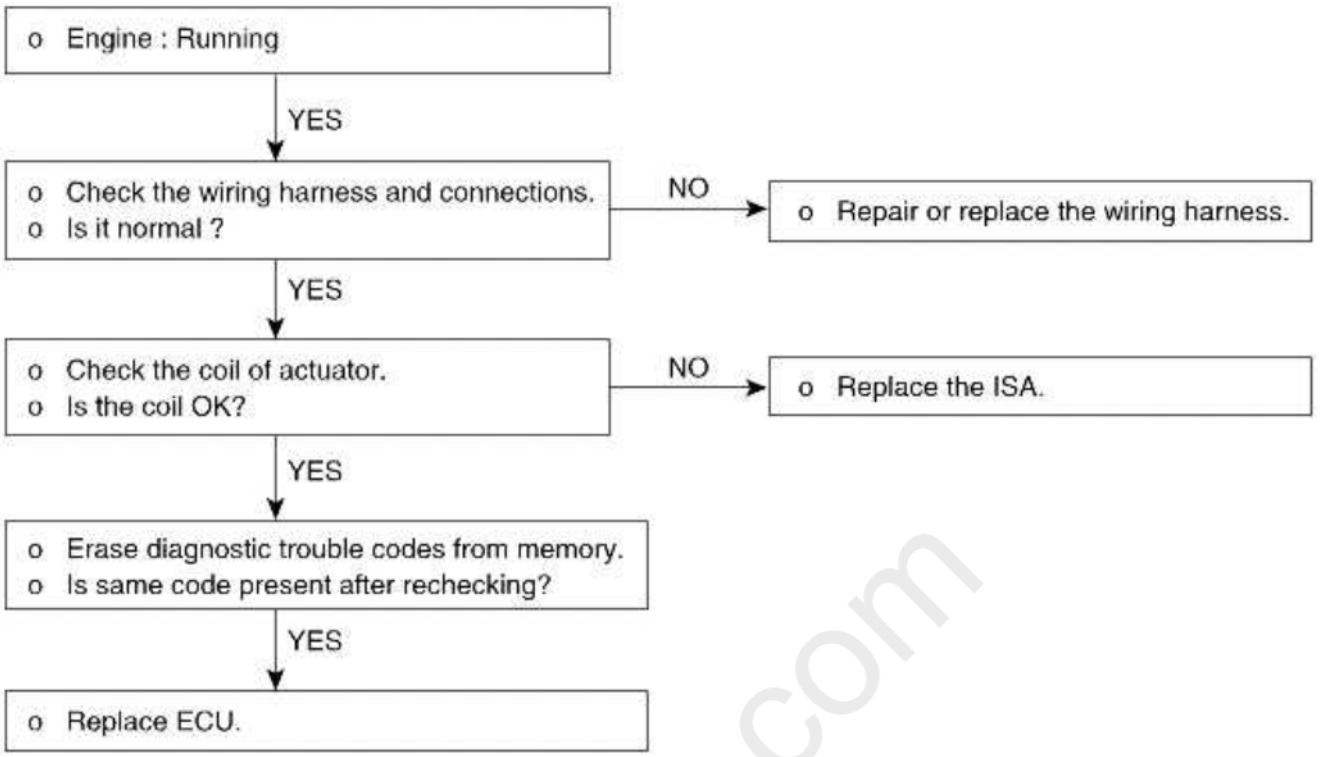
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[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal M47	ISA (Closing) Control
2	Main Relay	Battery Voltage
3	ECU Terminal M46	ISA (Open) Control

TROUBLESHOOTING PROCEDURES



TROUBLESHOOTING HINTS

The MIL is ON or the DTC is displayed on the HI-SCAN under the following conditions;

- When the primary voltage side in ECU is in short or open circuit.
- The ignition closed loop control in ECU is out of order.
- Open or short circuit is observed in idle air control system when ignition switch is turned on.

USING HI-SCAN

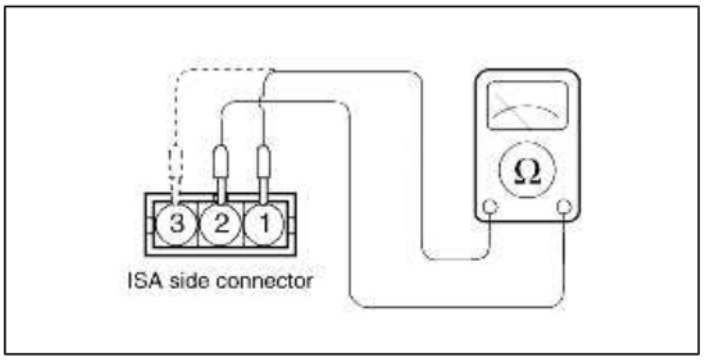
Check Item	Check condition	HI-SCAN display	Type
Idle speed control actuator • Actuator	Start the engine	ISA	Activate

ACTUATOR INSPECTION

1. Disconnect the connector at the idle speed control actuator.

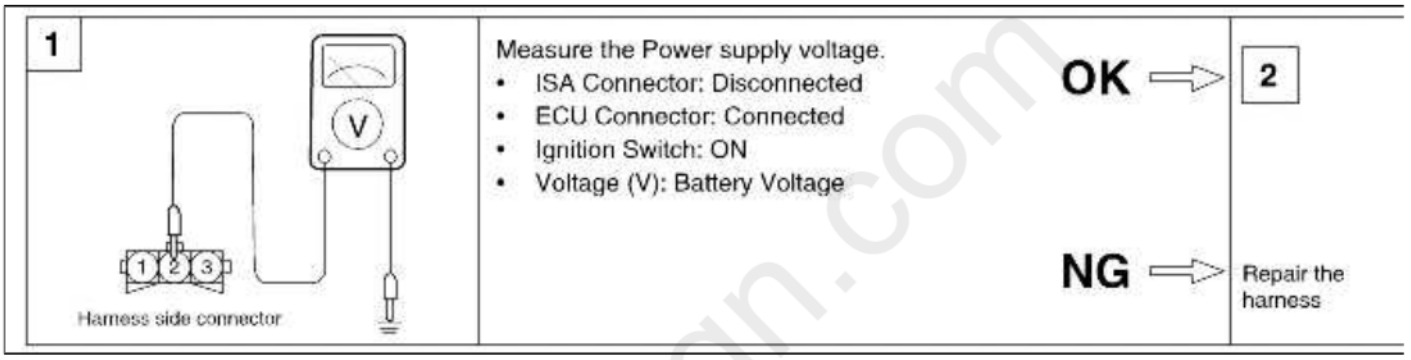
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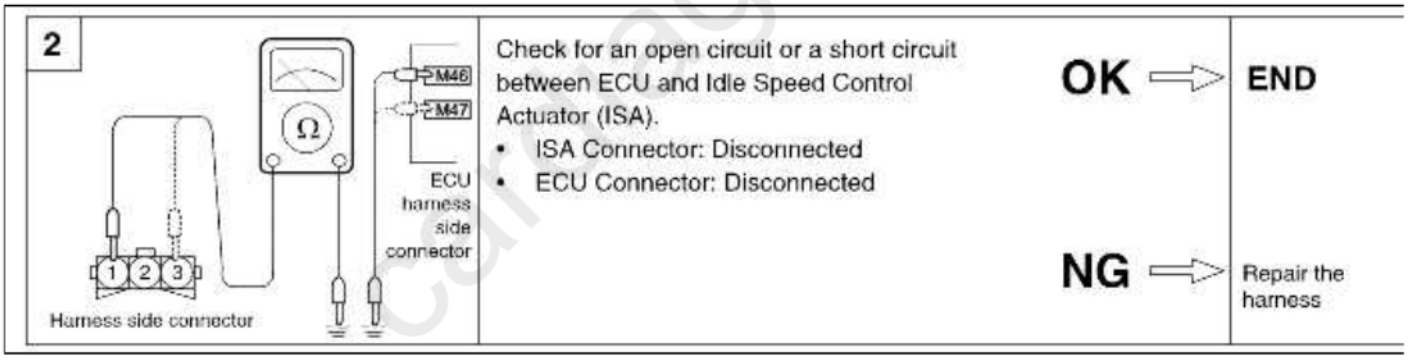
2. Measure the resistance between terminals.



Standard value :
Terminal 3 and 2 (Open) : 14.5 - 16.5 Ω
Terminal 1 and 2 (Closing) : 16.6 - 18.6 Ω [at 20°C (68°F)]

HARNESS INSPECTION PROCEDURES (ISA)



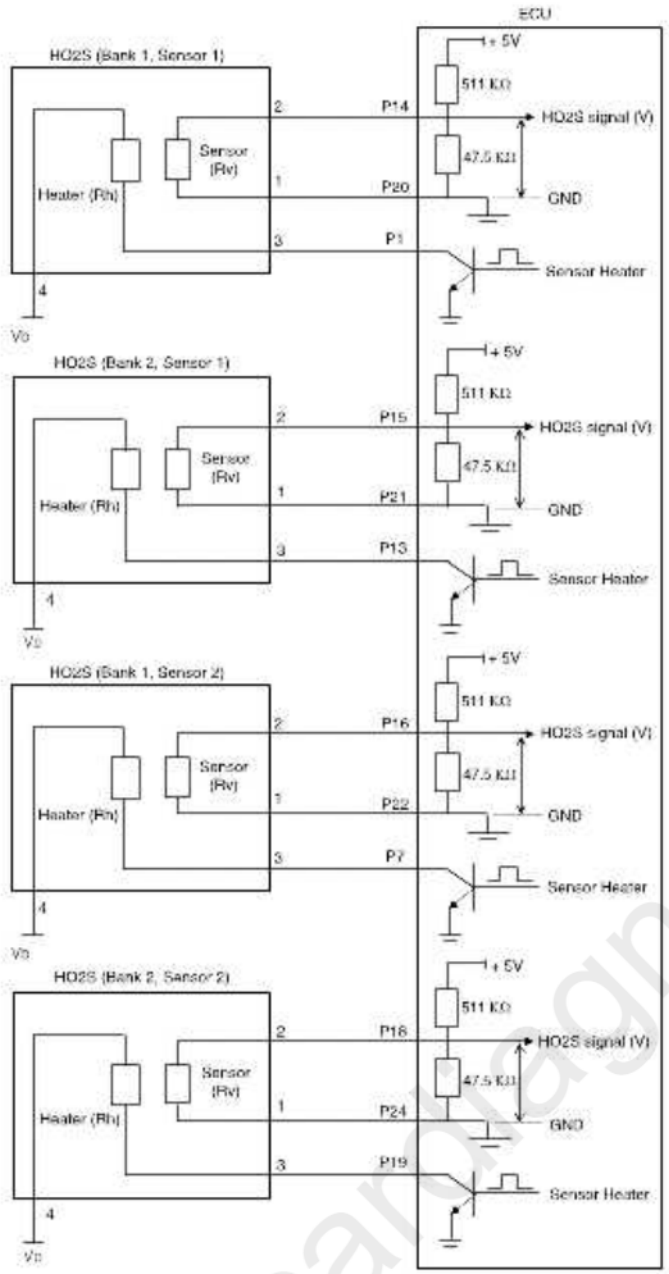


HEATED OXYGEN SENSOR (HO2S) - ZIRCONIA (Z O)

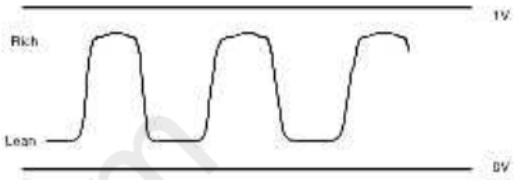
The heated oxygen sensor (HO2S) senses the oxygen concentration in exhaust gas and converts it into a voltage that is sent to the ECU. For Zirconium type sensors, the oxygen sensor outputs about 1V when the air fuel ratio is richer than the theoretical ratio, and outputs about 0V when the ratio is leaner (higher oxygen concentration in exhaust gas). The ECU controls the fuel injection ratio based on this signal so that the air fuel ratio is maintained at the stoichiometric ratio. The oxygen sensor has a heating element that ensures sensor performance during all driving conditions.

[CIRCUIT DIAGRAM (HO2S)]

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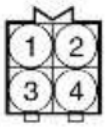


[OUTPUT FEATURE]



[HARNESS CONNECTOR]

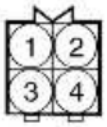
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(Bank 1, Sensor 1)

HO2S (Bank 1, Sensor 1)

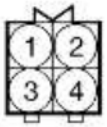
Pin	Connected to	Function
1	ECU Terminal P20	GND
2	ECU Terminal P14	HO2S Signal Output
3	ECU Terminal P1	Sensor Heater
4	Main Relay	Battery Voltage



(Bank 2, Sensor 1)

HO2S (Bank 2, Sensor 1)

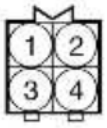
Pin	Connected to	Function
1	ECU Terminal P21	GND
2	ECU Terminal P15	HO2S Signal Output
3	ECU Terminal P13	Sensor Heater
4	Main Relay	Battery Voltage



(Bank 1, Sensor 2)

HO2S (Bank 1, Sensor 2)

Pin	Connected to	Function
1	ECU Terminal P22	GND
2	ECU Terminal P16	HO2S Signal Output
3	ECU Terminal P7	Sensor Heater
4	Main Relay	Battery Voltage



(Bank 2, Sensor 2)

HO2S (Bank 2, Sensor 2)

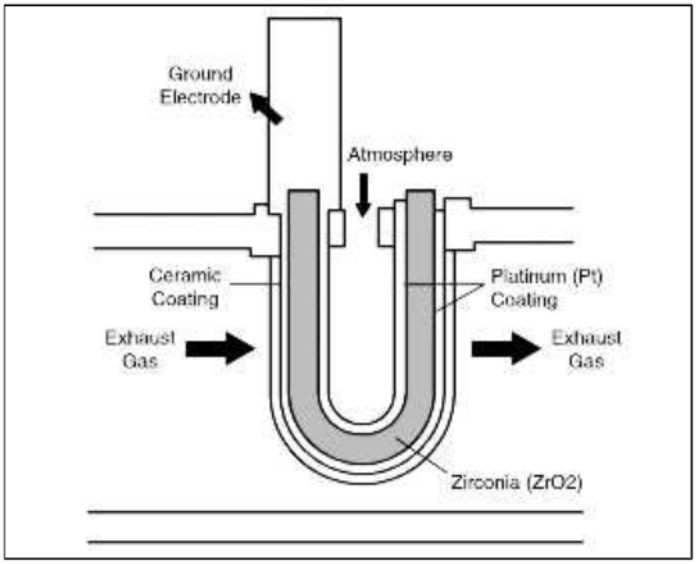
Pin	Connected to	Function
1	ECU Terminal P24	GND
2	ECU Terminal P18	HO2S Signal Output
3	ECU Terminal P19	Sensor Heater
4	Main Relay	Battery Voltage

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HO2S - ZIRCONIA (Z O) OPERATION PRINCIPLE

The Zirconia (ZrO) which is coated with Platinum (Pt) on both sides will generate the voltage if the density of oxygen on atmosphere side and exhaust gas side is different in high temperature.

In other words oxygen ion moves from high-density side (Atmosphere) to low-density side (exhaust gas), at a result Sensor Voltage is generated by Nernst equation between two electrodes.



TROUBLESHOOTING HINTS

1. If the HO2S is defective, abnormally high emissions may occur.
2. If the HO2S check results are normal, but the sensor output voltage is out of specification, check for the following items (related to air fuel ratio control system):
   (1) Defective Injector
   (2) Air leaks in the intake manifold
   (3) Defective Mass Air Flow (MAF) Sensor
   (4) Defective Intake Air Temperature Sensor (ATS)
   (5) Defective Water Temperature Sensor (WTS)
   (6) Defective Manifold Absolute Pressure (MAP) Sensor

SENSOR INSPECTION (HO2S)

1. USING HI-SCAN (PRO)

Check item	Check conditions	Engine state	Test specification
Heated Oxygen Sensor (HO2S)	Engine: Warm-up (make the mixture lean by engine speed reduction, and rich by racing)	When sudden deceleration from 4,000 rpm	200mV or lower
		When engine is suddenly raced	600-1,000 mV
	Engine: Warm-up (using the heated oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the ECU).	700 rpm (Idle)	Oscillate between less than 300 mV and more than 700 mV
		2,000 rpm	

2. USING VOLTMETER

NOTE

- Before checking, warm up the engine until the engine coolant temperature reaches 80 to 95 °C (176 to 205 °F).
- Use an accurate digital voltmeter.

(1) Disconnect the Heated Oxygen Sensor (HO2S) connector, and measure the resistance of heater between terminal 3 and terminal 4.

HO2S (Bank 1, Sensor 1): 4.0 ~ 5.2 Ω
HO2S (Bank 2, Sensor 1): 4.0 ~ 5.2 Ω
HO2S (Bank 1, Sensor 2): 4.0 ~ 5.2 Ω
HO2S (Bank 2, Sensor 2): 4.0 ~ 5.2 Ω

(2) Replace the Heated Oxygen Sensor (HO2S) if there is a malfunction.

(3) Apply battery voltage directly between terminal 3 and terminal 4.

NOTE

Be careful when applying the voltage. Damage will result if terminals 1 and 2 are connected to any voltage.

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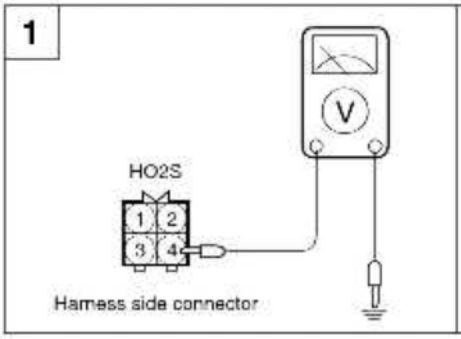
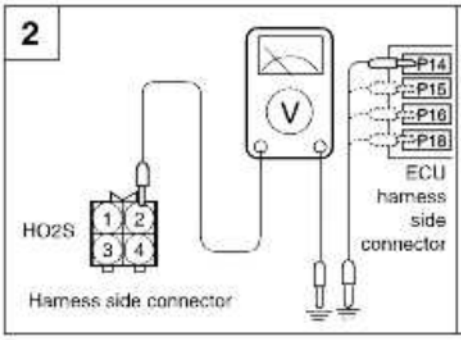
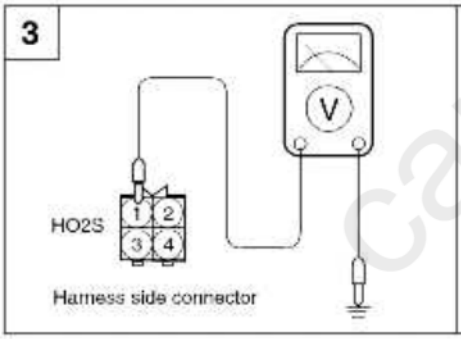
(4) Connect a high-impedance digital-type voltmeter between terminal 1 and terminal 2.

(5) While repeatedly racing the engine, measure the Heated Oxygen Sensor (HO2S) output voltage.

(6) If there is a problem, replace the Heated Oxygen Sensor (HO2S).

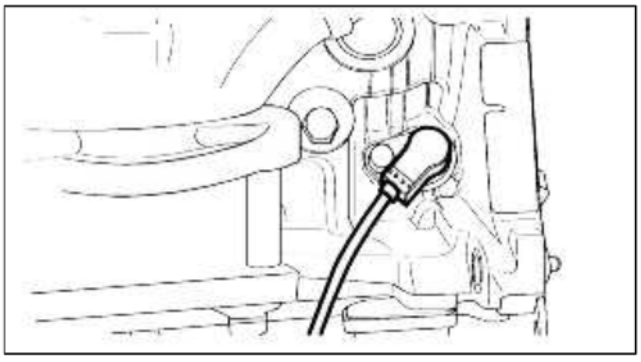
Tightening torque: 40 - 50 N·m (4.0 - 5.0 kg·m, 29 - 36 lb·ft)

HARNESS INSPECTION PROCEDURES (HO2S)

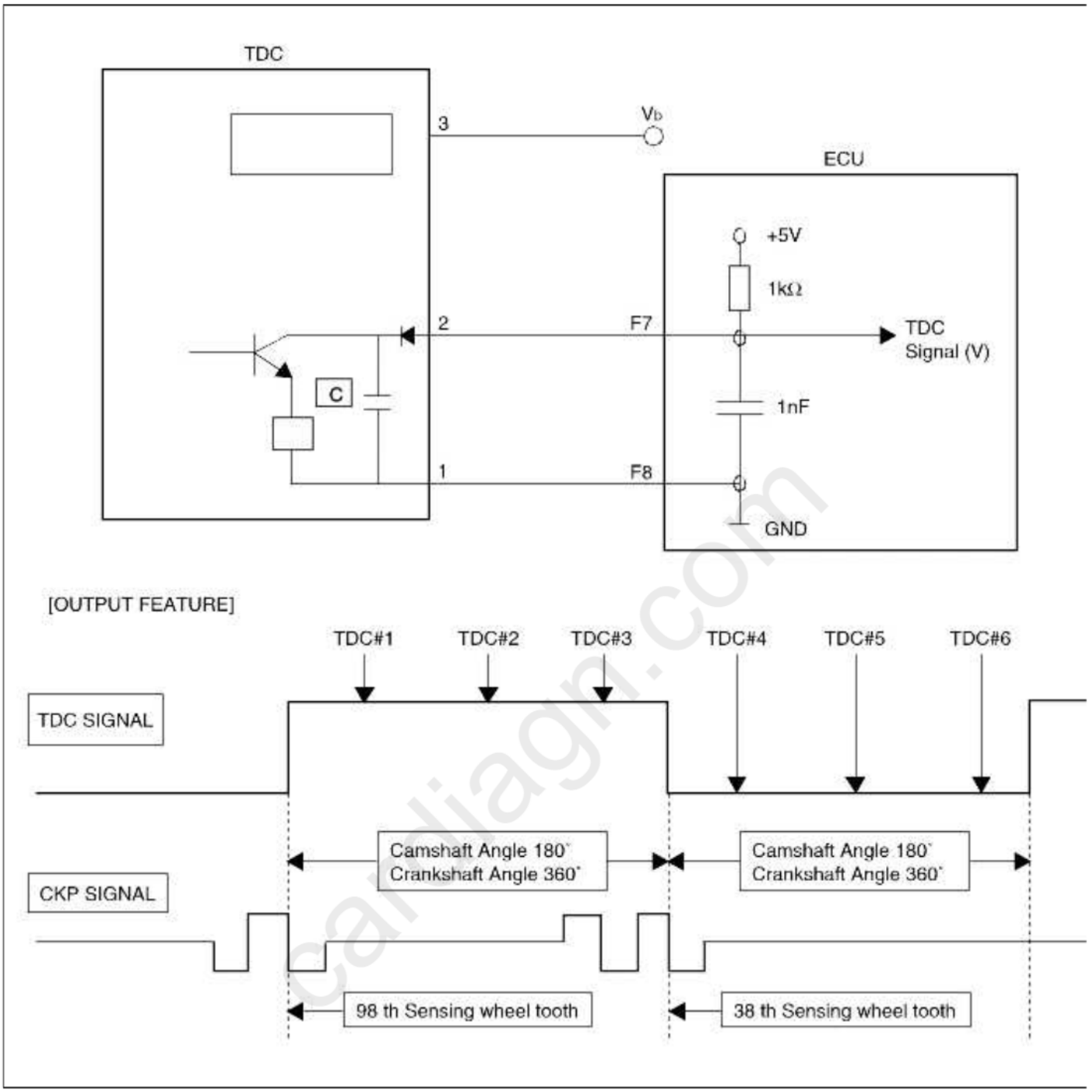
1		Measure the Power supply voltage. • Sensor Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Heated Oxygen Sensor (HO2S). • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END NG ⇨ Repair the harness

CAMSHAFT POSITION (TDC) SENSOR

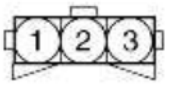
The TDC Sensor is a Hall-effect sensor that detects the camshaft position on the compression stroke of the No.1 cylinder, converts it into a pulse signal, and inputs it to the ECU. The ECU then computes the fuel injection sequence, etc. based on the input signal.



[CIRCUIT DIAGRAM AND OUTPUT FEATURE (TDC)]



[HARNESS CONNECTOR]

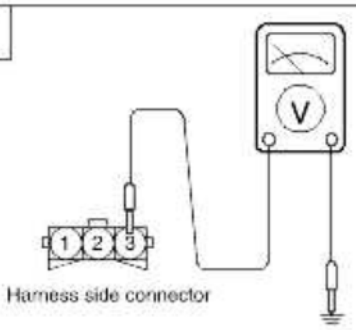
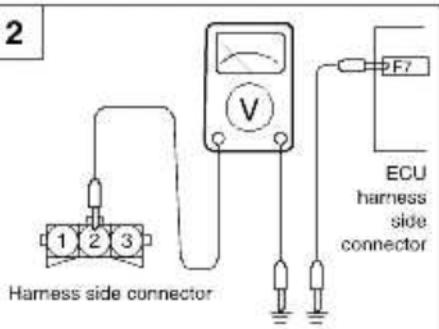
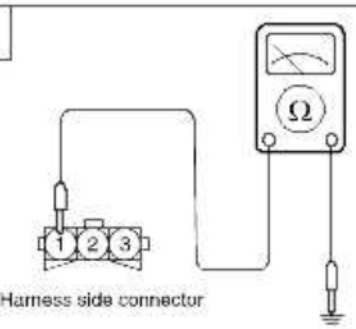


Pin	Connected to	Function
1	ECU Terminal F8	GND
2	ECU Terminal F7	TDC Signal Output
3	Main Relay	Battery Voltage

TROUBLEHSOOTING HINTS

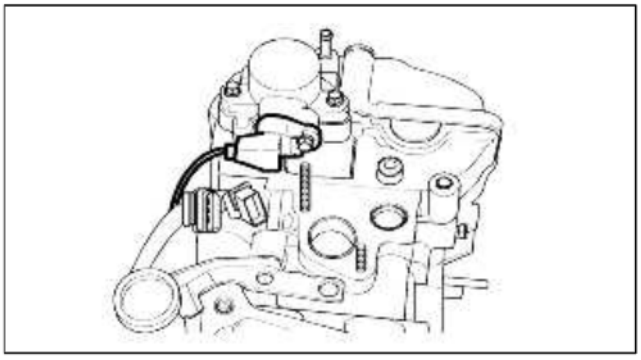
If the TDC Sensor does not operate correctly, sequential injection is may not occur and the engine may stall or run irregularly at idle or fail to accelerate normally.

HARNESS INSPECTION PROCEDURES (TDC)

1		Measure the Power supply voltage. • Sensor Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Camshaft Position (TDC) Sensor. • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END NG ⇨ Repair the harness

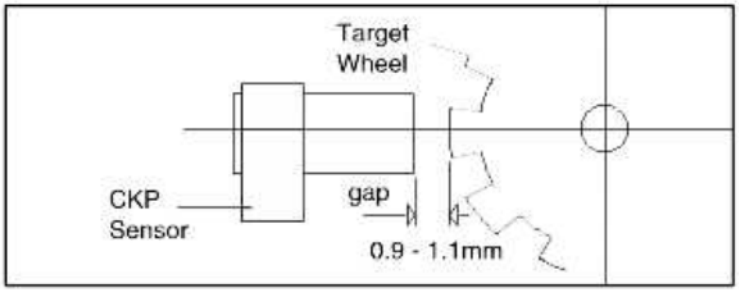
CRANKSHAFT POSITION (CKP) SENSOR

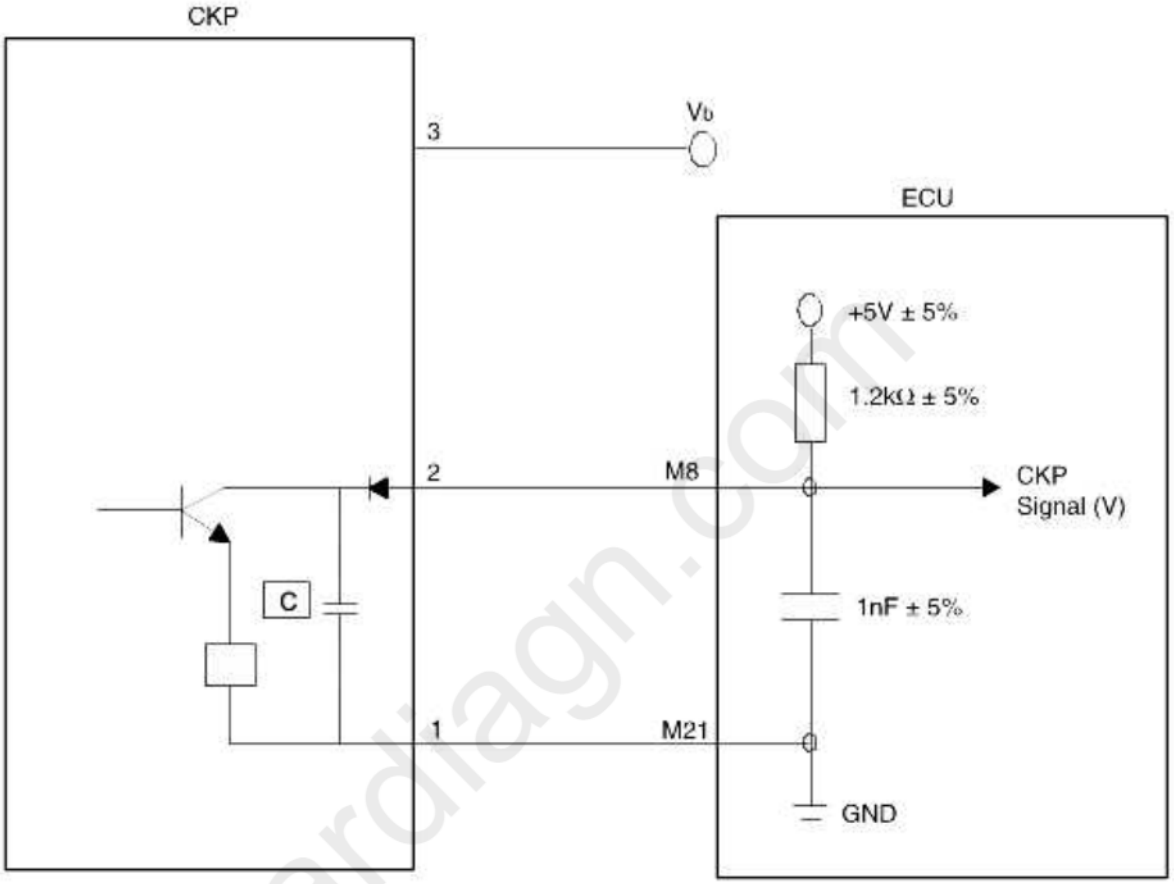
The Crankshaft Position Sensor is a Hall-effect sensor that senses the Crank angle (piston position) of each cylinder and converts it into a pulse signal. Based on the input signal, the ECU computes the engine speed and controls the fuel injection timing and ignition timing.



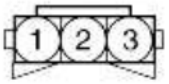
[CIRCUIT DIAGRAM (CKP)]

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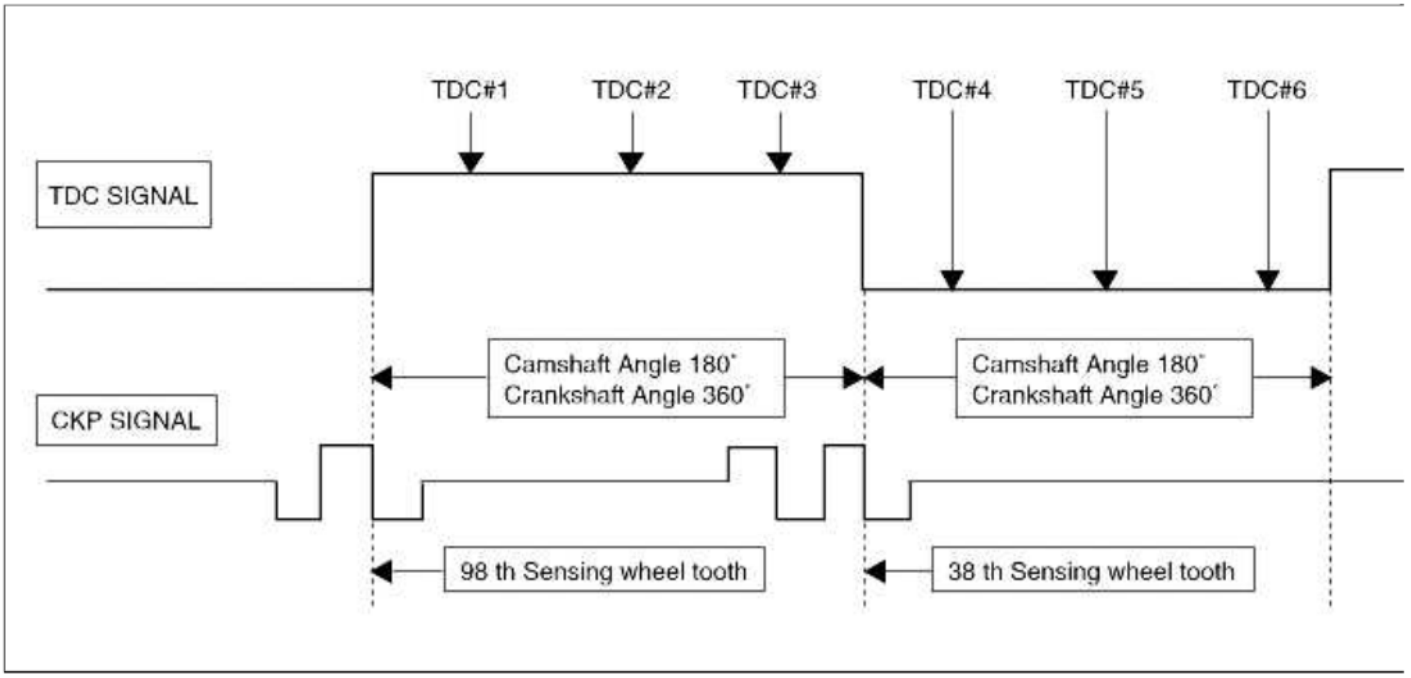
[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal M21	GND
2	ECU Terminal M8	CKP Signal Output
3	Main Relay	Battery Voltage

[OUTPUT FEATURE OF CKP]

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TROUBLEHSOOTING HINTS

1. If unexpected shocks are felt during driving or the engine stalls suddenly, shake the crankshaft position sensor harness. If this causes the engine to stall, check for poor sensor connector contact.
2. If the tachometer reads 0 rpm when the engine is cranked, check for faulty crank angle sensor, broken timing belt or ignition system problems.
3. If the engine can be run at idle even if the crank angle sensor reading is out of specification, check the following:
   (1) Faulty Water Temperature Sensor (WTS)
   (2) Faulty Idle Speed Control System
   (3) Poorly adjusted reference idle speed
4. The engine will crank without a crank angle sensor signal, but will not start. Once the sensor detects TDC, the data is stored until the next re-start.

SENSOR INSPECTION

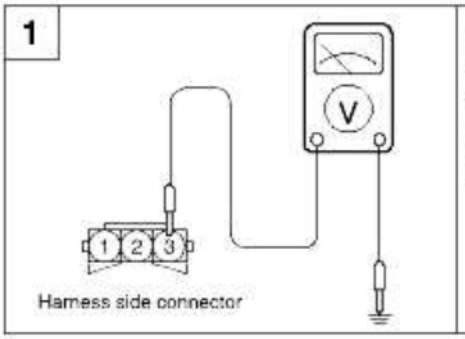
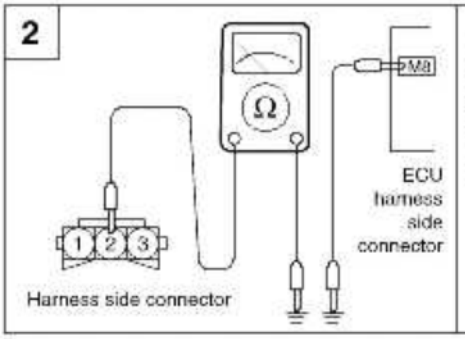
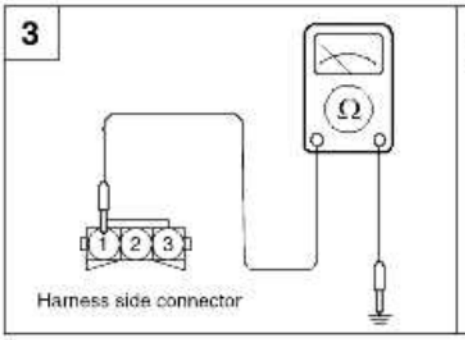
USSING HI-SCAN (PRO)

Check Item	Check conditions	Check content	Normal state
Crankshaft Position (CKP) Sensor	• Engine cranking • Tachometer connected (Check on and off ignition coil by tachometer)	Compare cranking speed and multi-tester reading	Indicated speed agrees

Check Item	Check conditions	Temperature [°C (°F)]	Test specification (rpm)
Crankshaft Position (CKP) Sensor	• Engine: Running at idle • Idle position switch: ON	-20 (-4)	1,500 ~ 1,700
		0 (32)	1,350 ~ 1,550
		20 (68)	1,200 ~ 1,400
		40 (104)	1,000 ~ 1,200
		80 (176)	650 ~ 850

HARNESS INSPECTION PROCEDURES (TDC)

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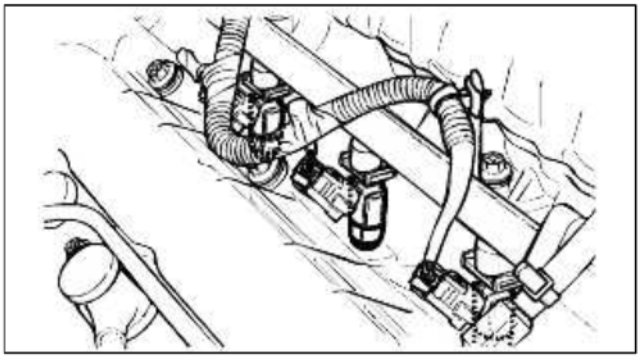
1		Measure the Power supply voltage. • Sensor Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Crankshaft Position (CKP) Sensor. • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END NG ⇨ Repair the harness

FUEL INJECTOR

The injectors inject fuel to cylinders according to the signal, suitable to engine condition, from ECU. The ECU drives the injectors by electric current driving mode.

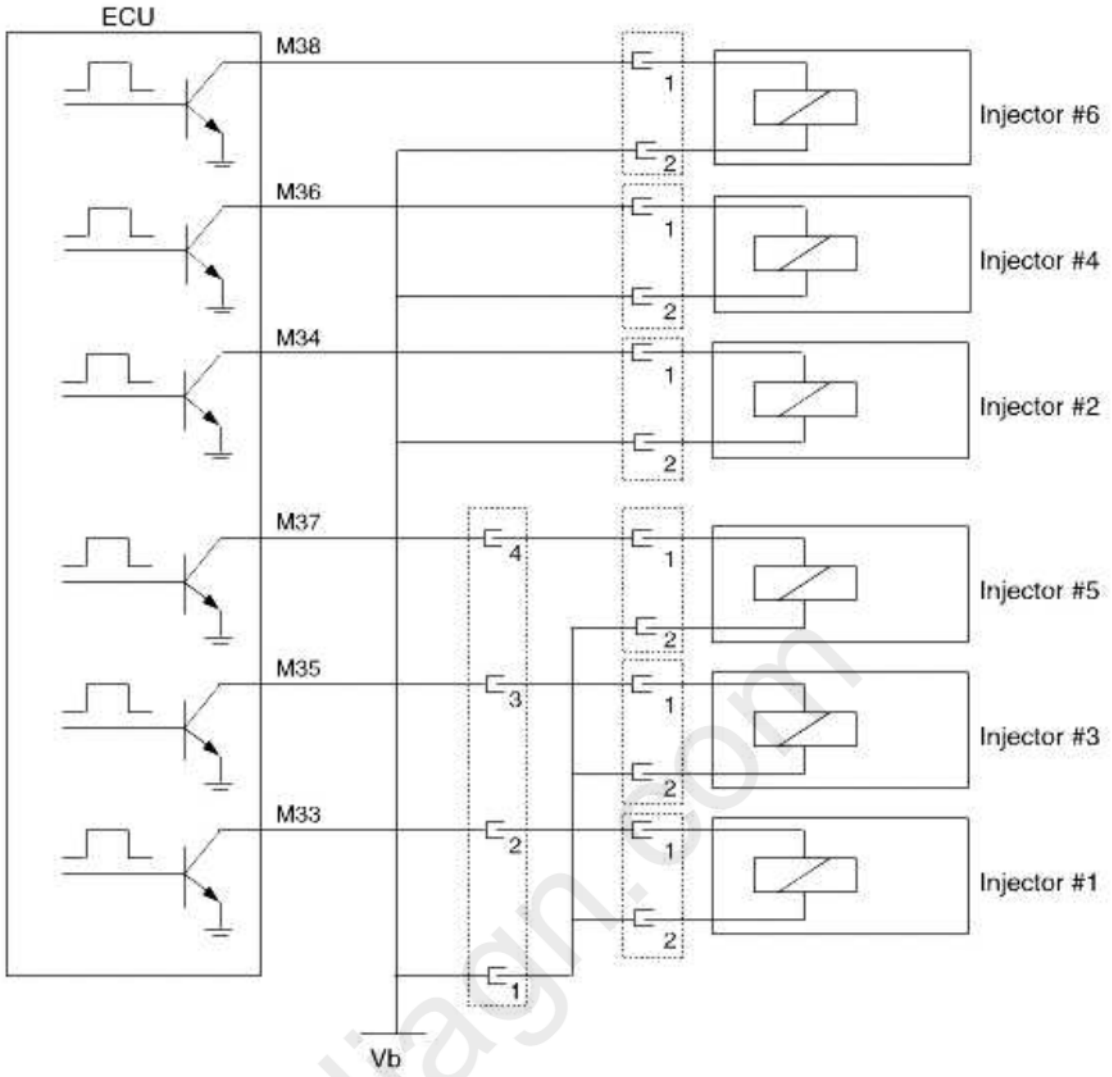
The basic fuel amount is performed by the mapping value based on the air amount and engine rate, and the fuel amount is corrected in the case of fuel amount correction (Air fuel ratio control signal, fuel evaporative emission gas control, learning increase of the fuel amount, warm-up control, catalytic heating control, fuel amount control in deceleration, idle control, fuel amount increase in full load, fuel increase in acceleration and restarting).

The fuel injection is controlled under unavailable state for safety purpose when engine rpm reaches the appropriate engine speed



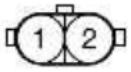
[CIRCUIT DIAGRAM (INJECTOR)]

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[HARNESS CONNECTOR]

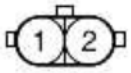
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Injector #1

Injector #1

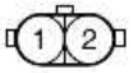
Pin	Connected to	Function
1	ECU Terminal M33	Injector #1 Operation Signal
2	Main Relay	Batter Voltage



Injector #2

Injector #2

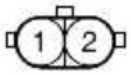
Pin	Connected to	Function
1	ECU Terminal M35	Injector #2 Operation Signal
2	Main Relay	Batter Voltage



Injector #3

Injector #3

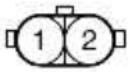
Pin	Connected to	Function
1	ECU Terminal M37	Injector #3 Operation Signal
2	Main Relay	Batter Voltage



Injector #4

Injector #4

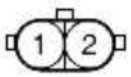
Pin	Connected to	Function
1	ECU Terminal M34	Injector #4 Operation Signal
2	Main Relay	Batter Voltage



Injector #5

Injector #5

Pin	Connected to	Function
1	ECU Terminal M36	Injector #5 Operation Signal
2	Main Relay	Batter Voltage



Injector #6

Injector #6

Pin	Connected to	Function
1	ECU Terminal M38	Injector #6 Operation Signal
2	Main Relay	Batter Voltage

INJECTOR INSPECTION

1. USING HI-SCAN (PRO)

Check Item	Data display	Check conditions	Check content [°C (°F)]	Test specification (ms)
Injector	Drive time (at staring)	Engine: Cranking	0 (32)	Approx. 17
			20 (68)	Approx. 35
			80 (176)	Approx. 8.5

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Check Item	Data display	Check conditions	Engine state	Test specification
Injector	Drive time	• Engine coolant temperature: 80 to 95°C (176 to 205°F) • Lamps, electric cooling fan, accessory modules: All OFF • Transaxle: Neutral (P range for vehicle with A/T) • Steering wheel: Neutral	Idle rpm	2.2~2.9 ms
			2,000 rpm	1.8~2.6 ms
			Rapid racing	Increasing

NOTE

- Drive time indicates the injector activation time when the supply voltage is 11V and the cranking speed is less than 250 rpm.
- When engine coolant temperature is lower than 0°C (32°F), the ECU fires all six cylinders simultaneously.
- When the vehicle is new (within initial operation of about 500 km [300 miles]), the injector drive time may be about 10% longer.

Check Item	Item No.	Drive content	Check condition	Normal state
Injector • Actuator test	01	No. 1 injector shut off	Engine: Idling after warm-up (Shut off the injectors in sequence during and after engine warm-up; check the idle condition)	Idle should become unstable as injector shuts off.
	02	No. 2 injector shut off		
	03	No. 3 injector shut off		
	04	No. 4 injector shut off		
	05	No. 5 injector shut off		
	06	No. 6 injector shut off		

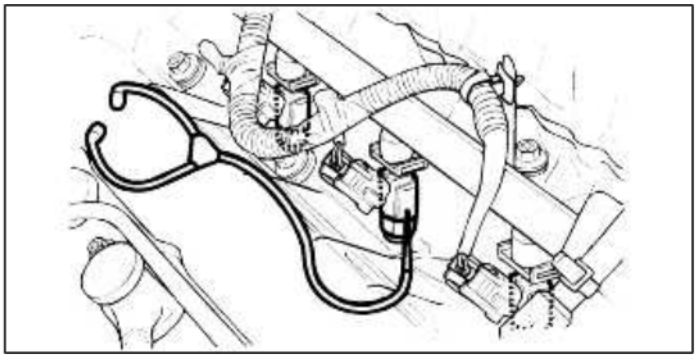
2. USING STETHOSCOPE AND VOLTMETER

(1) OPERATION SOUND CHECK

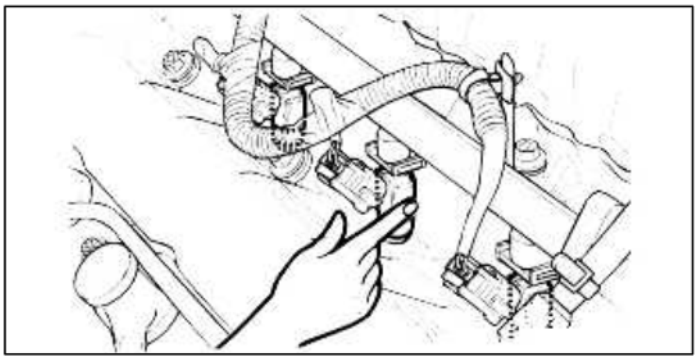
A. Using a stethoscope, check the injectors for a clicking sound at idle. Check that the sound is produced at shorter intervals as the engine speed increases.

CAUTION

Ensure that the sound from an adjacent injector is not being transmitted along the delivery pipe to an inoperative injector.



B. If a stethoscope is not available, check the injector operation with your finger. If no vibration is felt, check the wiring connector, injector or injection signal from the ECU.



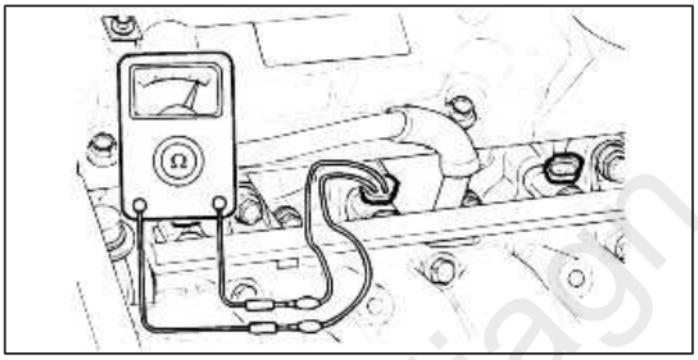
(2) RESISTANCE MEASUREMENT BETWEEN TERMINALS

A. Disconnect the connector at the injector.

B. Measure the resistance between terminals.

Standard value : 13 - 16 Ω [at 20°C (68°F)]

C. Re-connect the connector to the injector.

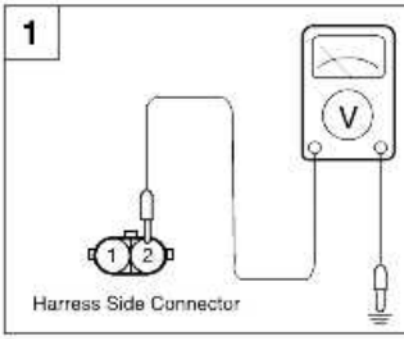


TROUBLESHOOTING HINTS

1. If the engine is hard to start when hot, check for fuel pressure and injector leaks.
2. If the injectors do not operate when the engine is cranked, then check the followings:
   A. Defective power supply circuit to the ECU, faulty ground circuit
   B. Defective control relay
   C. Defective Crankshaft Position (CKP) Sensor or Camshaft Position (TDC) Sensor
3. If there is any cylinder whose idle state remains unchanged when the fuel injectors are cut one after another during idling, check for the following items about that a cylinder.
   A. Injector and harness
   B. Ignition plug and high tension cable
   C. Compression pressure
4. If the injection system is OK but the injector drive time is out of specification, check for the following items.
   A. Poor combustion in the cylinder (faulty ignition plug, ignition coil, compression pressure, etc.)
   B. Loose EGR valve seating

HARNESS INSPECTION PROCEDURES

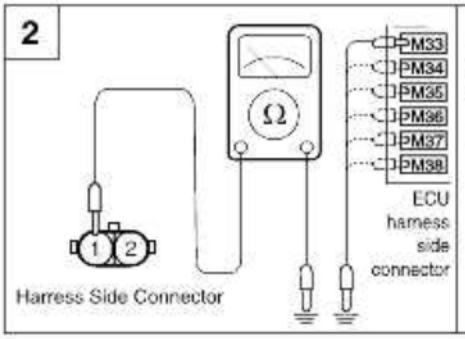
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Measure the Power supply voltage.
- Injector Connector: Disconnected
- ECU Connector: Connected
- Ignition Switch: ON
- Voltage (V): Battery Voltage

OK ⇨ 2

NG ⇨ Repair the harness



Check for an open circuit or a short circuit between ECU and Injector.
- Injector Connector: Disconnected
- ECU Connector: Disconnected

OK ⇨ END

NG ⇨ Repair the harness

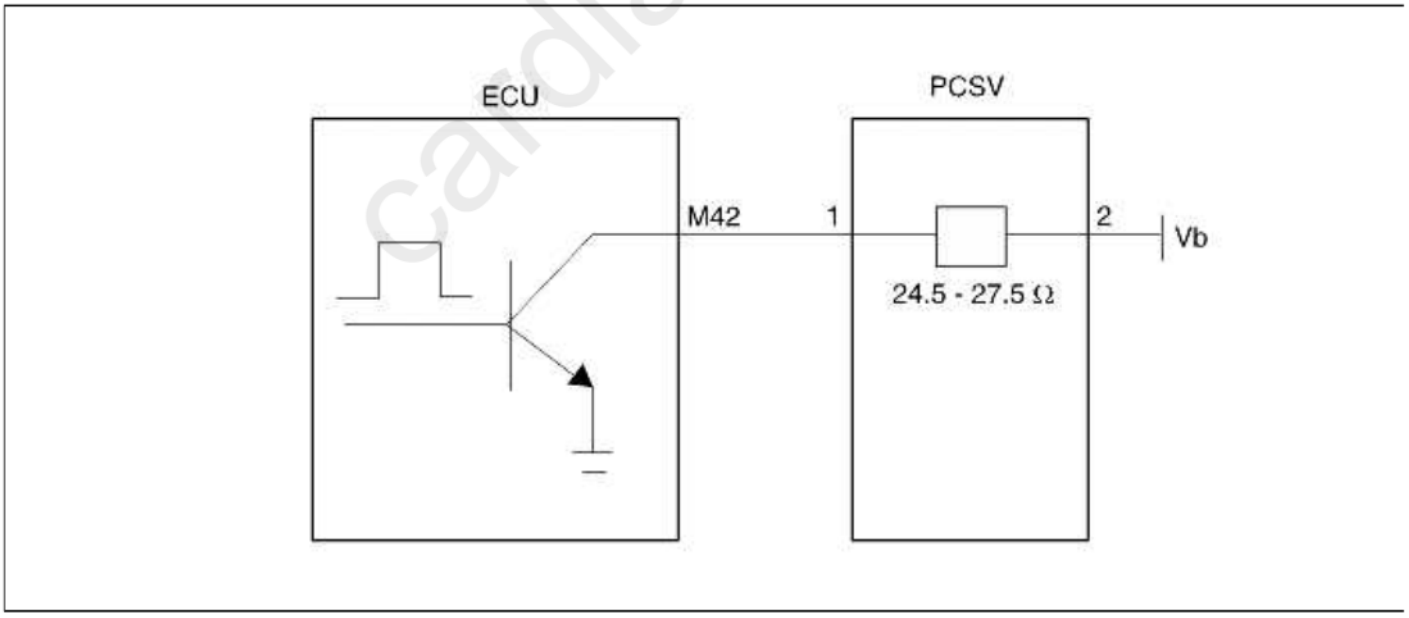
PURGE CONTROL SOLENOID VALVE (PCSV)

Purge Control Valve (PCV) controls evaporative gas gathered in canister. It is divided into duty type controlled by ECU and ON/OFF type controlled by vacuum in intake manifold and ECU.

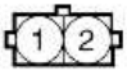
PCV is closed when water temperature is low or engine is idle and is open when water temperature is in normal temperature. When it is open, evaporative gas in canister is flowed into the intake manifold.

Especially duty type PCV is called Purge Control Solenoid Valve (PCSV). Duty is 0% when it is wholly closed, and 100% when it is wholly open (Generally Idle: 1~3 %, Max: 92%).

[CIRCUIT DIAGRAM AND OUTPUT FEATURE (PCSV)]

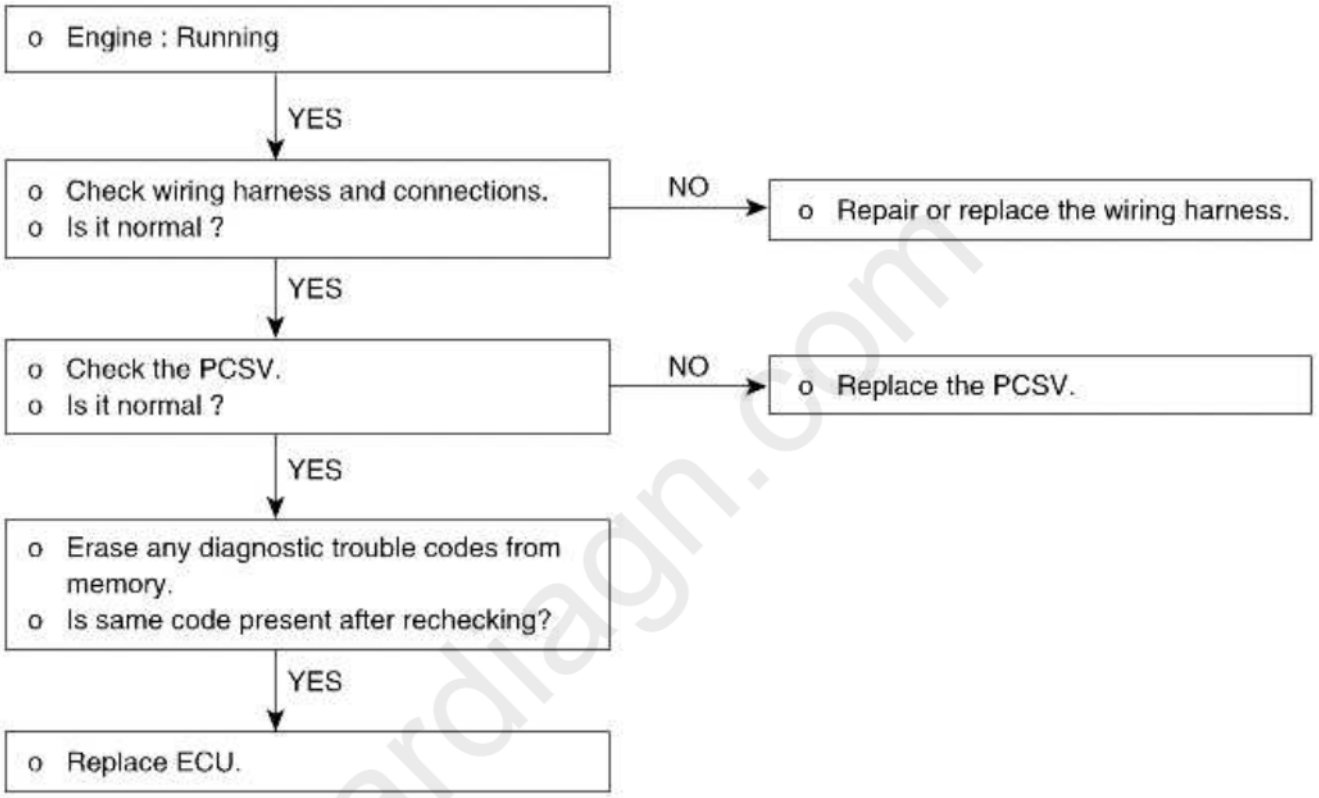


[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal M42	PCSV Control Signal
2	Main Relay	Battery Voltage

TROUBLESHOOTING PROCEDURES



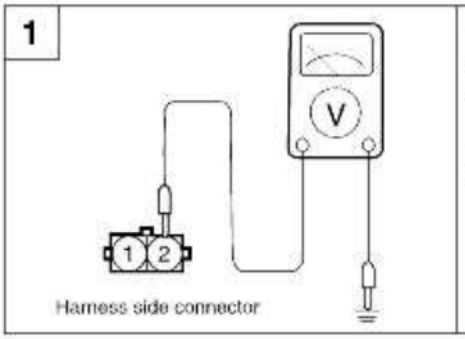
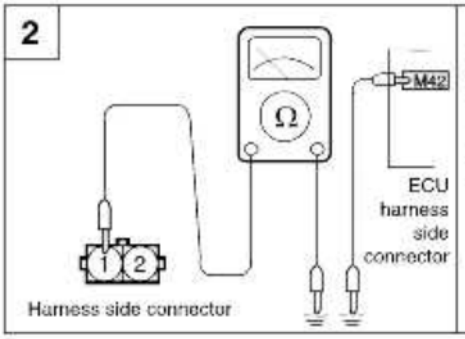
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PCSV INSPECTION

USSING HI-SCAN (PRO)

Check Item	Check conditions	Check content	Normal state
Evaporative emission Canister Purge Control Solenoid Valve (PCSV) • Actuator test	IG ON (Do not start)	PCSV	Activate

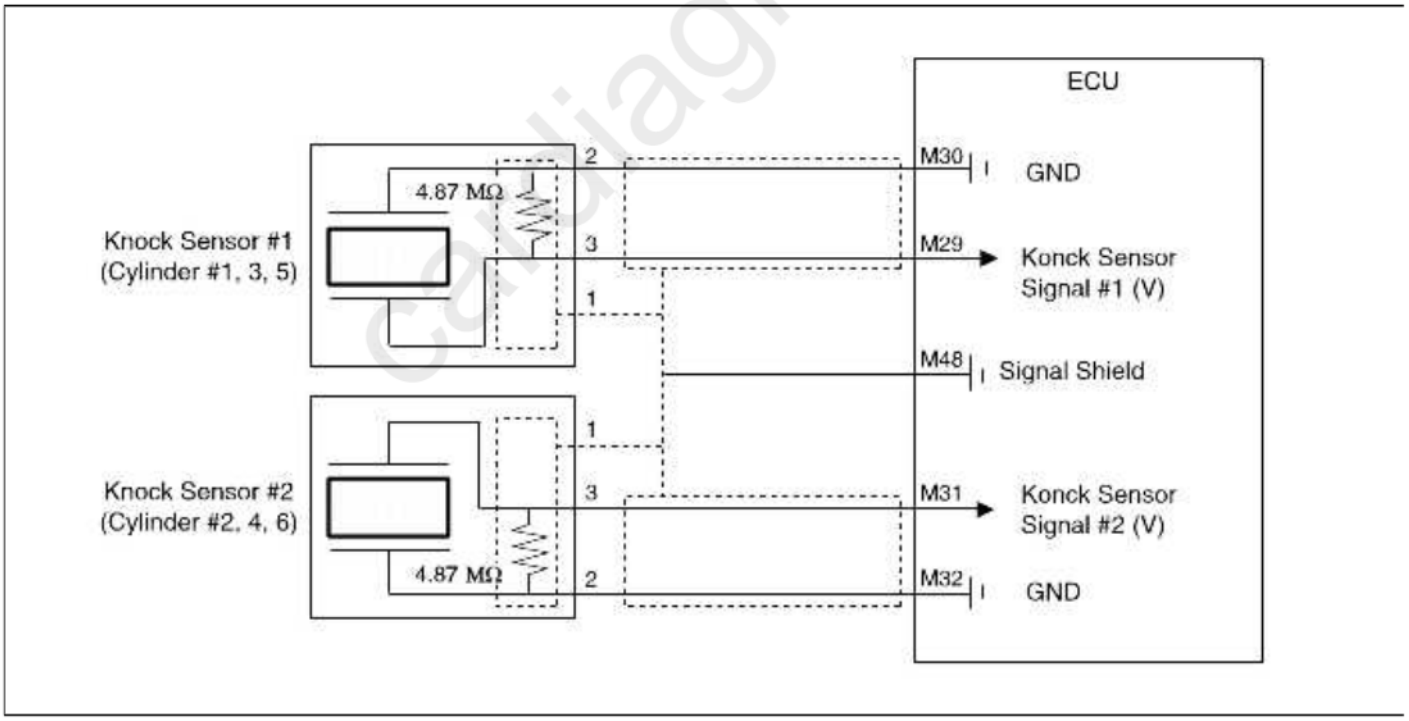
HARNESS INSPECTION PROCEDURES (PCSV)

1		Measure the Power supply voltage. • PCSV Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Purge Control Solenoid Valve (PCSV). • PCSV Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ END NG ⇨ Repair the harness

KNOCK SENSOR

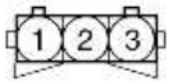
The knock sensor is a piezoelectric device attached to the cylinder block that senses pressure from engine knock conditions. This vibrational pressure is then converted into a voltage signal which is delivered as output. If engine knock occurs, ignition timing is retarded to suppress it.

[CIRCUIT DIAGRAM (KNOCK SENSOR)]



[HARNESS CONNECTOR]

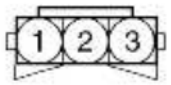
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Knock Sensor #1

Knock Sensor #1

Pin	Connected to	Function
1	ECU Terminal M48	Sensor Shield
2	ECU Terminal M30	GND
3	ECU Terminal M29	Sensor Signal Output #1

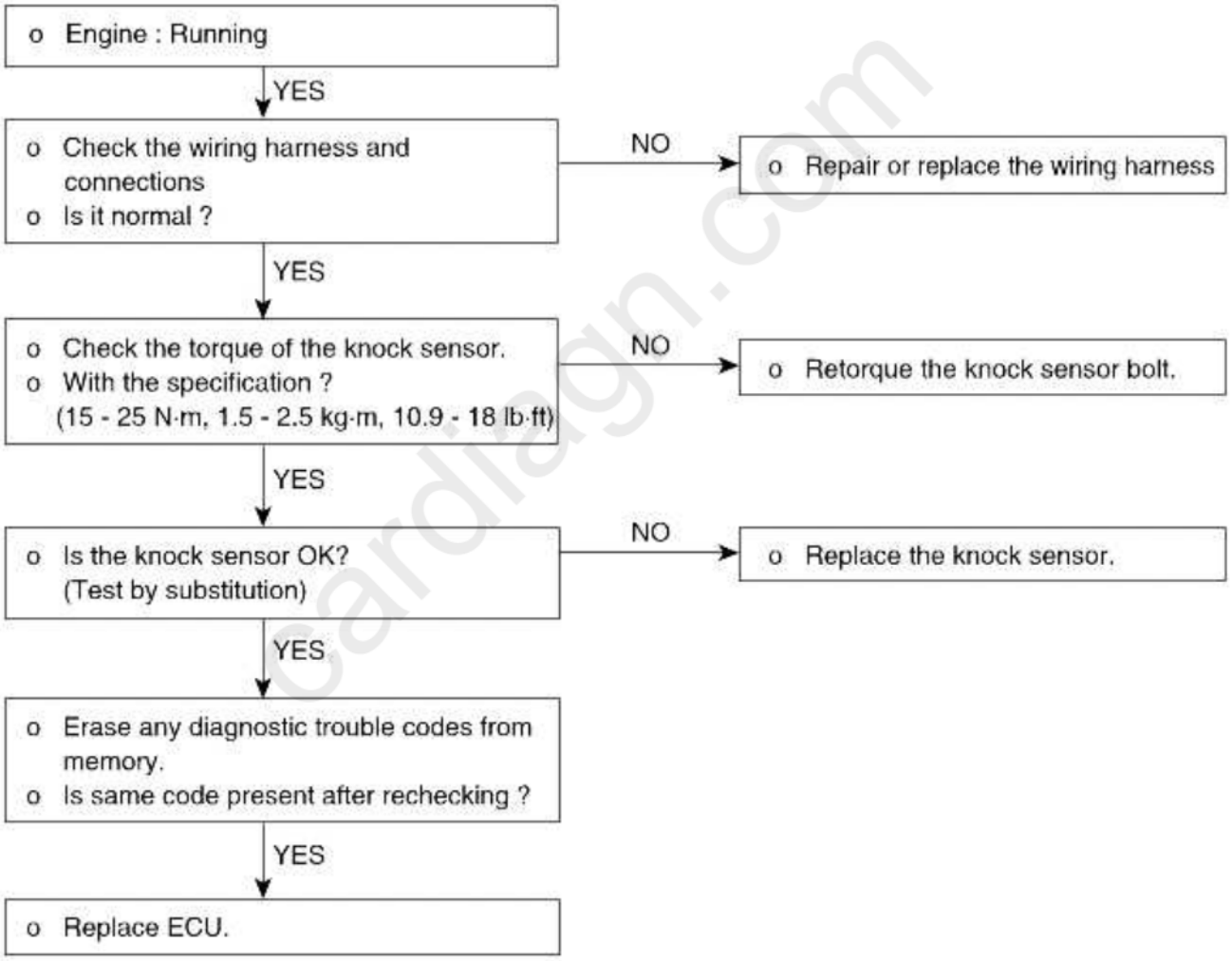


Knock Sensor #2

Knock Sensor #2

Pin	Connected to	Function
1	ECU Terminal M48	Sensor Shield
2	ECU Terminal M32	GND
3	ECU Terminal M31	Sensor Signal Output #2

TROUBLESHOOTING PROCEDURES

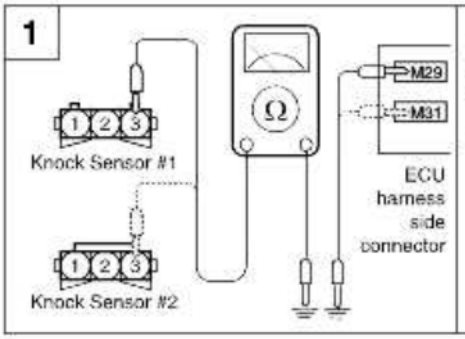
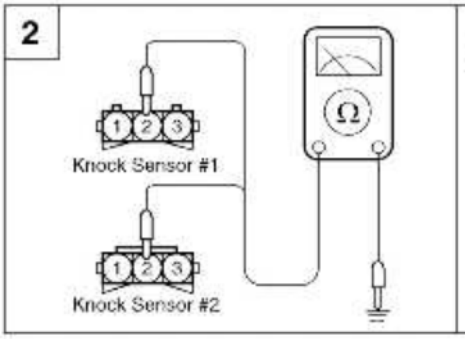


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TROUBLESHOOTING HINTS

1. The MIL is ON or the DTC is displayed on the HI-SCAN (PRO) under the following condition:
   (1) When the knock sensor signal is not detected, even though the engine is in an overload condition.
   (2) When the knock sensor signal is abnormally low.

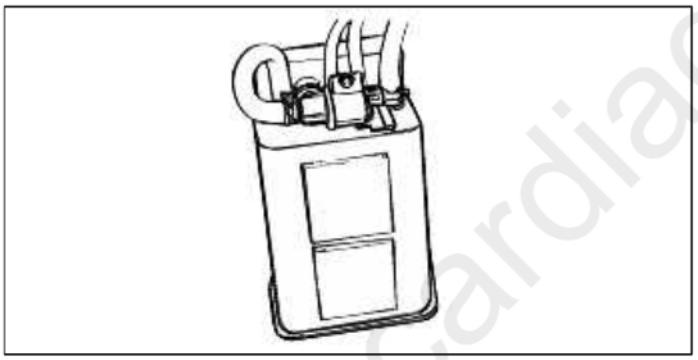
HARNESS INSPECTION PROCEDURES (KNOCK SENSOR)

1		Check for an open circuit or a short circuit between ECU and Knock Sensor. • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END NG ⇨ Repair the harness

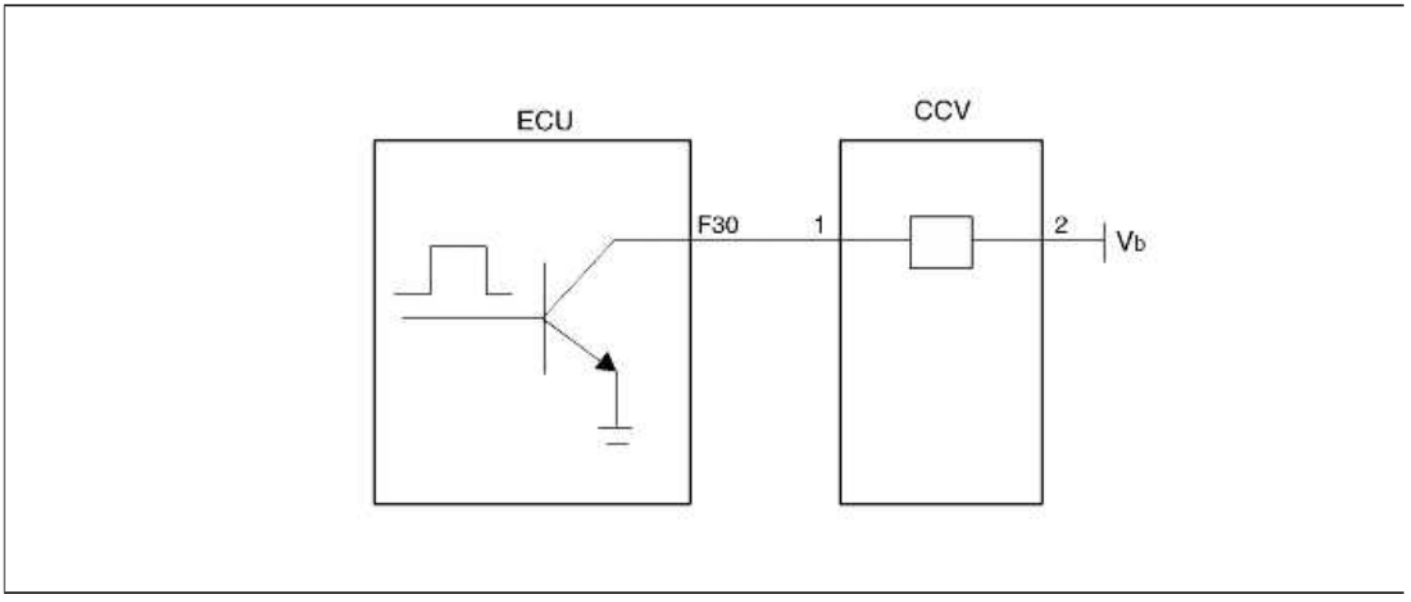
CANISTER CLOSE VALVE (CCV)

The canister close valve is an ON/OFF type which controls the inner pressure of fuel tank caused by fuel evaporation.

It is used to close the evaporative system and to observe tank pressure respectively with the fuel tank pressure sensor.

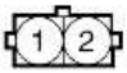


[CIRCUIT DIAGRAM (CCV)]



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[HARNESS CONNECTOR]



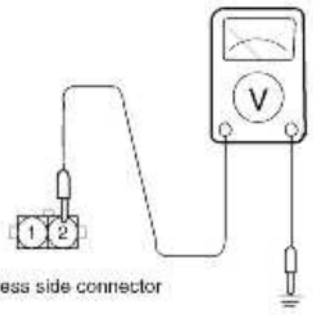
Pin	Connected to	Function
1	ECU Terminal F30	CCV Control Signal
2	Main Relay	Battery Voltage

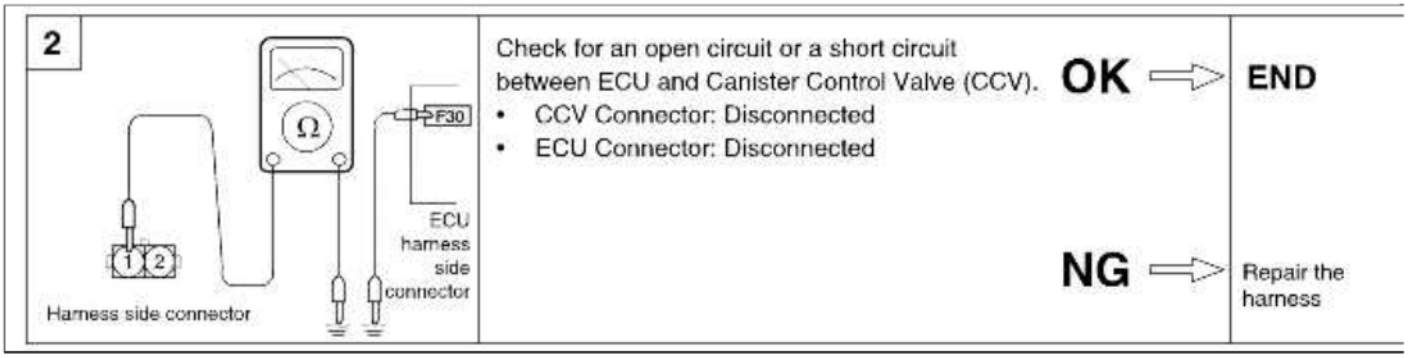
TROUBLESHOOTING PROCEDURES

- o Engine : Running
- YES
- o Check wiring harness and connections.
  o Is it normal ?
- NO → o Repair or replace the wiring harness.
- YES
- o Check the Canister Control Valve.
  o Is it normal ?
- NO → o Replace the Canister Control Valve.
- YES
- o Erase any diagnostic trouble codes from memory.
  o Is same code present after rechecking?
- YES
- o Replace ECU.

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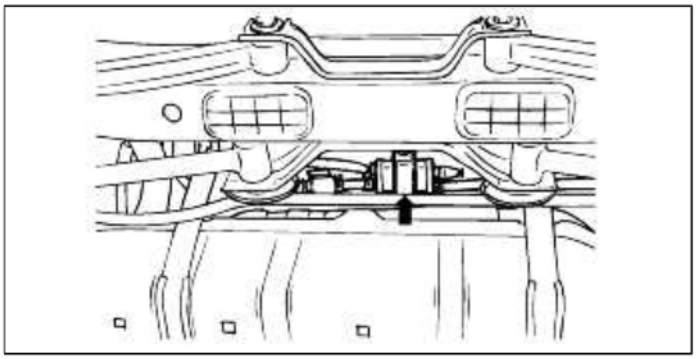
HARNESS INSPECTION PROCEDURES (CCV)

1		Measure the Power supply voltage. • CCV Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): Battery Voltage	**OK** ⇨ 2 **NG** ⇨ Repair the harness

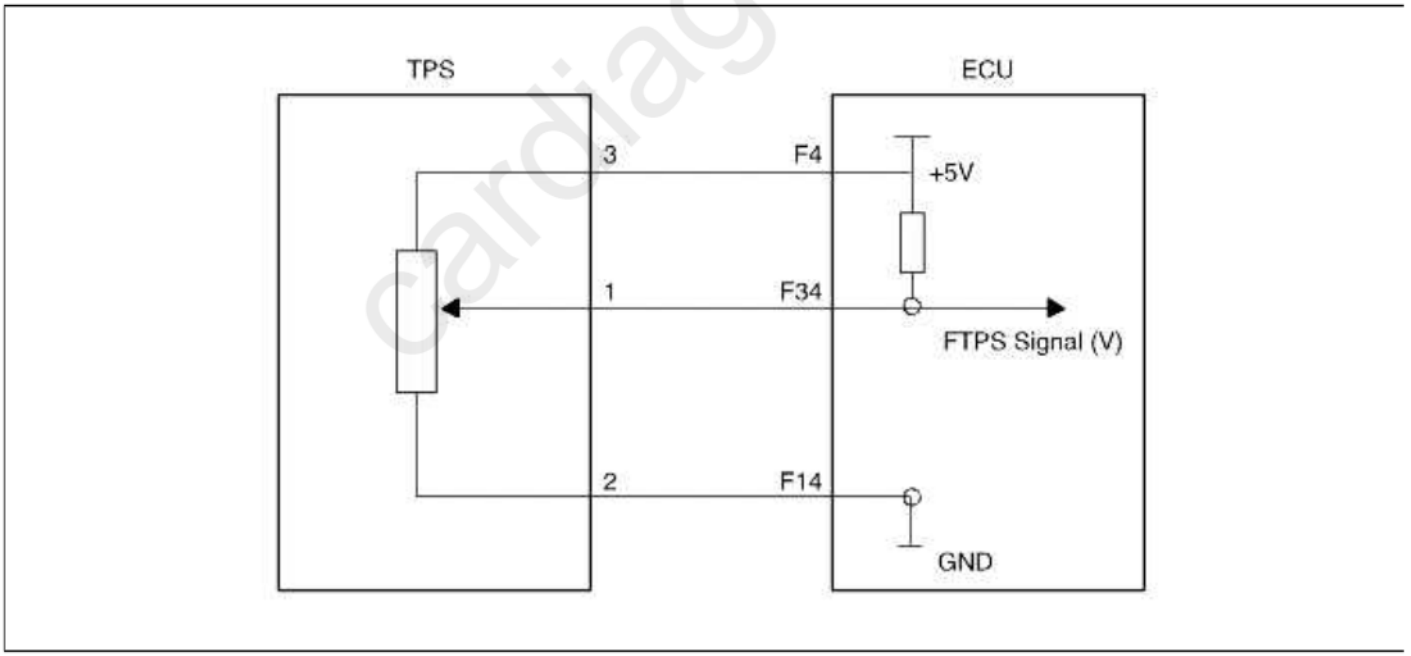


FUEL TANK PRESSURE SENSOR (FTPS)

The fuel tank pressure sensor is a pressure sensitive variable resistor that measures the change of pressure in the fuel tank to monitor for leaks. It is used in the EVAP leak test monitoring with the canister close and purge solenoid valves.

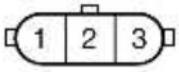


[Circuit Diagram (FTPS)]



[HARNESS CONNECTOR]

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Pin	Connected to	Function
1	ECU Terminal F34	FTPS Signal Output (V)
2	ECU Terminal F14	GND
3	ECU Terminal F4	Sensor Supply (5V)

TROUBLESHOOTING PROCEDURES

- o Engine : Running

YES

- o Check the wiring harness and connections.
- o It is normal?

NO → o Repair or replace the wiring harness.

YES

- o Check the leakage at evaporative system
- o Is it OK?

NO → o Repair or replace as necessary

- o Engine : Running

- o Check the wiring harness and connections.
- o It is normal?

NO → o Repair or replace the wiring harness.

YES

- o Check the Fuel Tank Pressure Sensor.
- o Is the sensor OK?

NO → o Repair the sensor.

YES

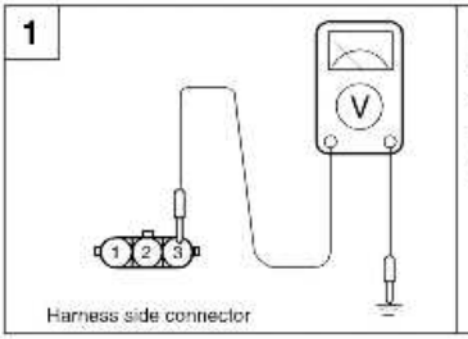
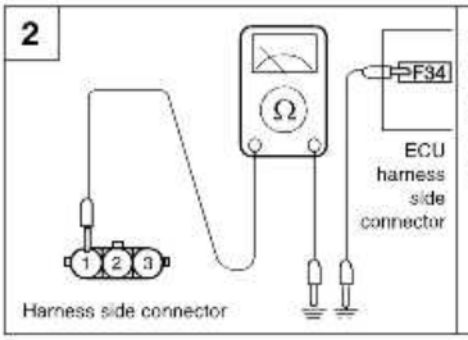
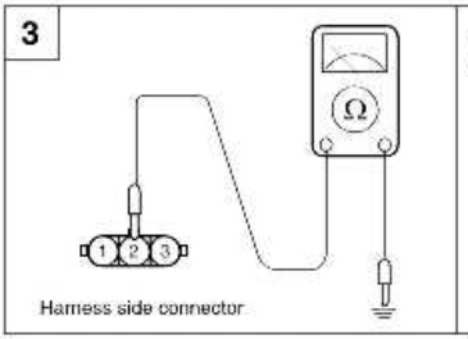
- o Erase any diagnostic trouble codes from memory.
- o Is same code present after rechecking ?

YES

- o Replace ECU.

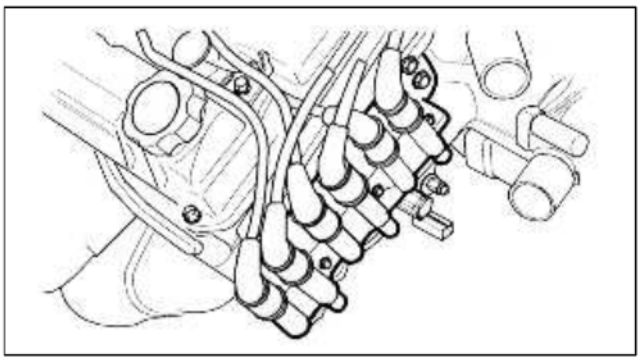
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HARNESS INSPECTION PROCEDURES (FTPS)

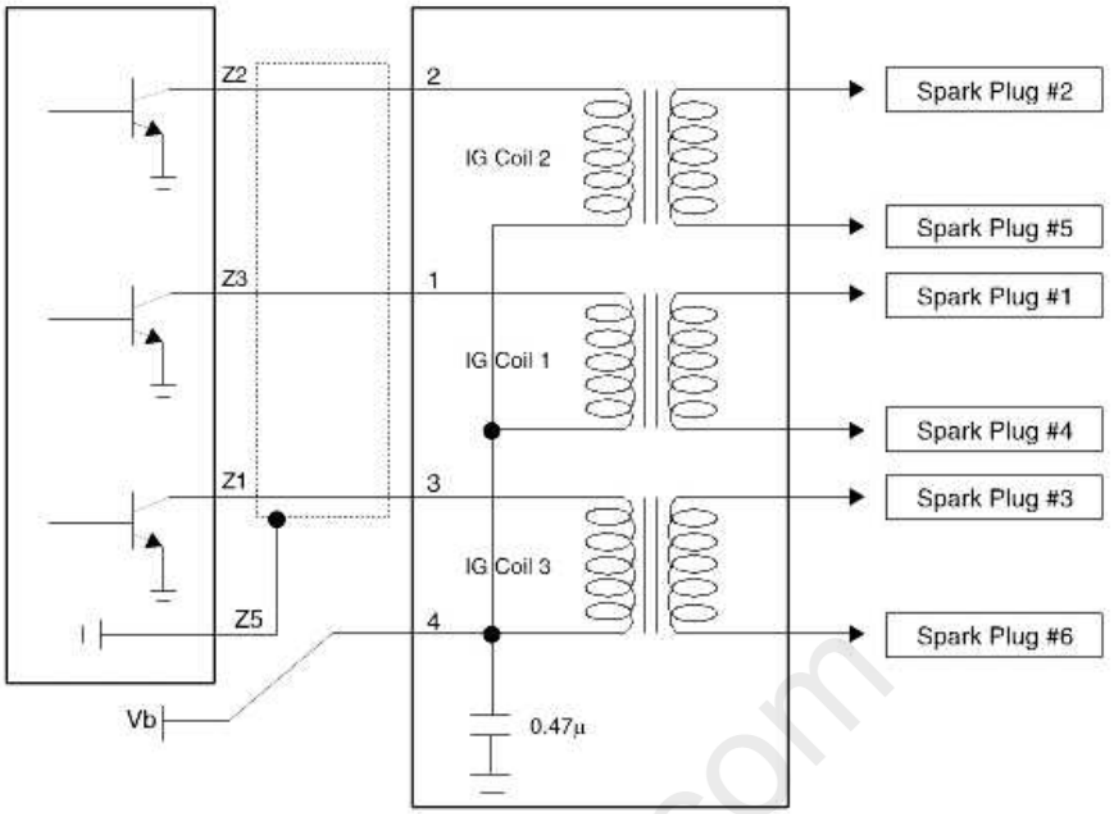
1		Measure the sensor supply voltage. • Sensor Connector: Disconnected • ECU Connector: Connected • Ignition Switch: ON • Voltage (V): 4.8 - 5.2 V	OK ⇨ 2 NG ⇨ Repair the harness
2		Check for an open circuit or a short circuit between ECU and Fuel Tank Pressure Sensor (FTPS). • Sensor Connector: Disconnected • ECU Connector: Disconnected	OK ⇨ 3 NG ⇨ Repair the harness
3		Check for the continuity of the sensor ground. • Sensor Connector: Disconnected	OK ⇨ END! NG ⇨ Repair the harness

IGNITION COIL

The ignition power transistor functions to control the ignition timing by controlling the ignition coil primary current through signals from the ECU and the ignition coil is of the type of ignition order of (#1/#4), (#2/#5), (#3/#6) and is controlled by the power TR built in the ECU.



[CIRCUIT DIAGRAM (IGNITION COIL)]



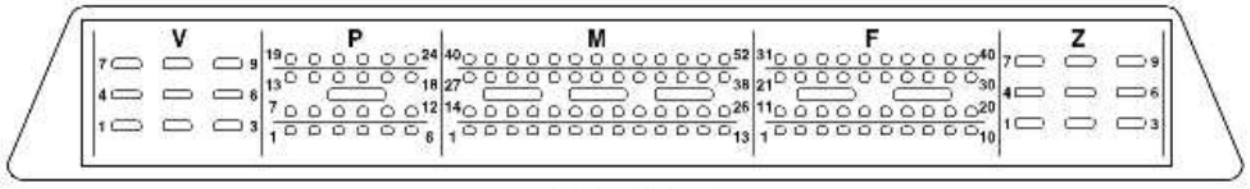
[HARNESS CONNECTOR]



Pin	Connected to	Function
1	ECU Terminal Z3	Ignition Coil 1 (Cylinder #1, 4)
2	ECU Terminal Z2	Ignition Coil 2 (Cylinder #2, 5)
3	ECU Terminal Z1	Ignition Coil 3 (Cylinder #3, 6)
4	Ignition Switch	Ignition Coil Battery Supply

Fuel System > Engine Control System > Specifications

ECU TERMINAL LAYOUT



ECU CONNECTOR

CONNECTOR [V]

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TERMINAL	SIGNAL	CONNECTED TO
V1	IG +	Ignition Switch
V2	-	-
V3	Diagnosis K-Line	Diagnosis Connector
V4	Ground	Chassis
V5	Ground	Chassis
V6	Ground	Chassis
V7	Battery Voltage	Main Realy
V8	Battery Voltage	Main Realy
V9	Battery Voltage	Main Realy

CONNECTOR [P]

TERMINAL	SIGNAL	CONNECTED TO
P1	HO2S Heater Control (Bank 1, Sensor 1)	HO2S (Bank 1, Sensor 1)
P2	-	
P3	-	
P4	-	
P5	-	
P6	-	
P7	HO2S Heater Control (Bank 1, Sensor 2)	HO2S (Bank 1, Sensor 2)
P8	HO2S Shield (Bank 1, Sensor 1)	HO2S (Bank 1, Sensor 1)
P9	HO2S Shield (Bank 2, Sensor 1)	HO2S (Bank 2, Sensor 1)
P10	HO2S Shield (Bank 1, Sensor 2)	HO2S (Bank 1, Sensor 2)
P11	HO2S Shield (Bank 2, Sensor 2)	HO2S (Bank 2, Sensor 2)
P12	-	
P13	HO2S Heater Control (Bank 2, Sensor 1)	HO2S (Bank 2, Sensor 1)
P14	HO2S Shield (Bank 1, Sensor 1)	HO2S (Bank 1, Sensor 1)
P15	HO2S Shield (Bank 2, Sensor 1)	HO2S (Bank 2, Sensor 1)

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P16	HO2S Shield (Bank 1, Sensor 2)	HO2S (Bank 1, Sensor 2)
P17	Fuel Comsumption Signal	Trip Computer
P18	HO2S Shield (Bank 2, Sensor 2)	HO2S (Bank 2, Sensor 2)
P19	HO2S Heater Control (Bank 2, Sensor 2)	HO2S (Bank 2, Sensor 2)
P20	HO2S Ground (Bank 1, Sensor 1)	HO2S (Bank 1, Sensor 1)
P21	HO2S Ground (Bank 2, Sensor 1)	HO2S (Bank 2, Sensor 1)
P22	HO2S Ground (Bank 1, Sensor 2)	HO2S (Bank 1, Sensor 2)
P23	Battery Voltage	Main Relay
P24	HO2S Ground (Bank 2, Sensor 2)	HO2S (Bank 2, Sensor 2)

CONNECTOR [M]

TERMINAL	SIGNAL	CONNECTED TO
M1	Mass Air Flow Sensor (MAF) Signal Input	MAF
M2	-	-
M3	-	-
M4	-	-
M5	-	-
M6	-	-
M7	-	-
M8	Crankshaft Position (CKP) Sensor Signal Input	CKP
M9	-	-
M10	Throttle Position Sensor (TPS) Reference Voltage (+5V)	TPS
M11	-	-
M12	-	-
M13	-	-
M14	-	-
M15	-	-
M16	-	-
M17	Sensor Ground	MAF
M18	-	-
M19	Throttle Position Sensor (TPS) Signal Input	TPS

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M20	Sensor Ground	TPS
M21	Sensor Ground	CKP
M22	Intake Air Temperature Sensor (ATS) Signal Input	ATS
M23	Sensor Ground	ATS
M24	Water Temperature Sensor (WTS) Signal Input	WTS
M25	Sensor Ground	WTS
M26	Power Steering Load Input	Power Steering Switch
M27	-	-
M28	-	-
M29	Knock Sensor Signal Input (Bank 1)	Knock Sensor (Bank 1)
M30	Sensor Ground	Knock Sensor (Bank 1)
M31	Knock Sensor Signal Input (Bank 2)	Knock Sensor (Bank 2)
M32	Sensor Ground	Knock Sensor (Bank 2)
M33	Injector 1 Control	Injector 1
M34	Injector 2 Control	Injector 2
M35	Injector 3 Control	Injector 3
M36	Injector 4 Control	Injector 4
M37	Injector 5 Control	Injector 5
M38	Injector 6 Control	Injector 6
M39	-	-
M40	-	-
M41	-	-
M42	Purge Control Solenoid Valve (PCSV) Control	PCSV
M43	-	-
M44	-	-
M45	-	-
M46	Idle Speed Control (Opening) Coil Control	Idle Speed Control Actuator (ISA)
M47	Idle Speed Control (Closing) Coil Control	Idle Speed Control Actuator (ISA)
M48	Line Shield For Knock Sensor	Knock Sensor
M49	-	-
M50	-	-
M51	-	-
M52	-	-

CONNECTOR [F]

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TERMINAL	SIGNAL	CONNECTED TO
F1	-	-
F2	-	-
F3	-	-
F4	Fuel Tank Pressure Sensor (FTPS) Reference Voltage (+5V)	FTPS
F5	Fuel Level Sensor (FLS) Signal Input	FLS
F6	-	-
F7	Camshaft Position (TDC) Sensor Signal Input	TDC
F8	Sensor Ground	TDC
F9	-	-
F10	Fuel Pump Relay Control	Fuel Pump Relay
F11	-	-
F12	-	-
F13	Throttle Position Sensor (TPS) Signal Output	EPS, ECS
F14	Sensor Ground	FTPS
F15	Ground	FLS
F16	-	-
F17	Engine Speed Signal	Tachometer
F18	Cooling Fan Low Control	Cooling Fan
F19	-	-
F20	MIL Control	MIL
F21	-	-
F22	Wheel Speed Signal Input [1]*	ABS ECU
F23	A/C Tripple Switch Signal (High/Low)	A/C Tripple Switch
F24	A/C Switch Signal	A/C Switch
F25	A/C Tripple Switch Signal (Middle)	A/C Tripple Switch
F26	-	-
F27	-	-
F28	-	-
F29	A/C Compressor Relay Control	A/C Compressor Relay
F30	Canister Close Valve (CCV) Control	CCV
F31	-	-
F32	-	-
F33	-	-
F34	Fuel Tank Pressure Sensor (FTPS) Signal Input	FTPS

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F35	-	-
F36	CAN-HIGH	TCS, TCU
F37	CAN-LOW	TCS, TCU
F38	Sensor Ground [2]*	Wheel Speed Sensor
F39	Wheel Speed Sensor Signal Input [2]*	Wheel Speed Sensor
F40	Cooling Fan High Control	Cooling Fan

NOTE

[1]* : This connection is valid for the vehicles WITH ABS.
[2]* : This connections are valid for the vehicles WITHOUT ABS.

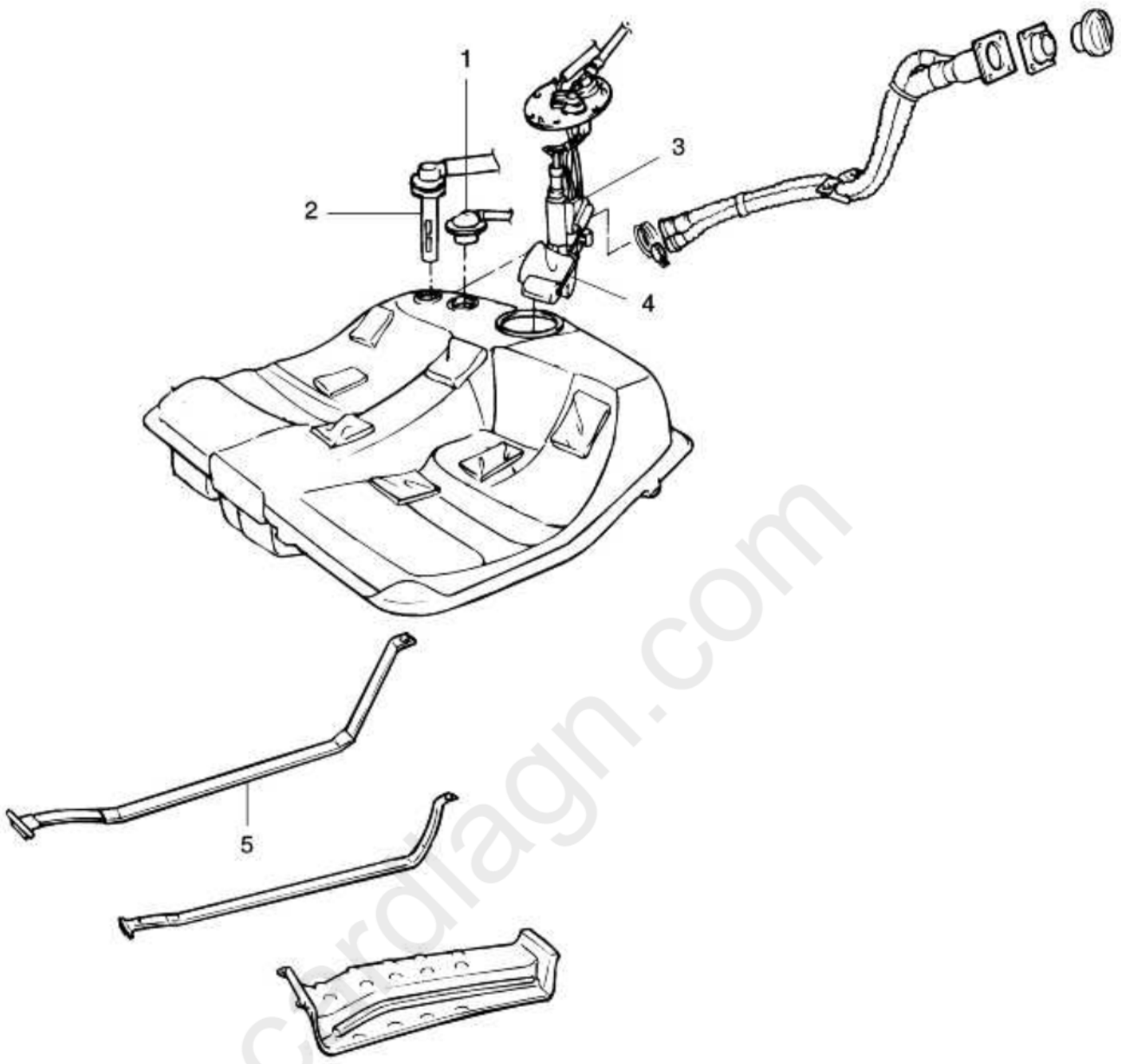
CONNECTOR [Z]

TERMINAL	SIGNAL	CONNECTED TO
Z1	Ignition Coil 3 (3 & 6) Control	Ignition Coil 3
Z2	Ignition Coil 2 (2 & 5) Control	Ignition Coil 2
Z3	Ignition Coil 1 (1 & 4) Control	Ignition Coil 1
Z4	-	-
Z5	Ignition Power Stage Ground	Ground
Z6	-	-
Z7	-	-
Z8	-	-
Z9	-	-

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Fuel System > Fuel Delivery System > Fuel Tank > Components and Components Location

COMPONENTS



TORQUE : Nm (kg·cm, lb·ft)

1. Fill vent valve
2. Fuel shut-off valve
3. Electrical fuel pump
4. Fuel sender
5. Tank band

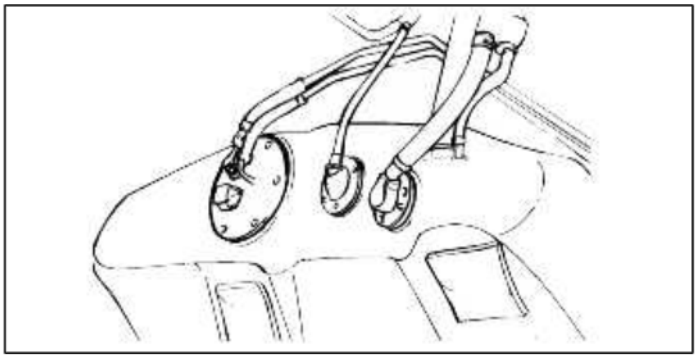
Fuel System > Fuel Delivery System > Fuel Tank > Repair procedures

REMOVAL

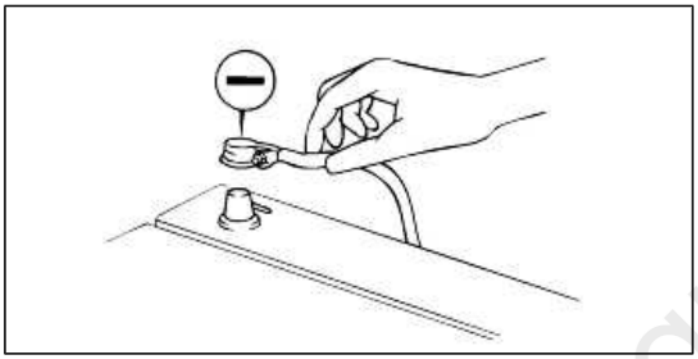
1. To reduce the internal pressure of the fuel main pipes and hose, first start the engine and then disconnect the electrical fuel pump connector in the rear seat side.

WARNING

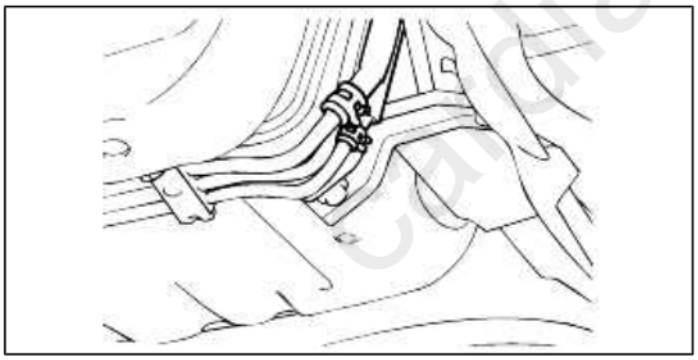
Be sure to reduce the fuel pressure before disconnecting the fuel main pipe and hose, otherwise fuel will spill out, leading to the risk of fire or explosion.



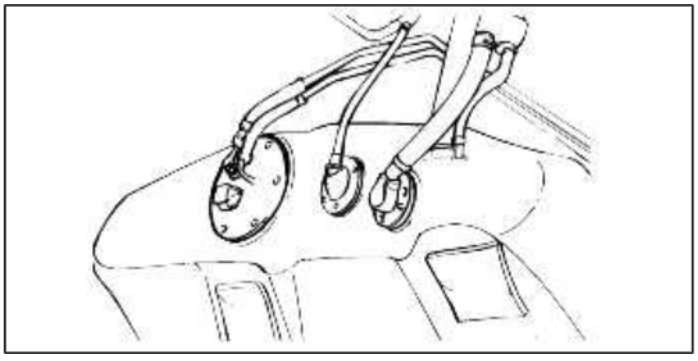
2. Disconnect the battery cable from the negative terminal of the battery.



3. Remove the fuel tank cap.
4. Disconnect the return hose and vapor hose.

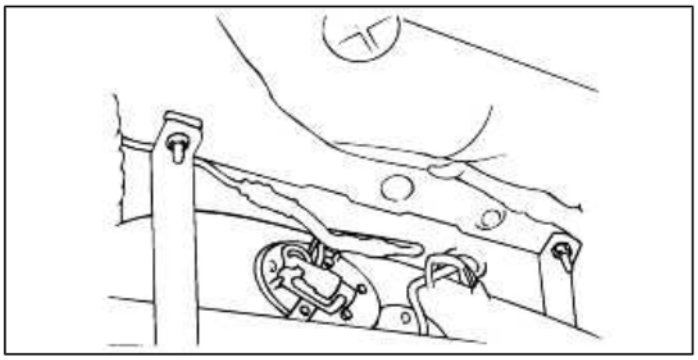


5. Disconnect the fuel sender connector.
6. Disconnect the high pressure hose from the fuel tank.

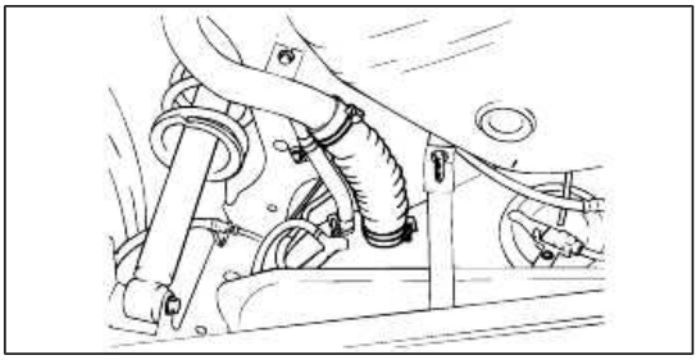


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7. Loosen the two self-locking nuts, that hold tank in the position and remove the two tank bands.

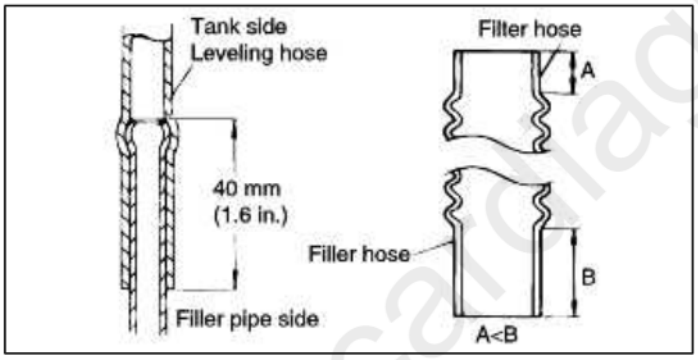


8. Detach the fuel filler hose and leveling hose.
9. Remove the fuel vapor hose and the fuel tank.

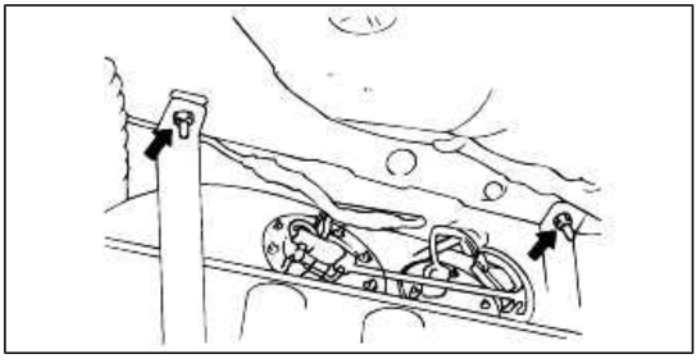


INSTALLATION

1. Connect the leveling hose to the tank and approximately 40 mm (1.6 in.) at the filler neck.

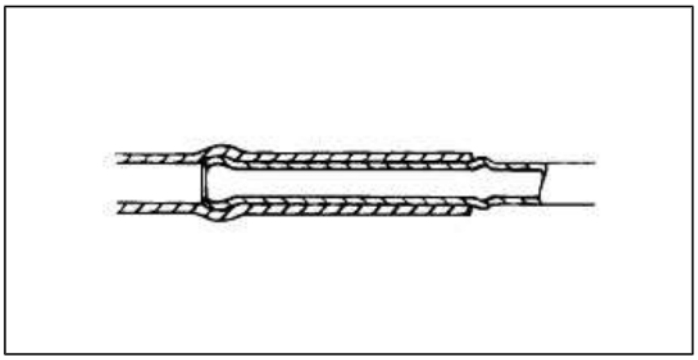


2. When connecting the filler hose, connect the end with the shorter straight pipe to the tank side.
3. Confirm that the pad is fully bonded to the fuel tank. Install the fuel tank by tightening the self-locking nuts to the tank bands until the rear end of the tank band contacts the body.



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4. Connect the vapor hose and return hose. Attach the fuel hose to the line as shown in the illustration.

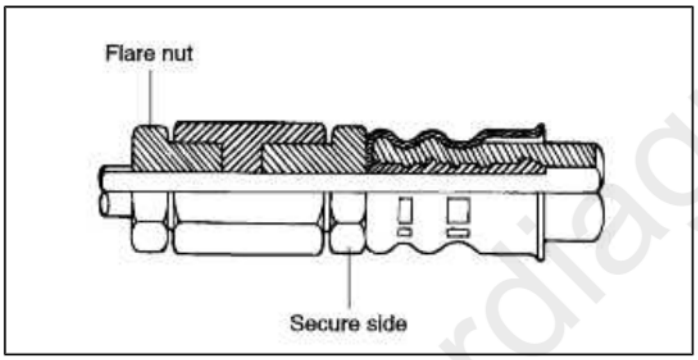


5. To connect the high pressure hose to the fuel pump, temporarily tighten the flare nut by hand, and then tighten it to the specified torque. Be careful that the fuel hose does not twist.

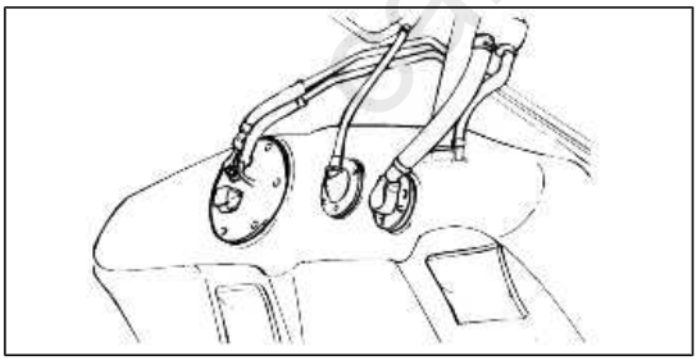
Tightening torque :
High pressure hose flare nut :
30~40 Nm (300~400 kg·cm, 22~29 lb·ft)

NOTE

When tightening the flare nut, be careful not to bend or twist the line to prevent damage to the fuel pump connection.



6. Connect the electrical fuel pump and fuel sender connector.

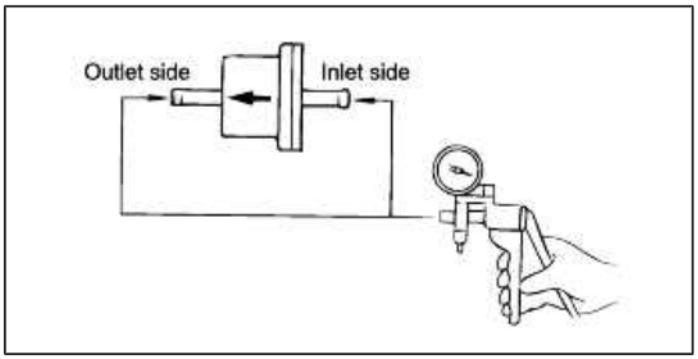


INSPECTION

1. Check the hoses and the pipes for cracks or damage.
2. Check the fuel tank cap for proper operation.
3. Check the fuel tank for deformation, corrosion or cracking.
4. Check the fuel tank inside for dirt or foreign material.
5. Check the in-tank fuel filter for damage or restriction.
6. Test the two-way valve for proper operation.

7. Using a vacuum hand pump, check the operation of the two-way valve.

Valve pump	Guide lines for acceptance or rejection
When connected to inlet side	Negative pressure generated and vacuum maintained
When connected to outlet side	No negative pressure generated



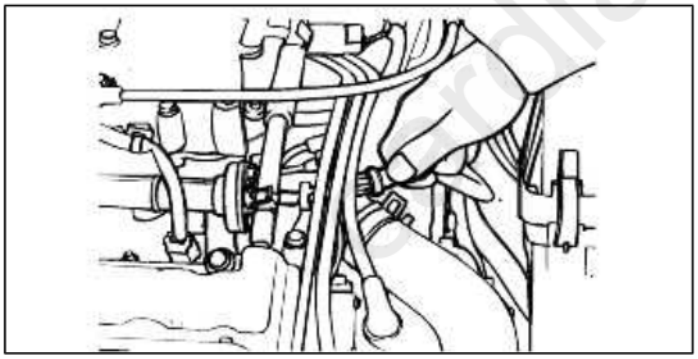
Fuel System > Fuel Delivery System > Fuel Pump > Repair procedures

Operation Check

1. Turn the ignition switch to OFF.
2. Apply battery voltage to the fuel pump drive connector to check that the pump operates.

> NOTE
>
> The fuel pump is an in-tank type and its operating sound is hard to hear without removing the fuel tank cap.

3. Pinch the fuel hose to check that fuel pressure is felt.

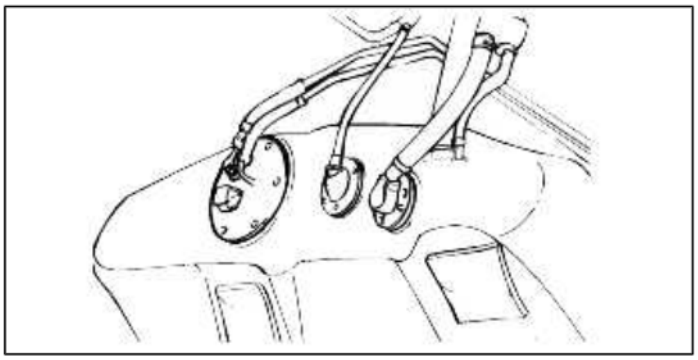


Fuel System > Fuel Delivery System > Fuel Filter > Repair procedures

Fuel Sender and fuel Filter Replacement

1. Remove the fuel tank cap to lower the tank's internal pressure.
2. Disconnect the harness connector from the fuel sender.

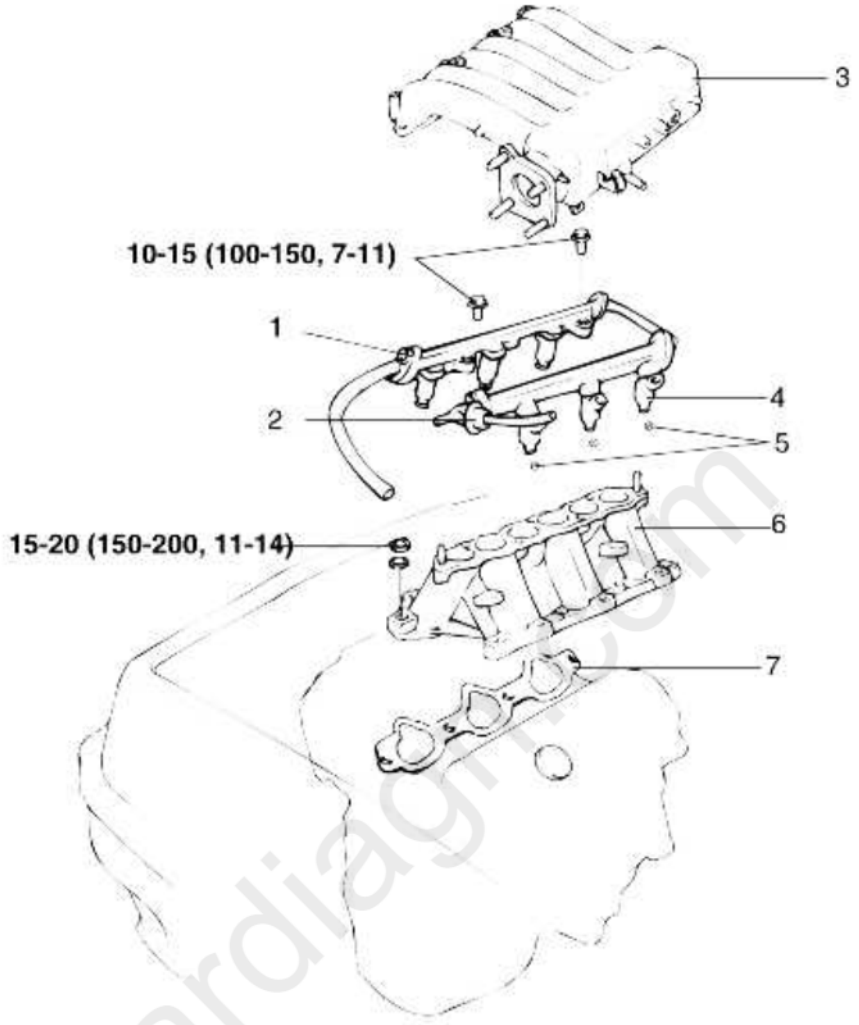
3. Remove the fuel tank module installation screws, and then remove the fuel sender assembly from the fuel tank.



Fuel System > Fuel Delivery System > Fuel Line > Components and Components Location

COMPONENTS

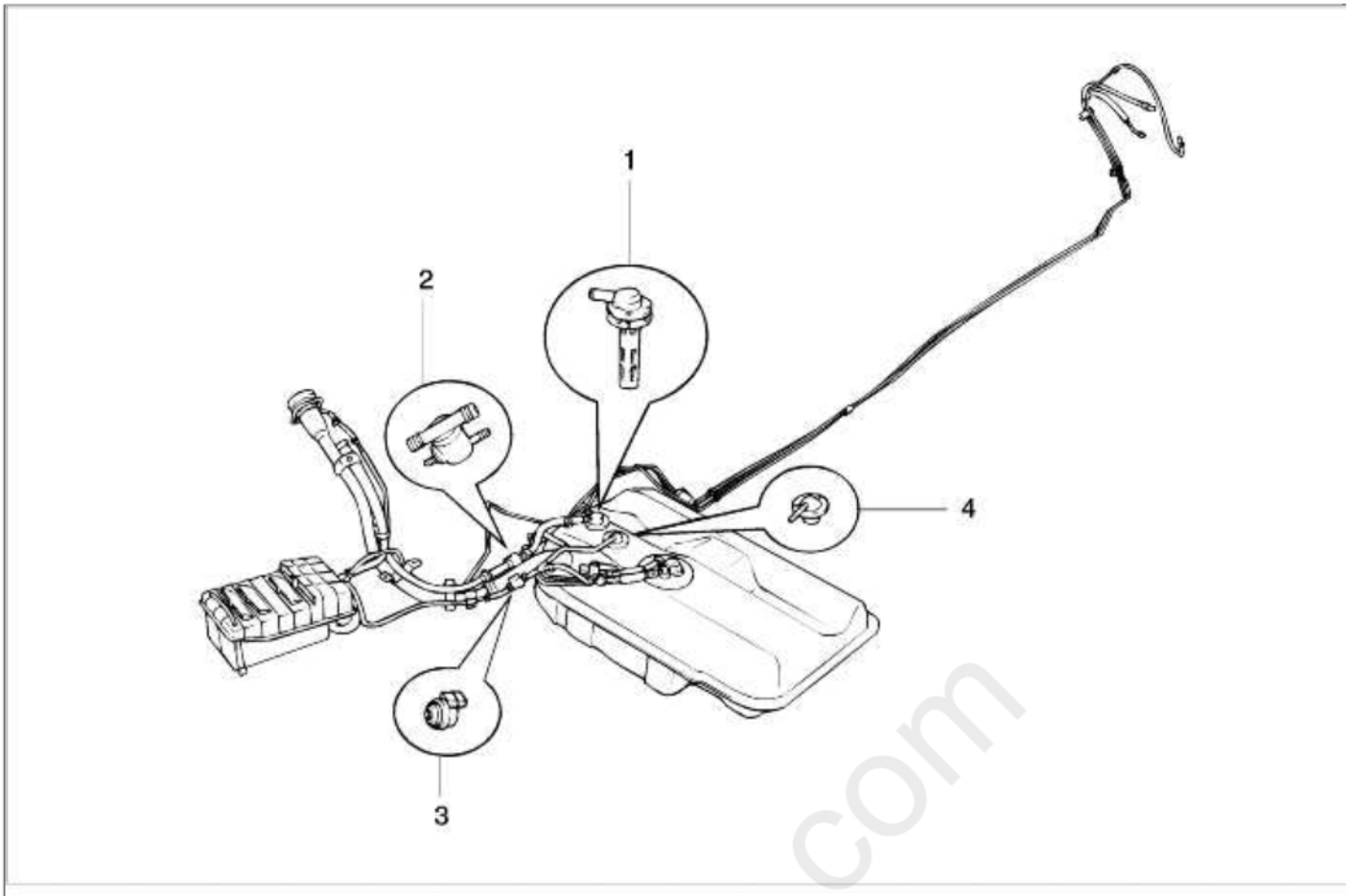
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TORQUE : Nm (kg·cm, lb·ft)

1. Delivery pipe
2. Pressure regulator
3. Air intake surge tank
4. Fuel injector
5. Insulator
6. Intake manifold
7. Gasket

COMPONENTS



1. Fill vent valve
2. Restrictive 4 way valve
3. 2 way valve
4. Fuel cut valve

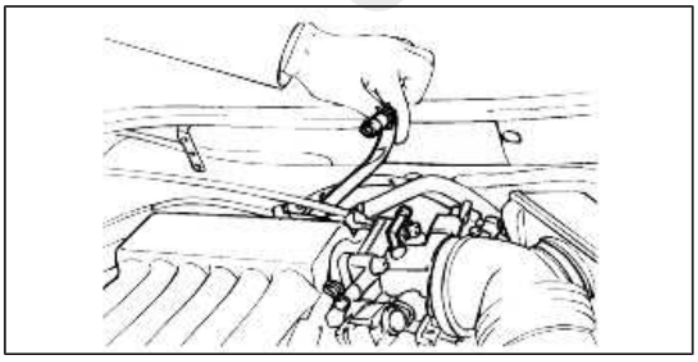
Fuel System > Fuel Delivery System > Fuel Line > Repair procedures

EVAP Canister Purge Port Vacuum Check

Checking Condition

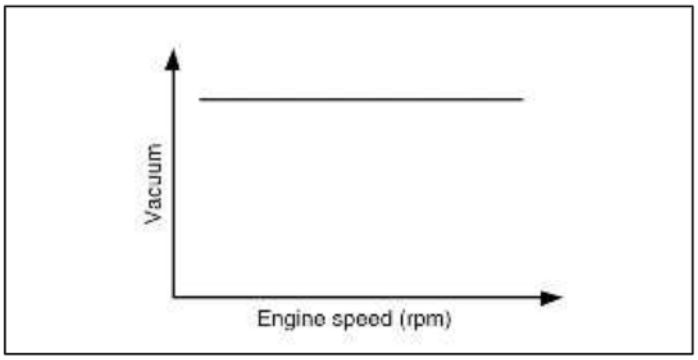
Engine coolant temperature: 80-95°C (176-205°F)

1. Disconnect the vacuum hose from the throttle body EVAP canister purge hose fitting and connect a vacuum gauge.



2. Start the engine and check that, after raising the engine speed, vacuum remains fairly constant.

> NOTE
>
> If there is no vacuum, it is possible that the throttle body port may be clogged and require cleaning.



REMOVAL

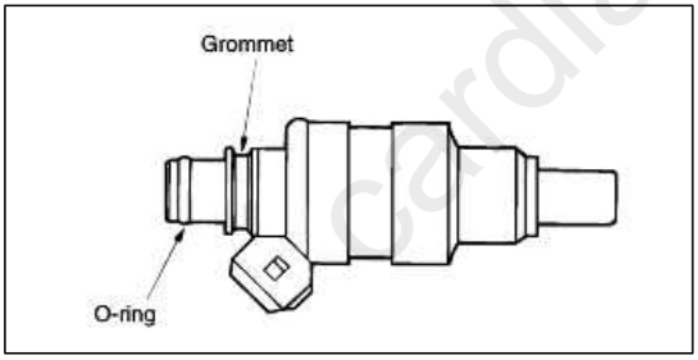
1. Release residual pressure from the fuel line to prevent fuel spilling.

> WARNING
>
> Cover the hose connection with rags to prevent splashing of fuel that could be caused by residual pressure in the fuel line.

2. Remove the delivery pipe with the fuel injector and pressure regulator.

INSTALLATION

1. Install a new grommet and O-ring to the injector.
2. Apply a coating of solvent, spindle oil or gasoline to the injector O-ring.

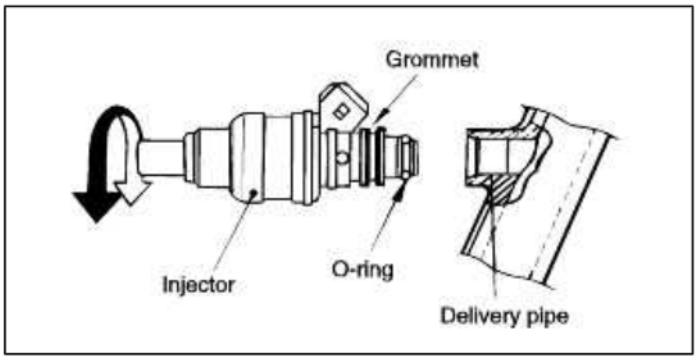


3. While turning the injector to the left and right, install it on to the delivery pipe.

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4. Be sure the injector turns smoothly.

> NOTE
>
> If injector does not turn smoothly, the O-ring may be jammed. Remove the injector and re-insert it into the delivery pipe and re-check.



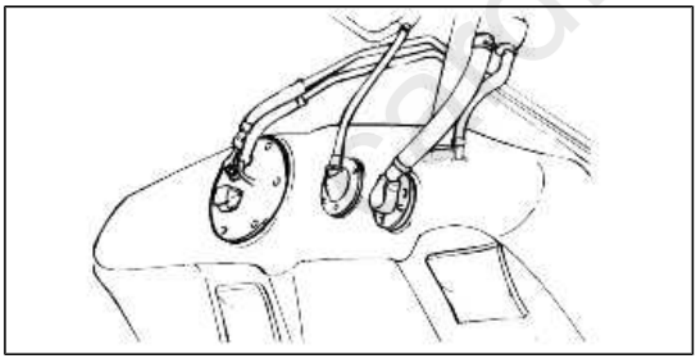
INSPECTION

1. Check the hoses and pipes for cracking, bending, deformation or restrictions.
2. Check the EVAP Canister for restrictions.
3. Check the fuel filter for restrictions and damage.

Fuel System > Fuel Delivery System > Repair procedures

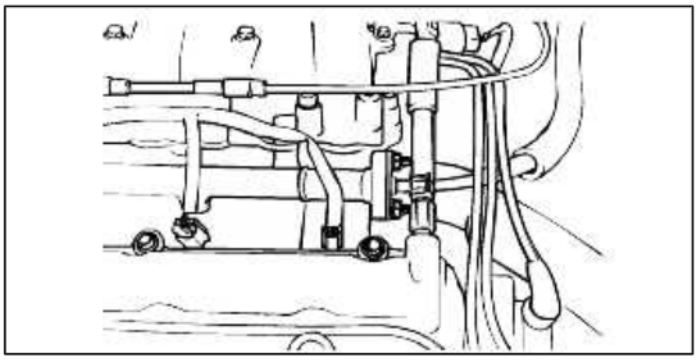
FUEL PRESSURE TEST

1. Reduce the internal pressure of the fuel pipes and hoses by the following procedures.
   A. Disconnect the fuel pump harness connector after removing the rear seat cushion.
   B. Start the engine and after it stalls, turn the ignition switch to the OFF position.
   C. Disconnect the battery negative (-) terminal.
   D. Connect the fuel pump harness connector.



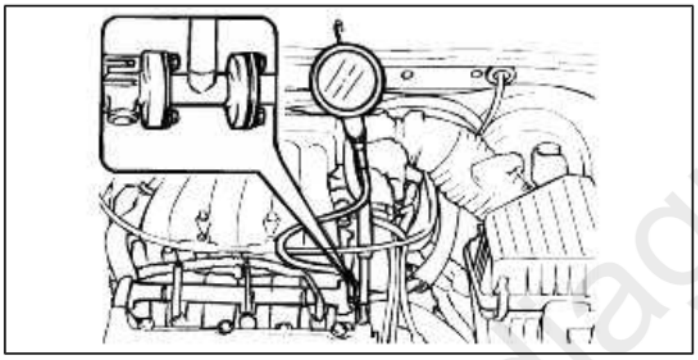
2. Remove the bolt connecting the fuel line to the fuel filter.

> WARNING
>
> Cover the hose connection with a shop towel to prevent splashing of fuel caused by fuel residual pressure in the fuel line.



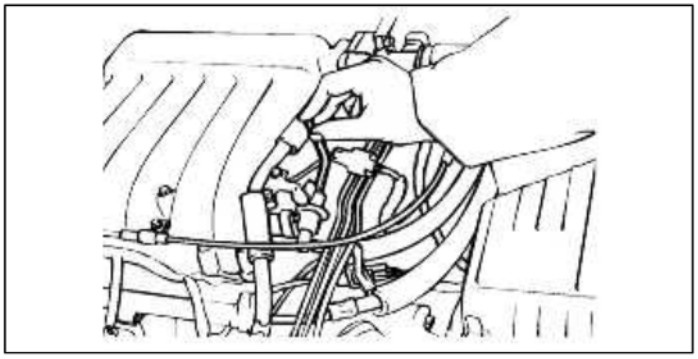
3. Using the fuel pressure gauge adapter, install the fuel-pressure gauge to the fuel filter. Tighten the bolt to the specified torque.

Fuel pressure gauge to fuel filter : 25-35 Nm (250-350 kg·cm, 18-26 lb·ft)



4. Connect the battery's negative (-) terminal.
5. Apply battery voltage to the terminal for the pump drive and activate the fuel pump: then, with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Start and run the engine at curb idle speed.
7. Disconnect the vacuum hose from the pressure regulator, and plug the hose end. Measure the fuel pressure at idle.

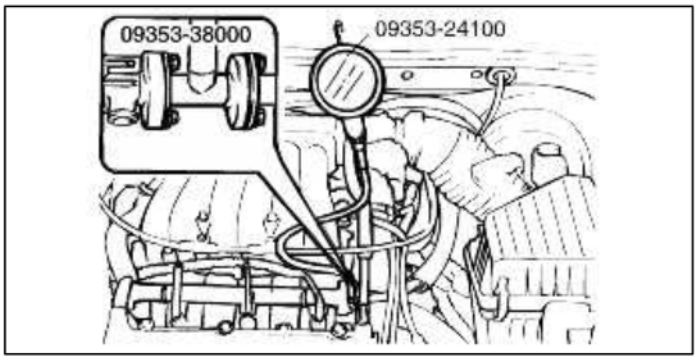
Standard value : 320-340 kPa (3.26-3.47 kg/cm², 46-49 psi)



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8. Measure the fuel pressure when the vacuum hose is connected to the pressure regulator.

Standard value : Approx. 255 kPa (2.57 kg/cm², 37 psi)



9. If the results of the measurements made in steps (7) and (8) are not within the standard value, use the table below to determine the probable cause, and make the necessary repairs.

Condition	Probable cause	Remedy
Fuel pressure is too low	• Clogged fuel filter • Fuel leakage to the return side, caused by poor seating of the fuel pressure regulator	• Replace fuel filter • Replace fuel pressure regulator
	• Low discharge pressure of the fuel pump	• Check the in-tank fuel hose or replace the fuel pump
Fuel pressure is toot high	• Sticking fuel-pressure regulator • Clogged or bent fuel return hose or pipe	• Replace fuel pressure regulator • Repair or replace hose or pipe
There is no difference in fuel pressure when the vacuum hose is connected and when it is not.	• Clogging, or damaged vacuum hose or the nipple • Sticking or poor seating of the fuel pressure regulator	• Repair or replace the vacuum hose or the nipple • Repair or replace hose or pipe

10. Stop the engine and check for a change in the fuel pressure gauge reading, which should hold for approximately 5 minutes.
If the gauge indication drops, observe the rate of drop. Determine and remove the causes according to the following table.

Condition	Probable cause	Remedy
Fuel pressure drops slowly after engine is stopped	• Injector leakage	• Replace injector
Fuel pressure drops immediately after engine is stopped	• The check valve within the fuel pump is open	• Replace fuel pump

11. Reduce the pressure in the fuel line.

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12. Disconnect the hose and the gauge.

> WARNING
>
> Cover the hose connection with a shop towel to prevent splashing of fuel caused by fuel residual pressure in the fuel line.

13. Replace the O-ring of the end of the hose.
14. Connect the fuel hose to the delivery pipe and tighten with the specified.
15. Check for fuel leakage.

Fuel System > Troubleshooting > P0030

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0030	**HO2S Heater Circuit Malfunction (Bank 1, Sensor 1)**
Diagnostic trouble code No. P0031	**HO2S Heater Circuit Low Input (Bank 1, Sensor 1)**
Diagnostic trouble code No. P0032	**HO2S Heater Circuit High Input (Bank 1, Sensor 1)**
[Related items]	• Open or short to battery between front HO2S heater and ECU • Short to chassis .ground between front HO2S heater and ECU • Open or short to chassis ground between front HO2S heater and main relay • Incorrect front HO2S heater resistance • Faulty front HO2S heater

step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Is DTC P0030, P0031, or P0032 also set?	Yes	Go to step 3.
		No	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
3	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow an engine to idle until WTS reaches operating temperature. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. • **Specification: approximately B+** Is measured voltage within specification?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
4	Turn ignition to OFF and disconnect ECU connector and HO2S connector.	Yes	Go to step 5.

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	Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Measure resistance between HO2S heater signal and battery power terminal. • **4.0 ~ 5.2Ω at 20°C (68°F)** Is measured resistance within specification?	Yes	Go to step 6.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0036

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0036	**HO2S Heater Circuit Malfunction (Bank 1, Sensor 2)**
Diagnostic trouble code No. P0037	**HO2S Heater Circuit Low Input (Bank 1, Sensor 2)**
Diagnostic trouble code No. P0038	**HO2S Heater Circuit High Input (Bank 1, Sensor 2)**
[Related items]	• Open or short to battery between rear HO2S heater and ECU • Short to chassis ground between rear HO2S heater and ECU • Open or short to chassis ground between rear HO2S heater and main relay • Incorrect rear HO2S heater resistance • Faulty rear HO2S heater

step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Is DTC P0036, P0037, P0038, or P1168 also set?	Yes	Go to step 3.
		No	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
3	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow an engine to idle until WTS reaches operating temperature. Measure voltage of HO2S heater battery voltage	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground

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	between HO2S harness connector and chassis ground. • **Specification: approximately B+** Is measured voltage within specification?		between main relay and HO2S harness connector.
4	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Measure resistance between HO2S heater signal and battery power terminal. • **4.0 ~ 5.2Ω at 20°C (68°F)** Is measured resistance within specification?	Yes	Go to step 6.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0050

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0050	**HO2S Heater Circuit Malfunction (Bank2, Sensor 1)**
Diagnostic trouble code No. P0051	**HO2S Heater Circuit Low Input (Bank2, Sensor 1)**
Diagnostic trouble code No. P0052	**HO2S Heater Circuit High Input (Bank2, Sensor 1)**
[Related items]	• Open or short to battery between front HO2S heater and ECU • Short to chassis ground between front HO2S heater and ECU • Open or short to chassis ground between front HO2S heater and main relay. • Incorrect front HO2S heater resistance • Faulty front HO2S heater

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step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Is DTC P0050, P0051, or P0052 also set?	Yes	Go to step 3.
		No	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
3	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow an engine to idle until WTS reaches operating temperature. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. • **Specification: approximately B+** Is measured voltage within specification?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
4	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Measure resistance between HO2S heater signal and battery power terminal. • **4.0 ~ 5.2Ω at 20°C (68°F)** Is measured resistance within specification?	Yes	Go to step 6.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0056

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0056	**HO2S Heater Circuit Malfunction (Bank2, Sensor2)**
Diagnostic trouble code No. P0057	**HO2S Heater Circuit Low Input (Bank2, Sensor2)**
Diagnostic trouble code No. P0058	**HO2S Heater Circuit High Input (Bank2, Sensor2)**
[Related items]	• Open or short to battery between rear HO2S heater and ECU • Short to chassis ground between rear HO2S heater and ECU • Open or short to chassis to ground between rear HO2S heater and main relay • Incorrect rear HO2S heater resistance • Faulty rear HO2S heater

step	Inspection		Action
1	Visually inspect the HO2S circuit for exposed wiring, contamination, corrosion and proper installation. Were any concerns found during the visual inspection?	Yes	Repair any concerns found in the visual inspection.
		No	Go to step 2.
2	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Is DTC P0056, P0057, P0058, or P1169 also set?	Yes	Go to step 3.
		No	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
3	Turn ignition switch to OFF and disconnect HO2S connector. Start engine and allow an engine to idle until ECT reaches operating temperature. Measure voltage of HO2S heater battery voltage between HO2S harness connector and chassis ground. • **Specification: approximately B+** Is measured voltage within specification?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between main relay and HO2S harness connector.
4	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S heater signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Measure resistance between HO2S heater signal and battery power terminal. • **4.0 ~ 5.2 Ω at 20°C (68°F)** Is measured resistance within specification?	Yes	Go to step 6.
		No	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.

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6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

Fuel System > Troubleshooting > P0101

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0101	**Mass or Volume Air Flow Circuit Range/Performance Problem**
[Related items]	• Dirty air cleaner • Air leak in intake system • Contaminated, deteriorated or damaged MAF • Poor connections at ECU, MAF or TPS • Faulty MAF or TPS NOTE If any codes relating to MAF or TPS are present, do all repairs associated with them before this troubleshooting procedure.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0102, P0103, P0122, or P0123 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL monitor MAF voltage signals. **• 0.6~1.0V @ idle** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and MAF.
		No	Go to step 3.
3	Thoroughly check MAF for loose, poor connection, bent, corrosion, contamination, deterioration, or damage. Is MAF okay?	Yes	Go to step 4.
		No	Clean or repair as necessary.
4	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL, monitor TP voltage signals. **• 0.3~0.9V (0.71~1.38 kΩ) @ idle** **• 4.0~4.4V (2.2~3.4 kΩ) @ full open** Is signal within specifications?	Yes	Go to step 5.
		No	Do all repairs associated with TPS before proceeding the next step.
5	Turn ignition switch to OFF and disconnect MAF connector. Turn ignition switch to ON and measure voltage of MAF power circuit between MAF harness connector and chassis ground.	Yes	Go to step 6.
		No	Open circuit or short circuit to chassis ground between MAF harness connector and ECU connector.

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	• **Specification: approximately 5V** Is voltage within specification?		Repair as necessary.
6	Turn ignition to OFF and disconnect ECU connector. Measure resistance of MAF signal circuit between MAF harness connector and ECU harness connector. Measure resistance of MAF ground circuit between MAF harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 7.
		No	Open circuit between MAF harness connector and ECU harness connector. Repair as necessary.
7	ECU connector and MAF connector is still disconnected. Turn ignition to ON. Measure voltage of MAF signal circuit between MAF harness connector and chassis ground. • **Specification: below 0.5V** Does voltage within specification?	Yes	Go to step 8.
		No	Short circuit to battery between MAF harness connector and ECU harness connector. Repair as necessary.
8	ECU connector and MAF connector is still disconnected. Turn ignition to OFF. Measure resistance between MAF harness connector and chassis ground at MAF signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Temporarily install a known good MAF and check for proper operation. If problem is corrected, replace MAF
		No	Short circuit to chassis ground between MAF harness connector and ECU harness connector. Repair as necessary.
9	Check air cleaner for dirt, blockage, or damage. Is air cleaner okay?	Yes	Go to step 10
		No	Repair or replace as necessary.
10	Check entire air intake system for leaks or blockages such as; • Throttle body • PCV valve • Intake manifold • Gasket between intake manifold and surge tank • Seals between intake manifold and fuel injectors • Seal between surge tank and PCV pipe • Etc Is entire air intake system okay?	Yes	Temporarily install a known good MAF and check for proper operation. If problem is corrected, replace MAF
		No	Repair or replace as necessary.
11	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P0102

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0102	**Mass or Volume Air Flow Circuit Low Input**
Diagnostic trouble code No. P0103	**Mass or Volume Air Flow Circuit High Input**
[Related items]	• Open between MAF and engine main relay • Open or short to chassis ground between MAF and ECU • Short to battery between MAF and ECU • Faulty MAF

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor MAF voltage signals. • **Specification: 0.6~1.0V** Is signal within specification?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and MAF.
		No	Go to step 2.
2	Turn ignition switch to OFF and disconnect MAF connector. Turn ignition switch to ON. Measure voltage of MAF reference 5V circuit between MAF harness connector and ECU connector. • **Specification: approximately 5V** Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between MAF harness connector and ECU connector. Repair as necessary.
3	Turn ignition to OFF and disconnect ECU connector. Measure resistance of MAF signal circuit between MAF harness connector and ECU harness connector. Measure resistance of MAF ground circuit between MAF harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between MAF harness connector and ECU harness connector. Repair as necessary.
4	ECU connector and MAF connector is still disconnected. Turn ignition to ON. Measure voltage of MAF signal circuit between MAF harness connector and chassis ground. • **Specification: below 0.5V** Does voltage within specification?	Yes	Go to step 5.
		No	Short circuit to battery between MAF harness connector and ECU harness connector. Repair as necessary.
5	ECU connector and MAF connector is still disconnected. Turn ignition to OFF. Measure resistance between MAF harness	Yes	Temporarily install a known good MAF and check for proper operation. If problem is corrected, replace MAF

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	connector and chassis ground at MAF signal circuit. Measure resistance between MAF signal circuit and MAF ground circuit. • **Specification: infinite** Does each resistance indicate open circuit?	No	Short circuit to chassis ground between MAF harness connector and ECU harness connector. Short circuit between MAF signal circuit and ground circuit. Repair as necessary.
6	Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0112

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0112	**Intake Air Temperature Sensor (ATS) Circuit High Input**
Diagnostic trouble code No. P0113	**Intake Air Temperature Sensor (ATS) Circuit Low Input**
[Related items]	• Open or short to chassis ground between ATS and main relay • Open or short to chassis ground between ATS and ECU • Short to battery between ATS and ECU • Short between ATS wires • Faulty ATS

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0102 or P0103 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor ATS signals. • **3.6~3.8V (2.22~2.82 KΩ) @ 20°C (68°F)** • **1.2~1.5V (0.29~0.36 KΩ) @ 80°C (176°F)** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and ATS.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ATS connector. Turn ignition to ON, measure voltage of ATS battery power circuit between ATS harness connector and chassis ground. • **Specification: approximately B+** Is voltage within specifications?	Yes	Go to step 4.
		No	Open circuit or short circuit to chassis ground between ATS harness connector and ECU main relay. Repair as necessary.
4	Turn ignition switch to OFF and disconnect ATS connector and ECU connector. Measure resistance of ATS signal circuit between ATS harness connector and ECU harness	Yes	Go to step 5.

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	connector. Measure resistance of ATSground circuit between ATS harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	No	Open circuit between ATS harness connector and ECU harness connector. Repair as necessary.
5	ECU connector and ATS connector is still disconnected. Turn ignition to ON. Measure voltage of ATS signal circuit between ATS harness connector and chassis ground. • **Specification: below 0.5V** Does voltage within specification?	Yes	Go to step 6.
		No	Short circuit to battery between ATS harness connector and ECU harness connector. Repair as necessary.
6	Ignition OFF, ATS connector and ECU connector is still disconnected. Measure resistance between ATS signal circuit and ATS ground circuit. Measure resistance between ATS harness connector and chassis ground at ATS signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Temporarily install a known good ATS and check for proper operation. If problem is corrected, replace ATS
		No	Short circuit between ATS signal circuit and ground circuit. Short circuit to chassis ground between ATS harness connector and ECU harness connector. Repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0116

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0116	**Water Temperature Circuit Range/Performance Problem**
Diagnostic trouble code No. P0125	**Insufficient Coolant Temperature for Closed Loop Fuel Control**
[Related items]	• After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) • Poor connections between WTS and ECU • Misplaced, loose or corroded terminals • Foreign materials fouled, contaminated, deteriorated WTS • Faulty WTS • Faulty thermostat NOTE If any codes relating to WTS are present, do all repairs associated with them before this troubleshooting procedure.

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step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector Turn ignition to ON and monitor other DTCs. Is DTC P0115 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor WTS signals. • **3.6~3.8V (2.31~2.59 KΩ) @ 20°C (68°F)** • **1.2~1.5V (0.31~0.33 KΩ) @ 80°C (176°F)** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and WTS.
		No	Go to step 3.
3	Check WTS for contamination, deterioration or damage. Is WTS contaminated, deteriorated or damaged?	Yes	If WTS is damaged or deteriorated, replace.
		No	Go to step 4.
4	Thoroughly check for loose, bent or corroded connectors at ECU connector and WTS connector. With ignition OFF, disconnect ECU connector and WTS connector. Measure resistance of all two circuits between WTS harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between WTS harness connector and ECU harness connector. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P0117

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0117	**Water Temperature Sensor (WTS) Circuit Low Input**
Diagnostic trouble code No. P0118	**Water Temperature Sensor (WTS) Circuit High Input**
[Related items]	• Open or short to battery between WTS and ECU • Short to chassis ground between WTS and ECU • Short between WTS wires • Faulty WTS

step	Inspection		Action
1	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor WTS signals. 1. **1.2~1.5V (0.31~0.33 KΩ) @ 80°C (176°F)** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and WTS.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect WTS connector. Turn ignition to ON and measure voltage of WTS reference power circuit between WTS harness connector and chassis ground. • **Specification: approximately 5V** Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between WTS harness connector and ECU harness connector. Repair as necessary.
3	Turn ignition to OFF and disconnect ECU connector. Measure resistance of WTS ground circuit between WTS harness connector and ECU harness connector. Measure resistance of WTS signal circuit between WTS harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between WTS harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of WTS signal circuit between WTS harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between WTS harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, WTS connector and ECU connector is still disconnected. Measure resistance between WTS signal circuit and WTS ground circuit. Measure resistance between WTS harness connector and chassis ground at WTS signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Temporarily install a known good WTS and check for proper operation. If problem is corrected, replace WTS
		No	Short circuit between WTS signal circuit and ground circuit. Short to chassis ground between WTS harness connector and ECU harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0119

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0119	**Water Temperature Sensor (WTS) Circuit Intermitttent**
[Related items]	• Short to battery between WTS and ECU • Poor connections between WTS and ECU • Misplaced, loose or corroded terminals • Foreign materials fouled WTS

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0117, or P0118 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor WTS signals. • **3.6~3.8V (2.31~2.59 KΩ) @ 20°C (68°F)** • **1.2~1.5V (0.31~0.33 KΩ) @ 80°C (176°F)** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and WTS.
		No	Go to step 3.
3	Check WTS for contamination, deterioration or damage. Is WTS contaminated, deteriorated or damaged?	Yes	Clean WTS with cleaner before installing. If WTS is damaged or deteriorated, replace.
		No	Go to step 4.
4	Thoroughly check for loose, bent or corroded connectors at ECU connector and WTS connector. With ignition OFF, disconnect ECU connector and WTS connector. Measure resistance of all two circuits between WTS harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each indicate continuity circuit?	Yes	Go to step 5.
		No	Open circuit between WTS harness connector and ECU harness connector. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0121

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0121	**Throttle Position Sensor (TPS) Circuit Range/Performance Problem**
[Related items]	• Open or short to chassis ground between TPS and ECU • Short to battery between TPS and ECU • Misplaced, loose or corroded terminals • contaminated, deteriorated TPS • Faulty TPS

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Is DTC P0122, or P0123 set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL and monitor TPS signals. • **0.3 ~ 0.9V (0.71 ~ 1.38 KΩ) @ idle** • **4.0 ~ 4.4V (2.2 ~ 3.4 KΩ) @ full open** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and TPS
		No	Go to step 3.
3	Igniton ON and engine OFF. Using SCAN TOOL and monitor TPS voltage signals while slowly opening the throttle. Does voltage signal increase?	Yes	Go to step 4
		No	Temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS.
4	Turn ignition to OFF and disconnect TPS connector. Turn ignition to ON and measure voltage of TPS reference voltage between TPS harness connector and chassis ground. • **Specifications: Approximately 5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Open circuit or short circuit to chassis ground between TPS harness connector and ECU connector. Repair as necessary.
5	Thoroughly check TPS for loose, poor connection, bent, corrosion, contamination, deterioration, or damage. Is TPS okay?	Yes	Temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS
		No	Clean TPS with cleaner before installing. If damaged or deteriorated, temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0122

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0122	**Throttle Position Sensor (TPS) Circuit Low Input**
Diagnostic trouble code No. P0123	**Throttle Position Sensor (TPS) Circuit High Input**
[Related items]	• Open or short to chassis ground between TPS and ECU • Short to battery between TPS and ECU • Short between TPS wires • Faulty TPS

step	Inspection		Action
1	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL, monitor TPS voltage signals. • **0.3~0.9V (0.71~1.38 KΩ) @ idle** • **4.0~4.4V (2.2~3.4 KΩ) @ full open** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and TPS.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect TPS connector. Turn ignition to ON and measure voltage TPS reference voltage between TPS harness connector and chassis ground. • **Specification: approximately 5V** Is voltage within specifications?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between TPS harness connector and ECU connector. Repair as necessary.
3	Turn ignition to OFF and disconnect ECU connector. Measure resistance of TPS ground circuit between TPS harness connector and ECU harness connector. Measure resistance of TPS signal circuit between TPS harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between TPS harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of TPS signal circuit between TPS harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between TPS harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, TPS connector and ECU connector is still disconnected. Measure resistance between TPS signal circuit and ground circuit. Measure resistance between TPS harness	Yes	Temporarily install a known good TPS and check for proper operation. If problem is corrected, replace TPS
		No	Short circuit between TPS signal circuit and ground

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	connector and chassis ground at TPS signal circuit. • **Specification: infinite** Does resistance indicate open circuit?		circuit. Short to chassis ground between TPS harness connector and ECU harness connector. Repair as necessary.
6	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0130

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0130	**HO2S Circuit Malfunction-Open (Bank 1, Sensor 1)**
Diagnostic trouble code No. P0131	**HO2S Circuit Low Input (Bank 1, Sensor 1)**
Diagnostic trouble code No. P0132	**HO2S Circuit High Input (Bank 1, Sensor 1)**
[Related items]	• Open or short to battery between front HO2S and ECU • Short to chassis ground between front HO2S and ECU • Short between front HO2S wires • Faulty front HO2S • Poor connections between front HO2S and ECU • Misplaced, bent, loose or corroded terminals

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor HO2S signal waveform. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector.	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.

	• **Specification: below 1Ω** Does each resistance indicate continuity circuit?		
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0133

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0133	**HO2S Circuit Slow Responsive (Bank 1, Sensor 1)**
Diagnostic trouble code No. P0153	**HO2S Circuit Slow Responsive (Bank 2, Sensor 1)**
[Related items]	• Abnormal combustion • Improper fuel pressure • Front and rear HO2S connections reversed • Faulty fuel delivery system • Leak in intake system • Leak in exhaust system • Faulty front HO2S NOTE If any misfire, purge solenoid valve, MAF or HO2S heater codes are present, do all repairs associated with those codes before proceeding this troubleshooting procedure.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Visually check for leak from exhaust system (especially between TWC converter and front exhaust pipe). Are any leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 3.
3	Visually check for leak from intake system. Are any vacuum leaks present?	Yes	Repair exhaust system leaks as necessary.
		No	Go to step 4.
4	Start engine after installing fuel pressure gauge at service valve in fuel rail. With engine running at operating temperature, is fuel pressure within specification? • **Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm²)**	Yes	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	1. If measured pressure is too high: Go to step 5 2. If measured pressure is too low: Go to step 6
5	Disconnect return line hose from fuel filter. Blow through line towards tank. Is return line restricted?	Yes	Check for blockage in return line, clean or replace as necessary.
		No	Repair pressure regulator
6	Clamp a return line from fuel filter and check if pressure rises. Do fuel pressure rise?	Yes	Replace fuel delivery module.
		No	Check fuel filter at fuel pump. If it is OK, measure fuel pump maximum pressure and repair as necessary.

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7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

Fuel System > Troubleshooting > P0134

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0134	**HO2S Circuit No Activity Detected (Bank 1, Sensor 1)**
[Related items]	• Open or short between front HO2S signal terminal and ECU • Contaminated, deteriorated or aged front HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty front HO2S NOTE If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this troubleshooting procedure

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTC. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected.	Yes	Go to step 6.

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	Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If OK, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S
7	Visually check for leak from exhaust system (especially between TWC (Three Way Catalytic) converter and front exhaust pipe). Are any leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 8.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0136

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0136	**HO2S Circuit Malfunctiont-Open (Bank 1, Sensor2)**
Diagnostic trouble code No. P0137	**HO2S Circuit Low Input (Bank 1, Sensor2)**
Diagnostic trouble code No. P0138	**HO2S Circuit High Input (Bank 1, Sensor2)**
[Related items]	• Open or short to chassis ground between rear HO2S and ECU • Short to battery between rear HO2S and ECU • Short between rear HO2S wires • Misplaced, bent, loose or corroded connector terminals • Faulty rear HO2S

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step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor HO2S signal waveform. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P0139

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0139	**HO2S Circuit Slow Responsive (Bank 1, Sensor 2)**
Diagnostic trouble code No. P0159	**HO2S Circuit Slow Responsive (Bank 2, Sensor 2)**
[Related items]	• Abnormal combustion • Improper fuel pressure • Front and rear HO2S connections reversed • Faulty fuel delivery system • Leak in intake system • Leak in exhaust system • Faulty rear HO2S NOTE If any misfire, purge solenoid valve, MAF or HO2S heater codes are present, do all repairs associated with those codes before proceeding this troubleshooting procedure.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Visually check for leak from exhaust system (especially between TWC (Three Way Catalytic) converter and front exhaust pipe). Are any leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 3.
3	Visually check for leak from intake system. Are any vacuum leaks present?	Yes	Repair exhaust system leaks as necessary.
		No	Go to step 4.
4	Start engine after installing fuel pressure gauge at service valve in fuel rail. With engine running at operating temperature, is fuel pressure within specification? • **Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm2)**	Yes	Temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	1. If measured pressure is too high: Go to step 5 2. If measured pressure is too low: Go to step 6
5	Disconnect return line hose from fuel filter. Blow through line towards tank. Is return line restricted?	Yes	Check for blockage in return line, clean or replace as necessary.
		No	Repair pressure regulator

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6	Clamp a return line from fuel filter and check if pressure rises. Do fuel pressure rise?	Yes	Replace fuel delivery module.
		No	Check fuel filter at fuel pump. If it is OK, measure fuel pump maximum pressure and repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0140

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0140	**HO2S Circuit No Activity Detected (Bank 1, Sensor 2)**
[Related items]	• Open or short between rear HO2S signal terminal and ECU • Contaminated, deteriorated or aged rear HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty rear HO2S NOTE If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this trouble area.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTC. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness

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	HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?		connector and ECU Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If OK, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S
7	Visually check for leak from exhaust system (especially between TWC (Three Way Catalytic) converter and front exhaust pipe). Are any leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 8.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0150

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0150	**HO2S Circuit Malfunction-Open (Bank 2, Sensor 1)**
Diagnostic trouble code No. P0151	**HO2S Circuit Low Input (Bank 2, Sensor 1)**
Diagnostic trouble code No. P0152	**HO2S Circuit High Input (Bank 2, Sensor 1)**
[Related items]	• Open or short to battery between front HO2S and ECU • Short to chassis ground between front HO2S and ECU • Short between front HO2S wires • Faulty front HO2S • Poor connections between front HO2S and ECU • Misplaced, bent, loose or corroded connector terminals.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor HO2S signal wavefrom. Does the HO2S signal switch lean to rich or rich to lean over 6 time for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness Connector. Measure resistance of HO2S harness connector and ECU harness connector. • **Specification : below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification : below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected.	Yes	Go to step 6.

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	Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification : infinite** Does resistance indicate open circuit?	No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper opeIf problem is corrected, replace HO2S ration.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0154

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0154	**HO2S Circuit No Activity Detected (Bank 2, Sensor 1)**
[Related items]	• Open or short between front HO2S signal terminal and ECU • Contaminated, deteriorated or aged front HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty front HO2S NOTE If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this trouble area.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTC. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector.	Yes	Go to step 4.

	Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?		
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If OK, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S
7	Visually check for leak from exhaust system (especially between TWC (Three Way Catalytic) converter and front exhaust pipe). Are any leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 8.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0156

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0156	**HO2S Circuit Malfunction-Open (Bank 2, Sensor 2)**
Diagnostic trouble code No. P0157	**HO2S Circuit Low Input (Bank 2, Sensor 2)**
Diagnostic trouble code No. P0158	**HO2S Circuit High Input (Bank 2, Sensor 2)**
[Related items]	• Open or short to battery between rear HO2S and ECU • Short to chassis ground between rear HO2S and ECU • Short between rear HO2S wires • Faulty rear HO2S • Poor connections between rear HO2S and ECU • Misplaced, bent, loose or corroded connector terminals

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor other DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL, monitor HO2S signal waveform. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected.	Yes	Go to step 6.

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	Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If connectors are okay, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S .
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0160

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0160	**HO2S Circuit No Activity Detected (Bank 2, Sensor 2)**
[Related items]	• Open or short between rear HO2S signal terminal and ECU • Contaminated, deteriorated or aged rear HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty rear HO2S NOTE If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this trouble area.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor any other DTC. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and HO2S.
		No	Go to step 3.
3	Turn ignition to OFF and disconnect ECU connector and HO2S connector.	Yes	Go to step 4.

	Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. • **Specification: below 1Ω** Does each resistance indicate continuity circuit?		
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
4	Turn ignition to ON. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specification: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
5	Ignition OFF, HO2S connector and ECU connector is still disconnected. Measure resistance between HO2S signal circuit and ground circuit. Measure resistance between HO2S harness connector and chassis ground at HO2S signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit between HO2S signal circuit and ground circuit. Short to chassis ground between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Thoroughly check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S.
		No	Verify ECU and HO2S connectors are secure. If OK, temporarily install a known good HO2S and check for proper operation. If problem is corrected, replace HO2S .
7	Visually check for leak from exhaust system (especially between TWC (Three Way Catalytic) converter and front exhaust pipe). Are any leaks present?	Yes	Repair intake system leaks as necessary.
		No	Go to step 8.
8	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0171

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0171	**Fuel System Too Lean (Bank 1)**
Diagnostic trouble code No. P0174	**Fuel System Too Lean (Bank 2)**
[Related items]	• Faulty fuel delivery system • Clogged fuel injectors • Faulty fuel injectors • Leak in intake system • Leak in exhaust system • Faulty MAF • Faulty TPS NOTE If any codes relating to injectors, HO2S, WTS or MAF are stored, do all repairs associated with those codes before proceeding with this troubleshooting procedure.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL, monitor long-term on fuel trim data. • **Long-term: -12~12%** Is long-term within the specifications indicated?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared.
		No	Go to step 3.
3	Visually/physically inspect the following items: • Throttle body gasket • Gasket between intake manifold and surge tank • Seals between intake manifold and fuel injectors • Seals between surge tank and PCV valves • Crankcase ventilation valve and/or system for leaks • Contaminated fuel Are the above items okay?	Yes	Go to step 4.
		No	Repair or replace as necessary.
4	Visually/physically inspect the following items: • Air cleaner element for being restricted • MAF for proper installation and foreign objects • Exhaust system for leaks Are the above items okay?	Yes	Go to step 5.
		No	Repair or replace as necessary.
5	Check vacuum hoses for splits and proper connections to engine dynamic chamber (especially PSV, ISC hose, throttle body, intake manifold, and brake booster). Are connections OK?	Yes	Go to step 6.
		No	Repair or replace as necessary.

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6	With engine idling disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valve. Is vacuum available at purge valve when EVAP valve is not operating?	Yes	EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair procedures.
		No	Go to step 7.
7	After installing fuel pressure gauge to service port on fuel rail, connect DLC F/P and B (B+) with a jumper wire. • **Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm2)** Is fuel line pressure correct with ignition switch ON?	Yes	Go to step 8
		No	Low pressure: Clamp return-line and check if pressure rises: - If pressure rises: replace pressure regulator - If pressure does not rise: check the strainer at the fuel pump. High pressure: Disconnect return-line from fuel filter side and blow through line towards tank. - If line is clear: replace fuel delivery module. - If line is blocked: check for blockage in return line and clear or replace as necessary. If it is OK, check fuel.
8	Start engine and check for engine rpm decrease when disconnecting each injector connector in sequence. Measure the decreasing engine rpm of all 6 cylinders. Is there any cylinder with no change in rpm or only a small rpm change?	Yes	Repair as necessary.
		No	Go to step 9.
9	Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders. Are any spark plugs with abnormal color compared to other cylinders?	Yes	Check for engine mechanical failure. If it is OK, replace spark plugs.
		No	Go to step 10
10	Check for ECU input signal from MAF, HO2S, TPS and other input signals. Are input signals within specification?	Yes	Go to step 11.
		No	Replace all failed parts.
11	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P0172

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0172	**Fuel System Too Rich (Bank 1)**
Diagnostic trouble code No. P0175	**Fuel System Too Rich (Bank 2)**
[Related items]	• Faulty ignition system • EVAP canister purge valve malfunction • Leak in intake system • Leak in exhaust system • Faulty fuel delivery system - Clogged fuel injectors - Faulty fuel injectors - Fuel pressure too high - Fuel pressure regulator failure • Faulty MAF • Faulty front HO2S • Faulty TPS NOTE If any injectors, front HO2S, WTS, and MAF codes are present, do all repairs associated with those codes before proceeding this troubleshooting procedure.

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Are any other codes set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Using SCAN TOOL, monitor long-term on fuel trim data. • **Long-term: -12~12%** Is long-term within the specifications indicated?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared.
		No	Go to step 3.
3	Visually/physically inspect the following items: • Throttle body gasket • Gasket between intake manifold and surge tank • Seals between intake manifold and fuel injectors • Seals between surge tank and PCV valves • Crankcase ventilation valve and/or system for leaks • Contaminated fuel Are the above items okay?	Yes	Go to step 4.
		No	Repair or replace as necessary.
4	Visually/physically inspect the following items: • Air cleaner element for being restricted. • MAF for proper installation and foreign objects • Exhaust system for leaks Are the above items okay?	Yes	Go to step 5.
		No	Repair or replace as necessary.

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5	Check vacuum hoses for splits and proper connections to engine dynamic chamber (especially PSV, ISC hose, throttle body, intake manifold, and brake booster). Are connections OK?	Yes	Go to step 6.
		No	Repair or replace as necessary.
6	With engine idling disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valve. Is vacuum available at purge valve when EVAP valve is not operating?	Yes	EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair procedures.
		No	Go to step 7.
7	After installing fuel pressure gauge to service port on fuel rail, connect DLC F/P and B (B+) with a jumper wire. • **Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm2)** Is fuel line pressure correct with ignition switch ON?	Yes	Go to step 8.
		No	Low pressure: Clamp return-line and check if pressure rises: - If pressure rises: replace pressure regulator. - If pressure does not rise: check the strainer at the fuel pump. High pressure: Disconnect return-line from fuel filter side and blow through line towards tank. - If line is clear: replace fuel delivery module. - If line is blocked: check for blockage in return line and clear or replace as necessary. If it is OK, check fuel.
8	Start engine and check for engine rpm decrease when disconnecting each injector connector in sequence. Measure the decreasing engine rpm of all 6 cylinders. Is there any cylinder with no change in rpm or only a small rpm change?	Yes	Repair as necessary.
		No	Go to step 9.
9	Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders. Are any spark plugs with abnormal color compared to other cylinders?	Yes	Check for engine mechanical failure. If it is OK, replace spark plugs.
		No	Go to step 10
10	Check for ECU input signal from MAF, HO2S, TPS and other input signals. Are input signals within specification?	Yes	Go to step 11.
		No	Replace all failed parts.
11	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0230

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0230	**Fuel Pump Circuit Malfunction**
[Related items]	• Open or short to chassis ground between fuel pump relay and ECU • Faulty fuel pump relay

step	Inspection		Action
1	Check for fuel pump relay. Is fuel pump relay normal?	Yes	Go to step 2.
		No	Replace fuel pump relay.
2	Turn ignition to ON and disconnect ECU connector. Measure voltage at fuel pump relay terminal and chassis ground. • **Specifications: approximately B+** Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit between fuel pump relay and ECU harness connector. Repair as necessary.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0261

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0261/P0262	**Cylinder 1 Injector Circuit Low/High Input**
Diagnostic trouble code No. P0264/P0265	**Cylinder 2 Injector Circuit Low/High Input**
Diagnostic trouble code No. P0267/P0268	**Cylinder 3 Injector Circuit Low/High Input**
Diagnostic trouble code No. P0270/P0271	**Cylinder 4 Injector Circuit Low/High Input**
Diagnostic trouble code No. P0273/P0274	**Cylinder 5 Injector Circuit Low/High Input**
Diagnostic trouble code No. P0276/P0277	**Cylinder 6 Injector Circuit Low/High Input**
[Related items]	• Open or short between main relay and injectors • Open or short between ECU and injectors • Short to battery between ECU and injectors • Faulty fuel injector

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step	Inspection		Action
1	Turn ignition switch to OFF and disconnect injector connector. Measure resistance between injector terminal 1 and terminal 2. • **13~16 Ω at 20°C (68°F)** Is measured resistance within specification?	Yes	Go to step 2.
		No	Temporarily install a known good injector and check for proper operation. If problem is corrected, replace HO2S.
2	Turn ignition switch to OFF and disconnect injector connector. With ignition ON and measure voltage of battery voltage between injector harness connector and chassis ground. • **Specification: approximately B+** Is measured voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between main relay and injector harness connector. Repair as necessary.
3	Disconnect ECU connector and injector connector. Measure resistance between injector harness connector and ECU harness connector. • **Specification: below 1Ω** Does resistance indicate continuity?	Yes	Go to step 4.
		No	Open circuit between injector harness connector and ECU harness connector. Repair as necessary.
4	ECU connector and injector connector is still disconnected. Measure resistance between injector harness connector and chassis ground at injector signal circuit. • **Specification: infinite** Does resistance indicate open circuit?	Yes	Temporarily install a known good injector and check for proper operation. If problem is corrected, replace HO2S.
		No	Short circuit to chassis ground between injector terminal 2 and ECU. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0325

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0325	**Knock Sensor Circuit Malfunction (Bank 1)**
Diagnostic trouble code No. P0330	**Knock Sensor Circuit Malfunction (Bank 2)**
[Related items]	• Open or short to GND between knock sensor and ECU • Source of high resistance between knock sensor and ECU • Faulty knock sensor

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step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor KS voltage signals. • **Specifications: 2.0~3.0V** Is signal within specifications?	Yes	Problem is intermittent or was repaired and engine control module memory was not cleared. Check terminal connections at ECU and KS.
		No	Go to step 2.
2	Start and run engine. Using SCAN TOOL monitor KS voltage signals from idle to 3000rpm. Does voltage signal increase?	Yes	Check any other DTCs. If any DTCs is present, do all repairs associated with those codes before proceeding next step.
		No	Go to step 3.
3	Thoroughly check KS and ECU for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 4.
4	Turn ignition to OFF and disconnect KS connector and ECU connector. Measures resistance of KS signal circuit between KS harness connector and ECU harness connector. Measure resistance of KS ground circuit between KS harness connector and chassis ground. • **Specifications: below 1Ω** Is each resistance within specification?	Yes	Go to step 5.
		No	Open circuit between KS harness connector and ECU harness connector and/or chassis ground. Repair as necessary.
5	Turn ignition to ON. Measures voltage of KS signal circuit between KS harness connector and chassis ground. • **Specifications: below 0.5V** Does voltage within specifications	Yes	Go to step 6.
		No	Short circuit to battery between KS harness connector and ECU harness connector. Repair as necessary.
6	Ignition OFF, KS connector and ECU connector is still disconnected. Measures resistance between KS harness connector and chassis ground at KS signal circuit. Measure resistance between KS signal circuit and ground circuit. • **Specifications: infinite** Does resistance indicate open circuit?	Yes	Temporarily install a known good knock sensor and check for proper operation. If problem is corrected, replace knock sensor.
		No	Short circuit to chassis ground between KS harness connector and ECU harness connector. Short circuit between KS signal circuit and ground circuit. Repair as necessary.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0335

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0335	**Crankshaft Position (CKP) Sensor Circuit Malfunction**
Diagnostic trouble code No. P1372	**Segment Time Acquisition Incorrect**
[Related items]	• Open or short to chassis ground between CKP and ECU • Short to battery between CKP and ECU • Short between CKP wires • Out of allowable air gap • Faulty Target wheel tolerance • Faulty CKP NOTE If P1529 or any codes relating to front RH wheel speed sensor (ABS) circuits air present, do all repairs associated with those coeds. If anti-lock brake system is not applied in your vehicle, proceed this troubleshooting guide.

step	Inspection		Action
1	Thoroughly check CKP and ECU for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect CKP connector. Turn ignition to ON and measure voltage of CKP power circuit between CKP harness connector and chassis ground. • **Specification: approximately B+** Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between CKP harness connector and main relay. Repair as necessary.
3	Turn ignition to OFF and disconnect ECU connector. Measure resistance of CKP signal circuit between CKP harness connector and ECU harness connector. Measure resistance of CKP ground circuit between CKP harness connector and chassis ground. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between CKP harness connector and ECU harness connector and/or chassis ground. Repair as necessary.
4	Turn ignition to ON. Measure voltage of CKP signal circuit between CKP harness connector and chassis ground. • **Specifications: below 0.5V** Is voltage within specifications?	Yes	Go to step 5.
		No	Short circuit to battery between CKP harness connector and ECU harness connector. Repair as necessary.
5	Tun ignition to OFF. Measures resistance between CKP harness connector and ECU harness connector at CKP signal circuit. Measure resistance between CKP signal circuit and	Yes	Go to step 6.
		No	Short circuit to chassis ground between KS harness connector and ECU harness connector.

	ground circuit. • **Specifications: infinite** Does resistance indicate open circuit?		Short circuit between CKP signal circuit and ground circuit. Repair as necessary.
6	Remove CKP and calculate air gap between sensor and flywheel/torque converter (0.3~1.7 mm [0.012~0.067 in]) {measure distance from hosing to teeth on flywheel/torque converter (measurement "A") and from mounting surface on sensor to sensor tip (measurement "B") subtract "B" from "A" = air gap}. Is air gap within specifications?	Yes	Temporarily install a known good CKP and check for proper operation. If problem is corrected, replace CKP.
		No	Remove CKP, install TDC correctly, and check CKP for proper operation. If not, temporarily install a known good CKP and check for proper operation. If problem is corrected, replace CKP.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0340

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0340	**Camshaft Position (TDC) Sensor Circuit Malfunction**
[Related items]	• Open or short to chassis ground between TDC and ECU • Short to battery between TDC and ECU • Short between TDC wires • Faulty TDC

step	Inspection		Action
1	Thoroughly check TDC and ECU for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is any problem present?	Yes	Repair as necessary.
		No	Go to step 2.
2	Turn ignition to OFF and disconnect TDC connector. Turn ignition to ON and measure voltage of TDC power circuit between TDC harness connector and chassis ground. • **Specification: approximately B+** Is voltage within specification?	Yes	Go to step 3.
		No	Open circuit or short circuit to chassis ground between TDC harness connector and main relay. Repair as necessary.
3	Turn ignition to OFF and disconnect ECU connector. Measure resistance of TDC signal circuit between TDC harness connector and ECU harness connector. Measure resistance of TDC ground circuit between TDC harness connector and chassis ground. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between TDC harness connector and ECU harness connector and/or chassis ground. Repair as necessary.
4	Turn ignition to ON.	Yes	Go to step 5.

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	Measure voltage of TDC signal circuit between TDC harness connector and chassis ground. • **Specifications: below 0.5V** Is voltage within specifications?	No	Short circuit to power between TDC harness connector and ECU harness connector. Repair as necessary.
5	Tun ignition to OFF. Measures resistance between TDC harness connector and ECU harness connector at TDC signal circuit. Measure resistance between TDC signal circuit and ground circuit. • **Specifications: infinite** Does resistance indicate open circuit?	Yes	Go to step 6.
		No	Short circuit to chassis ground between KS harness connector and ECU harness connector. Short circuit between TDC signal circuit and ground circuit. Repair as necessary.
6	Turn ignition to OFF and disconnect TDC connector. Check for TDC installation. Is TDC installed properly?	Yes	Temporarily install a known good TDC and check for proper operation. If problem is corrected, replace TDC.
		No	Remove TDC, install TDC correctly, and check TDC for proper operation. If not, temporarily install a known good TDC and check for proper operation. If problem is corrected, replace TDC.
7	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0461

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0461	**Fuel Level Sensor Circuit Range/Performance Problem**
Diagnostic trouble code No. P0462	**Fuel Level Sensor Circuit Low Input**
Diagnostic trouble code No. P0463	**Fuel Level Sensor Circuit High Input**
[Related items]	• Open or short to battery between FLS and ECU • Short to chassis ground between FLS and ECU • Poor connections between FLS and ECU • Misplaced, loose, bent or corroded terminals • Faulty FLS or FLS stuck

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step	Inspection		Action
1	Turn ignition to OFF and disconnect FLS connector. Turn ignition to ON Measure voltage of FLS signal circuit between FLS harness connector and chassis ground. • **Specification: approximately 5V** Is voltage within specification?	Yes	Go to step 2.
		No	Open circuit or short circuit between FLS harness connector and ECU connector. Repair as necessary.
2	Thoroughly check FLS and ECU for loose, bent, corroded, contaminated, deteriorated or damaged connectors. Is connection okay?	Yes	Temporarily install a known good FLS and check for proper operation. If problem is corrected, replace FLS.
		No	Repair as necessary.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0501

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0501	**Vehicle Speed Sensor Circuit Malfunction**
[Related items]	• Open between VSS and ECU. • Short to ground between VSS and ECU. • Short between VSS wires. • Faulty VSS. NOTE If any codes relating to ABS/TCS circuits are present, do all repairs associated with those codes before proceeding with this troubleshooting procedure.

step	Inspection		Action
1	Turn ignition to OFF and disconnect ECU connector and VSS connector. Measure resistance between ECU harness connector and VSS harness connector at VSS signal circuit. • **Specifications: below 1Ω** Does resistance indicate continuity circuit?	Yes	Go to step 2.
		No	Open circuit between ECU harness connector and VSS harness connector. Repair as necessary.
2	ECU connector and VSS connector is disconnected. Measure resistance between ECU harness connector and chassis ground at VSS signal circuit. • **Specifications: infinite** Does resistance indicate open circuit?	Yes	Go to step 3.
		No	Short circuit to chassis ground between ECU harness connector and VSS harness connector. Repair as necessary.
3	ECU connector and VSS connector is disconnected. Measure resistance between VSS signal terminal and	Yes	Go to step 4.

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	Measure resistance between VSS signal terminal and VSS ground terminal. • **Specifications: infinite** Does resistance indicate open circuit?	No	Short between VSS signal circuit and VSS ground circuit. Repair as necessary.
4	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0506

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0506	**Idle Control System Rpm Lower Than Expected**
[Related items]	• Open or short between main relay and ISA • Open or short between ECU and ISA • Intake system is plugged • Carbon fouled throttle plate • Faulty ISA NOTE If any codes relating to TPS, MAF, fuel injector or ISA present, do all repairs associated with them before proceeding with this troubleshooting guide

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Are any other codes also set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Check accelerator cable free play [0.040~0.120 in (1.0~3.0 mm)]. Is accelerator cable free play within specification.	Yes	Go to step 3.
		No	Adjust cable.
3	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL, monitor TPS voltage signals. • **0.3~0.9V @ idle** • **4.0~4.4V @ full open** Is signal within specifications?	Yes	Go to step 4.
		No	Do all repairs associated with TPS before proceeding the next step.
4	Turn ignition to OFF and disconnect ISA connector. With ignition ON, measure voltage of ISA battery voltage between ISA harness connector and chassis ground. • **Specifications: approximately B+** Is voltage within specifications?	Yes	Go to step 5.
		No	Open circuit or short circuit to chassis ground between ISA harness connector and main relay. Repair as necessary.
5	Turn ignition to OFF. Measure resistance of ISA opening coil and closing coil	Yes	Go to step 6.

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	Measure resistance of ISA opening coil and closing coil. • **Opening coil: 14.5~16.5 Ω at 20°C (68°F)** • **Closing coil: 16.6~18.6 Ω at 20°C (68°F)** Is each resistance within specification?	No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
6	Remove ISA from throttle body and check for excessive carbon deposits and sticking per following check. Connect ISA battery terminal to 12V power. One at a time, momentarily ground ISA opening coil signal terminal and closing coil terminal while visually verifying valve closes when the closing coil terminal is grounded and valve opens when opening coil signal terminal is grounded. Repeat numerous times to ensure valve reliability. Is ISA moving freely and is not carbon fouled? NOTE While ISA is removed, inspect throttle body for obstructions in idle circuit ports. Repair or replace as necessary.	Yes	Thoroughly check for loose, bent or corroded terminals at all connectors in circuit.
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
7	Turn ignition to OFF and disconnect ECU connector. Measure resistance of ISA opening coil signal circuit between ISA harness connector and ECU harness connector. Measure resistance of ISA closing coil signal circuit between ISA harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 8.
		No	Open circuit between ISA harness connector and ECU harness connector. Repair as necessary.
8	ECU connector and ISA connector is still disconnected. Measure resistance between ISA harness connector and chassis ground at ISA opening coil circuit.. Measure resistance between ISA harness connector and chassis ground at ISA closing coil circuit. • **Specifications: infinite** Does each resistance indicate open circuit?	Yes	Go to step 9.
		No	Short circuit to chassis ground between ISA harness connector and ECU harness connector. Repair as necessary.
9	Remove intake hose and inspect throttle plate for excessive carbon deposits. Is throttle plate being held open with excessive carbon deposits?	Yes	Clean throttle body.
		No	Go to step 10.
10	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P0507

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0507	**Idle Control System Rpm Higher Than Expected**
[Related items]	• Short to ground between ISA and ECU • Air leak in intake system • Improperly adjusted accelerator cable • Faulty ISA • Faulty TPS • Faulty PCV/PCSV NOTE If any codes relating to TPS, PSV, MAF, fuel injector or ISA are present, do all repairs associated with them before proceeding with this troubleshooting guide

step	Inspection		Action
1	Connect SCAN TOOL to data link connector or OBD-II check connector. Turn ignition to ON and monitor DTCs. Are any other codes also set?	Yes	Do all repairs associated with those codes before proceeding this procedure.
		No	Go to step 2.
2	Check accelerator cable free play [0.040~0.120 in (1.0~3.0 mm)]. Is accelerator cable free play within specification?	Yes	Go to step 3.
		No	Adjust cable.
3	Start engine and allow engine to idle until engine reaches operating temperature. Using SCAN TOOL, monitor TPS voltage signals. • **0.3~0.9V @ idle** • **4.0~4.4V @ full open** Is signal within specifications?	Yes	Go to step 4.
		No	Do all repairs associated with TPS before proceeding the next step.
4	Turn ignition to OFF and disconnect ISA connector. With ignition ON, measure voltage of ISA battery voltage between ISA harness connector and chassis ground. • **Specifications: approximately B+** Is voltage within specifications?	Yes	Go to step 5.
		No	Open circuit or short circuit to chassis ground between ISA harness connector and main relay. Repair as necessary.
5	Turn ignition to OFF. Measure resistance of ISA opening coil and closing coil. • **Opening coil: 14.5~16.5 Ω at 20°C (68°F)** • **Closing coil: 16.6~18.6 Ω at 20°C (68°F)** Is each resistance within specification?	Yes	Go to step 6.
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
6	Remove ISA from throttle body and check for excessive carbon deposits and sticking per following check. Connect ISA battery terminal to 12V power. One at a time, momentarily ground ISA opening coil signal terminal and closing coil terminal while visually verifying	Yes	Thoroughly check for loose, bent or corroded terminals at all connectors in circuit.

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	valve closes when the closing coil terminal is grounded and valve opens when opening coil signal terminal is grounded. Repeat numerous times to ensure valve reliability. Is ISA moving freely and is not carbon fouled? NOTE While ISA is removed, inspect throttle body for obstructions in idle circuit ports. Repair or replace as necessary.		
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
7	Turn ignition to OFF and disconnect ECU connector. Measure resistance of ISA opening coil signal circuit between ISA harness connector and ECU harness connector. Measure resistance of ISA closing coil signal circuit between ISA harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 7.
		No	Open circuit between ISA harness connector and ECU harness connector. Repair as necessary.
8	ECU connector and ISA connector is still disconnected. Measure resistance between ISA harness connector and chassis ground at ISA opening coil circuit. Measure resistance between ISA harness connector and chassis ground at ISA closing coil circuit. • **Specifications: infinite** Does each resistance indicate open circuit?	Yes	Go to step 9.
		No	Short circuit to chassis ground between ISA harness connector and ECU harness connector. Repair as necessary.
9	Check for any split, disconnected or perforated vacuum hoses. Also, check PCV valve for proper operation and purge solenoid valve for proper installation and operation. Are vacuum hoses, PCV and PCSV okay?	Yes	Go to step 10.
		No	Replace faulty vacuum hoses, PCV or PCSV
10	Visually/physically inspect the following items: • Throttle body gasket • Gasket between intake manifold and surge tank • Gasket between intake manifold and cylinder head • Seals between intake manifold and fuel injectors • Seals between surge tank and PCV valves • Crankcase ventilation valve and/or system for leaks Are the above items okay?	Yes	Go to step 11.
		No	Repair or replace as necessary.
11	With engine idling disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valve. Is vacuum available at purge valve when EVAP valve is not operating?	Yes	EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair procedures.
		No	Go to step 12.
12	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P0551

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0551	**Power Steering Switch Malfunction**
[Related items]	• Open between power steering switch and ECU • Short to chassis ground between power steering switch and ECU • Faulty power steering switch

step	**Inspecion**		**Action**
1	Turn ignition to OFF and disconnect power steering switch. Turn ignition to ON. Measure voltage of power steering switch between power steering switch harness connector and chassis ground. • **Specifications: approximately 10~15V** Is voltage within specifications?	Yes	Check power steering switch for poor terminal contacts due to bent, damaged, or misplaced terminal at power steering switch. If OK, temporally install a known good power steering switch and check power steering switch for proper operation. If problem is corrected, replace power steering switch.
		No	Open circuit or short circuit to chassis ground between power steering switch connector and ECU.
2	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0605

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P0605	**ECU Malfunction**
[Related items]	• Internal fault. There is no inspection of service possible for this diagnostic trouble code • Temporarily install a known good ECU and check for proper operation. If problem is corrected replace ECU. • Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

Fuel System > Troubleshooting > P0650

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P0650	**MIL Circuit Malfunction**
[Related items]	• Open or short to chassis ground between MIL and ECU • Faulty MIL

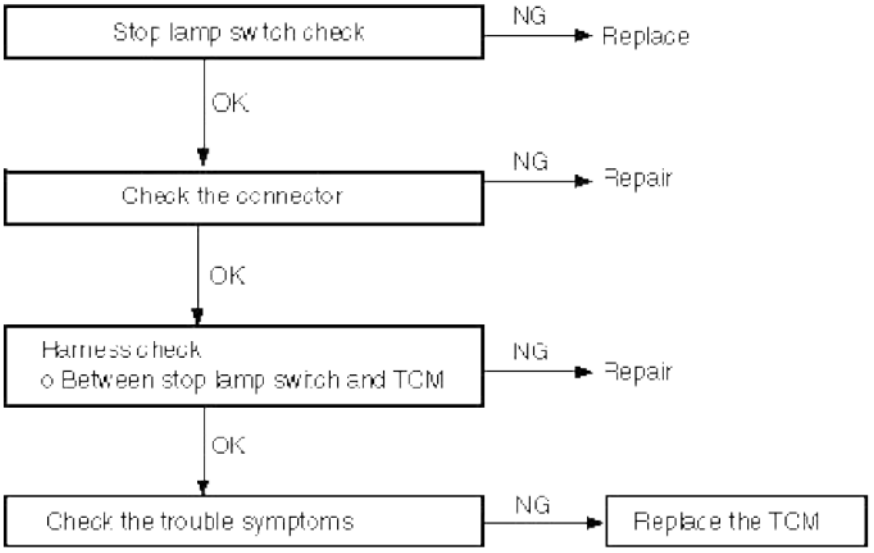
step	Inspection		Action
1	Turn ignition to OFF and disconnect ECU connector. Turn ignition to ON and measure voltage at ECU MIL control terminal. • **Specifications: approximately B+** Is voltage within specifications?	Yes	Poor terminal contact due to oxidation, bent or misplaced terminal at ECU. Repair as necessary.
		No	Go to step 2.
2	Check for MIL in instrument cluster Does MIL operate correctly?	Yes	Open circuit or short circuit to chassis ground between ECU harness connector and MIL. Repair as necessary.
		No	Replace MIL.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P0703

Stop lamp switch system

Code No.P0703 Stop lamp switch system	Probable cause
If the stop lamp switch is on for 5 minutes or more while driving, it is judged that there is a short circuit in the stop light switch and diagnostic trouble code P0703 is output.	• Malfunction of the stop lamp switch • Malfunction of connector • Malfunction of the TCM

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Fuel System > Troubleshooting > P1134

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1134	**HO2S Circuit Transition Switch Malfunction/slip (Bank 1, Sensor 1)**
Diagnostic trouble code No. P1154	**HO2S Circuit Transition Switch Malfunction/slip (Bank 2, Sensor 1)**
[Related items]	• Front HO2S Deteriorated • Foreign Material fouled front HO2S NOTE If any codes relating front HO2S are present, do all repairs associated with them before proceeding with this troubleshooting guide.

step	Inspecion		Action
1	First check for DTC relating to front HO2S. Do DTCs exist?	Yes	First repair all other malfunctions on DTCs.
		No	Go to step 2.
2	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the HO2S signal switch lean to rich or rich to lean over 6 times for 10 seconds?	Yes	Go to step 3.
		No	Temporarily install a known good front HO2S and check for proper operation. If problem is corrected, replace front HO2S.
3	Check HO2S for contamination, deterioration or damage. Is HO2S contaminated, deteriorated or damaged?	Yes	Clean HO2S with cleaner before installing. If damaged or deteriorated, replace.
		No	Go to step 4.
4	Thoroughly check for loose, bent or corroded connectors at ECU and HO2S connectors. Are connectors normal?	Yes	Go to step 5.
		No	Repair as necessary
5	Turn ignition switch to OFF and disconnect HO2S connector and ECU connector. Measure resistance of HO2S signal circuit between HO2S harness connector and ECU harness connector. Measure resistance of HO2S ground circuit between HO2S harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 6.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
6	Turn ignition to ON. ECU connector is still disconnected. Measure voltage of HO2S signal circuit between HO2S harness connector and chassis ground. • **Specifications: below 0.5V** Is measured resistance within specification?	Yes	Go to step 7.
		No	Short circuit to battery between HO2S harness connector and ECU harness connector. Repair as necessary.
7	Measure voltage of HO2S heater battery circuit between HO2S harness connector and chassis ground. • **Specifications: approximately B+** Is voltage within specifications?	Yes	Go to step 8.
		No	Open circuit or short circuit to chassis ground between HO2S harness connector and main relay. Repair as necessary.
8	Turn ignition to OFF. Measure resistance of HO2S heater ground circuit between HO2S harness connector and ECU harness connector. • **Specifications: below 1Ω** Does resistance indicate continuity circuit?	Yes	Go to step 9.
		No	Open circuit between HO2S harness connector and ECU harness connector. Repair as necessary.
9	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P1166

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1166	**Lambda Bank Control Limit (Bank 1)**
Diagnostic trouble code No. P1167	**Lambda Bank Control Limit (Bank 2)**
[Related items]	• Fuel system malfunction (fuel tank/pressure regulator/fuel pump/PCSV) • Poor connection to fuel line hose/sealing/cut • Sealing between PCSV and fuel tank • Air leakage in exhaust system • Ignition system malfunction (ignition coil, spark plug, cable) • Faulty surge tank and intake port NOTE If any codes relating front/rear HO2S, fuel system, EVAP, and ignition system are present, do all repairs associated with them before proceeding with this troubleshooting procedure.

step	Inspecion		Action
1	First check for DTC relating to front/rear HO2S, fuel system, EVAP, and ignition system. Do DTCs exist?	Yes	First repair all other malfunctions on DTCs.
		No	Go to step 2.
2	Check for correct vacuum hose connections to engine dynamic chamber (especially PCSV, ISC hose, and brake booster). Are connections OK?	Yes	Rectify as necessary.
		No	Go to step 3.
3	With engine idling disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valve Is vacuum available at purge valve when EVAP valve is not operating?	Yes	EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair procedures.
		No	Go to step 4.
4	After installing fuel pressure gauge to service port on fuel rail, connect DLC F/P and B (B+) with a jumper wire. Is fuel line pressure correct with ignition switch ON? • **Fuel pressure at idle: 46~49 psi (320~340kPa, 3.26~3.47kg/cm2)**	Yes	Go to step 5.
		No	Low pressure: Clamp return-line and check if pressure rises: - If pressure rises: replace pressure regulator - If pressure does not rise: check the strainer at the fuel pump. High pressure: Disconnect return-line from fuel filter side and blow through line towards tank. - If line is clear: replace fuel delivery module.

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			- If line is blocked check for blockage in return line and clear or replace as necessary. If it is OK, check fuel.
5	Warm up engine to normal operating temperature for more than 10 minutes. Using SCAN TOOL monitor HO2S signal. Does the front HO2S signal switch lean to rich and rich to lean over 6 times for 10 seconds?	Yes	Go to step 6.
		No	Temporarily install a known good front HO2S and check for proper operation. If problem is corrected, replace front HO2S.
6	Check front/rear HO2S for contamination, deterioration or damage. Is front/rear HO2S contaminated, deteriorated or damaged?	Yes	If damaged or deteriorated, replace front/rear HO2S.
		No	Go to step 7.
7	Thoroughly check for loose, bent or corroded connectors at ECU and front/rear HO2S connectors. Are connectors normal?	Yes	Go to step 8.
		No	Repair as necessary.
8	Visually check for leak from exhaust system. Are any leaks present?	Yes	Rectify as necessary.
		No	Go to step 9.
9	Start engine and check for engine rpm decrease when disconnecting each injector connector is sequence. Measure the decreasing engine rpm of all 6 cylinders. Is there any cylinder with no change in rpm or only a small rpm change?	Yes	Repair as necessary.
		No	Go to step 10.
10	Using SCAN TOOL monitor MAF voltage signals. • **0.6~1.0V @ idle** Is signal within specifications?	Yes	Go to step 11.
		No	Do all repairs associated with MAF.
11	Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders. Are any spark plugs with abnormal color compared to other cylinders?	Yes	Check for engine mechanical failure. If it is OK, replace spark plugs.
		No	Go to step 12.
12	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P1505

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1505	**Idle Air Control Valve Opening Coil Signal Low Input**
[Related items]	• Open or short to chassis ground between ISA and ECU • Faulty ISA

step	Inspecion		Action
1	Turn ignition to OFF and disconnect ISA connector. With ignition ON, measure voltage of ISA battery voltage between ISA harness connector and main relay. • **Specifications: approximately B+** Is voltage within specifications?	Yes	Go to step 2.
		No	Open circuit or short circuit to chassis ground between ISA harness connector and main relay. Repair as necessary.
2	Turn ignition to OFF. Measure resistance of ISA opening coil. • **Opening coil: 14.5~16.5 Ω at 20°C (68°F)** Is resistance within specification?	Yes	Thoroughly check for loose, bent or corroded terminals at all connectors in circuit.
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
3	ISA connector and ECU connector are still disconnected. Measure resistance of ISA opening coil signal circuit between ISA harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	Yes	Go to step 4.
		No	Open circuit between ISA harness connector and ECU harness connector. Repair as necessary.
4	ECU connector and ISA connector are still disconnected. Measure resistance between ISA harness connector and chassis ground at ISA opening coil circuit. • **Specifications: infinite** Does each resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit to chassis ground between ISA harness connector and ECU harness connector. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

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Fuel System > Troubleshooting > P1506

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1506	**Idle Air Control Valve Opening Coil Signal High**
[Related items]	• Short to battery between ISA and ECU • Faulty ISA

step	Inspecion		Action
1	Turn ignition to OFF and disconnect ISA connector and ECU connector. With ignition ON, measure voltage of ISA opening coil circuit between ISA harness connector and chassis ground. • **Specifications: below 0.5V** Is voltage within specifications?	Yes	Go to step 2
		No	Short circuit to battery between ISA harness connector and ECU harness connector. Repair as necessary.
2	Turn ignition to OFF. Measure resistance of ISA opening coil. • **Opening coil: 14.5~16.5 Ω @ 20°C (68°F)** Is resistance within specification?	Yes	Thoroughly check for loose, bent or corroded terminals at all connectors in circuit.
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P1507

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1507	**Idle Air Control Valve Closing Coil Signal Low**
[Related items]	• Open or short to chassis ground between ISA and ECU • Faulty ISA

step	Inspecion		Action
1	Turn ignition to OFF and disconnect ISA connector. With ignition ON, measure voltage of ISA battery voltage between ISA harness connector and chassis ground. • **Specifications: approximately B+** Is voltage within specifications?	Yes	Go to step 2.
		No	Open circuit or short circuit to chassis ground between ISA harness connector and main relay. Repair as necessary.
2	Turn ignition to OFF. Measure resistance of ISA closing coil. • **Closing coil: 16.6~18.6 Ω at 20°C (68°F)** Is resistance within specification?	Yes	Thoroughly check for loose, bent or corroded terminals at all connectors in circuit.
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
3	Turn ignition to OFF and disconnect ECU connector. Measure resistance of ISA closing coil signal circuit	Yes	Go to step 4.

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	between ISA harness connector and ECU harness connector. • **Specifications: below 1Ω** Does each resistance indicate continuity circuit?	No	Open circuit between ISA harness connector and ECU harness connector. Repair as necessary.
4	ECU connector and ISA connector are still disconnected. Measure resistance between ISA harness connector and chassis ground at ISA closing coil circuit. • **Specifications: infinite** Does each resistance indicate open circuit?	Yes	Go to step 5.
		No	Short circuit to chassis ground between ISA harness connector and ECU harness connector. Repair as necessary.
5	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P1508

TROUBLESHOOTING PROCEDURE FOR DTC

Diagnostic trouble code No. P1508	**Idle Air Control Valve Closing Coil Signal High**
[Related items]	• Short to battery between ISA and ECU • Faulty ISA

step	Inspecion		Action
1	Turn ignition to OFF and disconnect ISA connector and ECU connector. With ignition ON, measure voltage of ISA closing coil circuit between ISA harness connector and chassis ground. • **Specifications: below 0.5V** Is voltage within specifications?	Yes	Go to step 2.
		No	Short circuit to battery between ISA harness connector and ECU harness connector. Repair as necessary.
2	Turn ignition to OFF. Measure resistance of ISA closing coil. • **Closing coil: 16.6~18.6 Ω at 20°C (68°F)** Is resistance within specification?	Yes	Thoroughly check for loose, bent or corroded terminals at all connectors in circuit.
		No	Temporarily install a known good ISA and check for proper operation. If problem is corrected replace ISA.
3	Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.		

Fuel System > Troubleshooting > P1529

TROUBLESHOOTING PROCEDURE FOR DTC

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Diagnostic trouble code No. P1529	**TCU Request for MIL ON**
[Related items]	• This is only a request from TCU to turn the MIL ON. The fault code is stored in the TCU. The freeze frame data is stored in the ECU under the P1529 request code. Be sure to retrieve freeze frame data before clearing code P1529 from ECU. • Check TCU

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