WORKSHOP MANUAL

727 (N SERIES)

ENGINE CONTROL SYSTEM
(4HK1 ENGINE)

SECTION 1A

ISUZU

ISUZU

International Service & Parts
Tokyo, Japan

N O T I C E

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section - 0A under the headings “GENERAL REPAIR INSTRUCTIONS” and “HOW TO USE THIS MANUAL”.

All material contained in this Manual is based on the latest product information available at the time of publication.

ENGINE

Engine Control System

CONTENTS

Engine Control System

Precautions on Service

Circuit Test Tools

Unless otherwise specified in diagnostic procedures, do not use Test Light to diagnose the powertrain electrical system. When diagnostic procedures need probe connector, use Connector Test Adapter Kit 5-8840-0385-0.

On-Market Electrical Equipment and Vacuum Devices

On-market electrical equipment and vacuum devices refer to those components that will be installed to vehicles after shipment from manufacturing plants. Be careful that installation of these components is not considered during the process of vehicle design.

CAUTION:
Do not install on-market vacuum devices to vehicles.

CAUTION:
Connect on-market electrical equipment, as well as its power supplies and grounds, to the circuits isolated from the electronic control system.

The on-market electrical equipment, even when installed to vehicles in normal manner, may bring functional troubles to the electronic control system. Affected devices include those not connected to the vehicle electrical equipment system, for example, mobile phones or radios. Therefore, when you intend to diagnose the powertrain, check such the on-market electrical equipment has not been installed to the vehicle and, if installed, remove it. If faults still occur even after removal of on-market electrical equipment, diagnose the vehicle according to normal procedures.

Damage by Electrostatic Discharge

Electronic components used in the electronic control system are designed to work at very low voltages and, for this reason, they are susceptible to damage by electrostatic discharge and some types of electronic components may be damaged even by the static electricity of less than 100 V that is usually not sensed by persons. Persons' sensitivity level is 4,000 V. Persons are electrostatically charged in various ways and the most typical electrification sources are friction and induction. Shown below are examples.

- Electrification by friction occurs when a person slides on the seat in the vehicle.
- Electrification by induction occurs when a person with insulating shoes is standing near a highly electrifiable substance and touches a ground momentarily. Electric charges with the same polarity flow out and resultantly the person is charged at high opposite polarity. Since static electric charges cause damages, it is important when you handle or test electronic components.

CAUTION:
To prevent damages by electrostatic discharge, follow the guidelines shown below.

- **Do not touch ECM connector pins as well as electronic components soldered to the ECM circuit board.**
- **Do not unpack each replacement component until preparations are completed for the component.**
- **Before taking out a component from the package, connect the package to the normal grounding line of the vehicle.**
- **When you intend to slide on the seat, change the posture from standing to sitting, or walk by a certain distance to handle a component, touch an appropriate grounding material.**

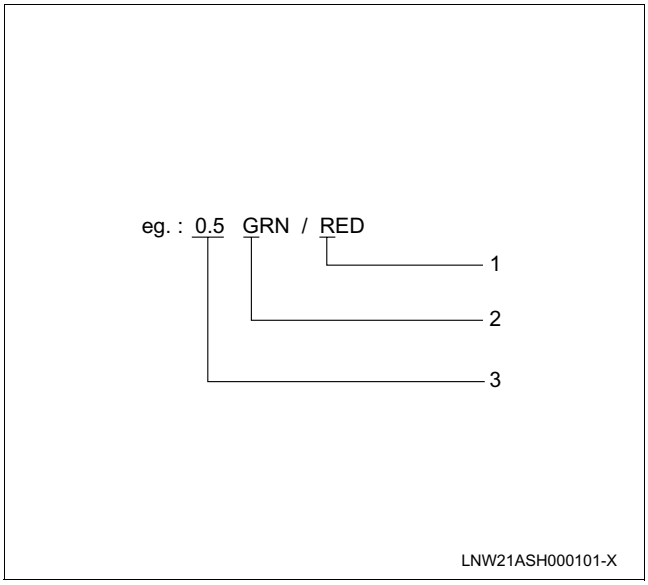
List of Abbreviations

Abbreviation	Original form	Meaning in this manual
A/C	Air Conditioner	Air conditioning units (cooler, heater, etc.)
AP	Accelerate Position	Depressing stroke of accelerator pedal
CKP	Crankshaft Position	Rotating reference signal of crankshaft
CMP	Camshaft Position	Rotating reference signal of pump camshaft
DLC	Data Link Connector	DLC connector (Tech 2 communication connector)
DTC	Diagnosis Trouble Code	DTC code
DVM	Digital Volt Meter	Special service tool (part No. 5-8840-0366-0)
ECT	Engine Coolant Temperature	Coolant temperature
ECM	Engine Control Modulle	Engine control computer
EDU	Engine Driver Unit	Fuel pump spill valve drive unit

Abbreviation	Original form	Meaning in this manual
EGR	Exhaust Gas Recirculation	Exhaust gas recirculation
ISM	Intake Step Motor	Intake throttle valve drive motor
ITP	Intake Throttle Position	Intake throttle valve opening
MIL	Malfunction Indicator Lamp	CHECK ENGINE Lamp
SPV	Spill Control Valve	Valve for high pressure circuit in the fuel pump
SW	Switch	
TCV	Timing Control Valve	Injection timing control valve in the fuel pump
Key SW	Key switch	Starter switch

Wire Color

All wiring harnesses are identified using colored jacket. The wiring harness used for the main circuit in an electrical system is identified with single color while the wiring harness used for the sub-circuit is identified with color stripe. The following rule is used in each wiring diagram to indicate size and color of a wiring harness.



Legend

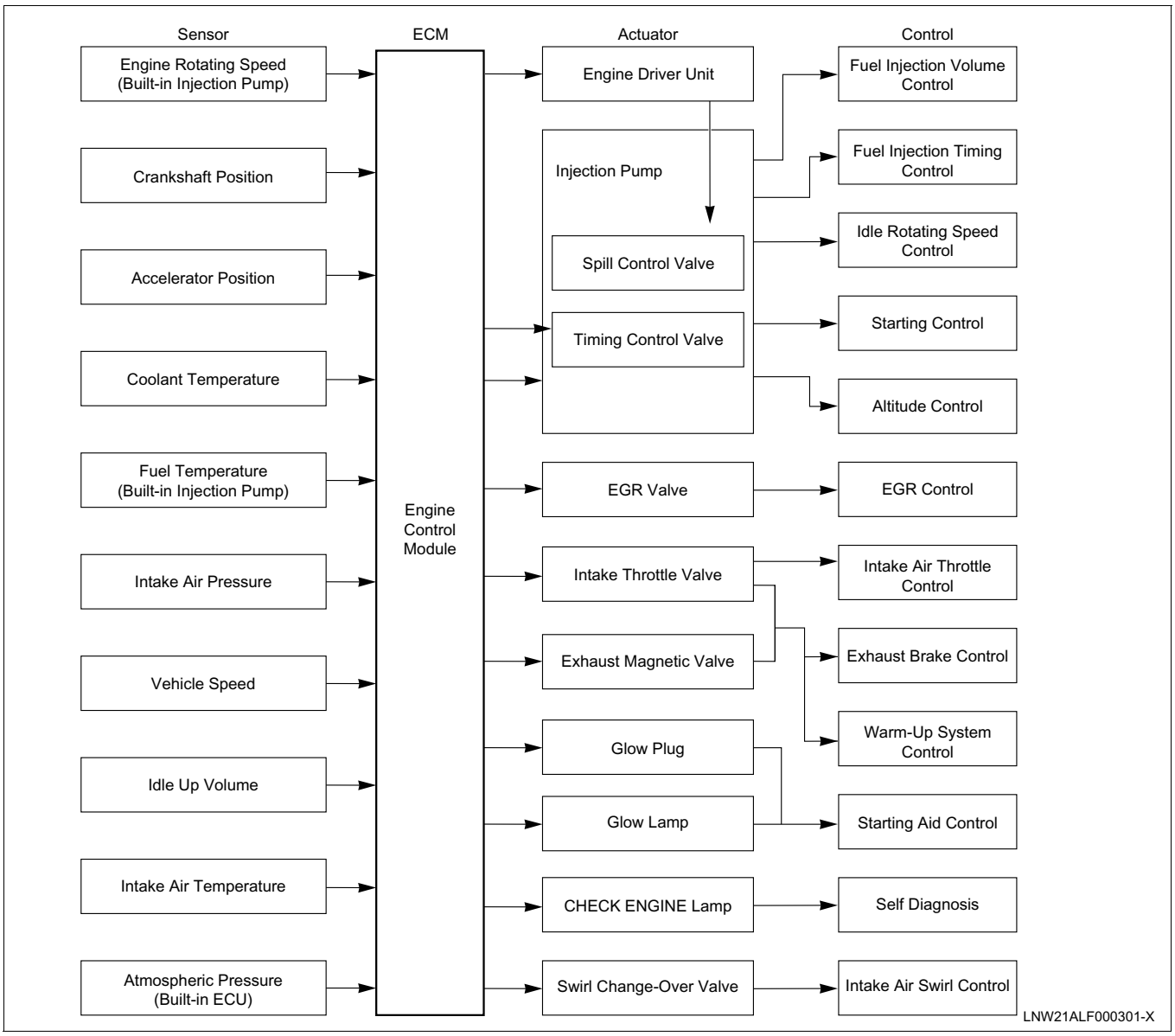
1. Red (stripe color)
2. Green (base color)
3. Harness size (0.5 mm^2)

Symbol	Color	Symbol	Color
B	Black	BR	Brown
W	White	LG	Light green
R	Red	GR	Gray
G	Green	P	Pink
Y	Yellow	LB	Light blue
L	Blue	V	Violet
O	Orange		

Function and Operation

Electronic Control System

The electronic control system processes the data, which has been collected with various types of sensors, by means of the control program installed to ECM (engine control module) to totally control engine parameters such as fuel injection amount, injection timing, engine startup, altitude compensation, and EGR.



ECM

ECM Description

The ECM is mounted in the glove box. The ECM monitors various data sent from diversified sensors and controls systems in the powertrain. The ECM diagnoses these systems to detect faults with respect to system operations and inform the driver of faulty condition via the CHECK ENGINE Lamp (MIL) and stores DTCs (diagnostic trouble codes). DTC identifies the trouble generation area to aid repairs by service operators.

Function of ECM

ECM supplies 5 V and 12 V voltages to various sensors and switches. Since powers are supplied via high resistances in ECM, Test Light, even when connected to the circuit, will not be lit. In a special case, a normal voltmeter does not indicate correct values since the resistance of the instrument is too low. To get accurate readings, you need a digital voltmeter whose input impedance is at least 10 MΩ. The special tool 5-8840-0366-0 is a proper choice for this measurement. In the ECM, the output circuit is controlled by regulating the

grounding system or power circuit via transistor or either of the devices listed below.

- Output driver module (ODM)
- Quad drive module (QDM)

ECM and Components

The ECM is designed to offer excellent drivability and fuel economy while achieving exhaust gas emission control requirements. The ECM monitors engine and vehicle functions via various electronic sensors such as CKP (crank position) and VS (vehicle speed) sensors.

Voltages from ECM

The ECM supplies reference voltages to various switches and sensors. Resistances of the ECM are very high and this allows the ECM to supply voltages to these devices, and voltages actually applied to circuits are low and even connecting Test Light to individual circuits may fail turn-on. Since the voltmeter normally used in service factories has low input impedance, correct readings may not be obtained. To get accurate readings, a digital voltmeter whose input impedance is 10 MΩ (for example, 5-8840-0366-0) should be used.
Input/output devices of the ECM include analog-to-digital converter, signal buffer, counter, and special driver. By using electronic switches, the ECM controls most system components and turning off a switch closes the ground circuit. These switches are divided into four-switch or seven-switch groups, and the former group is called quad driver module (QDM) and controls up to four output pins respectively while the latter group is called output driver module (ODM) and controls up to seven outputs respectively. Note that all the outputs are necessarily not used in the control.

Electrically Erasable Programmable ROM (EEPROM)

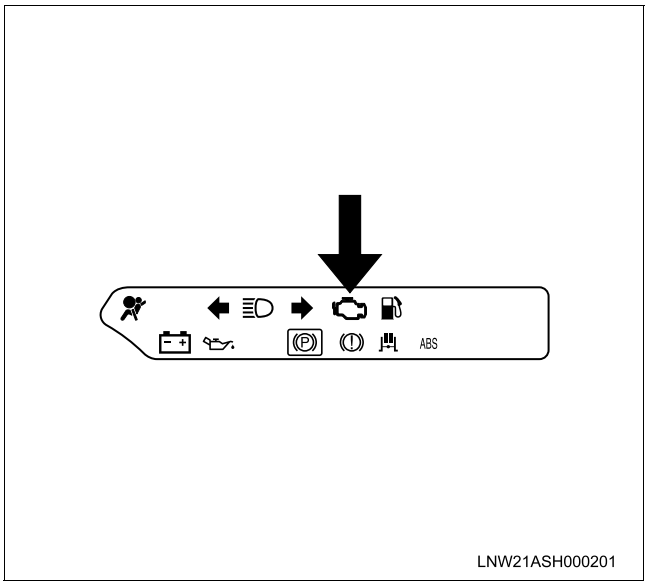
EEPROM is a permanent memory chip and soldered to the board in the ECM. EEPROM stores program and calibration data, both of which are necessary for the ECM to control the powertrain. Different from conventional ROMs, EEPROM cannot be replaced with new component. If EEPROM fails, the complete ECM assembly must be replaced with new one.

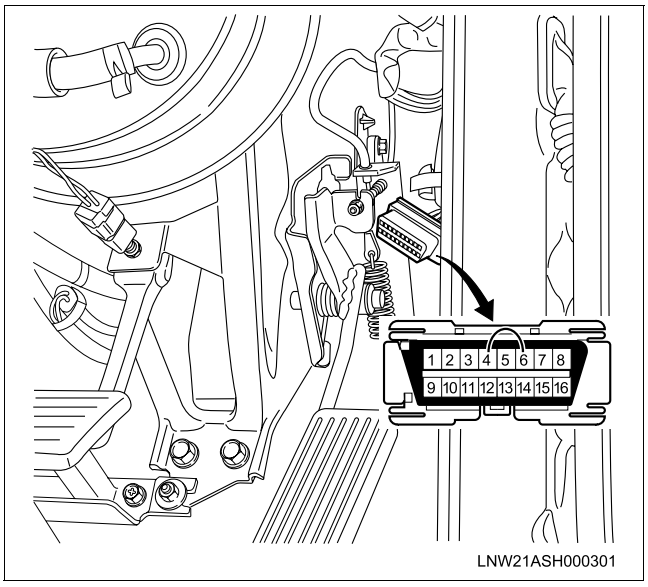
Precautions on ECM Service

The ECM is designed to withstand ordinary currents used in operations of a vehicle. Be careful that the circuits must not be overloaded. To test the ECM to check open wiring or short, ECM circuits must be connected to the ground or voltages must not be applied to the ECM. To test ECM circuits, the digital voltmeter 5-8840-0366-0 should always be used.

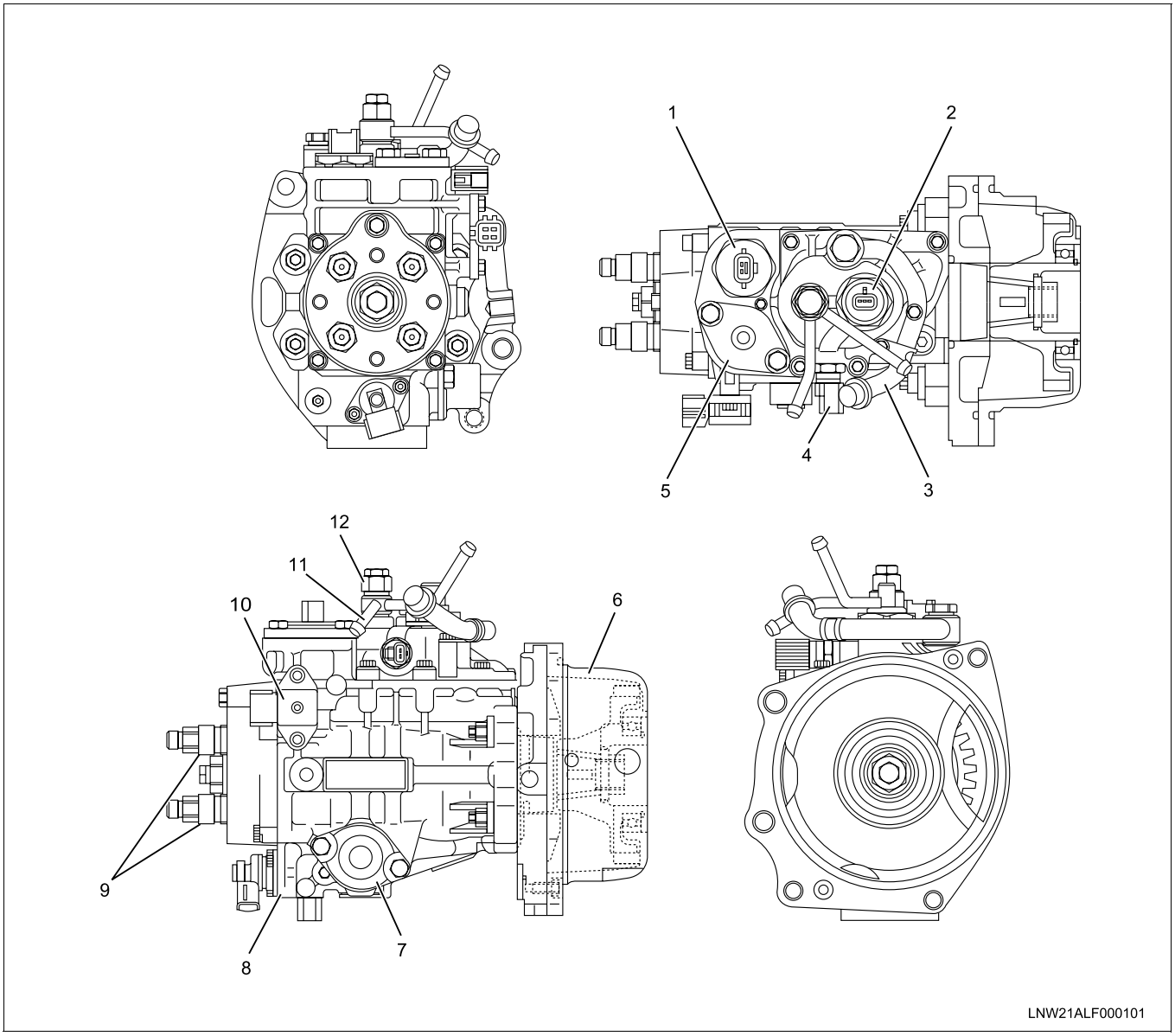
CHECK ENGINE Lamp (MIL)

Used as a means of communication between ECM and user usually in the user mode, by light on and off. If this lamp illuminates during operation, it warns some engine fault to the user.
In a service factory, 4 pins and 6 pins of DLC (data link connector) can be short to check the DTC while the CHECK ENGINE Lamp (MIL) is flashing.





Electronically Controlled Distributor Injection Pump



Legend

1. Spill control valve
2. Pump cam position sensor (engine speed sensor)
3. Inlet pipe
4. Fuel temperature sensor
5. Accumulator
6. Bearing cover
7. Timer
8. Timing control valve
9. Delivery valve holder
10. Compensation ROM
11. Overflow pipe
12. Overflow valve

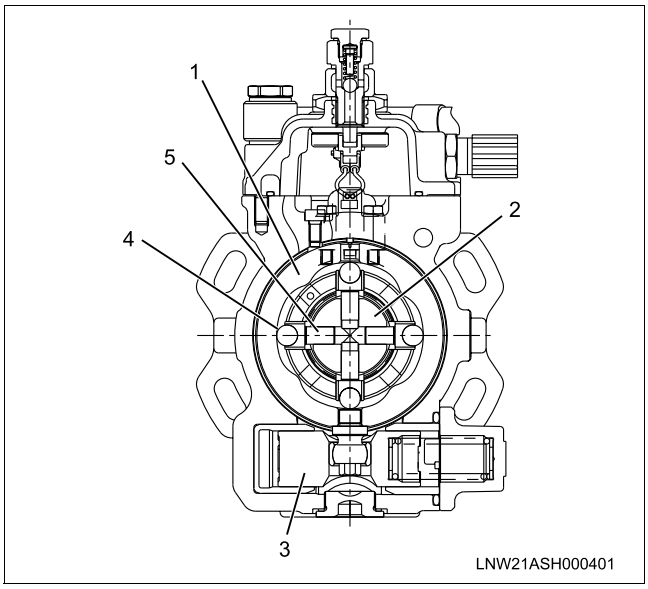
An electronically controlled distributor injection pump is employed to meet the requirements of the long-term exhaust gas control without impairing the fuel efficiency and output. These features allow finer particles of injected fuel, and optimum injection timing and injection amount while the vehicle is traveling, which was impossible with the former injection pump.

Fuel Dehumidifying Agent

Sliding parts in the injection pump are lubricated by the fuel (light oil) as in the existing distributor type injection pump. If dehumidifying agent is mixed in the fuel, it may exert adverse influence on the sliding parts. Particularly, dehumidifying agent of alcohol type is characterized by introducing moisture into water, causing rust generation. It should be explained to customers not to use fuel dehumidifying agent or other fuel additives.

Structure and Operation

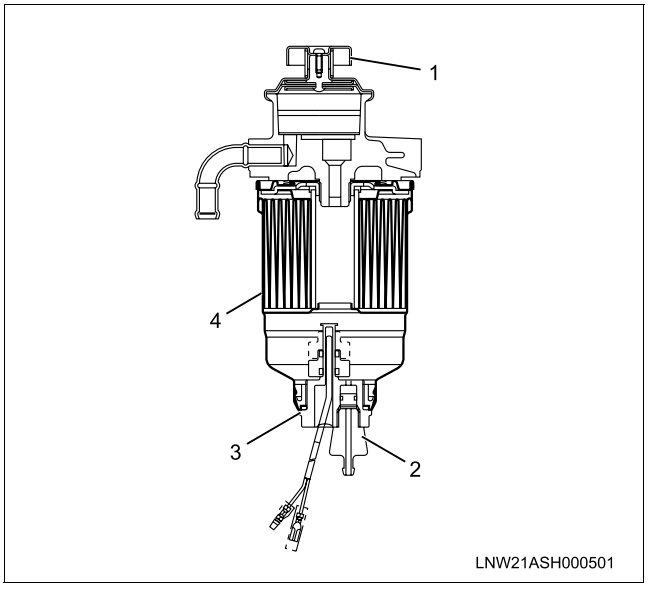
1. Higher pressure of injection fuel
   An inner cam with a cam ring and radial plunger are used to increase the pressure of the injection fuel.
   The cam ring is supported on the pump body side and provided with projections (cams) on the internal periphery.
   Four plungers are provided at an interval of 90°, incorporated in the rotor integrated with the drive shaft, and in contact with the internal periphery of the cam ring in the radial direction through the roller.
   When the drive shaft rotates, the plunger moves on the cam ring internal surface through the rolling of the roller, pushed out in the shaft center direction with the inner cam and compresses the fuel.
   Four plungers operate simultaneously. This enables higher pressure (75 ~ 130 MPa) and high rigidity is obtained since the load becomes relative load in the radial direction.
   Plunger diameter is ø7.5mm and the cam lift is 2.5mm.



Legend
1. Cam ring
2. Rotor
3. Timer piston
4. Roller
5. Plunger

2. Injection timing control
   Injection timing is adjusted by shifting the cam ring phase with the fuel pressure applied to the back of the timer piston. The fuel pressure applied to the timer piston is controlled with the ECM (engine control module) through the timing control valve.

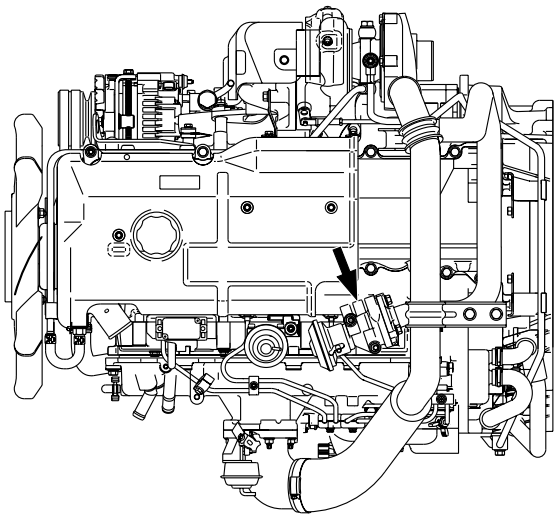
3. Fuel injection amount control
   Fuel injection amount is adjusted by opening or closing the fuel high pressure circuit with the high response SPV (spill control valve).
   EDU (engine driver unit; a high voltage driver) is employed to drive the SPV at a high speed. EDU can drive the SPV of high fuel pressure at a high speed by the high voltage and high speed energizing system.
4. Pump ROM
   In order to compensate the variation of correlation between the fuel pump and engine, variation of the injection amount inherent to the injection pump is corrected.
5. Air bleeding of injection pump
   a. Pumping until the pump is hard to operate.
   b. Start the engine. If not started, repeat pumping.
   c. After the engine is started, keep the engine speed at 1000 to 1500rpm for about 10 seconds.
   d. Stop the engine.
   e. Check for fuel leakage.



Legend
1. Priming pump
2. Plug
3. Sensor
4. Cartridge

EGR (Exhaust Gas Recirculation) Valve

In order to decrease NOx (nitrogen oxide) in the exhaust gas, an EGR system is employed.
The EGR valve is vacuum control type.



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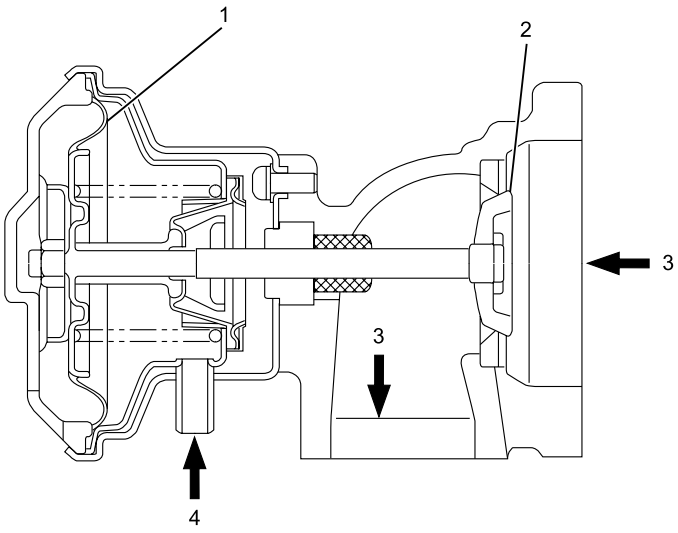

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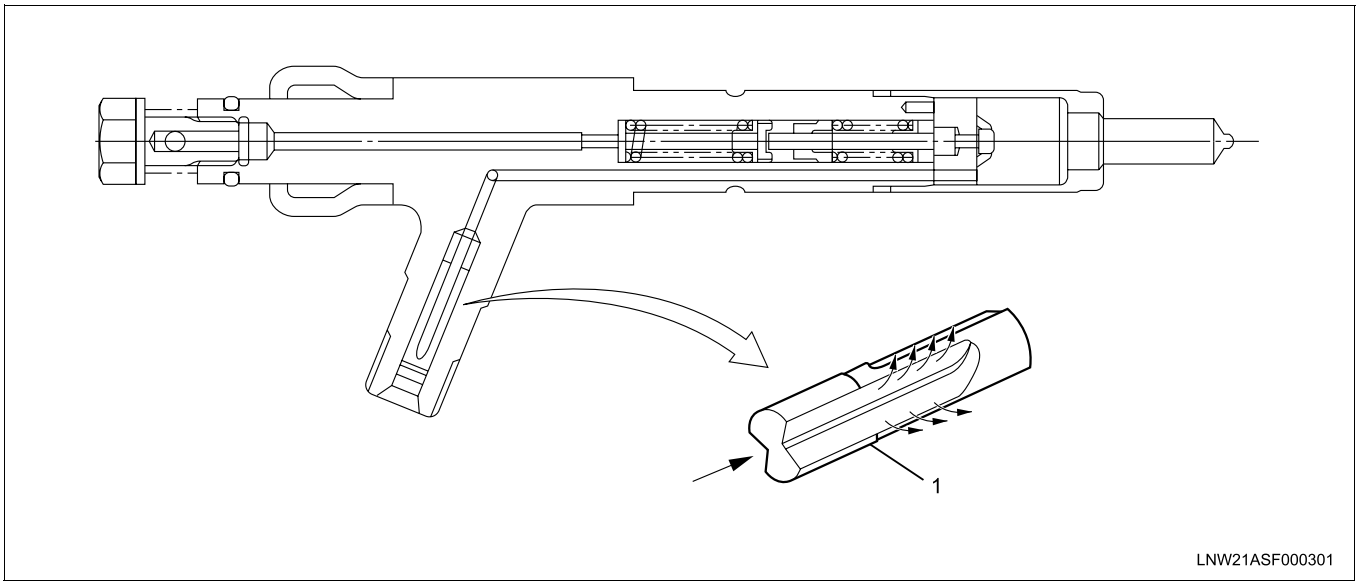
Legend

1. Diaphragm
2. Valve
3. Exhaust gas
4. Vacuum

Injection Nozzle



Legend
1. Edge filter

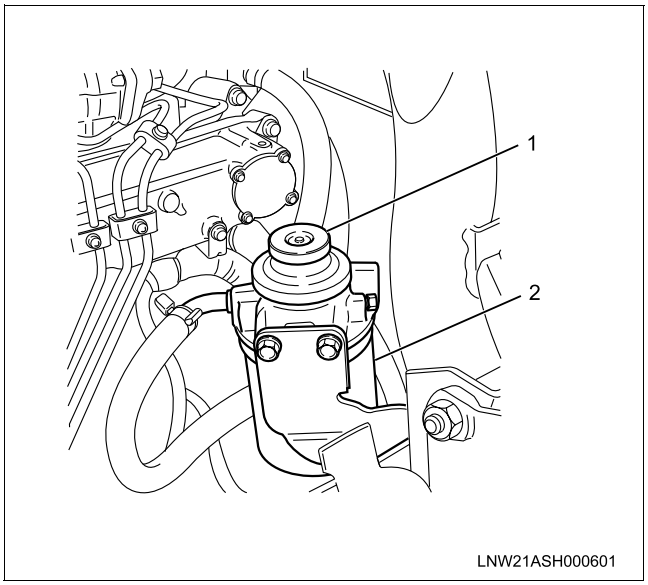
A two-step valve opening pressure nozzle is used as the injection nozzle. Spray particle size is reduced by reducing the injection hole diameter.
To prevent clogging of the nozzle injection hole, an edge filter is provided at the nozzle holder inlet.

Reference:
If the injection nozzle hole is clogged, ECM corrects the cylinder inside condition.
The cylinder correction amount in the Tech 2 data list is helpful to know the injection nozzle condition.

Item		Engine 4HK1
Valve opening pressure MPa(kg/cm^2)	1st valve opening pressure	18.0 {185} (Nominal value)
	2nd valve opening pressure	22.0 {225} (Nominal value)
No. of injection holes - Injection hole diameter (mm)		5 -ø0.25

Fuel Filter with Sedimentor

In order to secure the lubrication efficiency in the injection pump, a fuel filter with sedimentor to remove moisture in the fuel is provided.
This filter is provided with a priming pump to bleed the air from the injection pump.

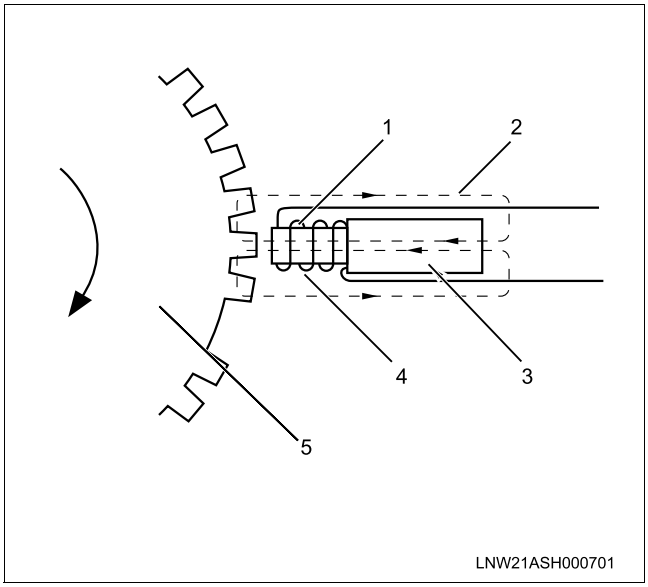


Legend
1. Priming pump
2. Fuel filter & sedimentor

Pump CMP (Cam Position) Sensor (Engine Rotation Sensor) = NE Sensor

The pump CMP sensor is positioned on the outer surface of the cam ring of the pump chamber. The pulser installed to the injection pump drive shaft interrupts the magnetic flux generated by the permanent magnet and iron core of the sensor according to the shaft rotation to generate AC wave signal to the coil. This is transmitted to ECM (engine control module) and converted to square wave signal. engine speed and cam position are calculated by this signal.

- Calculation of engine speed: No. of pulses per hour is counted.
- Calculation of cam position: When the cam ring slides, timing of signal read from the pulse of the sensor installed to the cam ring varies. ECM calculates the time difference between this signal and signal of the crank position sensor and calculates the cam position.

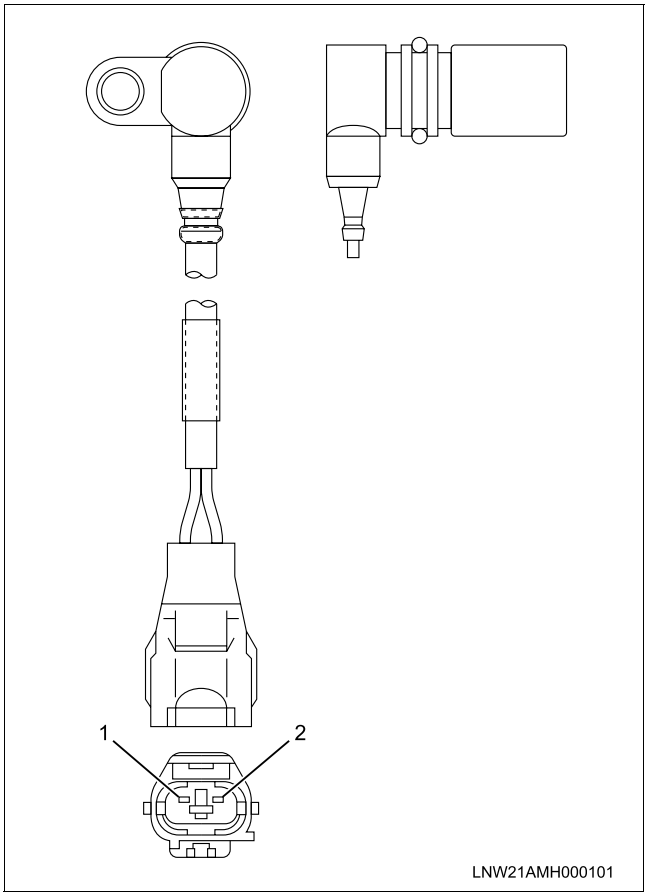


Legend

1. Iron core
2. Magnetic flux
3. Permanent magnet
4. Coil
5. Pulser

CKP (Crank Position) Sensor

CKP sensor to detect the crank position is installed to the flywheel housing. The sensor detects the rotating angle of the crankshaft in non-contact condition with the pointer installed to the flywheel and sends pulse signal to ECM. ECM calculates the injection timing at the pump cam position based on this pulse signal.

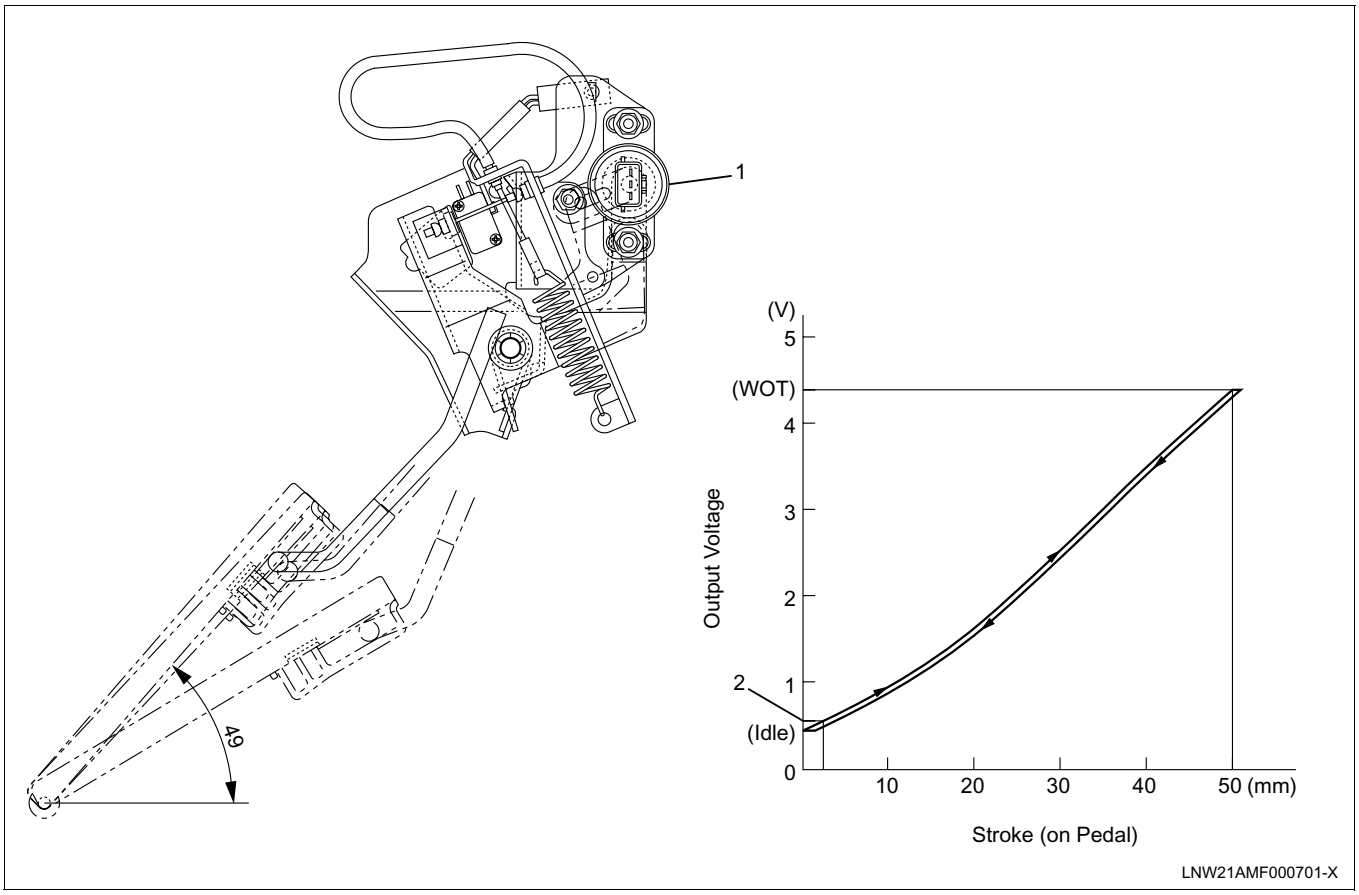


Legend

1. (–) Pin
2. (+) Pin

Accelerator Position Sensor

The accelerator control is accelerator position sensor type. This sensor is a potentiometer (variable resistance) installed to the accelerator pedal. Reference voltage is constantly applied to the sensor from ECM (engine control module) and the accelerator pedal stepping angle is detected from varying voltage. An accelerator switch (idle position switch) is also installed to the accelerator pedal. The accelerator switch is turned ON when the accelerator pedal is released and OFF when the accelerator pedal is stepped on.

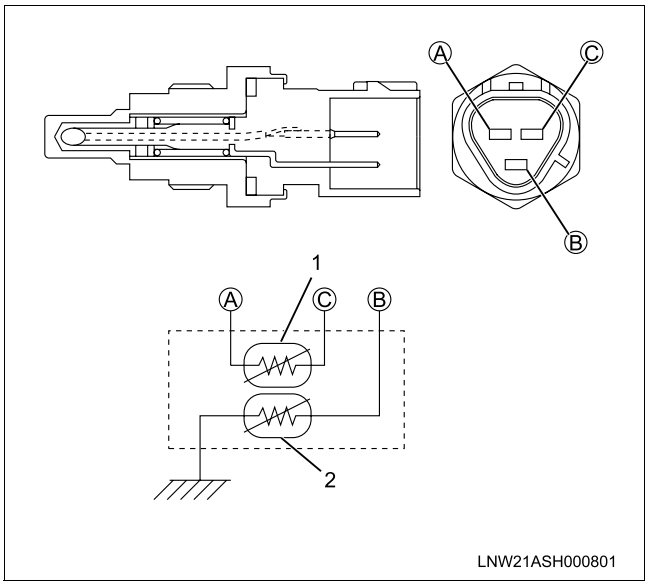


Legend

1. Accelerator position sensor
2. Accelerator switch operating point

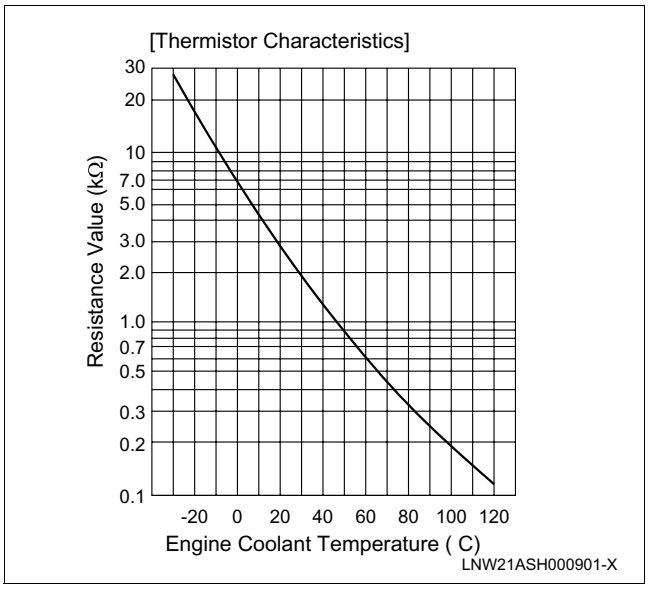
Engine Coolant Temperature Sensor (Coolant Temperature Sensor / ECT)

The engine coolant temperature sensor serves for both the ECM and thermo meter unit. The engine coolant temperature sensor is of the thermistor type that the electric resistance reduces with the increase of the temperature. It is installed on the left front of the cylinder head.



Legend

1. Thermistor for ECM
2. Thermistor for thermo meter



Fuel Temperature Sensor

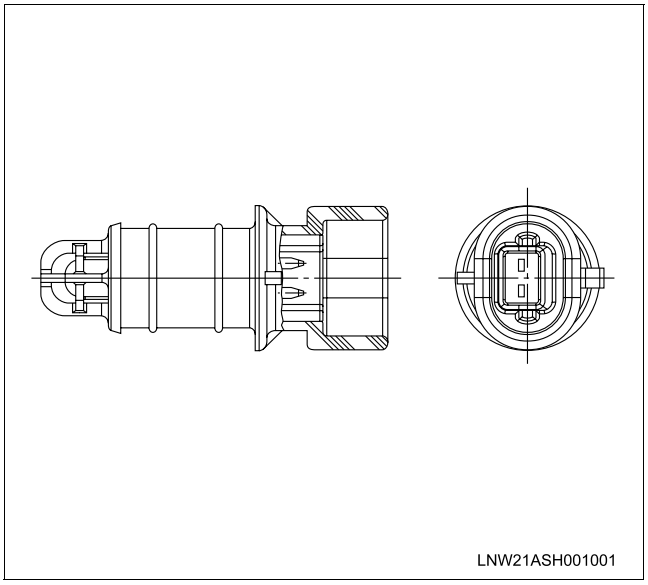
Fuel temperature sensor is installed in the pump chamber full of fuel. Thermistor is used for the temperature detector as in the thermo sensor and convert the changes of temperature to changes of resistance and values transmits to ECM.

Vehicle Speed Sensor

The vehicle speed sensor is used commonly with the speedometer. ECM receives signal from the speedometer.
By one turn of the speedometer driven gear, 25 pulses are generated indicating 60 km/h at 637rpm.

Intake Air Temperature Sensor

Intake air temperature sensor is installed to the intake duct. Thermistor is used for the temperature detector as in the thermo sensor to convert the changes of temperature to changes of resistance values and transmits to ECM.

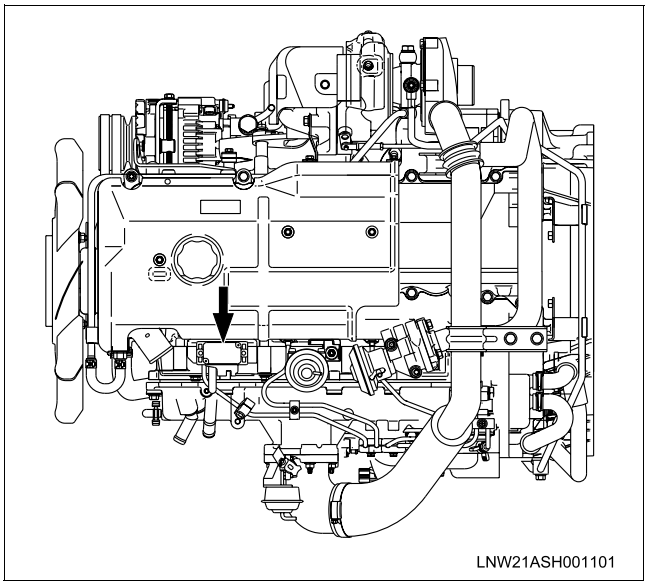


Atmospheric Pressure Sensor

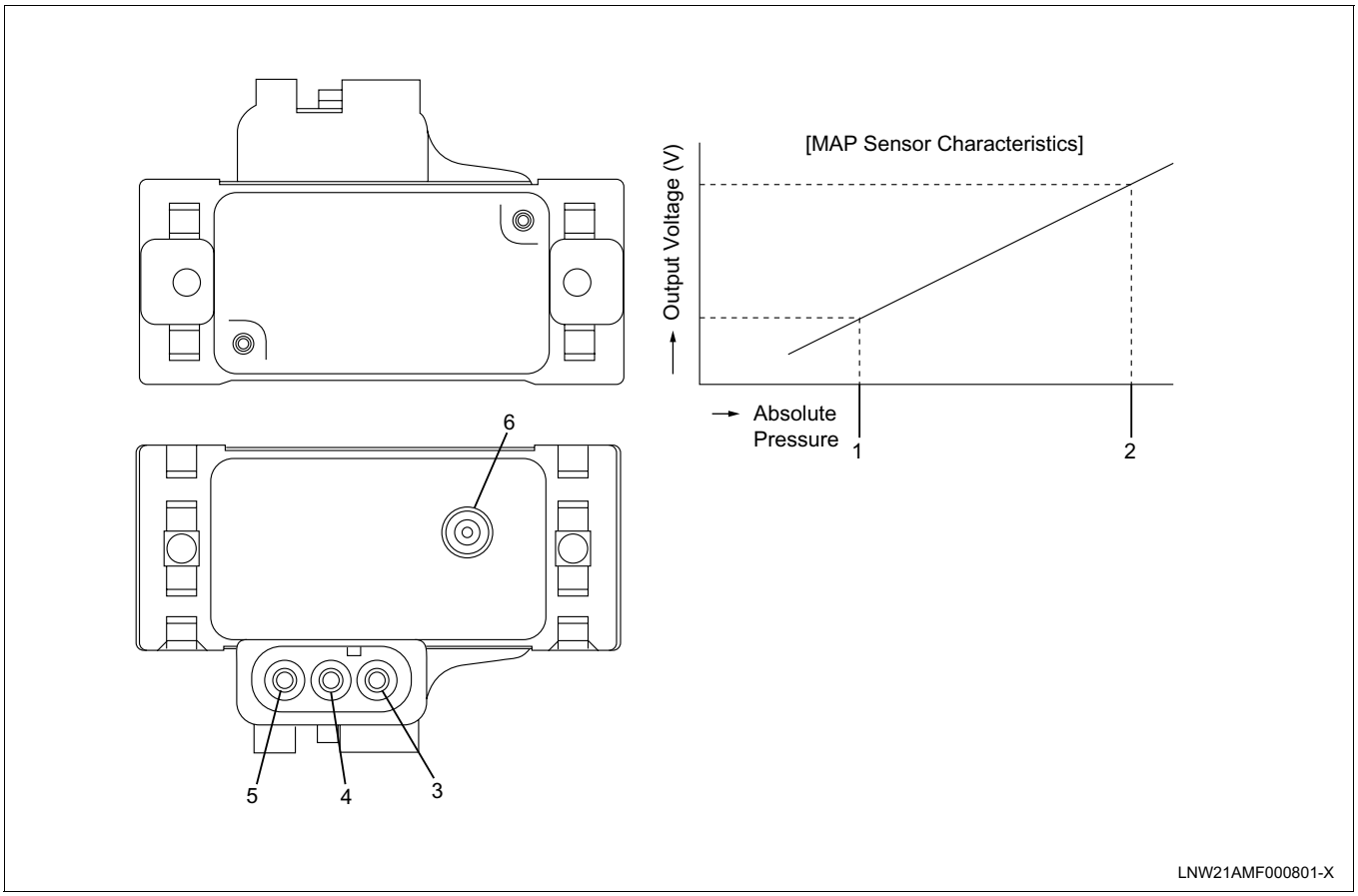
The atmospheric pressure sensor is incorporated in ECM.

MAP (Intake Air Pressure) Sensor

The MAP sensor is installed to the cylinder head cover. The MAP sensor is composed of piezo type semiconductor pressure element. Reference voltage is constantly applied to the MAP sensor from ECM and manifold pressure is detected by the changes of voltage. When the manifold pressure is low (at idling), low voltage signal is sent to ECM and when the pressure is high (at full throttle), high voltage signal is transmitted to ECM.



MAP (Intake Air Pressure) Sensor

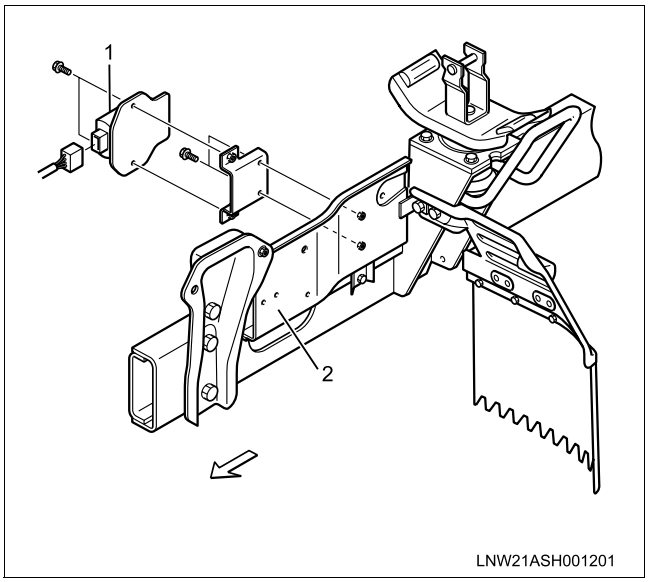


Legend

1. Pressure at idling (low pressure)
2. Pressure at rating point (absolute pressure (high pressure))
3. Power pin
4. Output pin
5. Ground pin
6. Vacuum hose connected pipe

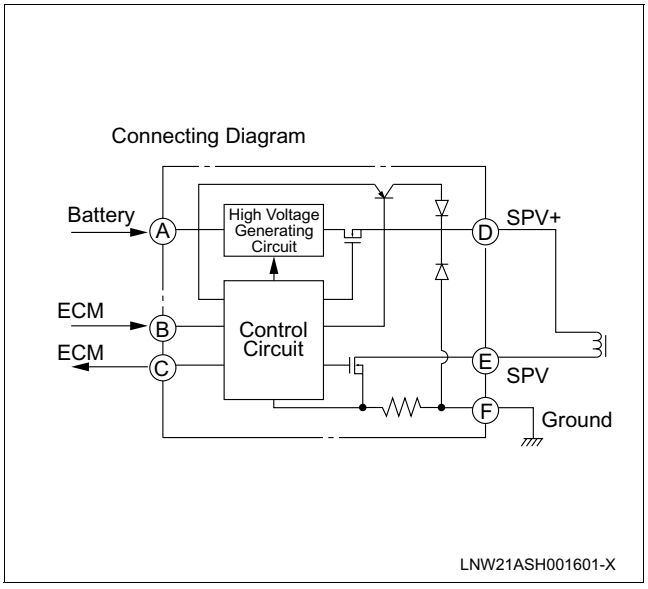
EDU (Engine Driver Unit)

EDU enables SPV high speed drive at high fuel pressure by the high voltage and high speed energizing system.
Maximum charging voltage is about 150V.



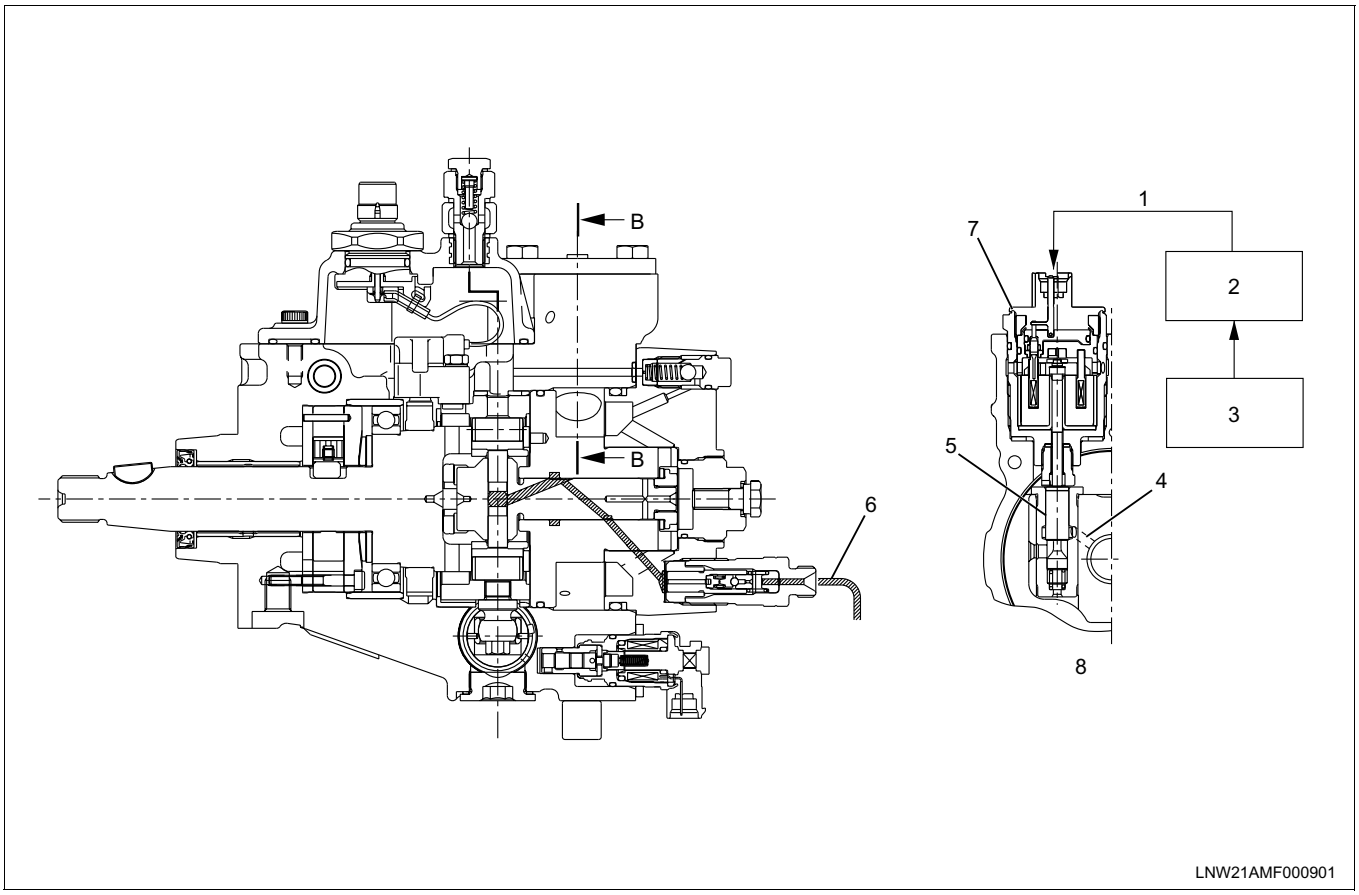
Legend

1. EDU
2. Left side cover



SPV (Spill Control Valve)

Fuel injection amount is controlled with the high-response SPV by opening and closing the fuel high pressure circuit.
SPV is incorporated in the injection pump.

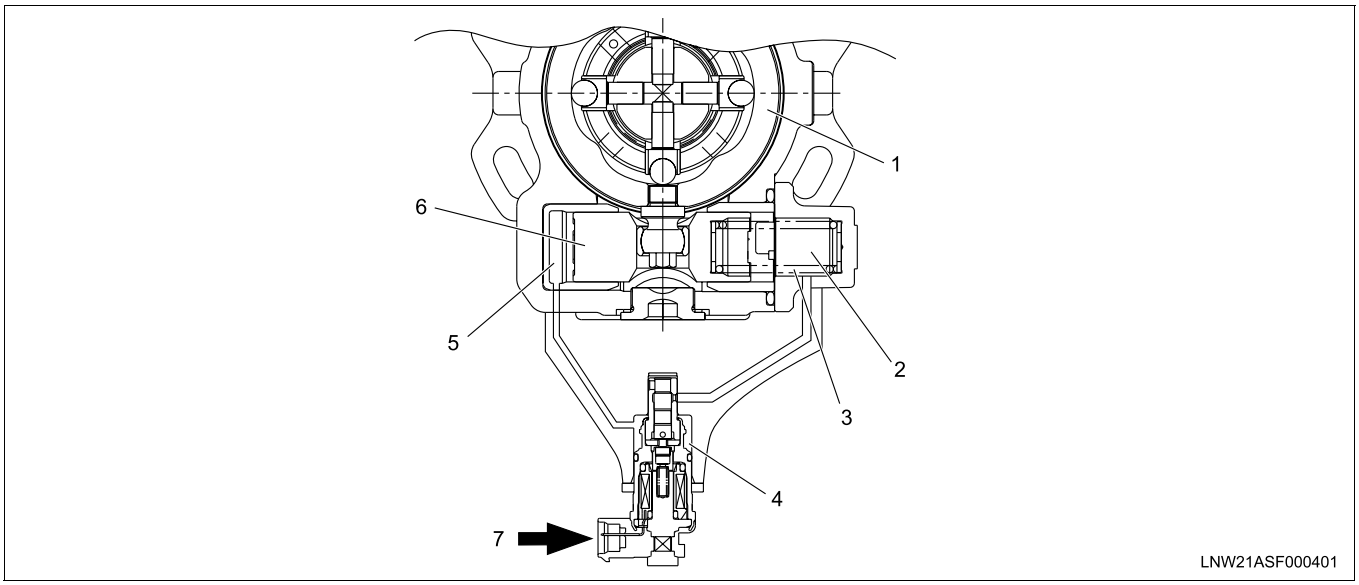


Legend

1. SPV drive signal
2. EDU
3. ECM
4. High pressure fuel
5. Valve
6. High pressure fuel passage
7. SPV
8. B-B section

TCV (Timing Control Valve)

TCV using a solenoid valve is installed to the oil pressure timer. Duty (energizing rate) controlled current with ECM increases or decreases the valve opening time to control the oil pressure in the high pressure chamber side. The timer piston is moved by the balance with the timer spring. By sliding the cam ring connected movably with the timer piston in the rotating direction, the injection timing is controlled.



Legend

1. Cam ring
2. Low pressure chamber
3. Timer spring
4. TCV
5. High pressure chamber
6. Timer piston
7. From ECM

Electronic Control Distributor Pump System

System Overview

The accelerator control uses an accelerator position sensor. The accelerator sensor of the potentio meter (variable resistance) type is installed to the accelerator pedal. Reference voltage is constantly applied to the sensor from the ECM (engine control module) to detect the accelerator pedal stepping angle from changes of voltage. An idle position switch (accelerator switch) is also installed to the accelerator pedal. The idle position switch (accelerator switch) is turned ON when the accelerator pedal is released and OFF when the accelerator is stepped on.

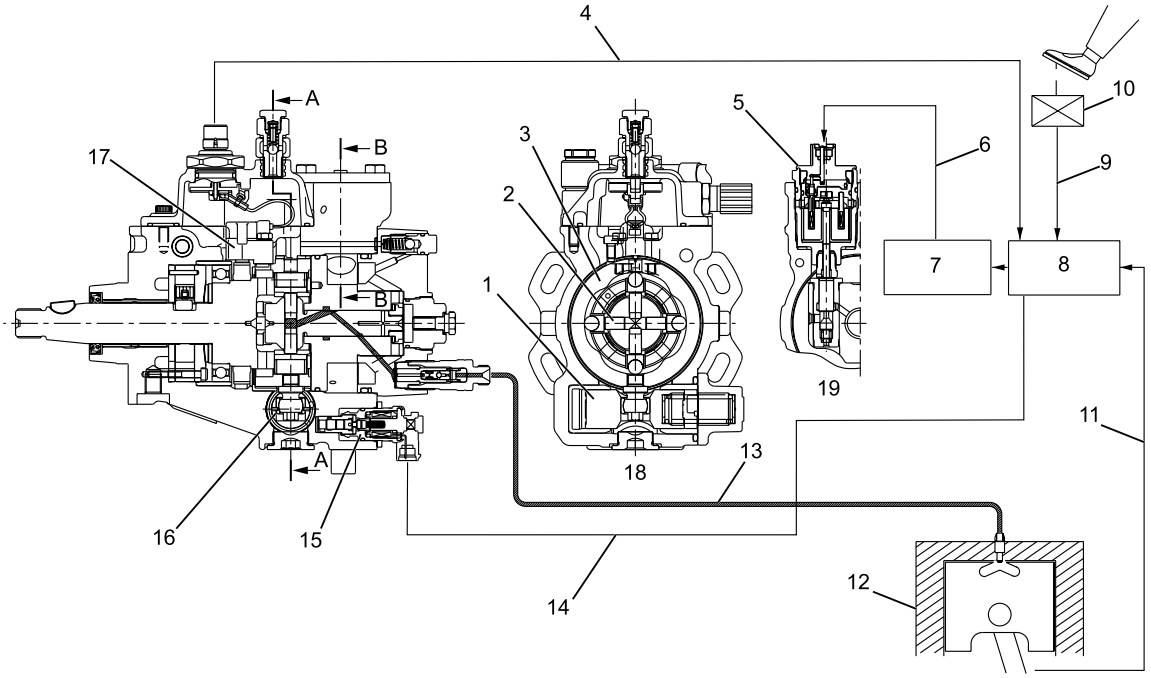
ECM detects the accelerator pedal stepping angle as AP (accelerator position) signal and after calculating, transmits SPV (spill controller valve) drive signal to EDU (engine driver unit).

EDU enables high speed drive of SPV which controls fuel injection amount.

The fuel injection amount is controlled by opening and closing the fuel high pressure circuit with the high response SPV.

SPV is incorporated in the injection pump.

The spill control valve and timing control valve are electronically controlled with ECM (engine control module).



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Legend

1. Timer piston
2. Plunger
3. Cam ring
4. Pump cam position signal (engine speed signal)
5. Spill control valve
6. Spill control valve drive signal
7. Engine driver unit
8. Engine control module
9. Accelerator pedal opening signal
10. Accelerator position signal
11. Crankshaft position signal
12. Engine
13. High pressure fuel passage
14. Injection timing control signal
15. Timing control valve
16. Timer piston
17. Pump cam position sensor (engine speed sensor)
18. A-A section
19. B-B section

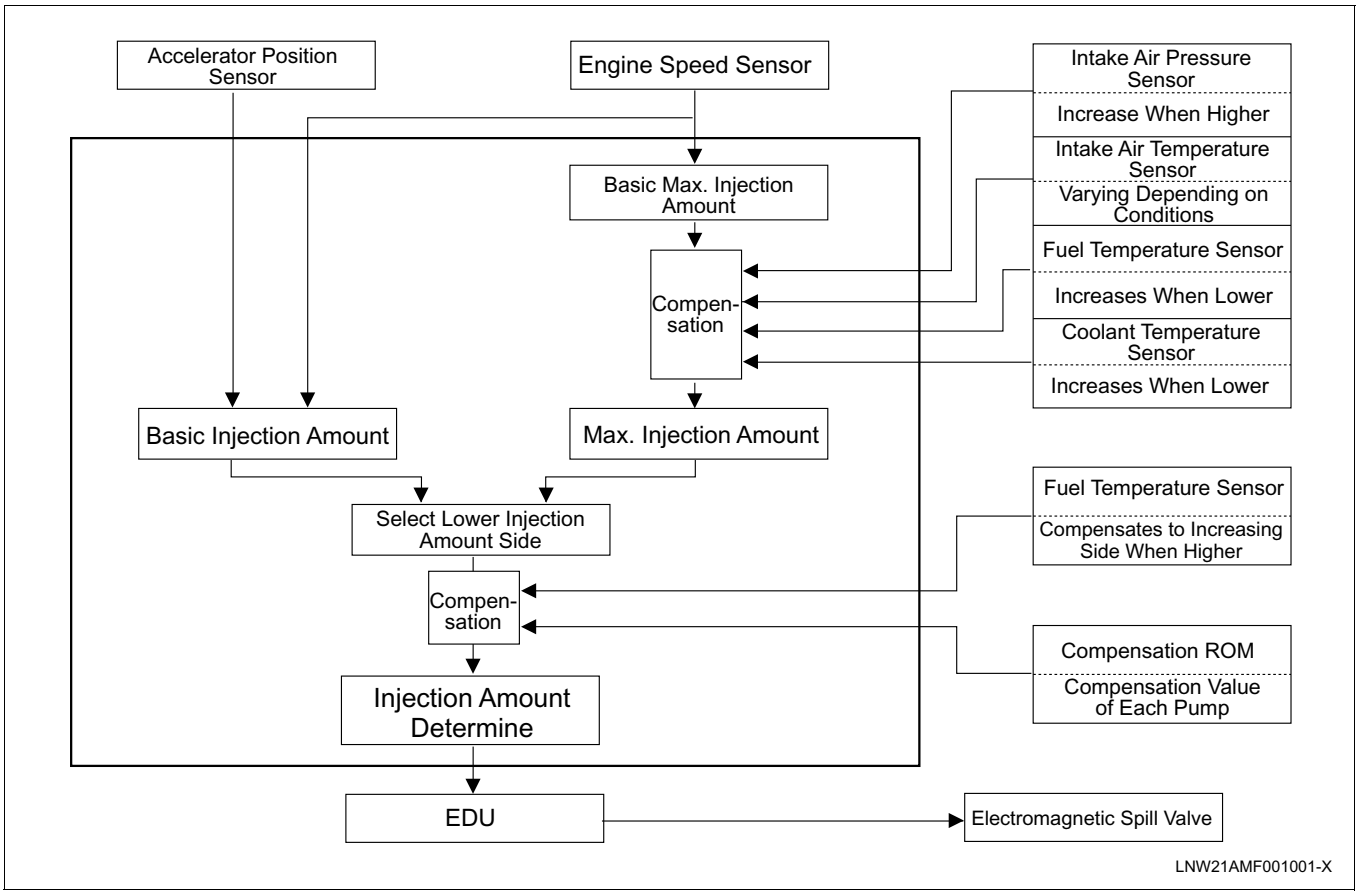
Fuel Injection Amount Control

The electromagnetic spill valve is opened by the signal from ECM (engine control module), pressure in the fuel forced feed unit (rotor unit) is decreased and injection is completed. Injection amount is controlled at this timing.

Operation

ECM calculates the basic injection amount optimum to the engine operating conditions and the maximum injection amount at that engine condition, compares and selects lower injection amount. By adding the phase compensated with the compensation ROM to that injection amount, the final injection amount is determined.

At the time of start, the optimum fuel injection amount is determined by the starter signal and coolant temperature. (Injection amount increases more when the coolant temperature is lower.)



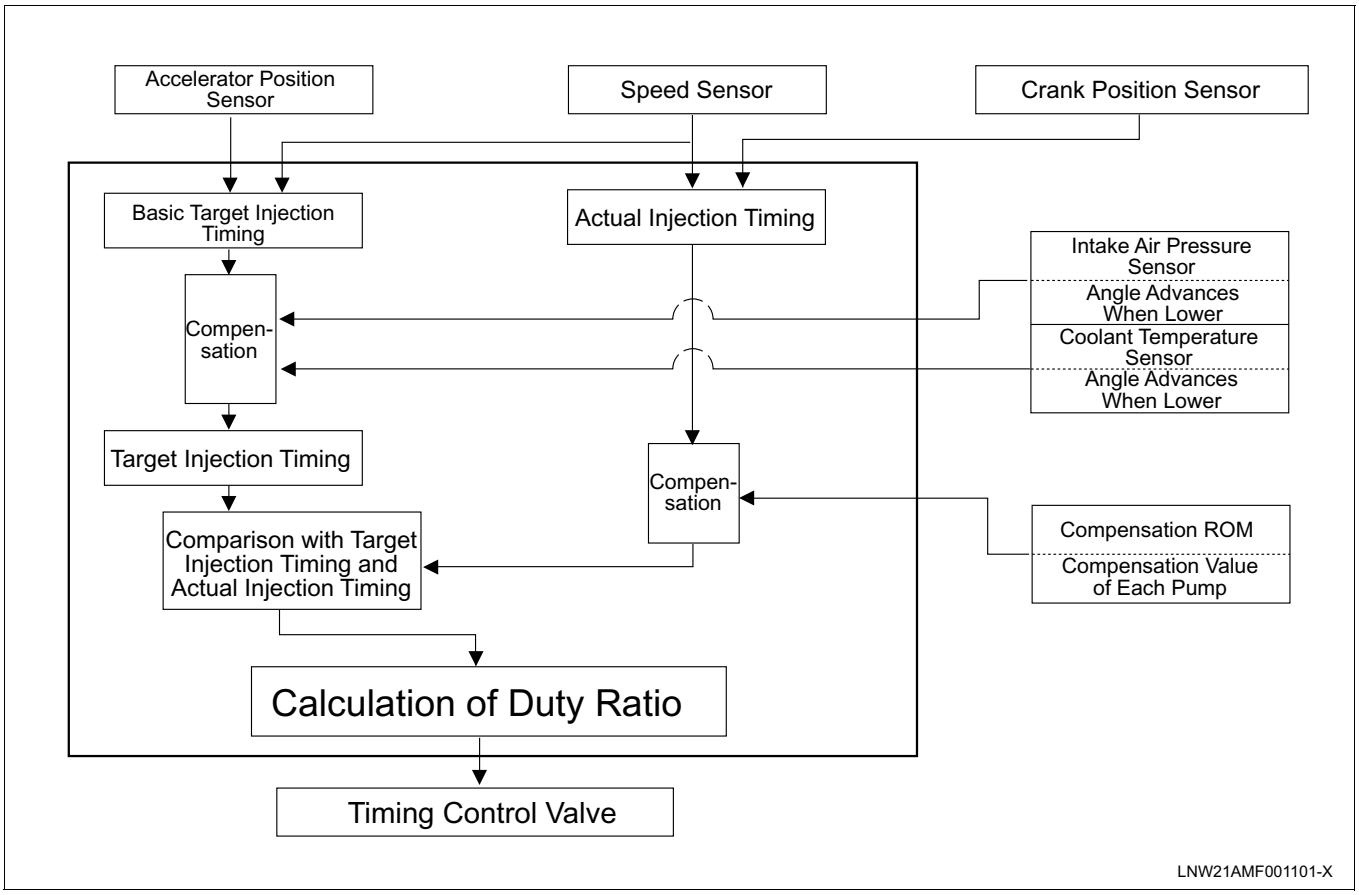
1. Basic injection amount
   Determined by accelerator opening and engine speed.
2. Max. injection amount
   Maximum injection amount is determined by adding compensation by signals of sensors to the basic maximum injection amount (amount which can be theoretically injected) determined based on the engine speed.
   a. Intake air pressure compensation
      When the intake air pressure is high, the air amount is increased and the injection amount is increased.
   b. Intake air temperature compensation
      Injection amount is increased or decreased depending on the difference of density based on the intake air temperature.
   c. Fuel temperature compensation
      When the fuel temperature decreases, the injection amount is increased.
   d. Coolant temperature compensation
      When the coolant temperature is lower, the injection amount is increased to secure the operability immediately after the cold start.
3. Injection amount compensation
   Since the actual injection amount decreases in comparison with the designated value of injection amount when the fuel temperature is higher, designated injection amount value is increased.

Fuel Injection Timing Control

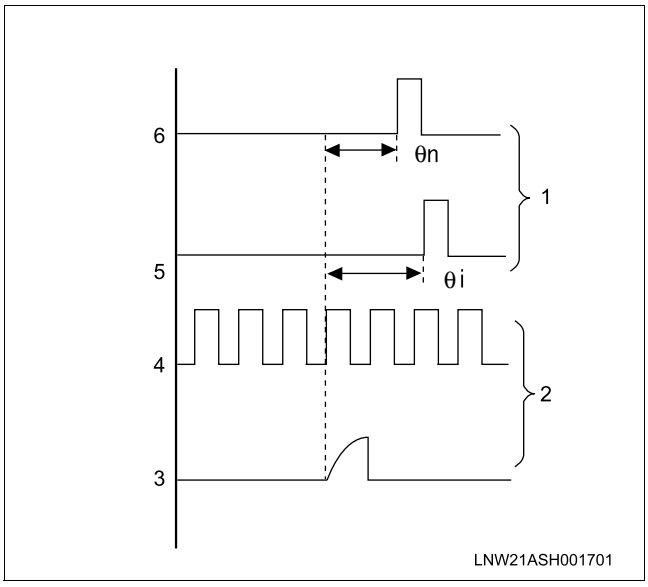
- Timing control valve is duty-controlled according to a signal from ECM (engine control module) to control the fuel injection start timing.
- Using the crankshaft angle feed back system, highly precise control is effected.

Operation

ECM calculates the optimum target injection timing for the engine condition, adding the compensation by signals from sensors based on the basic target injection timing.
At the time of start, the injection timing is determined by the starter signal, coolant temperature and engine speed (at the higher engine speed, the injection timing angle advances.)
Crank angle feedback system is employed to calculate the actual injection timing and feed back the result at the target injection timing.



1. Basic target injection timing
   Determined based on the accelerator opening and engine speed.
2. Injection timing compensation
   a. Intake air pressure compensation
      Basic target injection timing is compensated by the intake air pressure. When the atmospheric pressure is low on a altitude, for instance, the injection timing angle is advanced.
   b. Coolant temperature compensation
      Basic target injection timing is compensated based on the coolant temperature. When the coolant temperature is low, the injection timing angle is advanced.
3. Feedback control
   a. Calculation of actual injection timing
      When relation between the compression TDC position and crank angle reference position signal is correct on the engine side and the relation between the injection waveform and cam angle signal is correct on the pump side, actual injection timing θn can be calculated by calculating the phase difference θi between the crank angle reference position signal and cam angle signal.



Legend

1. Engine
2. Pump
3. Injection waveform
4. Cam angle signal
5. Crank angle reference position signal
6. Actual compression TDC

b. Feedback control
Timing control valve duty ratio is calculated so that the actual injection timing coincides the target injection timing.

Idle Speed Control

- Idle speed is controlled by increasing or decreasing the specified fuel injection amount value based on the signal from ECM (engine control module).

Operation

1. Feedback control
When there is a difference between the target speed calculated by the ECM and engine speed at the idle speed, the fuel injection amount is controlled by changing the signal to the electromagnetic spill valve and controls so that the engine speed coincides the idle speed.
2. Warm-up control
Optimum fast idle engine speed is controlled at idling by the coolant temperature.
3. Estimated control
Immediately after changing over the air conditioning switch, before the engine speed changes, the injection amount is changed by a constant amount to prevent change of idle speed by the change of load given to the engine.

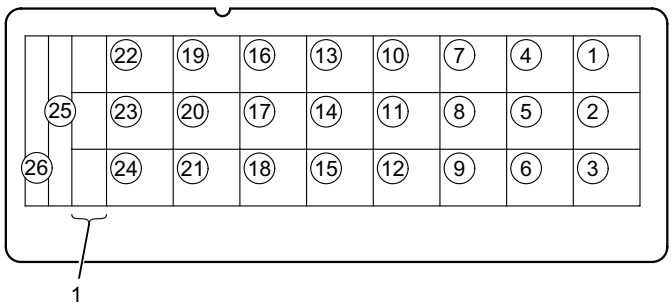
Idle Speed (P.N Range in A/T Vehicle) [r/min]

	M/T	A/T
Engine speed at no load	Approx. 580	Approx. 650
Air conditioner system ON	Approx. 800	Approx. 870

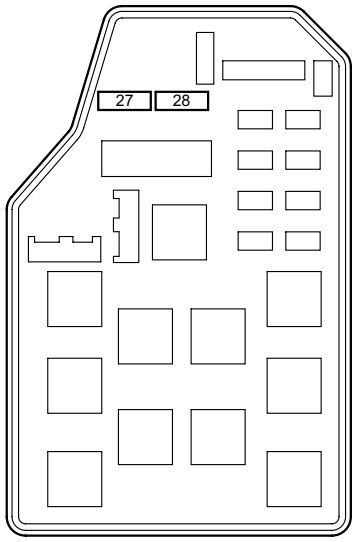
Component Layout

Fuse Layout

[Fuse Box Label, In Glove Box]



[Fuse Box, Front Left of Radiator]



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Legend

1. Spare fuse

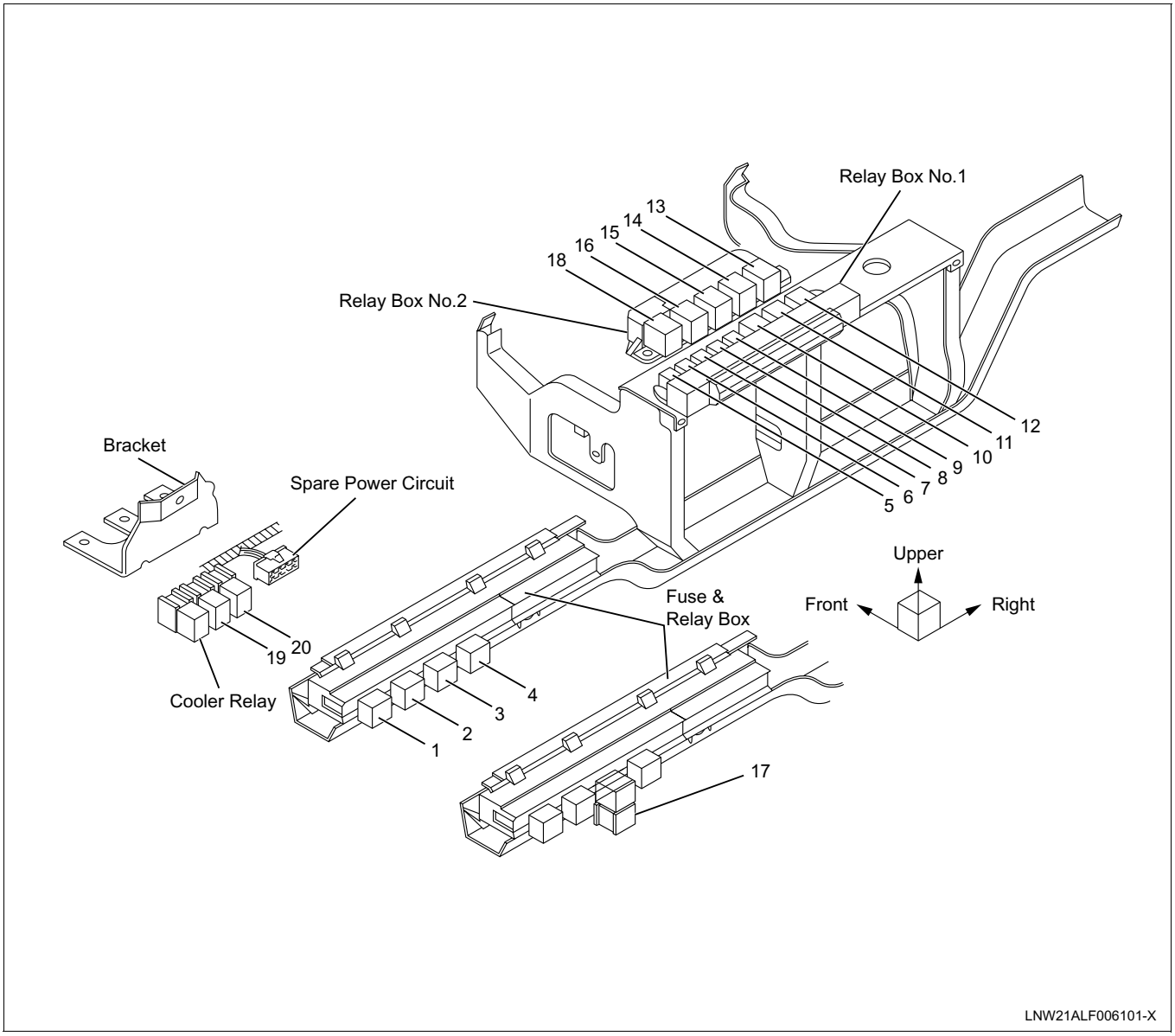
No.	Indication on label	Capacity	Devices connected
1	CONTROLLER	10A	Control unit
2	HAZARD,HORN (12V)	15A	Hazard warning flashing lamp, horn
	HAZARD,HORN (24V)	10A	
3	—	10A	—
4	AIR CON (12V)	10A	Air conditioner
	HEATER,AIR CON (24V)	15A	Heater, air conditioner
5	FUEL, SEAT HEATER (24V)	10A	Fuel, seat heater
6	ABS, HAB, RETARDER (24V)	15A	ABS, HAB, retarder

No.	Indication on label	Capacity	Devices connected
7	ROOM LAMP	15A	Room lamp
8	STOP LAMP	10A	Stop lamp
9	POWER WINDOW (24V)	20A	Power window
10	TAIL.ILLUMI (12V)	15A	Tail lamp
	TAIL.ILUMI (24V)	10A	
11	FOG.CORNER	10A	Fog lamp, cornering lamp
12	ELEC.PTO (24V)	10A	PTO switch (electric PTO)
13	WIPER,WASHER	15A	Wiper, window washer
14	TURN	10A	Turn signal lamp
15	GENERATOR (12V)	15A	Generator
	ELEC.PTO (24V)	20A	PTO solenoid valve (electric PTO)
16	MIRROR HEAT (12V)	10A	Heated side mirror
	ENG.CONT (24V)	15A	ECM
17	MIRROR	10A	Electrically operated mirror
18	CIGAR,AUDIO	10A	Cigarette lighter, audio
19	METER (12V)	10A	Meter
	METER (24V)	15A	
20	ENGINE STOP (12V)	10A	Engine stop
	HSA (24V)	10A	HSA
21	AIR BAG	10A	SRS airbag
22	STARTER	10A	Starter
23	H/LAMP RH	10A	Headlamp, RH
24	H/LAMP LH	10A	Headlamp, LH
25	HEATER (12V)	30A	Heater
	ENG CONTROLLER (24V)	30A	ECM (except for turbocharged vehicles)
26	POWER WINDOW (12V)	30A	Power window

External Fuse Box

No.	Indication on label	Capacity	Devices connected
27	MARKER LAMP	10A	Marker lamp
28	COND FAN	10A	Condenser fan

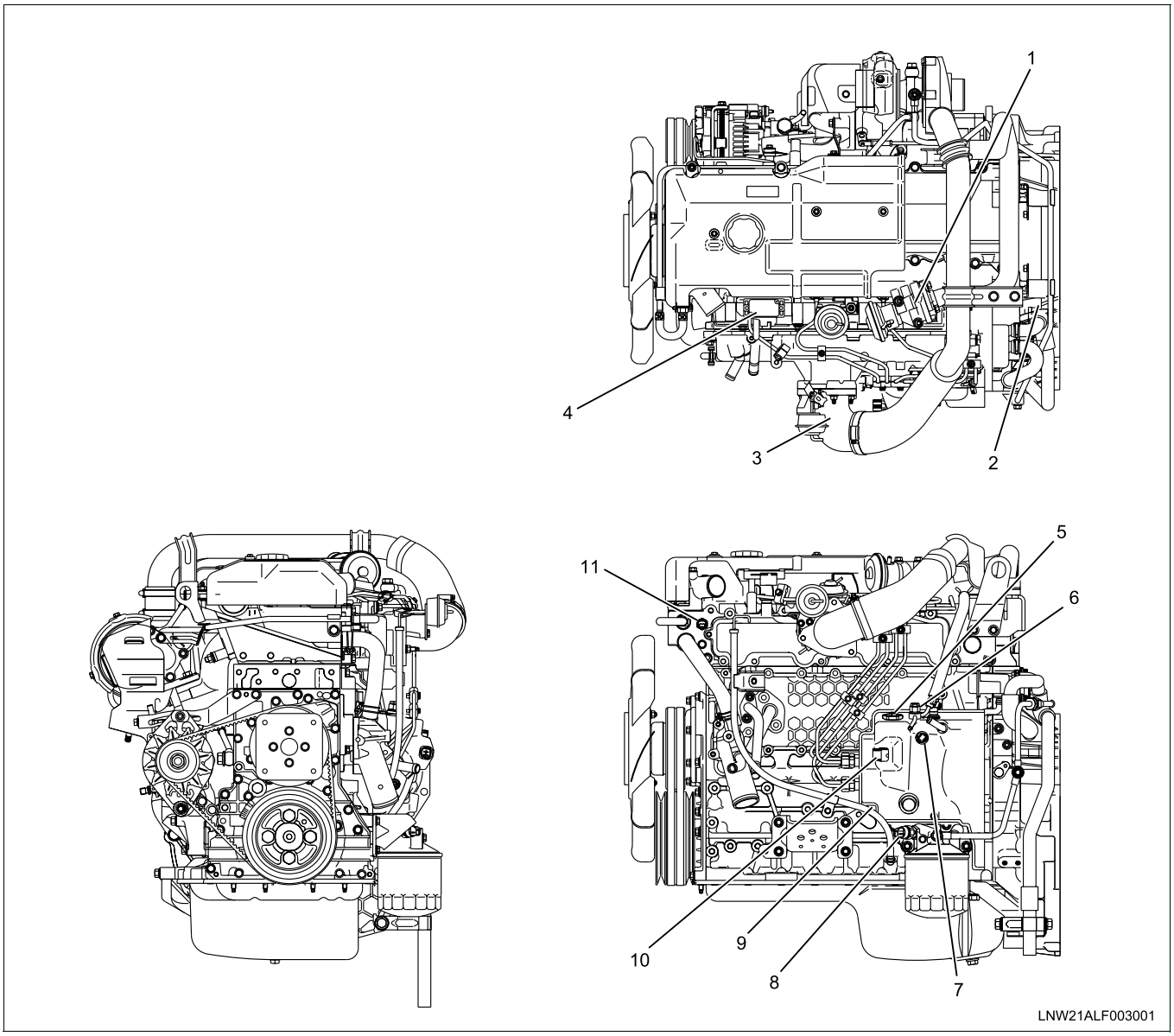
Relay Layout



No.	Legend
1	12 V: On relay
	24 V: Charge relay
2	Horn relay
3	12 V: ABS, VSV, FICD, EXH brake
	24 V: Headlamp relay
4	Tail relay
5	12 V: Headlamp relay
	24 V: 4WD relay
6	Dimmer relay
7	Power window relay
8	Fog lamp relay

No.	Legend
9	Cornering lamp relay
10	Air conditioner thermo relay
11	12 V: Charge relay
	24 V: Key on relay
12	Heater & air conditioner relay
13	24 V: PTO cut relay for electric PTO in fire engine (MT)
	24 V: PTO solenoid relay for electric PTO (AT)
	12 V: Exhaust brake cut relay (MT)
	24 V: Idle on relay for fire engine (AT)
	24 V: Idle stop, wiper relay (with CFS (clutch free system))
14	24 V: PTO solenoid relay for electric PTO (MT)
	24 V: PTO buzzer relay for electric PTO (AT)
	12 V: OD off relay (AT)
	24 V: Idle keep relay for fire engine (AT)
	24 V: Idle stop, radio relay (with CFS)
15	24 V: PTO main relay for electric PTO (MT)
	24 V: Garbage relay for garbage collector (AT)
	24 V: Indicator lamp relay for fire engine (AT)
	24 V: Idle stop, engine control module relay (with CFS)
16	4WD relay
	24 V: Idle stop, mirror relay (with CFS)
17	24 V: Full automatic air conditioner, high relay
	24 V: Automatic air conditioner, high relay
	24 V: Shift lock relay for fire engine (AT)
18	24 V: Shift relay for fire engine (AT)
	24 V: PTO main relay for electric PTO (MT)
19	24 V: PTO solenoid relay for electric PTO (MT)
20	24 V: PTO cut relay for electric PTO (MT)

Engine Component Layout

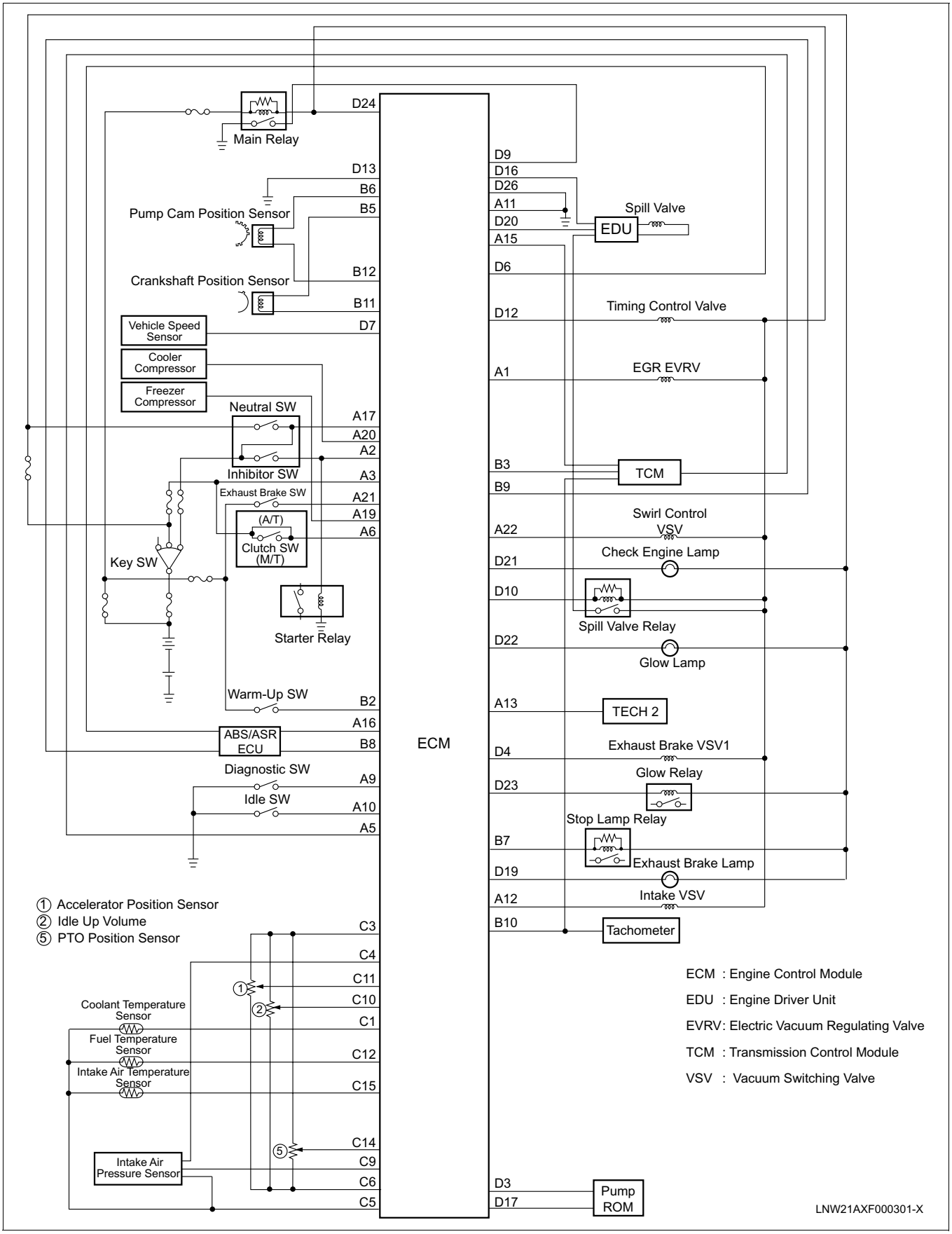


Legend

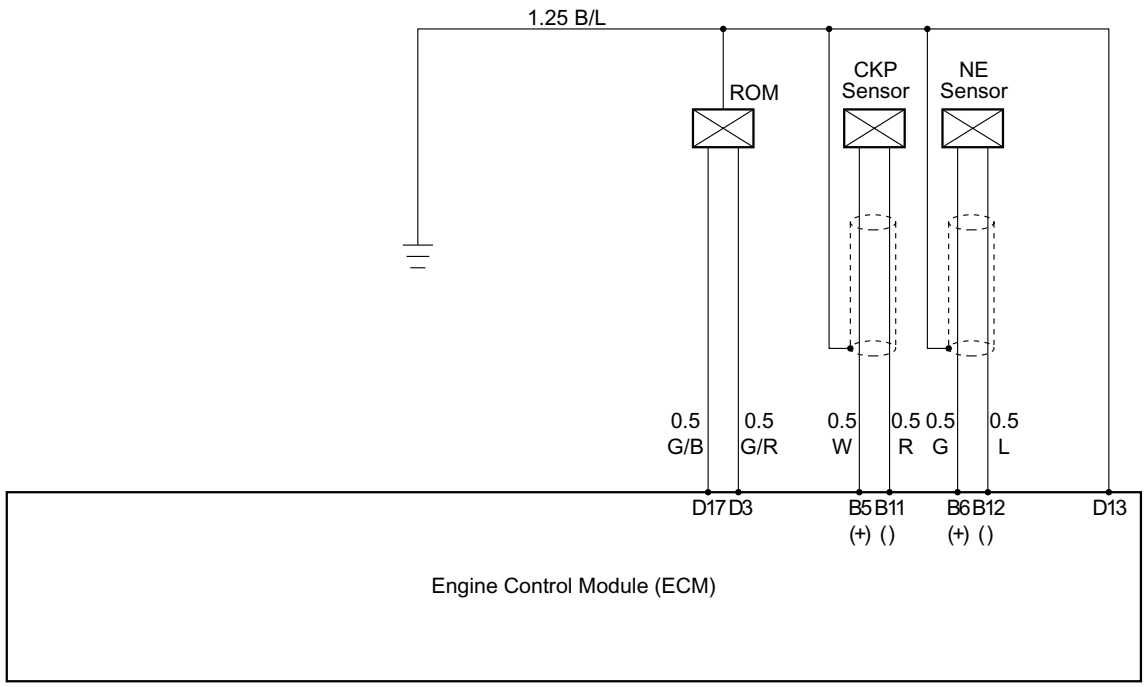
1. EGR valve
2. Crank position sensor (CKP sensor)
3. Intake throttle body
4. MAP sensor
5. NE sensor
6. SPV
7. Fuel temperature sensor (FT sensor)
8. Oil pressure SW
9. TCV
10. ROM
11. Coolant temperature sensor

Circuit diagram

ECM wiring diagram (1)



ECM Wiring Diagram (2)



Compensation ROM and NE Sensor are built in the Injection Pump

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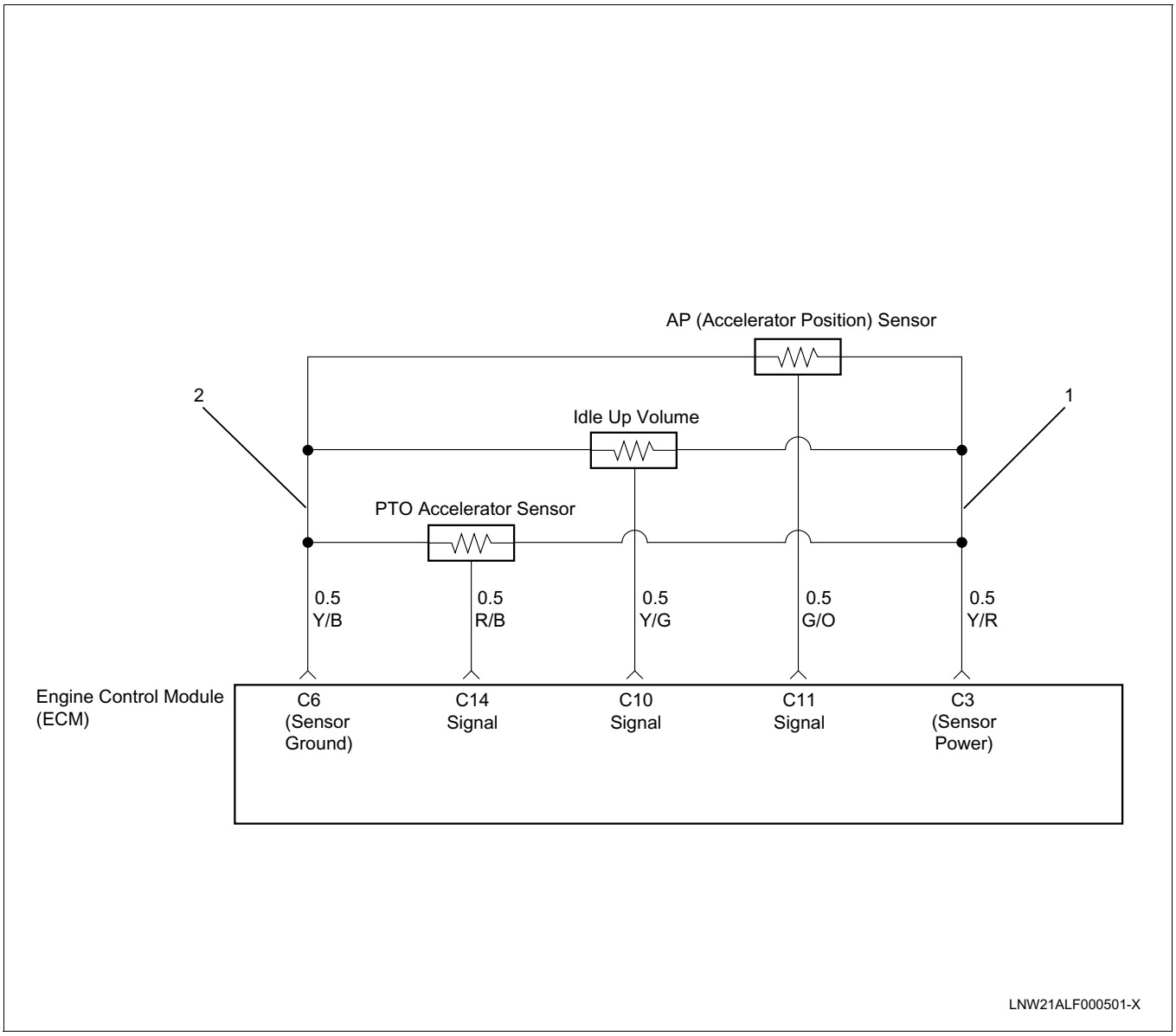
ECM Wiring Diagram (3)

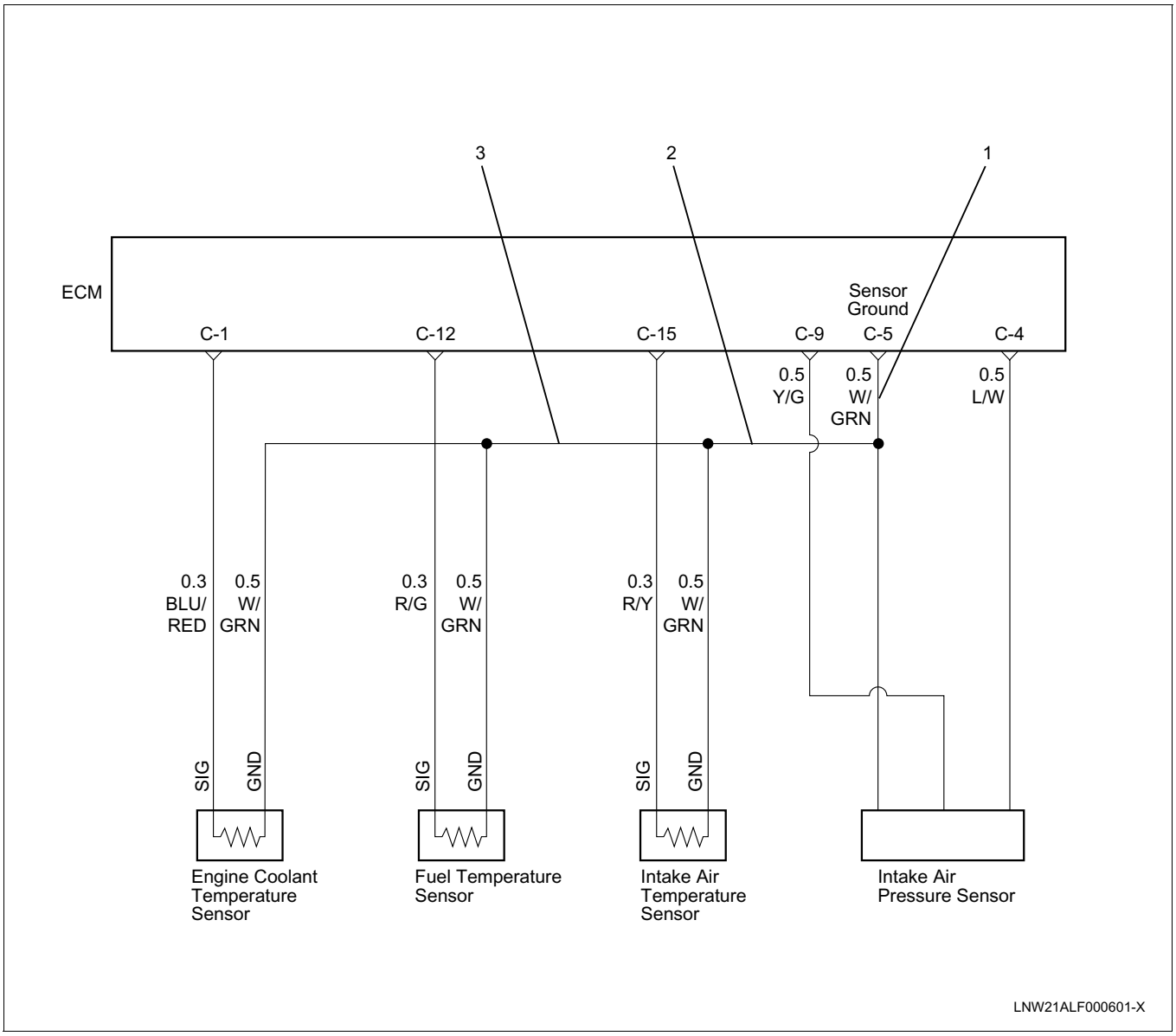


Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed.
  If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 shown above figure is the power common to the AP sensor and idle up volume, and the harness 2 is a common ground. In the event of open wiring in wire 1 or 2, DTC 24 and 31 are displayed at the same time. Like this, the case where two or more DTC's are displayed is the multiple DTC.
- If multiple DTC24 and 31 are displayed, the power supply wire 1 or ground wire 2 must be checked.

DTC	Sensor actuator (detection item)	
24	Accelerator position sensor	Connector not connected, harness open wiring, or short, failure of main unit
31	idle up volume	

ECM wiring diagram (4)



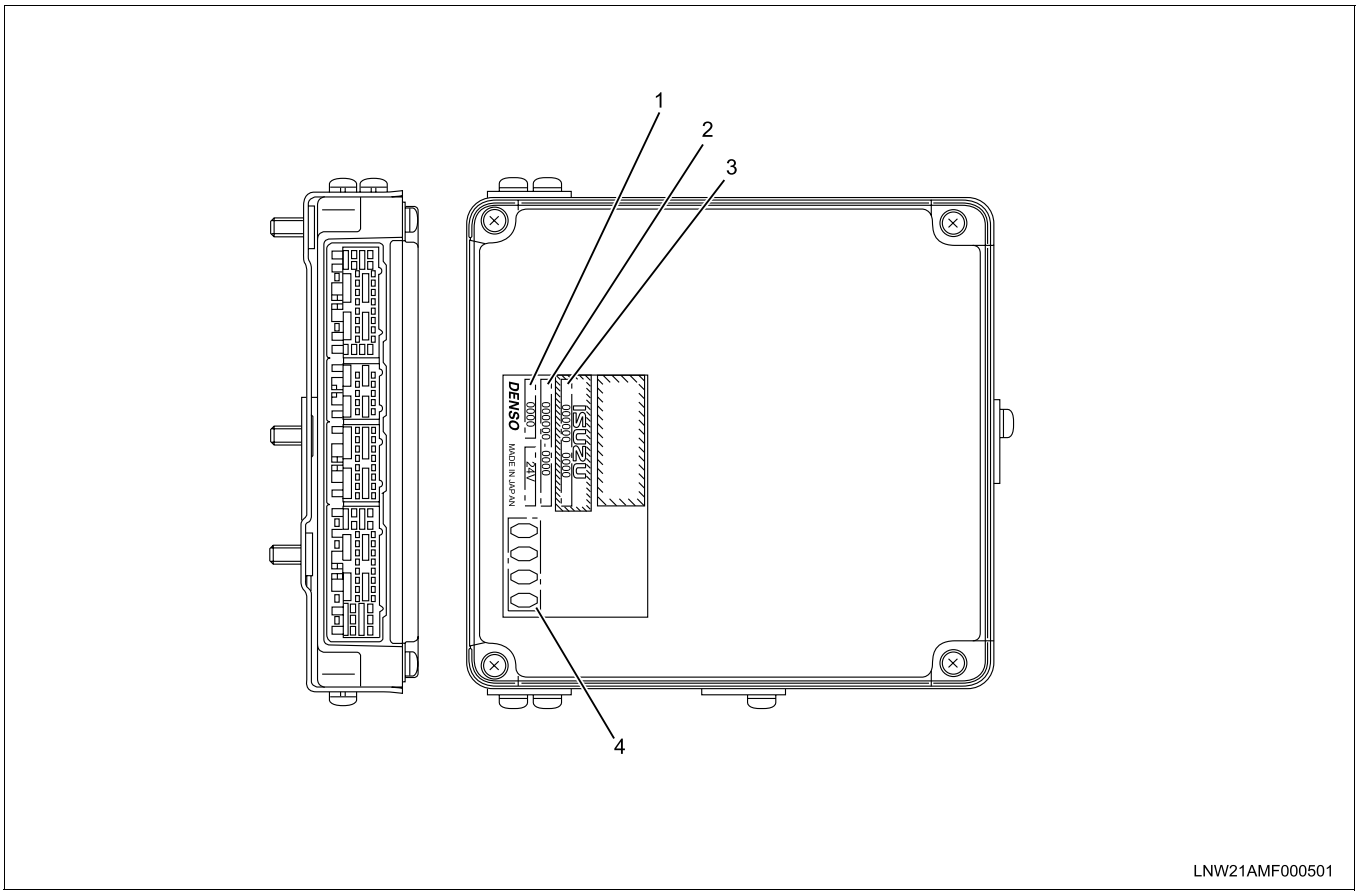
Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed.
  If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 in above figure is a common ground for the engine coolant temperature sensor, fuel temperature sensor, intake air temperature sensor and intake air pressure sensor. In the event of the open wiring in the wire 1, DTC 21, 23, 41 and 32 are displayed at the same time. In the event of the open wiring in the wire 2, DTC 21, 23, and 41 are displayed at the time. Like this, the case where two or more DTC's are displayed is the multiple DTC.
- If multiple DTC21, 23, 41, and 32 are displayed, the ground wire 1 must be checked.
- If multiple DTC21, 23, and 41 are displayed, the ground wire 2 must be checked.
- If multiple DTC21 and 23 are displayed, the ground wire 3 must be checked.

DTC	Sensor actuator (detection item)	
21	Engine coolant temperature sensor	Connector not connected, open wiring or short of harness, failure of main unit
23	Intake air temperature sensor	
41	Fuel temperature sensor	
32	Intake air pressure sensor	

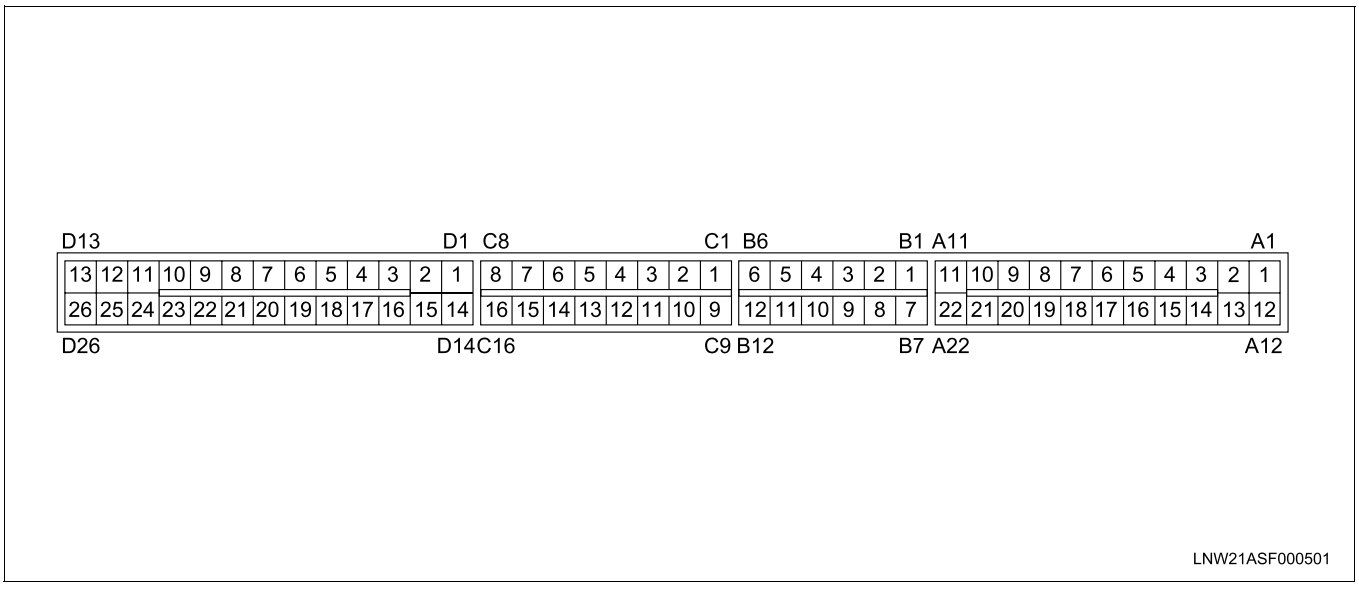
ECM Pinouts

ECM is installed in the center console and its input and output are made through 4 connectors of 26 pins, 16 pins, 12 pins and 22 pins respectively, 76 pins in total.



Legend

1. Engine model, rated voltage
2. Denso parts No.
2. Isuzu parts No.
4. Fuel injection unit model



No.	Connected to	No.	Connected to
A1	EGR,EVRV	A12	Intake throttle VSV

No.	Connected to	No.	Connected to
A2	Startar switch	A13	Tech 2 communications (DLC)
A3	Key switch	A14	Not used
A4	Not used	A15	Accelator position signal output (A/T)
A5	Exhaust brake cut signal (A/T)	A16	Exhaust brake cut signal (A/T)
A6	Cluch switch	A17	P/N switch, neutral switch
A7	Not used	A18	Not used
A8	Not used	A19	Freezer switch
A9	Diagnostic switch (DLC)	A20	Air conditioner switch
A10	Idle position switch	A21	Exhaust brake switch
A11	Power system ground	A22	Swirl control VSV

No.	Connected to	No.	Connected to
B1	Not used	B7	Stop lamp relay
B2	Warm-up switch	B8	Q down (ASR)
B3	Exhaust brake operating signal	B9	Exhaust brake answer signal (ASR)
B4	Not used	B10	Tachometer output
B5	Crank position sensor (+)	B11	Crank position sensor (–)
B6	Pump cam position sensor (+)	B12	Pump cam position sensor (–)

No.	Connected to	No.	Connected to
C1	Coolant temperature sensor (+)	C9	Intake air pressure
C2	Not used	C10	Idle up volume
C3	Sensor power (AP, PTO accelerator, Idle up volume)	C11	Accelerator position sensor signal
C4	Sensor power (MAP)	C12	Fuel temperature sensor (+)
C5	Sensor ground (MAP, coolant temp., intake temp., fuel temp.)	C13	Not used
C6	Sensor ground (AP, PTO accelerator, Idle up volume)	C14	PTO position sensor signal
C7	Not used	C15	Intake temperature sensor (+)
C8	Not used	C16	Not used

No.	Connected to	No.	Connected to
D1	Not used	D14	Not used
D2	Not used	D15	Not used
D3	Pump ROM communications	D16	EDU fail signal input
D4	Exhaust brake VSV1	D17	Pump ROM communications
D5	Not used	D18	Not used

No.	Connected to	No.	Connected to
D6	Accelerator position signal output (ASR)	D19	Exhaust brake indicator lamp
D7	Vehicle speed sensor signal	D20	Injection output signal (EDU)
D8	Not used	D21	CHEK ENGINE lamp
D9	Main relay	D22	Glow indicator lamp
D10	Spill control valve relay	D23	Glow relay
D11	Not used	D24	Battery power
D12	Timing control valve	D25	Not used
D13	Signal ground	D26	Power system ground

Strategy-Based Diagnostics

Strategy-Based System Diagnostics

The system diagnostic is a uniform approach to repair all electrical/electronic (E/E) systems. In the E/E system, different from general vehicle problems, faults frequently occur along the steps shown as follows:

1. Initial stage:
   - A single fault occurs for a short while and, therefore, the customer may miss it. In this stage, the customer complaint is unclear and the fault cannot be reproduced. But, the ECM may have stored the fault.
     = Past fault
2. Middle stage:
   - A single fault occurs for a short while but is observed intermittently. It always occurs under certain conditions. The customer complaint (description of fault) is clear but fault occurrence conditions are unidentified. If you comprehend these conditions, you can reproduce the trouble.
     = Intermittent fault (intermittent)
3. Realistic fault:
   - The fault occurs certainly and the customer complaint is realistic and clear. You can reproduce the fault. However, there may exist two or more causes.
     = Current fault

The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician how to proceed with a diagnosis:

1. Verify the customer complaint:
   - To verify the customer complaint, the technician should know the normal operation of the system.
2. Perform preliminary checks:
   - Conduct a thorough visual inspection.
   - Review the service history.
   - Detecting unusual sounds or odors.
   - Gather DTC (diagnostic trouble code) information using Tech 2
3. Check bulletins and other service information.
4. Refer to “Symptom Diagnosis Chart” in this manual.
   - “Symptom Diagnosis Chart” contain information on a system that may not be supported by one or more DTCs. “Symptom Diagnosis Chart” verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to related descriptions such as those for engine mechanicals.

DTC Stored

Follow the designated DTC chart exactly to make an effective repair.

No DTC

Select the symptom from the “Symptom Diagnosis Chart”. Follow to the diagnostic paths or suggestions to complete the repair. You may refer to the applicable components/system check in the functional check.

No Matching Symptom

1. Analyze the complaint.
2. Develop a plan for diagnostics.
3. Utilize the wiring diagrams and the theory of operation.

Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.

Intermittents

Conditions that are not always present are call intermittents. To resolve intermittents, perform the following steps.

1. Observe history DTCs, DTC modes, and engine data.
2. Evaluate the symptoms and the condition described by the customer.

3. Use a check sheet or other method to identify the circuit or electrical system component.

No Trouble Found

This condition exists when the vehicles is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

1. Reexamine the complaint.
   When the complaint cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in Intermittents, or could be normal.
2. Repair and verify.
   After isolating the cause, the repairs should be made. Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has been resolved under the following conditions:
   - Conditions noted by the customer.
   - If a DTC was diagnosed, verify a repair by duplicating conditions present when the DTC was set as noted by Tech 2 data.

Verifying Vehicle Repair

When the electronic control system has been repaired, it is necessary to verify the repair is appropriate. If the repair is incomplete, the CHECK ENGINE Lamp (MIL) may be lit again while the vehicle is released, or the drivability may be impaired. Particularly for the intermittents, it is necessary to reproduce the trouble under the same conditions described by the customer and check the trouble is no longer found.

No.	Item	Objective	Method
1	Verifying the DTC	To check the DTC is not set after the repair.	Clear the previous DTC. Sufficiently warm up the engine under idling, and increase the engine speed to 2200 rpm and provide racing to verify the test conditions.
2	Verifying the idle speed after warm-up	To check the idle control is normally performed.	Upon completion of engine warm-up, verify the idle speed is 580 rpm for a manual transmission vehicle or 650 rpm for an automatic transmission vehicle with the air conditioner turned off. If a fault is detected, refer to "Instable idling" in " “Symptom Diagnosis Chart" to identify the cause.
3	Verifying Tech 2 data list	To provide basic checking for engine control and communication conditions.	Monitor Tech 2 data list and examine the data using typical value sheet. Check typical values in Tech 2 data list.
4	Verifying the restartability	To check the start control correctly works.	Upon completion of engine warm-up, verify the cranking time is not more than 5 seconds and the engine speed is stable after startup.
5	Verifying the electromagnetic compatibility of strong electric wave emission equipment	To check electric wave emission equipment such as transceiver, if added, does not emit interfering waves.	Turn on and off the electric wave emission equipment, such as transceiver, to check whether idle speed will change. If a problem is found, inform the customer that the electric wave emission equipment must be dislocated or changing the power is needed.

Supplementary description about strong electric wave emission equipment: If a problem is found in this checking, provide the following advices to the customer.

- To install the antenna away from the vehicle electronic system components such as control unit and sensors as far as possible.
- To install the antenna cord at least 20 cm away from the vehicle electronic system components such as control unit and sensors.
- Do not arrange the antenna cord together with other cables. In addition, isolate the antenna cord from other cables as far as possible.
- Install additional devices certainly according to respective instruction manuals.
- Do not install high-power mobile communication equipment.

CAUTION:
Follow the steps below when you verify repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

1. Review and record Tech 2 data relative to the issued DTC.
2. Clear the DTC(s).
3. Operate the vehicle while checking the associated Tech 2 data.

Non-OEM Parts

All of the OBD diagnostics have been calibrated to run with OEM parts. Therefore, installation of general on-market sensors or switches are will result in incorrect OBD diagnostics and CHECK ENGINE Lamp (MIL) activation.
If on-market electronic devices such as mobile phones, stereos, and theft deterrent system are improperly installed, EMI (electromagnetic interference) radiation occurs and affects the control system. As a result, incorrect data are sent from sensors to turn on the CHECK ENGINE Lamp (MIL). To diagnose the vehicle with the OBD system, turn off or remove all the on-market parts.

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the CHECK ENGINE Lamp (MIL) to turn on if the vehicle is not maintained properly. Restricted oil filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD diagnostics. Vehicle maintenance cannot be classified as "non-vehicle fault", but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Related System Faults

Many of OBD system diagnostics will not run if the ECM detects a fault on a related system or component.

Visual/Physical Engine Compartment Inspection

Perform a careful visual/physical engine compartment inspection when performing diagnostic procedure. This can often lead repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection.

- Inspect all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.
- Inspect all harnesses in the engine compartment for proper connections, burned or chafed spots, pinched harnesses, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

IMPORTANT:
Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.
A basic understanding of hand tools, including scan tool, is necessary to effectively use this section of the Service Manual.

On-Board Diagnostic Tests

The diagnostic test is a series of steps, the result of which is a pass or fail reported to the Diagnostic Executive. When a diagnostic test reports a pass result, the Diagnostic Executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the Diagnostic Executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

Comprehensive Component Monitor Diagnostic Operation

Comprehensive component monitoring diagnostics are required to operate the engine properly.

Input Components

Input components are monitored for circuit continuity and out-of-range values. This includes rationality checking. Rationality checking refers to indicating a fault when the signal from a sensor does not seem reasonable, i.e., accelerator position sensor (APS) that indicates high throttle position at low engine loads or low voltage MAP (manifold absolute pressure). Input components may include, but are not limited to the following sensors:

- Intake air temperature (IAT) sensor
- Crank position (CKP) sensor
- Engine coolant temperature (ECT) sensor
- Intake air pressure (MAP) sensor
- Accelerator position (AP) sensor
- Fuel temperature (FT) sensor
- Vehicle speed (VS) sensor

Output Components

Output components are diagnosed for proper response to control module commands. Components where functional monitoring is not feasible will be monitored for circuit continuity and out-of-range values if applicable. Output components to be monitored include, but are not limited to, the following circuits:

- EGR EVRV
- Transmission control
- Intake throttle

Terms Commonly Used in Diagnosis

Diagnostic

When used as a noun, the word diagnostic refers to any on-board test run by the vehicle's Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification. There are many diagnostics, shown in the following list.

- EGR (exhaust gas recirculation)
- Engine speed
- Vehicle speed
- ECT (engine coolant temperature)
- MAP (intake air pressure)
- VSV (Vaccum switching valve)
- IAT (intake air temperature)
- AP (accelerator position)
- FT (fuel temperature)
- Idle position switch
- Brake switch

Diagnostic Executive

The Diagnostic Executive is a unique segment of software that is designed to coordinate and prioritize the diagnostic procedures as well as define the protocol for recording and displaying their results. The main responsibilities of the Diagnostic Executive are listed as following

- Commanding CHECK ENGINE Lamp (MIL) on and off
- DTC logging and clearing
- Tech 2 data recording
- Acquiring current status information on each diagnostic

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the CHECK ENGINE Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL)

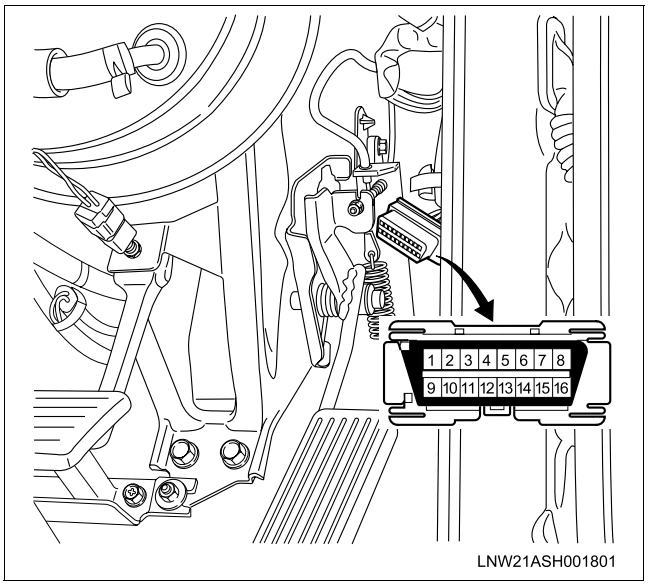
The malfunction indicator lamp (MIL) looks the same as the MIL you are already familiar with ("Check Engine" lamp).

Basically, the MIL is turned on when the electronic control system such as ECM (engine control module) fails and a DTC is detected.

Data Link Connector (DLC)

The provision of communication with the control module is the data link connector (DLC). The DLC is used to connect to Tech 2, or a scan tool. Some common uses of Tech 2 are listed below.

- Identifying stored diagnostic trouble codes (DTCs)
- Clearing DTCs
- Performing output control tests
- Reading serial data



Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with on-board diagnostic (OBD) system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record DTC diagnosed or Tech 2 data or both.
2. Clear DTC(s).
3. Operate the vehicle within the conditioned described by Tech 2 data.

4. Monitor the DTC status information for the specific DTC that has been diagnosed until the ECM performs the diagnostic test associated with that DTC.

Following these steps is very important in verifying repairs OBD systems. Failure to follow these steps could result in unnecessary repairs.

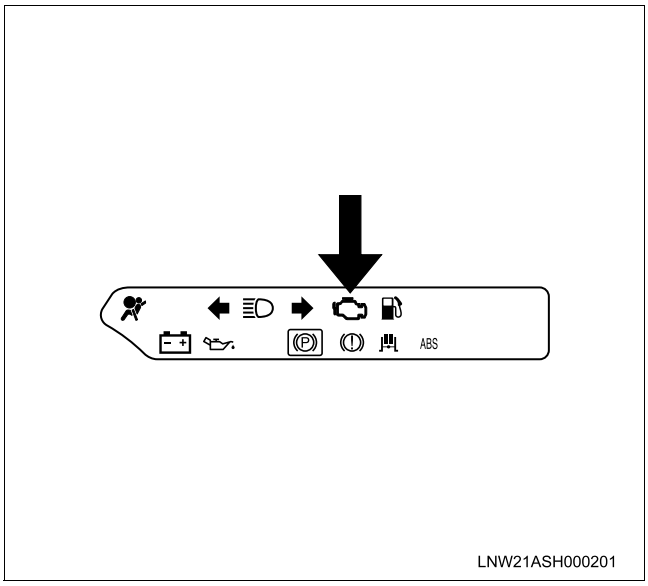
Diagnostic Trouble Code (DTC)

Whenever the starter switch is turned on, the ECM executes self-testing for almost wirings and components and, when detects a system fault, stores it and enables backup control according to the DTC set. When a fault occurs that will affect the running, the ECM turns on the CHECK ENGINE Lamp (MIL) in the meter panel or blinks the exhaust indicator lamp to inform the driver of the fact.

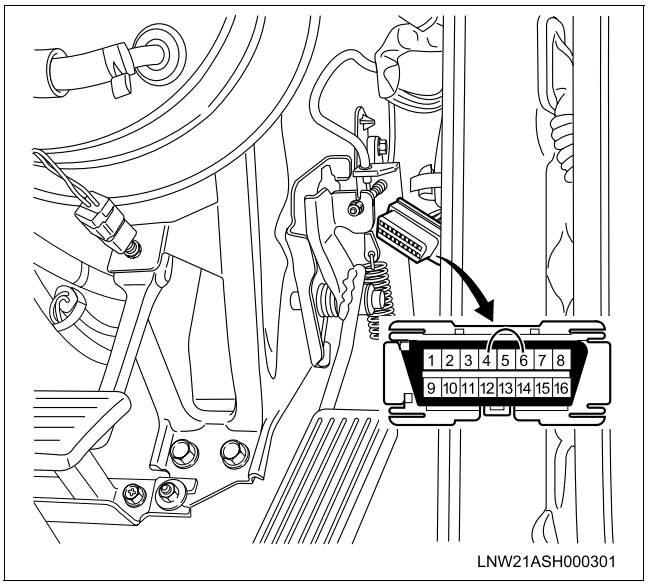
Reading Diagnostic Trouble Codes

Current and past DTCs stored to the ECM can be visualized in the form of blinking CHECK ENGINE Lamp (MIL) when the DLC (data link connector) is shorted. To this end, provide the following steps.

1. Turn on the key switch and check the CHECK ENGINE Lamp (MIL) is turned on. (Bulb check)



2. Keep the key switch turned on and the engine turned off.
3. Short pins 6 and 4 on the DLC. The DLC is a black 16-way connector and located at the lower right corner of the instrument panel.



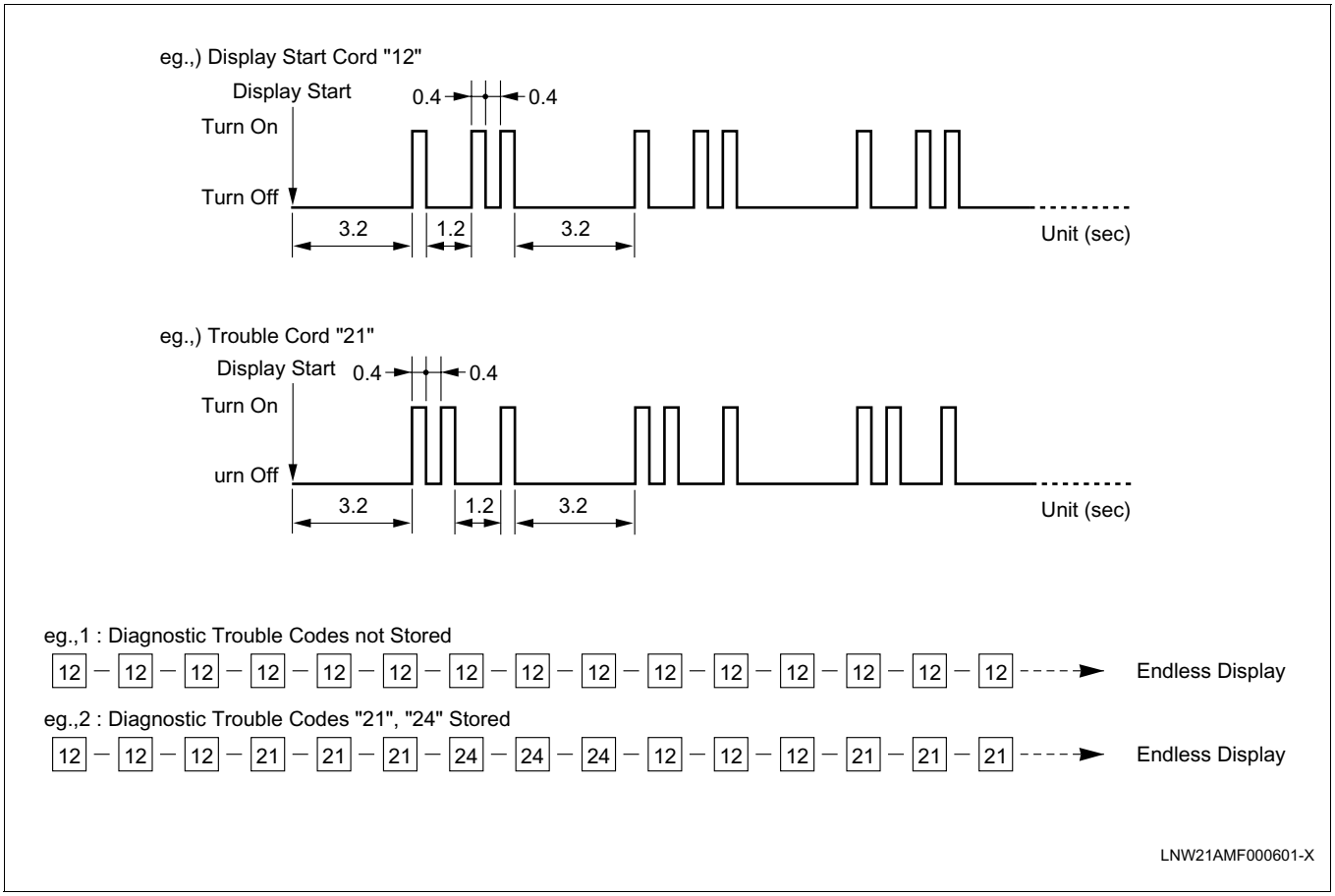
4. On the CHECK ENGINE Lamp (MIL), read the number of blinks.
5. Identify the DTC from the DTC Chart.

Diagnostic Trouble Codes Not Stored

Code 12 that shows initiation of indication is repeatedly displayed.

Diagnostic Trouble Codes Stored

Code 12 that is displayed three times and then stored code is displayed three times. When multiple DTCs are stored, each code is displayed three times, starting from the lowest number. After all DTCs are displayed, above sequence is repeated from code 12 as long as DLC is being shorted.



Clearing Diagnostic Trouble Codes

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the steps listed below.

- Keep the starter switch turned on and the engine turned off.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the CHECK ENGINE Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the starter switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Functional Check List

Hearing	The objective is to comprehend the symptom completely based on the customer complaint and provide accurate diagnostic.
On-Board Diagnostic System Check	The objective is to identify the faulty portion on the electronic engine control system. (Checking procedure)
Inactive CHECK ENGINE Lamp (MIL) Check	The objective is to check the CHECK ENGINE Lamp (MIL) when it is not turned on even after ignition switch turn-on.
Active CHECK ENGINE Lamp (MIL) Check	The objective is to check the CHECK ENGINE Lamp (MIL) is turn on through the DTC is not set while the engine running
Engine is crank but will not run	The objective is to check the engine is not started though it is cranked by turning the starter switch

Hearing Diagnostic

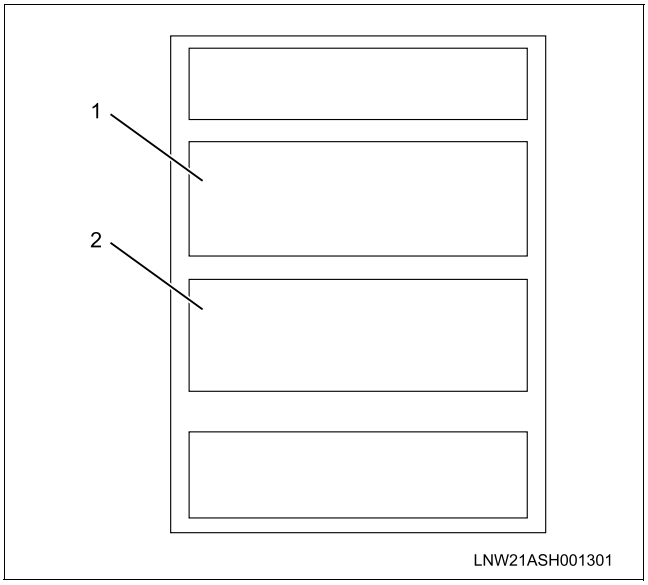
1. Using the Engine Control System Diagnostic Chart, completely hear and comprehend the customer complaint.
   Reference:
   Proceed the process by focusing on the possible faulty system estimated from the fault (fact) instead of random hearing.
2. Judge the failure information accurately.
   Comprehend the situation concretely based on 5W1H principle.
   Example: Low temperature, startup stage, permanent generation, vicinity of engine, metallic sound, etc.

Key points on hearing

• What	• Faulty event
• When	• Date and time, generation frequency
• Where	• Situation of road
• State	• Running condition, driving condition, weather conditions
• Result	• Feeling of fault

Engine Control System Diagnostic Chart

When receiving the vehicle from the customer in the service factory, you must verify both the symptom and failure data using the Engine Control System Diagnostic Chart.



Legend

1. Symptom
2. Failure generation frequency and conditions

The reason why this sheet is needed is as follows.

1. The symptom may not be reproduced in the service factory.
2. The customer complaint is always not represent failure.
3. If failure conditions are not input to the responsible technician correctly, unwanted repair man-hours will be generated.

• The Engine Control System Diagnostic Chart helps diagnostic, repair, and repair verification.

Engine Control System Diagnostic Chart

Inspector: _____

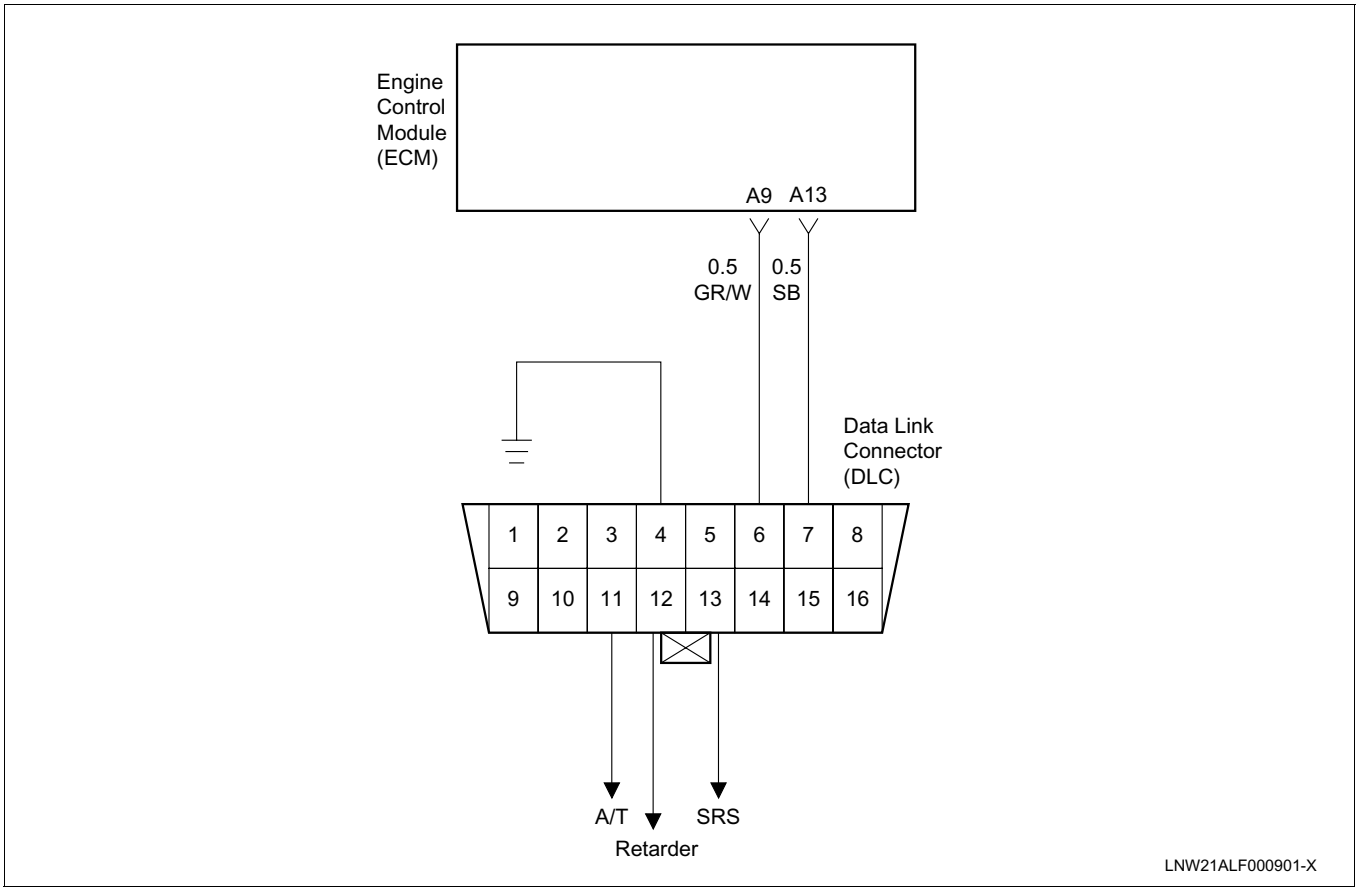
Customer		Vehicle model and model year	
Driver		Vehicle ID	
Vehicle acceptance date		Engine model	
Registration No.		Engine ID	
		Engine type	
		Odometer reading	km

Symptom	☐ No engine start	☐ No cranking ☐ No initial combustion ☐ Incomplete initial combustion
	☐ Poor startability	☐ Long cranking (6 seconds or more) ☐ Others _____
	☐ Instable idling	☐ Incorrect idle speed (idle speed enters into typical range after warm-up) ☐ Unusual idle speed ☐ High (rpm) ☐ Low (rpm) ☐ Rough idling (idle speed deviates from the typical range after warm-up) ☐ Others _____
	☐ Poor driveability	☐ Surging ☐ Knocking ☐ Extensive black/white smoke ☐ Engine vibration ☐ Unusual sound ☐ Others _____
	☐ Engine stall	☐ Immediately after engine startup ☐ At release of accelerator pedal ☐ At operation of A/C ☐ Immediately after engine oil replacement ☐ At gear shifting ☐ Others _____
	☐ Vibration at idling	☐ Engine has transverse vibration and body has vertical vibration (engine's vertical vibration is weaker than body's vibration)

Data observed at fault occurrence		
Fault generation frequency		☐ Always ☐ Occasionally (cycles: times/month) ☐ Once ☐ Others _____
Fault conditions	Weather	☐ Clear ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Combined/ others _____
	Temperature	☐ 30°C or above ☐ 20-30°C ☐ 10-15°C ☐ 0°C or below (°C)
	Place	☐ Highway ☐ Suburban area ☐ Urban area ☐ Uphill slope ☐ Downhill slope ☐ Rough road ☐ Others _____
	Engine temperature	☐ Cold ☐ Warm-up ☐ After warm-up ☐ Coolant temperature °C ☐ Oil temperature °C
	Driving conditions	☐ Startup ☐ Immediately after startup (minutes) ☐ Idling ☐ Racing ☐ Driving ☐ Steady-speed driving ☐ Acceleration ☐ Deceleration ☐ A/C SW ON/OFF ☐ Others _____

Check Engine lamp		☐ ON	☐ Occasionally ON	☐ OFF
DTC	Past	☐	☐ ☐	
	Present	☐	☐ ☐	
Fault history		☐ Date (year/month/day) _____ ☐ Date (year/month/day)		

On-Board Diagnostic (OBD) System Check



Circuit Description

The on-board diagnostic (OBD) system check is a starting point for any driveability complaint diagnosis. Before using this procedure, perform a visual/physical check the ECM (Engine Control Module) ground for cleanliness and correct tightening.
The OBD system check is an orgainzed approach to identifying a problem created by an electronic engine control system malfunction.

Diagnostic Aids

An intermitted may be caused by a poor connection, a rubbed through wire insulation, or a wire broken inside the insulator. Check for the poor connection or damaged harness.
Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged pin, poor pin-to-wire connection, and damaged harness.

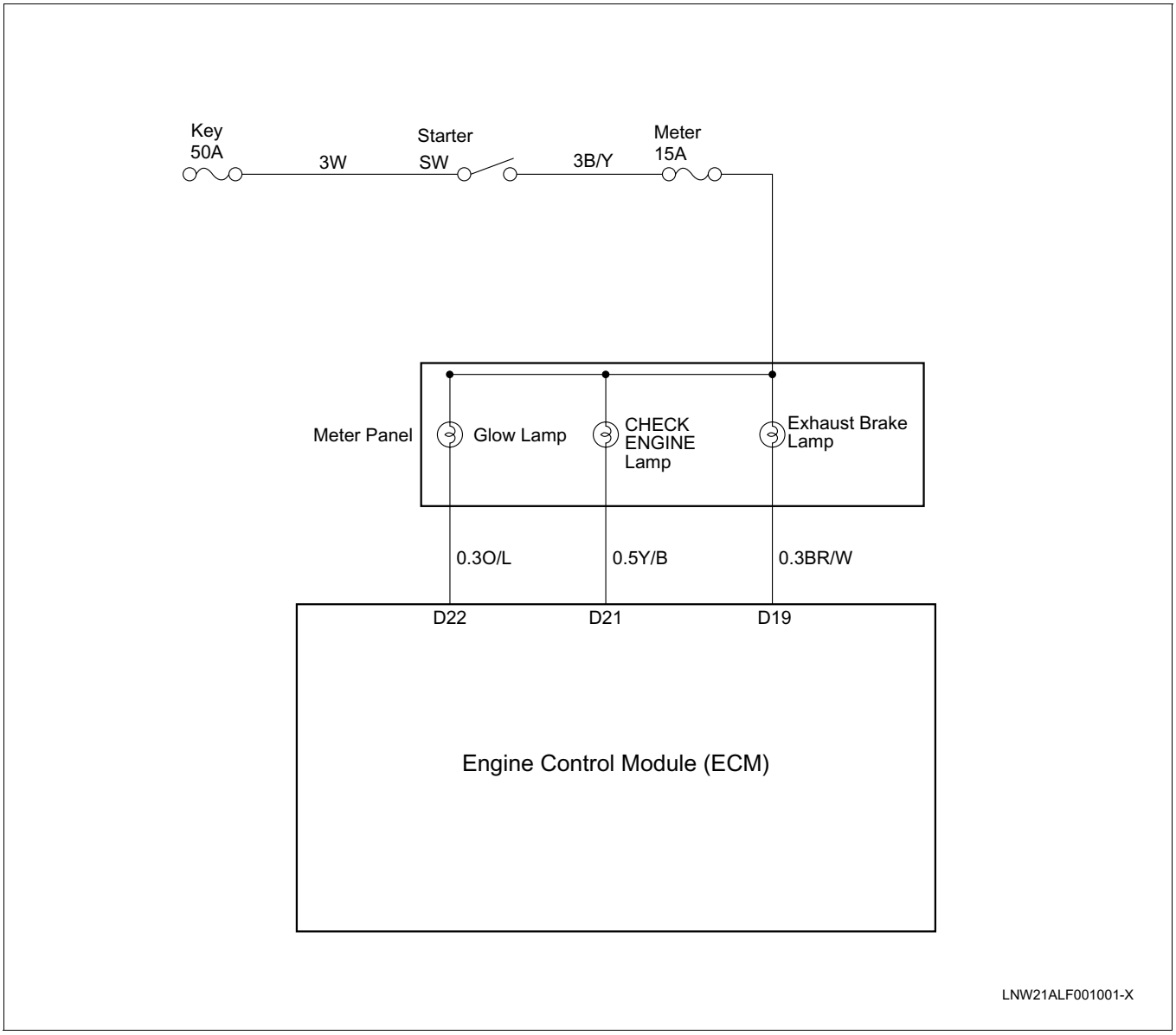
Test description

Number(s) below refer to the step number(s) on the Diagnostic Chart.
1. The CHECK ENGINE Lamp (MIL) should be “ON” steady while the starter switch is “ON” and engine “OFF”. If not “Inactive CHECK ENGINE Lamp (MIL)” check should be used to isolate the malfunction.
2. Check the communication data circuit and ensures that the ECM is able to transmit serial data.
3. This test ensures that the ECM is capable of controlling the CHECK ENGINE Lamp (MIL) and the CHECK ENGINE Lamp (MIL) driver circuit is not shorted to ground.
4. If the engine will not start, the Cranks But Will Not Run chart should be used to diagnose the condition.
7. A Tech 2 parameter that is not within the typical range may help to isolate the area that is causing the problem.

Step	Action	Value(s)	Yes	No
1	1. Starter switch "ON", and engine "OFF" 2. Observe the CHECK ENGINE Lamp (MIL). Is the CHECK ENGINE Lamp (MIL) "ON"?	—	Go to Step 2	Go to "Inactive CHECK ENGINE Lamp (MIL)".

Step	Action	Value(s)	Yes	No
2	1. Starter switch "OFF" 2. Install the Tech 2. 3. Starter switch "ON". 4. Using Tech 2 , display ECM engine data. Does the Tech 2 display engine data?	—	Go to Step 3	Go to Step 8
3	1. Remove the Tech 2 ,and short DLC (data link connector) pins 4 and 6. 2. Observe the CHECK ENGINE Lamp (MIL). Does the CHECK ENGINE Lamp (MIL) display "12"?	—	Go to Step 4	Go to “CHECK ENGINE Lamp (MIL) Remains Active".
4	Start the engine. Does the engine start and continue running?	—	Go to Step 5	Go to "Engine Cranks But Will Not Run".
5	Using Tech 2, select DTC. Are any DTC stored?	—	Go to Step 6	Go to Step 7
6	Is DTC 52 stored ?	—	Go to DTC 52 chart.	Go to the appropriate DTC Chart.
7	Compare ECM data values displayed on the Tech 2 to the typical value engine scan data. Are the displayed values a standard or close to the typical value?	—	The OBD system is in normal condition	Refer to "Diagnostic Aids"
8	1. Starter switch "OFF", disconnect the ECM. 2. Starter switch "OFF", engine "OFF". 3. Check the communication data circuit for an open wiring, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for and open wiring or short to ground and the DLC ground circuit for an open wiring. 4. If a problem is detected, repair as necessary. Was a problem detected?	—	Go to Step 2	Go to Step 9
9	Check the Tech 2 with another vehicle. Is the Tech 2 in abnormal?	—	Go to Step 11	Go to Step 10
10	Replace the ECM. Is the action complete?	—	Go to Step 2	—
11	Repair Tech 2 or preparation for another Tech 2. Is the action complete?	—	Go to Step 2	—

Inactive CHECK ENGINE Lamp (MIL)



Circuit Description

The CHECK ENGINE Lamp (MIL) should be “ON” steady while the starter switch (key switch) is “ON” and engine “OFF”. The ignition power voltage is applied to MIL through the meter fuse. ECM turns the MIL “ON” by connecting the MIL driver circuit to the ground.

Diagnostic Aids

An intermittent MIL “OFF” may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check the following items.

- Inspect the ECM harness and connector for broken locks, improperly formed or damaged pin, poor pin-to-wire connection, and damaged harness.
- When the engine is operating normally, check for burning out of the bulb, open wiring of MIL output circuit, or open wiring of the ignition power circuit.
- If the engine cranks but will not start, check for open wiring of the ECM ignition ON power or battery power circuit, or poor connection of the ECM and engine ground.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

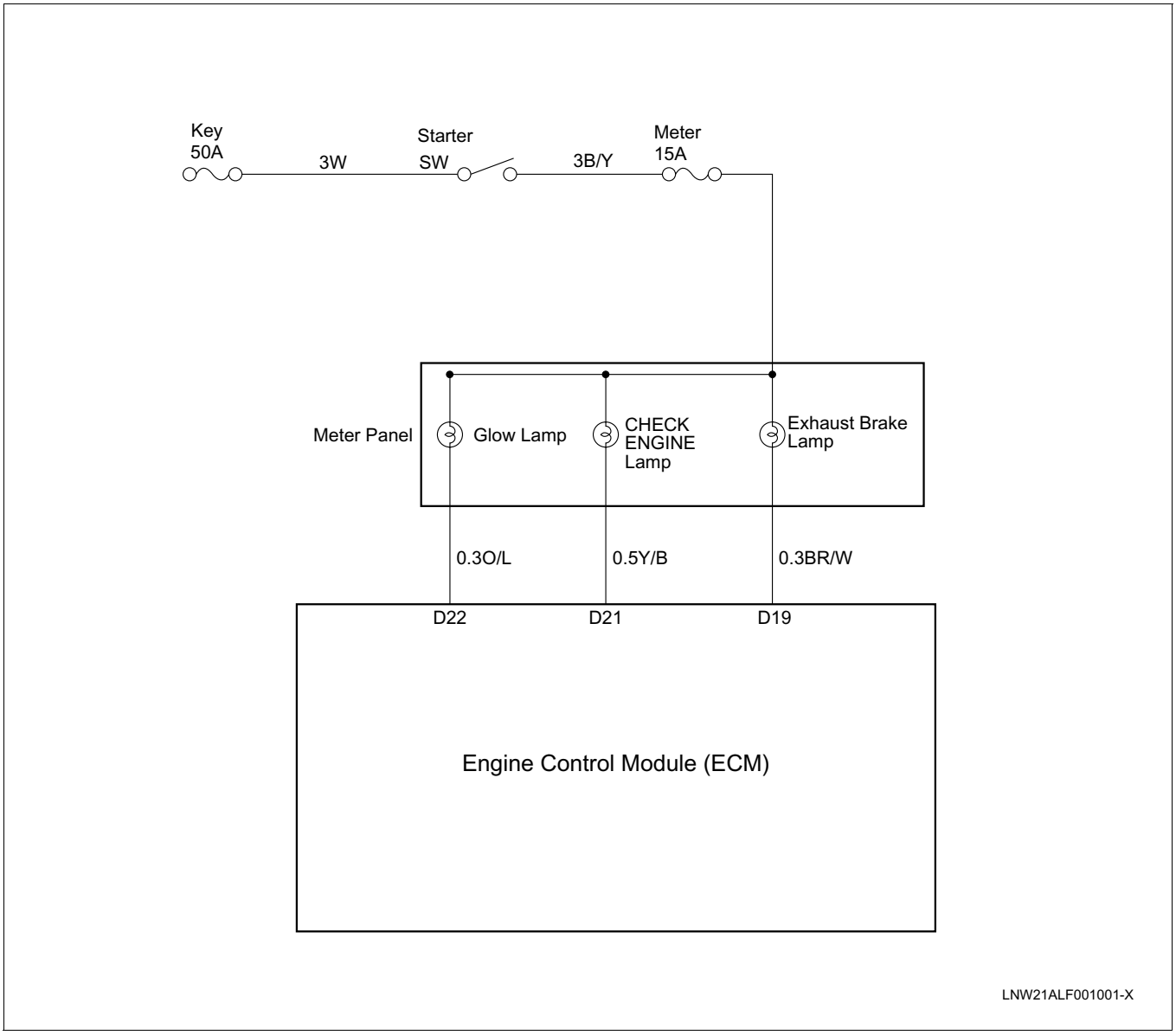
2. If the “Inactive CHECK ENGINE Lamp (MIL) will not start, ECM ignition supply fault or battery power circuit fault is considered.

9. Check each ECM ground pin with the test light connected to B+ to see if the ground condition is normal. For the pin position of the ECM ground circuit, refer to "ECM pin allocation".

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnosis (OBD) System Check" performed?	—	Go to Step 2	Go to the "OBD System Check"
2	Start the engine. Is the engine start?	—	Go to Step 3	Go to Step 7
3	Check the meter fuse for the instrument cluster ignition power circuit. (Meter 15A) Is the fuse in normal condition?	—	Go to Step 4	Go to Step 17
4	Starter switch "ON". Connect ground the test light 5-8840-0632-0, and check the cluster ignition power circuit. Is the test light “ON”?	—	Go to Step 5	Go to Step 14
5	Check the bulb for meter cluster and CHECK ENGINE Lamp (MIL). Replace the bulb if broken. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Starter switch "OFF". 2. Disconnect ECM. 3. Connect the MIL driver circuit of the ECM connector to the ground through a jumper. 4. Starter switch "ON". Is the malfunction indicator lamp (MIL) "ON"?	—	Go to Step 11	Go to Step 12
7	Check the ECM ignition power fuse, battery power circuit fuse, engine fuse and ECM fuse. Is the fuse in normal condition?	—	Go to Step 8	Go to Step 16
8	1. Starter switch "OFF". 2. Disconnect the ECM. 3. Starter switch "ON". 4. Connect ground the test light 5-8840-0607-0, and check the ignition power circuit for the ECM harness connector. Is the test light “ON”?	—	Go to Step 9	Go to Step 13
9	Connect ground the test light 5-8840-0607-0, and check the battery B+ power circuit for the ECM harness connector. Is the test light "ON"?	—	Go to Step 10	Go to Step 15
10	Check the ECM ground poor connection. Was a problem detected?	—	Verify repair	Go to Step 11
11	Check the ECM pin for damage. Was a problem detected?	—	Verify repair	Go to Step 18
12	Check the MIL driver circuit between ECM and MIL for open wiring and poor connection. Was a problem detected?	—	Verify repair	Go to Step 19

Step	Action	Value(s)	Yes	No
13	Replace the "normal " relay for ECM main relay. Was the malfunction corrected?	—	Verify repair	Go to Step 14
14	Repair the ignition power circuit open wiring or starter switch failure. Is the repair complete?	—	Verify repair	—
15	Repair the ECM battery power circuit for open wiring. Is the repair complete?	—	Verify repair	—
16	Repair the ground short for ECM ignition power circuit or ECM battery power circuit. Is the repair complete?	—	Verify repair	—
17	Repair the ground short for instrument cluster of ignition power circuit , and replace the fuse. Is the action complete?	—	Verify repair	—
18	Replace the ECM. Is the action complete?	—	Verify repair	—
19	Check the CHECK ENGINE Lamp (MIL) driver circuit for the instrument panel poor connection. Was a problem detected?	—	Verify repair	Go to "Diagnostic Aids"

CHECK ENGINE Lamp (MIL) Remains Active



Circuit Description

The CHECK ENGINE Lamp (MIL) should be “ON” steady while the starter switch (key switch) is "ON" and the engine “OFF”. The ignition power voltage is supplied to MIL through the meter fuse. ECM is turns MIL "ON" by ground the MIL driver circuit.
If the DTC is not set up while the engine is running, MIL does not keep ON. When the engine is running, DTC has been set up, and the MIL keeps ON, ground short of the MIL driver circuit is considered.

Diagnostic Aids

An intermittent MIL “ON” may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check the following items.

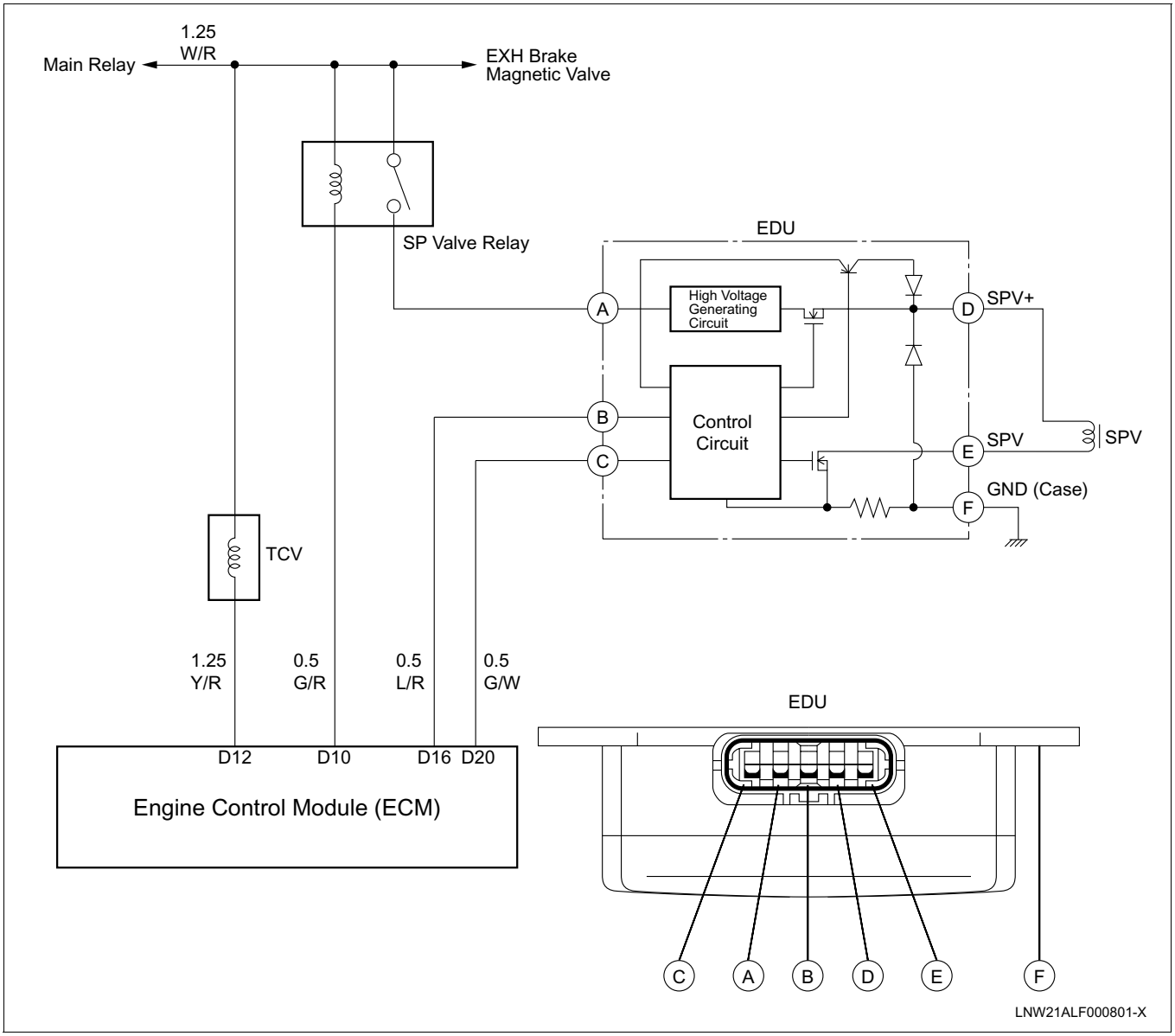
- Poor connection or damaged harness: Inspect the ECM harness and connector for improperly mating, broken locks, improperly formed or damage pin, poor pin-to-wire connection, and damaged harness.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.
2. If the MIL “ON” continue lighting when the ECM disconnect, the MIL driver wiring is not faulty.
6. When the MIL driver circuit is normal, the MIL driver wiring in the meter panel cluster is faulty.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnosis (OBD) system check" performed?	—	Go to Step 2	Go to the "OBD System Check"
2	1. Starter switch "OFF", disconnect the ECM. 2. Starter switch "ON", and monitor the CHECK ENGINE lamp (MIL). Is the CHECK ENGINE Lamp (MIL) "ON"?	—	Go to Step 3	Go to Step 5
3	1. Starter switch "OFF", disconnect the instrument panel connector. 2. Check for the ground short for MIL driver circuit between ECM and instrument panel cluster. 3. If a problem is detected, repair as necessary. Does the ground short for MIL driver circuit?	—	Go to the "OBD System Check"	Go to Step 4
4	Replace the instrument panel cluster. Is the action complete?	—	Go to the "OBD System Check"	—
5	1. Starter switch "OFF", and re-connect the ECM. 2. Short DLC 4 and 6. Starter switch "ON". Does the CHECK ENGINE Lamp (MIL) display DTC?	—	Go to the "OBD System Check"	Go to Step 6
6	Replace the ECM. Is the action complete?	—	Go to the "OBD System Check"	—

Engine Cranks But Will Not Run



Circuit Description

Fuel is injected by opening and closing the fuel high pressure circuit with the SPV (spill control valve). EDU (engine driver unit; high voltage driver) is used to drive the SPV at a high speed. EDU attains high speed drive of SPV at a high fuel pressure with a high voltage, quick energizing system. If the EDU, ECM or SPV fails, the engine is crank but the initial explosion does not take place.

Diagnostic Aids

An intermittent problem may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check the following items.

- Poor connection or damaged harness: Inspect the ECM harness and EDU harness connector for improper mating, broken locks, improperly formed or damage pin, poor pin-to-wire connection, and damaged harness.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

4. An obvious cause of low fuel pressure would be an empty fuel tank.

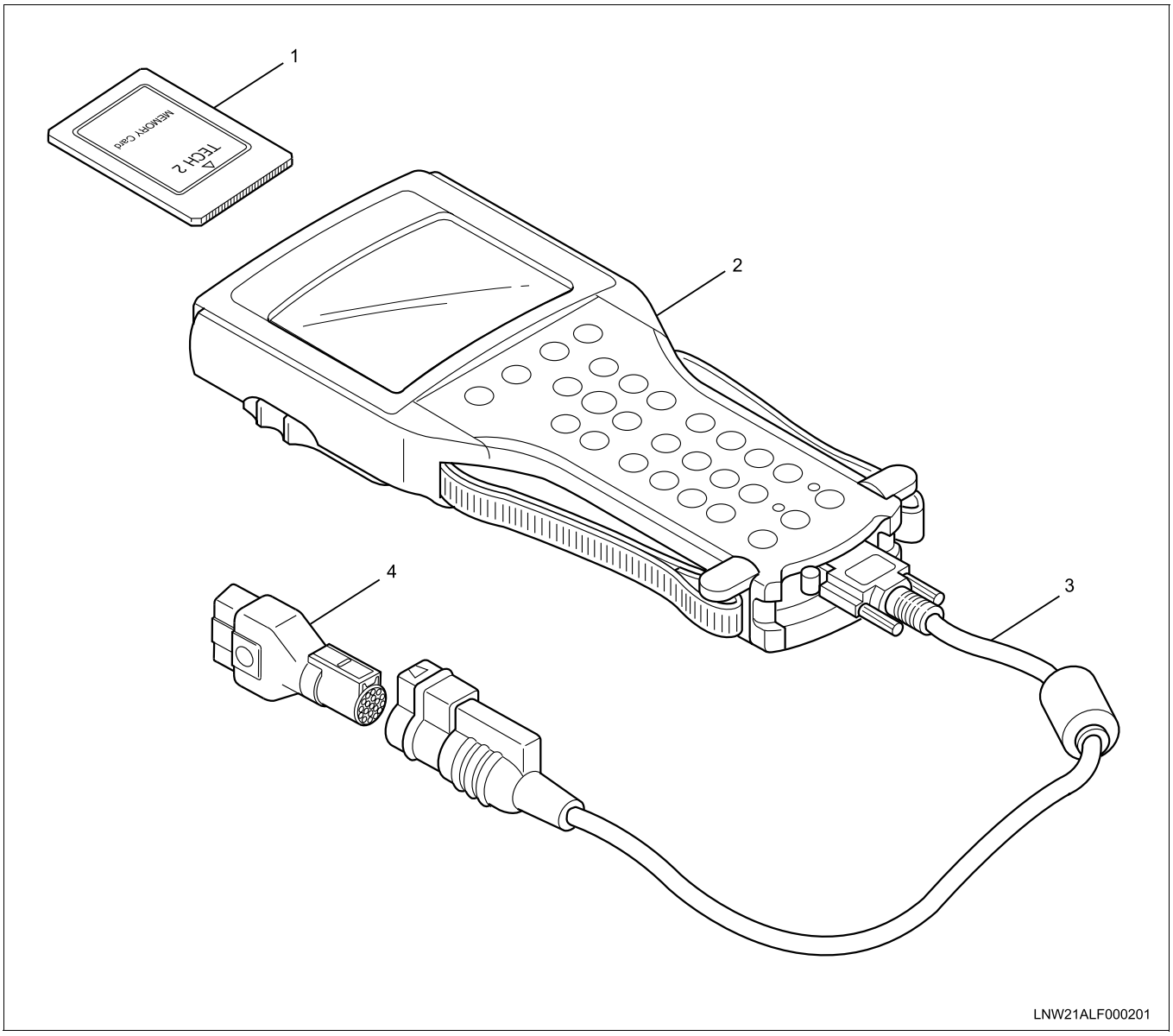
9. In case of open wiring or short of the EDU circuit, set DTC 53.

Step	Action	Value(s)	Yes	No
1	Was "On-board diagnosis (OBD) system check" performed?	—	Go to Step 2	Go to the "OBD System Check"
2	Check the 50A ECM fuse, 50A KEY SW fuse, 10A control fuse and the 15A control fuse. Was the fuse blown?	—	Go to Step 3	Go to Step 4
3	Check for a short to ground, and replace the fuse. Is the action complete?	—	Verify repair	—
4	Is the fuel tank empty?	—	Replenish to the fuel tank	Go to Step 5
5	Is a proper fuel used (use dehumidifying agent is not advisable)?	—	Go to Step 6	Replace the fuel
6	Using Tech 2. Set the DTC 11?	—	Go to DTC 11	Go to Step 7
7	Using Tech 2. Set the DTC 13?	—	Go to DTC 13	Go to Step 8
8	Using Tech 2. Set the DTC 16?	—	Go to DTC 16	Go to Step 9
9	Using Tech 2. Set the DTC 53? (Does the check for EDU circuit defective?)	—	Go to DTC 53	Go to Step 10
10	Using Tech 2. Set the DTC 52?	—	Go to DTC 52	Go to Step 11
11	1. Refer to engine mechanical diagnosis to diagnose the following conditions. • Faulty camshaft gear • Leaking valve or ring • Excessive valve deposits • Weak valve spring • Incorrect valve timing • Leaking head gasket • Excessive fuel filter deposits 2. If a problem is detected, repair or replace as necessary. Was a problem detected?	—	Verify repair	Go to Step 12
12	Replace the ECM. Is the action complete?	—	Verify repair	—

Diagnosis with Tech 2 Scan Tool

Tech 2 Scan Tool

Tech 2 is an effective tool for diagnosis of electrical failures on the engine control system. This scan tool is a small and lightweight handheld tester and, once connected to the DLC on a vehicle, communicates with the on-board ECM to perform various diagnostics and tests.



Legend

1. PCMCIA card
2. Tech 2
3. DLC cable
4. SAE 16/19-pin adapter

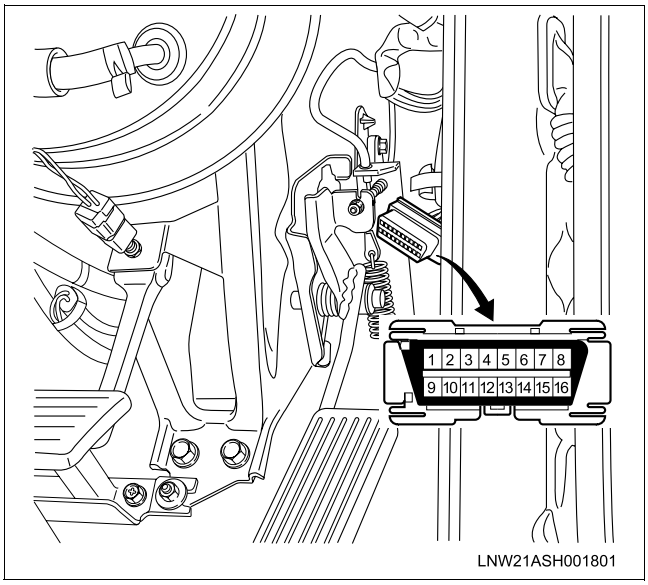
Features of Tech 2

- Tech 2 (2) is operated at 12 V. Therefore, 24-V power supply must not be used for this tool. If the vehicle electrical system rating is 24 V, the adapter must be connected to a 12 V battery. Tech 2 must not be powered by the cigarette lighter.
- Insert the PCMCIA card (1) into Tech 2. Then, connect the DLC cable (3) and SAE 16/19-pin adapter (4) to the VCI (vehicle communication interface) of Tech 2 and connect Tech 2 to the DLC on the vehicle.
- Insert or remove the PCMCIA card with the power supply turned off.

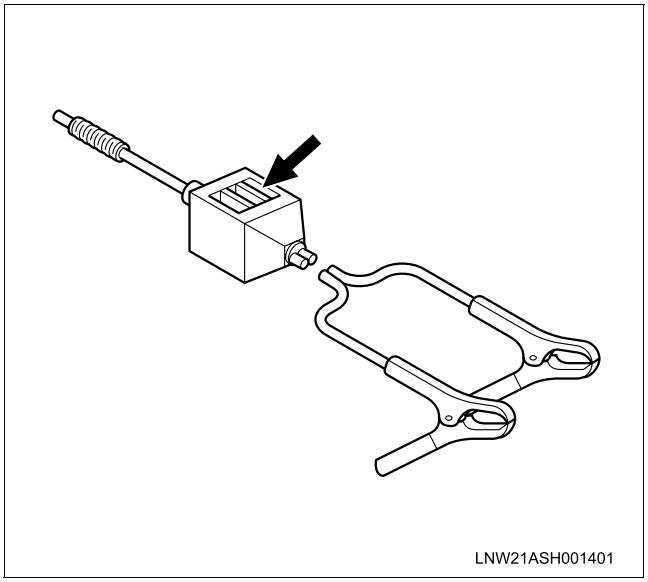
- Tech 2 supports two snapshot capacities.
- The PCMCIA card is susceptible to magnetism and static electricity and, therefore, complete care should be taken in handling.
- Tech 2 can plot snapshot graphs.
- Hitting the Exit key allows you to return to the main menu at any time.
- To clear DTC(s), you should open the application menu and select "F1: Clear DTC Info" or "Clear DTC".

Connection

1. Insert the ISUZU System PCMCIA card into Tech 2.
2. Install the SAE 16/19-pin adapter to the DLC cable.
3. Connect the DLC cable to Tech 2.
4. Check the starter switch is turned off.
5. Connect the Tech 2 SAE 16/19-pin adapter to the DLC (data link connector = black) on the vehicle.



Connect Tech 2 and 12 V battery with an adapter cable.

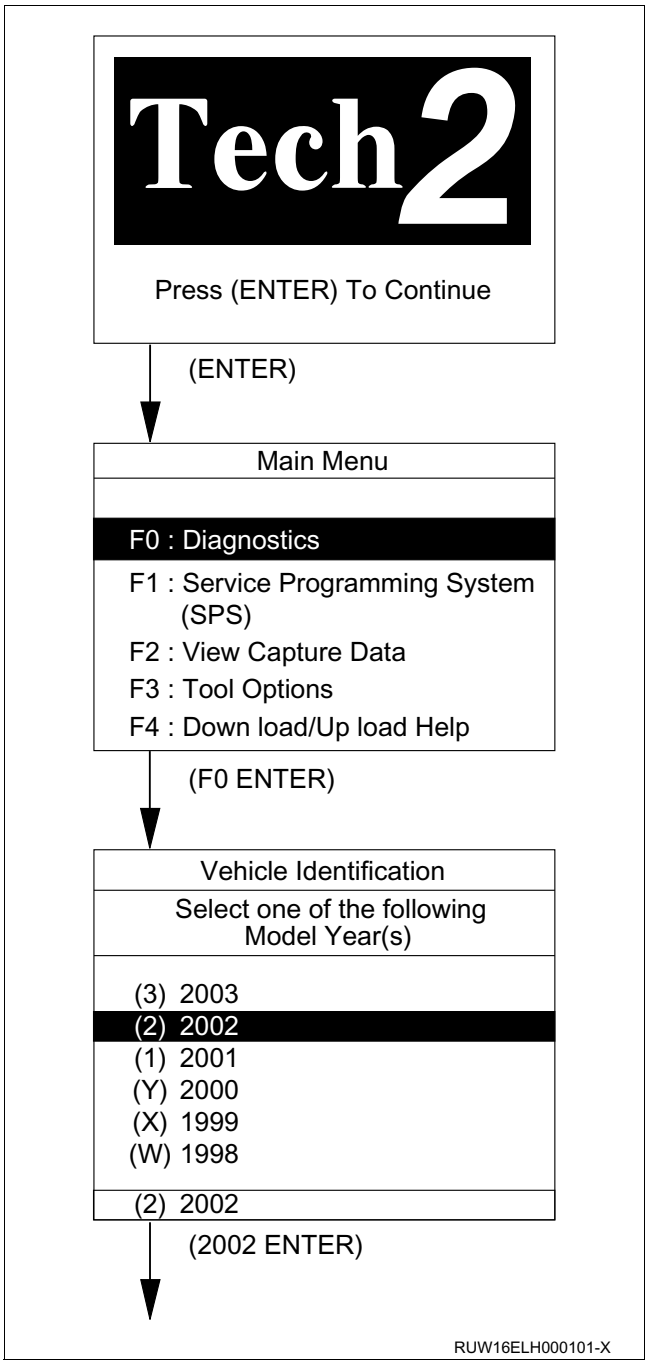


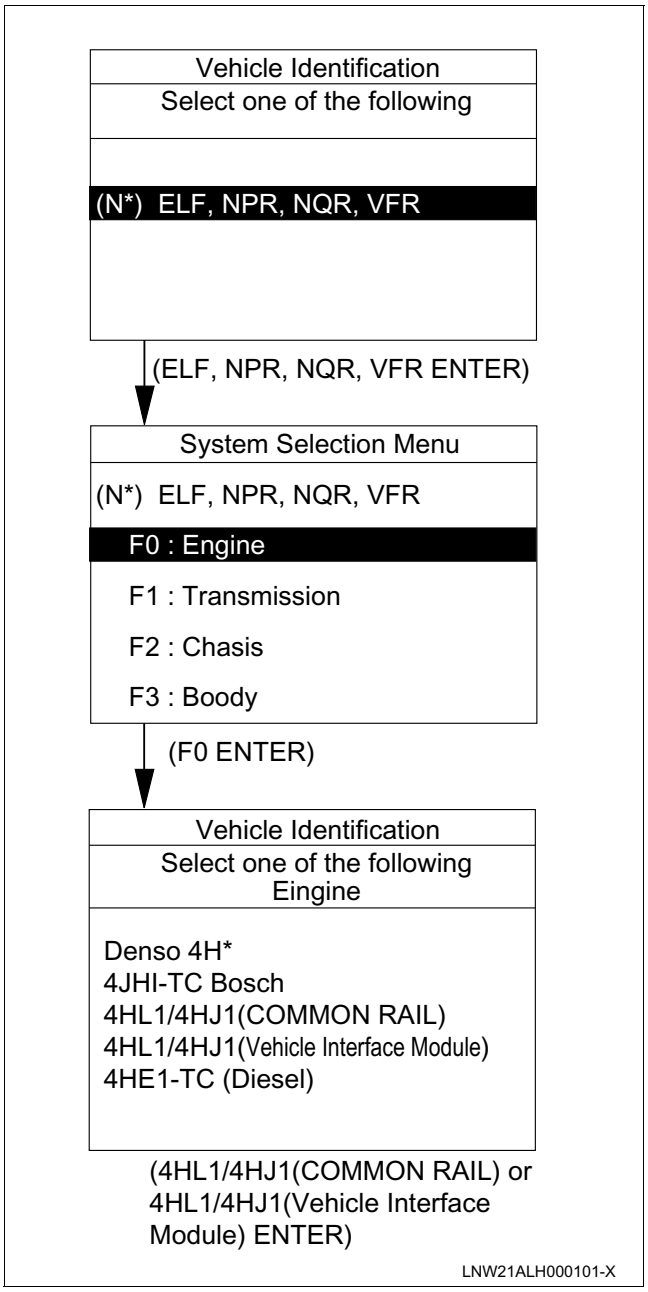
- If the voltage is not applied to Tech 2, check the 3 A fuse.

6. Turn on the starter switch and press the PWR key on Tech 2.
7. Check the following screen appears on the Tech 2 display.

CAUTION:
Before inserting or removing the PCMCIA card, always check the power is not applied to Tech 2.

Operating Procedure





Menu List

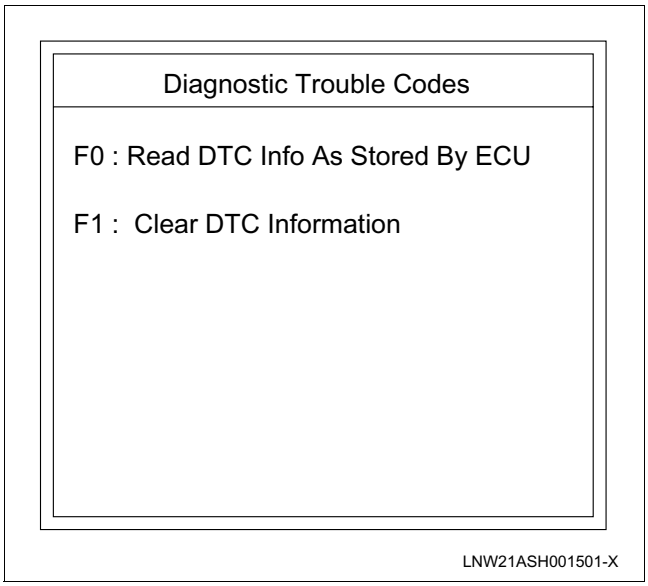
- The list below shows what function is currently used by the Tech 2 software.

F0: Diagnostic Trouble Codes
F0: Read DTC Info As Stored By ECU
F1: Clear DTC Information
F1: Data Display
F2: Snaphot

Menu Breakdown

Diagnostic Trouble Codes

- When you find a DTC, go to the DTC Chart.

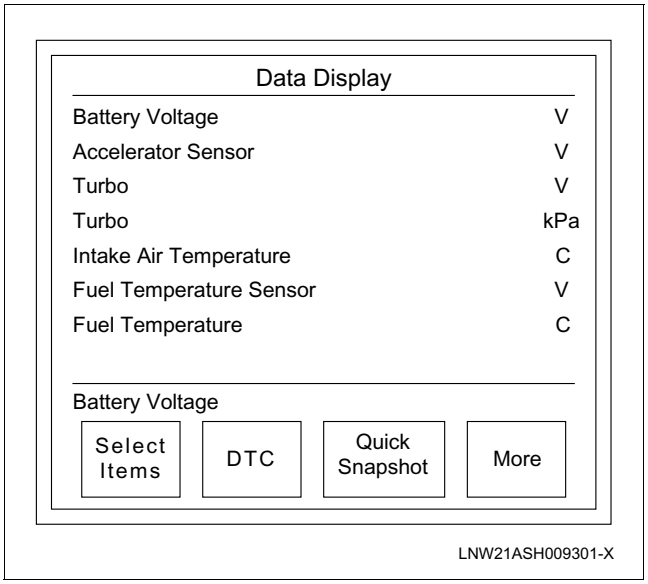


The DTC is a language allowing you to communicate with the on-board ECM. The DTC is coarsely divided into two categories, past DTC and current DTC.

- Current DTC: A fault (failure) is displayed that is found in the current ignition cycle.
- Past DTC: A fault (failure) is displayed that was found in the last or past ignition cycle.
- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the shared power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short. Using DTC clear mode erases the vehicle DTC information from the ECM.

Data Display

- Typical values are described in the Tech 2 data list.



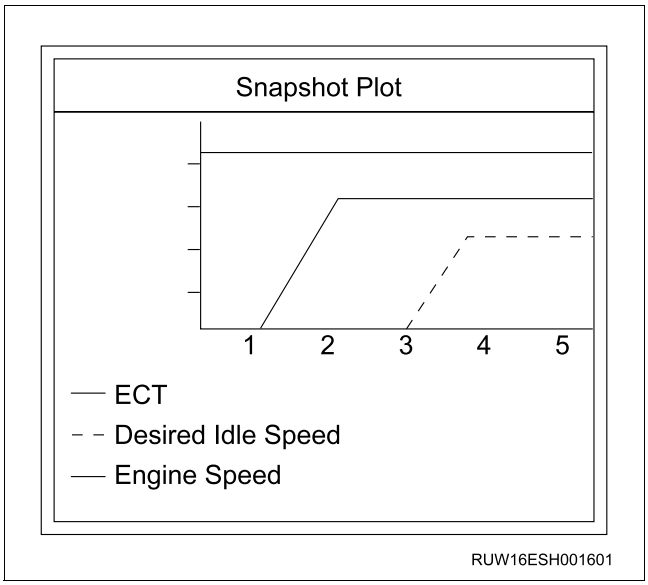
This menu displays the current data. The contents synchronize with the vehicle status. For example, the engine coolant temperature sensor is monitored and displayed on the screen and, if the engine is idling, the temperature on the screen will be changed accordingly.

- When you cannot select this data display menu:
  A fault presents on the cable between ECM and DLC.
- When an unusual value appears fixedly:
  Example - If the engine coolant temperature displayed is fixed to –40°C or +140°C, the possible cause is faulty ECT sensor, open wiring, or short.
  When moving connectors or wiring harnesses with hands changes the display, poor pin connection, improper pin layout, broken harness wires, or short is a cause and, therefore, repair is needed.
- When "*" appears instead of value:
  The Tech 2 software is faulty.
  If even one asterisk is observed instead of data on the display, the PCMCIA card needs version up.

Snapshot

- The snapshot mode records menus on the data list and plots graphs.
- Using this mode, you can reproduce and record customer's claimed conditions and find faulty engine data.
- You can replay the recorded data with the commercial power applied to home outlets.

- In the snapshot after determination of trigger type, you can record the data obtained when the DTC is displayed. Reviewing this data can reveal the cause of failure.



Snapshot After Data Indication

1. Select "Data Display" from the application menu.
2. After the vehicle data appears, select "Snapshot" at the screen bottom.
3. After the elapse of some time, press the Exit key.
4. The screen changes. After "Continue" appears at the bottom, select "Continue".
5. After "Plot" appears at the bottom, select "Plot".
6. The menu select screen appears. Move to the desired item and press the Enter key until three items are selected. Then, select "Approve" at the bottom.
7. A graph is plotted on the screen.

Snapshot After Determination of Trigger Type

1. Select "Data Display" from the application menu.
2. After items appears on the screen, select the desired item.
3. After the snapshot option screen appears, determine the trigger type and select "Record Snapshot" at the bottom.
4. When "Standby" blinks at the upper right of the screen, select "Trigger" at the bottom.
5. Verify the trigger type.
6. The screen changes. After "Continue" appears at the bottom, select "Continue".
7. After "Plot" appears at the bottom, select "Plot".
8. The menu select screen appears. Move to the desired item and press the Enter key until three items are selected. Then, select "Approve" at the bottom.
9. A graph is plotted on the screen.

Replaying Recorded Data Graph

1. Turn on Tech 2 and select "Snapshot data" displayed thereafter.
2. Check snapshot data titles appear on the screen.
3. Select the desired snapshot data title.
4. The data appears on the screen. To access the graph, select "Plot" at the bottom.
5. Menu select screen appears. Move to the desired item and press the Enter key until three items are selected. Then, select "Approve" at the bottom.
6. The graph is plotted on the screen.

Tech 2 Typical Data Values

The data list is used to check the condition of the vehicle (engine). The reference values (typical values) are compared to the data acquired from the actual vehicle to determine the current situation, for example, temporary or permanent deviation, so that you can diagnose the vehicle (engine) and think out appropriate repar plan. (The menu in your Tech 2 may differ from that shown above due to software version. Also, the menu may be changed without prior notice.)

Tech 2 Data Display	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after check
Battery Voltage	V	23 ~ 26V		
Accelerator Sensor	V	0.41 ~ 0.45V		
Turbo (MAP Sensor)	V	Depending on engine condition		
Turbo (MAP)	kPa	Depending on engine condition		
Intake Air Temperature	°C	Approx. 0 ~ 30°C depending on the temperature around the engine.		
Fuel Temperature Sensor	V	Approx. 2.35V depending on the temperature around the engine.		

Tech 2 Data Display	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after check
Fuel Temperature	°C	Depending on the temperature around the engine.		
Coolant Temperature Sensor	V	1.38 ~ 1.68V		
Coolant Temperature	°C	80 ~ 100°C		
PTO Sensor	V	0V		
Barometric Pressure	V	Approx. 3.3V		
Idle-Up Sensor	V	Approx. 3.3 ~ 0.45V		
Engine Speed	rpm	Approx. M/T: 580rpm, A/T : 650rpm		
Final Accelerator Opening	%	0%		
PTO Accelerator Opening	%	0%		
Vehicle Speed	km/h	0km/h		
ASR Accelerator Opening	%	100%		
Corrected Fuel Injection Amount	mm^3/stk	Approx. 12.6mm^3/stk		
Final Fuel Injection Amount	mm^3/stk	Approx. 61.3mm^3/stk		
Target Rotation Speed	rpm	Approx. M/T: 580rpm, A/T : 650rpm		
Fuel Spill Open Valve Angle	°CA	Approx. 92°CA		
Fuel Spill Close Valve Angle	°CA	Approx. 56°CA		
Fuel Injection Timing	°CA	5°CA		
Crank Angle Timing	°CA	5°CA		
TCV Duty Cycle	%	50 ~ 60%		
Cylinder 1 Compensation	°CA	±1°CA or less		
Cylinder 2 Compensation	°CA	±1°CA or less		
Cylinder 3 Compensation	°CA	±1°CA or less		
Cylinder 4 Compensation	°CA	±1°CA or less		
EGR Duty Cycle	%	Depending on engine condition		
Starter Switch (S)	On/Off	Off		
Neutral Switch	On/Off	Depending on the switch condition		
Diagnostic Switch	On/Off	Depending on the switch condition		
Key Switch (On)	On/Off	On		
Idle Switch	On/Off	On		
AC Switch	On/Off	Depending on the switch condition		
Clutch Switch	On/Off	Depending on the switch condition		
Exhaust Brake Switch	On/Off	Depending on the switch condition		
Exhaust Brake (AT) Cutoff Switch	On/Off	Off		
Exhaust brake (ASR) Cutoff Switch	On/Off	Off		
PTO Switch	On/Off	Depending on the switch condition		
Idle Speed Control	On/Off	On		
Engine Stop Switch	On/Off	Off		

Tech 2 Data Display	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after check
Engine Start	On/Off	Off		
Accelerator Switch	On/Off	Off		
Fuel Inj. Amount Limit (Injection)	On/Off	Off		
TCV Feedback	On/Off	On		
Thermo Switch	On/Off	Depending on the switch condition		
Exhaust Press. Valve 1	On/Off	Off		
Glow Time Lamp	On/Off	Off		
Glow Time Relay	On/Off	Off		
Starting Counter	(Counts)	Varying depending on the count of starter operations		

Copy this table and use for measurement.

- Typical value with starter switch ON (Engine stops.)

Display on Tech 2	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after confirmation
Battery Voltage	V	23 ~ 26V		
Accelerator Sensor	V	0.41 ~ 0.45V		
Turbo (MAP Sensor)	V	Depending on engine condition		
Turbo (MAP)	kPa	Depending on engine condition		
Intake Air Temperature	°C	Approx. 0 ~ 30°C depending on the temperature around the engine.		
Fuel Temperature Sensor	V	Approx. 2.39V depending on the temperature around the engine.		
Fuel Temperature	°C	Depending on the temperature around the engine.		
Coolant Temperature Sensor	V	1.80 ~ 2.05V		
Coolant Temperature	°C	0 ~ 30°C		
PTO Sensor	V	0V		
Barometric Pressure	V	Approx. 3.3V		
Idle-Up Sensor	V	Approx. 3.3 ~ 0.45V		
Engine Speed	rpm	0rpm		
Final Accelerator Opening	%	0%		
PTO Accelerator Opening	%	0%		
Vehicle Speed	km/h	0km/h		
ASR Accelerator Opening	%	100%		
Corrected Fuel Injection Amount	mm^3/stk	—		
Final Fuel Injection Capacity	mm^3/stk	—		
Target Rotation Speed	rpm	Approx. M/T: 580rpm, A/T : 650rpm		
Fuel Spill Open Valve Angle	°CA	Approx. 83°CA		
Fuel Spill Close Valve Angle	°CA	Approx. 56°CA		

Display on Tech 2	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after confirmation
Fuel Injection Timing	°CA	1°CA		
Crank Angle Timing	°CA	1°CA		
TCV Duty Cycle	%	0 ~ 1%		
Cylinder 1 Compensation	°CA	±1°CA or less		
Cylinder 2 Compensation	°CA	±1°CA or less		
Cylinder 3 Compensation	°CA	±1°CA or less		
Cylinder 4 Compensation	°CA	±1°CA or less		
EGR Duty Cycle	%	Depending on engine condition		
Starter Switch (S)	On/Off	Off		
Neutral Switch	On/Off	Depending on the switch condition		
Diagnostic Switch	On/Off	Depending on the switch condition		
Key Switch (On)	On/Off	On		
Idle Switch	On/Off	On		
AC Switch	On/Off	Depending on the switch condition		
Clutch Switch	On/Off	Depending on the switch condition		
Exhaust Brake Switch	On/Off	Depending on the switch condition		
Exhaust Brake (AT) Cutoff Switch	On/Off	Off		
Exhaust Brake (ASR) Cutoff Switch	On/Off	Off		
PTO Switch	On/Off	Depending on the switch condition		
Idle Speed Control	On/Off	On		
Engine Stop Switch	On/Off	Off		
Engine Start	On/Off	Off		
Accelerator Switch	On/Off	Off		
Fuel Inj. Amount Limit (Injection)	On/Off	Off		
TCV Feedback	On/Off	On		
Thermo Switch	On/Off	Depending on the switch condition		
Exhaust Press. Valve 1	On/Off	Off		
Glow Time Lamp	On/Off	Off		
Glow Time Relay	On/Off	Off		
Starting Counter	(Counts)	Varying depending on the count of starter operations		

Copy this table and use it for measurement. Typical values with the starter switch ON may vary depending on the previous operating conditions.

- Typical value at 1500rpm

Display on Tech 2	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after confirmation
Battery Voltage	V	23 ~ 26V		
Accelerator Sensor	V	1.52 ~ 1.55V		

Display on Tech 2	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after confirmation
Turbo (MAP Sensor)	V	Depending on engine condition		
Turbo (MAP)	kPa	Depending on engine condition		
Intake Air Temperature	°C	Approx. 0 ~ 30°C depending on the temperature around the engine.		
Fuel Temperature Sensor	V	Approx. 2.35V depending on the temperature around the engine.		
Fuel Temperature	°C	Depending on the temperature around the engine.		
Coolant Temperature Sensor	V	1.38 ~ 1.68V		
Coolant Temperature	°C	80 ~ 100°C		
PTO Sensor	V	0V		
Barometric Pressure	V	Approx. 3.3V		
Idle-Up Sensor	V	Approx. 3.3 ~ 0.45V		
Engine Speed	rpm	Approx. 1500rpm		
Final Accelerator Opening	%	25%		
PTO Accelerator Opening	%	0%		
Vehicle Speed	km/h	0km/h		
ASR Accelerator Opening	%	100%		
Corrected Fuel Injection Amount	mm^3/stk	—		
Final Fuel Injection Amount	mm^3/stk	—		
Target Rotation Speed	rpm	Approx. M/T: 580rpm, A/T : 650rpm		
Fuel Spill Open Valve Angle	°CA	Approx. 90°CA		
Fuel Spill Close Valve Angle	°CA	Approx. 56°CA		
Fuel Injection Timing	°CA	11°CA		
Crank Angle Timing	°CA	11°CA		
TCV Duty Cycle	%	60 ~ 70%		
Cylinder 1 Compensation	°CA	±1°CA or less		
Cylinder 2 Compensation	°CA	±1°CA or less		
Cylinder 3 Compensation	°CA	±1°CA or less		
Cylinder 4 Compensation	°CA	±1°CA or less		
EGR Duty Cycle	%	Depending on engine condition		
Starter Switch	On/Off	Off		
Neutral Switch	On/Off	Depending on the switch condition		
Diagnostic Switch	On/Off	Depending on the switch condition		
Key Switch	On/Off	On		
Idle Switch	On/Off	Off		
AC Switch	On/Off	Depending on the switch condition		
Clutch Switch	On/Off	Depending on the switch condition		
Exhaust Brake Switch	On/Off	Depending on the switch condition		

Display on Tech 2	Unit	Typical value at idling. Complete warm-up, air temperature 20°C	Value at diagnosis	Value after confirmation
Exhaust Brake (AT) Cutoff	On/Off	Off		
Exhaust Brake (ASR) Cutoff	On/Off	Off		
PTO Switch	On/Off	Depending on the switch condition		
Idle Speed Control	On/Off	On		
Engine Stop Switch	On/Off	Off		
Engine Start	On/Off	Off		
Accelerator Switch	On/Off	Off		
Fuel Inj. Amount Limit (Injection)	On/Off	Off		
TCV Feedback	On/Off	On		
Thermo Switch	On/Off	Depending on the switch condition		
Exhaust Press. Valve 1	On/Off	Off		
Glow Time Lamp	On/Off	Off		
Glow Time Relay	On/Off	Off		
Starting Counter	(Counts)	Varying depending on the count of starter operations		

Copy this table and use it for measurement. Typical values at 1500rpm may vary depending on conditions.

Tech 2 Data Description

Item	Tech 2 Data Display	Unit	Description	How to use parameters
1/52	Battery Voltage	V	Indicates voltage applied to ECM. Difference from the actual battery voltage may be caused due to loads in the circuit, slight resistance value at the harness or connector pin or other causes.	When the difference from the actual battery voltage is significant, any accessory attached to the circuit is considered as a cause, which may have dropped the voltage. If the value is out of the standard range, circuit, connector, connector mating, or ECM may have some fault.
2/52	Accelerator Sensor	V	Indicates a signal value from the accelerator position (AP) sensor. ECM reads the signal from AP sensor and indicates it. Voltage is applied from ECM to the AP sensor and ECM reads the accelerator pedal opening from varying sensor signal.	When the value of the AP sensor (pedal opening) becomes out of the standard value according to the accelerator pedal stepping stroke, some fault has occurred in the sensor, circuit, throttle valve or ECM. Check the sensor, circuit, accelerator pedal and ECM in such a case.
3/52	Turbo (Intake Air Pressure Sensor)	V	Indicates the signal value of the intake air pressure (MAP). Voltage from ECM is applied to the MAP sensor and ECM reads the intake air pressure from varying signal of the sensor and indicates that value.	If the signal value (pressure display) from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.
4/52	Turbo (Intake Air Pressure)	kPa	Voltage from ECM is applied to the intake air pressure (MAP) sensor and ECM reads the intake air pressure from the change of the sensor signal. The signal read by ECM is converted to pressure and indicated.	If the signal value (pressure display) from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.
5/52	Intake Air Temperature	°C	Indicates the intake air temperature. Using a thermistor type sensor which is characterized by a feature that the electric resistance decreases with increase of the intake air temperature, voltage is applied from ECM to the IAT sensor, and ECM receives signal from the sensor, calculates and indicates the result. In the event of a fault occurring in the sensor or circuit, the ECM performs failsafe by the backup value.	If the signal value (temperature display) from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
6/52	Fuel Temperature Sensor	V	Indicates the signal value of fuel temperature sensor. Voltage is applied from ECM to the fuel temperature sensor and ECM reads the fuel temperature from the varying sensor signal and indicates it.	Various control conditions (at start, low temperature, after warm-up, etc.) are checked based on the fuel temperature. May be used as conditions for DTC detection.
7/52	Fuel Temperature	°C	Indicates the fuel temperature. Using a thermistor type sensor which is characterized by a feature that the electric resistance decreases with increase of the fuel temperature, voltage is applied from ECM to the fuel temperature sensor, and ECM receives signal from the sensor, calculates and indicates the result. In the event of a fault occurring in the sensor or circuit, the ECM performs failsafe by the backup value.	If the signal (temperature display) from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.
8/52	Coolant Temperature Sensor	V	Indicates the signal value of the coolant temperature sensor. Voltage is applied from ECM to the coolant temperature sensor and ECM reads the engine coolant temperature from the varying sensor signal and indicates it.	Various control conditions (at start, low temperature, after warm-up, etc.) are checked based on the engine coolant temperature. May be used as conditions for DTC detection.
9/52	Coolant Temperature	°C	Indicates engine coolant temperature. Using a thermistor type sensor which is characterized by a feature that the electric resistance decreases with increase of the coolant temperature, voltage is applied from ECM to the coolant temperature sensor, and ECM receives signal from the sensor, calculates and indicates the result. In the event of a fault occurring in the sensor or circuit, the ECM performs failsafe by the backup value.	If the signal value (temperature display) from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
10/52	PTO Sensor	V	Indicates the signal value of PTO accelerator opening sensor (all speed accelerator sensor). ECM reads the signal from the PTO accelerator sensor and indicates. Voltage from ECM is applied to the sensor and ECM reads the accelerator pedal opening from the varying signal from the sensor.	If the value of the sensor is out of the standard range according to the accelerator opening, some fault has occurred in the sensor main unit, circuit, throttle valve or ECM. Check the sensor, circuit, accelerator pedal or ECM in such a case.
11/52	Barometric Pressure	V	Indicates signal value of the barometric pressure sensor. Voltage from ECM is applied to the sensor installed in ECM and ECM reads the varying signal value and indicates it.	Various control conditions (fuel injection amount control) are checked based on the barometric pressure. If the signal value from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.
12/52	Idle Up Sensor	V	Indicates the signal value of the idle up volume (idling speed adjusting switch). Voltage from ECM is applied to the sensor and ECM adjusts the idling speed based on the varying signal.	If the signal from the amount is out of the standard range, some fault has occurred in the sensor, circuit, or ECM. Check the sensor, circuit, or ECM in such a case.
13/52	Engine Speed	rpm	Engine speed is calculated based on the signal from the NE censer and CKP sensor. While the engine is idling, the engine speed follows up the target rotating speed and is stabilized. The NE sensor and CKP sensor generates electromotive voltage by the magnetic force and ECM incorporates that voltage as a signal.	Use the engine speed data comparing with the target rotating speed, while the engine is warming up and its idling speed is stable as the air conditioning system, etc. are OFF. The engine speed becomes stable around the target rotating speed. When the air conditioning system or other load is applied, the engine rotating speed is changed but stabilized.
14/52	Final Accelerator Opening	%	Indicates the accelerator pedal opening. ECM reads the signal from the AP sensor and converts the signal read to opening.	When the value of the AP sensor (pedal opening) becomes out of the standard value according to the accelerator pedal stepping stroke, some fault has occurred in the sensor, circuit, throttle valve or ECM. Check the sensor, circuit, throttle valve and ECM in such a case.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
15/52	PTO Accelerator Opening	%	Indicates the opening of the PTO accelerator. ECM reads the signal from the PTO accelerator sensor and converts the signal read to opening.	If the signal value from the sensor is out of the standard value, some fault has occurred in the sensor, circuit or ECM. Check the sensor, circuit or ECM in such a case.
16/52	Vehicle Speed	km/h	ECM receives signal (pulse) from the vehicle speed sensor, calculates the vehicle speed based on the signal and indicates the result.	If the indication is different from the reading on the speedo-meter, or if the indication does not change, any fault may be in the vehicle speed sensor, circuit or ECM.
17/52	ASR Accelerator Opening	%	On a vehicle equipped with ASR, when the ASR operates, it controls the opening of the accelerator to decrease the engine speed. Indicates the accelerator opening control value. It is usually 100% and decreases as the ASR operates.	If the value does not change, poor communication with ABS/ ASR control unit, ABS/ASR failure system, faulty ECM or ABS/ASR control unit, or fault in the circuit is the cause. Check them in such a case.
18/52	Corrected Fuel Injection Amount	mm^3/stk	ECM controls the fuel injection and correct the fuel injection amount for each engine (fuel amount necessary for hipressurization). It indicates fuel amount required to obtain the target fuel pressure at the time of injection depending on the engine condition. ECM indicates a value calculated from the spill control valve, engine speed, etc.	If the value is out of the standard range, any fault is in the spill control valve, vehicle speed sensor, circuit or ECM. Check the valve, sensor, circuit and ECM.
19/52	Final Fuel Injection Amount	mm^3/stk	Indicates fuel injection amount from the injector. ECU calculated the amount of pressurized fuel from the condition of the timing control valve and spill control valve and indicates the calculation result.	If the value is out of the standard range, any fault is in the spill control valve, timing control valve, vehicle speed sensor or circuit or ECM. Check the valves, sensor, circuits and ECM.
20/52	Target Rotation Speed	rpm	Idle speed calculated and indicated by ECM. ECM corrects and calculates the idle speed from the coolant temperature or engine load and indicates the result as the specified idle speed.	If the required idle speed does not stabilized, improper installation of ECM or sensors (improper mating of connector, bent pin, etc.) or incorrect signal of ECM or sensors may be considered. If the harness does not stabilize when vibration is given, fault of the harness, floating of the ground circuit, or poor connection of the connector is considered.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
21/52	Fuel Spill Open Valve Angle	°CA	Indicates the valve open timing when the spill control valve is controlled. ECM opens or closes the valve to obtain the fuel pressure required for injection and calculates and indicates the timing from the engine condition. ECM calculates the various timing of the engine based on the signals from the CKP sensor and NE sensor.	If the value is out of the standard range, any fault is in the timing control valve, sensors or, circuit or ECM. Check the valves, sensors, circuits and ECM.
22/52	Fuel Spin Close Valve Angle	°CA	Indicates the valve close timing when the spill control valve is controlled. ECM opens or closes the valve to obtain the fuel pressure required for injection and calculates and indicates the timing from the engine condition. ECM calculates the various timing of the engine based on the signals from the CKP sensor and NE sensor.	If the value is out of the standard range, any fault is in the timing control valve, sensors or circuit or ECM. Check the valves, sensors, circuits and ECM.
23/52	Fuel Injection Timing	°CA	Indicates the valve opening timing when the timing control valve is controlled. ECM opens or closes the valve to adjust the injection timing and calculates and indicates the timing from the engine condition. ECM calculates the target injection timing based on the signals from the accelerator opening, CKP sensor and NE sensor.	If the value is out of the standard range, any fault is in the timing control valve, sensors or circuit or ECM. Check the valves, sensors, circuits and ECM.
24/52	Crank Angle Timing	°CA	Indicates the actual fuel injection timing. ECM opens or closes the valve to adjust the injection timing properly and calculates and indicates the timing from the engine condition (target injection timing). ECM calculates the actual timing based on the signals from the CKP sensor and NE sensor.	If the value is out of the standard range, any fault is in the timing control valve, sensors or circuits or ECM. Check the valves, sensors, circuits and ECM.
25/52	TCV Duty Cycle	%	Indicates signal (duty ratio) to drive the timing control valve. ECM changes the valve opening or closing travel according to the changes of the signal voltage (duty ratio) to adjust the proper injection timing.	If the value is out of the standard range, any fault is in the timing control valve, sensors or circuit or ECM. Check the valves, sensors, circuits and ECM.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
26/52	Cylinder 1 Compensation	°CA	Indicates adjustment of fuel injection timing for each cylinder. As there are micro variations in mechanical parts such as injectors, pumps and fuel pipes, the ECM makes correction based on various timing and respective sensor signals to stabilize the engine speed.	If the value is out of the standard range, any fault is in the injector, pump, various piping systems, sensors, or circuits or ECM. Check the engine mechanical parts, valves, sensors, circuits and ECM.
27/52	Cylinder 2 Compensation	°CA	Indicates adjustment of fuel injection timing for each cylinder. As there are micro variations in mechanical parts such as injectors, pumps and fuel pipes, the ECM makes correction based on various timing and respective sensor signals to stabilize the engine speed.	If the value is out of the standard range, any fault is in the injector, pump, various piping systems, sensors, or circuits or ECM. Check the engine mechanical parts, valves, sensors, circuits and ECM.
28/52	Cylinder 3 Compensation	°CA	Indicates adjustment of fuel injection timing for each cylinder. As there are micro variations in mechanical parts such as injectors, pumps and fuel pipes, the ECM makes correction based on various timing and respective sensor signals to stabilize the engine speed.	If the value is out of the standard range, any fault is in the injector, pump, various piping systems, sensors, or circuits or ECM. Check the engine mechanical parts, valves, sensors, circuits and ECM.
29/52	Cylinder 4 Compensation	°CA	Indicates adjustment of fuel injection timing for each cylinder. As there are micro variations in mechanical parts such as injectors, pumps and fuel pipes, the ECM makes correction based on various timing and respective sensor signals to stabilize the engine speed.	If the value is out of the standard range, any fault is in the injector, pump, various piping systems, sensors, or circuits or ECM. Check the engine mechanical parts, valves, sensors, circuits and ECM.
30/52	EGR Duty Cycle	%	Indicates signal (duty ratio) to drive the motor to operate the EGR valve. ECM changes the valve opening or closing travel according to the changes of the signal voltage (duty ratio) to adjust the proper ECM operation.	If the value is out of the standard range, any fault is in the EGR valve, sensors, or circuits or ECM. Check the valves, sensors, circuits and ECM.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
31/52	Starter Switch	On/Off	Indicates the key switch is set to the [S] position [ON] is indicated while the starter motor is running.	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
32/52	Neutral Switch	On/Off	Indicates the neutral switch condition. [ON] is indicated while the neutral switch is ON.	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
33/52	Diagnostic Switch	On/Off	Indicates the diagnostic switch (when pins of DLC are connected). Indication is turned [ON] when the pins of DLC are connected.	If the indication does not change, any fault is in the switch, circuit or ECM. Check the DLC, circuit and ECM in such a case.
34/52	Key Switch	On/Off	Indicates the indication when the key switch is set to the [ON] position. When the key switch position is [ON], the indication is [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
35/52	Idle Position Switch	On/Off	Indicates the signal value of the switch installed to the accelerator pedal. Monitors the pedal position mutually with the accelerator pedal position sensor. At idling, the indication is turned [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
36/52	AC Switch	On/Off	Indicates the condition of the air conditioning switch. When the air conditioning switch is turned [ON], the indication becomes [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
37/52	Clutch Switch	On/Off	Indicates the clutch switch condition. When the clutch switch is turned [ON], the indication becomes [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
38/52	Exhaust Brake Switch	On/Off	Indicates the condition of the exhaust brake switch. When the exhaust brake switch is turned [ON], the indication becomes [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
39/52	Exhaust Brake (AT) Cutoff Switch	On/Off	On a vehicle equipped with an automatic transmission, when the engine coolant temperature is low, the exhaust brake is controlled and operated. Condition at this time is indicated. The indication is usually [OFF].	If the value does not change, poor communication with the AT control unit, system failure of AT, faulty ECM or AT control unit, or fault in the exhaust brake or circuit is the cause. Check them in such a case.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
40/52	Exhaust Brake (ASR) Cutoff Switch	On/Off	On the vehicle equipped with ASR, when the ASR operates, it controls the exhaust brake and stops it. Condition at this time is indicated. Usually [OFF is indicated, which is changed to [ON] when ASR is operated.	If the value does not change, improper communication with ABS/ASR control unit, system failure of ABS or ASR, faulty ECM or ABS/ASR control unit, or fault in the circuit is the cause. Check them in such a case.
41/52	PTO Switch	On/Off	Indicates the condition of PTO switch. When the PTO switch is turned [ON], the indication is turned [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
42/52	Idle Speed Control	On/Off	Indicates the engine idling condition. When ECM judges the engine idling, the indication is turned [ON].	When the indication does not change, some fault is in the various sensors (rotating sensor system), idle position switch, circuit or ECM. Check the sensor, switch, circuit, and ECM.
43/52	Engine Stop Switch	On/Off	Indicates the engine stop condition. When ECM determines engine stop, the indication is turned [ON].	If the indication does not change, any fault is in the motor unit, circuit or ECM. Check the motor unit, circuit and ECM in such a case.
44/52	Engine Start	On/Off	Indicates the starter motor operating condition. While the starter motor is operating, the indication is [ON].	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
45/52	Accelerator Switch	On/Off	ECM uses it to know the “Accelerator pedal opening condition” for various controls such as a starting control. When the accelerator pedal opening exceeds 50%, the indication is turned [ON].	If the indication does not change according to the accelerator pedal stepping travel, some fault is in the sensor, circuit, throttle valve or ECM. Check the sensor, circuit, accelerator pedal or ECM in such a case.
46/52	Fuel Inj. Amount Limit (Injection)	On/Off	Indicates limit of fuel injection. When the fuel injection is restricted by the failsafe function due to failure, etc., the indication is turned [ON].	If the indication turns to [ON], failure has occurred in some unit. Check DTC or other units and repair.
47/52	TCV Feedback	On/Off	When the engine starts rotating, TCV starts operating. ECM monitors the operation of TCV based on the signal from TCV and [ON] is indicated while the signal is being sent from TCV.	If the indication does not change, some fault is in the timing control valve, sensors or circuits or ECM. Check the valves, sensors, circuits and ECM in such a case.

Item	Tech 2 Data Display	Unit	Description	How to use parameters
48/52	Thermo Switch	On/Off	Indicates the condition of the thermo switch which operates QWS. When the coolant temperature is low, the thermo switch is turned [ON] and operates QWS.	If the indication does not change, any fault is in the switch, circuit or ECM. Check the switch, circuit and ECM in such a case.
49/52	Exhaust Press. Valve 1	On/Off	Indicates the condition of VSV which operates the exhaust brake. When VSV starts operation, the indication is turned [ON].	If the indication does not change, any fault is in the switch, VSV, circuit or ECM. Check the switch, VSV, circuit and ECM in such a case.
50/52	Glow Time Lamp	On/Off	Indicates operating condition of glow (QOS) lamp. When the lamp illuminates, the indication is turned [ON].	If the indication does not change, any fault is in the lamp, circuit or ECM. Check the lamp, circuit and ECM in such a case.
51/52	Glow Time Relay	On/Off	Indicates operating condition of the glow (QOS) relay. When the relay starts operation, the indication is turned [ON].	If the indication does not change, any fault is in the relay, circuit or ECM. Check the relay, circuit and ECM in such a case.
52/52	Starting Counter	— (Counts)	Frequency of signals given to the starter switch [S] is counted and indicated.	Check the frequency at the time of maintenance of the idling stop system.

(The display menu of Tech 2 may vary depending on the version of the Tech 2 software or may be subjected to modification without notice.)

Diagnostic Chart

DTC	Sensor actuator (detection item)		CHECK ENGINE lamp ON	Exhaust brake lamp blinking	Judgment criterion	Failsafe	Major fault	Point inspected
11	No Signal Crank Position Sensor (CKP Sensor)	Connector not Connected, Harness Open Wiring or Short, Failed Main Unit	ON	—	When not CKP signal is detected during 4 continuous broken tooth judgment at the idle speed.	Prohibition of feedback control. Prohibition of warm-up system, EGR, intake air throttling. Restricts the output.	Large knocking sound, poor driveability.	Wire harness and connector (CKP signal system), crank position sensor, ECM.
13	Timing Control Valve (TCV) Fault		ON	—	When the injection timing feedback is controlled, after complete warm-up, absolute value of difference between the target TCV advance and actual TCV advance is more than 7°CA continuously for more than 20 seconds.	Prohibition of warm-up system, EGR, intake air throttling. Restricts the output.	Large knocking sound, poor driveability.	Wire harness and connector (TCV system), timing control valve, ECM, fuel filter, fuel, injection pump.
14	Pump ROM Fault		ON	—	Fault of communication with pump ROM.	Corrects using data in EEPROM until communication is completed. Then there is no data, no correction is made until completion of initial com-munication. Restricts the output.	Large knocking sound, poor driveability.	Wire harness and connector (pump ROM system), pump ROM, ECM.

DTC	Sensor actuator (detection item)		CHECK ENGINE lamp ON	Exhaust brake lamp blinking	Judgment criterion	Failsafe	Major fault	Point inspected
15	Pump Cam Sensor (NE Sensor) Short Break Fault	Connector not Connected, Harness Open Wiring or Short, Failed Main Unit	—	—	When the engine speed is more than 650rpm, pump cam sensor (NE) signal fault is detected more then 10 times.		Engine stall	Wire harness and connector (NE signal system), NE sensor, ECM.
16	No Signal (Open Wiring) From Pump Cam Sensor (NE Sensor)		ON	—	No NE pulse is entered at idle speed in other than starting state. Or, after the starter switch turned ON, no NE pulse is entered and the ECM input voltage becomes below 22V even once, and when the starter switch turned OFF, the ECM input voltage exceeds 22V even once.	Spill valve relay OFF, Timing control valve ON/OFF, Fixes the time.	Engine stall, Cannot start.	Wire harness and connector (NE system), NE sensor, ECM.
21	Engine Coolant Tempera-ture Sensor (ECT Sensor) Fault		ON	—	When engine coolant temperature sensor output voltage more than 4.9V continues.	Controls using set value of coolant temperature (starter switch ON: 20°C, starter switch OFF: 110°C) Warm-up system, EGR.	Faulty starting in cold state, poor driveability.	Wire harness and connector (coolant temperature sensor system), coolant temperature sensor, ECM.
23	Intake Air Tempera-ture Sensor (IAT Sensor) Fault		ON	—	When intake air temperature sensor output voltage below 0.05V or voltage over 4.95V continues.	Controls using the set value of intake air temperature (25°C). Idle stop prohibited.	Poor driveability	Wire harness and connector (intake air temperature sensor system), intake air temperature sensor, ECM.

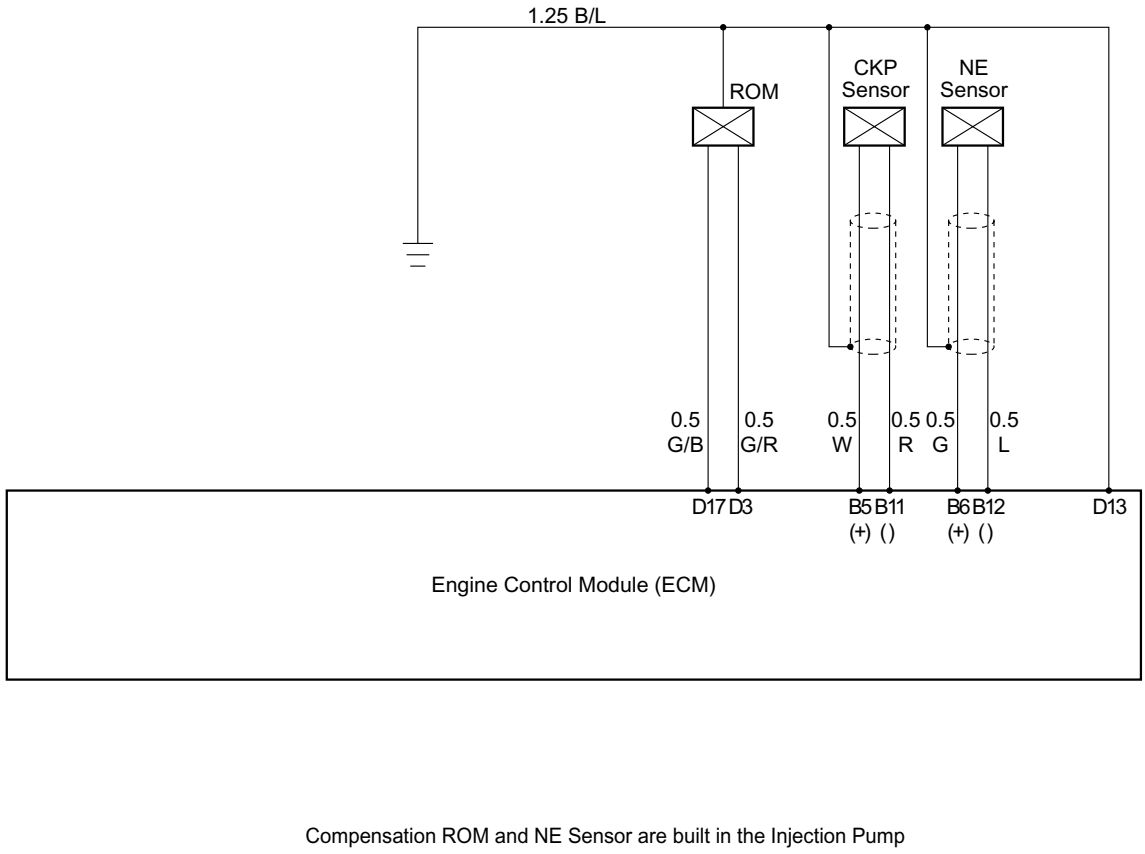
DTC	Sensor actuator (detection item)		CHECK ENGINE lamp ON	Exhaust brake lamp blinking	Judgment criterion	Failsafe	Major fault	Point inspected
24	Accelerator Position Sensor (AP) High Voltage, Low Voltage	Connector not Connected, Harness Open Wiring or Short, Failed Main Unit	ON	ON	When accelerator position sensor output voltage below 0.1V or over 4.85V continues.	Prohibits the exhaust brake, warm-up system, EGR, intake air throttling, controls the accelerator opening to restrict the output, and fix to 0% or 30% (idle position switch fixed to OFF : 30%, idle position switch ON: 0%).	Poor driveability	Wire harness and connector (AP signal system), accelerator position sensor, ECM.
25	No Signal from Vehicle Speed Sensor (VS Sensor)		ON	—	When the clutch and gear are connected (normal clutch switch, neutral sensor) and engine speed is over 2200rpm, vehicle speed is 0 km/h for more than 5 seconds.	Warm-up system prohibited	Improper speedometer indication	Wire harness and connector (vehicle speed sensor system), vehicle speed sensor, ECM.
31	Idle Up Volume Fault		—	—	When idle up volume output voltage below 0.2V or above 4.8V continues.	Idle up control prohibited	Poor driveability	Wire harness and connector (idle up volume signal system), idle up volume, ECM.
32	Intake Air Pressure Sensor (MAP Sensor) Fault		ON	—	When intake air pressure signal voltage over 4.9V or below 0.1V detected for more than 3 seconds.	ECM continues control using the set value of 100kPa.	Poor driveability	Intake air pressure sensor, intake air sensor circuit, ECM.

DTC	Sensor actuator (detection item)		CHECK ENGINE lamp ON	Exhaust brake lamp blinking	Judgment criterion	Failsafe	Major fault	Point inspected
34	Exhaust Brake Open Wiring Fault	Connector not Connected, Harness Open Wiring or Short, Failed Main Unit	ON	ON	When ECM input voltage is over 16V, exhaust brake VSV is ON at idle speed, when VSV signal voltage is LOW or VSV is OFF, or when VSV signal voltage at HI continues.	Prohibits the exhaust brake	Poor driveability	Exhaust brake VSV circuit, exhaust brake VSV, main relay, ECM.
35	Neutral Switch (P/N Switch) Fault		ON	ON	If the neutral switch is not changed from ON to OFF when the engine is rotating more than 60 seconds and the vehicle speed is over 80 km/h.	Prohibits the exhaust brake and warm-up system.	Poor driveability	Neutral switch, HSA, instrument panel, vehicle speed sensor, ECM.
36	Clutch Switch Fault		ON	ON	If the clutch switch is not changed from ON or OFF, or from OFF to ON when the engine is rotating for more than 180 seconds after the engine starts (M/T vehicle).	Prohibits exhaust brake and warm-up system.	Poor driveability	Clutch switch, HSA, instrument panel, vehicle speed sensor, ECM.
41	Fuel Tempera-ture Sensor (FT Sensor) Circuit High Voltage		ON	—	When output voltage of fuel temperature sensor over 4.9V continues.	Controls using the fuel temperature set value (40°C). Idle stop prohibited.	Poor driveability	Wire harness and connector (fuel temperature sensor system), fuel temperature sensor, ECM.

DTC	Sensor actuator (detection item)		CHECK ENGINE lamp ON	Exhaust brake lamp blinking	Judgment criterion	Failsafe	Major fault	Point inspected
51	Atmospheric Pressure Sensor Fault		ON	—	When output voltage of atmospheric pressure sensor under 1.9V or over 4.7V continues.	Controls using the atmospheric pressure set value (100 kPa). Idle stop prohibited.	Poor driveability	Replace the ECM.
52	ECM CPU Fault		—	—	When the ECM input voltage is over 22V and starter switch is OFF at the initial stage.	Restricts the limit accelerator opening to below specified value and returns the limit value gradually. Restricts the output. Idle stop prohibited.	Engine stall	ECM, non OEM parts, etc.
	ECM CPU Fault (Diagnosis with SUB-CPU in ECU)		—	—	When EEPROM judges ECM fault.	SPV relay/glow relay OFF. Prohibits injection command on EDU. Exhaust brake ON. Idle stop prohibited.	Engine stall	ECM
—	ECM High Integrated IC Fault		ON	—	When pulse signal fault continues in ECU with the starter switch OFF, ECM input voltage over 22V (faulty EEPROM).	Restricts the output. Idle stop prohibited.	Poor driveability	ECM
53	Engine Driver Unit (EDU) Fault	Connector not Connected, Harness Open Wiring or Short, Failed Main Unit	ON	—	When ECU fault and open wiring of SPV continues more than 5 times.	SPV and SPV relay OFF. Prohibition of injection command to EDU and feedback control. Exhaust brake ON, Idle stop prohibited.	Engine stall	ECM, EDU, spill valve (SPV), spill valve relay.

DTC	Sensor actuator (detection item)		CHECK ENGINE lamp ON	Exhaust brake lamp blinking	Judgment criterion	Failsafe	Major fault	Point inspected
55	Pump Unmatch (Difference from ECM Specifications)		ON	—	When pump ROM does not conform with ECM (normal pump ROM)	Restricts the output. Idle stop prohibited.	Cannot start	ECM (injection pump identification).
65	Idle Position Switch Fault	Connector not Connected, Harness Open Wiring or Short, Failed Main Unit	ON	ON	Idle position switch OFF when the accelerator position sensor output voltage is under 0.6V, or idle position switch is ON when the accelerator position sensor output voltage is over 1.0V for more than 10 seconds but the accelerator position sensor is normal. Or when the sensor output voltage is out of the specified value range: < AP sensor adjustment reference voltage> • Idle point: 0.43 ~ 0.73V • WOT point: 4.10 ~ 4.70V • Input voltage: 5V (idle position switch operating voltage: 0.59 ~ 0.79V).	Restricts the output. Prohibits the exhaust brake and warm-up system. Idle stop prohibited.	Poor driveability	Idle position switch, ECM.

DTC11 - No Signal CKP Sensor



Circuit Description

CKP (crank position) sensor generates CKP reference signal. While the crank shaft rotates once, a CKP reference pulse is generated.
ECM calculates the engine speed and crankshaft position using the CKP reference signal.
DTC 11 is set when ECM receives no pulse on the CKP reference circuit.

Major Faulty Event

- Large knocking sound
- Poor driveability

Conditions for Setting the DTC

- While broken tooth judgment is carried out 4 continuous times at the idle speed, not any CKP signal is detected.

Action Taken when the DTC Sets

- ECM illuminates the CHECK ENGINE Lamp (MIL) when DTC is set.
- Advance feedback control prohibited
- Warm-up system prohibited
- EGR prohibited
- Intake air throttle prohibited
- Output restricted

Conditions for Clearing MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

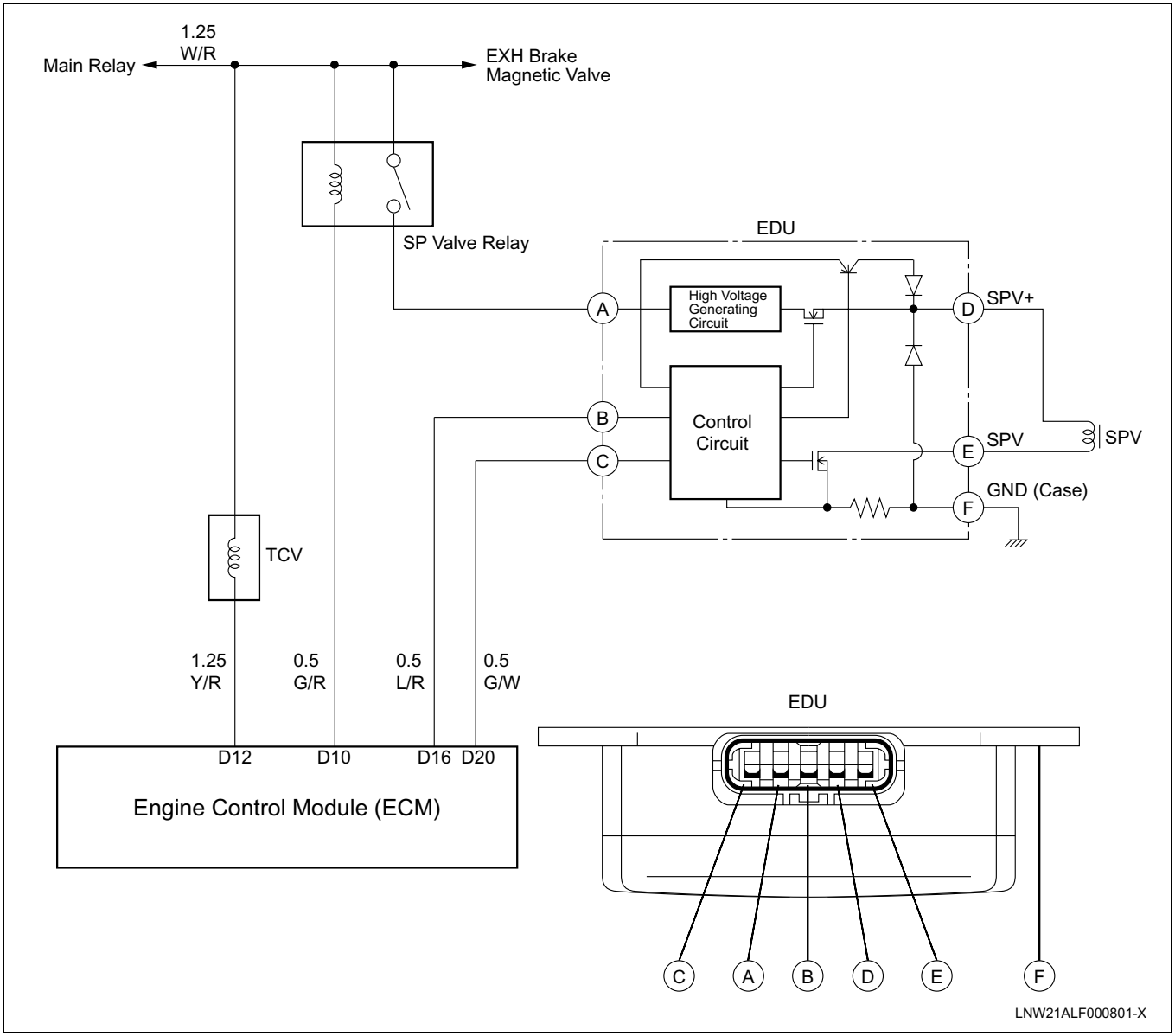
An intermittent may be cause by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following conditions.

- Poor connection: Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged pin, and pin-to-wire connection
- Damaged harness: Check the wiring harness for damage.

Step	Action	Value(s)	Yes	No
1	Perform the "On-Board Diagnostic (OBD) System Check.?	—	Go to Step 2	Go to "OBD System Check"
2	1. Review and record the failure records information. 2. Clear DTC 11. 3. Start the engine and idling for 1 minute. 4. Observe DTC. Was DTC 11 set up?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	Check the CKP sensor is correctly installed. If a problem, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	Starter switch "OFF". Disconnect the ECM connector and measure the resistance value between CKP+ and CKP–. Is the value normal?	25Ω	Go to Step 8	Go to Step 5
5	Remove the CKP sensor connector. Measure the resistance value between pins of the sensor. Is the value normal?	25Ω	Go to Step 6	Go to Step 7
6	Repair the open wiring or poor connection of between ECM and CKP. Is the repair complete?	—	Verify repair	—
7	Replace the CKP sensor. Is the action complete?	—	Verify repair	—
8	Check the CKP sensor circuit for +B short or ground short. If a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	Remove the CKP sensor. Turn the crankshaft, and check from the CKP sensor installing hole for damage of the pointer. If a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 10
10	Check the ECM connecter pin for fault. If a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC13 - TCV Fault



Circuit Description

Timing control valve (TCV) is installed to the injection pump. Electric signal from ECM opens or closes the fuel passage between the high pressure chamber and low pressure chamber of the timer piston. When current flows to the coil, the stator core becomes an electromagnet, which contracts the spring, the moving core is absorbed and the fuel passage is opened.
ECM controls the TCV (duty control) and controls the fuel injection start timing.
DTC 13 is set up when the target advance is remarkably different from the actual advance.

Major Faulty Event

- Large knocking sound
- Poor driveability

Conditions for Setting the DTC

- At the injection timing feedback, after complete warm-up, absolute value of difference more than 7°CA between the target TCV advance and actual TCV advance has continued for more than 20 seconds.

Action Taken when the DTC Sets

- When any failure is detected first time, ECM illuminates the CHECK ENGINE Lamp (MIL).
- Warm-up system, EGR and intake air throttle are prohibited.
- Output is restricted.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

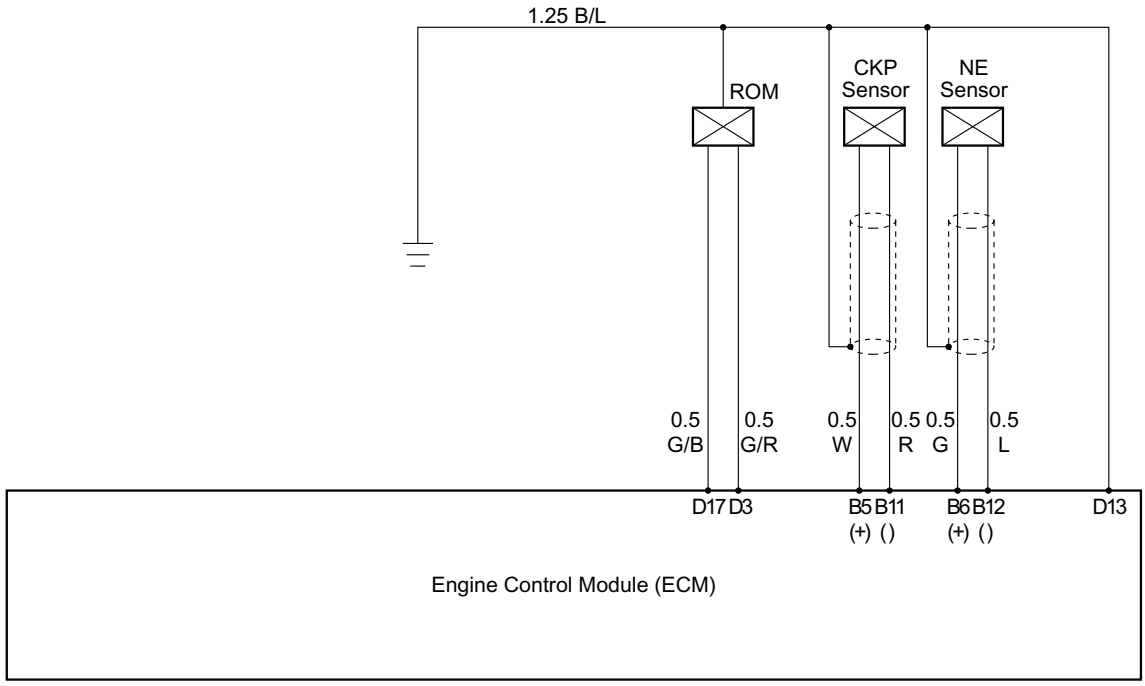
Diagnostic Aids

Check for the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.

Step	Action	Value(s)	Yes	No
1	Perform the "On-Board Diagnostic (OBD) System Check.?	—	Go to Step 2	Go to "OBD System Check"
2	1. Review and record the failure records information. 2. Clear DTC 13. 3. Start the engine, and run the idling until the coolant temperature increases above 60°C. 4. Observe the DTC. Set the DTC 13?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	1. Starter switch “OFF”. 2. Disconnect the TCV. 3. Check for open wiring or ground short between TCV connector and ECM harness connector and between the TCV connector and power source. 4. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	Check the connection at TCV and replace the pin as necessary. Was replacement of pin required?	—	Verify repair	Go to Step 5
5	Check the connection at ECM and replace the pin if required. Was the replacement of the pin required?	—	Verify repair	Go to Step 6
6	Measure the resistance value between the TCV connecter pins Is the value normal?	45Ω	Go to Step 7	Go to Step 8
7	Check the timing gear installing condition. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9
8	Replace the injection pump Was DTC 13 set up after the step?	—	Verify repair	Go to Step 9
9	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC14 - Pump ROM Fault



Circuit Description

Pump ROM corrects discrepancy of injection amount and injection timing caused by discrepancy of correlation between the NE (pump cam) signal and injection waveform, precisely for each injection pump. NE signal is detected by the NE sensor and used to control the injection amount, injection timing and idle speed.
ECM controls the injection amount and injection timing based on the signal from the pump ROM, CKP sensor and NE sensor. DTC 14 is set up when communication fault is caused with the pump ROM.

Major Faulty Event

- Poor driveability

Conditions for Setting the DTC

- When Fault is caused in the communication with the pump ROM when data is being received.

Action Taken when the DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- ECM continues control using the set value.
- Output is restricted.

Conditions for Clearing MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.

- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

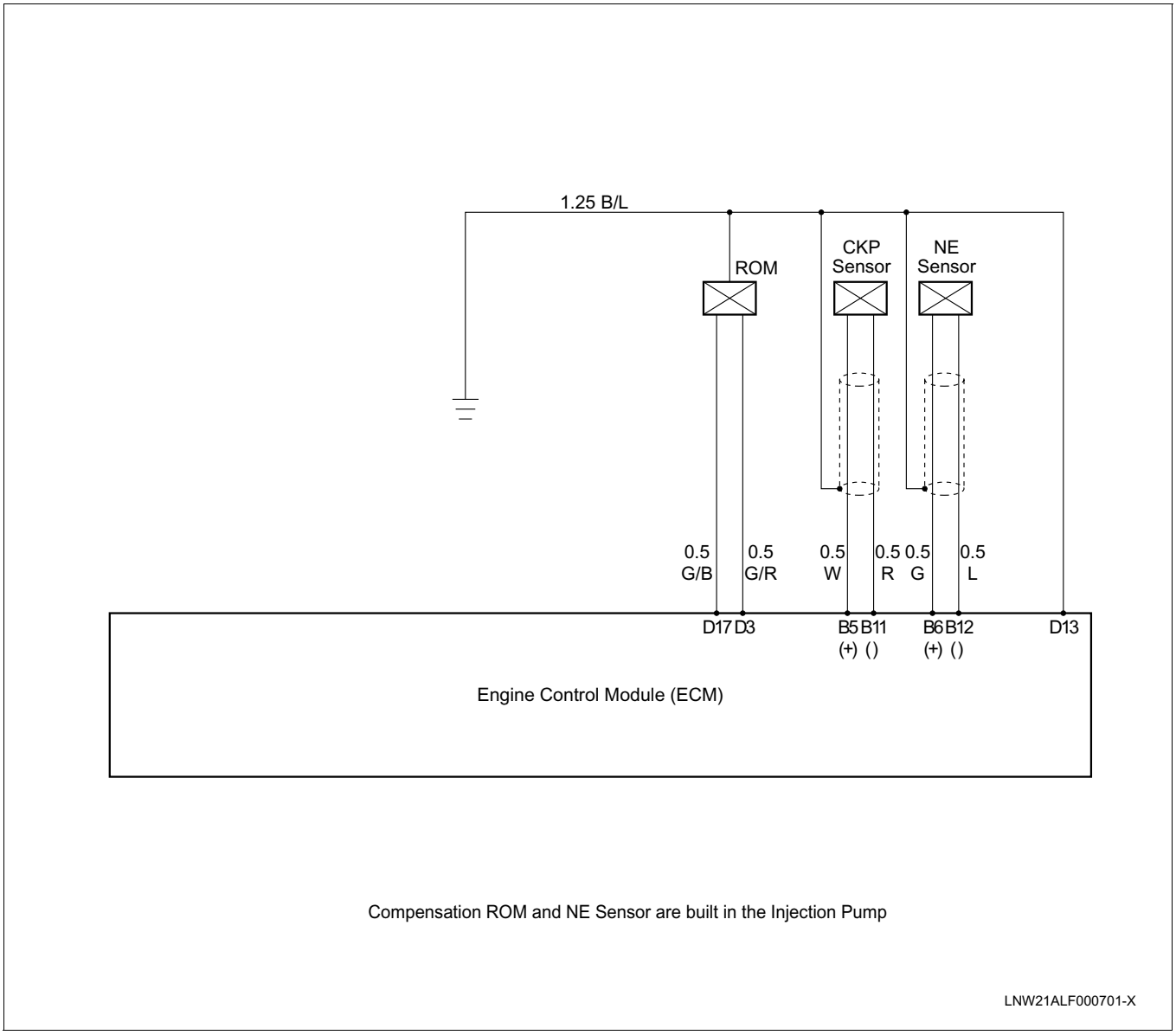
Diagnostic Aids

An intermittent may because by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following conditions.

- Poor connection: Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged pin, and pin-to-wire connection
- Damaged harness: Check the wiring harness for damage.

Step	Action	Value(s)	Yes	No
1	Perform the "On-Board Diagnostic (OBD) System Check.?	—	Go to Step 2	Go to "OBD System Check"
2	1. Review and record the failure records information. 2. Clear DTC 14. 3. Start the engine, and run the idling for 5 minutes. 4. Observe the DTC. Set the DTC 14?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	1. Starter switch "OFF". 2. Disconnect the pump ROM. 3. Check the pump ROM circuit between the pump ROM connector and ECM harness connector for open wiring or ground short. 4. Check for open wiring between the pump ROM connector and ground. 5. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	Check the connection at the pump ROM and replace the pin as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 5
5	Check the connection at ECM and replace the pin as necessary. Was replacement of the pin required?	—	Verify repair	Go to Step 6
6	Replace the injection pump. Set the DTC14 after completion of the step?	—	Verify repair	Go to Step 7
7	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC15 - Pump Cam Sensor (NE Sensor) Short Break Fault



Circuit Description

The NE (pump cam) sensor generates NE signal. ECM determines the injection amount and injection timing using the NE signal and starts the fuel injection.
DTC 15 is set up when the number of pulses on the NE standard circuit received by ECM is not proper.

Major Fault Event

- Engine stall

Conditions for Setting the DTC

NE signal Fault arose more than 10 times detect when the engine speed is more than 650rpm.

Action Taken when the DTC Sets

- If any failure is detected, the CHECK ENGINE Lamp (MIL) is kept ON (not blinking). (DTC is checked by Tech 2 or diagnosis switch.)

Conditions for Clearing MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)

4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

An intermittent may be cause by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following conditions.

- Poor connection: Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged pin, and pin-to-wire connection
- Damaged harness: Check the wiring harness for damage.

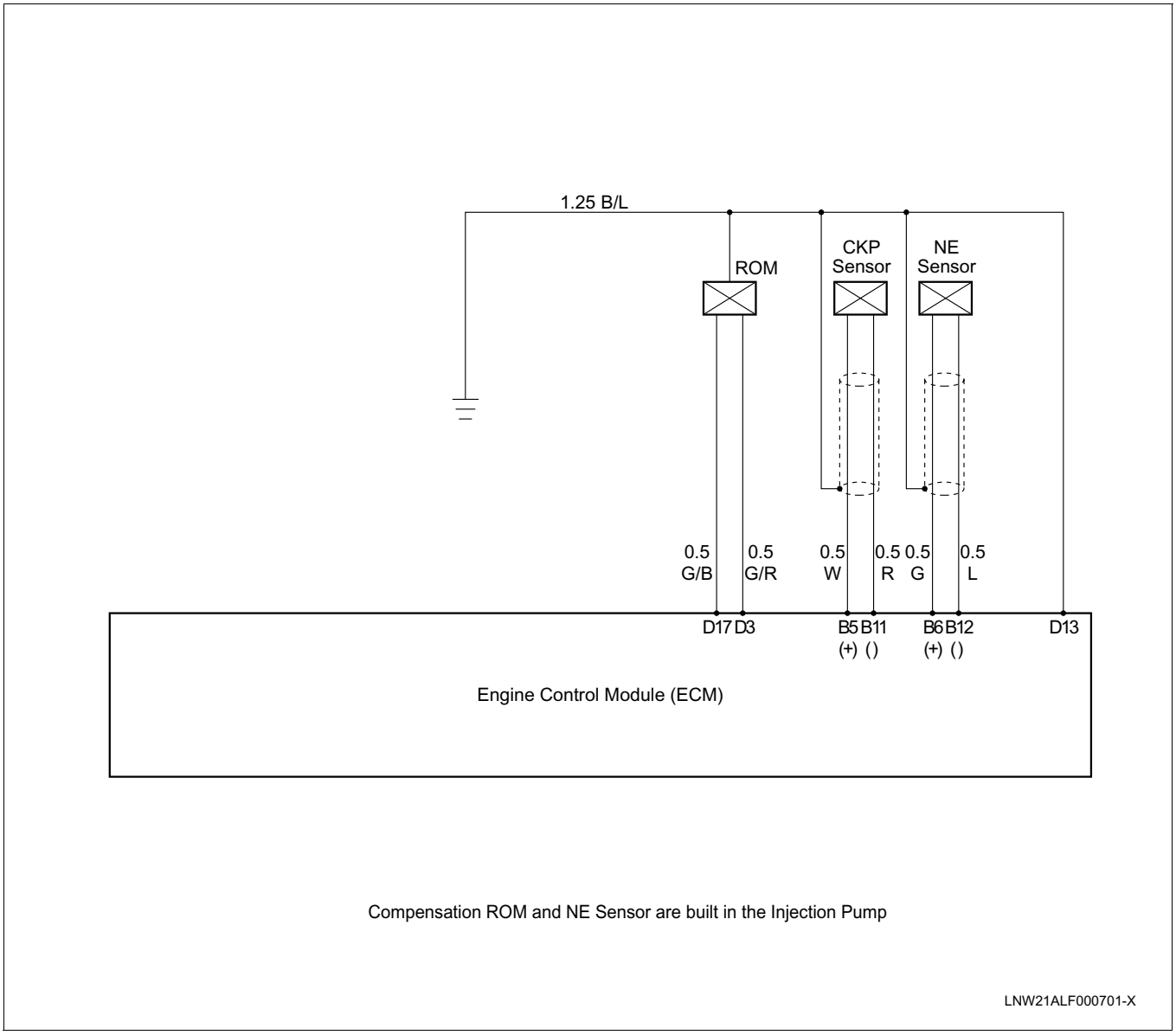
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Check for the presence of failure.

Step	Action	Value(s)	Yes	No
1	Perform the "On-Board Diagnostic (OBD) System Check.?	—	Go to Step 2	Go to "OBD System Check"
2	1. Review and record the failure records information. 2. Clear DTC 15. 3. Start the engine and running within the safety range. 4. Observe the DTC. Set the DTC 15?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	1. Starter switch "OFF". 2. Disconnect the NE sensor. 3. Check for open wiring, ground short or +B short between the NE censor connector and ECM connector. 4. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	Check the connection at the pump ROM and replace the pin as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 5
5	Check the connection at ECM and replace the pin as necessary. Was replacement required?	—	Verify repair	Go to Step 6
6	Replace the injection pump. Set the DTC15 after completion of the step?	—	Verify repair	Go to Step 7
7	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC16 - No Signal from Pump Cam Sensor (NE Sensor)



Circuit Description

The NE (pump cam) sensor generates NE signal. ECM determines the injection amount and injection timing using the NE signal and starts the fuel injection.
DTC 16 is set up when ECM does not receive NE signal.

Major Faulty Conditions Fault Condition

- Engine stall
- Engine cannot start.

Conditions for Setting the DTC

- NE signal is not received at the idle speed, except for the starting.
- When all of the following conditions are met:

1. When the starter switch is turned ON, no NE signal is received.
2. When the starter switch is turned ON, ECM input voltage decreases below 22V even once.
3. When the starter switch is turned OFF, ECM input voltage increases over 22V even once.

Action Taken when DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- Injection signal is stopped.
- Spill valve relay is turned OFF.
- Timing control valve ON/OFF time is fixed.

Conditions for Clearing MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

An intermittent may be cause by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following conditions.

- Poor connection: Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged pin, and pin-to-wire connection
- Damaged harness: Check the wiring harness for damage.

Test Description

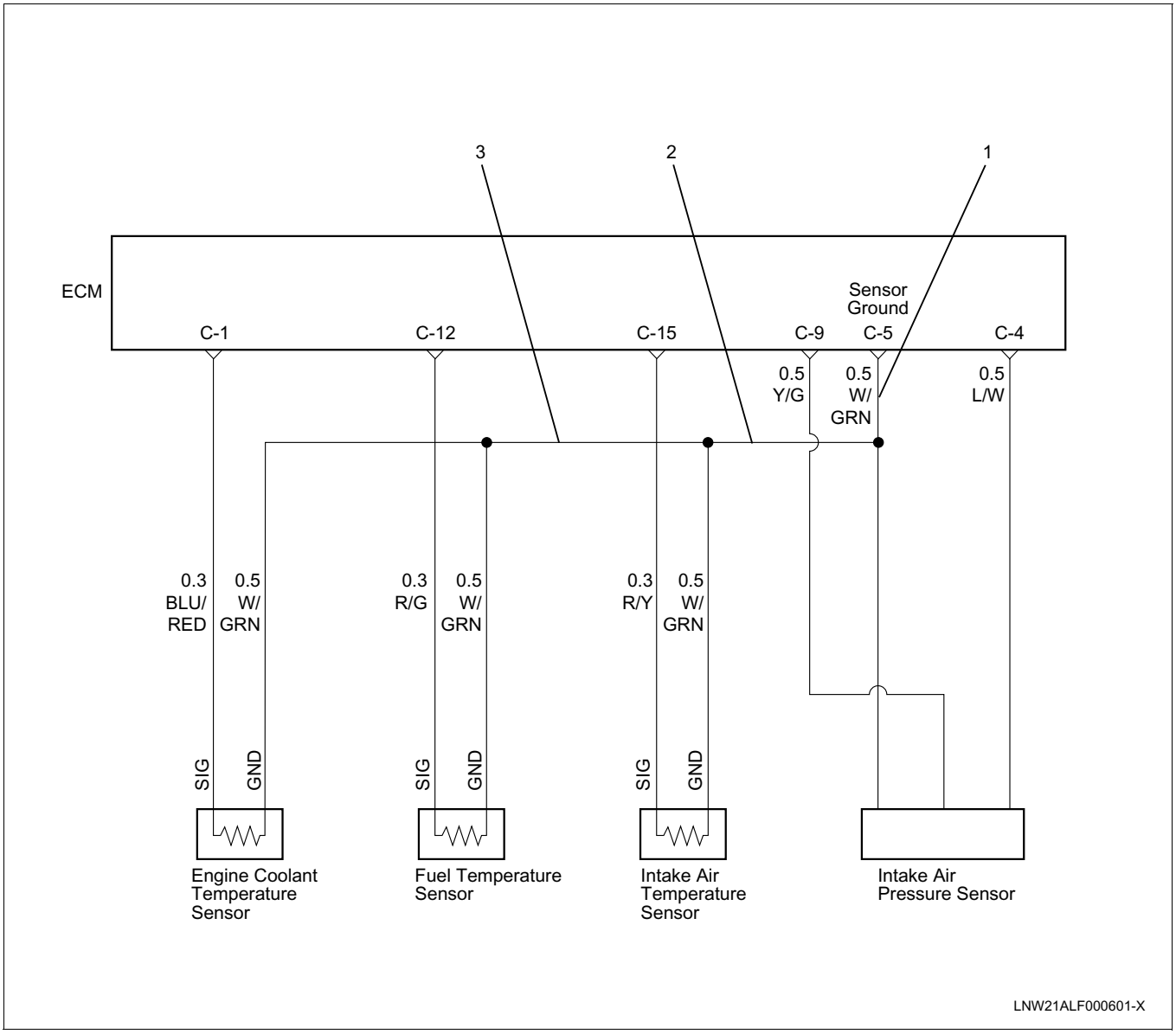
Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Check of the presence of failure.

Step	Action	Value(s)	Yes	No
1	Perform the "On-Board Diagnostic (OBD) System Check.?	—	Go to Step 2	Go to "OBD System Check"
2	1. Review and record the failure records information. 2. Clear DTC 16. 3. Crank the engine. 4. Observe the DTC. Set the DTC 16?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	1. Starter switch "OFF". 2. Disconnect the ECM. 3. Measure the resistance value between NE+ and NE– pins of the ECM connector. Is the value normal?	230Ω	Go to Step 6	Go to Step 4
4	1. Starter switch "OFF". 2. Disconnect the NE sensor. 3. Measure the resistance value between NE sensor connector pins. Is the value normal?	230Ω	Go to Step 5	Go to Step 8
5	Repair the open wiring or poor connection of between ECM and NE sensor. Is the repair complete?	—	Verify repair	—
6	Check for +B short or ground short in the NE sensor circuit. If a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Check for fault in the ECM connecter pin. If a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 8
8	Replace the injection pump. Was DTC16 setting cleard after the replacement?	—	Verify repair	Go to Step 9
9	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC21 - ECT Sensor Fault



Circuit Description

The ECT (engine coolant temperature) sensor is of the thermistor type. Resistance value changes according to the changes of the temperature. Resistance value is smaller when the engine coolant temperature is higher and increases with the decrease of the engine coolant temperature.

ECM applies voltage of 5V to the ECT sensor through the pull up resistance of the voltage. Engine coolant temperature is detected based on the changes of voltage. The voltage is decreased when the resistance is small (the temperature is high) while increased when the resistance is large (the temperature is low).

DTC 21 will be set when the signal voltage is excessively high or low.

Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 in figure is a common ground for the engine coolant temperature sensor, fuel temperature sensor, intake air temperature sensor , intake air pressure sensor and EGR position sensor. In the event of the open wiring in wire 1, DTC 21, 23, 41 and 32 are indicated at the same time. In the event of the open wiring in wire 2, DTC 21, 23, and 41 are indicated at the time. Like this, the case where two or more DTC's are displayed is the multiple DTC.
- If multiple DTC21, 23, 41, and 32 are displayed, the ground wire 1 must be checked.
- If multiple DTC21, 23, and 41 are displayed, the ground wire 2 must be checked.
- If multiple DTC21 and 23 are displayed, the ground wire 3 must be checked.

DTC	Sensor actuator (detection item)	
21	Engine coolant temperature sensor (ECT)	Connector not connected, open wiring or short of harness, failure of main unit
23	Intake air temperature sensor	
41	Fuel temperature sensor	
32	Intake air pressure sensor	

Major Faulty Event

- Faulty starting in cold state
- Poor driveability

Conditions for Setting the DTC

- When coolant temperature output voltage over 4.9V has continued.

Conditions for Clearing MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.

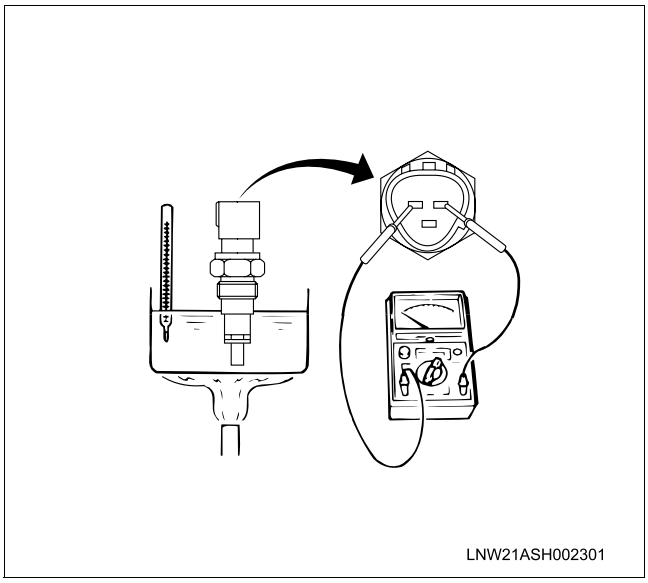
Test Description

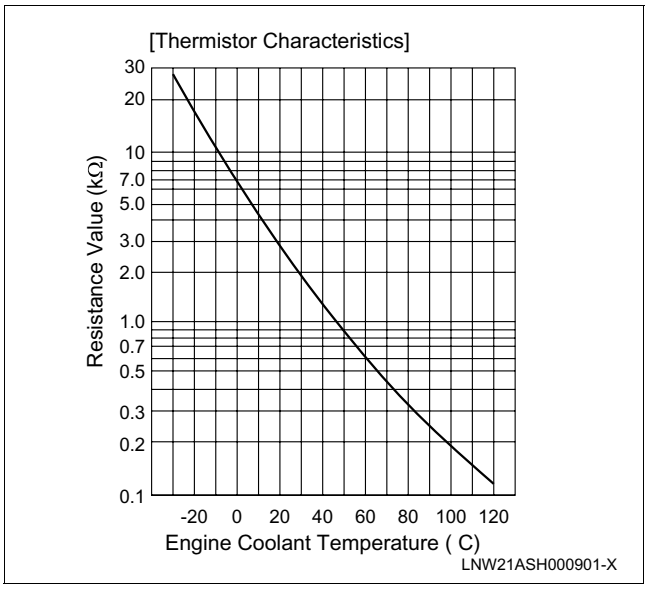
Number(s) below refer to the step number(s) on the Diagnostic Chart.
2. Check for the presence of failure.
3. If the repeat of DTC 21 is possible only by reproducing the failure record condition, refer to the table of "Temperature vs resistance value". ECT sensor can be tested to check for deviation in the sensor at various temperature using this table. If deviation exists in the sensor, replace the ECT sensor. When the ECT sensor is normal, the failure is an intermittent operation.

Engine Coolant Temperature Sensor

°C	Ω
Temperature vs. resistance value (approximate value)	
20	2500
50	840
90	247

1. Immerse the temperature sensing part of the sensor in the water and check the changing resistance values changing the coolant temperature.

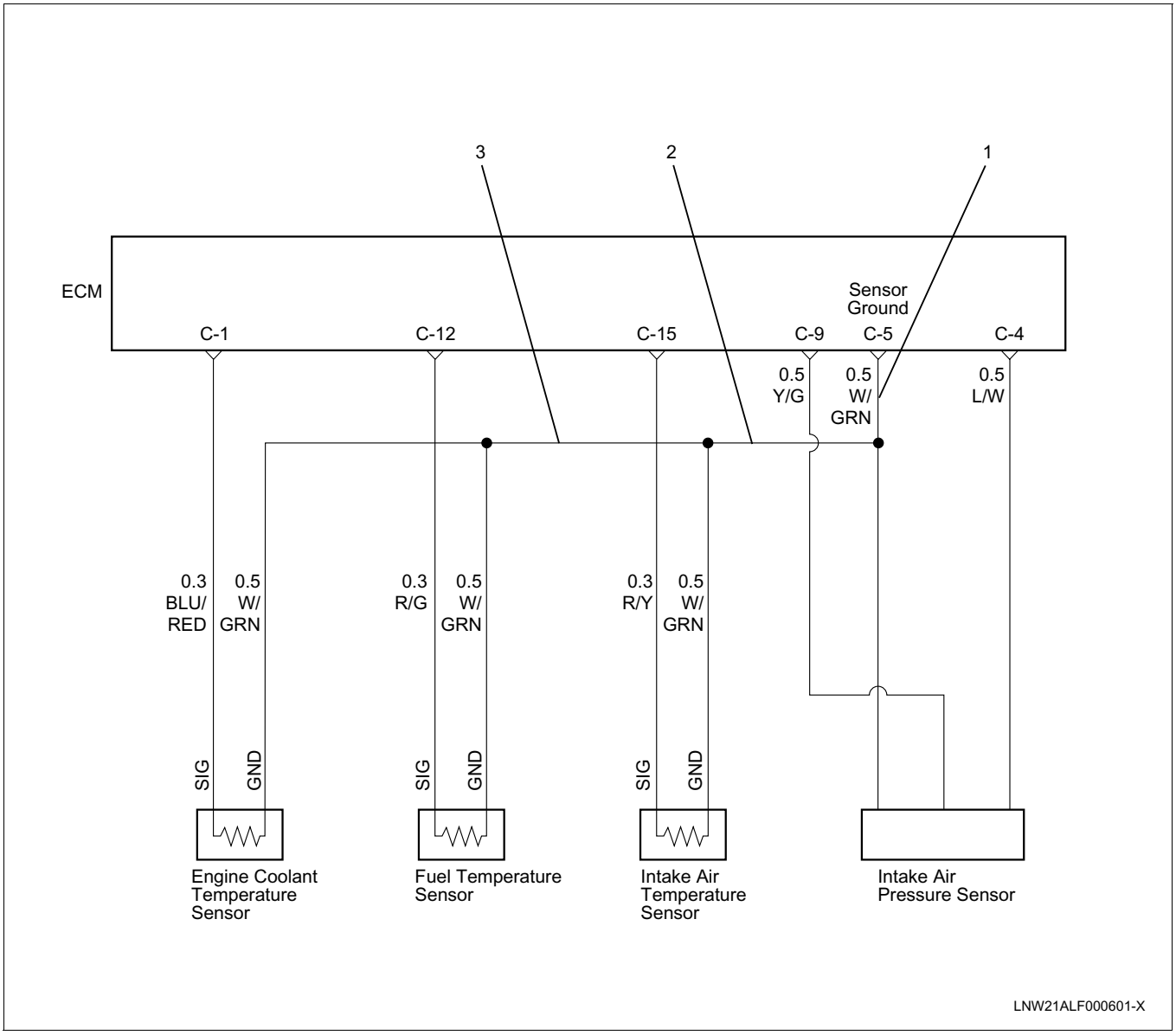




Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnosis (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON". 2. Using Tech 2, monitor the coolant temperature sensor output voltage display. Is the coolant temperature sensor output voltage higher than specified value?	4.9V	Go to Step 4	Go to Step 3
3	1. Starter switch "ON". Stop the engine. 2. Using Tech 2, monitor the DTC 21 Does Tech 2 display the DTC 21?	—	Refer to “Test Description”	Refer to "Diagnostic Aids"

Step	Action	Value(s)	Yes	No
4	1. Disconnect the ECT sensor electric connector. 2. Connect the ECT signal circuit and sensor ground circuit through a jumper with the ECT sensor harness connector. 3. Using Tech 2, monitor the coolant temperature sensor output voltage display. Is the coolant temperature sensor output voltage below specified value?	0.05V	Go to Step 6	Go to Step 5
5	1. Connect the ECT signal circuit of the ECT sensor harness connector through a jumper to the chassis ground. 2. Using Tech 2, monitor the coolant temperature sensor output voltage display. Is the coolant temperature sensor output voltage specified value?	0.05V	Go to Step 7	Go to Step 8
6	Check for poor connection on the ECT sensor and replace the pin as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 10
7	1. Starter switch "ON". 2. Disconnect the ECM and check for open wiring in the ECT sensor ground circuit. 3. If open wiring exists in the ECT sensor ground circuit, repair as necessary. Was there open wiring in the ECT sensor ground circuit?	—	Verify repair	Go to Step 9
8	1. Starter switch "ON". 2. Disconnect the ECM and check for open wiring in the ECT signal circuit. 3. If open wiring exists in the ECT sensor signal circuit, repair as necessary. Was there open wiring in the ECT signal circuit?	—	Verify repair	Go to Step 9
9	Check the ECM for poor connection of the sensor ground pin or poor connection of ECT signal circuit pin and replace the pin as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 11
10	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
11	Replace the ECM. Is the action complete?	—	Verify repair	—

DCT23 - IAT Sensor Fault



Circuit Description

IAT (intake air temperature) sensor is of the thermistor type. Resistance value changes according to the changes of temperature. Resistance value is smaller when the intake air temperature is higher and increases with the decrease of the intake air temperature.
ECM applies voltage of 5V to the IAT sensor through the pull up resistance. Intake air temperature is detected based on the changes of voltage. The voltage is decreased when the resistance is small (the temperature is high) while increased when the resistance is large (the temperature is low).
DTC 23 will be set when the signal voltage excessively high or excessivly low.

Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 in above figure is a common ground for the engine coolant temperature sensor, fuel temperature sensor, intake air temperature sensor , intake air pressure sensor and EGR position sensor. In the event of the open wiring in wire 1, DTC 21, 23, 41 and 32 are indicated at the same time. In the event of the open wiring in wire 2, DTC 21, 23, and 41 are indicated at the time. Like this, the case where two or more DTC's are displayed is the multiple DTC.
- If multiple DTC21, 23, 41, and 32 are displayed, the ground wire 1 must be checked.

- If multiple DTC21, 23, and 41 are displayed, the ground wire 2 must be checked.
- If multiple DTC21 and 23 are displayed, the ground wire 3 must be checked.

DTC	Sensor actuator (detection item)	
21	Engine coolant temperature sensor (ECT)	Connector not connected, open wiring or short of harness, failure of main unit
23	Intake air temperature sensor	
41	Fuel temperature sensor	
32	Intake air pressure sensor	

Major Faulty Event

- Poor driveability

Conditions for Setting the DTC

- When intake air temperature sensor signal voltage over 4.95V or below 0.05V is detected.

Action Taken when the DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- ECM continues to control using the set value. (25 °C)

Condition for Clearing the MIL/DTC

- When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.
- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.
2. Check for the presence of failure.
3. If the repeat of DTC 23 is possible only by reproducing the failure record condition, refer to the table of "Temperature vs resistance value". IAT sensor can be tested to check for deviation in the sensor at various temperature using this table. If deviation exists in the sensor, replace the IAT sensor. When the IAT sensor is normal, the failure is an intermittent operation.

Intake Air Temperature Sensor

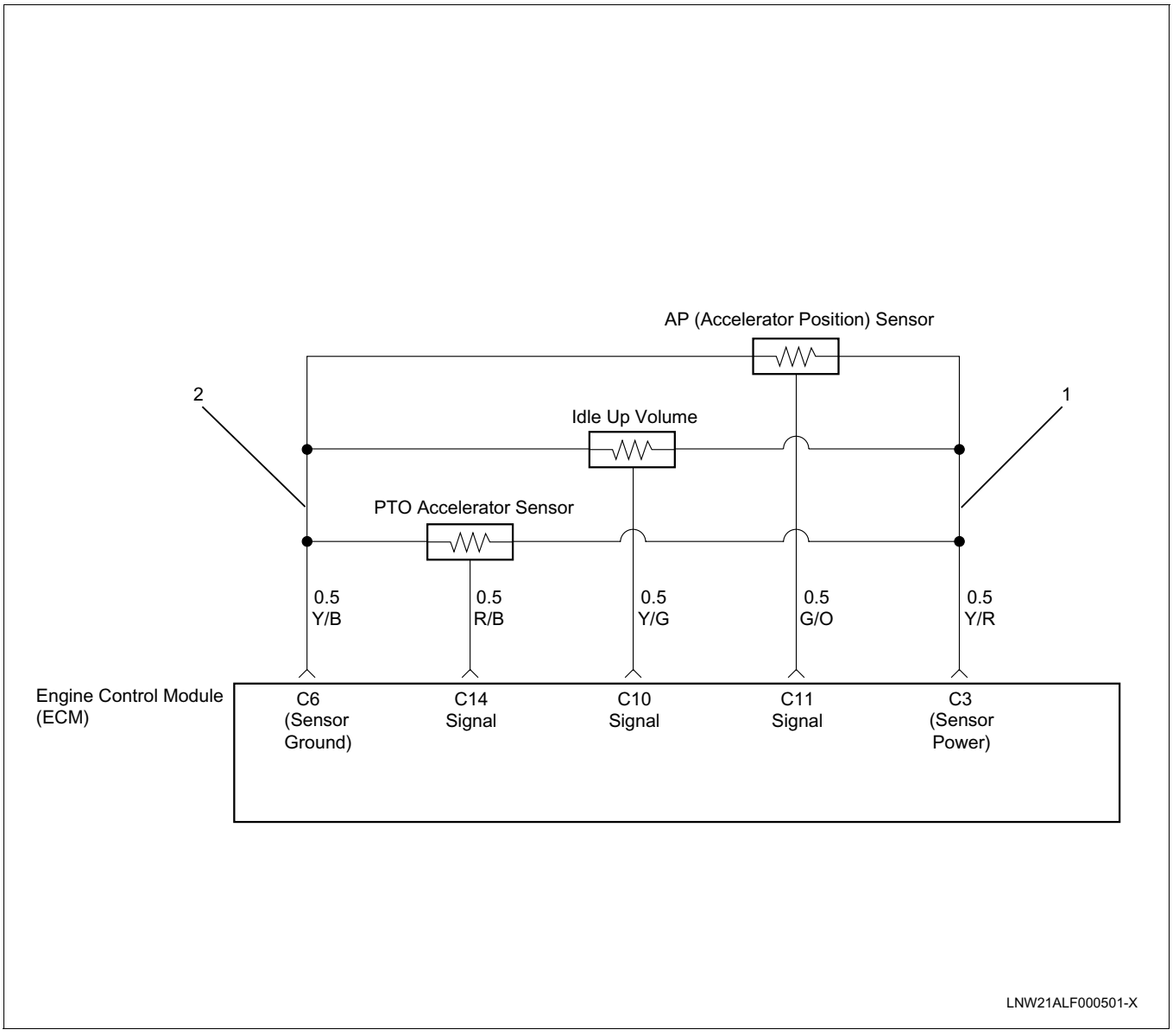
°C	Ω
Temperature vs. resistance value (approximate value)	
25	2796
15	4450
5	7280

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnosis (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"

Step	Action	Value(s)	Yes	No
2	1. Starter switch "ON". 2. Using Tech 2, monitor the "IAT sensor output voltage". Is the value larger than specified value?	4.9V	Go to Step 6	Go to Step 3
3	1. Starter switch "ON". 2. Using Tech 2, monitor the "IAT sensor output voltage". Is the value below the specified value?	0.05V	Go to Step 4	Go to Step 5
4	1. Remove the IAT sensor. 2. Using Tech 2, monitor the "IAT sensor output voltage". Is the value below the specified value?	0.05V	Go to Step 8	Go to Step 13
5	1. Stop the engine. 2. Operate the vehicle under the failure generating conditions. 3. Using Tech 2, monitor the DTC 23. Does Tech 2 display the DTC 23?	—	Refer to “Test Description”	Refer to "Diagnostic Aids"
6	1. Disconnect the IAT sensor connector. 2. Connect the signal circuit and ground circuit through a jumper with the sensor connector. 3. Using Tech 2, monitor the "IAT sensor output voltage". Is the value less than the specified value?	0.05V	Go to Step 8	Go to Step 7
7	1. Connect the IAT sensor signal circuit through a jumper to the chassis ground. 2. Using Tech 2, monitor the "IAT sensor output voltage". Is the value less than the specified value?	0.05V	Go to Step 9	Go to Step 10
8	Check for fault in the IAT sensor pin connector. If a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 11
9	Check the IAT sensor ground circuit for open wiring. Repair as necessary. Was open wiring?	—	Verify repair	Go to Step 12
10	Check the IAT signal circuit for open wiring. Repair as necessary. Was open wiring?	—	Verify repair	Go to Step 12
11	Check the IAT signal circuit for ground short. Repair as necessary. Was short?	—	Verify repair	Go to Step 12
12	Check the ECM connector pin for fault. Replace the pin as necessary. Was replacement of the pin required?	—	Verify repair	Go to Step 13

Step	Action	Value(s)	Yes	No
13	Check the IAT sensor and if a problem, replace it. Was a problem?	—	Verify repair	Go to Step 14
14	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC24 - AP Sensor Output Fault



Circuit Description

The AP (accelerator position) sensor supplies voltage signal which changes according to the accelerator pedal angle to ECM.
ECM controls the injection amount and other items using the AP signal.
DTC 24 will be set when the signal voltage is excessively high or low.

Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.

The harness 1 shown above figure is the power common to the AP sensor and idle up volume, and the harness 2 is a common ground. In the event of open wiring in wire 1 or 2, DTC 24 and 31 are displayed at the same time. Like this, the case where two or more DTC's are displayed is the multiple DTC.

- If multiple DTC24 and 31 are displayed, the power supply wire 1 or ground wire 2 must be checked.

DTC	Sensor/actuator (detection item)	
24	Accelerator position sensor	Connector not connected, open wiring of harness or short, failed main unit
31	Idle up volume	

Major Faulty Event

- Poor driveability

Conditions for Setting the DTC

- When AP sensor signal voltage below 0.1V or above 4.85V is detected

Action Taken for Setting DTC

- When a fault is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- When any fault is detected for the first time, the exhaust brake lamp blinks.
- Exhaust brake, war-up system, EGR, and intake air throttle are prohibited and output is restricted.
- Accelerator opening is controlled and fixed to 0% or 30%.
  (Starter switch OFF: 30%
  Starter switch ON: 0%)

Condition for Clearing the MIL/DTC

If any fault occurs in the system and DTC is memorized in the ECM, DTC information cannot be erased even though the failed position is repaired. In such a case, erase the information in the following procedure.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

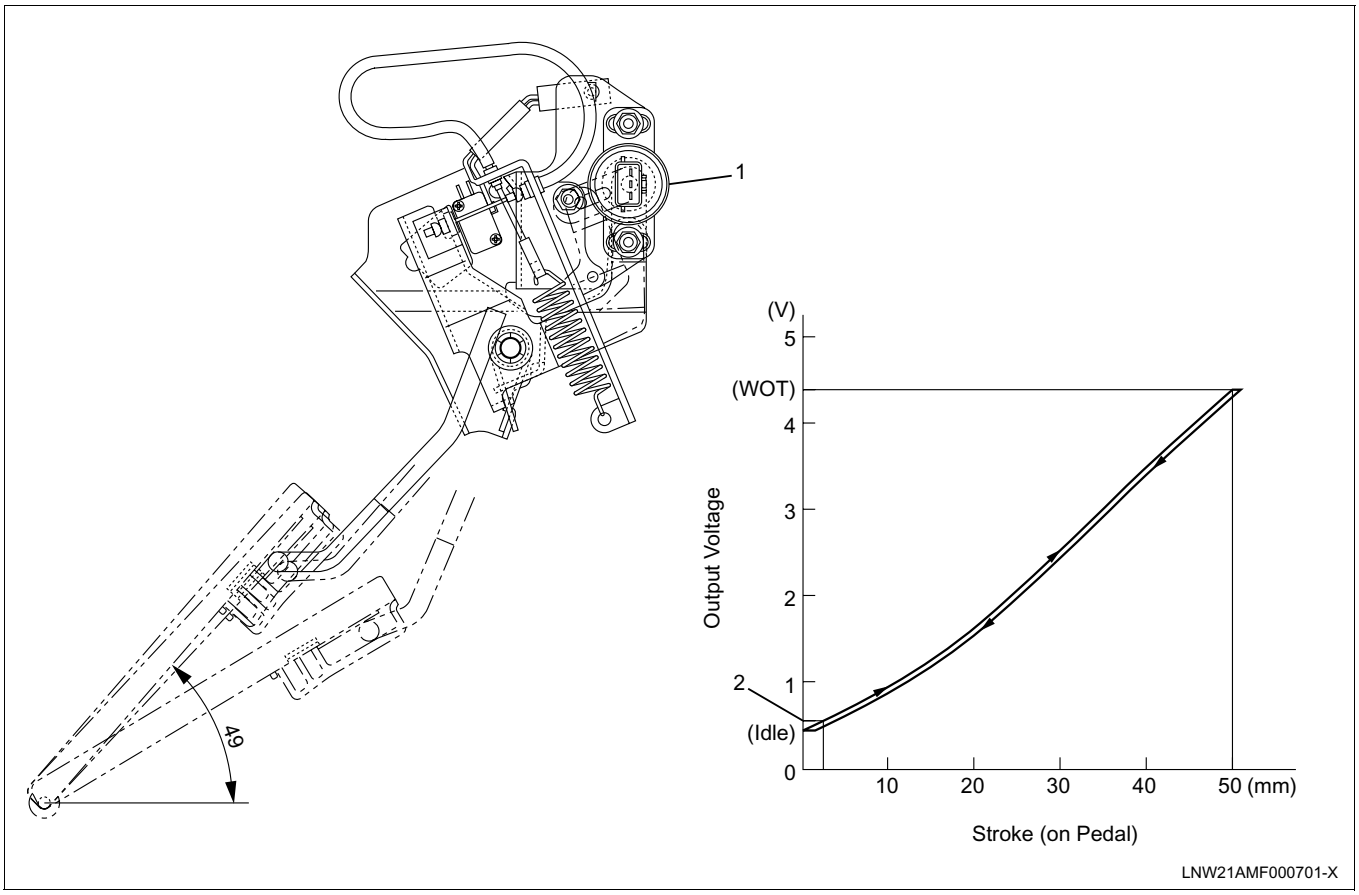
When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.
- Failed AP sensor: With the starter switch "ON" and the engine "OFF", check the AP sensor indication of Tech 2 pushing the accelerator slowly to wide open throttle. If the voltage exceeds 4.85V by usual accelerator pedal operation, replace the AP sensor.

Standard Values when Checking The AP Sensor



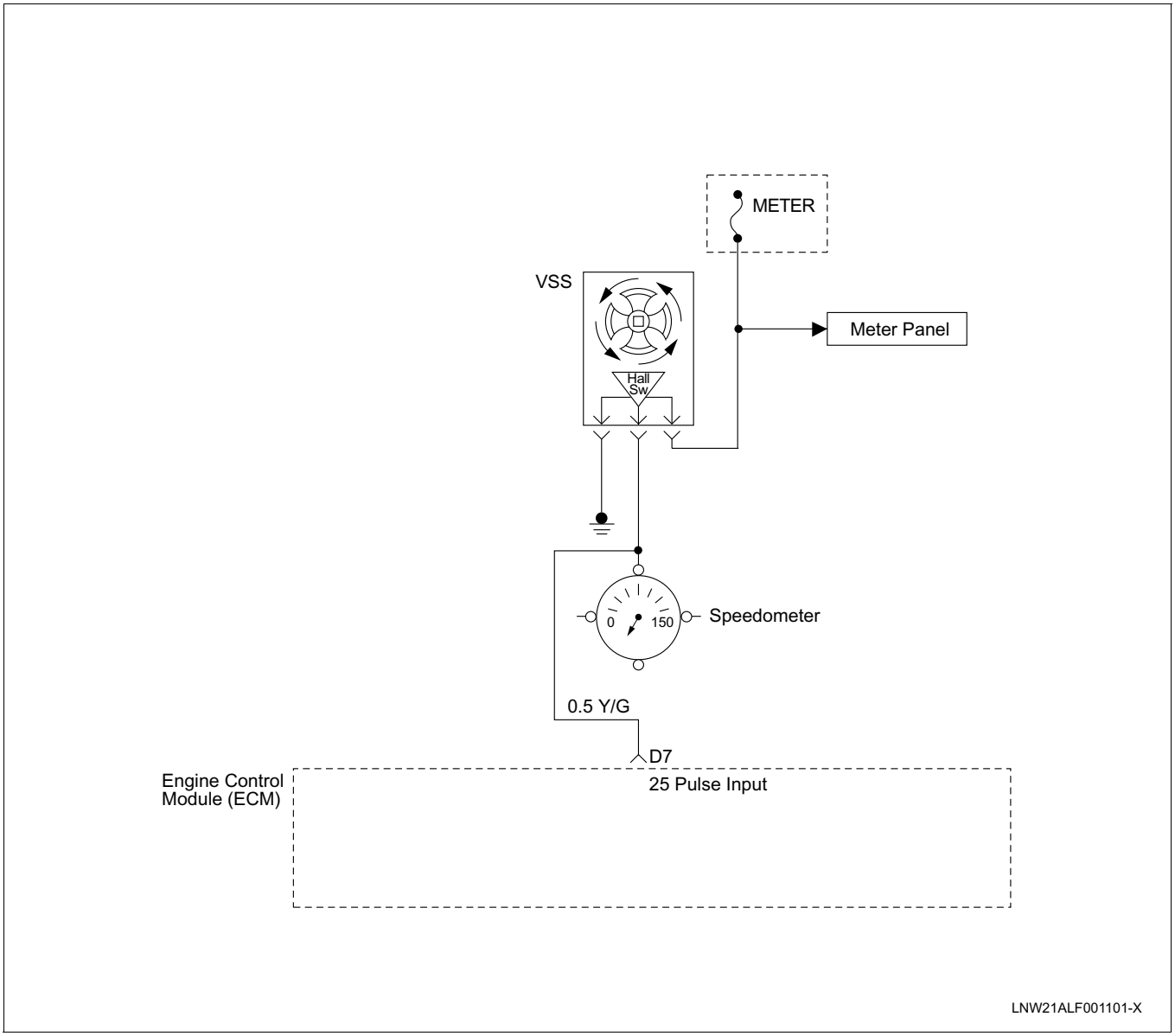
Legend

1. Accelerator position sensor
2. Accelerator switch operating point

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	Check the AP sensor signal circuit or +5V power circuit. Was open wiring detected in the AP sensor signal circuit or +5V power circuit? Or were those circuit damaged?	—	Replace the APS circuit	Go to Step 3
3	1. Starter switch "ON", stop the engine. 2. With the pedal closed, check the AP sensor display on Tech 2. Is the AP sensor value larger than specified value?	4.85V	Go to Step 5	Go to Step 4
4	1. Starter switch "ON", stop the engine. 2. Using Tech 2, monitor the DTC 24. Does Tech 2 display the DTC 24?	—	Go to Step 5	Refer to "Diagnostic Aids"
5	1. Disconnect the AP sensor electric connector. 2. Observe the AP sensor output voltage indication on Tech 2. Is the AP sensor as specified value?	0V	Go to Step 6	Go to Step 8

Step	Action	Value(s)	Yes	No
6	Check for ground short in the signal circuit, if a problem, repair as necessary. Was a problem?	—	Verify repair	Go to Step 7
7	Connect the test light 5-8840-0607-0 to B+ and check the sensor ground circuit of the AP sensor harness connector. Did the test light turned ON?	—	Go to Step 9	Go to Step 10
8	1. Starter switch "OFF", disconnect ECM. 2. Starter switch "ON", stop the engine. 3. Check for the electric short on the AP sensor signal circuit. 4. If the AP sensor signal circuit is short, repair as necessary. Was the AP sensor signal circuit short?	—	Verify repair	Go to Step 12
9	Check the AP sensor for poor connection and replace the pin, as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 11
10	1. Starter switch "OFF". 2. Disconnect the ECM and check for open wiring of the sensor ground circuit to the AP sensor. 3. If a problem is detected, repair as necessary. Was open wiring detected in the sensor ground circuit to AP sensor?	—	Verify repair	Go to Step 12
11	Observe the AP sensor. If a problem, replace the AP sensor. Was a problem?	—	Verify repair	Go to Step 12
12	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC25 - VS Sensor Circuit Fault



Circuit Description

The VS (vehicle speed) sensor is provided with a whole effect circuit. VS sensor transmits signal to ECM by the interaction with the magnetic field generated when the magnet installed to the transmission output shaft rotates together with the shaft. Power is supplied to the sensor from the meter fuse. ECM judges the vehicle speed based on the pulse width of VS signal.
DTC 25 is set when ECM receives no VS signal in the traveling condition (clutch connected).

Major Faulty Event

- Improper speedometer indication

Conditions for Setting the DTC

- Vehicle speed is 0km/h when the engine speed is more than 2200rpm with the clutch and gear connected (normal clutch switch and neutral sensor).

Action Taken when the DTC Sets

- When any failure is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- Warm-up system is prohibited.

Conditions for Clearing MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

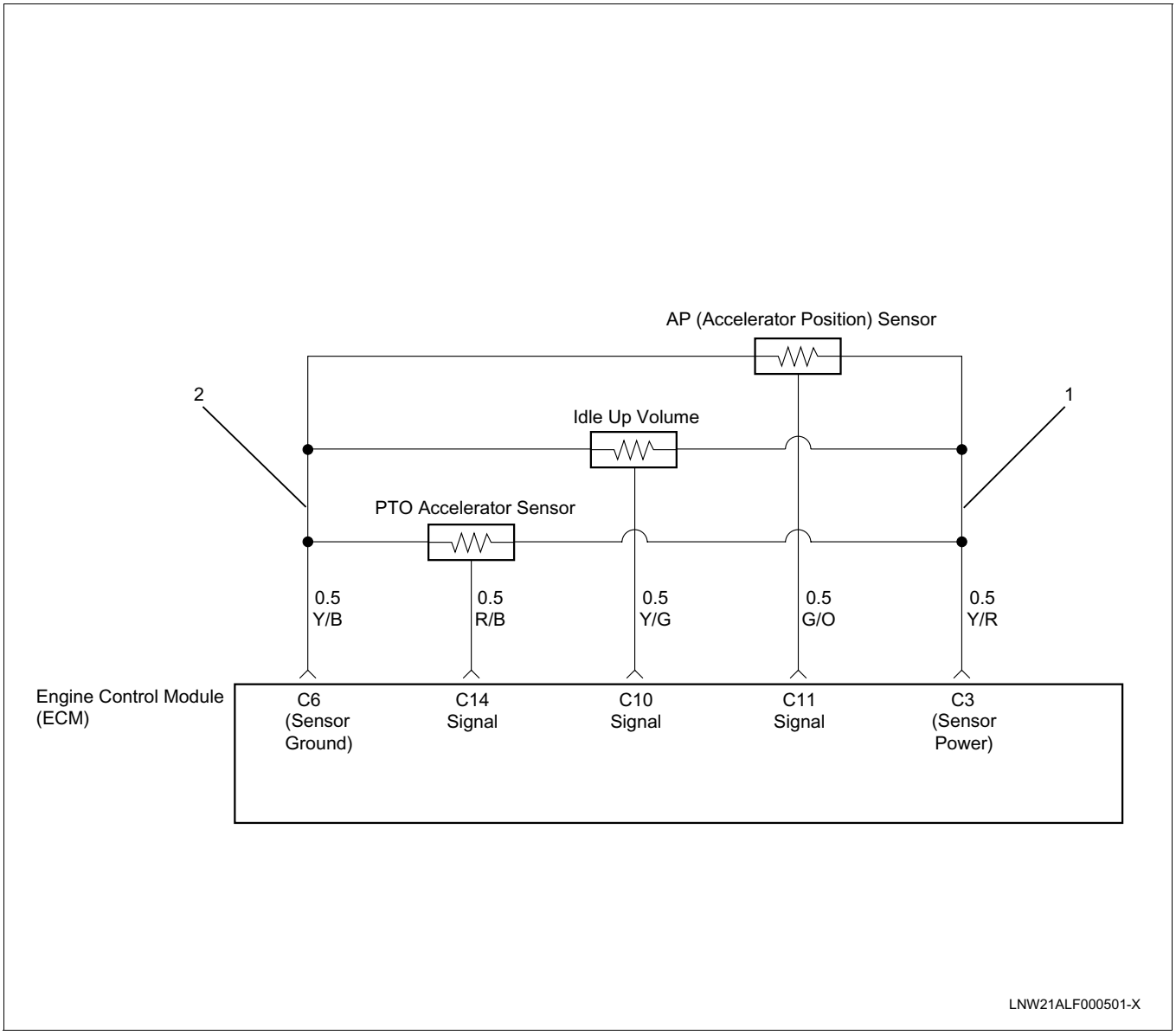
1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)

2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.
   After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	Observe the speedometer operation. Does the speedometer operate?	—	Go to Step 9	Go to Step 3
3	Observe the VS sensor power circuit. 1. Starter switch "OFF". 2. Disconnect the harness connectors from the VS sensor and ECM. 3. Measure the voltage between the harness connector power circuit of the VS sensor on the vehicle side and the ground at the Starter switch "ON" and "OFF" conditions respectively. Is the voltage value normal?	Starter switch "ON": Battery voltage Starter switch “OFF”: 0V	Go to Step 5	Go to Step 4
4	Repair the VS sensor power circuit. Is the action complete?	—	Go to Step 5	—
5	Observe the VS sensor ground circuit. 1. Starter switch "OFF". 2. Check the continuity between the connector ground circuit of the VS sensor on the vehicle side and the ground such as the body, etc. using a tester. Is the resistance value normal?	0.5Ω or below	Go to Step 7	Go to Step 6
6	Repair the VS sensor ground circuit. Is the action complete?	—	Go to Step 7	—
7	Observe the circuit between VS sensor and ECM. 1. Starter switch "OFF". 2. Connect the harness pin of the VS sensor on the vehicle side to ground such as the body, etc. 3. Connect the tester to the ground such as the body, etc. and perform the continuity test at the VS sensor signal pin of the ECM. Is the resistance value normal?	0.5Ω or below	Go to Step 9	Go to Step 8
8	Repair the circuit between VS sensor and ECM. Is the action complete?	—	Go to Step 9	—

Step	Action	Value(s)	Yes	No
9	Observe the speedometer power circuit. 1. Starter switch "ON", disconnect the VS sensor. 2. Using the DVM, measure the power source of the speedometer and ground. Was a problem?	Battery voltage	Go to Step 11	Go to Step 10
10	Observe the circuit between the speedometer and VS sensor. 1. Starter switch "OFF". 2. Connect the harness pin of the VS sensor on the vehicle side to the ground such as body, etc. 3. Connect the tester to the ground such as the body, etc. and perform the continuity test at the VS sensor signal pin of the speedometer. Is the resistance value normal?	0.5Ω or below	Go to Step 12	Go to Step 11
11	Repair the circuit between the speedometer and VS sensor. Is the action complete?	—	Go to Step 12	—
12	Check the speedometer main unit. Was a problem?	—	Go to Step 13	Go to Step 14
13	Replace the speedometer. Is the action complete?	—	Go to Step 14	—
14	Check for fault in the VS sensor connector pin. Repair as necessary. Was a problem?	—	Go to Step 15	Go to Step 15
15	Remove the VS sensor from the transmission. Check the VS sensor condition. Is the VS sensor condition normal?	—	Go to Step 17	Go to Step 16
16	Replace the VS sensor Is the action complete?	—	Go to Step 17	—
17	Install all the removed parts, and then observe the DTC. Was DTC 25 detected?	—	Go to Step 18	Verify repair
18	Replace the VS sensor. Is the action complete?	—	Go to Step 19	—
19	Check the DTC again. Was DTC 25 detected?	—	Go to Step 20	Verify repair
20	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC31 - Idle Up Volume Fault



Circuit Description

The idle up volume switch adjusts the idle speed when the engine is warm, and it is located on the instrument panel on the driver's seat side. The idle up is carried out only when the gear is in N position (P and N for A/T vehicles), and it is cancelled when the gear is shifted to other position. Receiving the idle up signal, the ECM controls the fuel injection quantity.
ETC 31 will be set when the signal voltage is excessively high or low.

Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 shown above figure is the power common to the AP sensor and idle up volume, and the harness 2 is a common ground. In the event of open wiring in wire 1 or 2, DTC 24 and 31 are displayed at the same time. Like this, the case where two or more DTC's are displayed is the multiple DTC.
- If multiple DTC24 and 31 are displayed, the power supply wire 1 or ground wire 2 must be checked.

DTC	Sensor • actuator (detection item)	
24	Accelerator position sensor	Connector not connected, open wiring of harness or short, failed main unit
31	Idle up volume	

Major Faulty Event

- Poor driveability

Conditions for Setting the DTC

- When the idle up volume signal voltage over 4.8V or under 0.2V is detected

Action Taken when the DTC Sets

- If any failure is detect, CHECK ENGINE Lamp (MIL) is not illuminated.
- Idle up control prohibited

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

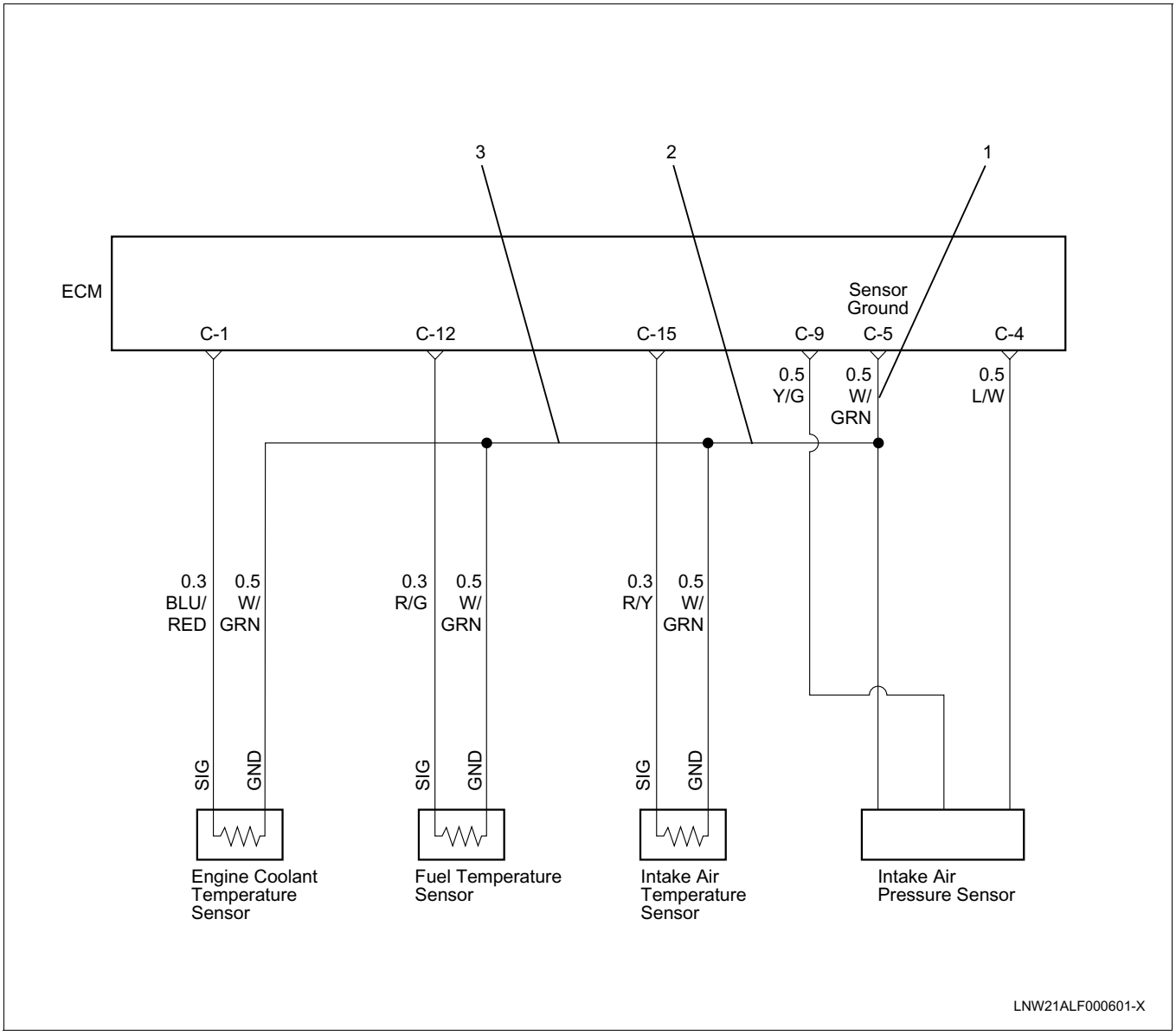
Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	Check the no open wiring in the idle up volume signal circuit of +5V power circuit. Repair as necessary. Was as necessary open wiring?	—	Verify repair	Go to Step 3
3	1. Starter switch "ON". Stop the engine. 2. Check the "accelerator (APP) sensor output voltage on the Tech 2 with the idle up volume returned and closed. Is the value larger than specified value?	4.9V	Go to Step 5	Go to Step 4
4	1. Starter switch "ON". Stop the engine. 2. Using Tech 2, monitor the DTC 31. Was DTC 31 displayed?	—	Go to Step 5	Refer to "Diagnostic Aids"
5	Disconnect the idle up volume connector. Observe "accelerator (APP) sensor output voltage" on the Tech 2.	0V	Go to Step 6	Go to Step 8
6	Check for gruond short in the signal circuit and repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Connect the test light 5-8840-0607-0 to B+ and check the ground circuit. Does the test light turn ON?	—	Go to Step 9	Go to Step 10
8	1. Starter switch "OFF". Disconnect the ECM. 2. Starter switch "ON". Stop the engine. 3. Check for +5V short in the signal circuit or short of +5V and SIGNAL pin at the idle up volume connector and repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 12
9	Check for idle up volume poor connection and repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 11
10	1. Starter switch "OFF". Disconnect the ECM. 2. Check for open wiring in the ground circuit and repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 12
11	Check the idle up volume and if a problem, repair as necessary. Was a problem defected?	—	Verify repair	Go to Step 12
12	Check the ECM connector pin for fault. Replace the pin, as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 13
13	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC32 - MAP Sensor Fault



Circuit Description

The MAP (intake air pressure) sensor is composed of piezo type semiconductor pressure elements. Its resistance value changes according to the intake air pressure. Resistance value is smaller when the intake air pressure is lower (at idling) and increases with the increase of the intake air pressure (at full throttle).
ECM applies voltage of 5V to the MAP sensor and detects the intake air pressure from the varying voltage.
Voltage is lower when the resistance is smaller (at idling) and increases when the resistance is larger (at full throttle).
DTC 32 will be set when the signal voltage is excessively high or low.

Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 in above figure is a common ground for the engine coolant temperature sensor, fuel temperature sensor, intake air temperature sensor , intake air pressure sensor. In the event of the open wiring in wire 1, DTC 21, 23, 41 and 32 are indicated at the same time. In the event of the open wiring in wire 2, DTC 21, 23, and 41 are indicated at the time. Like this, the case where two or more DTC's are displayed is the multiple DTC.

- If multiple DTC21, 23, 41, and 32 are displayed, the ground wire 1 must be checked.
- If multiple DTC21, 23, and 41 are displayed, the ground wire 2 must be checked.
- If multiple DTC21 and 23 are displayed, the ground wire 3 must be checked.

DTC	Sensor • actuator (detection item)	
21	Engine coolant temperature sensor (ECT)	Connector not connected, open wiring of harness or short, failed main unit
23	Intake air temperature sensor	
41	Fuel temperature sensor	
32	Intake air pressure sensor	

Major Faulty Event

- Poor driveability

Conditions for Setting the DTC

When coolant temperature sensor signal voltage over 4.9V or under 0.1V is detected for more than 3 seconds.

Action Taken when the DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- ECM continues control using the set value 100 kPa.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

Check the following conditions.

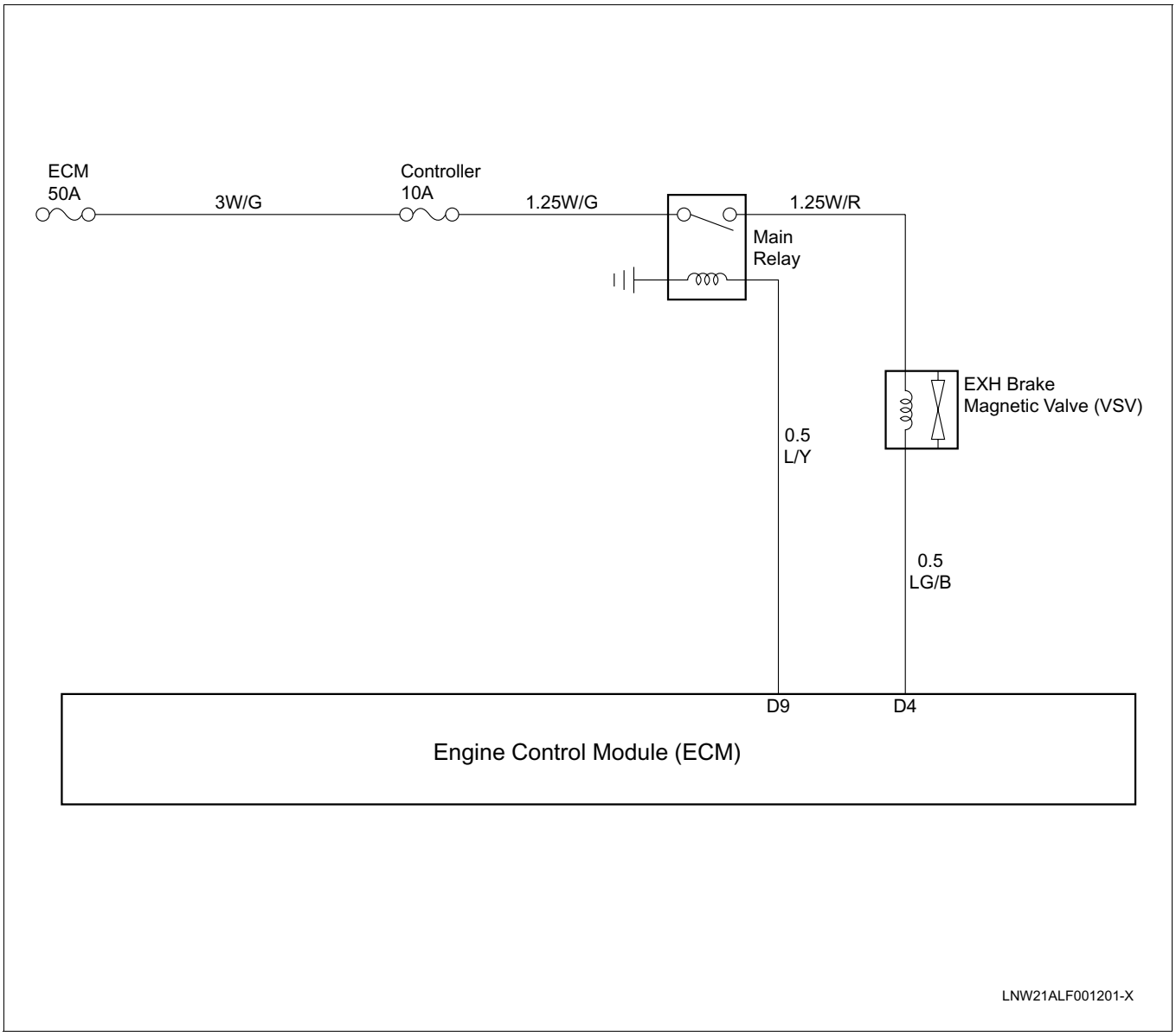
- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. When the engine idle is unstable or unsuitable, repair the trouble of idle before using this chart. Refer to "Symptom Diagnosis Chart". 2. Note the MAP (turbo) value of the Tech 2 while the engine is idling. Does the reading of MAP exceed the specified value?	4.9V	Go to Step 4	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Starter switch "ON". engine "OFF". 2. Observe and record the failure record data of the Tech 2. 3. Operate the vehicle within failure records conditions as noted. 4. Using Tech 2, monitor the DTC 32. Does Tech 2 indicate DTC 32?	—	Go to Step 4	Refer to "Diagnostic Aids"
4	1. Starter switch "ON". 2. Disconnect the MAP sensor connector. 3. Starter switch "ON". 4. Note the MAP sensor (turbo) voltage is displayed on the Tech 2. Is the MAP sensor voltage the specified value?	0.0V	Go to Step 5	Go to Step 6
5	Connect the test light 5-8840-0607-0 to B+ (battery power source) and check the sensor ground circuit. Does the test light turn ON?	—	Go to Step 7	Go to Step 9
6	1. Check for voltage short or 5V reference circuit short in the MAP signal circuit. 2. If the MAP sensor signal circuit is short, repair as necessary. Was the MAP sensor signal circuit short?	—	Verify repair	Go to Step 11
7	1. Check for a poor connection sensor ground pin in the MAP sensor connector. 2. If a problem is detected, replace the problem pin. Was the replacement of the pin required?	—	Verify repair	Go to Step 8
8	Check the MAP sensor vacuum circuit for clogging or leak. Was clogging or leak detected in the vacuum circuit?	—	Verify repair	Go to Step 12
9	1. Check for poor connection sensor ground pin in the ECM. 2. If a problem is detected, replace the problem pin. Was replacement of the pin required?	—	Verify repair	Go to Step 10
10	1. Check the continuity of the MAP (manifold absolute pressure) sensor ground circuit. 2. If resistance over 5Ω is measured in the MAP sensor ground circuit, repair the open wiring or poor connection. Was a problem detected?	—	Verify repair	Go to Step 11

Step	Action	Value(s)	Yes	No
11	Check the MAP sensor and replace the MAP sensor as necessary. Was replacement of the MAP sensor required?	—	Verify repair	Go to Step 12
12	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC34 - Exhaust Brake Open Wiring Fault



Circuit Description

The exhaust brake VSV supplies and discharge the compression air to open or close the exhaust brake valve. It receives current through the ECM fuse, controller fuse and main relay.
When the operating conditions are satisfied for the exhaust brake, ECM turns the main relay ON, and power is supplied to the exhaust brake VSV to turn it ON. VSV ON/OFF signal is given to ECM.
DTC 34 will be set when any fault arises in the exhaust brake VSV circuit.

Conditions for Setting the DTC

When either of the following conditions continues at the ECM input voltage over 16V and idle speed:

- When the exhaust brake VSV is ON, the VSV signal voltage is LOW
- When the exhaust brake VSV is OFF, the VSV signal voltage is HIGH

Action Taken when the DTC Sets

- When a fault is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- When a fault is detected, the exhaust brake lamp blinks.
- Exhaust brake is prohibited.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

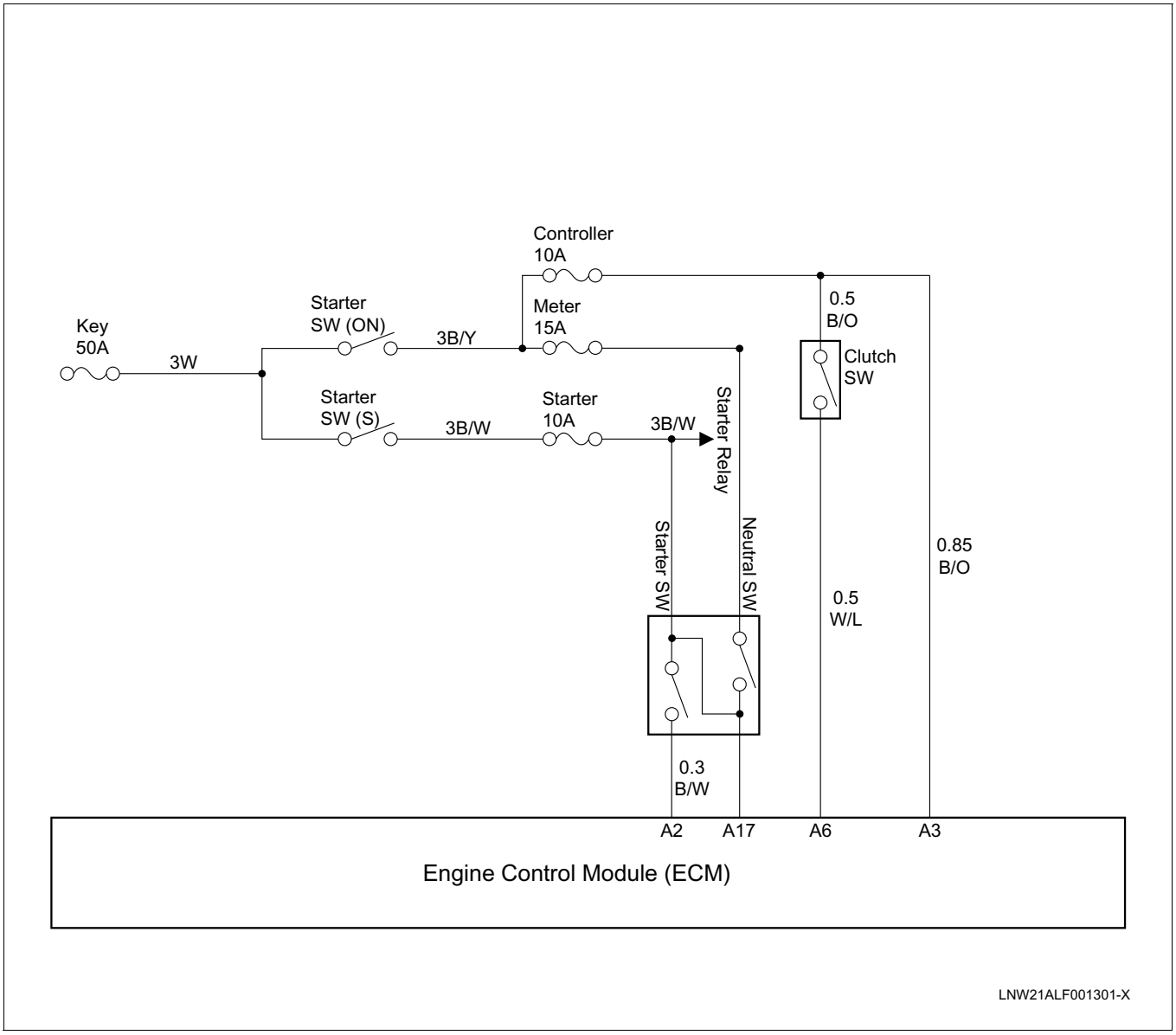
Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Review and record the Tech 2 failure record data. 3. Using the Tech 2, monitor the DTC 34. Does the Tech 2 indicate DTC 43?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	1. Starter switch "OFF". 2. Disconnect the exhaust brake VSV connector. 3. Check for open wiring, ground short poor connector or fault main relay in the exhaust brake VSV. Was a problem detected?	—	Verify repair	Go to Step 4
4	Replace the exhaust brake VSV. Was the action complete and fault solved?	—	Verify repair	Go to Step 5
5	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC35 - Neutral Switch Signal Fault



Circuit Description

The neutral switch (P/N switch on the A/T vehicles) is turned ON when the gear is shifted to the neutral (parking or neutral on A/T vehicles) position.
ECM receives the ON/OFF signal of the neutral (P/N) switch and controls so that starting is not allowed at any gear position other than the neutral (or parking) position.
DTC 35 is set in the event of the neutral (P/N) switch ON/OFF signal Fault.

Condition for Setting the DTC

If the neutral switch has never been turned OFF to ON when the engine is running for over 60 seconds and the vehicle speed is more than 80 km/h.

Action Taken when the DTC Sets

- When a fault is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- When a fault is detected, the exhaust brake lamp blinks.
- Exhaust brake and warm-up system are prohibited.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)

2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

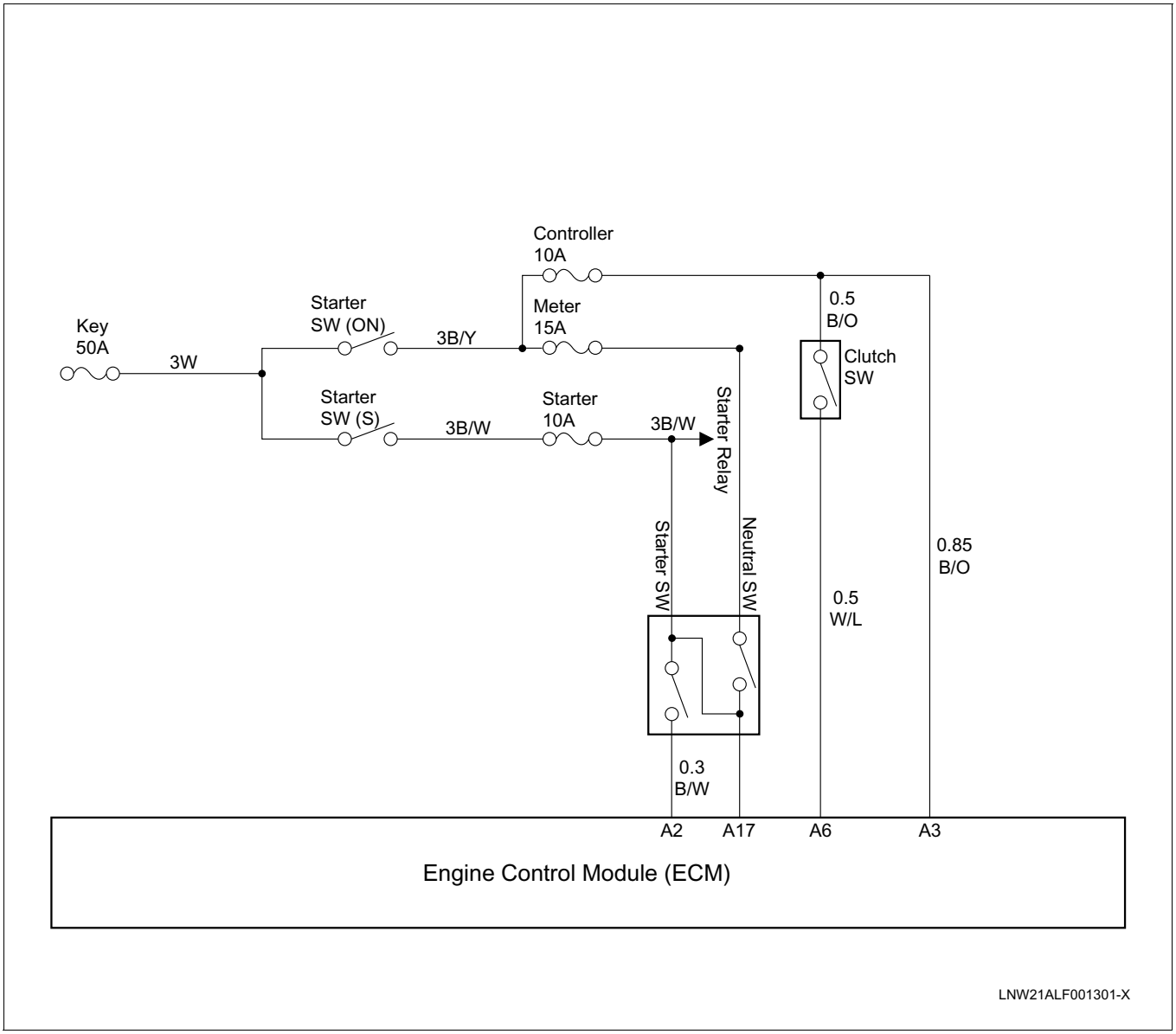
Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Review and record the Tech 2 failure record data. 3. Operate the vehicle within failure records conditions as noted. 4. Using Tech 2, monitor the DTC 32. Does the Tech 2 display DTC 35?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	Check for open wiring, short or faulty connector of the neutral (P/N) switch and repair as necessary. Was repair required?	—	Verify repair	Go to Step 4
4	Replace the neutral (P/N) switch. Was the action complete and fault resolved?	—	Verify repair	Go to Step 5
5	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC36 - Clutch Switch Signal Fault (M/T Vehicle only)



Circuit Description

The clutch switch is installed to the clutch pedal and turned OFF when the pedal is stepped on and ON when the pedal is released. ECM receives clutch switch ON/OFF signal and uses it to control the exhaust brake.
DTC 36 is set in the event of the clutch switch ON/OFF signal Fault.

Conditions for Setting the DTC

If the clutch switch has not been turned OFF from ON or ON from OFF even once when the engine is rotating for more than 180 seconds after the start and the vehicle speed is over 80 km/h.

Action Taken when the DTC Sets

- When a fault is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- When a fault is detected, the exhaust brake lamp blinks.
- Exhaust brake and warm-up system are prohibited.
- Warm-up system prohibited

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)

2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

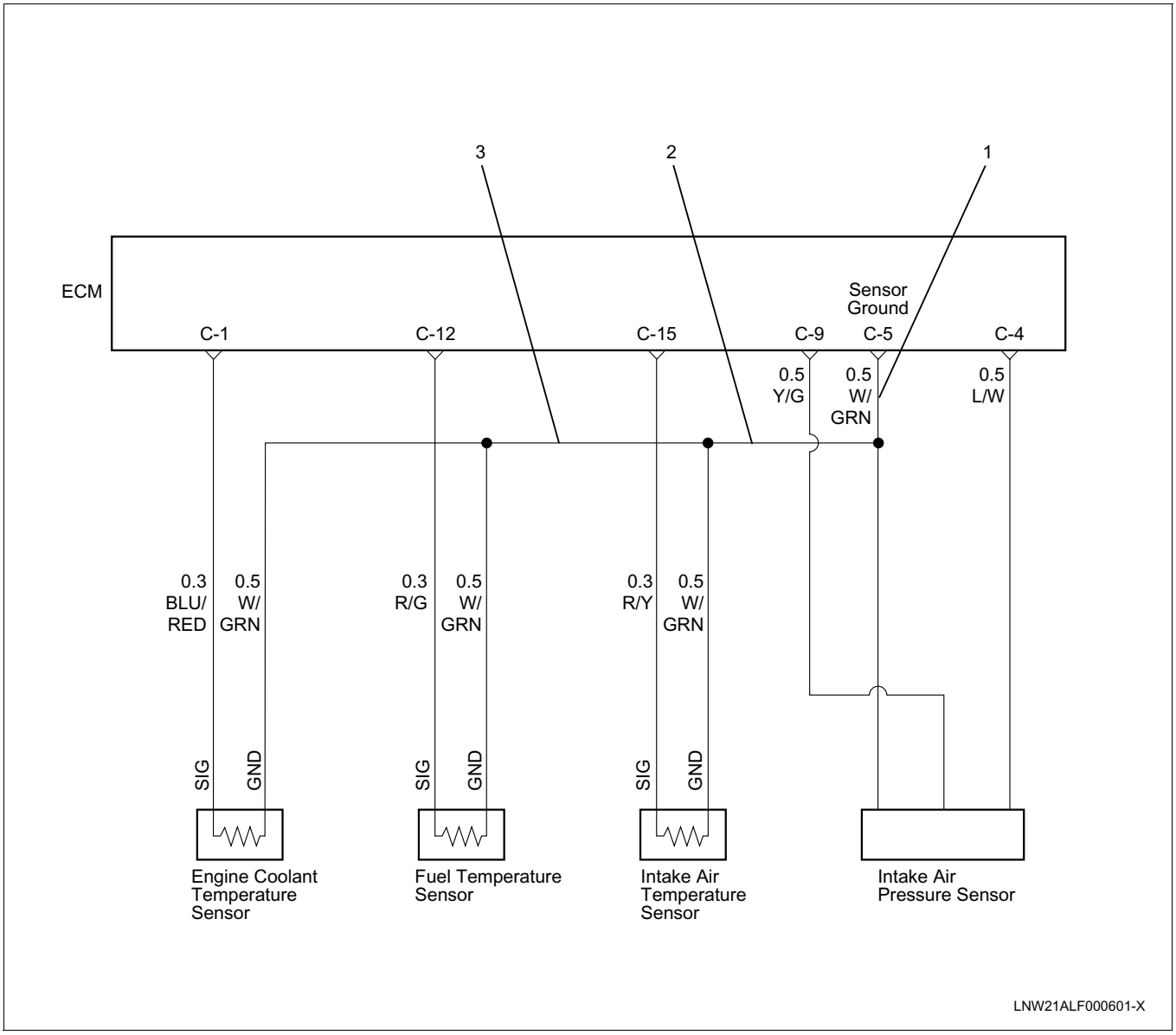
Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Review and record the Tech 2 failure record data. 3. Operate the vehicle within failure records conditions as noted. 4. Using Tech 2, monitor the DTC 36. Does the Tech 2 display DTC 36?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	Check for open wiring, short or faulty connector of the clutch switch and repair as necessary. Was repair required?	—	Verify repair	Go to Step 4
4	Replace the clutch switch. Was the action complete and the fault resolved?	—	Verify repair	Go to Step 5
5	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC41 - FT Sensor Circuit High Voltage



Circuit Description

The FT (fuel temperature) sensor is of the thermistor type. Resistance value changes according to the changes of temperature. Resistance value is smaller when the fuel temperature is higher and increases with the increase of the fuel temperature.
ECM applies voltage of 5 V to the FT sensor through the pull up resistance. Fuel temperature is detected based on the changes of voltage. The voltage is decreased when the resistance is small (the temperature is high) while increased when the resistance is large (the temperature is low).
DTC 41 will be set when the signal voltage is excessively high or low.

Characteristics of Circuit

- Multiple DTC is generated when several troubles (failures) occur. When multiple sensors or switches share a ground, or an open wiring or short occurs on the share power supply or ground, DTCs with respect to related sensors or switches are displayed. If several DTCs are displayed, it is necessary to inspect the shared power supply or ground for open wiring or short.
  The harness 1 in above figure is a common ground for the engine coolant temperature sensor, fuel temperature sensor, intake air temperature sensor , intake air pressure sensor. In the event of the open wiring in wire 1, DTC 21, 23, 32 and 41 are indicated at the same time. In the event of the open wiring in wire 2, DTC 21, 23, and 41 are indicated at the time. Like this, the case where two or more DTC’s are displayed is the multiple DTC.

- If multiple DTC21, 23, 41, and 32 are displayed, the ground wire 1 must be checked.
- If multiple DTC21, 23, and 41 are displayed, the ground wire 2 must be checked.
- If multiple DTC21 and 23 are displayed, the ground wire 3 must be checked.

DTC	Sensor • actuator (detection item)	
21	Engine coolant temperature sensor (ECT)	Connector not connected, open wiring of harness or short, failed main unit
23	Intake air temperature sensor	
41	Fuel temperature sensor	
32	Intake air pressure sensor	

Major Faulty Event

- Poor driveability

Conditions for Setting the DTC

- When the fuel temperature sensor signal voltage over 4.9V is detected.

Action Taken when the DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- ECM continues control using the set value. (40°C)

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.

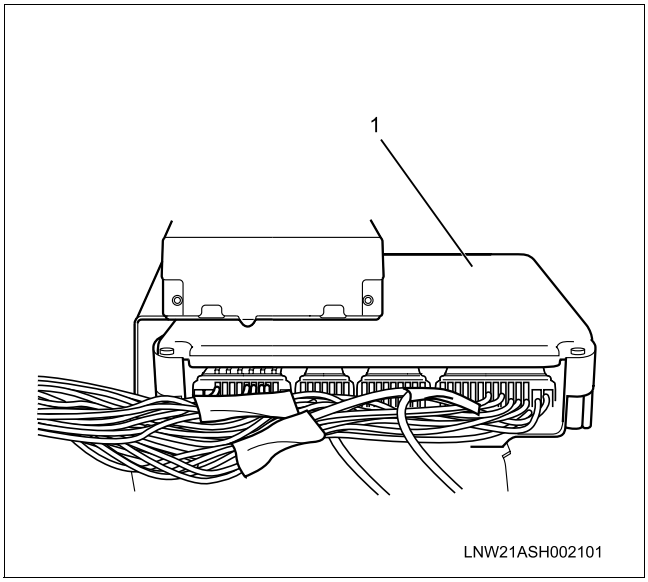
Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.
3. Check for the presence of trouble.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Observe the fuel temperature sensor output voltage indicated on the Tech 2. Is the output voltage below the specified value?	4.9V	Go to Step 4	Go to Step 3
3	Starter switch "ON", stop the engine. Using Teach 2, monitor the DTC 41. Does the Tech 2 display DTC 41?	—	Go to Step 4	Refer to "Diagnostic Aids"

Step	Action	Value(s)	Yes	No
4	1. Disconnect the FT sensor electric connector. 2. Connect the FT signal circuit and sensor ground circuit through the FT sensor harness connector through a jumper. 3. Observe the fuel temperature sensor output voltage displayed on the Tech 2. Is the fuel temperature sensor output voltage the specified value?	0.05V	Go to Step 6	Go to Step 5
5	1. Connect the FT signal circuit of the FT sensor harness connector through a jumper to the chassis ground. 2. Observe the fuel temperature sensor output voltage displayed on the Tech 2. Is the fuel temperature sensor output voltage the specified value?	0.05V	Go to Step 7	Go to Step 8
6	Check for FT sensor connection fault and replace the pin, as necessary. Was the replacement of the pin required?	—	Verify repair	Go to Step 10
7	1. Starter switch "OFF". 2. Disconnect the ECM and check for open wiring in the FT sensor ground circuit. 3. If open wiring is detected in the FT sensor ground circuit, repair as necessary. Was open wiring detected in the FT sensor ground circuit?	—	Verify repair	Go to Step 9
8	1. Starter switch "OFF". 2. Disconnect ECM and check for open wiring in the FT signal circuit. 3. If open wiring is detected in the FT sensor signal circuit, repair as necessary. Was open wiring detected in the FT sensor signal circuit?	—	Verify repair	Go to Step 9
9	Check for poor connection of the ECM sensor ground pin or FT signal circuit pin of ECM and replace the pin, as necessary. Was replacement of the pin required?	—	Verify repair	Go to Step 11
10	Replace the FT sensor (or injection pump). Is the action complete?	—	Verify repair	—
11	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC51 - Atmospheric Pressure Sensor Fault



Legend

1. ECM (engine control module)

Circuit Description

The atmospheric (barometric) pressure sensor is installed in the ECM. It converts the atmospheric pressure to voltage signal and transmits it to ECM.
ECM judges the altitude based on the signal from the atmospheric sensor and correct the fuel injection amount (correction for high ground).
DTC 51 will be set when the signal voltage is excessively high or low.

Major Faulty Event

- Poor driveability (output may be restricted)

Condition for Setting the DTC

- When atmospheric pressure sensor signal voltage over 4.7V or under 1.9V is detected.

Action Taken when the DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- ECM continues the control using the set value.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

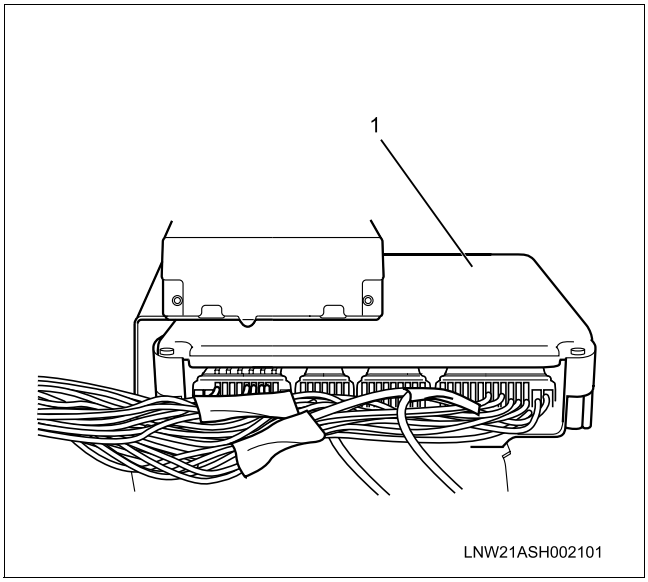
An intermittent problem may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check the following items.

- Poor connection: Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged pin and poor pin-to-wire connection.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Observe the atmospheric (barometric) pressure sensor displayed on the Tech 2. Is the value of the atmospheric sensor out of the specified value and fixed?	1.9V ~ 4.7V	Go to Step 4	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Starter switch "ON", stop the engine. 2. Review and record the Tech 2 failure record data. 3. Operate the vehicle within failure records conditions as noted. 4. Using Tech 2, monitor the DTC 51. Does the Tech 2 display DTC 51?	—	Go to Step 4	Refer to "Diagnostic Aids"
4	Replace the ECM. Is the action complete?	—	Verify repair	—

DTC52 - ECM Internal Fault



Legend

1. ECM (engine control module)

Action Taken when MIL Illuminates

- Output is restricted.

Action Taken when the DTC Sets

- If the CPU Fault is originated not from the main unit but from a strong electromagnetic interference, for instance, and is solved, past ETC 52 is memorized.
- Accelerator opening is restricted to some value below the specified value and returned gradually.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

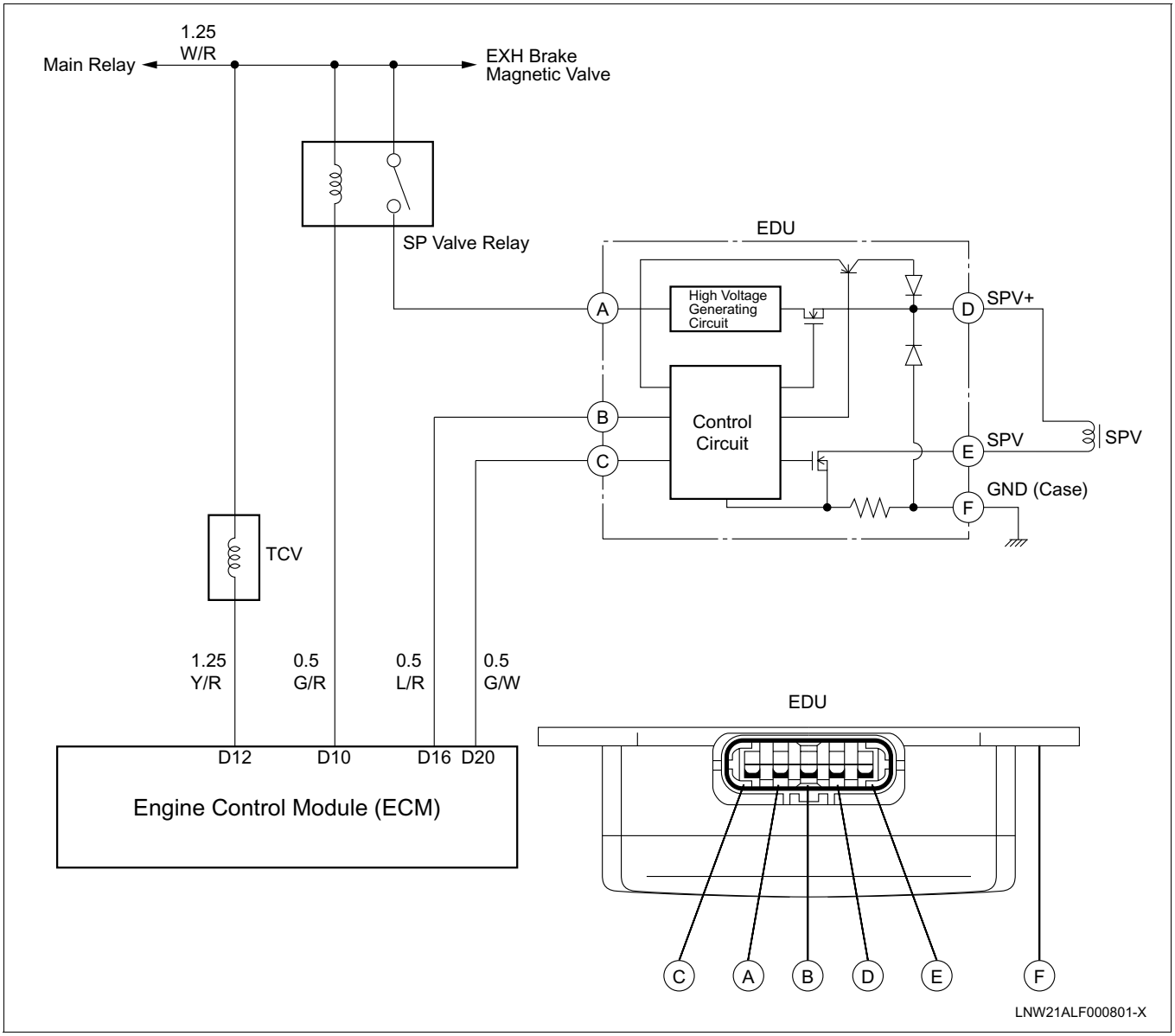
Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	The vehicle visually/physical check. 1. Is the power for the accessories (lamp, electric decoration, etc.) shared with the ECM? 2. Is a strong transceiver equipped? 3. Isn't cola, coffee or other drink attached to ECM? If any problem is detected, characteristics of the system should be explained to the customer. Was a problem detected?	—	Contact to Customer	Go to Step 3
3	1. Starter switch "ON", stop the engine. 2. Using Tech 2, clear the DTC 52. 3. Run the engine at the idling speed. Could the engine start and run at the idling speed?	—	Go to Step 4	Go to Step 7
4	1. Starter switch "ON", stop the engine. 2. Using the Tech 2, observe the system voltage (battery voltage) of data list. Is the system voltage (battery voltage) higher than the specified value?	23V	Go to Step 6	Go to Step 5
5	Measure the battery voltage. If a problem is detected, repair it. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Run the engine at the idling speed. 2. Using Tech2, observe the system voltage (battery voltage) of data list. 3. Start the accessories to the vehicle in succession. If the data list is cleared or communication is interrupted when some accessory is started, it should be notified to the customer that the fault has occurred due to that accessory. Was a problem detected?	—	Contact to Customer	Refer to "Diagnostic Aids"
7	Replace the ECM. Is the action complete?	—	Contact to Customer	Refer to "Diagnostic Aids"

DTC53 - Engine Driver Unit Fault



Circuit Description

The engine driver unit (EDU) is used to drive the spill valve (SPV) which operates at high voltage. The battery voltage is converted to higher voltage with the high voltage generating circuit (DC/DC converter) and supplied.
ECM determines the fuel injection amount according to the signal from each sensor and sends the signal to the EDU B pin. At this time, injection confirmation signal is sent from the EDU C pin to ECM.
DTC 53 is set when ECM receives no injection confirmation signal.

Action Taken when the DTC Sets

- When a fault is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- Engine stops.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)

4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

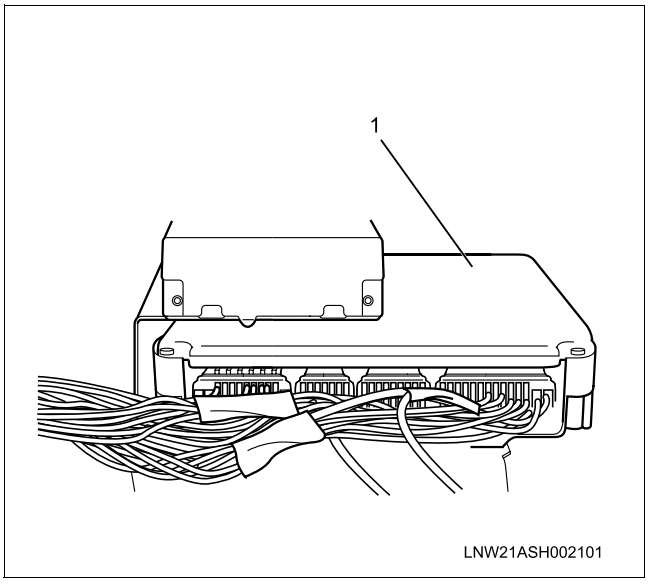
Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Damaged harness: Check the wiring harness for damage.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	The EDU visually/physical check. 1. Check for loosed tightening by moving the EDU by hand. If any fault is detected at the case ground, correct (retighten). 2. Disconnect the connector, check for irregularity and deformation of pins, and connect the connector again checking the connector lock. If a problem is detected, repair it. 3. Check visually for flaws, dints, and other damages. If a problem is detected, replace it. Was any defect detected?	—	Verify repair	Go to Step 3
3	1. Starter switch "ON", stop the engine. 2. Using Tech 2, monitor the DTC 53. Does the Tech 2 indicate DTC 53?	—	Go to Step 4	Refer to "Diagnostic Aids"
4	Measure the resistance value of SPV between the pins D and E at the engine harness EDU connector. Is the value approximately as specified?	1.2Ω	Go to Step 7	Go to Step 5
5	Disconnect the SPV connector and measure the resistance value between pins. Is the value approximately as specified?	1.2Ω	Go to Step 6	Go to Step 11
6	Check for open wiring of SPV+ and SPV– or poor SPV connector. Repair as necessary. Was a problem detected?	—	Verify repair	Refer to "Diagnostic Aids"
7	Check for ground short of the SPV + harness. Repair as necessary. Was a problem detected?	—	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
8	Check for the following item, problem and repair as necessary. 1. EDU power circuit open wiring. 2. EDU ground circuit open wiring. 3. SPV relay failure. 4. SPV relay circuit open wiring or short. 5. Injection signal circuit open wiring or short. 6. Poor connection of connectors Was a problem detected?	—	Verify repair	Go to Step 9
9	Replace the EDU. Was the action complete and the fault solved?	—	Verify repair	Go to Step 10
10	Replae the ECM. Is the action complete?	—	Verify repair	—
11	Replace the injection pump. Is the action complete?	—	Verify repair	—

DTC55 - Pump Unmatched (Difference from ECM Specifications)



Legend

1. ECM (engine control module)

Circuit Description

When the injection pump is unmatched to the ECM, ECM sets DTC 55.
Incorrect assembly of the injection pump or ECM is considered.

Action Taken when the DTC Sets

- When DTC is set, ECM illuminates the CHECK ENGINE Lamp (MIL).
- ECM restricts the engine output.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

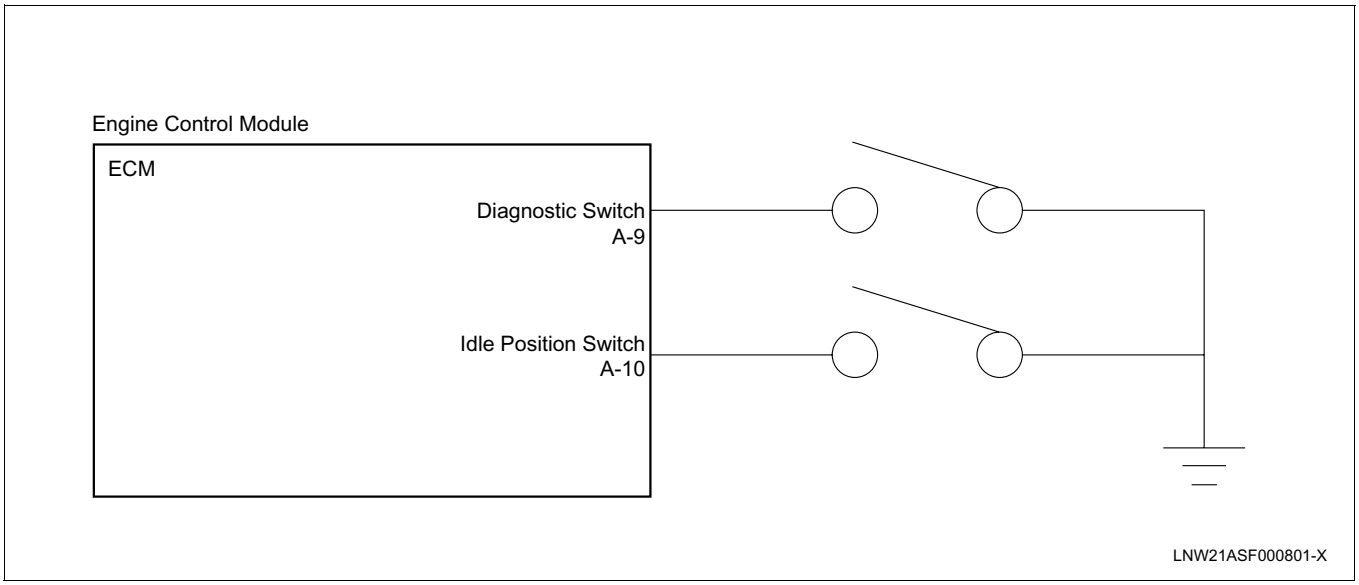
Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.
- Check the service records so far for the replacement of ECM.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Using the Tech 2, observe the broadcast code or part No.. Is the result of judgment matched?	—	Go to Step 4	Go to Step 3
3	Replace the ECM. Is the action complete?	—	Go to Step 5	—
4	Observe the part No. of the injection pump. If a problem, observe the past service records and repair as necessary. Is the part No. correct?	—	Go to Step 5	—
5	Replace the injection pump. Is the action complete?	—	Verify repair	—

DTC65 - Idle Position Switch Fault



Circuit Description

The idle position switch is installed to the accelerator pedal. When the pedal is stepped on the idle position switch is turned OFF and when the pedal is released it is turned ON.
ECM receives idle position switch ON/OFF signal and uses it to control the exhaust brake, etc.
DTC 65 is set when the idle position switch ON/OFF signal is faulty.

Condition for Setting the DTC

- If the idle position switch OFF (open wiring) at the AP sensor output voltage under 0.6V and the idle position switch ON (short) at the AP sensor output voltage over 0.1V continue for more than 10 seconds, while the AP sensor is normal
- When the AP sensor output voltage is out of the standard values

<AP Sensor Adjusting Reference Voltage>

- Idle point: 0.43 ~ 0.73V
- WOT point: 4.10 ~ 4.70V
- Input voltage: 5V
  (Idle position switch operating voltage: 0.59 ~ 0.79V)

Action Taken when the DTC Sets

- When a fault is first detected, ECM illuminates the CHECK ENGINE Lamp (MIL).
- When a fault is first detected, the exhaust brake lamp blinks.
- Exhaust brake and warm-up system are prohibited and output is restricted.

Condition for Clearing the MIL/DTC

When the system fails and the DTC is stored to the ECM, even repairing the faulty portion will not clear the DTC from the memory. To clear the DTC, conduct the following steps.

- Keep the starter switch turned on and the engine is not running.
- Short the data link connector.

Perform the following steps.

1. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
2. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
3. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
4. Turn on the idle position switch for not less than 1 second but not more than 3 seconds. (Release the accelerator pedal.)
5. Turn off the idle position switch for not less than 1 second but not more than 3 seconds. (Press the accelerator pedal.)
6. After the above operations are properly completed, the Check Engine Lamp (MIL) illuminates for 3 seconds to report the memory is cleared.
7. Turn off the key switch. Wait for 5 seconds and turn on the starter switch again.

When Tech 2 has been connected to the vehicle, the DTC can be cleared through the memory clear operation with Tech 2.

Diagnostic Aids

Check the following conditions.

- Poor connection at the ECM: Inspect harness connectors for backed-out pins, improper mating, broken locks, improperly formed or damaged pins, and poor pin-to-wire connection.

Step	Action	Value(s)	Yes	No
1	Was the "On-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Starter switch "ON", stop the engine. 2. Record the Tech 2 failure record. 3. Run the engine at the idling speed and step on the accelerator pedal gently several times. 4. Using Tech 2, monitor the DTC 65. Does the Tech 2 display DTC 65?	—	Go to Step 3	Refer to "Diagnostic Aids"
3	1. Using the Tech 2, observe the data list. 2. Run the engine at the idling speed and step on the accelerator pedal gently several times. 3. Observe the display of the idle position SW (idle switch) on the data list. Does the Tech 2 change of the idle position SW?	—	Verify repair	Go to Step 4
4	Check the idle position SW installing condition. 1. Check the contact with the pedal, movement of SW and stain moving the accelerator pedal slightly. 2. If a problem is detected, reconfirm it referring to the data list of the Tech 2 and repair as necessary. Was repair required?	—	Verify repair	Go to Step 5
5	Check the idle position SW connector and circuit. 1. Check for deformation of pin and damage of connector. 2. If a problem is detected, reconfirm it referring to the data list of the Tech 2 and repair as necessary. Was the repair required?	—	Verify repair	Go to Step 6
6	Replace the idle position switch. Is the action complete?	—	Verify repair	—

Symptom Diagnosis Chart

Symptom	Definition
Hard starting	The engine cranks but does not start for a long time. Finally it starts, or may start but immediately stalls.
Vehicle speed variation	Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.
Lack of power or faulty response:	Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part-way.
Unstable idling	The engine idling is not constant, or the engine idling speed varies. If the condition gets worse, the engine or vehicle may vibrate. In either case, at the worst, the engine may stall.
Engine not stall	Engine continues to run after key is turned “OFF,” but runs very rough. If engine runs smooth, check starter switch and adjustment.
Starter motor does not run	The engine does not crank because the starter motor does not rotate.
Quick On Start (QOS) system does not operate	The Quick On Start (QOS) system does not operate.
Excessive black smoke in exhaust gas	Excessive black smoke is exhausted in actual road test.
Excessive white smoke in exhaust gas	Excessive while smoke is exhausted in actual road test.
Noisy engine	Metallic knocking is caused by detonation (uncontrolled explosion in combustion room). The detonation sound varies from light level to serious level, and in general it becomes large during acceleration.
Nasty smell	Vehicle’s exhaust gas gives out a bad smell. (Excessively bad smell does not always mean excessive emission.)
Poor fuel economy	The fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticable lower than that attained on the samee vehicle in the previous road test. (The use of larger tires than standard will cause odometer readings to be smaller than that with standard tires. As a result, the fuel economy may be theoretically poor though it is actually normal.)
Excessive engine oil consumption	The engine oil consumption measured in actual road test is excessively larger than expectation.
Large engine vibration	Abnormal vibration occurs in the engine.

Hard Starting

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- Check if commercial accessory power is taken from the ECM power.
- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.
- Check if fuel leakage, pipe damage or dent is found in the fuel system.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

Coolant temperature sensor, CKP sensor, NE sensor, TCV, SPV, Fuel temperature sensor, EDU, Glow plug, Glow relay

Step	Action	Value(s)	Yes	No
1	DEFINITION: Engine cranks, but does not start for a long time. Finally it starts, or may start but immediately stalls. Was the ''On-board Diagnostic (OBD) System Check'' performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual/ Physical Check
4	Check engine coolant temperature (ECT) sensor for shift in value. 1. After 1~7 hours with the hood up and the engine not running, connect the Tech 2. 2. Starter switch ''ON'', engine ''OFF''. 3. Compare engine coolant temperature to intake air temperature (IAT). Are ECT and IAT within the specified value of each other?	±5°C	Go to Step 8	Go to Step 5
5	1. Using Tech 2 , display the engine coolant temperature and note the value. 2. Observe the resistance of the engine coolant temperature sensor. Refer to ''DTC 21 ECT Sensor Fault'' for resistance specifications. Is the resistance value ground resistance for the specified temperature?	—	Go to Step 7	Go to Step 6
6	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
7	Locate and repair high resistance or poor connection in the ECT signal circuit or the ECT sensor ground. Is the action complete?	—	Verify repair	—
8	1. Check if proper fuel is used. Also, check the fuel line for presence of air, the fuel filter for restriction, or the fuel warning lamp for lighting. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	Check if the value of fuel temperature sensor varies. 1. Connect the Tech 2 without starting the engine. 2. Starter switch "ON", engine "OFF" 3. Check if the resistance value of fuel temperature sensor is proper for the specified temperature. For the resistance specification, refer to "DTC 41F T Sensor Circuit High Voltage". 4. If a faulty, replace the fuel temperature sensor. Was the repair necessary?	—	Verify repair	Go to Step 10
10	1. Observe the battery voltage. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 11
11	1. Check the operation of intake throttle. Perform visual check to find the following: • Modification of throttle body (removal of the adjusting screw plug) • Fault in air intake system — Check the air intake duct for dint, the air cleaner element for restriction, or the air intake system for presence of foreign materials. • Check if the throttle body or air passage is blocked with foreign materials, or if foreign materials cling to the air passage, piston, throttle bore or throttle valve. Was the repair necessary in either of above cases?	—	Verify repair	Go to Step 12
12	1. Check the engine for evidence of the following mechanical problems. • Clogged nozzles, faulty valve opening pressure, or excessive nozzle tightening torque • Weak compression pressure • Leak from cylinder head gasket • Wear or improper camshaft 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 13

Step	Action	Value(s)	Yes	No
13	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Vehicle Speed Variation

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.
- Check the piping of exhaust system for rust or defects (holes, deformation)
- Check if fuel leakage, pipe damage or dent is found in the fuel system.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

AP sensor, CKP sensor, NE sensor, EDU

Step	Action	Value(s)	Yes	No
1	DEFINITION: Engine power varies under a steady throttle condition or cruising. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal. Was the ''On-board Diagnostic (OBD) System Check'' performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual/ Physical Check
4	Be sure that the driver understands transmission torque converter clutch and A/C compressor operation as explained in the owner's manual. Inform the customer how the TCC and the A/C clutch operate. Is the customer experiencing a normal condition?	—	System OK	Go to Step 5
5	Observe the fuel system. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Observe if the ECM ground is dirty or installed in proper locations. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Observe AP sensor connections. 2. If a problem is detected, repair the problem pins as necessary. Was a problem detected?	—	Verify repair	Go to Step 8
8	1. Visually/physically check vacuum hoses for splits, kinks, and proper connections and routing as shown on the ''Vehicle Emission Control Information'' label. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Observe the exhaust system for possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for thermal fatigue or possible internal failure. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
10	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Lack Power or Faulty Response

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.
- Check if the engine overheats.
- Check if the vehicle has run at highland (place of atmospheric pressure 90kPa or less).

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.
- Check the piping of exhaust system for rust or defects (holes, deformation).
- Check if fuel leakage, pipe damage or dent is found in the fuel system.
- Check the idle position switch for dirt or defects.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.

A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

AP sensor, Accelerator sensor, CKP sensor, Coolant temperature sensor, Intake air temperature sensor, Fuel temperature sensor, Atmospheric pressure sensor

Step	Action	Value(s)	Yes	No
1	DEFINITION: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part-way. Was the “On-Board diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual/ Physical Check
4	1. Remove and check the air cleaner element for dirt or restrictions. 2. Replace the air cleaner element if necessary. Was a repair required?	—	Verify repair	Go to Step 5
5	1. Observe the fuel for quality, or the fuel filter for restriction. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Check the exhaust system for possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for thermal fatigue or possible internal failure. • Inspect the exhaust brake for faulty return. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Observe the AP sensor system. Refer to ’’DTC24 AP Sensor Output Fault”. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 8
8	1. Check if the ECM ground is dirty or installed in proper locations. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Observe the ECT sensor system. Refer to ''DTC21 ECT Sensor Fault". 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
10	Observe the failure record memory. 2. Is DTC13 detected?	—	Go to Step 14	Go to Step 11
11	1. Start the engine. 2. With the engine in idling state, disconnect the TCV connector and check the engine sound. Did the engine sound change when the connector was disconnected?	—	Go to Step 14	Go to Step 12
12	1. Visual/physical check the TCV for dirt or rust. 2. If a problem is detected, repair as necessary. 3. Restore the TCV to original condition, and conduct again the test in step 11. Was a problem detected?	—	Go to Step 13	Go to Step 14
13	Replace the injection pump. Is the action complete?	—	Go to Step 15	—
14	Observe the failure record, and clear DTC13. Is the action complete?	—	Go to Step 15	—
15	Observe the atmospheric pressure sensor system. Refer to ''DTC51 Atmospheric Pressure Sensor Fault''. Was the problem detected?	—	Go to Step 16	Go to Step 17
16	Replace the ECM. Is the action complete?	—	Verify repair	—
17	1. Check the engine for mechanical problems. Check the compression pressure for low value, the camshaft for wear or other abnormality, or the nozzles for restriction or injection condition. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 18

Step	Action	Value(s)	Yes	No
18	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Unstable Idling

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.
- Check if fuel leakage, pipe damage or dent is found in the fuel system.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.
4. Compare the cylinder compensation 1~4, and check the nozzle or fuel pipe for the cylinder of which compensation value is larger than others.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

AP sensor, CKP sensor, Coolant temperature sensor, Vehicle speed sensor, NE sensor, TCV, SPV, EDU

Step	Action	Value(s)	Yes	No
1	DEFINITION: The engine idling is not constant, or the engine idling speed varies. If the condition gets worse, the engine or vehicle may vibrate. In either case, at the worst, the engine may stall. Was the “On-board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Go to Step 6	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual/ Physical Check
4	1. Check if the ECM ground is dirty or installed in proper locations. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Check for incorrect idle speed. Ensure that the following conditions are present: • The engine is fully warm. • The accessories are "OFF". 2. Using a Tech 2, monitor the AP position. Is the AP position within the specified values?	0%	Go to Step 10	Go to Step 9
6	1. Visually/physical check for the following conditions: • Restricted air intake system. Check for a possible collapsed air intake duct, restricted air filter element, or foreign objects blocking the air intake system. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Check the fuel for quality, or the fuel filter for restriction. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Check the transmission range switch circuit. Using Tech 2, and be sure the Tech 2 indicates that the vehicle is in drive with the gear selector in drive or overdrive. 2. If a problem is detected, diagnose and repair the transmission range switch as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
9	1. Check the engine for the following mechanical problems: • Low compression • Sticking or leaking valves • Worn camshaft lobe(s) • Incorrect valve timing • Valve clearance • Restricted nozzles, or low valve opening pressure 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
10	1. Observe for problem engine mounts, 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 11
11	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Engine Not Stall

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Wiring for proper connections, pinches and cuts.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring.
Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

SPV, EDU, Starter switch, Main relay

Step	Action	Value(s)	Yes	No
1	DEFINITION: Engine continues to run after starter switch is turned “OFF,” but runs very rough. If engine runs smooth, check starter switch and adjustment. Was the “On-board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to "OBD System Check"
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual/ Physical Check
4	1. Observe for a short between B+ and any of the ignition power circuit. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	

Starter Motor does Not Run

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Wiring for proper connections, pinches and cuts.
- Starter motor installation condition and damage
- Generator installation condition and damage
- Check if the fuse has blown.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

Starter switch, Starter relay

Step	Action	Value(s)	Yes	No
1	DEFINITION: The engine does not crank because the starter motor does not rotate. 1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 2
2	Was a visual/physical check performed?	—	Go to Step 3	Go to Visual/ Physical Check
3	1. Observe the battery cord pins for looseness or faulty contact due to corrosion. 2. Check the battery voltage. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	1. Observe the fan belts for loosen or damage. 2. If a problem is detected, adjustment or replace as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Observe the fuse link for open wire or short. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Observe the generator installation condition and damage 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Observe the starter switch and starter relay for damage and looseness, open wire or short. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 8
8	1. Observe the starter motor installation condition and damage 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Review all diagnostic procedures within this table. 2. When all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Quick On Start (QOS) System does Not Operate

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Wiring for proper connections, pinches and cuts.
- Check if the fuse has blown.
- Check if the glow plug is normal.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

Glow relay, Glow plug

Step	Action	Value(s)	Yes	No
1	Was the "On-board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to "OBD System Check"

Step	Action	Value(s)	Yes	No
2	Check the glow plug indicator light. Replace the bulb if broken. Was the problem detected?	—	Verify repair	Go to Step 3
3	1. Connect a circuit tester between glow plug and engine ground. 2. With the starter switch turned “ON” and the engine “OFF”, check that the glow indicator lights and the circuit tester indicates 0V for 0.6 to 18 seconds, and then check the power supply voltage. If the glow indicator does not light and the tester does not indicate, repair the terminals, wire harness, and glow relay. Was the repair necessary?	—	Verify repair	Go to Step 4
4	1. Remove the glow plug, and replace if damaged. 2. Observe the glow plug for continuity. Was the continuity confirmed?	—	Go to Step 6	Go to Step 5
5	Replace the glow plug. Is the action complete?	—	Verify repair	Go to Step 6
6	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. 3.If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Excessive Black Smoke in Exhaust Gas

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Air cleaner element for restriction
- Wiring for proper connections, pinches and cuts.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.
4. Compare the cylinder compensation 1~4, and check the nozzle or fuel pipe for the cylinder of which compensation value is larger than others.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

AP sensor, CKP sensor, Coolant temperature sensor, Intake air temperature sensor, NE sensor, Fuel temperature sensor, TCV, SPV, EGR, EDU

Step	Action	Value(s)	Yes	No
1	DEFINITION: Excessive black smoke is exhausted in actual road test. Was the “On-board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to “OBD System Check”
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	1. Check if proper fuel is used. 2. If a problem is detected, replace the fuel. Was a problem detected?	—	Verify repair	Go to Step 4
4	1. Observe the air cleaner element for restriction, or the intake system such as intake duct for any abnormality. 2. If a problem is detected, repair and replace as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Connect the Tech 2 to the vehicle. 2. Monitor the data list to check the operation of intake throttle valve. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Connect the Tech 2 to the vehicle. 2. From the Tech 2 data, check the operation of EGR. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Observe the valve clearance. Observe the valve opening pressure and injection condition of the nozzles. 2. If a problem is detected, adjustment as necessary. Was a problem detected?	—	Verify repair	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Excessive White Smoke in Exhaust Gas

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

CKP sensor, Coolant temperature sensor, EGR, TCV, EDU

Step	Action	Value(s)	Yes	No
1	DEFINITION: Excessive white smoke is exhausted in actual road test. Was the “On-board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to “OBD System Check”
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	1. Check if proper fuel is used. Check the fuel filter for restriction. 2. If a problem is detected, replace the fuel and fuel filter. Was a problem detected?	—	Verify repair	Go to Step 4
4	1. Connect the Tech 2 to the vehicle. 2. Monitor the data list to check the operation of intake throttle valve. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Check the valve opening pressure and injection condition of the nozzles. 2. If a problem is detected, adjustment as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. 3.If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Noisy Engine

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

TCV, EGR, EDU, NE, CKP sensors

Step	Action	Value(s)	Yes	No
1	DEFINITION: Metallic knocking is caused by detonation (uncontrolled explosion in combustion chamber). The detonation sound varies from light level to serious level, and in general it becomes large during acceleration. Was the “On-board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to “OBD System Check”
2	Was a visual/physical check performed?	—	Go to Step 3	Go to Visual/ Physical Check
3	Check if proper fuel is used. 1. Make the fuel tank empty and change to new fuel. 2. Start the engine. Is the engine noisy?	—	Go to Step 4	Verify repair
4	1. Check TCC (torque converter clutch) operation. (A/T only) 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Check the following items: • Check if engine coolant is lack. • Check if proper engine coolant is used. • Check the radiator fins or radiator tubes for restriction. • Check the EGR for operation. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Using the engine cleaner, remove the carbons that cling to the engine. 2. Start the engine. Is the engine noisy?	—	Go to Step 7	Verify repair
7	1. Check the TCV (timing control valve). Refer to "DTC13 TCV Fault". 2. If a problem is detected, repair as necessary. 3. Perform the exhaust gas test. Does the pass the exhaust gas test ?	—	Verify repair	Go to Step 8
8	1. Check for an engine mechanical problem. 2. Check the cylinder compression. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Nasty Smell

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.
- Check if fuel leakage, pipe damage or dent is found in the fuel system.
- Check the piping of exhaust system for rust or defects (holes, deformation)

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

TCV, SPV, EGR, Coolant temperature sensor, Fuel temperature sensor, Intake air temperature sensor.

Step	Action	Value(s)	Yes	No
1	DEFINITION: Vehicle's exhaust gas gives out a bad smell. (Excessively bad smell does not always mean excessive emission.) Was the "On-board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	Was a visual/physical check performed?	—	Go to Step 3	Go to Visual/ Physical Check
3	1. Check for vacuum leaks. Check the vacuum lines, intake manifold, throttle body, etc. 2. If a problem is detected, repair as necessary. Were any vacuum leaks located?	—	Go to Step 6	Go to Step 4
4	1. Check the PCV (Positive Crankcase Ventilation) valve for any problem, restriction, or improper installation. Also, check the PCV system for restriction. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Go to Step 6	Go to Step 5
5	1. Using the engine cleaner, remove the carbons that cling to the engine. 2. Perform the exhaust gas test. Does the pass the exhaust gas test?	—	Verify repair	Go to Step 7
6	Perform the exhaust gas test. Does the pass the exhaust gas test?	—	Verify repair	Go to Step 7
7	1. Check the EGR (Exhaust Gas Recirculation) valve or EVRV. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 8
8	1. Check the SPV (Spill Control Valve). Refer to "DTC53 EDU Fault". 2. If a problem is detected, repair as necessary. 3. Perform the exhaust gas test. Does the pass the exhaust gas test?	—	Verify repair	Go to Step 9
9	1. Check the TCV (Timing Control Valve). Refer to "DTC13 TCV Fault". 2. If a problem is detected, repair as necessary. 3. Perform the exhaust gas test. Does the pass the exhaust gas test?	—	Verify repair	Go to Step 10
10	1. Replace the injection pump. 2. Perform the exhaust gas test. Does the pass the exhaust gas test?	—	Verify repair	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Check for an engine mechanical problem. 2. Check the cylinder compression. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Go to Step 7	Go to Step 12
12	Replace the ECM. Is the action complete?	—	Go to Step 13	—
13	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Poor Fuel Economy

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Wiring for proper connections, pinches and cuts.
- Check if fuel leakage, pipe damage or dent is found in the fuel system.
- Air cleaner element for restriction.
- Check the piping of exhaust system for rust or defects (holes, deformation).
- Check the coolant and engine oil for level.
- Check the tires for installation condition.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

Related Sensors:

Coolant temperature sensor, Intake air temperature sensor, EGR, TCV, SPV, Vehicle speed sensor,

Step	Action	Value(s)	Yes	No
1	DEFINITION: The fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticable lower than that attained on the same vehicle in the previous road test. (The use of larger tires than standard will cause odometer readings to be smaller than that with standard tires. As a result, the fuel economy may be theoretically poor though it is actually normal.) Was the “On-board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to “OBD System Check”
2	Was a visual/physical check performed?	—	Go to Step 3	Go to Visual/ Physical Check
3	Was a trouble cord detected?	—	Go to trouble cord	Go to Step 4
4	1. Check the owner’s driving habits. • Is the A/C (air conditioner) "ON" full time? • Are tires at the correct pressure? • Are excessively heavy loads being carried? • Is acceleration too much, too often? • Rapid acceleration or frequent acceleration Is any item fit?	—	Go to Step 5	Go to Step 6
5	Review the items in Step4 with the customer and advise as necessary. Is the action complete?	—	System OK	—
6	1. Visually/physically check: Vacuum hoses for splits, kinks, and improper connections and routing as shown on the "Vehicle Emission Control Information" label. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Remove and check the air cleaner element for dirt or for restrictions. 2. Replace the air cleaner element is necessary. Was a repair required?	—	Verify repair	Go to Step 8
8	1. Check for low engine coolant level. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Check for an incorrect or faulty engine thermostat. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
10	1. Check the engine oil level. 2. If low, refill engine oil. Is the level proper?	—	Verify repair	Go to Step 11
11	1. Check the injection nozzles for atomizing condition. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 12
12	1. Check the TCV (Timing Control Valve). Refer to "DTC13 TCV Fault". 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 13
13	1. Check the SPV (Spill Control Valve). Refer to "DTC53 EDU Fault". 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 14
14	1. Check the PCV (Positive Crankcase Ventilation) valve for any problem, restriction, or improper installation. Also, check the PCV system for restriction. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Go to Step 7	Go to Step 15
15	1. Check the drive belt tension. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 16
16	1. Check the chassis-related troubles such as a brake dragging and clutch slip. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 17
17	1. Check if the engine compression pressure is low. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 18

Step	Action	Value(s)	Yes	No
18	1. Check the exhaust system for possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for thermal fatigue or possible internal failure. • Inspect the exhaust brake for faulty return. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 19
19	Check for proper calibration of the speedometer. Does the speed indicated on the speedometer closely match the vehicle speed displayed on the Tech 2?	—	Verify repair	Go to Step 20
20	Diagnose and repair an inaccurate speedometer condition as necessary. Was a problem detected?	—	Verify repair	Go to Step 21
21	1. Check the air intake system and crankcase for air leaks. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 22
22	Check the fuel for quality. 1. Make the fuel tank empty and change to new fuel. 2. Run the vehicle, and check the fuel economy. Does fuel economy in normal?	—	Verify repair	Go to Step 23
23	1. Review all diagnostic procedures within this table. 2. When all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Excessive Engine Oil Consumption

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- Check the engine oil for level.
- Check the oil filter for loose installation.
- Check the oil pan for loose installation.
- Check the oil pipe for crack or loose connection.
- Check the PCV hose for crack or loose connection.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.

Step	Action	Value(s)	Yes	No
1	DEFINITION: The engine oil consumption measured in actual road test is excessively larger than expectation. Was the "On-Board diagnostic(OBD) System Check" performed?	—	Go to Step 2	Go to "OBD System Check"
2	Was a visual/physical check performed?	—	Go to Step 3	Go to Visual/ Physical Check

Step	Action	Value(s)	Yes	No
3	1. Observe if proper engine oil is used. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	1. Observe if the engine oil level is too high. 2. If high, lower the level. Is the oil level proper?	—	Go to Step 5	Verify repair
5	1. Check the oil leak for oil pipe connection portions. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Check if oil leaks from oil seals or gaskets. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Check the PCV (Positive Crankcase Ventilation) valve for any problem, restriction, or improper installation. Also, check the PCV system for restriction. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 8
8	1. Check the valve stem and valve guide for wear. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9
9	1. Check the piston rings for wear, stick, chipping, and also check the ring grooves for wear. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
10	1. Review all diagnostic procedures within this table. 2. When all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

Large Engine Vibration

Preliminary Checks

Before using this section, perform the ''On-Board Diagnostic (OBD) System Check'' and verify all of the following items:

- The ECM and CHECK ENGINE Lamp (MIL) are operating correctly.
- There are no DTCs stored.
- Tech 2 data is within normal operating range.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom diagnosis chart.
- Ask the customer if the specified engine oil and fuel are used.

Visual/Physical Check

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time.
This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connectors, as shown on the ''Vehicle Emission Control Information'' label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Air cleaner element for restriction.
- Wiring for proper connections, pinches and cuts.
- Check the engine mount for any problems.
- Check if fuel leakage, pipe damage or dent is found in the fuel system.

Intermittents

IMPORTANT:
An intermittent problem may or may not turn on the CHECK ENGINE Lamp (MIL) or store a DTC. Do not use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problems.
Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- **Poor mating of the connector halves of a pin not fully seated in the connector (backed out).**
- **Improperly formed or damaged pin.**
- **All connector pin in the problem circuit should be carefully checked for proper contact tension.**
- **Poor pin-to-wire connection. This requires removing the pin from the connector body to check.**

Road test the vehicle with a Digital Multimeter (5-8840-0366-0) connected to a suspected circuit. In case of a malfunction, abnormal voltage indicates the presence of a fault in the circuit being checked. Use a scan tool to help detect intermittent Use a scan tool to help detect intermittent conditions. The scan tools have several features that can be used to locate an intermittent condition. Use the following feature for find intermittent faults:

The check for loss of DTC memory, disconnect the intake air pressure sensor and idle the engine until the CHECK ENGINE Lamp (MIL) comes on. DTC32 should be stored and kept in memory when the starter switch is turned "OFF". If not, the ECM is faulty. When this test is completed, make sure that you clear the DTC32 from memory.
A CHECK ENGINE Lamp (MIL) with no stored DTC may be caused by the following:

- **CHECK ENGINE Lamp (MIL) wire to ECM shorted to ground.**
- **Poor ECM grounds.**

Check for improper installation of electrical options such as lights, cellular phones, etc.

If DTC is not confirmed, snap-shot the Tech 2 data list, so that approximate faulty location can be estimated according to the follow-up performance or validity of numeric values, or identification of fixed values.

1. If a systematic error is recognized in numeric values, fundamental accuracy of instruments such as sensors will be faulty (for example, variations in sensor resistance value).
2. If a random error is recognized in numeric values, in general it will be caused by electrical (applied voltage) or mechanical troubles or noise.
3. If numeric values are fixed to high or low (fixed value error), the open wiring or short will occur in the circuits of instruments such as sensors.
4. Compare the cylinder compensation 1~4, and check the nozzle or fuel pipe for the cylinder of which compensation value is larger than others.

Further, you may be able to detect a trouble by disconnecting the connectors of related sensors and checking variations in numeric values or indication of Tech 2.
The part concerned is normal if a variation is recognized when its connector is disconnected, or it is faulty if no variation is recognized.

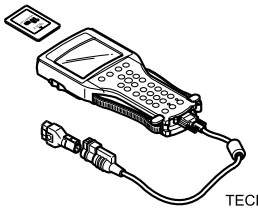
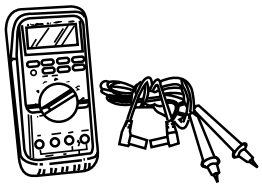
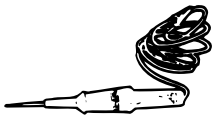
Related Sensors:

SPV, EDU

Step	Action	Value(s)	Yes	No
1	DEFINITION: Abnormal vibration occurs in the engine. Was the "On-Board diagnostic(OBD) System Check" performed?	—	Go to Step 2	Go to “OBD System Check”
2	Was a visual/physical check performed?	—	Go to Step 3	Go to Visual/ Physical Check
3	1. Observe if the ECM ground is dirty or installed in proper locations. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 4
4	1. Visually/physically the intake air system for the following conditions: • Restricted air intake system. • Collapsed air intake duct • Restricted air cleaner element. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 5
5	1. Visually/physically the fuel system for the following conditions: • Fuel leak fuel system. • Restricted fuel filter. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 6
6	1. Check the SPV (Spill Control Valve). Refer to "DTC53 EDU Fault". 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 7
7	1. Using Tech 2, check if the injection nozzles for all cylinders are normal. 2. If the nozzle for a certain cylinder is abnormal, repair or replace as necessary. Was a problem detected?	—	Verify repair	Go to Step 8
8	1. Check the injection nozzles for injection condition, and also check the valve opening pressure. 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Check the engine for the following mechanical problems: • Lack of compression • Sticking valves • Incorrect valve timing • Poor valve clearance 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 10
10	1. Check for problem engine mounts, 2. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	Go to Step 11
11	Check the fuel for quality. 1. Make the fuel tank empty and change to new fuel. 2. Start the engine, and check the symptom. Was a problem detected?	—	Verify repair	Go to Step 12
12	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical check • Tech 2 data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is detected, repair as necessary. Was a problem detected?	—	Verify repair	—

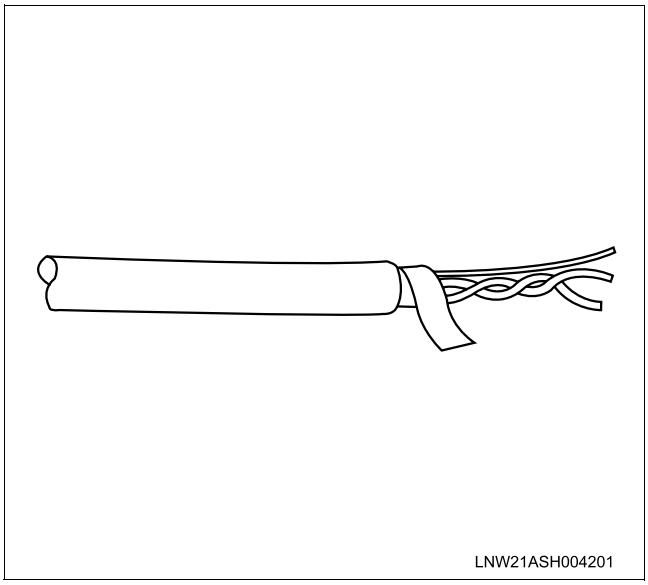
Special Tools

Illustration	Tool No. Tool name
 TECH2	Tech 2 Scan Tool
 5884003660	5-8840-0366-0 Digital Multimeter
 5884003850	5-8840-0385-0 Connector Test Adapter Kit
 5884006070	5-8840-0607-0 Test Light

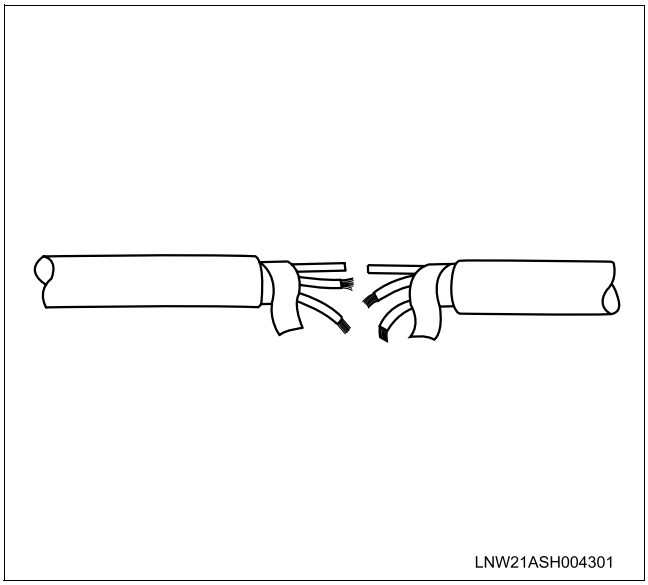
Wiring Harness Repair: Shielded Cable

Removal Procedure

1. Remove the outer jacket.
2. Unwrap the aluminum/mylar tape. Do not remove the mylar.

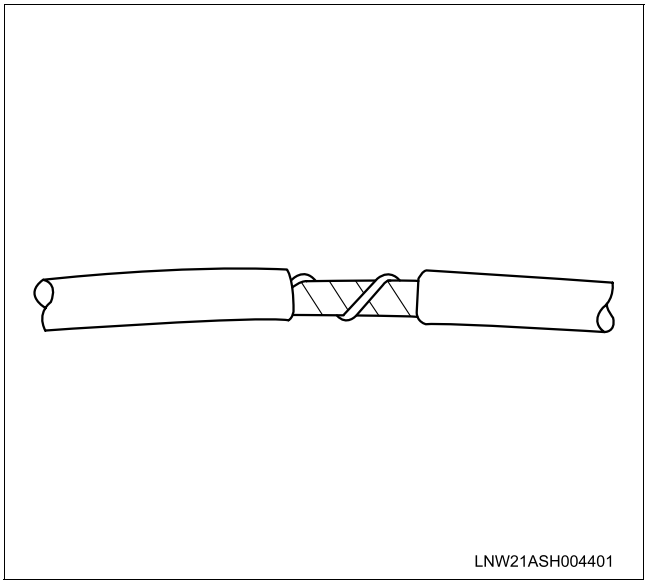


3. Untwist the conductors.
4. Strip the insulator as necessary.

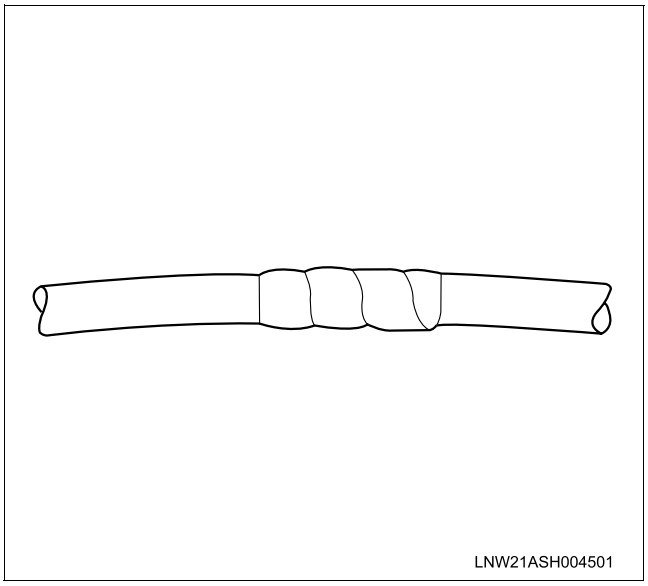


Installation Procedure

1. Splice the wires using splice clips and rosin core solder.
2. Wrap each splice to insulate.
3. Wrap the splice with mylar and with the drain (uninsulated) wire.



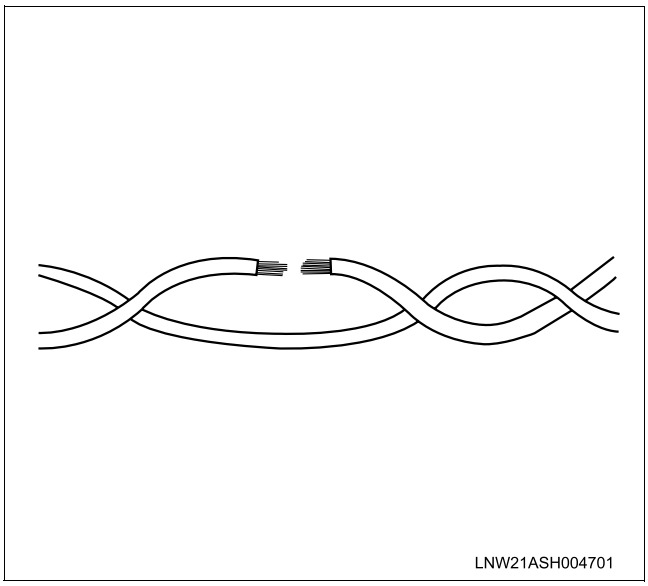
4. Tape over the whole bundle to secure.



Twisted Leads

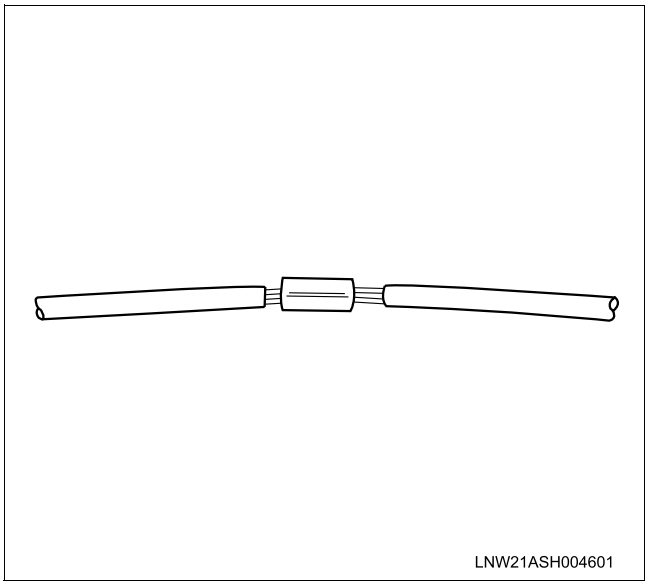
Removal Procedure

1. Locate the damaged wire.
2. Remove the insulation as required.

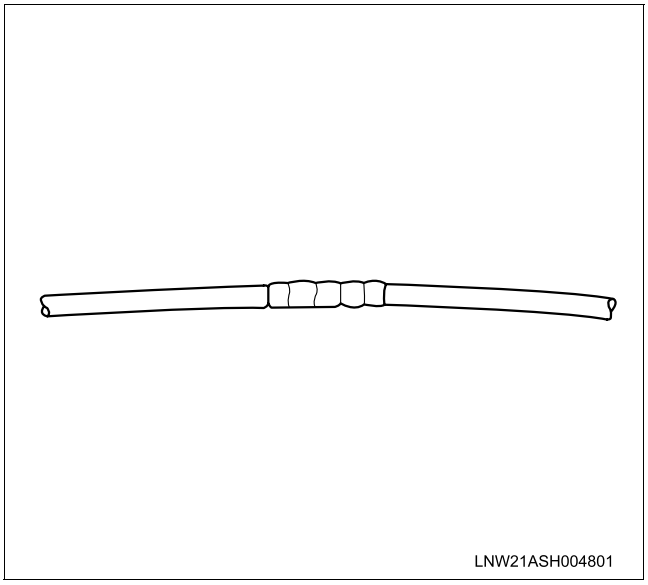


Installation Procedure

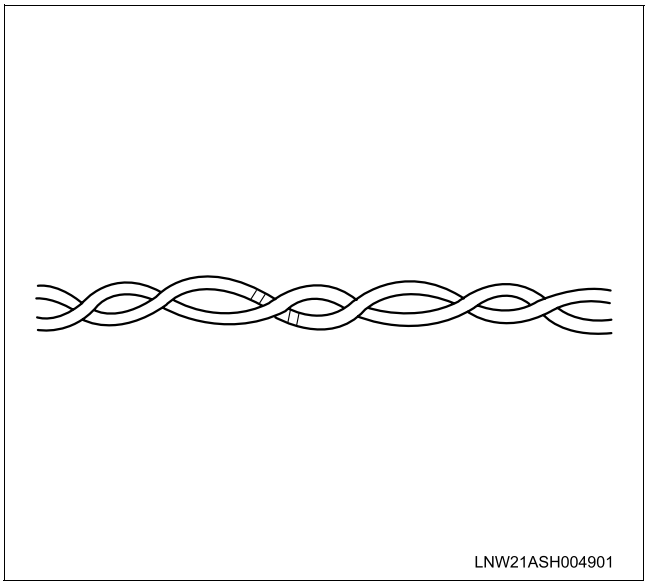
1. Use splice clips and rosin core solder in order to splice the two wires together.



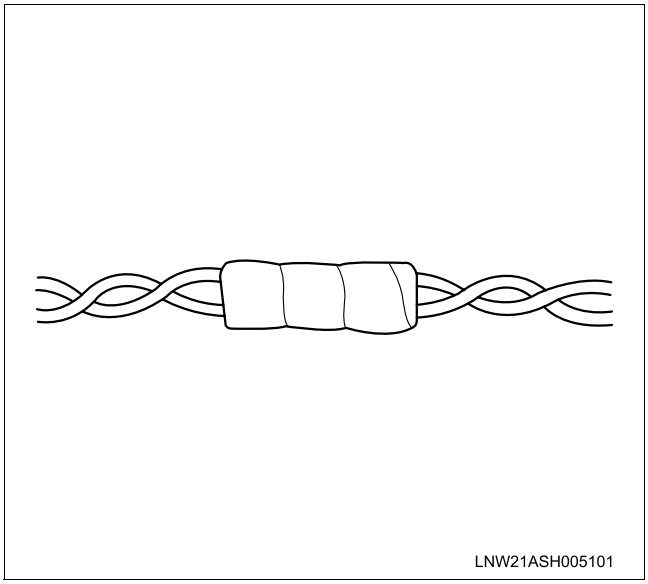
2. Cover the splice with tape in order to insulate it from the other wires.



3. Twist the wires as they were before starting this procedure.



4. Tape the wires with electrical tape. Hold in place.

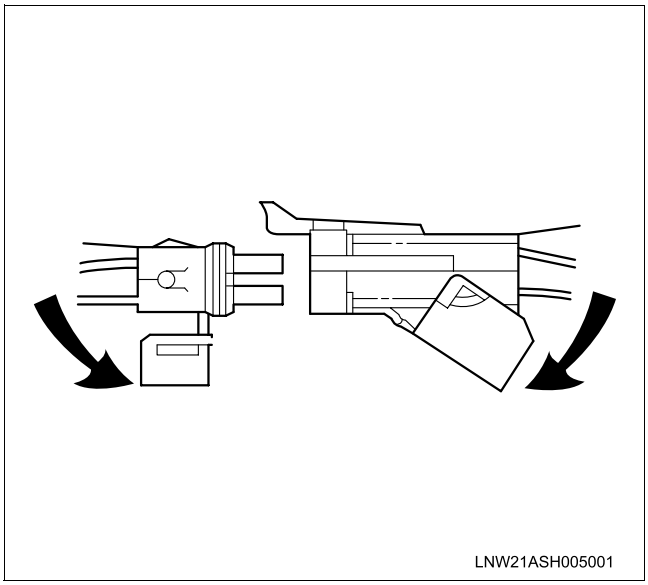


Weather-Pack Connector

Removal Procedure

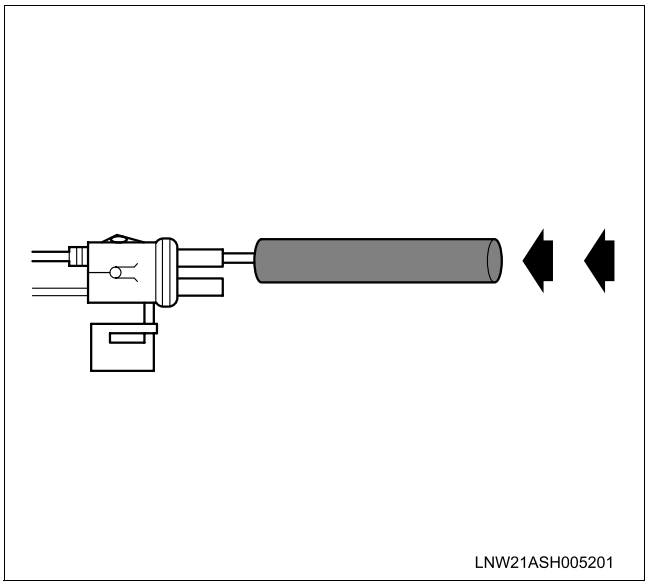
A Weather-Pack connector can be identified by a rubber seal at the rear of the connector. This engine room connector protects against moisture and dirt, which could form oxidation and deposits on the pins. This protection is important, because of the low voltage and the low amperage found in the electronic systems.

1. Open the secondary lock hinge on the connector.

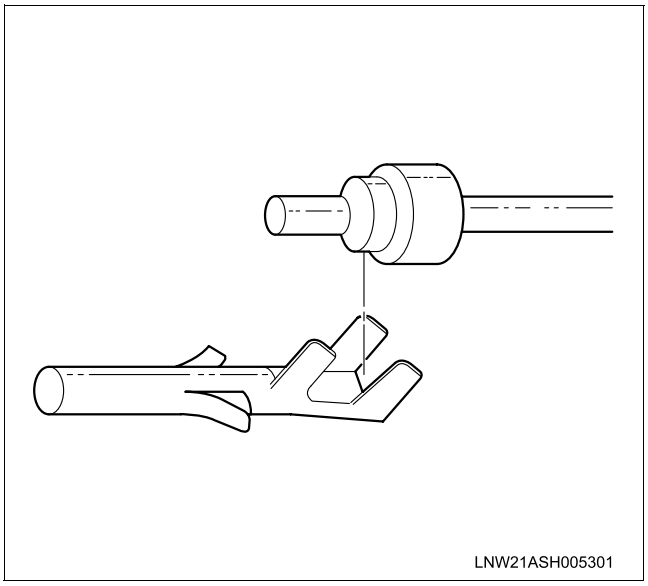


2. Use terminal remover 5-8840-0388-0 or the equivalent to remove the pin and sleeve pins. Push on 5-8840-0388-0 to release.

NOTE:
Do not use an ordinary pick or the pin may be bent or deformed. Unlike standard blade pins, these pins cannot be straightened after they have been improperly bent.



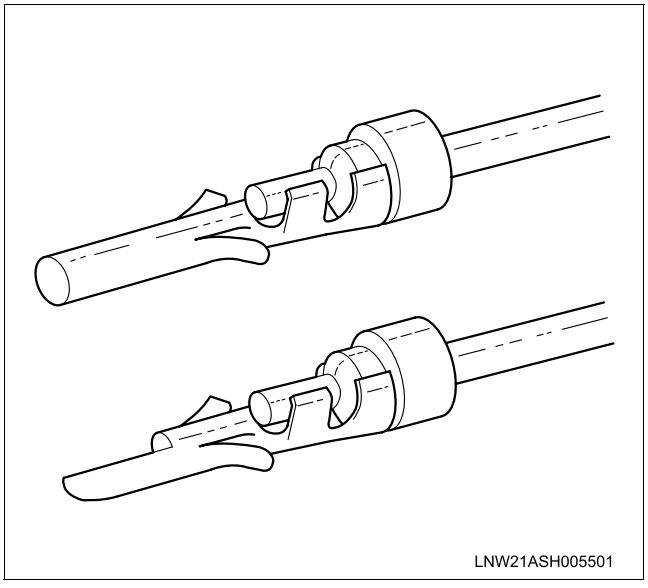
3. Cut the wire immediately behind the cable seal.



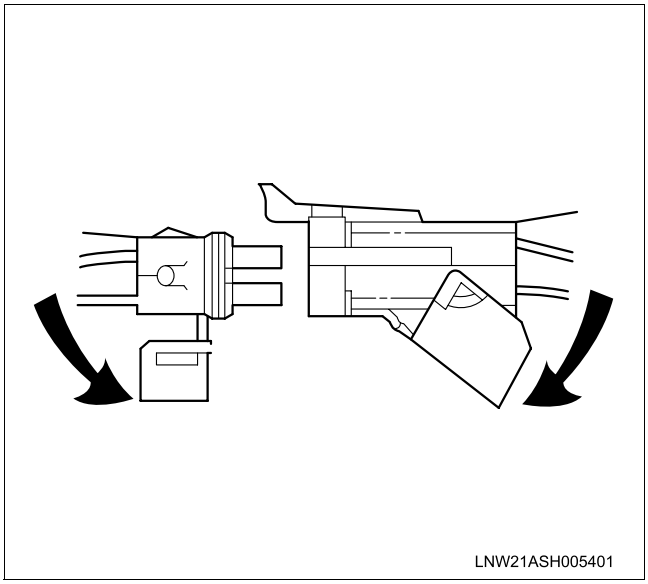
Installation Procedure

Make certain the connectors are properly seated and all of the sealing rings are in place when you reconnect the leads. The secondary lock hinge provides a backup locking feature for the connector. The secondary lock hinge is used for added reliability. This flap should retain the pin even if the small pin lock tangs are not positioned properly.
Do not replace the Weather-Pack connections with standard connections. Read the instructions provided with the Weather-Pack connector and pin packages.

1. Replace the pin.
2. Slip the new seal onto the wire.
3. Strip about 5 mm of insulation from the wire.
4. Crimp the pin over the wire and the seal.

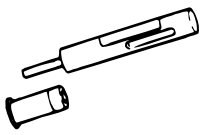


5. Push the pin and the connector to engage the locking tangs.



6. Close the secondary locking hinge.

Special Tools

Illustration	Tool No. Tool name
	5-8840-0388-0 Weather-Pack Terminal Remover

Com-Pack III

General Information

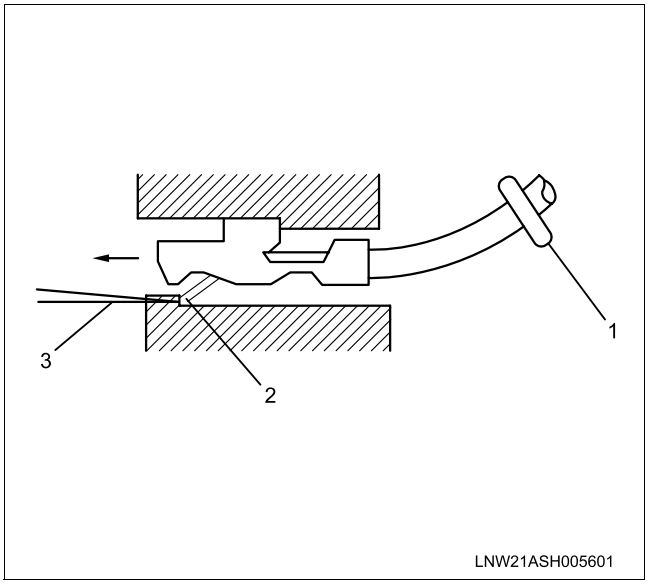
The Com-Pack III pin looks similar to some Weather-Pack pins. This pin is not sealed and is used where resistance to the environment is not required. Use the standard method when repairing a pin. Do not use the Weather-Pack Terminal tool 5-8840-0388-0 or equivalent. These will damage the pins.

Metri-Pack

Removal Procedure

Some connectors use pins called Metri-Pack Series 150. These may be used at the engine coolant temperature (ECT) sensor.

1. Slide the seal (1) back on the wire.
2. Insert the tool 5-8840-0632-0 or equivalent (3) in order to release the pin locking tang (2).

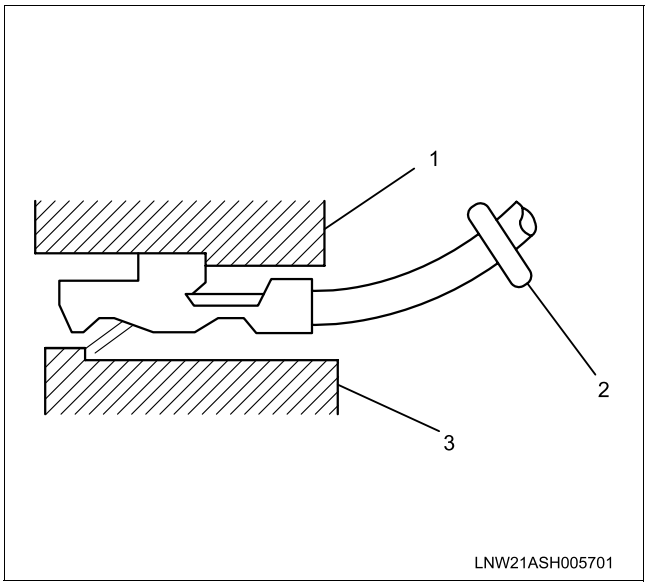


3. Push the wire and the pin out through the connector. IF you reuse the pin, reshape the locking tang.

Installation Procedure

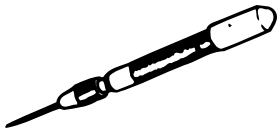
Metri-Pack pins are also referred to as "pull-to-seat" pins.

1. In order to install a pin onto a wire, the wire must be inserted through the seal (2) and through the connector (3).
2. The pin (1) is then crimped onto the wire.



3. Then, the pin is pulled back into the connector to seat it in place.

Special Tools

Illustration	Tool No. Tool name
	5-8840-0632-0 Terminal Remover

LG4HK-WE-0229DOM

You are requested to order this manual using the manual number that is shown above.

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INTERNATIONAL SERVICE DEPARTMENT

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