

ENGINE 4H SERIES

SECTION 6E (4HE1-TC/4HG1-T Only)

EMISSION AND ELECTRICAL DIAGNOSIS

Caution:

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength for (stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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GENERAL DESCRIPTION

The emission and electrical control system operates on a 12 or 24 volt power supply with negative ground polarity. Each wire in the vehicle is of a specific size and has an identifying colored insulation.

These colors are indicated in wiring diagrams and will help in tracing circuits and making proper connections. Wire size is determined by load capacity and circuit length. Some wires are grouped together and taped. Such a grouping of wires is called a harness.

The harness use a split corrugated tube to protect the wires from the elements. Each circuit consists of the following:

- Power source - the battery and the alternator.
- Wires - To carry electrical current through the circuit.
- Fuses - To protect the circuit against current overload.
- Relays - To protect voltage drop between the battery and the circuit parts and to protect the switch points against burning.
- Switches - To open and close the circuit.
- Load - Any device, such as a light or a motor, which converts the electrical current into useful work.
- Ground - To allow the current to flow back to the power source.

In this manual, such electrical device is classified by system. For major parts shown on the circuit based on the circuit diagram for each system, inspection and removal and installation procedures are detailed.

Notes for Working on Electrical Items

Battery Cable

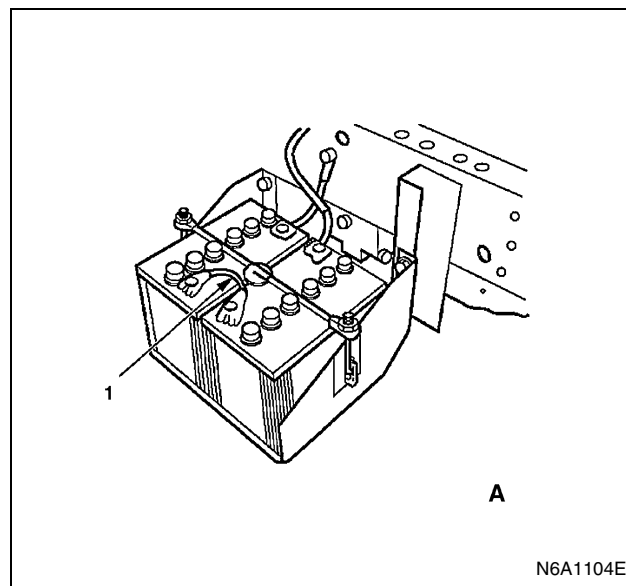
Disconnecting the Battery Cable

1. All switches should be in the "OFF" position.
2. Disconnect the battery ground cable.
3. Disconnect the battery positive cable
4. Disconnect the battery cable (1).

Caution:

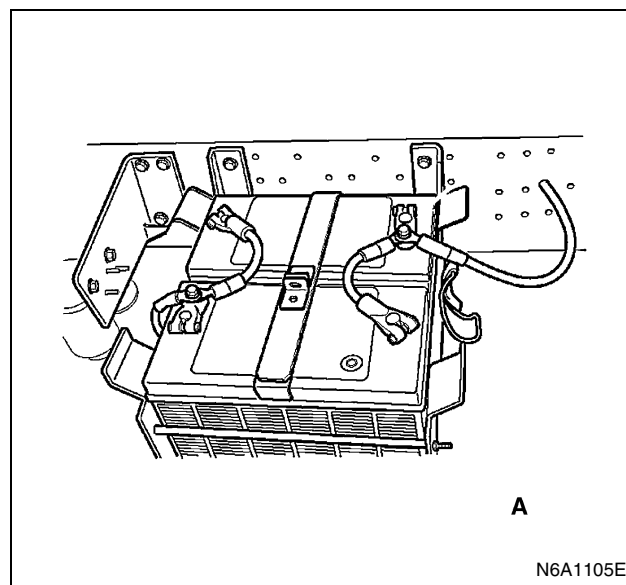
It is important that the battery ground cable be disconnected first.

Disconnecting the battery positive cable first can result in a short circuit.



Legend

- A. For 24 volt
1. Cable



Legend

- A. For 12 volt

Connecting the Battery Cable

Follow the disconnecting procedure in the reverse order.

Caution:

Clean the battery terminal and apply a light coat of grease to prevent terminal corrosion.

Connecting Handling

Disconnecting the Connectors

Some connectors have a tang lock to hold the connectors together during vehicle operation.

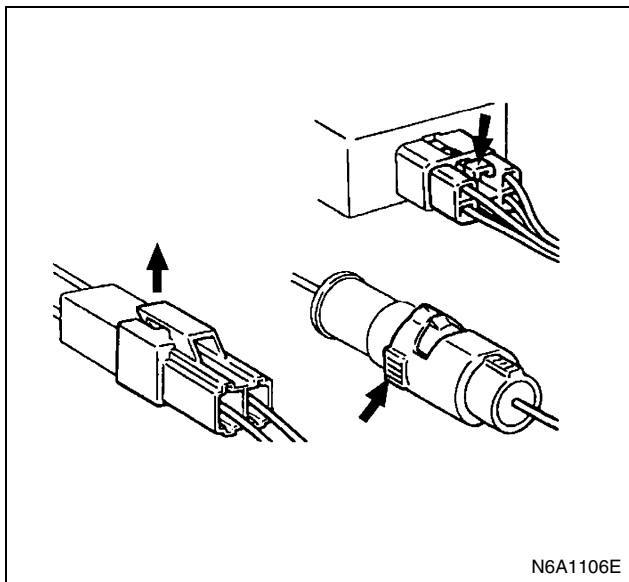
6E-4 EMISSION AND ELECTRICAL DIAGNOSIS

Some tang locks are released by pulling them towards you.

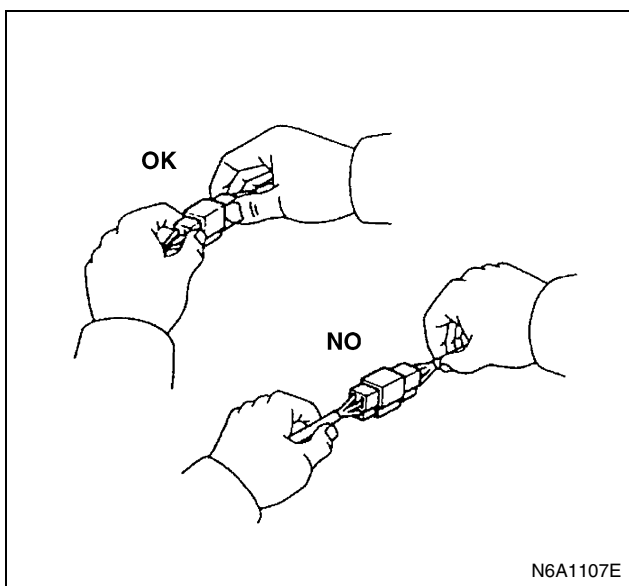
Other tang locks are released by pressing them forward. Determine which type of tang lock is on the connector being handled.

Firmly grasp both sides (male and female) of the connector.

Release the tang lock and carefully pull the two halves of the connector apart.

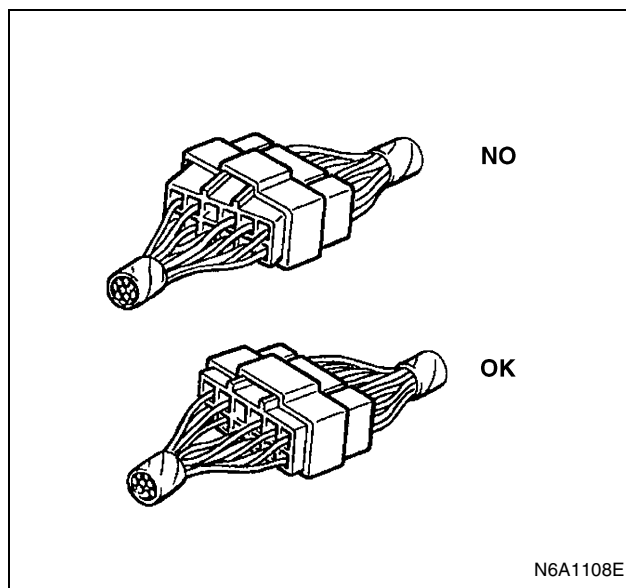


Never pull on the wires to separate the connectors. This will result in wire breakage.



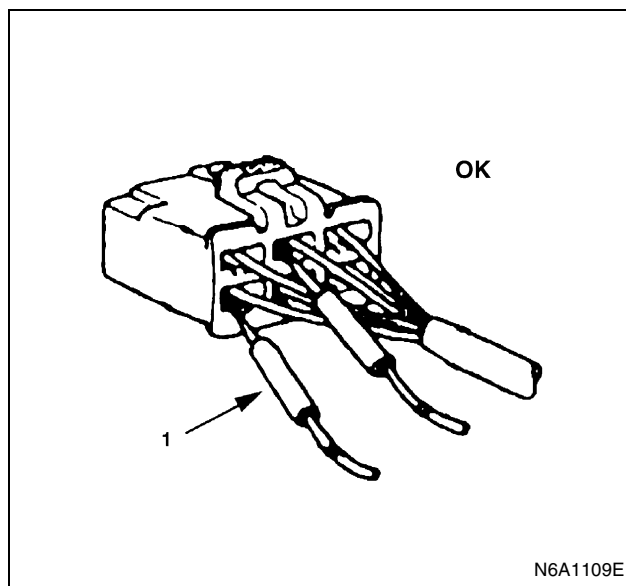
Connecting the Connector

Firmly grasp both sides (male and female) of the connector. Be sure that the connector pins and pin holes match. Be sure that both sides of the connector are aligned with each other. Firmly but carefully push the two sides of the connector together until a distinct click is heard.



Connector Inspection

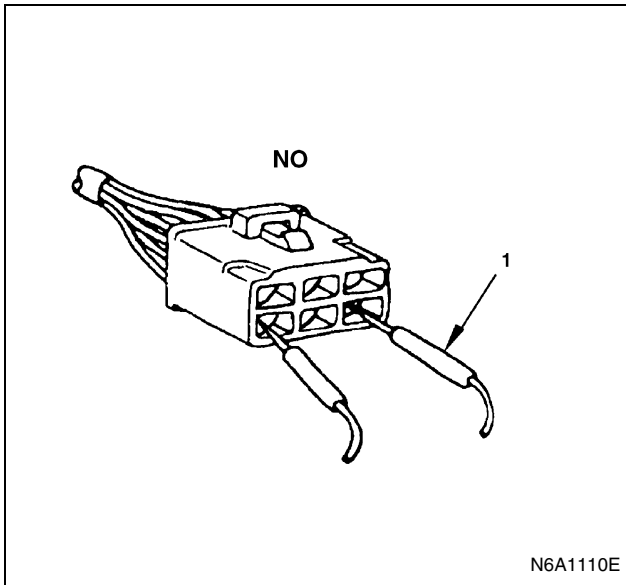
Use a circuit tester to check the connector for continuity. Insert the test probes from the connector wire side.



Legend

- 1. Test probe

Never insert the circuit tester test probes into the connector open end to test the continuity. Broken or open connector terminals will result.

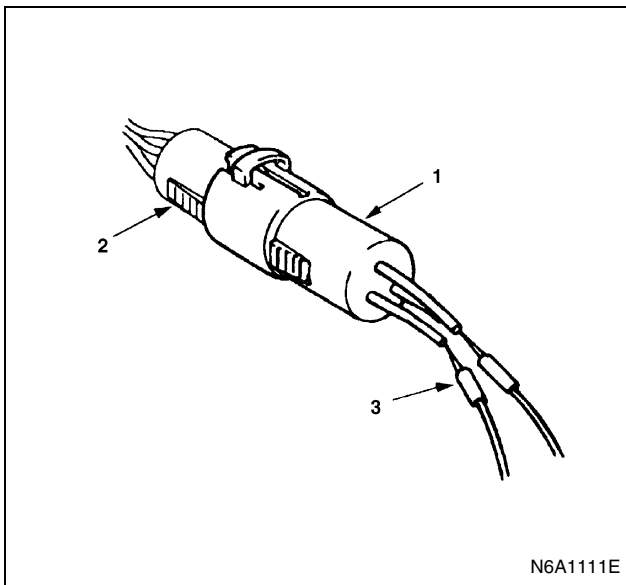
**Legend**

1. Test probe

Waterproof Connector Inspection

It is not possible to insert the test probes into the connector wire side of a waterproof connector.

Use one side of a connector (1) with its wires cut to make the test. Connect the test connector (2) to the connector to be tested. Connect the test probes to the cut wires to check the connector continuity.

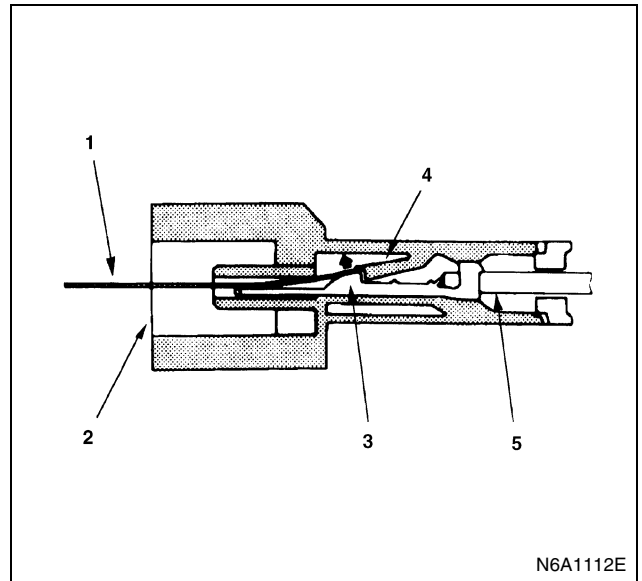
**Legend**

1. Connector
2. Test connector
3. Test probe

Connector Pin Removal**Connector Housing Tang Lock Type**

1. Insert a slender shaft into the connector housing open end.

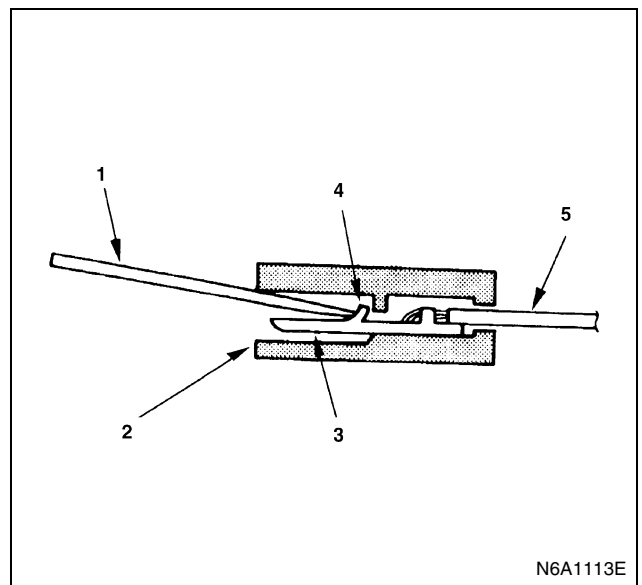
2. Push the tang lock up (in the direction of the arrow in the illustration). Pull the wire with pin free from the wire side of the connector.

**Legend**

1. Slender shaft
2. Housing open pad
3. Pin
4. Tang lock
5. Wire

Pin Tang Lock Type

1. Insert a slender shaft into the Connector housing open end.
2. Push the tang lock flat (toward the wire side of the connector). Pull the wire with pin free from the wire side of the connector.

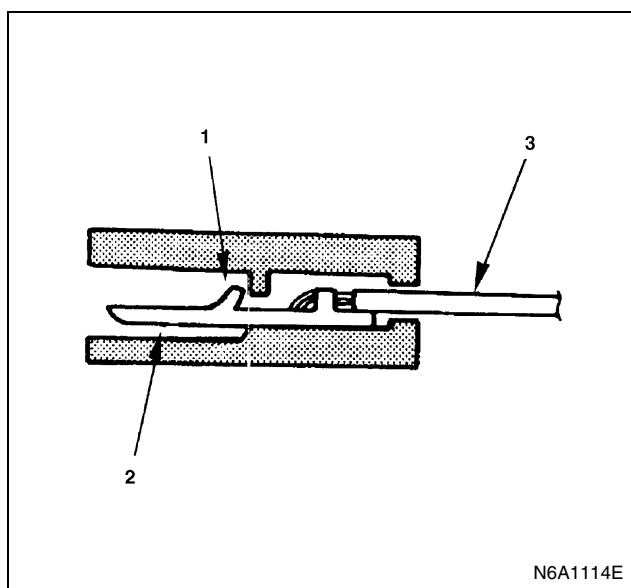


Legend

1. Slender shaft
2. Housing open pad
3. Pin
4. Tang lock
5. Wire

Connector Pin Insertion

1. Check that the tang lock is fully up.
2. Insert the pin from the connector wire side. Push the pin in until the tang lock closes firmly.
3. Gently pull on the wires to make sure that the connector pin is firmly set in place.

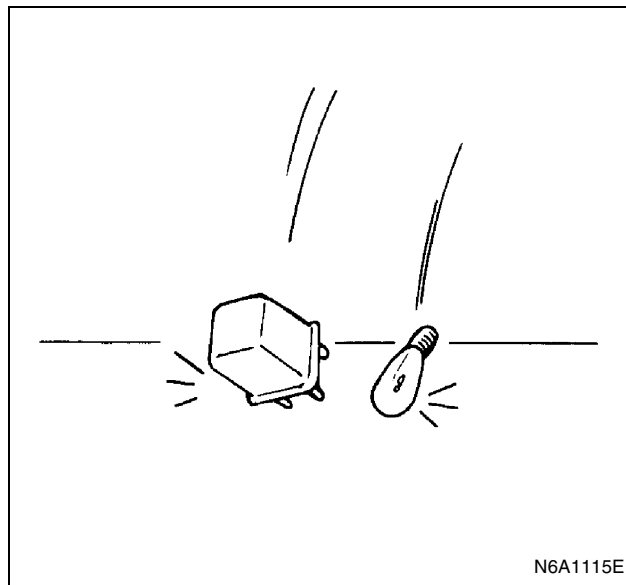


Legend

1. Tang lock
2. Pin
3. Wire

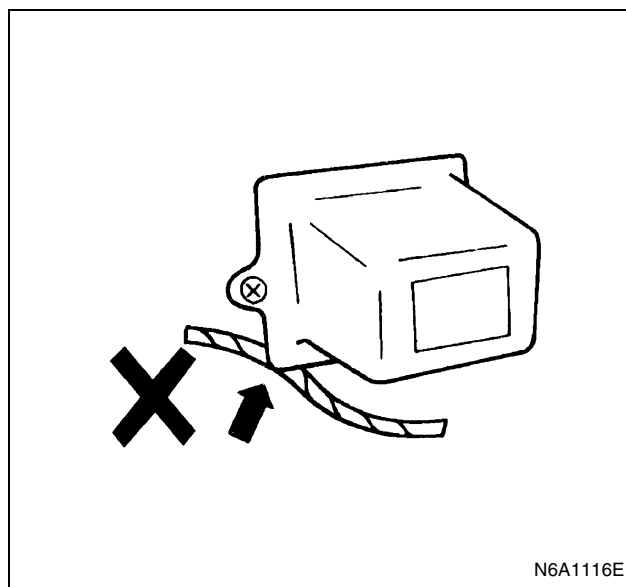
Parts Handling

Be careful when handling electrical parts. They should not be dropped or thrown, because short circuit or other damage may result.



Cable Harness

When installing the parts, be careful not to pinch or wedge the wiring harness. All electrical connections must be kept clean and tight.



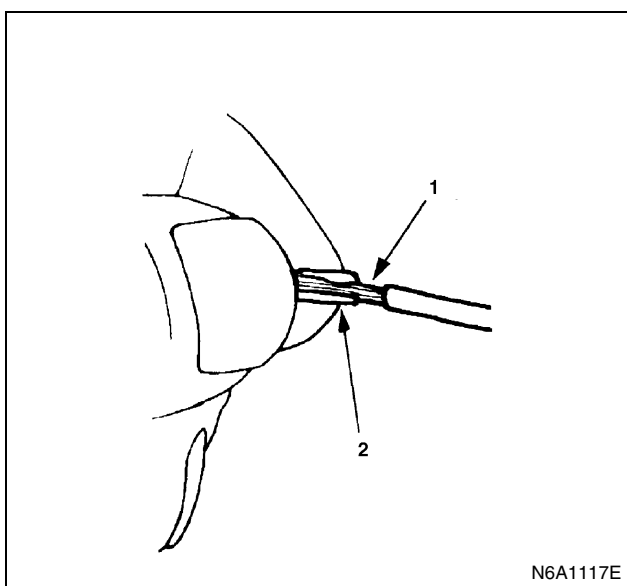
Splicing Wire

1. Open the Harness
If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness.
If the harness has a block plastic conduit, simply pull out the desired wire.
2. Cut the wire
Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 1.5 in (40 mm) away from other splices, harness branches, or connectors.
3. Strip the insulation

When replacing a wire, use a wire of the same size as the original wire. Check the stripped wire for nicks or cut stands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

4. Crimp the Wires

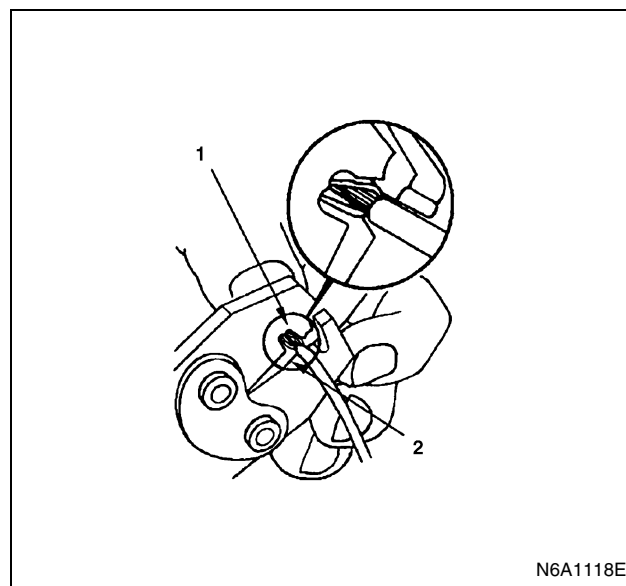
Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with your clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger. Then, center the splice clip under the stripped wires and hold it in place.



Legend

1. Over lap bare wires
2. Splice clip

- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the back of the splice clip touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. then, apply steady pressure until the crimping tool closes.



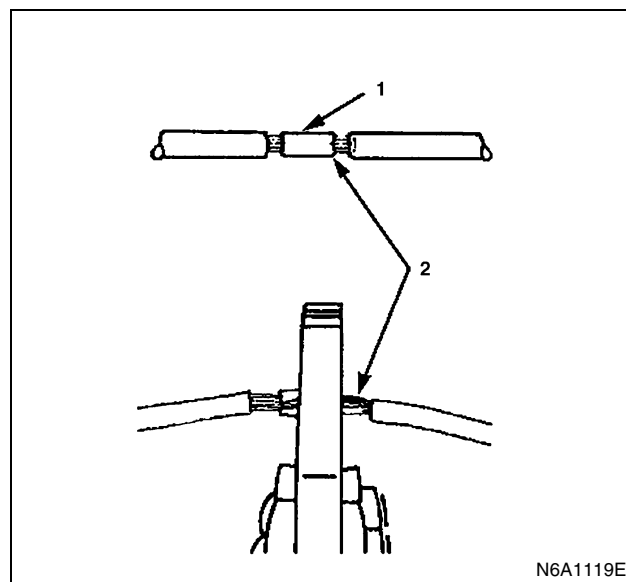
Legend

1. Wings of clip touching former
2. Back of clip centered on anvil

Before crimping the ends of the clip, be sure that:

- The wires extend beyond the clip in each direction.
- No strands of wire are cut loose, and
- No insulation is caught under the clip.

Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires.



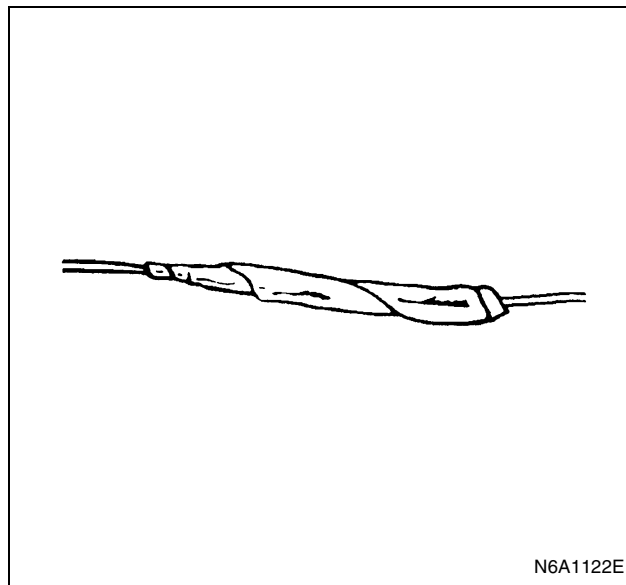
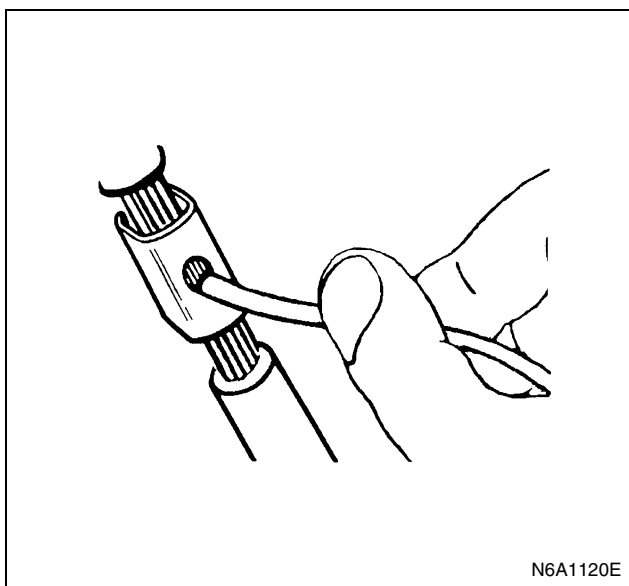
Legend

1. Splice clip
2. Align tool with edge of clip to crimp ends of splice

6E-8 EMISSION AND ELECTRICAL DIAGNOSIS

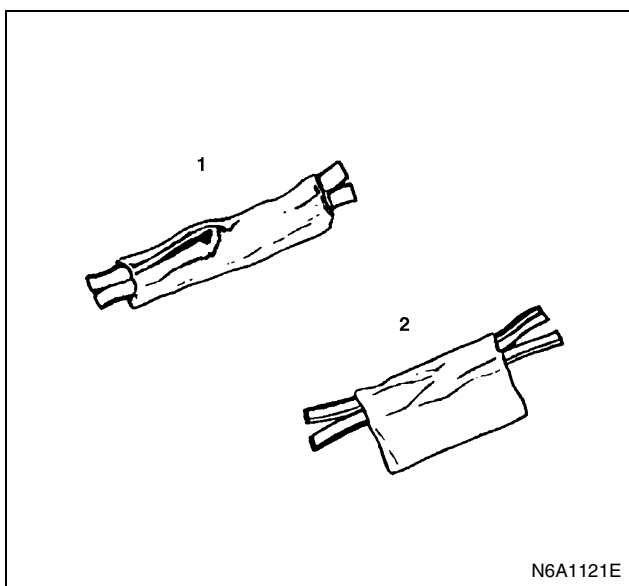
5. Solder

Apply 60/40 rosin core solder to the opening in the back of the clip. Follow the manufacturer's instructions for the solder equipment you are using.



6. Tape the Splice

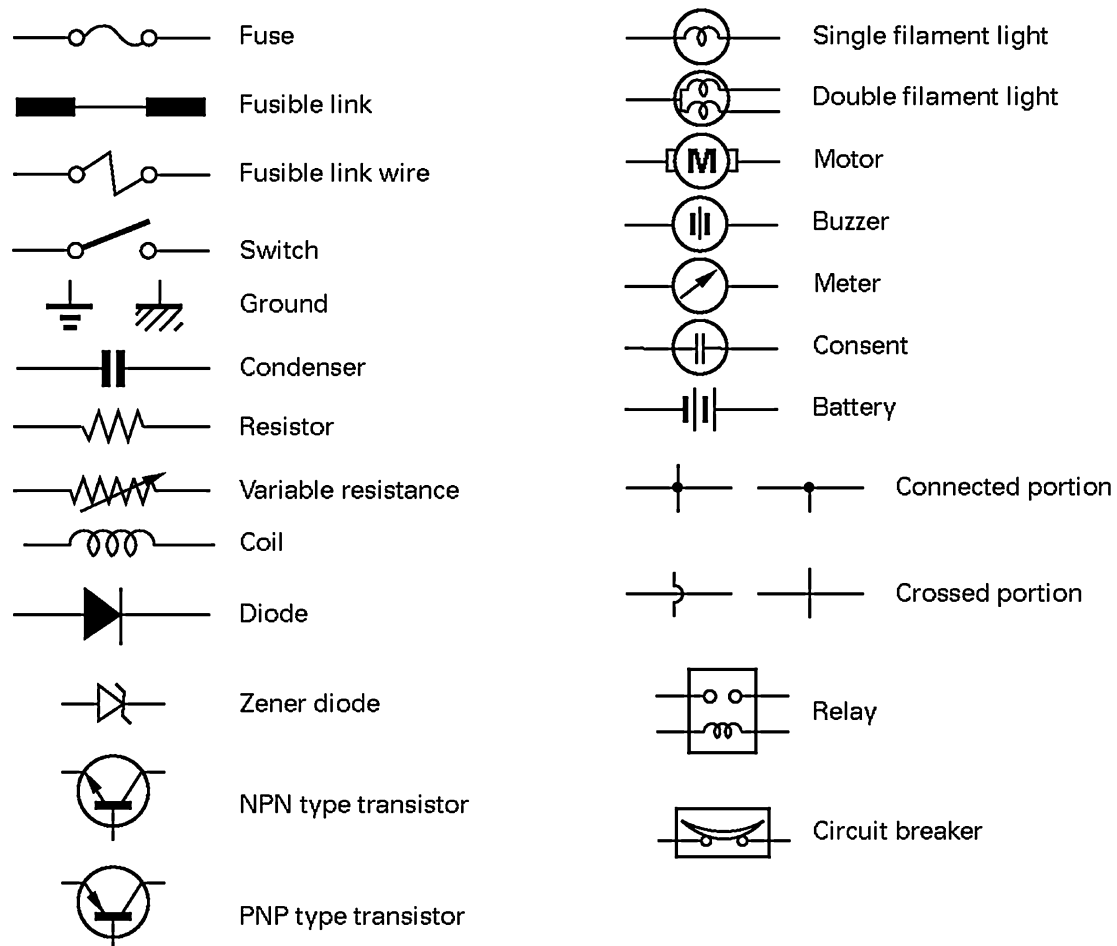
Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness.



Legend

1. Good (Rolled)
2. Bad (Flagged)

If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape.

Symbols and Abbreviations**Symbols**

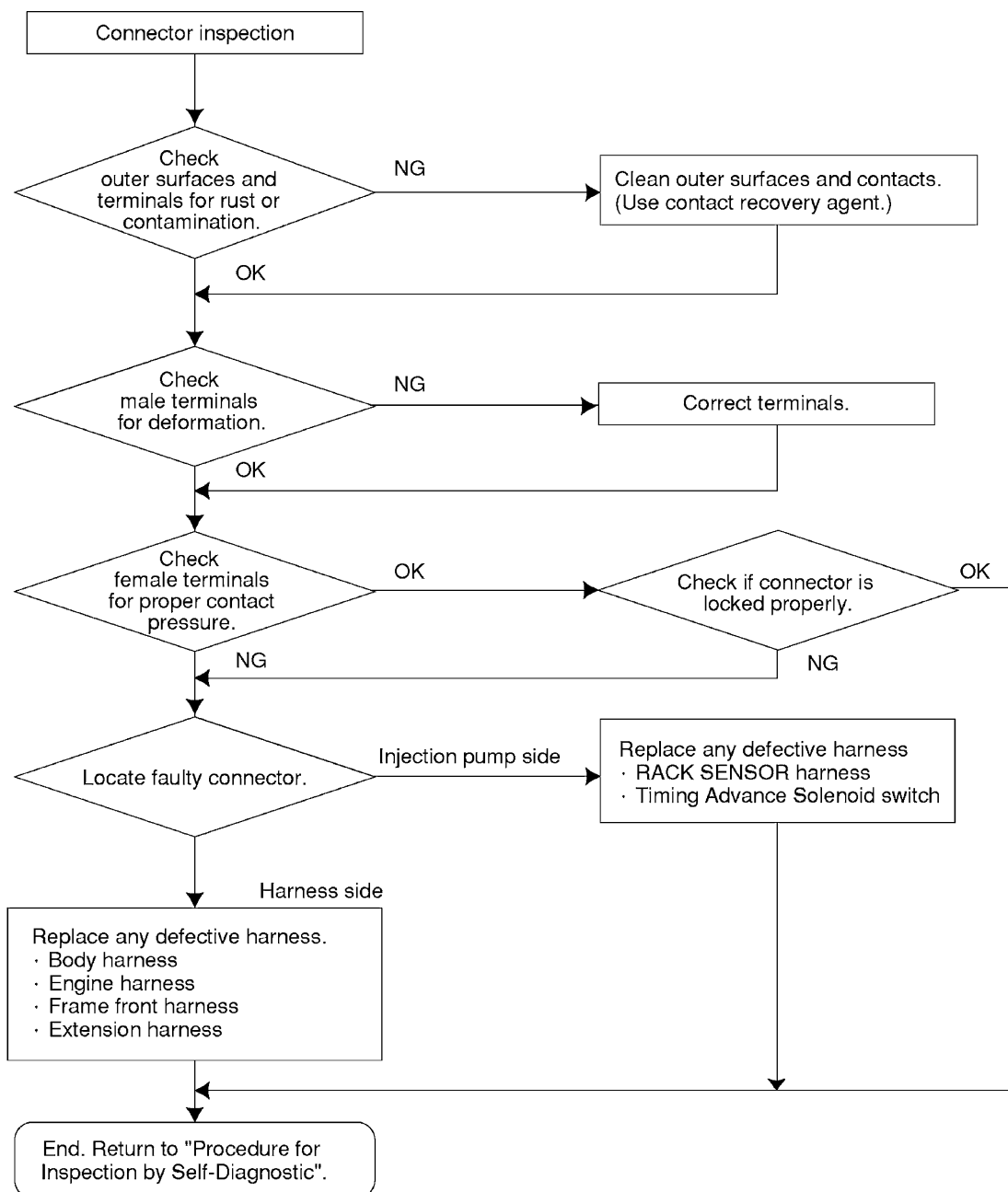
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Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
A/C	Air Conditioner	OBD	BOARD Diagnostic
ACC	Accessory	OFF	Turn Off (Switch/Lamp)
ACT	Actuator	ON	Turn On (Switch/Lamp)
ASSIT	Assistant	OPT	Option
BATT	Battery	P/BRAKE	Parking Brake
CAS	Cab Air Suspension	PGND	Power Ground (To Body Earth)
CAS C/U	Cab Air Suspension Control Unit	PIN	Pin or Terminal
CCS	Combined Charging System	P/L	Pilot (Warning) Lamp
CONN	Connector	PRESS	Pressure
		P/T	Power Train

6E-10 EMISSION AND ELECTRICAL DIAGNOSIS

Abbreviation	Meaning	Abbreviation	Meaning
C/U	Control Unit	PTO	Power Take Off
DC	Direct Current	Q ADJUST- MENT	Injection Quantity Adjustment
D/CONN	Diagnosis Connector	QOS	Quick On Start
DTC	Diagnostic Trouble Code	QWS	Quick Warm System
EC	Electrical Control Governor		
ECM	Engine Control Module	RH	Right Hand (Side)
ECT	Engine Coolant Temperature	RHD	Right Hand Drive
EGR	Exhaust Gas Recirculation	R/L	Relay
EH	Electrical and Hydraulic Timer	RR	Rear
EXH	Exhaust		
EVRV	Electronic Vacuum Regulating Valve	S/ASB	Shock Absorber
		SIG	Signal
FICD	Fast Idle Control Device	SS	Speed Sensor
FRT	Front	SS C/U	Speed Sensor Control Unit
		STD	Standard
GND	Ground (Body Earth)	SUSP	Suspension
		SW	Switch
IE	ISUZU Economy System		
IN	Inlet, Intake	TCV	Trailer Cock Valve
IVES	ISUZU Variable Electric and Economy Swirl	TICS	Timing and Injection Rate Control System
LH	Left Hand (Side)	VGS	Variable Geometry Turbocharging System
LHD	Left Hand Drive		
		VSS	Variable Swirl System
MAG	Magnetic	VSV	Vacuum Switching Valve
ME/CONN	Memory Eraser Connector		
MIL	Malfunction Indicator Lamp	W/L	Warning Lamp
M/V	Magnetic Valve	W/	With
		W/O	Without
N	Neutral (Transmission Gear)		
N-TDC	Numbers Top Dead Center		
NR	Noise Reducer		

Connector Inspecting Procedure**Connector Inspecting Procedure**

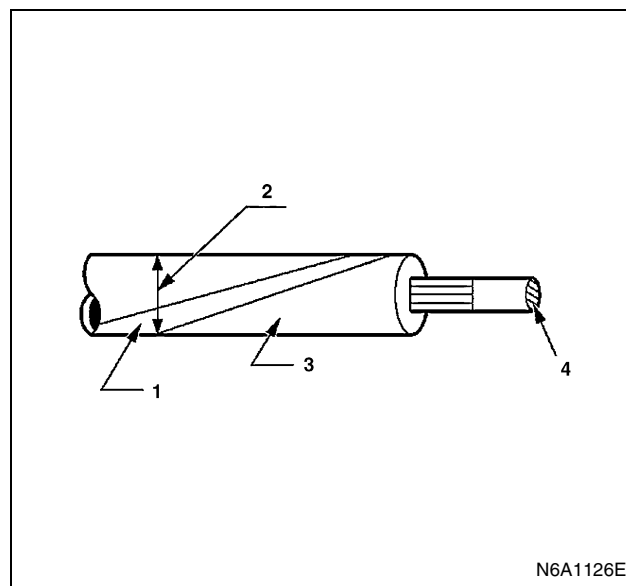
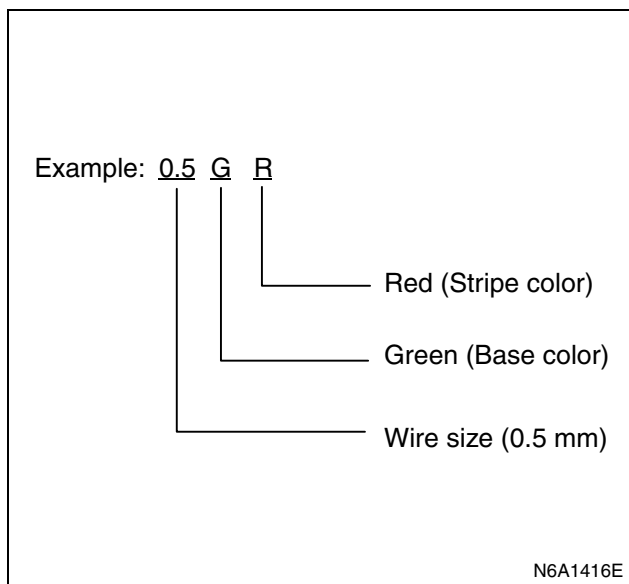
Parts for Electrical Circuit

Wiring

Wire Color

All wires have color-coded insulation.

Wires belonging to a system's main harness will have a single color. Wires belonging to a system's sub circuits will have a colored stripe. Striped wires use the following code to show wire size and colors.

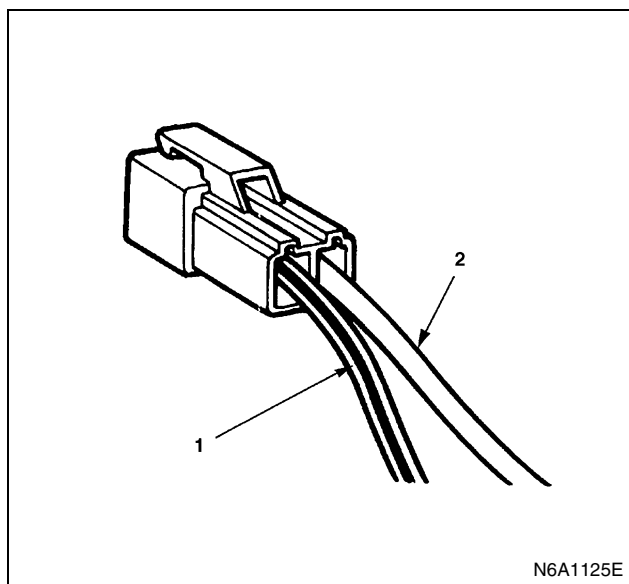


Legend

1. Stripe color
2. Outside diameter
3. Base color
4. Cross sectional area

Abbreviations are used to indicate wire color within a circuit diagram.

Refer to the following table.



Legend

1. Colored stripe
2. Single color

Wire Color Coding

Color-coding	Meaning	Color-coding	Meaning
B	Black	Br	Brown
W	White	Lg	Light green
R	Red	Gr	Gray
G	Green	P	Pink
Y	Yellow	Sb	Sky blue
L	Blue	V	Violet
O	Orange		

Stripe Color Coding

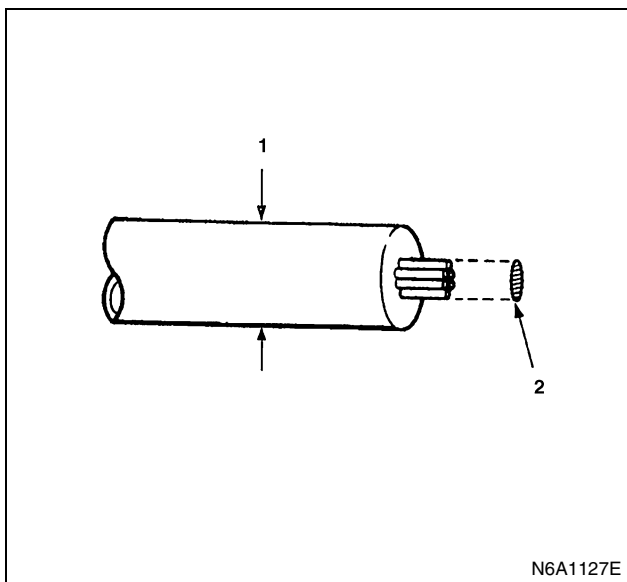
Color-code	Base Color	Stripe Color
LB	Blue	Black
OB	Orange	Black
PB	Pink	Black
PG	Pink	Green
PL	Pink	Blue
RY	Red	Yellow
VR	Violet	Red
VW	Violet	White
YB	Yellow	Black
YB	Yellow	Green
YV	Yellow	Violet

Wire Size

The size of wire, used in a circuit is determined by the amount of current (amperage), the length of the circuit, and the voltage drop allowed. The following wire size and load capacity, shown below, are specified by JIS (Japanese Industrial Standard) (Nominal size means approximate cross sectional area)

Legend

1. Outside diameter
2. Cross sectional area



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Nominal size (mm)	Cross sectional area (mm ²)	Outside diameter (mm)	Allowable current (A)
0.3	0.372	1.8	9
0.5	0.563	2	12
0.85	0.885	2.2	16
1.25	1.287	2.5	21
2	2.091	2.9	28
3	3.296	3.6	37.5
5	5.227	4.4	53
8	7.952	5.5	67
15	13.36	7	75
20	20.61	8.2	97

DIAGNOSIS (4HE1-TC Only)

Strategy-based Diagnostics

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. 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.
 - Detect unusual sounds or odors.
 - Gather diagnostic trouble code information to achieve an effective repair.
3. Check bulletins and other service information.
 - This includes videos, newsletters, etc.
4. Refer to service information (manual) system check (s).
 - "System checks" contain information on a system that may not be supported by one or more DTCs.

System checks verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to service diagnostics.

Diagnostic Trouble Code (DTC) Stored

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

No DTC

Select the symptom from the symptom tables.

Follow the diagnostic paths or suggestions to complete the repair. You may refer to the applicable component/system check in the system checks.

No Matchig 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 called intermittents. To resolve intermittents, perform the following steps:

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

3. Use a check sheet or other method to identify the circuit or electrical system component.
4. Follow the suggestions for intermittent diagnosis found in the service documentation.

Most scan tool, such as the Tech II have data-capturing capabilities that can assist in detecting intermittents.

No Trouble Found

This condition exists when the vehicle 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. Re-examine 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 according to customer complaint.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with OBD system diagnostics. Following a repair, the technician should perform the following steps:

Important:

Follow the steps below when you verify repairs on board diagnostic systems. Failure to follow these steps could result in unnecessary repairs.

1. Review and record the Failure Records for the DTC which has been diagnosed.
2. Clear the DTC (S).
3. Operate the vehicle within conditions according to customer complaint.
4. Monitor the Diagnostic Trouble Code (DTC) status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

General Service Information

On Board Diagnostic (OBD) Serviceability Issues

The list of non-vehicle faults that could affect the performance of the OBD system has been compiled. These non-vehicle faults vary from environmental conditions to the quality of fuel used.

The illumination of the Malfunction Indicator Lamp (MIL) ("Check Engine" lamp) due to a non-vehicle fault could lead to misdiagnosis of the vehicle, increased warranty expense and customer dissatisfaction. The following list of non-vehicle faults does not include every possible fault and may not apply equally to all product lines.

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the MIL to turn on if the vehicle is not maintained properly. Restricted air filters, fuel filters, oil 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. Poor vehicle maintenance can not be classified as a "non-vehicle fault", but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Maintenance Schedule

Refer to the maintenance Schedule.

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

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

Basic Knowledge of Tools Required

Notice:

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 is necessary to effectively use this section of the Service Manual.

On-Board Diagnostic (OBD)

On-Board Diagnostic Tests

A 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.

Common OBD Terms

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.

Enable Criteria

The term "enable criteria" is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run. "Enable criteria" is another way of saying "conditions required".

Trip

Technically, a trip is a key on-run-key off cycle in which all the enable criteria for a given diagnostic are met, allowing the diagnostic to run. Unfortunately, this concept is not quite that simple. A trip is official when all the enable criteria for a given diagnostic are met. But because the enable criteria vary from one diagnostic to another, the definition of trip varies as well. Some diagnostic are run when the vehicle is at operating temperature, some when the vehicle first start up; some require that the vehicle be cruising at a steady highway speed, some run only when the vehicle is idle.

Some run only immediately following a cold engine start-up.

A trip then, is defined as a key on-run-key off cycle in which the vehicle was operated in such a way as to satisfy the enables criteria for a given diagnostic, and this diagnostic will consider this cycle to be one trip. However, another diagnostic with a different set of enable criteria (which were not met) during this driving event, would not consider it a trip. No trip will occur for that particular diagnostic until the vehicle is driven in such a way as to meet all the enable criteria.

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 that 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 Malfunction Indicator Lamp (MIL) is illuminated.

Data Link Connector (DLC)

The provision for communication with the control module is the Data Link Connector (DLC). It is located at near the A post of driver side. The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Reading serial data.

Decimal/Binary/Hexadecimal Conversions

All scan tool manufacture will display a variety of vehicle information which will aid in repairing the vehicle. Some scan tools will display encoded messages which will aid in determining the nature of the concern. The method of encoding involves the use of a two additional numbering systems: Binary and Hexadecimal.

The binary number system has a base of two numbers. Each digits is either a 0 or a 1. A binary number is an eight digit number and is read from right to left. Each digit has a position number with the farthest right being the 0 position and the farthest left being the 7 position. The 0 position, when displayed by a 1, indicates 1 in decimal. Each position to the left is double the previous position and added to any other position values marked as a 1. A hexadecimal system is composed of 16 different alpha numeric characters. The alpha numeric characters used are numbers 0 through 9 and letters A through F. The hexadecimal system is the most natural and common approach for scan tool manufactures to display data represented by binary numbers and digital code.

Verifying Vehicle Repair

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

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC (s).
3. Operate the vehicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

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

On-Board Diagnostic (OBD) System Check

OBD System should be checked as follows:

1. When Ignition key is turned from the "OFF" to the "ON" position, make sure that MIL is lit for 0.3 — 0.8 sec.
 2. Connect Scan Tool and check to see if MIL is always lit.
- If so, OBD System is normal.

Reading Diagnostic Trouble Codes Using a Tech 2 or Other Scan Tool

The procedure for reading diagnostic trouble codes is to be used a diagnostic scan tool. When reading DTCs, follow instructions supplied by tool manufacturer.

Clearing Diagnostic Trouble Codes**Important:**

Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Freeze Frame and Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

If the fault that caused the DTC to be stored into memory has been corrected, the Diagnostic Executive will begin to count the "warm-up" cycles with no further faults detected, the DTC will automatically be cleared from the Engine Control Module (ECM) memory.

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTCs" or "clear Information" function. When clearing DTCs follow instructions supplied by the tool manufacturer.

When a scan tool is not available, DTCs can also be cleared by disconnecting one of the following sources for at least thirty (30) seconds.

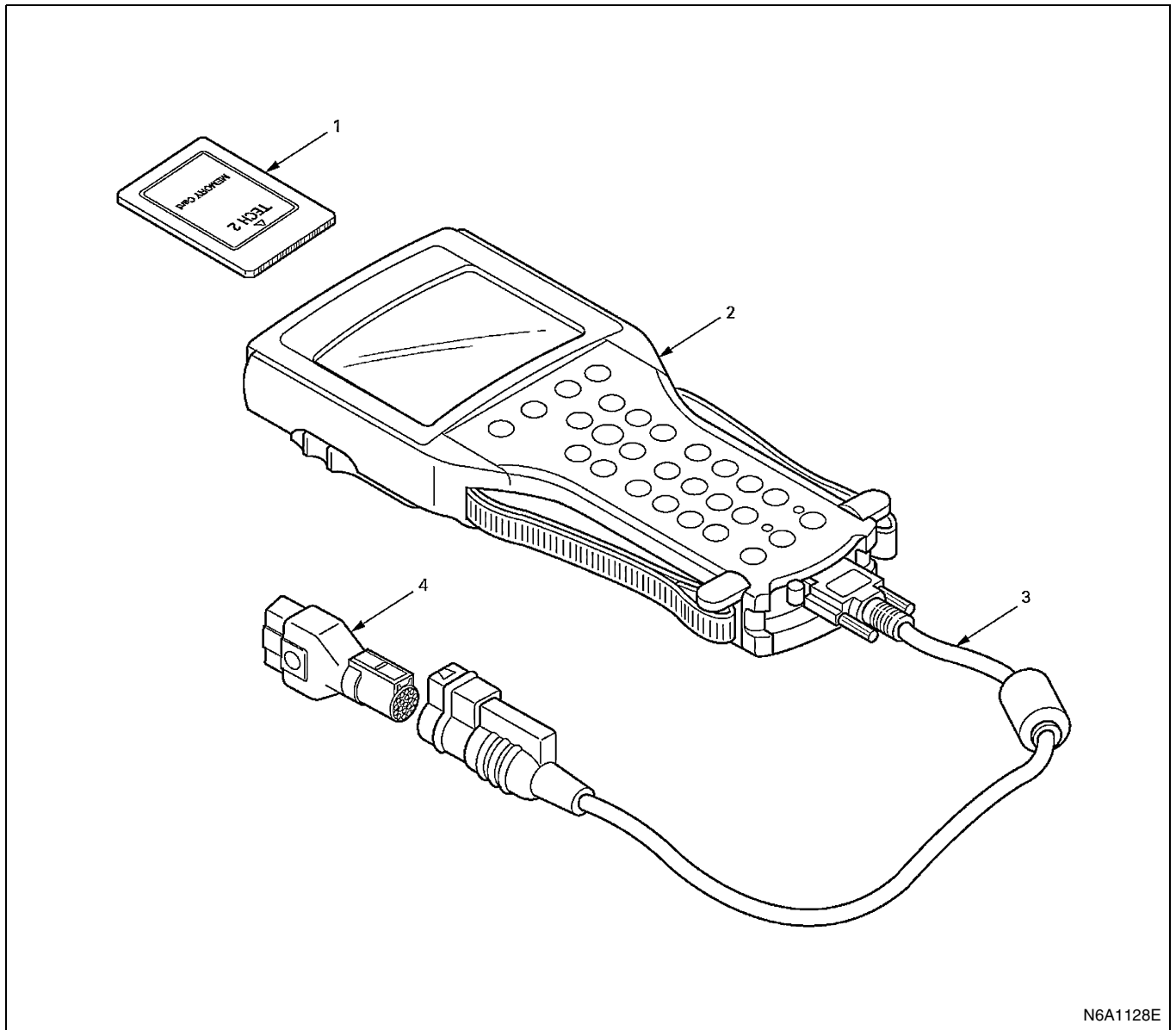
Notice:

To prevent system damage, the ignition key must be "OFF" when disconnecting or reconnecting battery power.

- The power source to the control module. Examples: fuse, pigtail at battery ECM connectors etc.
- The negative battery cable. (Disconnecting the negative battery cable will result in the loss of other on-board memory data, such as preset radio tuning).

Tech 2 Scan Tool

From 98 MY, Isuzu Dealer service departments are recommended to use Tech 2. Refer to Tech 2 scan tool user guide.



N6A1128E

Legend

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

Getting Started

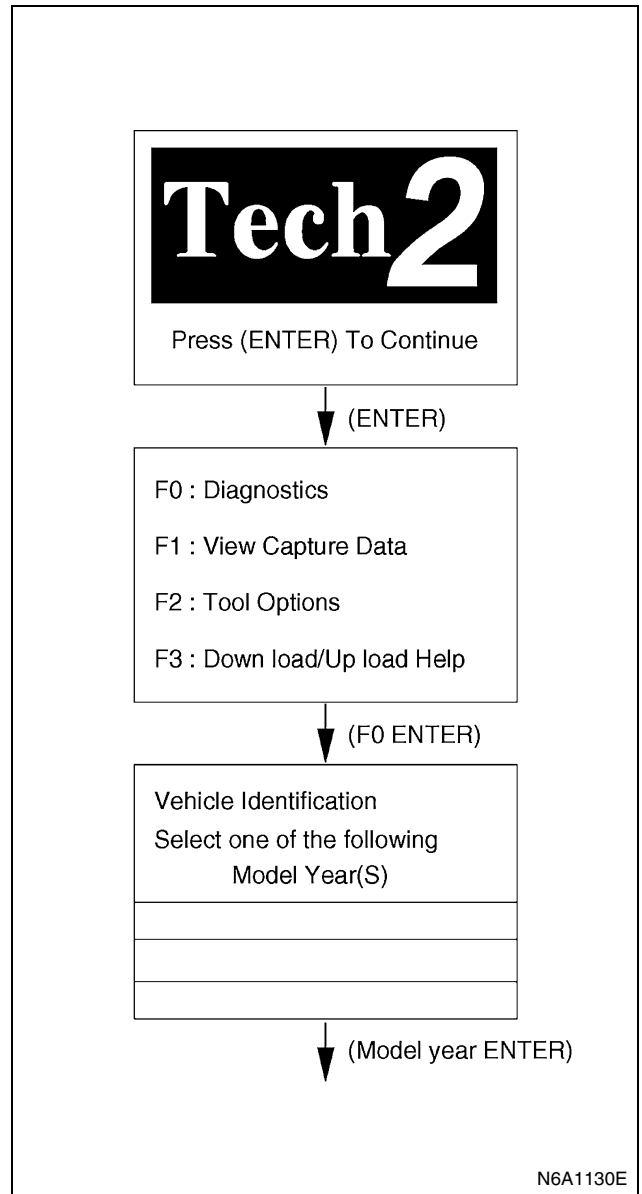
- Before operating the Isuzu PCMCIA card with the Tech 2, the following steps must be performed:
1. The Isuzu 98 System PCMCIA card (1) inserts into the Tech 2 (2).
 2. Connect the SAE 16/19 adapter (4) to the DLC cable (3).
 3. Connect the DLC cable to the Tech 2 (2).
 4. Make sure the vehicle ignition key is off.
 5. Connect the Tech 2 SAE 16/19 adapter to the vehicle ALDL/DLC.
 6. The vehicle ignition turns on.
 7. Verify the Tech 2 power up display.

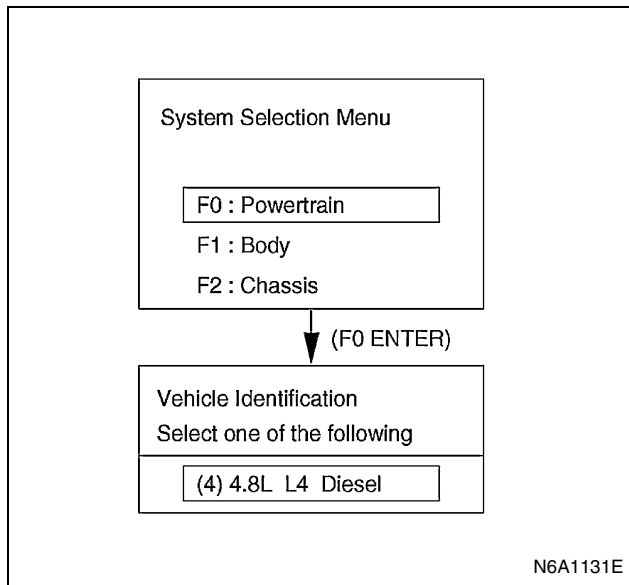
**Notice:**

The RS232 Loop back connector is only to use for diagnosis of Tech 2 and refer to user guide of the Tech 2.

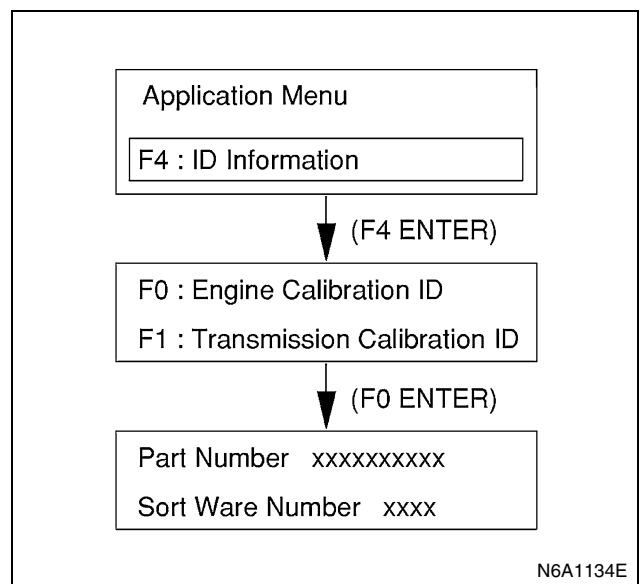
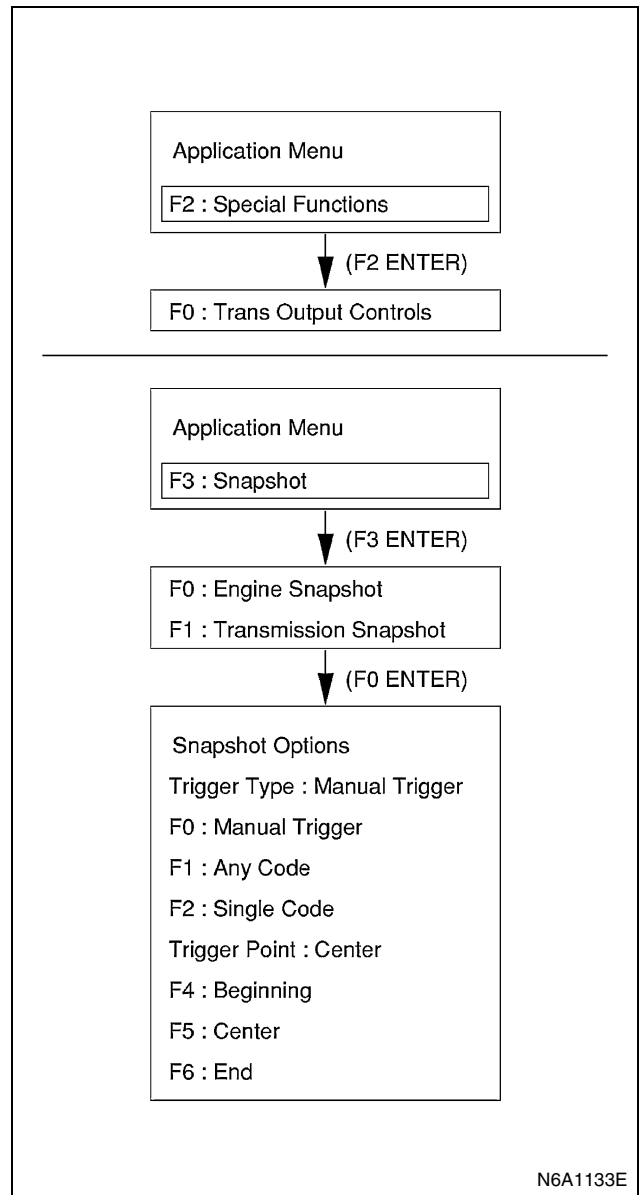
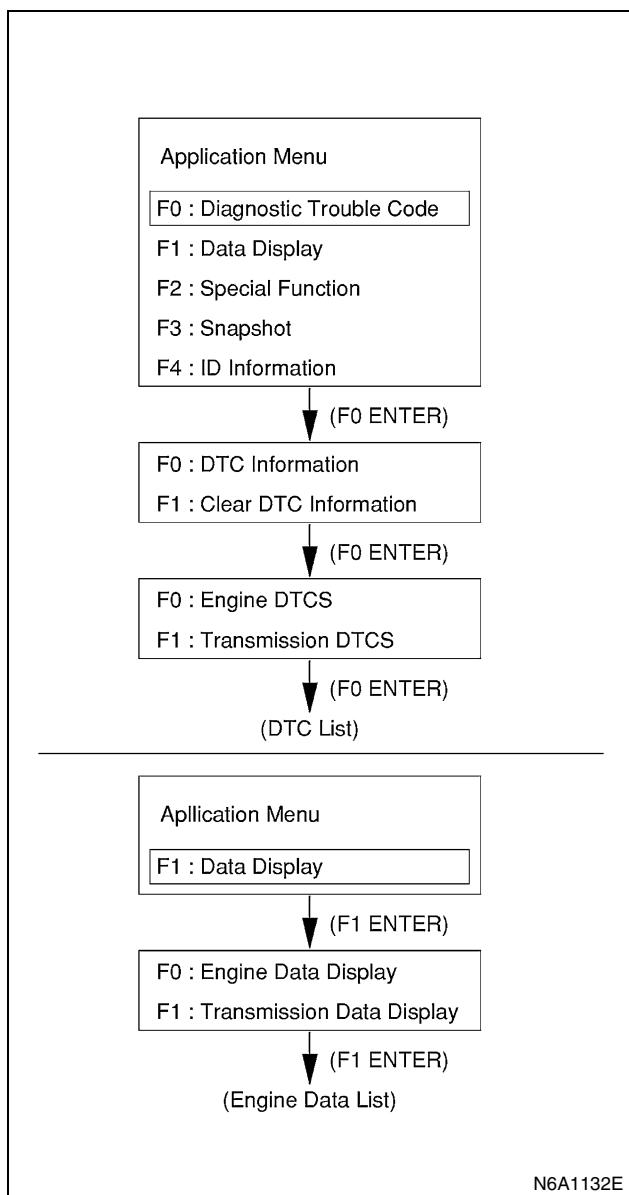
Operating Procedure (For example)

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card. Follow the operating procedure below.





- The following table shows, which functions are used the available equipment versions.



Typical Scan Data Values

Use the Typical Scan Data Values Table only after the On-Board Diagnostic System Check has been completed, no diagnostic trouble codes were noted, and you have determined that the on-board diagnostics are functioning properly. Scan tool values from a properly-running engine may be used for comparison with the engine you are diagnosing. The typical scan data values represent values that would be seen on a normally-running engine.

Notice:

A scan tool that displays faulty data should not be used, and the problem should be reported to the scan tool

manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary replacement of parts.

Only the parameters listed below are referred to in this service manual for use in diagnosis. For further information on using the scan tool to diagnose the engine control module and related sensors, refer to the applicable reference section listed below. If all values are within the typical range described below, refer to the symptoms section for diagnosis.

Test Conditions

Engine running, lower radiator hose hot, transmission in park or neutral, closed loop, accessories off, brake not applied and air conditioning off.

Data List (Typical Data)

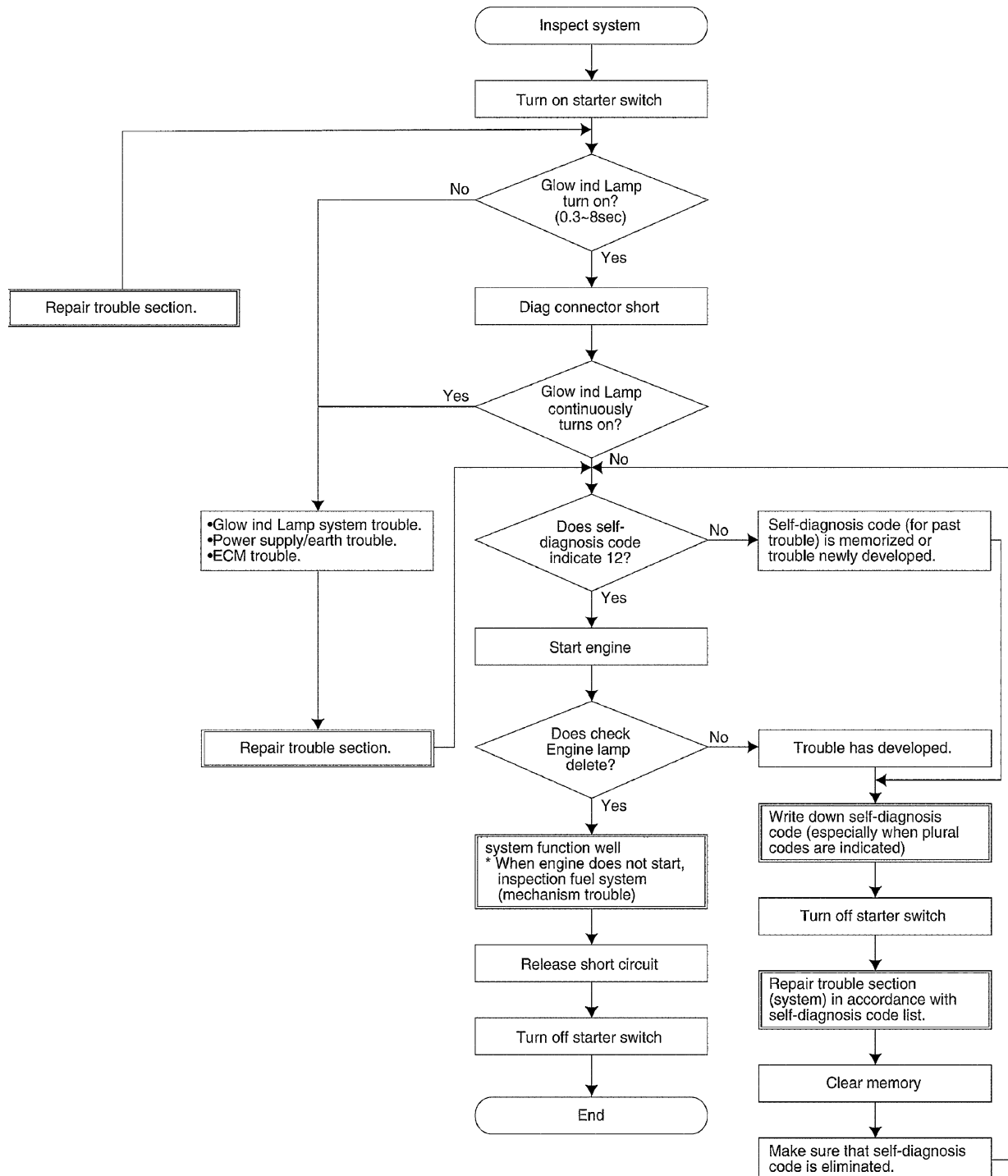
TECH 2 STRING		TYPICAL DATA VALUES (IDLE)
Ignition Switch	(On/Off)	On
Starter Switch	(On/Off)	Off
Exhaust Break Switch	(On/Off)	Off
Transmission Gear Position Switch		N.2.3.4.5.6
Transmission Spec. Select Switch	(AT/MT)	Automatic Trans
Engine Spec. Select Switch	(S/N)	S/N
IAT Switch	(Yes/No and High/Low)	High
EGR/VSS System	(Yes/No)	Yes
Rack Sensor Voltage	(V)	1
Engine Coolant Temperature Sensor Voltage	(V)	1.7 —1.9
Engine Coolant Temperature	°F(°C)	176 (80)
Engine Speed	(rpm)	800
Barometric Voltage	(V)	2.9
Barometric Pressure	(mmHg)	761

Troubleshooting

Caution taken in inspecting

1. In inspecting system, write down self-diagnosis code to be indicated. (especially, when plural self-diagnosis codes are indicated.)
2. Before eliminating the indicated self-diagnosis codes by a memory clear switch, doubly inspect abnormal place as indicated in self-diagnosis code. (Self-diagnosis code means 'Warning.' Make sure to inspect abnormal section.)

Inspection Procedure Flowchart



Notice:

Please note that some items of self-diagnosis code may not be generated unless the engine is warmed up or unless the vehicle is driven under load.

Self-diagnosis Functions**Memorization of self-diagnosis code**

The self-diagnosis code indicated will be memorized in Electronically Erasable Programmable Read Only Memory (EEPROM) with in the Engine Control Module (ECM). Accordingly even if the starter switch turns off or the ECM is removed from the vehicle, the memorized self-diagnosis code will not be eliminated.

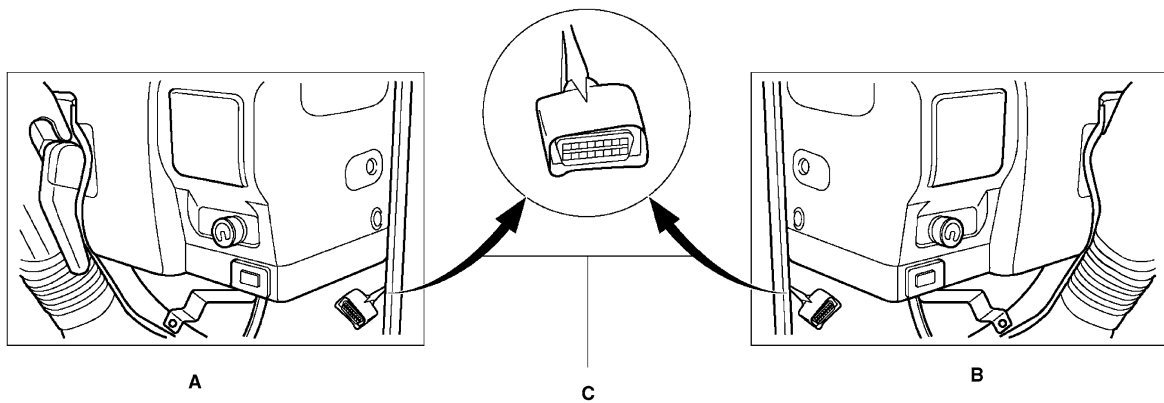
* Unless an elimination procedure is taken, the self-diagnosis code will remain in memory. (The memory will be eliminated only by a memory clear switch.)

Elimination of self-diagnosis code

The self-diagnosis code memorized in the EEPROM with in the ECM can be eliminated only by Scan Tool or the operation of the memory clear switch.

The elimination method memory clear switch will be described below:

1. Turn OFF ignition switch.
2. Use 4.7k Ω resistance and make short circuit on memory clear switch.
3. Turn ON ignition switch. The indication lamp turn on (lighting) continuously after three seconds flashing the indication lamp.
4. Turn OFF ignition switch.
5. Remove shortage resistance from memory clear switch.

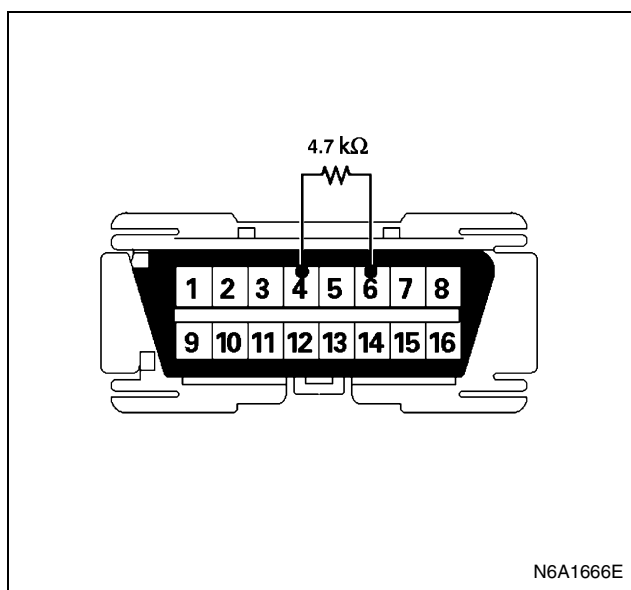
Location of the Memory Clear Switch**Location of the memory clear switch (DATA LINK CONNECTOR)**

N6A1665E

Legend

- A. Right-hand drive
- B. Left-hand drive

- C. Terminal assignment of data link connector (DLC)



NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4, 5	CHECKER GND

How to read flashing of the indicator lamp:

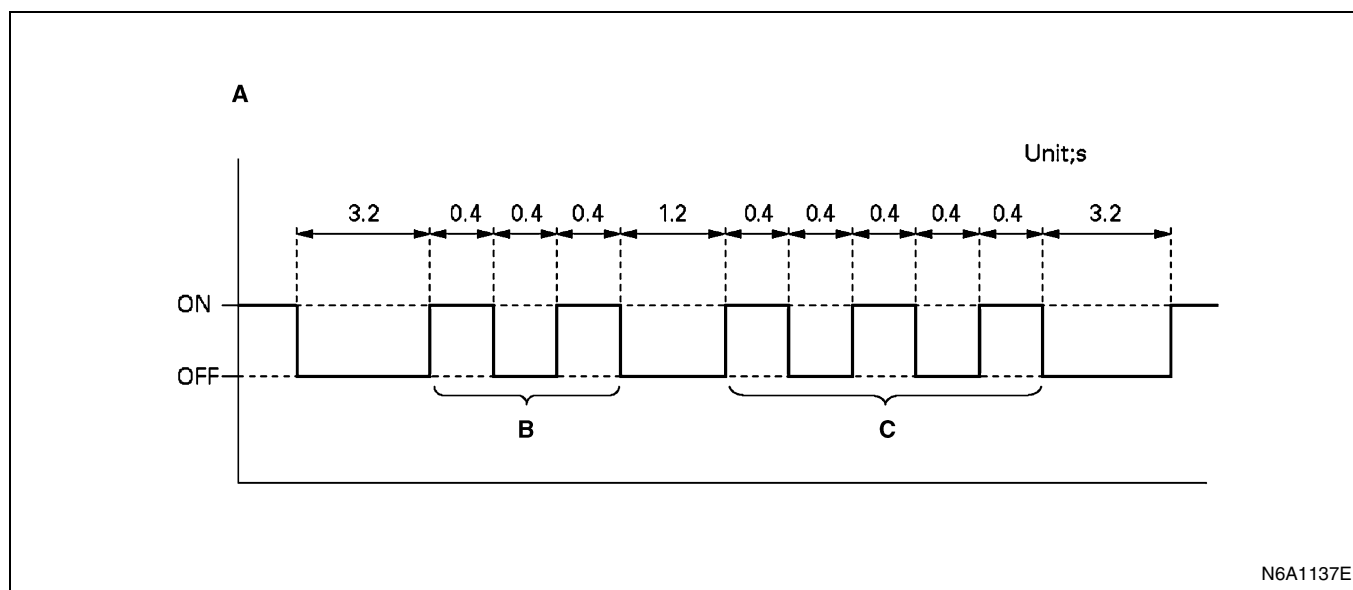
The two-digit self-diagnosis code flashes starting from ten's figure to indicate the self-diagnosis code.

Please read the self-diagnosis code from the flashing.

If the plural self-diagnosis codes are indicated, the same self-diagnosis code is flashed repeatedly in steps of three times.

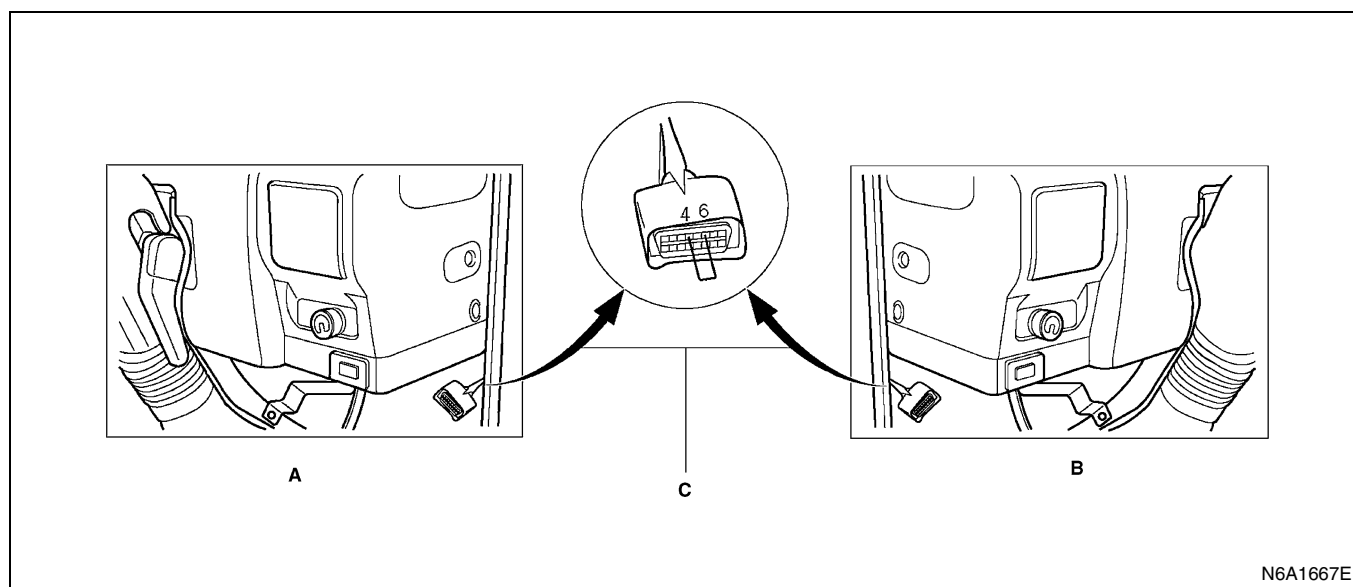
Please read it correctly.

- Diagnostic Trouble Code (DTC) outputting is done in decreasingly order of DTC number.
- Indication is changed over on completion of output DTC indication.
- DTC indicator is stopped with diagnostic switch being off.
- When there is no DTC output, "1" is outputted in normal DTC code.
- After indicating 3 times per 1 DTC, shift is conducted to the next DTC. (After making a round, the indications are repeated again.)
- In case of the same diagnostic code, it is used 1 DTC (3 times indication.)

Example Diagnosis Trouble Code Output**Legend**

A. (For example) In case of indicate two digits figure "DTC23"

B. Figure of ten
C. Figure of one

Flashing of Indicator Lamp**Legend**

- A. Right-hand drive
B. Left-hand drive

- C. Terminal assignment of data link connector (DLC)

Diagnosis Trouble Code List

DTC#	TECH 2 STRING
P21	Rack Sensor Circuit Low
P22	Rack Sensor Circuit High
P13	Engine Coolant Temperature (ECT) Sensor Circuit High
P14	ECT Sensor Circuit Low
P31 *	Exhaust Gas Recirculation (EGR) Electronic Vacuum Regulating Valve (EVRV) Solenoid Circuit Low
P32 *	EGR EVRV Solenoid Circuit High
P41	Quick On Start (QOS) Relay Control Circuit Low
P42	QOS Relay Control Circuit High
P23	Magnetic Switch Control Circuit Low
P24	Magnetic Switch Control Circuit High
P26	Quick Warm System (QWS) Relay Control Circuit High
P33 *	Variable Swirl System (VSS) Control Circuit Low
P34 *	VSS Control Circuit High
P43	Aneroid Compensator Vacuum Switching Valve (VSV) Control Circuit Low
P35 *	EGR Quick Cut VSV Control Circuit Low
P36 *	EGR Quick Cut VSV Control Circuit High
P44	Aneroid Compensator VSV Control Circuit High
P45	Engine Speed Sensor Circuit Low
P61	Barometric Sensor Circuit Error
P52	Electronically Erasable Programmable Read Only Memory (EEPROM) Error

* Equipped with EGR and VSS

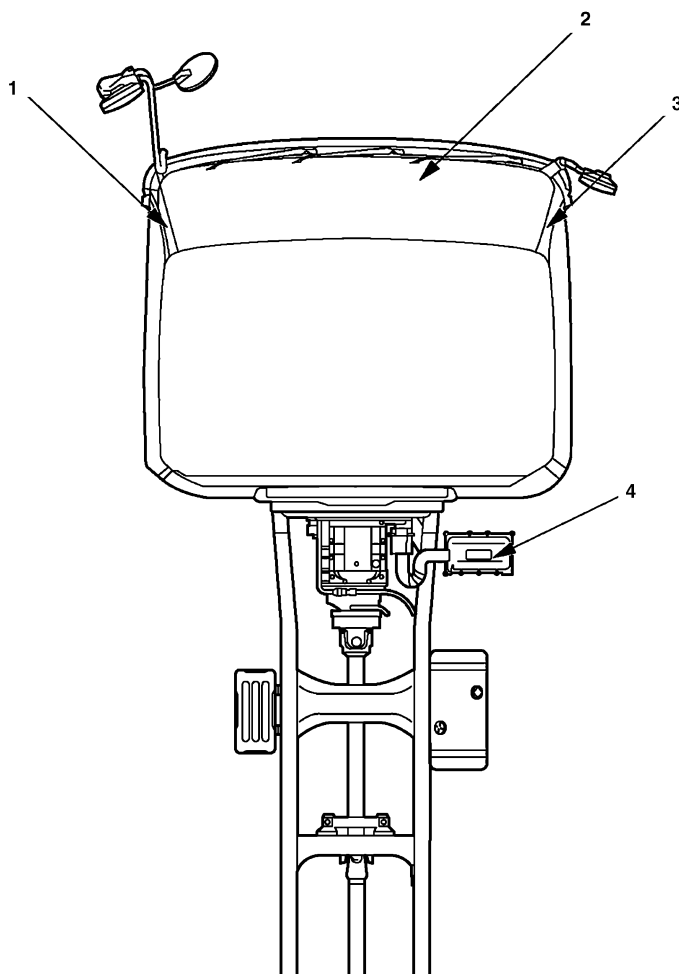
6E-26 EMISSION AND ELECTRICAL DIAGNOSIS

Error Classified		Trouble Code	Diagnostic Condition	Return Condition	Back Up	Judging Time
Relay: QWS	+B short	P26	Output TR Monitor	When forward normal	QWS: R/L Non-Continuity.	0.52 sec
VSV: VSS	Harness Open GND short	*P33	Output TR Monitor	When forward normal	VSS: VSV Output stop.	0.52 sec
	+B short	*P34				
VSV: ANECON	Harness Open GND short	P43	Output TR Monitor	When forward normal	ANECON: VSV Output stop.	0.52 sec
	+B short	P44				
VSV: EGR Quick	Harness Open GND short	*P35	Output TR Monitor	When forward normal	EVRV: EGR VSV: EGR Quick Cut The above output stops.	0.52 sec
	+B short	*P36				
Atmospheric Pressure Sensor	Output Abnormal	P61	1.5V (49.9 kPa / 374 mmHg / 7.23 psi) or lower, or 4.5V (160 kPa / 1200 mmHg / 23.2 psi) or higher detected.	When forward normal	EVRV: EGR VSV: EGR Quick Cut The above output stops. ANECON: VSV is actuated.	0.52 sec
	ECM EEPROM error	P52	Check when ECM is started and when Trouble Code is written.	When forward normal	Trouble Code other than 52 (EEPROM error) not indicated.	
Normal		P12	No other trouble code.		No history of this diagnosis recorded	—
Rack Sensor	Harness Open GND short	P21	Rack Voltage 0.3V or lower, Engine speed 600 — 900rpm, and water Temp. 0°C (32°F) or higher are detected for 3 seconds running.	When forward normal	EVRV: EGR VSV: EGR Quick Cut VSV: VSS The above outputs stop. R/L: QWS Non-continuity Idle position output stop. The above outputs stop. Rack Learning valve: 0	3.52 sec
	+5V short Rack Sensor Power Voltage	P22	5V or higher Rack Voltage detected.			0.52 sec
Water Temp Sensor	Harness Open +B short	P13	-79°C/-110°F (390kΩ) or lower, or 120°C/248°F (115kΩ) or higher detected.	When forward normal	EVRV: EGR VSV: EGR Quick Cut VSV: VSS MV: Timing Advance The above outputs stop. VSV: ANECON is actuated QOS: 0°C or lower control	0.52 sec
	GND short	P14				
EVRV: EGR	Harness Open GND short	*P31	Output TR Monitor	When forward normal	EVRV: EGR VSV: EGR Quick Cut The above outputs stop.	1.57 sec
	+B short	*P32				
Relay QOS	Harness Open GND short	P41	Output TR Monitor	When forward normal	QOS: RL Non-continuity	0.52 sec
	+B short	P42				

Error Classified		Trouble Code	Diagnostic Condition	Return Condition	Back Up	Judging Time
Magnetic Volume Timing	Harness Open	P23	Output TR Monitor	When forward normal	Timing Advance: MV output stop.	0.52 sec
	GND short +B short	P24				
	Harness Open GND short	P45	Engine speed 0, Rack Voltage $\geq 0.3V \leq 0.57$ is detected.	When forward normal	EVRV: EGR VSV: EGR Quick Cut VSV: VSS R/L: QWS The above outputs Idling position output stop when T/M POS SW outputted. VSV: ANECON is actuated	1.52 sec

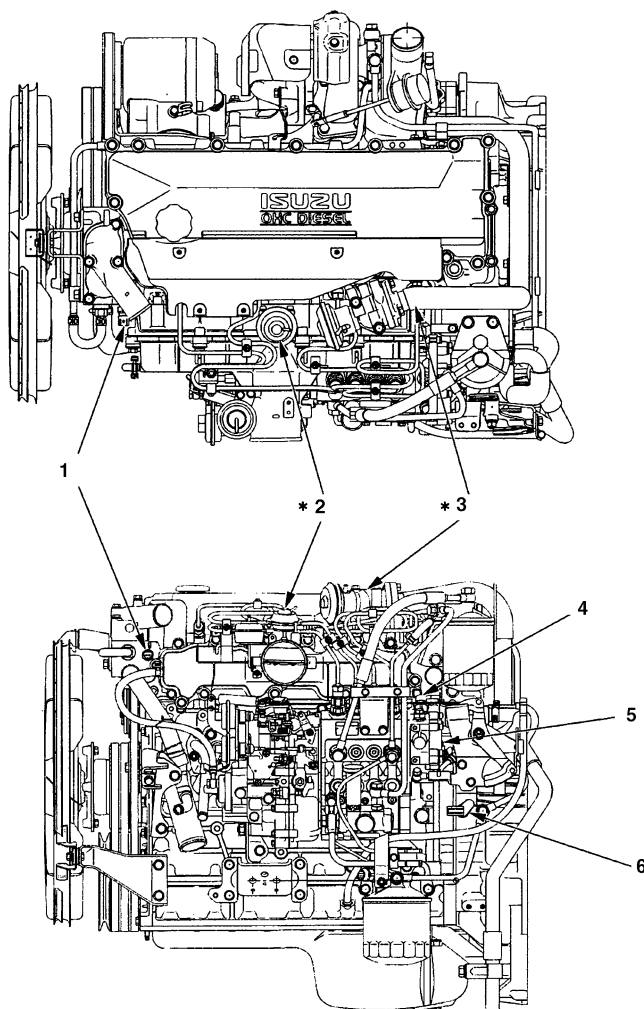
* Equipped with EGR and VSS

Location of Sensor and Switch



Legend

- | | |
|--|---|
| 1. Data link connector (Left-hand drive) | 3. Data link connector (Right-hand drive) |
| 2. ECM including atmospheric | 4. Intake air temp switch equipped with EGR and VSS |

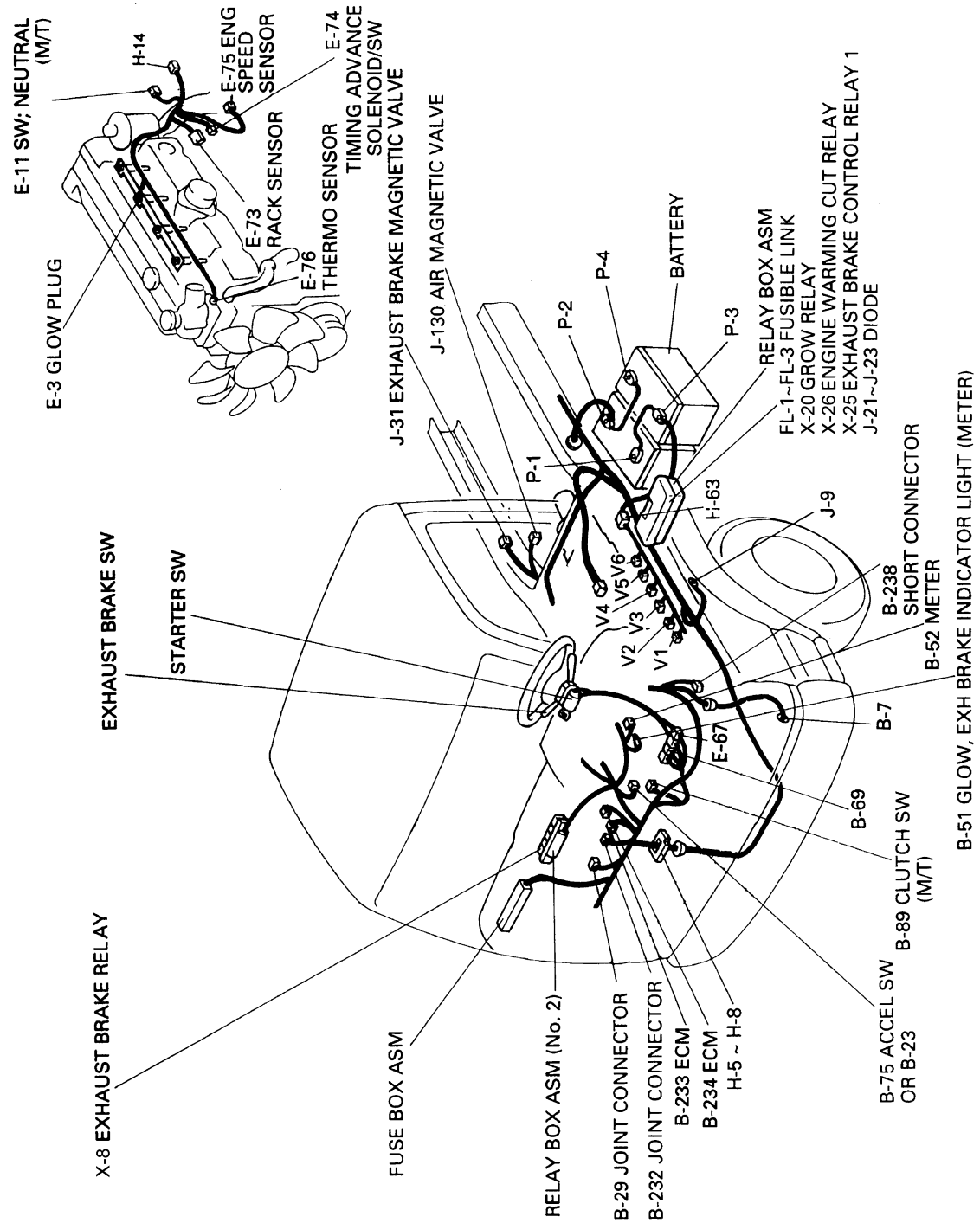


N6A1140E

Legend

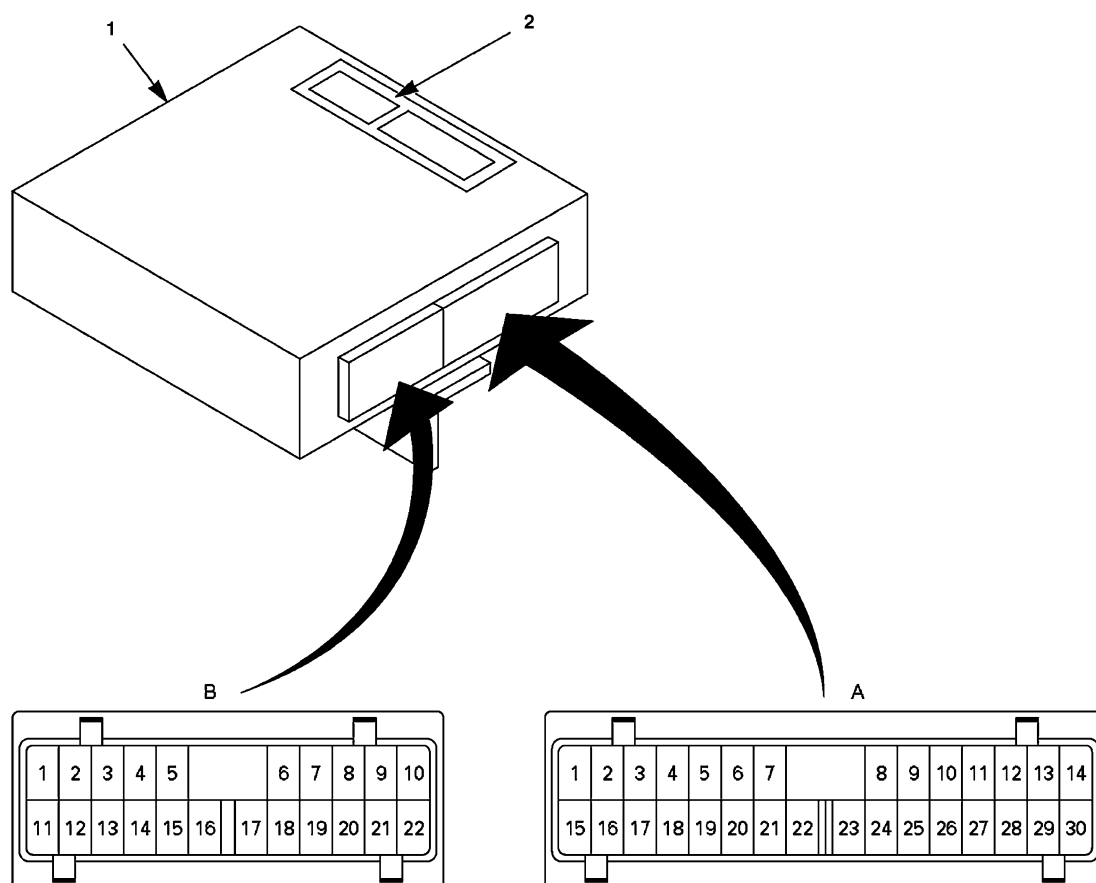
- | | |
|--------------------------------------|-----------------------------|
| 1. Engine coolant temperature sensor | 5. Rock sensor |
| 2. VSS | 6. Engine speed sensor |
| 3. EGR | * Equipped with EGR and VSS |
| 4. Timing advance solenoid switch | |

Parts Location



Engine Control Module (ECM)

Appearance of ECM



N6A1142E

Legend

- 1. ECM
- 2. Name plate
- A. Detail of 30 pins connector
- B. Detail of 22 pins connector

Chart of Engine Control Module (ECM) Input/Output

			Equipped without EGR and VSS	Equipped with EGR and VSS	
Connector	Connector number	Connector name	4HE1-XS	4HE1-XN	4HE1-XS
Conne- tor 30 pin	1	Checker SIG (Serial Communication)	○	○	○
	2	Intake Temperature Switch		○	○
	3	Engine Type		○	
	4	Not be used	—	—	—
	5	Transmission Type			
	6	Rack Sensor (+5V)	○	○	○
	7	Rack Sensor SIG	○	○	○
	8	Battery (+)	○	○	○
	9	Ignition Key	○	○	○
	10	Not be used	—	—	—
	11	Timing Advance Solenoid Switch Relay	○	○	○
	12	Not be used	—	—	—
	13	Electric Vacuum Regulating Valve Power Supply	×	○	○
	14	Electric Vacuum Regulating Valve GND	×	○	○
	15	Checker GND	○	○	○
	16	Diag Control	○	○	○
	17	Not be used	—	—	—
	18	Not be used	—	—	—
	19	Not be used	—	—	—
	20	Not be used	—	—	—
	21	Rack Sensor GND	○	○	○
	22	ECM GND	○	○	○
	23	Not be used	—	—	—
	24	Not be used	—	—	—
	25	Not be used	—	—	—
	26	Not be used	—	—	—
	27	Transmission Position Switch		○	
	28	Not be used	—	—	—
	29	Not be used	—	—	—
	30	FICD Magnetic Valve Power Supply	○	○	○

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			Equipped without EGR and VSS	Equipped with EGR and VSS	
Connector	Connector number	Connector name	4HE1-XS	4HE1-XN	4HE1-XS
Connector 22 pin	1	EGR Cut Magnetic Valve Power Supply	×	○	○
	2	Glow Relay	○	○	○
	3	Glow Indicator Lamp	○	○	○
	4	Rack Idle Position Out Put			
	5	Not be used	—	—	—
	6	Not be used	—	—	—
	7	Engine Coolant Temperature Sensor GND	○	○	○
	8	Engine Coolant Temperature Sensor SIG	○	○	○
	9	Engine Revolution Sensor GND	○	○	○
	10	Engine Revolution Sensor SIG	○	○	○
	11	VSS Magnetic Valve Power Supply	×	○	○
	12	QWS Relay	○	○	○
	13	Aneroid Compensator Magnetic Valve	○	○	○
	14	Not be used	—	—	—
	15	Not be used	—	—	—
	16	Not be used	—	—	—
	17	Not be used	—	—	—
	18	Starter Switch	○	○	○
	19	Exhaust Brake Status Switch	○	○	○
	20	Not be used	—	—	—
	21	Not be used	—	—	—
	22	Not be used	—	—	—

Notice:

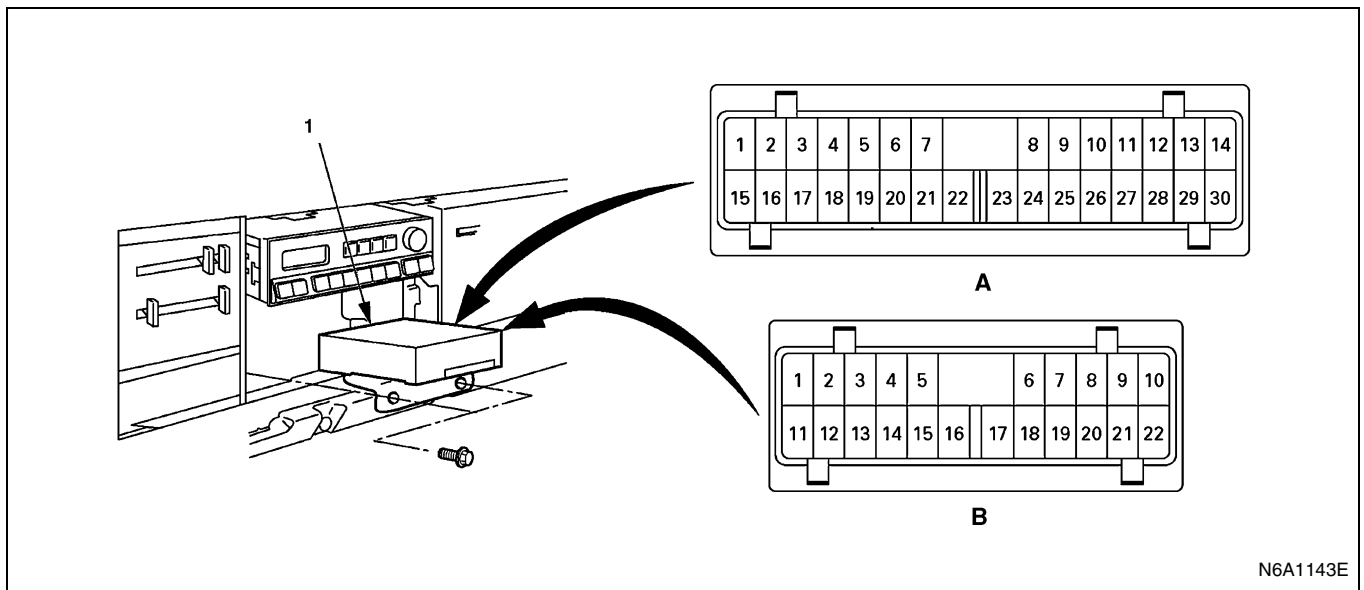
The meaning of symbol marks are:

○: Connect

BLANK: Not

×: Not Connect

Location of the Engine Control Module (ECM) Connector

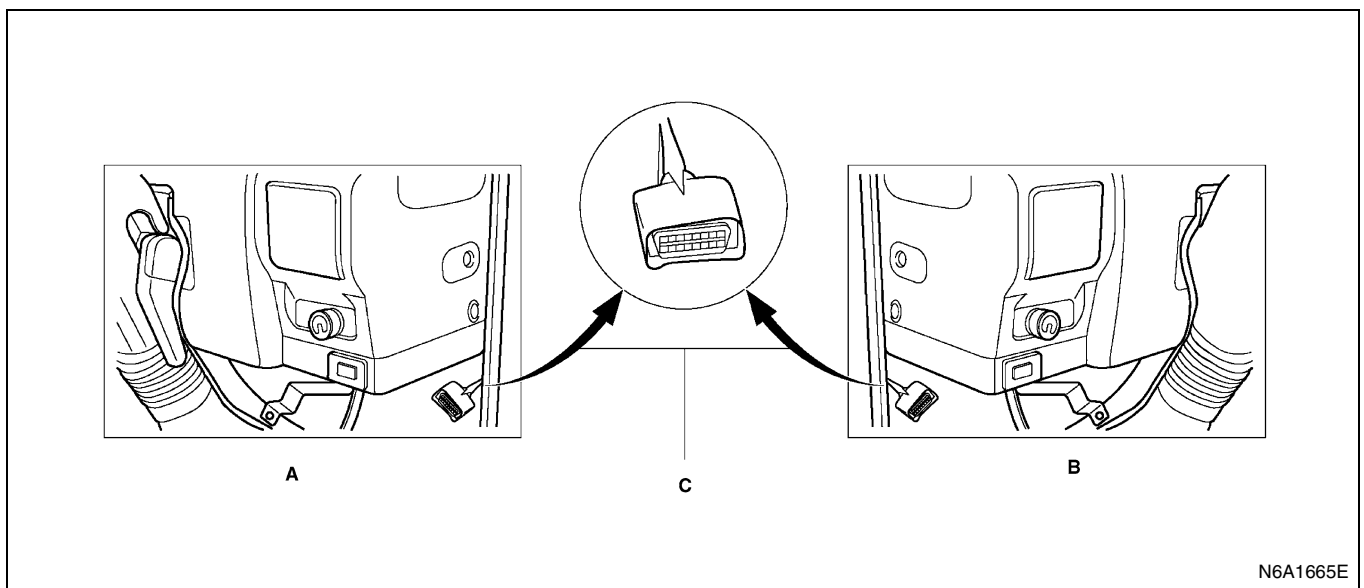


Legend

- A. 30 pins connector (green)
- B. 22 pins connector (green)

1. Engine control module (ECM)

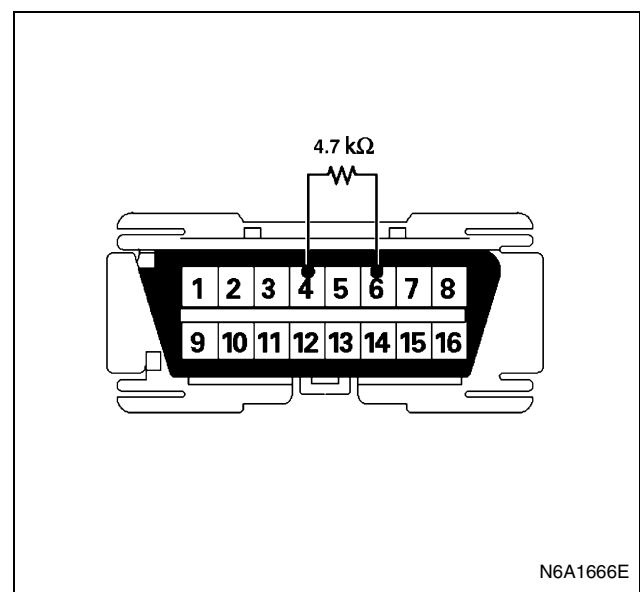
Location of Data Link Connector (DLC)



Legend

- A. Right-hand drive
- B. Left-hand drive

C. Terminal assignment of data link connector (DLC)



NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4, 5	CHECKER GND

BRIEF EXPLANATION OF EMISSION AND ELECTRICAL CONTROL SYSTEM

MITICS (Mechanically Integrated Timing and Injection Control System)

The Mechanically Integrated Timing and Injection rate Control System (MITICS) utilizes mechanical control, in comparison with TICS systems, which utilize electronic control.

MITICS is equipped with the RLD-M type governor, which contains a pre-stroke control mechanism.

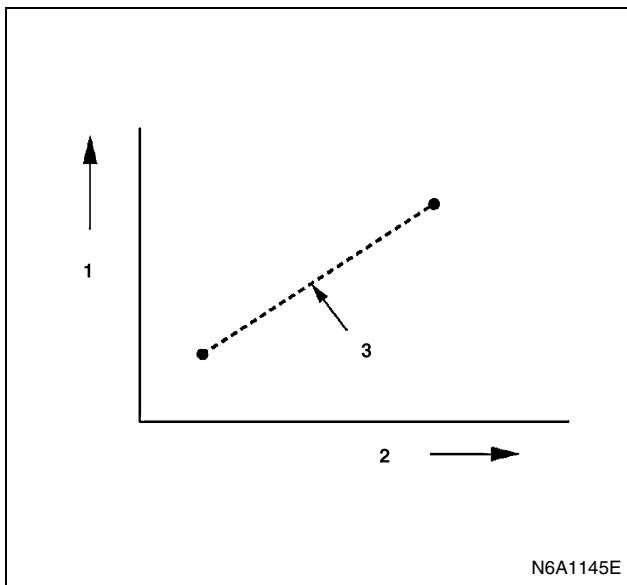
With this, pre-stroke position (i.e., beginning of static injection) can be varied to control injection timing and injection rate (i.e., the fuel injection quantity injected from the nozzle per cam angle degree).

This enables high injection rates¹ in the low and medium speed ranges through a short Injection interval, thus contributing to higher engine torque and cleaner exhaust.

MITICS was developed in response to the demands of medium sized diesel engines for low cost, low fuel consumption, high output and cleaner emissions.

High injection rates using a short injection interval.

- The speed at which the injection pump plunger rises slows as engine speed decreases and the pressure inside the injection pipe decreases. Because of this, the nozzle spray deteriorates and makes it impossible to obtain the proper fuel - air mixture. To obtain the proper mixture at low and medium speeds, it is necessary to increase the pressure inside the injection pipes using a short injection interval.



Legend

1. Injection pipe pressure
2. Engine speed
3. PE-AD type injection pump

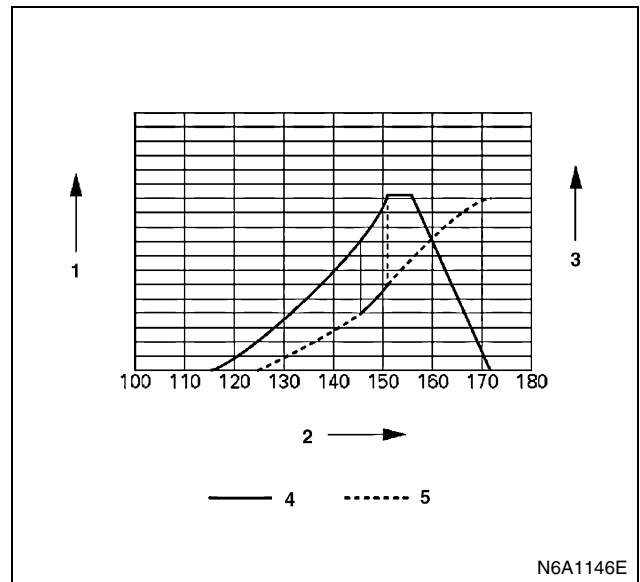
- The left hand figure shows plunger speed and cam lift in relation to cam angle. It can be seen from the graph that plunger speed increases together with cam lift.

MITICS varies the beginning of injection position at low and medium speeds so that injection occurs when the plunger speed increases during the latter half of cam lift (shown by the bold line).

At high speeds, injection is performed when the plunger speed decreases during the first half of cam lift to prevent an excessive increase in injection pipe pressure.

This enables high pressures at low and medium speeds with a fast plunger speed.

Thus, a fine fuel oil spray is injected into the cylinder from the nozzles within a short time to provide the proper mixture for combustion, helping to increase torque and keep exhaust emissions clean.



Legend

1. Plunger speed (m/sec)
2. Cam angle (degrees)
3. Cam lift (mm)
4. Plunger speed
5. Cam lift

Governor (Model RLD-M)

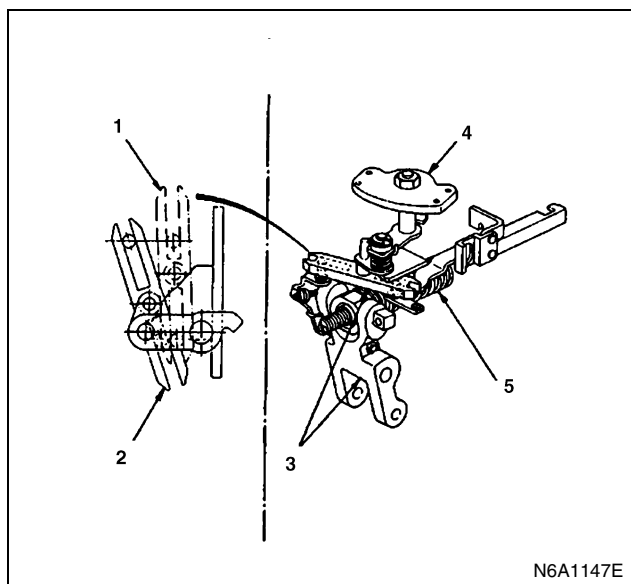
The RLD-J type governor can be used with the MI, MITICS injection pumps, and was designed to have better control and endurance than the previous RLD type governor.

Although the basic construction is identical to that of the RLD type governor, the RLD-M type is larger to match the applicable pumps' larger size.

Features

Variable speed control governor with decreased lever reaction force

As with the previous RLD type governor, RLD-M governor control is accomplished using the speed control lever to change the fulcrum of the internal link mechanism. Consequently, as the reaction force of the governor spring does not act directly on the speed control lever, only a very small lever reaction force is exerted on the accelerator pedal.



N6A1147E

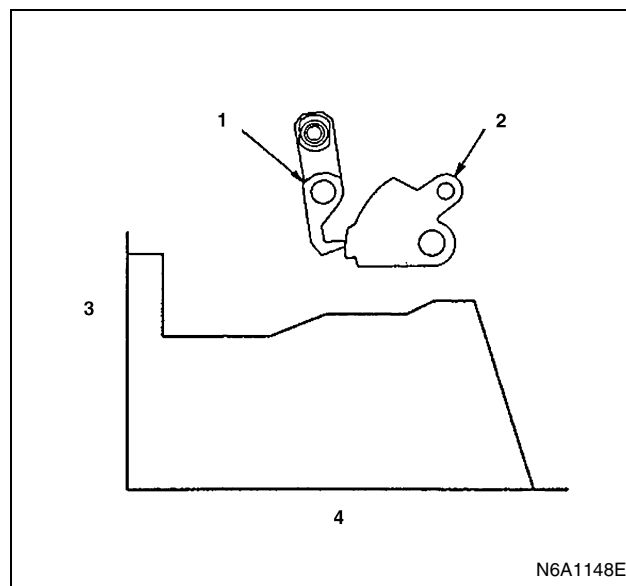
Legend

1. At maximum speed control
2. At idle speed control
3. Link mechanism
4. Speed control lever
5. Governor spring

Set torque characteristics through internal torque cam

At full load, the tip of the sensor lever traces the face of the torque cam to determine the full load rack position and control the full load injection quantity.

Consequently, the torque characteristics demanded by the engine can be freely set by changing the shape of the torque cam face.



N6A1148E

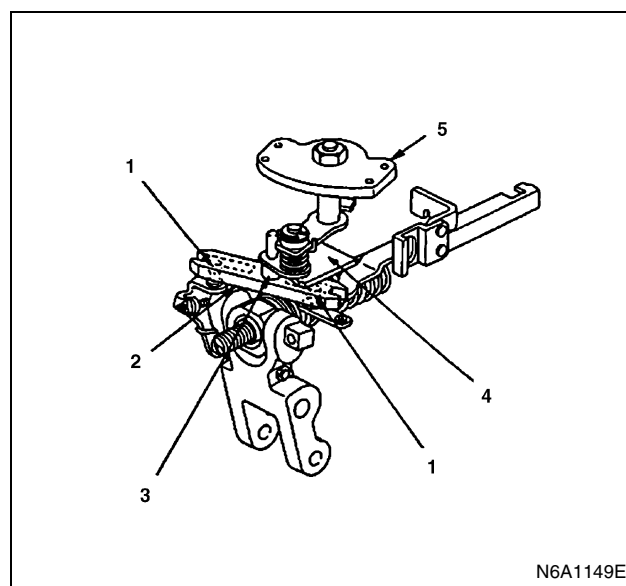
Legend

1. Sensor lever
2. Torque cam
3. Control rack position (mm)
4. Pump speed (r/min)

Improved control through internal guide plate

When the speed control lever is operated, the 2nd supporting lever's pin moves along the guide plate. The floating lever connected to the pin thus moves to change the ball joint fulcrum positions.

In the intermediate to high speed ranges, the guide plate causes the floating lever to move to increase the lever ratio continuously from 1.1 (idling) — 6 (full speed). This increase in the lever ratio in the intermediate to high speed range improves speed droop.



N6A1149E

Legend

1. Ball joint
2. Floating lever
3. 2nd supporting lever pin
4. Guide plate
5. Speed control lever

Timing Advance Control

Timing advance control is measuring the ECT to calculate drive current of the solenoid switch for the injection timing advance.

The injection timing is controlled by according to the ECT when engine is started.

Solenoid Switch

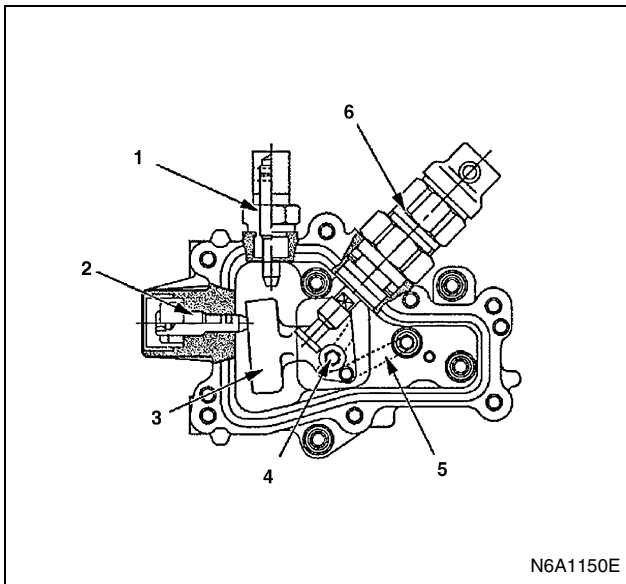
The solenoid switch is installed on the top of the injection pump to push the advance lever in the injection pump when 12 or 24 volts is supplied.

In this condition the injection timing is an additional 10 degree (BTDC) from normal injection timing.

If there is some trouble for electricity current, it will set the DTC-P23 or P24.

Refer to the DTC chart.

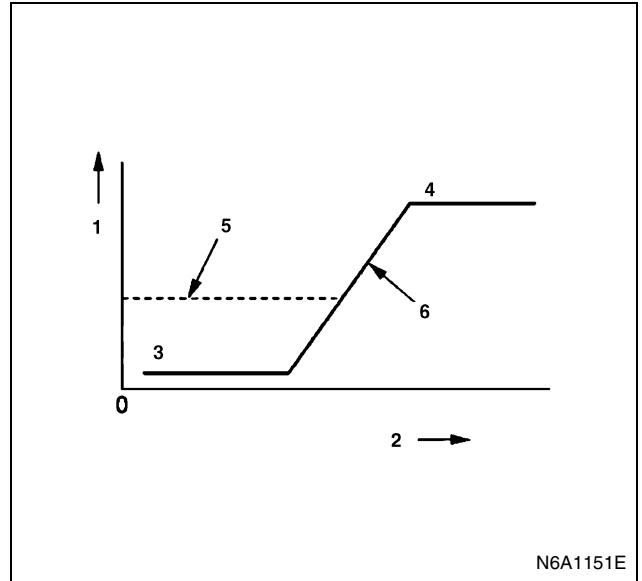
If remove the solenoid switch, it can not be reinstalled because it is necessary to readjust advance value on the injection pump tester.



N6A1150E

Legend

1. Adjust screw for maximum advance angle
2. Adjust screw for minimum advance angle
3. Counter weight
4. Timing rod center
5. Return spring
6. Solenoid switch



N6A1151E

Legend

1. Advance angle
2. Pump speed
3. Minimum advance angle
4. Maximum advance angle
5. Advance angle by solenoid switch
6. Control character by flyweight

EGR (Exhaust Gas Recirculation) System**EGR Purpose**

The exhaust gas recirculation (EGR) system is used to reduce emission levels of the oxides of nitrogen (NOx). The NOx emission levels are caused by a high combustion temperature. The EGR system lowers the NOx emission levels by decreasing the combustion temperature.

EGR Control

The main element of the system is the EGR valve. The EGR valve feeds small amounts of the exhaust gas back into the intake manifold. The EGR valve is controlled by the ECM and the ECM uses information from the following sensors to control the EGR valve.

- Engine coolant temperature (ECT) sensor.
- Engine speed sensor.
- Rack sensor
- Exhaust brake switch condition.
- Atmospheric pressure sensor.

EGR Valve Operation and Results of Incorrect Operation

The EGR valve is designed to accurately supply EGR to the engine independent of the intake manifold.

The EGR valve controls EGR flow from the exhaust manifold to the intake manifold through the VSV (Vacu-

um Switching Valve) with a ECM controlled EVRV (Electronic Vacuum Regulating Valve).

The ECM monitors related sensor or switch condition, if EVRV solenoid has incorrect operation, DTC P31 or P32 will be set.

If DTCs P13, P14, P21, P22, P35, P36, P45 or P61 are set, refer to the DTC charts.

Rack Sensor

The rack sensor is engaged with tip of injection pump rack.

The rack sensor signal will send during vehicle operating to the ECM, the ECM calculate together with other sensor's signal, the ECM output activation signal for EVRV.

Atmospheric Pressure Sensor

The atmospheric pressure sensor is built-in the ECM.

The EVRV activity will be stopped, when the atmospheric pressure will come below the setting pressure.

Exhaust Brake Switch

The exhaust brake switch is equipped on the steering column.

The exhaust brake switch is controlled by vehicle operator, when during the vehicle operating the vehicle operator will demand to apply the exhaust brake for assist the main brake system.

EGR Quick Cut Control

During the VSV action, when the EVRV drive current will come over the setting value (the drive current will decide relation of the engine load and speed) immediately stop the VSV.

Result of this action will reduce the PM (Particulate Matter).

EV RV Control

The EGR is controlled under normal temperature with separate stage by the ECT of engine condition.

ECM refer to EGR action map to demand the EVRV drive current, also ECM controls agree EVRV drive current and EVRV actual drive current each other.

Otherwise the ECM transitional stage controls for current of EVRV when EGR is controlled moving OFF area to ON area on the EGR action map.

Also stop the EVRV drive for stop the EGR system under following conditions.

When under low temperature of the ECT.

When acting the QWS system.

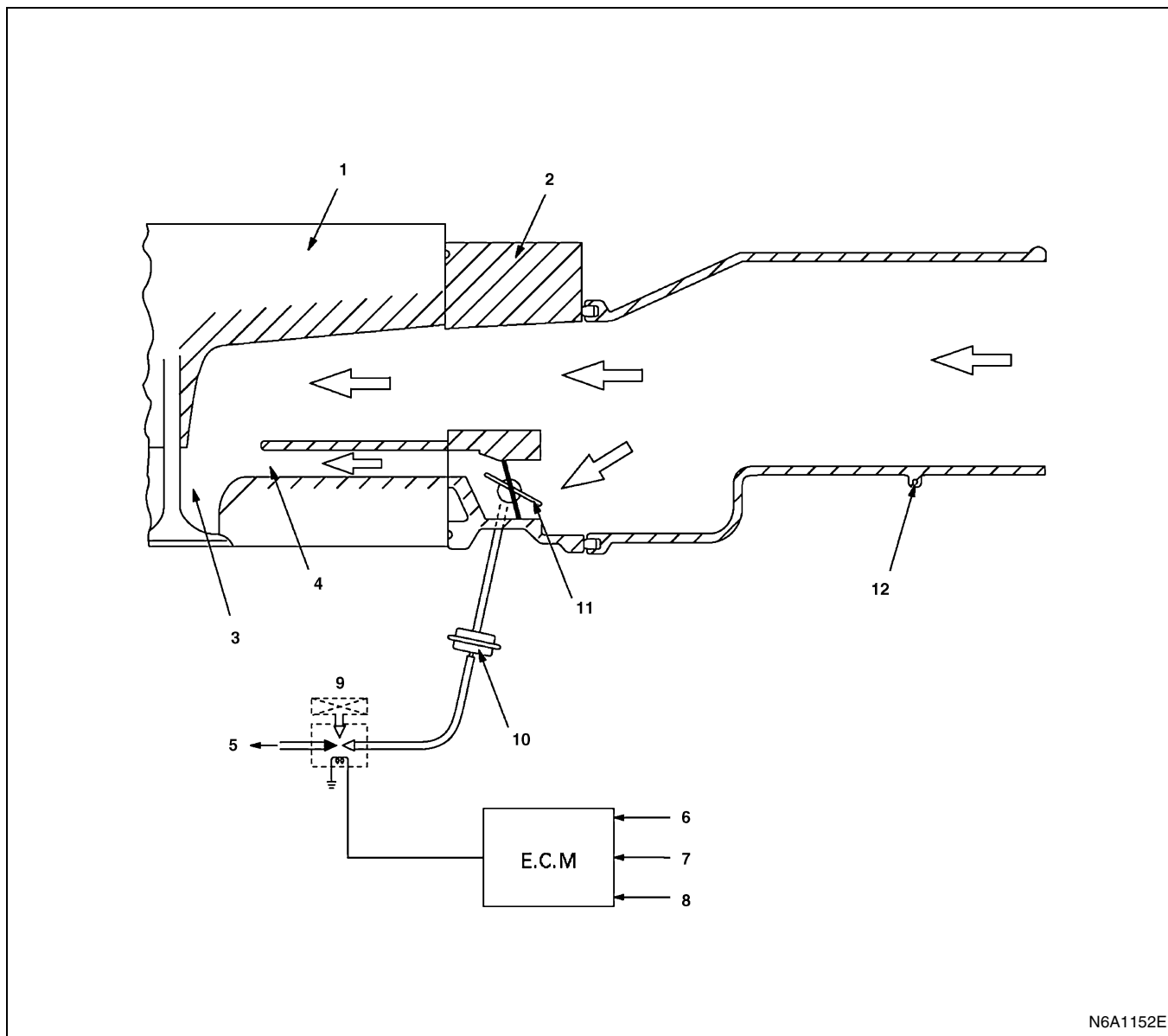
When acting the exhaust brake

When the atmospheric pressure comes under setting the pressure value.

VSS (Variable Swirl System)

The Variable Swirl System (VSS) is designed to adjust the intensity of swirl by allowing or not allowing air to flow through a sub-port (or bypass) that runs in parallel with the intake port for each cylinder. The swirl intensifies when there is no air flow through the sub-port, and vice versa.

The air flow is controlled by the on-off valve at the inlet to the sub-port and the valve in turn is turned on and off by computer signals which are dependent on engine speed, load and coolant temperature. Basically, the air is cut off at low speeds to maintain high swirl and is allowed to flow at high speeds to maintain low swirl.

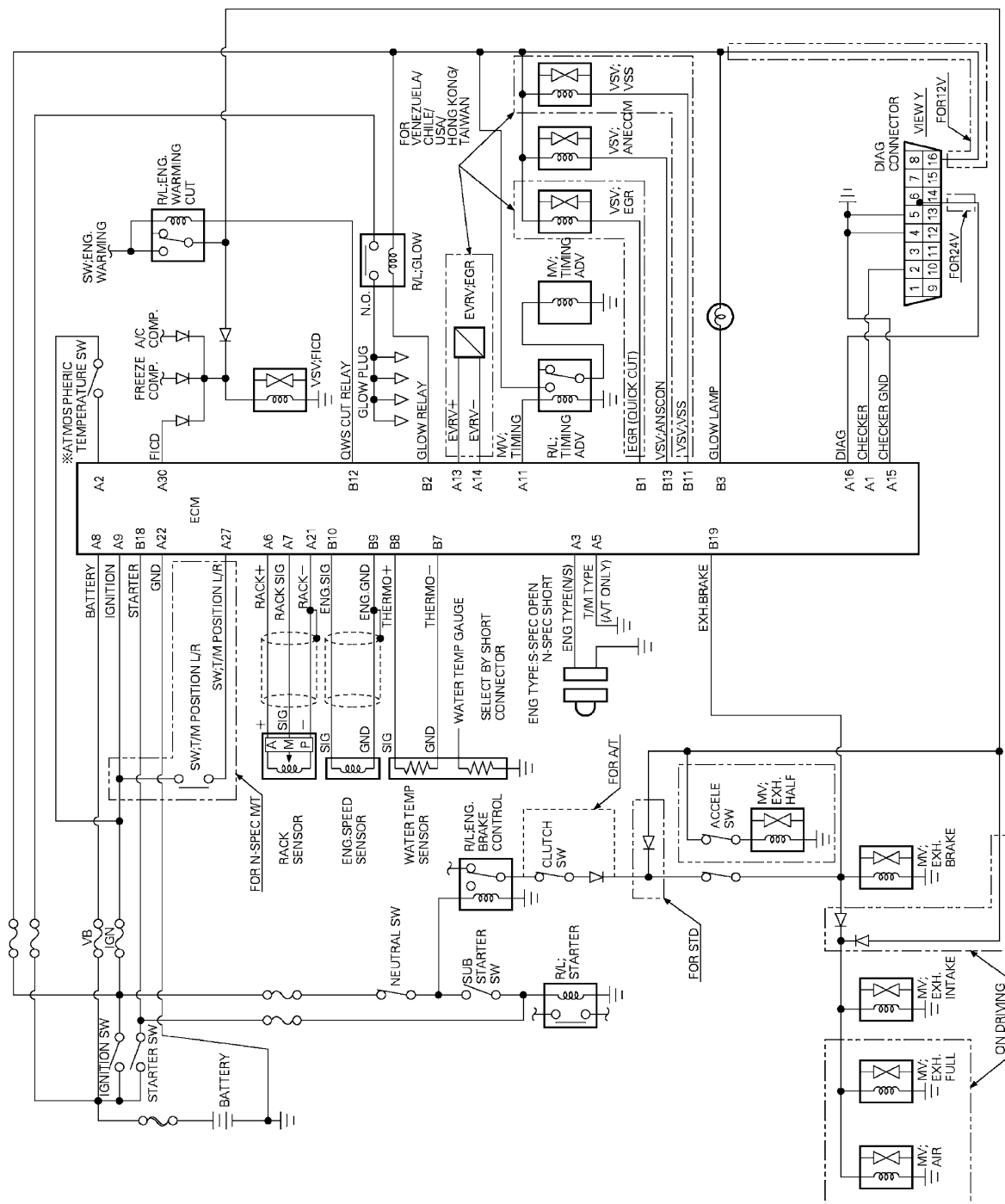
Variable Swirl System (Equipped with EGR and VSS)

N6A1152E

Legend

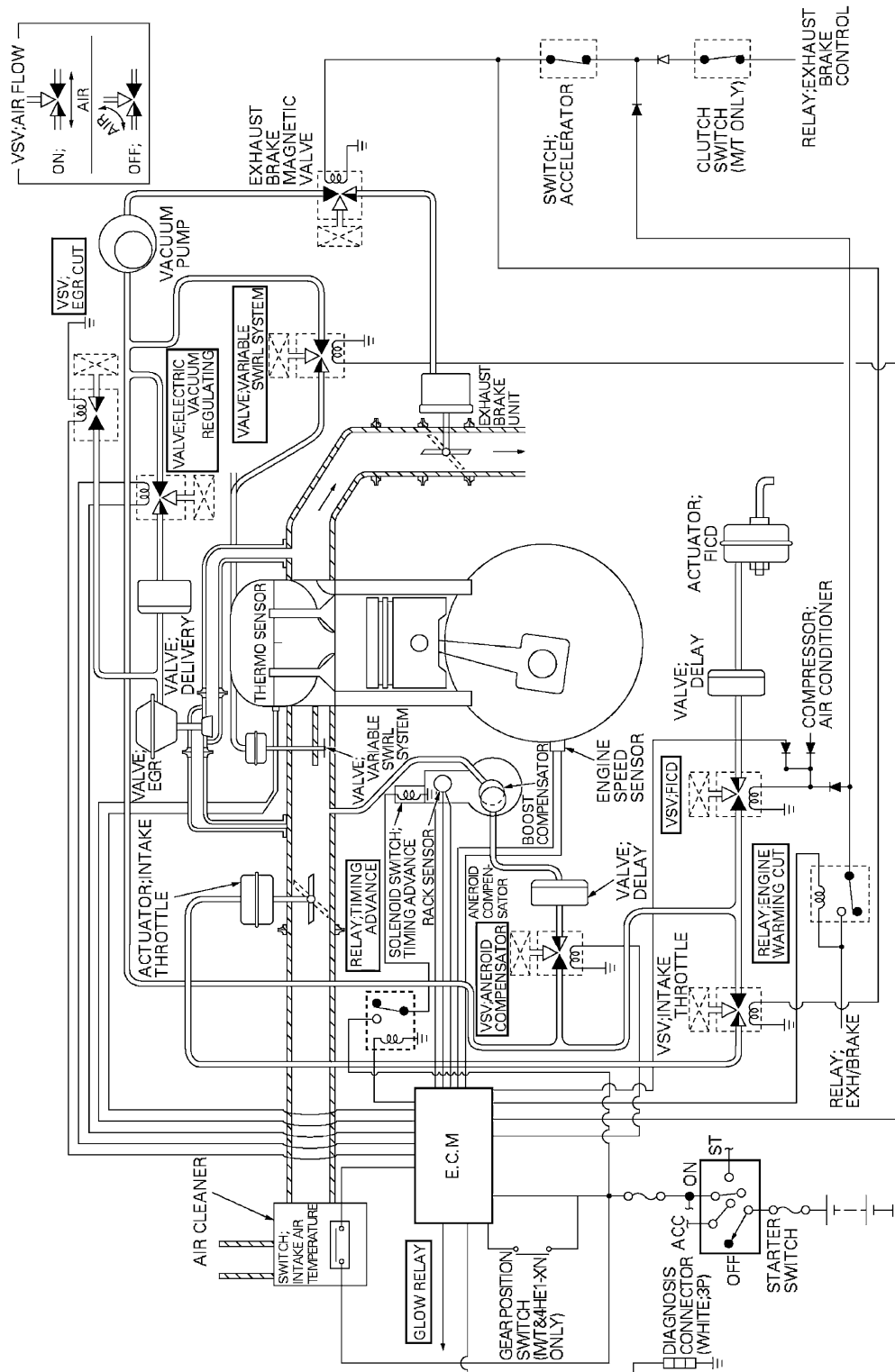
- | | |
|------------------|------------------------|
| 1. Cylinder head | 7. Engine speed sensor |
| 2. VSS case | 8. Rack sensor |
| 3. Inlet port | 9. VSV; VSS |
| 4. Sub-port | 10. Actuator |
| 5. Vacuum | 11. Control valve |
| 6. Thermo sensor | 12. Inlet manifold |

Engine Control Module (ECM) System Wiring Diagram

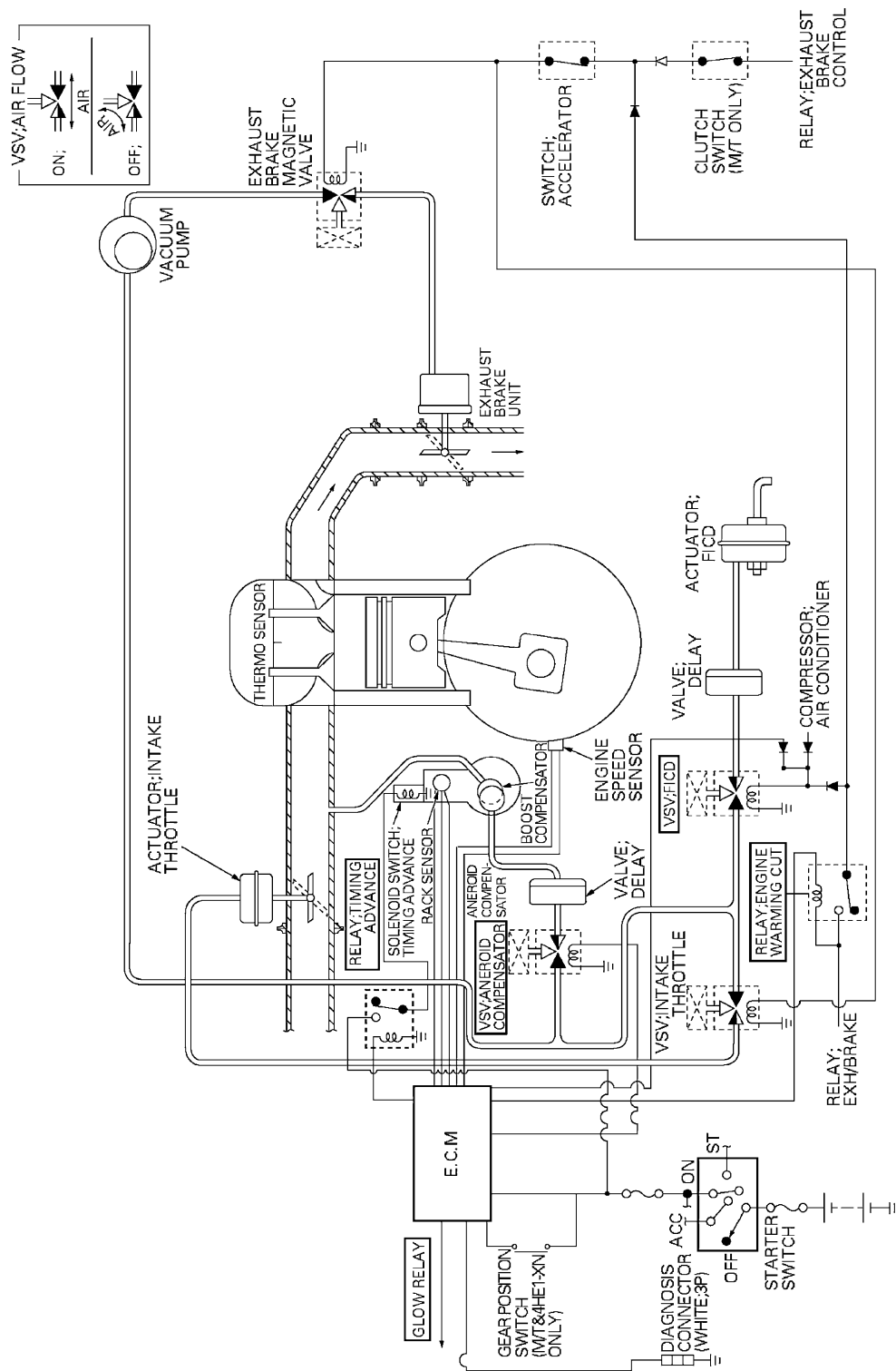


Auxiliary Engine Control System

Equipped with Exhaust Gas Recirculation and Variable Swirl System

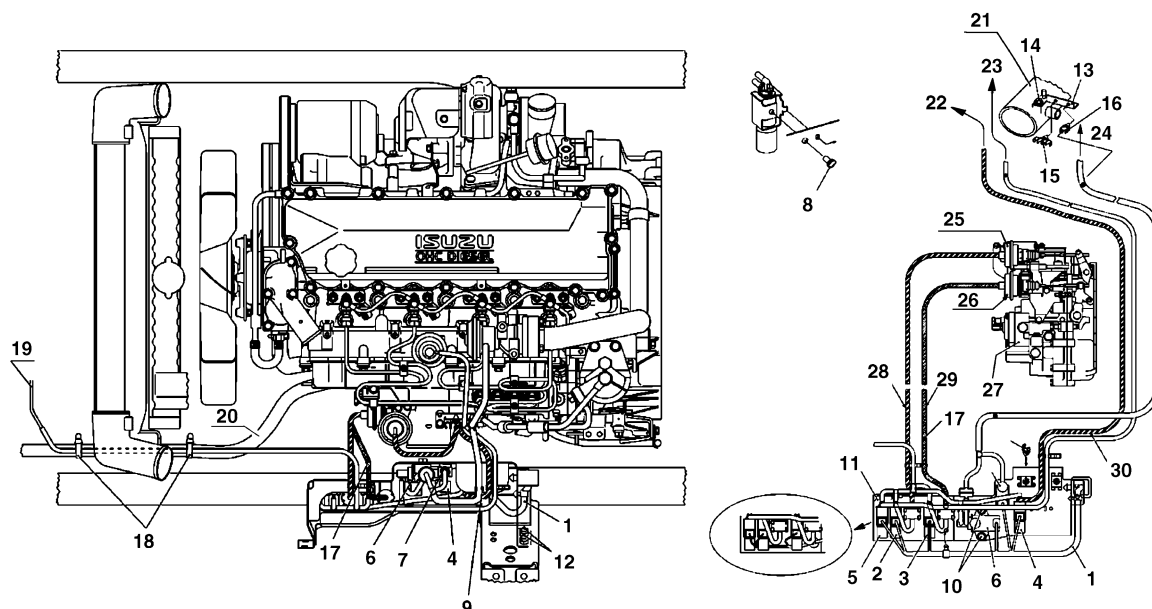


Equipped Without Exhaust Gas Recirculation and Variable Swirl System



Vacuum Switching Valve (VSV) Circuit

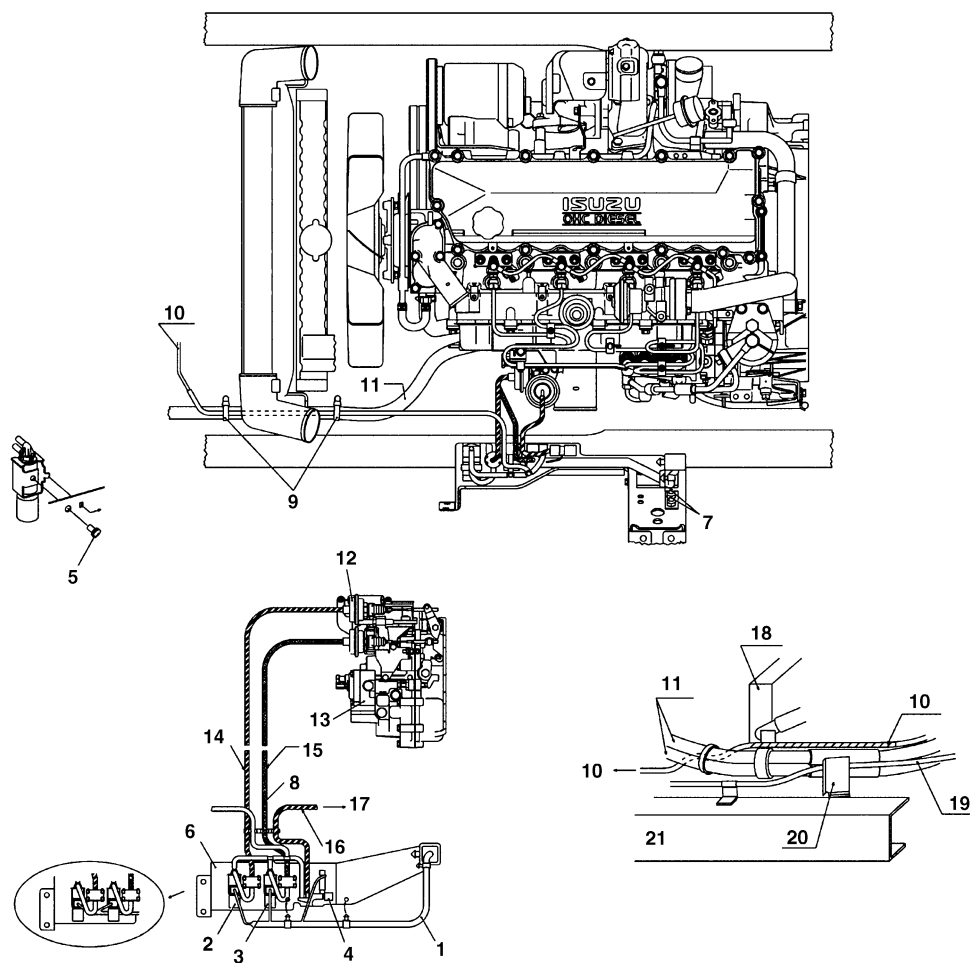
Equipped with Exhaust Gas Recirculation and Variable Swirl System



N6A1672E

Legend

- | | |
|---------------------------------------|-----------------------------------|
| 1. Extension harness | 16. EGR hose, injection pipe clip |
| 2. FICD vacuum S/W valve | 17. Vacuum hose assembly |
| 3. ANECOM vacuum S/W valve | 18. Vacuum hose clip |
| 4. I/T throttle vacuum S/W valve | 19. Vacuum pipe |
| 5. VSS vacuum S/W valve | 20. Heater hose |
| 6. Electronic vacuum regulating valve | 21. Inlet cover |
| 7. EGR cut vacuum S/W valve | 22. Inlet throttle |
| 8. VSV fix bolt | 23. VSS |
| 9. EGR hose, injection pump clip | 24. EGR valve |
| 10. Valve fix | 25. FICD diaphragm |
| 11. VSV bracket | 26. Aneroid diaphragm |
| 12. Case fix bolt | 27. Injection pump |
| 13. Rubber hose bracket | 28. White stripe |
| 14. Bracket fix bolt | 29. Yellow stripe |
| 15. VSS hose, injection pipe clip | 30. Green stripe |

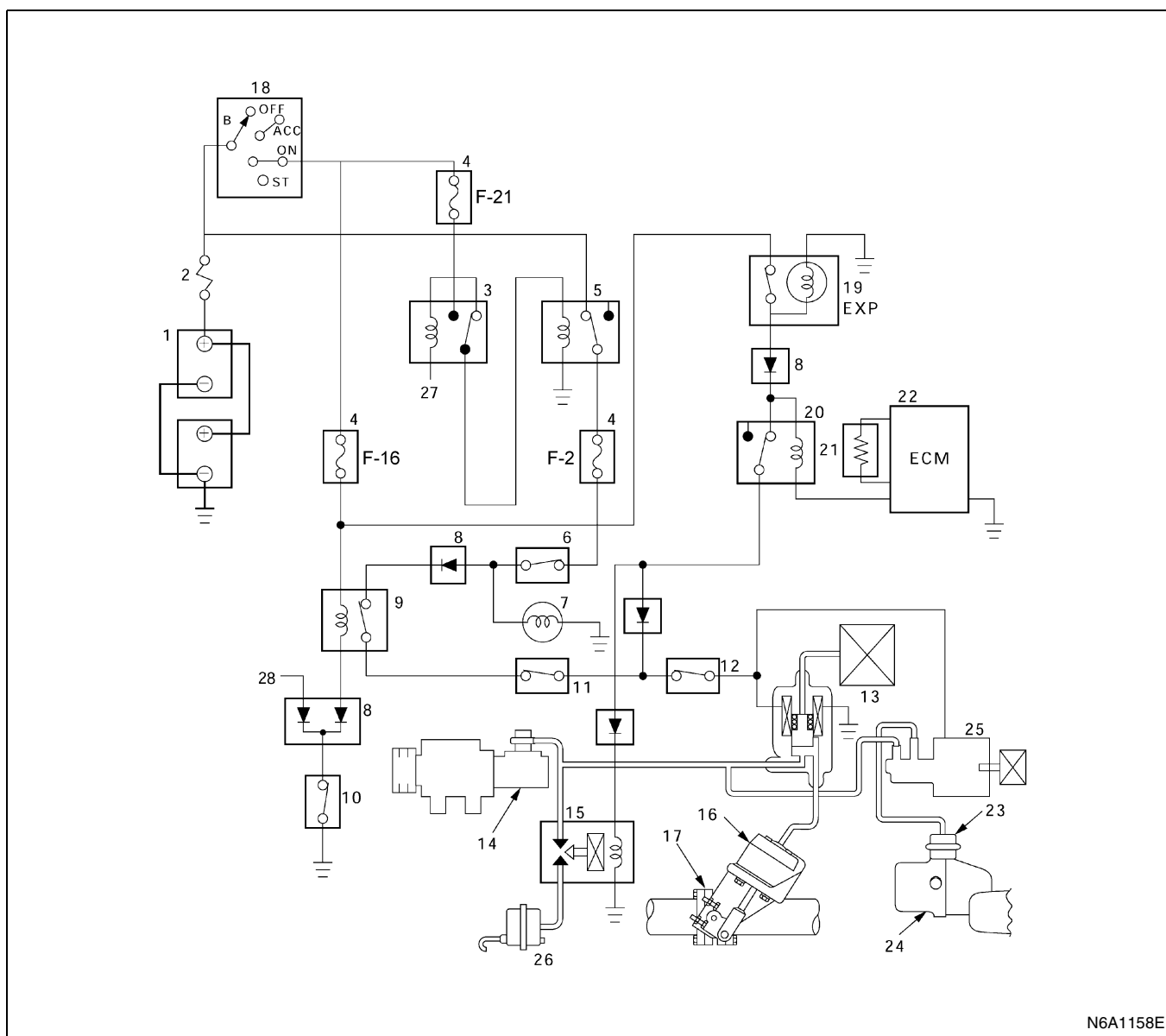
Equipped Without Exhaust Gas Recirculation and Variable Swirl System


N6A1157E

Legend

- | | |
|----------------------------------|-------------------------------|
| 1. Extension harness | 12. FICD diaphragm |
| 2. FICD vacuum S/W valve | 13. Injection pump |
| 3. ANECOM vacuum S/W valve | 14. White stripe |
| 4. I/T throttle vacuum S/W valve | 15. Yellow stripe |
| 5. VSV fix bolt | 16. Green stripe |
| 6. VSV bracket | 17. Intake throttle diaphragm |
| 7. Case fix bolt | 18. Inter cooler |
| 8. Vacuum hose assembly | 19. Accelerator cable |
| 9. Vacuum hose clip | 20. Guide plate |
| 10. Vacuum pipe | 21. Frame |
| 11. Heater hose | |

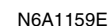
Exhaust Brake and Engine Warm-up Control



N6A1158E

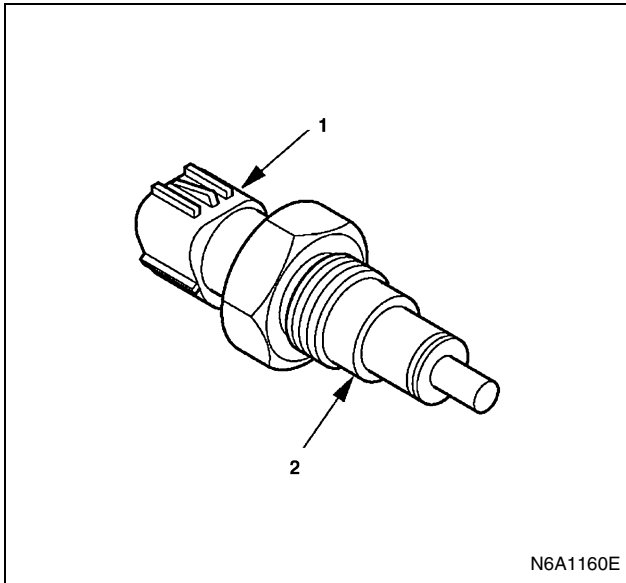
Legend

- | | |
|-----------------------------------|---------------------------------------|
| 1. Batteries | 15. Vacuum switch valve |
| 2. Fusible link wire | 16. Vacuum chamber: Exhaust brake |
| 3. Charge relay | 17. Exhaust brake valve |
| 4. Fuse | 18. Key switch |
| 5. Exhaust brake relay | 19. Engine warming-up switch |
| 6. Exhaust brake switch | 20. Engine warming cut relay |
| 7. Indicator light | 21. Engine coolant temperature sensor |
| 8. Diode | 22. ECM |
| 9. Exhaust brake control relay | 23. Vacuum chamber: Intake throttle |
| 10. Neutral switch | 24. Intake throttle |
| 11. Clutch switch | 25. Magnetic valve intake throttle |
| 12. Accelerator switch | 26. Actuator FICD |
| 13. Magnetic valve: Exhaust brake | 27. Generator (L) |
| 14. Vacuum pump | 28. Starter relay coil |



Appearance of Water Temperature Sensor and Connector Pin Assignment

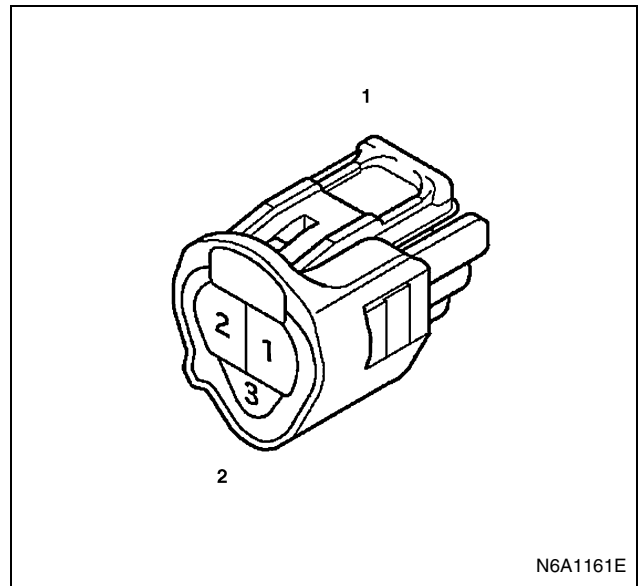
Temperature Sensor



Legend

1. 3 pin connector
2. Engine coolant temperature sensor

Connector Pin Assignment

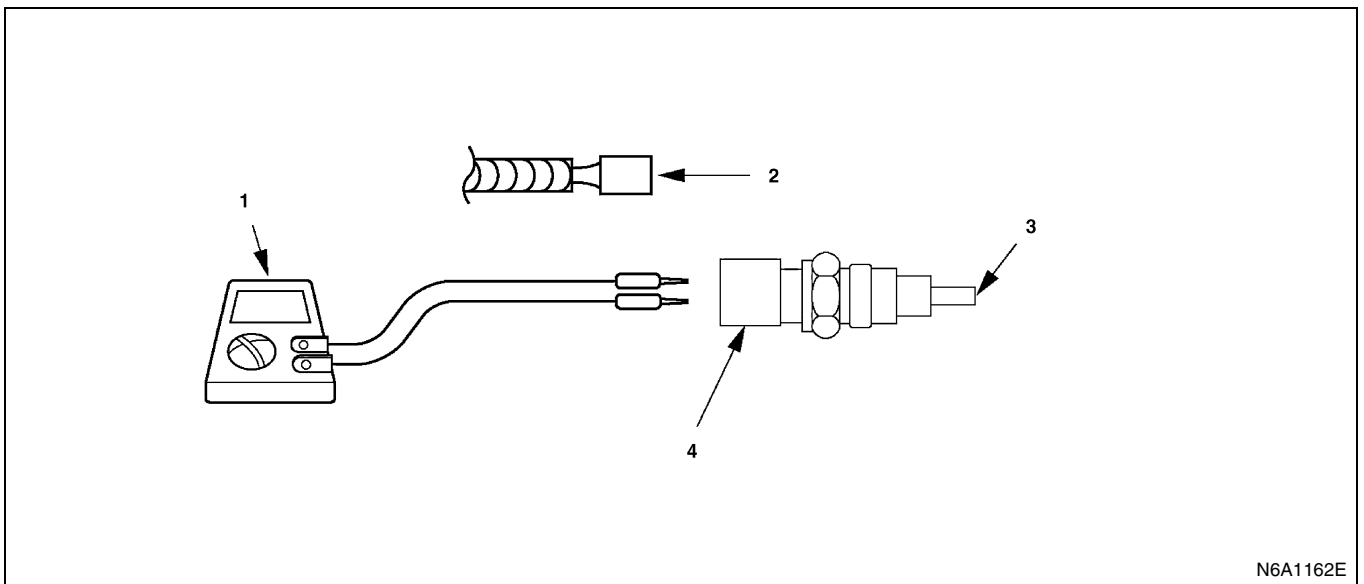


Legend

1. To ECT sensor
2. 3 pin gray

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure Resistance at Engine Coolant Temperature (ECT) Sensor



Legend

1. Circuit tester
2. Remove engine wire harness
3. Engine coolant temperature sensor
4. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Resistance value

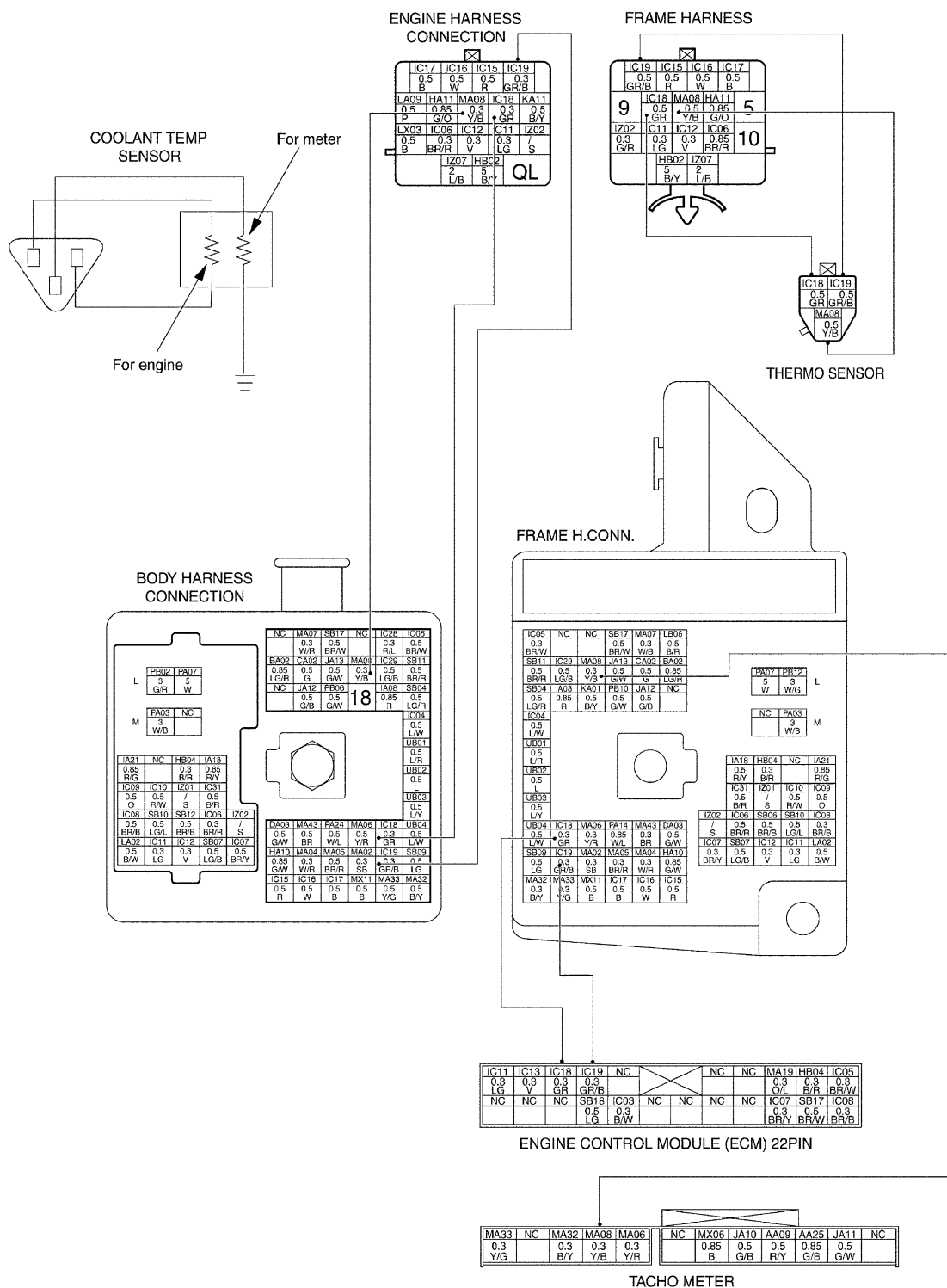
Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	1 ↔ 2	2.5 (kΩ)	20°C (68°F)	Thermistor for ENGINE
		247 (Ω)	90°C (194°F)	
	1 ↔ Body	∞	—	Thermistor for ENGINE ↔ Body
	2 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	3 ↔ Body	146.6 (Ω)	60°C (140°F)	Thermistor for meter ENGINE
	2 ↔ Body	∞	—	Thermistor for ECM ↔ Body

Notice:

Resistance value is difference according to the temperature of temperature sensor.

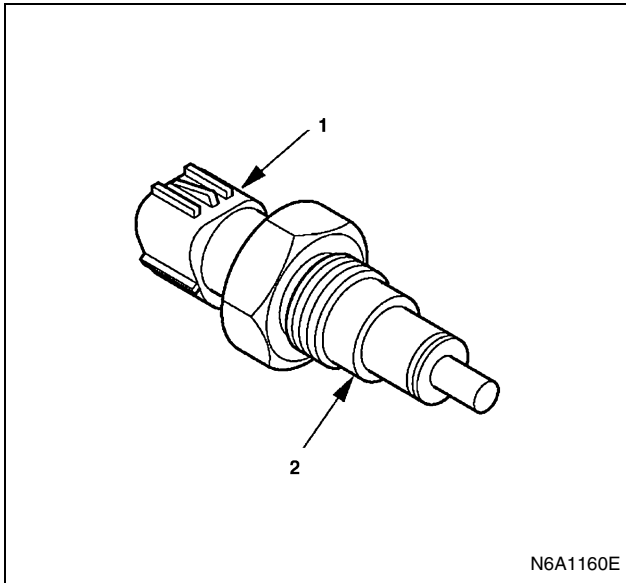
Step	Action	Value	YES	NO
1	Was the “on-board diagnostic (OBD) system check” performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition “OFF” 2. Disconnect the ECT sensor electrical connector. 3. Jumper the ECT sensor signal circuit and the ECT sensor ground circuit together at the ECT sensor harness connector. 4. Observe the “Engine cool temp” display on the scan tool. Is the “Engine cool temp” at the specified value?	120°C (248°F)	Go to Step 4	Go to Step 3
3	1. Ignition “OFF” 2. Jumper the ECT signal circuit at the ECT sensor harness connector to chassis ground. 3. Observe the “Engine cool temp” display on the scan tool. Is the “Engine cool temp” at the specified value?	120°C (248°F)	Go to Step 5	Go to Step 6
4	Check for poor connection at the ECT sensor and replace terminals if necessary. Did any terminals require replacement?	—	Go to Step 8	Go to Step 10
5	1. Ignition “OFF”. 2. Disconnect the ECM, and check the ECT sensor ground circuit for an open. 3. If the ECT sensor ground circuit is open, repair it as necessary. Was the ECT sensor ground circuit open?	—	Go to Step 7	Go to Step 10

Step	Action	Value	YES	NO
6	1. Ignition "OFF". 2. Disconnect the ECM, and check the ECT sensor signal circuit for an open. 3. If the ECT signal circuit is open, repair it as necessary. Was the ECT sensor signal circuit open?	—	Go to Step 7	Go to Step 10
7	Check for poor sensor ground or ECT sensor signal circuit terminal connection at the ECU and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	—	Go to Step 9	Go to Step 10
8	1. Ignition "OFF" 2. Replace the ECT Sensor. Is the action complete?	—	Go to Step 10	—
9	1. Replace the ECM. Is the action complete?	—	Go to Step 10	—
10	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 13 all right under Scan Tool Check?	—	Go to Step 11	Go to Step 2
11	Is any current trouble other than DTC 13 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P14 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

Appearance of Water Temperature Sensor and Connector Pin Assignment

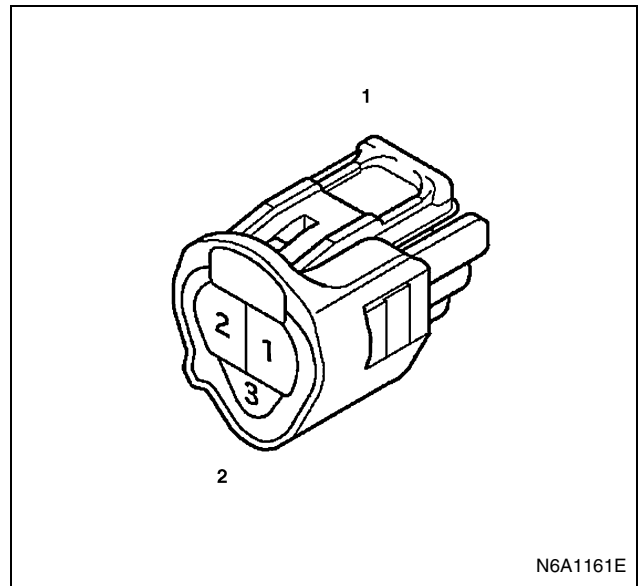
Temperature Sensor



Legend

1. 3 pin connector
2. Engine coolant temperature sensor

Connector Pin Assignment

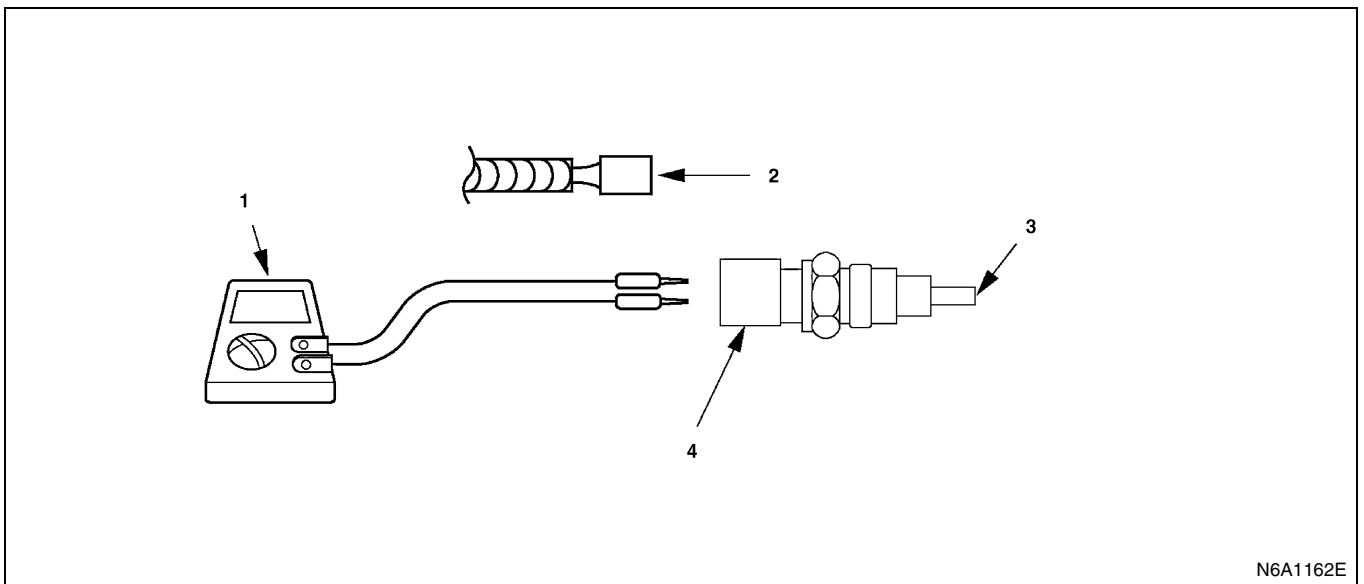


Legend

1. To ECT sensor
2. 3 pin gray

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure Resistance at Engine Coolant Temperature (ECT) Sensor



Legend

1. Circuit tester
2. Remove engine wire harness
3. Engine coolant temperature sensor
4. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

6E-52 EMISSION AND ELECTRICAL DIAGNOSIS

Resistance value

Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	1 ↔ 2	2.5 (kΩ)	20°C (68°F)	Thermistor for ENGINE
		247 (Ω)	90°C (194°F)	
	1 ↔ Body	∞	—	Thermistor for ENGINE ↔ Body
	2 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	3 ↔ Body	146.6 (Ω)	60°C (140°F)	Thermistor for meter ENGINE
	2 ↔ Body	∞	—	Thermistor for ECM ↔ Body

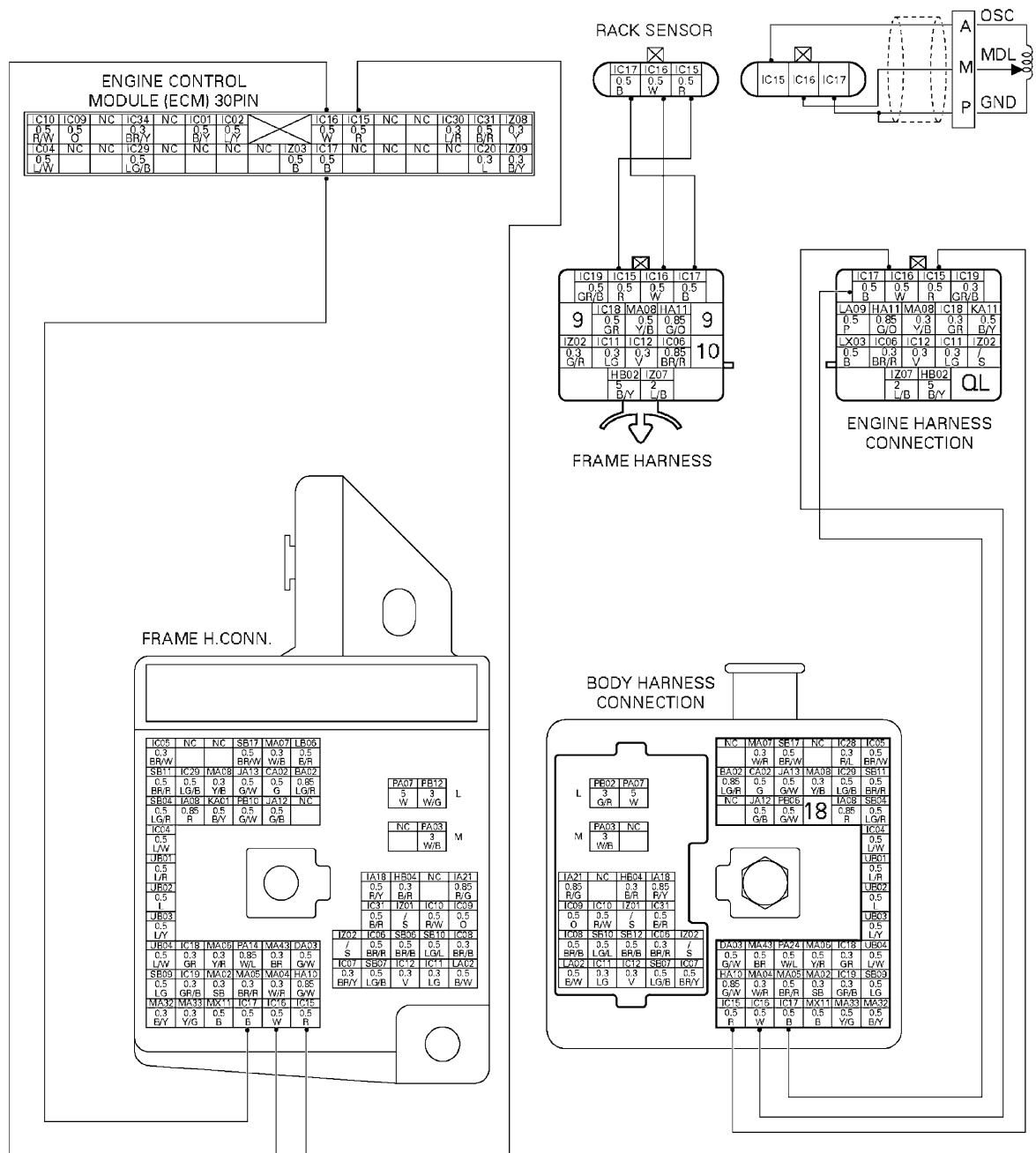
Notice:

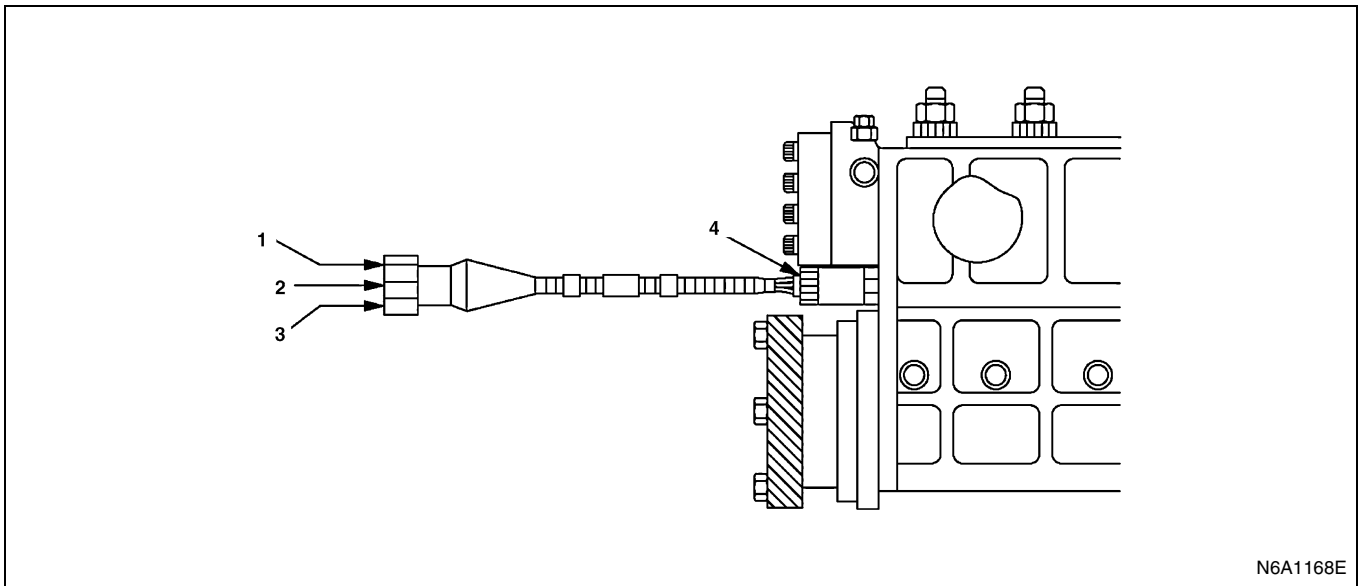
Resistance value is difference according to the temperature of temperature sensor.

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the ECT sensor. 3. Ignition "ON", Engine "OFF" 4. See scan Tool Display and Ignore trouble code 13. Does code 14 still remain faulty?	—	Go to Step 3	Go to Step 6
3	1. Ignition "OFF" 2. Check Connector ECT Sensor Harness for interterminal short. 3. Repair if necessary. Was ECT Sensor connector shorted?	—	Go to Step 4	Go to Step 8
4	1. Ignition "OFF" 2. Check the ECM connector terminal short. 3. Repair if necessary. Was ECM terminal shorted?	—	Go to Step 5	Go to Step 8
5	1. Disconnect the ECM. 2. Check if ECT sensor signal circuit for a short to ground or a short to ground circuit. 3. Repair if necessary. Is ECT sensor signal circuit shorted to ground?	—	Go to Step 7	Go to Step 8
6	1. Ignition "OFF" 2. Replace the ECT Sensor. Is the action complete?	—	Go to Step 8	—
7	1. Replace the ECM. Is the action complete?	—	Go to Step 8	—

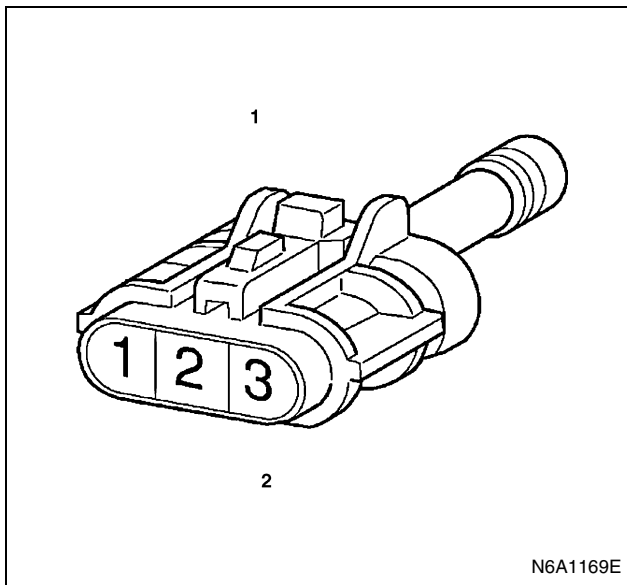
Step	Action	Value	YES	NO
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 14 all right under Scan Tool Check?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 14 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P21 Rack Sensor Circuit Low Voltage



Location of Rack Sensor Connector**Legend**

- | | |
|----------------|----------------|
| 1. OSC (red) | 3. GND (black) |
| 2. MDL (white) | 4. Rack sensor |

Connector Name of Rack Sensor**Legend**

- | |
|--------------------------|
| 1. Rack sensor connector |
| 2. Natural 3 pin |

Relation Between Connector Number and Signal Name

Connector No	Signal	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (MDL)	W
3	Rack sensor (GND)	B

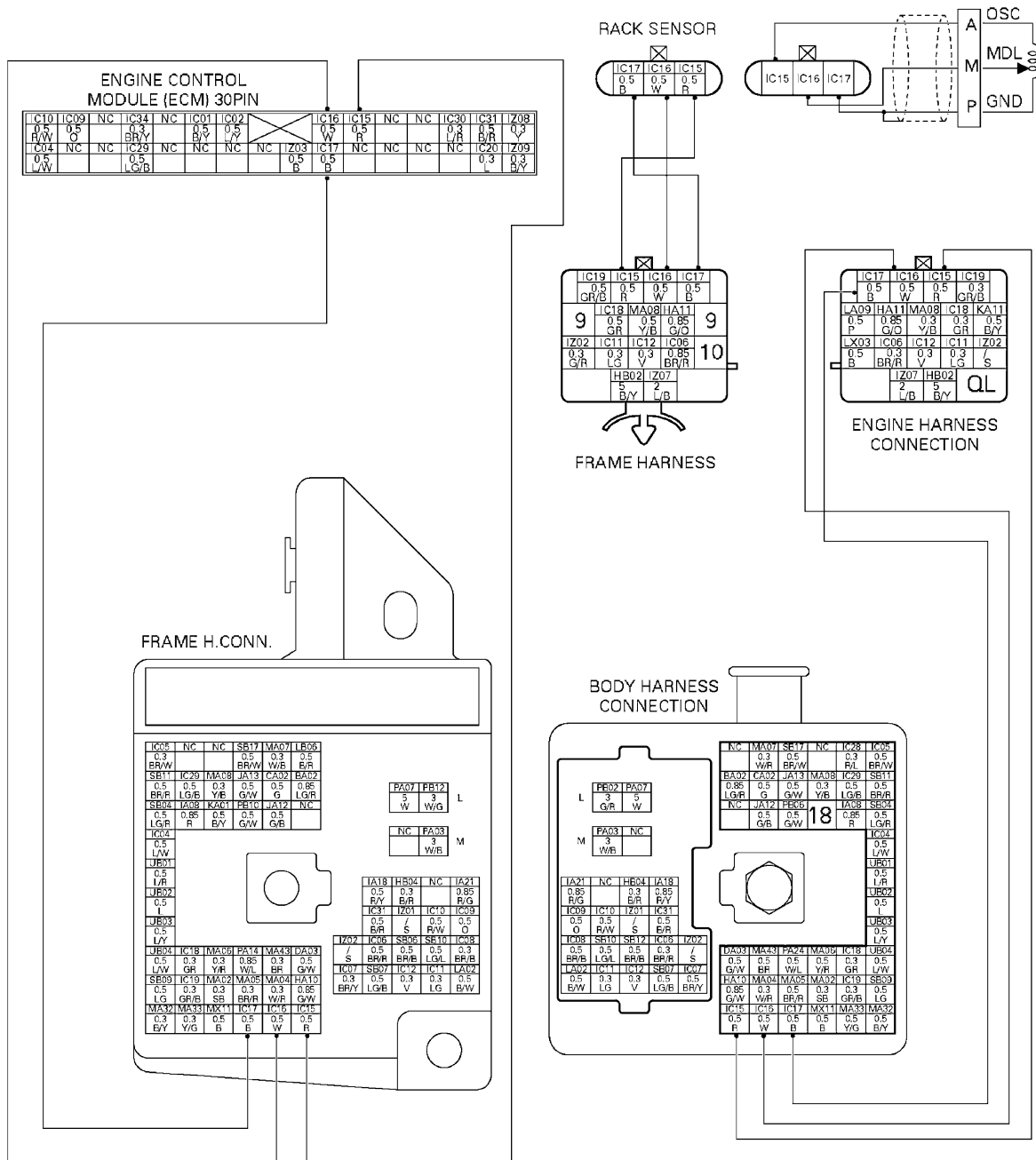
Notice:

Mark “___” on connector which is plugged, therefore, should be confirmed to be played.

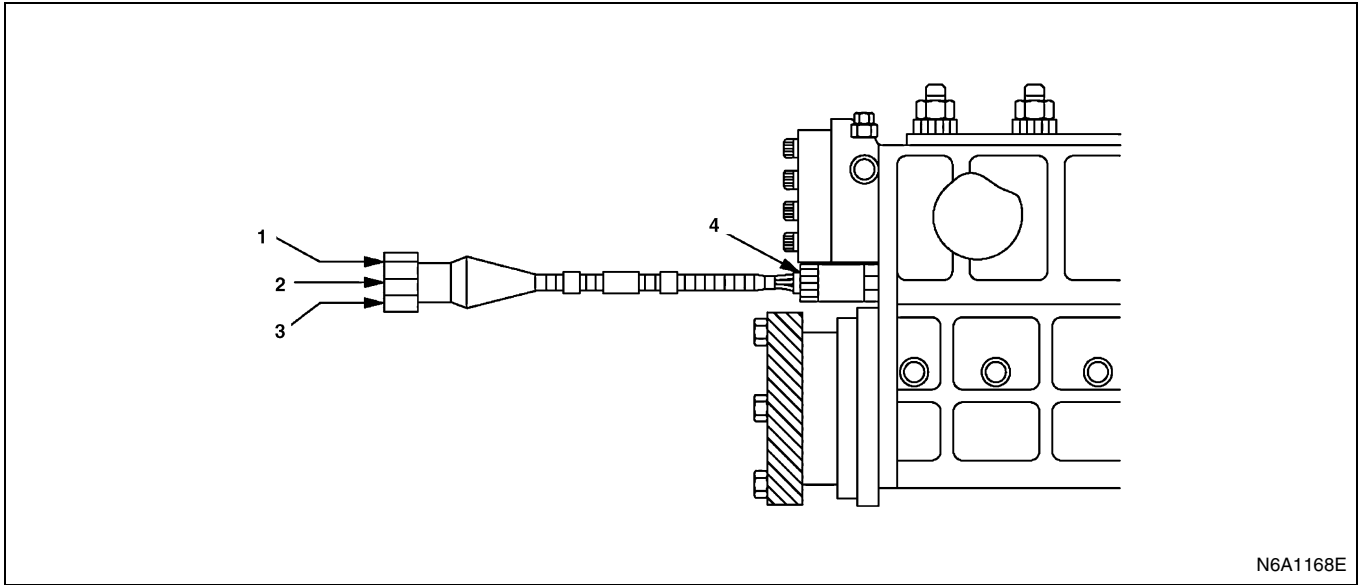
6E-56 EMISSION AND ELECTRICAL DIAGNOSIS

Step	Action	Value	YES	NO
1	Was the on-board diagnostic (OBD) system check performed?	—	Go to Step 2	Go to self diag system check
2	1. Check harness side power source circuit and signal circuit for GND short. 2. Repair if necessary. Has DTC21 been corrected?	—	Go to Step 10	Go to Step 3
3	Disconnect the Sensor Connector. Jumper RACK+ and RACK signal. Free from trouble now? Ignore code 22.	—	Go to Step 4	Go to Step 6
4	1. Apply 5V to RACK+ TERMINAL. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9 — 2.0V (Idling speed)	Go to Step 7	Go to Step 5
5	1. Check Rack Sensor Harness Signal Circuit and power source for GND short. Check signal circuit for disconnect. 2. Repair if necessary. Free from trouble now?	—	Go to Step 10	Go to Step 7
6	1. Check harness signal circuit and power source circuit for disconnect. 2. Repair if necessary. Free from trouble now?	—	Go to Step 10	Go to Step 8
7	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core (RACK end) inside RACK Sensor?	—	Go to Step 10	Go to Step 9
8	1. Replace the RACK Sensor. Is the action complete?	—	Go to Step 10	—
9	1. Replace the ECM. Is the action complete?	—	Go to Step 10	—
10	1. Reconnect all the connectors removed. 2. Ignition -ON+, Engine "OFF" Is DTC 21 all right under Scan Tool Check?	—	Go to Step 10	Go to Step 2
11	Is any current trouble other than DTC 21 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P22 Rack Sensor Circuit High Voltage



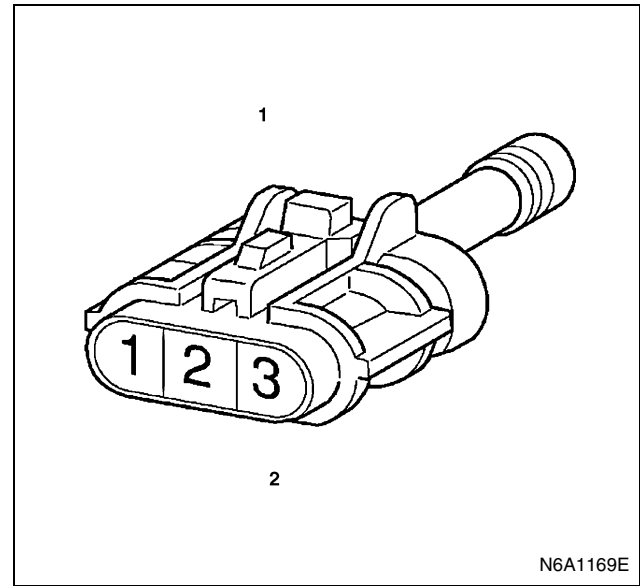
Location of Rack Sensor Connector



Legend

- 1. OSC (red)
- 2. MDL (white)
- 3. GND (black)
- 4. Rack sensor

Connector Name of Rack Sensor



Legend

- 1. Rack sensor connector
- 2. Natural 3 pin

Relation Between Connector Number and Signal Name

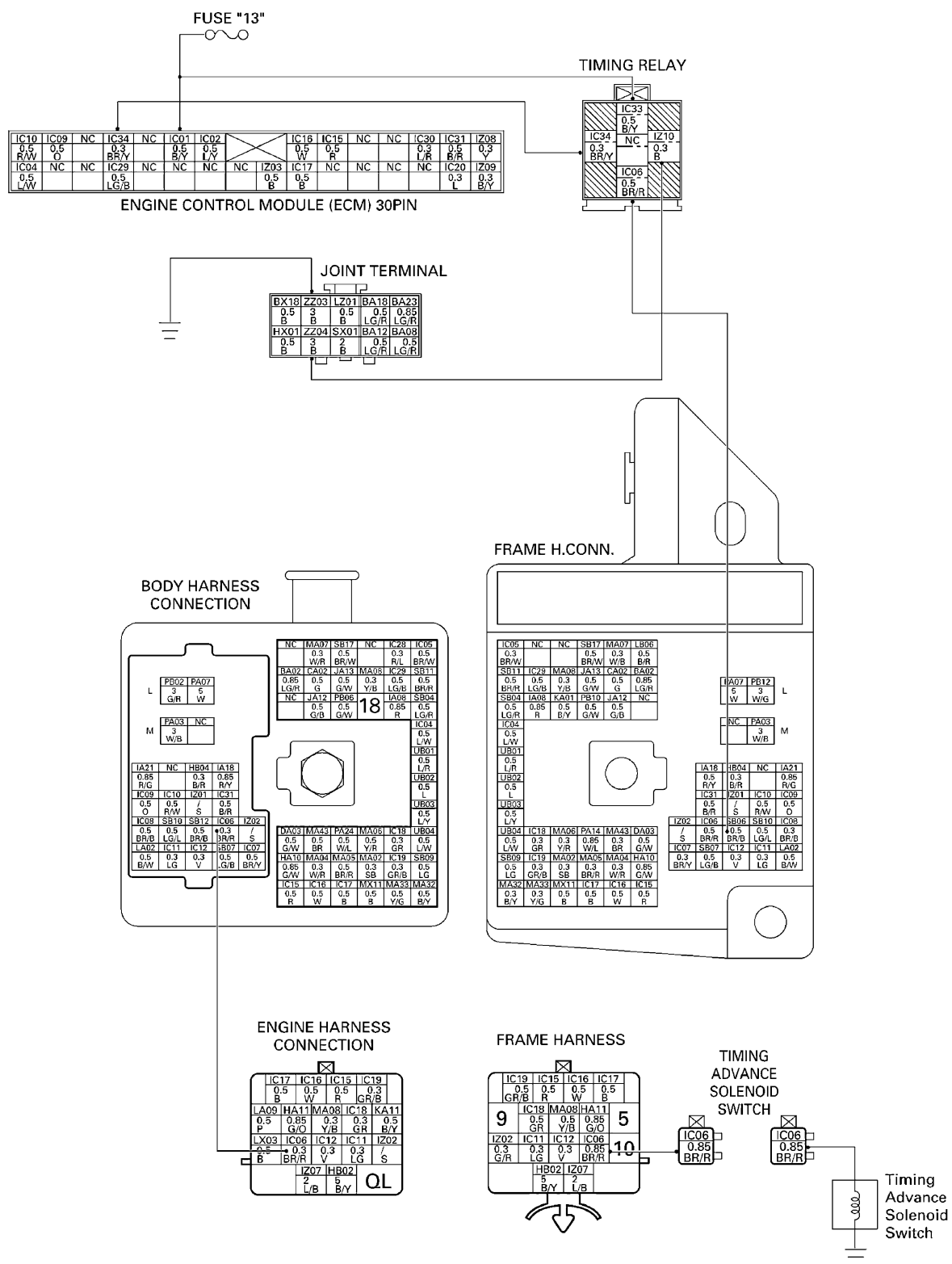
Connector No	Signal	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (MDL)	W
3	Rack sensor (GND)	B

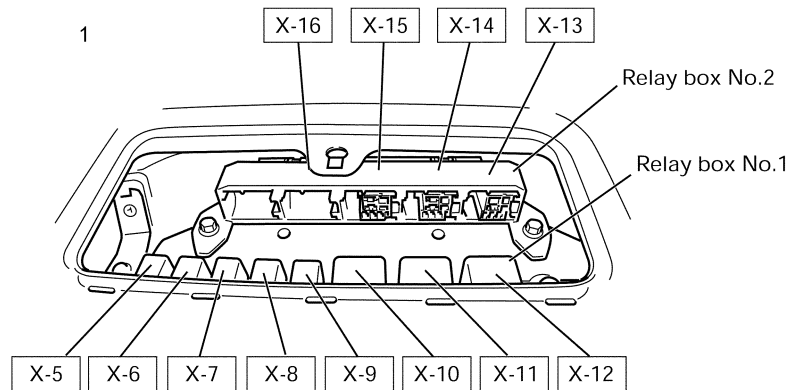
Notice:

Mark “___” on connector which is plugged, therefore, should be confirmed to be played.

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	Remove Sensor Connector. Has DTC22 been corrected? (Ignore DTC21)	—	Go to Step 3	Go to Step 7
3	1. Jump between Harness signal Terminal and GND terminal at the Sensor side of Connector. 2. Ignition "ON" Has DTC22 been corrected?	—	Go to Step 4	Go to Step 5
4	1. Check the Sensor Connector for inter terminal short. After check, repair if necessary. Was Connector Terminal shorted?	—	Go to Step 12	Go to Step 6
5	1. Check GND Circuit for disconnect. After check, repair if necessary. Is GND circuit disconnect?	—	Go to Step 12	Go to Step 11
6	1. Check Sensor Harness signal circuit and power source circuit for short. After check, repair if necessary. Was Harness shorted?	—	Go to Step 12	Go to Step 8
7	1. Check Harness signal circuit and power source for short. After check, repair if necessary. Was Harness shorted?	—	Go to Step 12	Go to Step 11
8	1. Apply 5V to RACK+ TERMINAL. 2. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9 — 2.0V (Idling speed)	Go to Step 9	Go to Step 10
9	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core(RACK end) inside RACK Sensor?	—	Go to Step 12	Go to Step 11
10	Replace the RACK Sensor. Is the action complete?	—	Go to Step 12	—
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC22 all right under Scan Tool Check?	—	Go to Step 13	Go to Step 2
13	Is any current trouble other than DTC 22 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P23 Solenoid Switch Control Circuit Low Voltage



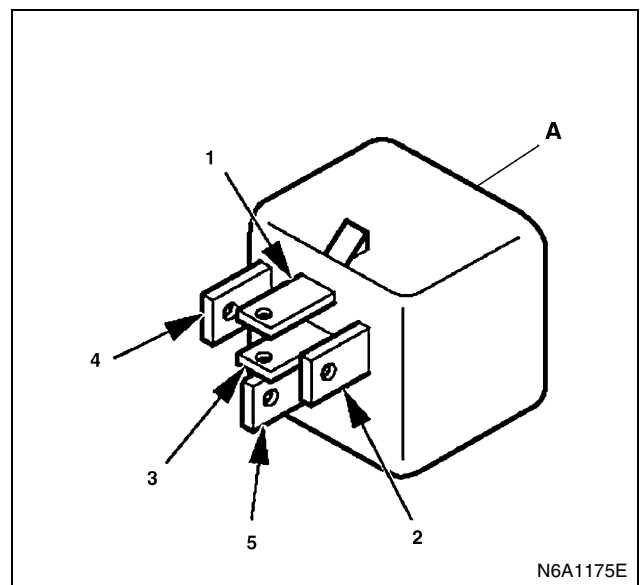
Location of Relay

N6A1174E

Legend

1. Relay box (Installed on the instrument panel)

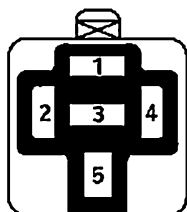
NO	RELAY NAME
X-5	ABS IND.
X-6	Dimmer
X-7	Power window
X-8	Exh. brake
X-9	Cornering lamp
X-10	Thermo A/C
X-11	Exh. Brake, Charge warning, Key ON
X-12	Heater & A/C
X-13	Buzzer cancel, Heater
X-14	ECU, PTO main, Timing
X-15	Tail, PTO solenoid, M/T
X-16	PTO cut

Inspection for Timing Advance Solenoid Switch cut relay

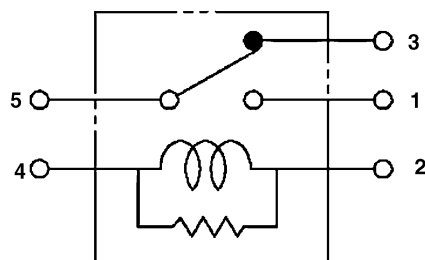
N6A1175E

Legend

A. Timing advance solenoid



N6A1176E



N6A1177E

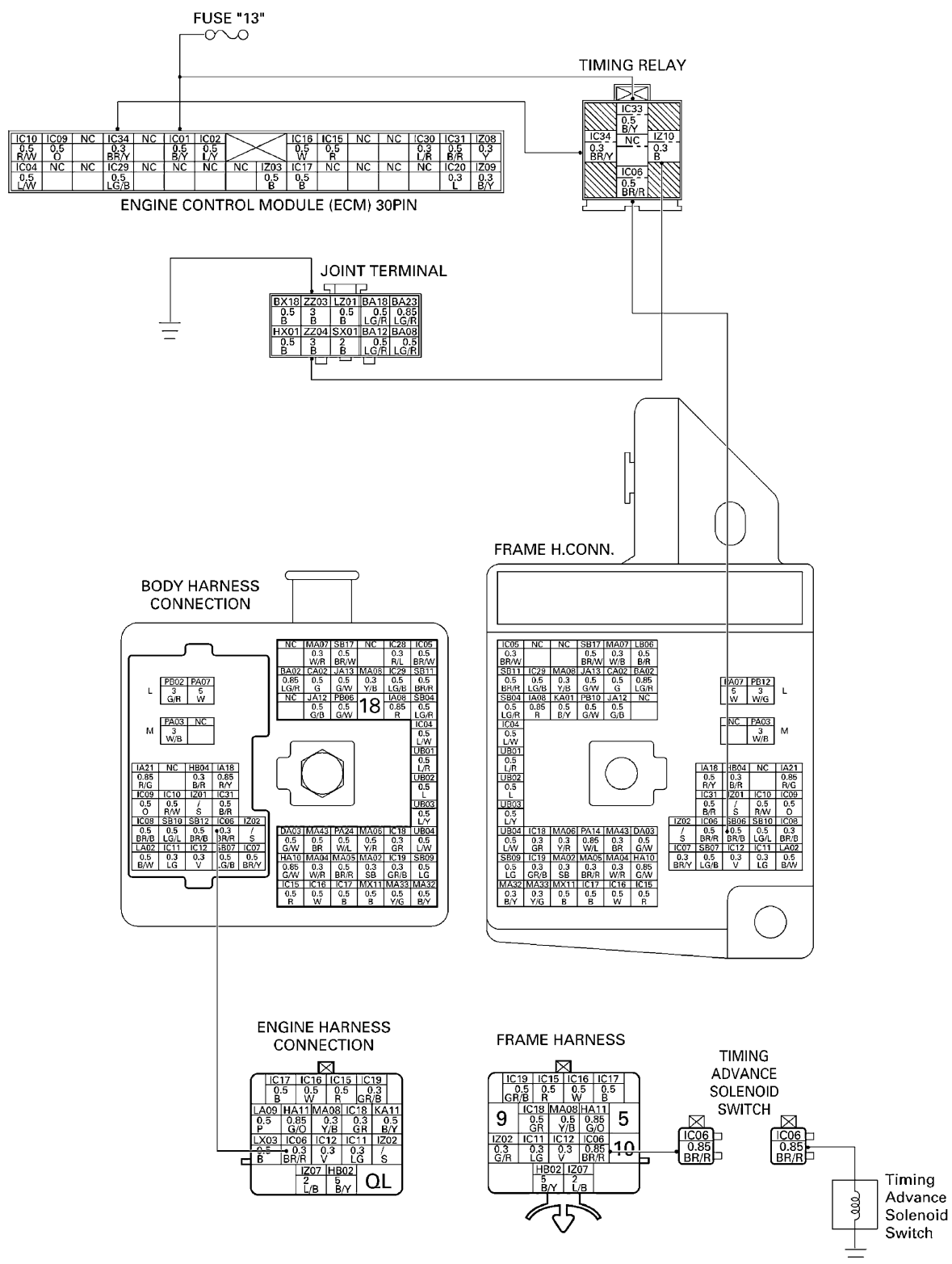
Resistance value

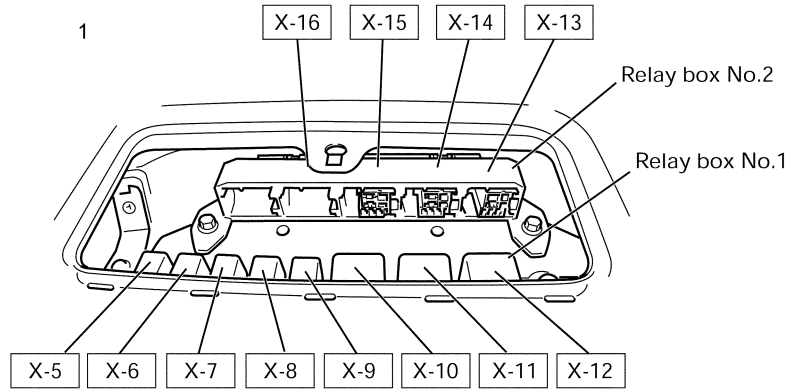
Inspection Point		Resistance	Reference
Inspection relay unit	2 $\longleftrightarrow$ 4	240 to 290 (Ω) (for 12 volt) 256 to 276 (Ω) (for 24 volt)	
	1 $\longleftrightarrow$ 5	∞	Not be supplied electricity
		Below 0.5 (Ω)	Be supplied electricity
	3 $\longleftrightarrow$ 5	Below 0.5 (Ω)	Be supplied electricity
		∞	Not be supplied electricity

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF", Engine "ON". 2. Jumper the magnetic switch Relay ground circuit at the Relay connector to chassis ground. 3. Observe the "Relay; solenoid switch" circuit open status on the scan tool. Has DTC23 been corrected?	—	Go to Step 4	Go to Step 3
3	1. Check for poor connector at the Relay connector and replace the terminals if necessary. Did any terminals require replacement?	—	Go to Step 11	Go to Step 5
4	1. Check the Relay ground circuit for an open. 2. If the Relay ground circuit is open, repair it as necessary. Was the Relay ground circuit open?	—	Go to Step 11	Go to Step 2

Step	Action	Value	YES	NO
5	1. Ignition "OFF", with scan tool disconnected. 2. Disconnect the Solenoid switch Relay connector. 3. Apply a circuit tester with voltage range or a test light to the output line for the Relay. 4. Ignition "ON", Measure the voltage or check the test light "ON". Ignition "OFF"	$\geq 8V$ or light "ON" (for 12 Volt) $\geq 16V$ or light "ON" (for 24 Volt)	Go to Step 8	Go to Step 6
6	1. Ignition "ON". 2. Disconnect ECM, and check for the Relay signal circuit terminal connector at the ECM and clean or replace terminal if necessary. Did any terminals need to be repaired?	—	Go to Step 11	Go to Step 7
7	1. Check the Relay signal circuit for an open. 2. If the Relay signal circuit is open, repair it as necessary. Was the Relay signal circuit open?	—	Go to Step 11	Go to Step 8
8	1. Disconnect the Relay. 2. Measure the resistance between the coil circuit terminals of the Relay. Is the resistance within specific value?	$240 - 290\Omega$ (for 12 Volt) $256 - 276\Omega$ (for 24 Volt)	Go to Step 10	Go to Step 9
9	1. Replace the Relay. Is the action complete?	—	Go to Step 11	—
10	1. Replace the ECM Is the action complete?	—	Go to Step 11	—
11	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF". 3. Ignition "OFF" after 30 seconds. 4. Install Scan tool. Is DTC 23 all right under Scan Tool Check?	—	Go to Step 12	Go to Step 2
12	Is any current trouble other than DTC 23 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P24 Solenoid Switch Control Circuit High Voltage



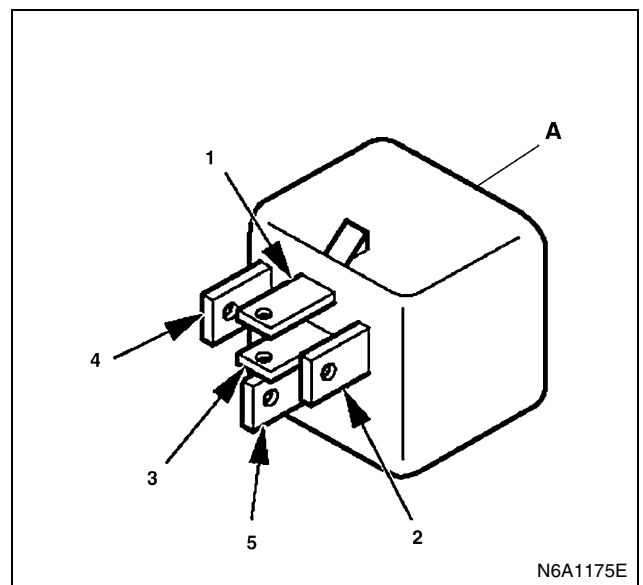
Location of Relay

N6A1174E

Legend

1. Relay box (Installed on the instrument panel)

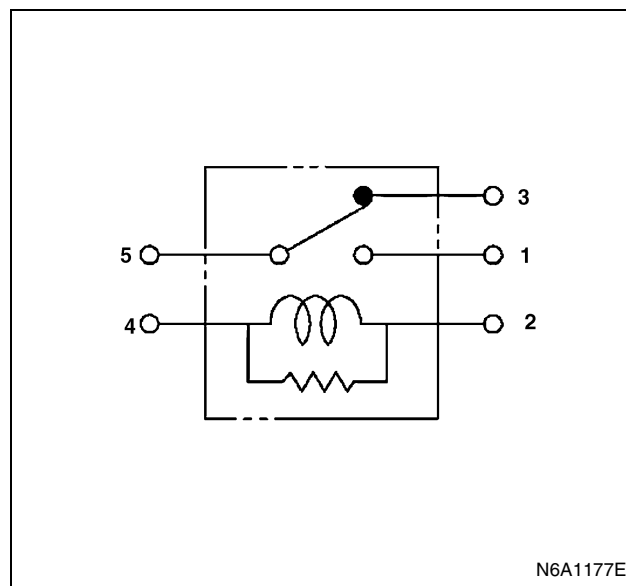
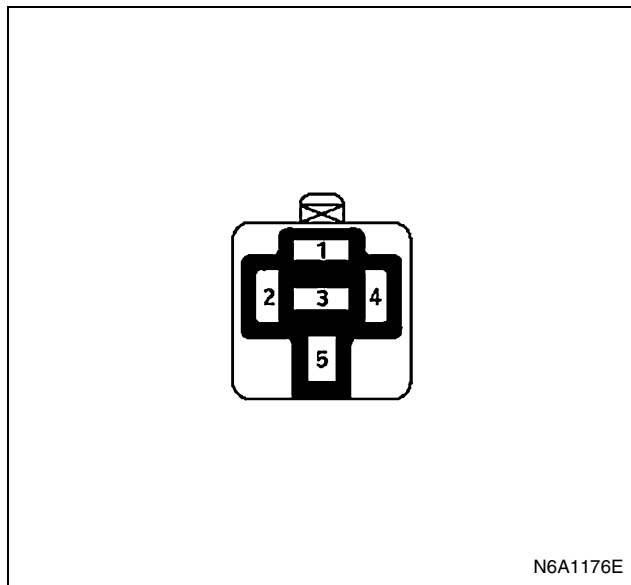
NO	RELAY NAME
X-5	ABS IND.
X-6	Dimmer
X-7	Power window
X-8	Exh. brake
X-9	Cornering lamp
X-10	Thermo A/C
X-11	Exh. Brake, Charge warning, Key ON
X-12	Heater & A/C
X-13	Buzzer cancel, Heater
X-14	ECU, PTO main, Timing
X-15	Tail, PTO solenoid, M/T
X-16	PTO cut

Inspection for Timing Advance Solenoid Switch cut relay

N6A1175E

Legend

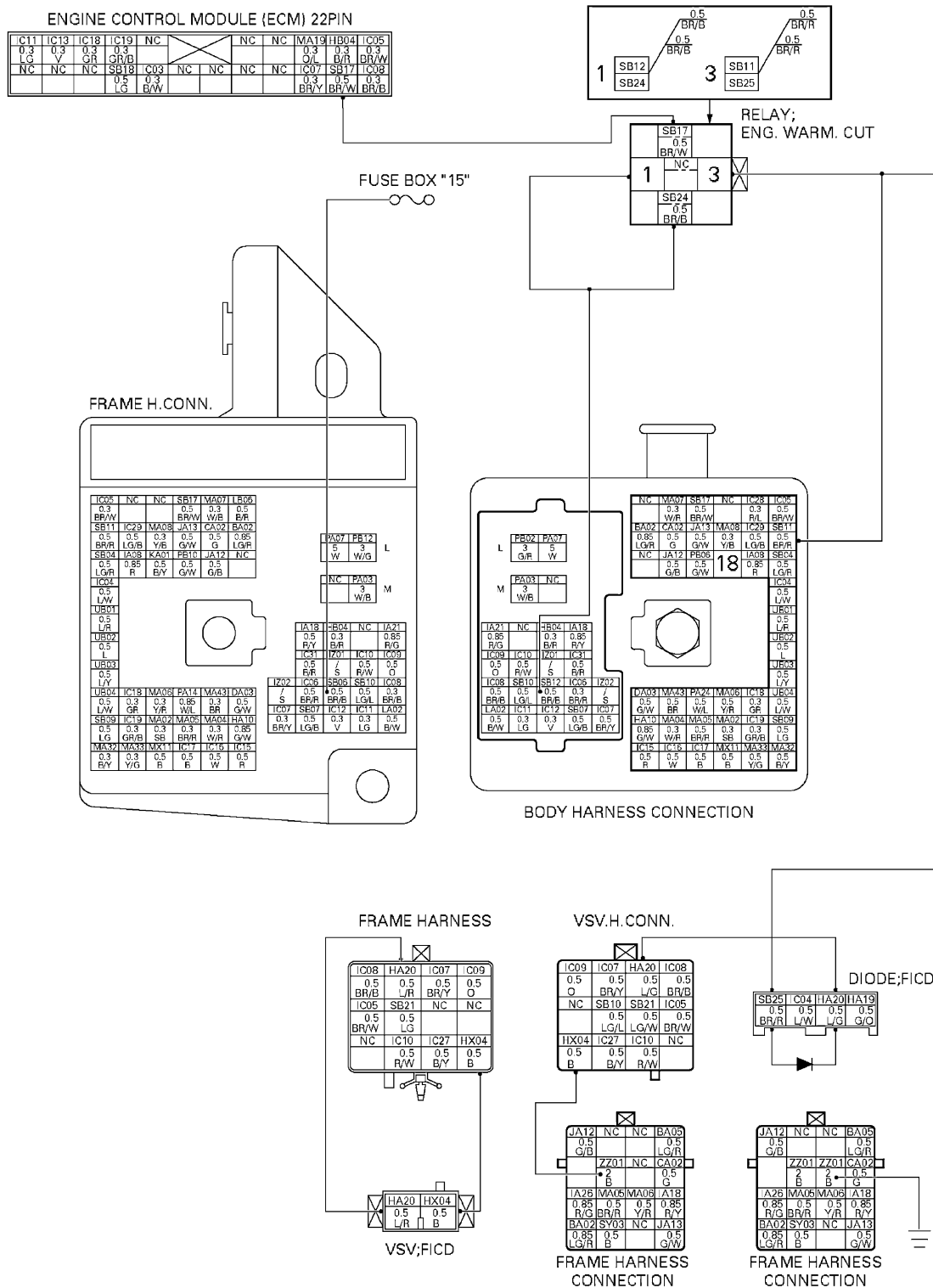
- A. Timing advance solenoid

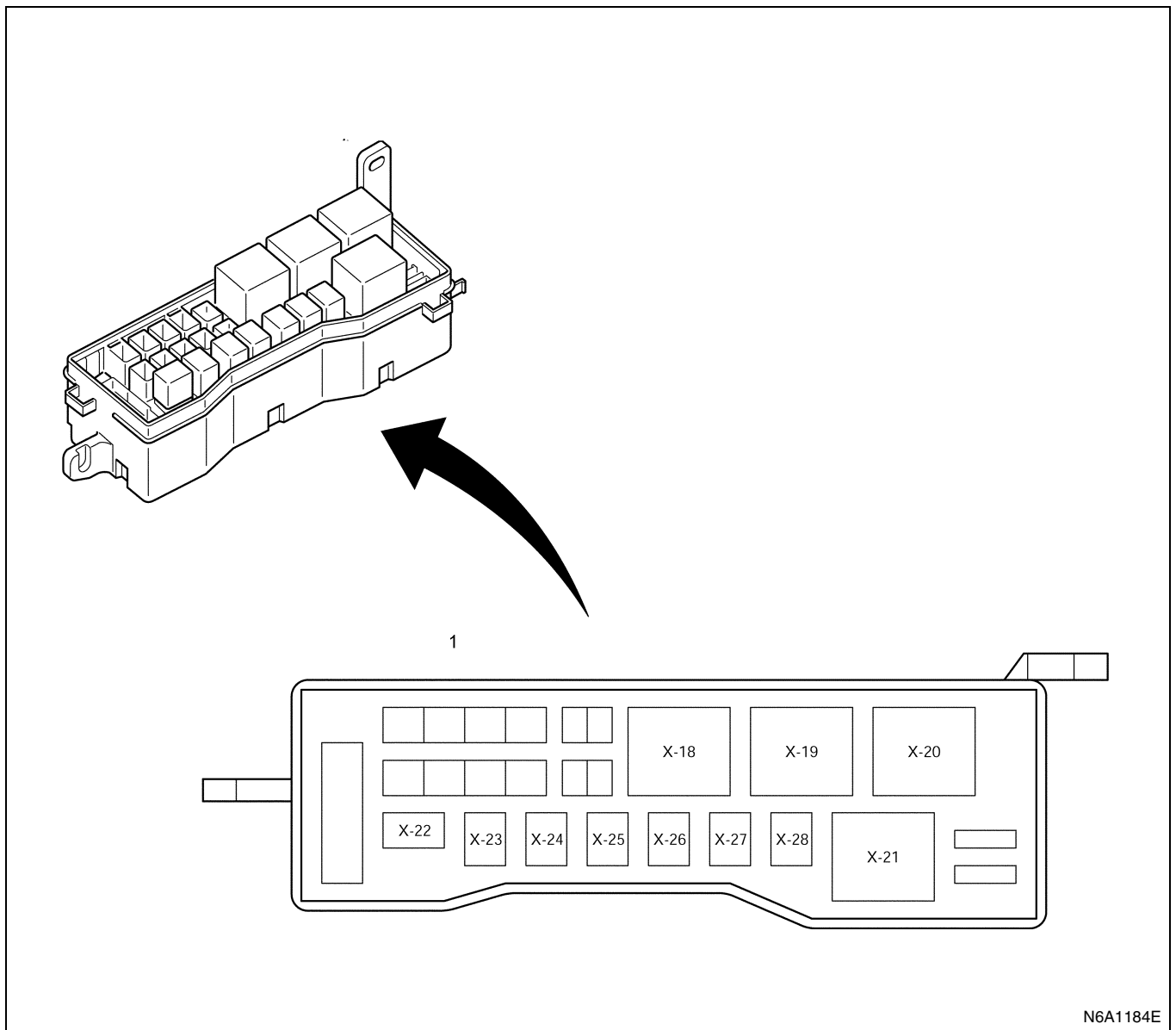
**Resistance value**

Inspection Point		Resistance	Reference
Inspection relay unit	2 ↔ 4	240 to 290 (Ω) (for 12 volt) 256 to 276 (Ω) (for 24 volt)	
	1 ↔ 5	∞	Not be supplied electricity
		Below 0.5 (Ω)	Be supplied electricity
	3 ↔ 5	Below 0.5 (Ω)	Be supplied electricity
		∞	Not be supplied electricity

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF", with scan tool disconnected. 2. Disconnect the Relay solenoid switch from the Relay box. 3. Apply a circuit tester with the voltage range or a test light to the output circuit for the Relay. 4. Ignition "ON", Engine "OFF". Is voltage as prescribed, or is test Light lit until 18 seconds?	$\geq 8V$ or light "ON" (for 12 Volt) $\geq 16V$ or light "ON" (for 24 Volt)	Go to Step 6	Go to Step 3
3	1. Ignition "OFF". 2. Check if there is no short between Relay Box Terminals. 3. Repair if necessary. Was the circuit shorted between Relay Box Terminals?	—	Go to Step 8	Go to Step 4
4	1. Disconnect the ECM. 2. Check if Relay Sig Circuit for a short to Chassis/GND or short to voltage. 3. Repair if necessary. Was Relay signal circuit shorted?	—	Go to Step 8	Go to Step 5
5	1. Disconnect the Relay. 2. Measure the resistance between the coil circuit terminal of the Relay. Is the resistance with in specific valve?	$240 - 290\Omega$ (for 12 Volt) $256 - 276\Omega$ (for 24 Volt)	Go to Step 8	Go to Step 6
6	1. Ignition "OFF". 2. Replace the Relay. Is the action complete?	—	Go to Step 8	—
7	1. Ignition "ON". 2. Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine OFF, and Ignition off after 30sec. 3. Install Scan tool. 4. Ignition "ON", Engine "OFF". Is DTC 24 all right under Scan Tool Check?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 24 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P26 Quick Warm System (QWS) Relay Control Circuit High Voltage



Location of Relay**Legend**

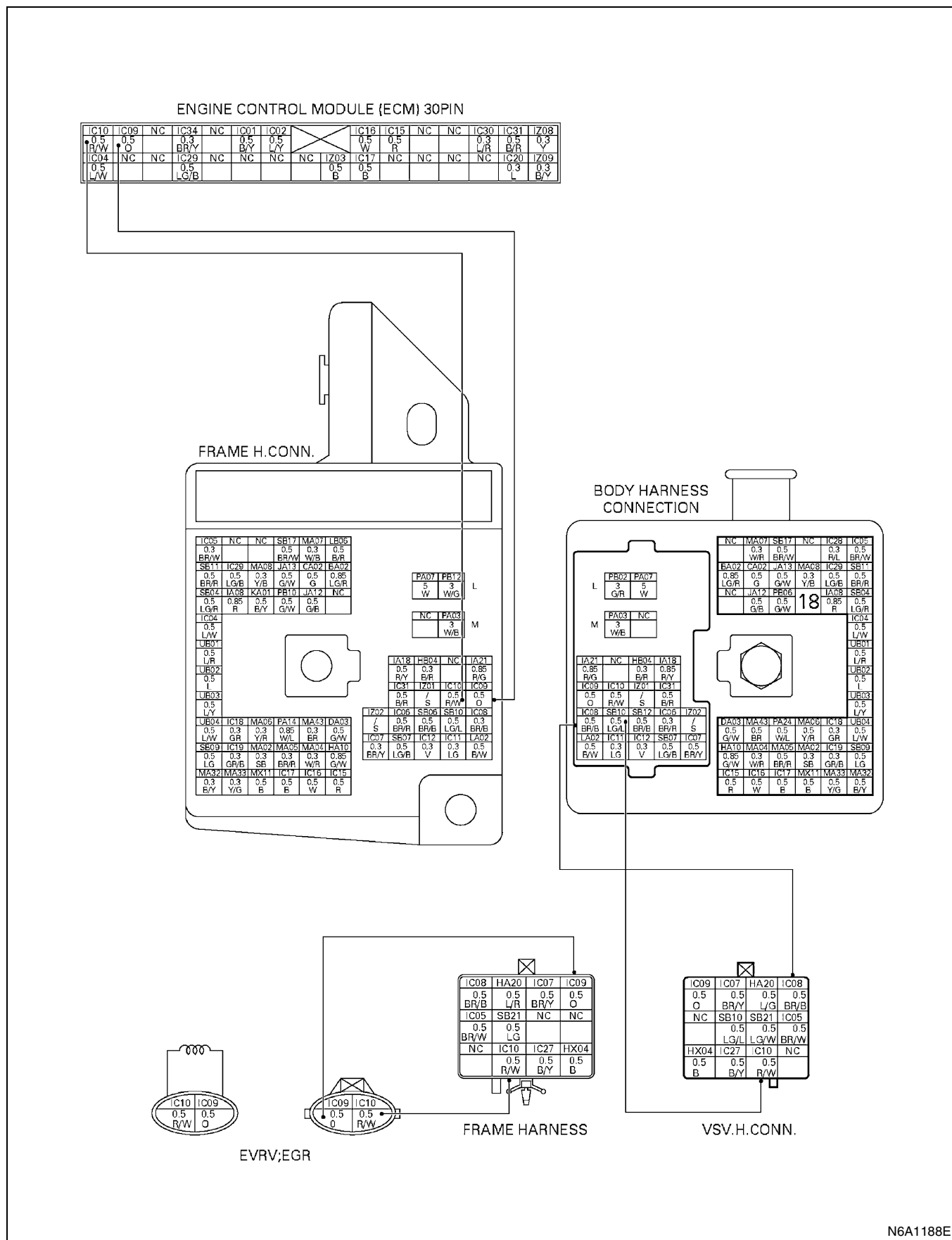
1. Relay box (Installed on the left side rear of the cab)

NO	RELAY NAME
X-20	Glow plug
X-21	Starter
X-22	Marker lamp
X-23	Rear fog
X-24	A/C COMP, 4WD ind. lamp
X-25	Exh, Brake control
X-26	CSD, A/C ON SIGNAL
X-27	Condenser fan
X-28	Exh. Brake cut

Inspection Point		Resistance	Reference
Inspection relay unit	2 ↔ 4	240 to 290 (Ω) (for 12 volt) 256 to 276 (Ω) (for 24 volt)	
	1 ↔ 5	∞	Not be supplied electricity
		Below 0.5 (Ω)	Be supplied electricity
	3 ↔ 5	Below 0.5 (Ω)	Be supplied electricity
		∞	Not be supplied electricity

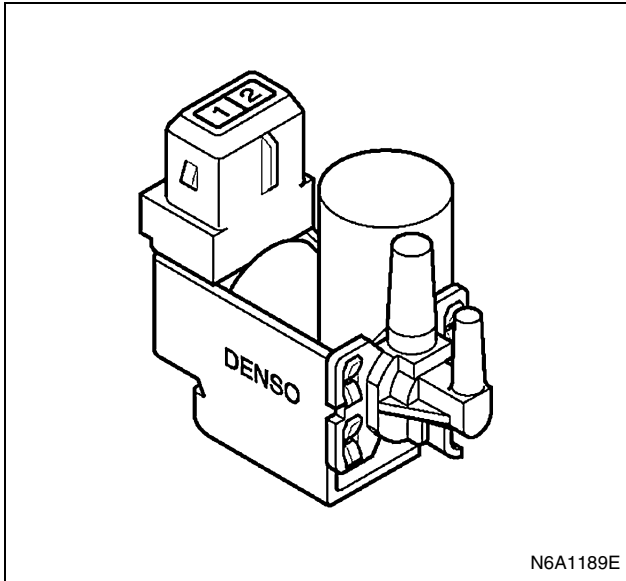
Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF", with scan tool disconnected. 2. Disconnect the Relay solenoid switch from the Relay box. 3. Apply a circuit tester with the voltage range or a test light to the output circuit for the Relay. 4. Ignition "ON", Engine "OFF". Is voltage as prescribed, or is test Light lit until 18 seconds?	≥ 8 V or light "ON" (for 12 Volt) ≥ 16 V or light "ON" (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of Relay circuit between the ECM and Relay connector. 4. Repair if necessary. Has DTC 26 been corrected?	—	Go to Step 6	Go to Step 5
4	Replace the Relay. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 6	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 26 all right under Scan Tool Check?	—	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 26 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P31 Exhaust Gas Recirculation (EGR) Electronic Vacuum Regulating Valve (EVRV) Solenoid Control Low Voltage

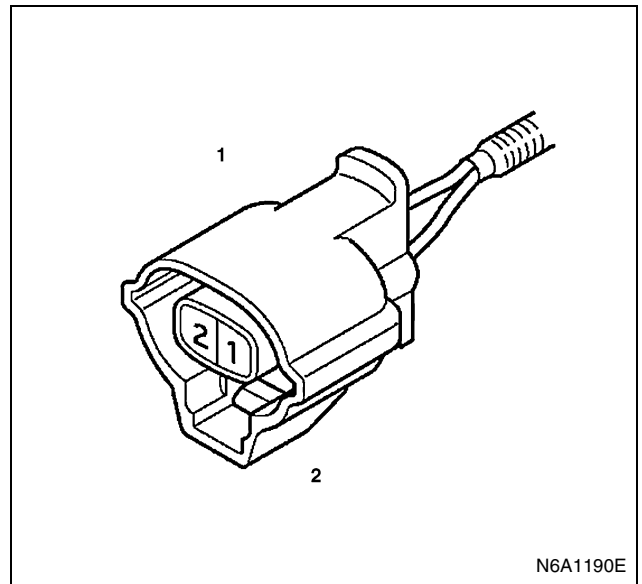


Appearance of Electronic Vacuum Regulating Valve (EVRV): Exhaust Gas Recirculation (EGR) Sensor and Connector Name

EVRV: EGR



EVRV: EGR Connector

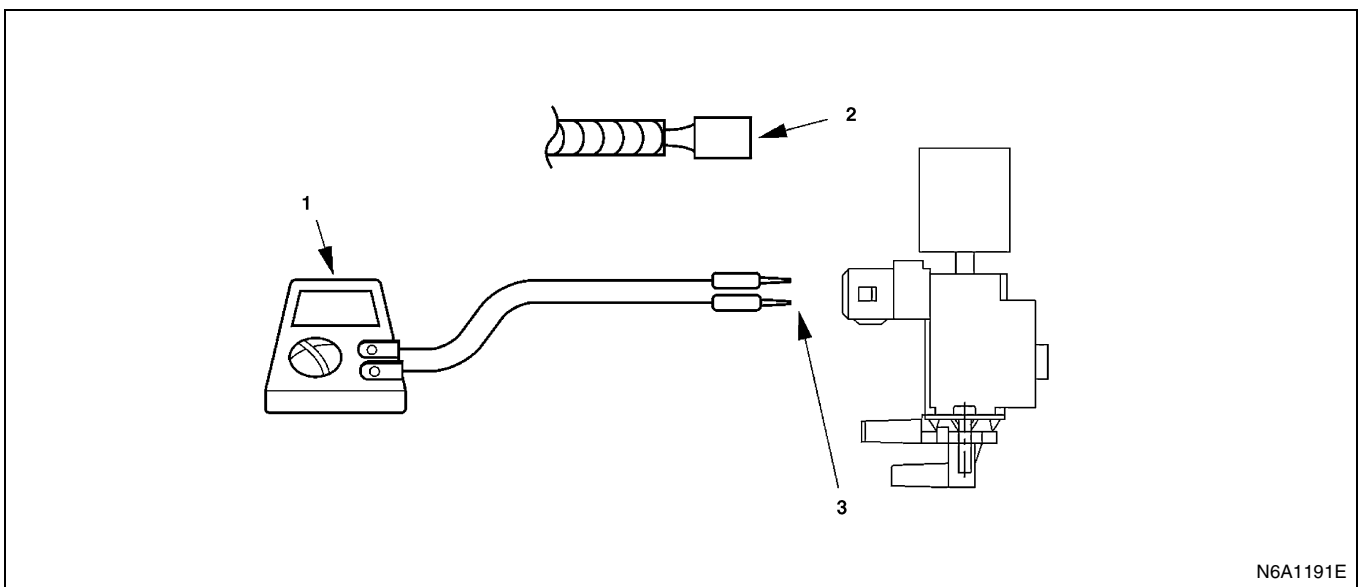


Legend

- 1. To EVRV: EGR
- 2. 2 pin

Connector No	Signal
1	GND
2	SIG

Measure Resistance at EVRV: EGR



Legend

- 1. Circuit tester
- 2. Remove EVRV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

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Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ↔ 1	12±1 (for 12 volt) 48±2 (for 24 volt)	SIG ↔ GND
	1 ↔ Body	∞	SIG ↔ Body

Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

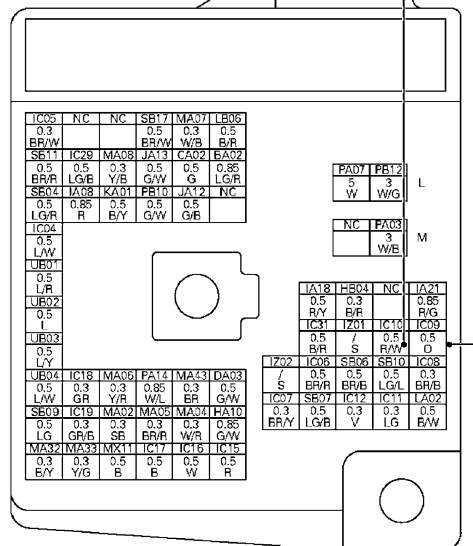
Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the EVRV from the wiring harness connector. 3. Check the EVRV signal circuit between the EVRV connector and the ECM for the following condition. • A short to ground • An open circuit 4. Repair if necessary. Has DTC31 been corrected?	—	Go to Step 7	Go to Step 3
3	Using the DVM, check the resistance of the EVRV. Does the DVM read the following Value?	12Ω (for 12 Volt) 48Ω (for 24 Volt)	Go to Step 4	Go to Step 5
4	1. Ignition "OFF" 2. Check an open circuit of the EVRV ground circuit between the ECM and EVRV connector. 3. Repair if necessary. Has DTC31 been corrected?	—	Go to Step 7	Go to Step 6
5	Replace the EVRV. Is the action complete?	—	Go to Step 7	Go to Step 6
6	Replace the ECM. Is the action complete?	—	Go to Step 7	—
7	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC31 all right under Scan Tool Check?	—	Go to Step 8	Go to Step 2
8	Is any current trouble other than DTC31 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P32 Exhaust Gas Recirculation (EGR) Electronic Vacuum Regulating Valve (EVRV) Solenoid Control High Voltage

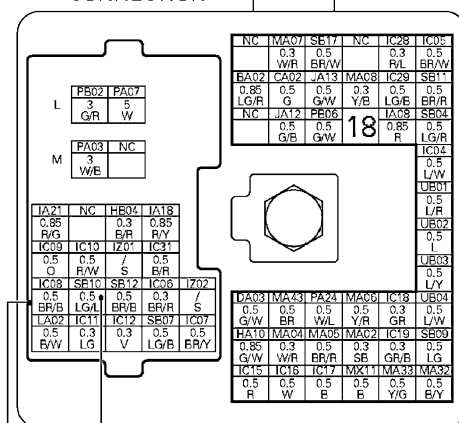
ENGINE CONTROL MODULE (ECM) 30PIN

IC10	IC09	NC	IC34	NC	IC01	IC02		IC16	IC15	NC	NC	IC30	IC31	IZ08
0.5 R/W	0.5 O		0.3 BR/Y		0.5 B/Y	0.5 L/Y		0.5 W	0.5 R			0.3 L/R	0.5 B/B	0.3 Y
IC04	NC	NC	IC29	NC	NC	NC	NC	IC17	IC17	NC	NC	NC	IC20	IZ09
0.5 L/W			0.5 L/G/B					0.5 B	0.5 B				0.3 L	0.3 B/Y

FRAME H.CONN.



BODY HARNESS CONNECTION



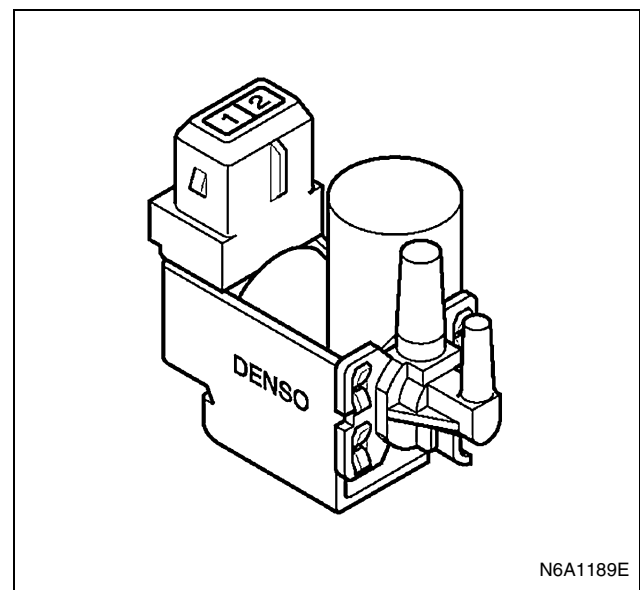
FRAME HARNESS

VSV.H.CONN.

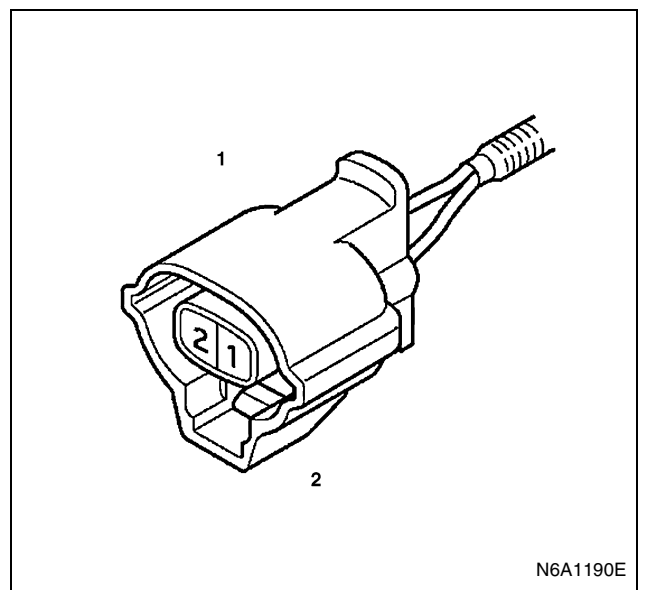
EVRV;EGR

Appearance of Electronic Vacuum Regulating Valve (EVRV): Exhaust Gas Recirculation (EGR) Sensor and Connector Name

EVRV: EGR



EVRV: EGR Connector

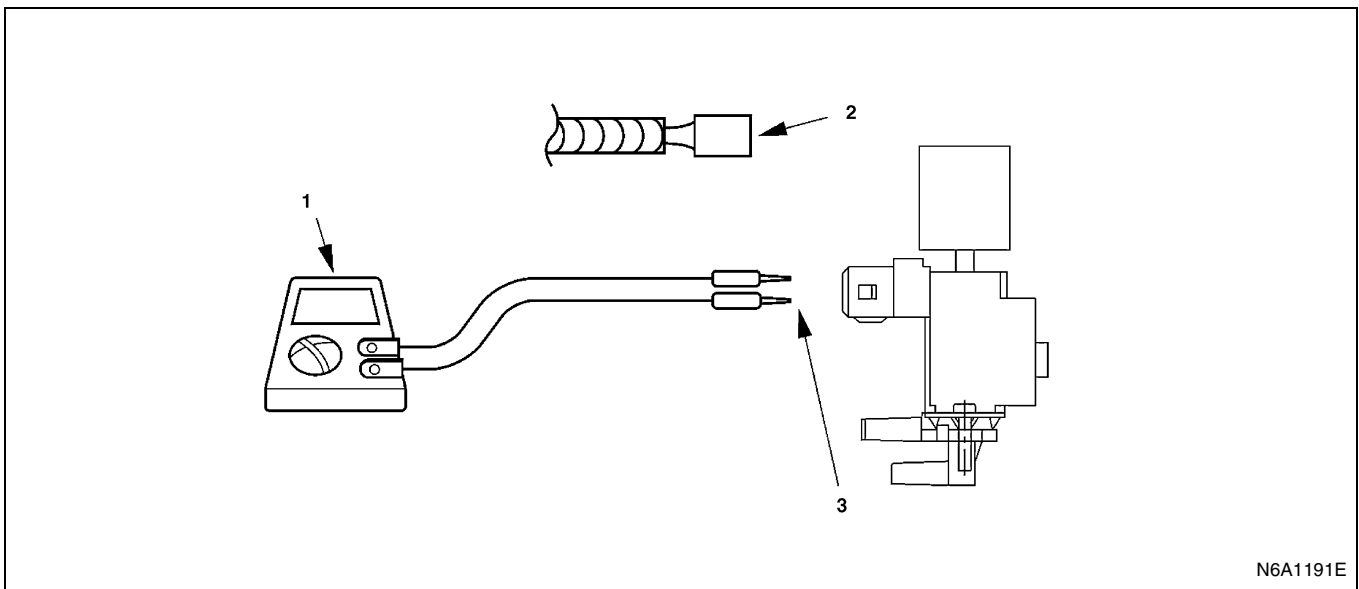


Legend

- 1. To EVRV: EGR
- 2. 2 pin

Connector No	Signal
1	GND
2	SIG

Measure Resistance at EVRV: EGR



Legend

- 1. Circuit tester
- 2. Remove EVRV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ↔ 1	12±1 (for 12 volt) 48±2 (for 24 volt)	SIG ↔ GND
	1 ↔ Body	∞	SIG ↔ Body

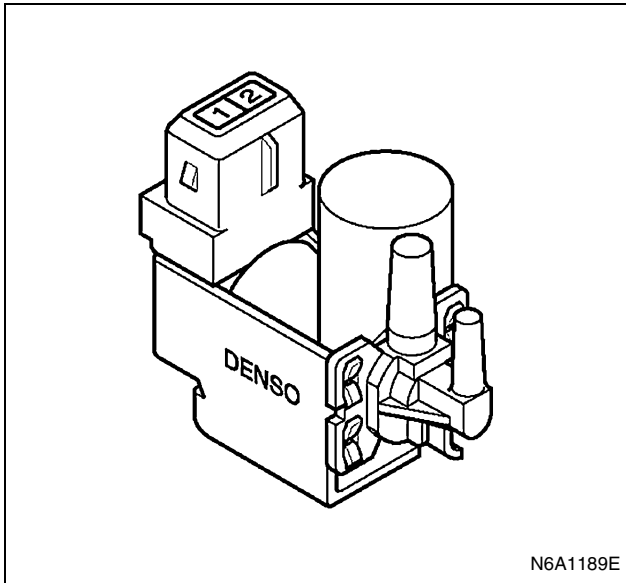
Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

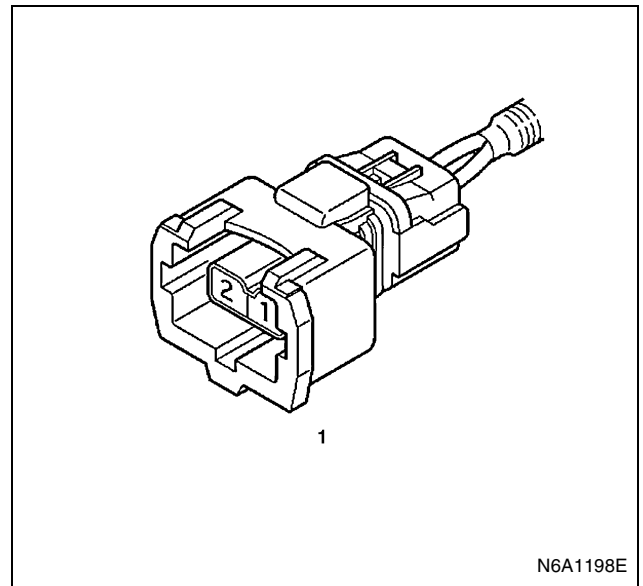
Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the EVRV from the wiring harness connector. 3. Check a short to voltage of the EVRV signal circuit and GND circuit between the EVRV connector and the ECM. 4. Repair if necessary. Has DTC32 been corrected?	—	Go to Step 5	Go to Step 3
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of EVRV circuit between the ECM and EVRV connector 4. Repair if necessary. Has DTC32 been corrected?	—	Go to Step 5	Go to Step 4
4	Replace the ECM. Is the action complete?		Go to Step 5	—
5	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC32 all right under Scan Tool Check?	—	Go to Step 6	Go to Step 2
6	Is any current trouble other than DTC32 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

Appearance of VSV for VSS and Connector Name

VSV for VSS



VSV Connector

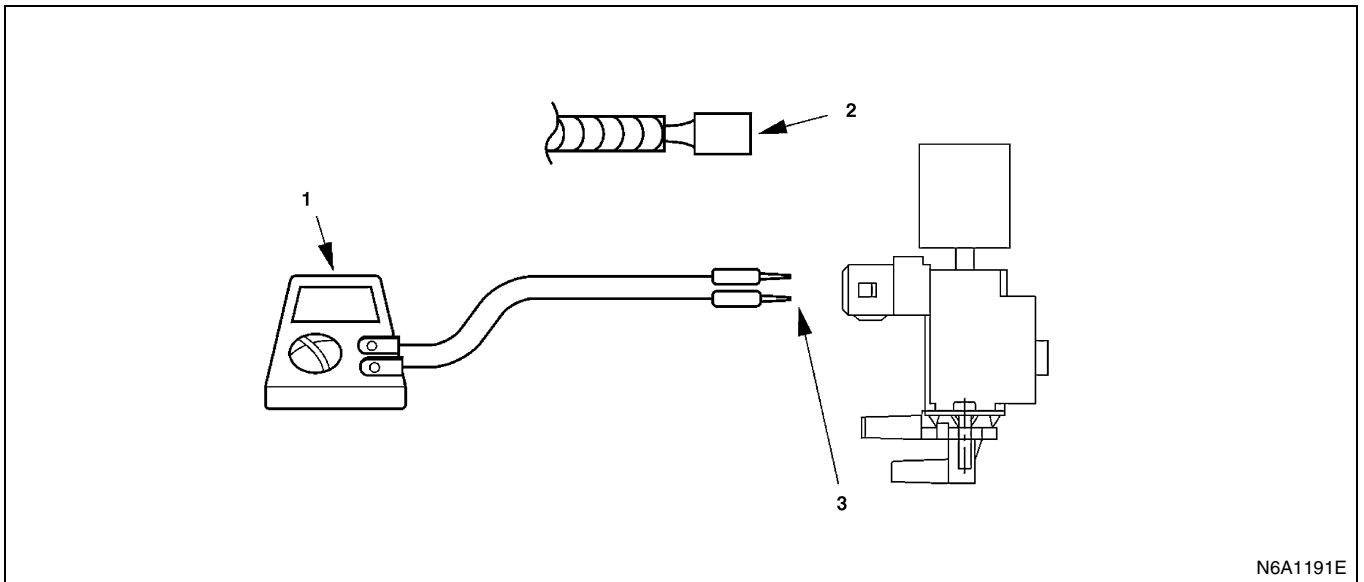


Legend

1. 2 pin

Connector No	Signal
1	SIG
2	GND

Measure Resistance at VSV for VSS



Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

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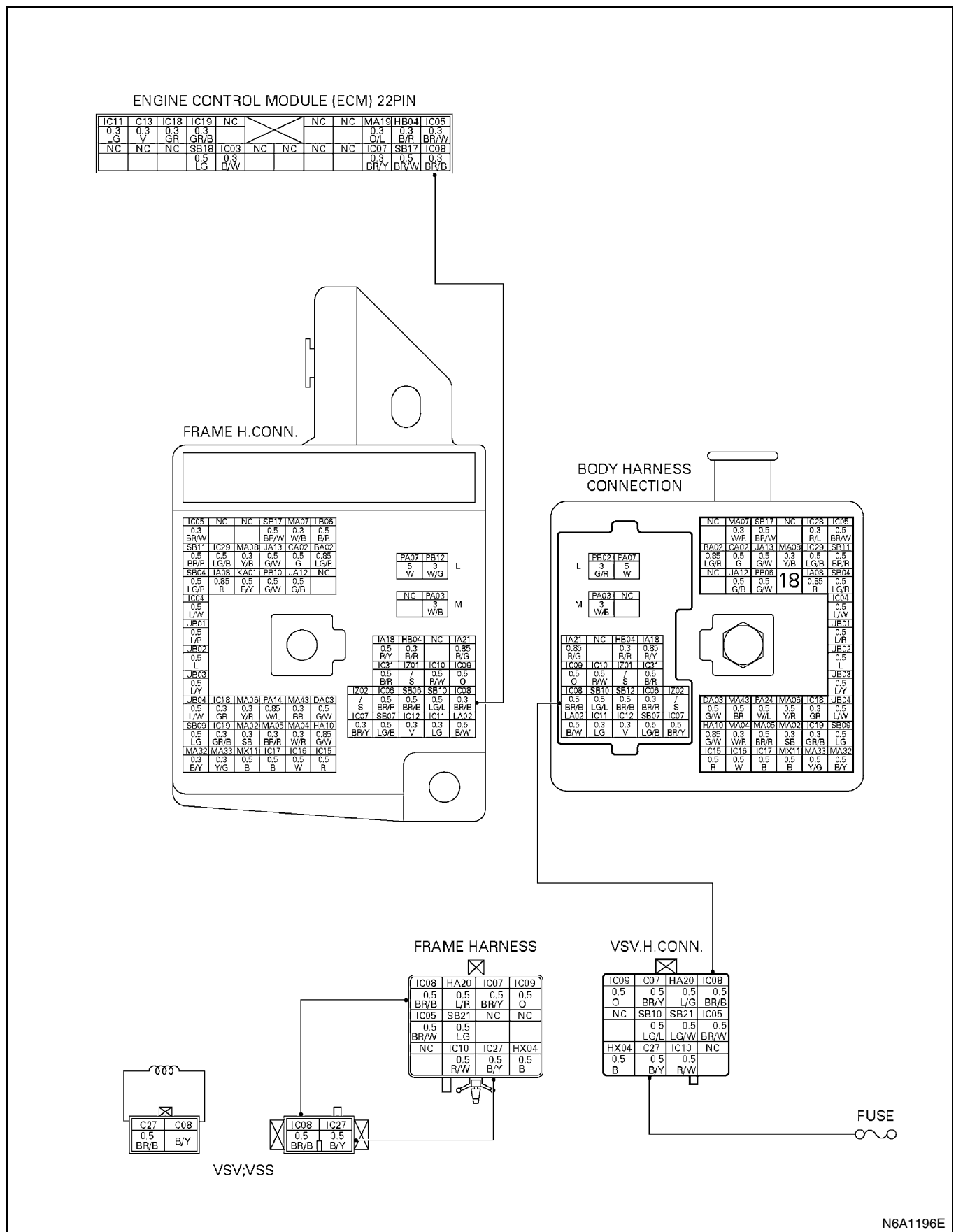
Resistance value

Inspection Point		Resistance Value (k Ω)	Reference
Connector	Pin No.		
2 pin Gray	2 $\longleftrightarrow$ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG $\longleftrightarrow$ GND
	1 $\longleftrightarrow$ Body	∞	SIG $\longleftrightarrow$ Body

Notice:

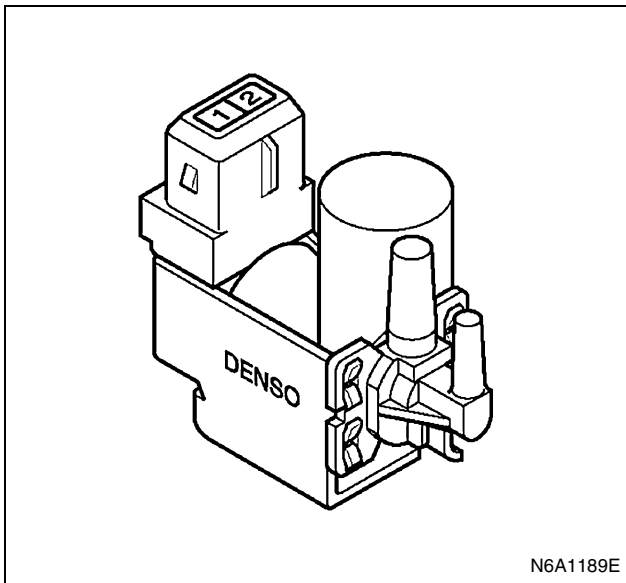
Resistance value is difference according to the engine temperature (condition of engine warming up).

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the VSV from the wiring harness connector. 3. Ignition "ON" Engine "OFF" 4. Using the Digital Voltmeter (DVM), check for voltage on the "IC27" of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and "Engine Ignition." Fuse for the following condition. • A short to ground • An open circuit 2. Repair if necessary. Has DTC 33 been corrected?	—	Go to Step 8	—
4	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44 Ω (for 12 Volt) 159 — 169 Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECU and VSV connector. • A short to ground • An open circuit 4. Repair if necessary. Has DTC 33 been corrected?	—	Go to Step 8	Go to Step 7
6	Replace the VSV. Is the action complete?	—	Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 33 all right under Scan Tool Check?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 33 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

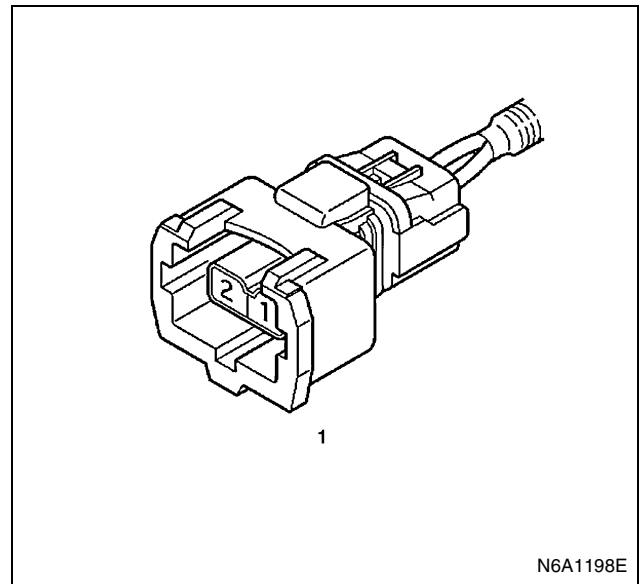


Appearance of VSV for VSS and Connector Name

VSV for VSS



VSV Connector

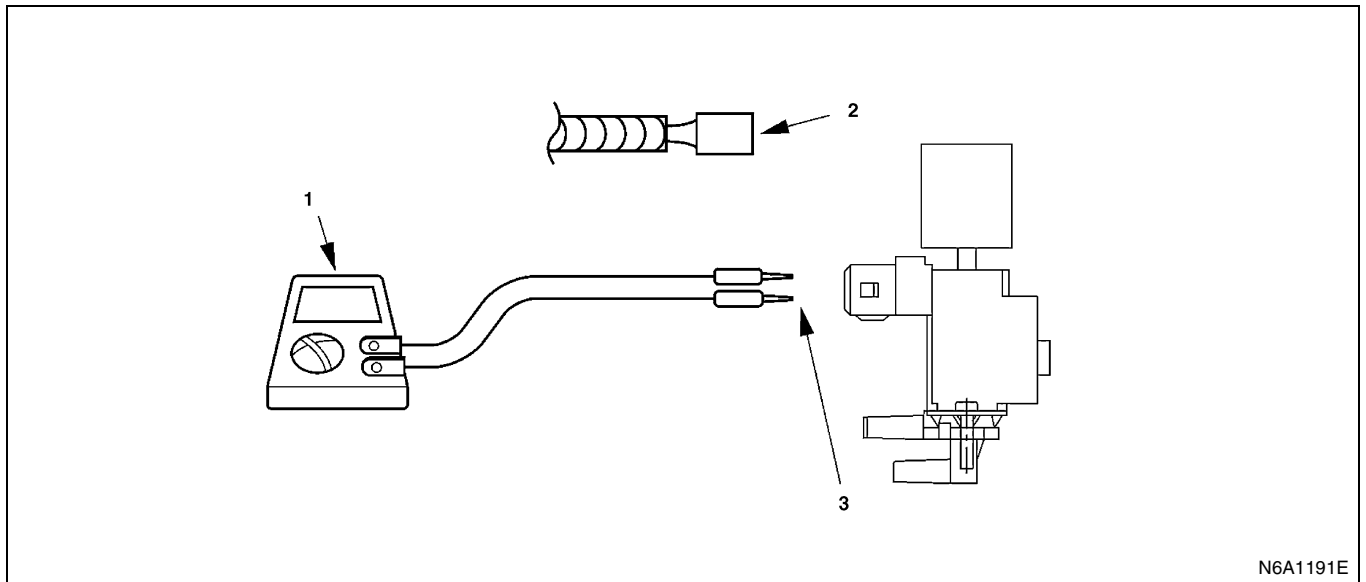


Legend

1. 2 pin

Connector No	Signal
1	SIG
2	GND

Measure Resistance at VSV for VSS



Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

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Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Gray	2 ↔ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ↔ GND
	1 ↔ Body	∞	SIG ↔ Body

Notice:

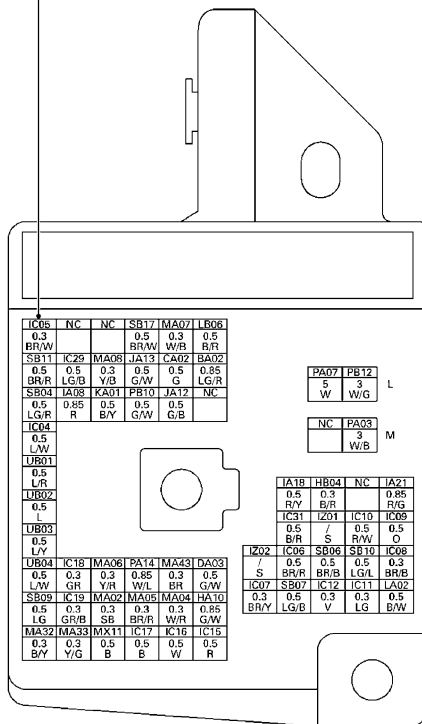
Resistance value is difference according to the engine temperature (condition of engine warming up).

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44Ω (for 12 Volt) 159 — 169Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector 4. Repair if necessary. Has DTC 34 been corrected?	—	Go to Step 6	Go to Step 5
4	Replace the VSV. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 6	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 34 all right under Scan Tool Check?	—	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 34 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

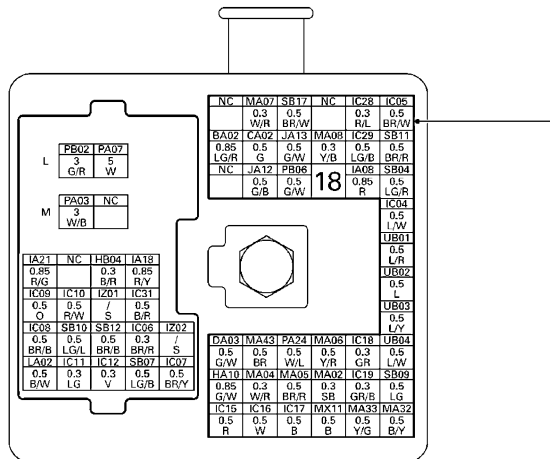
DTC-P35 Exhaust Gas Recirculation (EGR) Quick Cut Vacuum Switching Valve (VSV) Control Circuit Low Voltage

ENGINE CONTROL MODULE (ECM) 22PIN

IC11	IC13	IC18	IC19	NC	NC	NC	MA19	HB04	IC05
0.3 LG	0.3 V	0.3 GR	0.3 GR/B	NC	NC	NC	0.3 O/L	0.3 B/R	0.3 BR/W
NC	NC	NC	SB18	IC03	NC	NC	IC07	SB17	IC08
			0.5 LG	0.3 B/W			0.3 B/Y	0.5 BR/W	0.3 BR/B

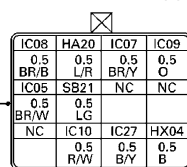


FRAME H.CONN.

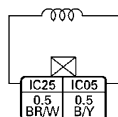
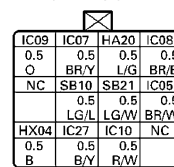


BODY HARNESS CONNECTION

FRAME HARNESS



VSV.H.CONN.

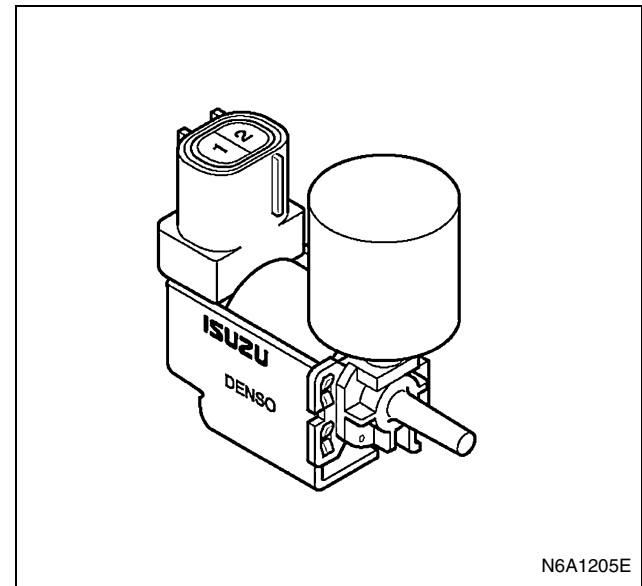


VSV:EGR CUT

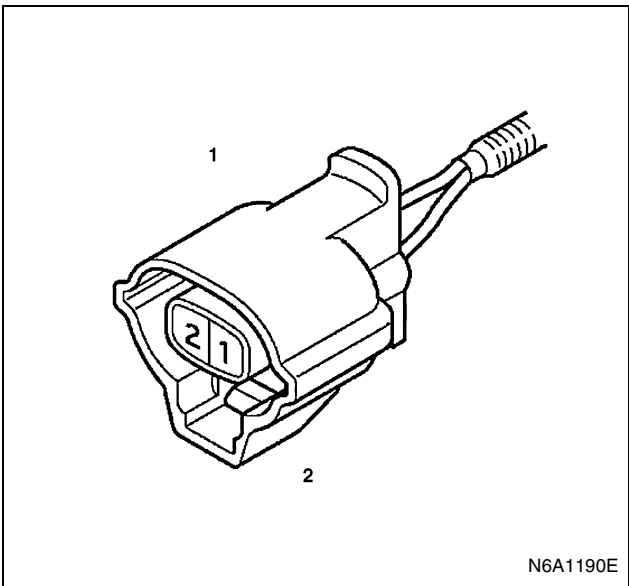


Appearance of Vacuum Switching Valve (VSV):
Exhaust Gas Recirculation (EGR) CUT and
Connector Name

VSV: EGR CUT



VSV: EGR CUT Connector

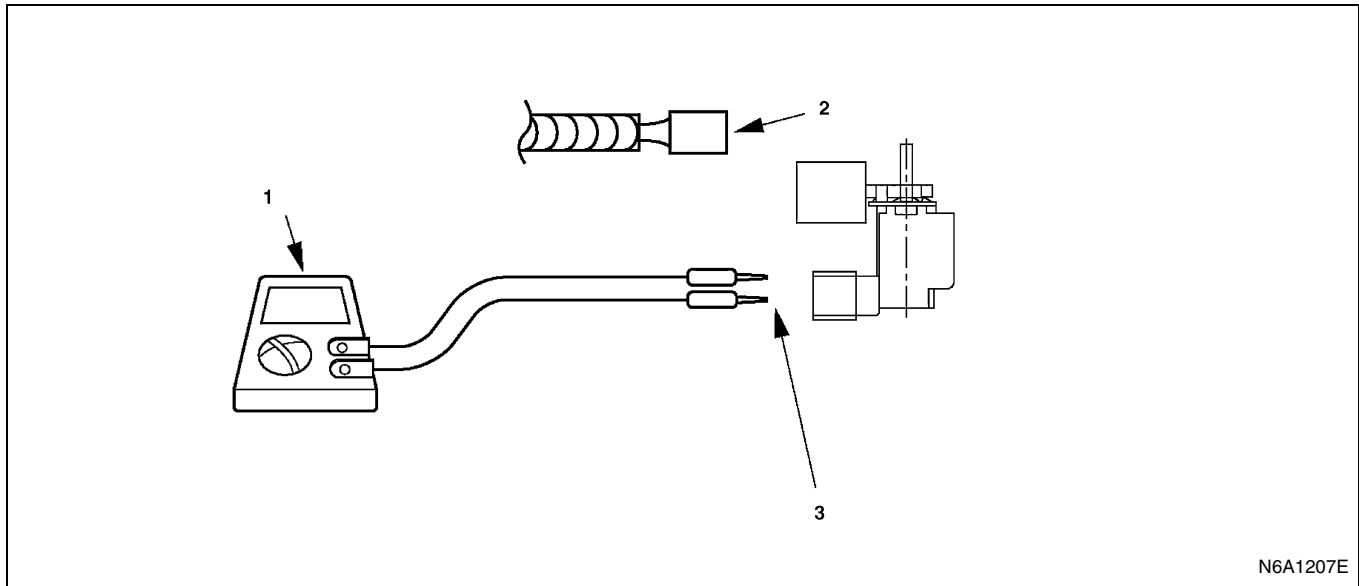


Legend

- 1. To VSV: EGR
- 2. 2 pin

Connector No	Signal
1	SIG
2	GND

Measure Resistance at VSV: EGR CUT



Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Resistance value

Inspection Point		Resistance Value (k Ω)	Reference
Connector	Pin No.		
2 pin Black	2 $\longleftrightarrow$ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG $\longleftrightarrow$ GND
	1 $\longleftrightarrow$ Body	∞	SIG $\longleftrightarrow$ Body

Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

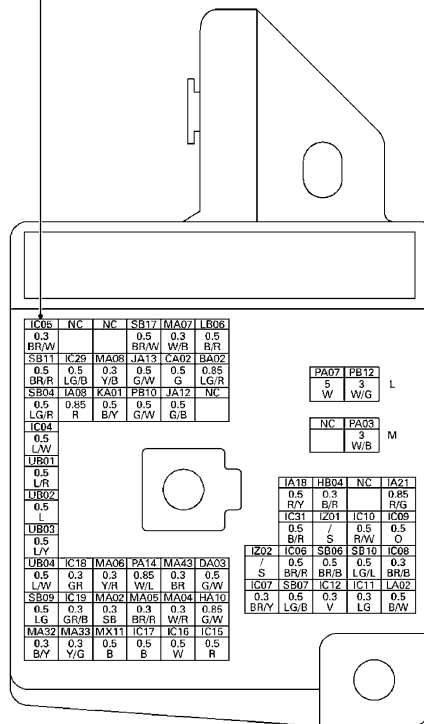
6E-88 EMISSION AND ELECTRICAL DIAGNOSIS

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the VSV from the wiring harness connector. 3. Ignition "ON" Engine "OFF" 4. Using the Digital Voltmeter (DVM), check for voltage on the "IC25" of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and "Engine Ignition." Fuse for the following condition. • A short to ground • An open circuit 2. Repair if necessary. Has DTC 35 been corrected?	—	Go to Step 8	—
4	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44 Ω (for 12 Volt) 159 — 169 Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECM and VSV connector. • A short to ground • An open circuit 4. Repair if necessary. Has DTC 35 been corrected?	—	Go to Step 8	Go to Step 7
6	Replace the VSV. Is the action complete?		Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 35 all right under Scan Tool Check?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 35 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

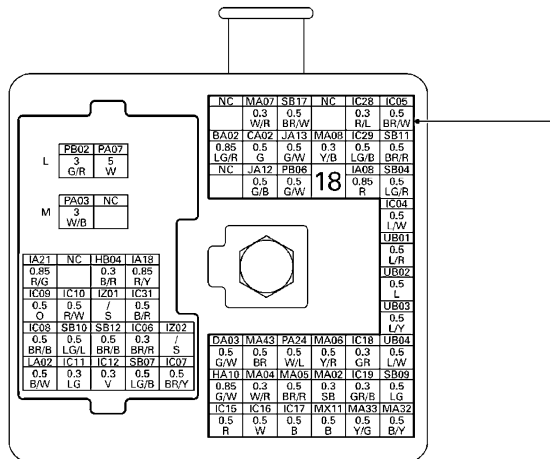
DTC-P36 Exhaust Gas Recirculation (EGR) Quick Cut Vacuum Switching Valve (VSV) Control Circuit High Voltage

ENGINE CONTROL MODULE (ECM) 22PIN

IC11	IC13	IC18	IC19	NC	NC	NC	MA19	HB04	IC05
0.3 LG	0.3 V	0.3 GR	0.3 GR/B	NC	NC	NC	0.3 O/L	0.3 B/R	0.3 BR/W
NC	NC	NC	SB18	IC03	NC	NC	NC	IC07	SB17
			0.5 LG	0.3 B/W				0.3 B/Y	0.3 BR/W

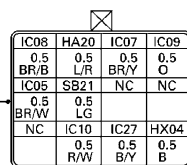


FRAME H.CONN.

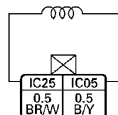
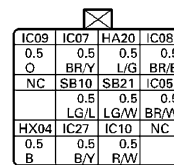


BODY HARNESS CONNECTION

FRAME HARNESS



VSV.H.CONN.

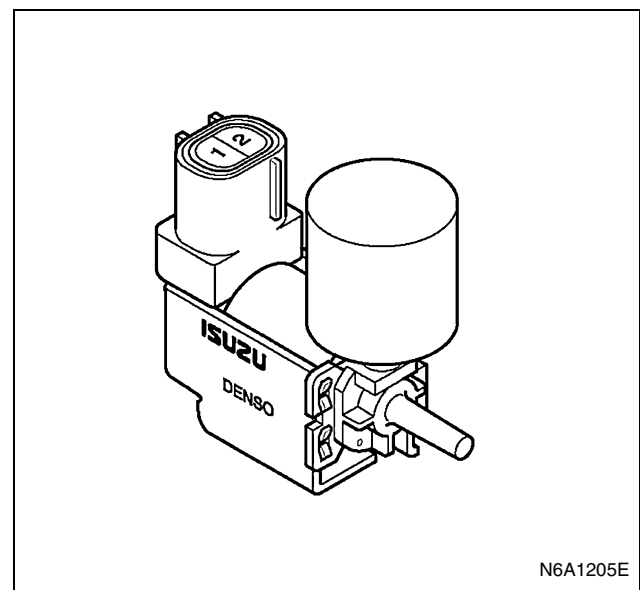


VSV:EGR CUT

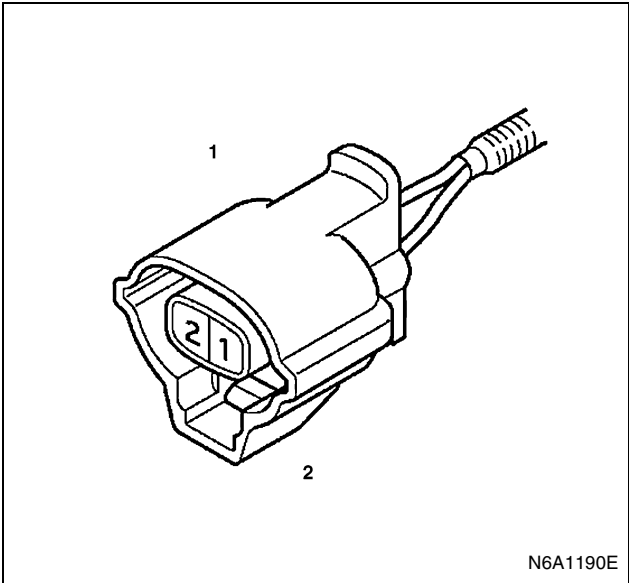


Appearance of Vacuum Switching Valve (VSV):
Exhaust Gas Recirculation (EGR) CUT Sensor
and Connector Name

VSV: EGR CUT



VSV: EGR CUT Connector

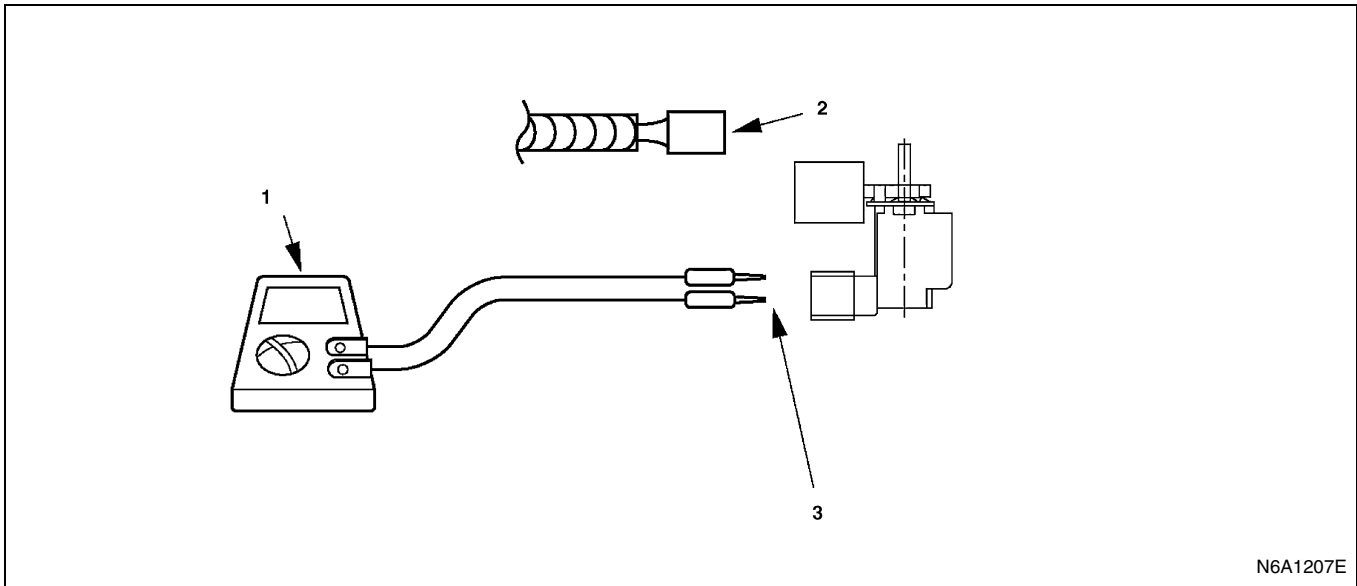


Legend

- 1. To VSV: EGR
- 2. 2 pin

Connector No	Signal
1	SIG
2	GND

Measure Resistance at VSV: EGR CUT



Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Resistance value

Inspection Point		Resistance Value (k Ω)	Reference
Connector	Pin No.		
2 pin Black	2 $\longleftrightarrow$ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG $\longleftrightarrow$ GND
	1 $\longleftrightarrow$ Body	∞	SIG $\longleftrightarrow$ Body

Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44 Ω (for 12 Volt) 159 — 169 Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector. 4. Repair if necessary. Has DTC 36 been corrected?	—	Go to Step 6	Go to Step 5
4	Replace the VSV. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 6	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 36 all right under Scan Tool Check?	—	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 36 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P41 Quick On Start (QOS) Relay Control Circuit Low Voltage

IC11	IC13	IC18	IC19	NC	NC	NC	MA19	HB04	IC05
0.3	0.3	0.3	0.3				0.3	0.3	0.3
LG	V	GR	GR/B				O/L	B/R	BR/W
NC	NC	NC	SB18	IC03	NC	NC	IC07	SB17	IC08
			0.3	0.3			0.3	0.5	0.3
			LG	B/W			BR/Y	BR/W	BR/B

ENGINE CONTROL MODULE (ECM) 22PIN

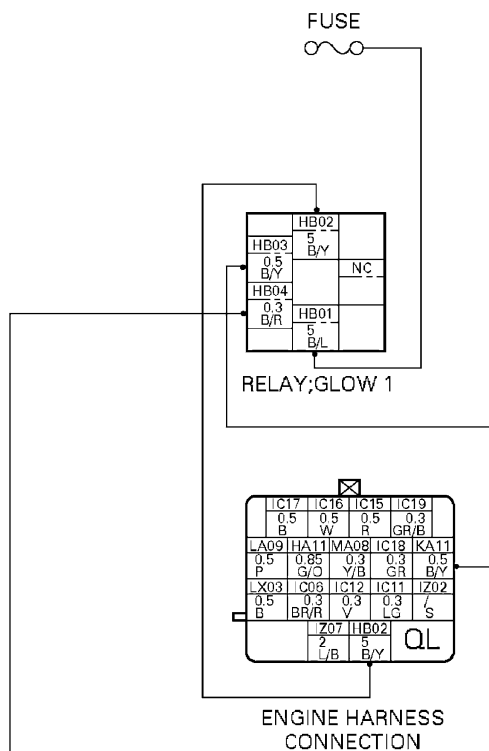
FRAME H.CONN.

IC05	NC	NC	SB17	MA07	LB06
0.3			0.5	0.3	0.5
BR/W			BR/W	W/B	B/R
SE11	IC29	MA09	JA13	CA02	EA02
0.5	0.5	0.3	0.5	0.5	0.85
BR/R	LG/B	Y/B	G/W	G	LG/R
SB04	IA08	KA01	PA10	JA12	NC
0.5	0.85	0.5	0.5	0.5	
LG/R	R	B/Y	G/W	G/B	
IC04					
0.5					
L/W					
UB01					
0.5					
L/R					
UB02					
0.5					
L					
UB03					
0.5					
I/Y					
UB04	IC18	MA06	PA14	MA43	DA03
0.5	0.3	0.3	0.85	0.3	0.5
L/W	GR	Y/R	W/L	BR	G/W
SP09	IC19	MA02	MA05	MA04	PA10
0.5	0.3	0.3	0.3	0.3	0.85
LG	GR/B	SR	BR/R	W/R	G/W
MA32	MA33	MX11	IC17	IC16	IC15
0.3	0.3	0.5	0.5	0.5	0.5
B/Y	Y/G	B	B	W	R

PA07	PA12
5	3
W	W/G

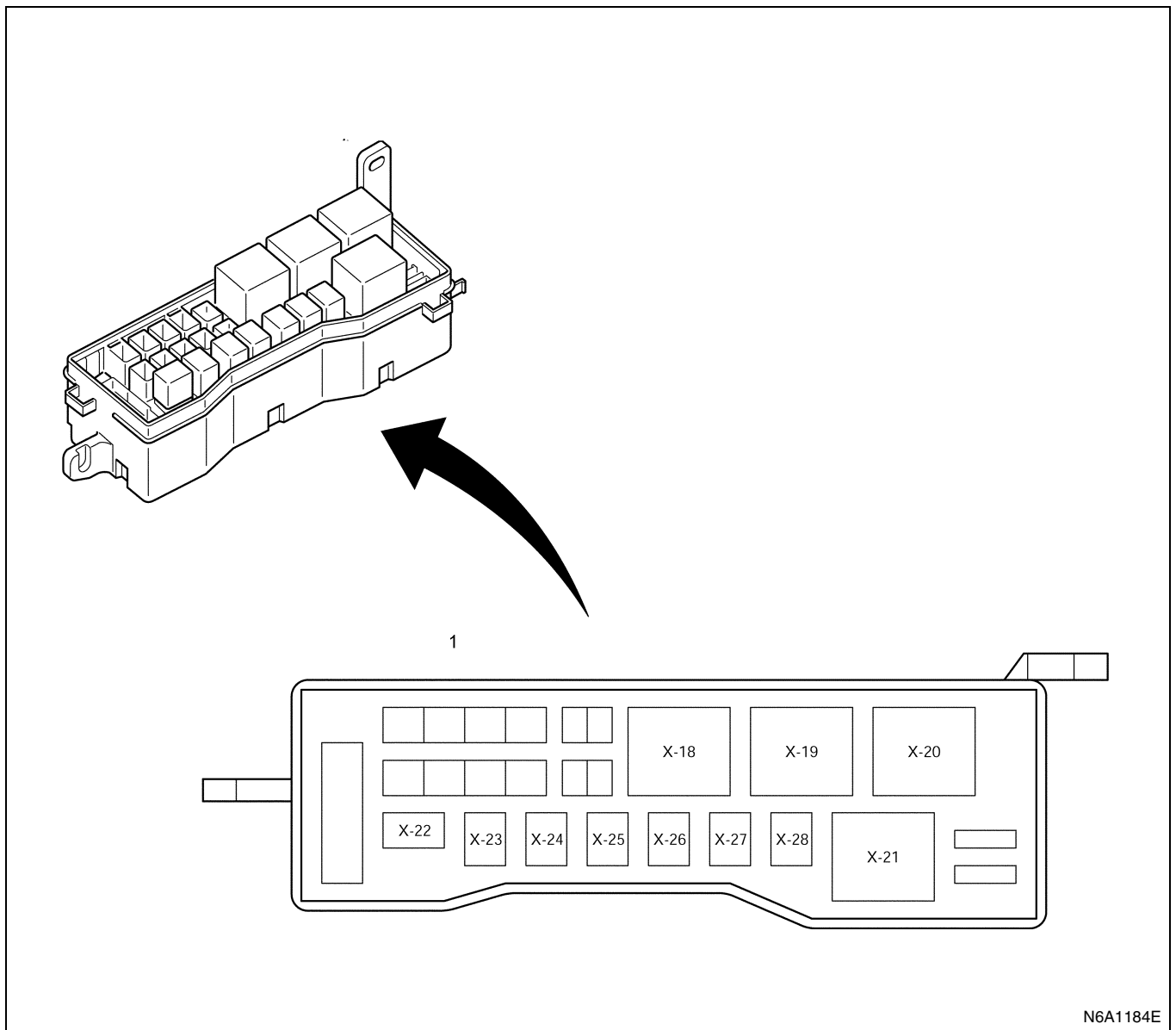
NC	PA03
	3
	W/B

IA18	HB04	NC	JA21
0.5	0.3		0.85
R/Y	B/R		R/G
IC31	IZ01	IC10	IC09
0.5	/	0.5	0.5
B/R	S	R/W	O
IZ02	IC05	SE05	SE10
/	0.5	0.5	0.3
S	BR/R	BR/B	LG/L
IC07	SE07	IC12	IC11
0.3	0.5	0.3	0.5
BR/Y	LG/B	V	LG



BODY HARNESS CONNECTION

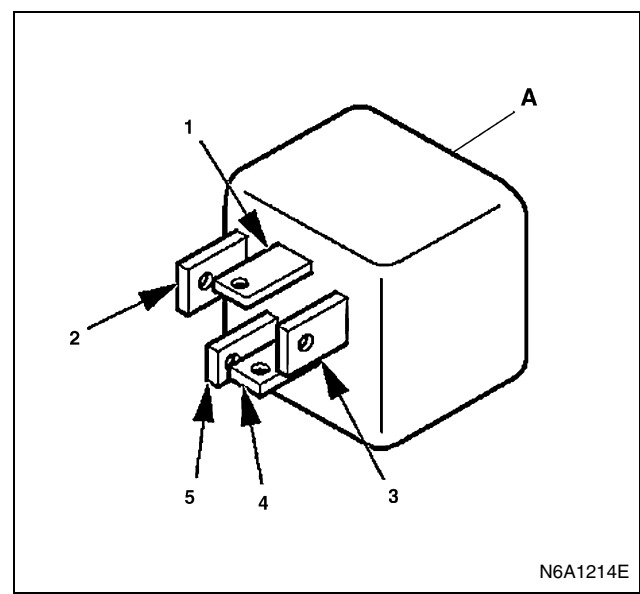
NC	MA07	SB17	NC	IC28	IC05
	0.3	0.5		0.3	0.5
	W/R	BR/W		R/L	BR/W
HA02	CA02	JA13	MA08	IC29	SB11
0.85	0.5	0.5	0.3	0.5	0.5
LG/R	G	G/W	V/B	LG/B	BR/R
NC	JA12	PA06	IA08	SB04	
	0.5	0.5	0.85	0.5	
	G/B	G/W	R	LG/R	
IC04					
0.5					
L/W					
UB01					
0.5					
L/R					
UB02					
0.5					
L					
UB03					
0.5					
I/Y					
UB04	MA03	PA21	MA09	IC18	UB04
0.5	0.5	0.5	0.5	0.3	0.5
G/W	BR	W/L	Y/R	GF	L/W
HA10	MA04	MA05	MA02	IC19	SB09
0.85	0.3	0.5	0.3	0.3	0.5
G/W	W/R	BR/R	SB	GR/B	LG
IC15	IC16	IC17	MX11	MA33	MA32
0.5	0.5	0.5	0.5	0.5	0.5
R	W	B	B	Y/G	B/Y

Location of Relay**Legend**

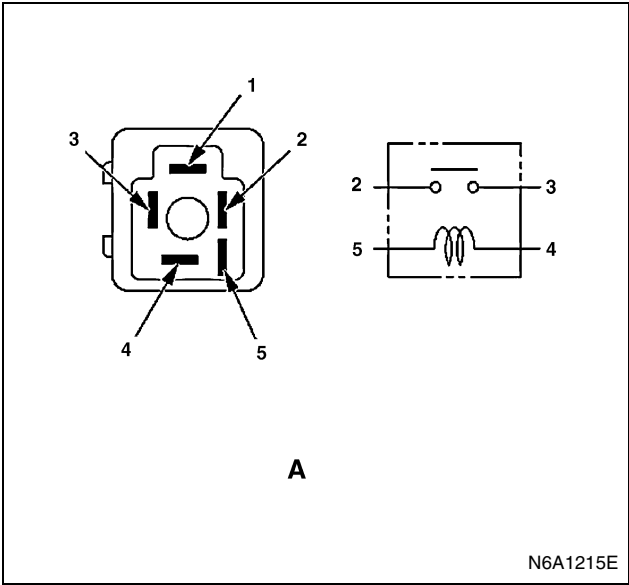
1. Relay box (Installed on the left side rear of the cab)

NO	RELAY NAME
X-20	Glow plug
X-21	Starter
X-22	Marker lamp
X-23	Rear fog
X-24	A/C COMP, 4WD ind. lamp
X-25	Exh, Brake control
X-26	CSD, A/C ON SIGNAL
X-27	Condenser fan
X-28	Exh. Brake cut

Inspection for quick on start (QOS) power cut relay



Legend
A. QOS relay



Legend
A. QOS relay

Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	4 ↔ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ↔ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the Relay from the Relay box connector. 3. Ignition "ON" Engine "OFF" 4. Using the Digital Voltmeter (DVM), check for voltage on the "HBOL" terminal of the Relay Box Connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the Relay connector. Fuse for the following condition. • A short to ground • An open circuit 2. Repair if necessary. Has DTC 41 been corrected?	—	Go to Step 8	Go to Step 4
4	Using the DVM, check the resistance of inter "4" "5" Relay terminal. Does the DVM read the following Value?	23 Ω (for 12 Volt) 100 Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECU and Relay connector. • A short to ground • An open circuit 4. Repair if necessary. Has DTC 41 been corrected?	—	Go to Step 8	Go to Step 7
6	Replace the Relay. Is the action complete?	—	Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 41 all right under Scan Tool Check?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 41 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P42 Quick On Start (QOS) Relay Control Circuit High Voltage

IC11	IC13	IC18	IC19	NC	NC	NC	NC	MA19	HB04	IC05
0.3 LG	0.3 V	0.3 GR	0.3 GR/B					0.3 O/L	0.3 B/R	0.3 BR/W
NC	NC	NC	SB18	IC03	NC	NC	NC	IC07	SB17	IC08
			0.3 LG	0.3 B/W				0.3 BR/Y	0.3 BR/W	0.3 BR/B

ENGINE CONTROL MODULE (ECM) 22PIN

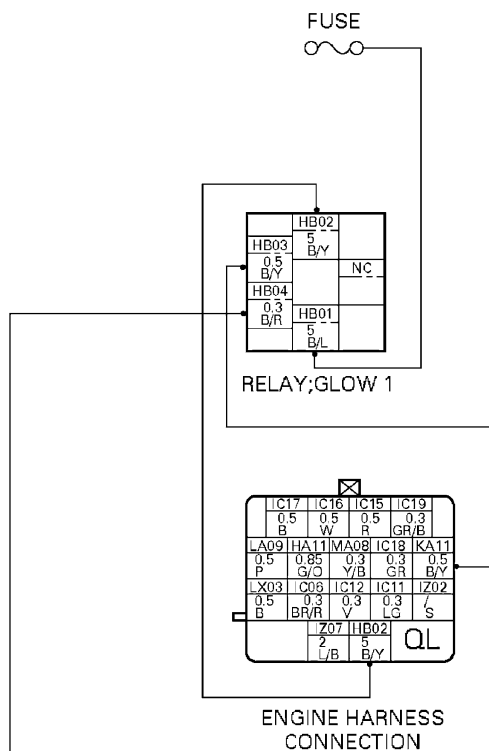
FRAME H.CONN.

IC05	NC	NC	SB17	MA07	LB06
0.3 BR/W			0.5 BR/W	0.3 W/B	0.5 B/R
SB11	IC23	MA09	JA13	CA02	EA02
0.5 BR/R	0.5 LG/B	Y/B	0.5 G/W	0.5 G	0.85 LG/R
SB04	IC08	KA01	PA10	JA12	NC
0.5 LG/R	0.85 R	0.5 B/Y	0.5 G/W	0.5 G/B	
IC04	0.5 L/W				
UB01	0.5 L/R				
UB02	0.5 L				
UB03	0.5 I/Y				
UB04	IC18	MA06	PA14	MA43	DA03
0.5 L/W	0.3 GR	0.3 Y/R	0.85 WL	0.3 BR	0.5 G/W
SP09	IC19	MA02	MA05	MA04	PA10
0.5 LG	0.3 GR/B	SR	0.3 BR/R	0.3 W/R	0.85 G/W
MA32	MA33	MX11	IC17	IC16	IC15
0.3 B/Y	0.3 Y/G	0.5 B	0.5 B	0.5 W	0.5 R

PA07	PA12
5	3
W	W/G

NC	PA03
	3
	W/B

IA18	HB04	NC	JA21
0.5 R/Y	0.3 B/R		0.85 R/G
IC31	IZ01	IC10	IC09
0.5 B/R	/	0.5 S	0.5 O
IZ02	IC05	SE05	SE10
/	0.5 S	0.5 BR/R	0.5 LG/L
IC07	SE07	IC12	IC11
0.3 BR/Y	0.5 LG/B	0.3 V	0.3 LG

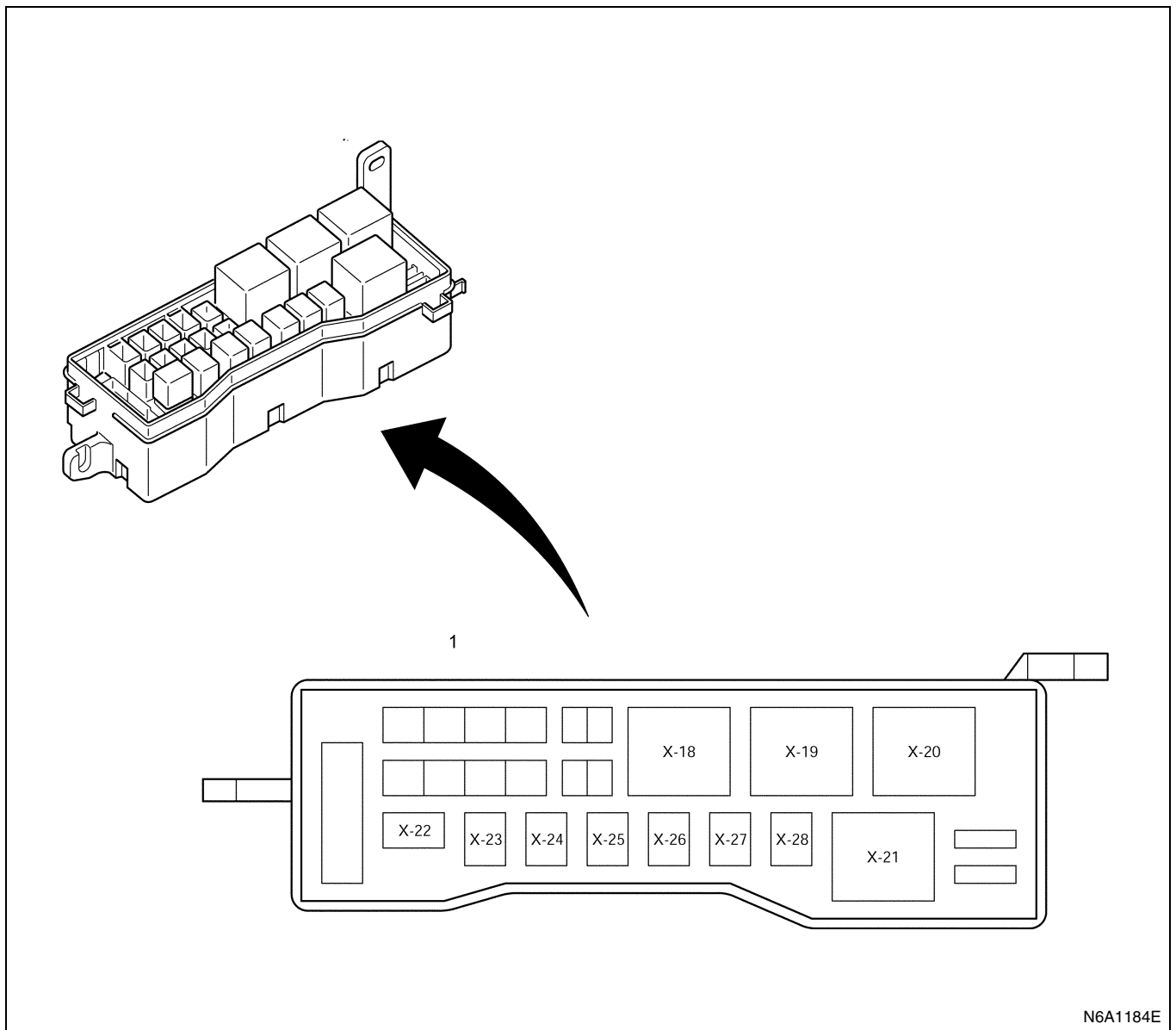


BODY HARNESS CONNECTION

NC	MA07	SB17	NC	IC28	IC05
0.3 W/R	0.5 BR/W	0.3 R/L	0.3 R/L	0.3 BR/W	0.5 BR/W
HA02	CA02	JA13	MA08	IC29	SB11
0.85 LG/R	0.5 G	0.5 G/W	0.3 LG/B	0.5 BR/R	0.5 LG/R
NC	JA12	PA06	JA08	SB04	0.5 LG/R
	0.5 G/B	0.5 G/W	0.85 R		
IC04	0.5 L/W				
UB01	0.5 L/R				
UB02	0.5 L				
UB03	0.5 I/Y				
UB04	IC18	MA06	PA14	MA43	DA03
0.5 L/W	0.3 GR	0.3 Y/R	0.85 WL	0.3 BR	0.5 G/W
SP09	IC19	MA02	MA05	MA04	PA10
0.5 LG	0.3 GR/B	SR	0.3 BR/R	0.3 W/R	0.85 G/W
MA32	MA33	MX11	IC17	IC16	IC15
0.3 B/Y	0.3 Y/G	0.5 B	0.5 B	0.5 W	0.5 R

IA21	NC	HB04	IA18
0.85 R/G		0.3 B/R	0.85 R/Y
IC09	IC10	IZ01	IC31
0.5 O	0.5 R/W	/	0.5 S
IC08	SE10	SE12	IC06
0.5 BR/B	0.5 LG/L	0.5 BR/B	0.5 BR/R
LA02	IC11	IC12	SE07
0.5 B/W	0.3 LG	0.3 V	0.5 LG/B

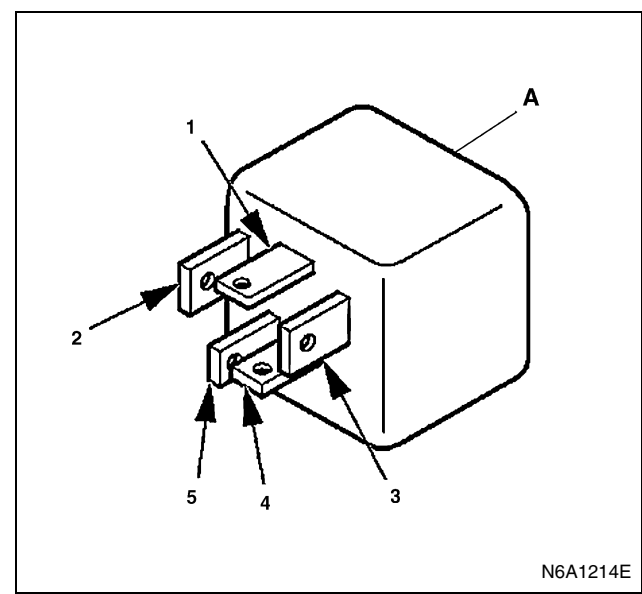
IA03	MA03	PA21	MA09	IC18	UB04
0.5 G/W	0.5 BR	0.5 WL	0.3 Y/R	0.3 GR	0.5 L/W
HA10	MA04	MA05	MA02	IC19	SP09
0.85 G/W	0.3 W/R	0.3 BR/R	0.3 SB	0.3 GR/B	0.5 LG
IC15	IC16	IC17	MX11	MA33	MA32
0.5 R	0.5 W	0.5 B	0.5 B	0.5 Y/G	0.5 B/Y

Location of Relay**Legend**

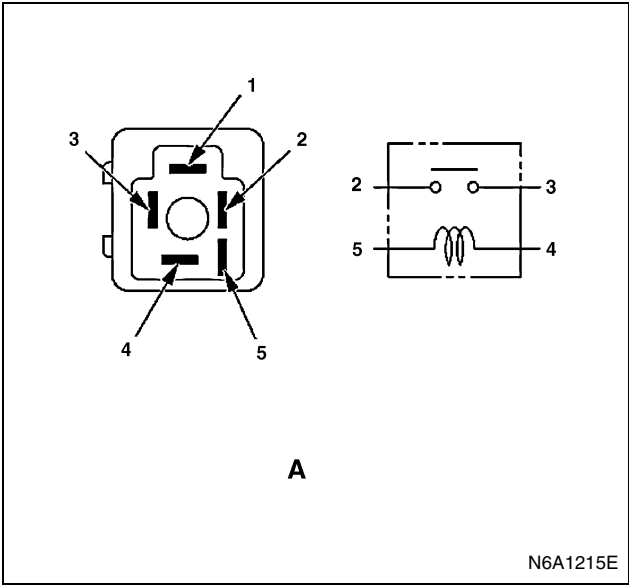
1. Relay box (Installed on the left side rear of the cab)

NO	RELAY NAME
X-20	Glow plug
X-21	Starter
X-22	Marker lamp
X-23	Rear fog
X-24	A/C COMP, 4WD ind. lamp
X-25	Exh, Brake control
X-26	CSD, A/C ON SIGNAL
X-27	Condenser fan
X-28	Exh. Brake cut

Inspection for quick on start (QOS) power cut relay



Legend
A. QOS relay



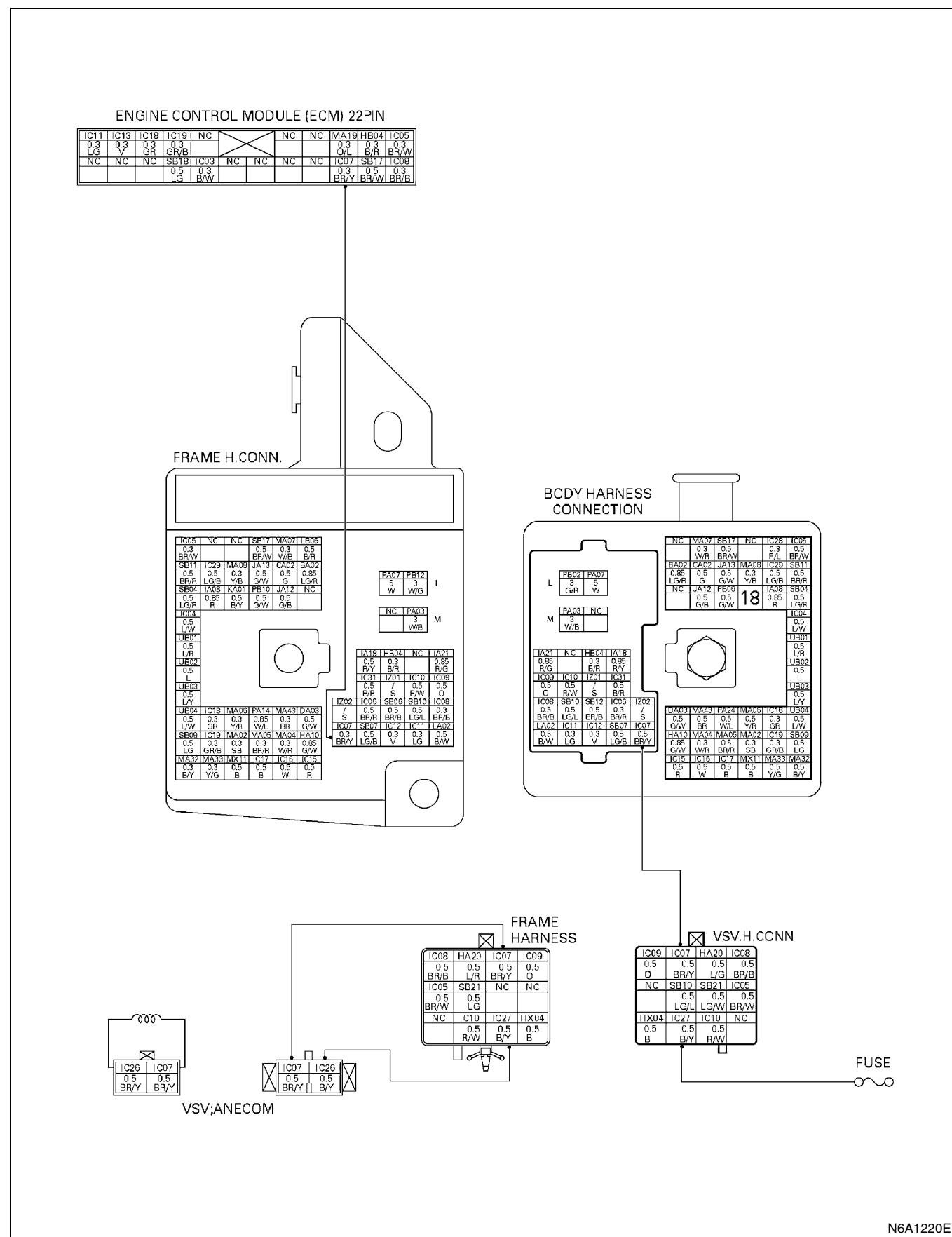
Legend
A. QOS relay

Resistance value

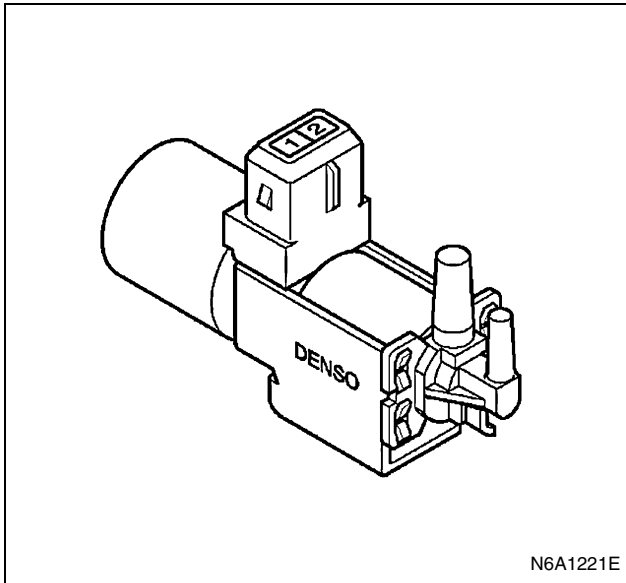
Inspection Point		Resistance	Reference
Inspection relay unit	4 ↔ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ↔ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF", with scan tool disconnected. 2. Disconnect the Relay solenoid switch from the Relay box. 3. Apply a circuit tester with the voltage range or a test light to the output circuit for the Relay. 4. Ignition "ON", Engine "OFF". Is voltage as prescribed, or is test Light lit until 18 seconds?	$\geq 8V$ or light "ON" (for 12 Volt) $\geq 16V$ or light "ON" (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of Relay circuit between the ECM and Relay connector. 4. Repair if necessary. Has DTC 42 been corrected?	—	Go to Step 6	Go to Step 5
4	Replace the VSV. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 6	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 42 all right under Scan Tool Check?	—	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 42 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

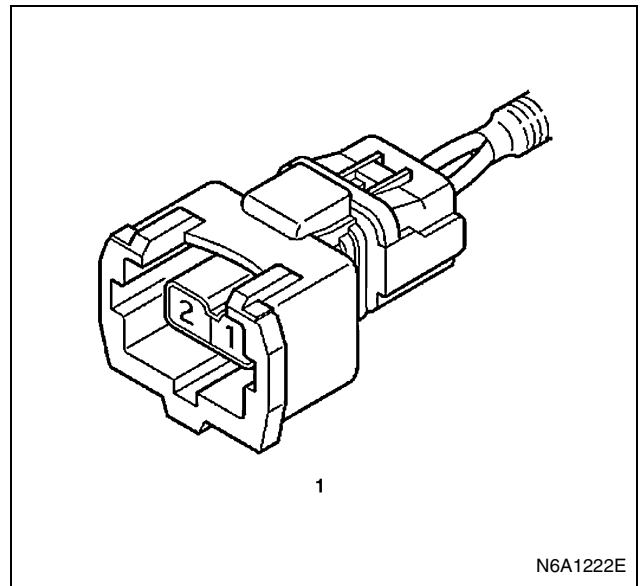
DTC-P43 Aneroid Compensator Vacuum Switching Valve (VSV) Control Circuit Low Voltage



**Appearance of Vacuum Switching Valve (VSV):
Aneroid Compensator and Connector Name**
VSV: Aneroid Compensator



VSV: Aneroid Compensator

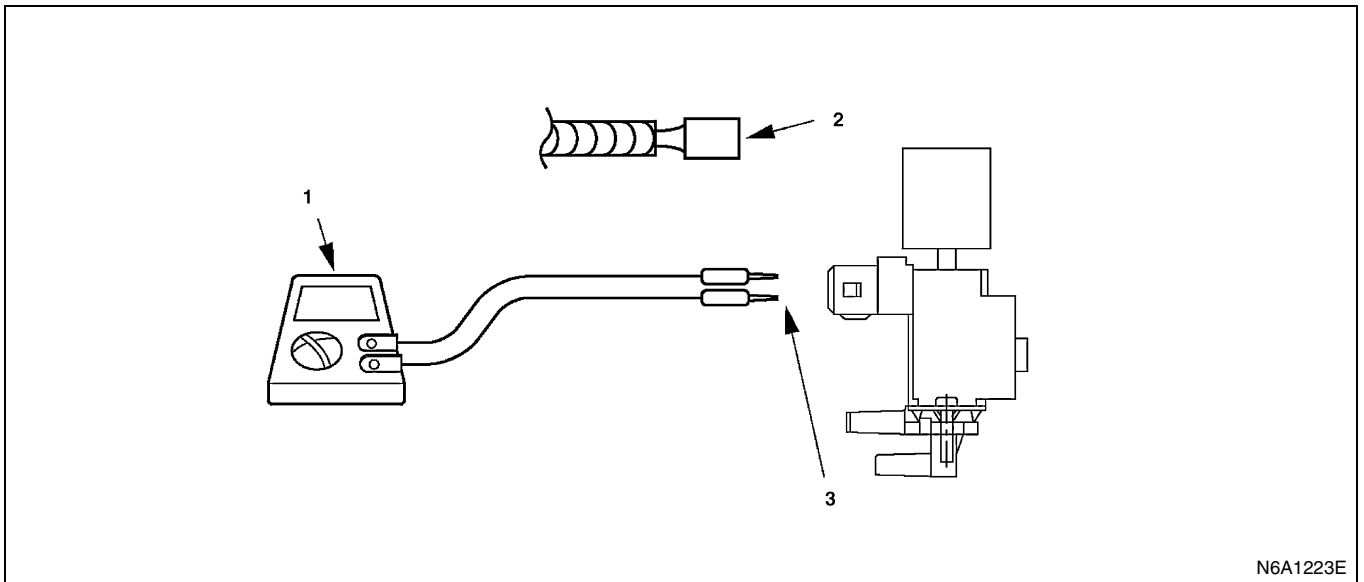


Legend

1. 2 pin

Connector No	Signal
1	SIG
2	GND

Measure Resistance at VSV Aneroid Compensator



Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

6E-102 EMISSION AND ELECTRICAL DIAGNOSIS

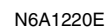
Resistance value

Inspection Point		Resistance Value (k Ω)	Reference
Connector	Pin No.		
2 pin Gray	2 $\longleftrightarrow$ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG $\longleftrightarrow$ GND
	1 $\longleftrightarrow$ Body	∞	SIG $\longleftrightarrow$ Body

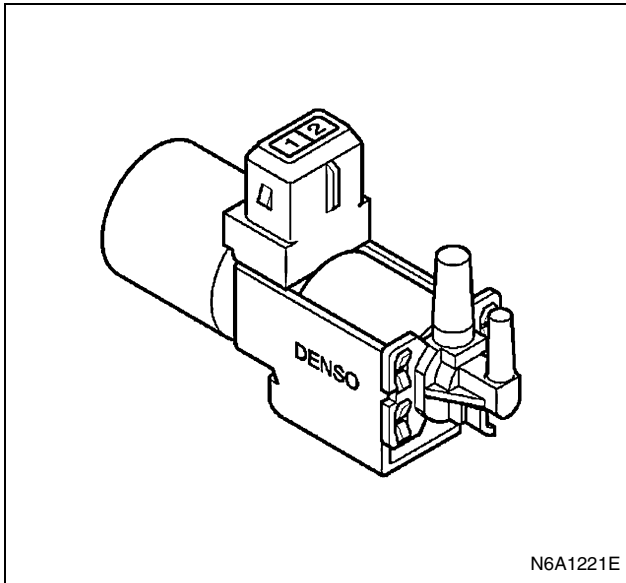
Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

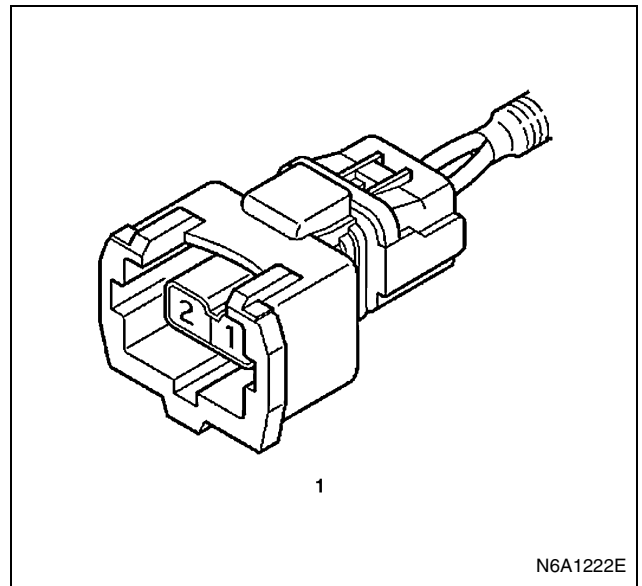
Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	1. Ignition "OFF" 2. Disconnect the VSV from the wiring harness connector. 3. Ignition "ON" Engine "OFF" 4. Using the Digital Voltmeter (DVM), check for voltage on the "IC26" of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and "Engine Ignition." Fuse for the following condition. • A short to ground • An open circuit 2. Repair if necessary. Has DTC 43 been corrected?	—	Go to Step 8	Go to Step 4
4	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44 Ω (for 12 Volt) 159 — 169 Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECM and VSV connector. • A short to ground • An open circuit 4. Repair if necessary. Has DTC 43 been corrected?	—	Go to Step 8	Go to Step 7
6	Replace the VSV. Is the action complete?	—	Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 9	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 43 all right under Scan Tool Check?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 43 displayed by scan tool?	—	Go to trouble code section	Trouble code clear



**Appearance of Vacuum Switching Valve (VSV):
Aneroid Compensator and Connector Name**
VSV: Aneroid Compensator



VSV: Aneroid Compensator

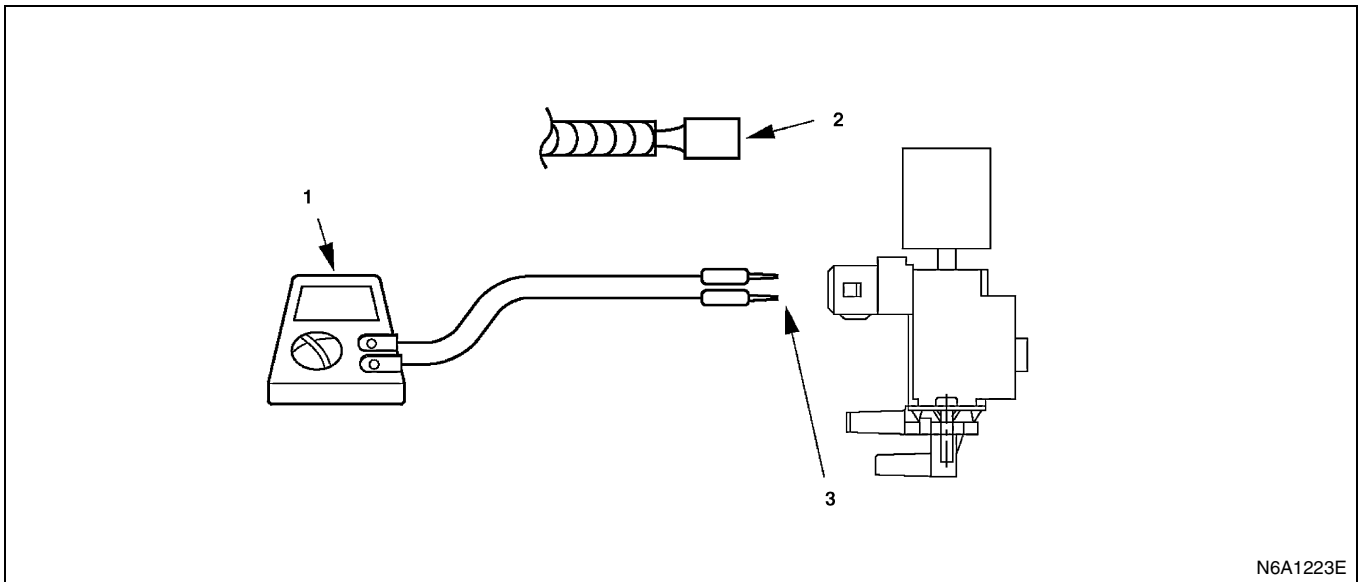


Legend

1. 2 pin

Connector No	Signal
1	SIG
2	GND

Measure Resistance at VSV Aneroid Compensator



Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

6E-106 EMISSION AND ELECTRICAL DIAGNOSIS

Resistance value

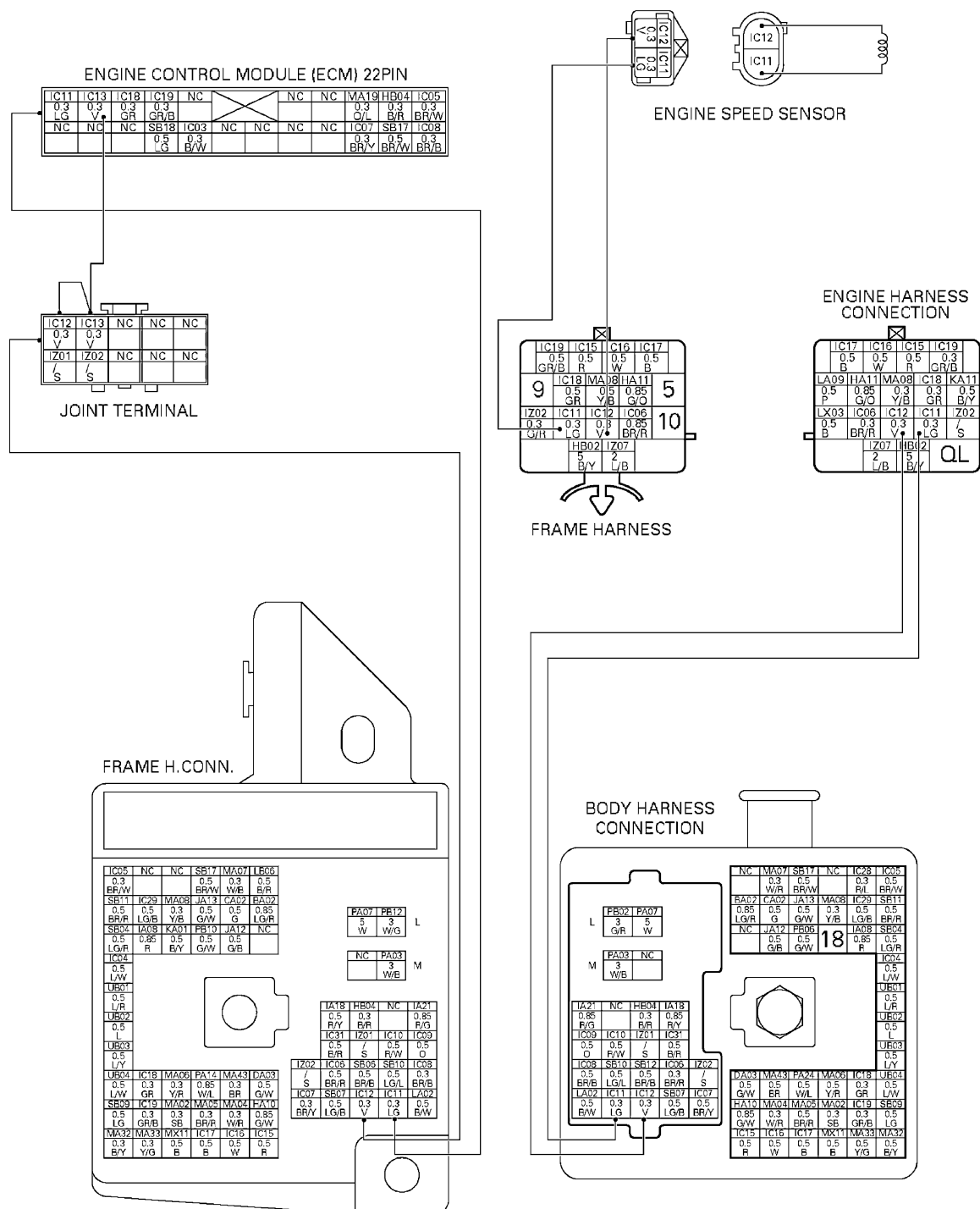
Inspection Point		Resistance Value (k Ω)	Reference
Connector	Pin No.		
2 pin Green	2 $\longleftrightarrow$ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG $\longleftrightarrow$ GND
	1 $\longleftrightarrow$ Body	∞	SIG $\longleftrightarrow$ Body

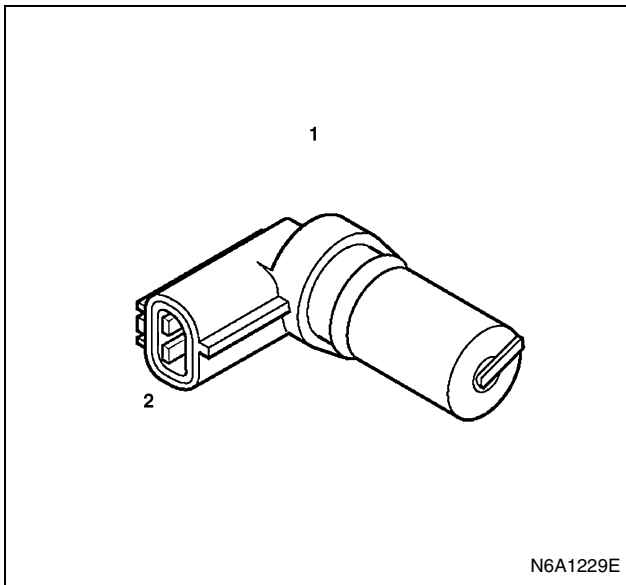
Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

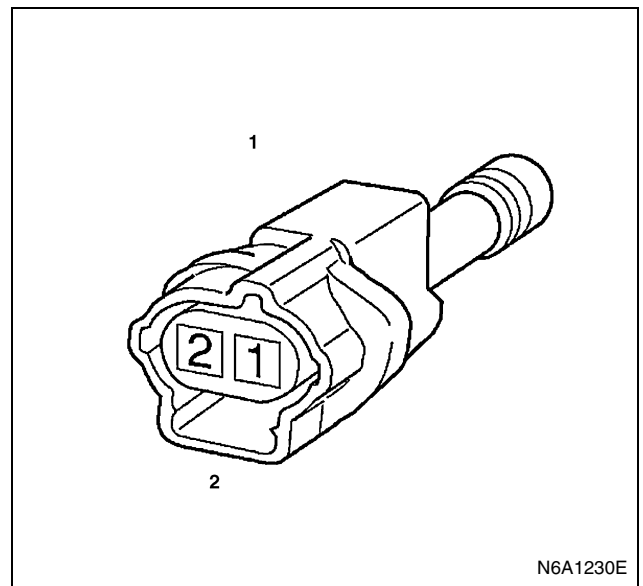
Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44 Ω (for 12 Volt) 159 — 169 Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector. 4. Repair if necessary. 5. Clear trouble code by Scan Tool. 6. Ignition "ON" Engine "ON". Does the MIL blink?	—	Go to Step 6	Go to Step 5
4	Replace the VSV. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 7	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF". Clear trouble code by Scan Tool. 3. Ignition "ON" Engine "ON". Does the MIL blink?	—	Go to Step 7	Go to Step 2
7	Connect Scan Tool. Is any current trouble other than DTC 44 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P45 Engine Speed Sensor Circuit Low Voltage



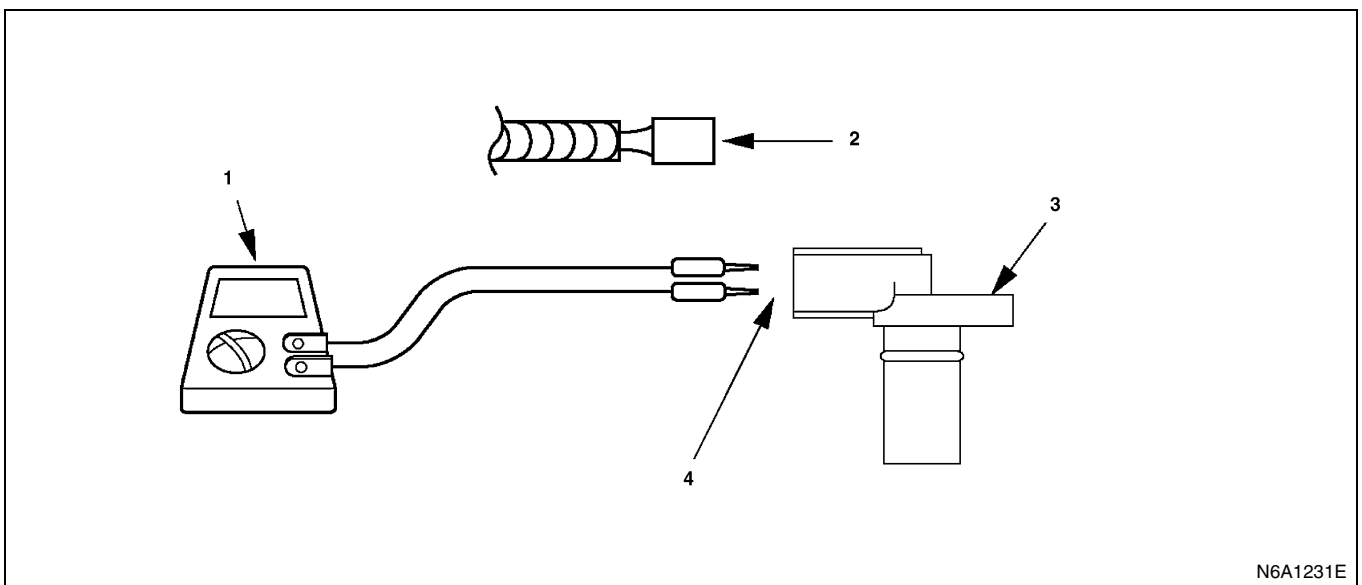
Appearance of Engine Speed Sensor and Connector Name**Engine Speed Sensor****Legend**

- 1. To engine speed sensor
- 2. 2 pin

Engine Speed Sensor Connector**Legend**

- 1. To engine speed sensor
- 2. 2 pin

Connector No	Signal
1	GND
2	SIG

Measure Resistance at Engine Speed Sensor**Legend**

- 1. Circuit tester
- 2. Remove engine wire harness
- 3. Engine speed sensor
- 4. Measure resistance between connector pin

Caution:

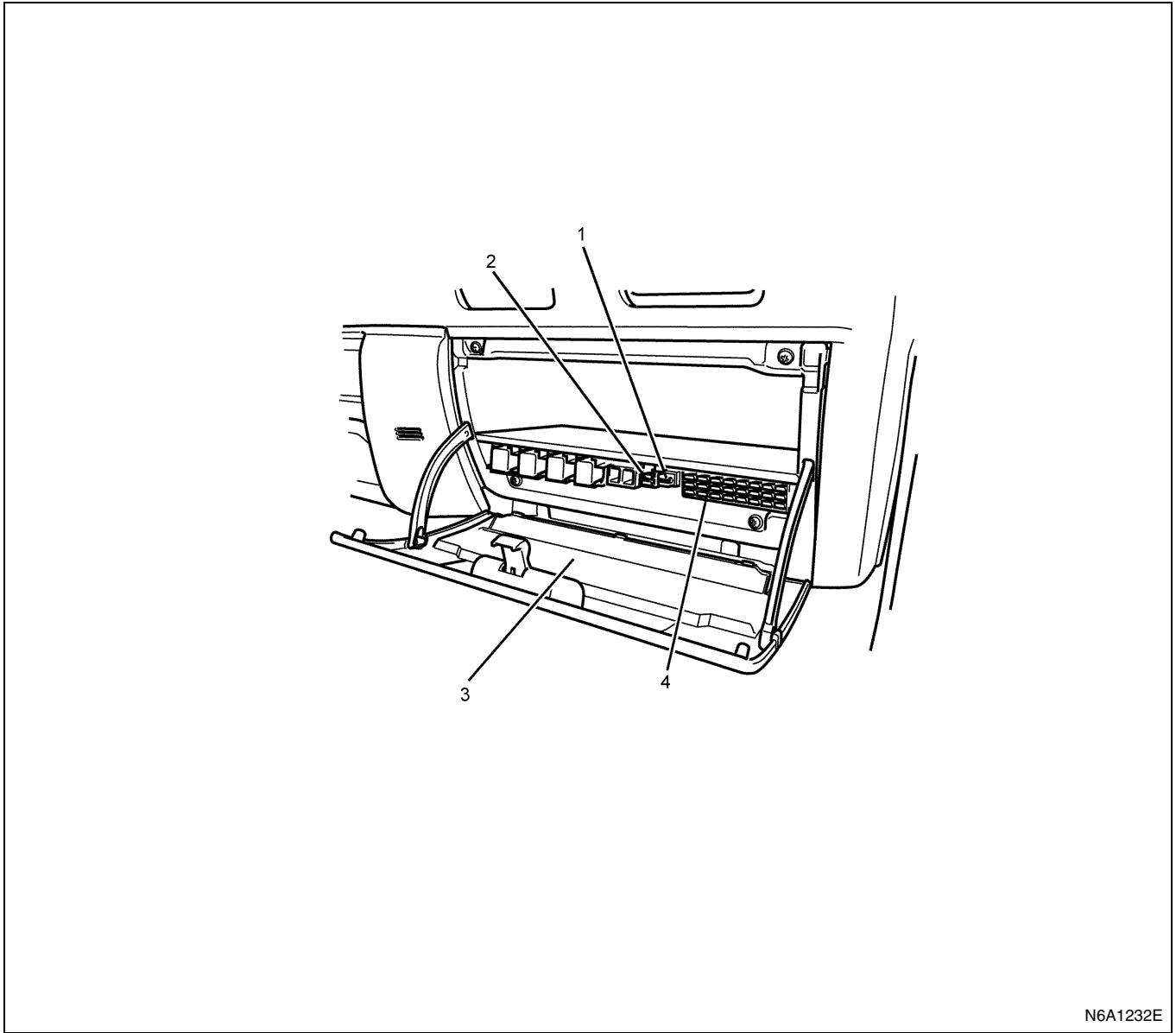
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ↔ 1	840±20%	SIG ↔ GND
	2 ↔ Body	∞	SIG ↔ Body

Notice:
Resistance value is difference according to the engine temperature (condition of engine warming up).

Location of Fuse



N6A1232E

Legend

1. Fuse puller

2. Spare fuses
3. Label

4. Fuses (F-1 — F-24)

Step	Action	Value	YES	NO
1	1. Ignition "ON", Engine "OFF" 2. Connect a voltmeter to the ECM connector terminals (ENGINE+) and (ENGINE-) Is the voltage 0V?	—	Go to Step 3	Go to Step 5
2	1. Ignition "ON", Engine "ON" 2. Connect a voltmeter to the ECM connector terminals (ENGINE+) and (ENGINE-). Is the voltage under the range of 0 — 1V (AC intermittently) when the engine speed is about 2000RPM? Does the Voltage increase as the engine speed is increased?	—	Go to Step 4	Go to Step 6
3	Check for poor sensor ground or sensor signal circuit terminal connection and terminal shorted at the ECM and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	—	Go to Step 8	Go to Step 4
4	1. Check sensor signal circuit for disconnection and power source for short. 2. Check sensor GND circuit for disconnection and power source for short. 3. Repair if necessary. Was repair needed?	—	Go to Step 8	Go to Step 5
5	1. Check signal circuit for GND short. 2. Repair if necessary. Was repair needed?	—	Go to Step 8	Go to Step 7
6	Replace the sensor. Is the action complete?	—	Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" 3. Connect the Scan Tool. 4. Ignition "ON" Engine "OFF" 5. Make Scan Tool indicate engine speed. Is a speed range of 700 rpm to 900 rpm indicated with the engine idling (accel. off)? And as engine speed rises with accel. on, does the indicated value rise?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 45 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P52 Electronically Erasable Programmable Read Only Memory (EEPROM) Error

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	Replace the ECM. Is the action complete?	—	Go to Step 3	—
3	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 52 all right under Scan Tool Check?	—	Go to Step 4	Go to Step 2
4	Is any current trouble other than DTC 52 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-P61 Barometric Pressure Sensor Circuit Error

Step	Action	Value	YES	NO
1	Was the "on-board diagnostic (OBD) system check" performed?	—	Go to Step 2	Go to self diag system check
2	Replace the ECM. Is the action complete?	—	Go to Step 3	—
3	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 61 all right under Scan Tool Check?	—	Go to Step 4	Go to Step 2
4	Is any current trouble other than DTC 61 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

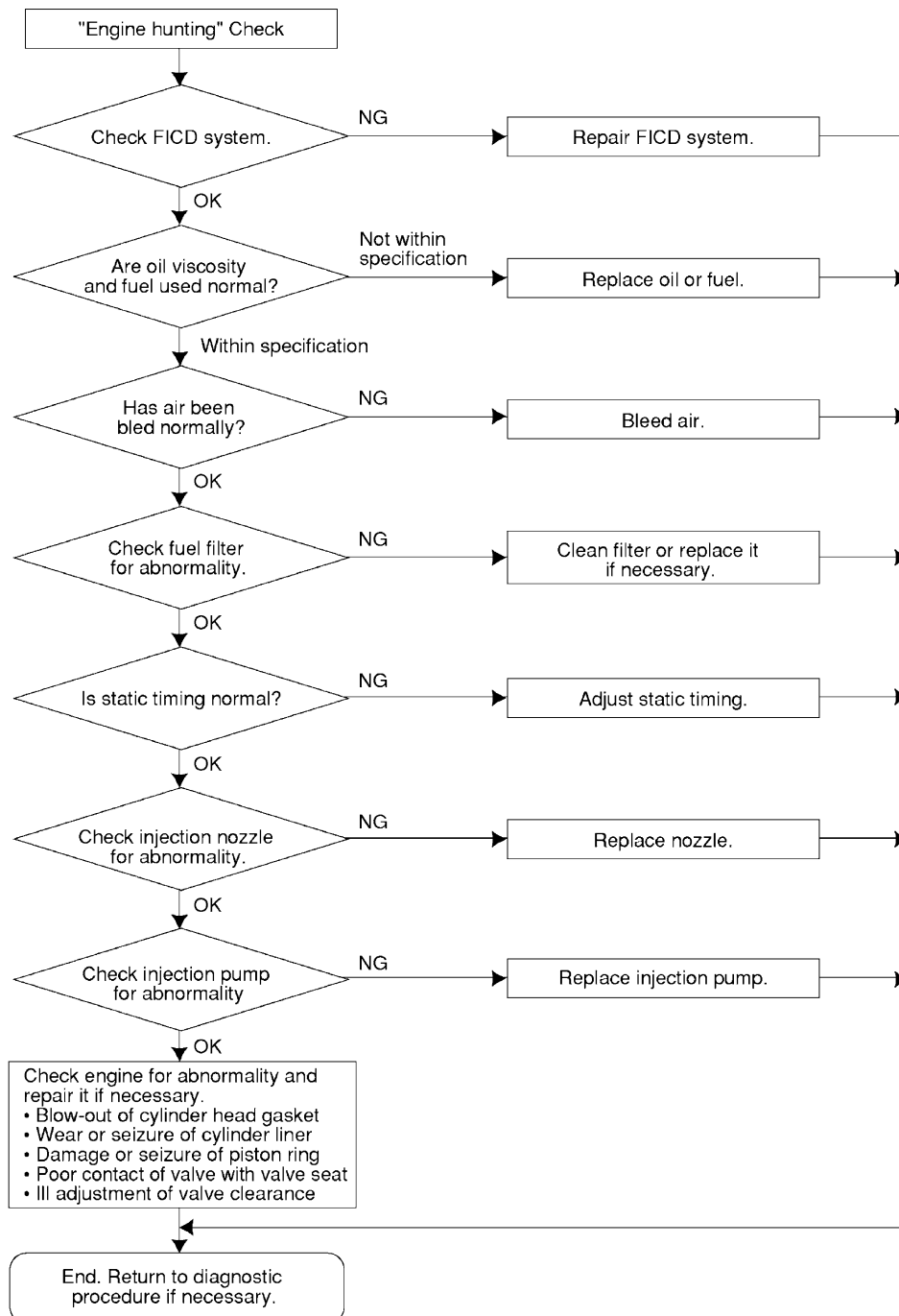
WITHOUT DIAGNOSIS TROUBLE CODE

Introduction

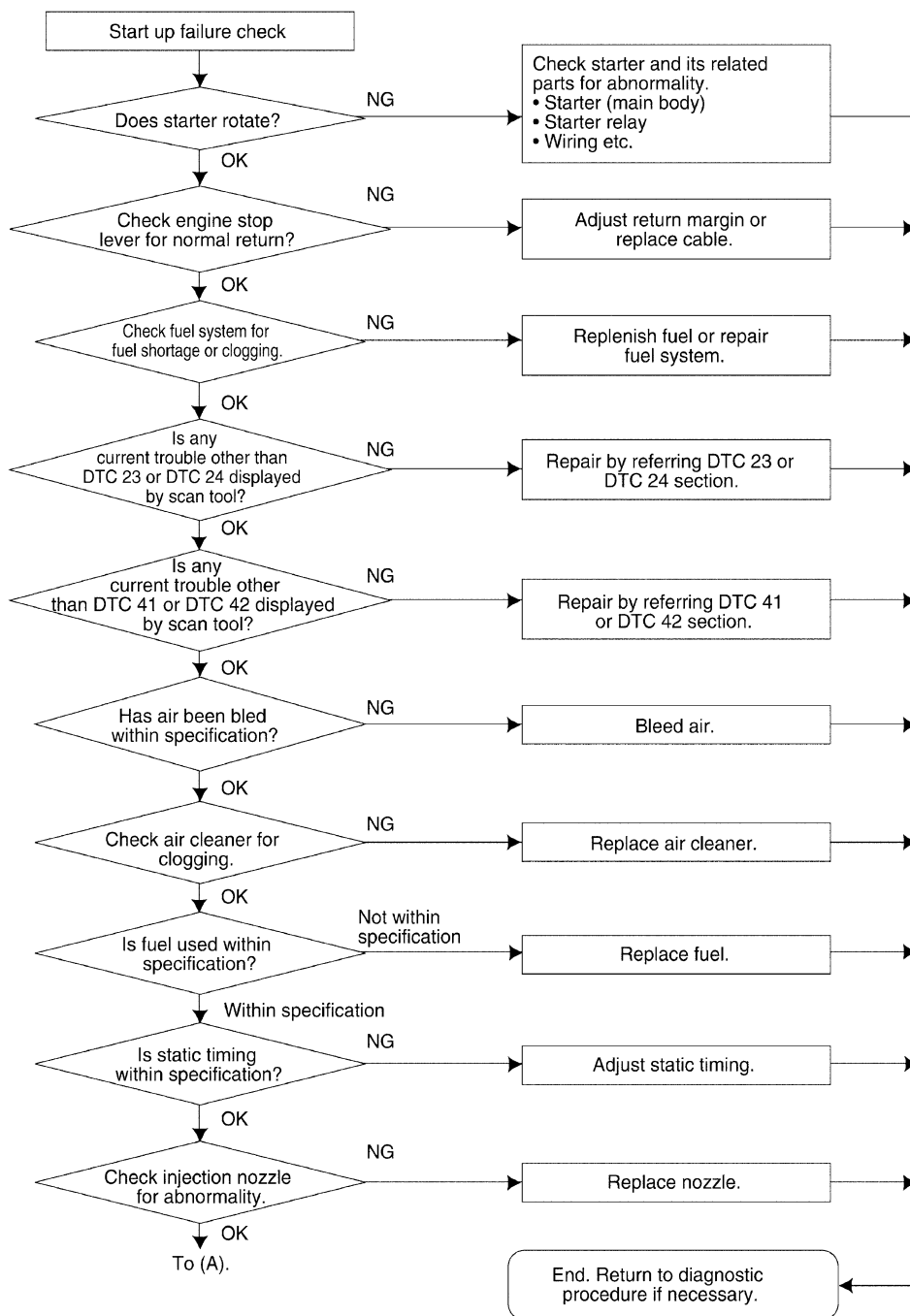
If there occurs a malfunction although no Diagnostic Trouble Code (DTC) is generated, then inspect and repair the system in accordance with the flowcharts given on the following pages.

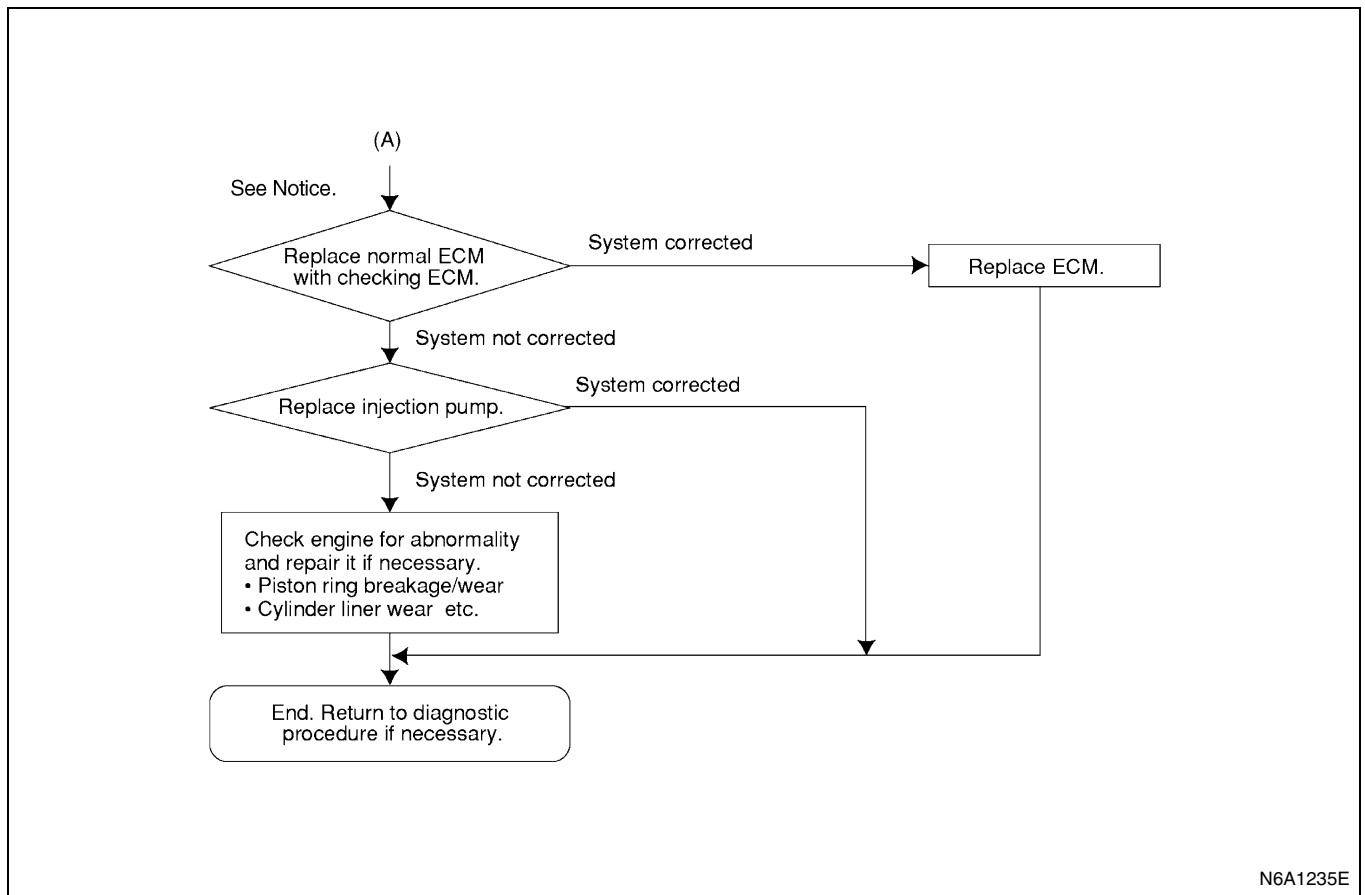
When a Diagnostic Trouble Code (DTC) is produced, inspect and repair system with reference to "EMISSION AND ELECTRICAL DIAGNOSIS".

Engine Hunting

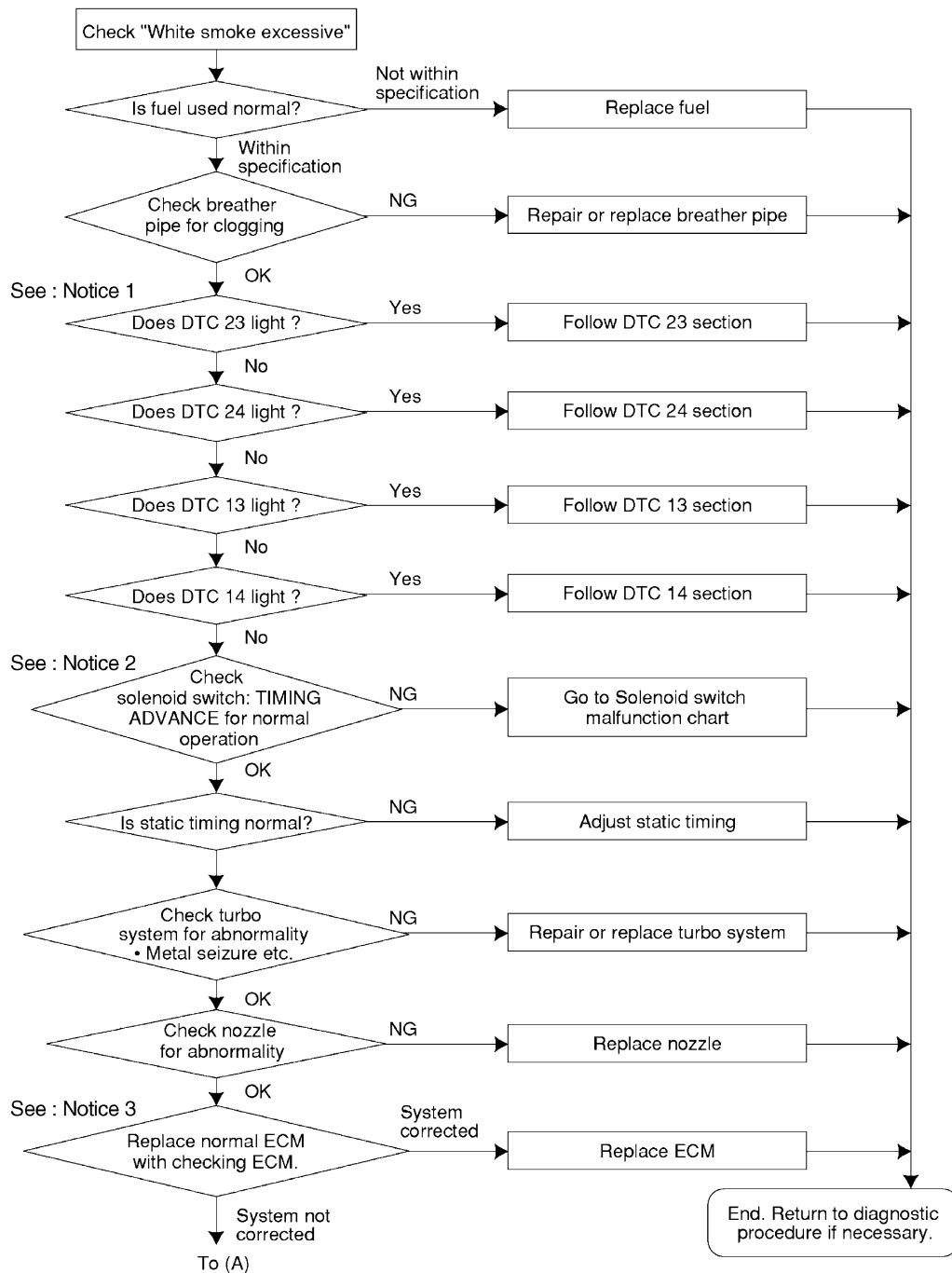


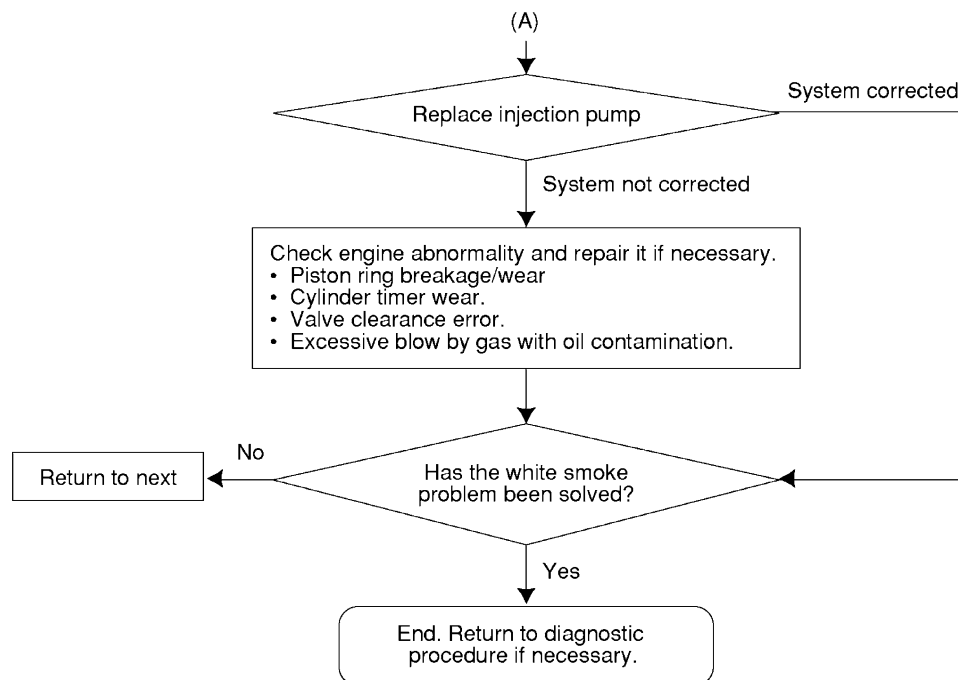
Startup Failure



**Notice:**

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

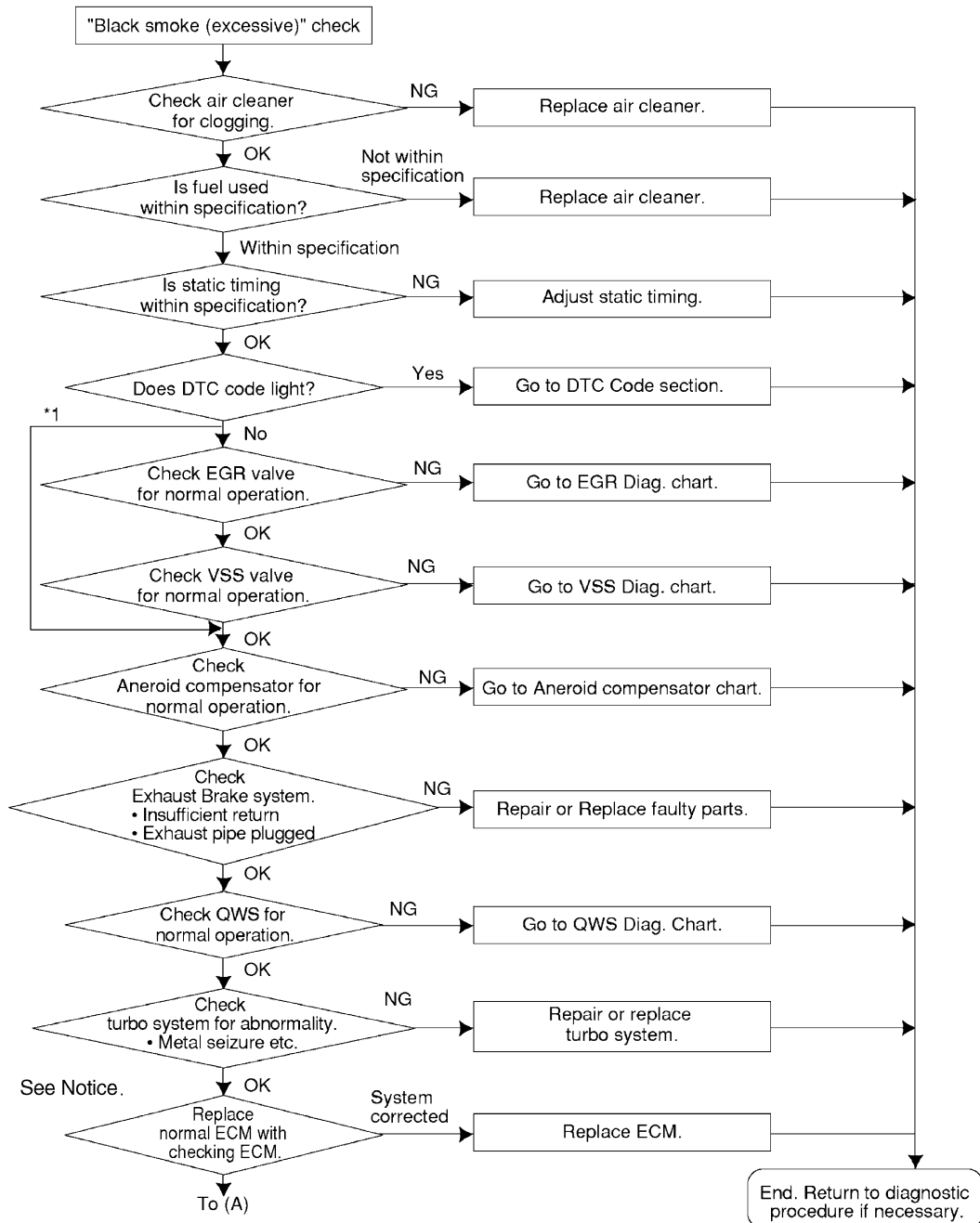
White Smoke (Excessive)

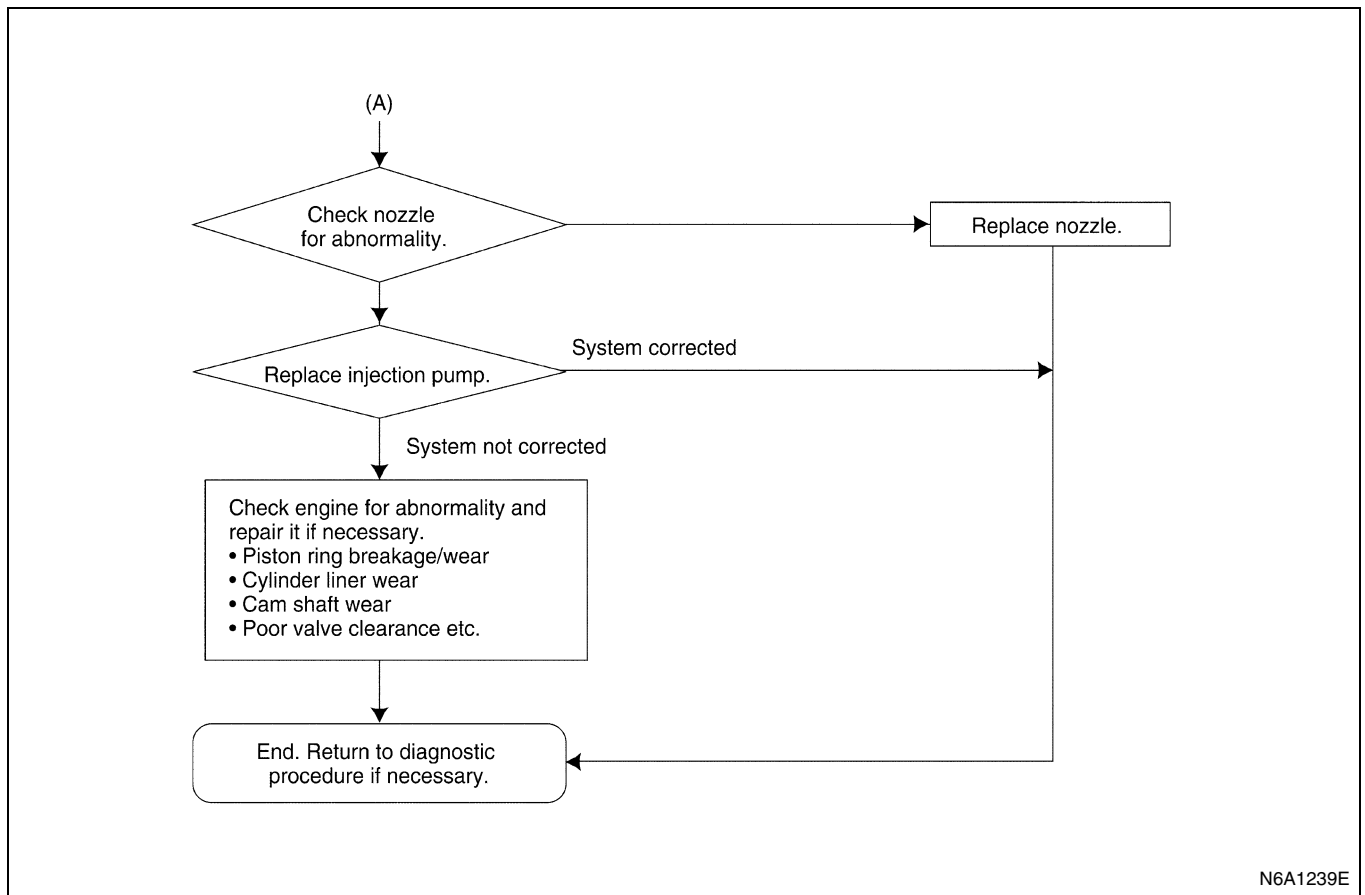


N6A1237E

Notice:

1. "Follow (DTC-13, 14, 23, 24)" means to refer "Workshop Manual EMISSION AND ELECTRICAL DIAGNOSIS 4HE1 6E Section of Diagnosis Trouble Code (DTC-13, 14, 23, 24)" for other DTC code, follow concerned DTC sections.
2. Turn the ignition key from the "OFF" position to the "ON" position to put on the solenoid switch attached to the injection pump. After the solenoid switch being on for 18 consecutive seconds, check from the outside of the vehicle if the release sound of the solenoid switch is heard.
3. The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

Black Smoke (Excessive)

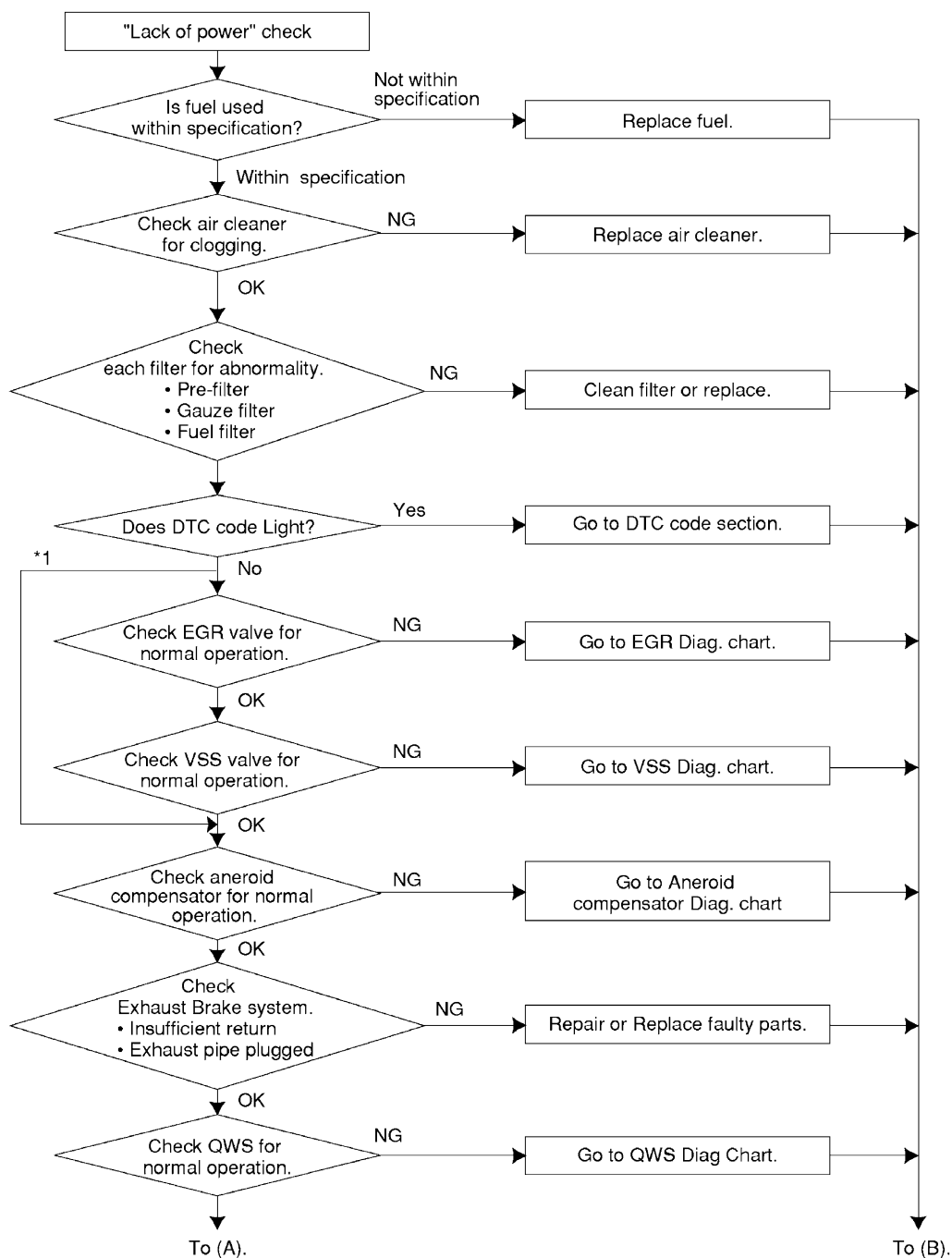
**Notice:**

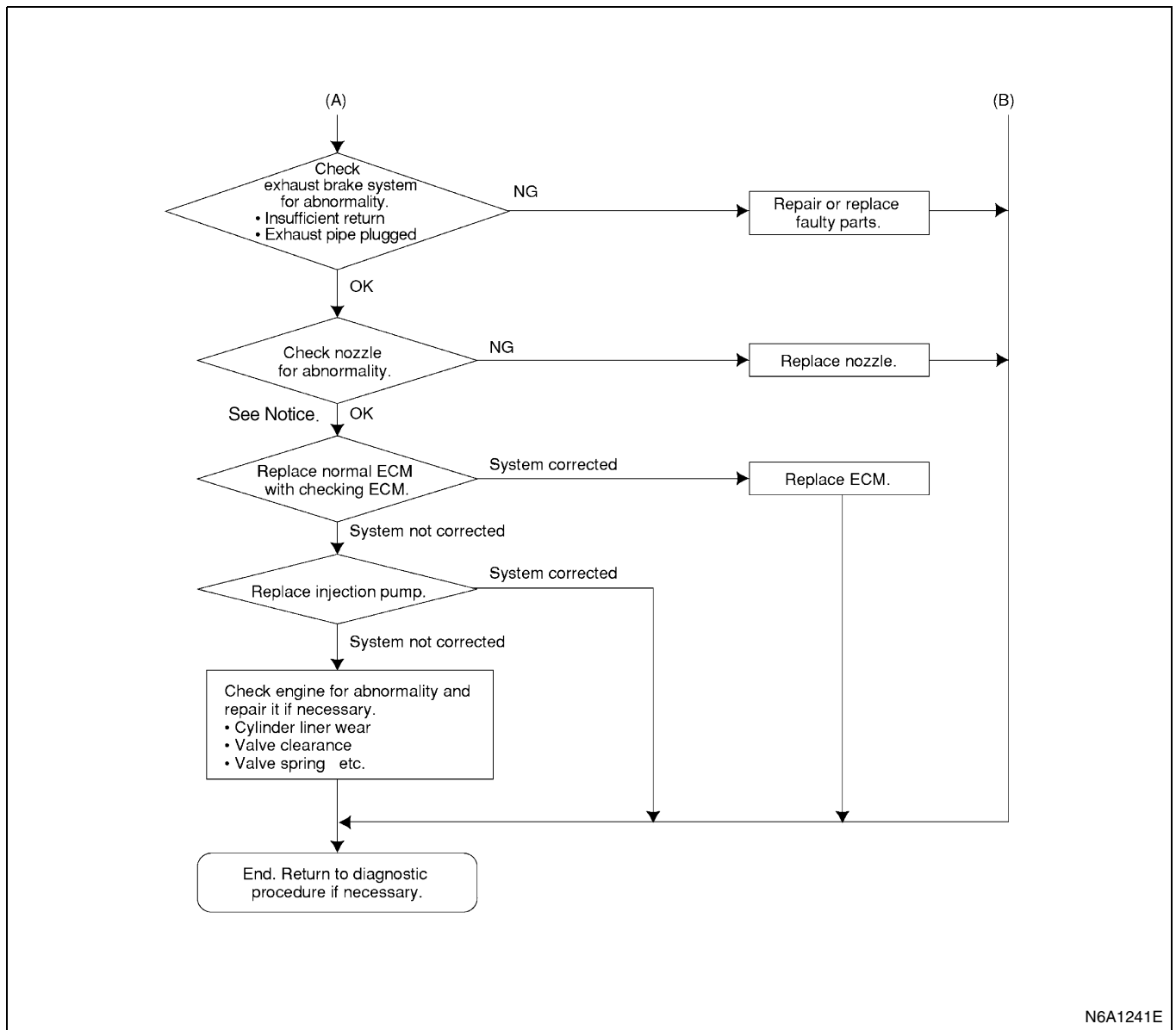
The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

Refer to a trouble code for a supplier's check, if available.

*1. Equipped without Exhaust Gas Recirculation (EGR) and Variable Swirl System (VSS).

Lack of Power



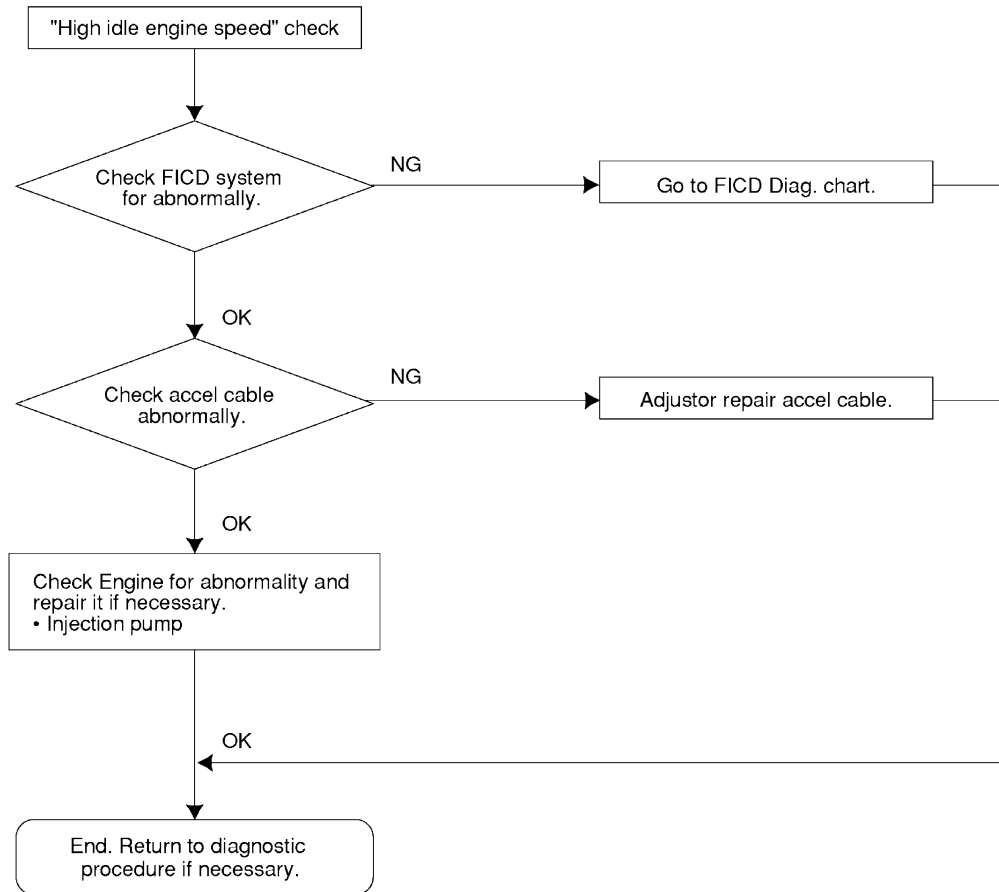


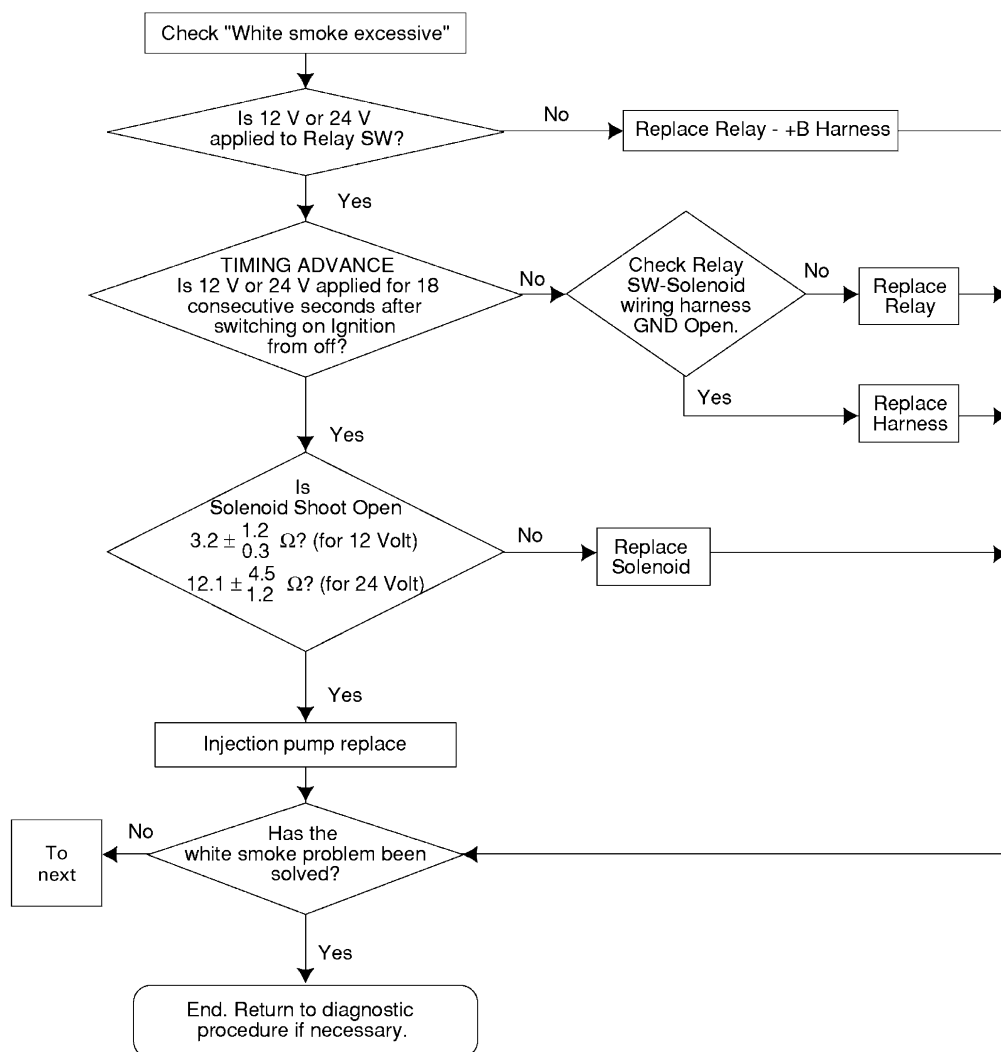
N6A1241E

Notice:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

*1. Equipped without Exhaust Gas Recirculation (EGR) and Variable Swirl System (VSS).

High Idle Engine Speed

Solenoid Switch Malfunction

N6A1243E

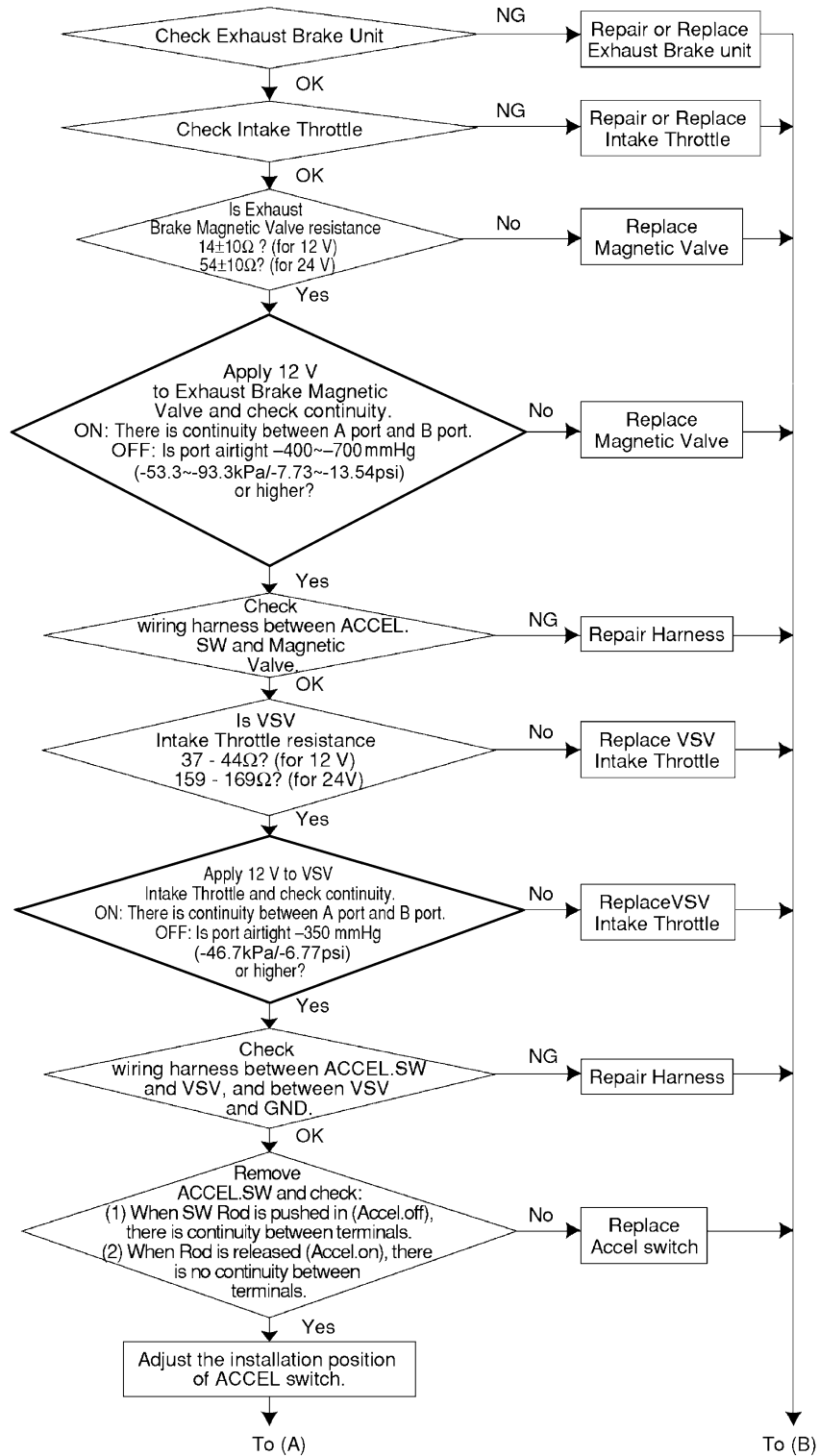
Inspection**Solenoid Switch**

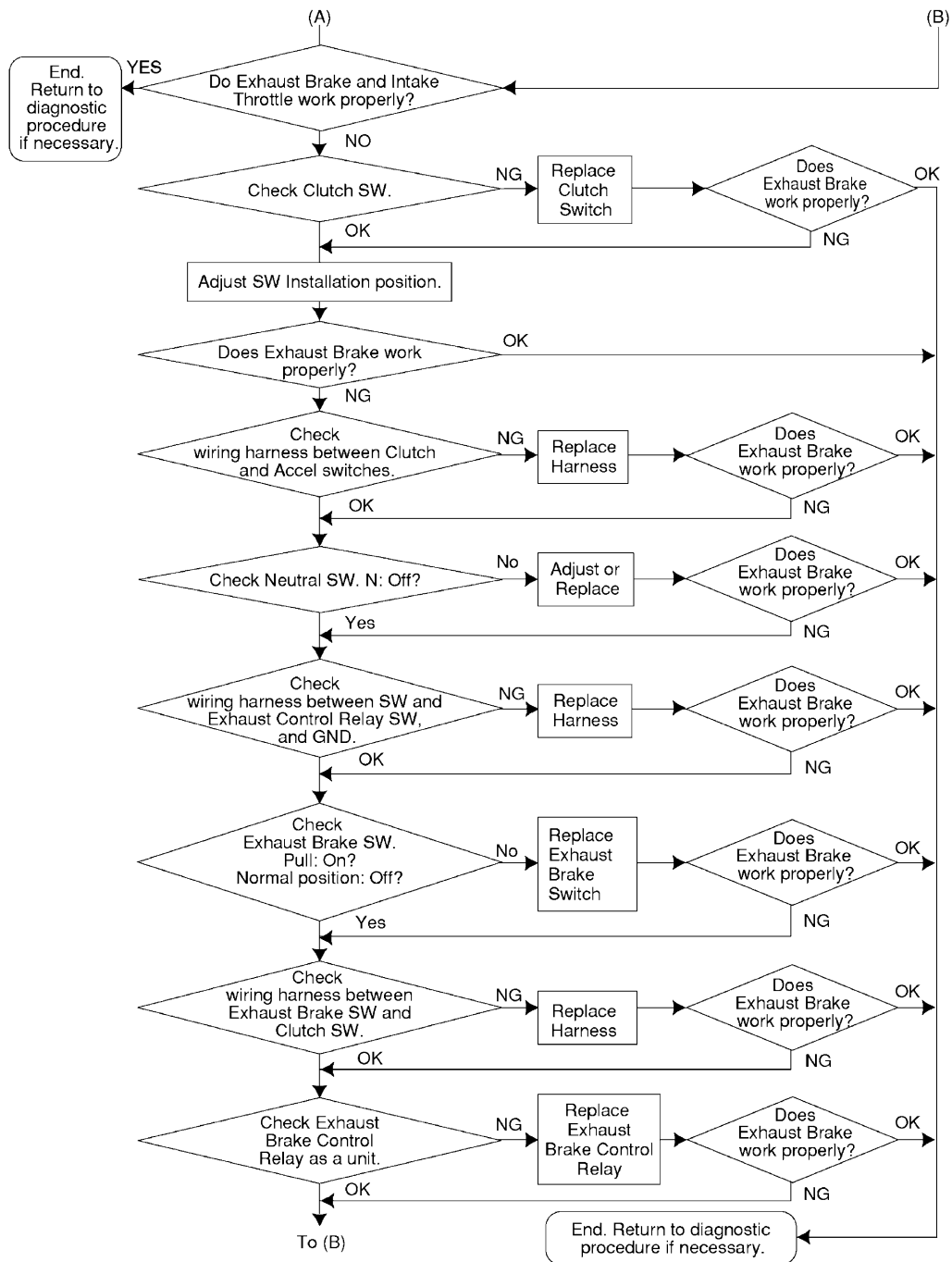
Disconnect the connector on the solenoid switch.

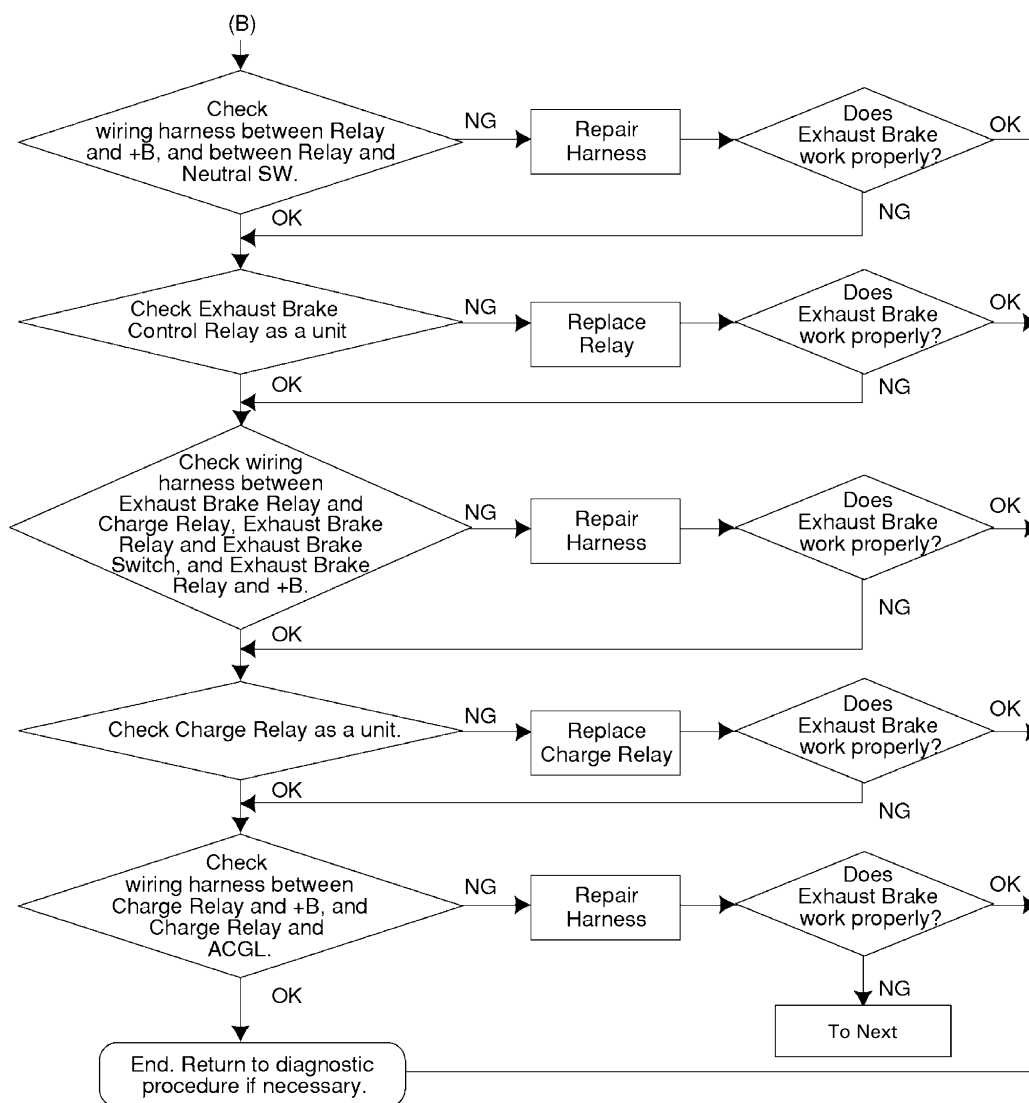
Apply 12 volts or 24 volts DC to the solenoid switch and hear the touching noise between solenoid switch and advance lever in the injection pump.

If can not hear the touching noise, do not remove the solenoids switch and contact injection pump service shop to repair it.

Exhaust Brake Malfunction







* Repair of wiring harness includes diode check.

Inspection

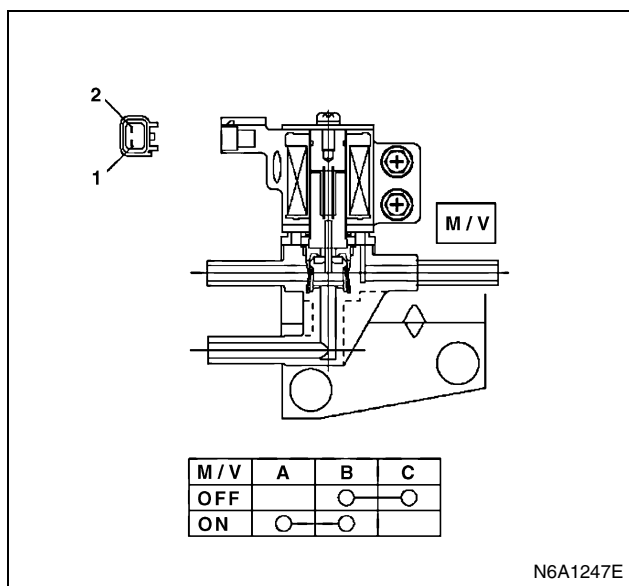
1. Exhaust Brake Magnetic Valve

Inspection

Connect the magnetic valve connector terminal No.1 and No.2 to (+) terminal and (-) terminal of battery, respectively, and check the continuity between the ports.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

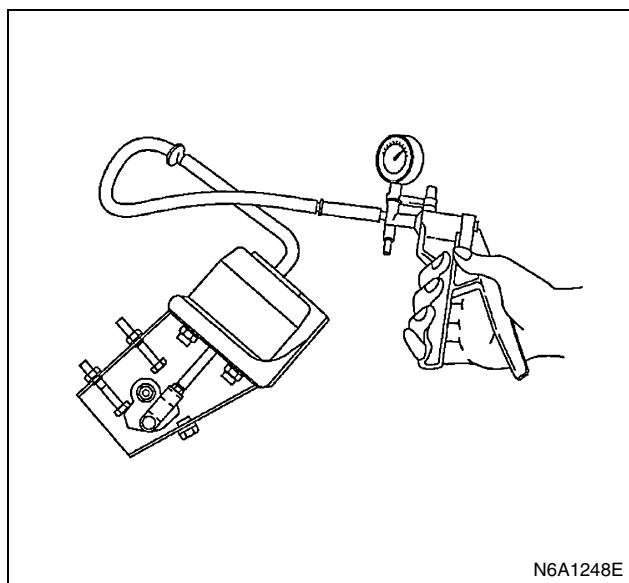
**Legend**

- A. Inlet (Vacuum pump)
- B. Outlet (unit)
- C. Exhaust (air filter)

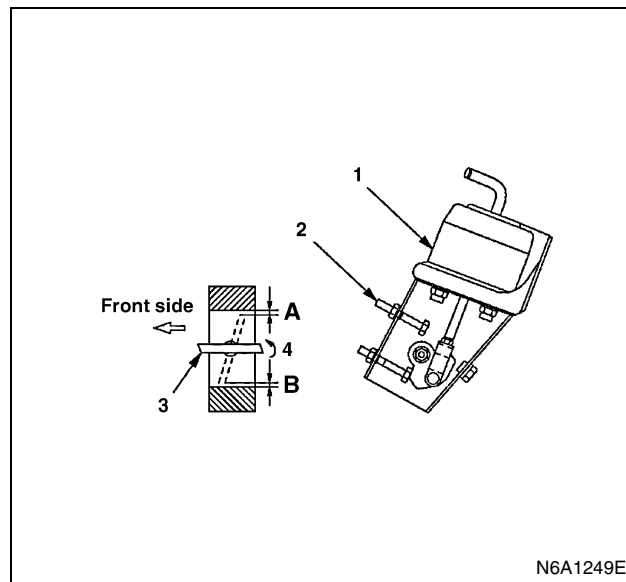
2. Exhaust Throttle Valve

Working Check

Actuate the exhaust brake with the engine idling and make sure that you hear the valve strike on the stopper.

**Airtight Check**

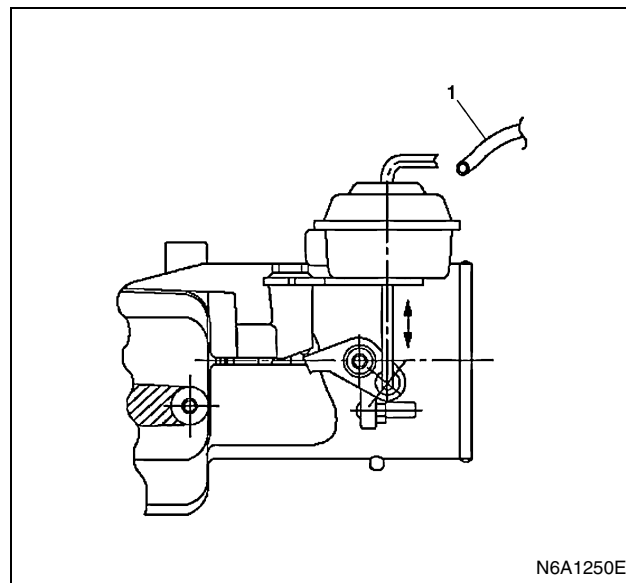
Apply a negative pressure of 53.3 — 93.3 kPa (400 — 700 mmHg/7.73 — 13.54 psi) to the power chamber by means of a vacuum pump and make sure of the smooth opening/closing of the exhaust brake valve.

**Legend**

- 1. Power chamber
- 2. Adjust bolt
- 3. Valve
- 4. Close

Apply a negative pressure of 86.7 — 93.3 kPa (650 — 700 mmHg/12.57 — 13.54 psi) to the power chamber using a vacuum pump and make sure the average of measurements at Point A and Point B of the clearance between valve and body is as follows: 0.4 — 0.6 mm (0.016 — 0.024 in) (Minimum: 0.4 mm/0.016 in)

If the clearance is out of this range, adjust with the adjusting bolt.



Legend

1. Vacuum hose

3. Intake Throttle Valve

Working Check

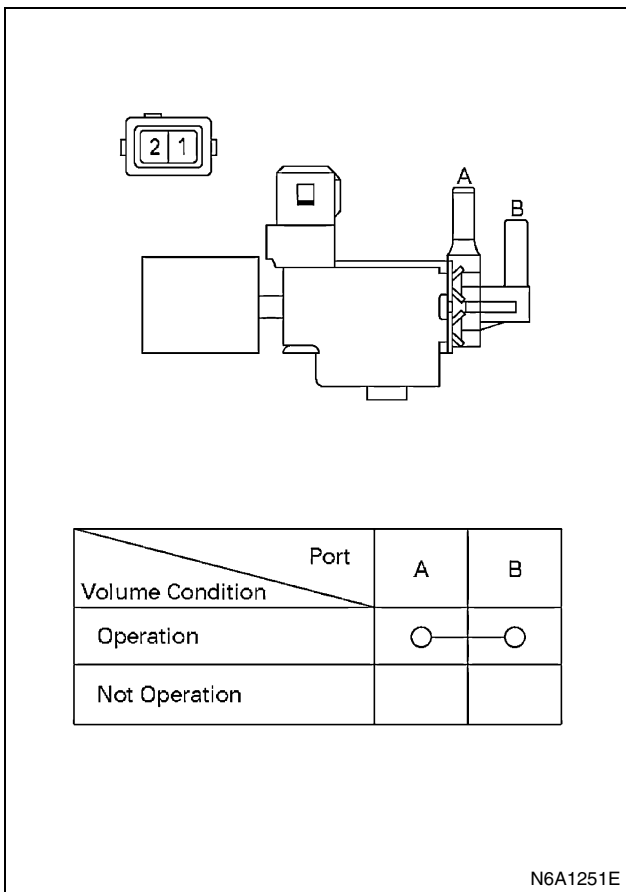
Disconnect the vacuum hose from the actuator and try to move the rod by hand, making sure of the smooth move of the rod.

4. Vacuum Switching Valve; Intake Throttle

Inspection

Connect the vacuum switching valve connector terminals No.1 and No.2 to (+) terminal and (-) terminals of battery, respectively, and check the continuity between the ports.

If the check result is abnormal, repair or replace the valve.



5. Accelerator Switch (2-pole connector type)

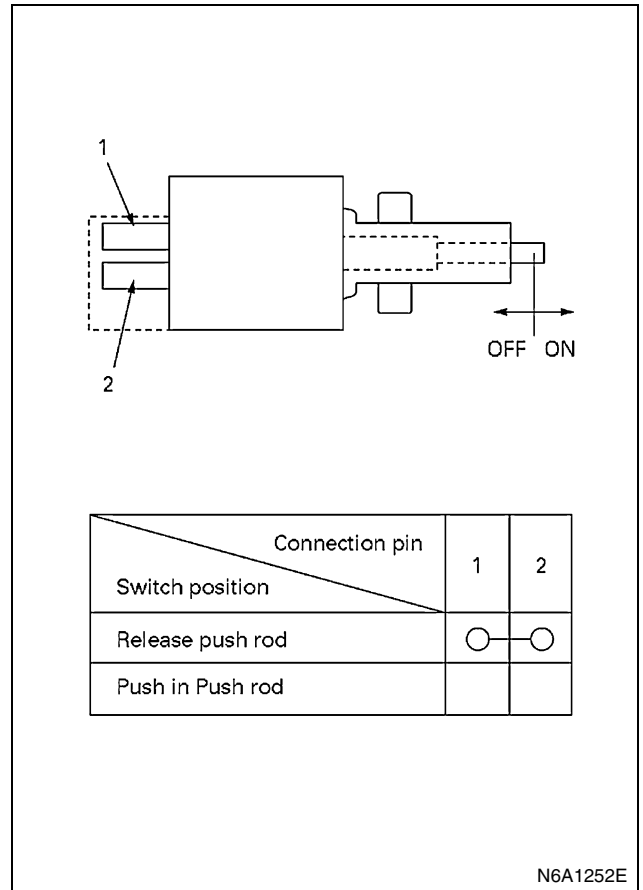
Inspection

- 1) Check the continuity between the switch connector terminals.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

- 2) Check the smooth move of the pushrod. If the check result is abnormal, repair or replace the push rod.

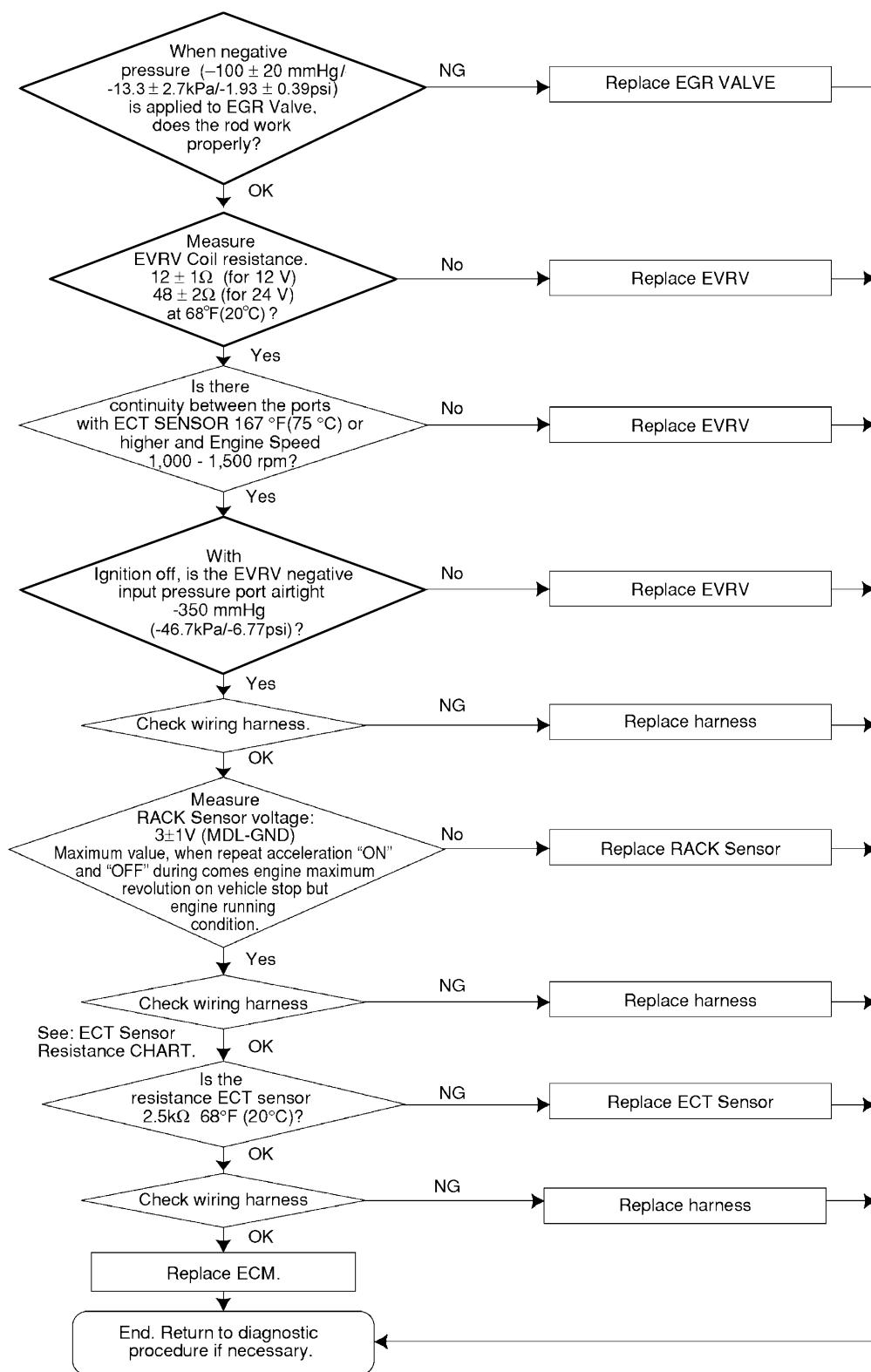
**Removal**

- 1) Accelerator Switch
- 2) Disconnect the connector.
Loosen the lock nut.
Turn the switch to remove.

Reinstallation

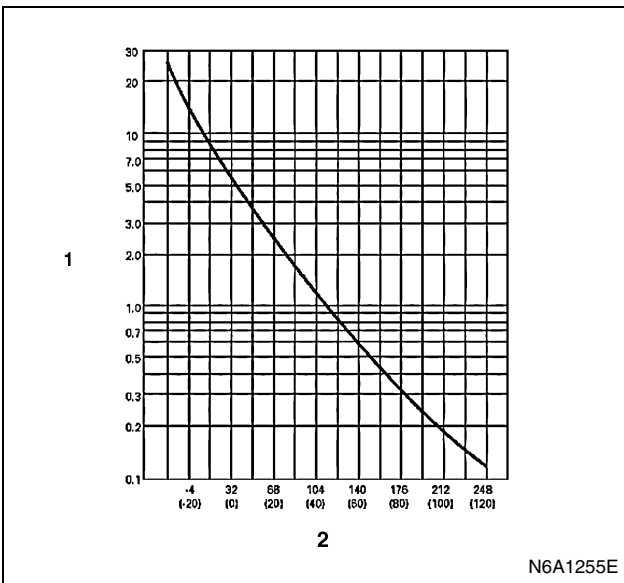
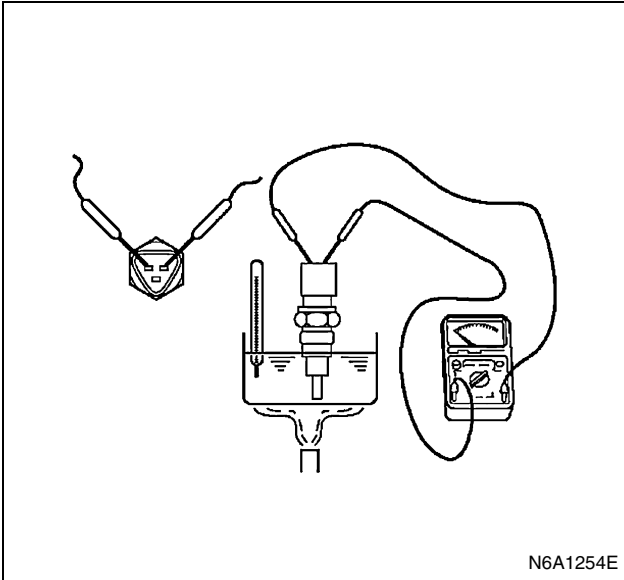
To install, follow the removal procedure in reverse order:

- 1) Drive the threaded part of the switch until its end surface becomes flush with that of the bracket side of nut.
- 2) Tighten the lock nut.
Tightening torque: 1.3 N·m (0.13 kg·m/11.5 lb·in)

EGR System Malfunction

Inspection

1. Thermosensor (Engine Coolant Temperature)
Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:

**Legend**

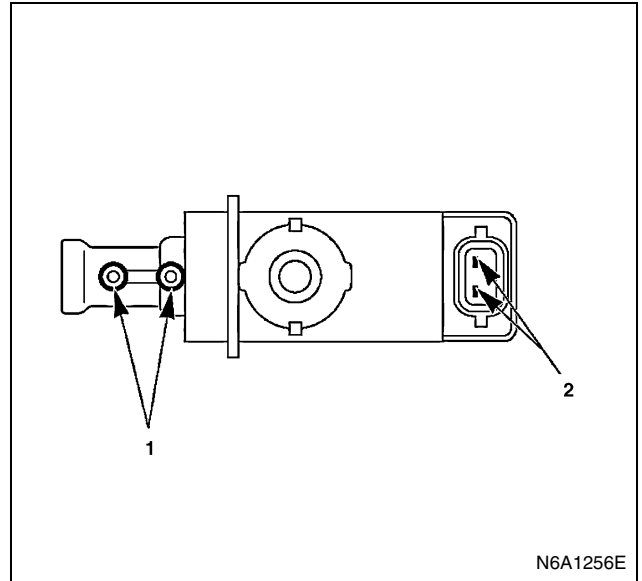
1. Resistance (kΩ)
2. ECT °F (°C)

2. Electronic Vacuum Regulating Valve (EVRV) (Equipped with Exhaust Gas Recirculation (EGR) and Variable Swirl System (VSS))

Resistance Check

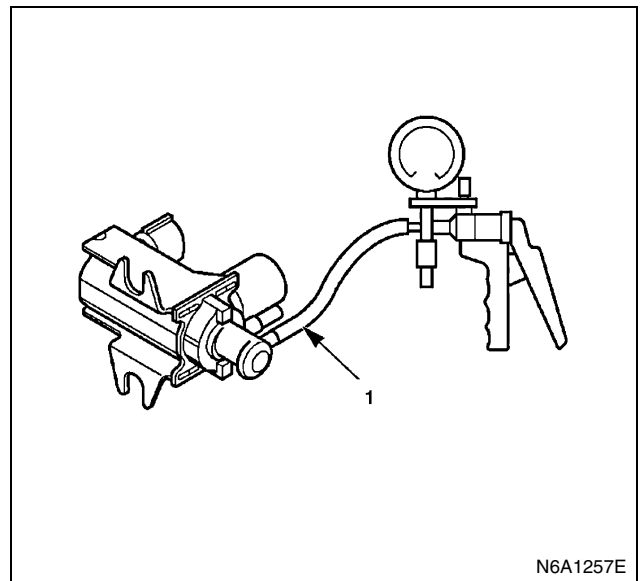
Check the resistance between the EVRV connector terminals using a circuit tester.

Cold Resistance: 12 ± 1 (Ω)

**Legend**

1. Port
2. Pin

Connect battery voltage between EVRV connector terminals and make sure of the continuity between the ports.

**Legend**

1. Vacuum port

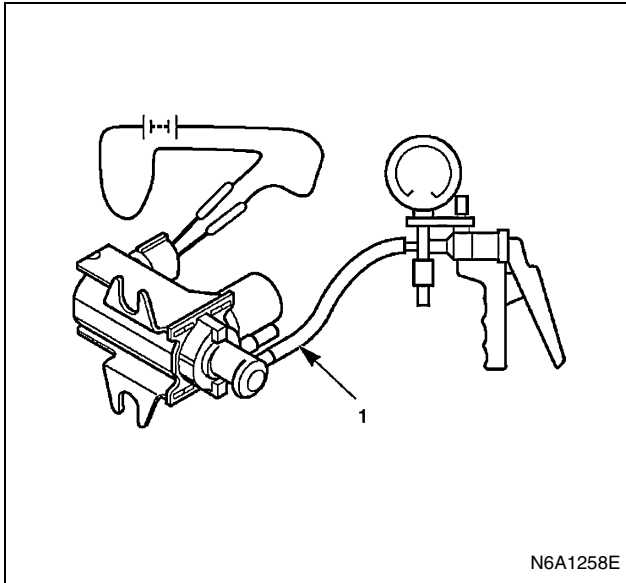
Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -46.7 kPa (-350 mmHg / -6.77 psi) or more.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



Legend

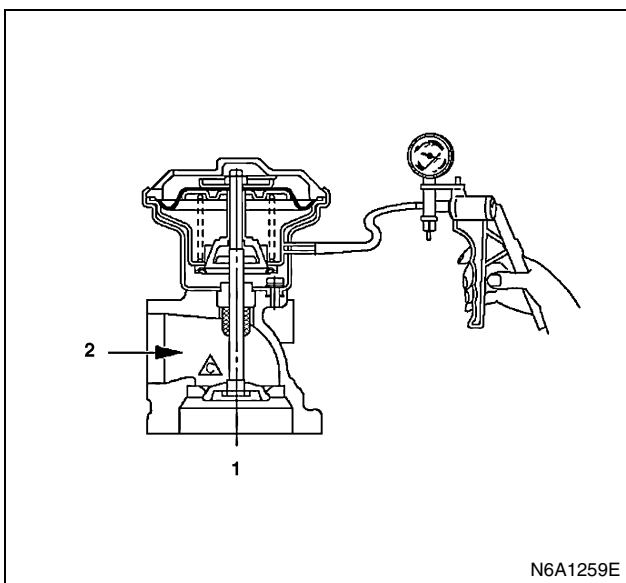
1. Vacuum port

Working Check

Apply powervoltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

3. Exhaust Gas Recirculation (EGR) Valve (Equipped with EGR and Variable Swirl System (VSS))
With negative pressure applied to the diaphragm chamber, make sure that the valve is smoothly actuated to make the area between (1) and (2) ventilated.

Startup: About -13.3 ± 2.7 kPa (-100 ± 20 mmHg / -1.93 ± 0.39 psi)

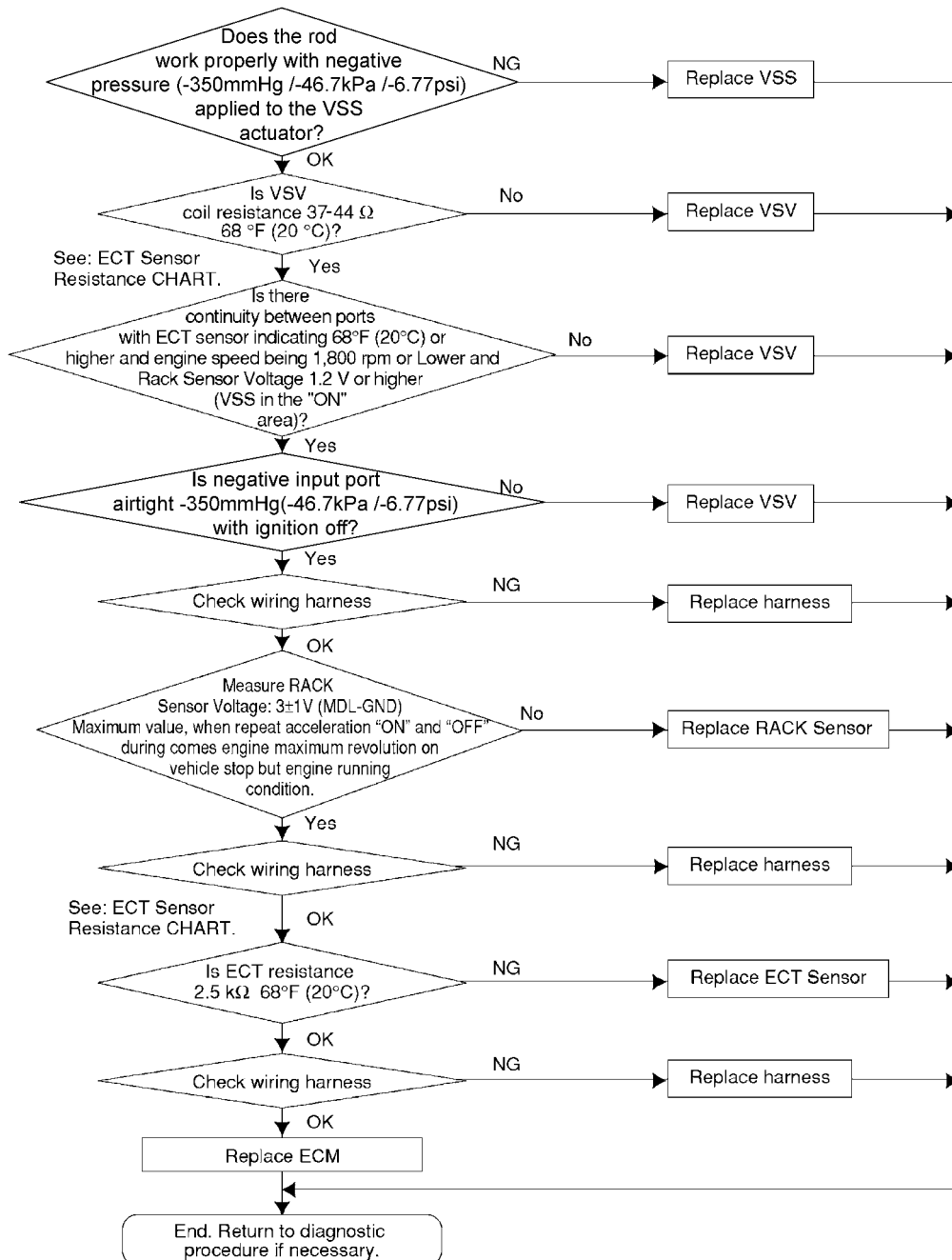


Check to see if EGR valve is normally actuated under the following conditions:

QWS off (After warming up)

Engine coolant temp.: 80°C (176°F) or higher

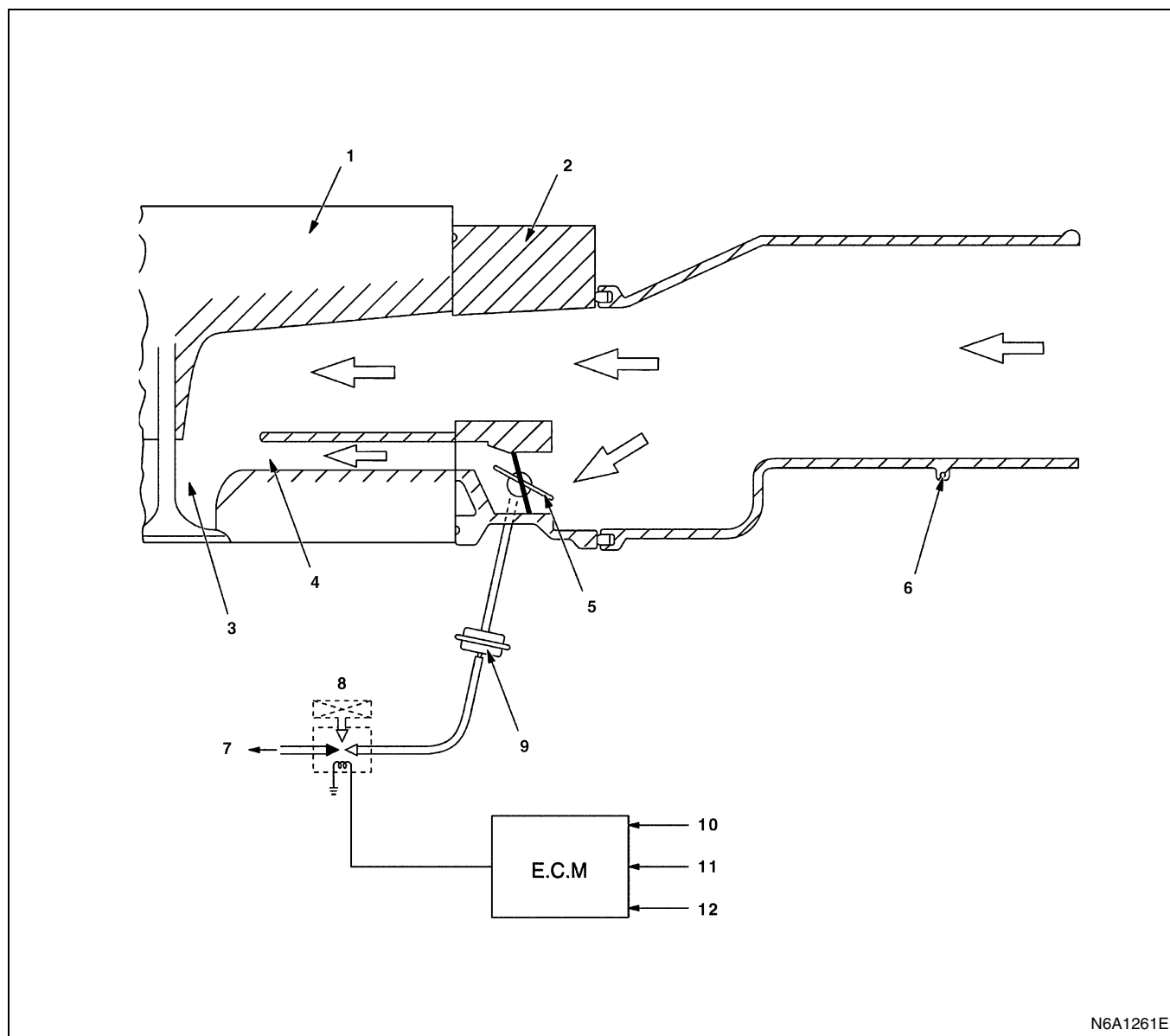
Variable Swirl System (VSS) System Malfunction (Equipped with Exhaust gas recirculation and VSS)



VSS (Variable Swirl System)

The Variable Swirl System (VSS) is designed to adjust the intensity of swirl by allowing or not allowing air to flow through a sub-port (or bypass) the runs in parallel with the intake port for each cylinder. The swirl intensifies when there is no air flow through the sub-port, and vice versa.

The air flow is controlled by the on-off valve at the inlet to the sub-port and the valve in turn is turned on and off by computer signals which are dependent on engine speed, load and coolant temperature. Basically, the air is cut off at low speeds to maintain high swirl and is allowed to flow at high speeds to maintain low swirl.

Variable Swirl System (Equipped with Exhaust gas recirculation (EGR) and VSS)

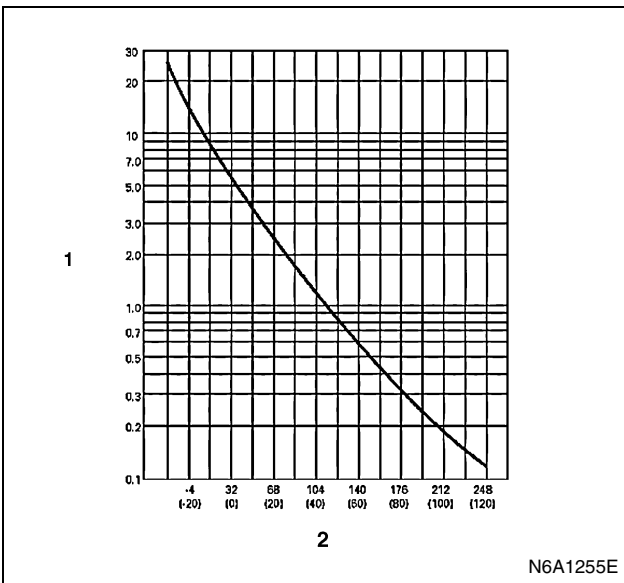
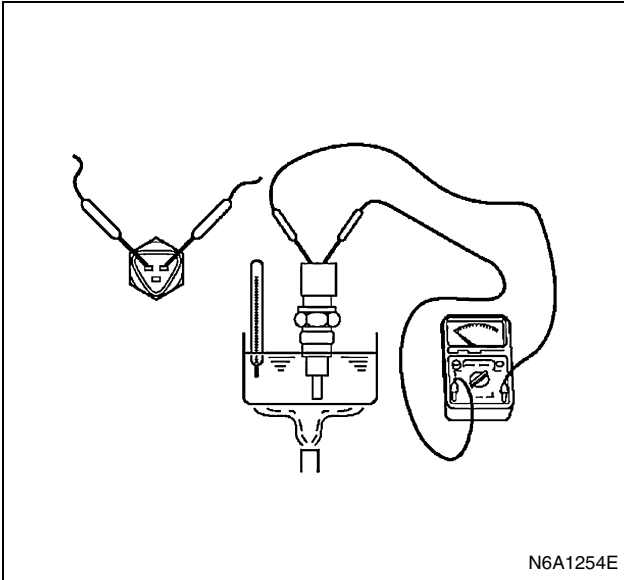
N6A1261E

Legend

- | | |
|-------------------|-------------------------|
| 1. Cylinder head | 7. Vacuum |
| 2. VSS case | 8. VSV; VSS |
| 3. Inlet port | 9. Actuator |
| 4. Sub-port | 10. Thermo sensor |
| 5. Control valve | 11. Engine speed sensor |
| 6. Inlet manifold | 12. Rack sensor |

Inspection

1. Thermosensor (Engine coolant temperature)
Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:

**Legend**

1. Resistance (kΩ)
2. ECT °F (°C)

2. Vacuum Switching Valve (VSV)

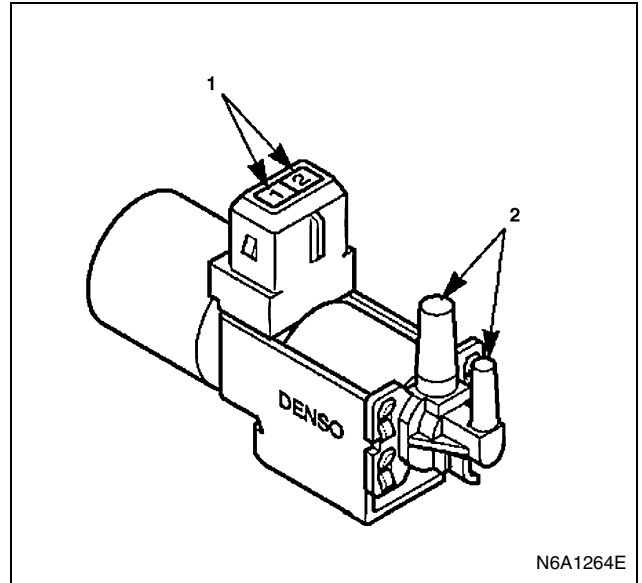
Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

Cold Resistance

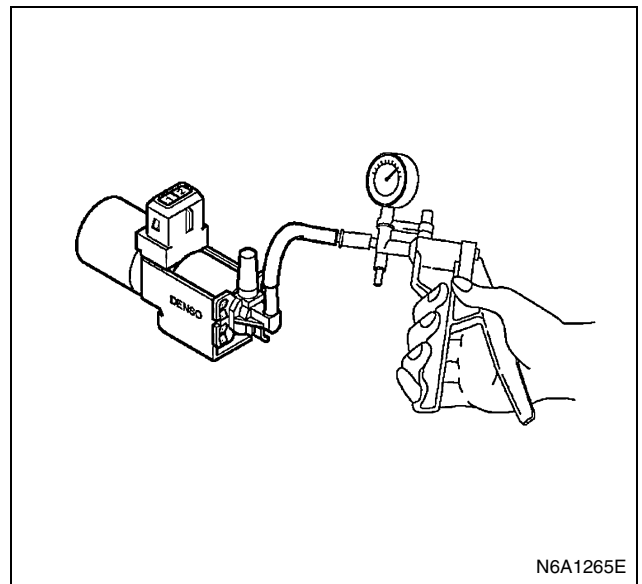
: 37 — 44 (Ω) (for 12 volt)

: 159 — 169 (Ω) (for 24 volt)

**Legend**

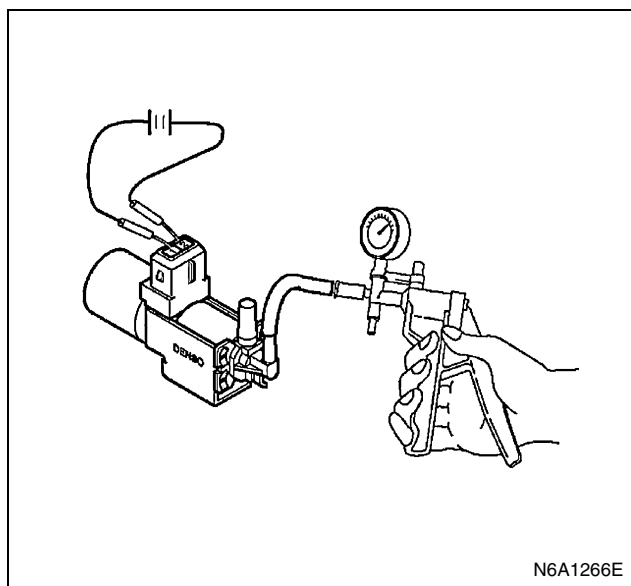
1. 2 Pin
2. Port

Connect battery voltage between VSV connector terminals and make sure of the continuity between the ports.

**Airtight Check**

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -46.7 kPa (-350 mmHg / -6.77 psi) or more.

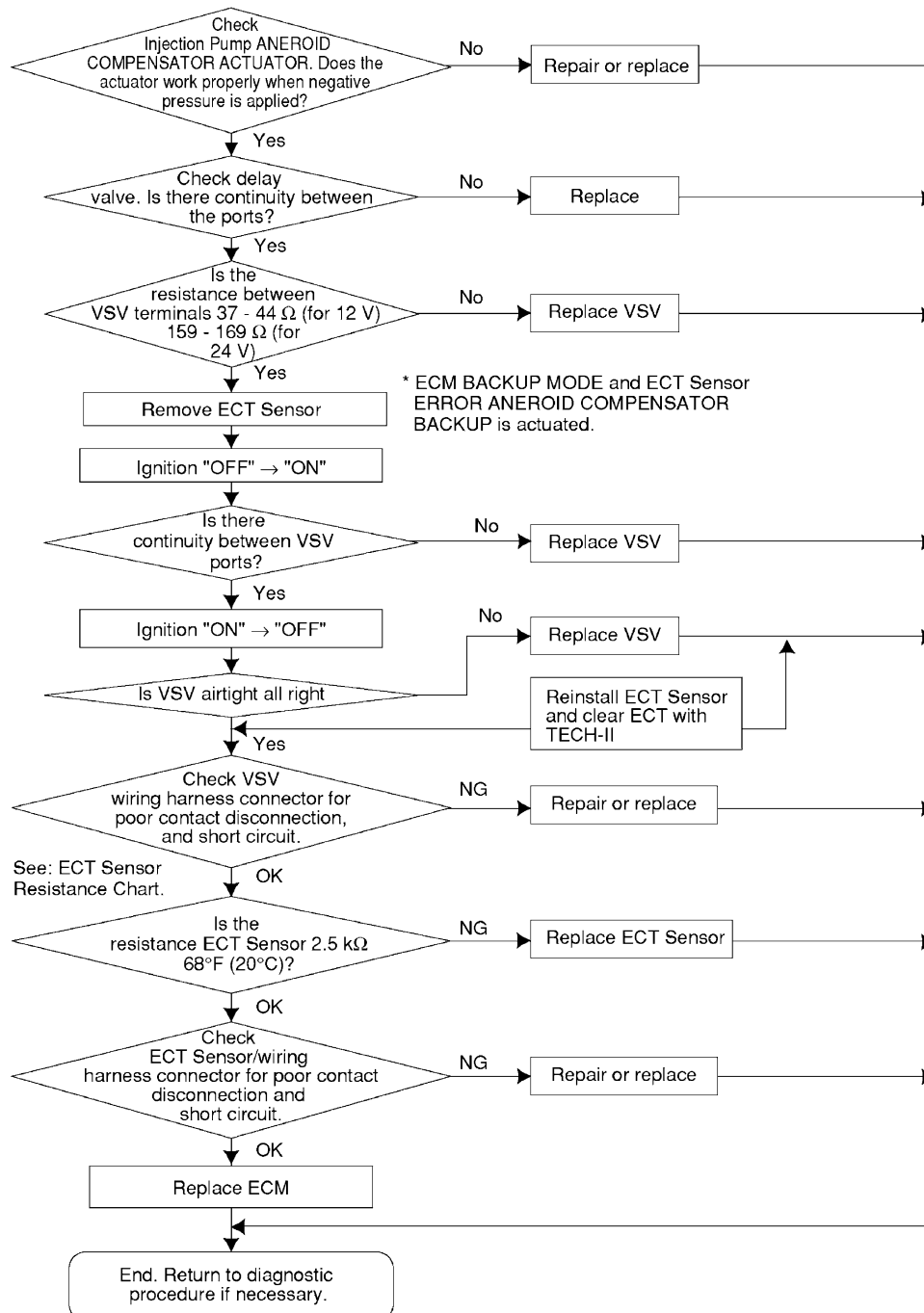


Working Check

Apply power voltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

Caution:

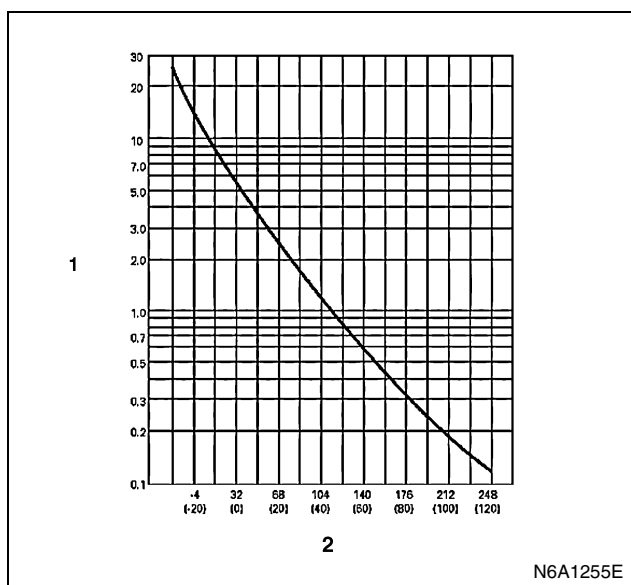
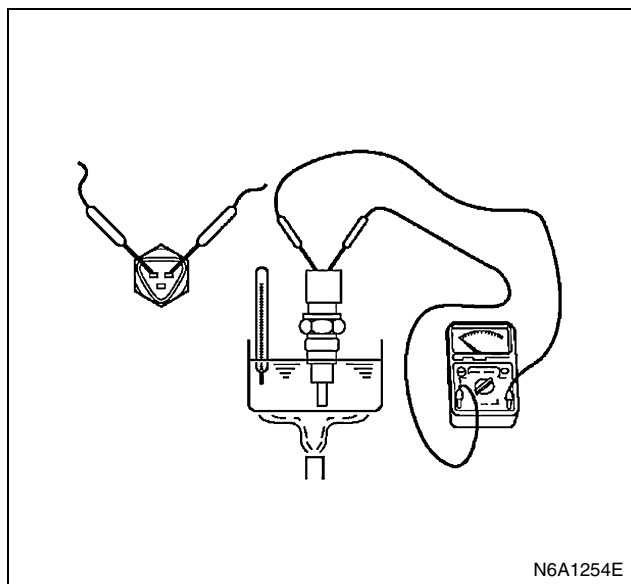
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Aneroid Compensator Malfunction

Inspection

1. Thermosensor (Engine coolant temperature (ECT))

Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:

**Legend**

1. Resistance (kΩ)
2. ECT °F (°C)

2. Vacuum Switching Valve (VSV)

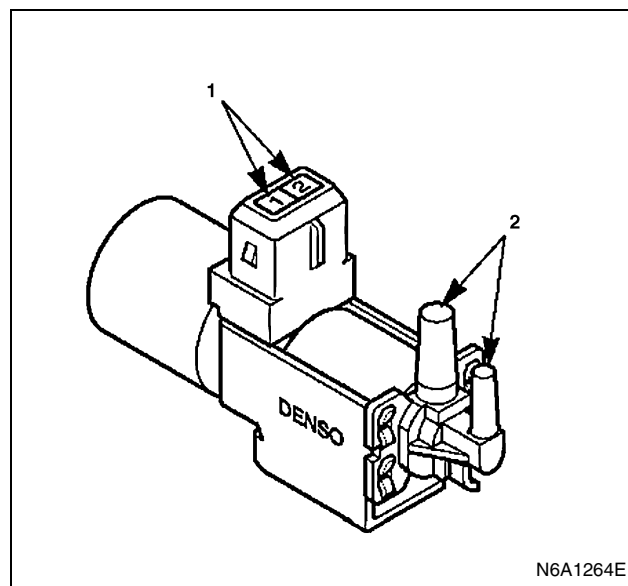
Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

Cold Resistance

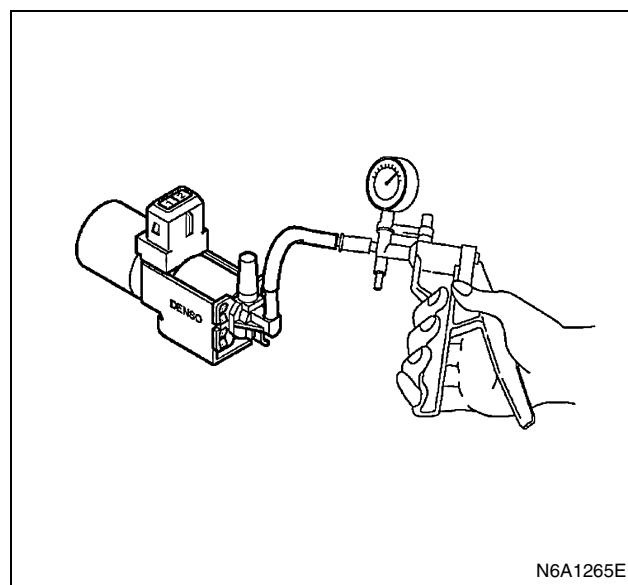
: 37 — 44 (Ω) (for 12 Volt)

: 159 — 169 (Ω) (for 24 Volt)

**Legend**

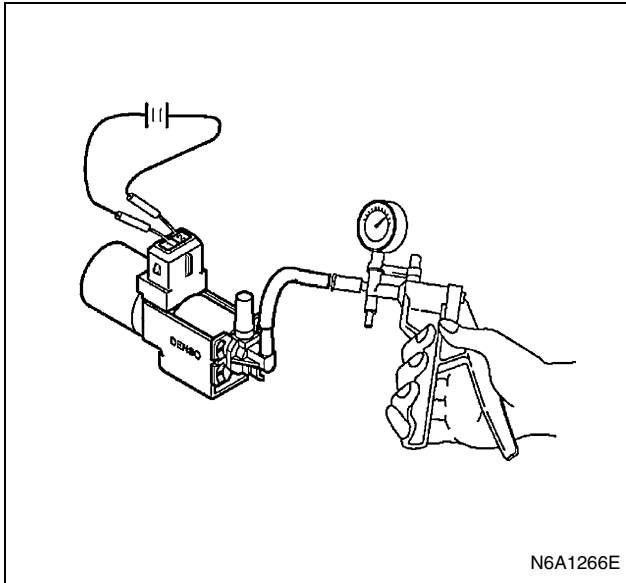
1. 2 Pin
2. Port

Connect battery voltage between VSV connector terminals and make sure of the continuity between the pots.

**Airtight Check**

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -46.7 kPa (-350 mmHg / -6.77 psi) or more.

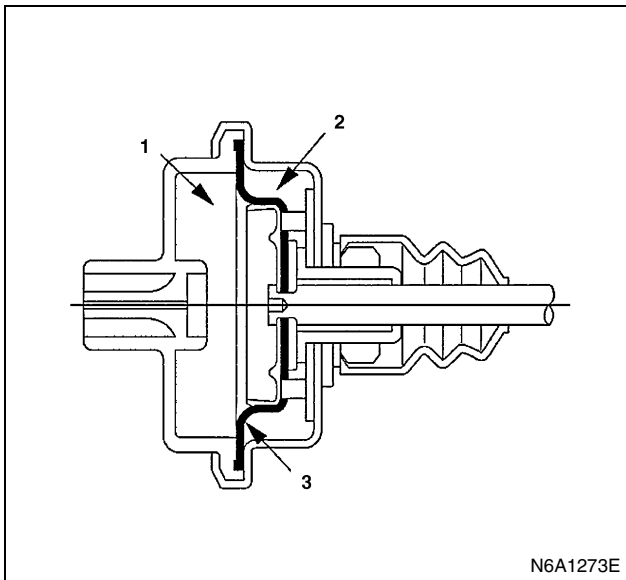
**Working Check**

Apply power voltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

Caution:

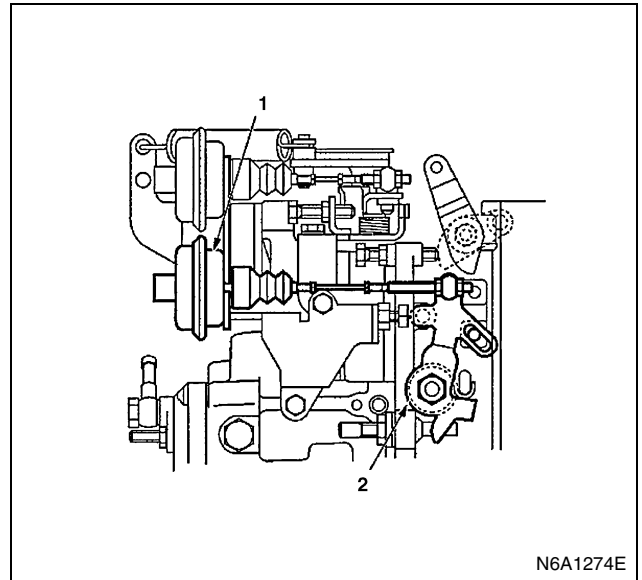
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

3. Actuator
Diaphragm is built in the actuator, by which the inside of the actuator is divided into two, atmospheric room and negative pressure room.

**Legend**

1. Vacuum chamber
2. Atmospheric chamber
3. Diaphragm

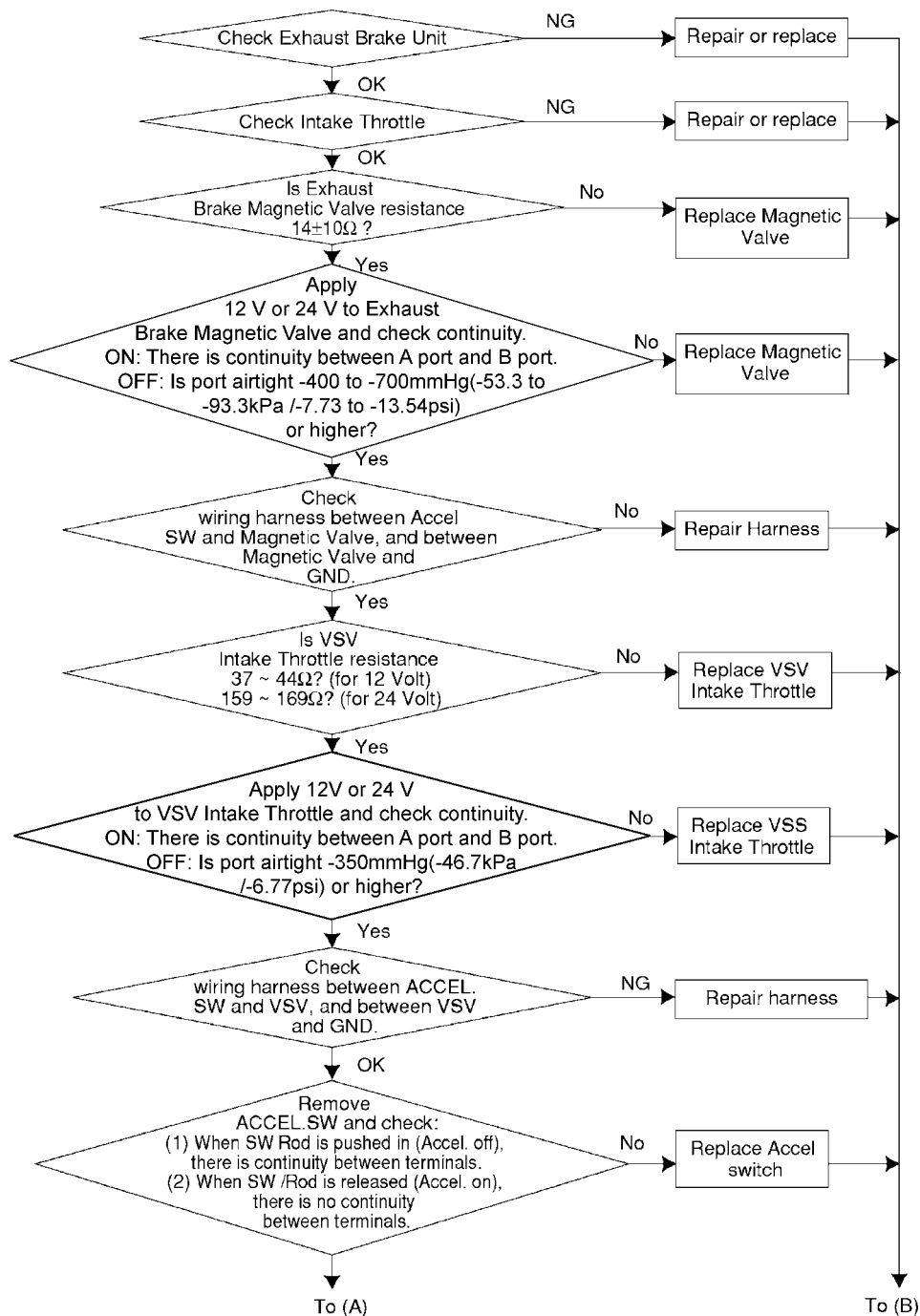
The full load set lever is connected to a U-lever. When the atmospheric sensor built in Engine Control Module (ECM) makes the actuator work, the full load set lever and U-lever are rotated to a specified position so that the control rack is drawn in the direction of reducing fuel injection amount.

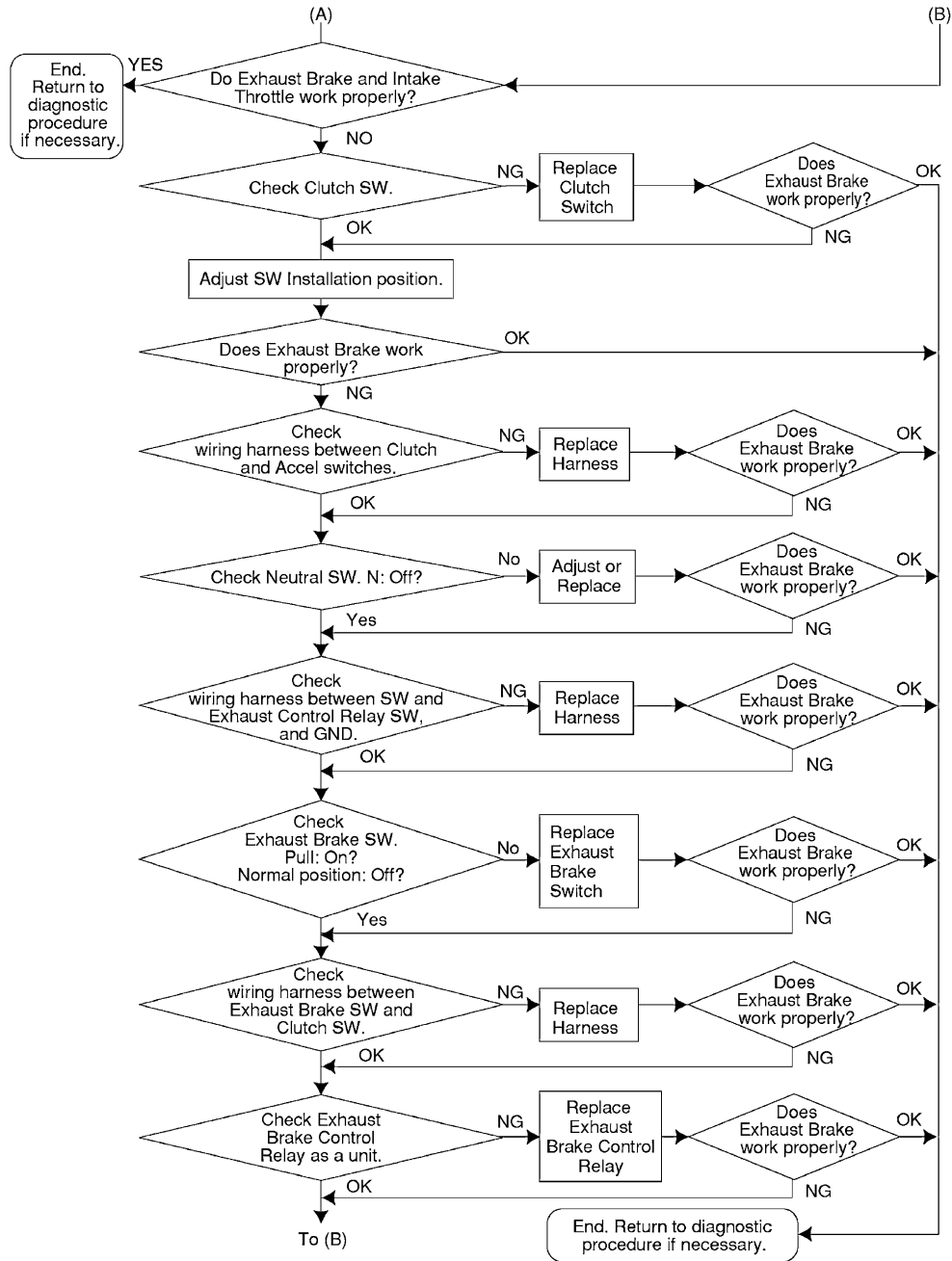
**Legend**

1. Aneroid compensator actuator
2. Full load set lever

4. Aneroid compensator Actuator
The link of the actuator for the aneroid compensator is connected to full load set lever.

Quick Warm System (QWS) Malfunction





Inspection

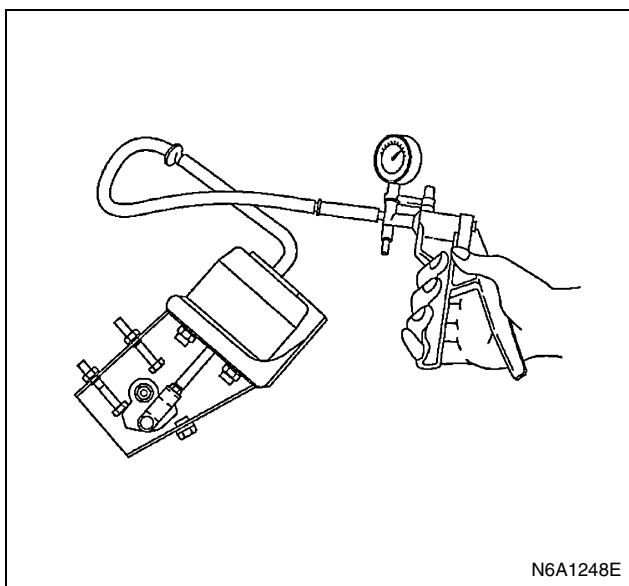
1. Exhaust Throttle Valve

Working Check

Actuate the exhaust brake with the engine idling and make sure that you hear the valve strike on the stopper.

Airtight Check

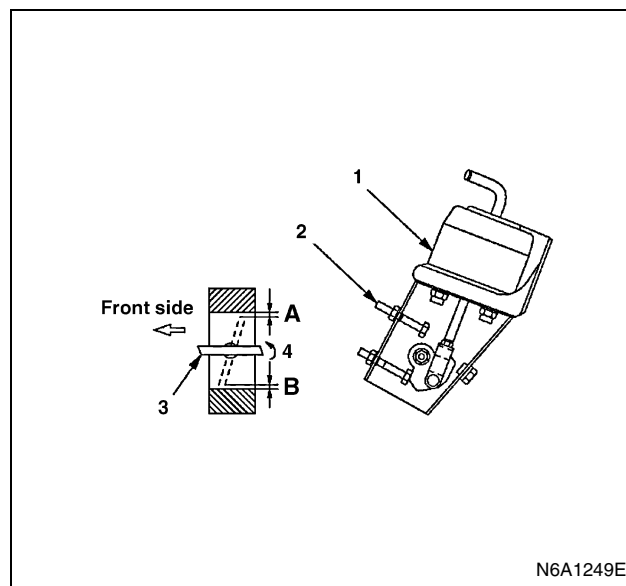
Apply a negative pressure of $-53.3 \text{ — } -93.3 \text{ kPa}$ ($-400 \text{ — } -700 \text{ mmHg}$ / $-7.73 \text{ — } -13.54 \text{ psi}$) to the power chamber by means of a vacuum pump and make sure of the smooth opening/closing of the exhaust brake valve.



Apply a negative pressure of $-86.7 \text{ — } -93.3 \text{ kPa}$ ($-650 \text{ — } -700 \text{ mmHg}$ / $-12.57 \text{ — } -13.54 \text{ psi}$) to the power chamber using a vacuum pump and make sure the average of measurements at Point A and Point B of the clearance between valve and body is as follows:

$0.4 \text{ — } 0.6 \text{ mm}$ ($0.016 \text{ — } 0.024 \text{ in}$) (Minimum: $0.4 \text{ mm}/0.016 \text{ in}$)

If the clearance is out of this range adjust with the adjusting bolt.

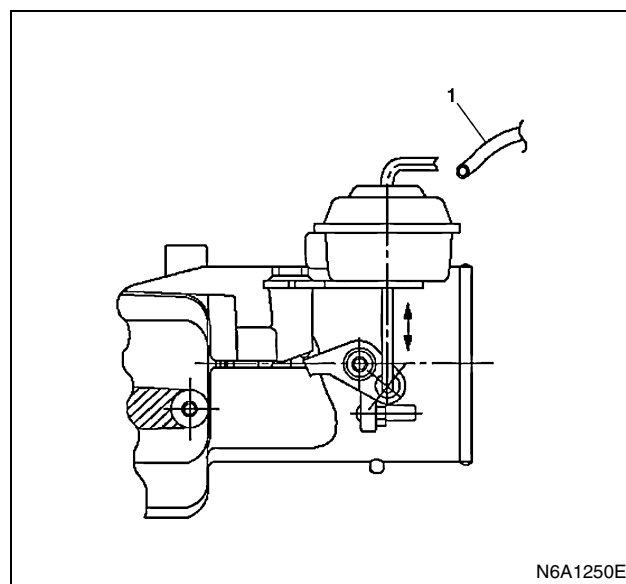
**Legend**

1. Power chamber
2. Adjust bolt
3. Valve
4. Close

2. Intake Throttle Valve

Working Check

Disconnect the vacuum hose from the actuator and try to move the rod by hand, making sure of the smooth move of the rod.

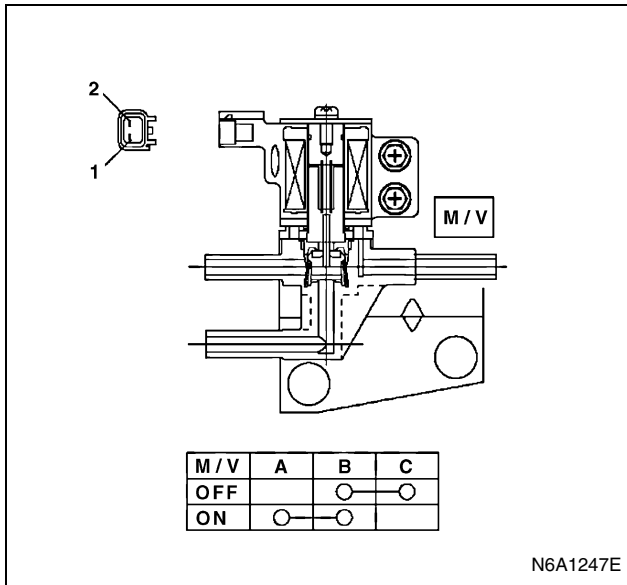
**Legend**

1. Vacuum hose

3. Exhaust Brake Magnetic Valve

Inspection

Connect the magnetic valve connector terminal No.1 and No.2 to (+) terminal and (-) terminal of battery respectively, and check the continuity between the ports.



Legend

- A. Inlet (vacuum pump)
- B. Outlet (unit)
- C. EXH (air filter)

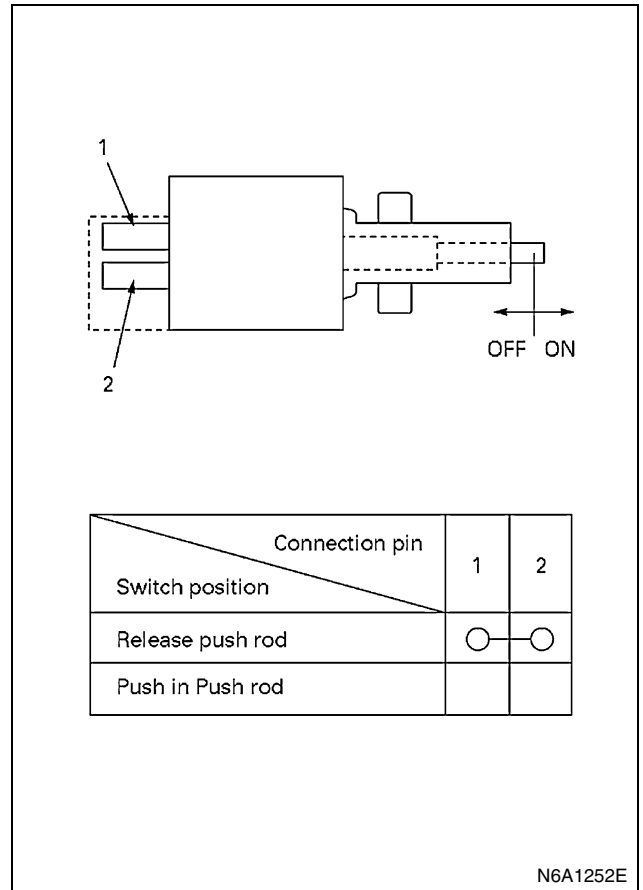
4. Accelerator Switch (2-pole connector type)

Inspection

- 1) Check the continuity between the switch connector terminals.
- 2) Check the smooth move of the pushrod. If the check result is abnormal, repair or replace the pushrod.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



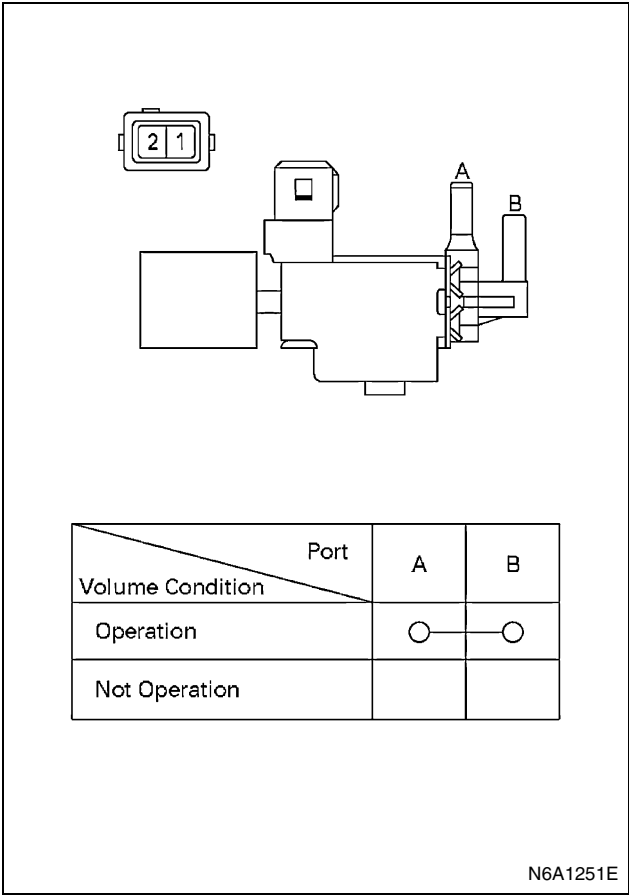
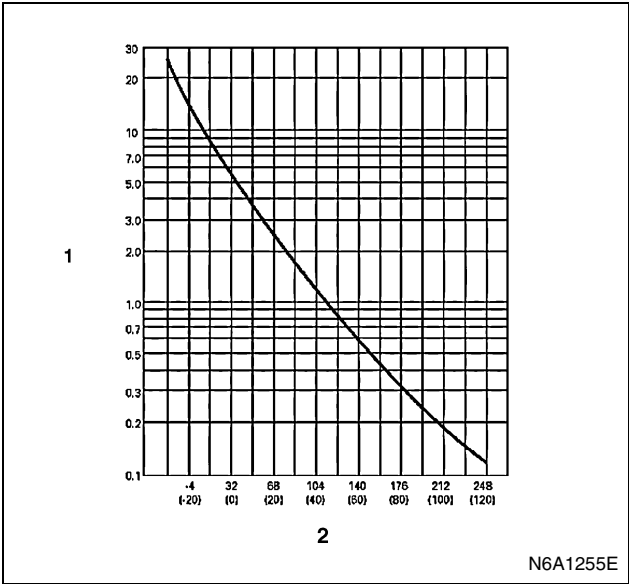
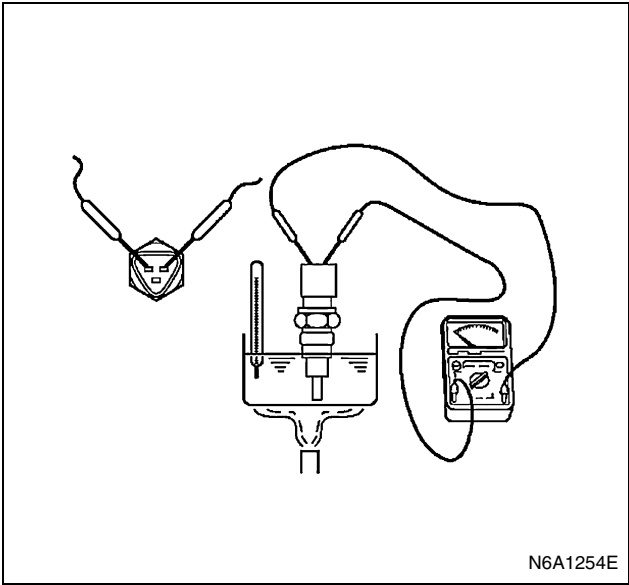
Removal

- 1) Accelerator Switch
Disconnect the connector.
Loosen the lock nut.
Turn the switch to remove.

Reinstallation

To install, follow the removal procedure in reverse order:

- 1) Drive the threaded part of the switch until its end surface becomes flush with that of the bracket side of nut.
- 2) Tighten the lock nut.
Tightening torque: 1.3 N·m (0.13 kg·m/11.5 lb·in)
5. Thermosensor (Engine coolant temperature)
Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:



Legend

- 1. Resistance (kΩ)
- 2. ECT °F (°C)

6. Vacuum Switching Valve; Intake Throttle

Inspection

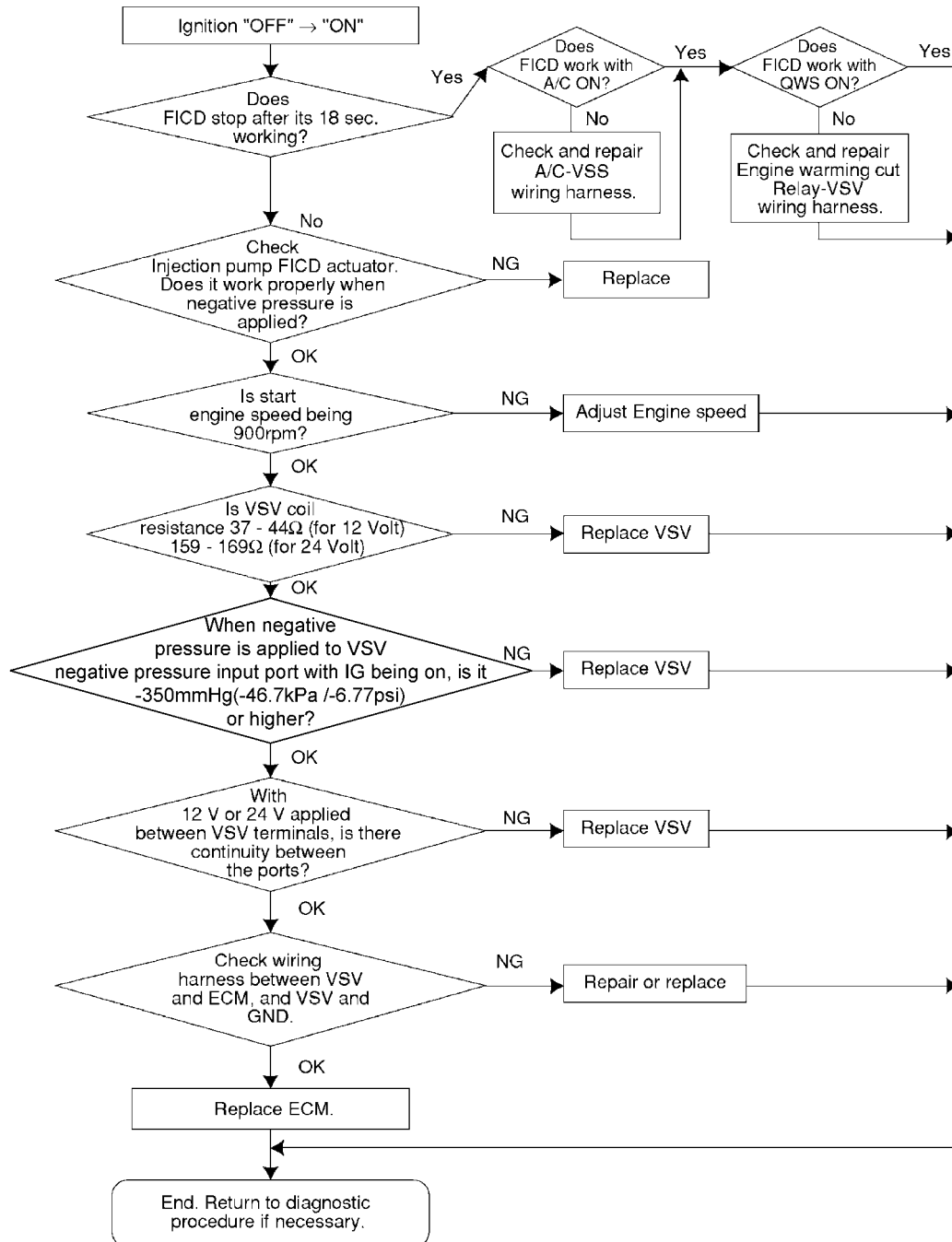
Connect the vacuum switching valve connector terminals No.1 and No.2 to (+) terminal and (-) terminals of battery respectively, and check the continuity between the ports.

If the check result is abnormal, repair or replace the valve.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Fast Idle Control Device (FICD) System Malfunction



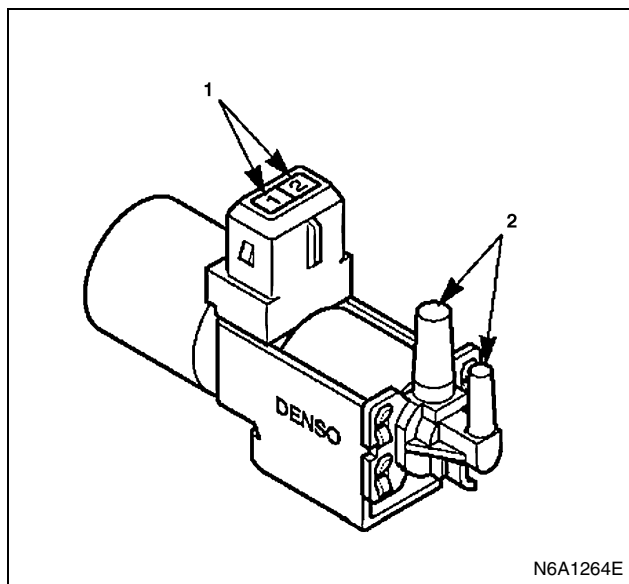
Inspection**Vacuum Switching Valve (VSV)****Resistance Check**

Check the resistance between the VSV connector terminals using a circuit tester.

Cold Resistance

: 37 — 44 (Ω) (for 12 Volt)

: 159 — 169 (Ω) (for 24 Volt)

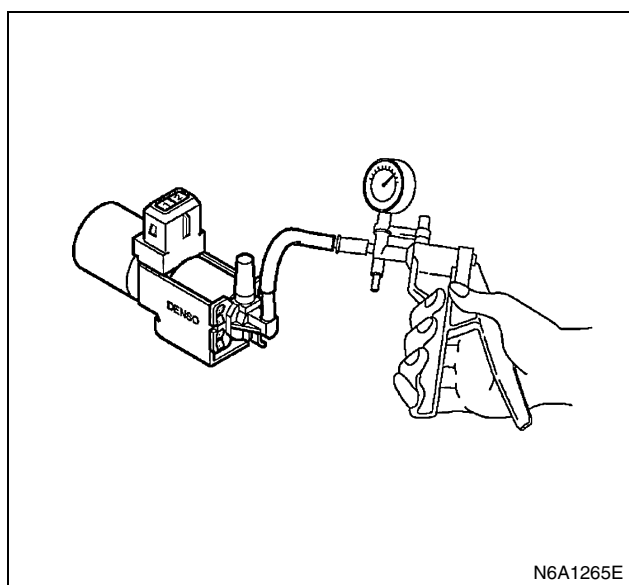


N6A1264E

Legend

1. 2 Pin
2. Port

Connect the battery voltage between VSV connector terminals and make sure of the continuity between the ports.

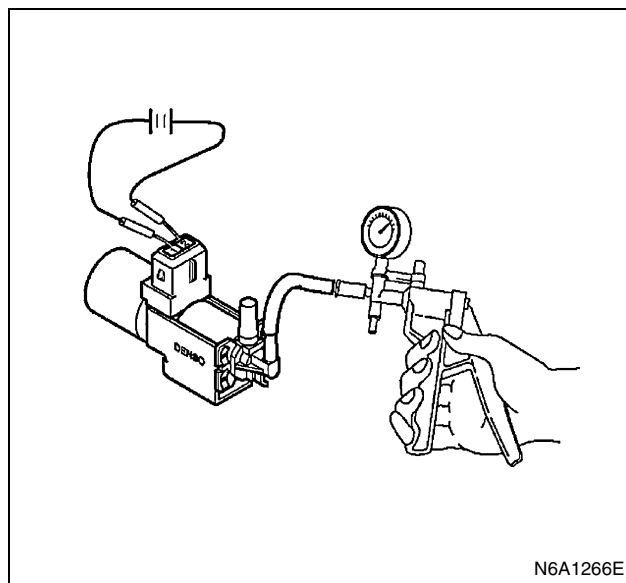


N6A1265E

Airtight Check

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -46.7 kPa (-350 mmHg / -6.77 psi) or more.



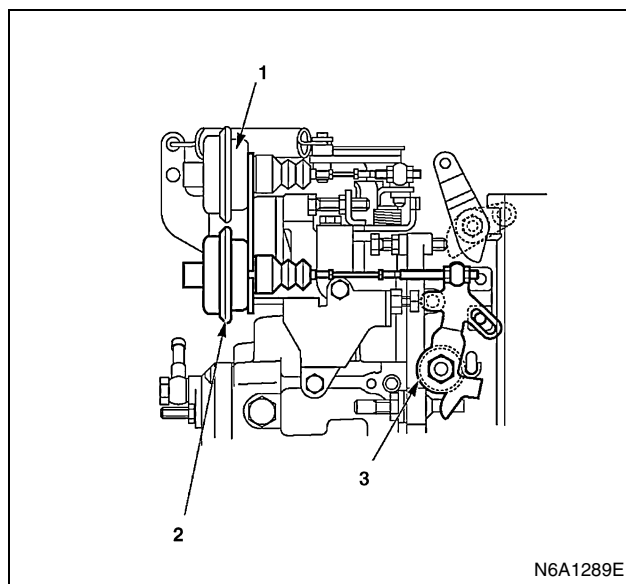
N6A1266E

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

Working Check

Apply power voltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

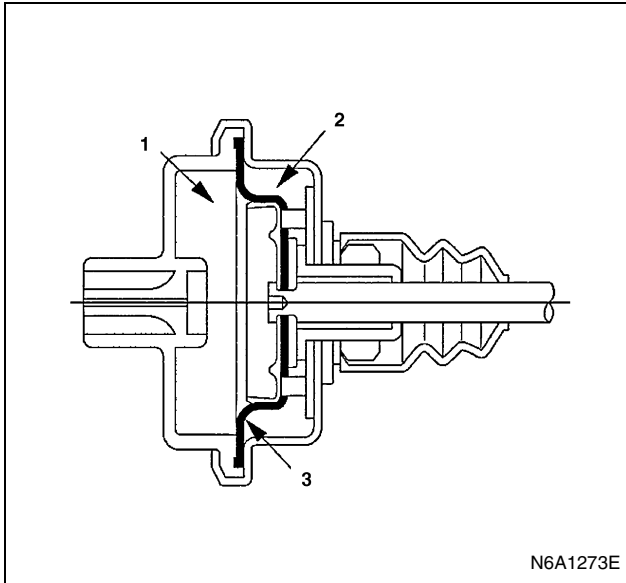


N6A1289E

Legend

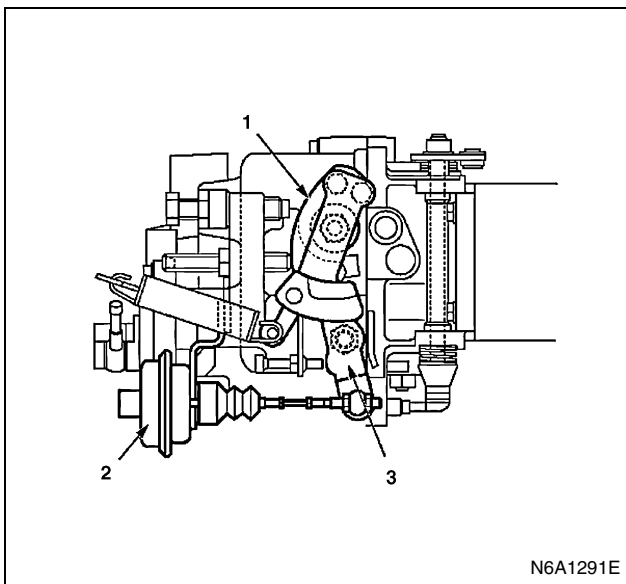
1. FICD actuator
2. Aneroid compensator actuator
3. Full rod set lever

1. Diaphragm is built in the actuator, by which the inside of the actuator is divided into two, atmospheric room and negative pressure room.

**Legend**

1. Vacuum chamber
2. Atmospheric chamber
3. Diaphragm

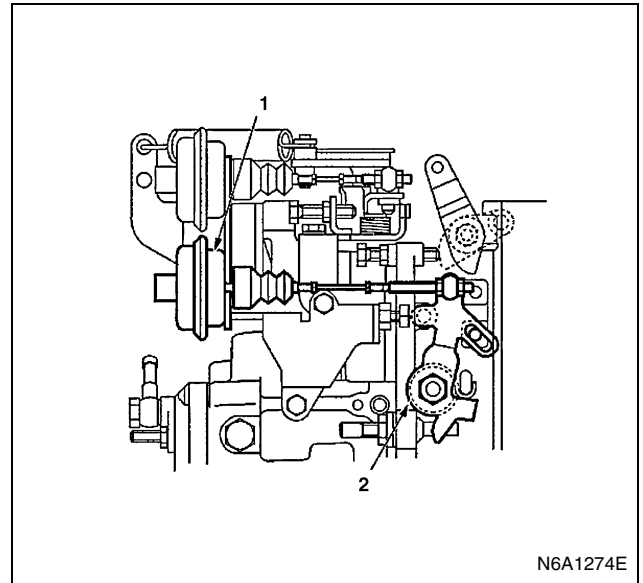
2. Fast Idle Control Device (FICD) actuator link is connected to FICD lever, setting speed control lever at a specified speed when FICD is at work at the time of idling.

**Legend**

1. Speed control lever
2. FICD actuator
3. FICD lever

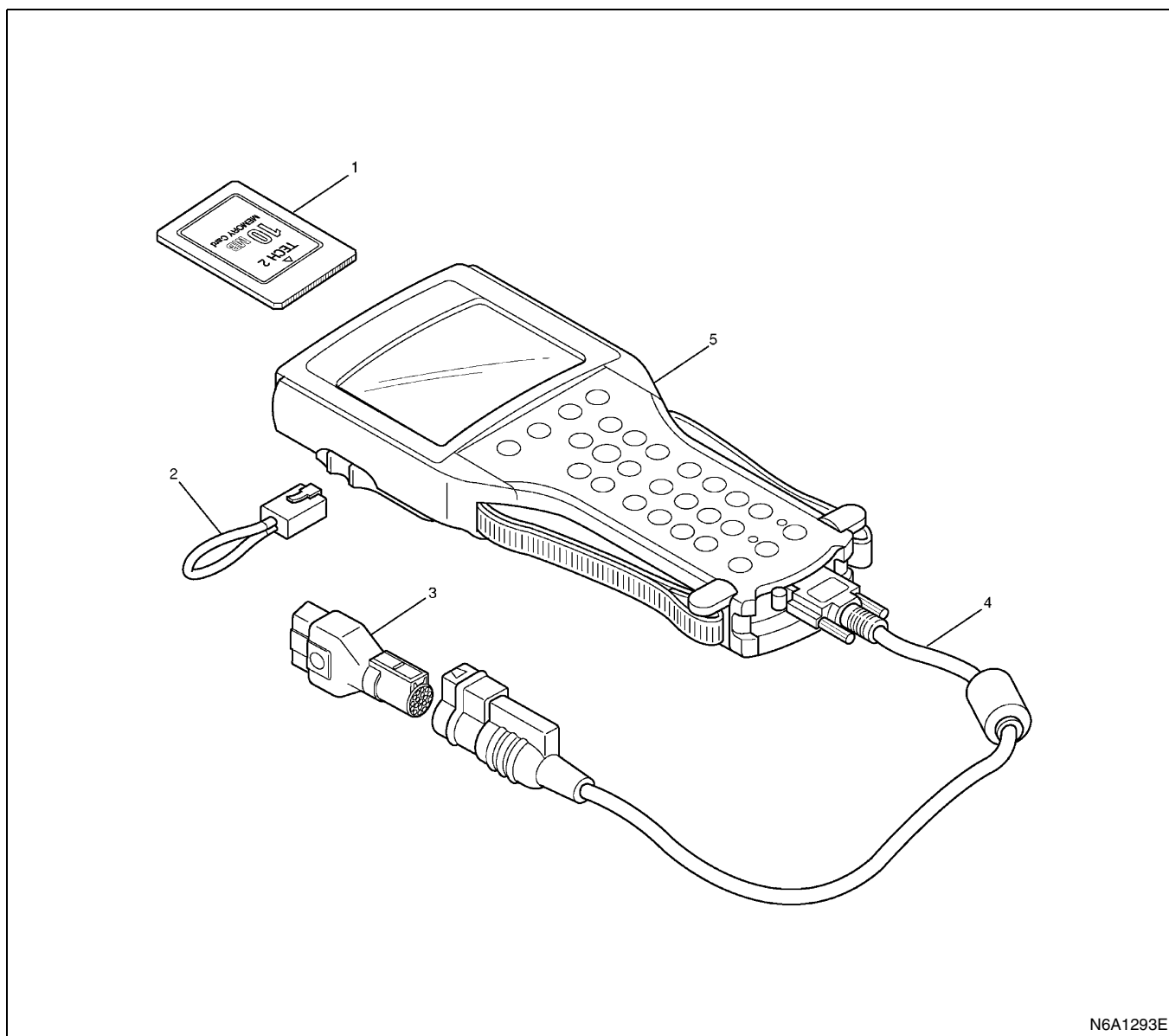
3. The link of the actuator for the aneroid compensator is connected to full load set lever. The full load set lever is connected to a U-lever. When the atmospheric sensor built in Engine Control Module (ECM) makes the actuator work, the full load set lever and U-lever are rotated to a specified position

so that the control rack is drawn in the direction of reducing fuel injection amount.

**Legend**

1. Aneroid compensator actuator
2. Full load set lever

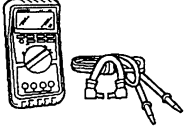
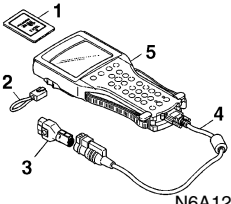
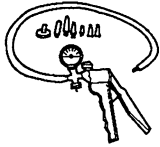
SPECIAL TOOLS



N6A1293E

Legend

- | | |
|------------------------------|--------------|
| 1. PCMCIA card | 4. DLC cable |
| 2. RS232 loop back connector | 5. TECH-2 |
| 3. SAE 16/19 adapter | |

Illustration	Tool Number / Description / Remarks
 5884003660	5-8840-0366-0 (J 39200) / High Impedance Multi- meter (Digital Voltmeter- DVM)
 N6A1295E	1. PCMCIA Card 2. RS232 Loop Back 3. SAE 16/19 Adapter 4. DLC Cable 5. TECH-2
 5884002790	5-8840-0279-0 (J 23738- A) / Vacuum Pump with Gauge

DIAGNOSIS (4HG1-T Only)

Strategy-Based Diagnostics

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. 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.
 - Detect unusual sounds or odors.
 - Gather diagnostic trouble code information to achieve an effective repair.
3. Check bulletins and other service information.
 - This includes videos, newsletters, etc.
4. Refer to service information (manual) system check (s).
 - "System checks" contain information on a system that may not be supported by one or more DTCs.
System checks verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to service diagnostics.

Diagnostic Trouble Code (DTC) Stored

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

No DTC

Select the symptom from the symptom tables.

Follow the diagnostic paths or suggestions to complete the repair. You may refer to the applicable component/system check in the system checks.

No Matchig 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 called intermittents. To resolve intermittents, perform the following steps:

1. Evaluate the symptoms and the conditions described by the customer.
2. Use a check sheet or other method to identify the circuit or electrical system component.

3. Follow the suggestions for intermittent diagnosis found in the service documentation.

No Trouble Found

This condition exists when the vehicle 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. Re-examine 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 according to customer complaint.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with self diagnostic system diagnostics. Following a repair, the technician should perform the following steps:

Important:

Follow the steps below when you verify repairs on self diagnostic systems. Failure to follow these steps could result in unnecessary repairs.

1. Review and record the Failure Records for the DTC which has been diagnosed.
2. Clear the DTCs.
3. Operate the vehicle within conditions according to customer complaint.
4. Monitor the Diagnostic Trouble Code (DTC) status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

GENERAL SERVICE INFORMATION

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

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

Basic Knowledge of Tools Required

Notice:

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 is necessary to effectively use this section of the Service Manual

Self Diagnostic System Check

Self Diagnostic System should be checked as follows:

1. When Ignition key is turned from the "OFF" to the "ON" position, make sure that Malfunction Indicator Lamp (MIL) is lit for 0.3 — 0.8 sec.
2. Connect Scan Tool and check to see if MIL is always lit.

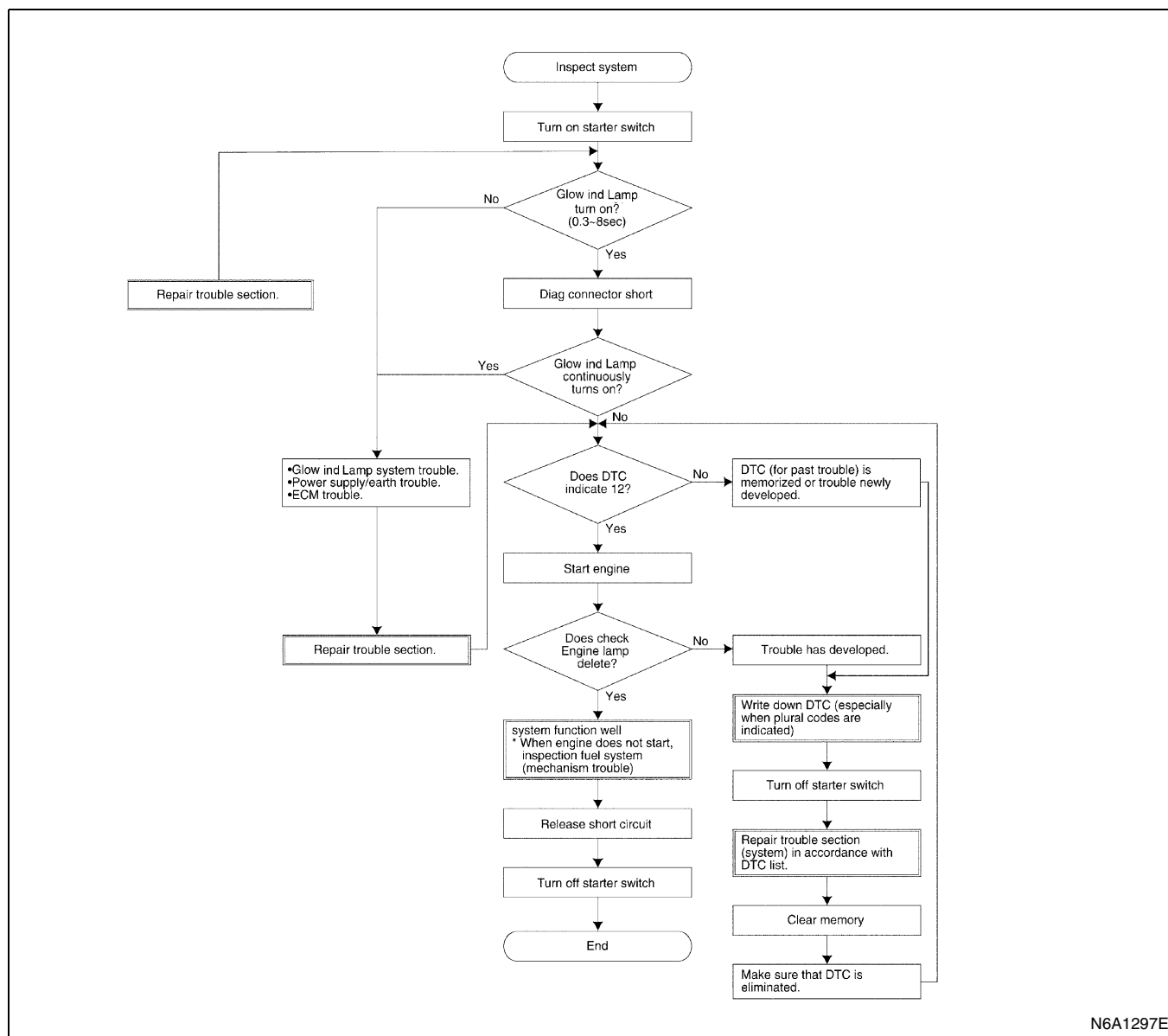
If so, Self Diagnostic System is normal.

Troubleshooting

Caution taken in inspecting

1. In inspecting system, write down Diagnostic Trouble Code (DTC) to be indicated. (especially, when plural self-diagnosis codes are indicated.)
2. Before eliminating the indicated DTC by a memory clear switch, doubly inspect abnormal place as indicated in DTC.

Inspection Procedure Flowchart (Diagnostic System Check)



N6A1297E

Notice:

Please note that some items of DTC may not be generated unless the engine is warmed up or unless the vehicle is driven under load.

Self-diagnosis Functions

Memorization of diagnostic trouble code

The self-diagnosis code indicated will be memorized in Electronically Erasable Programmable Read Only Memory (EEPROM) with in the Engine Control Module (ECM).

Accordingly even if the starter switch turns off or the ECM is removed from the vehicle, the memorized self-diagnosis code will not be eliminated.

* Unless an elimination procedure is taken, the diagnostic trouble code (DTC) will remain in memory. (The memory will be eliminated only by a memory clear switch.)

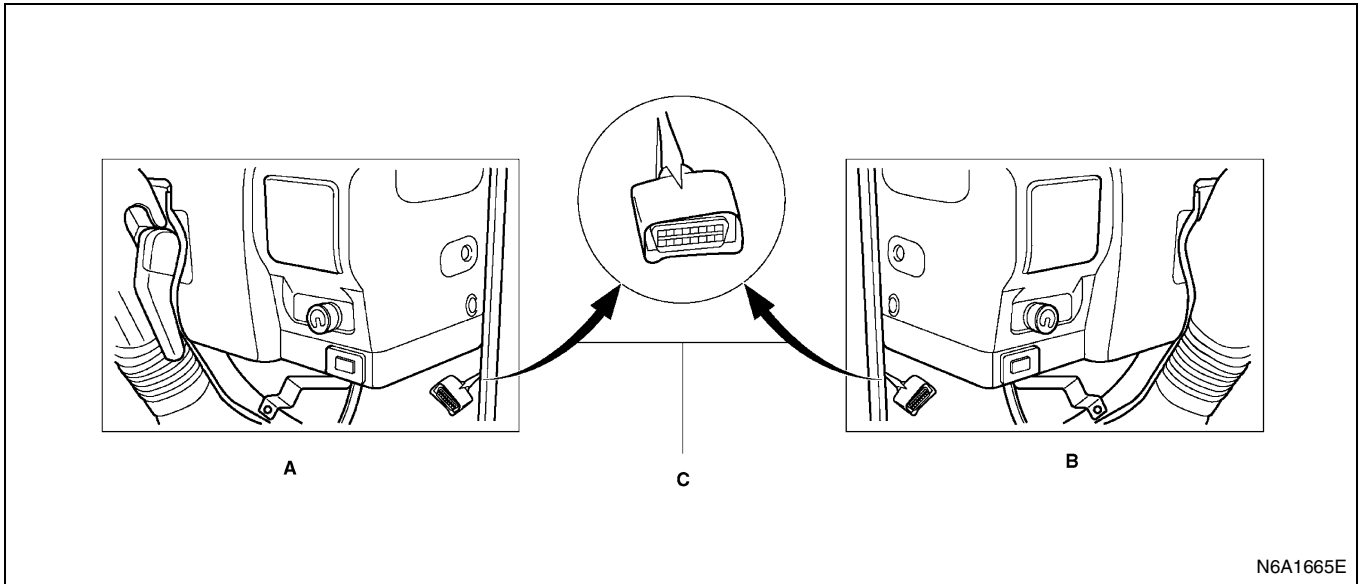
Elimination of diagnostic trouble code

The DTC memorized in the EEPROM with in the ECM can be eliminated only by the operation of the memory clear switch. The elimination method memory clear switch will be described below:

1. Turn OFF ignition switch.
2. Use 4.7k Ω resistance and make short circuit on memory clear switch.
3. Turn ON ignition switch. The indication lamp turn on (lighting) continuously after three seconds flashing the indication lamp.
4. Turn OFF ignition switch.
5. Remove shortage resistance from memory clear switch.

Location of the Memory Clear Switch

Location of the Memory Clear Switch (Diagnosis Connector)

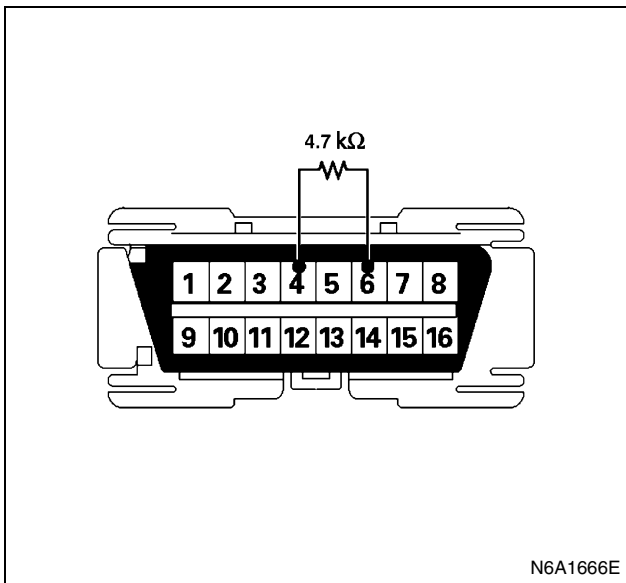


N6A1665E

Legend

- A. Right-hand drive
B. Left-hand drive

C. Terminal assignment of diagnosis connector



N6A1666E

How to read flashing of the indicator lamp:

The two-digit diagnosis code flashes starting from ten's figure to indicate the diagnosis code.

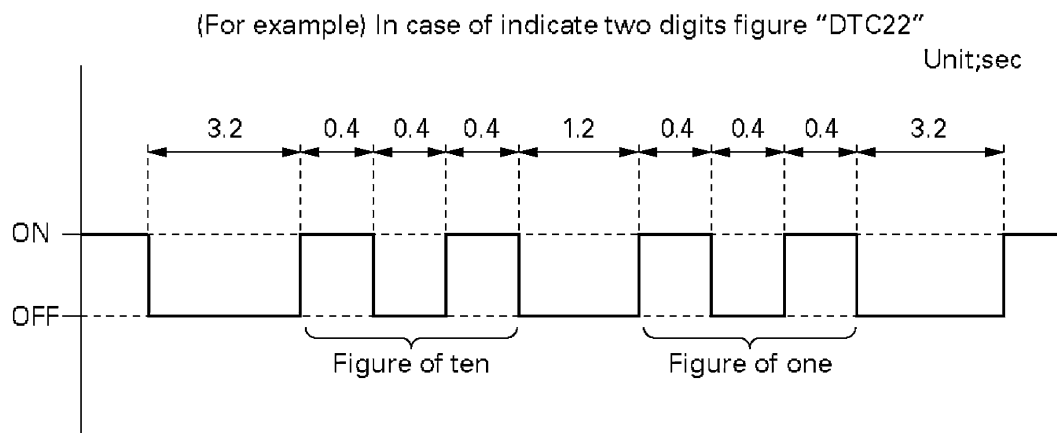
Please read the diagnosis code from the flashing.

If the plural diagnosis codes are indicated, the same diagnosis code is flashed repeatedly in steps of three times.

Please read it correctly.

- Diagnostic Trouble Code (DTC) outputting is done in decreasingly order of DTC number.
- Indication is changed over on completion of output DTC indication.
- DTC indicator is stopped with diagnostic switch being off.
- When there is no DTC output, -12+ is outputted in normal DTC code.
- After indicating 3 times per 1 DTC, shift is conducted to the next DTC. (After making a round, the indications are repeated again.)
- In case of the same diagnostic code, it is used 1 DTC (3 times indication.)

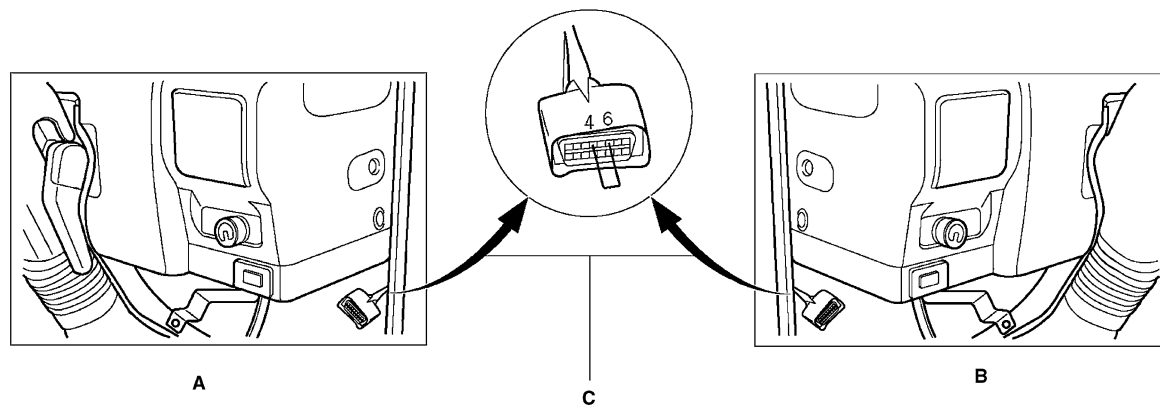
NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4, 5	CHECKER GND

Example Diagnosis Trouble Code Output

N6A1299E

Legend

1. (For example) In case of indicate two digits figure "DTC22"
2. Figure of ten
3. Figure of one

Flashing of Indicator Lamp

N6A1667E

Legend

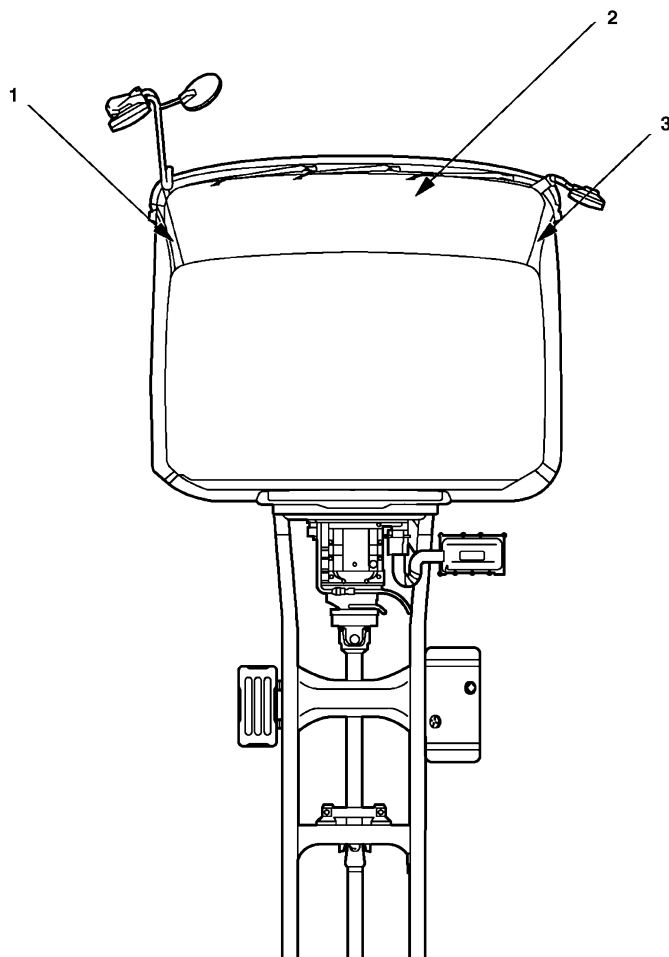
- A. Right-hand drive
- B. Left-hand drive
- C. Terminal assignment of diagnosis connector

Diagnosis Trouble Code (DTC) List

DTC#	TECH 2 STRING
21	Rack Sensor Circuit Low Voltage
22	Rack Sensor Circuit High Voltage
13	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage
14	ECT Sensor Circuit Low Voltage
31	Exhaust Gas Recirculation (EGR) Vacuum Switching Valve (VSV) Solenoid Circuit Low Voltage
32	EGR VSV Solenoid Circuit High Voltage
52	Electronically Erasable Programmable Read Only Memory (EEPROM) Error

Error Classified		Trouble Code	Diagnostic Condition	Return Condition	Back Up	Judging Time
Normal		12	No other trouble code.		No history of this diagnosis recorded	—
Rack Sensor	Harness Open GND short	21	Rack Voltage 0.3V or lower, Engine speed 600 — 900rpm, and water Temp. 0°C (32°F) or higher are detected for 3 seconds running.	When forward normal	VSV: EGR Output stop. Rack Learning valve: 0	3.52 sec
	+5V short Rack Sensor Power Voltage	22	5V or higher Rack Voltage detected.			0.52 sec
Water Temp Sensor	Harness Open +B short	13	-79°C/-110°F (390kΩ) or lower, or 120°C/248°F (115kΩ) or higher detected.	When forward normal	VSV: EGR Output stop.	0.52 sec
	GND short	14				
VSV: EGR	Harness Open GND short	*31	Output TR Monitor	When forward normal	VSV: EGR Output stop.	1.57 sec
	+B short	*32				
	ECM EEPROM error	52	Check when ECM is started and when Trouble Code is written.	When forward normal	Trouble Code other than 52 (EEPROM error) not indicated.	

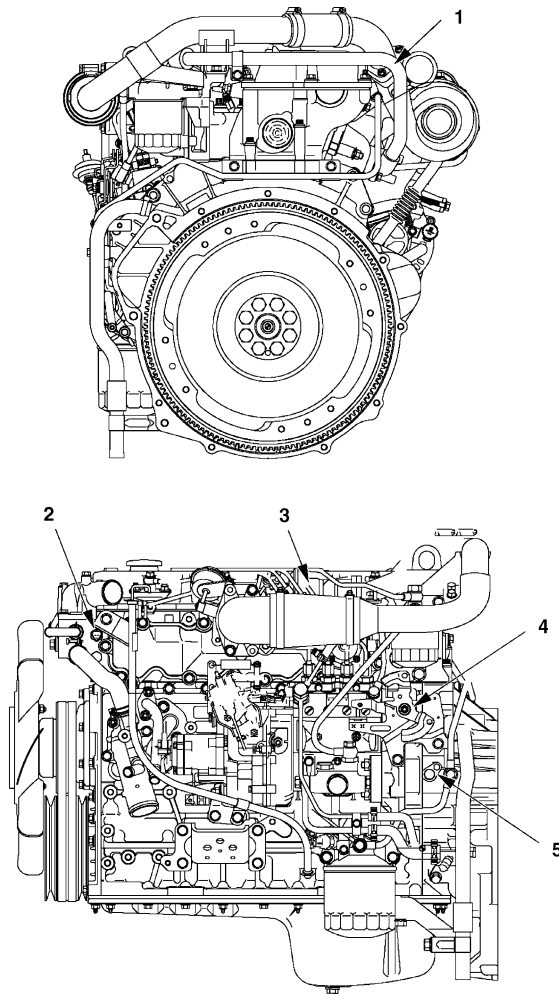
Location of Sensor and Switch



N6A1301E

Legend

- | | |
|--|---|
| 1. Diagnosis connector (Left-hand drive) | 3. Diagnosis connector (Right-hand drive) |
| 2. ECM including atmospheric | |
-

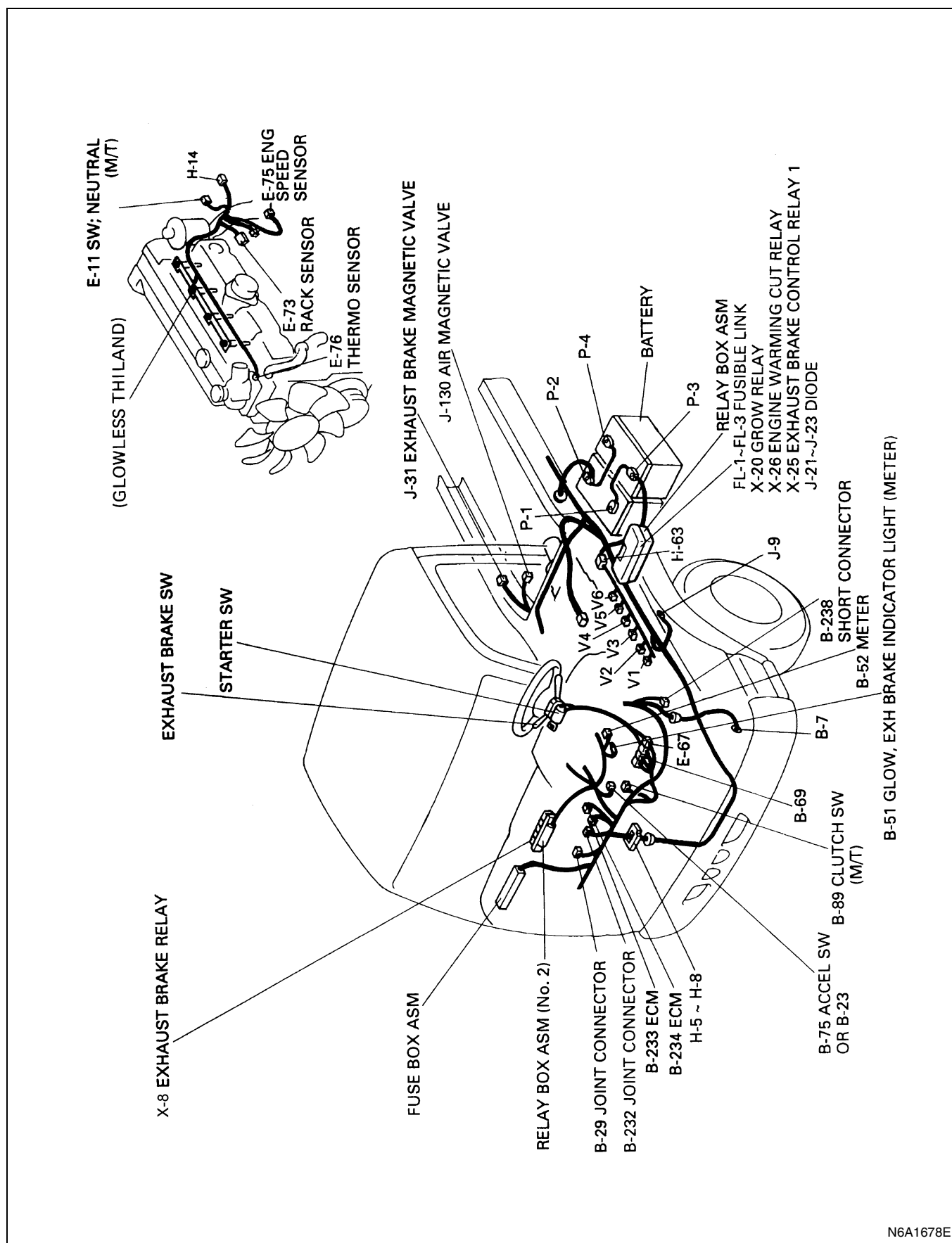


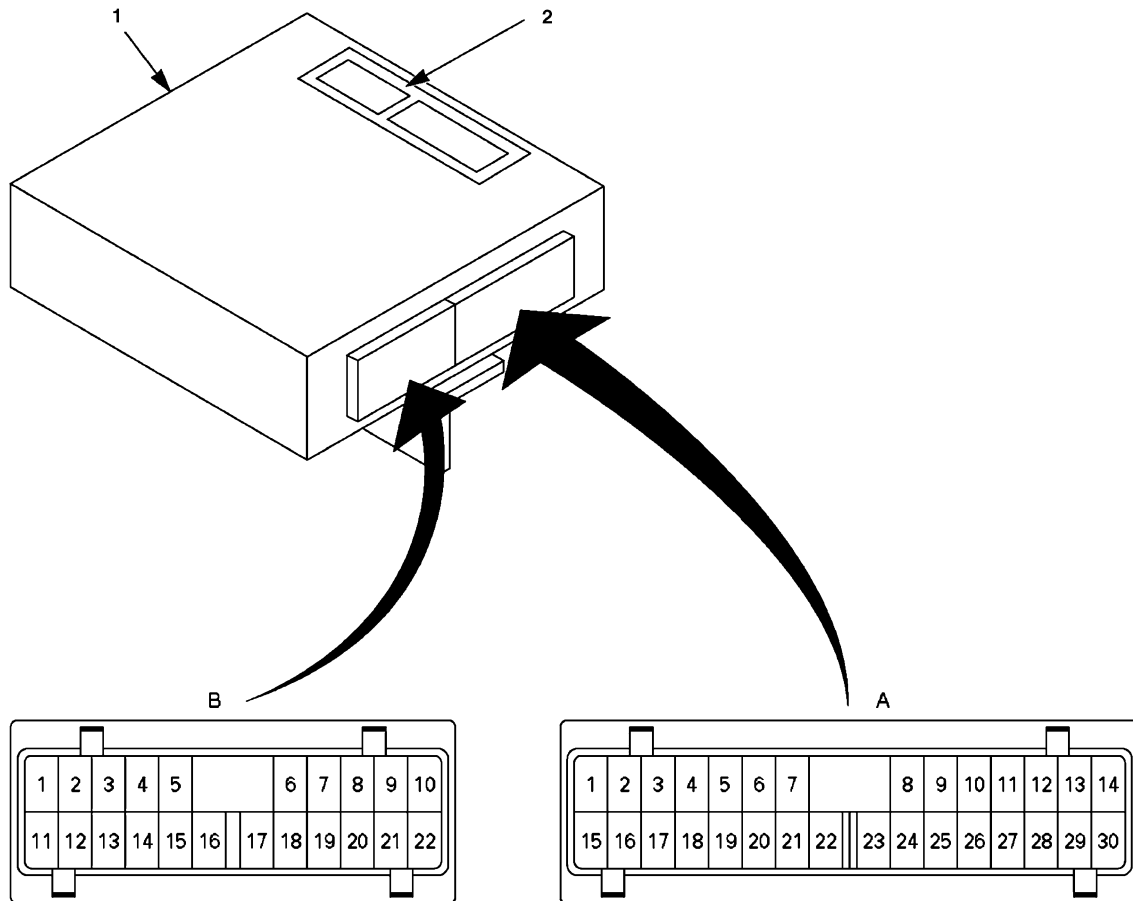
N6A1302E

Legend

- | | |
|------------------------|-----------------|
| 1. EGR pipe | 4. Rack sensor |
| 2. Coolant temp sensor | 5. Speed sensor |
| 3. EGR valve | |

Parts Location



Engine Control Module (ECM)**Appearance of ECM**

N6A1304E

Legend

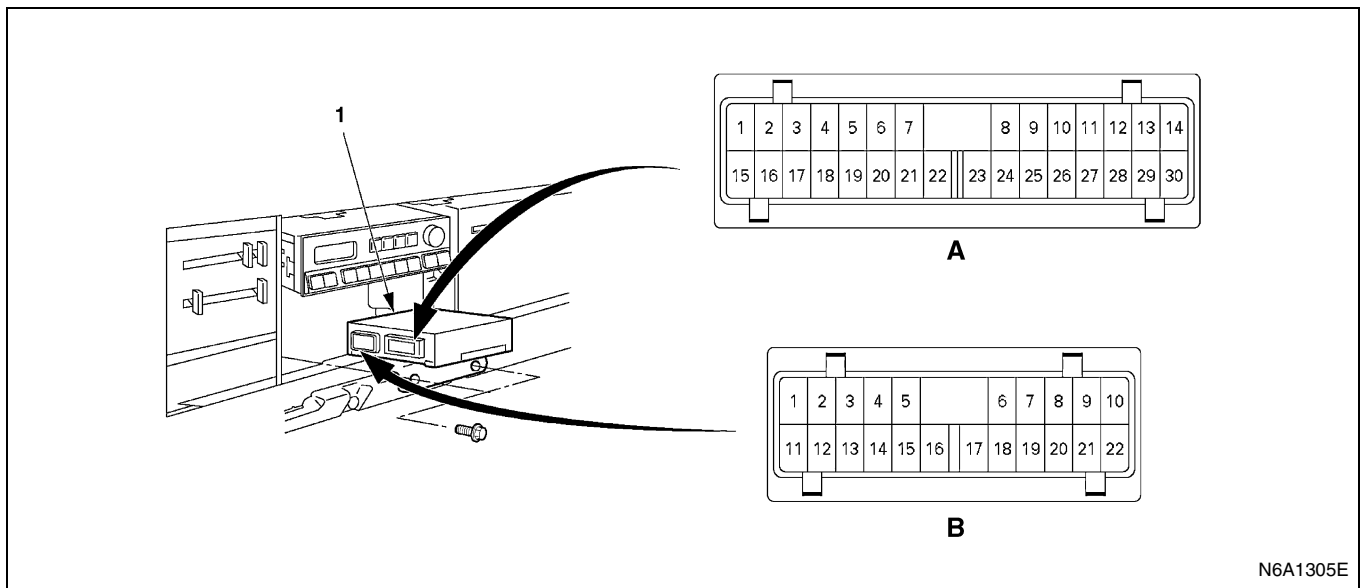
- A. Detail of 30 pins connector
B. Detail of 22 pins connector

1. ECM
2. Name plate

Chart of Engine Control Module (ECM) Input/Output

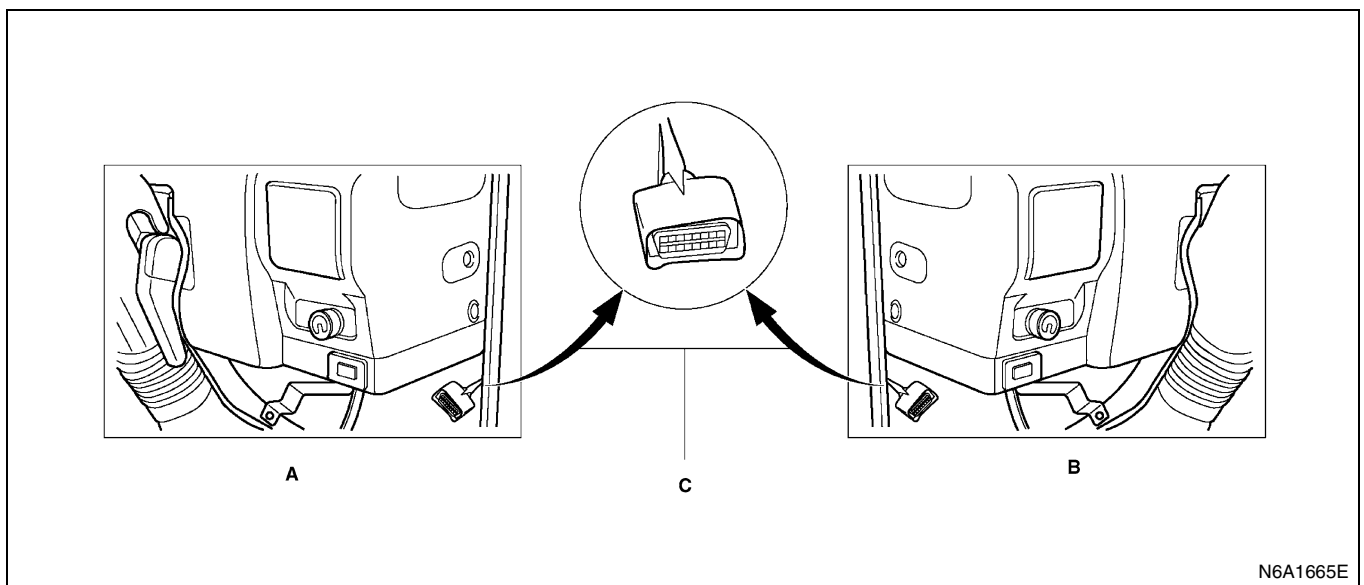
Connector number	Connector name
A-1	CHECKER
A-2	Not used
A-3	QOS (W/Glow only)
A-4	Not used
A-5	Not used
A-6	RACK+
A-7	RACK SIG
A-8	BATTERY
A-9	IGKBY
A-10	Not used
A-11	Not used
A-12	Not used
A-13	Not used
A-14	Not used
A-15	CHECKER GND
A-16	DIAG
A-17	Not used
A-18	Not used
A-19	Not used
A-20	Not used
A-21	RACK-
A-22	GND
A-23	Not used
A-24	Not used
A-25	Not used
A-26	Not used
A-27	Not used
A-28	Not used
A-29	Not used
A-30	Not used

Connector number	Connector name
B-1	VSV: EGR
B-2	GLOW RELAY
B-3	GLOW IND LAMP
B-4	Not used
B-5	Not used
B-6	Not used
B-7	THERMO -
B-8	THERMO +
B-9	ENGINE -
B-10	ENGINE +
B-11	Not used
B-12	Not used
B-13	Not used
B-14	Not used
B-15	Not used
B-16	Not used
B-17	Not used
B-18	STARTER
B-19	EXH BRAKE
B-20	Not used
B-21	Not used
B-22	Not used

Location of the Engine Control Module (ECM) Connector**Legend**

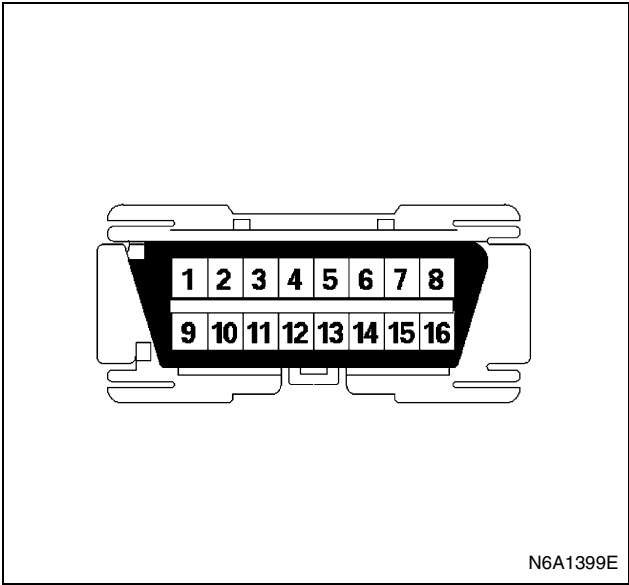
- A. 30 pins connector (green)
B. 22 pins connector (green)

1. Engine control module (ECM)

Location of Data Link Connector (DLC)**Legend**

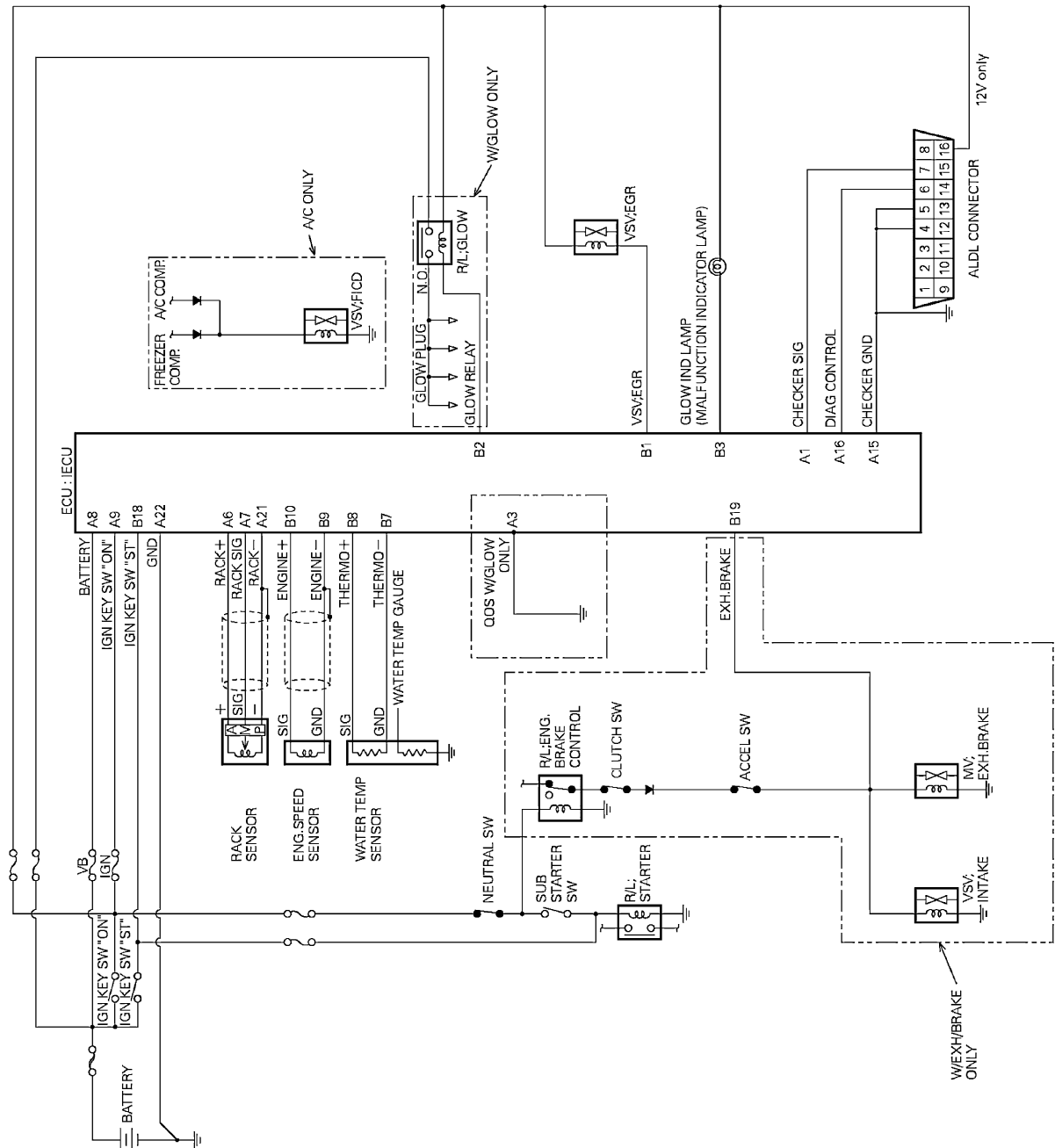
- A. Right-hand drive
B. Left-hand drive

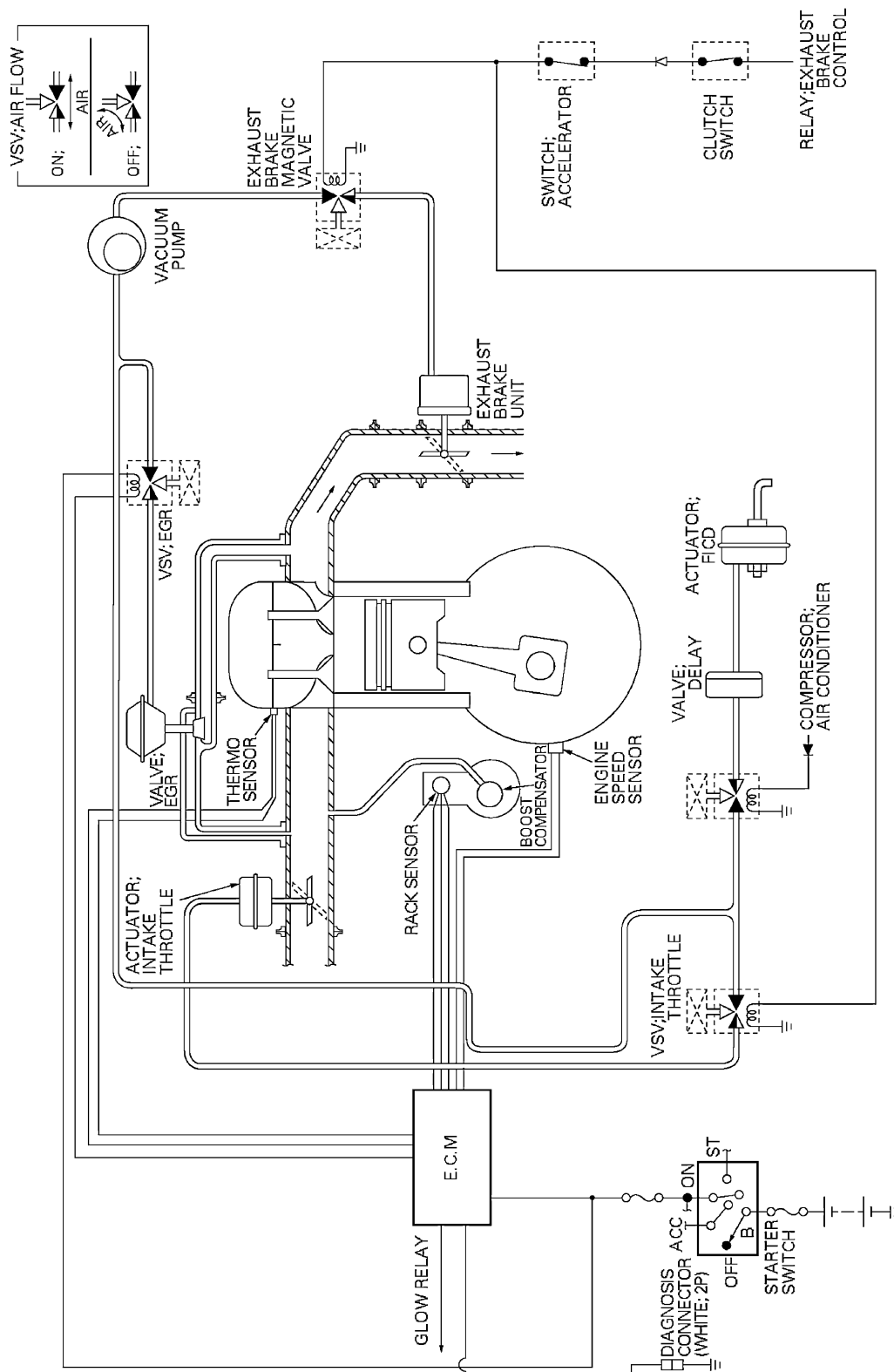
C. Terminal assignment of diagnosis connector

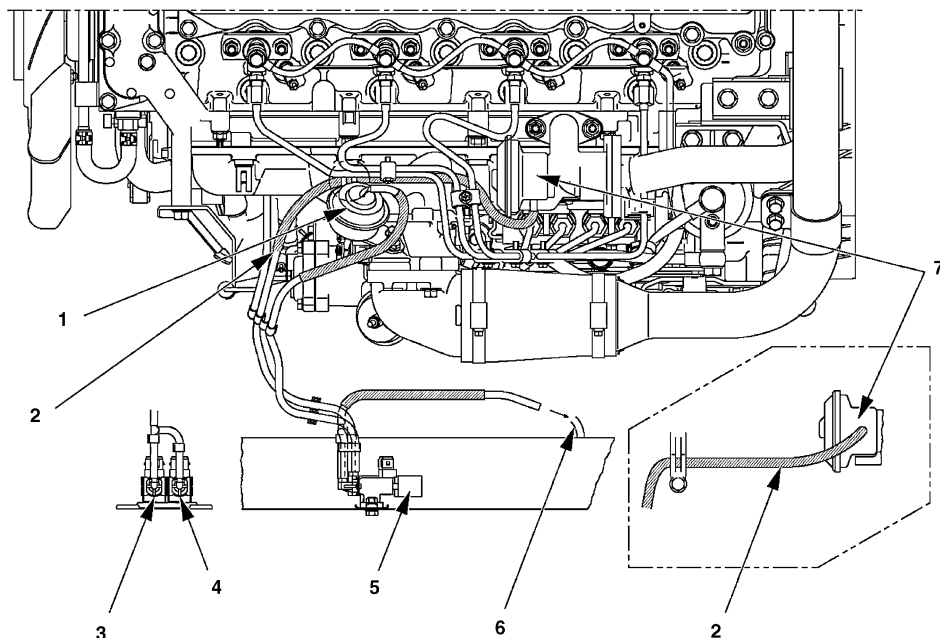


NO	TERMINAL NAME
6	DIAG CONTROL
7	CHECKER SIG
4, 5	CHECKER GND

Engine Control Module (ECM) System Wiring Diagram



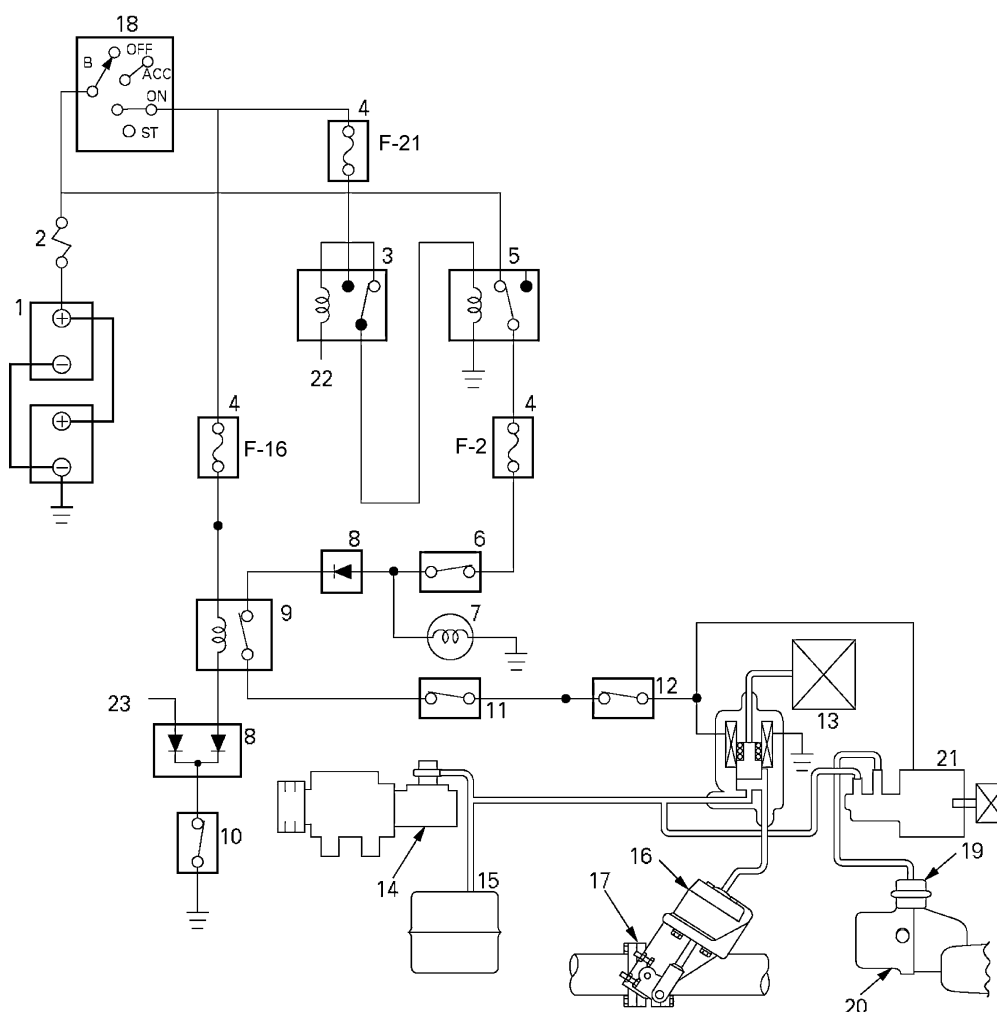
Auxiliary Engine Control System (Equipped with Exhaust gas recirculation (EGR))

Vacuum Switching Valve (VSV) Circuit (Equipped with Exhaust gas recirculation (EGR))

N6A1309E

Legend

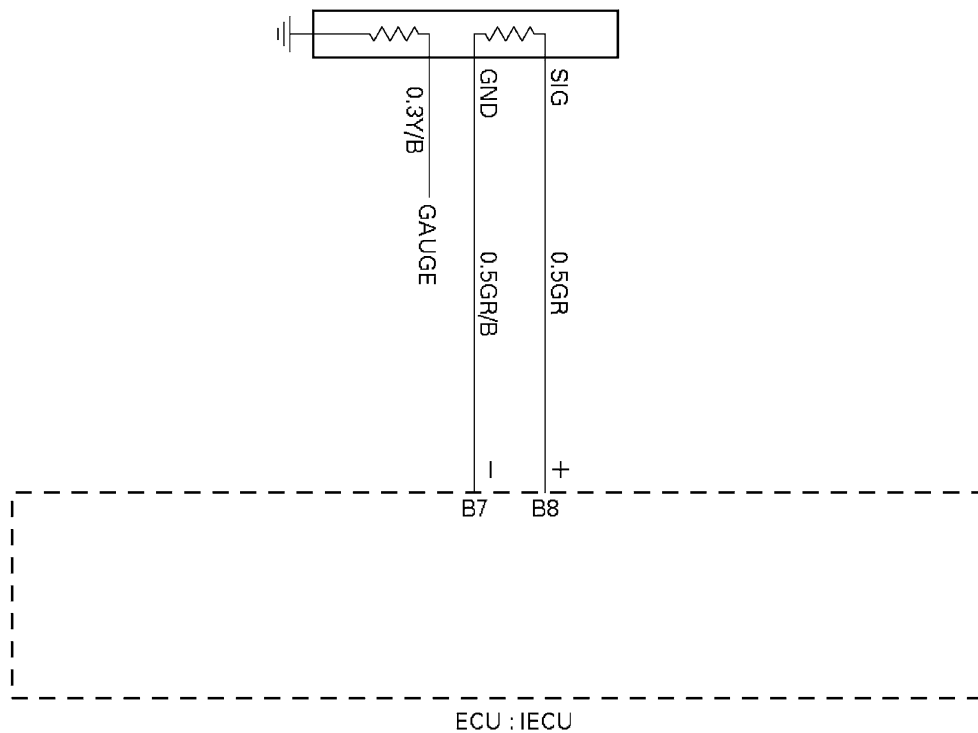
- | | |
|----------------------------|---------------------------|
| 1. Intake throttle chamber | 5. Vacuum Switching Valve |
| 2. Vacuum hose | 6. Vacuum source |
| 3. Intake throttle valve | 7. EGR valve |
| 4. FICD valve | |

Exhaust Brake Control

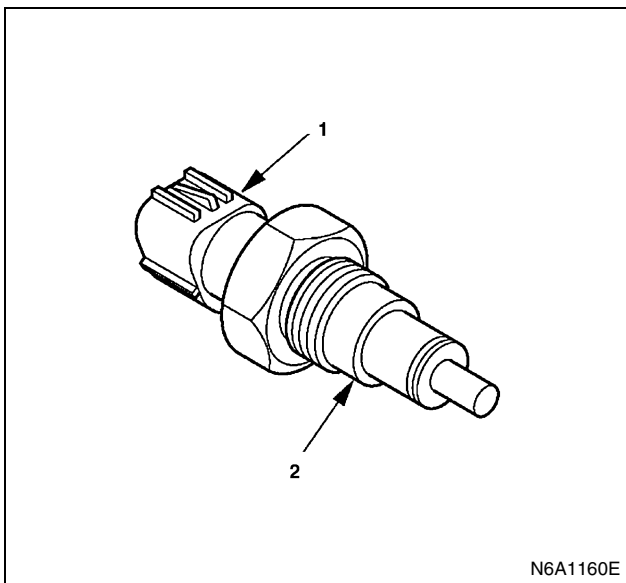
N6A1310E

Legend

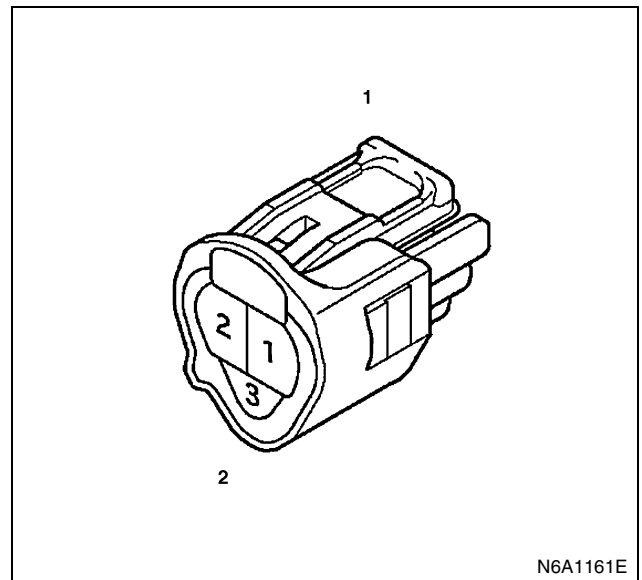
- | | |
|--------------------------------|-------------------------------------|
| 1. Batteries | 13. Magnetic valve: Exhaust brake |
| 2. Fusible link wire | 14. Vacuum pump |
| 3. Charge relay | 15. Vacuum tank |
| 4. Fuse | 16. Vacuum chamber: Exhaust brake |
| 5. Exhaust brake relay | 17. Exhaust brake valve |
| 6. Exhaust brake switch | 18. Key switch |
| 7. Indicator light | 19. Vacuum chamber: Intake throttle |
| 8. Diode | 20. Intake throttle |
| 9. Exhaust brake control relay | 21. Magnetic valve intake throttle |
| 10. Neutral switch | 22. Generator (L) |
| 11. Clutch switch | 23. Starter relay coil |
| 12. Accelerator switch | |

DTC-13 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

N6A1311E

Appearance of Water Temperature Sensor and Connector Pin Assignment**Temperature Sensor****Legend**

1. 3 pin connector
2. Engine coolant temperature sensor

Connector Pin Assignment**Legend**

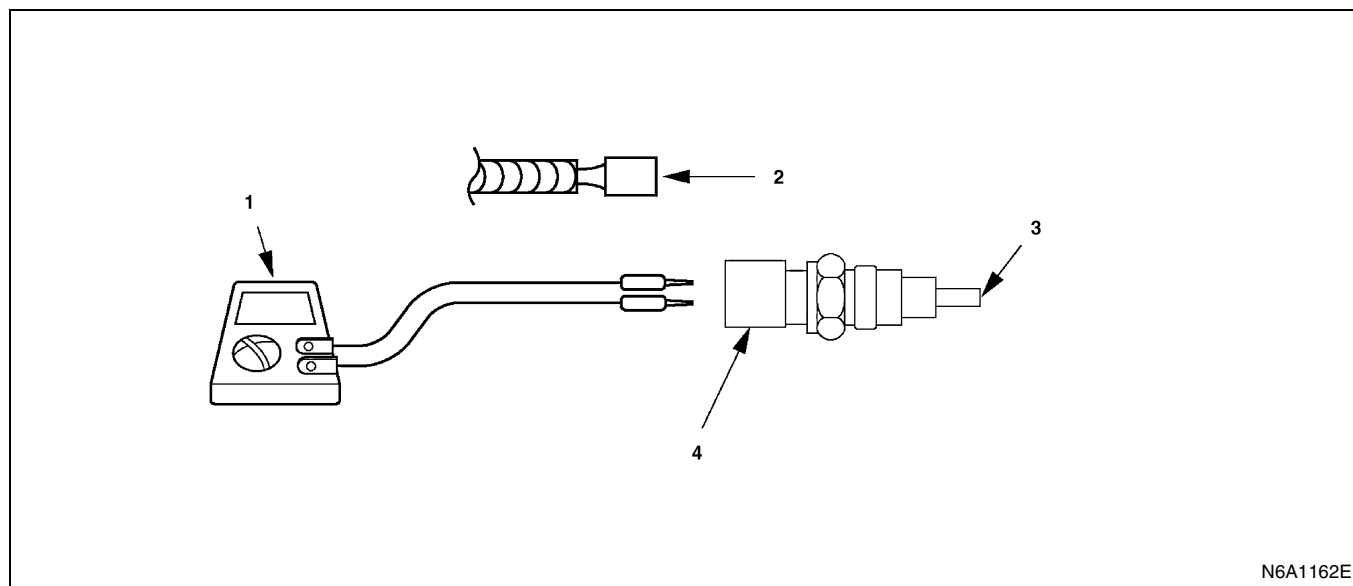
1. To ECT sensor
2. 3 pin gray

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure Resistance at Engine Coolant Temperature (ECT) Sensor

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



N6A1162E

Legend

- | | |
|-------------------------------|---|
| 1. Circuit tester | 3. Engine coolant temperature sensor |
| 2. Remove engine wire harness | 4. Measure resistance between connector pin |

Resistance value

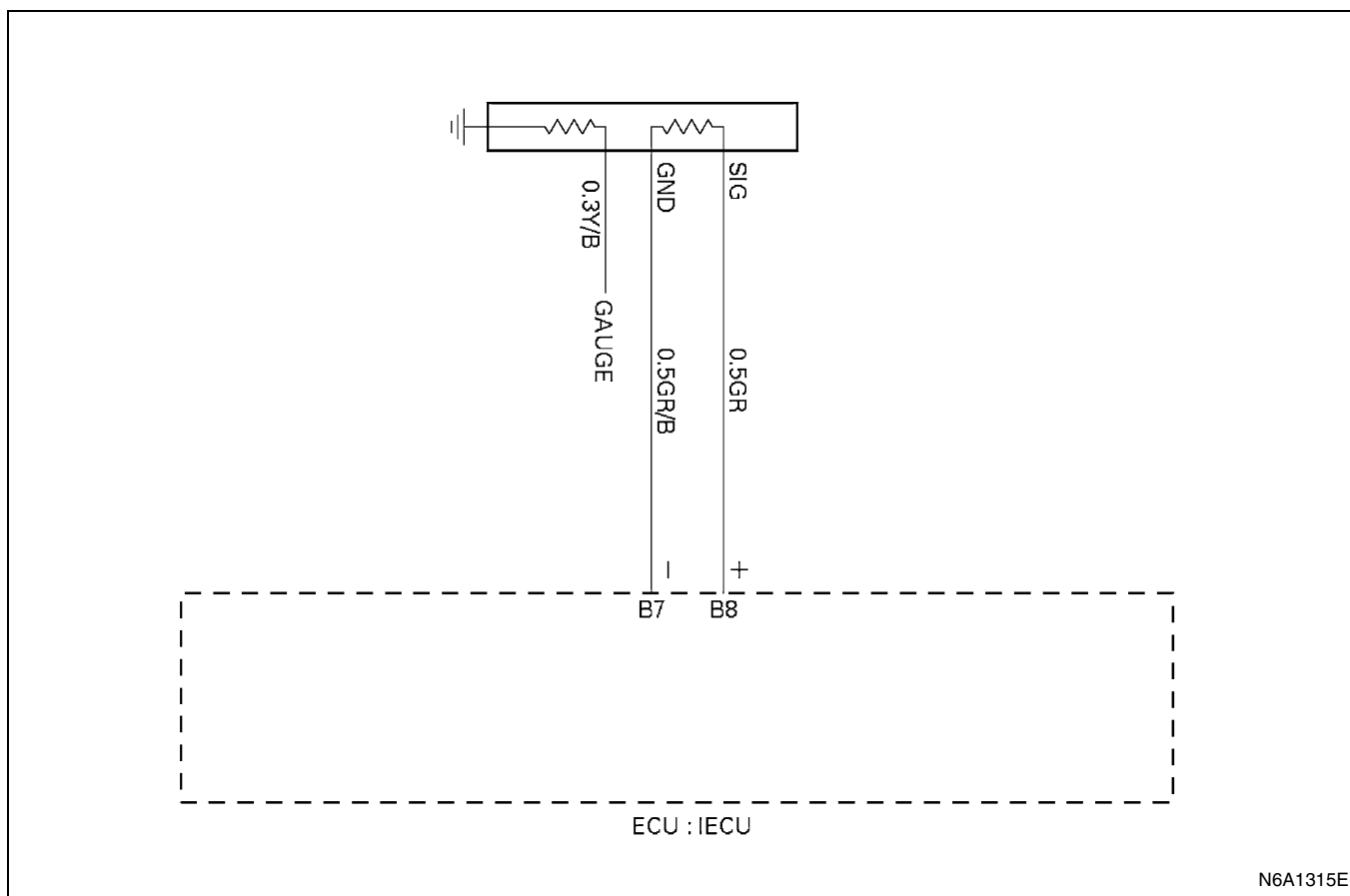
Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	1 ↔ 2	2.5 (kΩ)	20°C (68°F)	Thermistor for ENGINE
		247 (Ω)	90°C (194°F)	
	1 ↔ Body	∞	—	Thermistor for ENGINE ↔ Body
	2 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	3 ↔ Body	146.6 (Ω)	60°C (140°F)	Thermistor for meter ENGINE
	2 ↔ Body	∞	—	Thermistor for ECM ↔ Body

Notice:

Resistance value is difference according to the temperature of temperature sensor.

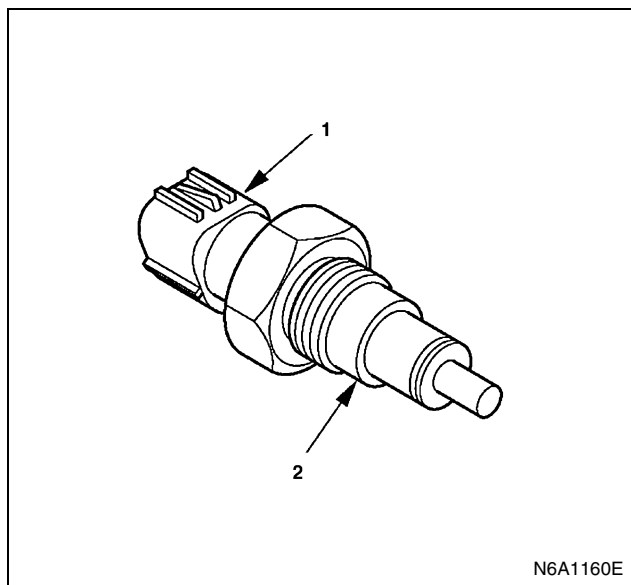
Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to self diagnostic system check
2	1. Ignition "OFF" 2. Disconnect the ECT sensor electrical connector. 3. Jumper the ECT sensor signal circuit and the ECT sensor ground circuit together at the ECT sensor harness connector. Does indicate DTC 13?	—	Go to Step 4	Go to Step 3
3	1. Ignition "OFF" 2. Jumper the ECT signal circuit at the ECT sensor harness connector to chassis ground. Does indicate DTC 13?	—	Go to Step 5	Go to Step 6
4	Check four poor connection at the ECT sensor and replace terminals if necessary. Did any terminals require replacement?	—	Go to Step 10	Go to Step 8
5	1. Ignition "OFF". 2. Disconnect the ECM, and check the ECT sensor ground circuit for an open. 3. If the ECT sensor ground circuit is open, repair it as necessary. Was the ECT sensor ground circuit open?	—	Go to Step 10	Go to Step 7
6	1. Ignition "OFF". 2. Disconnect the ECM, and check the ECT sensor signal circuit for an open. 3. If the ECT signal circuit is open, repair it as necessary. Was the ECT sensor signal circuit open?	—	Go to Step 10	Go to Step 7
7	Check for poor sensor ground or ECT sensor signal circuit terminal connection at the ECU and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	—	Go to Step 10	Go to Step 9
8	1. Ignition "OFF" 2. Replace the ECT Sensor. Is the action complete?	—	Go to Step 10	—
9	1. Replace the ECM. Is the action complete?	—	Go to Step 10	—
10	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Does DTC 13 come normal condition?	—	Go to Step 11	Go to Step 2
11	Is any current trouble other than DTC 13 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

DTC-14 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage



Appearance of Water Temperature Sensor and Connector Pin Assignment

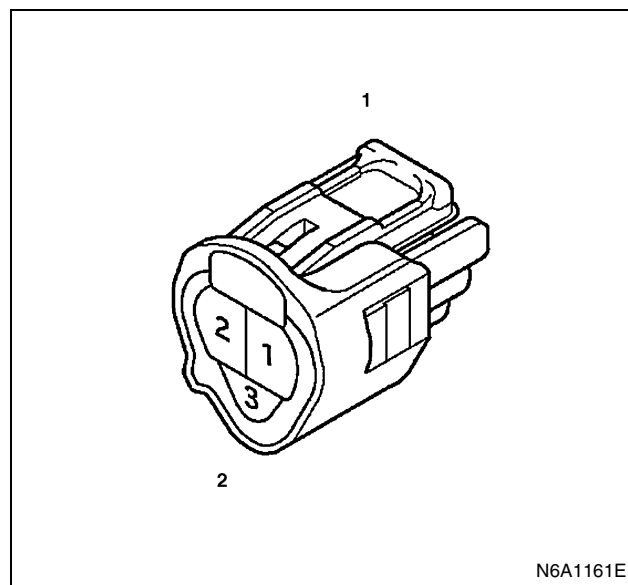
Temperature Sensor



Legend

1. 3 pin connector
2. Engine coolant temperature sensor

Connector Pin Assignment



Legend

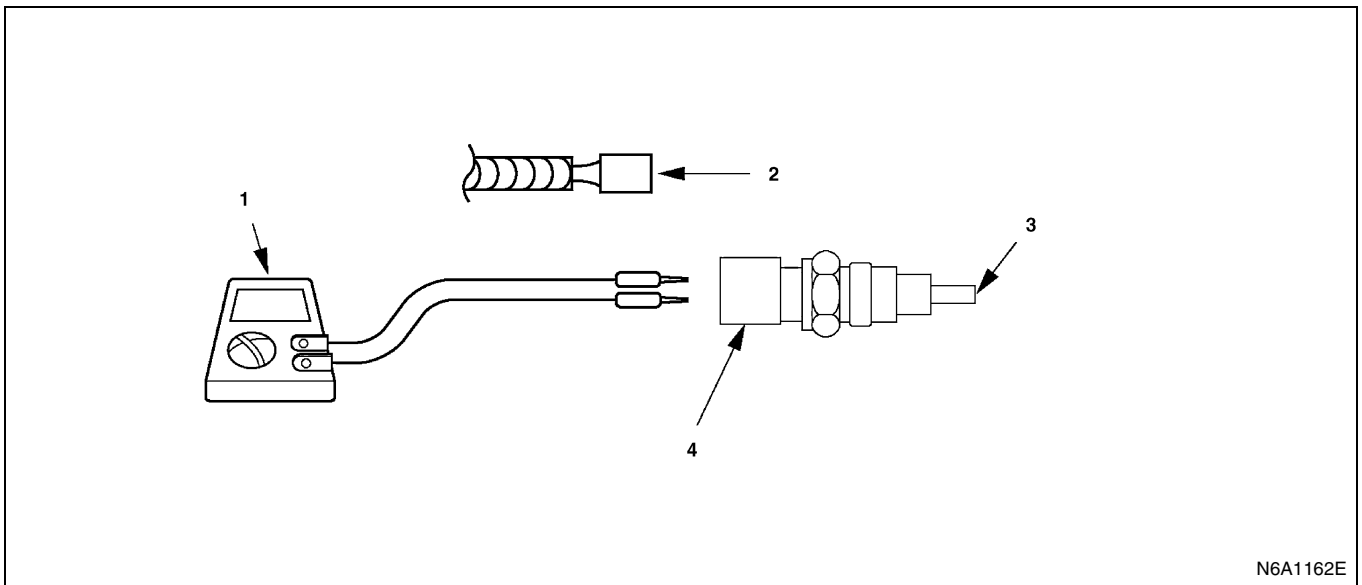
1. To ECT sensor
2. 3 pin gray

Connector No	Signal
1	Thermistor for engine
2	Thermistor for engine
3	Thermistor for meter

Measure Resistance at Engine Coolant Temperature (ECT) Sensor

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



N6A1162E

Legend

- | | |
|-------------------------------|---|
| 1. Circuit tester | 3. Engine coolant temperature sensor |
| 2. Remove engine wire harness | 4. Measure resistance between connector pin |

Resistance value

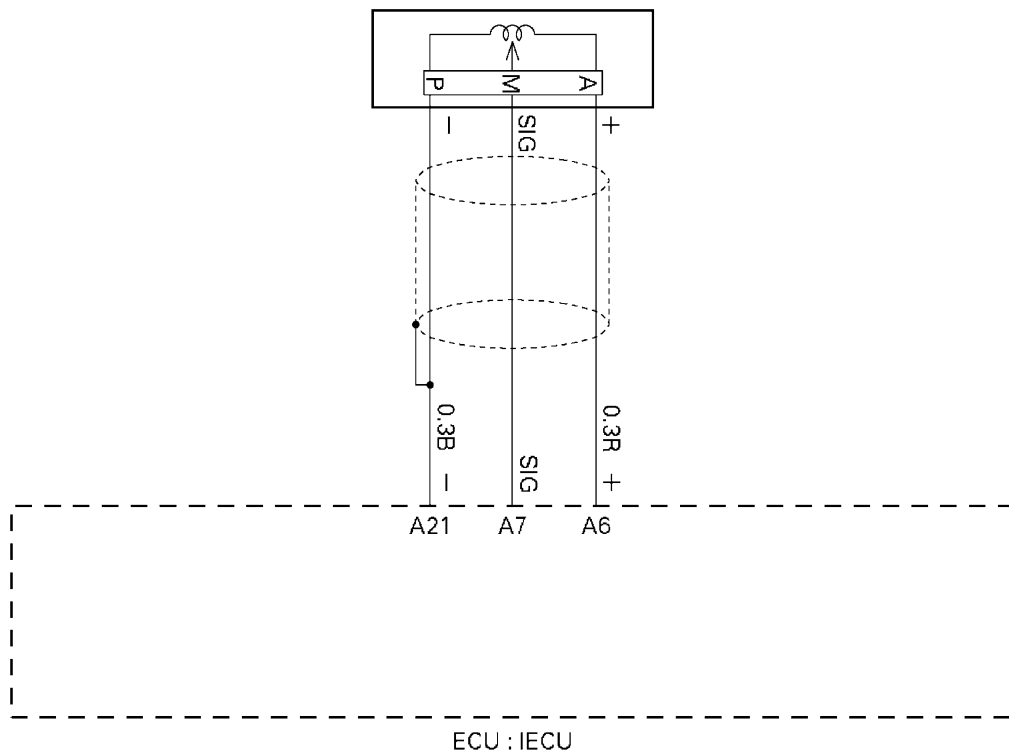
Inspection Point		Resistance Value	Temperature on sensor	Reference
Connector	Pin No.			
3 pin Black	1 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	1 ↔ 2	2.5 (kΩ)	20°C (68°F)	Thermistor for ENGINE
		247 (Ω)	90°C (194°F)	
	1 ↔ Body	∞	—	Thermistor for ENGINE ↔ Body
	2 ↔ 3	∞	—	Thermistor for ENGINE ↔ Thermistor for meter
	3 ↔ Body	146.6 (Ω)	60°C (140°F)	Thermistor for meter ENGINE
	2 ↔ Body	∞	—	Thermistor for ECM ↔ Body

Notice:

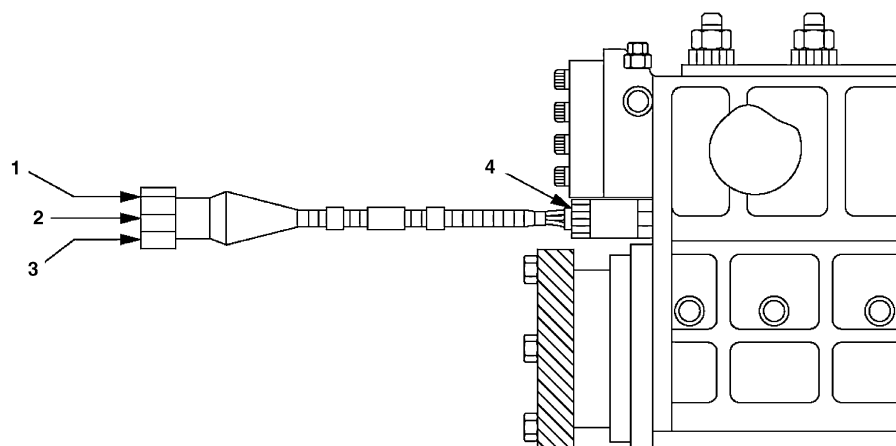
Resistance value is difference according to the temperature of temperature sensor.

6E-172 EMISSION AND ELECTRICAL DIAGNOSIS

Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to self diagnostic system check
2	1. Memory DTC to ECM. 2. Clear DTC. 3. Ignition "OFF" 4. Disconnect the ECT sensor. 5. Ignition "ON", Engine "OFF" Does indicate DTC 14? (Ignore DTC 13)	—	Go to Step 3	Go to Step 6
3	1. Ignition "OFF" 2. Check Connector ECT Sensor Harness for interterminal short. 3. Repair if necessary. Was ECT Sensor connector shorted?	—	Go to Step 8	Go to Step 4
4	1. Ignition "OFF" 2. Check the ECM connector terminal short. 3. Repair if necessary. Was ECM terminal shorted?	—	Go to Step 8	Go to Step 5
5	1. Disconnect the ECM. 2. Check if ECT sensor signal circuit for a short to ground or a short to ground circuit. 3. Repair if necessary. Is ECT sensor signal circuit shorted to ground?	—	Go to Step 8	Go to Step 7
6	1. Ignition "OFF" 2. Replace the ECT Sensor. Is the action complete?	—	Go to Step 8	—
7	1. Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Does DTC 14 come normal condition?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 14 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

DTC-21 Rack Sensor Circuit Low Voltage

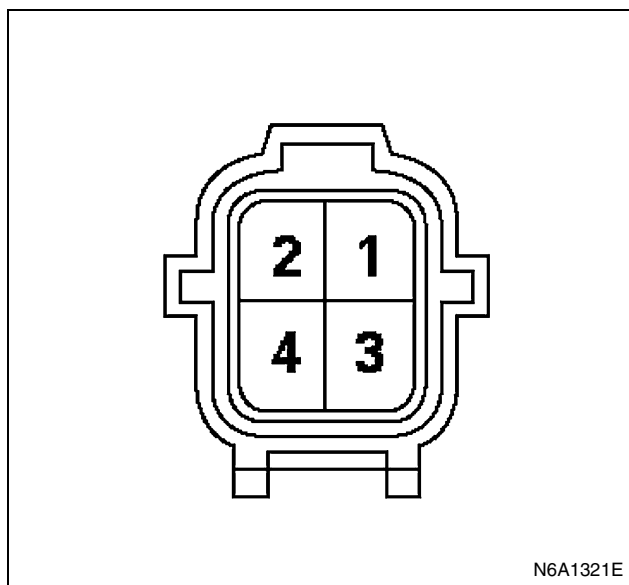
N6A1319E

Location of Rack Sensor Connector

N6A1320E

Legend

- | | |
|----------------|----------------|
| 1. OSC (red) | 3. GND (black) |
| 2. MDL (white) | 4. Rack sensor |

Connector Name of Rack Sensor**Notice:**

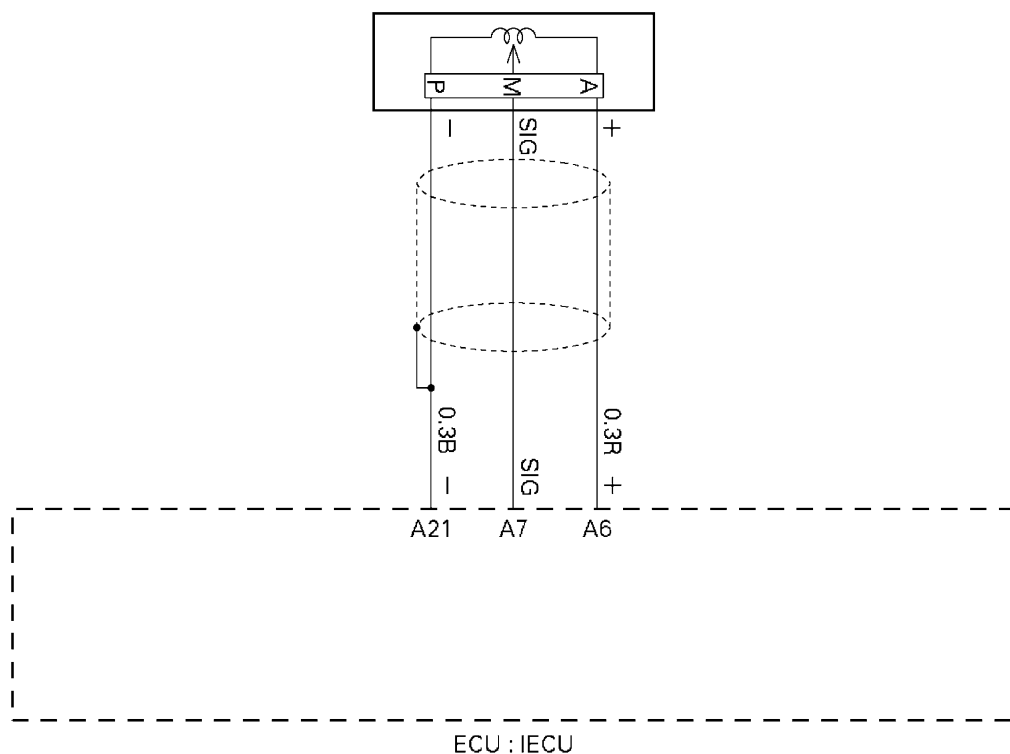
Mark “___” on connector which is plugged, therefore, should be confirmed to be played.

Relation Between Connector Number and Signal Name

Connector No	Signal name	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (GND)	W
4	Rack sensor (MDL)	B

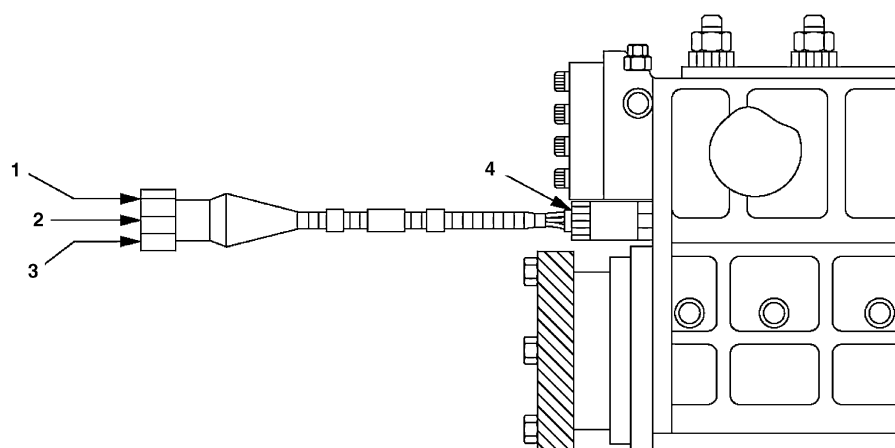
Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	1. Check harness side power source circuit and signal circuit for GND short. 2. Repair if necessary. Has DTC21 been corrected?	—	Go to Step 10	Go to Step 3
3	Disconnect Sensor Connector. Jumper RACK+ and RACK signal. Free from trouble now? Ignore code 22.	—	Go to Step 4	Go to Step 6
4	1. Apply 5V to RACK+ TERMINAL. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9 — 2.0V (Idling speed)	Go to Step 7	Go to Step 5
5	1. Check Rack Sensor Harness Signal Circuit and power source for GND short. Check signal circuit for disconnect. 2. Repair if necessary. Free from trouble now?	—	Go to Step 10	Go to Step 7
6	1. Check harness signal circuit and power source circuit for disconnect. 2. Repair if necessary. Free from trouble now?	—	Go to Step 10	Go to Step 9
7	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core (RACK end) inside RACK Sensor?	—	Go to Step 10	Go to Step 8
8	1. Replace the RACK Sensor. Is the action complete?	—	Go to Step 10	—
9	1. Replace the ECM. Is the action complete?	—	Go to Step 10	—
10	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 21 all right under Scan Tool Check?	—	Go to Step 11	Go to Step 2
11	Is any current trouble other than DTC 21 displayed by scan tool?	—	Go to trouble code section	Trouble code clear

DTC-22 Rack Sensor Circuit High Voltage



N6A1319E

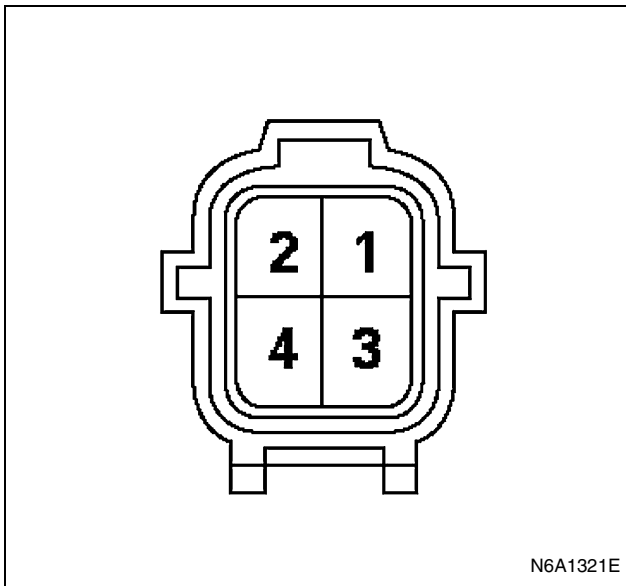
Location of Rack Sensor Connector



N6A1320E

Legend

- | | |
|----------------|----------------|
| 1. OSC (red) | 3. GND (black) |
| 2. MDL (white) | 4. Rack sensor |

Connector Name of Rack Sensor**Notice:**

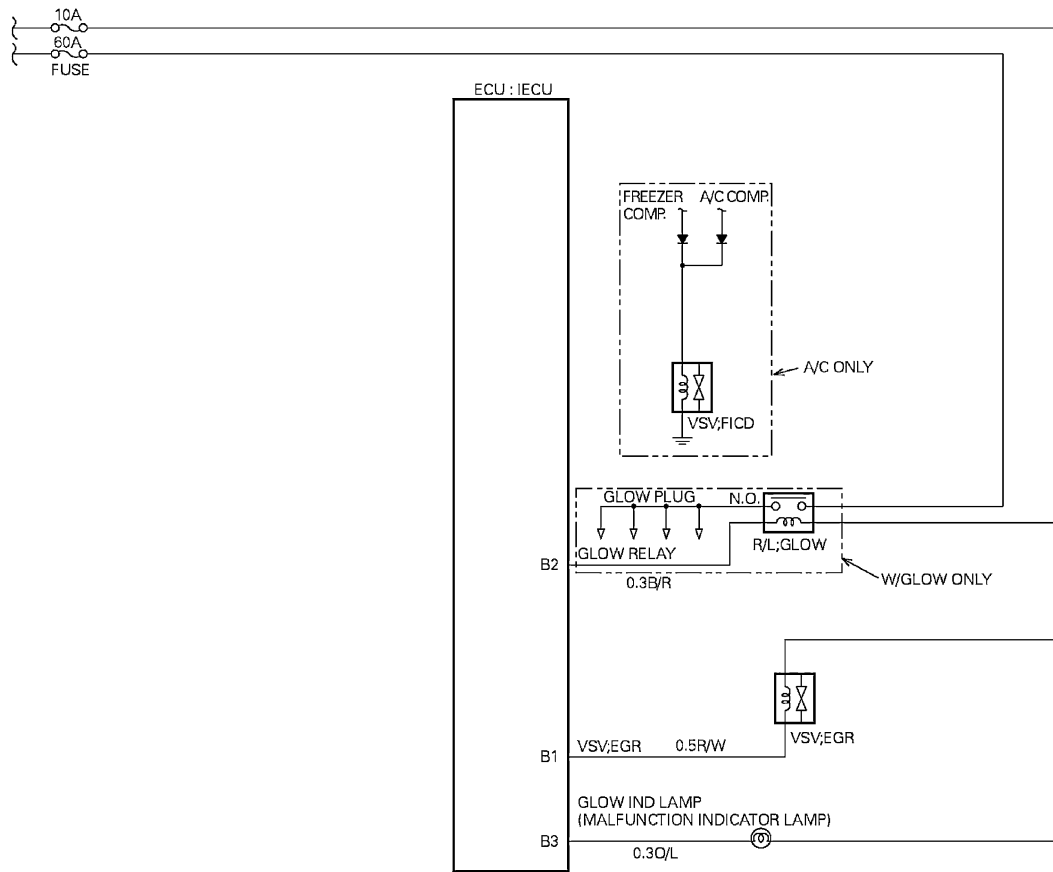
Mark “___” on connector which is plugged, therefore, should be confirmed to be played.

Relation Between Connector Number and Signal Name

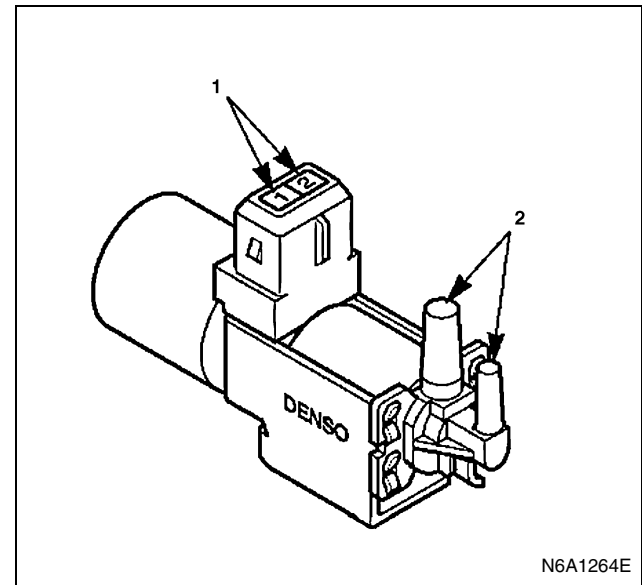
Connector No	Signal name	Wire color
1	Rack sensor (OSC)	R
2	Rack sensor (GND)	B
4	Rack sensor (MDL)	W

6E-178 EMISSION AND ELECTRICAL DIAGNOSIS

Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	Remove Sensor Connector. Has DTC22 been corrected? (Ignore DTC 21)	—	Go to Step 3	Go to Step 7
3	1. Jumper Harness signal Terminal and GND terminal at the Sensor side of Connector. 2. Ignition "ON" Has DTC22 been corrected?	—	Go to Step 4	Go to Step 5
4	1. Check the Sensor Connector for inter terminal short. After check, repair if necessary. Was Connector Terminal shorted?	—	Go to Step 12	Go to Step 6
5	1. Check the GND Circuit for disconnect. After check, repair if necessary. Is GND circuit disconnect?	—	Go to Step 12	Go to Step 11
6	1. Check the Sensor Harness signal circuit and power source circuit for short. After check, repair if necessary. Was Harness shorted?	—	Go to Step 12	Go to Step 8
7	1. Check the Harness signal circuit and power source for short. After check, repair if necessary. Was Harness shorted?	—	Go to Step 12	Go to Step 11
8	1. Apply 5V to RACK+ TERMINAL. 2. Measure RACK SIG Voltage. Is RACK SIG VOLTAGE as specified?	0.9 — 2.0V (Idling speed)	Go to Step 9	Go to Step 10
9	1. Check the iron core of RACK Sensor for damage, seizure, and wear. 2. After check, repair if necessary. Was there any trouble in the iron core(RACK end) inside RACK Sensor?	—	Go to Step 12	Go to Step 11
10	Replace the RACK Sensor. Is the action complete?	—	Go to Step 12	—
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC22 all right under Scan Tool Check?	—	Go to Step 13	Go to Step 2
13	Is any current trouble other than DTC 22 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

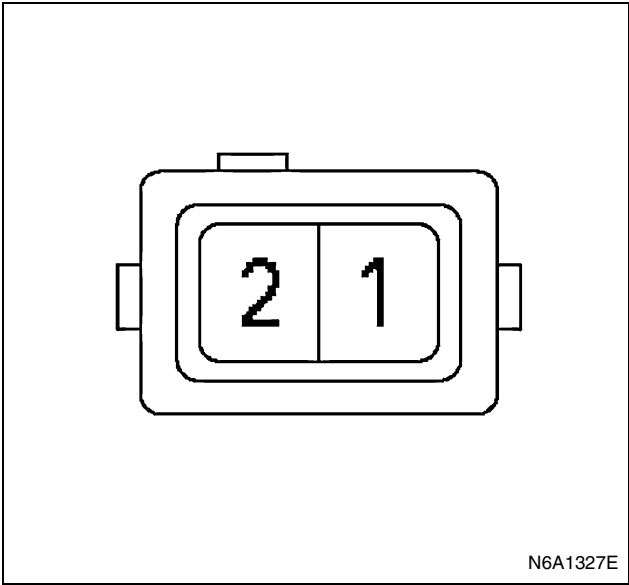
DTC-31 Exhaust Gas Recirculation (EGR) Vacuum Switching Valve (VSV) Solenoid Control Low Voltage

Appearance of Vacuum Switching Valve (VSV):
Exhaust Gas Recirculation (EGR) Connector
VSV: EGR



- Legend**
- 1. 2 pin
 - 2. Port

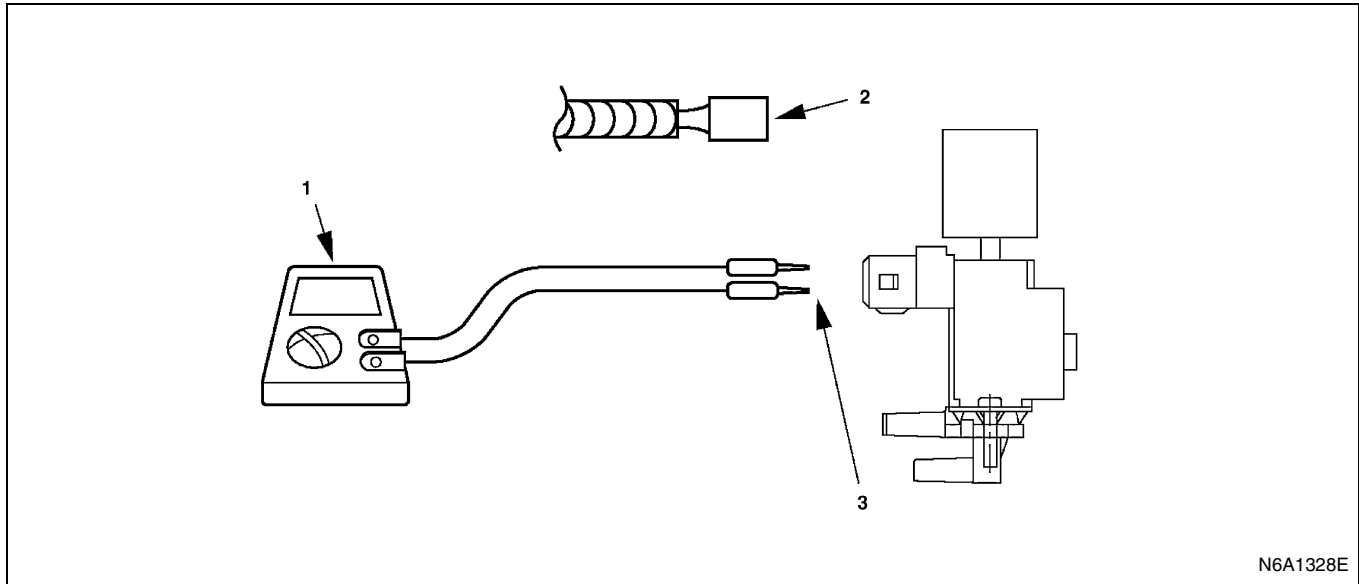
VSV: EGR Connector



Connector No	Signal
1	GND
2	SIG

Measure Resistance at VSV: EGR

Caution:
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



- Legend**
- 1. Circuit tester
 - 2. Remove VSV wire harness
 - 3. Measure resistance between connector pin

Resistance value

Inspection Point		Resistance Value (kΩ)	Reference
Connector	Pin No.		
2 pin Black	2 ↔ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG ↔ GND
	1 ↔ Body	∞	SIG ↔ Body

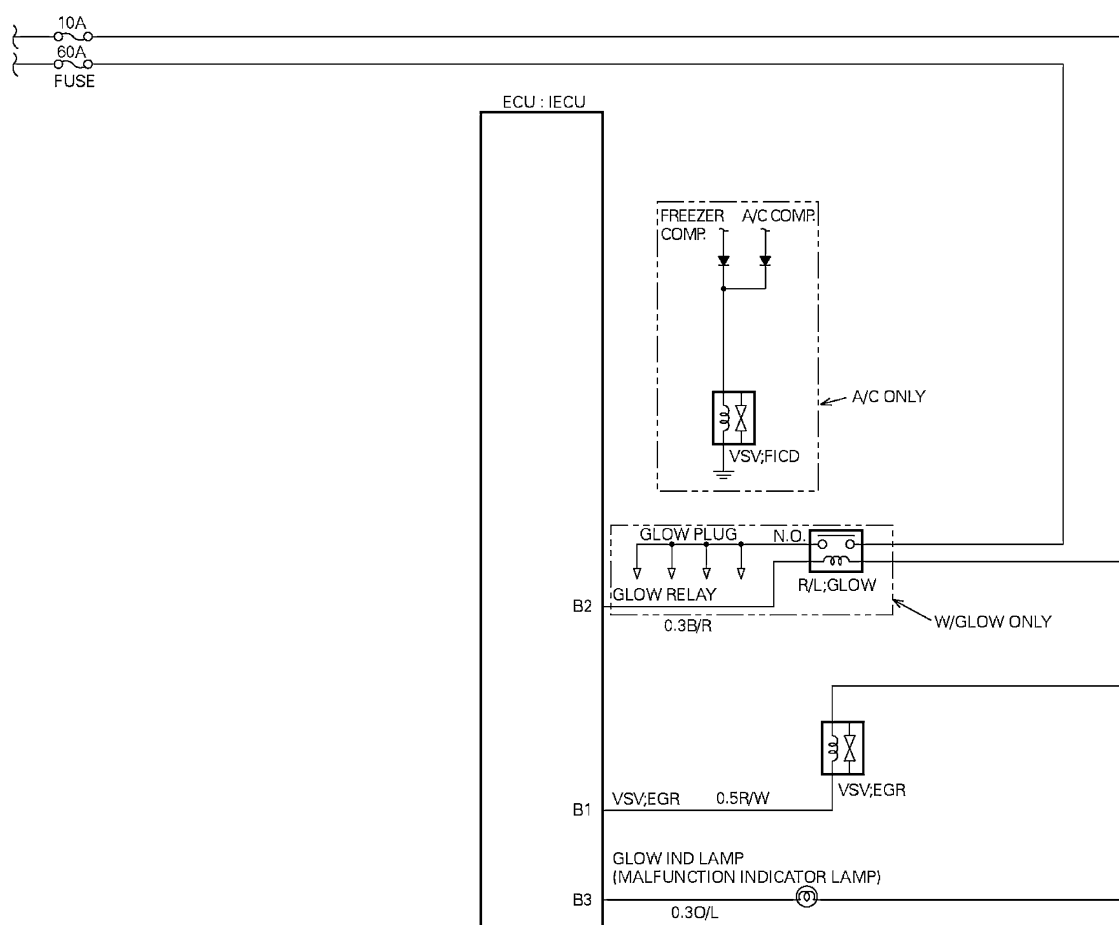
Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

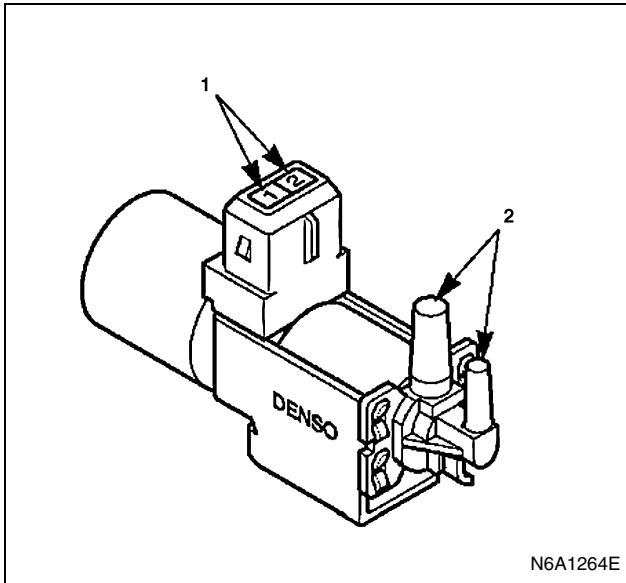
Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	1. Ignition "OFF". 2. Disconnect the VSV from the wiring harness connector. 3. Ignition "ON" Engine "OFF". 4. Using the Digital Voltmeter (DVM), check for voltage on the "Power supply side terminal" of the VSV harness connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the VSV connector and "Engine Ignition". Fuse for the following condition. • A short to ground • An open circuit 2. Repair if necessary. Has DTC 31 been corrected?	—	Go to Step 8	—
4	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44Ω 159 — 169Ω	Go to Step 5	Go to Step 6
5	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the VSV circuit between the ECU and VSV connector. • A short to ground • An open circuit 4. Repair if necessary. Has DTC 31 been corrected?	—	Go to Step 8	Go to Step 7
6	Replace the VSV. Is the action complete?	—	Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF". Does DTC 31 come normal condition?	—	Go to Step 9	Go to Step 2

Step	Action	Value	YES	NO
9	Is any current trouble other than DTC 31 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

DTC-32 Exhaust Gas Recirculation (EGR) Vacuum Switching Valve (VSV) Solenoid Control High Voltage



**Appearance of Vacuum Switching Valve (VSV):
Exhaust Gas Recirculation (EGR) Connector**
VSV: EGR

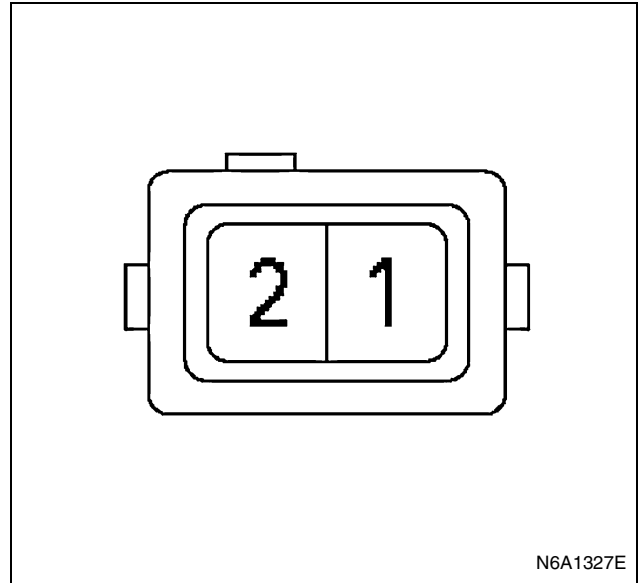


N6A1264E

Legend

- 1. 2 pin
- 2. Port

VSV: EGR Connector



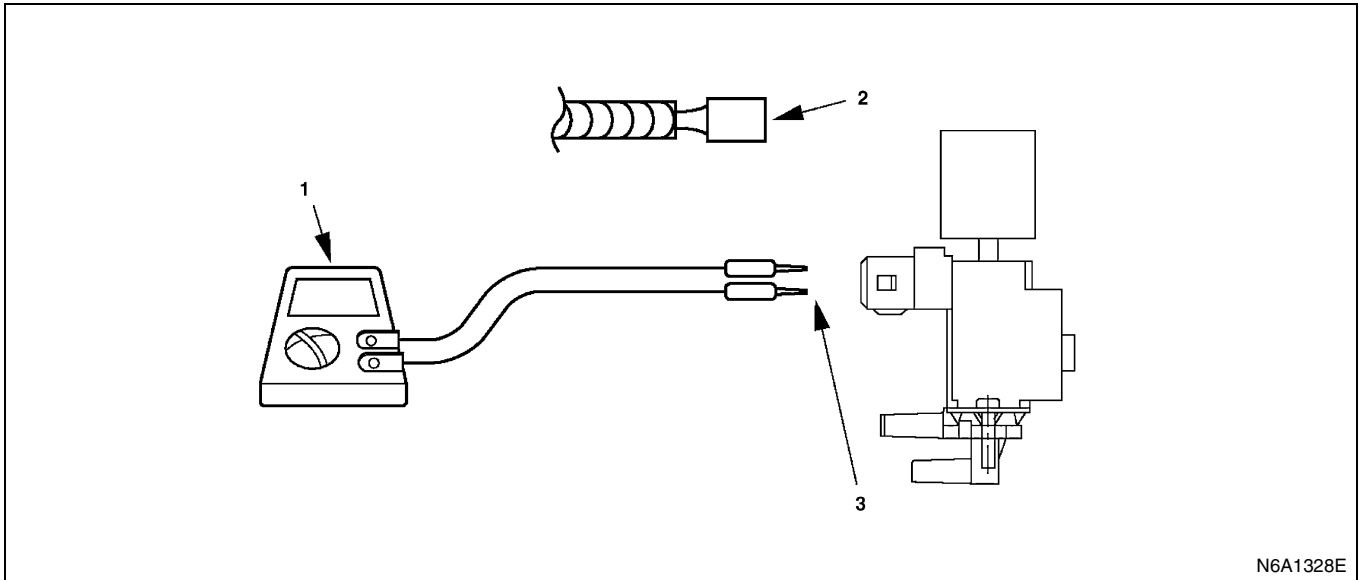
N6A1327E

Connector No	Signal
1	GND
2	SIG

Measure Resistance at VSV: EGR

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.



N6A1328E

Legend

- 1. Circuit tester
- 2. Remove VSV wire harness
- 3. Measure resistance between connector pin

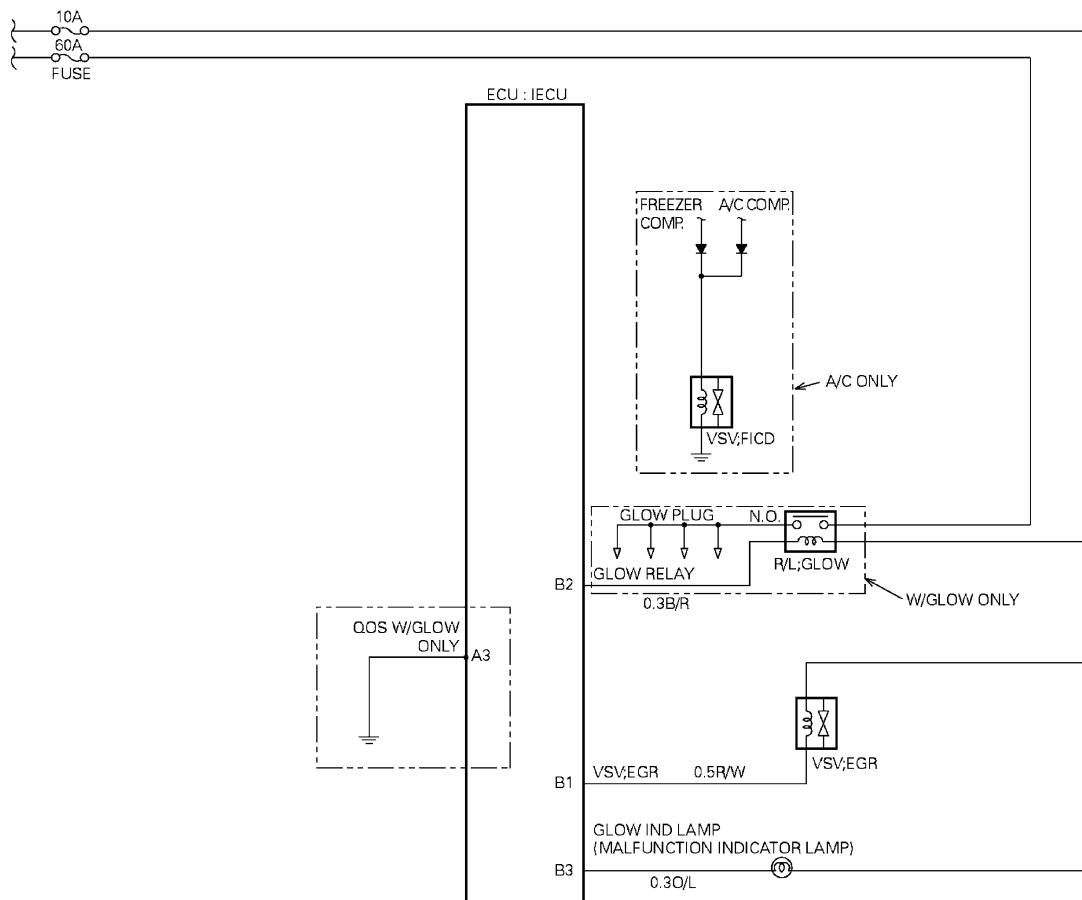
Resistance value

Inspection Point		Resistance Value (k Ω)	Reference
Connector	Pin No.		
2 pin Black	2 $\longleftrightarrow$ 1	37 to 44 (for 12 volt) 159 to 169 (for 24 volt)	SIG $\longleftrightarrow$ GND
	1 $\longleftrightarrow$ Body	∞	SIG $\longleftrightarrow$ Body

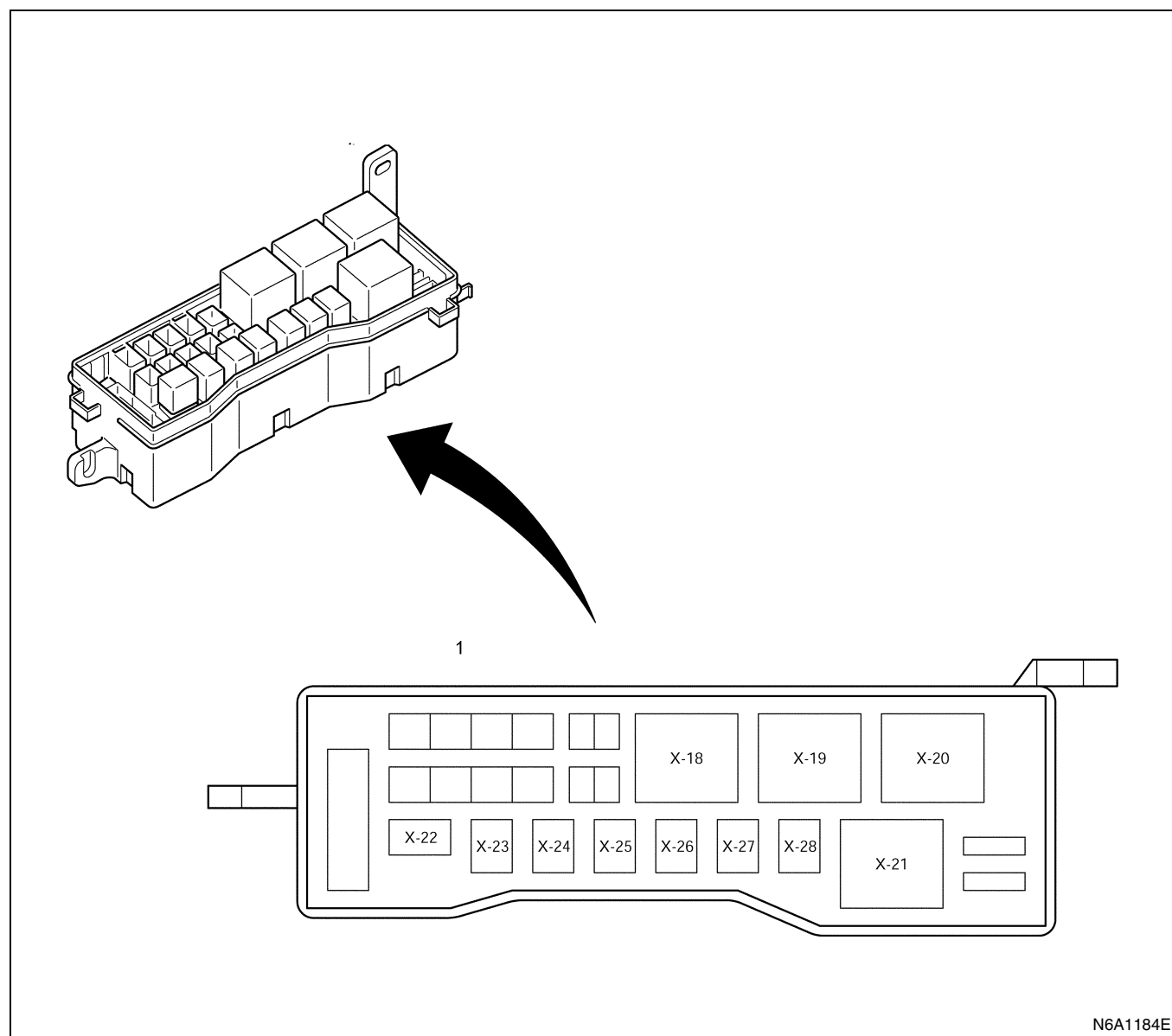
Notice:

Resistance value is difference according to the engine temperature (condition of engine warming up).

Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	Using the DVM, check the resistance of the VSV. Does the DVM read the following Value?	37 — 44 Ω 159 — 169 Ω	Go to Step 3	Go to Step 4
3	1. Ignition "OFF". 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of VSV circuit between the ECM and VSV connector. 4. Repair if necessary. Has DTC 32 been corrected?	—	Go to Step 6	Go to Step 5
4	Replace the VSV. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 6	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF". Does DTC 32 come normal condition?	—	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 32 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

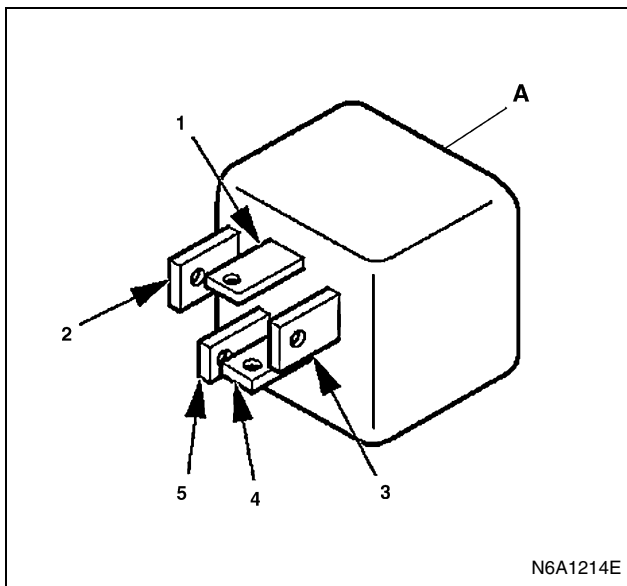
DTC-41 Quick On Start (QOS) Relay Control Circuit Low Voltage

N6A1333E

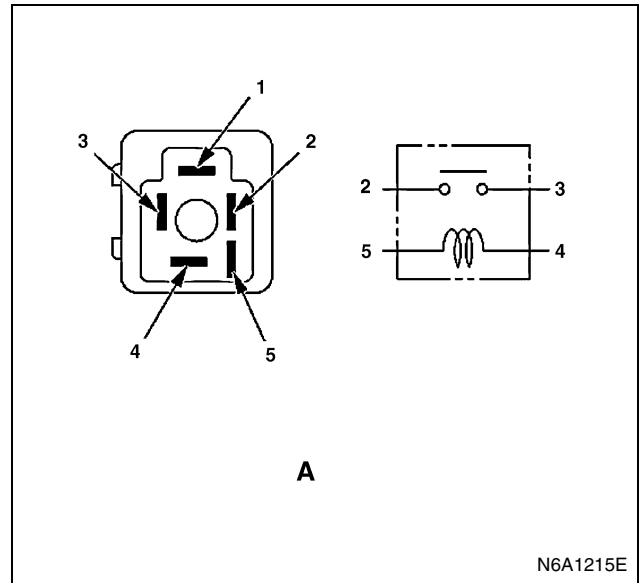
Location of Relay**Legend**

1. Relay box (Installed on the left side rear of the cab)

NO	RELAY NAME
X-20	Glow plug
X-21	Starter
X-22	Marker lamp
X-23	Rear fog
X-24	A/C COMP, 4WD ind. lamp
X-25	Exh, Brake control
X-26	CSD, A/C ON SIGNAL
X-27	Condenser fan
X-28	Exh. Brake cut

Inspection for prestroke power cut relay**Legend**

A. QOS relay

**Legend**

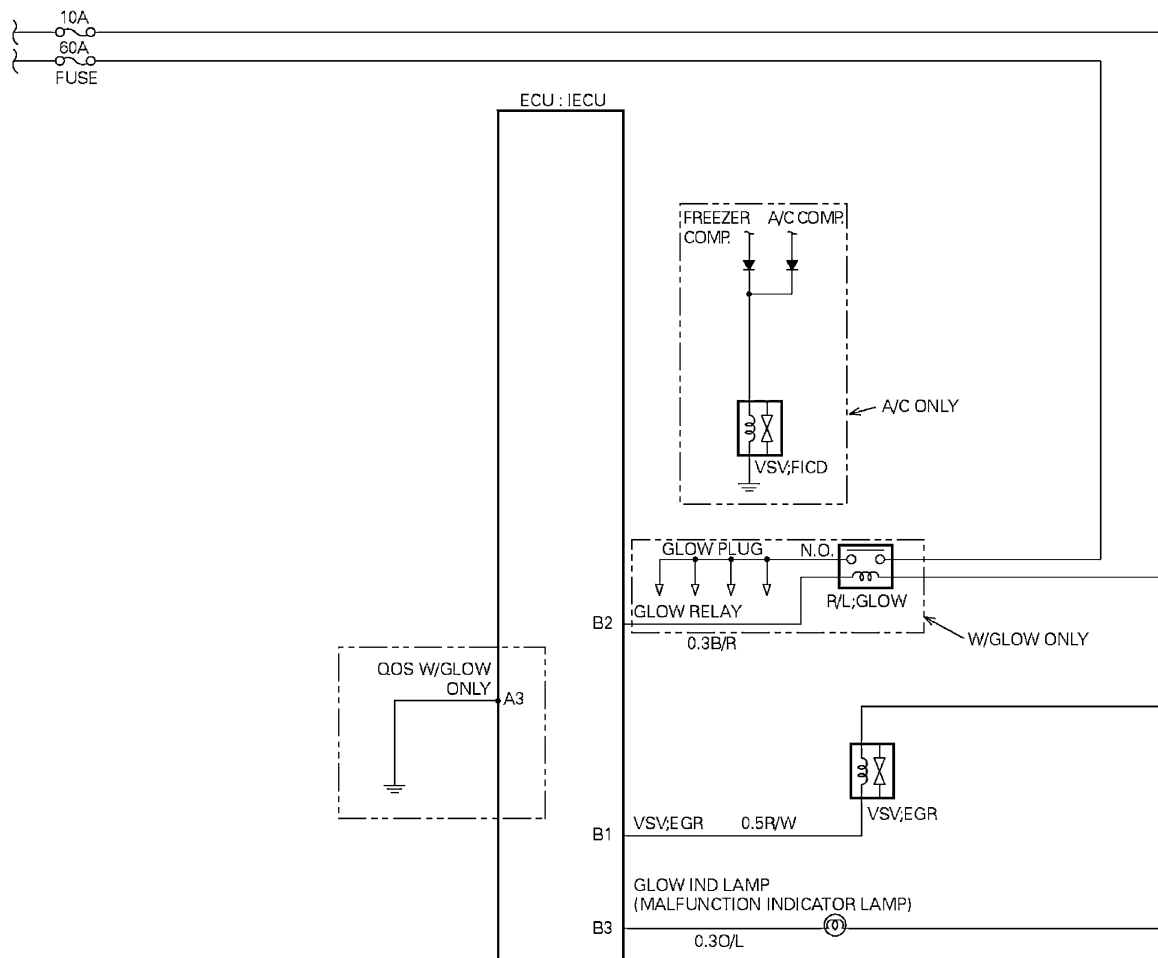
A. QOS relay

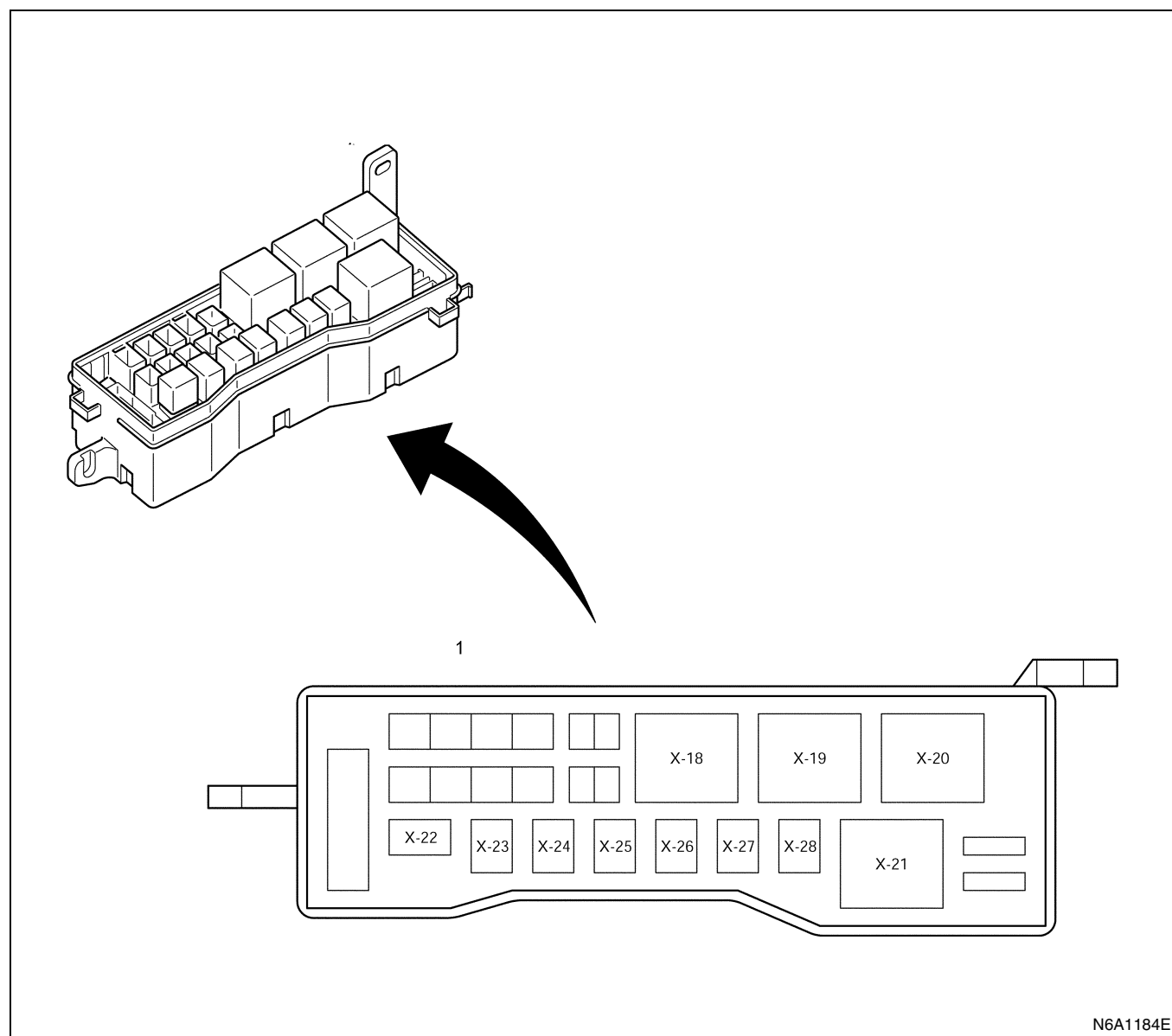
Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	4 ↔ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ↔ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	1. Ignition "OFF" 2. Disconnect the Relay from the Relay box connector. 3. Ignition "ON" Engine "OFF" 4. Using the Digital Voltmeter (DVM), check for voltage on the "Power supply side terminal" terminal of the Relay Box Connector. Does the DVM read the following value?	12 Volt or 24 Volt	Go to Step 4	Go to Step 3
3	1. Check the suspect circuit between the Relay connector. Fuse for the following condition. • A short to ground • An open circuit 2. Repair if necessary. Has DTC 41 been corrected?	—	Go to Step 8	—
4	Using the DVM, check the resistance of inter "4" "5" Relay terminal. Does the DVM read the following Value?	23 Ω (for 12 Volt) 100 Ω (for 24 Volt)	Go to Step 5	Go to Step 6
5	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the Relay circuit between the ECU and Relay connector. • A short to ground • An open circuit 4. Repair if necessary. Has DTC 41 been corrected?	—	Go to Step 8	Go to Step 7
6	Replace the Relay. Is the action complete?	—	Go to Step 8	—
7	Replace the ECM. Is the action complete?	—	Go to Step 8	—
8	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Does DTC 41 come normal condition?	—	Go to Step 9	Go to Step 2
9	Is any current trouble other than DTC 41 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

DTC-42 Quick On Start (QOS) Relay Control Circuit High Voltage

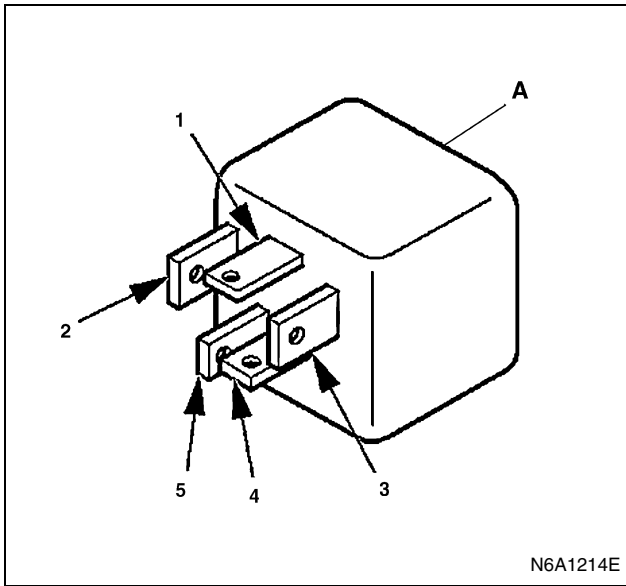


Location of Relay**Legend**

1. Relay box (Installed on the left side rear of the cab)

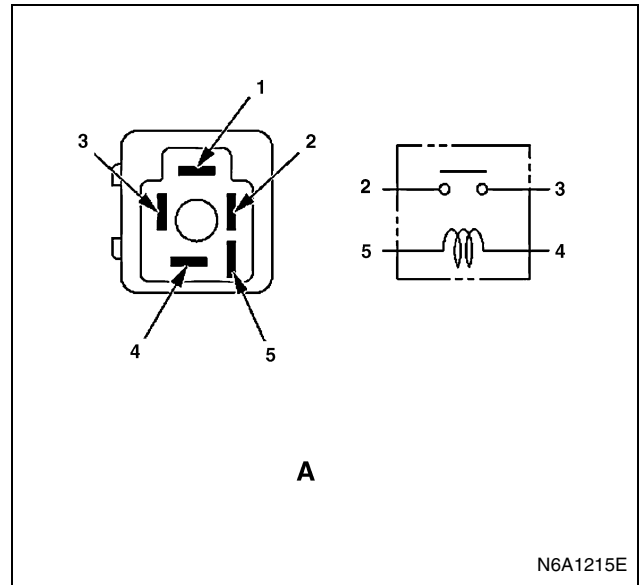
NO	RELAY NAME
X-20	Glow plug
X-21	Starter
X-22	Marker lamp
X-23	Rear fog
X-24	A/C COMP, 4WD ind. lamp
X-25	Exh, Brake control
X-26	CSD, A/C ON SIGNAL
X-27	Condenser fan
X-28	Exh. Brake cut

Inspection for Quick On Start (QOS) power cut relay



Legend

A. QOS relay



Legend

A. QOS relay

Resistance value

Inspection Point		Resistance	Reference
Inspection relay unit	4 ↔ 5	23 (Ω) (for 12 volt) 100 (Ω) (for 24 volt)	
	2 ↔ 3	∞	Not be supplied electricity to coil
		Below 0.5 (Ω)	Be supplied electricity to coil

6E-192 EMISSION AND ELECTRICAL DIAGNOSIS

Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	Using the DVM, check the resistance between terminal number 4 and 5 of the Relay. Does the DVM read the following Value?	23Ω (for 12 Volt) 100Ω (for 24 Volt)	Go to Step 3	Go to Step 4
3	1. Ignition "OFF" 2. Disconnect the ECM connector from ECM. 3. Check the short to voltage of Relay circuit between the ECM and Relay connector 4. Repair if necessary. Has DTC 42 been corrected?	—	Go to Step 6	Go to Step 5
4	Replace the Relay. Is the action complete?	—	Go to Step 6	—
5	Replace the ECM. Is the action complete?	—	Go to Step 6	—
6	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Does DTC 42 come normal condition?	—	Go to Step 7	Go to Step 2
7	Is any current trouble other than DTC 42 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

DTC-52 Electronically Erasable Programmable Read Only Memory (EEPROM) Error

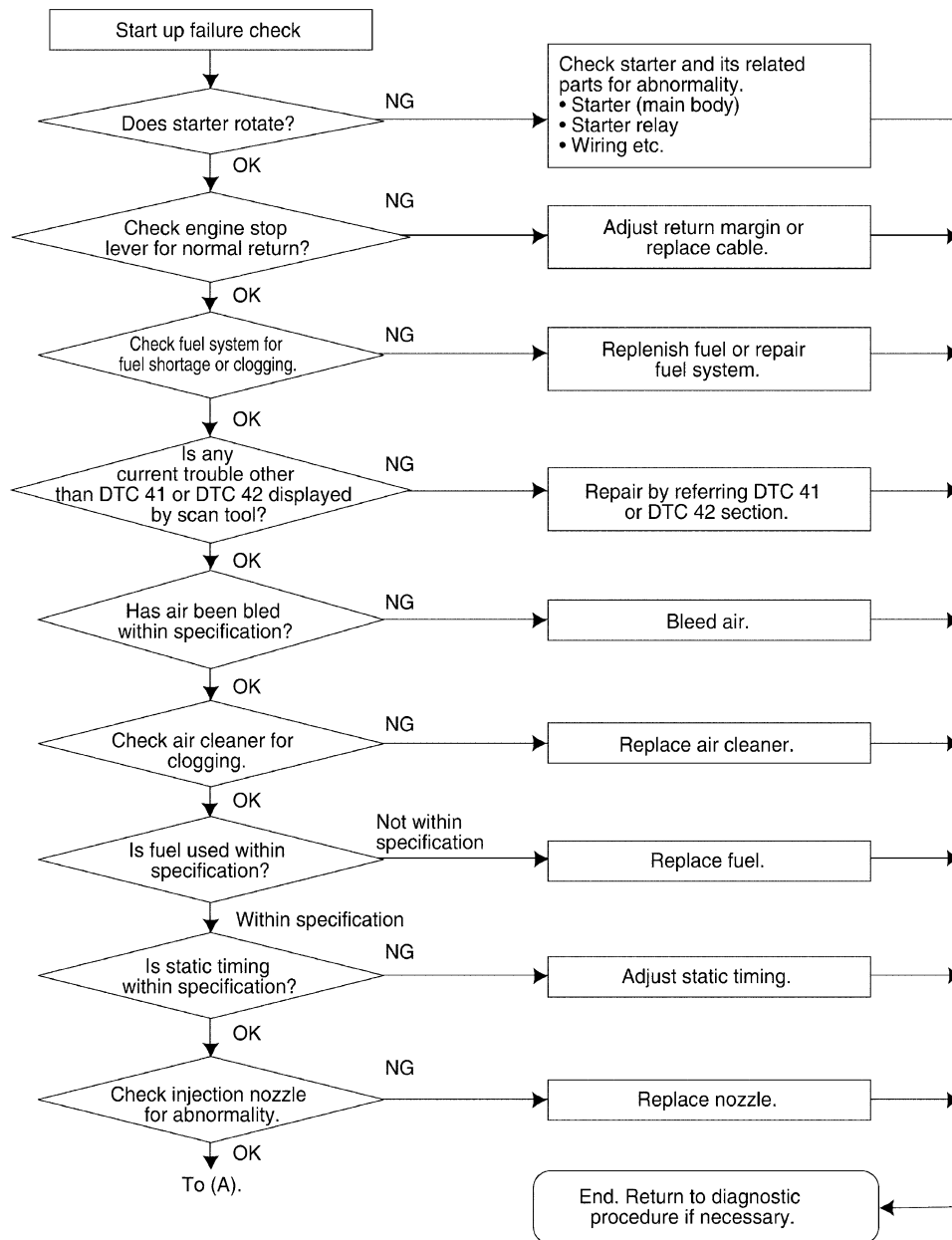
Step	Action	Value	YES	NO
1	Was the "Diagnostic system check" performed?	—	Go to Step 2	Go to diagnostic system check
2	Replace the ECM. Is the action complete?	—	Go to Step 3	—
3	1. Reconnect all the connectors removed. 2. Ignition "ON", Engine "OFF" Is DTC 52 all right under Scan Tool Check?	—	Go to Step 4	Go to Step 2
4	Is any current trouble other than DTC 52 displayed by indicator light?	—	Go to trouble code section	Trouble code clear

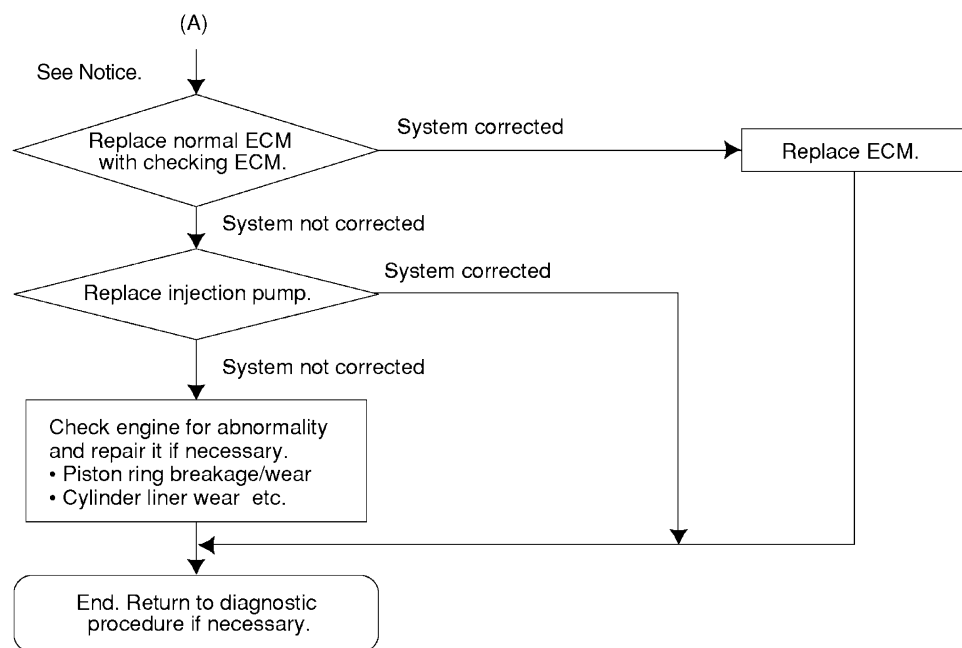
WITHOUT DIAGNOSIS TROUBLE CODE

Introduction

If there occurs a malfunction although no Diagnostic Trouble Code (DTC) is generated, then inspect and repair the system in accordance with the flowcharts given on the following pages.

When a Diagnostic Trouble Code (DTC) is produced, inspect and repair system with reference to "EMISSION AND ELECTRICAL DIAGNOSIS"

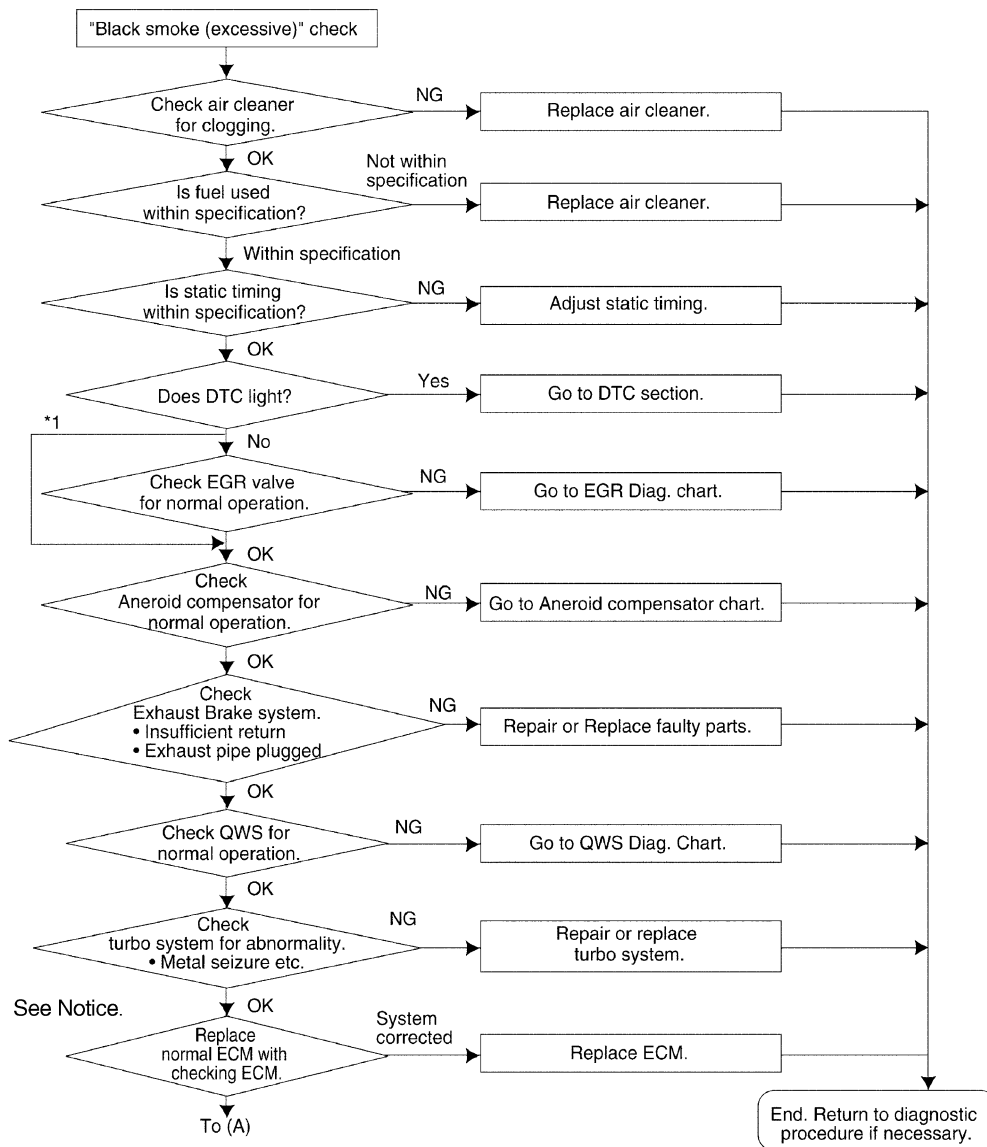
Startup Failure (Quick On Start (QOS) only)

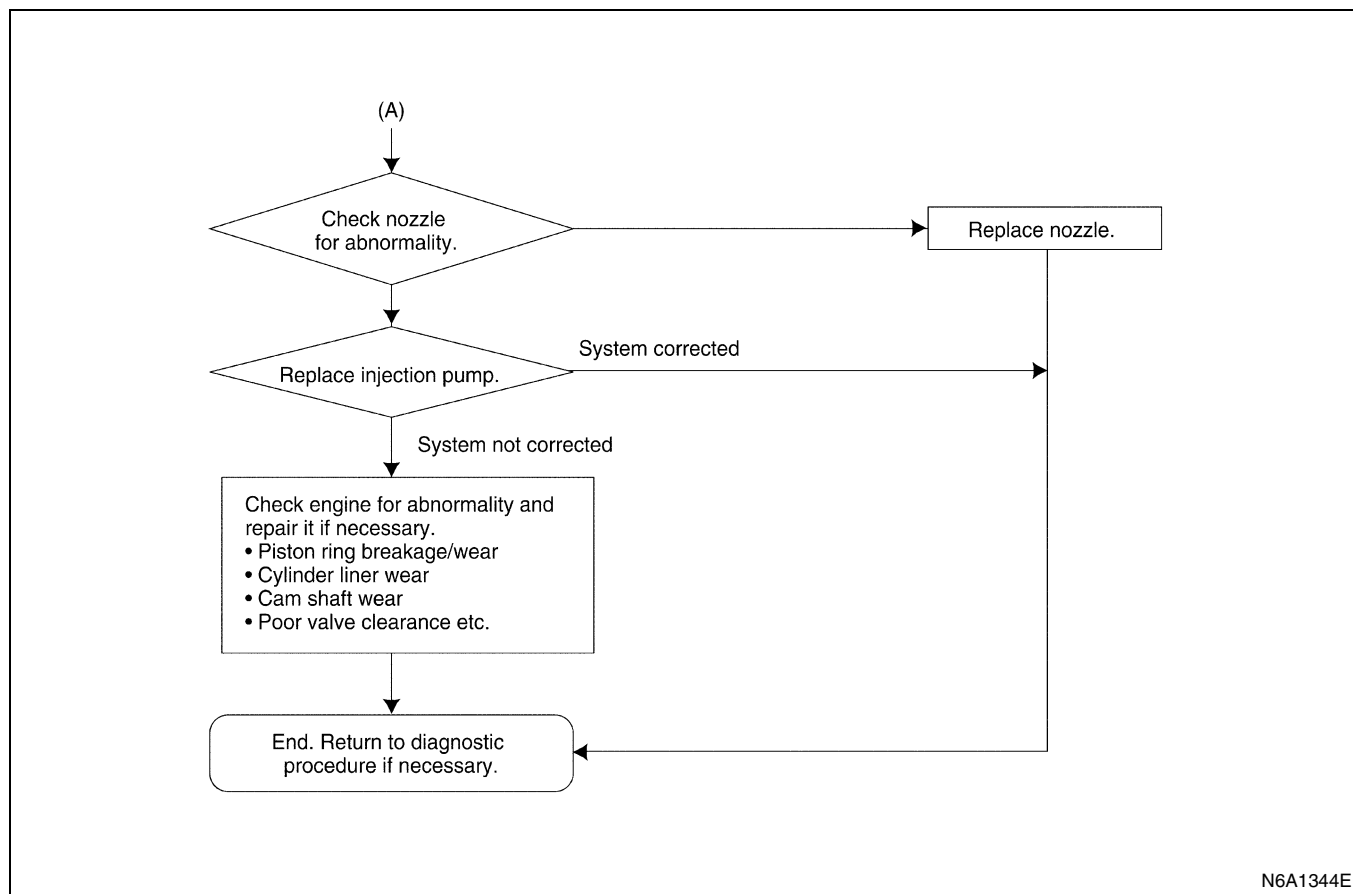


N6A1342E

Notice:

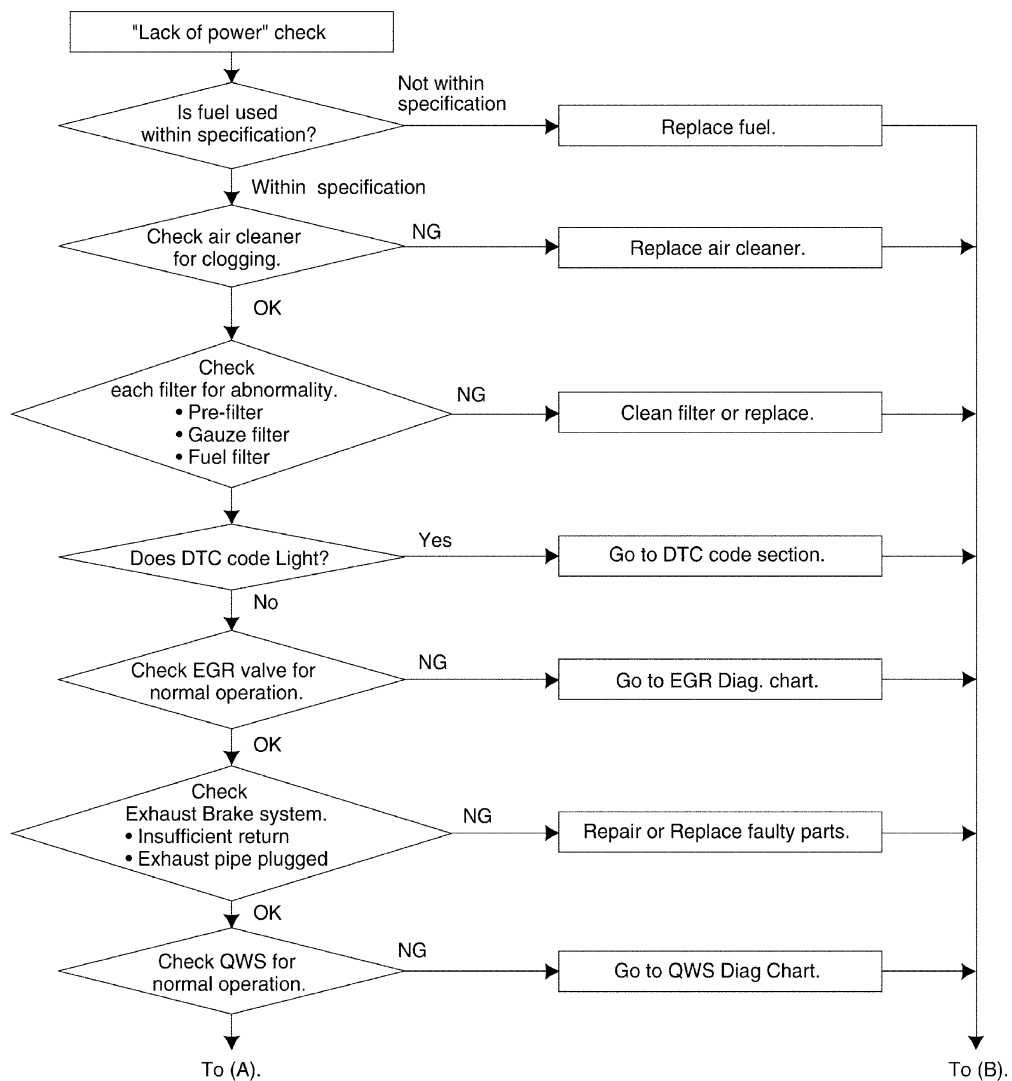
The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

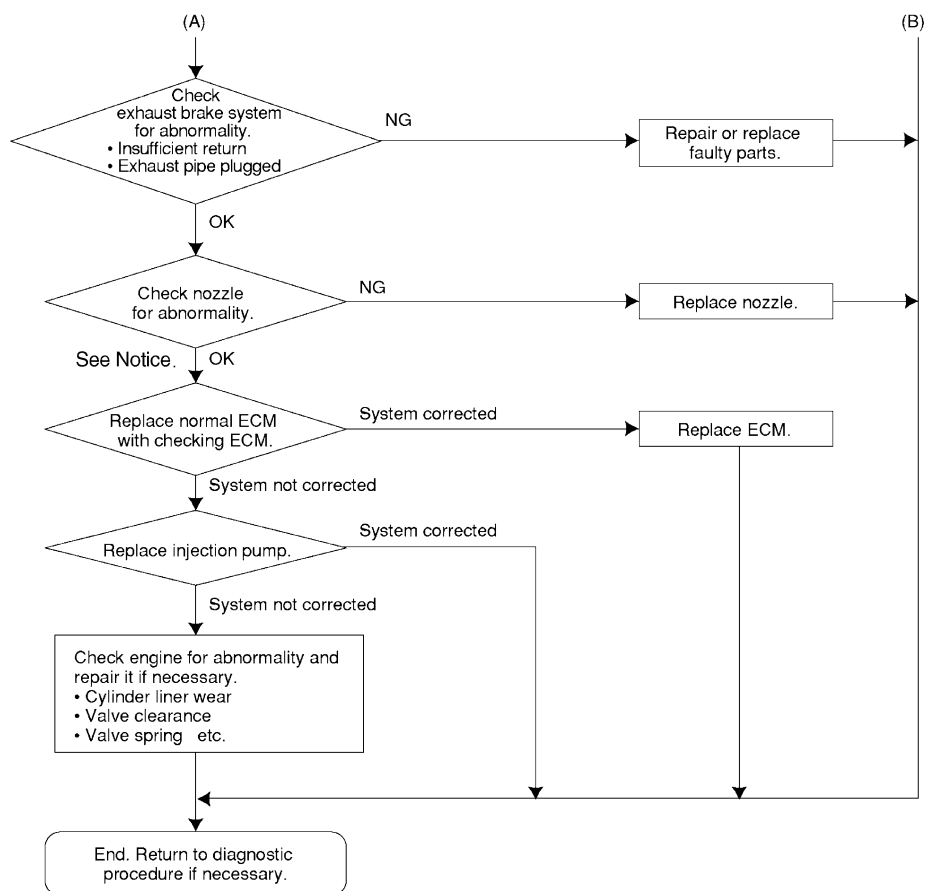
Black Smoke (Excessive)

**Notice:**

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

Refer to a trouble code for a supplier's check, if available.

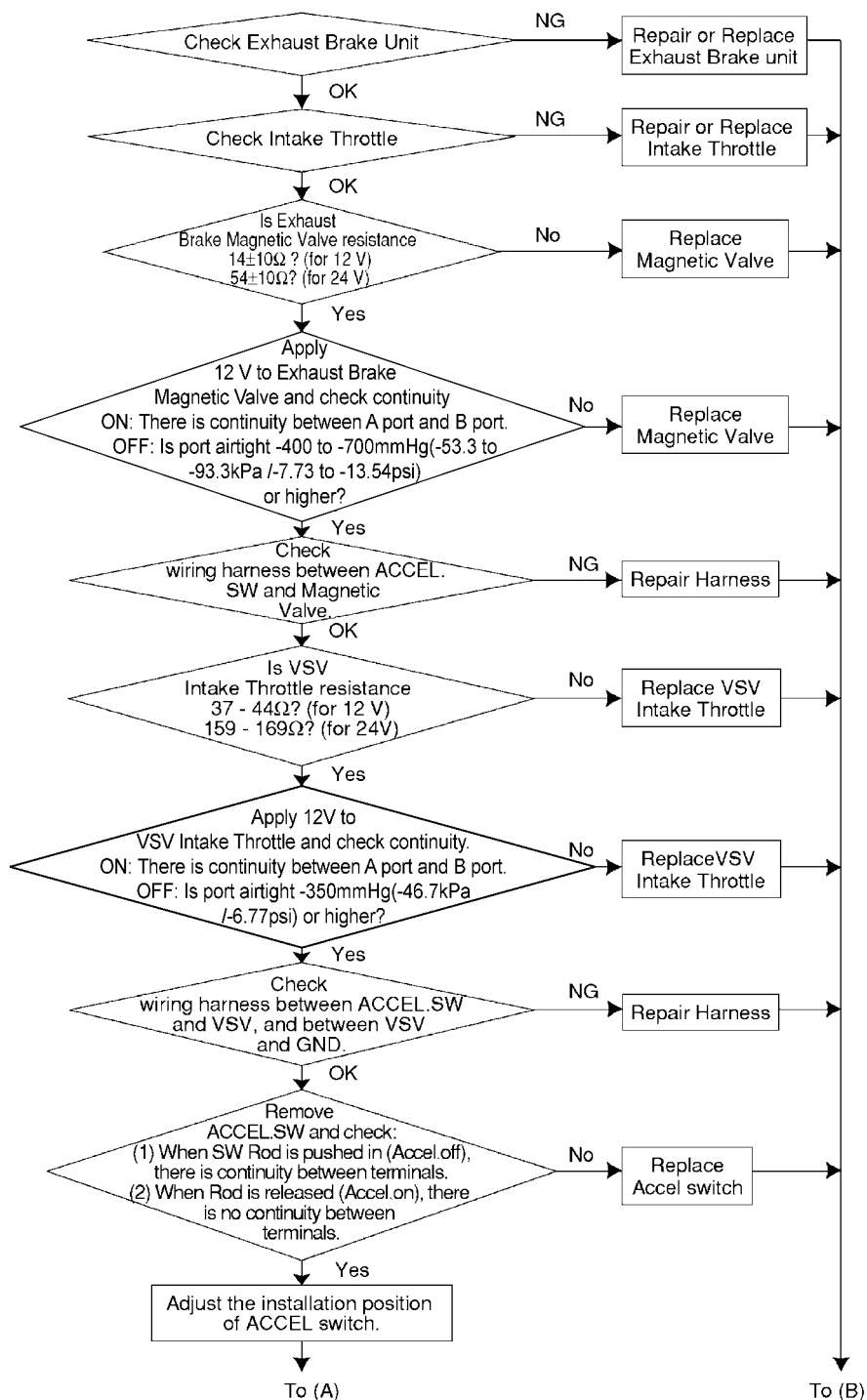
Lack of Power

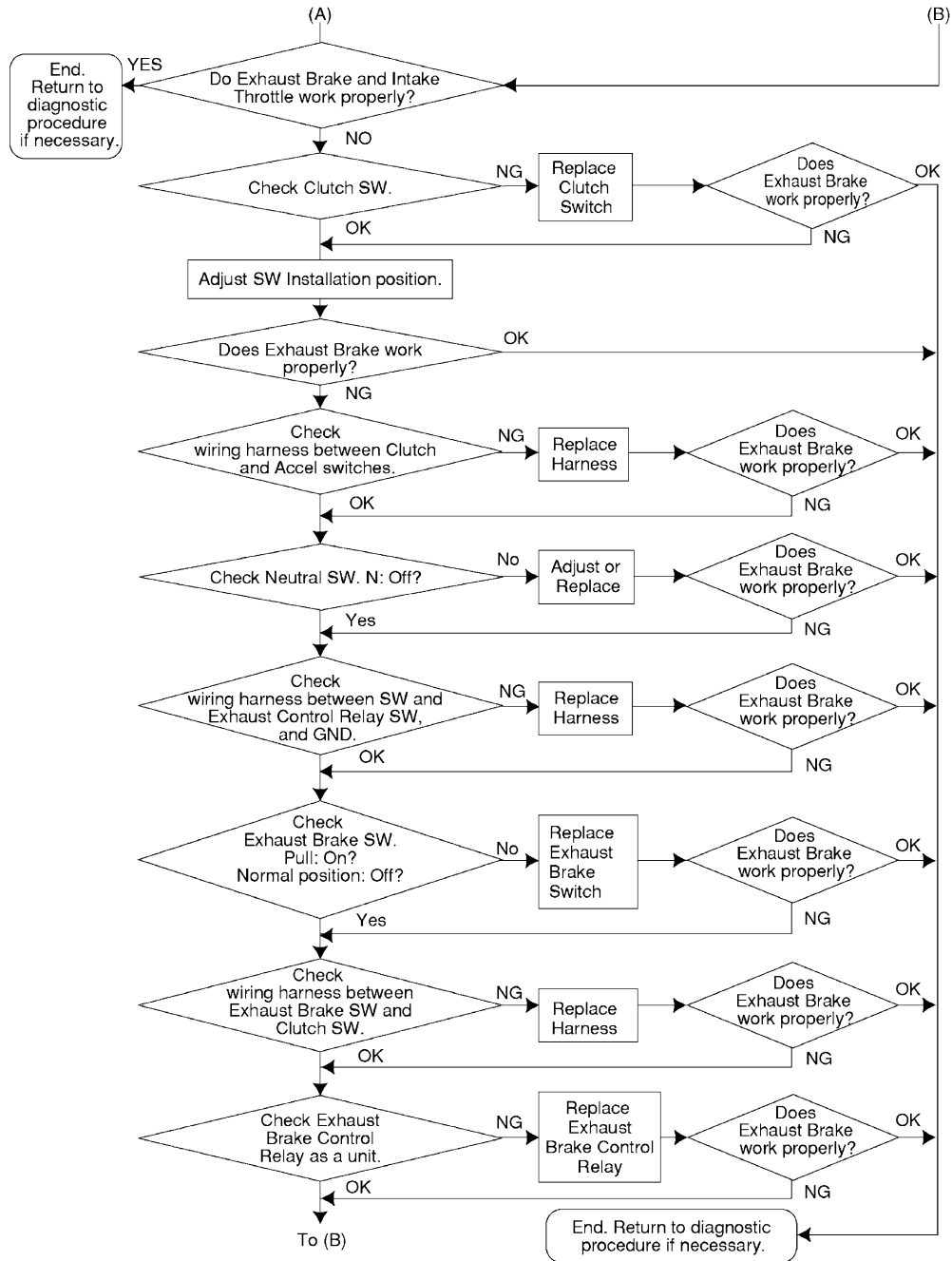


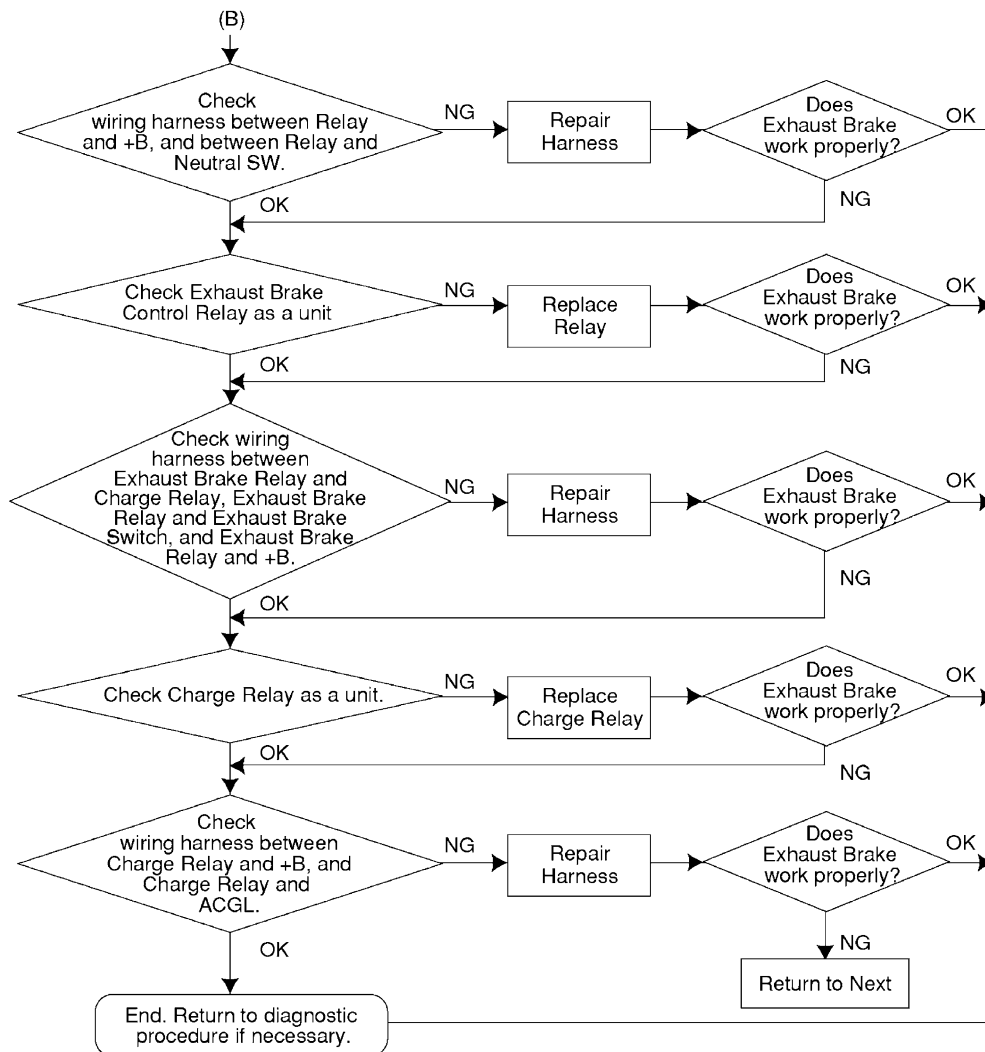
N6A1346E

Notice:

The condition of the system in which the malfunction has occurred should be checked by making comparisons between the vehicle Engine Control Module (ECM) and the checking ECM.

Exhaust Brake Malfunction (Exhaust Brake only)





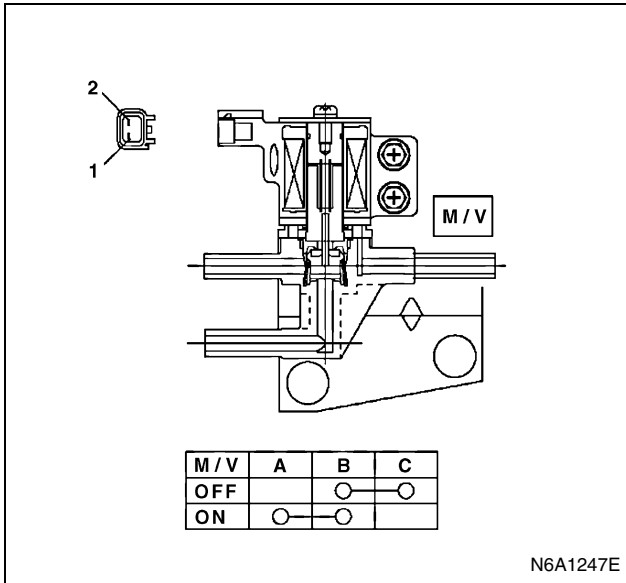
* Repair of wiring harness includes diode check.

Inspection**1. Exhaust Brake Magnetic Valve****Inspection**

Connect the magnetic valve connector terminal No.1 and No.2 to (+) terminal and (-) terminal of battery, respectively, and check the continuity between the ports.

Caution:

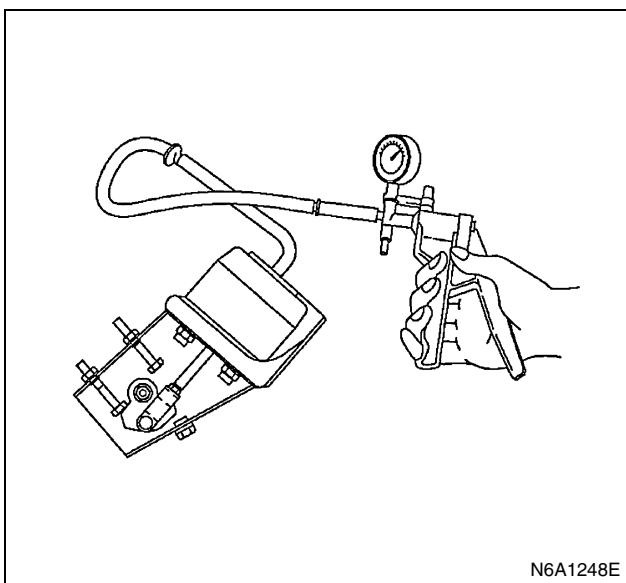
When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

**Legend**

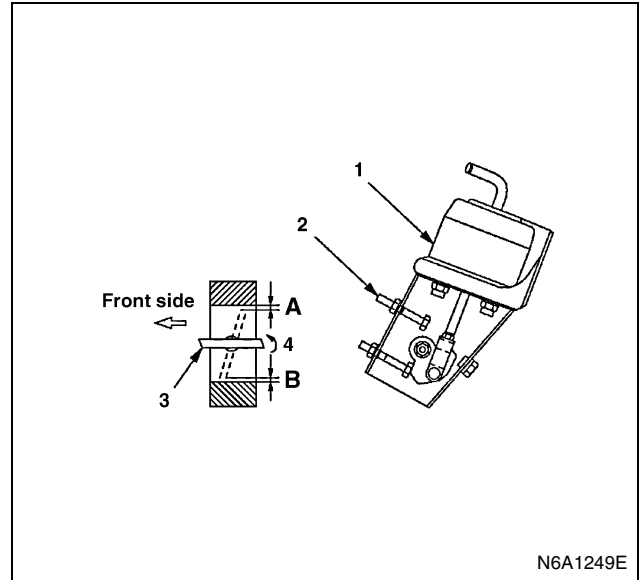
- A. Inlet (Vacuum pump)
- B. Outlet (unit)
- C. EXH (air filter)

2. Exhaust Throttle Valve**Working Check**

Actuate the exhaust brake with the engine idling and make sure that you hear the valve strike on the stopper.

**Airtight Check**

Apply a negative pressure of 53.3 — 93.3 kPa (400 — 700 mmHg/7.73 — 13.54 psi) to the power chamber by means of a vacuum pump and make sure of the smooth opening/closing of the exhaust brake valve.

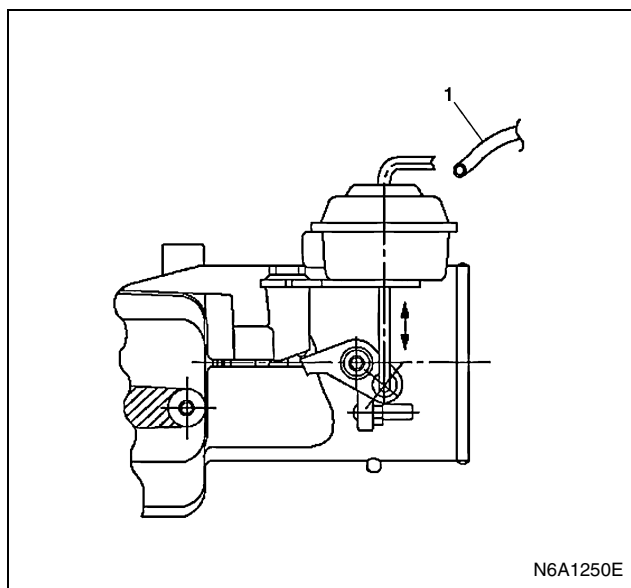
**Legend**

- 1. Power chamber
- 2. Adjust bolt
- 3. Valve
- 4. Close

Apply a negative pressure of 86.7 — 93.3 kPa (650 — 700 mmHg/12.57 — 13.54 psi) to the power chamber using a vacuum pump and make sure the average of measurements at Point A and Point B of the clearance between valve and body is as follows:

0.4 — 0.6 mm (0.016 — 0.024 in) (Minimum: 0.4 mm/0.016 in)

If the clearance is out of this range, adjust with the adjusting bolt.

**Legend**

1. Vacuum hose

3. Intake Throttle Valve

Working Check

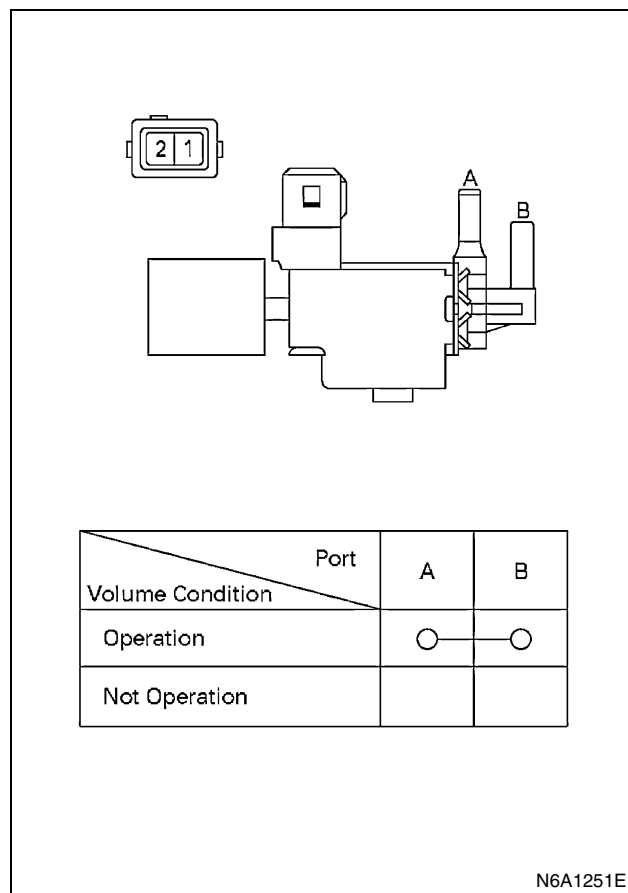
Disconnect the vacuum hose from the actuator and try to move the rod by hand, making sure of the smooth move of the rod.

4. EXHAUST GAS RECIRCULATION (EGR) SYSTEM MALFUNCTION4. Vacuum Switching Valve; Intake Throttle

Inspection

Connect the vacuum switching valve connector terminals No.1 and No.2 to (+) terminal and (-) terminals of battery, respectively, and check the continuity between the ports.

If the check result is abnormal, repair or replace the valve.



5. Accelerator Switch (2-pole connector type)

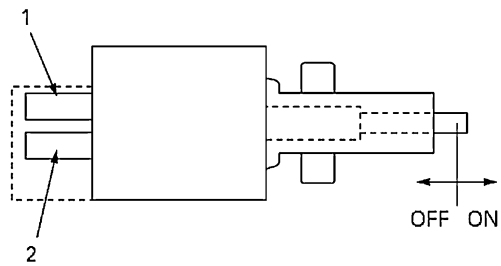
Inspection

- 1) Check the continuity between the switch connector terminals.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

- 2) Check the smooth move of the pushrod. If the check result is abnormal, repair or replace the pushrod.



Switch position	Connection pin	
	1	2
Release push rod	○	○
Push in Push rod		

N6A1252E

Removal

- 1) Accelerator Switch
Disconnect the connector.
Loosen the lock nut.
Turn the switch to remove.

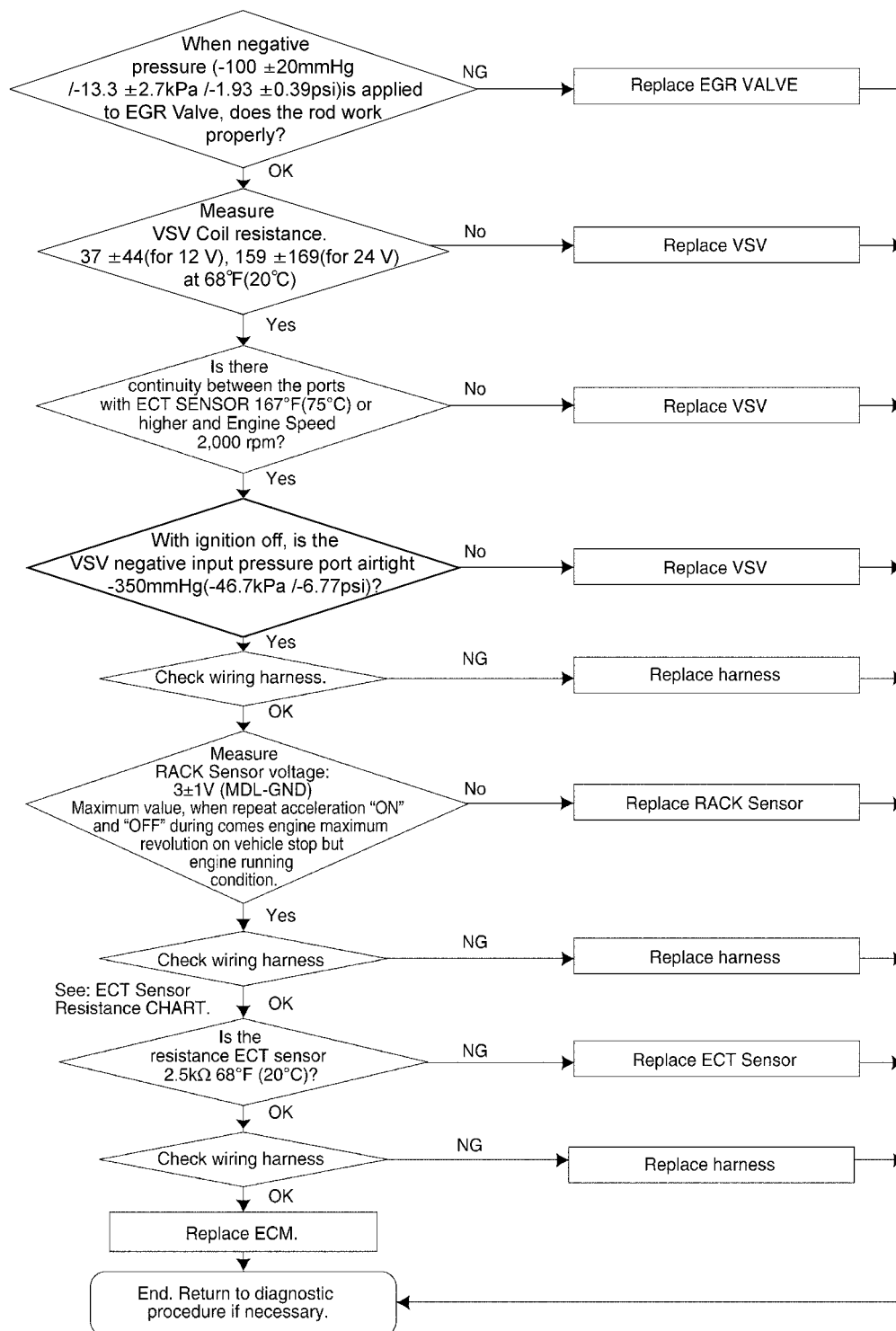
Reinstallation

To install, follow the removal procedure in reverse order:

- 1) Drive the threaded part of the switch until its end surface becomes flush with that of the bracket side of nut.
- 2) Tighten the lock nut.

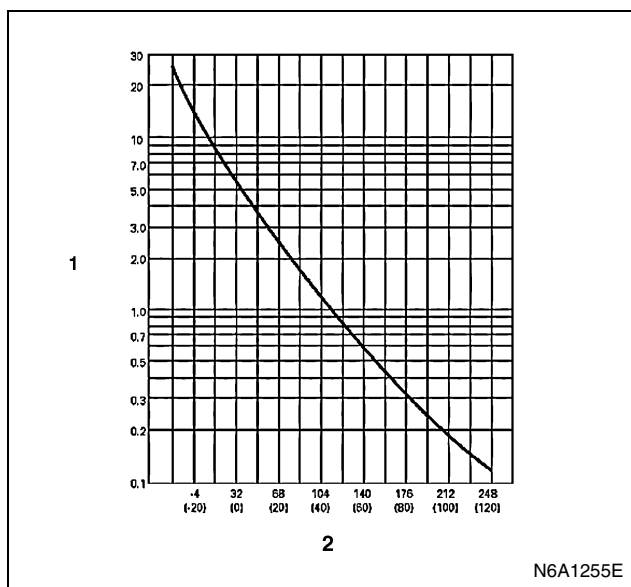
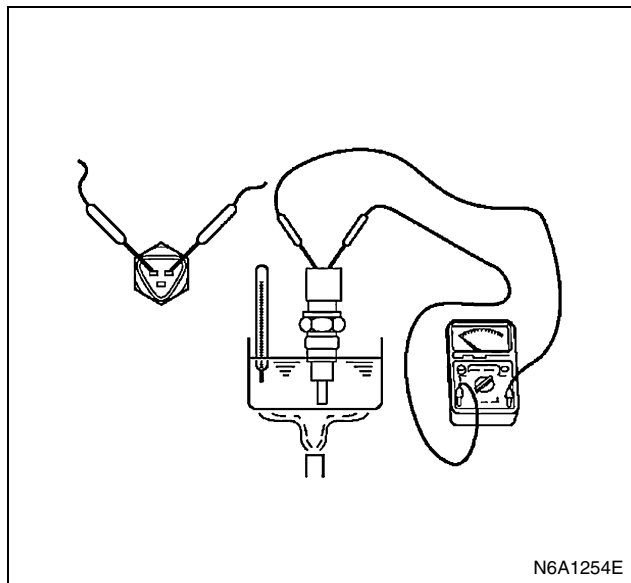
Tighten:

- Lock nut to 1.3 N·m (0.13 kg·m/11.5 lb-in)

Exhaust Gas Recirculation (EGR) System Malfunction

Inspection

1. Thermosensor (Engine coolant temperature)
Soak the temperature sensitive part of a thermosensor in the water, and while changing the water temperature, make sure the resistance is changed as the following graph shows:

**Legend**

1. Resistance (kΩ)
2. ECT °F (°C)

2. Vacuum Switching Valve (VSV)

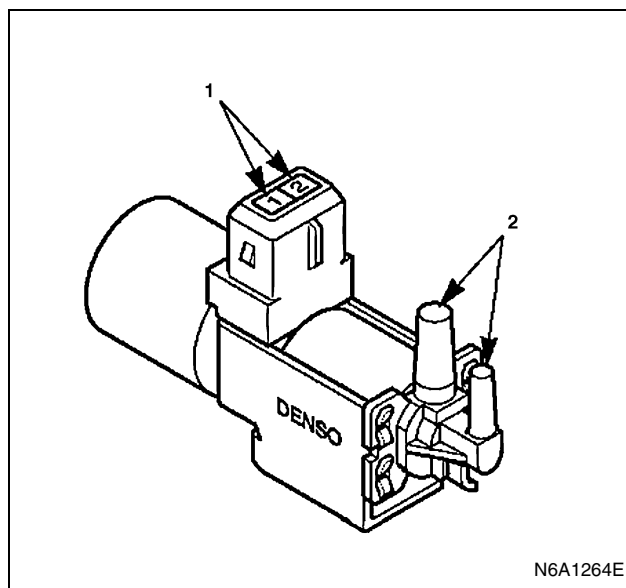
Resistance Check

Check the resistance between the VSV connector terminals using a circuit tester.

Cold Resistance

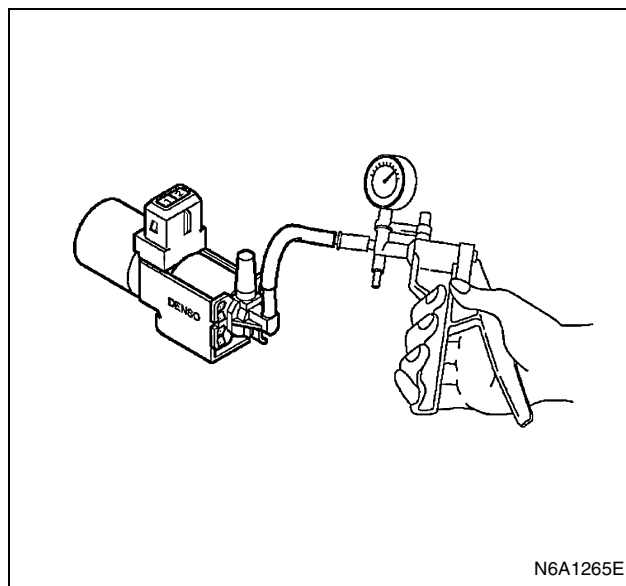
: 37 — 44 (Ω) (for 12 volt model)

: 159 — 169 (Ω) (for 24 volt model)

**Legend**

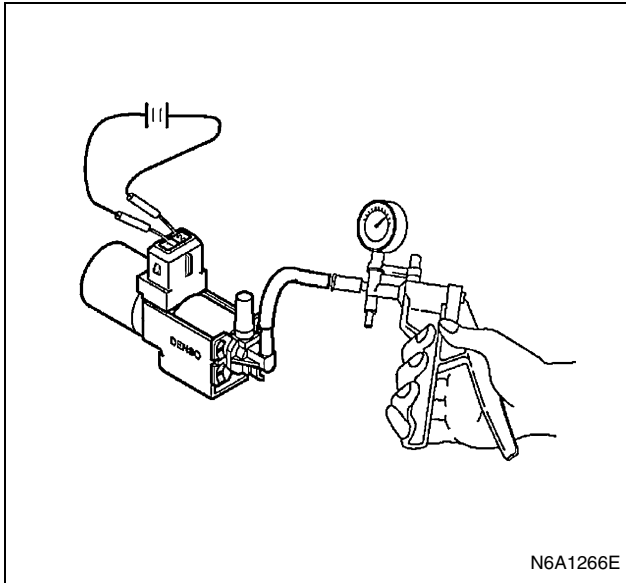
1. 2 Pin
2. Port

Connect battery voltage between VSV connector terminals and make sure of the continuity between the ports.

**Airtight Check**

Apply negative pressure to the negative pressure input port as illustrated on the left.

Although there is leakage, it is no problem if the negative pressure rises to -46.7 kPa (-350 mmHg / -6.77 psi) or more.



Working Check

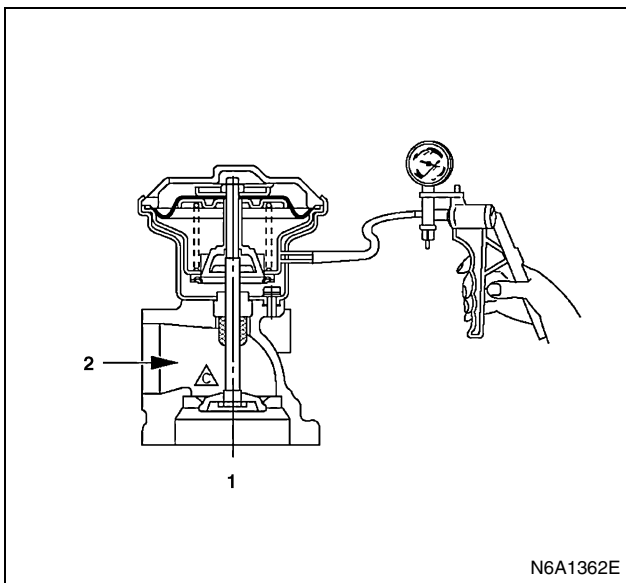
Apply power/voltage between the terminals, there is no problem if the negative pressure does not rise when applied to the input port.

Caution:

When measuring resistance with a circuit tester, be careful not to damage or deform the terminals.

3. Exhaust Gas Recirculation (EGR) Valve
With negative pressure applied to the diaphragm chamber, make sure that the valve is smoothly actuated to make the area between (1) and (2) ventilated.

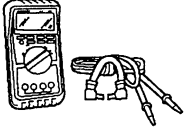
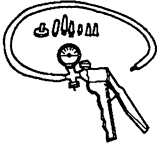
Startup: About -13.3 ± 2.7 kPa (-100 ± 20 mmHg / -1.93 ± 0.39 psi)



Check to see if EGR valve is normally actuated under the following conditions:

Engine coolant temp.: 80°C (176°F) or higher

SPECIAL TOOLS

Illustration	Tool Number / Description / Remarks
 5884003660	5-8840-0366-0 (J 39200) / High Impedance Multi- meter (Digital Voltmeter- DVM)
 5884002790	5-8840-0279-0 (J 23738- A) / Vacuum Pump with Gauge

