Injection Time (amount of injection)

The factors to determine the injection time are the basic injection time which is calculated on the basis of the engine speed and the intake manifold pressure (amount of the intake air) and various compensations which are determined according to the signals from various sensors that detect the state of the engine and driving conditions.

NOTE:

The amount of fuel drawn into the engine is determined by the injection frequency as well as injection time.

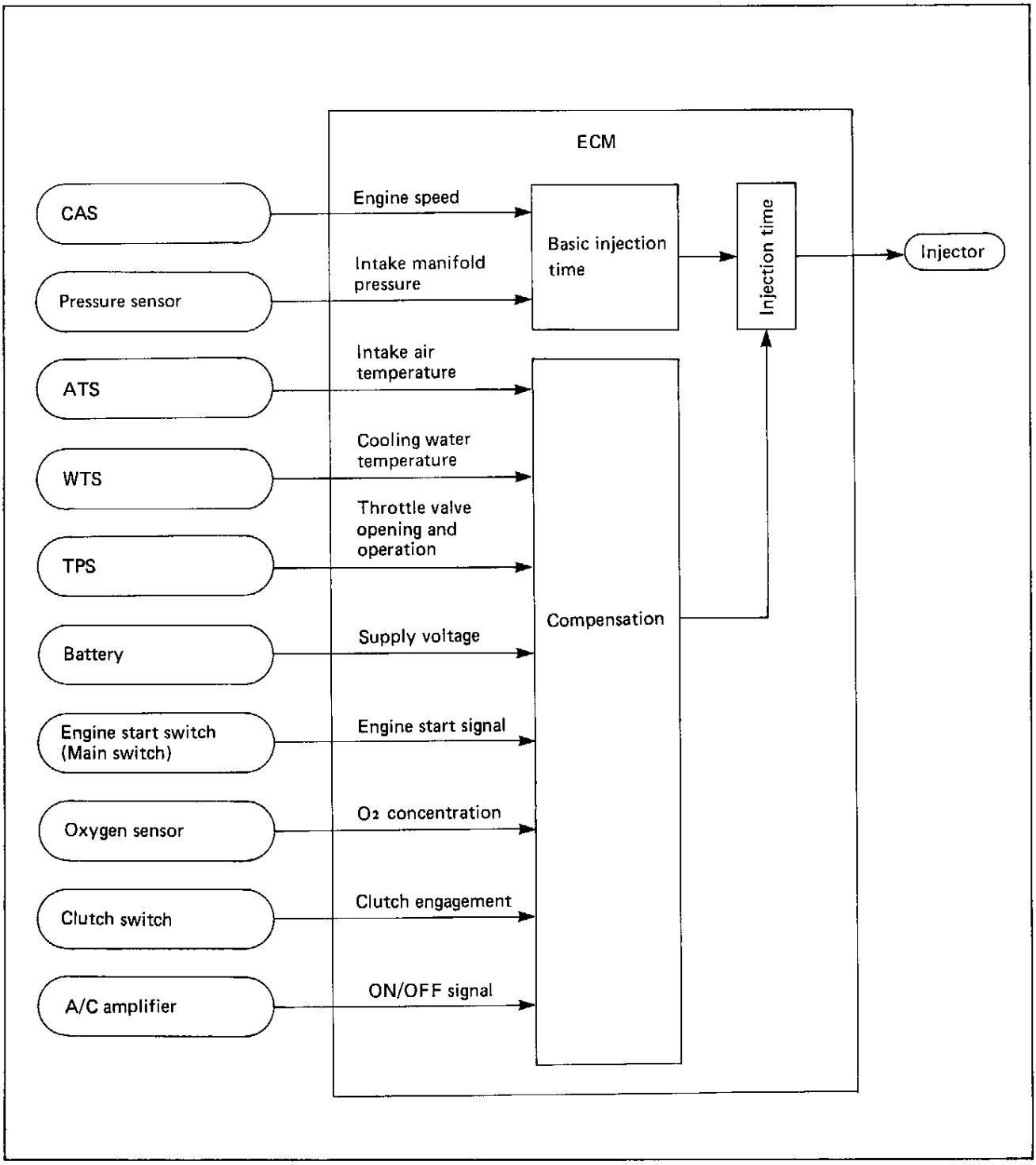


Fig. 4A-28-2 Parameter Diagram

Intake air temperature compensation
As the intake air volume varies with the temperature, it is compensated for its temperature.

Enriching compensation while warming up
When the engine is cold, enriching compensation is made to ensure good driveability till the engine cooling water temperature reaches the specified level. The amount to enrich the air/fuel mixture is decreased as the temperature rises.

Enriching compensation after engine start
For a certain time after the engine is started, air/fuel mixture enriching compensation is made so as to stabilize the engine speed. As the amount of compensation depends on the engine cooling water temperature, it is the largest immediately after the engine start and after that, it reduces gradually.

Enriching compensation while loaded high
Enriching compensation is made to make the air/fuel mixture ratio richer than the theoretical air/fuel mixture ratio to ensure good driveability under highly loaded driving condition.

Enriching compensation when accelerating
To attain smooth acceleration, enriching compensation is provided for a certain time according to each accelerating condition, which is obtained through operation using the signal from the pressure sensor (representing variation of pressure in the intake manifold).

Leaning compensation when decelerating
To obtain a proper air/fuel mixture ratio during moderate deceleration, compensation is made for a certain time so that the air/fuel mixture leans out to a proper ratio for each decelerating condition, which is obtained through operation using the signal from the throttle position sensor (representing variation of throttle valve opening).

Battery voltage compensation
A power voltage drop delays the mechanical operation of the injector. Then the actual injection time becomes shorter for the time that electricity is supplied to the injector. To compensate this, the electricity supply time is made longer when the voltage is lower.

Base air/fuel ratio compensation
The air/fuel ratio may vary due to such factors as variation in each engine itself and aging. To compensate such variation, feed back compensation is used and base air/fuel mixture ratio is adjusted to a proper level.

Fuel cut
When decelerating quickly, the fuel supply is cut or decreased to prevent unburned gas from being emitted by making the injector operating time as ineffective injection time.
Also, when the engine speed exceeds 6,800 r/min, the fuel supply is cut to protect the engine by making the injector operating time as ineffective injection time. The normal injection is restored when the engine speed is 6,500 r/min or lower.

Fuel feed back compensation (Air/fuel ratio compensation)

It is necessary to keep the air/fuel mixture close to the theoretical air/fuel ratio (14.7) to obtain efficient performance of the 3-way catalyst and high clarification rate of CO, HC and NOx in the exhaust gas. For that purpose, ECM operates as follows. It first compares the signal from the oxygen sensor with a specified reference voltage and if the signal is higher, it detects that the air/fuel ratio is richer than the theoretical air/fuel ratio and reduces fuel. On the other hand, if the signal is lower, it detects that the air/fuel ratio is leaner and increases fuel. By repeating these operations, it adjusts the air/fuel ratio closer to the theoretical air/fuel ratio.

1) When oxygen concentration in the exhaust gas is low, that is, when the air/fuel ratio is smaller than the theoretical air/fuel ratio (fuel is richer), electromotive force of the oxygen sensor increases and a rich signal is sent to ECM.
2) Upon receipt of the rich signal, ECM decreases the amount of fuel injection, which causes oxygen concentration in the exhaust gas to increase and electromotive force of the oxygen sensor to decrease. Then a lean signal is sent to ECM.
3) As ECM increases the amount of fuel injection according to the lean signal, oxygen concentration in the exhaust gas decreases and the situation is back to above 1).

This control process, however, will not take place under any of the following conditions.

- At engine start and when fuel injection is increased after engine start
- When engine cooling water temperature is low
- When highly loaded and fuel injection is increased
- At fuel cut
- When oxygen sensor is cold

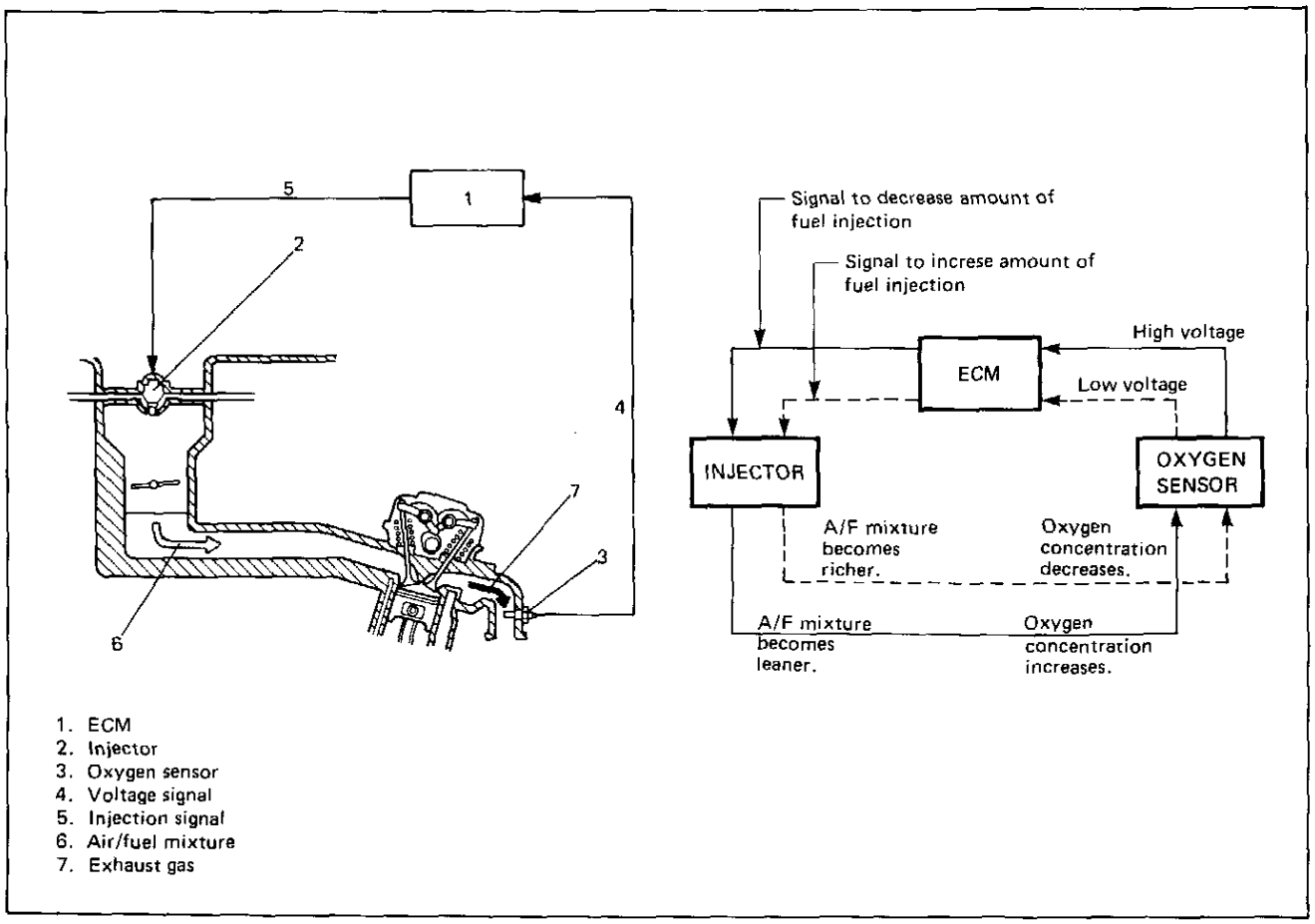


Fig. 4A-29 Fuel Feed Back Compensation

ISC SOLENOID VALVE CONTROL SYSTEM

This system controls the bypass air flow by means of ECM and ISC solenoid valve for the following three purposes.

- To keep the engine idle speed as specified at all times
  The engine idle speed can vary due to following reasons.
  * Load applied to engine (when electric load is applied, air-conditioner is turned ON, etc.)
  * Variation in atmospheric pressure
  * Change in engine itself with passage of time
  * Other factors causing idle speed to change
- To improve starting performance of engine
- To compensate air/fuel mixture ratio when decelerating (Dash-pot effect)

Operation

ISC solenoid valve opens the bypass air passage when it is turned ON by ECM and closes it when turned OFF.

ECM detects the engine condition by using signals from various sensors and switches and while repeating ON and OFF cycle of ISC solenoid valve at a certain rate (12.5 times a second), it controls bypass air flow by increasing and decreasing its ON time within a cycle.

While the engine is cranking, ECM keeps ISC solenoid valve ON (maximum ON time rate within one cycle) so as to obtain better start of the engine.

When the accelerator pedal is depressed while the engine is running (the idle switch is OFF and the throttle valve is at other than idle position), ECM sets the ON time of the ISC solenoid valve (rate of ON time within one cycle) so that it is determined by the engine conditions and keeps it. When decelerating, on the other hand, ECM reduces the valve ON time gradually (i.e., the bypass air flow is reduced gradually) to obtain dash-pot effect.

When the vehicle is at a stop, the throttle valve is at the idle position and the engine is running, ECM controls the bypass air flow by increasing or decreasing ON time of ISC solenoid valve so that the engine speed is kept at a specified idle speed.

With an A/C equipped vehicle, when the A/C is ON, a certain amount of the bypass air is supplied by the A/C VSV independently of this system. The bypass air supplied by this system is used for fine control to keep the idle speed as specified.

	A/C OFF	A/C ON
Engine idle speed specification	800 ± 50 r/min.	1,000 ± 50 r/min.

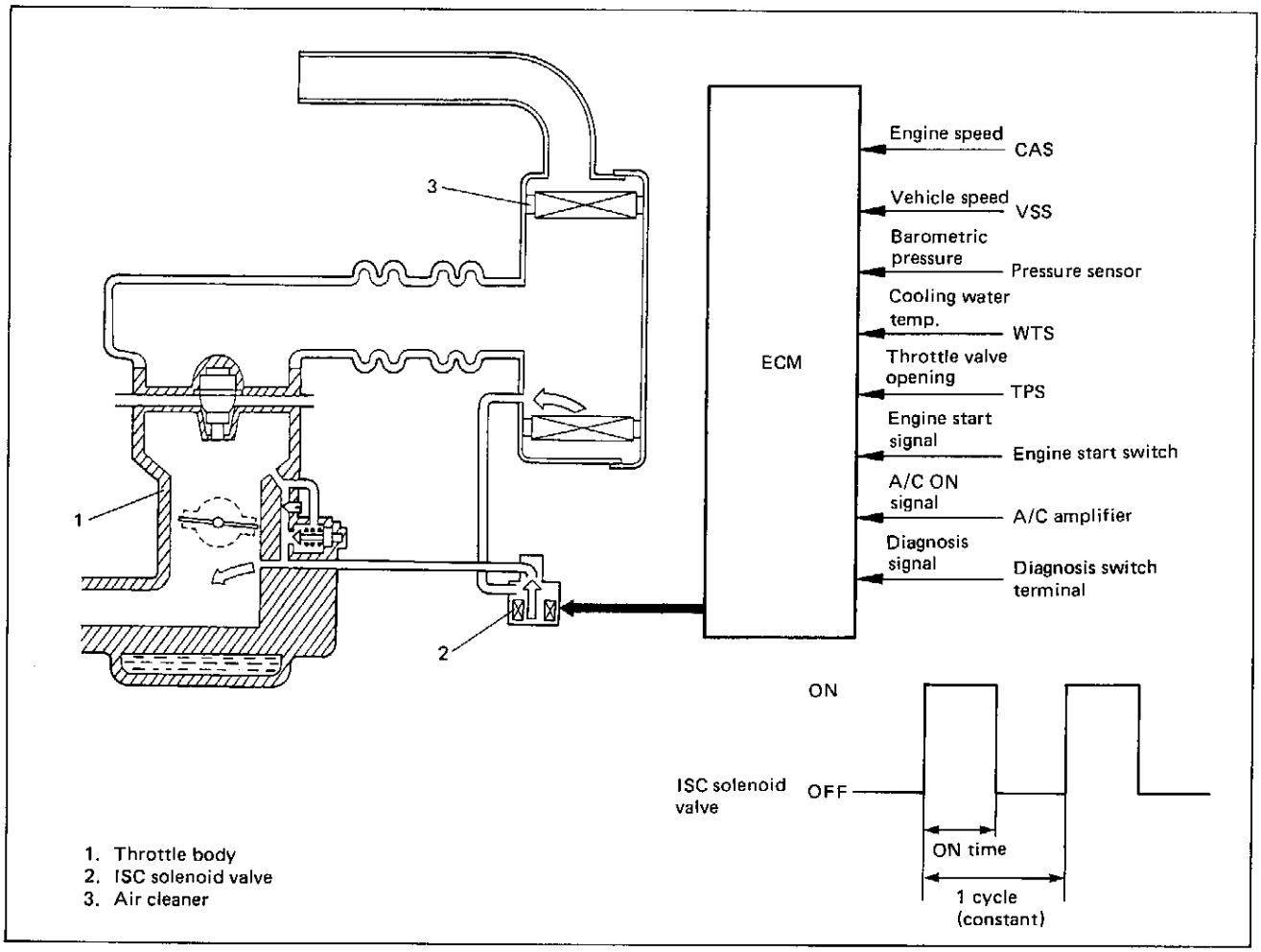
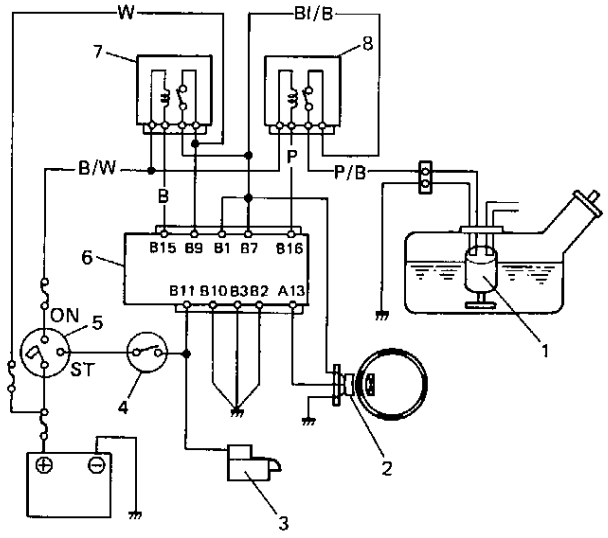


Fig. 4A-30 ISC Solenoid Valve Control System

FUEL PUMP CONTROL SYSTEM

ECM controls ON/OFF operation of the fuel pump by turning it ON via the fuel pump relay under any of the following condition.

- For 3 seconds after ignition switch ON.
- While cranking engine (while engine start signal is inputted to ECM).
- While CAS signal is inputted to ECM.



1. Fuel pump
2. CAS
3. Starter
4. Clutch switch
5. Main switch
6. ECM
7. Main relay
8. Fuel pump relay

Fig. 4A-31 Fuel Pump Circuit

THROTTLE OPENER CONTROL SYSTEM

In this system, the throttle valve is opened a little wider than the idle position to improve the engine performance at its start.

The throttle opener is controlled by VSV (Vacuum Switching Valve) which opens and closes the vacuum passage to the throttle opener.

ECM controls VSV according to the engine speed, starter signal and signal from the WTS and turns ON the electric circuit of VSV when;

- the engine is cranking
- the engine speed is less than 4,000 r/min, for 0 to some ten seconds after the engine start (duration time depends on the cooling water temperature, e.g. shorter for higher cooling water temperature.)

In either of the above conditions, VSV opens between the filter and passage "A" and closes between passages "A" and "B". In this state, like when the engine is at a stop, the chamber "C" of the throttle opener is under the atmospheric pressure. It means that the spring force pushes the rod to open the throttle valve.

Once the engine starts to run, ECM turns OFF the electric circuit of VSV which then opens between passages "A" and "B" and closes between the filter and passage "A". Consequently, the vacuum in the intake manifold is applied to the chamber "C" of the throttle opener and the diaphragm and rod are pulled. In this way, the throttle valve moves back to its idle position.

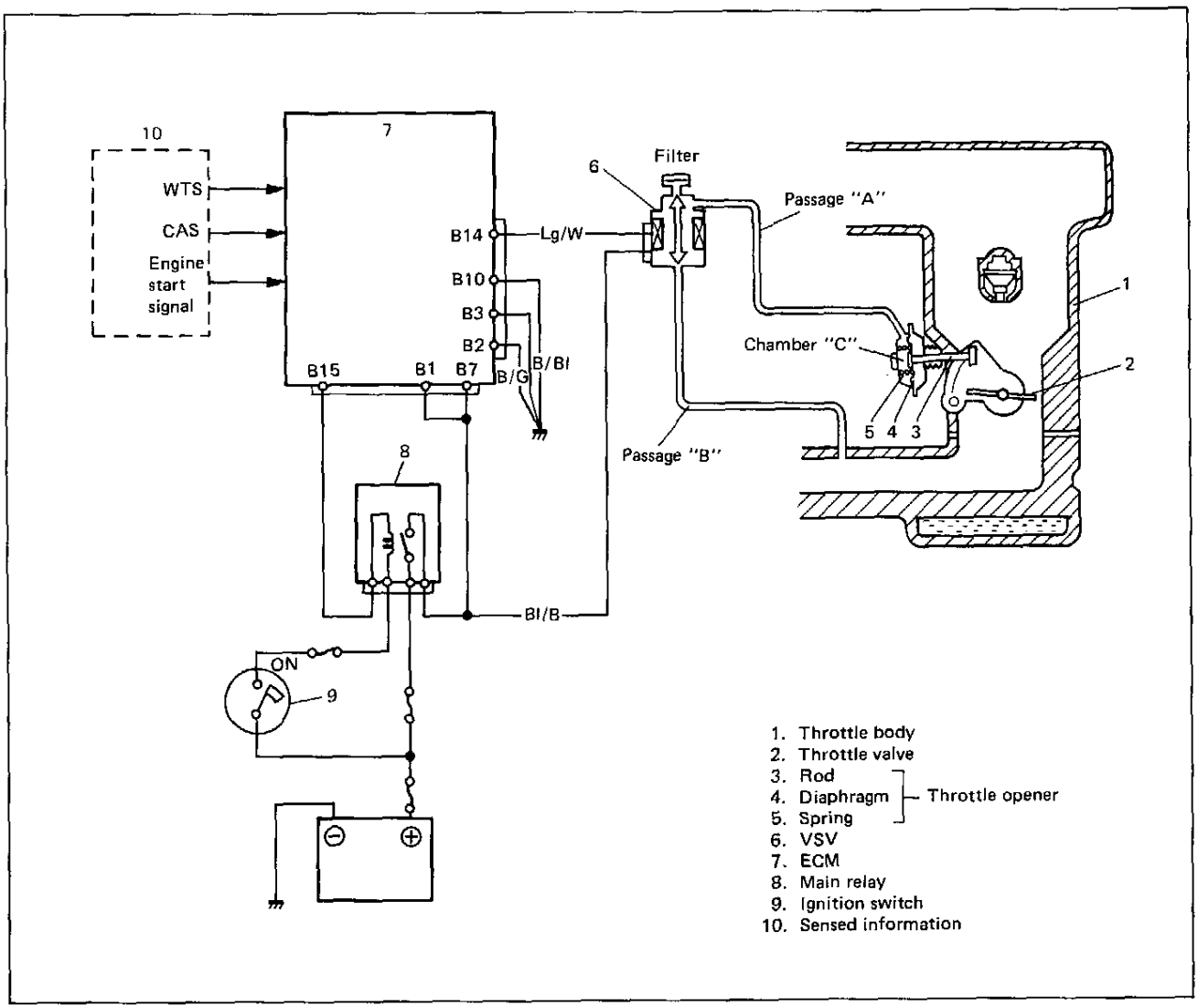


Fig. 4A-32 Throttle Opener Control System

EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM

This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifold.
The EGR valve is controlled by EGR modulator and VSV controlled by ECM according to signals from various sensors.
The diaphragm mounted in the EGR modulator is operated by back pressure of the exhaust gas to open and close the valve. By this opening and closing action of the valve, the EGR modulator controls the vacuum transmitted to the EGR valve.

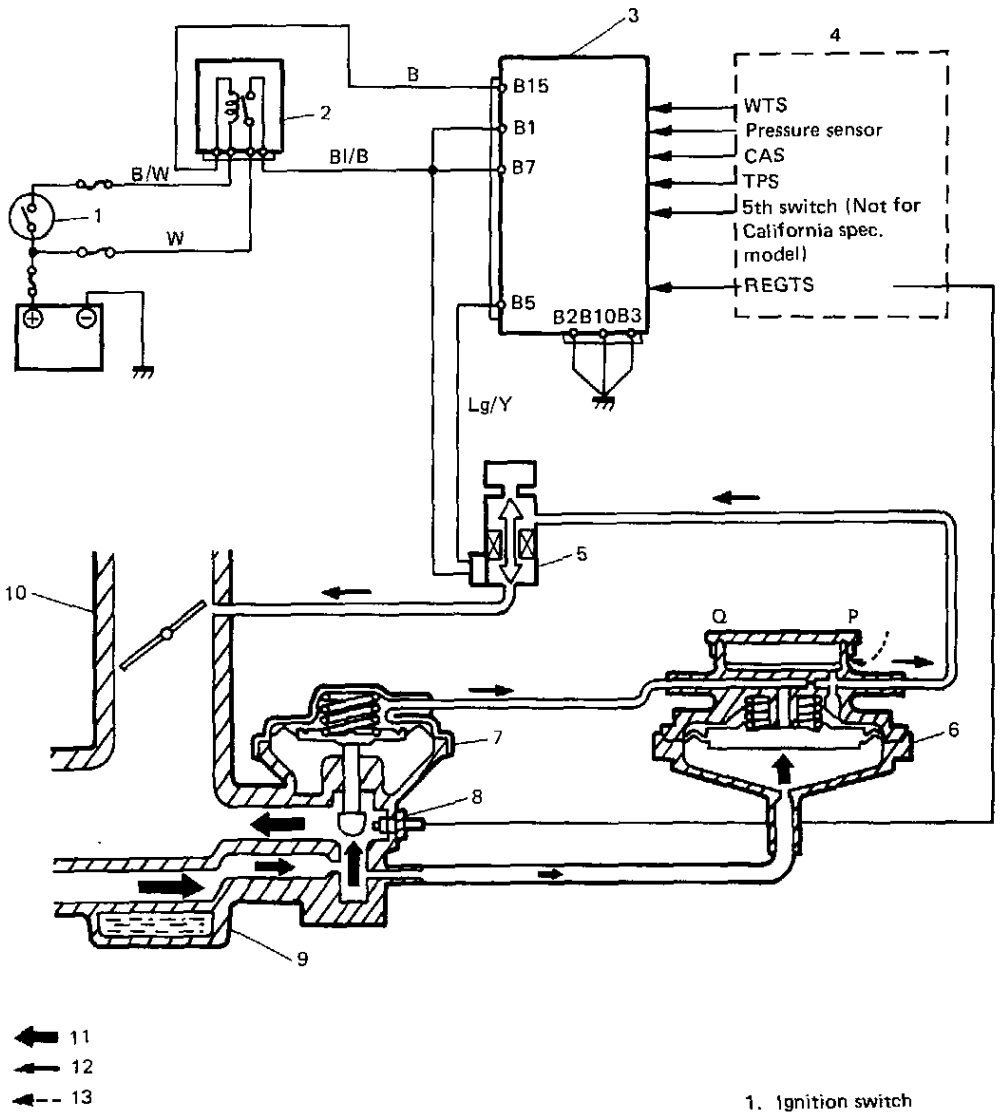
Under a low load condition such as low speed driving, the exhaust pressure is low. In this state, the diaphragm in the EGR modulator is pushed down by the spring force and the modulator valve opens to allow the air into the vacuum passage from the outside.
As a result, the vacuum transmitted to the EGR valve becomes smaller and so does the opening of the EGR valve.
Thus, less amount of exhaust gas is recirculated to the intake manifold.

Under a high load condition such as high speed driving, on the other hand, the exhaust pressure is high. By the high exhaust pressure, the diaphragm in the modulator is pushed up and closes its valve. As the air does not enter the vacuum passage in this state, the vacuum transmitted to the EGR valve grows larger and so does the opening of the EGR valve.
Thus, larger amount of exhaust gas is recirculated to the intake manifold.
Under any one of the following conditions, ECM closes the vacuum passage of VSV. In this state, as the vacuum is not transmitted to the EGR valve, it remains closed.

- When engine cooling water temperature is low
- When barometric pressure is low (at high altitude)
- When engine is running at high load
- When transmission is in 5th gear condition (Not for California spec. model)

Other than the above, EGR valve opens and closes in accordance with the EGR modulator operation.

Only California spec. model is equipped with REGTS (Recirculated Exhaust Gas Temperature Sensor).
The operation of EGR valves is monitored by ECM through the signal from the REGTS which measures the temperature in the exhaust passage. Should anyting abnormal occur, "CHECK ENGINE" light turns ON to warn it.



1. Ignition switch
2. Main relay
3. ECM
4. Sensed information
5. VSV
6. EGR modulator
7. EGR valve
8. REGTS (California spec. model only)
9. Intake manifold
10. Throttle body
11. Exhaust gas
12. Vacuum
13. Air

Fig. 4A-33 EGR Control System

ESA (ELECTRONIC SPARK ADVANCE) SYSTEM

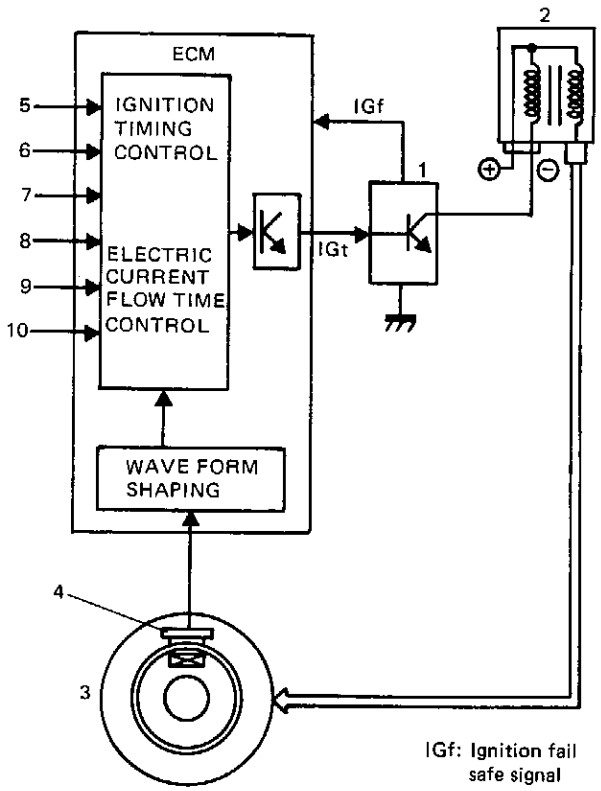
This system controls electronically the time of electric current flow to ignition primary coil as well as ignition timing.

ECM judges the engine condition by using signals from various sensors, selects the most suitable electric current flow time and ignition timing for that engine condition from among those pre-stored in its memory and sends a signal to the igniter (power unit).

The igniter turns ON and OFF the primary current of the ignition coil according to the signal from ECM.

Control of this system includes four different types as follows.

- Ignition timing control at engine start
- Ignition timing control after engine start
- Electric current flow time control



IGf: Ignition fail safe signal

IGt: Ignition trigger signal

1. Igniter
2. Ignition coil
3. Distributor
4. CAS
5. PS
6. TPS
7. WTS
8. Engine start switch
9. Battery voltage
10. Test switch terminal

Fig. 4A-34 System Diagram

Ignition Timing Control at Engine Start

To obtain better starting performance of the engine at the engine start (when the engine start switch is turned ON or the engine speed is lower than 400 r/min.) ESA system sets the ignition timing to BTDC 5°.

Ignition Timing Control After Engine Start

Under any conditions other than engine start, the ignition timing is determined according to the intake manifold pressure and the engine speed.

Electric Current Flow Time Control

To stabilize the secondary voltage generated in the ignition coil to a proper level, ESA system controls the time of primary current flow to the ignition coil.

NOTE:

The ignition timing is controlled by ECM as described above. Therefore, when checking or adjusting the ignition timing, the ignition timing must be fixed by grounding the test switch terminal.

DIAGNOSIS

ECM has a system self-diagnosis function as described previously (p. 4A-15).
Investigate where the trouble is by referring to the following "Diagnostic Flow Chart" and "Diagnostic Code".

PRECAUTIONS IN DIAGNOSING TROUBLES

[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC CODE]

- Before identifying diagnostic code indicated by "CHECK ENGINE" light, don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine. Such disconnection will erase memorized trouble in ECM memory.
- If abnormality or malfunction lies in two or more areas, "CHECK ENGINE" light indicates applicable codes three times each.
  And flashing of these codes is repeated as long as diagnosis terminal is grounded (spare fuse is connected) and ignition switch is held at ON position.
- Take a note of diagnostic code indicated first.

[INTERMITTENT TROUBLES]

- There are cases where "CHECK ENGINE" light indicates a diagnostic code representing a trouble which occurred only temporarily and has gone. In such case, it may occur that good parts are replaced unnecessarily. To prevent such an accident, be sure to follow instructions given below when checking by using "Diagnostic Flow Chart".
  * When trouble can be identified, that is, it is not an intermittent one:
    Check sensor (actuator), wires and each connection and if they are all in good condition, substitute a known-good ECM and recheck.
  * When trouble can not be identified but "CHECK ENGINE" light indicates a trouble code:
    Diagnose trouble by using that code No. and if sensor (actuator), wires and each connection are all in good condition, erase diagnostic code in ECM memory. Then conduct a test run and check what "CHECK ENGINE" light indicates. Only when it indicates trouble code again, substitute a known-good ECM and check again.
    If it indicates not trouble code but normal code No. 12, it means that an intermittent trouble did occur and has gone. In this case, check wires and connections carefully again.

[NOTES ON SYSTEM CIRCUIT INSPECTION]

- Intermittent trobles
  Most intermittent problems are caused by faulty electrical connections or wiring.
  Perform careful check of suspect circuits for:
  - Poor mating of coupler halves, or terminals not fully seated in coupler body (backed out).
  - Improperly formed or damaged terminals. All coupler terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection.
- Never connect any tester (voltmeter, ohmmeter, or whatever) to ECM when its coupler is disconnected. Attempt to do it may cause damage to ECM.
- Never connect an ohmmeter to ECM with its coupler connected to it. Attempt to do it may cause damage to ECM and sensors.
- Be sure to use a voltmeter with high impedance (MΩ/V minimum) or a digital type voltmeter. Any other voltmeter should not be used because accurate measurements are not obtained.

- When checking voltage at each terminal of the coupler which is connected to ECM, be sure to negative probe to body ground. Any other way is prohibited even by accident.
  Applying it improperly may cause the sensor or ECM to be shorted and damaged.

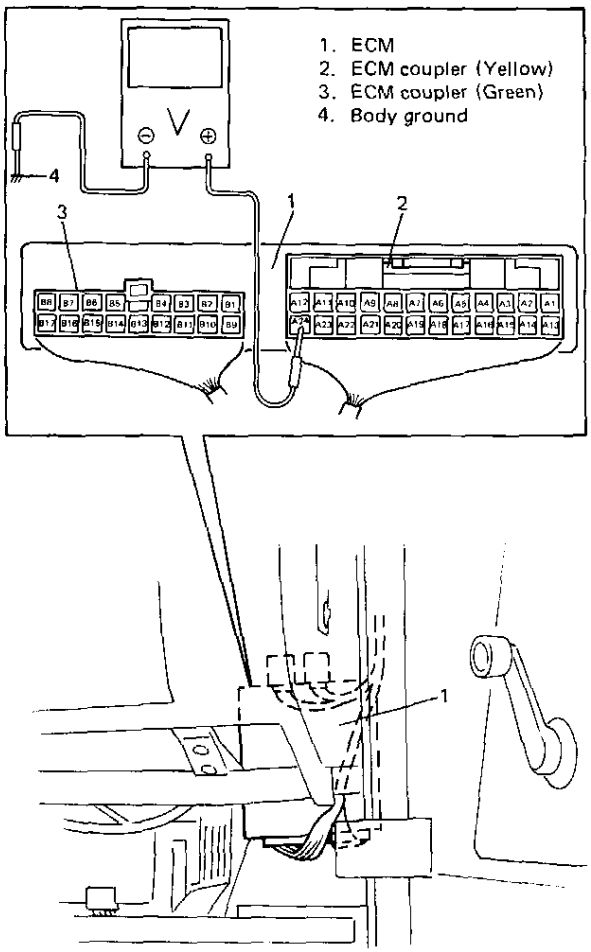


Fig. 4A-35 Checking Voltage and Terminal Position

- For ECM coupler terminal positions (A1, A2 . . . to A24 and B1, B2 . . . to B17), refer to Fig. 4A-35.
- When disconnecting and connecting coupler, make sure to turn ignition switch OFF.
- When there is a question "Are couplers connected properly? " in FLOW CHART, check male half of terminal for bend and female half for excessive opening, terminal for poor locking (looseness), corrosion, dust, etc.
- When connecting a probe of ohmmeter, voltmeter, etc. to coupler terminal, be sure to connect it from wire harness side of coupler.

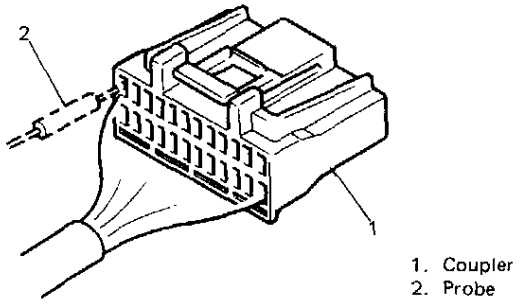


Fig. 4A-36 Connecting Meter Probe

- When connecting meter probe from terminal side of coupler because it can't be connected from harness side, use extra care not to bend male terminal of coupler or force its female terminal open for connection.
  In case of such coupler as shown below, connect probe as shown below to avoid opening female terminal.
  Never connect probe where male terminal is supposed to fit.

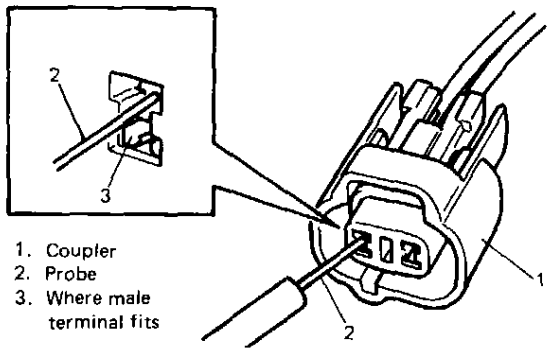


Fig. 4A-37 Connecting Meter Probe

- Before measuring voltage at each terminal, check to make sure that battery voltage is 11V or higher. Such terminal voltage check at low battery voltage will lead to erroneous diagnosis.

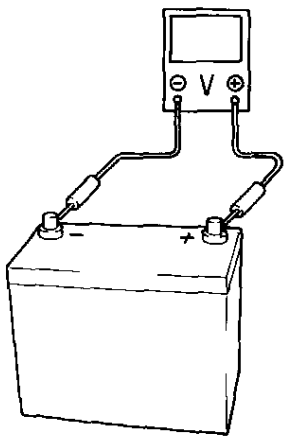


Fig. 4A-38 Checking Battery Voltage

DIAGNOSTIC FLOW CHART

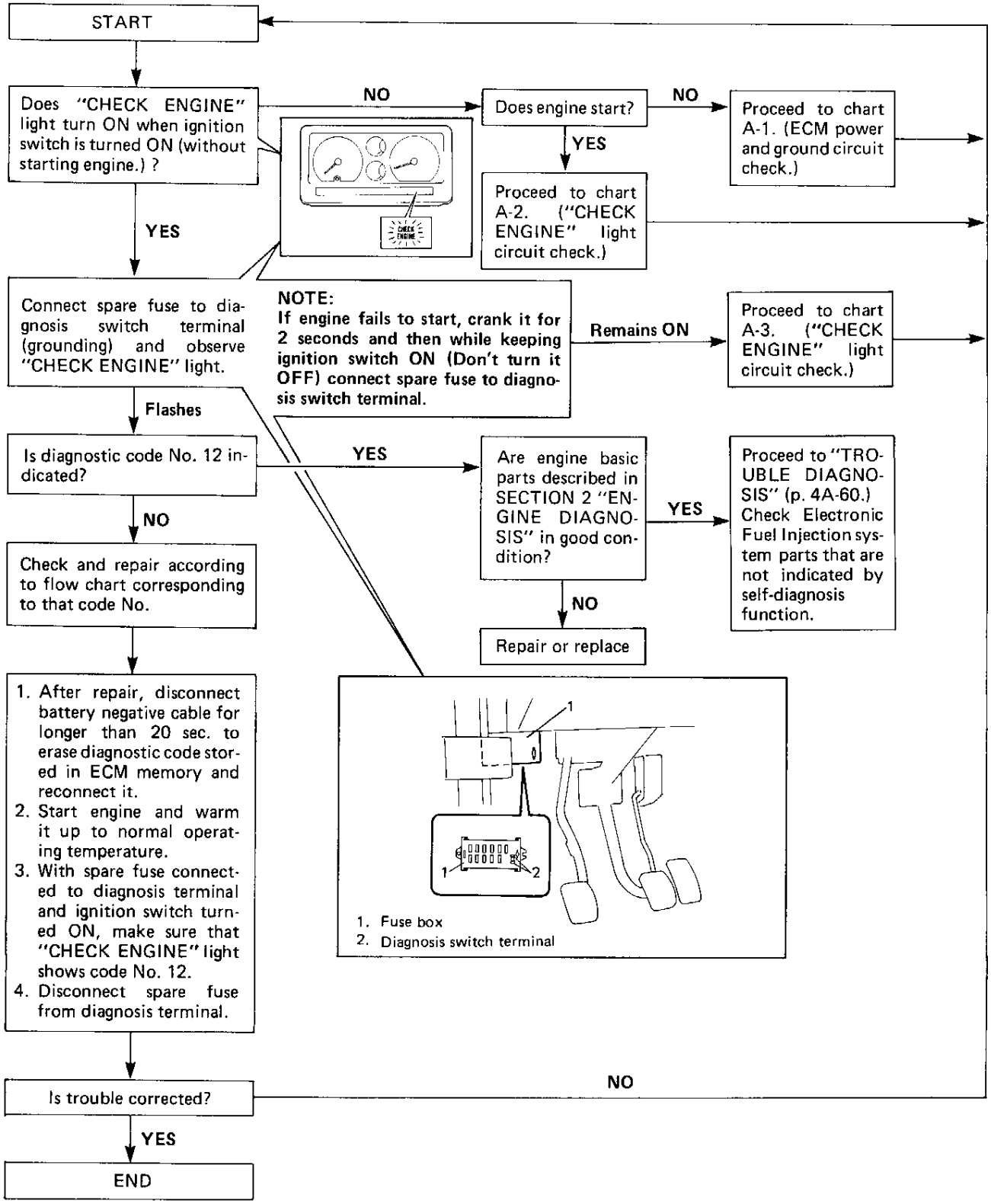
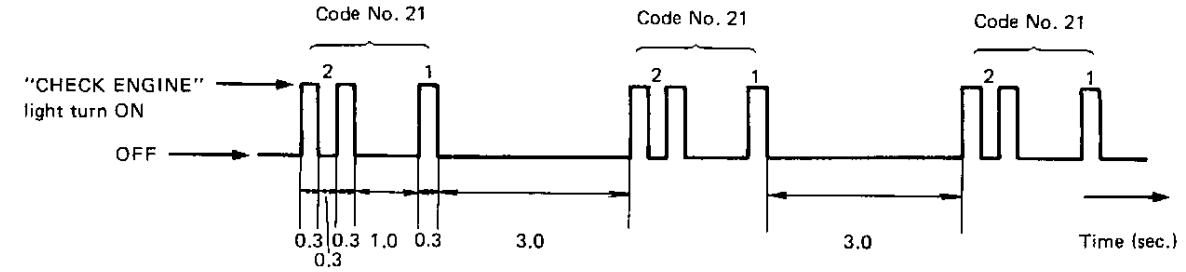


Fig. 4A-39 Diagnostic Flow Chart For Electronic Fuel Injection System

DIAGNOSIS CODE TABLE

EXAMPLE: When throttle position sensor is defective (Code No. 21)



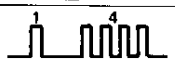
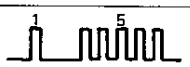
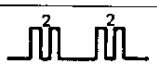
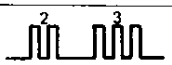
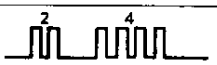
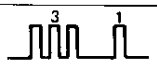
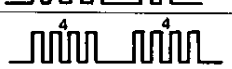
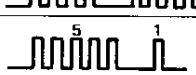
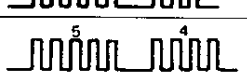
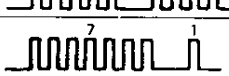
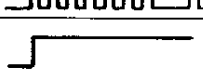
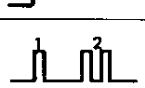
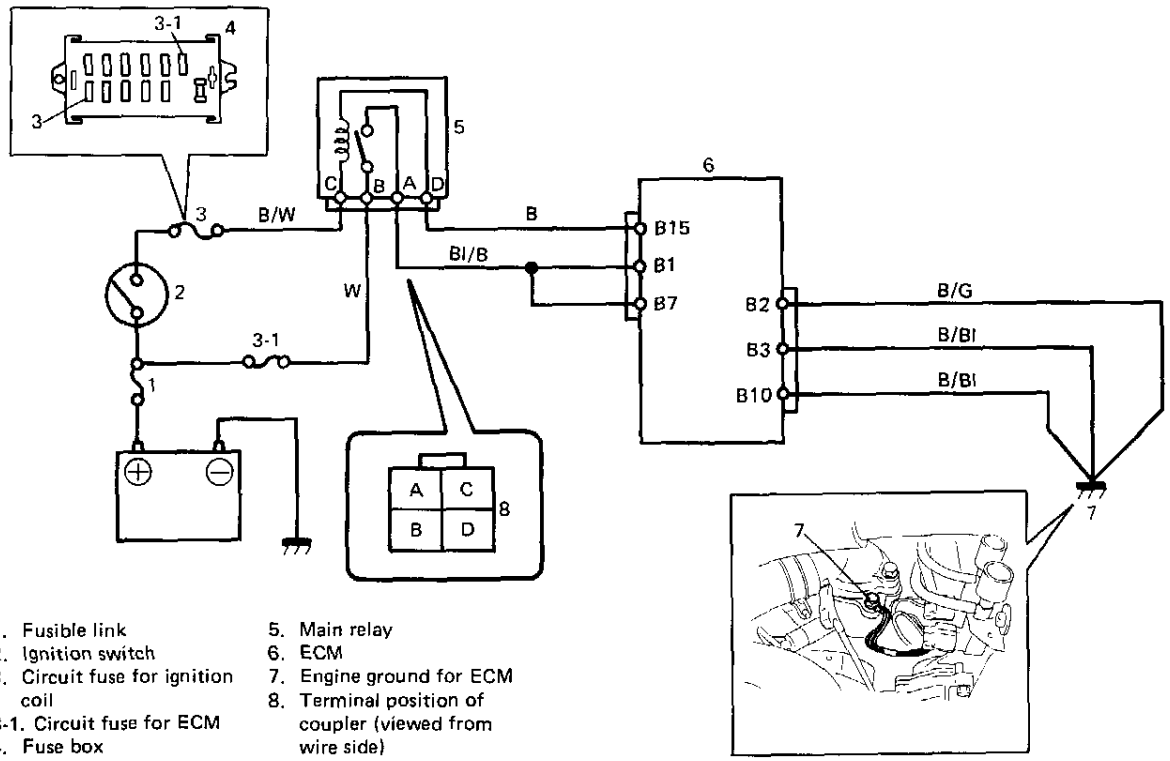
DIAGNOSTIC CODE NO.	"CHECK ENGINE" LIGHT FLASHING PATTERN	DIAGNOSTIC ITEM	DIAGNOSIS
13		Oxygen sensor	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
14		WTS	
15			
21		TPS	
22			
23		ATS	
25			
24		VSS	
31		Pressure sensor	
32			
41		Ignition signal	
42		CAS	
44		Idle switch of TPS	
45			
51		EGR system (For California spec. model only)	
53		Ground circuit (For California spec. model only)	
54		5th switch (Not for California spec. model)	
71		Test switch terminal	
ON		ECM	ECM failure.
12		Normal	This code appears when none of the other codes (Above codes) are identified.

Fig. 4A-40 Diagnostic Code Table

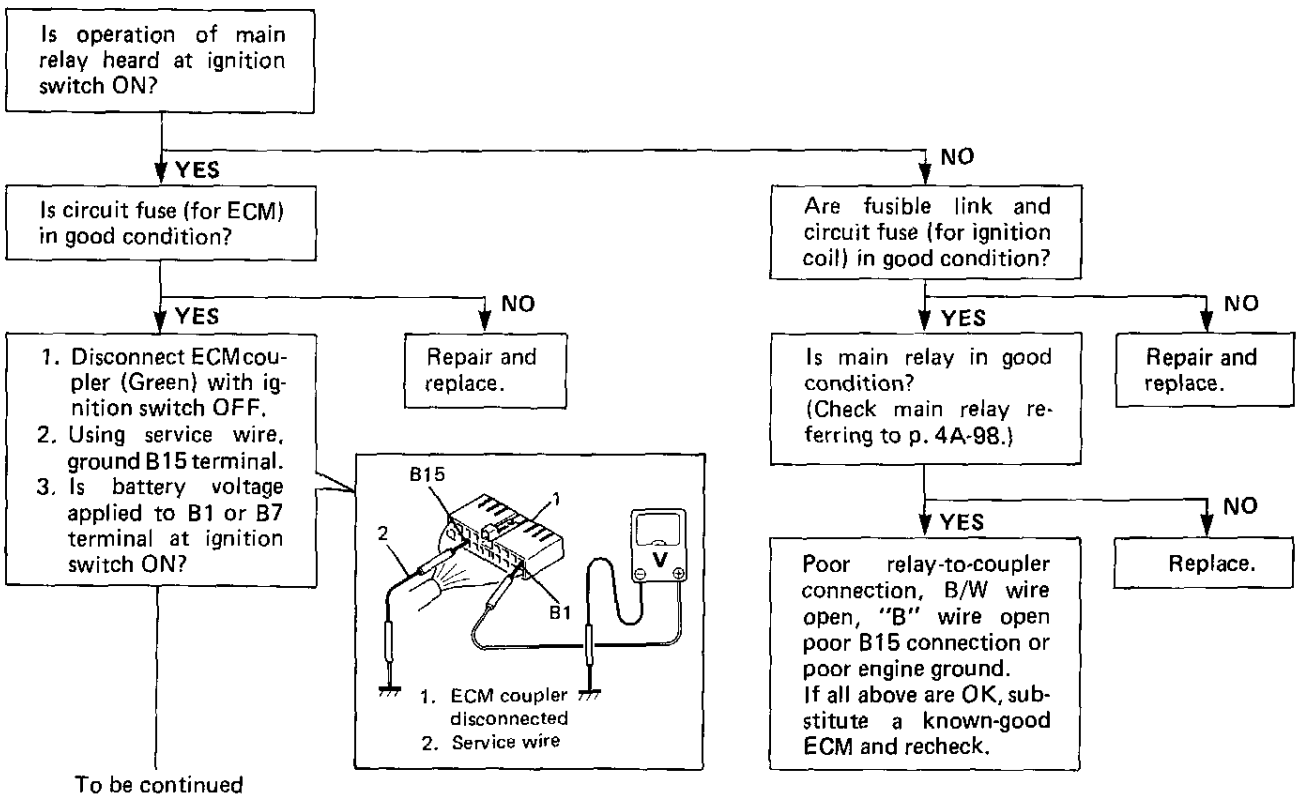
A-1 ECM POWER AND GROUND CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T LIGHT AT IGNITION SWITCH ON AND ENGINE DOESN'T START THOUGH IT IS CRANKED UP.)



1. Fusible link
2. Ignition switch
3. Circuit fuse for ignition coil
3-1. Circuit fuse for ECM
4. Fuse box
5. Main relay
6. ECM
7. Engine ground for ECM
8. Terminal position of coupler (viewed from wire side)

Fig. 4A-41 ECM Power and Ground Circuit



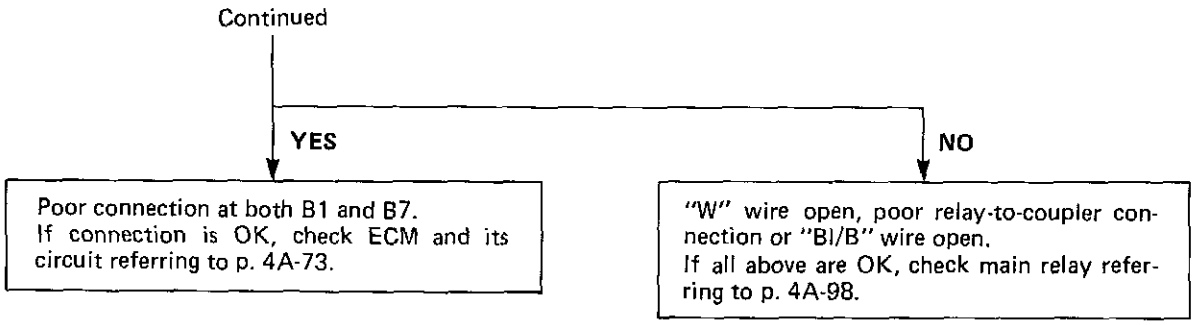
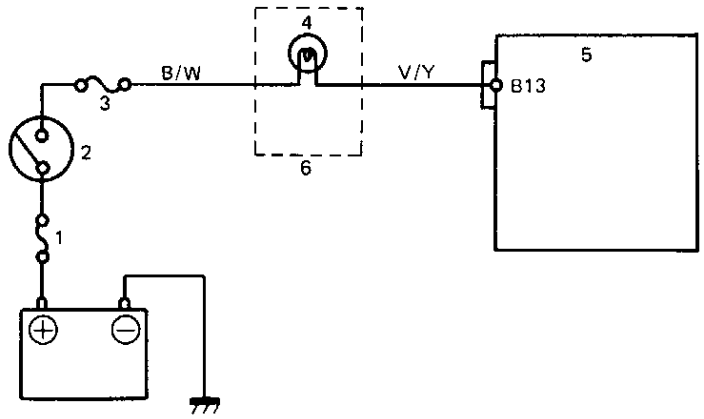


Fig. 4A-42 Diagnostic Flow Chart A-1 For ECM Power and Ground Circuit

A-2 "CHECK ENGINE" LIGHT CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T LIGHT AT IGNITION SWITCH ON THOUGH ENGINE STARTS.)



1. Main fuse
2. Ignition switch
3. Circuit fuse
4. "CHECK ENGINE" light bulb
5. ECM
6. Combination meter

Fig. 4A-43 "CHECK ENGINE" Light Circuit

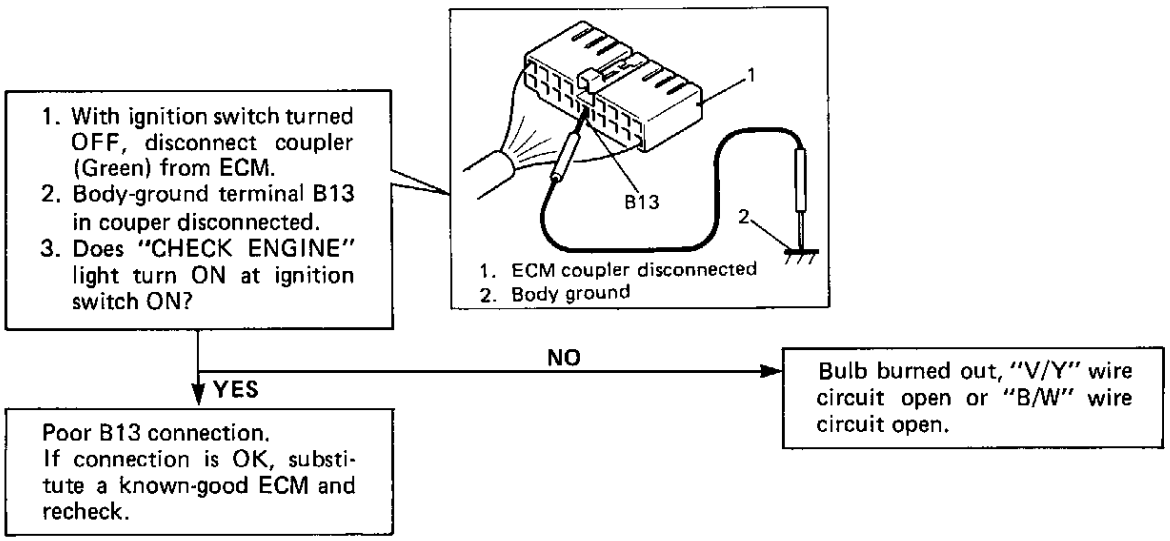
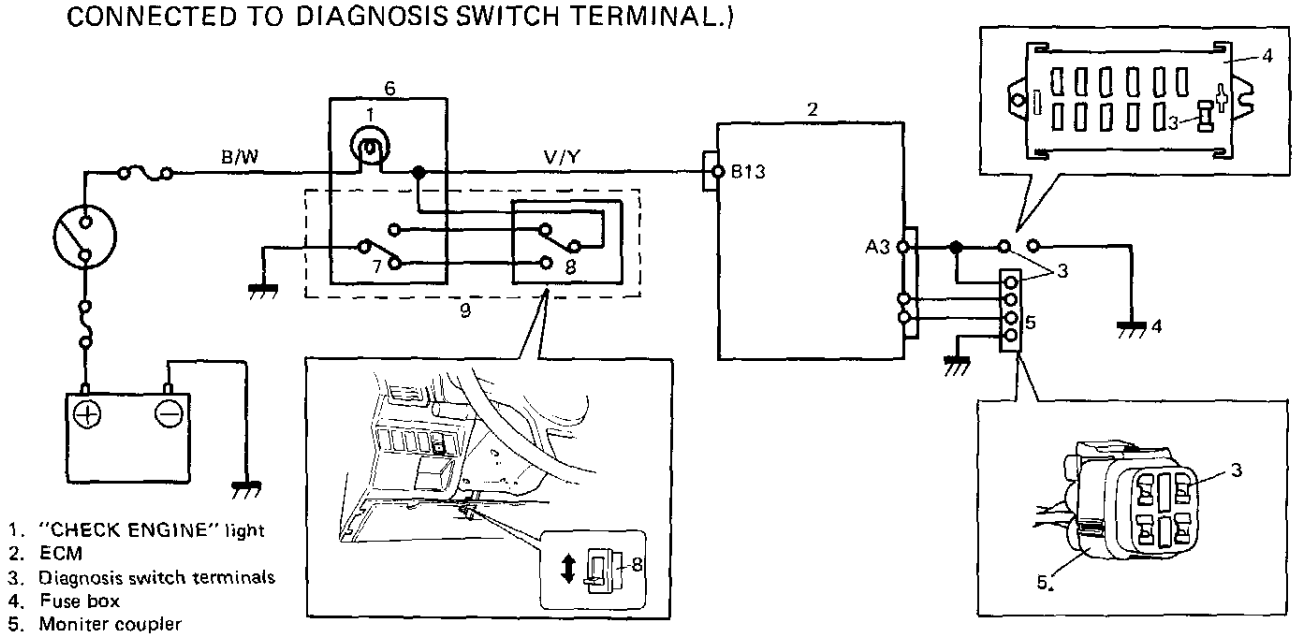


Fig. 4A-44 Diagnostic Flow Chart A-2 for "CHECK ENGINE" Light Circuit

A-3 "CHECK ENGINE" LIGHT CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T FLASH OR JUST REMAINS ON EVEN WITH SPARE FUSE CONNECTED TO DIAGNOSIS SWITCH TERMINAL.)



1. "CHECK ENGINE" light
2. ECM
3. Diagnosis switch terminals
4. Fuse box
5. Moniter coupler
6. Combination meter
7. Mileage sensor
8. Cancel switch
9. Applicable only to Federal spec. model exclusive of those of California and Canada specifications.

Fig. 4A-45 "CHECK ENGINE" Light Circuit

For California and Canada Spec. Model

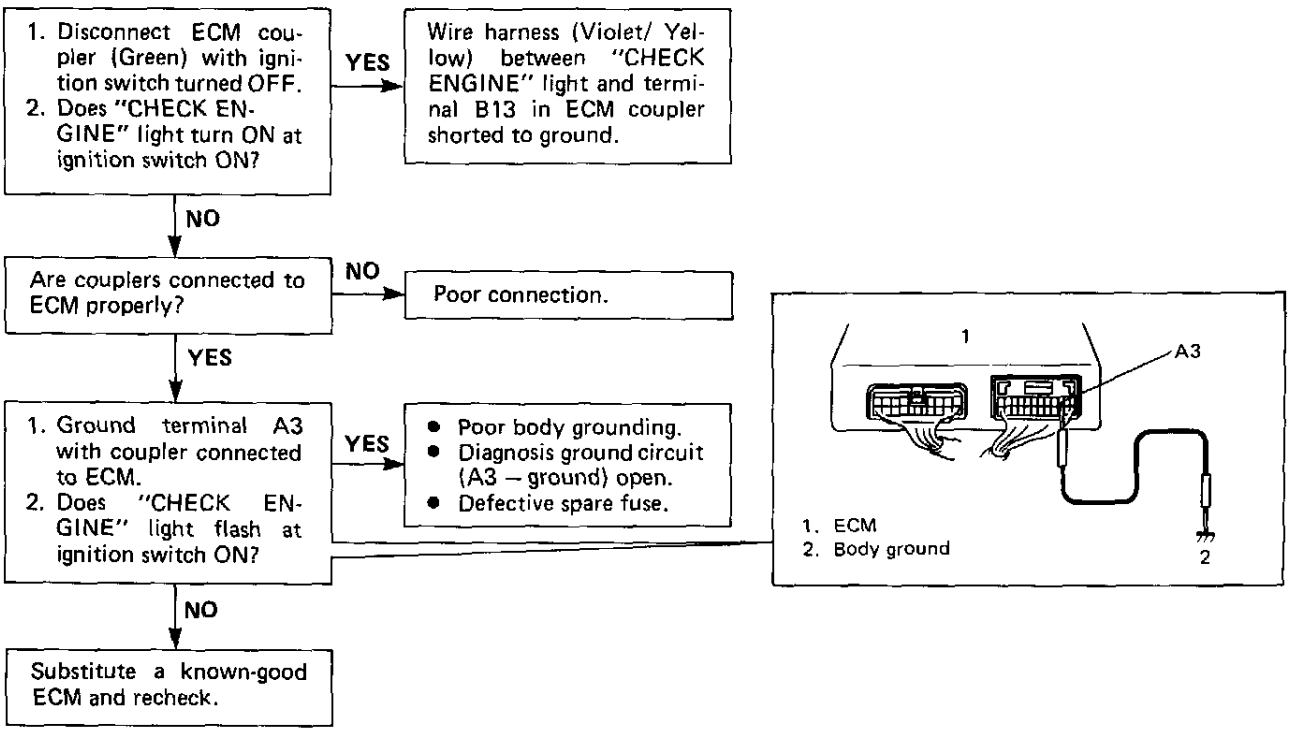


Fig. 4A-46 Diagnostic Flow Chart A-3 For "CHECK ENGINE" Light Circuit (For California and Canada spec. model)

For Federal Spec. Model Except California and Canada

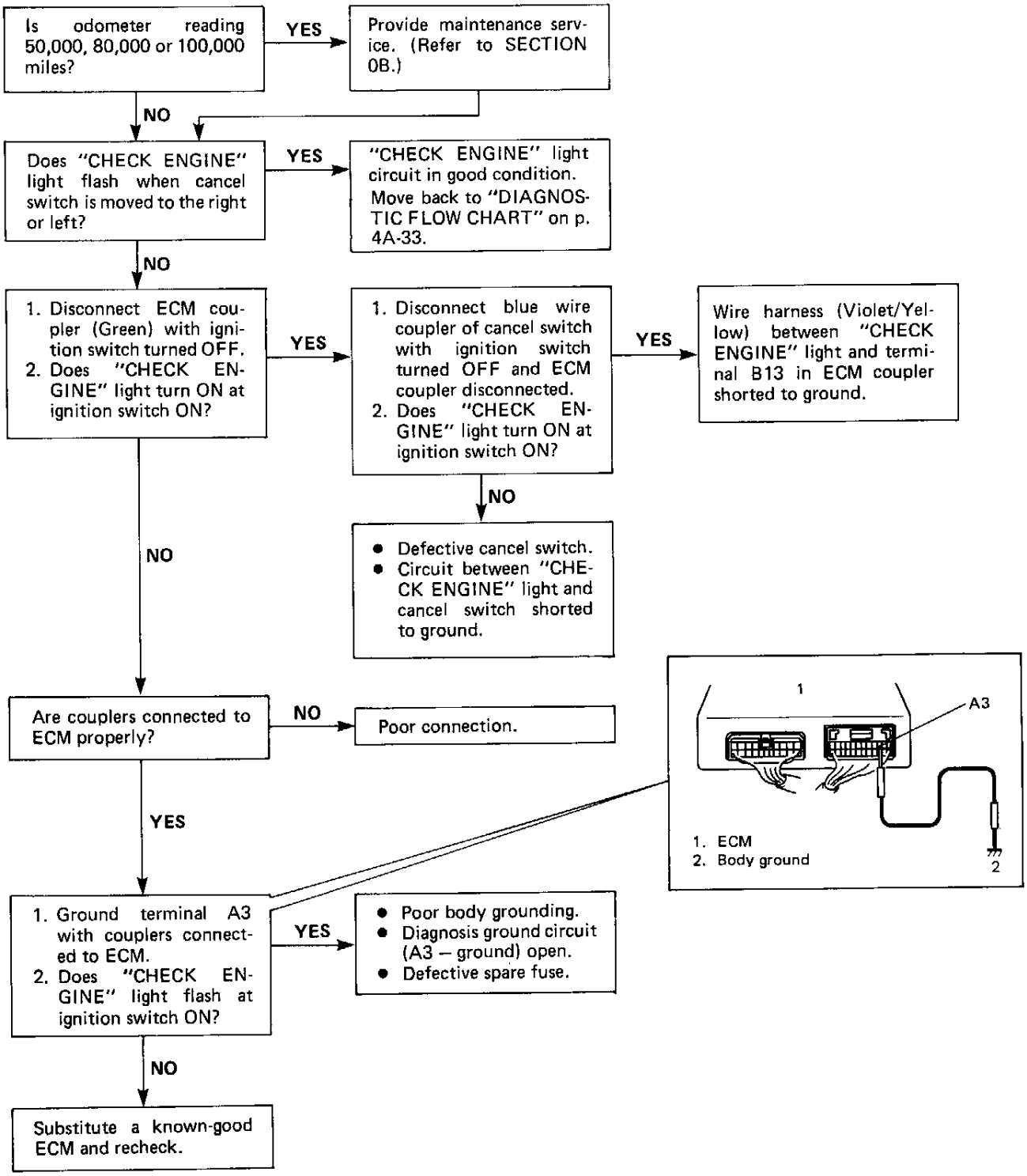


Fig. 4A-47 Diagnostic Flow Chart A-3 For "CHECK ENGINE" Light Circuit (For Federal spec. model Except California and Canada)

CODE NO. 13 OXYGEN SENSOR CIRCUIT (SIGNAL VOLTAGE LOW AND DOESN'T CHANGE)

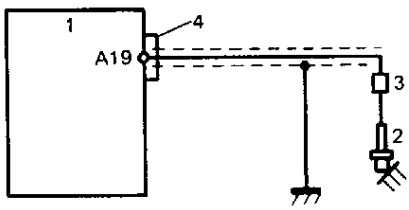
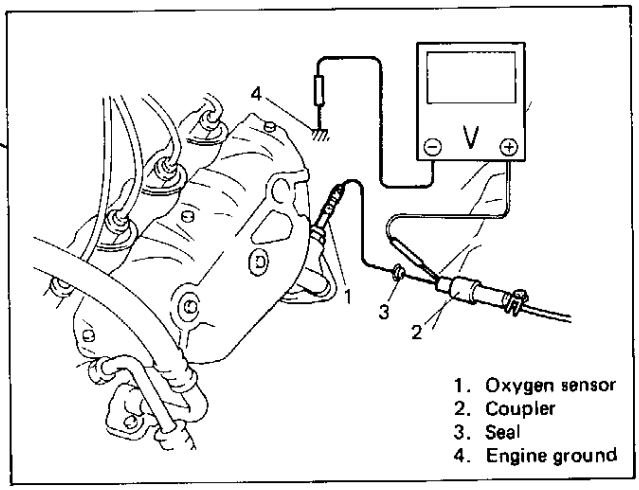


Fig. 4A-48 Oxygen Sensor Circuit

NOTE:

- Before diagnosing trouble according to flow chart given below, check to make sure that following system and parts other than Electronic Fuel Injection system are in good condition.
  - Air cleaner (clogged)
  - Vacuum leaks (air inhaling)
  - Spark plugs (contamination, gap)
  - High tension cords (crack, deterioration)
  - Distributor rotor or cap (wear, crack)
  - Ignition timing
  - Engine compression
  - Any other system and parts which might affect A/F mixture or combustion.
- If code No. 13 and another code No. are indicated together, the latter has priority. Therefore, check and correct what is represented by that code No. first and then proceed to the following check.

1. Warm up engine to normal operating temperature.
2. Remove seal from oxygen sensor coupler.
3. Connect voltmeter between oxygen sensor terminal and engine ground.
4. Maintain engine speed at 2000 r/min. After 60 seconds, check voltmeter.



0V → Replace oxygen sensor and recheck.

Remains unchanged at below 0.45V. → To ① on next page.

Remains unchanged at above 0.45V. → To ② on next page.

Deflects between above and below 0.45V repeatedly. → Oxygen sensor and its circuit (A/F ratio feed back system) are in good condition.
- Intermittent trouble or faulty ECM. Recheck referring to item "Intermittent trouble" on p. 4A-31.

CODE NO. 13 OXYGEN SENSOR CIRCUIT (Continued)

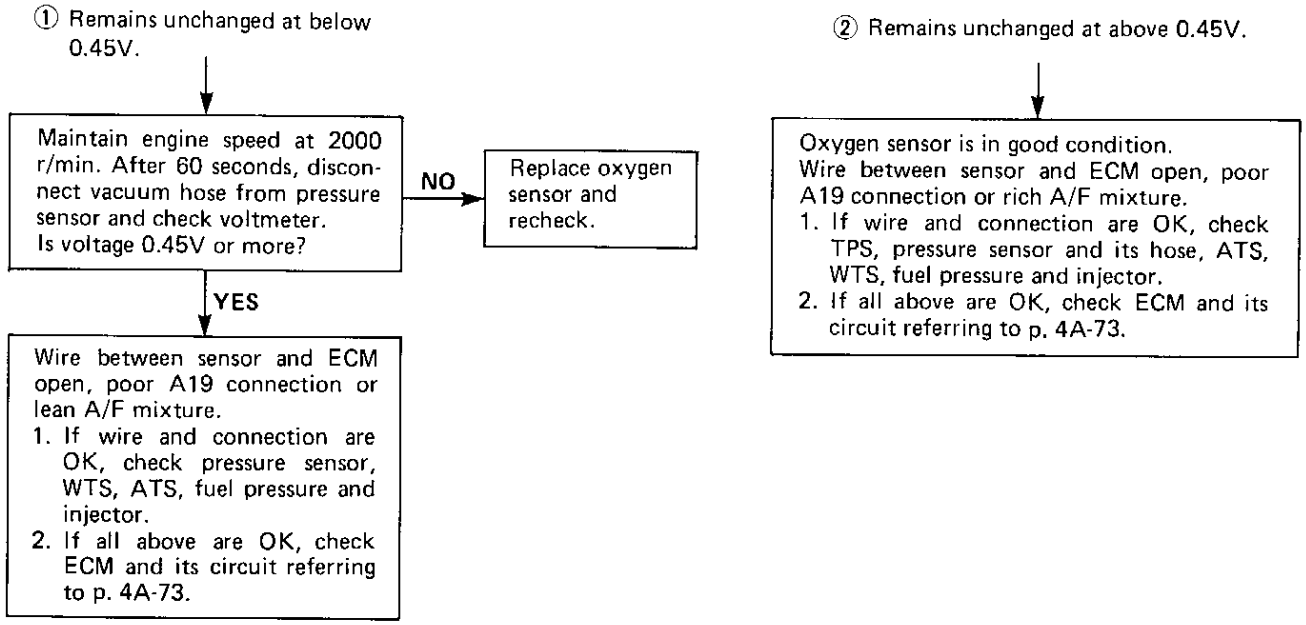
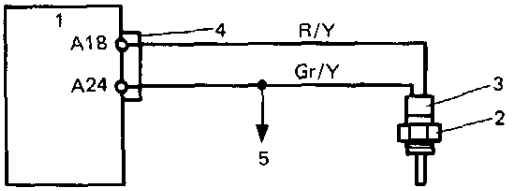


Fig. 4A-49 Diagnostic Flow Chart For Code No. 13

CODE NO. 14 WTS (WATER TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)



1. ECM
2. WTS
3. Coupler
4. ECM coupler
5. To other sensors

NOTE:
When Code Nos. 14, 21, 23, 31 and 44 are indicated together, it is possible that "Gr/Y" wire is open or A24 terminal connection is poor.

Fig. 4A-50 WTS Circuit

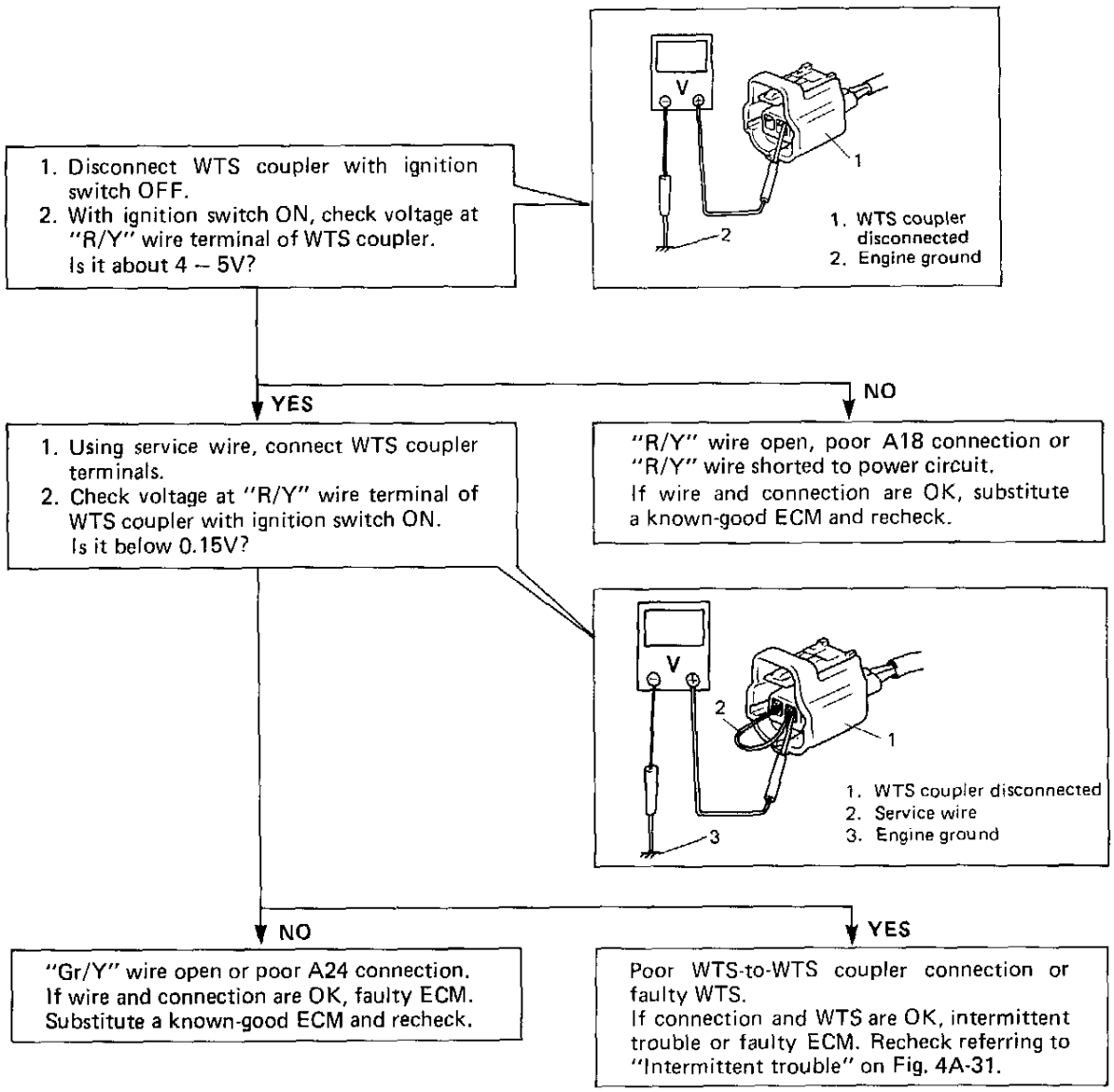


Fig. 4A-51 Diagnostic Flow Chart For Code No. 14

CODE NO. 15 WTS (WATER TEMPERATURE SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED, SIGNAL VOLTAGE LOW)

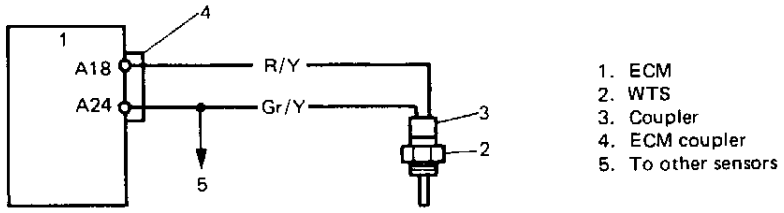


Fig. 4A-52 WTS Circuit

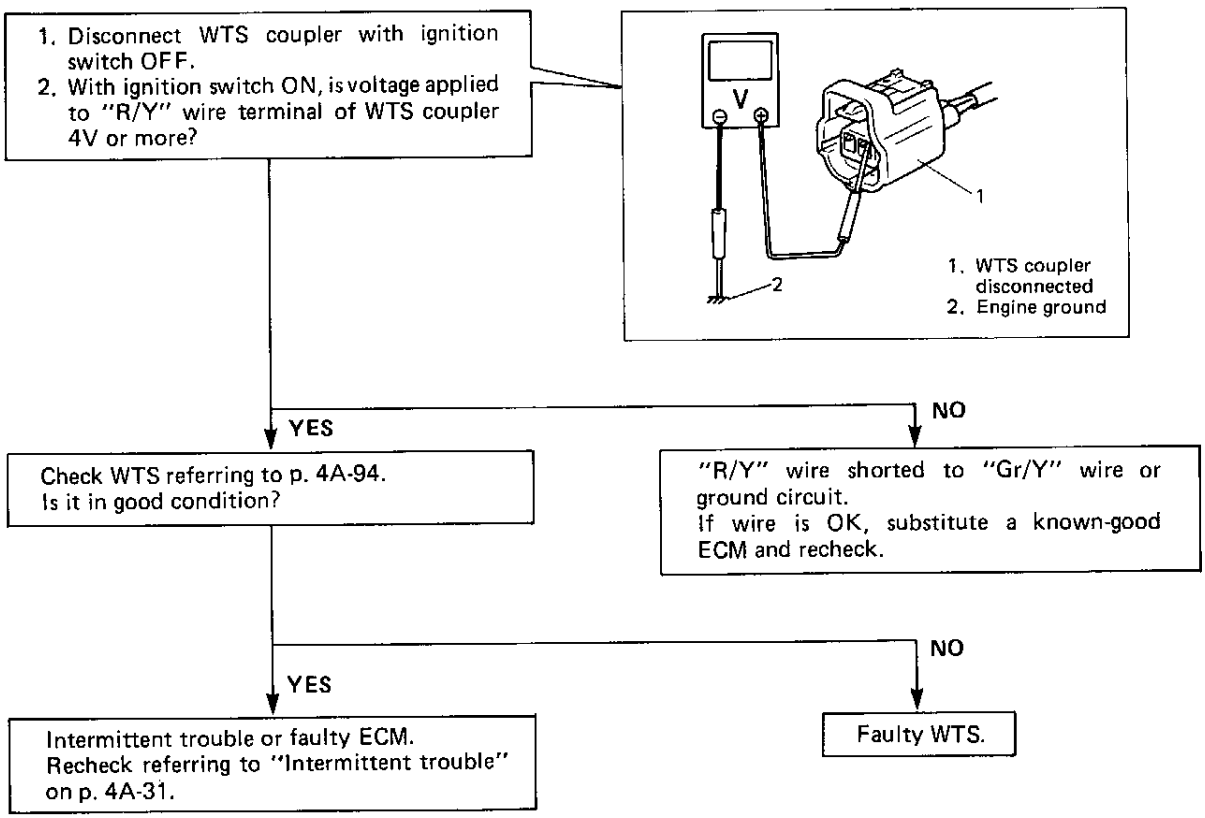
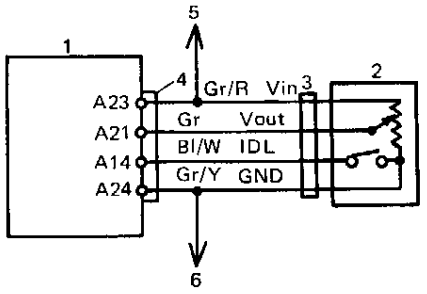


Fig. 4A-53 Diagnostic Flow Chart For Code No. 15

CODE NO. 21 TPS (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH)



1. ECM
2. TPS
3. Coupler
4. ECM coupler
5. To pressure sensor
6. To other sensors

Fig. 4A-54 TPS Circuit

NOTE:
Be sure to turn OFF ignition switch for this check.

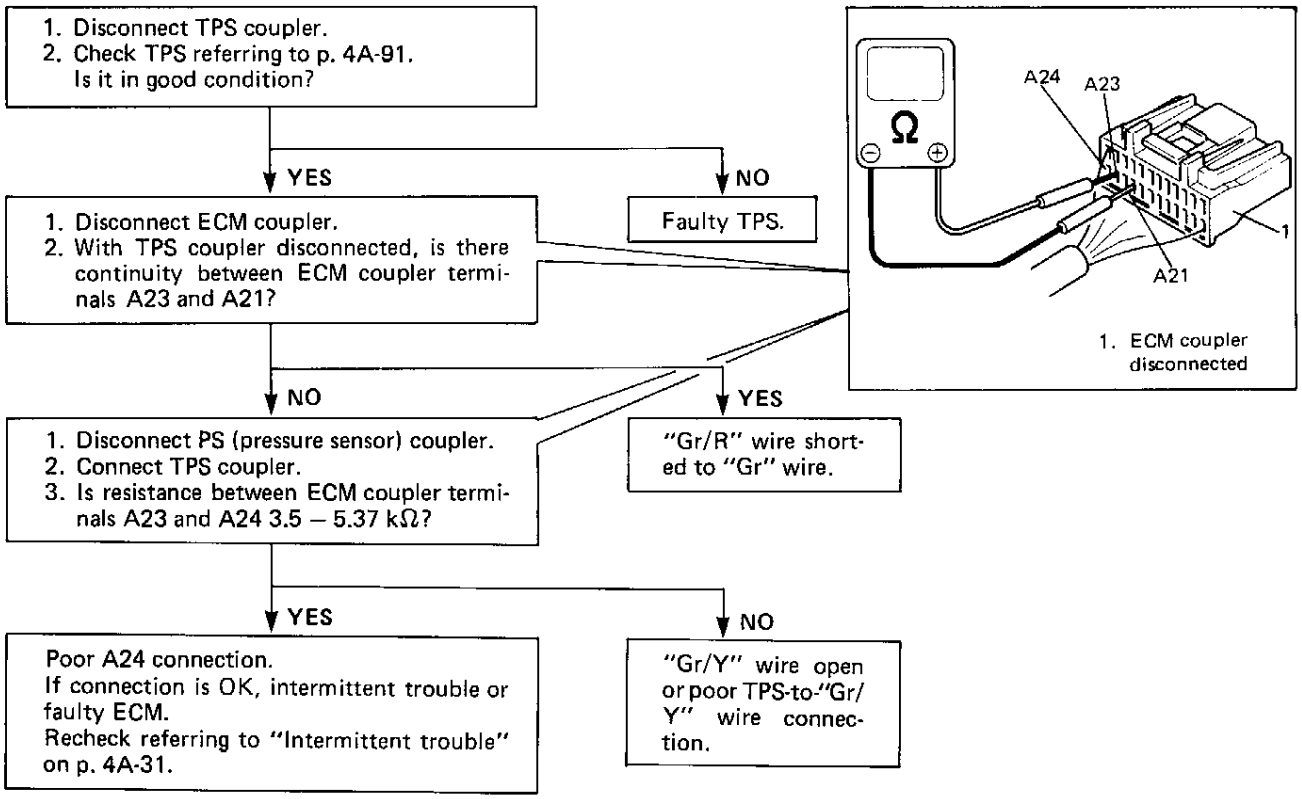
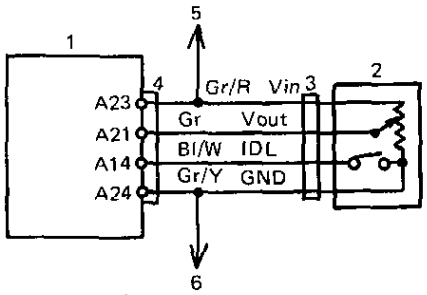


Fig. 4A-55 Diagnostic Flow Chart For Code No. 21

CODE NO. 22 TPS (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW)



1. ECM
2. TPS
3. Coupler
4. ECM coupler
5. To pressure sensor
6. To other sensors

Fig. 4A-56 TPS Circuit

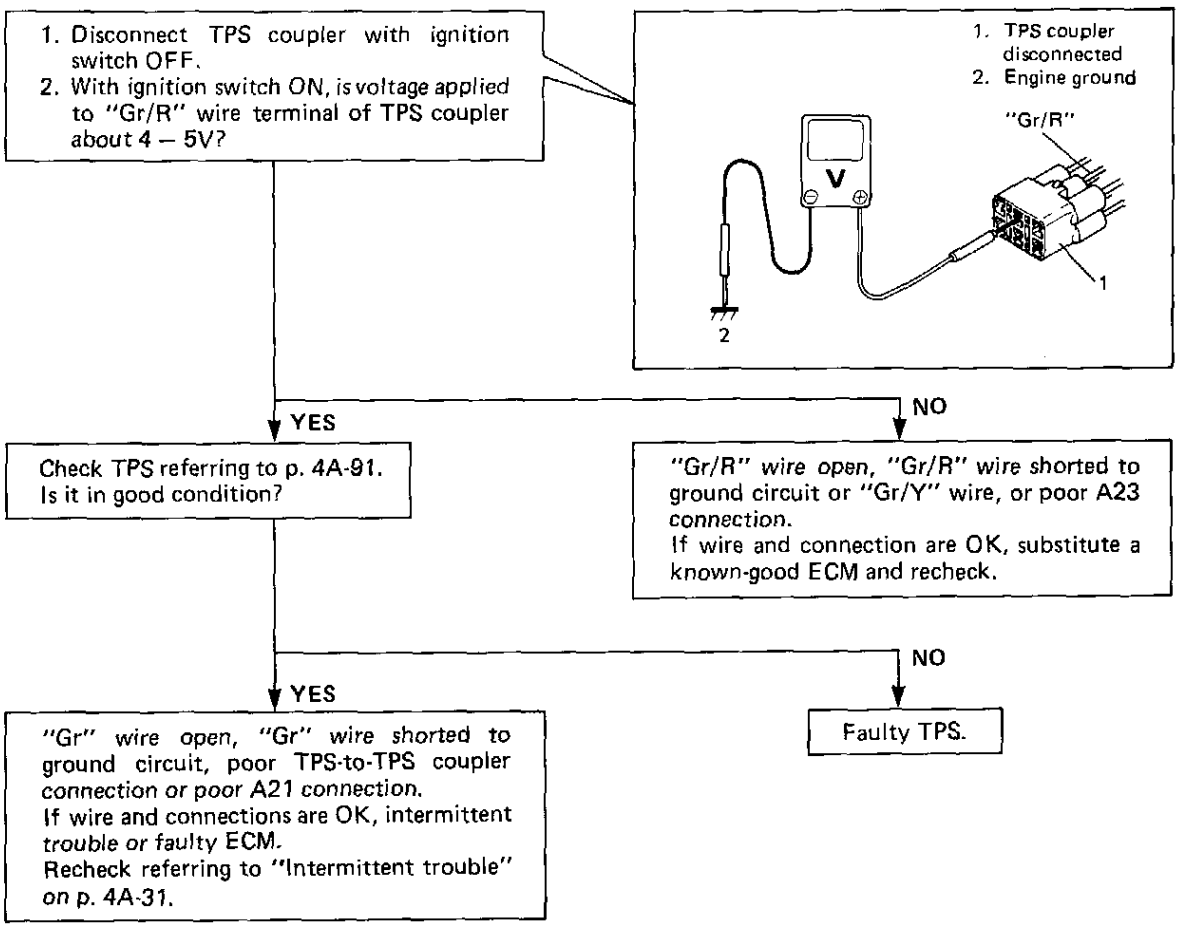
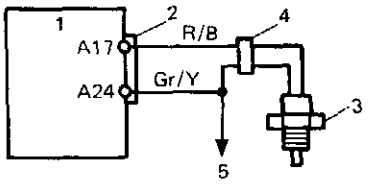


Fig. 4A-57 Diagnostic Flow Chart For Code No. 22

CODE NO. 23 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)



1. ECM
2. ECM coupler
3. ATS
4. ATS coupler
5. To other sensors

Fig. 4A-58 ATS Circuit

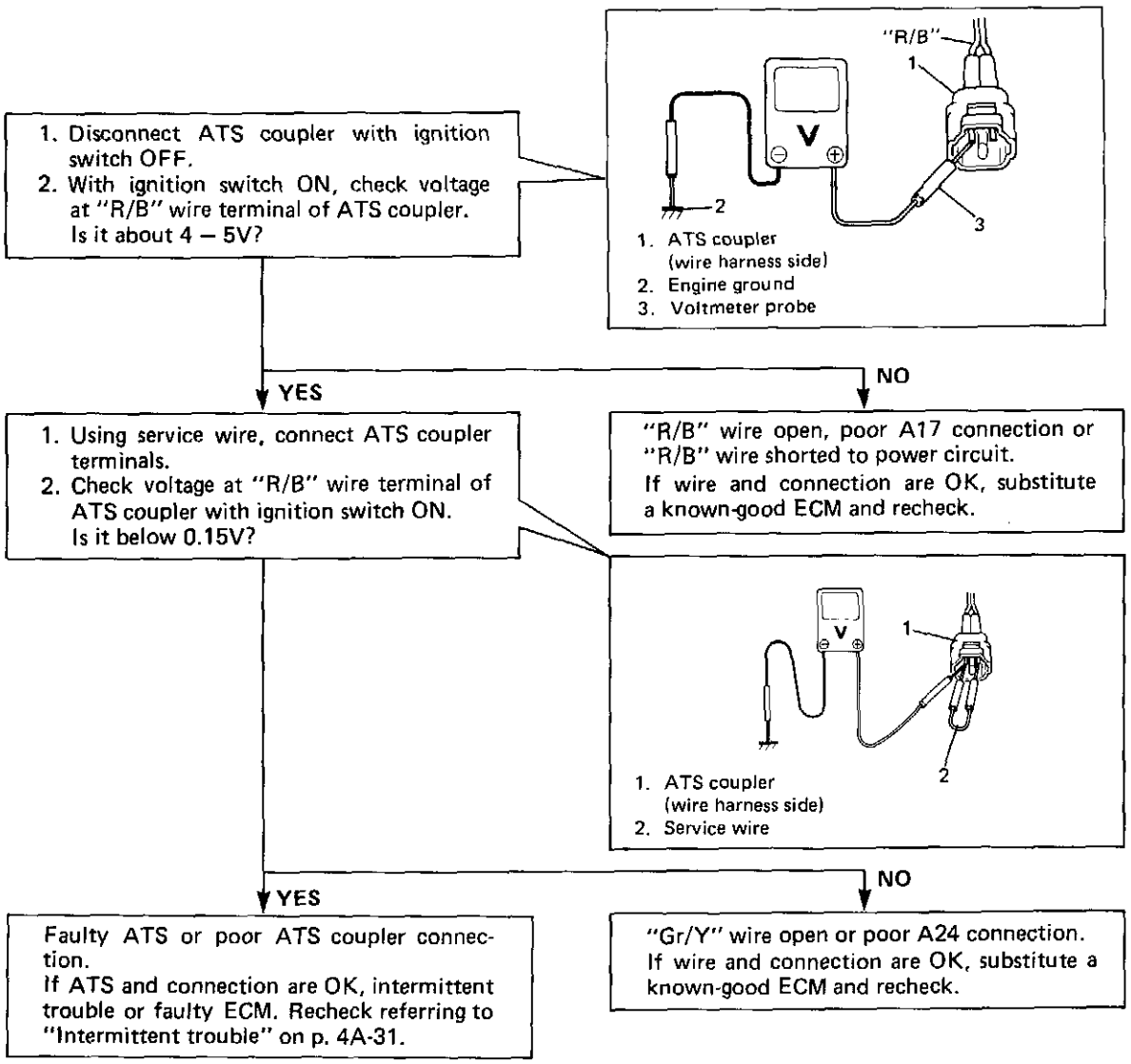
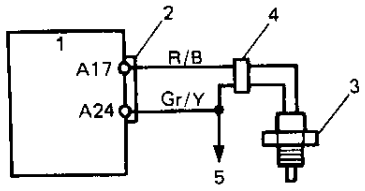


Fig. 4A-59 Diagnostic Flow Chart For Code No. 23

CODE NO. 25 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED, SIGNAL VOLTAGE LOW)



1. ECM
2. ECM coupler
3. VSS
4. ATS coupler
5. To other sensors

Fig. 4A-60 ATS Circuit

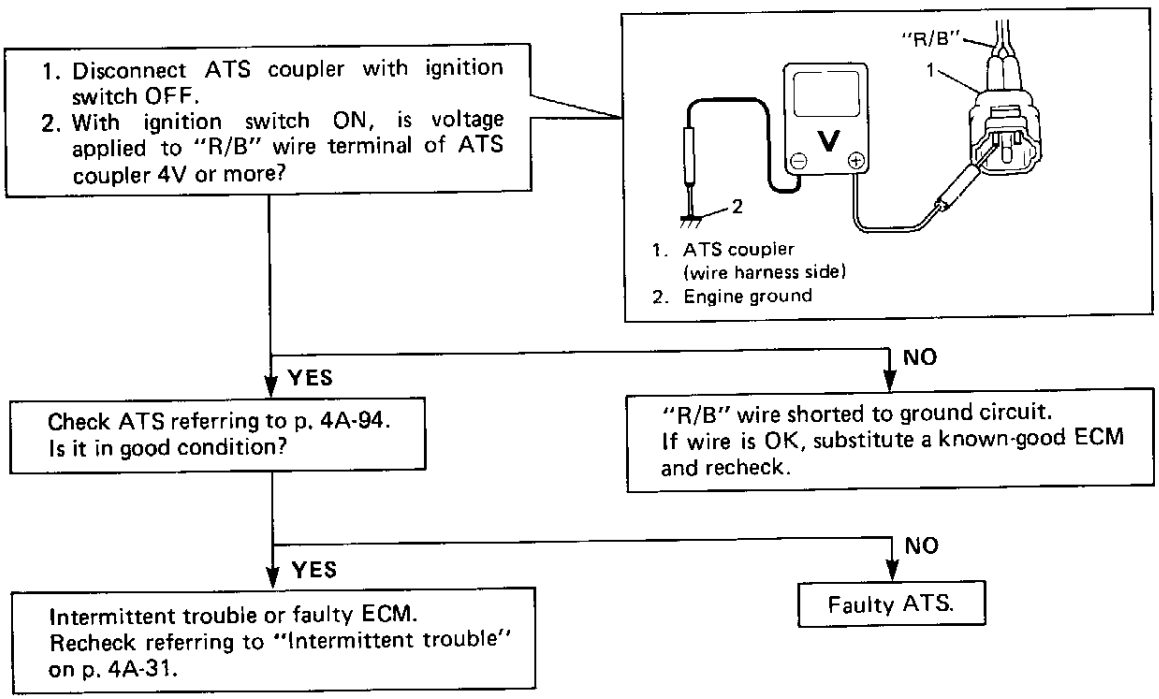
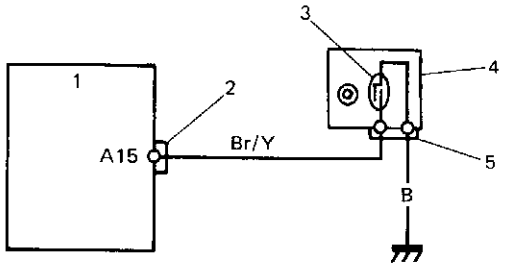


Fig. 4A-61 Diagnostic Flow Chart For Code No. 25

CODE NO. 24 VSS (VEHICLE SPEED SENSOR) CIRCUIT (VEHICLE SPEED LOWER THAN 1.4 km/h (0.9 mile/h) ALTHOUGH FUEL IS KEPT CUT FOR LONGER THAN 10 SECONDS)



1. ECM
2. ECM coupler
3. VSS
4. Speedometer
5. Coupler

NOTE:
Be sure to turn OFF ignition switch for this check.

Fig. 4A-62 VSS Circuit

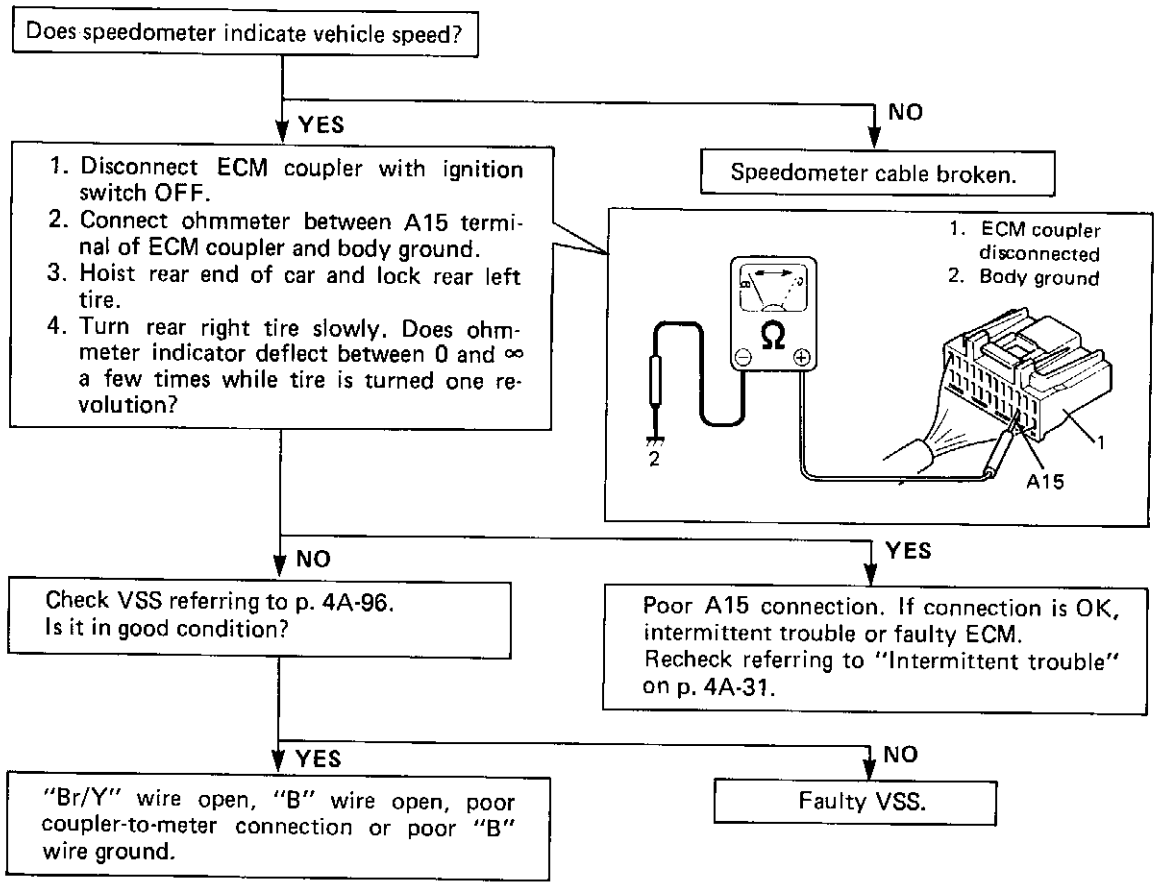
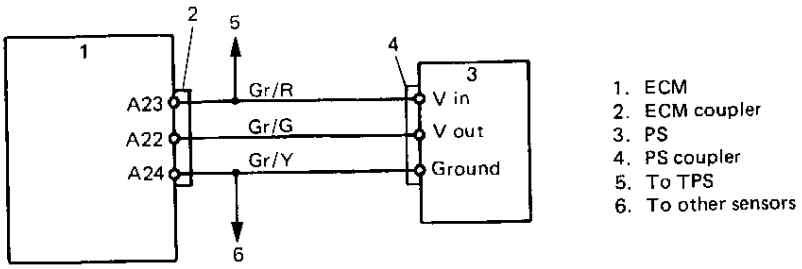


Fig. 4A-63 Diagnostic Flow Chart For Code No. 24

CODE NO. 31 PS (PRESSURE SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH–HIGH PRESSURE–LOW VACUUM)



1. ECM
2. ECM coupler
3. PS
4. PS coupler
5. To TPS
6. To other sensors

Fig. 4A-64 PS Circuit

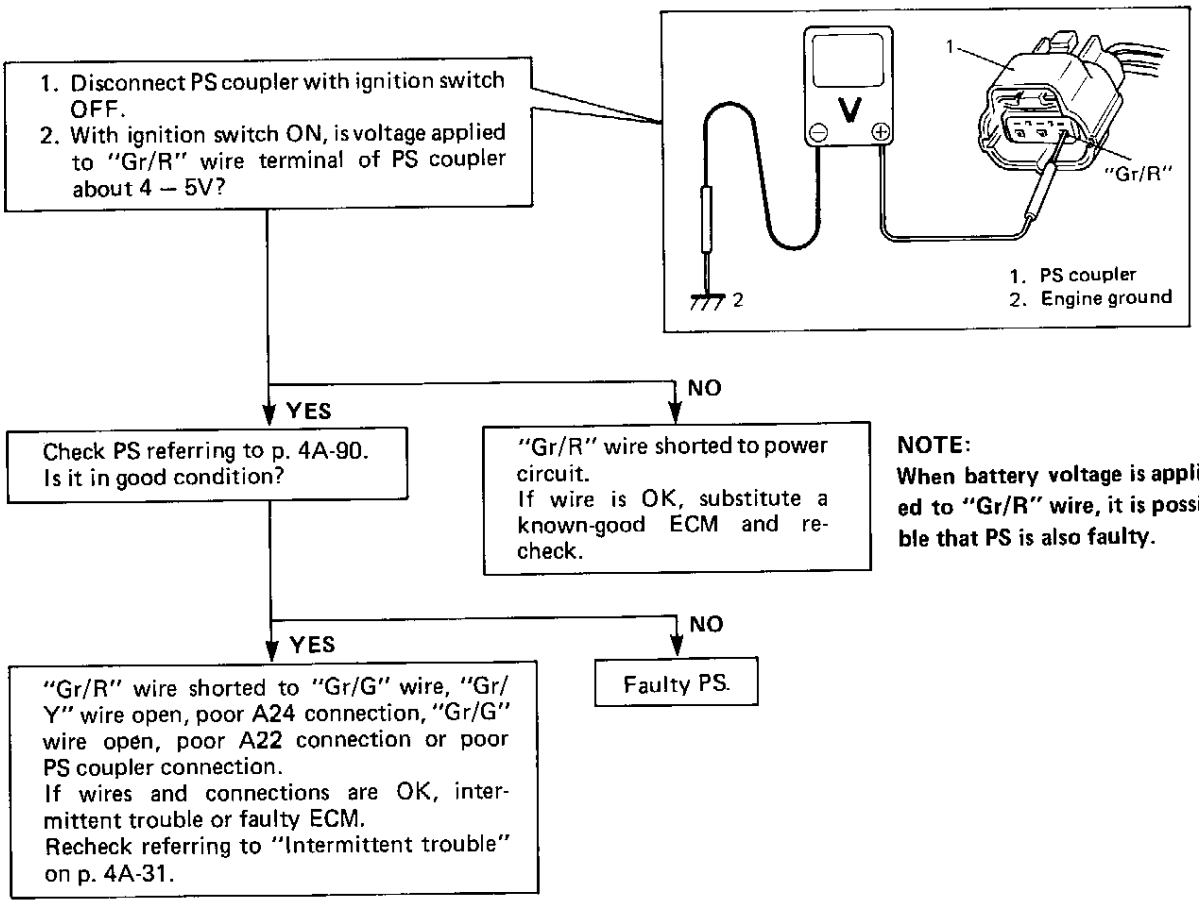
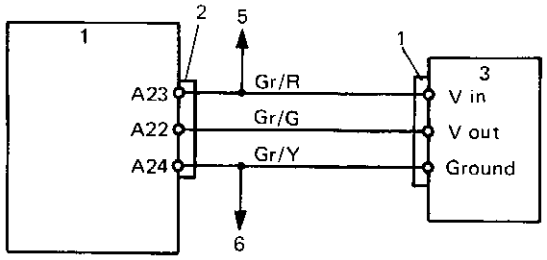


Fig. 4A-65 Diagnostic Flow Chart For Code No. 31

CODE NO. 32 PS (PRESSURE SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW—LOW PRESSURE—HIGH VACUUM)



1. ECM
2. ECM coupler
3. PS
4. PS coupler
5. To TPS
6. To other sensors

Fig. 4A-66 PS Circuit

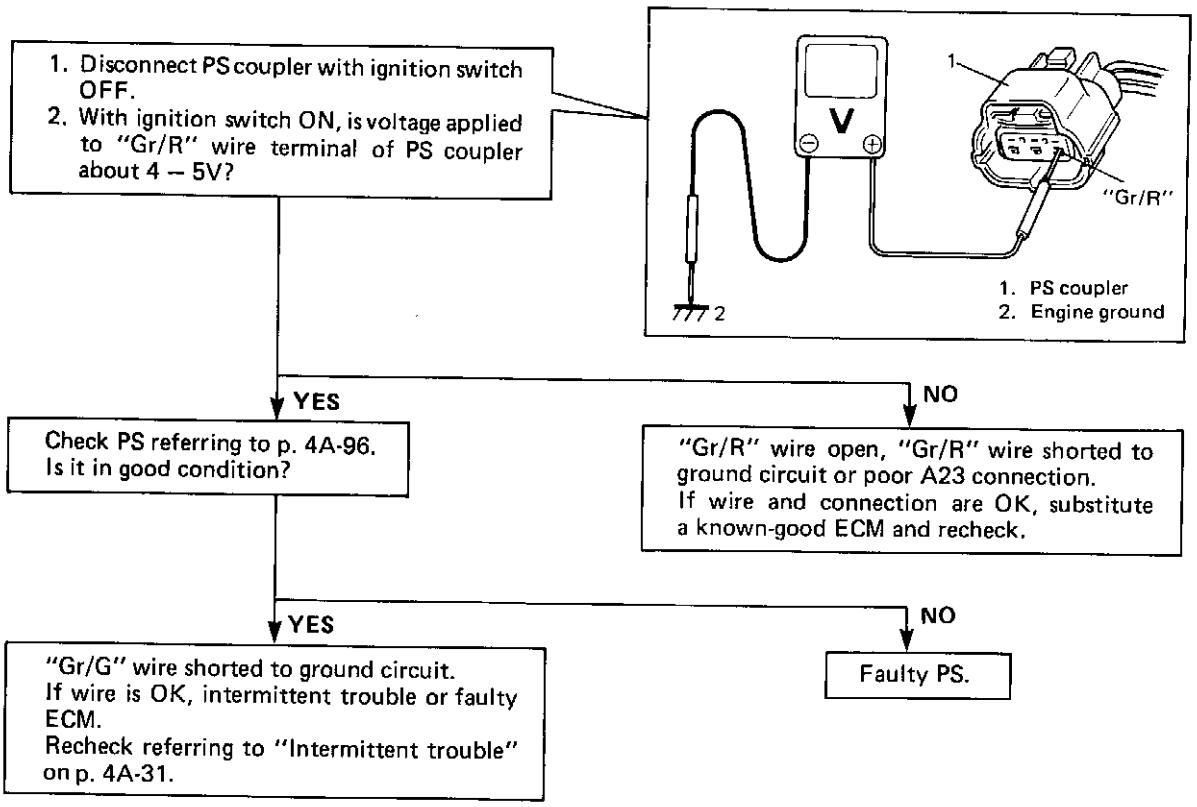


Fig. 4A-67 Diagnostic Flow Chart For Code No. 32

CODE NO. 41 IGNITION SIGNAL CIRCUIT (IGNITION FAIL SAFE SIGNAL NOT INPUTTED 6 TIMES CONTINUOUSLY)

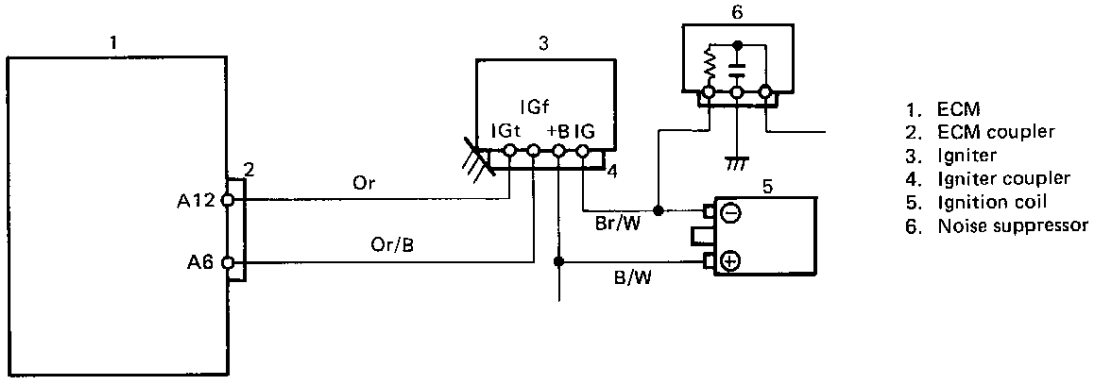


Fig. 4A-68 Ignition Signal Circuit

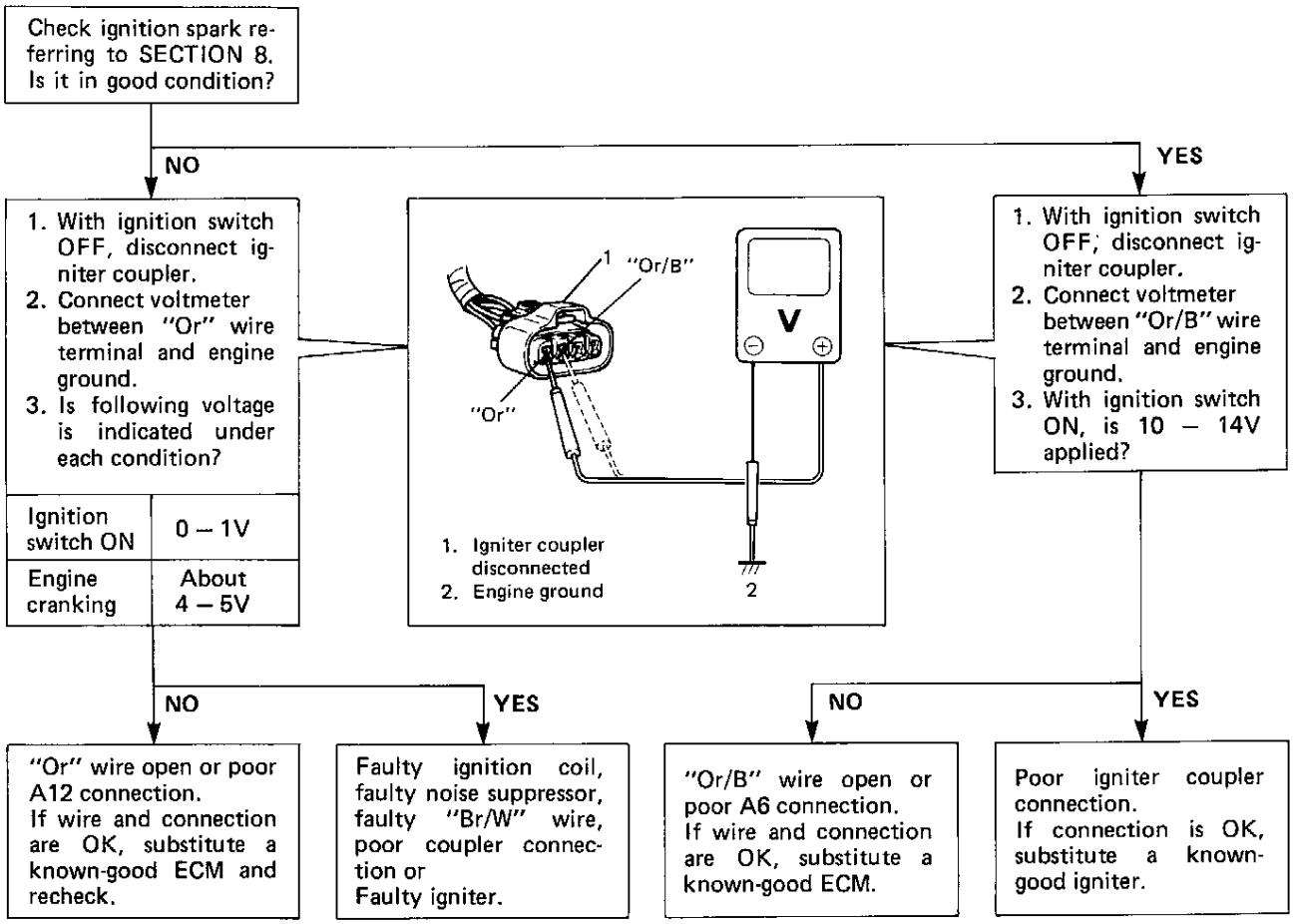
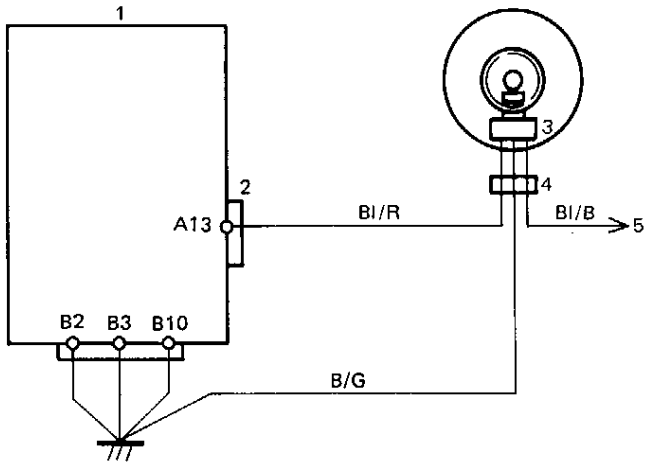


Fig. 4A-69 Diagnostic Flow Chart For Code No. 41

CODE NO. 42 CAS (CRANK ANGLE SENSOR) CIRCUIT (SENSOR SIGNAL NOT INPUTTED FOR 3 SECONDS AT ENGINE CRANKING)

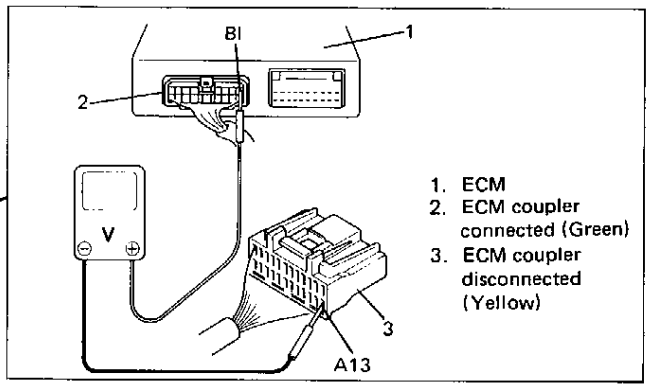


1. ECM
2. ECM coupler
3. CAS (in distributor)
4. Coupler
5. To main relay

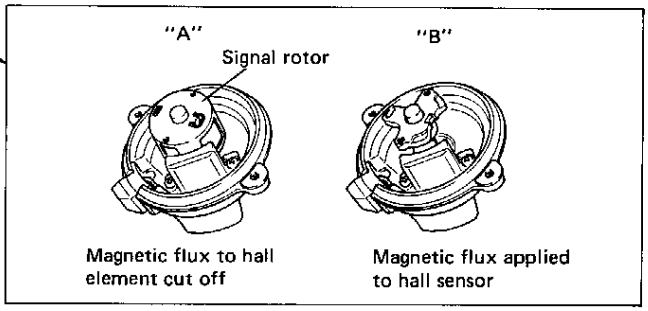
Fig. 4A-70 CAS Circuit

1. With ignition switch OFF, disconnect ECM coupler (Yellow).
2. Connect voltmeter between B1 terminal of ECM coupler (Green) and A13 terminal of yellow coupler (disconnected).
3. Remove distributor cap, rotor and shield cover.
4. With ignition switch ON, check voltage with signal rotor inserted between hall element and magnet ("A") and without it ("B") respectively.

"A"	Battery voltage
"B"	0V
Is it in good condition?	



1. ECM
2. ECM coupler connected (Green)
3. ECM coupler disconnected (Yellow)



NO

0V at both "A" and "B" → "Bl/R" wire open, "B/G" wire open, poor CAS coupler connection or faulty CAS.

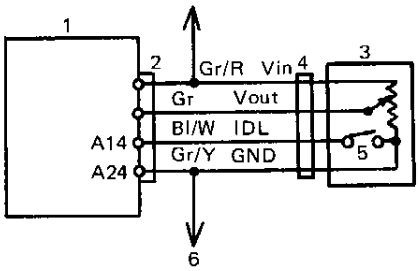
YES

Battery voltage at both "A" and "B" → "Bl/R" wire short to ground or faulty CAS.

Poor A13 connection.
If connection is OK, substitute a known-good ECM and recheck.

Fig. 4A-71 Diagnostic Flow Chart For Code No. 42

CODE NO. 44 IDLE SWITCH CIRCUIT (CIRCUIT OPEN OR TPS INSTALLATION ANGLE MALADJUSTED)



1. ECM
2. ECM coupler
3. TPS
4. TPS coupler
5. Idle switch
6. To other sensors

Fig. 4A-72 Idle Switch Circuit

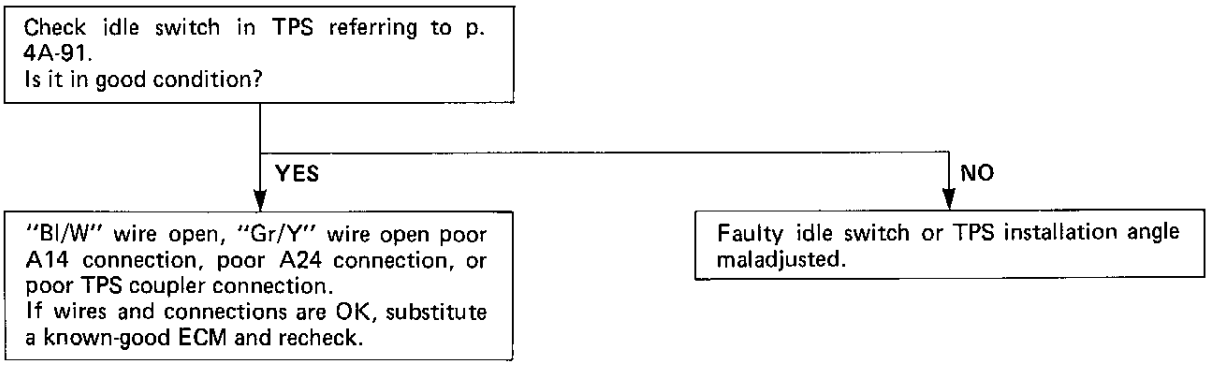


Fig. 4A-73 Diagnostic Flow Chart For Code No. 44

CODE NO. 45 IDLE SWITCH CIRCUIT (CIRCUIT SHORT OR TPS INSTALLATION ANGLE MALADJUSTED)

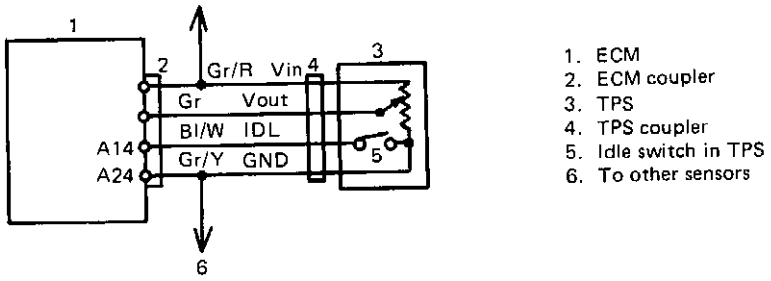


Fig. 4A-74 Idle Switch Circuit

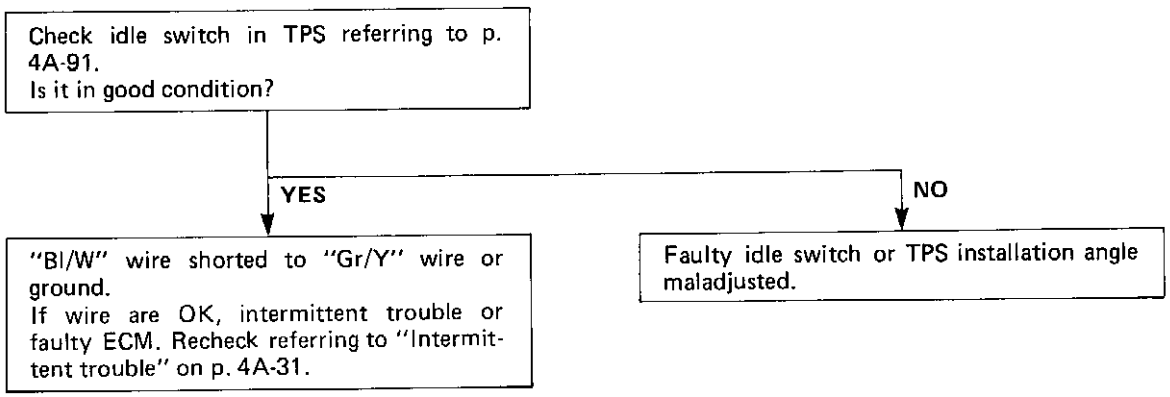


Fig. 4A-75 Diagnostic Flow Chart For Code No. 45

CODE NO. 51 EGR SYSTEM AND REGTS (RECIRCULATED EXHAUST GAS TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED)

California spec. model only

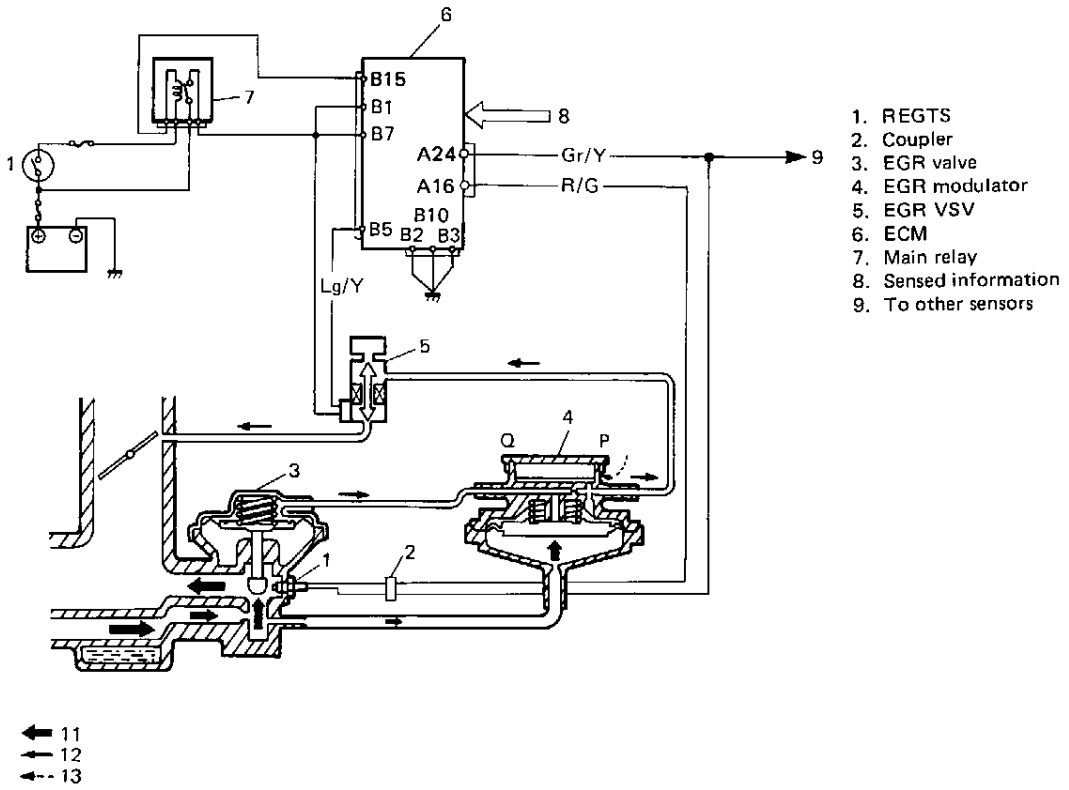


Fig. 4A-76 EGR System (California spec. model only)

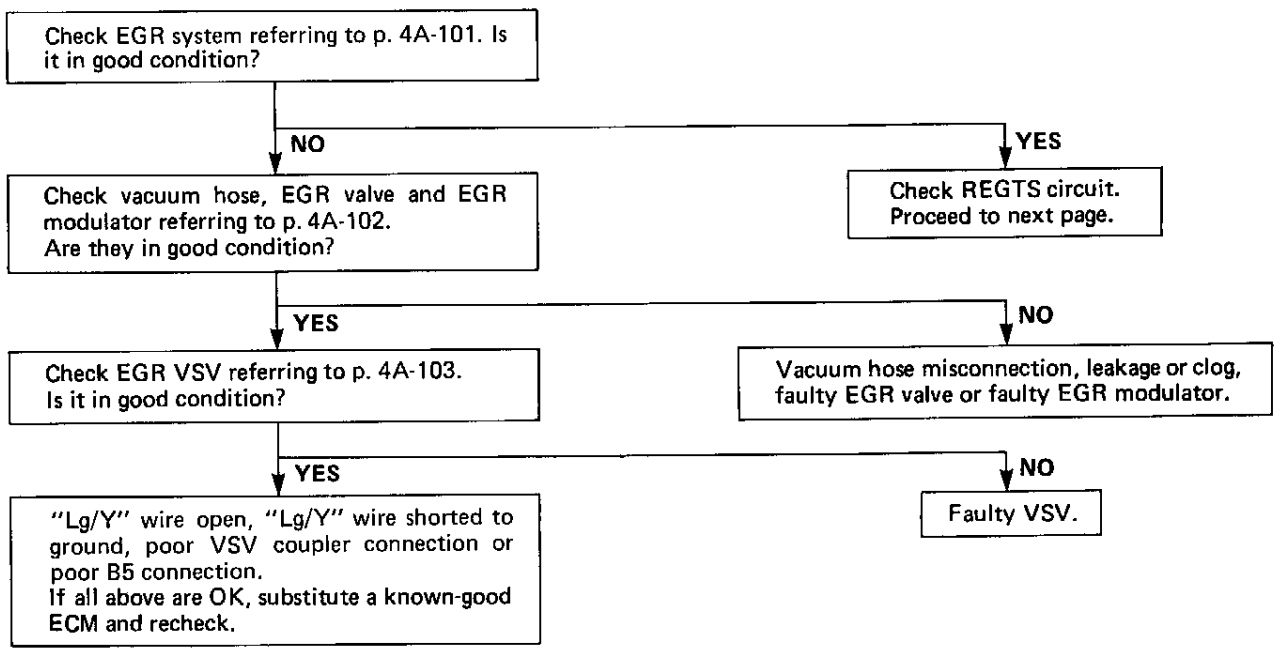


Fig. 4A-77 Diagnostic Flow Chart For Code No. 51 (1) (California spec. model only)

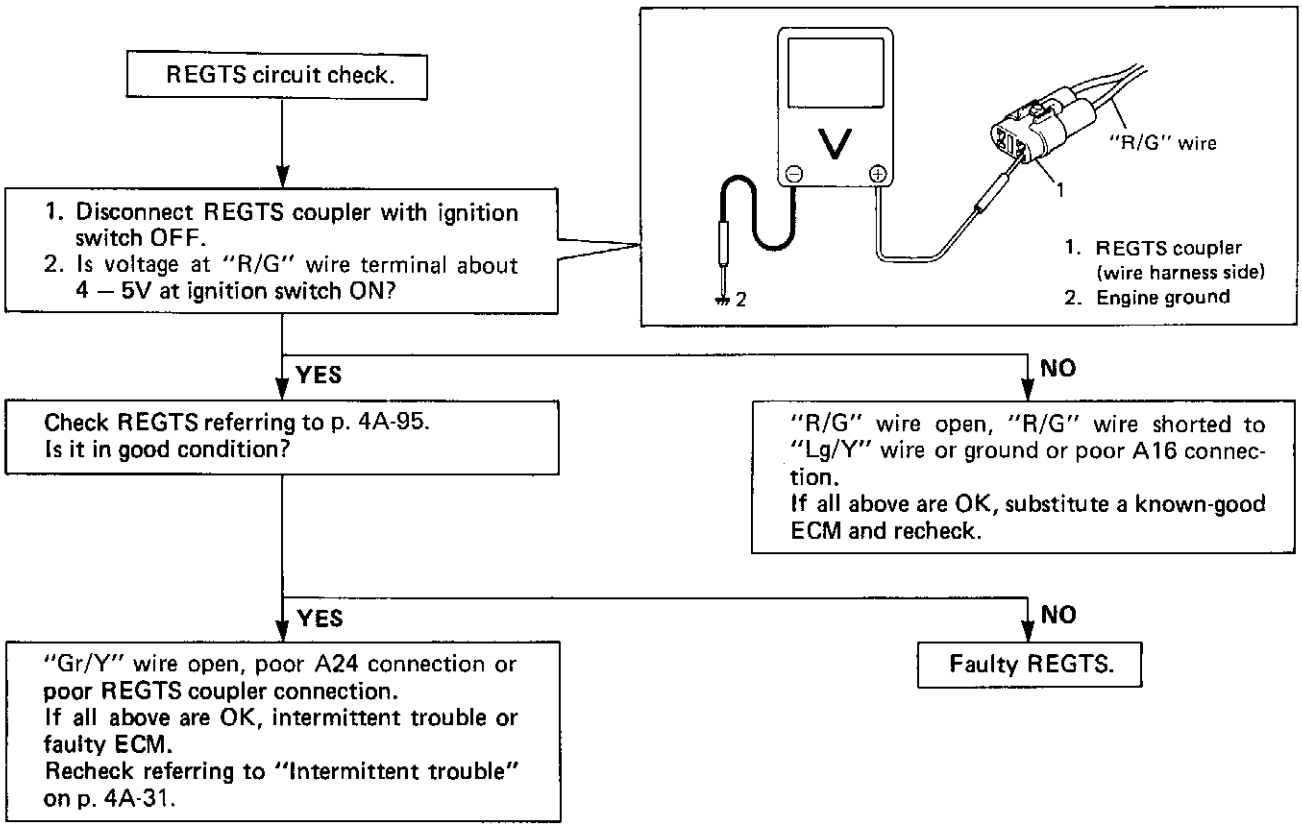


Fig. 4A-78 Diagnostic Flow Chart For Code No. 51 (2) (California spec. model only)

CODE NO. 53 GROUND CIRCUIT FOR CALIFORNIA SPEC. MODEL ONLY (CIRCUIT OPEN)

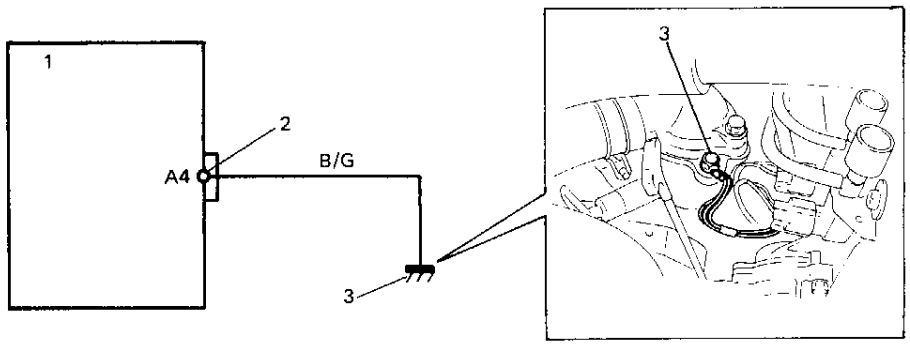


Fig. 4A-79 Ground Circuit (California spec. model only)

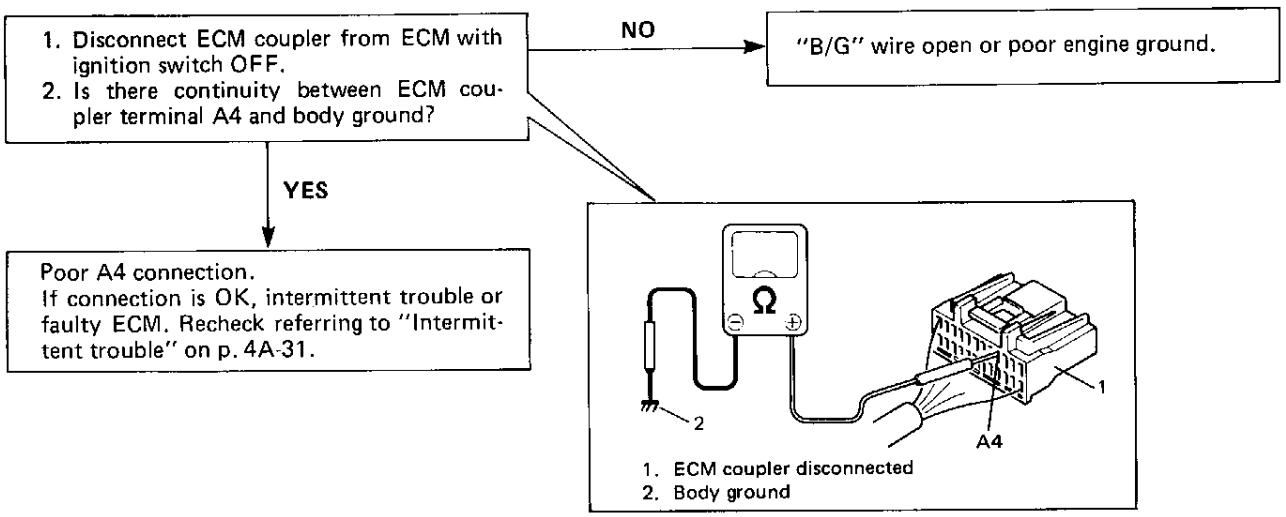


Fig. 4A-80 Diagnostic Flow Chart For Code No. 53 (California spec. model only)

CODE NO. 54 5TH SWITCH CIRCUIT (A5 TERMINAL GROUNDED–5TH SWITCH ON CONSTANTLY)

NOT FOR CALIFORNIA SPEC. MODEL

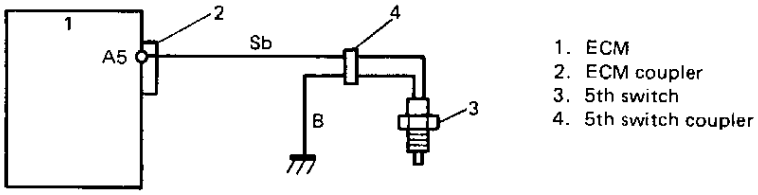


Fig. 4A-81 5th Switch Circuit (Not for California spec. model)

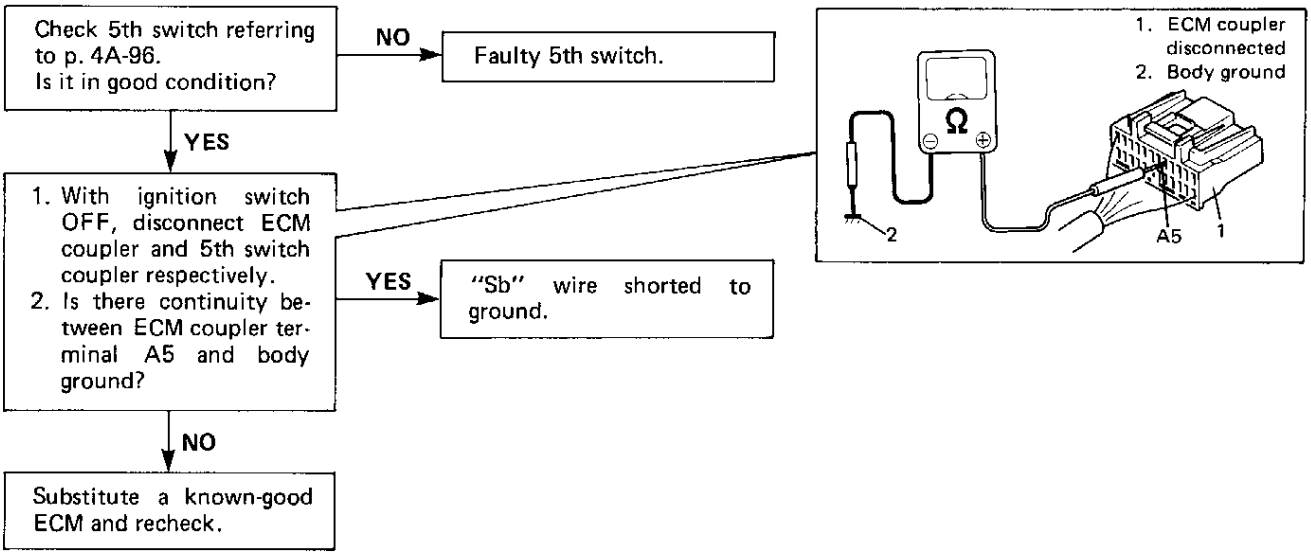


Fig. 4A-82 Diagnostic Flow Chart For Code No. 54 (Not for California spec. model)

CODE NO. 71 TEST SWITCH CIRCUIT (TEST SWITCH CIRCUIT GROUNDED FOR 5 SECONDS EVEN WHEN DRIVING AT 40 km/h (25 mile/h) OR HIGHER)

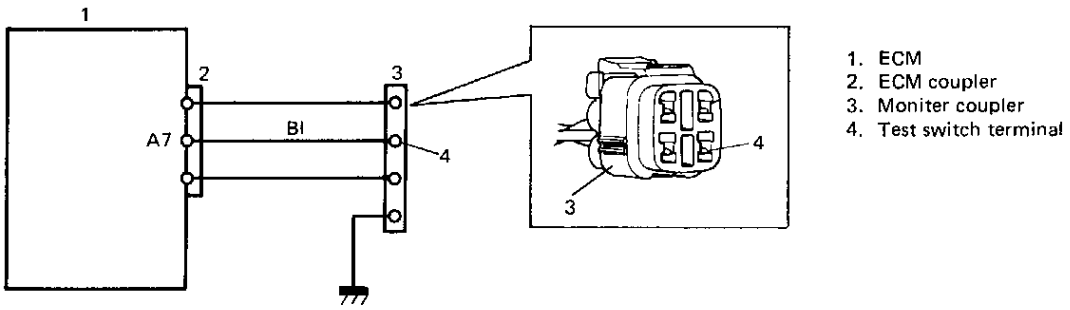


Fig. 4A-83 Test Switch Circuit

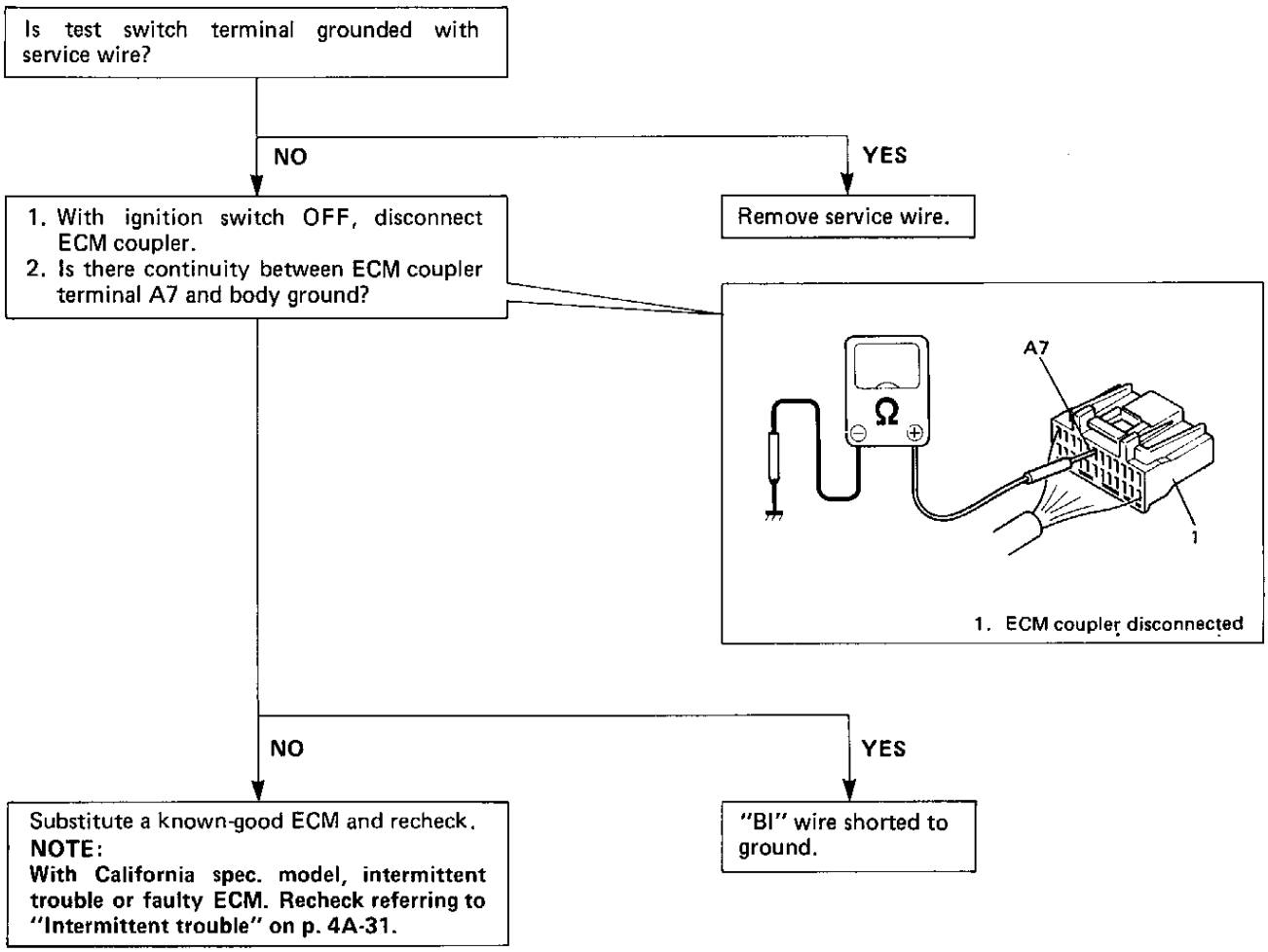


Fig. 4A-84 Diagnostic Flow Chart For Code No. 71

TROUBLE DIAGNOSIS

This section describes trouble diagnosis of Electronic Fuel Injection system parts whose trouble is not indicated by the self-diagnosis function.

When diagnostic code No. 12 is indicated by the self-diagnosis function and assuredly those engine basic parts as described in "ENGINE DIAGNOSIS" are all in good condition, check below Electronic Fuel Injection system parts which may be a possible cause for each symptom of the engine.

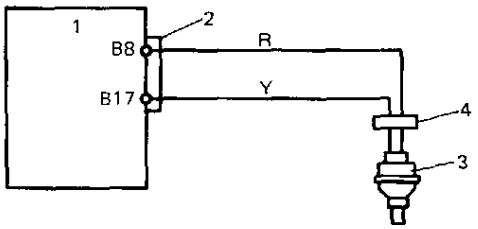
SYMPTOM	POSSIBLE CAUSE	INSPECTION
Hard or no starting (Engine cranks OK)	• Shortage of fuel in fuel tank	
	• Faulty fuel pump or its circuit open	Check if fuel pressure is felt at fuel return hose for 3 seconds after ignition switch ON. If not, advance to Diagnostic flow chart B-2
	• Injector or its circuit defective	Diagnostic flow chart B-1
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty air valve	See p. 4A-84
	• Open starter signal circuit	Check voltage at ECM coupler terminal B11 (refer to p. 4A-73)
	• Faulty throttle opener system	Diagnostic flow chart B-4
	• Poor performance of WTS, ATS or pressure sensor	See p. 4A-94, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
NOTE: • **If engine doesn't start at all, perform fuel injector and its circuit check first. (Advance to Diagnostic flow chart B-1.)** • **If engine is hard to start only when it is cold, check air valve first and then engine starter signal circuit.** • **If engine starts easily with help of accelerator pedal operation, check throttle opener system first. (Advance to Diagnostic flow chart B-4.)**		
Engine fails to idle	• Shortage of fuel in fuel tank	
	• Faulty ISC solenoid valve control system	Diagnostic flow chart B-5
	• Maladjusted idle speed adjusting screw	See p. 4A-78
	• Faulty air valve	See p. 4A-84
	• Faulty EGR system	See p. 4A-101
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty injector	Check injector for resistance injection condition and fuel leakage (Refer to p. 4A-87)

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Engine fails to idle	• Poor performance of WTS, ATS or pressure sensor	See p. 4A-94, 4A-94, 4A-90
	• Faulty ECM	See p. 4A-73
NOTE: **If engine fails to idle when it is cold, check air valve first.**		
Improper engine idle speed	• Maladjusted accelerator cable play	See p. 4A-78
	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Faulty throttle opener system	Diagnostic flow chart B-4
	• Faulty ISC solenoid valve control system	Diagnostic flow chart B-5
	• Faulty A/C VSV	
	• Maladjusted idle speed adjusting screw	See p. 4A-78
	• Faulty air valve	See p. 4A-84
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty injector	Check injector for resistance injection condition and fuel leakage (Refer to p. 4A-87)
	• Poor performance of WTS, ATS or pressure sensor	See p. 4A-94, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
NOTE: **If engine idle speed lowers below specification only when electric load (e.g. headlight ON), check ISC solenoid valve control system first.**		
Engine has no or poor power	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Maladjusted accelerator cable play	See p. 4A-78
	• Maladjusted installation angle of throttle position sensor	See p. 4A-92
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-6
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage. (Refer to p. 4A-87)
	• Poor performance of TPS, WTS, ATS or pressure sensor	See p. 4A-91, 4A-94, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Engine hesitates when acceleration	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Defective throttle valve operation	Check throttle valve for smooth operation
	• Poor performance TPS	See p. 4A-91
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-6
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 4A-87)
	• Poor performance of WTS or pressure sensor	See p. 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
Surges (Variation in vehicle speed is felt although accelerator pedal is not operated)	• Variable fuel pressure (Clogged fuel filter, defective fuel pressure regulator etc.)	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 4A-87)
	• Poor performance of TPS, WTS or pressure sensor	See p. 4A-91, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
Excessive detonation (Engine makes sharp metallic knocks that change with throttle opening)	• Low fuel pressure	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistfance, injection condition and fuel leakage (Refer to p. 4A-87)
	• Poor performance of TPS, WTS or pressure sensor	See p. 4A-91, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
Poor gasoline mileage	• High idle speed	Refer to item "Improper engine idle speed" previously
	• Fuel pressure out of specification of fuel leakage	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for fuel leakage (See p. 4A-87)
	• Poor performance of TPS, WTS or pressure sensor	See p. 4A-91, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Excessive hydrocarbons (HC) emission (Rich or lean fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc..)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic coverter	Check for absence of filler neck restrictor
	• Fuel leakage from injector	See p. 4A-87
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Poor performance of WTS, ATS or pressure sensor	See p. 4A-94, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
Excessive carbon monoxide (CO) emission (Rich fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc..)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Fuel leakage from injector	See p. 4A-87
	• Fuel pressure out of specification (High fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of WTS, ATS or pressure sensor	See p. 4A-94, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73
Excessive nitrogen oxides (NOx) emission (Lean fuel mixture)	• Improper ignition timing	See section 8
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Misrouted vacuum hoses	
	• Defective EGR system	Diagnostic flow chart B-6
	• Fuel pressure out of specfication (Low fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of WTS, ATS or pressure sensor	See p. 4A-94, 4A-94 or 4A-90
	• Faulty ECM	See p. 4A-73

B-1 FUEL INJECTOR AND ITS CIRCUIT CHECK (ENGINE NO STARTING)



1. ECM
2. ECM coupler
3. Injector
4. Injector coupler

Fig. 4A-85 Injector Circuit

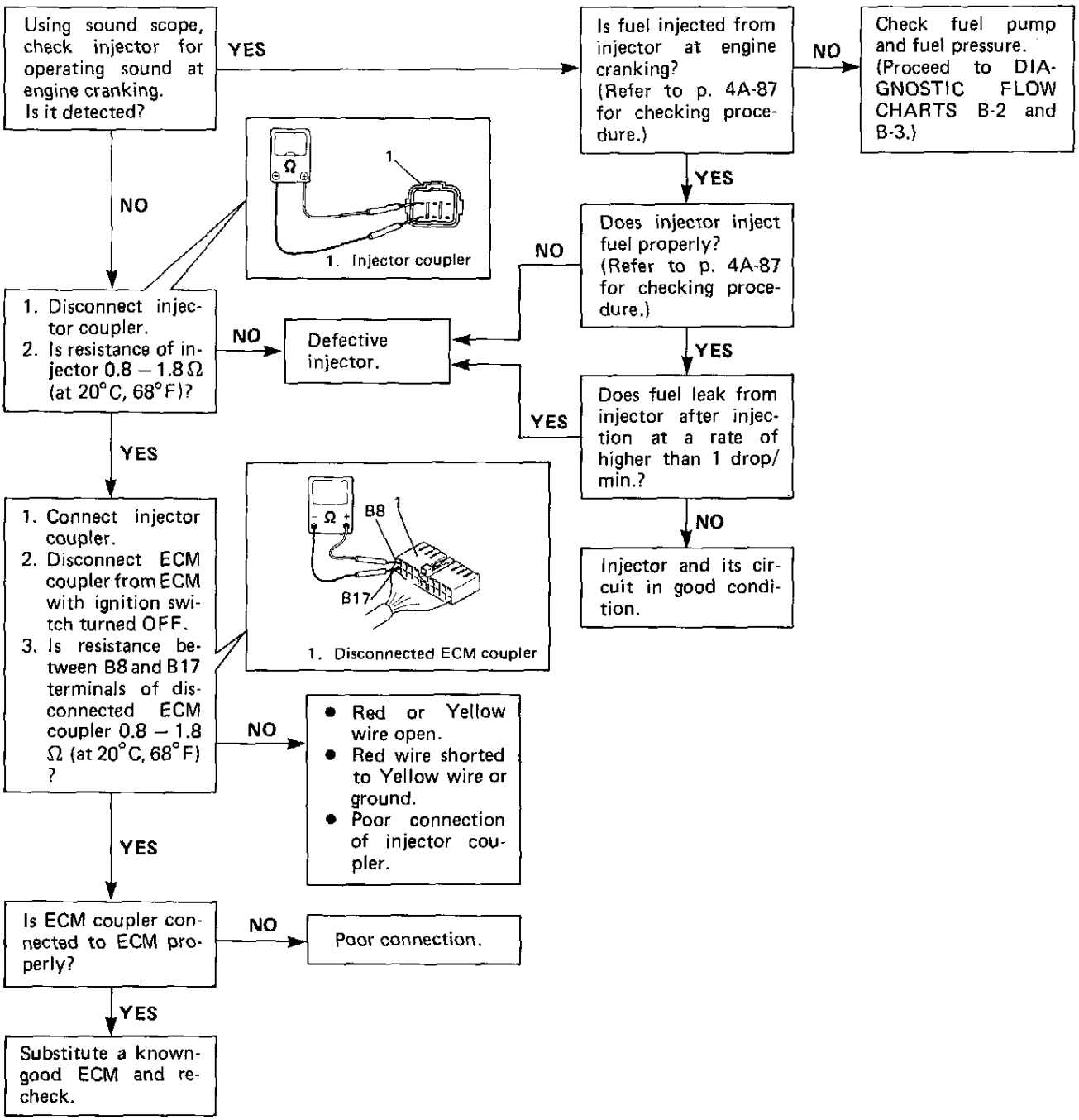


Fig. 4A-86 Diagnostic Flow Chart B-1 For Injector and Its Circuit

B-2 FUEL PUMP CIRCUIT CHECK

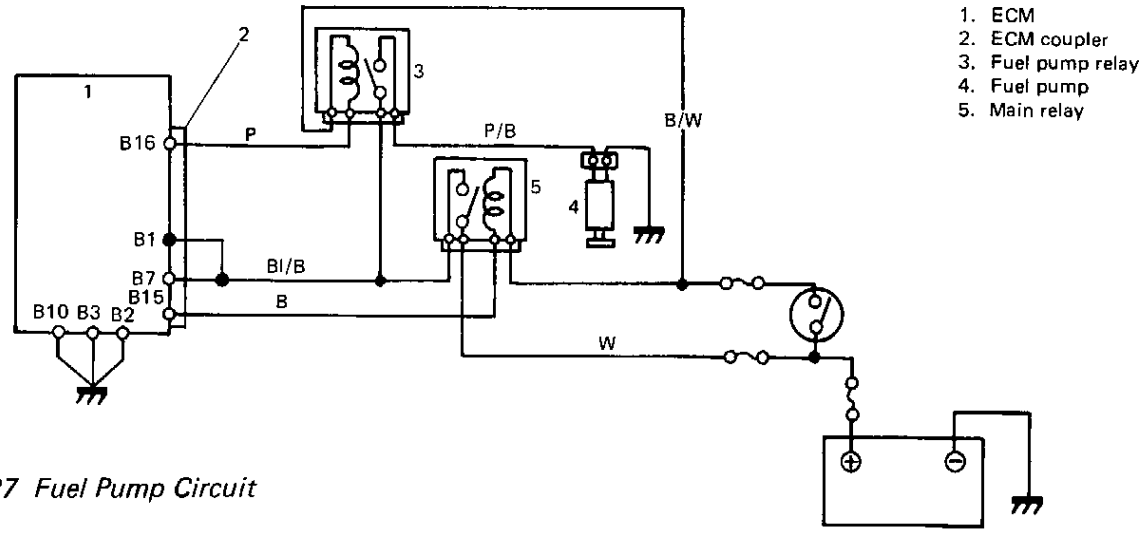


Fig. 4A-87 Fuel Pump Circuit

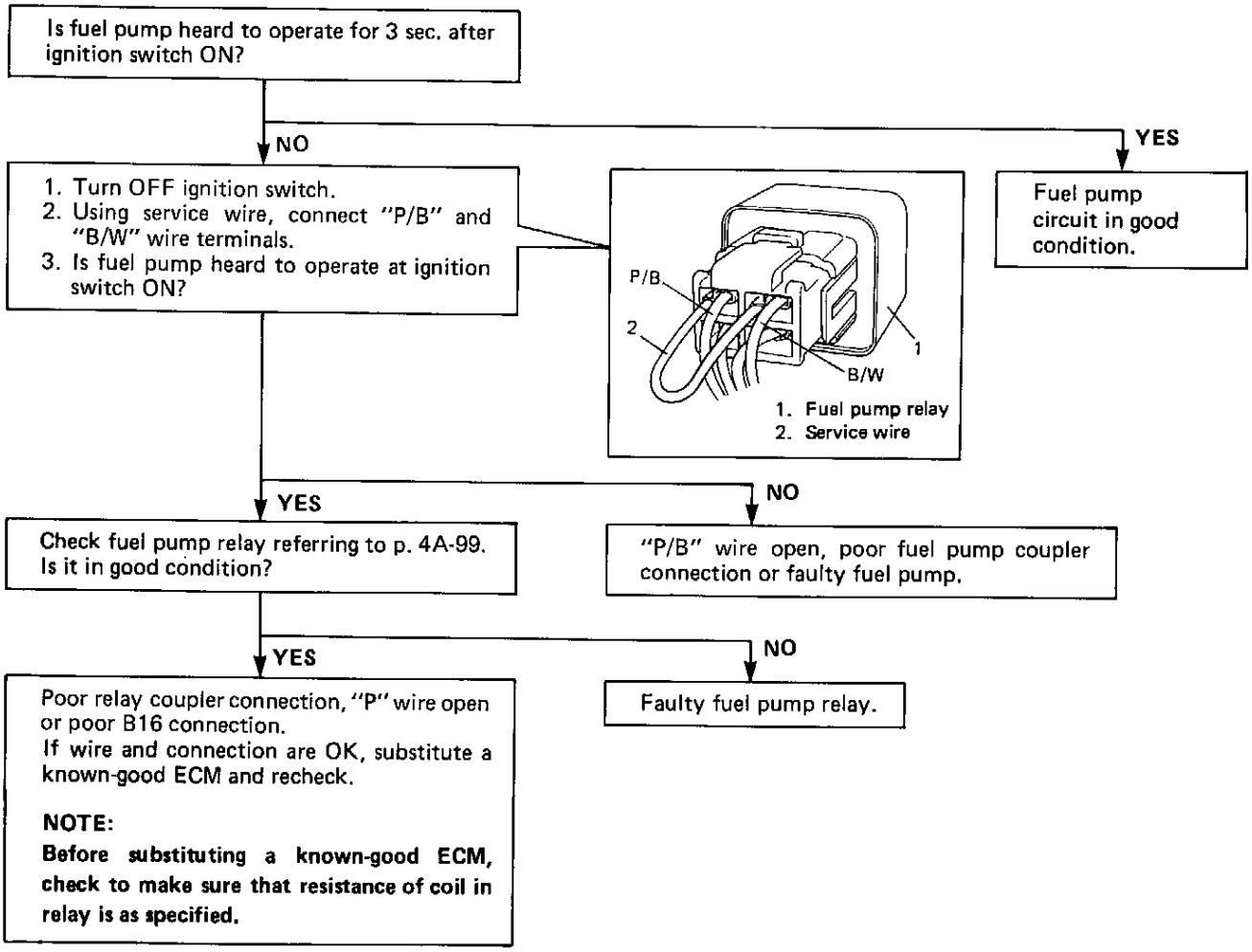


Fig. 4A-88 Diagnostic Flow Chart B-2 For Fuel Pump and Its Circuit Check

B-3 FUEL PRESSURE CHECK

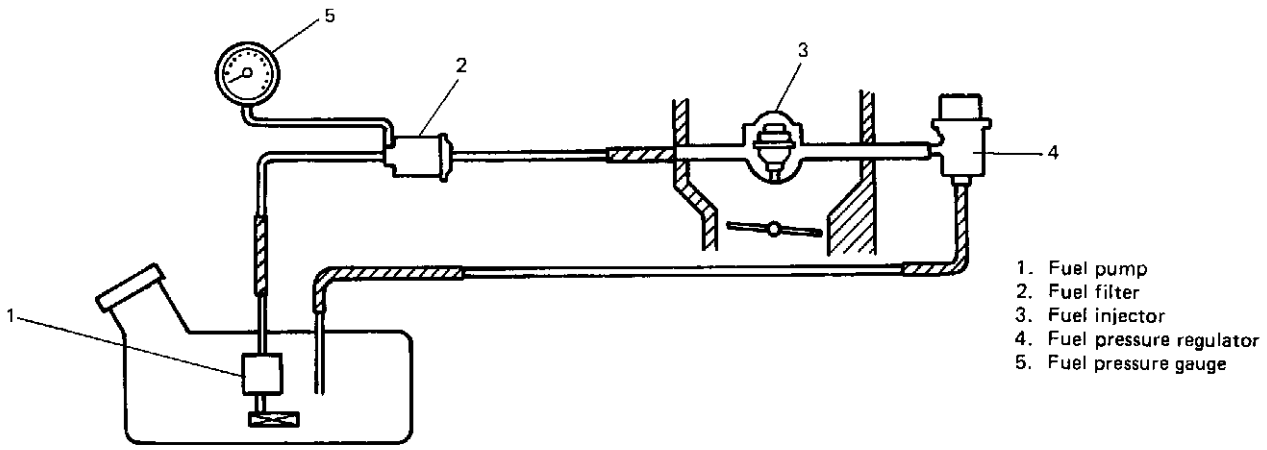


Fig. 4A-89 Fuel Pressure Check

NOTE:
Before using following flow chart, check to make sure that battery voltage is higher than 11V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

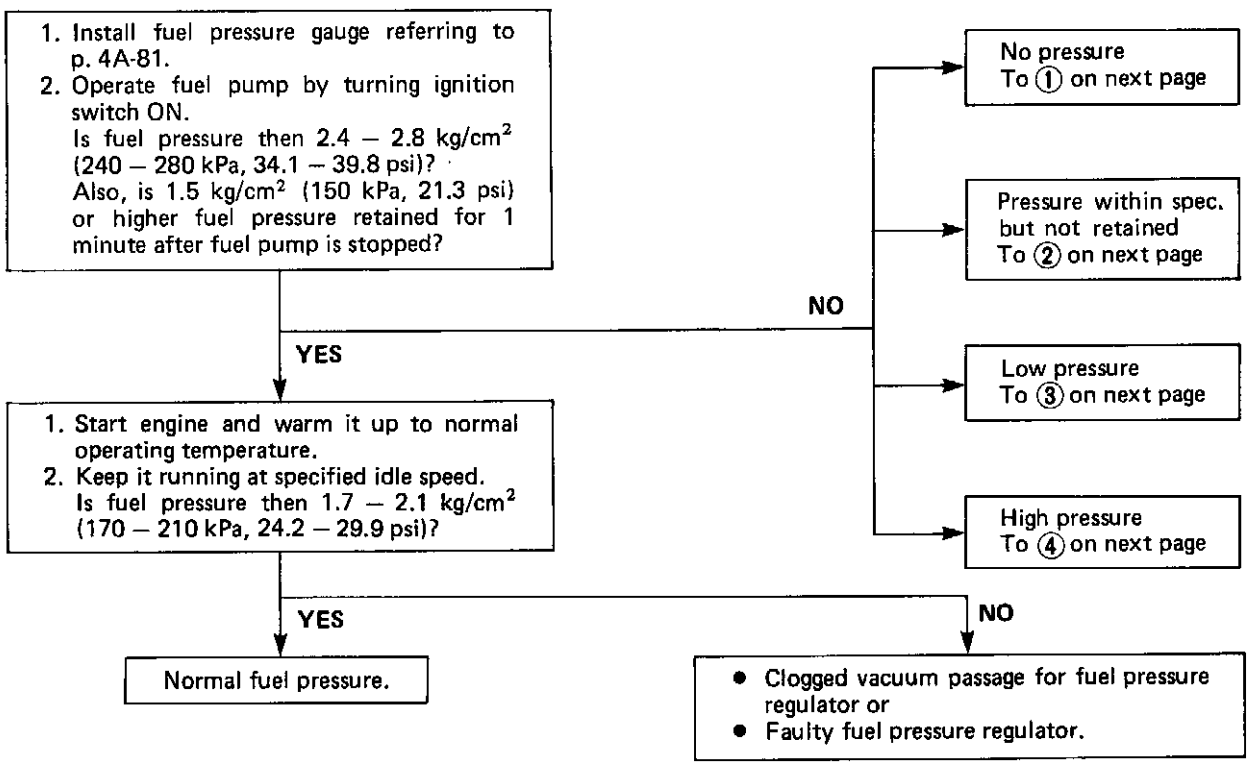


Fig. 4A-90 Diagnostic Flow Chart B-3 For Fuel Pressure Check (1)

B-3 FUEL PRESSURE CHECK (Continued)

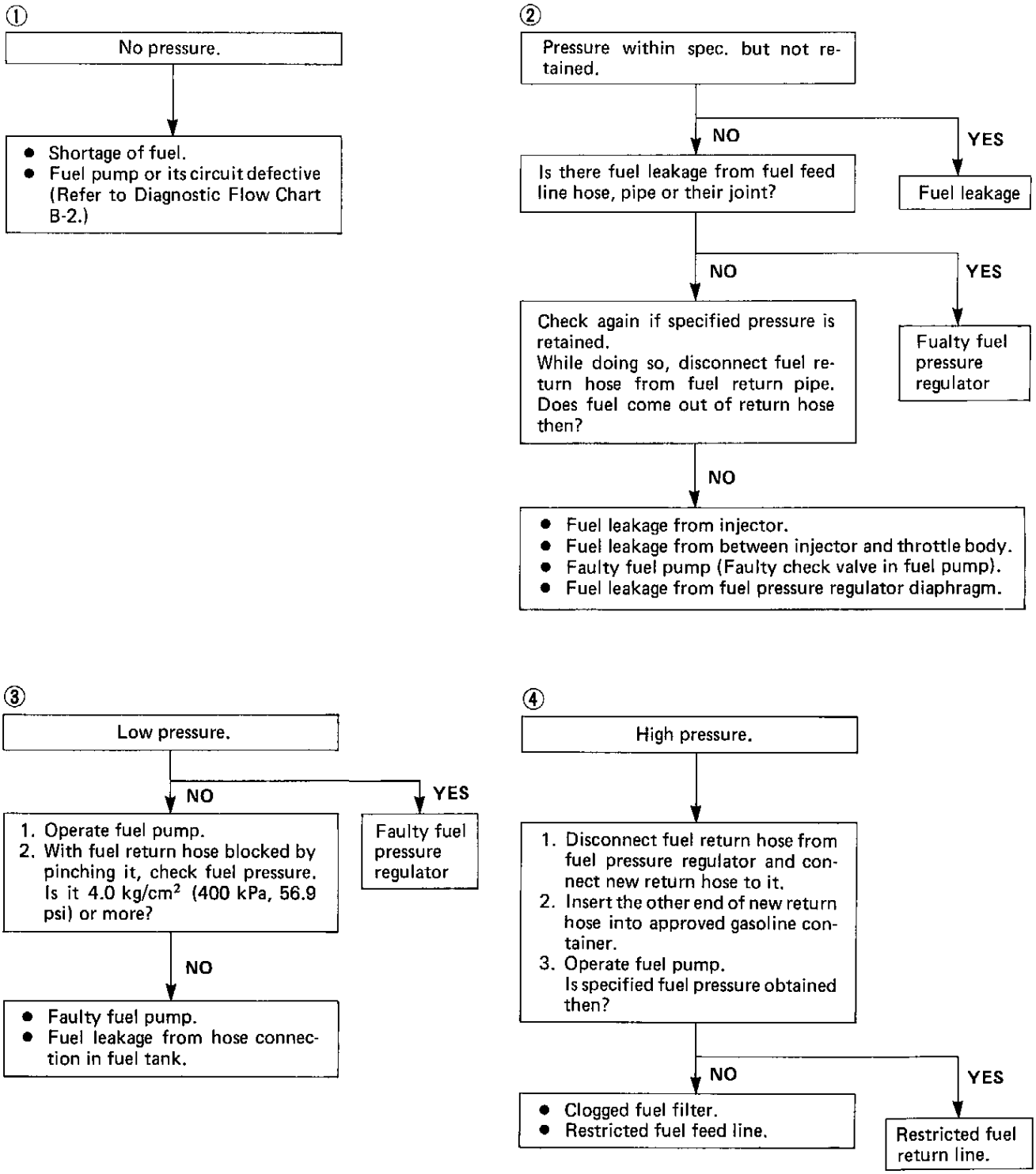
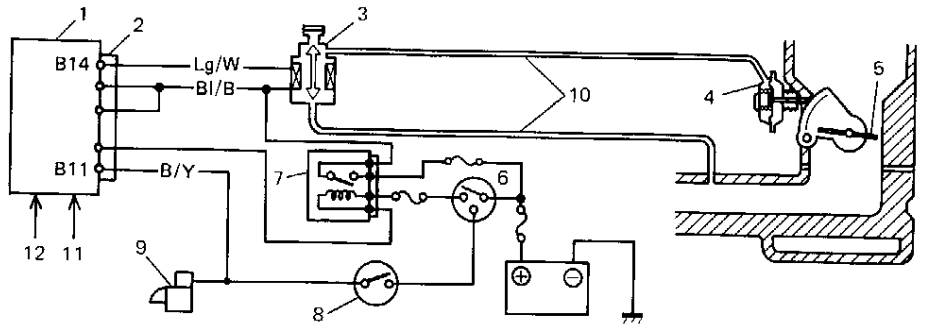


Fig. 4A-91 Diagnostic Flow Chart B-3 For Fuel Pressure Check (2)

B-4 THROTTLE OPENER SYSTEM CHECK



1. ECM
2. ECM coupler
3. VSV
4. Throttle opener
5. Throttle valve
6. Main switch
7. Main relay
8. Clutch switch
9. Starter
10. Vacuum hose
11. WTS
12. CAS

Fig. 4A-92 Throttle Opener System

1. Warm up engine to normal operating temperature.
2. Is throttle valve opened by throttle opener at both engine stop and cranking?

NO → Check throttle opener for operation referring to p. 4A-100. Is it in good condition?

YES → Adjust throttle valve opening by throttle opener referring to p. 4A-80.

NO → Faulty opener

YES → Does throttle opener rod retract 0 — 1 second after engine start?

YES → Check throttle valve opening by throttle opener referring to p. 4A-80.

YES → Throttle opener system in good condition.

NO → Adjust throttle valve opening by throttle opener referring to p. 4A-80.

NO → Check vacuum hose and opener referring to p. 4A-100. Are they in good condition?

NO →
- Vaccum hose misconnection, leakage, clog or deterioration.
- Defective opener.

YES → Check VSV for resistance and operation referring to p. 4A-100. Are they both in good condition?

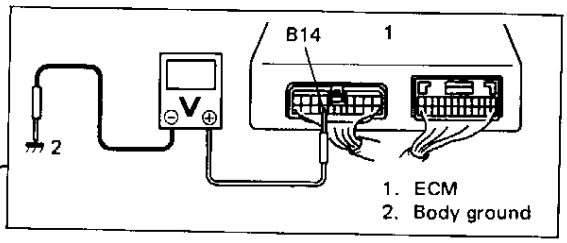
NO →
- Faulty VSV.

YES →
1. Connect ECM coupler.
2. Is battery voltage applied to ECM coupler terminal B14 at ignition switch ON?

NO →
- "Bl/B" wire open.
- "Lg/W" wire open.
- "Lg/W" wire shorted to ground or
- Poor VSV coupler connection.

If wires and connections are OK, substitute a known-good ECM and recheck.

YES → To be continued



1. ECM
2. Body ground

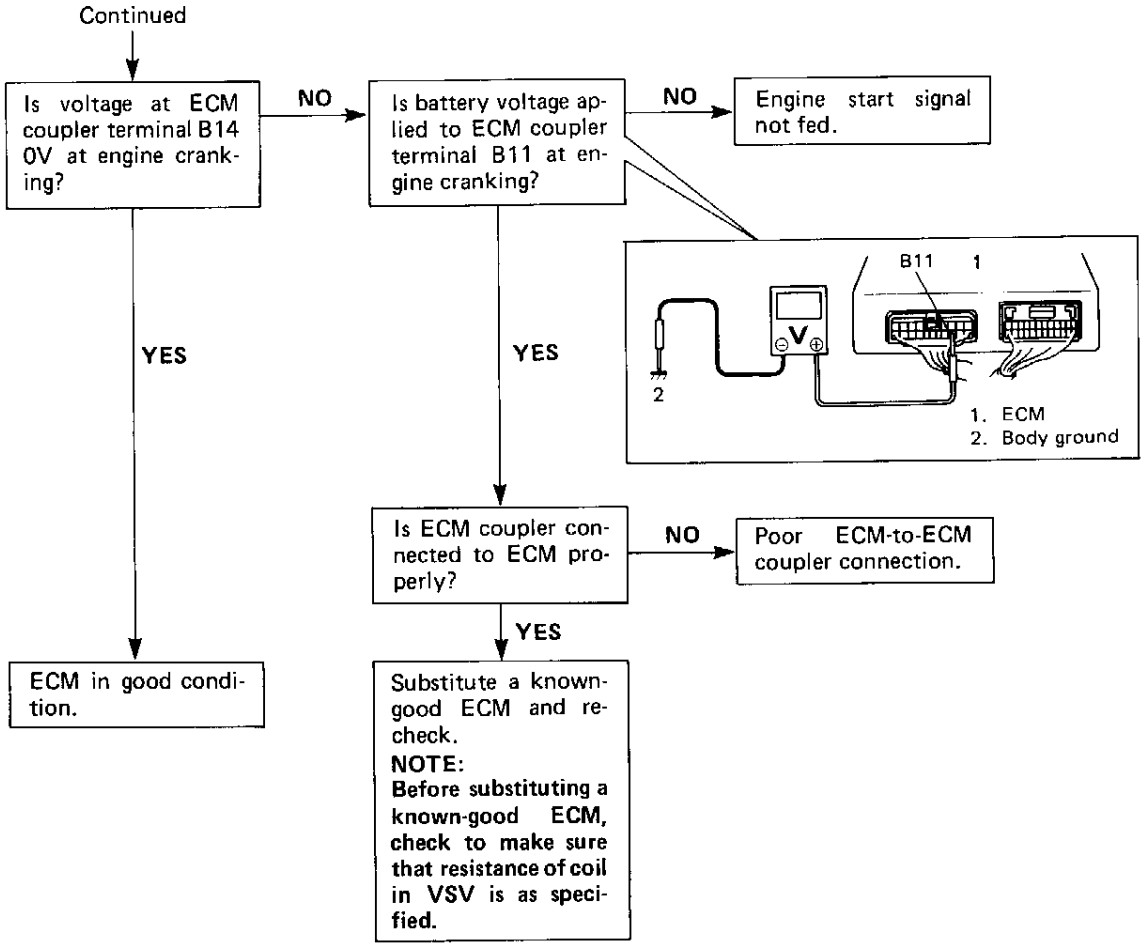


Fig. 4A-93 Diagnostic Flow Chart B-4 For Throttle Opener System

B-5 ISC SOLENOID VALVE CONTROL SYSTEM CHECK

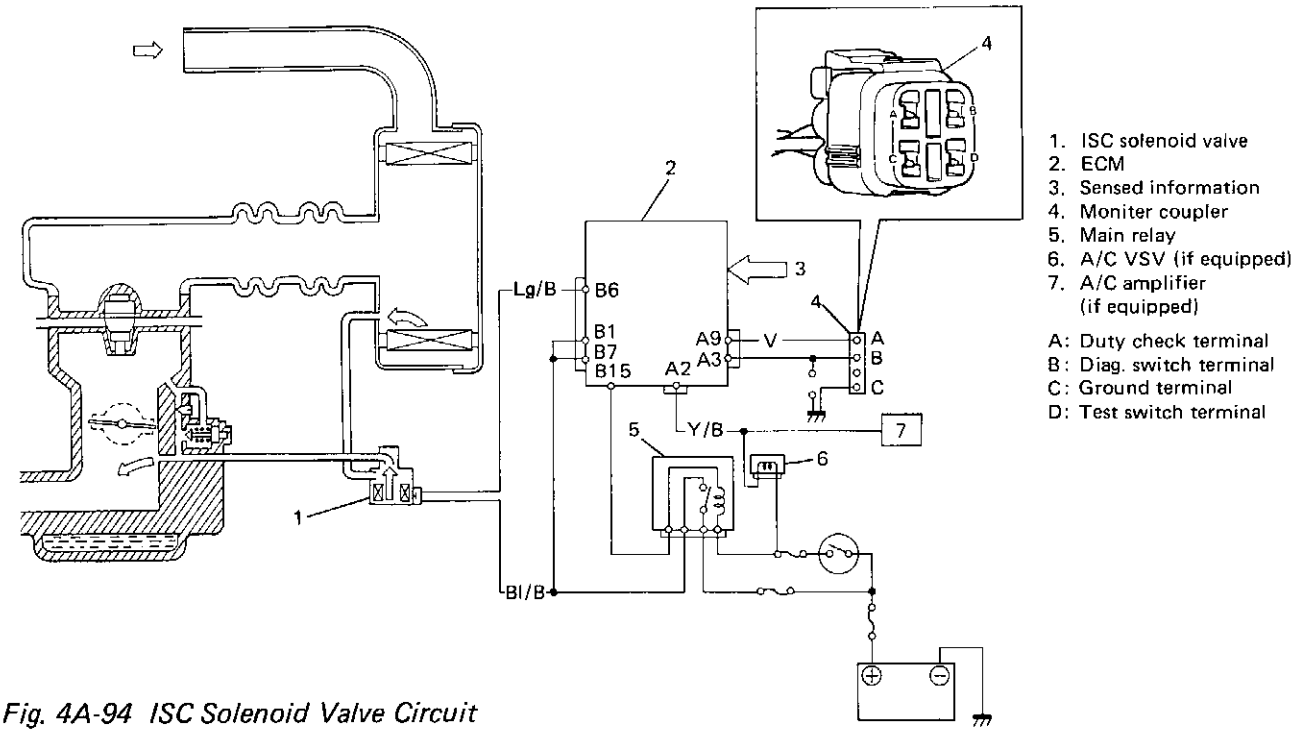


Fig. 4A-94 ISC Solenoid Valve Circuit

1. Warm up engine to normal operating temperature and keep it idle.
2. Connect spare fuse to diagnosis switch terminal.
3. Is diagnostic code No. 12 indicated?

YES

Check ISC duty and idle speed referring to p. 4A-78.
Are they within specification?

NO

Go back to "Diagnostic Flow Chart" on p. 4A-33.

NO

Idle speed is within specification but duty is not.
To ① on next page.

High idle speed
To ② on next page.

Low idle speed
To ③ on next page.

YES

System in good condition.

Fig. 4A-95 Diagnostic Flow Chart B-5 For ISC Solenoid Valve Control System (1)

B-5 ISC SOLENOID VALVE CONTROL SYSTEM CHECK (Continued)

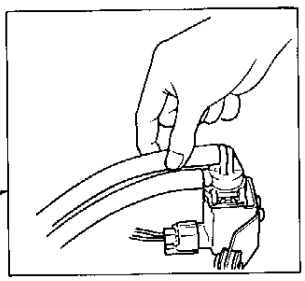
① Idle speed is within specification but duty is not.

Adjust ISC duty to specification referring to p. 4A-78.

NOTE:
- **When ON duty of ISC is close to 0% (but close to 100% with such duty meter that indicates OFF duty, in other words, when ISC is almost fully closed), check that air intake system is free from vacuum leakage and adjust it.**
- **If duty remains unchanged even when adjusting screw is turned, check duty check terminal circuit.**

② HIGH IDLE SPEED

1. Block ISC solenoid valve hose by pinching it.
2. Does engine speed reduce then?



YES

Check ISC solenoid valve for its resistance and operation. (Refer to p. 4A-99.)
Is it in good condition?

YES

"Lg/B" wire shorted to ground.
If wire is OK, substitute a known-good ECM and recheck.

NO

1. Check that air intake system (including A/C VSV) is free from vacuum leakage.
2. Adjust duty and idle speed referring to p. 4A-78.

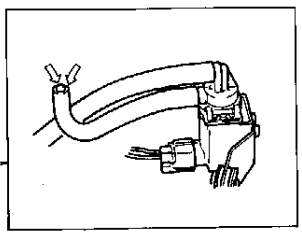
NOTE:
If not adjustable with idle speed adjusting screw, check air valve.

NO

Faulty ISC solenoid valve.

③ LOW IDLE SPEED

1. Disconnect ISC hose from air cleaner case.
2. Then, is air drawn into it?



NO

Check ISC solenoid valve for its resistance and operation. (Refer to p. 4A-99.)
Is it in good condition?

YES

- Clogged ISC hose,
- "Lg/B" wire open or
- Poor coupler connections.

If all above are OK, substitute a known-good ECM and recheck.

YES

Adjust duty and idle speed referring to p. 4A-78.

NO

Faulty ISC solenoid valve.

Fig. 4A-96 Diagnostic Flow Chart B-5 For ISC Solenoid Valve Control System (2)