
ANTI-SKID BRAKING SYSTEM (ABS) <2WD>

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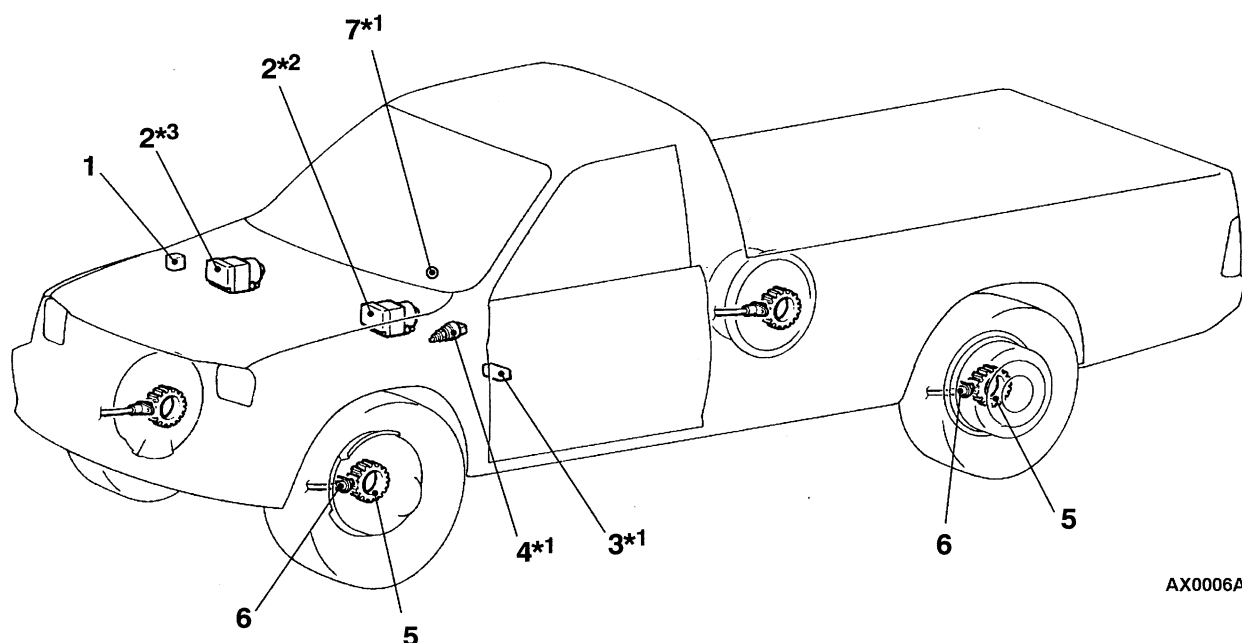
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GENERAL

OUTLINE OF CHANGE

- The ABS system has been revised as follows:
 - (1) The ABS control unit (ABS-ECU) and the hydraulic unit have been unified.
 - (2) The motor relay and the valve relay have been discontinued.
 - (3) The ABS warning lamp relay has been added.

CONSTRUCTION DIAGRAM



AX0006AA

1. ABS warning lamp relay
2. Hydraulic unit assembly (integrated in ABS-ECU)
3. Diagnosis connector

4. Stop lamp switch
5. ABS rotor
6. Wheel speed sensor
7. ABS warning lamp

NOTE

For R.H. drive vehicles, *1 indicates installation at the right side.

*2: LHD diesel-powered vehicles

*3: Except LHD diesel-powered vehicles

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

Refer to Basic Manual GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation of phenomenon
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment, but this is because the system operation check is being performed, and is not an abnormality.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump: suspension: squeak: tyres)
ABS operation (Long braking distance)	For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident.
Shock during system operation check	Shock may be felt when the brake pedal is depressed slightly at a low driving speed. This occurs due to ABS operation check (check at a vehicle speed of 8 km/h after starting), and does not indicate any malfunction.

Diagnosis detection condition can vary depending on the diagnosis code.

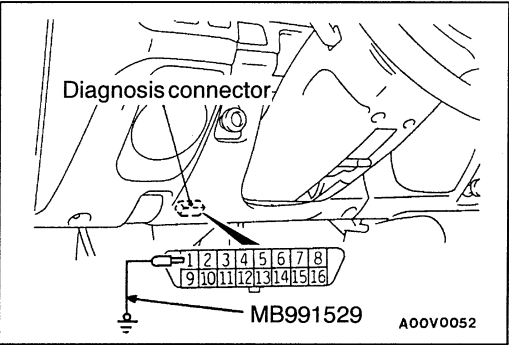
Make sure that checking requirements listed in the “Comment” are satisfied when checking the trouble symptom again.

DIAGNOSIS FUNCTION

DIAGNOSIS CODES CHECK

With the MUT-II

Refer to Basic Manual GROUP 00 – How to Use Troubleshooting/Inspection Service Points.



WHEN USING THE ABS WARNING LAMP

1. Use the special tool to earth No.1 terminal (diagnosis control terminal) of the diagnosis connector.
2. Turn on the ignition switch.
3. Read out a diagnosis code by observing how the ABS warning lamp flashes.

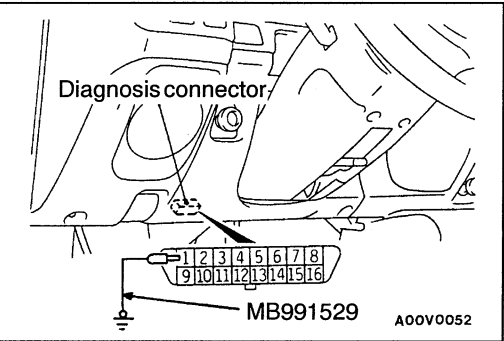
Indication of diagnosis code by ABS warning lamp

When the diagnosis code No.24 is output	When no diagnosis code is output
The diagram shows a pulse train for diagnosis code No.24. It starts with a 3-second pause (labeled 'Pause time 3 s'). This is followed by a 'Tens signal' consisting of two pulses, each 1.5 seconds wide, with a 0.5-second gap between them. This is followed by a 'Place division' of 2 seconds. Finally, there is a 'Units signal' consisting of four pulses, each 0.5 seconds wide, with a 0.5-second gap between them. The diagram is labeled A03X0113.	The diagram shows a pulse train when no diagnosis code is output. It consists of a series of pulses, each 0.25 seconds wide, with a 0.25-second gap between them. The diagram is labeled A03X0114.

ERASING DIAGNOSIS CODES

With the MUT-II

Refer to Basic Manual GROUP 00 – How to Use Troubleshooting/Inspection Service Points.



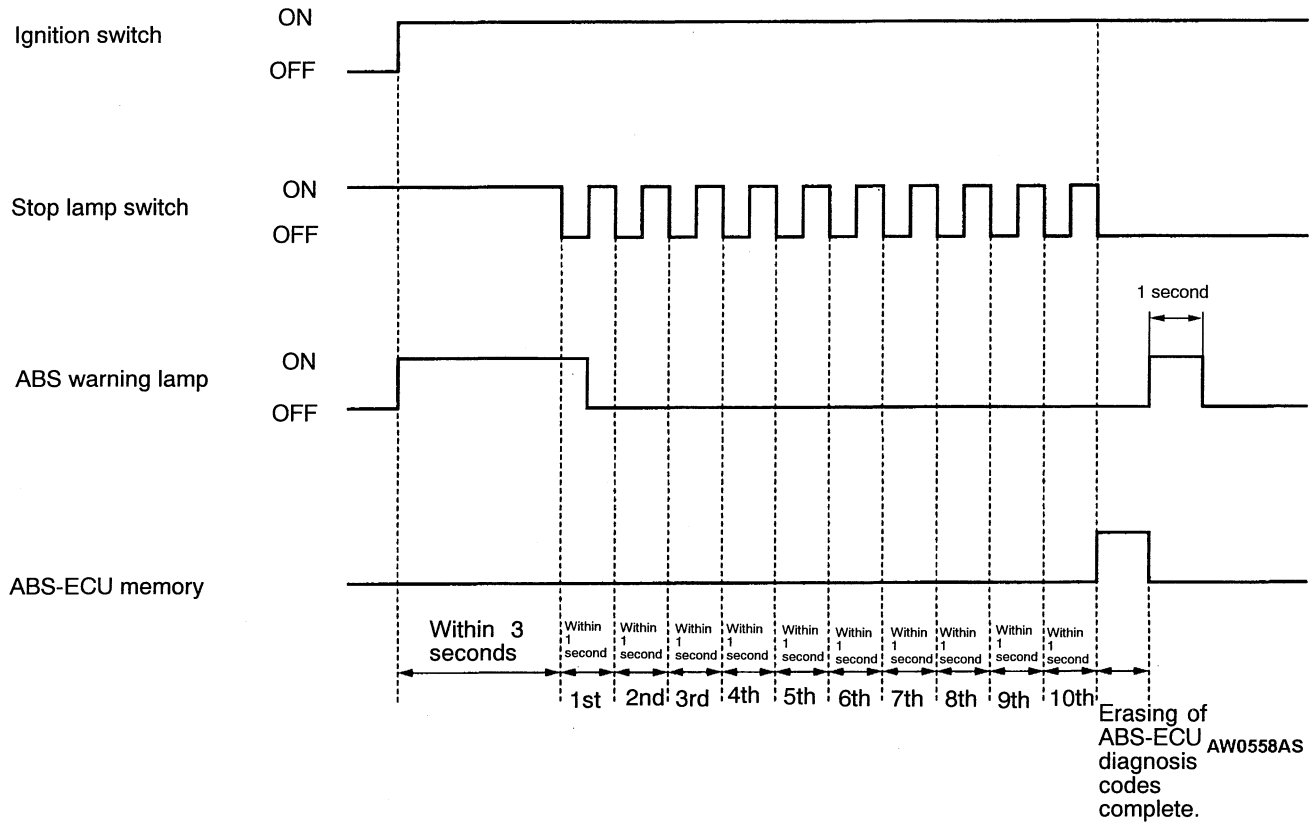
Without the MUT-II

1. Stop the engine.
2. Use the special tool to earth terminal (1) (diagnosis control terminal) of the diagnosis connector.
3. Turn on the stop lamp switch. (Depress the brake.)

4. After carrying out steps 1. to 3., turn the ignition switch to ON. Within 3 seconds after turning the ignition switch to ON, turn off the stop lamp switch (release the brake). Then, turn the stop lamp switch on and off a total of 10 times.

NOTE

If the ABS-ECU function has been stopped because of fail-safe operation, it will not be possible to erase the diagnosis codes.



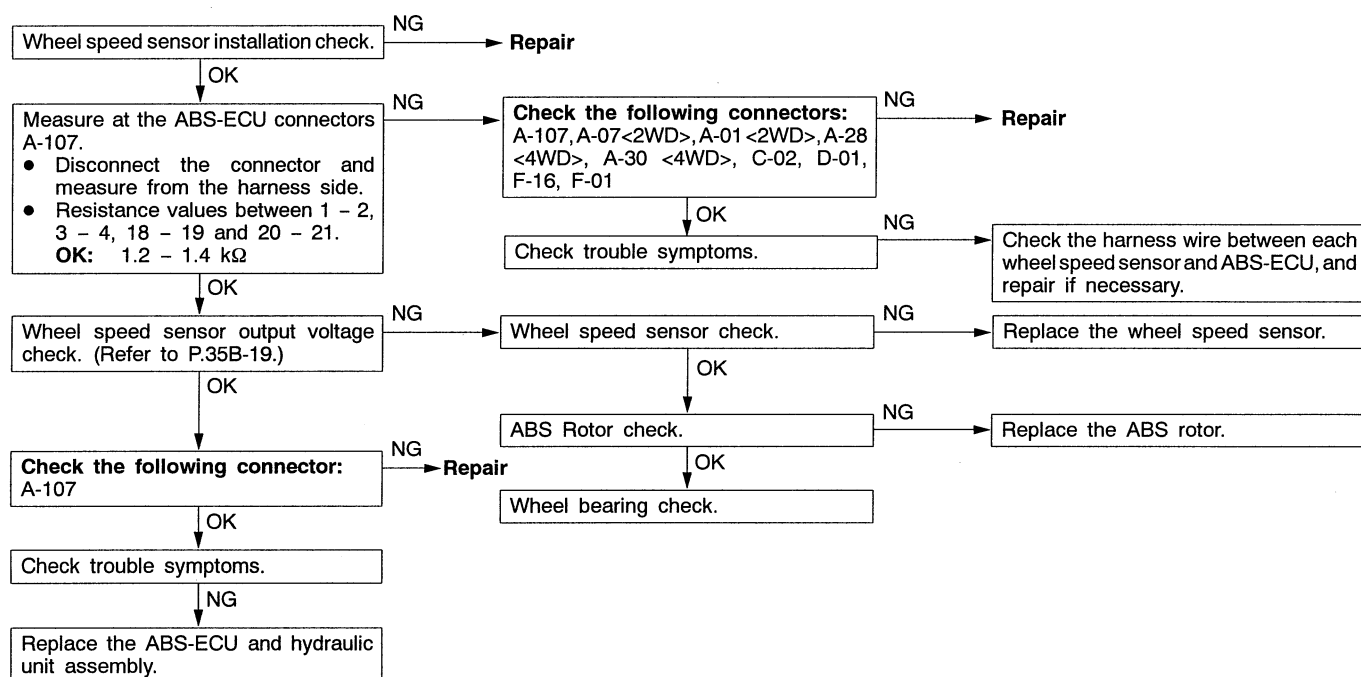
INSPECTION CHART FOR DIAGNOSIS CODES

Inspect according to the inspection chart that is appropriate for the malfunction code.

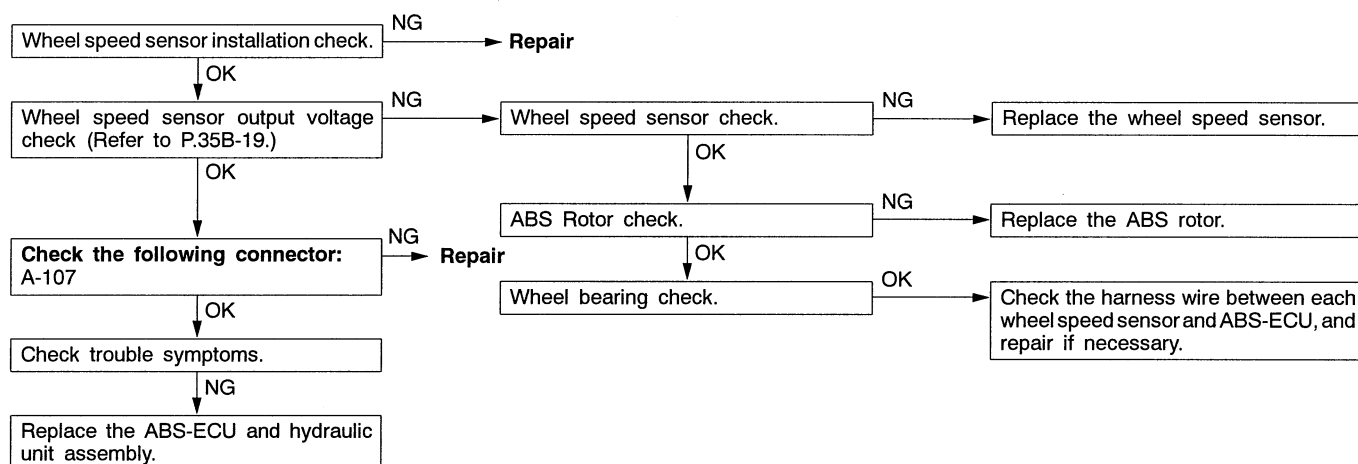
Diagnosis code No.	Inspection item	Diagnosis content	Reference page
11	Front right wheel speed sensor	Open or short circuit	35B-7
12	Front left wheel speed sensor		
13	Rear right wheel speed sensor		
14	Rear left wheel speed sensor		
15	Wheel speed sensor	Abnormal output signal	35B-8
16	Power supply system		35B-8
21	Front right wheel speed sensor	Abnormal	35B-7
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
25	Free wheel engage switch		35B-9
26	4WD position detection switch		
27	Rear differential lock detection switch		
32	G-sensor system		
33	Stop lamp switch system		35B-9
41	Front right solenoid valve		35B-10
42	Front left solenoid valve		
43	Rear solenoid valve		
51	Valve driver		
53	Motor driver		
63	ABS-ECU		Refer to P.35B-23. (Replace the ABS-ECU and hydraulic unit assembly.)

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

Code No. 11, 12, 13, 14 Wheel speed sensor open circuit or short circuit	Probable cause
Code No. 21, 22, 23, 24 Wheel speed sensor abnormal	
The ABS-ECU determines that an open circuit or short circuit occurs in more than one line of wheel speed sensors.	• Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly
These codes are output at the following times: • When an open circuit cannot be found, but more than one wheel speed sensor does not output any signal during driving at 8 km/h or higher. • When a chipped or plugged-up rotor tooth, etc. is detected. • When the sensor output drops and anti-lock control is continuously carried out due to a defective sensor or a warped rotor.	• Malfunction of wheel speed sensor • Malfunction of ABS rotor • Malfunction of wheel bearing • Malfunction of wiring harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly



Code No. 15 Wheel speed sensor (Abnormal output signal)	Probable cause
A wheel speed sensor outputs an abnormal signal (other than an open or short-circuit).	- Improper installation of wheel speed sensor - Malfunction of wheel speed sensor - Malfunction of ABS rotor - Malfunction of wheel bearing - Malfunction of wiring harness or connector - Malfunction of ABS-ECU and hydraulic unit assembly

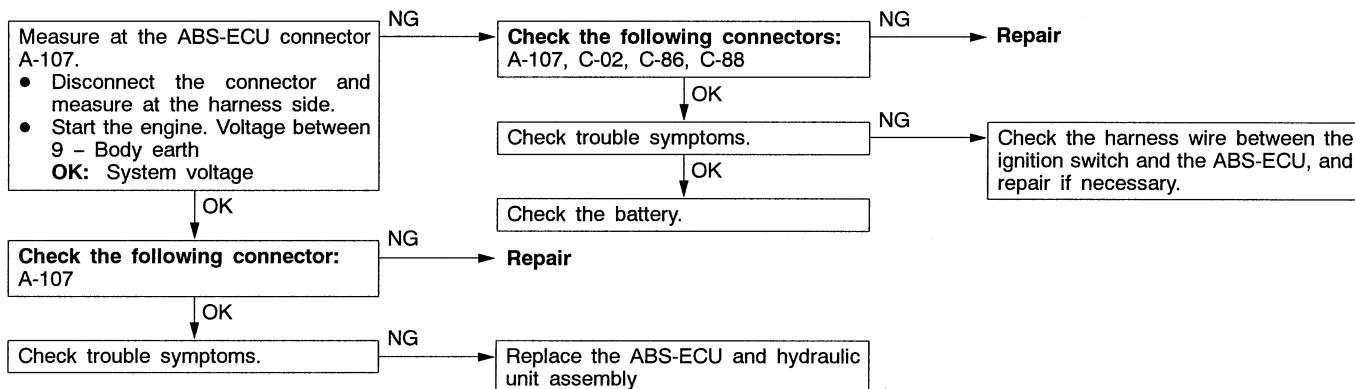


Code No. 16 Power supply system	Probable cause
The voltage of the ABS-ECU power supply drops lower or rises higher than the specified value. If the voltage returns to the specified value, this code is no longer output.	- Malfunction of wiring harness or connector. - Malfunction of ABS-ECU and hydraulic unit assembly

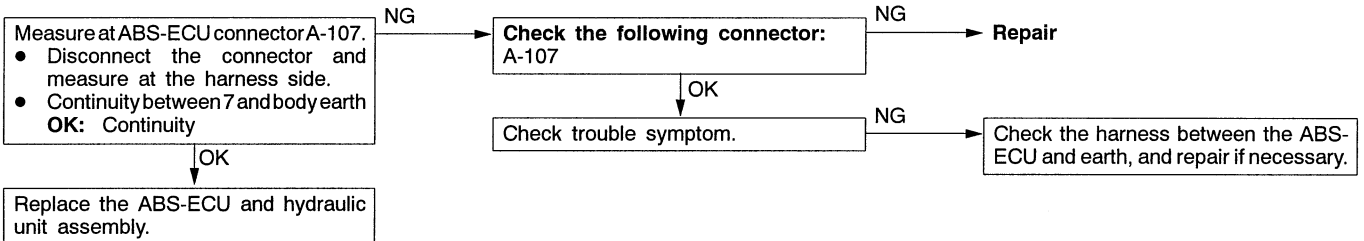
Caution

If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to standard value, this code is no longer output.

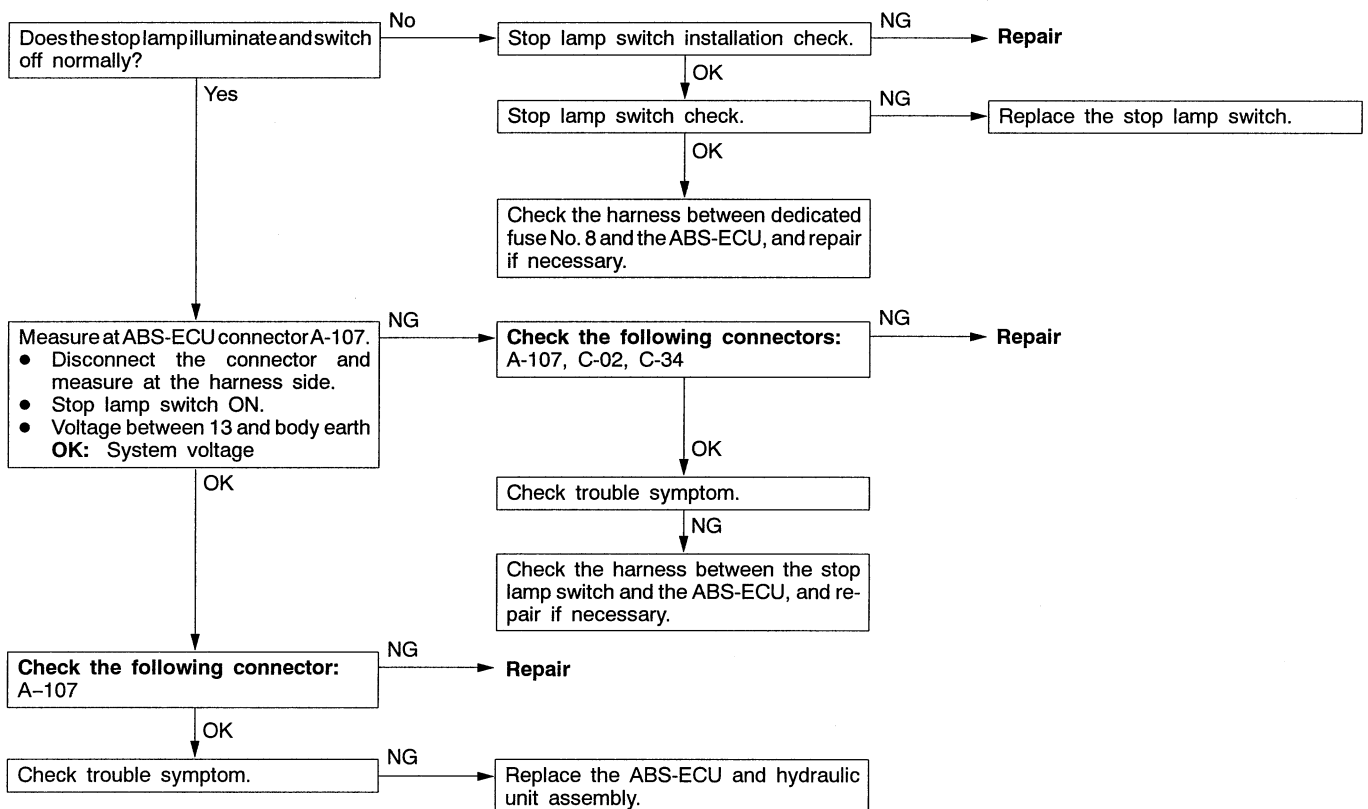
Before carrying out the following inspection, check the battery level, and refill distilled water if necessary.



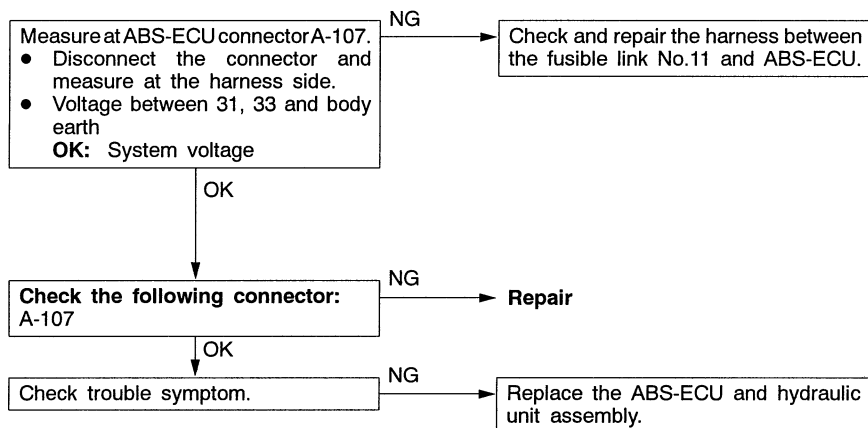
Code No. 25 Freewheel engage switch system	Probable cause
Code No. 26 4WD position detection switch system	
Code No. 27 Rear differential lock detection switch	
Code No. 32 G-sensor system	
The ABS-ECU is shared by 2WD and 4WD vehicles. To identify 2WD from 4WD, on 2WD vehicles, the ABS-ECU G-sensor signal input terminal (terminal No.7) is earthed. Code Nos. 25, 26, 27 and 32 are output when the earth line to that terminal is open circuit.	● Malfunction of wiring harness or connector ● Malfunction of ABS-ECU and hydraulic unit assembly

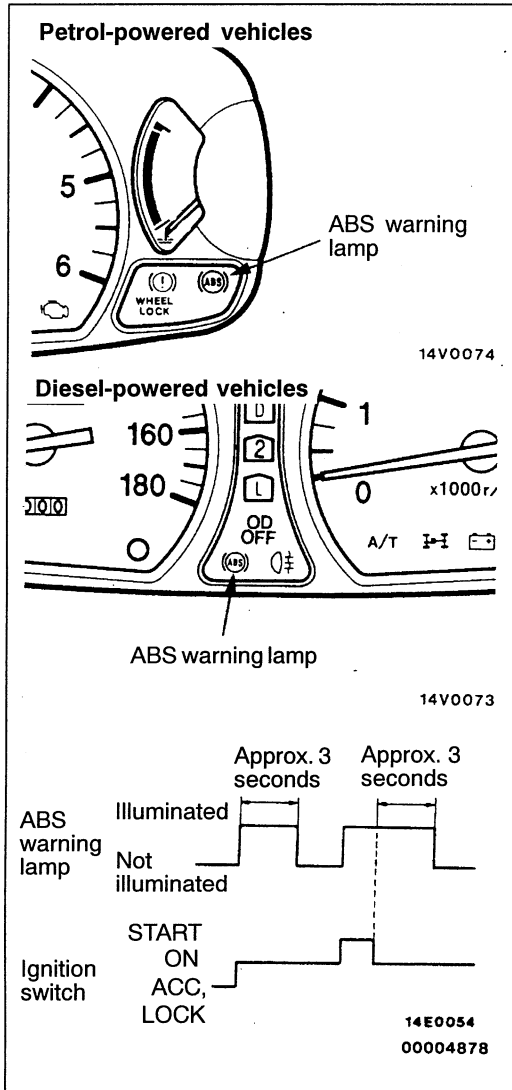


Code No. 33 Stop lamp switch system	Probable cause
This code is output when the stop lamp switch stays on for 15 minutes or more at a vehicle speed of 15 km/h or more due to a ON-failure in the stop lamp switch or open circuit in the stop lamp switch circuit.	
• Malfunction of stop lamp switch • Malfunction of harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly	



Code No. 41, 42, 43 Solenoid valve system	Probable cause
Code No. 51 Valve driver system	
Code No. 53 Motor driver system	
These codes are output in the following cases: ● If there is an open or short circuit in the ABS-ECU power circuit (solenoid valve, motor). ● If there is a malfunction in the ABS-ECU and hydraulic unit inner circuit.	● Malfunction of harness or connector ● Malfunction of ABS-ECU and hydraulic unit assembly





ABS WARNING LAMP INSPECTION

Check that the ABS warning lamp illuminates as follows.

1. When the ignition key is turned to "ON", the ABS warning lamp illuminates for approximately 3 seconds and then switches off.
2. When the ignition key is turned to "START", the ABS warning lamp remains illuminated.
3. When the ignition key is turned from "START" back to "ON", the ABS warning lamp illuminates for approximately 3 seconds and then switches off.

NOTE

The ABS warning lamp may remain on until the vehicle reaches a speed of several km/h. This is limited to cases where diagnosis code Nos.21 - 24 and 53 have been recorded because of a previous problem occurring. In this case, the ABS-ECU keeps the warning lamp illuminated until the problem corresponding to that diagnosis code can be detected.

4. If the illumination is other than the above, check the diagnosis codes.

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

Inspection Procedure 1

Communication with MUT-II is not possible. (Communication with all systems is not possible.)	Probable cause
The reason is probably a defect in the power supply system (including earth) for the diagnosis line.	• Malfunction of connector • Malfunction of harness

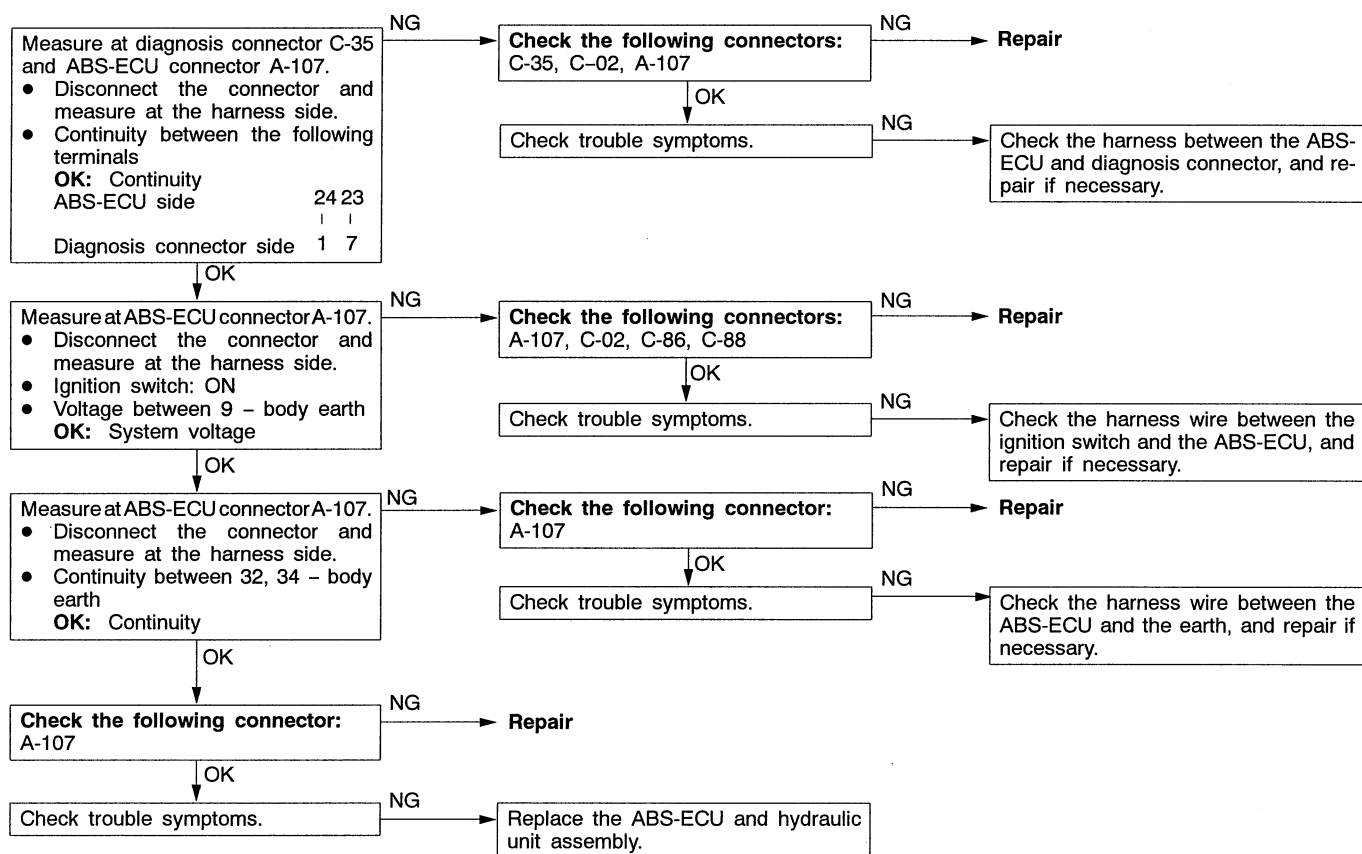
Refer to GROUP 13A - Troubleshooting*.

NOTE

*: Refer to '98 L200 Workshop Manual (Pub.No. PWTE96E1-B).

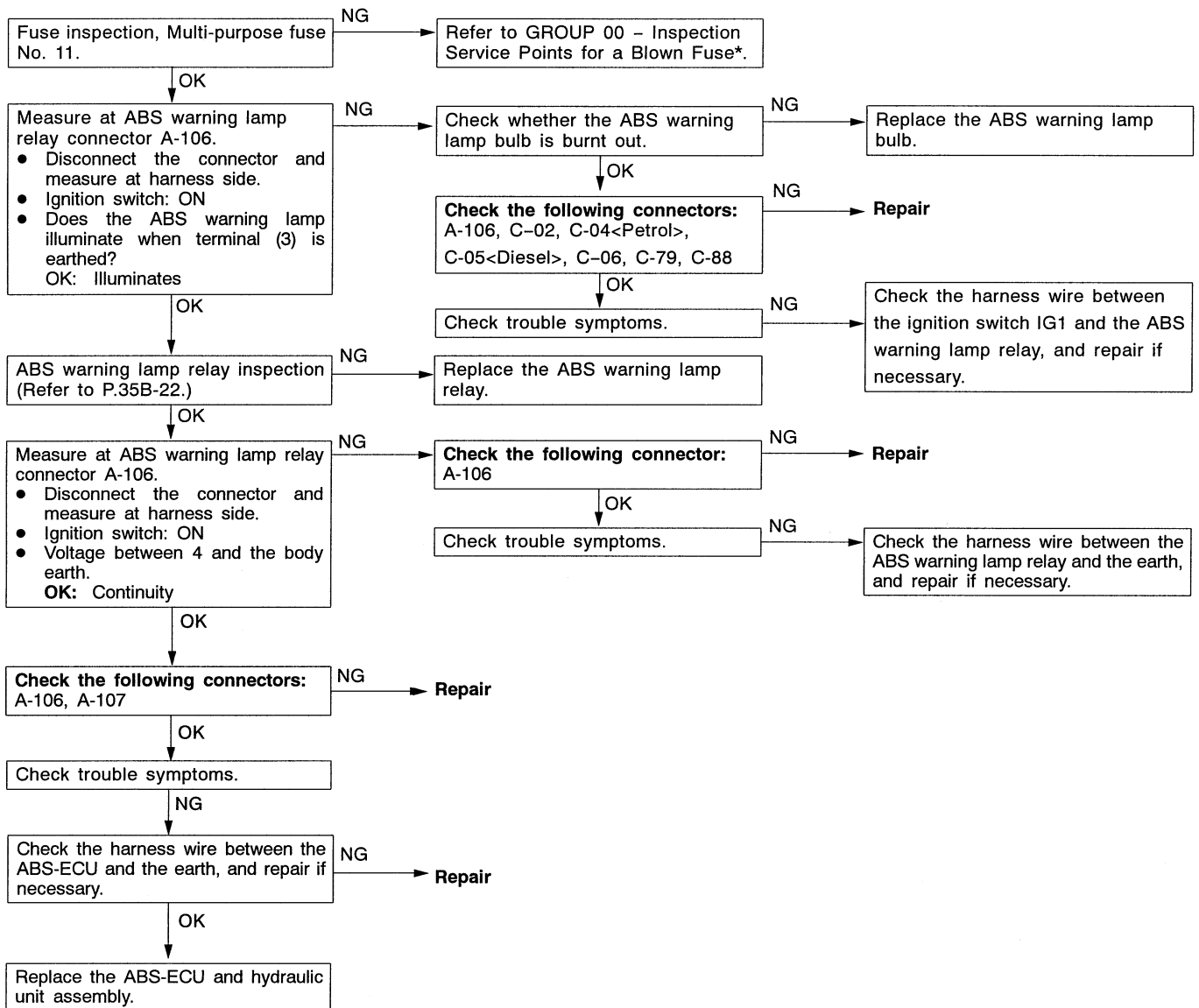
Inspection Procedure 2

Communication with MUT-II is not possible. (Communication with ABS only is not possible.)	Probable cause
When communication with the MUT-II is not possible, the cause is probably an open circuit in the ABS-ECU power circuit or an open circuit in the diagnosis output circuit.	• Blown fuse • Malfunction of wiring harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly



Inspection Procedure 3

When ignition key is turned to "ON" (engine stopped), ABS warning lamp does not illuminate.	Probable cause
Lamp power supply circuit disconnections, lamp bulb burnouts, ABS warning lamp relay faults, or circuit breaks between the ABS warning lamp and the earth are possible causes.	• Blown fuse • Burnt out ABS warning lamp bulb • Malfunction of the ABS warning lamp relay • Malfunction of wiring harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly



NOTE

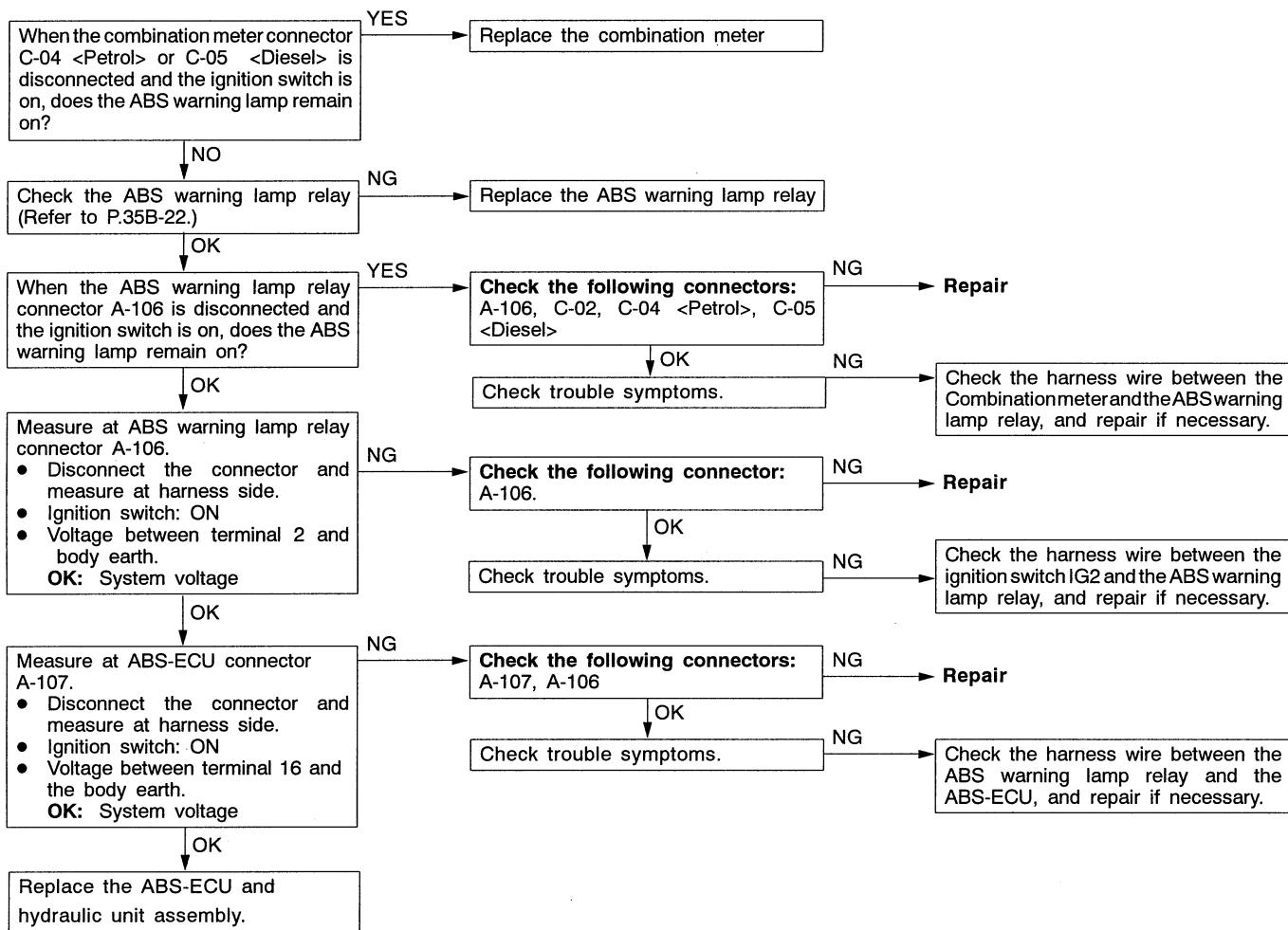
*: Refer to '97 L200 Workshop Manual (Pub.No. PWTE96E1).

Inspection Procedure 4

The ABS warning lamp remains illuminated after the engine is started.	Probable cause
The following causes are suspected: • Short circuit in the harness between the ABS warning lamp and the ABS warning lamp relay • Defective ABS warning lamp relay • Open circuit in the ABS warning lamp relay power supply circuit • Open circuit in the harness between the ABS-ECU and the ABS warning lamp relay	• Defective combination meter • Defective ABS warning lamp relay • Malfunction of wiring or connector • Defective ABS-ECU and hydraulic unit assembly

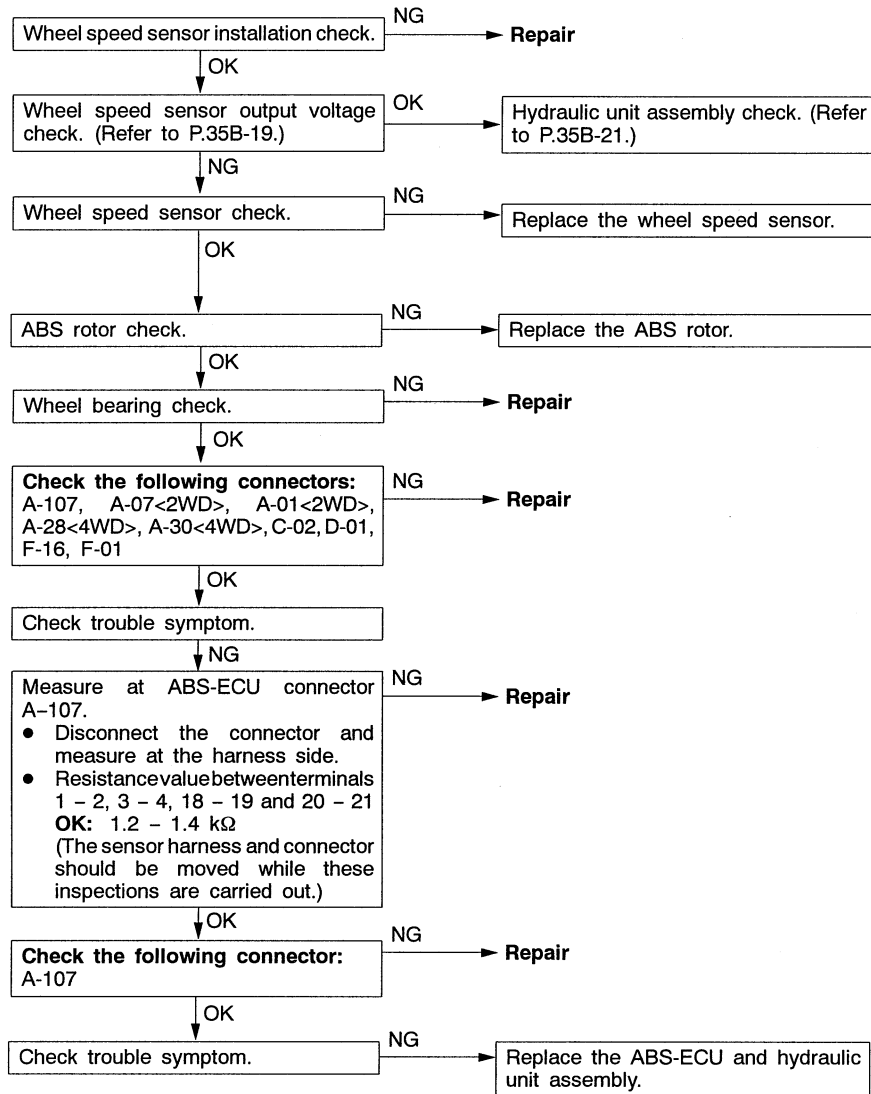
NOTE

This trouble symptom is limited to cases where communication with the MUT-II is possible (ABS-ECU power supply is normal) and the diagnosis code is a normal diagnosis code.



Inspection Procedure 5

Brake operation is abnormal.	Probable cause
This varies depending on the driving conditions and the road surface conditions, so problem diagnosis is difficult. However, if a normal diagnosis code is displayed, carry out the following inspection.	• Improper installation of wheel speed sensor • Incorrect sensor harness contact • Foreign material adhering to wheel speed sensor • Malfunction of wheel speed sensor • Malfunction of ABS rotor • Malfunction of wheel bearing • Malfunction of ABS-ECU and hydraulic unit assembly



DATA LIST REFERENCE TABLE

The following items can be read by the MUT-II from the ABS-ECU input data.

1. When the system is normal

Item No.	Check item	Checking requirements	Normal value
11	Front-right wheel speed sensor	Perform a test run	Vehicle speeds displayed on the speedometer and MUT-II are identical.
12	Front-left wheel speed sensor		
13	Rear-right wheel speed sensor		
14	Rear-left wheel speed sensor		
16	ABS-ECU power supply voltage	Ignition switch power supply voltage and valve monitor voltage	9 – 16 V
25	Freewheel engage switch	Always	OFF
26	4WD position detection switch	Always	OFF
27	Rear differential lock detection switch	Always	OFF
32	G-sensor system	Always	0V
33	Stop lamp switch	Depress the brake pedal.	ON
		Release the brake pedal.	OFF

2. When the ABS-ECU shut off ABS operation.

When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

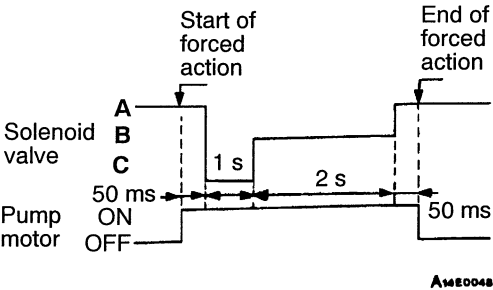
ACTUATOR TEST REFERENCE TABLE

The MUT-II activates the following actuators for testing.

NOTE

1. If the ABS-ECU runs down, actuator testing cannot be carried out.
2. Actuator testing is only possible when the vehicle is stationary. If the vehicle speed during actuator testing exceeds 10 km/h, forced actuation will be cancelled.
3. During the actuator test, the ABS warning lamp will illuminate and the anti-skid control will be cancelled.

Activation pattern



NOTE
A: Hydraulic pressure increases
B: Hydraulic pressure holds
C: Hydraulic pressure decreases

ACTUATOR TEST SPECIFICATIONS

No.	Item	
01	Solenoid valve for front-left wheel	Solenoid valves and pump motors in the hydraulic unit (simple inspection mode)
02	Solenoid valve for front-right wheel	
03	Solenoid valve for rear wheel	

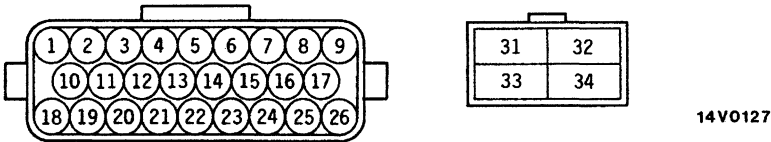
CHECK AT ABS-ECU

TERMINAL VOLTAGE CHECK CHART

1. Measure the voltages between terminals (32) and (34) (earth terminals) and each respective terminal.

NOTE
Do not measure terminal voltage for approximately three seconds after the ignition switch is turned on. The ABS-ECU performs the initial check during that period.

2. The terminal layouts are shown in the illustrations below.

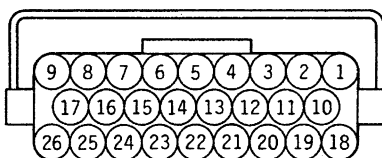
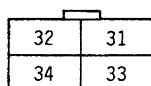


Connector terminal No.	Signal	Checking requirement		Normal condition
7	G-sensor signal	Ignition switch: "ON"		0 V
9	ABS-ECU power supply	Ignition switch: "ON"		System voltage
		Ignition switch: "START"		0 V
13	Input from stop lamp switch	Ignition switch: ON	Stop lamp switch: "ON"	System voltage
			Stop lamp switch: "OFF"	1 V or less
16	Control output to ABS warning lamp relay.	Ignition switch: ON	The lamp is switch off.	2 V or less
			The lamp is illuminated.	System voltage

Connector terminal No.	Signal	Checking requirement	Normal condition
23	MUT-II	Connect the MUT-II	Serial communication with MUT-II
		Do not connect the MUT-II	1 V or less
24	Input from diagnosis indication selection	Connect the MUT-II	0 V
		Do not connect the MUT-II	Approximately 12 V
31	Solenoid valve power supply	Always	System voltage
33	Motor power supply		

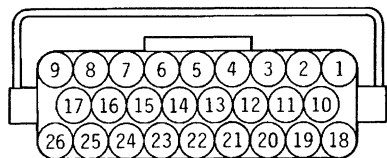
RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

1. Turn the ignition switch off and disconnect the ABS-ECU connectors before checking resistance and continuity.
2. Check between the terminals indicated in the table below.
3. The terminal layouts are shown in the illustration below.



14V0128

Connector terminal No.	Signal	Normal condition
20 – 21	Front-left wheel speed sensor	1.2 – 1.4 k Ω
1 – 2	Rear-right wheel speed sensor	1.2 – 1.4 k Ω
18 – 19	Front-right wheel speed sensor	1.2 – 1.4 k Ω
3 – 4	Rear-left wheel speed sensor	1.2 – 1.4 k Ω
32 – body earth	Solenoid valve earth	Continuity
34 – body earth	Motor earth	Continuity



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ON-VEHICLE SERVICE

WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK

1. Lift up the vehicle and release the parking brake.
2. Disconnect the ABS-ECU connector, and then use the special tool (inspection harness for connector pin contact pressure) to measure the output voltage at the harness-side connector.
3. Rotate the wheel to be measured at approximately 1/2–1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal No.	20	18	3	1
	21	19	4	2

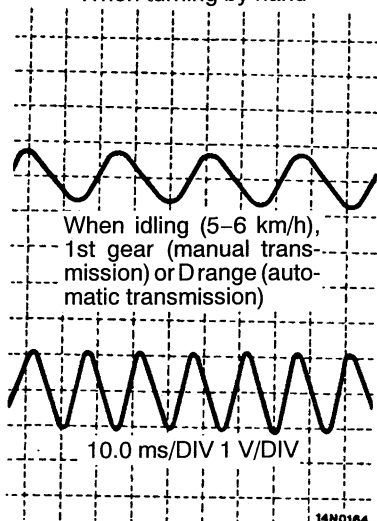
Output voltage

When measuring with a circuit tester:
70 mV or more

When measuring with an oscilloscope:
200 mV p-p or more

4. If the output voltage is lower than the above values, the reason could be as follow:
 - Faulty wheel speed sensor.
 So replace the wheel speed sensor.

When turning by hand



14N0164

Inspecting Waveforms With An Oscilloscope

Use the following method to observe the output voltage waveform from each wheel sensor with an oscilloscope.

- Start the engine, and rotate the rear wheels by engaging 1st gear (vehicles with manual transmission) or D range (vehicles with automatic transmission). Turn the front wheels manually so that they rotate at a constant speed.

NOTE

1. Check the connection of the sensor harness and connector before using the oscilloscope.
2. The waveform measurements can also be taken while the vehicle is actually moving.
3. The output voltage will be small when the wheel speed is low, and similarly it will be large when the wheel speed is high.

Points In Waveform Measurement

Symptom	Probable causes	Remedy
Too small or zero waveform amplitude	Faulty wheel speed sensor	Replace sensor
Waveform amplitude fluctuates excessively (this is no problem if the minimum amplitude is 100 mV or more)	Axle hub eccentric or with large runout	Replace hub
Noisy or disturbed waveform	Open circuit in sensor	Replace sensor
	Open circuit in harness	Correct harness
	Incorrectly mounted wheel speed sensor	Mount correctly
	ABS rotor with missing or damaged teeth	Replace ABS rotor

NOTE

The wheel speed sensor cable moves following motion of the front or rear suspension. Therefore, it is likely that it has an open circuit only when driving on rough roads and it functions normally on ordinary roads. It is, therefore, recommended to observe sensor output voltage waveform also under special conditions, such as rough road driving.

HYDRAULIC UNIT CHECK**Caution**

Turn the ignition switch off before connecting or disconnecting the MUT-II.

1. Jack up the vehicle and support the vehicle with rigid racks placed at the specified jack-up points or place the wheels which are checked on the rollers of the braking force tester.

Caution

- (1) The roller of the braking force tester and the tyre should be dry during testing.
- (2) When testing the front brakes, apply the parking brake, and when testing the rear brakes, stop the front wheels by chocking them.

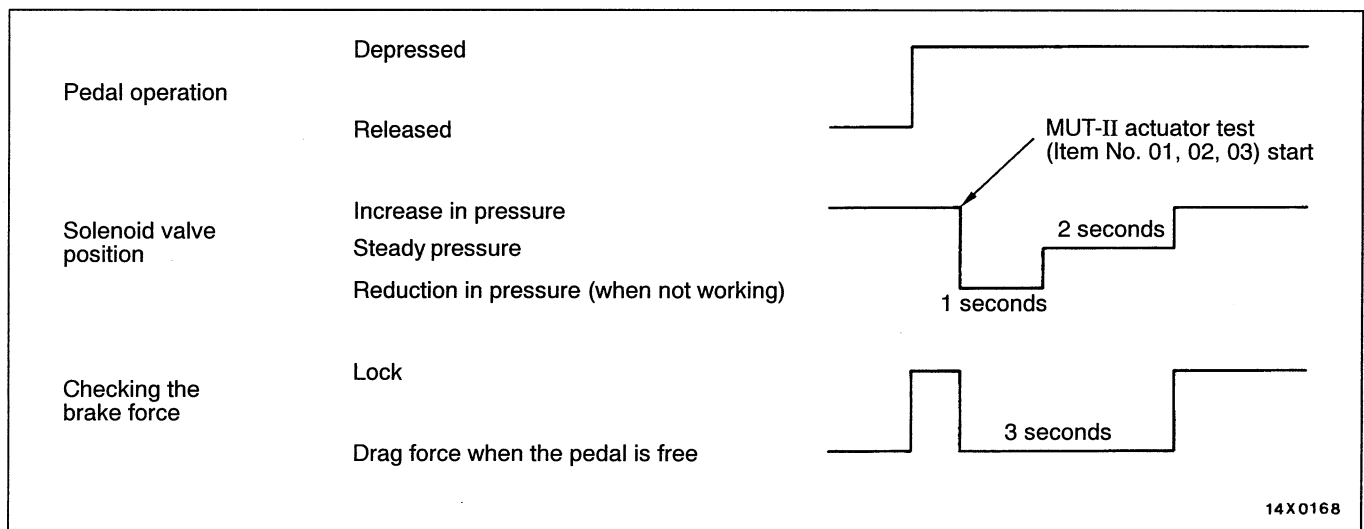
2. Release the parking brake, and feel the drag force (drag torque) on each road wheel.
When using the braking force tester, take a reading of the brake drag force.
3. Turn the ignition key to the OFF position and set the MUT-II.
4. After checking that the shift lever is in neutral, start the engine.
5. Use the MUT-II to force-drive the actuator.

NOTE

- (1) During the actuator test, the ABS warning lamp will illuminate and the anti-skid control will be cancelled.
 - (2) When the ABS has been interrupted by the fail-safe function, the MUT-II actuator testing cannot be used.
6. Turn the wheel by hand and check the change in braking force when the brake pedal is depressed.
When using the braking force tester, depress the brake pedal until the braking force is at the following values, and check that the braking force decreases when the actuator is force-driven.

Front wheel	2942 – 3334 N
Rear wheel	1275 – 1471 N

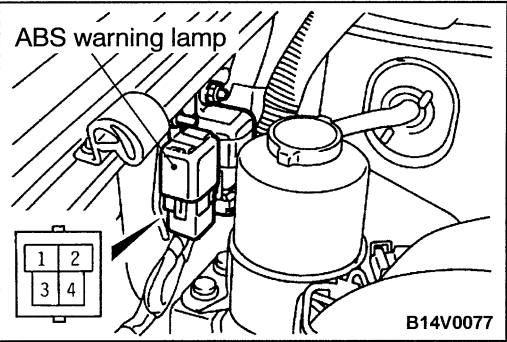
The result should be as shown in the following diagram.



7. If the result of inspection is abnormal, correct according to the "Diagnosis Table" (Refer to P.35B-22).
8. After inspection, disconnect the MUT-II immediately after turning the ignition switch to OFF.

Diagnosis Table

No.	Operation	Judgement – Normal	Judgement – Abnormal	Probable cause	Remedy
01	(1) Depress brake pedal to lock wheel.	Brake force released for 4 seconds after locking.	Wheel does not lock when brake pedal is depressed.	Clogged brake line other than hydraulic unit	Check and clean brake line
02	(2) Using the MUT-II, select the wheel to be checked and force the actuator to operate.			Clogged hydraulic circuit in hydraulic unit	Replace hydraulic unit assembly
03	(3) Turn the selected wheel manually to check the change of brake force.		Brake force is not released	Incorrect hydraulic unit brake tube connection	Connect correctly
				Hydraulic unit solenoid valve not functioning correctly	Replace hydraulic unit assembly



ABS WARNING LAMP RELAY CONTINUITY CHECK

Battery voltage	Terminal No.			
	1	2	3	4
Not applied	○	○	○	○
Applied	⊖	⊕		

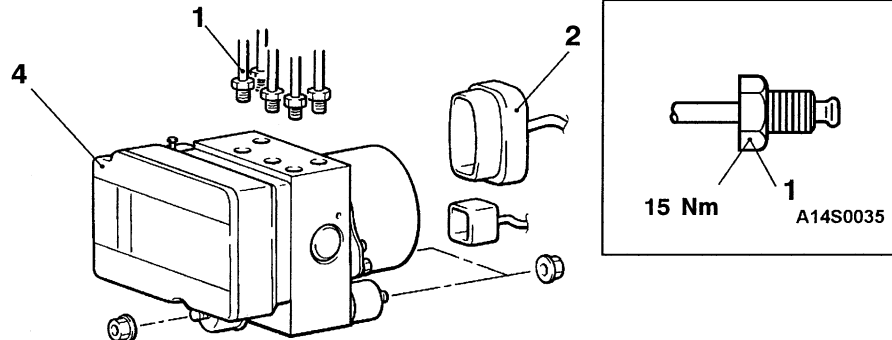
ABS-ECU AND HYDRAULIC UNIT

REMOVAL AND INSTALLATION

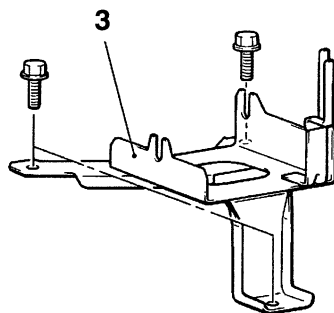
Pre-removal Operation
Brake Fluid Draining

Post-installation Operation

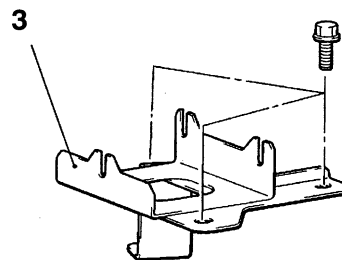
- Brake Fluid Filling
- Brake Line Bleeding



<4G6, 4D5 – R.H. drive vehicles>



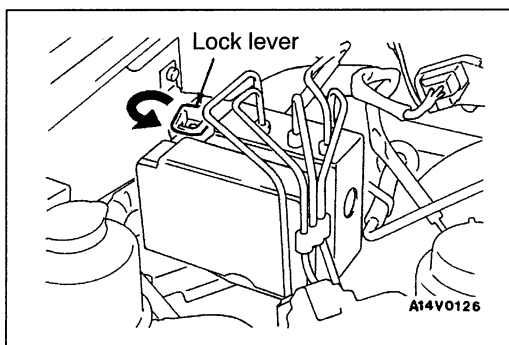
<4D5 – L.H. drive vehicles>



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Removal steps

- ◀A▶ 1. Brake tube
▶A▶ 2. Harness connector
3. Bracket assembly
◀B▶ 4. ABS-ECU and hydraulic unit assembly



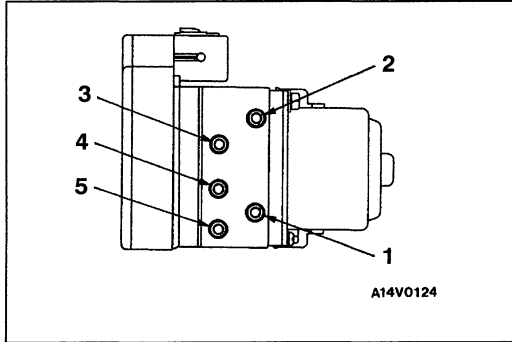
REMOVAL SERVICE POINTS

◀A▶ HARNESS CONNECTOR REMOVAL

Turn the lock lever in the direction shown in the illustration, and remove the harness.

◀B▶ ABS-ECU AND HYDRAULIC UNIT REMOVAL**Caution**

1. The ABS-ECU and hydraulic unit assembly is heavy. Use care when removing it.
2. The ABS-ECU and hydraulic unit assembly cannot be disassembled. Never loosen its nuts or bolts.
3. Do not drop or shock the ABS-ECU and hydraulic unit assembly.
4. Do not turn the ABS-ECU and hydraulic unit assembly upside down or lay it on its side.

**INSTALLATION SERVICE POINT****▶A◀ BRAKE TUBE INSTALLATION**

Connect the tubes to the hydraulic unit assembly as shown in the illustration.

1. Master cylinder and load sensing proportioning valve <Front system>
2. Master cylinder <Rear system>
3. Load sensing proportioning valve <Rear system>
4. Front brake <R.H.>
5. Front brake <L.H.>

ANTI-SKID BRAKING SYSTEM (ABS) <4WD>

CONTENTS

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ON-VEHICLE SERVICE

Wheel Speed Sensor Output Voltage Check
..... Refer to GROUP 35B

Hydraulic Unit Check

..... Refer to GROUP 35B

ABS Warning Lamp Relay Continuity Check

..... Refer to GROUP 35B

ABS-ECU AND HYDRAULIC UNIT

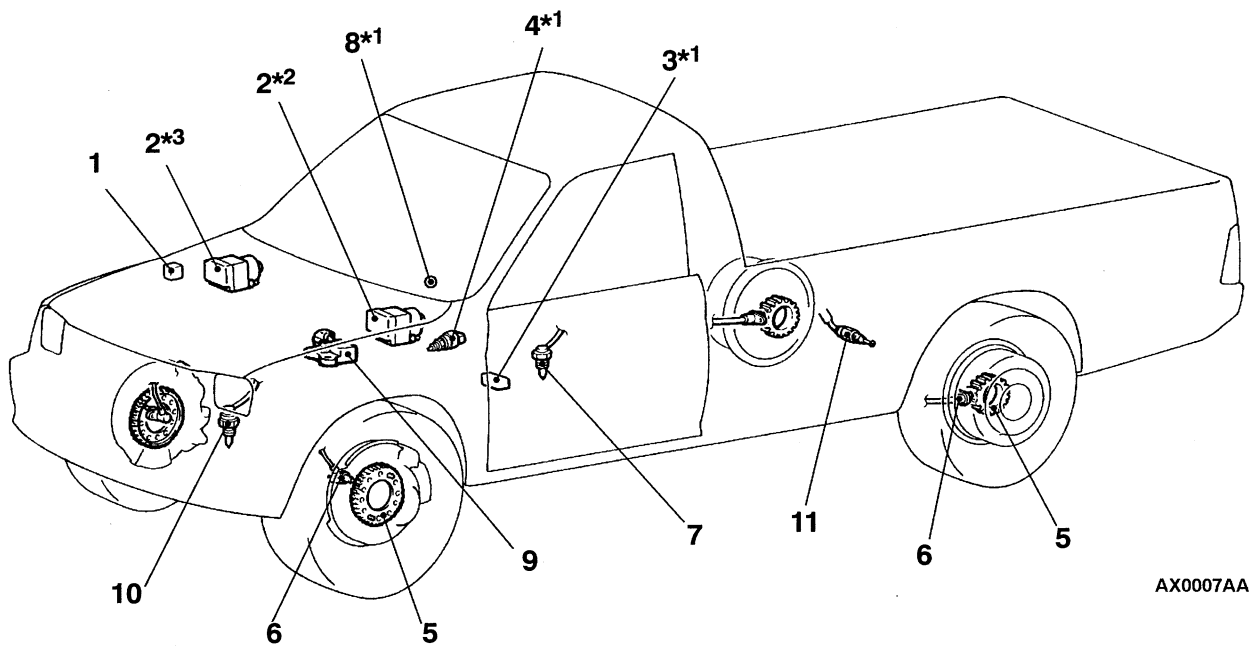
..... Refer to GROUP 35B

GENERAL

OUTLINE OF CHANGE

- The ABS system has been revised as follows:
 - (1) The ABS control unit (ABS-ECU) and the hydraulic unit have been unified.
 - (2) The motor relay and the valve relay have been discontinued.
 - (3) The ABS warning lamp relay has been added.

CONSTRUCTION DIAGRAM



AX0007AA

- | | |
|--|---|
| 1. ABS warning lamp relay | 7. 4WD position detection switch |
| 2. Hydraulic unit assembly (integrated in ABS-ECU) | 8. ABS warning lamp |
| 3. Diagnosis connector | 9. G-sensor |
| 4. Stop lamp switch | 10. Freewheel engage switch |
| 5. ABS rotor | 11. Rear differential lock detection switch <Vehicles with rear differential lock system> |
| 6. Wheel speed sensor | |

NOTE

For R.H. drive vehicles, *1 indicates installation at the right aide.

*2: LHD diesel-powered vehicles

*3: Except LHD diesel-powered vehicles

TROUBLESHOOTING

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

Refer to Basic Manual GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation of phenomenon
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment, but this is because the system operation check is being performed, and is not an abnormality.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation. (whine) 2. Sound is the generated along with vibration of the brake pedal. (scraping) 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release. (Thump: suspension; squeak: tyres)
ABS operation (Long braking distance)	For road surfaces such as snow-covered roads and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed and not being too overconfident.
Shock during system operation check	Shock may be felt when the brake pedal is depressed slightly at a low driving speed. This occurs due to ABS operation check (check at a vehicle speed of 8 km/h after starting), and does not indicate any malfunction.

Diagnosis detection condition can vary depending on the diagnosis code.

Make sure that checking requirements listed in the “Comment” are satisfied when checking the trouble symptom again.

DIAGNOSIS FUNCTION

DIAGNOSIS CODES CHECK

Refer to GROUP 35B – Troubleshooting.

ERASING DIAGNOSIS CODES

Refer to GROUP 35B – Troubleshooting.

INSPECTION CHART FOR DIAGNOSIS CODES

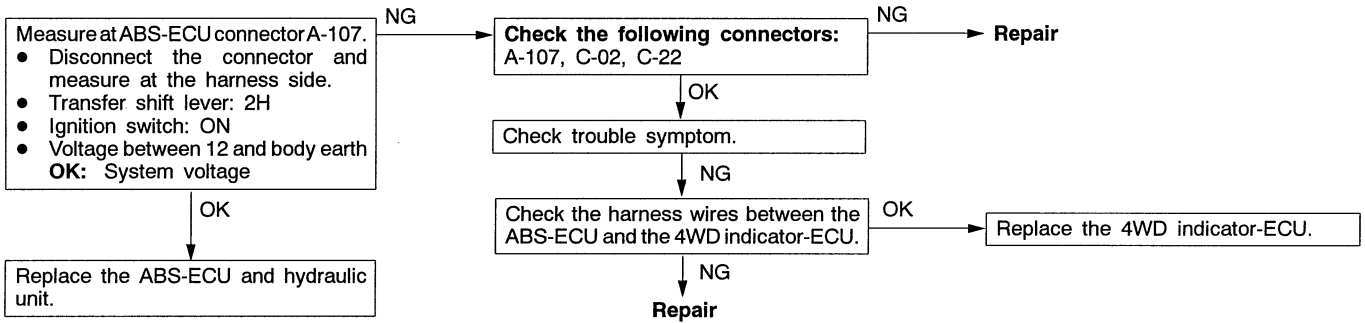
Inspect according to the inspection chart that is appropriate for the malfunction code.

Diagnosis code No.	Inspection item	Diagnosis content	Reference page
11	Front right wheel speed sensor	Open or short circuit	Refer to GROUP 35B – Troubleshooting.
12	Front left wheel speed sensor		
13	Rear right wheel speed sensor		
14	Rear left wheel speed sensor		
15	Wheel speed sensor	Abnormal output signal	Refer to GROUP 35B – Troubleshooting.
16	Power supply system		Refer to GROUP 35B – Troubleshooting.
21	Front right wheel speed sensor	Abnormal	Refer to GROUP 35B – Troubleshooting.
22	Front left wheel speed sensor		
23	Rear right wheel speed sensor		
24	Rear left wheel speed sensor		
25	Free wheel engage switch		35C-5
26	4WD position detection switch		35C-7
27	Rear differential lock detection switch		35C-7
32	G-sensor system		35C-8
33	Stop lamp switch system		Refer to GROUP 35B – Troubleshooting.
41	Front right solenoid valve		Refer to GROUP 35B – Troubleshooting.
42	Front left solenoid valve		
43	Rear solenoid valve		
51	Valve driver		Refer to GROUP 35B – Troubleshooting.
53	Motor driver		Refer to GROUP 35B – Troubleshooting.
63	ABS-ECU		Refer to GROUP 35B – ABS-ECU. (Replace the ABS-ECU and hydraulic unit assembly.)

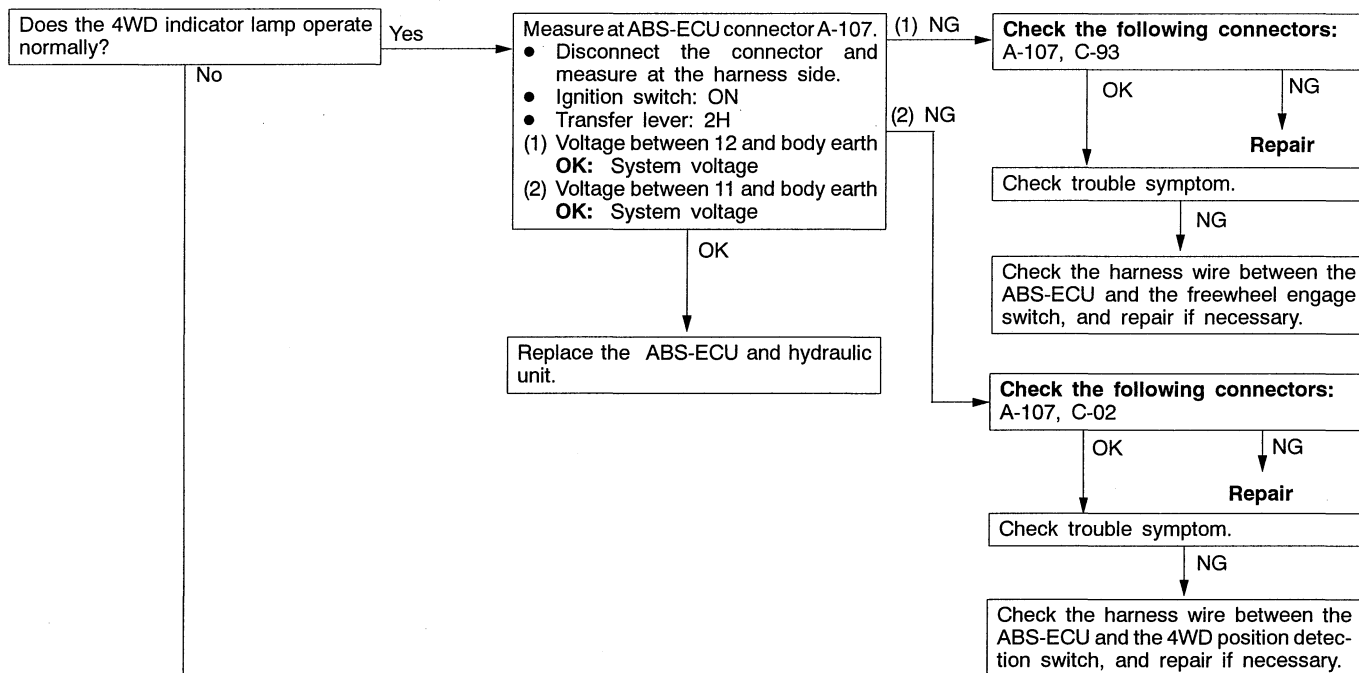
INSPECTION PROCEDURE CLASSIFIED BY DIAGNOSIS CODES

For diagnosis code numbers other than those listed below, refer to GROUP 35B – Troubleshooting.

Code No. 25 Free wheel engage switch	Probable cause
This diagnosis code is displayed under the following cases. For case (2), code No. 26 is also displayed at the same time. (1) The ABS-ECU determines that an open circuit exists in the freewheel engage switch system. (2) While the vehicle speed is 20 km/h or more, the freewheel engage switch remains off, and the 4WD position detection switch remains on for five minutes or more until the vehicle speed reaches 0 km/h (The switch signals are combined abnormality).	• Malfunction of wiring harness or connector • Malfunction of freewheel engage switch • Malfunction of 4WD position detection switch • Malfunction of 4WD indicator-ECU • Malfunction of ABS-ECU and hydraulic unit

<When only code No. 25 is displayed>

<When code Nos. 25 and 26 are displayed simultaneously>



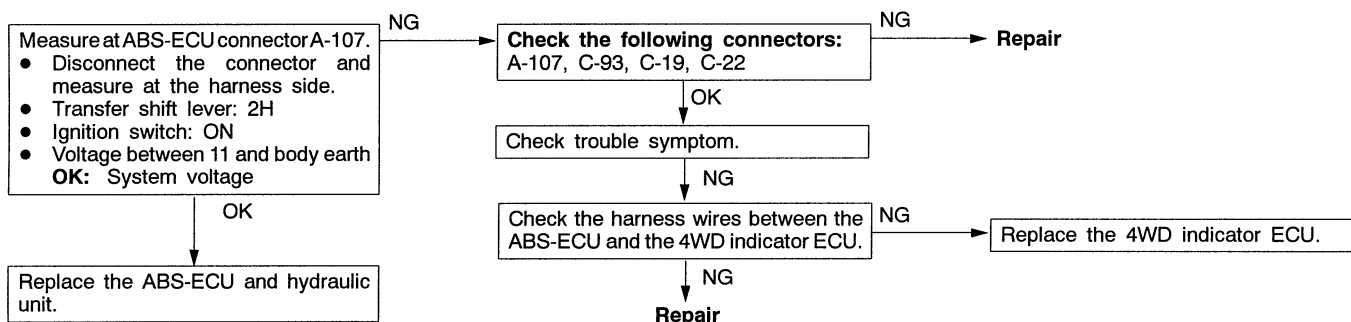
Trouble symptom	Main cause	Remedy
When the transfer shift lever is at "4H" position, the 4WD indicator lamp flashes, but does not remain on.	Broken harness wire between the 4WD indicator-ECU and the free-wheel engage switch, or broken earth wire from the free wheel engage switch	Repair the harness.
	Free wheel engage switch is defective.	Replace the switch.
	4WD indicator-ECU is defective.	Replace the 4WD indicator-ECU
When the transfer shift lever is at "2H" position, the 4WD indicator lamp flashes.	Short in the harness wire in the 4WD position detection switch circuit	Repair the harness.
	4WD position detection switch is defective.	Replace the switch.
	Short in the ABS-ECU circuit	Replace the ABS-ECU.
	4WD indicator-ECU is defective.	Replace the 4WD indicator-ECU.
No indicator is illuminated	Power circuit in the 4WD indicator-ECU is defective.	Repair the harness.
	Broken harness wire between the 4WD indicator-ECU and the freewheel engage switch, or broken earth wire from the freewheel engage switch	Replace the harness.
	Broken harness wire between the 4WD indicator-ECU and the 4WD position detection switch	Repair the harness.
	Freewheel engage switch or 4WD position detection switch is defective.	Repair the switch.
	4WD indicator-ECU is defective.	Replace the 4WD indicator-ECU.

NOTE

When checking a short in the ABS-ECU circuit, remove the ABS-ECU connector and check if the 4WD indicator returns to normal. If it returns to normal, the ABS-ECU is defective. Furthermore, if the ABS-ECU is normal, then the 4WD indicator-ECU will be defective.

Code No. 26 4WD position detection switch system	Probable cause
This diagnosis code is displayed under the following case. For case (2), code No. 25 is also displayed at the same time. (1) The ABS-ECU determines that an open circuit exists in the 4WD position detection switch system. (2) While the vehicle speed is 20 km/h or more, the freewheel engage switch remains off, and the 4WD position detection switch remains on for five minutes or more until the vehicle speed reaches 0 km/h (The switch signals are combined abnormally).	• Malfunction of wiring harness or connector • Malfunction of freewheel engage switch • Malfunction of 4WD position detection switch • Malfunction of 4WD indicator-ECU • Malfunction of ABS-ECU and hydraulic unit

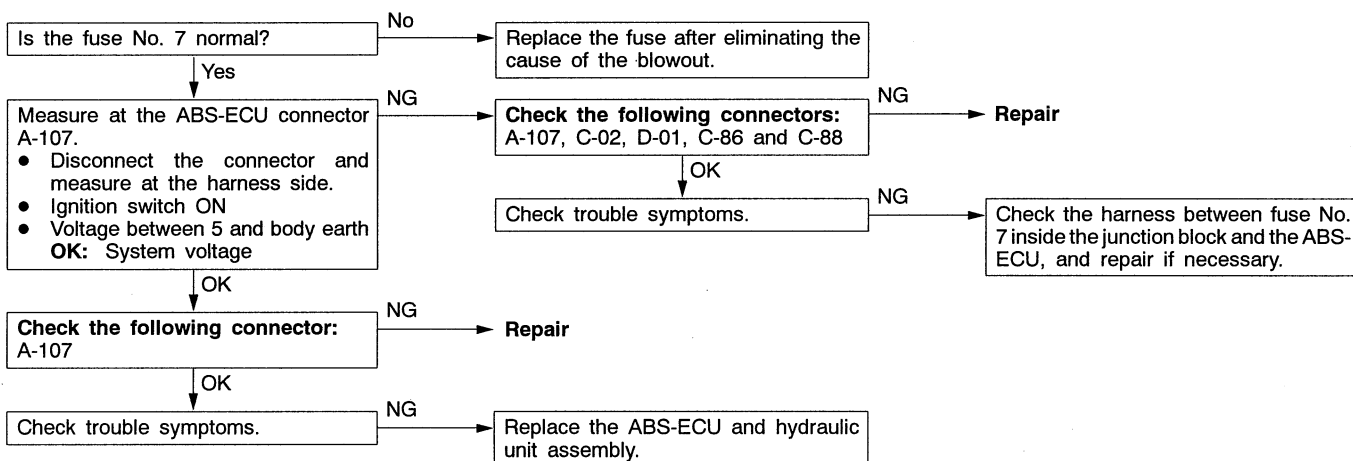
<When only code No. 26 is displayed>



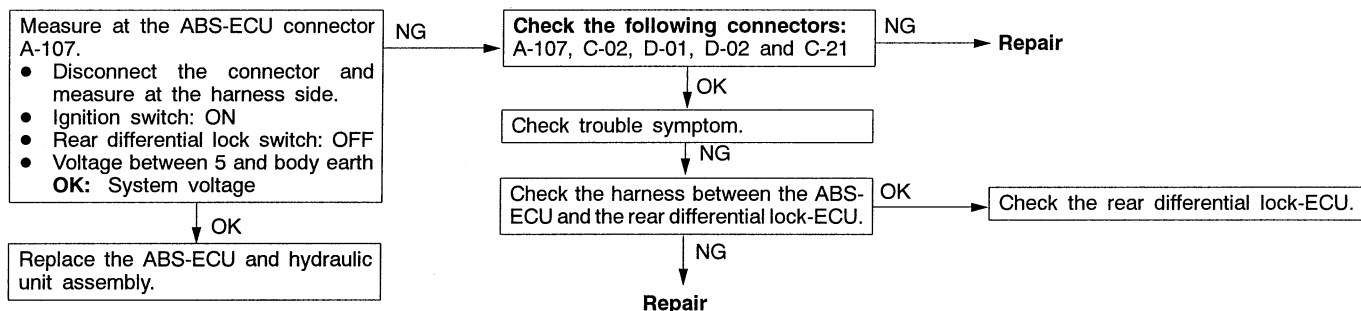
<When code Nos. 25 and 26 are displayed>

Refer to P.35C-6.

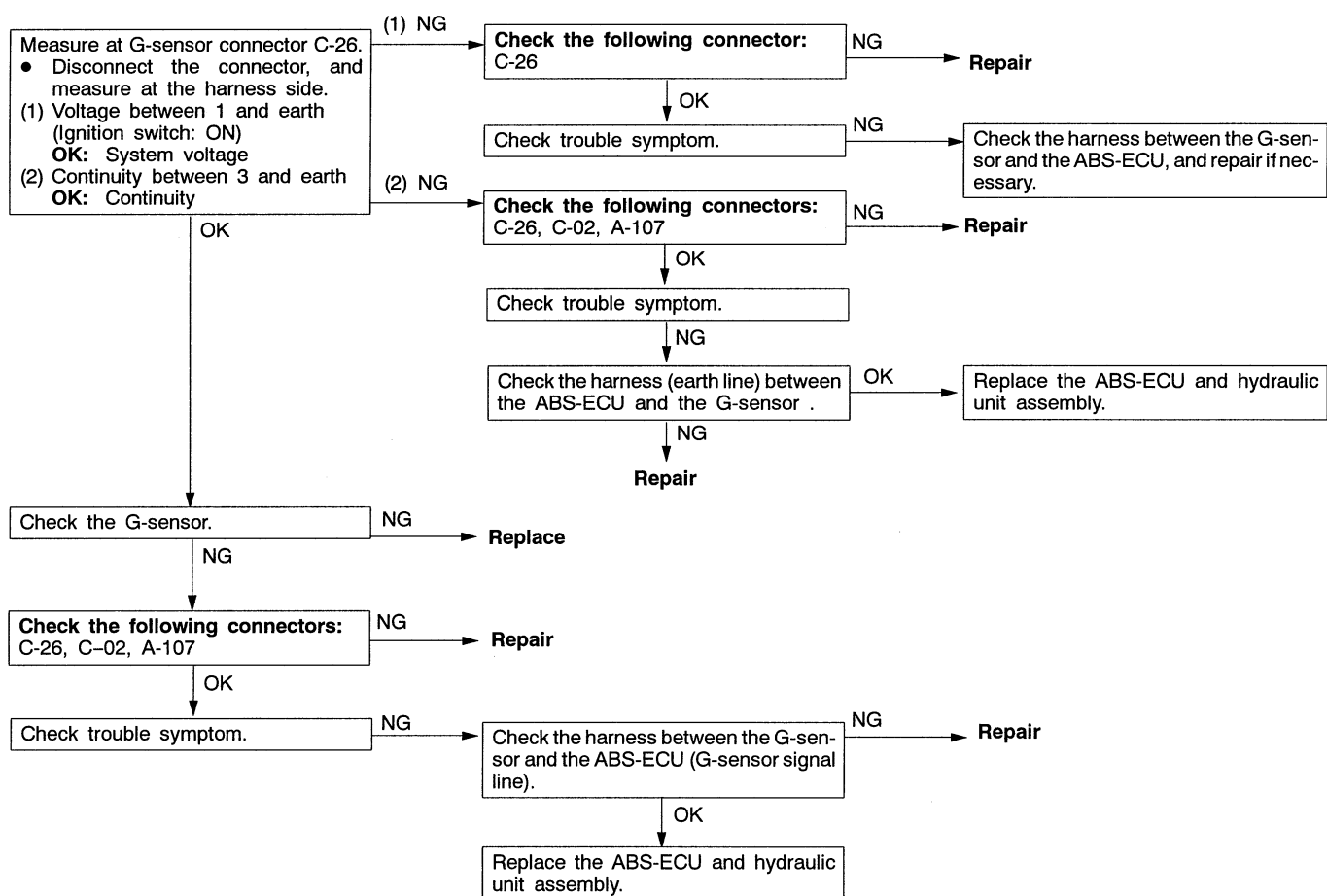
Code No. 27 Rear differential lock detection switch <Vehicles without rear differential lock>	Probable cause
For vehicles without rear differential lock, battery positive voltage is applied to the ABS-ECU terminal No. 46. This code is output when this line is interrupted.	• Malfunction of wiring harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly



Code No. 27 Rear differential lock detection switch <Vehicles with rear differential lock>	Probable cause
The ABS-ECU determines that an open circuit occurs in rear differential detection switch system.	• Malfunction of wiring harness or connector • Malfunction of rear differential lock-ECU • Malfunction of ABS-ECU and hydraulic unit assembly



Code No. 32 G-sensor system	Probable cause
This code is output at the following times: The G-sensor output is less than 0.5 V or more than 4.5 V. An open or short circuit is present in the G-sensor system.	• Malfunction of G-sensor • Malfunction of wiring harness or connector • Malfunction of ABS-ECU and hydraulic unit assembly



ABS WARNING LAMP INSPECTION

Refer to GROUP 35B – Troubleshooting.

INSPECTION CHART FOR TROUBLE SYMPTOMS

Refer to GROUP 35B – Troubleshooting.

DATA LIST REFERENCE TABLE

The following items can be read by the MUT-II from the ABS-ECU input data.

1. When the system is normal

Item No.	Check item	Checking requirements		Normal value
11	Front-right wheel speed sensor	Perform a test run		Vehicle speeds displayed on the speedometer and MUT-II are identical.
12	Front-left wheel speed sensor			
13	Rear-right wheel speed sensor			
14	Rear-left wheel speed sensor			
16	ABS-ECU power supply voltage	Ignition switch power supply voltage and valve monitor voltage		9 – 16 V
25	Free wheel engage switch	Engage 4WD		ON
		Engage 2WD		OFF
26	4WD detection switch	Place the transfer lever at 4H.		ON
		Place the transfer lever at 2H.		OFF
27	Rear differential lock detection switch	Vehicles with rear differential	Turn on the switch	ON
			Turn off the switch	OFF
		Vehicles without rear differential lock	Always	OFF
32	G-sensor output voltage	Stop the vehicle.		2.4 – 2.6 V
		Perform a test run.		Display value fluctuates with a mean value of 2.5 V.
33	Stop lamp switch	Depress the brake pedal.		ON
		Release the brake pedal.		OFF

2. When the ABS-ECU shut off ABS operation.

When the diagnosis system stops the ABS-ECU, the MUT-II display data will be unreliable.

ACTUATOR TEST INSPECTION TABLE

Refer to GROUP 35B – Troubleshooting.

CHECK AT ABS-ECU

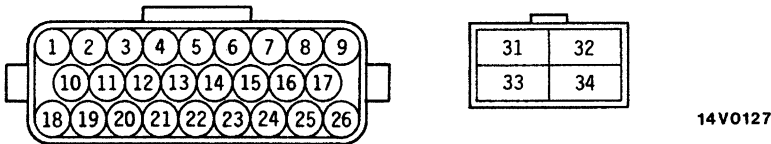
TERMINAL VOLTAGE CHECK CHART

1. Measure the voltages between terminals (32) and (34) (earth terminals) and each respective terminal.

NOTE

Do not measure terminal voltage for approximately three seconds after the ignition switch is turned on. The ABS-ECU performs the initial check during that period.

2. The terminal layouts are shown in the illustrations below.



Connector terminal No.	Signal	Checking requirement			Normal condition
5*1	Ignition switch	Ignition switch: ON			System voltage
5*2	Input from rear differential lock detection switch	Ignition switch: ON	Rear differential lock switch: ON		0 V
			Rear differential lock switch: OFF		System voltage
7	G-sensor signal	- Ignition switch: ON - Vehicle: parked on level ground			2.4 – 2.6 V
9	ABS-ECU power supply	Ignition switch: ON			System voltage
		Ignition switch: START			0 V
11	Input from 4WD detection switch	Ignition switch: ON	Transfer lever position: 2H		System voltage
			Transfer lever position: 4H		1 V or less
12	Input from freewheel engage switch	Ignition switch: ON	Transfer lever position: 2H		System voltage
			Transfer lever position: 4H		1 V or less

NOTE

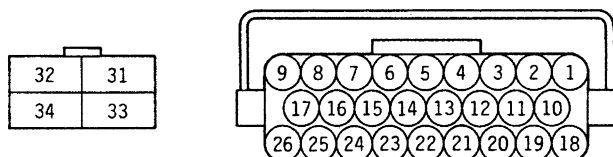
*1: Vehicles without rear differential lock

*2: Vehicles with rear differential lock

Connector terminal No.	Signal	Checking requirement		Normal condition
13	Input from stop lamp switch	Ignition switch: ON	Stop lamp switch: ON	System voltage
			Stop lamp switch: OFF	1 V or less
14	G-sensor	Always		0V
16	Control output to ABS warning lamp relay.	Ignition switch: ON	The lamp is switch off.	2 V or less
			The lamp is illuminated.	System voltage
23	MUT-II	Connect the MUT-II		Serial communication with MUT-II
		Do not connect the MUT-II		1 V or less
24	Input from diagnosis indication selection	Connect the MUT-II		0 V
		Do not connect the MUT-II		Approximately 12 V
31	Solenoid valve power supply	Always		System voltage
33	Motor power supply			

RESISTANCE AND CONTINUITY BETWEEN HARNESS-SIDE CONNECTOR TERMINALS

1. Turn the ignition switch off and disconnect the ABS-ECU connectors before checking resistance and continuity.
2. Check between the terminals indicated in the table below.
3. The terminal layouts are shown in the illustration below.



14V0128

Connector terminal No.	Signal	Normal condition
20 – 21	Front-left wheel speed sensor	1.2 – 1.4 kΩ
1 – 2	Rear-right wheel speed sensor	1.2 – 1.4 kΩ
18 – 19	Front-right wheel speed sensor	1.2 – 1.4 kΩ
3 – 4	Rear-left wheel speed sensor	1.2 – 1.4 kΩ
32 – body earth	Solenoid valve earth	Continuity
34 – body earth	Motor earth	Continuity