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

Click on the applicable bookmark to selected the required model year

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

## CONTENTS

35209000138



**WARNINGS REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICLES**

**WARNING!**

**(1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to the driver (from rendering the SRS inoperative).**

**(2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.**

**(3) MITSUBISHI dealer personnel must throughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) before begining any service or maintenance of any component of the SRS or any SRS-related component.**

NOTE

The SRS includes the following components: impact sensor, SRS diagnosis unit, SRS warning lamp, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

## For the items below, refer to GROUP 35A.

**SEALANTS**

**ON-VEHICLE SERVICE**

- Brake Pedal Check and Adjustment
- Stop Lamp Switch Inspection
- Brake Booster Operating Test
- Check Valve Operation Check
- Brake Booster Vacuum Switch Check
- Load Sensing Spring Length Check and Adjustment
- Load Sensing Proportioning Valve Function Test
- Front Disc Brake Rotor Check
- Brake Lining Thickness Check
- Brake Drum Inside Diameter Check
- Brake Lining and Brake Drum Connection Check

**BRAKE PEDAL**

**LOAD SENSING PROPORTIONING VALVE**

**REAR DRUM BRAKE**

## For the items below, refer to GROUP 35B.

**ON-VEHICLE SERVICE**

- Bleeding
- Disc Brake Pad Check and Replacement
- Wheel Speed Sensor Output Voltage Check
- Hydraulic Unit Check
- Solenoid Valve Check
- Motor Operation Check
- Motor Relay and Valve Relay Continuity Check
- Remedy for a Flat Battery

**MASTER CYLINDER AND BRAKE BOOSTER**

**HYDRAULIC UNIT**

**ABS-ECU**

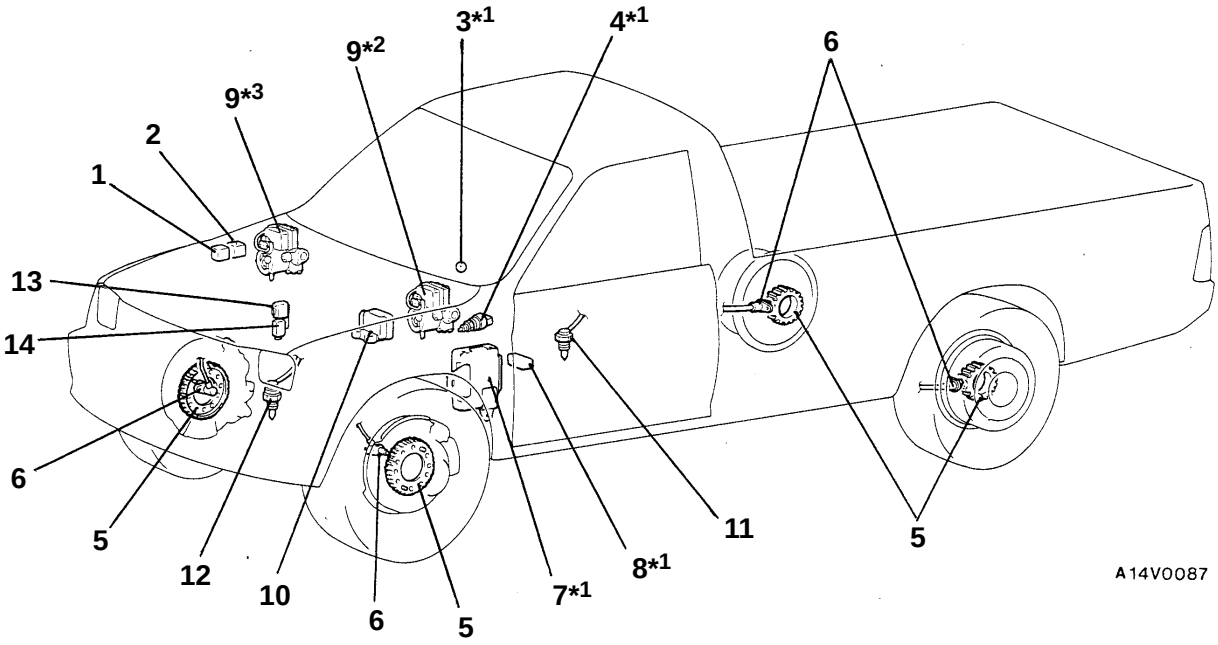
# GENERAL INFORMATION

35200010130

The ABS consists of wheel speed sensors, stop lamp switch hydraulic unit and the ABS-ECU. If a problem occurs in the system, the malfunctioning system can be identified by means of the diagnosis function, and the trouble symptom memory will not be erased even if the ignition switch is turned to OFF. (However, it will be erased if the battery is disconnected.)
In addition, reading of diagnosis codes and data list and actuator of testing are possible using the MUT-II.

| Items | Specifications |
|---|---|
| Speed sensor | Magnet coil type |
| Front rotor teeth | 47 |
| Rear rotor teeth | 47 |

## CONSTRUCTION DIAGRAM




NOTE
*1: For R.H. drive vehicles, those parts are installed at the right side.
*2: Diesel-powered vehicles – L.H. drive vehicles.
*3: Except diesel-powered vehicles – L.H. drive vehicles.

1. ABS valve relay
2. ABS motor relay
3. ABS warning lamp
4. Stop lamp switch
5. Rotor
6. Wheel speed sensor
7. ABS-ECU
8. Diagnosis connector
9. Hydraulic unit
10. G-sensor
11. 4WD position detection switch
12. Free wheel engage switch
13. Rear differential lock-ECU
14. 4WD indicator-ECU

## SERVICE SPECIFICATION

35200030143

| Items | | Standard value | Limit |
|---|---|---|---|
| Front disc brake pad thickness mm | | 10 | 2.0 |
| G-sensor output voltage V | When installed | 2.4 – 2.6 | – |
| | When removed with arrow mark facing down | 3.4 – 3.6 | – |

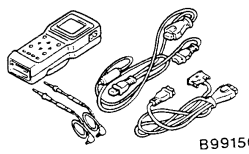
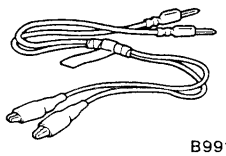
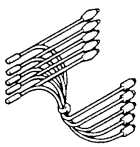
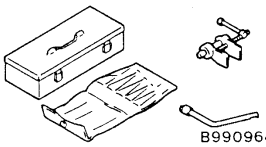
## LUBRICANTS

35200040030

| Items | Specified lubricant |
|---|---|
| Brake fluid | DOT3 or DOT4 |
| Brake piston seal | Repair kit grease |
| Guide pin boot inner surfaces | |
| Lock pin boot inner surfaces | |
| Piston boot mounting grooves | |
| Brake piston boot inner surfaces | |
| Lock pin bush inner surfaces | |
| Piston cup surface | |

## SPECIAL TOOLS

35200060142

| Tool | Number | Name | Use |
|---|---|---|---|
|  B991502 | MB991502 | MUT-II sub assembly | For checking of ABS (Diagnosis code display when using the MUT-II) |
|  B991529 | MB991529 | ABS check harness | For checking of ABS (Diagnosis code display when using the ABS warning lamp) |
|  B991348 | MB991348 | Test harness set | For checking of G-sensor |
|  B990964 | MB990964<br>MB990520 | Brake tool set | Pushing-in of the brake piston |

# TROUBLESHOOTING

35101110143

## STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING

Refer to 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)<br>2. Sound is the generated along with vibration of the brake pedal. (scraping)<br>3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release.<br>(Thump: suspension; squeak: tyres) |
| ABS operation<br>(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

35201120108

### DIAGNOSIS CODES CHECK

Read a diagnosis code by the MUT-II or ABS warning lamp. (Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.)

### ERASING DIAGNOSIS CODES

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

## INSPECTION CHART FOR DIAGNOSIS CODES

35201130163

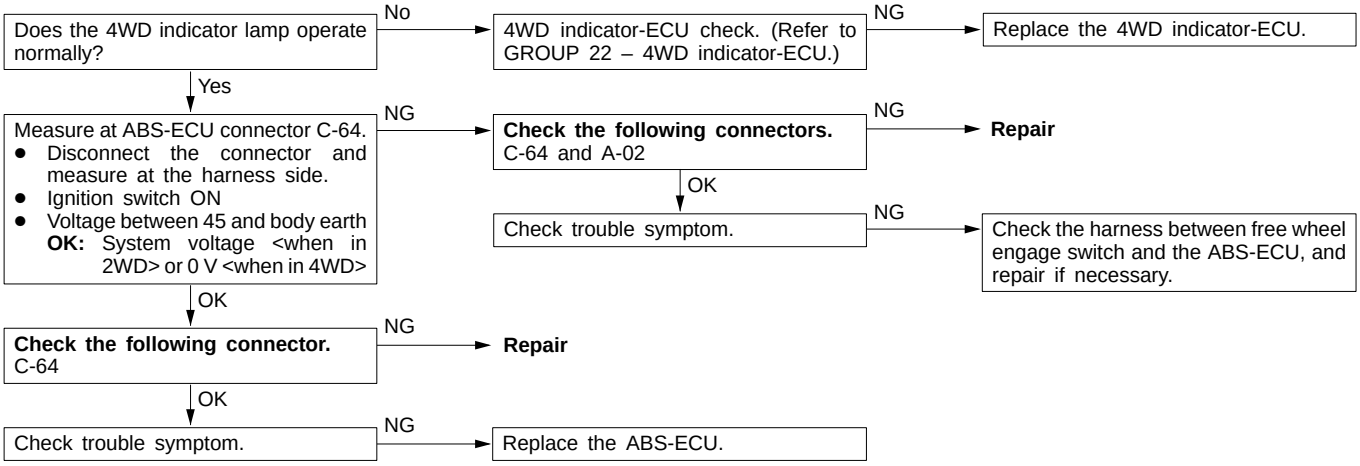
Inspect according to the inspection chart that is appropriate for the malfunction code.

| 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-7 |
| 26 | 4WD position detection switch | | 35C-8 |
| 27 | Rear differential lock detection switch | | 35C-9 |
| 32 | G-sensor system | | 35C-10 |
| 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 relay | | Refer to GROUP 35B – Troubleshooting. |
| 53 | Motor relay, motor | | Refer to GROUP 35B – Troubleshooting. |
| 63 | ABS-ECU | | Refer to GROUP 35B – ABS-ECU. (Replace the ABS-ECU.) |
| 64 | | | |

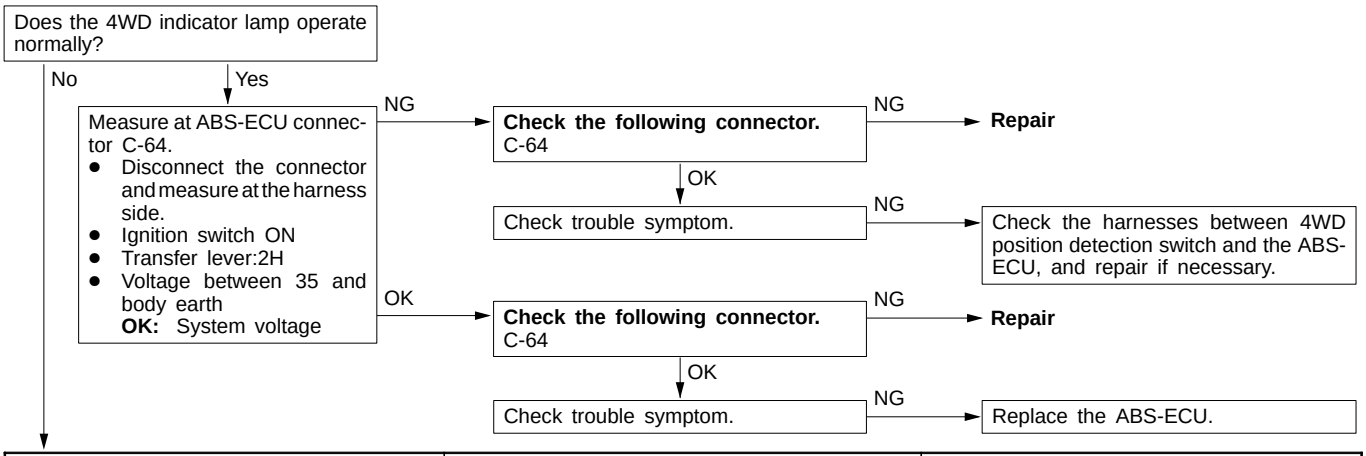
## INSPECTION PROCEDURE CLASSIFIED BY DIAGNOSIS CODES

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

| Code No. 25 Free wheel engage switch | Probable cause |
|---|---|
| ABS-ECU determines that an open circuit exists in the free wheel engage switch system. | • Malfunction of wiring harness or connector<br>• Malfunction of 4WD indicator-ECU<br>• Malfunction of ABS-ECU |



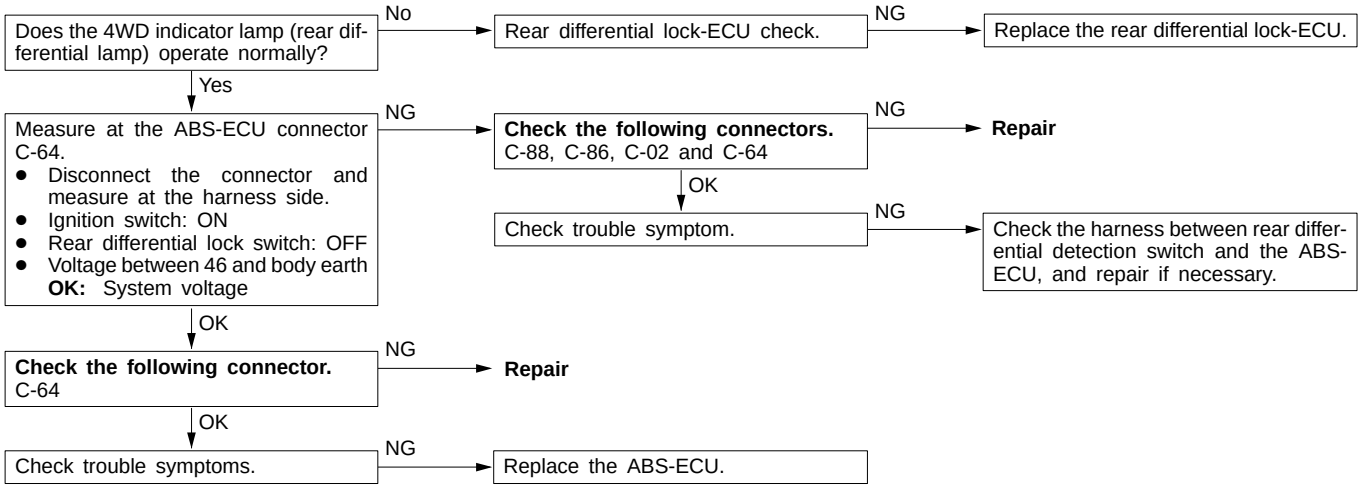
| Code No. 26 4WD position detection switch | Probable cause |
|---|---|
| This code is output at the following times:<br>ABS-ECU determines that an open circuit exists in the 4WD detection switch system.<br>The free wheel engage switch is off and the 4WD detection switch is on at a vehicle speed of 15km/h or more for 5 seconds or more. | • Malfunction of wiring harness or connector<br>• Malfunction of free wheel engage switch<br>• Malfunction of 4WD indicator-ECU<br>• Malfunction of 4WD position detection switch<br>• Malfunction of ABS-ECU |



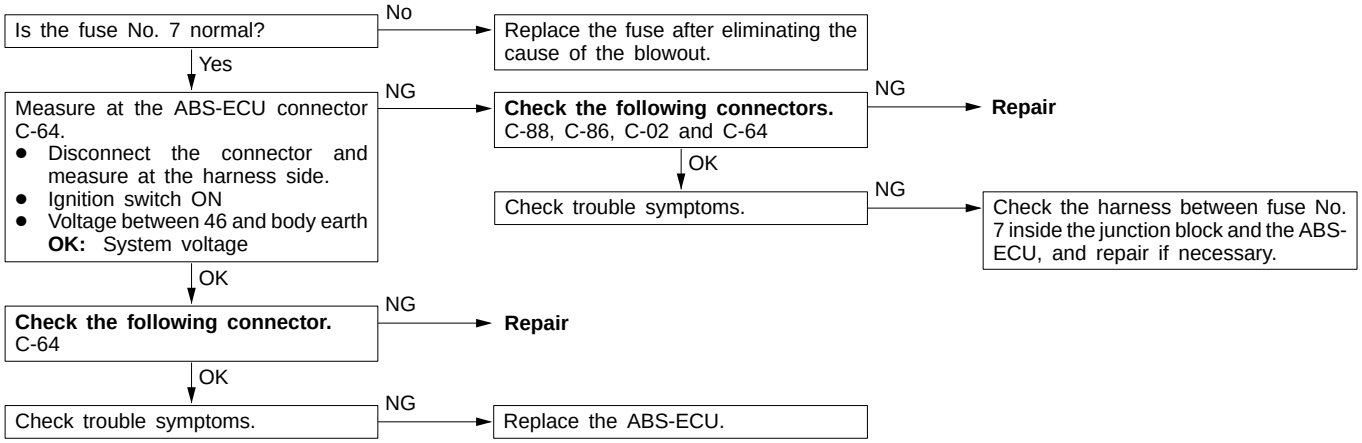

| Trouble symptom | Main cause | Remedy |
|---|---|---|
| Even when the transfer shift lever is in the ”4H” position, the 4WD front wheel indicator lamp does not illuminate. | Broken harness wire between the 4WD indicator-ECU and the free-wheel engage switch, or broken earth wire from the free wheel engage switch | Repair the harness. |
| | Free wheel engage switch is defective. | Replace the switch. |
| Even when the transfer shift lever is in the ”4H” position, the free wheel differential indicator lamp does not illuminate. | Broken harness wire between the 4WD indicator-ECU and the 4WD position detection switch | Repair the harness. |
| | Broken wire in the 4WD indicator-ECU circuit | 4WD indicator-ECU inspection (Refer to GROUP 22 – 4WD indicator-ECU.) |
| Free wheel differential indicator lamp illuminates regardless of the position of the transfer shift lever. | 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. |
| | Short in the 4WD indicator-ECU circuit | 4WD indicator-ECU inspection (Refer to GROUP 22 – 4WD indicator-ECU.) |
| No indicator is illuminated | Power circuit in the 4WD indicator-ECU is defective. | Repair the harness. |
| | 4WD indicator-ECU is defective. | 4WD indicator-ECU inspection (Refer to GROUP 22 – 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.

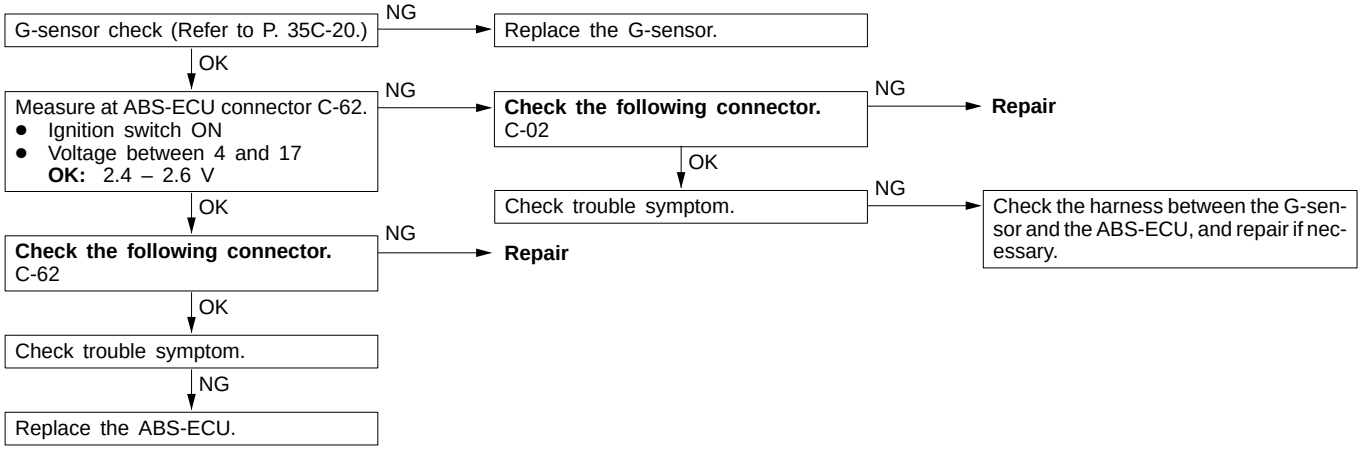
| Code No. 27 Rear differential lock detection switch <Vehicles with rear differential lock> | Probable cause |
|---|---|
| The ABS-ECU determines that an open circuit occurs in rear differential detection switch system. | • Malfunction of wiring harness or connector<br>• Malfunction of rear differential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




| 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.<br>This code is output when this line is interrupted. | • Malfunction of wiring harness or connector<br>• Malfunction of ABS-ECU |



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




## ABS WARNING LAMP INSPECTION

35201200086

Refer to GROUP 35B – Troubleshooting.

## INSPECTION CHART FOR TROUBLE SYMPTOMS

35201140159

Refer to GROUP 35B – Troubleshooting.

## DATA LIST REFERENCE TABLE

35201150107

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 | Turn on the switch. | ON |
| | | Turn off the switch. | 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

35201160056

Refer to GROUP 35B – Troubleshooting.

## CHECK AT ABS-ECU

35201180137

### TERMINAL VOLTAGE CHECK CHART

1. Measure the voltages between terminals (15), (16), (25) and (42) (earth terminals) and each respective terminal.

   NOTE
   Do not measure terminal voltage for approx. 3 seconds after the ignition switch is turned on. The ABS-ECU performs the initial check for that period.
2. The terminal layouts are shown in the illustrations below.


14W0043

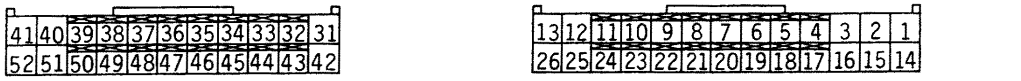
| Connector terminal No. | Signal | Checking requirements | | Normal condition |
|---|---|---|---|---|
| 1 | Output to front-left hydraulic unit solenoid valve (OUT side) | Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started) | | System voltage |
| 2 | Output to rear hydraulic unit solenoid valve (OUT side) | | | |
| 3 | Output to rear hydraulic unit solenoid valve (IN side) | | | |
| 4 | G-sensor signal | Ignition switch: ON | | 2.4 – 2.6 V (Horizontal condition) |
| 13 | ABS-ECU power supply | Ignition switch: ON | | System voltage |
| | | Ignition switch: START | | 0 V |
| 14 | Output to front-left hydraulic unit solenoid valve (IN side) | Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started) | | System voltage |
| 17 | G-sensor earth | Always | | 0 V |
| 26 | Output to relay power supply | Ignition switch: ON | | System voltage |
| 31 | Free wheel engage switch | Ignition switch: ON | 2WD | System voltage |
| | | | 4WD | 1 V or less |
| 32 | Memory power supply | Always | | System voltage |
| 34 | Input from stop lamp switch | Ignition switch: ON | Stop lamp switch ON | System voltage |
| | | | Stop lamp switch OFF | 1 V or less |
| 35 | Input from 4WD detection switch | Ignition switch: ON | Transfer lever position: 2H | System voltage |
| | | | Transfer lever position: 4H | 1 V or less |
| 36 | MUT-II | Connect the MUT-II. | | Serial communication with MUT-II |
| | | Do not connect the MUT-II. | | 1 V or less |

| Connector terminal No. | Signal | Checking requirements | | | Normal condition |
|---|---|---|---|---|---|
| 37 | Output to valve relay | Ignition switch: ON | Approximately 1 second after engine is started. The relay is on. | | 2 V or less |
| | | | The system runs down. The relay is off. | | System voltage |
| 38 | Output to motor relay | Ignition switch: ON (Approximately 1 second after engine is started) | | Motor is on | 2 V or less |
| | | | | Motor is off | System voltage |
| 39 | Idle-up solenoid valve (+) | Ignition switch: ON (When motor is on approximately 1 second after engine is started) | | | System voltage |
| 41 | Output to front-right hydraulic unit solenoid valve (OUT side) | Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started) | | | System voltage |
| 43 | Idle-up solenoid valve (–) | Ignition switch: ON (When motor is on approximately 1 second after engine is started) | | | 2 V or less |
| 45 | Input from free wheel engage switch | Ignition switch: ON | Engage 2WD | | System voltage |
| | | | Engage 4WD | | 1 V or less |
| 46*1 | Ignition switch | Ignition switch: ON | | | System voltage |
| | | Ignition switch: START | | | 0 V |
| 46*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 |
| 47 | Input from diagnosis indication selection | Connect the MUT-II. | | | 0 V |
| | | Do not connect the MUT-II. | | | Approx. 12 V |
| 48 | Input from valve relay monitor | Ignition switch: ON | | | System voltage |
| 49 | Motor monitor | Ignition switch: ON (Approximately 1 second after engine is started) | | Motor is on | System voltage |
| | | | | Motor is off | 0.5 V or less |
| 50 | Output to ABS warning lamp | Ignition switch: ON | The lamp is switched off | | System voltage |
| | | | The lamp illuminates | | 0 – 2 V |
| 52 | Output to front-right hydraulic unit solenoid valve (IN side) | Ignition switch: ON (When solenoid valve is off approximately 1 second after engine is started) | | | System voltage |

NOTE
*1: Vehicles without rear differential lock
*2: Vehicles with rear differential lock

**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 them between the terminals indicated in the table below.
3. The terminal layouts are shown in the illustrations below.




14W0042

| Connector terminal No. | Signal | Normal condition |
|---|---|---|
| 1 – Body earth | Front-left solenoid valve (OUT side) | 2.2 Ω |
| 2 – Body earth | Rear solenoid valve (OUT side) | 2.2 Ω |
| 3 – Body earth | Rear solenoid valve (IN side) | 5.0 Ω |
| 7 – 20 | Front-left wheel speed sensor (+ wire) | 1.2 – 1.4 kΩ |
| 8 – 21 | Rear-right wheel speed sensor (+ wire) | 1.2 – 1.4 kΩ |
| 9 – 22 | Rear-left wheel speed sensor (+ wire) | 1.2 – 1.4 kΩ |
| 10 – 23 | Front-right wheel speed sensor (+ wire) | 1.2 – 1.4 kΩ |
| 14 – Body earth | Front-left solenoid valve (IN side) | 5.0 Ω |
| 15 – Body earth | ABS-ECU earth | Continuity |
| 16 – Body earth | | |
| 25 – Body earth | | |
| 39 – 43 | Idle-up solenoid valve | 37 – 44 Ω |
| 41 – Body earth | Front-right solenoid valve (OUT side) | 2.2 Ω |
| 42 – Body earth | ABS-ECU earth | Continuity |
| 48 – Body earth | Input from valve relay monitor | Continuity |
| 49 – Body earth | Motor monitor | Continuity |
| 52 – Body earth | Front-right solenoid valve (IN side) | 5.0 Ω |

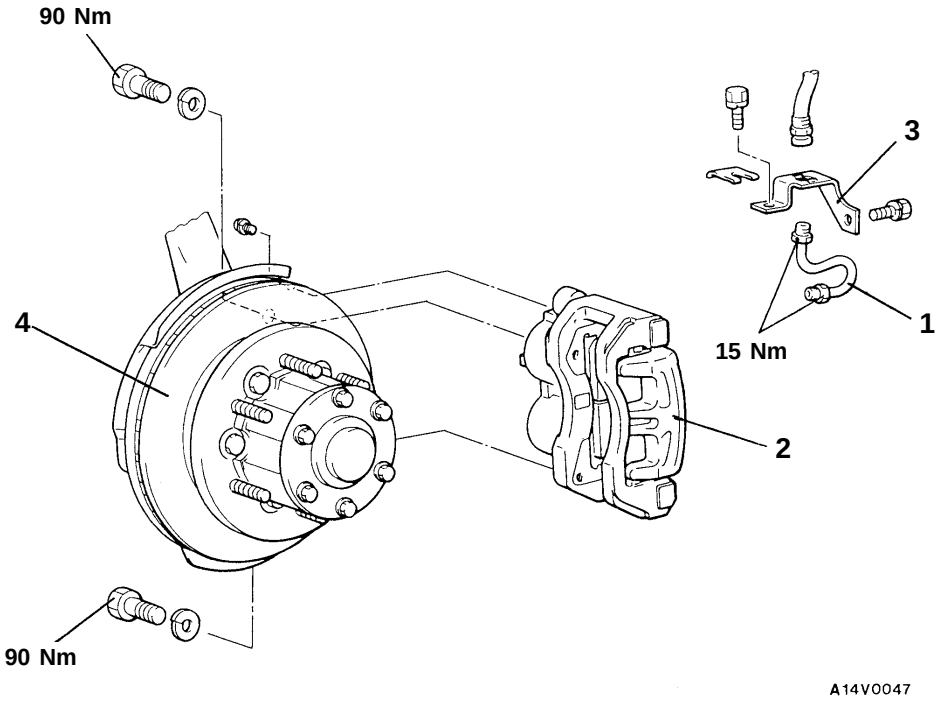
# FRONT DISC BRAKE

35200600023

## REMOVAL AND INSTALLATION

**Pre-removal Operation**
- Brake Fluid Draining

**Post-installation Operation**
- Brake Fluid Supplying
- Brake Line Bleeding
  (Refer to GROUP 35B – On-vehicle Service.)

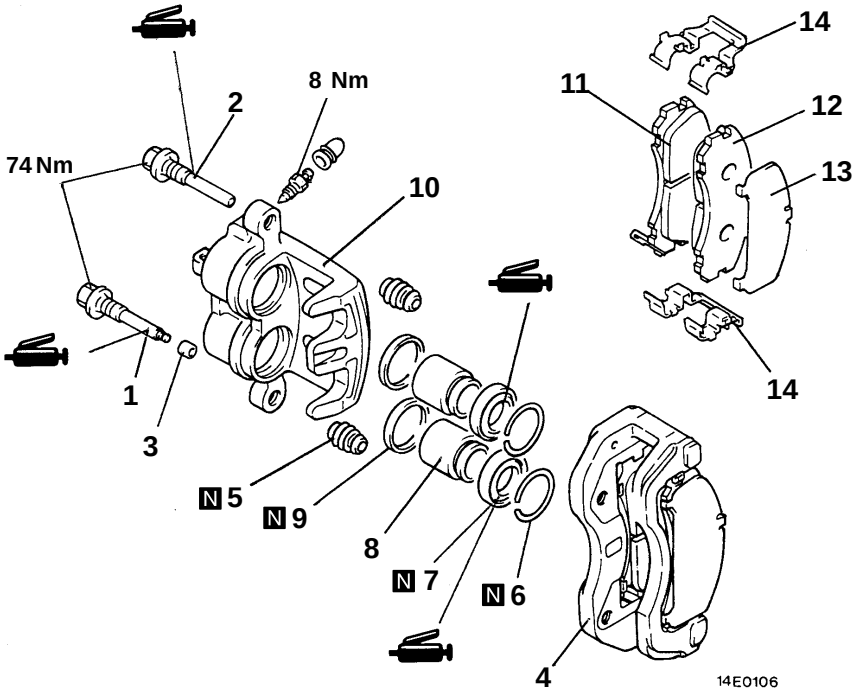


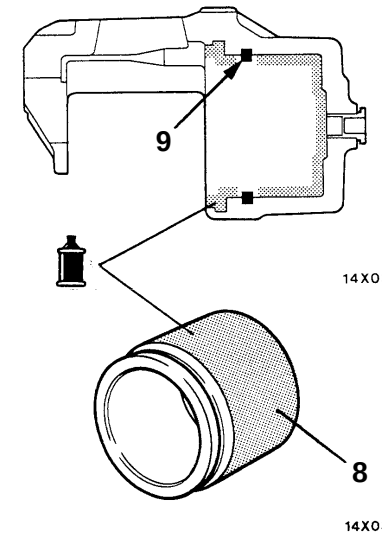

**Removal steps**

1. Brake tube
2. Front brake assembly (Refer to GROUP 35B – Front Disc Brake.)
3. Brake hose bracket
4. Brake disc (Refer to GROUP 26 – Front Hub Assembly.)

## DISASSEMBLY AND REASSEMBLY

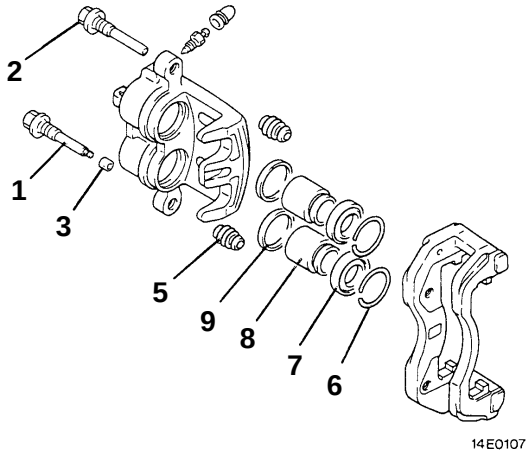
35200620029



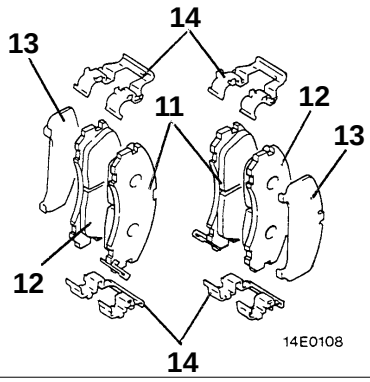




**Caution**
**The piston seal inside the seal and boot kit is coated with special grease, so do not wipe this grease off.**

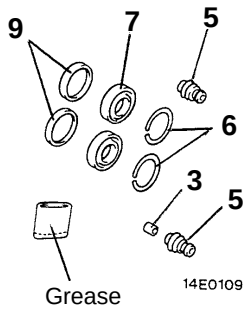
**Brake fluid: DOT3 or DOT4**




**Brake caliper kit**




**Pad kit**




**Seal and boot kit**

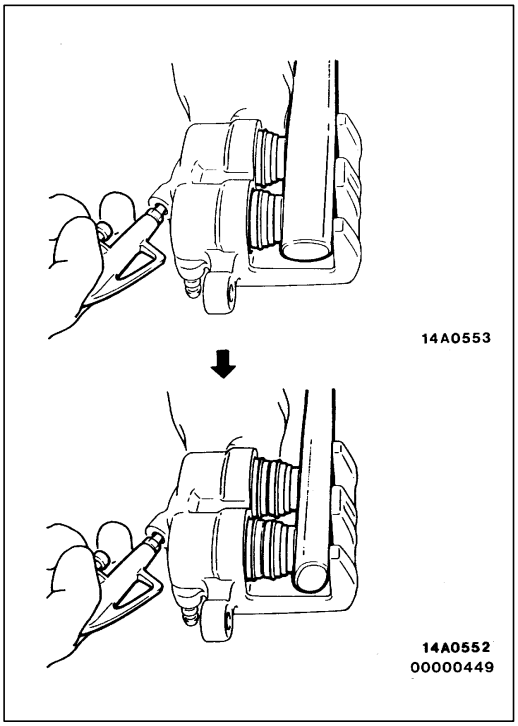
00004876

**Caliper assembly disassembly steps**

- ▶A◀ 1. Lock pin
- ▶A◀ 2. Guide pin
- 3. Bushing
- 4. Caliper support (Pad, clip and shim)
- 5. Pin boot
- 6. Boot ring
- ◀A▶ 7. Piston boot
- ◀A▶ 8. Piston
- ◀B▶ 9. Piston seal
- 10. Caliper body

**Pad assembly disassembly steps**

- ▶A◀ 1. Lock pin
- ▶A◀ 2. Guide pin
- 3. Bushing
- 4. Caliper support (Pad, clip and shim)
- 11. Pad and wear indicator assembly
- 12. Pad assembly
- 13. Outer shim
- 14. Clip



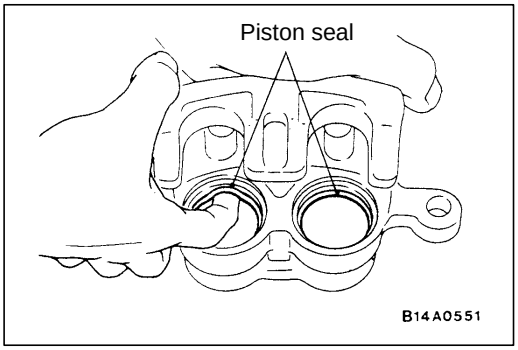

## DISASSEMBLY SERVICE POINTS

When disassembling the disc brakes, disassemble both sides (left and right) as a set.

### ◀A▶ PISTON BOOT/PISTON REMOVAL

Pump in compressed air through the brake hose installation hole and remove the pistons and piston boot.

**Caution**
**When removing the pistons, be sure to use the handle of a plastic hammer and adjust the height of the two pistons while pumping air slowly in so that the pistons protrude evenly.**
**Do not remove one piston completely before trying to remove the other piston because it will become impossible to remove the second piston.**



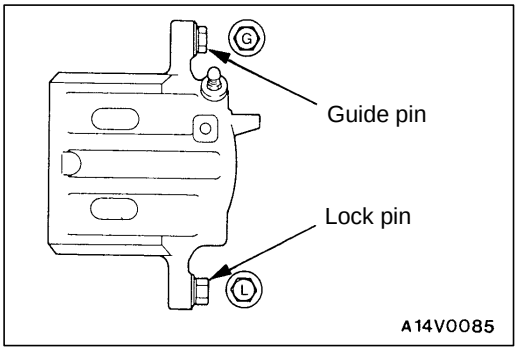

### ◀B▶ PISTON SEAL REMOVAL

(1) Remove piston seal with finger tip.

**Caution**
**Do not use a screwdriver or other tool to prevent damage to inner cylinder.**

(2) Clean piston surface and inner cylinder with trichloro-ethylene, alcohol or specified brake fluid.

**Specified brake fluid: DOT3 or DOT 4**




## REASSEMBLY SERVICE POINT

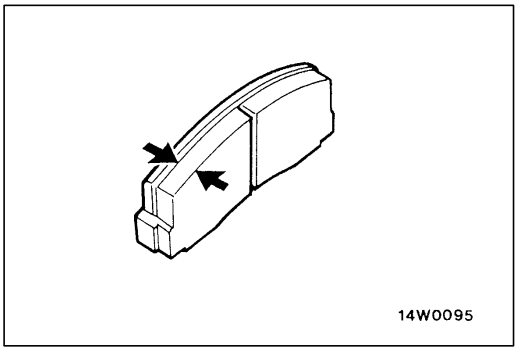
### ▶A◀ LOCK PIN/GUIDE PIN INSTALLATION

Install the lock pin and the guide pin to the caliper body as illustrated.

## INSPECTION

35200630015

- Check cylinder for wear, damage or rust.
- Check piston surface for wear, damage or rust.
- Check caliper body or sleeve for wear.
- Check pad for damage or adhesion of grease, check backing metal for damage.




**PAD WEAR CHECK**

Measure thickness at the thinnest and worn area of the pad. Replace pad assembly if pad thickness is less than the limit value.

**Standard value: 10 mm**

**Limit: 2.0 mm**

**Caution**

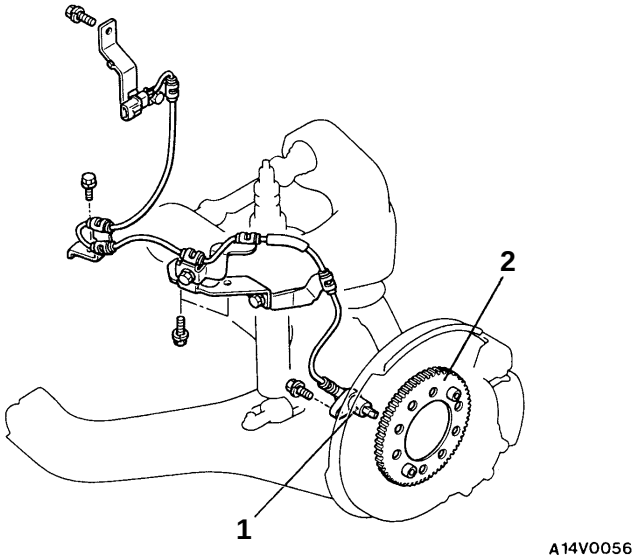
1. **When the limit is exceeded, replace the pads at both sides, and also the brake pads for the wheels on the opposite side at the same time.**
2. **If there is a significant difference in the thicknesses of the pads on the left and right sides, check the sliding condition of the piston, lock pin and guide pin.**

# WHEEL SPEED SENSOR

35200830170

## REMOVAL AND INSTALLATION

**Post-installation Operation**
- Wheel Speed Sensor Output Voltage Checking (Refer to GROUP 35B – On-vehicle Service.)




1. Front speed sensor
2. Front rotor
   (Refer to GROUP 26 – Front Hub.)

NOTE
The rear wheel speed sensor is the same as 2WD.

## INSPECTION

35200840135

Refer to GROUP 35B.

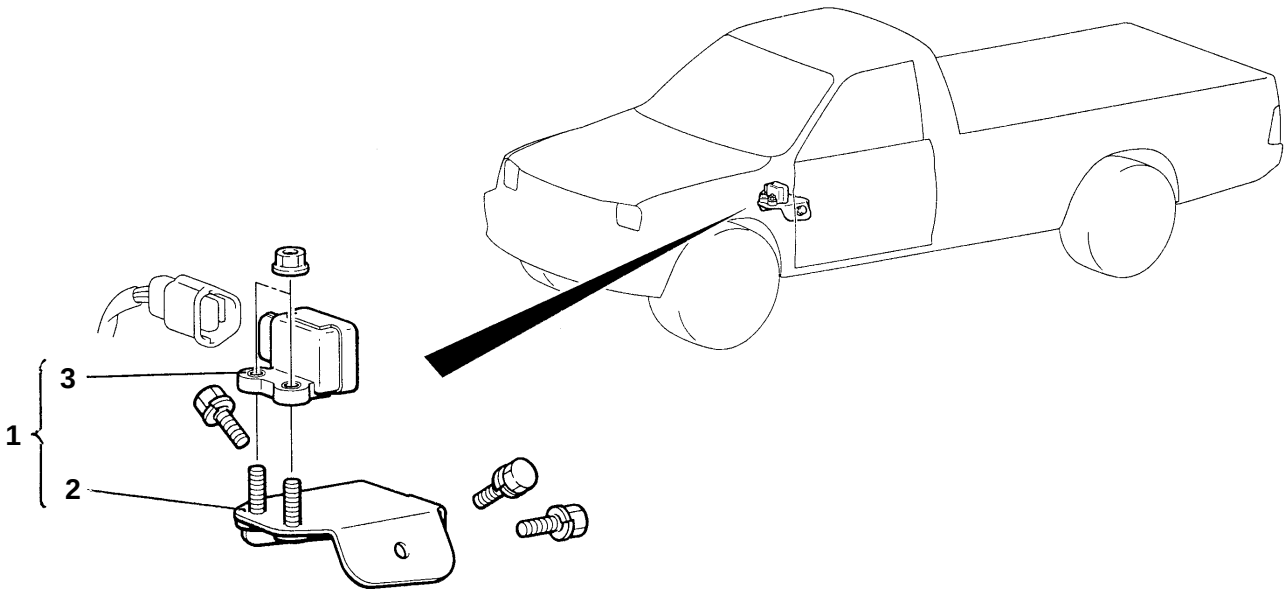
# G-SENSOR

35201010078

## REMOVAL AND INSTALLATION

**CAUTION: SRS**
**When removing and installing the G-sensor from/to vehicles equipped with SRS, do not let it bump against the SRS diagnostic unit or other components.**

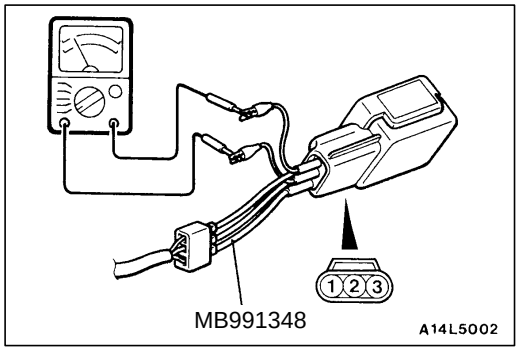
**Pre-removal and Post-installation Operation**
- SRS diagnostic unit Removal and Installation (Refer to GROUP 52B.)




A14V0065

**Removal steps**
1. G-sensor assembly
2. G-sensor bracket
3. G-sensor

**Caution**
**Do not drop the G-sensor or subject it to shocks.**

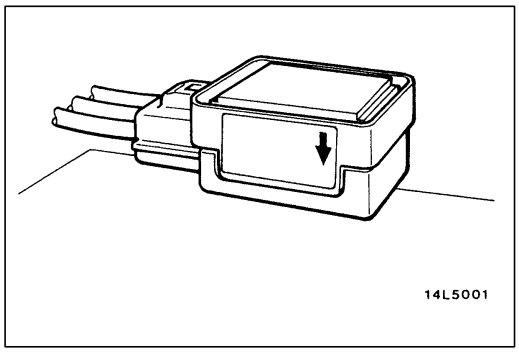



## INSPECTION

35201020057

(1) Disconnect the G-sensor connector and connect the special tool between the terminals of the disconnected connector.
(2) Turn the ignition switch to ON and take a reading of the following output voltage.
Between terminals (2) and (3).

**Standard value: 2.4 – 2.6 V**




(3) With the special tool still connected, secure the G-sensor so that the arrow mark on the sensor mounting surface faces straight down, and then take a reading of the following output voltage between terminals (2) and (3).

**Standard value: 3.4 – 3.6 V**

(4) If the voltages is outside the standard value, after checking to be sure that there is no abnormality in the power supply and earth wires, replace the G-sensor.

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

## CONTENTS

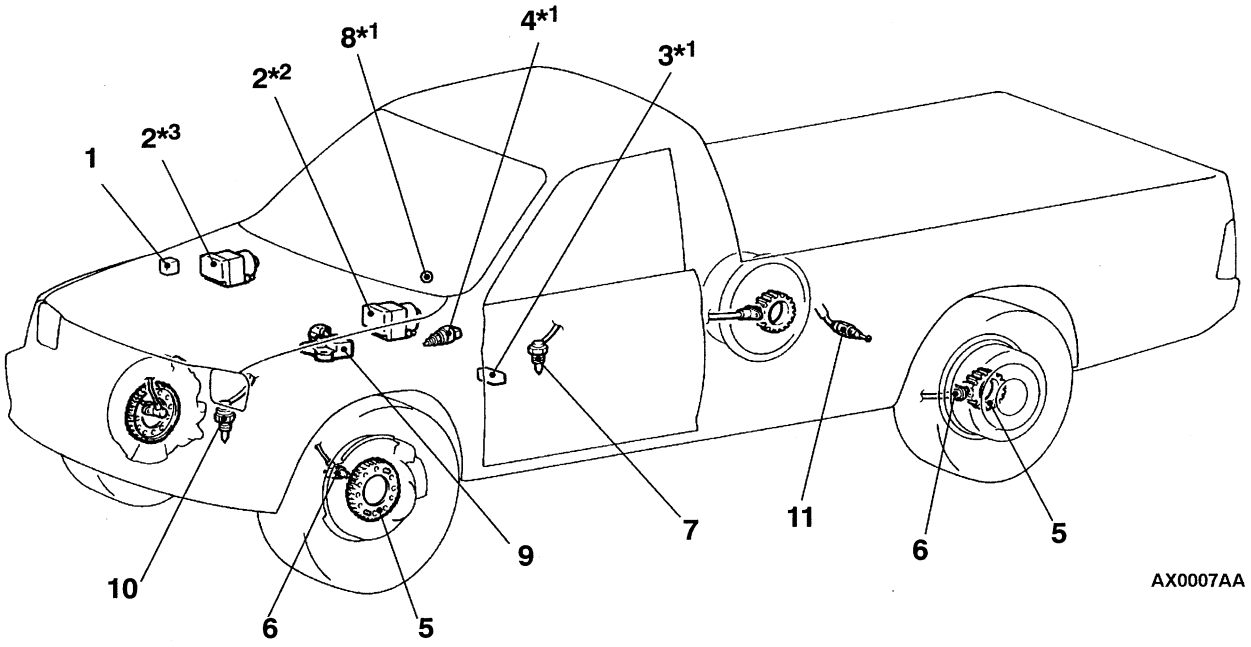
# GENERAL

## 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




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. 4WD position detection switch
8. ABS warning lamp
9. G-sensor
10. Freewheel engage switch
11. Rear differential lock detection switch <Vehicles with rear differential lock system>

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)<br>2. Sound is the generated along with vibration of the brake pedal. (scraping)<br>3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release.<br>(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.

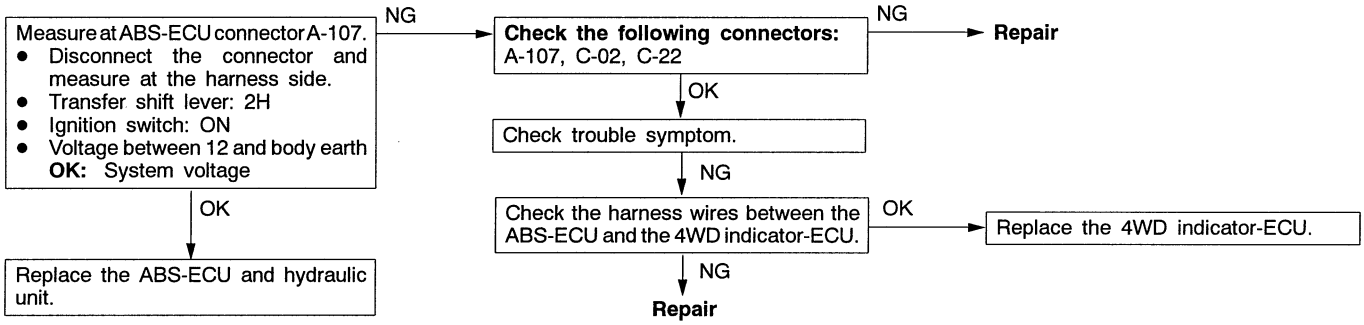
| Diagnosis code No. | Inspection item | Diagnosis content | Reference page |
|---|---|---|---|
| 11 | Front right wheel speed sensor | Open or short circuit | Refer to GROUP 35B – Troubleshooting. |
| 12 | Front left wheel speed sensor | | |
| 13 | Rear right wheel speed sensor | | |
| 14 | Rear left 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

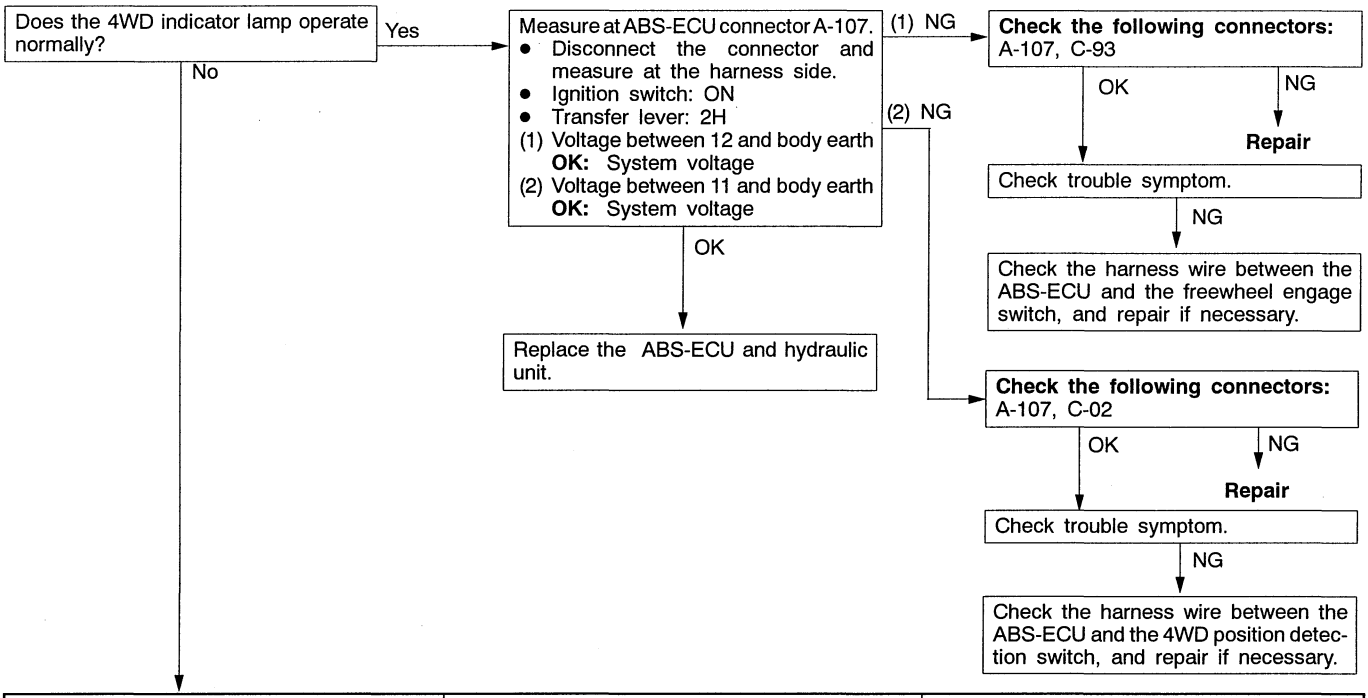
For diagnosis code numbers other than those listed below, refer to GROUP 35B – Troubleshooting.

| Code No. 25 Free wheel engage switch | Probable cause |
|---|---|
| This diagnosis code is displayed under the following cased. For case (2), code No. 26 is also displayed at the same time.<br>(1) The ABS-ECU determines that an open circuit exists in the freewheel engage switch system.<br>(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<br>• Malfunction of freewheel engage switch<br>• Malfunction of 4WD position detection switch<br>• Malfunction of 4WD indicator-ECU<br>• Malfunction of ABS-ECU and hydraulic unit |

### <When only code No. 25 is displayed>



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

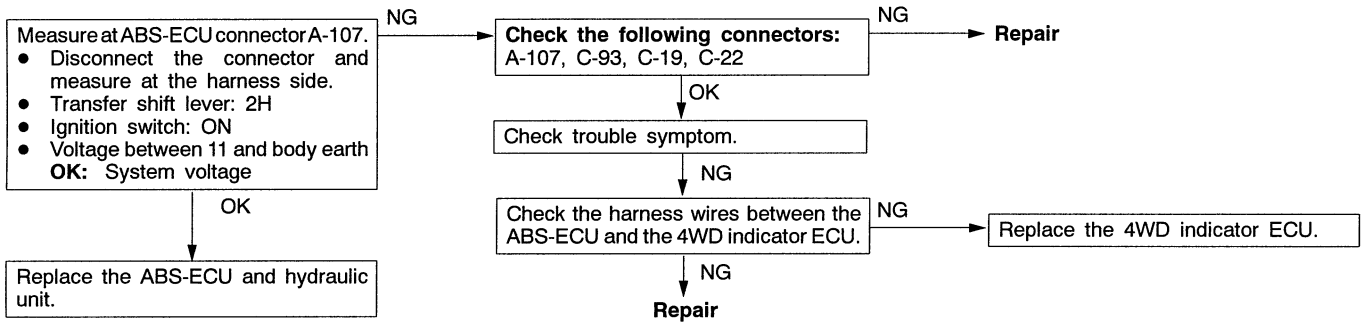



| Trouble symptom | Main cause | Remedy |
|---|---|---|
| When the transfer shift lever is at "4H" position, the 4WD indicator lamp flashes, but does not remain on. | Broken harness wire between the 4WD indicator-ECU and the free-wheel engage switch, or broken earth wire from the free wheel engage switch | 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.<br>(1) The ABS-ECU determines that an open circuit exists in the 4WD position detection switch system.<br>(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<br>• Malfunction of freewheel engage switch<br>• Malfunction of 4WD position detection switch<br>• Malfunction of 4WD indicator-ECU<br>• Malfunction of ABS-ECU and hydraulic unit |

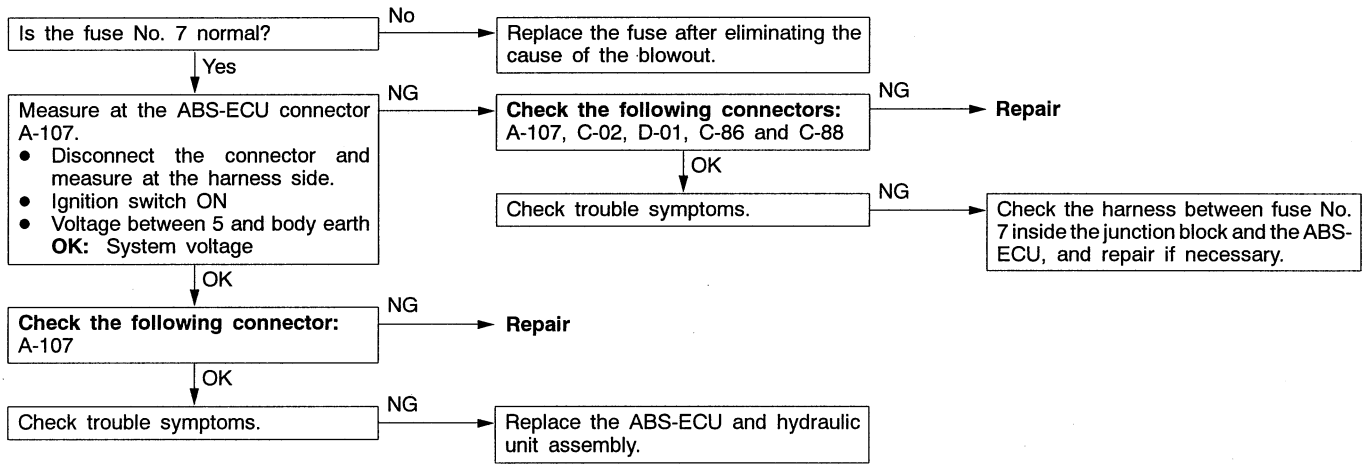
### <When only code No. 26 is displayed>



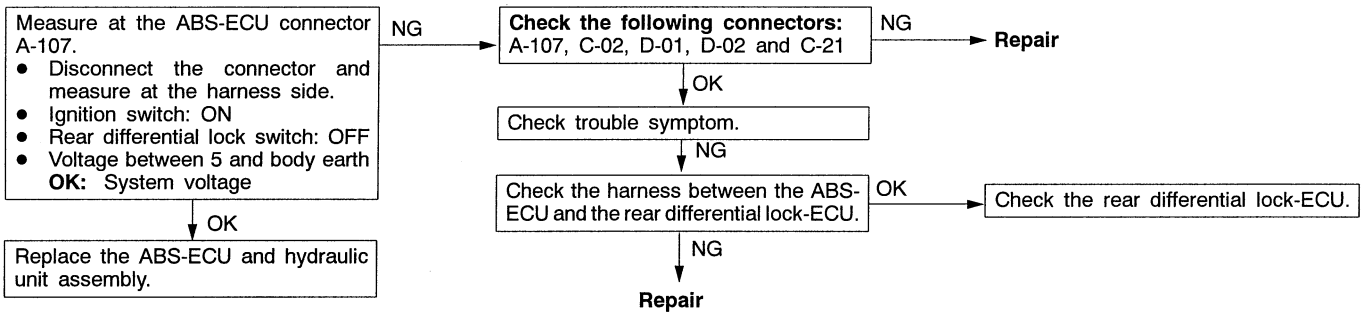

### <When code Nos. 25 and 26 are displayed>

Refer to P.35C-6.

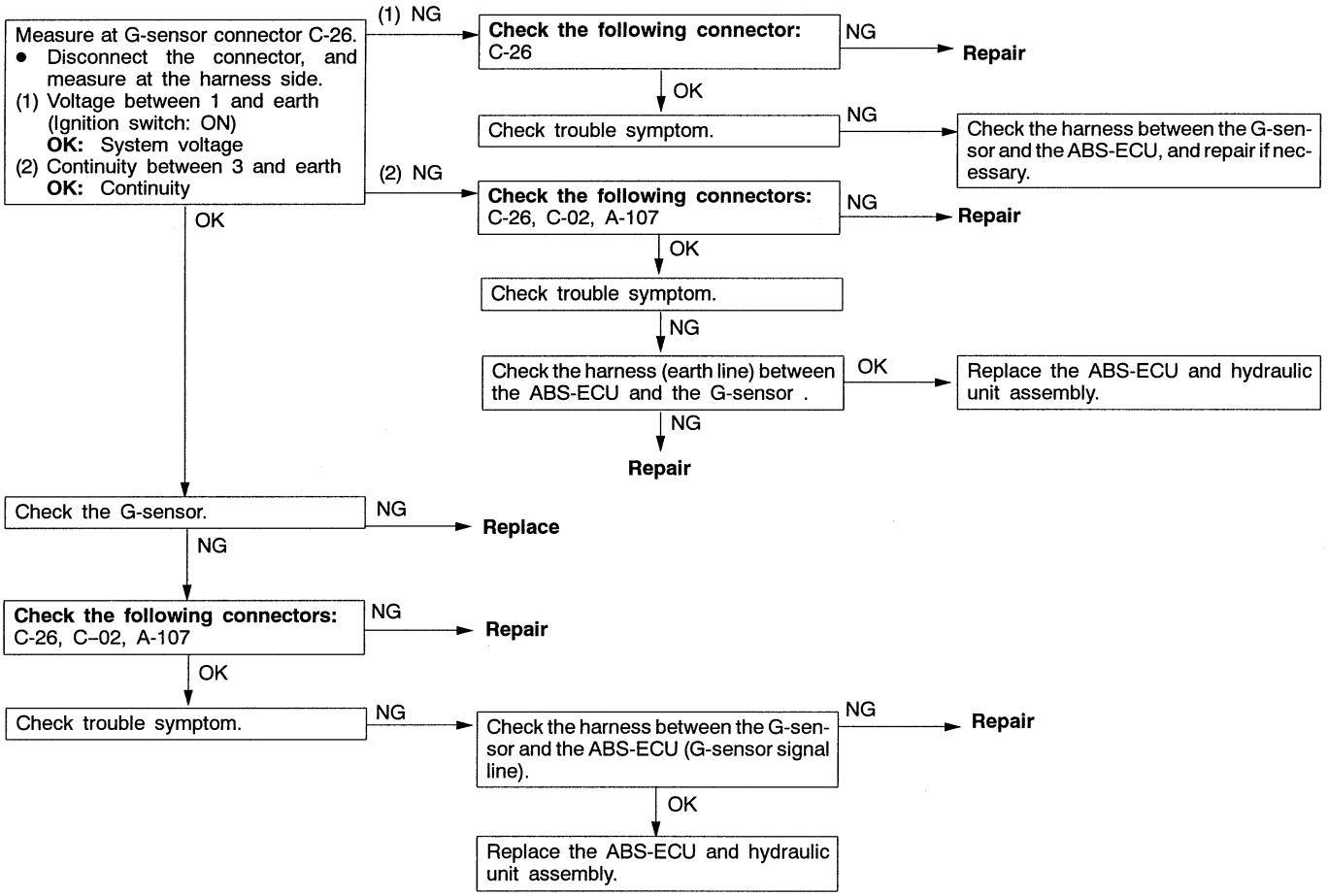
| Code No. 27 Rear differential lock detection switch <Vehicles without rear differential lock> | Probable cause |
|---|---|
| For vehicles without rear differential lock, battery positive voltage is applied to the ABS-ECU terminal No. 46.<br>This code is output when this line is interrupted. | • Malfunction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




| Code No. 32 G-sensor system | Probable cause |
|---|---|
| This code is output at the following times:<br>The G-sensor output is less than 0.5 V or more than 4.5 V.<br>An open or short circuit is present in the G-sensor system. | • Malfunction of G-sensor<br>• Malfunction of wiring harness or connector<br>• 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.

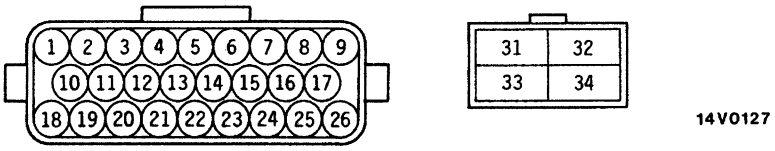
## CHECK AT ABS-ECU

### 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.



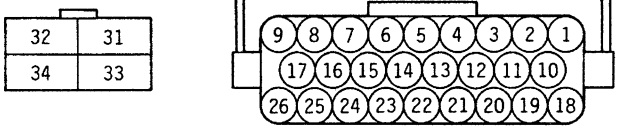

| Connector terminal No. | Signal | Checking requirement | | Normal condition |
|---|---|---|---|---|
| 5*1 | Ignition switch | Ignition switch: ON | | System voltage |
| 5*2 | Input from rear differential lock detection switch | Ignition switch: ON | Rear differential lock switch: ON | 0 V |
| | | | Rear differential lock switch: OFF | System voltage |
| 7 | G-sensor signal | • Ignition switch: ON<br>• 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 |