

GENERAL

OUTLINE OF CHANGES

Due to the addition of MITSUBISHI Active Stability and Traction Control System (M-ASTC) and MITSUBISHI Active Traction Control System (M-ATC), the following service procedures have been established. Operation must be carried out in the same manner as before except for the items described below:

TROUBLESHOOTING <VEHICLES WITH M-ASTC AND M-ATC>

DIAGNOSTIC FUNCTIONS

How to read diagnosis code:

Read the diagnostic codes using MUT-II .

NOTE

Connect MUT-II to the 16-pin diagnosis connector.

How to erase diagnosis code:

Connect MUT-II to the diagnosis connector and erase the diagnosis code.

CAUTION

Connection and disconnection of MUT-II must be carried out after the ignition switch is turned to the LOCK (OFF) position.

NOTE

Connect MUT-II to the 16-pin diagnosis connector.

DIAGNOSIS CODE CHART

Diagnosis code No.	Item		Refer to Page
11	ABS sensor (FR) open circuit or short circuit		35B-5
12	ABS sensor (FL) open circuit or short circuit		35B-5
13	ABS sensor (RR) open circuit or short circuit		35B-5
14	ABS sensor (RL) open circuit or short circuit		35B-5
16* ¹	Excessive decrease or increase in the power supply voltage to the M-ASTC-ECU or M-ATC-ECU		Refer to GROUP 35A
17* ²	MITSUBISHI Active Stability Control Switch System		Refer to GROUP 35C
21	ABS sensor (FR) system		35B-5
22	ABS sensor (FL) system		35B-5
23	ABS sensor (RR) system		35B-5
24	ABS sensor (RL) system		35B-5
25	Incorrect tyre size		35B-6
31	Ignition switch (IG2) system		Refer to GROUP 35A
33	Stop lamp switch system		35B-6
34	CAN communication error		Refer to GROUP 35C
35	Engine system fault		Refer to GROUP 35C
36	Engine-ECU communication error		Refer to GROUP 35C
37	A/T system fault		Refer to GROUP 35C
38	A/T-ECU communication error		Refer to GROUP 35C
41	Control solenoid valve (FR) system	If a solenoid valve does not respond to solenoid valve drive signals corresponding to individual items:	35B-7
42	Control solenoid valve (FL) system		35B-7
43	Control solenoid valve (RR) system		35B-7
44	Control solenoid valve (RL) system		35B-7
45	Switch solenoid valve (SA1) system		35B-7
46	Switch solenoid valve (SA2) system		35B-7
47	Switch solenoid valve (SA3) system		Refer to GROUP 35C
48	Switch solenoid valve (STR) system		Refer to GROUP 35C
51	Valve relay ON defective		35B-8
52	Valve relay OFF defective		35B-9

Diagnosis code No.	Item	Refer to Page
53	Motor system	Refer to GROUP 35A
54	Motor relay system	Refer to GROUP 35A
55	Motor system	Refer to GROUP 35A
56	Pressure switch system	Refer to GROUP 35A
57	Accelerator pressure sensor system	Refer to GROUP 35A
58	Power supply drive circuit system	Replace ASTC-ECU (Refer to GROUP 35C)
61	Master cylinder pressure sensor system	35B-10
63	G sensor output error	Refer to GROUP 35C
64	G sensor clogging defect	Refer to GROUP 35C
65	G sensor self-diagnosis error	Refer to GROUP 35C
66* ²	Steering wheel sensor self-diagnosis error	Refer to GROUP 35C
67* ²	Steering wheel sensor communication line error	Refer to GROUP 35C
68* ²	Steering wheel sensor output error	Refer to GROUP 35C
71* ²	Yaw rate sensor self-diagnosis error	Refer to GROUP 35C
72* ²	Yaw rate sensor 0-point error	Refer to GROUP 35C
73* ²	Yaw rate sensor output error	Refer to GROUP 35C
74	G and Yaw rate sensor communication error	Refer to GROUP 35C
75	Transfer switch defect	Refer to GROUP 35C
76	G sensor error	Refer to GROUP 35C
77* ²	Yaw rate sensor error	Refer to GROUP 35C
78	Engine-ECU inappropriately installed	Refer to GROUP 35C
81	G sensor initialization incomplete	Refer to GROUP 35C
82* ²	Yaw rate sensor initialization incomplete	Refer to GROUP 35C
83* ²	Steering wheel sensor initialization incomplete	Refer to GROUP 35C
84	Transfer switch initialization incomplete	Refer to GROUP 35C
85	Master cylinder pressure sensor initialization incomplete	Refer to GROUP 35C

NOTE

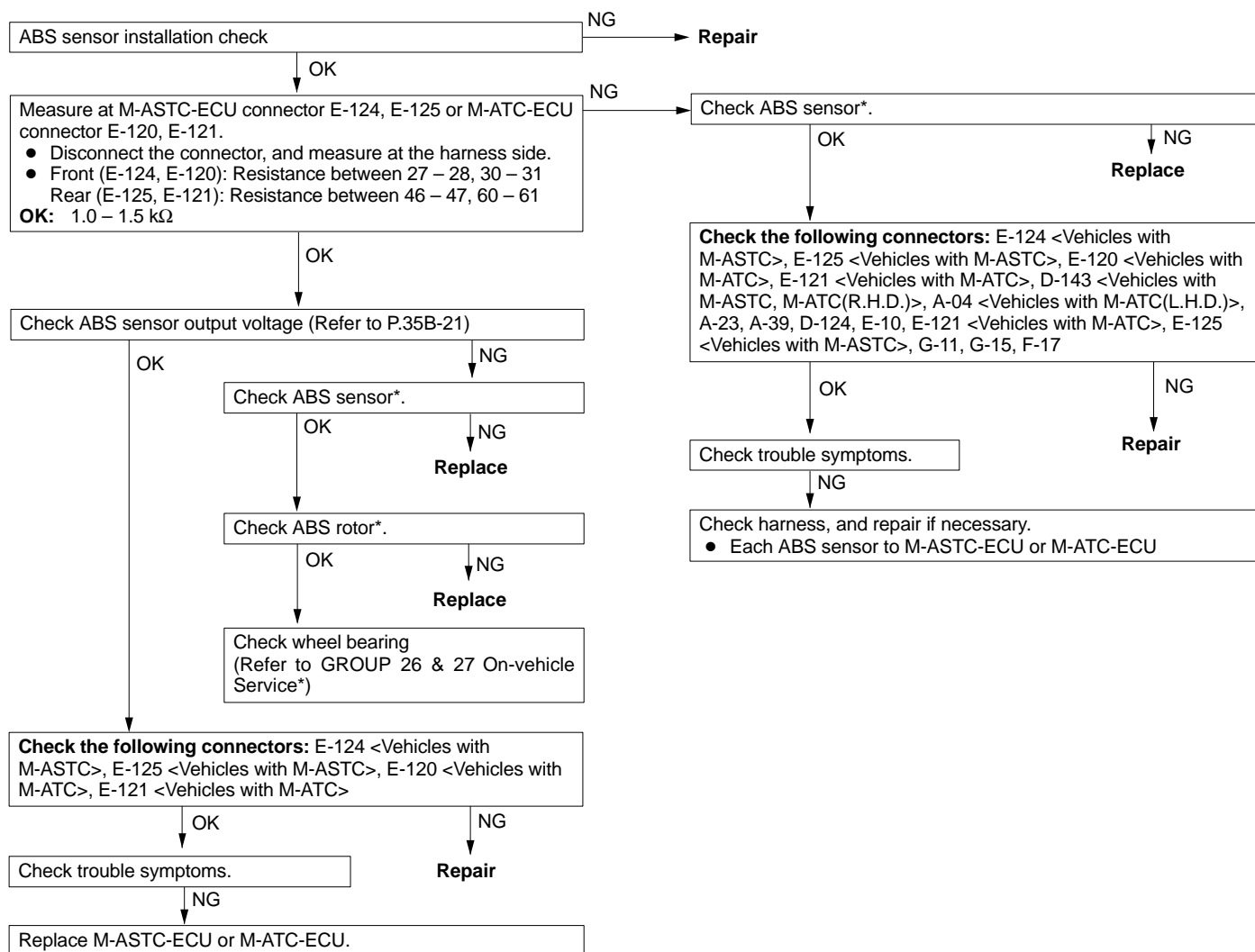
*1: Code No. 16 is erased if the system is returned to the normal status.

*2: Only vehicles with M-ASTC

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INSPECTION PROCEDURE CLASSIFIED BY DIAGNOSTIC CODE

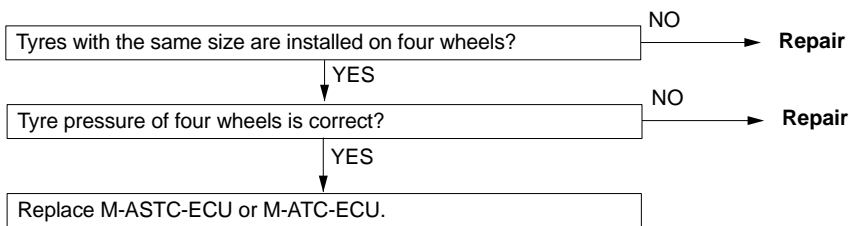
Code No. 11, 12, 13, 14 ABS sensor system (open or short circuit)	Probable cause
Code No. 21, 22, 23, 24 ABS sensor system	
Code No. 11, 12, 13 and 14 are set when open and short hardware circuit of M-ASTC-ECU or M-ATC-ECU are detected, and open or short circuit on the (+) or (–) line of either of 4 ABS sensors is detected.	<ul style="list-style-type: none"> Malfunction of ABS sensor Malfunction of harness or connector Malfunction of the M-ASTC-ECU or the M-ATC-ECU
Code No. 21, 22, 23 and 24 are output in the following cases: <ul style="list-style-type: none"> When any open circuit is not detected, but either of 4 ABS sensors cannot be input even if the vehicle speed reaches over the specified speed (km/h). When any ABS rotor gear is broken or clogged (one gear), and when anti-locking control continuously occurs by decrease of sensor output due to sensor defect and deformed rotor. 	<ul style="list-style-type: none"> Malfunction of ABS sensor Malfunction of harness or connector Malfunction of ABS rotor Extreme large gap between sensor and ABS rotor Malfunction of the M-ASTC-ECU or the M-ATC-ECU Malfunction of wheel bearing



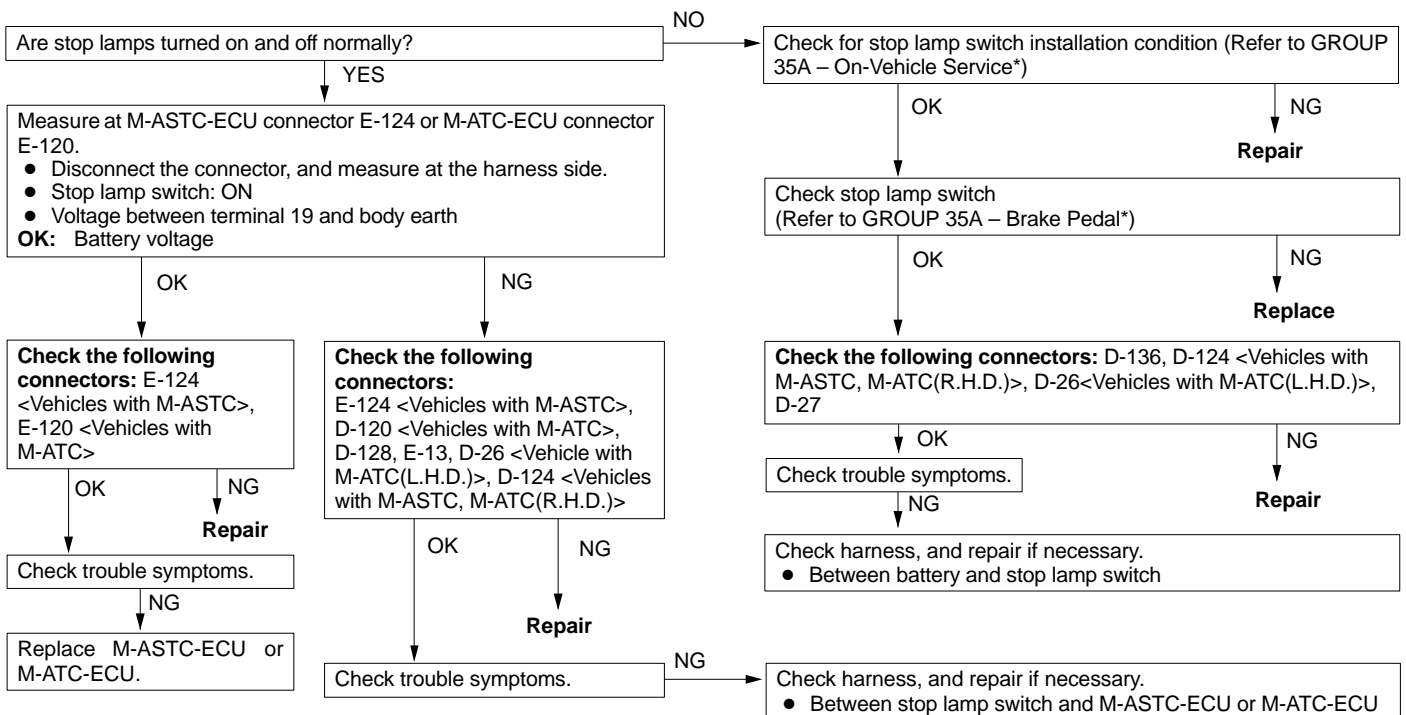
NOTE

*: Refer to 2001 PAJERO Workshop Manual [Pub. No. PWJE0005(2/2)]

Code No. 25: Incorrect tyre size	Probable cause
With Code No. 11, 12, 13, 14, 21, 22, 23, or 24 not yet set and the slowest wheel running at the speed of over 30 km/h, this code is set when the value of either of ABS sensor output signals is 1.2 times larger than that of the slowest wheel.	<ul style="list-style-type: none"> ● Tyre pressure too large or small ● Sizes of 4 tires not matched ● Punctured tyre ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU



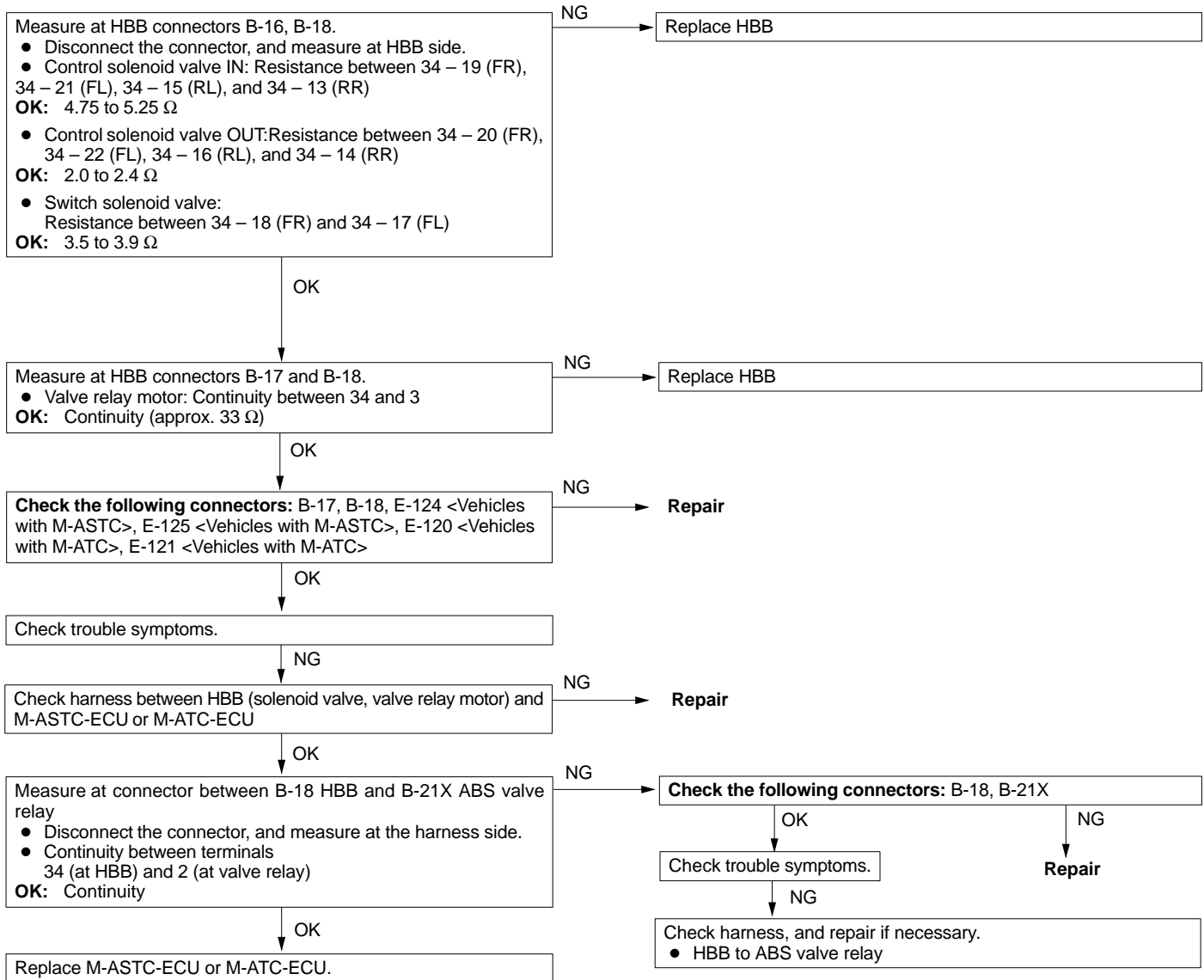
Code No. 33: Stop lamp switch system (open circuit or always-ON)	Probable cause
This code is set in the following cases: <ul style="list-style-type: none"> ● When stop lamp switch keeps ON for over 15 minutes on the road. ● When harness is open on stop lamp switch input circuit. 	<ul style="list-style-type: none"> ● Malfunction of stop lamp switch ● Malfunction of harness or connector ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU



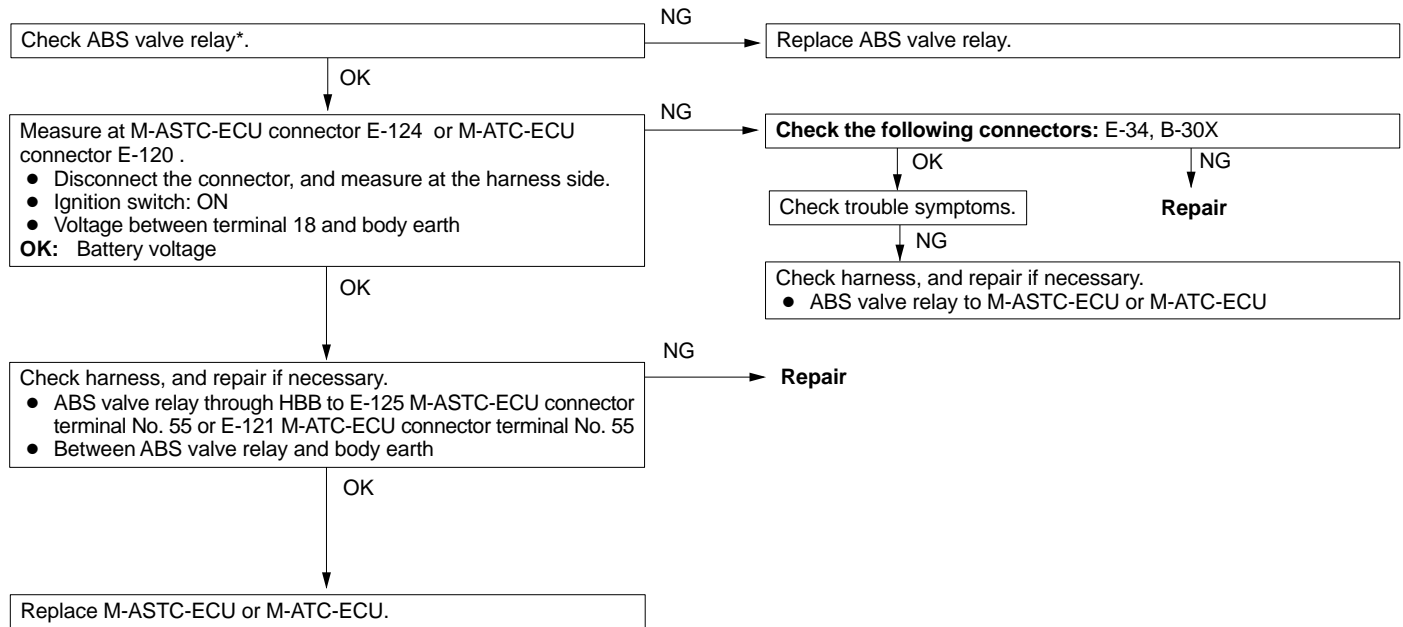
NOTE

*: Refer to 2001 PAJERO Workshop Manual [Pub. No. PWJE0005(2/2)]

Code No. 41, 42, 43 or 44: Control solenoid valve system	Probable cause
Code No. 45 and 46: Switch solenoid Valve System	
M-ASTC-ECU or M-ATC-ECU is always monitoring the solenoid valve drive circuit. This code is set by determination of open/short circuit on the solenoid coil or harness when the solenoid is not energized even if M-ASTC-ECU or M-ATC-ECU activates it, or the solenoid keep energized even if either of the ECU's switches it off.	<ul style="list-style-type: none"> ● Malfunction of harness or connector ● Malfunction of hydraulic brake booster (HBB) ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU

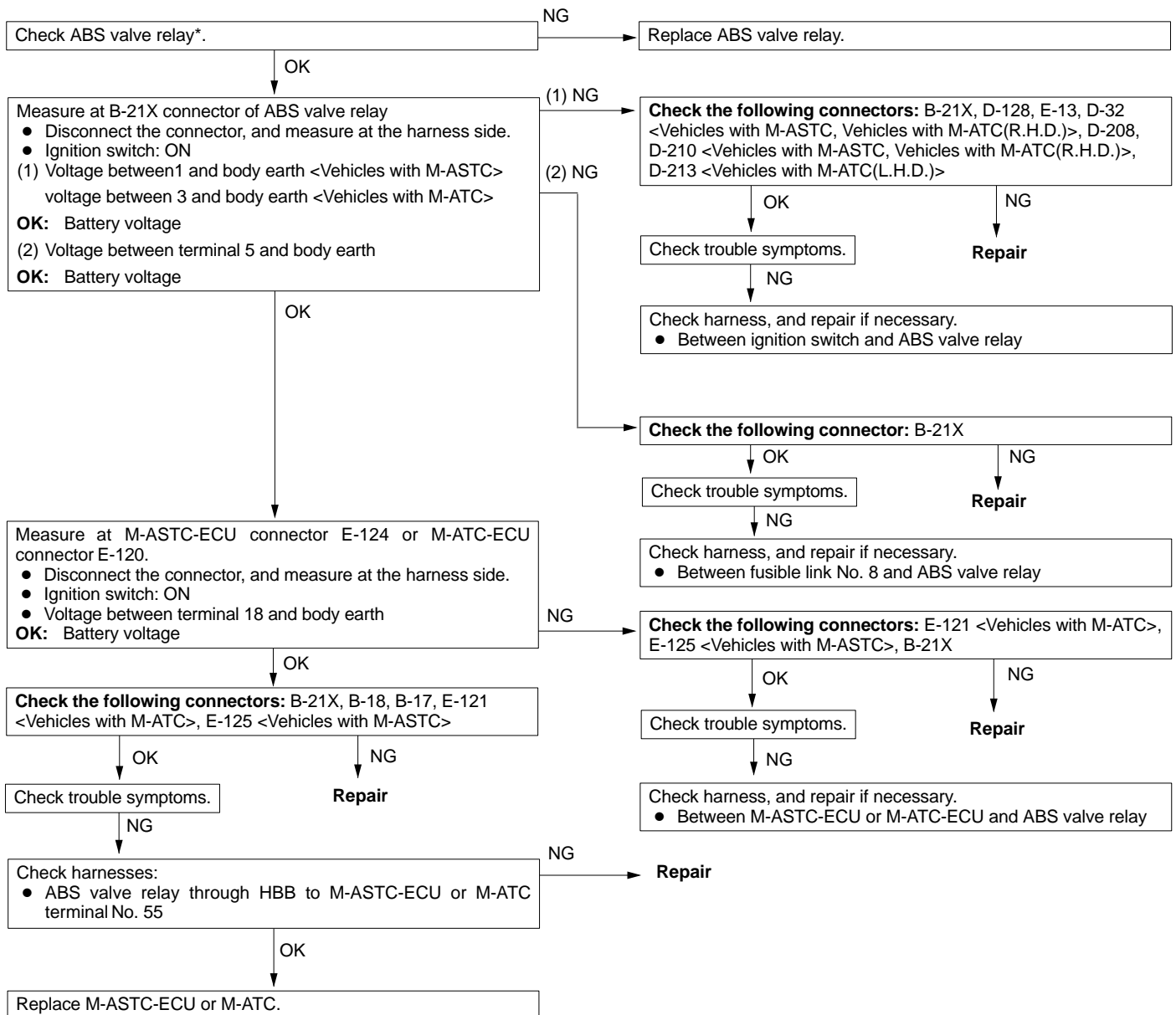


Code No. 51: Valve relay system (always-ON defect)	Probable cause
This code is output by determination of fused relay contacts or short relay drive circuit when the power is supplied to the solenoid valve even if the valve relay is deactivated in initial check with the ignition switch activated by M-ASTC-ECU or M-ATC-ECU.	<ul style="list-style-type: none"> ● Malfunction of harness or connector ● Malfunction of ABS valve relay ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU

**NOTE**

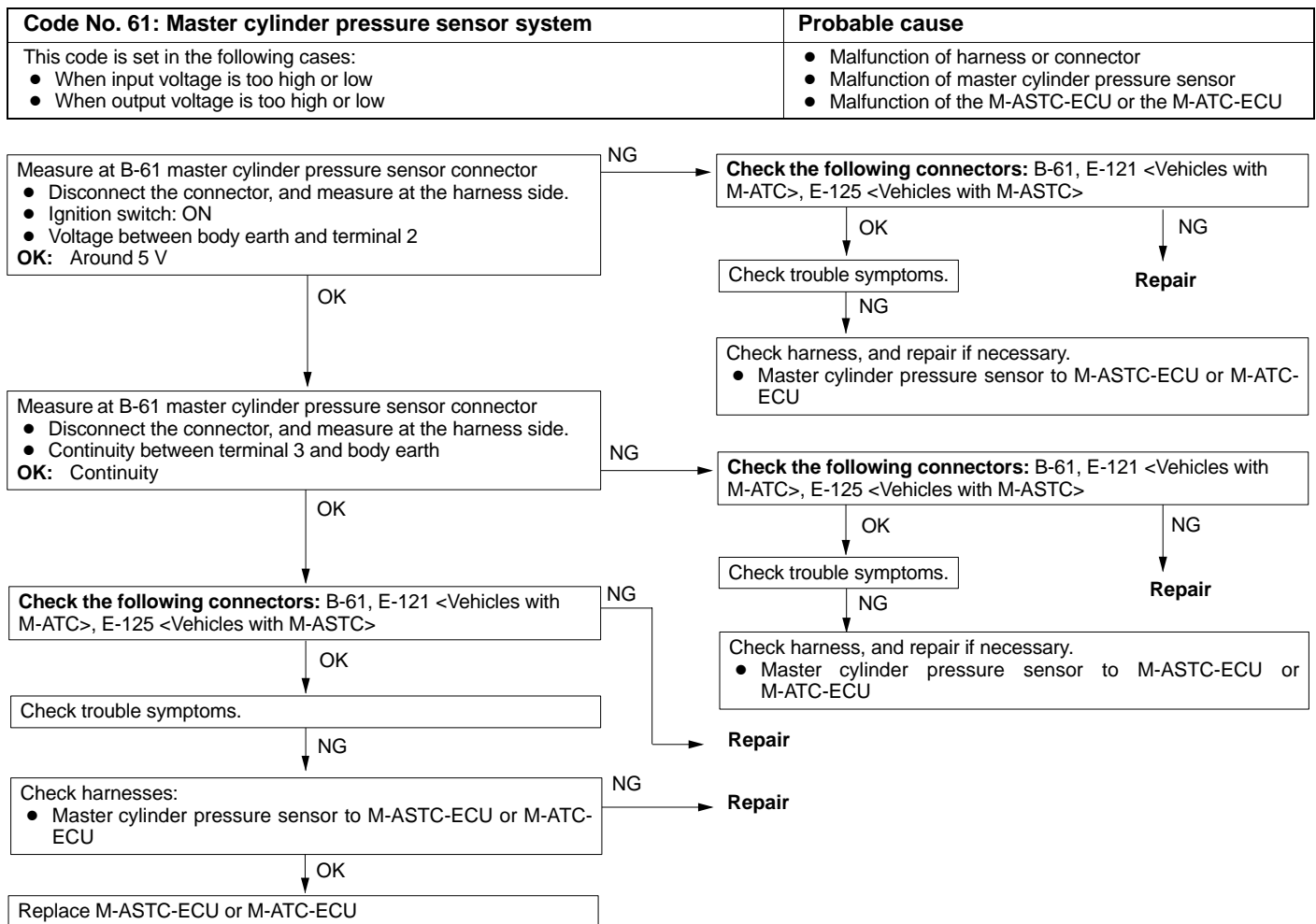
*: Refer to 2001 PAJERO Workshop Manual [Pub. No. PWJE0005(2/2)]

Code No. 52: Valve relay system (always-OFF defect)	Probable cause
This code is set by determination of valve relay defect (always-OFF) when the power is not supplied to the solenoid valve even if M-ASTC-ECU or M-ATC-ECU activated the valve relay.	<ul style="list-style-type: none"> Malfunction of harness or connector Malfunction of ABS valve relay Malfunction of the M-ASTC-ECU or the M-ATC-ECU



NOTE

*: Refer to 2001 PAJERO Workshop Manual [Pub. No. PWJE0005(2/2)]



INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptom	Inspection procedure No.	Reference page
MUT-II cannot communicate with other systems.	Refer to GROUP 13A.	
Communication between MUT-II and M-ASTC-ECU or M-ATC-ECU cannot be achieved.	1	35B-11
When the ignition switch is turned to ON position (with the engine not running), ABS warning lamp does not illuminate.	2	35B-12
The ABS warning lamp remains illuminated after the engine has started,	3	35B-12
After the engine is started, ABS warning lamp does not illuminate.	4	35B-13
When the ignition switch is turned to the "ON" position (with the engine not running), ABS warning lamp flashes twice. When the ignition switch is returned to the "ON" position (with the engine running) after further turning it to "START" position, ABS warning lamp flashes once.	5	35B-13
ABS malfunction	6	35B-14

Caution

- Other than in full braking, ABS system may operate on slippery roads, in fast cornering, or on bumpy roads. When asking your customer about the symptom, check whether ABS is triggered under these driving conditions or not.
- When ABS system is triggered, brake pedal feel is varied (i.e. vibration is generated, and the brake pedal cannot be depressed). This is not a defect because the fluid pressure is continuously fluctuated in the brake lines to prevent wheel locking.

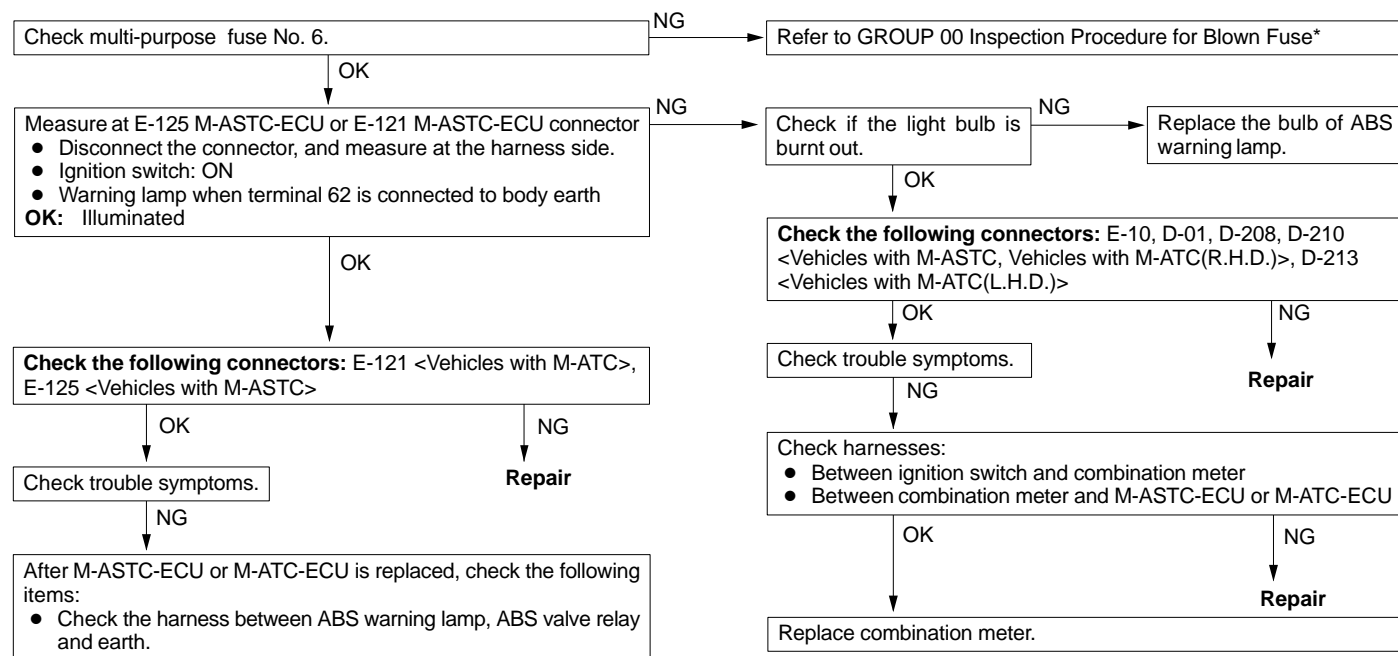
Inspection Procedure 1

Probable cause
<ul style="list-style-type: none"> ● Fuse blown out ● Malfunction of harness or connector ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU



Inspection Procedure 2

When the ignition switch is turned to ON position (with the engine not running), ABS warning lamp does not illuminate.	Probable cause
When M-ASTC-ECU or M-ATC-ECU is activated, it drives ABS valve relay from its OFF state to ON→OFF→ON for initial check. Therefore, when the lamp is not illuminated, lamp power circuit may be open, lamp bulb may be burnt out, or the circuit between ABS warning lamp and M-ASTC-ECU or M-ATC-ECU may be open.	<ul style="list-style-type: none"> ● Fuse blown out ● ABS warning lamp bulb burnt out ● Malfunction of ABS valve relay ● Malfunction of harness or connector ● Malfunction of combination meter ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU



NOTE

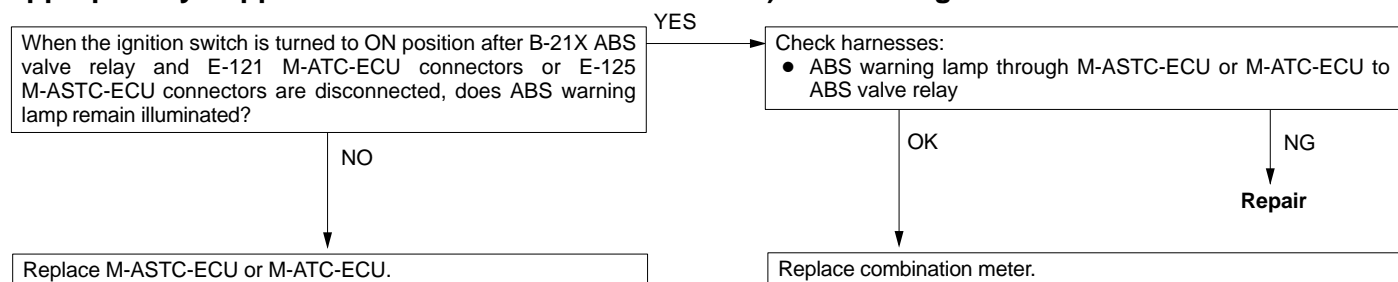
*: Refer to 2001 PAJERO Workshop Manual [Pub. No. PWJE0005(2/2)]

Inspection Procedure 3

The ABS warning lamp remains illuminated after the engine has started.	Probable cause
ABS warning lamp ON circuit may be short.	<ul style="list-style-type: none"> ● Malfunction of combination meter ● Malfunction of harness (short-circuit) ● Malfunction of the M-ASTC-ECU or the M-ATC-ECU

NOTE:

This fault symptom occurs only when the system can be communicated with MUT-II (i.e. power appropriately supplied to M-ASTC-ECU or M-ATC-ECU) and no diagnosis code is set.

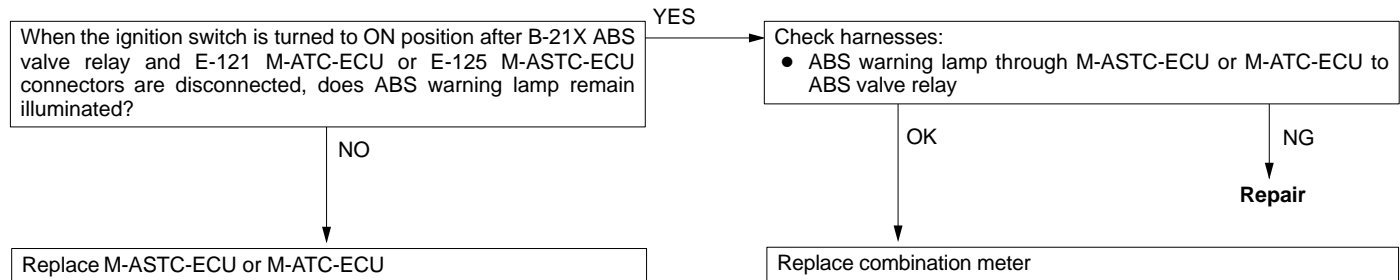


Inspection Procedure 4

After the engine is started, ABS warning lamp keeps illuminated.	Probable cause
ABS warning lamp ON circuit may be short.	<ul style="list-style-type: none"> Malfunction of combination meter Malfunction of harness (short-circuit) Malfunction of the M-ASTC-ECU or the M-ATC-ECU

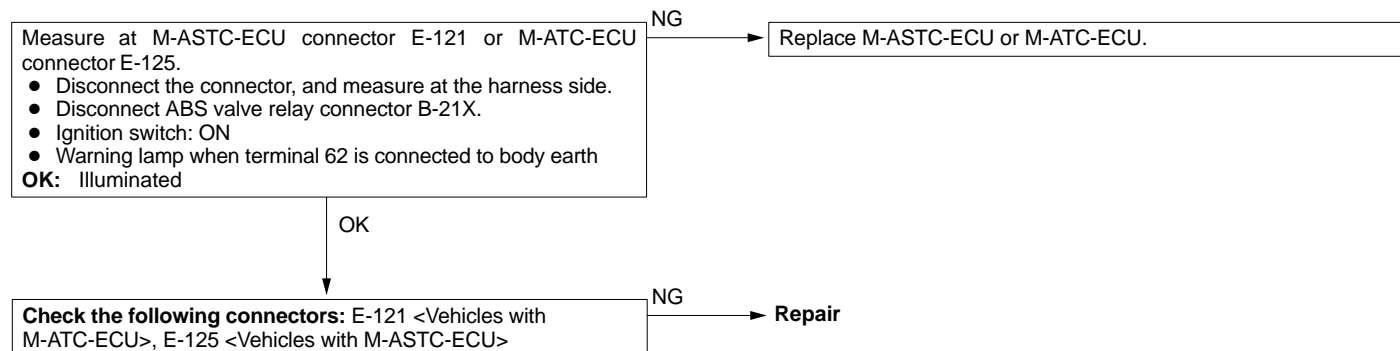
NOTE:

This fault symptom occurs only when the system can be communicated with MUT-II (i.e. power appropriately supplied to M-ASTC-ECU or M-ATC-ECU) and no diagnosis code is set.



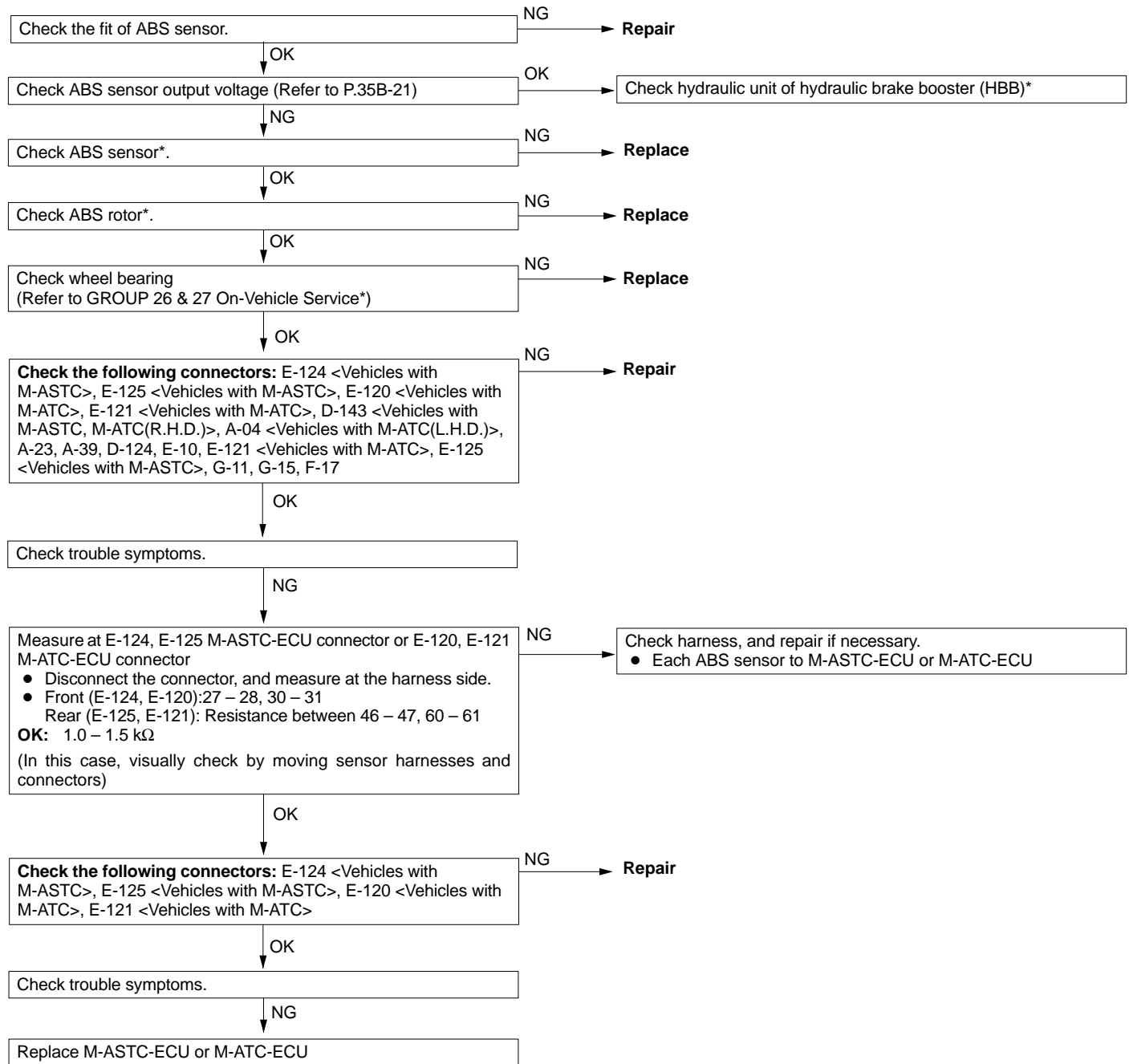
Inspection Procedure 5

When the ignition switch is turned to the "ON" position (with the engine not running), ABS warning lamp flashes twice. When the ignition switch is turned to the "ON" position again after turning it to "START" position, ABS warning lamp flashes once.	Probable cause
M-ASTC-ECU or M-ATC-ECU illuminates ABS warning lamp during initial check for 3 seconds. Either of two ECU's also drives the valve relay from its OFF state to ON"OFF"ON. In this fault symptom, ABS warning lamp is only illuminated when the valve relay is deactivated for valve relay inspection, which may lead to ABS warning lamp drive circuit malfunction of M-ASTC-ECU or M-ATC-ECU.	<ul style="list-style-type: none"> Malfunction of harness or connector Malfunction of the M-ASTC-ECU or the M-ATC-ECU



Inspection Procedure 6

ABS malfunction	Probable cause
It is not easy to locate the trouble cause, depending on the driving conditions and road surfaces. If the diagnosis code indicates a normal code, perform the following inspections:	<ul style="list-style-type: none"> • ABS sensor not installed properly • Malfunction of harness or connector • Malfunction of ABS sensor • Malfunction of ABS rotor • Foreign object attached on speed sensor • Malfunction of wheel bearing • Malfunction of HBB • Malfunction of the M-ASTC-ECU or the M-ATC-ECU



NOTE

*: Refer to 2001 PAJERO Workshop Manual [Pub. No. PWJE0005(2/2)]

DATA LIST REFERENCE TABLE

The following items from ECU input data can be read with MUT-II:

When the system normally operates:

Item no.	Check item	Inspection conditions		Normal condition
11	Front right wheel speed	Actually drive the vehicle		Indication of speedometer is almost matched with that of MUT-II
12	Front left wheel speed			
13	Rear right wheel speed			
14	Rear left wheel speed			
17	Engine Speed	Actually drive the vehicle		Indication of tachometer is almost matched with that of MUT-II
19	G sensor output voltage (Front & Rear)	Actually drive the vehicle		Indication varies between -14.7 and 14.7 m/s^2
20	G sensor output voltage (Left & Right, Diagonal)			
22	G sensor output voltage 1			
23	G sensor output voltage 2			
24	Master cylinder pressure sensor	Ignition switch: ON	Depress brake pedal gradually	The value of voltage rises to 0.5 V – 4.5 V
26	Transmission gear position	Actually drive the vehicle		Indication of shift lever position indicator is almost matched with that of MUT-II
27	Shift lever position	Actually drive the vehicle		Shift lever position is almost matched with indication of MUT-II
30	Transfer position	Actually drive the vehicle		Transfer shift lever position is almost matched with indication of MUT-II
31	Battery voltage	Ignition switch: ON		Display battery voltage
32	Steering wheel operation	Ignition switch: ON	Turn the steering wheel from the neutral position	Approximately the same value as turning angle of steering wheel is displayed
36	Stop lamp switch	Ignition switch: ON	When depressing brake pedal	ON
			When releasing brake pedal	OFF
37	Active stability control switch	Ignition switch: ON	Active stability control switch: neutral position	OFF
			Active stability control switch: OFF position	ON

Item no.	Check item	Inspection conditions		Normal condition
38	Active stability control switch	Ignition switch: ON	Active stability control switch neutral position	OFF
			Active stability control switch ON position	ON
75	Accelerator pedal position switch	Ignition switch: ON	Depress accelerator pedal	ON
			Release accelerator pedal	OFF
76	Pressure switch (for low pressure warning)	With the pressure of pressure switch at 10.8 MPa or less		ON
77	Pressure switch (for pump control)	With the pressure of pressure switch at 16.1 MPa or less		ON
		With the pressure of pressure switch at 18.3 MPa or more		OFF
78	Valve relay	Valve relay activated		ON
		Valve relay deactivated		OFF
79	Motor relay	Motor relay activated		ON
		Motor relay deactivated		OFF

LIST OF ACTUATOR TESTS

By using MUT-II, the next actuator can be driven forcibly.

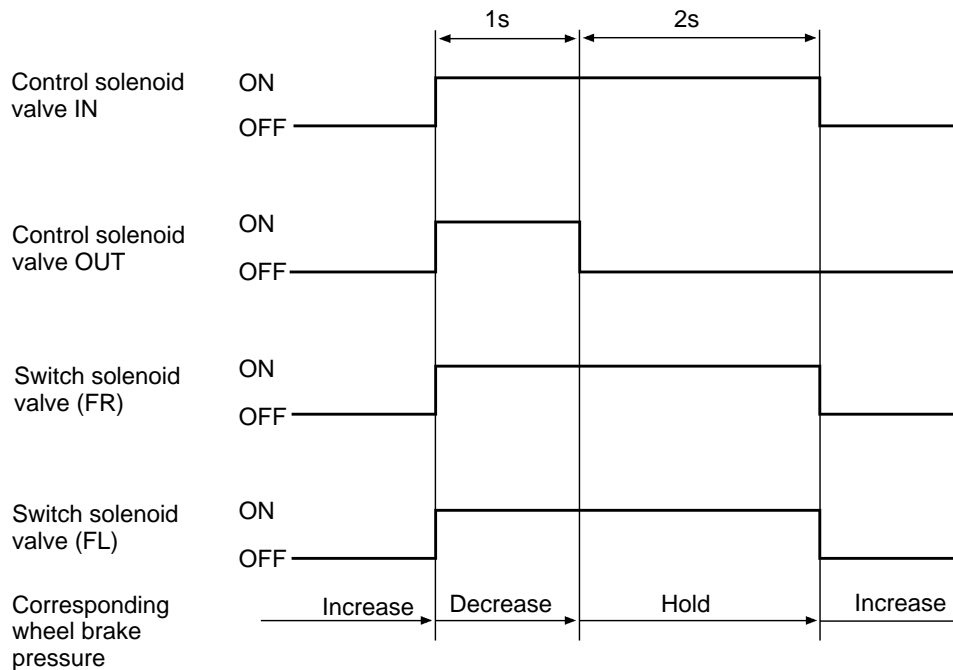
NOTE

1. When M-ASTC-ECU or M-ATC-ECU is deactivated by the fail safe function, the actuator test cannot be performed.
2. Actuator test can be performed only when the vehicle is stationed.

ACTUATOR TEST SPECIFICATIONS

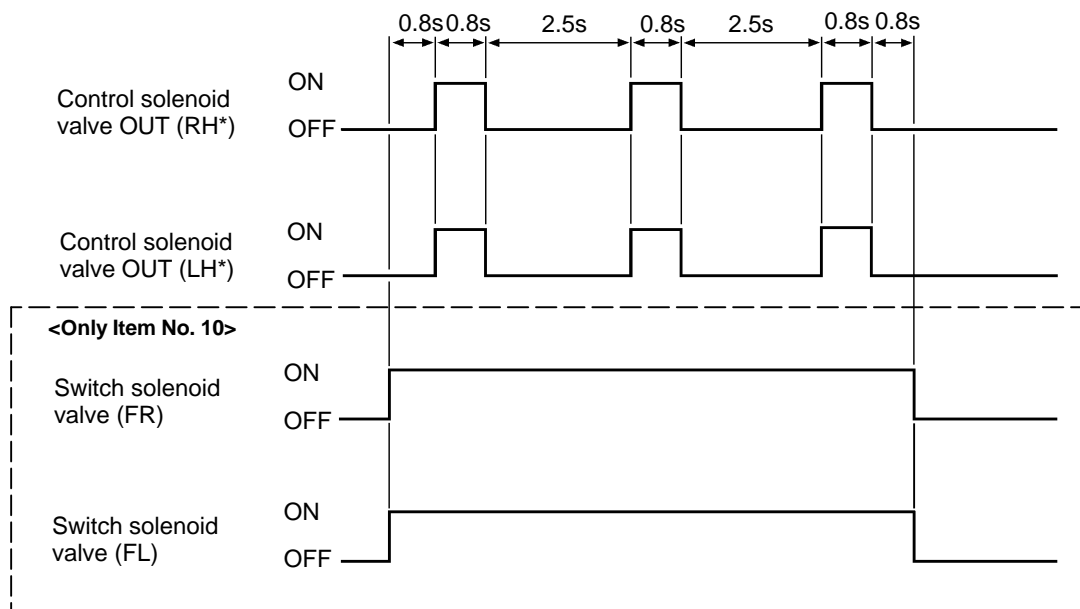
Item no.	Check Item	Drive content
01	Solenoid valve for front right wheel	Switch solenoid valve for HBB, and control solenoid valve corresponding to each channel
02	Solenoid valve for front left wheel	
03	Solenoid valve for rear right wheel	
04	Solenoid valve for rear left wheel	
09	Bleeding (1)	Switch solenoid valve for HBB, and control solenoid valve OUT (FR, FL)
10	Bleeding (2)	Control solenoid valve OUT (RR, RL) for HBB

Item No. 01 – 04 drive pattern



X1266CA

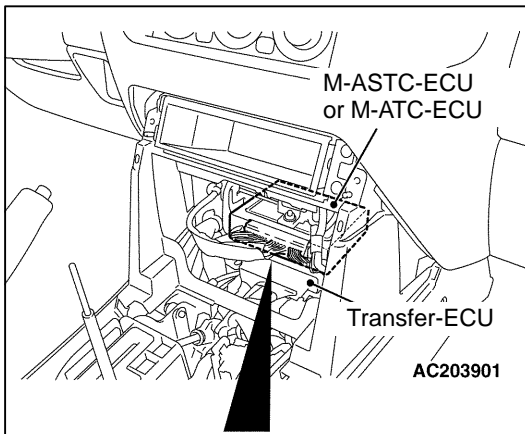
Item No. 09 – 10 drive pattern



X1267CA

NOTE

*: Solenoid valves for front wheels are driven when Item No. 09 is driven, and solenoid valves for rear wheels are driven when Item No. 10 is driven.



Connector at M-ASTC-ECU or M-ATC-ECU

AC204627AY

CHECK AT M-ASTC-ECU TERMINAL OR M-ATC-ECU TERMINAL

TERMINAL VOLTAGE TABLE

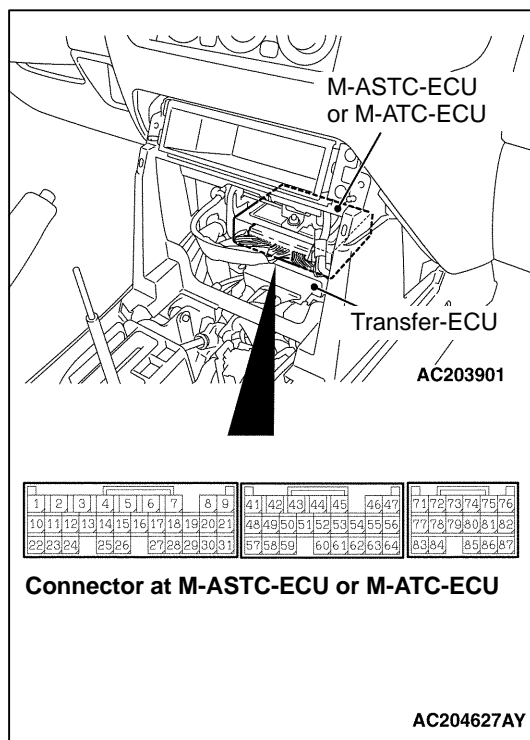
NOTE:

ECU's with the same profile are located at the upper and lower of the floor console. The upper ECU is M-ASTC-ECU or M-ATC-ECU, while the lower ECU is transfer-ECU.

1. Voltage is measured between individual terminals and earth terminals.
2. Individual terminals are arranged as shown in the figure.

Terminal No.	Check Item	Inspection Conditions		Normal Condition
1	Control solenoid valve OUT (RR)	Ignition switch: ON		Battery voltage
2	Control solenoid valve IN (RR)	Ignition switch: ON		Battery voltage
3	Control solenoid valve OUT (FL)	Ignition switch: ON		Battery voltage
5	Booster valve	Ignition switch: ON		Battery voltage
6	Cut-off valve	Ignition switch: ON		Battery voltage
7	Switch solenoid valve (FR)	Ignition switch: ON		Battery voltage
8	Switch solenoid valve (FL)	Ignition switch: ON		Battery voltage
10	Control solenoid valve IN (FL)	Ignition switch: ON		Battery voltage
19	Stop lamp switch input	Ignition switch: ON	Stop lamp switch: ON	Battery voltage
			Stop lamp switch: OFF	2 V or below
24	Power Supply to M-ASTC-ECU or M-ATC-ECU	Ignition switch: ON		Battery voltage
		Ignition switch: START		0 V
42	Control solenoid valve IN (FR)	Ignition switch: ON		Battery voltage
43	Control solenoid valve OUT (FR)	Ignition switch: ON		Battery voltage
44	Control solenoid valve IN (RL)	Ignition switch: ON		Battery voltage
45	Control solenoid valve OUT (RL)	Ignition switch: ON		Battery voltage
50	Pressure sensor power supply	Ignition switch: ON		Approx. 5 V
55	Valve relay monitor	Ignition switch: ON		Battery voltage
59	Pressure sensor	Ignition switch: ON		Approx. 0.14 – 4.85 V
62	ABS warning lamp output	Ignition switch: ON	With lamp OFF	Battery voltage
			With lamp ON	2 V or below

Terminal No.	Check Item	Inspection Conditions		Normal Condition
74	Active stability control system indicator/active traction control system indicator output	Ignition switch: ON	With active stability control switch OFF	Battery voltage
			With active stability control switch ON	2 V or below
75	2WD/4WD switch input	Ignition switch: ON	Transfer lever position: 2H, 4H	Battery voltage
			Transfer lever position: 4HLc, 4LLc	2 V or below
76	4LLc switch input	Ignition switch: ON	Transfer lever position: 4LLc	Battery voltage
			Transfer lever position: 2H, 4H, 4HLc	2 V or below
80	Center differential lock switch input	Ignition switch: ON	Transfer lever position: 2H, 4H	Battery voltage
			Transfer lever position: 4HLc, 4LLc	2 V or below
81	Brake warning lamp output	Ignition switch: ON	With lamp OFF	2 V or below
			With lamp ON	Battery voltage
86	2WD switch input	Ignition switch: ON	Transfer lever position: 2H	Battery voltage
			Transfer lever position: 4H, 4HLc, 4LLc	2 V or below
87	4H switch input	Ignition switch: ON	Transfer lever position: 2H, 4LLc	Battery voltage
			Transfer lever position: 4H, 4HLc	2 V or below



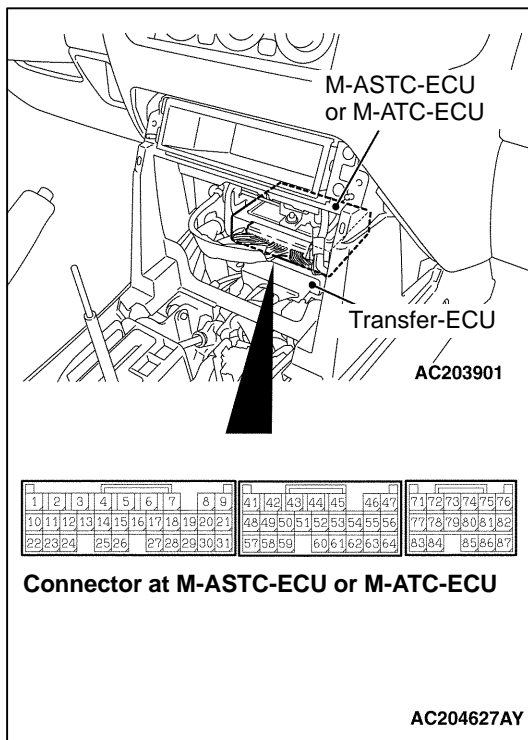
CHECK CHART FOR RESISTANCE AND CONTINUITY BETWEEN CONNECTOR TERMINALS AT HARNESS SIDE

NOTE:

ECU's with the same profile are located at the upper and lower of the floor console. The upper ECU is M-ASTC-ECU or M-ATC-ECU, while the lower ECU is transfer-ECU.

1. Turn the ignition switch to the LOCK (OFF) position.
2. Resistance measurement and continuity inspection must be performed with M-ASTC-ECU or M-ATC-ECU connector disconnected.
3. Resistance measurement and continuity inspection is performed between the terminals shown in the following table.
4. Individual terminals are arranged as shown in the figure:

Terminal No.	Signal name	Normal state
30 – 31	ABS sensor (FL)	1.0 to 1.5 kΩ
60 – 61	ABS sensor (RR)	
46 – 47	ABS sensor (RL)	
27 – 28	ABS sensor (FR)	
4 – body earth	Earth	Continuity
22 – body earth	Earth	
56 – body earth	Earth	
64 – body earth	Earth	



ON-VEHICLE SERVICE <VEHICLES WITH M-ASTC AND M-ATC>

ABS SENSOR OUTPUT VOLTAGE MEASUREMENT

NOTE:

ECU's with the same profile are located at the upper and lower of the floor console. The upper ECU is M-ASTC-ECU or M-ATC-ECU, while the lower ECU is transfer-ECU.

1. Lift up the vehicle and release the parking brake.
2. Disconnect connector of M-ASTC-ECU or M-ATC-ECU and measure voltage at harness connector.
3. Turn the wheel to be measured at the speed of about 1/2 – 1 turn/sec., and use multimeter (ACmV range) or oscilloscope to the output voltage.

Terminal No.

Front left	Front right	Rear left	Rear right
30	27	46	60
31	28	47	61

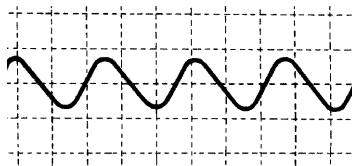
Output voltage:

For multimeter: 42 mV or more

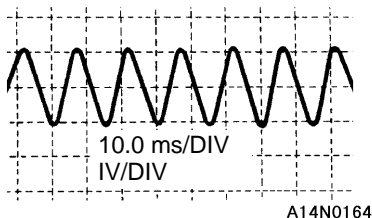
For oscilloscope: 120 mVP – P or more

4. When the output voltage is lower than the above value, check or replace ABS sensor due to the following possible causes:
 - Gap between ABS sensor ball piece and ABS rotor too large
 - Malfunction of ABS sensor

When rotated by hand



When engine is idling (5 – 6 km/h)
D range



WAVE PATTERN INSPECTION USING AN OSCILLOSCOPE

Ensure that ABS sensor harness and connector are properly connected. Use oscilloscope to measure the waveform with each ABS sensor set to the following output voltage waveform. Start the engine, and move the transfer lever to 4H, and shift the gear selector to D range to rotate the wheels.

NOTE

- (1) You can measure the waveform by actually driving the vehicle.
- (2) Output voltage is decreased at lower wheel speed, while it is increased at higher wheel speed.

WAVE PATTERN OBSERVATION POINTS

Symptom	Cause	Remedy
Waveform amplitude is too small, or no amplitude	Malfunction of ABS sensor	Replace the sensor
Fluctuation of waveform amplitude too large (however, no problem with minimum amplitude of 120 mV or more)	Axle hub vibration too large or off center	Replace the axle hub
	M-ASTC-ECU or M-ATC-ECU not properly connected to body earth	Repair
Noise added to the waveform, or waveform fluctuated	Sensor open-circuit	Replace the sensor
	Harness open-circuit	Repair the harness
	ABS sensor not installed properly	Reinstall the sensor
	Gear of ABS rotor is broken or collapsed	Replace the ABS rotor

CAUTION:

ABS sensor cable moves according to the motion of the front or rear suspension. Output voltage waveform of ABS sensor, therefore, should be also measured with the sensor harness oscillating.