

ABS

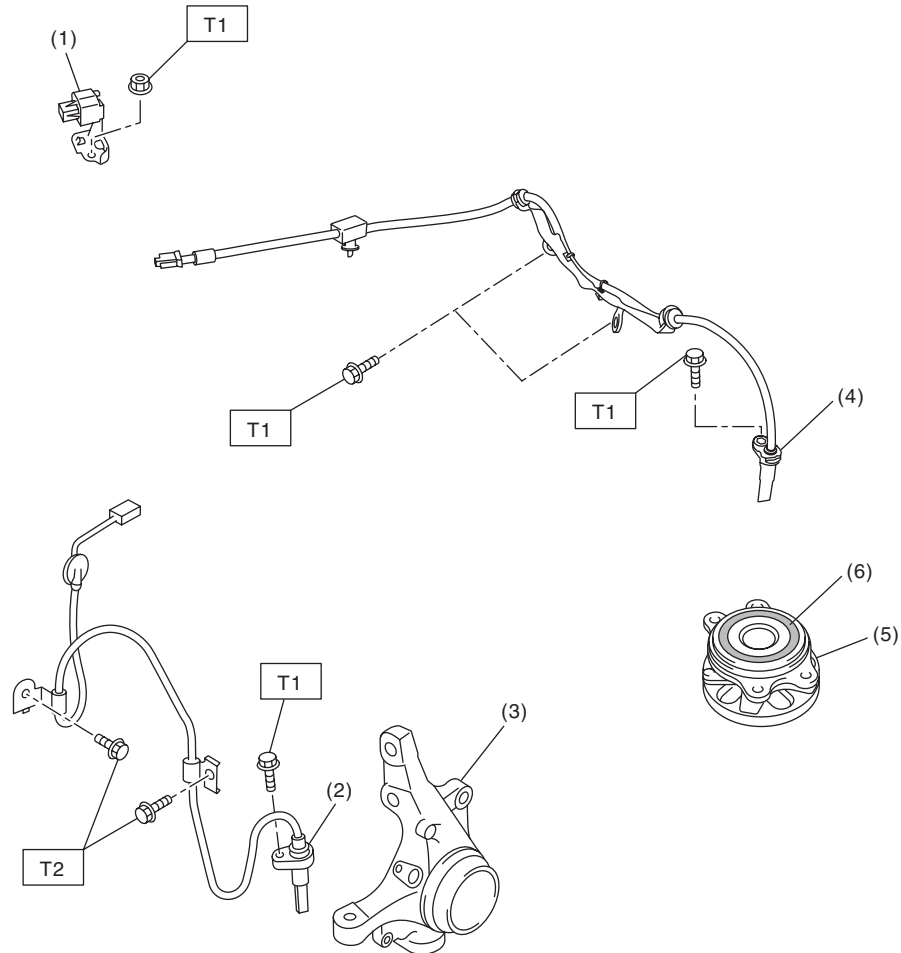
General Description

ABS

1. General Description

A: SPECIFICATION

Item				Specification or identification
ABS wheel speed sensor	ABS wheel speed sensor gap (for reference)		Front	0.77 — 1.43 mm (0.030 — 0.056 in)
			Rear	0.64 — 1.56 mm (0.025 — 0.061 in)
	Identifications of harness (marks, color)	Front	RH	K1 (White)
			LH	K2 (Yellow)
		Rear	RH	P1 (Pink)
			LH	P2 (Blue)
G sensor	G sensor voltage			2.3±0.2 V
ABSCM&H/U identification	AT			R2
	MT			R3

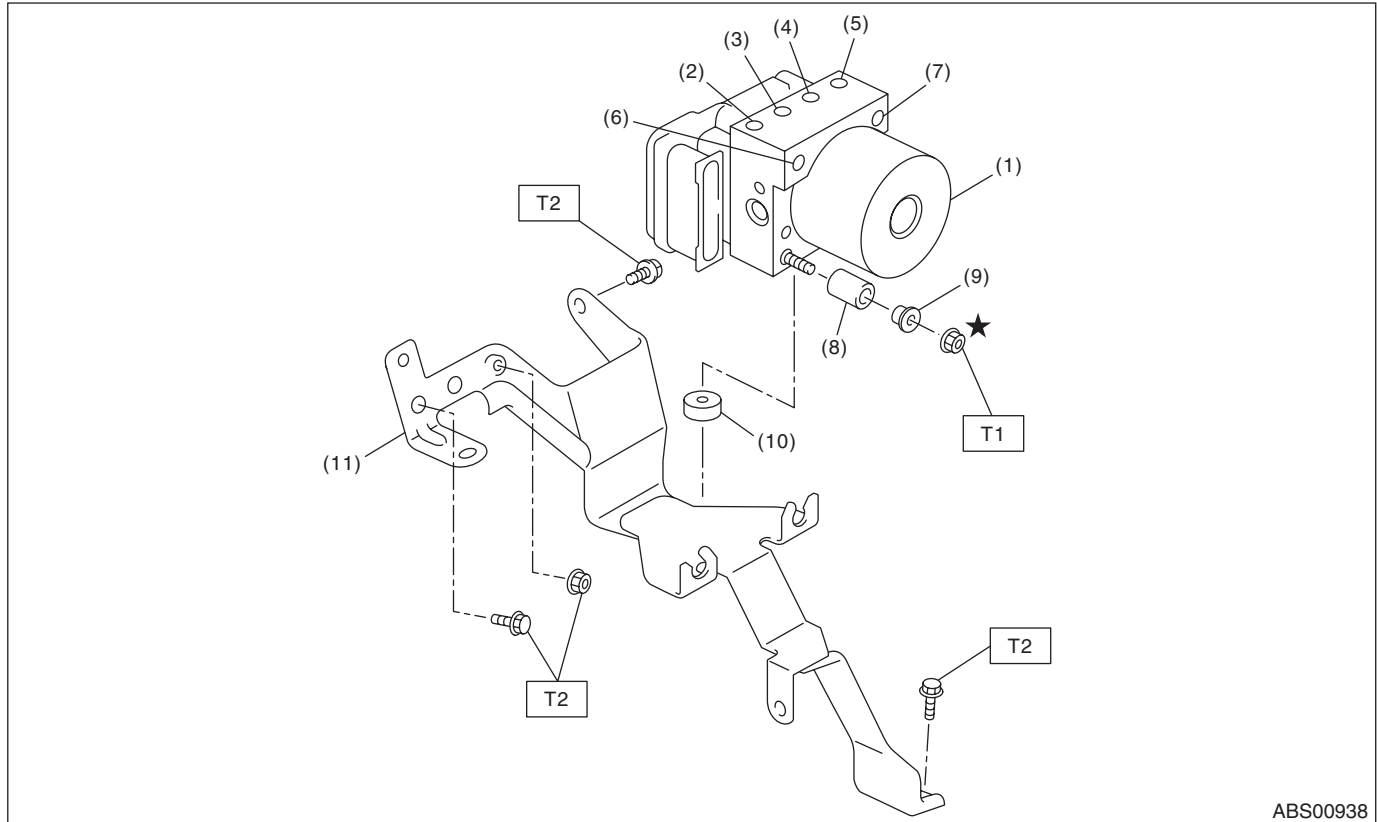
B: COMPONENT**1. ABS WHEEL SPEED SENSOR**

ABS01014

- | | |
|-------------------------------------|------------------------------------|
| (1) G sensor | (4) Rear ABS wheel speed sensor LH |
| (2) Front ABS wheel speed sensor LH | (5) Hub unit bearing |
| (3) Front housing | (6) Magnetic encoder |

Tightening torque: N·m (kgf-m, ft-lb)**T1: 7.5 (0.76, 5.5)****T2: 33 (3.4, 24.3)**

2. ABS CONTROL MODULE AND HYDRAULIC CONTROL UNIT (ABSCM&H/U)



- (1) ABS control module and hydraulic control unit (ABSCM&H/U)
- (2) Front outlet RH
- (3) Rear outlet LH
- (4) Rear outlet RH
- (5) Front outlet LH

- (6) Primary inlet
- (7) Secondary inlet
- (8) Damper
- (9) Spacer
- (10) Damper

- (11) Bracket

Tightening torque: N·m (kgf-m, ft-lb)

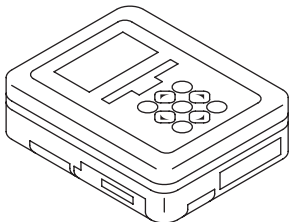
T1: 7.5 (0.76, 5.5)

T2: 33 (3.4, 24.3)

C: CAUTION

- Wear appropriate work clothing, including a cap, protective goggles and protective shoes when performing any work.
- Before disconnecting connectors of sensors or units, be sure to disconnect the battery ground cable from the battery.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly and replacement.
- Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or rigid racks at the specified points.

D: PREPARATION TOOL**1. SPECIAL TOOL**

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST1B021XU0</p>	1B021XU0	SUBARU SELECT MONITOR III KIT	Used for diagnosis of the electrical system.

2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Pressure gauge	Used for measuring oil pressure.
Oscilloscope	Used for measuring the sensor.
TORX® bit E5	Used for replacing the ABS control module.

2. ABS Control Module and Hydraulic Control Unit (ABSCM&H/U)

A: REMOVAL

- 1) Disconnect the ground cable from the battery.
- 2) Use compressed air to remove water and dust around the ABSCM&H/U.

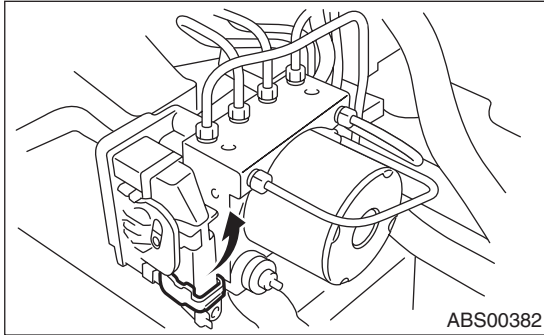
NOTE:

If the terminals become dirty, it may cause improper contact.

- 3) Lift the lock lever and disconnect the ABSCM&H/U connector.

CAUTION:

Do not pull on the harness when disconnecting the connector.



- 4) Remove the harness clip.
- 5) Disconnect the brake pipes from the ABSCM&H/U.
- 6) Wrap the brake pipe with a vinyl bag so as not to spill the brake fluid on the vehicle body.

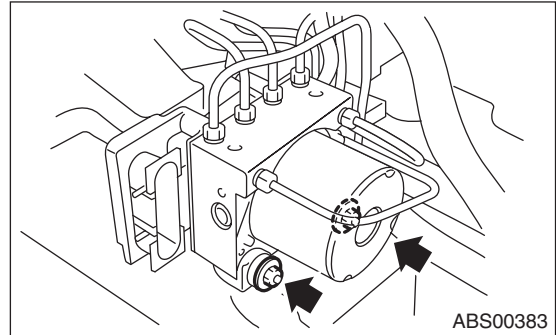
CAUTION:

If brake fluid is spilled on the vehicle body, wash it off immediately with water and wipe clean.

- 7) Loosen the nuts and remove the ABSCM&H/U.

CAUTION:

- Do not drop or bump the ABSCM&H/U.
- Do not turn the ABSCM&H/U upside down or place it sideways for storage.
- Be careful not to let foreign matter enter into ABSCM&H/U.
- Be careful that no water enters the connectors.



- 8) Remove the ABSCM&H/U bracket.

B: INSTALLATION

- 1) Install the ABSCM&H/U bracket.

Tightening torque:

3 N·m (3.4 kgf-m, 24.3 ft-lb)

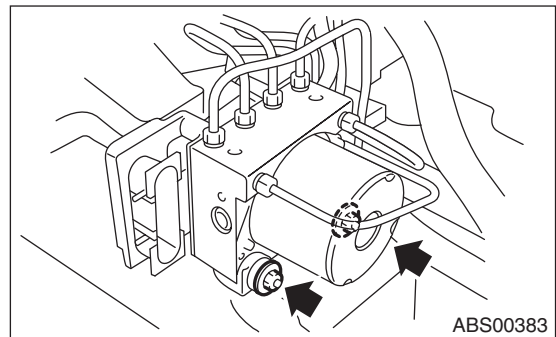
- 2) Align the damper groove of the ABSCM&H/U to the bracket side claw, and install the ABSCM&H/U with new nuts (023506000).

NOTE:

Check the identification marks of the ABSCM&H/U.

Tightening torque:

7.5 N·m (0.76 kgf-m, 5.5 ft-lb)



- 3) Connect the brake pipes to their correct ABSCM&H/U positions.

Tightening torque:

15 N·m (1.5 kgf-m, 10.8 ft-lb)

- 4) Using a harness clip, secure the ABSCM&H/U harness to the bracket.

5) Connect the connector to ABSCM&H/U.

NOTE:

- Be sure to remove all foreign matter from inside the connector before connecting.
- Make sure the ABSCM&H/U connector is securely locked.

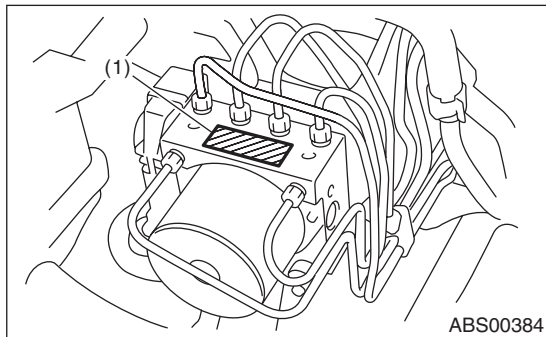
6) Bleed air from the brake system.

C: INSPECTION

1) Check the condition of connection and settlement of connector.

2) Check the mark used for ABSCM&H/U identification.

Refer to "SPECIFICATION" for the identification mark. <Ref. to ABS-2, SPECIFICATION, General Description.>



(1) Identification mark

1. CHECKING THE HYDRAULIC UNIT ABS OPERATION BY PRESSURE GAUGE

1) Lift up the vehicle, and remove the wheels.

2) Remove the air bleeder screws from FL and FR caliper bodies.

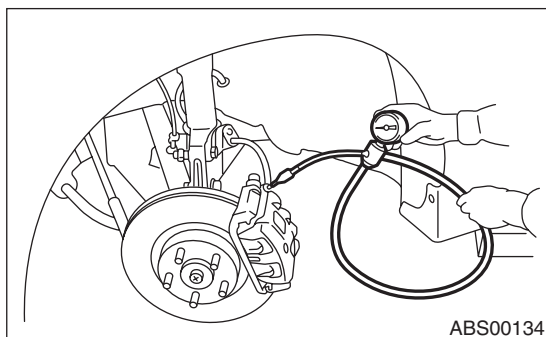
3) Connect two pressure gauges to FL and FR caliper bodies.

CAUTION:

- Use a pressure gauge used exclusively for brake fluid measurement.
- Do not use the pressure gauge used for the measurement of transmission oil. Doing so will cause the piston seal to expand and deform.

NOTE:

Wrap sealing tape around the pressure gauge.



4) Bleed air from the pressure gauges and the FL and FR caliper bodies.

5) Perform ABS sequence control.

<Ref. to ABS-10, ABS Sequence Control.>

6) When the hydraulic unit begins to work, first the FL side performs decompression, hold and compression, and then the FR side performs decompression, hold and compression.

7) Read values indicated on the pressure gauge and check if the fluctuation of the values between decompression and compression meets the standard values. Depress the brake pedal and check that the kick-back is normal, and tightness is normal.

	Front wheel	Rear wheel
Initial value	3,500 kPa (36 kgf/cm ² , 511 psi)	3,500 kPa (36 kgf/cm ² , 511 psi)
When depressurized	500 kPa (5 kgf/cm ² , 73 psi) or less	500 kPa (5 kgf/cm ² , 73 psi) or less
When pressurized	3,500 kPa (36 kgf/cm ² , 511 psi) or more	3,500 kPa (36 kgf/cm ² , 511 psi) or more

8) Disconnect the pressure gauges from FL and FR caliper bodies.

9) Install the air bleeder screws of FL and FR caliper bodies.

10) Remove the air bleeder screws from RL and RR caliper bodies.

11) Connect two pressure gauges to RL and RR caliper bodies.

12) Bleed air from the brake system.

13) Bleed air from RL and RR caliper bodies, and pressure gauge.

14) Perform ABS sequence control.

<Ref. to ABS-10, ABS Sequence Control.>

15) When the hydraulic unit begins to work, first the RR side performs decompression, hold and compression, and then the RL side performs decompression, hold and compression.

16) Read values indicated on the pressure gauge and check if the fluctuation of the values between decompression and compression meets specification. Depress the brake pedal and check that the kick-back is normal, and tightness is normal.

17) Disconnect the pressure gauge from the RL and RR caliper bodies.

18) Install the air bleeder screws of RL and RR caliper bodies.

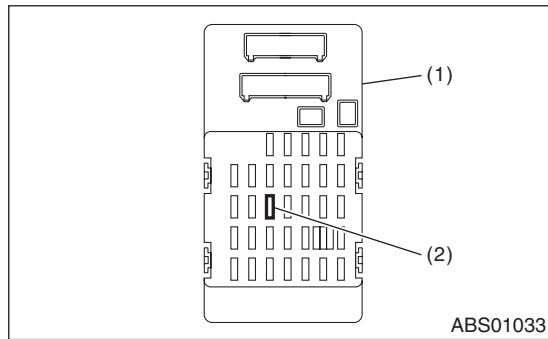
19) Bleed air from the brake system.

ABS Control Module and Hydraulic Control Unit (ABSCM&H/U)

ABS

2. CHECKING THE HYDRAULIC UNIT ABS OPERATION WITH THE BRAKE TESTER

1) For AT model, install the spare fuse to the FWD connector located in the fuse & relay box.



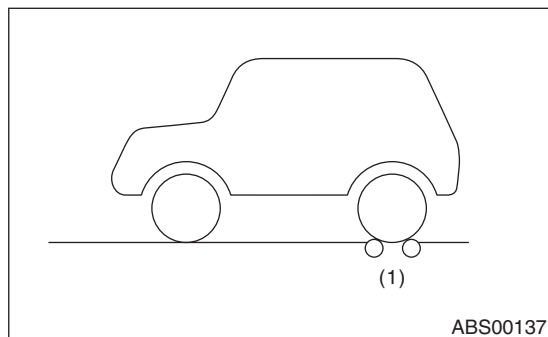
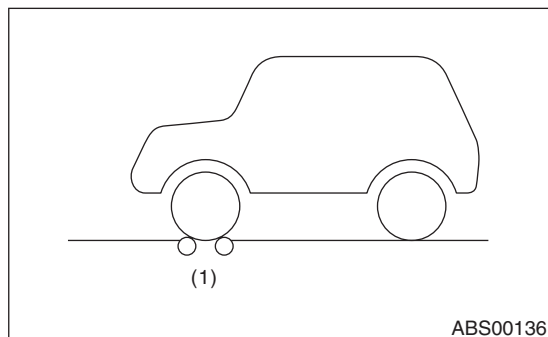
- (1) Fuse & Relay Box
(2) FWD connector (No. 15)

2) Since the MT model cannot cut off the AWD circuit, set the wheels other than the measured one on free rollers.

3) Prepare for ABS sequence control.

<Ref. to ABS-10, ABS Sequence Control.>

4) Set the front wheels or rear wheels on the brake tester and set the gear to "neutral".



- (1) Brake tester

5) Operate the brake tester.

6) Perform ABS sequence control.

<Ref. to ABS-10, ABS Sequence Control.>

7) When the hydraulic unit begins to work, check the following work sequence.

(1) The FL wheel performs decompression, hold and compression in sequence, and subsequently the FR wheel repeats the cycle.

(2) The RR wheel performs decompression, hold and compression in sequence, and subsequently the RL wheel repeats the cycle.

8) Read values indicated on the brake tester and check if the fluctuation of the values between decompression and compression meets specification.

	Front wheel	Rear wheel
Initial value	1,000 N (102 kgf, 225 lbf)	1,000 N (102 kgf, 225 lbf)
When depressurized	500 N (51 kgf, 112 lbf) or less	500 N (51 kgf, 112 lbf) or less
When pressurized	1,000 N (102 kgf, 225 lbf) or more	1,000 N (102 kgf, 225 lbf) or more

9) After the inspection, depress the brake pedal and check that it is not abnormally hard, and tightness is normal.

D: REPLACEMENT

CAUTION:

- Because the seal of the ABSCM cannot be replaced, do not pull or peel it by lifting it up.
- Because the screw of the H/U will become slightly worn in every replacement procedure, 5 times is the maximum number of times for replacement. If a problem is found such as not being able to torque the screw to specifications even before 5 replacement operations are performed, replace the H/U body.

• When installing the ABSCM, always use new screws.

• When the sealing surface of the ABSCM or H/U is dirty or damaged and it cannot be removed or repaired, replace with a new part.

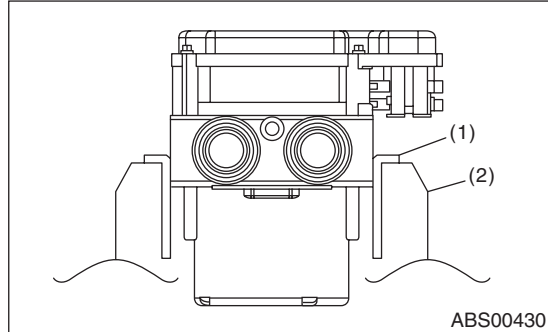
1) Remove the ABSCM&H/U. <Ref. to ABS-6, REMOVAL, ABS Control Module and Hydraulic Control Unit (ABSCM&H/U).>

2) To prevent entry of foreign objects and brake fluid leakage, plug the oil pressure port of the ABSCM&H/U using a screw plug, etc.

3) Set the pump motor section of the removed ABSCM&H/U face down on a vise.

NOTE:

Before securing a part in a vise, place cushioning material such as wood blocks, aluminum plate or cloth between the part and the vise.

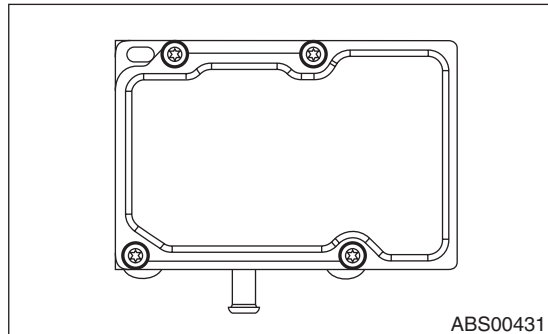


- (1) Aluminum plate, etc.
- (2) Vise

4) Using TORX® bit E5, remove the four screws of ABSCM.

NOTE:

These screws cannot be reused.



5) Slowly pull out the ABSCM upward from the H/U.

NOTE:

To prevent damaging of coil section, remove the ABSCM straight up from H/U without twisting.

6) Make sure there is no dirt or damage on the sealing surface of the H/U.

CAUTION:

- Do not clean the ABSCM&H/U by applying compressed air.
- Even if damage is found on the H/U seal, do not attempt repair by filing or with a metal scraper. To remove the seal residue, always use a plastic scraper. Do not use chemical such as paint thinner, etc., to clean.

7) Position the coil of the new ABSCM to align with the H/U valve.

8) To prevent deformation of the ABSCM housing cover, hold the corner of ABSCM and install it to the H/U without tilting.

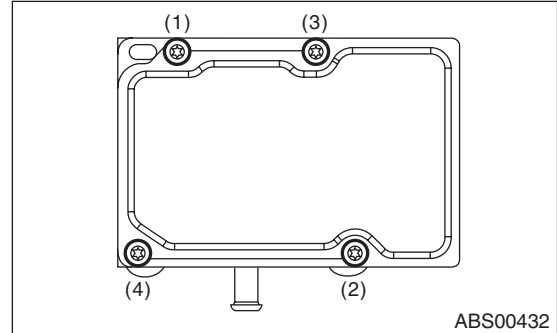
9) Using a TORX® bit E5, attach/tighten new screws in the order of (1) through (4).

CAUTION:

Always use new screws.

Tightening torque:

1.5 N·m (0.15 kgf-m, 1.1 ft-lb)



10) Check that there is no foreign matter in mating surface between the ABSCM & H/U.

11) Using a TORX® bit E5, tighten the screws in the order of (1) through (4) again.

Tightening torque:

3.3 N·m (0.3 kgf-m, 2.2 ft-lb)

12) Check that there is no gap in the mating surface between ABSCM&H/U.

13) Install the ABSCM&H/U to the vehicle.

3. ABS Sequence Control

A: OPERATION

1) While the ABS sequence control is being performed, the operation of the hydraulic unit can be checked using the brake tester or pressure gauge after the hydraulic unit solenoid valve operation.

2) ABS sequence control can be started by the Subaru Select Monitor.

1. ABS SEQUENCE CONTROL WITH SUBARU SELECT MONITOR

NOTE:

In the event of any trouble, the ABS sequence control will not operate.

1) Connect the Subaru Select Monitor to data link connector under the driver's side instrument panel lower cover.

2) Turn the ignition switch to ON.

3) Run the "PC application for Subaru Select Monitor".

4) Set the Subaru Select Monitor to "Brake Control" mode.

5) When the "Function check sequence" is selected, the "ABS sequence control" will start.

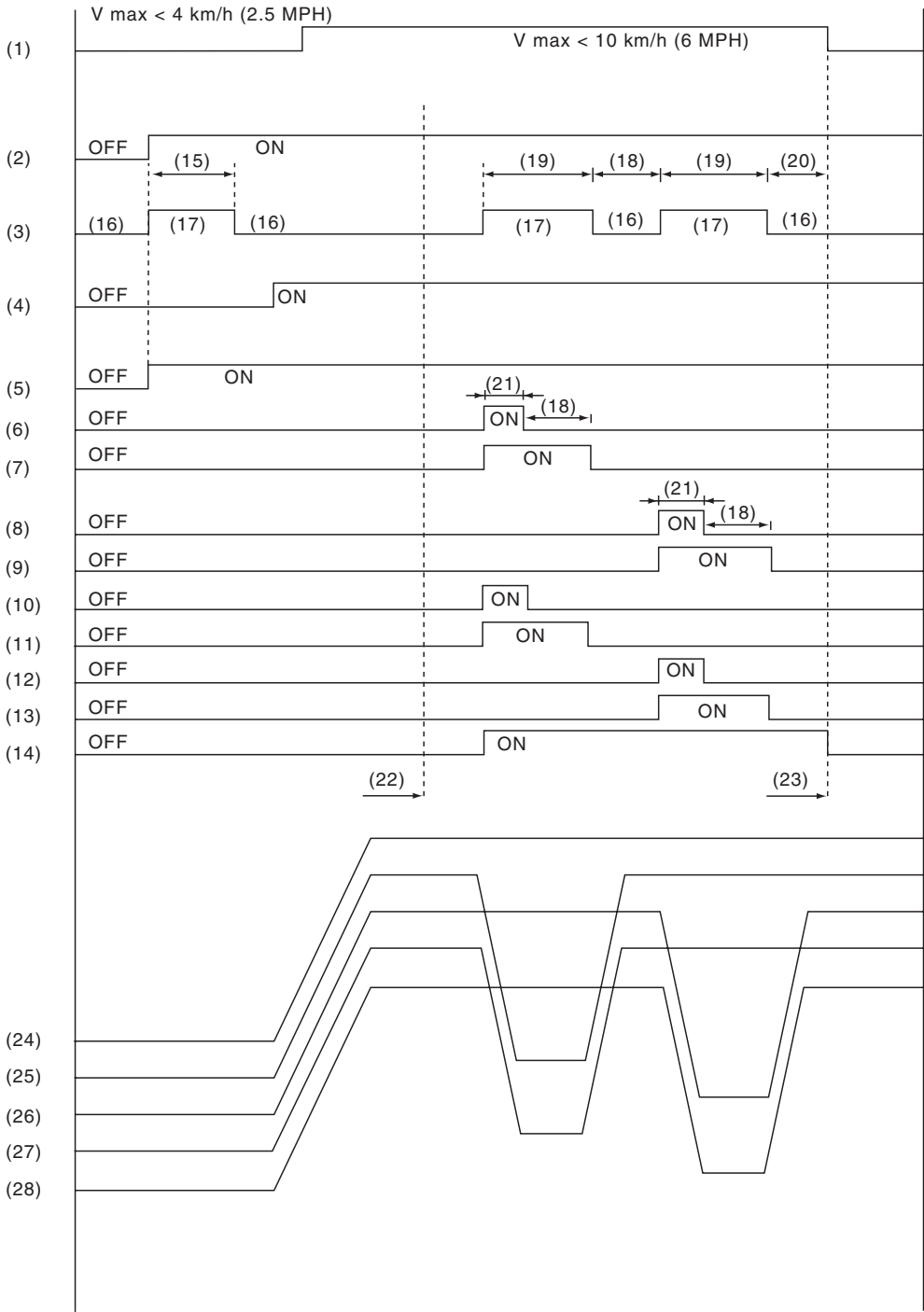
6) Execute the following operations when the message "Press the brake pedal so that the brake pedal force is between 100 and 150 kgf" is displayed.

(1) When using a brake tester, press the brake pedal pad with a force of 1,000 N (102 kgf, 225 lbf).

(2) When using a pressure gauge, press the brake pedal so that the pressure gauge indicates 3,500 kPa (36 kgf/cm², 511 psi).

7) The brake system being operated is displayed on the Subaru Select Monitor.

2. CONDITIONS FOR ABS SEQUENCE CONTROL



ABS00943

ABS Sequence Control

ABS

- | | | |
|-----------------------------|-----------------------------|---------------------------------|
| (1) All wheel speed | (11) RR compression valve | (20) 0.6 seconds |
| (2) Ignition key | (12) RL decompression valve | (21) 0.4 seconds |
| (3) ABS warning light | (13) RL compression valve | (22) Point A |
| (4) Stop light switch | (14) Pump motor | (23) Reset |
| (5) Valve relay | (15) 1.5 seconds | (24) Master cylinder pressure |
| (6) FL decompression valve | (16) Light OFF | (25) FL wheel cylinder pressure |
| (7) FL compression valve | (17) Light ON | (26) FR wheel cylinder pressure |
| (8) FR decompression valve | (18) 1.0 second | (27) RR wheel cylinder pressure |
| (9) FR compression valve | (19) 1.4 seconds | (28) RL wheel cylinder pressure |
| (10) RR decompression valve | | |

NOTE:

The control operation starts at point A.

B: SPECIFICATION

1. CONDITIONS FOR COMPLETION OF ABS SEQUENCE CONTROL

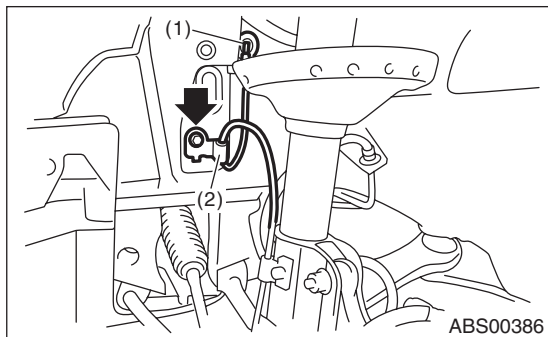
When the following conditions develop, the ABS sequence control stops and ABS operation is returned to the normal control mode.

- 1) When the speed of at least one wheel reaches 10 km/h (6 MPH).
- 2) When the brake pedal is released during ABS sequence control and the stop light switch becomes OFF.
- 3) After completion of ABS sequence control.
- 4) When a malfunction is detected.

4. Front ABS Wheel Speed Sensor

A: REMOVAL

- 1) Disconnect the ground cable from battery.
- 2) Disconnect the ABS wheel speed sensor connector located next to the front strut mounting house in the engine compartment.
- 3) Remove the sensor harness bracket.

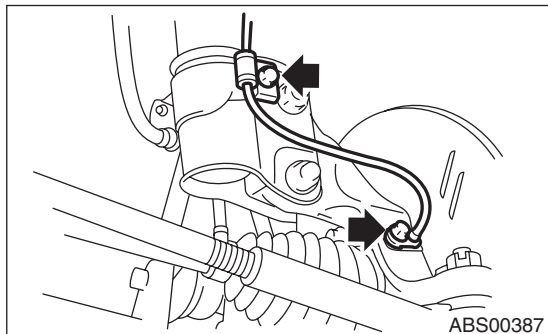


- (1) To the front ABS wheel speed sensor connector
- (2) Sensor harness bracket

- 4) Remove the bolts which secure the sensor harness to the front strut.
- 5) Remove the front ABS wheel speed sensor from housing.

CAUTION:

- Be careful not to damage the sensor.
- Do not apply excessive force to the sensor harness.



B: INSTALLATION

Install in the reverse order of removal.

Tightening torque:

Sensor:

7.5 N·m (0.76 kgf-m, 5.5 ft-lb)

Bracket:

33 N·m (3.4 kgf-m, 24.3 ft-lb)

CAUTION:

Be careful not to damage the sensor.

NOTE:

- Check the identification (mark) on the harness to make sure there is no warpage. (RH: K1 (White), LH: K2 (Yellow))
- Check if the harness is not pulled and does not come in contact with the suspension or body during steering wheel effort.

C: INSPECTION

1. CHECK WITH SUBARU SELECT MONITOR

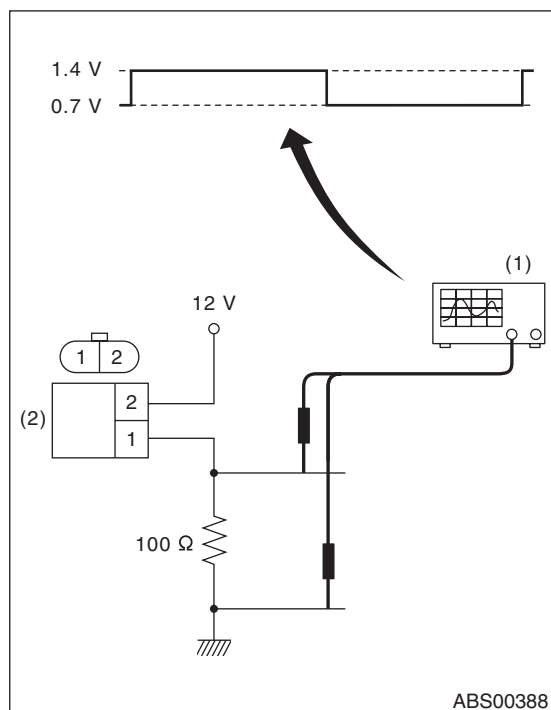
- 1) Connect the Subaru Select Monitor to the data link connector.
- 2) Select {Current Data Display & Save}. Check if the speed indicated on the display changes in the same manner as the speedometer reading during acceleration/deceleration when the steering wheel is in the straight-ahead position.
- 3) If the speed indicated on the display does not change, check the ABS wheel speed sensor. <Ref. to ABS-14, ABS WHEEL SPEED SENSOR, INSPECTION, Front ABS Wheel Speed Sensor.>

2. ABS WHEEL SPEED SENSOR

- 1) Check the tip of the ABS wheel speed sensor for foreign particles or damage. If necessary, clean the tip or replace the ABS wheel speed sensor.
- 2) Connect a 12 V power supply to No. 2 terminal of sensor connector as shown in the figure, then attach resistance to the No. 1 terminal. Rotate the wheel at about 2.75 km/h (2 MPH), and measure the voltage using an oscilloscope.

Standard value of output voltage:

0.7 — 1.4 V



- (1) Oscilloscope
(2) ABS wheel speed sensor

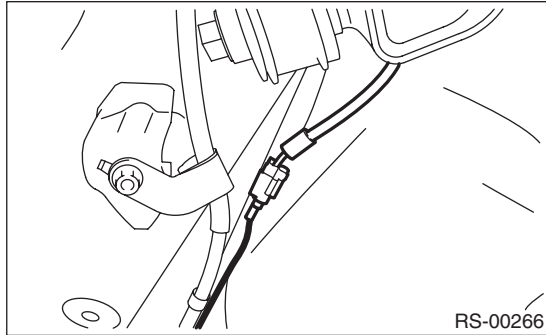
NOTE:

Check the ABS wheel speed sensor cable for discontinuity. If necessary, replace with a new part.

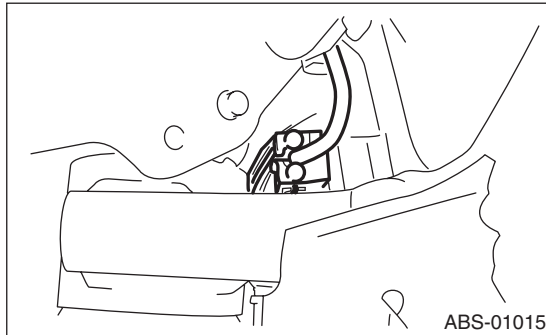
5. Rear ABS Wheel Speed Sensor

A: REMOVAL

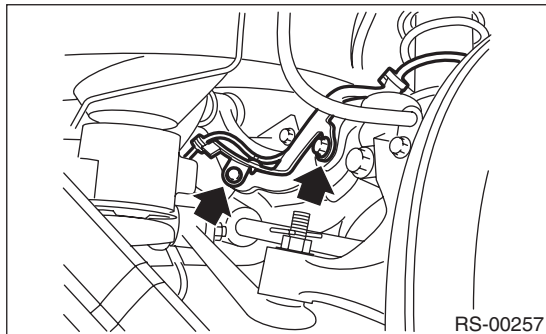
- 1) Disconnect the ground cable from the battery.
- 2) Disconnect the connector from the rear ABS wheel speed sensor.



- 3) Remove the sensor harness clamp of the rear sub frame.



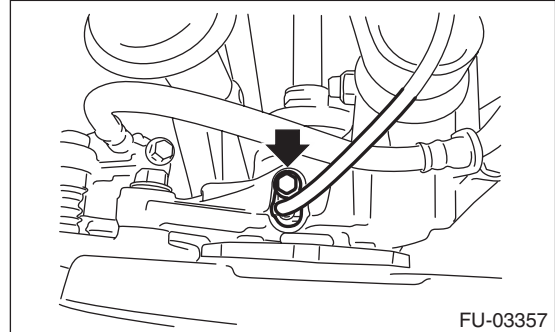
- 4) Remove the sensor harness bracket from the upper arm.



- 5) Remove the rear ABS wheel speed sensor from the rear axle.

CAUTION:

- Be careful not to damage the sensor.
- Do not apply excessive force to the sensor harness.



B: INSTALLATION

Install in the reverse order of removal.

CAUTION:

Be careful not to damage the sensor.

Tightening torque:

Sensor:

7.5 N·m (0.76 kgf-m, 5.5 ft-lb)

Bracket:

7.5 N·m (0.76 kgf-m, 5.5 ft-lb)

NOTE:

Check the identification (mark) on the harness to make sure there is no warpage.

(RH: P1 (Pink), LH: P2 (Blue))

C: INSPECTION

1. ABS WHEEL SPEED SENSOR

<Ref. to ABS-14, ABS WHEEL SPEED SENSOR, INSPECTION, Front ABS Wheel Speed Sensor.>

6. Front Magnetic Encoder

A: REMOVAL

Refer to “Front Hub Bearing” for removal, because the front magnetic encoder is integrated with front hub bearing.

<Ref. to DS-17, REMOVAL, Front Hub Unit Bearing.>

B: INSTALLATION

Refer to “Front Hub Bearing” for installation, because the front magnetic encoder is integrated with front hub bearing.

<Ref. to DS-18, INSTALLATION, Front Hub Unit Bearing.>

C: INSPECTION

Visually check the magnetic encoder for any damage. If necessary, replace with a new hub unit bearing.

NOTE:

Because the magnetic encoder is integrated with hub unit bearing assembly, replace the hub unit bearing with a new part if there is any defect found on the magnetic encoder.

7. Rear Magnetic Encoder

A: REMOVAL

Refer to “Rear Hub Unit Bearing” for removal, because the rear magnetic encoder is integrated with rear hub unit bearing.

<Ref. to DS-22, REMOVAL, Rear Hub Unit Bearing.>

B: INSTALLATION

Refer to “Rear Hub Unit Bearing” for installation, because the rear magnetic encoder is integrated with rear hub unit bearing.

<Ref. to DS-23, INSTALLATION, Rear Hub Unit Bearing.>

C: INSPECTION

Visually check the magnetic encoder parts for any damage. If necessary, replace with a new hub unit bearing.

NOTE:

Because the magnetic encoder is integrated with hub unit bearing assembly, replace the hub unit bearing with a new part if there is any defect found on the magnetic encoder.

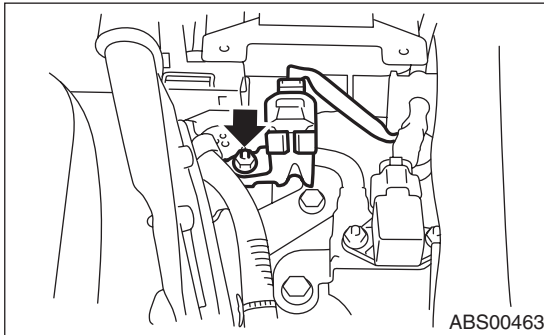
8. G Sensor

A: REMOVAL

- 1) Disconnect the ground cable from the battery.
- 2) Remove the console box.
<Ref. to EI-47, REMOVAL, Console Box.>
- 3) Disconnect the connector from G sensor.
- 4) Remove the G sensor from the body.

CAUTION:

- Do not drop or bump the G sensor.
- The G sensor integrated with the bracket. Do not disassemble.



B: INSTALLATION

Install in the reverse order of removal.

CAUTION:

Do not drop or bump the G sensor.

Tightening torque:

Refer to “COMPONENT” for tightening torque. <Ref. to ABS-3, ABS WHEEL SPEED SENSOR, COMPONENT, General Description.>

C: INSPECTION

Step	Check	Yes	No
1 CHECK G SENSOR. 1) Turn the ignition switch to OFF. 2) Connect the Subaru Select Monitor to the data link connector. 3) Set the Subaru Select Monitor to the {Brake Control} mode. 4) Set the display in the {Current Data Display & Save} mode. 5) Read the G sensor output value.	Is the value $-1.2 \text{ — } 1.2 \text{ m/s}^2$ when the vehicle is in horizontal position?	Go to step 2.	Repair the harness connector between the G sensor and ABSCM&H/U. Or replace G sensor.
2 CHECK G SENSOR. 1) Remove the console box. 2) Remove the G sensor from vehicle. (Do not disconnect the connector.) 3) Read the Subaru Select Monitor display.	Is the value $8.1 \text{ — } 11.2 \text{ m/s}^2$ when G sensor is inclined forward to 90° ?	Go to step 3.	Repair the harness connector between the G sensor and ABSCM&H/U. Or replace G sensor.
3 CHECK G SENSOR. Read the Subaru Select Monitor display.	Is the value $-8.1 \text{ — } -11.2 \text{ m/s}^2$ when G sensor is inclined backward 90° ?	G sensor is normal.	Repair the harness connector between the G sensor and ABSCM&H/U. Or replace G sensor.