General Information

Specifications

Item		Specification
Master cylinder	Type	Tandem
	Cylinder I.D.	26.99 mm (1.063 in)
	Piston stroke	31±1 mm (1.22±0.039 in)
	Fluid level switch	Provided
Brake booster	Type	9" + 9" Tandem
	Boosting ratio	9 : 1
Front Disc brake	Type	Ventilated disc
	Disc O.D.	328 mm (12.91 in)
	Disc thickness	28 mm (1.10 in)
	Caliper piston	Double
	Cylinder I.D.	Ø 48mm(1.89 in) X 2
Rear brake	Type	Solid disc
	Disc O.D.	324 mm (12.76 in)
	Disc thickness	13 mm (0.51 in)
	Caliper piston	Single
Parking brake	Type	DIH (Drum in hat)
	Drum I.D.	Ø 210 mm (7.48 in)

NOTICE

O.D. : Outer Diameter

I.D : Inner Diameter

Specification(ABS)

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	
	Type	Motor, valve relay intergrated type	
	Operating Voltage	10 ~ 16 V	
	Operating Temperature	-40 ~ 120 °C (-40 ~ 248°F)	
	Motor power	270 W	
Active Wheel speed sensor (ABS)	Supply voltage	DC 4.5 ~ 20 V	
	Output current low	5.9 ~ 8.4 mA	
	Output current high	11.8~ 16.8 mA	
	Output range	1 ~ 2500 Hz	
	Tone wheel	48 teeth	
	Air gap	0.5 ~ 1.5 mm	

Specification(ESP)

Part	Item	Standard value	Remark
HECU	System	4 Channel 4 Sensor (Solenoid)	Total control (ABS, EBD, TCS, ESP)
	Type	Motor, valve relay intergrated type	
	Operating Voltage	10 ~ 16 V	
	Operating Temperature	-40 ~ 120 °C (-40 ~ 248°F)	
	Motor power	270 W	
Active Wheel speed sensor (ABS)	Supply voltage	DC 4.5 ~ 20 V	
	Output current low	5.9 ~ 8.4 mA	
	Output current high	11.8~ 16.8 mA	
	Output range	1 ~ 2500 Hz	
	Tone wheel	48 teeth	
	Air gap	0.5 ~ 1.5 mm	
Steering Wheel Angle Sensor	Operating Voltage	8 ~ 16 V	
	Current Consumption	Max. 150 mA	
	Output measurement range	-780 ~ +199.9 °	
	Operating Angular velocity	0 ~ 1016 °/sec	
Yaw rate & Lateral G sensor (CAN TYPE)	Operating Voltage	8 V ~ 17 V	
	Current Consumption	Max. 140 mA	
	Yaw rate sensor measurement range	± 75 °/sec	
	Lateral G sensor measurement range	± 14.715 m/s²	

Service Standard

Items	Standard vale
Brake pedal height (Common pedal)	188 mm (7.40 in)
Brake pedal height (Adjustable pedal)	188 mm (7.40 in)
Brake pedal Full stroke (Common pedal)	128 mm (5.04 in)
Brake pedal Full stroke (Adjustable pedal)	128 mm (5.04 in)
Brake pedal Adjust stroke (Adjustable pedal)	71.5±2mm (2.82±0.079 in)
Stop lamp clearance	1.0 ~ 1.5 mm (0.04 ~ 0.06 in)
Brake pedal free play	3 ~ 8 mm (0.12 ~ 0.31 in)
Front brake disc thickness	28 mm (1.10 in)
Front brake disc pad thickness	10.5 mm (0.41 in)
Rear brake disc thickness	13 mm (0.51 in)
Rear brake disc pad thickness	10 mm (0.39 in)

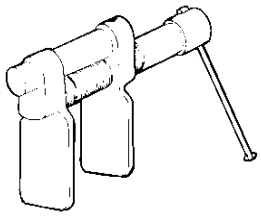
Tightening Torques

Items		N.m	kgf.m	lb-ft
Hub nut		88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Master cylinder to brake booster		12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
Brake booster mounting nuts		12.7 ~ 15.7	1.3 ~ 1.6	9.4 ~ 11.6
Air bleeding screw		6.9 ~ 12.7	0.7 ~ 1.3	5.1 ~ 9.4
Brake tube flare nuts	ABS	12.7 ~ 16.7	1.3 ~ 1.7	9.4 ~ 12.3
	ESP	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Front caliper guide rod bolts		21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Rear caliper guide rod bolts		21.6 ~ 31.4	2.2 ~ 3.2	15.9 ~ 23.1
Front caliper assembly to knuckle		78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Rear caliper assembly to knuckle		63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Brake hose to caliper		24.5 ~ 29.4	2.5 ~ 3.0	18.1 ~ 21.7
Brake pedal member bracket bolts		16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Brake pedal shaft nut		19.6 ~ 25.5	2.0 ~ 2.6	14.5 ~ 18.8
Stop lamp switch lock nut	Common pedal	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
	Adjustable pedal	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
Wheel speed sensor mounting bolt		6.9 ~ 10.8	0.7 ~ 1.1	5.0 ~ 8.0
HECU bracket mounting bolt and nut		16.7 ~ 25.5	1.7 ~ 2.6	12.3 ~ 18.8
Yaw rate & G sensor mounting bolts		4.9 ~ 6.7	0.5 ~ 0.7	3.6 ~ 5.1

Lubricants

Items	Recommended	Quantity
Brake fluid	DOT 3 or DOT 4	As required
Brake pedal bushing and bolt	Chassis grease	As required
Parking brake shoe and backing plate contacting surface	Heat resistance grease	As required
Front caliper guide rod and boot	AI-11P	1.0 ~ 1.7 g
Rear caliper guide rod and boot	AI-11P	0.8 ~ 1.3 g

Special Service Tools

Tool(Number and Name)	Illustration	Use
09581-11000 Piston expander	 EJDA043A	Spreading the front disc brake piston.

Problem Symptoms Table

Use the table below to help you find the cause of theproblem. The numbers indicate the priority of the likecause of the problem. Check each part in order.

If necessary, replace these parts.

Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance(Out of adjustment) 5. Master cylinder (Inoperative)	repair air·bleed replace adjust replace
Brake drag	1. Brake pedal free play (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Rear brake shoe clearance(Out of adjustment) 5. Pad or lining (Cracked or distorted) 6. Piston (Stuck) 7. Piston (Frozen) 8. Anchor or Return spring (Inoperative) 9. Booster system (Vacuum leaks) 10. Master cylinder (Inoperative)	adjust adjust repair adjust replace replace replace replace repair replace
Brake pull	1. Piston (Sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	replace replace replace replace replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad or lining (Worn) 4. Pad or lining (Cracked or distorted) 5. Rear brake shoe clearance(Out of adjustment) 6. Pad or lining (Oily) 7. Pad or lining (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	repair air·bleed replace replace adjust adjust replace replace repair
Noise from brake	1. Pad or lining (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Sliding pin (Worn) 5. Pad or lining (Dirty) 6. Pad or lining (Glazed) 7. Anchor or Return spring (Faulty) 8. Brake pad shim (Damage) 9. Shoe hold-down spring (Damage)	replace adjust replace replace clean replace replace replace replace
Brake fades	1. master cylinder	replace

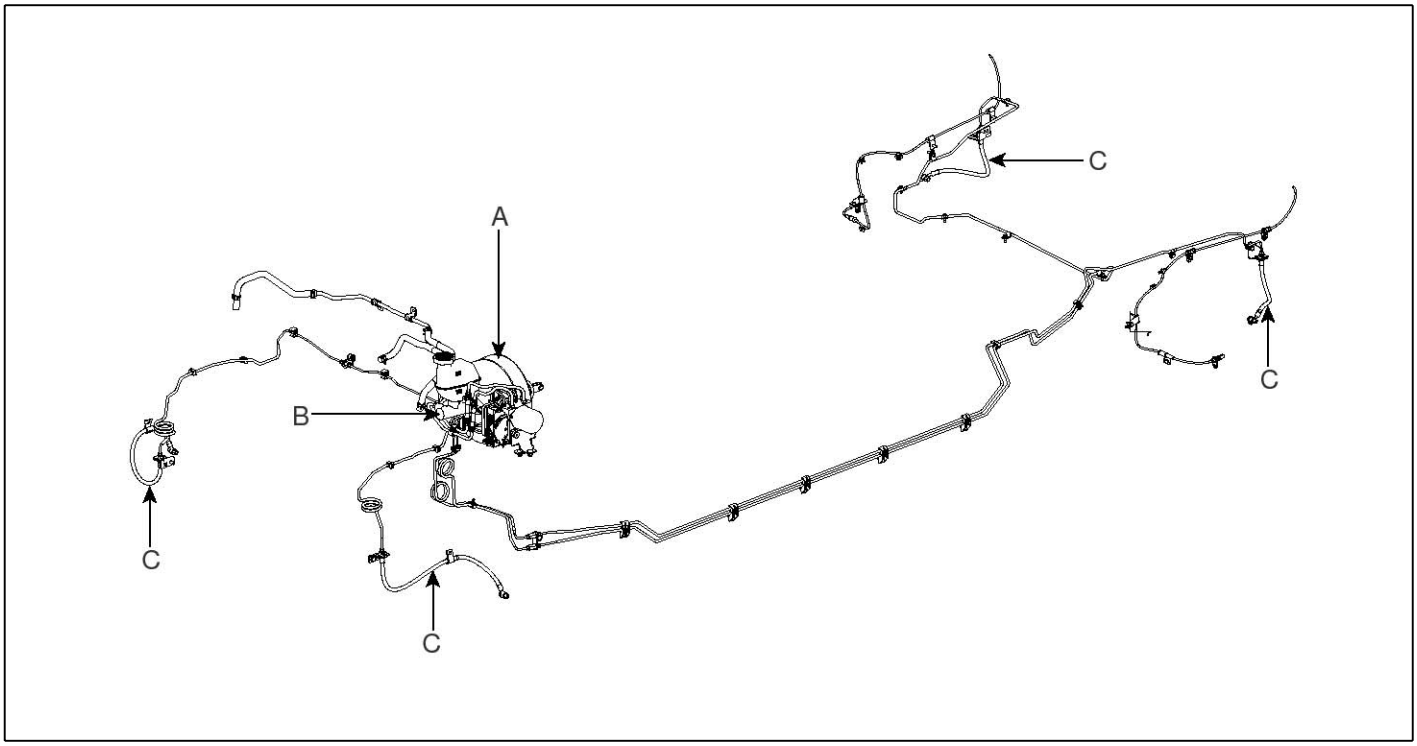
Symptom	Suspect Area	Reference
Brake vibration, pulsation	1. brake booster 2. pedal free play 3. master cylinder 4. caliper 5. master cylinder cap seal 6. damaged brake lines	replace adjust replace replace replace replace
Brake Chatter	Brake chatter is usually caused by loose or worn components, or glazed or burnt linings. Rotors with hard spots can also contribute to brake chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.	

Brake System

Operation and Leakage Check

Check all of the following items:

Component	Procedure
Brake Booster (A)	Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.
Piston cup and pressure cup inspection (B)	• Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. Replace the master cylinder as an assembly if the pedal does not work properly or if there is damage or signs of fluid leakage. • Check for a difference in brake pedal stroke between quick and slow brake applications. Replace the master cylinder if there is a difference in pedal stroke.
Brake hoses (C)	Look for damage or signs of fluid leakage. Replace the brake hose with a new one if it is damaged or leaking.
Caliper piston seal and piston boots (D)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, disassemble and inspect the brake caliper. Replace the boots and seals with new ones whenever the brake caliper is disassembled.



SHMBR8363D

Brake System Bleeding

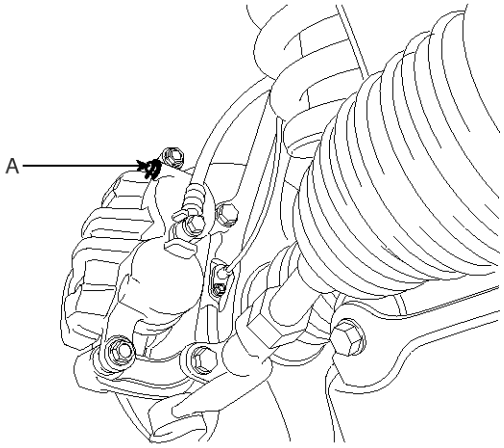
⚠CAUTION

- **Do not reuse the drained fluid.**
- **Always use genuine DOT3/DOT4 brake Fluid.**

  Using a non-genuine DOT3/DOT4 brake fluid can cause corrosion and decrease the life of the system.
- **Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.**
- **Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.**
- **The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.**

1. Make sure the brake fluid in the reservoir is at the MAX(upper) level line.
2. Have someone slowly pump the brake pedal several times, and then apply pressure.
3. Loosen the right-rear brake bleed screw (A) to allow air to escape from the system. Then tighten the bleed screw securely.

Front



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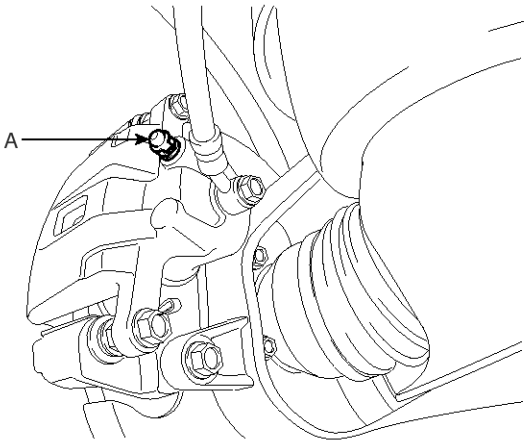
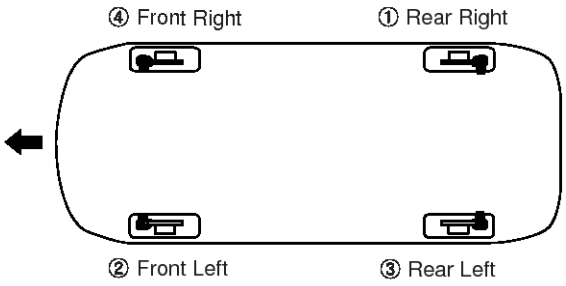
Rear



SHMBR8365D

4. Repeat the procedure for wheel in the sequence shown below until air bubbles no longer appear in the fluid.

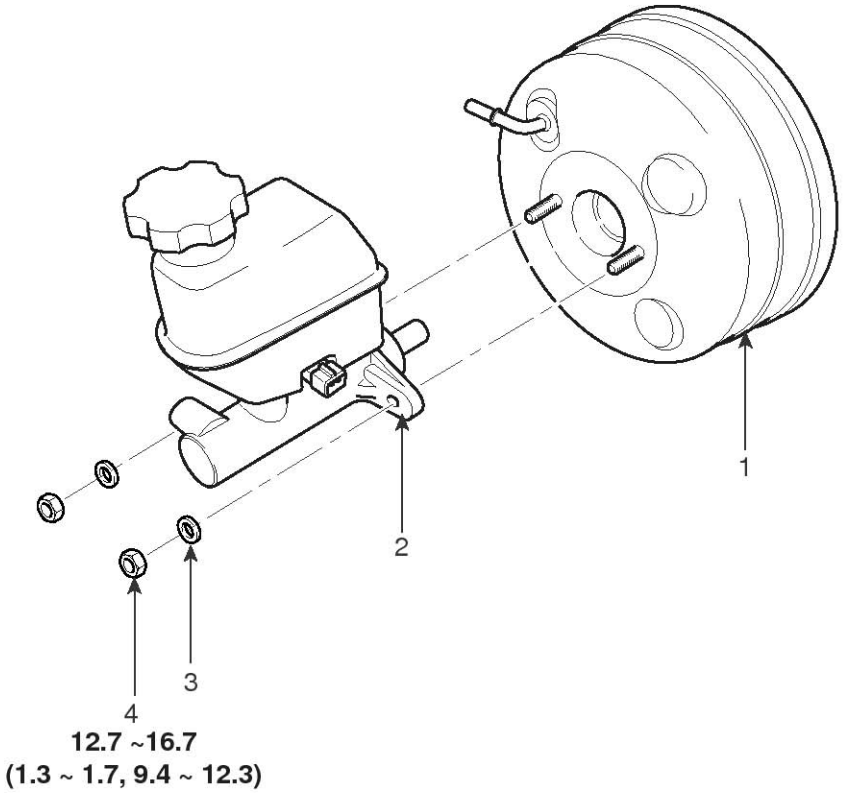


EJKE003B

5. Refill the master cylinder reservoir to MAX(upper) level line.

Brake Booster

Components



Torque : N.m (kgf.m, lb-ft)

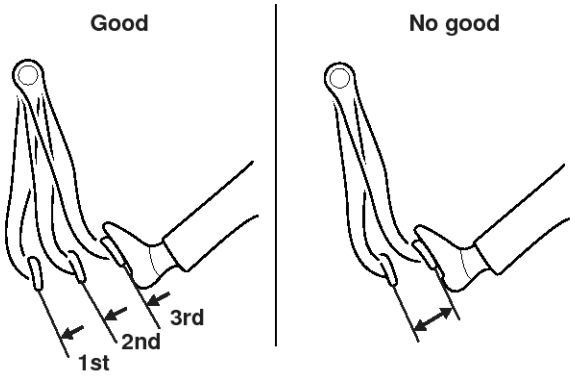
SHMBR9300L

1. Brake booster
2. Master cylinder assembly
3. Washer
4. Nut

Brake Booster Operating Test

For simple checking of the brake booster operation, carry out the following tests.

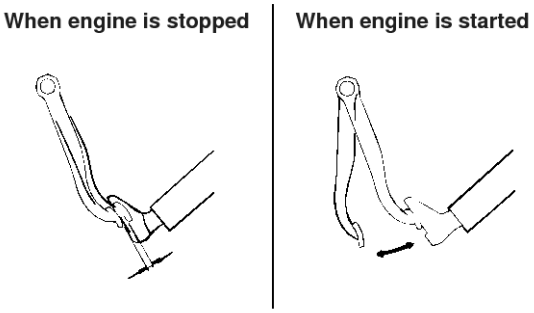
1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is inoperative.



EJRF500B

2. With the engine stopped, step on the brake pedal several times.

   Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is inoperative.

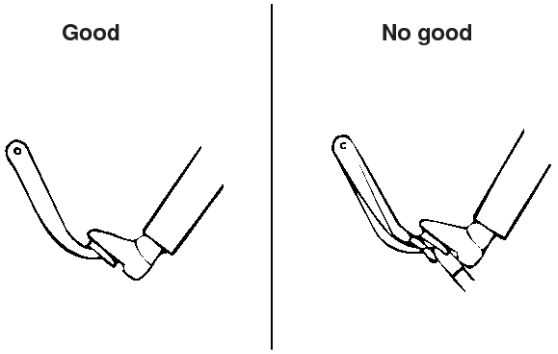


SCMBR6500L

3. With the engine running, step on the brake pedal and then stop the engine.Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is inoperative.

   If the above three tests are okay, the booster performance can be determined as good.

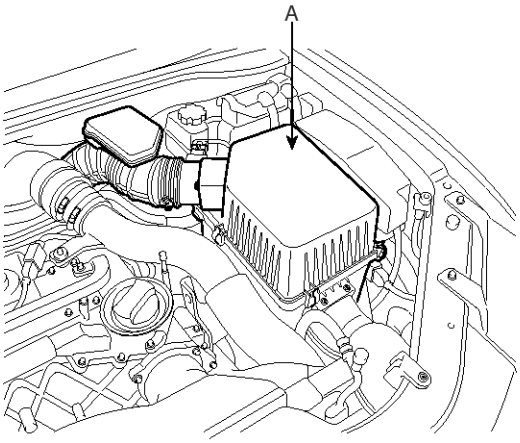
   Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for malfunction.



EJRF500C

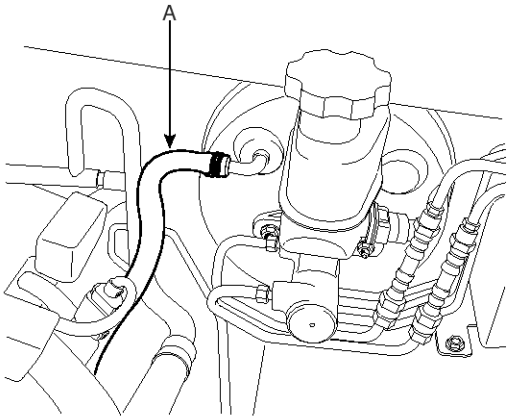
Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable
2. Remove the air cleaner assembly (A).



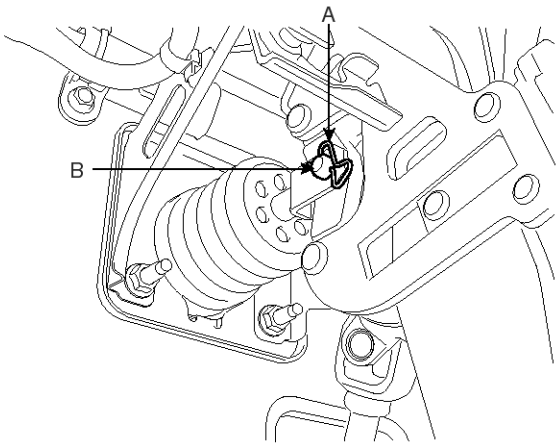
SHMBR8368D

3. Disconnect the vacuum hose (A) from the brake booster.



SHMBR8369D

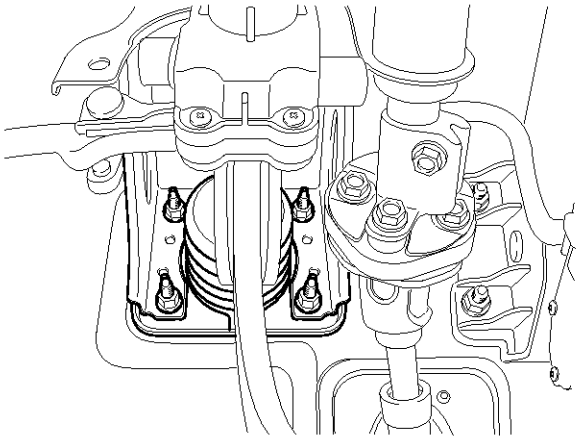
4. Remove the master cylinder. (Refer to Master cylinder)
5. Remove the ECM. (Refer to Fuel system group –ECM)
6. Remove the ABS control module. (Refer to ABS control module)
7. Remove the snap pin (A) and clevis pin (B).



SHMBR9329L

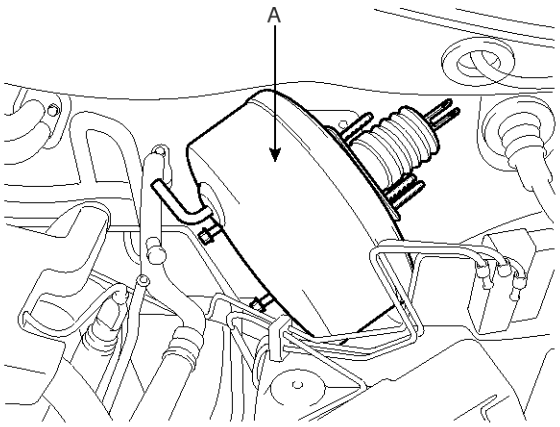
8. Remove the mounting nuts.

Tightening torque:
12.7 ~15.7 N.m (1.3 ~1.6 kgf.m, 9.4 ~11.6 lb-ft)



SHMBR8371D

9. Remove the brake booster.



SHMBR8372D

Inspection

1. Inspect the check valve in the vacuum hose.

   ⚠CAUTION
   Do not remove the check valve from the vacuum hose.

2. Check the boot for damage.

Installation

1. Installation is the reverse of removal.

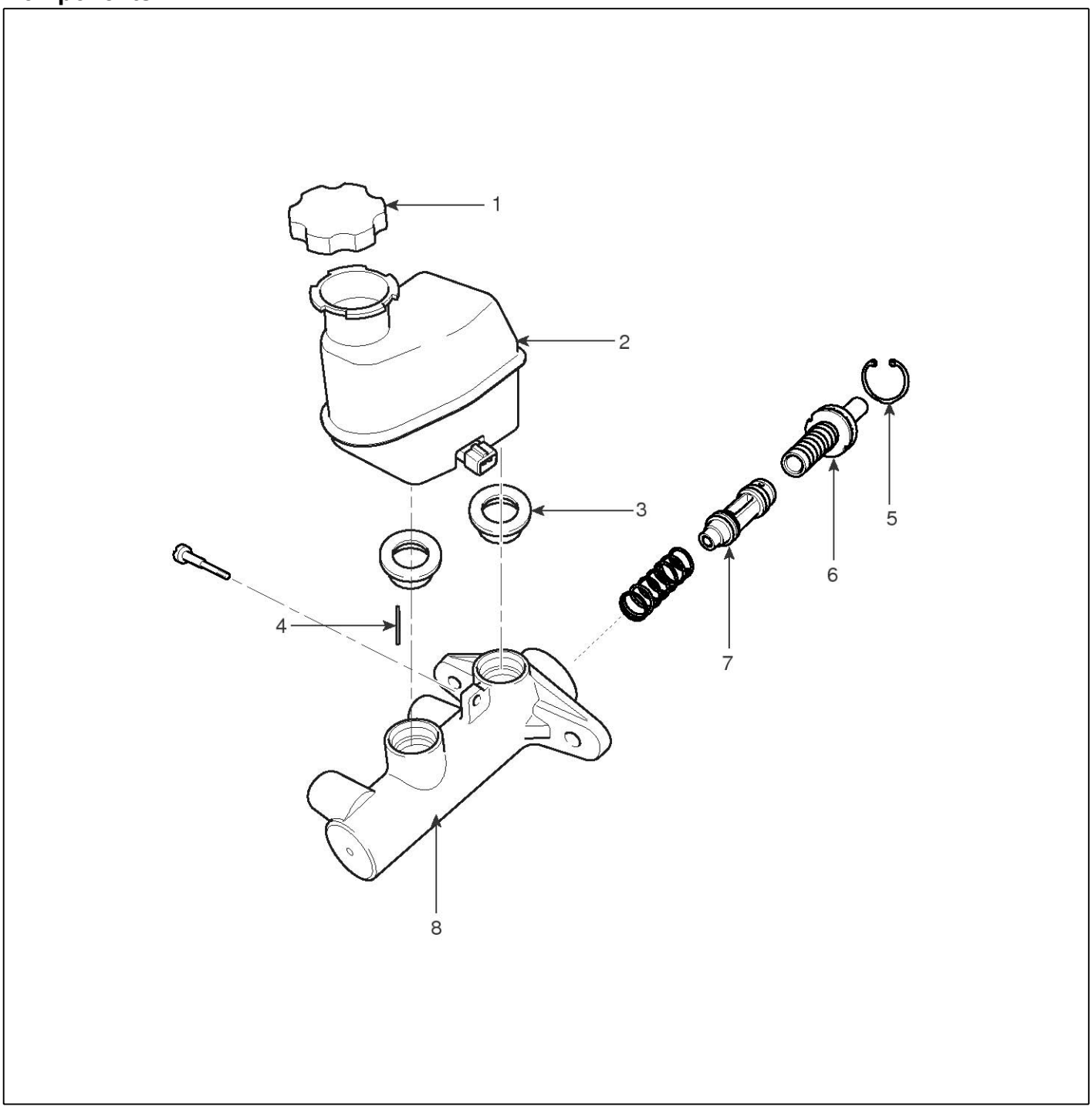
   ⚠CAUTION
   - **Before installing the pin, apply the grease to the joint pin.**
   - **Use a new snap pin whenever installing.**

2. After installing, bleed the brake system. (Refer to Brake system bleeding)
3. Adjust the brake pedal height and free play.

   (Refer to Brake pedal height and free play adjustment)

Master Cylinder

Components

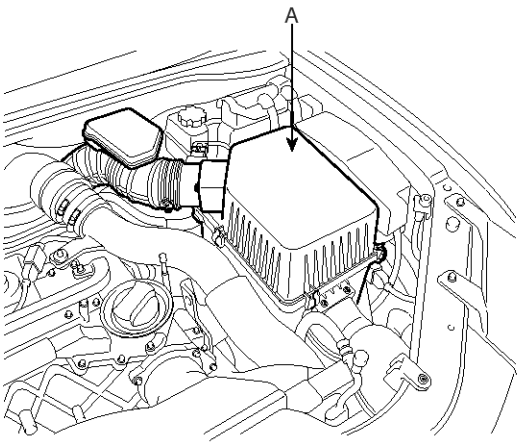


SHMBR8373D

1. Reservoir cap
2. Reservoir
3. Grommet
4. Cylinder pin
5. Retainer
6. Primary piston assembly
7. Secondary piston assembly
8. Master cylinder body

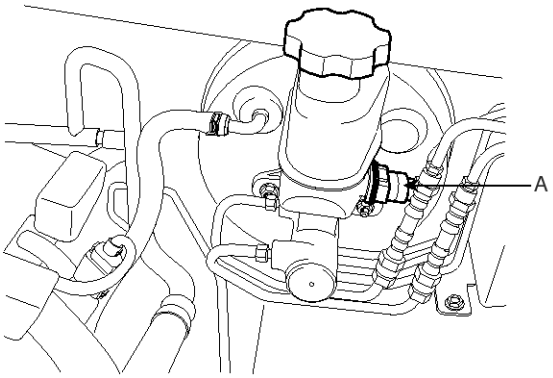
Removal

1. Remove the air cleaner assembly (A).



SHMBR8374D

2. Disconnect the brake fluid level switch connector (A) from the reservoir.



SHMBR9301L

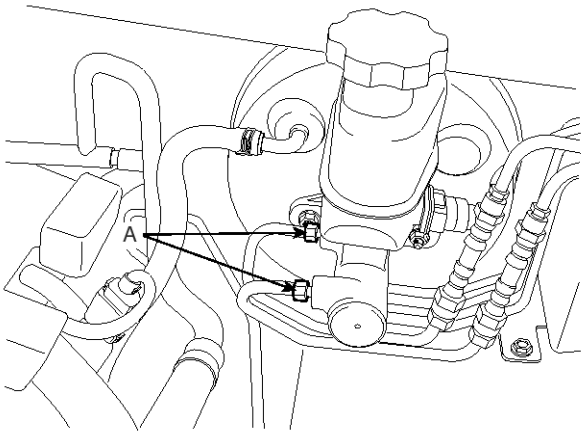
3. Remove the brake fluid from the master cylinder reservoir with a syringe.

⚠CAUTION

- **Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.**

4. Disconnect the brake tube (A) from the master cylinder by loosening the tube flare nut.

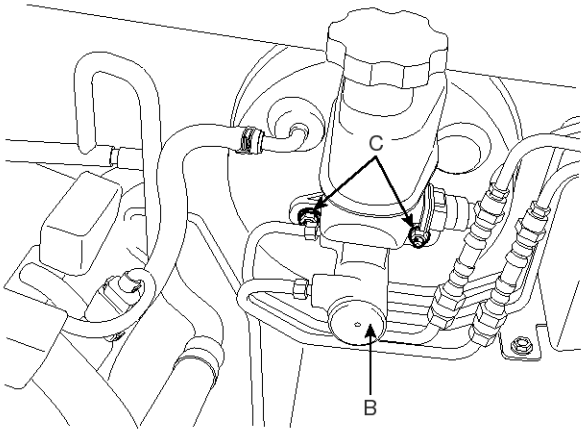
Tightening torque:
ABS : 12.7 ~ 16.7N.m (1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft)
ESP : 18.6 ~ 22.6N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)



SHMBR8376D

5. Remove the master cylinder (B) from the brake booster after loosening the mounting nuts (C).

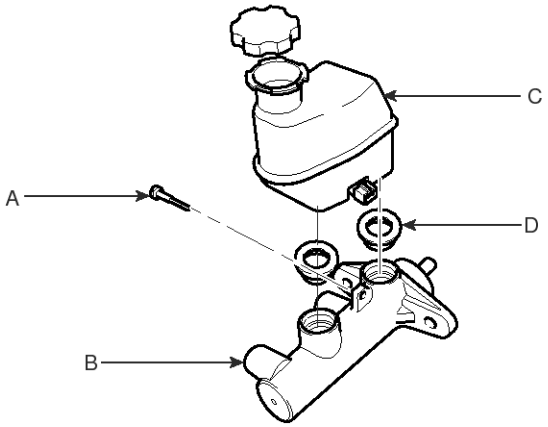
Tightening torque:
12.7 ~16.7N.m (1.3 ~1.7kgf.m, 9.4 ~12.3lb-ft)



SHMBR9302L

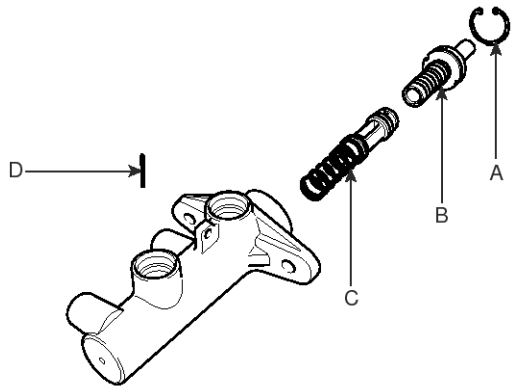
Disassembly

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove the reservoir (C) from the master cylinder (B), after remove mounting screw (A).



SHMBR8377D

3. Remove the retainer ring (A) by using the snap ring pliers.



SHMBR8378D

4. Remove the primary piston assembly (B).
5. Remove the pin (D) with the secondary piston(C) pushed completely using a screwdriver. Remove the secondary piston assembly (C).

NOTICE

Do not disassemble the primary and secondary piston assembly.

Inspection

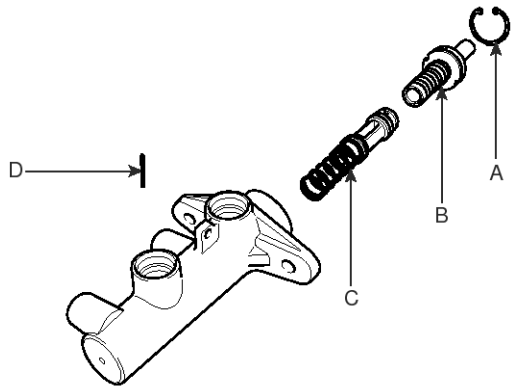
1. Check the master cylinder bore for rust or scratching.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

- **If the cylinder bore is damaged, replace the master cylinder assembly.**
- **Wash the contaminated parts in alcohol.**

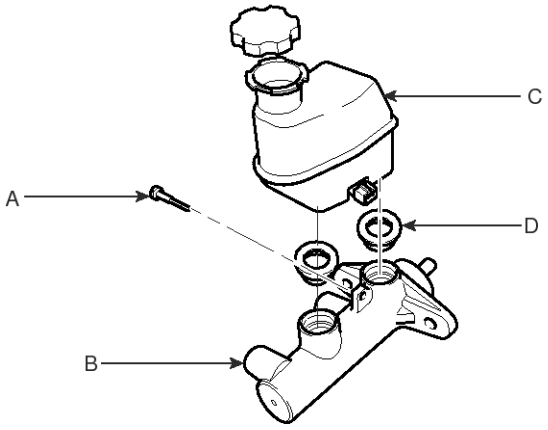
Reassembly

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
2. Carefully insert the springs and pistons in the proper direction.
3. Press the secondary piston (C) with a screwdriver and install the cylinder pin (D).



SHMBR8378D

4. Install the retainer ring (A) after installing primary piston assembly (B).
5. Mount two grommets (D).



SHMBR8377D

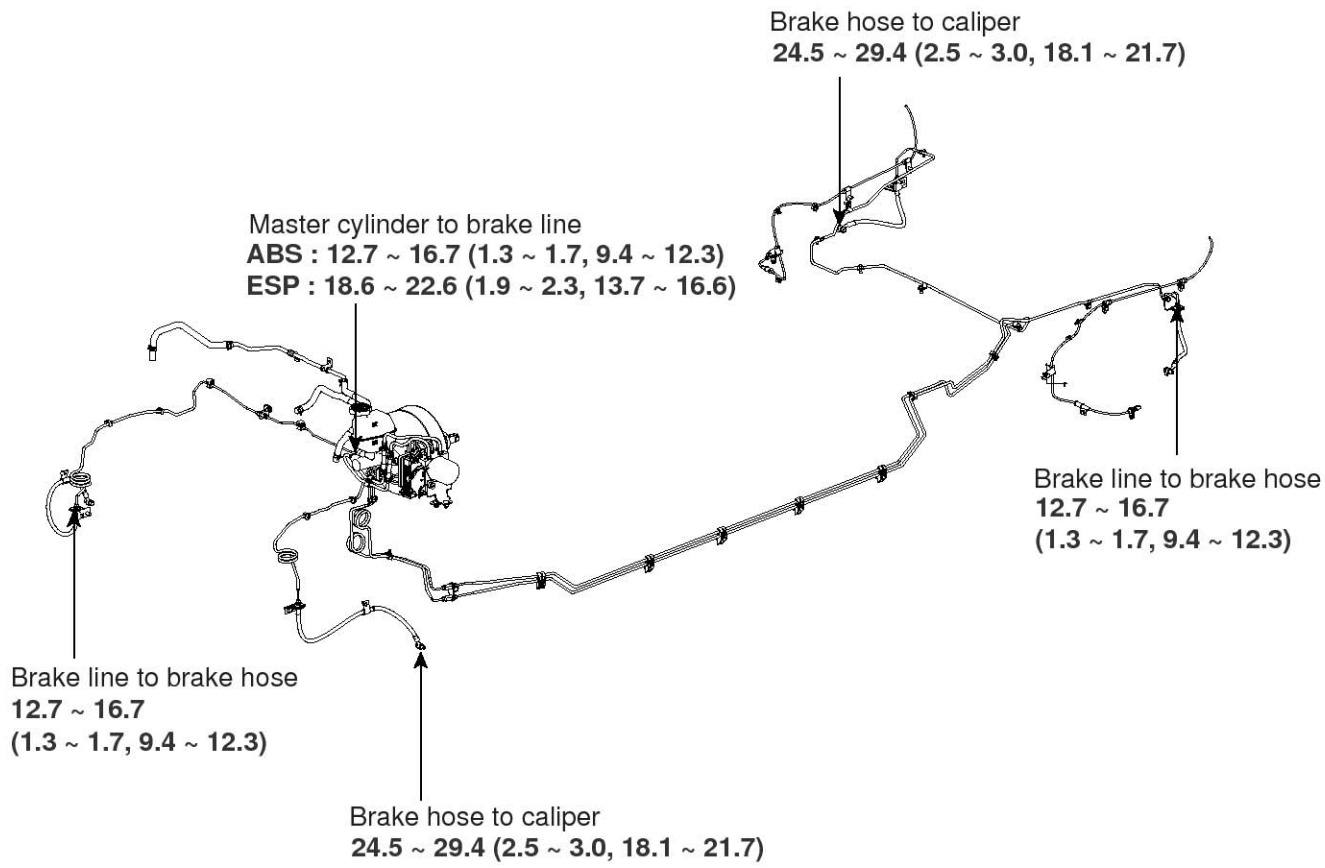
6. Install the reservoir (C) on the cylinder (B), and then install the mounting screw (A).

Installation

1. Installation is the reverse of removal.
2. After installation, bleed the brake system. (Refer to Brake system bleeding)

Brake Line

Components



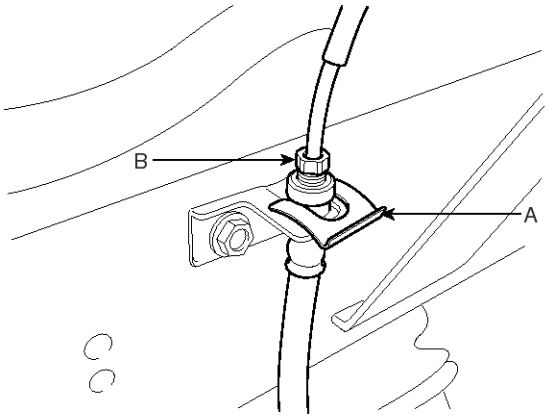
Torque : N.m (kgf.m, lb-ft)

SHMBR9303L

Removal

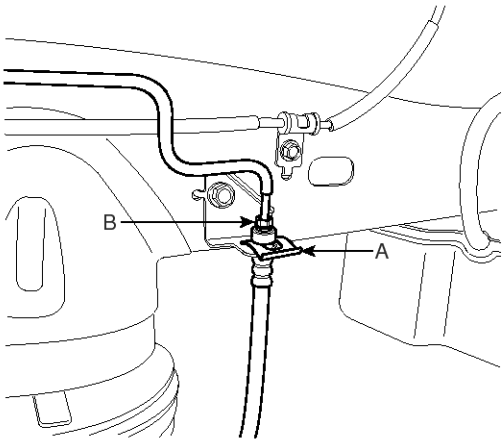
1. Remove the wheel & tire.
2. Remove the brake hose clip (A).

Front



SHMBR8382D

Rear



SHMBR8383D

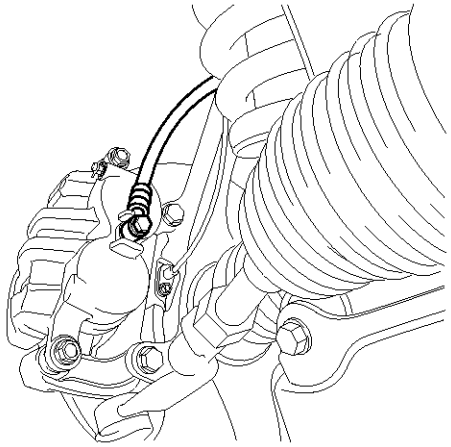
3. Disconnect the brake tube by loosening the tube flare nut (B).

Tightening torque:
12.7 ~16.7 N.m (1.3 ~1.7 kgf.m, 9.4 ~12.3 lb-ft)

4. Disconnect the brake hose from the brake caliper by loosening the bolt.

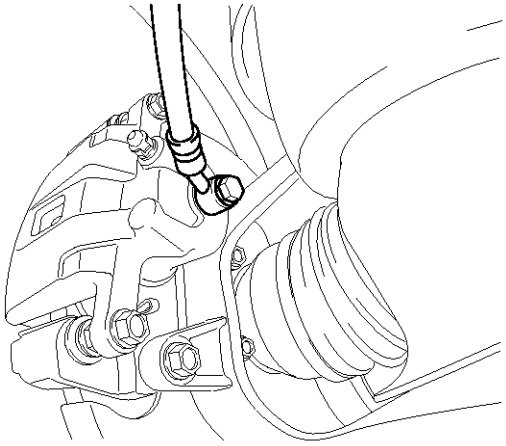
Tightening torque:
24.5 ~29.4 N.m (2.5 ~3.0 kgf.m, 18.1 ~21.7 lb-ft)

Front



SHMBR8384D

Rear



SHMBR8385D

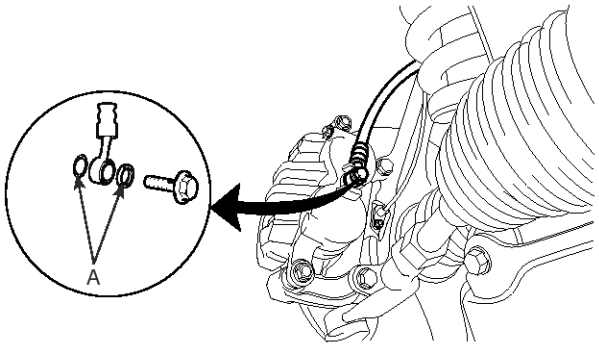
Inspection

1. Check the brake tubes for cracks, crimps and corrosion.
2. Check the brake hoses for cracks, damage and fluid leakage.
3. Check the brake tube flare nuts for damage and fluid leakage.
4. Check brake hose mounting bracket for crack or deformation.

Installation

1. Installation is the reverse of removal.

   ⚠CAUTION
   Use a new washer (A) whenever installing.

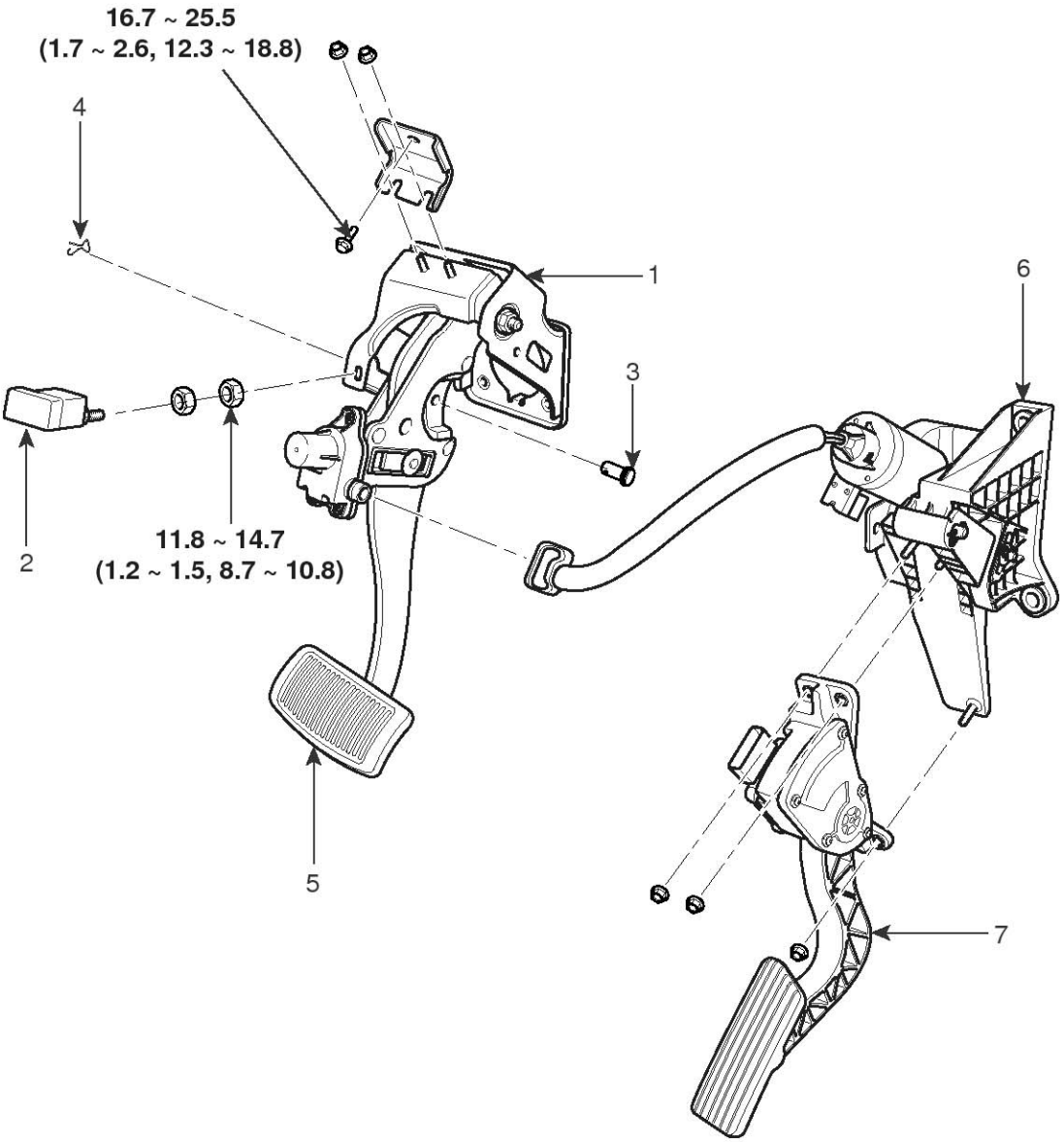


SHMBR8386D

2. After installation, bleed the brake system. (Refer to Brake system bleeding)
3. Check the spilled brake oil.

Brake Pedal

Components



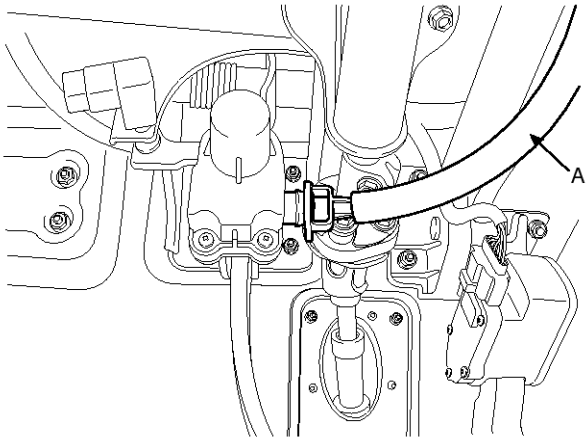
Torque : N.m (kgf.m, lb-ft)

SHMBR9304L

1. Brake pedal member assembly
2. Stop lamp switch
3. Clevis pin
4. Snap pin
5. Brake pedal
6. Accelerator pedal bracket
7. Accelerator pedal assembly

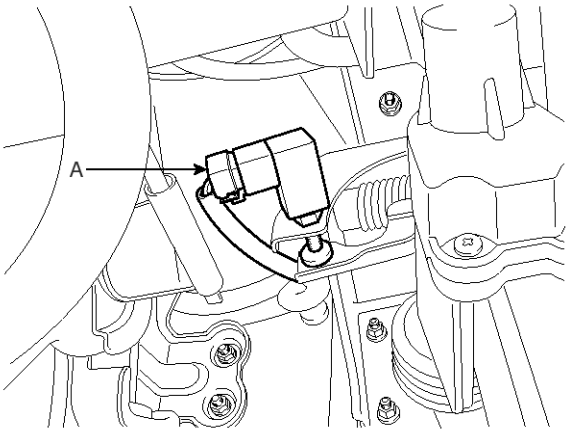
Removal

1. Remove the crash pad lower panel. (Refer to the Body group- crash pad).
2. Remove the IPM after removing the nut and connector. (Refer to the Body Electrical System group-BCM)
3. Disconnect the adjust cable (A).



SHMBR9305L

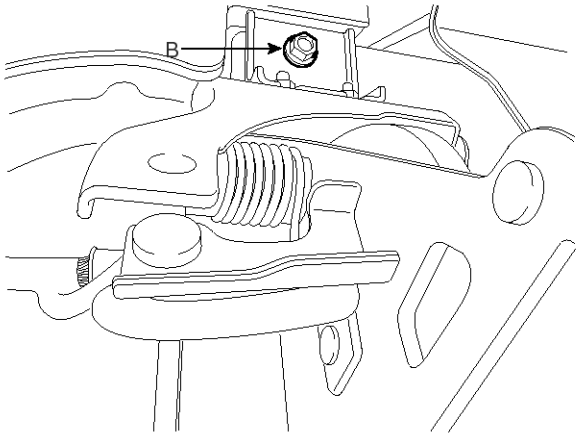
4. Remove the steering column assembly by loosening the mounting nuts.
5. Disconnect the stop lamp switch connector (A).



SHMBR8389D

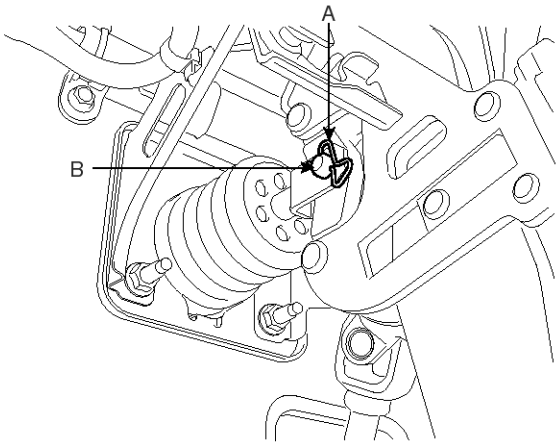
6. Remove the mounting bracket bolts (B).

Tightening torque:
16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)



SHMBR8390D

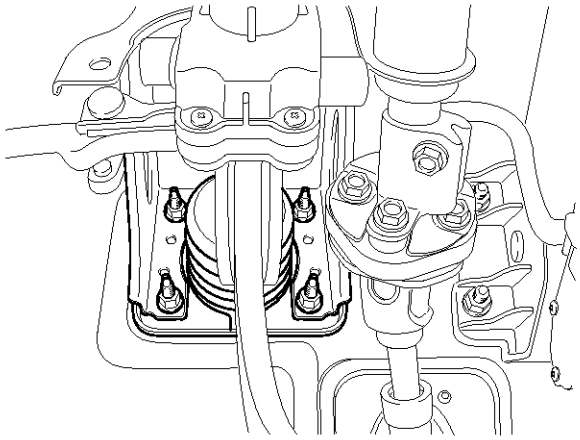
7. the snap pin (A) and clevis pin (B).



SHMBR9329L

8. Remove the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.

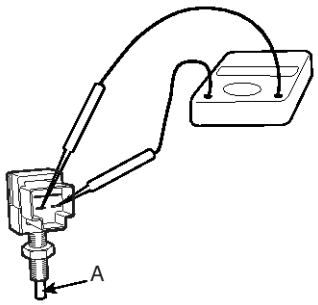
Tightening torque:
12.7 ~15.7 N.m (1.3 ~1.6 kgf.m, 9.4 ~11.6 lb-ft)



SHMBR8371D

Inspection

1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch.
   1) Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.
   2) The stop lamp switch is in good condition if there is no continuity when plunger(A) is pushed.



SCMBR6530D

Installation

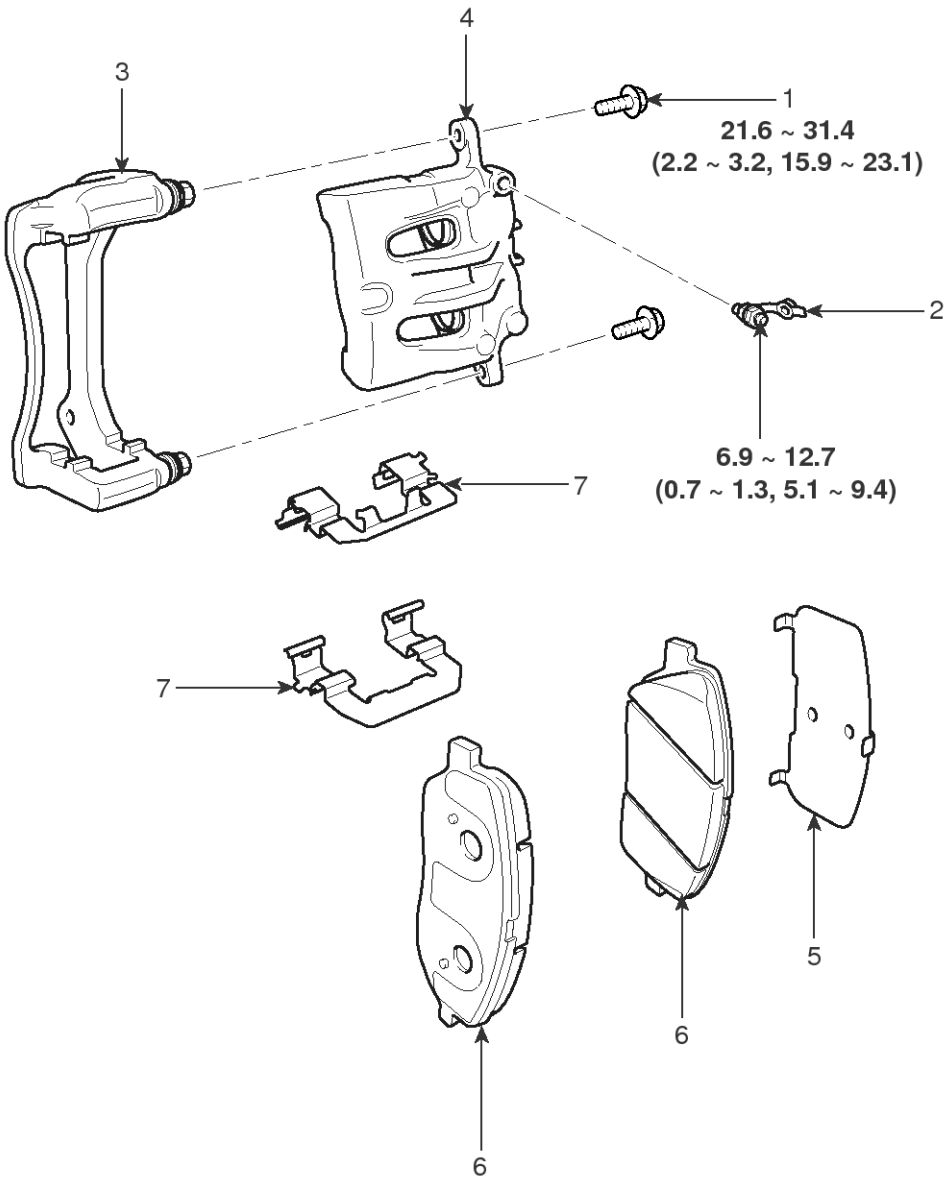
1. Installation is the reverse of removal.

   ⚠CAUTION
   - **Before installing the pin, apply the grease to the clevis pin.**
   - **Use a new snap pin whenever installing.**

2. Check the brake pedal operation.

Front Disc Brake

Components



Torque : N.m (kgf.m, lb-ft)

SHMBR9306L

1. Guide rod bolt
2. Bleed screw
3. Caliper bracket
4. Caliper body
5. Inner pad shim
6. Brake pad
7. Pad retainer

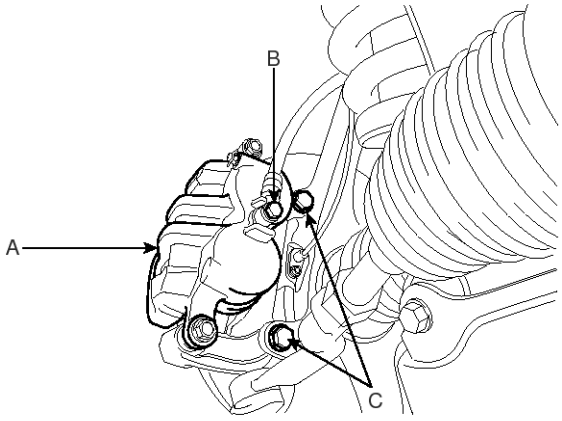
Removal

1. Remove the front wheel & tire.

Tightening torque:
88.3 ~107.9 N.m (9.0 ~11.0 kgf.m, 65.1 ~79.6 lb-ft)

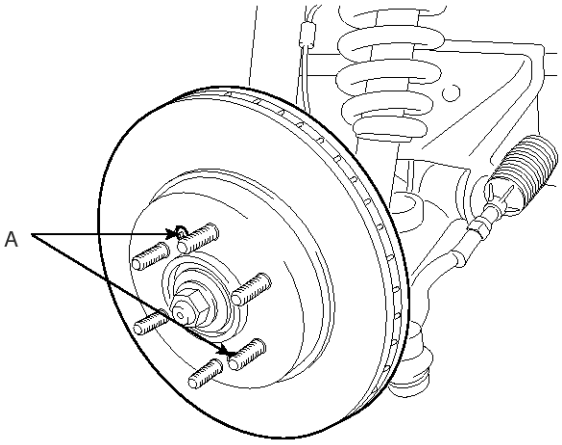
2. Loosen the hose eyebolt (B) and caliper mounting bolts (C), then remove the front caliper assembly (A).

Tightening torque:
Brake hose to caliper:
24.5 ~29.4 N.m (2.5 ~3.0 kgf.m, 18.1 ~21.7 lb-ft)
Caliper assembly to knuckle:
78.5 ~98.1 N.m (8.0 ~10.0 kgf.m, 57.9 ~72.3 lb-ft)



SHMBR8394D

3. Remove the front brake disc by loosening the screws (A).



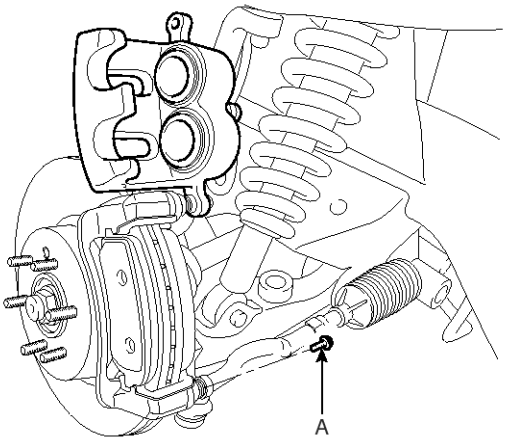
SHMBR8395D

Replacement

Front Brake Pads

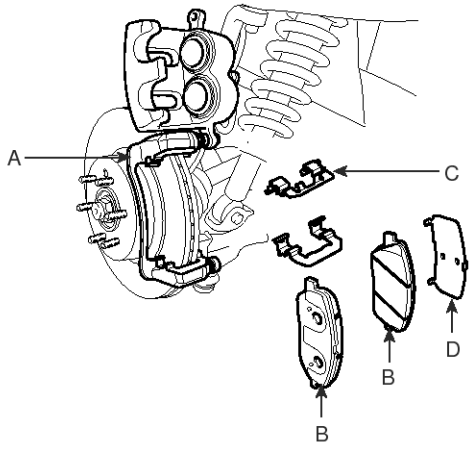
1. Loosen the guide rod bolt (B) and pivot the caliper up out of the way.

Tightening torque:
21.6 ~31.4 N.m (2.2 ~3.2 kgf.m, 15.9 ~23.1 lb-ft)



SHMBR8396D

2. Replace pad shim (D), pad retainers (C) and brake pads (B) in the caliper bracket (A).



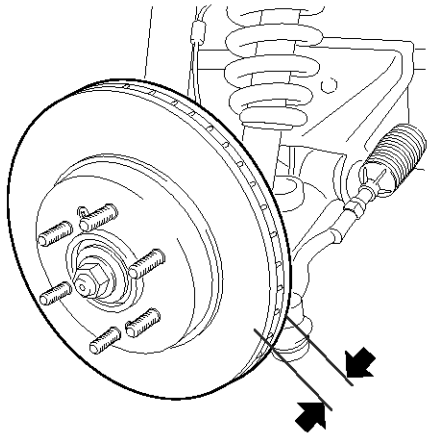
SHMBR8397D

Inspection

Front Brake Disc Thickness Check

1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

Brake disc thickness
Standard: 28mm (1.10in)
Service limit: 26mm (1.024in)
Deviation: Less than 0.005mm (0.0002in)



SHMBR8398D

4. If wear exceeds the limit, replace the discs and pad assembly left and right of the vehicle.

Front Brake Pad Check

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

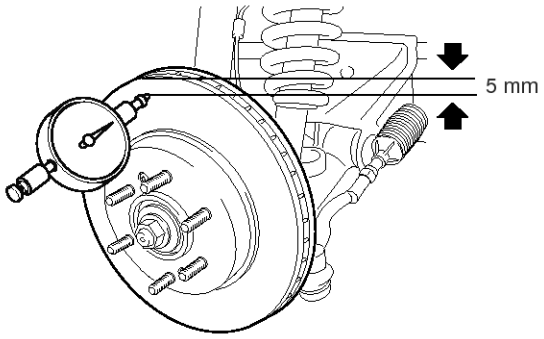
Pad thickness
Standard value: 10.5 mm (0.413 in)
Service limit: 2.0 mm (0.0787 in)

2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

Front Brake Disc Runout Check

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

Brake disc runout
Limit: 0.03 mm (0.00118 in.) or less (new one)



SHMBR8400D

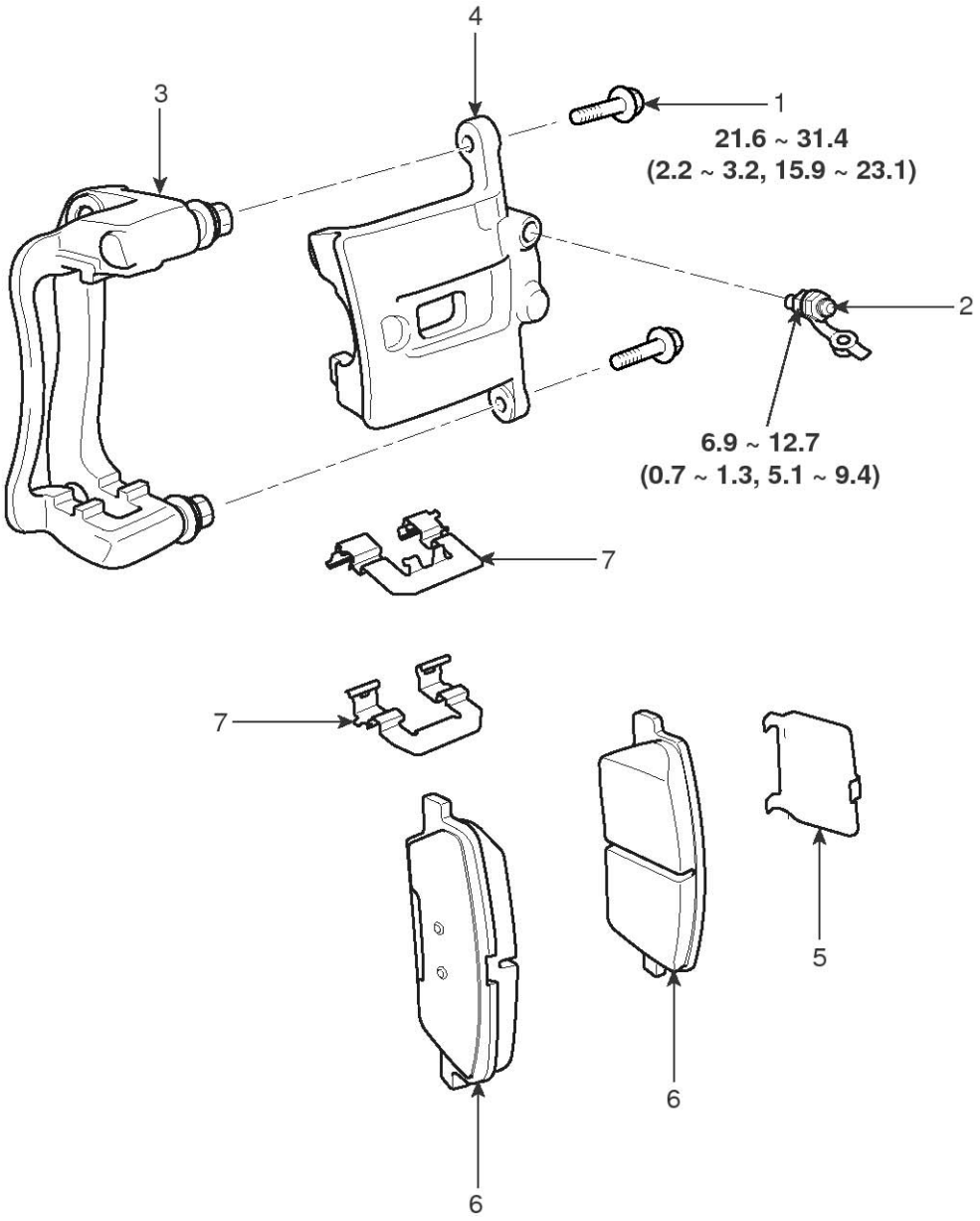
2. If the runout of the brake disc exceeds the limit specification, replace the disc, and then measure the runout again.
3. If the runout does not exceed the limit specification, install the brake disc after turning it 180° and then check the runout of the brake disc again.
4. If the runout cannot be corrected by changing the position of the brake disc, replace the brake disc.

Installation

1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system. (Refer to Brake system bleeding)

Rear Disc Brake

Components



Torque : N.m (kgf.m, lb-ft)

SHMBR9307L

1. Guide rod bolt
2. Bleed screw
3. Caliper bracket
4. Caliper body
5. Inner pad shim
6. Brake pad
7. Pad retainer

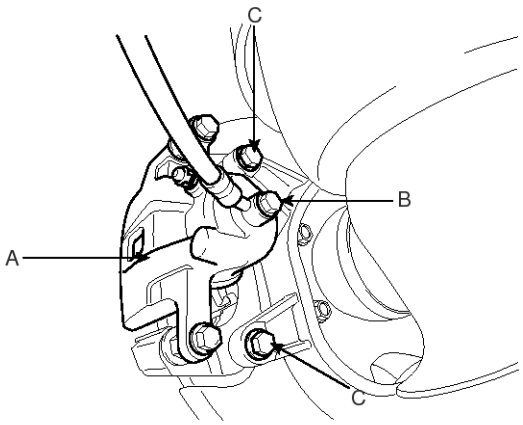
Removal

1. Remove the rear wheel & tire.

Tightening torque:
88.3 ~107.9 N.m(9.0 ~11.0 kgf.m, 65.1 ~79.6 lb-ft)

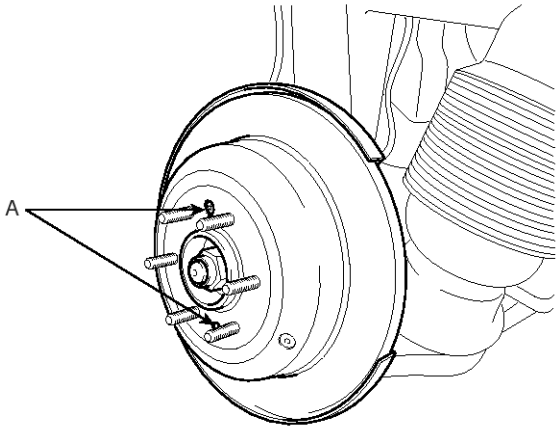
2. Loosen the hose eyebolt (B) and caliper mounting bolts (C), then remove the rear caliper assembly (A).

Tightening torque:
Brake hose to caliper:
24.5 ~29.4 N.m (2.5 ~3.0 kgf.m, 18.1 ~21.7 lb-ft)
Caliper assembly to carrier:
63.7 ~73.5 N.m (6.5 ~7.5 kgf.m, 47.0 ~54.2 lb-ft)



SHMBR8402D

3. Remove the rear brake disc by loosening the screws (A).



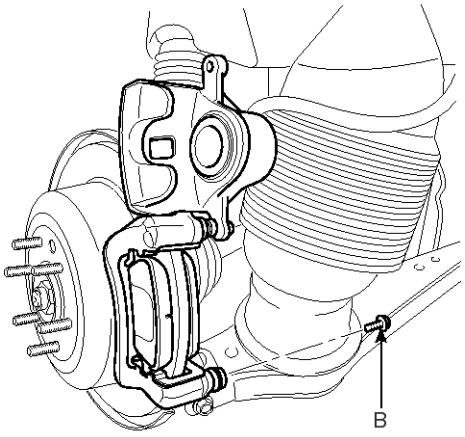
SHMBR8403D

Replacement

Rear Brake Pads

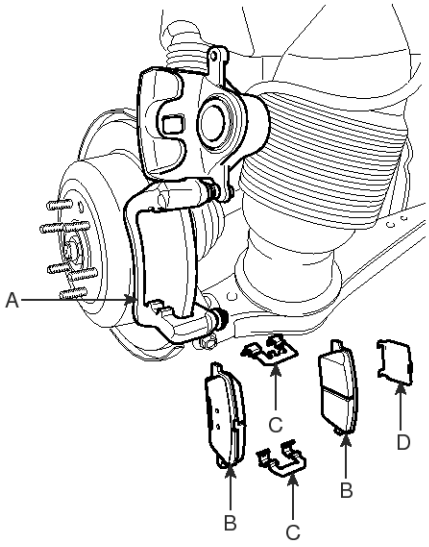
1. Loosen the guide rod bolt (B) and pivot the caliper up out of the way.

Tightening torque:
21.6 ~31.4 N.m (2.2 ~3.2 kgf.m, 15.9 ~23.1 lb-ft)



SHMBR8404D

2. Replace pad shim (D), pad retainers (C) and brake pads (B) in the caliper bracket (A).



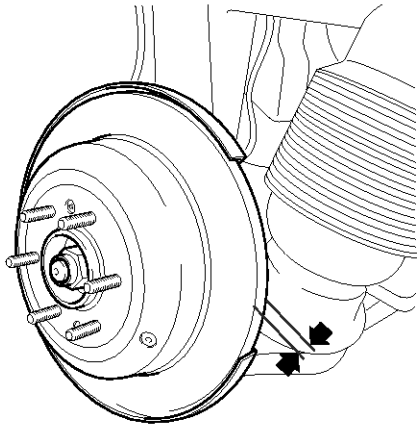
SHMBR8405D

Inspection

Rear Brake Disc Thickness Check

1. Check the brake pads for wear and fade.
2. Check the brake disc for damage and cracks.
3. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

Brake disc thickness
Standard: 13 mm (0.51 in)
Service limit: 11.4 mm (0.45 in)
Deviation: less than 0.005 mm (0.0002 in)



SHMBR8406D

4. If wear exceeds the limit, replace the discs and pad assembly left and right of the vehicle.

Rear Brake Pad Check

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

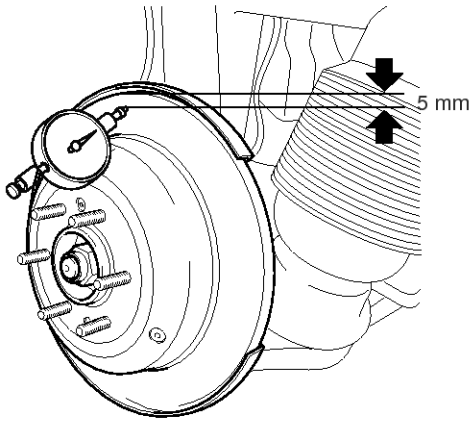
Pad thickness
Standard value: 10 mm (0.393 in)
Service limit: 2.0 mm (0.0787 in)

2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

Rear Brake Disc Runout Check

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the runout of the disc.

Brake disc runout
Limit: 0.03 mm (0.00118 in.) or less (new one)



SHMBR8407D

2. If the runout of the brake disc exceeds the limit specification, replace the disc, and then measure the runout again.
3. If the runout exceeds the limit specification, install the brake disc after turning it 180° and then check the runout of the brake disc again.
4. If the runout cannot be corrected by changing the position of the brake disc, replace the brake disc.

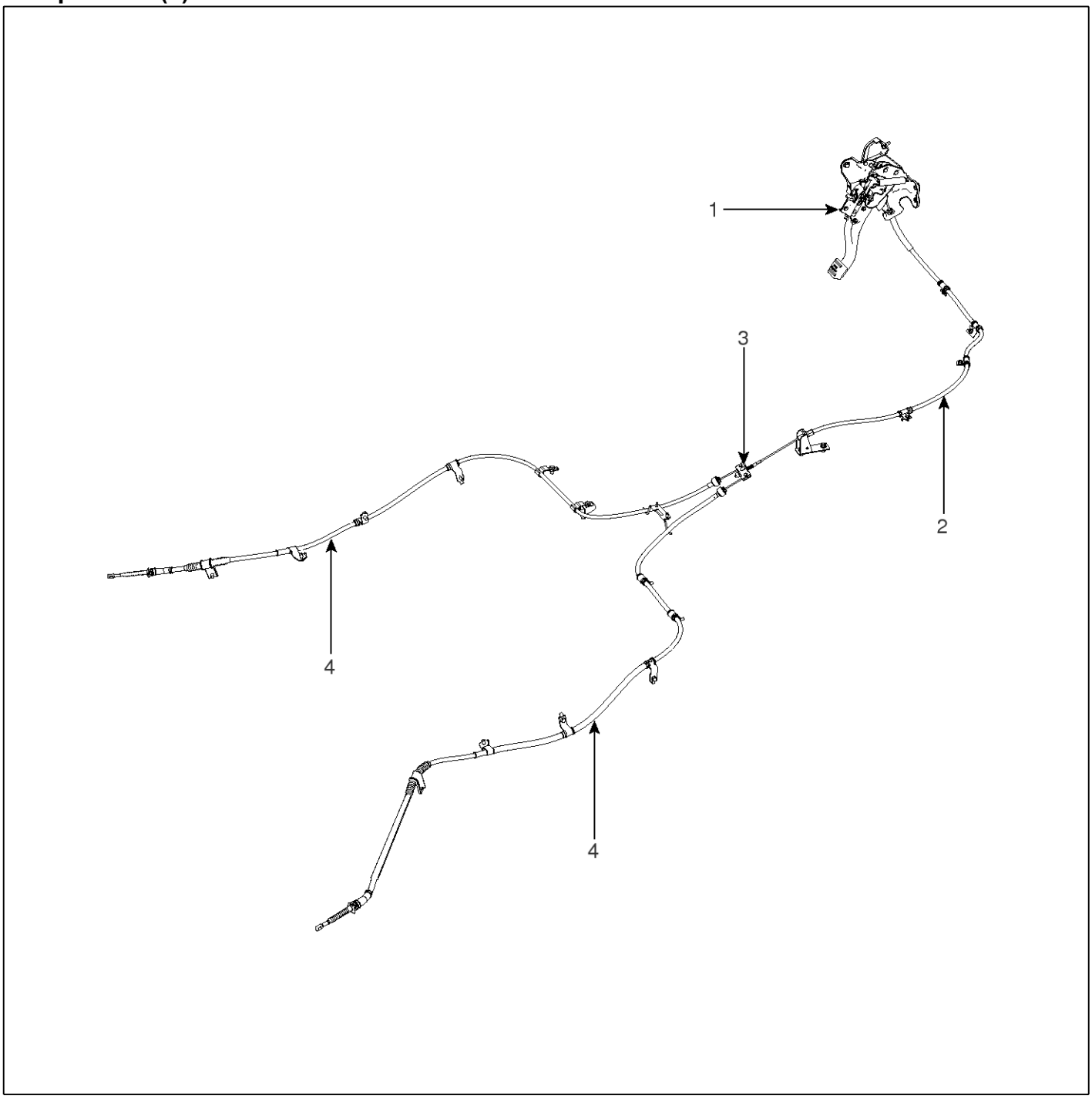
Installation

1. Installation is the reverse of removal.
2. Use a SST (09581-11000) when installing the brake caliper assembly.
3. After installation, bleed the brake system. (Refer to Brake system bleeding)

Parking Brake System

Parking Brake Assembly

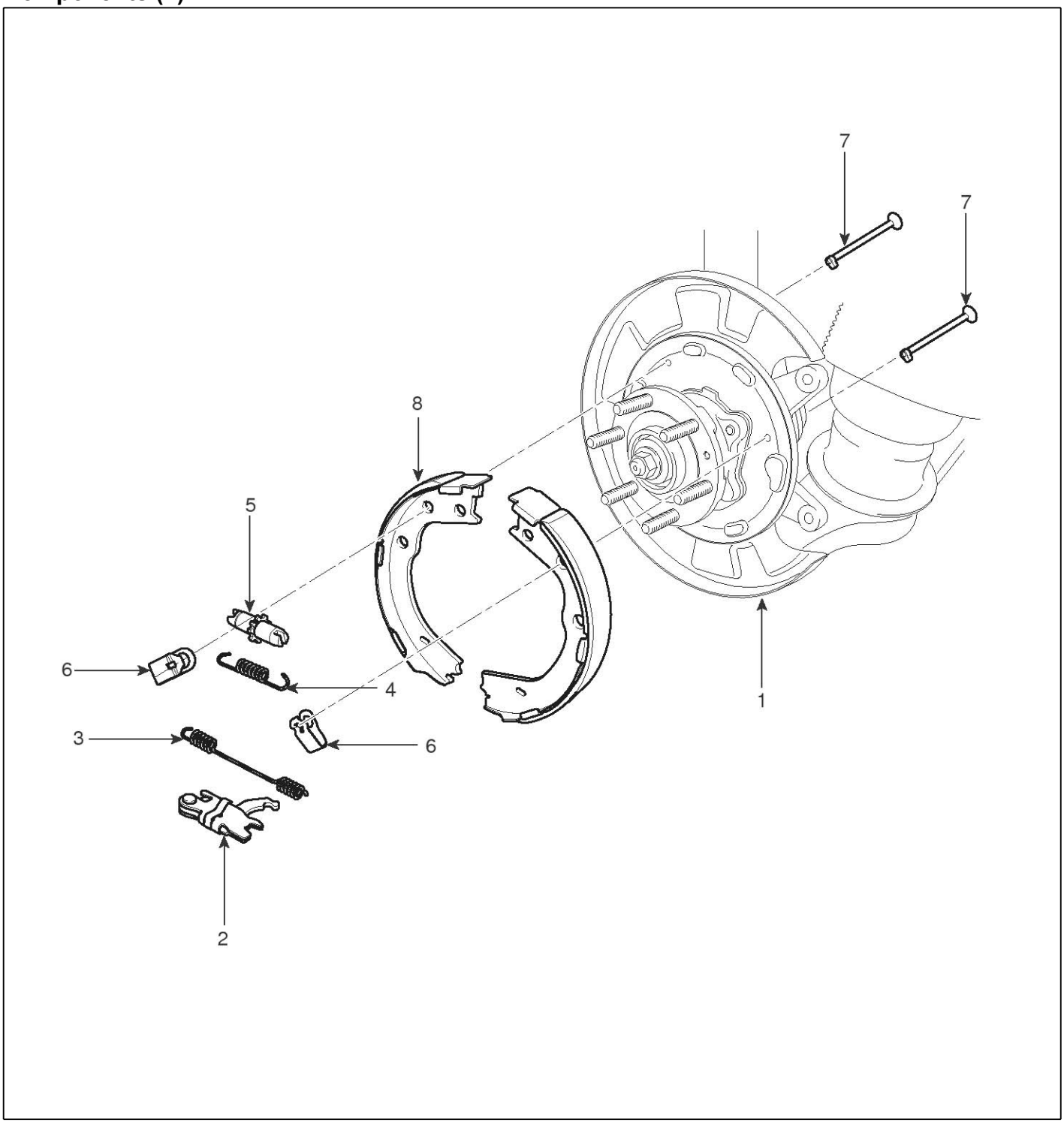
Components (1)



SHMBR8408D

1. Parking brake pedal
2. Front parking brake cable
3. Equalizer assembly
4. Rear parking brake cable

Components (2)



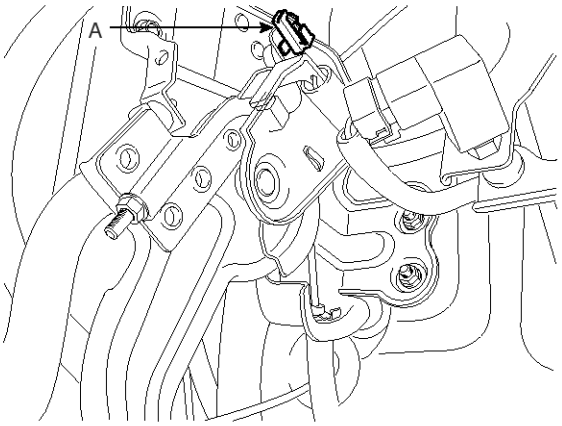
SHMBR8409D

1. Backing plate
2. Operating lever
3. Upper spring
4. Lower spring
5. Adjuster
6. Shoe hold down spring
7. Shoe hold down pin
8. Parking brake shoe

Removal

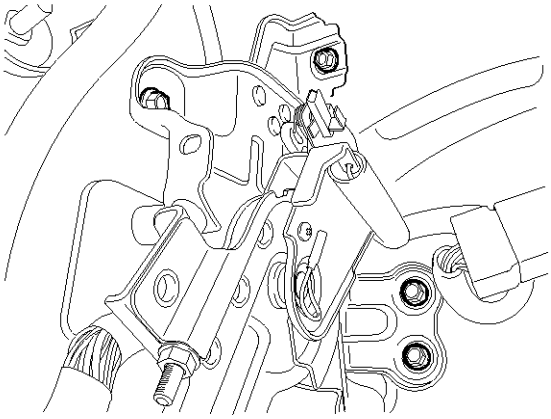
Parking Brake Pedal

1. Remove the crash pad lower panel. (Refer to the Body group-crash pad)
2. Remove the IPM after removing the nut and connector. (Refer to the Body Electrical System group-BCM)
3. Disconnect the parking brake switch connector (A).



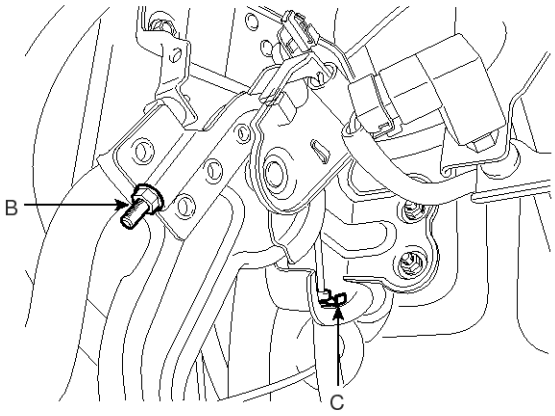
SHMBR8410D

4. Remove the parking brake pedal mounting bolts and nut, then remove the parking brake pedal.



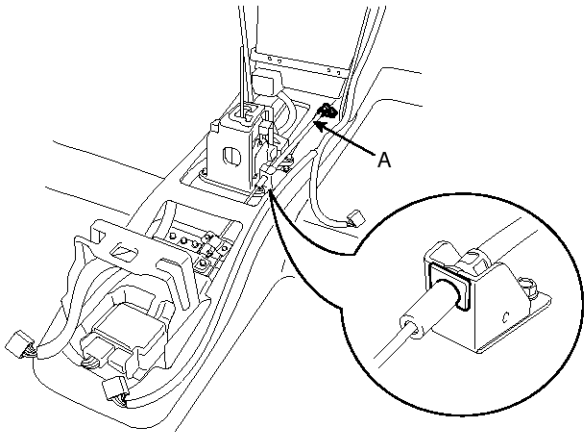
SHMBR8411D

5. Remove the cable adjusting nut (B) and the mounting clip (C), then remove the parking brake cable.



SHMBR8435D

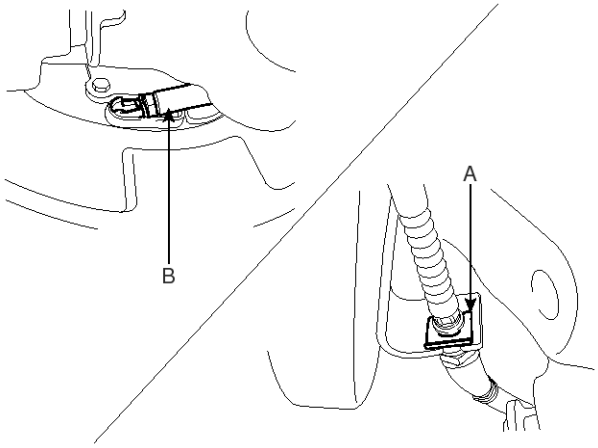
6. Remove the floor console. (Refer to the Body group-Console).
7. Loosen the cable fixing clip and bolts and remove the rear parking brake cable which connected equalizer. And then remove front parking brake cable (A).



SHMBR8412D

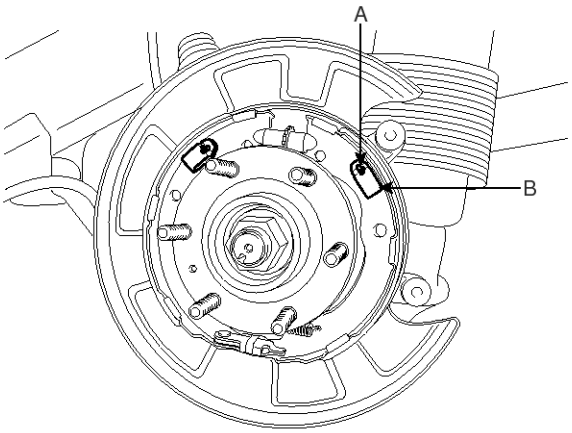
Parking Brake Shoe

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the brake caliper and Rear disc brake.
   (Refer to "Rear disc brake removal")
4. Remove the parking brake cable (B), after removing the clip (A).



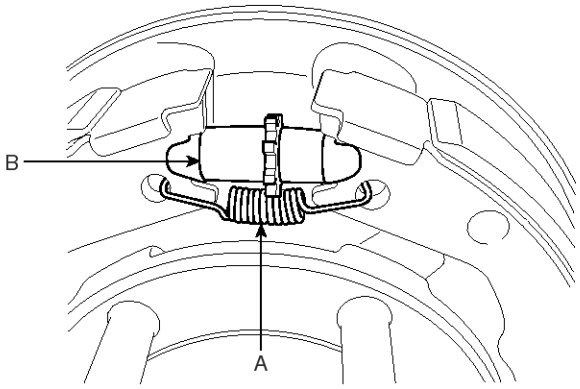
SHMBR8413D

5. Remove the shoe hold down pin (A) and the spring (B) by pressing and rotating the spring.



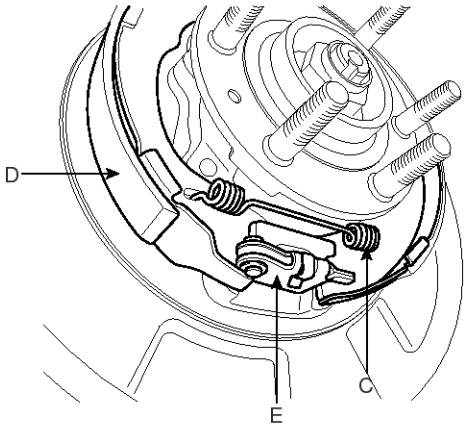
SHMBR8414D

6. Remove the adjuster assembly (B) and the lower return spring (A).



SHMBR8415D

7. Remove the upper return spring (C) and the brake shoes (D).



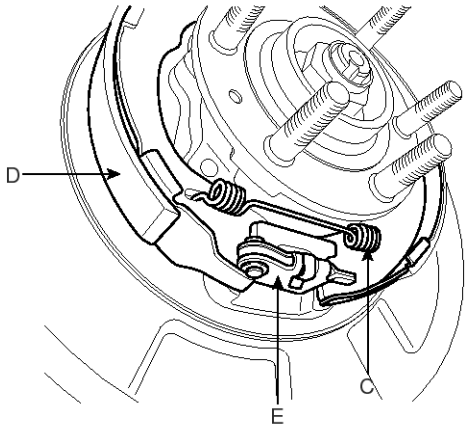
SHMBR8416D

8. Remove the operating lever assembly (E).

Installation

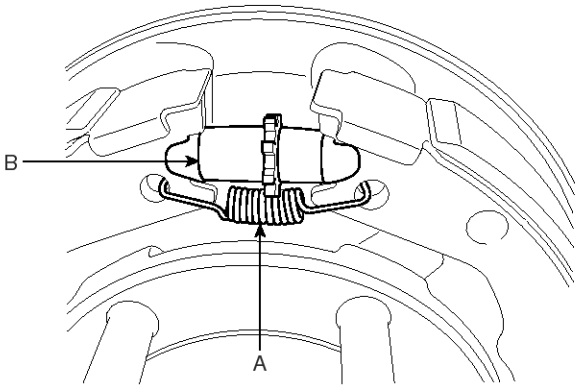
Parking Brake Shoe

1. Install the operating lever assembly (E).



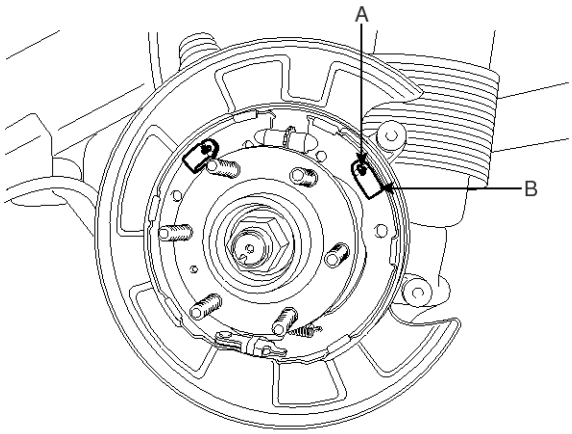
SHMBR8416D

2. Install the upper return spring (C) and the brake shoes (D).
3. Install the adjuster assembly (B) and the lower return spring (A).



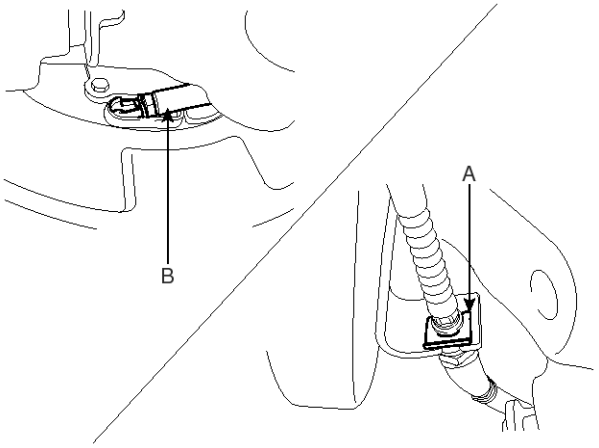
SHMBR8415D

4. Install the shoe hold down pin (A) and spring (B) by pressing and rotating the spring.



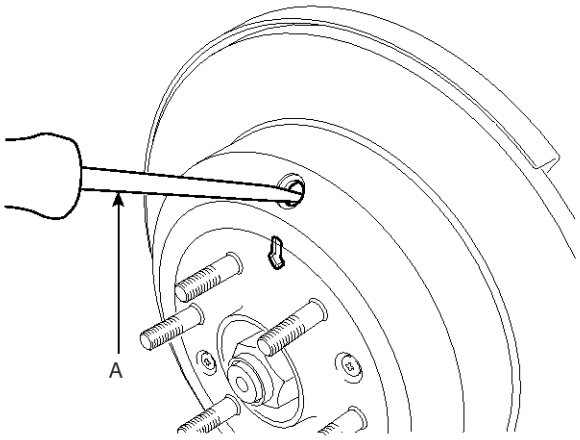
SHMBR8414D

5. Install the parking brake cable (B), then install the clip (A).



SHMBR8413D

6. Install the rear brake disc, then adjust the rear brake shoe clearance.
   1) Remove the plug from the disc.
   2) Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 5 notches in the opposite direction.



SHMBR8421D

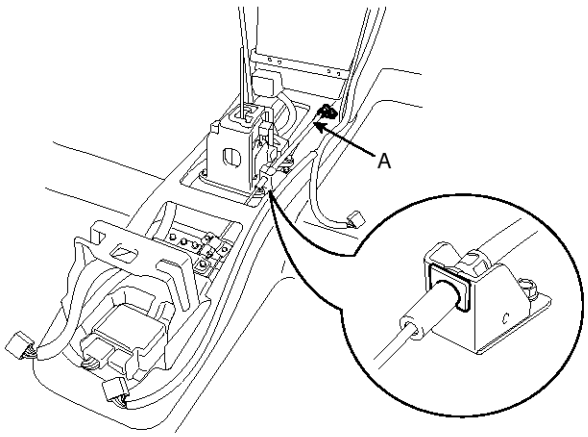
7. Install the brake caliper assembly. (Refer to "Rear brake installation")
8. Install the tire and wheel.
9. If the parking brake shoe or the brake disc are replaced a newly one, perform the brake shoe bed-in procedure.
   1) While operating the parking brake pedal for 98N (10kgf, 22 lbf) effort, drive the vehicle 500 meters (0.31 miles) at the speed of 60kph (37.3 mph).
   2) Repeat the above procedure more than two times.
   3) Must be held on at 30% uphill.

⚠CAUTION
After adjusting parking brake, notice following matter;

1. **Must be free from troubles when the parking pedal is operated at 981 N (100 kgf, 220 lbf).**
2. **Check that all parts move smoothly.**
3. **The parking brake indicator lamp must be on after the parking pedal is worked and must be off after the pedal is released.**

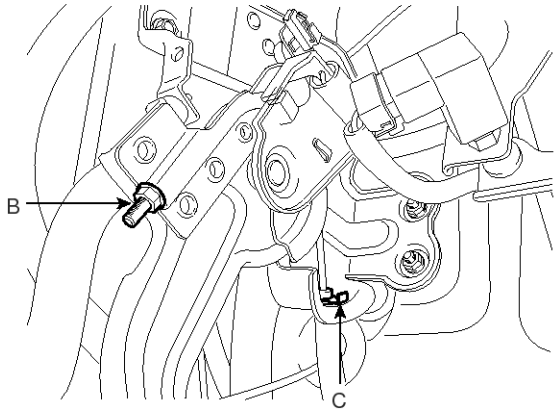
Parking Brake Pedal

1. Install the parking brake cable (A).



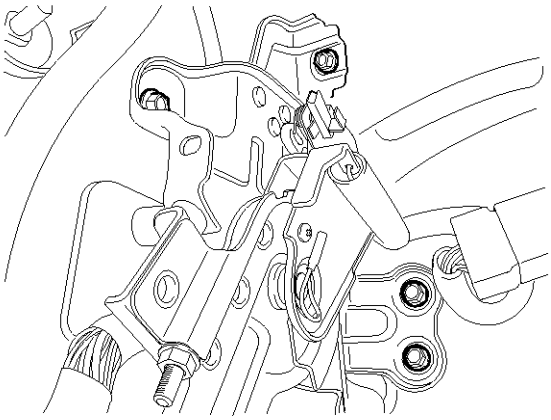
SHMBR8412D

2. Install the fixing clip (C) and the cable adjusting nut (B) after fixing the parking brake cable.



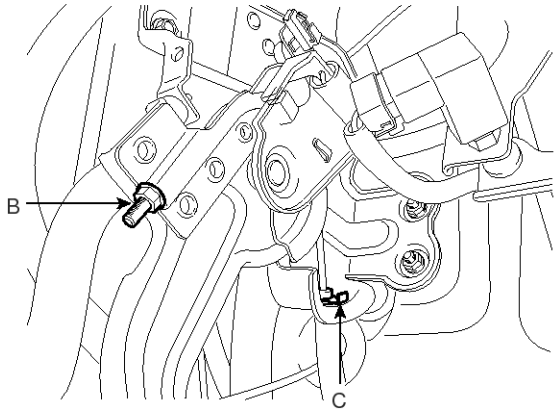
SHMBR8435D

3. Install the parking brake pedal, and then install the parking brake pedal mounting bolts and nut.



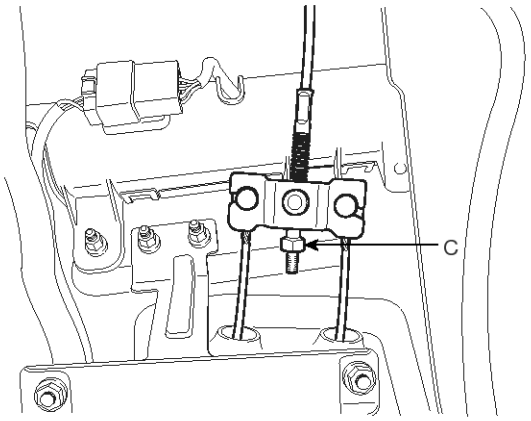
SHMBR8411D

4. Adjust the parking brake pedal stroke by turning the adjusting nut (B).
   1) Adjust the adjusting nut (B) so that parking brake pedal stroke is to be between 4~5notches when operating effort is 196 N (20 kg.f, 44 lb) after full stroke operation of parking brake pedal over 3 times for setting parking wire.



SHMBR8435D

   2) Adjust cable stroke with the equalizer adjusting nut (D) inside floor console if the cable adjusting nut (B) can't be used because of insufficiency of an adjusting section of the front cable.

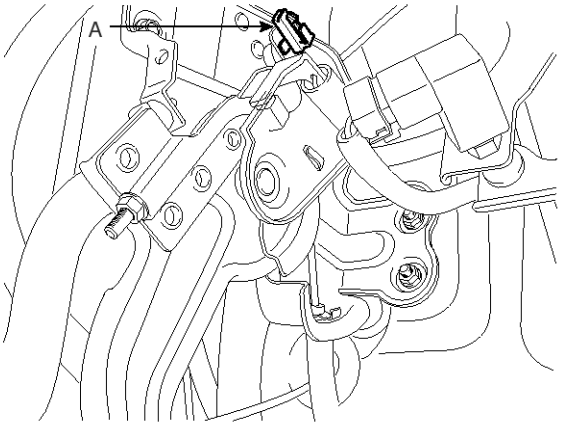


SHMBR9309L

⚠CAUTION

1. **The parking brake adjustment must be carried out after adjusting the rear shoe.**
2. **After adjusting parking brake, notice following matter.**
   a. **Must be free from clearance between adjusting nut and pin.**
   b. **Check securely that the brake is not dragging.**

5. Reconnect the parking brake switch connector(A).



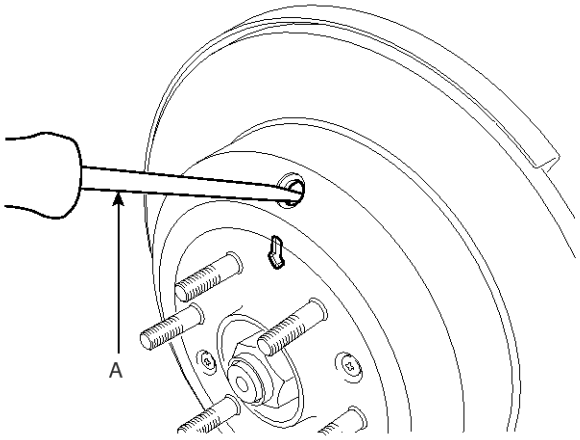
SHMBR8410D

6. Install the IPM. (Refer to the Body Electrical System group - BCM)
7. Install the crash pad lower panel. (Refer to Body group - Crash pad)
8. Install the floor console. (Refer to Body group - Console).

Adjustment

Parking Brake Shoe Clearance Adjustment

1. Raise the vehicle, and make sure it is securely supported.
2. Remove the rear tire and wheel.
3. Remove the plug from the disc.

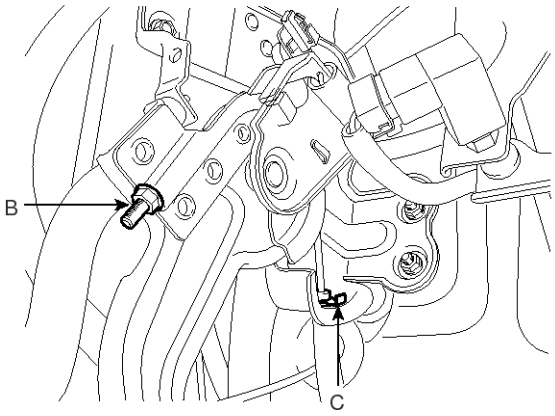


SHMBR8421D

4. Rotate the toothed wheel of adjuster by a screw driver until the disc is not moving, and then return it by 5 notches in the opposite direction.
5. Install the rear wheel & tire after installing the plug on the disc.

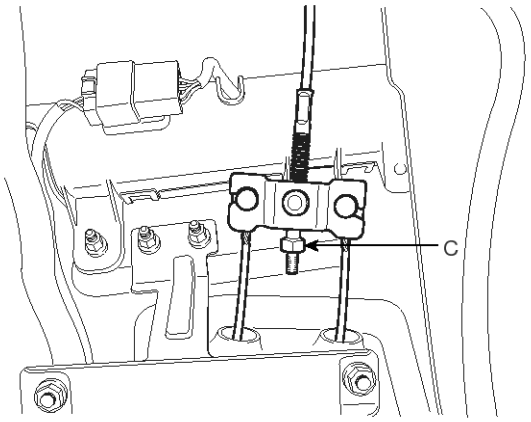
Parking Brake Pedal Stroke Adjustment

1. Adjust the adjusting nut (B) so that parking brake pedal stroke is to be between 4~5notches when operating effort is 196 N (20 kg.f, 44 lb) after full stroke operation of parking brake pedal over 3 times for setting parking wire.



SHMBR8435D

2. Adjust cable stroke with the equalizer adjusting nut (D) inside floor console if the cable adjusting nut (B) can't be used because of insufficiency of an adjusting section of the front cable.



SHMBR9309L

⚠CAUTION

1. The parking brake adjustment must be carried out after adjusting the rear shoe.

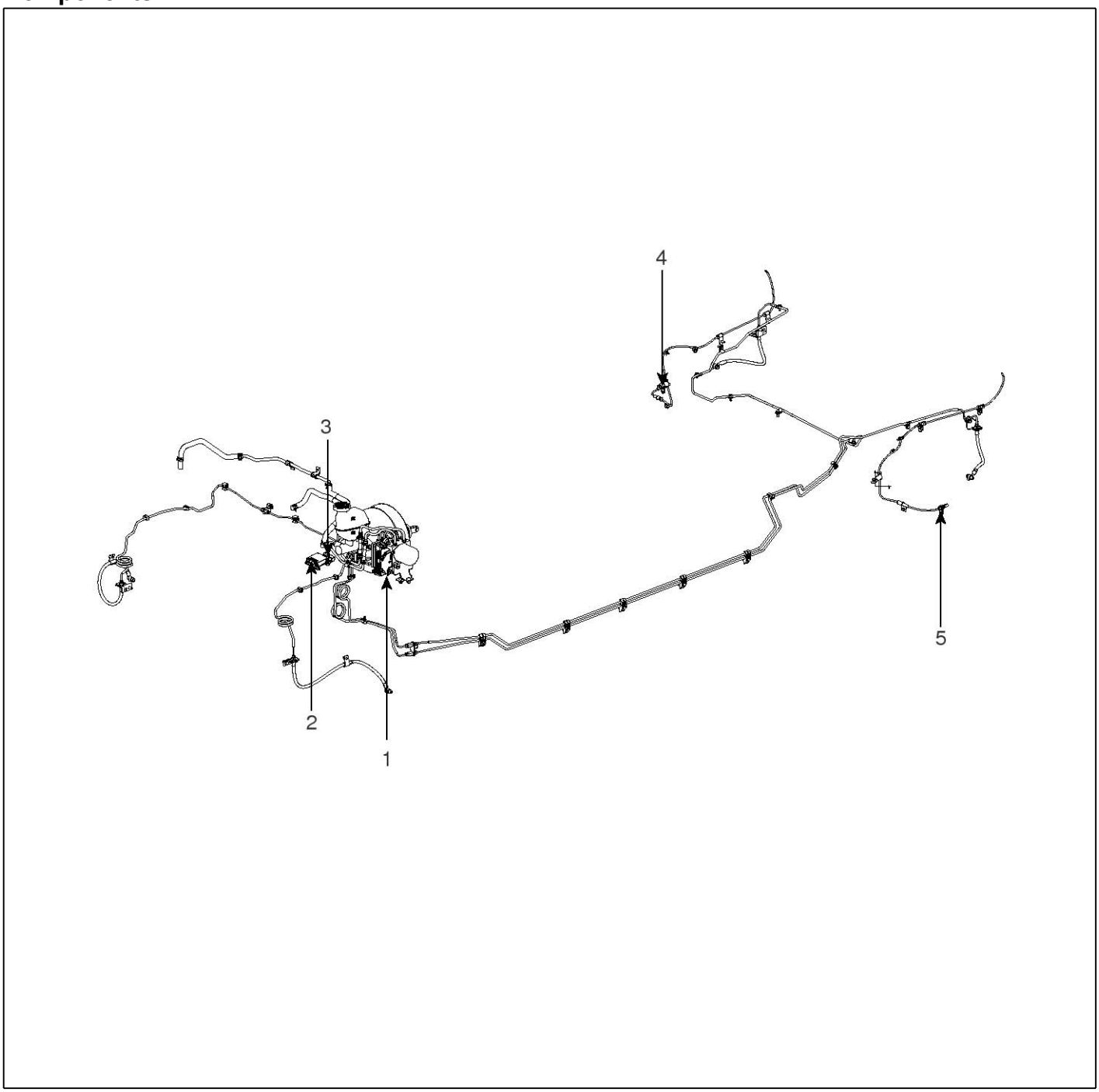
2. After adjusting parking brake, notice following matter.

a. Must be free from clearance between adjusting nut and pin.

b. Check securely that the brake is not dragging.

ABS(Anti-Lock Brake System)

Components



SHMBR8300D

1. ABS control module (HECU)
2. Yaw-rate & lateral G sensor
3. Longitudinal G sensor
4. Rear right wheel speed sensor
5. Rear left wheel speed sensor

Description

This specification applies to HCU(Hydraulic Control Unit) and ECU(Electronic Control Unit) of the HECU.(Hydraulic and Electronic Control Unit)

This specification is for the wiring design and installation of ABS/ESP ECU.

This unit has the functions as follows.

- Input of signal from Pressure sensor, Steering angle sensor, Yaw & Lateral G sensor,the wheel speed sensors attached to each wheel.
- Control of braking force / traction force / yaw moment.
- Failsafe function.
- Self diagnosis function.
- Interface with the external diagnosis tester.

Installation position : engine compartment

- Brake tube length from Master cylinder port to HECU inlet port should be max. 1m
- The position should not be close to the engine block and not lower than the wheel.

Operation

The ECU shall be put into operation by switching on the operating voltage (IGN).

On completion of the initialization phase, the ECU shall be ready for operation.

In the operating condition, the ECU shall be ready, within the specified limits (voltage and temperature), to process the signals offered by the various sensors and switches in accordance with the control algorithm defined by the software and to control the hydraulic and electrical actuators.

Wheel Sensor Signal Processing

The ECU shall receive wheel speed signal from the four active wheel sensors.

The wheel signals are converted to voltage signal by the signal conditioning circuit after receiving current signal from active wheel sensors and given as input to the MCU.

Solenoid Valve Control

When one side of the valve coil is connected to the positive voltage that is provided through the valve relay and the other side is connected to the ground by the semiconductor circuit, the solenoid valve goes into operation.

The electrical function of the coils are always monitored by the valve test pulse under normal operation conditions.

Voltage Limits

- Overvoltage

  When overvoltage is detected(above 17 ± 0.5 V), the ECU switches off the valve relay and shuts down the system.

  When voltage is returned to operating range, the system goes back to the normal condition after the initialization phase.

- Undervoltage

  In the event of undervoltage(below 10V), ABS control shall be inhibited and the warning lamp shall be turned on.

  When voltage is returned to operating range, the warning lamp is switched off and ECU returns to normal operating mode.

Pump Motor Checking

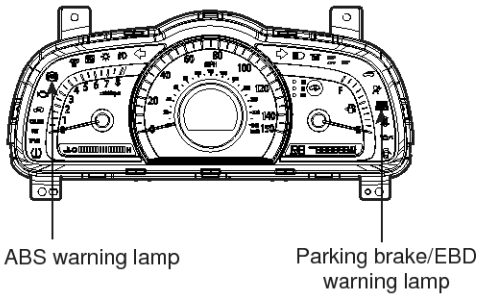
The ECU performs a pump motor test at a speed of 15 km/h(9 MPH) once after IGN is switched on.

Diagnostic Interface

Failures detected by the ECU are encoded on the ECU, stored in a EEPROM and read out by diagnostic equipment when the ignition switch is turned on.

The diagnosis interface can also be used for testing the ECU during production of the ECU and for actuating the HCU in the test line of manufactories (Air-bleeding line or Roll and Brake Test line).

Warning Lamp Module



SHMBR9310L

1. ABS Warning Lamp module

   The active ABS warning lamp module indicates the self-test and failure status of the ABS.

   The ABS warning lamp shall be on:

   - During the initialization phase after IGN ON. (continuously 3 seconds).
   - In the event of inhibition of ABS functions by failure.
   - During diagnostic mode.
   - When the ECU Connector is seperated from ECU.

2. PARKING/EBD warning lamp module

   The active EBD warning lamp module indicates the self-test and failure status of the EBD.

   However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions.

   The EBD warning lamp shall be on:

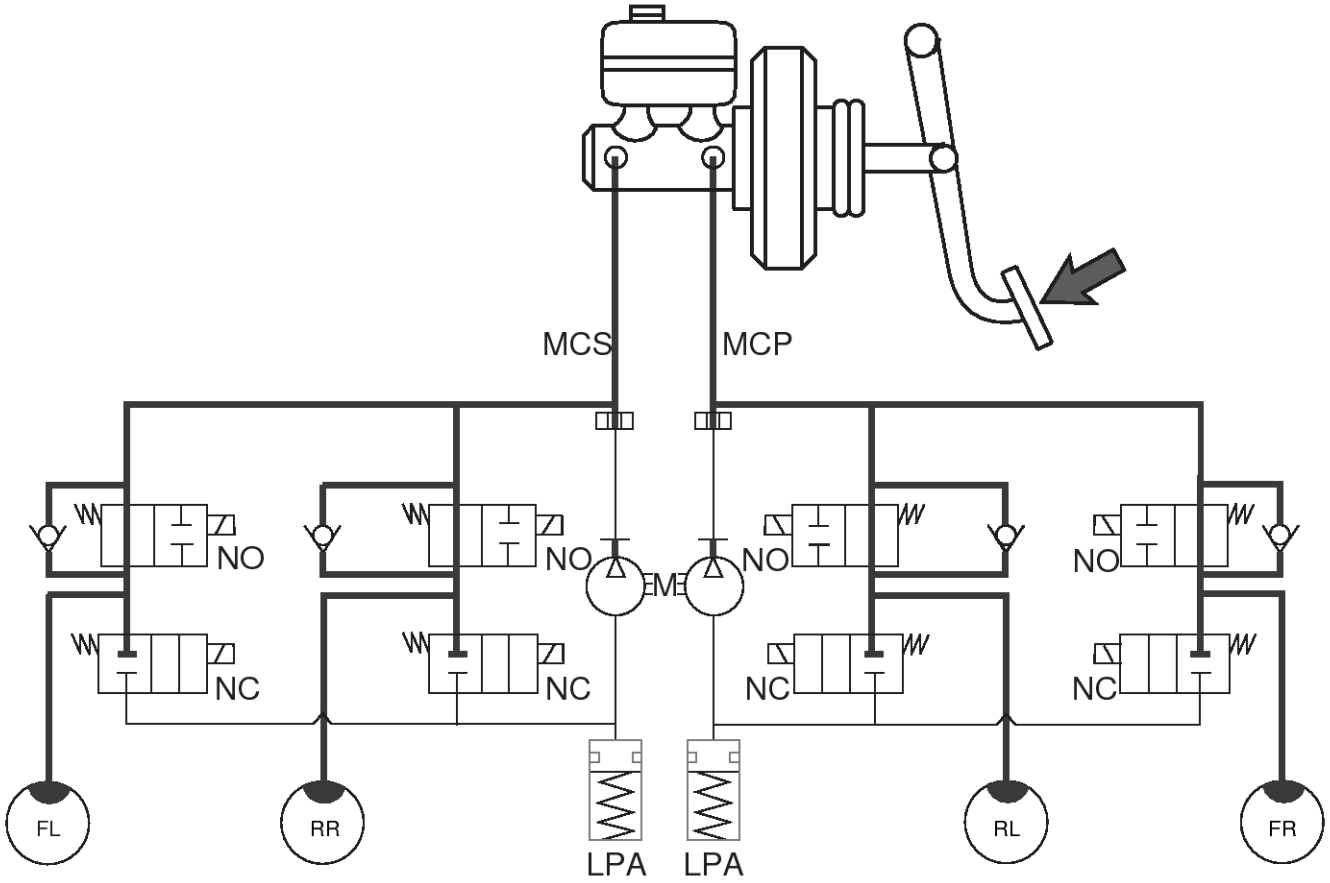
   - During the initialization phase after IGN ON. (continuously 3 seconds).
   - When the Parking Brake Switch is ON or brake fluid level is low.
   - When the EBD function is out of order.
   - During diagnostic mode.
   - When the ECU Connector is seperated from ECU.

ABS Control

1. NORMAL BRAKING without ABS

   Under the normal braking, voltage is not supplied to solenoid valve, inlet valve is opened and outlet valve is closed.When the brake is depressed, brake fluid is supplied to the wheel cylinder via solenoid valve to activate the brake.When the brake is released, brake fluid is back to the master cylinder via inlet valve and check valve.

Solenoid valve	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	Open	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	

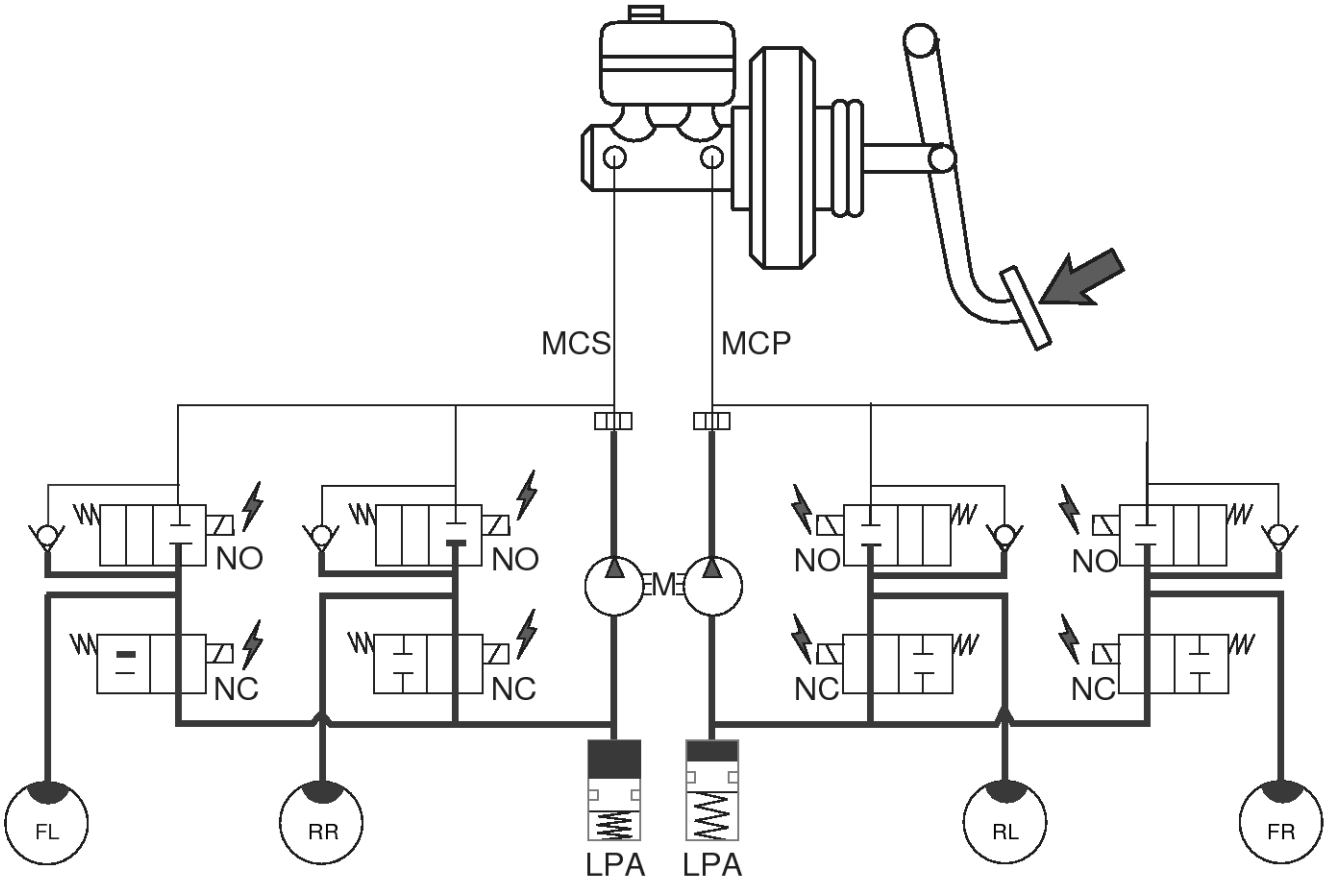


LJJF500W

2. Dump Mode

Under the emergency braking, if the wheels start to lock up, HECU sends a signal to the solenoid valve to decrease the brake fluid, then voltage is supplied to each solenoid. At this time inlet valve is closed and brake fluid is blocked from the master cylinder. Conversely outlet valve is opened and brake fluid passes through wheel cylinder to reservoir, resulting in pressure decrease.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	Close	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	ON	Open	Wheel cylinder ⇔ Reservoir	

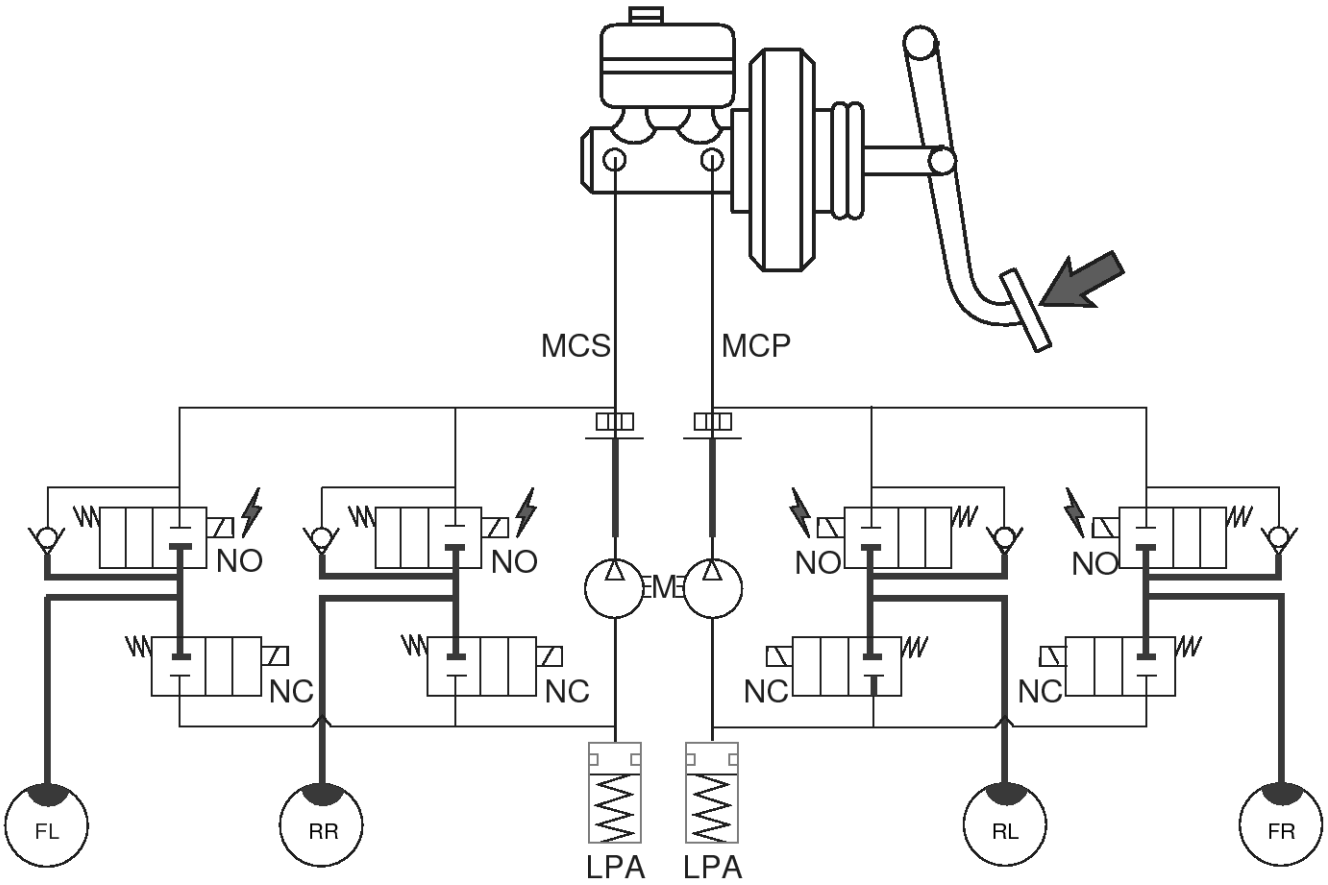


LJJF500X

3. Hold Mode

When the brake fluid pressure is maximally decreased in wheel cylinder, HECU sends a signal to solenoid valve to keep the fluid pressure, voltage is supplied to inlet valve but it is not supplied to outlet valve. At this time inlet and outlet valves are closed and brake fluid is kept in wheel cylinder.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	Close	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	

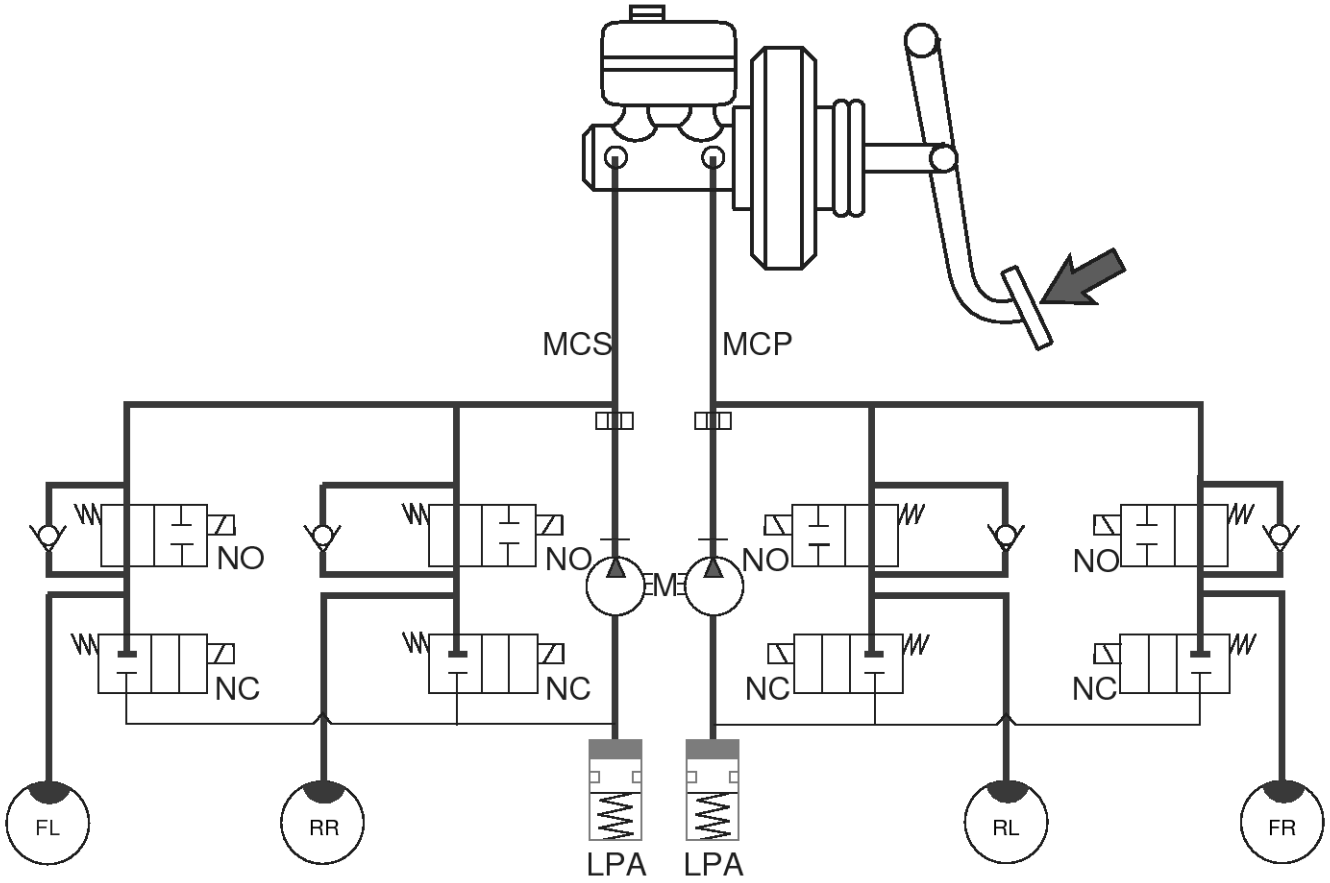


LJJF500Y

4. Increase Mode

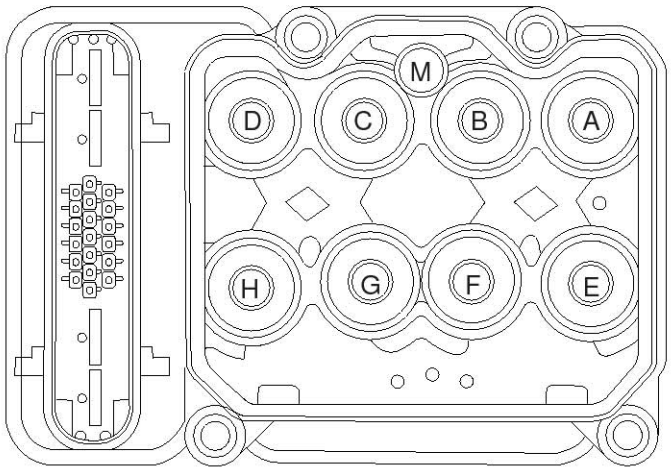
   If HECU determines there's no lock-up in the wheel, HECU cuts voltage to solenoid valve. So voltage is not supplied to each solenoid valve, brake fluid passes through the inlet valve to wheel cylinder, resulting in pressure increase.

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	Open	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	OFF	Close	Wheel cylinder ⇔ Reservoir	



LJJF500Z

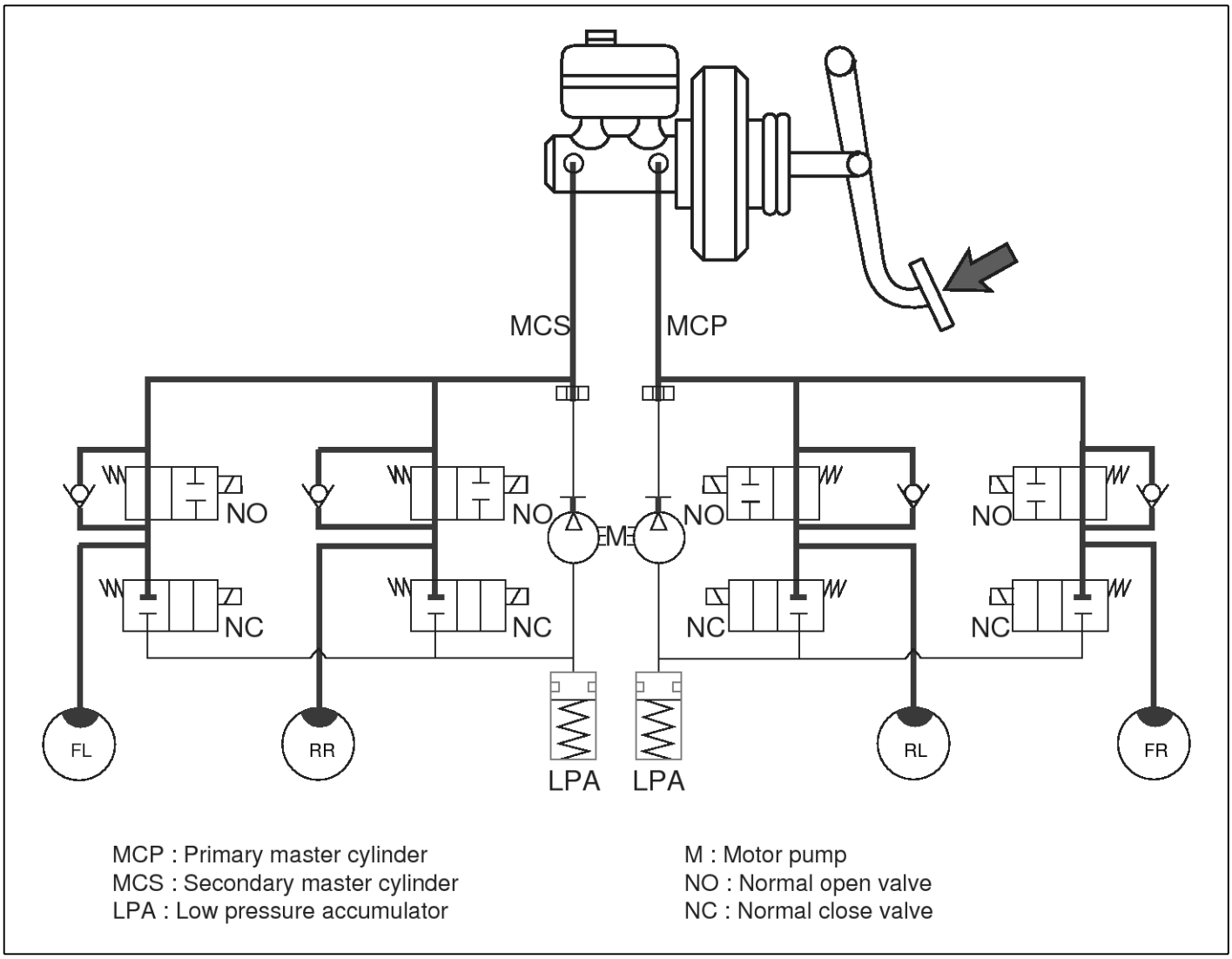
ABS HECU External Diagram



A : INLET VALVE (FR)
B : INLET VALVE (RL)
C : INLET VALVE (RR)
D : INLET VALVE (FL)
E : OUTLET VALVE (FR)
F : OUTLET VALVE (RL)
G : OUTLET VALVE (RR)
H : OUTLET VALVE (FL)
M : MOTOR Connector

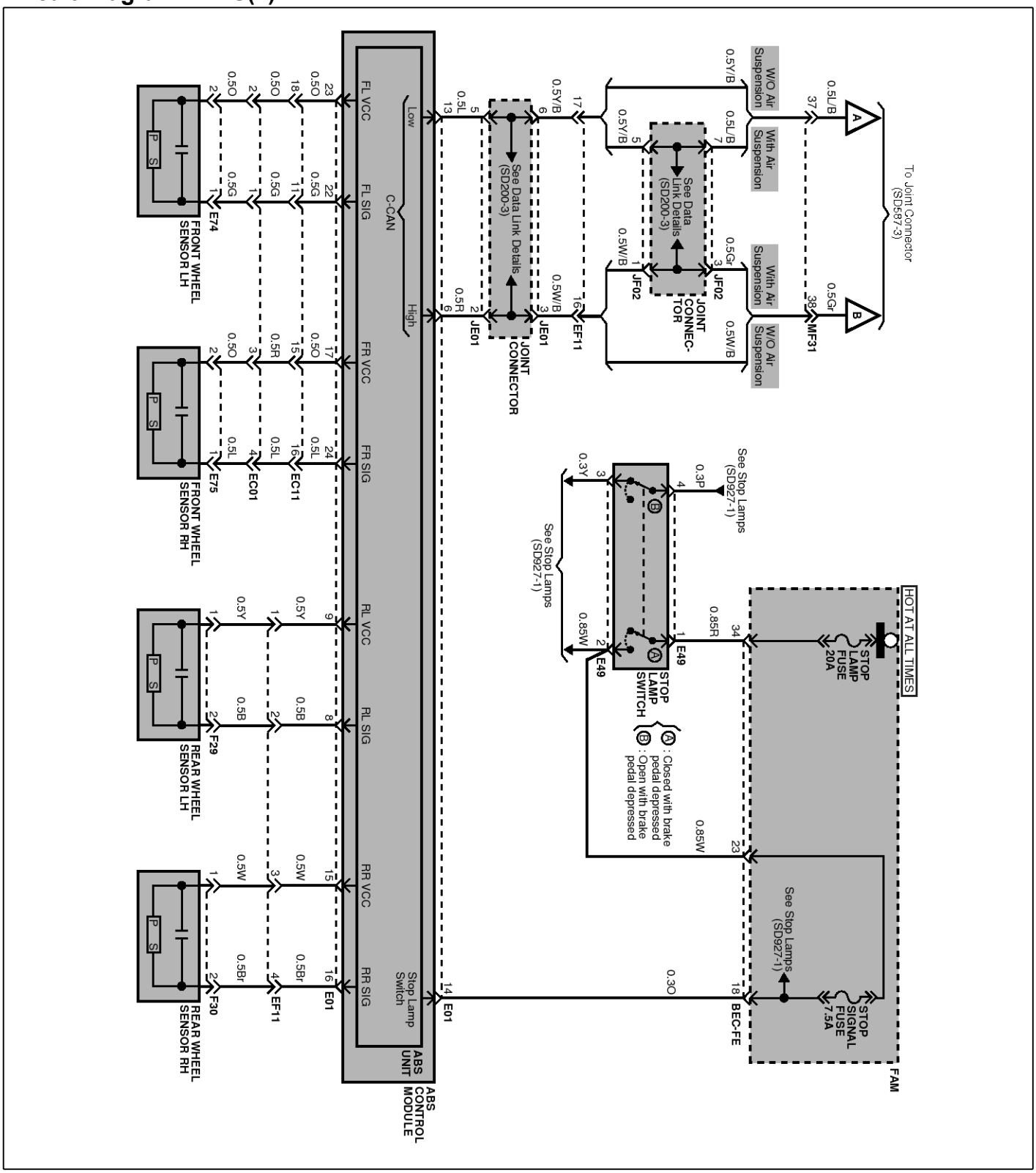
SHMBR8302D

Hydraulic System Diagram



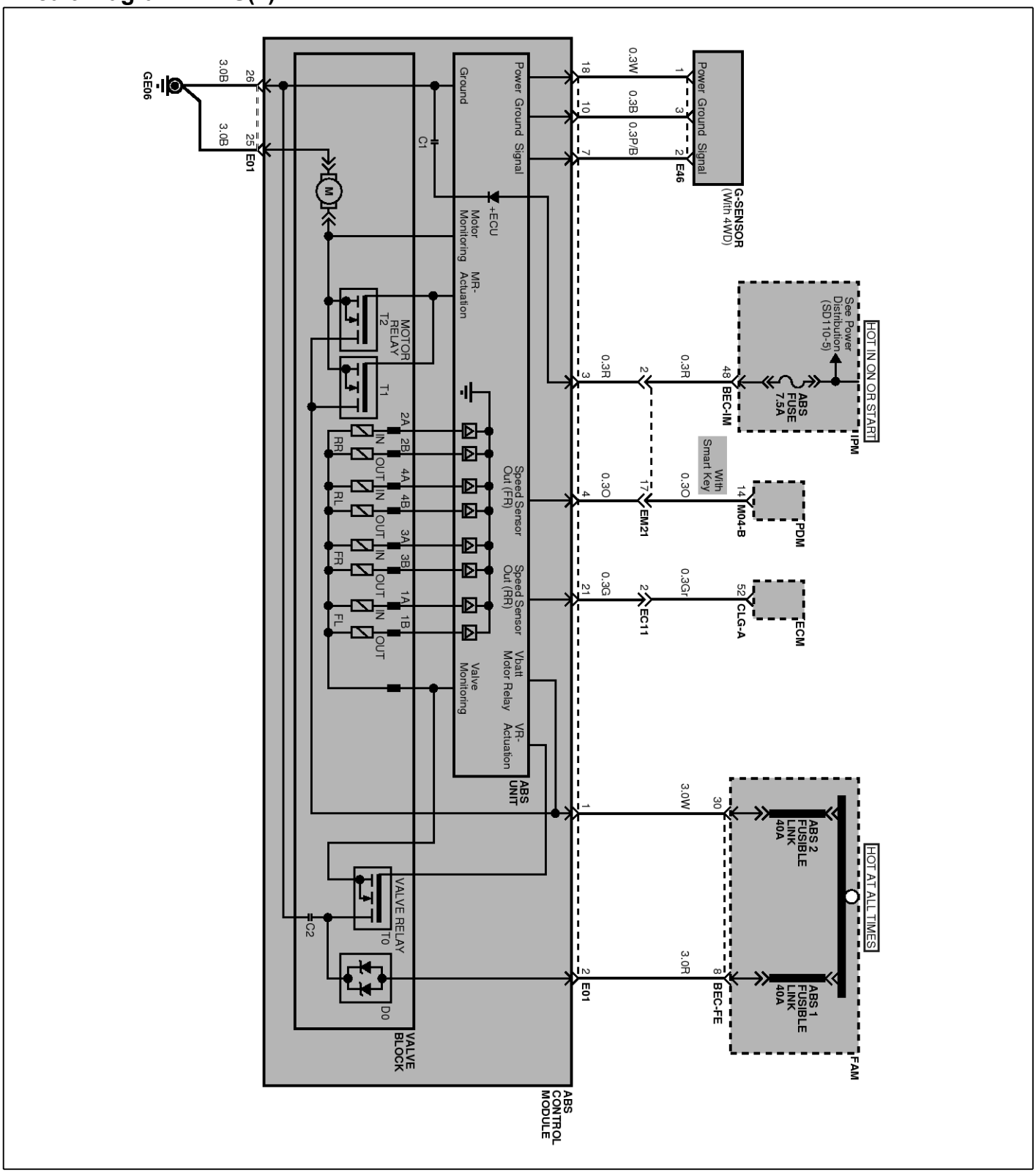
LJJF501B

Circuit Diagram - ABS(1)



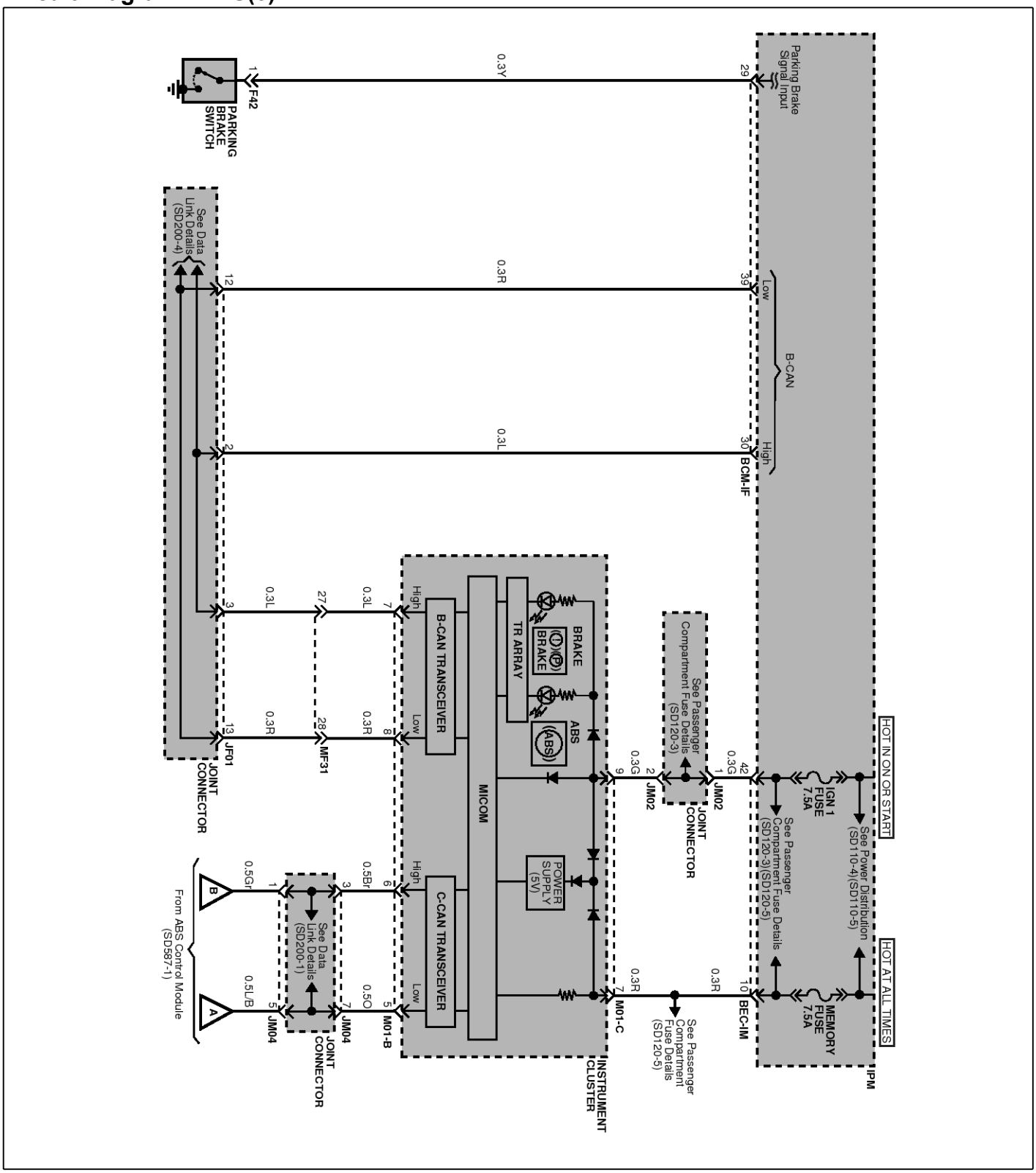
SHMBR9311L

Circuit Diagram - ABS(2)



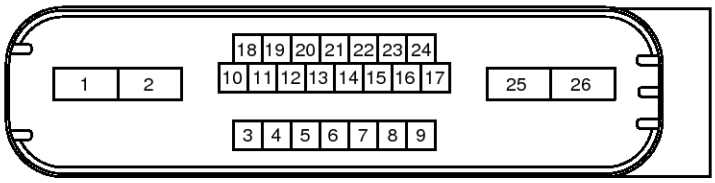
SHMBR9312L

Circuit Diagram - ABS(3)



SHMBR9313L

ABS Connector Input/Output



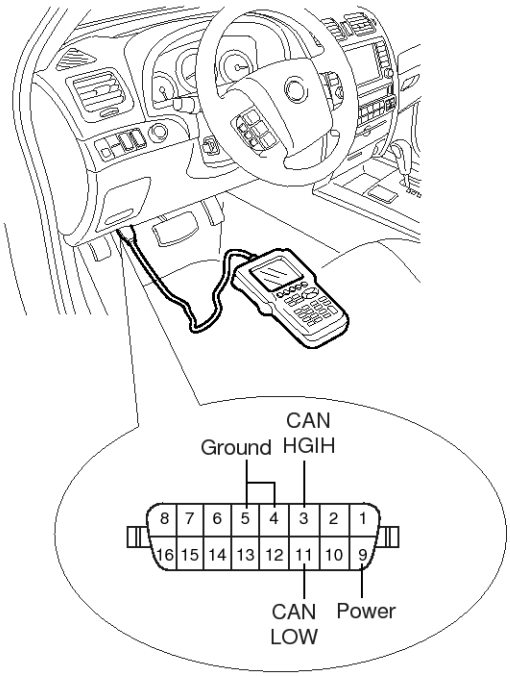
SENBR7602D

Connector Terminal		Specification	Remark
No	Description		
3	IGNITION1(+)	Over voltage range: 17 ± 0.5V Operating voltage range: 9.5 ± 0.5V < V < 17 ± 0.5V Low voltage range: 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current: I < 300mA	
2	POS. BATTERY.(SOLENOID)	Max leakage current : I < 0.8mA Operating voltage range: 9.5 ± 0.5V < V < 17 ± 0.5V Max current : I < 40A	
1	POS, BATTERY.(MOTOR)	Operating voltage range: 9.5 ± 0.5V < V < 16.5 ± 0.5V Rush current : I < 100A Max current : I < 40A Max leakage current : I < 0.2mA	
26	GROUND	Rated current : I < 300mA Max. current: I < 30A	
25	PUMP MOTOR GROUND	Rush current : I < 100A Max current : I < 40A	
10	G SENSOR GROUND (4WD Only)	- Rated current : I < 10mA	
18	G SENSOR POWER (4WD Only)	- Max Output current : I < 10mA - Max Output voltage : 4.75V ≤ V ≤ 5.25V	
7	G SENSOR SIGNAL (4WD Only)	- Input voltage : 0V ≤ V ≤ 5.0V - Zero offset voltage : 2.5 ± 0.1V	
14	BRAKE LIGHT SWITCH	Input voltage low: 0V ≤ V ≤ 3.0V Input voltage High: 7.0V ≤ V ≤ 16.0V	
23	SENSOR FRONT LEFT POWER	- Output voltage : IGN[V] ± 1V - Output current : Max 30mA	
17	SENSOR FRONT RIGHT POWER		
9	SENSOR REAR LEFT POWER		
15	SENSOR REAR RIGHT POWER		
22	SENSOR FRONT LEFT SIGNAL	- Input current LOW : 5.9 ~ 8.4mA - Input current HIGH : 11.8 ~ 16.8mA - Frequency range : 1 ~ 2500Hz - Input duty : 50 ± 20%	
24	SENSOR FRONT RIGHT SIGNAL		
8	SENSOR REAR LEFT SIGNAL		
16	SENSOR REAR RIGHT SIGNAL		

Connector Terminal		Specification	Remark
No	Description		
13	CAN BUS LINE (LOW)	Max. current : I < 10mA	
6	CAN BUS LINE (HIGH)		
4	SENSOR FRONT RIGHT OUTPUT	Max. current : I < 16mA External pull up resister : 1kΩ < R Output duty : 50 ± 20%	

Scan Tool Check

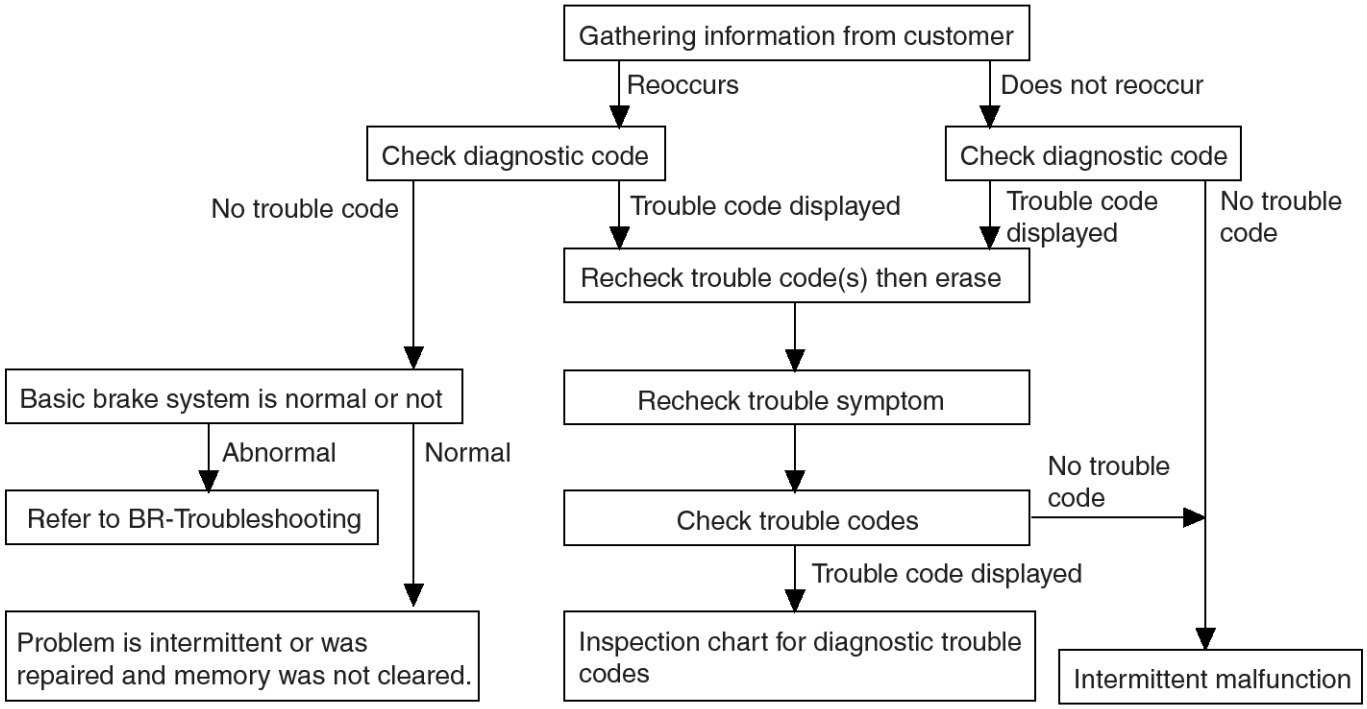
1. Turn the ignition switch OFF.
2. Connector the Hi-scan(pro) to the 16P data link connector located the driver's side kick panel.



SHMBR9330L

3. Turn the ignition switch ON.
4. Check for diagnostic trouble using the scan tool.
5. After completion trouble of the repair or correction of the problem, erase the stored fault codes the clear key on the scan tool.
6. Disconnect the scan tool from the 16P data link connector.

Standard Flow of Diagnostic Troubleshooting



*** Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.**

EJKB055A

Notes With Regard To Diagnosis

The phenomena listed in the following table are not abnormal.

Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered 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.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

ABS Check Sheet

ABS Check Sheet

Inspector's Name _____

Customer's Name		Registration No.	
		Registration Year	/ /
		VIN.	
Date Vehicle Brought In	/ /	Odometer	Km Miles

Date the Problem First Occurred	/ /
Frequency of Occurence of Problem	☐ Continuous ☐ Intermittent (times a day)

Symptoms	☐ ABS does not operate.	
	☐ ABS does not operate efficiently.	☐ Intermittent (times a day)
	ABS Warning Light Abnormal	☐ Remains ON ☐ Does not light up

Diagnostic Trouble Code Check	1st Time	☐ Normal Code	☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code	☐ Malfunction Code (Code)

EJDA017A

Problem Symptoms Table

Symptom	Suspect Area
ABS does not operate.	Only when 1. -4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit. 4. Check the hydraulic circuit for leakage.
ABS does not operate intermittently.	Only when 1. -4. are all normal and the problem is still occurring, replace the ABS actuator assembly. 1. Check the DTC reconfirming that the normal code is output. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU

⚠CAUTION

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

ABS Does Not Operate.

STQBR8319L

Detecting Condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult.However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection Procedures

DTC Inspection

1. Connect the scan tool with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO ▶ Check the power source circuit.

YES ▶ Erase the DTC and recheck using scan tool.

Check the Power Source Circuit

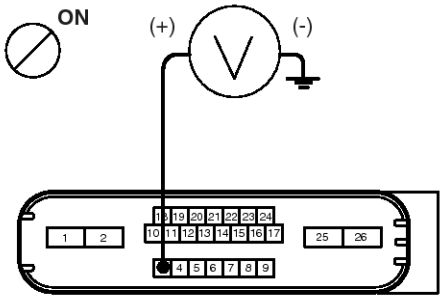
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

Specification: approximately B+

3. Is the voltage within specification?

YES ▶ Check the ground circuit.

NO ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module. Repair if necessary.



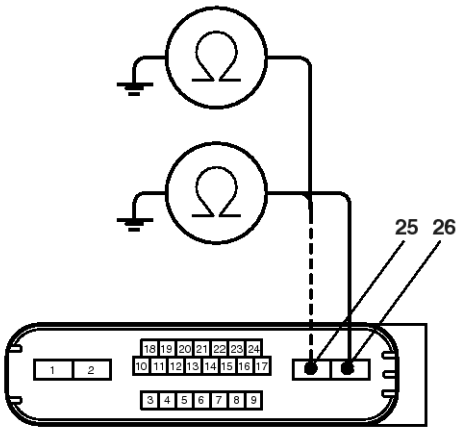
SENBR7603D

Check the Ground Circuit

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 25, 26 of the ABS control module harness side connector and ground point.
3. Is there continuity?

YES ▶ Check the wheel speed sensor circuit.

NO ▶ Repair an open in the wire and ground point.



SENBR7604D

Check the Wheel Speed Sensor Circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

YES ▶ Check the hydraulic circuit for leakage.

NO ▶ Repair or replace the wheel speed sensor.

Check the Hydraulic Circuit for Leakage

1. Refer to the hydraulic lines.
2. Inspect leakage of the hydraulic lines.
3. Is it normal?

YES ▶ The problem is still occurring, replace the ABS control module.

NO ▶ Repair the hydraulic lines for leakage.

ABS Does Not Operate (Intermittently).

STQBR8320L

Detecting Condition

Trouble Symptoms	Possible Cause
Brake operation varies depending on driving conditions and road surface conditions, so diagnosis can be difficult. However if a normal DTC is displayed, check the following probable cause. When the problem is still occurring, replace the ABS control module.	- Faulty power source circuit - Faulty wheel speed sensor circuit - Faulty hydraulic circuit for leakage - Faulty HECU

Inspection Procedures

DTC Inspection

1. Connect the scan tool with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
3. Is the normal code output?

NO ▶ Check the wheel speed sensor circuit.

YES ▶ Erase the DTC and recheck using scan tool.

Check the Wheel Speed Sensor Circuit

1. Refer to the DTC troubleshooting procedures.
2. Is it normal?

YES ▶ Check the stop lamp switch circuit.

NO ▶ Repair or replace the wheel speed sensor.

Check The Stop Lamp Switch Circuit

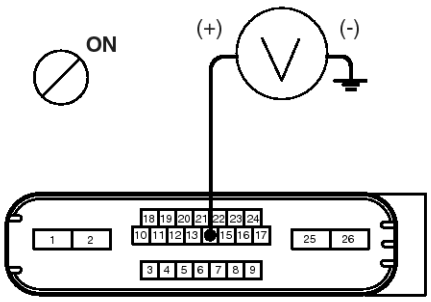
1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 14 of the ABS control module harness side connector and body ground when brake pedal is depressed.

Specification : approximately B+

3. Is the voltage within specification?

YES ▶ Check the hydraulic circuit for leakage.

NO ▶ Repair the stop lamp switch. Repair an open in the wire between the ABS control module and the stop lamp switch.



SENBR7605D

Check the Hydraulic Circuit for Leakage

1. Refer to the hydraulic lines.
2. Inspection leakage of the hydraulic lines.
3. Is it normal?

YES ▶ The problem is still occurring, replace the ABS control module.

NO ▶ Repair the hydraulic lines for leakage.

Communication with Scan-Tool is not possible.
(Communication with any system is not possible)

STQBR8321L

Detecting Condition

Trouble Symptoms	Possible Cause
Possible defect in the power supply system (including ground) for the diagnosis line.	- An open in the wire - Poor ground - Faulty power source circuit

Inspection Procedures

Check The Power Supply Circuit For The Diagnosis

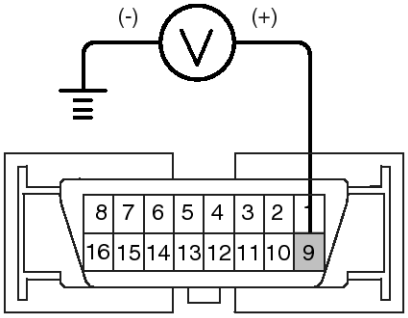
1. Measure the voltage between terminal 9 of the data link connector and body ground.

Specification : approximately B+

2. Is voltage within specification?

YES ▶ Check the ground circuit for the diagnosis.

NO ▶ Repair an open in the wire. Check and replace fuse (15A) from the engine compartment junction block.

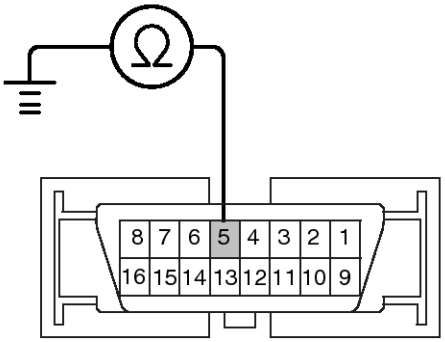


SUNBR6519L

Check the Ground Circuit for the Diagnosis

1. Check for continuity between terminal 5 of the data link connector and body ground.
2. Is there continuity?

NO ▶ Repair an open in the wire between terminal 5 of the data link connector and ground point.



SUNBR6520L

Communication with Scan Tool is not possible.
(Communication with ABS only is not possible)

STQBR8322L

Detecting Condition

Trouble Symptoms	Possible Cause
When communication with Hi-Scan (pro) is not possible, the cause may be probably an open in the HECU power circuit or an open in the diagnosis output circuit.	- An open in the wire - Faulty HECU - Faulty power source circuit

Inspection Procedures

Check for Continuity in the Diagnosis Line

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 7 of the ABS control module connector and 1 of the data link connector.
3. Is there continuity?

YES ▶ Check the power source of ABS control module.

NO ▶ Repair an open in the wire.

Check the Power Source of ABS Control Module

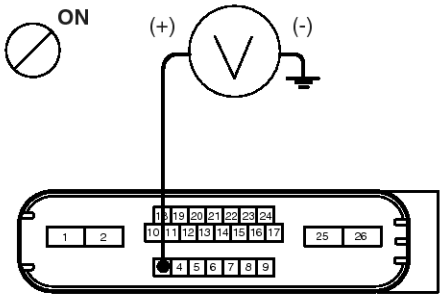
1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 3 of the ABS control module harness side connector and body ground.

Specification : approximately B+

3. Is voltage within specification?

YES ▶ Check for poor ground.

NO ▶ Check the harness or connector between the fuse (10A) in the engine compartment junction block and the ABS control module.Repair if necessary.



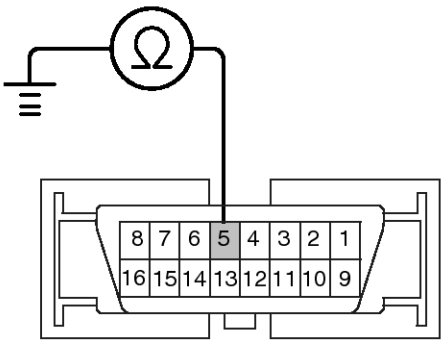
SENBR7603D

Check for Poor Ground

1. Check for continuity between terminal 5 of the data link connector and ground point.

YES ▶ Replace the ABS control module and recheck.

NO ▶ Repair an open in the wire or poor ground



SUNBR6520L

When Ignition Key Is Turned ON (engine OFF), The ABS Warning Lamp Does Not Light Up.

STQBR8323L

Detecting Condition

Trouble Symptoms	Possible Cause
When current flows in the HECU the ABS warning lamp turns from ON to OFF as the initial check.Therefore if the lamp does not light up, the cause may be an open in the lamp power supply circuit, a blown bulb, an open in the both circuits between the ABS warning lamp and the HECU, and the faulty HECU.	- Faulty ABS warning lamp bulb - Blown fuse is related to ABS in the engine compartment junction block - Faulty ABS warning lamp module - Faulty HECU

Inspection Procedures

Problem Verification

1. Disconnect the connector from the ABS control module and turn the ignition switch ON.
2. Does the ABS warning lamp light up?

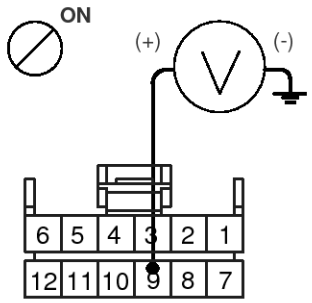
YES ▶ Inspect again after replacing the ABS HECU .

NO ▶ Check the power source for the ABS warning lamp.

Check the Power Source for The ABS Warning Lamp

1. Disconnect the instrument cluster connector (M01-C) and turn the ignition switch ON.
2. Measure the voltage between terminal (M01-C) 9 of the cluster harness side connector and body ground.

Specification : approximately B+



SHMBR8315D

3. Is voltage within specification?

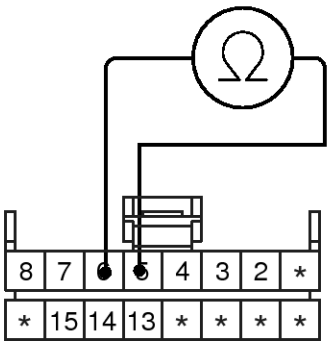
YES ▶ Check the CAN circuit resistance for ABS warning lamp.

NO ▶ Check for blown fuse.

Check the Can Circuit Resistance for ABS Warning Lamp

1. Disconnect the instrument cluster connector (M01-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M01-B) 5 and 6 of the cluster harness side connector.

Specification : 60Ω



SHMBR8316D

3. Is resistance within specification?

YES ▶ Repair ABS warning lamp bulb or instrument cluster assembly.

NO ▶ Check the CAN circuit wiring for ABS warning lamp.

Check the Can Circuit Wiring for ABS Warning Lamp

1. Disconnect the instrument cluster connector (M01-B) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M01-B) 6 of the cluster harness side connector and terminal 6 of ABS HECU harness side.

   Check for continuity between terminal (M01-B) 5 of the cluster harness side connector and terminal 13 of ABS HECU harness side.

Specification : Below 1Ω

3. Is resistance within specification?

YES ▶ Repair short of wiring between terminal 6, 6 of ABS HECU harness connector and ABS warning lamp module.

NO ▶ Repair open of wiring between terminal 5, 13 of ABS HECU harness connector and ABS warning lamp module.

Even After The Engine Is Started, The ABS Warning Lamp Remains ON.

STQBR8324L

Detecting Condition

Trouble Symptoms	Possible Cause
If the HECU detects trouble, it lights the ABS warning lamp while at the same time prohibiting ABS control. At this time, the HECU records a D-TC in memory.Even though the normal code is output, the ABS warning lamp remains ON, then the cause may be probably an open or short in the ABS warning lamp circuit.	- An open in the wire - Faulty instrument cluster assembly - Faulty ABS warning lamp module - Faulty HECU

Inspection Procedures

Check DTC Output

1. Connect the scan tool to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using scan tool.
3. Is DTC output?

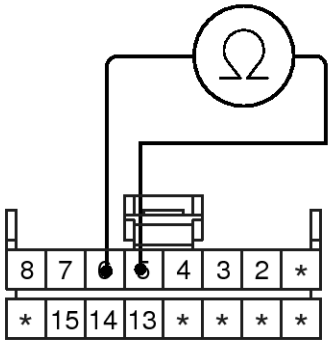
YES ▶ Perform the DTC troubleshooting procedure (Refer to DTC troubleshooting).

NO ▶ Check the CAN circuit resistance for ABS warning lamp.

Check the Can Circuit Resistance for ABS Warning Lamp

1. Disconnect the instrument cluster connector (M01-B) and turn the ignition switch OFF.
2. Measure the resistance between terminal (M01-B) 5 and 6 of the cluster harness side connector.

Specification : 60Ω



SHMBR8316D

3. Is resistance within specification?

YES ▶ Repair ABS warning lamp bulb or instrument cluster assembly.

NO ▶ Check the CAN circuit wiring for ABS warning lamp.

Check the Can Circuit Wiring for ABS Warning Lamp

1. Disconnect the instrument cluster connector (M01-B) and ABS HECU connector, and then turn the ignition switch OFF.
2. Check for continuity between terminal (M01-B) 6 of the cluster harness side connector and terminal 6 of ABS HECU harness side.

   Check for continuity between terminal (M01-B) 5 of the cluster harness side connector and terminal 13 of ABS HECU harness side.

Specification : Below 1Ω

3. Is there continuity?

YES ▶ Repair short of wiring between terminal 5 , 13 of ABS HECU harness connector and ABS warning lamp module.If no trouble in wiring, inspect again after replacing the ABS HECU.

NO ▶ Repair short of wiring between terminal 5 , 13 of ABS HECU harness connector and ABS warning lamp module.If no trouble in wiring, inspect again after replacing the ABS HECU.

Bleeding of Brake System

This procedure should be followed to ensure adequate bleeding of air and filling of the ABS unit, brake lines and master cylinder with brake fluid.

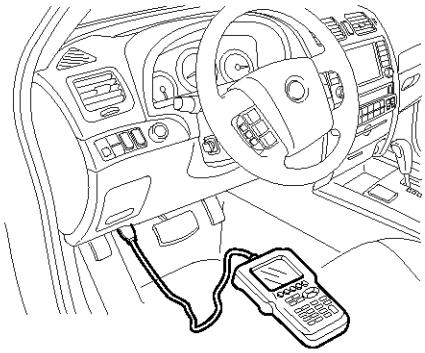
1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

   ⚠CAUTION
   If there is any brake fluid on any painted surface, wash it off immediately.

   NOTICE
   When pressure bleeding, do not depress the brake pedal.

   Recommended fluid..... DOT3 or DOT4

2. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.
3. Connect the scan tool to the data link connector located underneath the dash panel.



SHMBR9331L

4. Select and operate according to the instructions on the scan tool screen.

   ⚠CAUTION
   You must obey the maximum operating time of the ABS motor with the hi-scan (Pro) to prevent the motor pump from burning.

   1) Select vehicle name.
   2) Select Anti-Lock Brake system.
   3) Select air bleeding mode.
   4) Press "YES" to operate motor pump and solenoid valve.

```
          < PRE BLEEDING >

1. Perform the bleeding of conventiona
   parts certainly.

2. Press [ENTER] key to activate pump
   motor and all NC valves.
```

SUNBR6522L

   5) Wait 60 sec. before operating the air bleeding. (If not, you may damage the motor.)

```
 NOW, ALL NC VALVES AND PUMP MOTOR
ARE ACTIVATING. DURING THIS TIME,
IT SHOULD BE REPEATED THAT DEPRESS-
ING THE BRAKE PEDAL UNTIL IT REACHES
TO THE BOTTOM OF FLOOR WITHOUT REA-
CTION AND RELEASING THE BRAKE PEDAL
UNTIL THE KICK BACK SITUATION IS
OVER.
 PLEASE WAIT 120 SECONDS.
```

SUNBR6523L

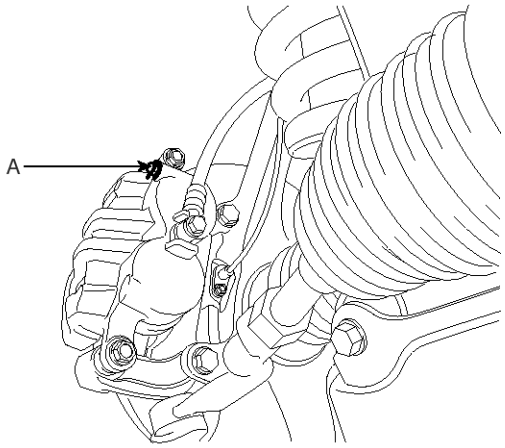
6) Perform the air bleeding.

```
< FINAL BLEEDING >
1. Perform the bleeding of conventiona
   parts certainly.
2. If the brake pedal stroke is not so
   good after above procedure, perform
   the all procedure more some times
   and recheck the brake pedal stroke.
3. Press [ENTER] key to return the
   first bleeding mode.
```

SUNBR6621L

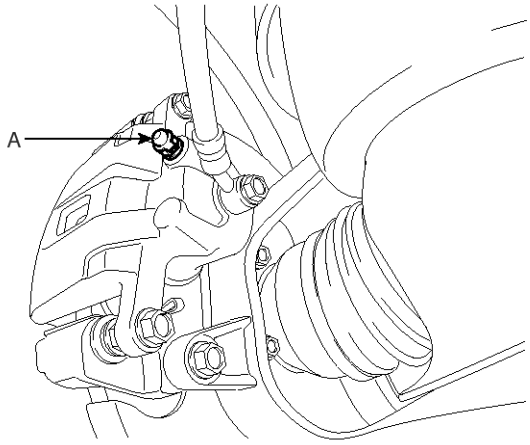
5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.

Front



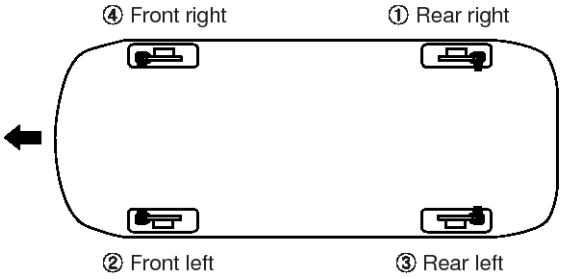
SHMBR8364D

Rear



SHMBR8365D

6. Repeat step 5 until there are no more bubbles in the fluid for each wheel.



KJKE003B

7. Tighten the bleeder screw.

Bleed screw tightening torque:
6.86 ~ 12.74 N.m (0.7 ~ 1.3 kgf.m, 5.09 ~ 9.45 lb-ft)

Diagnostic Trouble Code Chart(DTC)

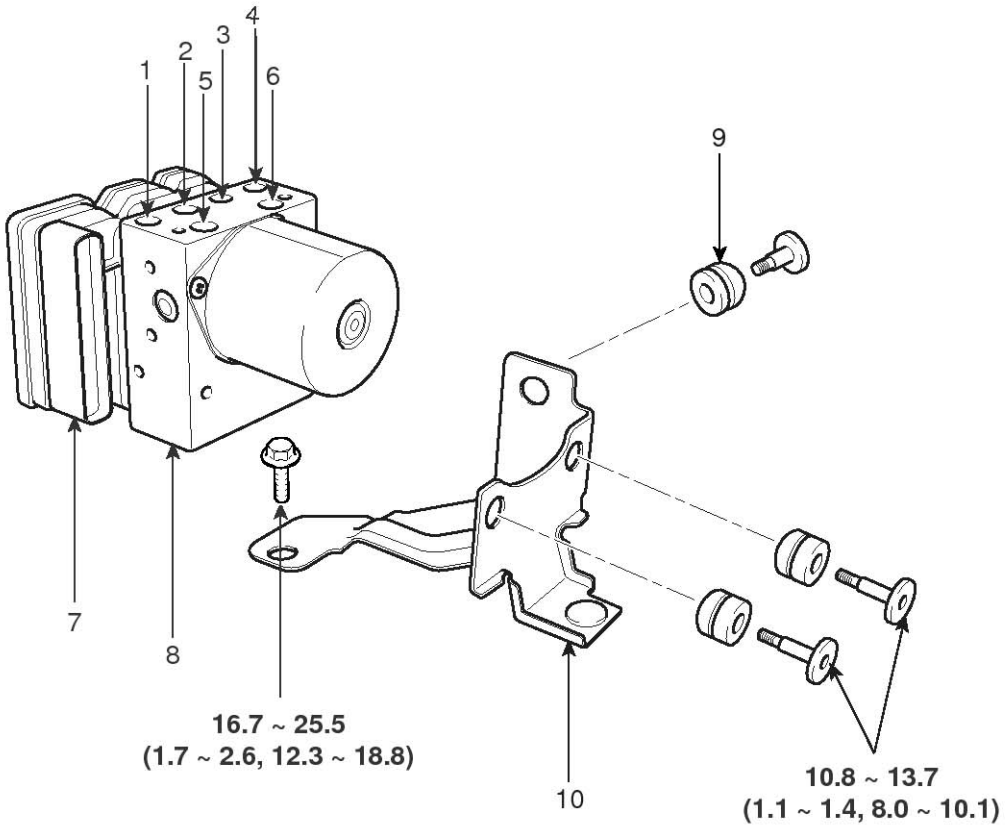
● : MIL ON ○ : MIL OFF

DTC CODE	Trouble description	Warning lamp condition			Remark
		EBD	ABS	ESP	
C1101	Battery Voltage High	●	●	●	ABS/ESP
C1102	Battery Voltage Low	○/●	●	●	ABS/ESP
C1112	Sensor Source Voltage	○	○/●	●	ABS/ESP
C1200	Wheel Speed Sensor Front-LH Open/ Short	○/●	●	●	ABS/ESP
C1201	Wheel Speed Sensor Front-LH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1202	Wheel Speed Sensor Front-LH Invalid/ No signal	○/●	●	●	ABS/ESP
C1203	Wheel Speed Sensor Front-RH Open/ Short	○/●	●	●	ABS/ESP
C1204	Wheel Speed Sensor Front-RH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1205	Wheel Speed Sensor Front-RH Invalid/ No signal	○/●	●	●	ABS/ESP
C1206	Wheel Speed Sensor Rear-LH Open/ Short	○/●	●	●	ABS/ESP
C1207	Wheel Speed Sensor Rear-LH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1208	Wheel Speed Sensor Rear-LH Invalid/ No signal	○/●	●	●	ABS/ESP
C1209	Wheel Speed Sensor Rear-RH Open/ Short	○/●	●	●	ABS/ESP
C1210	Wheel Speed Sensor Rear-RH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1211	Wheel Speed Sensor Rear-RH Invalid/ No signal	○/●	●	●	ABS/ESP
C1235	Primary Pressure Sensor - Electrical	○	○	●	ESP
C1237	Primary Pressure Sensor - Signal	○	○	●	ESP
C1260	Steering Angle Sensor Circuit - Signal	○	○	●	ESP
C1261	Steering Angle Sensor Not Calilbrated	○	○	●	ESP
C1274	Longitudianl G Sensor Open/ Short	○	●	●	4/4WD
C1275	Longitudianl G Sensor Range/ Performance Error	○	●	●	4/4WD
C1282	Yaw Rate & Lateral G Sensor - Electrical	○	○	●	ESP
C1283	Yaw Rate & Lateral G Sensor - Signal	○	○	●	ESP
C1503	TCS/ ESP Switch Error	○	○	●	ESP
C1513	Brake Switch Error	○	○	●	ESP
C1526	DBC Switch Error	○	○	○	ESP
C1604	ECU Hardware Error	●	●	●	ABS/ESP
C1605	CAN Hardware Error	○	○	●	ESP
C1611	CAN Time-Out ECM	○	○	●	ESP

DTC CODE	Trouble description	Warning lamp condition			Remark
		EBD	ABS	ESP	
C1612	CAN Time-Out TCM	○	○	●	ESP
C1613	CAN Wrong Message	○	○	●	ESP
C1616	CAN Bus Off	○	○	●	ESP
C1623	CAN Time-out Steering Angle Sensor	○	○	●	ESP
C1627	CAN Time-Out 4WD	○	○	●	ABS/ESP
C1647	CAN Hardware Error - Sensor Channel	○	○	●	ESP
C1702	Variant Coding Error	○	●	●	ABS/ESP
C2112	Valve Relay Error	●	●	●	ABS/ESP
C2130	Brake Lamp Relay Error	○	○	○	ESP
C2227	Excessive Temperature of Brake Disc	○	○	●	ESP
C2380	ABS/TCS/ESP Valve Error	●	●	●	ABS/ESP
C2402	Motor Failure	○	●	●	ABS/ESP

ABS Control Module

Components



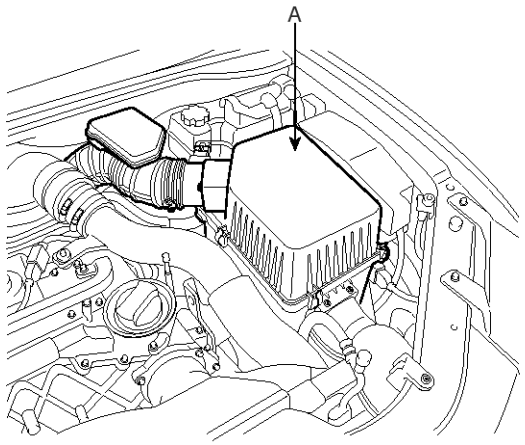
Torque : N.m (kgf.m, lb-ft)

SHMBR9314L

1. Front-left tube
2. Rear -right tube
3. Rear-left tube
4. Front-right tube
5. MC2
6. MC1
7. ABS control module connector (26P)
8. ABS control module (HECU)
9. Damper
10. Bracket

Removal

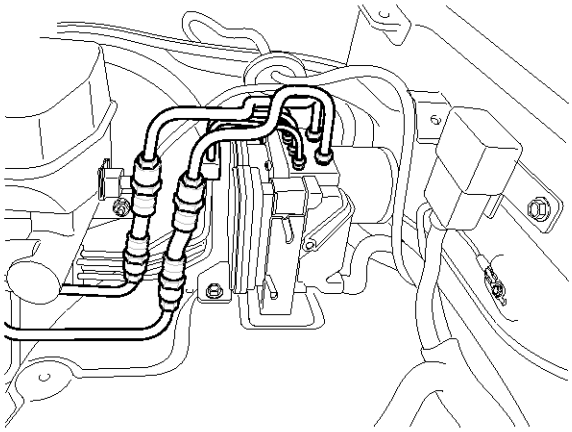
1. Turn the ignition switch OFF.
2. Remove the air cleaner assembly (A).



SHMBR8368D

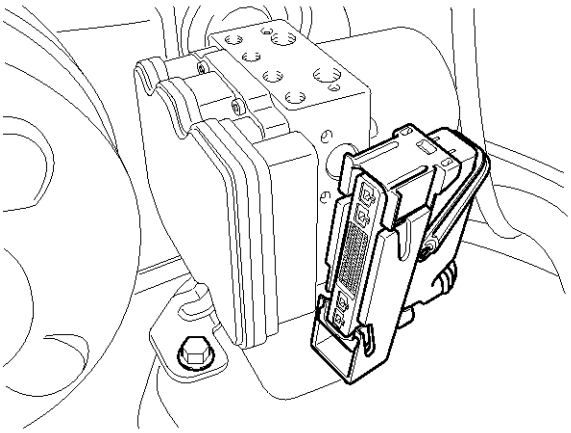
3. Remove the ECM. (Refer to Fuel system group - ECM)
4. Disconnect the brake tubes from the HECU by unlocking the nuts counterclockwise with a spanner.

Tightening torque:
ABS : 12.7 ~ 16.7N.m(1.3 ~ 1.7kgf.m, 9.4 ~ 12.3lb-ft
ESP : 18.6 ~ 22.6N.m(1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft



SHMBR8323D

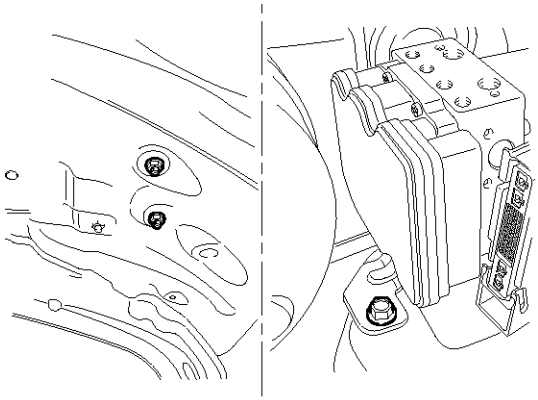
5. Pull up the lock of the ABS control unit 26P connector , then disconnect the connector.



SHMBR8362D

6. Remove the front wheel guard.
7. Loosen the ABS HECU bracket bolt(1EA) and nuts(2EA), then remove HECU and bracket.

Tightening torque:
16.7 ~ 25.5N.m (1.7 ~ 2.6kgf.m, 12.3 ~ 18.8lb-ft)



SHMBR9328L

⚠CAUTION

1. **Never attempt to disassemble the HECU.**
2. **The HECU must be transported and stored in.**
3. **Never shock to the HECU.**

8. Remove the 3 bolts, then remove the bracket from HECU.

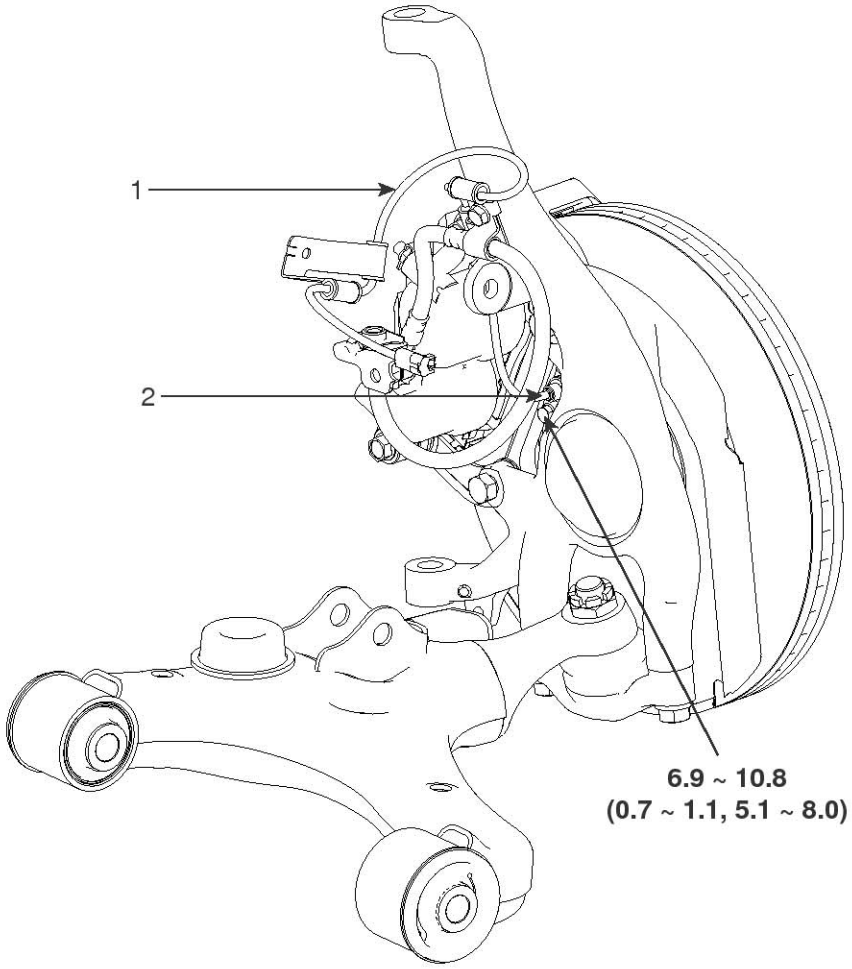
Tightening torque:
10.8 ~ 13.7N.m (1.1 ~ 1.4kgf.m, 8.0 ~ 10.1lb-ft)

Installation

1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and nuts to the specified torque.

Front Wheel Speed Sensor

Components



Torque : N.m (kgf.m, lb-ft)

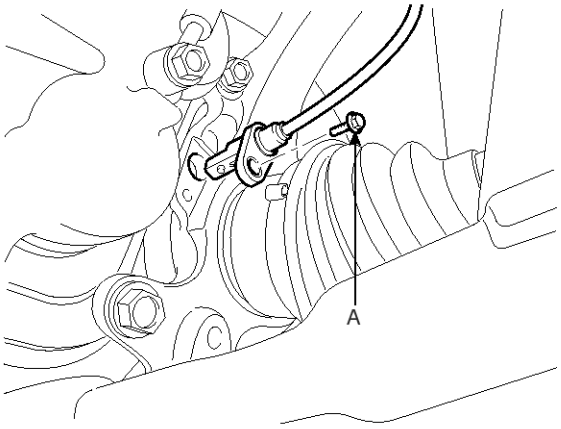
SHMBR9315L

1. Front wheel speed sensor cable
2. Front wheel speed sensor

Removal

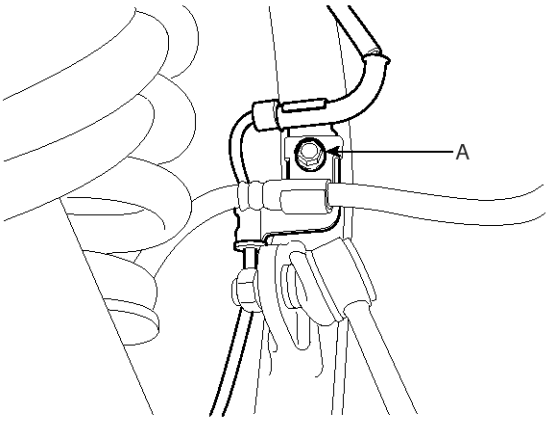
1. Remove the front wheel speed sensor mounting bolt (A).

Tightening torque:
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



SHMBR8326D

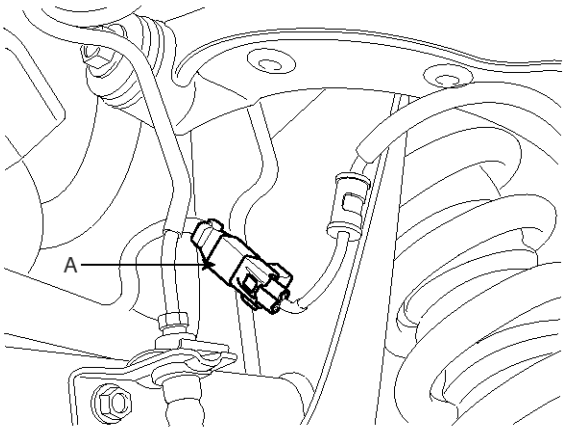
2. Remove the front wheel speed sensor bracket (A).



SHMBR8327D

3. Remove the front wheel guard .

4. Disconnect the front wheel speed sensor connector (A) , then remove the front wheel speed sensor.

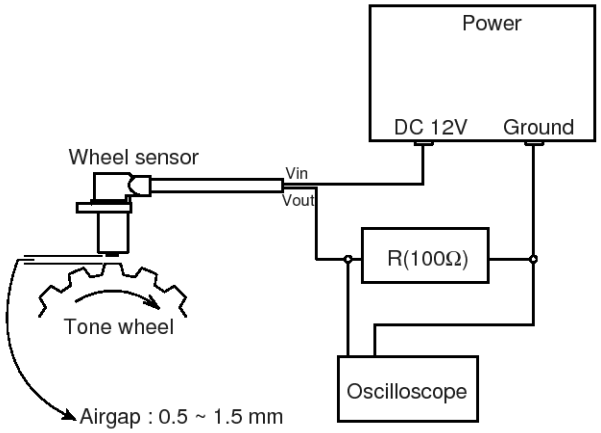


SHMBR8328D

Inspection

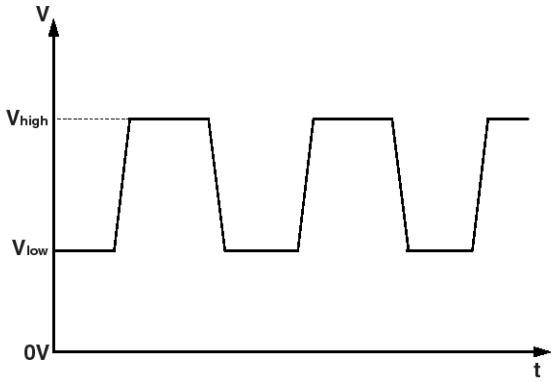
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

   ⚠CAUTION
   In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resister must be used as shown.



SHMBR9322L

2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.

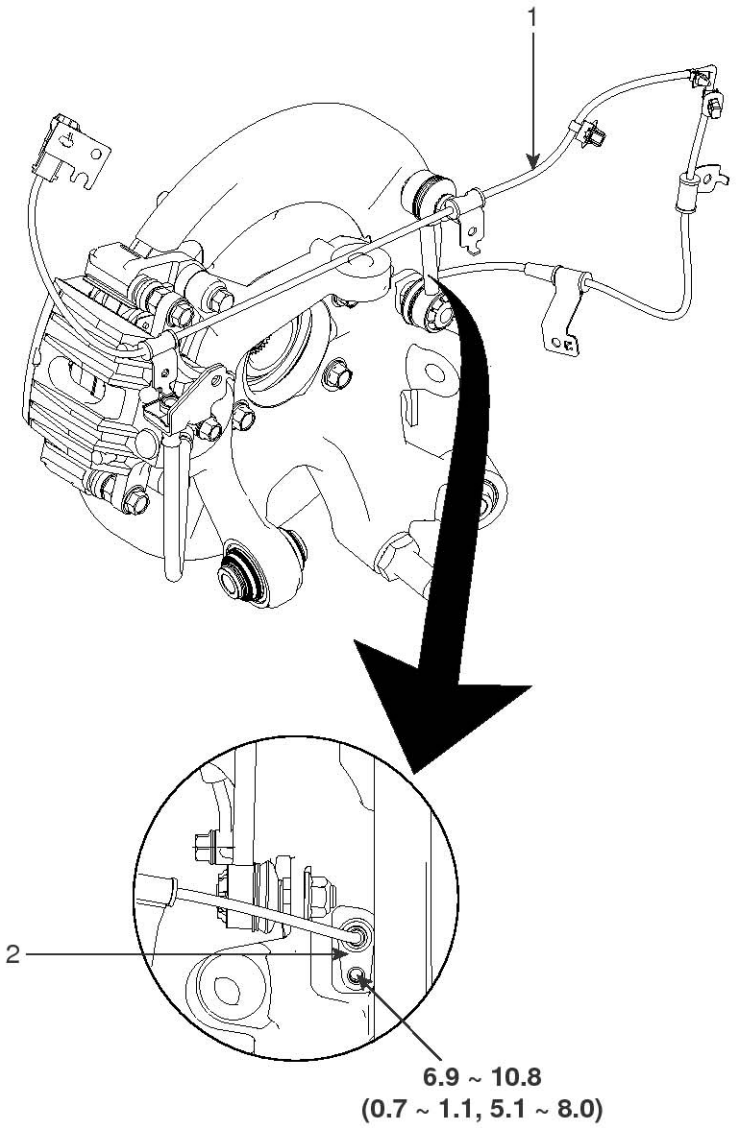


ARJE503Z

V_low : 0.59V ~ 0.84V
V_high : 1.18V ~ 1.68V
Frequency range : 1 ~ 2,500Hz

Rear Wheel Speed Sensor

Components



Torque : N.m (kgf.m, lb-ft)

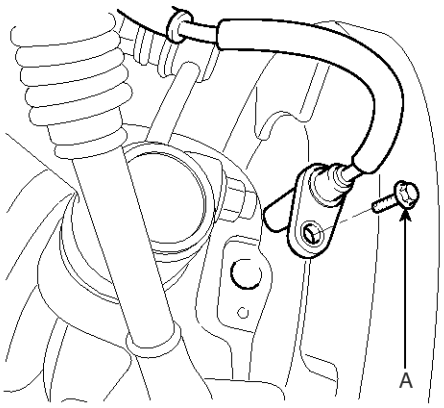
SHMBR9316L

1. Rear wheel speed sensor cable
2. Rear wheel speed sensor

Removal

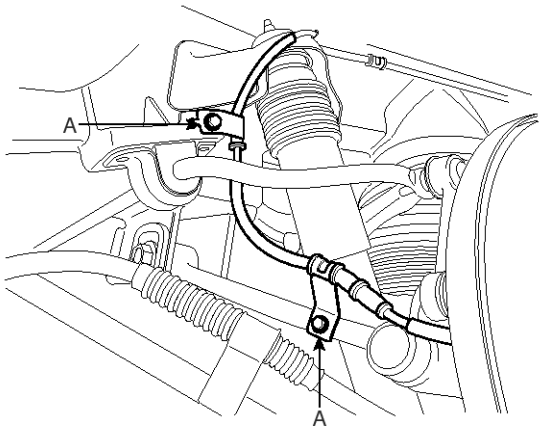
1. Remove the rear wheel speed sensor mounting bolt (A).

Tightening torque:
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



SHMBR8331D

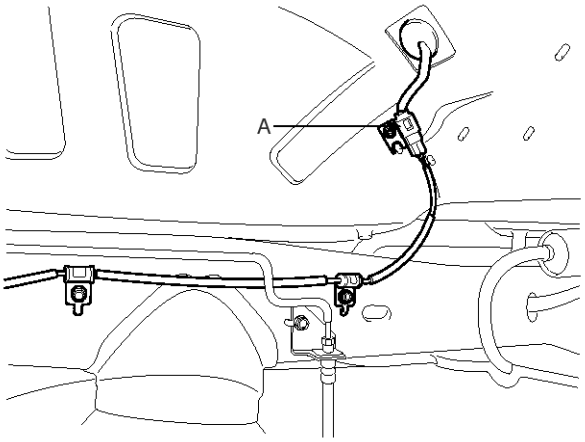
2. Remove the rear wheel speed sensor bracket (A).



SHMBR8332D

3. Remove the rear wheel guard .

4. Disconnect the rear wheel speed sensor connector (A) , then remove the rear wheel speed sensor.

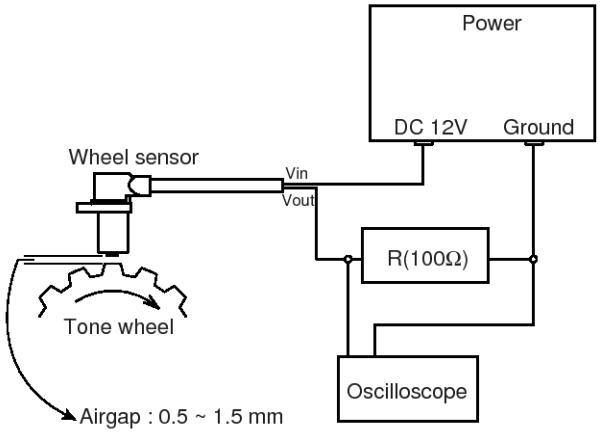


SHMBR8333D

Inspection

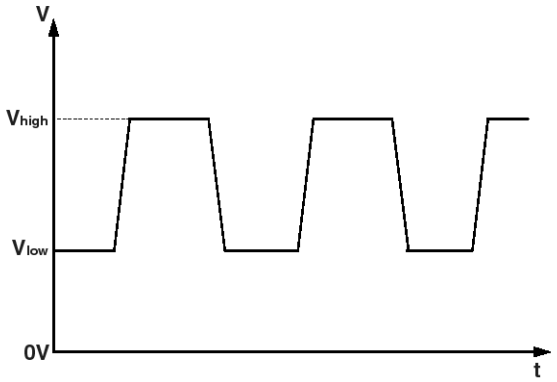
1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.

   ⚠CAUTION
   In order to protect the wheel speed sensor, when measuring output voltage, a 100 Ω resister must be used as shown.



SHMBR9322L

2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



ARJE503Z

V_low : 0.59V ~ 0.84V
V_high : 1.18V ~ 1.68V
Frequency range : 1 ~ 2,500Hz

EBD(Electronic Brake-force Distribution)

EBD (Electronic Brake-force Distribution) Operation

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the effective adhesion utilization by the rear wheels.

It further utilizes the efficiency of highly developed ABS equipment by controlling the slip of the rear wheels in the partial braking range.

The brake force is moved even closer to the optimum and controlled electronically, thus dispensing with the need for the proportioning valve.

The proportioning valve, because of a mechanical device, has limitations to achieve an ideal brake force distribution tothe rear wheels as well as to carry out the flexible brake force distribution proportioning to the vehicle load or weight increasing. And in the event of malfunctioning, driver cannot notice whether it fails or not.

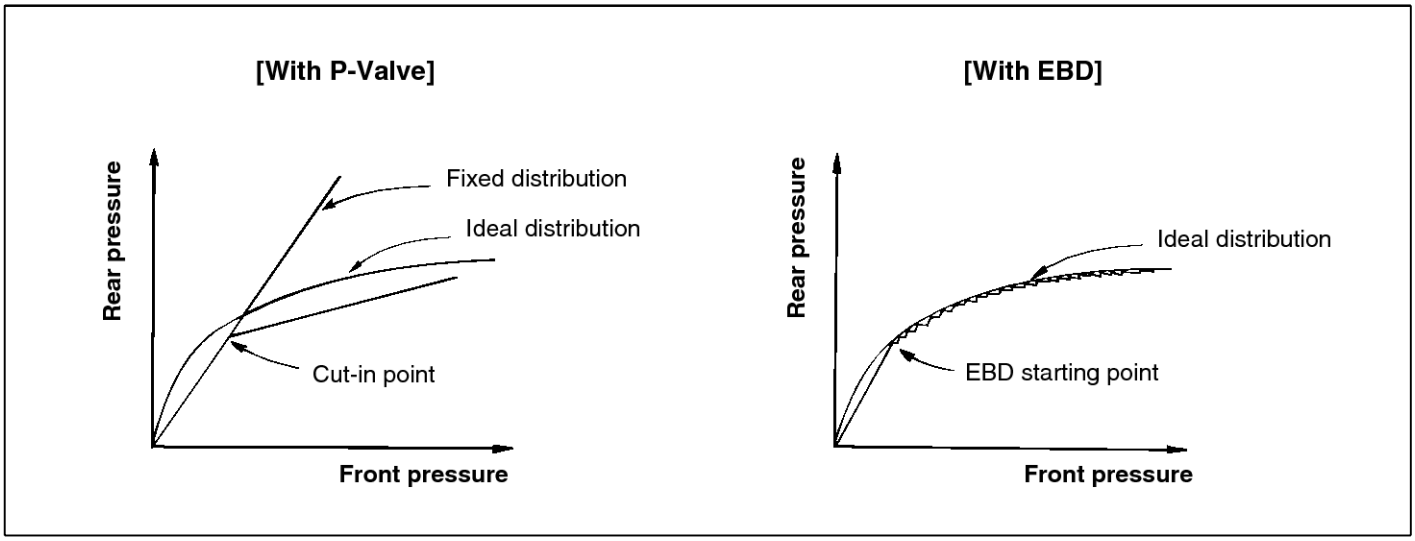
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

Advantages

- Function improvement of the base-brake system.
- Compensation for the different friction coefficients.
- Elimination of the proportioning valve.
- Failure recognition by the warning lamp.

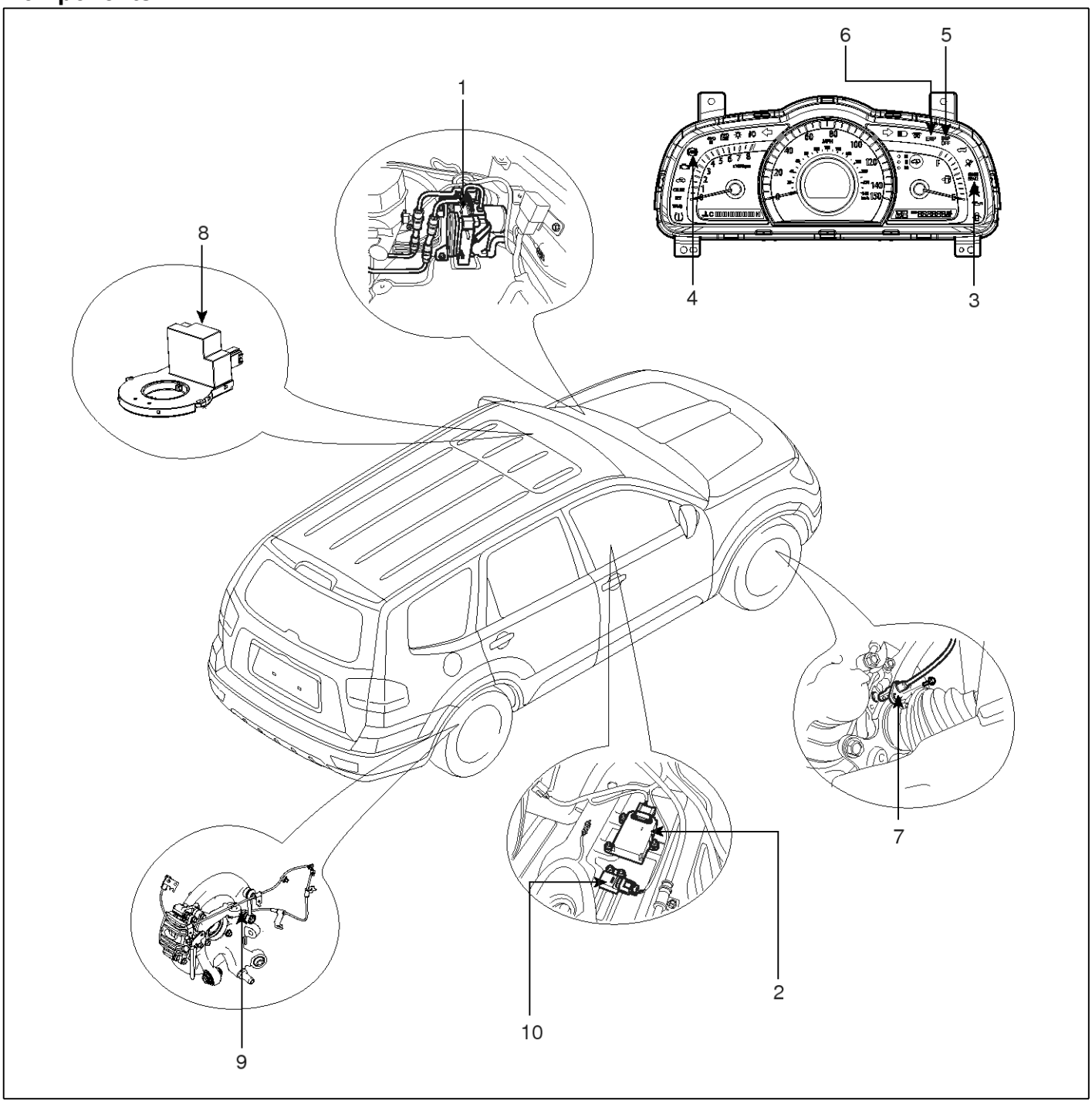
Comparison between Proportioning Valve and EBD



EJA0032A

ESP(Electronic Stability Program) System

Components



SHMBR9317L

1. HECU module
2. Yaw rate & Lateral G sensor
3. Parking brake/EBD warning lamp
4. ABS warning lamp
5. ESP function lamp
6. ESP OFF warning lamp
7. Front wheel speed sensor
8. Steering angle sensor
9. Rear wheel speed sensor
10. Longitudinal G sensor

Description of ESP

Optimum driving safety now has a name : ESP, the Electronic Stability Program.

ESP is based on the MGH 40 ABS Hydraulic System. ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake or the gas pedal.

ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and EDC functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about its vertical axis.

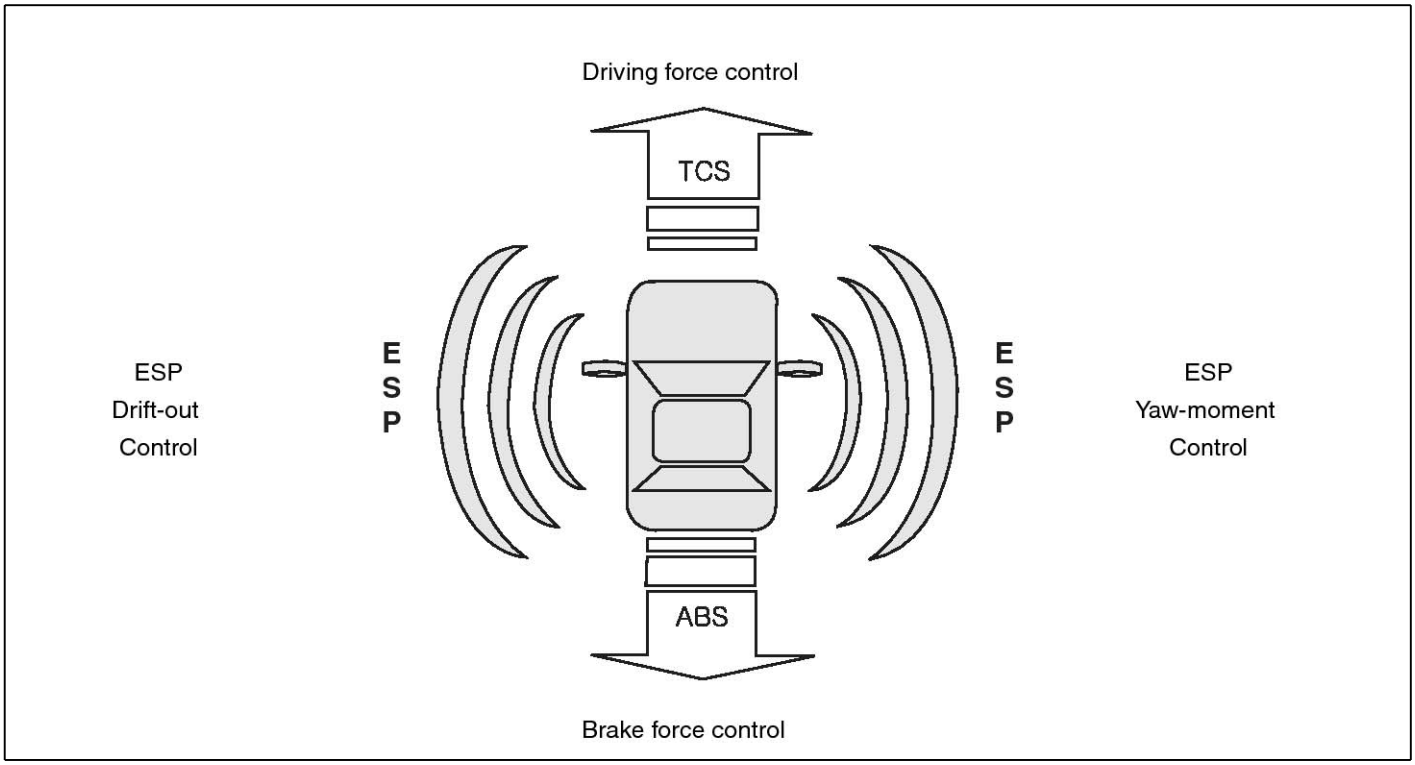
This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

ESP essentially consists of three assemblies : the sensors, the electronic control unit and the actuators.

The electronic control unit incorporates the technological experience accumulated in connection with the MGH 40 system, but has been substantially expanded in terms of capacity and monitoring concept in order to permit the additional sensor signals and arithmetic operations to be processed and converted into corresponding valve, pump and engine control commands. Two 16-bit processors and one 8-bit processor, which monitor each other, cooperate to handle these requirements.

Of course, the stability control feature works under all driving and operating conditions. Under certain driving conditions, the ABS/TCS function can be activated simultaneously with the ESP function in response to a command by the driver.

In the event of a failure of the stability control function, the basic safety function, ABS, is still maintained.



LJCD201A

Description Of ESP Control

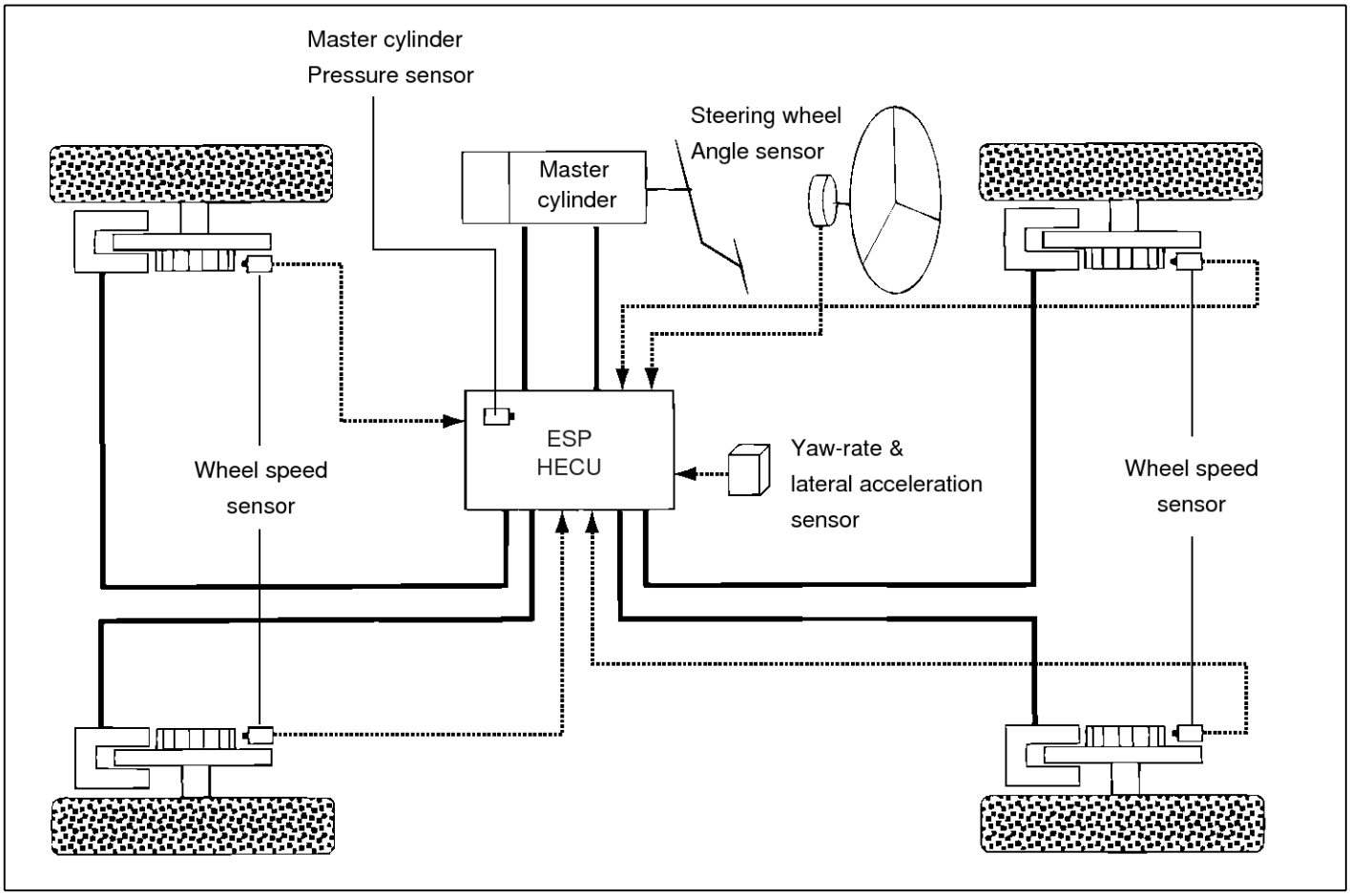
ESP system includes ABS/EBD, TCS and AYC function.

ABS/EBD function : The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave.By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels.And, the ECU judges whether the ABS/EBD should be actuated or not.

TCS function prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication.TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

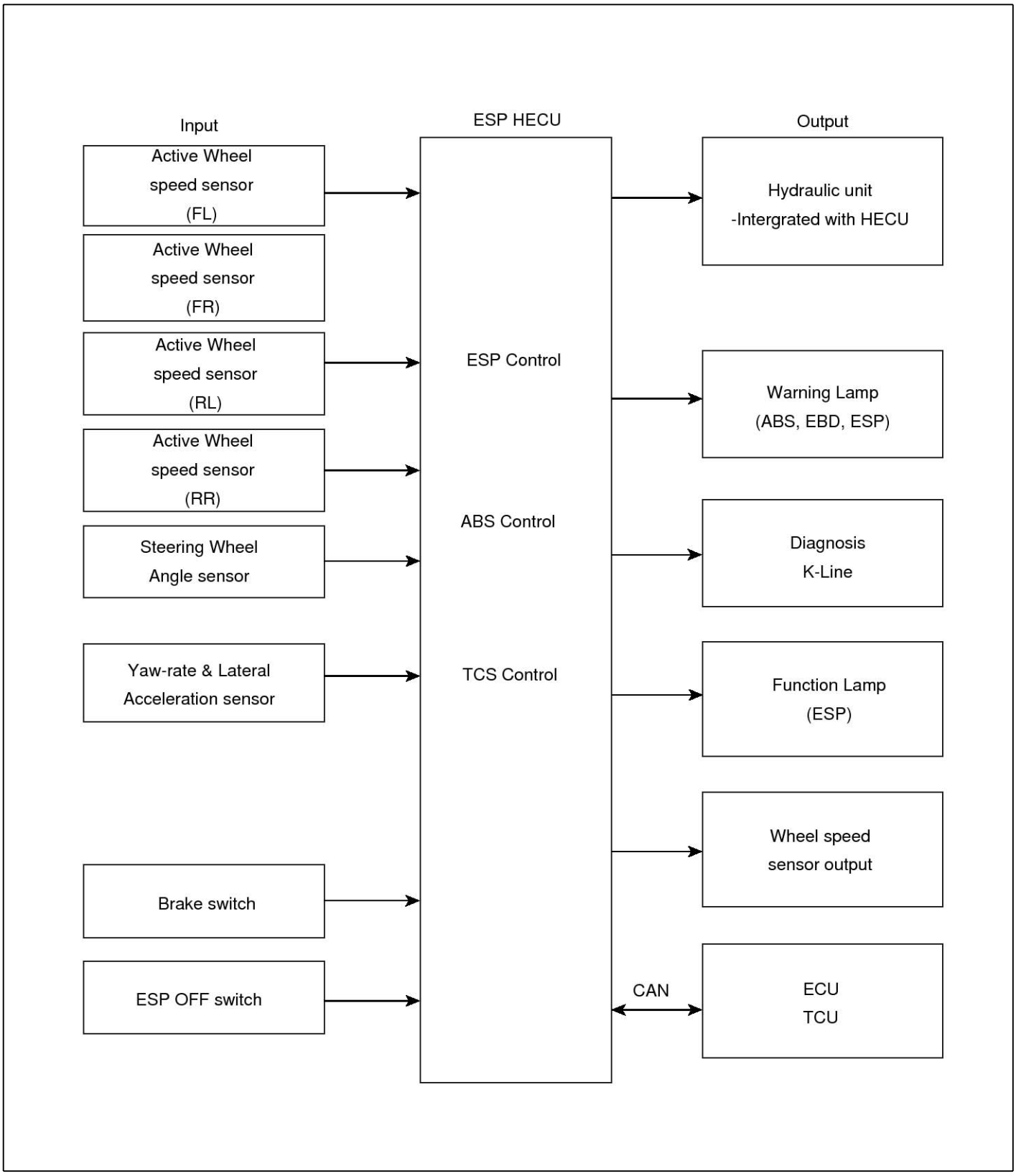
AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals(Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor).If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake pressure on certain wheel, and send engine torque reduction signal by CAN.

After the key-on, the ECU continually diagnoses the system failure. (self-diagnosis)If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)



SHMBR9332L

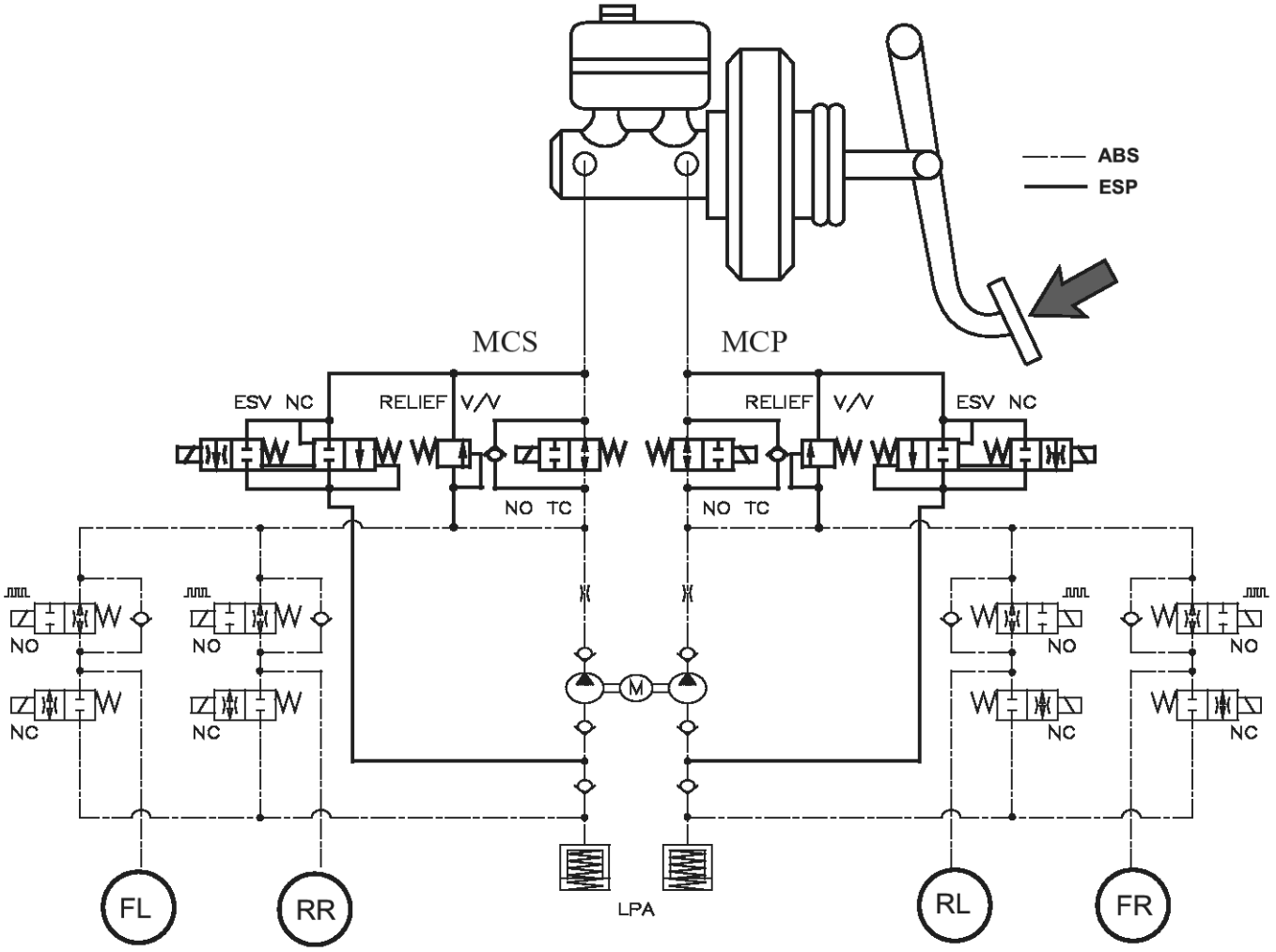
Inputand Output Diagram



SBHBR9325L

ESP Operation Mode

ESP Hydraulic System Diagram



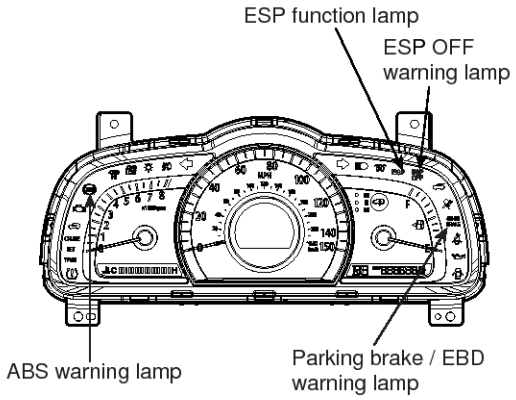
LJJF501P

1. ESP Non-operation : Normal braking.

Solenoid valve	Continuity	Valve	Motor pump	TC Valve
IN (NO)	OFF	OPEN	OFF	OFF
OUT (NC)	OFF	CLOSE		

2. ESP operation

Solenoid valve		Continuity	Valve	Motor pump	TC Valve
Understeering (Only inside of rear wheel)	IN(NO)	OFF	OPEN	ON	ON
	OUT(NC)	OFF	CLOSE		
Oversteering (Only outside of front wheel)	IN(NO)	OFF	OPEN		
	OUT(NC)	OFF	CLOSE		



SHMBR9318L

ABS Warning Lamp Module

The active ABS warning lamp module indicates the self-test and failure status of the ABS .The ABS warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ABS functions by failure.
- During diagnostic mode.
- When the ECU Connector is seperated from ECU.

EBD/Parking Brake Warning Lamp Module

The active EBD warning lamp module indicates the self-test and failure status of the EBD. However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions. The EBD warning lamp shallbe on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order .
- During diagnostic mode.
- When the ECU Connector is seperated from ECU.

ESP Warning Lamp (ESPSystem)

The ESP warning lamp indicates the self-test and failure status of the ESP.

The ESP warning lamp is turned on under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ESP functions by failure.
- When driver trun off the ESP function by on/off switch.
- During diagnostic mode.

ESP Function Lamp (ESP System)

The ESP function lamp indicates the self-test and operating status of the ESP.

The ESP Function lamp operates under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the ESP control is operating. (Blinking - 2Hz)

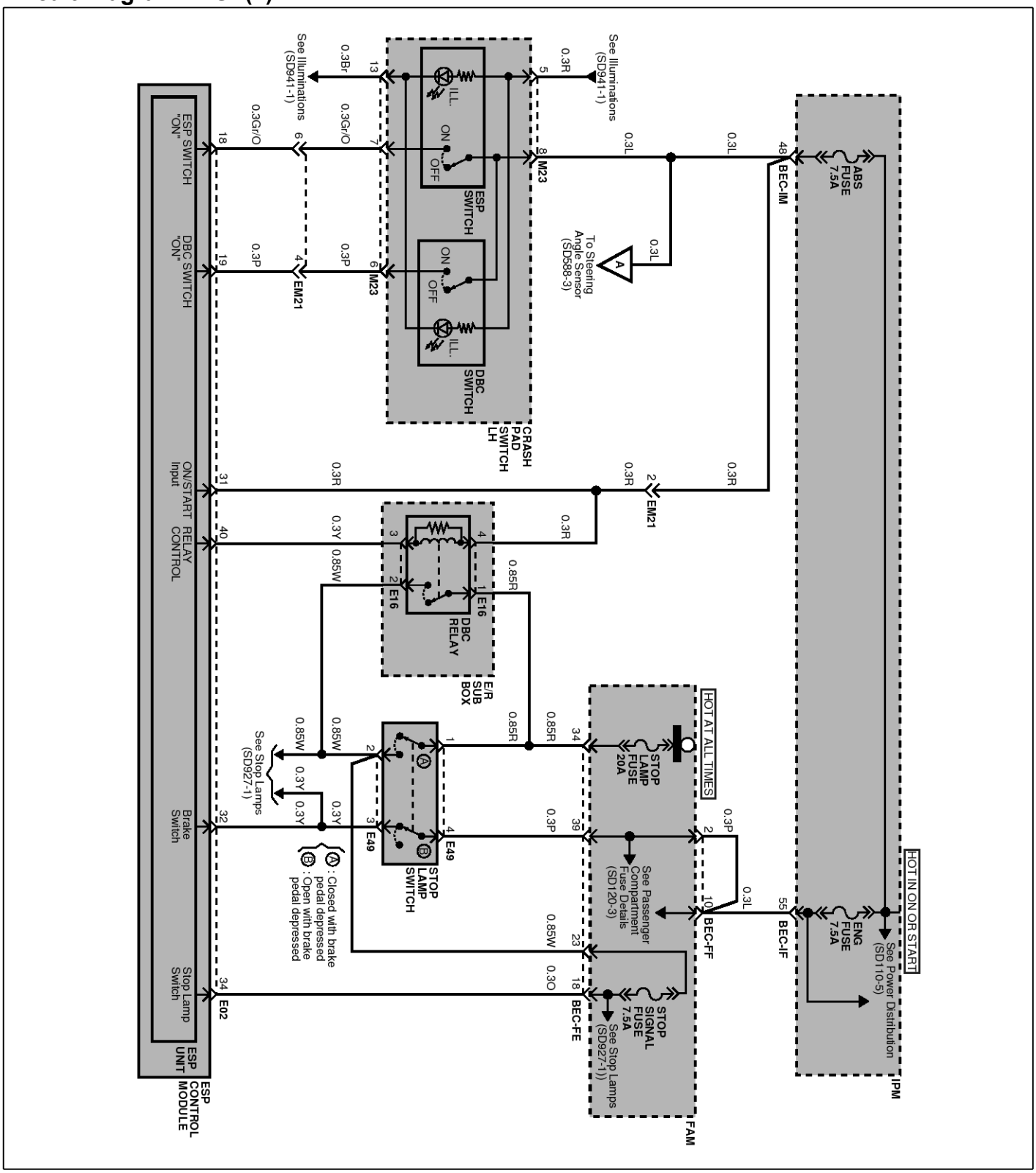
ESP On/Off Switch (ESP System)

The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input.

The On/Off switch shall be a normally open, momentary contact switch.Closed contacts switch the circuit to ignition.

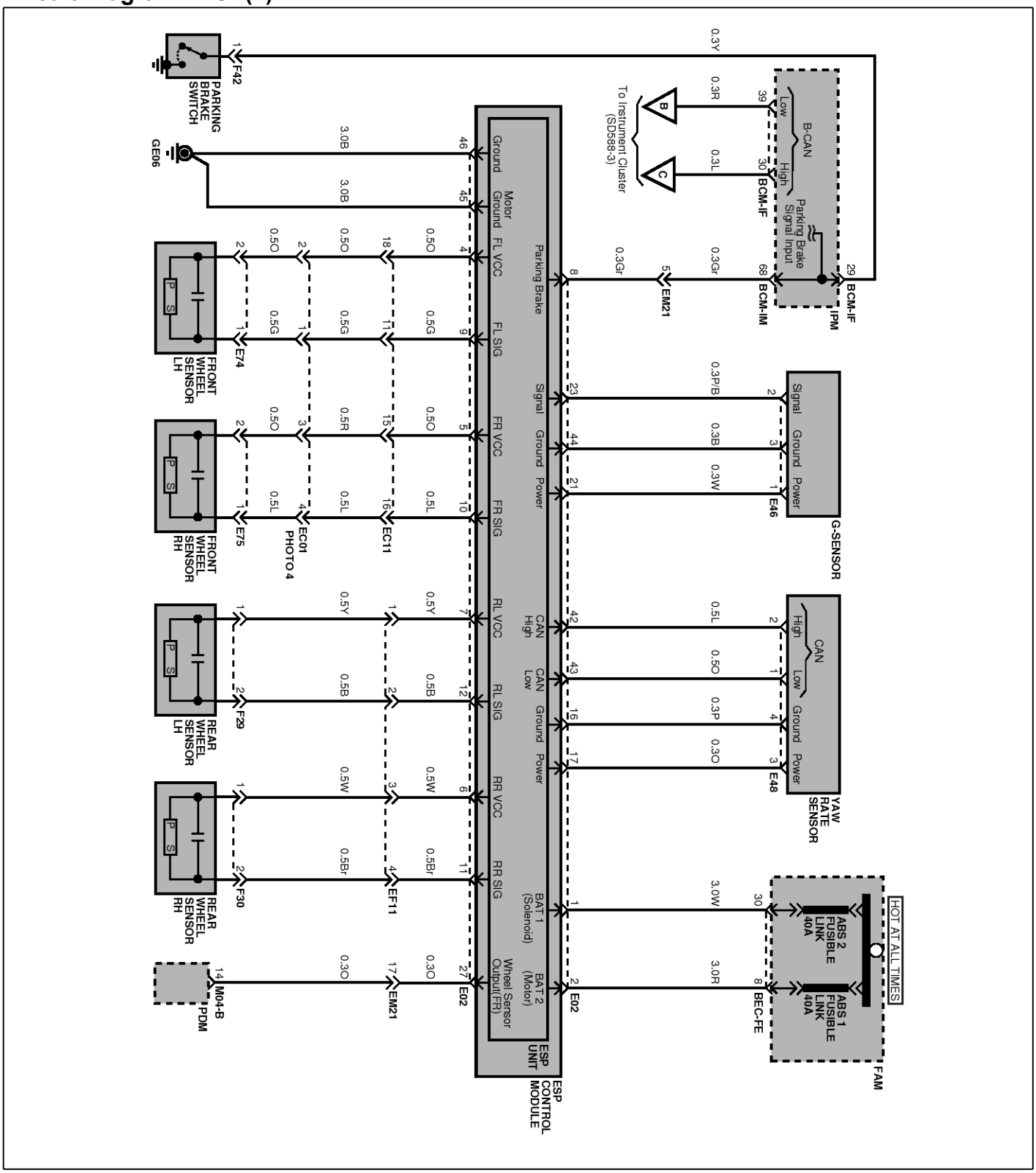
Initial status of the ESP function is on and switch toggle the state.

Circuit Diagram - ESP(1)



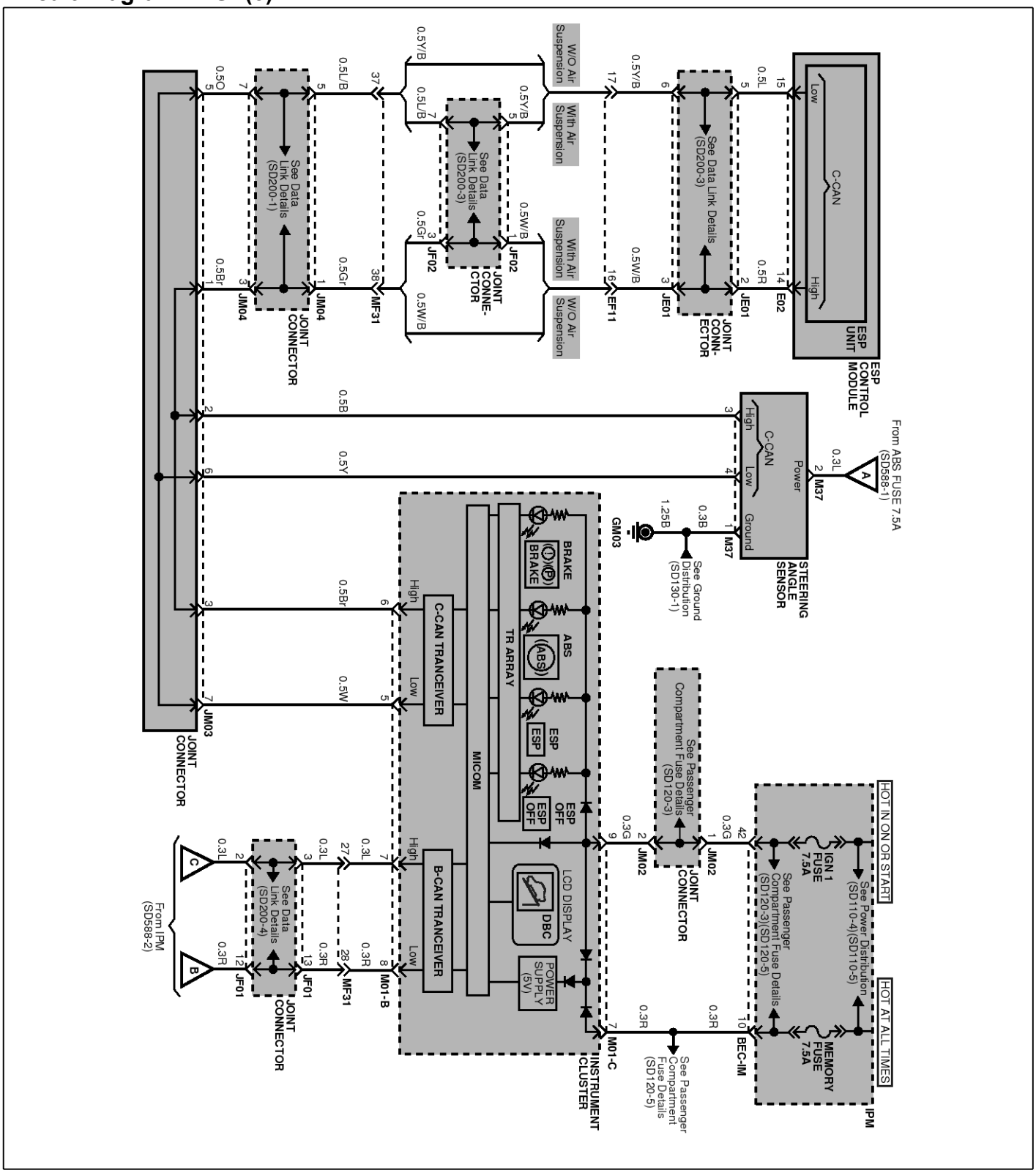
SHMBR9319L

Circuit Diagram - ESP(2)



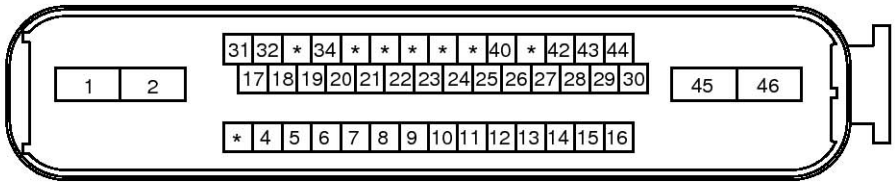
SHMBR9320L

Circuit Diagram - ESP(3)



SHMBR9321L

ESP Connector Input/Output



SHMBR8347D

Connector Terminal		Specification	Remark
No	Description		
31	IGNITION1(+)	Over voltage range : 17 ± 0.5V Operating voltage range : 9.5 ± 0.5V < V < 17 ± 0.5V Low voltage range : 7.0 ± 0.5V < V < 9.5 ± 0.5V Max. current : I < 500mA	
1	POS.BATTERY.(SOLENOID)	Max leakage current : I < 0.8mA Operating voltage range : 9.5 ± 0.5V < V < 17 ± 0.5V Max. current : I < 40A	
2	POS.BATTERY.(MOTOR)	Operating voltage range: 9.5 ± 0.5V < V < 16.5 ± 0.5V Rush current : I < 100A Max current : I < 40A Max leakage current : I < 0.2mA	
46	GROUND	Rated current : I <500mA Max. current: I < 30A	
45	PUMP MOTOR GROUND	Rush current : I < 100A Max current : I < 30A	
16	YAW & LATERAL G SENSOR GROUND	Rated current : I <150mA	
17	YAW SENSOR POWER	Max Output current : I < 150mA Max Output voltage : V(IGN) ± 1V	
34	BRAKE LIGHT SWITCH	Input voltage (Low) : 0V ≤ V ≤ 3.0V Input voltage (High) : 7.0V ≤ V ≤ 16.0V	
32	BRAKE SWITCH		
8	PARKING BRAKE SWITCH	Input voltage (Low) : 0V ≤ V_Low ≤ 3.0V Input voltage (High) : 7.0V ≤ V_High ≤ 16.0V Max input current : I < 10mA	
27	SENSOR FRONT RIGHT OUTPUT	Max current : I < 16mA External pull up resistance :1 KΩ < R Output duty :50 ± 20%	

Connector Terminal		Specification	Remark
No	Description		
18	ESP ON/OFF SWITCH	Input voltage (Low) :0V ≤ V ≤ 3.0V Input voltage (High) : 7.0V ≤ V ≤ 16.0V Max input current:I : < 10mA	
15	CAN BUS LINE(LOW)		
14	CAN BUS LINE(HIGH)		
4	SENSOR FRONT LEFT POWER	Output voltage : IGN (V) ± 1V Output current : Max 30mA	
5	SENSOR FRONT RIGHT POWER		
7	SENSOR REAR LEFT POWER		
6	SENSOR REAR RIGHT POWER		
9	SENSOR FRONT LEFT SIGNAL	Input current LOW : 5.9 ~ 8.4mA Input current HIGH :11.8 ~ 16.8mA Frequency range :1 ~ 2500Hz Input duty : 50 ± 20%	
10	SENSOR FRONT RIGHT SIGNAL		
12	SENSOR REAR LEFT SIGNAL		
11	SENSOR REAR RIGHT SIGNAL		
44	G SENSOR GROUND (4WD Only)	- Rated current : I < 10mA	
21	G SENSOR POWER (4WD Only)	- Max output current : I < 10mA - Max output voltage : 4.75V ≤ V ≤ 5.25V	
23	G SENSOR SIGNAL (4WD Only)	- Input voltage : 0V ≤ V ≤ 5.0V - Zero offset voltage : 2.5 ± 0.1V	
19	DBC SWITCH	Input voltage (Low) : 0V ≤ V ≤ 3.0V Input voltage (High) : 7.0V ≤ V ≤ 16.0V Max input current : I < 10mA	
40	DBC RELAY	Max current : I < 180mA Max output Low voltage : V < 0.5V	
42	SENSOR CAN BUS LINE (High)		
43	SENSOR CAN BUS LINE (Low)		

Failure Diagnosis

1. In principle, ESP and TCS controls are prohibited in case of ABS failure.
2. When ESP or TCS fails, only the failed system control is prohibited.
3. However, when the solenoid valve relay should be turned off in case of ESP failure, refer to the ABS fail-safe.
4. Information on ABS fail-safe is identical to the fail-safe in systems where ESP is not installed.

Memory of Fail Code

1. It keeps the code as far as the backup lamp power is connected. (O)
2. It keeps the code as far as the HCU power is on. (X)

Failure Checkup

1. Initial checkup is performed immediately after the HECU power on.
2. Valve relay checkup is performed immediately after the IG2 ON.
3. It executes the checkup all the time while the IG2 power is on.
4. Initial checkup is made in the following cases.
   1) When the failure is not detected now
   2) When ABS and ESP are not in control.
   3) Initial checkup is not made after ECU power on.
   4) If the vehicle speed is over 5 mph(8 km/h) when the brake lamp switch is off.
   5) When the vehicle speed is over 24.8 mph(40 km/h).
5. Though, it keeps on checkup even if the brake lamp switch is on.
6. When performing ABS or ESP control before the initial checkup, stop the initial checkup and wait for the HECU power input again.
7. Judge failure in the following cases.
   1) When the power is normal.
   2) From the point in which the vehicle speed reaches 4.9 mph(8 km/h) after HECU power on.

Countermeasures In Fail

1. Turn the system down and perform the following actions and wait for HECU power OFF.
2. Turn the valve relay off.
3. Stop the control during the operation and do not execute any until the normal condition recovers.

Warning Lamp ON

1. ESP operation lamp turn on for 3sec after IGN ON.
2. ESP operation lamp blinks when ESP Act.
3. ESP OFF warning lamp turn on in case of
   - ESP Switch OFF
   - ESP Failure Detect
   - 3sec after IGN ON

Diagnostic Trouble Code Chart(DTC)

● : MIL ON ○ : MIL OFF

DTC CODE	Trouble description	Warning lamp condition			Remark
		EBD	ABS	ESP	
C1101	Battery Voltage High	●	●	●	ABS/ESP
C1102	Battery Voltage Low	○/●	●	●	ABS/ESP
C1112	Sensor Source Voltage	○	○/●	●	ABS/ESP
C1200	Wheel Speed Sensor Front-LH Open/ Short	○/●	●	●	ABS/ESP
C1201	Wheel Speed Sensor Front-LH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1202	Wheel Speed Sensor Front-LH Invalid/ No signal	○/●	●	●	ABS/ESP
C1203	Wheel Speed Sensor Front-RH Open/ Short	○/●	●	●	ABS/ESP
C1204	Wheel Speed Sensor Front-RH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1205	Wheel Speed Sensor Front-RH Invalid/ No signal	○/●	●	●	ABS/ESP
C1206	Wheel Speed Sensor Rear-LH Open/ Short	○/●	●	●	ABS/ESP
C1207	Wheel Speed Sensor Rear-LH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1208	Wheel Speed Sensor Rear-LH Invalid/ No signal	○/●	●	●	ABS/ESP
C1209	Wheel Speed Sensor Rear-RH Open/ Short	○/●	●	●	ABS/ESP
C1210	Wheel Speed Sensor Rear-RH Range/ Performance/ Intermittent	○/●	●	●	ABS/ESP
C1211	Wheel Speed Sensor Rear-RH Invalid/ No signal	○/●	●	●	ABS/ESP
C1235	Primary Pressure Sensor - Electrical	○	○	●	ESP
C1237	Primary Pressure Sensor - Signal	○	○	●	ESP
C1260	Steering Angle Sensor Circuit - Signal	○	○	●	ESP
C1261	Steering Angle Sensor Not Calilbrated	○	○	●	ESP
C1274	Longitudianl G Sensor Open/ Short	○	●	●	4/4WD
C1275	Longitudianl G Sensor Range/ Performance Error	○	●	●	4/4WD
C1282	Yaw Rate & Lateral G Sensor - Electrical	○	○	●	ESP
C1283	Yaw Rate & Lateral G Sensor - Signal	○	○	●	ESP
C1503	TCS/ ESP Switch Error	○	○	●	ESP
C1513	Brake Switch Error	○	○	●	ESP
C1526	DBC Switch Error	○	○	○	ESP
C1604	ECU Hardware Error	●	●	●	ABS/ESP
C1605	CAN Hardware Error	○	○	●	ESP
C1611	CAN Time-Out ECM	○	○	●	ESP

DTC CODE	Trouble description	Warning lamp condition			Remark
		EBD	ABS	ESP	
C1612	CAN Time-Out TCM	○	○	●	ESP
C1613	CAN Wrong Message	○	○	●	ESP
C1616	CAN Bus Off	○	○	●	ESP
C1623	CAN Time-out Steering Angle Sensor	○	○	●	ESP
C1627	CAN Time-Out 4WD	○	○	●	ABS/ESP
C1647	CAN Hardware Error - Sensor Channel	○	○	●	ESP
C1702	Variant Coding Error	○	●	●	ABS/ESP
C2112	Valve Relay Error	●	●	●	ABS/ESP
C2130	Brake Lamp Relay Error	○	○	○	ESP
C2227	Excessive Temperature of Brake Disc	○	○	●	ESP
C2380	ABS/TCS/ESP Valve Error	●	●	●	ABS/ESP
C2402	Motor Failure	○	●	●	ABS/ESP

C1101 Battery Voltage High

General Description

The ABS ECU(Electronic Control Unit) checks the battery voltage and generator output voltage to determine, as a safety issue, whether the ABS system can operate normally or not.

The normal battery voltage range is essential for controlling the ABS system as intended.

DTC Description

The ABS ECU monitors battery voltage and alternator output voltage.

When the voltage is higher than the expected normal value, this code is set, and the ABS/EBD/ESP functions are prohibited.

If the voltage recovers, to within normal operating ranges, then the controller returns to normal operation as well.

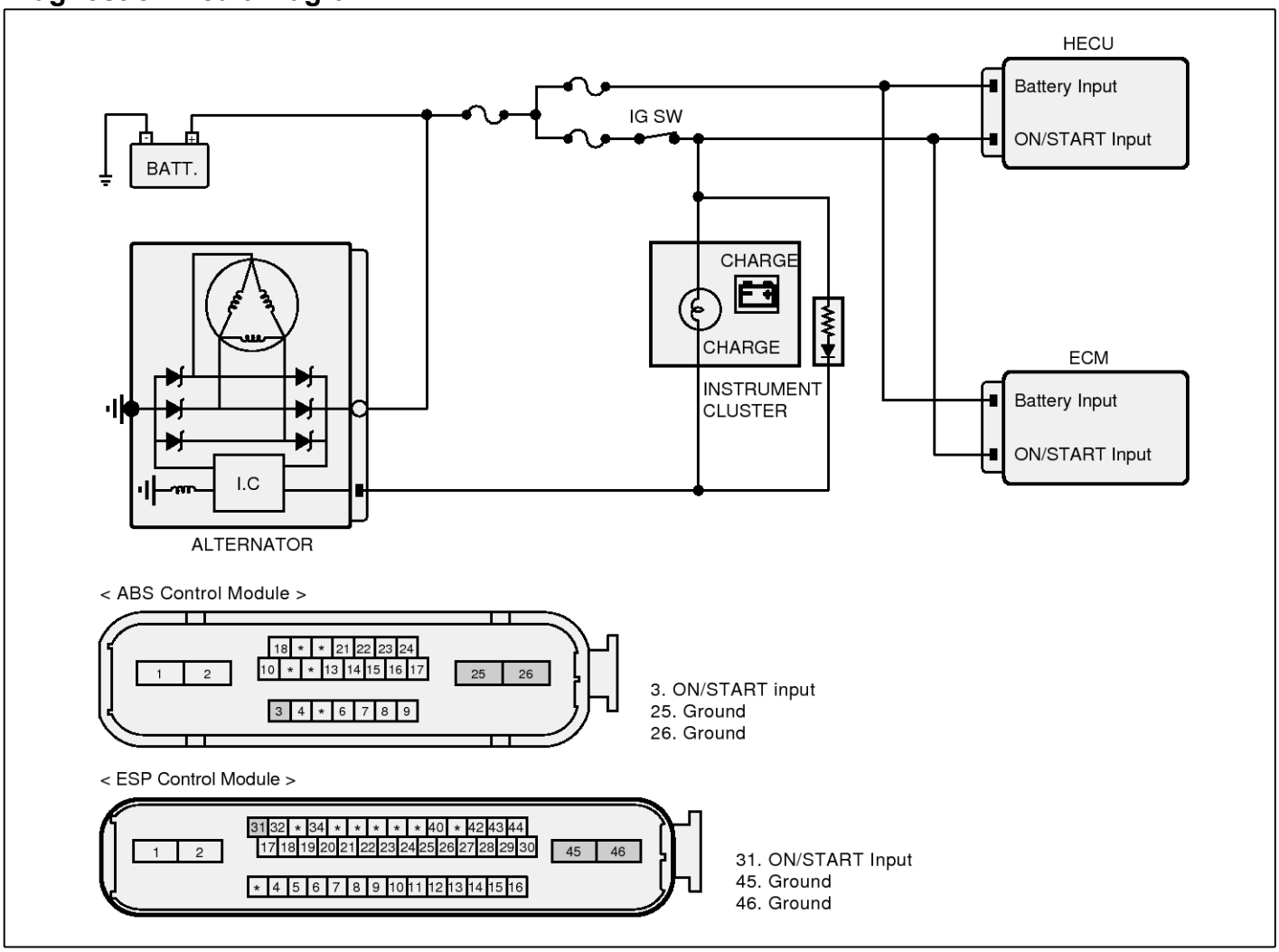
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Battery Voltage Monitoring	• Poor connection in power supply circuit (IGN+) • Faulty Alterator • Faulty HECU
Enable Conditions	• When Vign>17V±0.5V is continued for 500msec. - If the voltage recovers to normal operating range, the controller returns to normal state.	
Fail Safe	• The ABS/EBD/ESP functions are inhibited. • The ABS/EBD/ESP warning lamps are activated.	

Specification

Normal Voltage Range	ENG "ON"
	10V ~ 16V

Diagnostic Circuit Diagram



SHMBR9501L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC)
2. Ignition "ON" & Engine "ON".
3. Monitor the "BATTERY VOLTAGE" parameter on the scantool.

Specification : Below. 17.5V

Sensor Name	Value	Ref. Min	Ref. Max	Unit	Test Condition
☑ Battery Positive Voltage	13.2			V	-
☑ 5V Reference	5.0			V	-

Fig.1

SHMBR9601L

Fig 1) Test Condition : Ignition "ON" & Engine "ON".
Normal Data

4. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in power harness (IGN+) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Verify presence of battery voltage codes in other ECUs (SRS, etc).
If battery voltage codes are not present in other ECUs, go to "Power Circuit Inspection" procedure.
If battery voltage codes are present in other ECUs, go to "Alternator Output Voltage Inspection" procedure.

Alternator Output Voltage Inspection

■ Charging System Check

1. Ignition "ON" & Engine "ON".
2. Maintain ENG RPM 2,500RPM over 2 minutes.
3. Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : Below. 17±0.5V

4. Is the measured value within specifications?

YES ▶ Go to "Power Circuit Inspection" procedure.

NO ▶ Check that the tension of drive belt, ENG RPM, fuse, terminal of battery, all terminals of alternator are in good condition and Check for damaged harness and poor connection between alternator and battery.
If OK repair or replace alternator and then go to "Verification of vehicle Repair" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between the battery terminal(+) and power terminal of the HECU harness connector.

Specification : Approx. below 0.2V

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown ABS fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then go to "Verification of vehicle Repair" procedure.

Ground Circuit inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Repair open or short in ground circuit between HECU harness connector and chassis ground and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1102 Battery Voltage Low

General Description

The ABS ECU(Electronic Control Unit) checks the battery voltage and generator output voltage to determine, as a safety issue, whether the ABS system can operate normally or not.

The normal battery voltage range is essential for controlling the ABS system as intended.

DTC Description

The ABS ECU monitors the battery voltage and alternator output voltage by reading the value of voltage.

When the voltage is lower than the expected normal value, this code is set.

The ABS/ESP functions are prohibited and the EBD function is allowed on LOW VOLTAGE CONDITION, the ABS/EBD/ESP functions are prohibited on UNDER VOLTAGE CONDITION.

If the voltage recovers, to within normal operating ranges, then the controller returns to normal operations as well.

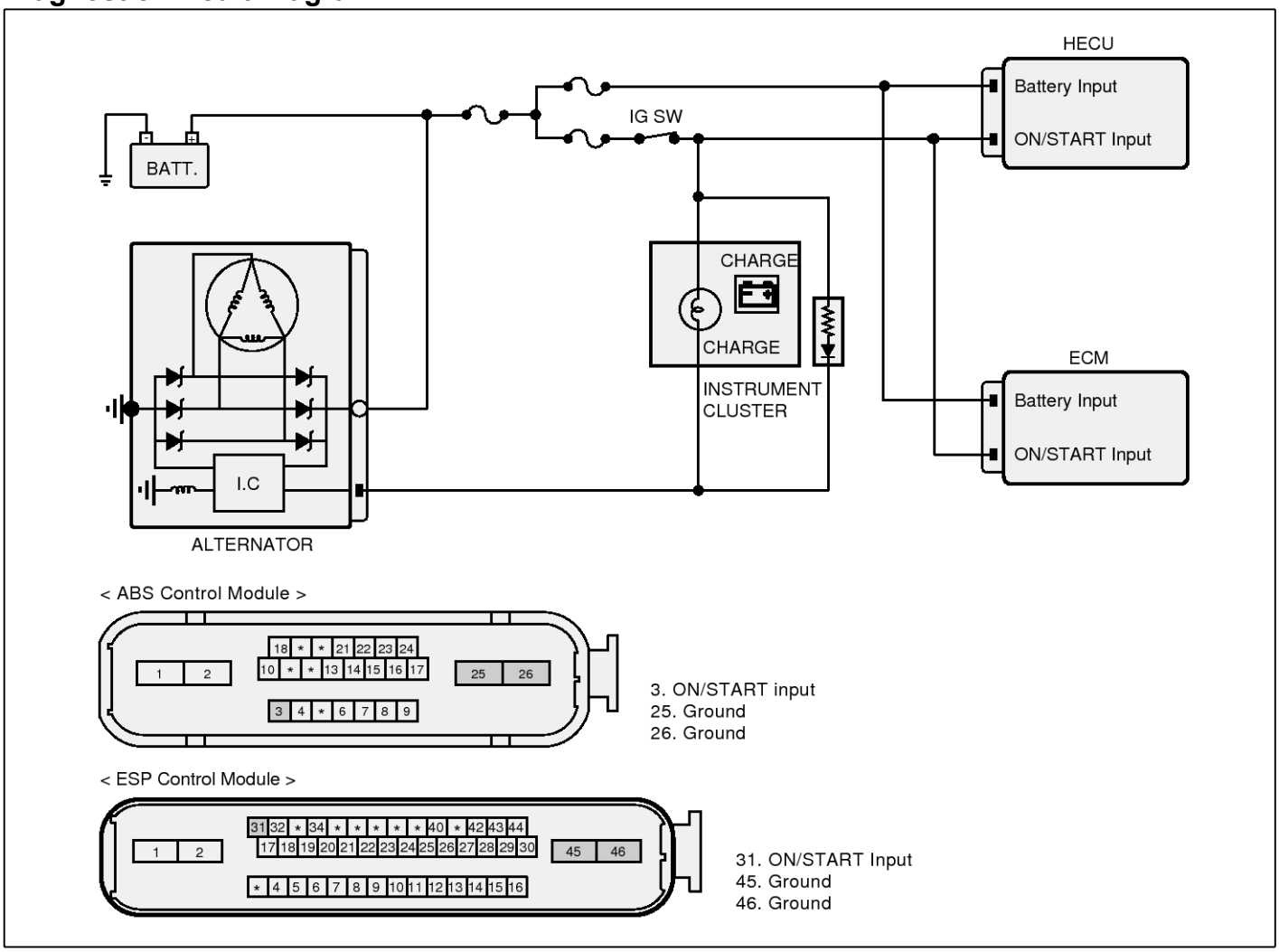
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Battery Voltage Monitoring	• Poor connection in power supply circuit (IGN+) • Faulty HECU • Discharge of electricity
Case1 (Low voltage)	Enable Conditions	• When Vign<9.5V±0.5V is continued for 500msec during Vref >= 7Km/h. • When Vign<8.5V±0.5V is continued for 500msec during Vref < 7Km/h or ABS/ESP control. - If IGN voltage is recovered to normal operating voltage, the system recovers to normal state.	
	Fail Safe	• Outside the ABS control cycle : Inhibit the ABS/ESC control, allow the EBD control , The ABS/ESP warning lamps are activated, When the voltage recovers the normal operating range, erase the error code. • Inside the ABS control cycle : Inhibit the ABS/ESP control. The ABS/ESP warning lamps are activated. Although the voltage recovers the normal operating range, warning lamps are illuminated and the error code is always stored.	
Case2 (Under voltage)	Enable Conditions	• When Vign<7.2V±0.5V is continued for 56msec. - If IGN voltage is recovered to normal operating voltage, the system recovers to normal state.	
	Fail Safe	• The ABS/EBD/ESP functions are inhibited. • The ABS/EBD/ESP warning lamps are activated.	

Specification

Normal Voltage Range	ENG "ON"
	10V ~ 16V

Diagnostic Circuit Diagram



SHMBR9501L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC)
2. Ignition "ON" & Engine "ON".
3. Monitor the "BATTERY VOLTAGE" parameter on the scantool.

Specification : Above. 9±0.5V

Sensor Name	Value	Ref. Min	Ref. Max	Unit	Test Condition
☑ Battery Positive Voltage	13.2			V	-
☑ 5V Reference	5.0			V	-

Fig.1

SHMBR9601L

Fig 1) Test Condition : Ignition "ON" & Engine "ON".
Normal Data

4. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in power harness (IGN+) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Alternator Output Voltage Inspection" procedure.

Alternator Output Voltage Inspection

■ Charging System Check

1. Ignition "ON" & Engine "ON".
2. Maintain ENG RPM 2,500RPM over 2 minutes.
3. Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : Above. 9±0.5V

4. Is the measured value within specifications?

YES ▶ Go to "Power Circuit Inspection" procedure.

NO ▶ Check that the tension of drive belt, ENG RPM, fuse, terminal of battery, all terminals of alternator are in good condition and Check for damaged harness and poor connection between alternator and battery.
If OK repair or replace alternator and then go to "Verification of vehicle Repair" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between the battery terminal(+) and power terminal of the HECU harness connector.

Specification : Approx. below 0.2V

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown ABS fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then go to "Verification of vehicle Repair" procedure.

Ground Circuit inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Repair open or short in ground circuit between HECU harness connector and chassis ground and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC C1101 : Battery Voltage High

C1112 Sensor source voltage

General Description

The HECU supplies operating voltage with Steering angle senor (12V), Yaw rate & lateral G sensor (12V), G sensor (5V).

The HECU monitors supply voltage of each sensor for normal ESP control.

If supply voltage is out of specified range ABS/ESP warning lamps are turned on and ABS/ESP controls are inhibited.

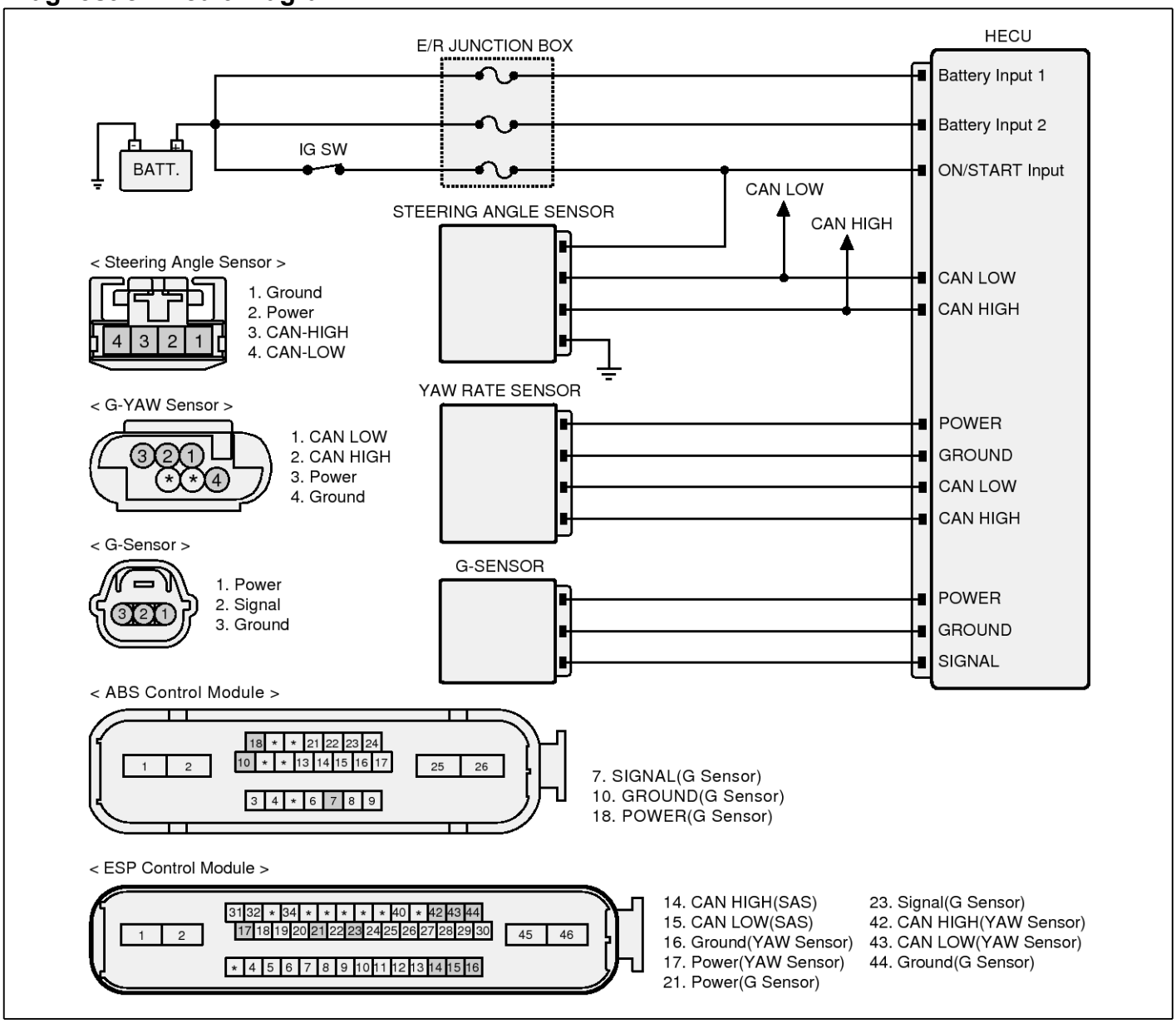
DTC Description

A failure is detected if the external sensor supply voltage is out of the specified range for more than the specified min. fault duration.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Battery Voltage Monitoring	• Faulty HECU • Poor connection in power supply circuit to sensor
Enable Conditions	• During sensor power ON, If the voltage of sensor power is out of the specified range for 500ms. • During sensor power OFF, If the voltage of sensor power is out of the specified range for 500ms.	
Fail Safe	• ABS/ESP functions are inhibited, EBD function is allowed and the ABS/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SHMBR9502L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC)
2. Ignition "ON" & Engine "ON".
3. Monitor the "BATTERY VOLTAGE, 5 VOLT REFERENCE" parameter on the scantool.

Specification :
BATTERY VOLTAGE (Approx. 10V ~ 16V)
5 VOLT REFERENCE (Approx. 5V)

Sensor Name	Value	Ref. Min	Ref. Max	Unit	Test Condition
☑ Battery Positive Voltage	13.2			V	-
☑ 5V Reference	5.0			V	-

Fig.1

SHMBR9601L

Fig 1) Test Condition : Ignition "ON" & Engine "ON".
Normal Data

4. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the steering angle sensor, Yaw rate & lateral G sensor, G sensor harness connector and chassis ground.

Specification : Approx. 12V (steering angle sensor, Yaw rate & lateral G sensor),
Approx. 5V (G sensor)

3. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Repair open or short in power circuit between HECU harness connector and steering angle sensor, Yaw rate & lateral G sensor, G sensor harness connector and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1200 Wheel Speed Sensor Front-LH Open/Short

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor circuit continuously.

If the sensor signal current is continuously out of the specified range for 140msec, then the HECU determines that the circuit is open/short, and sets this code.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h (6.2mph).

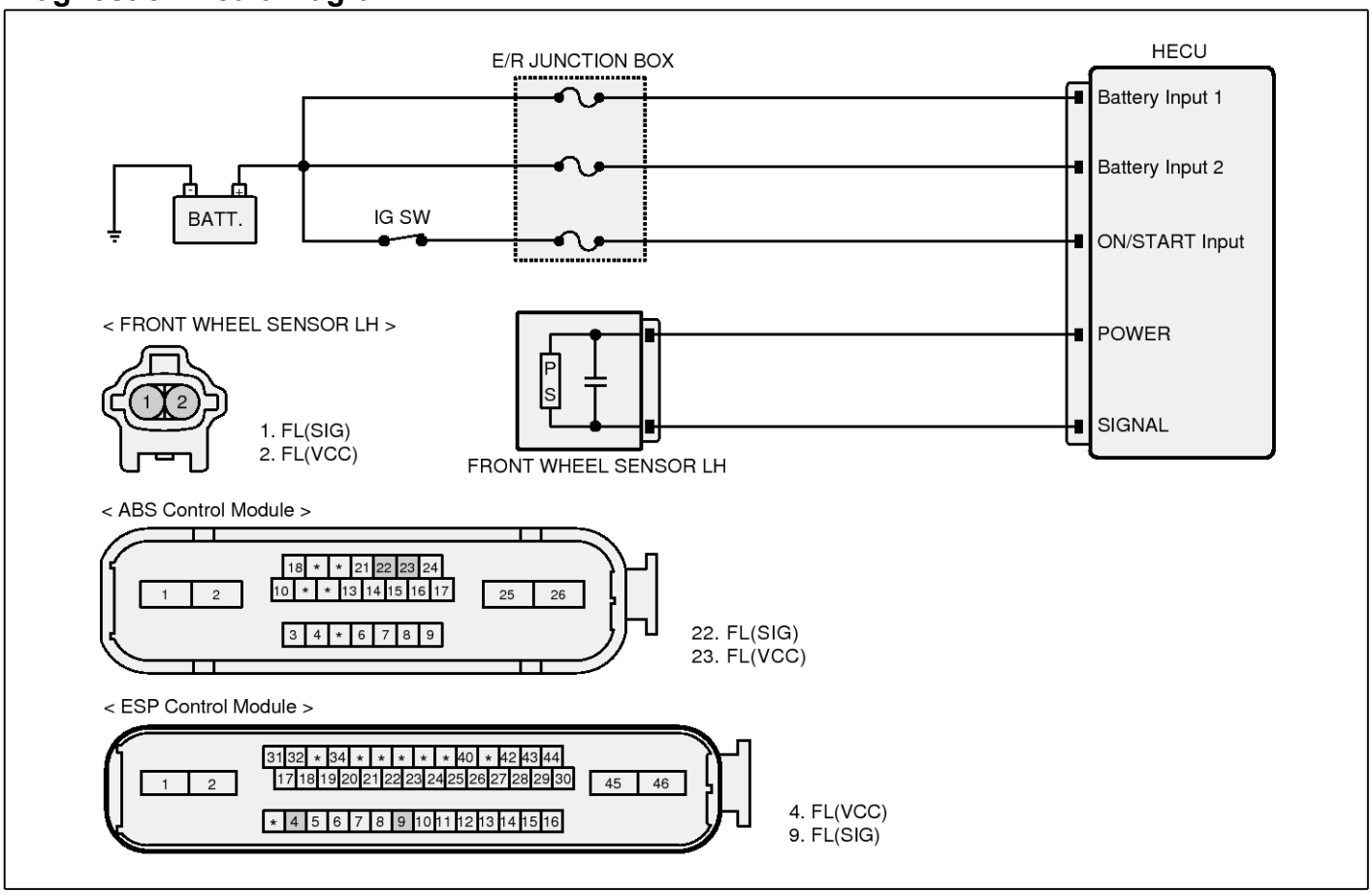
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Current Monitoring	• Open or short of Wheel speed sensor circuit • Faulty Wheel speed sensor
Enable Conditions	• When the sensor signal current is continuously out of the specified range of 4 mA ± 10% ~ 22 mA ± 10% for 140msec.	
Fail Safe	1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9503L

Signal Waveform

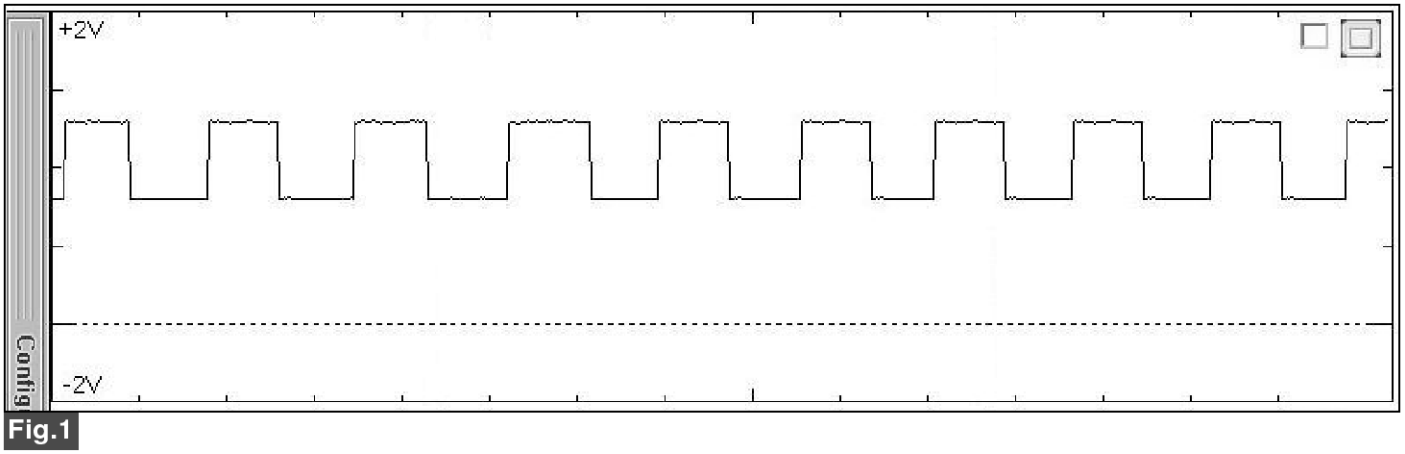


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU harness connector and wheel speed sensor sensor harness connector and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between wheel speed sensor signal terminal of the HECU harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

6. Is the measured waveform within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open or short in signal circuit between HECU harness connector and wheel speed sensor harness connector, and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (FL).
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. IG OFF and then IG ON again.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1201 Wheel Speed Sensor Front-LH Range / Performance / Intermittent

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set if an abnormal speed change ratio is detected while the vehicle speed is more than 2Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

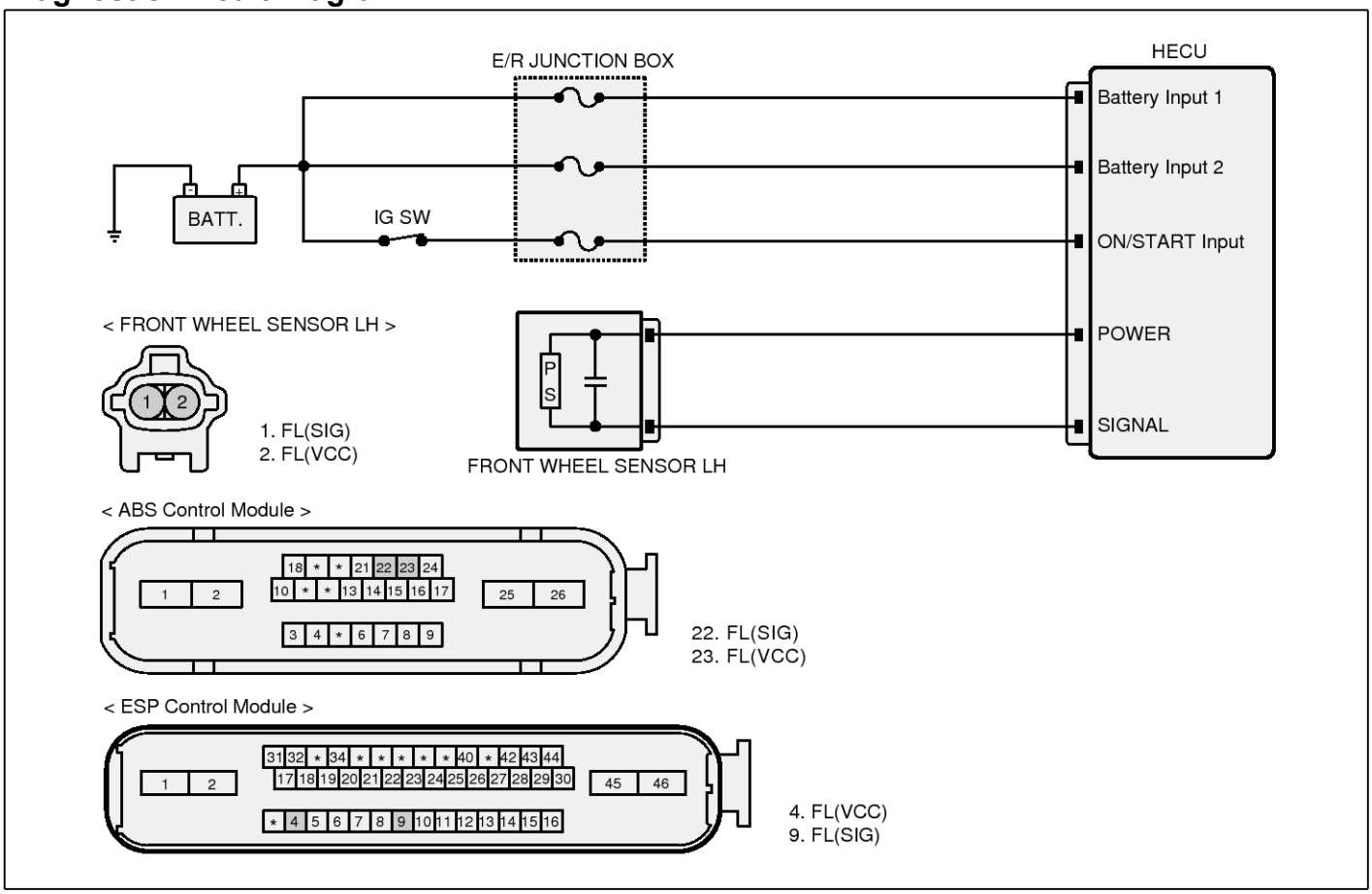
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Enable Conditions	Case1	• Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. if this condition is lasted for 2 minutes. • Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. if this condition is lasted for 2 minutes.	
	Case2	• Controller counts the number of the wheel acceleration of 100g[(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. • Controller counts the number of the wheel acceleration of 70g[(17.5km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or When the numbers at more two wheels exceed 20 times, controller recognize the failure. • Controller counts the number of the wheel deceleration of -100g[(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. • The wheel deceleration of –100g[(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. • In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or When the numbers of 70g at each wheel exceed 20 times, controller recognize the failure. - The counter of speed jump is cleared every 30min. - This monitoring is performed for the period that the velocity of each wheel exceeds 2km/h.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9503L

Signal Waveform

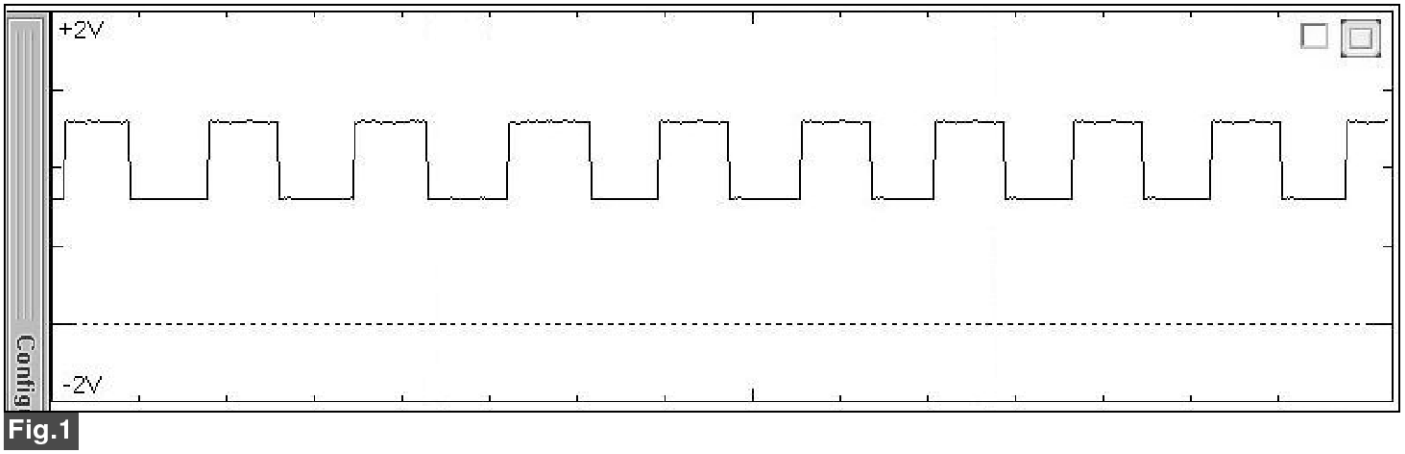


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 40km/h. (24mph)
4. Monitor the "WHEEL SPEED(FL)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (FL) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interferencebetween harnesses.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 40kmh. (24mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1202 Wheel Speed Sensor Front-LH Invalid/no Signal

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set when the sensor air gap is out of specified range or when the ABS control cycle is continued abnormally.

The HECU checks for air gap malfunctioning by monitoring the sensor signal at speeds between 2Km/h to 10 Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h (6.2mph).

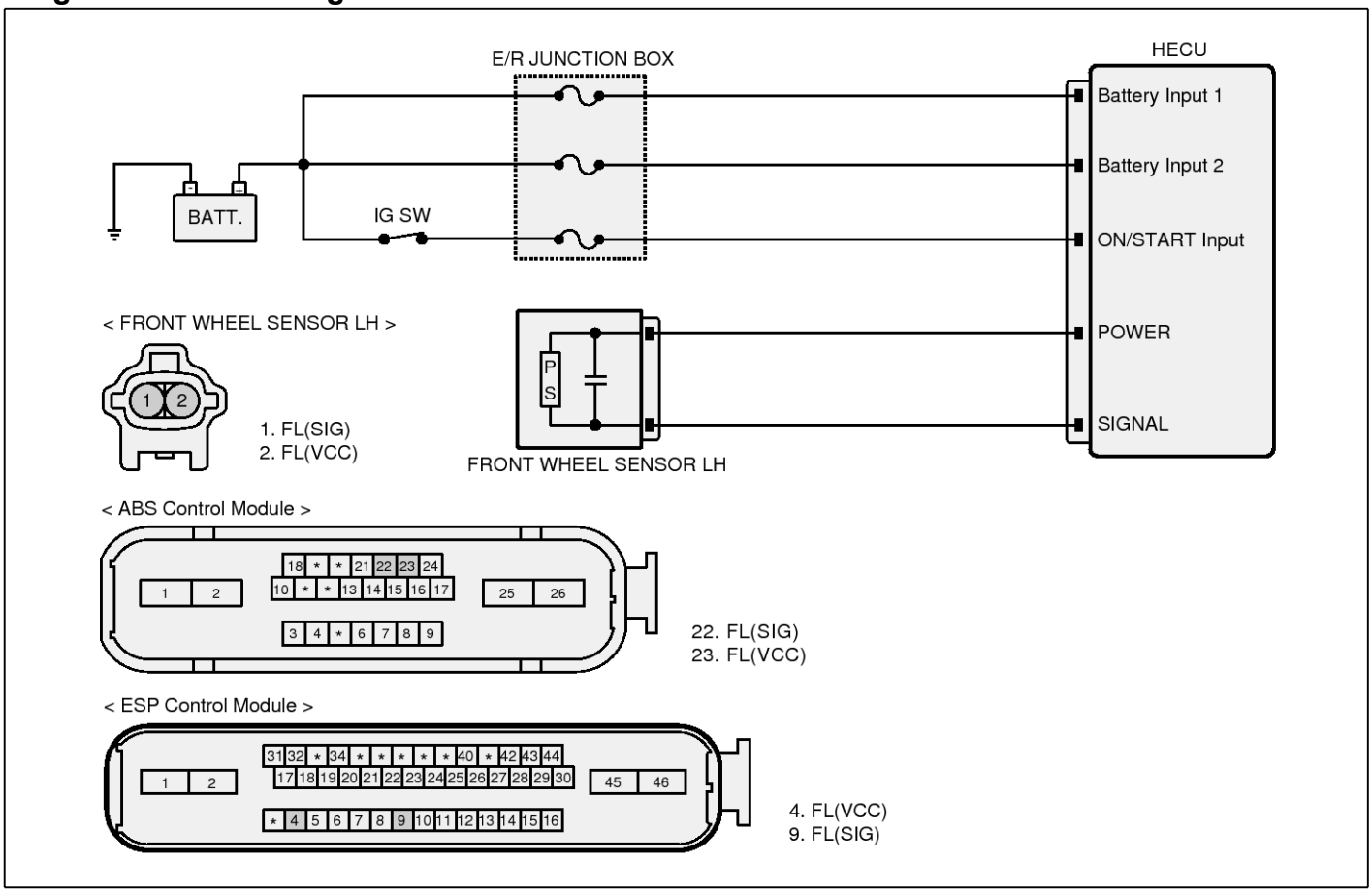
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Case1 (LargeAir-Gap)	Enable Conditions	• When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h (6.2mph) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their difference below 4km/h (2.5mph) is continued for 140msec, Otherwise, if their difference beyond 4km/h (2.5mph) or >0.4g is continued for 2 minutes. • In < 0.4g, when the velocity of more two wheels is 2km/h (1.2mph) and the max. wheel velocity exceeds 10km/h (6.2mph), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. • After velocity of 4 wheel exceeds 10km/h (6.2mph), when velocity of 1 wheel or 2 wheel is 2km/h (1.2mph)and difference of other 2 wheel velocity is less than 4km/h (2.5mph) under that those velocity is more than 10km/h (6.2mph), if that conditions are continued for 12 seconds. - This monitoring is performed for the period that the minimum velocity rises from 2km/h (1.2mph) to 10km/h (6.2mph).	
Case2 (long term ABS mode)	Enable Conditions	• During the ABS control cycle, if the wheel velocity of 2km/h (1.2mph) is lasted for more than 12sec. • If the ABS control cycle is continued for more than 36sec.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9503L

Signal Waveform

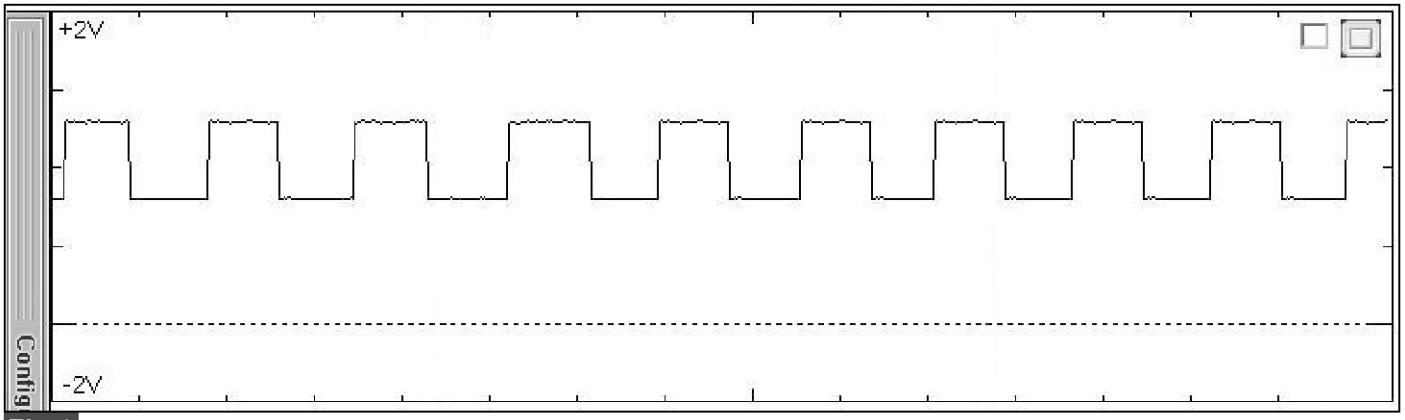


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(FL)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (FL) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interferencebetween harnesses.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to " Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1203 Wheel Speed Sensor Front-RH Open/Short

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor circuit continuously.

If the sensor signal current is continuously out of the specified range for 140msec, then the HECU determines that the circuit is open/short, and sets this code.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

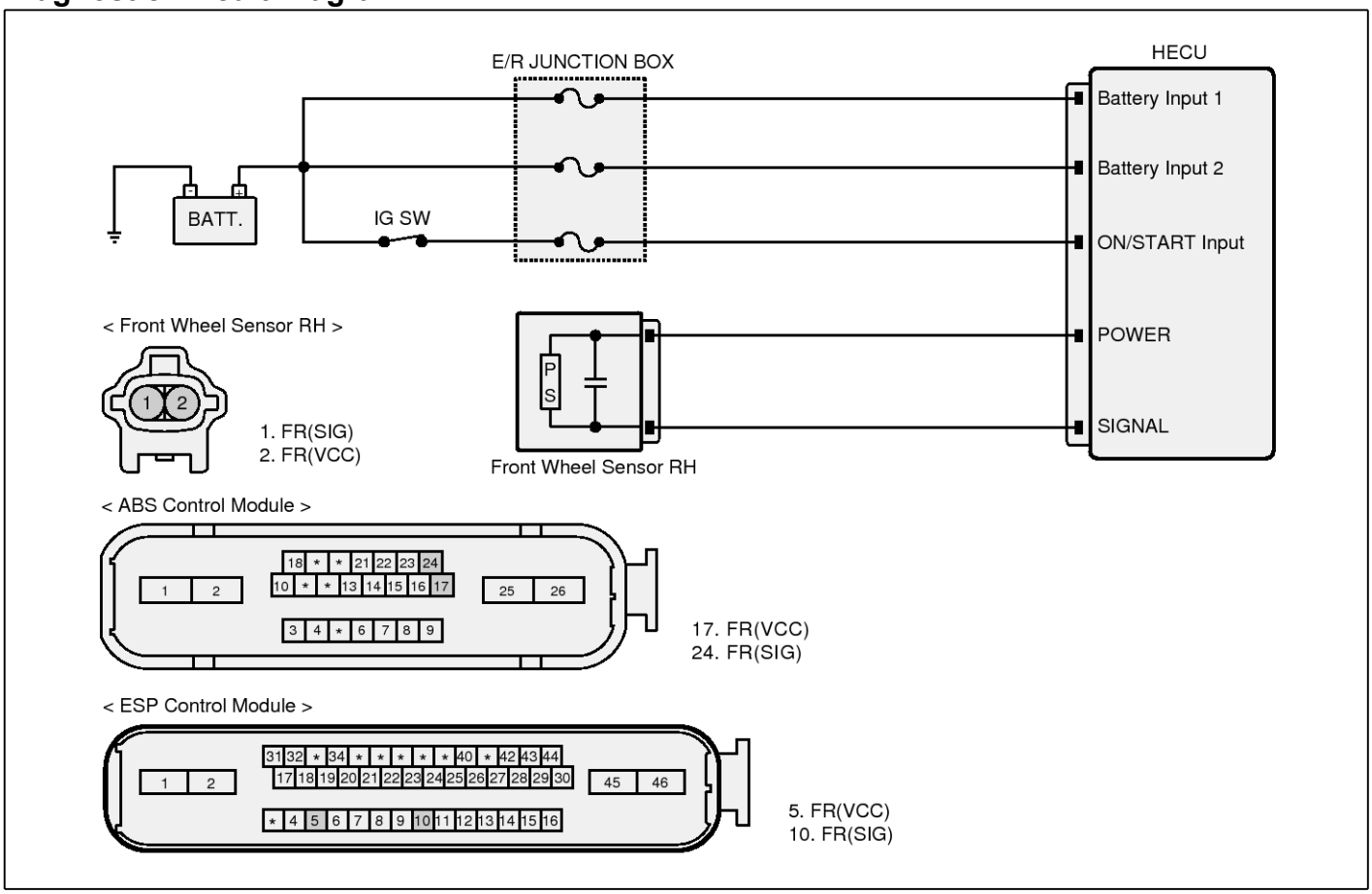
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Current Monitoring	• Open or short of Wheel speed sensor circuit • Faulty Wheel speed sensor
Enable Conditions	• When the sensor signal current is continuously out of the specified range of 4 mA ± 10% ~ 22 mA ± 10% for 140msec.	
Fail Safe	1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9504L

Signal Waveform

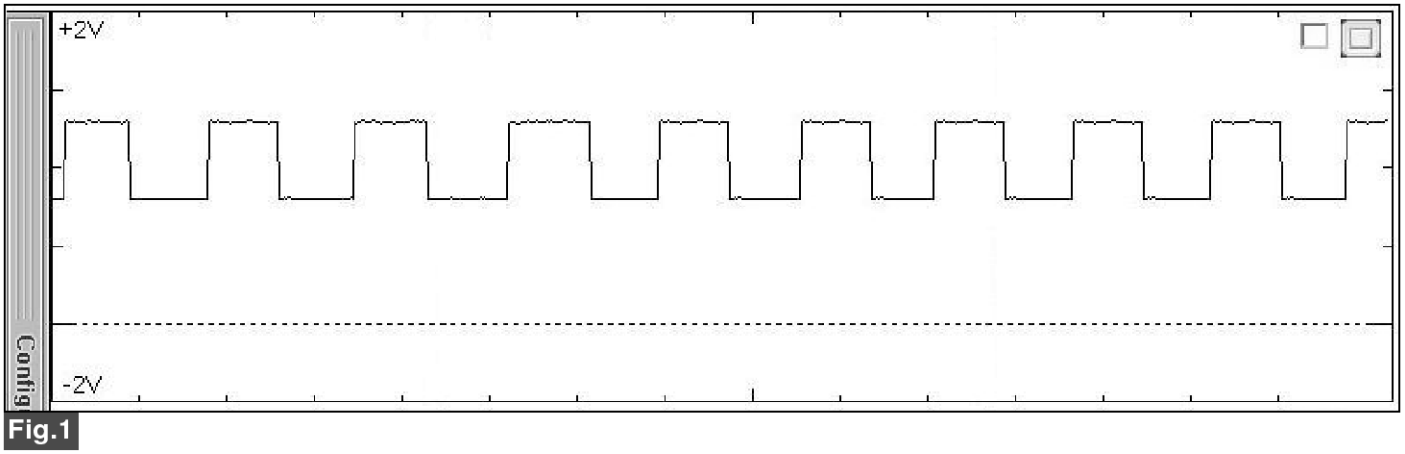


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU harness connector and wheel speed sensor sensor harness connector and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between wheel speed sensor signal terminal of the HECU harness connector and chassis ground .

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

6. Is the measured waveform within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open or short in signal circuit between HECU harness connector and wheel speed sensor harness connector, and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (FR).
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. IG OFF and then IG ON again.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1204 Wheel Speed Sensor Front-RH Range / Performance / Intermittent

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set if an abnormal speed change ratio is detected while the vehicle speed is more than 2Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

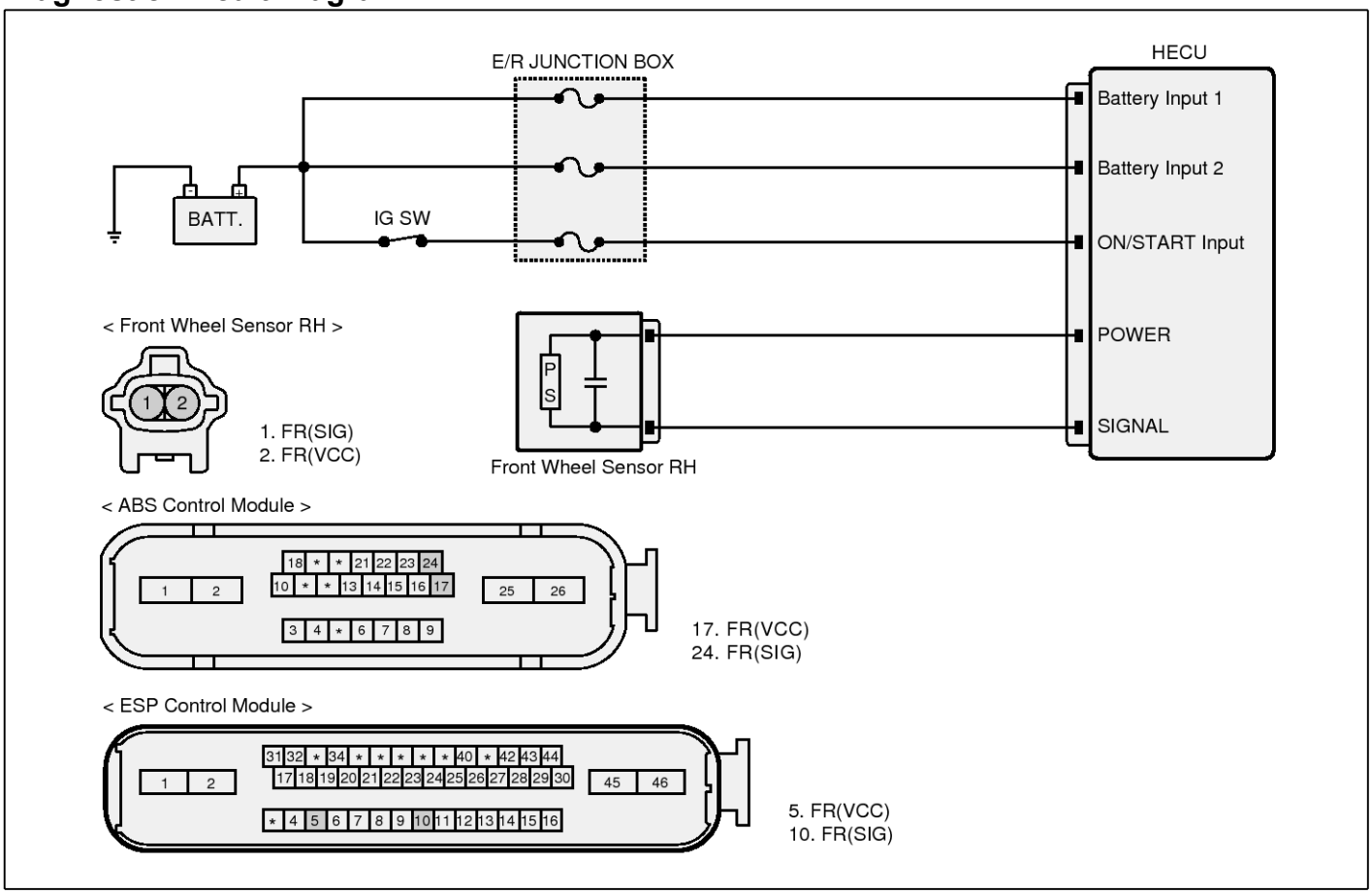
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Enable Conditions	Case1	• Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. if this condition is lasted for 2 minutes. • Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. if this condition is lasted for 2 minutes.	
	Case2	• Controller counts the number of the wheel acceleration of 100g[(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. • Controller counts the number of the wheel acceleration of 70g[(17.5km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or When the numbers at more two wheels exceed 20 times, controller recognize the failure. • Controller counts the number of the wheel deceleration of -100g[(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. • The wheel deceleration of –100g[(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. • In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or When the numbers of 70g at each wheel exceed 20 times, controller recognize the failure. - The counter of speed jump is cleared every 30min. - This monitoring is performed for the period that the velocity of each wheel exceeds 2km/h.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



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Signal Waveform

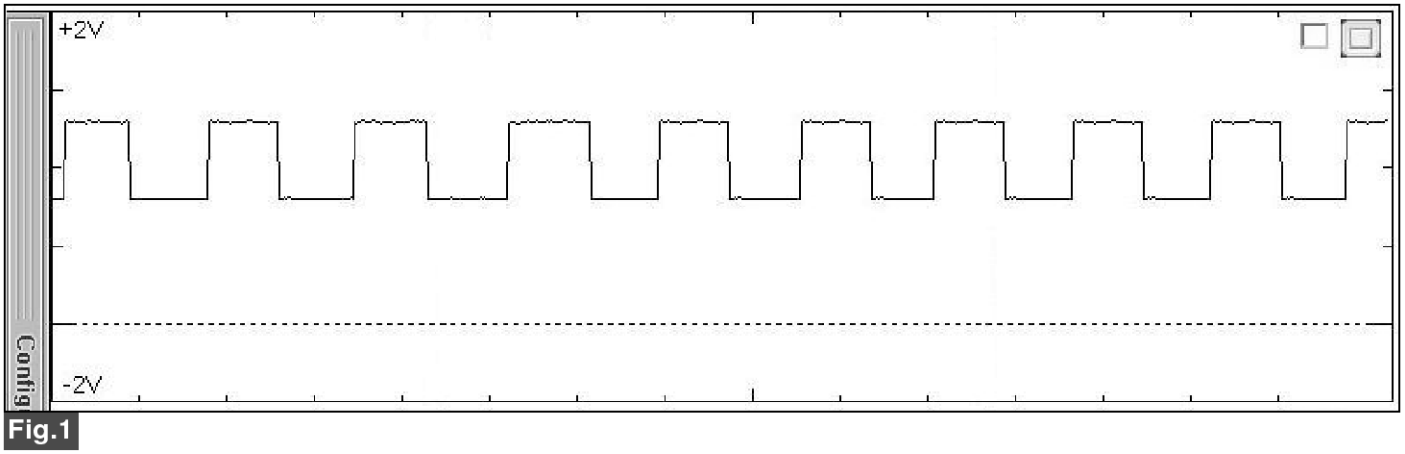


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 40km/h. (24mph)
4. Monitor the "WHEEL SPEED(FR)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (FR) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interferencebetween harnesses.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 40kmh. (24mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1205 Wheel Speed Sensor Front-RH Invalid/no Signal

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set when the sensor air gap is out of specified range or when the ABS control cycle is continued abnormally.

The HECU checks for air gap malfunctioning by monitoring the sensor signal at speeds between 2Km/h to 10 Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h (6.2mph).

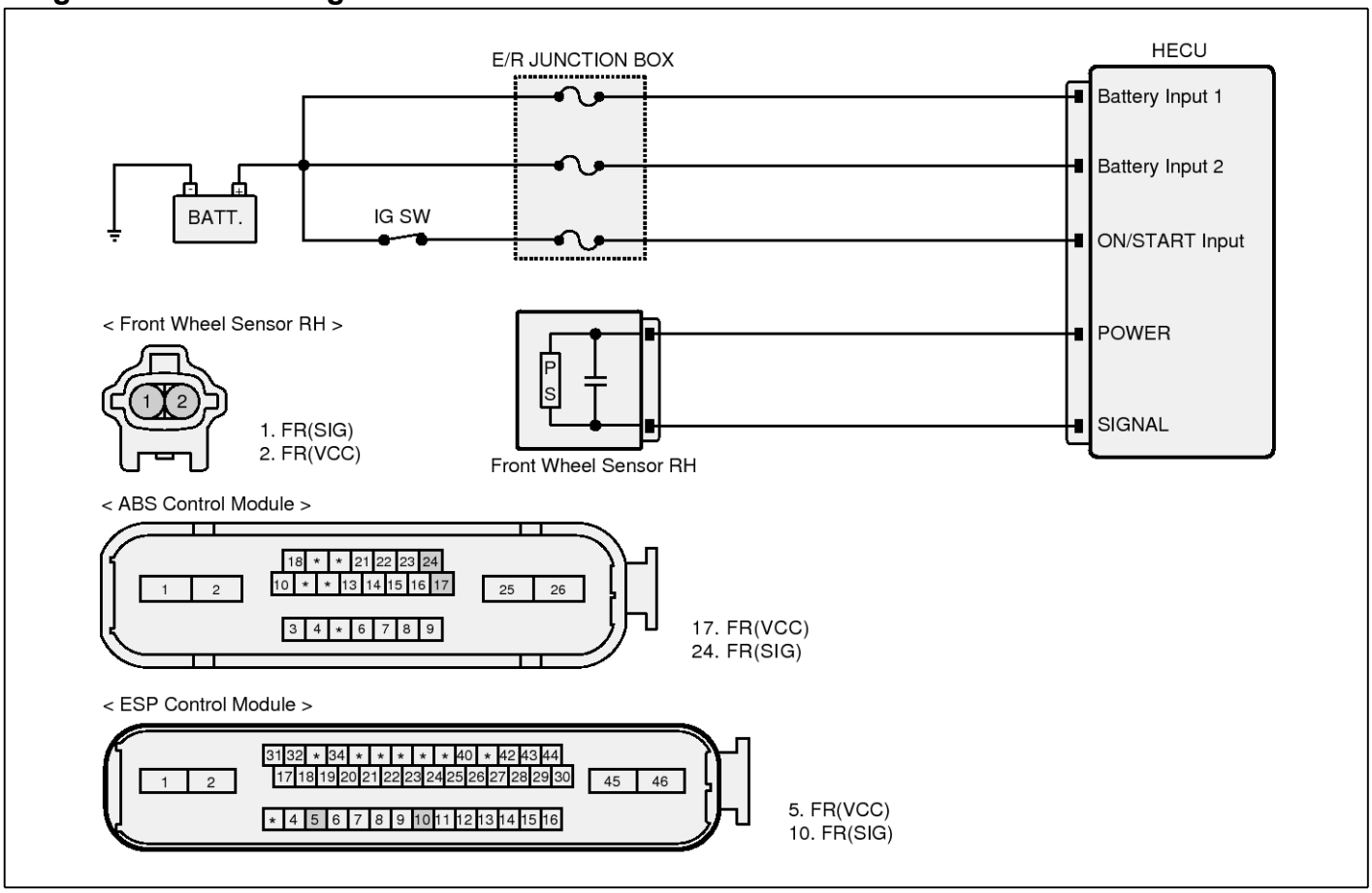
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Case1 (LargeAir-Gap)	Enable Conditions	• When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h (6.2mph) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their difference below 4km/h (2.5mph) is continued for 140msec, Otherwise, if their difference beyond 4km/h (2.5mph) or >0.4g is continued for 2 minutes. • In < 0.4g, when the velocity of more two wheels is 2km/h (1.2mph) and the max. wheel velocity exceeds 10km/h (6.2mph), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. • After velocity of 4 wheel exceeds 10km/h (6.2mph), when velocity of 1 wheel or 2 wheel is 2km/h (1.2mph)and difference of other 2 wheel velocity is less than 4km/h (2.5mph) under that those velocity is more than 10km/h (6.2mph), if that conditions are continued for 12 seconds. - This monitoring is performed for the period that the minimum velocity rises from 2km/h (1.2mph) to 10km/h (6.2mph).	
Case2 (long term ABS mode)	Enable Conditions	• During the ABS control cycle, if the wheel velocity of 2km/h (1.2mph) is lasted for more than 12sec. • If the ABS control cycle is continued for more than 36sec.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



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Signal Waveform

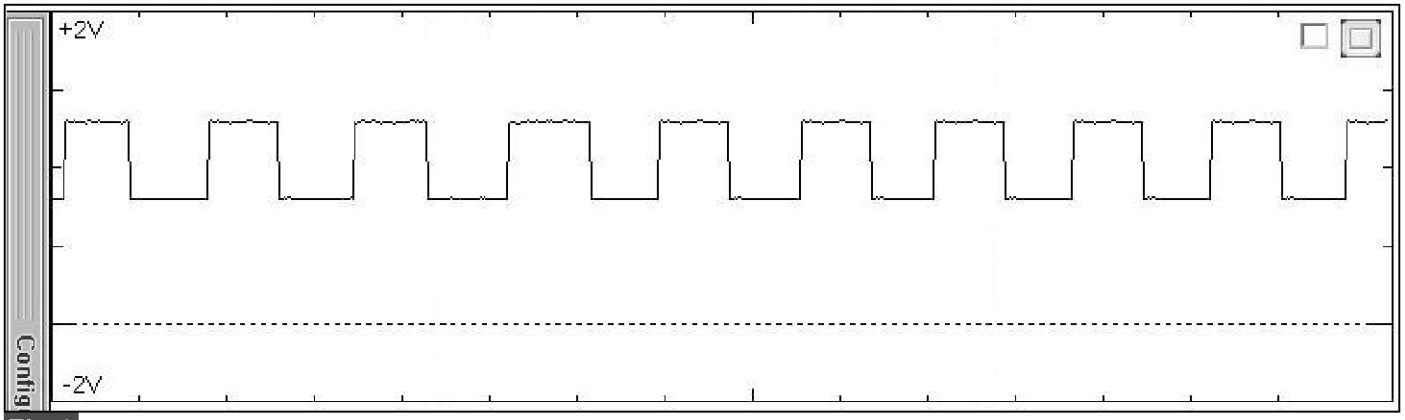


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(FR)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (FR) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interferencebetween harnesses.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC C1202 : Wheel Speed Sensor Front-LH Invalid/ No signal

C1206 Wheel Speed Sensor Rear-LH Open/Short

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor circuit continuously.

If the sensor signal current is continuously out of the specified range for 140msec, then the HECU determines that the circuit is open/short, and sets this code.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

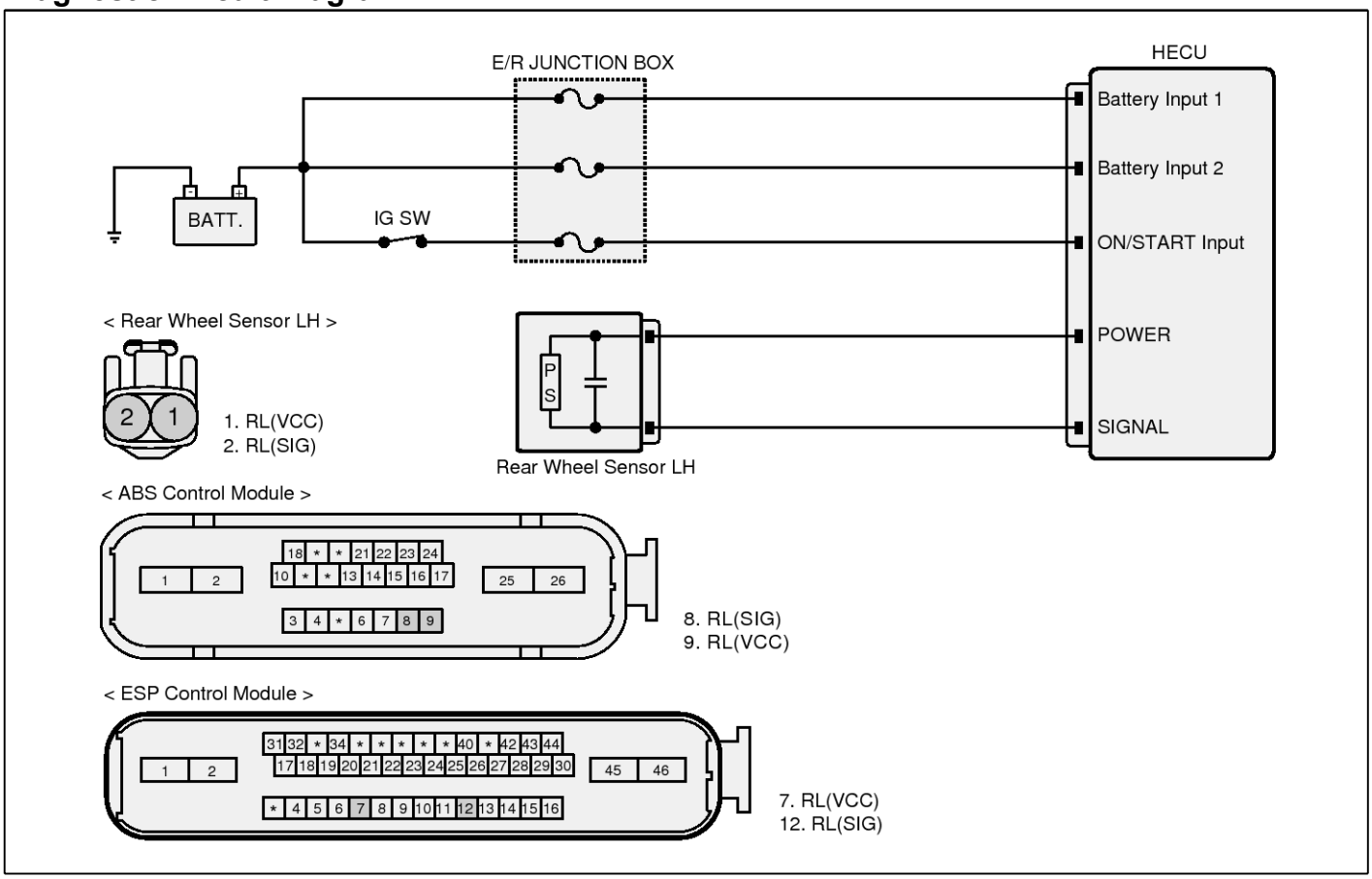
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Current Monitoring	• Open or short of Wheel speed sensor circuit • Faulty Wheel speed sensor
Enable Conditions	• When the sensor signal current is continuously out of the specified range of 4 mA ± 10% ~ 22 mA ± 10% for 140msec.	
Fail Safe	1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9505L

Signal Waveform

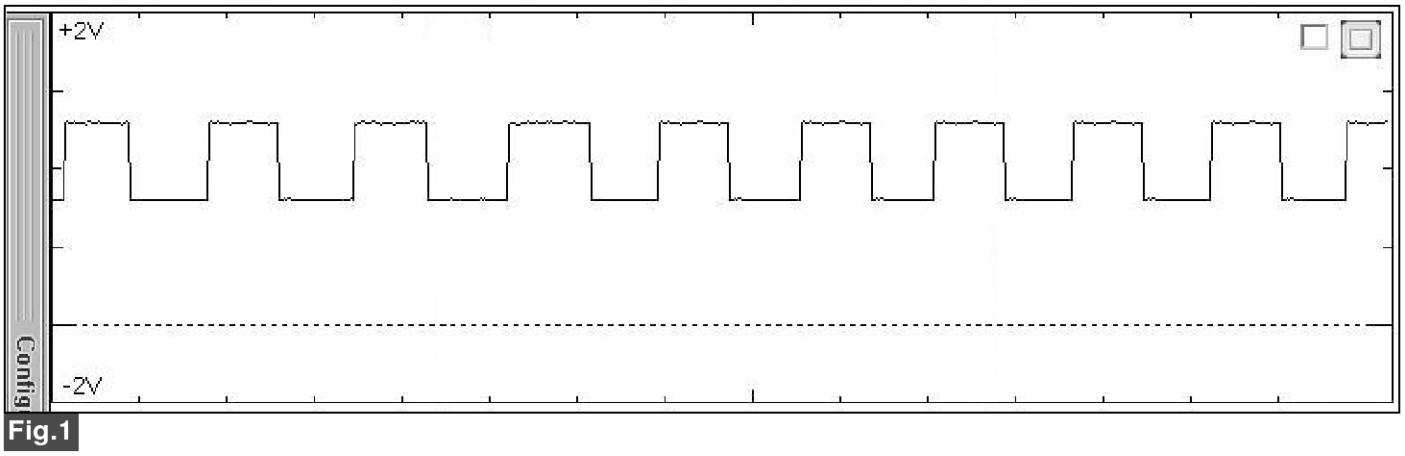


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU harness connector and wheel speed sensor harness connector and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between wheel speed sensor signal terminal of the HECU harness connector and chassis ground.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

6. Is the measured waveform within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open or short in signal circuit between HECU harness connector and wheel speed sensor harness connector, and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (RL).
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. IG OFF and then IG ON again.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1207 Wheel Speed Sensor Rear-LH Range / Performance / Intermittent

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set if an abnormal speed change ratio is detected while the vehicle speed is more than 2Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

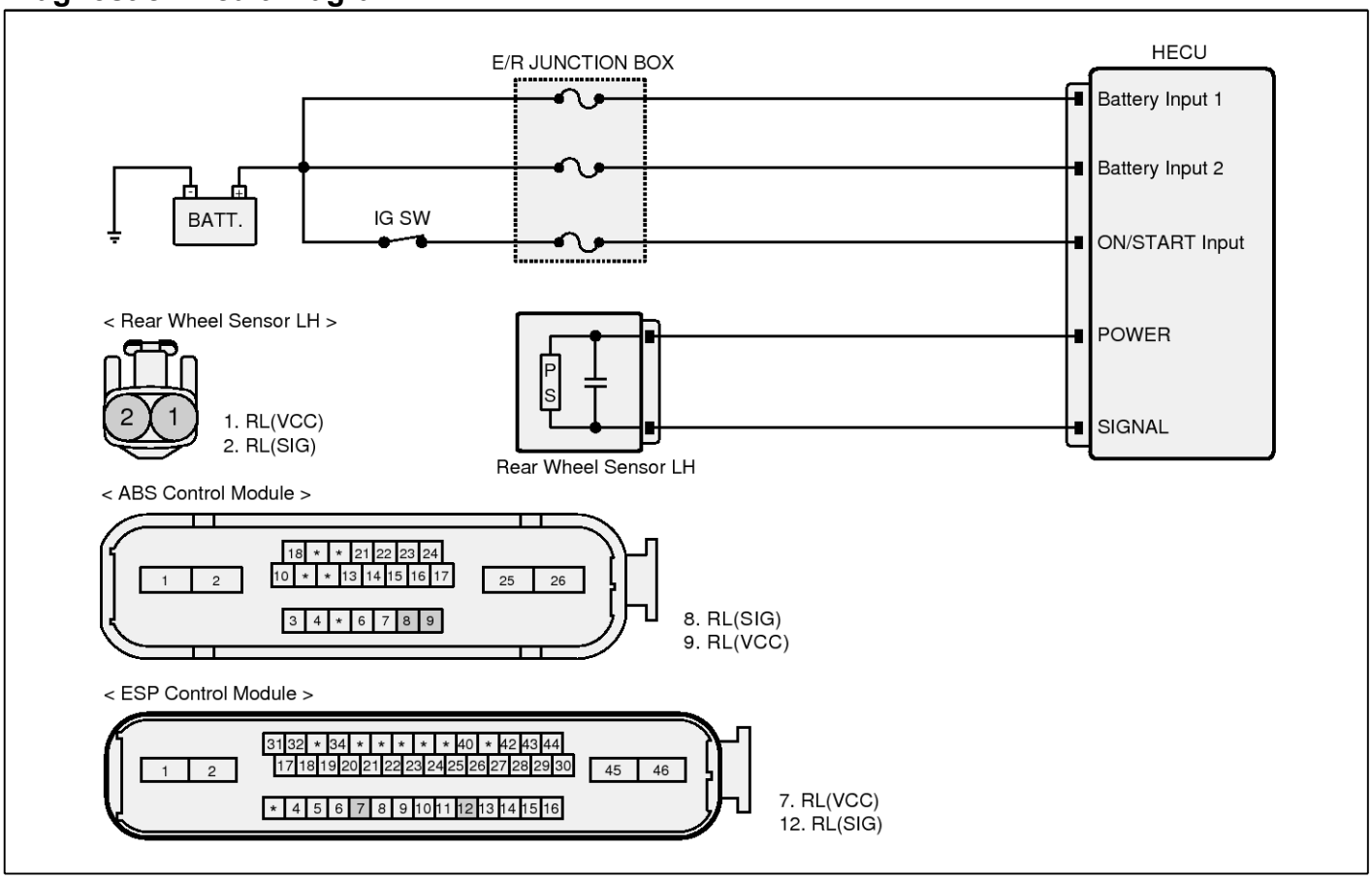
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Enable Conditions	Case1	• Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. if this condition is lasted for 2 minutes. • Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. if this condition is lasted for 2 minutes.	
	Case2	• Controller counts the number of the wheel acceleration of 100g[(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. • Controller counts the number of the wheel acceleration of 70g[(17.5km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or When the numbers at more two wheels exceed 20 times, controller recognize the failure. • Controller counts the number of the wheel deceleration of -100g[(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. • The wheel deceleration of –100g[(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. • In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or When the numbers of 70g at each wheel exceed 20 times, controller recognize the failure. - The counter of speed jump is cleared every 30min. - This monitoring is performed for the period that the velocity of each wheel exceeds 2km/h.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9505L

Signal Waveform

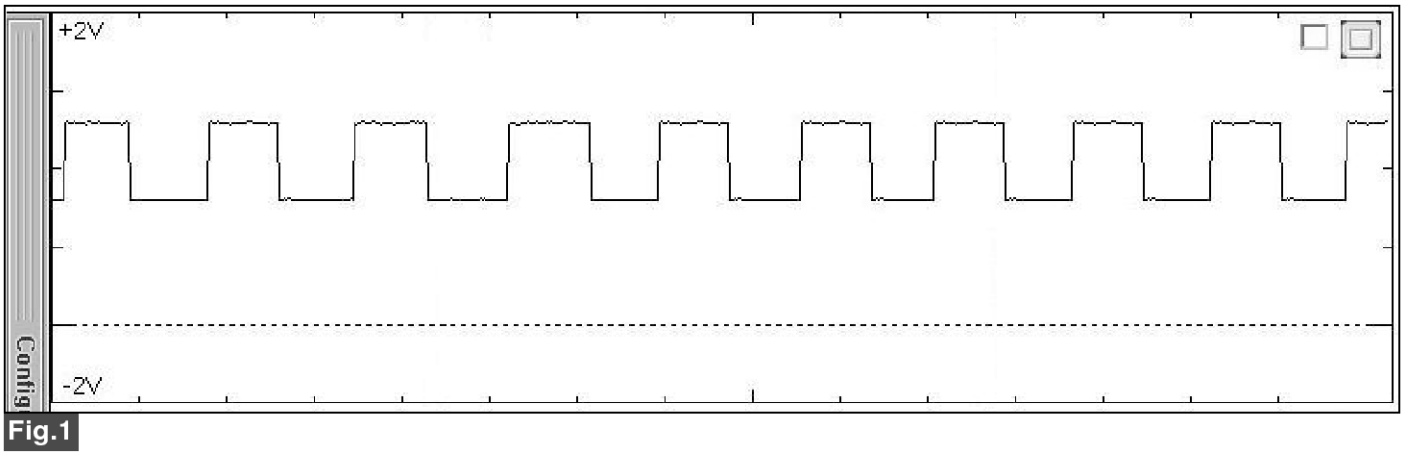


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 40km/h. (24mph)
4. Monitor the "WHEEL SPEED(RL)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (RL) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interferencebetween harnesses.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to " Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 40kmh. (24mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1208 Wheel Speed Sensor Rear-LH Invalid/no Signal

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set when the sensor air gap is out of specified range or when the ABS control cycle is continued abnormally.

The HECU checks for air gap malfunctioning by monitoring the sensor signal at speeds between 2Km/h to 10 Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h (6.2mph).

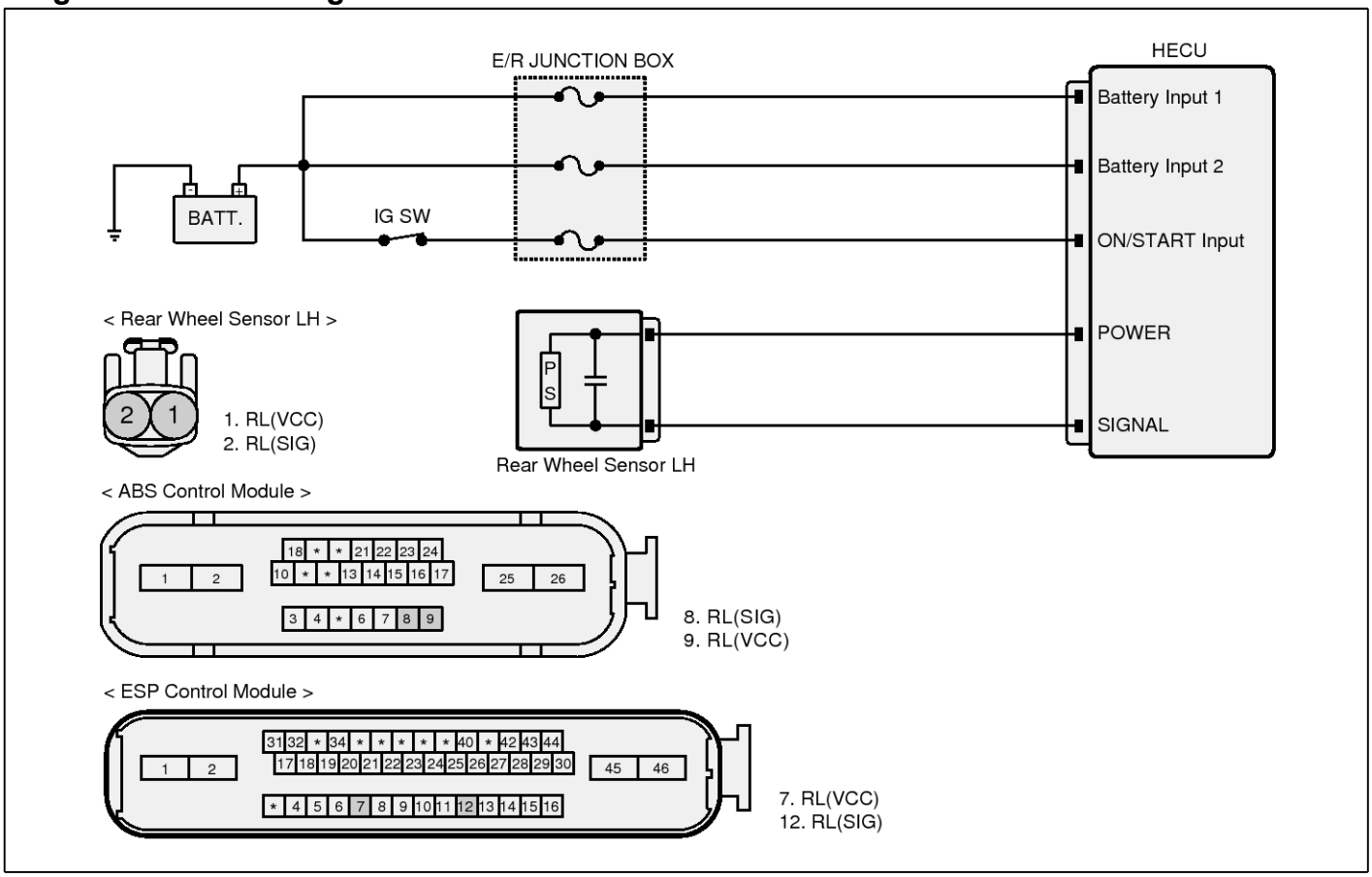
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Case1 (LargeAir-Gap)	Enable Conditions	• When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h (6.2mph) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their difference below 4km/h (2.5mph) is continued for 140msec, Otherwise, if their difference beyond 4km/h (2.5mph) or >0.4g is continued for 2 minutes • In < 0.4g, when the velocity of more two wheels is 2km/h (1.2mph) and the max. wheel velocity exceeds 10km/h (6.2mph), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. • After velocity of 4 wheel exceeds 10km/h (6.2mph), when velocity of 1 wheel or 2 wheel is 2km/h (1.2mph)and difference of other 2 wheel velocity is less than 4km/h (2.5mph) under that those velocity is more than 10km/h (6.2mph), if that conditions are continued for 12 seconds. - This monitoring is performed for the period that the minimum velocity rises from 2km/h (1.2mph) to 10km/h (6.2mph).	
Case2 (long term ABS mode)	Enable Conditions	• During the ABS control cycle, if the wheel velocity of 2km/h (1.2mph) is lasted for more than 12sec. • If the ABS control cycle is continued for more than 36sec.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9505L

Signal Waveform

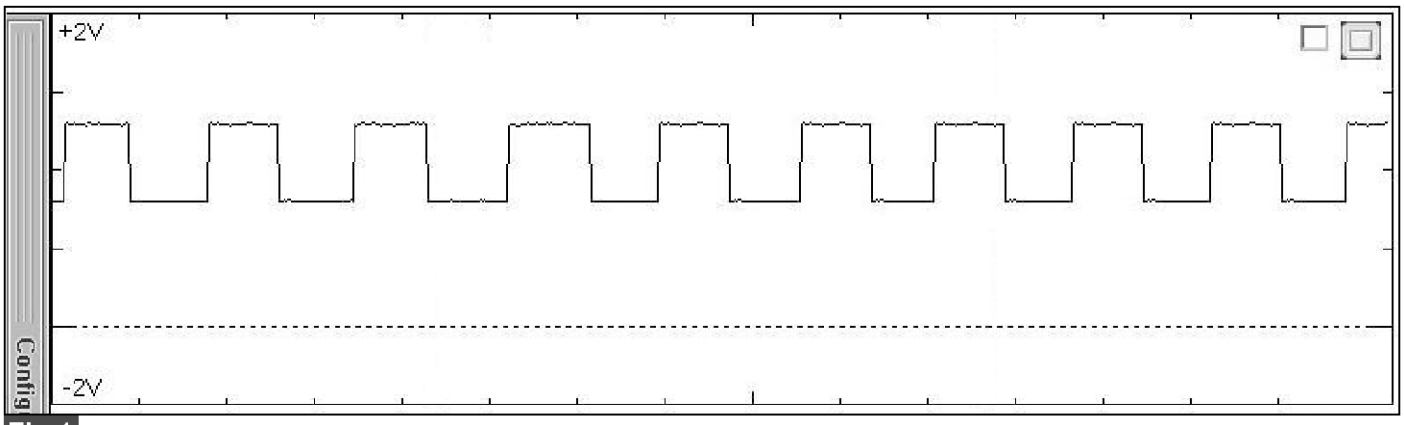


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(RL)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (RL) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interferencebetween harnesses.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1209 Wheel Speed Sensor Rear-RH Open/Short

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor circuit continuously.

If the sensor signal current is continuously out of the specified range for 140msec, then the HECU determines that the circuit is open/short, and sets this code.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

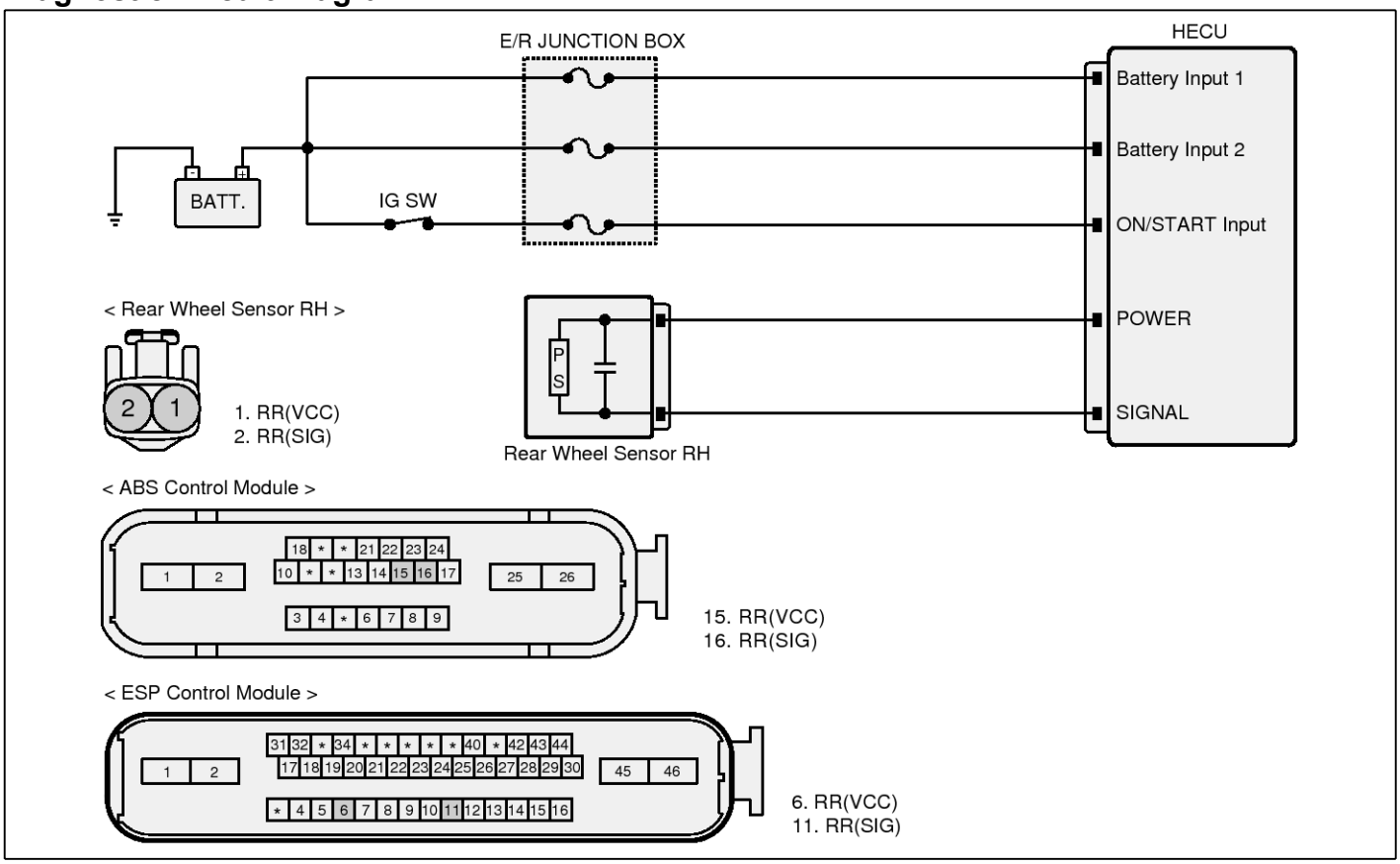
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Current Monitoring	• Open or short of Wheel speed sensor circuit • Faulty Wheel speed sensor
Enable Conditions	• When the sensor signal current is continuously out of the specified range of 4 mA ± 10% ~ 22 mA ± 10% for 140msec.	
Fail Safe	1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9506L

Signal Waveform

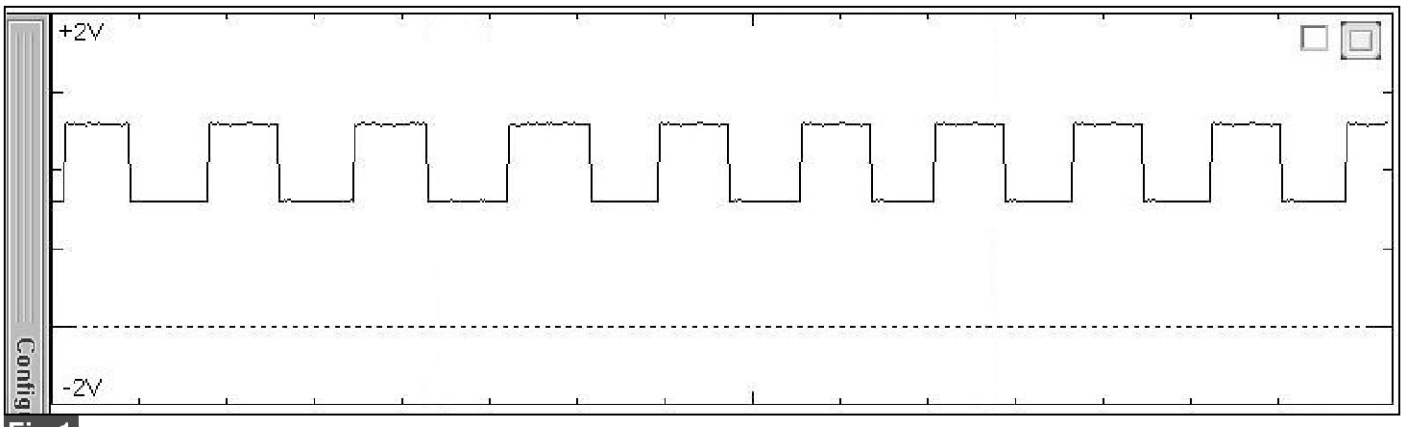


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the wheel speed sensor harness connector and chassis ground.

Specification : Approx. B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between HECU harness connector and wheel speed sensor harness connector and then go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

6. Is the measured waveform within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open or short in signal circuit between HECU harness connector and wheel speed sensor harness connector, and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (RR).
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. IG OFF and then IG ON again.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1210 Wheel Speed Sensor Rear-RH Range / Performance / Intermittent

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set if an abnormal speed change ratio is detected while the vehicle speed is more than 2Km/h.

Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h.

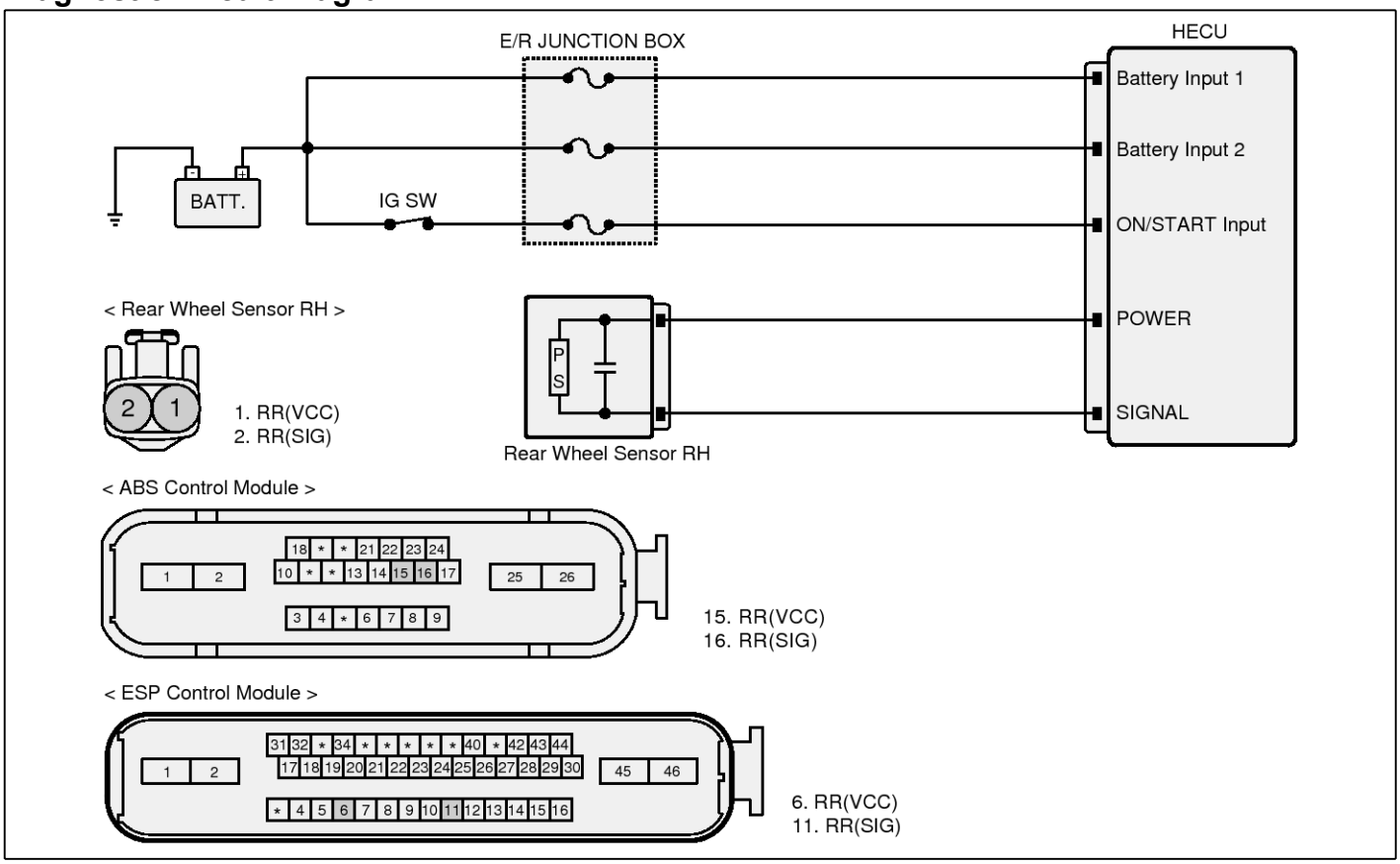
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Enable Conditions	Case1	• Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. if this condition is lasted for 2 minutes. • Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. if this condition is lasted for 2 minutes.	
	Case2	• Controller counts the number of the wheel acceleration of 100g[(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. • Controller counts the number of the wheel acceleration of 70g[(17.5km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or When the numbers at more two wheels exceed 20 times, controller recognize the failure. • Controller counts the number of the wheel deceleration of -100g[(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. • The wheel deceleration of –100g[(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. • In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or When the numbers of 70g at each wheel exceed 20 times, controller recognize the failure. - The counter of speed jump is cleared every 30min. - This monitoring is performed for the period that the velocity of each wheel exceeds 2km/h.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9506L

Signal Waveform

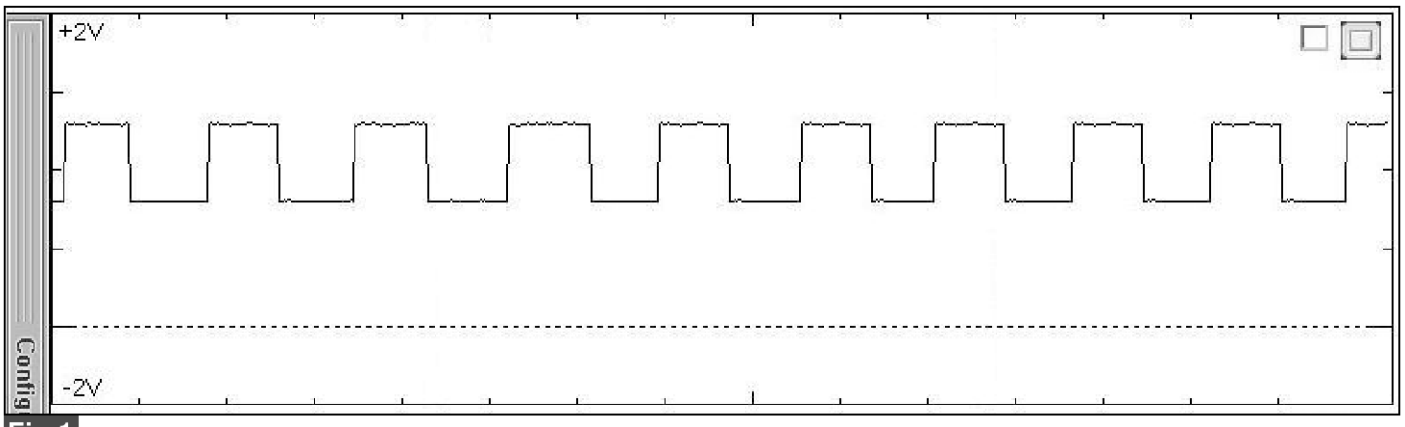


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 40km/h. (24mph)
4. Monitor the "WHEEL SPEED(RR)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (RR) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interference between harnesses, was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 40kmh. (24mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1211 Wheel Speed Sensor Rear-RH Invalid/no Signal

General Description

The wheel speed sensor is the essential component the ABS ECU uses to calculate vehicle speed and to determine whether wheel lock occurs.

For example, rear wheel speed signal is used as a referecnce value, for vehicle speed, in front wheel drive vehicles, and if a difference between front and rear wheel speed occurs, then ABS control is performed.

Wheel speed sensor is active hall-sensor type.

DTC Description

The ABS ECU monitors the wheel speed sensor signal continuously.

This code is set when the sensor air gap is out of specified range or when the ABS control cycle is continued abnormally.

The HECU checks for air gap malfunctioning by monitoring the sensor signal at speeds between 2Km/h to 10 Km/h. Warning lamp is turned OFF unless additional faults are detected when the IG KEY is turned ON again, and wheel speed is more than 10 Km/h (6.2mph).

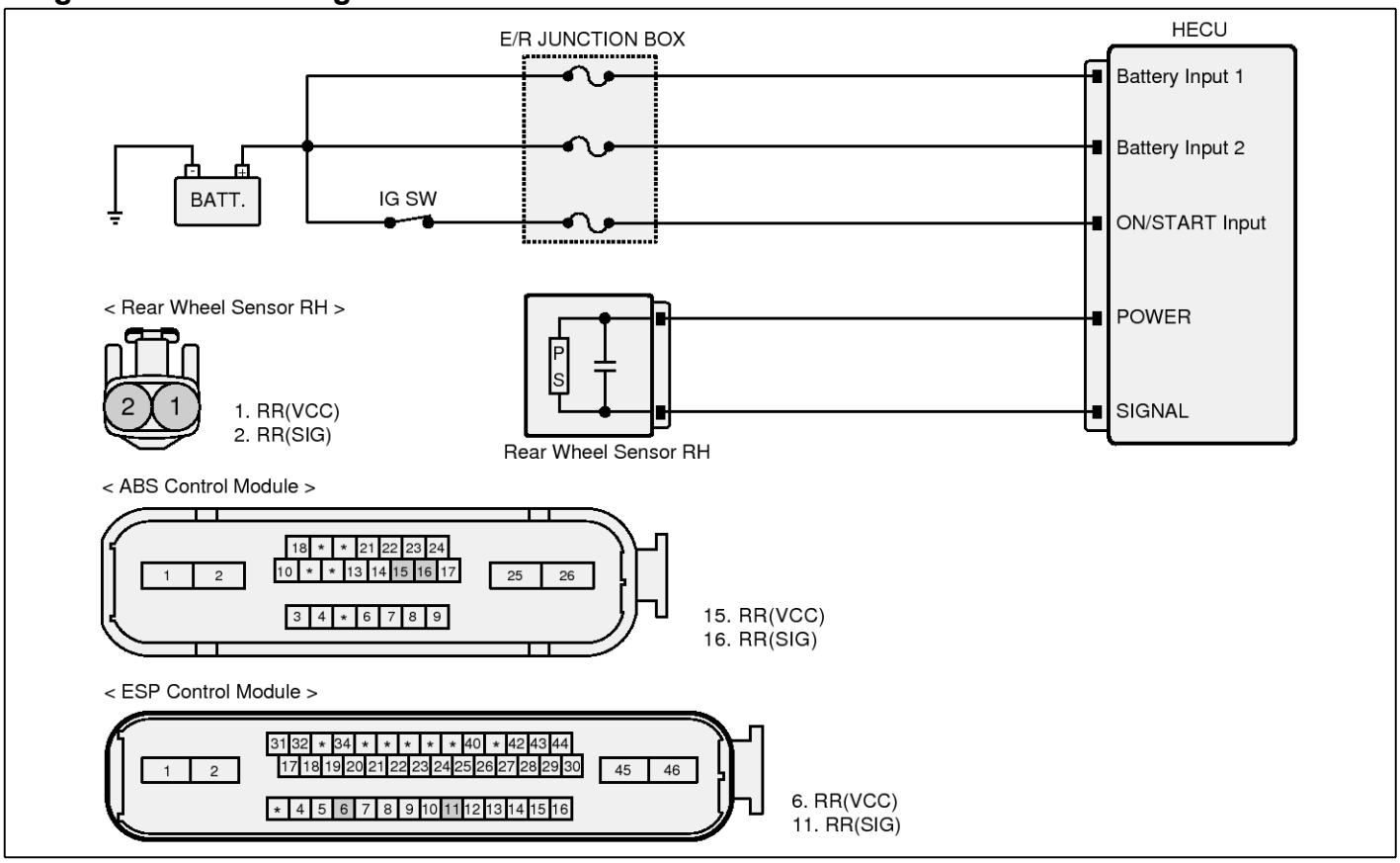
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor
Case1 (Large Air-Gap)	Enable Conditions	• When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h (6.2mph) with the acceleration of < 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their difference below 4km/h (2.5mph) is continued for 140msec, Otherwise, if their difference beyond 4km/h (2.5mph) or >0.4g is continued for 2 minutes • In < 0.4g, when the velocity of more two wheels is 2km/h (1.2mph) and the max. wheel velocity exceeds 10km/h (6.2mph), the condition is continued for 20 sec. Otherwise, In >0.4g, the condition is 2 minutes. • After velocity of 4 wheel exceeds 10km/h (6.2mph), when velocity of 1 wheel or 2 wheel is 2km/h (1.2mph)and difference of other 2 wheel velocity is less than 4km/h (2.5mph) under that those velocity is more than 10km/h (6.2mph), if that conditions are continued for 12 seconds. - This monitoring is performed for the period that the minimum velocity rises from 2km/h (1.2mph) to 10km/h (6.2mph).	
Case2 (long term ABS mode)	Enable Conditions	• During the ABS control cycle, if the wheel velocity of 2km/h (1.2mph) is lasted for more than 12sec. • If the ABS control cycle is continued for more than 36sec.	
Fail Safe		1. Only one wheel failure : Inhibit the ABS/ESP control, allow the EBD control. The ABS/ESP warning lamps are activated, the EBD warning lamp is not activated. 2. More than two wheels failure : The ABS/EBD/ESP functions are inhibited. The ABS/EBD/ESP warning lamps are activated.	

Specification

Sensor Type	Output Voltage		Tooth Count	Airgap
	HIGH	LOW		
Active Type	1.4V	0.7V	48	0.4~1.5mm

Diagnostic Circuit Diagram



SHMBR9506L

Signal Waveform

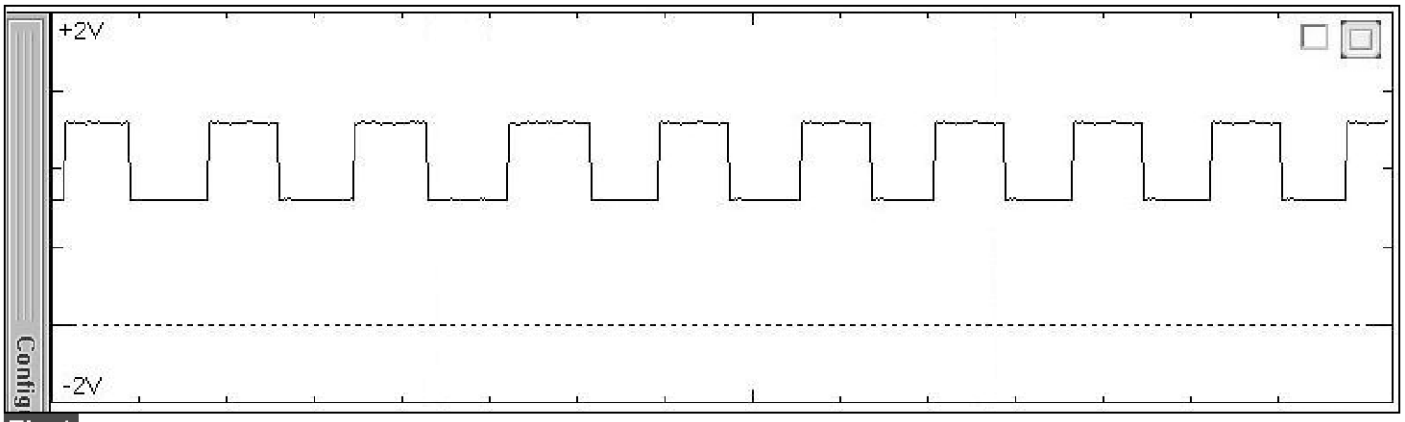


Fig.1

SHMBR9602L

Fig 1) Normal waveform of wheel speed sensor (Active type)

Monitor Scantool Data

1. Ignition "ON" & Engine "ON".
2. Connect scantool to Data Link Connector(DLC)
3. Start and drive vehicle in gear and maintain vehicle speed at or above 10km/h. (6.2mph)
4. Monitor the "WHEEL SPEED(RR)" parameter on the Scantool.

Specification : Compare with other parameters related to wheel speed sensor.
If it is the same as other parameters, it is in normal condition.

5. Is parameter displayed within specifications?

YES ▶ Fault is intermittent caused by poor connection in wheel speed sensor harness (RR) and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

■ Wheel speed sensor circuit check

1. Lift the vehicle.
2. Ignition "ON" & Engine "OFF".
3. Turn the wheel by hand.
4. Measure waveform between signal terminal of the wheel speed sensor harness connector and chassis ground with osciloscope.

Specification : High : 1.18~1.68V , Low : 0.59~0.84V

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by faulty HECU, wheel speed sensor or external noise, an interference between harnesses, was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.

Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
Substitute with a known-good Wheel speed sensor and check for proper operation.
If problem is corrected, replace Wheel speed sensor and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information. (Start and drive vehicle in gear and maintain vehicle speed at or above 10kmh. (6.2mph))
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1235 Primary Pressure Sensor-Electrical

General Description

The pressure sensor, installed in the HECU, senses the brake oil pressure to judge a driver's brake intention when the ESP program is operated. If pressure of master cyclinder is applied to pressure sensor, the strain of the piezo element is changed and then the resistance of bridge circuit is changed according to the changed strain. Therefore this changed resistance changes the output voltage of bridge circuit and the output voltage changes linearly. The sensor output is an analog signal in proportion to the supply voltage, and the HECU recognizes a pressure value according to signal ratio about supply voltage.

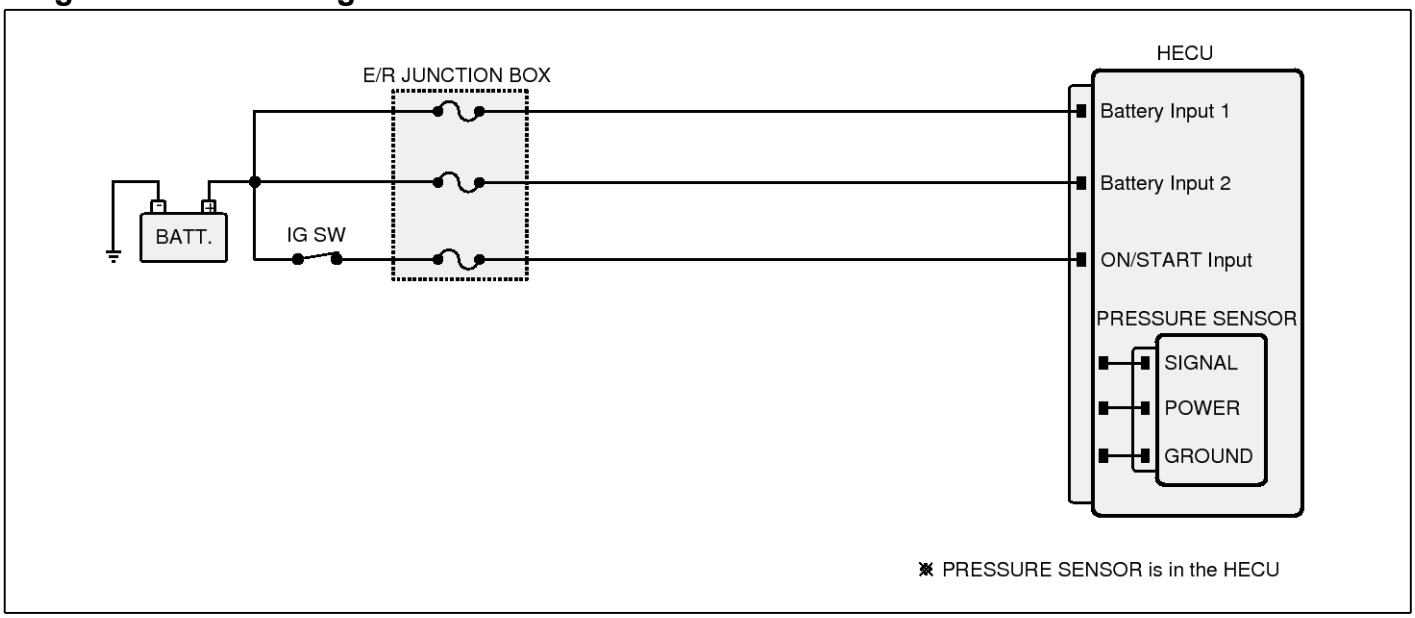
DTC Description

A failure is detected if the output signal voltage of the pressure sensor is out of specified range.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Monitoring	• Open or short of pressure sensor circuit • Faulty pressure sensor
Enable Conditions	• The output signal voltage of the pressure sensor is out of the specified range. - The monitoring starts 1sec after power up.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9508L

Component Inspection

1. Ignition "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Check if the pressure sensor's service data shows '0 bar' on the scantool while not pressing the brake pedal.
6. Check if the pressure sensor's service data rises on the scantool while pressing the brake pedal.
7. Is the pressure sensor's data unusually shown?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ This fault is intermittently caused by pressure sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1237 Primary Pressure Sensor-Signal

General Description

The pressure sensor, installed in the HECU, senses the brake oil pressure to judge a driver's brake intention when the ESP program is operated. If pressure of master cyclinder is applied to pressure sensor, the strain of the piezo element is changed and then the resistance of bridge circuit is changed according to the changed strain. Therefore this changed resistance changes the output voltage of bridge circuit and the output voltage changes linearly. The sensor output is an analog signal in proportion to the supply voltage, and the HECU recognizes a pressure value according to signal ratio about supply voltage.

DTC Description

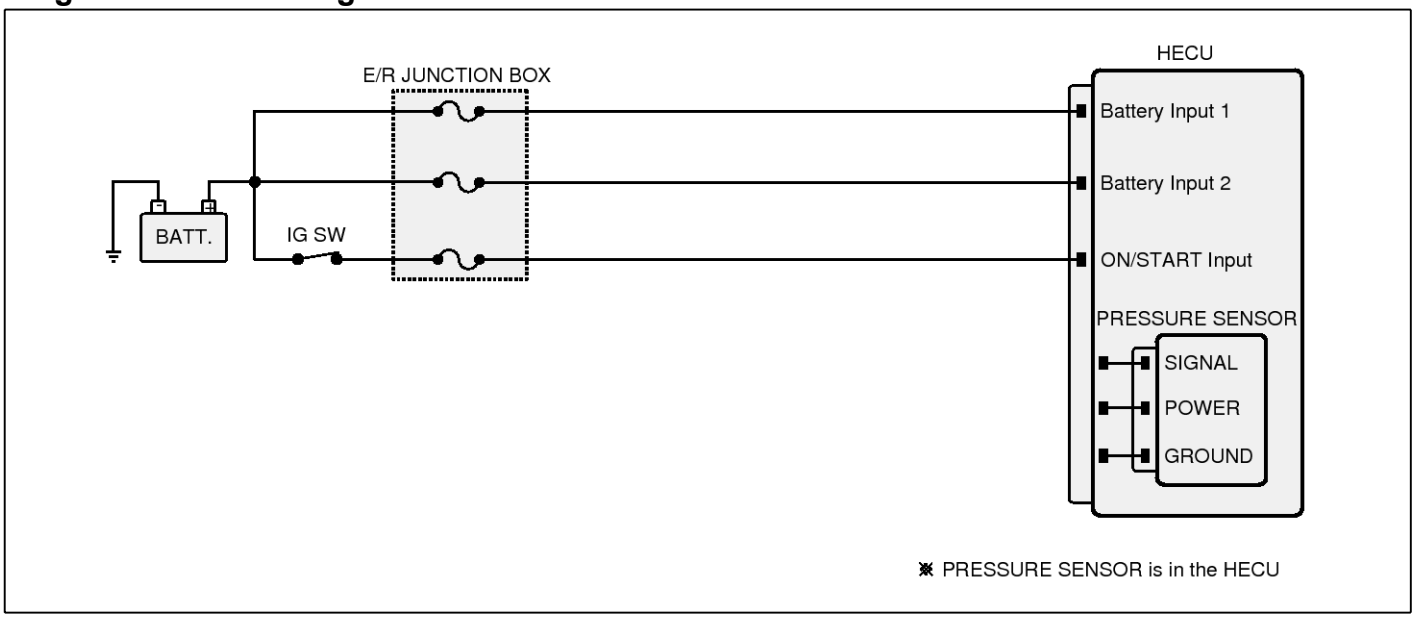
The failure is detected if the pressure sensor signal noise is out of normal range, or the pressure sensor signal is changed abnormally.

In spite of no brake switch signal, master cylinder pressure exceeds 20bar when brake switch is normal.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Monitoring	• External noise. • Faulty pressure sensor
Enable Conditions	• If input signal is noisy, Which the gradient of the sensor signal is larger than predefined value for specific times, ECU detect the failure. • Outside an ABS/ESP control, And after normal operation of BLS, If the pressure sensor signal is higher than 20bar and BLS is low for 3sec, ECU detect the failure.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9508L

Component Inspection

1. Ignition "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Check if the pressure sensor's service data shows '0 bar' on the scantool while not pressing the brake pedal.
6. Check if the pressure sensor's service data rises on the scantool while pressing the brake pedal.
7. Is the pressure sensor's data unusually shown?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ This fault is intermittently caused by pressure sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1260 Steering Angle Sensor Circuit-Signal

General Description

The Steering wheel angle sensor uses two sensors (A-sensor and B-sensor) to determine the direction of the rotation.

The main components of each sensor are LED, photo transistor and slit plate.

The slit plate, which has 45 holes, is installed between LED and photo transistor, and generates signals if slit plate rotates according to the steering wheel rotation.

The sensor signals are generated by photo transistor which is driven whenever the light passes through the holes. The HECU detects operating speed and direction of the steering wheel by this input signal, and the signal is used to input signal for anti-roll control.

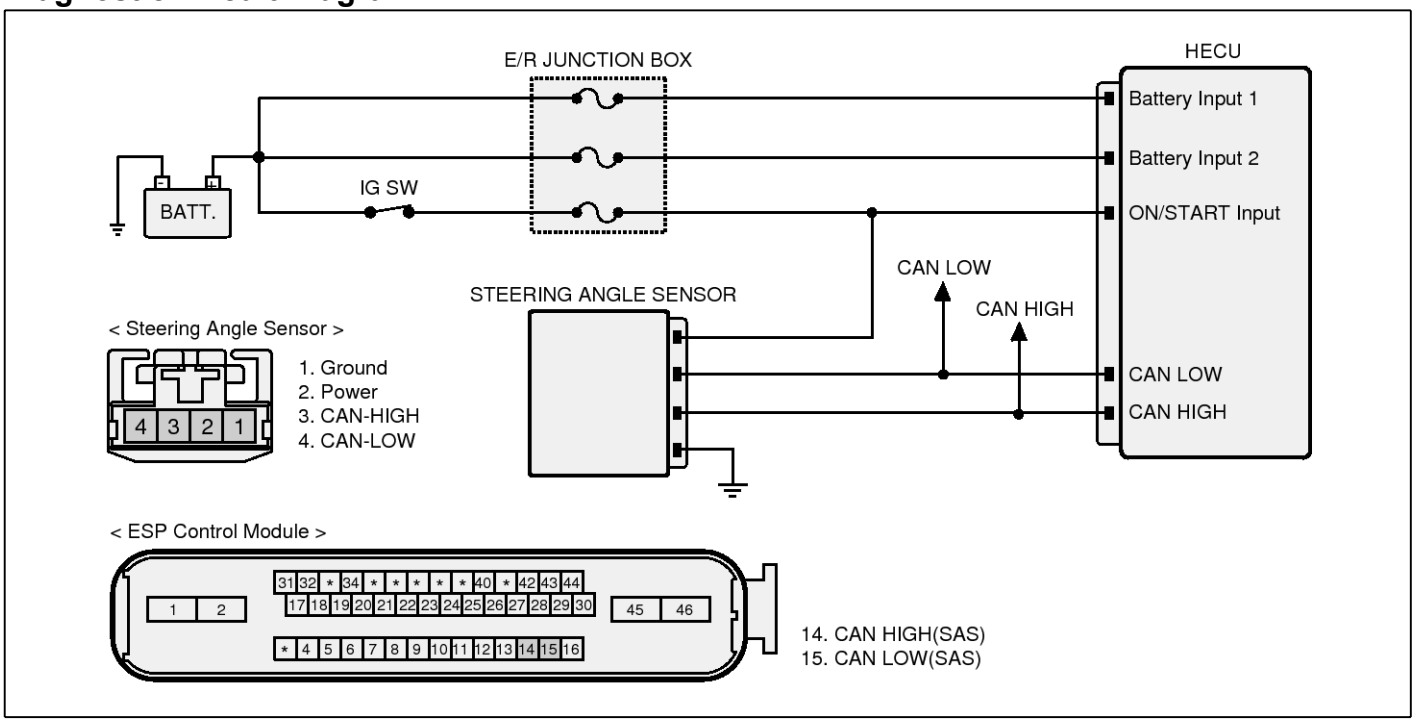
DTC Description

The HECU monitors the signals of the steering angle sensor and if the abnormal signal is detected or the difference between the angle speed calculated from the other sensors and the the angle speed measured from the steering angle sensor is above a certain value, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal Monitoring	• Incorrect calibration • Improper installation of steering angle sensor • Faulty steering angle sensor
Enable Conditions	• There is the difference between a calculated angle speed and a measured angle speed. • During driving straight, the steering angle sensor offset is more than 55 degrees. • The angle of steering is out of the normal range.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9509L

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ▶ This DTC may be caused by an incorrect calibration of the steering angle sensor. Perform the calibration of the sensor by scantool again. This DTC may be caused by an improper installation of the steering angle sensor. Check it for the installation.
If there is no problem about the above items, Substitute with a known-good Steering Angle Sensor and check for proper operation. If problem is corrected, replace Steering Angle Sensor and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing the Steering Angle Sensor, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ This fault is intermittently caused by poor connection of the Steering Angle Sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1261 Steering Angle Sensor Not Calibrated

General Description

The Steering wheel angle sensor uses two sensors (A-sensor and B-sensor) to determine the direction of the rotation. The main components of each sensor are LED, photo transistor and slit plate. The slit plate, which has 45 holes, is installed between LED and photo transistor, and generates signals if slit plate rotates according to the steering wheel rotation. The sensor signals are generated by photo transistor which is driven whenever the light passes through the holes. The HECU detects operating speed and direction of the steering wheel by this input signal, and the signal is used to input signal for anti-roll control.

DTC Description

The steering angle sensor in the ESP system is an absolute angle sensor type. For this reason, the steering angle sensor needs the zero setting(Calibration) by the scantool. If the calibration of this sensor is undone, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal monitoring	• Calibration not completed • Faulty steering angle sensor • Faulty HECU
Enable Conditions	• when the calibration of the steering angle sensor has not completed	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Monitor Scantool Data

1. Line up wheels like Figure 1.
   1) Perform the wheel alignment.
   2) Line up the wheel in a straight.
   3) Drive the vehicle ahead and back 2~3 times without holding steering wheel.
2. Connect scantool to Data Link Connector(DLC).
3. Perform steering angle sensor calibration.(Figure 2)
4. Disconnect scantool.
5. Check the condition of SAS zero point adjustment by driving the vehicle to right-turn and left-turn at least one time.

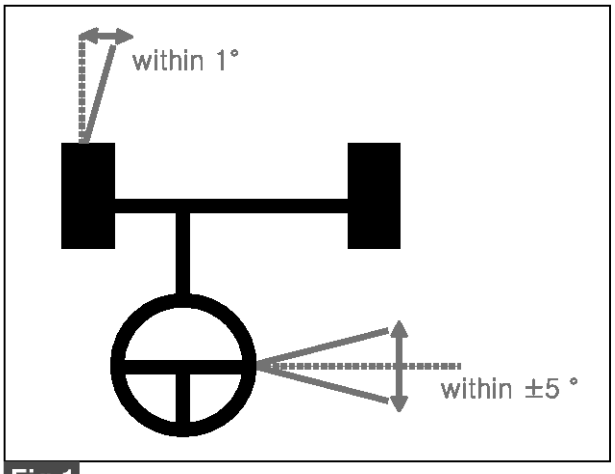


Fig.1

SHMBR9603L

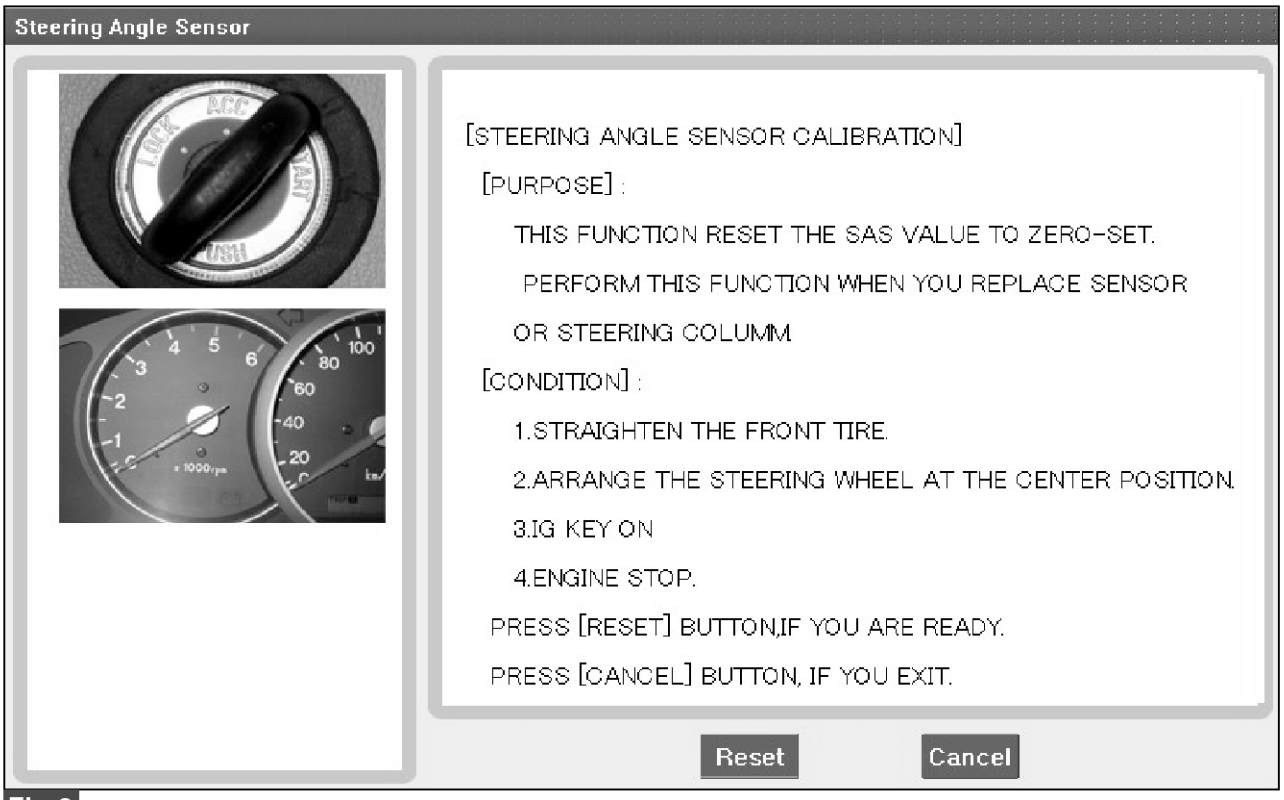


Fig.2

SHMBR9604L

6. Is the calibration(zero point adjustment) completed?

YES ▶ Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good Steering Angle Sensor/ HECU and check for proper operation.
If problem is corrected, replace Steering Angle Sensor/ HECU and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1274 Longitudinal G sensor open/short

General Description

The 4WD vehicle measures the G-sensor signal to solve for 4WD vehicle unique problems. For example all 4 wheels are locked early on a low-friction road or control response is delayed when road friction coefficients vary. The HECU uses a filtered signal, as a supplementary value, to determine the road friction coefficient. This value is used for the accurate calculations of assumed vehicle speed, or precise division of control starting points.

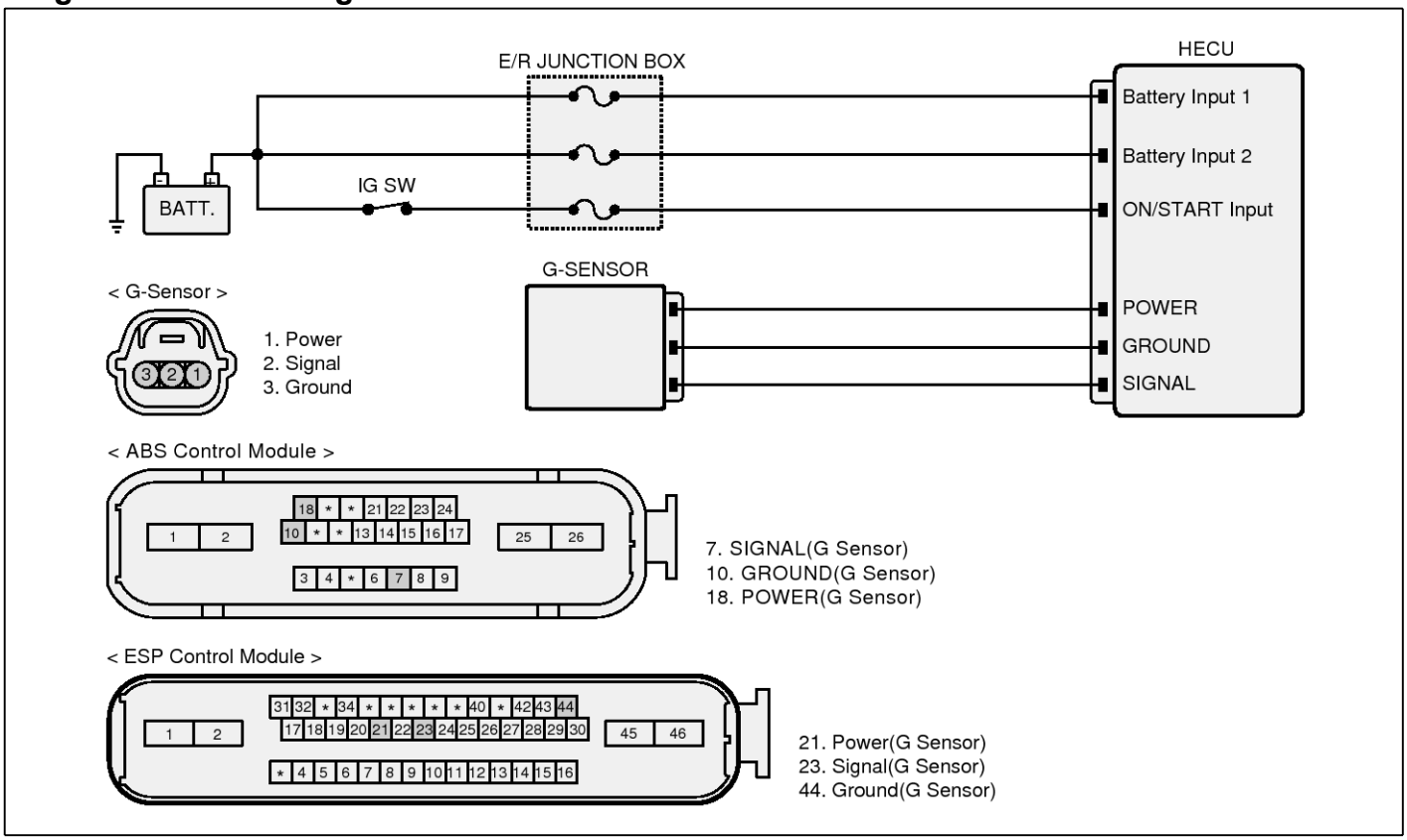
DTC Description

The HECU monitors the G-sensor voltage continuosly,and sets this code if the voltage is either higher than the permissible normal value (approx. 4.5 V) or lower than the value (approx. 0.6V) for more than 250ms.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Monitoring	• Open or short of G-Sensor circuit • Faulty G-Sensor
Enable Conditions	• When the voltage of G sensor signal is >4.5±0.1V or <0.6±0.1V for 250msec continuously.	
Fail Safe	• ABS/ESP functions are inhibited, EBD function is allowed and the ABS/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SHMBR9518L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the G sensor harness connector and chassis ground.

Specification : Approx. 5V

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between the G sensor harness connector and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect the G sensor connector.
3. Measure resistance between ground terminal of the G sensor harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in ground circuit between the G sensor harness connector and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Disconnect the G sensor connector and HECU connector.
3. Measure resistance between signal terminal of the G sensor harness connector and the G sensor signal terminal of the HECU harness connector.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open or short in signal circuit between the G sensor harness connector and HECU harness connector, and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between signal terminal of the G sensor harness connector and chassis ground.

Specification : Approx. 2.5V

3. Is the measured value within specifications?

YES ▶ Fault is intermittent caused by poor connection in G sensor harness and/or HECU's connector.
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good G sensor and check for proper operation.
If problem is corrected, replace G sensor and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing the G sensor, operate "Steering Angle Sensor Calibration" by scantool.

Verification of Vehicle Repair

Refer to DTC C1101 : Battery Voltage High

C1275 Longitudinal G Sensor Range/Performance error

General Description

The 4WD vehicle measures the G-sensor signal to solve for 4WD vehicle unique problems. For example all 4 wheels are locked early on a low-friction road or control response is delayed when road friction coefficients vary. The HECU uses a filtered signal, as a supplementary value, to determine the road friction coefficient. This value is used for the accurate calculations of assumed vehicle speed, or precise division of control starting points.

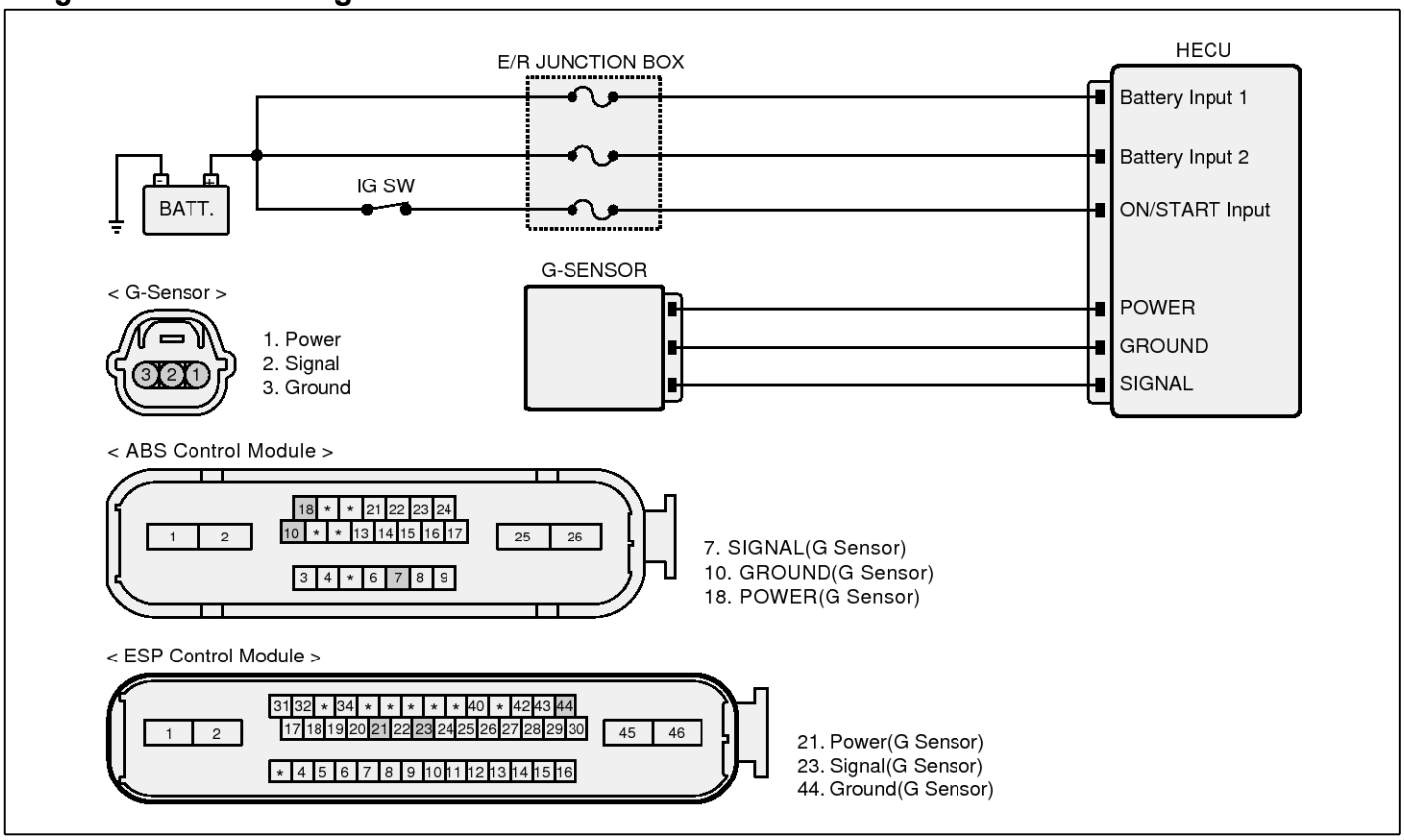
DTC Description

The HECU monitors the G-sensor voltage continuosly,and sets this code if the G-sensor value is either higher than 0.5G for more than 20 seconds when vehicle speed is above 10 Km/h and brake switch is OFF, or if G-sensor value is lower than 0.1G for more than 60 seconds when wheel sensor minimum value is above 0.2G.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal Monitoring	• Improper installation of G-Sensor • Faulty G-Sensor
Enable Conditions	• When vehicle speed is >10km/h and the brake light switch is off, |G|>0.5G for 20sec continuously. • When |min wheel speed| / dt ≥0.2G and |G| ≤0.1G for 60sec continuously.	
Fail Safe	• ABS/ESP functions are inhibited, EBD function is allowed and the ABS/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SHMBR9518L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ G Sensor Check

1. Check installation condition of G-sensor. If NG, repair as necessary and go to "Verification vehicle Repair" procedure.
2. Check damage of rotor teeth or wheel bearing. If NG, repair as necessary and go to "Verification vehicle Repair" procedure.
3. Ignition "ON" & Engine "OFF".
4. Measure waveform between signal terminal of the G sensor harness connector and chassis ground with osciloscope.

Specification : Approx. 2.5V
0.3V ~ 4.7V (acceleration or deceleration)

5. Is the measured waveform within specifications?

YES ▶ Fault is intermittent caused by poor connection in G sensor harness and/or HECU's connector.
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good G sensor and check for proper operation.
If problem is corrected, replace G sensor and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing the G sensor, operate "Steering Angle Sensor Calibration" by scantool.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1282 Yaw Rate & Lateral G Sensor-Electrical

General Description

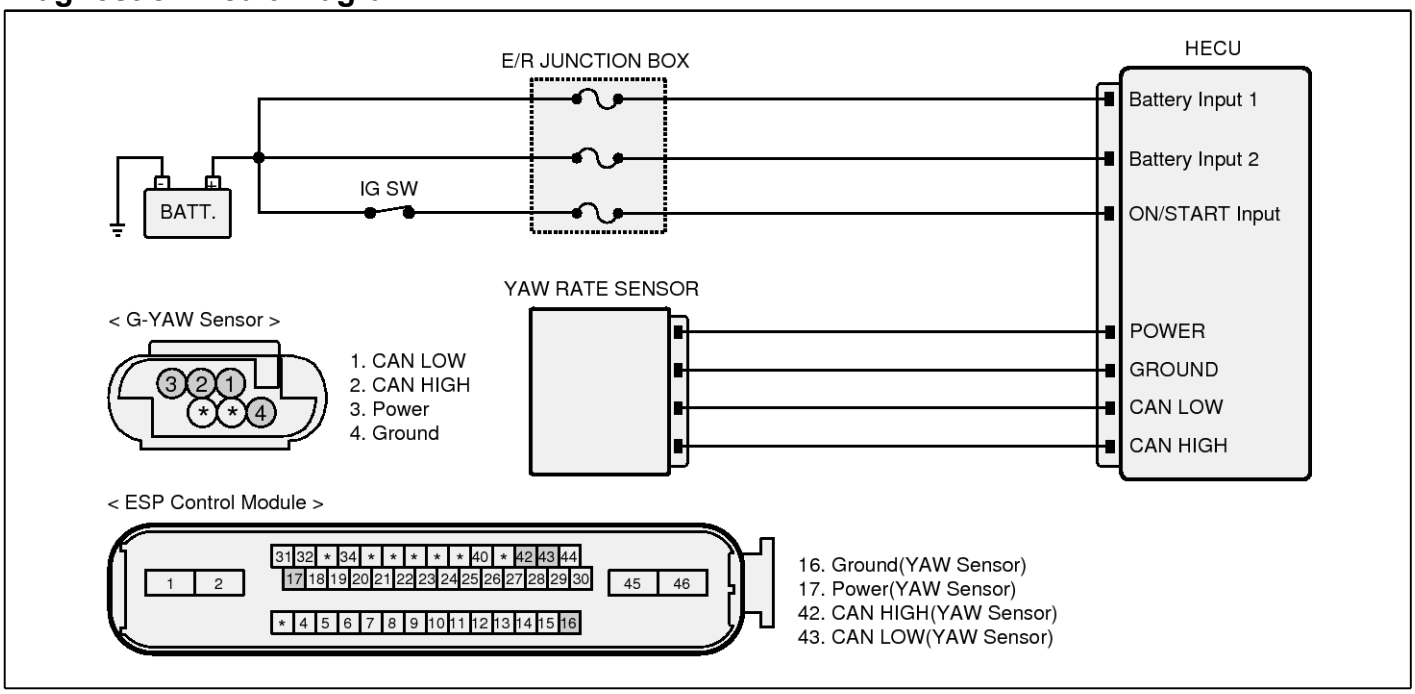
When the vehicle is turning, the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor. If the yaw velocity reaches the specific velocity after it detects the vehicle's yawing, the ESP control is reactivated. The lateral G sensor senses the vehicle's lateral acceleration. A small element inside the sensor is attached to a deflectable leverarm by lateral acceleration. Direction and magnitude of lateral acceleration loaded to vehicle can be known by electrostatic capacity changing according to lateral acceleration. It interchanges signals with HECU through extra CAN line which is only used for communication between HECU and the sensor.

DTC Description

A failure is detected if the Yaw rate & lateral G sensor's message was not received or the HECU detects the sensor CAN Bus off state for more than the specified failure detection time. The Monitoring starts after Power-Up.

Item		Detecting Condition	Possible cause
Case1	DTC Strategy	• Yaw rate & lateral G sensor message monitoring	• Faulty Yaw Rate & Lateral G senso • Open or short of Yaw Rate & Lateral G sensor
	Enable Conditions	• In case that Yaw rate & lateral G sensor message was not received for more than 500ms within normal voltage condition. - The Monitoring starts after Power-Up.	
Case2	DTC Strategy	• Open, short monitoring	
	Enable Conditions	• In case sensor CAN BUS off state continued for more than 100ms.	
Fail Safe		• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9510L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between power terminal of the Yaw Rate & Lateral G sensor harness connector and chassis ground.

Specification : Approx. 12V

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between the yaw rate & lateral G sensor harness connector and HECU harness connector and then , go to "Verification of vehicle Repair"

Ground Circuit Inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect yaw rate & lateral G sensor connector.
3. Measure resistance between ground terminal of the yaw rate & lateral G sensor harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in ground circuit between the yaw rate & lateral G sensor harness connector and HECU harness connector and then , go to "Verification of vehicle Repair"

Signal Circuit Inspection

■ Short Check (to ground)

1. Ignition "OFF" & Engine "OFF".
2. Disconnect yaw rate & lateral G sensor, HECU connector.
3. Measure resistance between CAN LOW terminal, CAN HIGH terminal of the yaw rate & lateral G sensor harness connector and chassis ground.

Specification : ∞ Ω

4. Is the measured value within specifications?

YES ▶ Go to next procedure.

NO ▶ Repair short to ground in CAN signal circuit in case of abnormal resistance measured and then go to "Verification of vehicle Repair" procedure.

■ Short Check (to battery)

1. Ignition "ON" & Engine "OFF".
2. Disconnect HECU connector.
3. Measure voltage between CAN LOW terminal, CAN HIGH terminal of the HECU harness connector and chassis ground.

Specification : Approx. 0 V

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in CAN signal circuit in case of abnormal voltage measured and then, go to"Verification of vehicle Repair" procedure.

Component Inspection

1. IG "OFF"
2. IG "ON"
3. After connecting scantool, check DTC on the scantool.
4. Using scantool, Erase the DTCs.
5. Using a scantool, Check DTC present.
6. Is the same DTC shown?

YES ▶ Substitute with a known-good Yaw-rate & Lateral G & Longitudinal G sensor and check for proper operation. If problem is corrected, replace Yaw-rate & Lateral G & Longitudinal G sensor and then go to "Verification of Vehicle Repair" procedure.

NO ▶ This fault is intermittently caused by the sensor. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1283 Yaw Rate & Lateral G Sensor-Signal

General Description

When the vehicle is turning, the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor. If the yaw velocity reaches the specific velocity after it detects the vehicle's yawing, the ESP control is reactivated. The lateral G sensor senses the vehicle's lateral acceleration. A small element inside the sensor is attached to a deflectable leverarm by lateral acceleration. Direction and magnitude of lateral acceleration loaded to vehicle can be known by electrostatic capacity changing according to lateral acceleration. It interchanges signals with HECU through extra CAN line which is only used for communication between HECU and the sensor.

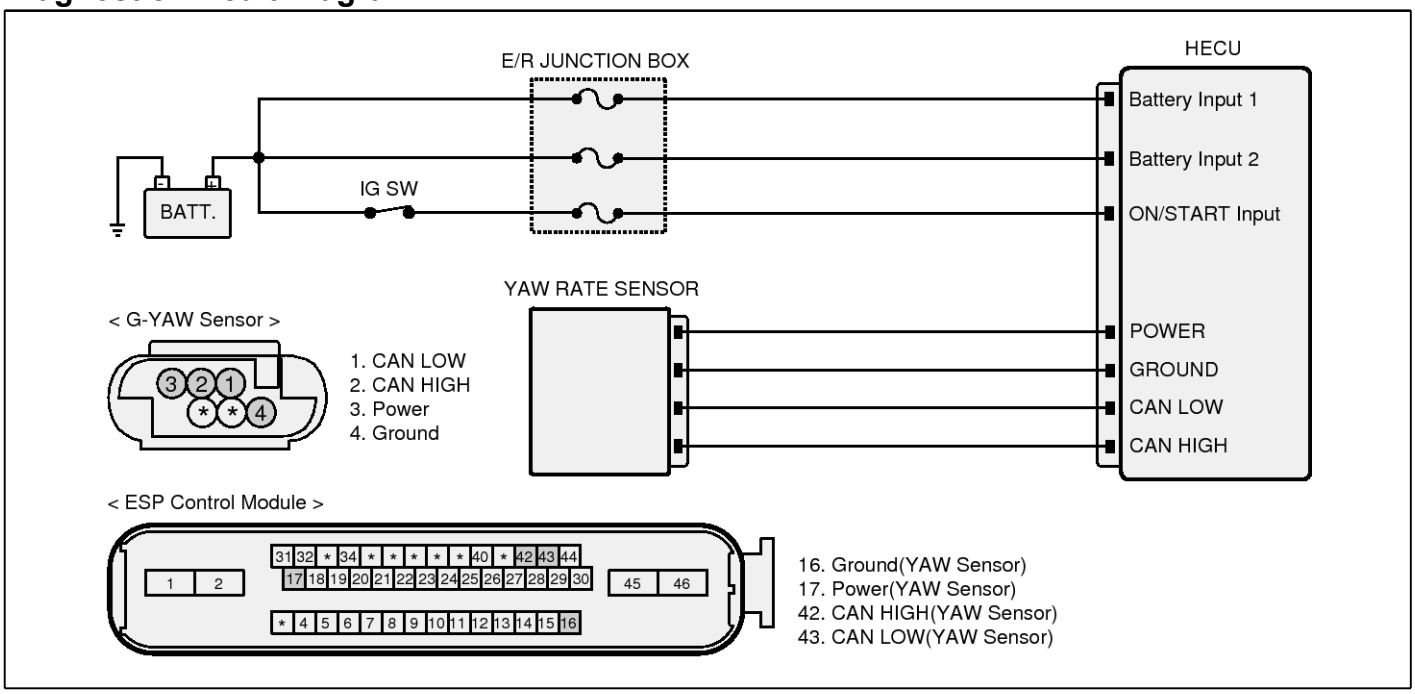
DTC Description

If the difference between the estimated value from the other sensors and the measured value from the yaw rate and lateral G sensor is larger than predefined value for predefined time, the failure is recognized.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal monitoring	• Faulty Yaw Rate & Lateral G sensor
Case1	Enable Conditions	• When the difference between estimated value and measured value of the yaw rate sensor is lager than Predefined value for specific time , ECU detects failure.	
Case2	Enable Conditions	• When the difference between estimated value and measured value of the lateral G sensor is lager than Predefined value for specific time , ECU detects failure.	
Case3	Enable Conditions	• Yaw signal is smaller than predefined value when CBIT is transmitted • Lateral G signal is smaller than defined value when CBIT is transmitted. ※ CBIT : Commanded Built In Test	
Case4	Enable Conditions	• In case that Yaw&Lateral G Sensor Fail Flag is detected for defined time	
Fail Safe		• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9510L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

1. IG "OFF"
2. Ignition "ON" & Engine "OFF".
3. Drive the vehicle within DTC Detecting Condition in General Information, including the left turn one time and the right turn one time.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ 1) Substitute with a known-good Yaw Rate & Lateral G sensor and check for proper operation.
If problem is corrected, replace Yaw Rate & Lateral G sensor and then go to "Verification of Vehicle Repair" procedure.
2) Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent caused by poor connection in Yaw Rate & Lateral G sensor harness and/or HECU's connector. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC C1101 : Battery Voltage High

C1503 TCS/ESC(ESP) Switch error

General Description

Driver can inhibit the ESP control by ESP switch.

When switch signal sends into the HECU, the ESP warning lamp goes "ON" and the ESP control is stopped and if the next switch signal is inputted again, the ESP control is ready. This function is used for sporty driving or vehicle inspection.

DTC Description

This DTC is set when the condition that the level of ESP switch is high is continued for more than 60 seconds.

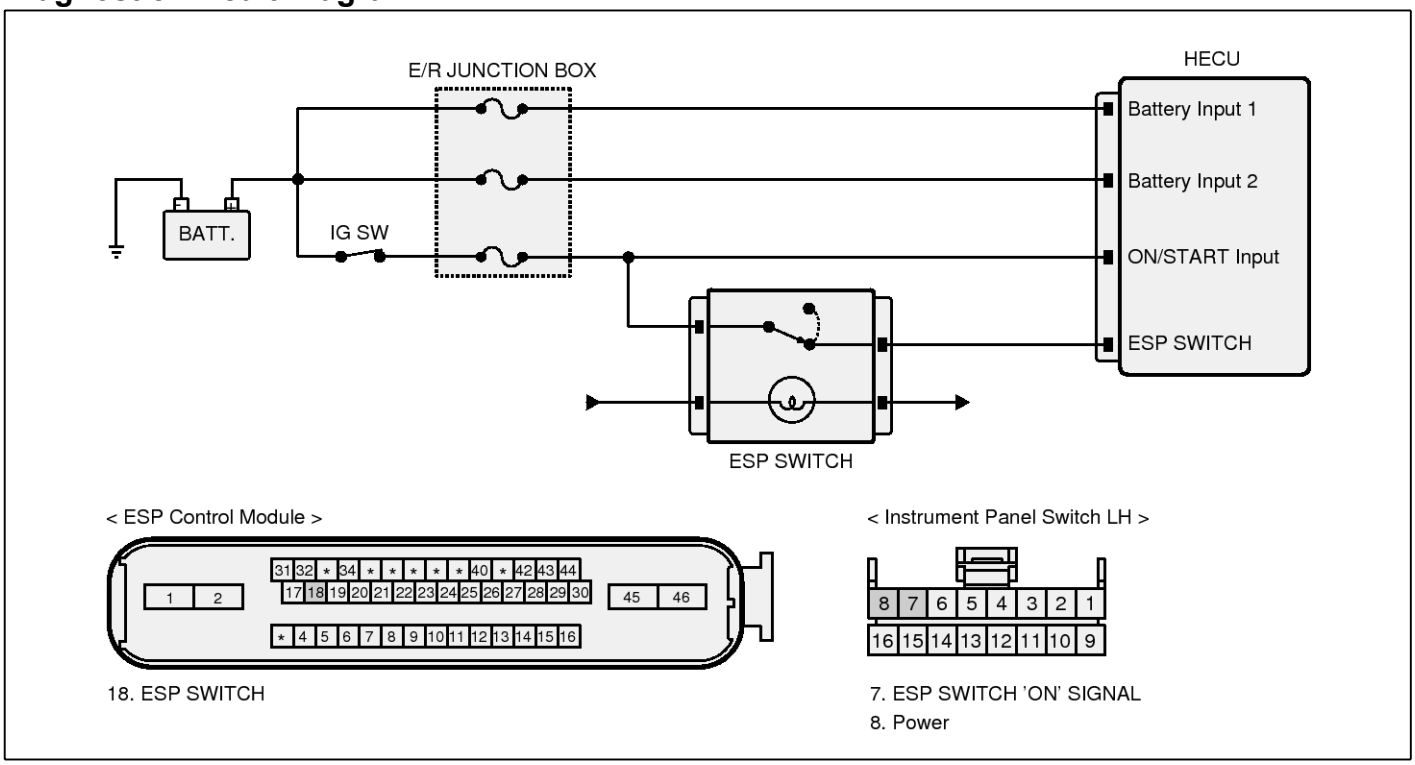
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Circuit Monitoring	• Open or short ESP switch circuit • Faulty ESP switch
Enable Conditions	• When the ESP switch is ON for 1 minute.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Specification

Engine ON	ESP switch HIGH	ESP switch LOW
	7.0V ~ 16.0V	0V ~ 3.0V

Diagnostic Circuit Diagram



SHMBR9511L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Press the ESP SWITCH.
3. Measure voltage between ESP switch signal terminal of the HECU harness connector and chassis ground.

Specification : Approx B+

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" Procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Component Inspection

■ ESP switch Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect the ESP switch connector.
3. Measure resistance between power terminal and siganl terminal of the ESP switch connector.

Specification : Approx. below 1Ω (In case of pressing the ESP switch)
Approx. ∞ Ω (In case of not pressing the ESP switch)

4. Is the measured value within specifications?

YES ▶ Fault is intermittent caused by poor connection in ESP switch harness and/or HECU's connector.
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good ESP switch and check for proper operation.
If problem is corrected, replace ESP switch and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1513 Brake switch error

General Description

This switch is mounted on the pedal assembly and is used to send the status of the brake pedal to the HECU.

The switch is turned on when the brake pedal is pressed. The brake light switch is a normally-open contact type which runs to battery voltage when it is active (this means that the brake pedal is pressed). When it is passive (this means that the brake pedal is released), the line is grounded via the brake light bulb.

DTC Description

The brake light signal is a reference to judge driver's intention for braking.

The HECU checks open or short circuit of brake light switch for normal ESP control.

If an error is present, the warning lamp will illuminate.

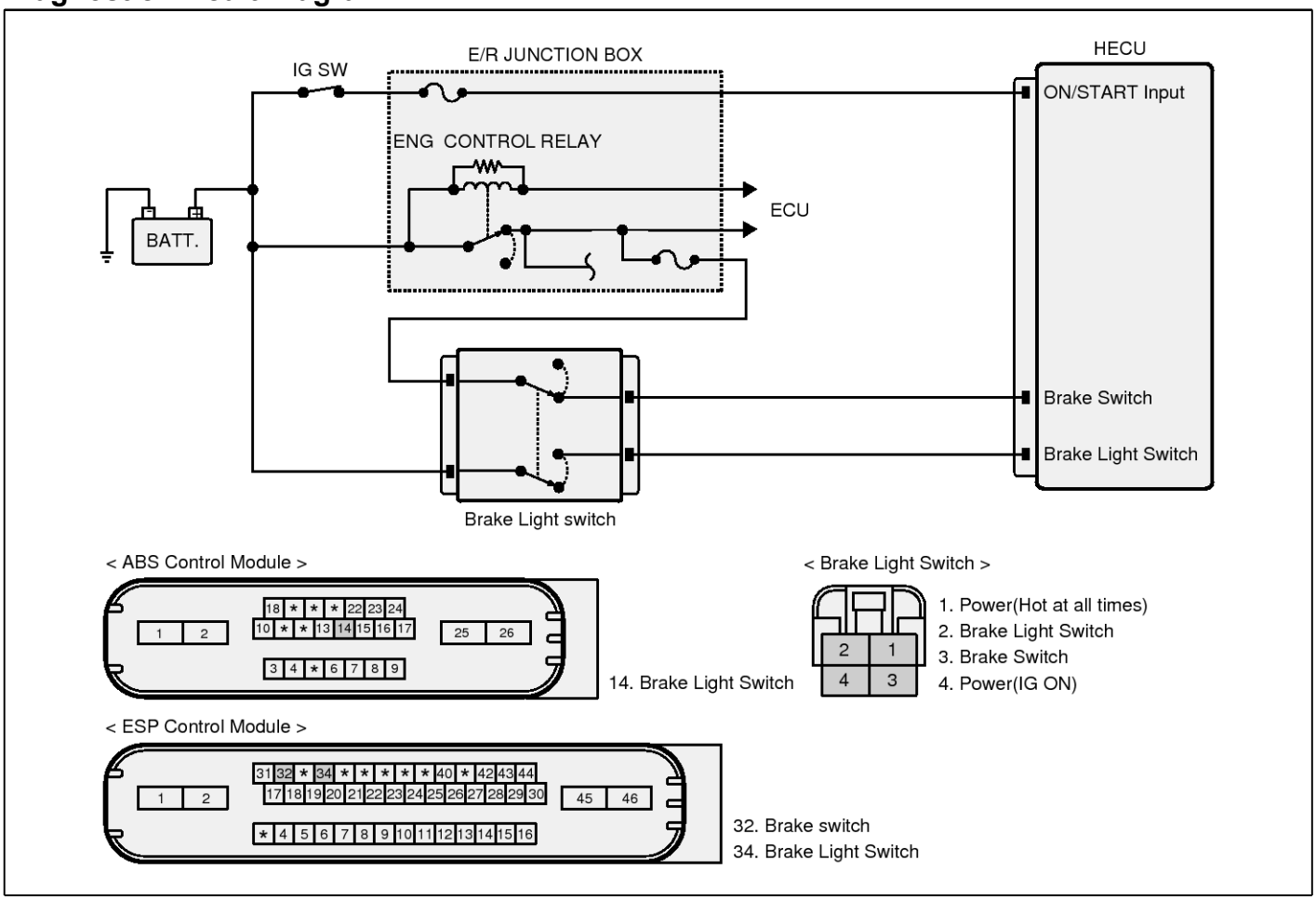
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Open circuit monitoring	• Open circuit in brake switch line • Faulty brake light switch • Faulty input stage in HECU
Enable Conditions	• If both BLS(brake lamp switch) and BS(brake switch) have a same state and MCP (Master Cylinder Pressure) > 20bar for 500ms. • Outside an ABS/ESP control, and after normal operation of MCP, If the pressure sensor signal is higher than 20bar and BLS is low for 3sec. • If the BLS/BS changed more than 40times and MCP > 20bar for 5sec. • While Vehicle speed > 10km/h, TPS > 5%, MCP < 7bar , if BLS is high over 1min.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Specification

Brake Light Switch	Voltage Range of "High"	Voltage Range of "Low"
	7.0V ~ 16.0V	0V ~ 3V

Diagnostic Circuit Diagram



SHMBR9512L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC)
2. Ignition "ON" & Engine "OFF".
3. Press the brake pedal.
4. Check the service data related to "Brake Switch" on the scantool.

Specification :
The brake switch's signal changes from OFF to ON.

5. Does the service data change normally?

YES ▶ Fault is intermittent caused by poor connection in brake light switch harness and/or HECU's connector or was repaired and HECU memory was not cleared.
Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Terminal and Connector Inspection" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal Circuit Inspection (brake pedal isn't pressed)" procedure.

Signal circuit inspection

Signal circuit inspection (brake pedal isn't pressed)

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between brake light switch (brake switch) terminal of the HECU harness connector and hassis ground.

Specification : Brake light switch - 0V
Brake switch - B+

3. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection (brake pedal is pressed)" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection (brake pedal is pressed)

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Press the brake pedal.
3. Measure voltage between brake light switch (brake switch) terminal of the HECU harness connector and chassis ground.

Specification : Brake light switch - B+
Brake switch - 0 V

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Brake light switch Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect the brake light switch connector.
3. Measure resistance between power terminal and siganl terminal of the brake light switch connector.

Specification :
Resistance between terminals of the brake light switch - ∞Ω (when the plunger is pushed down), 0Ω (when the plunger isn't pushed down).
Resistance between the terminals of the brake switch - ∞Ω (when the plunger is not pushed down), 0Ω (when the plunger is pushed down).

4. Is the measured value within specifications?

YES ▶ Fault is intermittent caused by poor connection in brake light switch harness and/or HECU's connector.
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good brake light switch and check for proper operation.
If problem is corrected, replace brake light switch and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1526 DBC Switch Error

General Description

The DBC function is the shorten word of Downhill Brake Control function. When a vehicle goes down the hill, just pushing the DBC switch enables the car to keep its vehicle's speed at a constant value without operating the brake pedal. The DBC function is operated when the vehicle is on the decline and its velocity is under the predetermined speed.

DTC Description

This DTC is set if the DBC switch has a short circuit and the DBC function is inhibited.

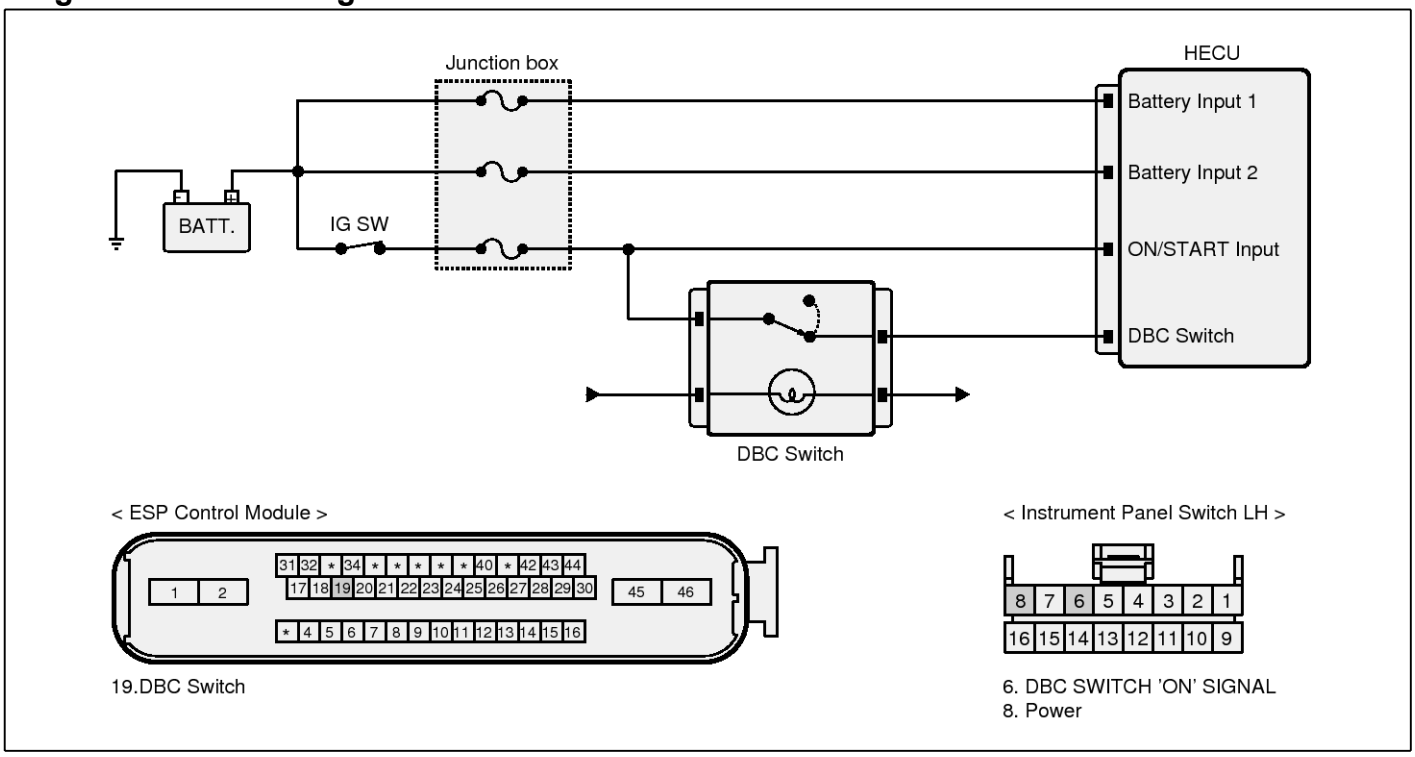
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitoring DBC switch circuit	• Short in the DBC switch circuit • Faulty DBC switch
Enable Conditions	• When the HECU detects a continuous signal of DBC switch pressed more than 1 minute	
Fail Safe	• Inhibit the DBC function and allow the ABS/EBD/ESP control. • The DBC warning lamp is activated.	

Specification

Engine ON	DBC Switch "HIGH"	DBC Switch "LOW"
	7.0V ~ 16.0V	0V ~ 3.0V

Diagnostic Circuit Diagram



SHMBR9513L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Press the DBC SWITCH.
3. Measure voltage between DBC switch signal terminal of the HECU harness connector and chassis ground.

Specification : Approx B+

4. Is the measured value within specifications?

YES ▶ Go to "Component Inspection" Procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Component Inspection

■ DBC switch Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect the DBC switch connector.
3. Press the DBC switch.
4. Measure resistance between power terminal and siganl terminal of the DBC switch connector.

Specification : Approx. below 1Ω

5. Is the measured value within specifications?

YES ▶ Fault is intermittent caused by poor connection in DBC switch harness and/or HECU's connector.
Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known-good DBC switch and check for proper operation.
If problem is corrected, replace DBC switch and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1604 ECU Hardware Error

General Description

The HECU consists of an ECU (Electronic Control Unit) and a HCU(Hydraulic Control Unit).

The HCU portion of the assembly contains a pump motor, solenoid valves, and accumulator.

Increase and decrease of hydraulic pressure is opreated by electronic motor, according to a measured signal by wheel speed sensor.

The function of HCU is to increase, decrease or maintain the hydralic pressure supplied to a wheel cylinder by operating return pump according to HECU control signal while ABS control is active.

The ECU monitors various sensor and switch inputs.

These inputs are used to make decisions regarding HCU component operation.

DTC Description

The HECU monitors the operation of the IC components such as memory, register, A/D converter and so on.

The ECU sets this code when the EEPROM data read by the master processor is different than prior data written, or when the master/slave processor detects abnormal operation in RAM, Status Register, Interrupt, Timer, A/D converter or cycle time.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Internal Monitoring	• Faulty HECU
Enable Conditions	• When the MCU can't erase or write a data of the EEPROM. • When the master/slave processor detects abnormal operation in RAM, status register, interrupt, timer, A/D converter and cycle time.	
Fail Safe	• The ABS/EBD/ESP functions are inhibited. • The ABS/EBD/ESP warning lamps are activated.	

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by faulty HECU or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1605 CAN Hardware error

General Description

The HECU sends requirement data, such as torque reduction, the number of fuel cut cylinders, and the ESP control request, to the PCM(ECM & TCM) through CAN bus line. The PCM(ECM) performs the fuel cut function according to a request signal from the HECU and then retards an ignition timing. The PCM(TCM) maintains current gear position during the ESP control period in order not to increase power which causes a Kickdown shift.

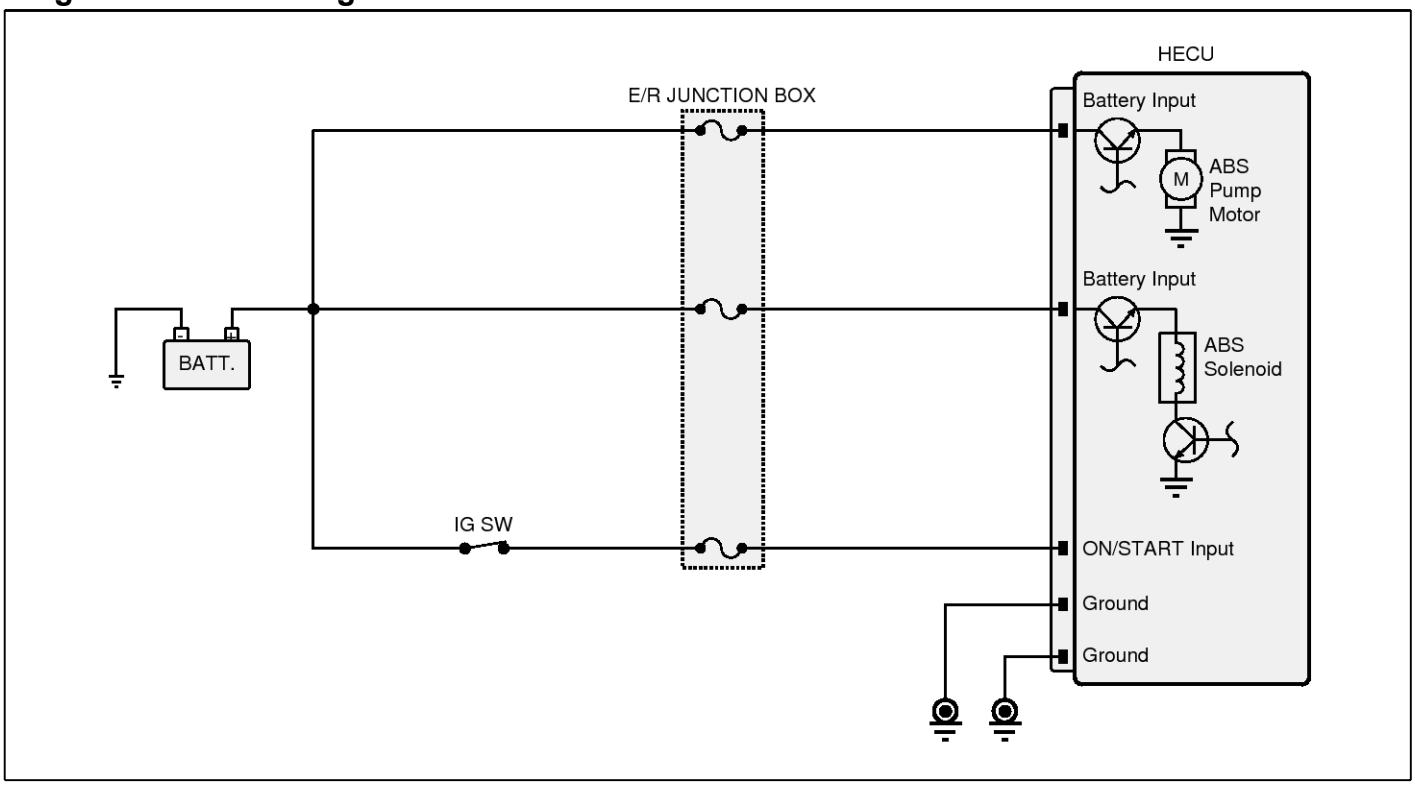
DTC Description

The HECU checks the CAN RAM for normal TCS control, and sets this code if a CAN RAM malfunction is detected.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN RAM monitoring	• Faulty HECU
Enable Conditions	• CAN Hardware failure.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9520L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by a poor connection of HECU or was repaired and HECU memory was not cleared. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1611 CAN Time-out ECM

General Description

The HECU sends requirement data, such as torque reduction, the number of fuel cut cylinders, and the ESP control request, to the PCM(ECM & TCM) through CAN bus line. The PCM(ECM) performs the fuel cut function according to a request signal from the HECU and then retards an ignition timing.

The PCM(TCM) maintains current gear position during the ESP control period in order not to increase power which causes a Kickdown shift.

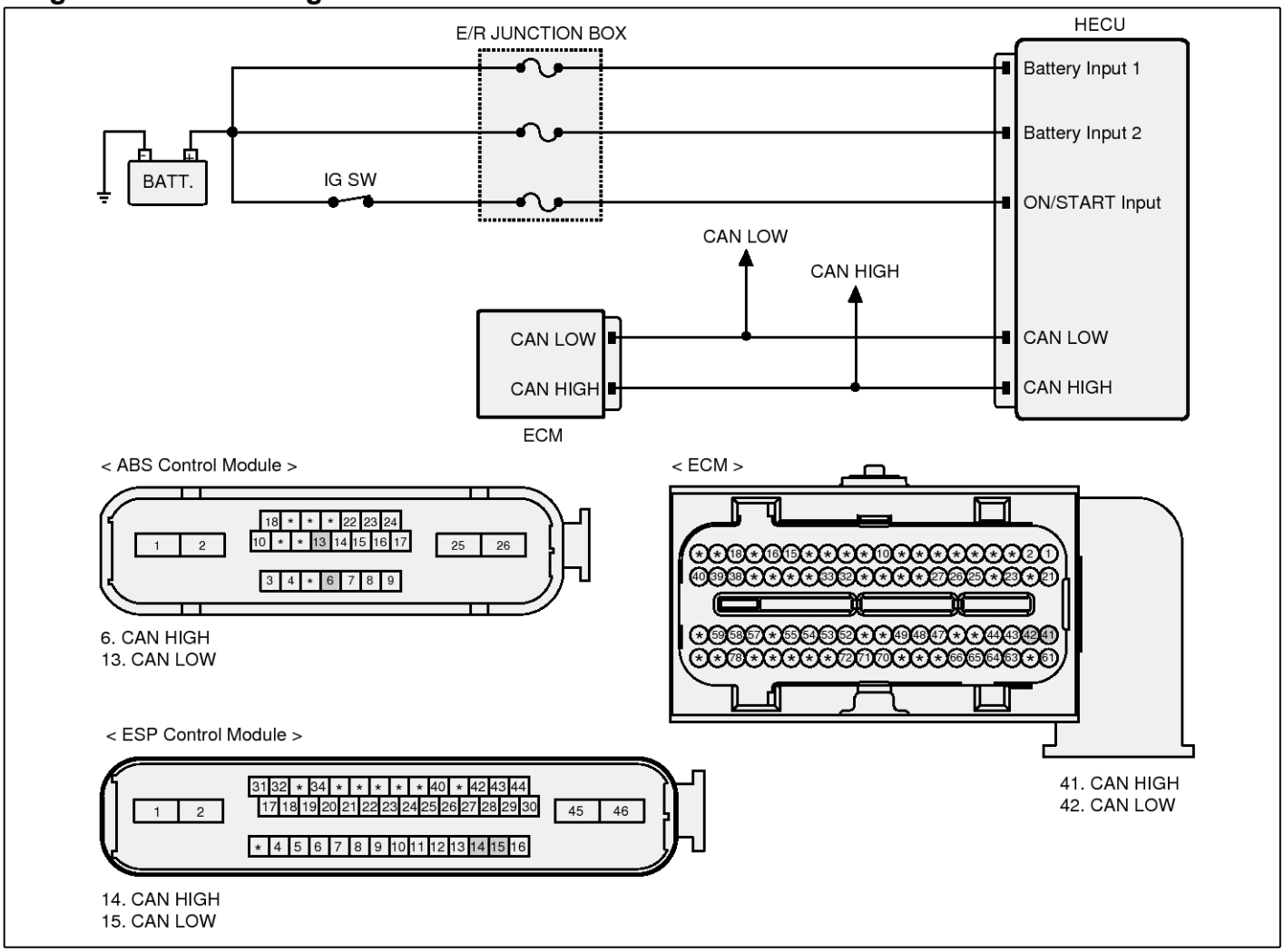
DTC Description

The HECU checks the CAN communcation lines for normal ESP control, and sets this code if an ECM message is not received within 500ms.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN message monitoring	• Faulty ECM • Open or short in CAN communication line • Poor connection
Enable Conditions	• In case that EMS1 or EMS2 message was not received for more than 500ms within normal voltage condition.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9514L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure.

Signal circuit inspection

■ Open Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU and ECM connector.
3. Measure resistance between CAN HIGH, LOW terminal of the HECU harness connector and CAN HIGH, LOW terminal terminal of the ECM harness connector.

Specification : Approx. below 1Ω

4. Is the measured resistance within specifications?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Repair open in CAN BUS line between HECU harness connector and ECM harness connector and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good PCM(ECM) and check for proper operation.
If problem is corrected, replace PCM(ECM) and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by a poor connection of HECU/ PCM(ECM) or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1612 CAN Time-out TCM

General Description

The HECU sends requirement data, such as torque reduction, the number of fuel cut cylinders, and the ESP control request, to the PCM(ECM & TCM) through CAN bus line. The PCM(ECM) performs the fuel cut function according to a request signal from the HECU and then retards an ignition timing.

The PCM(TCM) maintains current gear position during the ESP control period in order not to increase power which causes a Kickdown shift.

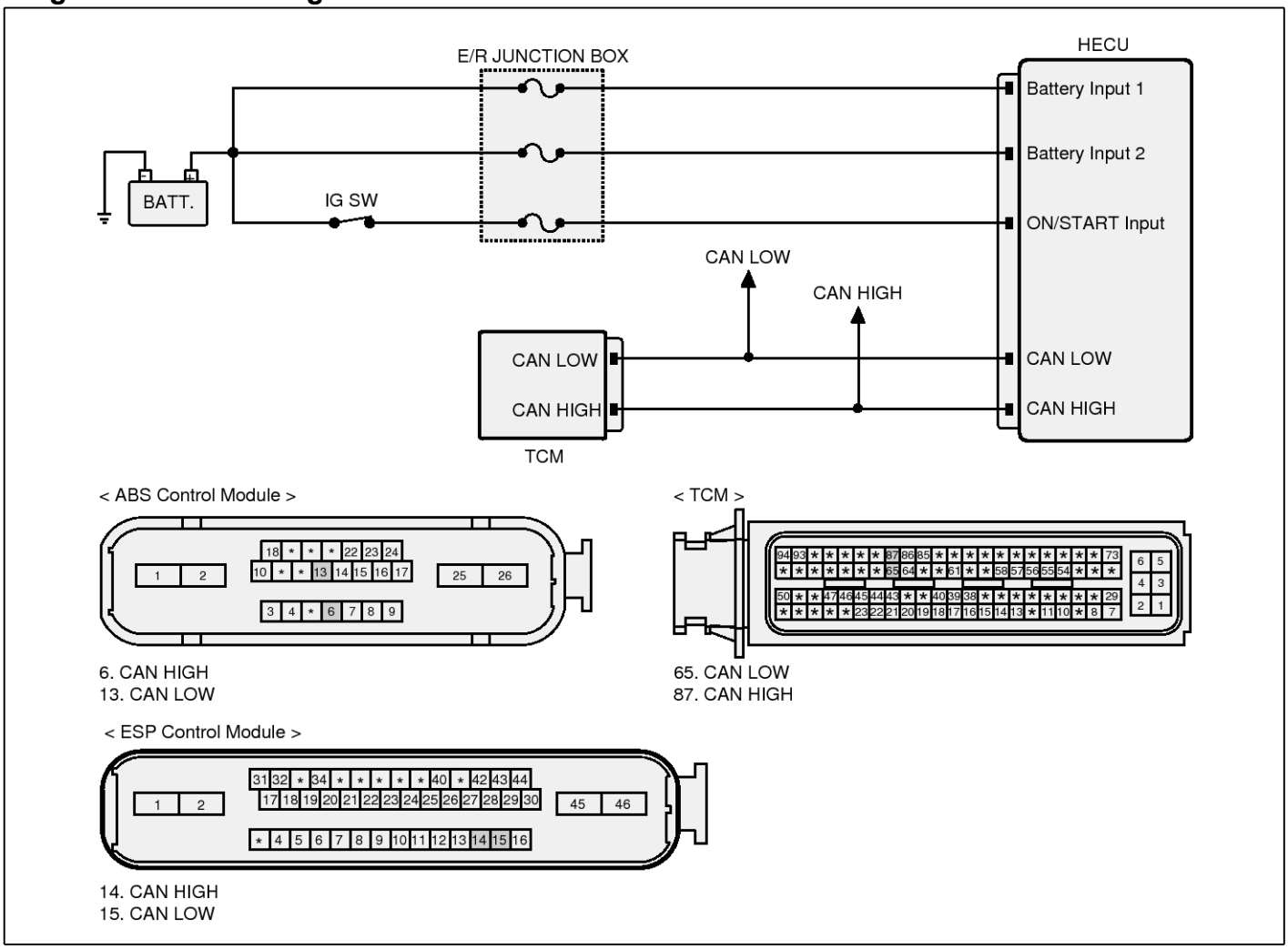
DTC Description

The HECU checks the CAN communcation lines for the normal ESP control, and sets this code if an TCM message is not received within 500ms.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN message monitoring	• Faulty TCM • Open or short in CAN communication line • Poor connection
Enable Conditions	• In case that TCM message was not received for more than 500ms within normal voltage condition.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9515L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure.

Signal circuit inspection

■ Open Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU and ECM connector.
3. Measure resistance between CAN HIGH, LOW terminal of the HECU harness connector and CAN HIGH, LOW terminal terminal of the TCM harness connector.

Specification : Approx. below 1Ω

4. Is the measured resistance within specifications?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Repair open in CAN BUS line between HECU harness connector and TCM harness connector and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good PCM(TCM) and check for proper operation.
If problem is corrected, replace PCM(TCM) and then go to "Verification of Vehicle Repair" procedure.
If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by a poor connection of HECU/ PCM(TCM) or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1613 CAN Wrong Message

General Description

The HECU sends requirement data, such as torque reduction, the number of fuel cut cylinders, and the ESP control request, to the PCM(ECM & TCM) through CAN bus line. The PCM(ECM) performs the fuel cut function according to a request signal from the HECU and then retards an ignition timing.

The PCM(TCM) maintains current gear position during the ESP control period in order not to increase power which causes a Kickdown shift.

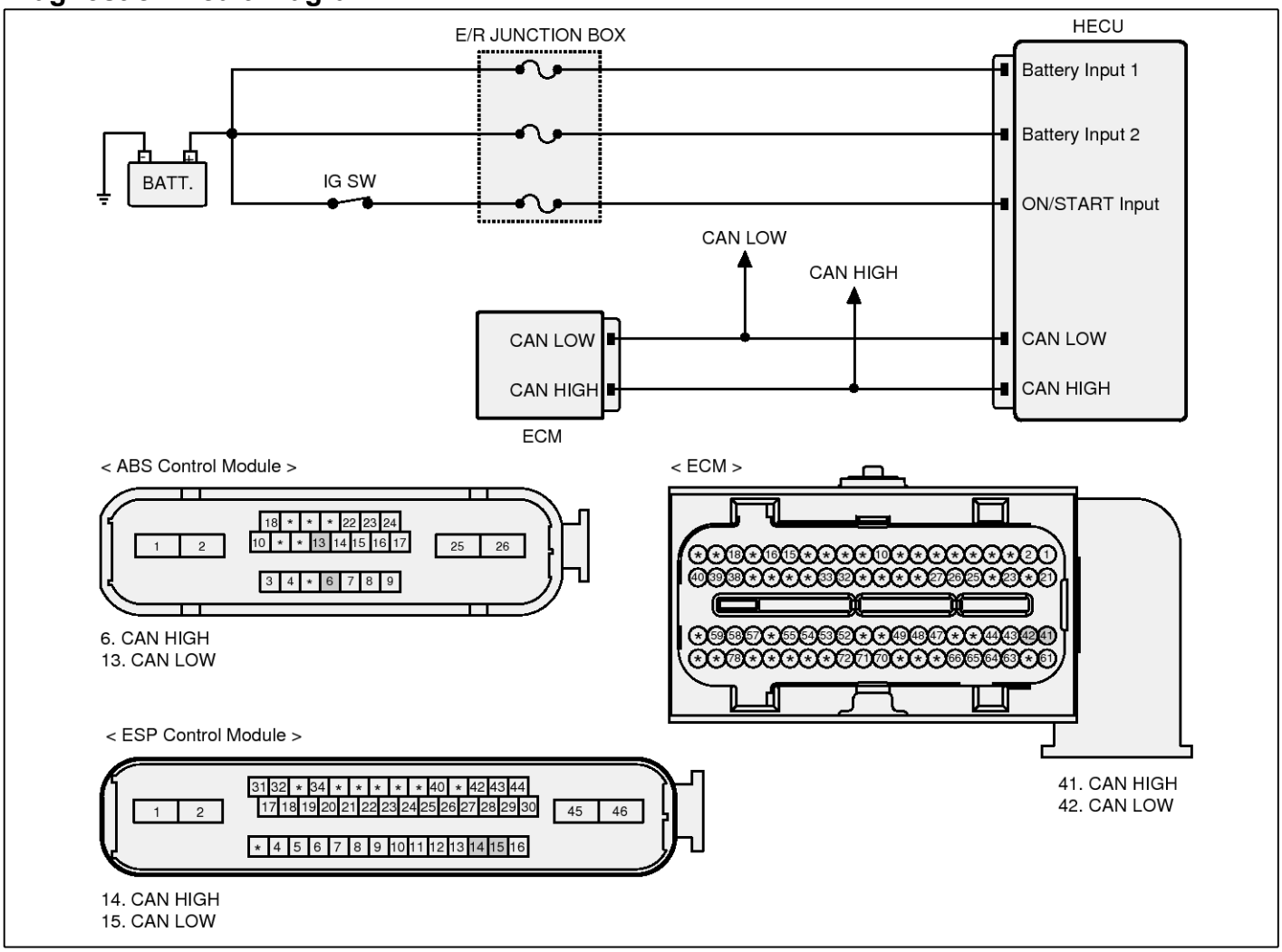
DTC Description

The HECU checks the CAN communcation lines for the normal ESP control, and sets this code if the data received from EMS2 is not the same with that from TCM.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN message monitoring	• Faulty PCM(ECM) • Faulty HECU
Enable Conditions	• In case that the information about transmission is different in the EMS2 message and TCM message within normal voltage condition.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9514L

Component Inspection

1. Ignition "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good PCM(ECM) and check for proper operation.
If problem is corrected, replace PCM(ECM) and then go to "Verification of Vehicle Repair" procedure.
If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by a poor connection of HECU/ PCM(ECM) or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC C1101 : Battery Voltage High

C1616 CAN Bus off

General Description

The HECU sends requirement data, such as torque reduction, the number of fuel cut cylinders, and the ESP control request, to the PCM(ECM & TCM) through CAN bus line. The PCM(ECM) performs the fuel cut function according to a request signal from the HECU and then retards an ignition timing. The PCM(TCM) maintains current gear position during the ESP control period in order not to increase power which causes a Kickdown shift.

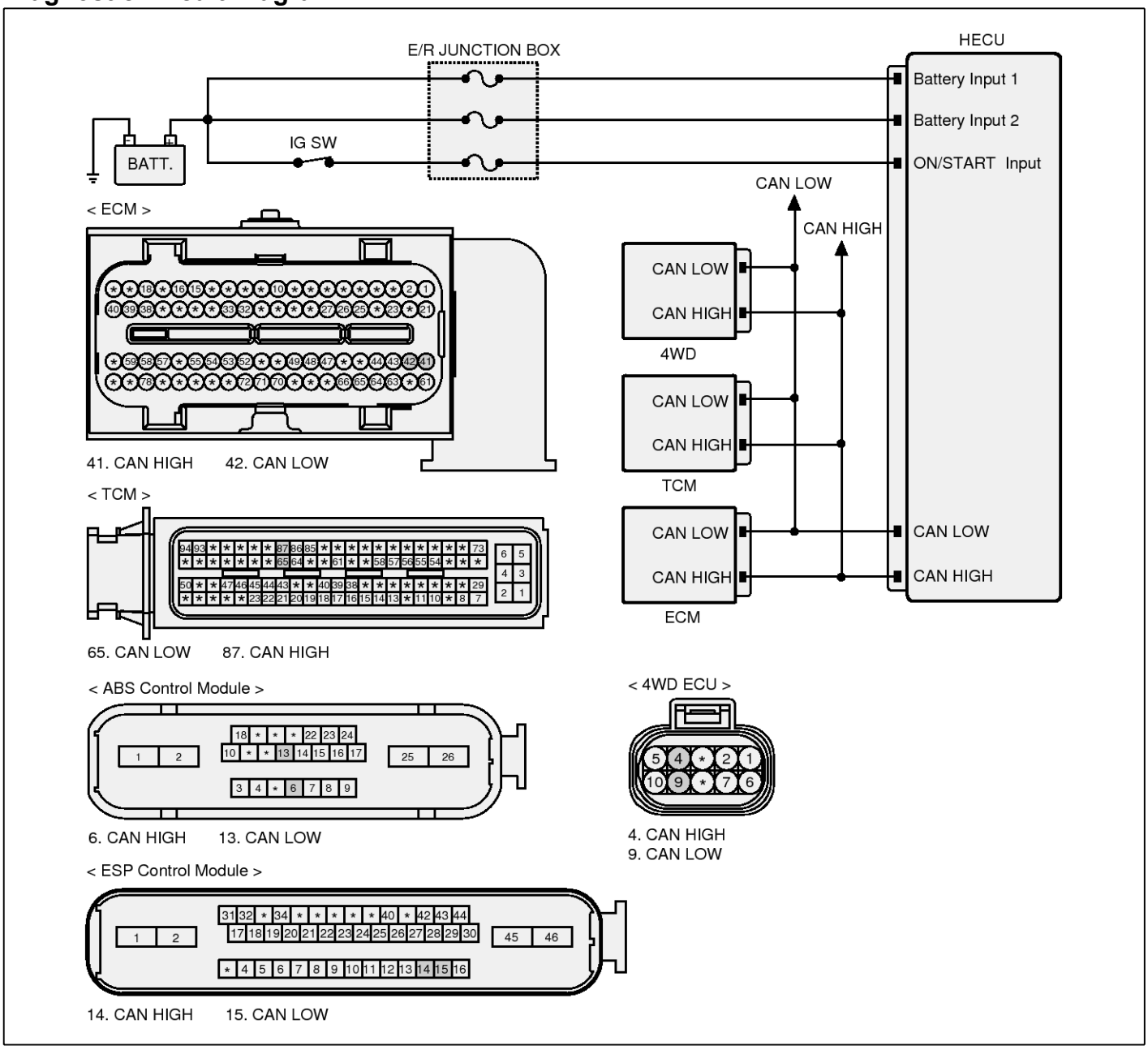
DTC Description

The HECU checks the CAN communication lines for normal TCS control, and sets this code if CAN BUS OFF status is detected for more than 100ms.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Open or short circuit monitoring	• Open or short circuit in CAN line • Faulty HECU
Enable Conditions	• In case CAN BUS off state continued for more than 100 ms.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9516L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "CAN Signal Circuit Inspection" procedure.

CAN Signal Circuit Inspection

■ Check CAN communication line for open

1. Ignition "OFF" & Engine "OFF".
2. Disconnect ECM/TCM/4WD connector and HECU connector.
3. Measure resistance between CAN-High terminal of ECM/TCM/4WD harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of ECM/TCM/4WD harness connector and CAN-Low terminal of HECU harness connector.

Specification : Approx. below 1Ω

5. Is the measured resistance within specifications?

YES ▶ Go to "Check CAN communication line for short" procedure.

NO ▶ Repair open in the CAN communication line between ECM/TCM/4WD ECU and HECU, Go to "Verification of Vehicle Repair" procedure.

■ Check CAN communication line for short

1. Ignition "OFF" & Engine "OFF".
2. Disconnect ECM/TCM/4WD connector and HECU connector.
3. Measure resistance between CAN-High terminal of ECM/TCM/4WD harness connector and chassis ground.
4. Measure resistance between CAN-Low terminal of ECM/TCM/4WD harness connector and chassis ground.
5. Measure resistance between CAN-High terminal and CAN-Low of ECM/TCM/4WD harness connector.

Specification : Infinite (∞ Ω)

6. Is the measured resistance within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short in the CAN communication line between ECM/TCM/4WD ECU and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by poor connection in CAN signal harness and/or HECU's connector.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1623 CAN Time-out Steering Angle Sensor

General Description

The Steering wheel angle sensor uses two sensors (A-sensor and B-sensor) to determine the direction of the rotation. The main components of each sensor are LED, photo transistor and slit plate. The slit plate, which has 45 holes, is installed between LED and photo transistor, and generates signals if slit plate rotates according to the steering wheel rotation. The sensor signals are generated by photo transistor which is driven whenever the light passes through the holes. The HECU detects operating speed and direction of the steering wheel by this input signal, and the signal is used to input signal for anti-roll control.

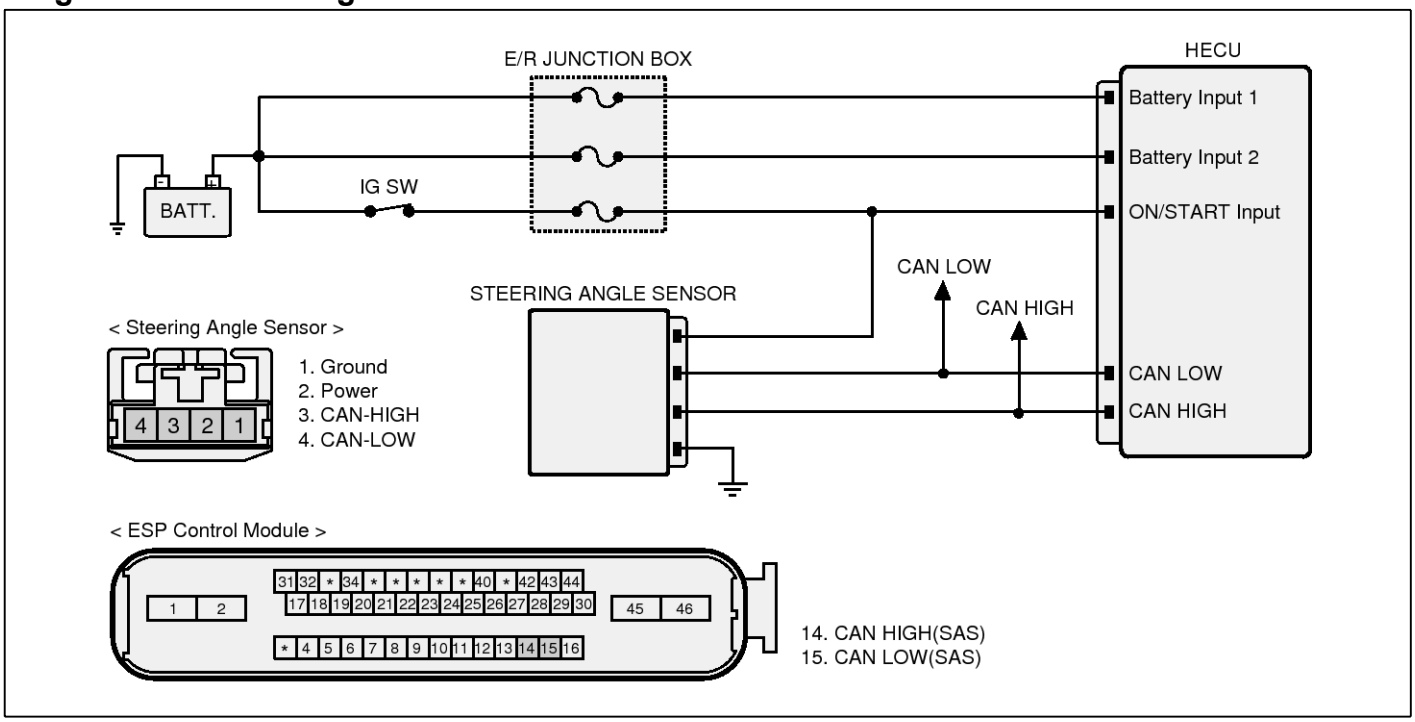
DTC Description

The HECU checks the CAN communcation lines for normal control and if a steering anlge sensor's message is not received for a certain period, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN message monitoring	• Faulty Steering Angle Sensor (SAS) • Open or short in CAN communication line
Enable Conditions	• When the steering anlge sensor's messages are not received for more than 0.5 second with a normal voltage condition	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9509L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "OFF"
2. Disconnect Steering Angle Sensor connector.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between power terminal of the steering angle sensor harness connector and chassis ground.

Specification : Approx. 12V

5. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open or short in power circuit between steering angle sensor and HECU, and then go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect steering angle sensor connector.
3. Measure resistance between ground terminal of the steering angle sensor harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short in ground circuit between steering angle sensor and HECU and then, go to "Verification of vehicle Repair" procedure.

Signal Circuit Inspection

■ Open or Short Check

1. IG "OFF"
2. Disconnect Steering Angle Sensor connector and HECU connector.
3. Measure resistance between CAN-High terminal of Steering Angle Sensor harness connector and CAN-High terminal of HECU harness connector.
4. Measure resistance between CAN-Low terminal of Steering Angle Sensor harness connector and CAN-Low terminal of HECU harness connector.

Specification : Below approx. 1Ω

5. Is the measured value within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in the signal circuit between Steering Angle Sensor and HECU, Go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Using a scantool, Check DTC present.
6. Are any DTCs present ?

YES ▶ This DTC may be caused by an incorrect calibration of the steering angle sensor. Perform the calibration of the sensor by scantool again.
This DTC may be caused by an improper installation of the steering angle sensor. Check it for the installation.
If there is no problem about the above items, Substitute with a known-good Steering Angle Sensor and check for proper operation. If problem is corrected, replace Steering Angle Sensor and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing the Steering Angle Sensor, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ This fault is intermittently caused by poor connection of the Steering Angle Sensor.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1627 CAN time-out 4WD

General Description

The HECU sends requirement data, such as torque reduction, the number of fuel cut cylinders, and the ESP control request, to the PCM(ECM & TCM) through CAN bus line. The PCM(ECM) performs the fuel cut function according to a request signal from the HECU and then retards an ignition timing.

The PCM(TCM) maintains current gear position during the ESP control period in order not to increase power which causes a Kickdown shift.

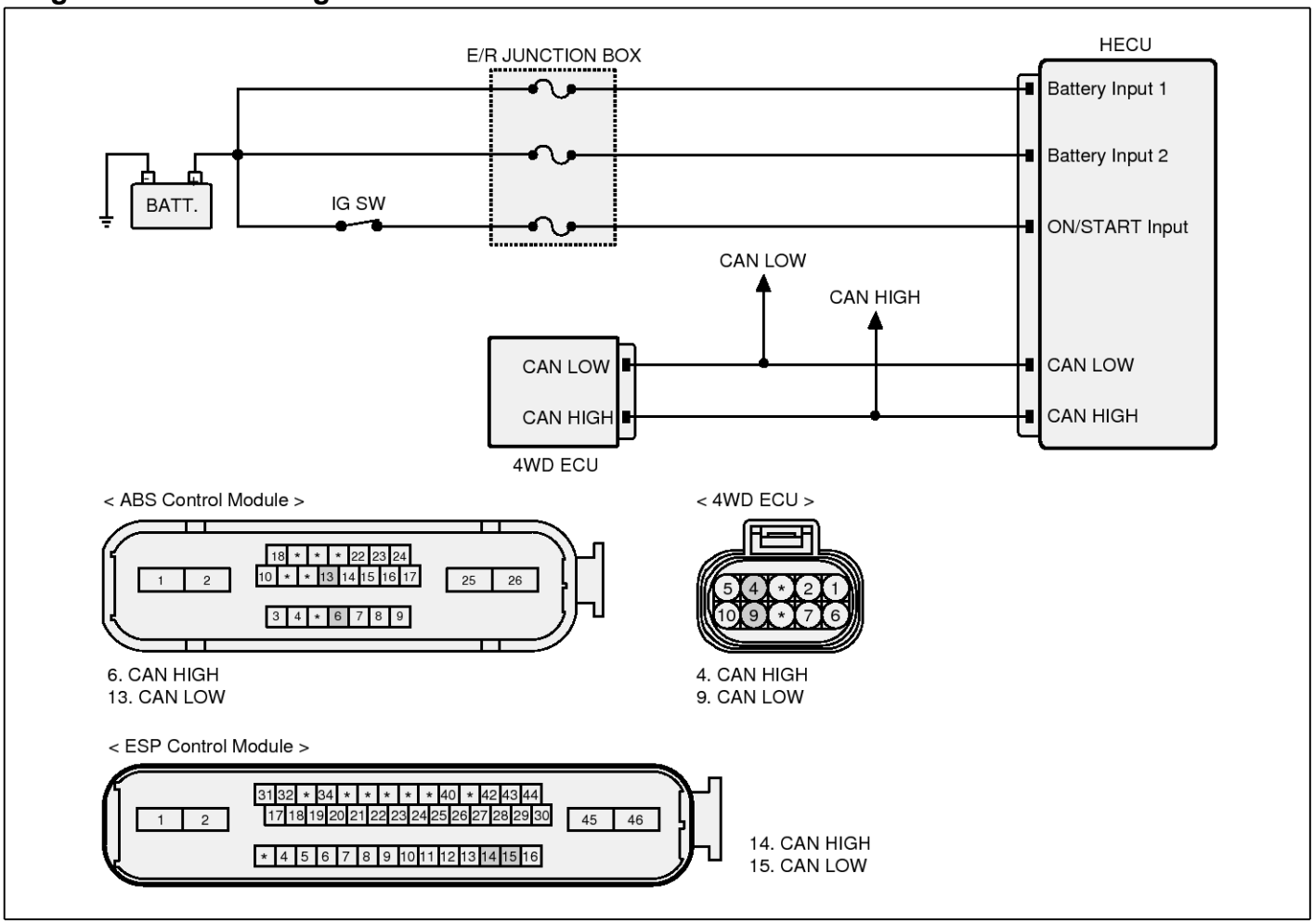
DTC Description

The HECU checks the CAN communcation lines and sets this code if an 4WD ECU message is not received within 500ms.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• CAN message monitoring	• Faulty 4WD ECU • Open or short in CAN communication line • Poor connection
Enable Conditions	• In case that 4WD ECU message was not received for more than 500ms within normal voltage condition.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9517L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Signal circuit inspection" procedure.

Signal Circuit Inspection

■ Open Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect HECU and 4WD ECU connector.
3. Measure resistance between CAN HIGH, LOW terminal of the HECU harness connector and CAN HIGH, LOW terminal terminal of the 4WD ECU harness connector.

Specification : Approx. below 1Ω

4. Is the measured resistance within specifications?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in CAN BUS line between HECU harness connector and 4WD ECU harness connector and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

1. Ignition "OFF"
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good 4WD ECU and check for proper operation. If problem is corrected, replace 4WD ECU and then go to "Verification of Vehicle Repair" procedure.
If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by a poor connection of HECU/ 4WD ECU or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1647 CAN Hardware Error - Sensor Channel

General Description

When the vehicle is turning, the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor. If the yaw velocity reaches the specific velocity after it detects the vehicle's yawing, the ESP control is reactivated. The lateral G sensor senses the vehicle's lateral acceleration. A small element inside the sensor is attached to a deflectable leverarm by lateral acceleration. Direction and magnitude of lateral acceleration loaded to vehicle can be known by electrostatic capacity changing according to lateral acceleration. It interchanges signals with HECU through extra CAN line which is only used for communication between HECU and the sensor.

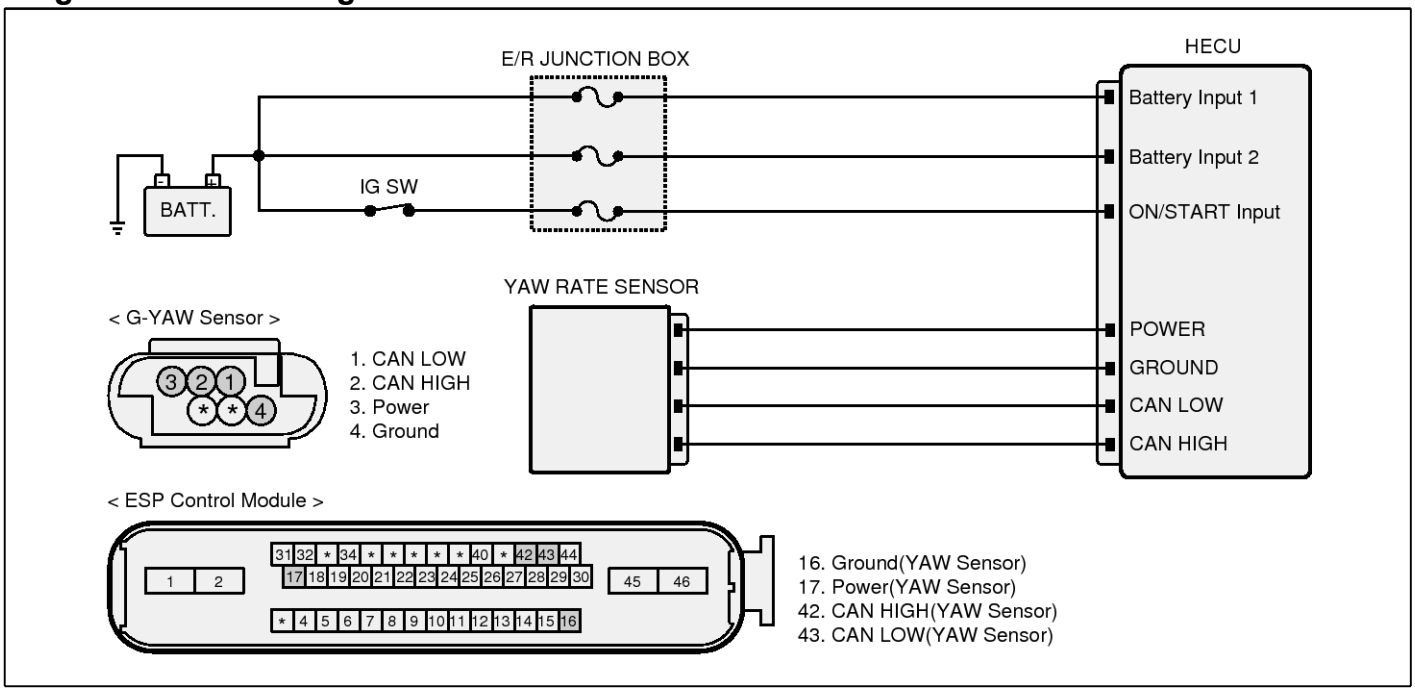
DTC Description

The HECU checks the sensor CAN H/W for normal ESP control, and sets this code if a sensor CAN H/W malfunction is detected.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Internal Monitoring	• Faulty HECU
Enable Conditions	• Sensor CAN H/W failure.	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Diagnostic Circuit Diagram



SHMBR9510L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by a poor connection of HECU or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C1702 Variant Coding Error

General Description

The ESP system is the shorten word of Electronic Stability Control system. This system recognizes a critical driving condition by Yaw-rate sensor, Lateral acceleration sensor and Steering angle sensor. And then it stabilizes the vehicle by a individual wheel braking and engine torque control through CAN communication. There is no difference in the HECU's hardware side according to a vehicle speficiation, but there is a difference in its software side because the applied vehicle parameters differ according to a vehicle specification. The HECU stores the variant code value in the ECU's memory based on the received data by CAN communication.

DTC Description

The HECU checks variant code and if an inappropriate variant code or no variant code is detected, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Internal monitoring	• Variant coding not carried out • Faulty HECU
Enable Conditions	• when a variant code isn't entered in the HECU	
Fail Safe	• ABS/ESP funtions are inhibited. • ABS/ESP warning lamps are activated.	

Variant coding

1. Connect scantool to Data Link Connector(DLC)
2. IG "ON"
3. Using scantool, Perform Variant coding program.(Fig.1)
4. IG "OFF" and wait for about 10 seconds, and then IG "ON"
5. IG "OFF" and wait for about 10 seconds again, and then, IG "ON
6. Go to "Component Inspection" procedure.

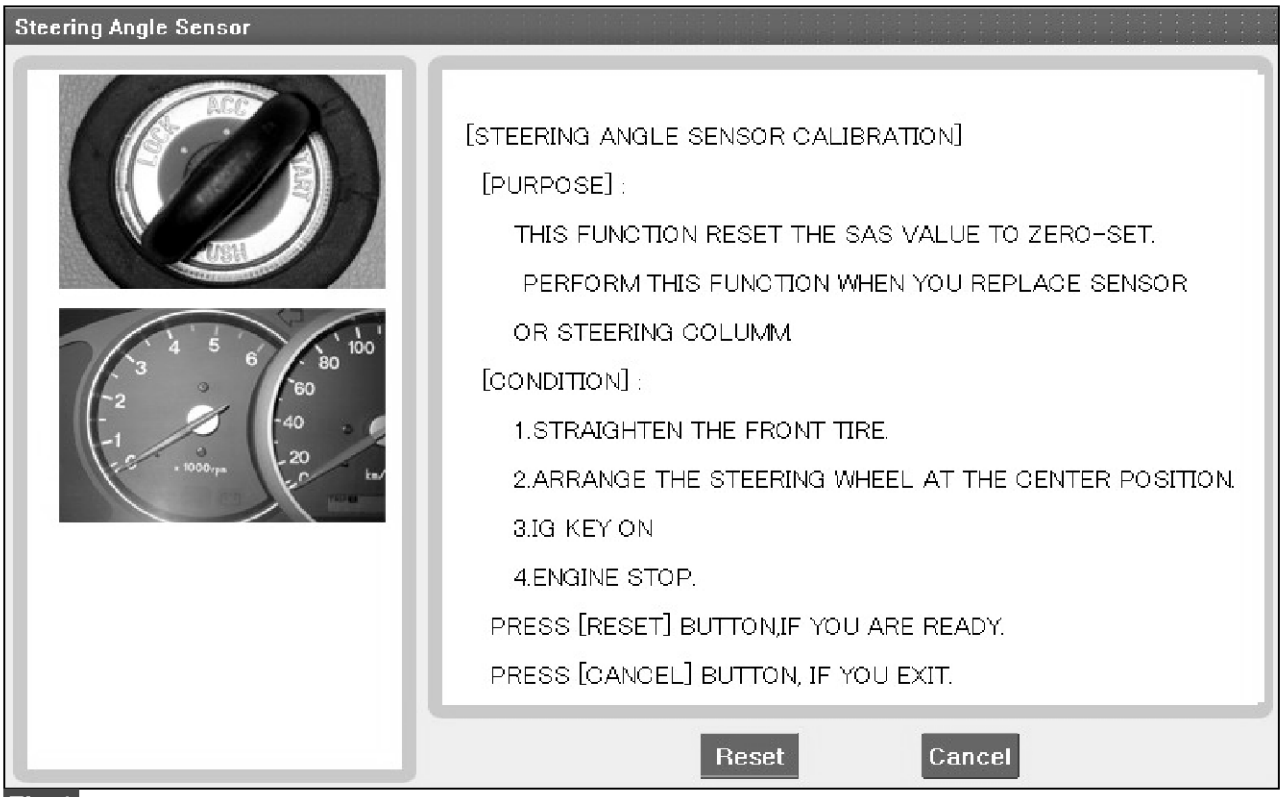


Fig.1

SHMBR9605L

Fig.1) Scantool diagnostic item -VARIANT CODING

Component Inspection

1. IG "OFF"
2. IG "ON" & Engine "OFF"
3. After connecting scantool, Check DTC.
4. Using scantool, Clear DTC.
5. Again using scantool, Check DTC present.
6. Is the same DTC shown, agian?

YES ▶ Substitute with a known-good HECU and check for proper operation. If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure.
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by poor connection in HECU's connector or was repaired and HECU memory was not cleared.
▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C2112 Valve Relay Error

General Description

The HECU supplies battery power to all soleonid valves with a valve relay which is controlled by the Electronic Control UNIT(ECU).

The valve relay and all solenoid valves are installed inside the HECU (Hydraulic and Electronic Control Unit).

DTC Description

ABS ECU monitors voltage of the valve relay to check if ABS ECU can perform ABS control normally.

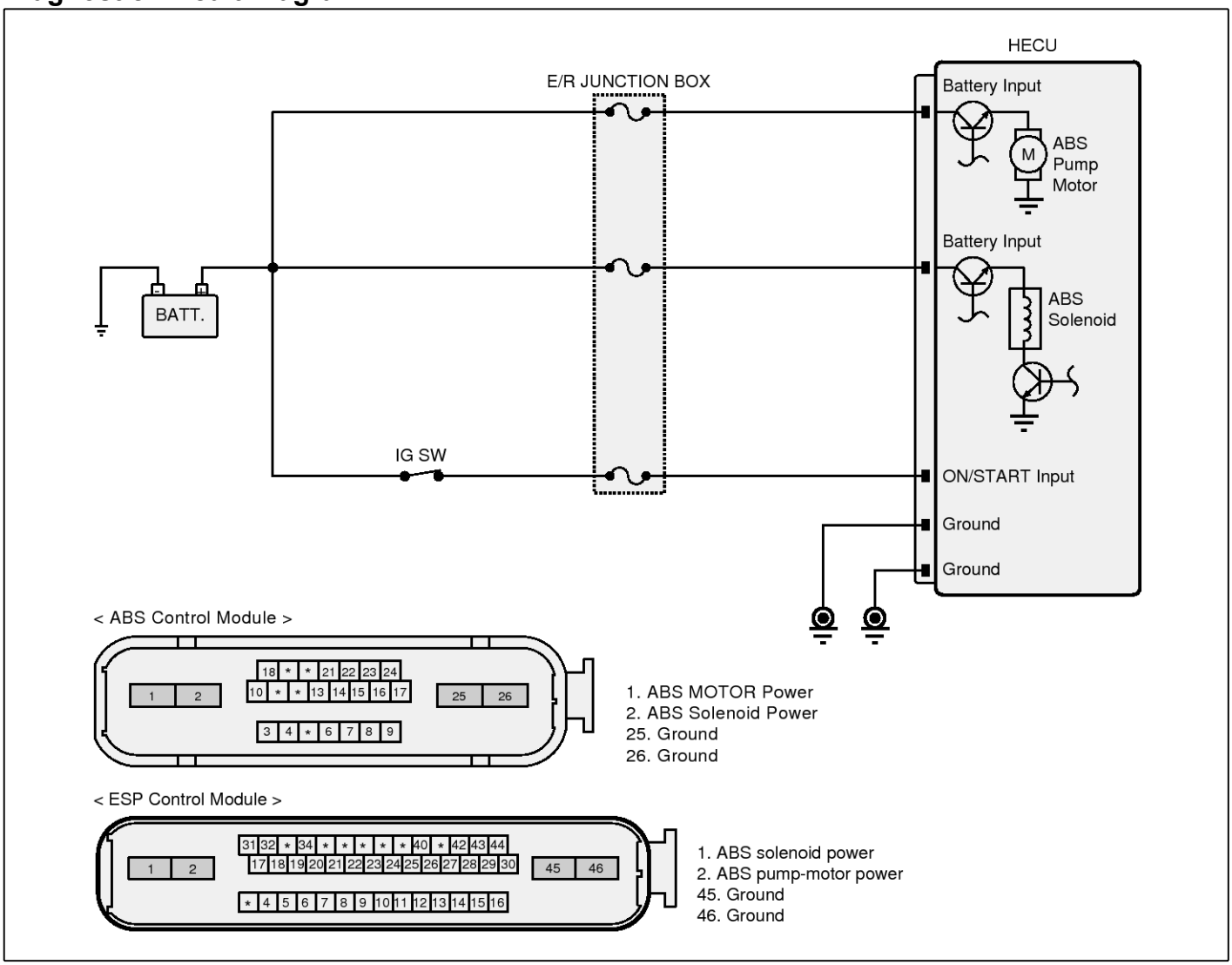
When the valve relay is switched to ON, the HECU will set this code if the solenoid drive voltage is below permissible voltage ranges for a period of time.

When the valve relay is switched to OFF, the HECU sets this code if the solenoid drive voltage is over the permissible voltage range for a period of time.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Voltage Monitoring	• Open or short of power supply circuit • Faulty HECU
Case1 (Open)	Enable Conditions	• If the valve relay is switched on and the reference voltage of valve relay < 5±0.5V continuously for 56ms, the failure is detected.	
Case2 (Short or leakage)	Enable Conditions	• If the valve relay is switched off and voltage of valve relay > 6±0.5V or < 2.5±0.5V continuously for 56ms, the failure is detected.	
Fail Safe		• The ABS/EBD/ESP functions are inhibited. • The ABS/EBD/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SHMBR9507L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between valve relay power terminal of the HECU harness connector and chassis ground.

Specification : B+

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown ABS fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect the HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Repair open or short in ground circuit between HECU harness connector and chassis ground, and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C2130 Brake Lamp Relay Error

General Description

The DBC function is the shorten word of Downhill Brake Control function. When a vehicle goes down the hill, just pushing the DBC switch enables the car to keep its vehicle's speed at a constant value without operating the brake pedal. The DBC function is operated when the vehicle is on the decline and its velocity is under the predetermined speed.

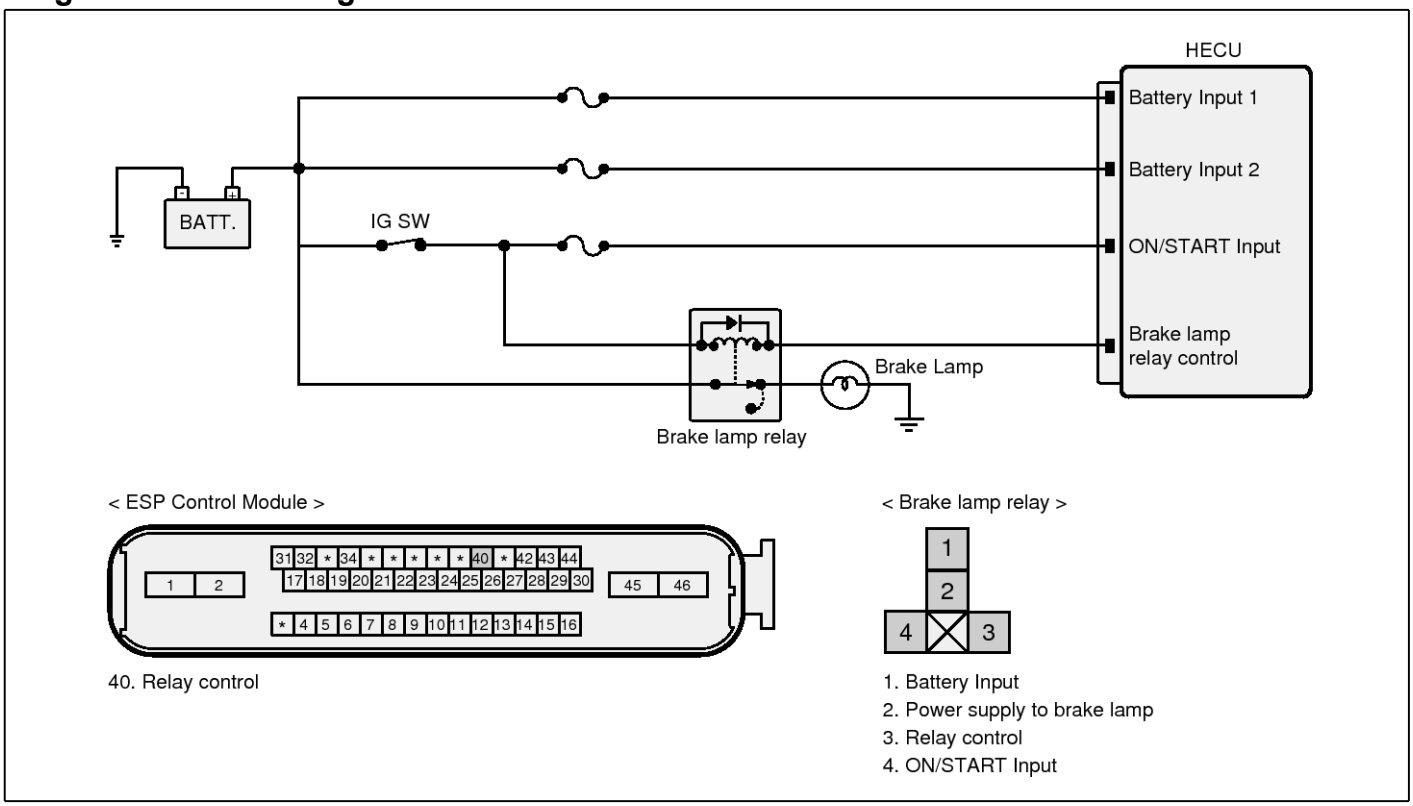
DTC Description

The HECU monitors the brake lamp relay for a normal operation and if there is a open or short circuit in the relay, this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage Monitoring	• Open or short in the brake lamp relay circuit • Faulty brake lamp relay
Enable Conditions	• When the brake lamp is switched off, the brake lamp drive monitor has a low value for more than a certain period • When the brake lamp is switched on, the brake lamp drive monitor has a high value for more than a certain period • When the brake lamp is switched on, the brake lamp signal(BLS) has a low value for more than a certain period	
Fail Safe	• -	

Diagnostic Circuit Diagram



40. Relay control

1. Battery Input
2. Power supply to brake lamp
3. Relay control
4. ON/START Input

SHMBR9519L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "OFF"
2. Disconnect Brake Lamp Relay.
3. Ignition "ON" & Engine "OFF"
4. Measure voltage between power terminal of brake lamp relay harness connector and chassis ground.

Specification : Battery voltage

5. Is the measured value within specifications?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check for open or blown fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and the realy and then, Go to "Verification of vehicle Repair" procedure.

Control Circuit Inspection

■ Open Check

1. Ignition "OFF"
2. Disconnect Brake Lamp Relay and HECU connector.
3. Measure resistance between control terminal of brake lamp relay harness connector and brake lamp control terminal of HECU harness connector.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Go to "Short Check" procedure.

NO ▶ Repair open in control circuit between the brake lamp relay and HECU and then, Go to "Verification of vehicle Repair" procedure.

■ Short Check

1. Ignition "OFF"
2. Disconnect Brake Lamp Relay and HECU connector.
3. Measure resistance between control terminal of brake lamp relay harness connector and chassis ground.

Specification : Infinite (∞ Ω)

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good Brake Lamp Relay and check for proper operation.
If problem is corrected, replace Brake Lamp Relay and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Repair short in control circuit between Brake Lamp Relay and HECU, and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C2227 Excessive Temperature Of Brake Disc

General Description

BTCS (Brake Traction Control System) is operated when the value (Wheel acceleration value + speed difference value) exceeds the specified value when vehicle speed is lower than the 50 Km/h.

The BTCS intalled HECU calculates the DISC temperature logically, which is an assumed value, by using the value of Wheel speed, vehicle speed change, control mode and BLS(Brake Lamp Signal) signal.

Assumed DISC Temperature is used to protect DISC overheating, caused by long-time operation, which may cause a decrease in brake efficiency.

DTC Description

The HECU calculates a disc's temperature for a normal operation and if the calculated disc's temperature is over 500 ℃(932 ˚F), this DTC is set.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Internal monitoring	• Faulty HECU • Overheated brake disc
Enable Conditions	• When the calculated temperature of disc is higher than predefined value(500℃/ 932 ˚F)	
Fail Safe	• Inhibit the ESP control and allow the ABS/EBD control. • The ESP warning lamp is activated.	

Component Inspection

1. Wait until the brake disc sufficiently gets cold.
2. Ignition "OFF" & Engine "OFF".
3. Ignition "ON" & Engine "OFF".
4. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode
5. Using a scantool, Clear DTC.
6. Select "Diagnostic Trouble Codes(DTCs)" mode again.
7. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by poor connection in HECU's connector or was repaired and HECU memory was not cleared.
▶ The DTC code can be set by excessive TCS control in normal system status. Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C2380 ABS/TCS/ESC(ESP) valve error

General Description

The ABS HECU is composed of a ECU (Electronic Control Unit) and an HCU(Hydraulic Control Unit), so the HECU hardware includes all solenoid valves inside the unit as well as the ECU.

Solenoid valves are switched to ON, OFF by HECU when the ABS is activated. Solenoid valves function is to increase, decrease or maintain the hydralic pressure supplied to a wheel cylinder.

DTC Description

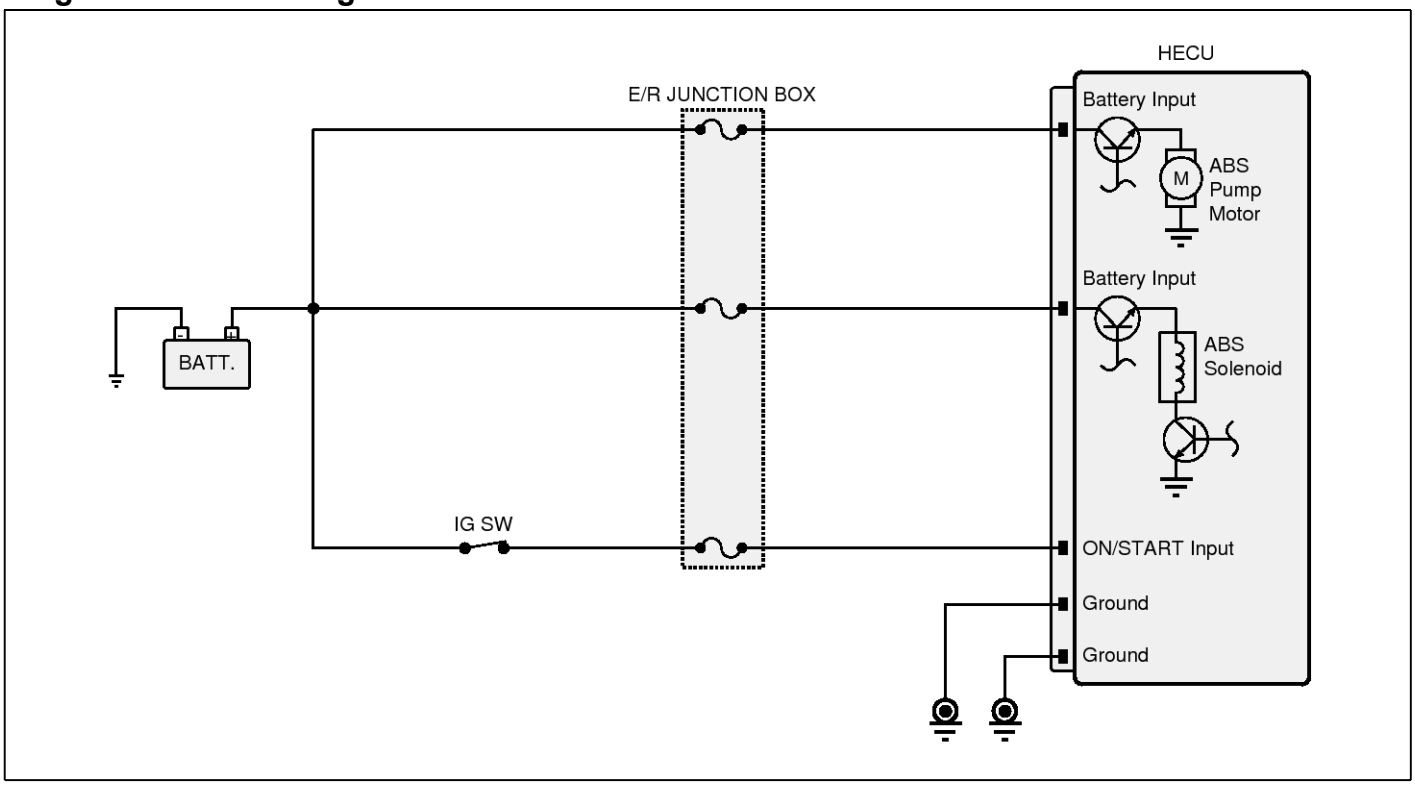
The HECU monitors the operation of the valves by checking the drive circuit of the solenid valves, and then sets this code when the unexpcted drive voltage is detected.

For example, the HECU sets the DTC if an unexpected high drive voltage is detected when the valve relay is switched to OFF. (or unexpected low voltage is detected when the solenoid valve drive TR is switched to ON)

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Internal Monitoring	• Faulty HECU
Enable Conditions	• If the valve relay is switched ON and corresponding solenoid driver OFF and the voltage of solenoid < 3.5±0.5V continuously for 56ms, the failure is detected. • If the valve relay is switched ON and corresponding solenoid driver ON and the voltage of solenoid > 1.5±0.5V continuously for 56ms, the failure is detected.	
Fail Safe	• The ABS/EBD/ESP functions are inhibited. • The ABS/EBD/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SHMBR9520L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" Procedure.

Component Inspection

1. Ignition "OFF" & Engine "OFF".
2. Ignition "ON" & Engine "OFF".
3. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
4. Using a scantool, Clear DTC.
5. Select "Diagnostic Trouble Codes(DTCs)" mode again.
6. Are any DTCs present ?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Fault is intermittent caused by faulty HECU or was repaired and HECU memory was not cleared.
Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

C2402 Motor Failure

General Description

The ABS ECU supplies battery power to the electric motor by way of a motor relay which is controlled by the Electronic Control Unit(ECU).

The electric motor pump supplies hydraulic pressure to all wheel brake calipers by operating the piston inside the pump.

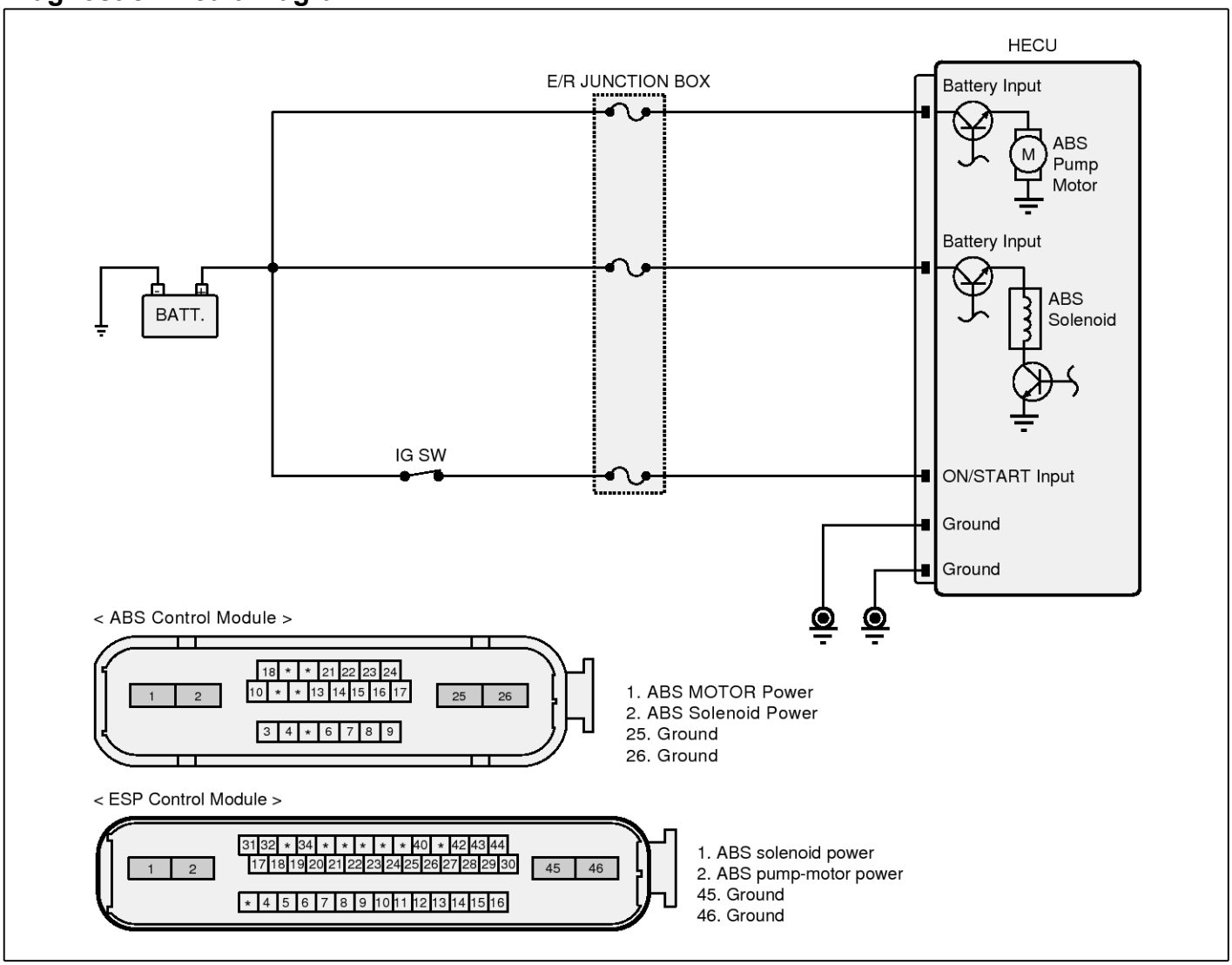
DTC Description

The ABS ECU monitors the pump motor relay or fuse open, open or short in motor or motor lock and then sets this code if a malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Battery Voltage Monitoring	• Open or short of power supply circuit • Blown fuse • Faulty HECU
Case1 (Motor Relay Open orMotor Short to GND)	Enable Conditions	• If the motor relay is switched ON and motor voltage < (IGN voltage – 4V±0.5V) continued for 49msec, the failure is detected.	
Case2 (Motor Lock)	Enable Conditions	• After motor relay is switched OFF, VMR is measured. If the time which VMR > 1±0.1V is less than evaluation time, recheck is performed again for a maximum of three times. When VMR is not normal even on the third recheck, the controller recognizes it as failure.	
Case3 (Motor Open, Motor Short to BATT)	Enable Conditions	• After 1.8sec from the time that motor relay is switched OFF, VMR > 4±0.5V continued for 1.8sec, the failure is detected.	
Case4 (Motor Fuse Open)	Enable Conditions	• If the motor relay is switched OFF and VMRP (Motor power supply voltage) < 4±0.5V continued for 1sec, the failure is detected.	
Fail Safe		• ABS/ESP functions are inhibited, EBD function is allowed and the ABS/ESP warning lamps are activated.	

Diagnostic Circuit Diagram



SHMBR9507L

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Open or Short Check

1. Ignition "ON" & Engine "OFF".
2. Measure voltage between motor power terminal of the HECU harness connector and chassis ground.

Specification : B+

3. Is the measured value within specifications?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Check for open or blown ABS fuse referring to "Circuit Diagram".
Repair open or short in power circuit between battery and HECU harness connector and then, go to "Verification of vehicle Repair" procedure.

Ground Circuit Inspection

■ Open or Short Check

1. Ignition "OFF" & Engine "OFF".
2. Disconnect the HECU connector.
3. Measure resistance between ground terminal of the HECU harness connector and chassis ground.

Specification : Approx. below 1Ω

4. Is the measured value within specifications?

YES ▶ Substitute with a known-good HECU and check for proper operation.
If problem is corrected, replace HECU and then go to "Verification of Vehicle Repair" procedure .
※ In a case of replacing HECU, operate "Steering Angle Sensor Calibration" by scantool.

NO ▶ Repair open or short in ground circuit between HECU harness connector and chassis ground, and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
2. Using a Scantool, Clear DTC.
3. Operate the vehicle within DTC Detecting Condition in General Information.
4. Using a scantool, Check DTC present.
5. Are any DTCs present ?

YES ▶ Go to the applicable troubleshooting procedure.

NO ▶ System performing to specification at this time.

Yaw-rate and Lateral G Sensor

Description

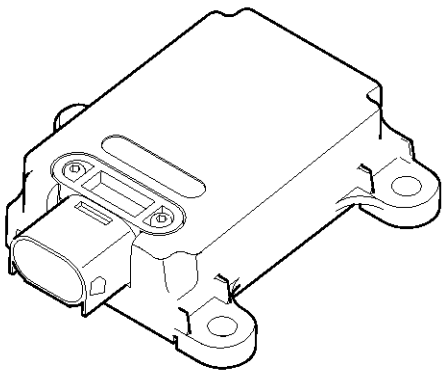
When the vehicle is turning with respect to a vertical axis the yaw rate sensor detects the yaw rate electronically by the vibration change of plate fork inside the yaw rate sensor.

If yaw velocity reaches the specific velocity after it detects the vehicle' yawing, the ESP control is reactivated.

The later G sensor senses vehicle's lateral G. A small element inside the sensor is attached to a deflectable lever arm by later G.

Direction and magnitude of lateral G loaded to vehicle can be known with electrostatic capacity changing according to lateral G.

It interchanges signals with HECU through extra CAN line which only used for communication between HECU and sensor.

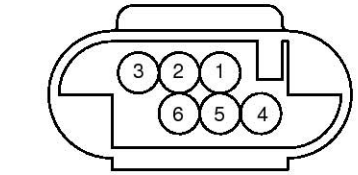


SHMBR8348D

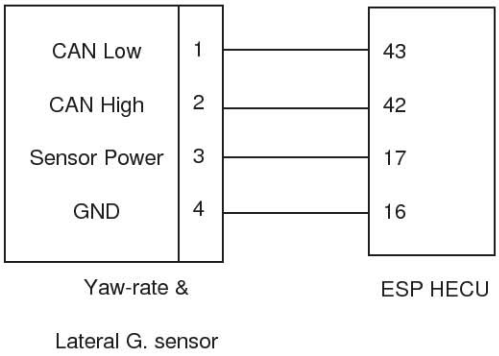
Specifications

Description		Specification	Remarks
Operating voltage		8 ~ 17V	
Output signal		CAN Interface	
Operating temperature		-40 ~ 85℃(-40 ~ 185˚F)	
Yaw-rate sensor	Measurement range	-75 ~ 75˚/sec	
	Frequency response	18 ~ 22Hz	
Lateral G sensor	Measurement range	-1.5 ~ 1.5g	
	Frequency response	50Hz±60%	

External Diagram



[Yaw-rate & Lateral G sensor's connector]

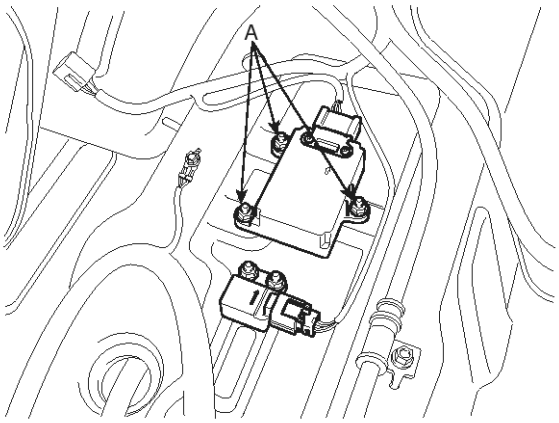


SENBR7559L

Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad assembly. (Refer to Body group-Crash pad)
3. Remove the heater & blower unit. (Refer to heater group- heater unit)
4. Disconnect the yaw rate & lateral G sensor connector.
5. Remove the mounting bolts (A).

Tightening torque:
7.9 ~ 10.8 N.m (0.8 ~ 1.1 kgf.m, 5.8 ~ 8.0 lb-ft)



SHMBR8352D

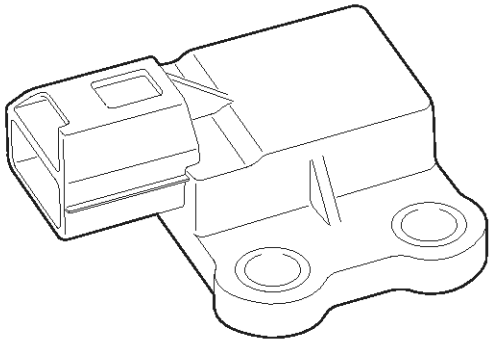
6. Installation is the reverse of removal.

Longitudinal G sensor

Description

The 4WD vehicle measures the G-sensor signal to solve for 4WD vehicle unique problems. For example all 4 wheels are locked early on a low-friction road or control response is delayed when road friction coefficients vary.

The HECU uses a filtered signal, as a supplementary value, to determine the road friction coefficient. This value is used for the accurate calculations of assumed vehicle speed, or precise division of control starting points.



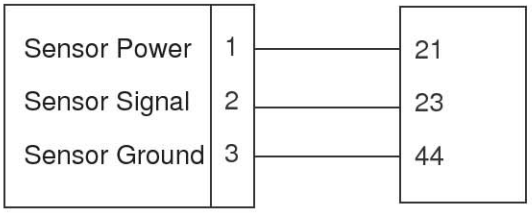
SHMBR8355D

Specifications

Description	Specification	Remarks
Operating voltage	4.75V ~ 5.25V	
Operating temperature	-40 ~ 125℃(-40 ~ 257°F)	
Measurement range	-1.5g ~ 1.5g	
Zero point output voltage	2.5V	
Output voltage range	1.0V ~ 4.0V	

External Diagram

[Longitudinal G sensor]

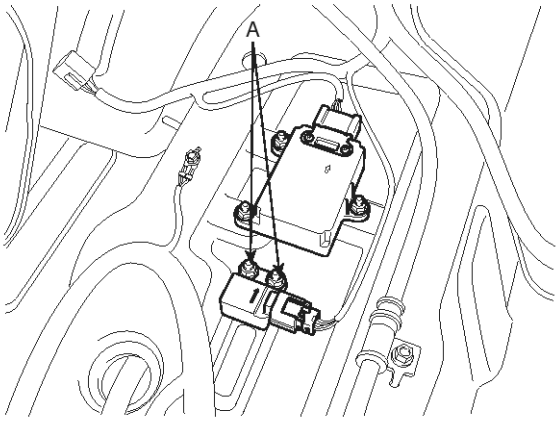


SHMBR9323L

Removal

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the crash pad assembly. (Refer to Body group-Crash pad)
3. Remove the heater & blower unit. (Refer to heater group- heater unit)
4. Disconnect the Longitudinal G sensor connector.
5. Remove the mounting bolts (A).

Tightening torque:
4.9 ~ 6.8 N.m (0.5 ~ 0.7 kgf.m, 3.6 ~ 5.1 lb-ft)



SHMBR8436D

6. Installation is the reverse of removal.

NOTICE
Deviation to reference axis perpendicular to driving direction ±2°

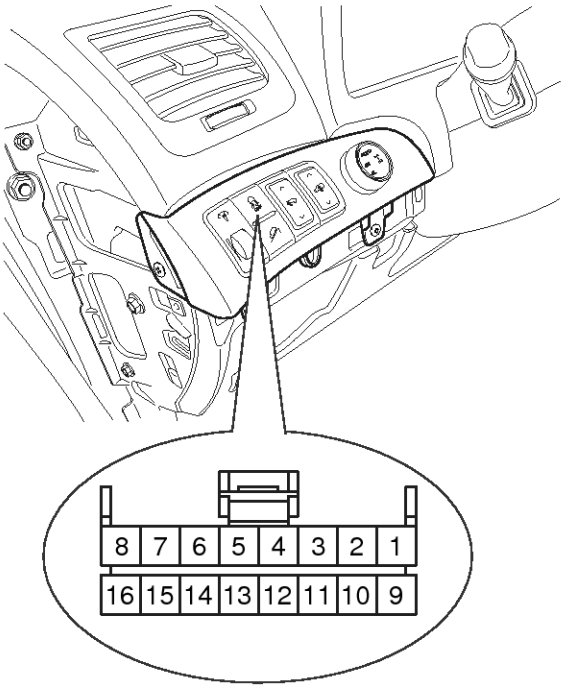
ESP OFF Switch

Description

1. The ESP OFF switch is for the user to turn off the ESP system.
2. The ESP OFF lamp is on when ESP OFF switch is engaged.

Inspection

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the lower panel. (Refer to Body group- crash pad)
3. Remove the lower crash pad switch assembly by using the scraper and then disconnect the connectors.



SHMBR8353D

4. Check the continuity between the switch terminals as the ESP OFF switch is engaged.

Terminal / Position	8	7	13	5
ON	○	○	○	○
OFF				

SHMBR9324L

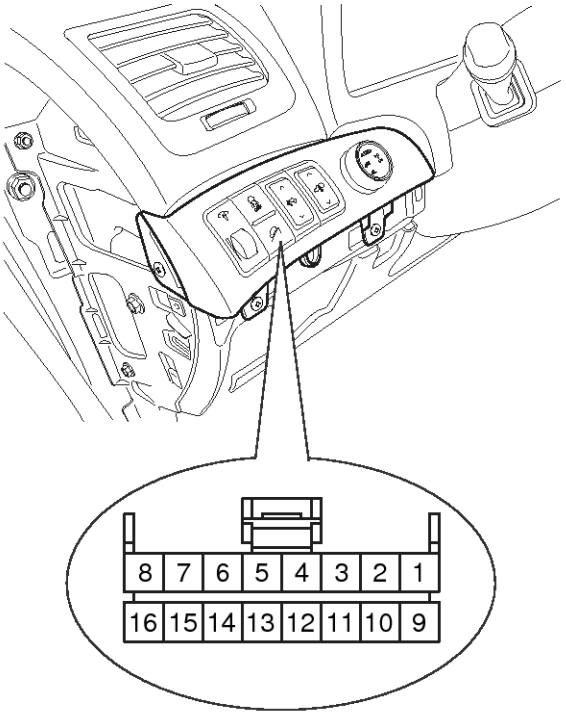
DBC Switch

Description

The DBC function is the shorten word of Downhill Brake Control function. When a vehicle goes down the hill, just pushing the DBC switch enables the car to keep its vehicle's speed at a constant value without operating the brake pedal. The DBC function is operated when the vehicle is on the decline and its velocity is under the predetermined speed.

Inspection

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the lower panel. (Refer to Body group- crash pad)
3. Remove the lower crash pad switch assembly by using the scraper and then disconnect the connectors.



SHMBR8431D

4. Check the continuity between the switch terminals as the DBC switch is engaged.

Terminal / Position	8	6	13	5
ON	○	○	○	○
OFF				

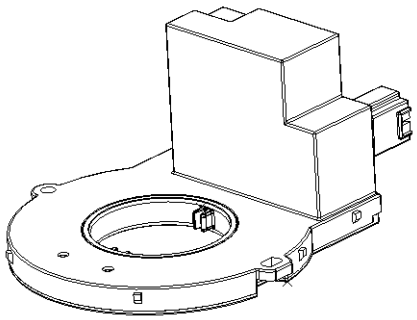
SHMBR9325L

Steering Wheel Angle Sensor

Description

Steering Wheel Angle Sensor detects rotating direction of the vehicle. Rotating direction detected by the sensor is communicated with HECU as CAN signal involving information about the angle through CAN communication line.

HECU detects speed of the steering wheel handling and the angle with this CAN signal. HECU also uses this signal as the input signal to control anti-roll.

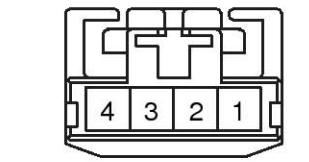


SHMBR8358D

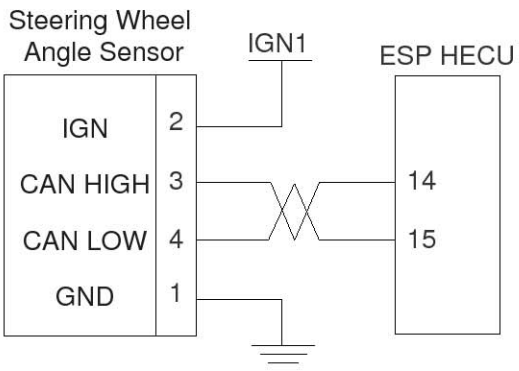
Specification

Description		Specification
Operating voltage		8 ~ 16V
Operating temperature		-40 ~ 85℃(-40 ~ 185˚F)
Current consumption		Max.150mA
Measuring range	Angle	-780 ~ 779.9˚
	Angular velocity	0 ~ 1016˚/sec
Output signal		CAN Interface

Circuit Diagram



[Steering Wheel Angle Sensor]



SHMBR9326L

Calibration (Setting up the zero angle)

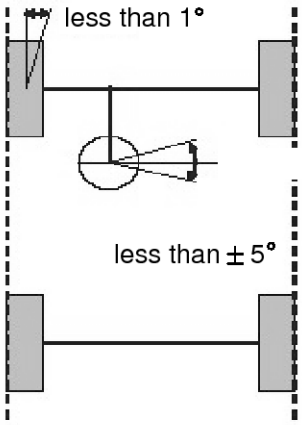
Steering Wheel Angle Sensor of a absolute angle type (CAN type) measures the angle under the standard of the zero angle set.

Calibration must be performed as following cases.

- Replacement of the Steering Wheel Angle Speed Sensor
- Replacement or repair of the Steering column
- Detection of DTC codes (C1260, C1261)
- Replacement of the sensor cluster
- Replacement of HECU

Calibration procedure

Perform wheel alignment and stand the steering wheel in a line within ±5˚error.



SHMBR9327L

1. Connect the scan tool.(CAN line or OBD connector)
2. Turn ignition switch on.
3. Press calibration button of the Steering Wheel Angle Sensor.
4. HECU calibration procedure is performed.
   (Calibration records, DTC codes erasure)
5. Turn ignition switch off after calibration procedure.
6. Confirm success or failure of calibration.
   - Warning lamp must not be lighted when driving test (Turning left and right).
   - ESP lights ESP OFF warning lamp when making an error in comparison with values of other sensors.