Brake System

GENERAL

SPECIFICATIONS EA11CB1B

Item	Specification
Master cylinder · Type · I.D. mm(in) · Piston stroke mm(in) · Output port(ABS/ESP) · Fluid level warning sensor	 Tandem type 25.4/(1.0) 31(1.22) 2port Provided
Brake booster · Type · Effective dia. mm(in.) · Boosting ratio	 Vacuum 8+9 in 9:1
Front brake(Disc) · Type · Disc O.D. · Disc I.D. · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D.	 Floating type with ventilated disc 280 mm (11.02 in) 172 mm (6.77 in.) 26 mm (1.02 in) 11 mm (0.43 in) single piston 57.2 mm (2.25 in.)
Rear brake(Drum) · Type · Drum I.D. · Lining width · Brake offset	 Leading trailing drum 228.6 mm (9.0 in.) 42 mm (1.65 in.) 29.6 mm (1.17 in)
Rear brake(Disc) · Type · Disc O.D. · Parking Brake Drum I.D · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D	 Floating type with solid disc 262 mm (10.31 in.) 168 mm (6.61 in.) 10 mm (0.39 in.) 10 mm (0.39 in.) single piston 34 mm (1.34 in.)
Parking brake · Actuation · Cable arrangement	 Mechanical brake acting on rear wheels Lever

O.D=Outer Diameter
I.D=Inner Diameter

NOTE

ABS : Anti-lock Brake System
ESP : Electronic Stability Program

SPECIFICATION (ABS) E6F779E2

Part	Item	Standard value	Remark
HECU(Hydraulic and Electronic Control Unit)	System	4 channel 4 sensor (Solenoid)	·ABS system:ABS & EBD control
	Type	Motor, valve relay intergrated type	
	Operating voltage	10 V~16 V(DC)	
	Operating temperature	-40~120 °C(-40~248 °F)	
Warning lamp	Operating voltage	12 V	·ABS W/L:ABS failure ·Brake W/L:Parking, brake oil, EBD failure
	Current consumption	80 mA	
Acitve wheel speed sensor(ABS)	Supply voltage	DC 4.5~2.0 V	
	Output current low	5.9~8.4 mA	Typ.7 mA
	Output current High	11.8~16.8 mA	Typ.14 mA
	Frequency range	1~2500 HZ	
	Air gap	0.4~1.0 mm (0.0157~0.04 in.)	
	Tone wheel	47 teeth	
	Output duty	30~70 %	

SPECIFICATION(ESP)

Part	Item	Standard value	Remark
HECU(Hydraulic and Electronic Control Unit)	System	4 channel 4 sensor(Solenoid)	·Total control(ABS, EBD, TCS, ESP)
	Type	Motor, valve relay intergrated type	
	Operating voltage	10 V~16 V(DC)	
	Operating temperature	-40~120 °C(-40~248 °F)	
Warning lamp	Operating voltage	12 V	·ESP Operating Lamp ·ESP Warning Lamp
	Current consumption	80 mA	
Active wheel speed sensor	Supply voltage	DC 4.5~20 V	
	Output current low	5.9~8. mA	
	Output current high	11.8~16.8 mA	
	Tone wheel	47 teeth	
	Frequency range	1~2500 HZ	
	Airgap	0.4~1.0 mm (0.02~0.04 in)	
Steering Wheel Angle Sensor	Operating Voltage	8 V~16 V	
	Current Consumption	Max 150 mA	
	Operating Angular velocity	Max ±2000 °/sec	
Yaw-rate & Lateral G sensor	Operating Voltage	8 V~16 V	
	Current Consumption	Max. 120 mA	
	Output Voltage	0.35 V~4.65 V	
	Yaw Sensor Operating Range	±100 ° /s	
	G Sensor Operating Range	±1.8 G	
	Reference voltage output	2.464~2.536 V	Typ. 2.5 V

SERVICE STANDARD E9E4D54D

	Standard value	Service limit
Brake pedal height	184.5 mm(7.264 in.)	
Brake pedal full stroke	128 mm (5.04 in.)	
Adjust Brake pedal full stroke	76.2 mm(3 in.)	
Brake pedal free play	3~8 mm(0.11~0.31 in.)	
Stop lamp switch outer case to pedal stopper clearance	0.5~1.0 mm (0.02~0.04 in.)	
Booster push rod to master cylinder piston clearance	0 (at 500 mmHg vacuum)	
Parking brake lever stroke when lever assembly is pulled with 196N (20Kgf, 44lb force)	7 clicks	
Front disc brake pad thickness	11 mm (0.43 in.)	2 mm (0.079 in.)
Front disc thickness	26 mm (1.024 in.)	24.4 mm (0.961 in.)
Front disc runout		Max.0.03 mm (0.001 in.)
Front disc thickness variation		Max.0.005 mm (0.0002 in.)
Rear drum brake lining width	42 mm (1.65 in.)	
Rear drum brake drum I.D.	228.6 mm (9 in.)	Max.230.6mm (9.079 in.)
Rear disc brake pad thickness	10 mm (0.394 in.)	2 mm (0.079 in.)
Rear disc brake disc thickness	10 mm (0.394 in.)	8 mm (0.315 in.)
Rear disc runout		Max.0.03 mm (0.001 in.)
Rear disc thickness variation		Max.0.01 mm (0.0004 in.)

TIGHTENING TORQUE

	Nm	Kgf·cm	lb-ft
Master cylinder to booster mounting nut	7.84~11.76	80~120	5.9~8.9
Brake booster mounting nut	12.74~15.68	130~160	9.6~11.8
Bleeder screw	6.86~12.74	70~130	5.2~9.6
Brake tube nut, brake hose	13.72~16.66 (M10) 18.62~22.54 (M12)	140~170 (M10) 190~230 (M12)	10.326~12.54 (M10) 14.01~16.964 (M12)
Caliper assembly to knuckle	78.4~98	800~1000	59.0~73.8
Brake hose to front caliper	24.5~29.4	250~300	18.4~22.1
Brake hub flange nut	196~254.8	2000~2600	147.5~191.8
Push rod locking nut	15.68~21.56	160~220	11.8~16.2
Caliper guide rod bolt	21.56~31.36	220~320	16.2~23.6
Stop lamp switch mounting nut	7.84~9.8	80~100	5.9~7.38

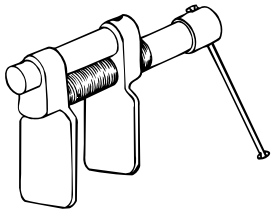
TIGHTENING TORQUE (ABS)

Item	Nm	kgf·cm	lb-ft
Active wheel speed sensor mounting bolt on the brake plate	7.84~8.82	80~90	5.9~6.54
Hydraulic & electronic control unit mounting bolt	13.72~17.64	140~180	10.326~13.276
Hydraulic & electronic control unit mounting bracket bolt	16.66~25.48	170~260	12.54~19.177
Brake tubes nut	13.72~16.66	140~170	10.326~12.54
Air bleeder screw	6.86~12.74	70~130	5~9.6

TIGHTENING TORQUE (ESP)

Item	Nm	kgf·cm	lb-ft
Yaw rate & lateral acceleration sensor Nut	4.9~7.84	50~80	3.69~5.9
Brake tube nut	13.72~16.66 (M10) 18.62~22.54(M12)	140~170 (M10) 190~230(M12)	10.326~12.54 (M10) 14.01~16.964 (M12)

SPECIAL TOOL EF2DDBAE

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

TROUBLESHOOTING E8F58C98

PROBLEM SYMPTOMS TABLE

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the like cause 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 (Faulty)	repair air·bleed replace adjust replace
Brake drag	1. Brake pedal freeplay (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 (Faulty) 9. Booster system (Vacuum leaks) 10. Master cylinder (Faulty)	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

Symptom	Suspect Area	Reference
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
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.	

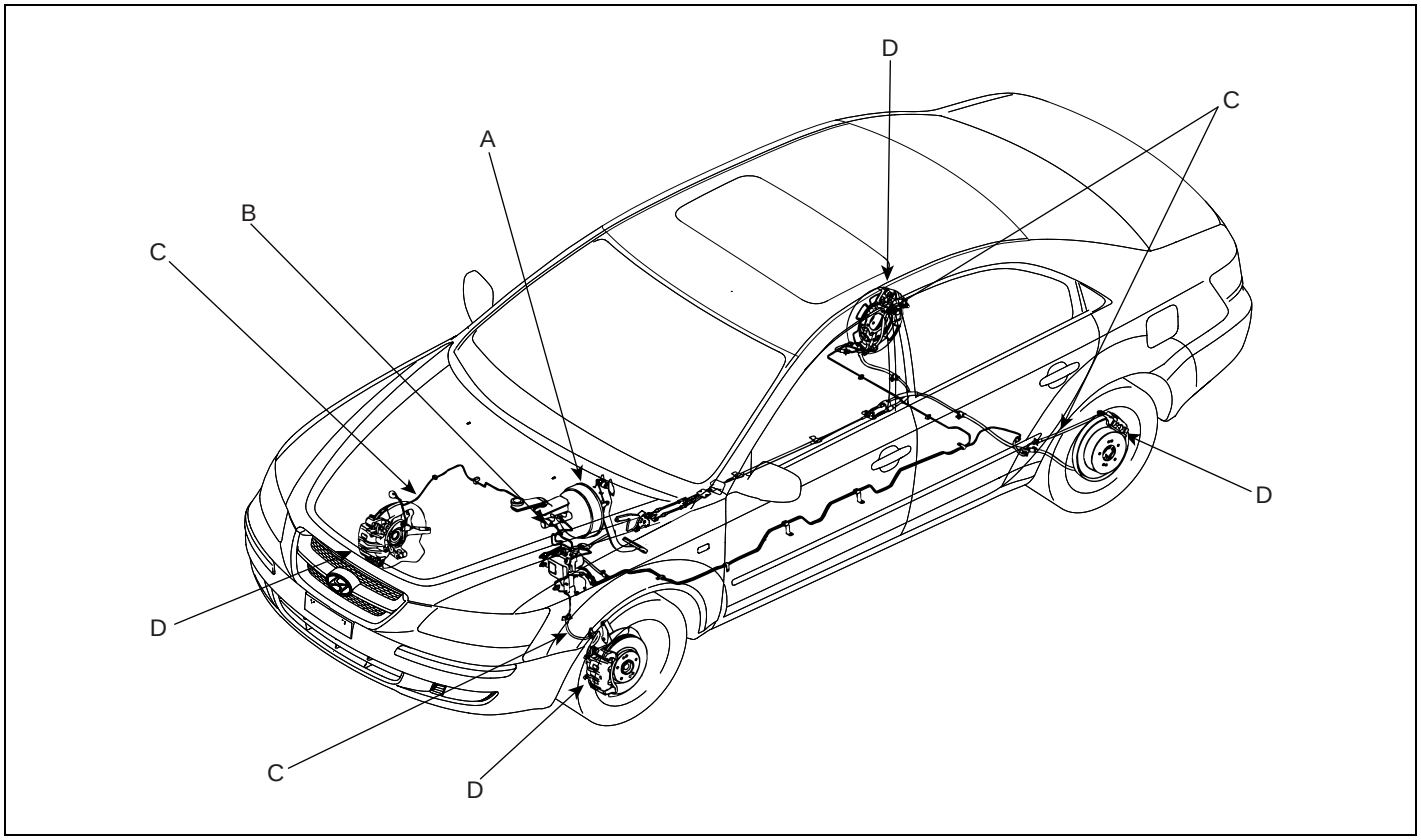
BRAKE SYSTEM

OPERATION AND LEAKAGE

CHECK ECC7DE4E

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 thebrake caliper is disassembled.

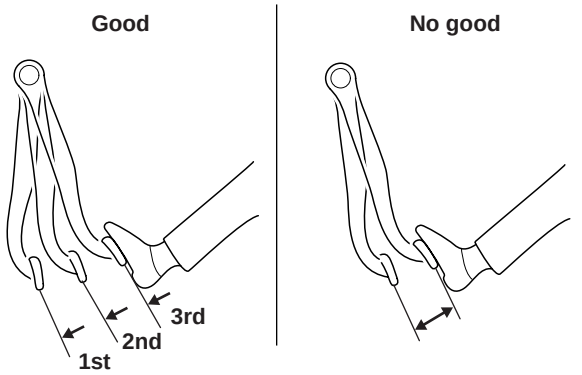


EJRF500A

BRAKE BOOSTER OPERATING TEST

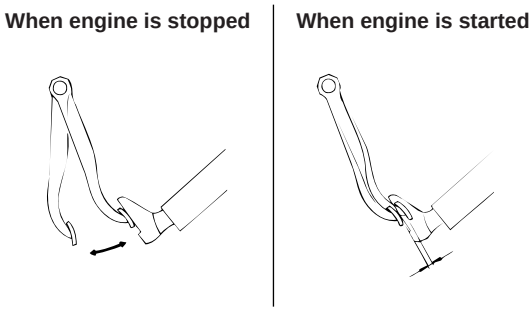
For simple checking of the brake booster operation, carry out the following tests

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, thebooster is defective.



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 defective.



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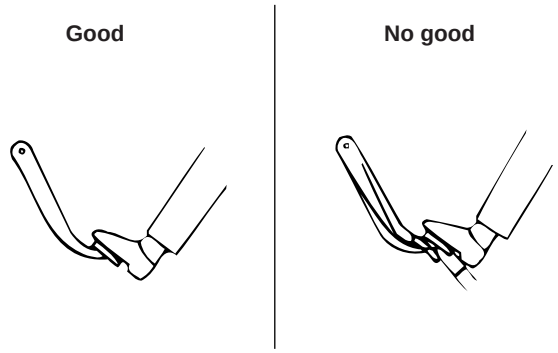
3. With the engine running, step on the brake pedal and then stop the engine.
   Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective.
   If the above three tests are okay, the booster performance 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 defect.

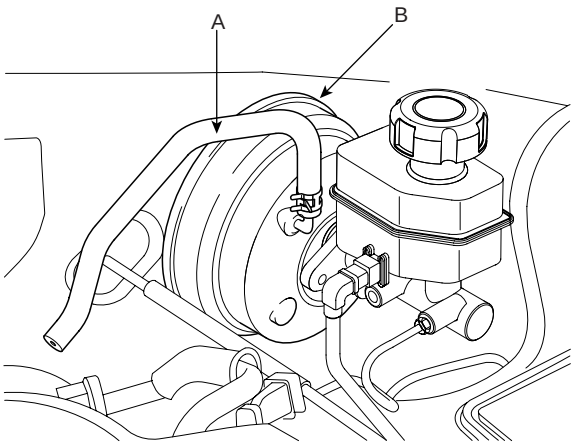


EJRF500C

VACUUM HOSE (CHECK VALVE)

INSPECTION

1. Disconnect the brake booster vacuum hose (check valve built in) (A) at the booster (B).
2. Start the engine and let it idle. There should be vacuum available. If no vacuum is available, the check valve is not working properly. Replace the brake booster vacuum hose and check valve and retest.



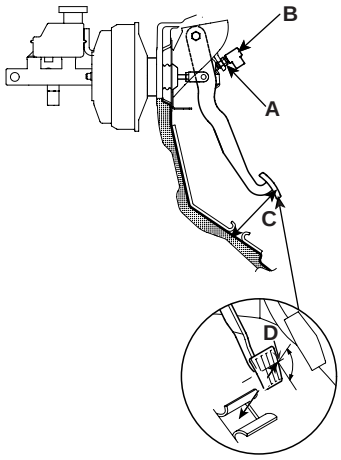
EJRF500D

BRAKE PEDAL BRAKE SWITCH ADJUSTMENT

PEDAL HEIGHET

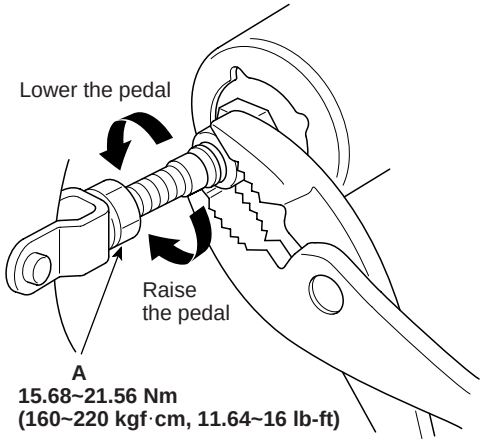
1. Disconnect the brake switch connector, loosen the brake switch locknut (A), and brake off the brake switch (B) until it is no longer touching the brake pedal.
2. Lift up the carpet. At the insulator cutout, measure the pedal height (C) from the middle of the left-side center of the pedal pad (D).

Standard pedal height(with carpet removed):
184.5 mm(7.26 in.)



EJKE001A

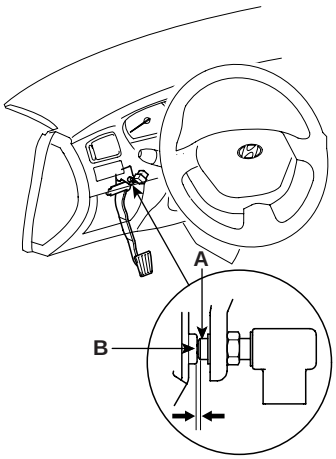
3. Loosen the pushrod locknut (A), and screw the pushrod in or out with pliers until the standard pedal height from the floor is reached. After adjustment, tighten the locknut firmly. Do not adjust the pedal height with the pushrod depressed.



EJRF500E

BRAKE SWITCH CLEARANCE

Screw in the brake switch until its plunger is fully depressed (threded end (A) touching the pad (B) on the pedal arm) then brake off the switch 3/4 turn to make 0.5~1.0mm(0.0197~0.0394 in.) of clearance between the brake switch connector. Make sure that the brake lights go off when the pedal is released.

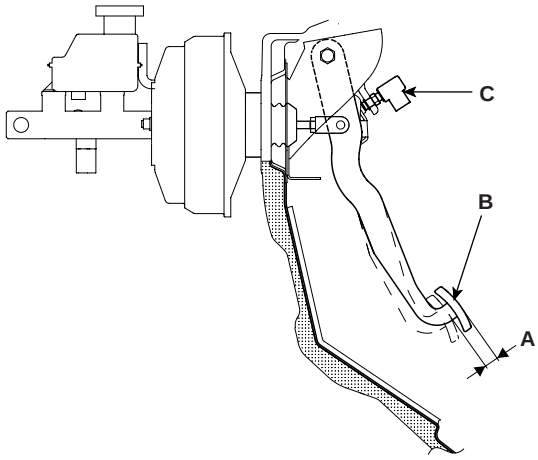


EJKE001C

PEDAL FREE PLAY

1. With the engine off, inspect the pedal free play (A) on the pedal pad (B) by pushing the pedal by hand.

Free play: 3~8 mm (0.12~0.31 in.)



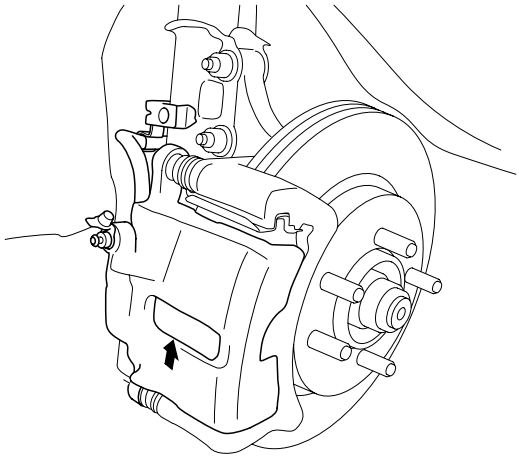
EJKE001D

2. If the pedal free play is out of specification, adjust the brake switch (C). If the pedal free play is insufficient, it may result in brake drag.

INSPECTION OF FRONT DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole.

Pad thickness
Standard value : 11.0 mm (0.43 in.)
Service limit : 2.0 mm (0.0787 in.)



KJQE050H

CAUTION

- ***If the pad lining thickness is out of specilfication, left and right pads must be replaced as a complete set.***
- ***When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.***

INSPECTION OF REAR DISC BRAKE PAD

1. Check the rear disk brake pad thickness through the caliper body inspection hole.

Pad thickness
Standard value : 10.0 mm (0.39 in.)
Service limit : 2.0 mm (0.0787 in.)

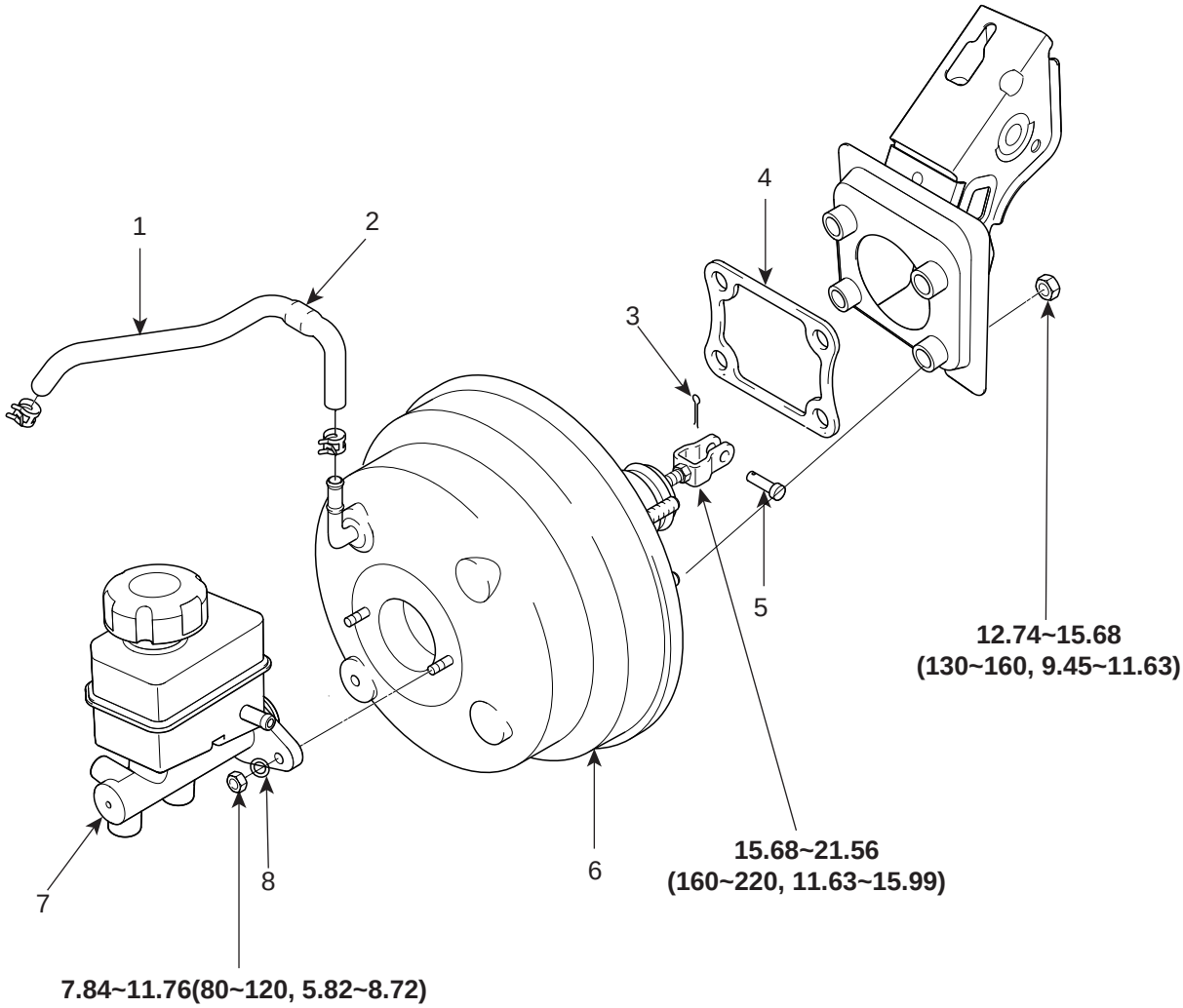
EGGE700M

CAUTION

- ***If the pad thickness is out of specification, left and right pads must be replaced as a complete set.***
- ***When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.***

BRAKE BOOSTER

COMPONENTS E7AF580C



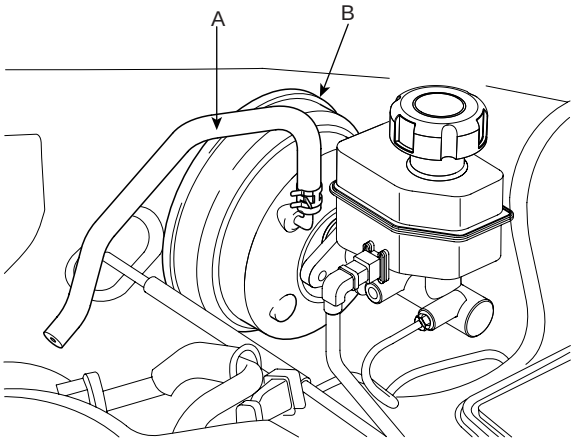
TORQUE : Nm (kgf·cm, lb-ft)

1. Vacuum hose
2. Check valve
3. Snap pin
4. Seal
5. Clevis pin
6. Brake booster
7. Master cylinder
8. Washer

EJRF500F

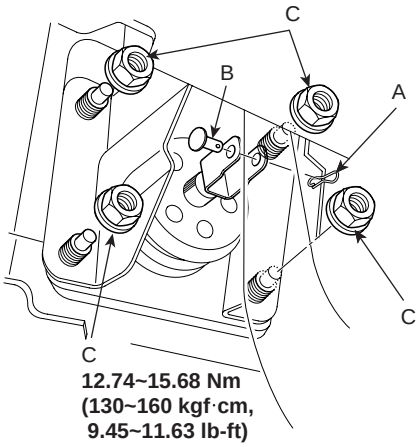
REMOVAL EDB5B296

1. Remove the master cylinder.
2. Disconnect the vacuum hose (A) from the brake booster (B).



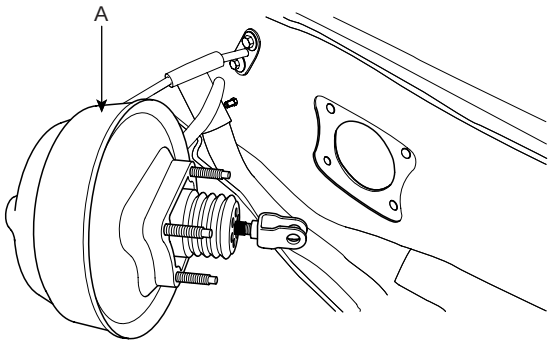
LJIF501U

3. Remove the snap pin (A) and clevis pin (B).



EJRF500G

4. Remove the four booster mounting nuts (C).
5. Remove the brake booster (A).

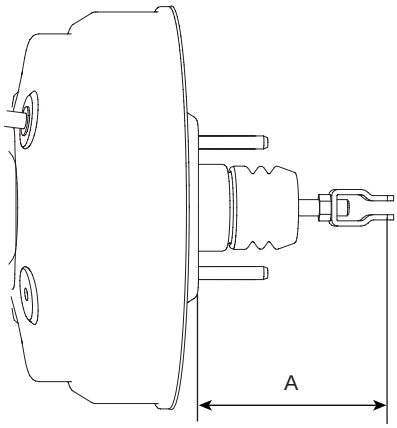


EJKE305D

INSTALLATION E50AF6FE

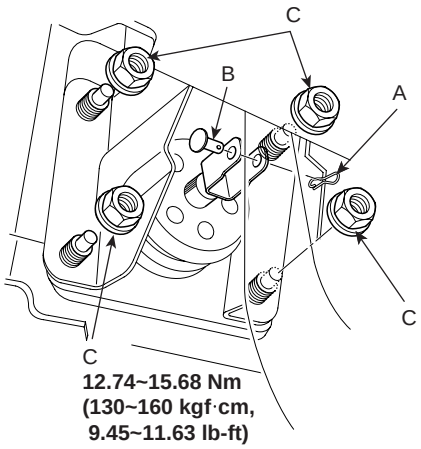
1. Adjust push rod length of the booster, and then install the seal on the booster assembly.

Standard length (A): 108± 0.5 mm (4.25 ± 0.019 in.)



KJQE050C

2. Insert the booster and tighten the nuts (C).



EJRF500H

3. Connect the booster push rod and brake pedal with a pin (B) and install a snap clevis pin (A) to the clevis pin (B).

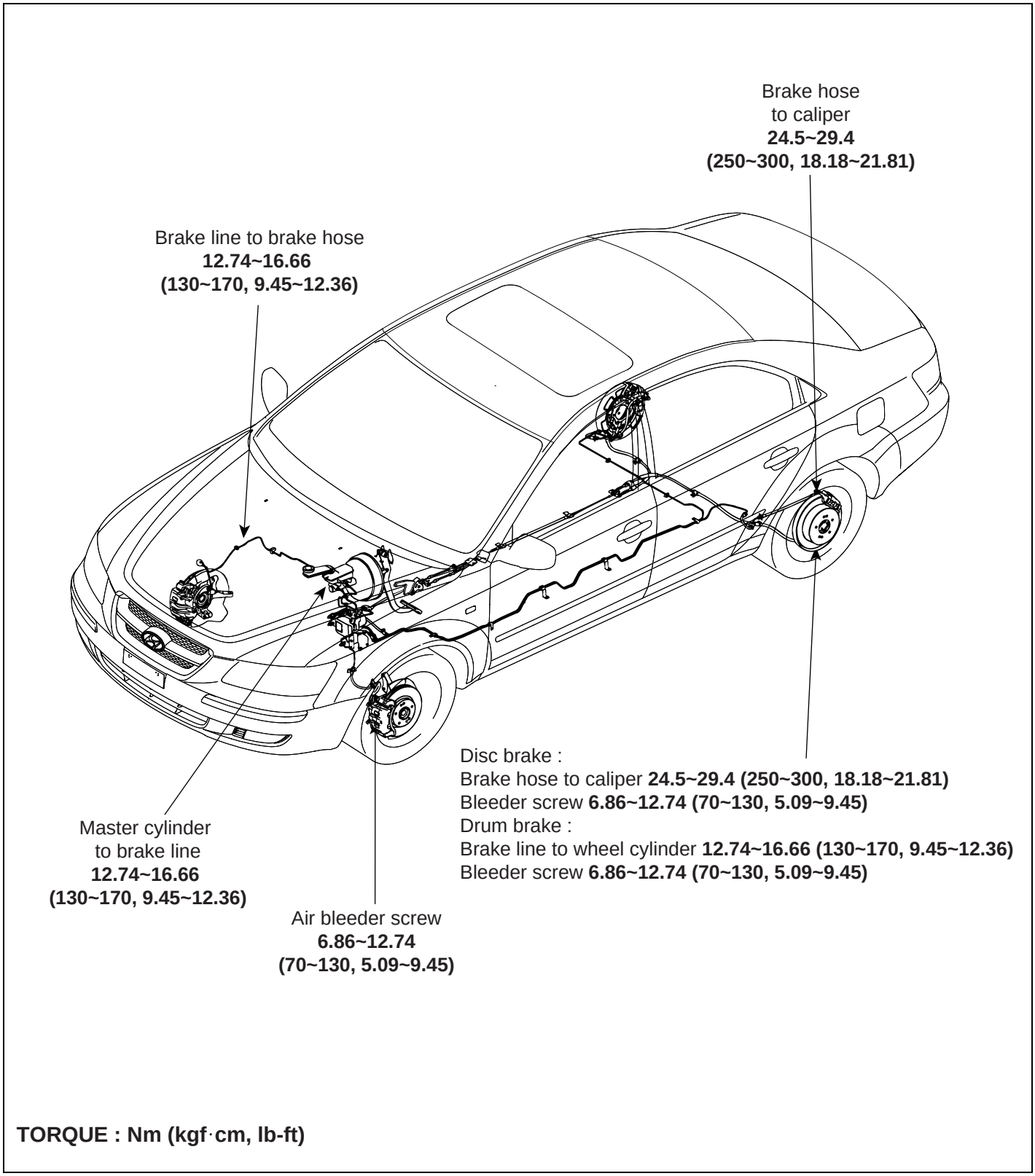
CAUTION

Grease the pin before installing the snap pin.
Always use a new snap pin.

4. Install the master cylinder.
5. Connect the vacuum hose to the brake booster.
6. After filling the brake reservoir with brake fluid, bleed the system.
7. Check for fluid leakage.
8. Check and adjust the brake pedal for proper operation.

BRAKE LINE

COMPONENT EFDAF8C6

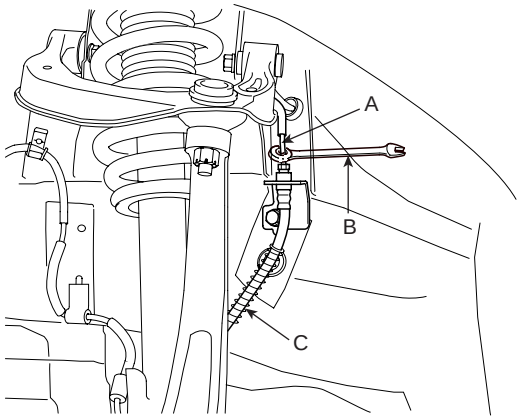


TORQUE : Nm (kgf·cm, lb-ft)

EJRF500I

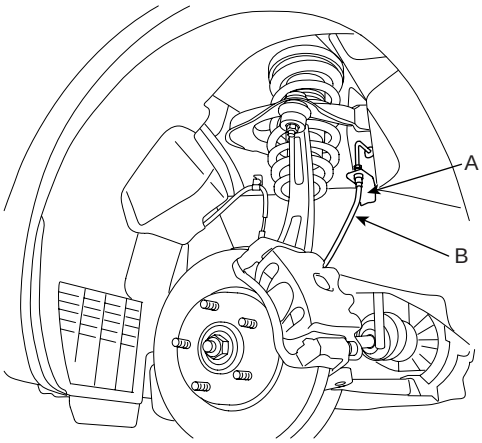
REMOVAL EB13C0C5

1. Disconnect the brake hose(C) from the brake line(A) using a flare-nut wrench(B).



KJRE050A

2. Remove the bracket mounting bolt(A), and then remove the brake hose(B).

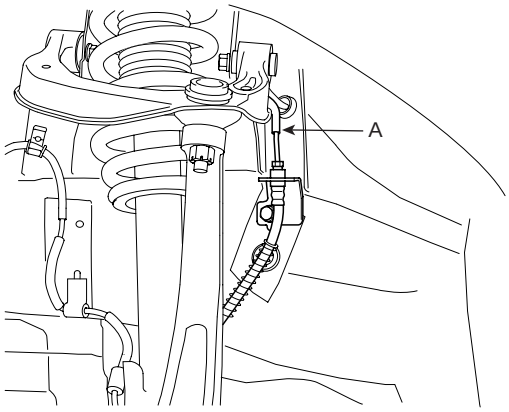


KJRE050B

3. Remove the connector bolt from the caliper, and disconnect the brake hose from the caliper.

INSTALLATION E654E9E8

1. Install a brake hose on the caliper with tightening brake hose bolt.
2. Install the bracket and the brake hose mounting bolt.



EJRF500J

3. Connect the brake hose(A) to the brake line.
4. After installing the brake hose, bleed the brake system.

INSPECTION E0905EE1

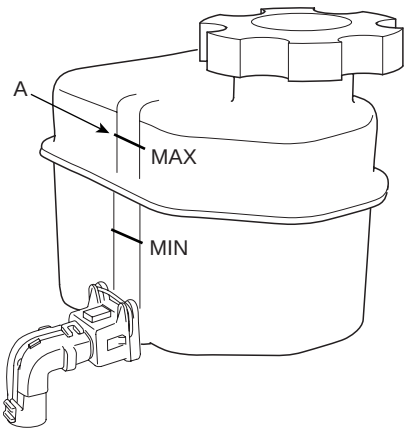
- Check the brake tubes for cracks, crimps and corrosion.
- Check the brake hoses for cracks, damaged and oil leakage.
- Check the brake tube flare nuts for damage and oil leakage.

BRAKE SYSTEM BLEEDING E6D5B0DF

NOTE

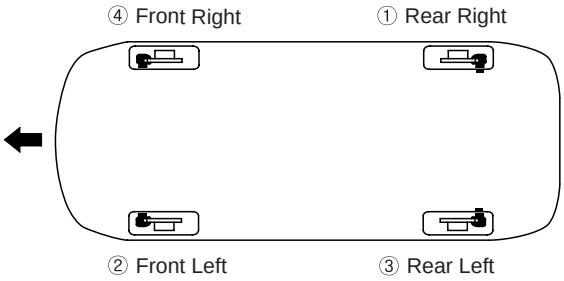
- *Do not reuse the drained fluid.*
- *Always use Genuine DOT3 or DOT 4 Brake Fluid. Using a non-Genuine DOT or 4 brake fluid can cause corrosion and decrease the life of the system.*
- *Make sure no dirt of other foreign matter is allowed to contaminate the brake fluid.*
- *Do not spill brake fluid 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 (A).



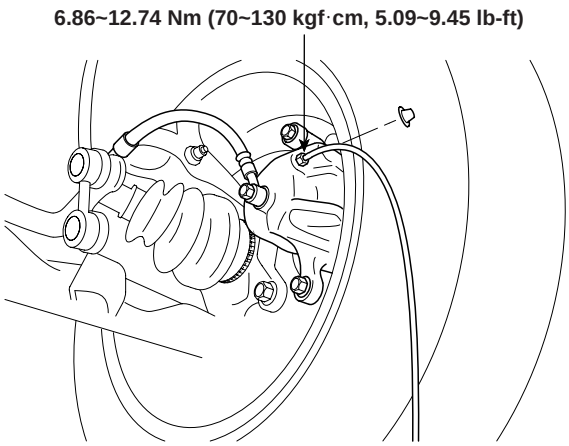
EJQE003A

2. Have someone slowly pump the brake pedal several times, then apply pressure.
3. Lossen the right-rear brake bleed screw to allow air to escape from the system. Then tighten the bleed screw securely.
4. Repeat the procedure for wheel in the sequence shown below unit air bubbles no longer appear in the fluid.
5. Refill the master cylinder reservoir to MAX(upper) level line.



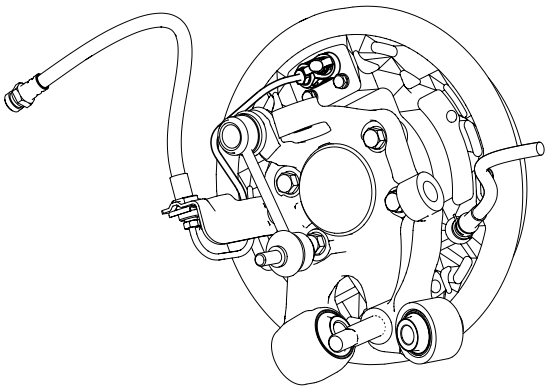
EJKE003B

FRONT DISC BRAKE



EJRF500K

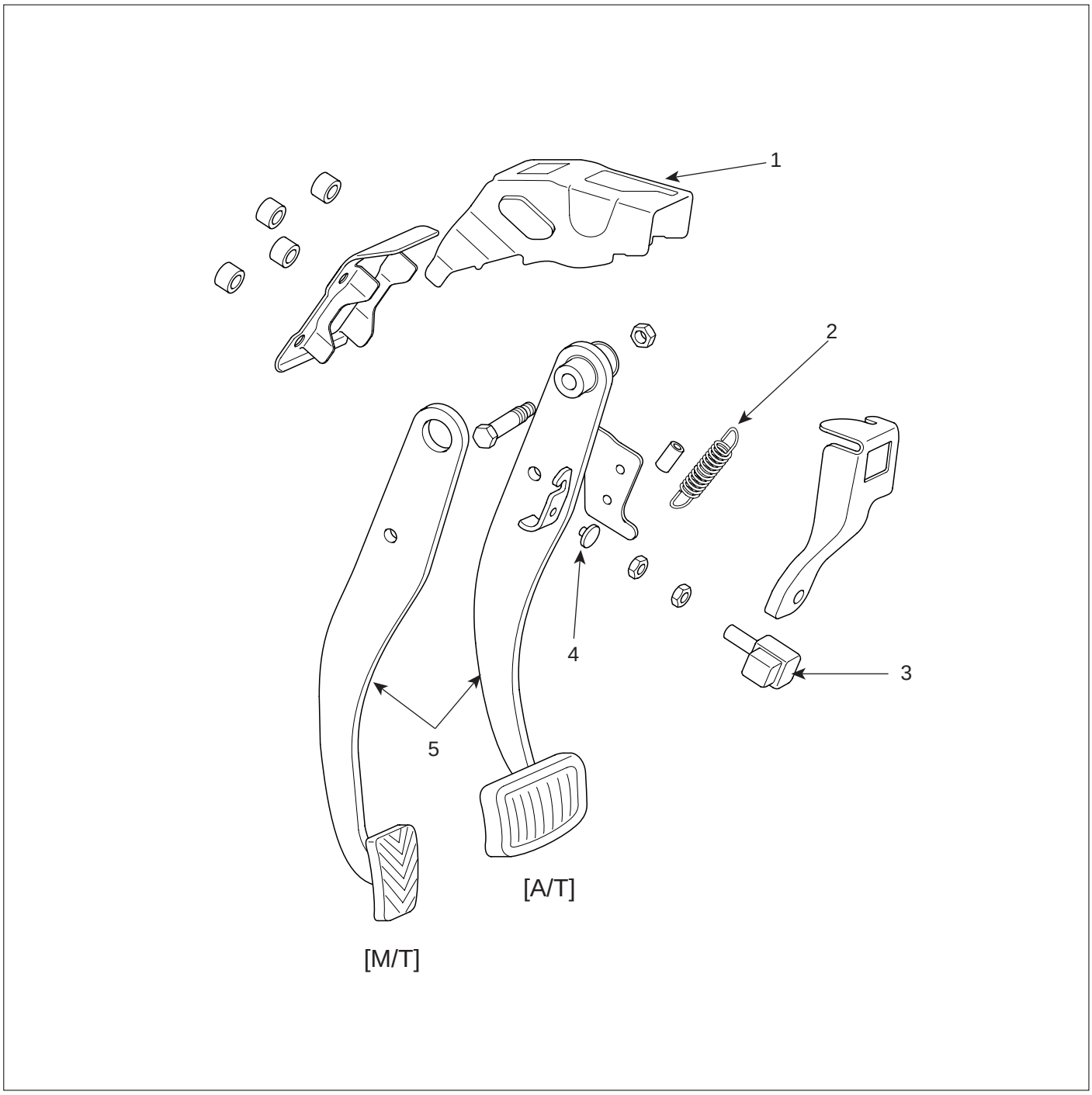
REAR DRUM BRAKE



EJRF500L

BRAKE PEDAL

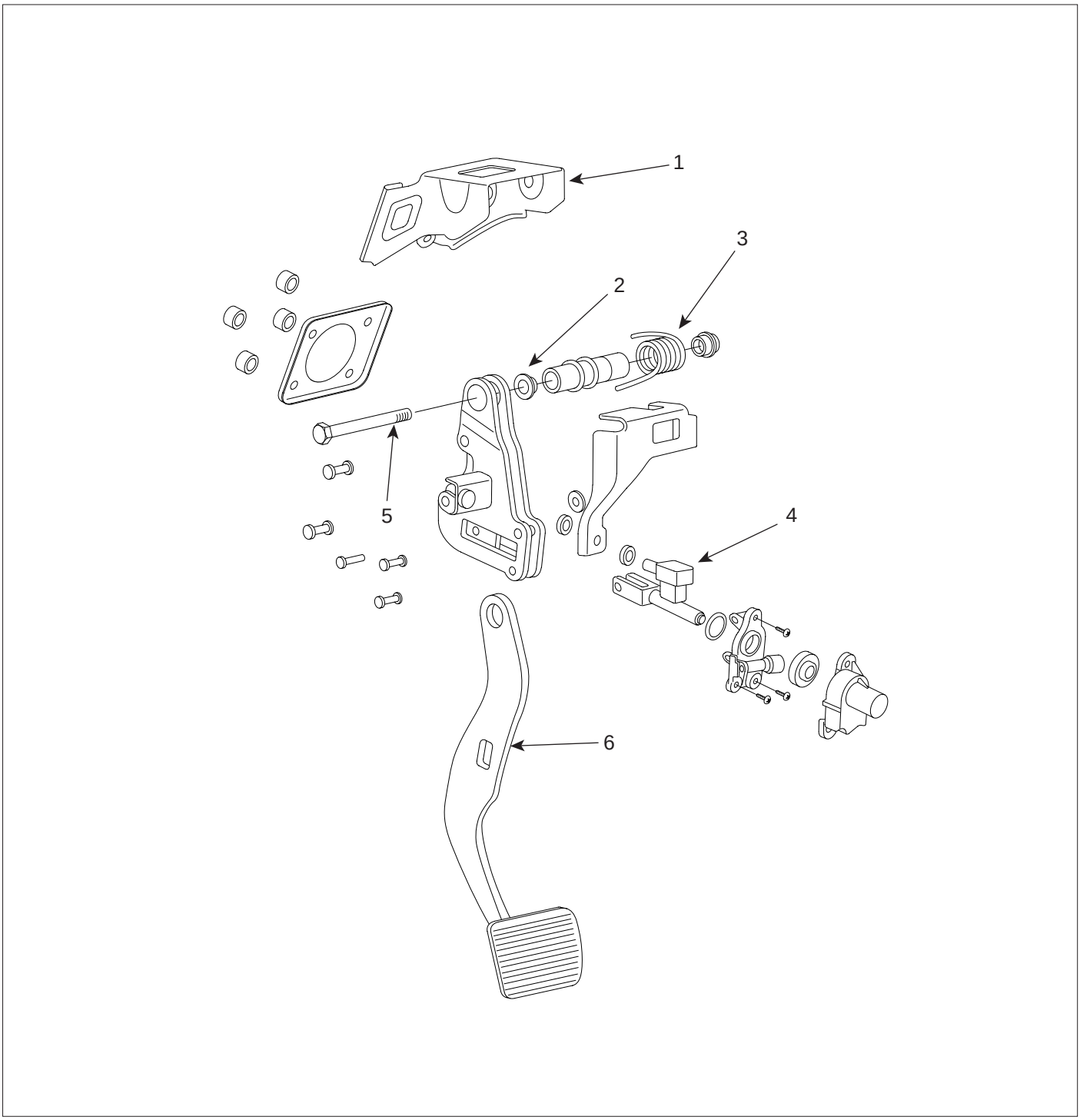
COMPONENTS EE12FE0E



1. Member assembly bracket
2. Return spring
3. Stop lamp switch
4. Bushing
5. Brake pedal

EJRF500M

COMPONENTS (ADJUSTABLE PEDAL)

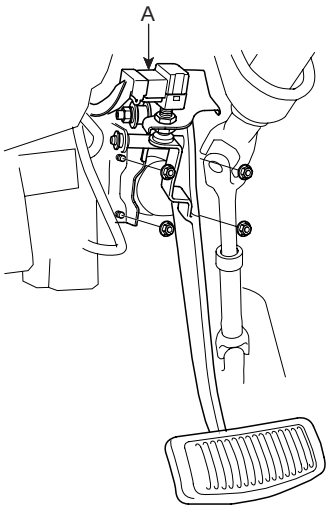


1. Member assembly bracket
2. Bushing
3. Return spring
4. Stop lamp switch
5. Shaft bolt
6. Brake pedal

EJRF500N

REMOVAL ECDCEE5C

1. Remove the lower crash pad.(Refer to BD-"crash pad")
2. Pull down steering column shaft after removing 4 bolts.
3. Remove the stop lamp switch connector (A).
4. Remove the shift lock cable (A/T).



KJQE010A

5. Remove the pin and snap pin.
6. Loosen the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.

INSTALLATION EE9A8E5E

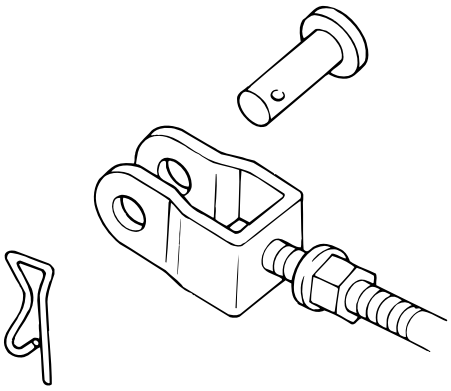
1. Installation is the reverse of removal.

CAUTION

Coat the inner surface of the bushings with the specified grease.

Specified grease : SAE J310

2. Before inserting the pin, apply the specified grease to the joint pin.



EJQE008R

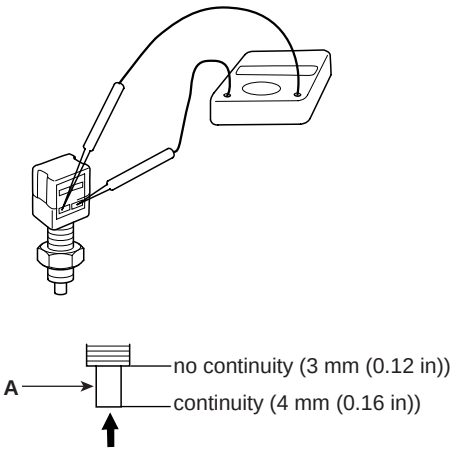
3. Install the snap pin.
4. Install the nuts with specified torque, when installing the brake pedal.

TORQUE : Nm(kgf·cm,lb-ft); 12.74~15.68(130~160, 9.45~11.63)

5. Adjust the brake pedal height and free play.
6. Install the stop lamp switch.

INSPECTION EE61AEE1

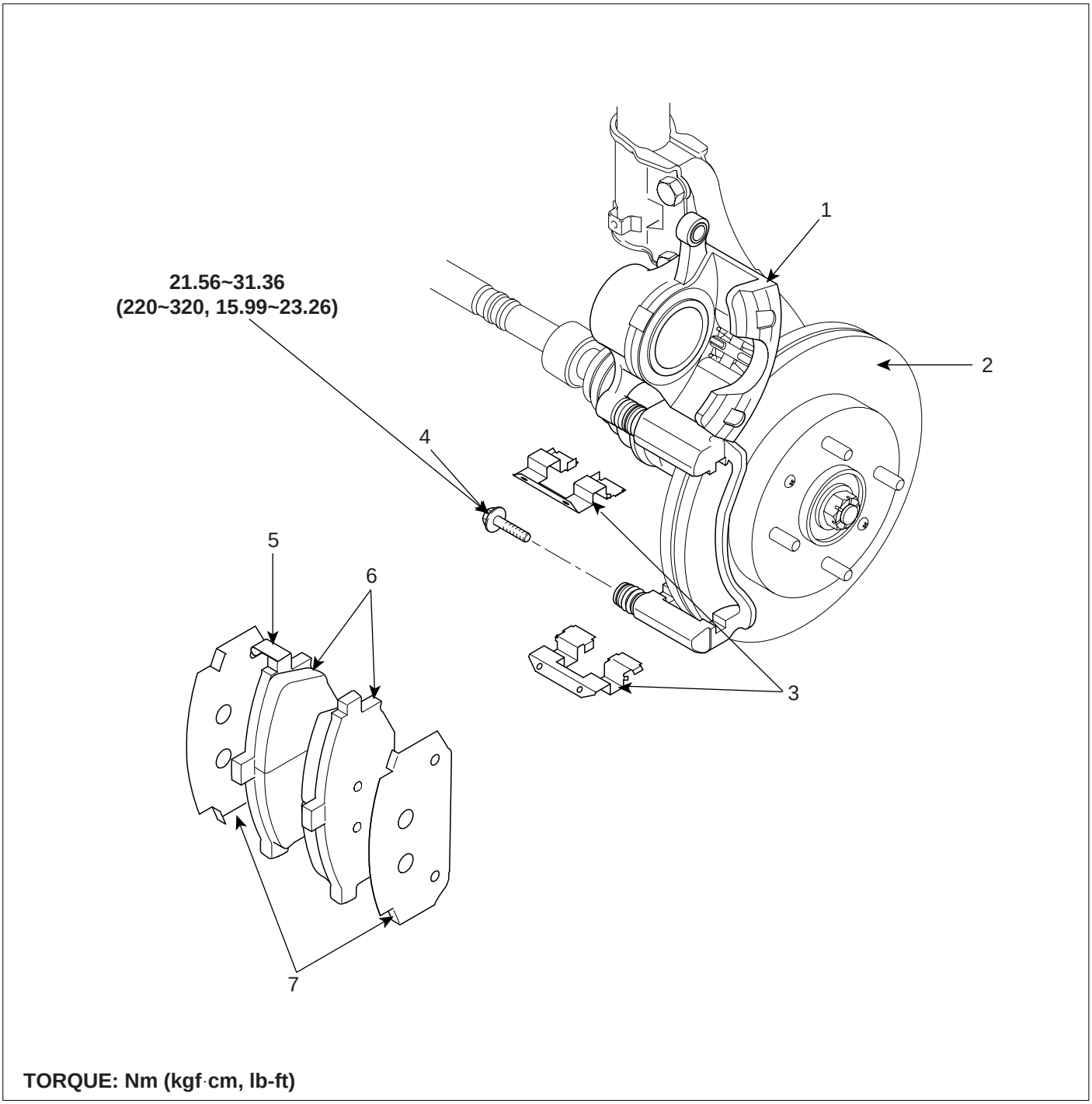
1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch.
   1) Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the 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.



EJRF500O

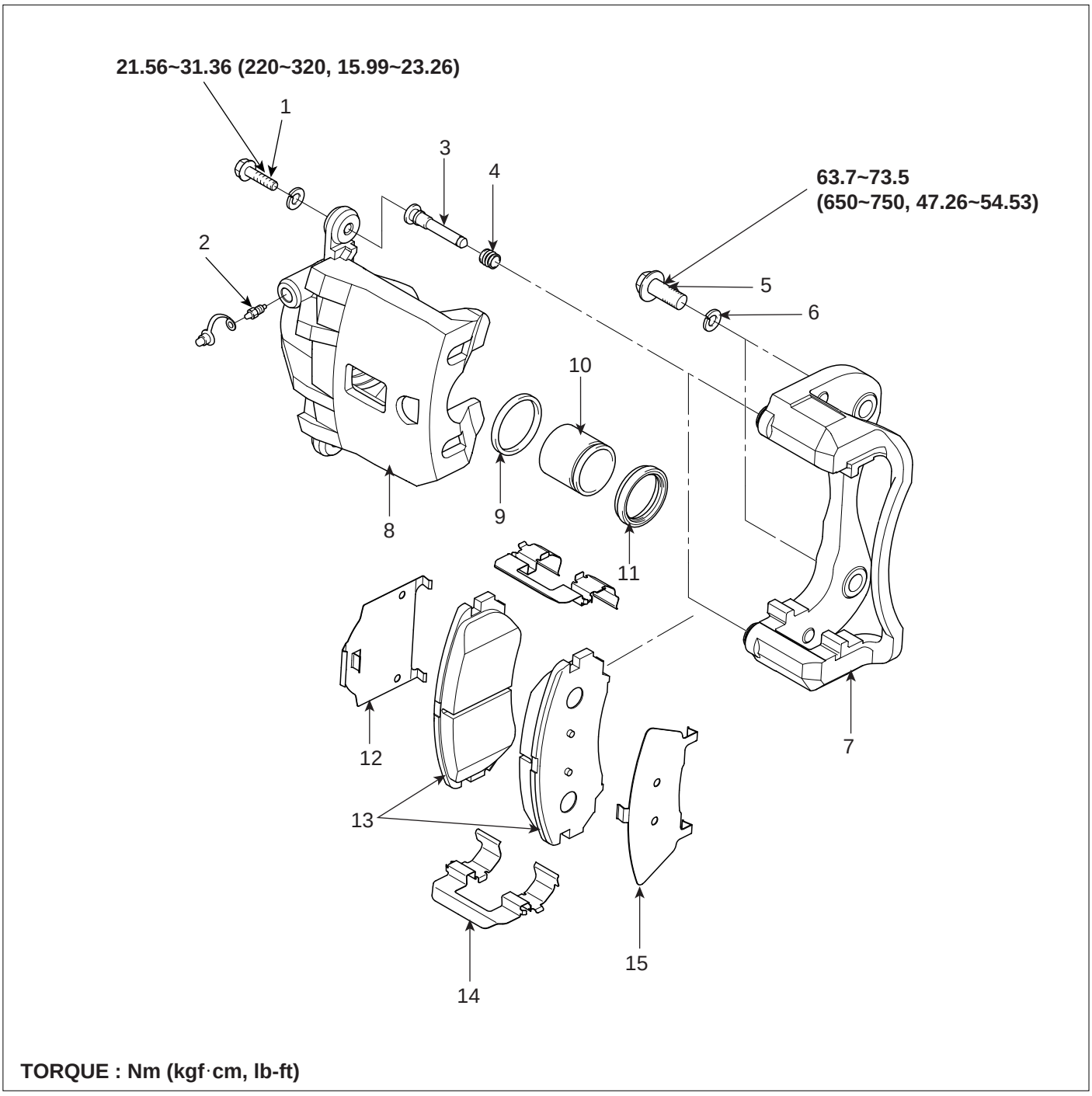
FRONT DISC BRAKE

COMPONENTS EAA0A1CD



1. Brake caliper
2. Brake disc
3. Pad retainers
4. Guide rod bolt
5. Indicator
6. Brake pads
7. Brake pad shims

EJRF500P



TORQUE : Nm (kgf·cm, lb-ft)

1. Guide rod bolt
2. Bleeder screw
3. Guide rod
4. Boot
5. Caliper mounting bolt
6. Washer
7. Caliper bracket
8. Caliper body
9. Piston seal
10. Piston
11. Piston boot
12. Inner shim
13. Brake pad
14. Pad retainer
15. Outer shim

EJRF500Q

REMOVAL EBFCF815

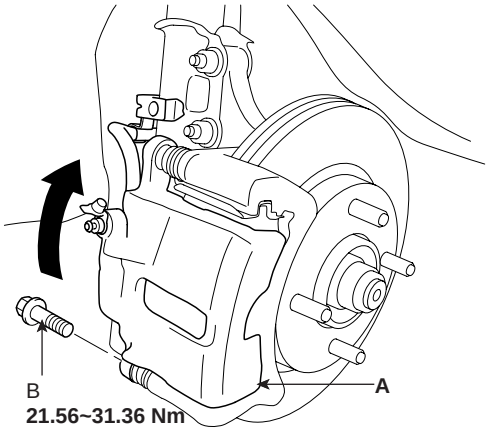
CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- ***Avoid breathing dust particles.***
- ***Never use on air hose or brush to clean brake assemblies.***

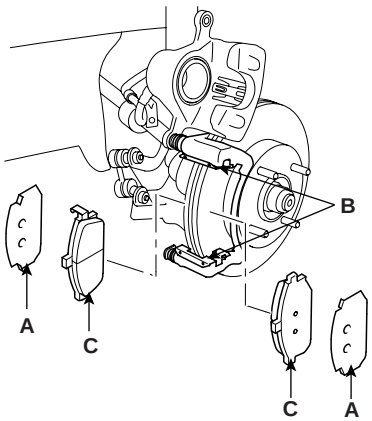
1. Lossen the front wheel nuts slightly. Raise the front of the vehicle, and make sure it is securely supported. Remove the front wheels.

2. Remove the guide rod bolt(B), After raise the caliper assembly(A), support it with a wire.



EJRF500R

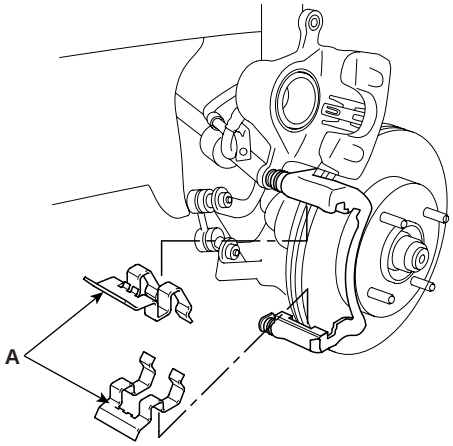
3. Remove pad shim(A), pad retainer(B) and pad assembly(C) in the caliper bracket.



ARJE501L

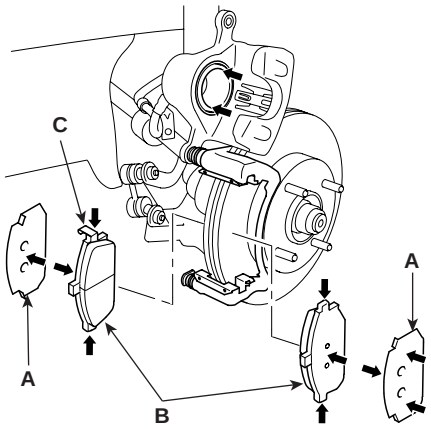
INSTALLATION EFDB65AB

1. Install the pad retainers (A) on the caliper bracket.



ARJE501M

2. Check the foreign material at the pad shims (A) and the back of the pads (B).
Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.

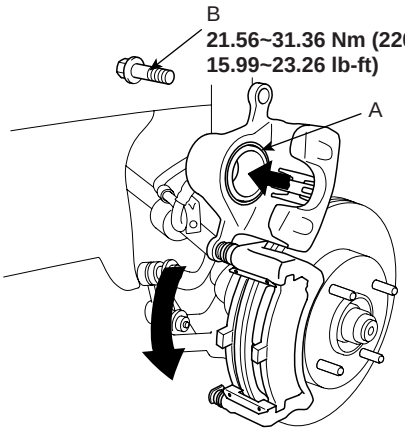


ARJE501N

3. Install the brake pads (B) and pad shims (A) correctly. Install the pad with the wear indicator (C) on the inside.
   If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.

4. Push in the piston (A) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.

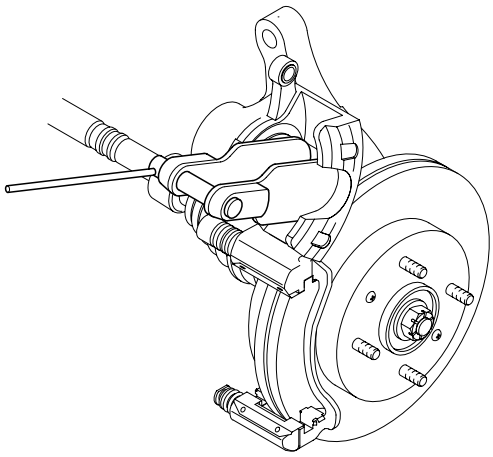
5. Pivot the caliper down into position. Being careful not to damage the pin boot, install the guide rod bolt (B) and torque it to proper specification.



EJRF500S

NOTE

Insert the piston in the cylinder using the special tool (09581-11000).



EGGE700L

6. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set.Several applications of the brake will restore the normal pedal stroke.
Be sure to do this before driving the vehicle.

7. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

INSPECTION E1355021

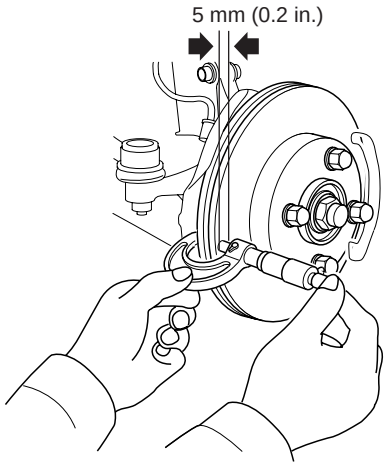
FRONT BRAKE DISC THICKNESS CHECK

1. Remove all rust and contramination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5 mm) front the brake disc outer circle.

Front brake disc thickness
Standard value : 26.0 mm(1.024 in.)
Limit : 24.4 mm(0.961 in.)

2. Thickness variation should not exceed 0.005 mm (0.0002 in.) (circumference) and 0.01 mm (in.)(radius) at any directions.

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

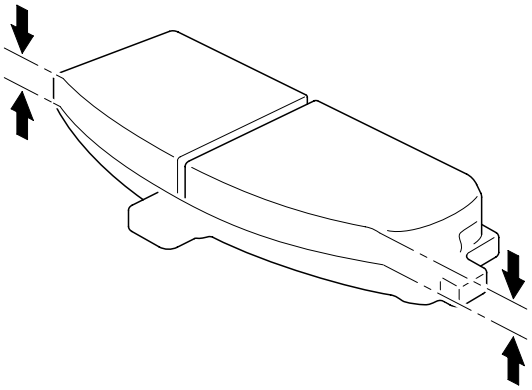


EJRF502O

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 : 11 mm (0.43 in.)
Service limit : 2.0 mm (0.0787 in.)



KJQE088A

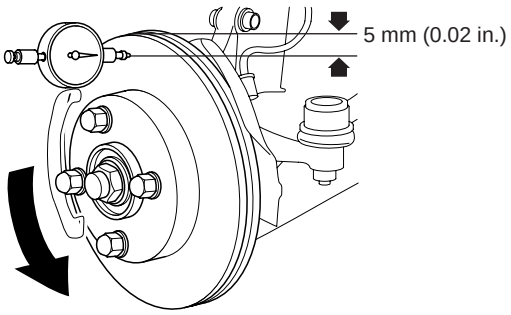
2. Check that grease is applied, to sliding contact points and the pad and backing metal for damage.

FRONT BRAKE DISC RUN OUT CHECK

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

Brake disc run out Limit : 0.04 mm (0.0016 in.) or less (new one)

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



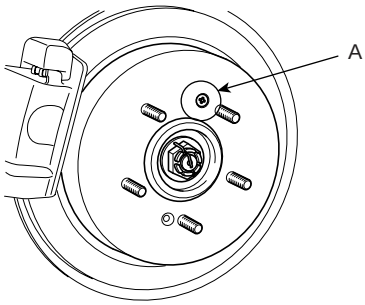
EJRF500T

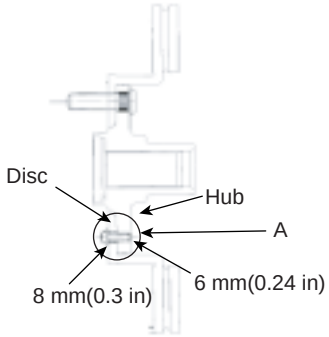
SEIZE OF FRONT BRAKE DISC

1. Remove the brake disc from hub using M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheat.

NOTE

Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.

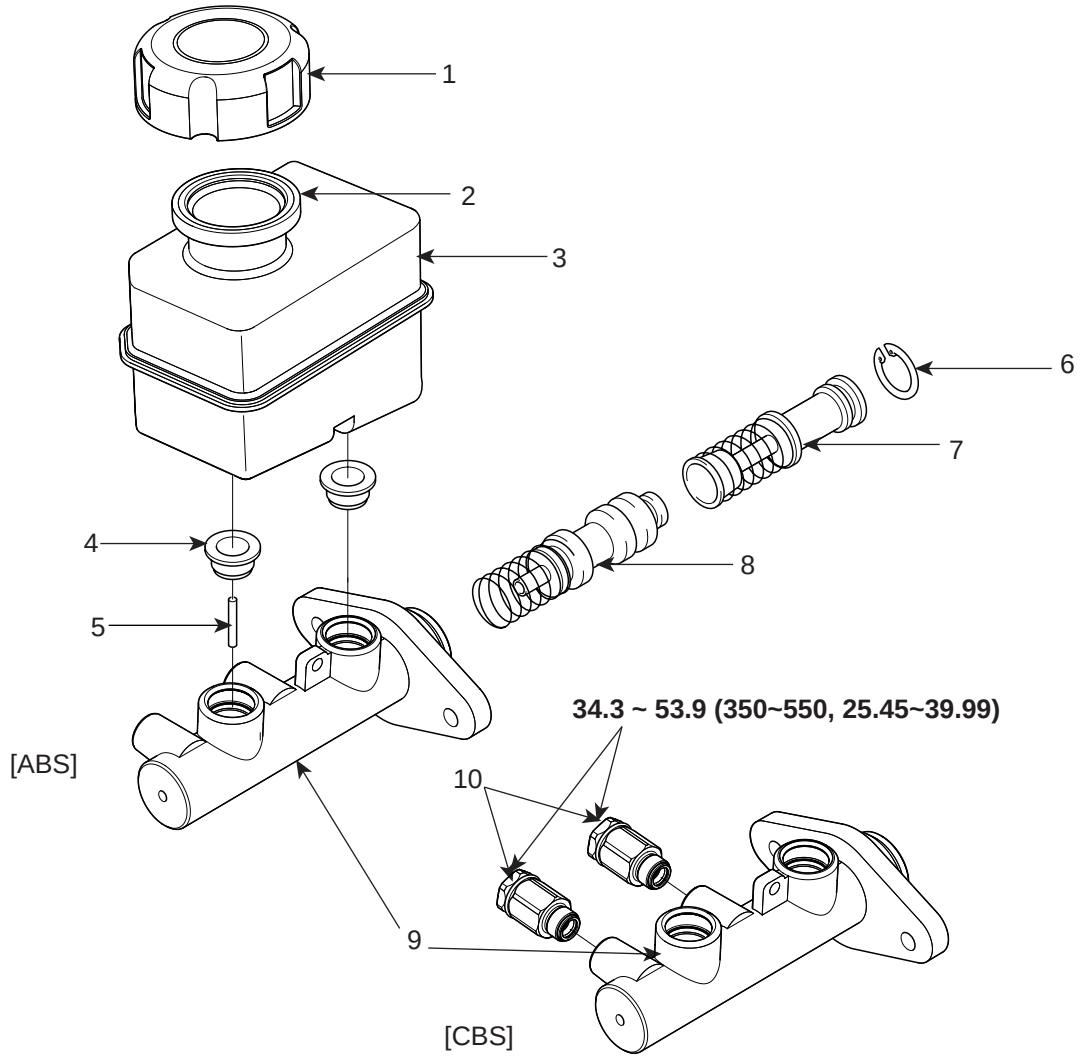




EJRF502R

MASTER CYLINDER

COMPONENTS EE7F52A0



TORQUE : Nm (Kgf·cm, lb-ft)

1. Reservoir cap
2. Brake fluid filter
3. Reservoir
4. Grommet
5. Cylinder pin
6. Retainer
7. Primary piston assembly
8. Secondary piston assembly
9. Master cylinder body
10. Proportioning valve

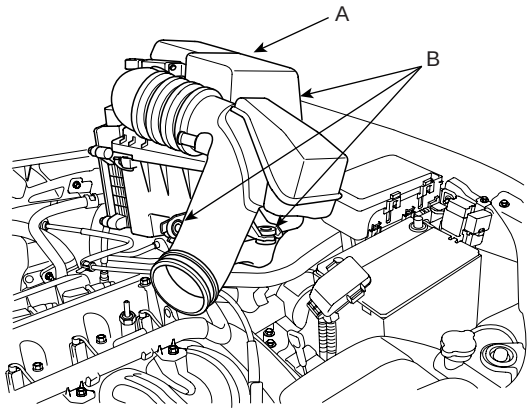
EJRF500U

REMOVAL ED2AAABE

NOTE

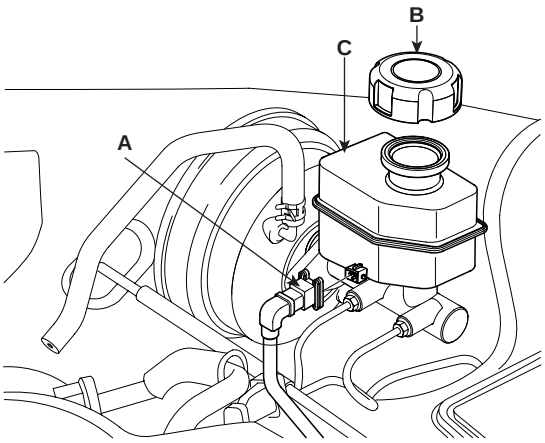
Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

1. Remove air cleaner mounting bolts (B) from the air cleaner mounting bracket and air cleaner body (A).



KJRE500W

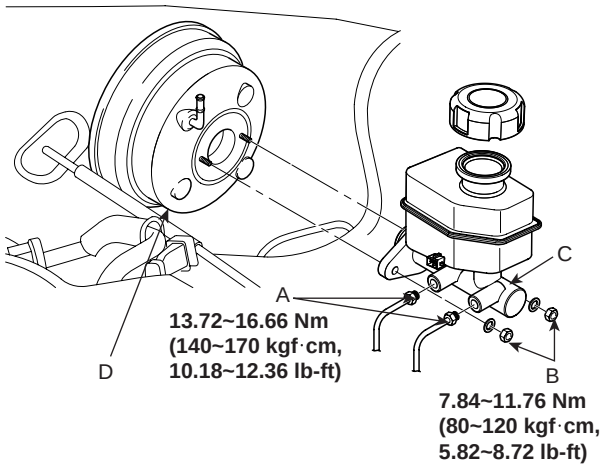
2. Disconnect the brake fluid level switch connectors (A), and remove the reservoir cap (B).



ARJE500Y

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

4. Disconnect the brake lines (A) from the master cylinder. To prevent spills, cover the hose joints with rags or shop towels.



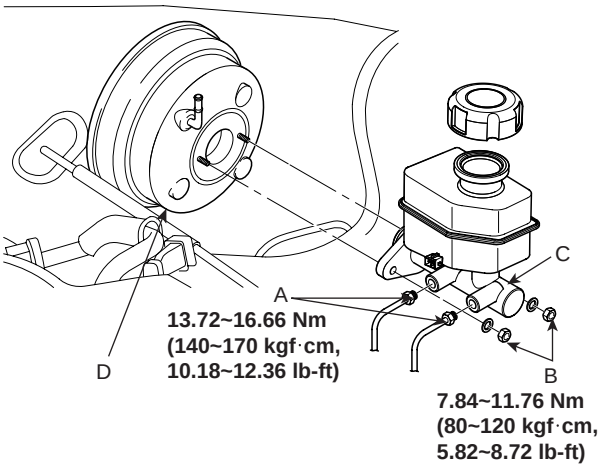
EJRF500V

5. Remove the master cylinder mounting nuts (B) and washers.

6. Remove the master cylinder(C) from the brake booster (D). Be careful not to bend or damage the brake lines when removing the master cylinder.

INSTALLATION E4C7D3AC

1. Install the master cylinder on the brake booster with 2 nuts.
2. Connect 2 brake tubes and the brake fluid level sensor connector.

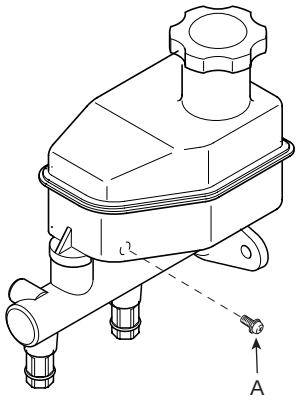


EJRF500V

3. Fill the brake reservoir with the brake fluid and bleed the brake system.

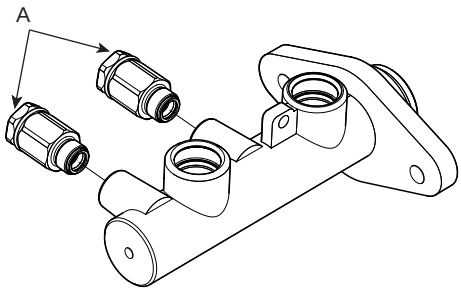
DISASSEMBLY EF6EA8AC

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



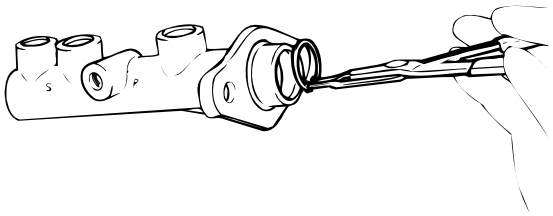
EGGE700D

4. Remove the proportioning valves (A) - CBS only.



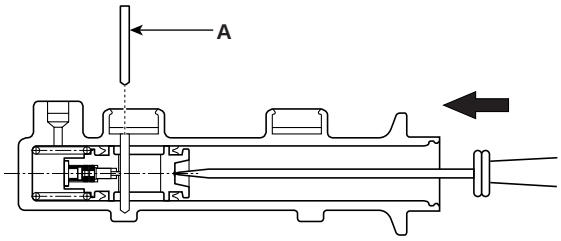
EJRF500W

5. Remove the retainer ring by using the snap ring pliers then remove the primary piston assembly.



EJA9009C

6. Remove the pin with the secondary piston pushed completely using a screwdriver. Remove the secondary piston assembly.



KJQE014B

NOTE

Do not disassemble the primary and secondary piston assembly.

INSPECTION E47CBB11

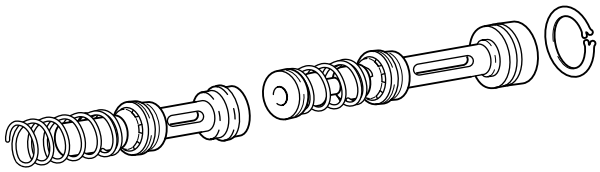
1. Check the master cylinder bore for rust or scratch.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

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

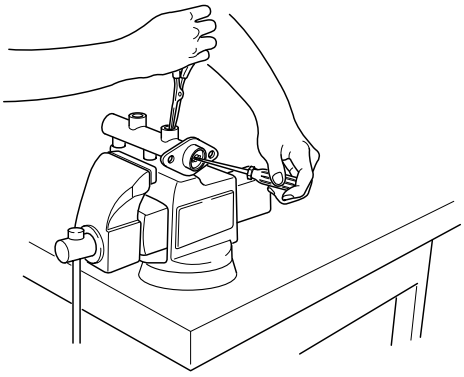
REASSEMBLY E2A58FE6

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.



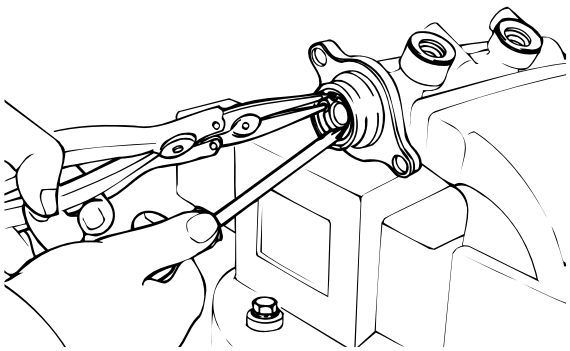
KFW8016A

3. Press the piston with a screwdriver and install the cylinder pin.



EGGE700F

4. Press the piston with a screwdriver and install the retainer ring.



EGGE700G

5. Mount two grommets.

6. Install the reservoir on the cylinder.

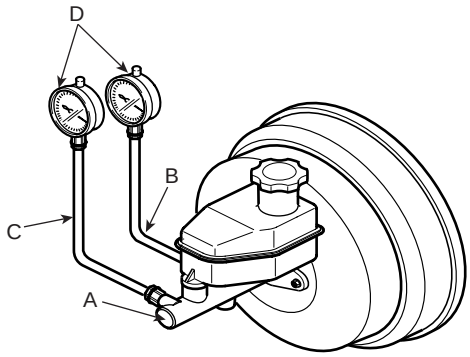
PROPORTIONING VALVE

DESCRIPTION E7D9C04E

Do not disassemble the proportioning valve. The proportioning valve makes the ideal distribution of fluid pressure to the front and rear brakes to prevent the brakes from skidding in the event of rear wheel lock up and to obtain a higher brake efficiency within the range of service brake application.

INSPECTION EFA58D2B

1. Remove the front brake tube (B) and rear brake tube (C) from the master cylinder (A).
2. Connect two pressure gauges (D); one to the output valve of the front (B) and rear (C) brake.

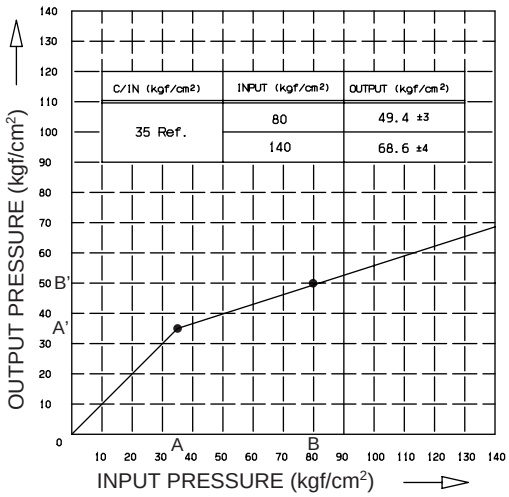


EJRF500X

NOTE

Be sure to bleed the system after connecting the pressure gauges.

3. With the brake applied, measure the front pressure and the rear pressure.
   If the measured pressures are within the specified range as illustrated, the proportioning valve is good.



EJRF500Y

4. Reconnect the brake lines in their original positions and bleed the system.

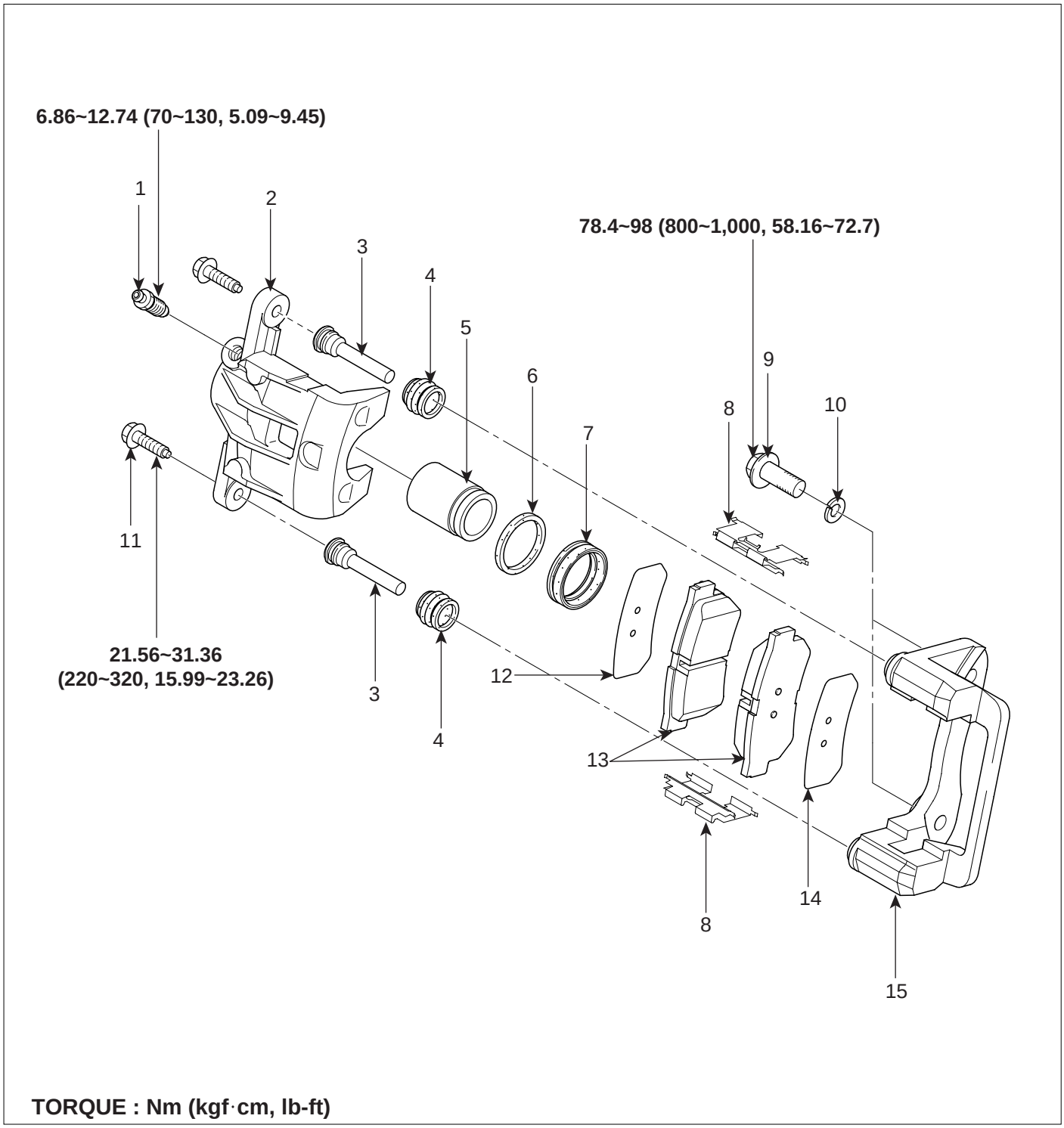
NOTE

This table shows characteristics of the proportioning valve as the pressure increases.

Input Pressure	Output Pressure
A : 35 kg/cm²	A' : 35 kg/cm²
B : 80 kg/cm²	B' : 49.4 kg/cm²

REAR DISC BRAKE

COMPONENTS EA4DDEDD



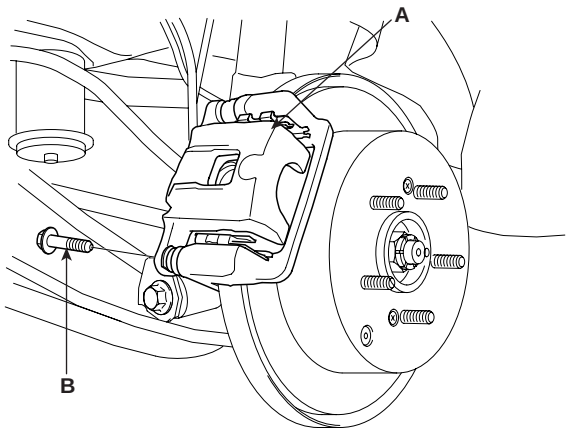
TORQUE : Nm (kgf·cm, lb-ft)

1. Bleeder screw
2. Caliper body
3. Guide rod
4. Boot
5. Piston
6. Piston seal
7. Piston boot
8. Pad retainer
9. Caliper mounting bolt
10. Washer
11. Guide rod bolt
12. Inner shim
13. Brake Pad
14. Outer shim
15. Caliper bracket

EJRF500Z

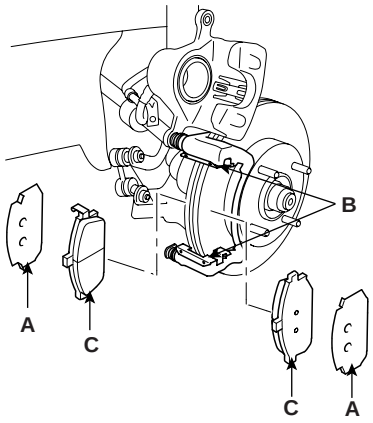
REMOVAL ECB86F4F

1. Raise the rear of the vehicle and make sure it is securely supported. Remove the rear wheel.
2. Remove the guide rod bolt(B), After raise the caliper assembly(A), support it with a wire.



ARJE501U

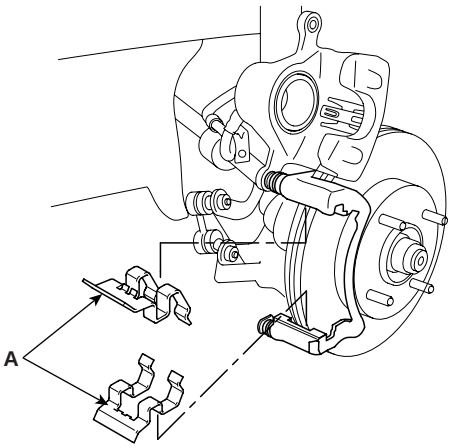
3. Remove pad shim(A), pad retainer(B) and pad assembly(C) in the caliper bracket.



ARJE501V

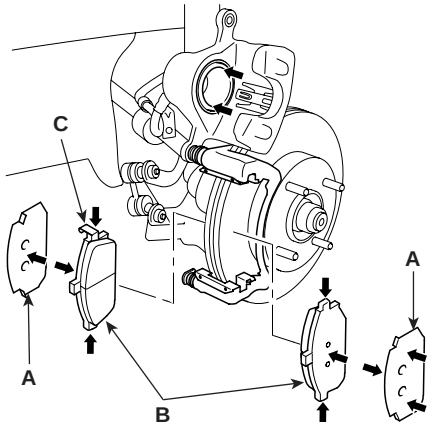
INSTALLATION EDC5ADC4

1. Install the pad retainers(A) on the caliper bracket.



ARJE501M

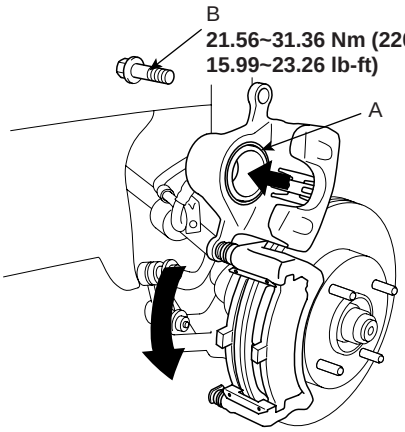
2. Check the foreign material at the pad shim (A) and the back of the pads (B).



ARJE501N

3. Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.
4. Install the brake pads (B) and pad shims (A) correctly. Install the pad with the wear indicator (C) on the inside.
   If you are reusing the pads, always reinstall the brake pads in their original position to prevent a momentary loss of braking efficiency.
5. Push in the piston (A) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.

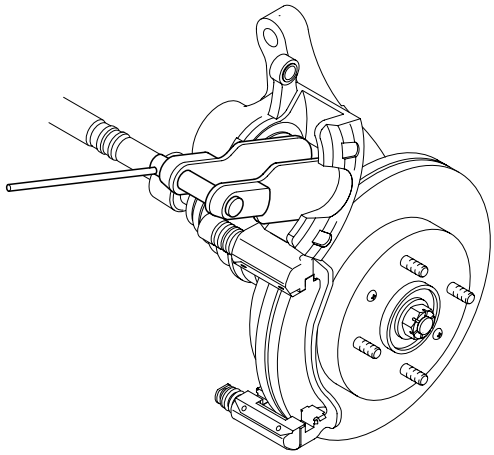
6. Pivot caliper down into position. Being careful not to damage the pin boot, install the guide rod bolt (B) and torque it to proper specification



EJRF501A

NOTE

Insert the piston in the cylinder using the special tool(09581-11000).



EGGE700L

7. Depress the brake pedal several time to make sure the brakes work, then test-drive.

NOTE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.

8. After installaion, check for leaks at hose and line joints or connections, and retighten if necessary.

INSPECTION EAE7DA7F

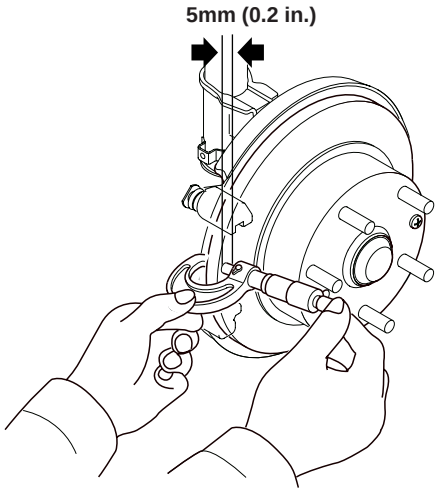
REAR BRAKE DISC THICKNESS CHECK

1. Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 points, al least, of the same distance (5mm) from the brake disk outer circle.

Rear brake disc thickness Standard value : 10.0 mm (0.39 in.) Limit : 8.0 mm (0.315 in.)

2. Thickness variation should not exceed 0.01 mm(0.0004 in.) (circumference) and 0.01 mm(0.0004 in.) (radius) at any directions.

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

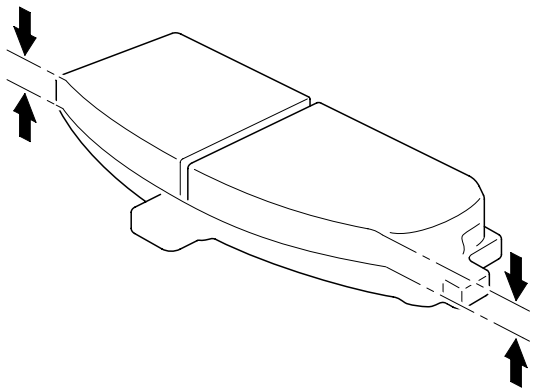


EJRF502Q

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 : 10.0 mm (0.39 in.)
Service limit : 2.0 mm (0.0787 in.)



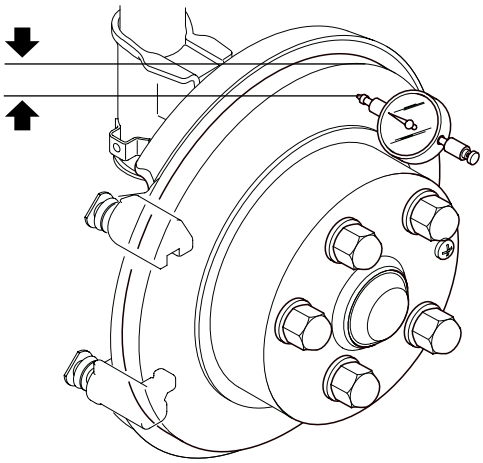
KJQE088A

2. Check that grease is applied, and the pad and backing metal for damage.

REAR BRAKE DISC RUN OUT CHECK

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

Brake disc run out
Limit : 0.05 mm (0.002 in.) or less (new one)



KJQE100E

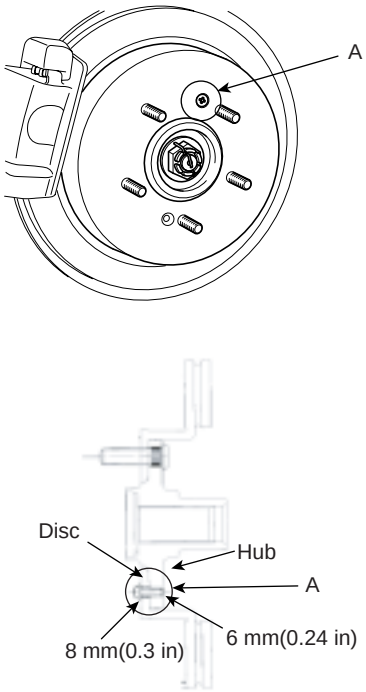
2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot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

SEIZE OF REAR BRAKE DISC

1. Remove the brake disc from hub using M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheat.

   NOTE

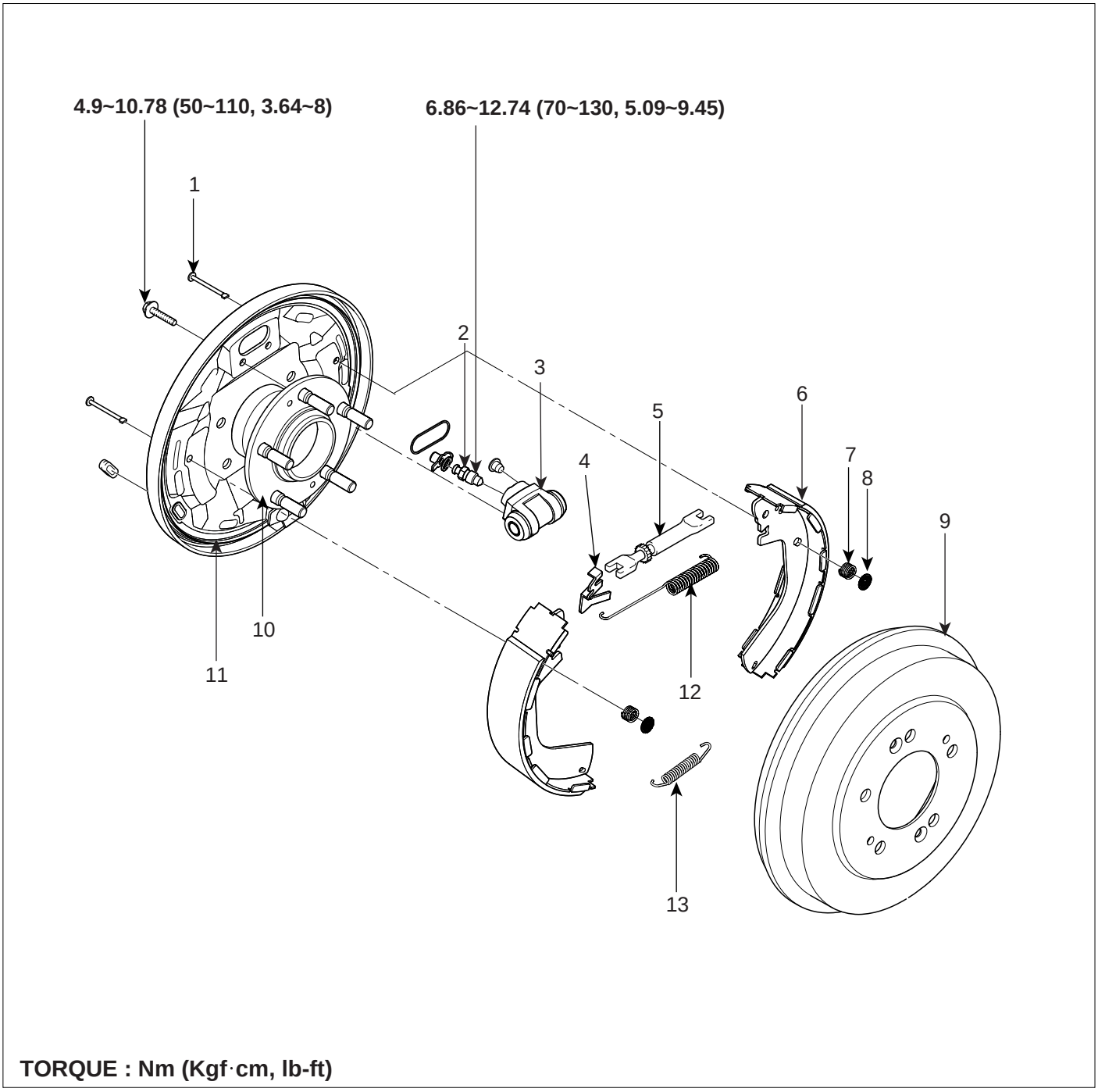
   Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.



EJRF502R

REAR DRUM BRAKE

COMPONENTS E04DCF1B



TORQUE : Nm (Kgf·cm, lb-ft)

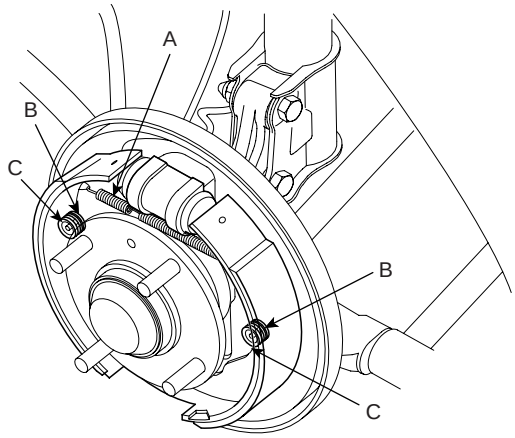
1. Shoe hold down pin
2. Bleeder screw
3. Wheel cylinder
4. Shoe adjuster lever
5. Shoe adjuster
6. Shoe & lining assembly
7. Shoe hold down spring
8. Cup washer
9. Brake drum
10. Rear hub
11. Rear brake backing plate
12. Upper shoe return spring
13. Lower shoe return spring

EJRF501B

REMOVAL EBBBD1A2

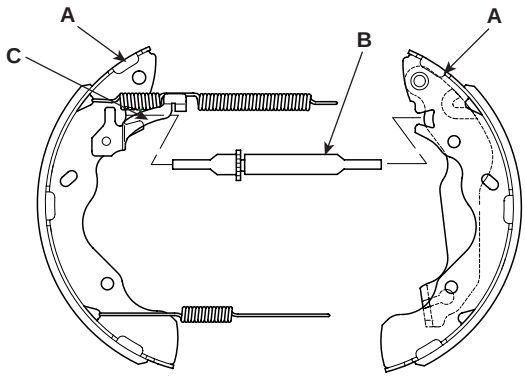
> ***CAUTION***
>
> ***Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.***
> - ***Avoid breathing dust particles.***
> - ***Never use an air hose or brush to clean brake assemblies.***

1. Remove the shoe hold down pins (B) by pushing the shoe hold cup washer (C) and turning them.
2. Disengage the upper return spring (A).



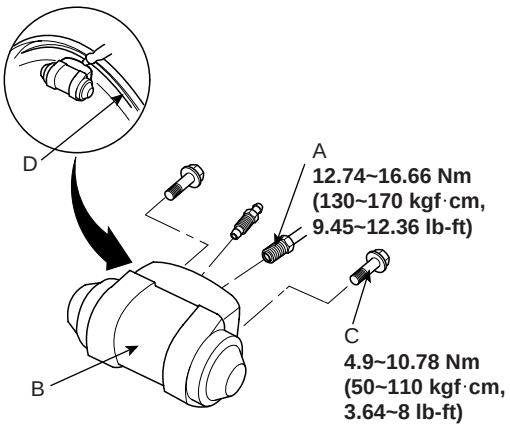
EGGE700T

3. Remove the lower shoe return spring (B) as removing the brake shoe assembly(A). Make sure not to damage the dust cover on the wheel cylinder.
4. Disconnect the parking brake cable from the parking brake lever.
5. Remove the brake shoe assembly.
6. Remove shoe adjuster (B) and lever (C) from the brake shoes.



ARJE502H

7. Disconnect the brake tube (A) from the wheel cylinder.
8. Remove the bolt (C) and the wheel cylinder from the backing plate(D).



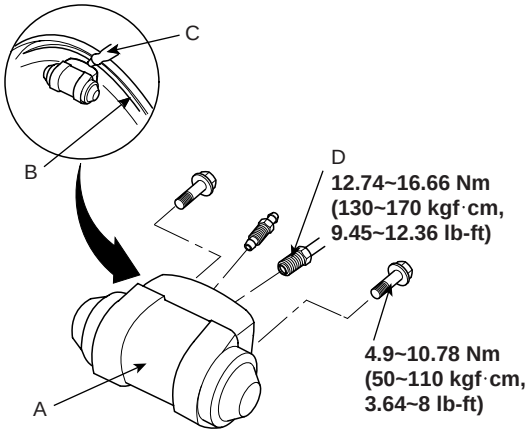
EJRF501C

INSTALLATION E70DA3AC

NOTE

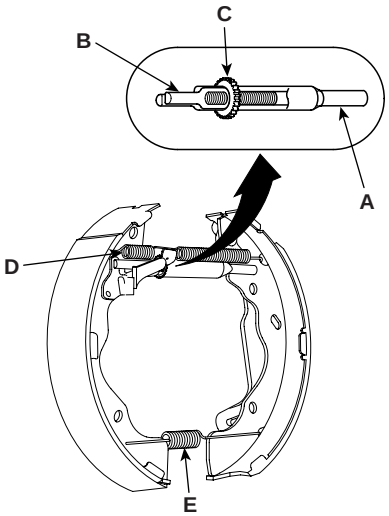
- *Do not spill brake fluid on the vehicle: it may damage the paint; if brake fluid does contact the paint. Wash it off immediately with water.*
- *To prevent spills, cover the hose joints with rags or shop towels.*
- *Use only a genuine wheel cylinder special bolt.*

1. Apply sealant (C) between the wheel cylinder (A) and backing plate (B), and install the wheel cylinder.



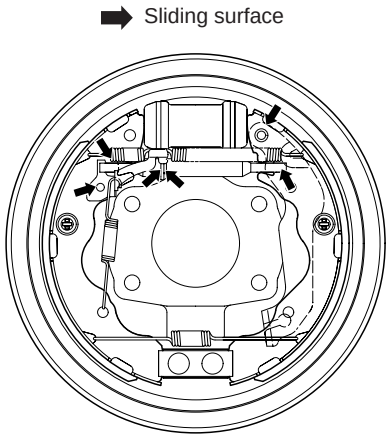
EJRF501D

2. Connect the brake tubes (D) to the wheel cylinder.
3. Connect the parking brake cable to the parking brake lever.
4. Clean the threaded portions of adjuster sleeve (A) and push rod female (B). Grease the threads of the adjuster assembly,turn the adjuster bolt (C), adjusting the length of the shoe adjuster assembly.



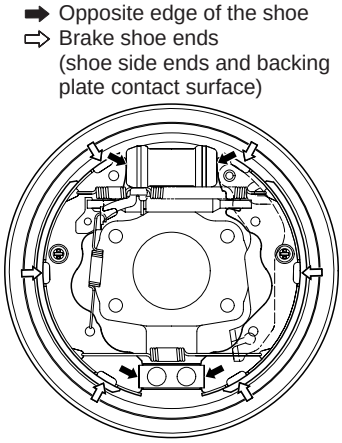
LJIF501Y

5. Hook the shoe adjuster then install to the brake shoe.
6. Install the shoe adjuster assembly and upper return spring (D), noting the installation direction. Be careful not to damage the wheel cylinder dust covers.
7. Install the lower return spring (E).
8. Grease brake cylinder to the sliding surfaces as shown below. Wipe off any excess. Don't get grease on the brake linings.



EGGE700V

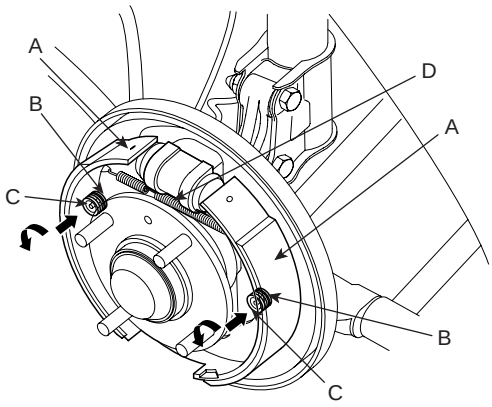
9. Grease brake cylinder to the brake shoe ends and opposite edges of the as shoes as shown below. Wipe off any excess. Don't get grease on the brake linings.



EGGE700W

10. Grease brake shoes (A) onto the backing plate. Be careful not to damage the wheel cylinder dust covers.

11. Install the shoe hold down pins (B), shoe hold down spring and the shoe hold down cup (C).



EJKE803F

12. Install the brake drum.

13. Bleed the brake system,after refilling the brake fluid.

14. Depress the brake pedal several times to set the self-adjusting brake.

15. Adjust the parking brake.

INSPECTION EC923F30

CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- ***Avoid breathing dust particles.***
- ***Never use an air hose or brush to clean brake assemblies.***

NOTE

- *Contaminated brake linings or drums reduce stopping ability.*
- *Block the front wheels before jacking up the rear of the vehicle.*

1. Raise the rear of the vehicle, and make sure it is securely supported.

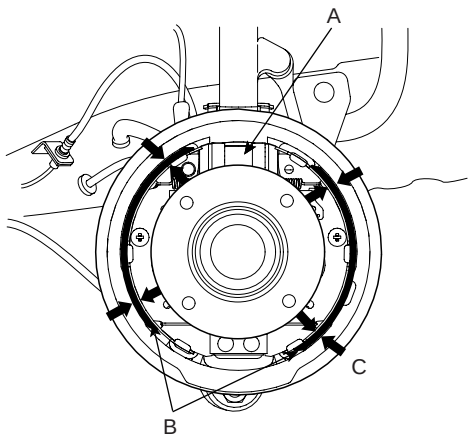
2. Release the parking brake, and remove the rear brake drum.

3. Check the wheel cylinder (A) for leakage.

4. Check the brake linings (B) for cracking, glazing, wear, and contamination.

5. Measure the brake lining thickness (C).
Measurement does not include brake shoe thickness.

Brake lining thickness
Standard : 4.5 mm (0.177 in.)
Service limit : 1.0 mm (0.039 in.)



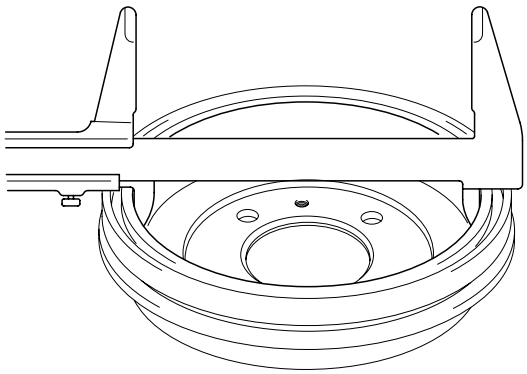
EGGE700R

6. If the brake lining thickness is less than the service limit, replace the brake shoes as a set.

7. Check the bearings in the hub unit for smooth operation. If it requires servicing, replace it.

8. Measure the inside diameter of the brake drum with inside vernier calipers.

Drum inside diameter:
Standard : 228.6 mm (9 in.)
Service limit : 230.6 mm (9.079 in.)
Drum roundness
Service limit : 0.06 mm (0.00236 in.)



EGGE700S

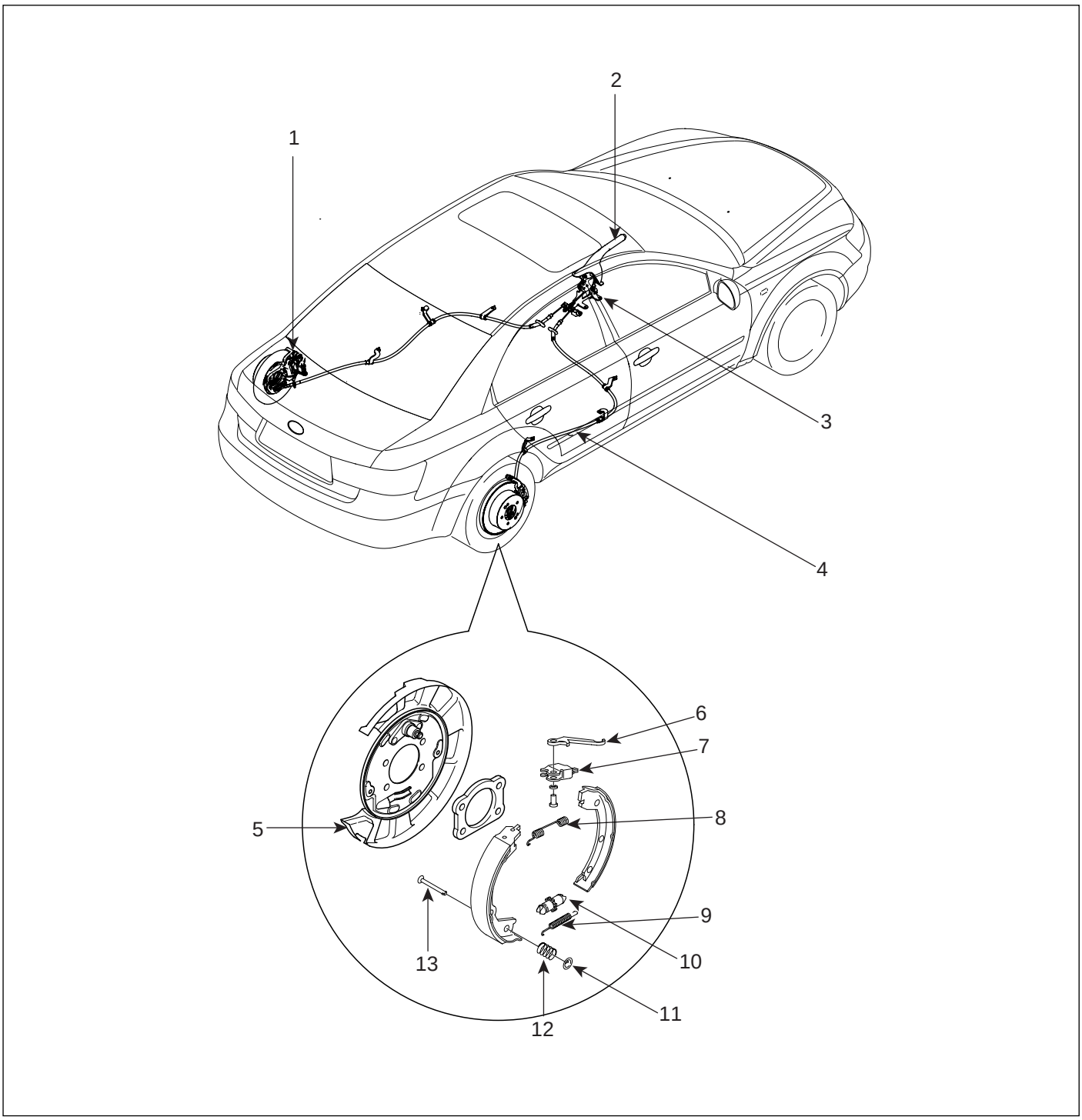
9. If the inside diameter of the brake drum is more than the service limit, replace the brake drum.

10. Check the brake drum for scoring, grooves, and cracks.

PARKING BRAKE SYSTEM

PARKING BRAKE

COMPONENTS EBD134D3



1. Rear brake caliper
2. Parking brake lever
3. Parking brake switch
4. Parking brake cable
5. Backing plate
6. Operating lever
7. Strut
8. Upper spring
9. Lower spring
10. Adjuster
11. Cup washer
12. Shoe hold down spring
13. Shoe hold down pin

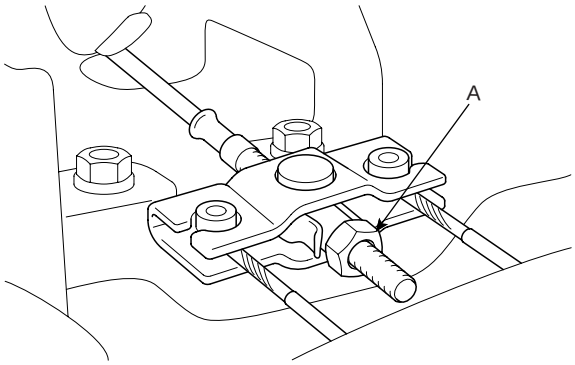
EJRF501E

REMOVAL ED2E63F7

NOTE

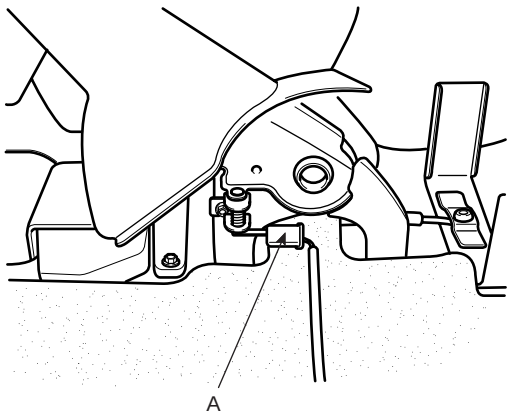
The parking brake cables must not be bent or distorted.
This will lead to stiff operation and premature failure.

1. Remove the floor console.
2. Loosen the adjusting nut (A) and remove the parking brake cables.



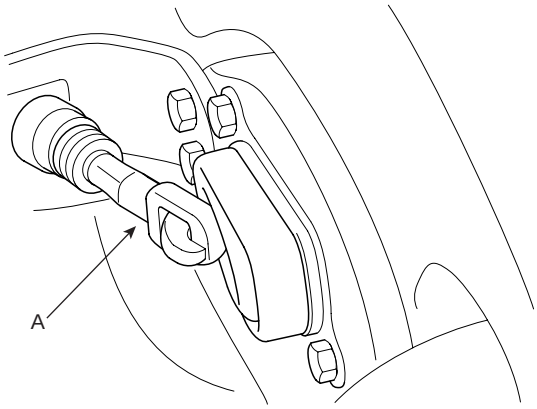
EJKE002D

3. Disconnect the connector(A) of the parking brake switch connector.



EGGE700X

4. Remove the bolts and parking brake lever assembly(A).
5. Remove the wheel and tire.
6. Remove the brake disc and the brake shoe (Refer to the rear disc brake).
7. Remove the parking brake hook(A).



KJRE502V

8. Remove the parking brake cable assembly.

INSTALLATION E445CBA2

1. Install the removed parts in the reverse order of removal.
2. Apply the specified grease to each sliding parts of the ratchet plate or the ratchet pawl.

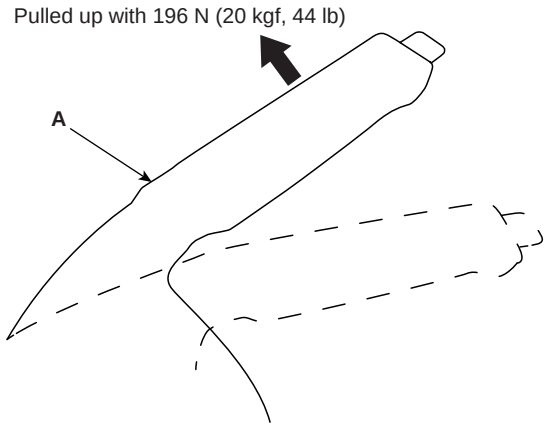
Specified grease :
Multi purpose grease SAE J310, NLGI No.2

3. After installing the parking brake cable adjuster, adjust the parking brake lever stroke (Refer to the parking brake check and adjustment).

INSPECTION EE4EA48E

1. Pull the parking brake lever (A) with 196 N (20 kgf, 44 lb) force to fully apply the parking brake. The parking brake lever should be locked within the specified number of clicks.

Lever locked clicks:7



EJRF501F

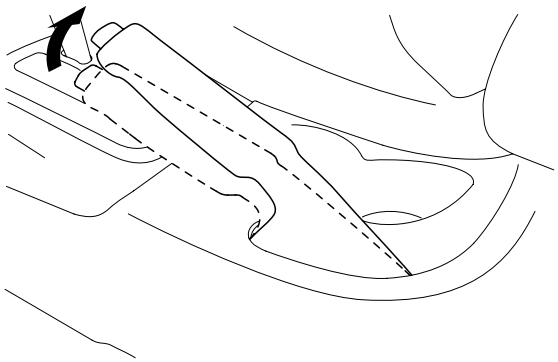
2. Adjust the parking brake if the lever clicks are out of specification.

ADJUSTMENT EE4EA49E

NOTE

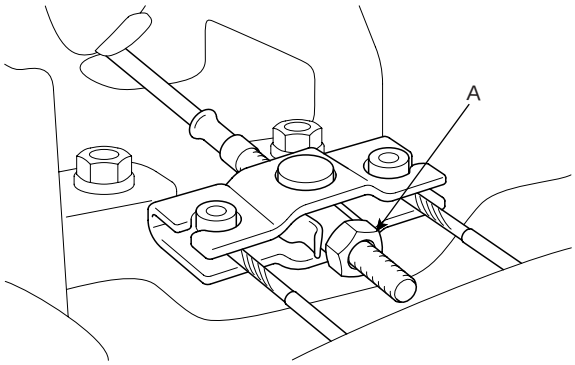
After rear brake caliper servicing, loosen the parking brake adjusting nut, start the engine and depress the brake pedal several times to set the self-adjusting brake before adjusting the parking brake.

1. Block the front wheels, then raise the rear of the vehicle and make sure it is securely supported.
2. Pull the parking brake lever up one click.



EJKE002C

3. Remove the floor console.
4. Tighten the adjusting nut (A) until the parking brakes are dragged slightly when the rear wheels are turned.



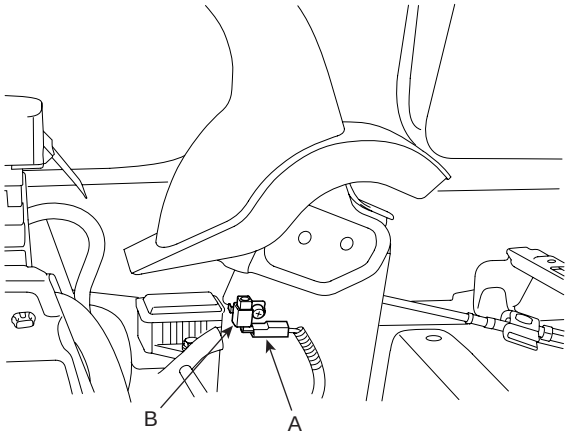
EJKE002D

5. Release the parking brake lever completely, and check if parking brakes are not dragged when the rear wheels are turned. Readjust if necessary.
6. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up completly.
7. Reinstall the floor console.

PARKING BRAKE SWITCH

INSPECTION ED3E4A76

1. Remove the floor console and the connector(B) from the switch(A).

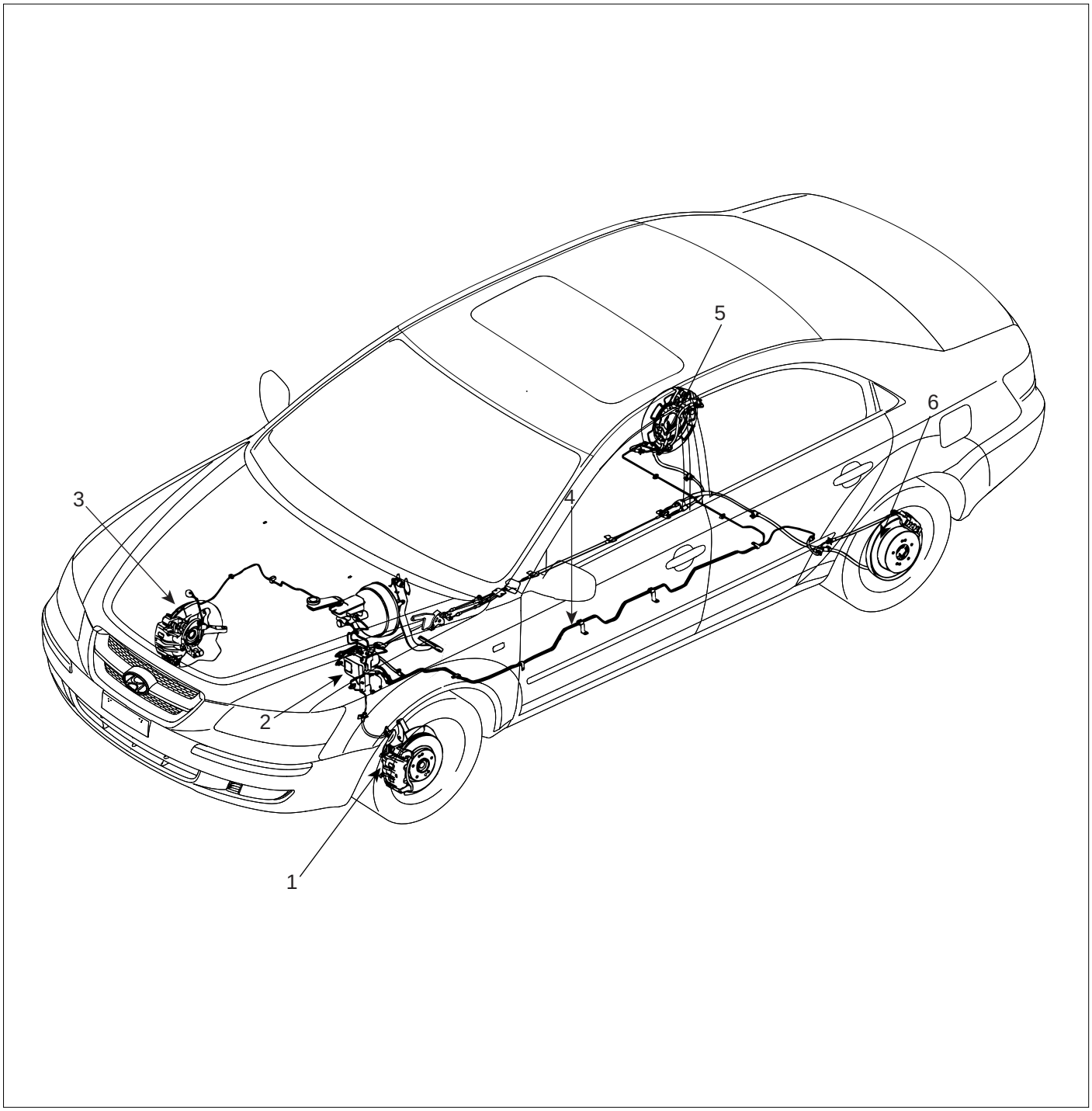


KJRE501C

2. Inspect the continuity between (-) terminal and the ground.
   - When the brake lever is pulled, there should be the continuity between them.
   - When the brake lever is released, there should be no continuity between them.

ABS (ANTI-LOCK BRAKE SYSTEM)

COMPONENTS E7ECFFCA



1. Front left wheel speed sensor
2. ABS control module(HECU)
3. Front right wheel speed sensor
4. Hydrauric line
5. Rear right wheel speed sensor
6. Rear left wheel speed sensor

EJRF501G

DESCRIPTION E87D629D

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/TCS/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 16V), 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.

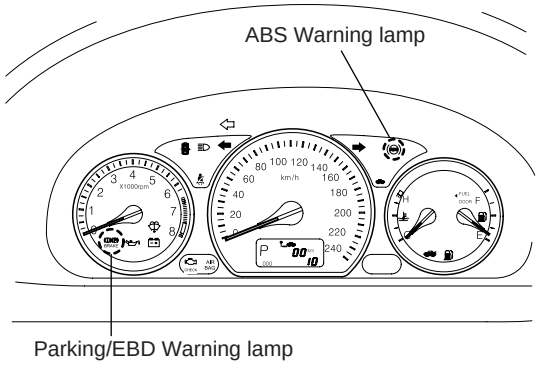
PUMP MOTOR CHECKING

The ECU performs a pump motor test at a speed of 12km/h 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



EJRF501I

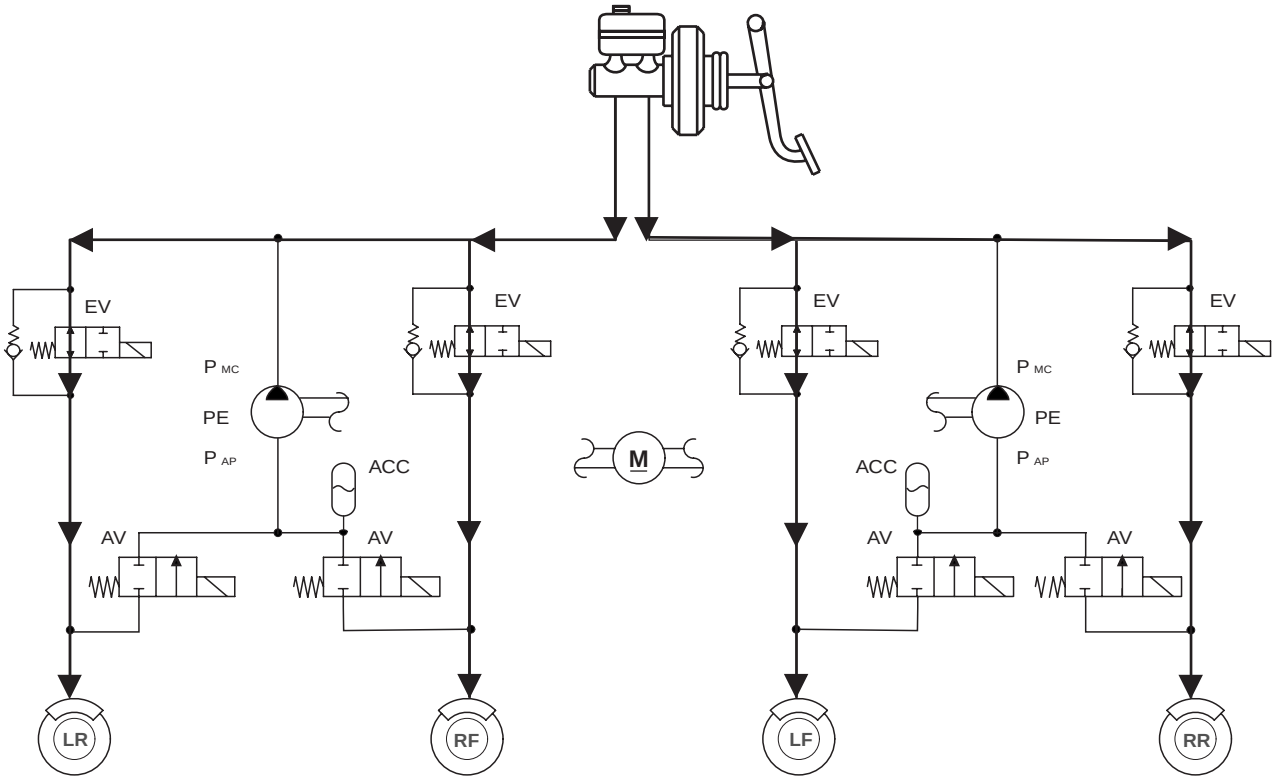
1. ABS WARNING LAMP MODULE
   The active ABS warning lamp module indicates the selftest and failure status of the ABS.The ABS warning lamp shall be on:
   - During the initialization phase after IGN ON. (continuously 3 seconds).
   - In the event of inhibition of ABS functions by failure.
   - During diagnostic mode.
   - When the ECU Connector is seperated from ECU.

2. PARKING/EBD WARNING LAMP MODULE
   The active EBD warning lamp module indicates the selftest 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 EFC9BCEA

1. NORMAL BRAKING without ABS

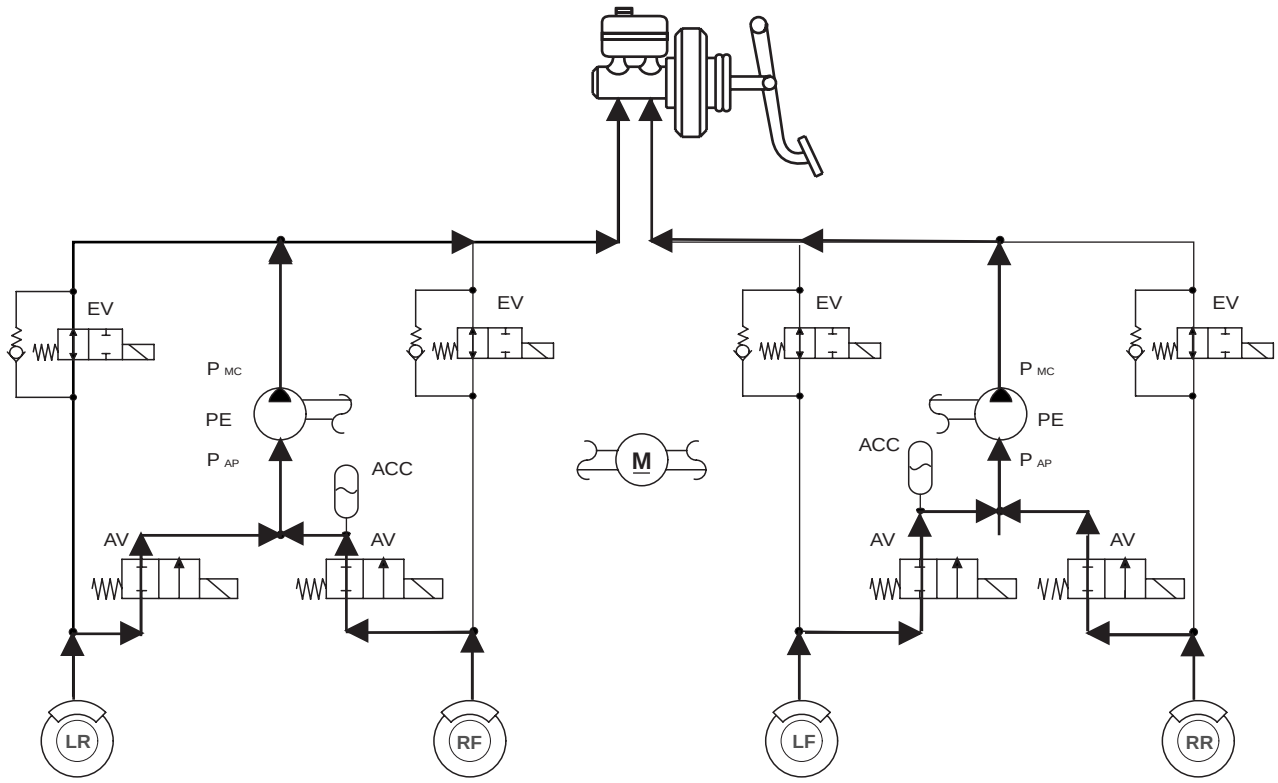
	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Open	Close	OFF



KJRE501E

2. DECREASE MODE

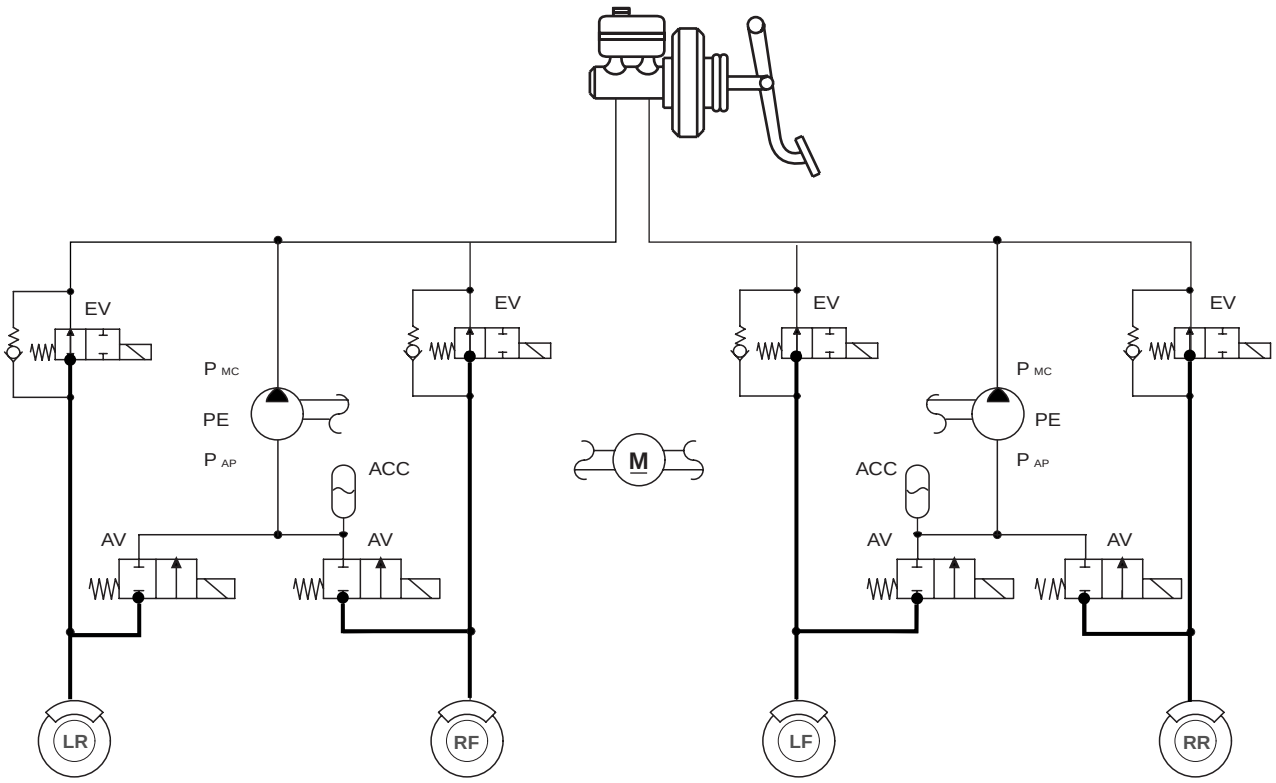
	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Close	Open	ON(Motor speed control)



KJRE501F

3. HOLD MODE

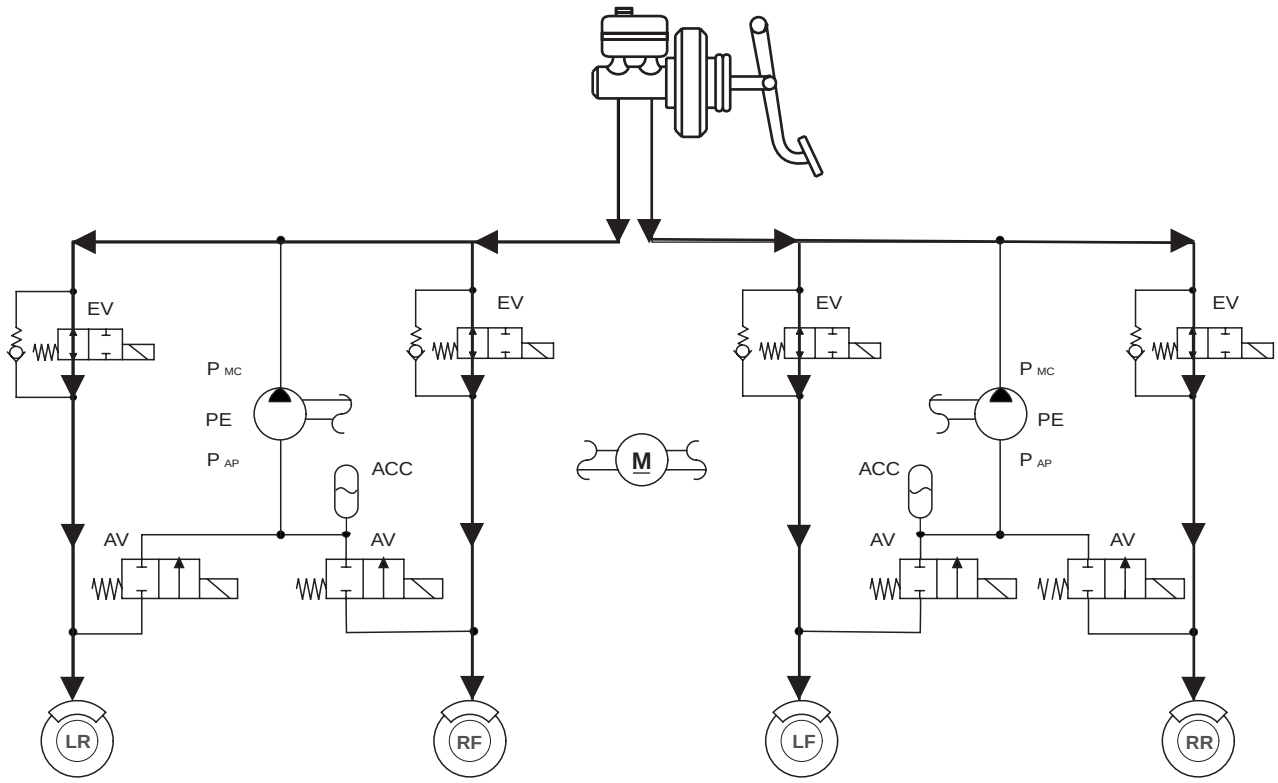
	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Close	Close	OFF



KJRE501G

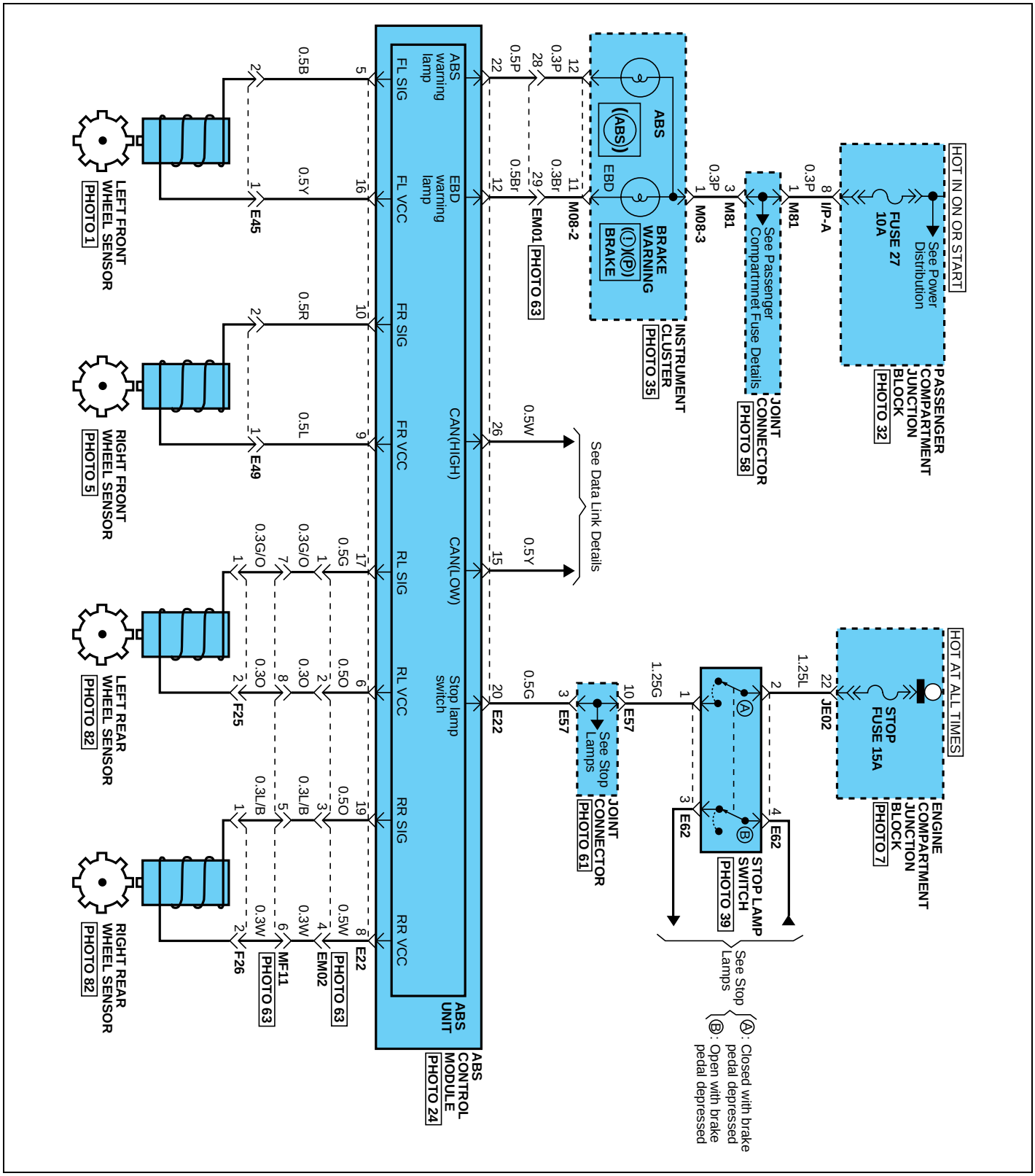
4. INCREASE MODE

	Inlet valve(EV)	Outlet valve(AV)	Pump motor
Operation	Open	Close	OFF



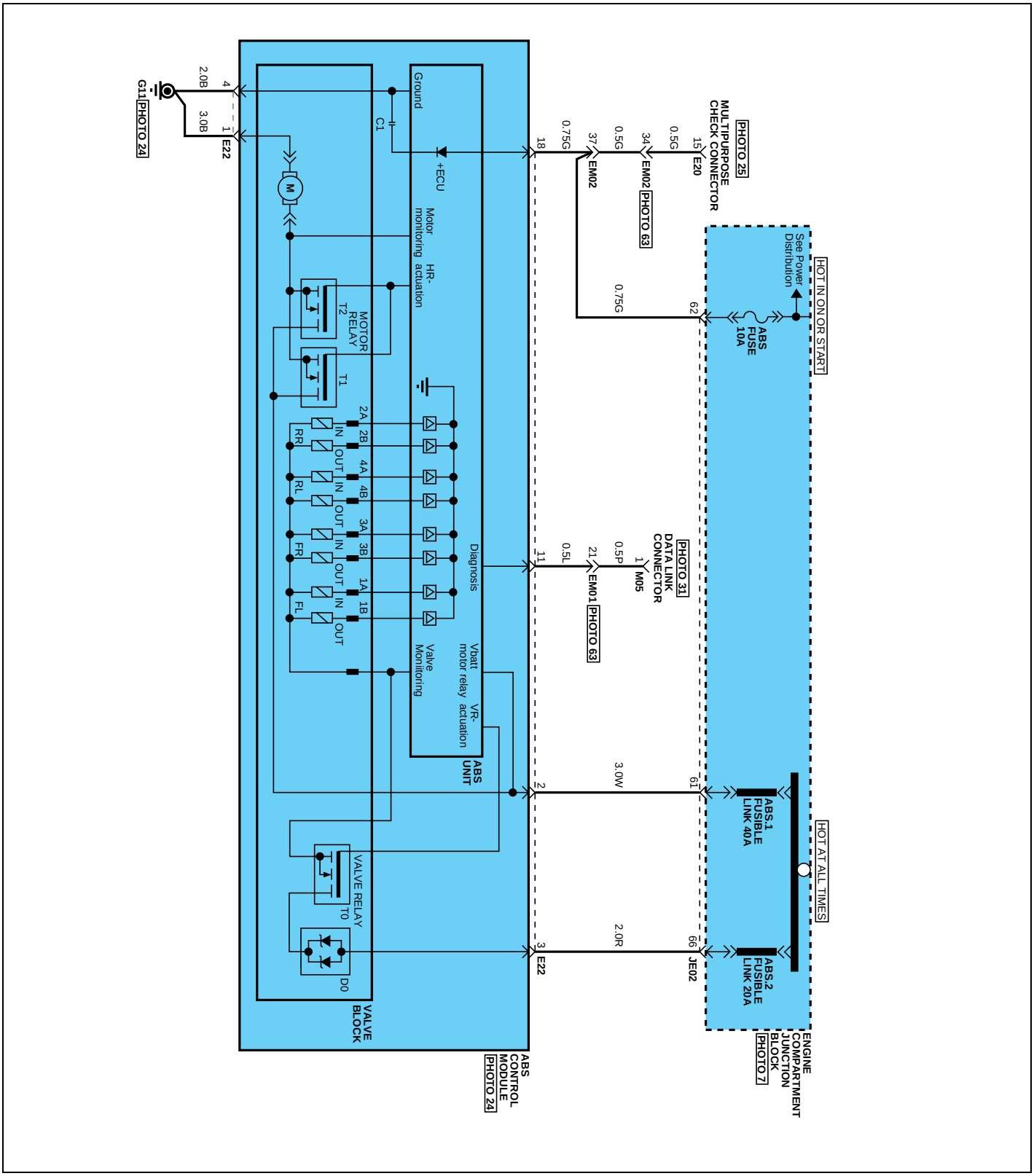
KJRE501H

ABS CIRCUIT DIAGRAM(1) E9B2028F



EJRF502S

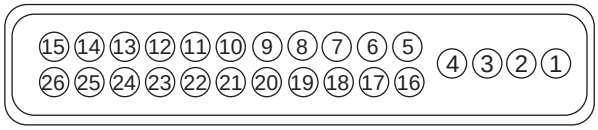
ABS CIRCUIT DIAGRAM(2)



EJRF502T

HECU CONNECTOR

INPUT/OUTPUT(ABS) E3E3DCA2



KJRE502O

Wire No.	Designation	Current		max.permissible wire resistance R_L (mΩ)	min.leakage resistance R_P (kΩ)
		max	min		
1	Ground for recirculation pump	20~39 A	10 A	10	
4	Ground for solenoid valves and ECU	5~15 A	2.5 A	10	
2	Voltage supply for pump motor	20~39 A	10 A	10	200
3	Voltage supply for solenoid valves	5~15 A	2 A	10	200
18	Voltage for hybrid ECU	1 A	500 mA	60	200
5,10,17,19	signal wheel speed sensor FL, FR, RL,RR	6 mA	16 mA	250	200 to ground 1.5M to bat
16,9,6,8	Voltage supply for the active wheel speed sensor FL,FR, RL, RR	6 mA	16 mA	250	200 to ground 1.5M to bat
14,24	wheel speed sensor output (FR, RL)	20 mA	10 mA	250	200
11	Diagnostic wire K	6 mA	3 mA	250	200
22	ABS-warning lamp actuation	30 mA	5 mA	250	200
12	EBD-warning lamp actuation	30 mA	5 mA	250	200
20	brake light switch	10 mA	5 mA	250	200

ABS HECU CONNECTOR

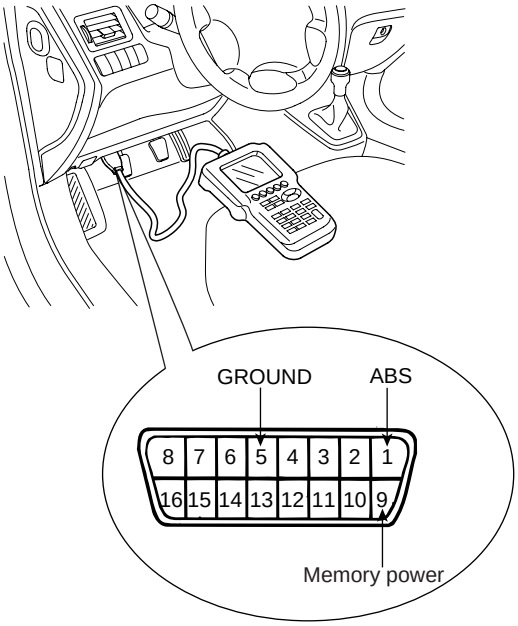
Connector terminal		Specification	Condition
Number	Description		
1	Ground for recirculation pump	Current range: Min.10A Max.20~39A	Always
4	Ground for solenoid valves and ECU	Current range: Min.2.5A Max.5~15A	Always
2	Voltage supply for pump motor	Battery voltage	Always
3	Voltage supply for solenoid valves		
16	Voltage supply for the active wheel speed sensor FL,FR, RL, RR	Battery voltage	IG ON
9			
6			
8			
5	signal wheel speed sensor FL, FR, RL,RR	Voltage(High) : 0.89~1.26 V Voltage (Low) : 0.44~0.63 V	On driving
10			
17			
19			
11	Diagnostic wire K	Voltage (High) ≥ 0.8 * IG ON Voltage (Low) ≤ 0.2 * IG ON	On HI-SCAN commu-nication
18	Voltage for hybrid ECU	Battery voltage	KEY ON/OFF
20	Brake light switch	Voltage (High) ≥ 0.8 * IG ON Voltage (Low) ≤ 0.3 * IG ON	BRAKE ON/OFF

SENSOR OUTPUT ON HI-SCAN(ABS)

	Description	Abbreviation	Unit	Remarks
1	Vehicle speed sensor	VEH. SPD	Km/h	
2	Battery voltage	BATT. VOL	V	
3	FL Wheel speed sensor	FL WHEEL	Km/h	
4	FR Wheel speed sensor	FR WHEEL	Km/h	
5	RL Wheel speed sensor	RL WHEEL	Km/h	
6	RR Wheel speed sensor	RR WHEEL	Km/h	
7	ABS Warning lamp	ABS LAMP	-	
8	EBD Warning lamp	EBD LAMP	-	
9	Brake Lamp	B/LAMP	-	
10	Pump relay state	PUMP RLY	-	
11	Valve relay state	VALVE RLY	-	
12	Motor	MOTOR	-	
13	Front Left valve(IN)	FL INLET	-	
14	Front Right valve (IN)	FR INLET	-	
15	Rear Left valve (IN)	RL INLET	-	
16	Rear Right valve (IN)	RR INLET	-	
17	Front Left valve (OUT)	FL OUTLET	-	
18	Front Right valve (OUT)	FR OUTLET	-	
19	Rear Left valve(OUT)	RL OUTLET	-	
20	Rear Right valve (OUT)	RR OUTLET	-	

HI-SCAN (PRO) CHECK EAD7B9E7

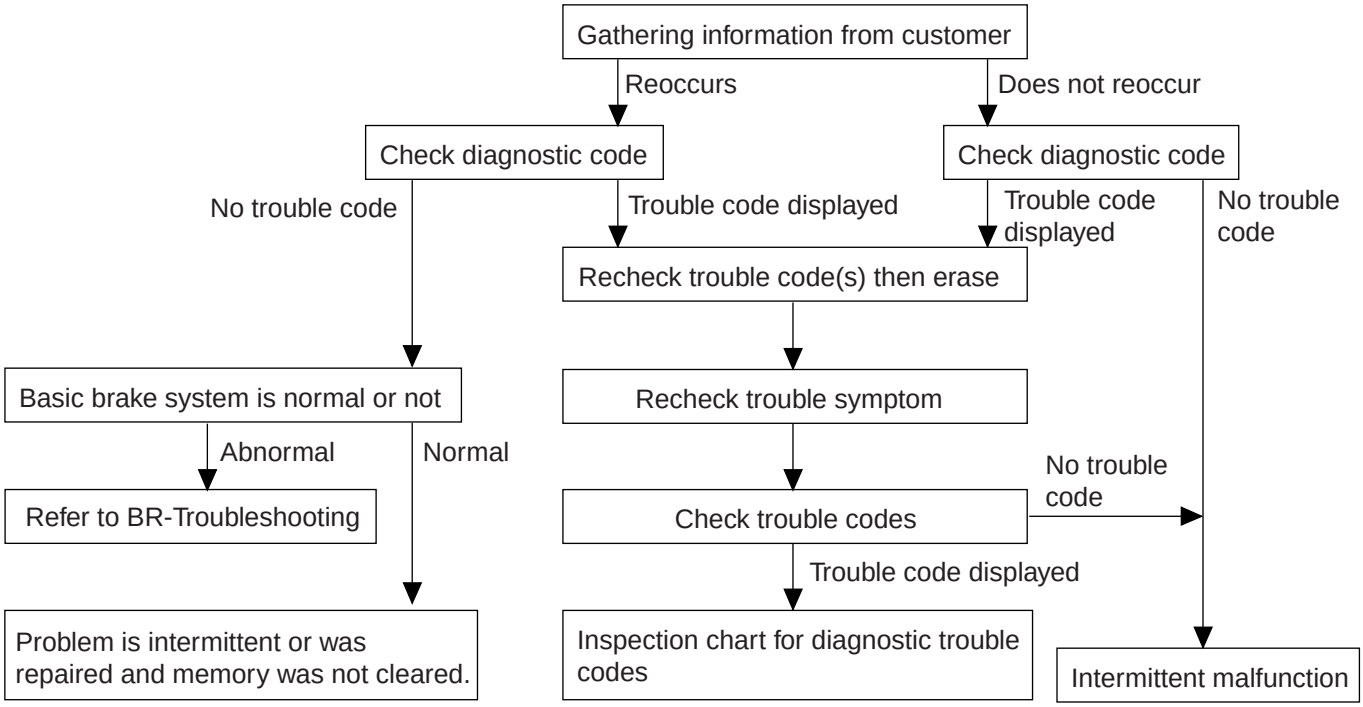
1. Turn the ignition switch OFF.
2. Connector the Hi-scan(pro) to the 16P data link connector located the driver's side kick panel.



EJRF502M

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

STANDARD FLOW OF DIAGNSTIC 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

If a normal code is displayed during the DTC check but the problem still occurs, check the circuits for each problem symptom in the order given in the table below and proceed to the relevant troubleshooting page.

Symptom	Suspect Area	See page
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.	BR - 68
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.	BR - 70
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line	BR - 71
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU	BR - 72
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU	BR - 73
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU	BR - 74

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

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 Hi-Scan (pro) with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
   Is the normal code output?

NO

▶ Check the power source circuit.

YES

▶ Erase the DTC and recheck using Hi-Scan (pro).

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 18 of the ABS control module harness side connector and body ground.

Specification: approximately B+

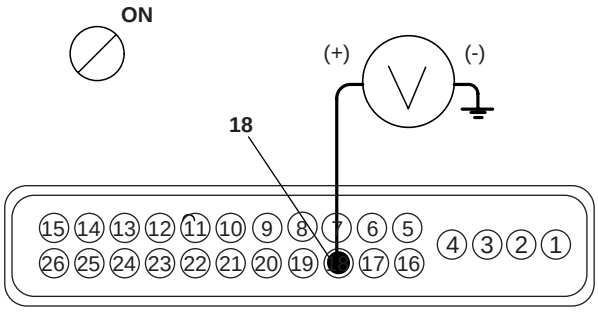
Is the voltage within specification?

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.



KJRE500H

CHECK THE GROUND CIRCUIT.

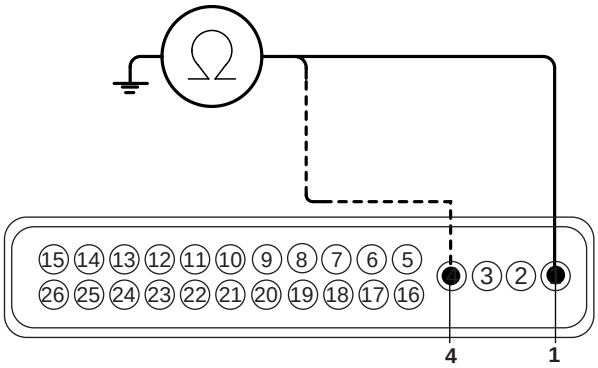
1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 1,4 of the ABS control module harness side connector and ground point.
   Is there continuity?

YES

▶ Check the wheel speed sensor circuit.

NO

▶ Repair an open in the wire and ground point.



KJRE501D

CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.
Is it normal?

YES

▶ Check the hydraulic circuit for leakage.

NO

▶ Repair or replace the wheel speed sensor.

CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.
Inspect leakage of the hydraulic lines.
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.

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 Hi-Scan (pro) with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.
   Is the normal code output?

NO

▶ Check the wheel speed sensor circuit.

YES

▶ Erase the DTC and recheck using Hi-Scan (pro).

CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.
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 20 of the ABS control module harness side connector and body ground when brake pedal is depressed.

Specification: approximately B+

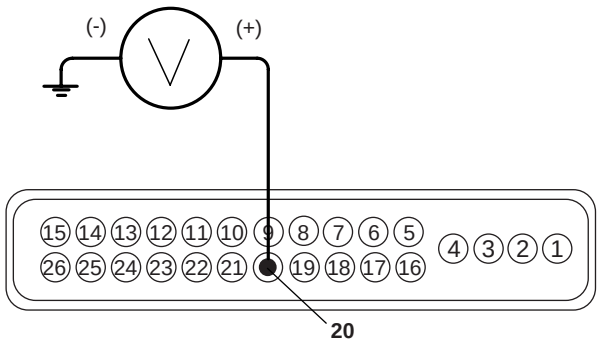
Is the voltage within specification?

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.



KJRE501I

CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

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

YES

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

NO

▶ Repair the hydraulic lines for leakage.

Communication With Hi-Scan (pro) Is Not Possible.
(Communication With Any System Is Not Possible)

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

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

Specification: approximately B+

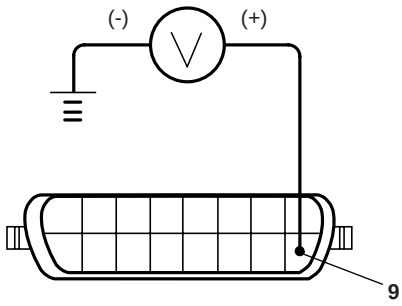
Is voltage within specification?

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.



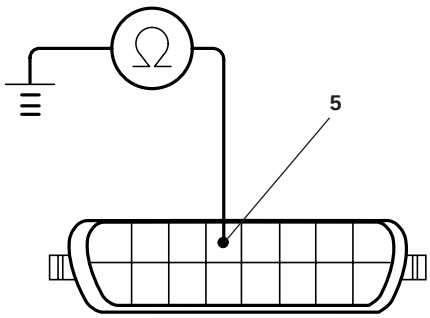
KJQE900D

CHECK THE GROUND CIRCUIT FOR THE DIAGNOSIS

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

NO

▶ Repair an open in the wire between terminal 5 of the data link connector and ground point.



KJQE900E

Communication With Hi-Scan (pro) Is Not Possible.
(Communication With ABS Only Is Not Possible)

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 11 of the ABS control module connector and 1 of the data link connector.
   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 18 of the ABS control module harness side connector and body ground.

Specification: approximately B+

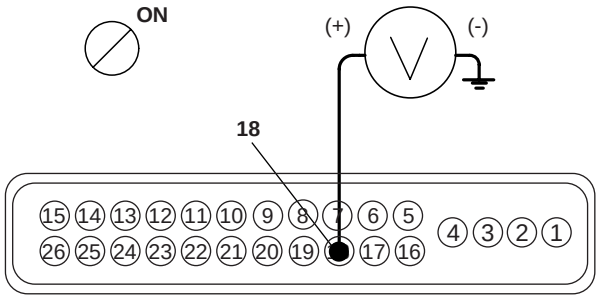
Is voltage within specification?

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.



KJRE501J

CHECK FOR POOR GROUND

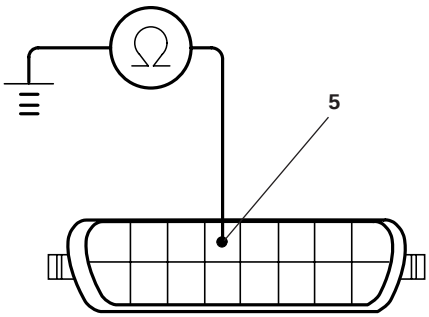
Check for continuity between terminal 5 of the data link connector and ground point.

YES

▶ Replace the ABS control module and recheck.

NO

▶ Repair an open in the wire or poor ground.



KJQE900E

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

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 No.2 fuse (10A) in the engine compartment junction block - Faulty ABS warning lamp module - Faulty HECU

INSPECTION PROCEDURES

PROBLEM VERIFICATION

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

NO

▶ It is normal. Recheck the ABS control module.

YES

▶ Check the power source for the ABS warning lamp.

CHECK THE POWER SOURCE FOR THE ABS WARNING LAMP

1. Disconnect the instrument cluster connector and turn the ignition switch ON.
2. Measure the voltage between terminal 5 of the cluster harness side connector and body ground.

Specification: approximately B+

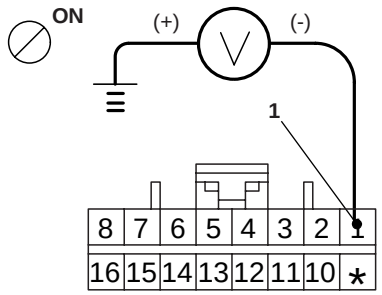
Is voltage within specification?

NO

▶ Repair bulb or instrument cluster assembly.

YES

▶ Check for blown fuse.



KJRE501K

CHECK FOR BLOWN FUSE.

Check continuity of fuse (10A) from the engine compartment junction block.
Is there continuity?

NO

▶ Repair an open in the wire between ABS fuse and 1 of cluster connector.

YES

▶ Replace the blown fuse.

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

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 DTC 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 Hi-Scan (pro) to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using Hi-Scan (pro).
   Is DTC output?

NO

▶ Repair circuit indicated by code output.

YES

▶ Check instrument cluster.

CHECK INSTRUMENT CLUSTER

Disconnect the cluster connector and turn the ignition switch ON.
Does the ABS warning lamp remains ON?

YES

▶ Replace the instrument cluster.

NO

▶ Check for open the wire.

CHECK FOR OPEN IN THE WIRE

Check for continuity in the wire between cluster and ABS control module.
Is there continuity?

YES

▶ Replace the ABS control module and recheck.

NO

▶ Repair an open in the wire between cluster and ABS control module.

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.

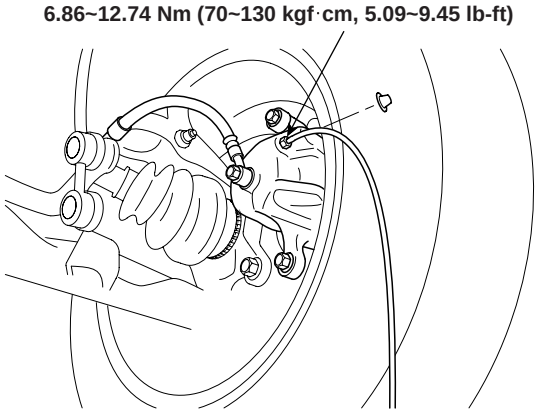
   CAUTION

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

   NOTE

   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.



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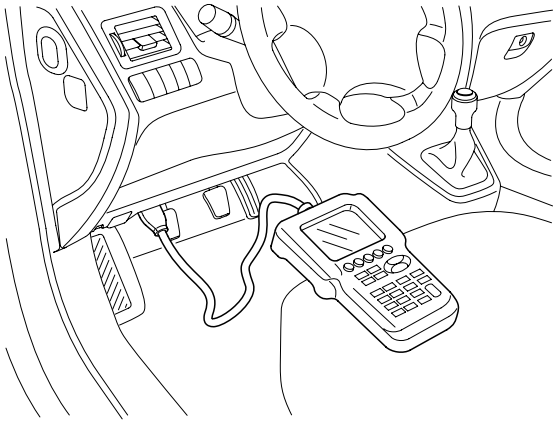
3. Connect the hi-scan (pro) to the data link connector located underneath the dash panel.



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4. Select and operate according to the instructions on the hi-scan (Pro) 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 hyundai vehicle diagnosis.
   2) Select vehicle name.
   3) Select Anti-Lock Brake system.
   4) Select air bleeding mode.
   5) Press "YES" to operate motor pump and solenoid valve.

1.6 AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
01. SOLENOID VALVE STATUS	CLOSE
02. MOTOR PUMP STATUS	OFF
DO YOU WANT TO START ?	
(PRESS [YES] KEY)	

EJDA014F

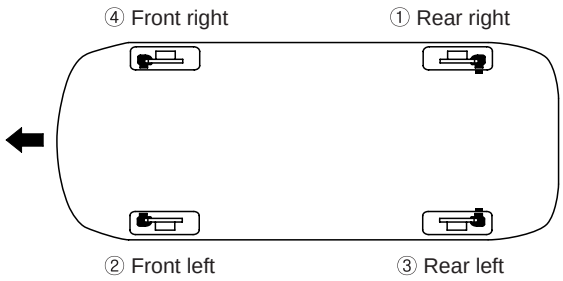
   6) Wait 60 sec. before operating the air bleeding. (If not, you may damage the motor.)

1.6 AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
01. SOLENOID VALVE STATUS	OPEN
02. MOTOR PUMP STATUS	ON
TIME : AUTOMATIC COUNT (1-60 SEC.)	

EJDA014G

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.

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 Nm (70 ~ 130 kgf·cm, 5.09 ~ 9.45 lb-ft)

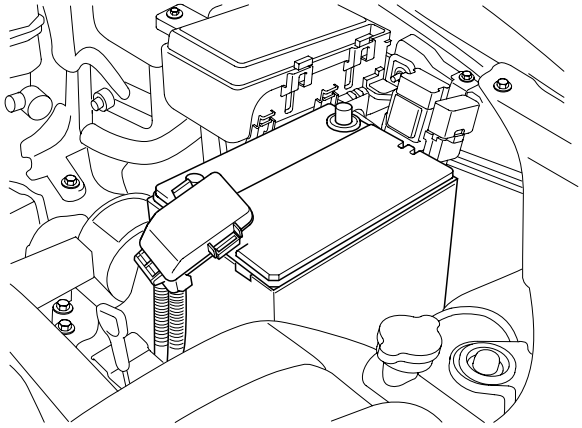
DIAGNOSTIC TROUBLE CODE CHART(DTC)

DTC	DESCRIPTION	WARNING LAMP			REMARK	SEE PAGE
		ABS	EBD	ESP		
C1101	BATTERY VOLTAGE HIGH	O	O	O		BR - 79
C1102	BATTERY VOLTAGE LOW	O		O		BR - 79
C1200	FL WHEEL SPEED SENSOR- OPEN/SHORT	O		O		BR - 84
C1201	FL WHEEL SPEED SENSOR- RANGE/ PERFORMANCE	O		O		BR - 88
C1202	FL WHEEL SPEED SENSOR-NO SIGNAL	O		O		BR - 91
C1203	FR WHEEL SPEED SENSOR- OPEN/SHORT	O		O		BR - 84
C1204	FR WHEEL SPEED SENSOR- RANGE/ PERFORMANCE	O		O		BR - 88
C1205	FR WHEEL SPEED WHEEL SPEED SENSOR-NO SIGNAL	O		O		BR - 91
C1206	RL WHEEL SPEED SENSOR- OPEN/SHORT	O		O		BR - 84
C1207	RL WHEEL SPEED SENSOR- RANGE/ PERFORMANCE	O		O		BR - 88
C1208	RL WHEEL SPEED WHEEL SPEED SENSOR-NO SIGNAL	O		O		BR - 91
C1209	RR WHEEL SPEED SENSOR- OPEN/SHORT	O		O		BR - 84
C1210	RR WHEEL SPEED SENSOR- RANGE/ PERFORMANCE	O		O		BR - 88
C1211	RR WHEEL SPEED SENSOR-NO SIGNAL	O		O		BR - 91
C1213	WHEEL SPEED FREQUENCY ERROR	O		O		BR - 95
C1235	PRESSURE SENSOR-ELECTRICAL			O	ESP	BR - 97
C1237	PRESSURE SENSOR-SIGNAL FAULT			O	ESP	BR - 97
C1260	STEERING ANGLE SENSOR-SIGNAL			O	ESP	BR - 100
C1261	STEERING ANGLE SENSOR IS NOT CALIBRATED			O	ESP	BR - 100
C1282	YAW RATE & LATERAL G SENSOR-ELECTRICAL			O	ESP	BR - 103
C1283	YAW RATE & LATERAL G SENSOR-SIGNAL			O	ESP	BR - 107
C1503	ESP SWITCH ERROR			O	ESP	BR - 110
C1513	BRAKE LIGHT SWITCH MAL.			O		BR - 113
C1604	ECU HARDWARE ERROR	O	O	O		BR - 115
C1605	CAN CONTROL HARDWARE ERROR			O	ESP	BR - 117
C1611	CAN TIME OUT-ECM			O	ESP	BR - 119
C1612	CAN TIME OUT-TCU			O	ESP	BR - 119
C1616	CAN BUS OFF			O	ESP	BR - 121

DTC	DESCRIPTION	WARNING LAMP			REMARK	SEE PAGE
		ABS	EBD	ESP		
C1623	CAN TIMEOUT STEERING ANGLE SENSOR			O	ESP	BR - 119
C1625	CAN TIME OUT-ESP			O	ESP	BR - 123
C1626	IMPLAUSIBLE CONTROL	O	O	O	ESP	BR - 125
C1702	VARIANT CODING			O	ESP	BR - 127
C2112	VALVE RELAY MAL.	O	O	O		BR - 128
C2308	FL INLET VALVE MAL.	O	O	O		BR - 131
C2312	FL OUTLET VALVE MAL.	O	O	O		BR - 131
C2316	FR INLET VALVE MAL.	O	O	O		BR - 131
C2320	FR OUTLET VALVE MAL.	O	O	O		BR - 131
C2324	RL INLET VALVE MAL.	O	O	O		BR - 131
C2328	RL OUTLET VALVE MAL.	O	O	O		BR - 131
C2332	RR INLET VALVE MAL.	O	O	O		BR - 131
C2336	RR OUTLET VALVE MAL.	O	O	O		BR - 131
C2366	TC VALVE PRIMARY(USV1) ERROR	O	O	O	ESP	BR - 134
C2370	TC VALVE SECONDARY (USV2) ERROR	O	O	O	ESP	BR - 134
C2372	ESP VALVE 1(HSV1) ERROR	O	O	O	ESP	BR - 134
C2374	ESP VALVE 2 (HSV2) ERROR	O	O	O	ESP	BR - 134
C2402	MOTOR-ELECTRICAL	O	O	O		BR - 135

DTC C1101 BATTERY VOLTAGE HIGH
DTC C1102 BATTERY VOLTAGE LOW

COMPONENT LOCATION EBC713EC



KJRE760C

GENERAL DESCRIPTION E9BEF58E

The ABS ECU(Electronic Control Unit) checks the battery 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 E8E06CCF

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

1. When the voltage is higher than the expected normal value, this code is set, and the ABS/EBD/TCS/ESP functions are prohibited. If the voltage recovers, to within normal operating ranges, then the controller returns to normal operation as well.

2. When the voltage is lower than the expected normal value, this code is set. The ABS/TCS/ESP functions are prohibited and the EBD function is allowed on LOW VOLTAGE CONDITION 1, the ABS/EBD/TCS/ESP functions are prohibited on UNDER VOLTAGE CONDITION.

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

DTC DETECTING CONDITION E3FDDE1E

Item	Detecting Condition		Possible cause
DTC Strategy	Battery Voltage Monitoring		• Poor connection in power supply circuit (IGN+) • Faulty Alternator • Faulty HECU
Enable Conditions	C1101	High voltage problem will be monitored if filtered Ignition Voltage is > 16.8 V. It will be reset if filtered Ignition Voltage < 16.7 V.	
	C1102	1. Ignition Voltage is monitored for a level of filtered Ignition Voltage < 9.3 V outside control, or a level of filtered Ignition Voltage < 9.2 V during control. 2. Hard under voltage due to low voltage glitches is detected if unfiltered Ignition Voltage < = 8.2 V for t >= 20 ms. 3. A hard under voltage problem will be detected if the filtered UZ < 7.7 V. The system remains in this condition until filtered UZ > 7.8 V. ***NOTE*** *All under voltage failures will only be saved in EEPROM if vehicle speed is > 6 km/h(3 MPH). This prevents false failure entries due to a bad battery at ignition on.*	
Monitoring period	Continuous. Under voltage faults are only entered in the EEPROM if the vehicle speed is v > 6 km/h (3 MPH). Over voltage faults will be always stored.		
Effect	The proper function of valves and return pump is not guaranteed.		
Fail Safe	• System down. The ABS/EBD/TCS/ESP functions are inhibited. - The valve relay and all solenoids are prevented from being switched on. • The ABS/EBD/TCS/ESP warning lamps are activated.		

SPECIFICATION EED630FA

Voltage : 9.3 ≤ V ≤ 16.8 V

TERMINAL & CONNECTOR INSPECTION ECDFEACF

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 the next step.

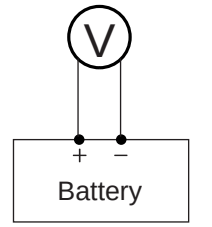
POWER SUPPLY CIRCUIT INSPECTION EEAABFE2

1. ALTERNATOR OUTPUT VOLTAGE INSPECTION

   1) Engine "ON".

   2) Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : Approx. 14.4 ± 0.3 V (20 °C)



1. Battery terminal (+)
2. Battery terminal (-)

Voltage regulator ambient temperature(°C)	Regulating voltage
-30	14.1 ~ 15.2
20	14.1 ~ 14.7
120	13.3 ~ 14.7

EJRF501J

Is the measured voltage within specifications?

YES

▶ Go to "Power Circuit Inspection" procedure.

NO

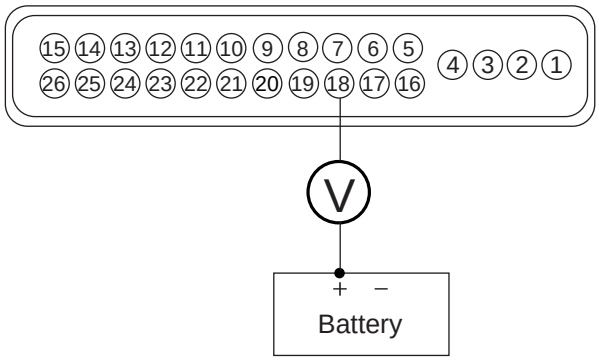
▶ Check for damaged harness and poor connection between alternator and battery. If OK , repair or replace alternator and then go to "Verification of vehicle Repair" procedure.

2. POWER CIRCUIT INSPECTION

   1) Engine "ON".

   2) Measure voltage between the battery terminal(+) and terminal "18(28:ESP)" of the HECU harness connector.

Specification : Approx. below 0.2 V



EJRF501K

Is the measured voltage within specifications?

YES

▶Go to "Ground Circuit Inspection" procedure.

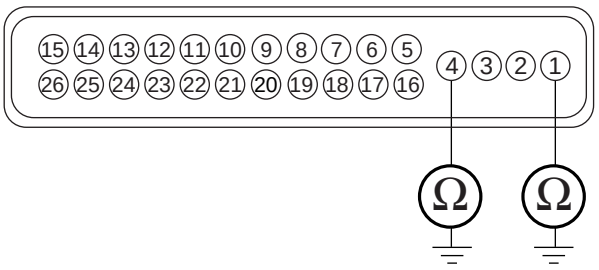
NO

▶ Check for damaged harness and poor connection between the battery terminal(+) and terminal "18(28:ESP)" of the HECU harness connector. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION K1A7AC8E

1. Ignition "OFF".
2. Disconnect HECU connector.
3. Measure resistance between terminal "1,4" of the HECU harness connector and chassis ground.

Specification : Approx. below 1 Ω



KJRE501R

Is the measured resistance within specifications?

NO

▶ Check for damaged harness and poor connection between terminal "1,4" of the HECU harness connector and chassis ground. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

YES

▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION EC4594E7

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

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.

NO

▶ Fault is intermittent caused by poor connection in power harness (IGN+), faulty Alternator and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EBBCF62B

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.
   Are any DTCs present?

YES

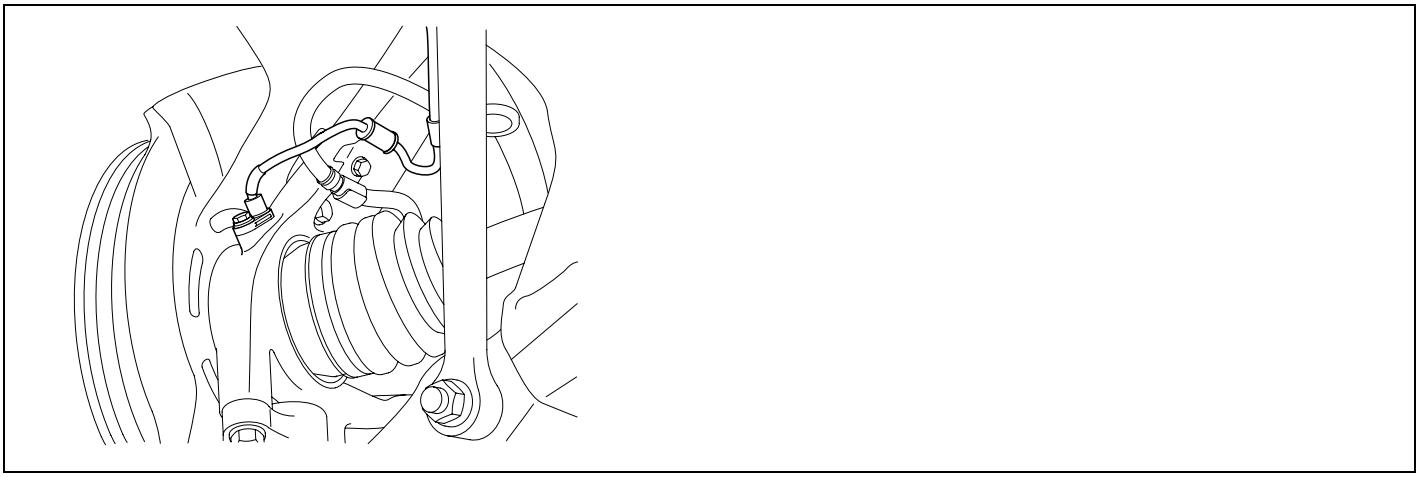
▶ Go to the applicable troubleshooting procedure.

NO

▶ A system performs normally at this time.

DTC C1200 FL SENSOR-OPEN/SHORT
DTC C1203 FR SENSOR-OPEN/SHORT
DTC C1206 RL SENSOR-OPEN/SHORT
DTC C1209 RR SENSOR-OPEN/SHORT

COMPONENT LOCATION E2AC644A



KJRE502M

GENERAL DESCRIPTION E7EC844A

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 reference 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 an active hall-sensor type and good at temperature and noise charicteristic. Digital wave is produced as tone wheel rotate according as hall sensor principle. Frequency of duty wave is changed in proportion to rotation of tone wheel and HECU calculate vehicle speed by this frequency.

DTC DESCRIPTION K3A0FE9D

The ABS ECU monitors the wheel speed sensor circuit continuously. If the sensor signal current is continuously out of the specified range for 200msec, then the HECU determines that the circuit is open/short, and sets this code. Warning lamp is turned OFF if the detected fault is not more than when the IG KEY is turned to ON again, and wheel speeds are more than 10 Km/h(6 MPH).

DTC DETECTING CONDITION E3AD2BA0

Item	Detecting Condition		Possible cause
DTC Strat-egy	Current Monitoring		• Open or short of Wheel speed sensor circuit • Faulty Wheel speed sensor • Faulty HECU
CASE 1	Monitoring period	Once after power up.	
	Enable Conditions	Wheel speed sensor test starts immediate after power. Especially shorts between WSS(Wheel speed sensor) lines and shorts to UZ(ECU voltage supply) can be detected by switching single WSS channels in sequence. After end of test only the channels with no fault are switched on.	
CASE 2	Monitoring period	Continuous	
	Enable Conditions	The sensor circuitry has two current levels I = 7mA and I= 14mA. If the sensor line is broken, shorted to ground or shorted to supply voltage a faulty current level will be detected.WSS line faults are detected, if the fault condition exists uninterrupted for t ＞= 200ms.	
Effect	No correct WSS Signal can be generated. Control of the corresponding wheel is no longer possible. If a sensor fault occurs on a front wheel, pressure is increased; on a rear wheel, pressure is decreased (until switch off).		

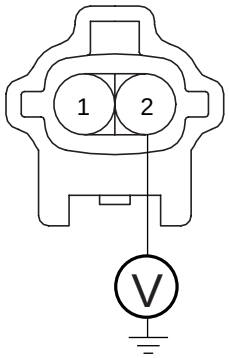
TERMINAL & CONNECTOR INSPECTION EBEA9B88

Refer to DTC C1101.

POWER SUPPLY CIRCUIT INSPECTION ECBF51BA

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

Specification : approx. B+



1. Wheel speed sensor(-)
2. Wheel speed sensor(+)

EJRF501L

Is the measured voltage within specifications?

YES

▶ Go to "Signal Circuit Inspection" procedure.

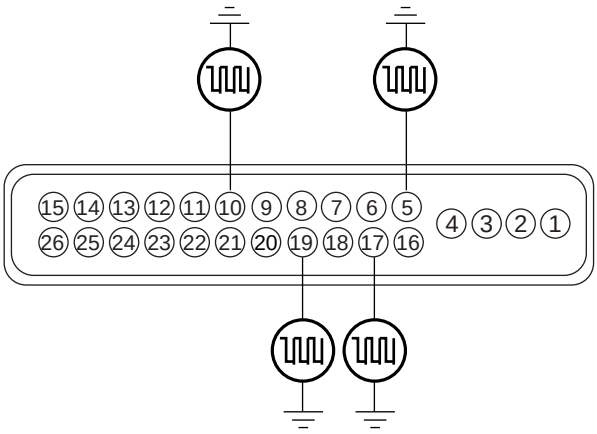
NO

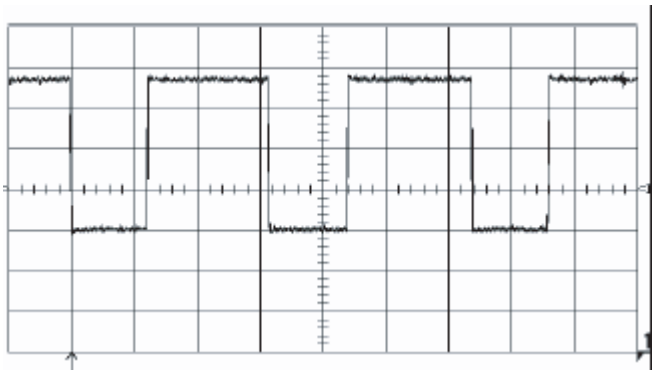
▶ Check for open or short to GND in wheel speed sensor harness between terminal "16(ESP:26),9,6,8" of the HECU harness connector and terminal "2" of the Wheel speed sensor harness connector. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION EDF71F93

1. Ignition "ON" & Engine "OFF".
2. By turning the wheel with hand.
3. Measure voltage between terminal "5,10,17(ESP:27),19(ESP:29)" of the HECU harness connector and chassis ground.

Specification : High : 0.89~1.26V , Low : 0.44~0.63V





KJRE501Y

Is the measured voltage within specifications?

YES

▶Go to "Component Inspection" procedure.

NO

▶ Check for open or short to GND in wheel speed sensor harness between terminal "1" of the wheel speed sensor harness connector and terminal "5,10,17(ESP:27),19(ESP:29)" of the HECU harness connector. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION EEF0D679

1. Ignition "OFF".
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 10km/h or more(6mph or more).
   Does warning lamp remain On?

   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.

   NO

   ▶ Fault is intermittent caused by open or short of wheel speed sensor harness, faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR K8BFAC21

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 is approx. 10km/h or more(6mph or more))
   Are any DTCs present?

   YES

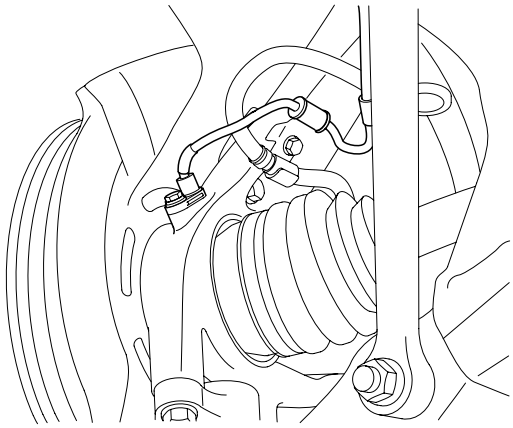
   ▶ Go to the applicable troubleshooting procedure.

   NO

   ▶ A system performs normally at this time.

DTC C1201 FL SENSOR-RANGE/PERFORMANCE
DTC C1204 FR SENSOR-RANGE/PERFORMANCE
DTC C1207 RL SENSOR-RANGE/PERFORMANCE
DTC C1210 RR SENSOR-RANGE/PERFORMANCE

COMPONENT LOCATION EF53B644



KJRE502M

GENERAL DESCRIPTION E99BF177

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 reference 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 an active hall-sensor type and good at temperature and noise charicteristic. Digital wave is produced as tone wheel rotate according as hall sensor principle. Frequency of duty wave is changed in proportion to rotation of tone wheel and HECU calculate vehicle speed by this frequency.

DTC DESCRIPTION EA98CDAF

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 10~80 Km/h(6~50 MPH). Warning lamp is turned OFF if the detected fault is not more than when the IG KEY is turned to ON again, and wheel speeds are more than 12 Km/h(7 MPH).

DTC DETECTING CONDITION E1B722FB

Item	Detecting Condition		Possible cause
DTC Strategy	Current Monitoring		• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor • Faulty HECU
CASE 1	Monitoring period	The monitoring is active from 10 km/h to 80km/h(6~50 MPH) and if no ABS-control is active at a front wheel and a rear wheel.	
	EnableConditions	Every time, if a gap in the wheel speed sensor signal occurs cyclically with one wheel rotation, a fault counter is increased by one. If the fault counter exceeds its limit of 10, a wheel specific fault is stored in the EEPROM.	
CASE 2	Monitoring period	Continuous if V_Vehicle > 12 m/s	
	EnableConditions	No wheel speed signals within 10 ms to 20 ms at a vehicle speed> 12 m/s (43.2 km/h, 27 MPH). If the dynamic sensor monitor responses, the failures will be stored into failure memory immediately after a waiting period of 60ms.	
Effect	Due to faulty wheel speed information the control of the corresponding wheel is no longer possible. reaction of the controller: If a sensor fault occurs on a front wheel, pressure is increased; on a rear wheel, pressure is decreased.		

MONITOR SCANTOOL DATA E701AC41

1. Connect scantool to Data Link Connector(DLC).
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 40km/h or more(24 mph or more) Monitor the "Wheel speed sensor" parameter on the Scantool.

Specification : Approx. 12 km/h or more(7 mph or more)

Is it normal?

YES

▶ Fault is intermittent caused by faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Repair or replace as necessary and then go to "Component Inspection" procedure.

NO

1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) 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.

COMPONENT INSPECTION EDF75AF5

1. Ignition "OFF".
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 12 km/h or more(7 mph or more).
   Does warning lamp remain On?

   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.

   NO

   ▶ Fault is intermittent caused by open or short of wheel speed sensor harness, faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EE24FA21

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 is approx. 12 km/h or more(7 mph or more))
   Are any DTCs present ?

   YES

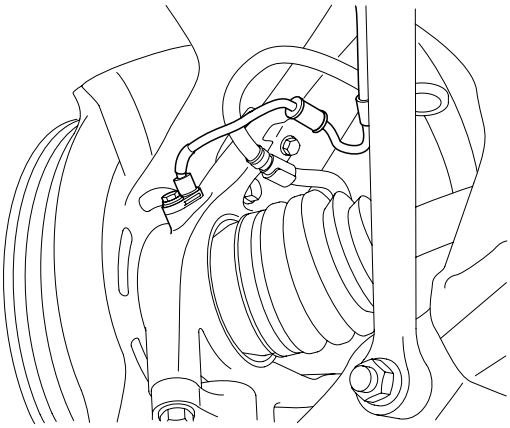
   ▶ Go to the applicable troubleshooting procedure.

   NO

   ▶ A system performs normally at this time.

DTC C1202 FL WHEEL SPEED SENSOR-NO SIGNAL
DTC C1205 FR WHEEL SPEED SENSOR-NO SIGNAL
DTC C1208 RL WHEEL SPEED SENSOR-NO SIGNAL
DTC C1211 RR WHEEL SPEED SENSOR-NO SIGNAL

COMPONENT LOCATION E547F2AF



KJRE502M

GENERAL DESCRIPTION EA259C69

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 reference 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 an active hall-sensor type and good at temperature and noise charicteristic. Digital wave is produced as tone wheel rotate according as hall sensor principle. Frequency of duty wave is changed in proportion to rotation of tone wheel and HECU calculate vehicle speed by this frequency.

DTC DESCRIPTION EFAECF2E

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 No wheel speed signals within 10 ms to 20 ms at a vehicle speed ＞ 43.2 km/h(26 MPH) . Warning lamp is turned OFF if the detected fault is not more than when the IG KEY is turned to ON again, and wheel speeds are more than 12 Km/h(7MPH).

DTC DETECTING CONDITION E454E88F

Item	Detecting Condition		Possible cause
DTC Strategy	Signal monitoring		• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor • Faulty HECU
CASE 1	Monitoring period	Continuous except no under voltage is detected.	
	Enable Conditions	The test detects a failure if one (or two) wheel are at Vmin(2.75 km/h ;1.7 MPH) and the other wheels are above 12 km/h for longer than 1s.A fault could also be set during driving, if the vehicle accelerates 18 km/h after a particular wheel speed gets to vmin(2.75 km/h ;1.7 MPH) and stays there. This monitoring could only detect singular faults.	
CASE 2	Monitoring period	Continuous except no under voltage is detected.	
	Enable Conditions	No wheel speed signals within 10 ms to 20 ms at a vehicle speed > 12 m/s (43.2 km/h). If the dynamic sensor monitor responses, the failures will be stored into failure memory immediately after a waiting period of 60ms.	
CASE 3	Monitoring period	• The main monitor (λ 5) needs additional information of the ESP-sensors and is active for a velocity > 20 km/h(12 MPH) and no under voltage(9.2 V) is detected. • The backup monitor (λ 6) manages with the wheel speeds alone.	
	EnableConditions	• The main monitor (λ 5): If the maximum difference of wheel speeds related to maximum wheel speed exceeds 5% a wheel specific wheel speed sensor fault is set. - the above conditions apply for 20s for 1 defective WSS. - the above conditions apply for 40s for 2 defective WSS. • The backup monitor (λ 6):If the velocity is higher than 50 km/h(31 MPH), the deviation between the fastest and the slowest wheel must exceeds 6% related to the fastest wheel. If the velocity is below 50 km/h(31 MPH), the deviation must exceed an absolute value of 3km/h(1.8 MPH). - detection filter time : normally 20s	
Effect	Due to faulty wheel speed information the control of the corresponding wheel is no longer possible. reaction of the controller: If a sensor fault occurs on a front wheel, pressure is increased; on a rear wheel, pressure is decreased		

MONITOR SCANTOOL DATA E7A7DC54

1. Connect scantool to Data Link Connector(DLC).
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 50 km/h or more(31 mph or more) Monitor the "Wheel speed sensor" parameter on the Scantool.

Specification : Approx. 50 km/h or more(31 mph or more)

Is it normal?

YES

▶ Fault is intermittent caused by faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Repair or replace as necessary and then go to "Component Inspection" procedure.

NO

1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) 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.

COMPONENT INSPECTION EDA02C6B

1. Ignition "OFF".
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 50 km/h or more(31 mph or more).
   Does warning lamp remain On?

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.

NO

▶ Fault is intermittent caused by open or short of wheel speed sensor harness, faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR E7CB563D

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 is approx. 50km/h or more(31mph or more)).
   Are any DTCs present ?

   YES

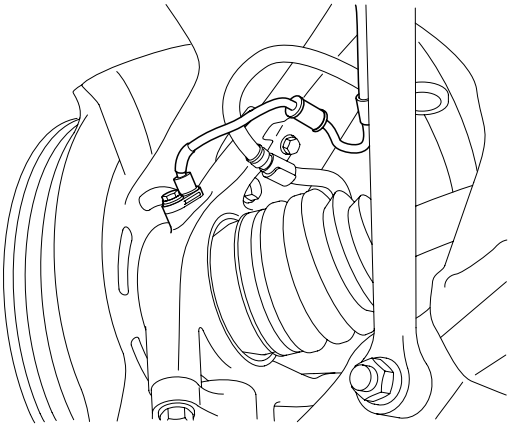
   ▶ Go to the applicable troubleshooting procedure.

   NO

   ▶ A system performs normally at this time.

DTC C1213 WHEEL SPEED FREQUENCY ERROR

COMPONENT LOCATION E8BFFEF1



KJRE502M

GENERAL DESCRIPTION E0B1D280

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 reference 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 an active hall-sensor type and good at temperature and noise charicteristic. Digital wave is produced as tone wheel rotate according as hall sensor principle. Frequency of duty wave is changed in proportion to rotation of tone wheel and HECU calculate vehicle speed by this frequency.

DTC DESCRIPTION EDED9D4A

The ABS ECU monitors the wheel speed sensor signal continuously. The monitoring reports a failure if the ABS target slip breaks out.

DTC DETECTING CONDITION E8E24EBB

Item	Detecting Condition	Possible cause
DTC Strategy	Signal monitoring	• Improper installation of wheel speed sensor • Abnormal Rotor and wheel bearing • Faulty Wheel speed sensor • Faulty HECU
Enable Conditions	The monitoring reports a failure if the ABS target slip is exceeded for a time period >= 10 s at one or more wheels. If the driver brakes or the velocity is lower than 50 km/h(31 MPH) the detection time is enlarged to 60s.	
Monitoring period	Continuous	
Effect	Reduced function of the ESP system.	

MONITOR SCANTOOL DATA E0945DFA

1. Connect scantool to Data Link Connector(DLC).
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 10k m/h or more(6 mph or more). Monitor the "Wheel speed sensor" parameter on the Scantool.

Specification : Approx.10 km/h or more(6 mph or more)

Is it normal?

YES

▶ Fault is intermittent caused by faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Repair or replace as necessary and then go to "Component Inspection" procedure.

NO

1) Check for improper installation of wheel speed sensor. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
2) Check for damage of rotor teeth or wheel bearing. If NG, repair as necessary and then go to "Verification of vehicle Repair" procedure.
3) 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.

COMPONENT INSPECTION EA4CCCB9

1. Ignition "OFF".
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 10k m/h or more(6 mph or more).
   Does warning lamp remain On?

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.

NO

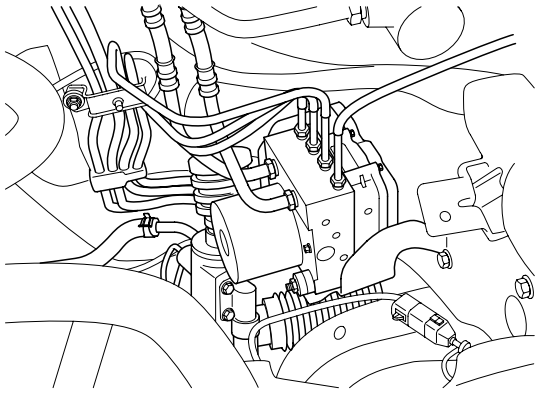
▶ Fault is intermittent caused by open or short of wheel speed sensor harness, faulty wheel speed sensor and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EEA9B1EE

Refer to DTC C1200.

DTC C1235 PRESSURE SENSOR-ELECTRICAL
DTC C1237 PRESSURE SENSOR-SIGNAL FAULT

COMPONENT LOCATION EE83DBEF



KJRE423B

GENERAL DESCRIPTION EB4F41D4

The pressure sensor senses the brake oil pressure to judge driver's brake intention when ESP is operating.

DTC DETECTING CONDITION EFA08C77

Item		Detecting Condition	Possible cause
DTC Strategy		Signal monitoring	• Faulty HECU
C1235	Enable Conditions	1. Sensor supply voltage is continuous monitored (except power on). A sensor supply failure is detected if Sensor Supply Voltage > 5.3 V OR Sensor Supply Voltage < 4.7 V for ≥ 60 ms. 2. Pressure signal 1 (DSO: original pressure value) is continuous monitored (except power on). Line faults like open, short to GND or short to UZ are detected. A Fault is set if the DSO signal is U DSO > 4.7 V OR U DSO < 0.3 V for a time t >= 100 ms. 3. Pressure signal 2 (DSI: inverted pressure value) is continuous monitored (except power on). Line faults like open, short to GND or short to UZ are detected. A Fault is set if the DSI signal isU DSI > 4.7 V OR U DSI < 0.3 V for a time t >= 100 ms. 4. Plausibility of DSO and DSI pressure lines are continuous monitored.Internal DS5 faults (amplification-, bridge-, analog-digital converter malfunction, etc.) are detected if DSO+DSI < 4.5 V OR DSO+DSI > 5.5 V is present longer than >= 100 ms . 5. POS(Power On Selftest) detects internal sensor malfunctions. sensor element, amplification, etc.) The test phase is divided in two 60 ms parts. DSO signal must be <0.5 V for 30 ms. In phase 2 DSO signal must be between 1.9 V and 3.1 V for also 30 ms then the POS Test is passed. The test phase is divided in two 60 ms parts. DSO and DSI signal must be < 0.5 V for 30 ms. In phase 2 DSO and DSI signal must be between 1.9 V and 3.1 V for also 30 ms then the POS Test is passed.	
	Monitoring period	1~4 : Continuous 5 : Once during Power Up	
C1237	Enable Conditions	1. The DS(Pressure sensor)-offset value must be in the range of 15 bar. A failure is detected if this range is exceeded. 2. There are three monitoring which have different thresholds concerning the allowed pressure and the detection time. a) Plausibility 1 : For redundancy reasons an additional hardware-BLS signal is created by the pressure sensor signal. If the pressure sensor is compensated, the threshold for generating the hardware-BLS signal is 10 bar. If the pressure sensor is not compensated, the threshold is increased by 15 bar. If this signal is set without any hardware-BLS-signals being set, and if no pump is operated during that time, a fault is set after the braking. b) Plausibility 2 : If the pressure signal is higher than 30 bar and not both of the hardware-BLS are set, a fault is stored after 2s. c) Plausibility 3: If the pressure signal is higher than 80 bar and not both of the hardware-BLS are set, a fault is stored after 1s.	
	Monitoring period	1. After DS-initialization, no under voltage, no pumps are running and no BLS-signal is set. 2. Continuous in the normal operating voltage range.	
Effect		No Pressure Signal available.	

COMPONENT INSPECTION E8DDDBBA

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

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.

NO

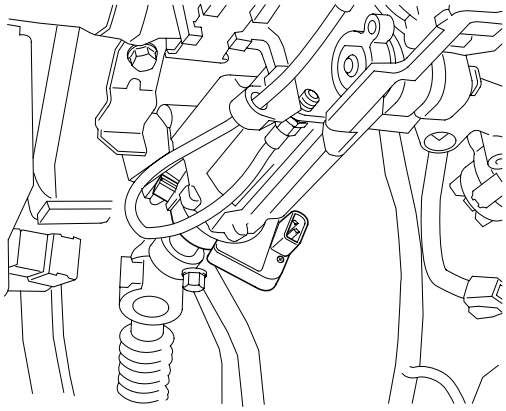
▶ Fault is intermittent caused by faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR ECADBFBA

Refer to DTC C1101.

DTC C1260 STEERING ANGLE SNSR-SIGNAL
DTC C1261 STEERING ANGLE SENSOR IS NOT CALIBRATED

COMPONENT LOCATION EABB4863



KJRE342A

DTC DESCRIPTION E410EEFA

The Steering wheel angle sensor determines the direction of the rotation.

DTC DETECTING CONDITION E015A95F

Item	Detecting Condition	Possible cause
DTC Strategy	Signal monitoring	• Faulty steering wheel sensor
Enable Conditions	1. LWS(steering angle sensor) offset monitoring : If the offset value exceeds a threshold of approximately 15 deg a LWS-fault is determined. 2. LWS Gradient monitoring : - signal gradient (steering angle velocity) from one 20 ms-cycle to another is higher than 40° or - change of this gradient (steering angle acceleration) is higher than 15° 3. LWS range monitoring : If value is higher than possible range for more than 300 ms a fault is determined. 4. LWS Plausibility monitoring : Dependent on the driving conditions failures in size of [10 + 60 m/s / FZREF(reference speed)] deg at steering angle are recognized within 400 .. 4800 ms . 5. LWS Constant Signal Monitoring : If there is no change in the signal, but a right AND left cornering has been recognized, a fault is determined. (lateral acceleration > 2 m/s² in combination with a yaw rate > 6 °/s in both directions). 6. LWS Wrong Sign Monitoring : If the signals don't fit and forwards driving is detected, a fault is determined. 7. LWS Message counter monitoring : If the message counter shows an increase higher than 3 or lower than 1 in one 20 ms-cyle, a fault is stored after 160 ms.	
Monitoring period	1. Continuous during driving. 2. no under voltage and at least one LWS-message was sent in the current 20 ms-cycle. 3. After initialization and no under voltage detected. 4. Continuous during driving. 5. Initialization once in every ignition cycle. 6,7. Continuous during driving.	
Effect	Reduced controller function caused by faulty LWS signal.	

COMPONENT INSPECTION EACD1983

1. CHECK INSTALLATION OF STEERING ANGLE SENSOR
   Check if the steering angle sensor is properly installed.
   Is the installation proper?

   YES

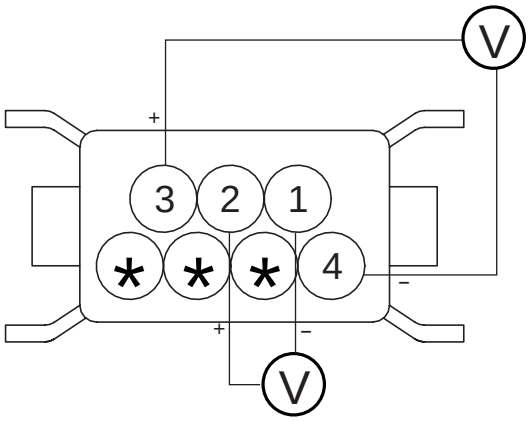
   ▶ Check power of steering angle sensor.

   NO

   ▶ Reinstall the steering angle sensor properly.

POWER SUPPLY CIRCUIT INSPECTION E4BAAF7C

1. Disconnect the steering angle sensor connector, and measure the voltage between terminal 3 and 4 of the steering angle sensor connector.
2. Measure the voltage between terminal 1 and 2 of the steering angle sensor connector.



KJRE502X

Is the voltage within 8~16V?

YES

▶ Clear the DTC, and then drive a vehicle over 40 Km/h(24 MPH) .If ESP warning lamp turn on, replace the steering wheel sensor. Then go to "Verification of Vehicle Repair" procedure.

NO

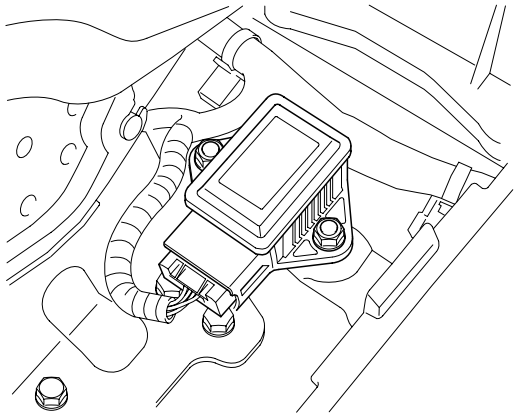
▶ Check harness and connector between the HECU and the steering angle sensor. If NG ,replace the steering wheel sensor.

VERIFICATION OF VEHICLE REPAIR E31B84FE

Refer to DTC C1101.

DTC C1282 YAW RATE & LATERAL G SENSOR-ELECTRICAL

COMPONENT LOCATION E9D8B46C



KJRE422A

GENERAL DESCRIPTION EA24B68C

The yaw-rate & Lateral G sensor are used for the stability of a vehicle. The yaw-rate is used to measure angular velocity while the Lateral G is to measure the force that moves the vehicle away from the center, when a vehicle is cornering.

DTC DESCRIPTION E4B82741

This code sets when there is an open or short in the circuit of the yaw-rate & lateral G sensor.

DTC DETECTING CONDITION EAF30E39

Item	Detecting Condition	Possible cause
DTC Strategy	Signal monitoring	• Open or short of Yaw Rate & Lateral G sensor circuit • Faulty Yaw Rate & Lateral G sensor • Faulty HECU
Enable Conditions	1. The AY(Acceleration Sensor) sensor voltage is monitored for a is out of range value. A line fault is detected if AY < 0.3 V OR AY > 4.7 V for a time t >= 100 ms.. 2. Open line, short to GND and short to UZ are detected. The DRS sensor voltage is monitored for a is out of range value. A line fault is detected, if - DRSS < 0.225 V OR DRSS > 4.774 V for a time t >= 100 ms. - DRSR < 2.1 V OR DRSR > 2.9 V for a time t > 200 ms. ※DRSS (Yaw sensor reference), DRS(yaw sensor), DRSR(Yaw sensor signal)	
Monitoring period	Continuous	
Effect	Reduced controller function caused by faulty DRS and AY signal.	

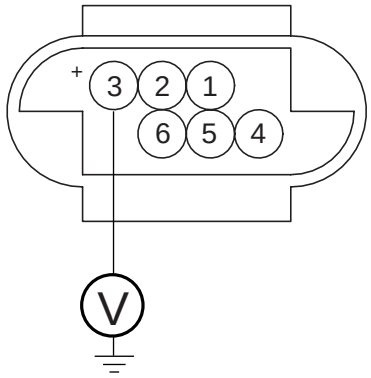
TERMINAL & CONNECTOR INSPECTION EAF9C4BD

Refer to DTC C1101.

POWER SUPPLY CIRCUIT INSPECTION E8EB60C9

1. Ignition "ON" & Engine "ON".
2. Measure voltage between terminal "3" of the Yaw Rate & Lateral G sensor harness connector and chassis ground.

Specification : 11.75 ~ 12.25 V



EJRF501M

Is the measured voltage within specifications?

YES

▶ Go to "Ground Circuit Inspection" procedure.

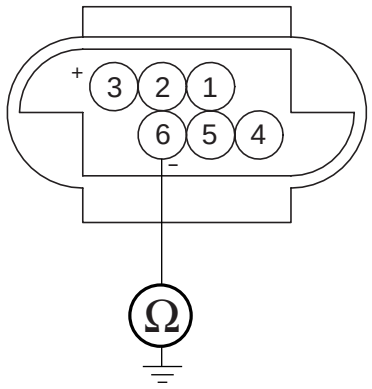
NO

▶ Check for open or short to GND in the Yaw Rate & Lateral G sensor harness between terminal "3" of the Yaw Rate & Lateral G sensor harness connector and terminal "16,20" of the HECU harness connector. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E25C0DCE

1. Ignition "OFF".
2. Disconnect Yaw Rate & Lateral G sensor connector.
3. Measure resistance between terminal "6" of the Yaw Rate & Lateral G sensor harness connector and chassis ground.

Specification : Approx. below 1Ω



EJRF501N

Is the measured resistance within specifications?

YES

▶ Go to "Signal Circuit Inspection" procedure.

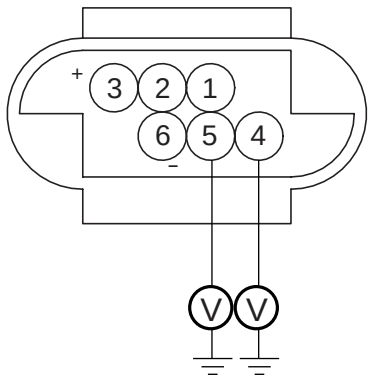
NO

▶Check for open or short in the Yaw Rate & Lateral G sensor harness between terminal "6" of the Yaw Rate & Lateral G sensor harness connector and terminal "15" of the HECU harness connector. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

SIGNAL CIRCUIT INSPECTION E1412AE8

1. Ignition "OFF" & Engine "OFF".
2. Measure voltage between terminal "4, 5" of the Yaw Rate & Lateral G sensor harness connector and chassis ground.

Specification : Approx. 2.5V



EJRF501O

Is the measured voltage within specifications?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Check for open or short in the Yaw Rate & Lateral G sensor harness between terminal "4, 5" of the Yaw Rate & Lateral G sensor harness connector and terminal "16, 20" of the HECU harness connector. Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EE25C98B

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

YES

▶ 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.

NO

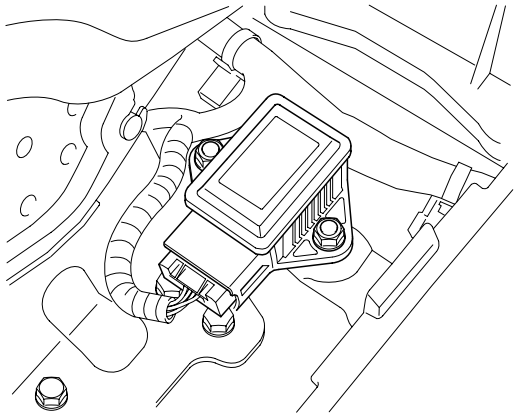
▶ Fault is intermittent caused by open or short of Yaw Rate & Lateral G sensor harness and/or faulty Yaw Rate & Lateral G sensor or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR E1B7FC62

Refer to DTC C1101.

DTC C1283 YAW RATE & LATERAL G SENSOR-SIGNAL

COMPONENT LOCATION EE9FBC63



KJRE422A

GENERAL DESCRIPTION EAB70386

The yaw-rate & Lateral G sensor are used for the stability of a vehicle. The yaw-rate is used to measure angular velocity while the Lateral G is to measure the force that moves the vehicle away from the center, when a vehicle is cornering.

DTC DESCRIPTION E9BABEC5

This code sets when there is an open or short in the circuit of the yaw-rate & lateral G sensor.

DTC DETECTING CONDITION E3EAF5E4

Item	Detecting Condition	Possible cause
DTC Strategy	Signal monitoring	• Faulty Lateral Acceleration Sensor • Faulty Yaw Rate Sensor • Faulty HECU
Enable Conditions	This test detects internal AY(Acceleration sensor) sensor malfunctions. 1. During the POS measure window (t = 100 ms) the AY signal must be for at least t = 60 ms between 0.2 V < AY < 0.8 V 2. If during stable vehicle behavior an AY-Failure larger than approximately 2.5 m/s occurs, the ESP controller will disregard the AY sensor information so that a false ESP intervention is prevented. A fault is recognized after 1.6 s during model validity. 3. If the offset value exceeds a threshold of approximately 2.25 m/s² an AY fault is determined. 4. During standstill the plausible range of |AY| is below 7 m/s². If the filtered value of |AY| is larger than 7 m/s² for more than 400 m/s a fault is set. 5. If the lateral acceleration is higher than 15 m/s² for more than 800 ms a suspected failure bit is set. After 1,6 s a fault is detected. 6. Standstill compensation: Failure threshold 5.25 °/s.Fast compensation (during driving if no standstill compensation could be completed): Failure threshold is 7,5 °/s.Long-term ("normal") compensation (during driving after succeeded standstill or fast offset compensation): Failure threshold is 7,5 °/s. 7. The fault criteria is approx. 25 % sensitivity failure. 8. If the measured yaw rate deviates more than 2.5 °/s plus a dynamicthreshold from the reference yaw rate during model validity, a failure isrecognized after 1.6 s. The dynamic threshold is between 2.5 °/s and more than 5 °/s. A typical value is 3 °/s. 9. The measured yaw rate and the model yaw rates, calculated from theWSS and LWS are compared. If the signals doesn.t fit and forward driving is recognized, a fault is determined. 10. In case of a YRS-failure, the YRS will send an abnormal yaw rate signal.	
Monitoring period	1. Once after power up and no low voltage. 2,3,8. Continuous during stable driving. 4. Continuous during standstill. 5. Continuous, if no under voltage is detected. 6. Continuous, dependent on driving situation. 7. During stable cornering after completed offset compensation. 9. After every standstill 10. Continuous	
Effect	Reduced controller function caused by faulty DRS(yaw sensor) signal.	

TERMINAL & CONNECTOR INSPECTION EDB6E09E

Refer to DTC C1101.

COMPONENT INSPECTION E18FD52E

1. Ignition "OFF".
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 20 km/h or more(12 mph or more)
   Does warning lamp remain On?

   YES

   ▶ 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.

   NO

   ▶ Fault is intermittent caused by open or short of Yaw Rate & Lateral G sensor harness and/or faulty Yaw Rate & Lateral G sensor or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR E6DABD15

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 is approx. 20 km/h or more(12 mph or more))
   Are any DTCs present?

   YES

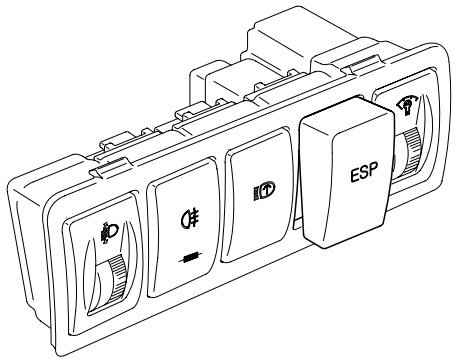
   ▶ Go to the applicable troubleshooting procedure.

   NO

   ▶ A system performs normally at this time.

DTC C1503 ESP SWITCH ERROR

COMPONENT LOCATION EA9ED8EF



EJRF501P

GENERAL DESCRIPTION ED874ED2

Driver can inhibit the ESP control by ESP switch. When switch signal send into HECU, ESP warning lamp go ON and ESP control is stopped and if next switch signal is inputted again, ESP control is ready. This function is used for sporty driving or vehicle inspection.

DTC DESCRIPTION EFC1B5B7

Trouble code is set when the condition that the level of ESP switch is high is continued for 60sec.When the ESP switch failure is set there is no signal in the warning lamp and HECU inhibit the ESP control and allow the ABS/EBD control.

DTC DETECTING CONDITION E8F05D2F

Item	Detecting Condition	Possible cause
DTC Strategy	Short circuit monitoring	• Open or short ESP switch
Enable Conditions	Trouble code is set when the condition that the level of ESP switch is high is continued for 60 sec.	
Monitoring period	Continuous	

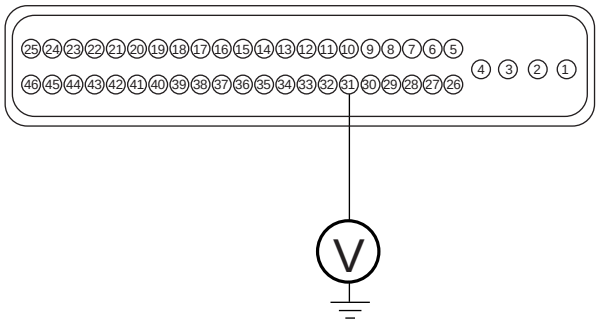
TERMINAL & CONNECTOR INSPECTION E4134BE7

Refer to DTC C1101.

SIGNAL CIRCUIT INSPECTION E22AB445

1. Ignition "ON" & Engine "OFF" & ESP Switch"ON".
2. Measure voltage between terminal "31" of the HECU harness connector and chassis ground.

Specification : Approx B+



EJRF501Q

Is the measured voltage within specifications?

YES

▶ Fault is intermittent caused by open or short in ESP switch line, faulty ESP switch or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

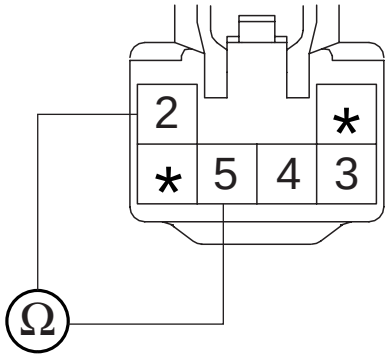
NO

▶ Check for damaged harness and poor connection in the power harness between the battery terminal(+) and the terminal "31" of the HECU harness connector . Check for open or blown 10A fuse referring to "Circuit Diagram" . Repair as necessary and then go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION E31CC225

1. Ignition "OFF".
2. Disconnect ESP switch connector.
3. Press the ESP switch.
4. Measure resistance between terminal "2" of the ESP switch harness connector and terminal "5" of the ESP switch harness connector.

Specification : Approx below 1 Ω



EJRF501R

Is the measured resistance within specifications?

YES

▶ Fault is intermittent caused by faulty ESP switch or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

NO

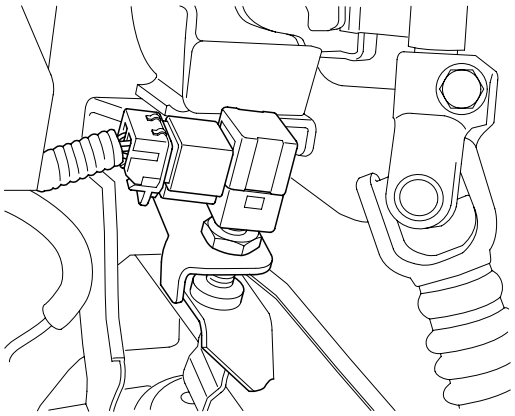
▶ Substitute with a known-good ESP switch and check for proper operation. If problem is corrected, replace ESP switch and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E7626E6B

Refer to DTC C1101.

DTC C1513 BRAKE LIGHT SWITCH MAL.

COMPONENT LOCATION ED9CFA35



KJRE433C

GENERAL DESCRIPTION ECB9AA2D

The brake light switch indicates brake pedal status to the ABS control unit. The switch is turned on when brake is depressed. The brake light switch is a normally-open contact which runs to battery voltage when active (brake depressed). When passive (brake not depressed), the cable is grounded via the break light bulbs.

DTC DESCRIPTION EF4392B0

The brake light signal is a reference to judge driver's will for braking. ABS ECU monitor open circuit of brake light switch for normal ABS control.

DTC DETECTING CONDITION EEACDAB7

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 the BLS-signals is high for 60 s, while the gas pedal is stepped, with vehicle speed > 3 m/s, offset compensated pVor < 5 bar and no control is active, a fault is set.	
Monitoring period	Continuous, if no under voltage is detected.	
Effect	Reduced function caused by a faulty brake light switch.	

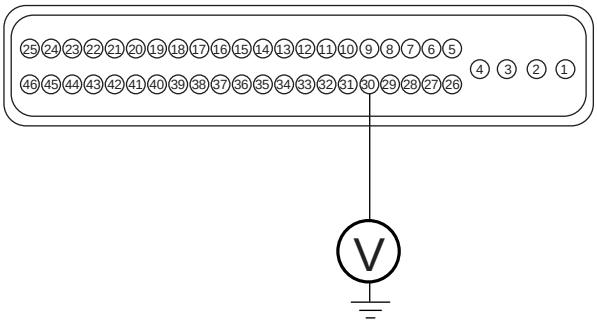
TERMINAL & CONNECTOR INSPECTION E50FCDE6

Refer to DTC C1101.

SIGNAL CIRCUIT INSPECTION E5481F09

1. Ignition "ON" & Engine "OFF".
2. Press the brake pedal.
3. Measure voltage between the terminal "30" of the HECU harness connector and chassis ground.

Specification : Brake Light Switch - Approx. B+



EJRF501S

Is the measured voltage within specifications?

YES

▶ Fault is intermittent caused by open harness in brake lamp switch and brake switch line, faulty brake lamp switch was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

NO

▶ Check for damaged harness and poor connection in the power harness between the battery terminal(+) and the terminal "30" of the HECU harness connector . Check for open or blown 15A STOP fuse. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION E439AA5C

1. Connect a ohmmeter to the connector of brake light switch, and check whether or not there is continuity when the plunger of the brake light switch is pushed in and when it is released.
   The switch is in good condition if there is no continuity when the plunger is pushed.
2. Is there no continuity when the plunger is pushed?

YES

▶ Fault is intermittent caused by open harness in brake light switch line, faulty brake lamp switch or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

NO

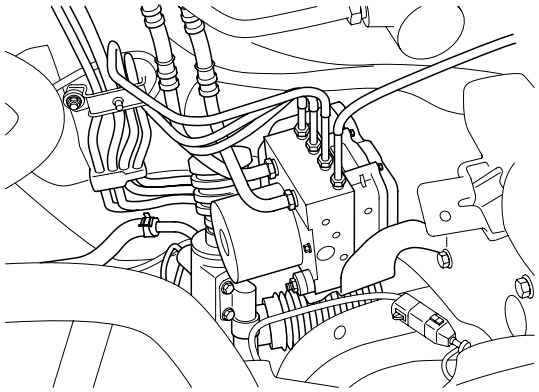
▶ Substitute with a known-good brake lamp switch and check for proper operation. If problem is corrected, replace brake lamp switch and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EA44DFDB

Refer to DTC C1101.

DTC C1604 ECU HARDWARE ERROR

COMPONENT LOCATION E9484A4E



KJRE423B

GENERAL DESCRIPTION E84ADDAF

The HECU is composed of a ECU (Electronic Control Unit) and a HCU(Hydraulic Control Unit) , so the HECU hardware includes all solenoid valves inside the unit as well as the ECU.

DTC DESCRIPTION ED7C74DB

The HECU monitors the operation of the IC components such as memory, register, A/D converter and so on. The HECU sets this code when the EEPROM data read by the master processor is different than prior data writed, or when the master/slave processor detects abnormal operation in RAM, Status Register, Interrupt, Timer, A/D converter or cycle time.

DTC DETECTING CONDITION EBC1164B

Item	Detecting Condition	Possible cause
DTC Strategy	Internal monitoring	• Faulty HECU
Enable Conditions	1. Internal control unit failures of the Micro controller and peripheral integrated circuits will be continuous monitored for proper function. 2. After EEPROM-values have been read from EEPROM, the values are monitored for corrupt data. Failure is set if: a) Checksum not correct or b) PSW-EEPROM-Handler reported unknown failure during EEPROM-value reading. 3. Evaluate EEPROM reading sequence. If EEPROM reading sequence take longer then 3 s, a failure is set.	
Monitoring period	1.Continuos 2,3.directly after ignition on, during reading of EEPROM-values.	
Effect	No control is available.	

COMPONENT INSPECTION EF8AB42E

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

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.

NO

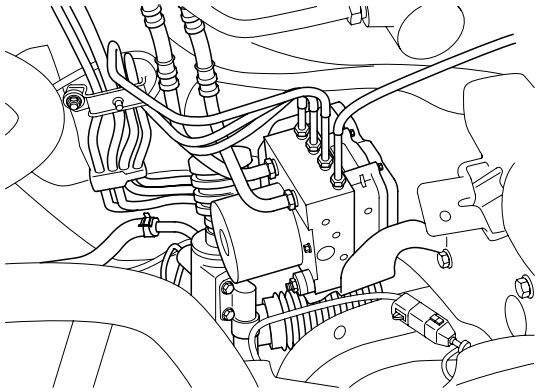
▶ Fault is intermittent caused by faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EAF3B0AF

Refer to DTC C1101.

DTC C1605 CAN CONTROL HARDWARE ERROR

COMPONENT LOCATION E155180B



KJRE423B

GENERAL DESCRIPTION EFCEE06D

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.

DTC DESCRIPTION EBECBE5E

This code shows in case that there is an error on the CAN hardware. In this case, replace the HECU and check.

DTC DETECTING CONDITION ECA9F9D9

Item	Detecting Condition	Possible cause
DTC Strategy	CAN RAM monitoring	• Faulty HECU
Enable Conditions	1. Monitoring whether the initialization software has write access to the configuration registers of the CAN-controller module.Faults are detected immediately. 2. Monitoring includes line short to ground, line short to supply voltage and mutual line short. Line interruptions are detected by CAN message monitor.After detecting a BUSOFF failure the transmission is reinitialized. A BUSOFF fault is established if re-initialization is tried for 15 times in sequence without success.	
Monitoring period	1. immediate during start up. 2. Continuous	
Effect	1. CAN-Controller is not initialized correctly. Possibly no reception or transmission of messages. 2. CAN messages can not be processed. BLS is not controlled.	

COMPONENT INSPECTION EF616370

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

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.

NO

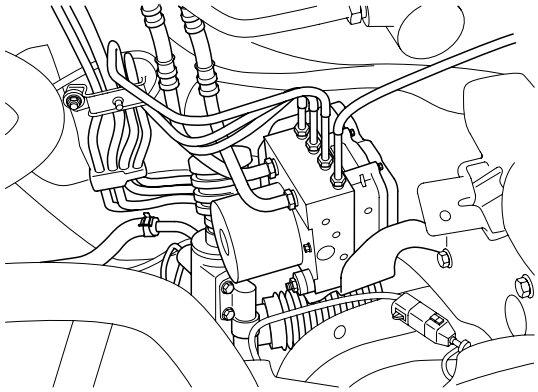
▶ Fault is intermittent caused by short harness in CAN line and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EFCF02FE

Refer to DTC C1101.

DTC C1611 CAN TIME OUT-ECM
DTC C1612 CAN TIME OUT-TCU
DTC C1623 CAN TIMEOUT STEERING ANGLE SENSOR

COMPONENT LOCATION E6626A8C



KJRE423B

GENERAL DESCRIPTION EFAC4B05

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.

DTC DESCRIPTION ECE364A4

This code shows in case that there is an error on the CAN hardware. In this case, replace the HECU and check.

DTC DETECTING CONDITION ED0B8F49

Item	Detecting Condition	Possible cause
DTC Strategy	CAN RAM monitoring	• Faulty HECU • Faulty ECM • Faulty TCU • Faulty Steering angle sensor
Enable Conditions	1. Purpose is to monitor if transmitted message was not transmitted by CAN controller of ABS8/ESP8 ECU.Faults are detected after filtering. Filtering has to be customized. 2. Purpose is to monitor if transmitted message has the expected data length.Actually the monitoring is reduced the check for too short messages.A message with oversized data length causes no fault. Faults are detected immediate.	
Monitoring period	Continuous	
Effect	1. CAN messages are not correct sent. 2. CAN messages are not according to what was expected at compile time of the software.	

COMPONENT INSPECTION EFF1B327

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

YES

▶ Substitute with a known-good ECM(C1611)[TCU(C1612)/Steering angle sensor(C1623)] and check for proper operation. If problem is corrected, replace ECM(C1611)[TCU(C1612)/Steering angle sensor(C1623)] and then go to "Verification of Vehicle Repair" procedure. If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.

NO

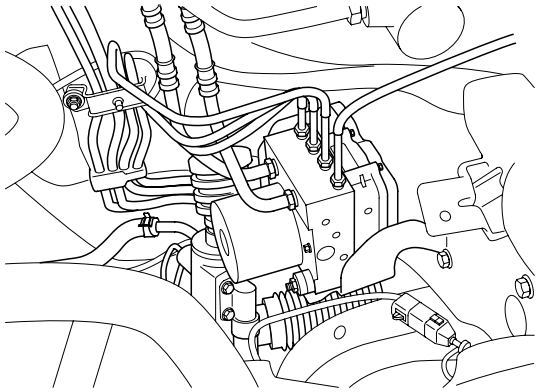
▶ Fault is intermittent caused by faulty ECM(C1611)[TCU(C1612)/Steering angle sensor(C1623)] and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EBAAFAD0

Refer to DTC C1101.

DTC C1616 CAN BUS OFF

COMPONENT LOCATION E7B1A03A



KJRE423B

GENERAL DESCRIPTION EFFAB1E9

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.

DTC DESCRIPTION E7246BC3

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 100 ms.

DTC DETECTING CONDITION E084C50D

Item	Detecting Condition	Possible cause
DTC Strategy	Open or short circuit monitoring	• Open or short circuit in CAN line
Enable Conditions	Monitoring includes line short to ground, line short to supply voltage and mutual line short. Line interruptions are detected by CAN message monitor. After detecting a BUSOFF failure the transmission is reinitialized. A BUSOFF fault is established if re-initialization is tried for 15 times in sequence without success.	
Monitoring period	Continuous	
Effect	CAN messages can not be processed. BLS(Brake light switch) is not controlled.	

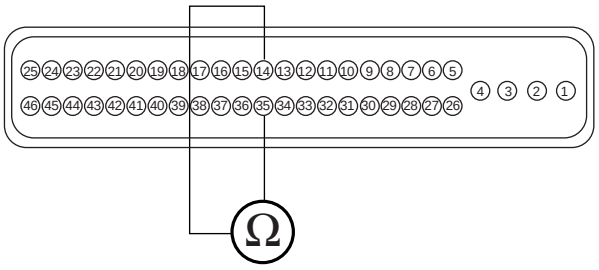
TERMINAL & CONNECTOR INSPECTION ED5BFE2E

Refer to DTC C1101.

SIGNAL CIRCUIT INSPECTION EEAC2FA0

1. Ignition "OFF".
2. Measure resistance between terminal "35" of the HECU harness connector and terminal "14" of the HECU harness connector.

Specification : Approx. 60 Ω



EJRF501T

Is the measured resistance within specifications?

YES

▶ Fault is intermittent caused by open or short in CAN signal harnessor was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

NO

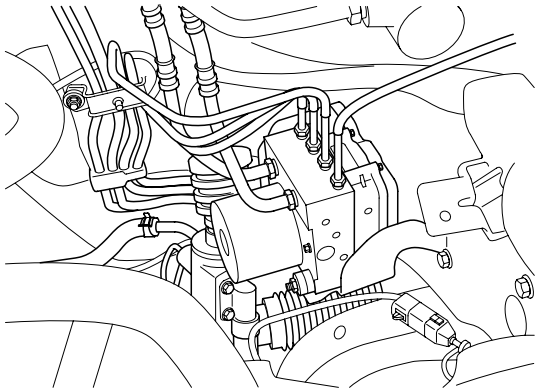
▶ Check for open or short in CAN signal harness between terminal "35" of the HECU harness connector and terminal "14" of the HECU harness connector. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E1ADCEEC

Refer to DTC C1101.

DTC C1625 CAN TIME OUT-ESP

COMPONENT LOCATION E2B091EE



KJRE423B

GENERAL DESCRIPTION EEDAC1CA

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.

DTC DETECTING CONDITION EEEC52A7

Item	Detecting Condition	Possible cause
DTC Strategy	Open or short circuit monitoring	• Open or short circuit in CAN line • Faulty HECU
Enable Conditions	Purpose is to monitor if receive message was not received on time by the CAN controller of ABS8/ESP8 ECU. Faults are detected after filtering.	
Monitoring period	Continuous	
Effect	CAN messages are not received on time.	

TERMINAL & CONNECTOR INSPECTION ECC97A5D

Refer to DTC C1101.

SIGNAL CIRCUIT INSPECTION EEBEB7CE

1. Check for open or short in CAN signal harness between terminal "35" of the HECU harness connector and PCM harness connector.
2. Check for open or short in CAN signal harness between terminal "14" of the HECU harness connector and PCM harness connector.
   Is it normal?

YES

▶ Replace the HECU. Then go to "Verification of vehicle Repair" procedure.

NO

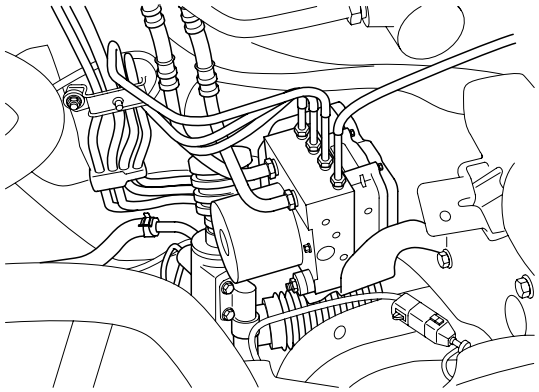
▶ Repair or replace harness and connector.

VERIFICATION OF VEHICLE REPAIR E4CD4A94

Refer to DTC C1101.

DTC C1626 IMPLAUSIBLE CONTROL

COMPONENT LOCATION EFAEE38F



KJRE423B

DTC DETECTING CONDITION E61B09FE

Item	Detecting Condition	Possible cause
DTC Strategy	Internal error	• Faulty HECU
Enable Conditions	1. Under normal conditions, the inlet valves of all four wheels are not closed during control for longer than 1.28 s. If the controller requests pressure-hold or pressure-decrease for longer than 1.28 s, a fault is stored. 2. The monitoring reports a failure if continuous ESP control occurs for a time period >= 10 s. A continuous ESP control for longer than 10 s is not possible under normal conditions.	
Monitoring period	1. Continuous 2. detected under voltage and a fault is not already detected.	
Effect	1. Reduced function as all wheel valves will remain in pressure build-up position. 2. Reduced function of the ESP system, no more ESP, no more ABS.	

COMPONENT INSPECTION E8DAF5C2

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

YES

▶ Replace the HECU. Then go to "Verification of vehicle Repair" procedure.

NO

▶ Fault is intermittent caused by faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR E5BA8CD9

Refer to DTC C1101.

DTC C1702 VARIANT CODING

GENERAL DESCRIPTION EC5EBC2F

A hardware difference of ECU does not exist according to the specification of the vehicle, but a software changes according to deference of vehicle parameter. The ESP stores variant code (data of engine, displacement volume , T/M) at the ECU memory. Since then a ESP uses the stored data.

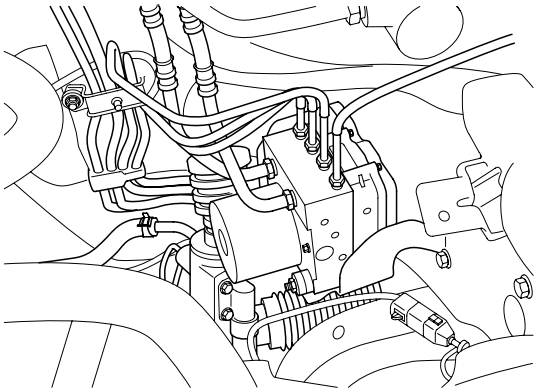
COMPONENT INSPECTION EC91556F

*Variant Coding

1. Install a EMS/TCU/ESP normally.
2. Connect a scanner to the vehicle.
3. IGN On
4. Scanner On
5. Select a brake mode.
6. Push the Variant Coding button.
7. Scanner Off
8. IGN Off
9. Remove the scanner.
10. IGN On
11. Finish the Variant Coding.

DTC C2112 VALVE RELAY MAL.

COMPONENT LOCATION E9CA651C



KJRE423B

GENERAL DESCRIPTION EB7E53C7

The ABS ECU supplies battery power to all solenoid valves by way of 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 EFD5C8B1

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 EA202C60

Item	Detecting Condition	Possible cause
DTC Strategy	Battery Voltage Monitoring	• Open or short of power supply circuit • Faulty HECU
Enable Conditions	1. Watchdog and VR(valve relay) function is tested during startup.FSA test(Fail Save Circuit test) detects if the VR/Enable remains in off position when it is turned on and vice versa. Reason could be short to GND or UZ(ECU voltage supply), interrupted lines or a defective output stage etc. 2. A Fault is detected if UVR(valve relay voltage) < 0.8 * UZ for a time t > 500 ms. 3. This test evaluates the function of the VR (vale relay) periodically. The VR is switched off and back on. VR malfunction and UVR short to UZ or UBVR(supply solenoid valves) and medium or high ohmic short of UVR (or a valve) to UZ, UBVR(supply solenoid valves) or GND are detected.	
Monitoring period	1.Once during startup. 2,3.Continuous	
Effect	No valve actuation possible.	

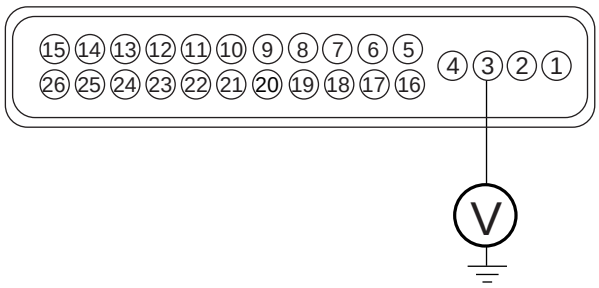
TERMINAL & CONNECTOR INSPECTION ED71DA3F

Refer to DTC C1101.

POWER SUPPLY CIRCUIT INSPECTION EE72AFE6

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

Specification :Approx. B+



EJRF501U

Is the measured voltage within specifications?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Check for open or short in power harness between battery terminal(+) and terminal "3" of the HECU harness connector. Check for open or blown 20A fuse . Repair as necessary and then go to "Verification of vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION E25C0DCE

1. Ignition "OFF".
2. Disconnect HECU connector.
3. Measure resistance between terminal "4" of the HECU harness connector and chassis ground.

Specification :Approx.below 1 Ω

Is the measured resistance within specifications?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Check for damaged harness and poor connection between terminal "4" of the HECU harness connector and chassis ground. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION E97DF095

1. Ignition "OFF".
2. Engine "ON".
   Does warning lamp remain On?

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.

NO

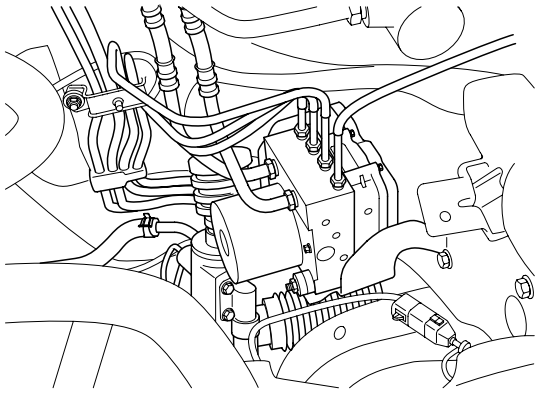
▶ Fault is intermittent caused by open or short of power harness and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR EB6A1AAF

Refer to DTC C1101.

DTC C2308 FL INLET VALVE MAL.
DTC C2312 FL OUTLET VALVE MAL.
DTC C2316 FR INLET VALVE MAL.
DTC C2320 FR OUTLET VALVE MAL.
DTC C2324 RL INLET VALVE MAL.
DTC C2328 RL OUTLET VALVE MAL.
DTC C2332 RR INLET VALVE MAL.
DTC C2336 RR OUTLET VALVE MAL.

COMPONENT LOCATION E46C9B59



KJRE423B

GENERAL DESCRIPTION E59AFBE4

The ABS HECU is composed of an ECU (Electronic Control Unit) and a 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 hydraulic pressure supplied to a wheel cylinder.

DTC DESCRIPTION EEDC0E1D

The HECU monitors the operation of the valves by checking the drive circuit of the solenoid 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.

DTC DETECTING CONDITION EEAB5B72

Item	Detecting Condition	Possible cause
DTC Strategy	Battery Voltage Monitoring	• Faulty HECU
Enable Conditions	1. The electrical feedback signal does not match the actuation signal for the corresponding valve: Actuation Signal != Feedback Signal Fault filter time is t = 30 ms (for current controlled valves and under voltage conditions: t =80 ms) 2. Cyclic Valve and Relay Test (CVRT): • A Fault is found if UVR(Valve relay voltage) is not within 0.1 * UZ(Ignition voltage) < UVR < 0.8 * UZ • A Fault is found if UVR is not UVR < 0.2 * UZ and the Valve Feedback is not act. Valve = = FALSE, not act. Valve = = TRUE At least VR is switched on again. 3. The valve and pump motor test detects electrical actuation malfunction of ABS valves. The test actuates all valves in series (to detect short cuts or shunts between the valve lines). Faults are detected by monitoring the valve response signals.	
Monitoring period	1. Continuous 2. CVRT is executed immediately after power on and then periodic every t =20 s. The Test is canceled if any control/valve actuation takes place or if the Vehicle is in motion and the BLS is on. 3. The Valve and Pump motor Test is performed once after ignition on if vehicle speed is >= 15 km/h(9 MPH).	
Effect	Valve cannot be actuated or valve is incorrectly actuated. This may result in locked wheels or wheels without pressure.	

COMPONENT INSPECTION E4AFF464

1. Ignition "OFF".
2. Engine "ON".
3. Start and drive vehicle in gear and maintain vehicle speed is approx. 15 km/h or more(9 mph or more)
   Does warning lamp remain On?

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.

NO

▶ Fault is intermittent caused by faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure.

VERIFICATION OF VEHICLE REPAIR E6DABD16

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 is approx. 15 km/h or more(9 mph or more))
   Are any DTCs present ?

   YES

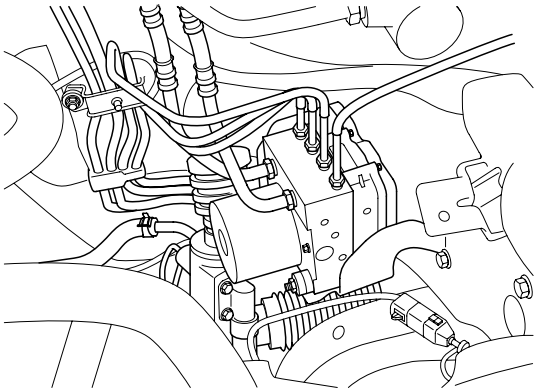
   ▶ Go to the applicable troubleshooting procedure.

   NO

   ▶ A system performs normally at this time.

DTC C2366 TC VALVE PRIMARY(USV1) ERROR
DTC C2370 TC VALVE SECONDARY(USV2) ERROR
DTC C2372 ESP VALVE 1(HSV1) ERROR
DTC C2374 ESP VALVE 2(HSV2) ERROR

COMPONENT LOCATION EF6AF078



KJRE423B

GENERAL DESCRIPTION E1FF760A

The ESP HECU is composed of an ECU (Electronic Control Unit) and a 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/ESP is activated. Solenoid valves function is to increase, decrease or maintain the hydraulic pressure supplied to a wheel cylinder.

DTC DETECTING CONDITION EDF0C317

Item	Detecting Condition	Possible cause
DTC Strategy	Battery Voltage Monitoring	• Faulty HECU
Enable Conditions	The valve and pump motor test detects electrical actuation malfunction of USV and HSV valves. The test actuates all valves in series (to detect shorts or shunts between the valve lines). Faults are detected by monitoring the valve response signals.	
Monitoring period	The USV Test is performed once after ignition on at standstill if the BLS is off and at vehicle speed is v >= 15 km/h(9 MPH) if the BLS is on.	
Effect	Valve cannot be actuated or valve is incorrectly actuated. This may result in locked wheels or wheels without pressure.	

COMPONENT INSPECTION EFCEA1F9

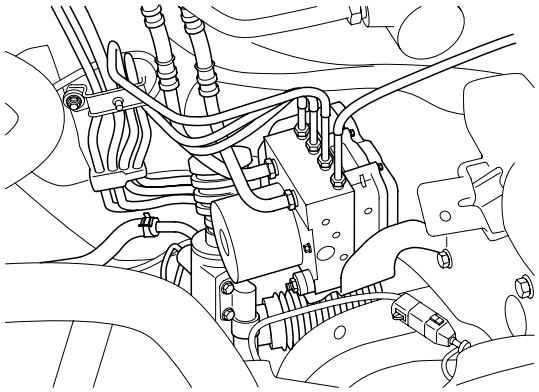
Refer to DTC C2308.

VERIFICATION OF VEHICLE REPAIR EAEBFBB6

Refer to DTC C2308.

DTC C2402 MOTOR-ELECTRICAL

COMPONENT LOCATION EFC48FCB



KJRE423B

GENERAL DESCRIPTION E6CFFA87

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 EBDEB5B2

The ABS/ESP 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 E1ADBDCB

Item	Detecting Condition	Possible cause
DTC Strategy	Battery Voltage Monitoring	• Open or short of power supply circuit • Faulty HECU
Enable Conditions	1. A failure is detected if the voltage UM (Pump motor voltage) > 2.0 V for a time t >= 1 s. 2. A failure is detected if the voltage UM (Pump motor voltage) < (UZ(battery voltage) - 4.0 V) for a time t >= 100 ms. 3. After the end of the actuation of the motor relay has, the pump motor is still in motion and is generating a Voltage during it.s slowdown. The generated UM is monitored for a certain time on high level. The time depends on the supply voltage and is in the range of t = 30 ms to t = 125 ms.If the slow down condition isn.t met, the pump is activated again (see actuation times below) and the slowdown time is measured again. This is repeated for maximum n = 3 times. If, after the last pump activation, the pump motor slowdown time is still to short, a failure is detected.Actuation times: 1st actuation: 200 ms 2nd actuation: 1000 ms 3rd actuation: 3000 ms	
Monitoring period	1. Stop monitor is active if the pump is off i.e. not actuation and no Slowdown. 2. The monitor is active if the pump is switched on . 3. Monitor is always active in the transition "pump on -> pump off".	
Effect	1. The return pump does not work correct. 2. Pressure decrease (outlet valve) is no longer possible (wheels block). 3. Pressure decrease (outlet valve) is no longer possible (wheels lock).	

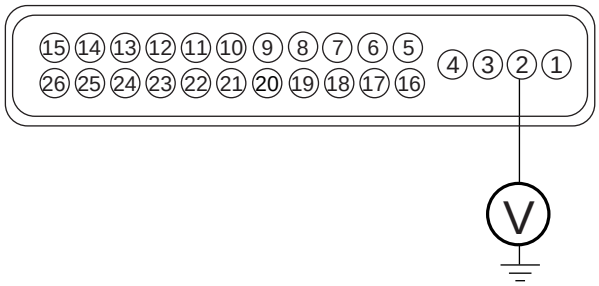
TERMINAL & CONNECTOR INSPECTION E105DC30

Refer to DTC C1101.

POWER SUPPLY CIRCUIT INSPECTION ED01E6CB

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

Specification :Approx. B+



EJRF501V

Is the measured voltage within specifications?

YES

▶ Go to "Ground Circuit Inspection" procedure.

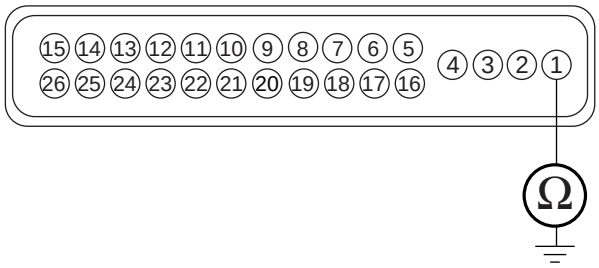
NO

▶ Check for open or short in power harness between battery terminal(+) and terminal "2" of the HECU harness connector. Check for open or blown 40A fuse . Repair as necessary and then go to "Verification of vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EC5BCE5F

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

Specification :Approx.below 1 Ω



EJRF501W

Is the measured resistance within specifications?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Check for damaged harness and poor connection between terminal "1" of the HECU harness connector and chassis ground. Repair as necessary and then go to "Verification of vehicle Repair" procedure.

COMPONENT INSPECTION EC1BFE7C

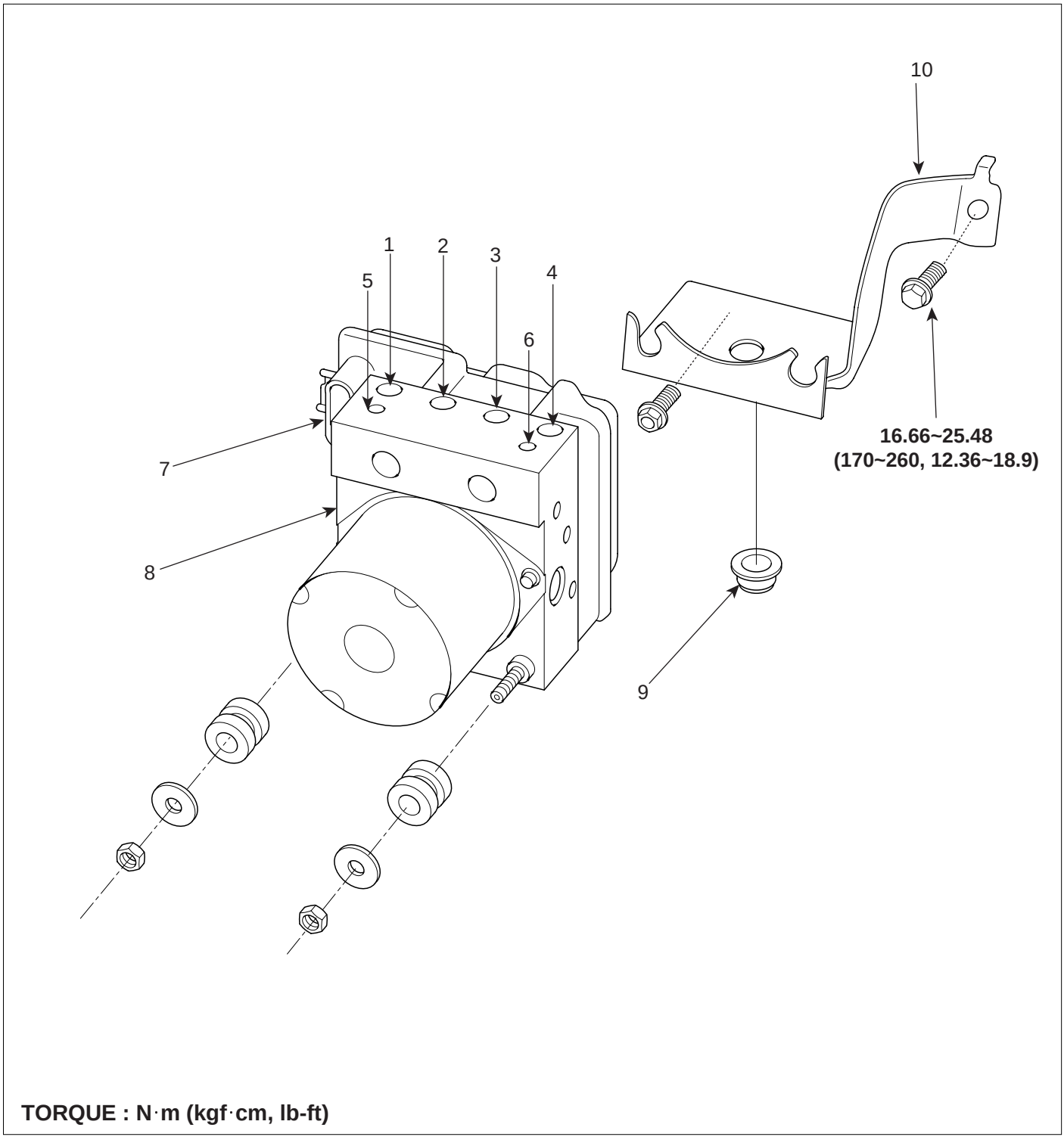
Refer to DTC C2308.

VERIFICATION OF VEHICLE REPAIR ECD40451

Refer to DTC C2308.

ANTI-LOCK BRAKING SYSTEM CONTROL MODULE

COMPONENTS E4BF16F7

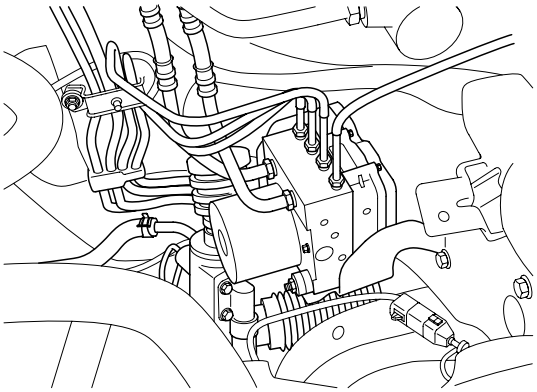


1. Front-left tube
2. Front-right tube
3. Rear-left tube
4. Rear-right tube
5. MC2
6. MC1
7. ABS control module connector(26P)
8. ABS control module(HECU)
9. Damper
10. Bracket

EJRF501X

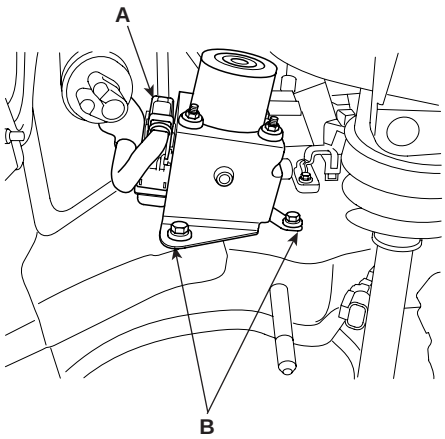
REMOVAL E8AC4A3F

1. Disconnect the brake tube from the HECU by unlocking the nuts counterclockwise with a spanner.



KJRE502T

2. Lift up the vehicle.
3. Disconnect the connector(A) from the HECU.



KJRE503S

4. Remove the two HECU brake mounting bolts(B) , and then disassemble the HECU with the bracket.

CAUTION

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

5. Remove the two HECU mounting nuts and washer, and then remove the bracket.

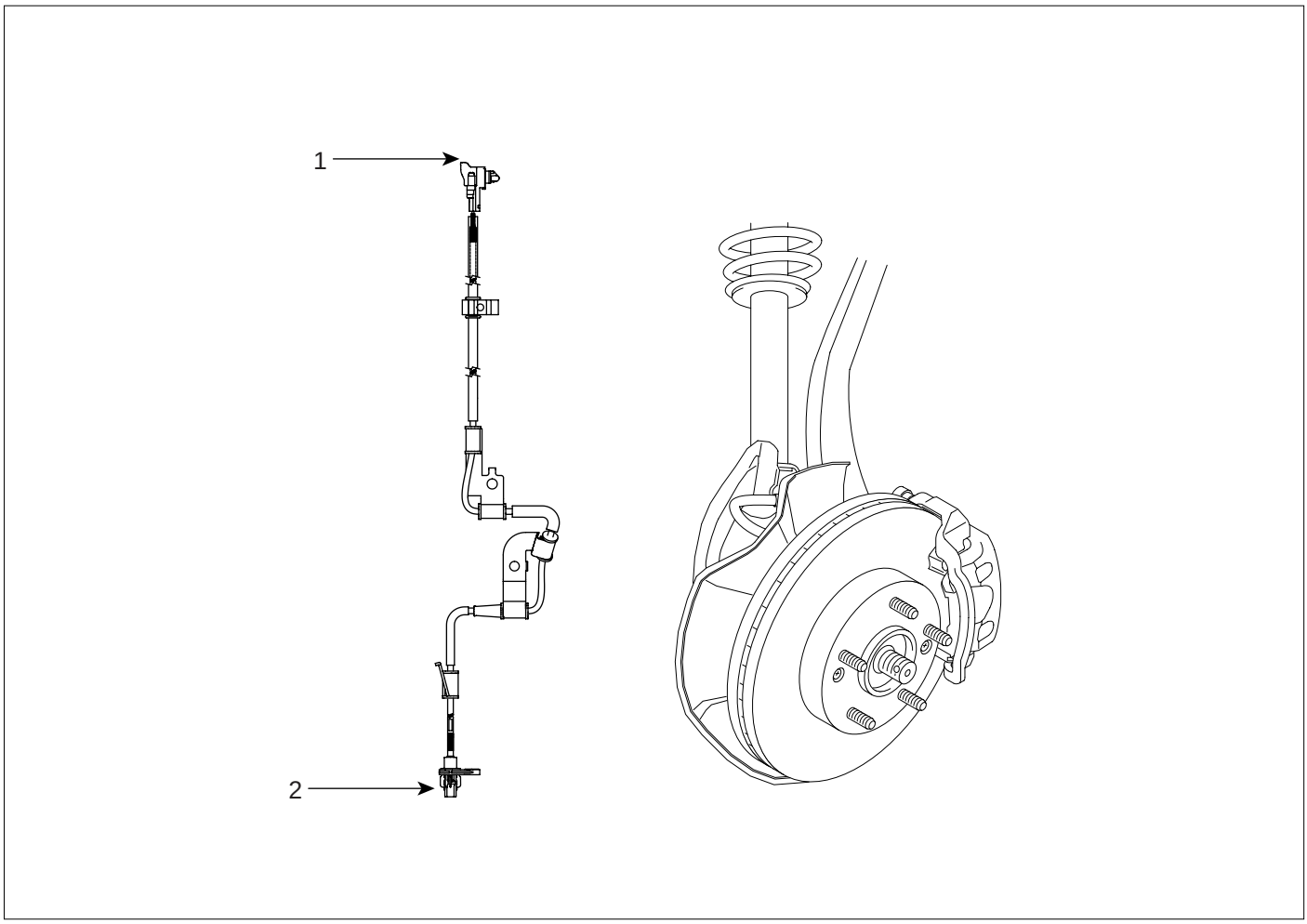
INSTALLATION EEB5ADBE

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

Tighterning torque
HECU mounting nut :
5.88~9.8 Nm (60~100 kgf·cm, 4.36~7.27 lb-ft)
HECU bracket mounting bolt:
16.66~25.48 Nm (170~260 kgf·cm, 12.36~18.9 lb-ft)

FRONT WHEEL SPEED SENSOR

COMPONENTS E9BA1C3F

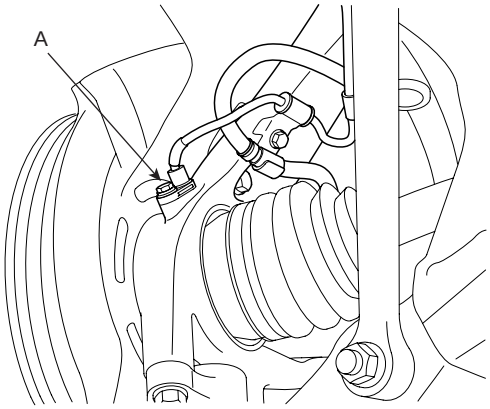


1. Front wheel speed sensor connector
2. Front wheel speed sensor

EJRF501Y

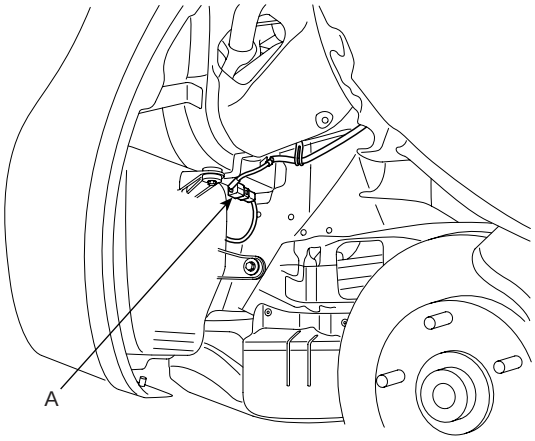
REMOVAL EA8CB8C7

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



KJRE504J

2. Remove the front wheel guard.
3. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector(A).



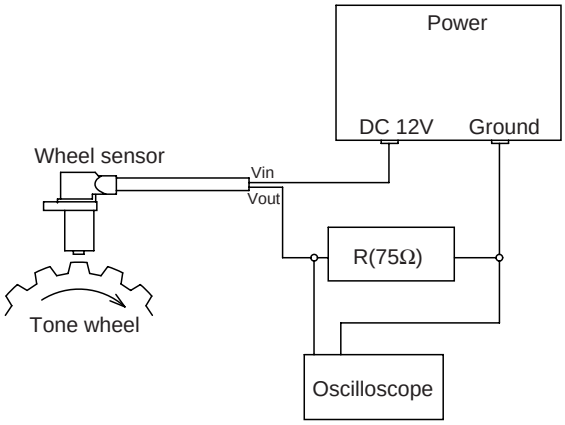
KJRE503V

INSPECTION EA0FA5F9

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

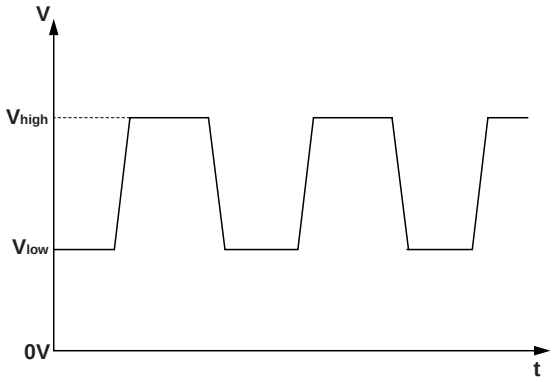
CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 75Ω resister must be used as shown.



EJRF501Z

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

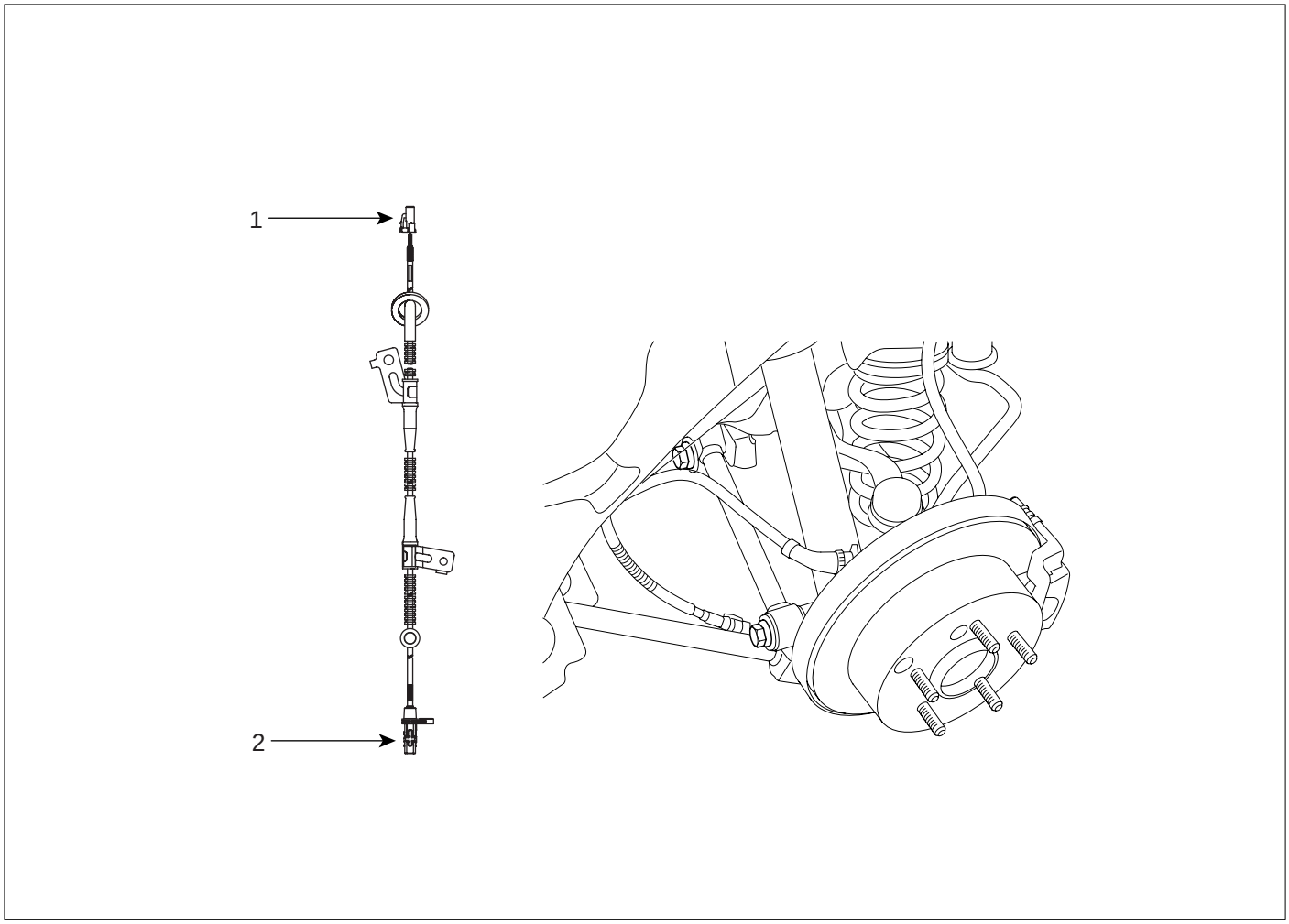


KJQE260B

- V_low : 0.44 V ~ 0.63 V
- V_high : 0.885 V ~ 1.26 V
- Frequency range : 1~2,500 Hz

REAR WHEEL SPEED SENSOR

COMPONENTS E53F460A

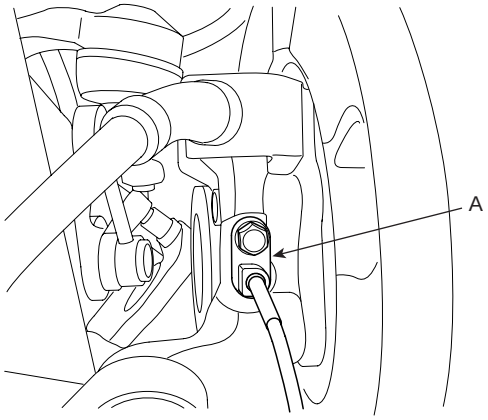


1. Rear wheel speed sensor connector
2. Rear wheel speed sensor

EJRF502A

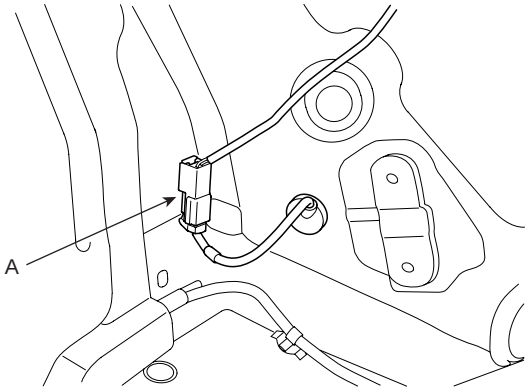
REMOVAL EAE1450B

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



KJRE503W

2. Remove the rear seat side pad then disconnect the rear wheel speed sensor connector(A).



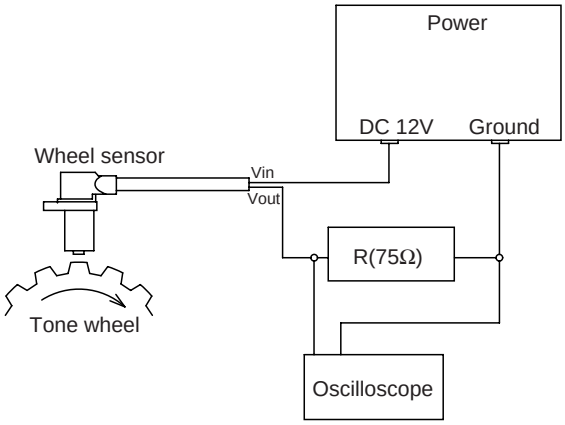
KJRE503X

INSPECTION EC85D750

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

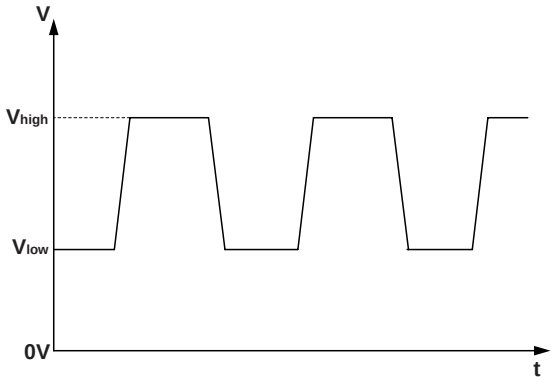
CAUTION

In order to protect the wheel speed sensor, when measuring output voltage, a 75Ω resister must be used as shown.



EJRF501Z

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



KJQE260B

- V_low : 0.44 V ~ 0.63 V
- V_high : 0.885 V ~ 1.26 V
- Frequency range : 1~2,500 Hz

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION)

DESCRIPTION ECEEDFAE

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.

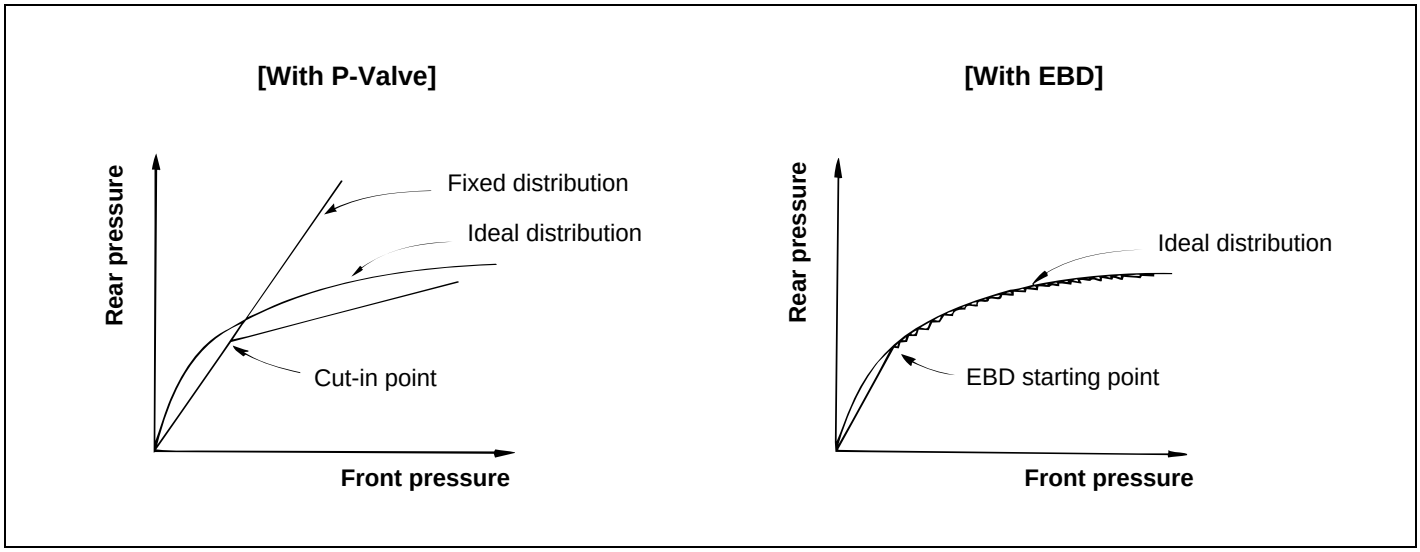
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

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

DESCRIPTION OF ESP EAEE26D8

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

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 needfor actuating the brake or the gas pedal.

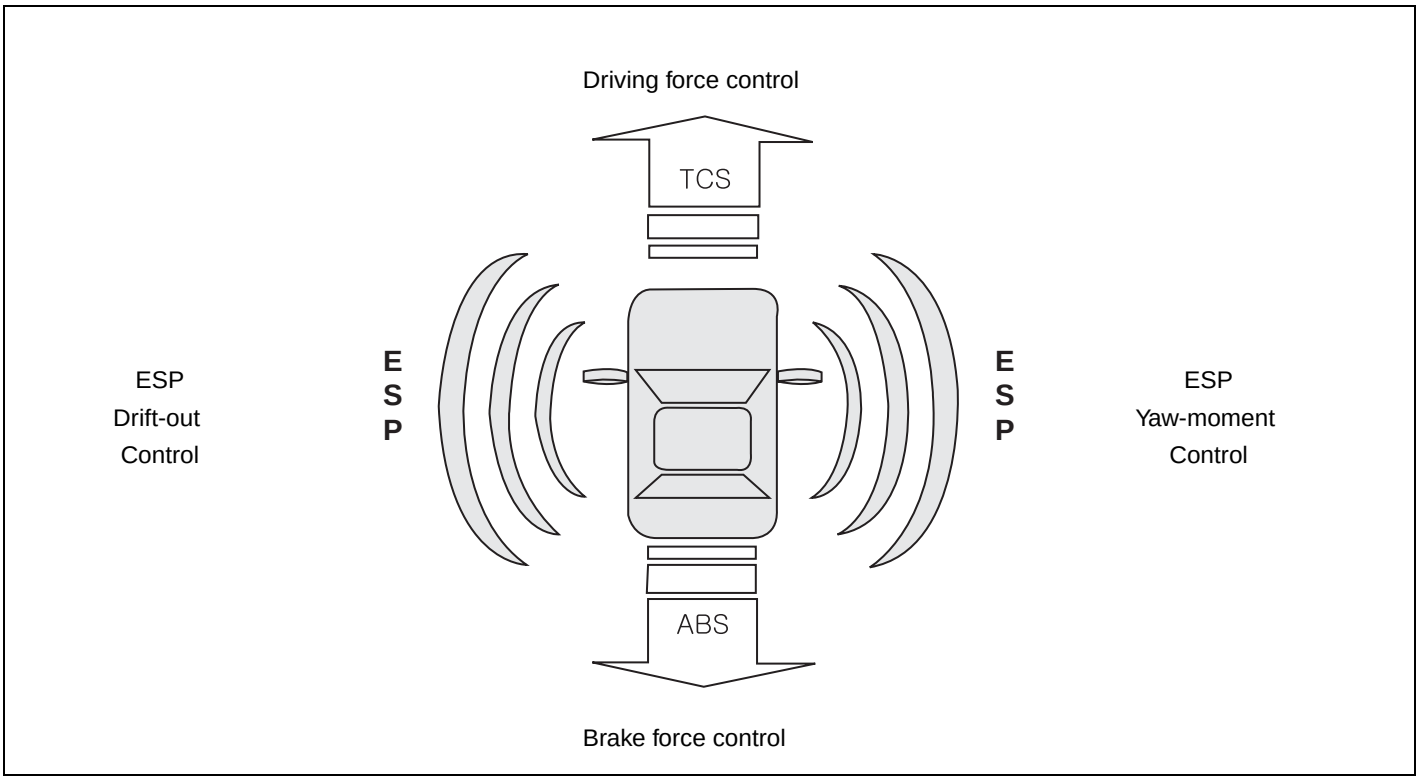
ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and ESP functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about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

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

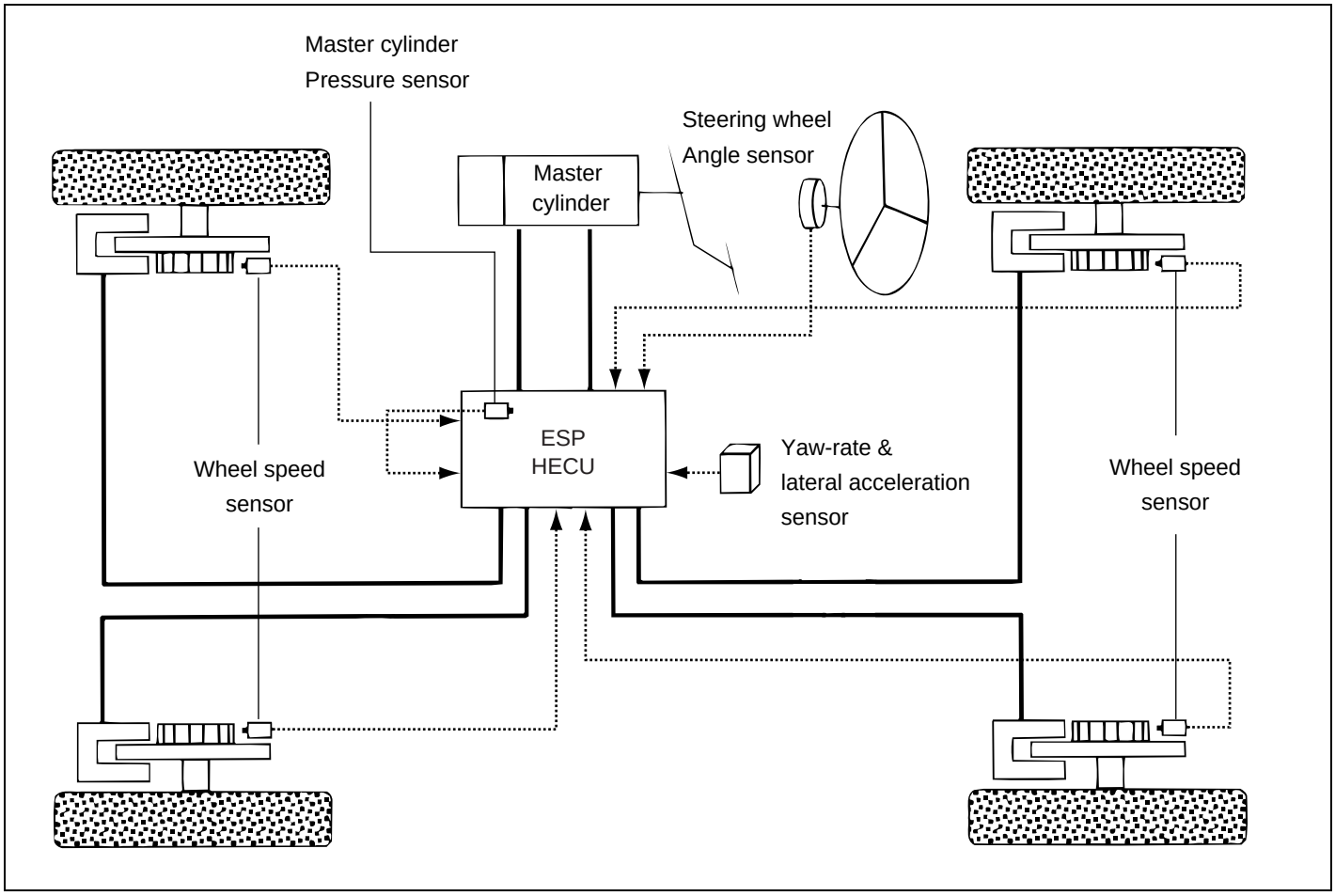
ESP system includes ABS/EBD, TCS and AYC function.

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.

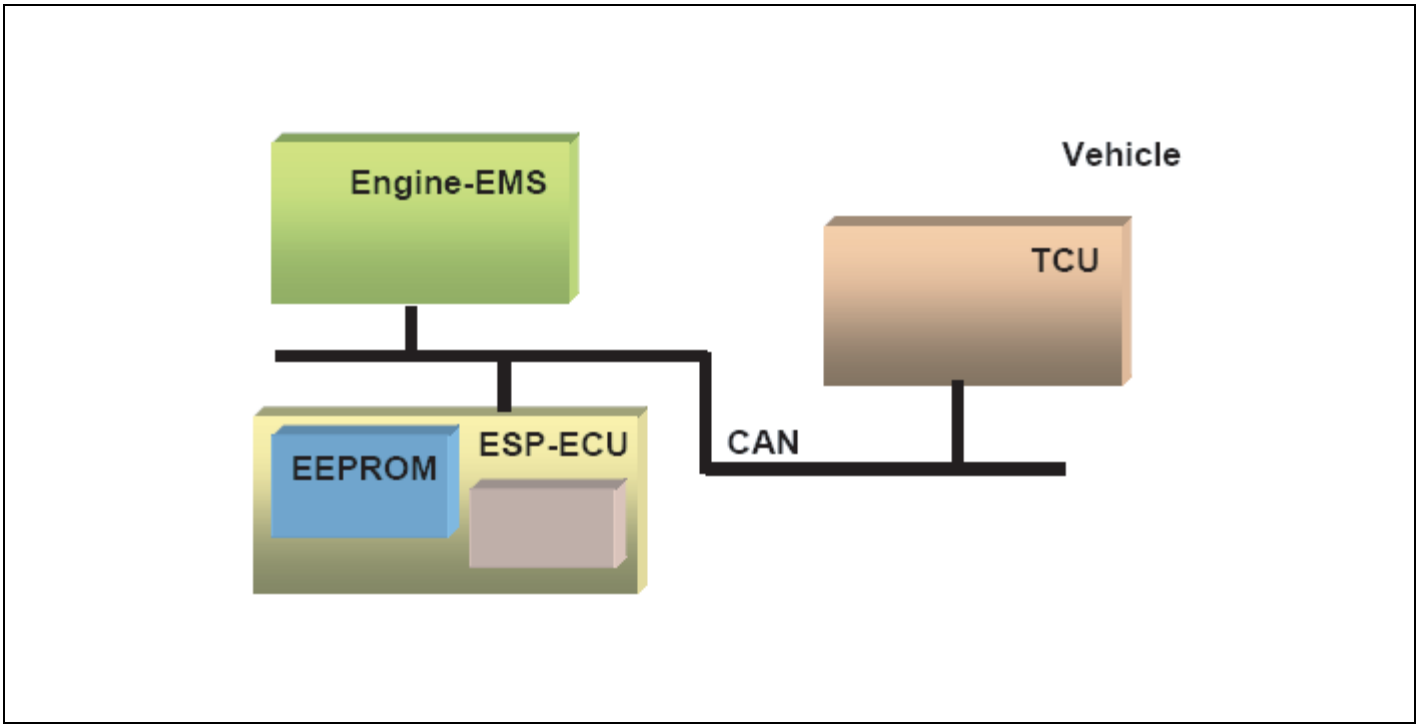
After the key-on, the ECU continually diagnoses the system failure. (self-diagnosis)If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)



EJRF502K

VARIANT CODING

A hardware difference of ECU does not exist according to the specification of the vehicle, but a software changes according to deference of vehicle parameter. The ESP stores variant code (data of engine, displacement volume , T/M) at the ECU memory. Since then an ESP uses the stored data.

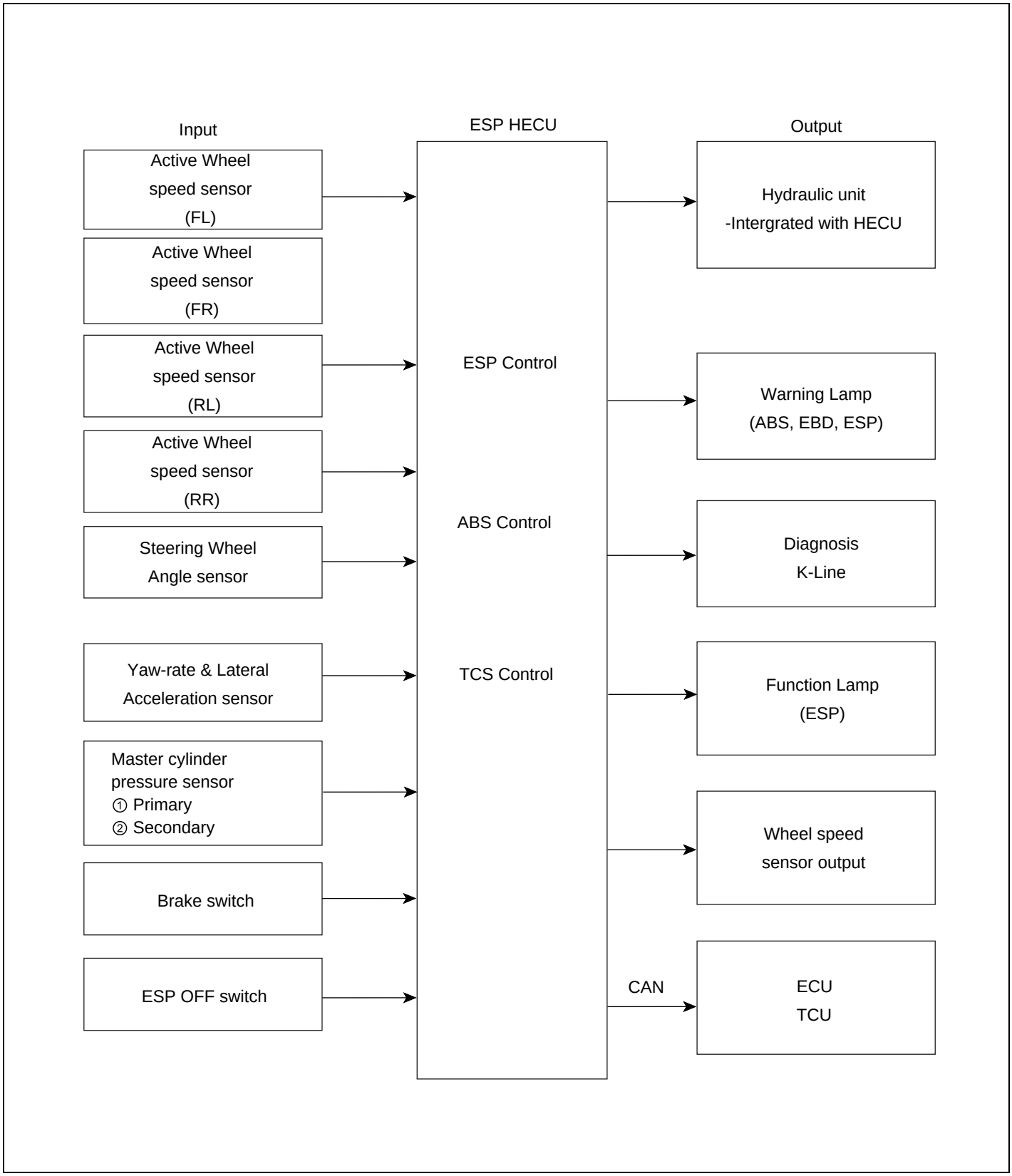


KJRE500L

***PROCEDURE**

1. Install a EMS/TCU/ESP normally.
2. Connect a scanner to the vehicle.
3. IGN On
4. Scanner On
5. Select a brake mode.
6. Push the Variant Coding button.
7. Scanner Off
8. IGN Off
9. Remove the scanner.
10. IGN On
11. Finish the Variant Coding.

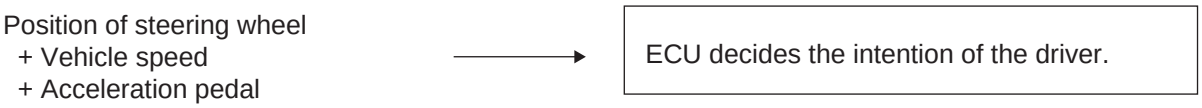
INPUT AND OUTPUT DIAGRAM



EJRF502N

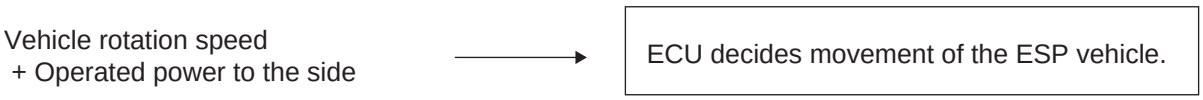
ESP OPERATION MODE E9D3CE94

1. STEP 1
   The ESP analyzes the intention of the driver.



EJRF502B

2. STEP 2
   It analyzes the movement of the ESP vehicle.



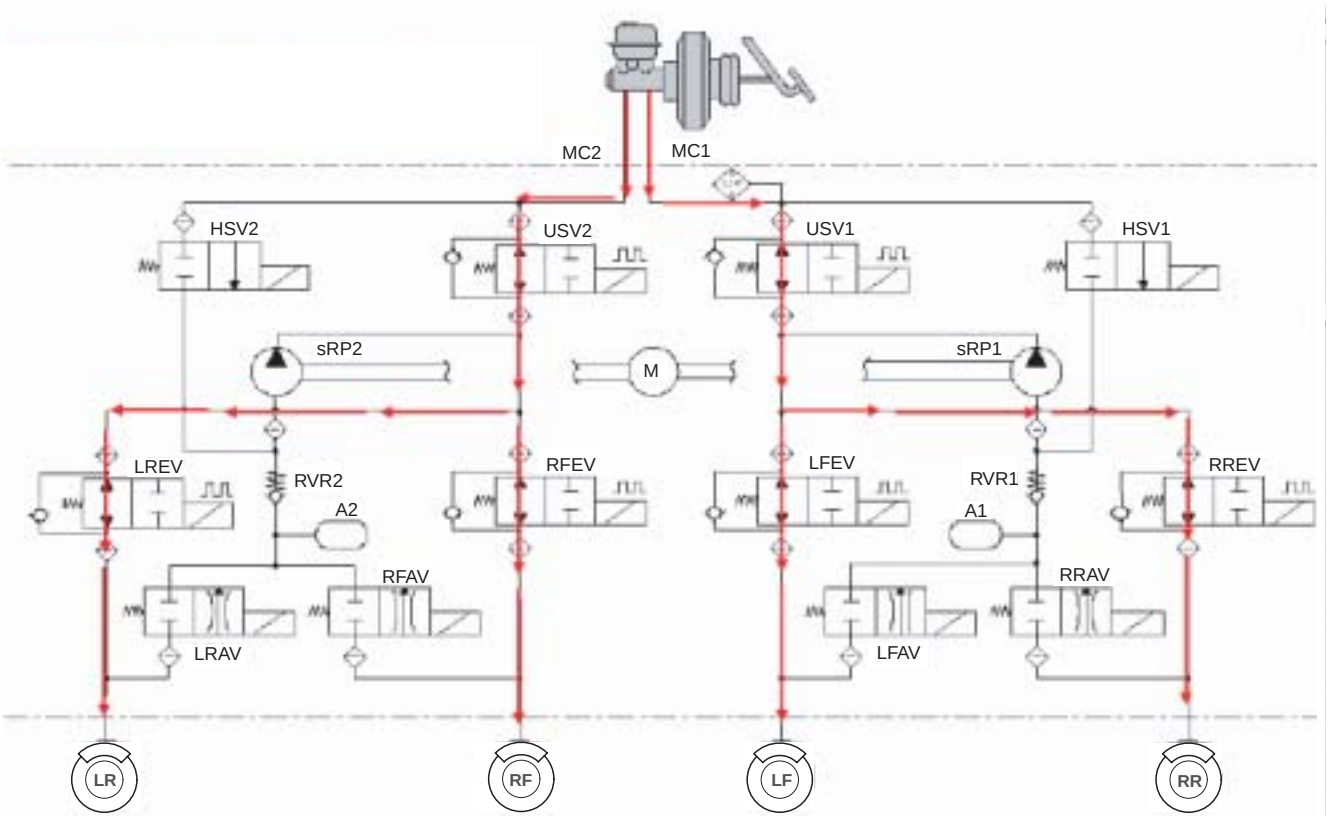
EJRF502C

3. STEP 3
   It controls a vehicle posture control through the ESP braking power.
   - The ECU calculates the needed countermeasure.
   - The hydraulic unit controls Independently the braking power of an each wheel.
   - The ESP adjusts an engine output through an engine and communication line to be connected.

ESP OPERATION MODE

1. ESP Non-operation-Normal braking.

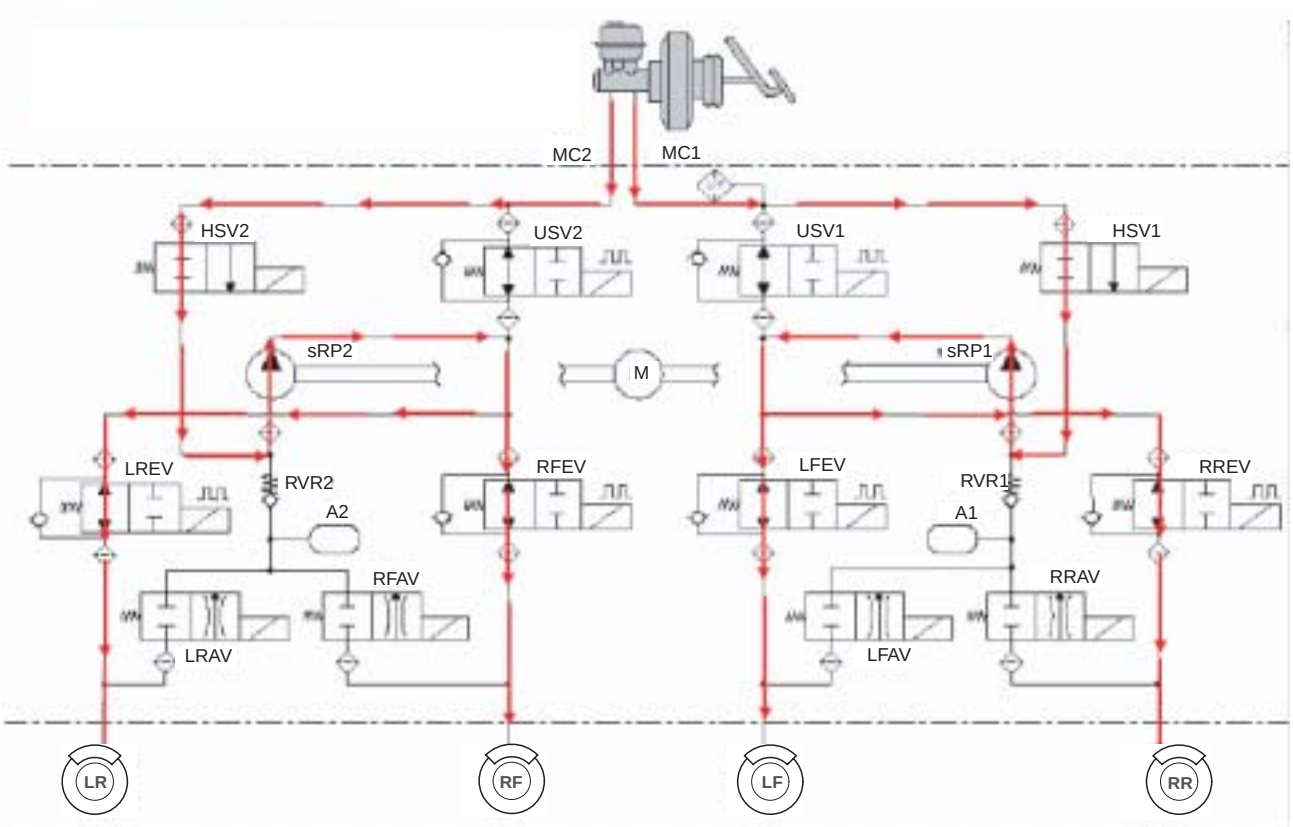
	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Open	Close	Open	Close	OFF



KJRE501L

2. ESP INCREASE MODE

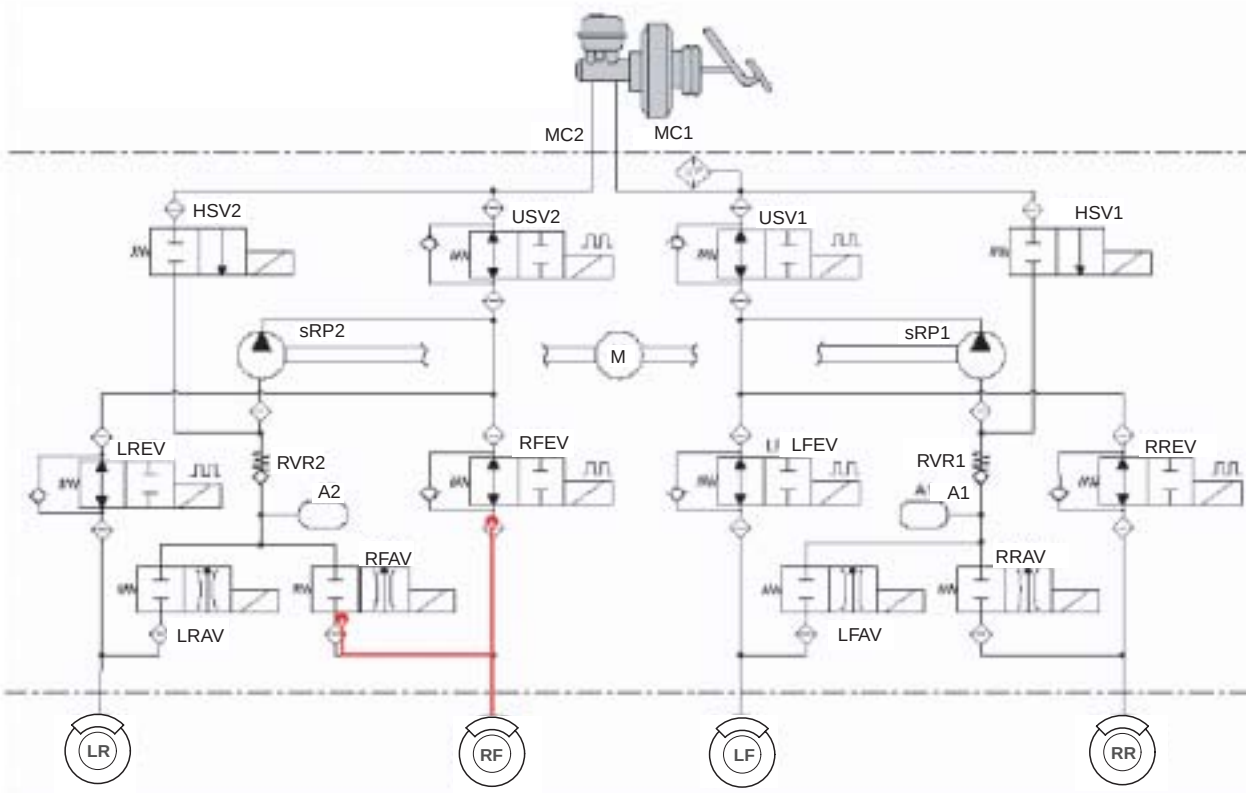
	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Open	Close	Close(Partial)	Open	ON(Motor speed control)



KJRE501M

3. ESP HOLD MODE (FR is only controlled.)

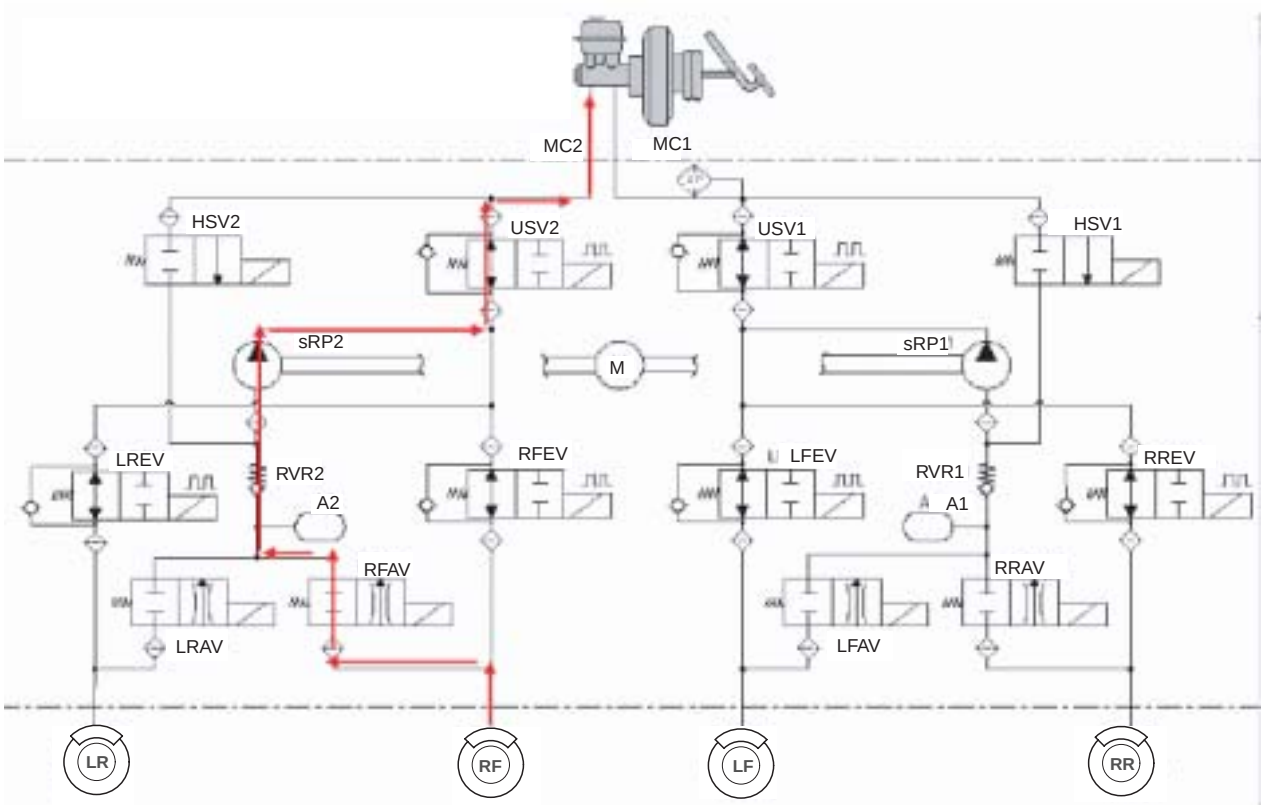
	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Close	Close	Close(Partial)	Open	ON(Motor low speed control)



KJRE501N

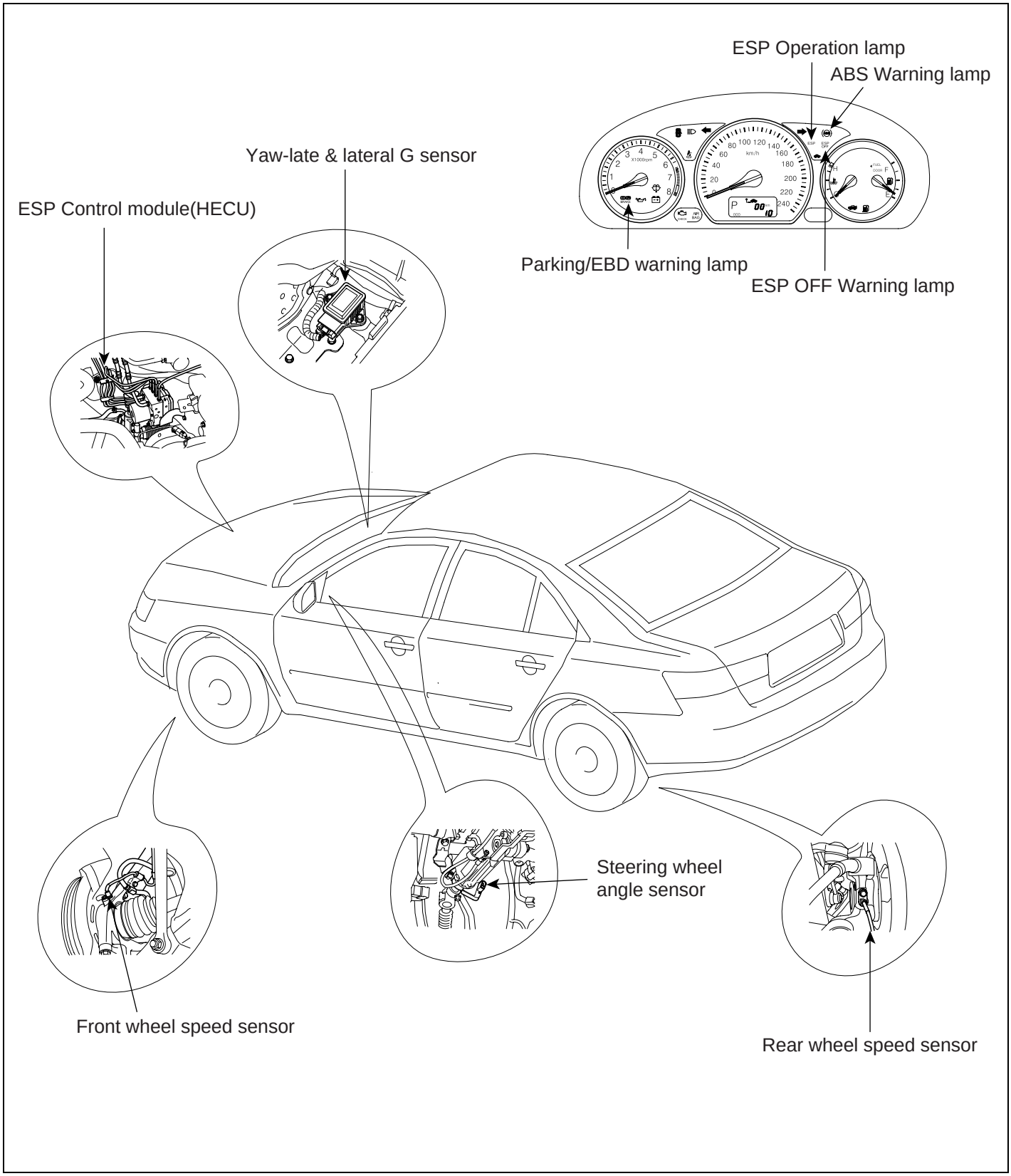
4. ESP DECREASE MODE (FR is only controlled)

	Inlet valve(EV)	Outlet valve(AV)	Pilot valve(USV)	High pressure switch valve(HSV)	Pump motor
Normal braking	Close	Open	Close(Partial)	Open	ON(Motor low speed control)



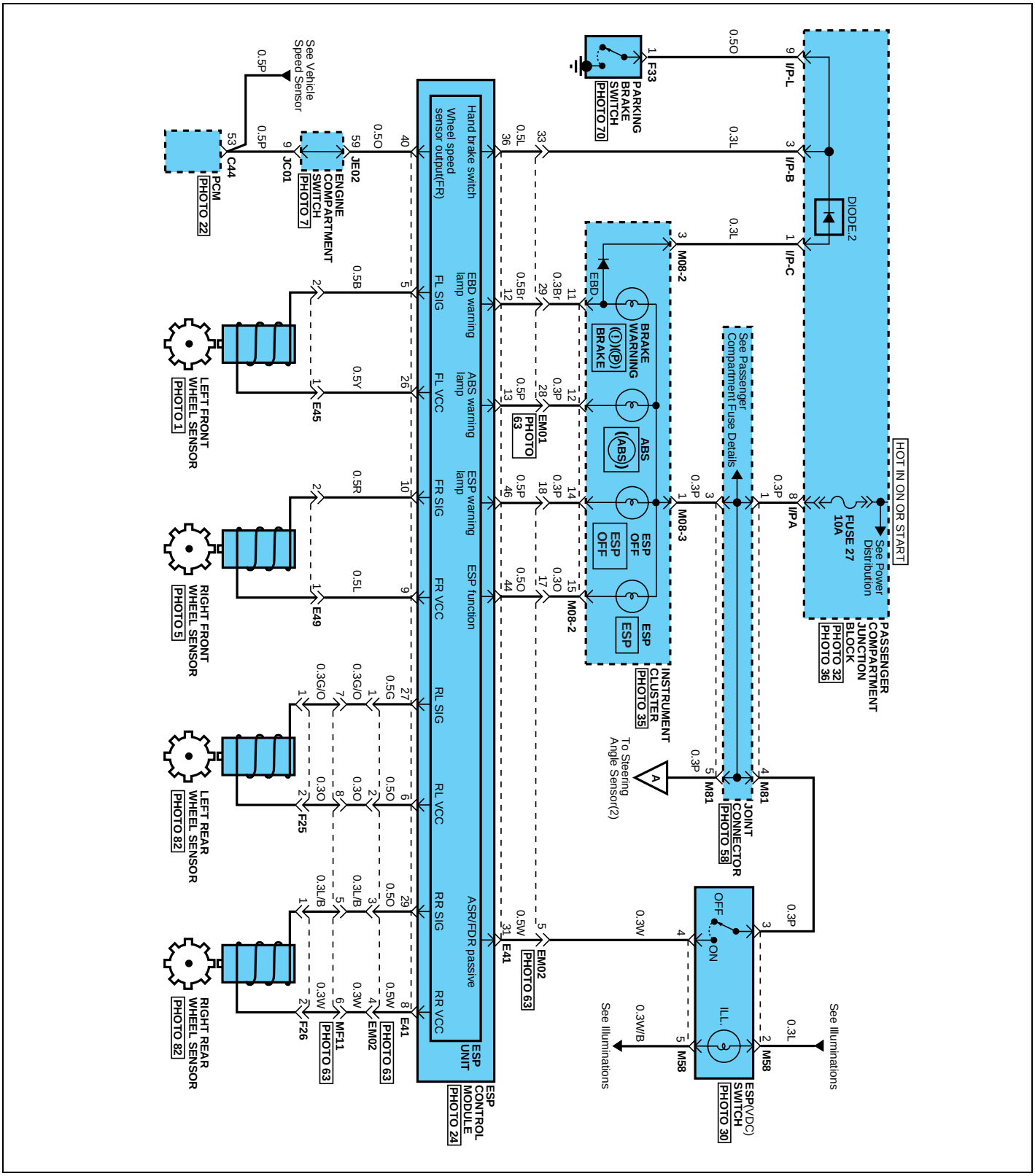
KJRE501O

COMPONENTS E4CFAAFE



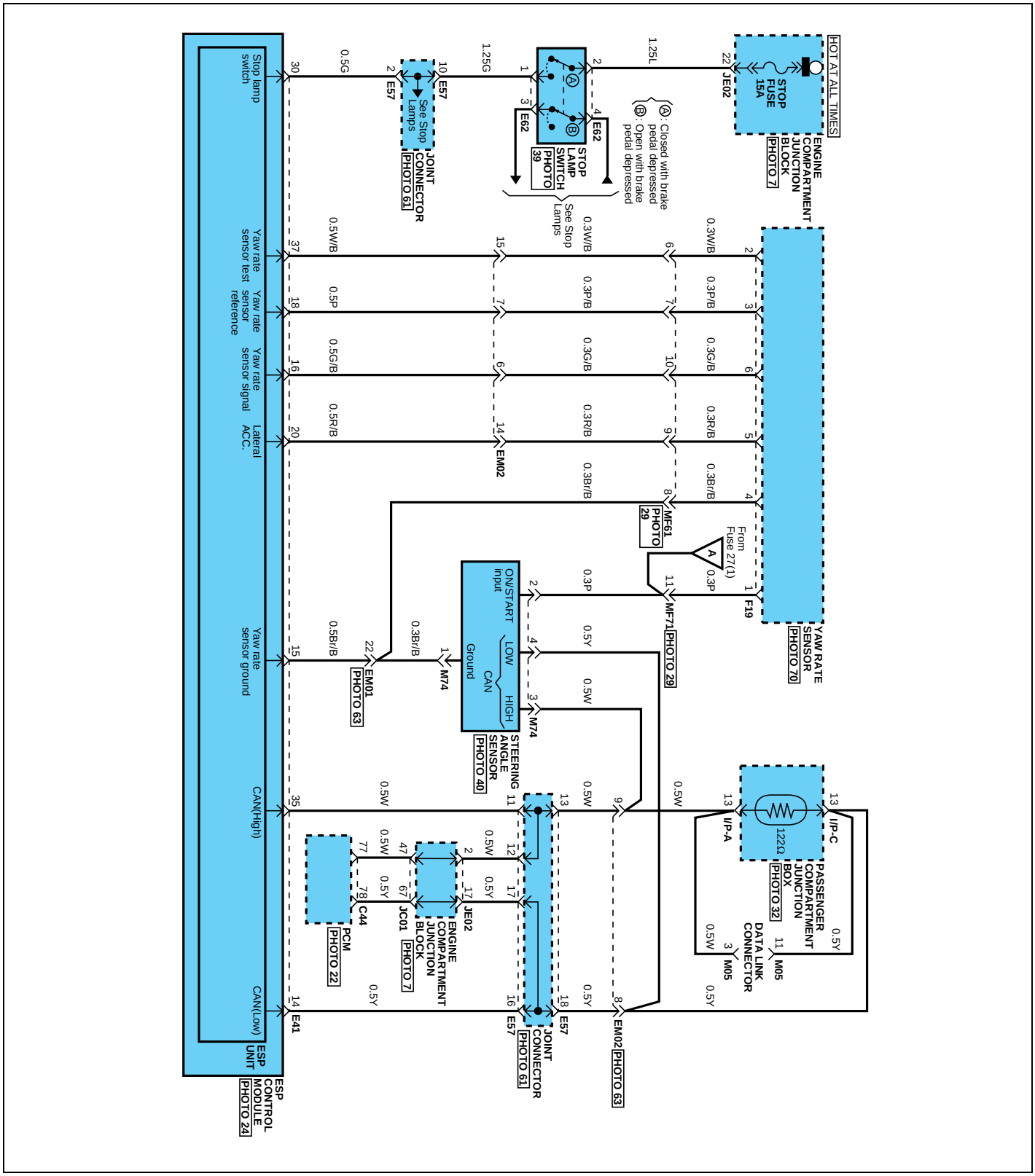
EJRF502D

ESP CIRCUIT DIAGRAM(1) EB7C81E2



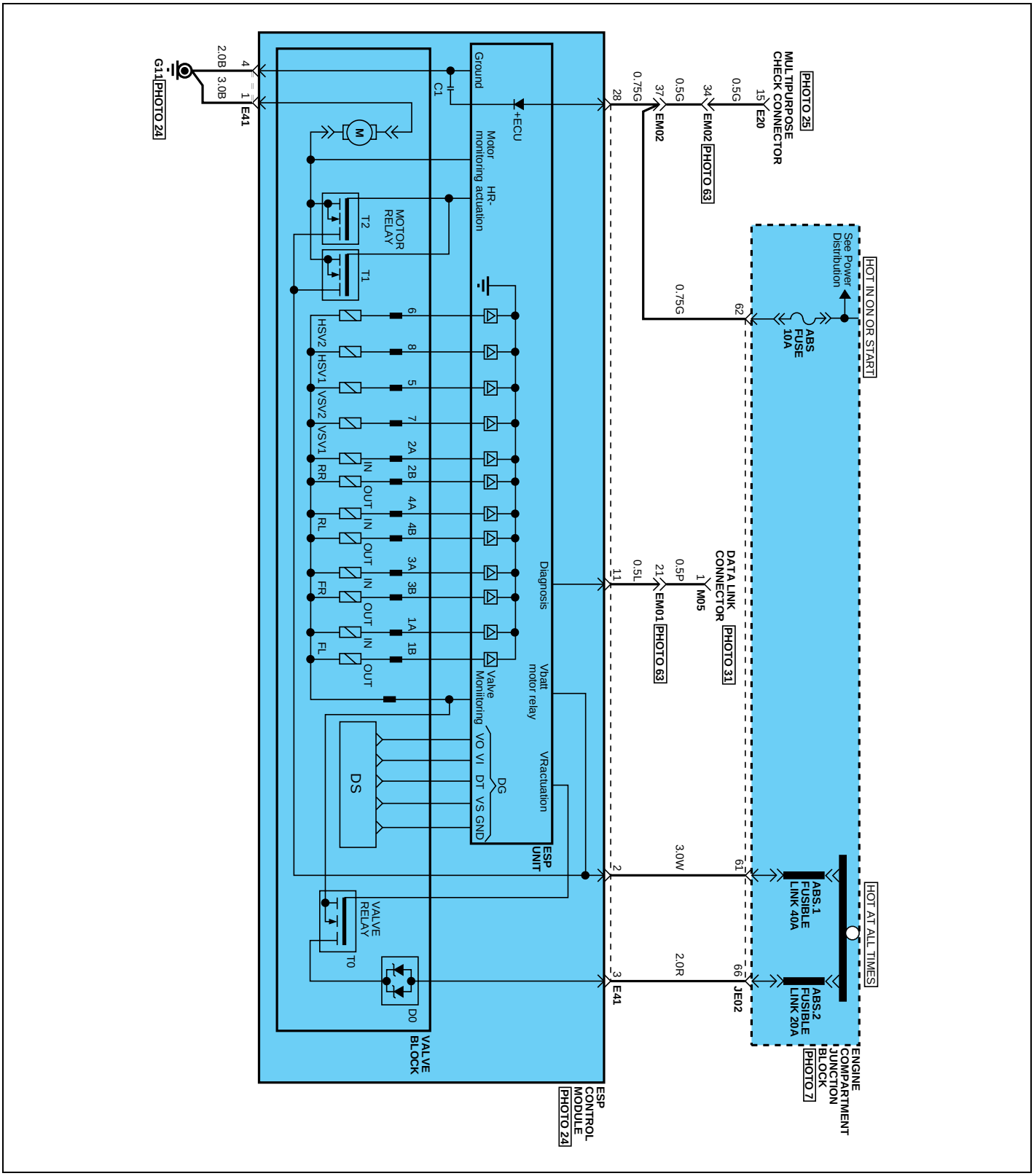
EJRF502U

ESP CIRCUIT DIAGRAM(2)



EJRF502V

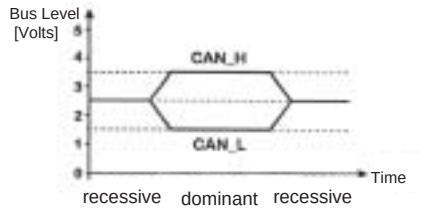
ESP CIRCUIT DIAGRAM(3)



EJRF502W

ESP HECU CONNECTOR INPUT / OUTPUT E603C607

Connector Terminal		Signal name	Specifications	Conditions
No	Description			
1	Ground(Pump)	GND	Current range : Min-10 A Max-20~39 A	Always
4	Ground(Valve,ECU)	GND	Current range : Min-2.5A Max-5~15A	Always
2	Supply voltage(Pump)	Vb MOTOR	Battery voltage	Always
3	Supply voltage(Valve)	Vb VALVE		
26	Wheel sensor voltage(FL)	WP FL	Battery voltage	IG ON
9	Wheel sensor voltage(FR)	WP FR		
6	Wheel sensor voltage(RL)	WP RL		
8	Wheel sensor voltage(RR)	WP RR		
5	Wheel sensor signal(FL)	WS FL	Voltage(High) : 0.89~1.26 V Voltage(Low) : 0.44~0.63 V	RUNNING
10	Wheel sensor signal(FR)	WS FR		
27	Wheel sensor signal(RL)	WS RL		
29	Wheel sensor signal(RR)	WS RR		
11	Diagnosis Input/oupput	DIAG'K'	Voltage(High) : 0.8 * IG ON more Voltage(Low) : 0.2 * IG ON lower	HI-SCAN Communication
28	Ignition	IG.KEY	Battery voltage	KEY ON/OFF
31	ESP Passive switch	ESP Passive switch	Voltage(High) : 0.6 * IG ON more Voltage(Low) : 0.4 * IG ON lower	Switch ON/OFF
36	Hand brake switch	Hand brake switch	Voltage(High) : 0.7 * IG ON more Voltage(Low) : 0.3 * IG ON lower	Switch ON/OFF
37	Yaw Rate Sensor Test	Yaw Rate Sensor Test	Voltage(High) : 4.1 V more Voltage(Low) : 1 V lower	IG ON
18	Yaw Rate Sensor Reference	Yaw Rate Sensor Reference	2.464 V ~ 2.536 V	IG ON
16	Yaw Rate Sensor Signal	Yaw Rate Sensor Signal	Offset voltage :2.5 Vrange : 0.35 V ~ 4.65 V(-100~100 ° /s)	IG ON
20	Acceleration Sensor Signal	Acceleration Sensor Signal	Offset voltage :2.5 Vrange : 0.35 V ~ 4.65 V(-1.8g ~ 1.8g)	IG ON
15	Yaw Rate Sensor Ground	Yaw Rate Sensor Ground	GND LEVEL	Always

Connector Terminal		Signal name	Specifications	Conditions
No	Description			
35	CAN High	CAN High	not communication:2.5 ± 0.5 V communication :  EJRF502L	IG ON
14	CAN Low	CAN Low		
30	BRAKE LIGHT SWITCH	BRAKE LIGHT SWITCH	voltage(High) : 0.8 * IG ON more voltage(Low) : 0.3 * IG ON lower	BRAKE ON/OFF

NF ABS/ESP SENSOR OUTPUT LIST

	DISPLAY(Hi-DS Scanner)	Abbreviation	Unit	Remarks
1	ENGINE SPEED	ENG. SPD	RPM	ESP ONLY
2	VEHICLE SPEED	VEH. SPD	Km/h	
3	THROTTLE P. SNESOR	TP. SNSR	%	ESP ONLY
4	SHIFT LEVER POSITION	SHIFT POSI.	-	ESP ONLY
5	BATTERY VOLTAGE	BATT. VOL	V	
6	WHEEL SPEED SNSR-FL	FL WHEEL	Km/h	
7	WHEEL SPEED SNSR-FR	FR WHEEL	Km/h	
8	WHEEL SPEED SNSR-RL	RL WHEEL	Km/h	
9	WHEEL SPEED SNSR-RR	RR WHEEL	Km/h	
10	ABS WARNING LAMP	ABS LAMP	-	
11	EBD WARNING LAMP	EBD LAMP	-	
12	ESP FUNCTION LAMP	ESP LAMP	-	ESP ONLY
13	ESP OFF LAMP	ESP OFF	-	ESP ONLY
14	ESP OFF SWITCH	ESP SW	-	ESP ONLY
15	BRAKE LAMP SWITCH	B/LAMP	-	
16	PUMP RELAY STATE	PUMP RLY	-	
17	VALVE RELAY STATE	VALVE RLY	-	
18	MOTOR	MOTOR	-	
19	FL VALVE (IN)	FL INLET	-	
20	FR VALVE (IN)	FR INLET	-	
21	RL VALVE (IN)	RL INLET	-	
22	RR VALVE (IN)	RR INLET	-	
23	FL VALVE (OUT)	FL OUTLET	-	
24	FR VALVE (OUT)	FR OUTLET	-	
25	RL VALVE (OUT)	RL OUTLET	-	
26	RR VALVE (OUT)	RR OUTLET	-	
27	TCS VALVE(USV)1	USV1	-	ESP ONLY
28	TCS VALVE(USV)1	USV2	-	ESP ONLY
29	ESP VALVE(HSV1)	HSV1	-	ESP ONLY
30	ESP VALVE(HSV2)	HSV2	-	ESP ONLY
31	STEERING ANGLE SNSR	SAS	deg	-720 ~ 720 °(ESP ONLY)
32	YAW RATE SNSR-LATERAL	LATERAL	g	-1.8 ~ 1.8 G(ESP ONLY)
33	YAW RATE SNSR-YAW	YAW	deg/S	-200 ~ 200 deg/s(ESP ONLY)
34	PRESSURE SENSOR	PRES. SNSR	bar	-42.5 ~ 425 bar(ESP ONLY)
35	PARKING BRAKE SIGNAL	P/BRAKE	-	ESP ONLY
37	SAS CALIBRATED	SAS CALI.	-	ESP ONLY
38	YAW RATE SENSOR TEST PASSED	YAW TEST	-	ESP ONLY

FAILURE DIAGNOSIS EC4E4E4C

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

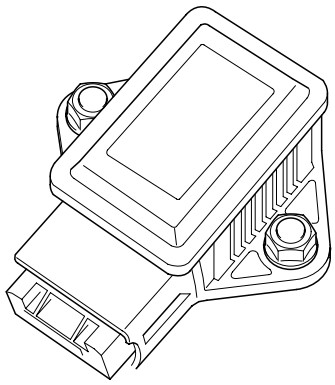
1. ABS warning lamp turns on when ABS is fail.
2. ESP operation lamp turns on when ESP is fail.

When power voltage and valve relay voltage are abnormal, input/output related failure judgment is not made.

YAW-RATE SENSOR

DESCRIPTION EE9CB3F8

1. The yaw-rate & lateral G sensor is applied for the ESP system.
2. The yaw-rate is the angular velocity, when a vehicle turns a corner, and the lateral G is the acceleration to move a vehicle out of the way when cornering.
3. The sensor is located in the crash pad lower floor on vehicle.

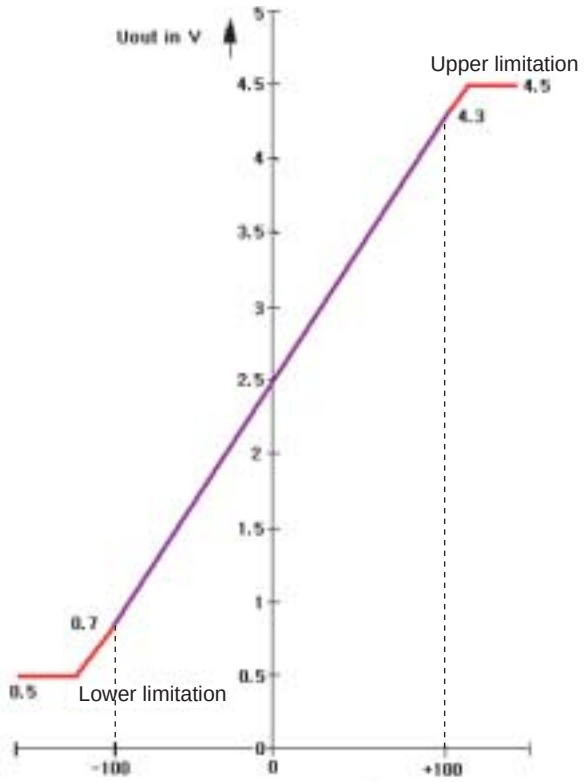


KJRE504E

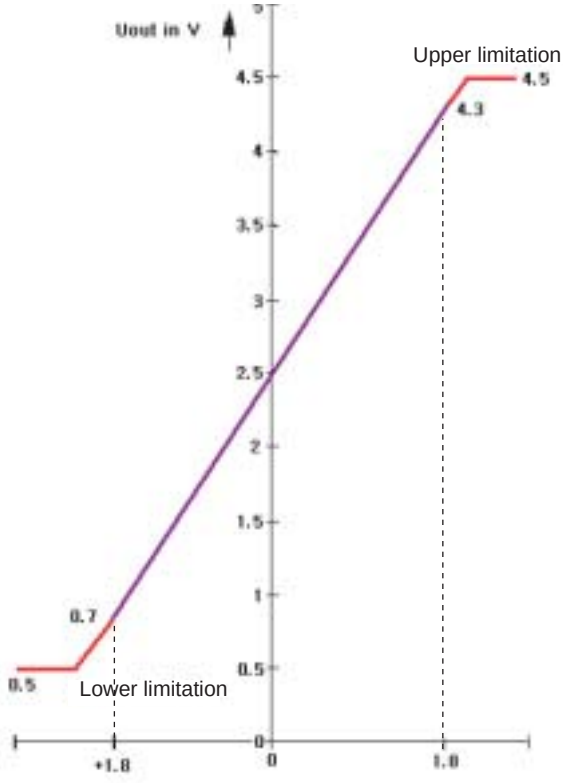
SPECIFICATION

DESCRIPTION			SPECIFICATION	REMARKS
Nominal supply voltage			11.5 ~ 12.5 V	
Supply voltage range			8 ~ 16 V	
Supply current			Max. 120 mA	Typ. 75 mA
Reference Voltage Output			2.464 ~ 2.536 V	Typ. 2.5 V
Operating temperature range			-40 ~ 85 ℃	
Yaw-late sensor	Measurement range	+w direction, left turn	Min.100 °/s	Typ. 111°/S
		-w direction, right turn	Min.100 °/s	Typ. 111°/S
	Non-linearity		-1 ~ 1 %	
	Offset (within life,within operating temperature)		3.75 °/S	
	Upper cut-off frequency		Min. 45 Hz	Typ. 60 Hz
Lateral G sensor	Measurement range	+y direction, left turn	Min.1.8 g	Typ. 2 g
		-y direction, right turn	Min. -1.8 g	Typ. 2 g
	Non-linearity		-4 ~ 4 %	
	Offset (within life,within operating temperature)		-0.09 ~ 0.09 g	
	Upper cut-off frequency		Min. 20 Hz	Typ. 40 Hz

OUTPUT CHARACTERISTIC



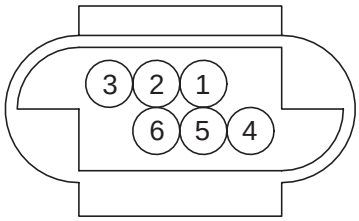
Yaw-rate w in°/s



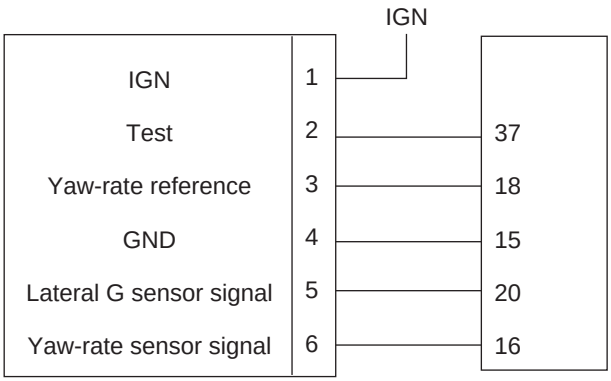
Acceleration a in g

EJRF502E

CIRCUIT DIAGRAM (YAW-RATE & LATERAL G SENSOR)



[Yaw-rate & lateral G sensor connector]



Yaw-rate & lateral G sensor ESP HECU

EJRF502F

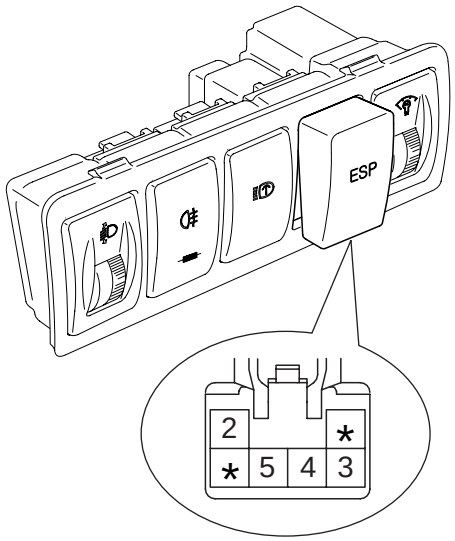
ESP SWITCH

DESCRIPTION EA7AEFA9

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 EC146ABF

1. Remove the ESP OFF switch from the switch panel on the crushpad of the driver's side.



EJRF502G

2. Check the continuity between the switch terminals as the ESP OFF switch is engaged.

Terminal / Position	2	5	3	4
ON	○	○	○	○
OFF				

EJRF502H

STEERING WHEEL ANGLE SPEED SENSOR

DESCRIPTION EC8A2BA9

GENERAL DATA

The steering angle speed sensor detects the angle of the steering wheel in order to which direction a user chooses.The sensor is detached on the MPS(Mutil-Function Switch) under the steering wheel.

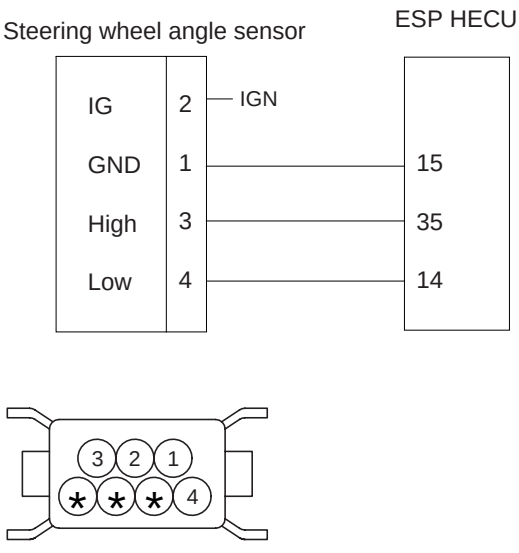
MEASUREING PRINCIPLE

A non contact, analog angle sensor carrying out absolute measuring by the use of the Anisotropic-Magneto-Resistive effect (AMR).Measuring of the absolute angle by means of a toothed measuring gear with magnetic properties in combination with different ratios. Corresponding AMR elements that change their electrical resistance according to the magnetic field direction detect the angle position of the measuring gears.A micro-controller decodes the measured voltage signals after A/D converting with the help of a mathematical function. Output of the digital angle value and velocity via CAN-interface.

SPECIFICATION

DESCRIPTION		SPECIFICATION
Operating voltage		8 ~ 16 V
Operating temperature		-40 ~ 85 ℃
Current consumption		Max.150 mA
Steering angle velocity		Max. ±2000 °/sec
Connection delay time		t < 200 ms
Reverse voltage		-13.5 V
Measuring range	Angle	-780 ° ~ 779 °
	Angular velocity	0 ~ 1016 °/s
Nonlinearity angle		-2.5° ~ +2.5 °
Hysteresis angle		0 ° ~ 5 °
Rotational friction torque measuring		10 °/s

CIRCUIT DIAGRAM(STEERING WHEEL SPEED ANGLE SENSOR)

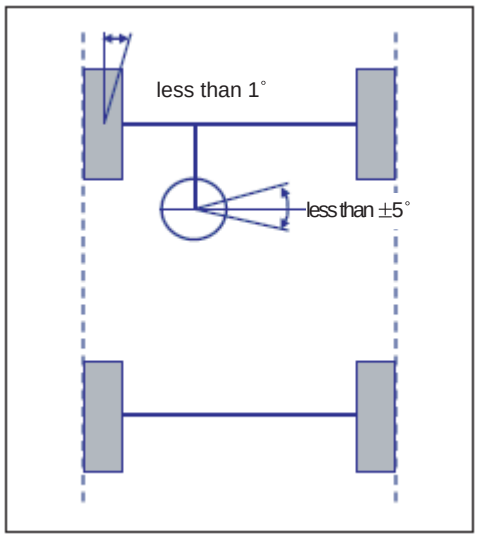


EJRF502I

STEERING ANGLE SENSOR (SAS) CALCULATION

1. PURPOSE OF CALCULATION
   - On vehicle control, a ESP analyzes the intention of the driver.
   - A ESP recognizes a steering angle which a driver rotates through the steering angle sensor.
   - A steering angle sensor used in ESP8 adjusts 0° setting of steering wheel through K-line or CAN communication.

2. STEERING ANGLE SENSOR (SAS) CALIBRATION METHOD



EJRF502J

   1) Align the wheel to the straight line. (steering wheel < ± 5°)
      ex) Perform the wheel alignment first.
      Align the wheel to the straight line.
      A driver moves the vehicle to the front and back about 5 meters twice or three times.

   2) Connect Hi-scan to the vehicle.

   3) Select Brake system.

   4) Select Steering angle sensor(SAS) calculation.

   5) Perform the Steering angle sensor(SAS) calculation.

   6) Scanner OFF.

   7) Remove the scanner from the vehicle.

   8) Confirm the Steering angle sensor(SAS) calculation as driving the vehicle. (turn left once, turn right once)