

Brake System

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GENERAL

SPECIFICATIONS

EDBE8CD6

Master cylinder - Type - Piston stroke - I.D. mm(in.) - Fluid level warning sensor	Tandem type 31mm 23.81 (0.94) : CBS 25.4 (1.0) : ABS (ESP) Provided
Brake booster - Type - Effective dia.mm(in.) - Boosting ratio	Vacuum type with tandem booster Tandem type with 7+8 in. (CBS) Tandem type with 8+9 in. (ABS, ESP) 7.0 : 1
Proportioning valve - Cut-in pressure (Split point) - Decompression ratio	3.4 MPa (35 kg/cm ² , 498 psi) 0.27 : 1
Front disc brake - Type - Disc O.D. - Disc thickness - Pad thickness - Cylinder I.D.	Floating type with ventilated disc 280 mm (11.02 in.) 26 mm (1.024 in.) 11 mm (0.433 in.) 57.2 mm (2.25 in.)
Rear disc brake - Type - Disc O.D. - Clearance adjustment - Disc thickness - Pad thickness - Cylinder I.D.	Floating type with solid disc 258 mm (10.16 in.) Automatic 10 mm (0.394 in.) 9 mm (0.354 in.) 33.96 mm (1.34 in.)
Parking brake - Actuation - Type	Mechanical brake acting on rear wheels Lever



NOTE

*Note

CBS : Conventional Brake System

ABS : Anti-Lock Brake System

ESP : Electronic Stability Program

SPECIFICATION (ABS)

E3BB2CD5

PART	ITEM		STANDARD VALUE	REMARK
HECU(Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor (MGH-25)	·ABS system:ABS & EBD control
	Type		Motor, valve relay integrated type	
	Operating voltage		10V~16V(DC)	
	Operating temperature		-40~110°C(-40~230°F)	
	Motor power		180W	
	Pump orifice		Ø0.5mm(0.0197 in.)	
	Accumulator capacity	LPA	MCS:3.0cc/MCP:3.0cc	LPA:Low pressure accumulator
		HPA	0.13cc	HPA:High pressure accumulator
	Valve	Inlet valve(NO)	Front:Ø0.71mm (0.0280 in.) Rear:Ø0.40mm (0.0157in.)	NO valve:4
		Outlet valve(NC)	Front:Ø0.56mm (0.0220 in.) Rear:Ø0.355mm (0.0140 in.)	NC valve:4
Warning lamp	Operating voltage		12V	·ABS W/L:ABS failure ·Brake W/L:Parking, brake oil, EBD failure
	Current consumption		80mA	
Active wheel speed sensor(ABS)	Supply voltage		DC 12V	
	Output current low		5.9~8.4mA	Typ.7mA
	Output current High		11.8~16.8mA	Typ.14mA
	Frequency range		1~2000HZ	
	Air gap		0.2~1.5mm (0.008~0.0591 in.)	
	Tone wheel		44 teeth	

SPECIFICATION(ESP)

PART	ITEM		STANDARD VALUE	REMARK
HECU(Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor(MGH-25)	·Total control(ABS, EBD, TCS, ESP) ·CAN communication with ECU & TCU
	Type		Motor, valve relay intergrated type	
	Operating voltage		10V~16V(DC)	
	Operating temperature		-40~110°C(-40~230°F)	
	Motor power		250W	
	Pump orifice		Ø0.5mm(0.0197 in.)	
	Accumu- lator ca- pacity	LPA	MCS:3.0cc /MCP:3.0cc	LPA:Low pressure accumulator
		HPA	0.13cc	HPA:High pressure accumulator
	Valve	Inlet valve(NO)	Front:Ø0.71mm (0.0280 in.) Rear:Ø0.40mm (0.0157 in.)	NO valve:4
		Outlet valve(NC)	Front:Ø0.56mm (0.0220 in.) Rear:Ø0.355mm (0.0140 in.)	NC valve:4
Traction Control valve relief pressure		120~150bar		
Warning lamp	Operating voltage		12V	·ESP Operating Lamp ·ESP Warning Lamp
	Current consumption		80mA	
Active wheel speed sensor	Supply voltage		DC12V	
	Output current low		5.9~8.4mA	
	Output current high		11.8~16.8mA	
	Frequency range		1~2000HZ	
	Airgap		0.2~1.5mm	
Steering Wheel Angle Sensor	Operating Voltage		9V~16V	
	Current Consumption		Max 100mA	
	High Output voltage		3.0V~4.1V	
	Low output voltage		1.3V~2.0V	
	Operating Angular velocity		Max 1500°/sec	

GENERAL**BR -5**

PART	ITEM	STANDARD VALUE	REMARK
Yaw-rate & G sensor	Operating Voltage	4.75V~5.25V	Typ. 5V
	Current Consumption	Max. 65mA	
	Output Voltage	0.5V~4.5V	
	Yaw Sensor Operating Range	±75° /s	
	G Sensor Operating Range	±1.5G	
	Nominal Offset	2.5V	
	Operating Temperature	-40~85℃	
Master Pressure Sensor	Operating Voltage	4.75V~5.25V	
	Current Consumption	Max. 15mA	
	Output Voltage Range	0.5V~4.4V	
	Output Pressure Range	0~200bar	
	Max Pressure	350 bar	
	Nominal Offset	0.5V	

SERVICE STANDARD EF3EEC4D

	Standard value	Service limit
Brake pedal height	170mm(6.693in.)	
Brake pedal full stroke	128 mm (5.04 in.)	
Brake pedal free play	3~8mm(0.11~0.31in.)	
Brake pedal to floorboard clearance	61mm(2.4in.)	
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)	6~7 clicks	
Front disc brake pad thickness	11 mm (0.43 in.)	2 mm (0.079 in.)
Front disc thickness (minimum)	26 mm (1.024 in.)	24.4 mm (0.961in.)
Rear disc brake pad thickness	9 mm (0.354 in.)	2 mm (0.079 in.)
Rear disc brake disc thickness	10 mm (0.394 in.)	8 mm (0.315 in.)

TIGHTENING TORQUE

	Nm	Kgf·cm	lbf·ft
Proportioning valve to master cylinder	22.4~26.5	224~265	16.5~19.545
Master cylinder to booster mounting nut	8~12	80~120	5.9~8.9
Brake booster mounting nut	13~16	130~160	9.6~11.8
Brake booster vacuum hose fitting to surge tank	15~18	150~180	11.1~13.3
Bleeder screw	7~13	70~130	5.2~9.6
Brake tube nut, brake hose	13~17	130~170	9.6~12.5
Caliper assembly to knuckle	65~75	650~750	47.94~55.32
Brake hose to front caliper	25~30	250~300	18.4~22.1
Caliper guide rod bolt	22~32	220~320	16.2~23.6

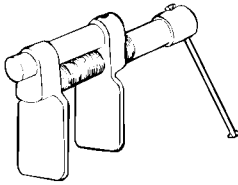
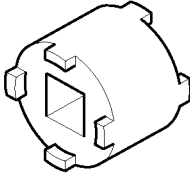
TIGHTENING TORQUE (ABS)

ITEM	N·m	kgf·cm	lbf·ft
Active wheel speed sensor mounting bolt on the brake plate	8~9	80~90	5.6~6.6
·Front	8~9	80~90	5.6~6.6
·Rear			
Hydraulic & electronic control unit mounting bolt	8~10	80~100	5.6~6.9
Hydraulic & electronic control unit mounting bracket bolt	17~26	170~260	12~19
Brake tubes nut	13~17	130~170	9.59~12.54
Air bleeder screw	7~13	70~130	5~9.6

TIGHTENING TORQUE (ESP)

ITEM	N·m	kgf·cm	lbf·ft
Yaw rate & lateral acceleration sensor Nut	4~6	40~60	2.9~4.4
Steering wheel nut	40~50	400~500	28.9~36.9
Master cylinder pressure sensor	22.4~26.5	224~265	16.5~19.5

SPECIAL TOOLS E8BECB34

Tool (Number and Name)	Illustration	Use
09581 - 11000 Piston expander	 EJDA043A	Spreading the front brake piston
09580 - 34000 Rear brake piston adjuster	 EJKB004A	Removal and installation of the rear brake piston

PRECAUTION E3509B00

- Care must be taken to replace each part properly as it could affect the performance of the brake system and result in a driving hazard. Replace the parts with parts of the same part number or equivalent.
- It is very important to keep parts and the area clean when repairing the brake system.

TROUBLESHOOTING E86DA69F

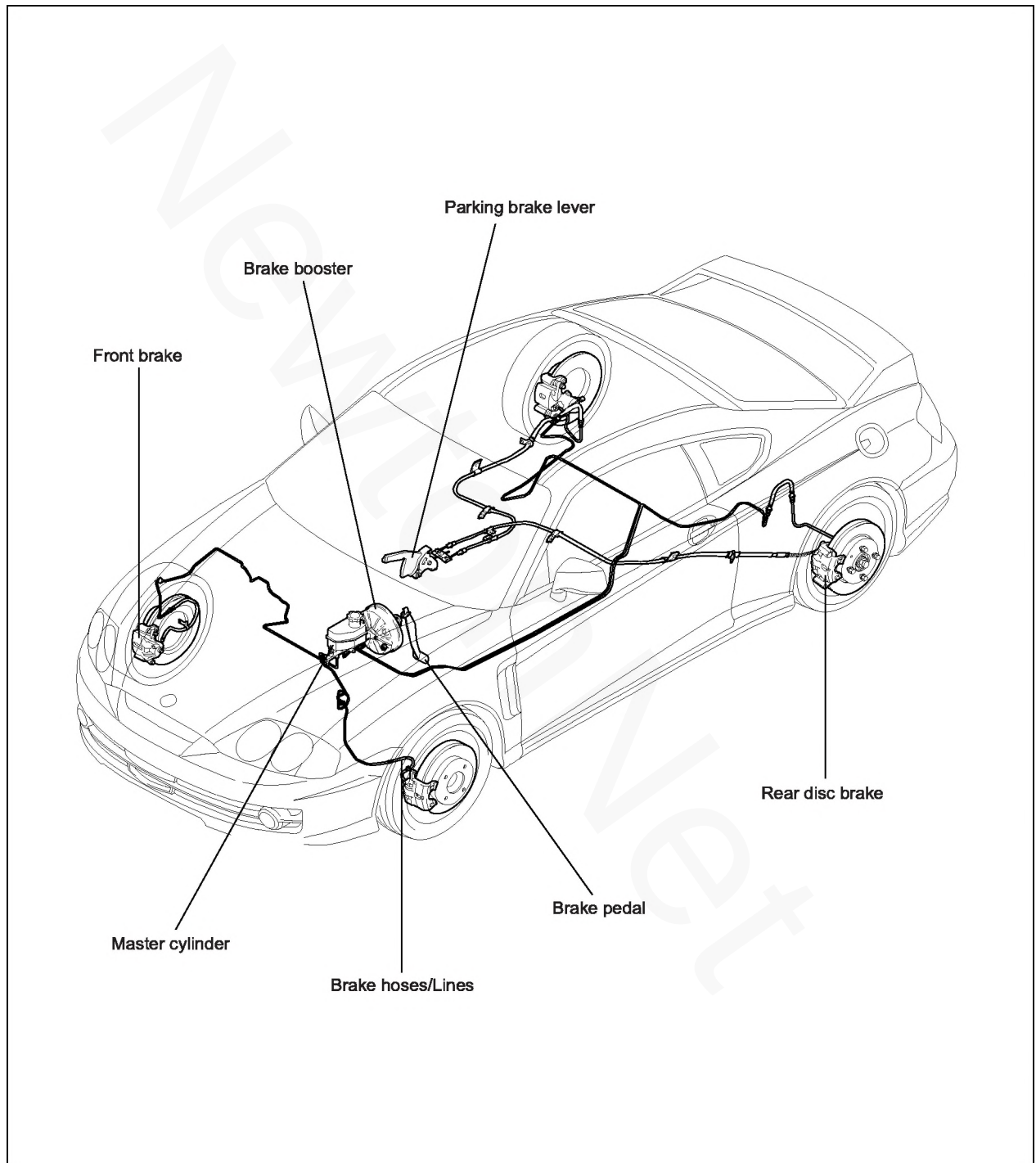
PROBLEM SYMPTOMS TABLE

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	Remedy
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Master cylinder (Faulty)	Correct Bleeding Replace Replace
Brake drag	1. Brake pedal freeplay (Minimal) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Pad (Cracked or distorted) 5. Piston (Stuck) 6. Piston (Frozen) 7. Booster system (Vacuum leaks) 8. Master cylinder (Faulty)	Adjust Adjust Correct Replace Replace Replace Replace Replace
Brake pull	1. Pad (Oily) 2. Piston (Frozen) 3. Disc (Scored) 4. Pad (Cracked or distorted)	Replace Replace Replace Replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad (Worn) 4. Pad (Cracked or distorted) 5. Pad (Oily) 6. Pad (Glazed) 7. Disc (Scored) 8. Booster system (Vacuum leaks)	Correct Bleeding Replace Replace Replace Replace Replace Replace
Noise from brake	1. Pad (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Pad retainers (Loosen) 5. Sliding pin (Worn) 6. Pad (Dirty) 7. Pad (Glazed) 8. Brake pad shim (Damage)	Replace Retighten Replace Replace Replace Clearing Replace Replace

BRAKE SYSTEM

COMPONENT LOCATING INDEX E6285D2B

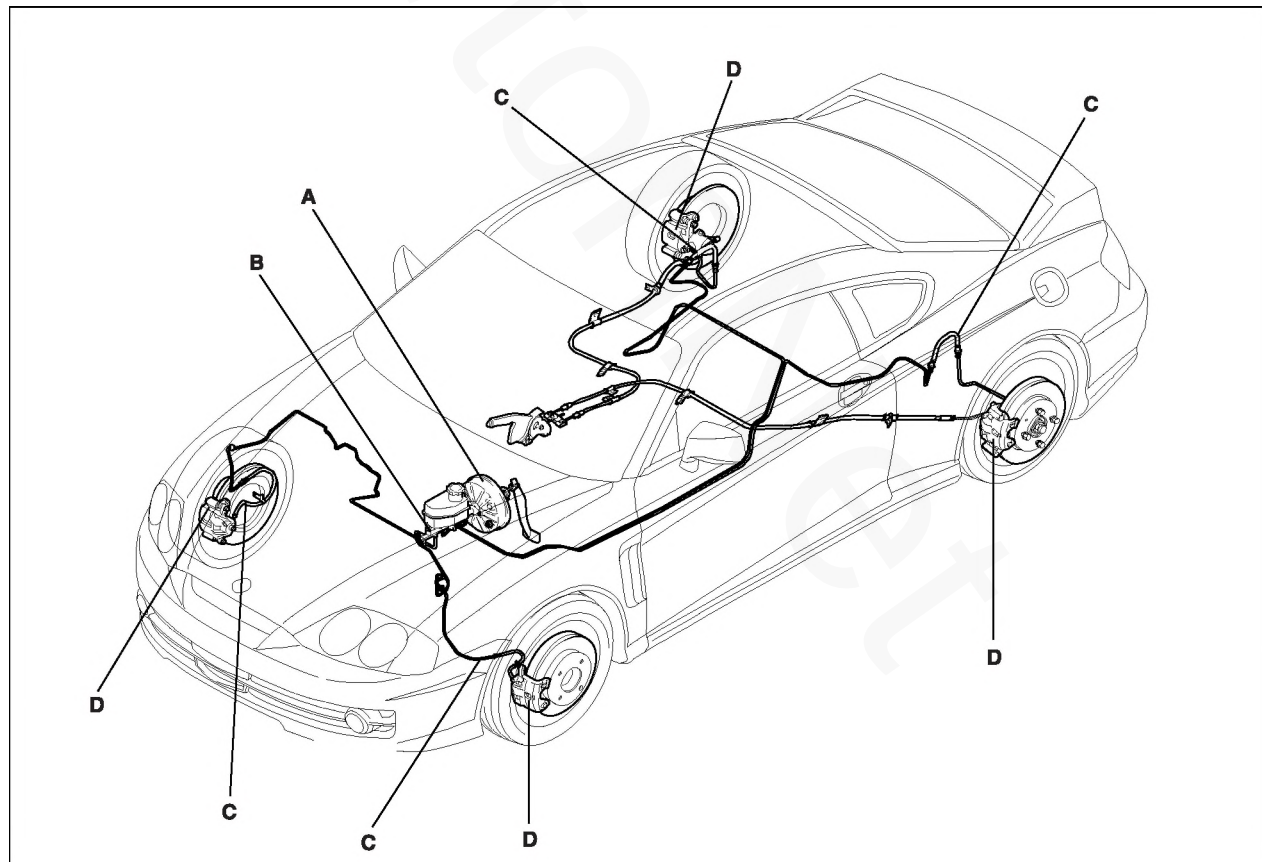


OPERATION AND LEAKAGE

CHECK EDAEC7E9

CHECK ALL OF THE FOLLOWING ITEMS:

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

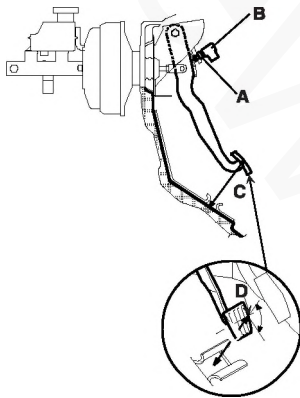


BRAKE PEDAL AND BRAKE SWITCH
ADJUSTMENT

Pedal Height

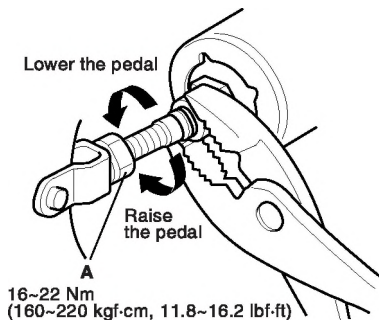
1. Disconnect the brake switch connector, loosen the brake switch locknut (A), and back off the brake switch (B) until it is no longer touching the brake pedal.
2. Lift up the carpet. At the insulator cutout, measure the pedal height (C) from the middle of the left-side center of the pedal pad (D).

Standard pedal height (with carpet removed):
170 mm (6.69 in.)



EJDE001A

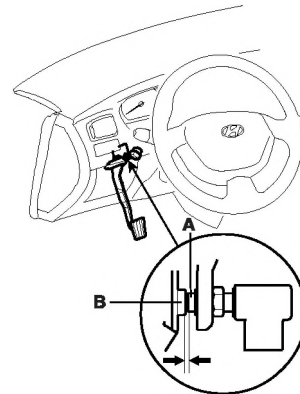
3. Loosen the pushrod locknut (A), and screw the pushrod in or out with pliers until the standard pedal height from the floor is reached. After adjustment, tighten the locknut firmly. Do not adjust the pedal height with the pushrod depressed.



EJDE001B

BRAKE SWITCH CLEARANCE

Screw in the brake switch until its plunger is fully depressed (threaded end (A) touching the pad (B) on the pedal arm). Then back off the switch 3/4 turn to make 0.9 mm (0.04 in.) of clearance between the threaded end and pad. Tighten the locknut firmly. Connect the brake switch connector. Make sure that the brake lights go off when the pedal is released.

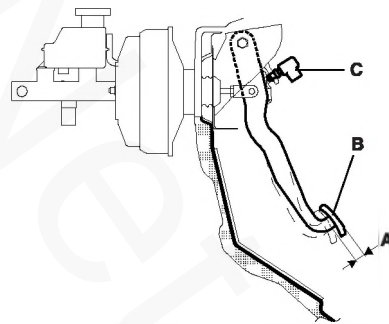


EJDE001C

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 (0.11~0.31in.)



EJDE001D

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.

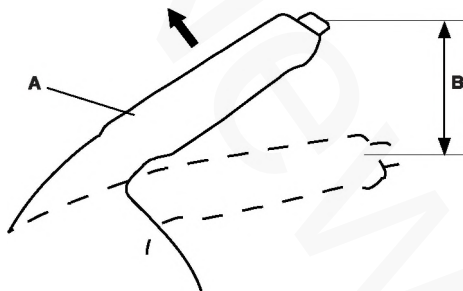
PARKING BRAKE CHECK AND ADJUSTMENT

CHECK

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

Lever locked clicks: 6~7

Pulled up with 196 N (20 kgf, 44 lbf)



EJDE002A

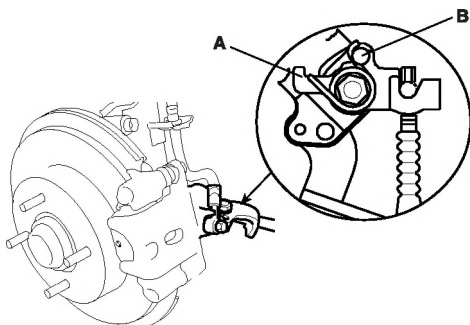
2. Adjust the parking brake if the lever clicks are out of specification.

ADJUSTMENT

NOTE

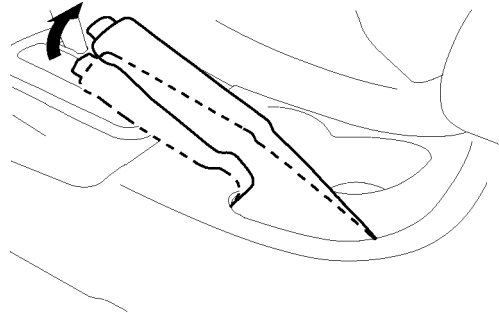
After rear brake caliper servicing, loosen the parking brake adjusting nut, start the engine and depress the brake pedal several times to set the self-adjusting brake before adjusting the parking brake.

1. Block the front wheels, then raise the rear of the vehicle and make sure it is securely supported.
2. Make sure the parking brake arm (A) on the rear brake caliper contacts the brake caliper pin (B).



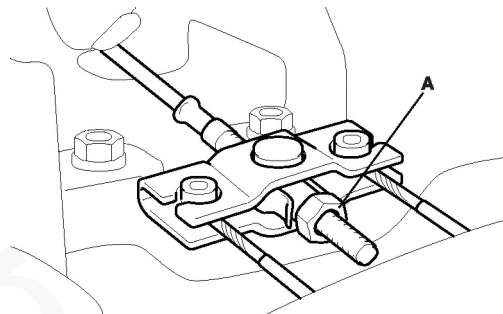
EJOE002B

3. Pull the parking brake lever up one click.



EJDE002C

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



EJDE002D

6. Release the parking brake lever fully, and check that parking brakes do not drag when the rear wheels are turned. Readjust if necessary.
7. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up fully.
8. Reinstall the console.

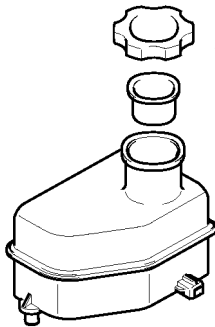
BRAKE SYSTEM BLEEDING



NOTE

- Do not reuse the drained fluid.
- Always use Genuine DOT 3 or DOT 4 Brake Fluid. Using a non-Genuine DOT3 or DOT 4 brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.
- The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.

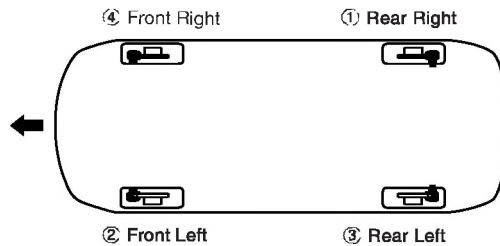
1. Make sure the brake fluid level in the reservoir is at the MAX (upper) level line (A).



EJOE003A

2. Have someone slowly pump the brake pedal several times, then apply steady pressure.
3. Loosen 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 each wheel in the sequence shown below until air bubbles no longer appear in the fluid.

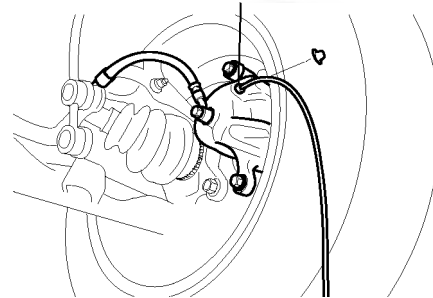
5. Refill the master cylinder reservoir to the MAX (upper) level line.



EJDE003B

FRONT DISC BRAKE:

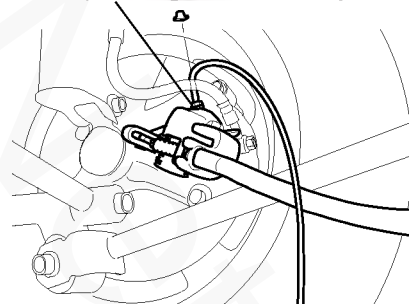
7~13 Nm (70~130 kgf-cm, 5.2~9.6 lbf-ft)



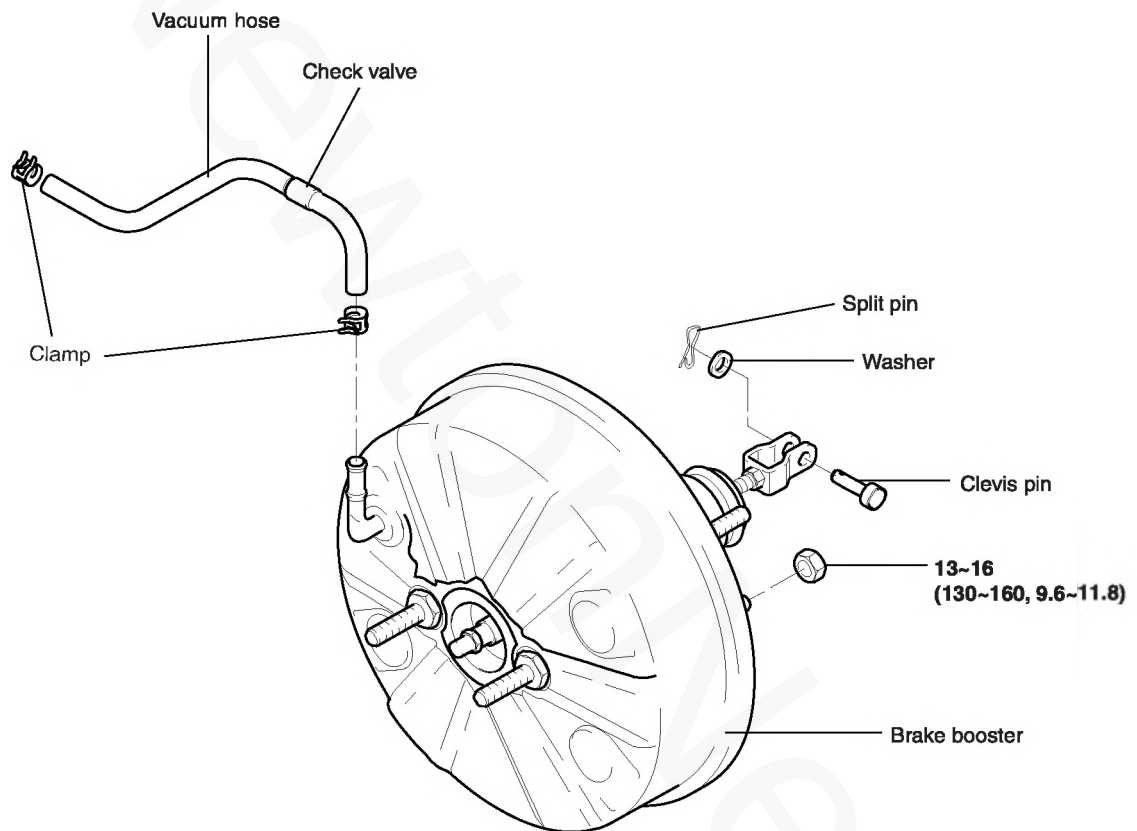
EJDE003C

REAR DISC BRAKE:

7~13 Nm (70~130 kgf-cm, 5.2~9.6 lbf-ft)

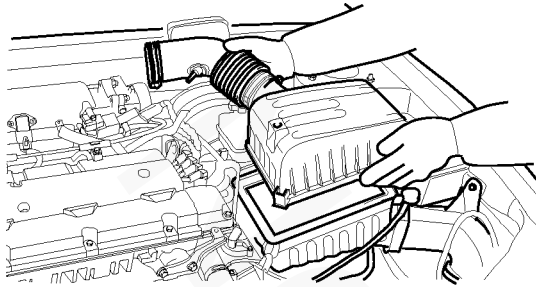


EJOE003D

BRAKE BOOSTER**COMPONENT** EBB71DD1**TORQUE: Nm (kgf-cm, lbf-ft)**

REMOVAL E2FF21EC

1. Remove the air cleaner.



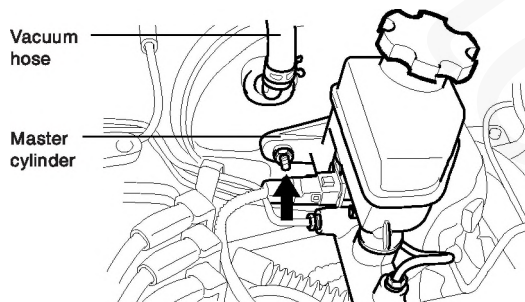
KGKBR87A

2. Disconnect the brake tube from the master cylinder.
3. Remove the master cylinder.



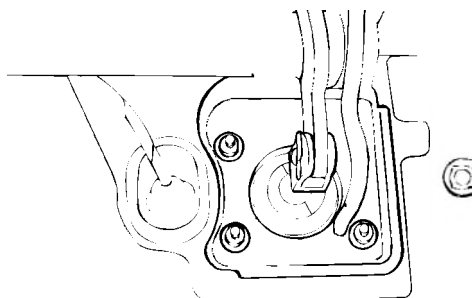
CAUTION

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



EGKBR04A

4. Disconnect the vacuum hose from the booster.
5. Remove the operating rod from the brake pedal.
6. Loosen the booster mounting nuts.
7. Lift out the booster assembly.



EJDA025A

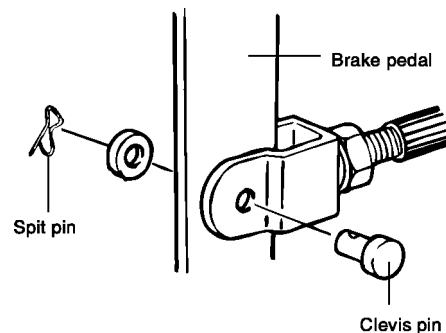
INSTALLATION E2DEBA52

1. When the booster assembly is installed, replace the packing at each end of the booster mounting holder, if necessary.
2. Install the brake booster and tighten the mounting nuts.

Tightening torque:

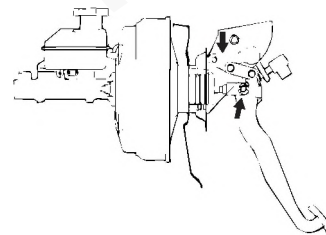
13~16 Nm (130~160 kgf-cm, 9.6~11.8 lbf-ft)

3. Apply sufficient grease inside the brake pedal hole.
4. Connect the clevis to the brake pedal with the clevis pin and install the split pin to the clevis pin.



KSRBR05B

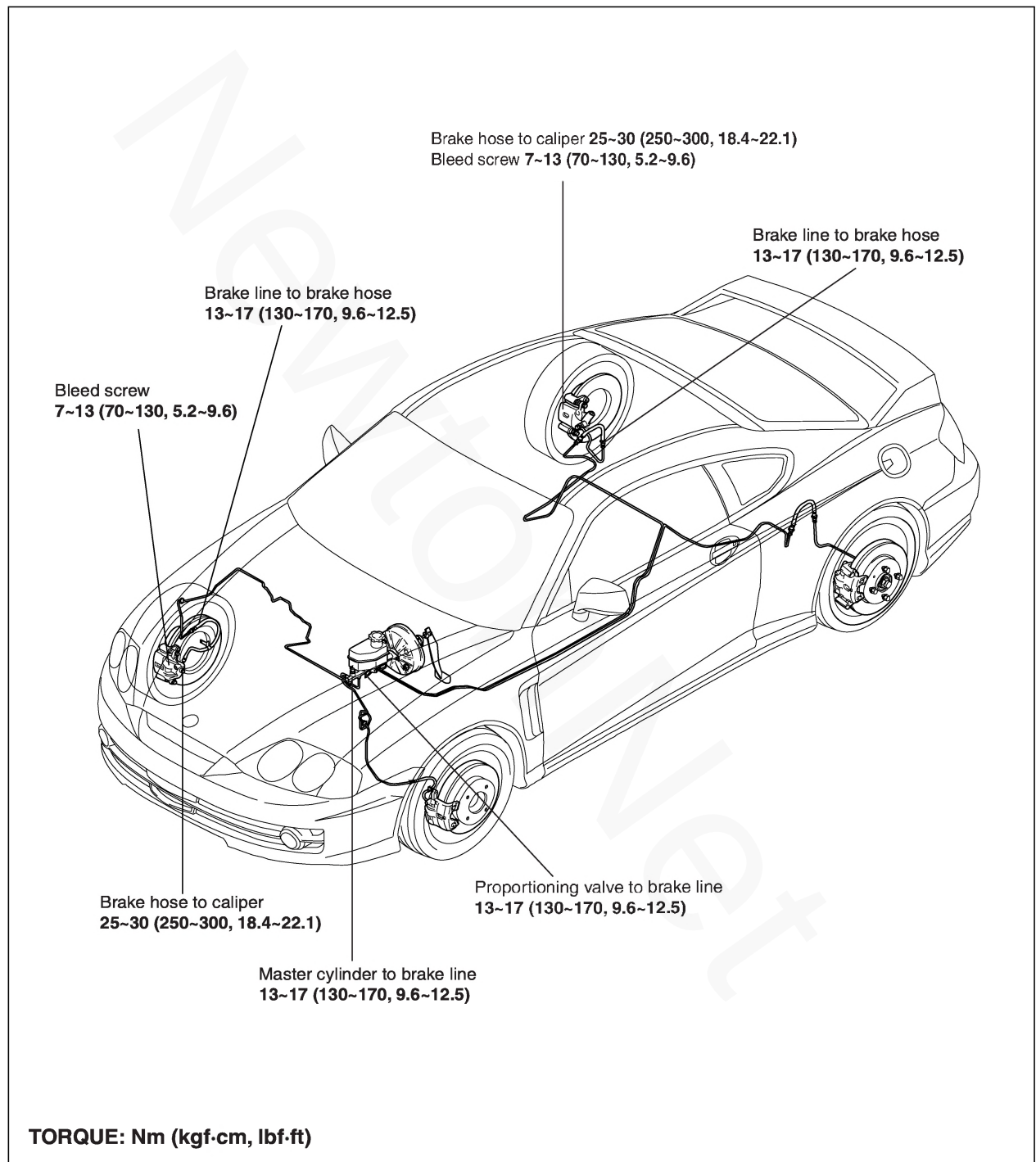
5. Install the master cylinder and connect the brake tube to the master cylinder.
6. Connect the vacuum hose to the brake booster.
7. Fill the brake reservoir with brake fluid and bleed the system.
8. Check for fluid leakage.
9. Check and adjust the brake pedal.
10. After installation, apply sufficient grease to contact points of the clevis and brake pedal.



KGKBR89A

BRAKE LINE**COMPONENT LOCATION**

E6810C77



INSPECTION EBB95169

1. Inspect the brake hoses, for damage, deterioration, leaks, interference and twisting.
2. Check the brake lines for damage, rusting, and leakage. Also check for bent brake lines.
3. Check for leaks at hose and line joints or connections, and retighten if necessary.
4. Check the master cylinder for damage and leakage.

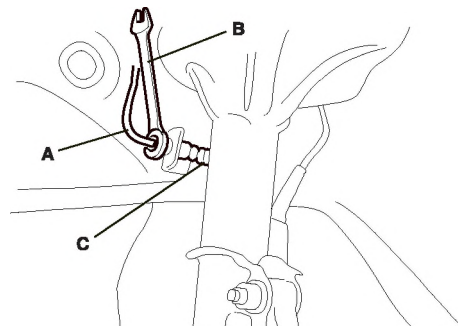
**NOTE**

Replace the brake hose clip whenever the brake hose is serviced.

REPLACEMENT EBABCD4E**NOTE**

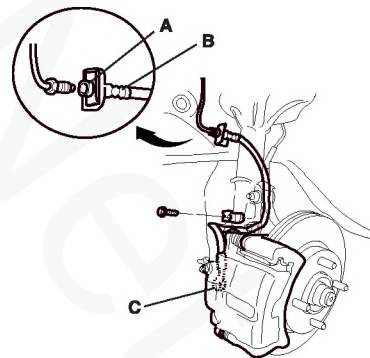
- Before reassembling, check that all parts are free of dust and other foreign particles.
- Replace parts with new ones whenever specified to do so.
- Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.

1. Replace the brake hose (A) if the hose is twisted, cracked, or if it leaks.



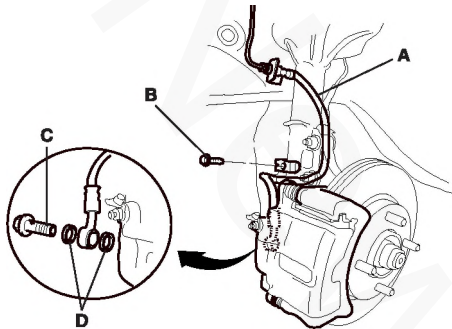
EJDE050A

2. Disconnect the brake hose from the brake line (B) using a 10mm flare-nut wrench (C).
3. Remove and discard the brake hose clip (A) from the brake hose (B).



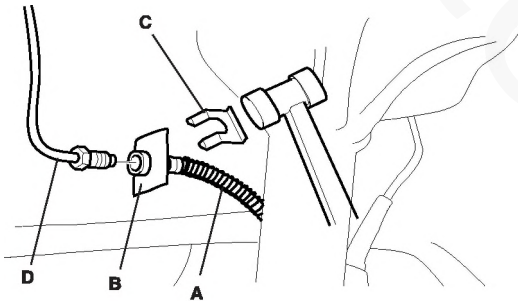
EJDE050B

4. Remove the connector bolt (C), and disconnect the brake hose from the caliper.
5. Remove the brake hose from the knuckle.
6. Install the brake hose (A) on the knuckle with 12mm flange bolt (B) first, then connect the brake hose to the caliper with the connector bolt (C) and new sealing washers (D).



EJDE050C

7. Install the brake hose (A) on the upper brake hose bracket (B) with a new brake hose clip (C).

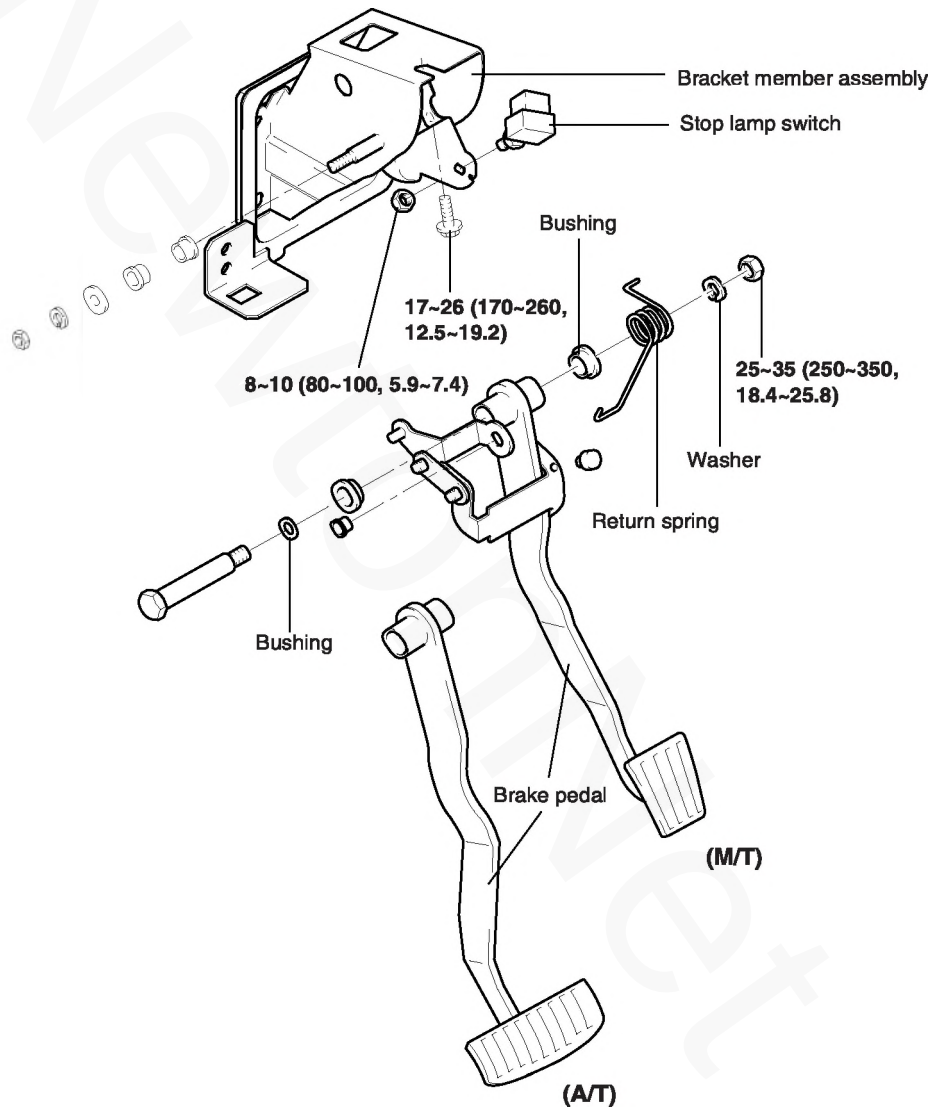


EJDE050D

8. Connect the brake line (D) to the brake hose
9. After installing the brake hose, bleed the brake system.
10. Perform the following checks.
 - Check the brake hose and line joint for leaks, and tighten if necessary.
 - Check the brake hoses for interference and twisting.

BRAKE PEDAL

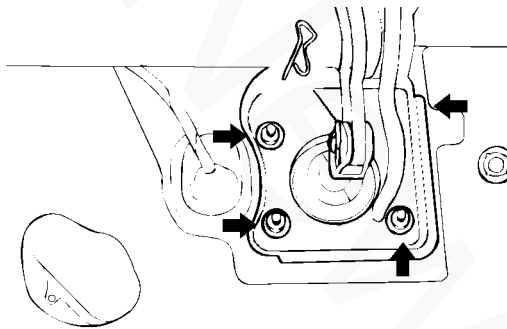
COMPONENTS E7CBAE11



TORQUE: Nm (kgf-cm, lbf-ft)

REMOVAL E9AC4FFA

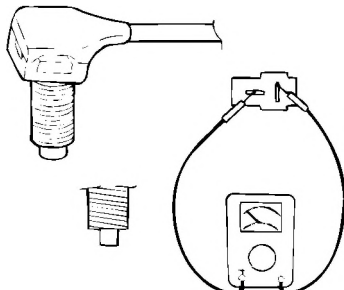
1. Remove the stop lamp switch.
2. Remove the split pin and clevis pin.
3. Remove the flange nuts of the brake mounting bracket.
4. Remove the brake pedal assembly.



EJKB010A

INSPECTION E66EE7A2

1. Check the bushing for wear.
2. Check the brake pedal for distortion.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch.
 - 1) With an ohmmeter connected to the stop lamp switch terminals, check for continuity.
 - 2) If there is no continuity when the plunger is depressed and there is continuity when the plunger is released, the stop lamp switch is normal.



Brake switch check

EJDA026A

INSTALLATION E9C27718

1. Installation is the reverse of removal.

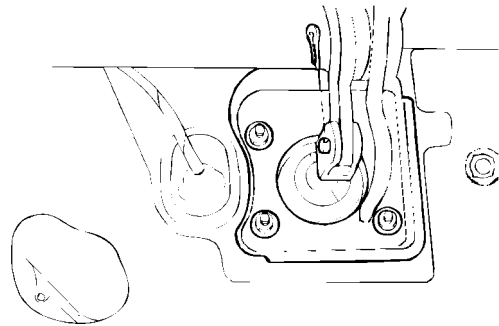
NOTE

Be sure to install the split pin on the operating rod clevis pin.

2. Install the brake pedal assembly and tighten the flange nuts (booster mounting nuts) and bolt.

Tightening torque:

13~16 Nm (130~160 kgf-cm, 6~9 lbf-ft)

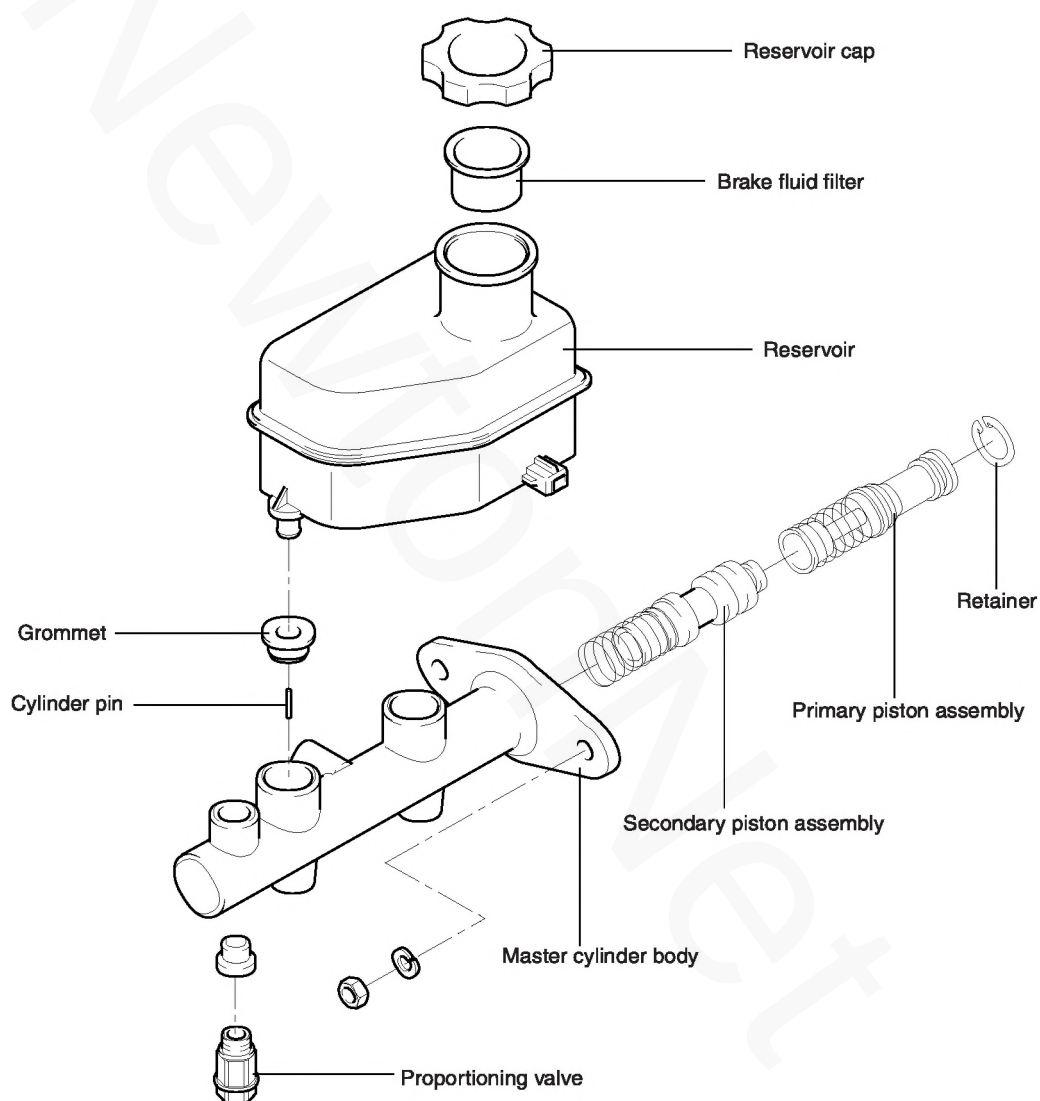


EJDA025B

3. Adjust the brake pedal height and free play.
4. Install the stop lamp switch.

MASTER CYLINDER

COMPONENT EA1F8A84



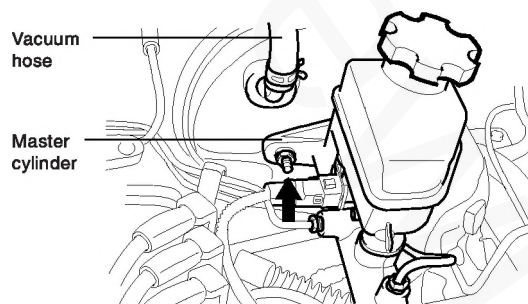
REMOVAL E2F7FCE8

1. Remove the fluid level warning device connector.
2. Detach the brake tubes from the master cylinder, and then install the plug.

**CAUTION**

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

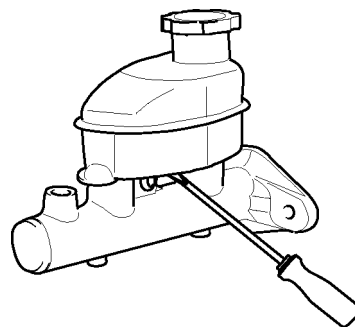
3. Remove master cylinder mounting nuts and then lift out the master cylinder.



EGKBR04A

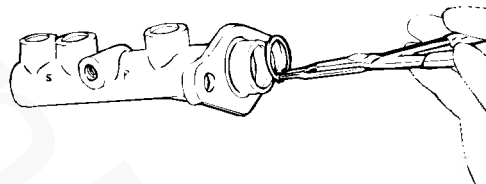
DISASSEMBLY E5B7B998

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. After disconnecting the mounting screws, pry the reservoir free from the master cylinder.



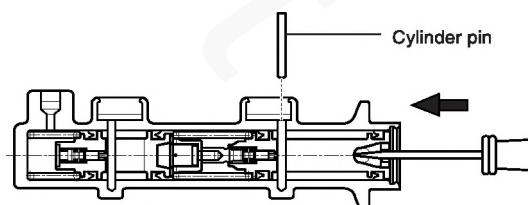
KGKBR07A

3. Using a snap ring pliers, remove the retainer ring.



EJA9009C

4. Remove the primary cylinder pin, pushing the primary piston with a screwdriver and remove the primary piston assembly.

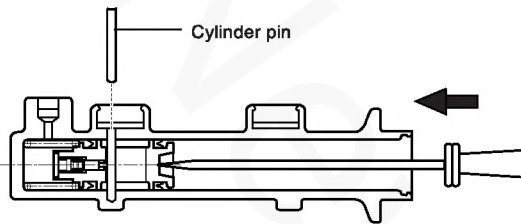


AFW8013A

5. Remove the secondary cylinder pin. Push the secondary piston with a screwdriver and remove the secondary piston assembly.

**NOTE**

Do not disassemble the primary and secondary piston assembly.



KFW8014A

INSPECTION

EEC4DFA9

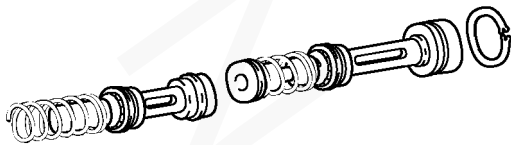
1. Check the master cylinder bore for rust or scoring.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

**NOTE**

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

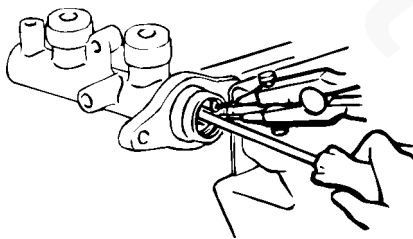
REASSEMBLY ED22D725

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.



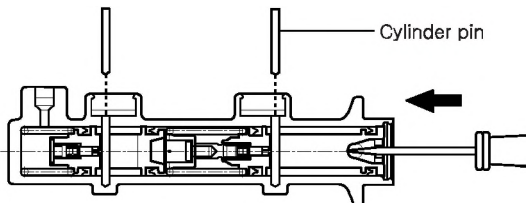
KFW8016A

2. Carefully insert the springs and pistons in the proper direction.
3. Press against the pistons with a screwdriver and install the retainer ring.



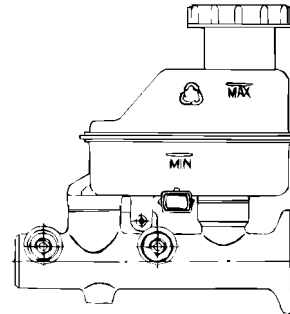
HE5811

4. With the piston pushed completely by a screwdriver, install the cylinder pin.



EGKB08A

5. Mount two grommets.
6. Install the reservoir on the cylinder.



EJKB016A

INSTALLATION EFB2F0C5

1. Install the master cylinder to the brake booster.
2. Install the booster and master cylinder to the dash panel.
3. Connect the brake tubes to the master cylinder.
4. Install the vacuum hose tightly.
5. Connect the operating rod to the brake pedal.
6. After filling the brake reservoir with the brake fluid, bleed the system.

**CAUTION**

Don't disassemble the brake booster.

PROPORTIONING VALVE

DESCRIPTION E4D8A4F5

The proportioning valve distributes the proper fluid pressure to the front and rear wheels to obtain greater braking efficiency and prevents premature rear wheel lock-up. You should not disassemble it because the performance of the valve is closely connected with the mounting tension of the spring.

REMOVAL ED5093A0

Remove the proportioning valve from the master cylinder.

INSPECTION EBA33CE5

1. Connect two pressure gauges; one to the input side, and one to the output side.

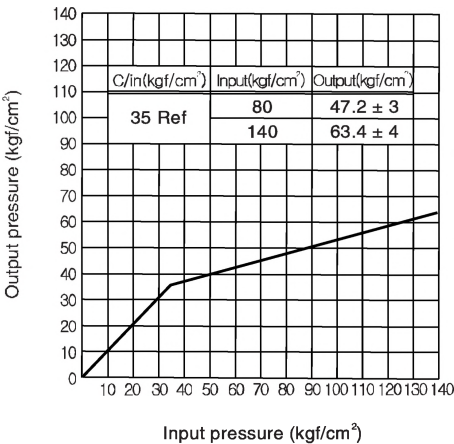
 NOTE

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

2. With the brakes applied, measure the input pressure and the output pressure. If the measured pressures are within the specified range as illustrated, the proportioning valve is good.
3. Reconnect the brake lines in their original positions and bleed the system.

 NOTE

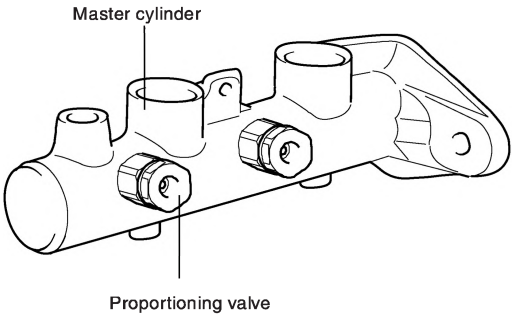
This figure shows characteristics of the proportioning valve as the pressure increases.



EGKBR11A

INSTALLATION EF1EAAAF

1. Install the master cylinder according to the illustration.



EGKBR09A

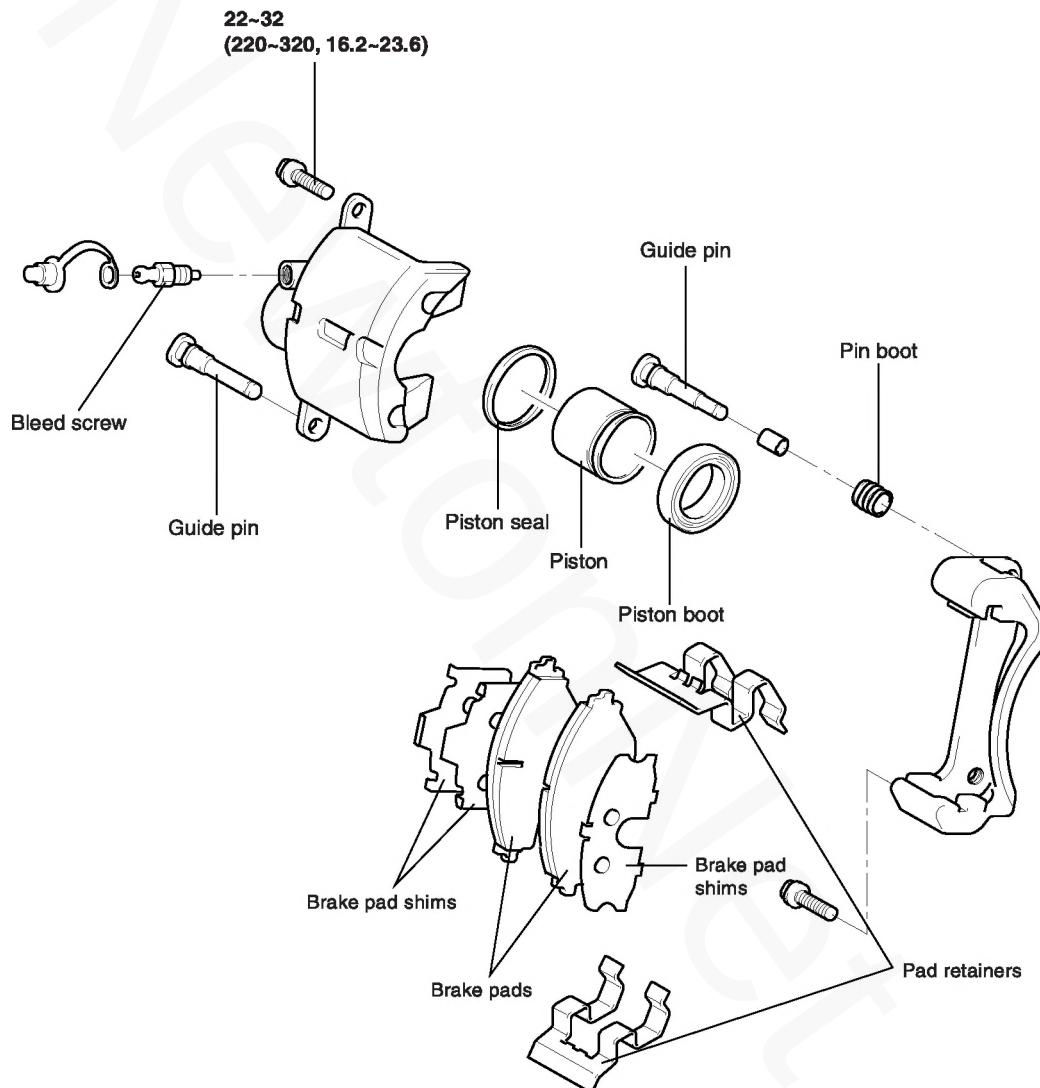
2. Tighten the flare nuts and bleed the system.

Tightening torque

Brake tube flare nut:
13~17 Nm (130~170 kgf·cm, 9~12 lbf·ft)
Proportioning valve mounting nut:
35~55 Nm (350~550 kgf·cm, 30~40 lbf·ft)

FRONT DISC BRAKE

COMPONENTS E92D03AB



TORQUE: Nm (kgf-cm, lbf-ft)

REPLACEMENT

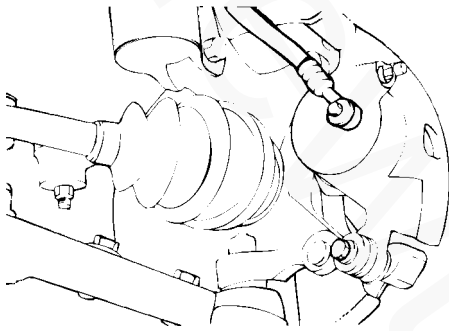
EFF7C69E

BRAKE PAD REMOVAL

1. Remove the 2 guide pin bolt, remove the caliper assembly from the knuckle and secure it with a wire or some other retaining method.
2. Remove the pads.

**CAUTION**

Do not depress the brake pedal while disassembling the pads.



EJDA032A

BRAKE PAD INSPECTION

1. Check the pads for wear or oil contamination and replace, if necessary.

**CAUTION**

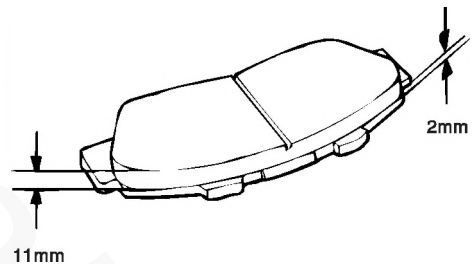
- **The pads for the right and left wheels should be replaced at the same time. Never "drop" or intermix brake pad sets.**
- **All four pads must be replaced as a complete set.**
- **When replacing the brake pad, check for deformation. When replacing the guide spring, use a new one or the used one after cleaning away foreign material.**

2. Check the pad for damage or deformation.

Brake pad thickness:

Standard value: 11mm (0.43 in.)

Service limited value: 2mm (0.079 in)



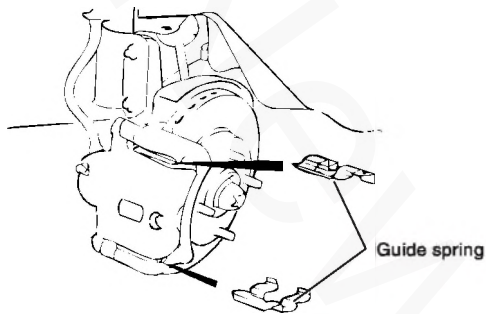
KXDBR04A

BRAKE PAD INSTALLATION

1. Install the pad clips.
2. Install the pads onto each pad clip.

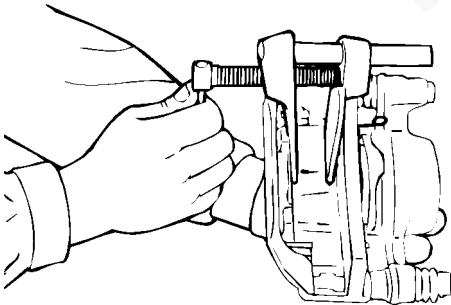
**NOTE**

Position the pad with its pad wear indicator upward on the piston side.



EJDA033A

3. Insert the piston in the cylinder using the Special Tool (09581-11000).

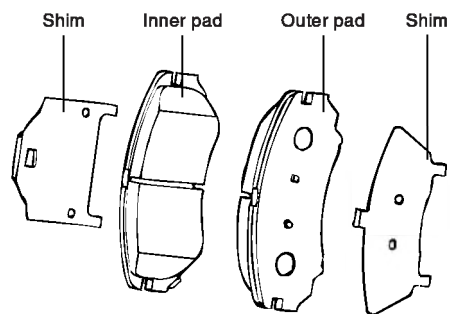


EJDA033B

4. Install the new pads. The shims are attached to the each pad as illustrated.

**CAUTION**

Be careful so that the disc or pad isn't contaminated by grease.

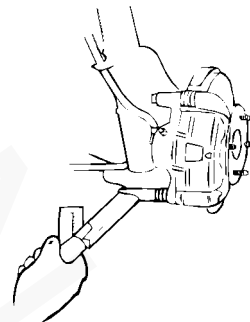


EGKBR63A

5. Install the bolt and tighten to the specified value.

Tightening torque

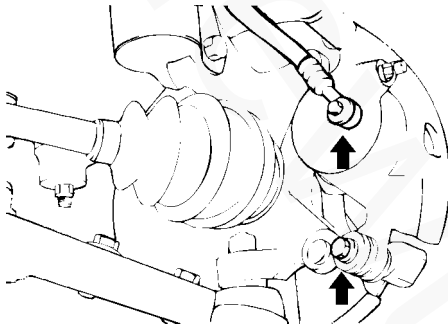
Guide rod bolt: 22~32 Nm (220~320 kgf-cm, 16~24 lbf-ft)



EJDA033D

REMOVAL E0C0D6A7

1. Remove the wheel and tire.
2. Disconnect the brake hose.
3. Remove the cylinder mounting bolt.
4. Remove cylinder and pads.
5. Remove the caliper mounting bolts (2EA) from the knuckle.
6. Remove the caliper.



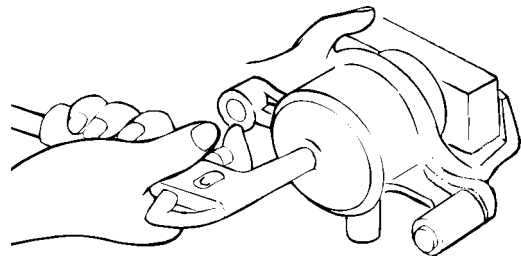
EJKB027A

DISASSEMBLY EB7FA830

1. Remove the piston boot.
2. Remove the piston using compressed air.

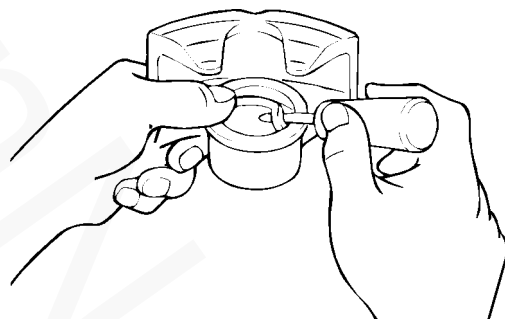
**NOTE**

1. Do not put your fingers in front of the piston when using compressed air.
2. Be careful not to splatter the brake fluid.



EJDA034A

3. Remove the piston seal from the caliper by using a screwdriver.



EJDA034B

INSPECTION

ED6253EA

1. Check the caliper for wear, damage, cracks and dust.
2. Check the piston for dust, damage, cracks and wear on the outer surface.
3. Check the sleeve and pin for damage and dust.
4. Check the pad spring and boots for damage.
5. Check the carrier for damage, dust, wear and cracks.

**CAUTION**

1. **Do not use sand paper on the piston surface.**
2. **All rubber parts must be replaced with new parts.**

6. Inspect the disc by using a calipers and a dial gauge.

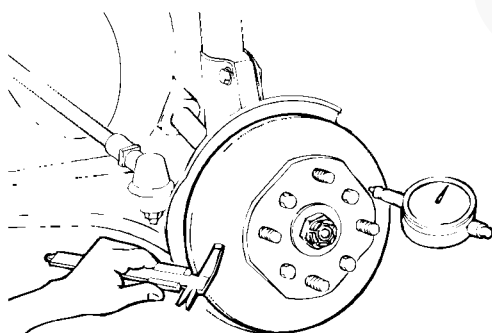
Thickness of disc mm (in.)

Standard value : 26 (1.024)

Service limit : 24.4 (0.961)

Runout of the disc mm (in.) : 0.08 (0.003)

Difference of thickness : 0.01mm (0.0004 in.)



E.JKB029A

**NOTE**

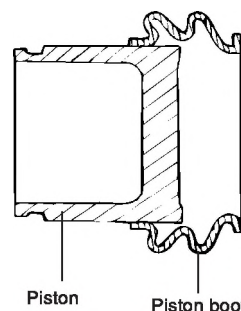
1. Using a micrometer, measure the disc thickness at eight positions approximately 10mm from the outer edge of the disc and at 45° intervals. If you subtract the minimum of measurements from the maximum, you get the difference of the disc thickness.
2. When measuring the disc runout, fix a dial gauge approximately 5mm from the outer edge of the disc, and rotate the disc 360°. At this time, if you subtract the minimum of measurements from the maximum, you get the disc runout.

7. If necessary, replace the brake disc.

REASSEMBLY

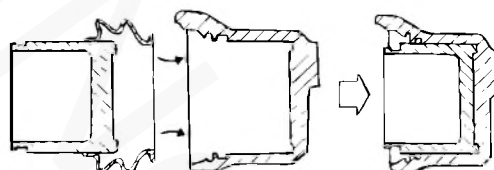
EFAE107C

1. Clean all components except the pads and shims with isopropyl alcohol.
2. Apply rubber grease on the piston seal and install the piston seal in the cylinder.



EJDA035A

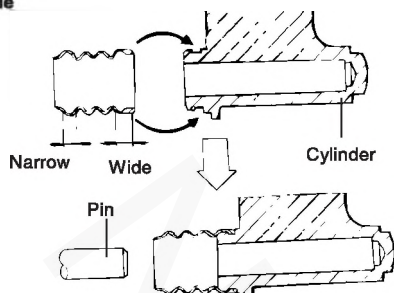
3. Assemble the piston and piston boots according to the following procedure.
 - 1) Apply rubber grease to the caliper bore, the outside surface of the piston and the piston boot.
 - 2) Install the piston boot on the piston as illustrated.
 - 3) Insert the piston boot in the inner groove of the caliper and push the piston into the caliper.



EJDA035B

4. Assemble the sliding parts according to the following procedure.
 - 1) Apply rubber grease to the outside surface of the sleeve and pin, pin and sleeve bore of the caliper, pin boot and sleeve boot.
 - 2) Insert the boot into the groove of the caliper.

Pin side



EJDA035D

INSTALLATION

ECF3E45F

1. Install the pads and brake cylinder.
2. Install the brake hose to the caliper.

Bleeder screw tightening torque:

7~13 Nm (70~130 kgf-cm, 5.2~9.6 lbf-ft)

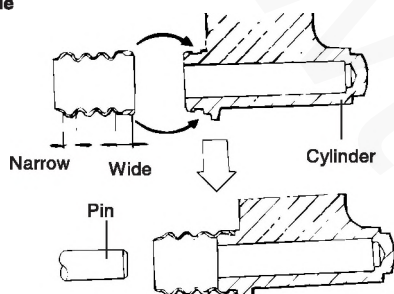
3. Fill the brake reservoir with brake fluid.
4. Bleed the system.

5. Install the pads.

**NOTE**

Be careful so that the disc or pad is contaminated by grease

Pin side



EJDA035D

6. Tighten the brake hose connecting bolt.

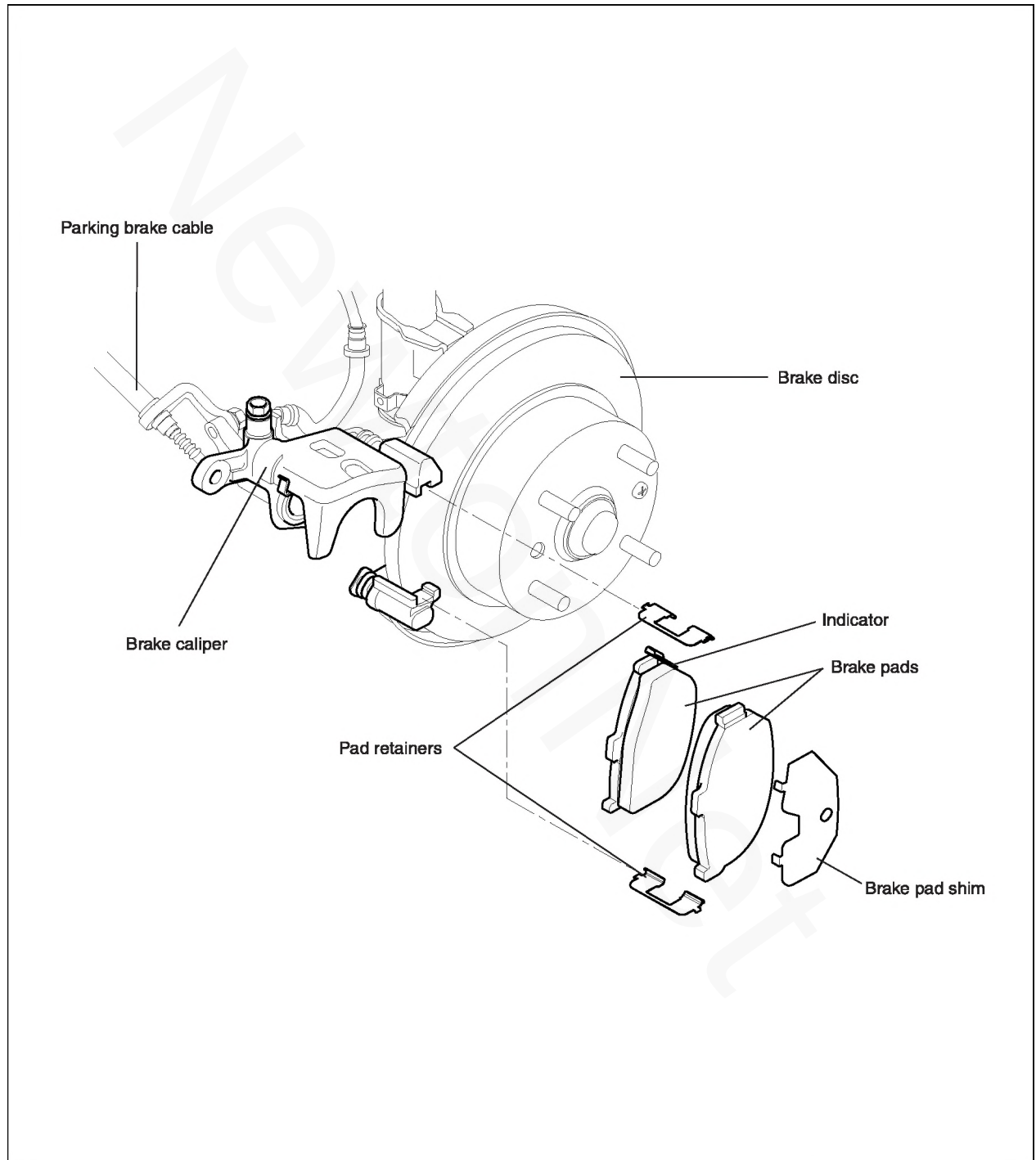
Tightening torque	Nm (kgf-cm, lbf-ft)
Sliding pin	34~44 (350~450, 26~33)
Carrier mounting bolt	64~74 (650~750, 48~54)
Brake hose mounting oil bolt	25~29 (250~300, 18~22)

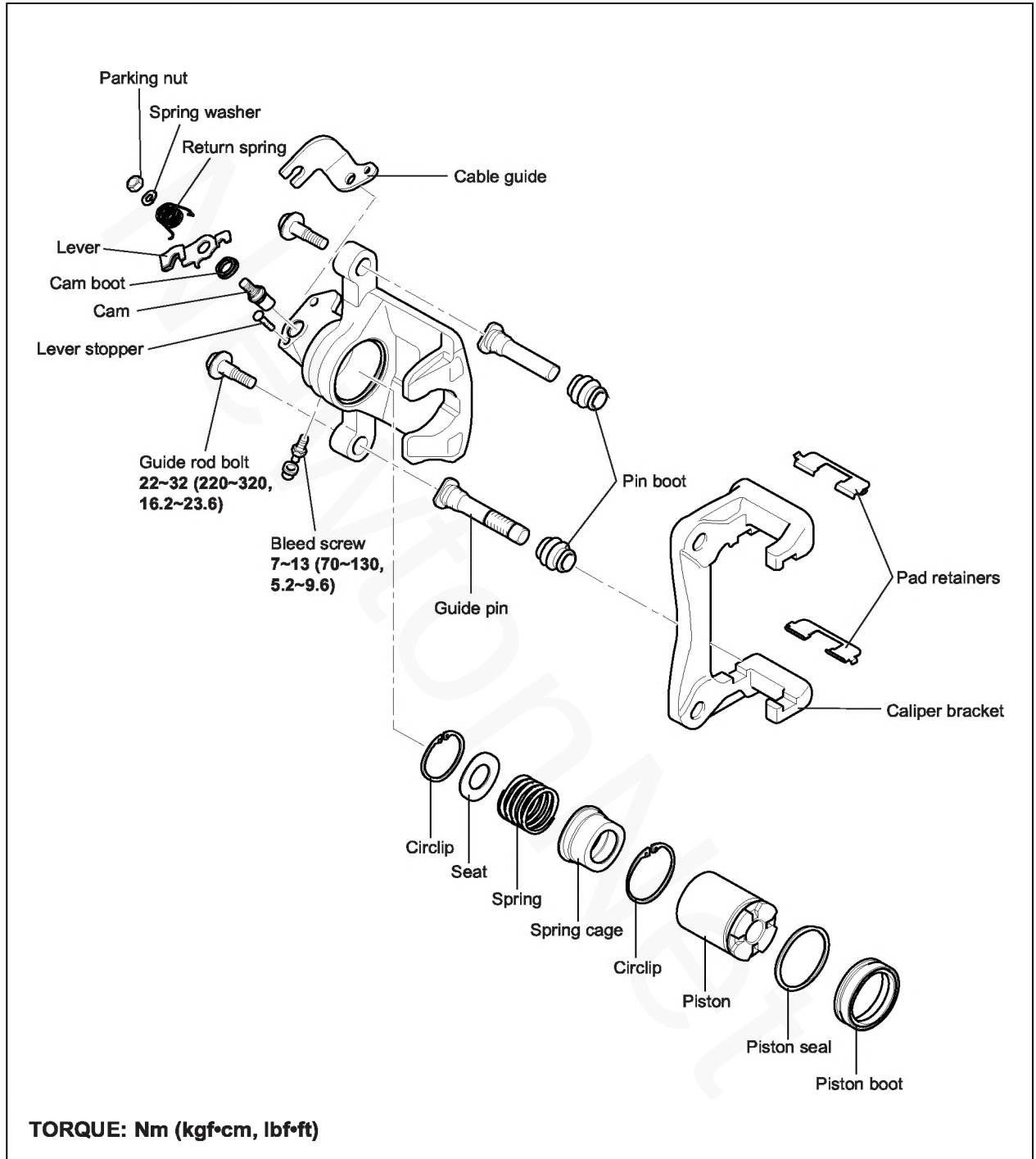
**NOTE**

1. Check that the surface of the pin and bolts is not damaged before tightening.
2. Bleed the system. Depress the pedal several times and check for fluid leakage from all connecting parts.

REAR DISC BRAKE

COMPONENTS E8CEA497





DESCRIPTION

E77153DB

**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.**

Remove, disassemble, inspect, reassemble, and install the caliper and note these items:

- Do not spill brake fluid on the vehicle; it may damage the paint; If brake fluid gets on the paint, wash it off immediately with water.
- Clean all parts in brake fluid and air dry; blow out all passages with compressed air.
- Before reassembling, check that all parts are free of dirt and other foreign particles.
- Replace parts with new ones as specified in the illustration.
- Make sure no dirt or other foreign matter gets into the brake fluid.
- Make sure no grease or oil gets on the brake discs or pads.
- When reusing pads, always reinstall them in their original positions to prevent loss of braking efficiency.
- Do not reuse drained brake fluid.
- Always use Genuine DOT 3 or DOT 4 brake fluid. Non Genuine DOT 3 or DOT 4 brake fluid cause corrosion and shorten the life of the system.
- Coat the piston, piston seal groove, and caliper bore with clean brake fluid.
- Replace all rubber parts with new ones.
- After installing the caliper, check the brake hose and line for leaks, interference, interference, and twisting.

REPLACEMENT

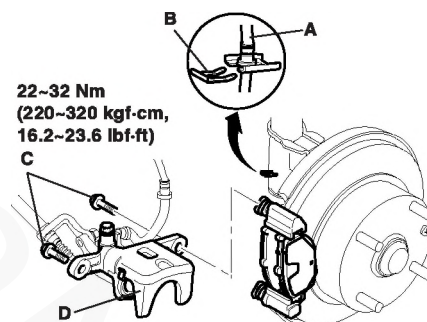
ED4BC288

**CAUTION**

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

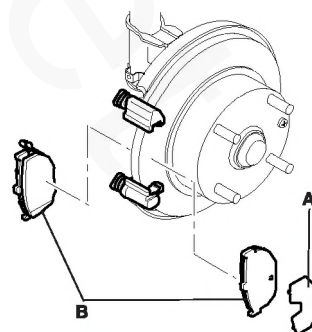
- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

1. Raise the rear of the vehicle and make sure it is securely supported. Remove the rear wheel.
2. Release the parking brake.
3. Remove the brake hose (A) from the suspension arm by removing the brake hose clip (B). Thoroughly clean the outside of the caliper to prevent dust and dirt from entering inside. Support the caliper with a piece of wire so that it does not hang from the brake hose.



EJOE600A

4. Remove the two guide rods (C) and caliper (D) from the bracket.
5. Remove the pad shim (A) and brake pads (B).



EJOE600B

6. Using vernier calipers, measure the thickness of each brake pad lining. Measurement does not include pad backing plate (A) thickness.

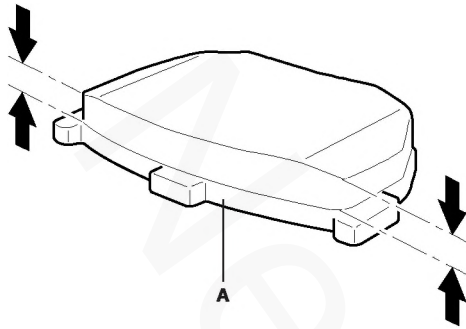
BRAKE SYSTEM

BR -35

Brake pad thickness:

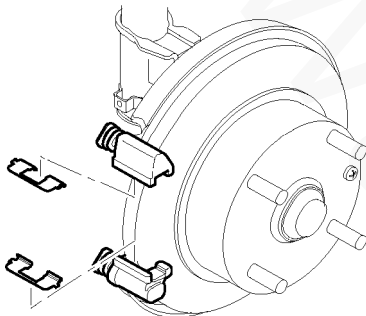
Standard: 9 mm (0.35 in.)

Service limit: 2 mm (0.08 in.)



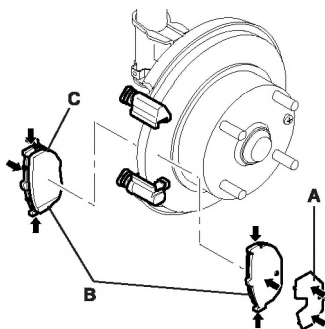
EJOE600C

7. Remove the pad retainers.



EJKE600D

8. Clean the caliper thoroughly; remove any rust, and check for grooves and cracks.
9. Check the brake disc for damage and cracks.
10. Install the pad retainers.
11. Check the foreign material at the pad shim (A) and the back of the pads (B). Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.

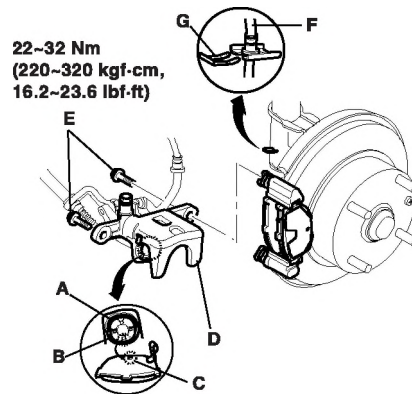


EJOE600E

12. Install the brake pads (B) and pad shim (A) on the caliper bracket. Install the inner pad with its wear indicator (C) facing down ward.

If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.

13. Rotate the caliper piston (A) clockwise into the cylinder, then align the cutout (B) in the piston with the tab (C) on the inner pad by turning the piston back. Lubricate the boot with rubber grease to avoid twisting the piston boot. If the piston boot is twisted, back it out so it is positioned properly.



EJOE600F

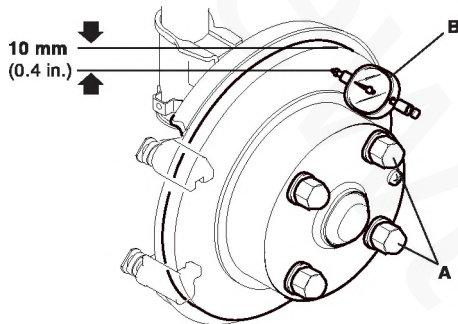
14. Install the brake caliper (D).
15. Install and torque the guide rods (E) to proper specification.
16. Install the brake hose (F) onto the suspension arm with the brake hose clip (G).
17. After installation, check for leaks at hose and line joints and connections, and retighten if necessary.
18. Depress 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 pedal will restore the normal pedal stroke.

INSPECTION E7F63BEE**RUNOUT**

1. Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the brake pads.
3. Inspect the disc surface for damage and cracks clean the disc thoroughly and remove all rust.
4. Use wheel nuts and suitable flat washers (A) to hold the disc securely against the hub, then mount a dial indicator (B) as shown, and measure the runout at 10 mm (0.4 in.) from the outer edge of the disc.



EJOE605A

5. If the disc is beyond the service limit, refinish the brake disc.

Max. Refinishing limit: 8.0 mm (0.315 in.)

NOTE

A new disc should be refinished if its runout is greater than 0.10 mm (0.004 in.)

THICKNESS AND PARALLELISM

1. Loosen the rear wheel nuts slightly, then raise the vehicle, and make sure it is securely supported. Remove the rear wheels.
2. Remove the brake pads.
3. Using a micrometer (A), measure disc thickness at eight points, approximately 45° apart and 10 mm (0.4 in.) in from the outer edge of the disc. Replace the brake disc if the smallest measurement is less than the max. refinishing limit.

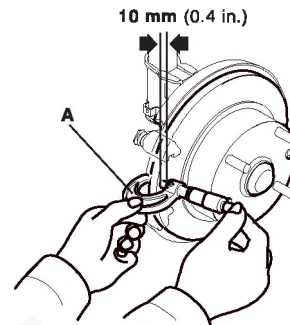
Brake disc thickness:

Standard: 10 mm (0.4 in.)

Max. Refinishing limit: 8.0 mm (0.315 in.)

Brake disc parallelism: Max. 0.015 mm (0.0006 in.)

This is the maximum allowable difference between the thickness measurements.



EJOE605B

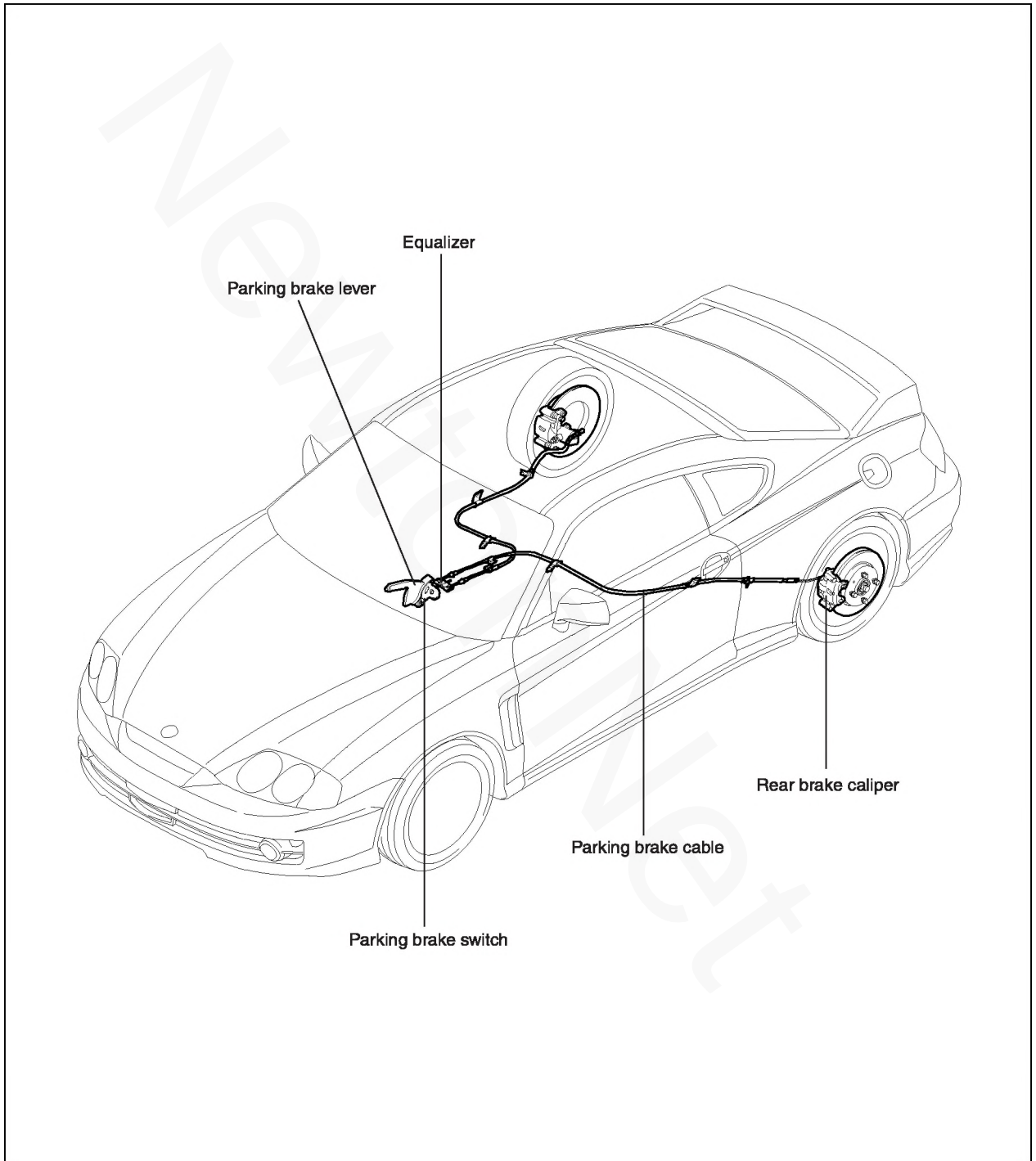
4. If the disc is beyond the service limit for parallelism, refinish the brake disc.

NOTE

If the brake disc is beyond the service limit for refinishing, replace it (see DS group-rear axle).

PARKING BRAKE SYSTEM

COMPONENTS EC894A9E

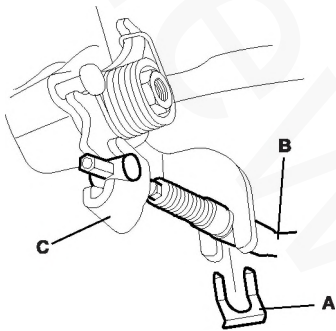


REMOVAL EFFFFDAD**NOTE**

- *The parking brake cables must not be bent or distorted. This will lead to stiff operation and premature failure.*
- *Refer to the component as needed during this procedure.*

REAR DISC BRAKE

1. Release the parking brake lever fully, and remove the parking cable clip (A) from the parking brake cable.

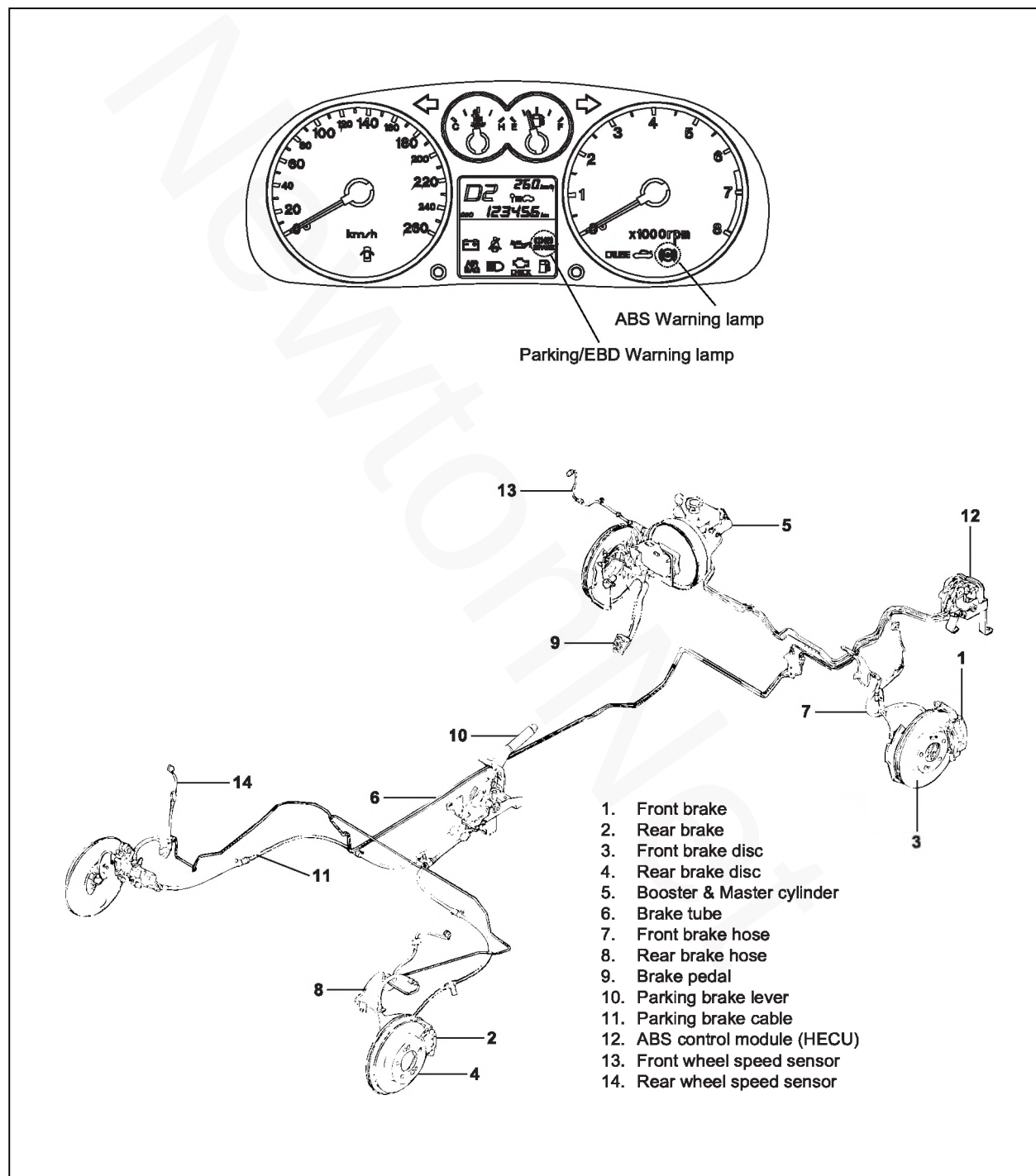


EJOE900A

2. Disconnect the parking brake cable (B) from the lever (C).

ABS (ANTI-LOCK BRAKE SYSTEM)

COMPONENTS E3CAC046



DESCRIPTION

E432FBC0

This specification applies to Hydraulic and Electronic Control Unit (HECU) of the Anti lock Braking System(ABS).

This HECU has the functions as follows:

- Input of signal from the wheel speed sensors attached to each wheel.
- Control of braking force and traction force
- Failsafe function
- Self diagnosis function
- Interface with the external diagnosis tester

OPERATION

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

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

In the operating condition, the HECU 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. The HECU shall receive wheel speed signal from the four inductive wheel sensors.

The wheel signals are converted to square wave by the signal conditioning circuit and given as input to the μ - processor.

The sensor connections shall be monitored for short-circuit and inter-ruption and then in the event of 2 sensor failures, the HECU shall shut down the system.

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 MOSFET, the solenoid valve goes into operation.

The electrical function of the valves are always monitored by the valve test pulse under normal operation conditions. When overvoltage is detected(above 16V), the HECU 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.

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

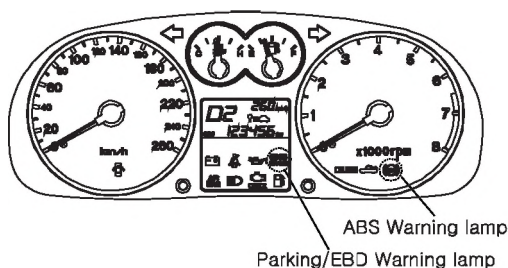
When voltage is returned to operating range, the warning lamp is switched off and the HECU returns to normal operating mode.

The pump motor operates when the ABS is functioning.

The HECU performs a pump motor test at a speed of 20km/h once after turned the Ignition switch on. You may hear the motor operate at this time, but it is normal.

Malfunctions or failures detected by the HECU are encoded on the HECU, stored in a EEPROM and read out by diagnostic equipment (hi-scan pro) when the ignition switch is turned on.

WARNING LAMP CONTROL



EJOF600G

1. ABS warning lamp module
The ABS warning lamp module indicates the operating condition of the ABS.

The ABS warning lamp is turned on under the following conditions.

- During the initialization phase after ignition switch ON (3 seconds).
- In the event of inhibition of ABS functions by failure.
- When the system ECU is shut down even though ignition power is applied.
- During diagnostic mode.
- When the HECU connector is disconnected.

2. EBD warning lamp module
The EBD warning lamp module indicates the operating condition 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 is turned on under the following conditions.

- During the initialization phase after ignition switch ON. (3 seconds).
- When the system ECU is shut down even though ignition power is applied.
- When the parking brake switch is ON or brake fluid is low level.
- In the event of inhibition of EBD functions by failure.

DIAGNOSTIC TROUBLE CODE (DTC)

1. If the CPU cannot be activated or the CPU fails, the ABS indicator comes on, but the DTC is not memorized.
2. The memory can hold any number of DTCs. However, when the same DTC is detected more than once, the later one is written over the old one. Therefore, when the same problem is detected repeatedly, it is memorized as one DTC.
3. The DTCs are indicated in the order they occur.
4. The DTCs are memorized in the EEPROM (non - volatile memory). Therefore, the memorized DTCs cannot be canceled by disconnecting the battery. Perform the specified procedures to erase the DTCs.

SELF-DIAGNOSIS

1. Self diagnosis can be classified into two categories:
 - Initial diagnosis:
Performed right after the engine starts and until the ABS indicator goes off.
 - Regular diagnosis:
Performed right after the initial diagnosis until the ignition switch is turned OFF.
2. When a problem is detected by self-diagnosis, the system:
 - Turns the solenoid valve OFF
 - Turns the pump motor OFF
 - Turns the ABS indicator ON

HOW TO TROUBLESHOOT ABS DTC

The troubleshooting flowchart procedures assume that the cause of the problem is still present and the ABS indicator is still on. Following the flowchart when the ABS indicator does not come on can result in incorrect diagnosis.

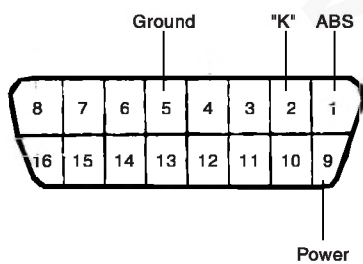
1. Question the customer about the conditions when the problem occurred, and try to reproduce the same conditions for troubleshooting. Find out when the ABS indicator came on, such as during initial diagnosis, during ABS control, after ABS control, when vehicle speed was at a certain speed, etc.
2. When the ABS indicator does not come on during the test-drive, but troubleshooting is performed based on the DTC. check for loose connectors, poor contact of the terminals, etc. before you start troubleshooting.
3. After troubleshooting, erase the DTC and test-drive the vehicle. Be sure the ABS indicator does not come on.

HI-SCAN (PRO) CHECK

1. Turn the ignition switch OFF.
2. Connect the Hi-scan (pro) to the 16P data link connector located underneath the lower crash pad panel.



KTOB211A

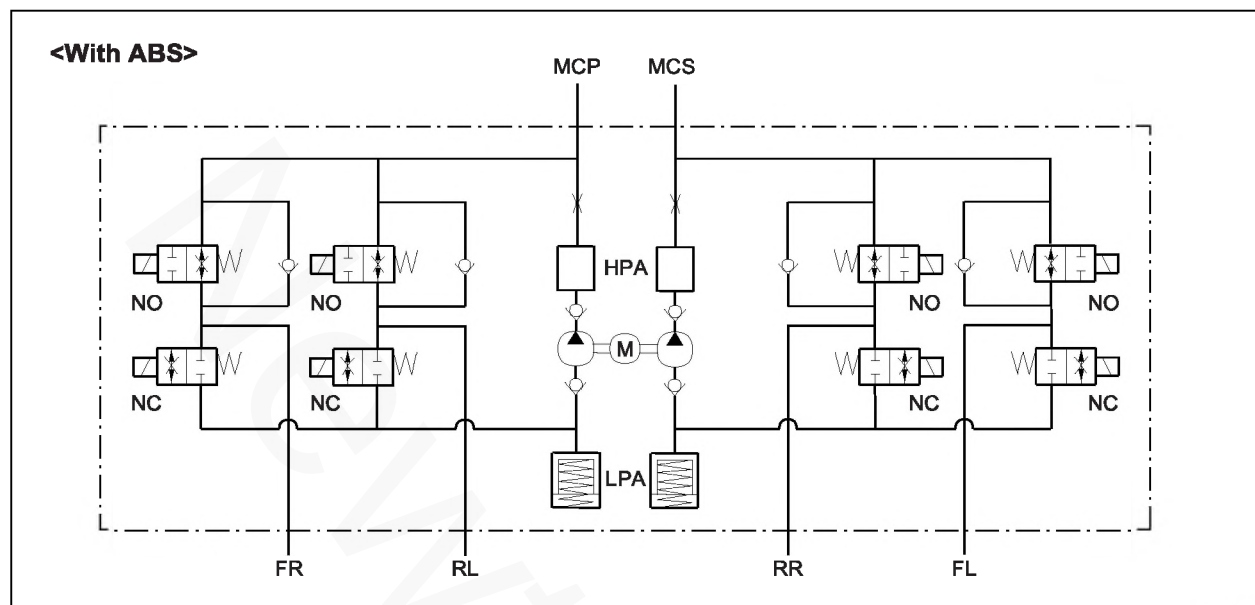


DATA LINK CONNECTOR

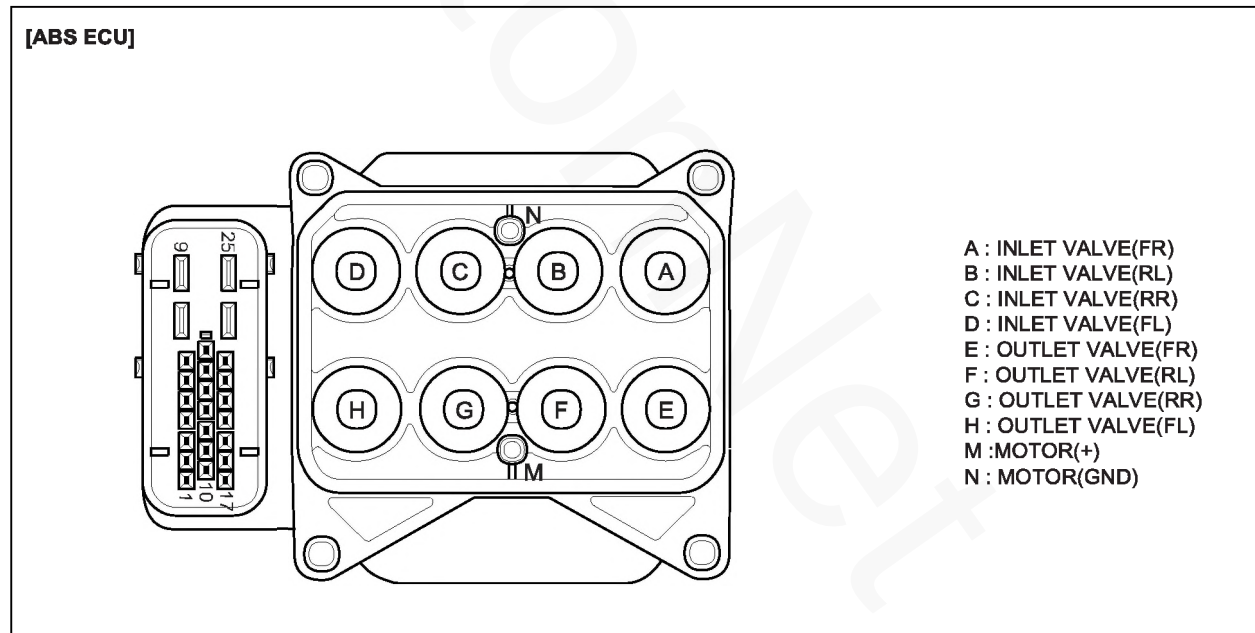
EJOC545A

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

HYDRAULIC SYSTEM DIAGRAM E4EEDE6D



HECU EXTERNAL DIAGRAM

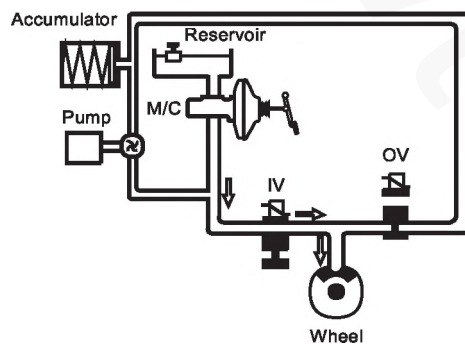


ABS CONTROL EDFDF8B7

1. NORMAL BRAKING without ABS

Solenoid valve	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	OPEN	Master cylinder $\Leftrightarrow$ Wheel cylinder	OFF
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder $\Leftrightarrow$ Reservoir	

When braking, the hydraulic pressure in the TMC is increased. The pressure reaches the wheel brake via the current less open inlet valve IV. The current less closed outlet valve OV is closed. For the sake of simplicity the diagram is limited to only the solenoid valve pair of one brake circuit. The wheel speed is reduced as the brake pressure increases, in the extreme case until the wheel locks.



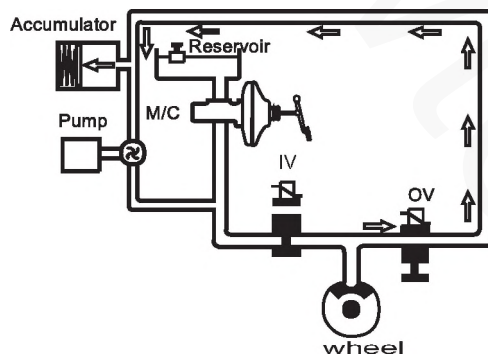
EJQE015A

2. With ABS
1) DUMP MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	CLOSE	Master cylinder $\Leftrightarrow$ Wheel cylinder	ON
Outlet valve (NC)	ON	OPEN	Wheel cylinder $\Leftrightarrow$ Reservoir	

If the wheel speed decreases, there is still a tendency to lock; the brake pressure on the corresponding wheel must be reduced accordingly. For this, the outlet valve OV is opened, the inlet valve IV remains closed.

The brake pressure to the low-pressure accumulator is reduced. The wheel in danger of locking gains speed again.

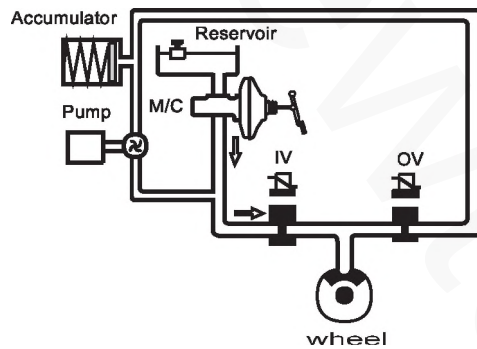


EJQE016A

2) HOLD MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	CLOSE	Master cylinder $\leftrightarrow$ Wheel cylinder	OFF
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder $\leftrightarrow$ Reservoir	

When a wheel (or several) tends to lock the inlet valve IV is first closed to avoid a further increase in brake pressure. The outlet valve OV remains closed: the brake pressure is kept constant.



EJQE017A

3) INCREASE MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	OPEN	Master cylinder $\Rightarrow$ Wheel cylinder	ON
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder $\Rightarrow$ Reservoir	

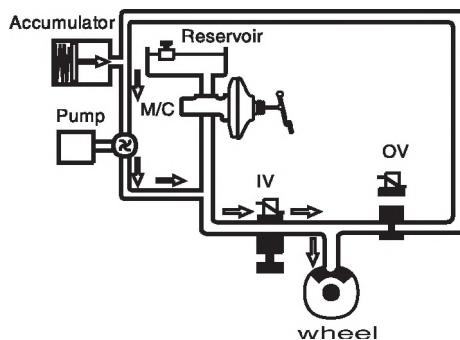
For optimum brake from the certain wheel acceleration a brake pressure increase is necessary. For this, the inlet valve IV is opened and the outlet valve OV is closed. The pump of the unit starts to run and aspirates the necessary quantity of fluid from the Low-pressure accumulator, in order to produce the necessary brake pressure for the pressure increase phase in seconds.

With an increase in the brake pressure the wheel speed is reduced. These control phases are repeated until the ABS control unit no longer detects any tendency of the wheels to lock.

Conventional brake system operates under the circumstance.

**NOTE**

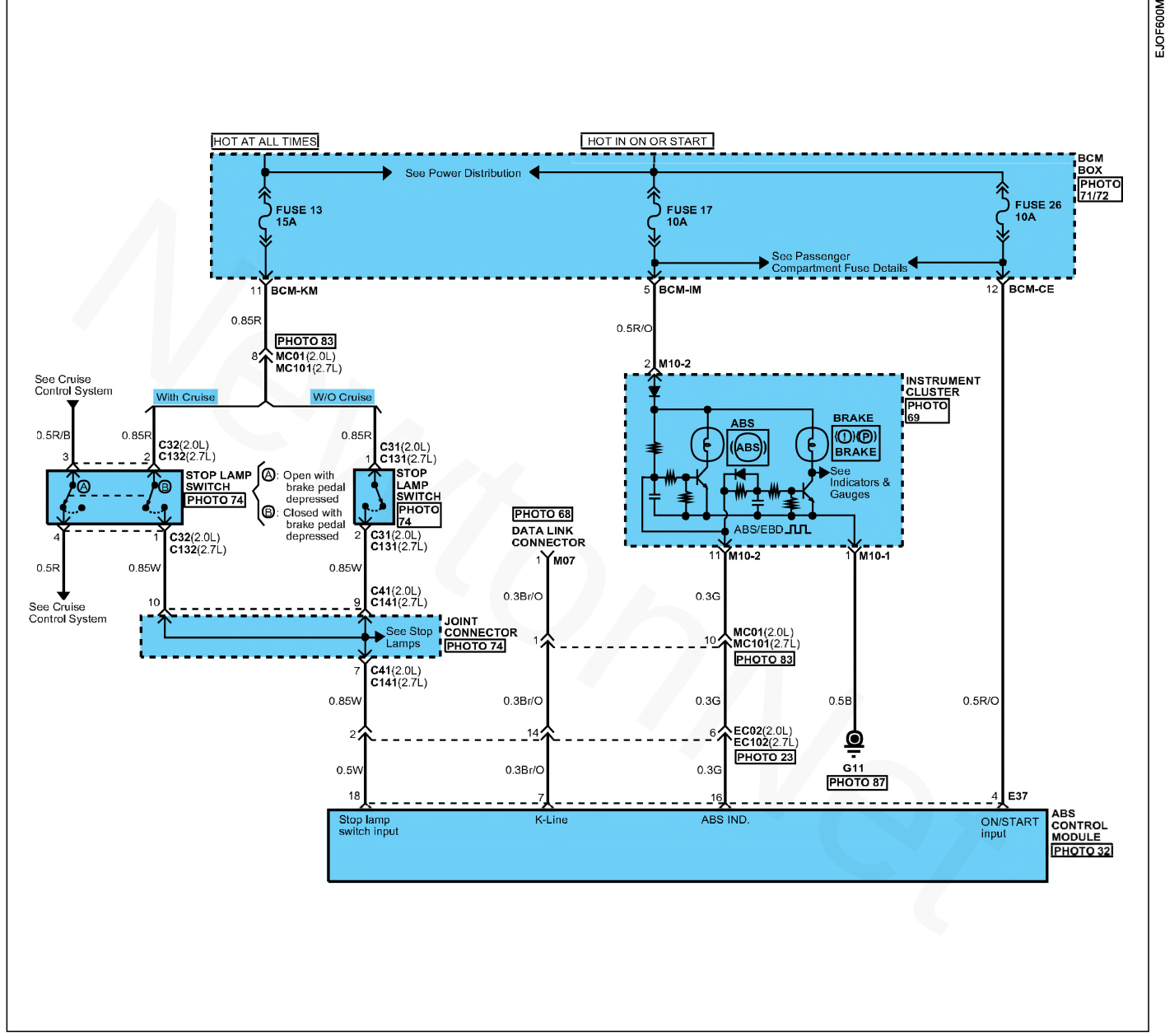
During ABS control function, the brake pedal only moves in accordance with the volume requirement of the wheels. Because of a sudden change in friction coefficient this pedal movement may increase slightly.

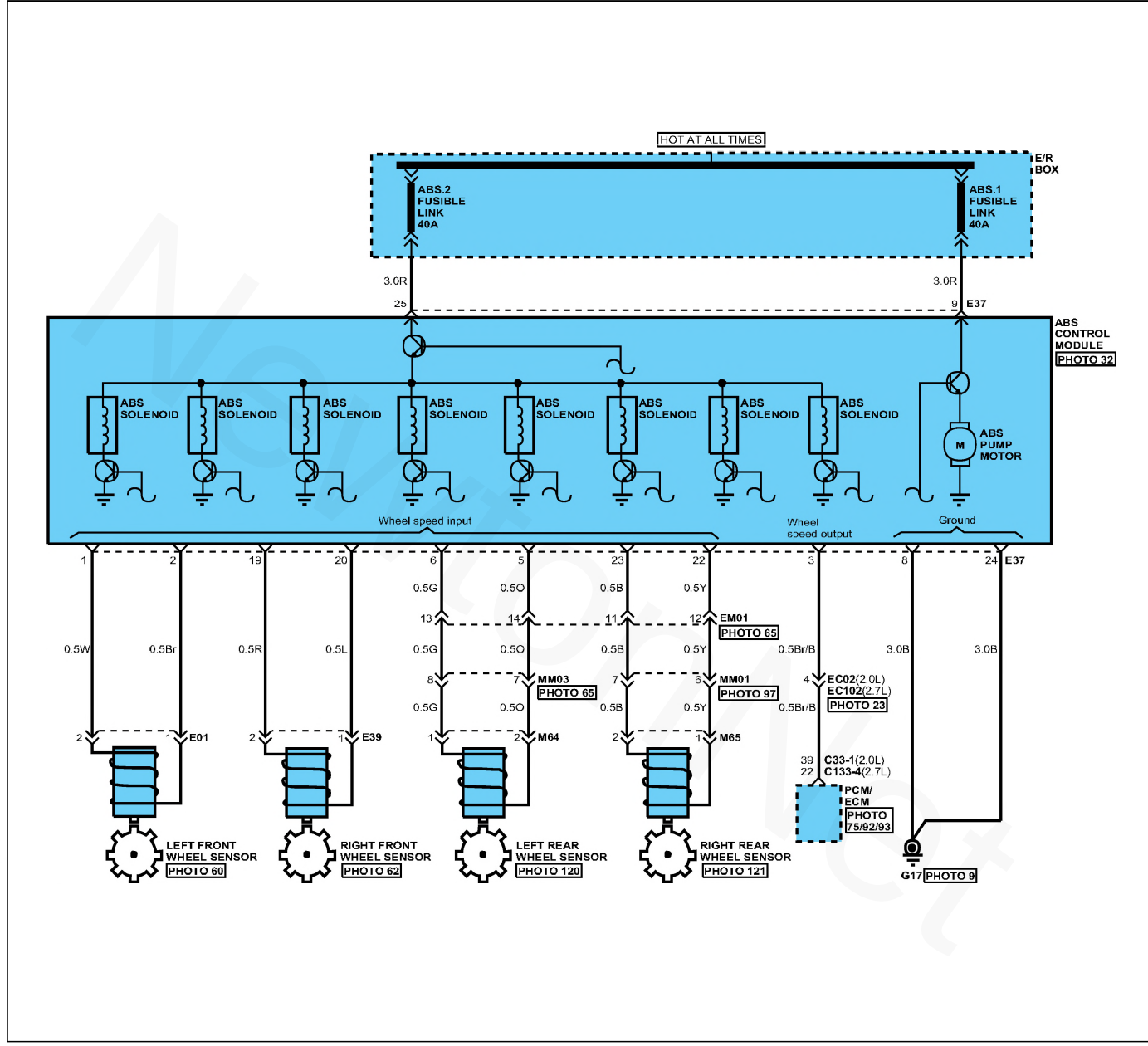


EJQE018A

3. Fail Safe Function

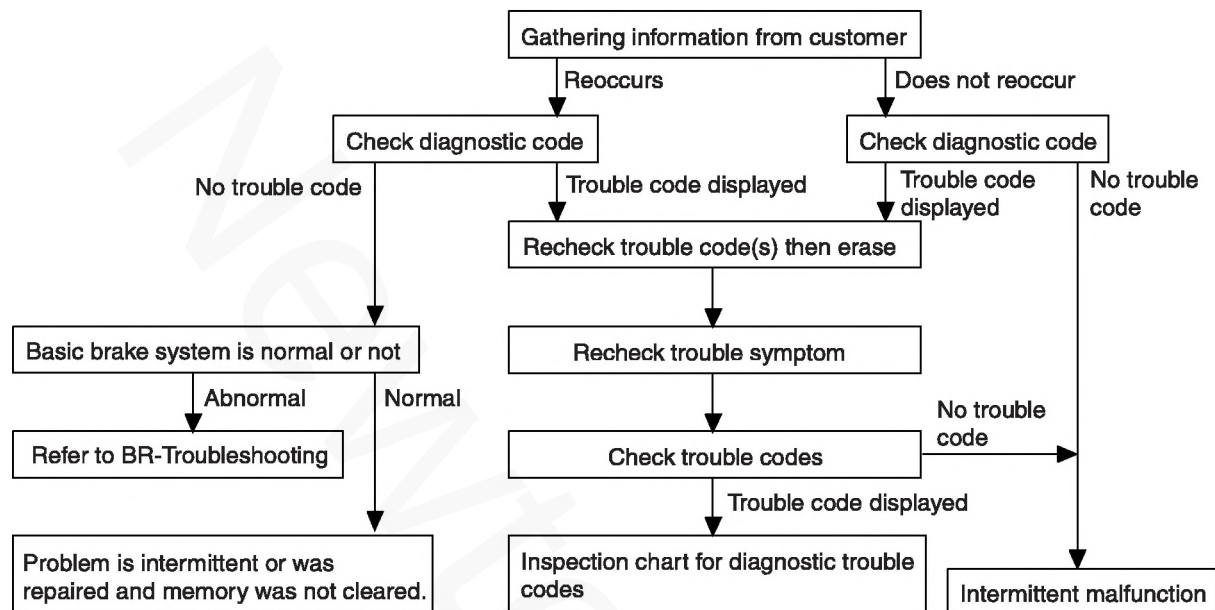
If there is a problem with the ABS system, the Failsafe function operates, turning off the relay which supplies the power to the solenoid valve, stopping the output of the control signal, and turning on the ABS warning lamp in order to warn the user of malfunction of the ABS system.





TROUBLESHOOTING EB4C736F

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING



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

EJKB055A

NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

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

ABS CHECK SHEET

ABS Check Sheet

Inspector's
Name _____

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

Date the Problem First Occurred	/ /
Frequency of Occurrence 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)

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 - 53
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 - 55
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line	BR - 57
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 - 58
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU	BR - 59
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU	BR - 60
Brake warning lamp is abnormal.	1. Brake oil level sensor 2. Parking brake switch 3. Brake warning lamp circuit	BR - 61

**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

EJKD222A

1. CHECK THE DTC RECONFIRMING THAT THE NORMAL CODE IS OUTPUT.

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?

Yes

No

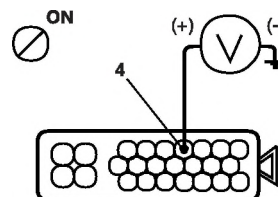
Erase the DTC and recheck using Hi-Scan (pro).

EJKD222B

2. 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 4 of the ABS control module harness side connector and body ground.
- **Specification: approximately B+**

Is the voltage within specification?



Yes

No

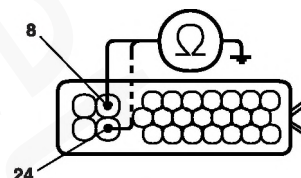
Check the harness or connector between the fuse (10A) in the passenger compartment junction block and the ABS control module. Repair if necessary.

LJIF500S

3. CHECK THE GROUND CIRCUIT.

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 8,24 of the ABS control module harness side connector and ground point.

Is there continuity?



Yes

No

Repair an open in the wire and ground point.

LJIF500T

4. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

OK

NG

Repair or replace the wheel speed sensor.

LJIF500U

5. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

OK

NG

Repair the hydraulic lines for leakage.

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

LJIF500V

ABS Does Not Operate Intermittently

EJKD222G

1. CHECK THE DTC RECONFIRMING THAT THE NORMAL CODE IS OUTPUT.

1. Connect the Hi-Scan (pro) to the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.

Is the normal code output?

Yes

No

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

EJKD222H

2. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

OK

NG

Repair or replace the wheel speed sensor.

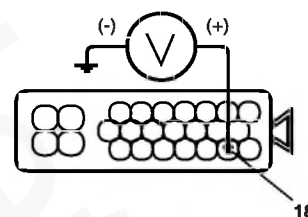
LJIF500W

3. 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 18 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

No

Repair the stop lamp switch.
Repair an open in the wire between the ABS control module and the stop lamp switch.

LJIF500X

4. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.



NG

Repair the hydraulic lines for leakage.

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

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

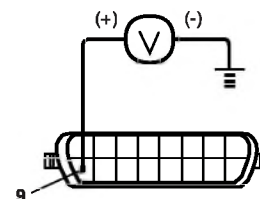
EJKD222L

1. 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

No

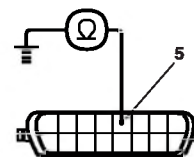
Repair an open in the wire.
Check and replace fuse (15A) from the passenger compartment junction block

LJIF500Z

2. 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.

LJIF501A

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

EJKD222O

1. CHECK FOR CONTINUITY IN THE DIAGNOSIS LINE

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

Is there continuity?

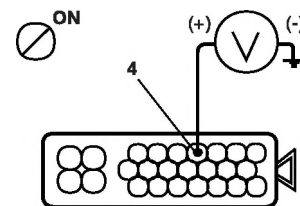
Yes

No Repair an open in the wire.

LJIF501B

2. 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 4 of the ABS control module harness side connector and body ground.
- **Specification: approximately B+**



Is voltage within specification?

Yes

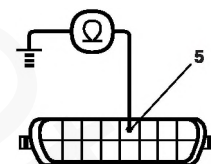
No Check the harness or connector between the fuse (10A) in the passenger compartment junction block and the ABS control module.
Repair if necessary.

LJIF501C

3. CHECK FOR POOR GROUND

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

Is there continuity?



Yes

No Repair an open in the wire or poor ground.

Replace the ABS control module and recheck.

LJIF501D

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

EJKD222S

1 . PROBLEM VERIFICATION

Disconnect the connector from the ABS control module and turn the ignition switch ON.

Does the ABS warning lamp light up?



Yes	Check for short circuit in the ABS control module connector.
-----	--

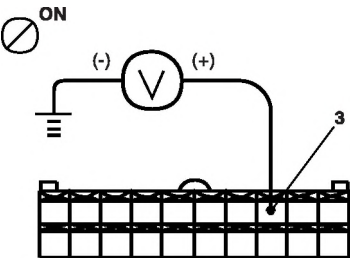
EJKD222T

2 . 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 3 of the cluster harness side connector and body ground.

• Specification: approximately B+

Is voltage within specification?



Yes	Repair bulb or instrument cluster assembly.
-----	---

LJIF501E

3 . CHECK FOR BLOWN FUSE

Check continuity of fuse (10A) from the passenger compartment junction block.

Is there continuity?



No	Replace the blown fuse.
----	-------------------------

Repair an open in the wire between terminals 12 of I/P-H connector and 3 of cluster connector.

LJIF501F

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

EJKD222W

1 . 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

Yes Repair circuit indicated by code output.

EJKD222X

2 . CHECK INSTRUMENT CLUSTER

Disconnect the cluster connector and turn the ignition switch ON.

Does the ABS warning lamp remains ON?

No

Yes Replace the instrument cluster.

LJIF501G

3 . CHECK FOR OPEN IN THE WIRE

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

Is there continuity?

Yes

No Repair an open in the wire between cluster and ABS control module.

Replace the ABS control module and recheck.

EJKD222Z

Brake Warning Lamp Is Abnormal

EJKD223A

1. CHECK PARKING BRAKE SWITCH CIRCUIT

OK

NG

Repair or replace parking brake switch circuit.

EJKD223B

2. CHECK BRAKE OIL LEVEL WARNING SWITCH CIRCUIT

OK

NG

Repair or replace brake oil level warning switch circuit.

EJKD223C

3. CHECK BRAKE WARNING LAMP CIRCUIT IN CLUSTER

OK

NG

Repair or replace the instrument cluster.

EJKD223D

4. CHECK FOR OPEN OR SHORT CIRCUIT IN HARNESS AND CONNECTOR

OK

NG

Repair or replace the harness and connector.

Replace the ABS control module and recheck.

EJKD223E

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.

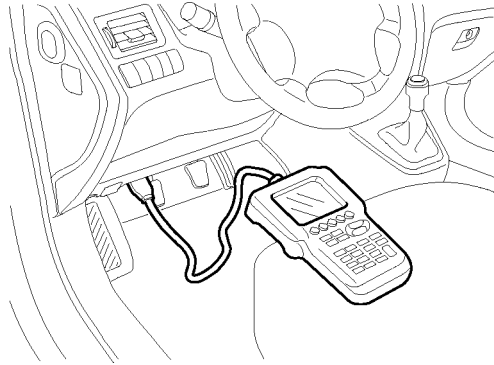
**NOTE**

When pressure bleeding, do not depress the brake pedal.

Recommended fluid..... DOT3 or DOT4

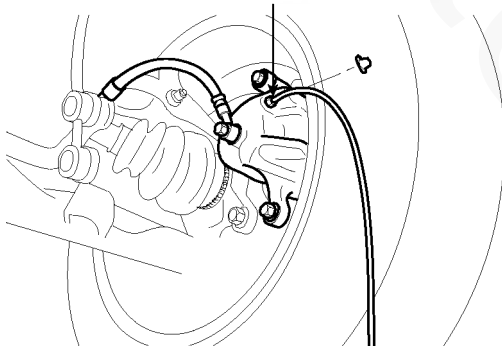
2. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.

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



KRQE900A

7~13 Nm (70~130 kgf·cm, 5.1~9.5 lbf·ft)



LJIF501H

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)	

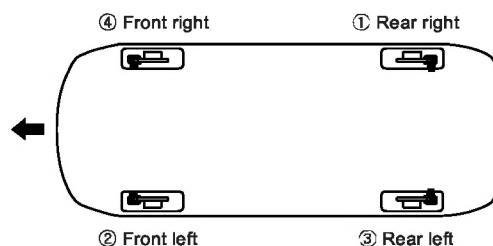
EJDA014F

- 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:
7~13 Nm (70 ~130 kg·cm, 5.1 ~ 9.5 lb·ft)

DIAGNOSTIC TROUBLE CODE CHART(DTC)

●:ON ○:OFF

DTC No.	Detection Item	Warning Lamp(On/Off)			Page
		EBD	ABS	ESP	
C1101	Battery voltage high	●	●	●	BR - 66
C1102	Battery voltage low	○/●	●	●	BR - 66
C1112	Sensor power voltage	○	○	●	BR - 67
C1200	Wheel speed sensor FR-LH open/short	○/●	●	●	BR - 68
C1201	Wheel speed sensor FR-LH range/performance/intermittent	○/●	●	●	BR - 69
C1202	Wheel speed sensor FR-LH invalid/no signal	○/●	●	●	BR - 70
C1203	Wheel speed sensor FR-RH open/short	○/●	●	●	BR - 68
C1204	Wheel speed sensor FR-RH range/performance/intermittent	○/●	●	●	BR - 69
C1205	Wheel speed sensor FR-RH invalid/no signal	○/●	●	●	BR - 70
C1206	Wheel speed sensor RR-LH open/short	○/●	●	●	BR - 68
C1207	Wheel speed sensor RR-LH range/performance/intermittent	○/●	●	●	BR - 69
C1208	Wheel speed sensor RR-LH invalid/no signal	○/●	●	●	BR - 70
C1209	Wheel speed sensor RR-RH open/short	○/●	●	●	BR - 68
C1210	Wheel speed sensor RR-RH range/performance/intermittent	○/●	●	●	BR - 69
C1211	Wheel speed sensor RR-RH invalid/no signal	○/●	●	●	BR - 70
C1235	Pressure sensor(primary) - electrical	○	○	●	BR - 71
C1237	Pressure sensor(secondary) - electrical	○	○	●	BR - 71
C1259	Steering angle sensor - electrical	○	○	●	BR - 72
C1260	Steering angle sensor - signal	○	○	●	BR - 72
C1282	Yaw rate & lateral G sensor - electrical	○	○	●	BR - 73
C1283	Yaw rate & lateral G sensor - signal	○	○	●	BR - 73
C1503	ESP switch error	○	○	●	BR - 74
C1513	Brake switch error	○	○	●	BR - 75
C1604	ECU hardware error	●	●	●	BR - 76
C1605	CAN hardware error	○	○	●	BR - 76
C1611	CAN time-out EMS	○	○	●	BR - 76
C1612	CAN time-out TCU	○	○	●	BR - 77
C1613	CAN wrong message	○	○	●	BR - 76
C1616	CAN bus off	○	○	●	BR - 78
C2112	Valve relay error	●	●	●	BR - 79

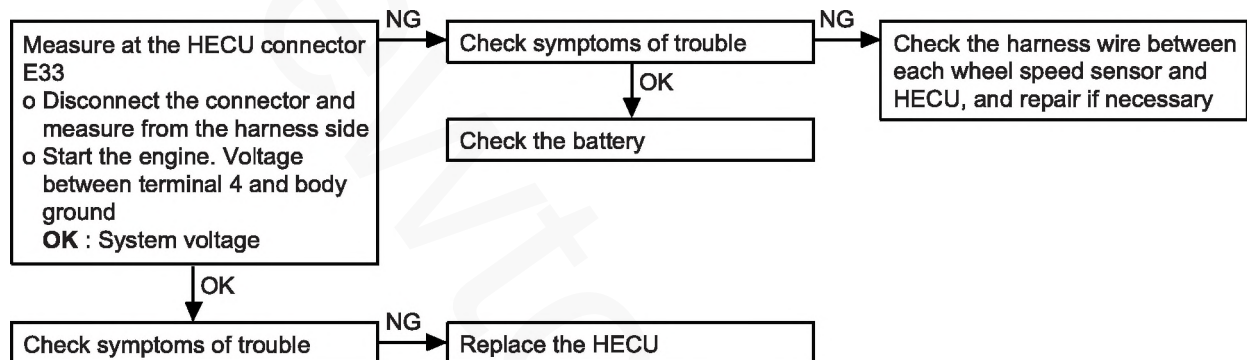
DTC No.	Detection Item	Warning Lamp(On/Off)			Page
		EBD	ABS	ESP	
C2227	Excessive temperature of brake disc	○	○	●	BR - 80
C2380	ABS/TCS/ESP valve error		●	●	BR - 81
C2402	Motor - electrical	○	●	●	BR - 82

CIRCUIT INSPECTION EDF55AC7

DTC No. C1101, C1102 Voltage out of range(Low and over voltage)	Probable cause
The voltage of the HECU power supply drops lower than or rises higher than the specified value. If the voltage returns to the specified value, this code is no longer output.	• Malfunction of wiring harness or connector • Malfunction of HECU.

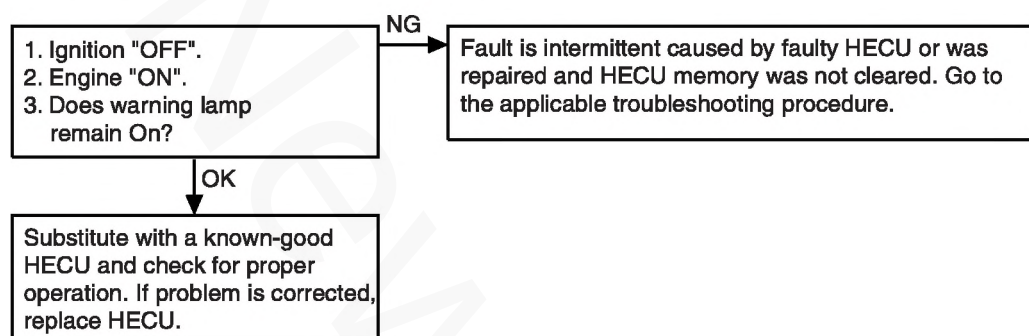
 CAUTION

If battery voltage drops or rises during inspection, this code will be output as well. If the voltage returns to the standard value, the code is no longer output. Before carrying out the following inspection, check the battery level, and refill if necessary.



CIRCUIT INSPECTION EB98A4FF

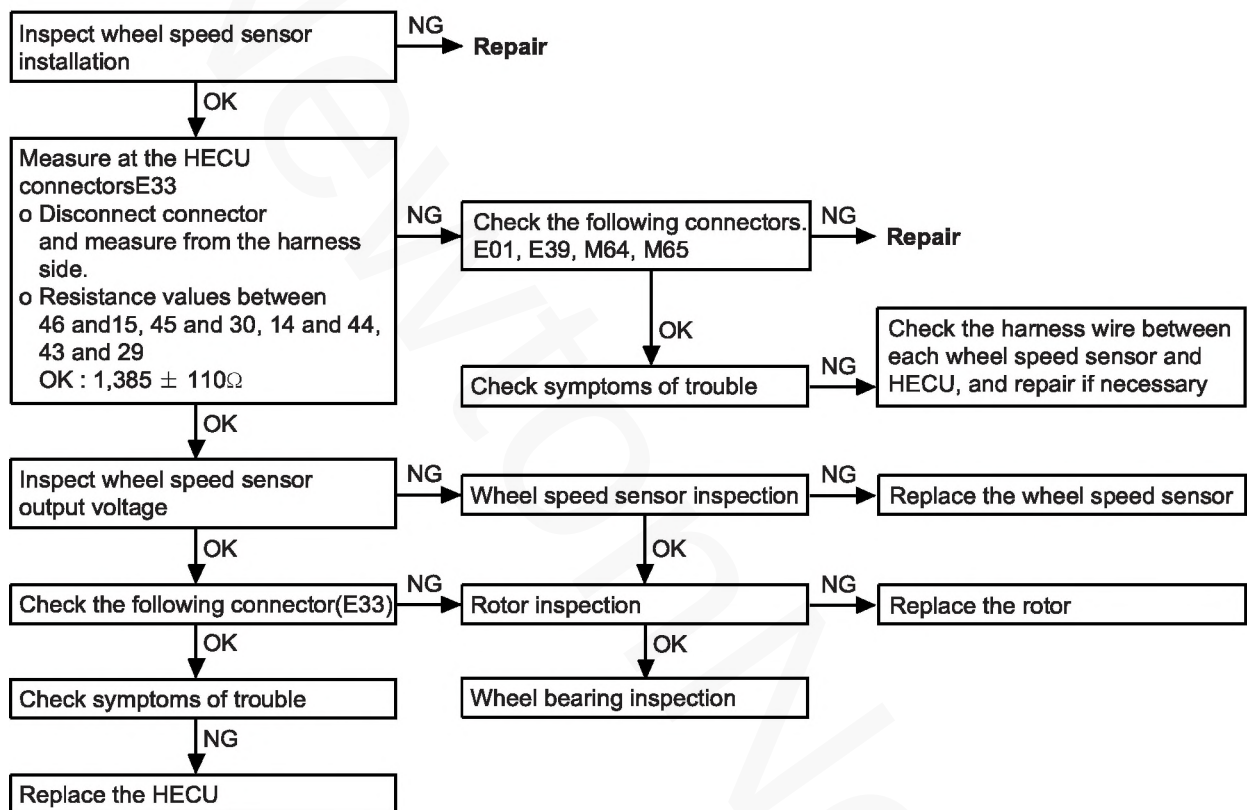
DTC No. C1112 Sensor power voltage error	Probable cause
The HECU supplies operating voltage with pressure sensor & lateral G sensor in master cylinder. The HECU monitors supply voltage of each sensor for normal ESP control. If supply voltage is out of specified range, ESP warning lamp is turned on and ESP control is inhibited.	Faulty HECU



CIRCUIT INSPECTION

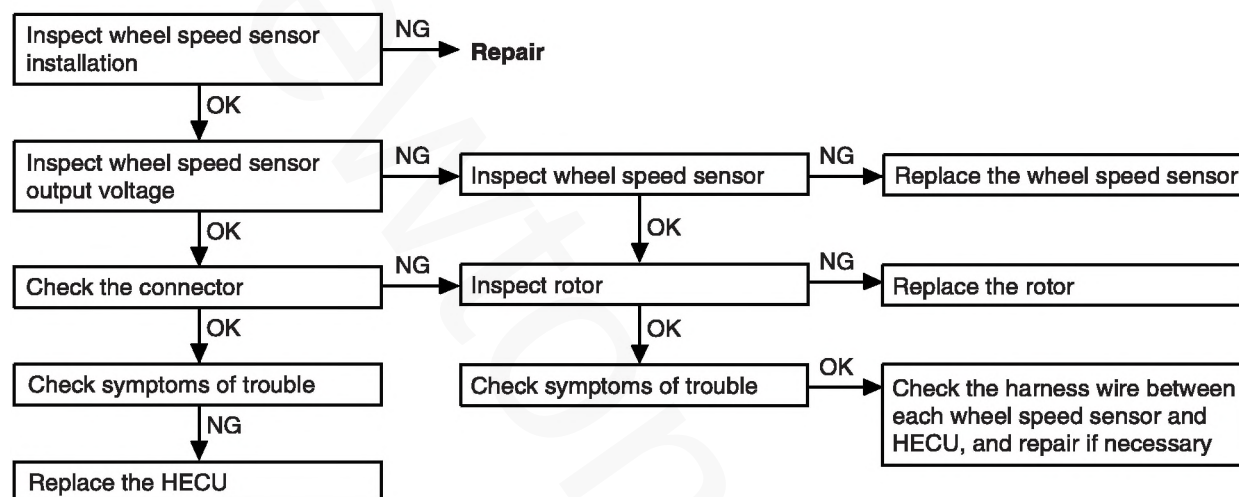
EE4C82C1

DTC No. C1200, C1203, C1206, C1209 Wheel speed sensor open or short to GND circuit	Probable cause
The HECU determines that an open or short circuit has occurred in more than one wire of a wheel speed sensor.	• Malfunction of wheel speed sensor • Malfunction of wiring harness or connector • Malfunction of HECU



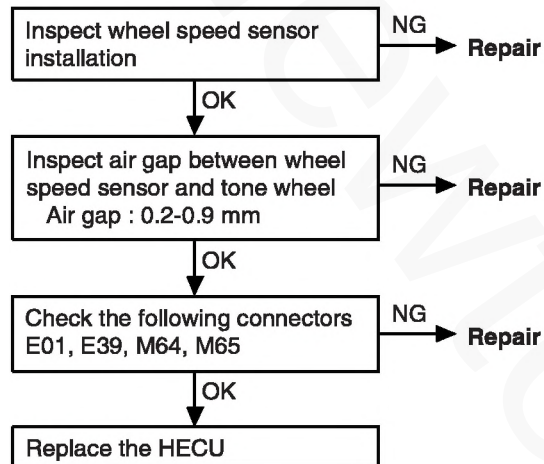
CIRCUIT INSPECTION E15BACEE

DTC No. C1201, C1204, C1207, C1210 (Speed jump or wrong exciter)	Probable cause
Abnormal output signal from a wheel speed sensor other than an open or short circuit.	• Improper installation of wheel speed sensor • Malfunction of wheel speed sensor • Malfunction of rotor • Malfunction of wheel bearing • Malfunction of wiring harness or connector • Malfunction of HECU



CIRCUIT INSPECTION EFE8972E

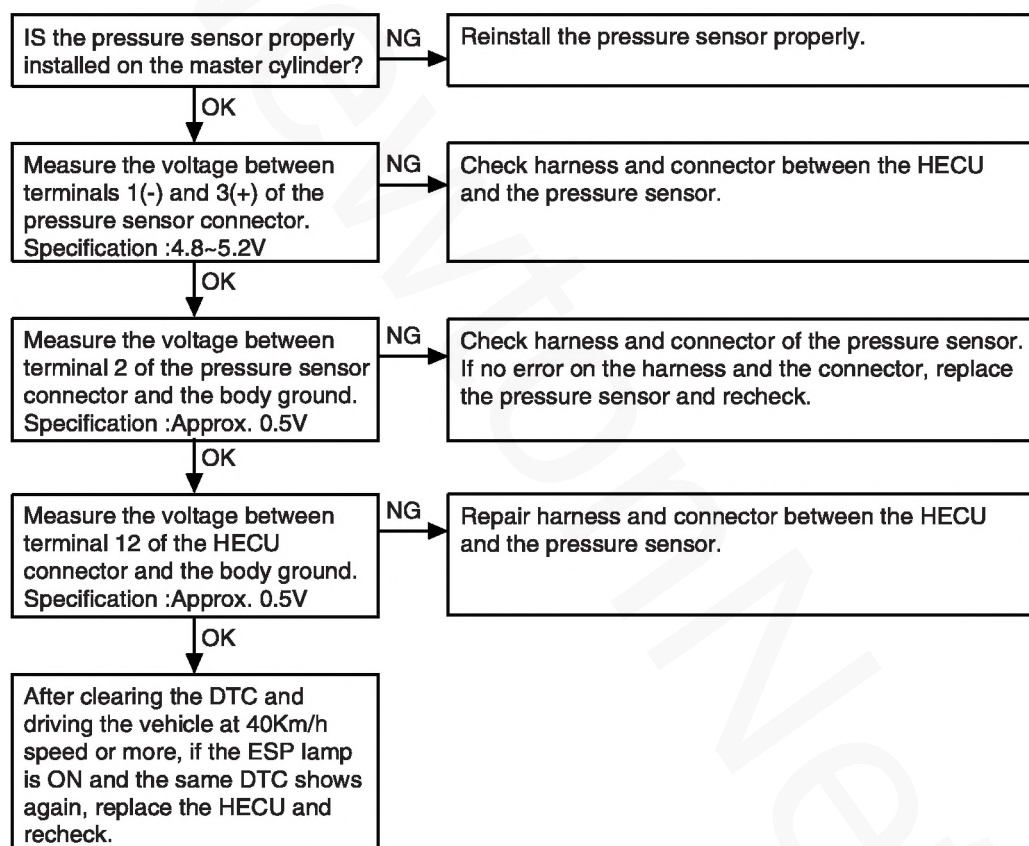
DTC No. C1202, C1205, C1208, C1211 (Large air gap)	Probable cause
No wheel speed sensor output signal.	• Malfunction of wheel speed sensor • Improper installation of wheel speed sensor • Malfunction of rotor (excitor) • Malfunction of wiring harness or connector • Malfunction of HECU



CIRCUIT INSPECTION

EB1E7463

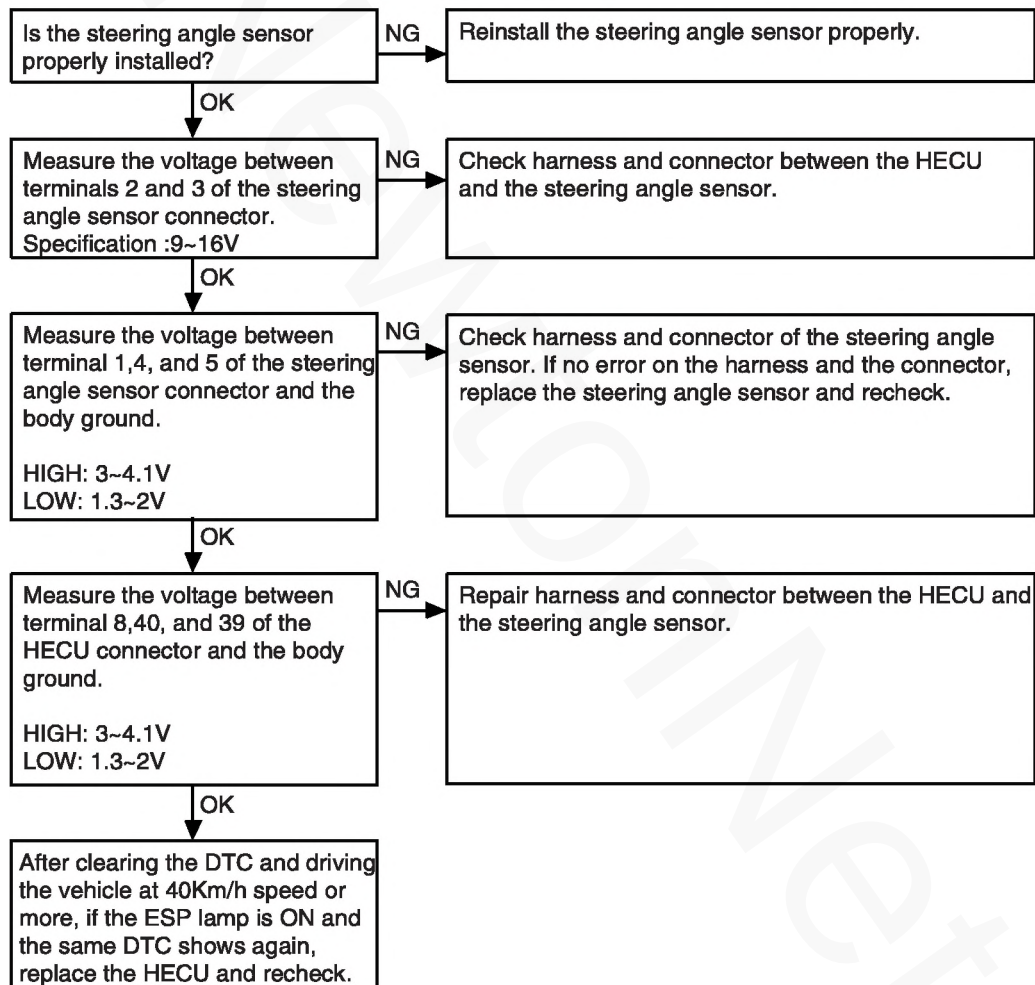
DTC No. C1235 Pressure sensor(primary)-electrical C1237 Pressure sensor(secondary)-electrical	Probable cause
The pressure sensor signals are read via A/D converter. Each unfiltered input signal voltage is monitored to be in the range of 0.2V < input signal voltage < 4.8V. There is no restriction of the pressure sensor output voltage if the specified operating range is reached or exceeded. The signal can therefore reach into a fault area without any fault being present in the sensor. A failure is detected if the output signal stays in one of the fault areas longer than the monitoring time.	• Open or short of pressure sensor circuit • Faulty pressure sensor • Faulty HECU



CIRCUIT INSPECTION

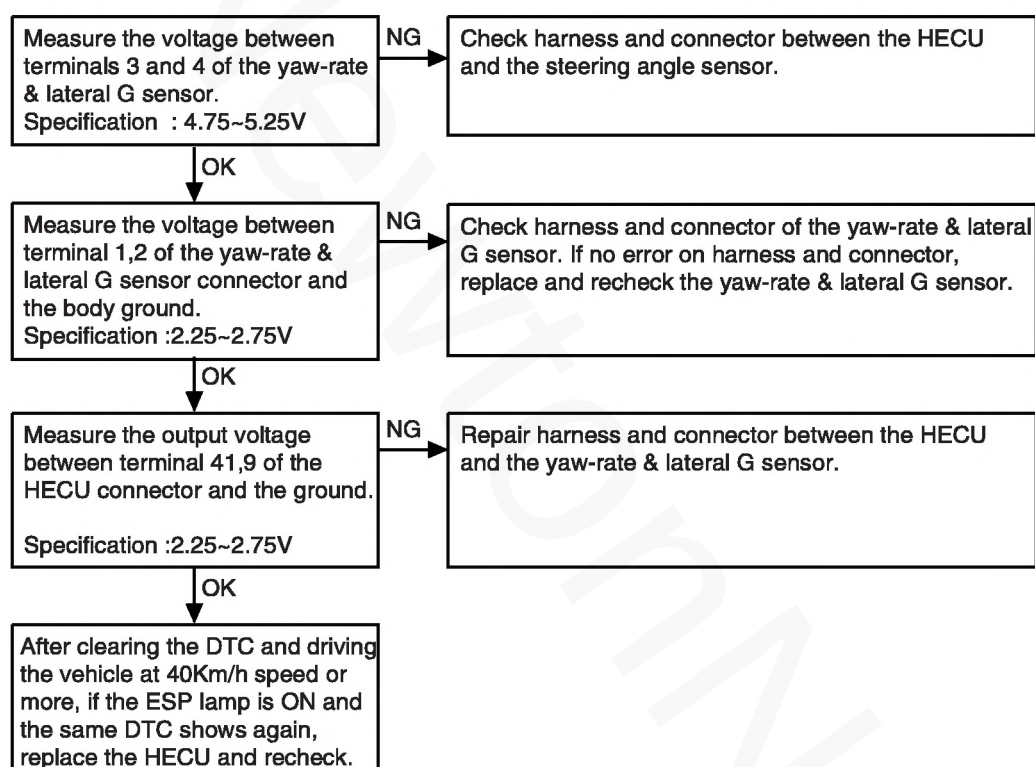
EFDCF822

DTC No. C1259 Steering angle sensor-electrical C1260 Steering angle sensor-signal)	Probable cause
If some signal voltage stays in abnormal voltage range, the time is counted separately. And if the monitored time exceeds the specified min. fault duration, failure is detected. The monitoring starts 1sec after Power Up.	• Open or short of steering wheel sensor circuit • Faulty steering wheel sensor



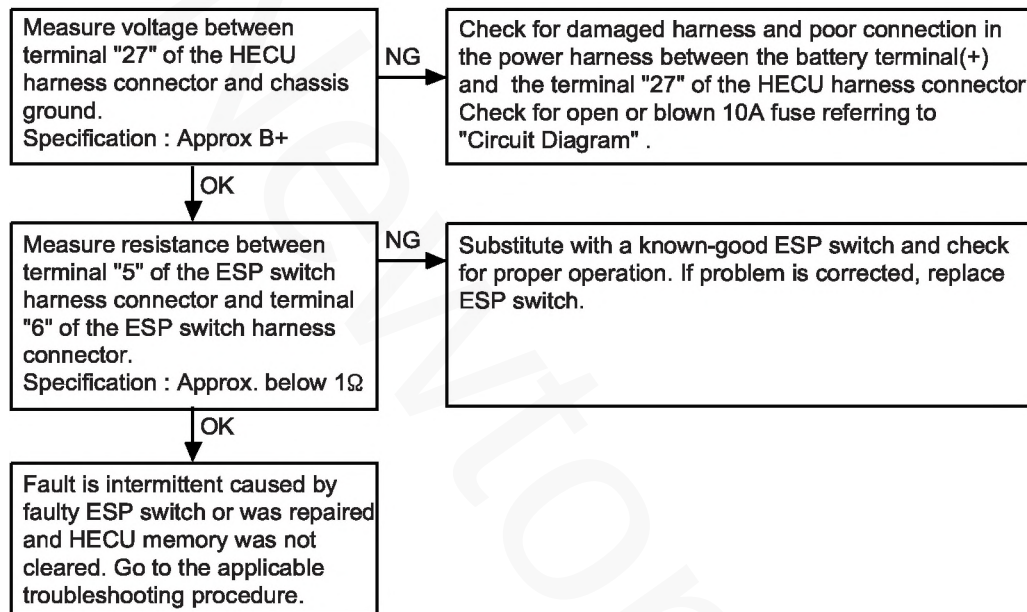
CIRCUIT INSPECTION E5078A20

DTC No. C1282 Yaw rate & lateral G sensor-electrical C1283 Yaw rate & lateral G sensor-signal	Probable cause
A failure is detected if the lateral acceleration sensor or yaw rate sensor signal stays in the fault range longer than the specified failure detection time. The Monitoring starts 1sec after Power Up.	• Open or short of Yaw Rate & Lateral G sensor circuit • Faulty Yaw Rate & Lateral G sensor • Faulty HECU



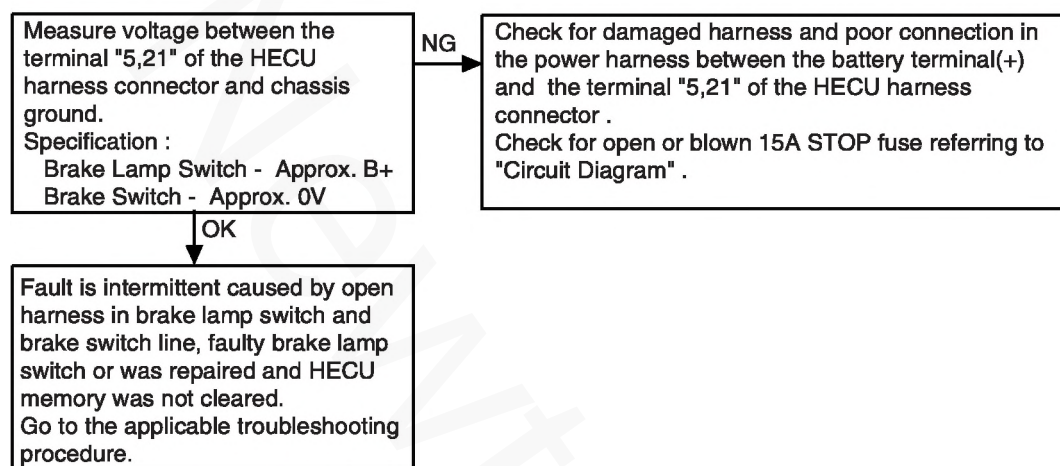
CIRCUIT INSPECTION E38CECB2

DTC No. C1503 ESP switch error	Probable cause
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.	Open or short ESP switch



CIRCUIT INSPECTION E7F414FD

DTC No. C1513 Brake switch error	Probable cause
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.	• Open circuit in brake switch line • Faulty brake light switch • Faulty input stage in HECU



CIRCUIT INSPECTION EA7CE8F2

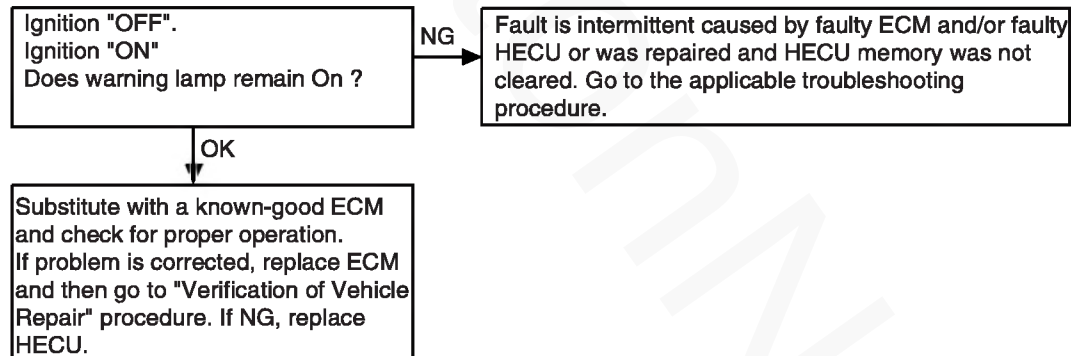
DTC No. C1604 HECU Hardware(EEPROM and ECU failure)	Probable cause
The HECU always monitors the solenoid valve drive circuit. It determines that there is an open or short-circuit in the solenoid coil or in a harness even if no current flows in the solenoid or through the HECU.	• Malfunction of wiring harness • Malfunction of HECU

CIRCUIT INSPECTION E871C9E9

DTC No. C1605 CAN Hardware error	Probable cause
The HECU checks the CAN RAM for normal TCS control, and sets this code if a CAN RAM malfunction is detected.	• Faulty HECU -Replace HECU.

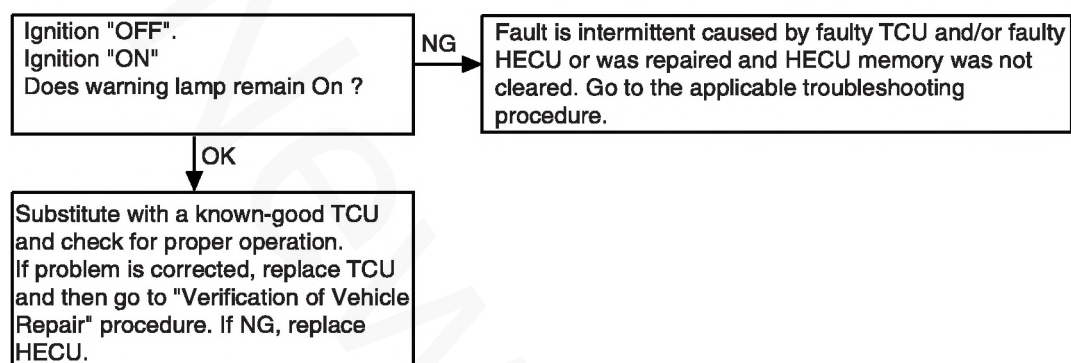
CIRCUIT INSPECTION E2FEF0FE

DTC No. C1611 CAN time-out EMS C1613 CAN wrong message	Probable cause
The HECU checks the CAN communication lines for normal TCS control, and sets this code if an ECM message is not received within 500ms. The HECU does not detect this code until 2 seconds after the IG KEY is turned to ON.	• Faulty ECM • Faulty HECU



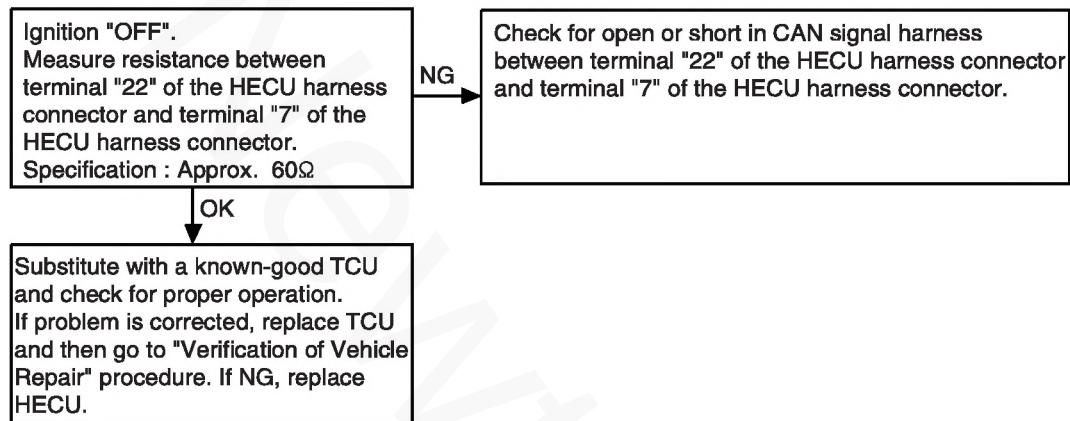
CIRCUIT INSPECTION EF64E81C

DTC No.C1612 CAN time-out TCU	Probable cause
The HECU checks the CAN communication lines for normal TCS control, and sets this code if an TCU message is not received within 500ms. The HECU does not detect this code until 3 seconds after the IG KEY is turned to ON.	- Faulty TCU - Faulty HECU



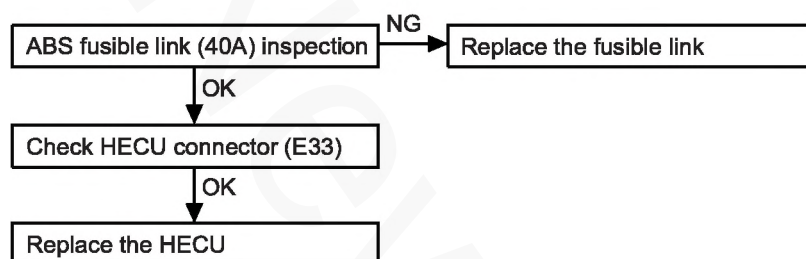
CIRCUIT INSPECTION EBBAG5F0

DTC No. C1616 CAN bus OFF	Probable cause
The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and ECM/TCM.	• Open/short in CAN bus circuit. • Faulty CAN bus • Faulty HECU



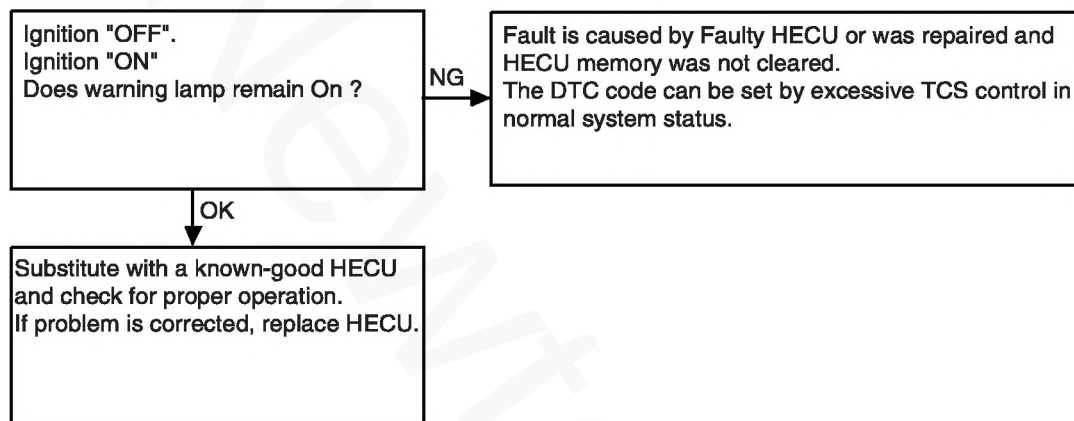
CIRCUIT INSPECTION E7865FC2

DTC No. C2112 Valve relay(Including fuse failure)	Probable cause
When the ignition switch is turned ON, the HECU switches the valve relay on and off during its initial check. During this time, voltage sent to the valve relay is compared to the voltage in the valve power monitor line. If no current is detected in the valve power monitor line, the HECU determines that there is an open circuit and DTC C2112 is recorded.	• Malfunction of wiring harness or connector • Malfunction of HECU



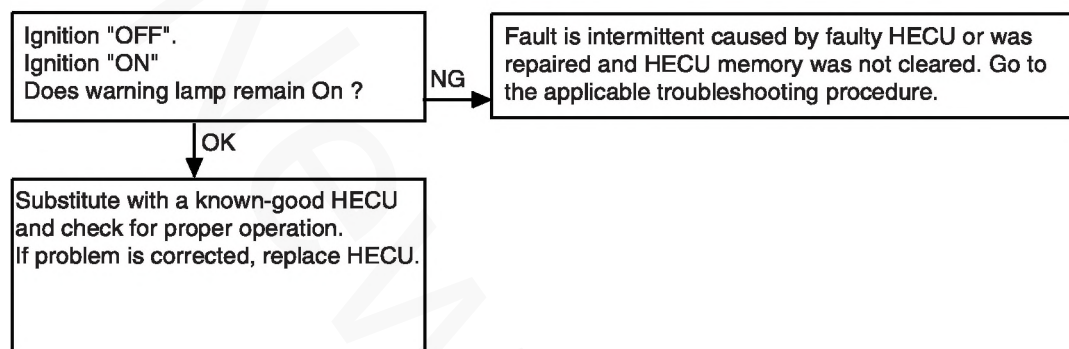
CIRCUIT INSPECTION E2754C77

DTC No.C2227 Excessive temperature of brake disc	Probable cause
If the HECU decides that the Disc is over-heated (above 500 ℃), then it turns the ESP lamp ON and inhibits TCS operation to protect overheating of the disc. If the calculated temperature becomes lower than specified value (approx. 250 ℃), then the HECU turns the TCS lamp OFF and operates the BTCS again.	Faulty HECU



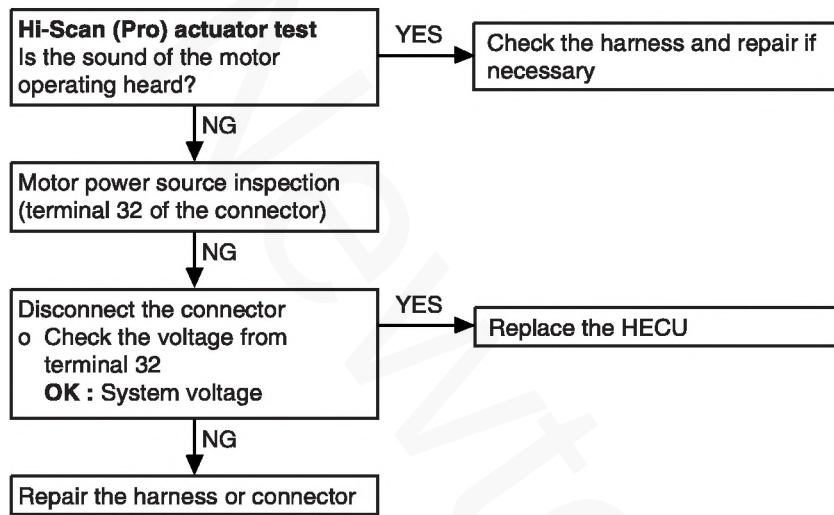
CIRCUIT INSPECTION EBCCDAB8

DTC No. C2380 ABS/TCS/ESP valve error	Probable cause
The HECU monitors the solenoid valve operating circuit. If there is no continuity of the solenoid valve, when the HECU switches the solenoid valve ON, it is a cause an open or short in the circuit of the solenoid coil or harness.	Faulty HECU



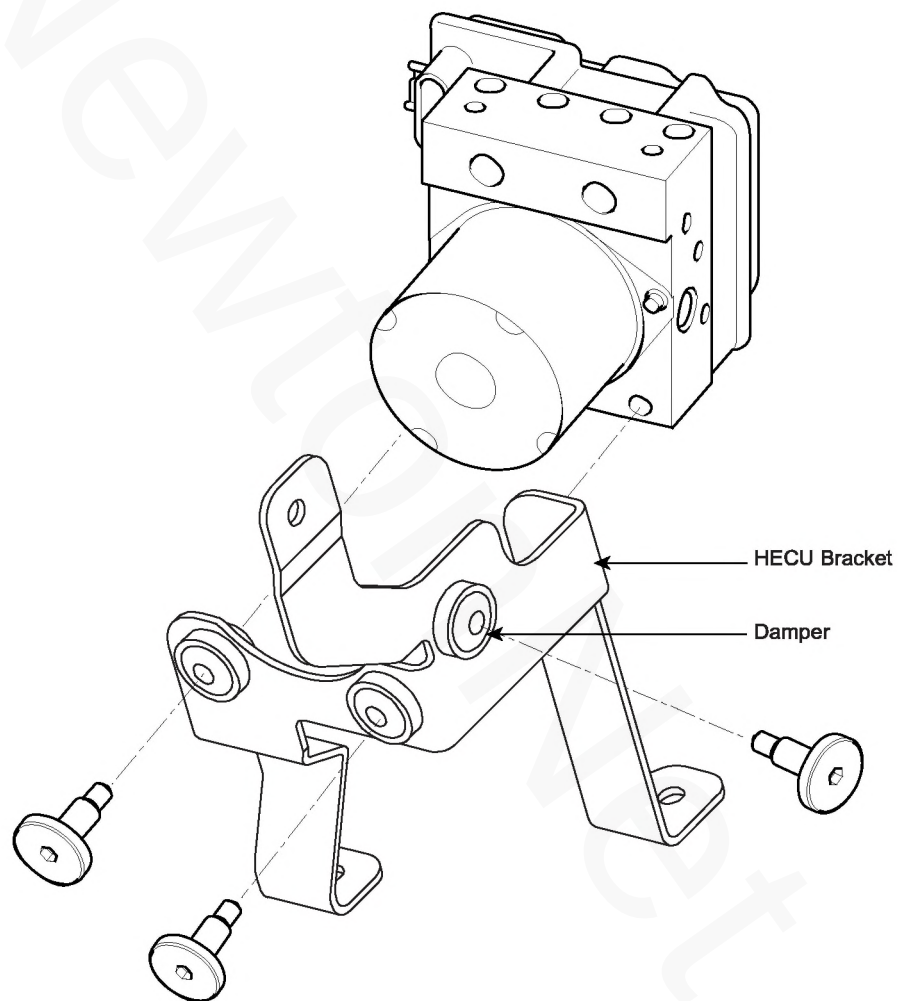
CIRCUIT INSPECTION E59C5BE8

DTC No. C2402 motor pump failure(Motor relay, motor)	Probable cause
When the motor power line is normal but no signal is in detected in the motor monitor line.	• Malfunction of wiring harness • Malfunction of HECU



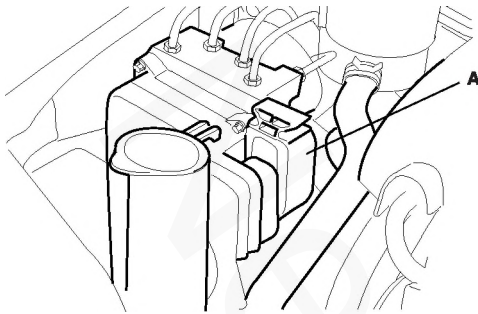
ANTI-LOCK BRAKING SYSTEM CONTROL MODULE

COMPONENTS EEEEBB5F9



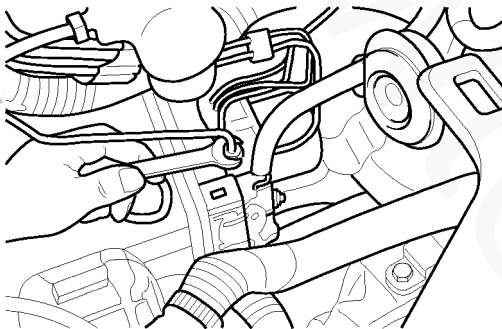
REMOVAL E2DF215A

1. Disconnect the double lock connector (A) from the HECU.



EJOE002E

2. Disconnect the brake tubes from the HECU.

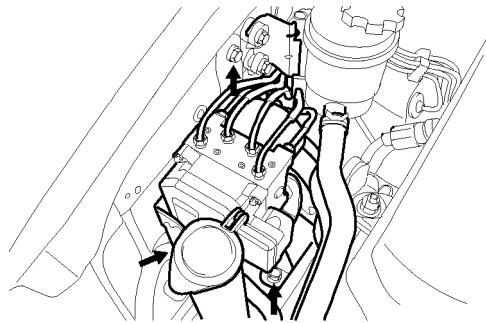


EJPC580B

3. Remove the HECU bracket mounting bolts and remove the HECU.

**CAUTION**

1. **Never attempt to disassemble the HECU.**
2. **The HECU must be transported and stored in an upright position and with the ports sealed. The HECU must not be drained.**



KJOC002C

Tightening torque

HECU bracket mounting bolts:

17~26 Nm (170~260 kg·cm, 12.5~19.1 lb·ft)

**NOTE**

- Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.
- Take care not to damage or deform the brake lines during removal and installation.
- To prevent the brake fluid from flowing, plug and cover the hose ends and joints with a shop towel or equivalent material.

INSTALLATION E06115FD

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

Tightening torque

HECU mounting bolt:

8~10 Nm (80~100 kg·cm, 5.9~7.3 lb·ft)

HECU bracket mounting bolt:

17~26 Nm (170~260 kg·cm, 12.5~19.1 lb·ft)

Brake tube nut:

13~17 Nm (130~170 kg·cm, 9.5~12.5 lb·ft)

INSPECTION E6A9F729**WHEEL SPEED SENSOR OUTPUT VOLTAGE CHECK**

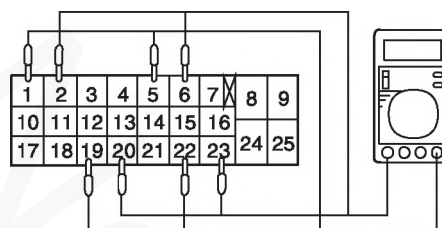
1. Raise the vehicle and release the parking brake.
2. Disconnect the HECU harness connector's and measure from the harness side connector.

**CAUTION**

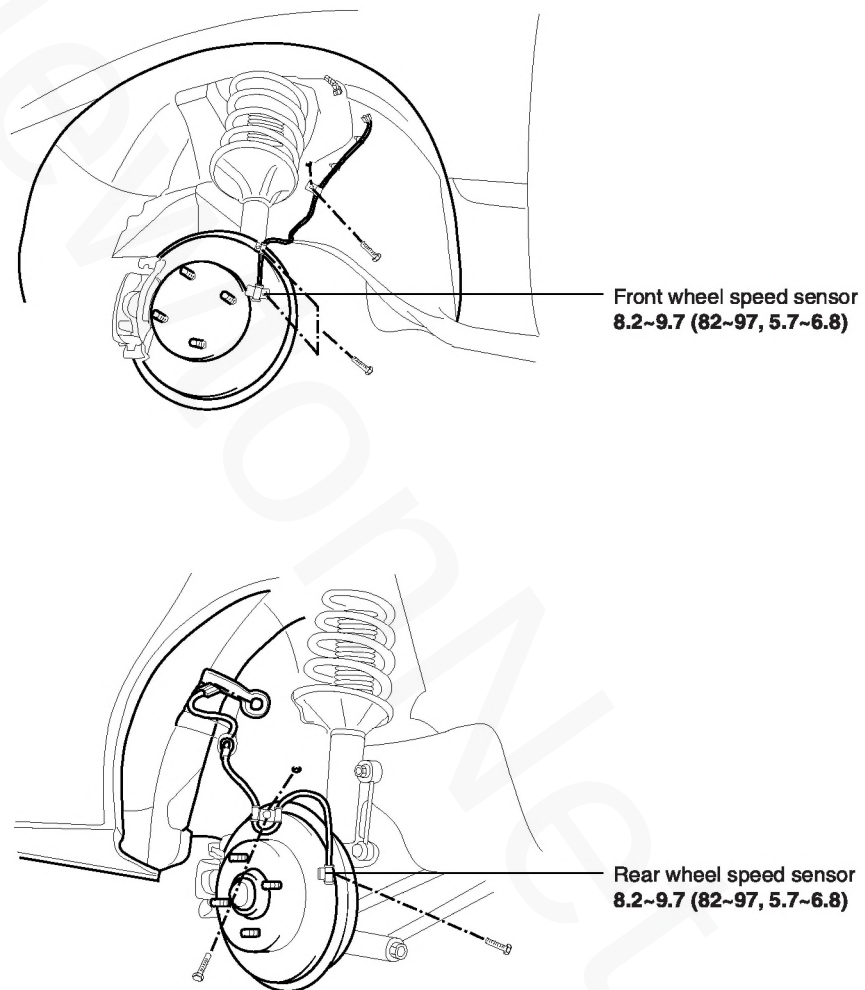
Be sure to remove the connector's double lock and insert the probe into the harness side (back-probe). Inserting it into the terminal side may result in a bad connection.

3. Rotate the wheel to be measured approximately 1/2 to 1 rotation per second, and check the output voltage using a circuit tester or an oscilloscope.

Wheel speed sensor	Front left	Front right	Rear left	Rear right
Terminal	1	19	5	22
	2	20	6	23

Output voltage:**When measuring with an oscilloscope:****130mV p-p or more**

KGX8074A

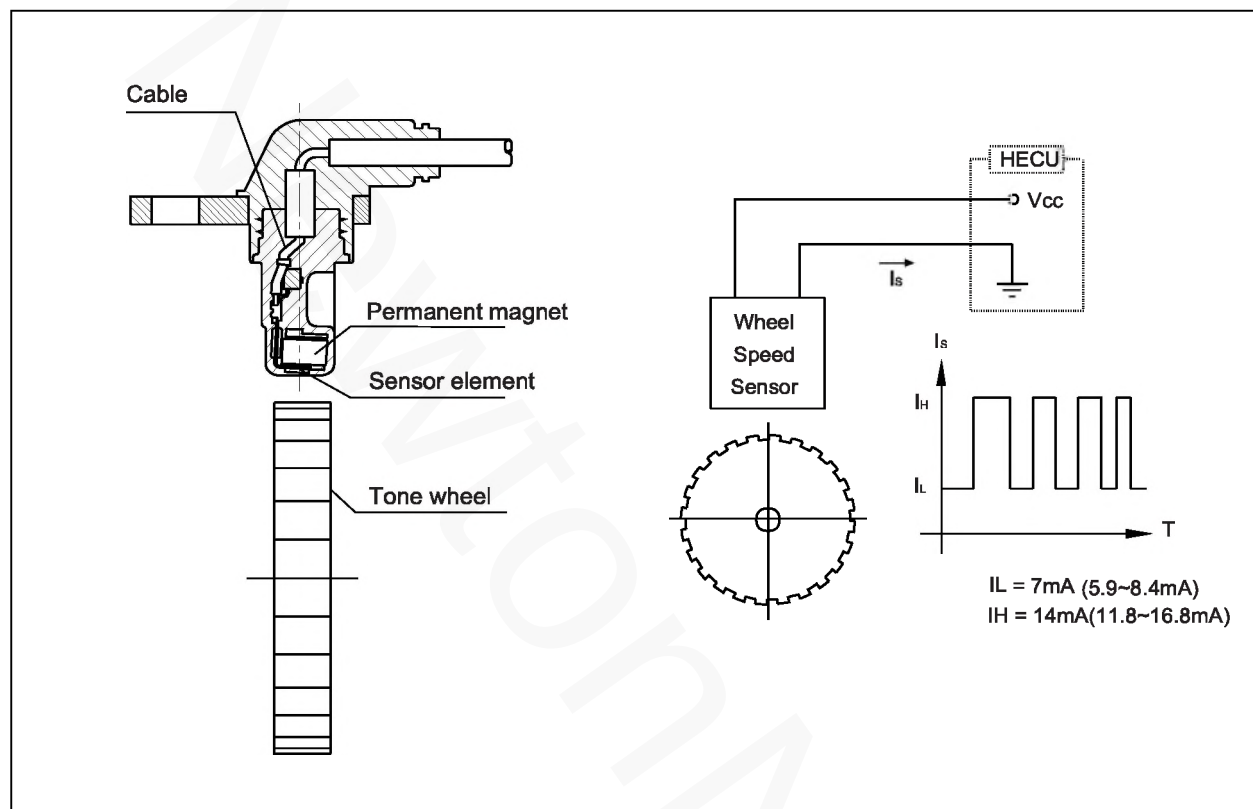
**ANTI-LOCK BRAKING SYSTEM
WHEEL SPEED SENSOR****COMPONENTS** EECBF30**TORQUE : Nm (kg·cm, lb·ft)**

DESCRIPTION E7DACDEF

A toothed rotor is fixed to the rotating member of the wheel, and the sensor is fixed to the static member of the suspension. As the wheel rotates the toothed rotor causes magnetic flux changes in the magnetic field of the permanent magnet. The sensor element senses these changes.

Depending on the flux changes the sensor sends a signal out to the ECU. The change in magnet flux thus the sensor signal is directly related to the wheel speed.

The controller monitors the sensor signal, compares the four wheel-speed signals and initiates action as required.



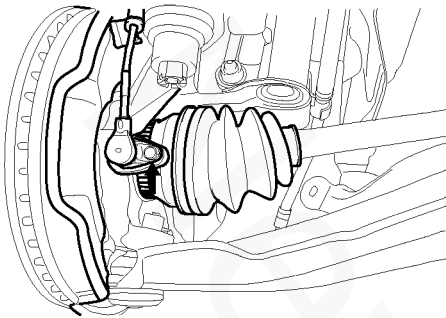
LJIF502E

SPECIFICATIONS

Item		Standard Value	Remark
Supply voltage		DC 12V	
Operating temperature		-40~120°C	R=100Ω
Output current range	Low	7mA(5.9~8.4mA)	
	High	14mA(11.8~16.8mA)	
Frequency range		1~2000 Hz	
Airgap		0.2~1.5mm(0.008~0.0591 in.)	
Tone wheel	Number	44	

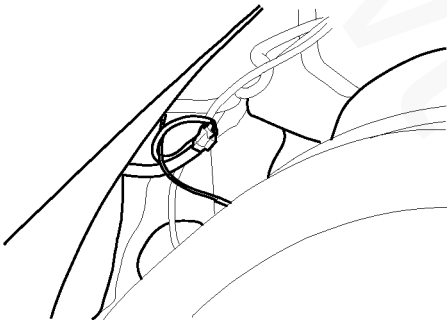
REMOVAL E3ABBF1D**FRONT WHEEL SPEED SENSOR**

1. Remove the front wheel speed sensor mounting bolt.



KJOC002D

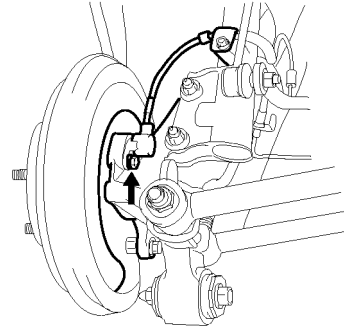
2. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector.



KJOC002P

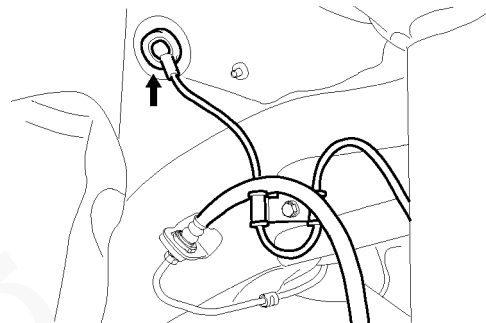
REAR WHEEL SPEED SENSOR

1. Remove the rear wheel speed sensor mounting bolt.



KJOC002G

2. Remove the luggage trim and disconnect the wire connector from the rear wheel speed sensor.



KJOC002H

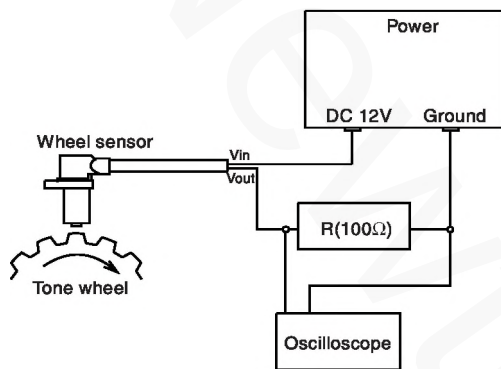
INSPECTION EFBCEF81

- Frequency range : 1~2,000Hz

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

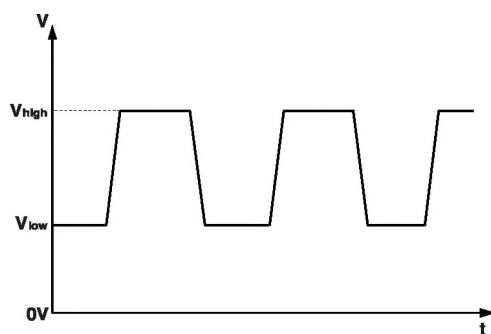
 CAUTION

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



EJQE280A

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



KJQE280B

- V_low : 590mV ~ 840mV
- V_high : 1.18V ~ 1.68V

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION)

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION) OPERATION

EA4D7477

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 to the 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.

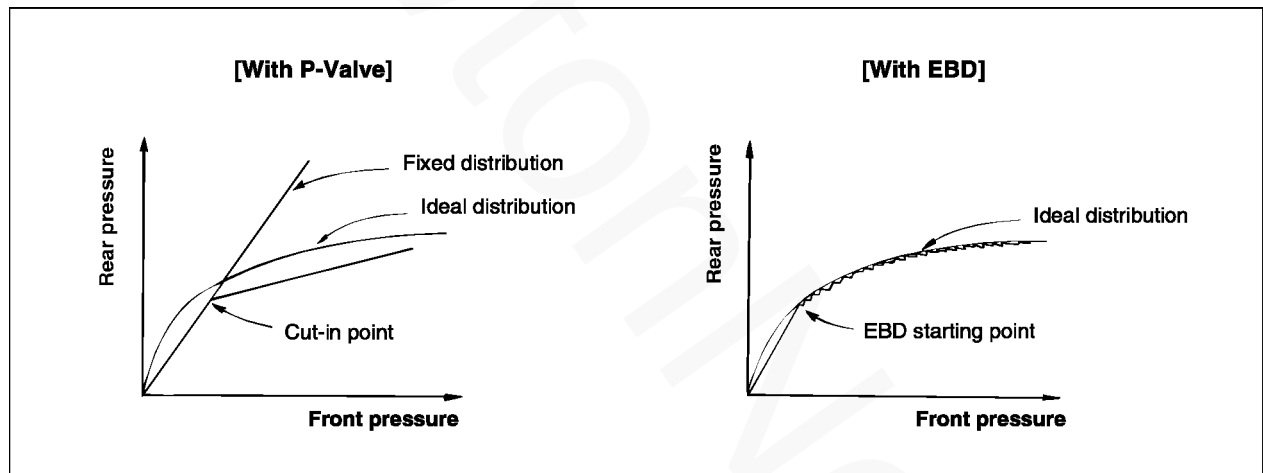
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

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 EEBCCA5A

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

ESP is based on the MGH 25 ABS Hydraulic System. ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake or the gas pedal.

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

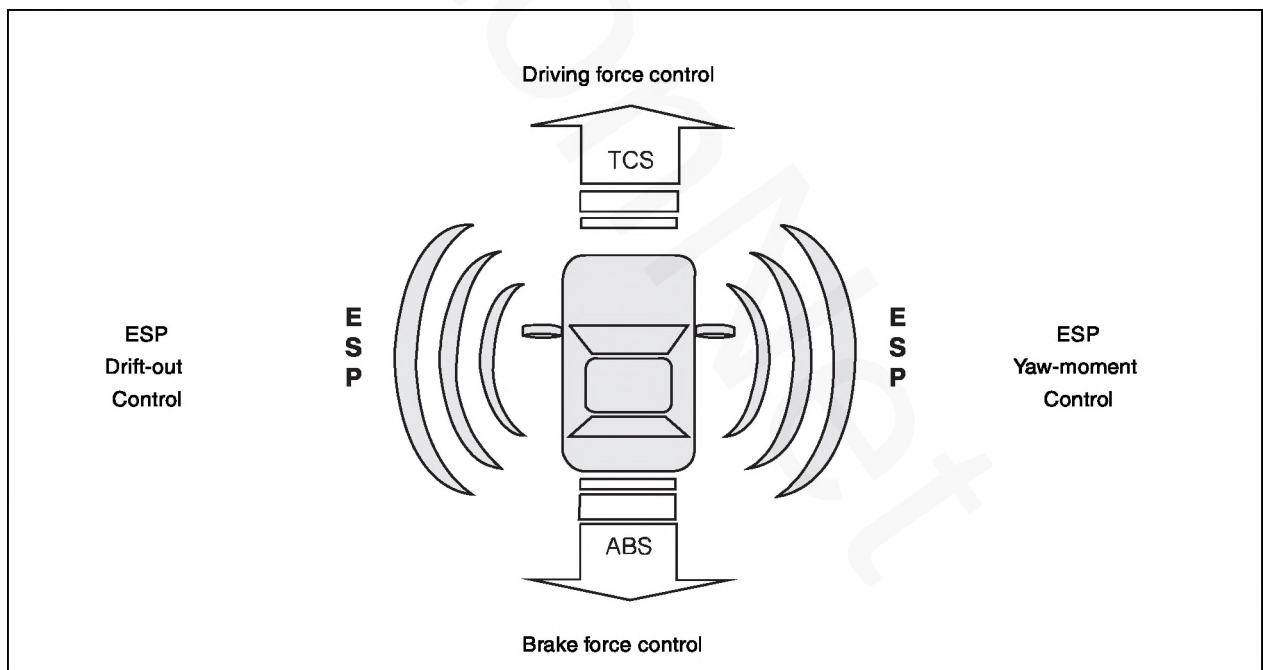
This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

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

The electronic control unit incorporates the technological experience accumulated in connection with the MK 20 system, but has been substantially expanded in terms of capacity and monitoring concept in order to permit the additional sensor signals and arithmetic operations to be processed and converted into corresponding valve, pump and engine control commands. Two 16-bit processors and one 8-bit processor, which monitor each other, cooperate to handle these requirements.

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

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



DESCRIPTION OF ESP CONTROL

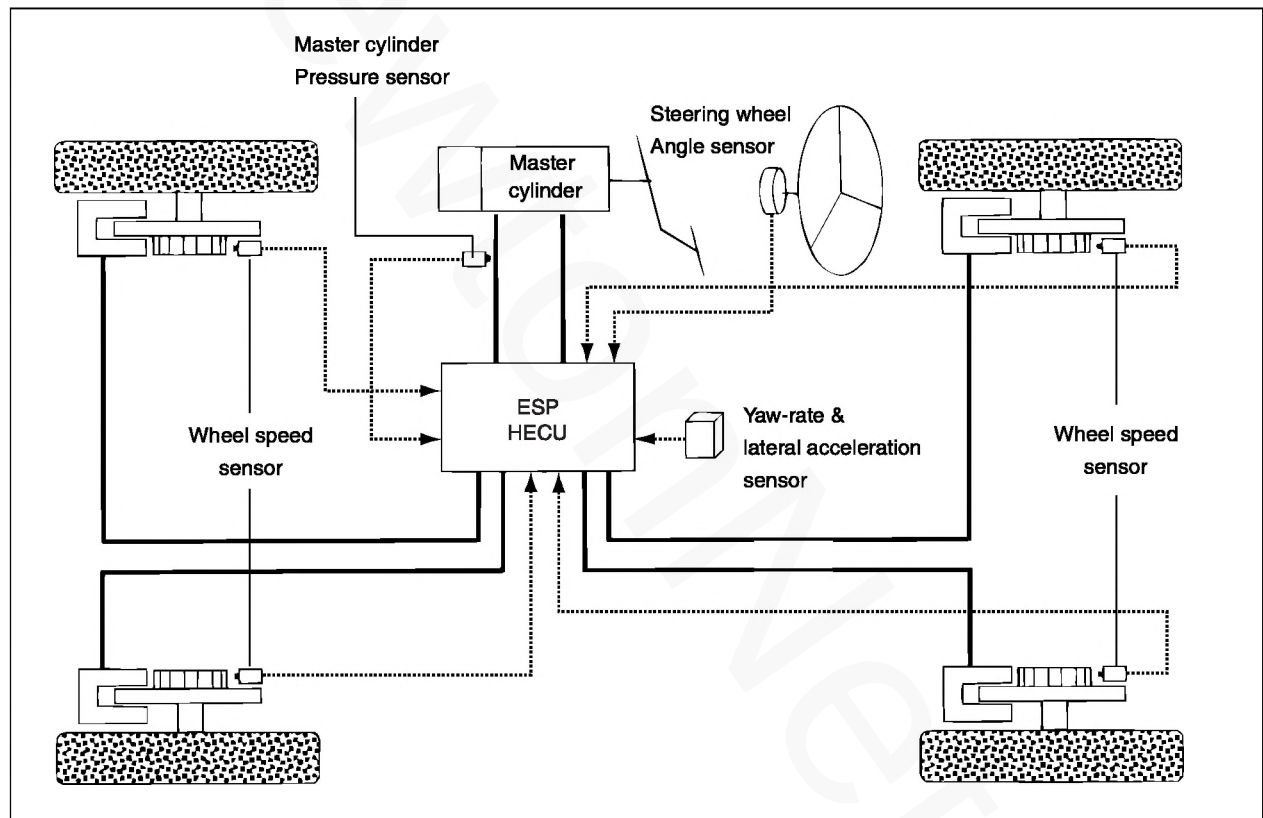
ESP system includes ABS/EBD, TCS and AYC function.

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.

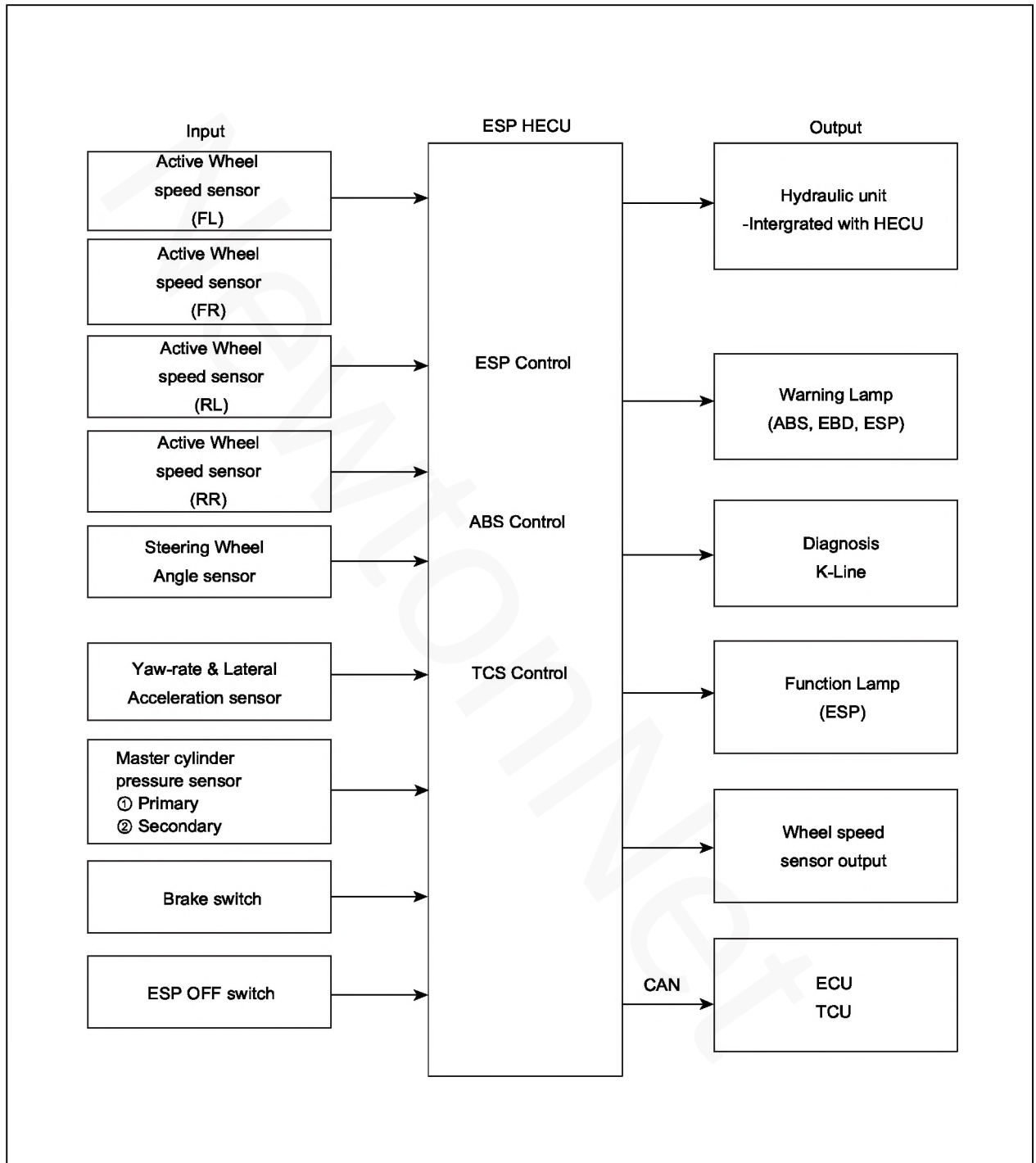
TCS function prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication. TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

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.

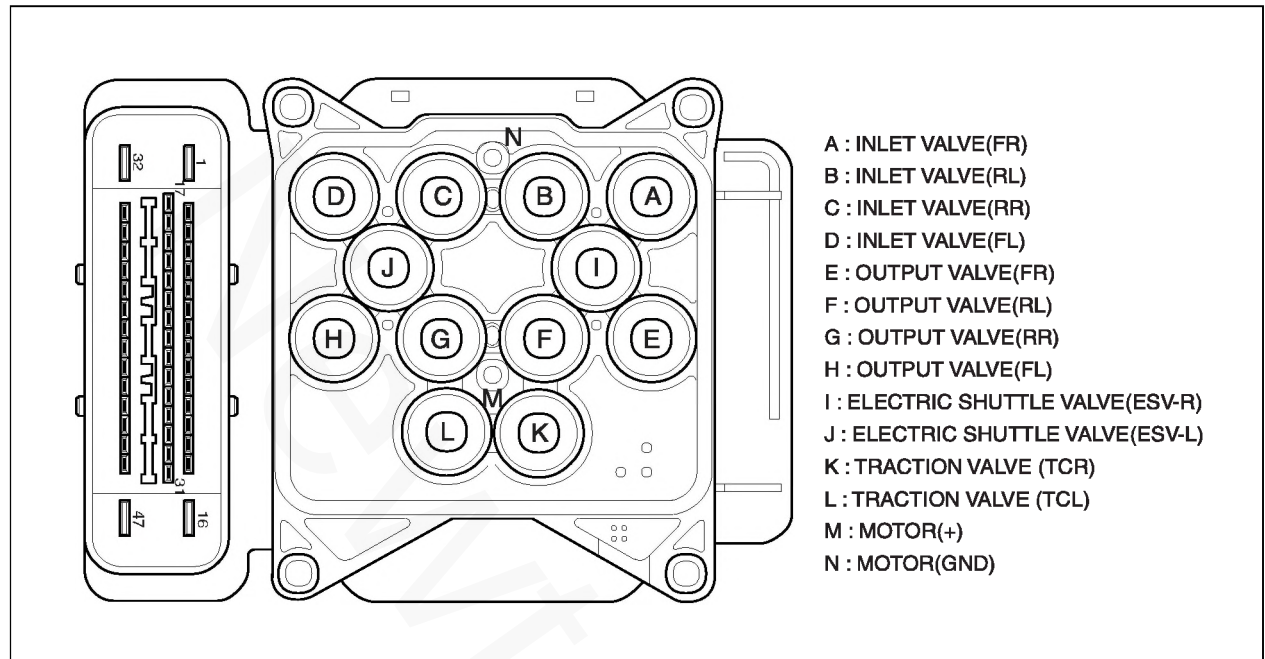
After the key-on, the ECU continually diagnoses the system failure. (self-diagnosis) If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)



INPUT AND OUTPUT DIAGRAM

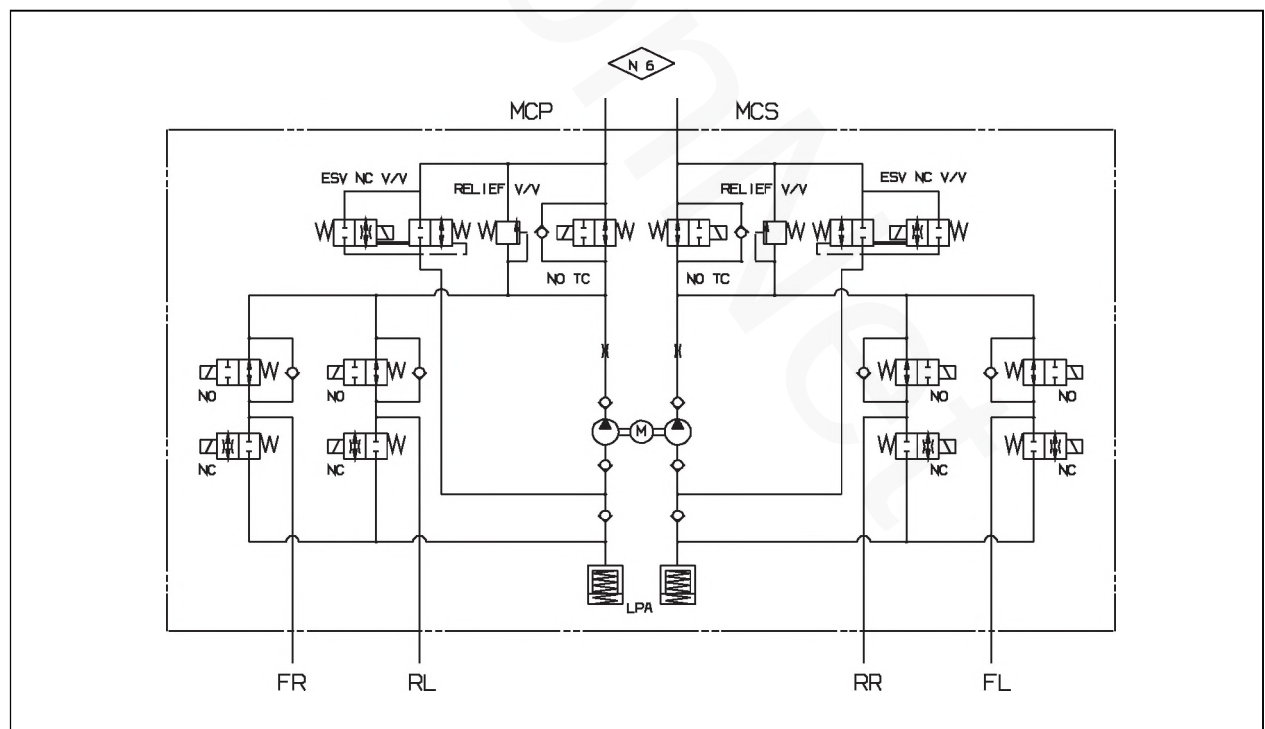


EXTERNAL DIAGRAM



EJOF500B

HYDRAULIC DIAGRAM E7D694B4



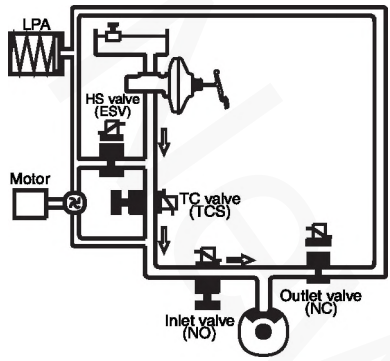
KJOF501B

ESP OPERATION MODE E0CB29F0

Operation

1. ESP Non-operation-Normal braking.

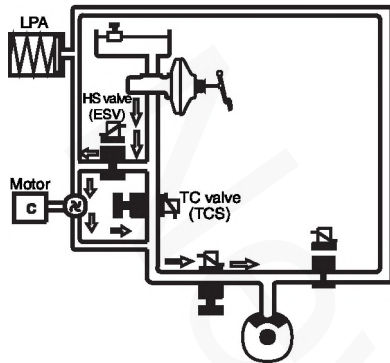
In this position, the inlet valve and the TCS valve are open, the electrically operated shuttle valve and the outlet valve are closed.
* ESV : Electric reversing valve.



LJCD207A

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

2. ESP operation

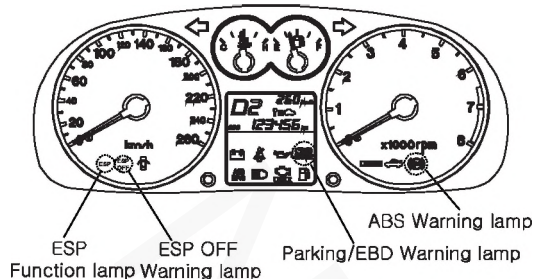


Operation

The on/off booster builds up a pressure of approx. 10 bar in order to enable the ESP pump to suck brake fluid at low temperatures. In this position, the inlet valve is driven in a pulsed cycle. The TCS valve is closed. The outlet valve remains closed. The electrically operated shuttle valve is opened. The hydraulic pressure is led to the wheel brakes which are to be applied for a brief period of time.

LJCD208A

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



EJOF500C

ESP ON/OFF SWITCH (ESP SYSTEM)

The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input. The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition.

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

ABS WARNING LAMP MODULE

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

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

EBD WARNING LAMP MODULE

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

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

ESP WARNING LAMP (ESP SYSTEM)

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

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

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

ESP FUNCTION LAMP (ESP SYSTEM)

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

The ESP Function lamp operates under the following conditions :

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

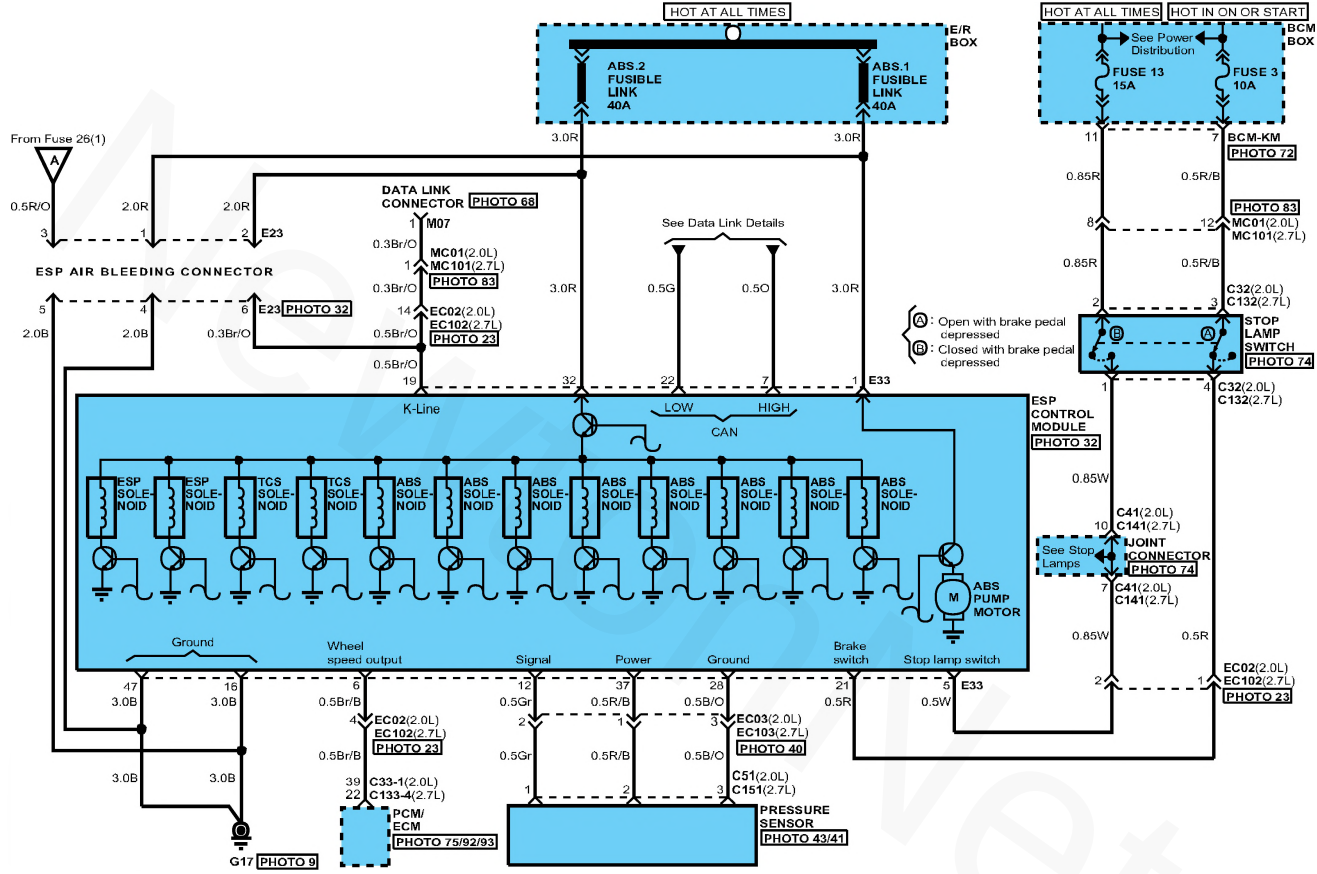
EF6099CC



ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

BR -99

CIRCUIT DIAGRAM(2) - ESP



EJOF600P

ESP CONNECTOR INPUT/OUTPUT E8E4A2F7

Connector Terminal		Specification	Remark
No	Description		
4	IGNITION1(+)		
32	POS.BATTERY.(SOLENOID)	Max leakage current : $I < 0.8\text{mA}$	
1	POS.BATTERY.(MOTOR)	Operating voltage range: $9.5\pm0.5\text{V} < V < 16.5\pm0.5\text{V}$ Max current : $I < 40\text{A}$ Max leakage current : $I < 0.2\text{mA}$	
16	GROUND	Rated current : $I < 300\text{mA}$ Max. current: $I < 40\text{A}$	
47	PUMP MOTOR GROUND	Max current : $I < 40\text{A}$	
23	YAW & LATERAL G SENSOR GROUND	Rated current : $I < 65\text{mA}$	
28	MASTER PRESSURE SENSOR GROUND	Rated current : $I < 10\text{mA}$	
31	STEERING ANGLE SENSOR GROUND	Rated current : $I < 100\text{mA}$	
37	MASTER PRESSURE SENSOR POWER	Max Output current : $I < 10\text{mA}$ Max Output voltage : $4.9\text{V} \leq V \leq 5.1\text{V}$	
36	YAW SENSOR POWER	Max Output current : $I < 65\text{mA}$ Max Output voltage : $4.9\text{V} \leq V \leq 5.1\text{V}$	
5	BRAKE LIGHT SWITCH	Input voltage low: $0\text{V} \leq V \leq 3.0\text{V}$ Input voltage High: $7.0\text{V} \leq V \leq 16.0\text{V}$	
21	BRAKE SWITCH		
6	SENSOR FRONT RIGHT OUTPUT	Max current : $I < 2\text{mA}$ External pull up RESISTANCE $:10\text{K}\Omega < R$ Output duty : $50 \pm 20\%$	
18	ABS/EBD W/LAMP DRIVE	Max. current: $I < 200\text{mA}$ Max. output low voltage: $V < 1.2\text{V}$	
34	ESP W/LAMP DRIVE		
35	ESP F/LAMP DRIVE		
27	ESP ON/OFF SWITCH	Input voltage low: $0\text{V} \leq V \leq 3.0\text{V}$ Input voltage High: $7.0\text{V} \leq V \leq 16.0\text{V}$ Max input current: $I < 10\text{mA}$	
22	CAN BUS LINE(LOW)	Max. current : $I < 10\text{mA}$	
7	CAN BUS LINE(HIGH)		
46	SENSOR FRONT LEFT POWER	Output voltage : $\text{IGN}(V) \pm 1\text{V}$ Output current : Max 30mA	
45	SENSOR FRONT RIGHT POWER		
44	SENSOR REAR LEFT POWER		
43	SENSOR REAR RIGHT POWER		
15	SENSOR FRONT LEFT SIGNAL	Input current LOW : $5.9 \sim 8.4 \text{ mA}$ Input current HIGH : $11.8 \sim 16.8 \text{ mA}$ Frequency range : $1 \sim 2000 \text{ Hz}$ Input duty : $50 \pm 20\%$	
30	SENSOR FRONT RIGHT SIGNAL		
14	SENSOR REAR LEFT SIGNAL		
29	SENSOR REAR RIGHT SIGNAL		

ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM**BR -101**

Connector Terminal		Specification	Remark
No	Description		
8	STEERING ANGLE SENSOR PHASE 1	Input duty (ST1, ST2): 50 ±10% Phase difference (ST1, ST2): 2 ± 0.6deg High voltage: 3.0V < V < 4.1V Low voltage: 1.3V < V < 2.0V	
40	STEERING ANGLE SENSOR PHASE 2		
39	STEERING ANGLE SENSOR PHASE N		
12	MASTER PRESSURE SENSOR SIGNAL	Sensor Input Voltage : 0V ≤ V ≤ 5.0V Zero offset Voltage : 0.5V ± 0.15V Input current :Max 2 mA	
9	LATERAL G SENSOR SIGNAL	Sensor Input Voltage :0V ≤ V ≤ 5.0V Zero offset Voltage : 2.5 ± 0.1V	
41	YAW SENSOR SIGNAL	Sensor Input Voltage :0V ≤ V ≤ 5.0V Zero offset Voltage : 2.5 ±0.1V	
19	DIAGNOSIS INPUT/OUTPUT	Input voltage IL(V) < 0.3 IGN (V) IH(V) > 0.7 IGN (V) Output voltage OL(V) < 0.2 IGN (V) OH(V) > 0.8 IGN (V)	
24	SELF TEST	Output Voltage : 0V≤ V≤ 5.0V	

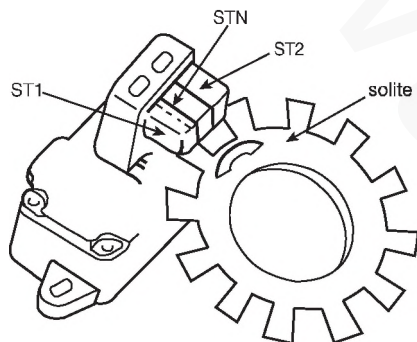
STEERING WHEEL ANGLE SPEED SENSOR

DESCRIPTION E814A7E7

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.

OPERATION

The split of the steering angle sensor detects a steering angle of the steering wheel by a ON/OFF pulse caused by whether or not the LED lights go through the hole of the split, rotating as the steering wheel revolves. There are three LEDs, two(ST1, ST2) for detecting a steering direction, and the other for the neutral position. The HECU calculates the steering angle by the pulse from the steering angle sensor.

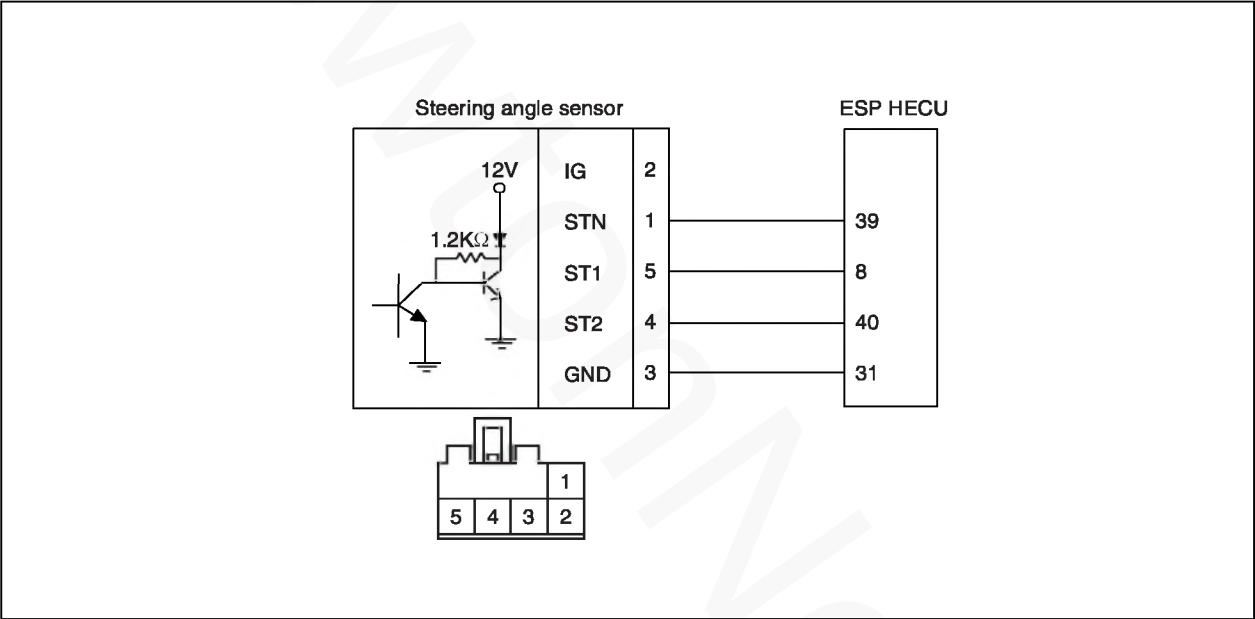


LJIF501S

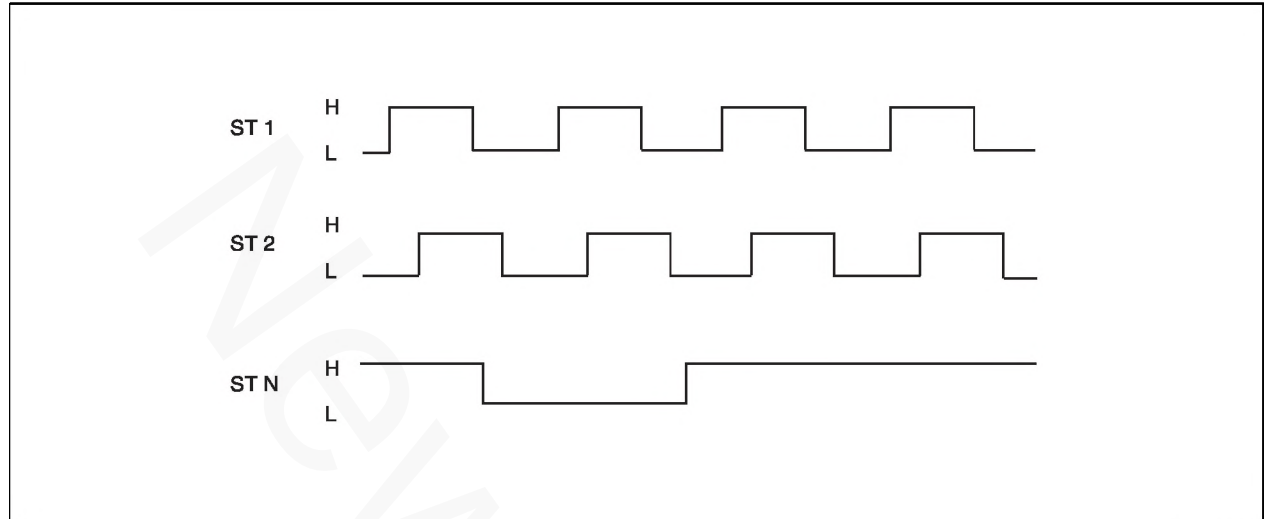
SPECIFICATIONS

Item	Specification
Operating Voltage	9V~16V
Operating temperature	-30°C~75°C
Current consumption	Max. 100mA
Pulse duty	50±10%
Pulse width	8°/1pulse
Voltage(HIGH)	3.0V~4.1V
Voltage(LOW)	1.3V~2.0V
Steering angle velocity	Max 1500°/sec

CIRCUIT DIAGRAM E70F3DBD



OUTPUT CHARACTERISTIC



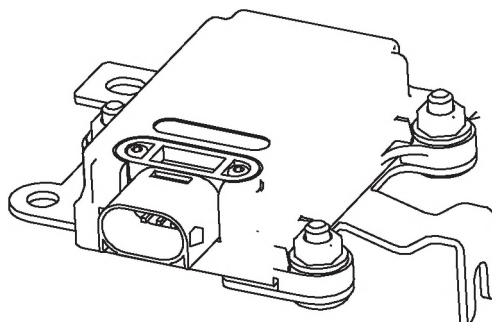
ARCD204A

No.	INPUT		OUTPUT	Steering direction	Remark
1	ST1	L	L	Right	
	ST2	L	H		
	ST1	L	H	Left	
	ST2	L	L		
2	ST1	L	L	Left	
	ST1	H	L		
	ST1	L	H	Right	
	ST2	H	H		
3	ST1	H	H	Left	
	ST2	L	H		
	ST1	H	L	Right	
	ST2	L	L		
4	ST1	H	H	Right	
	ST2	H	L		
	ST1	H	L	Left	
	ST2	H	H		

YAW-RATE SENSOR AND LATERAL G-SENSOR

DESCRIPTION E2FCA6CE

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.

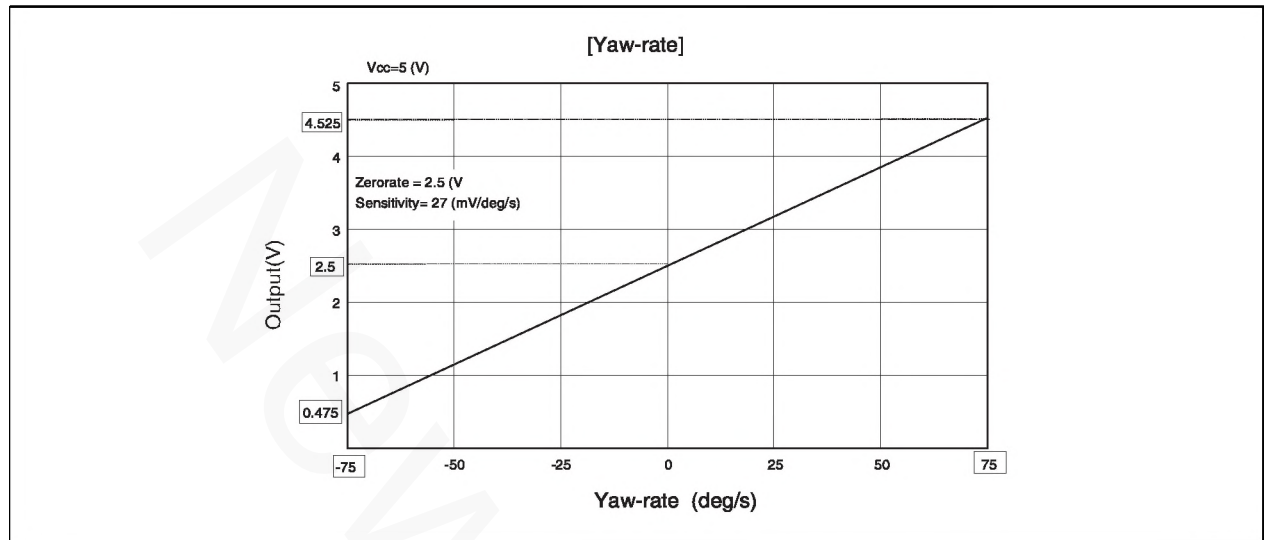


KJOF501H

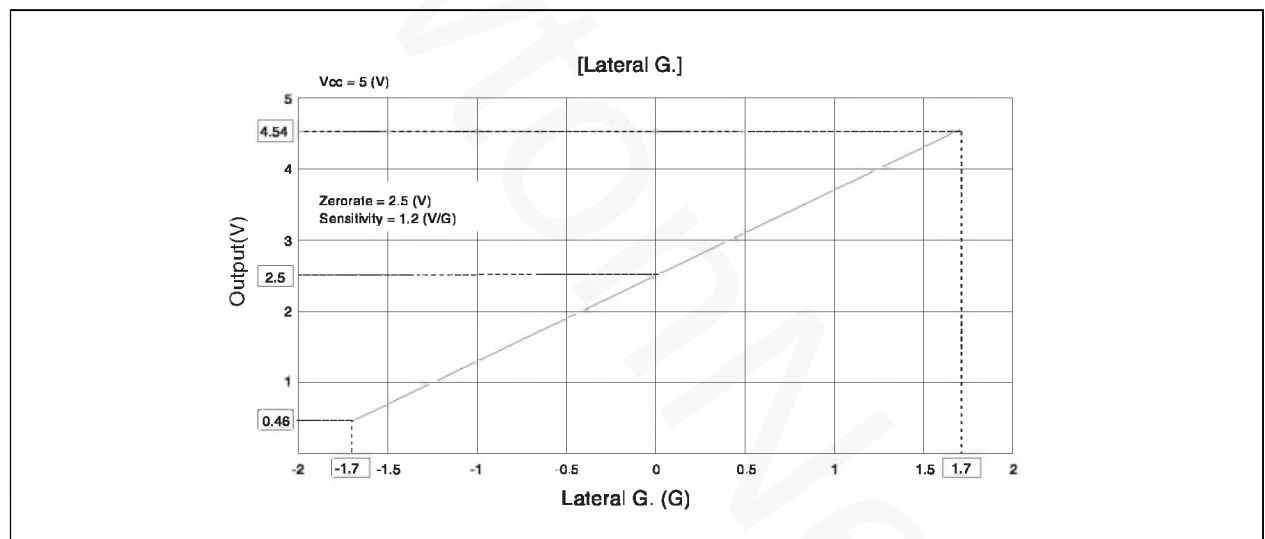
SPECIFICATIONS

ITEM		SPECIFICATION	REMARK
Operating voltage		4.75 ~ 5.25V	
Current consumption		less than 65mA	
Output voltage range		0.5 ~4.5V	
Operating temperature		-40 ~85°C	
Yaw-rate sensor	Measurement range	-75 ~ +75°/sec	
	Output voltage range	0.5 ~ 4.5V	
	Sensitivity	26.67mV(°/sec.)	
	Zero rate output	2.5V	
	Frequency response	18~22Hz	
Lateral G. sensor	Measurement range	-1.5 ~ +1.5g	
	Output voltage range	0.5 ~ 4.5 V	
	Sensitivity	0.136V/g	
	Zero rate output	2.5V	
	Frequency response	50Hz	

OUTPUT CHARACTERISTIC

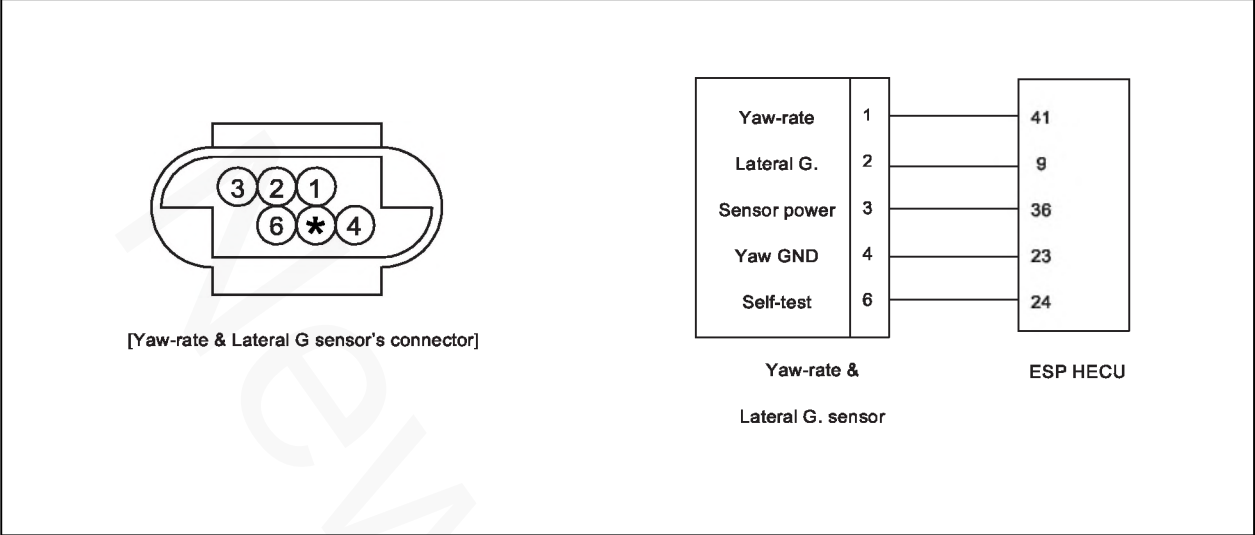


EJQE206A



EJQE206B

EXTERNAL DIAGRAM

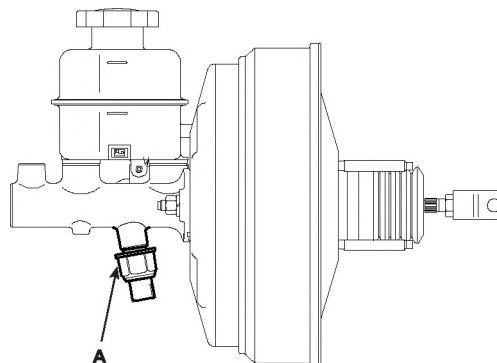


MASTER CYLINDER PRESSURE SENSOR

DESCRIPTION E2E2950C

The pressure sensor(A) is connected to the master cylinder, when ESP is on operation, detecting the brake pressure in order to sense the user's will to brake a vehicle.

The pressure sensor(A) consists of two ceramic discs, one is fixed and the other movable, so that changes the distance of the two discs.
(Max. measurable pressure is 200bar.)

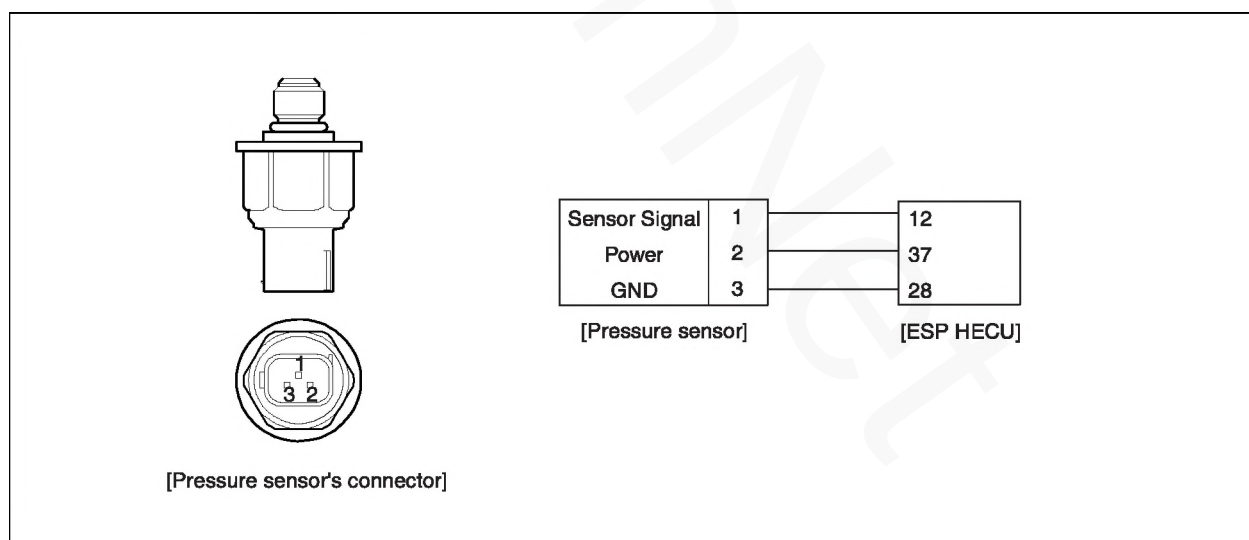


EJOF600L

SPECIFICATIONS

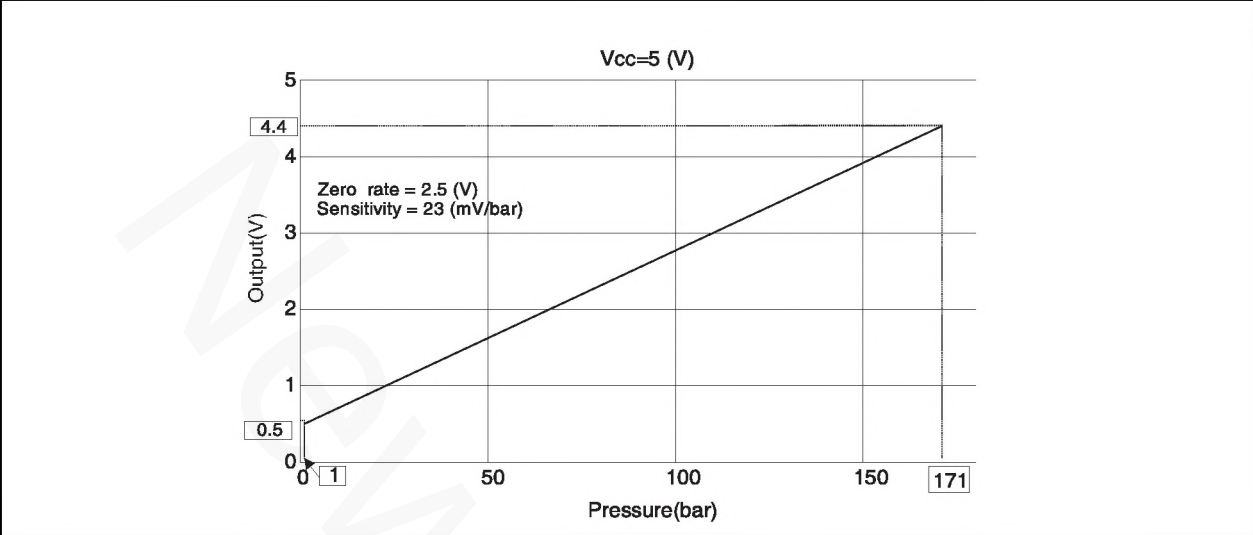
Item	Specification	Remark
Supply voltage	4.75V ~ 5.25V	
Supply current	less than 15mA	
Operating temperature	-40°C ~ 125°C	
Measurement pressure range	0 ~ 200bar	
Max. pressure limit	350bar	
Zero rate output	0.5V	
Output range	0.5 ~ 4.4V	

CIRCUIT DIAGRAM



LJIF502D

OUTPUT CHARACTERISTIC



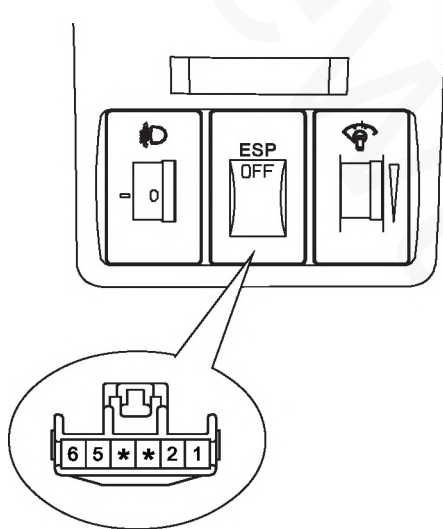
ESP SWITCH

DESCRIPTION E0A70CBF

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 EF9F5308

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



EJOF500X

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

Terminal Function	5	6
ON		

EJOF500Y