Brake System

GENERAL

SPECIFICATIONS EAA87808

Item	Specification
Master cylinder · Type · I.D. mm(in.)(CBS/ABS) · Piston stroke mm(in) · Output port(CBS/ABS) · Fluid level warning sensor	 Tandem type 22.22(0.875) 3.1(1.22) 4port/2port Provided
Proportioning valve · Cut-in pressure(Split point) · Decompression ratio	 15Kgf / ㎠ 0.27:1(2WD) 0.32:1(4WD)
Brake booster · Type · Effective dia. mm(in.) · Boosting ratio	 Vacuum 8+9 in 9:1
Front brake(Disc) · Type · Disc O.D. · Disc I.D. · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D.	 Floating type with ventilated disc 280 mm 172 mm (6.77 in.) 26 mm 11 mm single piston 60 mm (2.36 in.)
Rear brake(Drum) · Type · Drum I.D. · Brake lining thickness · Clearance adjustment	 Leading trailing drum 228.6 mm (9.0 in.) 4.5 mm (0.17 in.) Automatic
Rear brake(Disc) · Type · Disc O.D. (2WD/4WD) · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D	 Floating type with solid disc 262/284 mm (10.31/11.18 in.) 10 mm (0.39 in.) 10 mm (0.39 in.) single piston 34 mm (1.34 in.)
Parking brake · Type · Actuation · Cable arrangement	 V type Mechanical brake acting on rear wheels Lever

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

NOTE

CBS : Conventional Brake System

SPECIFICATION (ABS & TCS)

PART	ITEM		STANDARD VALVE	REMARK
HECU (Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor (MGH-25)	·ABS system: ABS & EBD control ·FTCS system: ABS & EBD control (Both Brake and Engine control)
	Type		Mortor, valve relay intergrated 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: 2.5cc/MCP2.5cc	LPA: Low pressure accumulator
		HPA	0.13cc	HPA:High pressure accumulator
	Valve	Inlet valve(NO)	Front: Ø 0.71mm (0.0280in.) Rear: Ø 0.315mm (0.0124 in.)	NO valve: 4
		Outlet valve(NC)	Front: Ø 0.56mm (0.0220 in.) Rear: Ø 0.355mm (0.0140 in.)	NC valve: 4
	Traction Control valve relief pressure		120bar	With TCS
Warning lamp	Operating voltage		12V	· ABS W/L: ABS failure · Brake W/L: Parking, brake oil, EBD failure · TCS W/L: TCS failure
	Current consumption		80mA	
wheel speed sensor(CBS)	Internal reistance		1385±110Ω	23±5°C
	Output range		15~2000HZ	
	Min.Voltage peak		130mVp.p(15HZ) 200mVp.p(1000HZ)	Max.air gap
	Air gap		0.2~1.3mm (0.0079~0.0512 in.)	
Active wheel speed sensor(ABS)	Supply voltage		DC12V	
	Operating temperature		-40~120°C	
	Output current low		5.9~8.4mA	
	Output current high		11.8~16.8mA	
	Frequency range		1~2000HZ	
	Air gap		0.5~1.5mm (0.019~0.0591in)	

SPECIFICATION (ESP)

PART	ITEM		STANDARD VALVE	REMARK
HECU (Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor (MGC-25)	·ABS system: ABS & EBD control ·FTCS system: ABS & EBD control (Both Brake and Engine control)
	Type		Mortor, 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.)	
	Accumulator capacity	LPA	MCS: 3.0cc/MC3.0cc	LPA: Low pressure accumulator
		HPA	0.13cc	HPA:High pressure accumulator
	Valve	Inlet valve(NO)	Front: Ø 0.71mm (0.0280in.) Rear: Ø 0.315mm (0.0124 in.)	NO valve: 4
		Outlet valve(NC)	Front: Ø 0.56mm (0.0220 in.) Rear: Ø 0.355mm (0.0140 in.)	NC valve: 4
	Traction Control valve relief pressure		120~150bar	With TCS
Warning lamp	Operating voltage		12V	· ABS W/L: ABS failure · Brake W/L: Parking, brake oil, EBD failure · TCS W/L: TCS failure
	Current consumption		80mA	
Active wheel speed sensor	Supply voltage		DC12V	
	Operating temperature		-40~120°C	
	Output current low		5.9~8.4mA	
	Output current high		11.8~16.8mA	
	Frequency range		1~2000HZ	
	Airgap		0.5~1.5mm	
Steering Wheel Angle Sensor	Operating Voltage Current Consumption High output voltage Low output voltage Operating Angular velocity		9V~16V Max 100mA 3.0V~4.1V 1.3V~2.0V Max 1500°/sec	

SERVICE STANDARD

	Standard value	Service limit
Brake pedal height	163mm(0.209in.)	
Brake pedal stroke	128 mm (5.04 in.)	
Brake pedal free play	3~8mm(0.11~0.31in.)	
Brake pedal to floorboard clearance	82mm(3.23in.)	
Stop lamp switch outer case to pedal stopper clearance	0.5~1.0 mm (0.02~0.04 in.)	
Booster push rod to master cylinder piston clearance	0 (at 500 mmHg vacuum)	
Parking brake lever stroke when lever assembly is pulled with 196N (20Kgf, 44lb force)	7~8 clicks	
Front disc brake pad thickness	11 mm (0.43 in.)	2 mm (0.079 in.)
Front disc thickness (minimum)	26 mm (10.24 in.)	24.4 mm (0.961in.)
Front disc runout		Max.0.03 mm (0.001in.)
Front disc parallelism		Max.0.005 mm (0.0002in.)
Rear drum brake lining thickness	4.5 mm (0.177 in.)	1.0 mm (0.039 in.)
Rear drum brake drum I.D.	228.6 mm (9 in.)	Max.230.6mm (9.079 in.)
Rear disc brake pad thickness	10 mm (0.394 in.)	2 mm (0.079 in.)
Rear disc brake disc thickness	10 mm (0.394 in.)	8 mm (0.315 in.)
Rear disc runout		Max.0.03mm (0.001in.)
Rear disc parallelism		Max.0.005 mm (0.0002in.)

TIGHTENING TORQUE

	Nm	Kgf·cm	lbf·ft
Proportioning valve to master cylinder	35~55	350~550	25.8~40.6
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 guide rod bolt	22~32	220~320	16.2~23.6
Caliper pin bolt	35~45	350~450	25.8~33.2
Caliper assembly to knuckle	80~100	800~1000	59.0~73.8
Brake hose to front caliper	25~30	250~300	18.4~22.1
Brake hub flange nut	200~260	2000~2600	147.5~191.8
Push rod locking nut	16~22	160~220	11.8~16.2

CAUTION

Replace self-locking nuts with new one after removal.

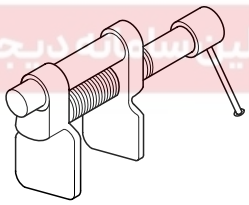
TIGHTENING TORQUE (ABS & TCS)

ITEM	N·m	kgf·cm	lbf·ft
Active wheel speed sensor mounting bold on the brake plate ·Front ·Rear	 8~9 8~9	 80~90 80~90	 5.6~6.6 5.6~6.6
Hydraulic & electronic control unit mounting bolt	8~10	80~100	5.6~6.9
Hydraulic & electronic control unit mounting bolt	17~26	170~260	12~19
Break tubes nut	12~16	120~160	9~12
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 bolt	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 TOOL EE6F8D10

TOOL(Numder and Name)	IIIUSTRATION	USE
09581-11000 Piston expander	 EJDA043A	Spreading the front brake piston

TROUBLESHOOTING EBEFCC25

PROBLEM SYMPTOMS TABLE

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the like cause of the problem. Check each part in order. If necessary, replace these parts

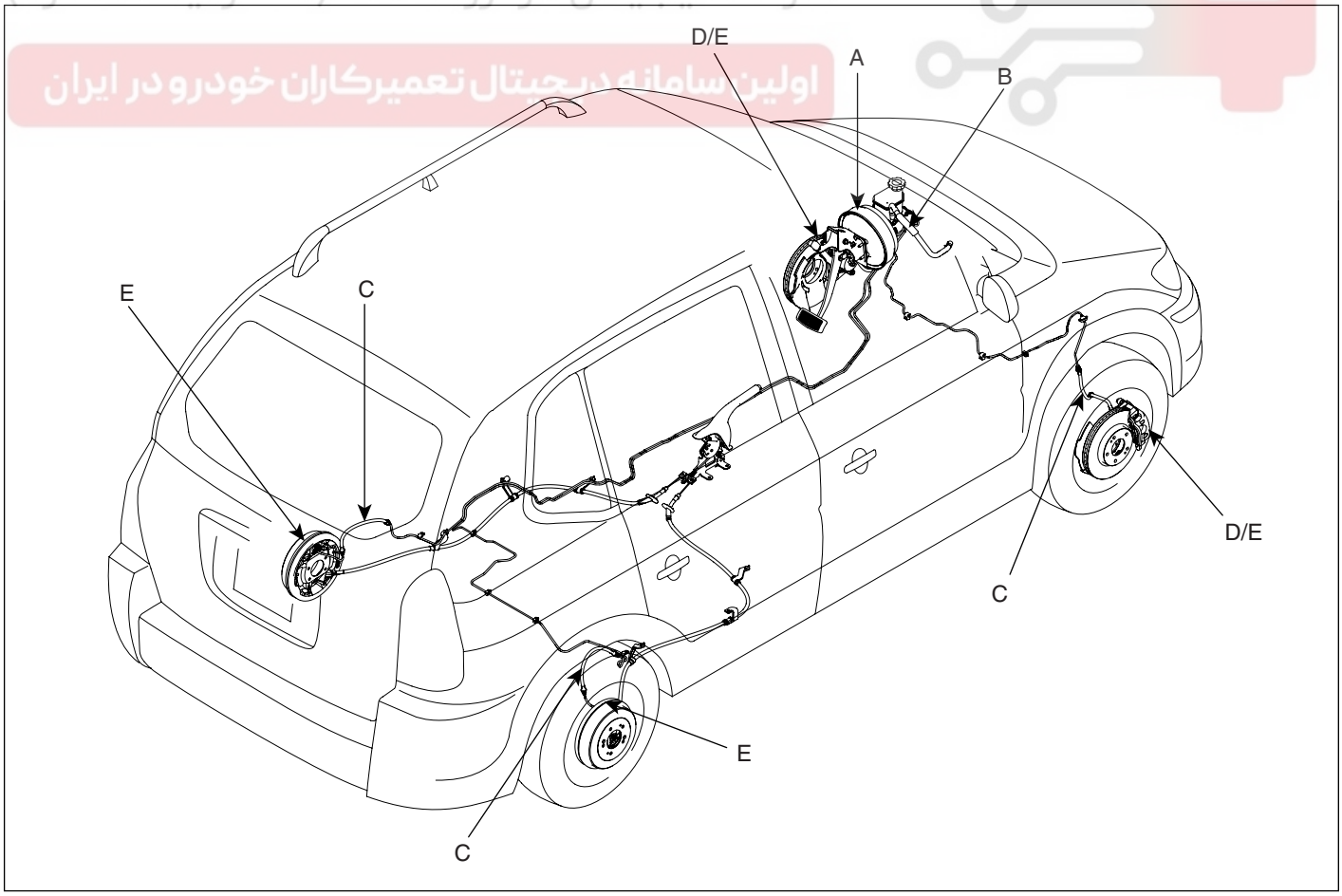
Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance(Out of adjustment) 5. Master cylinder (Faulty)	repair air·bleed relace adjust replace
Brake drag	1. Brake pedal freeplay (Minimal)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

OPERATION AND LEAKAGE

CHECK EDCFBA2B

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.
Wheel cylinder piston cup and dust cover (E)	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, replace the wheel cylinder.



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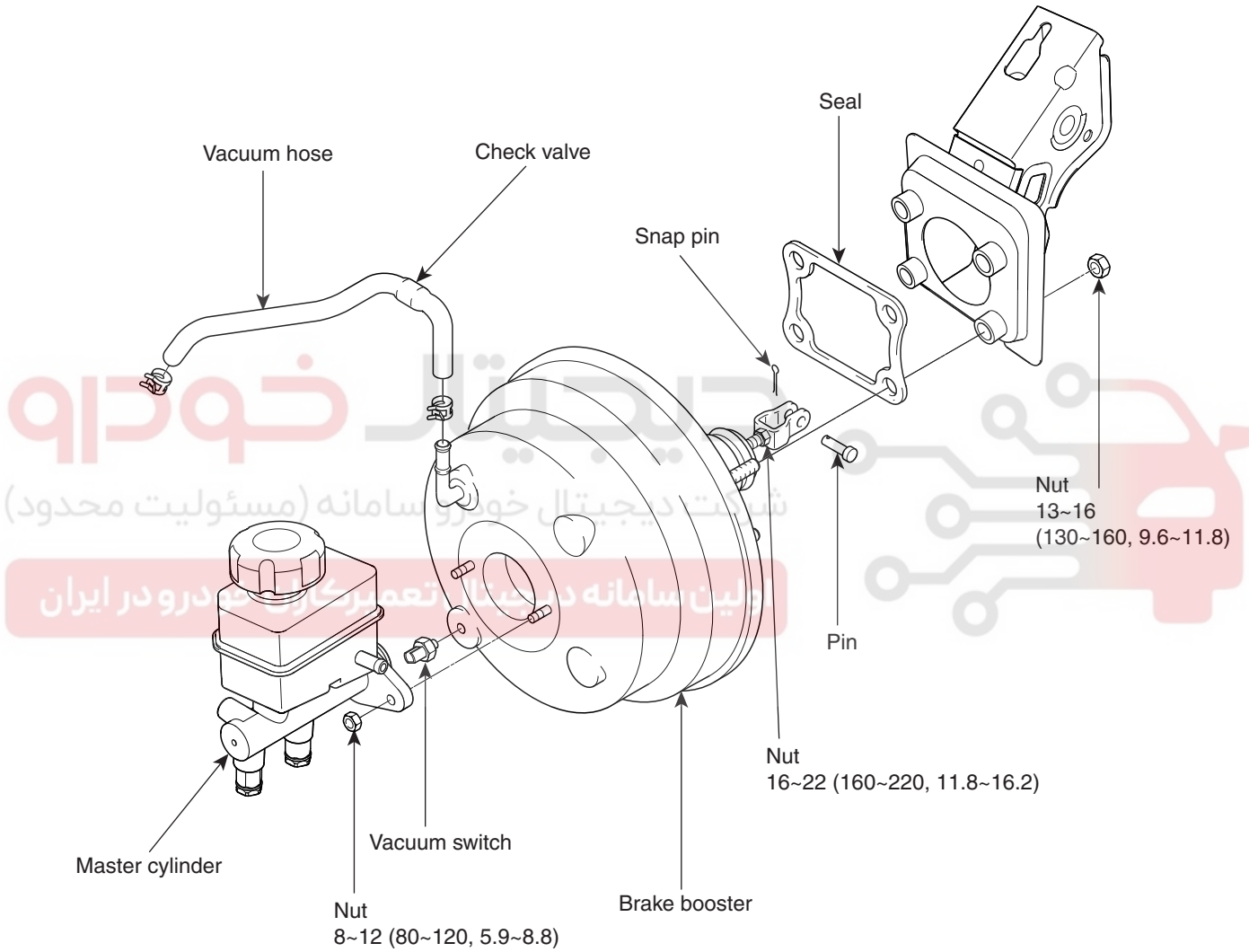
BRAKE SYSTEM

BRAKE BOOSTER

COMPONENTS E2131FB8



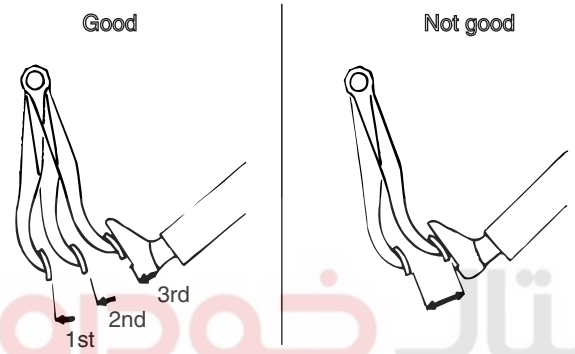
TORQUE: Nm (kgf·cm,lbf·ft)

EJQE010C

BRAKE BOOSTER OPERATING TEST E2EA0EF6

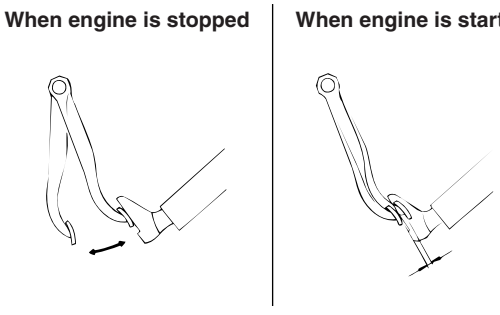
For simple checking of the brake booster operation, carry out the following tests

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



EGGE700A

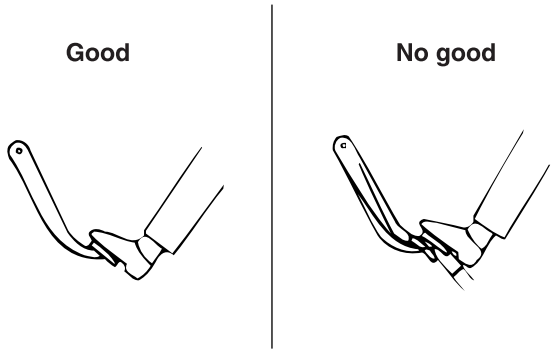
2. With the engine stopped, step on the brake pedal several times.
Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.



EGGB700B

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

If the above three tests are okay, the booster performance can be determined as good.
Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for defect.



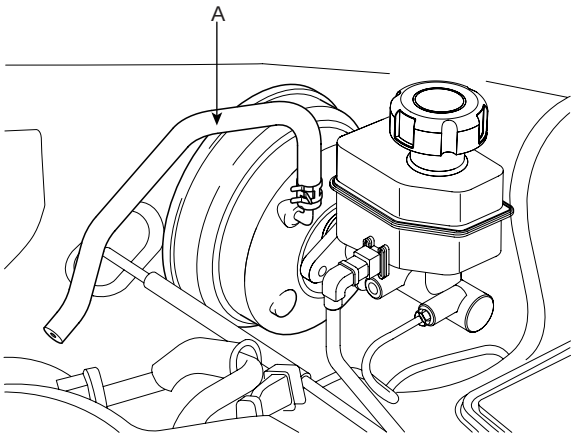
EGGE700C

VACUUM HOSE (CHECK VALVE)

INSPECTION

1. Disconnect the brake booster vacuum hose (check valve built in) (A) at the booster (B).

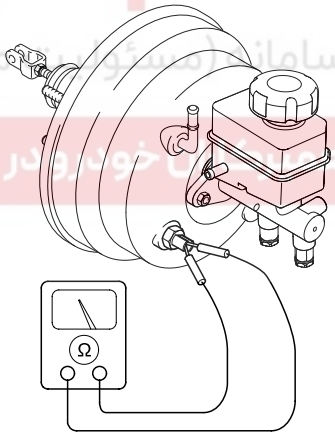
2. Start the engine and let it idle. There should be vacuum available. If no vacuum is available, the check valve is not working properly. Replace the brake booster vacuum hose and check valve and retest.



KJQE050A

VACUUM SWITCH (ONLY DIESEL ENGINE)
For simple checking of the vacuum switch peration, carry out the following tests:

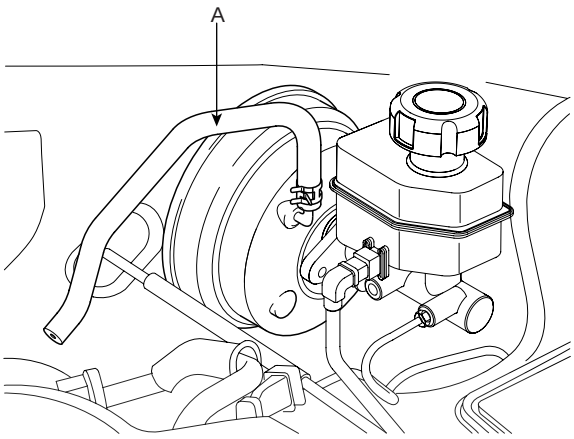
3. Block the tire with a suitable block.
4. Relese the parking brake and check the brake fluid level.
5. With the engine stopped, step on the brake pedal more then 20 times.
6. When IG ON, check whether parking brake pedal waring lamp turn on.
7. If the parking brake waring lamp is not off, stop the engine, and step on the brake pedal more than 20 times.
8. Check the continuity between terminals of the vacuum switch, after disconnenting the connector from the vacuum switch.
9. If there is no continuity, replace vacuun switch.



KJQE750A

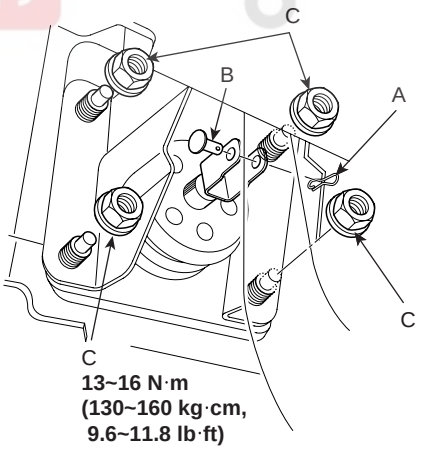
REMOVAL E1570C4B

1. Remove the master cylinder.(Reference to BR- 23)
2. Disconnect the vacuum hose (A) from the brake booster (B).



KJQE050A

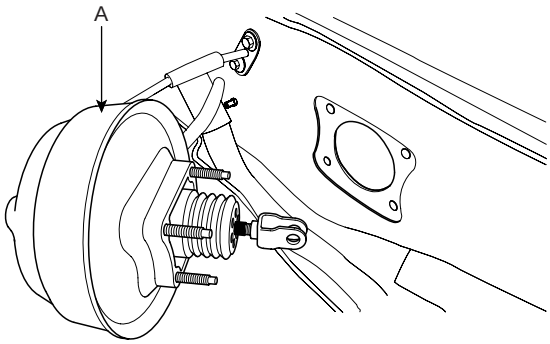
3. Remove the snap pin (A) and pin (B).



EJQE040A

4. Remove the four booster mounting nuts (C).

5. Remove the brake booster (A) from the engine compartment.

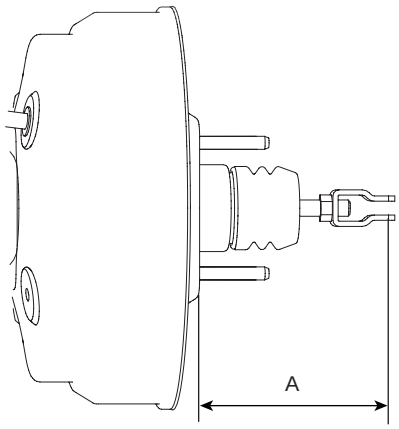


EJKE305D

INSTALLATION E74C7153

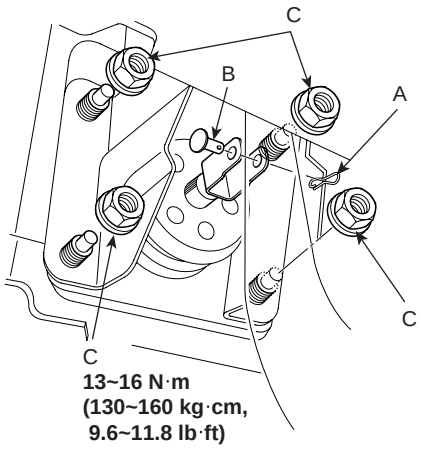
1. Adjust push rod length of the booster, and then install the seal on the booster assembly.

Standard length (A): 106± 0.5 mm (4.173 ± 0.019 in.)



KJQE050C

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



EJQE040A

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

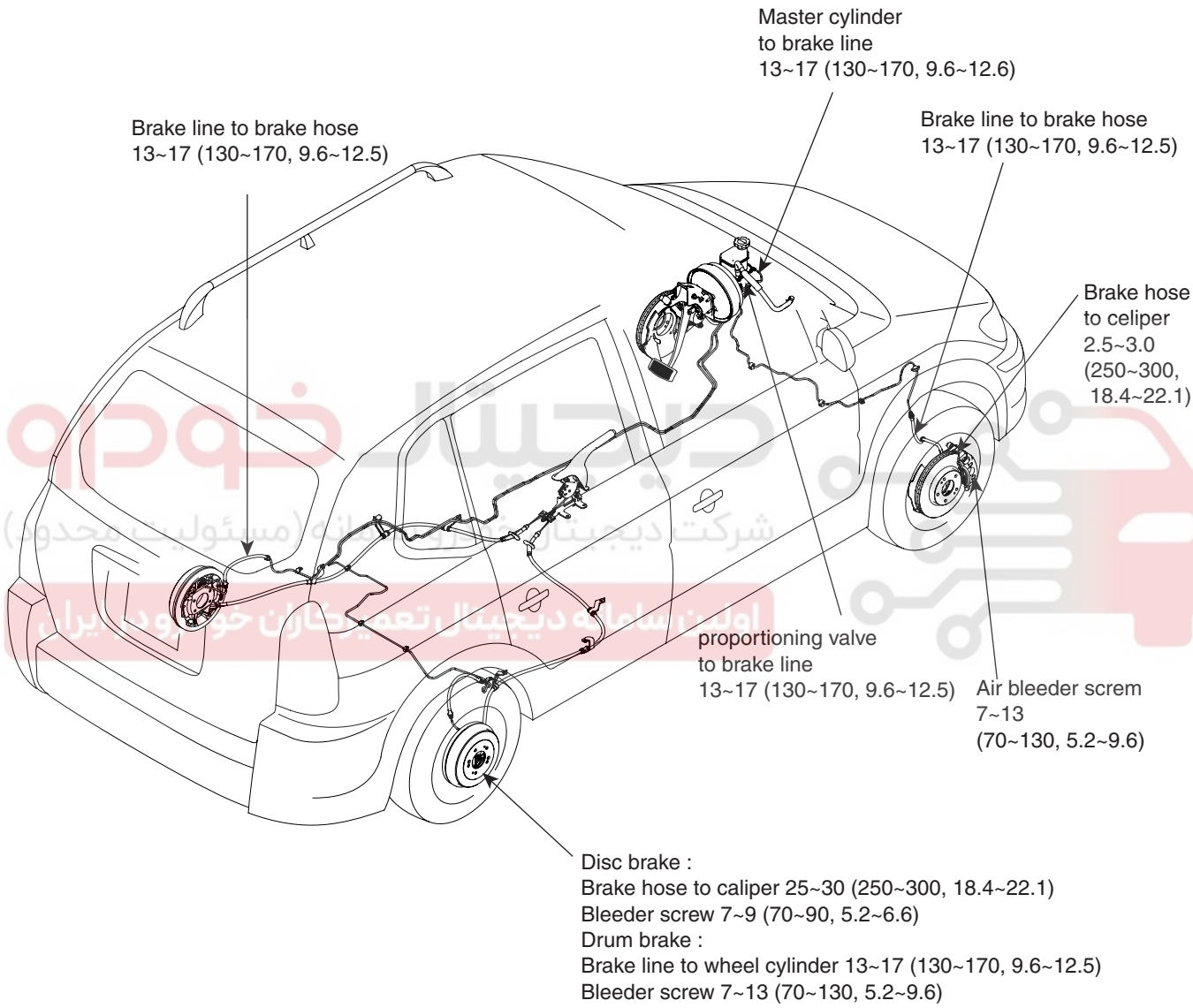
CAUTION

Greaee the pin before installing the snap pin. When installing the snap pin, it must be used new one.

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

BRAKE LINE

COMPONENT EAFA885D



TORQUE : Nm (kgf·cm, lbf·ft)

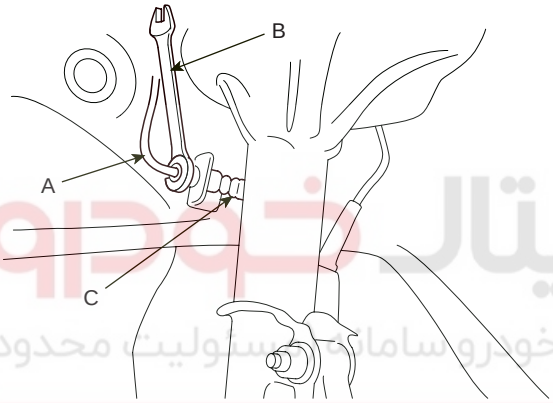
EJQE030C

INSPECTION E4BDB66D

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

REMOVAL E93DE4EF

1. Disconnect the brake hose(C) from the brake line(A) using a 10mm flare-nut wrench(B).

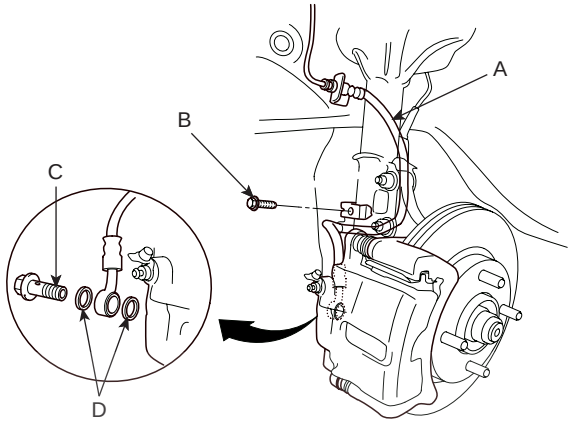


EJKE050A

2. Remove the brake house clip(A) from the brake(B).
3. Remove the connector bolt (C), and disconnect the brake hose from the caliper.

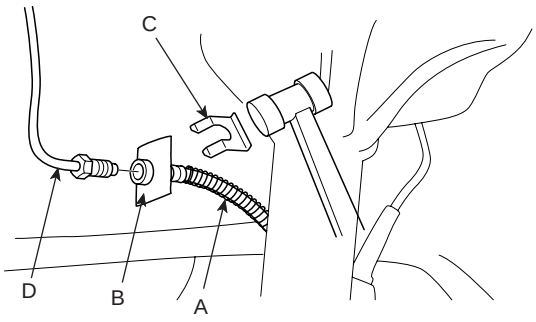
INSTALLATION ED22CAE0

1. 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).



EJKE050C

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



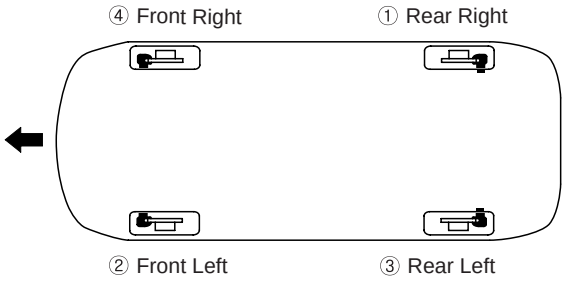
EJKE050D

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

BRAKE SYSTEM BLEEDING E20E2F86

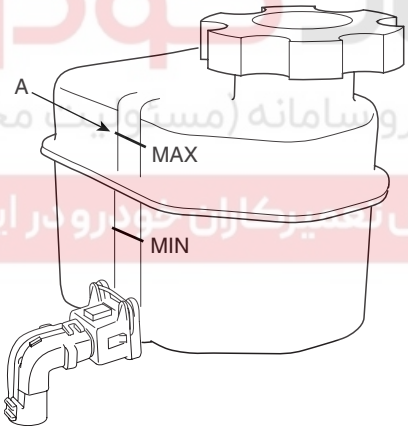
NOTE

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



EJKE003B

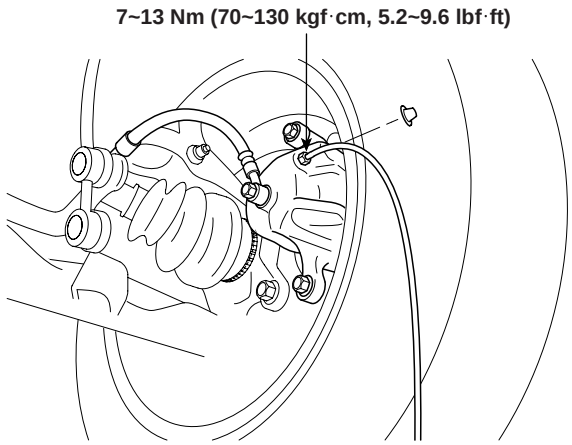
1. Make sure the brake fluid in the reservoir is at the MAX (upper) level line (A).



EJQE003A

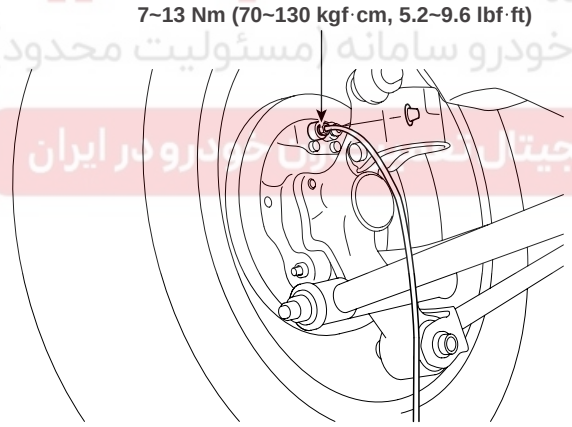
2. Have someone slowly pump the brake pedal several times, then apply pressure.
3. Lossen the right-rear brake bleed screw to allow air to escape from the system. Then tighen the bleed screw securely.
4. Repeat the procedure for wheel in the sequence shown below unit air bubbles no longer appear in the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

FRONT DISK BRAKE



EJKE003C

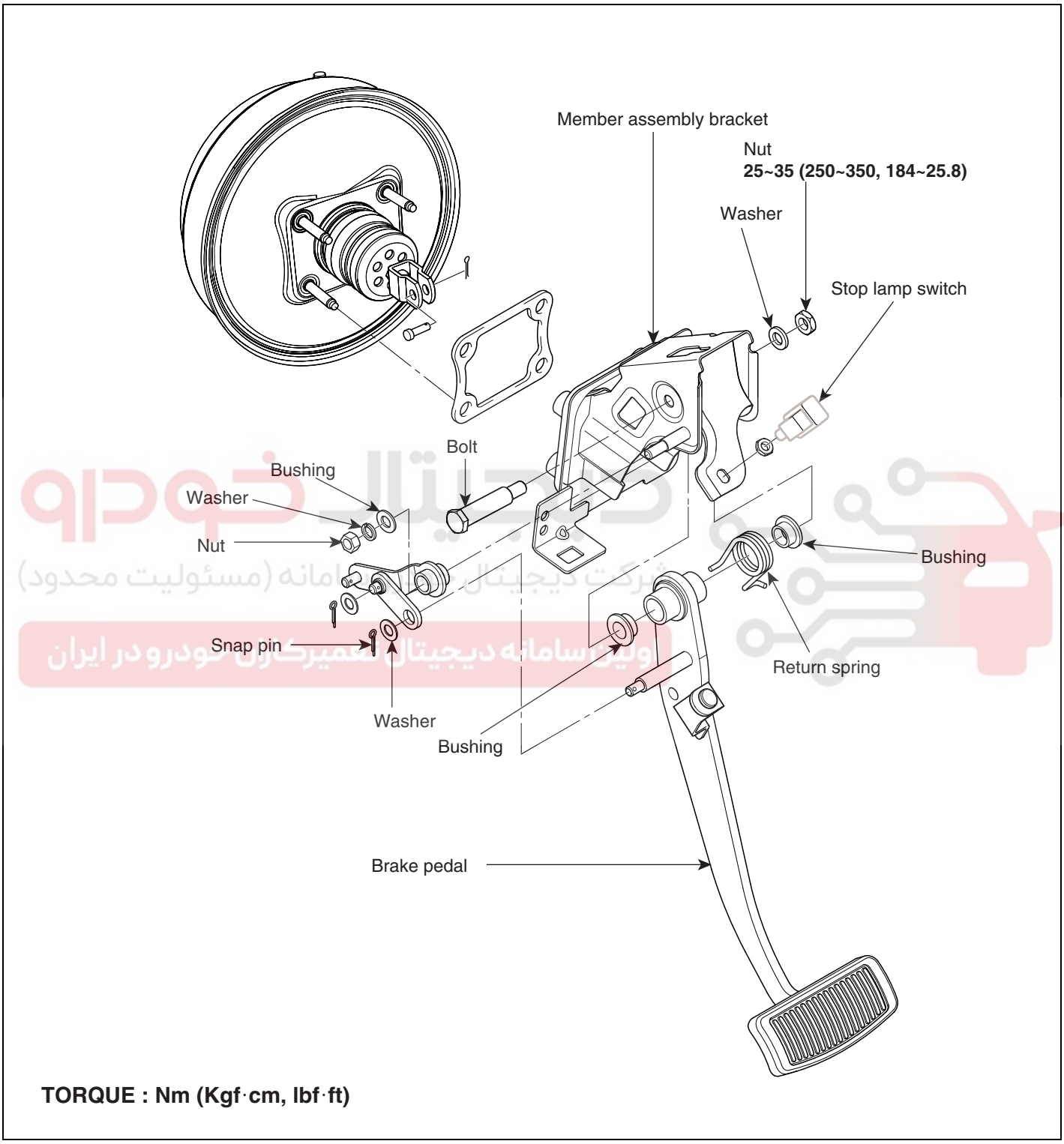
REAR DRUM BRAKE



EJKE003E

BRAKE PEDAL

COMPONENTS EE3ADDF5



TORQUE : Nm (Kgf·cm, lbf·ft)

EJQE010B

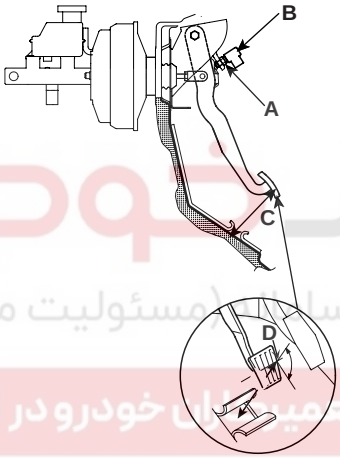
BRAKE PEDAL BRAKE SWITCH ADJUSTMENT EBCA1C90

PEDAL HEIGHT

1. Disconnect the brake swithch connector, loosen the brake switch locknut (A), and bake off the brake switch (B) unil it is no longer touching the brake pedal.

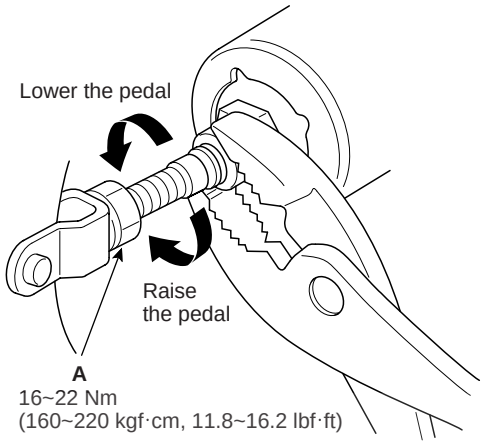
2. Life up the carpet. At the insulator cutout, measure the pedal heigh (C) from the middle of the lefe-side center of the pedal pad (D).

Standard pedal height(with carpet removed): 163mm(6.41 in.)



EJKE001A

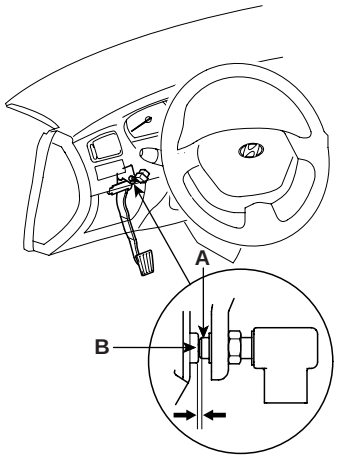
3. Loosen the pushrod locknut (A), and screw the pushrod in or out with pliers until the standard pedal height from the floor is reached. After adjustment, tighten the locknut firmly. Do not adjust the pedal height with the pushrod depressed.



EJKE001B

BRAKE SWITCH CLEARANCE

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

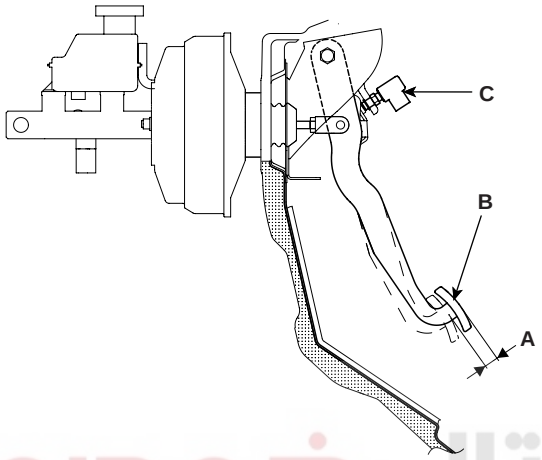


EJKE001C

PEDAL FREE PLAY

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

Free play: 3~8mm (0.11~0.31 in.)

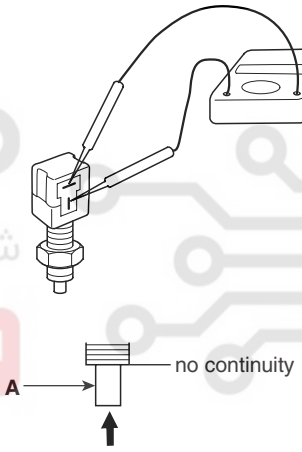


EJKE001D

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

INSPECTION EEC8E00A

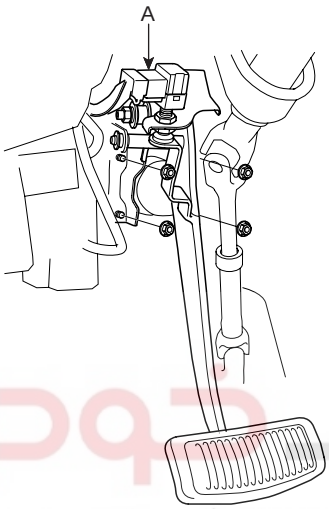
1. Check the blushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch
   1) Connect a circuit tester to the connector (1-2terminals) of stop lamp switch, and check whether or not there is continuity when the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



EJQE020D

REMOVAL E184FFA4

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



KJQE010A

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

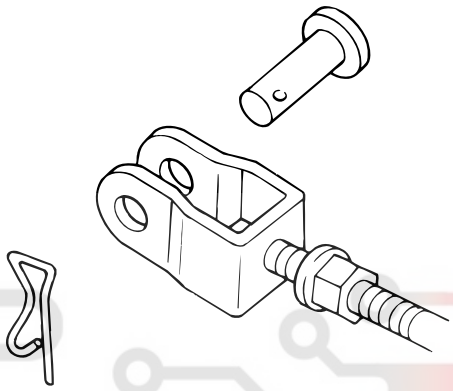
INSTALLATION ED1826A3

1. Installation is the reverse of removal.

CAUTION

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

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



EJQE008R

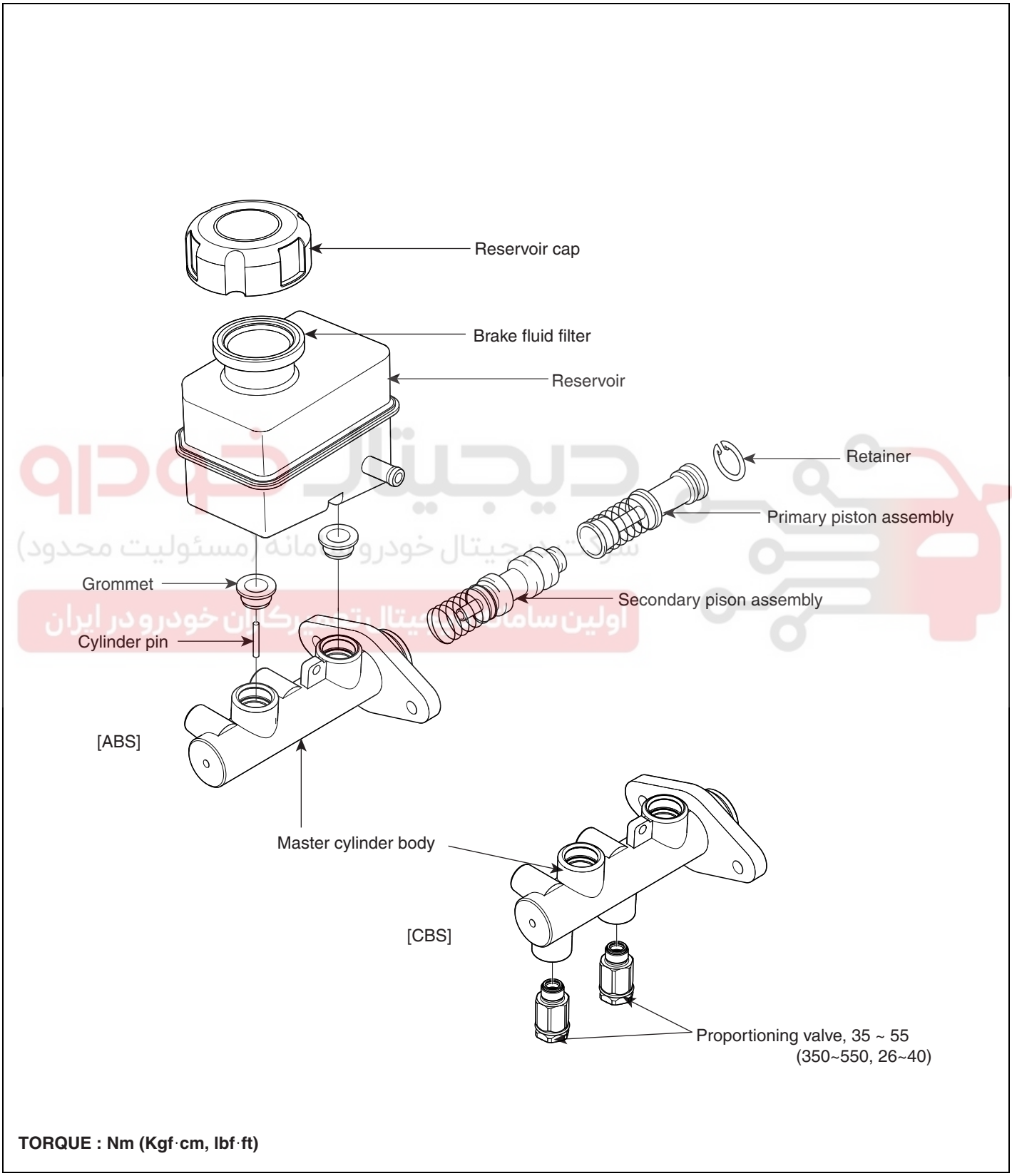
3. Install the nuts with speacified torque, when installing the brake pedal.

TORQUE Nm(kgf·cm,lbf·ft); 13~16(1.3~1.6, 9.6~11.8)

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

MASTER CYLINDER

COMPONENTS EA28ECBE



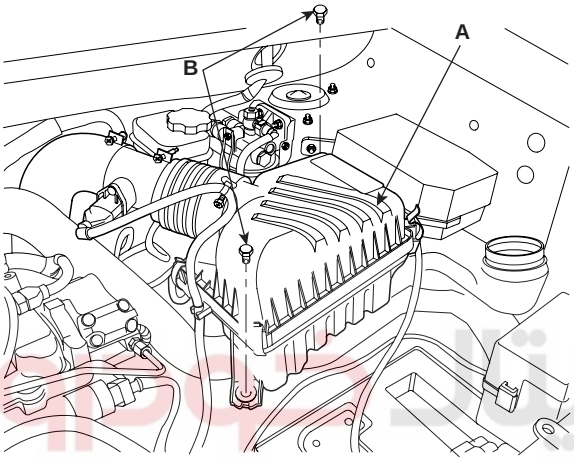
TORQUE : Nm (Kgf·cm, lbf·ft)

EJQE050D

REMOVAL E61DC1B8

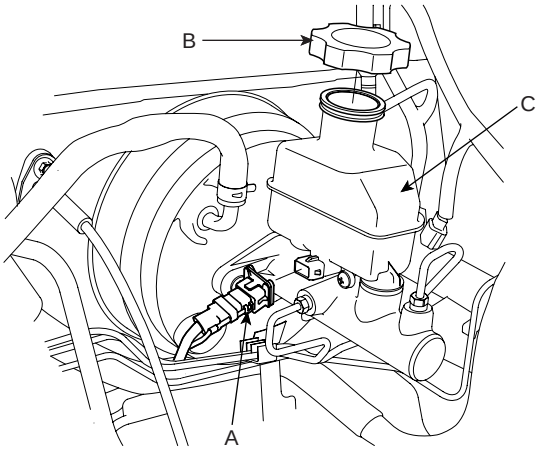
> **NOTE**
>
> *Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.*

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



KJQE050M

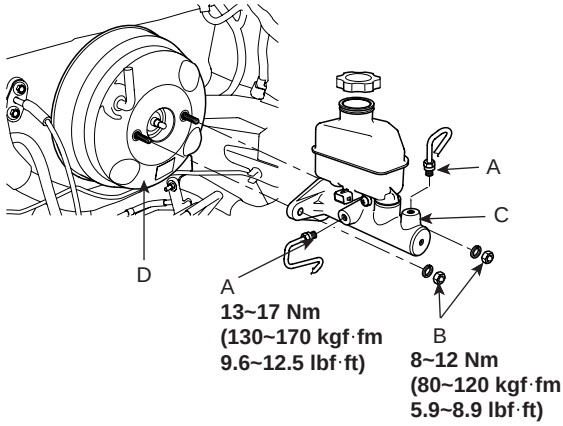
2. Disconnect the brake fluid level switch connectors (A), and remove the reservoir cap (B).



EJKE200F

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

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



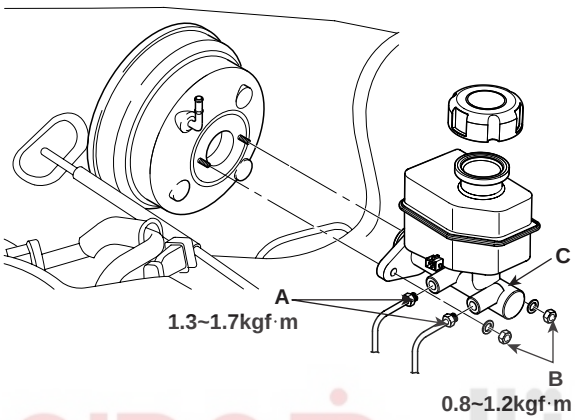
EJKE200C

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

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

INSTALLATION EBF0383C

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

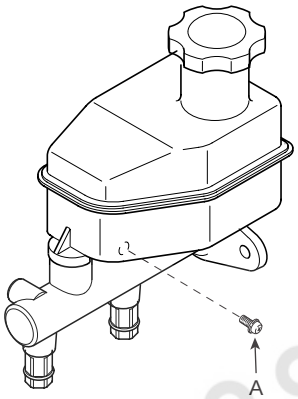


KJQE050F

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

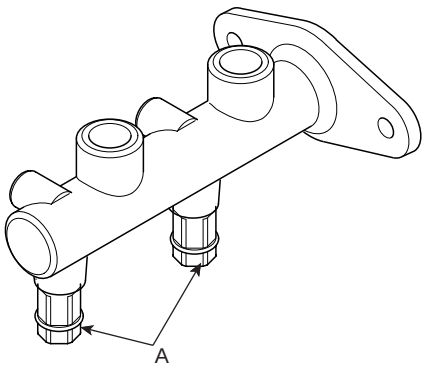
DISASSEMBLY E7B3ED3C

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



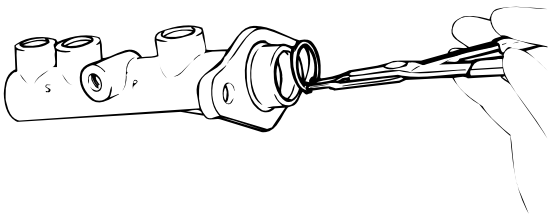
EGGE700D

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



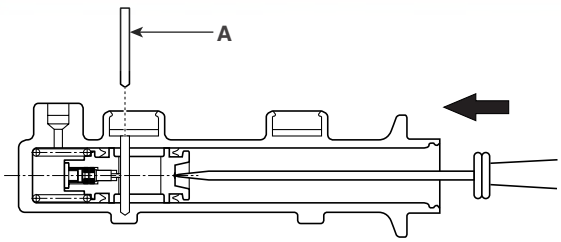
EGGE700E

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



EJA9009C

6. Remove the pin with the secondary piston pushed completely using a screwdriver. Remove the secondary piston assembly.-ABS/TCS/ESP



KJQE014B

NOTE

Do not disassemble the primary and secondary piston assembly.

INSPECTION E2C4BCCF

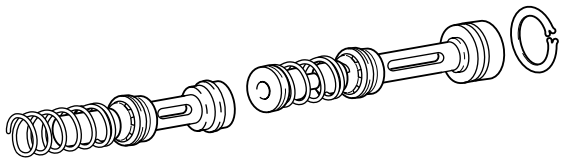
1. Check the master cylinder bore for rust or scratch.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.

CAUTION

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

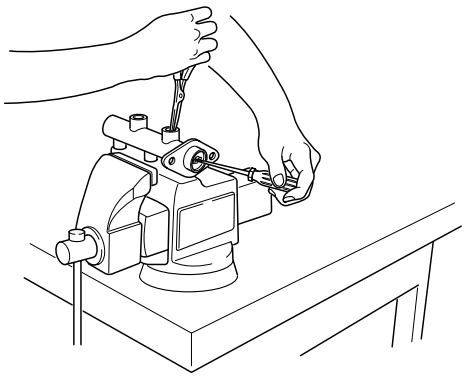
REASSEMBLY E4F41A45

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
2. Carefully insert the springs and pistons in the proper direction.



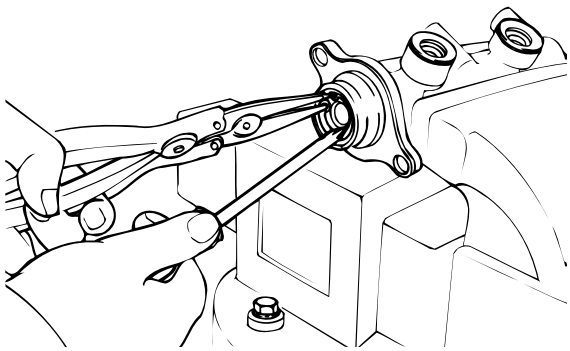
KFW8016A

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



EGGE700F

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



EGGE700G

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

Tightening torque : 1.5~3.0 N·m(15~30kg·cm, 1.2~2.1 lbf·ft)

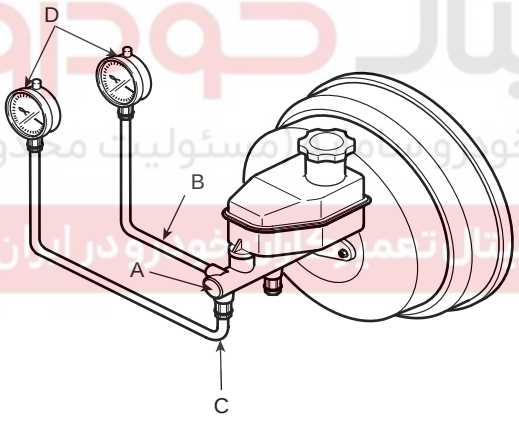
PROPORTIONING VALVE

DESCRIPTION EA7EAFD2

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

INSPECTION ED0B3DD0

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

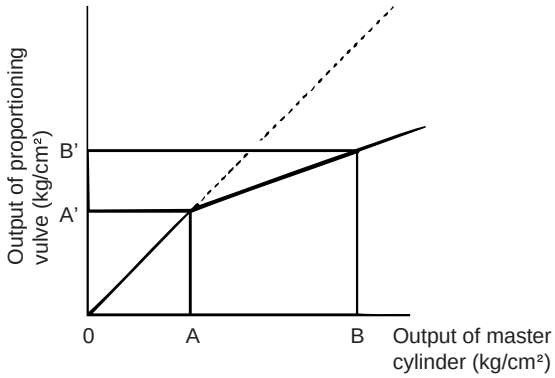


EGGE700H

NOTE

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

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



EGGE700I

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

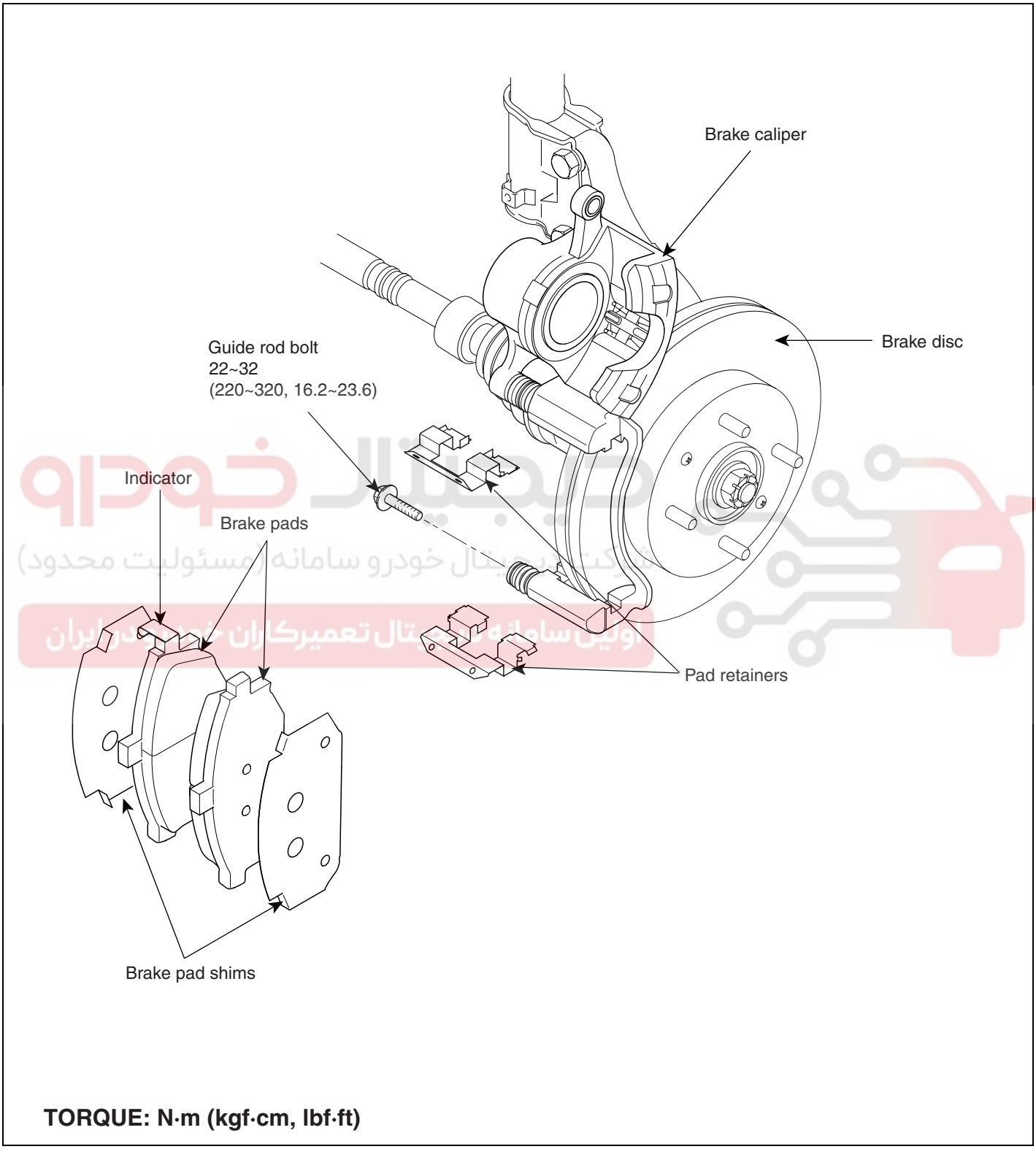
NOTE

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

Front (Output of master cylinder)	Rear (Output of proportioning valve)
A : 26 kg/cm² (2.55MPa, 370psi)	A' : 26 kg/cm² (2.55MPa, 370psi)
B : 80 kg/cm² (7.84MPa, 1137psi)	B' : 40.6 ± 3 kg/cm² (3.98 ± 0.3MPa, 577 ± 42psi)

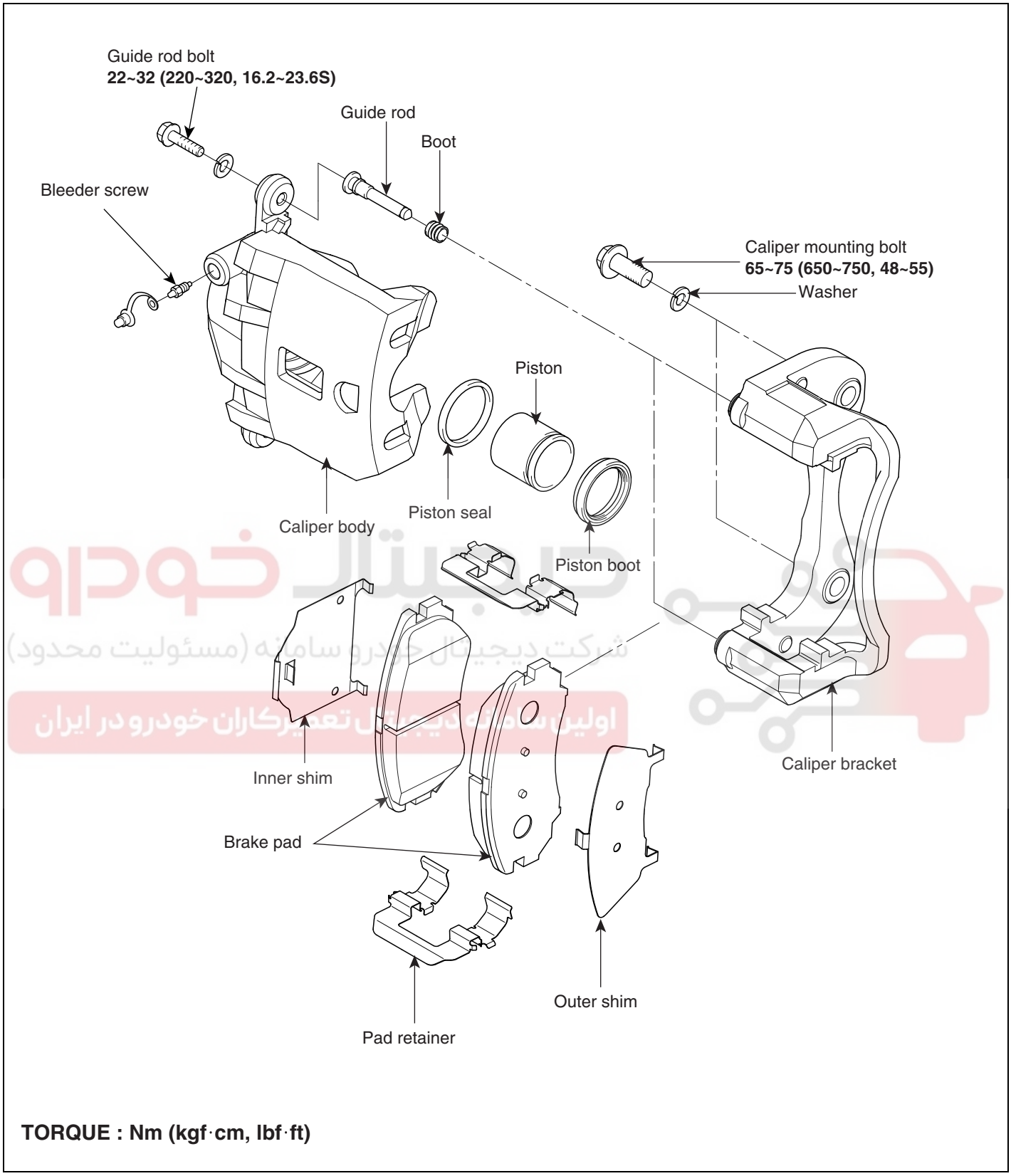
FRONT DISC BRAKE

COMPONENTS EAABFC65



TORQUE: N·m (kgf·cm, lbf·ft)

EJKE401A



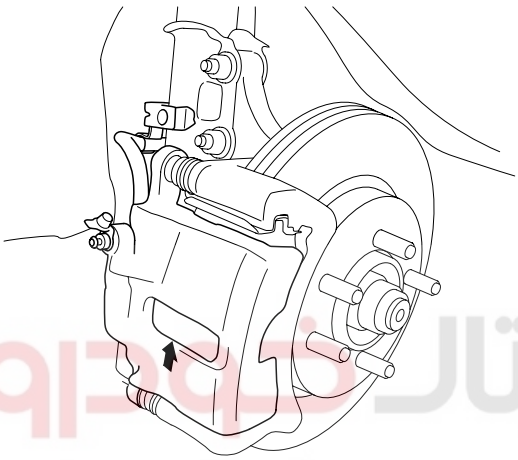
TORQUE : Nm (kgf·cm, lbf·ft)

EJQE050G

INSPECTION OF FRONT DISC BRAKE PAD EEA9517D

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

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



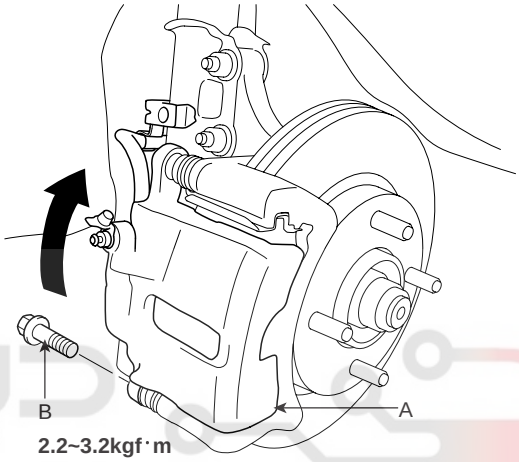
KJQE050H

CAUTION

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

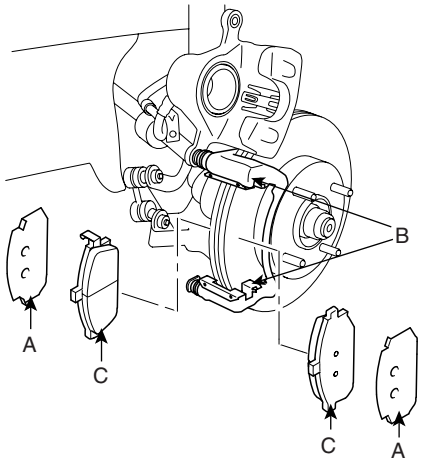
REMOVAL E9567F79

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 two guide rod bolt (B) and support the caliper assembly with a piece of wire so that it does not hang from the brake hose.



KJQE050J

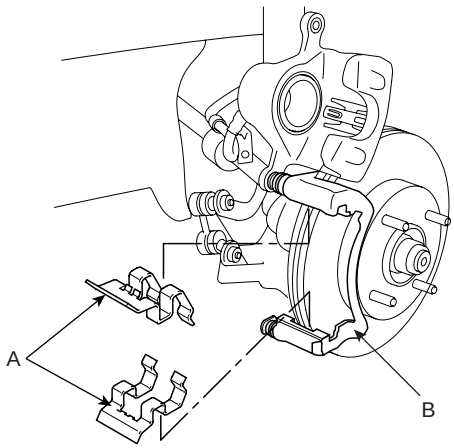
4. Remove the pad shims (A), pad retainers(B), and pads (C).



EJKE400B

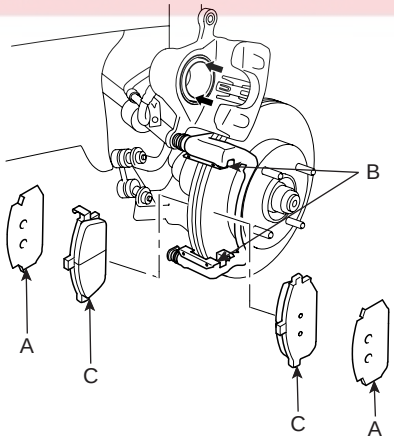
INSTALLATION E7AE7D81

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



KJQE400D

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

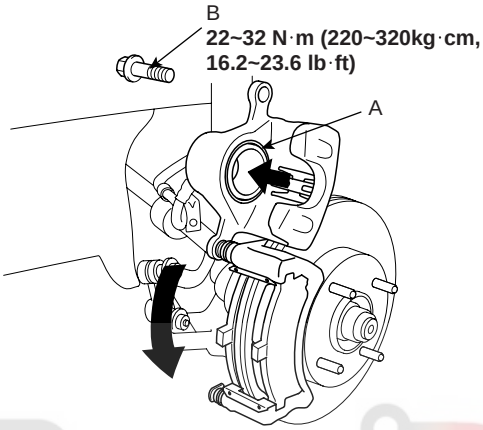


EGGE700J

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

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

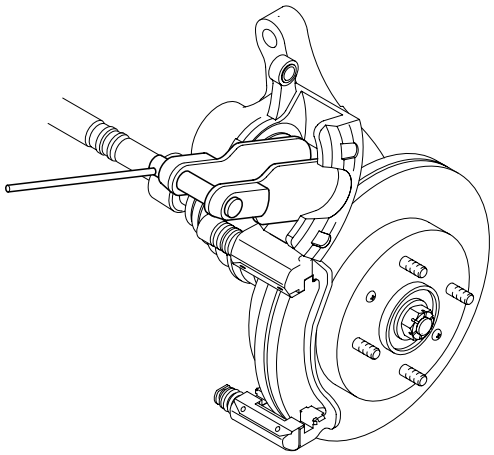
5. Pivot the caliper down into position. Being careful not to damage the pin boot, install the guide rod bolt (B) and torque it to proper specification.



EGGE700K

NOTE

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



EGGE700L

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

NOTE

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

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

INSPECTION E227B3F6

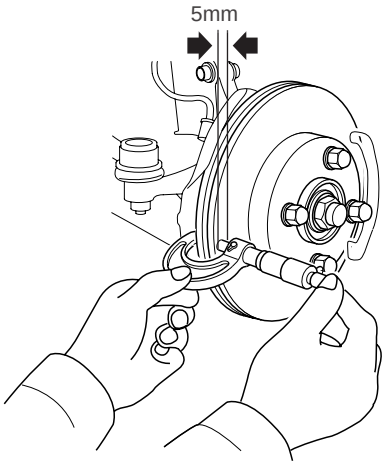
FRONT BRAKE DISC THICKNESS CHECK

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

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

2. Thickness variation should not exceed 0.005mm (0.0004 in.) (circumference) and 0.01mm (in.)(radius) at any directions.

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

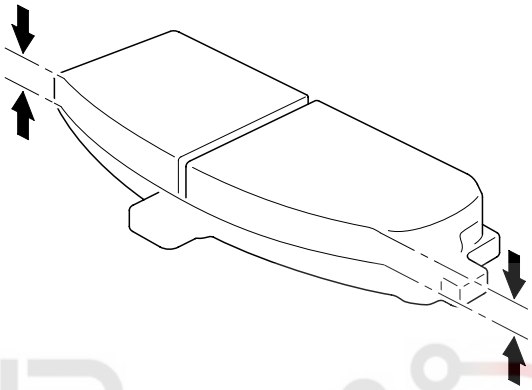


KJQE100D

FRONT BRAKE PAD CHECK

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

Pad thickness
Standard value : 9.0 mm (0.35 in.)
Service limit : 2.0 mm (0.0787 in.)



KJQE088A

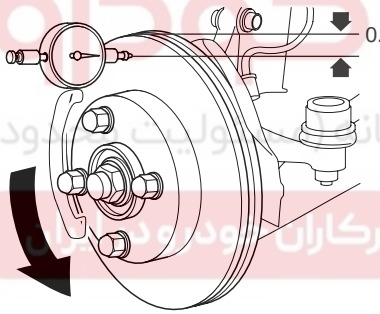
2. Check that grease is applied, and the pad and backing metal for damage.

FRONT BRAKE DISC RUN OUT CHECK

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

Brake disc run out
Limit : 0.03 mm (0.0012 in.) or less

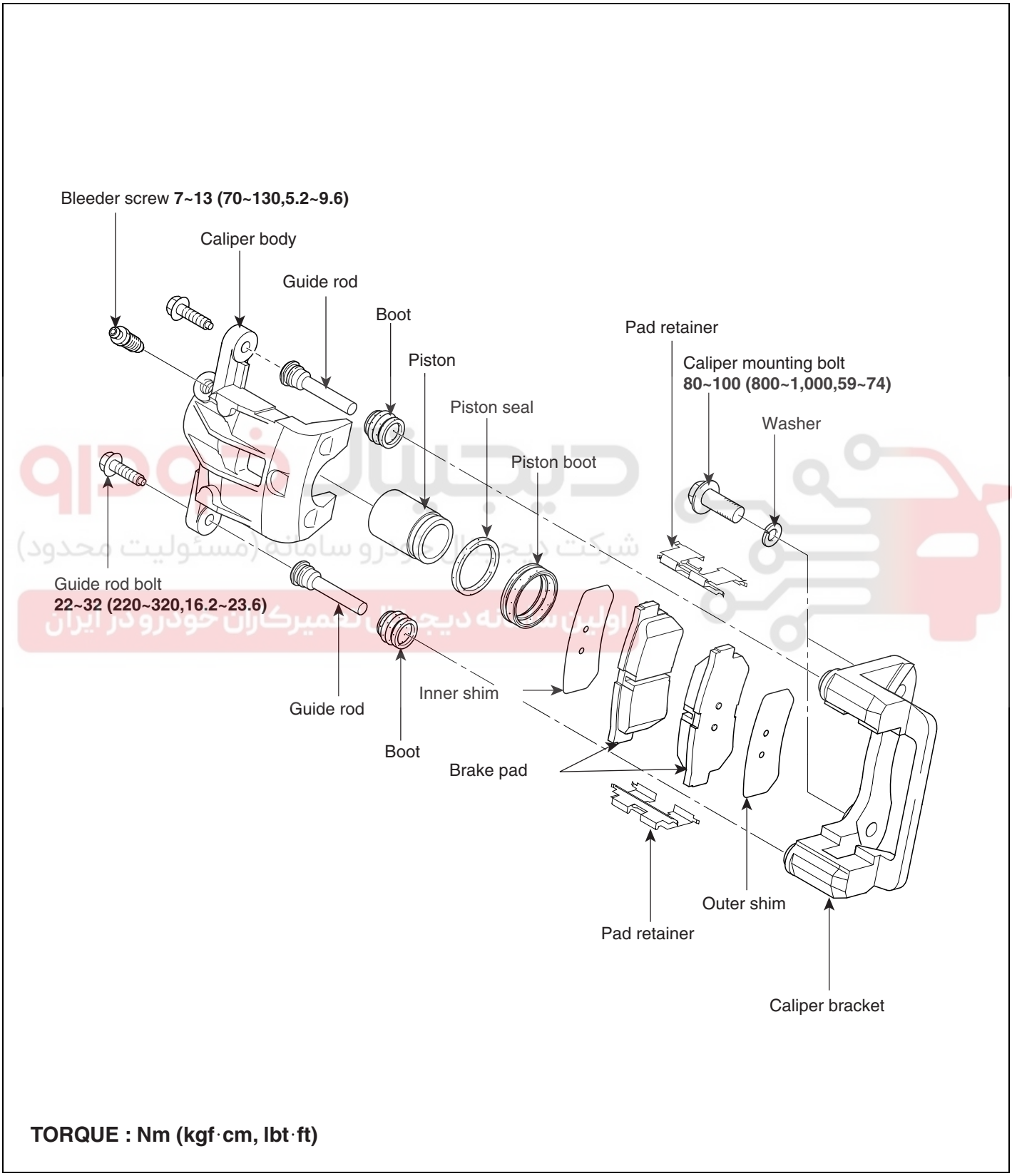
2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot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



EJQE100C

REAR DISC BRAKE

COMPONENTS EFDF3C70



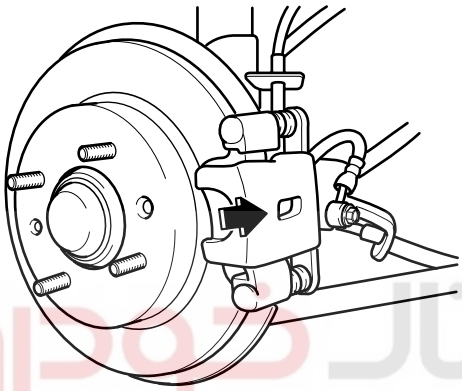
TORQUE : Nm (kgf·cm, lbt·ft)

EJQE050K

INSPECTION OF REAR DISC BRAKE PAD ED4BBAF6

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

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



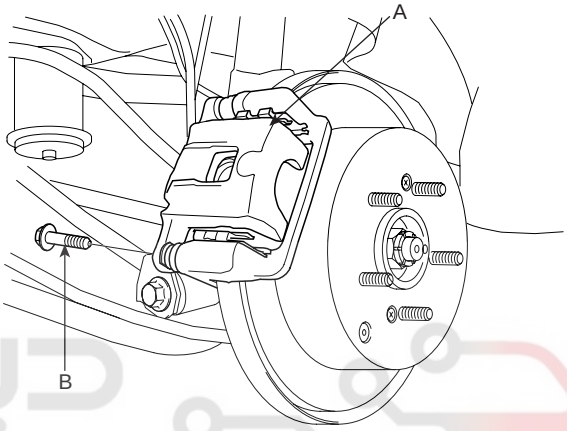
EGGE700M

CAUTION

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

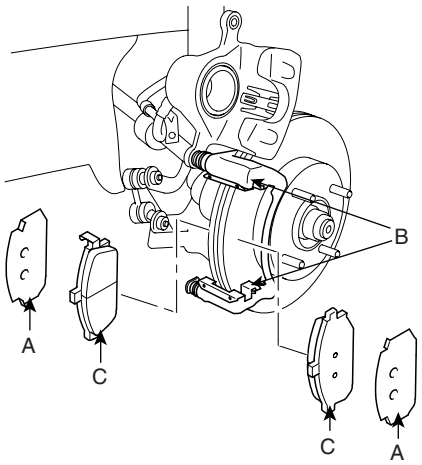
REMOVAL E96659F5

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 two guide rod bolt (B) and support the caliper assembly with a piece of wire so that it does not hang from the brake hose.



KJQE100B

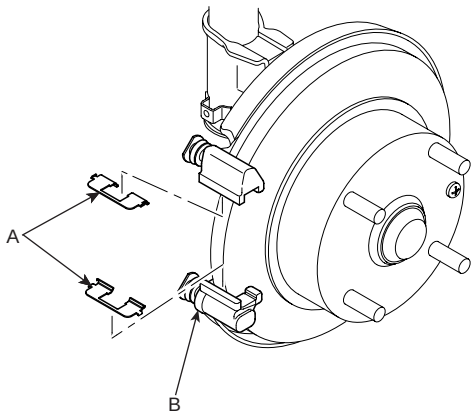
4. Remove the pad shims (A), pad retainers(B), and pads (C).



EJKE400B

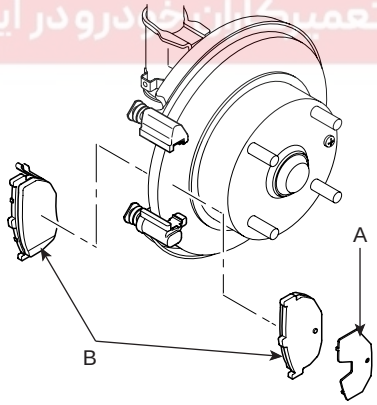
INSTALLATION E4E6AD00

1. Install the pad springs(A) to the carrier(B).



EGGE700N

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

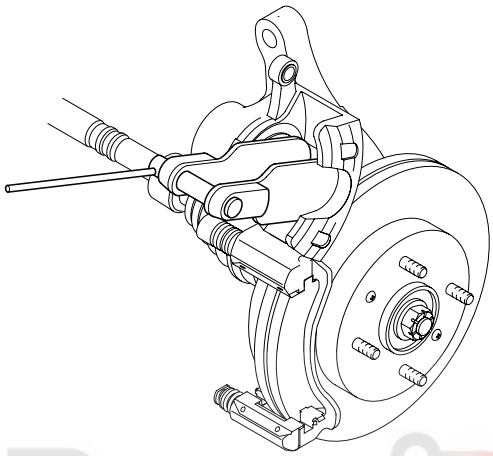


EGGE700O

3. Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.

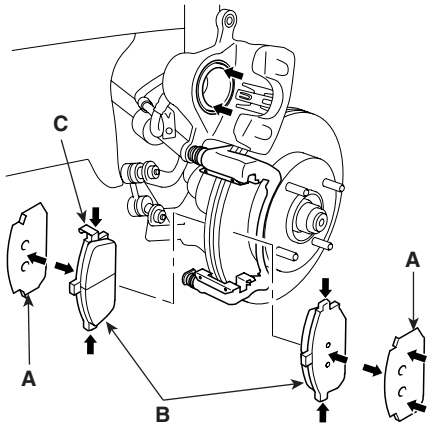
NOTE

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



EGGE700L

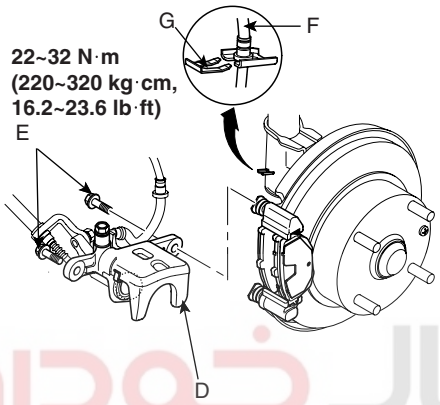
4. Install the brake pads (B) and pad shim (A) on the capliper braket.
Install the inner pad with its wear indicator (C) facing down ward.
If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momtary loss of braking efficiency.



ARJE501N

5. Rotate the caliper piston clockwise into the cylinder, the align the cutout in the piston with the tab 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.

6. Install the brake caliper (D).



EGGE700Q

7. Install and torque the guide rods (E) to proper specification.

8. Install the brake hose (F) onto the suspension arm with the brake hose clip (G).

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

10. 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 E07C730A

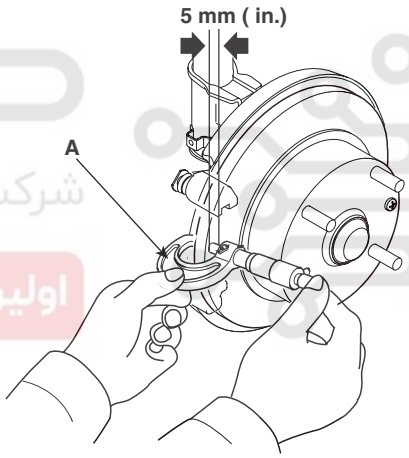
REAR BRAKE DISC THICKNESS CHECK

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

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

2. Thickness variation should not exceed 0.005mm(0.0002 in.) (circumference) and 0.01mm(0.0020 in.) (radius) at any directions.

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

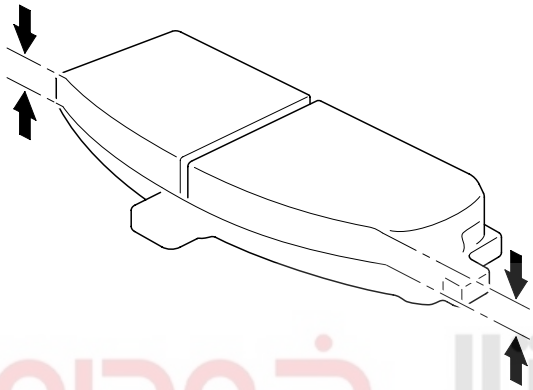


KJQE100F

REAR BRAKE PAD CHECK

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

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



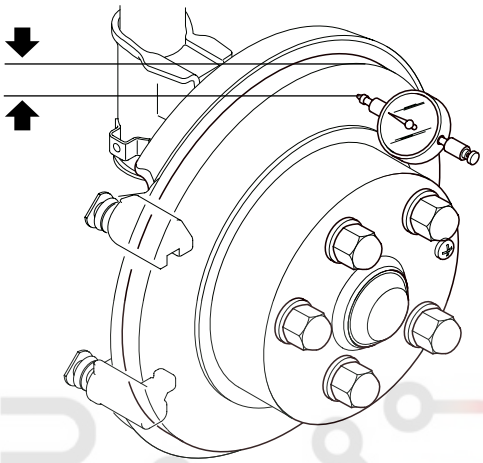
KJQE088A

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

REAR BRAKE DISC RUN OUT CHECK

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

Brake disc run out
Limit : 0.03 mm (0.0012 in.) or less

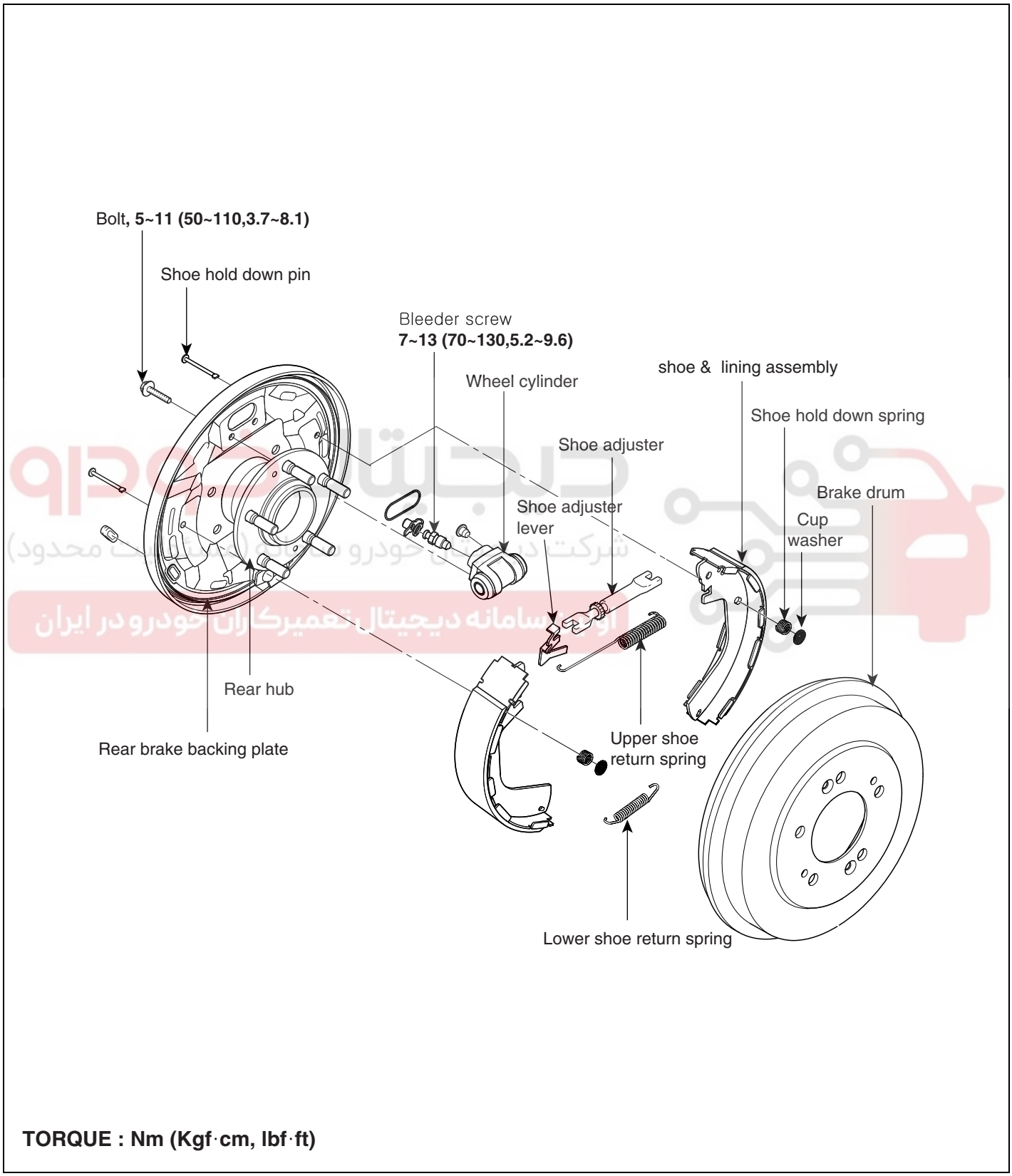


KJQE100E

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

REAR DRUM BRAKE

COMPONENTS E29B305C



TORQUE : Nm (Kgf·cm, lbf·ft)

EJQE105A

INSPECTION EAEE9A2C

CAUTION

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

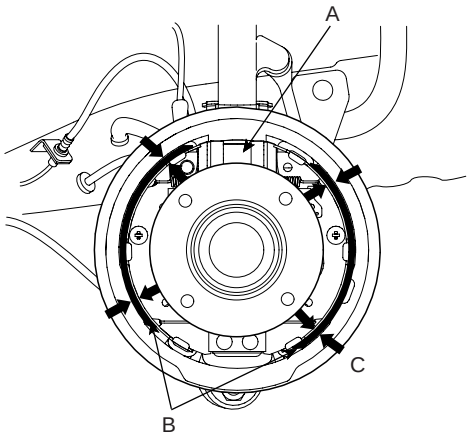
- ***Avoid breathing dust particles.***
- ***Never use an air hose or brush to clean brake assemblies.***

NOTE

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

1. Raise the rear of the vehicle, and make sure it is securely supported.
2. Release the parking brake, and remove the rear brake drum.
3. Check the wheel cylinder (A) for leakage.
4. Check the brake linings (B) for cracking, glazing, wear, and contamination.
5. Measure the brake lining thickness (C). Measurement does not include brake shoe thickness.

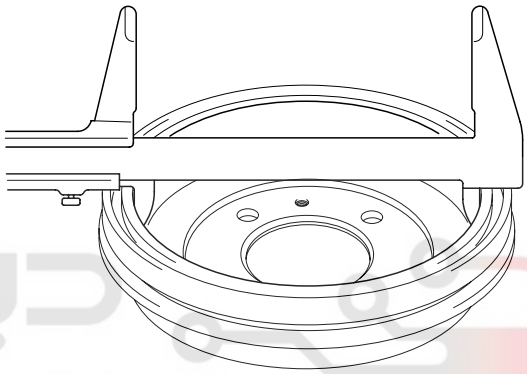
Brake lining thickness
Standard : 4.5 mm (0.177 in.)
Service limit : 1.0 mm (0.039 in.)



EGGE700R

6. If the brake lining thickness is less than the service limit, replace the brake shoes as a set.
7. Check the bearings in the hub unit for smooth operation. If it requires servicing, replace it.
8. Measure the inside diameter of the brake drum with inside vernier calipers.

Drum inside diameter:
Standard : 228.6 mm (9 in.)
Service limit : 230.6 mm (9.079in.)
Drum roundness
Service limit : 230.6mm (0.0024in.)



EGGE700S

9. If the inside diameter of the brake drum is more than the service limit, replace the brake drum.
10. Check the brake drum for scoring, grooves, and cracks.

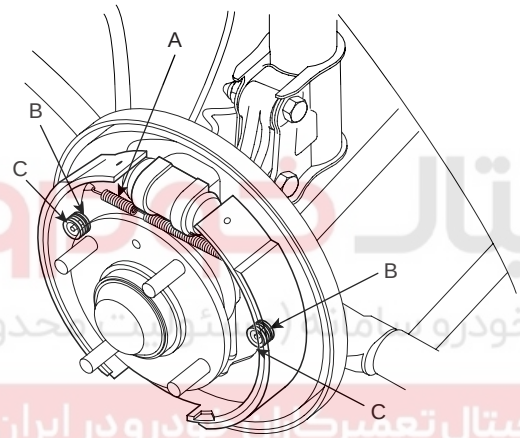
REMOVAL EE61FEB0

CAUTION

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

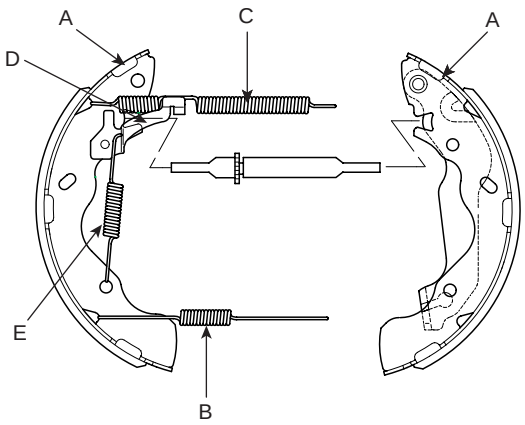
- ***Avoid breathing dust particles.***
- ***Never use an air hose or brush to clean brake assemblies.***

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



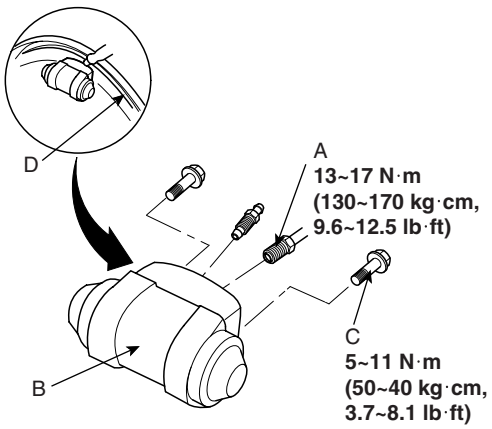
EGGE700T

3. Remove the lower shoe return spring (B) as removing the brake shoe assembly(A). Make sure not to damage the dust cover on the wheel cylinder.



KJQE040C

4. Disconnect the parking brake cable from the parking brake lever.
5. Remove the brake shoe assembly.
6. Remove the upper return spring (C), shoe adjuster lever (D), and separate the brake shoes.
7. Disconnect the brake line (A) from the wheel cylinder (B).
8. Remove the bolt (C) and the wheel cylinder from the backing plate(D).



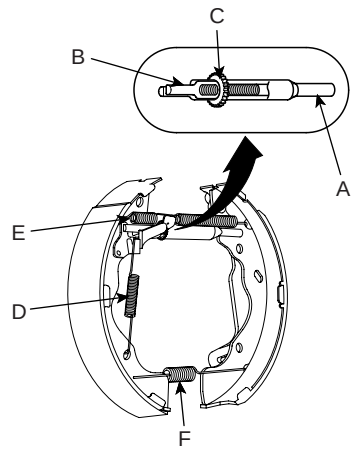
EJQE040D

INSTALLATION E1F515C8

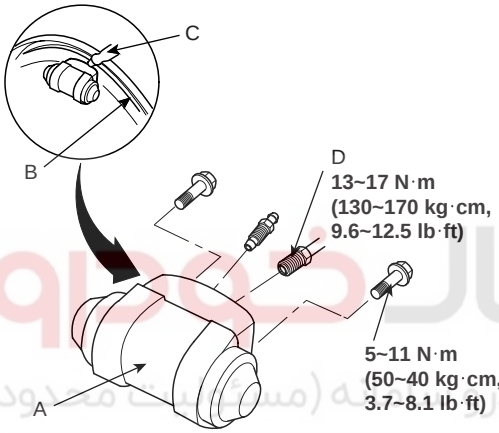
NOTE

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

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

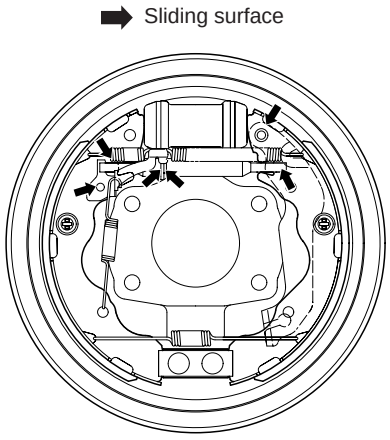


KJQE040H



EGGE700U

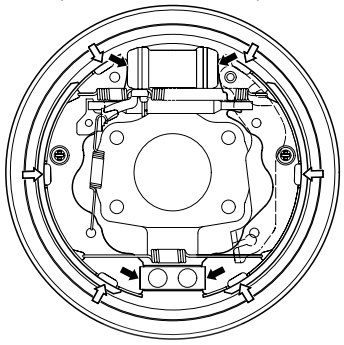
2. Connect the brake tubes (D) to the wheel cylinder.
3. Connect the parking brake cable to the parking brake lever.
4. Clean the threaded portions of adjuster sleeve (A) and push rod female (B). Grease the threads of the adjuster assembly, turn the adjuster bolt (C), adjusting the length of the shoe ajuster assembly.
5. Hook the shoe adjuster spring (D) to the adjuster lever first, then to the brake shoe.
6. Install the shoe adjuster assembly and upper return spring (E), noting the installation direction. Be careful not to damage the wheel cylinder dust covers.
7. Install the lower return spring (F).
8. Grease brake cylinder to the sliding surfaces as shown below. Wipe off any excess. Don't get grease on the brake linings.



EGGE700V

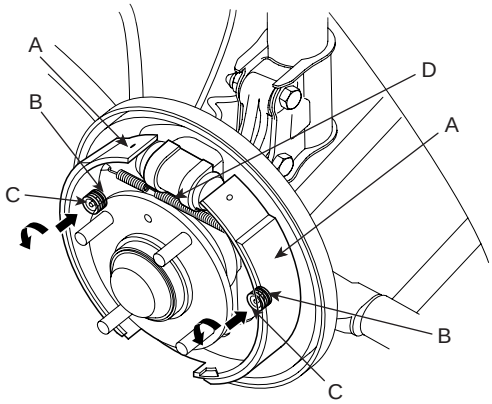
9. Grease brake cylinder to the brake shoe ends and opposite edges of the as shoes as shown below. Wipe off any excess. Don't get grease on the brake linings.

➡ Opposite edge of the shoe
⇨ Brake shoe ends (shoe side ends and backing plate contact surface)



EGGE700W

10. Grease brake shoes (A) onto the backing plate. Be careful not to damage the wheel cylinder dust covers.
11. Install the shoe hold down pins (B) and the shoe hold down washers (C).

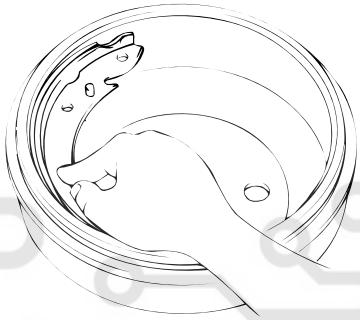


EJKE803F

12. Install the upper return spring (D).
13. Install the brake drum.
14. Bleed the brake system,after refilling the brake fluid.
15. Depress the brake pedal several times to set the self-adjusting brake.
16. Adjust the parking brake.

INSPECTION E6056B43

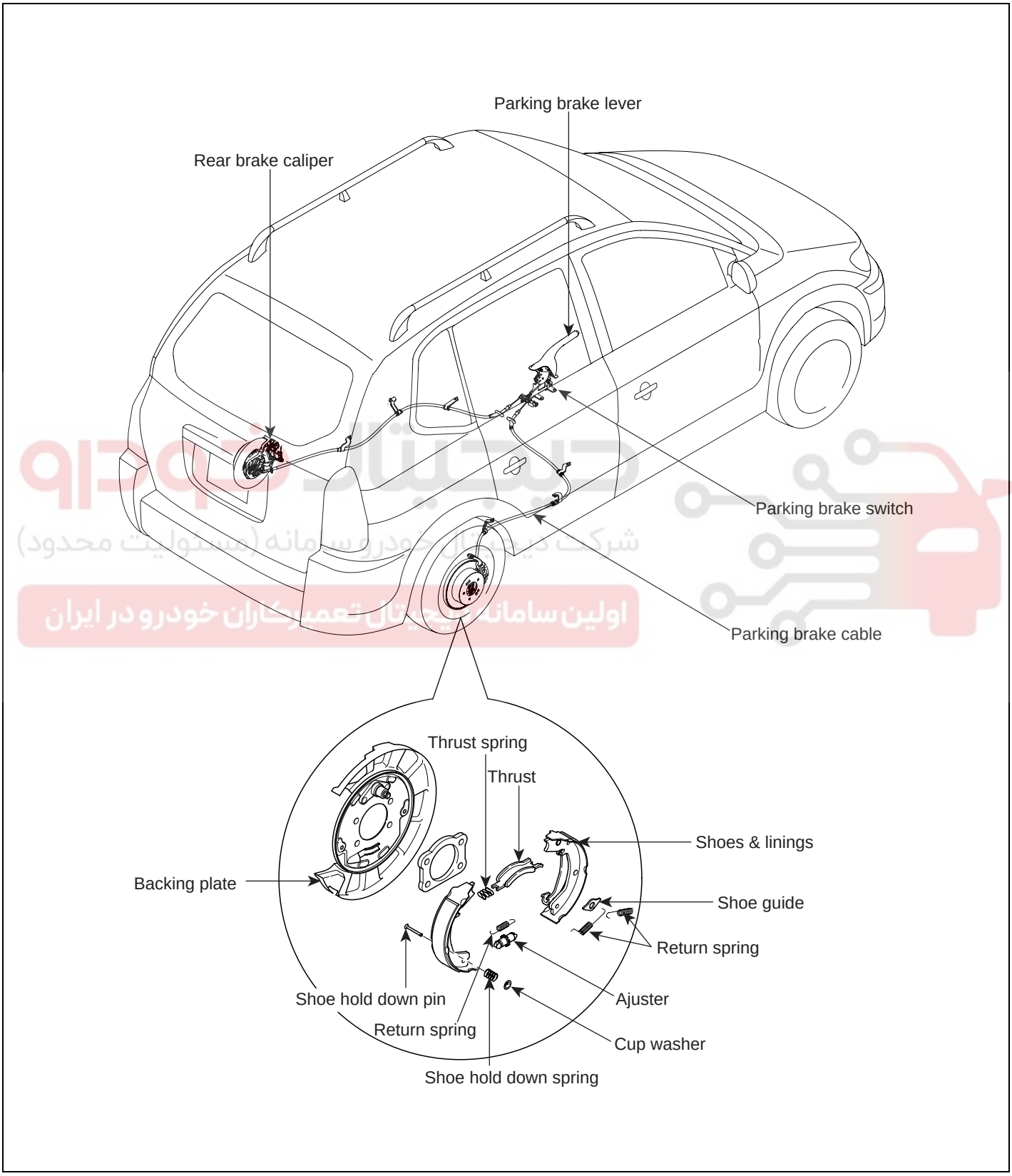
1. Inspect the brake lining and drum for proper contact.
2. Inspect the wheel cylinder outside for excessive wear and damage.
3. Inspect the backing plate for wear or damage.



EJDA038C

PARKING BRAKE SYSTEM

COMPONENTS ECB09114



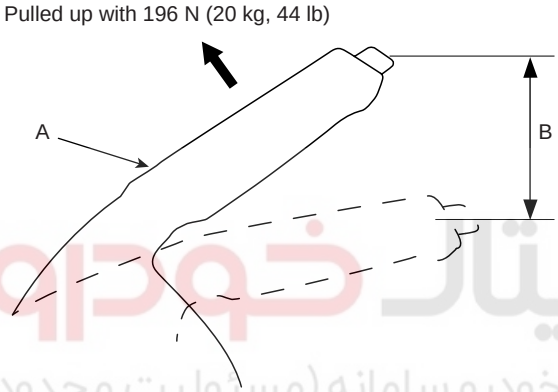
EJQE460A

PARKING BRAKE CHECK AND ADJUSTMENT E8CCB913

INSPECTION

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

Lever locked clicks:7~8



EJKE002A

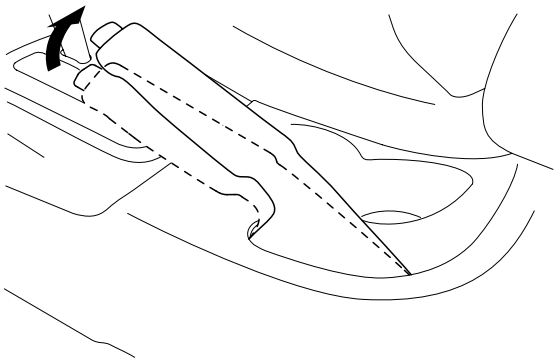
2. Adjust the parking brake if the lever clicks are out of specification.

ADJUSTMENT

NOTE

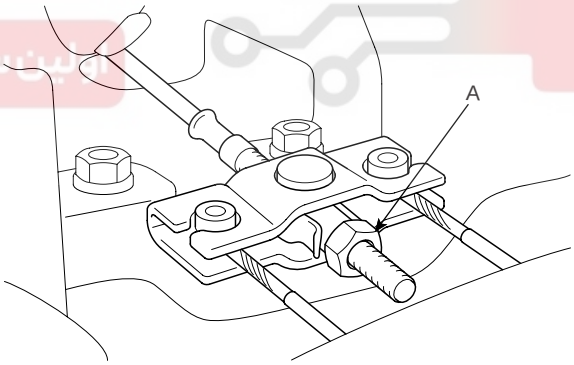
After rear brake caliper servicing, loosen the parking brake adjusting nut, start the engine and depress the brake pedal several times to set the self-adjusting brake before adjusting the parking brake.

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



EJKE002C

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



EJKE002D

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

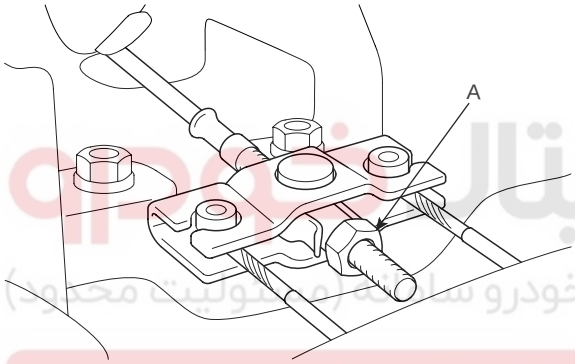
PARKING BRAKE

REMOVAL E36C76BE

NOTE

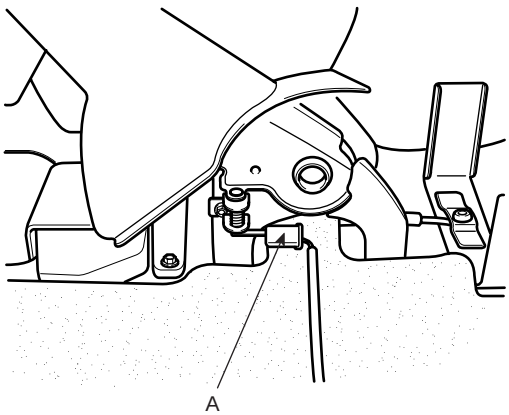
The parking brake cables must not be bent or distorted.
This will lead to stiff operation and premature failure.

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



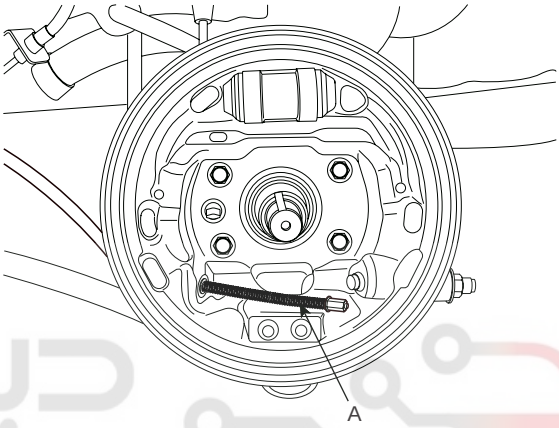
EJKE002D

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



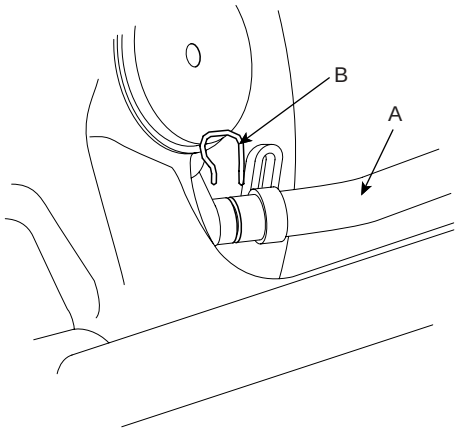
EGGE700X

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



KJQE040K

8. Remove the parking brake cable retaining ring (B), from the parking brake cable (A).



EJKE900B

INSTALLATION EF514CB8

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

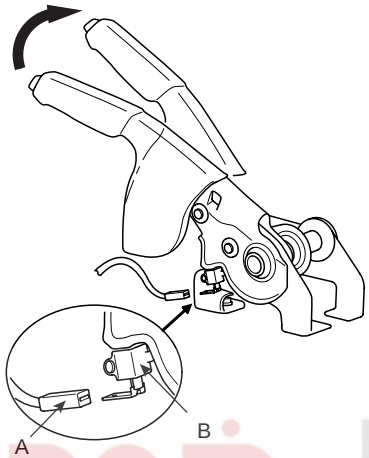
Specified grease :
Multi purpose grease SAE J310, NLGI No.2

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

PARKING BRAKE SWITCH

INSPECTION E63D3A3C

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



EJQE004R

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

ABS (ANTI-LOCK BRAKE SYSTEM)

DESCRIPTION EA6F6FCC

This specification applies to HCU(Hydraulic Control Unit) and ECU(Electronic Control Unit) of the HECU.(Hydraulic and Electronic Control Unit)
This specification is for the wiring design and installation of ABS/TCS/ESP ECU.
This unit has the functions as follows.

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

Installation position : engine room

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

OPERATION

The ECU shall be put into operation by switching on the operating voltage (IGN).
On completion of the initialization phase, the ECU shall be ready for operation.
In the operating condition, the ECU shall be ready, within the specified limits (voltage and temperature), to process the signals offered by the various sensors and switches in accordance with the control algorithm defined by the software and to control the hydraulic and electrical actuators.

WHEEL SENSOR SIGNAL PROCESSING

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

SOLENOID VALVE CONTROL

When one side of the valve coil is connected to the positive voltage that is provided through the valve relay and the other side is connected to the ground by the semiconductor circuit, the solenoid valve goes into operation.
The electrical function of the coils are always monitored by the valve test pulse under normal operation conditions.

VOLTAGE LIMITS

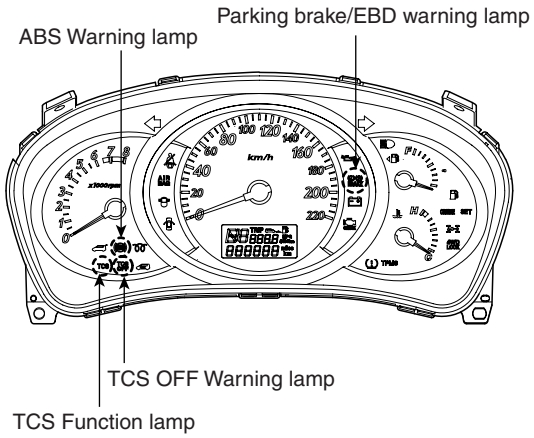
- Overvoltage
  When overvoltage is detected(above 16V), the ECU switches off the valve relay and shuts down the system.
  When voltage is returned to operating range, the system goes back to the normal condition after the initialization phase.
- Undervoltage
  In the event of undervoltage(below 10V), ABS control shall be inhibited and the warning lamp shall be turned on.
  When voltage is returned to operating range, the warning lamp is switched off and ECU returns to normal operating mode.

PUMP MOTOR CHECKING

The ECU performs a pump motor test at a speed of 12km/h once after IGN is switched on.

DIAGNOSTIC INTERFACE

Failures detected by the ECU are encoded on the ECU, stored in a EEPROM and read out by diagnostic equipment when the ignition switch is turned on.
The diagnosis interface can also be used for testing the ECU during production of the ECU and for actuating the HCU in the test line of manufactories (Air-bleeding line or Roll and Brake Test line).



EJQE300A

ABS WARNING LAMP MODULE

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

EBD WARNING LAMP MODULE

The active EBD warning lamp module indicates the self-test and failure status of the EBD.
However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions.
The EBD warning lamp shall be on:
- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order.
- During diagnostic mode.
- When the ECU Connector is seperated from ECU.

TCS WARNING LAMP (TCS SYSTEM)

The TCS warning lamp indicates the self-test and failure status of the TCS.
The TCS 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 TCS functions by failure.
- When driver trun off the TCS function by on/off switch.
- During diagnostic mode.

TCS FUNCTION LAMP (TCS SYSTEM)

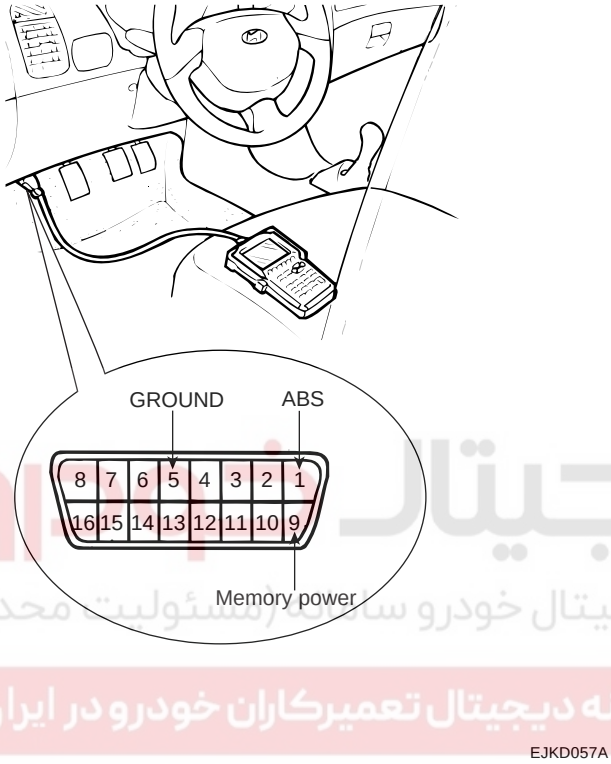
The TCS function lamp indicates the self-test and operating status of the TCS.
The TCS Function lamp operates under the following conditions :
- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the TCS control is operating. (Blinking - 2Hz)

TCS ON/OFF SWITCH (TCS SYSTEM)

The TCS On/Off Switch shall be used to toggle the TCS 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 TCS function is on and switch toggle the state.

HI-SCAN (PRO) CHECK

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



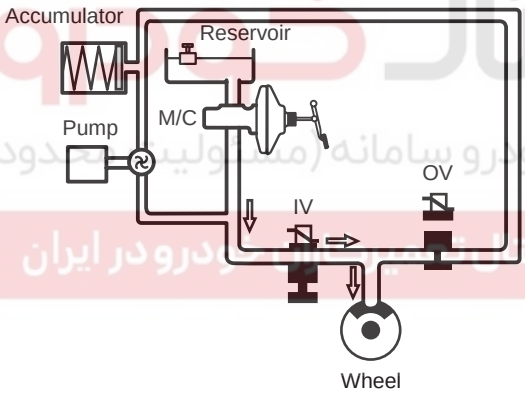
3. Turn the ignition switch ON.
4. Check for diagnostic trouble using the Hi-scan(pro).
5. After completion trouble of the repair or correction of the problm, erase the stored fault codes the clear key on the Hi-scan(pro).
6. Disconnect the Hi-scan (pro) from the 16P date link connector.

ABS CONTROL E4AF5BFB

1. NORMAL BRAKING without ABS

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

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.



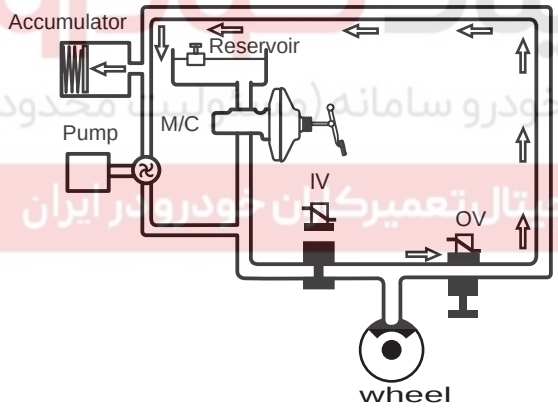
EJQE015A

2. With ABS

1) DUMP MODE

Solenoid	State	Valve	Passage	Pump motor
INLET VALVE (NO)	ON	CLOSE	MASTER CYLINDER ⇔ WHEEL CYLINDER	ON
OUTLET VALVE (NC)	ON	OPEN	WHEEL CYLINDER ⇔ 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.

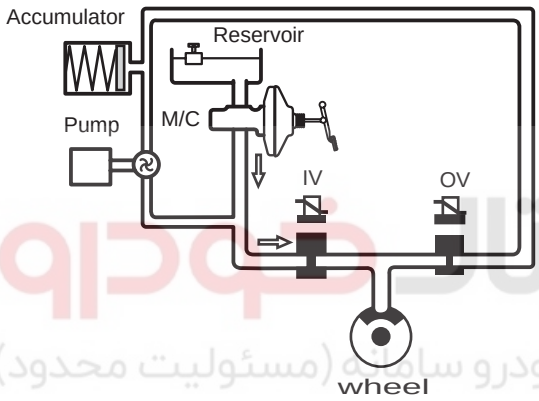


EJQE016A

2)HOLD MODE

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

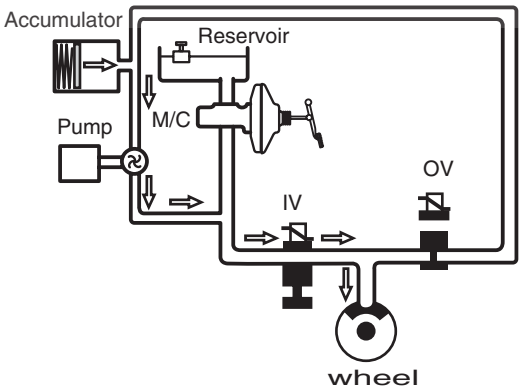
3) INCREASE MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	OPEN	Master cylinder ⇔ Wheel cylinder	ON
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder ⇔ 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.

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, stoping 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.

Conventional brake system operates under the circumstance.

TRACTION CONTROL SYSTEM (TCS)

FUNCTION

1. Main performance
   - Traction: Lower vibration and higher launchability, acceleration and climbability by slip control.
   - Cornering and passing: Stable cornering and passing.
   - Steering stability: Control traction force traverse vector prior to provide easy turning when turning the steering wheel.

2. General TCS features
   - Improved drivability. Minor operation of acceleration is not necessary in launching and acceleration on slippery road.
   - More stable cornering by stable acceleration on normal road condition.
   - TCS system will compare vehicle speed received from rear wheel speed sensor and driving wheel speed from front wheel speed sensor on slippery road condition, and provide optimum slipping rate of driving wheels.

TYPE

FULL TRACTION CONTROL SYSTEM (FTCS)

1. The TCS control module (HECU) controls TCS control. It includes ABS control module.

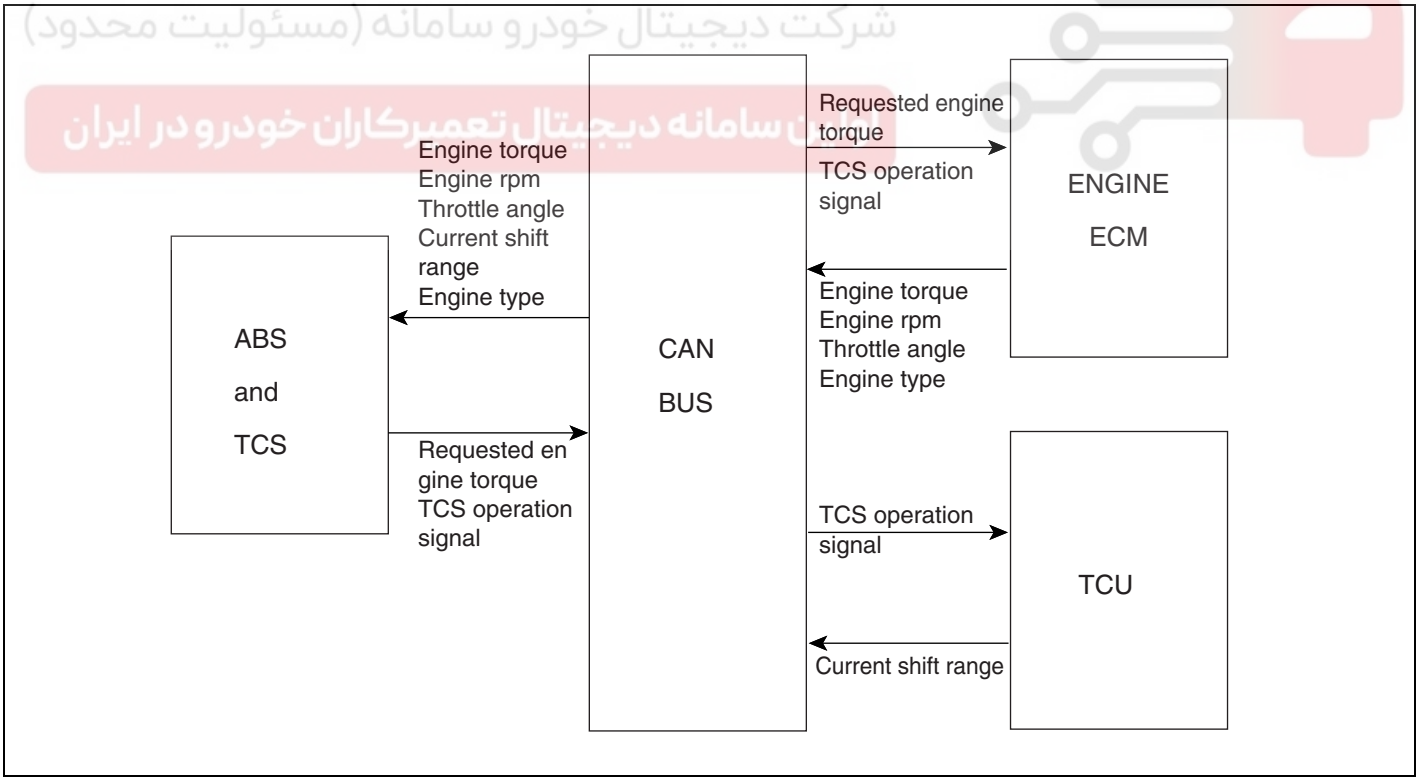
2. HECU will compare signals from front (driving) and rear wheel speed sensors to detect driving wheels slip.

3. Upon detecting driving wheels slip, HECU will perform TCS control. The TCS control will include brake TCS (BTCS) control.

4. HECU will transmit engine torque reduction request, fuel cut cylinder number, and TCS control request signals in accordance with slip level to engine ECM and TCM through BUS line which will provide CAN communication for TCS control.

5. Engine ECM will perform fuel cut as requested by HECU and retard ignition timing as per engine torque reduction request signal.

6. TCM will hold shift position by TCS control time according to TCS operation signal. Then enhanced acceleration by kick-down will not occur.



EJQE027A

BRAKE TRACTION CONTROL SYSTEM (BTCS)

1. On TCS control, only brake control will be performed. (engine and TCM control will not happen)

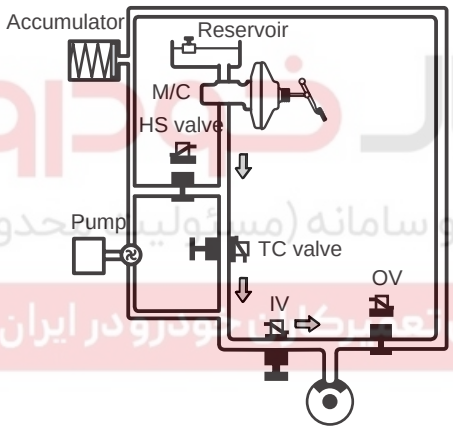
2. Controlled by motor pump output pressure.

TRACTION CONTROL SYSTEM (TCS)

1. NORMAL MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	OFF	OPEN	OFF	OFF
Outlet (NC)	OFF	CLOSE		

- In the normal driving condition, TC valve (normally open) is the passage between the master cylinder and the each wheel cylinder.
- When brake pedal is applied, brake pressure is delivered to the wheel cylinders via NO-TC valve and all solenoid valves inside the hydraulic unit are deactivated.
- In case of TCS malfunction, it does not affect brake operation.

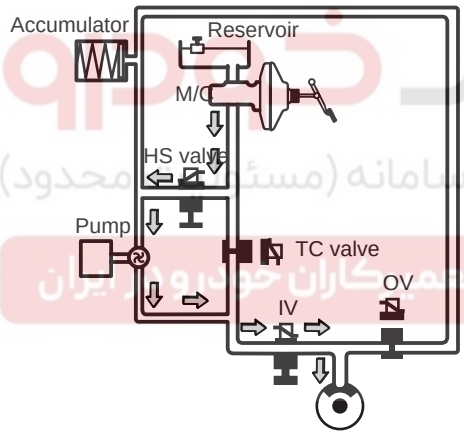


LJCD019A

2. PRESSURE INCREASE MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	FRONT: OFF REAR: ON	FRONT: OPEN REAR: CLOSE	ON	ON
Outlet (NC)	OFF	CLOSE		

- If a front wheel spin is detected, TCS begins a brake control to decrease a wheel spin.
- Hydraulic shuttle valve (HSV) is opened.
  Brake fluid is supplied from the master cylinder by motor operation to the spin wheel via HSV.
- TC valve is closed (ON).
  Brake pressure generated from motor pump is delivered only to the front wheel.
- Inlet valve remains open to deliver the brake pressure generated from motor pump to the spinning wheels.

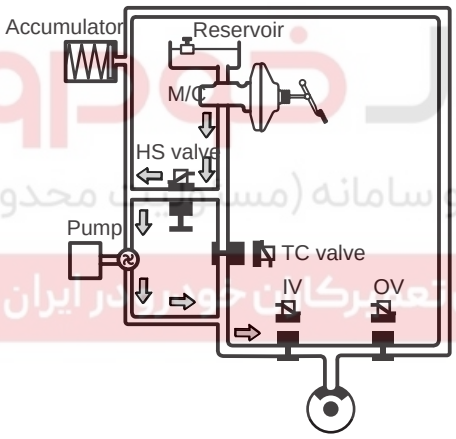


LJCD020A

3. PRESSURE DUMP MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	ON	CLOSE	ON	ON
Outlet (NC)	FRONT : ON REAR : OFF	FRONT : OPEN REAR : CLOSE		

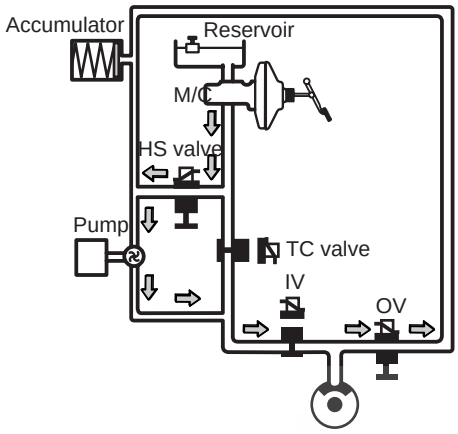
- When the wheel deceleration is under the threshold and the wheel spin is reduced under a slip threshold, applied brake pressure is reduced to get an optimum traction force.
- Outlet valve is open to release the brake pressure and inlet valve is closed to block the pressure increase from the motor pump.
- Hydraulic shuttle valve (HSV) remains opened, TC valve is ON.
- Motor is ON, to dump the brake fluid being released from the lock-up wheel.



LJCD021A

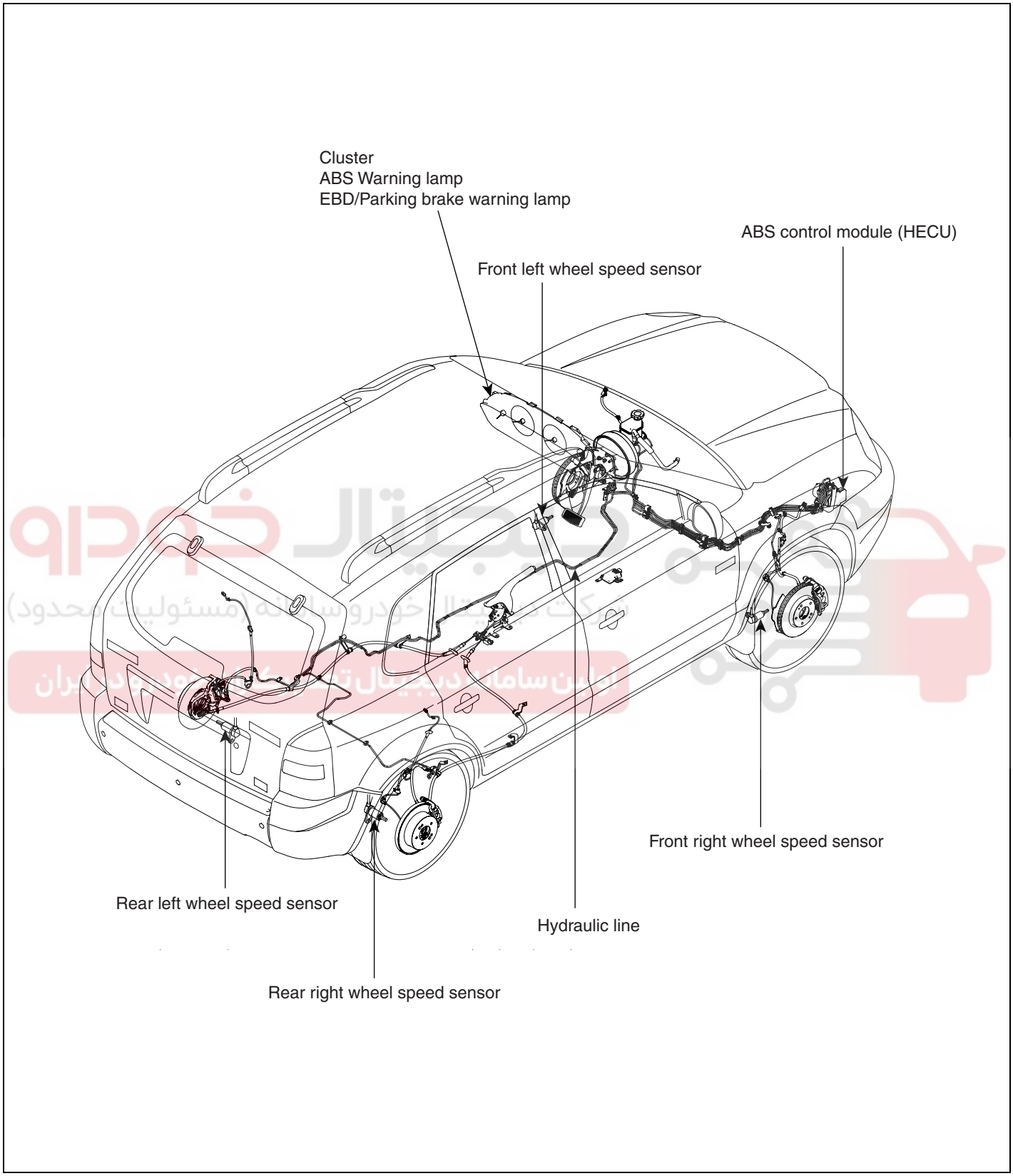
4. PRESSURE HOLD MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	ON	CLOSE	ON	ON
Outlet (NC)	OFF	CLOSE		



LJCD022A

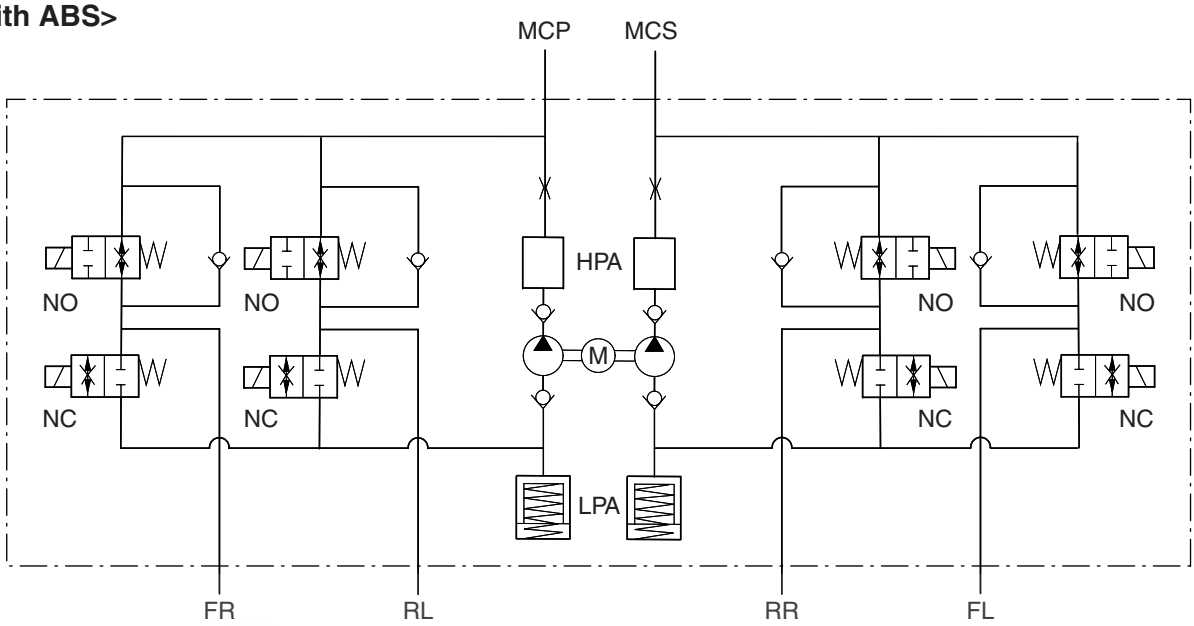
COMPONENTS E1E78359



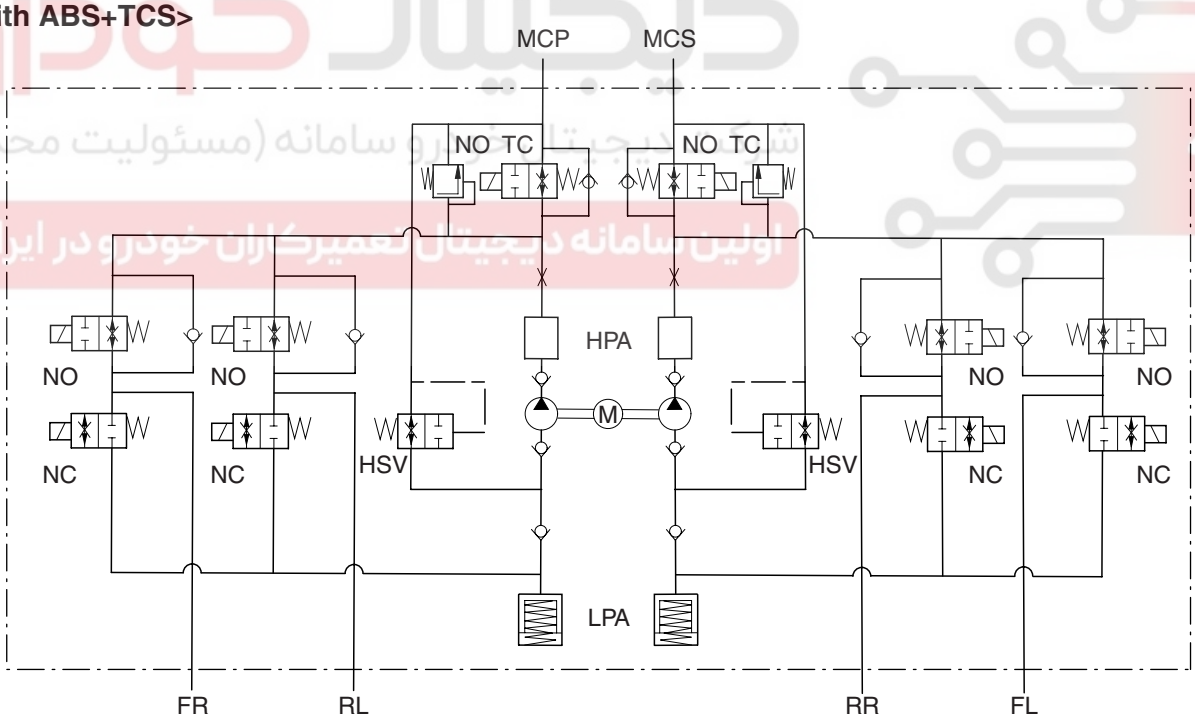
EJQE030B

HYDRAULIC SYSTEM DIAGRAM E4130AD2

<With ABS>



<With ABS+TCS>

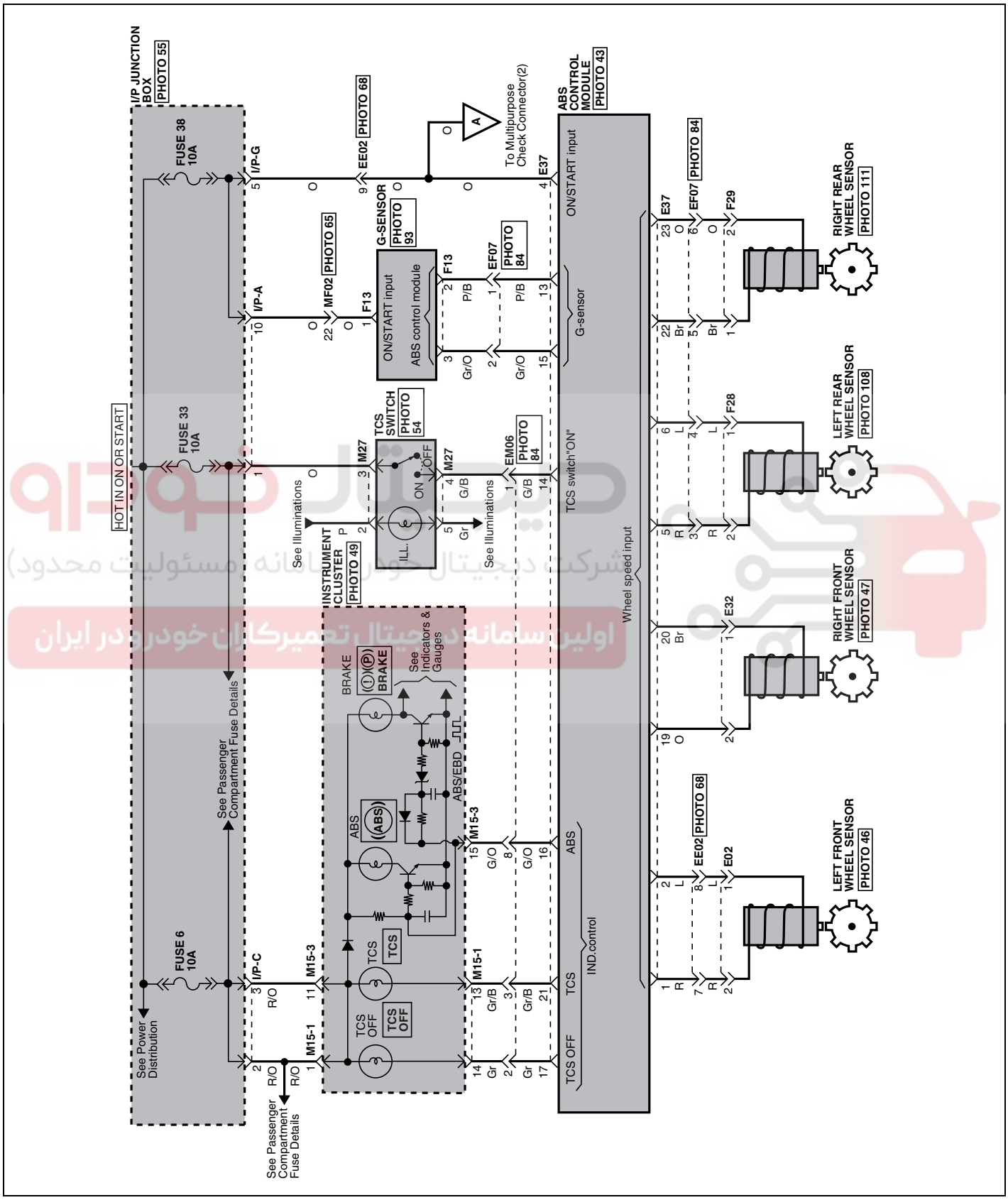


TCS : Traction Control System
MCP : Master Cylinder Primary
MCS : Master Cylinder Secondary
HPA : High Pressure Accumulator
LPA : Low Pressure Accumulator
M : Motor Pump
HSV : Hydraulic Shuttle Valve
TC : Traction Control valve
NO : Normal Open valve
NC : Normal Close valve

EJKD515A

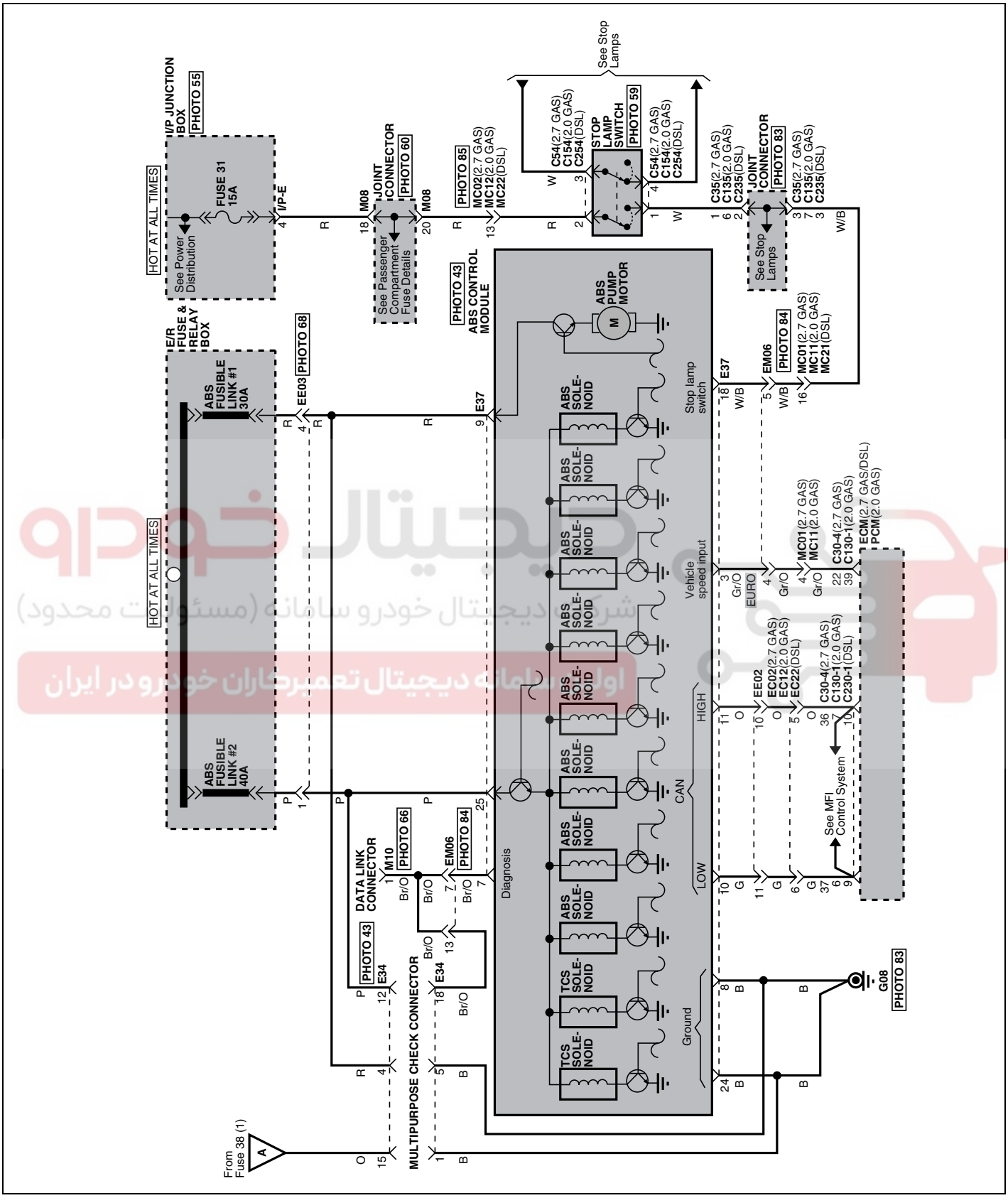
CIRCUIT DIAGRAM E847C9E1

CIRCUIT DIAGRAM(1)



EJQE903A

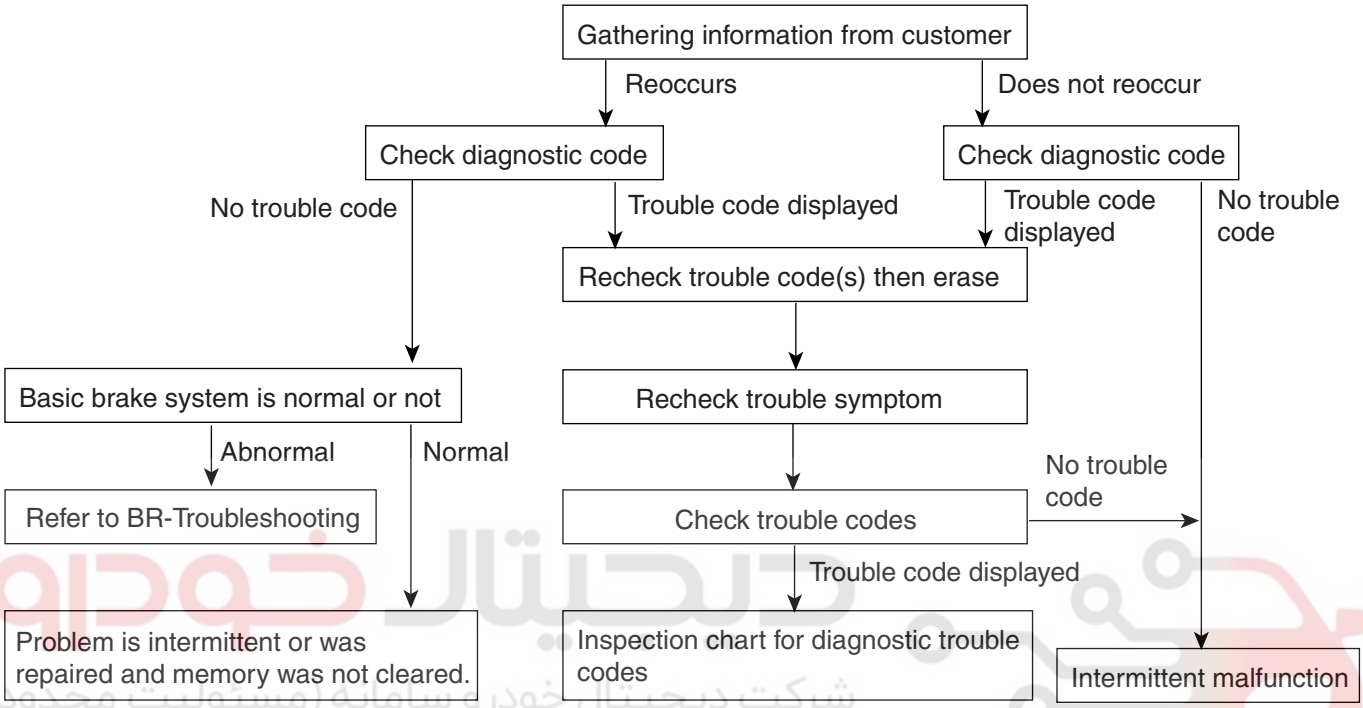
CIRCUIT DIAGRAM(2)



EJQE903B

TROUBLESHOOTING E3578EE5

STANDARD FLOW OF DIAGNSTIC TROUBLESHOOTING



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

EJKB055A

NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

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

ABS CHECK SHEET

ABS Check Sheet

Inspector's Name _____

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

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

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

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

EJDA017A

PROBLEM SYMPTOMS TABLE

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

Symptom	Suspect Area	See page
ABS does not operate.	Only when 1. -4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit. 4. Check the hydraulic circuit for leakage.	BR - 70
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 - 72
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line	BR - 74
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 - 75
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU	BR - 76
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU	BR - 77
Brake warning lamp is abnormal.	1. Brake oil level sensor 2. Parking brake switch 3. Brake warning lamp circuit	BR - 78

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.

DIAGNOSTIC TROUBLE CODE CHART

Follow an inspection procedure of a detected DTC in the chart below.

NOTE

EBD △ - warning lamp "ON", in case of errors on more than 2 wheels.

DTC	DESCRIPTION	WARNING LAMP "ON"				DTC MEMORY	REMARK	SEE PAGE
		ABS	EBD	TCS	ESP			
C1101	Battery voltage high	○	○	○	○	○		BR-79
C1102	Battery voltage low	○	○	○	○	○		BR-82
C1200	Wheel speed sensor FR-LH open/short	○	○	○	○	○		BR-84
C1201	Wheel speed sensor FR-LH range/performance/intermittent	○	△	○	○	○		BR-86
C1202	Wheel speed sensor FR-LH invalid/no signal	○	△	○	○	○		BR-89
C1203	Wheel speed sensor FR-RH open/short	○	△	○	○	○		BR-84
C1204	Wheel speed sensor FR-RH range/performance/intermittent	○	△	○	○	○		BR-86
C1205	Wheel speed sensor FR-RH invalid/no signal	○	△	○	○	○		BR-89
C1206	Wheel speed sensor RR-LH open/short	○	△	○	○	○		BR-84
C1207	Wheel speed sensor RR-LH range/performance/intermittent	○	△	○	○	○		BR-86
C1208	Wheel speed sensor RR-LH invalid/no signal	○	△	○	○	○		BR-89
C1209	Wheel speed sensor RR-RH open/short	○	△	○	○	○		BR-84
C1210	Wheel speed sensor RR-RH range/performance/intermittent	○	△	○	○	○		BR-86
C1211	Wheel speed sensor RR-RH invalid/no signal	○	△	○	○	○		BR-89
C1604	ECU hardware error	○	○	○	○	○		BR-92
C2112	Valve relay error	○	○	○	○	○		BR-93
C2380	ABS/TCS/ESP valve error	○	○	○	○	○		BR-95
C2402	Motor - electrical	○	×	○	○	○		BR-97
C1274	G sensor - electrical	○	×	○	○	○	4WD	BR-100
C1275	G sensor - signal	○	×	○	○	○	4WD	BR-102
C1503	TCS switch error	×	×	○	○	○		BR-104
C1605	CAN harware error	×	×	○	○	○		BR-106
C1611	CAN time-out EMS	×	×	○	○	○		BR-107
C1612	CAN time-out TCU	×	×	○	○	○		BR-108

DTC	DESCRIPTION	WARNING LAMP "ON"				DTC MEMORY	REMARK	SEE PAGE
		ABS	EBD	TCS	ESP			
C1613	CAN wrong message	×	×	○	○	○		BR-109
C1616	CAN bus off	×	×	○	○	○		BR-110
C2227	Excessive temperature of brake disc	×	×	○	○	○		BR-111
C1112	Sensor source voltage	×	×	○	○	○		BR-112
C1235	Pressure sensor(primary) - electrical	×	×	×	○	○		BR-113
C1237	Pressure sensor(secondary) - electrical	×	×	×	○	○		BR-115
C1259	Steering angle sensor - electrical	×	×	×	○	○		BR-117
C1260	Steering angle sensor - signal	×	×	×	○	○		BR-119
C1282	Yaw rate & lateral G sensor - electrical	×	×	×	○	○		BR-121
C1283	Yaw rate & lateral G sensor - signal	×	×	×	○	○		BR-123
C1513	Brake switch error	×	×	×	○	○		BR-125

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).

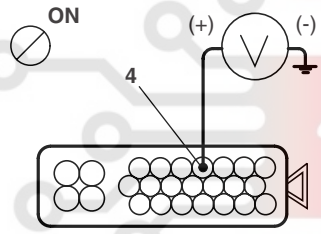
EJKD222B

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 (E37) and body ground.

- **Specification: approximately B+**

Is the voltage within specification?



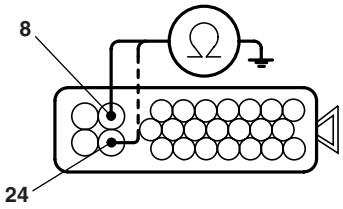
Yes		
	No	Check the harness or connector between the No.11 fuse (10A) in the passenger compartment junction block and the ABS control module. Repair if necessary.

EJKD222C

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 (E37) and ground point (G17).

Is there continuity?



Yes		
	No	Repair an open in the wire and ground point (G17).

EJKD222D

4. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.(see page BR- 84)

OK

NG	Repair or replace the wheel speed sensor.

EJKD222E

5. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines. (see page BR- 14)

OK

NG	Repair the hydraulic lines for leakage.

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

EJKD222F

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. (see page BR- 84)

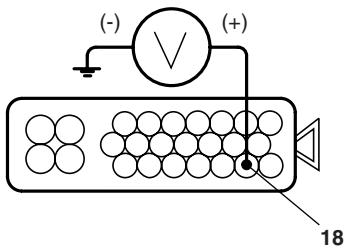
OK	
NG	Repair or replace the wheel speed sensor.

EJKD222I

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 (E37) 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.

EJKD222J

4. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines. (see page BR- 14)

OK	
NG	Repair the hydraulic lines for leakage.

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

EJKD222K

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

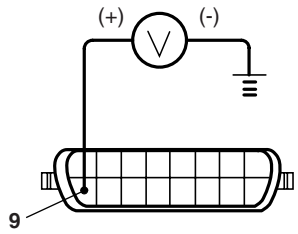
EJKD222L

1. CHECK THE POWER SUPPLY CIRCUIT FOR THE DIAGNOSIS

Measure the voltage between terminal 9 of the data link connector (M07) and body ground.

- **Specification: approximately B+**

Is voltage within specification?



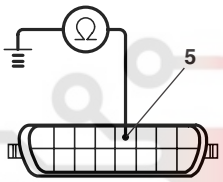
Yes	
No	Repair an open in the wire. Check and replace fuse (15A) from the passenger compartment junction block

EJKD222M

2 . CHECK THE GROUND CIRCUIT FOR THE DIAGNOSIS

Check for continuity between terminal 5 of the data link connector (M07) and body ground.

Is there continuity?



No	Repair an open in the wire between terminal 5 of the data link connector (M07) and ground point (G14).

EJKD222N

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 (E37) and 1 of the data link connector (M07).

Is there continuity?

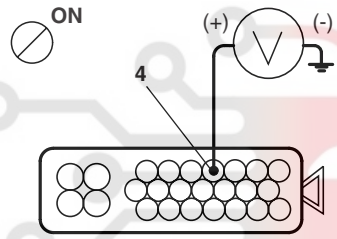
Yes	
No	Repair an open in the wire.

EJKD222P

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 (E37) and body ground.

- **Specification: approximately B+**



Is voltage within specification?

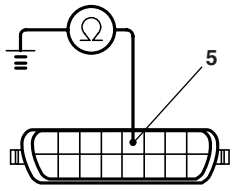
Yes	
No	Check the harness or connector between the No.11 fuse (10A) in the passenger compartment junction block and the ABS control module. Repair if necessary.

EJKD222Q

3 . CHECK FOR POOR GROUND

Check for continuity between terminal 5 of the data link connector (M07) and ground point (G14).

Is there continuity?



Yes	
No	Repair an open in the wire or poor ground.

Replace the ABS control module and recheck.

EJKD222R

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?

No

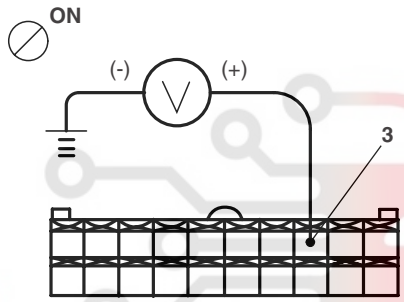
Yes	Check for short circuit in the ABS control module connector.

EJKD222T

2 . CHECK THE POWER SOURCE FOR THE ABS WARNING LAMP

1. Disconnect the instrument cluster connector (M10-1) and turn the ignition switch ON.
2. Measure the voltage between terminal 3 of the cluster harness side connector (M10-1) and body ground.

- **Specification: approximately B+**



Is voltage within specification?

No

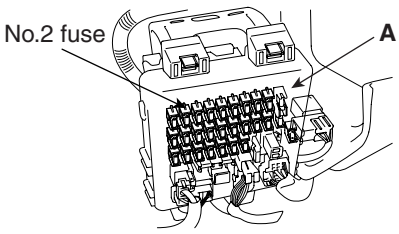
Yes	Repair bulb or instrument cluster assembly.

EJKD222U

3 . CHECK FOR BLOWN FUSE

Check continuity of No.2 fuse (10A) from the passenger compartment junction block (A).

Is there continuity?



Yes

No	Replace the blown fuse.

Repair an open in the wire between terminals 12 of I/P-H connector and 3 of cluster connector (M10-1).

EJKD222V

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 (M10-1) and turn the ignition switch ON.

Does the ABS warning lamp remains ON?

No

Yes	Replace the instrument cluster.

EJKD222Y

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

DTC C1101 BATTERY VOLTAGE HIGH

DESCRIPTION E65EC6D4

This code shows in case that the power source for the HECU drops lower than or rises higher than the specified value. If the power source returns within the specified value, this code will not show any longer.

CAUTION

Before carrying out the following inspection, check and recharge, if necessary, the battery.

DTC DETECTING CONDITION E81E34DA

DTC No	Condition	Possible Cause
C1101 (High Voltage) C1102 (Low Voltage)	**High Voltage:** 1. When Vign more than 16±0.5V is continued for 500msec. 2. When Vign more than 19±0.5V is continued for 49msec. 3. if the voltage recover normal operating range, the controller is reset **Low Voltage :** 1. When Vign less than 9.5V±0.5V is continued for 500msec during Vref more than or equal to 7Km/h. 2. When Vign less than 8.5V±0.5V is continued for 500msec during Vref less than or equal to 7Km/h or ABS, TCS(ESP) control. 3. When Vign less than 7.2V±0.5V is continued for 28msec. 4. If IGN voltage is recovered to normal operating voltage, the system recovers to normal state.	- Open/short in power supply circuit - Faulty power source - Faulty HECU

FAILSAFE FUNCTION

High voltage :
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.
Low voltage :

1. Without the ABS control : inhibit the ABS, TCS(ESP) control of front wheels and allow the ABS control of rear wheels, deactivating the motor, and the ABS, TCS(ESP) warning lamps are switched on. When the voltage recover to the normal operating range, enable ABS function and ABS, TCS(ESP) warning lamps are switched off and erase the error code

2. With the ABS control : inhibit ABS control of the front wheels and allow ABS control of the rear wheels, deactivating the motor. the ABS, TCS(ESP) warning lamps are directly switched on and the state keeps continuously. the error code is always stored.

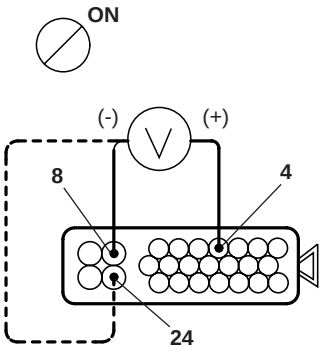
INSPECTION PROCEDURE EDF0B167

1. CHECK POWER BETWEEN TERMINAL OF HECU CONNECTOR.

   1) Disconnect the connector from the ABS control module, and then turn the ignition switch ON.

   2) Measure the voltage between terminals 4(+) and 8(-) or 24(-) of the HECU connector.

Specification: 9.4~17V



EJQE900H

Is the voltage within the specification?

YES

▶Check the HECU connector.If no error is founded, replace the HECU and recheck.

NO

▶Check battery.

2. CHECK BATTERY.
Measure the voltage between positive(+) and negative(-) terminals of the battery.
Is the voltage below 9.4V?

YES

▶Check and replace the battery.

NO

▶Check circuit for contingtinuty between bettery and HECU.

3. CHECK CIRCUIT FOR CONTINUITY BETWEEN BATTERY AND HECU.
Check the resistance between terminal 4(+) of the HECU connector and battery positive(+) terminal.
Is the resistance below 1Ω ?

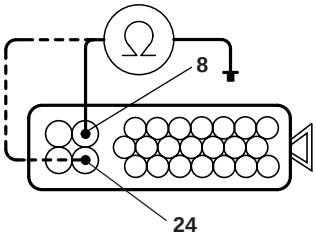
NO

▶Repair harness or connector.

YES

▶Check circuit for continuity between the HECU and body ground.

4. CHECK CIRCUIT FOR CONTINUITY BETWEEN THE HECU AND BODY GROUND.
Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

▶Check and readjust the installing of the body groud.

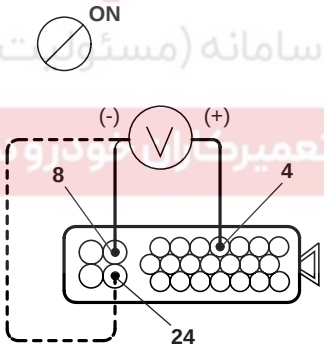
YES

▶Check voltage beween the HECU connector.

5. CHECK VOLTAGE BETWEEN THE HECU CONNECTOR.

1) Turn the ignition switch ON.

2) Measure the voltage between terminals 4(+) and 8(-), 24(-) of the HECU connector.



EJQE900H

Is the voltage above 17V?

YES

▶Repair and replace, if necessary, the charging system.

NO

▶Repeat the inspection procedure.

DTC C1102 BATTERY VOLTAGE LOW

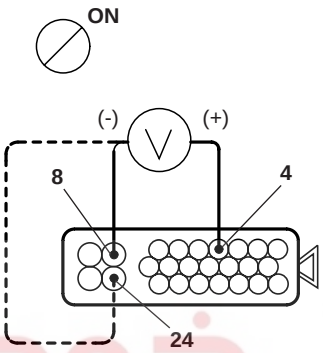
INSPECTION PROCEDURE EC7F8BFD

1. CHECK POWER BETWEEN TERMINAL OF HECU CONNECTOR.

   1) Disconnect the connector from the ABS control module, and then turn the ignition switch ON.

   2) Measure the voltage between terminals 4(+) and 8(-) or 24(-) of the HECU connector.

Specification: 9.4~17V



EJQE900H

Is the voltage within the specification?

YES

▶Check the HECU connector.If no error is founded, replace the HECU and recheck.

NO

▶Check battery.

2. CHECK BATTERY.
   Measure the voltage between positive(+) and negative(-) terminals of the battery.
   Is the voltage below 9.4V?

YES

▶Check and replace the battery.

NO

▶Check circuit for continuity between bettery and HECU.

3. CHECK CIRCUIT FOR CONTINUITY BETWEEN BATTERY AND HECU.
   Check the resistance between terminal 4(+) of the HECU connector and battery positive(+) terminal.
   Is the resistance below 1Ω ?

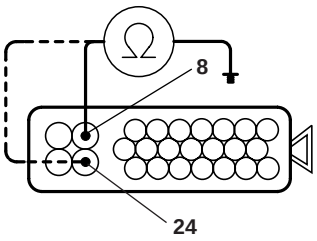
NO

▶Repair harness or connector.

YES

▶Check circuit for continuity between the HECU and body ground.

4. CHECK CIRCUIT FOR CONTINUITY BETWEEN THE HECU AND BODY GROUND.
Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

▶Check and readjust the installing of the body groud.

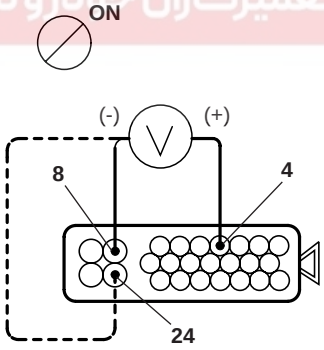
YES

▶Check voltage beween the HECU connector.

5. CHECK VOLTAGE BETWEEN THE HECU CONNECTOR.

1) Turn the ignition switch ON.

2) Measure the voltage between terminals 4(+) and 8(-), 24(-) of the HECU connector.



EJQE900H

Is the voltage above 17V?

YES

▶Repair and replace, if necessary, the charging system.

NO

▶Repeat the inspection procedure.

DTC C1200 FL SENSOR-OPEN/SHORT

DESCRIPTION E9B45F66

The HECU receives wheel speed signals from the four wheel speed sensors.
The wheel signals are converted to voltage signals by the signal converting circuit and given as input to the HECU.
The HECU checks an open or short in the circuit of the wheel speed sensor.
If more than one wheel speed sensor malfunctions, the system stops.

DTC DETECTING CONDITION E4C4AD7A

DTC No	Condition	Possible Cause
C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	If the sensor signal current is continuously out of the specified range of 4 mA ±10% ~ 22 mA ±10% for 140msec, the failure is detected.	- Open/short in circuit of wheel speed sensor - Faulty wheel speedsensor - Faulty HECU

FAILSAFE FUNCTION

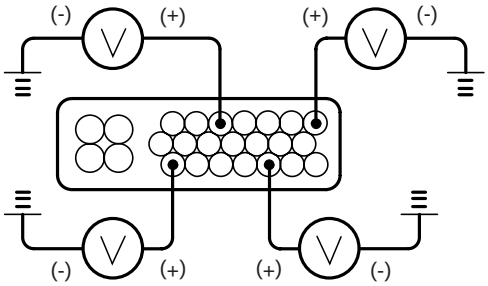
Sensor malfunction without ABS control :
- One wheel sensor malfuntion
Only the ABS, TCS(ESP) functions are inhibited. the ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp is OFF.
- More than two wheels malfunction
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. the ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.
Sensor malfunction with ABS control :
- One front wheel malfunction
Inhibit the ABS control of a wheel with a malfunctioning sensor and maintain the ABS control of other wheels.
After the ABS control has completed, the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON but the EBD warning lamp is OFF.
- One rear wheel malfunction
Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased. After the controller completes the ABS control, Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON but the EBD warning lamp is OFF.
- More than two wheels malfunction
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE EABB738B

1. CHECK POWER FOR WHEEL SPEED SENSOR
   Measure the voltage between an appropriate wheel sensor(+) terminal and the body ground (see the table below).

DTC	Terminal
C1200 (Front-left) C1203 (Front-right) C1206 (Rear-right) C1209 (Rear-right)	1 19 5 23

Specification:Battery positive(+)



KJQE900K

Is the voltage within the specification?

NO

▶Repair short to power in the (+) circuit between the HECU and the appropriate wheel sensor.

YES

▶Check output of the wheel speed sensor

2. CHECK OUTPUT OF THE WHEEL SPEED SENSOR
Check the volrange between terminals (see the table below)of the HECU and the body ground.

DTC	Terminal
C1200 (Font-left)	2
C1203 (Font-right)	20
C1206 (Rear-right)	6
C1209 (Rear-right)	22

Specification:0.4~2.2V

Is the voltage within the specification?

YES

▶Replace the wheel sensor and recheck.

NO

▶Repair the wire between the HECU and the wheel speed sensor.

DTC C1201 FL SNSR-RANGE/PERFORMANCE

DESCRIPTION E0AE6F1C

This code shows in case that a speed signal from any of the 4 wheel speed sensors does not match to the others at any speed.

DTC DETECTING CONDITION

DTC No	Condition	Possible Cause
C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	**Speed Jump :** This monitoring is performed for the period that the velocity of each wheel exceeds 2km/h. - Controller counts the number of the wheel acceleration of 100g[(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. - Controller counts the number of the wheel acceleration of 40g[(10km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or When the numbers at more two wheels exceed 20 times, controller recognize the failure. - Controller counts the number of the wheel deceleration of -100g[(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. - The wheel deceleration of -100g[(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. - In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or When the numbers of 40g at each wheel exceed 20 times, controller recognize the failure. - The counter of speed jump is cleared every 30min. **Wrong Exciter :** - Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. if this condition is lasted for 2 minutes. - Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. if this condition is lasted for 2 minutes. - Faulty installing of wheel speed sensor	- Open/short in circuit of wheel speed sensor - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

FAILSAFE FUNCTION

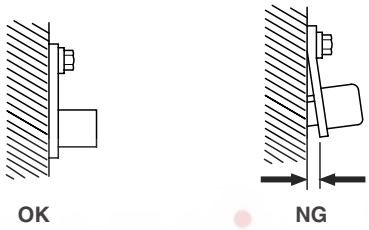
Sensor malfunction without ABS control :
- One wheel sensor malfuntion
Only the ABS, TCS(ESP) functions are inhibited. the ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp is OFF.
- More than two wheels malfunction
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. the ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.
Sensor malfunction with ABS control :
- One front wheel malfunction
Inhibit the ABS control of a wheel with a malfunctioning sensor and maintain the ABS control of other wheels.
After the ABS control has completed, the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.
- One rear wheel malfunction
Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.

After the controller completes the ABS control, Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.
- More than two wheels malfunction.
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE ED2816B9

1. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.
   Visually check the installing of wheel speed sensors and rotors(see the table below)

Specification : 0.5~1.5mm



EJQE900L

DTC	Appropriate wheel sensor
C1201	Front - left wheel sensor
C1204	Front - right wheel sensor
C1207	Rear- left wheel sensor
C1210	Rear- right wheel sensor

NOTE

The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.

Is the air gap within the specification?

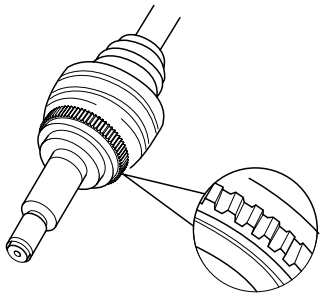
NO

▶Reinstall or replace, if neccessary, wheel speed sensors in trouble.

YES

▶Check sensor rotor and sensor tip.

2. CHECK SENSOR ROTOR AND SENSOR TIP
Check visually the sensor rotor and the sensor tip have scratches, missing teeth or foreign objects.



EJQE900M

Is it normal?

NO

1) Remove foreign objects form the sensor rotor and tip.

2) Replace the sensor rotor or the sheel speed sensor.

YES

▶After clearing the DTC and driving the vehicle at 40km/h speed or more, if the TCS(ESP) lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1202 FL WHEEL SPEED SNSR-NO SIGNAL

DESCRIPTION E7E79FBC

This code shows in case that there is no signal from any of the wheel speed sensors caused by an air gap, etc.

DTC DETECTING CONDITION E37C66C4

DTC No	Condition	**Possible**Cause
C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	**Large AirGap :** This monitoring is performed for the period that the minimum velocity rises from 2km/h to 10km/h. - When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h with the less than acceleration of 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their difference below 4km/h is continued for 140msec, Otherwise, if their difference beyond 4km/h or more than 0.4g is continued for 2 minutes. - In < 0.4g, when the velocity of more than two wheels is 2km/h and the max. wheel velocity exceeds 10km/h, the condition is continued for 20 sec. Otherwise, In more than 0.4g, the condition is 2 minutes. - After velocity of 4 wheel exceeds 10km/h, when velocity of 1 wheel or 2 wheel is 2km/h and difference of other 2 wheel velocity is less than 4km/h under that those velocity is more than 10km/h, if that conditions are continued for 12 seconds. **Long Term ABS mode :** - During the ABS control cycle, if the wheel velocity of 2km/h is lasted for more than 12sec. - If the ABS control cycle is continued for more than 36sec.	- Faulty installing of wheel speed sensor - Open/short in circuit of wheel speed sensor - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

FAILSAFE FUNCTION

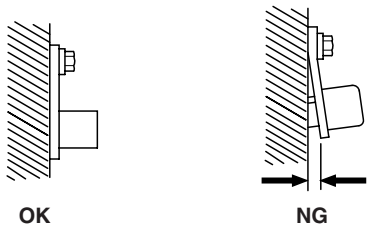
Sensor malfunction without ABS control :
- One wheel sensor malfuntion
Only the ABS, TCS(ESP) functions are inhibited. the ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp is OFF.
- More than two wheels malfunction
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. the ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

Sensor malfunction with ABS control :
- One front wheel malfunction
Inhibit the ABS control of a wheel with a malfunctioning sensor and maintain the ABS control of other wheels.
After the ABS control has completed, the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.
- One rear wheel malfunction
Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.
After the controller completes the ABS control, Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.
- More than two wheels malfunction.
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE EAD8C340

1. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.
   Visually check the installing of wheel speed sensors and rotors(see the table below).

Specification : 0.5~1.5mm



EJQE900L

DTC	Appropriate wheel sensor
C1202	Front - left wheel sensor
C1205	Front - right wheel sensor
C1208	Rear- left wheel sensor
C1211	Rear- right wheel sensor

NOTE

The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.

Is the air gap within the specification?

NO

▶Reinstall or replacece if neccessary, wheel speed sensors in trouble.

YES

▶Check resistance between terminals of wheel speed sensor.

2. CHECK RESISTANCE BETWEEN TERMINALS OF WHEEL SPEED SENSOR.

   1) Disconnect the HECU connector.

   2) Measure the resistance between wheel speed sensors(+) and (-) circuit terminals(see the table below).

DTC	TERMINAL	
	(+)side	(-)side
C1202 (Front - left)	1	2
C1205 (Front - right)	19	20
C1208 (Rear - left)	5	6
C1211 (Rear - right)	23	22

Is the resistance within less than 1Ω ?

YES

1)There is a short in the circuit between the HECU and the wheel speed sensor.
2)Replace the wheel speed sensor.

NO

▶Check speed of each wheel.

3. CHECK SPEED OF EACH WHEEL
Check if the speed of each of four wheel properly represents the speed of a vehicle, increasing the speed of the vehicle till 60km/h.
Is the speed of each wheel the same as that of the vehicle?

NO

1) Check any foreign objects on the rotor of the wheel in trouble.

2) Check if the exitor is genuine.

YES

After cleaning the DTC and driving the vehicle at 40 km/h speed or more, if the ABS warning lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1604 ECU HARDWARE ERROR

DTC DETECTING CONDITION E83D1CE8

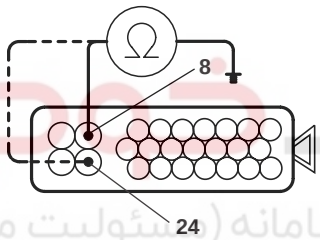
DTC No	Condition	Possible Cause
C1604	- When the MCU can't erase or write a data of the EEPROM. - If the master/slave processor detects abnormal operation in RAM, status register, interrupt, timer, A/D converter and cycle time.	- EEPROM Failure of HECU - MCU failure of HECU

FAILSAFE FUNCTION

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE EB6ACBE6

1. CHECK CIRCUIT FOR CONTINUITY BETWEEN THE HECU AND BODY GROUND.



EJQE900J

Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.
Is the resistance below 1Ω ?

NO

▶ Check and readjust the installing of the body groud.

YES

▶ After cleaning the DTC and driving the vehicle at 40 km/h speed or more, if the ABS warning lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C2112 VALVE RELAY MAL.

DESCRIPTION E4ED910E

The HECU makes the valve relay OFF, when the ignition switch is turned ON, but ON during its initial check.
The HECU checks the valve relay by checking the voltage of the valve power monitoring wire and comparing the signals from the valve relay. The HECU also checks continuity of the valve power monitoring wire.

DTC DESRIPTION E98D49AB

This code shows in case that there is no continuity of the valve power monitoring wire.

DTC DETECTING CONDITION E14DC7A9

DTC No	Condition	Possible Cause
C2112	- If the valve relay is switched on and the reference voltage of valve relay, less than 5±0.5V continuously for 56ms, the failure is detected. - If the valve relay is switched off and the reference voltage of valve relay, more than 6±0.5V continuously for 56ms, the failure is detected. - If the valve relay is switched off and all solenoid drivers are switched off and reference voltage of valve relay, less than 2.5±0.5V continuously for 56ms, , the failure is detected.	- Open/short in the value regal circuit - Faulty HECU

FAILSAFE FUNCTION

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

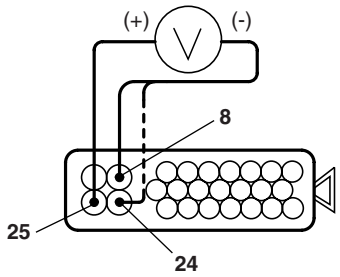
INSPECTION PROCEDURE EFB92415

1. CHECK POWER SOURCE OF MOTOR.

   1) Disconnect the connector from the HECU.

   2) Measure the voltage between the terminals 9(+) and 8(-), 24(-) of the HECU connector.

Specification: Battery positive(+)



EJQE900P

Is the voltage within the specification?

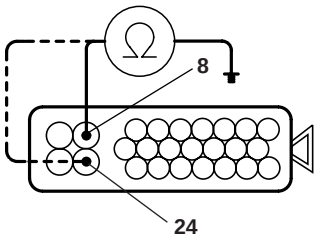
NO

1) Check ABS fuse (10A) and fusible link (30A).
2) Check and repair harness or connector.

YES

▶ Check circuit for conyinuty to ground.

2. CHECK CIRCUIT FOR CONTINUITY TO GROUND.



EJQE900J

1) Disconnect the connector from the HECU.
2) Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.

Is the resistance below 1Ω ?

NO

▶ Check and readjust the installing of the body ground.

YES

▶ Test motor actuation by using hi-scan (pro)

3. TEST MOTOR ACTUATION BY USING HI-SCAN (PRO).
Is the sound of motor operating heard?

YES

▶ Check repair, if necessary, harness and connector.

NO

▶ Replace the HECU then reckeck.

DTC C2380 ABS/TCS/ESP VALVE ERROR

DESCRIPTION EEF1A4FA

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.

DTC DESRIPTION E1B43BFA

This code shows in case that there is an open or short in the circuit of the solenoid coil or harness.

DTC DETECTING CONDITION E6C58F04

DTC No	Condition	Possible Cause
C2380	- If the valve relay is switched ON and corresponding solenoid driver OFF and the voltage of solenoid, less than 3.5±0.5V continuously for 56ms, the failure is detected. - If the valve relay is switched ON and corresponding solenoid driver ON and the voltage of solenoid, more than 1.5±0.5V continuously for 56ms, the failure is detected.	- Open/short in the solenoid valve circuit. - Faulty HECU

FAILSAFE FUNCTION

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE EBBB5E1D

1. CHECK THE DTC

   1) Clear the DTC using the Hi-Scan(pro).

   2) Turn the ignition wsitch OFF.

   3) Turn the ignition switch ON, and check if the same DTC is stored in the memory.

   Is the same DTC output?

   NO

   ▶ Problem is intermittent and the HECU memory was not cleared.

   YES

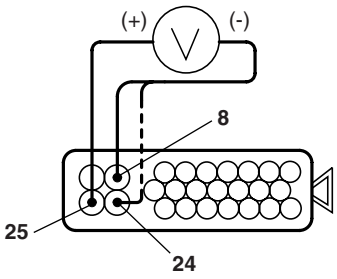
   ▶ Check power source of valve relay

2. CHECK POWER SOURCE OF VALVE RELAY

   1) Disconnect the connector from the HECU.

   2) Measure the voltage between the terminals 25 and 8, 24 of the HECU connector.

Specification: Battery positive(B+)



EJQE900P

Is the voltage within the specification?

NO

3) Check and replace fuse (10A) and fusible link (30A).

4) Check and repair harness or connector.

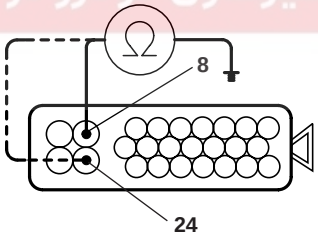
YES

▶ Check circuit for continuity to ground.

3. CHECK CIRCUIT FOR CONTINUITY TO GROUND.

1) Disconnect the connector from the HECU.

2) Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

▶ Check and readjust the installing of the body ground.

YES

▶ Replace the HECU then reckeck.

DTC C2402 MOTOR-ELECTRICAL

DESCRIPTION EE2899DB

When the ABS system operates, the HECU turns the ABS motor relay ON so that operates the ABS pump motor

DTC DESRIPTION E3266E63

This code shows in case that there is no signal to the motor monitering wire or an error on the motor power.

CAUTION

Keep a vehicle idling because the compulsive operating of the motor shall cause the discharge of the battery, when testing the actuator.

DTC DETECTING CONDITION EA9A5CEF

DTC No	Condition	Possible Cause
C2402	- If the motor relay is switched ON and motor voltage is 4V less than IGN voltage continued for 56ms, the failure is detected. - After 1.8sec from motor relay is switched OFF, the motor voltage is more than 4V continued for 1.8sec, the failure is detected. - After motor relay is switched OFF, motor voltage is measured. If the time which motor voltage less than 1V is less than evaluation time, the motor is reactivated for 500msec and the above check is performed again for a maximum of two times. When the motor voltage is not normal even on the second recheck, the controller recognizes it as failure. If the motor relay is swithched OFF and motor power supply voltage < 4V continued for 200ms, the failure is detected.	- Open/short in motor regal or motor circuit. - Motor lock - Faulty HECU

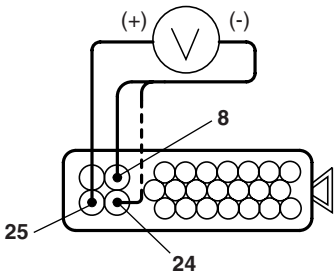
FAILSAFE FUNCTION

1. Motor error without the ABS control : only the ABS, TCS(ESP) functions are inhibited. The ABS,TCS(ESP) warning lamps are ON, but the EBD warning lamp OFF.
2. Motor error with the ABS control : inhibit the ABS control of front wheels, allow ABS control of the rear wheels. After the ABS control has completed, the ABS,TCS(ESP) warning lamps are ON.

INSPECTION PROCEDURE E42C81EF

1. CHECK POWER SOURCE OF MOTOR.
   1) Disconnect the connector from the HECU.
   2) Measure the voltage between the terminals 9(+) and 8(-), 24(-) of the HECU connector.

Specification: Battery positive(+)



EJQE900P

Is the voltage within the specification?

NO

3) Check ABS fuse (10A) and fusible link (30A).

4) Check and repair harness or connector.

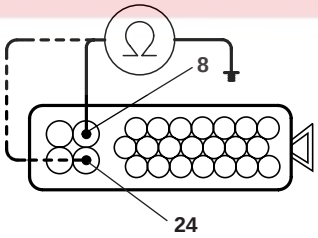
YES

▶ Check circuit for conyinuty to ground.

2. CHECK CIRCUIT FOR CONTINUITY TO GROUND.

1) Disconnect the connector from the HECU.

2) Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

▶ Check and readjust the installing of the body ground.

YES

▶ Test motor actuation by using hi-scan (pro)

3. TEST MOTOR ACTUATION BY USING HI-SCAN (PRO).
Is the sound of motor operating heard?

YES

▶ Check repair, if necessary, harness and connector.

NO

▶ Replace the HECU then reckeck.

DTC C1274 G SENSOR-ELECTRICAL

DTC DETECTING CONDITION EA92128E

DTC No	Condition	Possible Caese
C1274	When the voltage of Gsensor signal is more than 4.5V or less than 0.6V for 250msec continuously.	- Open/short in G-sensor circuit. - Faulty G-sensor - Faulty installing of G-sensor - Faulty HECU

FAILSAFE FUNCTION

Only the ABS, TCS(ESP) functions are inhibited. The ABS,TCS(ESP) warning lamps are ON, but the EBD warning lamp OFF.

INSPECTION PROCEDURE EEFA8F98

1. CHECK SHORT IN CIRCUIT TO BATTERY(+).

   1) Disconnect the connector from the HECU.

   2) Turn the ignition switch ON.

   3) Measure the voltage between terminal 13 of the HECU connector and the body ground.
   Is the voltage above 4.5V?

   YES

   ▶ Repair short in the circuit to battery(+) between the G-sensor and the HECU.

   NO

   ▶ Check short in circuit to ground.

2. CHECK SHORT IN CIRCUIT TO GROUND.

   1) Disconnect the connector from the HECU.

   2) Measure the resistance between terminal 13 of the HECU connector and the body ground.
   Is the resistance below 1Ω ?

   YES

   ▶ Repair short in the circuit to the body ground between the G-sensor and the HECU.

   NO

   ▶ Check output in HECU connector

3. CHECK OUTPUT IN HECU CONNECTOR.

   1) Disconnect the connector from the HECU and turn the ignition switch ON.

   2) Measure the voltage between terminals 13(+) and 15(-) of the HECU connector.
   Is the voltage within 0.6V ~ 4.5V?

YES

▶ Check the HECU harness or connector.

NO

▶ If necessary, replace the HECU then recheck.

4. CHECK OUTPUT IN G-SENSOR CONNECTOR.

1) Turn the ignition switch ON.

2) Measure the voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Specification: approximately 3.5V

Is the voltage within the specification?

NO

▶ Replace the G-sensor.

YES

▶ Replace the HECU then recheck.

DTC C1275 G SENSOR-SIGNAL

DTC DETECTING CONDITION E03E9EF1

DTC No	Condition	Possible Caese
C1275	- When vehicle speed is more than10km/h and the brake light switch is off, ' |G| > 0.5G' for 20sec continuously. - When ' |min. wheel speed| / dt ≥ 0.2G and |G| ≤ 0.1G' for 60sec continuously.	- Open/short in G-sensor circuit. - Faulty G-sensor - Faulty installing of G-sensor - Faulty HECU

FAILSAFE FUNCTION

Only the ABS, TCS(ESP) functions are inhibited. The ABS,TCS(ESP) warning lamps are ON, but the EBD warning lamp OFF.

INSPECTION PROCEDURE E89704AC

1. CHECK OPEN/SHORT IN CIRCUIT OF G-SENSOR.

   1) Turn the ignition switch ON.

   2) Measure the output voltage between terminals 2(+) and 3(-) of the G-sensor connector.

   Is the voltage within 0.6V ~ 4.5V?

   NO

   ▶ Repair an open or short in the circuit between the G-sensor and the HECU.

   YES

   ▶ Check installing of G-sensor

2. CHECK INSTALLING OF G-SENSOR
   Visually check for the intalling of the G-sensor.
   Be sure to install the G-sensor with the arrow mark to be facing forward direction.
   Is it installed correctly?

   NO

   ▶ Reinstall the G-sensor and recheck.

   YES

   ▶ Check output voltage in G-sensor connector

3. CHECK OUTPUT VOLTAGE IN G-SENSOR CONNECTOR.
Turn the ignition switch ON.
Measure the voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Specification : approximately 2.5V

Incline the G-sensor to 90 degrees angle then measure the voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Specification : approximately 3.5V

Is the voltage within the specification?

NO

▶ Replace the G-sensor.

YES

▶ Replace the HECU then recheck.

DTC C1503 TCS SWITCH ERROR

DESCRIPTION EEEA0F8B

The TCS(ESP) OFF switch is for ON/OFF of TCS(ESP) function.
When the TCS(ESP) OFF switch is pushed, the TCS(ESP) system stops and the TCS(ESP) OFF lamp is ON.

DTC DETECTING CONDITION E3E7E682

DTC No	Condition	Possible Cause
C1503	When the TCS/ESP switch is ON for 1 min.	- Open/short in TCS/ESP switch circuit. - Faulty TCS/ESP switch - Faulty HECU

FAILSAFE FUNCTION

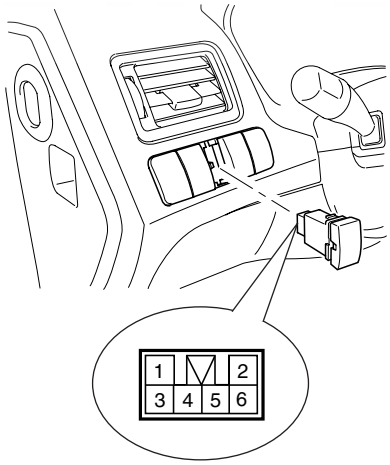
The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EACB53FF

1. CHECK TCS(ESP) OFF SWITCH

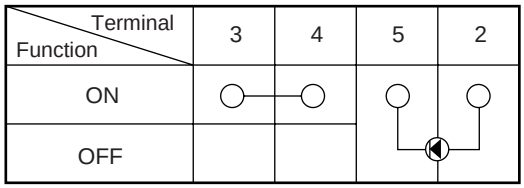
   1) Remove the TCS(ESP) OFF switch from the panel of the driver's side crashpad.

   2) Check for the continuity between the TCS(ESP) OFF switch terminals, when the TCS(ESP) OFF switch is ON.



KJQE900S

Is there continuity between terminals 3 and 4 of the TCS (ESP) switch connector?



EJQE900R

NO

▶ Replace with a new TCS(ESP) OFF switch.

YES

▶ Check short in circuit of TCS/ESP Switch

2. CHECK SHORT IN CIRCUIT OF TCS/ESP SWITCH

1) Remove the TCS(ESP) OFF switch from the panel of the driver's side crashpad.

2) After the ignition switch is ON, measure the voltage between terminal 3 of the TCS(ESP) OFF switch connector and the body ground.

Specification : Battery positive (B+)

Is the voltage within the specification?

NO

(1) Check and replace fuse(10A).
(2) Check and repair harness and connector.

YES

▶ Check open/short in circuit between TCS(ESP) OFF switch and the HECU.

3. CHECK OPEN/SHORT IN CIRCUIT BETWEEN TCS(ESP) OFF SWITCH AND THE HECU
Check an open or short in the circuit between terminal 3 of TCS(ESP) OFF switch connector and terminal 14 (ESP:27) of the HECU connector.
Is the circuit normal?

NO

▶ Check and repair the circuit between the switch and the HECU.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the TCS(ESP) lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1605 CAN CONTROL HARDWARE ERROR

DESCRIPTION E3D3DB24

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

DTC DESCRIPTION E863AF39

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

DTC DETECTING CONDITION ECDAED3A

DTC No	Condition	Possible Cause
C1605	In case that CAN has hardware failure.	- Faulty CAN bus

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1611 CAN TIME OUT-ECM

DESCRIPTION E70EFCC3

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.
This code shows in case that there is no signal to the CAN from EMS.

DRC DETECTING CONDITION ED68F1D5

DTC No	Condition	Possible Cause
C1611	1. In case that EMS1 or EMS2 message was not received for more than 500ms within normal voltage condition. 2. The monitoring starts 2000 ms after power up.	- Open/short in CAN bus circuit. - Faulty CAN bus - Faulty EMS - Faulty HECU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EAE95850

1. CHECK DTC DETECTED IN HI-SCAN

   1) Clear the DTC related to the CAN, from the EMS or TCU by using the HI-SCAN.

   2) Check if any DTC related to the CAN is detected again, when the ignition switch ON.

   Is any DTC related to the CAN, detected again?

   NO

   ▶ Problem is intermittent and the HECU memory was not cleared.

   YES

   ▶ Check open/short in sircuit of the CAN

2. CHECK OPEN/SHORT IN CIRCUIT OF THE CAN

   1) Check an open or short in the circuit between terminal 10 of the HECU connector and terminal 4 of PCM connector.

   2) Check an open or short in the circuit between terminal 11 of the HECU connector and terminal 7 of PCM connector.

   Is the circuit normal?

   NO

   ▶ Check and repair harness and connector.

   YES

   ▶ Check the PCM (refer to EE or TR group).

DTC C1612 CAN TIME OUT-TCU

DESCRIPTION EBC946DE

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.
This code shows in case that there is no signal to the CAN from TCU.

DRC DETECTING CONDITION EFABC46C

DTC No	Condition	Possible Cause
C1612	1. In case that TCU message was not received for more than 500ms within normal voltage condition.2. The monitoring starts 2000 ms after power up.	- Open/short in CAN bus circuit. - Faulty CAN bus - Faulty TCU - Faulty HECU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE E3CE617B

1. CHECK DTC DETECTED IN HI-SCAN

   1) Clear the DTC related to the CAN, from the EMS or TCU by using the HI-SCAN.

   2) Check if any DTC related to the CAN is detected again, when the ignition switch ON.

   Is any DTC related to the CAN, detected again?

   NO

   ▶ Problem is intermittent and the HECU memory was not cleared.

   YES

   ▶ Check open/short in circuit of the CAN

2. CHECK OPEN/SHORT IN CIRCUIT OF THE CAN

   1) Check an open or short in the circuit between terminal 10 of the HECU connector and terminal 4 of PCM connector.

   2) Check an open or short in the circuit between terminal 11 of the HECU connector and terminal 7 of PCM connector.

   Is the circuit normal?

   NO

   ▶ Check and repair harness and connector.

   YES

   ▶ Check the PCM (refer to EE or TR group).

DTC C1613 CAN WRONG MESSAGE

DESCRIPTION E85EB9EE

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.
This code shows in case that EMS misunderstands a vehicle with A/T to with M/T. In this case check if it is correct the information received from EMS by using the HI-SCAN.

DTC DETECTING CONDITION E454FDF8

DTC No	Condition	Possible Cause
C1613	1. In case that the information about transmission is different in the EMS2 and TCU within normal voltage condition.2. The monitoring starts 2000 ms after power up.	- Faulty CAN bus - Faulty EMS or TCM

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1616 CAN BUS OFF

DESCRIPTION E006C3B1

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

DTC DETECTING CONDITION EC3071B0

DTC No	Condition	Possible Cause
C1616	In case CAN BUS off state continued for more than 100ms.	- Open/short in CAN bus circuit. - Faulty CAN bus - Faulty HECU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EF4AB9B5

1. CHECK OPEN/SHORT IN CIRCUIT OF THE CAN

   1) Check an open or short in the circuit between terminal 10 of the HECU connector and terminal 4 of PCM connector.

   2) Check an open or short in the circuit between terminal 11 of the HECU connector and terminal 7 of PCM connector.

   Is the circuit normal?

   NO

   ▶ Check and repair harness and connector.

   YES

   ▶ Check the PCM (refer to EE or TR).

DTC C2227 EXCESSIVE TEMPERATURE OF BRAKE DISC

DESCRIPTION E8FC144F

The TCS controls the brake by using the motor pump.
When the TCS operates, The TCS detects overheating of the brake disk.

DTC DETECTING CONDITION E2AFC14E

DTC No	Condition	Possible Cause
C2227	1.When the calculated temperature of disc is higher than 500℃. 2.If the calculated temperature drops below 300℃, the controller recovers to normal state. 3.When IGN switched OFF, ECU calculate temperature of disc until calculated temperature drops below 80℃ by BATT1 power.	- Brake disc over working

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1112 SENSOR SOURCE VOLTAGE

DTC DETECTING CONDITION E54E9DCD

DTC No	Condition	Possible Cause
C1112	If the voltage of sensor power is out of the range of 5V±0.5V for 0.5sec, the failure is recognized.	- Faulty Sensor Power - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1235 PRESSURE SENSOR-ELECTRICAL

GENERAL DESCRIPTION E9C43F83

Master cylinder pressure sensor is used for detecting the pressure delivered to wheels when the brake system is working.

DTC DESCRIPTION EF021FEA

This code shows in case that there is an open or short in the circuit of the pressure sensor.

DTC DETECTING CONDITION EBD8367C

DTC No.	Detecting Condition	Possible Cause
C1235	1. When VMCP > 4.8V or VMCP < 0.2V continue 1second, 2. The Monitoring starts 1 sec after Power Up.	- Open/Short in the pressure sensor circuit - Faulty the pressure sensor - Faulty installing of the pressure sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EDE2DC8B

1. CHECK INSTALLING OF PRESSURE SENSOR

   1) Check if the pressure sensor is properly installed on the master cylinder.
   Is the pressure sensor installed properly?

   NO

   ▶ Reinstall the pressure sensor properly.

   YES

   ▶ Check power of pressure sensor

2. CHECK POWER OF PRESSURE SENSOR

   1) Disconnect the pressure sensor connector, and measure the voltage between terminals 1(-) and 3(+) of the pressure sensor connector.

Specification : 4.8~5.2 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the pressure sensor.

YES

▶ Check output voltage of pressure sensor

3. CHECK OUTPUT VOLTAGE OF PRESSURE SENSOR

1) Measure the voltage between terminal 2 of the pressure sensor connector and the body ground.

Specification : 0.5~4.5V

Is the output voltage within the specification?

NO

▶ Check harness and connector of the pressure sensor. If no error on the harness and the connector, replace the pressure sensor and recheck.

YES

▶ Check output voltage of HECU connector

4. CHECK OUTPUT VOLTAGE OF HECU CONNECTOR

1) Measure the voltage between terminal 12 of the HECU connector and the body ground.

Specification : 0.5~4.5V

Is the voltage within the specification?

NO

▶ Repair harness and connector between the HECU and the pressure sensor.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1237 PRESSURE SENSOR-SIGNAL FAULT

GENERAL DESCRIPTION E3A85118

Master cylinder pressure sensor is used for detecting the pressure delivered to wheels when the brake system is working.

DTC DESCRIPTION E5E8D9BD

This code shows in case that there is an irregular or no signal of the pressure sensor.

DTC DETECTING CONDITION EBCB3621

DTC No.	Detecting Condition	Possible Cause
C1237	1. If input signal is noisy, which the gradient of the sensor signal is larger than predefined value, the failure is recognized. 2. Outside an ABS/BTCS control, correlation of the vehicle deceleration and the pressure sensor signal is evaluated, if it is not reasonable ECU detect the failure. 3. When the vehicle speed is higher than predefined value and pressure signal is higher than predefined value, if there is no variation of the pressure sensor signal for predefined time ECU detect the failure.	- Open/Short in the pressure sensor circuit - Faulty the pressure sensor - Faulty installing of the pressure sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE E7EDE430

1. CHECK INSTALLING OF PRESSURE SENSOR
   Check if the pressure sensor is properly installed on the master cylinder.
   Is the installing proper ?

   NO

   ▶ Reinstall the pressure sensor properly.

   YES

   ▶ Check power of pressure sensor

2. CHECK POWER OF PRESSURE SENSOR
   Disconnect the pressure sensor connector, and measure the voltage between terminals 1 and 3 of the pressure sensor connector.

Specification : 4.8~5.2 V

Is the power voltage within the specification?

NO

▶ Check harness and connector between the HECU and the pressure sensor.

YES

▶ Check output voltage of pressure sensor

3. CHECK OUTPUT VOLTAGE OF PRESSURE SENSOR
Measure the output voltage between terminal 2 of the pressure sensor connector and the body ground.

Specification : 0.5~4.5V

Is the output voltage within the specification?

NO

▶ Check harness and connector of the pressure sensor. If no error on the harness and the connector, replace the pressure sensor and recheck.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1259 STEERING ANGLE SENSOR-ELECTRICAL

GENERAL DESCRIPTION E28D21CD

Steering angle sensor is a plate between the photo-controller LED and the photo transistor. As the plate rotates with steering wheel rotation, electrical signal will be generated depending on whether the LED light passes through the plate to the photo-transistor or not. The signal is the steering wheel operation angular velocity and used to detect the steering wheel turning direction.

DTC DESCRIPTION E873FFCD

This code shows in case that there is an open or short in the circuit of the steering angle sensor.

DTC DETECTING CONDITION EAB0A7CF

DTC No.	Detecting Condition	Possible Cause
C1259	1.When Vsas > 4.4 or Vsas < 1.1 or 2.3V < Vsas < 2.7V continue 1sec, 2.The Monitoring starts 1 sec after Power Up.	- Faulty steering angle sensor - Faulty installing of steering angle sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EF8AA4DA

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

   NO

   ▶ Reinstall the steering angle sensor properly.

   YES

   ▶ Check power of steering angle sensor

2. CHECK POWER OF STEERING ANGLE SENSOR
   Disconnect the steering angle sensor connector, and measure the voltage between terminals 2 and 3 of the steering angle sensor connector.

Specification : 9~16 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the steering angle sensor.

YES

▶ Check output voltage of steering angle sensor

3. CHECK OUTPUT VOLTAGE OF STEERING ANGLE SENSOR
Measure the voltage between terminal 1,4, and 5 of the steering angle sensor connector and the body ground.

Specification : High : 3.0~4.1V Low : 1.3~2.0V

Is the voltage within the specification?

NO

▶ Check harness and connector of the steering angle sensor. If no error on the harness and the connector, replace the steering angle sensor and recheck.

YES

▶ Check output of HECU connector

4. CHECK OUTPUT OF HECU CONNECTOR
Measure the voltage between terminal 8,40, and 39 of the HECU connector and the body ground.

Specification : High : 3.0~4.1V Low : 1.3~2.0V

Is the voltage within the specification?

NO

▶ Repair harness and connector between the HECU and the steering angle sensor.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1260 STEERING ANGLE SNSR-SIGNAL

GENERAL DESCRIPTION ECFB6A6D

Steering angle sensor is a plate between the photo-controller LED and the photo transistor. As the plate rotates with steering wheel rotation, electrical signal will be generated depending on whether the LED light passes through the plate to the photo-transistor or not. The signal is the steering wheel operation angular velocity and used to detect the steering wheel turning direction.

DTC DESCRIPTION EDDBDF63

This code shows in case that there is an irregular or no signal of the steering angle sensor.

DTC DETECTING CONDITION E335CEEF

DTC No.	Detecting Condition	Possible Cause
C1260	1. When the steering wheel is turned more than 36 degrees, if neutral signal is maintained ECU detects the failure. 2. When the steering wheel is turned more than 364 degrees, if neutral signal is not detected, ECU detects the failure. 3.When the steering wheel angle is larger than 700 degrees ECU detects the failure. 4.During straight driving, if the steering wheel angle is larger than predefined degree ECU detects the failure. 5. When the vehicle speed is higher than 15km/H and reference steering wheel angle is larger than ±15 degrees, if there is no variation of the steering wheel angle for predefined time ECU detect the failure.	- Open/short in circuit of steering angle sensor - Faulty steering angle sensor - Faulty installing of steering angle sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EE69E4EF

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

   NO

   ▶ Reinstall the steering angle sensor properly.

   YES

   ▶ Check power of steering angle sensor

2. CHECK POWER OF STEERING ANGLE SENSOR
   Disconnect the steering angle sensor connector, and measure the voltage between terminal 2 and 3 of the steering angle sensor connector.

Specification : 9~16 V

   Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the steering angle sensor.

YES

▶ Check output signal of steering angle sensor

3. CHECK OUTPUT SIGNAL OF STEERING ANGLE SENSOR

1) Check if both ST1 and ST2 alternate High and Low signal, rotating the wheel.

2) Check if STN has Low signal, rotating the wheel at 360 degree in one direction.
Is the signal of the steering angle sensor normal?

NO

▶ Check harness and connector of the steering angle sensor. If no error on the harness and the connector, replace the steering angle sensor and recheck.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1282 YAW RATE & LATERAL G SENSOR-ELECTRICAL

GENERAL DESCRIPTION EBE9B1F3

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

DTC DESCRIPTION E87EAFFC

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

DTC DETECTING CONDITION E1ACB797

DTC No.	Detecting Condition	Possible Cause
C1282	[Yaw Rate Sensor Open, short to GND, B+] 1) When Vyaw > 4.85V or Vyaw < 0.15V continue 1sec, 2) The Monitoring starts 1 s after Power Up [Lateral G Sensor Open, Short to GND, B+] 1) When Vlg > 4.85V or Vlg < 0.15V continue 1sec, 2) The Monitoring starts 1 s after Power Up	- Yaw Rate & Lateral G Sensor Open, short to GND - Faulty Yaw Rate & Lateral G Sensor - Faulty HECU

INSPECTION PROCEDURE E5CE5406

1. CHECK POWER OF YAW-RATE & LATERAL G SENSOR
   Disconnect the connector from the yaw-rate& Lateral G sensor, and measure the voltage between terminals 3 and 4 of the yaw-rate& Lateral G sensor.

Specification : 4.75~5.25 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

▶ Check output of yaw-rate & lateral G sensor

2. CHECK OUTPUT OF YAW-RATE & LATERAL G SENSOR

   1) When the ignition switch is OFF, measure the voltage between terminal 1 of the yaw-rate sensor connector and the body ground.

   2) When the ignition switch is OFF, measure the voltage between terminal 2 of the lateral G sensor connector and the body ground.

Specification : 2.25~2.75V

Is the voltage within the specification?

NO

▶ Check harness and connector of the yaw-rate & lateral G sensor. If no error on harness and connector, replace and recheck the yaw-rate & lateral G sensor.

YES

▶ Check output voltage of HECU connector for yaw-rate & lateral G sensor

3. CHECK OUTPUT VOLTAGE OF HECU CONNECTOR FOR YAW-RATE G SENSOR

1) When the ignition switch is OFF, measure the output voltage between terminal 41 of the HECU connector and the ground.

2) When the ignition switch is OFF, measure the output voltage between terminal 9 of the HECU connector and the ground.

Specification : 2.25~2.75V

Is the output voltage within the specification?

NO

▶ Repair harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1283 YAW RATE & LATERAL G SENSOR-SIGNAL

GENERAL DESCRIPTION E05E02A0

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

DTC DESCRIPTION E6557F1A

This code shows in case that there is an irregular or no signal of the yaw-rate & lateral G sensor.

DTC DETECTING CONDITION EC2FDDBE

DTC No.	Detecting Condition	Possible Cause
C1283	[Yaw Rate Sensor offset error, noisy signal, stick] 1) During standstill if yaw rate value is larger than predefined value, the failure is recognized. 2)If input signal is noisy, which the gradient of the sensor signal is larger than predefined value, the failure is recognized. If the difference between estimated value and measured value of the sensor is larger than predefined value for predefined time, the failure is recognized. [Lateral G Sensor offset error, noisy signal, stick] 1)If input signal is noisy, which the gradient of the sensor signal is larger than predefined value, the failure is recognized. 2) If the difference between estimated value and measured value of the sensor is larger than predefined value for predefined time, the failure is recognized.	- Yaw Rate & Lateral G Sensor Open, short to GND - Faulty Yaw Rate & Lateral G Sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EE5B94BD

1. CHECK POWER OF YAW-RATE & LATERAL G SENSOR
   Disconnect the connector from the yaw-rate& Lateral G sensor, and measure the voltage between terminal 3 and 4 of the yaw-rate& Lateral G sensor.

Specification : 4.75~5.25 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

▶ Check output of yaw-rate & lateral G sensor

2. CHECK OUTPUT OF YAW-RATE & LATERAL G SENSOR

1) When the ignition switch is OFF, measure the output voltage between terminal 1 of the yaw-rate sensor connector and the body ground.

2) When the ignition switch is OFF, measure the output voltage between terminal 2 of the lateral G sensor connector and the body ground.

Specification : 2.25~2.75V

Is the output voltage within the specification?

NO

▶ Check harness and connector of the yaw-rate & lateral G sensor. If no error on harness and connector, replace and recheck the yaw-rate & lateral G sensor.

YES

▶ Check output voltage of HECU connector for yaw-rate & lateral G sensor

3. CHECK OUTPUT VOLTAGE OF HECU CONNECTOR FOR YAW-RATE G SENSOR

1) When the ignition switch is OFF, measure the output voltage between terminal 41 of the HECU connector and the body ground.

2) When the ignition switch is OFF, measure the output voltage between terminal 9 of the HECU connector and the body ground.

Specification : 2.25~2.75V

Is the output voltage within the specification?

NO

▶ Repair harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

▶ Check output of yaw-rate & lateral G sensor when vehicle cornering

4. CHECK OUTPUT OF YAW-RATE G SENSOR WHEN VEHICLE CORNERING.
Check if any change of the voltage of the yaw-rate & lateral G sensor, when a vehicle is cornering.
Is there any change of the voltage of the sensor?

NO

▶ Replace and recheck the yaw-rate & lateral G sensor.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1513 BRAKE LIGHT SWITCH MAL.

GENERAL DESCRIPTION EBE3CB3A

The brake lamp switch is a normal-open(NO) type, and the brake switch is a normal-close(NC) type.

DTC DESCRIPTION EFD01941

This code shows in case that there is an open or short in the circuit of the brake switch, or an error on the brake switch.

DTC DETECTING CONDITION E2072EDD

DTC No.	Detecting Condition	Possible Cause
C1513	If both brake lamp switch and brake switch have a same state for predetermined time, the failure is recognized.	- Brake switch Open, short to GND - Faulty brake switch - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE ED30545C

1. CHECK OPEN/SHORT IN CIRCUIT OF BRAKE SWITCH

   1) Disconnect the connector from the HECU, and measure the voltage between terminal 21 of the HECU connector and the body ground, not pushing the brake pedal.

Specification : Battery (B+)

   2) Disconnect the connector from the HECU, and measure the voltage between terminal 21 of the HECU connector and the body ground, pushing the brake pedal.

Specification : 0V

   Is the voltage within the specification?

   NO

   ▶ Repair harness and connector of the brake switch.

   YES

   ▶ Check open/short in circuit of brake lamp switch

2. CHECK OPEN/SHORT IN CIRCUIT OF BRAKE LAMP SWITCH

   1) Disconnect the connector from the HECU, and measure the voltage between terminal 5 of the HECU connector and the body ground, not pushing the brake pedal.

Specification : 0V

2) Disconnect the connector from the HECU, and measure the voltage between terminal 21 of the HECU connector and the body ground, pushing the brake pedal.

Specification : Battery (B+)

Is the voltage within the specification?

NO

▶ Repair harness and connector of the brake lamp switch.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

BLEEDING OF BRAKE SYSTEM E94DD4ED

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 (A) and fill the brake reservoir with brake fluid.

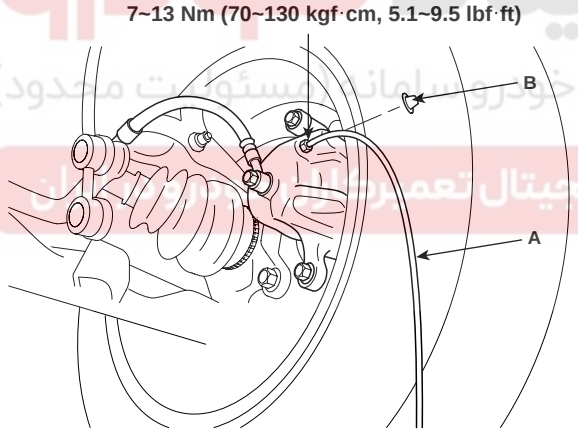
CAUTION

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

NOTE

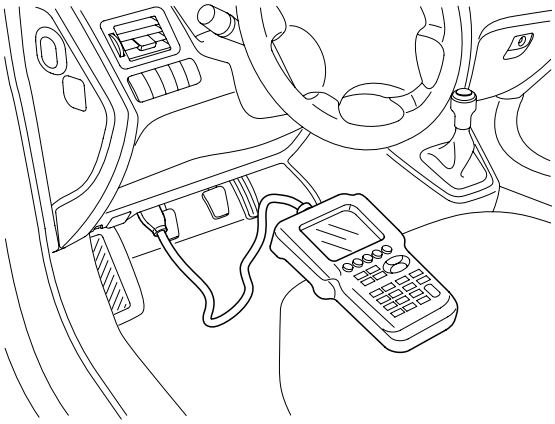
When pressure bleeding, do not depress the brake pedal.
Recommended fluid..... DOT3 or DOT4

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



EJQE620C

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



KRQE900A

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

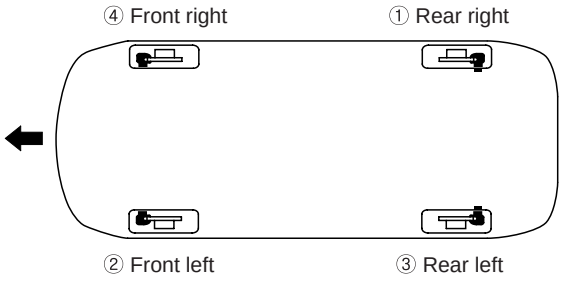
6) Wait 60 sec. before operating the air bleeding. (If not, you may damage the motor.)

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

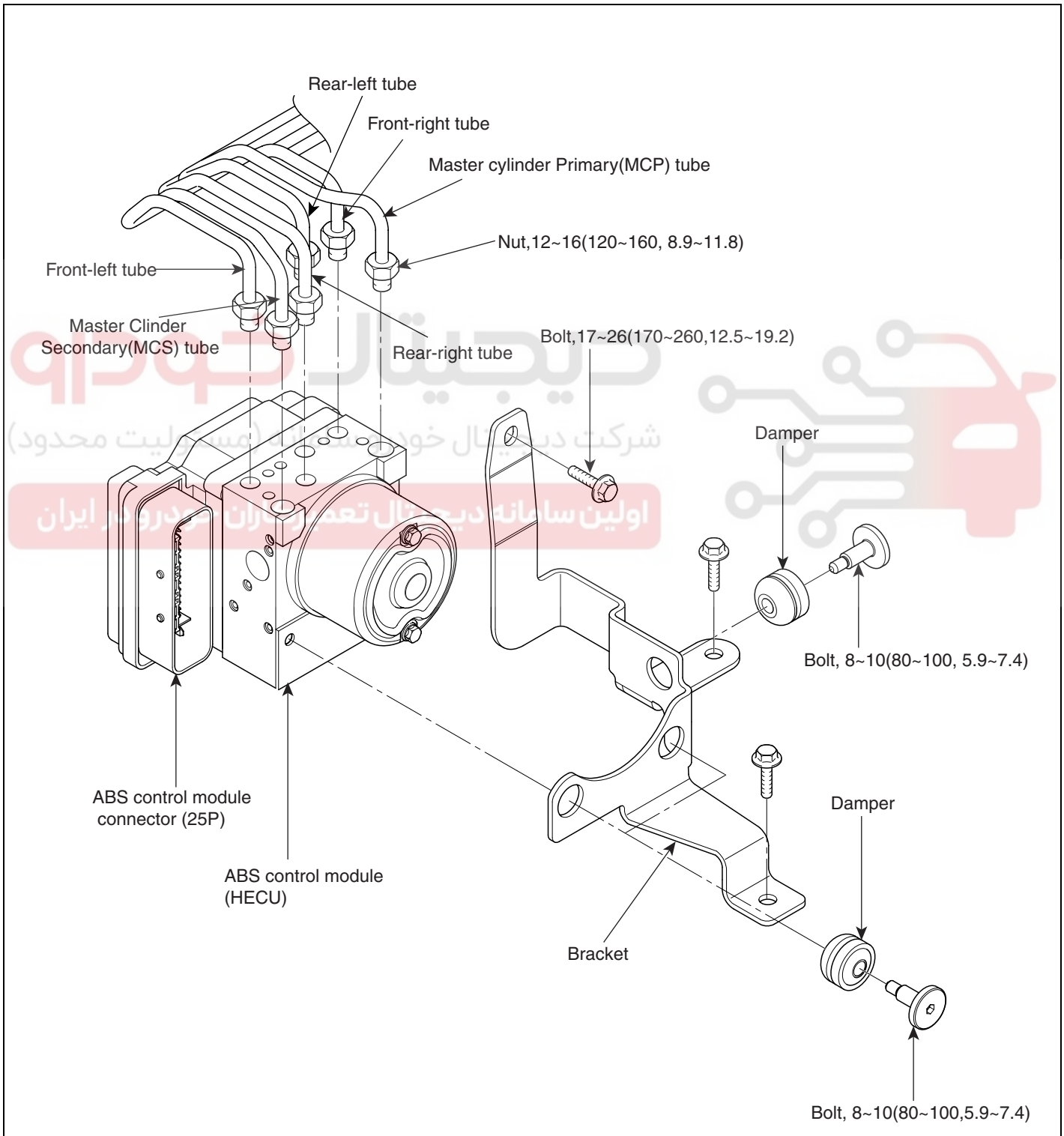
7. Tighten the bleeder screw.

Bleed screw tightening torque:
7~13 Nm (70 ~130 kg·cm, 5.1 ~ 9.5 lb·ft)

ABS (ANTI-LOCK BRAKE SYSTEM)

ANTI-LOCK BRAKING SYSTEM CONTROL MODULE

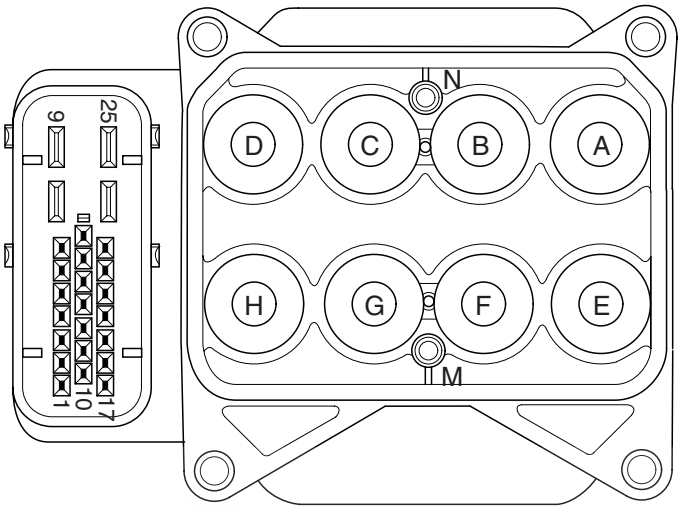
COMPONENTS EEB94182



TORQUE : Nm(Kgf·cm,lbf·ft)

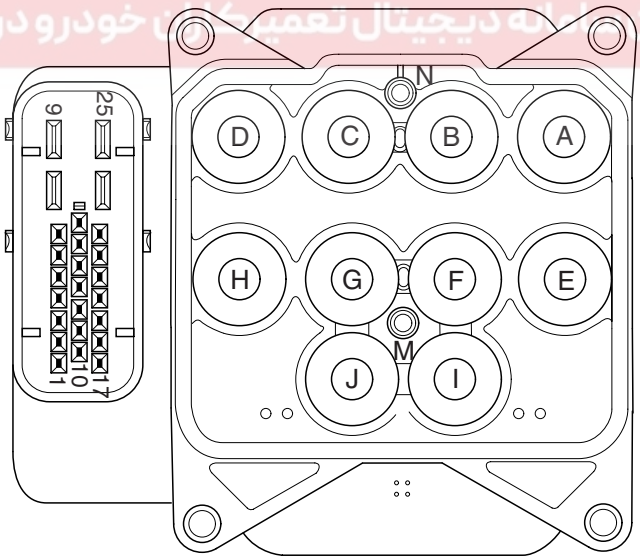
HECU EXTERNAL DIAGRAM EB66A90A

[ABS ECU]



A : INLET VALVE(FR)
B : INLET VALVE(RL)
C : INLET VALVE(RR)
D : INLET VALVE(FL)
E : OUTLET VALVE(FR)
F : OUTLET VALVE(RL)
G : OUTLET VALVE(RR)
H : OUTLET VALVE(FL)
M :MONITER(+)
N : MOTER(GND)

[TCS ECU]

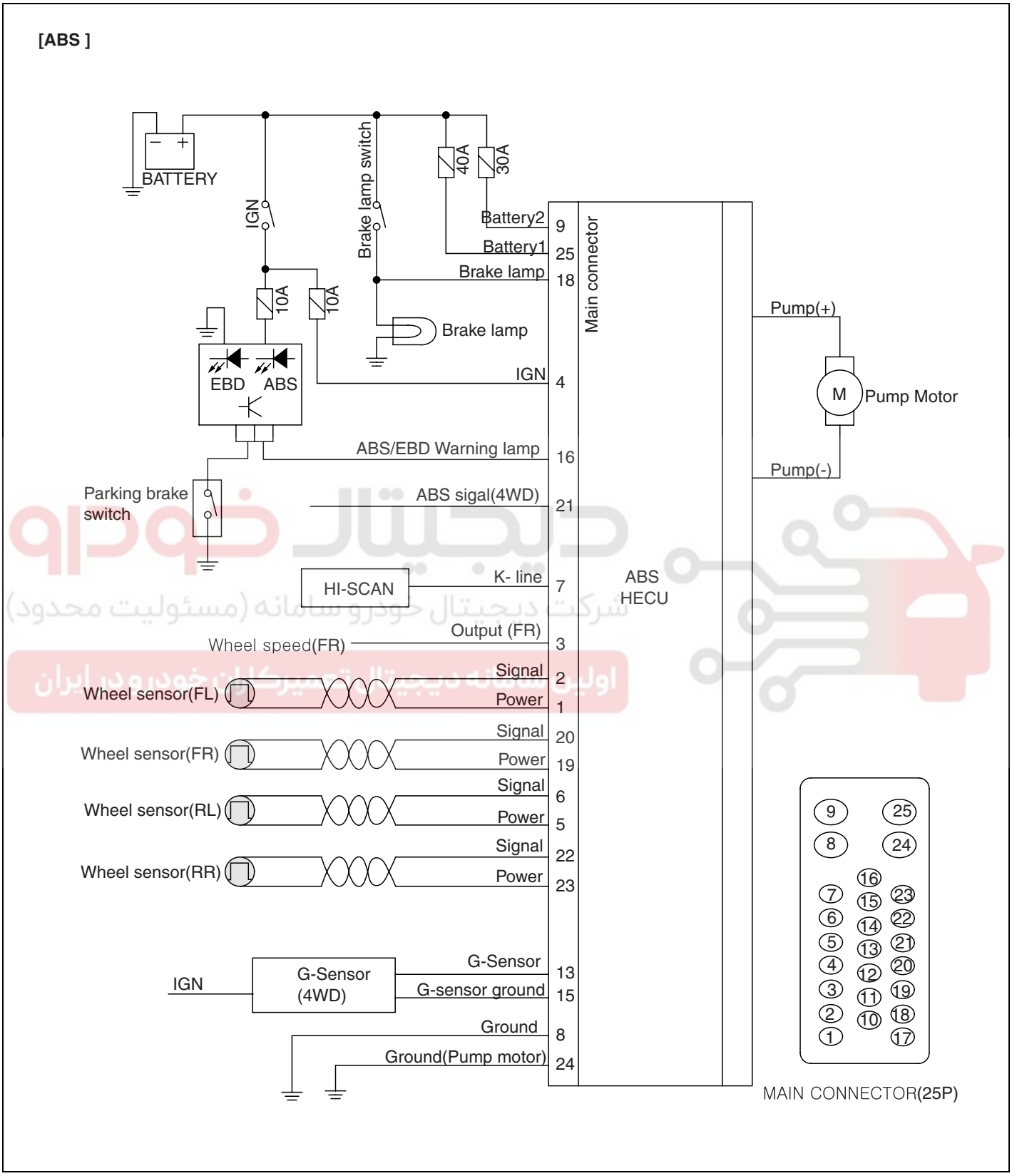


A : INLET VALVE(FR)
B : INLET VALVE(RL)
C : INLET VALVE(RR)
D : INLET VALVE(FL)
E : OUTLET VALVE(FR)
F : OUTLET VALVE(RL)
G : OUTLET VALVE(RR)
H : OUTLET VALVE(FL)
I : TRACTION VALVE(TCR)
J : TRACTION VALVE(TCL)
M : MOTER(+)
N : MOTER(GND)

EJQE220D

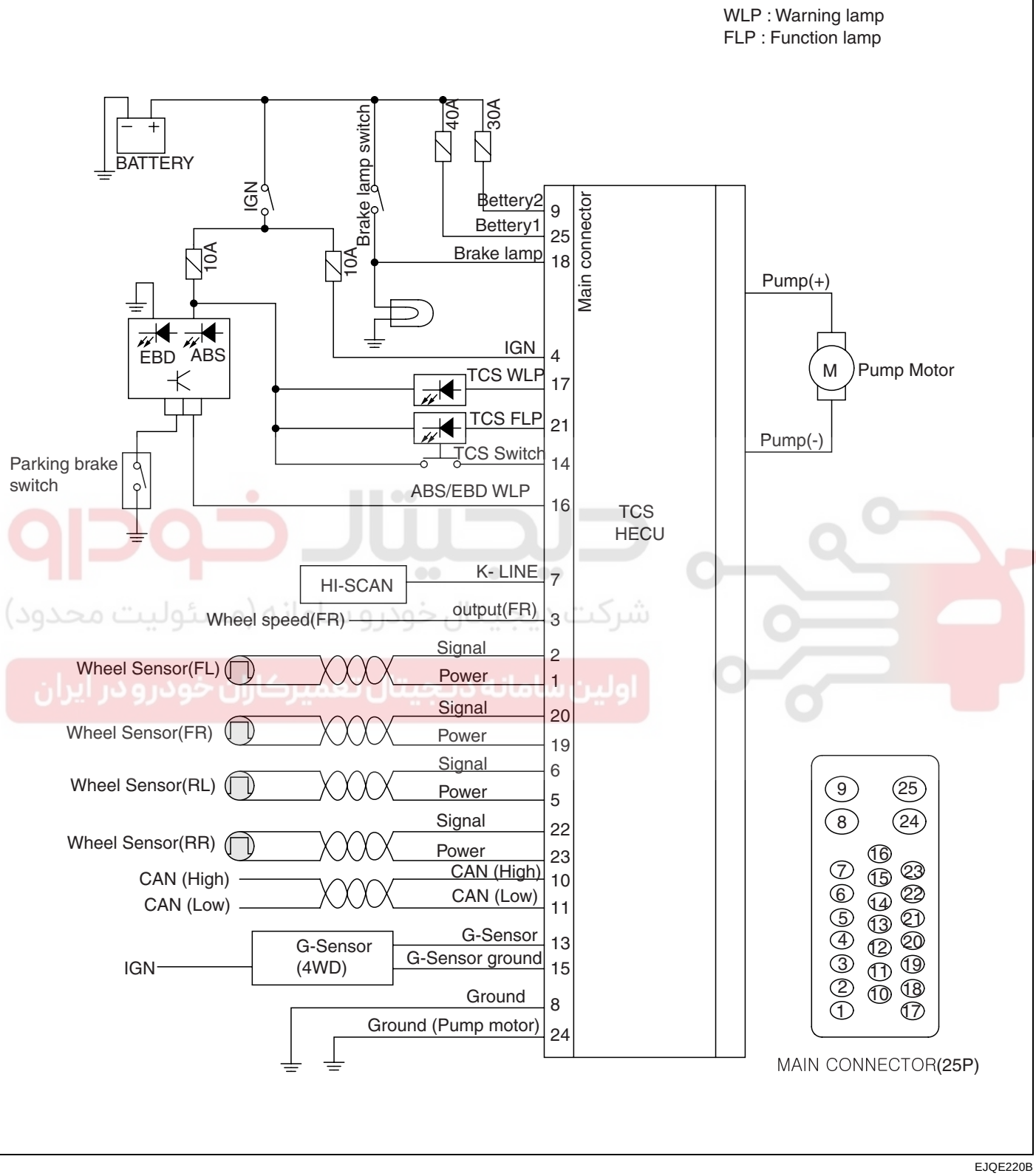
CIRCUIT DIAGRAM EAD2EF91

[ABS]



EJQE220A

[TCS]



EJQE220B

ABS/TCS CONNECTOR

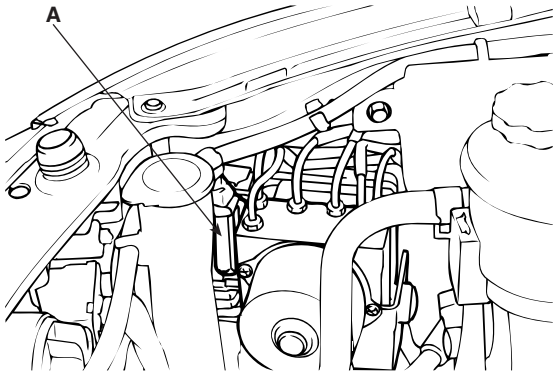
INPUT/OUTPUT EC9BE439

Connector Terminal		Specification	Remark
No	Description		
4	IGNITION1(+)	Over voltage range: 16.5±0.5V Operating voltage range: 9.5±0.5V < V < 16.5±0.5V Low voltage range: 7.0±0.5V < V < 9.5±0.5V Max. current: I < 300mA	
25	POS. BATTERY.(SOLENOID)	Max leakage current : I < 0.8mA Operating voltage range: 9.5±0.5V < V < 16.5±0.5V Max current : I < 30A	
9	POS, BATTERY.(MOTOR)	Operating voltage range: 9.5±0.5V < V < 16.5±0.5V Rush current : I < 100A Max current : I < 30A Max leakage current : I < 0.2mA	
8	GROUND	Rated current : I < 300mA Max. current: I < 30A	
24	PUMP MOTOR GROUND	Rush current : I < 100A Max current : I < 30A	
18	BRAKE LIGHT SWITCH	Input voltage low: 0V ≤ V ≤ 3.0V Input voltage High: 7.0V ≤ V ≤ 16.0V	
3	SENSOR FRONT RIGHT OUTPUT	Max current : I < 2mA External pull up resister : 10KW < R Output duty : 50 ±20%	
16	ABS/EBD W/LAMP DRIVE	Max. current: I < 200mA Max. output low voltage : V < 1.2V	
17	TCS W/LAMP DRIVE		with TCS
21	TCS F/LAMP DRIVE		with TCS
14	TCS ON/OFF SWITCH	- Input voltage low: 0V ≤ V ≤ 3.0V - Input voltage High: 7.0V ≤ V ≤ 16.0V - Max input current: I < 10mA	with TCS
11	CAN BUS LINE(LOW)	Max. current : I < 10mA	with TCS
10	CAN BUS LINE(HIGH)		
1	SENSOR FRONT LEFT POWER	- Output voltage : IGN[V] ± 1V - Output current : Max 30mA	
19	SENSOR FRONT RIGHT POWER		
5	SENSOR REAR LEFT POWER		
23	SENSOR REAR RIGHT POWER		
2	SENSOR FRONT LEFT SIGNAL	- Input current LOW : 5.9 ~8.4 ㎃ - Input current HIGH : 11.8 ~ 16.8 ㎃ - Frequency range : 1 ~ 2000 Hz - Input duty : 50 ±20%	
20	SENSOR FRONT RIGHT SIGNAL		
6	SENSOR REAR LEFT SIGNAL		
22	SENSOR REAR RIGHT SIGNAL		

21	ABS ACTIVE SIGNAL	Max. current : I < 200mA	with 4WD
13	G SENSOR SIGNAL	Input Voltage : 0≤ V≤ 5.0V	with 4WD
15	G SENSOR GROUND	Rated current : I < 10mA	
7	DIAGNOSIS INPUT/OUTPUT	Input voltage : VIL < 0.3 IGN[V] VIH > 0.7 IGN[V] Output voltage : VOL < 0.2 IGN[V] VOH > 0.8 IGN[V]	

REMOVAL E5632DAD

1. Disconnect the double lock (A) from the Hecu.



KJQE710D

2. Disconnect the brake tube from the HECU by unlocking the nuts centerclockwise with a spanner.

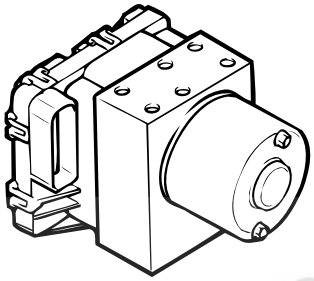
NOTE

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

3. Remove the three HECU brake mounting bolts disassembly the HECU with the bracket.

CAUTION

1. ***Never attemlt to disassemble the HECU.***
2. ***The HECU must be transported and stored in an upright podution and with the ports sealed.***



EJDA008B

4. Remove the three HECU mounting bolts and disassembly the HECU from the bracket.

INSTALLATION EECBFB33

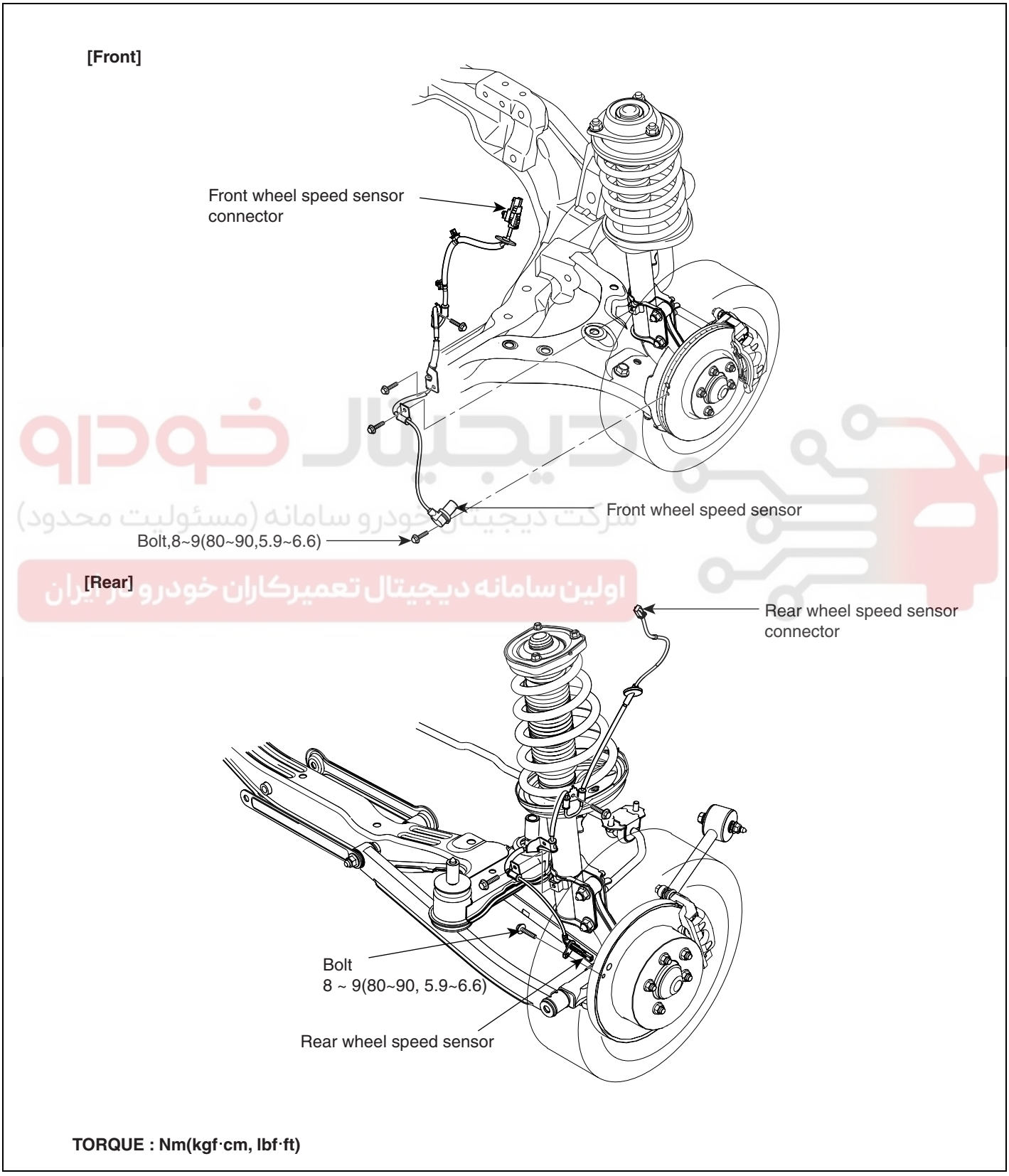
1. Installation is the reverse of removal.

2. Tighten the HECU mounting bolts and brake tube nuts to the specified torque.

Tighterning torque
HECU mounting bolt:
8~10Nm (80~100 kg·cm, 5.9~7.3 lbf·ft)
HECU braket mounting bolt:
17~26 Nm (170~260 kg·cm, 12.5~19.1 lbf·ft)
Brake tube nut:
13~17 Nm (130~170 kg·cm, 9.5~12.5 lbf·ft)

ANTI-LOCK BRAKING SYSTEM
WHEEL SPEED SENSOR

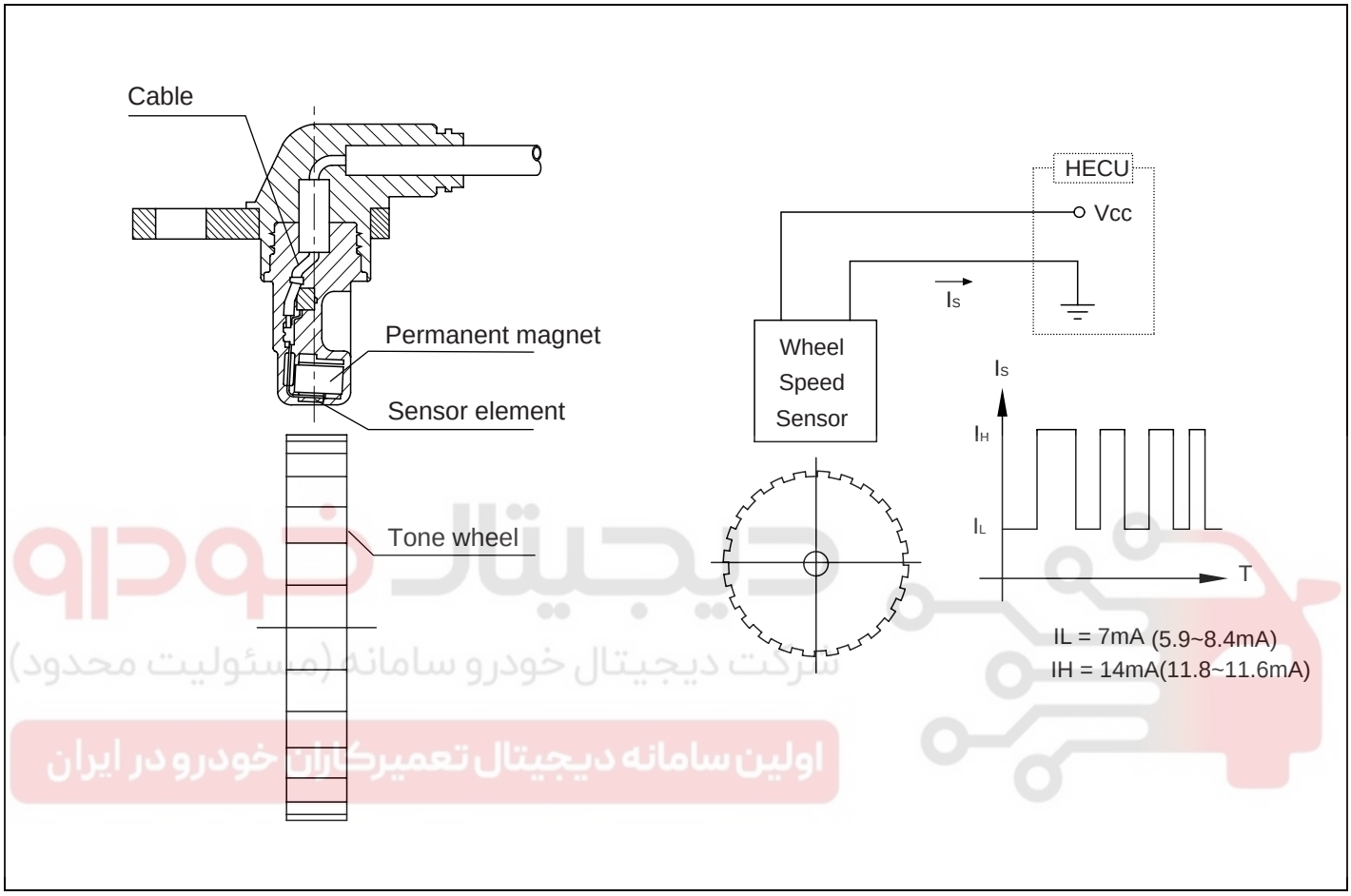
COMPONENTS EBDAF3AE



EJQE210B

DESCRIPTION E50EAAAA

A toothed rotor is fixed to the rotating member of the wheel, the sensor 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 correlated to the wheel speed.
The controller monitors the sensor signal, compares the four wheel-speed signals and initiates action as required.



EJQE206D

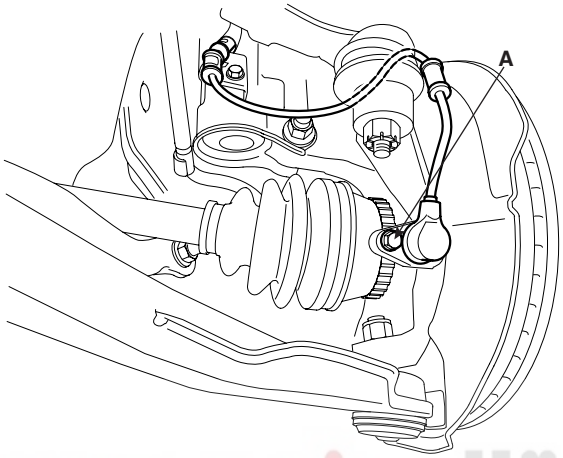
SPECIFICATIONS EF3ACFBF

Item		Stangard Value		Remark
Supply voltage		DC 12V		
Operating temperature		-40~120°C		R=100Ω
Output current range		Low		
		High	14mA(11.8~16.8mA)	
Fruency range		1~200 0Hz		
Airgap		0.5~1.5mm(0.0197~0.0591 in.)		
Tone wheel	Numper	48		

REMOVAL ECCAFD2C

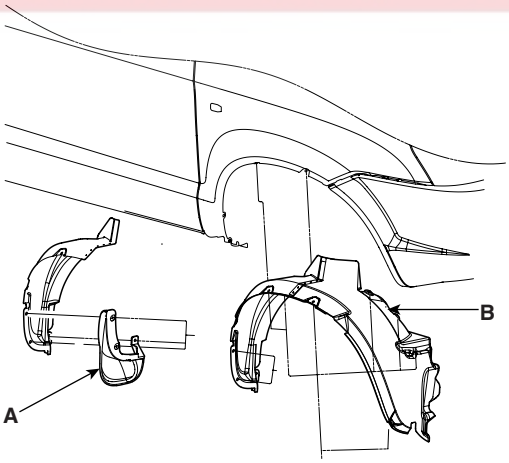
FRONT WHEEL SPEED SENSOR

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



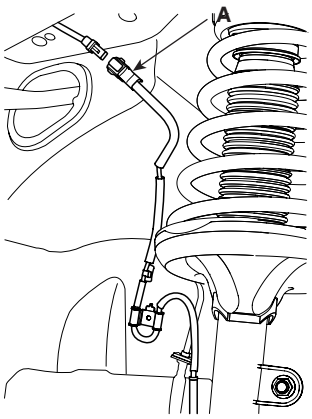
KJKD220A

2. Remove the front wheel guard (B), after removing the mud ground (A).



KJQE160C

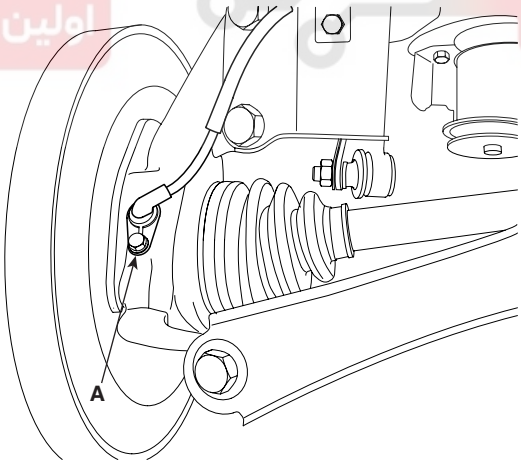
3. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector (A).



KJQE710A

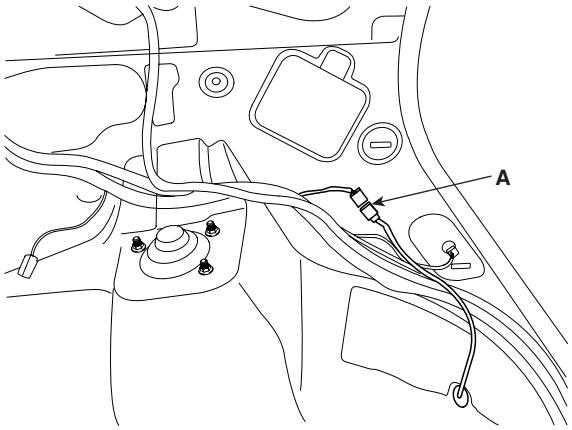
REAR WHEEL SPEED SENSOR

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



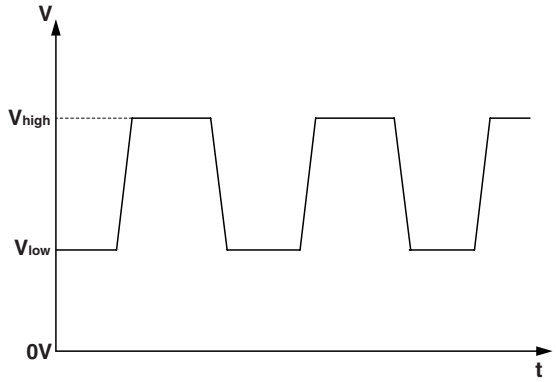
KJQE710B

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



KJQE710C

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



KJQE260B

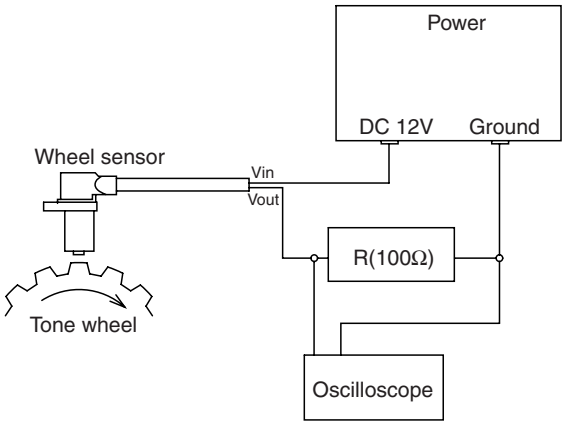
INSPECTION EAC8D334

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

CAUTION

Must use the resistance(100Ω), as shown below, in order to protect the active wheel speed sensor, before measuring the output voltage.

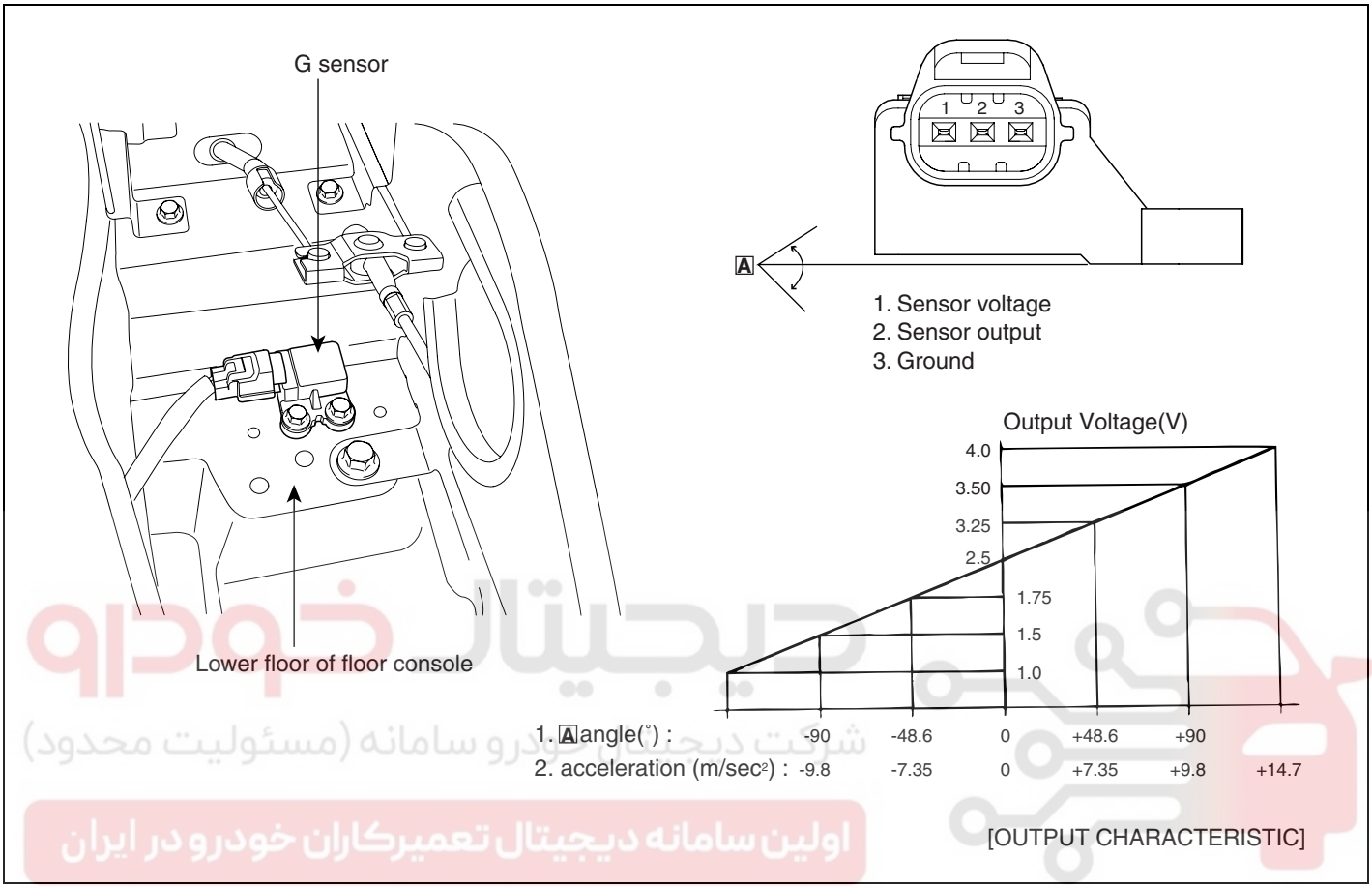
- V : 590mV ~ 840mV
- V : 1.18V ~ 1.68V
- Frequency range : 1~2,000Hz



EJQE260A

G SENSOR

COMPONENTS E385EB37

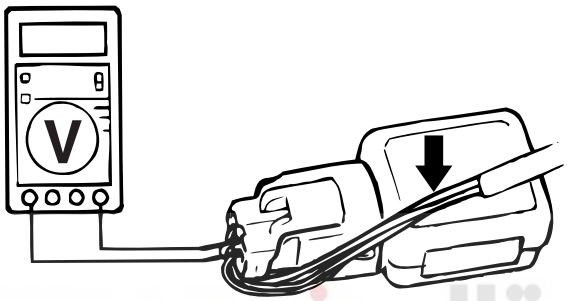


EJQE820A

INSPECTION E1CDFF4F

1. Connect a tester to both 2 and 3 terminals of the G sensor.
2. Measure the output voltage when IGN is on.

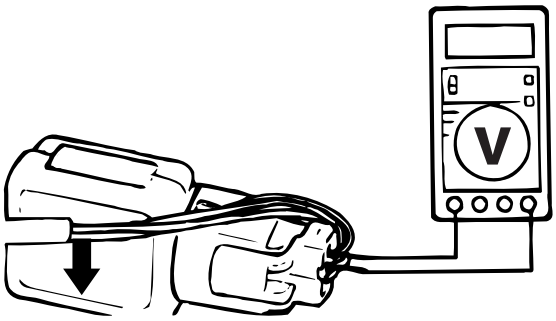
Specification : 2.5V



KJQE820D

3. Measure the output voltage between 2 and 3 terminals, posing the arrow mark on the G sensor downward.

Specification : 3.5V

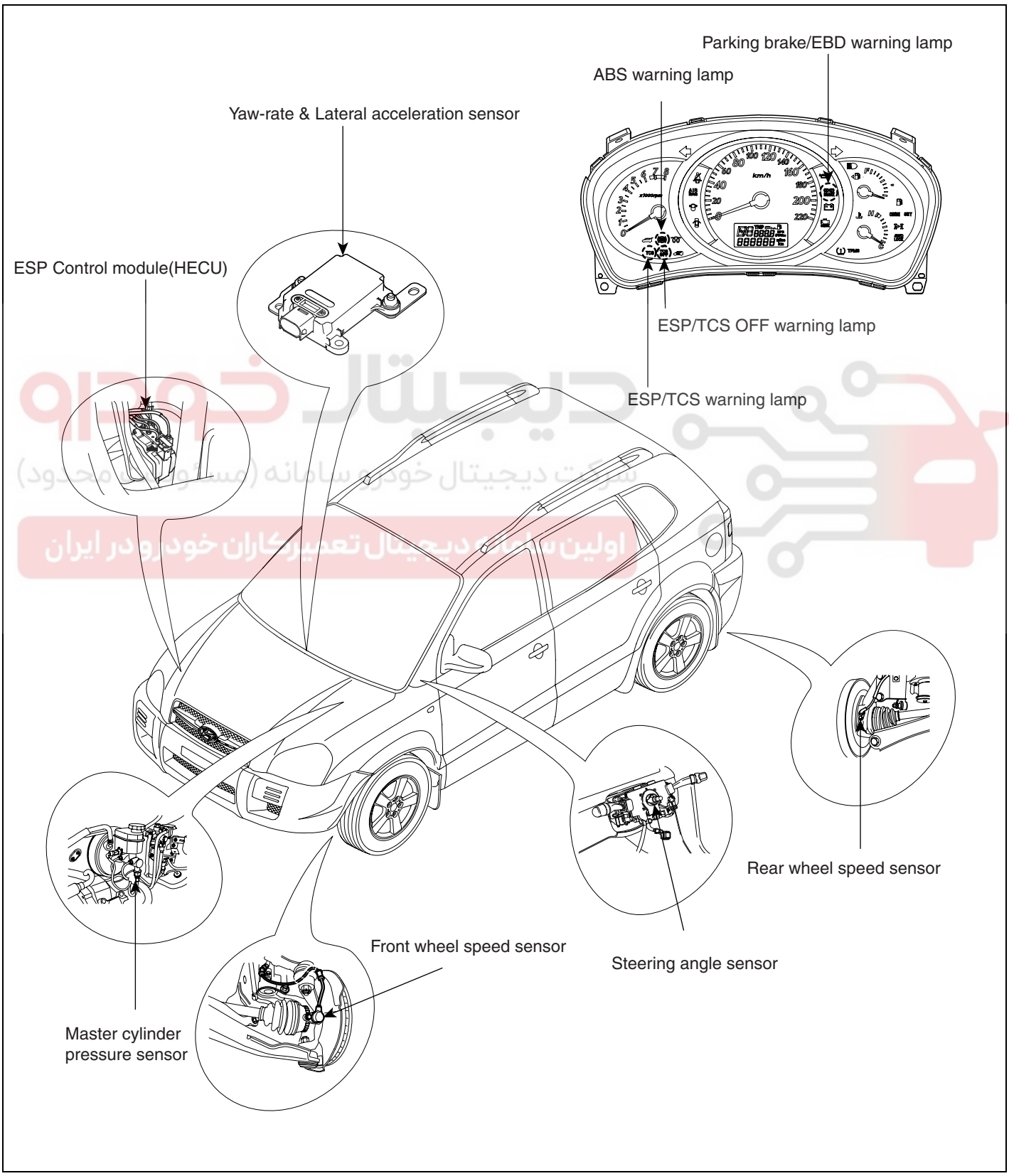


KJQE820C

4. Replace the G sensor if the output voltage is not on the specification.

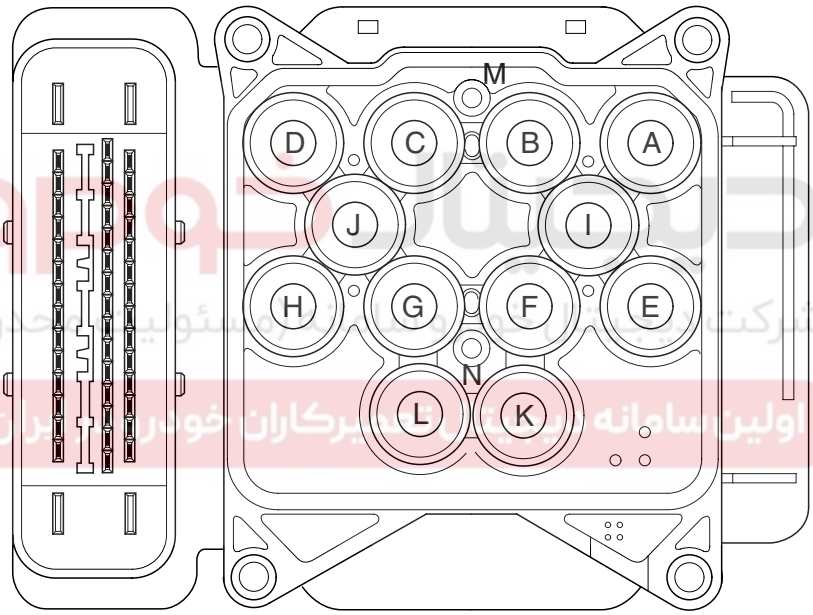
ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

COMPONENTS EA4A12D8



EJQE901A

ESP HECU EXTERNAL DIAGRAM EE4F7FEF



A : INLET VALVE(FR)
B : INLET VALVE(RL)
C : INLET VALVE(RR)
D : INLET VALVE(FL)
E : OUTPUT VALVE(FR)
F : OUTPUT VALVE(RL)
G : OUTPUT VALVE(RR)
H : OUTPUT VALVE(FL)
I : ELECTRIC SHUTTLE VALVE(ESV-R)
J : ELECTRIC SHUTTLE VALVE(ESV-L)
K : TRACTION VALVE (TCR)
L : TRACTION VALVE (TCL)
M : MOTOR(+)
N : MPTOR(GND)

EJQE220F

DESCRIPTION OF ESP ECB2ED75

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.

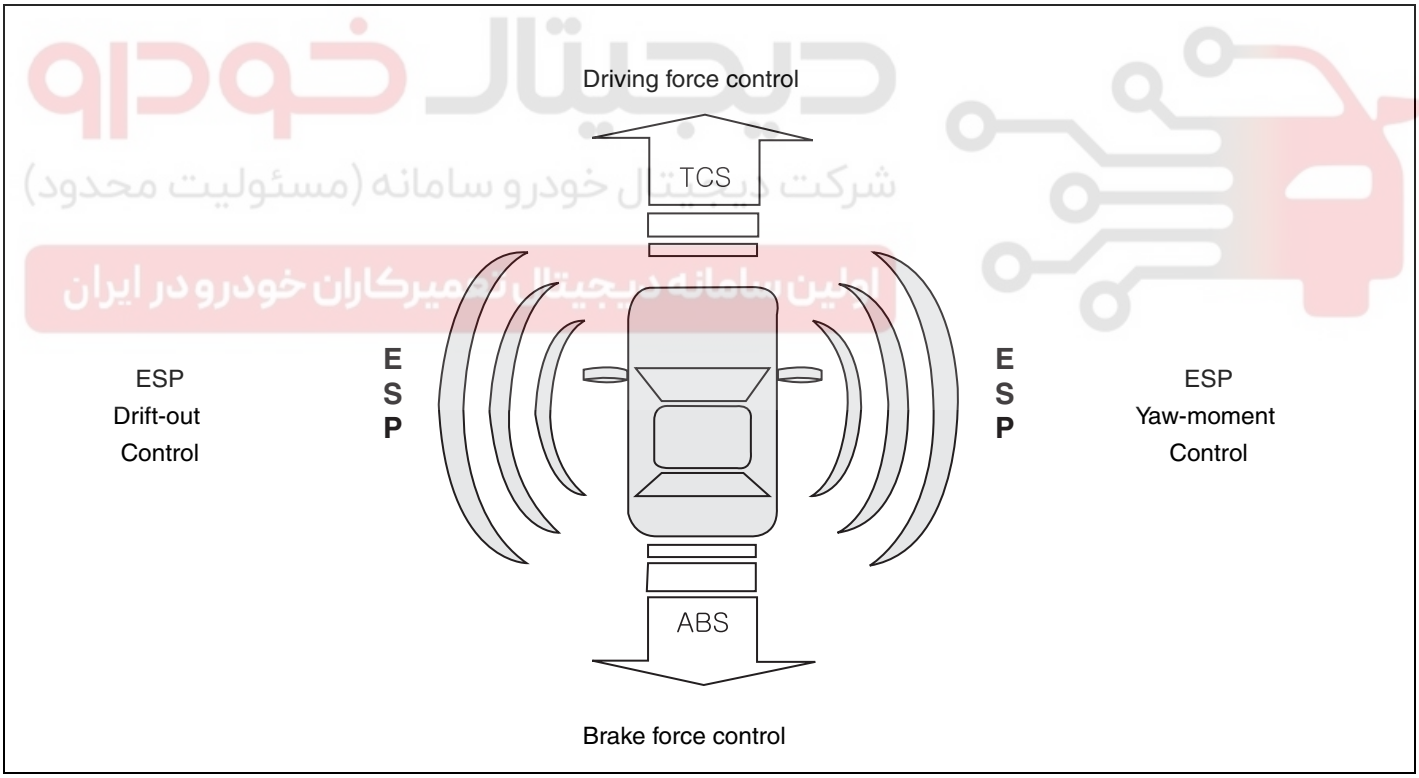
This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

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.



LJCD201A

DESCRIPTION OF ESP CONTROL

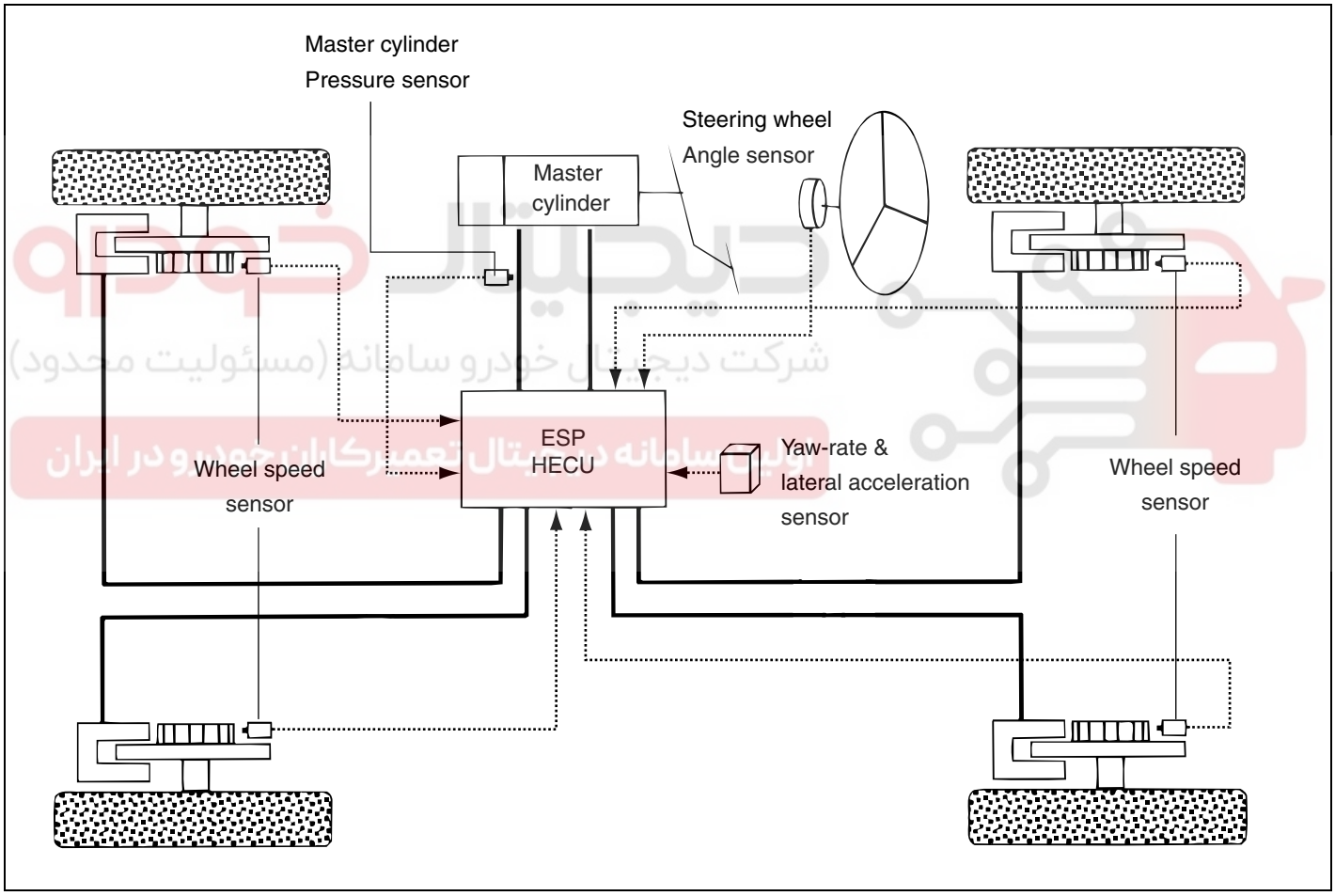
ESP system includes ABS/EBD, TCS and AYC function.

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

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

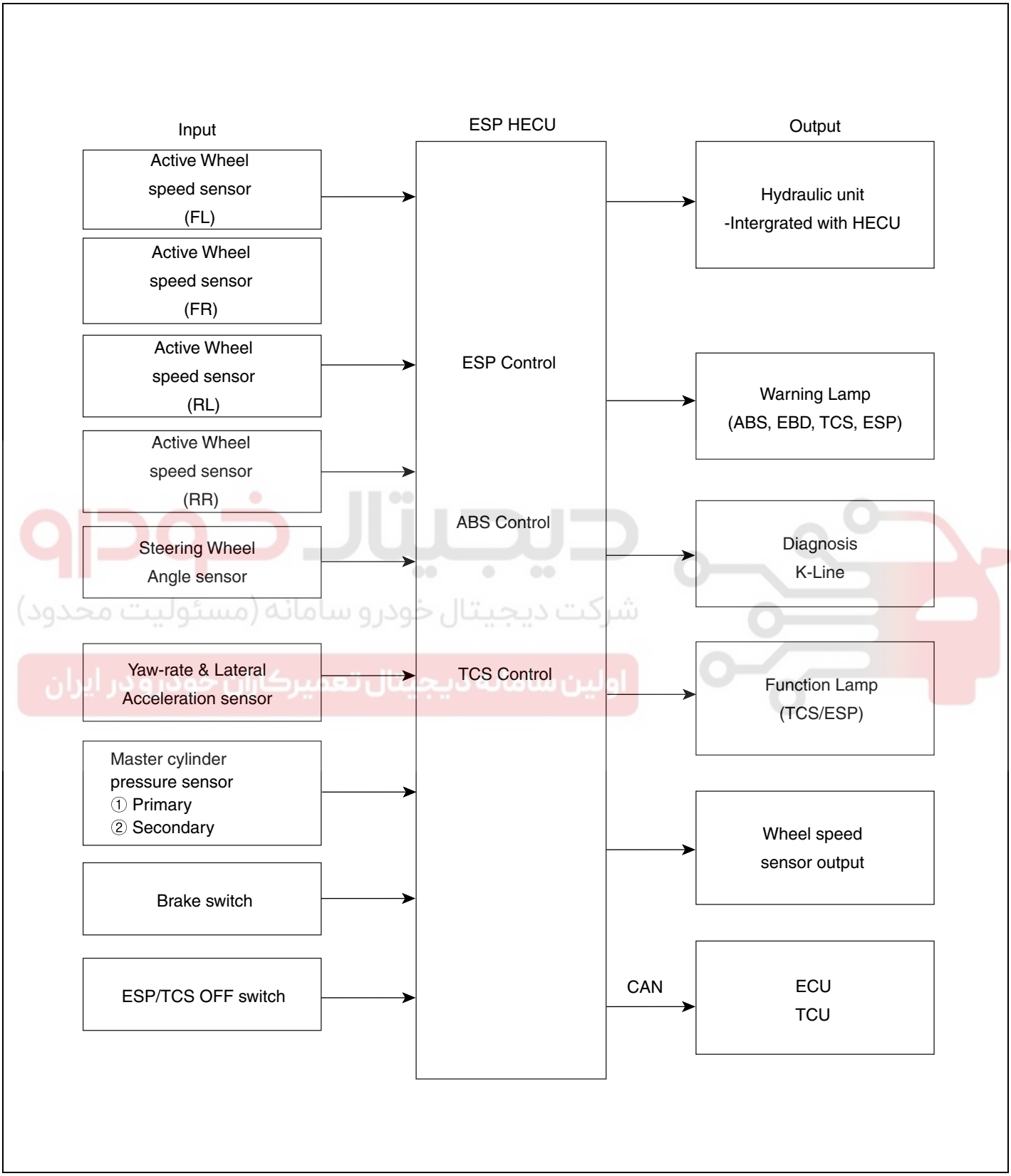
AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals(Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor).If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake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

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



EJQE005M

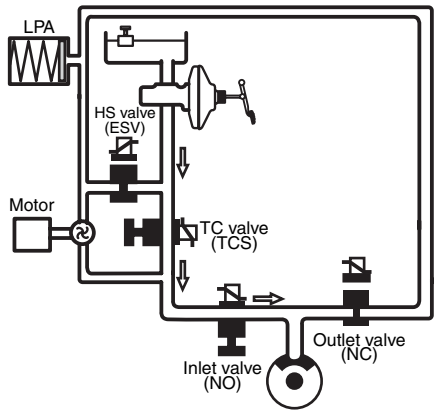
INPUT AND OUTPUT DIAGRAM



EJQE901C

ESP OPERATION MODE EEA3FB0A

1. ESP Non-operation-Normal braking.



LJCD207A

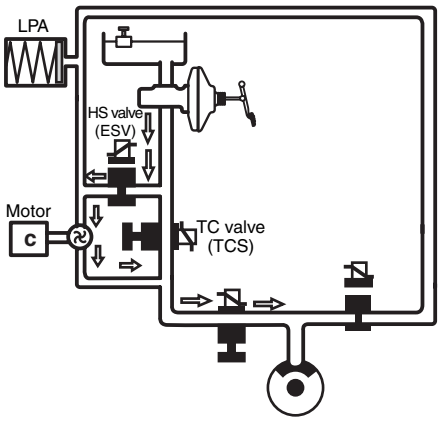
Operation

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.

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

2. ESP operation

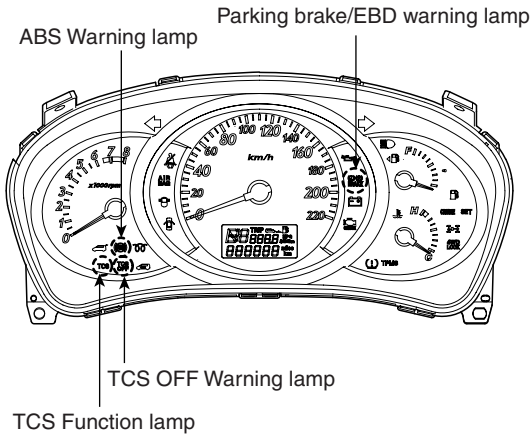


LJCD208A

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.

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		



EJQE300A

ABS WARNING LAMP MODULE

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

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

EBD WARNING LAMP MODULE

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

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

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 trun off the ESP function by on/off switch.
- During diagnostic mode.

ESP FUNCTION LAMP (ESP SYSTEM)

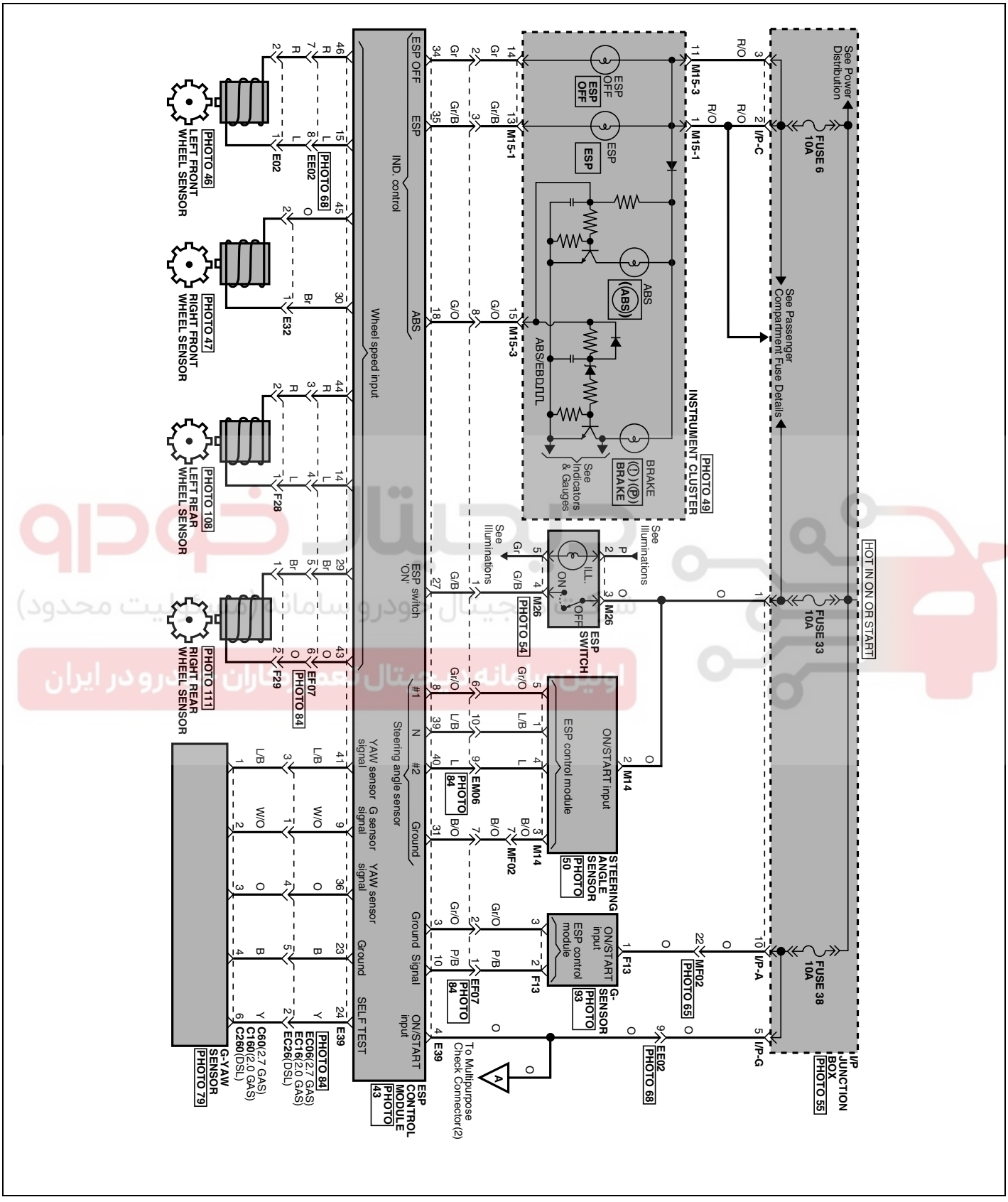
The ESP function lamp indicates the self-test and operating status of the ESP.
The ESP Function lamp operates under the following conditions :

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

ESP ON/OFF SWITCH (ESP SYSTEM)

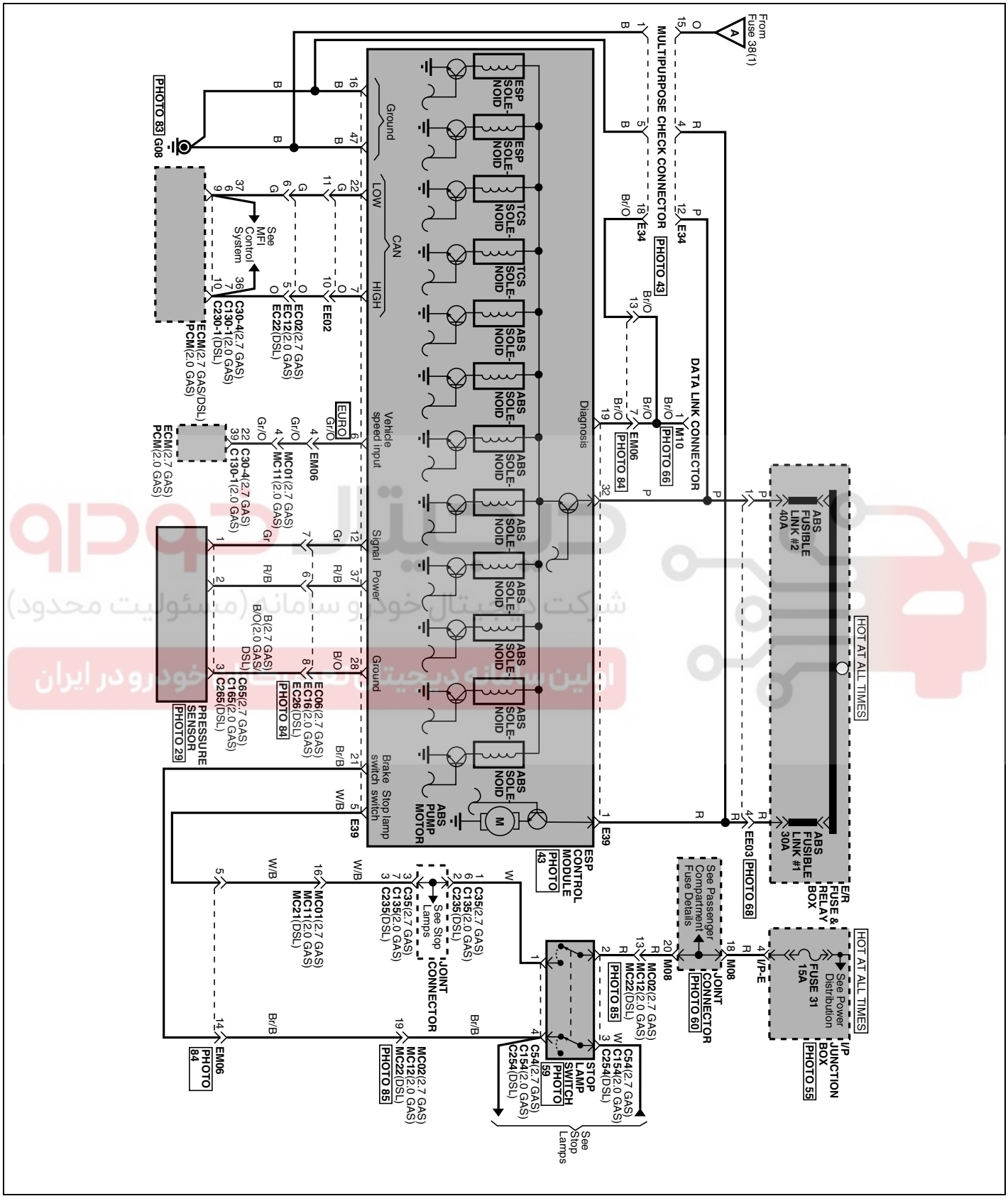
The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input.
The On/Off switch shall be a normally open, momentary contact switch.Closed contacts switch the circuit to ignition.
Initial status of the ESP function is on and switch toggle the state.

CIRCUIT DIAGRAM(1) E8C60C85



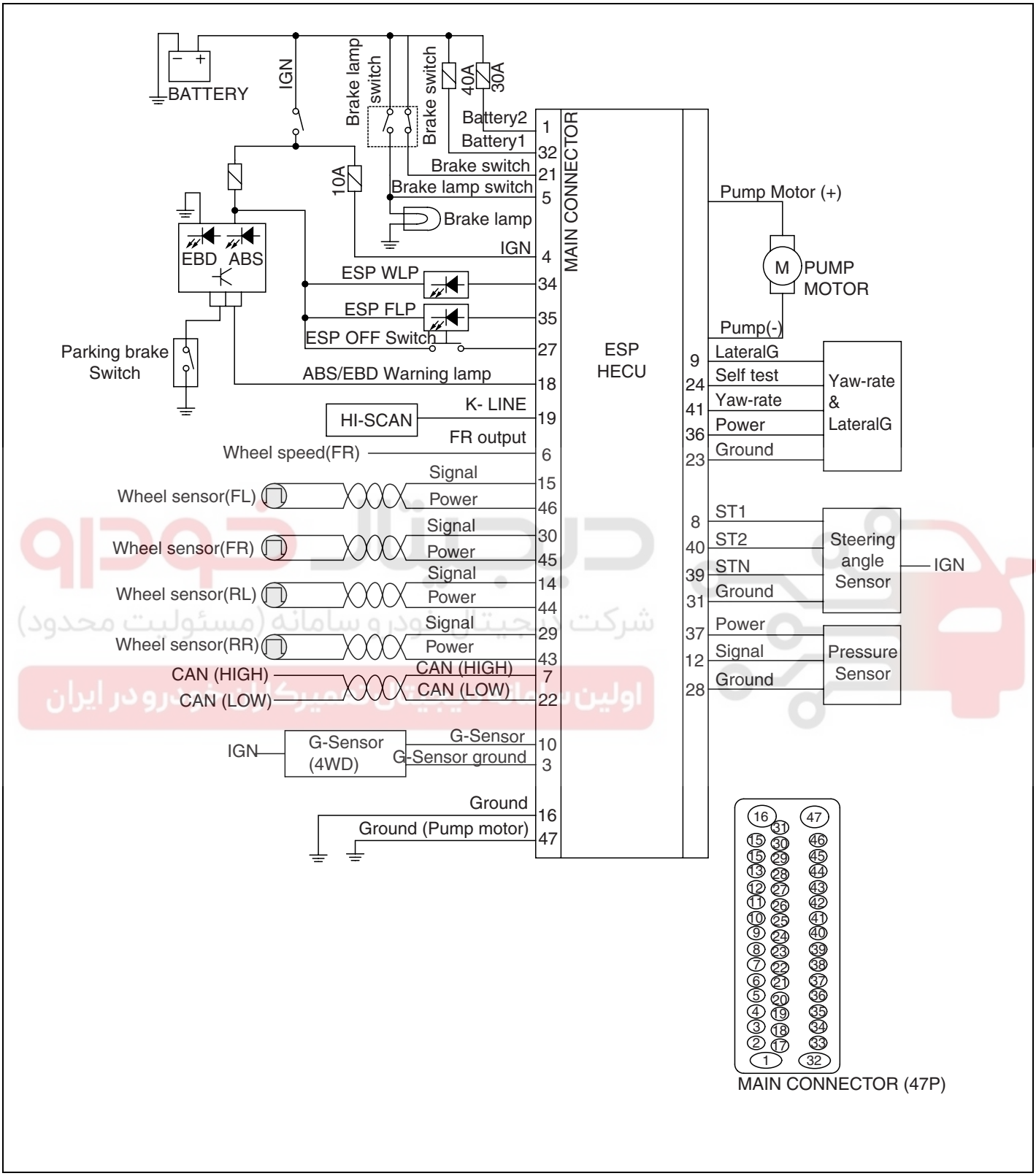
EJQE903C

CIRCUIT DIAGRAM(2)



EJQE903D

ESP CIRCUIT DIAGRAM E8C60C84



EJQE220C

ESP CONNECTOR INPUT/OUTPUT E526CF9D

Connector Terminal		Specification	Remark
No	Description		
4	IGNITION1(+)		
32	POS.BATTERY.(SOLENOID)	Max leakage current : I < 0.8mA	
1	POS.BATTERY.(MOTOR)	Operating voltage range: 9.5±0.5V < V < 16.5±0.5V Rush current : I < 100A Max current : I < 30A Max leakage current : I < 0.2mA	
16	GROUND	Rated current : I < 300mA Max. current: I < 30A	
47	PUMP MOTOR GROUND	Rush current : I < 100A Max current : I < 30A	
23	YAW & LATERAL G SENSOR GROUND	Rated current : I < 65mA	only with ESP
28	MASTER PRESSURE SENSOR GROUND	Rated current : I < 10mA	only with ESP
31	STEERING ANGLE SENSOR GROUND	Rated current : I < 100mA	only with ESP
37	MASTER PRESSURE SENSOR POWER	Max Output current : I < 10mA Max Output voltage : 4.9V ≤ V ≤ 5.1V	only with ESP
36	YAW SENSOR POWER	Max Output current : I < 65mA Max Output voltage : 4.9V ≤ V ≤ 5.1V	only with ESP
5	BRAKE LIGHT SWITCH	Input voltage low: 0V ≤ V ≤ 3.0V Input voltage High: 7.0V ≤ V ≤ 16.0V	
21	BRAKE SWITCH		
6	SENSOR FRONT RIGHT OUTPUT	Max current : I < 2mA External pull up resister :10KW < R Output duty :50 ±20%	
18	ABS/EBD W/LAMP DRIVE	Max. current: I < 200mA Max. output low voltage: V < 1.2V	
34	ESP W/LAMP DRIVE		only with ESP
35	ESP F/LAMP DRIVE		
27	ESP ON/OFF SWITCH	Input voltage low:0V ≤ V ≤ 3.0V Input voltage High: 7.0V ≤ V ≤ 16.0V Max input current:I < 10mA	only with ESP
22	CAN BUS LINE(LOW)	Max. current : I < 10mA	only with ESP
7	CAN BUS LINE(HIGH)		
46	SENSOR FRONT LEFT POWER	Output voltage : IGN(V) ± 1V 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 ~8.4 ㎃ Input current HIGH :11.8 ~ 16.8 ㎃ Frequency range :1 ~ 2000 Hz Input duty : 50 ±20%	
30	SENSOR FRONT RIGHT SIGNAL		
14	SENSOR REAR LEFT SIGNAL		
29	SENSOR REAR RIGHT SIGNAL		
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	only with ESP
40	STEERING ANGLE SENSOR PHASE 2		
39	STEERING ANGLE SENSOR PHASE N		
12	"MASTER PRESSURESENSOR SIGNAL	Sensor Input Voltage : 0V ≤ V ≤ 5.0V Zero offset Voltage : 0.5V ± 0.15V Input current :Max 2 Ma	only with ESP
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	only with ESP
10	G SENSOR SIGNAL Input Voltage	Input Volge: 0≤ V≤ 5.0V	with 4WD
3	G SENSOR GROUND	Rated current: I < 10mA	
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)	

FAILURE DIAGNOSIS EB9A3EAB

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

MEMORY OF FAIL CODE

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

FAILURE CHECKUP

1. Initial checkup is performed immediately after the HECU power on.
2. Valve relay checkup is performed immediately after the IG2 ON.
3. It executes the checkup all the time while the IG2 power is on.
4. Initial checkup is made in the following cases.
   1) When the failure is not detected now
   2) When ABS and ESP are not in control.
   3) Initial checkup is not made after ECU power on.
   4) If the vehicle speed is over 409 mph(8 km/h) when the brake lamp switch is off.
   5) When the vehicle speed is over 24.8 mph(40 km/h).
5. Though, it keeps on checkup even if the brake lamp switch is on.
6. When performing ABS or ESP control before the initial checkup, stop the initial checkup and wait for the HECU power input again.
7. Judge fail in the following cases.
   1) When the power is normal.
   2) From the point in which the vehicle speed reaches 4.9 mph(8 km/h) after HECU power on.

COUNTERMEASURES IN FAIL

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

WARNING LAMP ON

1. ABS warning lamp turns on when ABS is fail.
2. TCS warning lamp turns on when TCS is fail.
3. ESP operation lamp turns on and TCS OFF warning lamp blinks when ESP is fail.

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

DIAGNOSTIC TROUBLE CODE CHART

Follow an inspection procedure of a detected DTC in the chart below.

NOTE

EBD △ - warning lamp "ON", in case of errors on more than 2 wheels.

DTC	DESCRIPTION	WARNING LAMP "ON"				DTC MEMORY	REMARK	SEE PAGE
		ABS	EBD	TCS	ESP			
C1101	Battery voltage high	○	○	○	○	○		BR-79
C1102	Battery voltage low	○	○	○	○	○		BR-82
C1200	Wheel speed sensor FR-LH open/short	○	○	○	○	○		BR-84
C1201	Wheel speed sensor FR-LH range/performance/intermittent	○	△	○	○	○		BR-86
C1202	Wheel speed sensor FR-LH invalid/no signal	○	△	○	○	○		BR-89
C1203	Wheel speed sensor FR-RH open/short	○	△	○	○	○		BR-84
C1204	Wheel speed sensor FR-RH range/performance/intermittent	○	△	○	○	○		BR-86
C1205	Wheel speed sensor FR-RH invalid/no signal	○	△	○	○	○		BR-89
C1206	Wheel speed sensor RR-LH open/short	○	△	○	○	○		BR-84
C1207	Wheel speed sensor RR-LH range/performance/intermittent	○	△	○	○	○		BR-86
C1208	Wheel speed sensor RR-LH invalid/no signal	○	△	○	○	○		BR-89
C1209	Wheel speed sensor RR-RH open/short	○	△	○	○	○		BR-84
C1210	Wheel speed sensor RR-RH range/performance/intermittent	○	△	○	○	○		BR-86
C1211	Wheel speed sensor RR-RH invalid/no signal	○	△	○	○	○		BR-89
C1604	ECU hardware error	○	○	○	○	○		BR-92
C2112	Valve relay error	○	○	○	○	○		BR-93
C2380	ABS/TCS/ESP valve error	○	○	○	○	○		BR-95
C2402	Motor - electrical	○	×	○	○	○		BR-97
C1274	G sensor - electrical	○	×	○	○	○	4WD	BR-100
C1275	G sensor - signal	○	×	○	○	○	4WD	BR-102
C1503	TCS switch error	×	×	○	○	○		BR-104
C1605	CAN harware error	×	×	○	○	○		BR-106
C1611	CAN time-out EMS	×	×	○	○	○		BR-107
C1612	CAN time-out TCU	×	×	○	○	○		BR-108

DTC	DESCRIPTION	WARNING LAMP "ON"				DTC MEMORY	REMARK	SEE PAGE
		ABS	EBD	TCS	ESP			
C1613	CAN wrong message	×	×	○	○	○		BR-109
C1616	CAN bus off	×	×	○	○	○		BR-110
C2227	Excessive temperature of brake disc	×	×	○	○	○		BR-111
C1112	Sensor source voltage	×	×	○	○	○		BR-112
C1235	Pressure sensor(primary) - electrical	×	×	×	○	○		BR-113
C1237	Pressure sensor(secondary) - electrical	×	×	×	○	○		BR-115
C1259	Steering angle sensor - electrical	×	×	×	○	○		BR-117
C1260	Steering angle sensor - signal	×	×	×	○	○		BR-119
C1282	Yaw rate & lateral G sensor - electrical	×	×	×	○	○		BR-121
C1283	Yaw rate & lateral G sensor - signal	×	×	×	○	○		BR-123
C1513	Brake switch error	×	×	×	○	○		BR-125

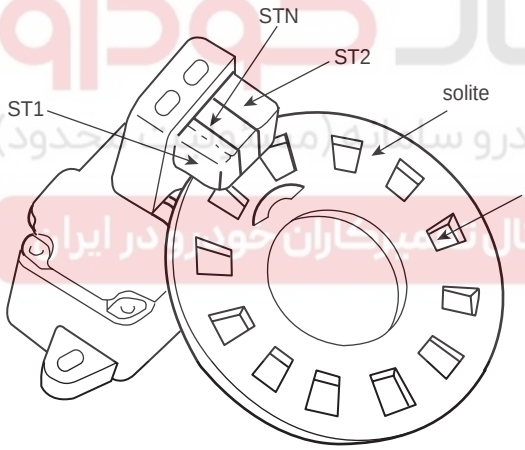
STEERING WHEEL ANGLE SPEED SENSOR

DESCRIPTION E62CE4A1

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.

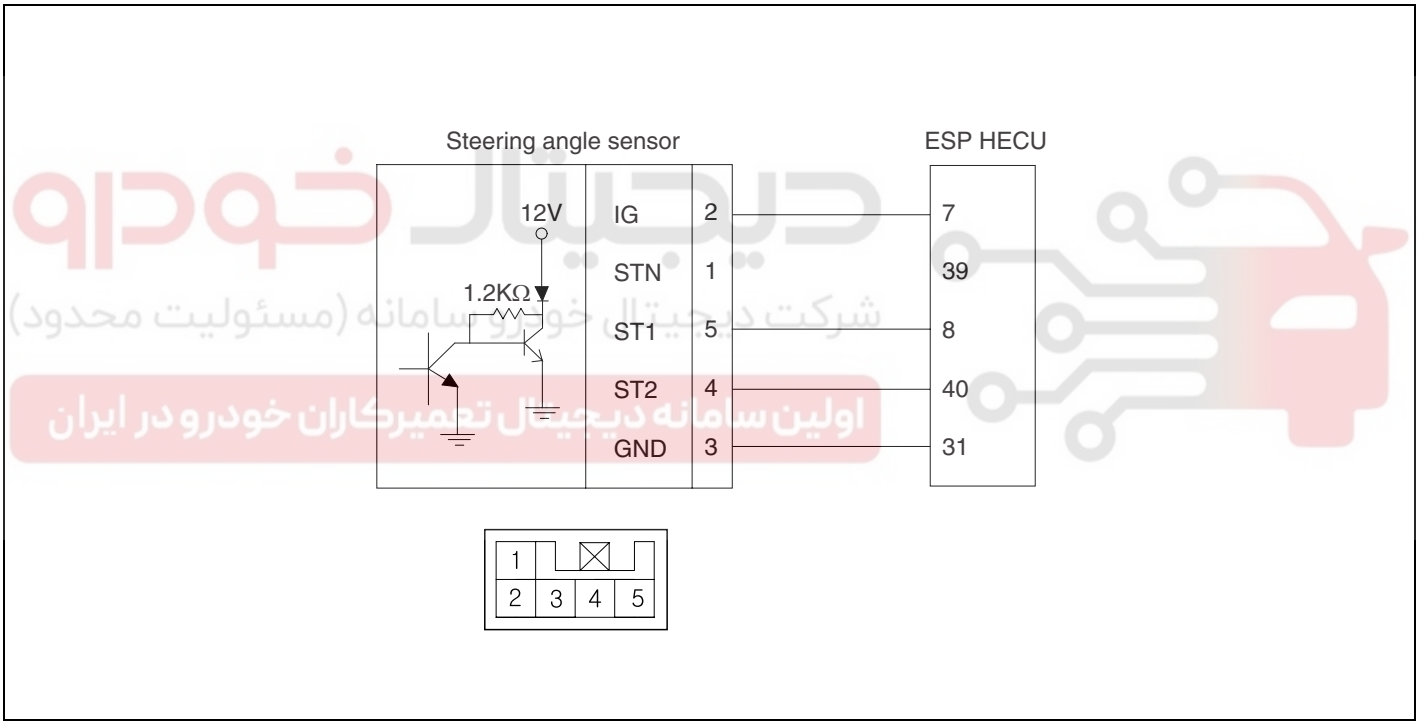


EJQE129A

SPECIFICATIONS E1C41B1D

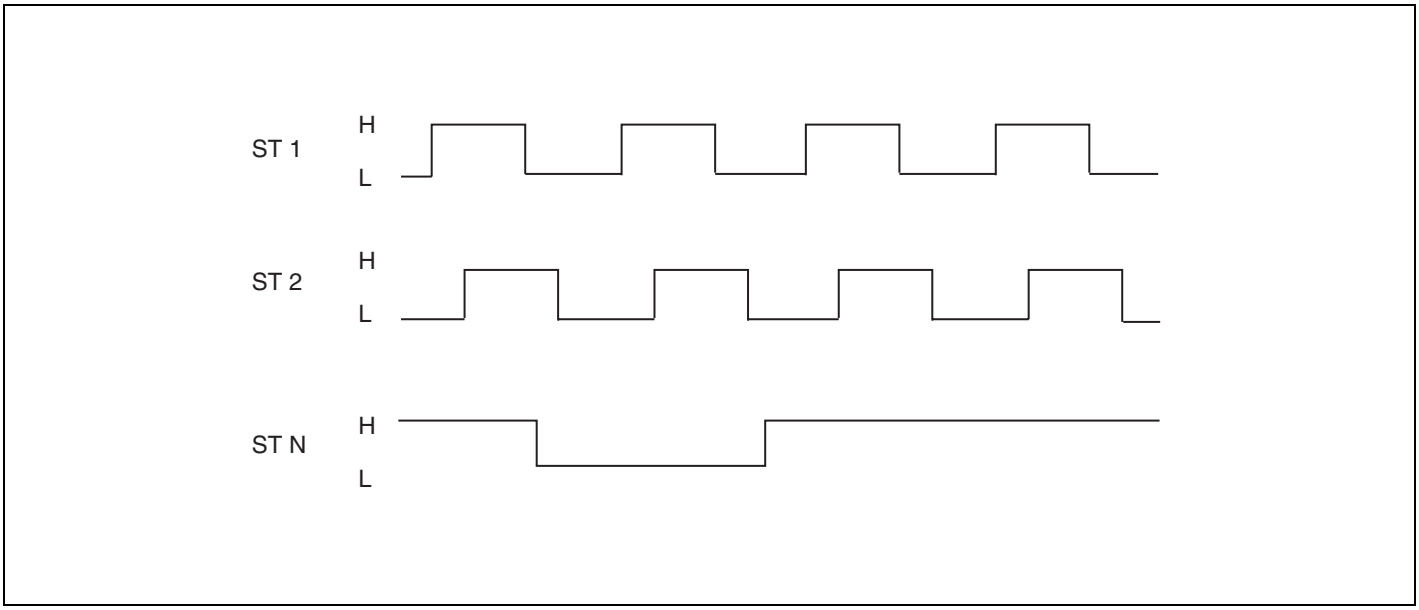
Item	Specification
Operating Voltage	9V~16V
Operating temperature	-30°C~75°C
Current cousumption	Max. 100mA
Pulse duty	50±10%
Pulse width	8°/1pulse
Voltage(HIGH)	3.0V~4.1V
Voltage(LOW)	1.3V~2.0V
Steering angle velocity	Max 1500°/sec

CIRCUIT DIAGRAM EA86D422



EJQE901E

OUTPUT CHARACTERISTIC EA78AE2A



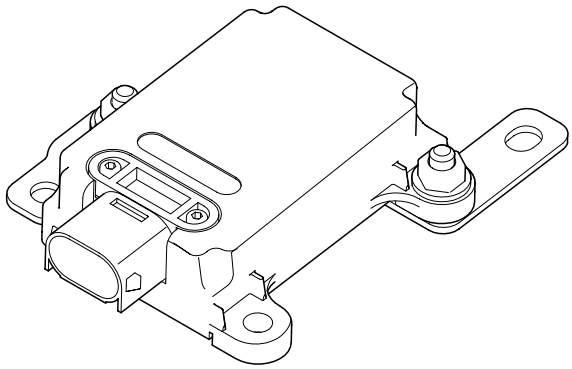
ARCD204A

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

DESCRIPTION E213C5D3

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.

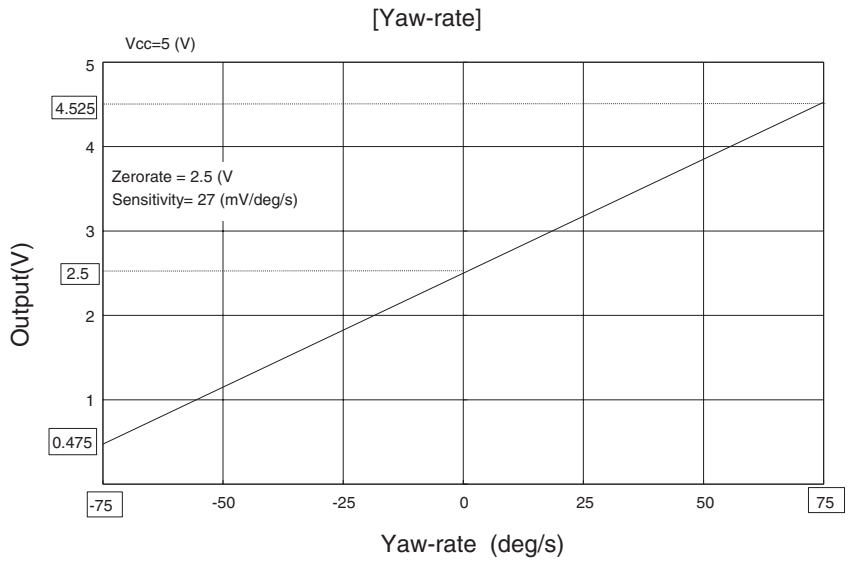


KJQE380A

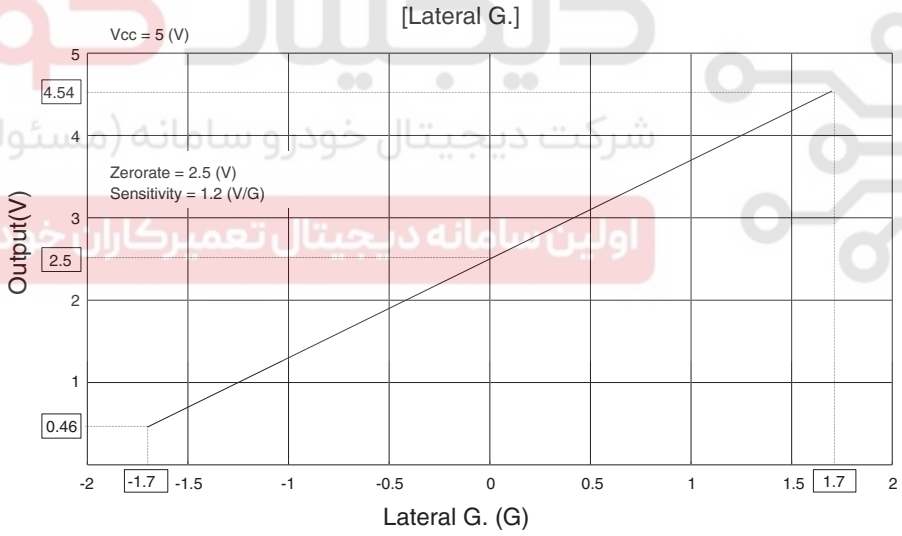
SPECIFICATIONS EEE8E7EB

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	10Hz	
Lateral G. sensor	Measurement range	-1.5 ~ +1.5g	
	Output voltage range	0.5 ~ 4.5 V	
	Sensitivity	1.33V/g	
	Zero rate output	2.5V	
	Frequency response	50Hz	

OUTPUT CHRACTERISTIC E724FB78

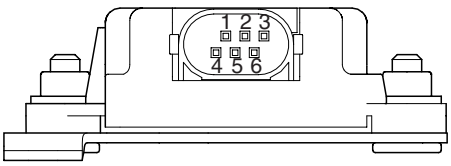


EJQE206A

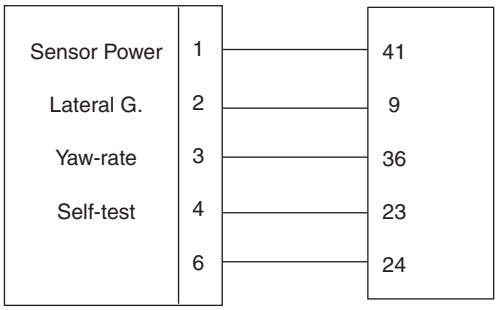


EJQE206B

EXTERNAL DIAGRAM E9948A75



[Yaw-rate & Lateral G sensor's connector]



KJQE901G

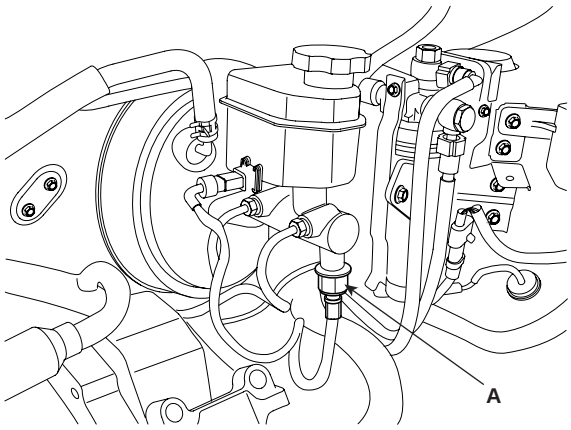
MASTER CYLINDER PRESSURE SENSOR

DESCRIPTION EAFB05FA

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) is consisted of two ceramic disks, one is fixed and the other movable, so that changes the distance of the two disks.

(Max. measurable pressure is 200bar.)

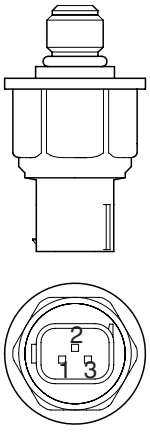


KJQE710E

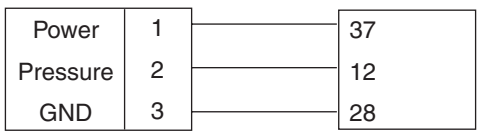
SPECIFICATIONS E54D4809

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 E60BD2FD



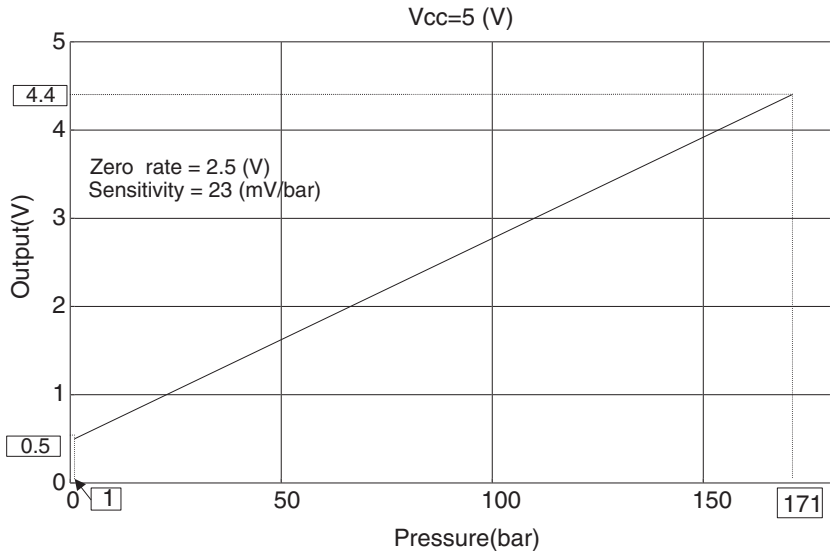
[Pressure sensor's connector]



[Pressure sensor] [ESP HECU]

EJQE901H

OUTPUT CHARACTERISTIC EB092AA6



EJQE206C

ESP SWITCH

DESCRIPTION EF70E50F

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 ECF023A3

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

KJQE900S

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

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

EJQE900R