ANTI-LOCK BRAKE SYSTEM

4890-01/4890-02/4892-00/4892-01/

INDEX ABS

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ABS 4892-01

GENERAL INFORMATION

1. SPECIFICATIONS

Item			Specifications
HECU	Operating voltage		10.0 ± 0.5 V to 16.0 ± 0.5 V
	Operating temperature		−40°C to 125°C
	Max. allowed current		40 A
	Dark current		0.1 mA
	Pressure sensor		Built-in
	Motor power		270 W
	Oil piping type		X-Shape
	Channel		4 channels
Wheel speed sensor	Air gap	Front	0.3 to 1.3mm
		Rear	0.5 to 1.5mm
	Operation frequency		1 to 2500 Hz
	Sensor operating temperature		−40°C to 150°C
	Tightening torque	Front	8 ± 2 Nm
		Rear	9.0 ± 1.5 Nm
G-sensor	Operating voltage		4.75 to 5.25 V
	Operating temperature		− 30°C to 85°C
	Operating range		-1.5 to 1.5 g
	Output voltage		0.5 to 4.5 V

Modification basis	
Application basis	
Affected VIN	

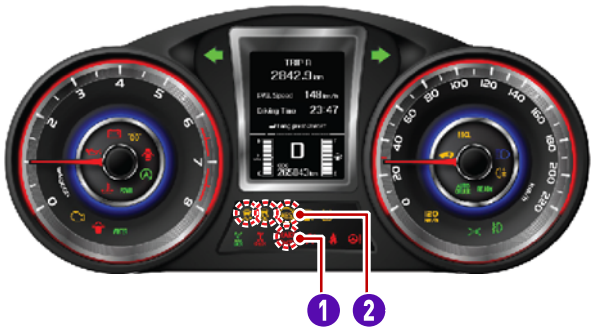
2. MAJOR FUNCTIONS

1) Term Definition

- ESP: Electronic Stability Program
- ABS: Anti-lock Brake System
- EBD: Electronic Brake-Force Distribution
- TCS: Traction Control System
- HBA: Hydraulic Brake Assist
- ARP: Active Rollover Protection
- HSA: Hill Start Assist
- ESS: Emergency Stop Signal
- CBC: Cornering Brake Control
- DST: Dynamic Steering Torque Assist
- FBC: Fading Brake Compensation

Modification basis	
Application basis	
Affected VIN	

3. ABS SYSTEM WARNING LAMPS

Supervision instrument cluster	Standard instrument cluster
	

1. Parking brake operating indicator (EBD warning lamp: both parking brake operating indicator and ABS warning lamp come on at the same time)
2. ABS warning lamp

Warning lamps	Color	Indicator	Operating conditions
Parking brake indicator	Red	BRAKE	ON: Parking brake applied
ABS warning lamp	Amber	ABS	ON: Faulty ABS function
EBD warning lamp	Amber + Red	ABS BRAKE	ON: Faulty EBD function

Modification basis	
Application basis	
Affected VIN	

1) ABS Warning Lamp

The ABS warning lamp module performs self diagnosis for ABS function and displays the fault status.
The ABS warning lamp is turned ON when:

A. the ignition switch is turned ON (for 4 seconds). If the ABS is normal, the lamp will go off. (Initialization mode)
B. there is a fault in the ABS.
C. the self-diagnosis function is activated.
D. the HECU connector is disconnected.
E. If the ABS warning lamp is turned on, the ABS function is deactivated and only normal braking is available.
F. the communication with the warning lamp drive CAN module is not available.

2) EBD Warning Lamp

If the EBD system is malfunctioning, the ABS warning lamp ( ) and parking brake operating indicator (BRAKE) are turned on at the same time.

The EBD warning lamp is turned ON when:

A. the ignition switch is turned ON (for 4 seconds). If the EBD is normal, the lamp will go off. (Initialization mode)
B. the parking brake switch is turned ON.
C. the brake fluid level is low.
D. the self-diagnosis function is activated.
E. the HECU connector is disconnected.
F. the EBD system is uncontrollable (EBD not operated). - In this case, the ABS warning lamp is also turned on.
   - faulty solenoid valve
   - two or more sensors are malfunctioning
   - faulty HECU
   - overvoltage
   - faulty valve relay
G. the communication with the warning lamp drive CAN module is not available.

Modification basis	
Application basis	
Affected VIN	

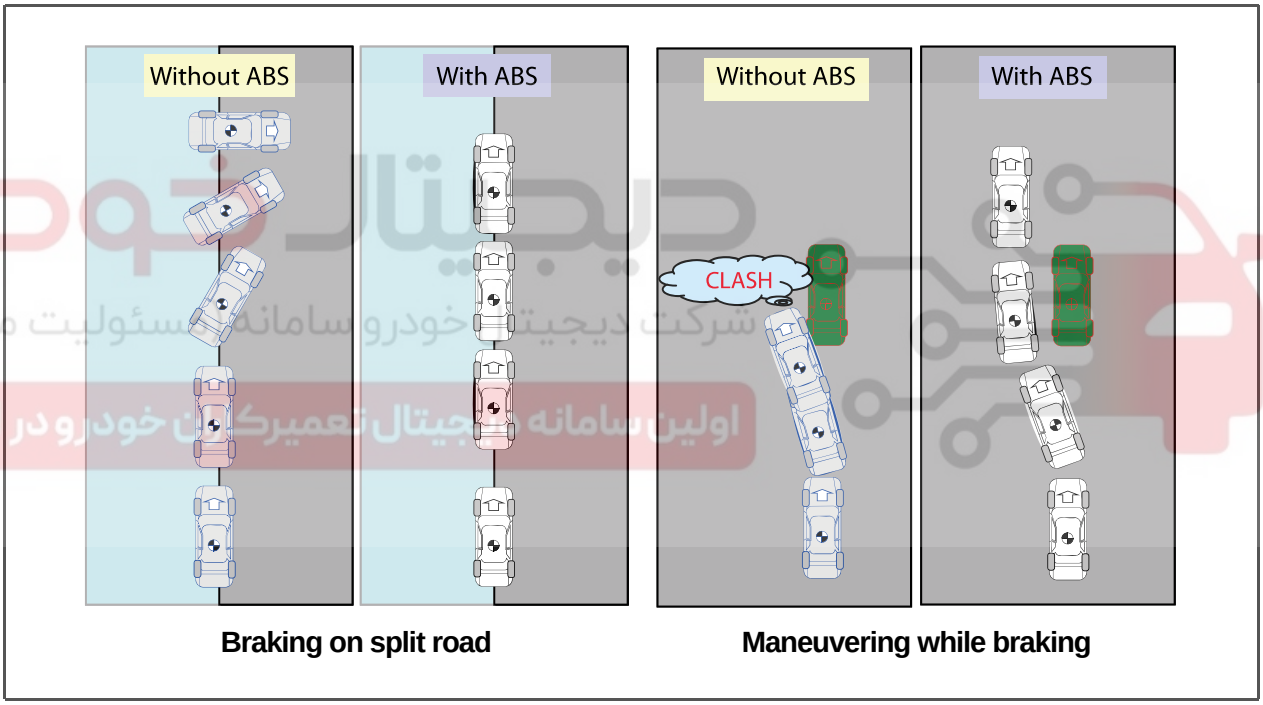
OVERVIEW AND OPERATING PROCESS

1. SYSTEM OVERVIEW

1) What is ABS?

When braking suddenly or braking on slippery roads, the vehicle keeps moving forward but the wheels are locking and not rotating. If these happen, the vehicle may lose stability or rotate resulting in an accident. ABS helps to maintain directional stability and control of the vehicle. ABS is designed to secure more safety and increase the control of steering wheel during emergency braking situation. But, ABS does not guarantee perfect safety beyond its physical limit. ABS in this vehicle contains EBD function. In normal driving conditions, the brake system operates without ABS function.

▶ **ABS effect according to braking conditions**

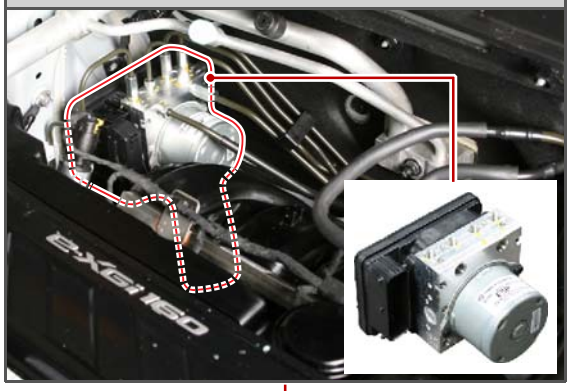


2) What is EBD (Electronic Brake-force Distribution)?

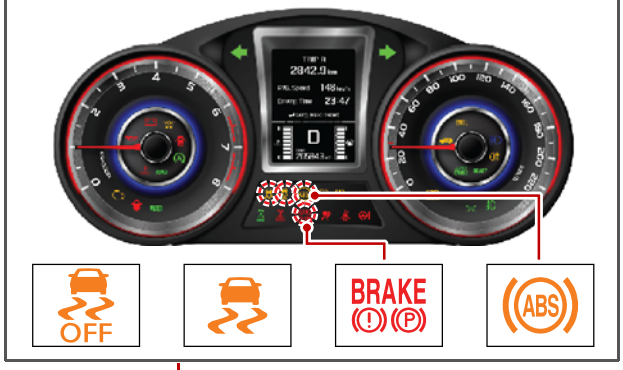
EBD is an automobile brake technology that automatically varies the amount of force applied to each of a vehicle's brakes, based on road conditions, speed, loading, etc. Always coupled with anti-lock braking systems, EBD can apply more or less braking pressure to each wheel in order to maximize stopping power whilst maintaining vehicular control. EBD does not operate when ABS is working.

2. COMPONENTS

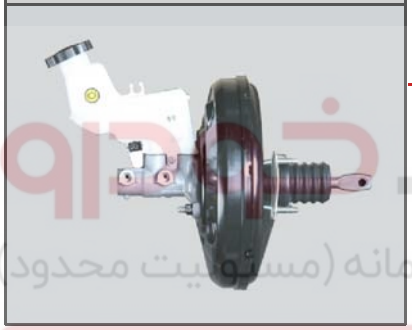
HECU

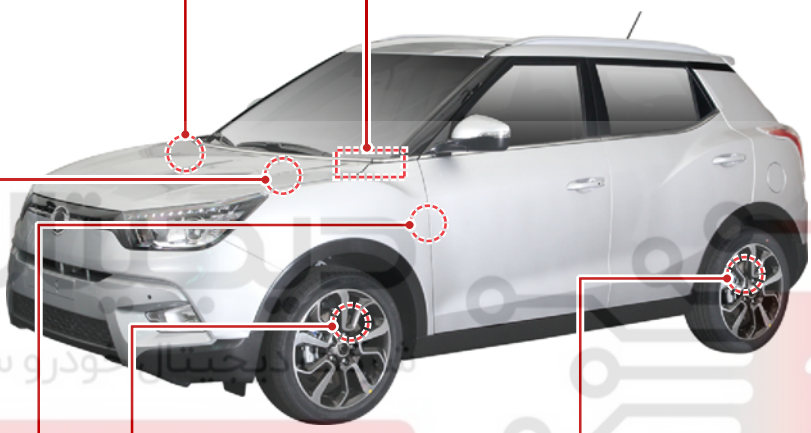


Indicator lamp on instrument cluster



Master cylinder with booster

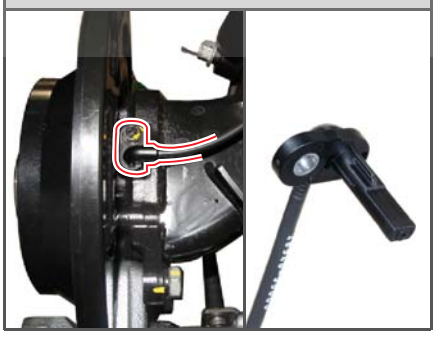




G-sensor (only for 4WD)

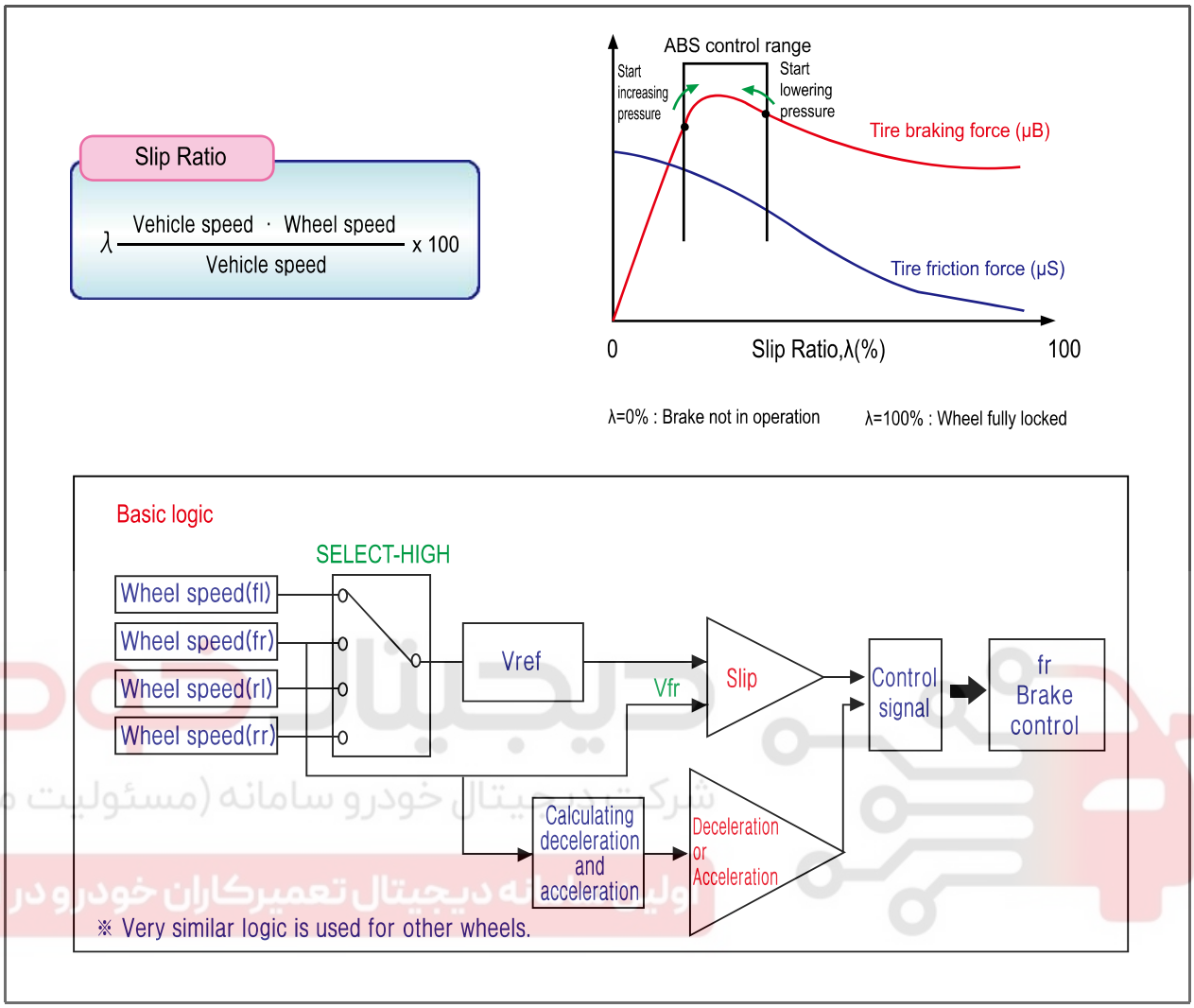
Front wheel speed sensor

Rear wheel speed sensor



Modification basis	
Application basis	
Affected VIN	

3. ABS CONTROL LOGIC



The principal ABS control logic is the determination of the reference speed by choosing one wheel meeting a certain condition, while sensing the speed information from 4 wheel speed sensors when the vehicle is being driven.

For example, when the comparison of the reference speed with front right wheel speed shows a slip, the control signal is determined according to whether it's deceleration or acceleration. If the control conditions are met, the brake for the front right wheel will be got under control.

Modification basis	
Application basis	
Affected VIN	

4. SYSTEM OPERATION

1) Basic Theory of ABS Function

To give you a better understanding of the tasks and functions of ABS, we will first look at the physics principles.

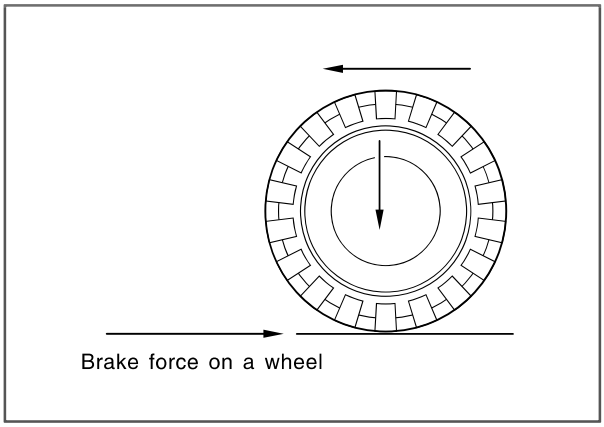
(1) Stopping distance

The stopping distance depends on the vehicle weight and initial speed when braking starts. This also applies for vehicle with ABS, where ABS always tries to set an optimum brake force on each wheel. As great forces are exerted between the tires and the carriageway when braking, even with ABS the wheels may scream and rubber is left on the road. With an ABS skid mark one may be able to clearly recognize the tire profile. The skid mark of an ABS vehicle does not however leave any hint of the speed of the vehicle in the case of an accident, as it can only be clearly drawn at the start of braking.

(2) Brake force on a wheel

The maximum possible brake force on a wheel depends on the wheel load and the adhesion coefficient between tire and carriageway. With a low adhesion coefficient the brake force, which can be obtained is very low. You are bound to know the result already from driving on winter roads. With a high adhesion coefficient on a dry road, the brake force, which can be obtained, is considerably higher. The brake force, which can be obtained, can be calculated from below formula:

▶ **Maximum brake force**



Brake force on a wheel

FBmax = wheel load FR x coefficient of frictionMh

The braking process cannot be described sufficiently accurately with the brake forces calculated. The values calculated only apply if the wheel is not locked. In the case of a locking wheel, the static friction turns into lower sliding friction, with the result that the stopping distance is increased. This loss of friction is termed "slip" in specialist literature.

Modification basis	
Application basis	
Affected VIN	

▶ Slip

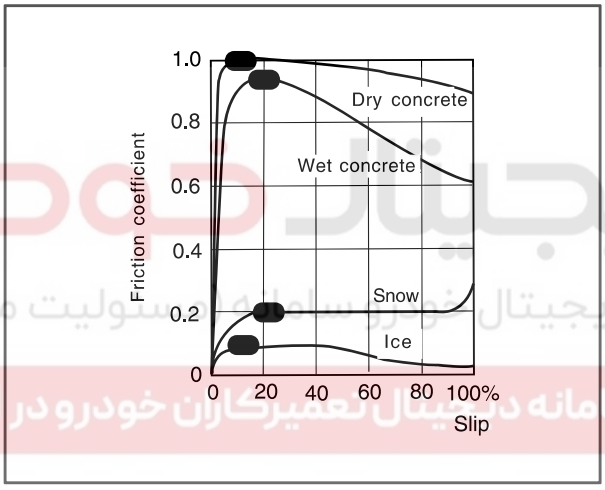
The brake slip is the difference between the vehicle speed and the wheel circumference speed. If the wheel locks, the slip is greatest, that is 100 %. If the wheel is running freely and un-braked, the slip is the lowest, equal to 0 %. Slip can be calculated from the vehicle speed Vveh and the wheel speed Vw. The equation for this is:

Vveh = 100 km/h, Vw = 70 km/h

$$\text{Slip ratio (S)} = \frac{\text{Vveh - Vw}}{\text{Vveh}} \times 100\%$$

S = 30%

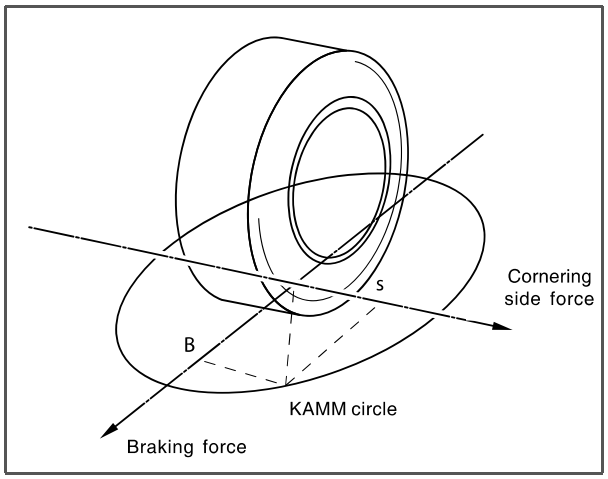
▶ Typical Slip Curves



For the various road conditions, the friction coefficients were plotted. The typical course of the curves is always the same. The only special feature is shown by the curve for freshly fallen snow, for this curve increases at 100 % slip. In a vehicle without ABS, the wheel locks on braking and therefore pushes a wedge before it. This wedge of loose surface or freshly fallen snow means and increased resistance and as a result the stopping distance is shorter. This reduction in stopping distance is not possible with a vehicle with ABS, as the wheel does not lock. On these surfaces the stopping distance with ABS is longer than without ABS. The reason for this is based in physics and not in the Anti-Lock System.
However, as mentioned before, ABS is not about the stopping distance, but maneuverability and driving stability, for the vehicle with locking wheels without ABS cannot be steered.

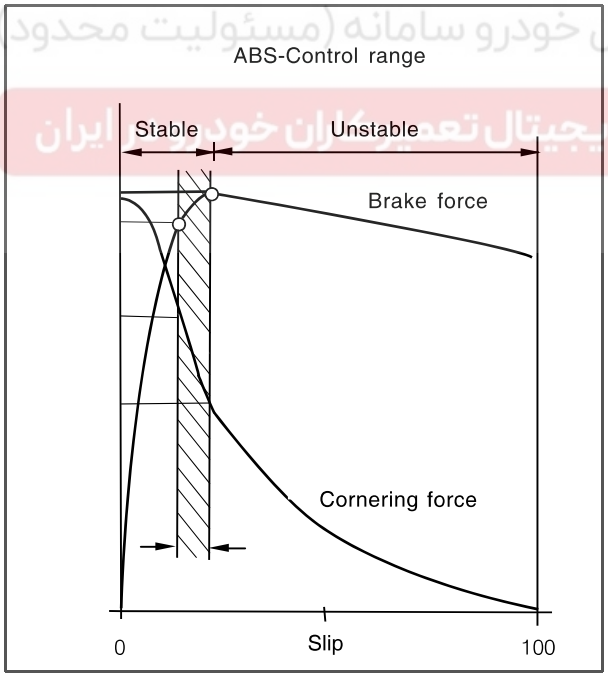
Modification basis	
Application basis	
Affected VIN	

▶ KAMM circle



Before we go into the Kamm circle, you should know that a tire offers a maximum of 100 % transmissibility. It is all the same for the tire whether we require 100 % in the direction of braking or in the direction of the acting lateral force, e.g. when driving round curves. If we drive into a curve too fast and the tire requires 100 % transmissibility as cornering force, the tire cannot transmit any additional brake force. In spite of the ABS the car is carried out of the curve. The relationship between brake force B and cornering force S is shown very clearly in the Kamm circle. If we put a vehicle wheel in this circle, the relationship becomes even clearer. In this relationship: as long as the acting forces and the resulting force remain within the circle, the vehicle is stable to drive. If a force exceeds the circle, the vehicle leaves the road.

▶ Brake and cornering force

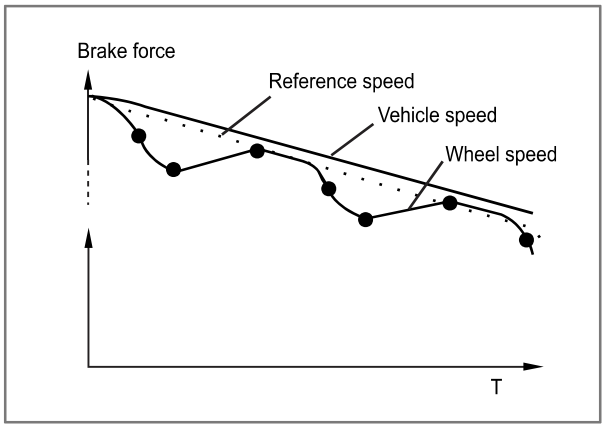


- **Brake force**
  When depressing the brake pedal the brake force increases to the maximum, then the brake force decreases until the wheel locks.
- **Cornering force**
  The cornering force is a maximum when the wheel is turning freely with zero slip. When braking the cornering force falls to zero if the wheel locks (slip 100 %).
- **ABS operating range**
  The operating range starts just before the maximum brake force and ends in maximum, for the unstable range then begins, in which no further modulation is possible. The ABS controls the regulation of the brake pressure so that the brake force only becomes great enough for a sufficient proportion of cornering force to remain. With ABS we remain in the Kamm circle as long as the car is driving sensibly. We will leave driving physics with these statements and turn to the braking systems with and without ABS.

Modification basis	
Application basis	
Affected VIN	

2) Basic ABS Control

▶ Operation of ABS control unit



Applications of the ABS control unit The signals produced by the wheel sensors are evaluated in the electronic control unit. From the information received, the control unit must first compute the following variables:

- Wheel speed
- Reference speed
- Deceleration
- Slip

▶ Operation of ABS control unit

The reference speed is the mean, I.e. average speed of all wheel speeds determined by simple approximation.

▶ Simplified ABS control

If, during braking, one wheel speed deviates from the reference speed, the ABS control unit attempts to correct that wheel speed by modulating the brake pressure until it again matches the reference speed. When all four wheels tend to lock, all four wheels speeds suddenly deviate from the previously determined reference speed. In that case, the control cycle is initiated again in order to again correct the wheel speed by modulating the brake pressure.

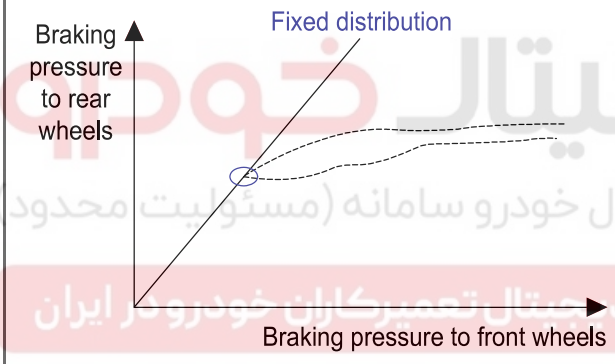
Modification basis	
Application basis	
Affected VIN	

5. ELECTRONIC BRAKE FORCE DISTRIBUTION(EBD)

Sudden braking while the vehicle is driven causes nose down in which the load of the vehicle is pulled to the front axle. In this case, the friction on the rear wheels is larger than the friction on the front wheels. Therefore the rear wheels are locked before the front wheels are locked, resulting in poor straight ahead run. To resolve this problem, the vehicle is equipped with electronic brake force distribution (EBD) system which is an advanced form of proportioning valve.

The proportioning valve can control the pressure but cannot control according to the vehicle loading, number of occupants, cornering, and road conditions. But the EBD can control the braking force applied on each wheel independently by receiving the wheel speed from the wheel speed sensor.

For a vehicle with EBD system, the HECU measures the wheel retardation continuously and the separate program of the ABS controls the rear brake pressure to ensure good straight ahead run. The EBD system works before the ABS is activated.

<table>
<tr><th colspan="2">Braking force</th></tr>
<tr><th>Proportioning valve</th><th>EBD</th></tr>
<tr>
<td> 
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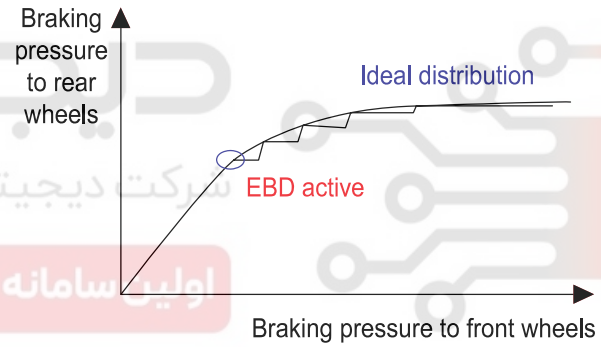
<td> 
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<tr>
<td colspan="2">1) EBD control
The EBD control function detects the wheel speed, vehicle speed, slip, and vehicle retardation to compare the sips of the front wheels and rear wheels. The brake pressure for the rear wheels is determined by the slip comparison value. The rear braking is controlled depending on the cornering control as follows:
- Braking while cornering: rear braking, independently
- Braking while cornering: rear braking, simultaneously

2) Advantage
- Implemented by the ABS system
- Effective response according to the driving conditions.
- Different pressure controls between the inside and outside of corner during cornering control
- Constant braking force distribution over the life of the vehicle.
- Controls the brake pressure close to ideal distribution</td>
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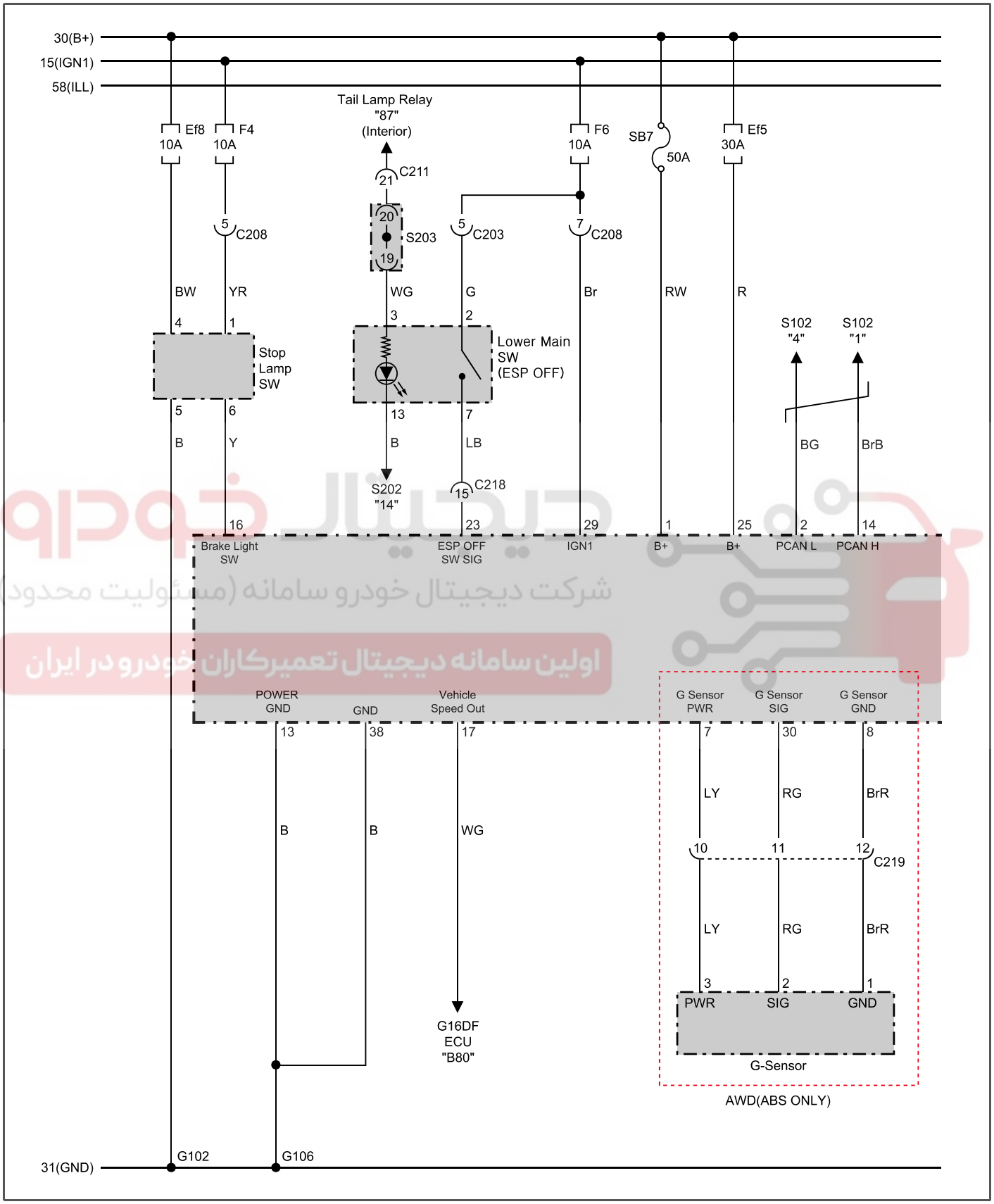
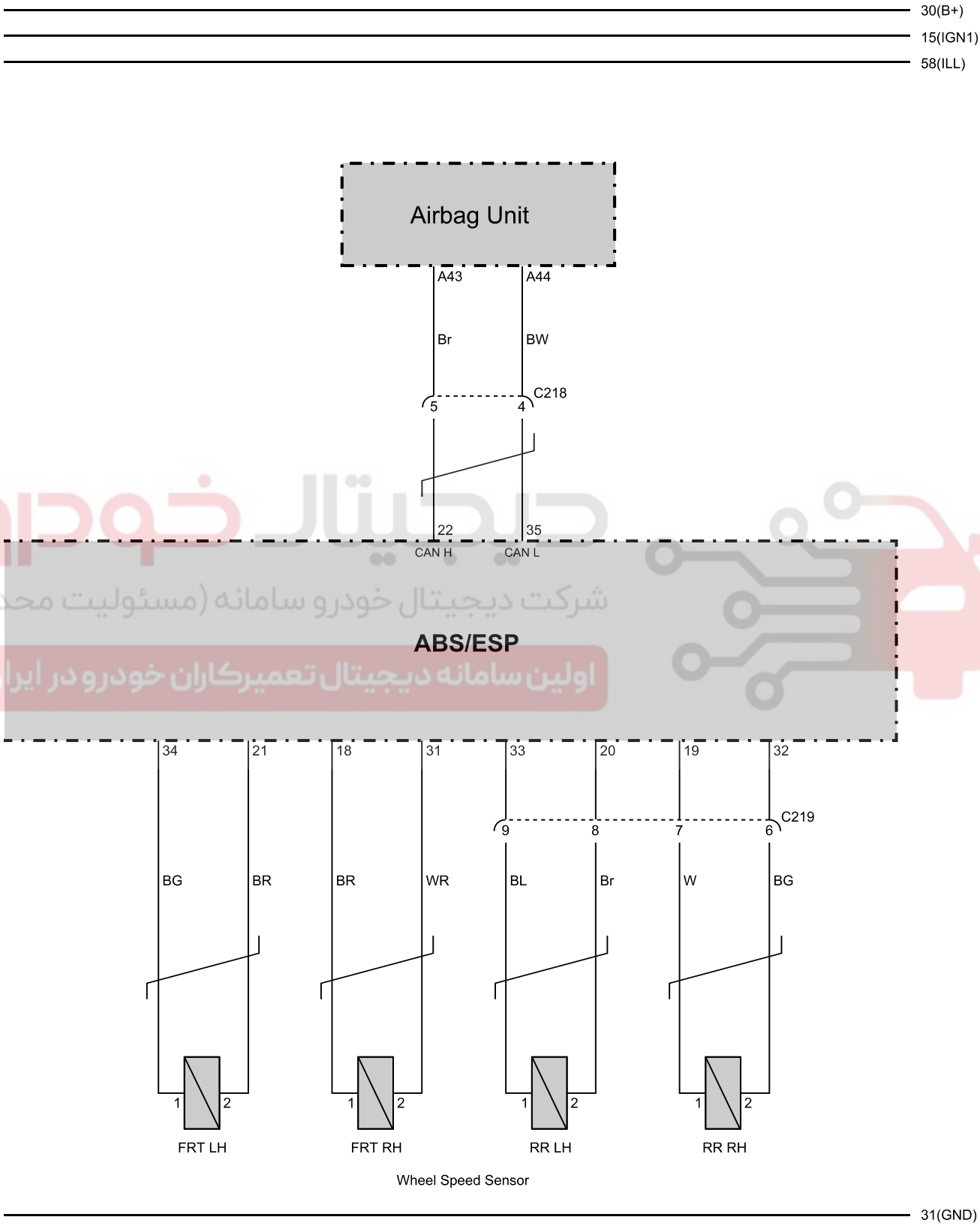
Modification basis	
Application basis	
Affected VIN	

Memo

6. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

CONFIGURATION AND FUNCTIONS

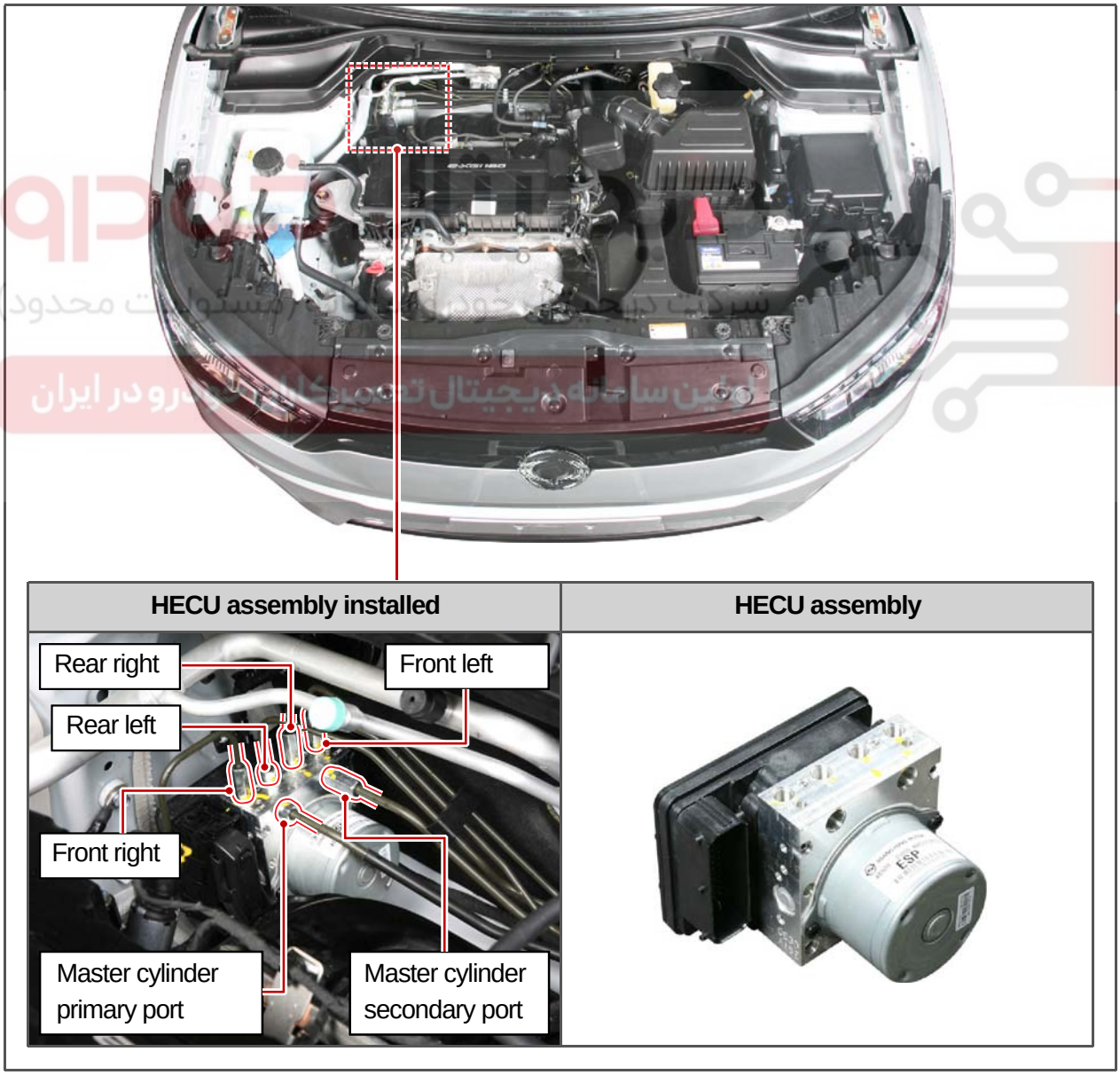
S.G.N. 4892-01

HYDRAULIC & ELECTRONIC CONTROL UNIT (HECU)

1) Overview

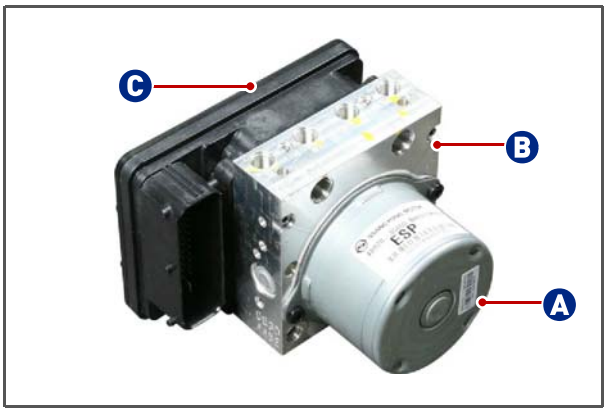
The hydraulic & electronic control unit (HECU) is installed to the dash panel side on the right side of the engine compartment.
The HECU consists of the motor pump section, solenoid valve body section, and ECU including pressure sensor. The ECU connector has 38 pins total.

2) Mounting Location



Modification basis	
Application basis	
Affected VIN	

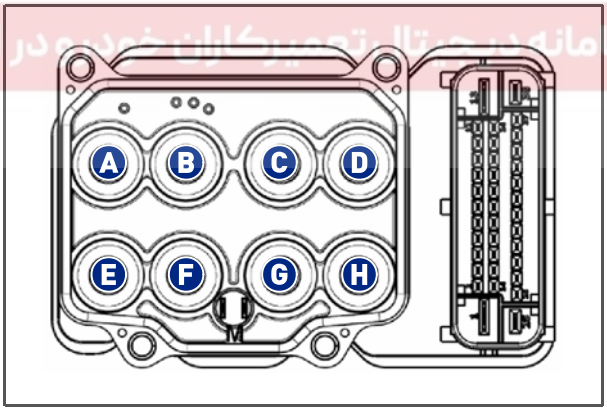
3) Components



The HECU consists of the motor pump section (A), solenoid valve section (B), and ECU with pressure sensor (C).

▶ Electronic control unit (ECU)

HECU controls the hydraulic valves by supplying or cutting off the voltage to solenoid valves depending on the wheel speed and other information from wheel speed sensors. The ABS ECU has 8 solenoid valves. It has four channels; 2 channels for front wheels and 2 channels for rear wheels. Each channel has one inlet and one outlet valve, therefore, there are eight solenoid valves.



*** ECU lower cover**

Since the electrical components are susceptible to moisture and water, GoreTex-based plate is used in the ECU lower cover to cut off water entry as well as the air flow.

A: Outlet valve (FL)
B: Outlet valve (RR)
C: Outlet valve (RL)
D: Outlet valve (FR)
E: Inlet valve (FL)
F: Inlet valve (RR)
G: Inlet valve (RL)
H: Inlet valve (FR)

▶ Hydraulic control unit (HCU)

The hydraulic circuit contains the primary circuit and secondary circuit for ABS operation. This unit controls the hydraulic pressure to each wheel. If the system needs ABS operation, the valves in the unit operate to control HOLD, RISE and DUMP according to ECU control logic.

Modification basis	
Application basis	
Affected VIN	

4) HECU Self-Diagnosis

The HECU performs the tests for solenoid and pump as follows:

Item	Operating conditions	
Solenoid valve	Non-operating test	- After IGN ON
	Operating test	- During initial check after IGN ON - When the vehicle speed is 40 km/h or higher
Pump motor	Operating test	When the vehicle speed reaches 15 km/h to 30 km/h after IGN ON

NOTE

The system check is performed before the completion of HECU self-diagnosis.

No.	Function
1	BAT + (motor power supply)
2	P-CAN Low
3	-
4	-
5	-
6	-
7	G Sencor PWR
8	G Sencor GND
9	-
10	-
11	-
12	-
13	Ground
14	P-CAN High
15	-
16	Brake switch signal input
17	Vehicle speed “ECU B80"
18	Wheel speed sensor power supply (FR)
19	Wheel speed sensor power supply (RR)

No.	Function
20	Wheel speed sensor signal (RL)
21	Wheel speed sensor signal (FL)
22	-
23	-
24	-
25	BAT + (solenoid power supply)
26	-
27	-
28	-
29	IGN 1
30	G Sencor SIG
31	Wheel speed sensor signal (FR)
32	Wheel speed sensor signal (RR)
33	Wheel speed sensor power supply (RL)
34	Wheel speed sensor power supply (FL)
35	-
36	-
37	-
38	Ground

Modification basis	
Application basis	
Affected VIN	

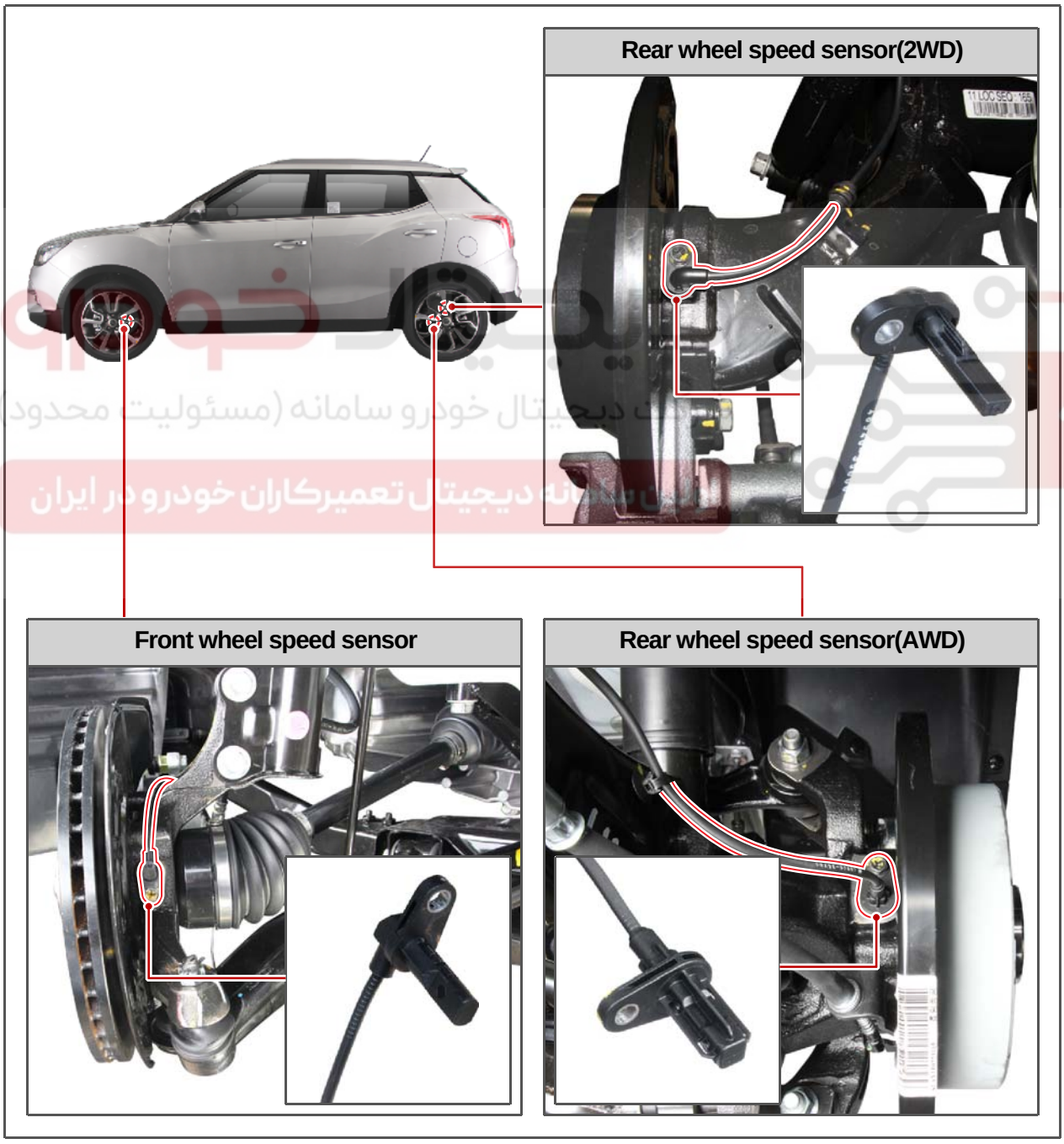
S.G.N. 4890-01

FRONT AND REAR WHEEL SPEED SENSORS

1) Overview

The wheel speed sensor is installed to the knuckle on each wheel. For the 2WD vehicle, the front sensor has the same shape as the rear sensor. The rear wheel speed sensor for the AWD vehicle differs slightly. While the sensor detects the wheel speed using a magnetic wheel of the hub for the 2WD vehicle, the rear wheel speed sensor detects the wheel speed using a tone wheel of the rear drive shaft for the AWD vehicle.

2) Mounting Location



Modification basis	
Application basis	
Affected VIN	

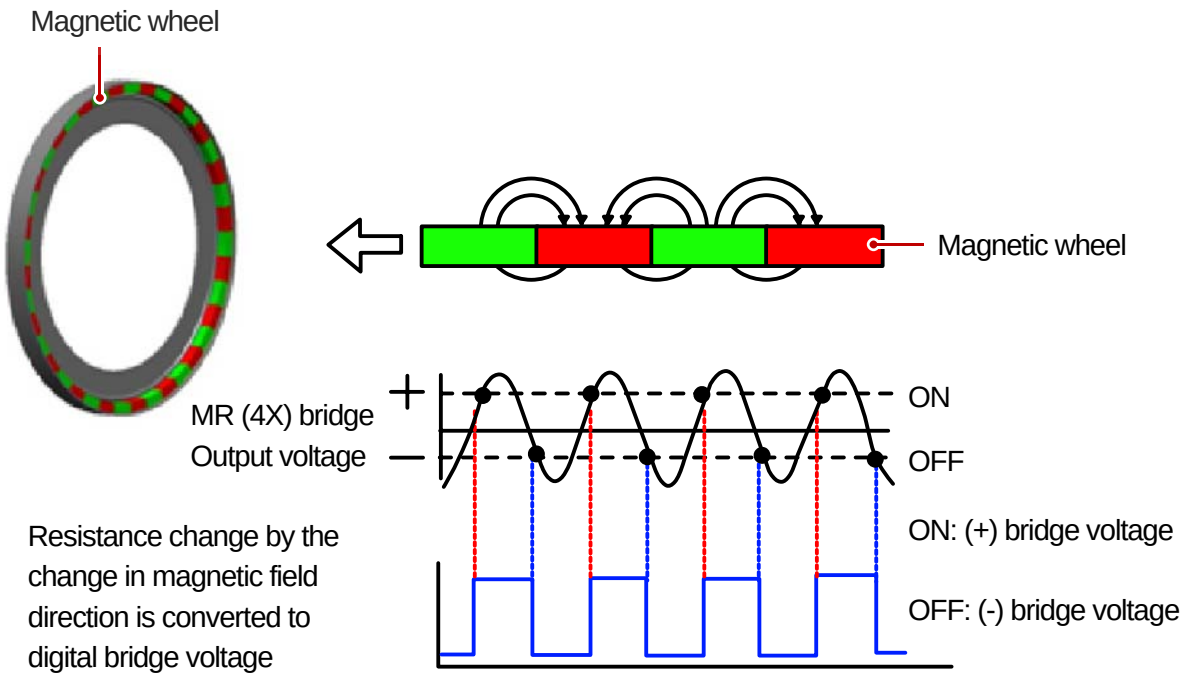
3) Operating Process

(1) 2WD (front/rear), AWD (front) wheel sprrd sensor

The wheel speed sensor consists of the permanent magnet (ring magnet) and magnetic resistance element and is used to record the wheel speed. When the magnetic resistance element is under the influence of the magnetic field, it is changed into a resistor. The ring magnet is seated on the plate of the hub and connected to the tire wheel through the hub. As the magnetic field is changed by the rotational movement of the internal gear magnet, the magnetic resistance element is changed to the resistor.
The HECU receives this information to control the ESP system. If it detects an open or short circuit of the wheel speed sensor, it will stop the ABS operation and turn on the warning lamp.

Front	Rear(2WD)
	

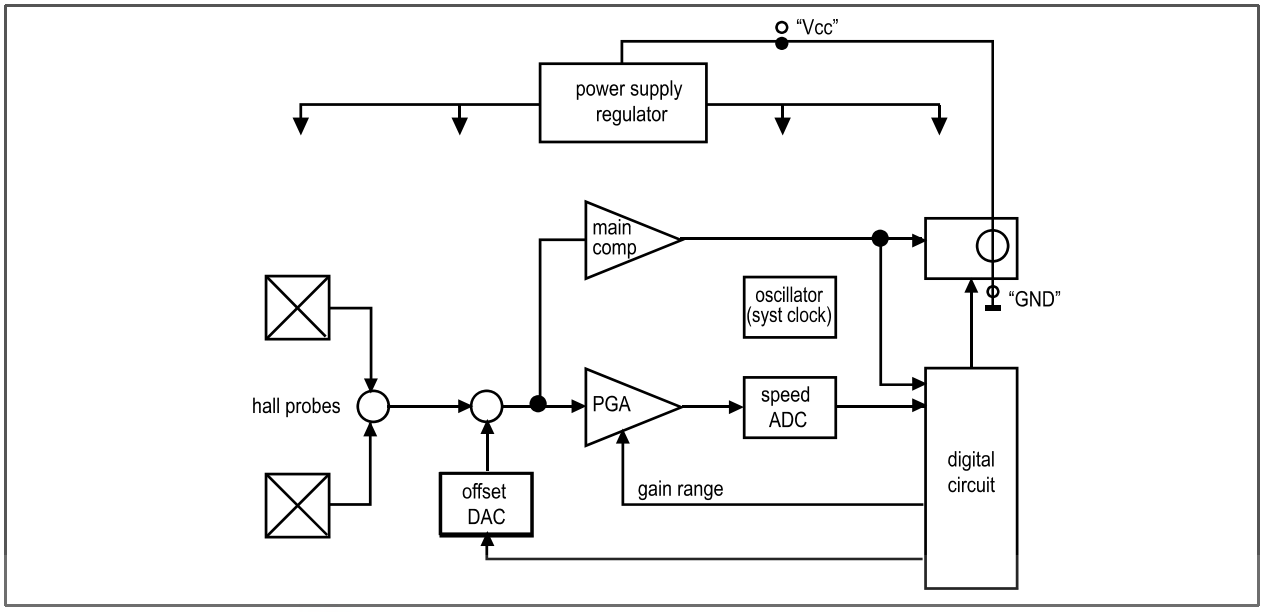
A. Wheel speed sensor
B. Magnetic wheel
C. Hub assembly



Modification basis	
Application basis	
Affected VIN	

(2) (Rear) Wheel Speed Sensor for AWD

▶ Block diagram



- Two hall elements with varying voltage according to magnetic field
- Power supply (12 V)
- Amplifier/Comparator
- Analog/digital converter

▶ Function of active wheel speed sensor system

Rear drive shaft tone wheel

- Basically, the tone wheel or the magnetized encoder wheel is required to activate the sensor. When the wheel rotates, the magnetic flux is changed as a sine wave form and this change is converted to voltage value by the hall elements. The voltage of sine wave form is amplified by the amplifier and finally converted to rectangular wave form by the comparator. This signal is transmitted to the
- ABS control unit to measure the speed. When the vehicle wheel rotates, the tone wheel rotates, and this rotation of the wheels changes the magnetic flux of the sensor and generates the induced electromotive force. The frequency of this duty waveform changes relative to the number of the rotation counts, and this frequency is controlled to detect the wheel speed.

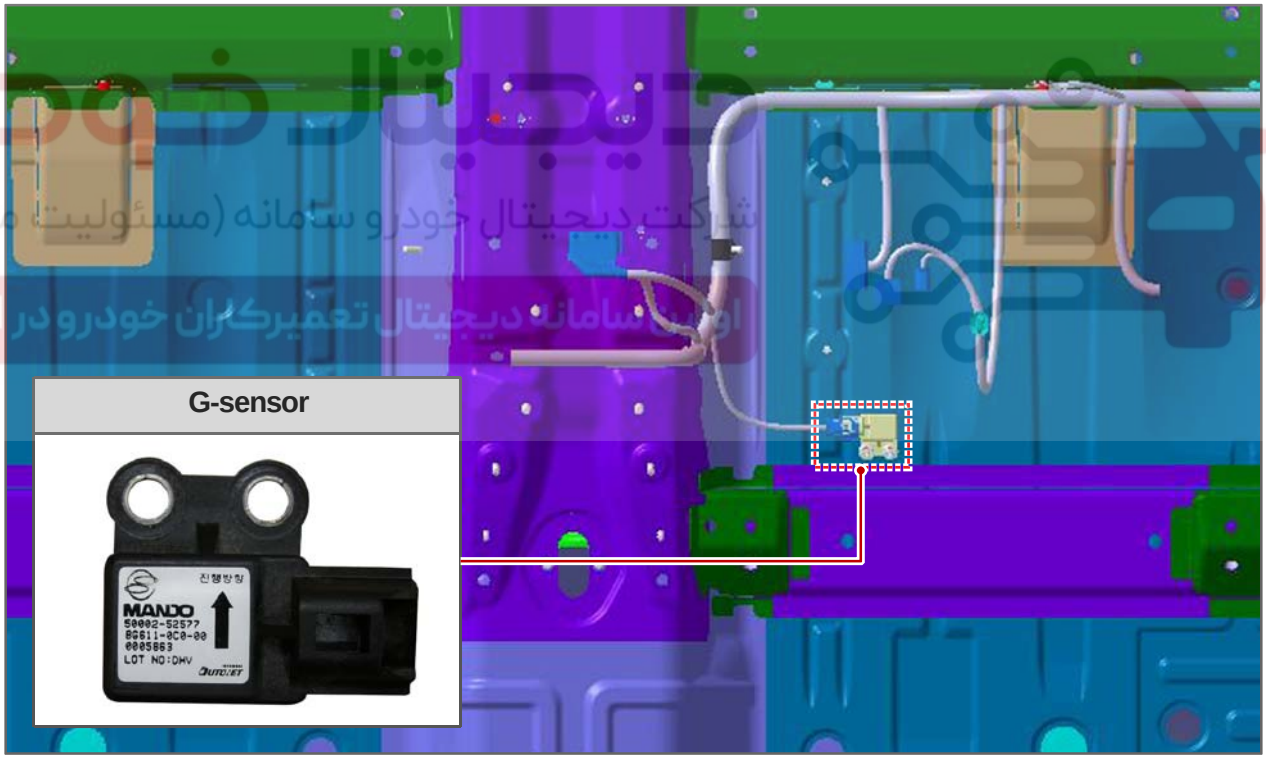
Modification basis	
Application basis	
Affected VIN	

S.G.N.
0000-00 G-SENSOR (ONLY FOR 4WD)

1) Overview

For the vehicle with the ABS, a speed difference between the wheels is not noticeable as all the wheels are slipping during abrupt braking. Therefore, the vehicle needs the speed information from other sensors other than the wheel speed sensor. On the 2WD vehicle, there is not large difference between the vehicle speed reduction and actual wheel speed reduction in the event of braking since the driving wheels are in the front. So, the ABS HECU can control the vehicle, based on a calculation value. But, on the 4WD vehicle, if a speed reduction occurs in the front or rear of the vehicle, it affects the other side wheel. In other words, braking the rear wheels induces also a large speed reduction in the front wheels. The longitudinal acceleration sensor is used for this case. It controls the ABS by using the signals from the sensor during abrupt braking and acceleration.

2) Mounting Location



Modification basis	
Application basis	
Affected VIN	

REMOVAL AND INSTALLATION

S.G.N. 4892-00 BLEEDING ABS/ESP SYSTEM

▶ **The ABS/ESP system needs to be bled when:**

- the brake caliper is replaced, removed/installed.
- the brake hydraulic pipe and hose are replaced, removed/installed.
- the brake master cylinder is replaced, removed/installed.
- the HECU is replaced, removed/installed.

NOTE

What is an air bleeding using a diagnostic device?

A program which drives the hydraulic pump of the HECU forcibly to facilitate the air bleeding from the ESP system.

CAUTION

- Do not re-use the drained brake fluid.
- Avoid mixing different brake fluids and use only specified brake fluid DOT4. It may cause the brake system damage.
- After finishing the work, make sure the brake fluid level is between the MAX and MIN marks on the reservoir tank (0.7 to 0.8 liters).
- Make sure that no foreign materials get into the system when bleeding and working on the brake system.
- Avoid getting brake fluid on your body or other vehicle parts. In case of contact, wash with plenty of water.

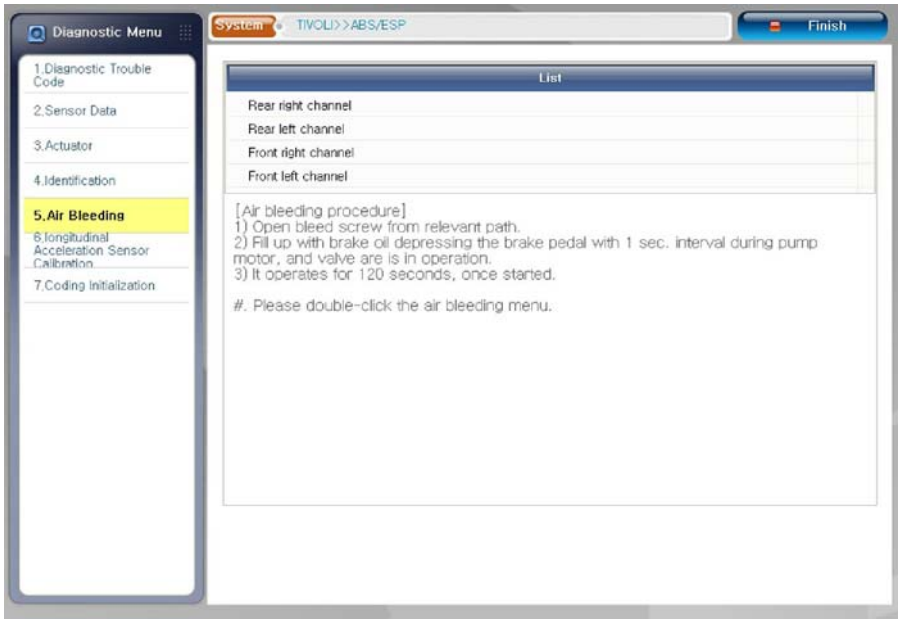
Modification basis	
Application basis	
Affected VIN	

1

1. Install the brake fluid supplier with pressurizer (equipment for brake fluid change).

Master cylinder reservoir tank location

2. Start the vehicle and install the diagnostic device.
3. Under the start-up screen, click on "Air Bleeding" in the "Vehicle Name" → "System" → "ESP Diagnosis".



Modification basis	
Application basis	
Affected VIN	

4. Operate the brake fluid supplier with pressurizer.

CAUTION

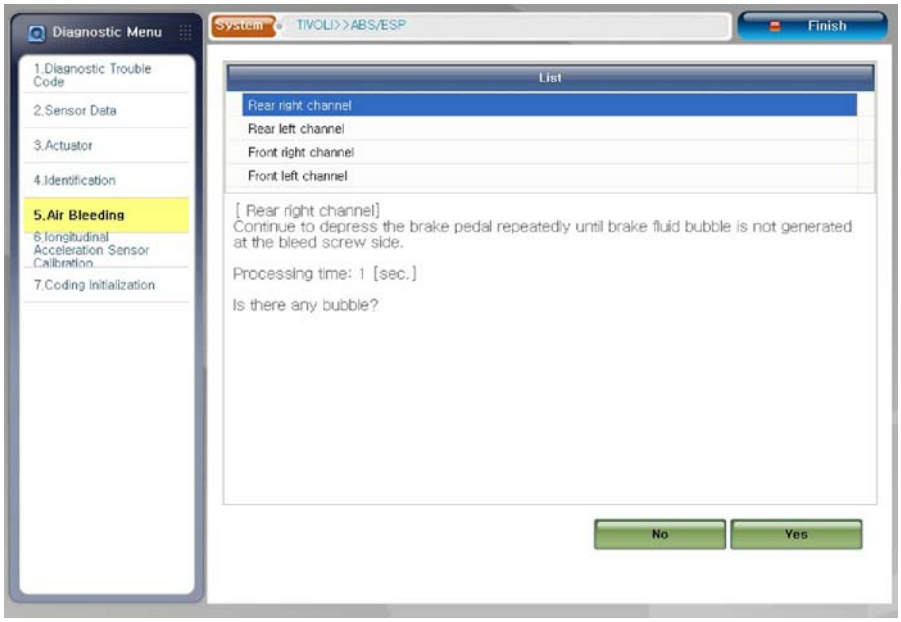
Check that the brake fluid level in the pressurizer is sufficient before performing the air bleeding.

NOTE

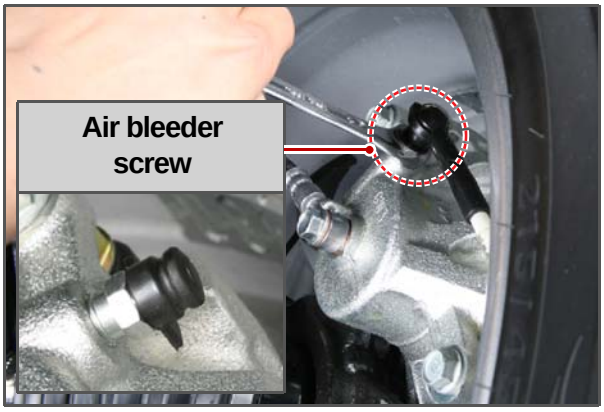
Oil specification

DOT4

5. Select "Rear right path" in the Diagnostics menu, unscrew the caliper air bleeder screw at the rear right hand side, and connect the transparent hose. (When performing air bleeding, the hydraulic pump of the HECU is operated for 120 seconds. Depress the pedal until the air bubbles are invisible.)



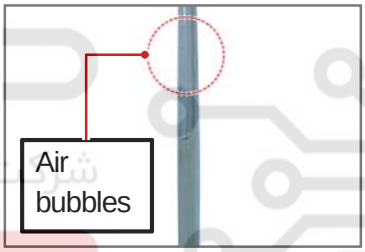
Modification basis	
Application basis	
Affected VIN	



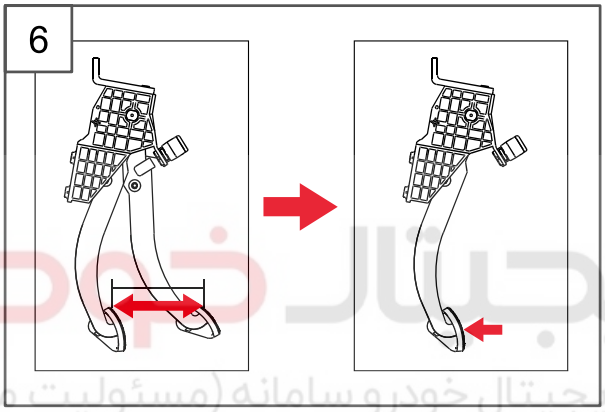
NOTE

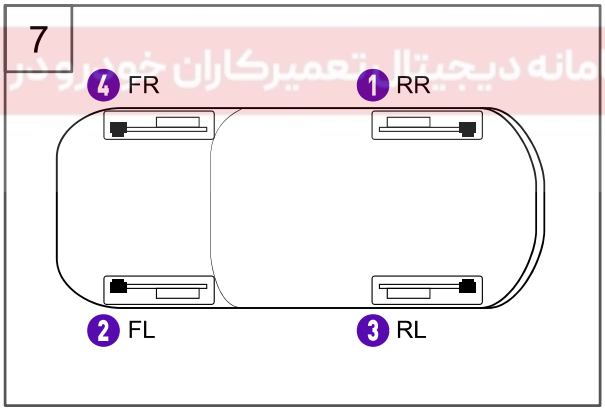
Air bleeding order: 1. rear right → 2. front left → 3. rear left → 4. front right

6. The mechanic A should depress the brake pedal repeatedly while the mechanic B drains the brake fluid by removing the brake air bleeder screw until the bubbles are invisible, and tighten the screw.

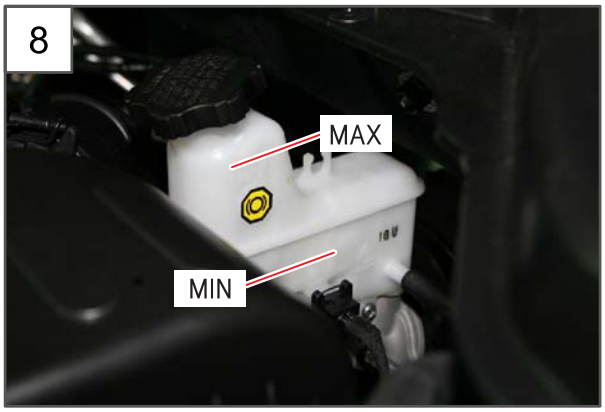


If no bubbles are visible, press "YES" under the corresponding diagnostic menu.





7. Carry out air bleeding for the rest of the wheels in the order shown in the figure (1. rear right → 2. front left → 3. rear left → 4. front right) using the method described above.



8. After finishing the service work, visually check the brake operation and oil leaks, and fill the brake reservoir tank with the brake fluid level between the MIN and MAX marks on the tank.

Modification basis	
Application basis	
Affected VIN	

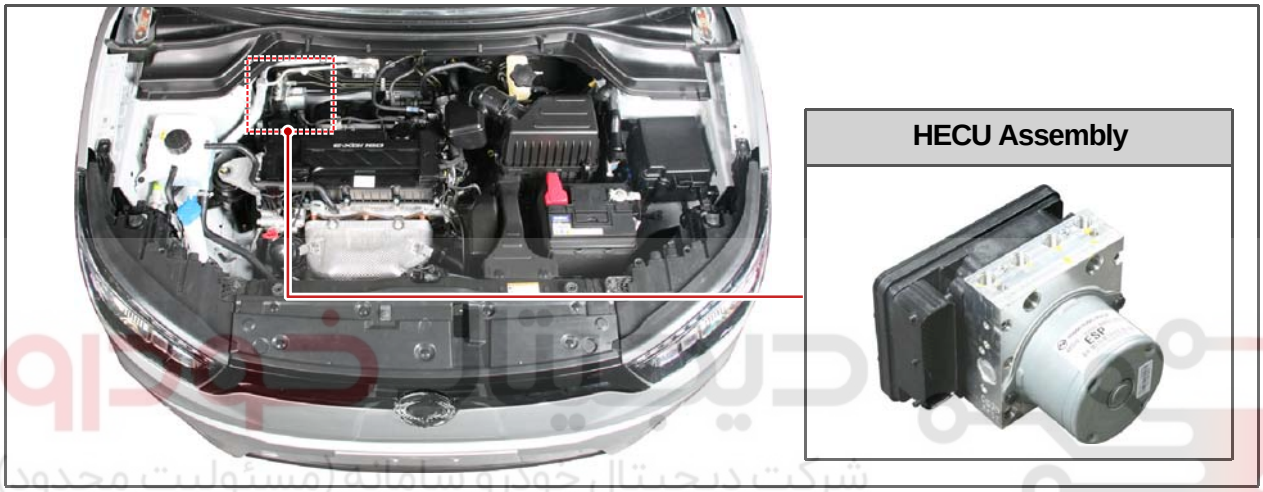
S.G.N. 4892-01

HECU

Preceding work - Disconnect the negative battery cable.

CAUTION

- Avoid getting brake fluid on the painted surface of the vehicle. In case of contact, rinse with plenty of water.
- Be careful not to allow any entry of air to the hydraulic modulator. If the air enters to the hydraulic system, perform bleeding using a diagnostic device which is programmed for ESP system.



HECU Assembly

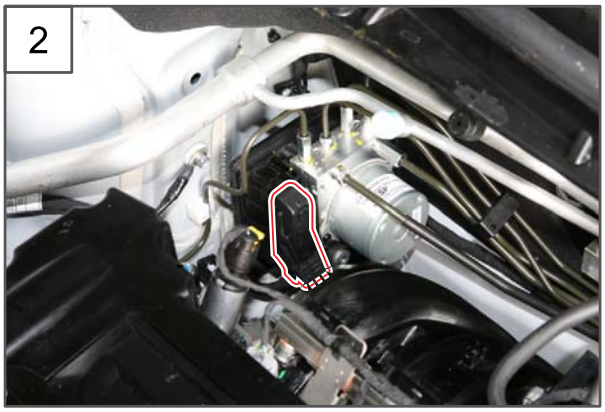
1

1. Collect the brake fluid from the brake fluid reservoir tank using an oil pump.

CAUTION

Make sure that the brake fluid does not come into contact with the vehicle body or skin.

2



2. Disconnect the HECU connector.

Modification basis	
Application basis	
Affected VIN	

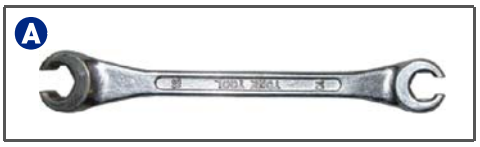
3

3. Remove the 2 mounting nuts (12 mm) securing the HECU brake pipes to the master cylinder.

Tightening torque 19.6 to 23.5 Nm

CAUTION

Use only the dedicated tool (A) when removing the brake pipe mounting nut.



4

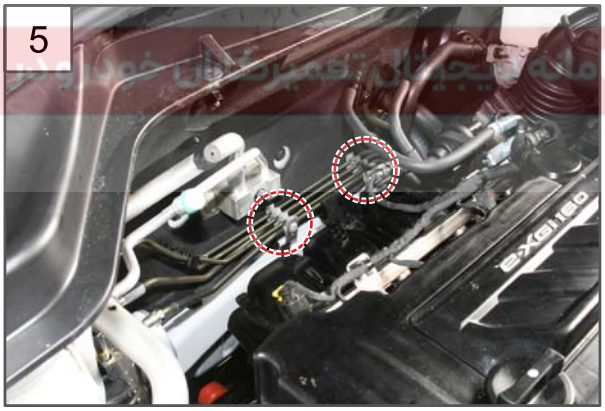
4. Remove the 4 mounting nuts (10 mm) securing the caliper brake pipe to the HECU.

Tightening torque 14.7 to 18.6 Nm

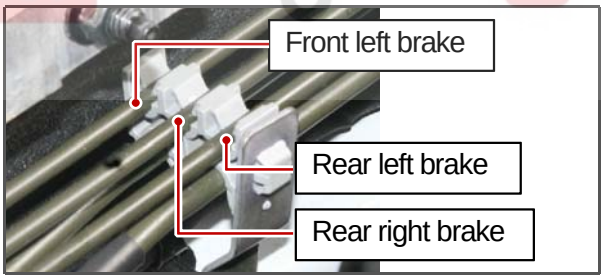
CAUTION

If the threads of the brake pipe and HECU are not fitted correctly, the pipe and HECU can be damaged and oil leaks can occur.

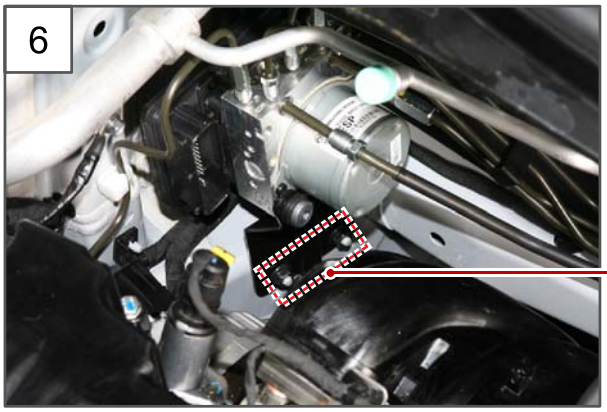
5



5. Free the following brake pipes from the 2 pipe mounting holders.

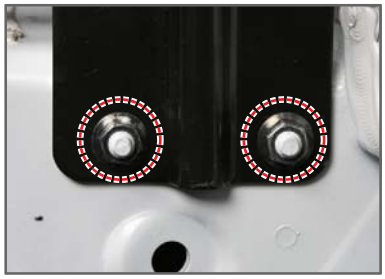


6



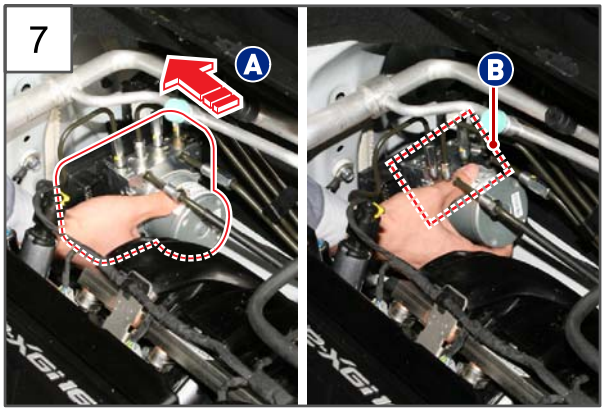
6. Remove the 2 mounting nuts (12 mm) for the HECU bracket.

Tightening torque 10.0 to 14.0 Nm



Modification basis	
Application basis	
Affected VIN	

7

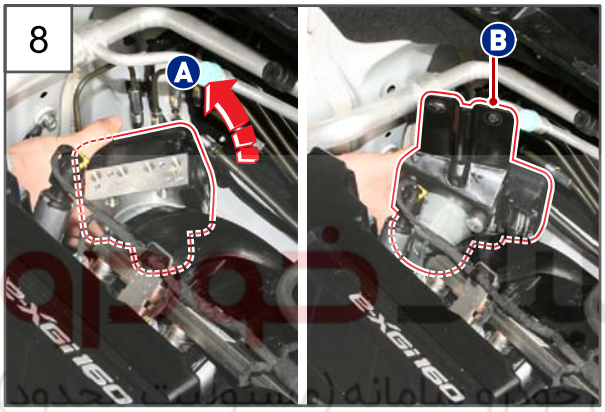


7. Swing the HECU assembly up in the direction of the arrow (A) to prise loose between the HECU assembly and brake pipe (B) as shown in the picture.

CAUTION

Make sure to avoid the pipe damage from contact with the brake pipes.

8

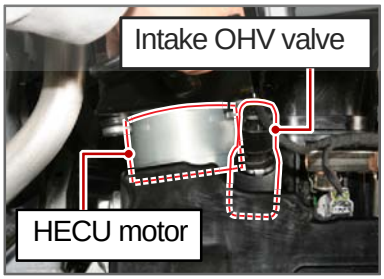


8. Turn the HECU assembly 180° in the direction of the arrow (A) from the right side of the intake manifold, so that the bracket (B) faces upward.

9

9. Remove the HECU assembly.

CAUTION



Be careful not to damage the intake OHV valve connector.

10

10. Unscrew 3 hexagon HECU bracket mounting bolts (6 mm) to remove the bracket.

Tightening torque 11.0 to 14.0 Nm

Modification basis	
Application basis	
Affected VIN	

11

11.Install in the reverse order of removal.

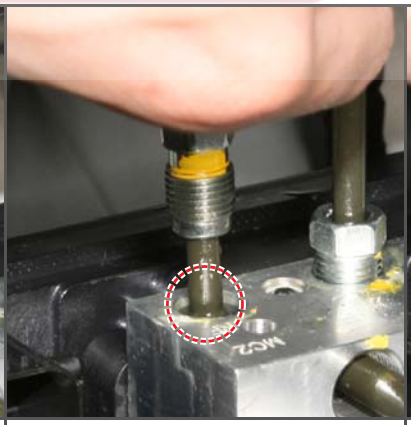
CAUTION

- Always perform air bleeding after replacing. (Refer to "BLEEDING ABS/ESP SYSTEM" under this subsection)
  When you install a new HECU to the vehicle,
- coding is executed automatically.

Cautions for installation of HECU

Observe the following when installing the pipe and HECU to prevent damage to the components or oil leaks.

Pull up the brake pipe with the mounting nut in the direction of the arrow shown in the picture.



Insert the brake pipe into the hole of the HECU.

Tighten the mounting nut by hand and tighten the nut to the specified torque using a proper tool.

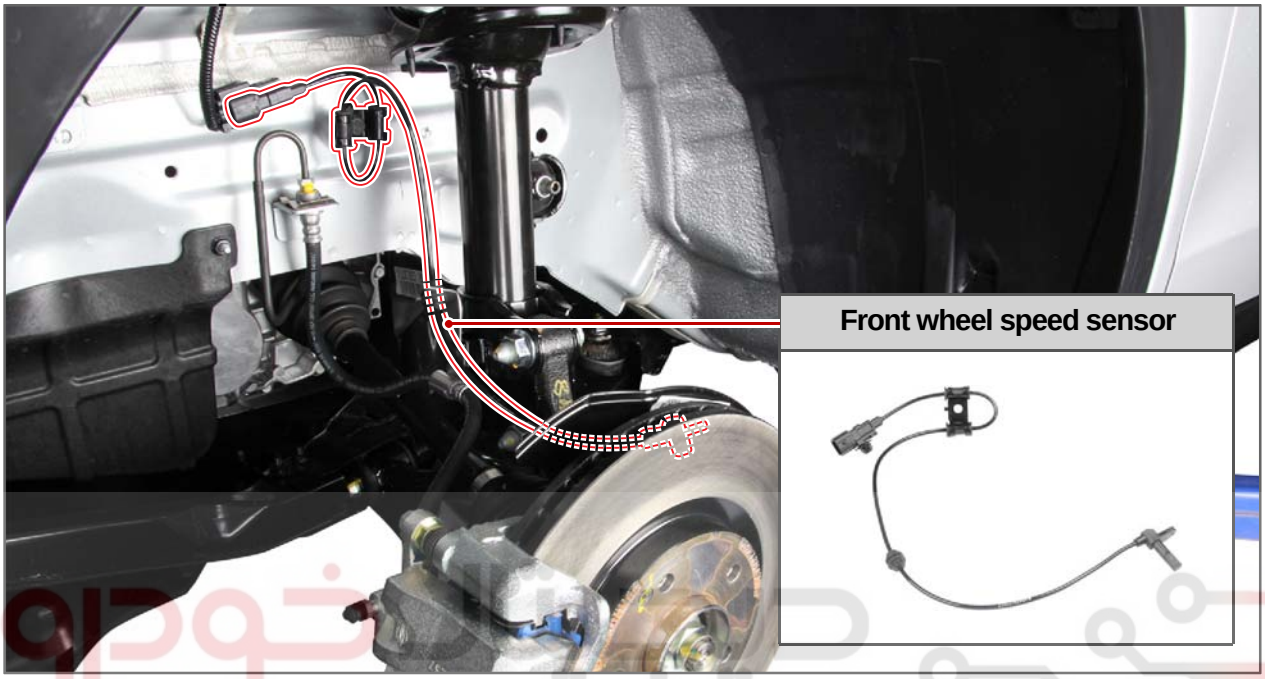
Modification basis	
Application basis	
Affected VIN	

S.G.N. 4890-01

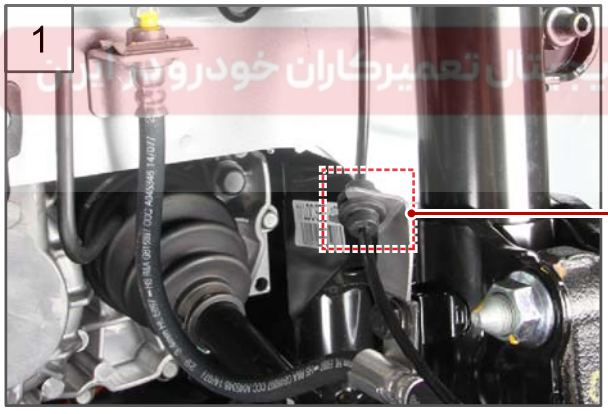
FRONT WHEEL SPEED SENSORS

Preceding work

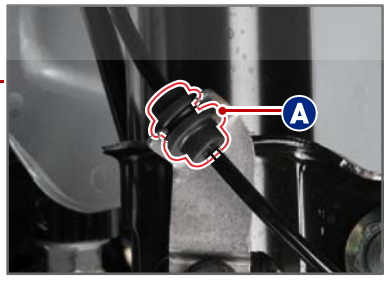
- Disconnect the negative battery cable.
  Remove the tire.



1



1. Free the mounting for the front wheel speed sensor (A).



2

2. Unscrew the mounting bolt (12 mm) for the front wheel speed sensor.

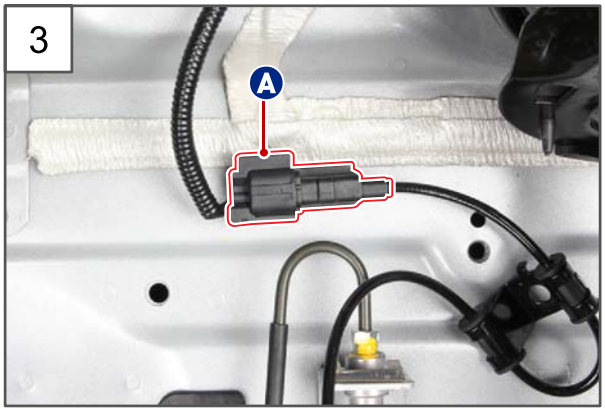
Tightening torque 9.8 to 12.7 Nm

CAUTION

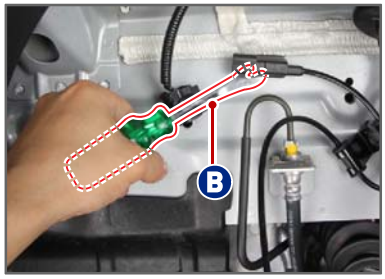
Check the left (L) and right (R) marks on the mounting bracket when installing the front wheel speed sensor.

Modification basis	
Application basis	
Affected VIN	

3



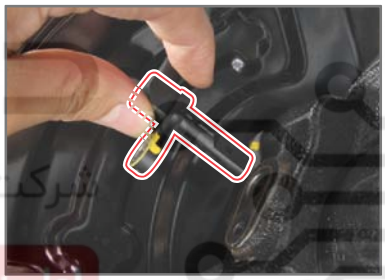
3. Disconnect the front wheel speed sensor connector (A) and remove it from the vehicle using a hand remover (B).



4

4. Unscrew the front wheel speed sensor mounting bolt (10 mm) and separate the wheel speed sensor from the knuckle.

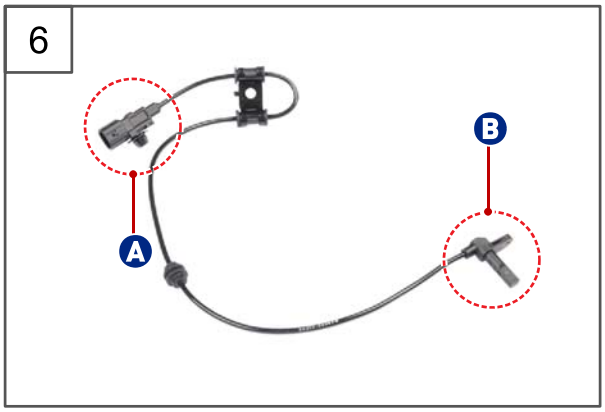
Tightening torque 8.0 ± 2.0 Nm



5

5. Remove the front wheel speed sensor.

6



6. Install in the reverse order of removal.

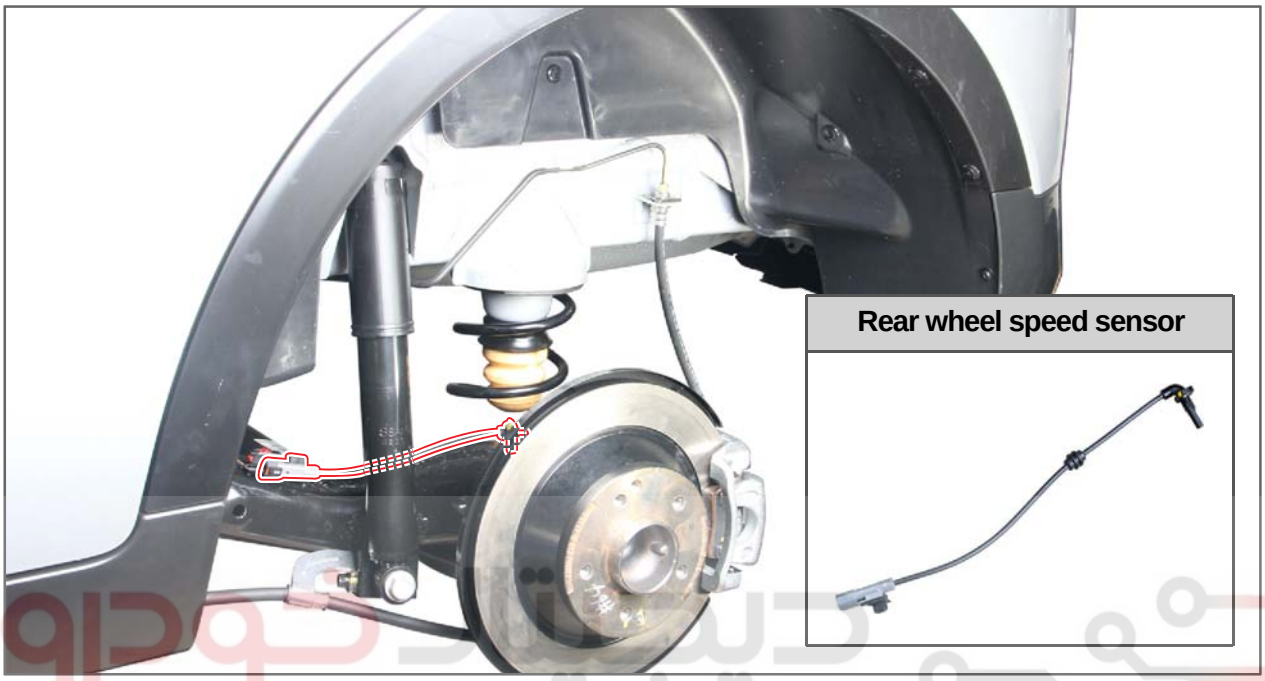
A Connector	B Sensor
	

Modification basis	
Application basis	
Affected VIN	

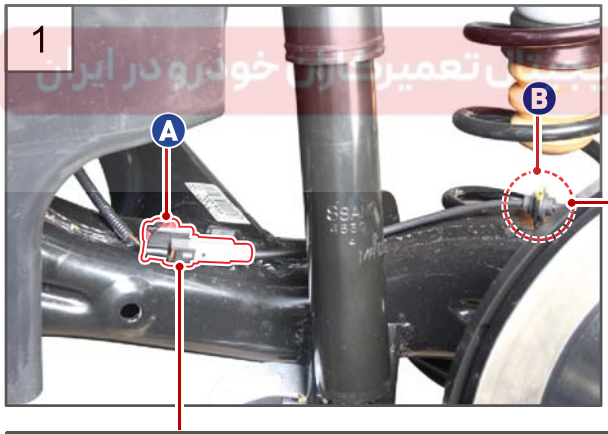
S.G.N. 4890-02 REAR ACTIVE WHEEL SPEED SENSOR (2WD)

Preceding work

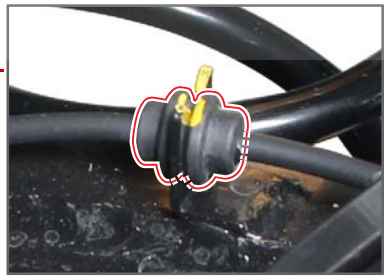
- Disconnect the negative battery cable.
- Remove the tire.

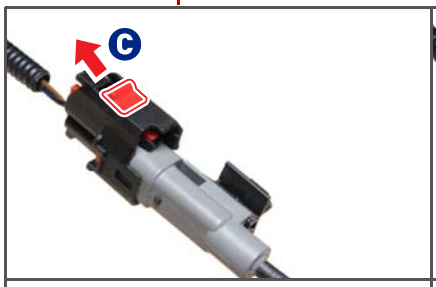
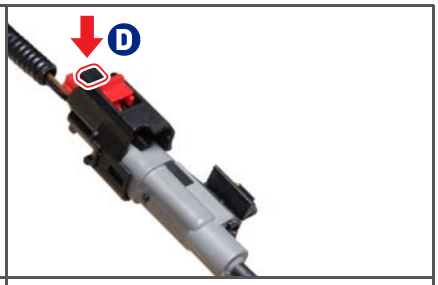


1



1. Remove the connector (A) and cable mounting (B) for the rear wheel speed sensor.



	
Move the connector locking part (red) in the direction of the arrow (C).	Press on the locking part in the direction of the arrow (D) to disconnect the connector.

Modification basis	
Application basis	
Affected VIN	

2

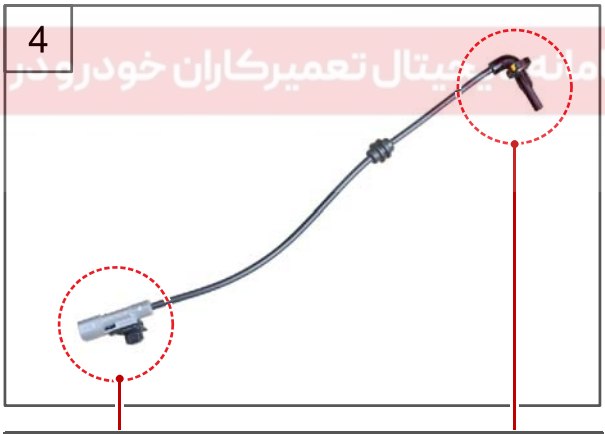
2. Unscrew the mounting bolt (10 mm) for the rear wheel speed sensor.

Tightening torque 9.0 ± 1.5 Nm

3

3. Remove rear wheel speed sensor.

4



4. Install in the reverse order of removal.

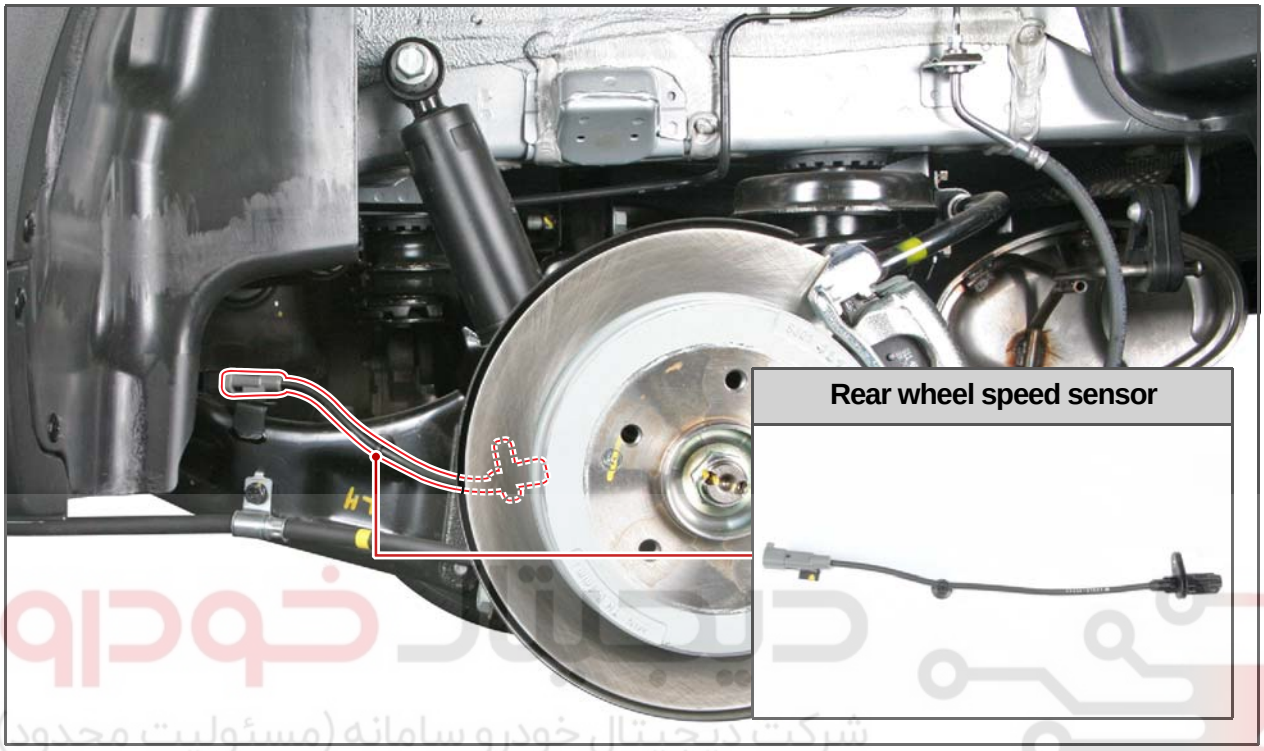
Connector	Sensor
	

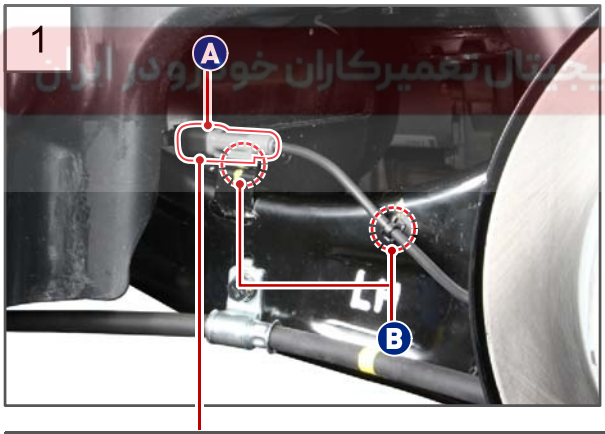
Modification basis	
Application basis	
Affected VIN	

S.G.N. 4892-02

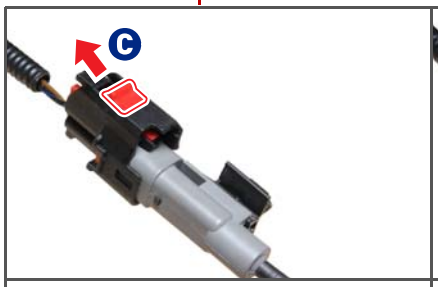
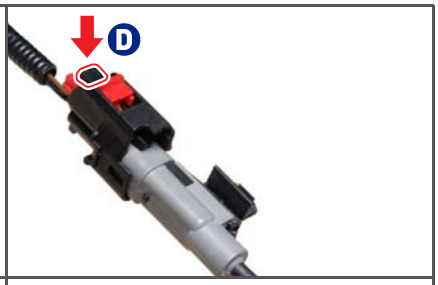
REAR ACTIVE WHEEL SPEED SENSOR (AWD)

Preceding work
- Disconnect the negative battery cable.
- Remove the rear wheel.





1. Remove the connector (A) and cable mounting (B) for the rear wheel speed sensor.

	
Move the connector locking part (red) in the direction of the arrow (C).	Press on the locking part in the direction of the arrow (D) to disconnect the connector.

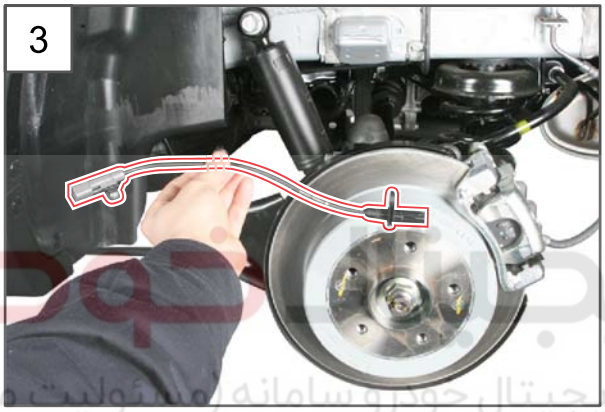
Modification basis	
Application basis	
Affected VIN	

2

2. Unscrew the rear wheel speed sensor mounting bolt (10 mm).

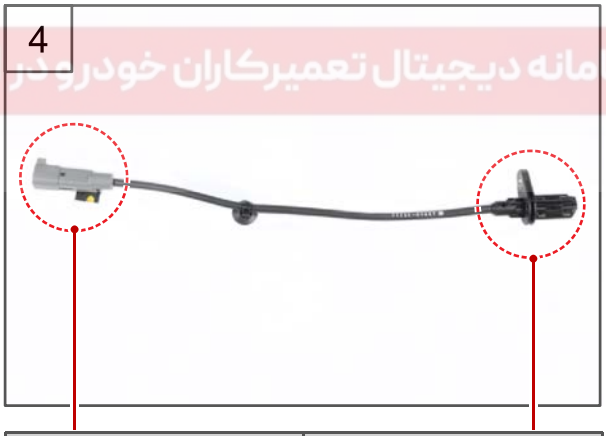
Tightening torque 9.0 ± 1.5 Nm

3



3. Remove rear wheel speed sensor.

4



4. Install in the reverse order of removal.

Connector Appearance	Sensor
	

Modification basis	
Application basis	
Affected VIN	

Memo