ELECTRIC POWER STEERING STEERING SYSTEM

4610-01/4610-02/4610-04/4610-06/4620-01/

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ELECTRIC POWER STEERING STEERING SYSTEM 4610-00

GENERAL INFORMATION

1. SPECIFICATIONS

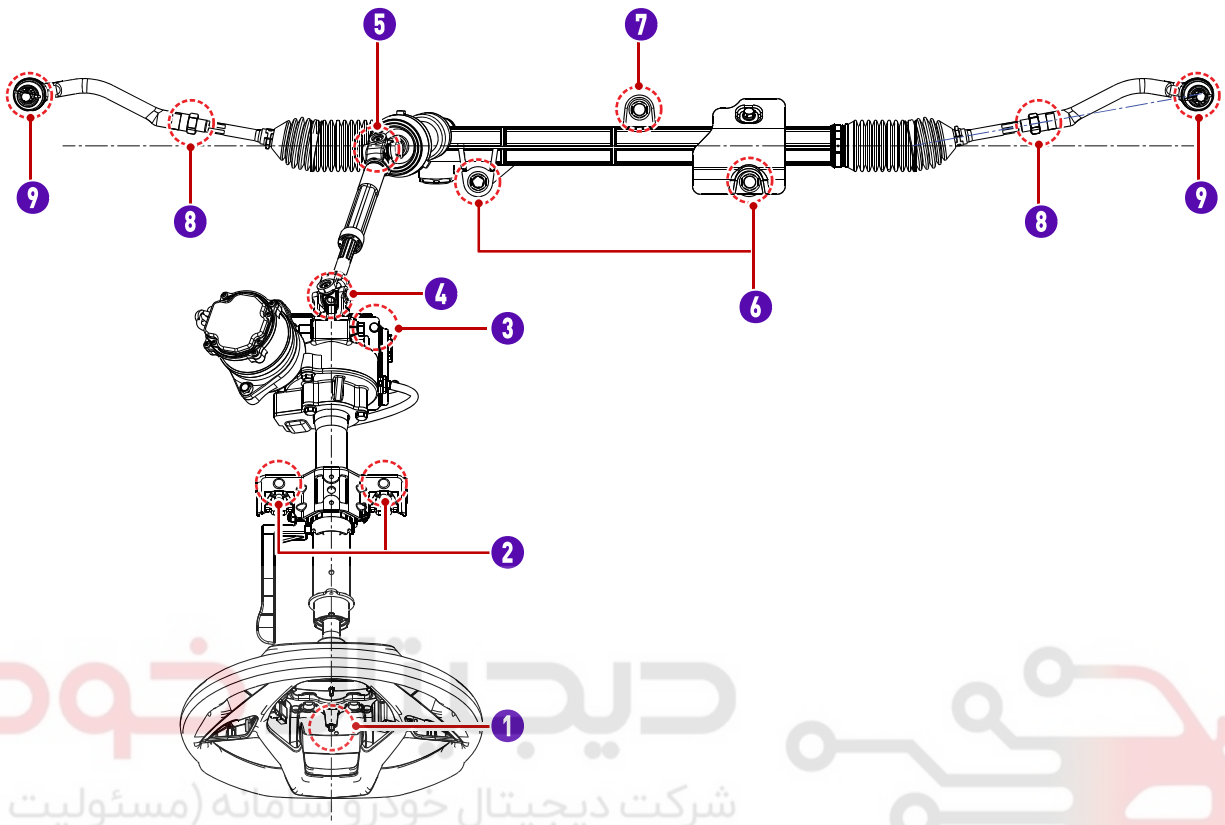
Category	Item		Specifications
EPS ECU	Operation type		Motor driven power steering system
	Operating temperature		−40°C to 85°C
	Max. humidity		95%
	Operating voltage	Rated voltage	12 V
		Operating voltage	6.0 to 20.0 V 9.0 to 17.0 V (EPS 100%) 8.3 to 9.0 V (EPS 20%)
		Assist operating voltage	17.0 to 20.0 V
		CAN network	8.3 to 20.0 V
	Operating current	Dark current	0.3 mA or lower (12.0 V, Unloaded)
		Operating current	500 mA (12.0 V, Unloaded)
		Max. output current	99 A (11.0 to 16.0 V)
BLAC motor	Type		Brushless type
	Operating temperature		−40°C to 85°C
	Rated voltage		12 V
	Rated voltage		70 A
	Turning torque		4.3 Nm (25°C) 4.1 Nm (85°C)
	Rotational speed		1,100 RPM
	Position sensor type		Hall sensor type
Torque angle sensor	Type		Non-contact
	Rated voltage		5 V
	Operating temperature		−40°C to 125°C
	Measuring angle range		±738° (Torque: ±8°)

Modification basis	
Application basis	
Affected VIN	

Category	Item		Specifications
Steering column	Tilting angle	Up	2°
		Down	2°
Steering wheel	Type		4 spokes
	Outside diameter		Φ373 (D-CUT range: Φ368.5)
	Heated wire unit	Type	Simple ON/OFF
		Rated voltage	13.5V ± 0.1V
		Operating voltage	9.0V ~ 16.0V
		Rated voltage	Max. 12.4 A
		Low voltage	7.5 V ± 0.5 V (No operation recovery after turning off the LED and heated wire)
		HI voltage	18.0 V ± 0.5 V (16.5 V ± 0.5 V, Auto recovery)
Steering gear linkage	Type		Rack and pinion
	Gear ratio		50.7
	Rack stroke		148mm ± 1.5mm
Steering angle	Inner		31.10° ± 1°
	Outer		37.67° ± 1°
Lower shaft	Type		Sliding (Ball slip)

Modification basis	
Application basis	
Affected VIN	

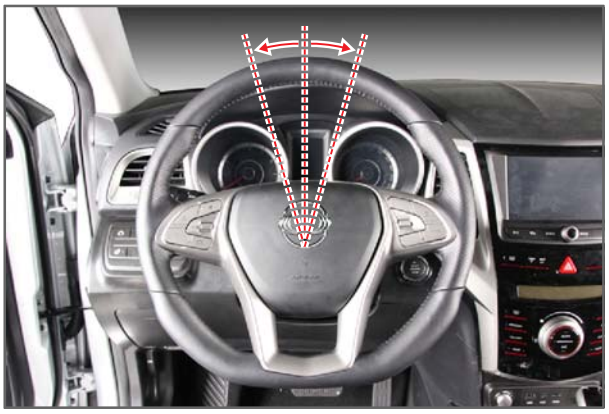
2. TIGHTENING TORQUE



No.	Item		Tightening torque	Remarks
1	Steering wheel mounting nut		39.2 to 49.0 Nm	22 mm X 1 off
2	Steering column shaft	Upper mounting nut	19.6 to 24.5 Nm	12 mm X 2 off
3		Lower mounting bolt	44.1 to 49.0 Nm	14 mm X 1 off
4	Lower shaft	Upper mounting bolt	27.4 to 32.3 Nm	12 mm
5		Lower mounting bolt	27.4 to 32.3 Nm	12 mm
6	Steering gear box	Mounting bolt	68.6 to 98.0 Nm	19 mm X 2 off
7		Mounting bolt	49.0 to 68.6 Nm	17 mm X 1 off
8	Tie rod mounting nut		63.7 to 83.5 Nm	22 mm
9	Tie rod end mounting nut		44.1 to 83.5 Nm	17 mm (Castle nut)

Modification basis	
Application basis	
Affected VIN	

3. EPS STEERING WHEEL FREE PLAY CHECK



A. Start the engine and position the front wheels at straight ahead direction.
B. Turn the steering wheel until the tires starts to move and measure the amount of movement (free play) on the circumference of the steering wheel.

Free play	30 mm or lower

▶ **If the free play exceeds 30 mm, check the following to adjust or replace corresponding components.**

1. Steering wheel mounting nut
2. Steering column upper mounting nut
3. Steering column lower mounting bolt
4. Lower shaft upper/lower mounting bolt
5. Steering gear box mounting bolt
6. Tie rod mounting nut
7. Tie rod end mounting nut
8. Connection of knuckle arm and ball joint
9. Ball joint play
10. Rack & pinion gear

Modification basis	
Application basis	
Affected VIN	

4. PRECAUTIONS

1) Cautions For Handling

Possible cause	Related part	Symptom	Cause	Remarks
Drop, impact and overload	Motor	Noise increase	- Possible to cause internal damage without deformation and leads to uneven load distribution when using any dropped parts -Motor/precise parts in ECU are sensitive to vibration and impact and malfunction may arise -Excessive load weight causes unexpected faults	-Do not use the EPS exposed to an impact -Do not load weight more than the weight of the product itself to each part
	ECU	Malfunction due to broken circuit -Out of welding point -Damage to PCB -Damage to precise parts		
	Torque sensor	Impaired steerability due to torque sensor malfunction	Torque sensor malfunctions due to excessive weight load to input shaft	-Do not use the EPS exposed to an impact -Always use the specified tool when removing steering wheel (do not use a hammer) -Do not impact when working on the connections
	Shaft	-Impaired steerability (not same on left and right sides) -Difficult installation resulting from shaft's deformation	-	-

Modification basis	
Application basis	
Affected VIN	

Possible cause	Related part	Symptom	Cause	Remarks
Pull/Dent	Harness	-Malfunction (impossible to switch on) -Unstable EPS performance	Harness connection and harness itself will be disconnected	-Do not load to the harness -Avoid excessive use of EPS
Incorrect storage temperature/ humidity	Motor/ECU	Poor steerability due to malfunctioning motor/ECU	-Waterproof is available in normal conditions but water in the parts may lead to breakdown -Small amounts of water can lead to malfunction of motor/precise parts in ECU	-Store at room temperature and keep proper humidity -Avoid water penetration due to e.g. rain

1. Never subject the electronic parts to physical shocks. If those parts are exposed to a large impact, such as dropping, you should replace them with new ones.
2. Do not keep the electronic parts in a place with high temperature and humidity.
3. Do not touch the connector terminal by your hands since problems may arise because of deformation and static electricity.
4. Never subject the motor and torque sensor to severe impacts. If those parts are exposed to a large impact, such as dropping, you should replace them with new ones.
5. You should connect and disconnect the connector with the ignition off.

Modification basis	
Application basis	
Affected VIN	

2) Misdiagnosis Cases

(1) Over heat protection control

1. When the driver turns the steering wheel and the twist between the input shaft and the output shaft occurs, the motor generates an assist torque.
2. If the driver keeps the steering wheel at the maximum steering angle, the steering wheel is stopped rotating by the stopper but the torque signal is generated continuously.
3. Then the motor controls the assist torque continuously according to the torque signal. And this can leads to overheating of the motor and eventually the system may be damaged.
4. To prevent this, the C-EPS ECU gradually reduces the assist torque. (This can be confirmed by checking the current output using a scanner.)
5. As the motor control level decreases, the steering effort continues to increase.
6. This is not a malfunction but a simple C-EPS control to prevent the motor from overheating.

NOTE

If the vehicle equipped with EPS is stationary, turning the steering wheel to the left or right end over a long time will trigger the overheating protection function and you may feel the steering becomes heavy. But it is not a malfunction and the system will be restored to its original status.

(2) Operating sound of C-EPS

For a vehicle with C-EPS, the motor is installed inside the vehicle, so the driver may misunderstand the operating sound of the motor as a noise. The system makes the following sounds during normal operation:

1. C-EPS ECU operating sound (clicking sound): Occurs about 1 sec after turning the ignition key ON/OFF
2. Motor operating sound (whining sound): Occurs primarily when the steering wheel is operated suddenly
3. Contact sound of outer ring in the worm shaft bearing (knocking sound): Can occur at the decelerator when driving on a poor road
4. In other cases, when creaking noise are heard, check the MDPS assembly and check-tighten the bolts on the body.

NOTE

If one of the following occurs while no warning lamp on the instrument cluster is turned on, the EPS is operating normally.

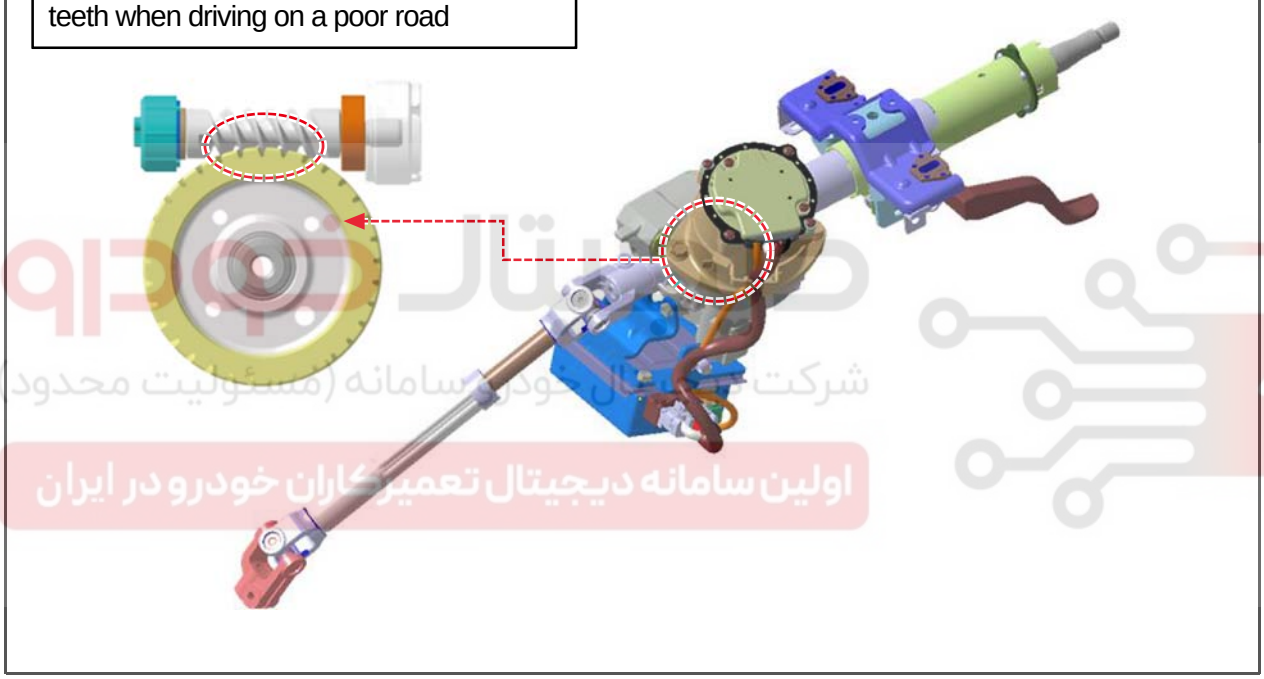
- The steering effort becoming heavy during the time for C-EPS system diagnosis (1 sec) right after starting the engine, then it returns to normal.
- After turning the engine ON or OFF, a clicking sound due to the contact of the relay is heard but this is not a defect.
- When the steering wheel is turned while the vehicle is stationary or driving at low speed, a motor operating sound may be heard. This occurs when the power steering motor rotates and it is not a defect.

(3) EPS operation delay and operating sound

If one of the following occurs while no warning lamp on the instrument cluster is turned on, the EPS is operating normally.

- The steering effort becoming heavy during the time for EPS system diagnosis (1 sec) right after starting the engine, then it returns to normal.
- After turning the engine ON or OFF, a clicking sound due to the contact of the relay is heard but this is not a defect.
- When the steering wheel is turned while the vehicle is stationary or driving at low speed, a motor operating sound may be heard. This occurs when the power steering motor rotates and it is not a defect.

Rattling sound due to contact between gear teeth when driving on a poor road



Modification basis	
Application basis	
Affected VIN	

5. TROUBLESHOOTING

Symptom	Cause	Action
Hard steering	Abnormal wear or stuck of steering ball joint due to foreign materials, lack of lubrication	Lubricate or replace
	Damaged or faulty steering gear	Replace gear assembly
	Faulty steering shaft joint	Replace
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Steering is pulled to one side	Damaged steering linkage	Replace
	Damaged wheel or tire	Repair or replace
	Faulty brake system	Repair or replace
	Faulty suspension system	Repair or replace
Excessive free play of steering wheel	Worn steering gear	Replace gear assembly
	Worn or damaged steering ball joint	Replace
	Loosened steering gearbox mounting bolt	Retighten
Poor return of steering wheel	Damaged or stuck steering ball joint	Replace
	Improper preload of steering pinion	Replace gear assembly
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Steering wheel vibration (Shimmy)	Damaged steering linkage	Replace
	Loosened steering gearbox mounting bolt	Retighten
	Damaged or stuck steering ball joint	Replace
	Worn or damaged front wheel bearing	Replace
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace

Symptom	Cause	Action
Abnormal noise from steering system	Loosened steering gearbox mounting bolt	Retighten
	Faulty steering gear	Replace gear assembly
	Steering column interference	Repair
	Loosened steering linkage	Retighten
Abnormal noise while the operation	Loosened steering column mounting nut or bad tightening	Retighten nut
	Worn or damaged steering shaft bearing	Replace steering column
Excessive steering force	Worn or damaged steering shaft bearing	Replace steering column

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

Recently, the enhanced steering system, called EPS (Electric Power Steering) is widely used to achieve optimal steering assistance, reduce fuel consumption, and meet the environmental regulations. The EPS does not have any belt-driven steering pump constantly running, so it is lightweight and the motor consumes energy only when the steering wheel is turned by the driver, and this leads to improvement in fuel efficiency. Also, the elimination of a belt-driven pump and its accessories greatly simplifies manufacturing and maintenance. While offering these benefits, as it does not contain any steering oil, the environment is not polluted both when the steering system is produced and discarded.
In other words, the EPS system uses the electric motor to assist the steering force. It functions independently regardless of whether the engine is running or not, unlike the conventional hydraulic power steering.
The EPS system generates an assist steering force variably depending on the driving conditions by controlling the motor's operation, based on the input signals from the sensors such as torque sensor and angle sensor. The EPS receives the torque signal by the driver's input of the steering wheel as well as the vehicle speed, and uses 3-phase BLAC motor to determine the motor torque. Then the EPS controls the motor to reach the target torque with the phase current of the motor and the signal from the rotation position sensor. Another features of EPS are fail-safe function, diagnosis function, communication function between units, and interface function for external diagnostic device.
The EPS system components such as the torque sensor, steering angle sensor, fail-safe relay, etc. are located in the steering column and EPS unit assembly.

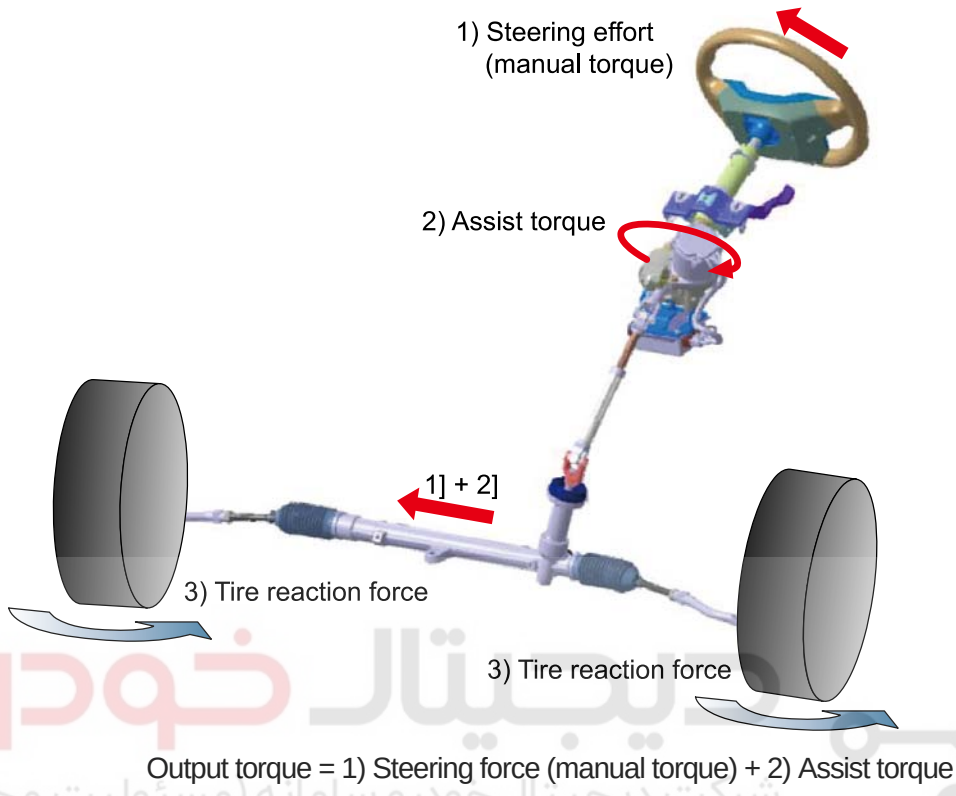
▶ **Advantages:**

(1) Assurance of improved steering
- Provides optimal steering force according to the vehicle speed:
  For example, in low-speed driving conditions, such as parking, EPS provides higher level of assistance than it does at higher speeds. The greater assist makes it easier to maneuver the vehicle. On the contrary, when the vehicle speed is high, the electronic power assist is gradually reduced for direct and precise controlling.
- Enhanced steering stability while driving at high speed
- Damping compensation control, friction compensation control

(2) Reduced fuel consumption
- Consumes power only when the power assist is required:
  Fuel economy improved
- Energy saving:
  Saving up the energy compared to hydraulic steering
- Elimination of pump, hose, pulley, oil reservoir, belt, fittings

Modification basis	
Application basis	
Affected VIN	

2. OPERATING PROCESS

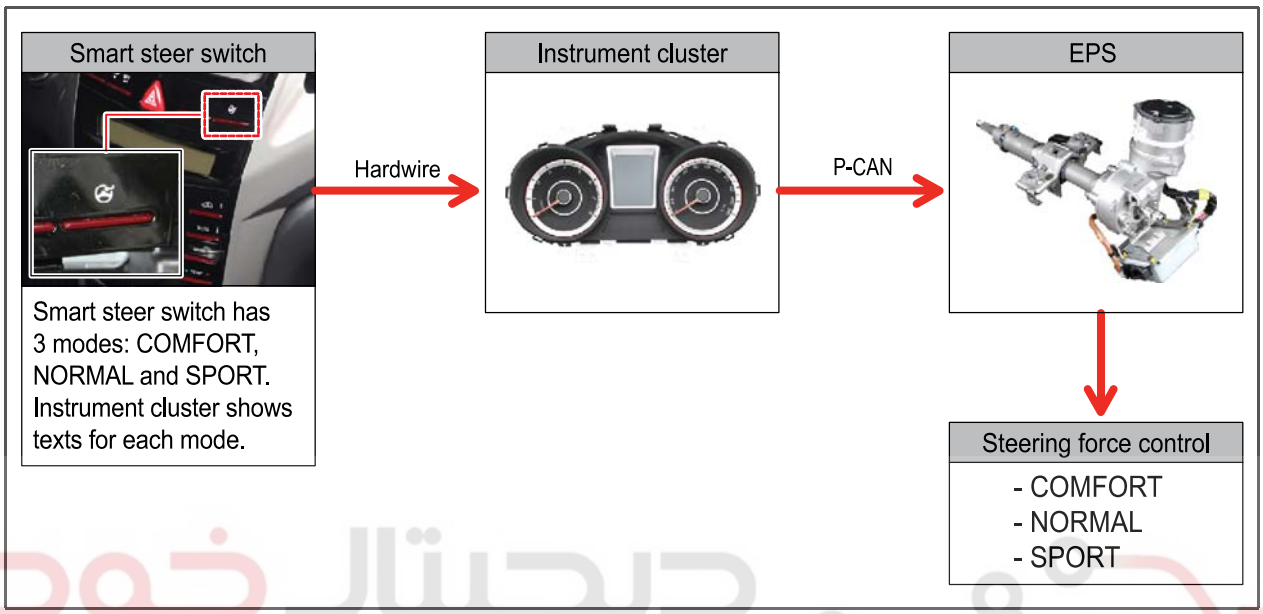


When the driver turns the steering wheel, torque is generated and the torque sensor and the steering angle sensor in the EPS system detect the intention of the driver to run the electric motor. At this time, the worm gear connected to the motor drives the helical gear mounted to the steering column to generate the assist torque for the steering column. This allows the driver to operate the steering wheel easier.

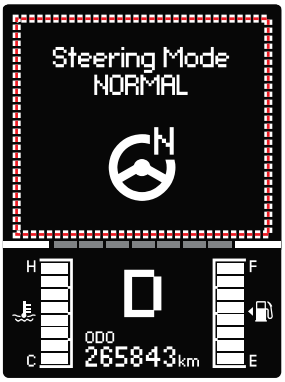
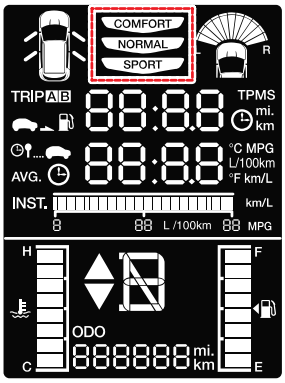
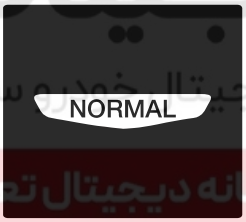
Modification basis	
Application basis	
Affected VIN	

3. SMART STEER MODE

The smart steer mode allows the steering force of the steering wheel change according to the driver's input or road conditions. Three types of modes (COMFORT, NORMAL, SPORT) are available and can be selected by the smart steer switch.



Modification basis	
Application basis	
Affected VIN	

Supervision instrument cluster	Standard instrument cluster	Operating conditions
		Pressing the smart steer switch displays the currently selected steer mode on the screen of the instrument cluster. The mode is changed in the order of COMFORT → NORMAL → SPORT each time the switch is pressed within 4 sec. If the switch is not pressed within 4 sec., the mode returns to the previously selected mode. The selected smart steer mode is maintained even if the ignition switch is turned OFF and ON again.
		The COMFORT mode is used when smoother or more comfortable ride than NORMAL mode is required.
		The NORMAL mode is used for typical driving conditions.
		The SPORT mode is used for heavy steering (heavier than NORMAL mode) and high speed operation.

CAUTION

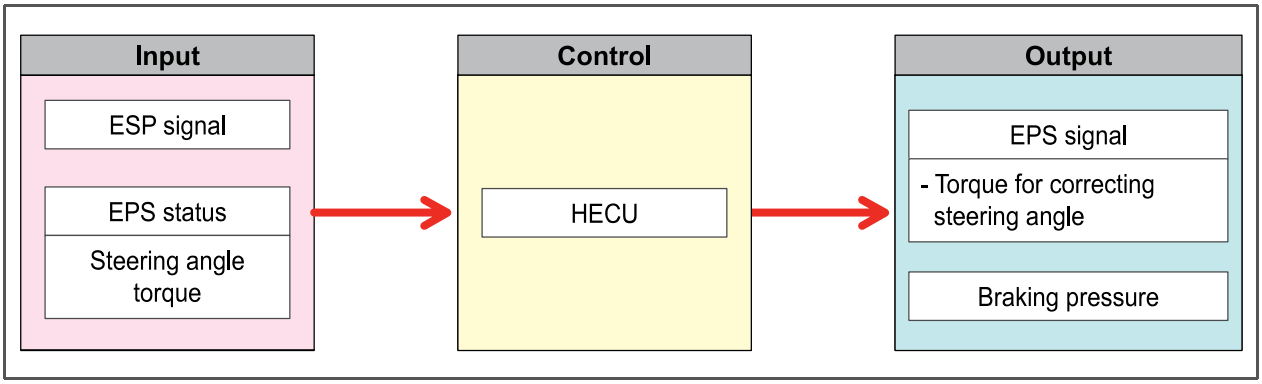
- When changing smart steer mode during driving, all attention should be kept on the roadway ahead.
- When changing the smart steer mode while turning the steering wheel, the selected mode is displayed on the instrument cluster screen, but the steering force may not change immediately. If this is the case, the mode will be changed to the selected mode automatically after the steering wheel has been operated.
  If the EPS system does not operate because of the malfunction in the system, the smart steer
- mode will not be available.

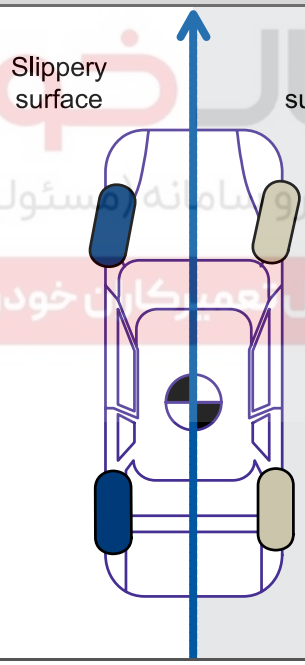
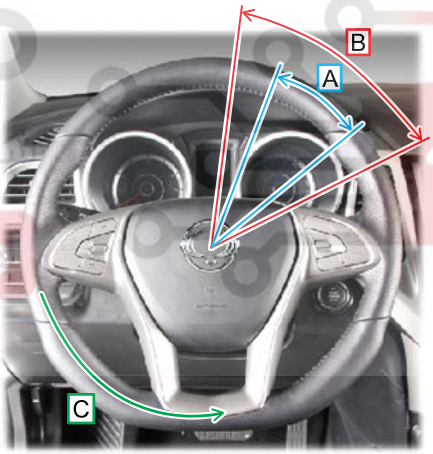
Modification basis	
Application basis	
Affected VIN	

4. ESP RELATED SYSTEM

- **Dynamic Steering Torque Assist (DST)**

The dynamic steering torque assist system compensate the braking force and additional torque for steering on a slippery road.

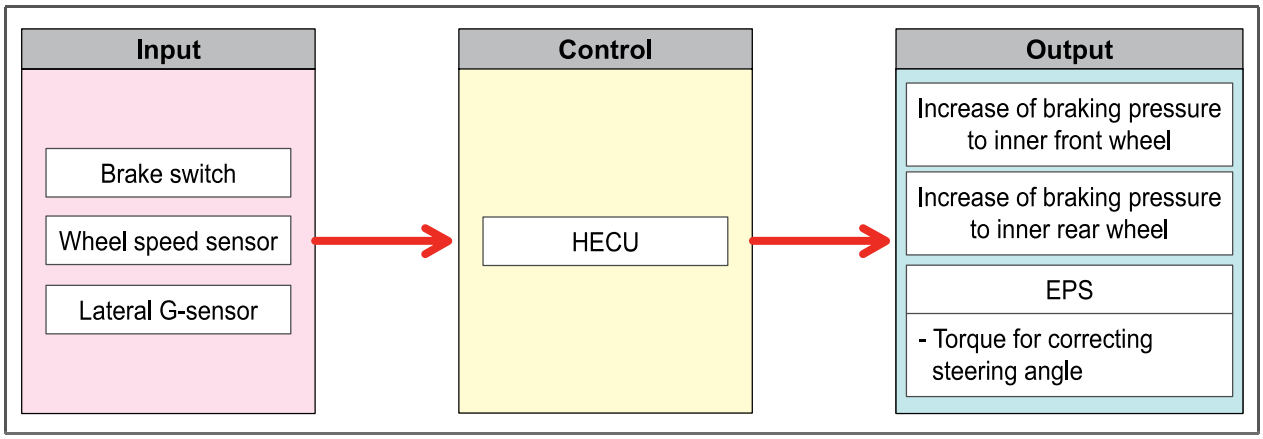


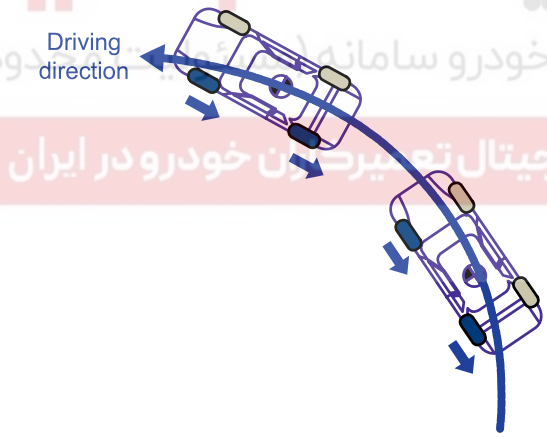
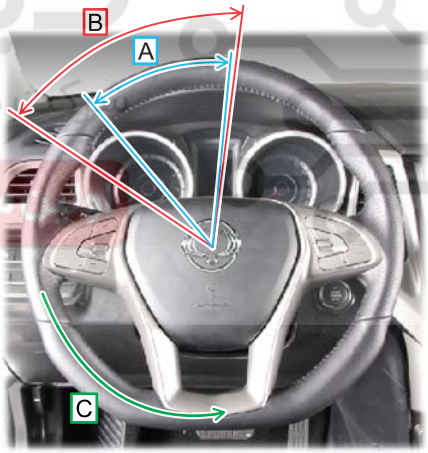
Driving direction	Steering wheel operation
	 A : DST active B : DST inactive C : Torque for correcting steering angle

When the brake pedal is depressed on a road where the surfaces contacting with the left and right wheels are different from each other, the steering is turned toward the surface side with high friction, resulting in veering off the carriageway. At this time, the DST system controls the ESP with EPS together (generating torque required for correcting the steering angle).

- **Cornering Brake Control (CBC)**

When applying the brake to the vehicle driving on winding road at high speed, a slip occurs with the vehicle load pulled toward the outside of the corner.
The cornering brake control (CBC) system minimizes the vehicle slip when the vehicle is turning by applying more brake hydraulic pressure to the inner wheels.



Driving direction	Steering wheel operation
 Inner braking pressure control	 A : CBC active B : CBC inactive C : Torque for correcting steering angle

When oversteer or understeer occurs while the vehicle is turning, the system generates the torque required for correcting steering angle of the EPS along with the EPS operation to make the vehicle stay in line.

Modification basis	
Application basis	
Affected VIN	

CONFIGURATION AND FUNCTIONS

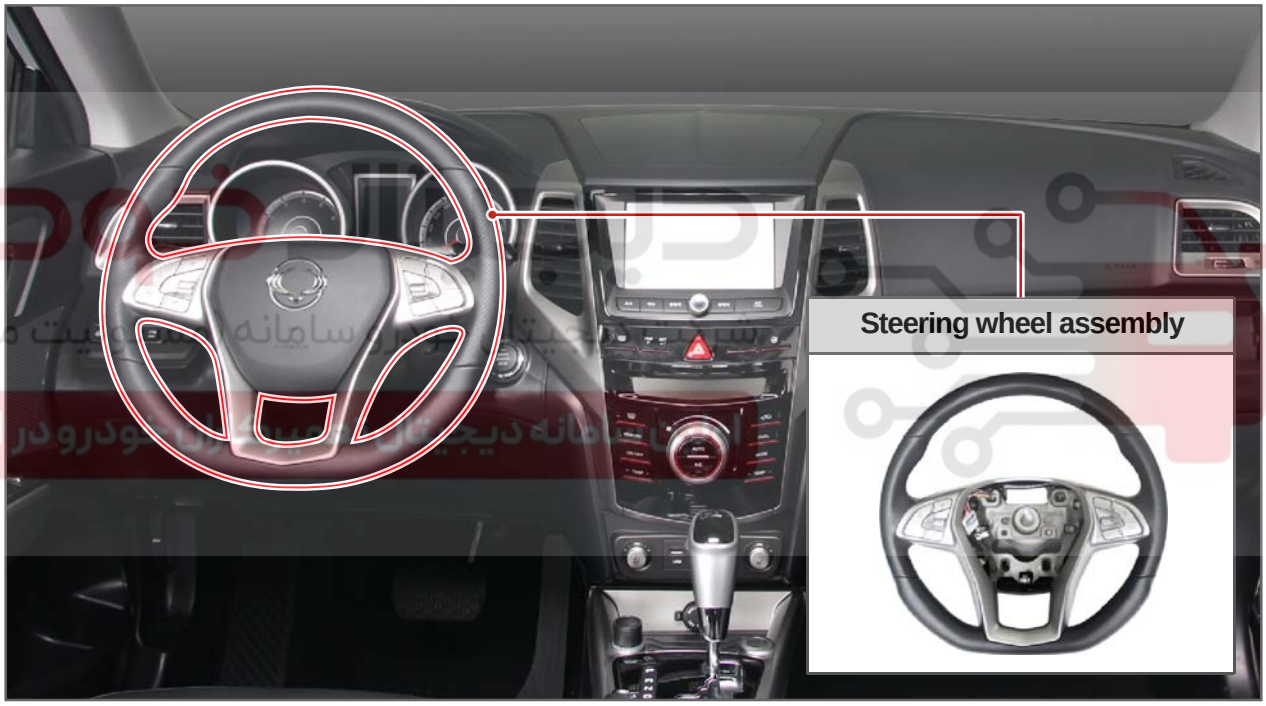
S.G.N. 4610-01

STEERING WHEEL ASSEMBLY

1) Overview

The steering wheel used in this vehicle is covered with 100% real leather to provide the driver ideal finishing touch. The steering wheel ergonomics is improved for ensuring the best grip. D-cut design is applied under the steering wheel to make room for knees.
In addition, the heated wire built in the steering wheel keeps the driver's hands warm in cold weather.

2) Mounting Location



Modification basis	
Application basis	
Affected VIN	

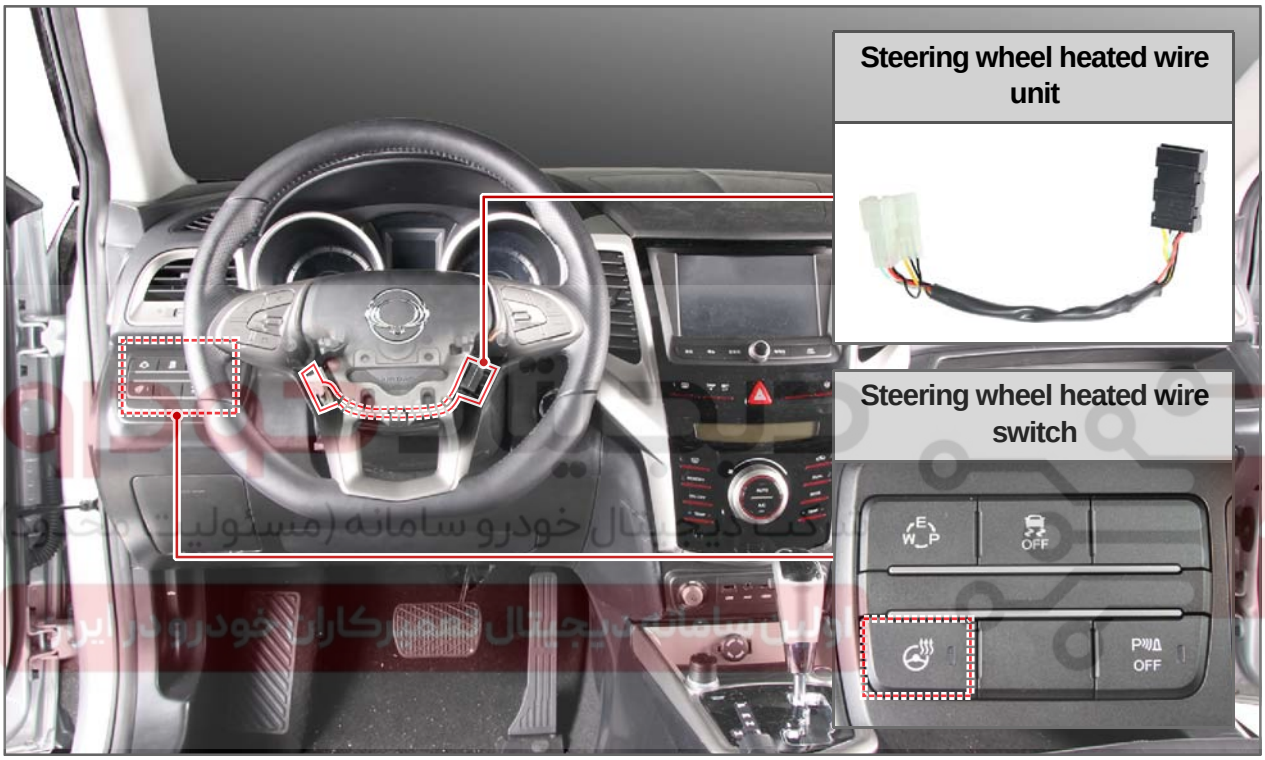
S.G.N. 4610-02

STEERING WHEEL HEATED WIRE UNIT

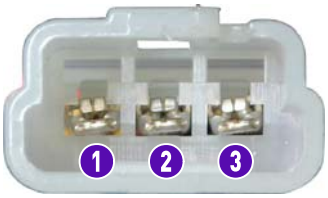
1) Overview

The steering wheel heated wire unit is installed inside the steering wheel body. The steering wheel heated wire switch is installed to the lower main panel. The LED on the switch indicates the operating status of the steering wheel heated wire.

2) Mounting Location

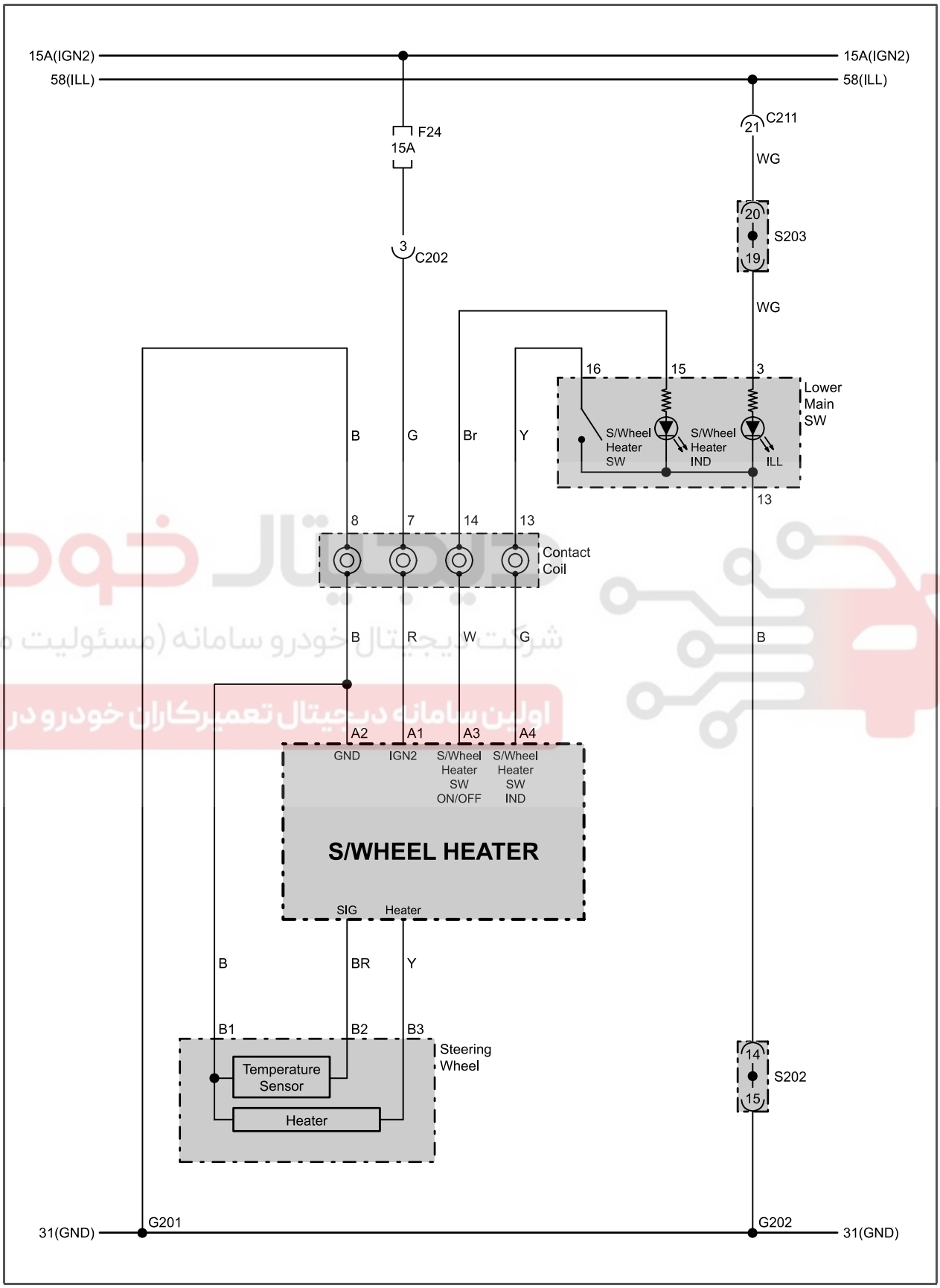


3) Connector

Heated wire connector A	Heated wire connector B
	
1. Ground - 2. Power + 3. Heating switch ON/OFF 4. Heating switch illumination	1. Heated wire power supply + 2. Detecting temperature 3. Ground-

Modification basis	
Application basis	
Affected VIN	

▶ Circuit diagram

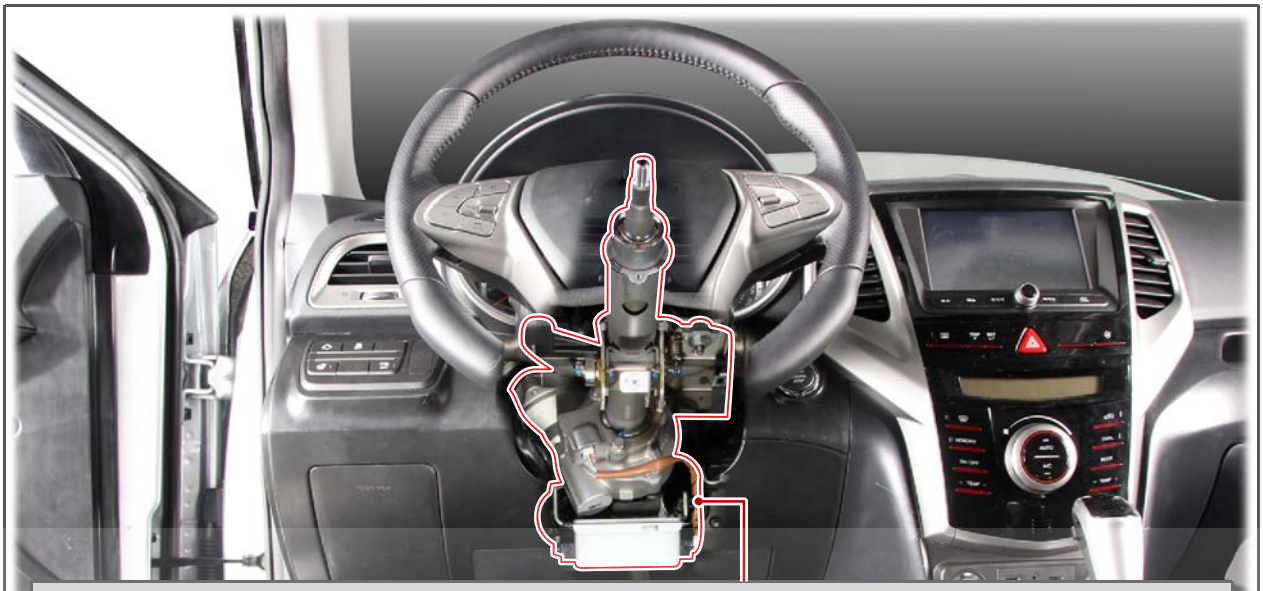


Modification basis	
Application basis	
Affected VIN	

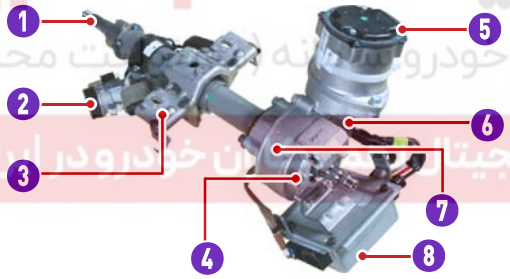
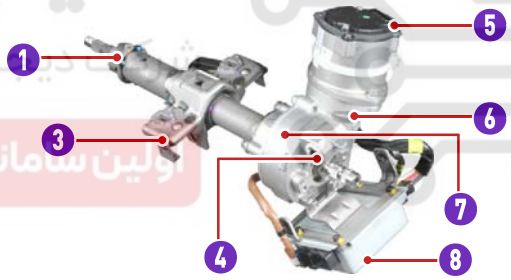
S.G.N. 4610-04

STEERING COLUMN SHAFT ASSEMBLY

1) Mounting Location



Steering column shaft assembly

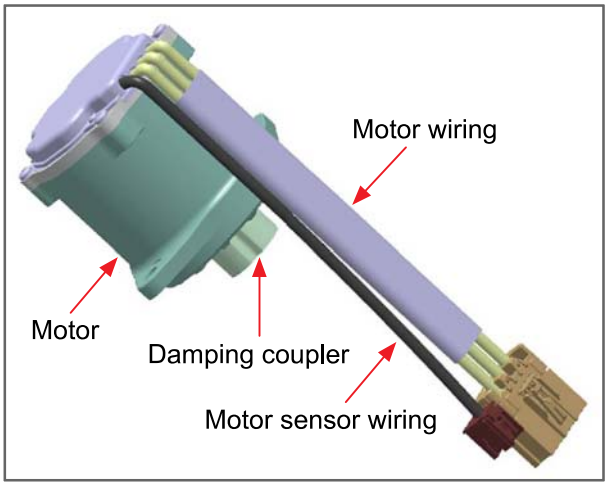
With ignition lock	Without ignition lock
	

No.	With ignition lock	Without ignition lock	Remarks
1	Steering column	←	Only tilting is available
2	Immobilizer antenna and ignition lock body assembly	None	-
3	Upper mounting	←	-
4	Lower mounting	←	-
5	Motor	←	BLAC motor (70 A)
6	Torque angle sensor	←	Non-contact digital type
7	Reduction gear	←	Reduction gear ratio: 18.5
8	EPS ECU	←	32 bit, 64 MHz

Modification basis	
Application basis	
Affected VIN	

2) Components

(1) BLAC motor



The BLAC motor is a brushless type motor. The magnet of the BLACK motor rotates while the coil rotates for the conventional DC motor. In this way, high power output, high responsiveness, high speed, high torque performance and high heat protection can be achieved.

▶ **Advantages**

- High power output density
- Low inertia (high responsiveness)
- High speed/torque performance
- Low maintenance cost
- High torque ratio/inertia ratio
- High heat dissipation efficiency

(2) Torque and angle sensor

The torque sensor is one unit together with the angle sensor. The torque sensor outputs the analogue voltage and the angle sensor outputs two PWM signals.

▶ **Torque and angle sensor**

- Operating temperature: −40 to 125°C
- Power supply: 5.0 V
- Output signal form
  (Torque: 2x2 signal for double check)
  (Angle: PWM)
- Torque measuring range: ±8°
  (±16 Nm at 2 Nm/° of torsion bar stiffness)
- Angle measuring range: ±738°

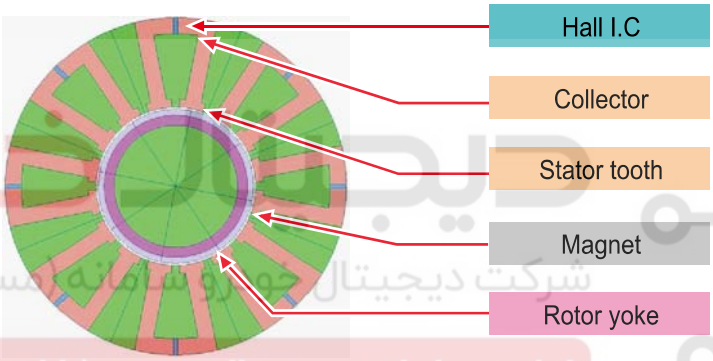
3) Sensor Characteristics

▶ Torque sensor

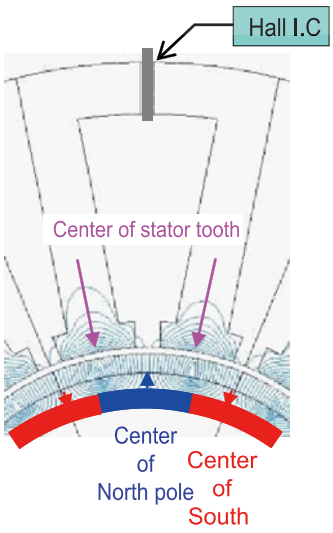
- Detection

When a magnetic field is applied to a current flowing through a conductor, the electric current carriers in the conductor experience a force in a direction perpendicular to the magnetic field and current field. The newly developed electric field results in a potential difference and this effect is called Hall-effect. A Hall-effect sensor is based on this effect. The sensor converts the intensity of magnetic field into a voltage value. The torque sensor for EPS system uses a linear type hall-IC to convert the value of intensity change in magnetic field strength into a voltage value.
That is, the major function of the hall-effect type torque sensor is to detect the change in magnetic flux around the hall IC in accordance with the twist amount (angle) between the input shaft and the output shaft.

Structure of torque sensor

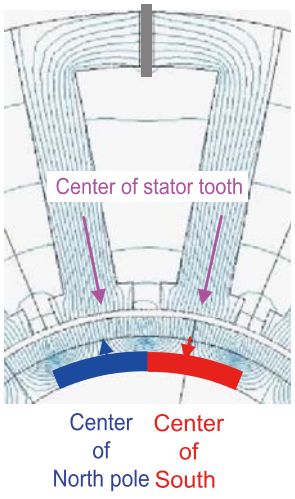


0 deg. position



Alignment position:
Center of stator tooth where both poles meet together

22.5deg. position



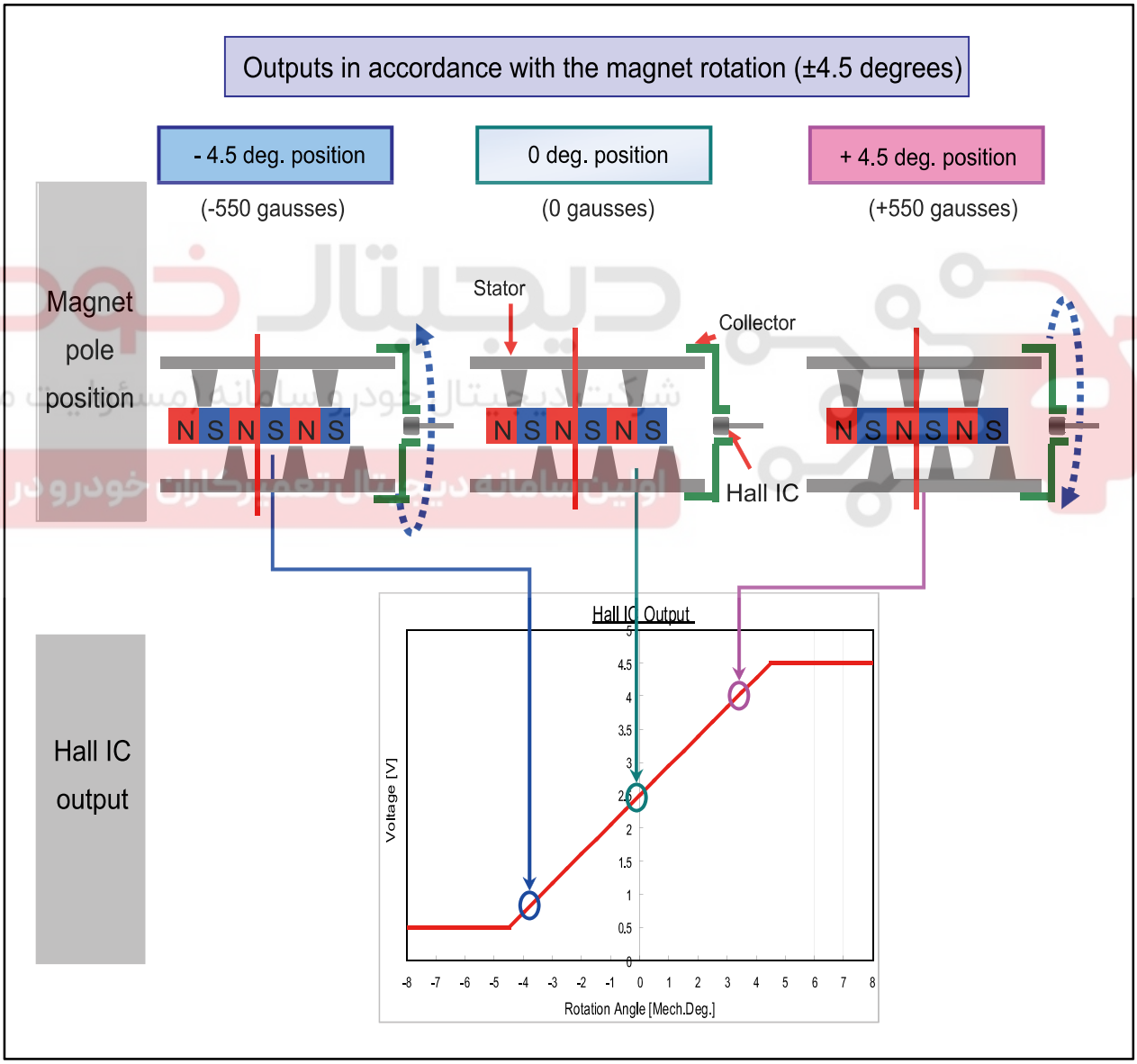
Alignment position:
Center of stator tooth which is the center of each pole

Modification basis	
Application basis	
Affected VIN	

- Operation

The operation range of the torque sensor built in this system, is 2.5 rotations (± 900 degrees) on each side (left & right) which is the same as that of the steering wheel. And this sensor should detect the twist amount (up to ± 4.5 degrees) between the input shaft and the output shaft within the operation range of the steering wheel.

The torque sensor consists of a permanently magnetized multi-pole (16 poles) magnet rotor with round shape connected to the input shaft of the steering wheel, upper and lower stators connected to the output shaft with a number of teeth which contact with the magnetized poles, a collector which collects the magnetic flux induced to the stator which rotates as much as the steering wheel rotates into the hall IC, and a hall IC sensor which converts the value of flux change into a voltage value.



Modification basis	
Application basis	
Affected VIN	

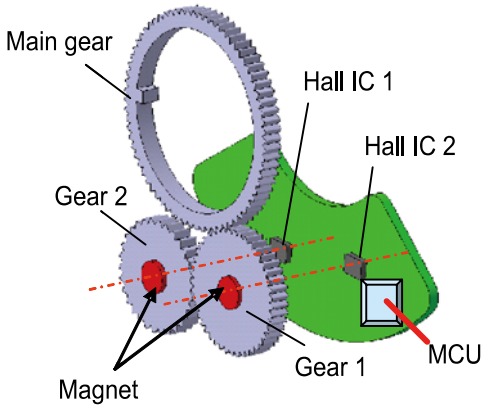
If the twist amount is zero, the magnet rotor poles and the stator teeth are equally spaced. Thus the magnetic flux generated by the permanent magnet cannot be induced to the hall IC.
That is, the flux value around the hall IC is zero. But, if the twist amount is not zero, a contact area difference is made between the permanent magnet poles and the upper & lower stator teeth. This leads to the change in the magnetic flux around the hall IC (with a value corresponding to the contact area difference). As a result, the output voltage value from the hall IC is changed.

When the driver turns the steering wheel counterclockwise while the vehicle is stationary or driven straight ahead, the permanent magnet rotor connected to the input shaft is turned counterclockwise in conjunction with the input shaft; but the upper and lower stators do not rotate as much as the rotor rotates.

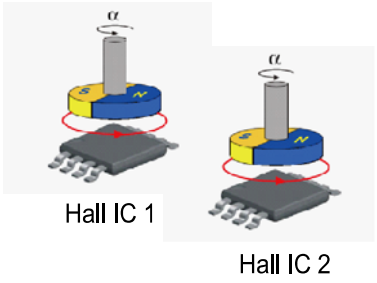
If the amount of twist between the rotor and the stator reaches the maximum value (−4.5˚), an upper stator tooth contacts completely with the South pole of the magnet and a lower stator tooth contacts completely with the North pole. So the force of magnetic flows from the North pole on the lower stator tooth to the upper stator tooth which rests against the South pole, through the collector. At this time, the magnetic flux increases to its maximum level around the hall effect sensor positioned in the collector.
The relation between the twist amount and the contact area of the stator teeth and the permanent magnet is linear in the range between 0˚ and −4.5˚. And the contact area has linear relation to the magnetic flux generated around the hall IC. The magnetic flux is converted into voltage as a output value, therefore the output voltage and the twist amount also have a linear relation.

Modification basis	
Application basis	
Affected VIN	

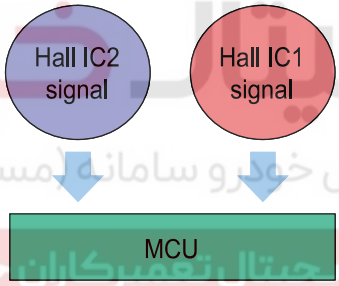
▶ Angle sensor



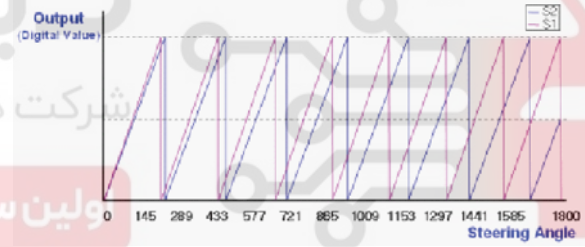
Gear rotation in accordance with rotor rotation



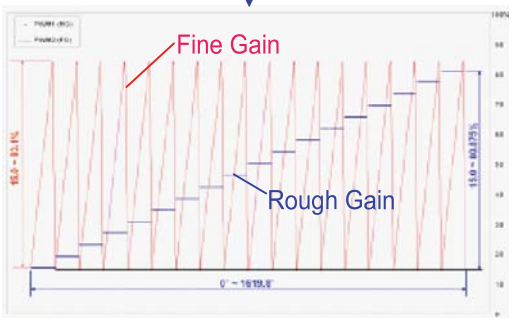
SAS magnet rotation in accordance with gear rotation



Torque angle sensor calculates absolute angle by using difference between two signals



Two rotary hall IC SPI outputs by the magnet rotation

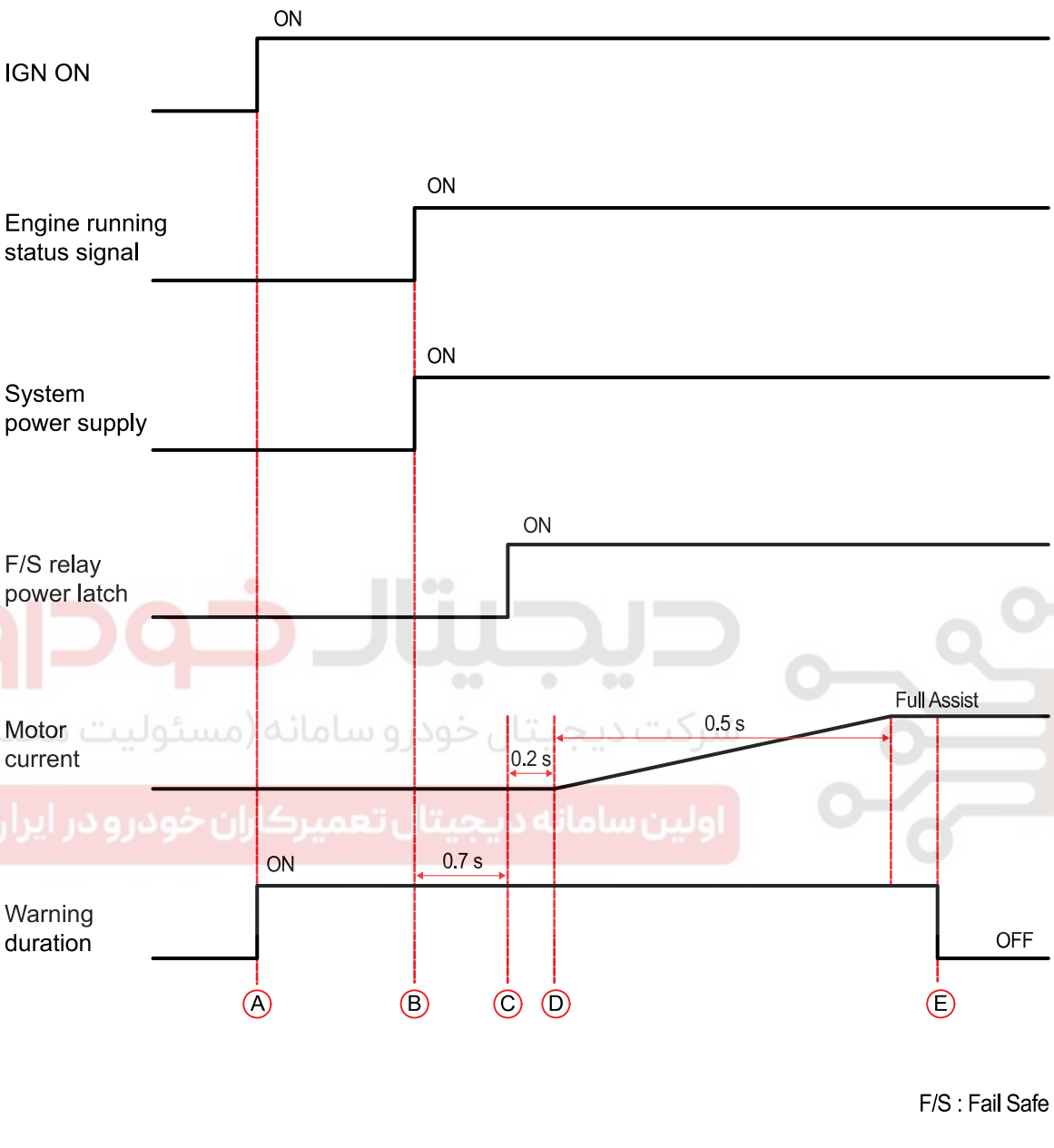


The calculated absolute angle is output as two PWM signals (Rough gain, Fine gain)

Converted into CAN messages at ECU

Modification basis	
Application basis	
Affected VIN	

4) EPS ECU Operation



A. Warning lamp ON when IGN ON
B. System power supply ON upon engine operating signal input
C. Fail safe relay ON after initial check (0.7 sec.)
D. Starts PWM current control
E. Warning lamp OFF after motor full current control

Modification basis	
Application basis	
Affected VIN	

5) Warning Lamp ON Conditions

Mode	EPS lamp	Remarks
Initial check	ON	-
Faulty EPS (Major fault)	ON	Serious faults, including a torque sensor signal error, defective motor, internal defect, etc.
Faulty EPS (Mild 1 fault)	ON	Faults that can be rectified such as problems regarding battery, insufficient ignition power, etc.
Faulty EPS (Mild 2 fault)	OFF	Faults that can be partially controlled such as incorrect messages, issues regarding vehicle speeds, etc.
EPS in operation	OFF	-
Diagnostic mode	Flashing (1 Hz)	OHP or diagnostic mode
Normal condition	OFF	-
CAN error (Signal nor received by instrument cluster, BUS OFF, message time out)	ON	Warning lamp ON when CAN error has occurred within the same ignition cycle
EPS not reinstalled after removal	ON	See active lamp specifications

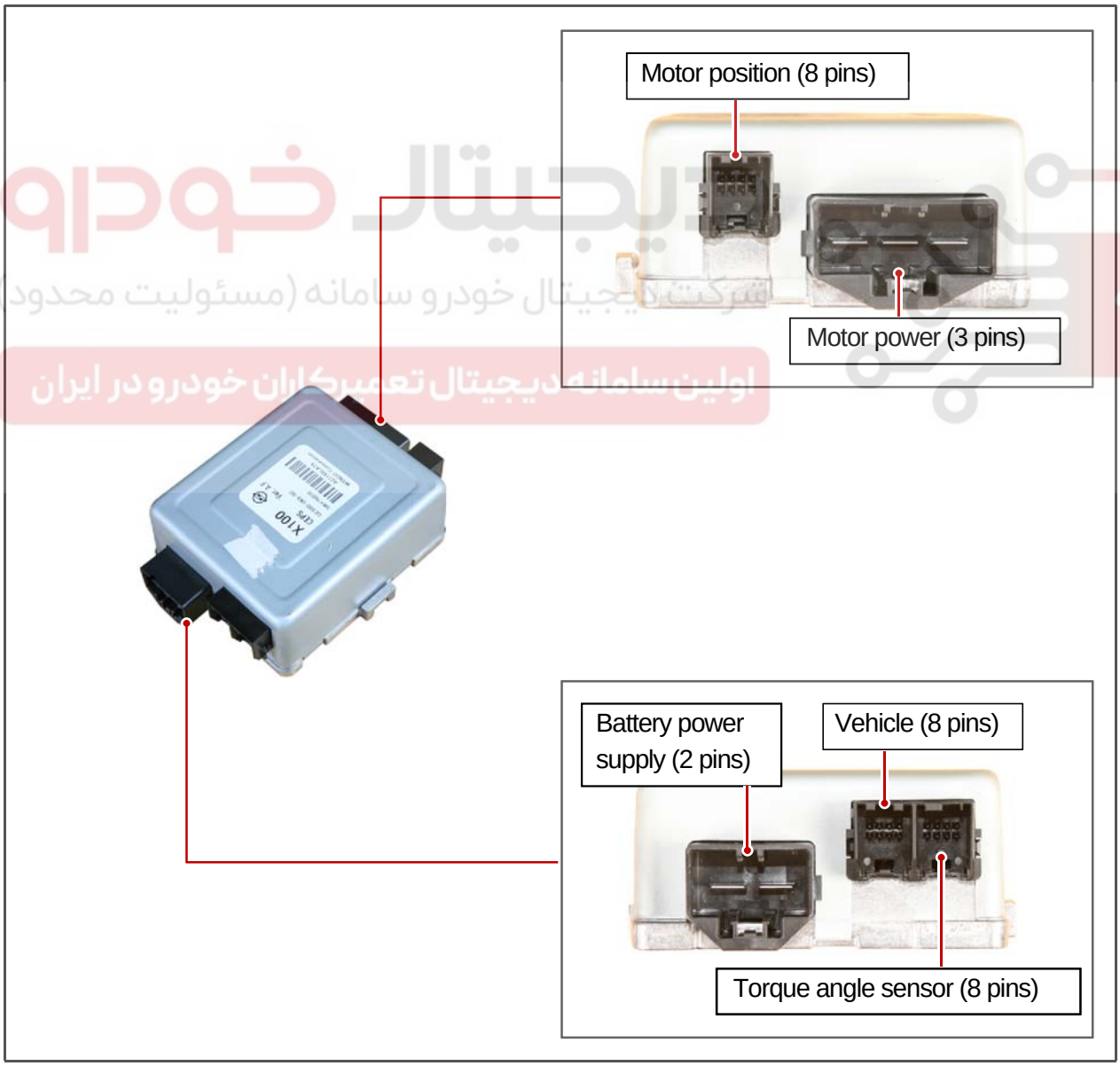
Modification basis	
Application basis	
Affected VIN	

6) EPS ECU

The ECU controls the electric power steering system depending on the driving conditions, based on the signals from the torque and angle sensor.

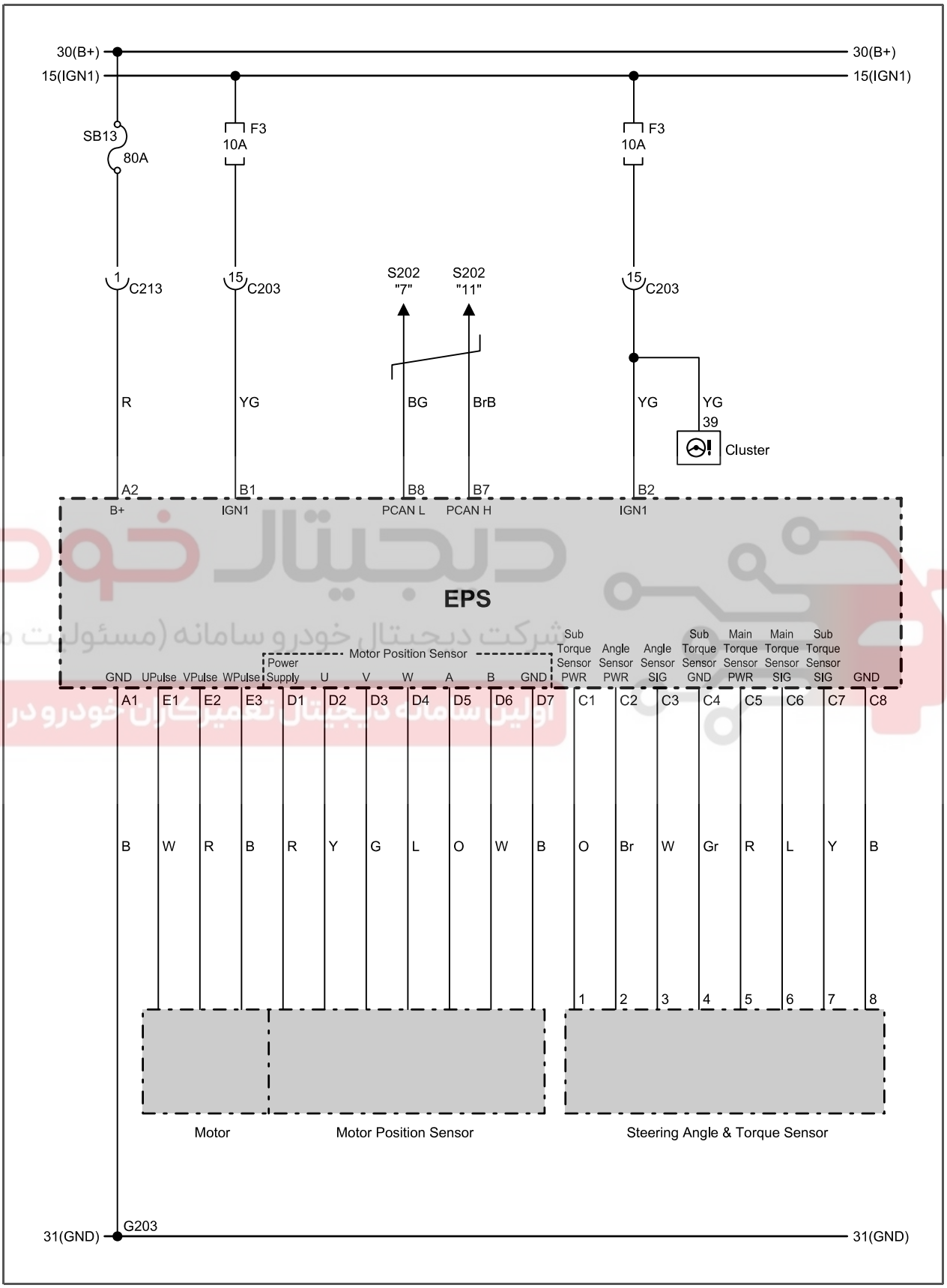
- Mounting location: Steering column
- Operating voltage: 6.0 V to 20.0 V
- Operating temperature: −40 to 85°C

(1) External connection terminal



Modification basis	
Application basis	
Affected VIN	

7) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

S.G.N. 4610-06

LOWER SHAFT

1) Overview

The lower shaft is intended to transfer the rotation from the steering wheel and column shaft to the steering gear linkage. It is mounted under the steering column shaft.

2) Mounting Location

Modification basis	
Application basis	
Affected VIN	

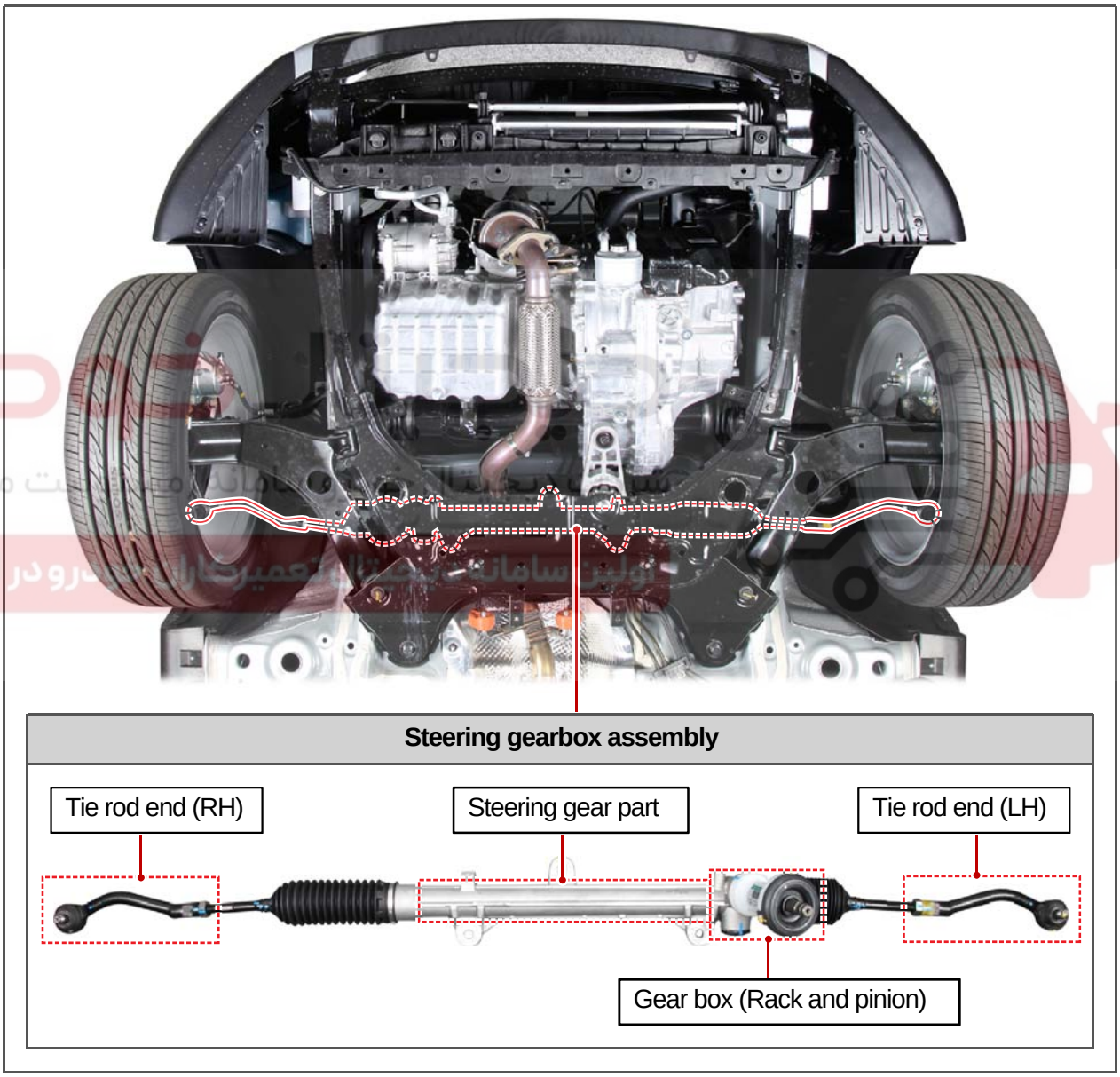
S.G.N. 4620-01

STEERING GEAR BOX ASSEMBLY

1) Overview

The steering gear box assembly is mounted to the front sub frame.

2) Mounting Location



Modification basis	
Application basis	
Affected VIN	

REMOVAL AND INSTALLATION

S.G.N. 4610-01 STEERING WHEEL ASSEMBLY

Preceding work - Disconnect the negative battery cable.

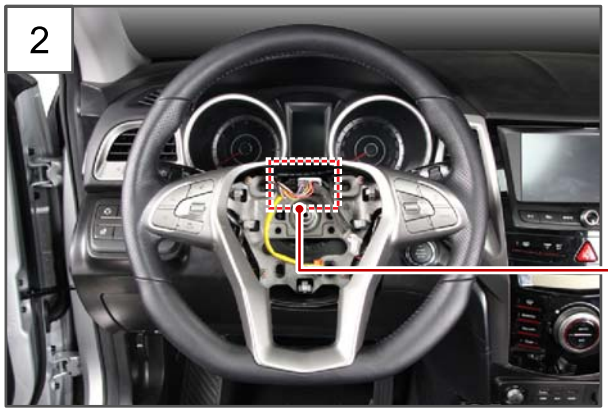
1

1. Remove the driver's air bag module.

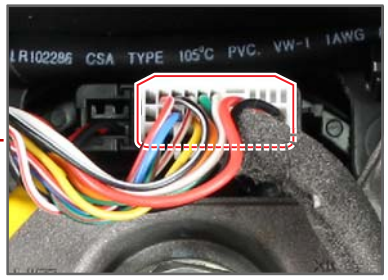
NOTE

Refer to "DRIVER'S AIR BAG MODULE ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "AIR BAG" section in "BODY" chapter.

2

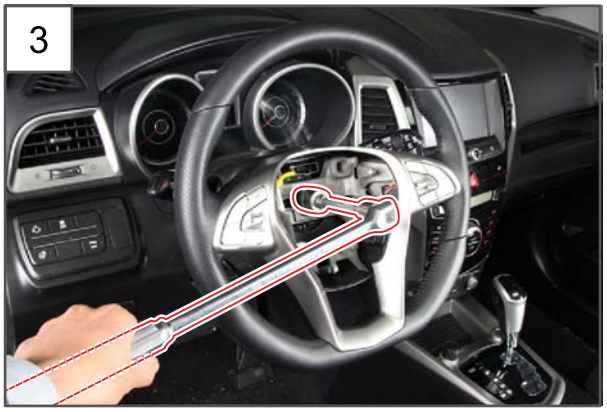


2. Disconnect the connector connected to the steering wheel.



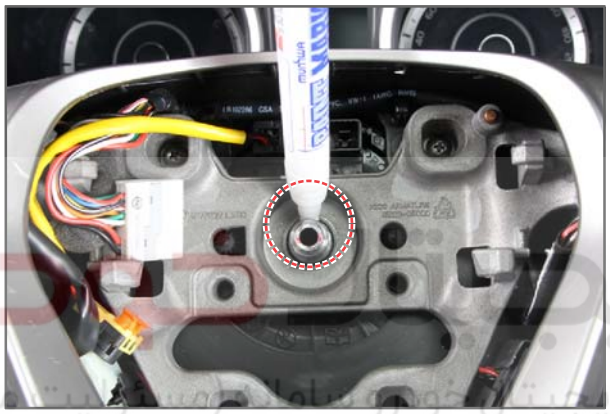
Modification basis	
Application basis	
Affected VIN	

3



3. Unscrew the steering wheel mounting nut (22 mm).

Tightening torque 39.2 to 49.0 Nm



NOTE

Before removing the steering wheel assembly, make a paint mark on it as shown in the picture.

4

4. Remove the steering wheel assembly.

5

5. Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 4610-02

STEERING WHEEL HEATED WIRE UNIT

Preceding work - Disconnect the negative battery cable.

1

1. Remove the steering wheel assembly.

NOTE

Refer to "STEERING WHEEL ASSEMBLY" under this subsection.

2

2. Remove the 4 mounting screws for steering wheel upper cover at the back side of the steering wheel.

Modification basis	
Application basis	
Affected VIN	

3

3. Remove the steering wheel upper cover and disconnect the connectors (A) and (B).

   (A) Audio remote control switch connector
   (B) Cruise control switch connector

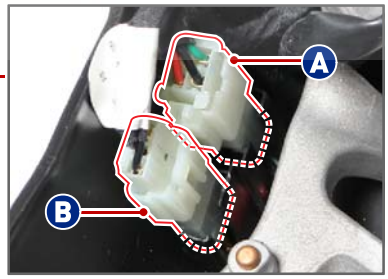
4

4. Remove the steering wheel upper cover.

Steering wheel upper cover

5

5. Disconnect the steering wheel heated wire unit connector (A) and the heated wire connector (B).



6

6. Unscrew the 2 mounting screws on the rear cover of the steering wheel.

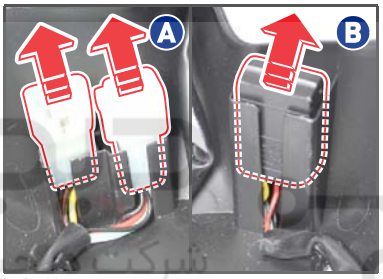
Modification basis	
Application basis	
Affected VIN	

7

7. Remove the rear cover of the steering wheel.

8

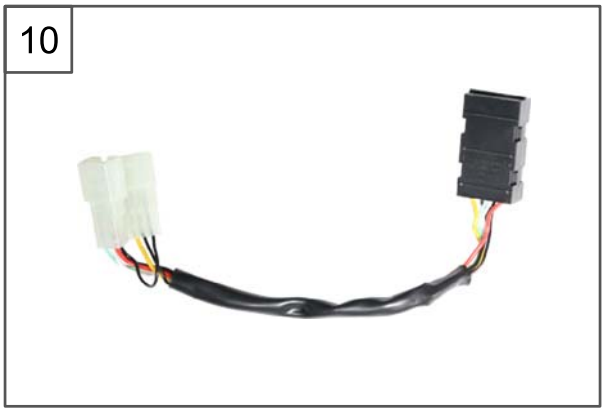
8. Lift up the heated wire connector (A) and heated wire unit (B) connected to the rear cover of the steering wheel in the direction of



9

9. Remove the steering wheel heated wire unit.

10



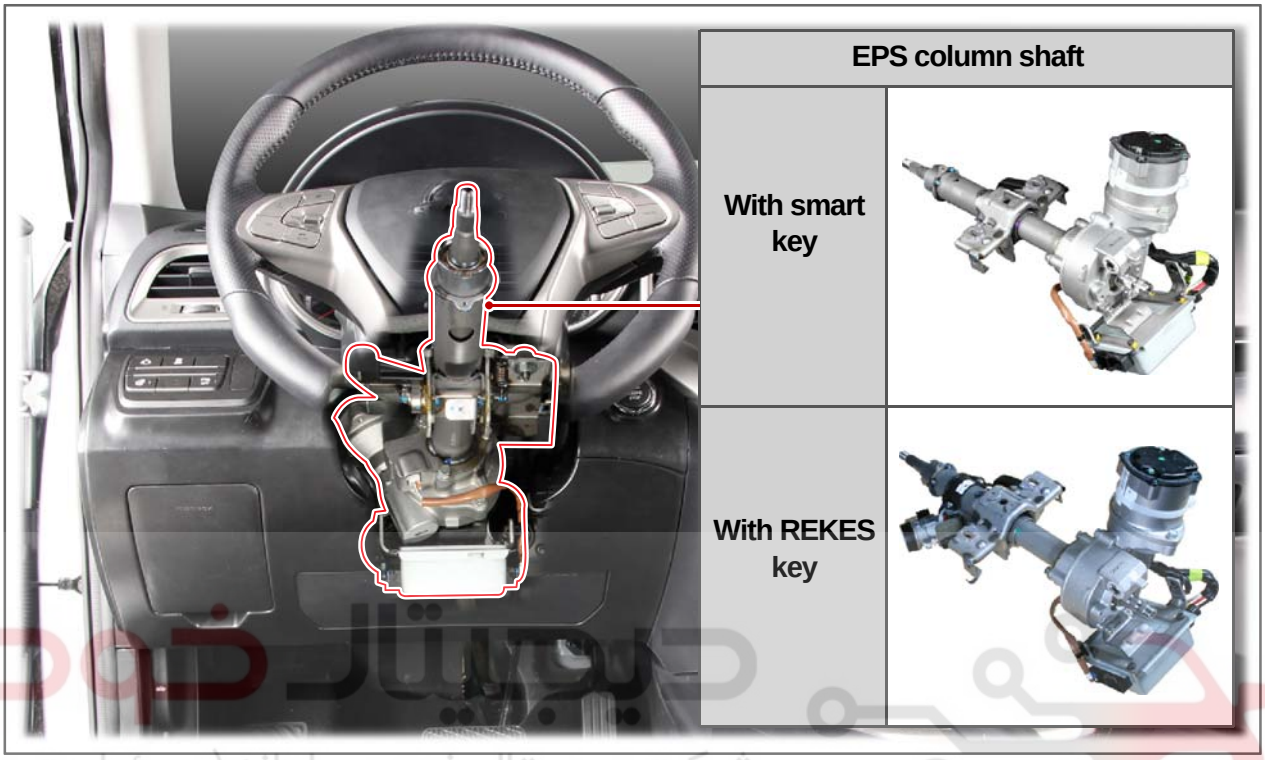
10.Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 4610-04

STEERING COLUMN SHAFT

Preceding work - Disconnect the negative battery cable.

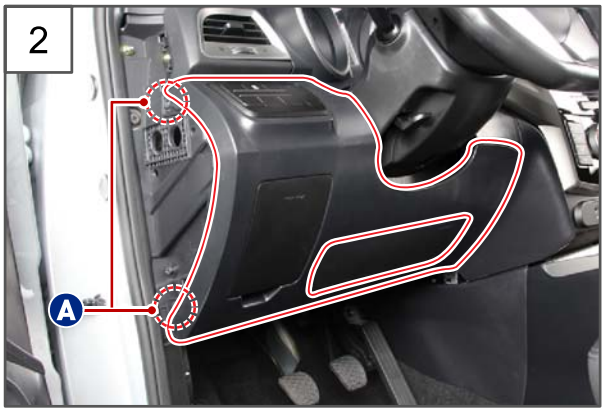


EPS column shaft	
With smart key	
With REKES key	

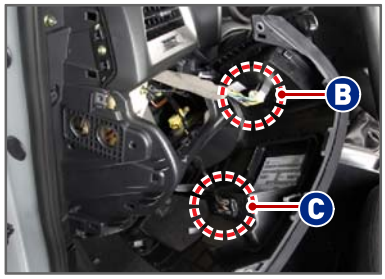
1

1. Remove the LH crash pad side cover.

2

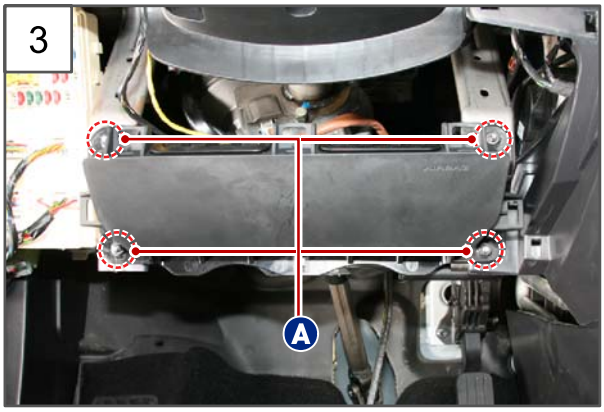


2. Unscrew the 2 lower main panel mounting screws (A) to prise apart the lower main panel. And disconnect the connector (B) for lower main switch and connector (C) for diagnosis connector to remove the lower main panel.



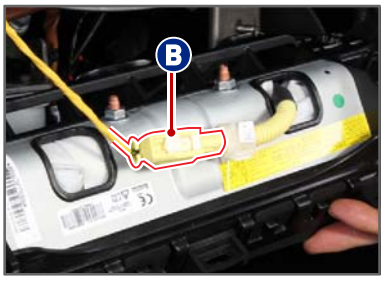
Modification basis	
Application basis	
Affected VIN	

3



3. Unscrew the 4 mounting nuts (A, 10 mm) for the knee air bag and disconnect the connector (B) connected to the rear side.

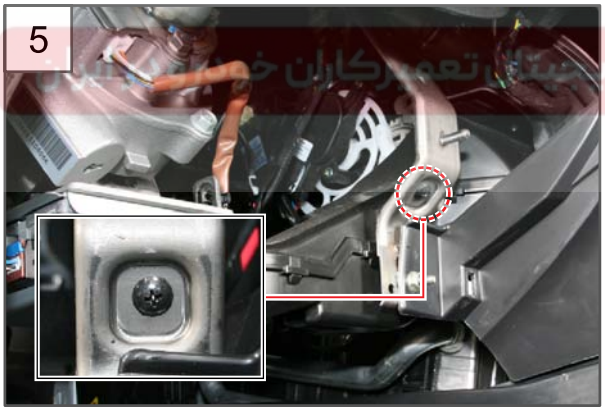
Tightening torque 5.8 to 11.7 Nm



4

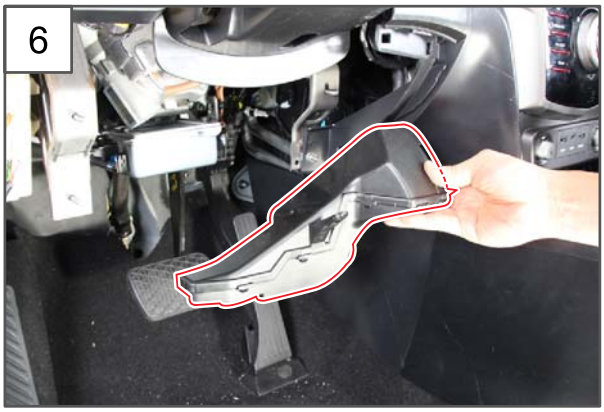
4. Remove the knee air bag.

5



5. Unscrew the mounting screw for the driver side foot duct.

6



6. Remove the driver foot duct.

Modification basis	
Application basis	
Affected VIN	

7

7. Remove the steering wheel assembly.

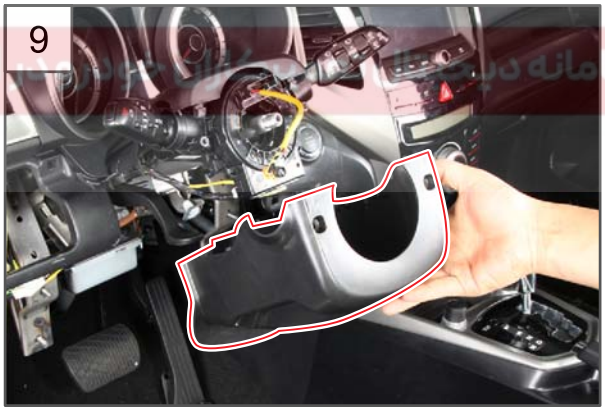
NOTE

Refer to "STEERING WHEEL ASSEMBLY" under this subsection.

8

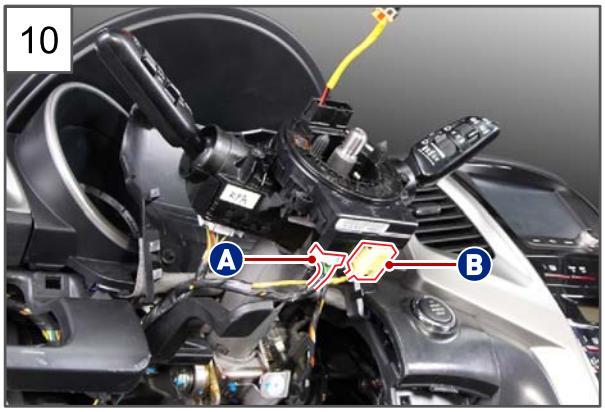
8. Unscrew the 3 mounting screws on the shroud lower panel.

9



9. Remove the shroud lower panel.

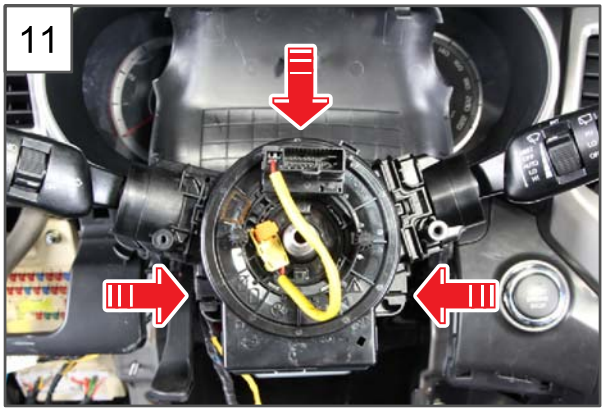
10



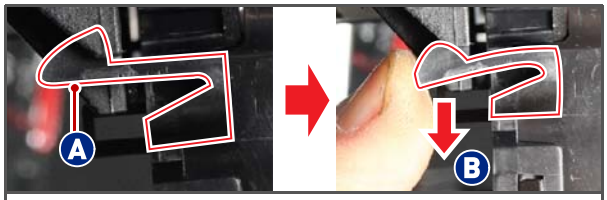
10. Disconnect the connectors (A) and (B) connected to the contact coil.

Modification basis	
Application basis	
Affected VIN	

11



11.Disengage the mountings (3 points) and remove the contact coil assembly from the column shaft.

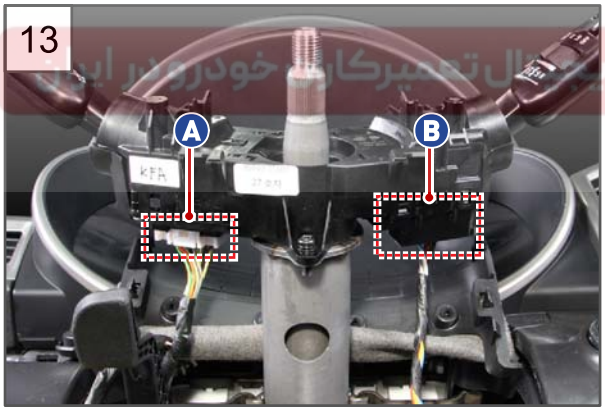


Pull the contact coil mounting (A) in the direction of the arrow (B) to remove it.

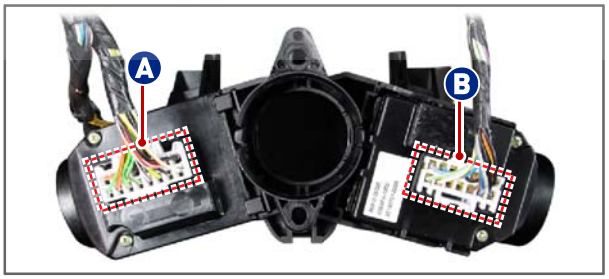
12

12.Remove the contact coil.

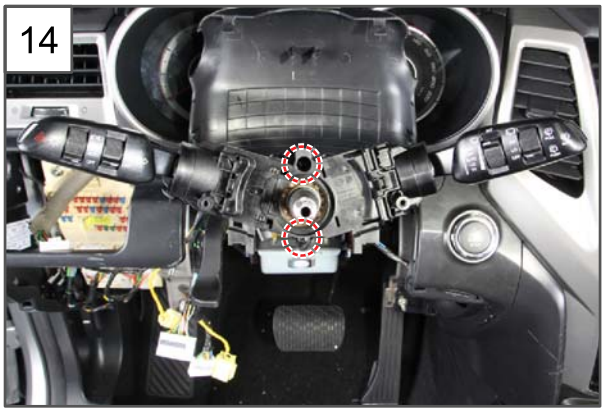
13



13.Disconnect the light switch connector (A) and the wiper switch connector (B).



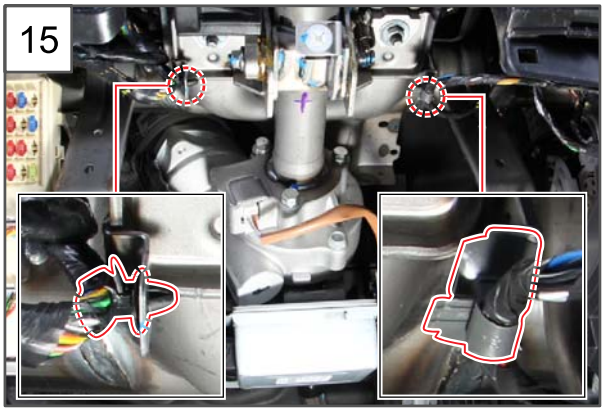
14



14.Remove the light switch and wiper switch and wiper switch by unscrewing the 2 mounting screws.

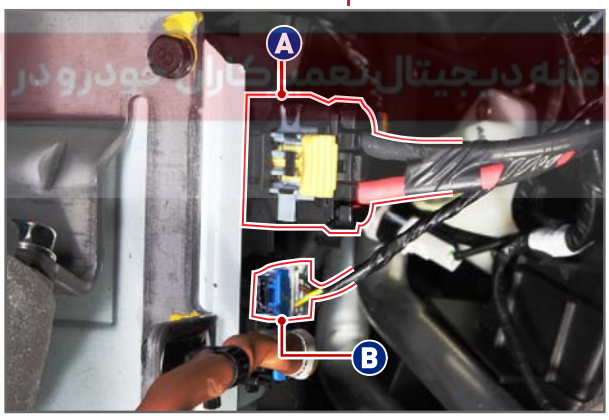
Modification basis	
Application basis	
Affected VIN	

15

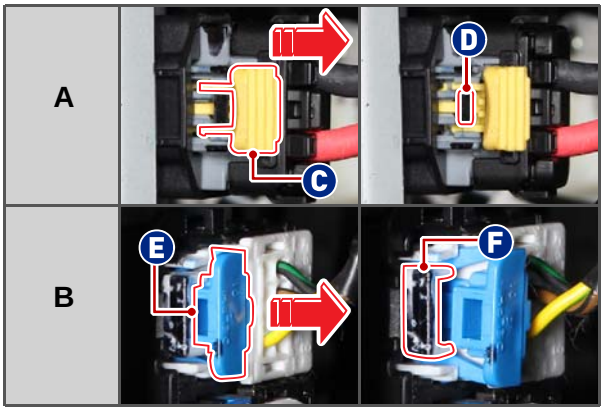


15.Remove the 2 wirings fitted to the steering column.

16



16.Disconnect the battery power connector (A) and vehicle signal connector (B) connected to the EPS ECU.

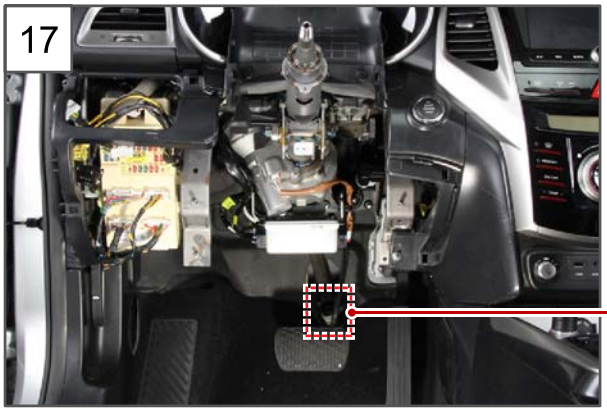


NOTE

When removing the connector, pull the connector primary locking parts (C and E) in the direction of the arrow and press the secondary locking parts (D and F).

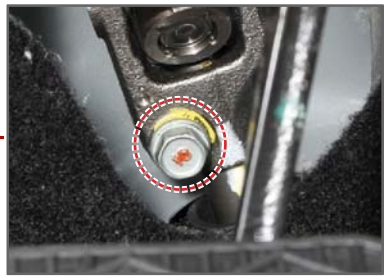
Modification basis	
Application basis	
Affected VIN	

17

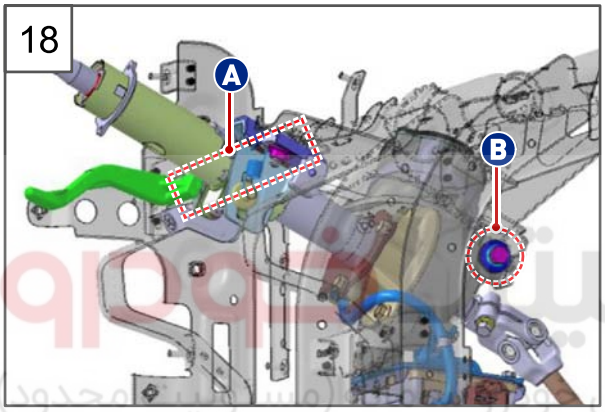


17.Unscrew the mounting bolt (12 mm) for the lower shaft.

Tightening torque 27.4 to 32.3 Nm

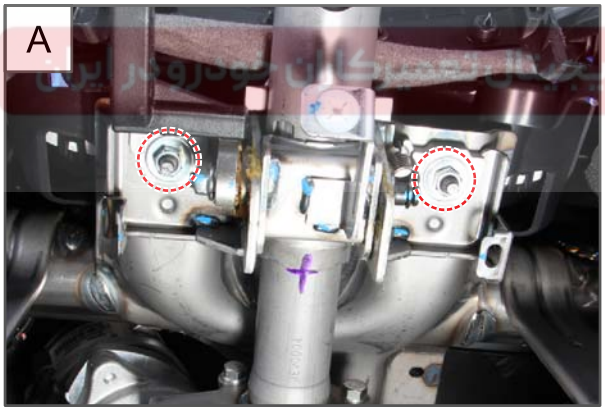


18



18.Remove the steering column mounting parts in the following order.

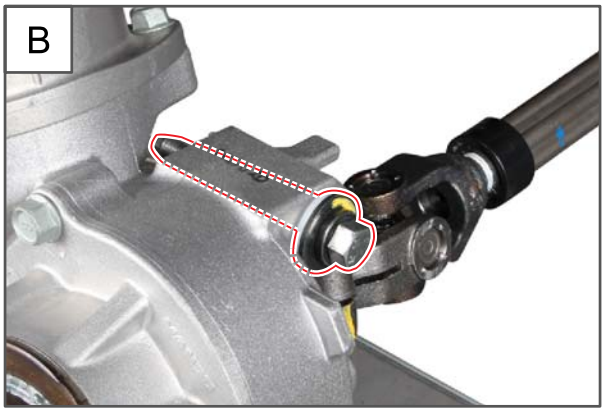
A



A. Unscrew the 2 steering column upper mounting nuts (12 mm).

Tightening torque 19.6 to 24.5 Nm

B



B. Unscrew the steering column lower mounting bolt (14 mm).

Tightening torque 44.1 to 49.0 Nm

Modification basis	
Application basis	
Affected VIN	

19 Install in the reverse order of removal.

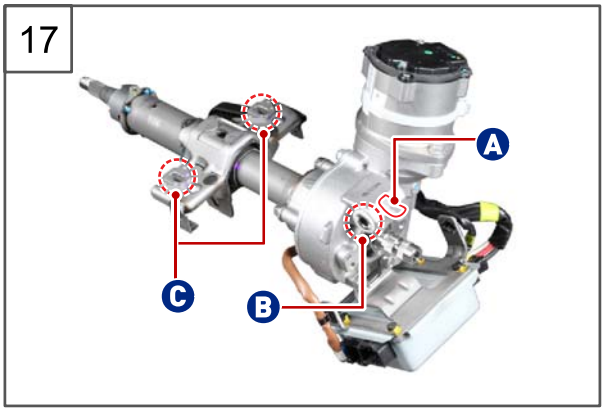
CAUTION

Check the tilting operation after installing the steering column.

Modification basis	
Application basis	
Affected VIN	

Cautions for installation

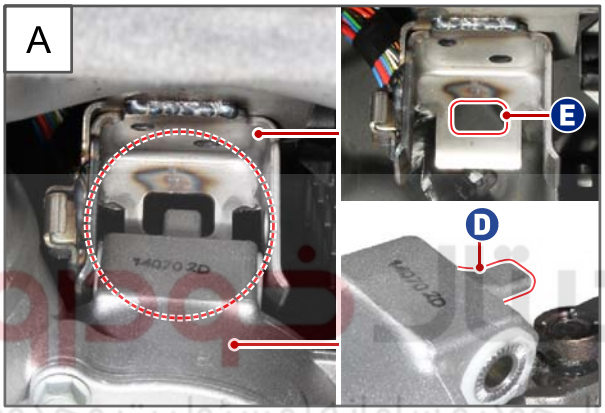
17



Install the steering column in the order shown below.

(A)Place the steering column.
(C)Fasten temporarily.
(B)Fasten temporarily.
(C)Tighten to the specified torque (Tightening sequence for nut: LH → RH)
(B)Tighten to the specified torque

A



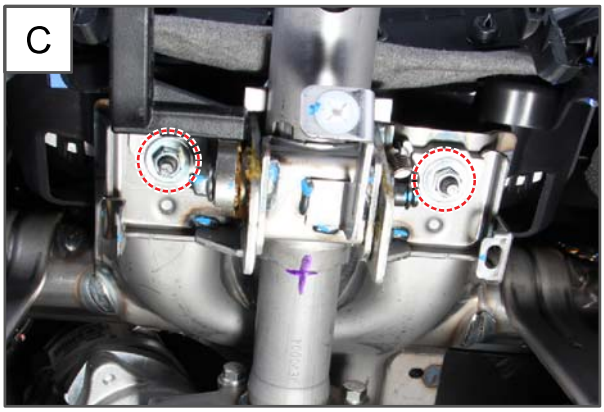
A. Make sure that the protrusion of the steering column (D) is seated correctly on the retaining hole (E).

B

B. Fasten the steering column lower mounting bolt (14 mm) temporarily.

Tightening torque 44.1 to 49.0 Nm

C



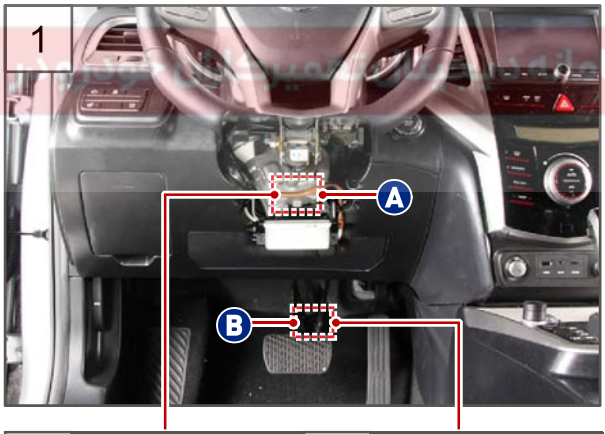
C. Fasten the 2 steering column upper mounting nuts (12 mm) temporarily (the gap between the nut and IP frame: 1 mm or lower). Tighten the mounting bolt (B) and then mounting nut (C) to the specified torque.

Tightening torque 19.6 to 24.5 Nm

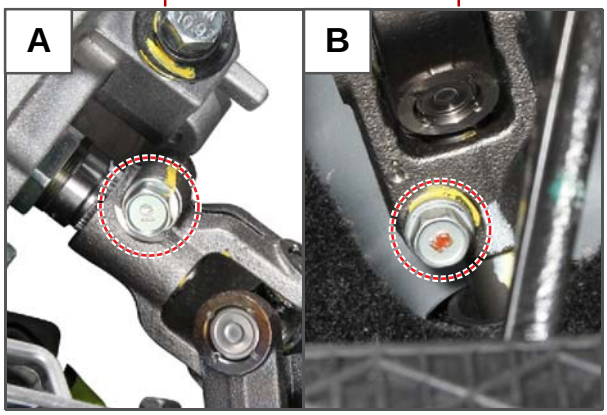
Modification basis	
Application basis	
Affected VIN	

S.G.N. 4610-06

LOWER SHAFT



1. Unscrew the upper mounting bolt (A, 12 mm) and the lower mounting bolt (B, 12 mm) of the lower shaft.



Tightening torque (A) 27.4 to 32.3 Nm

Tightening torque (B) 27.4 to 32.3 Nm

Modification basis	
Application basis	
Affected VIN	

2

2. Remove the lower shaft.

3

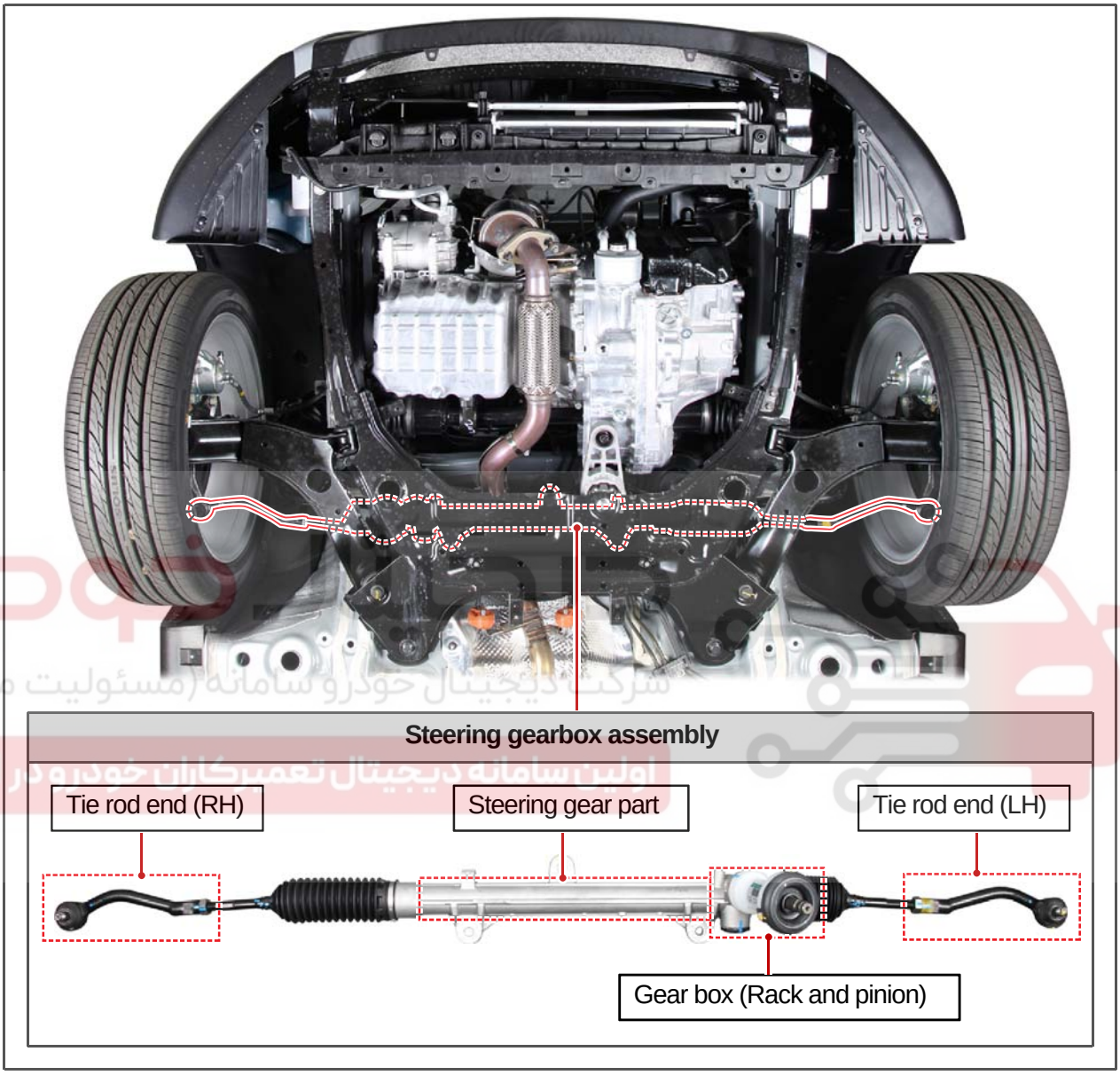
3. Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 4620-01

STEERING GEAR BOX ASSEMBLY

Preceding work - Disconnect the negative battery cable.



1

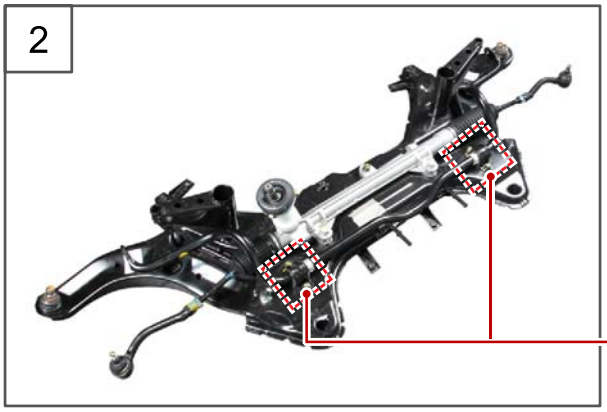
1. Remove the front sub frame assembly.

NOTE

Refer to "FRONT SUB FRAM ASSEMBLY" under "REMOVAL AND INSTALLATION" subsection of "SUB FRAME ASSEMBLY" section in "CHASSIS" chapter.

Modification basis	
Application basis	
Affected VIN	

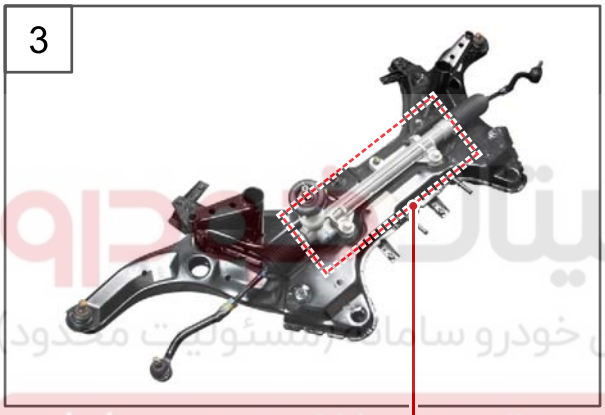
2



2. Unscrew the 2 mounting bolts (14 mm) for the stabilizer bar brackets on both sides to remove the stabilizer bar assembly.

Tightening torque 39.2 to 58.8 Nm

3



3. Unscrew the mounting bolt (A, 17 mm) and 2 mounting bolts (B, 19 mm) to remove the steering gear box assembly.

Tightening torque (A) 49.0 to 68.6 Nm

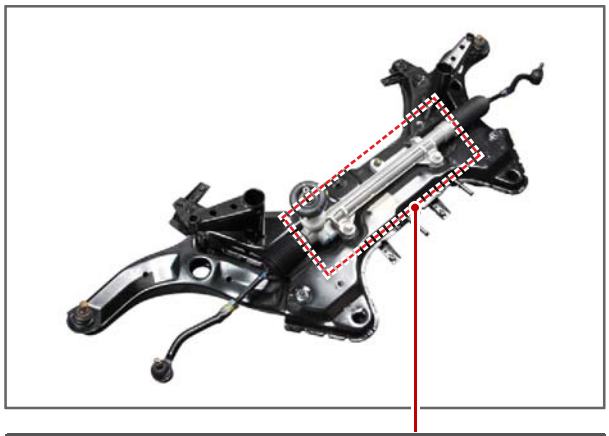
Tightening torque (B) 68.6 to 98.0 Nm

4

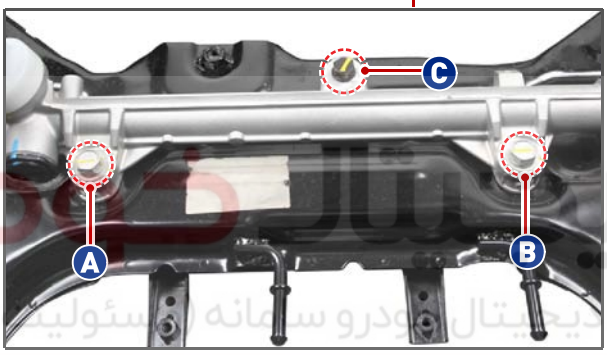
4. Install in the reverse order of removal.

Modification basis	
Application basis	
Affected VIN	

Cautions for installation



Tighten the mounting bolts in the order shown below when installing the steering gear box assembly.



(A),(B) Tighten the mounting bolts temporarily.
(A) Tighten to the specified torque
(B) Tighten to the specified torque
(C) Tighten temporarily and to the specified torque.

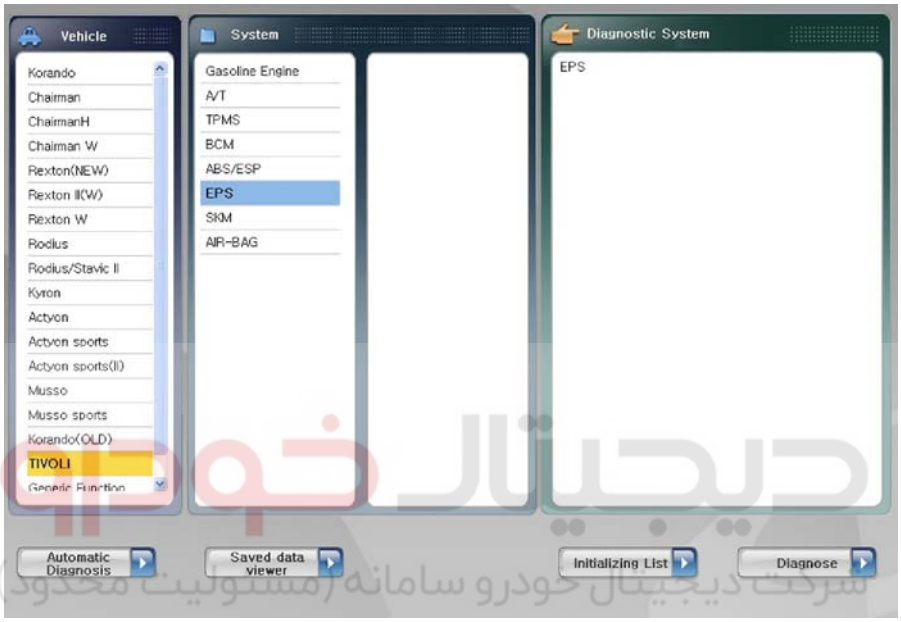
Modification basis	
Application basis	
Affected VIN	

CODING PROCESS

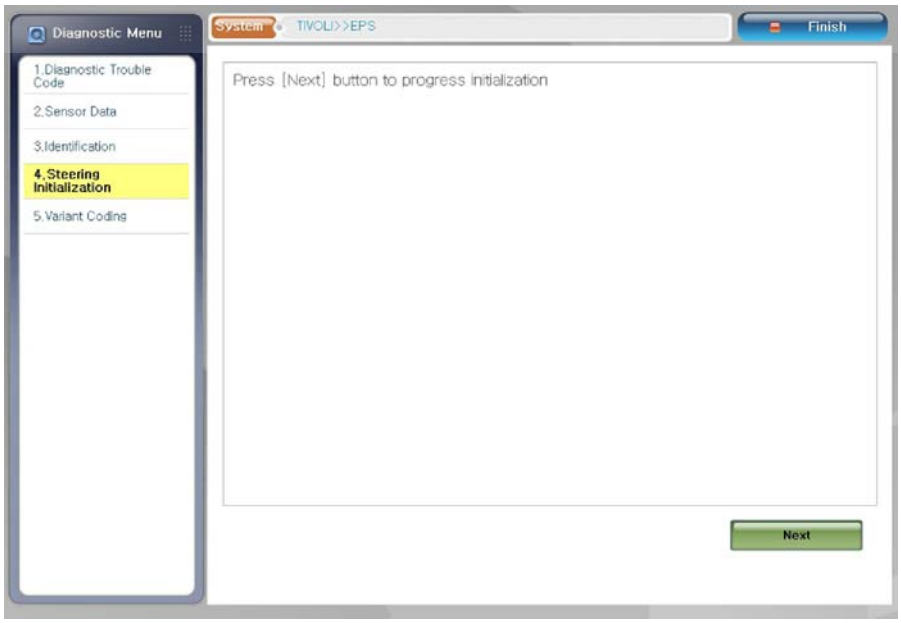
1. STEERING INITIALIZATION

▶ **Perform steering initialization when replacing the EPS unit or adjusting wheel alignment.**

1. Turn the ignition ON and select vehicle type and system (EPS) on the diagnostic program for diagnosis.

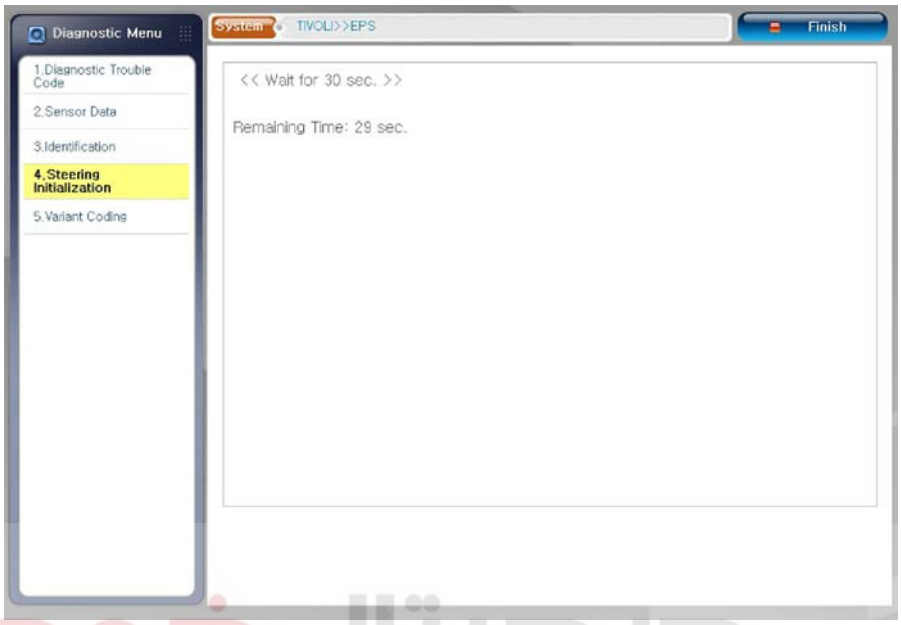


2. Select the steering initialization menu and press the [Next] button.

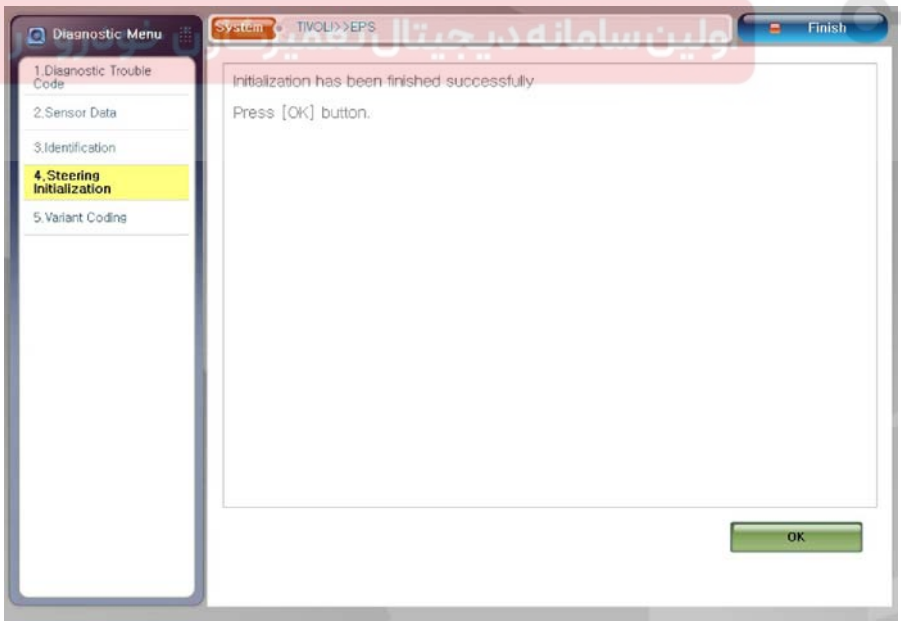


Modification basis	
Application basis	
Affected VIN	

3. Wait for 30 seconds.



4. Press the [OK] button after the initialization has been completed.



Modification basis	
Application basis	
Affected VIN	

Memo